FOREWORD

This wiring diagram incorporates the wiring schematics of the Mazda CX-5 and available optional equipment. Actual vehicle wiring may vary slightly depending on optional equipment or local specifications, or both.

For proper repair and maintenance, a thorough familiarization with this manual is important, and it should always be kept in a handy place for quick and easy reference.

All the contents of this manual, including drawings and specifications, are the latest available at the time of printing.
As modifications affecting repair or maintenance occur, relevant information supplementary to this volume will be made available at Mazda dealers. This manual should be kept up-to-date.

Ford Motor Company reserves the right to alter the specifications and contents of this manual without obligation or advance notice.

WARNING

Servicing a vehicle can be dangerous. If you have not received service-related training, the risks of injury, property damage, and failure of servicing increase. The recommended servicing procedures for the vehicle in this workshop manual were developed with Mazda-trained technicians in mind. This manual may be useful to non-Mazda trained technicians, but a technician with our service-related training and experience will be at less risk when performing service operations. However, all users of this manual are accepted at least to know general safety procedures.

This manual contains “Warnings” and “Cautions” applicable to risks not normally encountered in a general technician’s experience. They should be followed to reduce the risk of injury and the risk that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that the “Warnings” and “Cautions” are not exhaustive. It is impossible to warn of all the hazardous consequences that might result from failure to follow the procedures.

The procedures recommended and described in this manual are effective methods of performing service and repair. Some require tools specifically designed for a specific purpose. Persons using procedures and tools which are not recommended by Mazda Motor Corporation must satisfy themselves thoroughly that neither personal safety nor safety of the vehicle will be jeopardized.

The contents of this manual, including drawings and specifications, are the latest available at the time of printing, and Mazda Motor Corporation reserves the right to change the vehicle designs and alter the contents of this manual without notice and without incurring obligation.

Parts should be replaced with genuine Mazda replacement parts or with parts which match the quality of genuine Mazda replacement parts. Persons using replacement parts of lesser quality than that of genuine Mazda replacement parts must satisfy themselves thoroughly that neither personal safety nor safety of the vehicle will be jeopardized. Mazda Motor Corporation is not responsible for any problems which may arise from the use of this manual. The cause of such problems includes but is not limited to insufficient service related training, use of improper tools, use of replacement parts of lesser quality than that of genuine Mazda replacement parts, or not being aware of any revision of this manual.

MAZDA CX-5 Technical Guide

APPLICATION:
This manual is applicable to vehicles beginning with the Vehicle Identification Numbers (VIN) shown on the following page.

CONTENTS

GENERAL INFORMATION

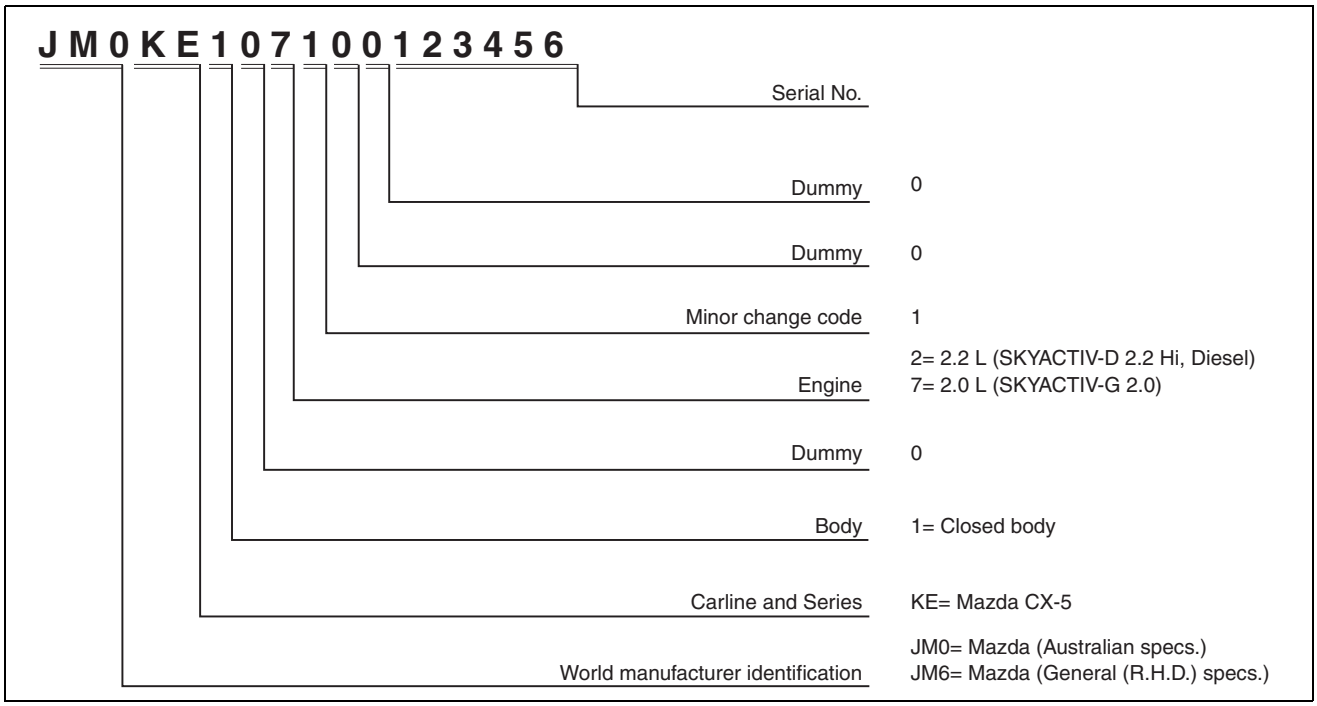
00
SECTION

00-00 GENERAL INFORMATION

GENERAL INFORMATION

VEHICLE IDENTIFICATION NUMBER (VIN) CODE

Australian, General (R.H.D.) specs.



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GENERAL INFORMATION

VEHICLE IDENTIFICATION NUMBER (VIN)

Australian, General (R.H.D.) specs.

JM0 KE102100 100001—
JM0 KE107100 100001—
JM6 KE1071*0# 100001—

ac5wzw0000458

GENERAL INFORMATION

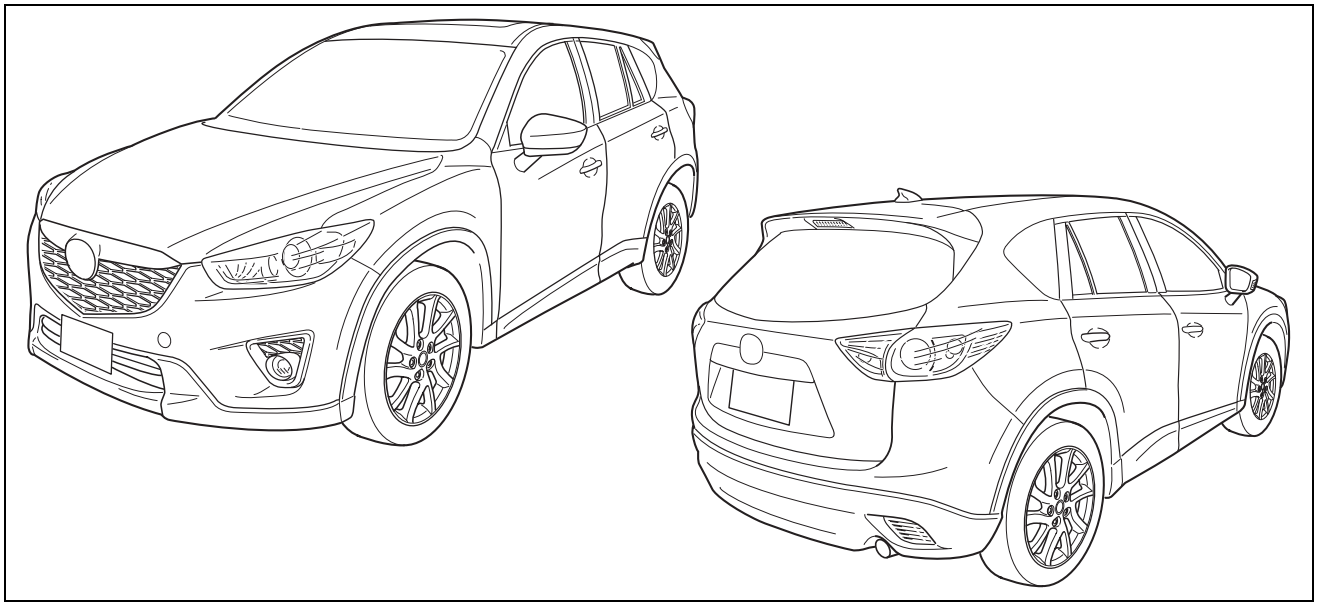
AIM OF DEVELOPMENT

id000000100100

Product Concept
Creation of a new category in vehicles with a sports-minded concept distinctive from conventional SUVs.

Vehicle Outline
Packaging
- The large diameter tires are top-in-class for the current SUV class. The front tires are positioned further forward of the front occupants to express the vehicle's sporty proportions and strong, solid feel.
- The shape of the windshield, with greater angularity than existing vehicles, realizes smooth, sleek proportions.

External View



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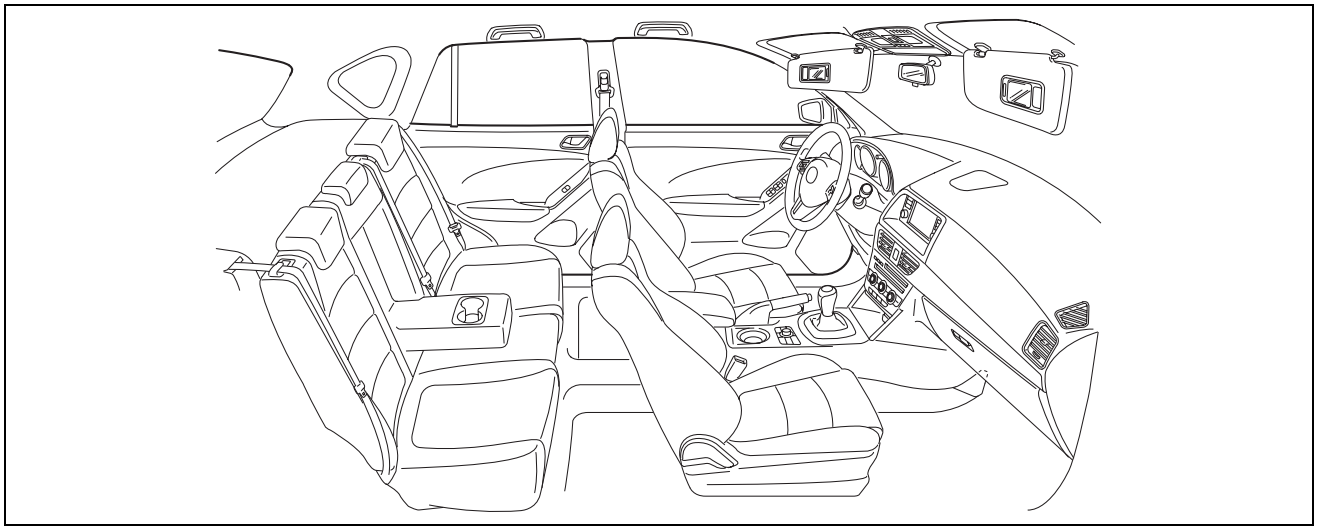
Design theme
- Advanced emotional styling
- Exceptional dynamic performance
- Support of sophisticated urban lifestyle

Interior design
- The use of high quality materials realizes a high quality design as seen in the refined area around the gauges.
- A stylish, dynamic interior is realized by an instrument panel providing a roomy interior space, and by an equipment layout in consideration of driver usability.
- A sporty design is realized by eliminating the meter hood and emphasizing the gauges themselves.



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GENERAL INFORMATION

Engine
- SKYACTIV-G 2.0 (Gasoline engine) and SKYACTIV-D 2.2 (Diesel engine) has been adopted.

Engine mechanical [SKYACTIV-G 2.0]
- For SKYACTIV-G 2.0, the following is performed to lower fuel consumption.
  - — Improvement of mechanical resistance loss
    - Narrowed down crankshaft journal
    - Optimized piston skirt shape
    - Lowered piston ring tension
    - Roller follower adopted
    - Reduction of valve spring load
    - Stabilization of timing chain behavior
    - Optimized engine coolant passage
    - Optimized water pump impeller shape
    - Lowered drive belt tension
    - Optimized oil passage
    - Optimized oil pump shape
    - Oil pump discharging pressure control has been adopted.
  - — Improvement of pumping loss
    - Variable valve timing mechanism has been adopted on both sides of intake and exhaust.

Engine mechanical [SKYACTIV-D 2.2]
- For SKYACTIV-D 2.2, the following is performed to lower fuel consumption.
  - — Low compression ratio
    - Combustion efficiency by lower compression ration (14.0)
  - — Weight reductions
    - Aluminum alloy cylinder block adopted
    - Exhaust manifold integrated cylinder heads adopted
  - — Weight reduction and mechanical resistance loss improvements
    - Piston shape optimized
    - Narrowed down crankshaft journal
- The SKYACTIV-D 2.2 has adopted a variable valve lift function for improved ignition stability during cold engine starts.

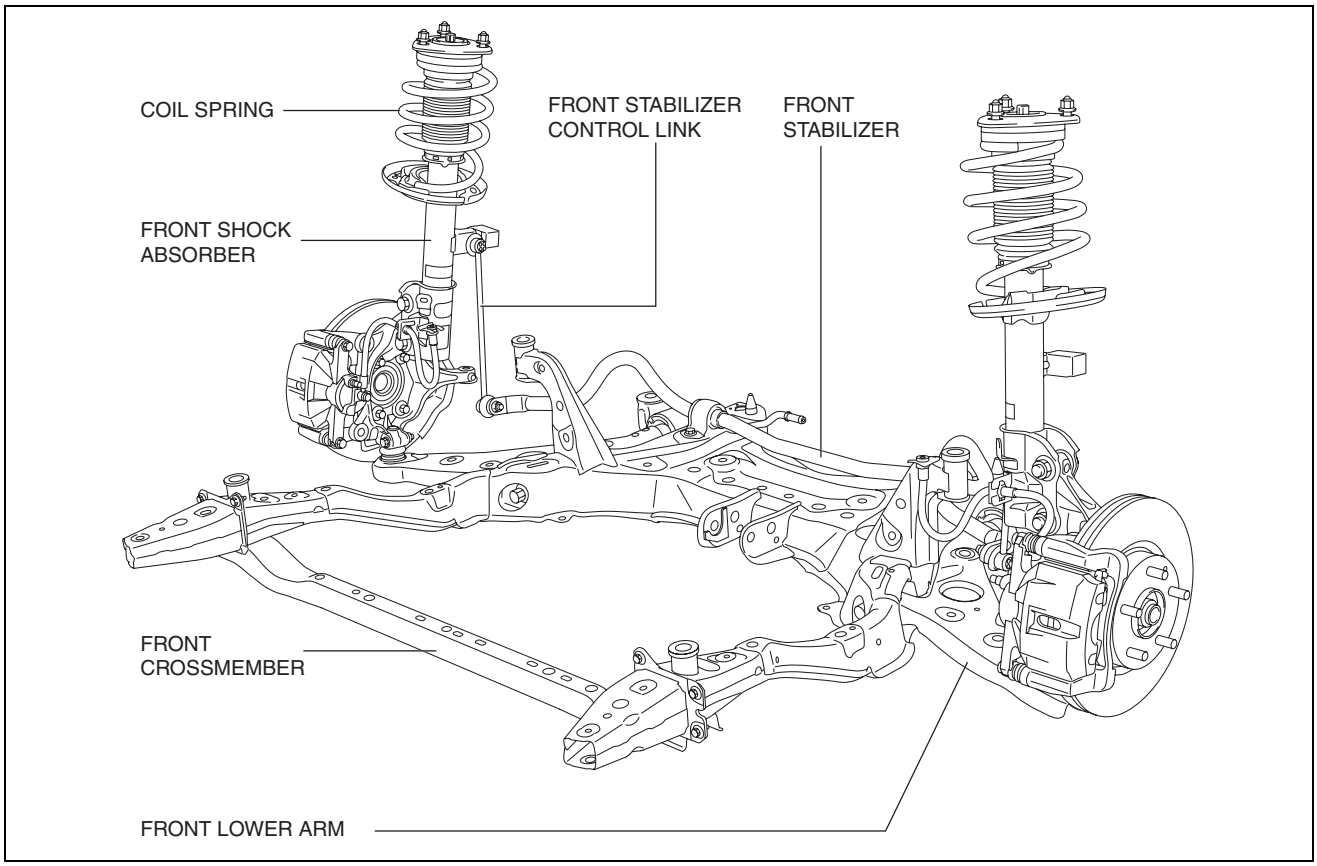
ENGINE CONTROL [SKYACTIV-G 2.0]
- L-jetronic and D-jetronic type detectors have been combined for intake air amount detection, improving the accuracy of the intake air amount measurement.
- Electric variable valve timing control has been adopted on the intake side for improved fuel efficiency and pumping loss reduction by variably controlling the intake valve timing without any influence from the engine conditions.
- An exhaust gas recirculation (EGR) system has been adopted for cleaner exhaust emissions and improved fuel efficiency.
- An exhaust gas recirculation (EGR) system has been adopted for cleaner exhaust emissions and improved fuel efficiency.
- i-stop control has been adopted for improved fuel efficiency, reduced exhaust gas emissions, and reduced idling noise. (with i-stop control)

ENGINE CONTROL [SKYACTIV-D 2.2]
- Two-step boost control has been adopted which realizes low emissions, low fuel consumption and high torque/response by the efficient, high air charging obtained in all ranges.
- An exhaust gas recirculation (EGR) system has been adopted for cleaner exhaust emissions and improved fuel efficiency.
- i-stop control has been adopted for improved fuel efficiency, reduced exhaust gas emissions, and reduced idling noise.

GENERAL INFORMATION

Suspension

- Front suspension
  - — Strut-type suspension adopted
  - — For the front / rear crossmembers, the welded flange has been eliminated (flange-less), the cross-section expanded and the connection rigidity of the welded parts improved to achieve both rigidity and light weight.
  - — By adoptiong a 6-point rigid mount-type front crossmember, the force generated from the tires is transmitted directly, and an agile vehicle response in low-to-mid speed range has been realized.



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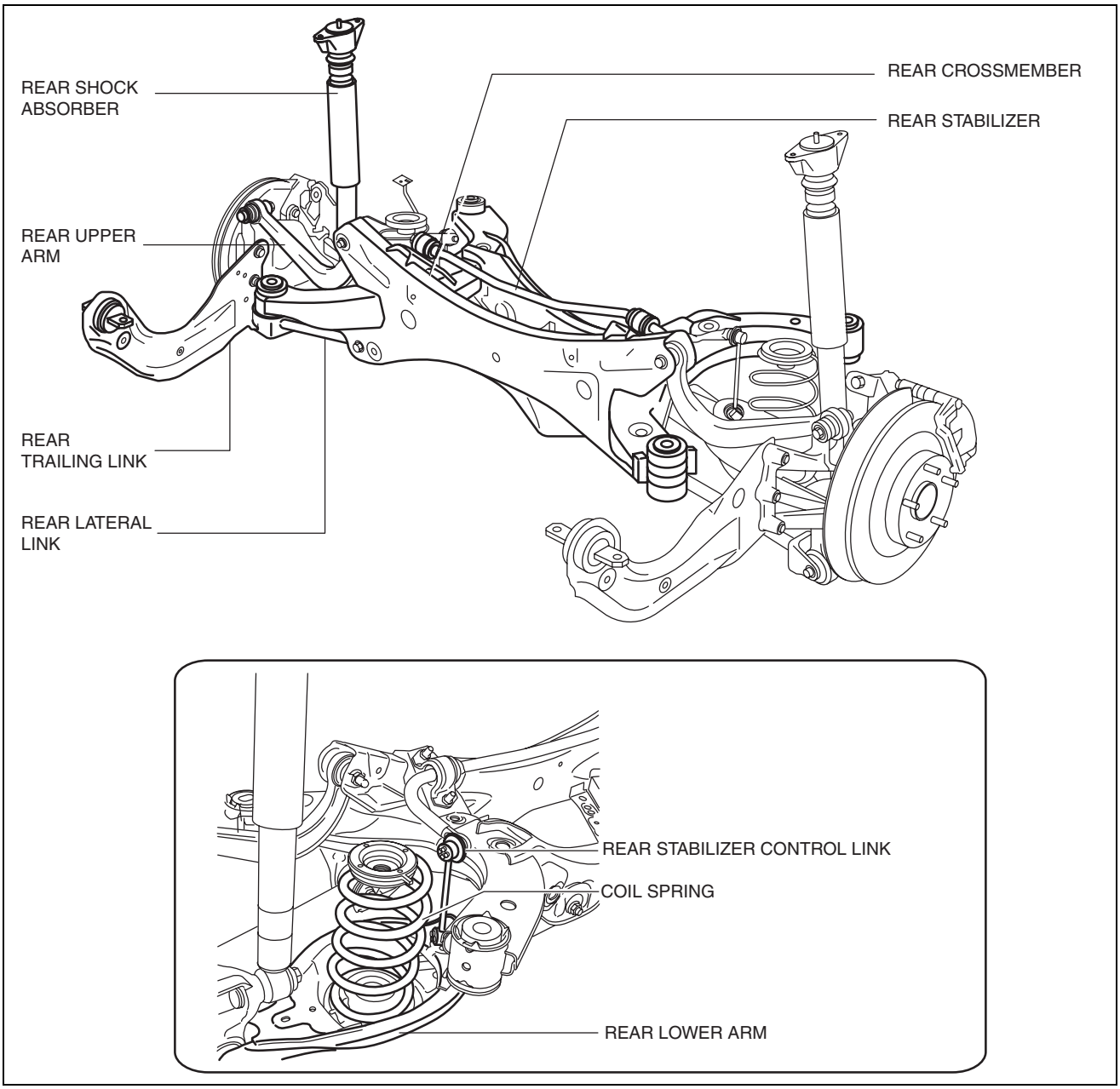
- Rear suspension
  - — An E-type multi-link rear suspension adopted.
  - — For the front /rear crossmembers, the welded flange has been eliminated (flange-less), the cross-section expanded and the connection rigidity of the welded parts improved to achieve both rigidity and light weight.

GENERAL INFORMATION

2WD



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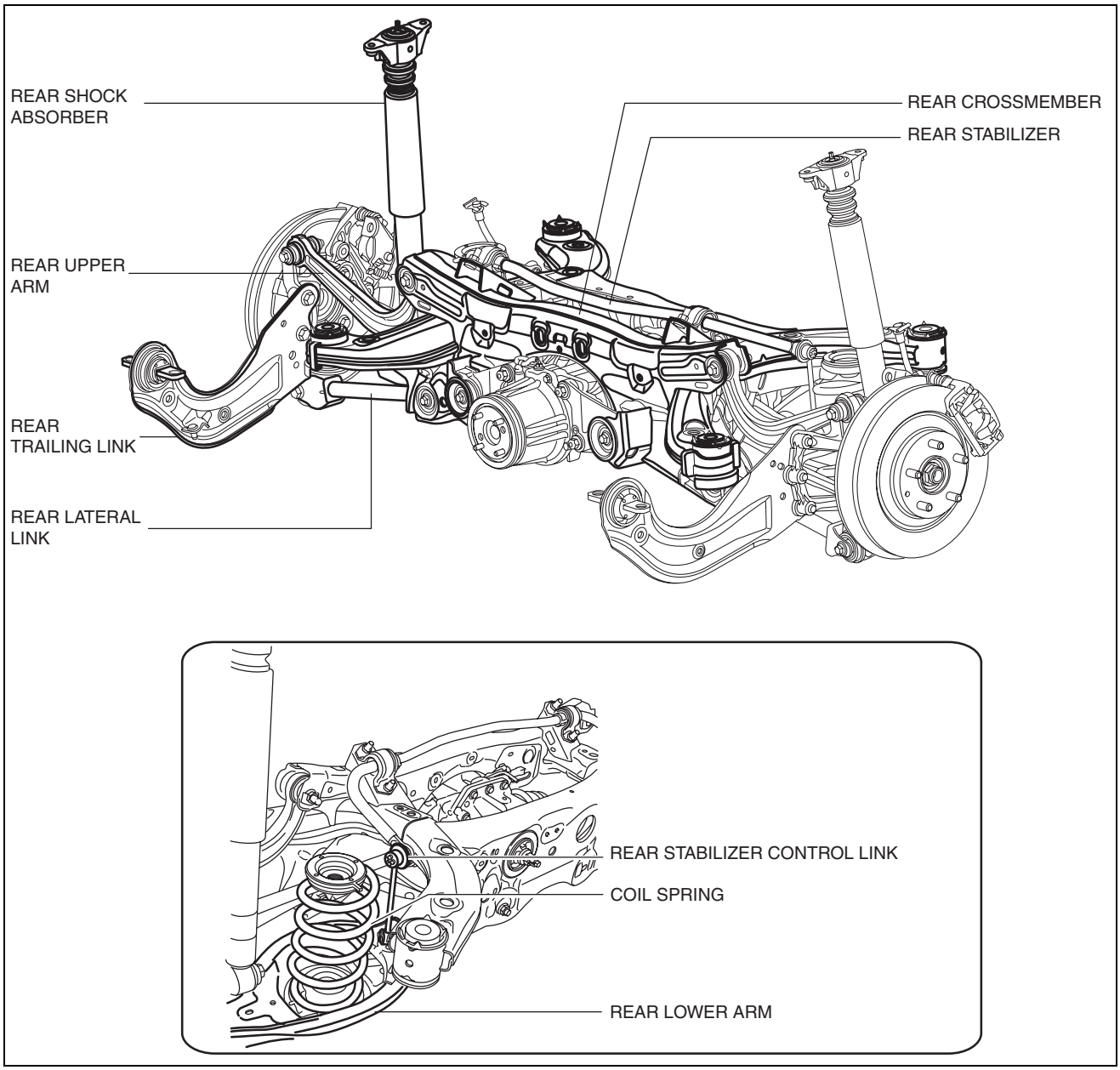
GENERAL INFORMATION

4WD



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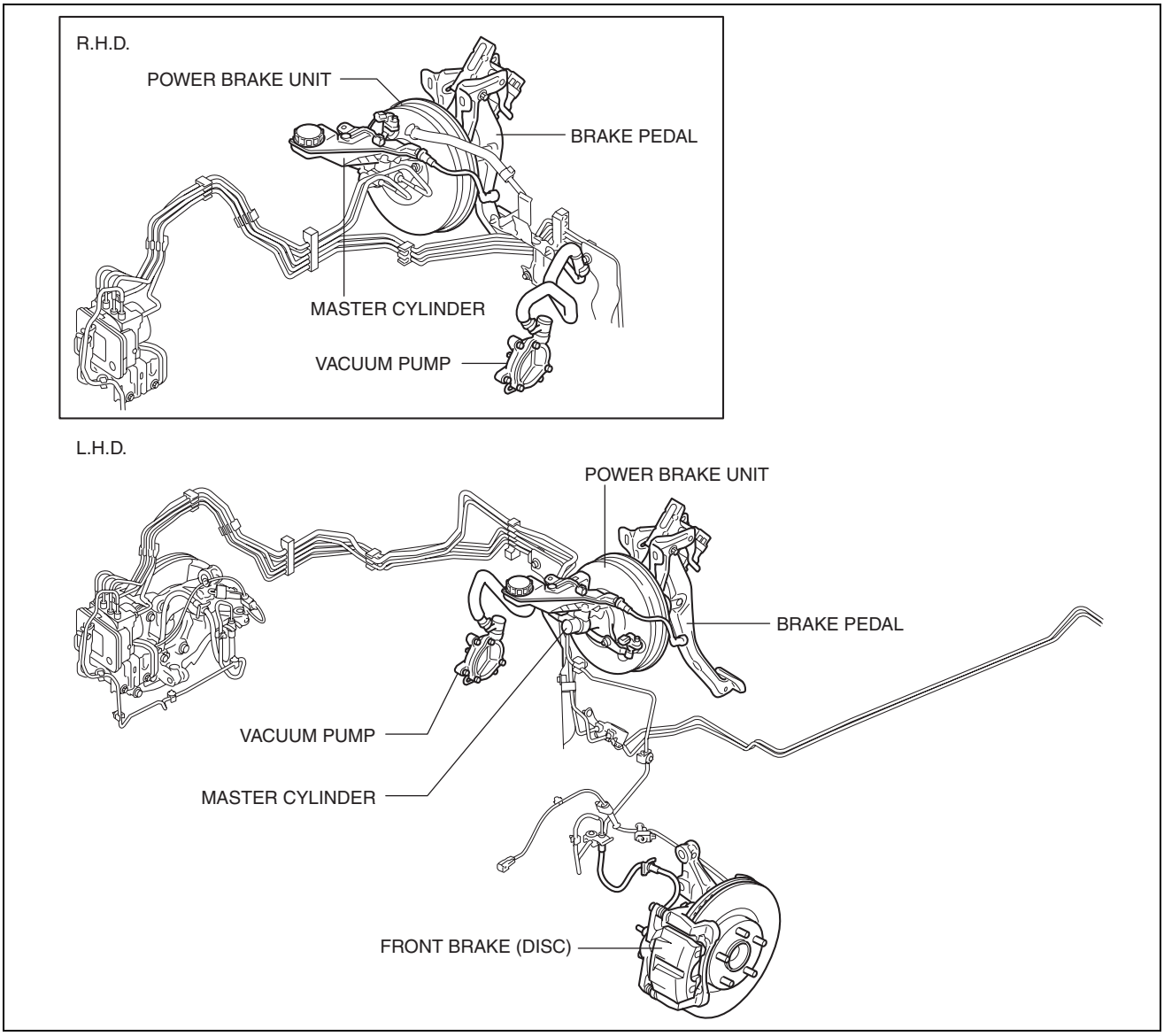
Brakes

- Conventional brake system
  - — A brake pedal with an intrusion minimizing mechanism has been adopted. As a result, driver safety has been improved.
  - — A small diameter long-stroke type master cylinder has been adopted, improving operability and response.
  - — A vacuum pump has been adopted, improving brake force.
  - — A large diameter, ventilated disc-type front brake has been adopted, improving braking force.

GENERAL INFORMATION

— A large diameter, solid disc-type rear brake has been adopted, improving braking force.

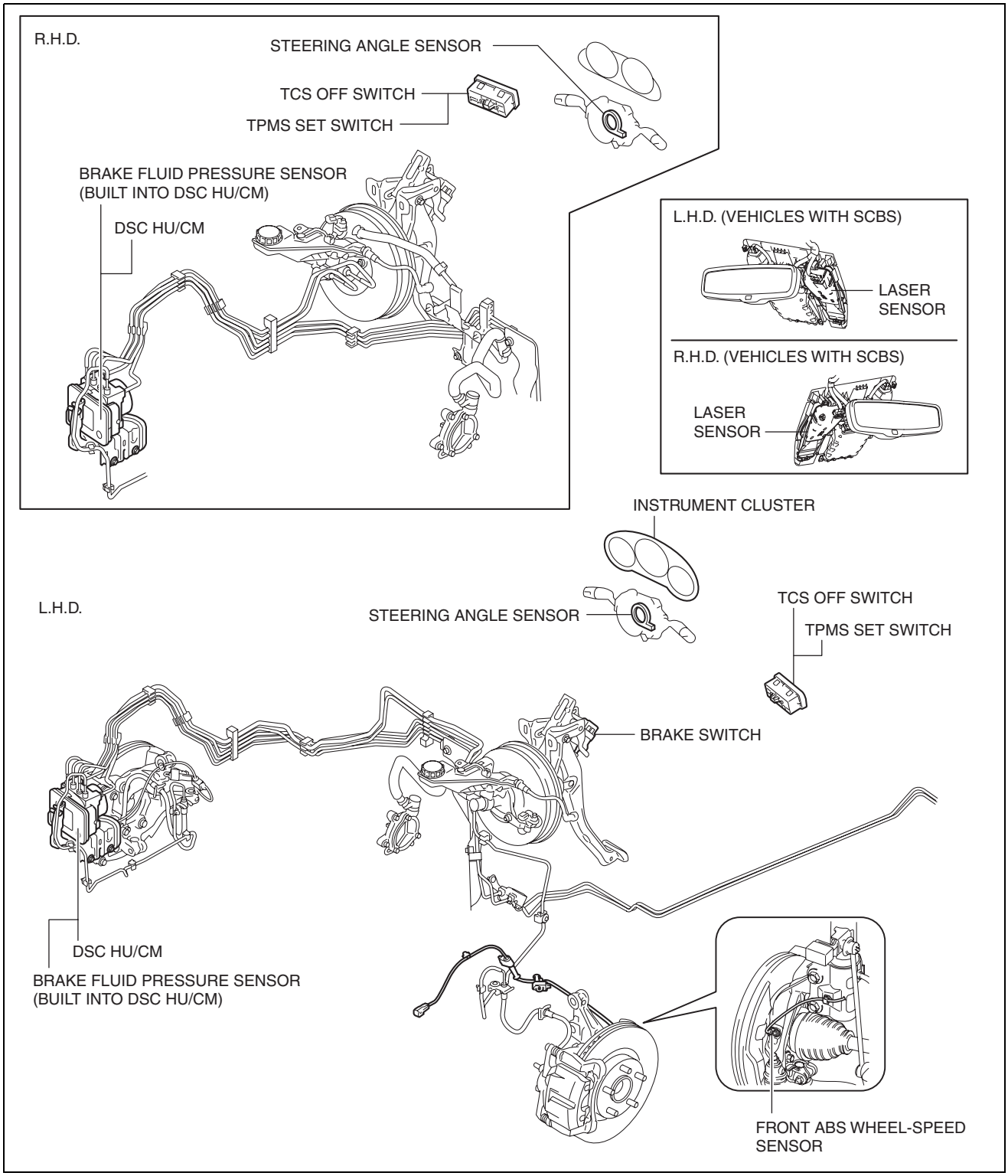


ac5wzn00001050

- Dynamic stability control
  — Electrical brake assist control has been adopted, improving safety.
  — The DSC HU/CM, integrating both the hydraulic unit (HU) and control module (CM), has been adopted, resulting in a size and weight reduction.
  — An enhanced malfunction diagnosis system, used with the Mazda Modular Diagnostic System (M-MDS), improving serviceability.
  — Serviceability improved by the automatic configuration function.

GENERAL INFORMATION

— Receives the lateral-G and yaw rate signals between the sophisticated air bag sensor (SAS) control module and the DSC HU/CM via controller area network (CAN) lines instead of the conventional combined sensor.



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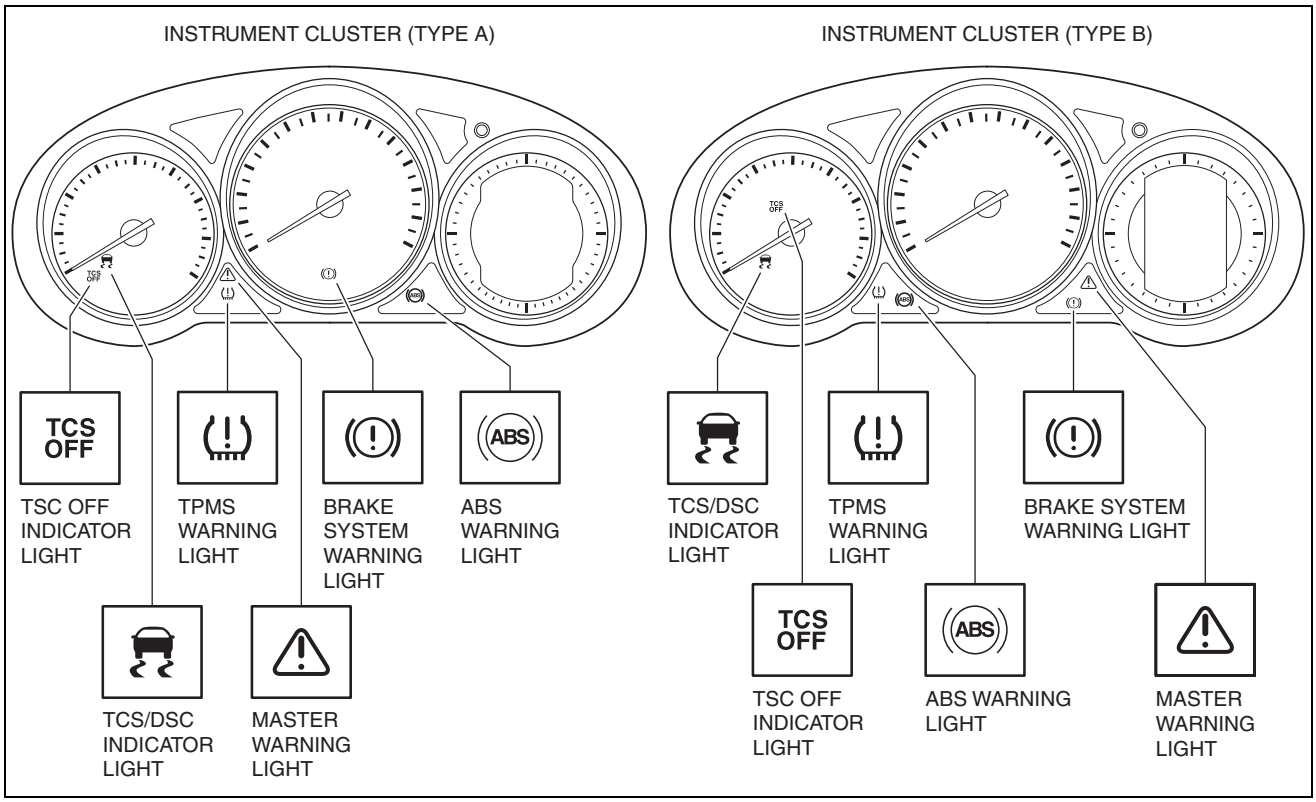
GENERAL INFORMATION



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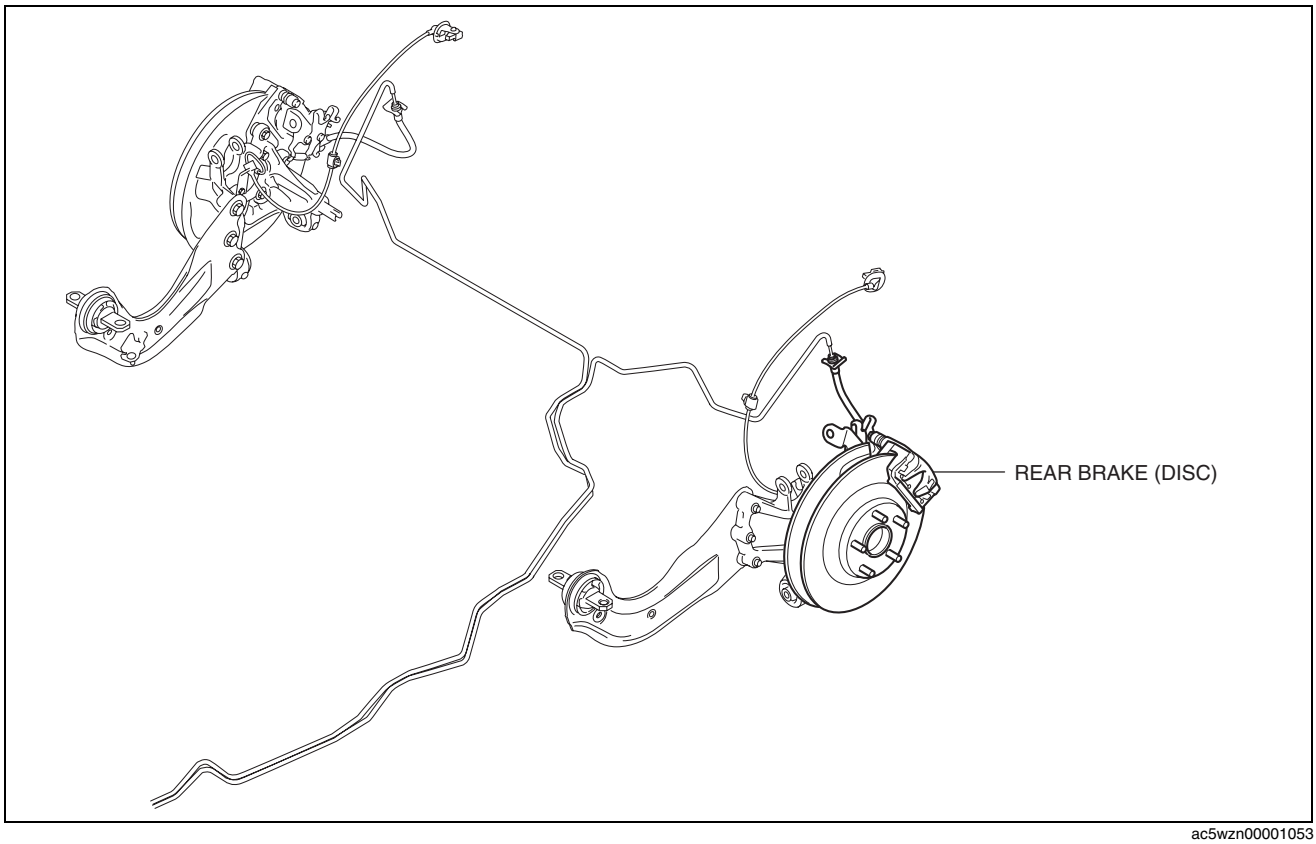
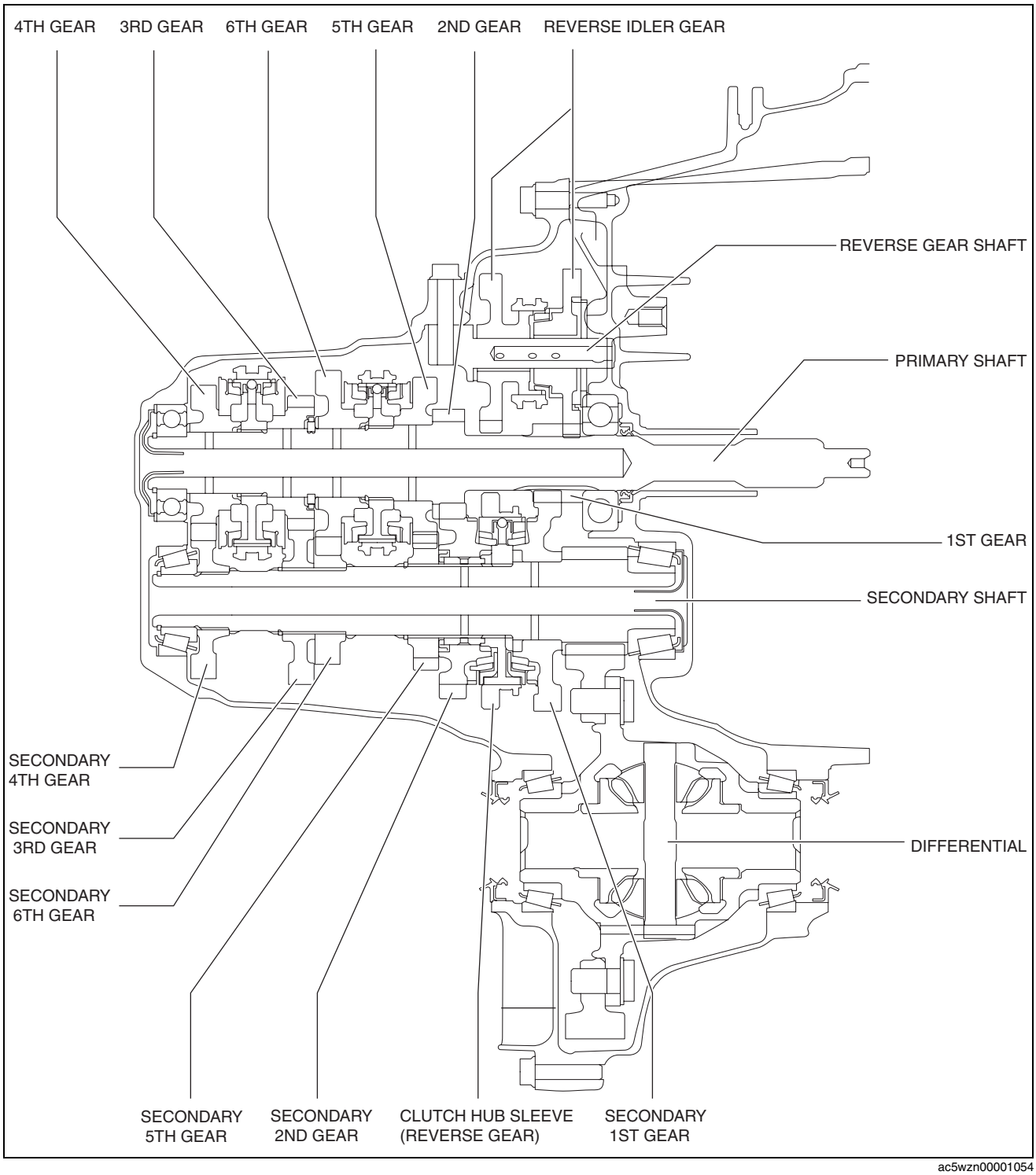


ac5wzn00001053

Transaxle

- Manual transaxle (C66M-R, C66MX-R)
  - — For SKYACTIV-G 2.0, six-speed C66M-R, C66MX-R manual transaxle has been adopted.

GENERAL INFORMATION



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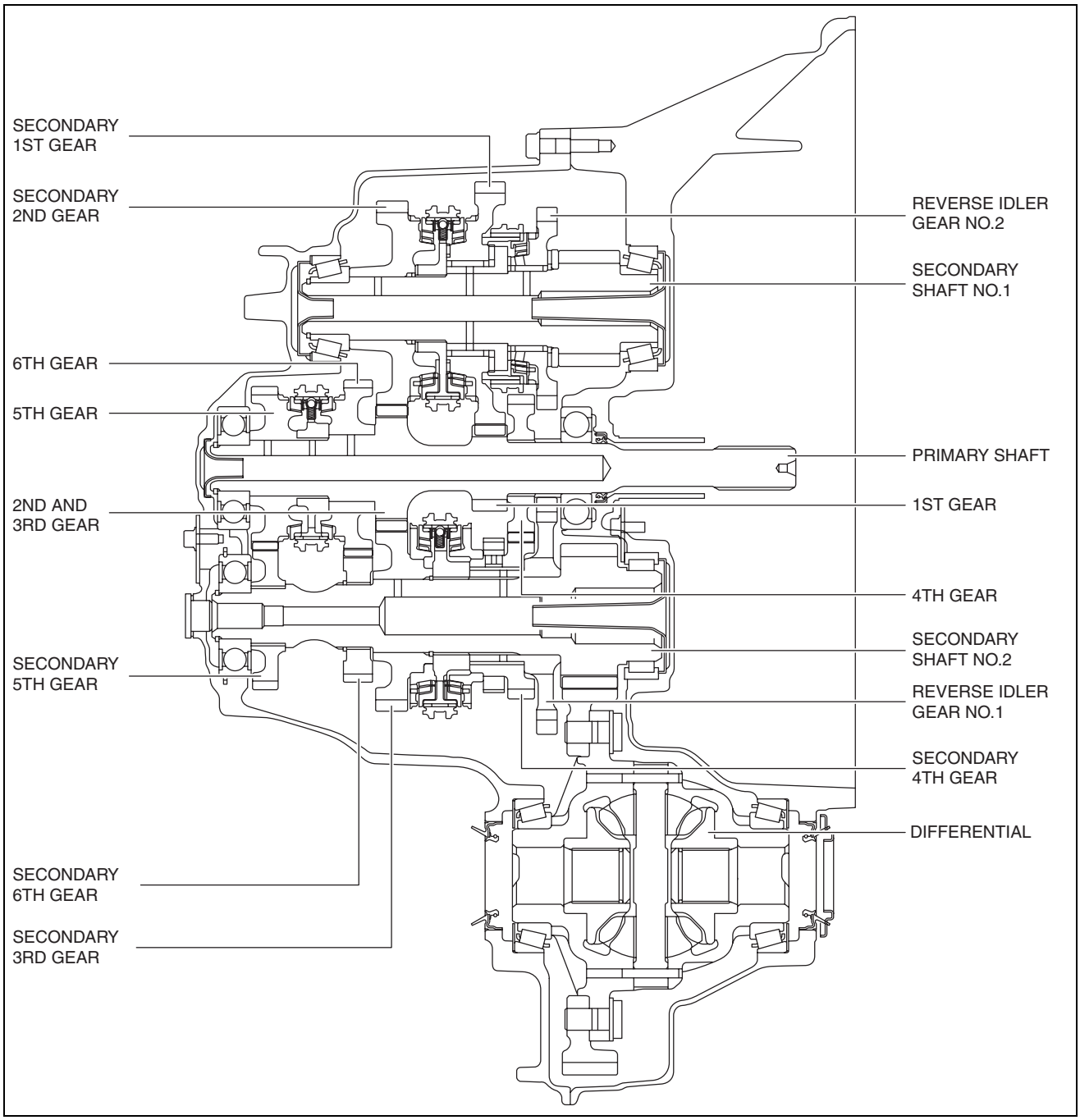
- Manual transaxle (D66M-R, D66MX-R)
  — For SKYACTIV-D 2.2, six-speed D66M-R, D66MX-R manual transaxle has been adopted.

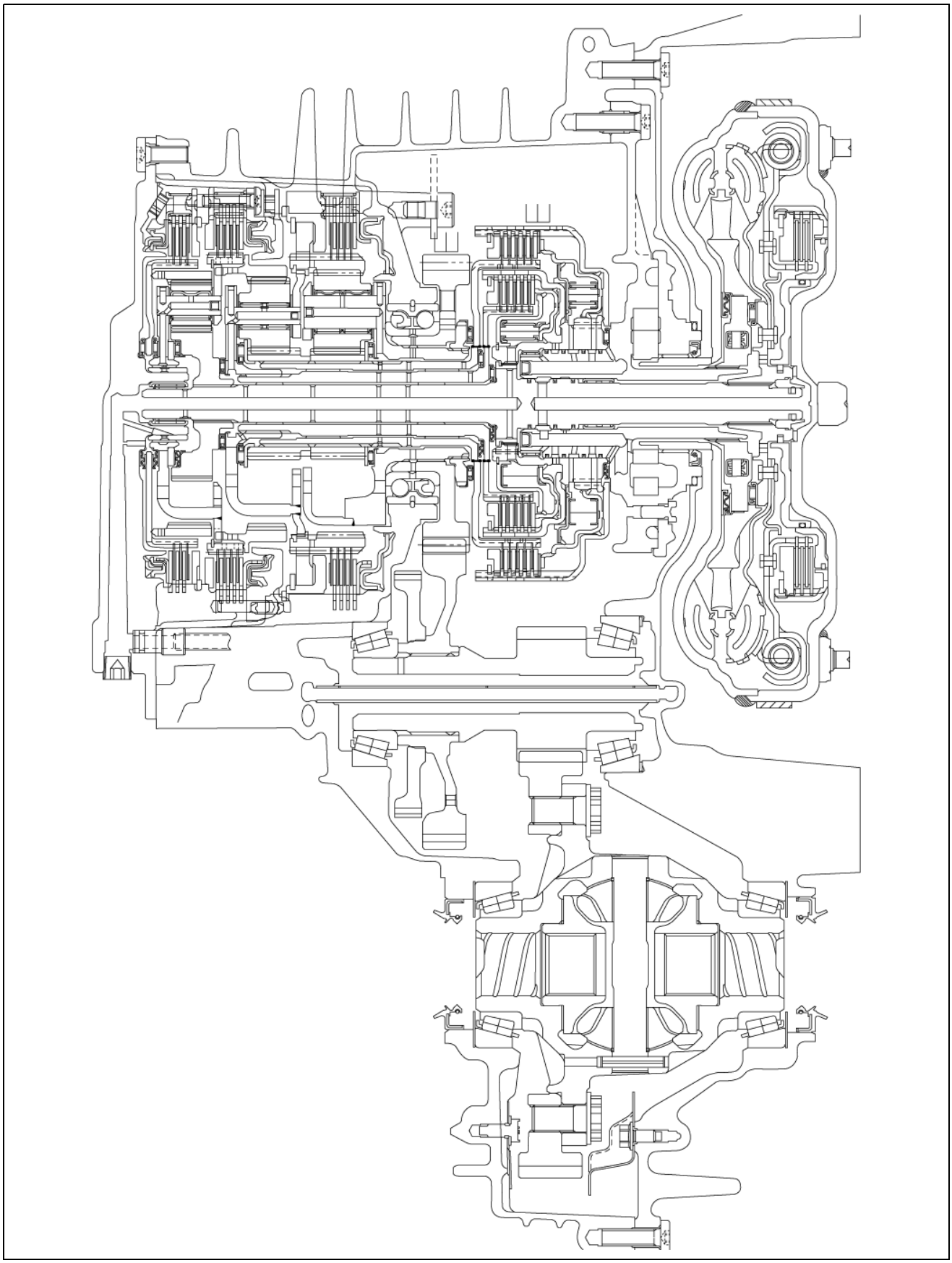
GENERAL INFORMATION



ac5wzn00001738

- Automatic transaxle (FW6A-EL, FW6AX-EL)
  — For SKYAVTIV-G 2.0, six-speed FW6A-EL, FW6AX-EL automatic transaxle has been adopted.

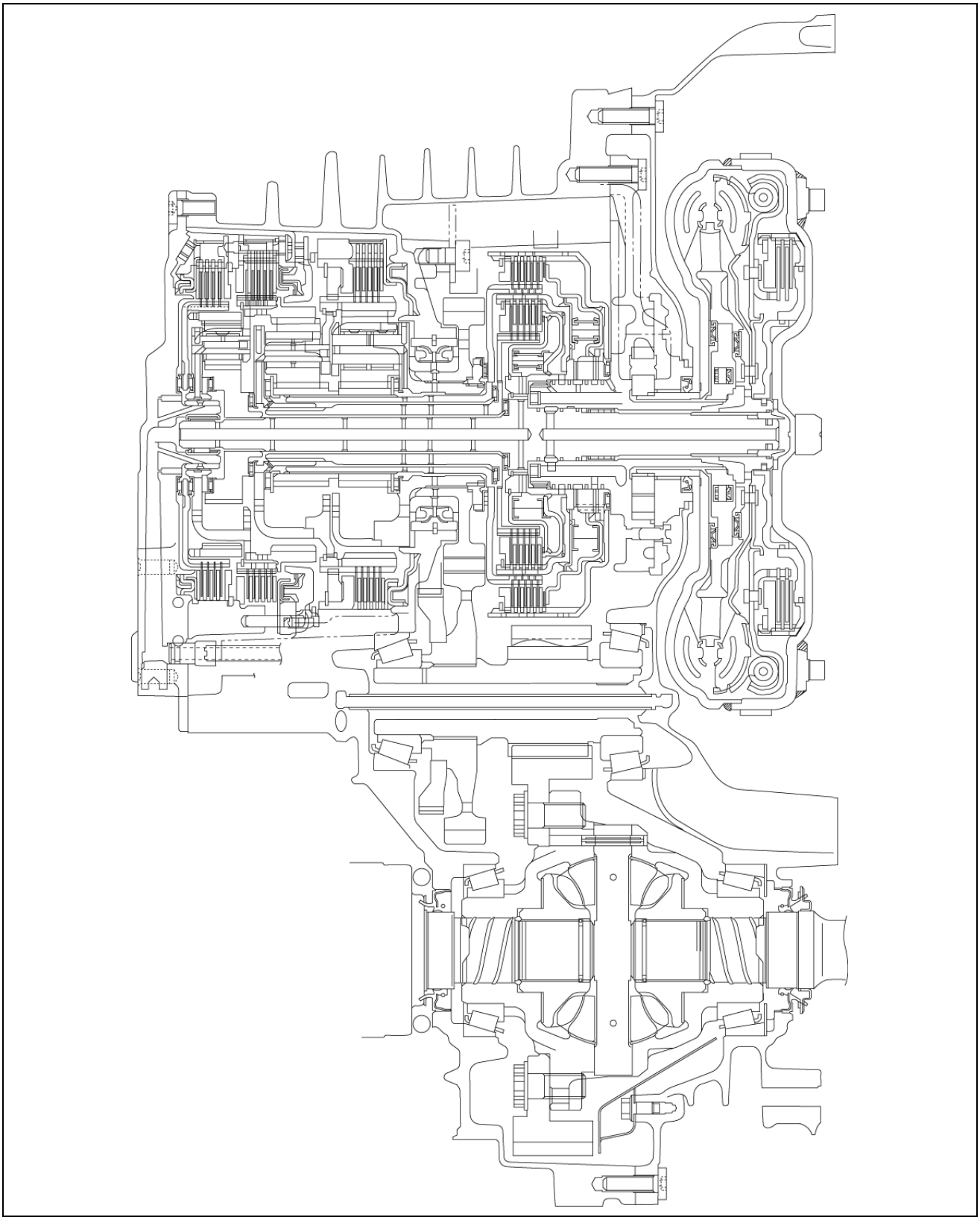
GENERAL INFORMATION



ac5wzn00001055

- Automatic transaxle (GW6A-EL, GW6AX-EL)
  — For SKYAVTIV-D 2.2, six-speed GW6A-EL, GW6AX-EL automatic transaxle has been adopted.

GENERAL INFORMATION



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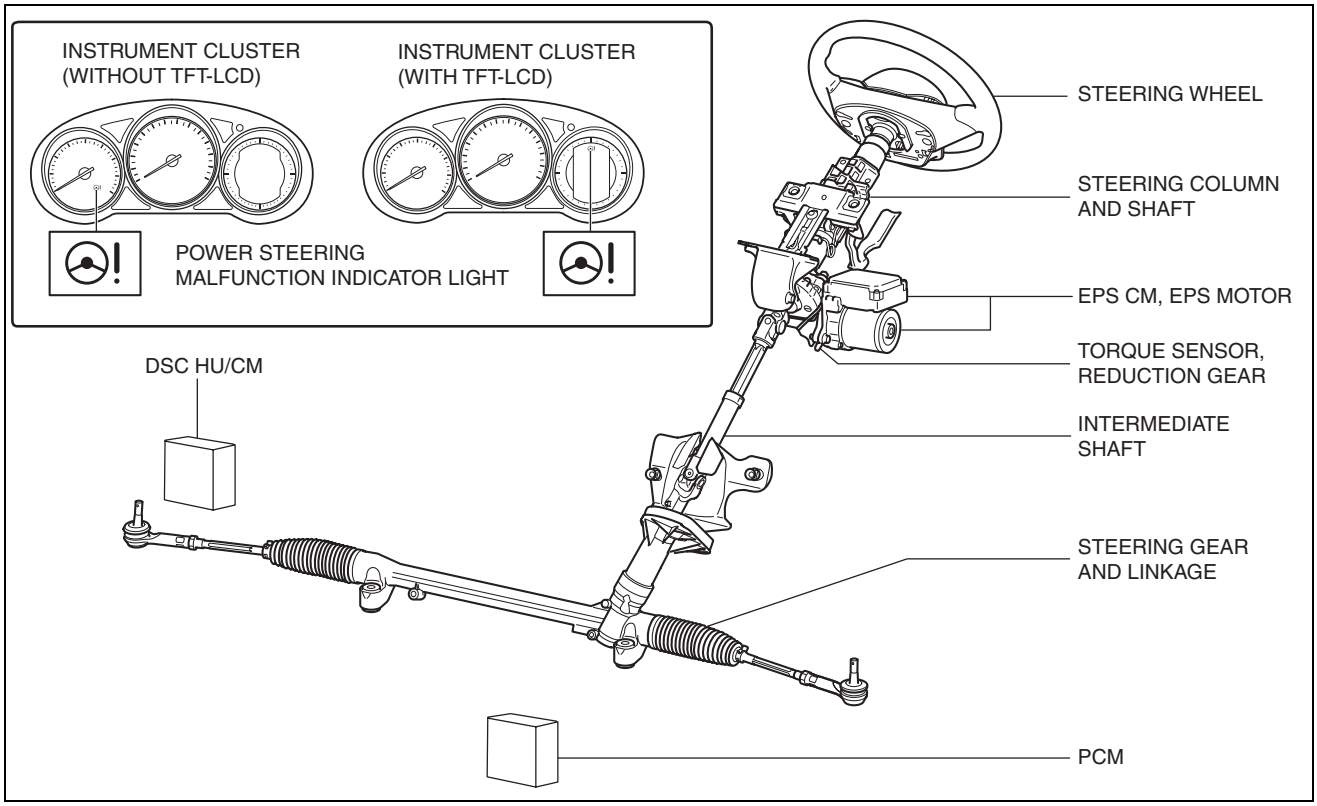
GENERAL INFORMATION

Steering

- Power steering
  - — A column assist-type EPS has been adopted call modeles.
  - — EPS provides smooth handing from low to high speeds as a result of the excellent steering feel provided by the electronic control and the vehicle-speed responsive control.
  - — EPS does not require a power steering oil pump and generates assist force only when the steering wheel is steered. As result, engine load is lowered and fuel efficiency is improved.
  - — Serviceability improved by the automatic configuration and the steering angle neutral position auto-learning function.



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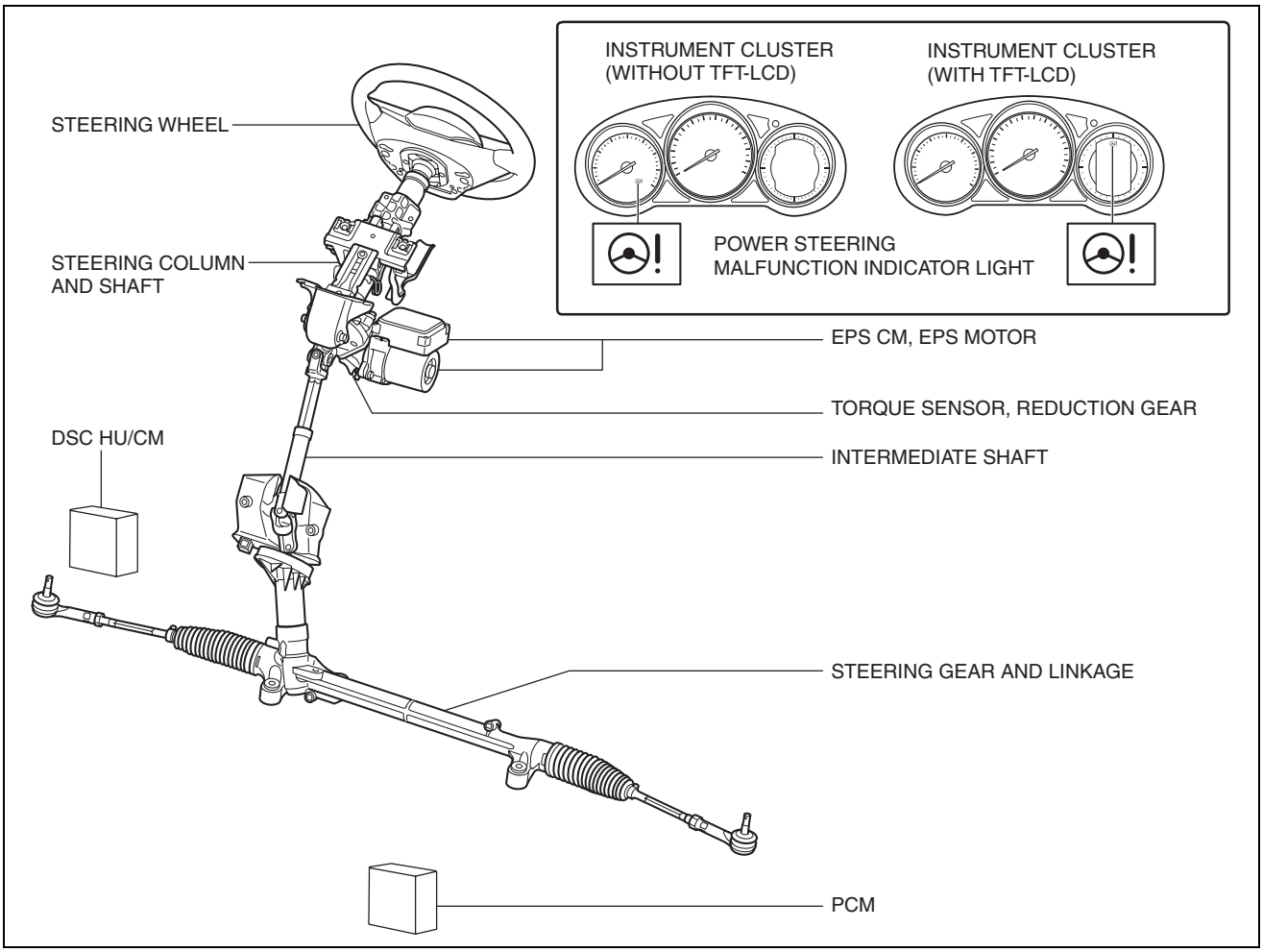

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Safety

- The adoption of the triple-H, strengthened frames on the floor, sides and roof areas provides enhanced protection.
- An immobilizer system has been adopted. This anti-theft device prevents the engine from being started unless the encrypted identification code, transmitted from a special electronic chip embedded in the key, corresponds with the identification code registered in the vehicle.
- World-class collision protection is provided due to the lightweight and highly rigid Mazda Advanced Impact-energy Distribution and Absorption System body.
- Curtain air bags have been adopted that deploy and cover the front and rear side windows to protect the heads of front and rear passengers.
- Side air bags that effectively protect the chest area have been adopted for the front seats.
- Pre-tensioner and load limiter mechanisms have been adopted for the front seat belts.
- Steering shaft with energy adsorbing mechanism adopted.
- An intrusion minimizing brake pedal has been adopted.
- Both ISOFIX and top tether anchors are provided in the rear seat for child-seat fixing.
- Auto-dimming mirror has adopted.

Driver's support

- Rear vehicle monitoring system adopted.
- Blind spot monitoring system adopted.
- ESS (Emergency Stop signal System) adopted.
- Hi beam control system adopted.
- Lane departure warning system adopted.

UNITS

id000000801600

Electric current	A (ampere)
Electric power	W (watt)

GENERAL INFORMATION

Electric resistance	ohm
Electric voltage	V (volt)
Length	mm (millimeter)
	in (inch)
Negative pressure	kPa (kilo pascal)
	mmHg (millimeters of mercury)
	inHg (inches of mercury)
Positive pressure	kPa (kilo pascal)
	kgf/cm^2 (kilogram force per square centimeter)
	psi (pounds per square inch)
Number of revolutions	rpm (revolutions per minute)
Torque	N·m (Newton meter)
	kgf·m (kilogram force meter)
	kgf·cm (kilogram force centimeter)
	ft·lbf (foot pound force)
	in·lbf (inch pound force)
Volume	L (liter)
	US qt (U.S. quart)
	Imp qt (Imperial quart)
	ml (milliliter)
	cc (cubic centimeter)
	cu in (cubic inch)
	fl oz (fluid ounce)
Weight	g (gram)
	oz (ounce)

Conversion From SI Units (Système International d'Unités)

- All numerical values in this manual are based on SI units. Numbers shown in conventional units are converted from these values.

Number Of Digits For Converted Values

- The number digits for converted values is the same as the number of significant figures*1 of the SI unit.
- For the torque value, the number of significant figures is, in principle, is 2 digits, in consideration of market practicalities.However, if the number of decimal places at the upper and lower limits of the converted value differs, the one with least number of decimal places is used. In addition, if the integer part is 3 digits or more, the integer part becomes the significant number of figures.

*1 : The number of significant figures is the number of digits from the left-most non-zero digit to the right-most digit including 0. (Example: 0.12 is 2 digits, 41.0 is 3 digits)

Converted Value Rounding Off And Rounding Up/down

- If there is no tolerance in the SI unit value, after conversion, rounding off is to within the number of significant digits.
- If there is tolerance in the SI unit value and the figure after conversion indicates the upper limit, the number of digits is rounded down to within the number of significant figures. If it indicates the lower limit, they are rounded up to within the number of significant figures.
- Even if the SI unit value is the same, the converted value may differ based on whether that value is the upper or lower limit.

NEW STANDARDS

id000000801400

- Following is a comparison of the previous standard and the new standard.

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
AP	Accelerator Pedal	—	Accelerator Pedal	
APP	Accelerator Pedal Position	—	Accelerator Pedal Position	
ACL	Air Cleaner	—	Air Cleaner	
A/C	Air Conditioning	—	Air Conditioning	

GENERAL INFORMATION

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
A/F sensor	Air Fuel Ratio Sensor	—	—	
BARO	Barometric Pressure	—	Atmospheric Pressure	
B+	Battery Positive Voltage	V_B	Battery Voltage	
—	Brake Switch	—	Stoplight Switch	
—	Calibration Resistor	—	Corrected Resistance	#6
CMP sensor	Camshaft Position Sensor	—	Crank Angle Sensor	
LOAD	Calculated Load Voltage	—	—	
CAC	Charge Air Cooler	—	Intercooler	
CLS	Closed Loop System	—	Feedback System	
CTP	Closed Throttle Position	—	Fully Closed	
CPP	Clutch Pedal Position	—	Clutch Position	
CIS	Continuous Fuel Injection System	EGI	Electronic Gasoline Injection System	
CS sensor	Control Sleeve Sensor	CSP sensor	Control Sleeve Position Sensor	#6
CKP sensor	Crankshaft Position Sensor	—	Crank Angle Sensor 2	
DLC	Data Link Connector	—	Diagnosis Connector	
DTM	Diagnostic Test Mode	—	Test Mode	#1
DTC	Diagnostic Trouble Code(s)	—	Service Code(s)	
DI	Distributor Ignition	—	Spark Ignition	
DLI	Distributorless Ignition	—	Direct Ignition	
EI	Electronic Ignition	—	Electronic Spark Ignition	#2
ECT	Engine Coolant Temperature	—	Water Thermo	
EM	Engine Modification	—	Engine Modification	
—	Engine Speed Input Signal	—	Engine RPM Signal	
EVAP	Evaporative Emission	—	Evaporative Emission	
EGR	Exhaust Gas Recirculation	—	Exhaust Gas Recirculation	
FC	Fan Control	—	Fan Control	
FF	Flexible Fuel	—	Flexible Fuel	
4GR	Fourth Gear	—	Overdrive	
—	Fuel Pump Relay	—	Circuit Opening Relay	#3
FSO solenoid	Fuel Shut Off Solenoid	FCV	Fuel Cut Valve	#6
GEN	Generator	—	Alternator	
GND	Ground	—	Ground/Earth	
HO2S	Heated Oxygen Sensor	—	Oxygen Sensor	With heater
IAC	Idle Air Control	—	Idle Speed Control	
—	IDM Relay	—	Spill Valve Relay	#6
—	Incorrect Gear Ratio	—	—	
—	Injection Pump	FIP	Fuel Injection Pump	#6
—	Input/Turbine Speed Sensor	—	Pulse Generator	
IAT	Intake Air Temperature	—	Intake Air Thermo	
KS	Knock Sensor	—	Knock Sensor	
MIL	Malfunction Indicator Lamp	—	Malfunction Indicator Light	
MAP	Manifold Absolute Pressure	—	Intake Air Pressure	
MAF	Mass Air Flow	—	Mass Air Flow	
MAF sensor	Mass Air Flow Sensor	—	Airflow Sensor	
MFI	Multiport Fuel Injection	—	Multiport Fuel Injection	
OBD	On-Board Diagnostic	—	Diagnosis/Self Diagnosis	
OL	Open Loop	—	Open Loop	
—	Output Speed Sensor	—	Vehicle Speed Sensor 1	
OC	Oxidation Catalytic Converter	—	Catalytic Converter	
O2S	Oxygen Sensor	—	Oxygen Sensor	
PNP	Park/Neutral Position	—	Park/Neutral Range	
PID	Parameter Identification	—	Parameter Identification	

GENERAL INFORMATION

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
—	PCM Control Relay	—	Main Relay	#6
PSP	Power Steering Pressure	—	Power Steering Pressure	
PCM	Powertrain Control Module	ECU	Engine Control Unit	#4
—	Pressure Control Solenoid	—	Line Pressure Solenoid Valve	
PAIR	Pulsed Secondary Air Injection	—	Secondary Air Injection System	Pulsed injection
—	Pump Speed Sensor	—	NE Sensor	#6
RAM	Random Access Memory	—	—	
AIR	Secondary Air Injection	—	Secondary Air Injection System	Injection with air pump
SAPV	Secondary Air Pulse Valve	—	Reed Valve	
SFI	Sequential Multipoint Fuel Injection	—	Sequential Fuel Injection	
—	Shift Solenoid A	—	1–2 Shift Solenoid Valve	
		—	Shift A Solenoid Valve	
—	Shift Solenoid B	—	2–3 Shift Solenoid Valve	
		—	Shift B Solenoid Valve	
—	Shift Solenoid C	—	3–4 Shift Solenoid Valve	
3GR	Third Gear	—	3rd Gear	
TWC	Three Way Catalytic Converter	—	Catalytic Converter	
TB	Throttle Body	—	Throttle Body	
TP	Throttle Position	—	—	
TP sensor	Throttle Position Sensor	—	Throttle Sensor	
TCV	Timer Control Valve	TCV	Timing Control Valve	#6
TCC	Torque Converter Clutch	—	Lockup Position	
TCM	Transmission (Transaxle) Control Module	—	EC-AT Control Unit	
—	Transmission (Transaxle) Fluid Temperature Sensor	—	ATF Thermosensor	
TR	Transmission (Transaxle) Range	—	Inhibitor Position	
TC	Turbocharger	—	Turbocharger	
VSS	Vehicle Speed Sensor	—	Vehicle Speed Sensor	
VR	Voltage Regulator	—	IC Regulator	
VAF sensor	Volume Air Flow Sensor	—	Air Flow Sensor	
WUTWC	Warm Up Three Way Catalytic Converter	—	Catalytic Converter	#5
WOT	Wide Open Throttle	—	Fully Open	

#1: Diagnostic trouble codes depend on the diagnostic test mode
#2: Controlled by the PCM
#3: In some models, there is a fuel pump relay that controls pump speed. That relay is now called the fuel pump relay (speed).
#4: Device that controls engine and powertrain
#5: Directly connected to exhaust manifold
#6: Part name of diesel engine

ABBREVIATIONS

id000000801000

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid

GENERAL INFORMATION

ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position
CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle
DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
EPS	Electric Power Steering
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System
HBC	High Beam Control
HF/TEL	Hands-Free Telephone
HI	High
HS	High Speed
HU	Hydraulic Unit
IDS	Integrated Diagnostic Software
IG	Ignition
IN	Intake
INT	Intermittent
KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification

GENERAL INFORMATION

POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear
2GR	Second Gear
2WD	2-Wheel Drive
3GR	Third Gear
4GR	Fourth Gear
4WD	4-Wheel Drive
5GR	Fifth Gear
6GR	Sixth Gear

ENGINE

01
SECTION

01-00 OUTLINE

OUTLINE

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ENGINE ABBREVIATIONS

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position

OUTLINE

CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle
DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System
HBC	High Beam Control
HF/TEL	Hands-Free Telephone
HI	High
HS	High Speed
HU	Hydraulic Unit
IDS	Integrated Diagnostic Software
IG	Ignition
IN	Intake
INT	Intermittent
KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System

OUTLINE

RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear
2GR	Second Gear
2WD	2-Wheel Drive
3GR	Third Gear
4GR	Fourth Gear
4WD	4-Wheel Drive
5GR	Fifth Gear
6GR	Sixth Gear

ENGINE [SKYACTIV-G 2.0]

id0100000002dd

Special Features

- For SKYACTIV-G 2.0, the following is performed to lower fuel consumption.
  - — Improvement of mechanical resistance loss
    - Narrowed down crankshaft journal
    - Optimized piston skirt shape
    - Lowered piston ring tension
    - Roller follower adopted
    - Reduction of valve spring load
    - Stabilization of timing chain behavior
    - Optimized engine coolant passage
    - Optimized water pump impeller shape
    - Lowered drive belt tension
    - Optimized oil passage
    - Optimized oil pump shape
    - Oil pump discharging pressure control has been adopted.
  - — Improvement of pumping loss
    - Variable valve timing mechanism has been adopted on both sides of intake and exhaust.
- L-jetronic[*1] and D-jetronic[*2] type detectors have been combined for intake air amount detection, improving the accuracy of the intake air amount measurement.
  - — MAF sensor adopted
  - — MAP sensor adopted
  - — IAT sensor No.1 and No.2 adopted
- Valve timing control has been adopted on both sides of the intake and exhaust, improving fuel economy and emission performance.
  Intake side: Electric variable valve timing control
  - — Intake CMP sensor adopted
  - — Electric variable valve timing motor/driver adopted
  - — Electric variable valve timing relay adopted

  Exhaust side: Hydraulic variable valve timing control
  - — Exhaust CMP sensor adopted
- Engine oil control has been adopted reducing engine load.
  - — Engine oil solenoid valve adopted
- DC-DC converter control has been adopted for improved power supply stability.
  - — DC-DC converter adopted

OUTLINE

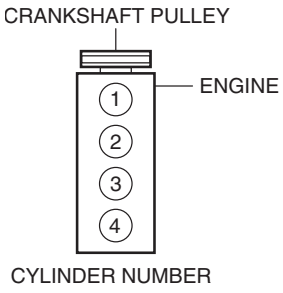
- With the adoption of fuel pump control, fuel pump power consumption has been reduced, improving fuel economy.
  — Fuel pump control module adopted
- Generator output control adopted, fuel economy/idling stability improved.
  — Current sensor adopted
- With the adoption of the ion sensor, which detects pre-ignition, engine reliability has been improved.
- LIN communication has been adopted to the current sensor and DC-DC converter for simplified wiring harnesses.

*1 : Measures the intake air amount directly using the MAF sensor.
*2 : Measures the intake air pressure introduced into the cylinder using the MAP sensor and calculates the intake air amount indirectly.

Specification

Item				Specification
MECHANICAL				
Type				Gasoline, 4-cycle
Cylinder arrangement and number				In-line, 4-cylinder
Combustion chamber				Pentroof
Valve system				DOHC, timing chain driven, 16 valves
Displacement			(ml {cc, cu in})	1,998 {1,998, 121.9}
Bore × stroke			(mm {in})	83.5 × 91.2 {3.29 ×3.59}
Compression ratio [European (L.H.D. U.K.) specs.]				14.0:1
Compression ratio [Except European (L.H.D. U.K.) specs.]				13.0:1
Compression pressure [European (L.H.D. U.K.) specs.]			(kPa {kgf/cm^2, psi} [rpm])	978 {9.97, 142} [300]
Compression pressure [Except European (L.H.D. U.K.) specs.]			(kPa {kgf/cm^2, psi} [rpm])	885 {9.02, 128} [300]
Valve timing	IN	Open	BTDC (°)	-32—42
		Closed	ABDC (°)	110—36
	EX	Open	BBDC (°)	54—11
		Closed	ATDC (°)	7—50
LUBRICATION SYSTEM				
Type				Force-fed type
Oil pressure (reference value) [Water temperature 80—90 degrees C]			(kPa {kgf/cm^2, psi} [rpm])	Low oil pressure: 110—175 {1.13—1.78, 16.0—25.3}[1,500] High oil pressure: 300—430 {3.06—4.38, 43.6—62.3}[4,500]
Oil pump	Type			Trochoid gear type
Oil filter	Type			Full-flow, paper element
	Bypass pressure		(kPa {kgf/cm^2, psi})	78—118 {0.80—1.20, 12.0—17.1}
Oil capacity (approx. quantity)	Total (dry engine)		(L {US qt, Imp qt})	Without oil cooler : 4.9 {5.2, 4.3} With oil cooler : 5.0 {5.3, 4.4}
	Oil replacement		(L {US qt, Imp qt})	4.0 {4.2, 3.5}
	Oil and oil filter replacement		(L {US qt, Imp qt})	4.2 {4.4, 3.7}
COOLING SYSTEM				
Type				Water-cooled, Electromotive
Coolant capacity [European (L.H.D.) specs.] (approx. quantity)			(L {US qt, Imp qt})	ATX : 7.6 {8.0, 6.7} MTX : 7.4 {7.8, 6.5}
Coolant capacity [European (U.K.) specs.] (approx. quantity)			(L {US qt, Imp qt})	7.4 {7.8, 6.5}
Coolant capacity [General (R.H.D.) specs.] (approx. quantity)			(L {US qt, Imp qt})	ATX : 7.4 {7.8, 6.5} MTX : 7.1 {7.5, 6.2}
Coolant capacity [Israel, China] (approx. quantity)			(L {US qt, Imp qt})	7.5 {7.9, 6.6}
Coolant capacity [Saudi] (approx. quantity)			(L {US qt, Imp qt})	7.8 {8.2, 6.9}

OUTLINE

Item			Specification
Coolant capacity [Except European (L.H.D. U.K.) specs., General (R.H.D.) specs., Israel, Saudi, China] (approx. quantity)		(L {US qt, Imp qt})	ATX : 7.5 {7.9, 6.6} MTX : 7.3 {7.7, 6.4}
Water pump	Type		Centrifugal, V-ribbed belt-driven
Thermostat	Type		Wax type
	Opening temperature	(°C {°F})	80.5—83.5 {177—182}
	Full-open temperature	(°C {°F})	95 {203}
	Full-open lift	(mm {in})	8.5 {0.33} or more
Radiator	Type		Corrugated fin type
Cooling system cap	Valve opening pressure	(kPa {kgf/cm^2, psi})	93.2—122.6 {0.951—1.250, 13.6—17.7}
Cooling fan	Type		Electric type
	Number of blades		Cooling fan No.1 : 5 Cooling fan No.2 : 7
	Outer diameter	(mm {in})	320 {12.6}
	Cooling fan motor output	(W)	80
FUEL SYSTEM			
Fuel injector	Type		High resistance
	Fuel supply method		Top-feed
	Drive types		Electronic type
Pressure regulator control pressure		(kPa {kgf/cm^2, psi})	Approx. 430 {4.38, 62.4}
Fuel pump	Type		Electric
Fuel tank	Capacity (L {US gal, Imp gal})	2WD	56.0 {14.8, 12.3}
		4WD	58.0 {15.3, 12.8}
EMISSION SYSTEM			
Catalyst	Type		WU-TWC (monolith) TWC (monolith)
EVAP control system	Type		Charcoal canister type
PCV system	Type		Closed type
CHARGING SYSTEM			
Battery	Voltage	(V)	12
	Type and capacity (5-hour rate)	(A·h)	Q-85 (52)
Generator	Output	(V-A)	12-100
	Regulated voltage		Controlled by PCM
	Self diagnosis function		
IGNITION SYSTEM			
Ignition system	Type		SEI
	Spark advance		Electronic
	Firing order		1—3—4—2 (all cylinders independent firing)
			
Spark plug	Type		PE01-18-110, PE02-18-110
STARTING SYSTEM			
Starter	Type		Coaxial reduction
	Output	(kW)	1.4
CONTROL SYSTEM			

OUTLINE

Item	Specification
i-stop OFF switch	ON/OFF
Neutral switch	ON/OFF
CPP switch	ON/OFF
MAF sensor	Hot film
IAT sensor	Cold resistor
MAP sensor	Sealant diaphragm
TP sensor	Hall element
APP sensor	Hall element
CKP sensor	MR element
CMP sensor	GMR element
ECT sensor	Thermistor
BARO sensor	Piezoelectric element
Fuel pressure sensor	Metal diaphragm
KS	Piezoelectric element
Current sensor	Shunt resistance, Thermistor
A/F sensor	Zirconium element
HO2S	Zirconia element
Clutch stroke sensor	Hall element
Power brake unit vacuum sensor	Piezoelectric element

Engine oil [Europe]

Recommended engine oil		Alternative engine oil	
Mazda Original Oil Supra 0W-20	Mazda Original Oil Ultra 5W-30	API SM/SN 0W-20	API SL/SM or ACEA A3/A5 5W-30

Engine oil [Except Europe]

Item	Specifications
Grade	API SG/SH/SJ/SL/SM/SN or ILSAC GF-2/GF-3/GF-4/GF-5
Viscosity (SAE)	10W-30, 10W-40, 10W-50, 5W-20, 5W-30, 5W-40, 0W-20, 0W-30*1

*1 : Except China

Fuel	Research Octane Number	Country
Premium unleaded fuel (Conforming to EN 228 and within E10)*1	95 or above	New Caledonia, Turkey, Azerbaijan, Canary Islands, Reunion, Morocco, Austria, Greece, Italy, Switzerland, Belgium, Denmark, Finland, Norway, Portugal, Spain, Sweden, Hungary, Germany, Poland, Bulgaria, Croatia, Slovenia, Luxembourg, Slovakia, Latvia, Lithuania, Russia, Belarus, France, Ukraine, Czech, Estonia, Faeroe, Iceland, Romania, The Netherlands, Macedonia, Bosnia and Herzegovina, Serbia, Montenegro, Albania, Moldova, Martinique, F.Guiana, Guadeloupe, Cyprus, Malta, Ireland, UK, Tahiti, Vanuatu, Iran, UAE, Lebanon, Israel, Algeria, Libya, Tunisia, Madagascar, Guatemala, Bolivia, Honduras, Nicaragua, Aruba, Singapore, Hong Kong, Malaysia, Macau, Mauritius, Jamaica, Barbados, Grenada, St. Lucia, St. Vincent, Antigua
Regular unleaded fuel (Conforming to Fuel Quality Standards Act 2000)*2	90 or above	Taiwan, Vietnam, The Philippines, Marshall Islands, Ustt*3, Kuwait, Oman, Qatar, Saudi Arabia, Syria, Bahrain, Jordan, Nigeria, Angola, Chile, El Salvador, Costa Rica, Ecuador, Haiti, Colombia, Dominican Republic (LHD), Panama, Peru, B. Virgin, Curacao, St. Martin, Indonesia, Thailand, Brunei, Nepal, Sri Lanka, Fiji, Papua New Guinea, Zimbabwe, South Africa, Trinidad and Tobago, Commonwealth of Dominica, Australia
	92 or above	Egypt
	93	China

*1 : Europe

*2 : Australia

OUTLINE

*3 : Republic of Palau & Federated States of Micronesia

ENGINE [SKYACTIV-D 2.2]

id0100000002x6

Special Features

- For SKYACTIV-D 2.2, the following is performed to lower fuel consumption.
  - — Low compression ratio
    - Combustion efficiency by lower compression ration (14.0)
  - — Weight reductions
    - Aluminum alloy cylinder block adopted
    - Exhaust manifold integrated cylinder heads adopted
  - — Weight reduction and mechanical resistance loss improvements
    - Piston shape optimized
    - Narrowed down crankshaft journal
- The SKYACTIV-D 2.2 has adopted a variable valve lift function for improved ignition stability during cold engine starts.
- Two-step boost control has been adopted which realizes low emissions, low fuel consumption and high torque/ response by the efficient, high air charging obtained in all ranges.
- An exhaust gas recirculation (EGR) system has been adopted for cleaner exhaust emissions and improved fuel efficiency.
- i-stop control has been adopted for improved fuel efficiency, reduced exhaust gas emissions, and reduced idling noise.

Specification

Item				Specification
MECHANICAL				
Type				Diesel, 4-cycle
Cylinder arrangement and number				In-line, 4-cylinder
Combustion chamber				Direct injection
Valve system				DOHC, timing chain driven, 16 valves
Displacement			(ml {cc, cu in})	2,191 {2,191, 133.7}
Bore × stroke			(mm {in})	86.0 × 94.3 {3.39 × 3.71}
Compression ratio				14.0:1
Compression pressure			(kPa {kgf/cm^2, psi} [rpm])	2,255 {22.99, 327.1} [180]
Valve timing	IN	Open	BTDC (°)	9
		Closed	ABDC (°)	36
	EX	Open	BBDC (°)	40 (VARIABLE VALVE LIFT : -276)
		Closed	ATDC (°)	8 (VARIABLE VALVE LIFT : 200)
LUBRICATION SYSTEM				
Type				Force-fed type
Oil pressure (reference value) [Oil temperature 80—90 degrees C, Water temperature 80—90 degrees C]			(kPa {kgf/cm^2, psi} [rpm])	Low oil pressure: 140—190 {1.43—1.93, 20.4—27.5}[1,500] High oil pressure: 300—440 {3.06—4.48, 43.6—63.8}[3,500]
Oil pump	Type			Trochoid gear type
Oil filter	Type			Full-flow, paper element
	Bypass pressure		(kPa {kgf/cm^2, psi})	78—118 {0.80—1.20, 12.0—17.1}
Oil capacity (approx. quantity)	Total (dry engine)		(L {US qt, Imp qt})	6.0 {6.3, 5.3}
	Oil replacement		(L {US qt, Imp qt})	4.8 {5.1, 4.2}
	Oil and oil filter replacement		(L {US qt, Imp qt})	5.1 {5.4, 4.5}
COOLING SYSTEM				
Type				Water-cooled, Electromotive
Coolant capacity [European (L.H.D.) specs.] (approx. quantity)			(L {US qt, Imp qt})	8.9 {9.4, 7.8}
Coolant capacity [European (R.H.D.) specs.] (approx. quantity)			(L {US qt, Imp qt})	9.1 {9.6, 8.0}
Coolant capacity [Except European specs.] (approx. quantity)			(L {US qt, Imp qt})	9.2 {9.7, 8.1}

OUTLINE

Item			Specification
Water pump	Type		Centrifugal, V-ribbed belt-driven
Thermostat	Type		Wax type
	Opening temperature	(°C {°F})	80—84 {176—183}
	Full-open temperature	(°C {°F})	95 {203}
	Full-open lift	(mm {in})	8.5 {0.33} or more
Radiator	Type		Corrugated fin type
Cooling system cap	Valve opening pressure	(kPa {kgf/cm^2, psi})	93.2—122.6 {0.951—1.250, 13.6—17.7}
Cooling fan	Type		Electric type
	Number of blades		Cooling fan No.1 : 7 Cooling fan No.2 : 9
	Outer diameter	(mm {in})	320 {12.6}
	Cooling fan motor output	(W)	240
FUEL SYSTEM			
Supply pump	Type		Electric control
Fuel injector	Type		Piezo-electric
Fuel tank	Capacity (L {US gal, Imp gal})	2WD	56.0 {14.8, 12.3}
		4WD	58.0 {15.3, 12.8}
Fuel type	Type		EN590 or the equivalent
CHARGING SYSTEM			
Battery	Voltage	(V)	12
	Type and capacity (5-hour rate)	(A·h)	T-110 (64)
Generator	Output	(V-A)	12-150
	Regulated voltage		Controlled by PCM
	Self diagnosis function		
STARTING SYSTEM			
Starter	Type		Coaxial reduction
	Output	(kW)	1.8
CONTROL SYSTEM			
i-stop OFF switch			ON/OFF
Neutral switch			ON/OFF
CPP switch			ON/OFF
MAF sensor			Hot film
IAT sensor			Thermistor
MAP sensor			semiconductor gauge
APP sensor			Hall element
CKP sensor			MR (Magnetic Resistance) element
CMP sensor			MR (Magnetic Resistance) element
ECT sensor			Thermistor
BARO sensor			Piezoelectric element
Fuel pressure sensor			Piezoelectric element
Current sensor			Shunt resistance, Thermistor
A/F sensor			zirconium element
Boost air temperature sensor			Thermistor
Fuel temperature sensor			Thermistor
Exhaust gas temperature sensor			Thermistor
Exhaust gas pressure sensor			semiconductor gauge
Engine oil temperature sensor			Thermistor
Engine oil pressure sensor			semiconductor gauge
Intake shutter valve position sensor			Hall element
EGR valve position sensor			Hall element
EGR cooler bypass valve position sensor			Hall element
Clutch stroke sensor			Hall element
Power brake unit vacuum sensor			Piezoelectric element

OUTLINE

Engine oil [Europe]

Recommended engine oil		Alternative engine oil
Mazda Original Oil Supra DPF 0W-30	Mazda Original Oil Ultra DPF 5W-30	ACEA C3 0W-30, 5W-30

Engine oil [Except Europe]

Item	Specifications	
Grade	ACEA C3	ACEA C1 or JASO DL-1
Viscosity (SAE)	0W-30, 5W-30	5W-30

01-02 ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

ON-BOARD DIAGNOSTIC OUTLINE [SKYACTIV-G 2.0]

id0102h1100100

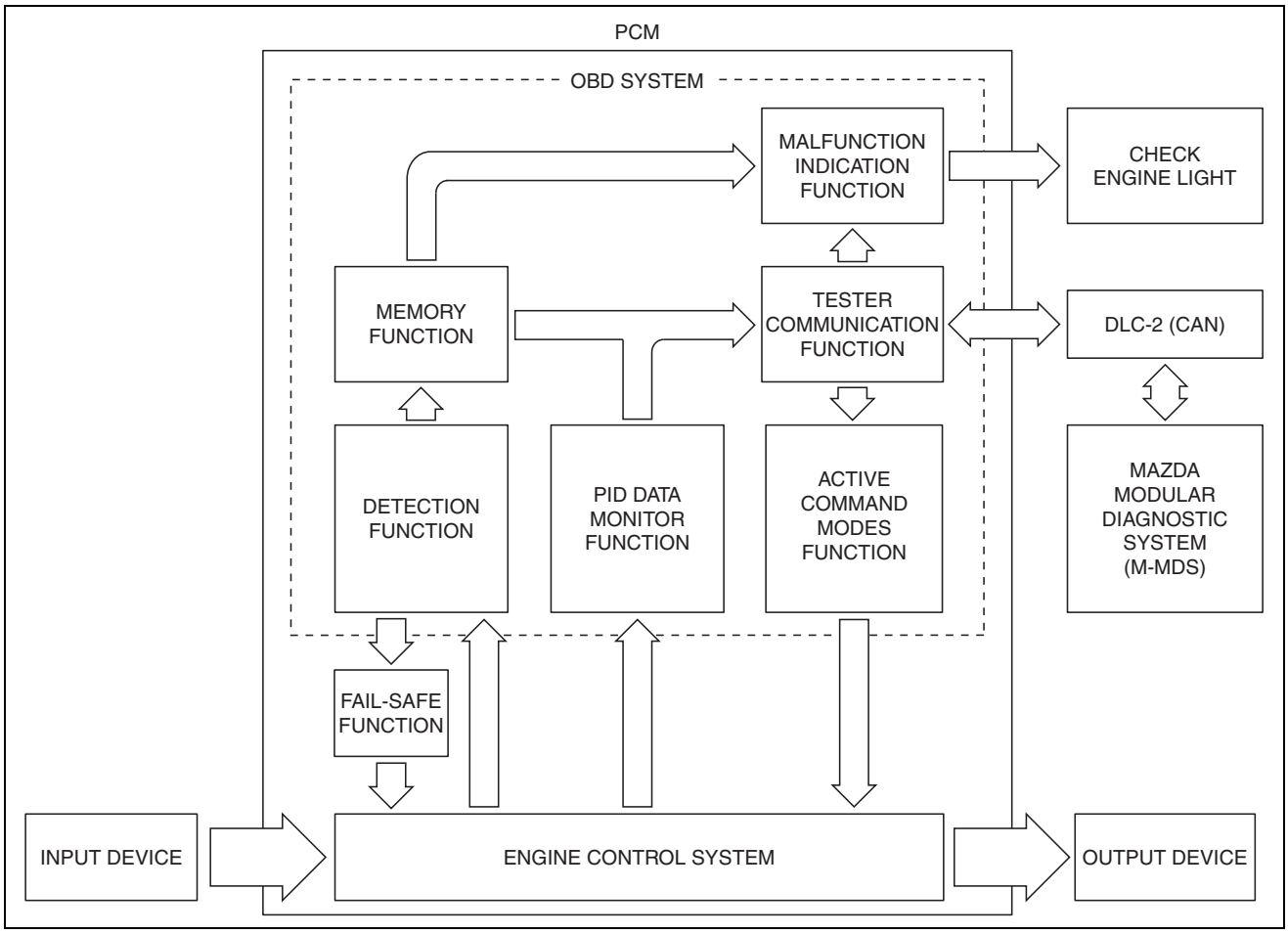
Features

- The PCM performs self-diagnosis to check for malfunctions in the engine control system.
- If a malfunction occurs in the engine control system, the driver is notified.
- On-board diagnosis can be performed easily using an external tester.

To meet the OBD regulations	• Diagnostic test modes adopted
Improved serviceability	• DTCs adopted • KOEO/KOER self test function adopted • PID/DATA monitor function adopted • Active command modes function adopted

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

Block Diagram



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ON-BOARD DIAGNOSTIC SYSTEM TEST MODE [SKYACTIV-G 2.0]

id0102h1142500

Diagnostic Test Mode

- To match the OBD regulations, the following diagnostic test modes have been supported.

Diagnostic test mode	Item
Mode 01	Sending diagnostic data (PID data monitor/On-board system readiness test)
Mode 02	Sending freeze frame data
Mode 03	Sending emission-related malfunction code (Diagnostic trouble code: DTC)
Mode 04	Clearing/resetting emission-related malfunction information
Mode 07	Sending continuous monitoring system test results (Pending code)
Mode 08	On-board device control (Simulation test, active command mode)
Mode 09	Request vehicle information

Sending Diagnostic Data (Mode 01)

PID data monitor

- The PID data monitor items are shown below.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

PID data monitor table

Full names	Unit
Monitor status since DTCs cleared	No unit
Fuel system loop status	Refer to list below.
LOAD	%
ECT	°C, °F
Short term fuel trim	%
Long term fuel trim	%
MAP	kPa
Engine speed	rpm
Vehicle speed	km/h, mph
Spark advance	°
IAT	°C, °F
MAF	g/s
Absolute TP	%
A/F sensor and HO2S location	No unit
Input voltage from HO2S	V
OBD requirement according to vehicle design	No unit
Time since engine start	s
Distance travelled while check engine light is activated	km, miles
Fuel pressure	kPa
Purge solenoid valve control signal	%
Number of warm-up since DTCs cleared	No unit
Distance travelled since DTCs cleared	km, miles
Barometric pressure	kPa
A/F sensor output current	mA
Estimated catalyst converter temperature	°C, °F
Monitor status this driving cycle	—
PCM voltage	V
Absolute load value	%
Theoretical air/fuel ratio coefficient to calculate target air/fuel ratio	No unit
Relative TP	%
TP from TP sensor No.2	%
APP from APP sensor No.1	%
APP from APP sensor No.2	%
Throttle valve actuator control signal	%
Short term fuel trim (HO2S)	%
Long term fuel trim (HO2S)	%

Meaning of fuel system loop status

- The following information is displayed on the tester
  - — Feedback stops: ECT is lower than the determined feedback zone
  - — Feedback operating: A/F sensor, HO2S being used for feedback is normal
  - — Feedback stops: Open loop due to driving condition
  - — Feedback stops: Open loop due to detected system fault
  - — Feedback operating: Malfunction occurred in HO2S system

Sending Freeze Frame Data (Mode 02)

Freeze frame data

- The freeze frame data consists of data for vehicle and engine control system operation conditions when malfunctions in the engine control system are detected and stored in the PCM.
- Freeze frame data is stored at the instant the check engine light illuminates, and only a part of the DTC data is stored.
- For the freeze frame data, if there are several malfunctions in the engine control system, the data for the malfunction which occurred initially is stored. Thereafter, if a misfire or fuel injection control malfunction occurs, data from the misfire or fuel injection control malfunction is written over the initially stored data. However, if the initially stored freeze frame data is a misfire or fuel injection control malfunction, it is not overwritten.

Snapshot data

- The snapshot data stores the currently detected DTC data.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

- The recording timing for the freeze frame data/snapshot data differs depending on the number of DTC drive cycles.
  - — For a DTC with a drive cycle number 1, only the malfunction determination data is recorded.
  - — For a DTC with a drive cycle number 2, both the malfunction determination and undetermined data is recorded.

Freeze frame data table

Freeze frame data item	Unit	Description	Corresponding PID data monitor item
FUELSYS1	OL/CL/OL-Drive/OL-Fault/ CL-Fault	Fuel system status	FUELSYS
LOAD	%	Calculated engine load	—
ECT	°C, °F	Engine coolant temperature	ECT
SFT1	%	Short term fuel trim	SHRTFT1
LFT1	%	Long term fuel trim	LONGFT1
MAP	KPa {MPa}, mBar {Bar}, psi, in H20	Manifold absolute pressure	MAP
RPM	RPM	Engine speed	RPM
VS	KPH, MPH	Vehicle speed	VSS
SPARKADV	°	Ignition timing	SPARKADV
IAT	°C, °F	Intake air temperature	IAT
MAF	g/sec	Mass airflow	MAF
TP	%	Throttle valve position No.1	TP1
RUNTM	hh:mm:ss	Time from engine start	—
FRP	KPa {MPa}, mBar {Bar}, psi, in H20	Fuel pressure	FUEL_PRES
EVAPPCT	%	Purge solenoid valve controlled value	EVAPCP
FLI	%	Fuel level in fuel tank	FLI
WARMUPS	—	Number of warm-up cycle after DTC cleared	—
CLRDIST	km, ft {mi}	Mileage after DTC cleared	—
BARO	KPa {MPa}, mBar {Bar}, psi, in H20	Barometric pressure	BARO
CATTEMP11	°C, °F	Estimated catalytic converter temperature	CATT11_DSD
VPWR	V	Module supply voltage	VPWR
ALV	%	Engine load	LOAD
EQ_RAT	—	Target equivalence ratio (lambda)	EQ_RAT11_DSD
TP_REL	%	Relative throttle position	TP REL
AAT	°C, °F	Ambient air temperature	AAT
TP_B	%	Throttle valve position No.2	TP2
APP_D	%	Accelerator pedal position No.1	APP1
APP_E	%	Accelerator pedal position No.2	APP2
TAC_PCT	%	Target throttle valve position	ETC_DSD
STSO2FT1	%	Short term fuel trim (HO2S)	—
LGSO2FT1	%	Long term fuel trim (HO2S)	—
IAT11	°C, °F	Intake air temperature No.1	IAT
IAT12	°C, °F	Intake air temperature No.2	IAT2

Snapshot data table

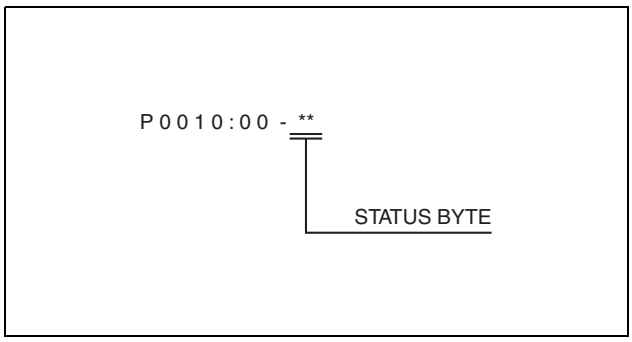
Snapshot data item	Unit	Definition	Corresponding PID data monitor item
FUELSYS	OL/CL/OL-Drive/OL-Fault/ CL-Fault	Fuel system status	FUELSYS
LOAD_C	%	Calculated engine load	—
ECT	°C, °F	Engine coolant temperature	ECT
SHRTFT1	%	Short term fuel trim	SHRTFT1
LONGFT1	%	Long term fuel trim	LONGFT1
MAP	KPa {MPa}, mBar {Bar}, psi, in H20	Manifold absolute pressure	MAP

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

Snapshot data item	Unit	Definition	Corresponding PID data monitor item
RPM	RPM	Engine speed	RPM
VSS	KPH, MPH	Vehicle speed	VSS
SPARKADV	°	Ignition timing	SPARKADV
IAT	°C, °F	Intake air temperature No.1	IAT
MAF	g/sec	Mass airflow	MAF
TP1	%	Throttle valve position No.1	TP1
EG_RUN_TIME	—	Time from engine start	—
FUEL_PRES	KPa {MPa}, mBar {Bar}, psi, in H20	Fuel pressure	FUEL_PRES
SEGRP_DSD	%	Target EGR valve position	SEGRP DSD
EVAPCP	%	Purge solenoid valve controlled value	EVAPCP
FLI	%	Fuel level in fuel tank	FLI
CLR_CNT	—	Number of warm-up cycle after DTC cleared	—
CLR_DIST	km, ft {mi}	Mileage after DTC cleared	—
FTP	KPa {MPa}, mBar {Bar}, psi, in H20	Fuel tank pressure	FTP
BARO	KPa {MPa}, mBar {Bar}, psi, in H20	Barometric pressure	BARO
CATT11_DSD	°C, °F	Estimated catalytic converter temperature	CATT11_DSD
VPWR	V	Module supply voltage	VPWR
LOAD	%	Engine load	LOAD
EQ_RAT11_DSD	—	Target equivalence ratio (lambda)	EQ_RAT11_DSD
TP REL	%	Relative throttle position	TP REL
AAT	°C, °F	Ambient air temperature	AAT
TP2	%	Throttle valve position No.2	TP2
APP1	%	Accelerator pedal position No.1	APP1
APP2	%	Accelerator pedal position No.2	APP2
ETC_DSD	%	Target throttle valve position	ETC_DSD
SHRTFT12	%	Short term fuel trim (HO2S)	—
LONGFT12	%	Long term fuel trim (HO2S)	—
ECT2_SUP	—	Engine coolant temperature No.2 support	—
ECT2	°C, °F	Engine coolant temperature No.2	ECT2_V
IAT12	°C, °F	Intake air temperature No.2	IAT2
ALTT_V	V	Generator output voltage	—
BATT_RES	ohm	Battery inferred internal resistance	—
ALT_CUR_DSD	A	Generator current desired	—
TOTAL_DIST	km, ft {mi}	Total distance	—

Status Byte for DTC

- The status byte is the two-digit code (two digits after hyphen (-)) after the DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the M-MDS when reading the DTC.



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ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

Sending Emission-related Malfunction Code (DTC) (Mode 03)

- The DTCs are shown below.

×: Applicable
—: Not applicable

DTC No.	Check Engine Light	Charging System Warning Light	Master Warning Light	i-stop Warning Light (Amber)	Condition	Fail-safe function	Drive Cycle	Monitor item	Self test type*1	Memory function
P0010:00	ON	OFF	OFF	OFF	Electric variable valve timing control circuit range/performance problem	×	1	CCM	C, R	×
P0011:00	ON	OFF	OFF	OFF	Intake CMP timing over-advanced	×	1	CCM	C	×
P0012:00	ON	OFF	OFF	OFF	Intake CMP timing over-retarded	×	1	CCM	C	×
P0014:00	ON	OFF	OFF	OFF	Exhaust CMP timing over-advanced	×	2	CCM	C	×
P0015:00	ON	OFF	OFF	OFF	Exhaust CMP timing over-retarded	×	2	CCM	C	×
P0031:00	ON	OFF	OFF	OFF	A/F sensor heater control circuit low input	×	2	A/F sensor heater, HO2S heater	C, R	×
P0032:00	ON	OFF	OFF	OFF	A/F sensor heater control circuit high input	×	2	A/F sensor heater, HO2S heater	C, R	×
P0037:00	ON	OFF	OFF	OFF	HO2S heater control circuit low input	×	2	A/F sensor heater, HO2S heater	C, R	×
P0038:00	ON	OFF	OFF	OFF	HO2S heater control circuit high input	×	2	A/F sensor heater, HO2S heater	C, R	×
P0069:00	ON	OFF	OFF	OFF	Manifold absolute pressure/atmospheric pressure correlation problem	—	2	CCM	C	×
P0072:00*7	OFF	OFF	OFF	OFF	Ambient temperature sensor circuit low input	—	1	Other	C, O, R	×
P0073:00*7	OFF	OFF	OFF	OFF	Ambient temperature sensor circuit high input	—	1	Other	C, O, R	×
P0089:00	ON	OFF	OFF	OFF	Spill valve control solenoid valve control circuit range/performance problem	×	1	CCM	C, R	×
P0091:00	ON	OFF	OFF	OFF	Fuel pressure regulator control circuit low input	×	1	CCM	C, O, R	×
P0092:00	ON	OFF	OFF	OFF	Fuel pressure regulator control circuit high input	×	1	CCM	C, O, R	×
P0097:00	ON	OFF	OFF	OFF	IAT sensor No.2 circuit low input	—	1	CCM	C, O, R	×
P0098:00	ON	OFF	OFF	OFF	IAT sensor No.2 circuit high input	—	1	CCM	C, O, R	×
P0101:00	ON	OFF	OFF	OFF	MAF sensor circuit range/performance problem	—	2	CCM	C	×
P0102:00	ON	OFF	OFF	OFF	MAF sensor circuit low input	×	1	CCM	C, O, R	×
P0103:00	ON	OFF	OFF	OFF	MAF sensor circuit high input	×	1	CCM	C, O, R	×
P0107:00	ON	OFF	OFF	OFF	MAP sensor circuit low input	×	1	CCM	C, O, R	×
P0108:00	ON	OFF	OFF	OFF	MAP sensor circuit high input	×	1	CCM	C, O, R	×
P0112:00	ON	ON	OFF	OFF	IAT sensor No.1 circuit low input	×	1	CCM	C, O, R	×
P0113:00	ON	ON	OFF	OFF	IAT sensor No.1 circuit high input	×	1	CCM	C, O, R	×
P0116:00	ON	OFF	OFF	OFF	ECT sensor circuit range/performance problem	—	1	Engine cooling system	C	×
P0117:00	ON	OFF	OFF	OFF	ECT sensor circuit low input	×	1	Engine cooling system	C, O, R	×

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Check Engine Light	Charging System Warning Light	Master Warning Light	i-stop Warning Light (Amber)	Condition	Fail-safe function	Drive Cycle	Monitor item	Self test type*1	Memory function
P0118:00	ON	OFF	OFF	OFF	ECT sensor circuit high input	×	1	Engine cooling system	C, O, R	×
P0122:00	ON	OFF	OFF	OFF	TP sensor No.1 circuit low input	×	1	CCM	C, O, R	×
P0123:00	ON	OFF	OFF	OFF	TP sensor No.1 circuit high input	×	1	CCM	C, O, R	×
P0130:00	ON	OFF	OFF	OFF	A/F sensor circuit problem	×	2	A/F sensor, HO2S	C, R	×
P0131:00	ON	OFF	OFF	OFF	A/F sensor circuit low input	×	2	A/F sensor, HO2S	C, R	×
P0132:00	ON	OFF	OFF	OFF	A/F sensor circuit high input	×	2	A/F sensor, HO2S	C, R	×
P0133:00	ON	OFF	OFF	OFF	A/F sensor circuit slow response	—	2	A/F sensor, HO2S	C	×
P0134:00	ON	OFF	OFF	OFF	A/F sensor circuit no activity detected	×	2	A/F sensor, HO2S	C	×
P0137:00	ON	OFF	OFF	OFF	HO2S circuit low input	—	2	A/F sensor, HO2S	C	×
P0138:00	ON	OFF	OFF	OFF	HO2S circuit high input	—	2	A/F sensor, HO2S	C, O, R	×
P013A:00	ON	OFF	OFF	OFF	HO2S circuit slow response	—	2	A/F sensor, HO2S	C	×
P013B:00	ON	OFF	OFF	OFF	HO2S circuit slow response	—	2	A/F sensor, HO2S	C	×
P0140:00	ON	OFF	OFF	OFF	HO2S circuit no activity detected	—	2	A/F sensor, HO2S	C	×
P0171:00	ON	OFF	OFF	OFF	Fuel trim system too lean	—	2	Fuel system	C	×
P0172:00	ON	OFF	OFF	OFF	Fuel trim system too rich	—	2	Fuel system	C	×
P0191:00	ON	OFF	OFF	OFF	Fuel pressure sensor circuit range/ performance problem	×	1	CCM	C	×
P0192:00	ON	OFF	OFF	OFF	Fuel pressure sensor circuit low input	×	1	CCM	C, O, R	×
P0193:00	ON	OFF	OFF	OFF	Fuel pressure sensor circuit high input	×	1	CCM	C, O, R	×
P0201:00	ON	OFF	OFF	OFF	Fuel injector circuit/open cylinder No.1	—	1	CCM	C, O, R	×
P0202:00	ON	OFF	OFF	OFF	Fuel injector circuit/open cylinder No.2	—	1	CCM	C, O, R	×
P0203:00	ON	OFF	OFF	OFF	Fuel injector circuit/open cylinder No.3	—	1	CCM	C, O, R	×
P0204:00	ON	OFF	OFF	OFF	Fuel injector circuit/open cylinder No.4	—	1	CCM	C, O, R	×
P0222:00	ON	OFF	OFF	OFF	TP sensor No.2 circuit low input	×	1	CCM	C, O, R	×
P0223:00	ON	OFF	OFF	OFF	TP sensor No.2 circuit high input	×	1	CCM	C, O, R	×
P025B:00	ON	OFF	OFF	OFF	Fuel pump control module circuit range/ performance problem	×	1	CCM	C, O, R	×
P025C:00	ON	OFF	OFF	OFF	Fuel pump control module result of on-board diagnostic test low input	—	1	CCM	C, O, R	×
P025D:00	ON	OFF	OFF	OFF	Fuel pump control module result of on-board diagnostic test high input	—	1	CCM	C, O, R	×
P0300:00	Flash /ON	OFF	OFF	OFF	Random misfire detected	×	2	Misfire	C	×
P0301:00	Flash /ON	OFF	OFF	OFF	Cylinder No.1 misfire detected	×	2	Misfire	C	×

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Check Engine Light	Charging System Warning Light	Master Warning Light	i-stop Warning Light (Amber)	Condition	Fail-safe function	Drive Cycle	Monitor item	Self test type*1	Memory function
P0302:00	Flash /ON	OFF	OFF	OFF	Cylinder No.2 misfire detected	×	2	Misfire	C	×
P0303:00	Flash /ON	OFF	OFF	OFF	Cylinder No.3 misfire detected	×	2	Misfire	C	×
P0304:00	Flash /ON	OFF	OFF	OFF	Cylinder No.4 misfire detected	×	2	Misfire	C	×
P0327:00	ON	OFF	OFF	OFF	KS circuit low input	×	1	CCM	C, O, R	×
P0328:00	ON	OFF	OFF	OFF	KS circuit high input	×	1	CCM	C, O, R	×
P0335:00	ON	OFF	OFF	OFF	CKP sensor circuit problem	×	1	CCM	C, R	×
P0340:00	ON	OFF	OFF	OFF	Intake CMP sensor circuit problem	×	1	CCM	C, R	×
P0365:00	ON	OFF	OFF	OFF	Exhaust CMP sensor circuit problem	×	1	CCM	C, R	×
P0421:00	ON	OFF	OFF	OFF	Warm up catalyst system efficiency below threshold	—	2	Catalyst	C	×
P0443:00	ON	OFF	OFF	OFF	Purge solenoid valve circuit problem	—	2	CCM	C, R	×
P0461:00	ON	OFF	OFF	OFF	Fuel gauge sender unit circuit range/ performance problem	—	2	CCM	C	×
P0462:00	ON	OFF	OFF	OFF	Fuel gauge sender unit circuit low input	—	2	CCM	C, O, R	×
P0463:00	ON	OFF	OFF	OFF	Fuel gauge sender unit circuit high input	—	2	CCM	C, O, R	×
P0480:00	OFF	OFF	OFF	OFF	Cooling fan relay No.1 control circuit malfunction	—	1	Other	C, O, R	×
P0482:00	OFF	OFF	OFF	OFF	Cooling fan relay No.2 and No.3 control circuit malfunction	—	1	Other	C, O, R	×
P0500:00	ON	OFF	OFF	OFF	VSS circuit problem	×	2	CCM	C	×
P0506:00	ON	OFF	OFF	OFF	IAC system RPM lower than expected	—	2	CCM	C	×
P0507:00	ON	OFF	OFF	OFF	IAC system RPM higher than expected	—	2	CCM	C	×
P0520:00	OFF	OFF	OFF	OFF	Oil pressure switch circuit problem	—	1	Other	C, O	×
P0524:00	OFF	OFF	OFF	OFF	Engine oil pressure too low	—	1	Other	C	×
P0532:00*7	OFF	OFF	OFF	OFF	Refrigerant pressure sensor circuit low input	—	1	Other	C, O, R	×
P0533:00*7	OFF	OFF	OFF	OFF	Refrigerant pressure sensor circuit high input	—	1	Other	C, O, R	×
P0555:00*6	OFF	OFF	OFF	Flash	Power brake unit vacuum sensor circuit problem	×	1	Other	C, O, R	×
P0571:00	ON	OFF	ON	OFF	Brake switch circuit problem	—	1	Other	C	×
P057F:00*6	OFF	OFF	ON	Flash	Power supply malfunction	×	1	Other	C, O, R	×
P058A:00*6	OFF	ON	ON	Flash	Current sensor problem	×	2	Other	C, O, R	×
P0600:00	ON	OFF	OFF	OFF	Serial communication link	—	1	CCM	C, O, R	×
P0601:00	ON	OFF	OFF	OFF	PCM memory check sum error	×	1	CCM	C, O, R	×
P0602:00	ON	OFF	OFF	OFF	PCM programming error	—	1	CCM	C, O, R	×
P0604:00	ON	OFF	OFF	OFF	PCM RAM error	×	1	CCM	C, O, R	×
P0606:00	ON	OFF	OFF	OFF	PCM processor error	×	1	CCM	C, O, R	×
P0607:00	ON	OFF	OFF	OFF	Control module performance problem	—	1	CCM	C, O, R	×

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Check Engine Light	Charging System Warning Light	Master Warning Light	i-stop Warning Light (Amber)	Condition	Fail-safe function	Drive Cycle	Monitor item	Self test type*1	Memory function
P0610:00	ON	OFF	OFF	OFF	PCM vehicle configuration error	—	1	CCM	C, O, R	×
P0615:00*6	OFF	OFF	OFF	Flash	Starter relay circuit problem	×	1	Other	C, O, R	×
P061B:00	ON	OFF	OFF	OFF	Internal control module torque calculation performance problem	×	1	CCM	C, O, R	×
P061D:00	ON	OFF	OFF	OFF	Internal control module engine air mass performance problem	×	1	CCM	C, O, R	×
P061F:00	OFF	OFF	OFF	OFF	Internal control module throttle valve actuator controller performance problem	—	1	Other	C, O, R	×
P0628:00	ON	OFF	OFF	OFF	Fuel pump control module circuit low input	—	1	CCM	C, O, R	×
P0629:00	ON	OFF	OFF	OFF	Fuel pump control module circuit high input	×	1	CCM	C, O, R	×
P0638:00	ON	OFF	OFF	OFF	Throttle valve actuator control range/ performance problem	×	1	CCM	C, O, R	×
P064D:00	ON	OFF	OFF	OFF	Internal control module A/F sensor processor performance problem	×	1	CCM	C, R	×
P0685:00	ON	OFF	OFF	OFF	Main relay control circuit open	—	2	CCM	C	×
P06B8:00	ON	OFF	OFF	OFF	Internal control module non-volatile RAM error	—	1	Other	C, O, R	×
P06DA:00	OFF	OFF	ON	OFF	Engine oil solenoid valve circuit problem	—	1	Other	C, R	×
P0703:00	ON	OFF	ON	OFF	Brake switch input circuit problem	—	2	CCM	C	×
P0704:00*3	ON	OFF	OFF	OFF	CPP switch input circuit problem	—	2	CCM	C	×
P07BE:00*8	OFF	OFF	OFF	OFF	Transmission indeterminate failure (failed to neutral)	—	1	Other	C, O, R	×
P0850:00*3	ON	OFF	OFF	OFF	Neutral switch No.1 input circuit problem	—	2	CCM	C	×
P0A0F:00*6	OFF	OFF	OFF	Flash	Engine failed to restart	×	1	Other	C, O, R	×
P0A8D:00*6	OFF	OFF	ON	Flash	Power supply system circuit low input	×	1	Other	C, R	×
P0A94:00*6	OFF	OFF	OFF	Flash	DC-DC converter control circuit signal error	×	1	Other	C, R*5	×
P111A:00	OFF	OFF	OFF	OFF	Engine coolant temperature is high	×	1	Other	C	×
P117A:00	OFF	OFF	OFF	OFF	Engine oil temperature is high	×	1	Other	C	×
P1260:00	OFF	OFF	OFF	OFF	Immobilizer system problem	—	—	Other	C, O	—
P1380:00	OFF	OFF	OFF	OFF	Electric variable valve timing control circuit problem	×	1	CCM	C, R	×
P151B:00*2	OFF	OFF	OFF	OFF	IAC system problem	—	—	Other	R	×
P176E:00*8	OFF	OFF	OFF	OFF	Clutch stroke sensor/Starter interlock switch correlation problem	—	1	Other	C, O, R	×
P2090:00	ON	OFF	OFF	OFF	OCV circuit low input	×	1	CCM	C, R	×
P2091:00	ON	OFF	OFF	OFF	OCV circuit high input	×	1	CCM	C, R	×
P2096:00	ON	OFF	OFF	OFF	Target A/F feedback system too lean	—	2	Fuel system	C	×
P2097:00	ON	OFF	OFF	OFF	Target A/F feedback system too rich	—	2	Fuel system	C	×
P2101:00	ON	OFF	OFF	OFF	Throttle valve actuator control motor circuit range/performance problem	×	1	CCM	C, O	×
P2107:00	ON	OFF	OFF	OFF	Throttle valve actuator control module processor error	×	1	CCM	C, O, R	×
P2109:00	ON	OFF	OFF	OFF	TP sensor minimum stop range/ performance problem	×	1	CCM	C, O, R	×
P2110:00	ON	OFF	OFF	OFF	Throttle valve actuator control system-forced limited RPM	×	1	CCM	C, R	×

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DTC No.	Check Engine Light	Charging System Warning Light	Master Warning Light	i-stop Warning Light (Amber)	Condition	Fail-safe function	Drive Cycle	Monitor item	Self test type*1	Memory function
P2112:00	ON	OFF	OFF	OFF	Throttle valve actuator motor current range/performance problem	×	1	CCM	C, R	×
P2119:00	ON	OFF	OFF	OFF	Throttle valve actuator control throttle body range/performance problem	×	1	CCM	C, O, R	×
P2122:00	ON	OFF	OFF	OFF	APP sensor No.1 circuit low input	×	1	CCM	C, O, R	×
P2123:00	ON	OFF	OFF	OFF	APP sensor No.1 circuit high input	×	1	CCM	C, O, R	×
P2127:00	ON	OFF	OFF	OFF	APP sensor No.2 circuit low input	×	1	CCM	C, O, R	×
P2128:00	ON	OFF	OFF	OFF	APP sensor No.2 circuit high input	×	1	CCM	C, O, R	×
P2135:00	ON	OFF	OFF	OFF	TP sensor No.1/No.2 voltage correlation problem	×	1	CCM	C, O, R	×
P2138:00	ON	OFF	OFF	OFF	APP sensor No.1/No.2 voltage correlation problem	×	1	CCM	C, O, R	×
P2199:00	ON	OFF	OFF	OFF	IAT sensor No.2 circuit range/performance problem	—	2	CCM	C	×
P2228:00	ON	OFF	OFF	OFF	BARO sensor circuit low input	×	1	CCM	C, O, R	×
P2229:00	ON	OFF	OFF	OFF	BARO sensor circuit high input	×	1	CCM	C, O, R	×
P2237:00	ON	OFF	OFF	OFF	A/F sensor positive current control circuit open	×	2	A/F sensor, HO2S	C, R	×
P2243:00	ON	OFF	OFF	OFF	A/F sensor reference voltage circuit open	×	2	A/F sensor, HO2S	C, R	×
P2251:00	ON	OFF	OFF	OFF	A/F sensor negative current control circuit open	×	2	A/F sensor, HO2S	C, R	×
P2299:00	OFF	OFF	OFF	OFF	Accelerator pedal: spring back malfunction	×	1	Other	C, R	×
P2302:00	OFF	OFF	OFF	OFF	Ion sensor No.1 circuit problem	—	1	Other	C, R	×
P2305:00	OFF	OFF	OFF	OFF	Ion sensor No.2 circuit problem	—	1	Other	C, R	×
P2308:00	OFF	OFF	OFF	OFF	Ion sensor No.3 circuit problem	—	1	Other	C, R	×
P2311:00	OFF	OFF	OFF	OFF	Ion sensor No.4 circuit problem	—	1	Other	C, R	×
P2502:00	OFF	ON	OFF	Flash	Charging system voltage problem	×	1	Other	C, R	×
P2503:00	OFF	ON	OFF	Flash	Charging system voltage low input	×	1	Other	C, R	×
P2504:00	OFF	ON	OFF	Flash	Charging system voltage high input	×	1	Other	C, R	×
P2507:00	ON	OFF	OFF	OFF	PCM battery voltage low input	—	1	CCM	C, O, R	×
P2610:00	ON	OFF	OFF	OFF	Instrument cluster internal engine off timer performance problem	—	2	CCM	C, R	×
U0073:00	OFF	OFF	OFF	OFF	CAN system communication error (HS CAN)	—	1	Other	C, O, R	×
U0074:00*4	OFF	OFF	OFF	OFF	CAN system communication error (local CAN between PCM and TCM)	—	1	Other	C, O, R	×
U0101:00*4	ON	OFF	OFF	Flash	CAN communication: communication error to TCM	×	1	Other	C, O, R	×
U0121:00	ON	OFF	OFF	Flash	CAN communication: communication error to DSC HU/CM	×	1	Other	C, O, R	×
U0131:00	OFF	OFF	OFF	Flash	CAN communication: communication error to EPS control module	—	1	Other	C, O, R	×
U0140:00	OFF	OFF	OFF	Flash	CAN communication: communication error to front body control module (FBCM)	—	1	Other	C, O, R	×
U0151:00	OFF	OFF	OFF	Flash	CAN communication: communication error to SAS control module	—	1	Other	C, O, R	×

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Check Engine Light	Charging System Warning Light	Master Warning Light	i-stop Warning Light (Amber)	Condition	Fail-safe function	Drive Cycle	Monitor item	Self test type*1	Memory function
U0155:00	ON	OFF	OFF	Flash	CAN communication: communication error to instrument cluster	—	1	Other	C, O, R	×
U0214:00	OFF	OFF	OFF	Flash	CAN communication: communication error to start stop unit	×	1	Other	C, O, R	×
U0235:00	OFF	OFF	OFF	Flash	CAN communication: communication error to laser sensor	×	1	Other	C, O, R	×
U0298:00*6	OFF	OFF	OFF	Flash	CAN/LIN communication system: DC-DC converter information communication error with front body control module (FBCM)	×	1	Other	C, O, R	×
U0302:00*4	ON	OFF	OFF	OFF	TCM processor error	—	1	Other	C, O, R	×
U0315:00	OFF	OFF	OFF	OFF	DSC HU/CM error	—	1	Other	C, O, R	×
U0320:00	OFF	OFF	OFF	OFF	EPS control module error	—	1	Other	C, O, R	×
U0323:00	OFF	OFF	OFF	OFF	Instrument cluster error	—	1	Other	C, O, R	×
U0336:00	OFF	OFF	OFF	OFF	SAS control module error	—	1	Other	C, O, R	×
U0338:00	OFF	OFF	OFF	OFF	Start stop unit error	—	1	Other	C, O, R	×
U0433:00	OFF	OFF	OFF	OFF	Abnormal message from rear body control module (RBCM)	—	1	Other	C, O, R	×
U1007:00*6	OFF	ON	OFF	Flash	CAN/LIN communication system: current sensor information communication error with front body control module (FBCM)	×	1	Other	C, O, R	×
U2300:00	OFF	OFF	ON	OFF	Global central configuration error	×	1	Other	C, R	×
U3000:41	OFF	OFF	OFF	OFF	PCM processor error	—	—	Other	C, O	—

*1 : C: CMDTC self test, O: KOEO self test, R: KOER self test
*2 : KOER self test only
*3 : MTX
*4 : ATX
*5 : Perform the self test after i-stop operates
*6 : Vehicles with i-stop system
*7 : Vehicles with air conditioner
*8 : Vehicles with i-stop system (MTX)

Sending Continuous Monitoring System Test Results (pending code) (Mode 07)
- These appear when a problem is detected in a monitored system.

1-drive cycle type
- If any problems are detected in the first drive cycle, pending codes will be stored in the PCM memory, as well as DTCs.
- After pending codes are stored, if the PCM determines that the system is normal in any future drive cycle, the PCM deletes the pending codes.

2-drive cycle type
- The code for a failed system is stored in the PCM memory in the first drive cycle. If the PCM determines that the system returned to normal or the problem was mistakenly detected, and deletes the pending code. If the problem is found in the second drive cycle too, the PCM determines that the system has failed, and stores the pending codes, and the DTCs.
- After pending codes are stored, if the PCM determines that the system is normal in any future drive cycle, the PCM deletes the pending codes.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC DETECTION LOGIC AND CONDITIONS [SKYACTIV-G 2.0]

id0102h1100300

×: Applicable
—: Not applicable

DTC No.	Condition	Detection condition
P0010:00	Electric variable valve timing control circuit range/performance problem	• A malfunction is detected in the results of the on-board diagnostic test received from electric variable valve timing driver. • The motor speed signal received from the electric variable valve timing driver is in error.
P0011:00	Intake CMP timing over-advanced	• The actual intake valve timing advance is the specification or more compared to the target intake valve timing for a continuous specified time with the following condition met. **MONITORING CONDITIONS** — Engine speed: **below 5,000 rpm** — ECT: **above 60 °C {140 °F}**
P0012:00	Intake CMP timing over-retarded	• The actual intake valve timing retard is the specification or more compared to the target intake valve timing for a continuous specified time with the following condition met. **MONITORING CONDITIONS** — Engine speed: **below 5,000 rpm** — ECT: **above 60 °C {140 °F}**
P0014:00	Exhaust CMP timing over-advanced	• The actual exhaust valve timing is over-advanced by specification from the target exhaust valve timing for specified period when the oil control valve (OCV) is controlled in the feedback mode. **MONITORING CONDITIONS** — ECT: **above 60 °C {140 °F}**
P0015:00	Exhaust CMP timing over-retarded	• The actual exhaust valve timing is over-retarded by specification from the target exhaust valve timing for specified period when the oil control valve (OCV) system control is within the maximum cam retard mode. **MONITORING CONDITIONS** — ECT: **above 60 °C {140 °F}**
P0031:00	A/F sensor heater control circuit low input	• The PCM monitors the A/F sensor heater output voltage. If the PCM turns the A/F sensor heater off but the A/F sensor heater circuit remains low voltage, the PCM determines that the A/F sensor heater circuit has a malfunction.
P0032:00	A/F sensor heater control circuit high input	• The PCM monitors the A/F sensor heater output voltage. If the PCM turns the A/F sensor heater on but the A/F sensor heater circuit remains high voltage, the PCM determines that the A/F sensor heater circuit has a malfunction.
P0037:00	HO2S heater control circuit low input	• The PCM monitors the HO2S heater output voltage. If the PCM turns the HO2S heater off but the HO2S heater circuit remains low voltage, the PCM determines that the HO2S heater circuit has a malfunction.
P0038:00	HO2S heater control circuit high input	• The PCM monitors the HO2S heater output voltage. If the PCM turns the HO2S heater on but the HO2S heater circuit remains high voltage, the PCM determines that the HO2S heater circuit has a malfunction.
P0069:00	Manifold absolute pressure/atmospheric pressure correlation problem	• The PCM monitors difference between intake manifold vacuum and atmospheric pressure. If the difference is **below −12 kPa {−0.12 kgf/cm^2, −1.7 psi}** or **above 12 kPa {0.12 kgf/cm^2, 1.7 psi}** when the following conditions are met, the PCM determines that there is a MAP sensor performance problem. **MONITORING CONDITIONS** — **12—15 s** from when ignition is switched to off.
P0072:00*5	Ambient temperature sensor circuit low input	• The PCM monitors the input signal from the ambient temperature sensor. If the voltage from the ambient temperature sensor is **below 0.2 V** for **5 s**, the PCM determines that the ambient temperature sensor circuit has a malfunction.
P0073:00*5	Ambient temperature sensor circuit high input	• The PCM monitors the input signal from the ambient temperature sensor. If the voltage from the ambient temperature sensor is **above 4.8 V** for **5 s**, the PCM determines that the ambient temperature sensor circuit has a malfunction.
P0089:00	Spill valve control solenoid valve control circuit range/performance problem	• The average fuel pressure on the high pressure side, measured by the fuel pressure sensor while the camshaft is rotating at the specified speed, exceeds the specified value.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Condition	Detection condition
P0091:00	Fuel pressure regulator control circuit low input	• When the PCM turns the spill valve control solenoid valve off but the spill valve control solenoid valve control circuit voltage is low for **5 s**, the PCM determines that the spill valve control solenoid valve control circuit has a malfunction. **MONITORING CONDITIONS** — The following conditions are met: • Engine speed: **5,700 rpm or less** • Battery voltage: **10.5 V or more**
P0092:00	Fuel pressure regulator control circuit high input	• When the PCM turns the spill valve control solenoid valve on but the spill valve control solenoid valve circuit voltage is high for **5 s**, the PCM determines that the spill valve control solenoid valve control circuit has a malfunction. **MONITORING CONDITIONS** — The following conditions are met: • Engine speed: **5,700 rpm or less** • Battery voltage: **10.5 V or more**
P0097:00	IAT sensor No.2 circuit low input	• If the PCM detects that the IAT sensor No.2 voltage at the PCM terminal 1CE is **0.33 V or less** for **5 s**, the PCM determines that the IAT sensor No.2 circuit voltage is low.
P0098:00	IAT sensor No.2 circuit high input	• If the PCM detects that the IAT sensor No.2 voltage at the PCM terminal 1CE is **4.96 V or more** for **5 s**, the PCM determines that the IAT sensor No.2 circuit voltage is high.
P0101:00	MAF sensor circuit range/performance problem	• When the conditions are as follows, the PCM compares the intake airflow amount with the estimated intake airflow amount (calculated from the barometric pressure, MAP sensor and throttle opening angle). **MONITORING CONDITIONS** — Engine speed: **above 500 rpm** — Intake manifold absolute pressure divided by barometric pressure: **below 0.93** — Throttle position (before **0.02 s**): **below 10 %** — Amount of fluctuation in intake camshaft position for **0.04 s**: **below 10 °CA** — Battery voltage: **above 8 V** • The difference between the intake air amount measured by the MAF sensor and the estimated intake air amount estimated by the MAP sensor is outside of the specified value.
P0102:00	MAF sensor circuit low input	• The PCM monitors input voltage from the MAF sensor when the engine is running. If the input voltage at the PCM terminal 2BC is **below 0.2 V** for **5 s**, the PCM determines that the MAF sensor circuit has a malfunction.
P0103:00	MAF sensor circuit high input	• The PCM monitors the input voltage from the MAF sensor when the engine is running. If the input voltage at the PCM terminal 2BC is **above 4.94 V** for **5 s**, the PCM determines that the MAF sensor circuit has a malfunction.
P0107:00	MAP sensor circuit low input	• The PCM monitors the input voltage from the MAP sensor. If the input voltage at the PCM terminal 1BW is **below 0.08 V** for **5 s**, the PCM determines that the MAP sensor circuit has a malfunction.
P0108:00	MAP sensor circuit high input	• The PCM monitors the input voltage from the MAP sensor. If the input voltage at the PCM terminal 1BW is **above 4.89 V** for **5 s**, the PCM determines that the MAP sensor circuit has a malfunction.
P0112:00	IAT sensor No.1 circuit low input	• The PCM monitors the IAT sensor No.1 signal. If the PCM detects that the IAT sensor No.1 voltage at the PCM terminal 2U is **below 0.19 V** for **5 s**, the PCM determines that the IAT sensor No.1 circuit has a malfunction.
P0113:00	IAT sensor No.1 circuit high input	• The PCM monitors the IAT sensor No.1 signal. If the PCM detects that the IAT sensor No.1 voltage at the PCM terminal 2U is **above 4.62 V** for **5 s**, the PCM determines that the IAT sensor No.1 circuit has a malfunction.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Condition	Detection condition
P0116:00	ECT sensor circuit range/performance problem	• The PCM monitors the maximum value and minimum value of engine coolant temperature when the engine is started and **5 min** have been passed after leaving the vehicle **6 h or more**. If difference between maximum and minimum values of engine coolant temperature is **below 6 °C {43 °F}** the PCM determines that there is an ECT sensor circuit range/performance problem.
P0117:00	ECT sensor circuit low input	• The PCM monitors the ECT sensor signal. If the PCM detects that the ECT sensor voltage at the PCM terminal 1AK is **below 0.2 V** for **5 s**, the PCM determines that the ECT sensor circuit has a malfunction.
P0118:00	ECT sensor circuit high input	• The PCM monitors the ECT sensor signal. If the PCM detects that the ECT sensor voltage at the PCM terminal 1AK is **above 4.6 V** for **5 s**, the PCM determines that the ECT sensor circuit has a malfunction.
P0122:00	TP sensor No.1 circuit low input	• If the PCM detects that the TP sensor No.1 voltage at the PCM terminal 1BP is **below 0.1 V** while the engine is running, the PCM determines that the TP sensor No.1 circuit has a malfunction.
P0123:00	TP sensor No.1 circuit high input	• If the PCM detects that the TP sensor No.1 voltage at the PCM terminal 1BP is **above 4.9 V** after the ignition is switched to ON, the PCM determines that the TP sensor No.1 circuit has a malfunction.
P0130:00	A/F sensor circuit problem	• The PCM monitors the voltage between PCM terminal 1AG and 1AB while the A/F sensor active. If the voltage is **above 2.3 V** or **below –2.1 V**, the PCM determines that there is a A/F sensor circuit problem. **MONITORING CONDITIONS** — Battery voltage: **11—18 V**
P0131:00	A/F sensor circuit low input	• The PCM monitors the input voltage from the A/F sensor when the engine is running. If the following PCM terminal voltage is below specified, the PCM determines that the A/F sensor circuit voltage is low. — PCM terminal 1W: **1.2 V** — PCM terminal 1AB: **1.2 V** — PCM terminal 1AG: **2 V** **MONITORING CONDITIONS** — Battery voltage: **11—18 V**
P0132:00	A/F sensor circuit high input	• The PCM monitors the input voltage from the A/F sensor when the engine is running. If the following PCM terminal voltage is above specified, the PCM determines that the A/F sensor circuit voltage is high. — PCM terminal 1W: battery voltage–**1.2 V** — PCM terminal 1AB: **6.2 V** — PCM terminal 1AG: battery voltage–**1.2 V** **MONITORING CONDITIONS** — Battery voltage: **11—18 V**
P0133:00	A/F sensor circuit slow response	• The PCM monitors the peak differential value of the oxygen sensor signal after the A/F fluctuation being provided when the following conditions are met. If the peak differential value is lower than the threshold value, the PCM determines that the A/F sensor circuit is slow. **MONITORING CONDITIONS** — Drive Mode 03 (Variable Valve Timing, A/F Sensor Heater, HO2S Heater, A/F Sensor, HO2S and TWC Repair Verification Drive Mode) — Following conditions are met: • A/F sensor heater monitor is completed. • Fuel system loop status is closed loop fuel control. — ECT sensor and A/F sensor heater are normal. — Engine speed: **1,100—3,500 rpm** — Charging efficiency: **16—63 %** (at engine speed: **2,500 rpm**) — Intake airflow amount: **5—40 g/s {0.7—5.2 lb/min.}** — ECT: **above 50 °C {122 °F}**

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DTC No.	Condition	Detection condition
P0134:00	A/F sensor circuit no activity detected	• The PCM monitors the element impedance of the A/F sensor when the following conditions are met. Under the following monitoring conditions, if the element impedance is more than specified value, the PCM determines that the A/F sensor is not activated. **MONITORING CONDITIONS** — Drive Mode 03 (Variable Valve Timing, A/F Sensor Heater, HO2S Heater, A/F Sensor, HO2S and TWC Repair Verification Drive Mode) — The following conditions are met: • A/F sensor heater is turned on for **above 35 s**. • Battery voltage: **11—18 V**
P0137:00	HO2S circuit low input	• The PCM monitors input voltage from HO2S. If the input voltage from the HO2S is **below** –**1.15 V** or HO2S bias voltage is **below 1.3 V** for **5 s** or the voltage from the HO2S is **below** –**0.15 V** for **25 s** while the HO2S is active, the PCM determines that the HO2S circuit input is low.
P0138:00	HO2S circuit high input	• The PCM monitors input voltage from HO2S. If the input voltage from the HO2S is **above 1.2 V** or HO2S bias voltage is **above 1.8 V** for **5 s**, the PCM determines that the HO2S circuit input is high.
P013A:00	HO2S circuit slow response	• The PCM monitors the rich (**0.55 V**) to lean (**0.3 V**) response time of the HO2S. The PCM measures the response time when the following conditions are met. The PCM determines a HO2S response deterioration malfunction when the measured response time is **more than 0.2 s** for **2 of 3 times**. **MONITORING CONDITIONS** — Drive Mode 03 (Variable Valve Timing, A/F Sensor Heater, HO2S Heater, A/F Sensor, HO2S and TWC Repair Verification Drive Mode) — Following conditions are met: • During deceleration fuel cut • Estimated temperature of the zirconia element inside the HO2S: **above 450 °C {842 °F}** • The PCM monitors for a time-out malfunction (when HO2S remains **above 0.2 V** for longer than a specified period of time during fuel cut control). The PCM measures the amount of time from when the following conditions are met until the HO2S output voltage drops **below 0.2 V**. The PCM determines a HO2S time-out malfunction when the detected time is **more than 5 s** for **2 of 3 times**. **MONITORING CONDITIONS** — Drive Mode 03 (Variable Valve Timing, A/F Sensor Heater, HO2S Heater, A/F Sensor, HO2S and TWC Repair Verification Drive Mode) — Following conditions are met: • During deceleration fuel cut • Estimated temperature of the zirconia element inside the HO2S: **above 450 °C {842 °F}**
P013B:00	HO2S circuit slow response	• During recovery from deceleration fuel cut, the HO2S voltage is **0.2 V or less**, and the following condition is met: — When the elapsed time for the HO2S voltage to transition from **0.3 V** to **0.55 V** is greater than the specification 2 out of 3 times or more. **MONITORING CONDITIONS** — Drive Mode 03 (Variable Valve Timing, A/F Sensor Heater, HO2S Heater, A/F Sensor, HO2S and TWC Repair Verification Drive Mode) — Following conditions are met: • During deceleration fuel cut • Estimated temperature of the zirconia element inside the HO2S: **above 450 °C {842 °F}** • Intake airflow amount: **above 8 g/s {1 lb/min}**

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DTC No.	Condition	Detection condition
P0140:00	HO2S circuit no activity detected	• The PCM monitors the input voltage from the HO2S when the following conditions are met. Under the following monitoring conditions, if the input voltage from the HO2S does not **exceed 0.75 V** even though the short term fuel trim is controlled up to **10 %** for specified period, the PCM determines that the HO2S circuit is not activated. **MONITORING CONDITIONS** — Drive Mode 03 (Variable Valve Timing, A/F Sensor Heater, HO2S Heater, A/F Sensor, HO2S and TWC Repair Verification Drive Mode) — Estimated temperature of the zirconia element inside the HO2S **above 450 °C {842 °F}**
P0171:00	Fuel trim system too lean	• When any of the following conditions is met: — During idling or driving, the correction amount of the fuel feedback correction plus the fuel learning correction is a volume increase correction exceeding the specified value. — During idling or driving, the amount of the fuel feedback increase correction reaches the upper limit.
P0172:00	Fuel trim system too rich	• When any of the following conditions is met: — During idling or driving, the correction amount of the fuel feedback correction plus the fuel learning correction is a volume decrease correction exceeding the specified value. — During idling or driving, the amount of the fuel feedback decrease correction reaches the upper limit.
P0191:00	Fuel pressure sensor circuit range/ performance problem	• The difference between the actual and target fuel pressure is equal to or more than the specification, even though the fuel pressure feedback amount is maintained low or high.
P0192:00	Fuel pressure sensor circuit low input	• If the input voltage at the PCM terminal 1CA is **less than 0.156 V** for **5 s**, the PCM determines that the fuel pressure sensor circuit is low.
P0193:00	Fuel pressure sensor circuit high input	• If the input voltage at the PCM terminal 1CA is **more than 4.86 V** for **5 s**, the PCM determines that the fuel pressure sensor circuit is high.
P0201:00	Fuel injector circuit/open cylinder No.1	• If the fuel injection verification signal is not input at **25 times** continuously even though the PCM drives the fuel injector No.1, the PCM determines that there is an open circuit in the fuel injector No.1 control circuit. **MONITORING CONDITIONS** — The following conditions are met: • Battery voltage: **10.5 V or more** • Fuel injection control: except during fuel cut
P0202:00	Fuel injector circuit/open cylinder No.2	• If the fuel injection verification signal is not input at **25 times** continuously even though the PCM drives the fuel injector No.2, the PCM determines that there is an open circuit in the fuel injector No.2 control circuit. **MONITORING CONDITIONS** — The following conditions are met: • Battery voltage: **10.5 V or more** • Fuel injection control: except during fuel cut
P0203:00	Fuel injector circuit/open cylinder No.3	• If the fuel injection verification signal is not input at **25 times** continuously even though the PCM drives the fuel injector No.3, the PCM determines that there is an open circuit in the fuel injector No.3 control circuit. **MONITORING CONDITIONS** — The following conditions are met: • Battery voltage: **10.5 V or more** • Fuel injection control: except during fuel cut
P0204:00	Fuel injector circuit/open cylinder No.4	• If the fuel injection verification signal is not input at **25 times** continuously even though the PCM drives the fuel injector No.4, the PCM determines that there is an open circuit in the fuel injector No.4 control circuit. **MONITORING CONDITIONS** — The following conditions are met: • Battery voltage: **10.5 V or more** • Fuel injection control: except during fuel cut

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DTC No.	Condition	Detection condition
P0222:00	TP sensor No.2 circuit low input	• If the PCM detects that the TP sensor No.2 voltage at the PCM terminal 1BU is **below 0.1 V**, the PCM determines that the TP sensor No.2 circuit has a malfunction.
P0223:00	TP sensor No.2 circuit high input	• If the PCM detects that the TP sensor No.2 voltage at the PCM terminal 1BU is **above 4.9 V**, the PCM determines that the TP sensor No.2 circuit has a malfunction.
P025B:00	Fuel pump control module circuit range/ performance problem	• When any of the following conditions is met: — Engine overheating is detected. — Output duty ratio signal received from PCM is in error. — Output signal from fuel pump control module is erratic (noise overlap).
P025C:00	Fuel pump control module result of on-board diagnostic test low input	• Result of on-board test cannot be received from fuel pump control module (voltage is too low).
P025D:00	Fuel pump control module result of on-board diagnostic test high input	• Result of on-board test cannot be received from fuel pump control module (voltage is too high).
P0300:00	Random misfire detected	• The PCM monitors the CKP sensor input signal interval time. The PCM calculates the change of interval time for each cylinder. If the change of interval time exceeds the preprogrammed criteria, the PCM detects a misfire in the corresponding cylinder. While the engine is running, the PCM counts the number of misfires that occurred at **200 crankshaft revolutions** or **1000 crankshaft revolutions** and calculates the misfire ratio for each crankshaft revolution. If the ratio exceeds the preprogrammed criteria, the PCM determines that a misfire, which can damage the catalytic converter or affect emission performance, has occurred.
P0301:00	Cylinder No.1 misfire detected	• The PCM monitors the CKP sensor input signal interval time. The PCM calculates the change of interval time for each cylinder. If the change of interval time exceeds the preprogrammed criteria, the PCM detects a misfire in the corresponding cylinder. While the engine is running, the PCM counts the number of misfires that occurred at **200 crankshaft revolutions** or **1000 crankshaft revolutions** and calculates the misfire ratio for each crankshaft revolution. If the ratio exceeds the preprogrammed criteria, the PCM determines that a misfire, which can damage the catalytic converter or affect emission performance, has occurred.
P0302:00	Cylinder No.2 misfire detected	
P0303:00	Cylinder No.3 misfire detected	
P0304:00	Cylinder No.4 misfire detected	
P0327:00	KS circuit low input	• The PCM monitors input signal from the KS when the engine is running. If the input voltage is **below 1.1 V** for **5 s**, the PCM determines that the KS circuit has a malfunction.
P0328:00	KS circuit high input	• The PCM monitors the input signal from the KS when the engine is running. If the input voltage is **above 2.4 V** for **5 s**, the PCM determines that the KS circuit has a malfunction.
P0335:00	CKP sensor circuit problem	• There is no CKP sensor signal input while the exhaust camshaft rotates **5 times**. • CKP sensor input signal pattern, received while crankshaft rotates **10 times**, is incorrect.
P0340:00	Intake CMP sensor circuit problem	• Intake CMP sensor input signal pattern, received while crankshaft rotates **24 times**, is incorrect.
P0365:00	Exhaust CMP sensor circuit problem	• Exhaust CMP sensor input signal pattern, received while crankshaft rotates **24 times**, is incorrect. • Cylinder identification is not completed while the crankshaft rotates **13 times**.
P0421:00	Warm up catalyst system efficiency below threshold	• The PCM compares the number of the A/F sensor and HO2S inversions for a predetermined time to detect the inversion ratio. It does this by monitoring the HO2S inversion counts when the following conditions are met. If the inversion ratio is below specification, the PCM determine that the catalyst system has deteriorated. — The A/F sensor inversion counts is as prescribed when the following monitoring conditions are met: — The accumulated occurrence time of the following monitoring conditions has exceeded the prescribed time limit: **MONITORING CONDITIONS** • Calculated TWC temperature: **above 400 °C {752 °F}** • Engine speed: **1,100—3,000 rpm** • LOAD: **19—63 %** (at engine speed of **1,500 rpm**)

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DTC No.	Condition	Detection condition
P0443:00	Purge solenoid valve circuit problem	• The PCM monitors the purge solenoid valve control signal voltage and current. If the following conditions are met, the PCM determines that there is the purge solenoid valve control circuit problem. — The PCM turns the purge solenoid valve off, but the voltage of the purge solenoid valve control signal remains low. — The PCM turns the purge solenoid valve on, but the current of the purge solenoid valve control signal remains high.
P0461:00	Fuel gauge sender unit circuit range/ performance problem	• The PCM monitors the fuel tank level difference before and after the PCM-calculated fuel consumption has reached **more than 25 L {26 US qt, 22 Imp qt}**. If the difference is **less than 5 %**, the PCM determines that there is a fuel gauge sender unit circuit range/performance problem.
P0462:00	Fuel gauge sender unit circuit low input	• The PCM monitors the fuel level signal and fuel gauge sender unit output voltage from the instrument cluster. If the PCM detects a fuel level or fuel gauge sender unit output voltage that is too low, the PCM determines that the fuel gauge sender unit circuit has a malfunction.
P0463:00	Fuel gauge sender unit circuit high input	• The PCM monitors the fuel level signal and fuel gauge sender unit output voltage from the instrument cluster. If the PCM detects a fuel level or fuel gauge sender unit output voltage that is too high, the PCM determines that the fuel gauge sender unit circuit has a malfunction.
P0480:00	Cooling fan relay No.1 control circuit malfunction	• The PCM monitors the cooling fan relay No.1 control signal voltage and current. If the following conditions are met, the PCM determines that there is the cooling fan relay No.1 control circuit problem. — The PCM turns the cooling fan relay No.1 off, but the voltage of the cooling fan relay No.1 control signal remains low for **5 s**. — The PCM turns the cooling fan relay No.1 on, but the current of the cooling fan relay No.1 control signal remains high for **5 s**.
P0482:00	Cooling fan relay No.2 and No.3 control circuit malfunction	• The PCM monitors the cooling fan relay No.2 and No.3 control signal voltage and current. If the following conditions are met, the PCM determines that there is the cooling fan relay No.2 and No.3 control circuit problem. — The PCM turns the cooling fan relay No.2 and No.3 off, but the voltage of the cooling fan relay No.2 and No.3 control signal remains low for **5 s**. — The PCM turns the cooling fan relay No.2 and No.3 on, but the current of the cooling fan relay No.2 and No.3 control signal remains high for **5 s**.
P0500:00	VSS circuit problem	• If an error in the wheel speed signal from the DSC HU/CM is detected by CAN when the following conditions are met: — Neutral switch No.1, neutral switch No.2 and CPP switch: OFF (MTX) — Shift position: except P or N position (ATX) — Absolute load: **above 40 %** — Engine speed: **above 2,000 rpm** — Brake switch: OFF
P0506:00	IAC system RPM lower than expected	• The actual idle speed is lower than expected by **100 rpm** for **14 s**, when the brake pedal is depressed (brake switch is on). **Note** • If the atmospheric pressure is **less than 72.3 kPa {0.737 kgf/cm^2, 10.5 psi}** or the intake air temperature is **below** – **10 °C {14 °F}**, the PCM cancels the diagnosis of DTC P0506:00.
P0507:00	IAC system RPM higher than expected	• The actual idle speed is higher than expected by **200 rpm** for **14 s**, when the brake pedal is depressed (brake switch is on). **Note** • If the atmospheric pressure is **less than 72.3 kPa {0.737 kgf/cm^2, 10.5 psi}** or the intake air temperature is **below** – **10 °C {14 °F}**, the PCM cancels the diagnosis of DTC P0507:00.
P0520:00	Oil pressure switch circuit problem	• The oil pressure switch is off for a continuous **5 s** even though the engine is stopped.

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DTC No.	Condition	Detection condition
P0524:00	Engine oil pressure too low	• The oil pressure switch is on for a continuous **5 s** with the following condition met: (engine oil pressure warning light illuminates when **1 s** has elapsed) — When engine coolant temperature is **30 °C {86 °F} or less** and engine speed is **above 650 rpm** — When engine coolant temperature is **68 °C {154 °F} or less** and engine speed is **above 1,500 rpm** — When engine coolant temperature is **68 °C {154 °F} or more** and engine speed is **above 2,500 rpm**
P0532:00*5	Refrigerant pressure sensor circuit low input	• The PCM monitors input voltage from the refrigerant pressure sensor when the ignition switch is ON. If the input voltage at the PCM terminal 2AX is **below 0.1 V** for **5 s**, the PCM determines that the refrigerant pressure sensor circuit has a malfunction.
P0533:00*5	Refrigerant pressure sensor circuit high input	• The PCM monitors the input voltage from the refrigerant pressure sensor when the ignition switch is ON. If the input voltage at the PCM terminal 2AX is **above 4.9 V** for **5 s**, the PCM determines that the refrigerant pressure sensor circuit has a malfunction.
P0555:00*4	Power brake unit vacuum sensor circuit problem	• The PCM monitors the power brake unit vacuum sensor signal voltage while the ignition switch is ON. If the PCM detects the power brake unit vacuum sensor voltage is **below 0.15 V** or **above 4.8 V** for **5 s**, the PCM determines that the power brake unit vacuum sensor circuit has problem.
P0571:00	Brake switch circuit problem	• The PCM monitors changes in input voltage for brake switch No.1 and No.2. • The brake switch circuit malfunction is determined when the following **2 conditions** are repeated **5 times or more**. — Brake switch No.1 and No.2 are on or off simultaneously for a continuous **3 s or more**. — The brake is operated.
P057F:00*4	Power supply malfunction	• The battery charge/discharge flow exceeds the specification.
P058A:00*4	Current sensor problem	• The following conditions are met: — Current sensor internal malfunction — Battery voltage malfunction — Battery fluid temperature malfunction
P0600:00	Serial communication link	• PCM internal malfunction.
P0601:00	PCM memory check sum error	• PCM internal memory check sum error.
P0602:00	PCM programming error	• No configuration data in the PCM. **Note** • If the “PCM CONFIGURATION” is successful, the PCM stores the DTC P0602:00 and illuminates the check engine light (system is normal). Clear the DTC P0602:00 using the M-MDS after the “PCM CONFIGURATION”. • The check engine light goes out after three drive cycles with no failure (the DTCs remain in PCM).
P0604:00	PCM RAM error	• PCM internal RAM malfunction.
P0606:00	PCM processor error	• PCM internal CPU malfunction.
P0607:00	Control module performance problem	• PCM internal malfunction.
P0610:00	PCM vehicle configuration error	• PCM data configuration error.
P0615:00*4	Starter relay circuit problem	• The PCM records DTCs when the number of times the engine has been started reaches the warranted performance frequency for the starter or starter relay.
P061B:00	Internal control module torque calculation performance problem	• Indicates that a calculation error occurred in the PCM. • There is a malfunction in the sensor input signal to the PCM.
P061D:00	Internal control module engine air mass performance problem	• Indicates an error occurred in the PCM.
P061F:00	Internal control module throttle valve actuator controller performance problem	• When any of the following conditions is met: — CAN communication line between start stop unit and PCM malfunction — Start stop unit internal malfunction — PCM internal malfunction
P0628:00	Fuel pump control module circuit low input	• When the PCM outputs a duty signal to the fuel pump control module, the difference in voltage between fuel pump unit terminals B and D is **less than 1.5 V** for a continuous **5 s**.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Condition	Detection condition
P0629:00	Fuel pump control module circuit high input	• Over-current is detected.
P0638:00	Throttle valve actuator control range/ performance problem	• The PCM compares the actual TP with the target TP. If the difference is more than the threshold value, the PCM determines that there is a throttle valve actuator control range/performance problem.
P064D:00	Internal control module A/F sensor processor performance problem	• The A/F sensor IC integrated in the PCM converts to the voltage value for the fuel control and for the diagnosis based on the A/F sensor signal current and sends to the CPU (integrated in the PCM). If there is a transmission format error from the A/F sensor IC to the PCM, the PCM will detect a transmission error. **MONITORING CONDITIONS** — Drive Mode 03 (Variable Valve Timing, A/F Sensor Heater, HO2S Heater, A/F Sensor, HO2S and TWC Repair Verification Drive Mode) — Following conditions are met: • Engine is running • Battery voltage: **11—18 V**
P0685:00	Main relay control circuit open	• This DTC sets when the ignition switch position run circuit indicates the key is in the off, ACC, or LOCK position, and the amount of time the PCM remains powered through the PCM power relay exceeds a predetermined amount of time.
P06B8:00	Internal control module non-volatile RAM error	• PCM internal EEPROM malfunction.
P06DA:00	Engine oil solenoid valve circuit problem	• The engine oil solenoid valve control current exceeds the specification or the control voltage at the PCM terminal 1AS is less than the specification relative to the PCM control condition.
P0703:00	Brake switch input circuit problem	• The PCM monitors the input signal from the brake switch No.1. If the input signal does not change while following decelerating **8 times**, the PCM determines that there is a brake switch No.1 input circuit problem. **MONITORING CONDITIONS** — Vehicle speed: from **above 30 km/h {19 mph}** to **30 km/h {19 mph} or less** — Deceleration rate: **exceeds 2.4 km/h {1.5 mph} per sec**
P0704:00*2	CPP switch input circuit problem	• The PCM monitors changes in input voltage from the CPP switch. If the PCM does not detect a voltage change while the vehicle runs with vehicle speed **above 30 km/h {19 mph}** and stops **8 times** alternately, the PCM determines that the CPP switch circuit has a malfunction.
P07BE:00*6	Transmission indeterminate failure (failed to neutral)	• Correlation malfunction between neutral switches No.1 and No.2.
P0850:00*2	Neutral switch No.1 input circuit problem	• The PCM monitors changes in input voltage from the neutral switch No.1. If the PCM does not detect a voltage change while driving the vehicle at a vehicle speed **above 30 km/h {19 mph}** and clutch pedal is pressed and released **10 times** repeatedly, the PCM determines that the neutral switch No.1 circuit has a malfunction.
P0A0F:00*4	Engine failed to restart	• Any of following conditions occurs: — When the engine should restart after it is stopped by the i-stop control, it does not start even though it is cranked for **3 s or more**. — When the engine should restart after it is stopped by the i-stop control, it does not cranked.
P0A8D:00*4	Power supply system circuit low input	• Any of the values for the battery voltage, voltage for PCM control, and voltage for DC-DC converter control is low when the engine is started.
P0A94:00*4	DC-DC converter control circuit signal error	• Internal malfunction signal from DC-DC converter via front body control module (FBCM) is received.(CAN/LIN communication). • Input signal from the DC-DC converter limits the pressure increase time. • Input signal from the DC-DC converter does not implement pressure increase after a pressure increase command to the DC-DC converter.
P111A:00	Engine coolant temperature is high	• The engine coolant temperature is **122 °C or more**.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Condition	Detection condition
P117A:00	Engine oil temperature is high	• With the transmission in 4th gear or lower gear, an engine speed of **6,100 rpm** continues for **6 min**.
P1260:00	Immobilizer system problem	• The start stop unit detects an immobilizer system malfunction.
P1380:00	Electric variable valve timing control circuit problem	• A malfunction is detected in the results of the on-board diagnostic test received from electric variable valve timing driver.
P151B:00*1	IAC system problem	• The PCM cannot control the idle speed toward the target idle speed during the KOER self test.
P176E:00*6	Clutch stroke sensor/Starter interlock switch correlation problem	• Correlation malfunction between clutch stroke sensor and starter interlock switch. — If the clutch stroke sensor circuit voltage **above 4.9 V** or **below 0.1 V** for **10 s**, the PCM determines that the clutch stroke sensor circuit has a malfunction. — CPP switch stuck ON or OFF. — Starter interlock switch stuck ON.
P2090:00	OCV circuit low input	• The PCM monitors the OCV voltage. If the PCM detects the OCV control voltage (calculated from the OCV) is below the specification voltage (calculated from the battery positive voltage), the PCM determines that the OCV circuit has a malfunction.
P2091:00	OCV circuit high input	• The PCM monitors the OCV current. If the PCM detects that the OCV control current (calculated from the OCV) is above the specification current, the PCM determines that the OCV circuit has a malfunction.
P2096:00	Target A/F feedback system too lean	• The PCM monitors the target A/F fuel trim when under the target A/F feedback control. If the fuel trim is more than the specification, the PCM determines that the target A/F feedback system is too lean.
P2097:00	Target A/F feedback system too rich	• The PCM monitors the target A/F fuel trim when under the target A/F feedback control. If the fuel trim is less than specification, the PCM determines that the target A/F feedback system is too rich.
P2101:00	Throttle valve actuator control motor circuit range/performance problem	• The PCM turns the main relay on, but if the input voltage is **6.0 V or less**, then the PCM determines that the main relay control circuit voltage is low. • There is a system error in the electrical throttle control system of the PCM.
P2107:00	Throttle valve actuator control module processor error	• Throttle valve actuator control module internal processor error.
P2109:00	TP sensor minimum stop range/ performance problem	• If the fully-close throttle position is **5.1 ° or lower**, or **15.9 ° or more** (even though the fully-close throttle position learning is finished), the PCM determines there is a malfunction.
P2110:00	Throttle valve actuator control system-forced limited RPM	• The throttle valve actuator control system is in the failure mode effects management mode.
P2112:00	Throttle valve actuator motor current range/performance problem	• If the duty ratio is **95 % or more**, the PCM determines that there is a throttle valve actuator control system range/performance problem.
P2119:00	Throttle valve actuator control throttle body range/performance problem	• The PCM compares the actual TP with initial setting TP when the ignition is switched to off. If the TP is higher than the initial setting TP, the PCM determines that there is a throttle valve return spring malfunction.
P2122:00	APP sensor No.1 circuit low input	• The PCM monitors the input voltage from APP sensor No.1 when the engine is running. If the input voltage at the PCM terminal 2AN is **less than 0.1 V**, the PCM determines that the APP sensor No.1 circuit input voltage is low.
P2123:00	APP sensor No.1 circuit high input	• The PCM monitors the input voltage from APP sensor No.1 when the engine is running. If the input voltage at the PCM terminal 2AN is **above 4.9 V**, the PCM determines that the APP sensor No.1 circuit input voltage is high.
P2127:00	APP sensor No.2 circuit low input	• The PCM monitors the input voltage from APP sensor No.2 when the engine is running. If the input voltage at the PCM terminal 2AS is **less than 0.1 V**, the PCM determines that the APP sensor No.2 circuit has a malfunction.
P2128:00	APP sensor No.2 circuit high input	• The PCM monitors the input voltage from APP sensor No.2 when the engine is running. If the input voltage at the PCM terminal 2AS is **more than 4.9 V**, the PCM determines that the APP sensor No.2 circuit has a malfunction.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Condition	Detection condition
P2135:00	TP sensor No.1/No.2 voltage correlation problem	• The PCM compares the input voltage from TP sensor No.1 with the input voltage from TP sensor No.2. If the difference is more than the specification, the PCM determines that there is a TP sensor No.1/No.2 voltage correlation problem.
P2138:00	APP sensor No.1/No.2 voltage correlation problem	• The PCM compares the input voltage from APP sensor No.1 with the input voltage from APP sensor No.2 when the engine is running. If the difference is more than the specification, the PCM determines that there is an APP sensor No.1/No.2 angle correlation problem.
P2199:00	IAT sensor No.2 circuit range/ performance problem	• IAT sensor No.1 and IAT sensor No.2 are compared after the engine is started* and correlation error occurs. *: Ignition switch on when **6 h or more** has passed since the ignition was switched off.
P2228:00	BARO sensor circuit low input	• The PCM monitors input voltage from the BARO sensor. If the input voltage is below specified value for **5 s**, the PCM determines that the BARO sensor circuit has a malfunction.
P2229:00	BARO sensor circuit high input	• The PCM monitors input voltage from the BARO sensor. If the input voltage is above specified value for **5 s**, the PCM determines that the BARO sensor circuit has a malfunction.
P2237:00	A/F sensor positive current control circuit open	• The PCM monitors A/F sensor positive current control circuit voltage. If the voltage is between **2.2 V** and **2.4 V** while the engine is running, the PCM determines that the A/F sensor positive current control circuit is open.
P2243:00	A/F sensor reference voltage circuit open	• The PCM monitors the A/F sensor signal voltage at the PCM terminal 1W. If either of the following conditions is met, the PCM determines that the A/F sensor reference voltage circuit is open. — The PCM terminal 1W voltage is **above 5.3 V** for **30 s**. — The PCM detects DTC P0134:00 while the pending code P2243:00 is stored. **MONITORING CONDITIONS** — Drive Mode 03 (Variable Valve Timing, A/F Sensor Heater, HO2S Heater, A/F Sensor, HO2S and TWC Repair Verification Drive Mode) — Following conditions are met: • Engine is running • Battery voltage: **11—18 V** • A/F sensor element impedance: specified or more
P2251:00	A/F sensor negative current control circuit open	• The PCM monitors the A/F sensor signal voltage at the PCM terminal 1W. If either of the following conditions is met, the PCM determines that the A/F sensor negative current control circuit is open. **MONITORING CONDITIONS** — Circuit voltage oscillation or the PCM terminal 1W voltage is **below 5.3 V**. — The PCM detects the DTC P0134:00 while the pending code P2251:00 is stored. — A/F sensor element impedance: specified or more — Battery voltage: **11—18 V**
P2299:00	Accelerator pedal: spring back malfunction	• Brake override system operates.
P2302:00	Ion sensor No.1 circuit problem	• After the engine is started, when the engine speed is **2,000 rpm or less**, the signal input to the PCM from ion sensor No.1 is in error.
P2305:00	Ion sensor No.2 circuit problem	• After the engine is started, when the engine speed is **2,000 rpm or less**, the signal input to the PCM from ion sensor No.2 is in error.
P2308:00	Ion sensor No.3 circuit problem	• After the engine is started, when the engine speed is **2,000 rpm or less**, the signal input to the PCM from ion sensor No.3 is in error.
P2311:00	Ion sensor No.4 circuit problem	• After the engine is started, when the engine speed is **2,000 rpm or less**, the signal input to the PCM from ion sensor No.4 is in error.
P2502:00	Charging system voltage problem	• The PCM determines that the generator output voltage is **more than 17 V**, and the battery voltage is **less than 11 V**, **for 5 s** while the engine is running.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Condition	Detection condition
P2503:00	Charging system voltage low input	• The PCM determines that the generator output voltage is **less than 8.5 V**, and the generator target output current is **more than 20 A**, for **5 s** while the engine is running.
P2504:00	Charging system voltage high input	• The PCM determines that the generator output voltage is **more than 18.5 V**, or battery voltage is **more than 16.0 V**, for **5 s** while the engine is running.
P2507:00	PCM battery voltage low input	• The PCM monitors the voltage of backup battery positive terminal. If the PCM detects that the battery positive terminal voltage is **below 6 V** for **5 s**, the PCM determines that the backup voltage circuit has a malfunction.
P2610:00	Instrument cluster internal engine off timer performance problem	• Instrument cluster internal engine off timer is damaged.
U0073:00	CAN system communication error (HS CAN)	• Malfunction in CAN bus communication line.
U0074:00*3	CAN system communication error (local CAN between PCM and TCM)	• Malfunction in CAN bus communication line.
U0101:00*3	CAN communication: communication error to TCM	• Communication error between the TCM continues for **5 s or more**.
U0121:00	CAN communication: communication error to DSC HU/CM	• Communication error between the DSC HU/CM continues for **5 s or more**.
U0131:00	CAN communication: communication error to EPS control module	• Communication error between the EPS control module continues for **5 s or more**.
U0140:00	CAN communication: communication error to front body control module (FBCM)	• Communication error between the front body control module (FBCM) continues for **5 s or more**.
U0151:00	CAN communication: communication error to SAS control module	• Communication error between the SAS control module continues for **5 s or more**.
U0155:00	CAN communication: communication error to instrument cluster	• Communication error between the instrument cluster continues for **5 s or more**.
U0214:00	CAN communication: communication error to start stop unit	• Communication error between the start stop unit continues for **5 s or more**.
U0235:00	CAN communication: communication error to laser sensor	• Communication error between the laser sensor continues for **5 s or more**.
U0298:00*4	CAN/LIN communication system: DC-DC converter information communication error with front body control module (FBCM)	• PCM detects a DC-DC converter information communication error from front body control module (FBCM).
U0302:00*3	TCM processor error	• When any of the following conditions is met: — CAN communication line between TCM and PCM malfunction — TCM internal malfunction
U0315:00	DSC HU/CM error	• When any of the following conditions is met: — CAN communication line between DSC HU/CM and PCM malfunction — DSC HU/CM internal malfunction
U0320:00	EPS control module error	• When any of the following conditions is met: — CAN communication line between EPS control module and PCM malfunction — EPS control module internal malfunction
U0323:00	Instrument cluster error	• When any of the following conditions is met: — CAN communication line between instrument cluster and PCM malfunction — Instrument cluster internal malfunction
U0336:00	SAS control module error	• When any of the following conditions is met: — CAN communication line between SAS control module and PCM malfunction — SAS control module internal malfunction
U0338:00	Start stop unit error	• When any of the following conditions is met: — CAN communication line between start stop unit and PCM malfunction — Start stop unit internal malfunction
U0433:00	Abnormal message from rear body control module (RBCM)	• Correct data cannot be received from rear body control module (RBCM).

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

DTC No.	Condition	Detection condition
U1007:00*4	CAN/LIN communication system: current sensor information communication error with front body control module (FBCM)	• PCM detects a current sensor information communication error from front body control module (FBCM).
U2300:00	Global central configuration error	• Any of following conditions occurs: — No configuration of instrument cluster — The configuration signal with the estimated CAN ID is not sent from the instrument cluster. — The configuration signal value sent via CAN from the instrument cluster is unknown or invalid. — The configuration signal value sent via CAN from the instrument cluster is a value other than the estimated value. — The configuration signal value sent via CAN from the instrument cluster does not match the PCM value.
U3000:41	PCM processor error	• PCM internal EEPROM malfunction.

*1 : KOER self test only
*2 : MTX
*3 : ATX
*4 : Vehicles with i-stop system
*5 : Vehicles with air conditioner
*6 : Vehicles with i-stop system (MTX)

KOEO/KOER SELF-TEST [SKYACTIV-G 2.0]

id0102h1100400

- On-board diagnosis is performed using the flow pre-set in the PCM, and according to the test execute command sent to the PCM from the external tester.
- If a malfunction is detected as a result of the on-board diagnosis, a DTC is recorded in the PCM.

KOEO (Key ON, Engine Off) Self Test

- The KOEO self test is a powertrain control system self-diagnosis, performed when the ignition is switched to ON and the engine is stopped. A KOEO self test begins when the connected M-MDS sends an execute command to the PCM.
- As the KOEO self test is performed, the PCM performs the inspection for set DTCs and if a malfunction is detected, the DTC is displayed on the M-MDS.

KOER (Key ON, Engine Running) Self Test

- The KOER self test is a powertrain control system self-diagnosis, performed when the ignition is switched to ON and the engine is idling. A KOER self test begins when the connected M-MDS sends an execute command to the PCM.
- As the KOER self test is performed, the PCM performs the inspection for set DTCs and if a malfunction is detected the DTC is displayed on the M-MDS.

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [SKYACTIV-G 2.0]

id0102h1142100

- The PID/DATA monitor items are shown below.

PID/DATA monitor item table

—: Not applicable

Item	Definition	Unit/Condition
AAT*4	Ambient air temperature	°C, °F
ACCS*4	A/C relay	OFF/ON
AC_PRES*4	Refrigerant pressure sensor	KPa {MPa}, mBar {Bar}, psi, in H20
		V
AC_REQ*4	A/C request signal	OFF/ON
ALTF	Generator field current control duty value	%
ALTT V	Generator output voltage	V
AMB_TEMP*4	Ambient air temperature	°C, °F
APP	Accelerator pedal position	%
APP1	APP sensor No.1	%
		V

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

Item	Definition	Unit/Condition
APP2	APP sensor No.2	%
		V
ARPMDES	Target engine speed	RPM
BARO	Barometric pressure	KPa {MPa}, mBar {Bar}, psi, in H20
		V
BATT_CUR	Battery current	A
BATT_DAY	Number of days elapsed since current sensor initialization	—
BATT_RES	Battery internal resistance (estimated)	—
BATT_SOC	Battery charge condition (estimated)	%
BATT_TEMP	Battery temperature	°C, °F
BATT_V	Battery voltage	V
BBP*3	Power brake unit vacuum sensor	KPa {MPa}, mBar {Bar}, psi, in H20
		V
BFP	Brake fluid pressure	KPa {MPa}, mBar {Bar}, psi, in H20
BOO	Brake switch (No.1 signal)	OFF/ON
BPA	Brake switch (No.2 signal)	OFF/ON
CATT11_DSD	Estimated catalytic converter temperature	°C, °F
CHRGLP	Charging system warning light	OFF/ON
COLP	Refrigerant pressure sensor	OFF/ON
CLU_CUT_SW*1	Starter interlock switch	OFF/ON
CPP*1	Clutch pedal position	OFF/ON
CPP/PNP*1	Shift lever position	OFF/ON
ECT	Engine coolant temperature (No.1)	°C, °F
		V
EQ_RAT11	Actual lambda signal	—
EQ_RAT11_DSD	Target lambda	—
ETC_ACT	Throttle control	°
ETC_DSD	Throttle control desired	%
		°
EVAPCP	Purge solenoid valve duty value	%
FAN1	Cooling fan relay No.1	OFF/ON
FAN2	Cooling fan relay No.2	OFF/ON
FAN3	Cooling fan relay No.3	OFF/ON
FIA	Fuel injection amount	%
FLI	Fuel level	%
FP	Fuel pump relay	OFF/ON
FP_DUTY	Fuel pump duty cycle	%
FP_Hi_PRES	Spill valve control solenoid valve	OFF/ON
FUELPW	Fuel injector duration	sec
FUELSYS	Fuel system status	OL/CL/OL-Drive/OL-Fault/CL-Fault
FUEL_PRES	Fuel pressure	KPa {MPa}, mBar {Bar}, psi, in H20
		V
FUEL_P_DSD	Desired fuel pressure	KPa {MPa}, mBar {Bar}, psi, in H20
GEAR*2	Gear commanded	1st, 2nd, 3rd, 4th, 5th, 6th, 7th, Park, Neutral, Drive, Reverse
HTR11	A/F sensor heater control	OFF/ON
		%
HTR12	HO2S heater control	OFF/ON
		%

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

Item	Definition	Unit/Condition
IAT	Intake air temperature (No.1)	°C, °F
		V
IAT2	Intake air temperature (No.2)	°C, °F
		V
ISC_FBK	ISC feedback value	%
ISC_FBK_LRN	ISC feedback learning value	%
I-Stop_OFF*3	i-stop OFF mode	OFF/ON
I-Stop_TRD*3	i-stop transmission D position selected status	OFF/ON
I-Stop_VSP*3	i-stop vehicle speed history flag	OFF/ON
I-Stop_VST*3	i-stop vehicle stop flag	OFF/ON
IVS	CTP condition	Idle/Off Idle
KNOCKR	Knocking retard	°
LOAD	Engine load	%
LONGFT1	Long term fuel trim	%
LONGFT12	Long term fuel trim (HO2S)	%
LOW_OIL	Engine oil level status	NO/YES
MAF	Mass air flow	g/sec
		V
MAP	Manifold absolute pressure	KPa {MPa}, mBar {Bar}, psi, in H20
		V
MF_CAT1	Number of misfires corresponding to possible catalytic converter damage (No.1 cylinder)	—
MF_CAT_2	Number of misfires corresponding to possible catalytic converter damage (No.2 cylinder)	—
MF_CAT_3	Number of misfires corresponding to possible catalytic converter damage (No.3 cylinder)	—
MF_CAT_4	Number of misfires corresponding to possible catalytic converter damage (No.4 cylinder)	—
MF_CAT_FCC	Number of misfire determinations (for catalytic converter)	—
MF_CAT_TTL	Number of misfires corresponding to possible catalytic converter damage (total)	—
MF_EMI1	Number of misfires possibly affecting emission (No.1 cylinder)	—
MF_EMI_2	Number of misfires possibly affecting emission (No.2 cylinder)	—
MF_EMI_3	Number of misfires possibly affecting emission (No.3 cylinder)	—
MF_EMI_4	Number of misfires possibly affecting emission (No.4 cylinder)	—
MF_EMI_FCC	Number of misfire determinations (for emission)	—
MF_EMI_TTL	Number of misfires possibly affecting emission (total)	—
M_GEAR*1	Manual gear position	Neutral, 1st, 2nd, 3rd, 4th, 5th, 6th, Reverse, Undefined, Auto, In_Progress, YSF, Error
MIL	Check engine light	OFF/ON
MIL_DIS	Travelled distance since check engine light illuminated	km, ft {mi}
NEUTRAL_SW1*1	Neutral switch No.1	OFF/ON
NEUTRAL_SW2*5	Neutral switch No.2	OFF/ON
O2S11	A/F sensor	A
O2S12	HO2S	V
OIL_P_SOL	Engine oil solenoid valve	OFF/ON
OIL_TEMP	Estimated engine oil temperature	°C, °F
PN_SW	Parking/neutral	Open/Closed
RO2FT1	HO2S fuel trim	%
RPM	Engine speed	RPM
SHRTFT1	Short term fuel trim	%
SHRTFT12	Short term fuel trim (HO2S)	%
SPARKADV	Ignition timing	°

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

Item	Definition	Unit/Condition
Test	Test mode	OFF/ON
TP REL	Throttle position signal (relative value)	%
TP1	TP sensor No.1	%
		V
TP2	TP sensor No.2	%
		V
TPCT	TP sensor No.1 voltage at CTP	V
TPCT2	TP sensor No.2 voltage at CTP	V
VPWR	Battery positive voltage	V
VSS	Vehicle speed	KPH, MPH
VT_EX_ACT	Actual exhaust valve timing	°
VT_EX_DES	Desired exhaust valve timing	°
VT_EX_DUTY	OCV duty cycle	%
VT_IN_ACT	Actual intake valve timing	°
VT_IN_DES	Desired intake valve timing	°

*1 : MTX
*2 : ATX
*3 : Vehicles with i-stop system
*4 : Vehicles with air conditioner
*5 : Vehicles with i-stop system (MTX)

ON-BOARD DIAGNOSTIC SYSTEM ACTIVE COMMAND MODES FUNCTION [SKYACTIV-G 2.0]

id0102h1105400

- The simulation items are shown below.

Simulation item table

Item	Applicable component	Unit/Condition
ACCS*1	A/C relay	OFF/ON
ALTF	Generator field coil	OFF/ON
ARPMDES	Target engine speed	RPM
EVAPCP	Purge solenoid valve	%
FAN1	Cooling fan relay No.1	OFF/ON
FAN2	Cooling fan relay No.2	OFF/ON
FAN3	Cooling fan relay No.3	OFF/ON
FP	Fuel pump relay	OFF/ON
INJ_1	Fuel injector No.1	OFF
INJ_2	Fuel injector No.2	OFF
INJ_3	Fuel injector No.3	OFF
INJ_4	Fuel injector No.4	OFF
OIL_P_SOL	Engine oil solenoid valve	OFF/ON
Test	Test mode	OFF/ON
VT_EX_DES	OCV	°

*1 : Vehicles with air conditioner

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL DIAGNOSTIC UNIT COMMUNICATION FUNCTION [SKYACTIV-G 2.0]

id0102h1141800

Outline

- Function for allowing both the PCM and external tester to receive and send data.
- The DLC-2 has been adopted as the communication medium.

Function

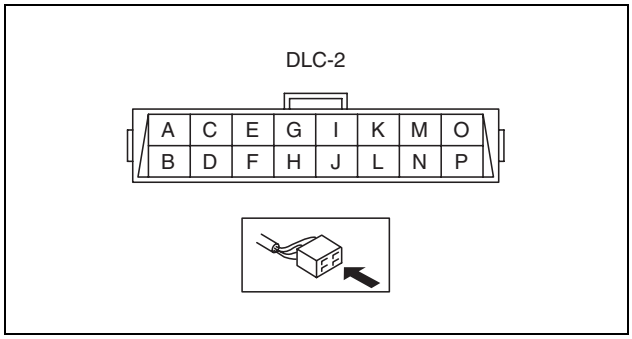
- The types of data which the PCM and external tester can receive and send using the external tester communication function include the following items:
  — Recording of engine control system information in the PCM.

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

— Data related to exhaust emission such as input/output signals, the PCM-calculated values and system status.

DLC-2 Outline

- The DLC-2 located in the driver compartment is a service connector defined by OBD regulations.
- The following are functions for each terminal.



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Terminal	Function
A	Battery positive voltage
B	—
C	—
D	—
E	CAN communication line LO (HS)
F	CAN communication line HI (HS)
G	—
H	Ground (signal)
I	—
J	Ground (chassis)
K	CAN communication line LO (MS)
L	CAN communication line HI (MS)
M	—
N	—
O	—
P	—

ON-BOARD DIAGNOSTIC SYSTEM MALFUNCTION DISPLAY FUNCTION [SKYACTIV-G 2.0]

id0102h1142000

Outline

- Illuminates the check engine light to notify the driver of a malfunction occurring in the engine control system.
- The check engine light is in the instrument cluster. (See 01-02-29 CHECK ENGINE LIGHT [SKYACTIV-G 2.0].)

Function

- The check engine light illuminates when a malfunction occurs in the engine control system, and it illuminates at the same time a DTC is recorded in the PCM.
- The illumination/non-illumination conditions of the check engine light are determined by the number of drive cycles. (See 01-02-2 ON-BOARD DIAGNOSTIC SYSTEM TEST MODE [SKYACTIV-G 2.0].)

ON-BOARD DIAGNOSTIC SYSTEM DIAGNOSTIC DATA MEMORY FUNCTION [SKYACTIV-G 2.0]

id0102h1141700

Outline

- Records diagnostic data related to the engine control system in the PCM.

Function

- The diagnostic data recording/erasing conditions are determined by the number of drive cycles set for each item. (See 01-02-2 ON-BOARD DIAGNOSTIC SYSTEM TEST MODE [SKYACTIV-G 2.0].)
- Diagnostic data which can be recorded in the PCM are as follows:
  - — Number of DTCs
  - — DTC
  - — Pending code
  - — Freeze frame data
  - — On-board diagnostic system diagnosis condition

ON-BOARD DIAGNOSTIC [SKYACTIV-G 2.0]

- Another method for erasing diagnostic data is by using the memory clearing function of the external tester.

CHECK ENGINE LIGHT [SKYACTIV-G 2.0]

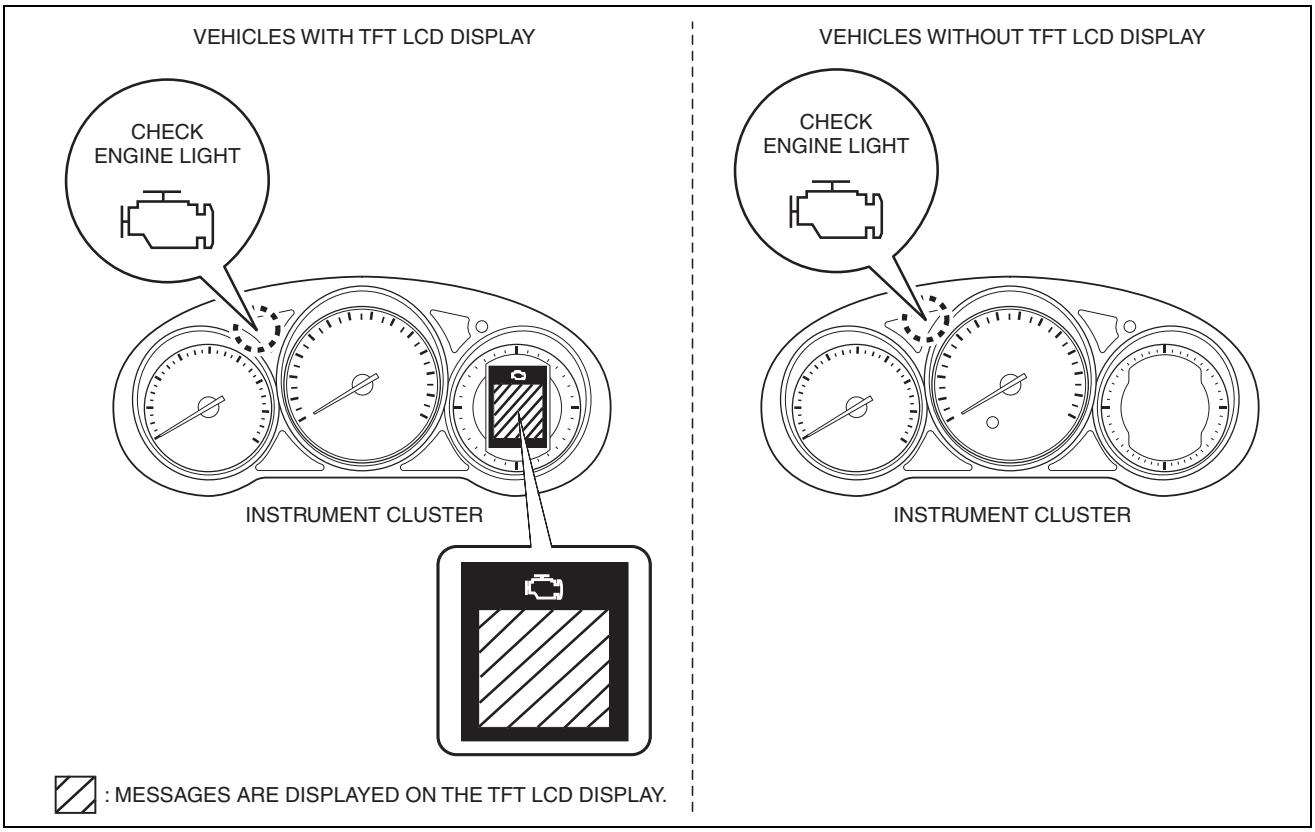
id0102h1549100

Purpose/Function

- If a malfunction occurs in the engine control system, the light illuminates to warn the driver of the malfunction.

Construction

- The check engine light is built into the instrument cluster.



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Operation

- The check engine light illuminates when a malfunction occurs in the engine control system, and it illuminates at the same time a DTC is recorded in the PCM.
- The illumination conditions for the check engine light are determined by the number of drive cycles set for each DTC. For details on the drive cycle, refer to “ON-BOARD DIAGNOSTIC SYSTEM TEST MODE”. (See 01-02-2 ON-BOARD DIAGNOSTIC SYSTEM TEST MODE [SKYACTIV-G 2.0].)
- For DTCs with one drive cycle, if a malfunction is detected in the first drive cycle, the check engine light illuminates.
- For DTCs with two drive cycles, if each malfunction is detected in the first and second drive cycles, the check engine light illuminates. However, if the same malfunction as the DTC stored in the PCM is detected, the check engine light illuminates in the first drive cycle even if the DTC is two drive cycles.
- If the PCM detects that the engine control system is continuously normal for three drive cycles, the illuminated check engine light turns off. However, the DTC is not cleared from the PCM at this time. If the PCM determines that the engine control system is continuously normal for **41** warm-up cycles*, the DTC is cleared.

* : A warm-up cycle is a drive cycle including the period until the engine is completely warmed up after a cold-engine starts. This cycle repeated **41 times** is a **41** warm-up cycle.

- The PCM sends a check engine light illumination request to the instrument cluster via CAN communication.

01-10A MECHANICAL [SKYACTIV-G 2.0]

MECHANICAL [SKYACTIV-G 2.0]

MECHANICAL [SKYACTIV-G 2.0]

id0110h2000100

Outline

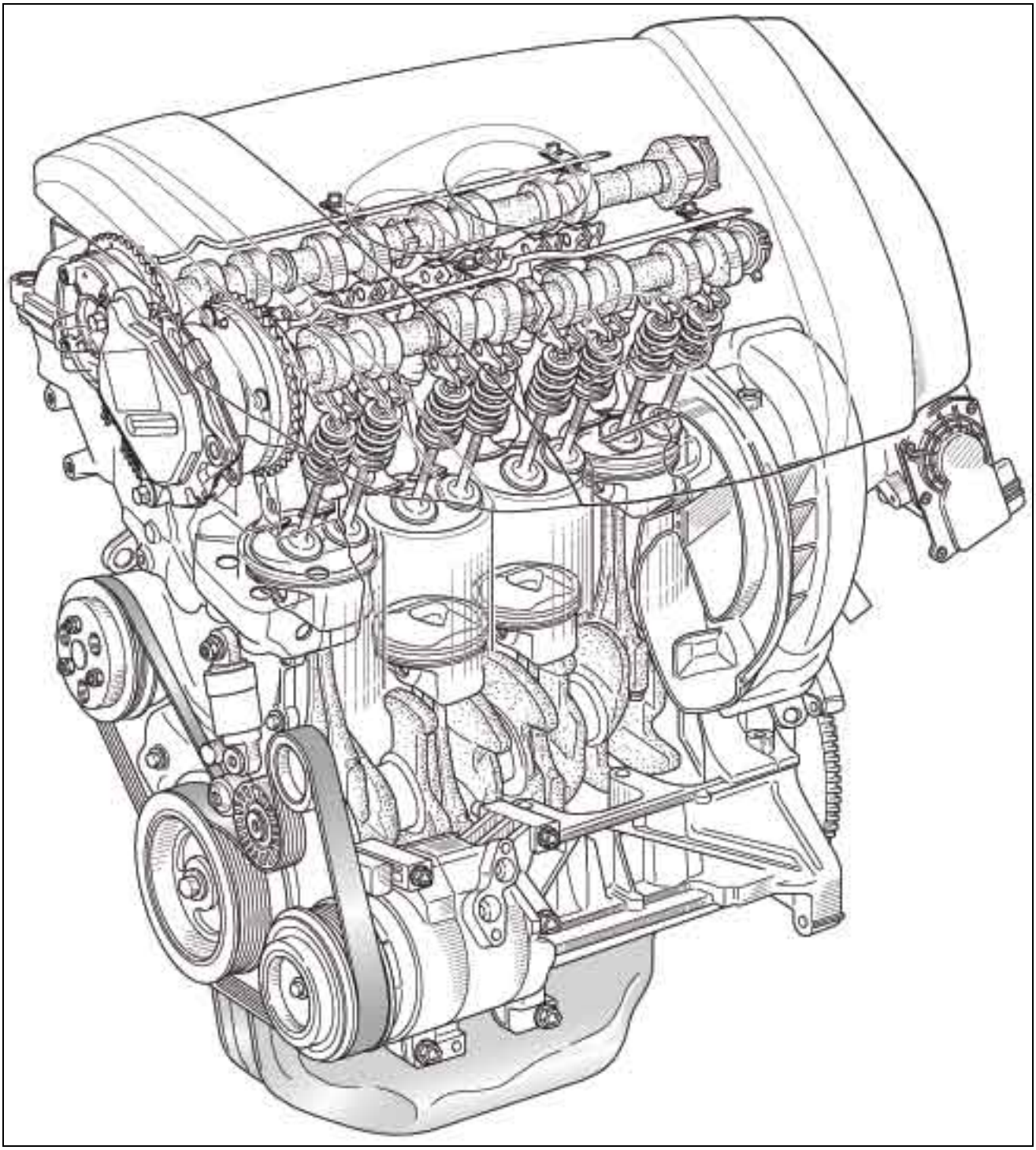
- The sliding resistance*1 has been reduced by:
  - the adoption of a rocker arm (built into needle roller bearing)
  - reducing load on the valve spring
  - narrowing down the crankshaft journal
  - optimizing the piston skirt shape

  - — adoption of a low-tension piston ring
  - — lowered tensioning of the drive belt
- A maintenance-free design for valve clearance has been achieved with the adoption of the HLA.
- With the adoption of a piston cavity, cooling loss has been reduced.
- The pumping loss*2 has been reduced with the adoption of the variable valve timing mechanism on both sides of the intake and exhaust.
- The timing chain behavior has been stabilized and sliding resistance has been reduced by optimizing the shape and rigidity of the timing chain-related parts.

*1 : Resistance (friction force) which occurs when two object slide against each other. The larger the sliding resistance, the greater the energy loss.
*2 : Energy loss which occurs from each type of resistance corresponding to intake and exhaust is called pumping loss.

MECHANICAL [SKYACTIV-G 2.0]

Structural View



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Structure

- Consists of the following parts:

Cylinder head cover	(See 01-10A-4 CYLINDER HEAD COVER [SKYACTIV-G 2.0].)
Cylinder head	(See 01-10A-5 CYLINDER HEAD [SKYACTIV-G 2.0].)
Cylinder head gasket	(See 01-10A-7 CYLINDER HEAD GASKET [SKYACTIV-G 2.0].)
Cylinder block	(See 01-10A-7 CYLINDER BLOCK [SKYACTIV-G 2.0].)
Crankshaft	(See 01-10A-8 CRANKSHAFT, MAIN BEARING [SKYACTIV-G 2.0].)
Piston	(See 01-10A-10 PISTON, PISTON RING, PISTON PIN [SKYACTIV-G 2.0].)
Connecting rod	(See 01-10A-11 CONNECTING ROD, CONNECTING ROD BEARING [SKYACTIV-G 2.0].)

MECHANICAL [SKYACTIV-G 2.0]

Engine front cover	(See 01-10A-12 ENGINE FRONT COVER [SKYACTIV-G 2.0].)
Crankshaft pulley	(See 01-10A-14 CRANKSHAFT PULLEY [SKYACTIV-G 2.0].)
Drive belt	(See 01-10A-15 DRIVE BELT [SKYACTIV-G 2.0].)
Valve	(See 01-10A-18 VALVE, VALVE SPRING, VALVE SEAL, VALVE GUIDE [SKYACTIV-G 2.0].)
HLA	(See 01-10A-22 HYDRAULIC LASH ADJUSTER, ROCKER ARM [SKYACTIV-G 2.0].)
Camshaft	(See 01-10A-19 CAMSHAFT [SKYACTIV-G 2.0].)
Timing chain	(See 01-10A-21 TIMING CHAIN, CHAIN TENSIONER [SKYACTIV-G 2.0].)
OCV	(See 01-10A-28 OIL CONTROL VALVE (OCV) [SKYACTIV-G 2.0].)
Hydraulic variable valve timing actuator	(See 01-10A-29 HYDRAULIC VARIABLE VALVE TIMING ACTUATOR [SKYACTIV-G 2.0].)
Electric variable valve timing actuator	(See 01-10A-30 ELECTRIC VARIABLE VALVE TIMING ACTUATOR [SKYACTIV-G 2.0].)
Electric variable valve timing relay	(See 01-10A-32 ELECTRIC VARIABLE VALVE TIMING RELAY [SKYACTIV-G 2.0].)
Engine mount	(See 01-10A-26 ENGINE MOUNT [SKYACTIV-G 2.0].)

MILLER CYCLE ENGINE [SKYACTIV-G 2.0]

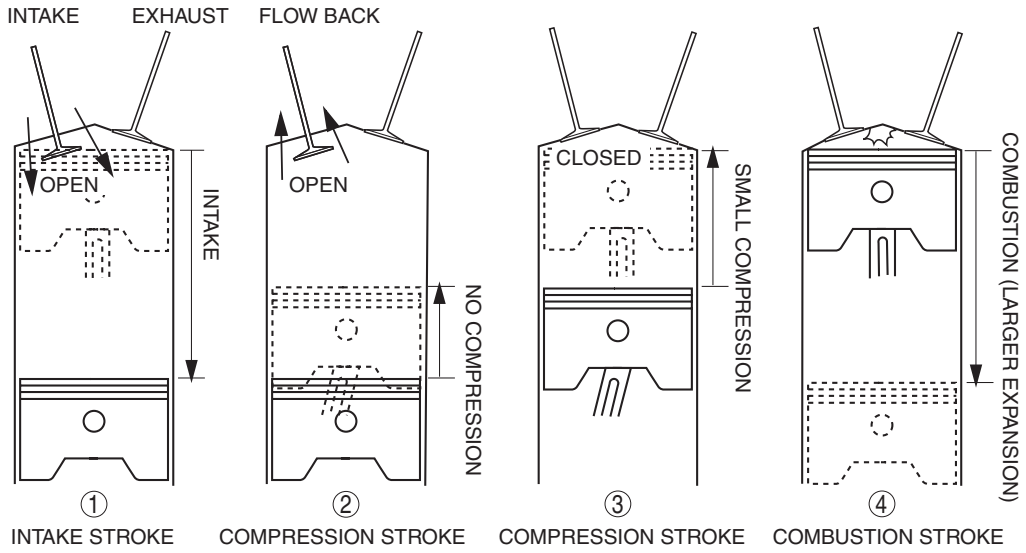
id0110h2001900

Outline

- The Miller cycle engine is a high-efficiency engine which achieves high fuel economy performance by obtaining a high-expansion ratio.
- The Miller cycle engine achieves a high-expansion ratio without increasing its effective compression ratio by retarding the intake air valve close timing.

Operation

1. Intake air is introduced into the cylinder.
2. The intake valve is kept open after the intake stroke is finished to force the air in the cylinder to flow back to the intake pipe.
3. The compression stroke starts from the position in which the intake valve is closed (small compression).
4. The air-fuel mixture is combusted and the piston is pushed down to BDC (large expansion).



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CYLINDER HEAD COVER [SKYACTIV-G 2.0]

id0110h2105000

Purpose, Function

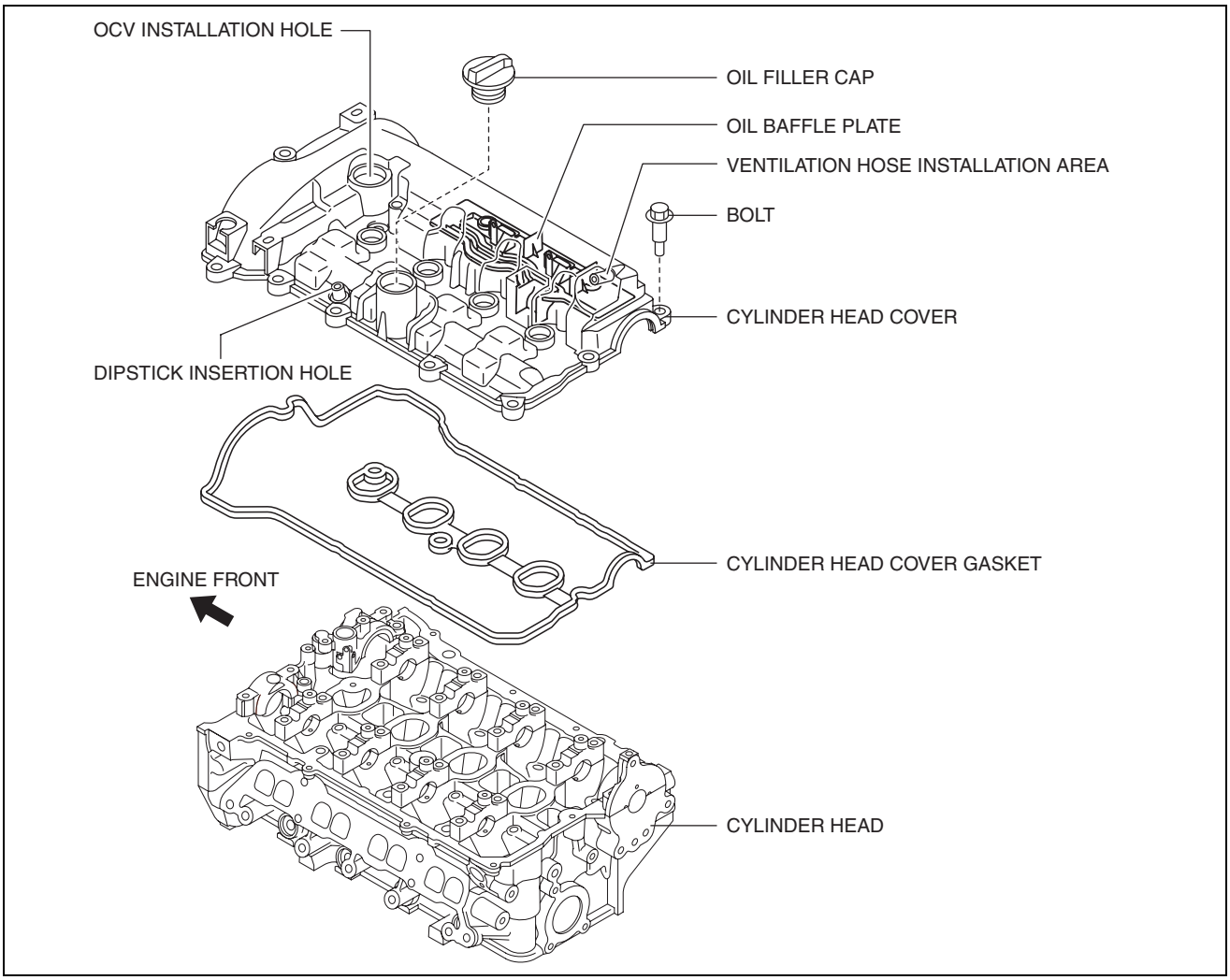
- The cylinder head cover prevents foreign material penetration and engine oil spatter.
- The oil baffle plate reduces engine oil consumption by separating the engine oil from the blow-by gas.

Construction

- The lightweight cylinder head cover is made of hard plastic with excellent noise absorption.

MECHANICAL [SKYACTIV-G 2.0]

- The cylinder head cover has the following parts:



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CYLINDER HEAD [SKYACTIV-G 2.0]

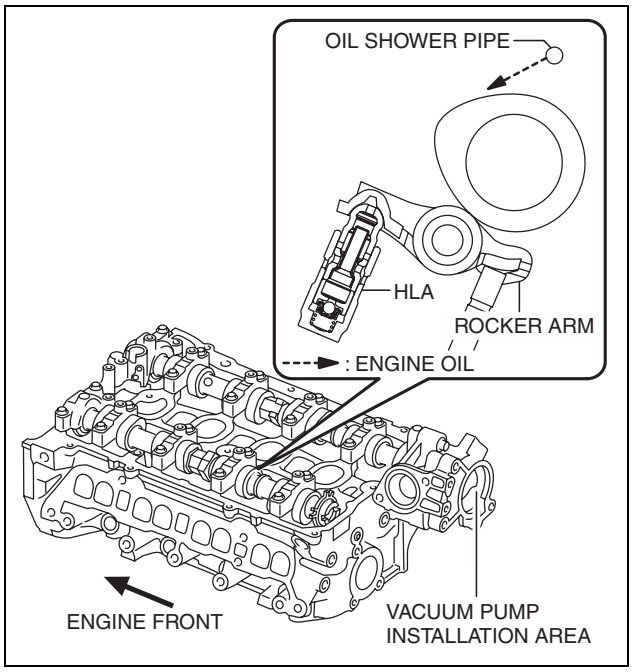
id0110h2000400

Outline

- With the adoption of the rocker arm (built into needle roller bearing), the sliding resistance has been reduced.
- With the adoption of the HLA, the valve clearance is maintained at 0 mm at all the times.
- The contact point of the rocker arm and cam is lubricated by the engine oil injected from the oil shower pipe.

MECHANICAL [SKYACTIV-G 2.0]

- Because the SKYACTIV-G 2.0 is implemented on the Miller cycle, the intake manifold vacuum is insufficient during the intake valve opening timing. To improve this, the intake manifold vacuum insufficiency is supplemented with the adoption of the vacuum pump. (See 01-13A-9 VACUUM PUMP [SKYACTIV-G 2.0].)



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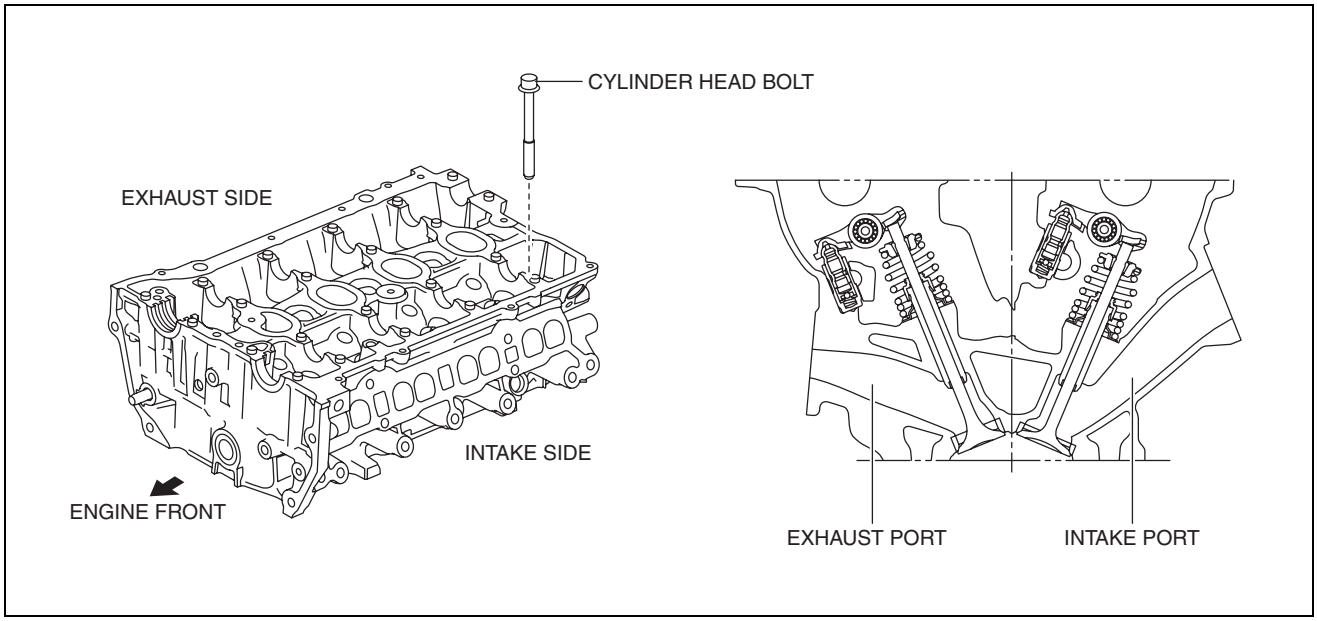
Purpose, Function
- The cylinder head forms the combustion chamber and intake and exhaust ports.

Construction
- The lightweight cylinder head is made of aluminum alloy with excellent thermal conductivity.
- Designing a compact pentroof combustion chamber and positioning the spark plugs on the top of the combustion chamber has improved the combustion efficiency.
- There are two intake valves and two exhaust valves per cylinder for a total of four valves and the intake/exhaust type has been changed to a cross-flow type, improving intake and exhaust efficiency.
- High pressurization is achieved by optimizing the intake port shape, improving the tumble ratio, increasing the combustion speed, and suppressing knocking.
- With the adoption of plastic region tightening* for the cylinder head bolts, axial force has been stabilized.



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* : Plastic region tightening is a method of controlling the tightening using the rotation angle of a bolt. By tightening to the region (plastic tightening region) in which bolt deformation does not become irreversible, variation in axial force is suppressed.

MECHANICAL [SKYACTIV-G 2.0]

CYLINDER HEAD GASKET [SKYACTIV-G 2.0]

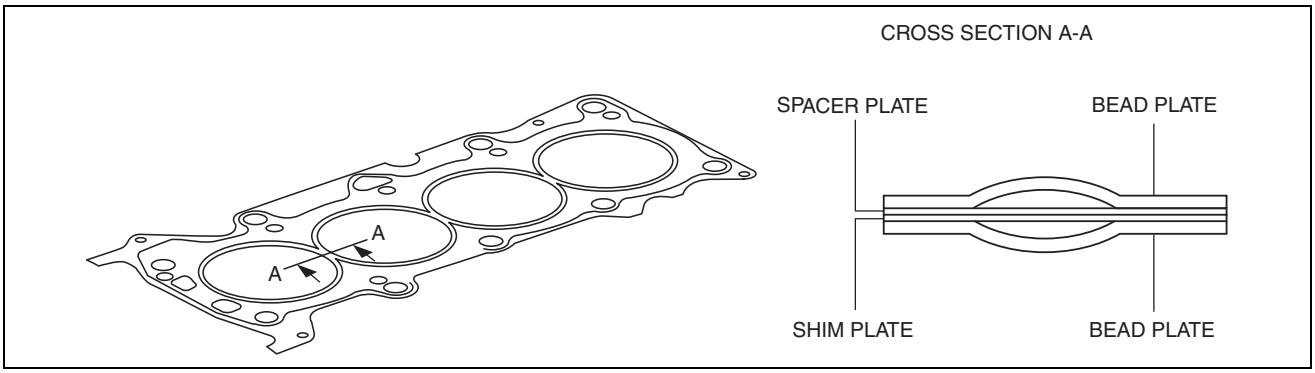
id0110h2000300

Purpose, Function

- The cylinder head gasket is installed between the cylinder head and cylinder block to prevent leakage of air-fuel mixture, combustion gas, engine oil, and engine coolant.

Construction

- A four-layer type metal gasket has been adopted for the cylinder head gasket.



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CYLINDER BLOCK [SKYACTIV-G 2.0]

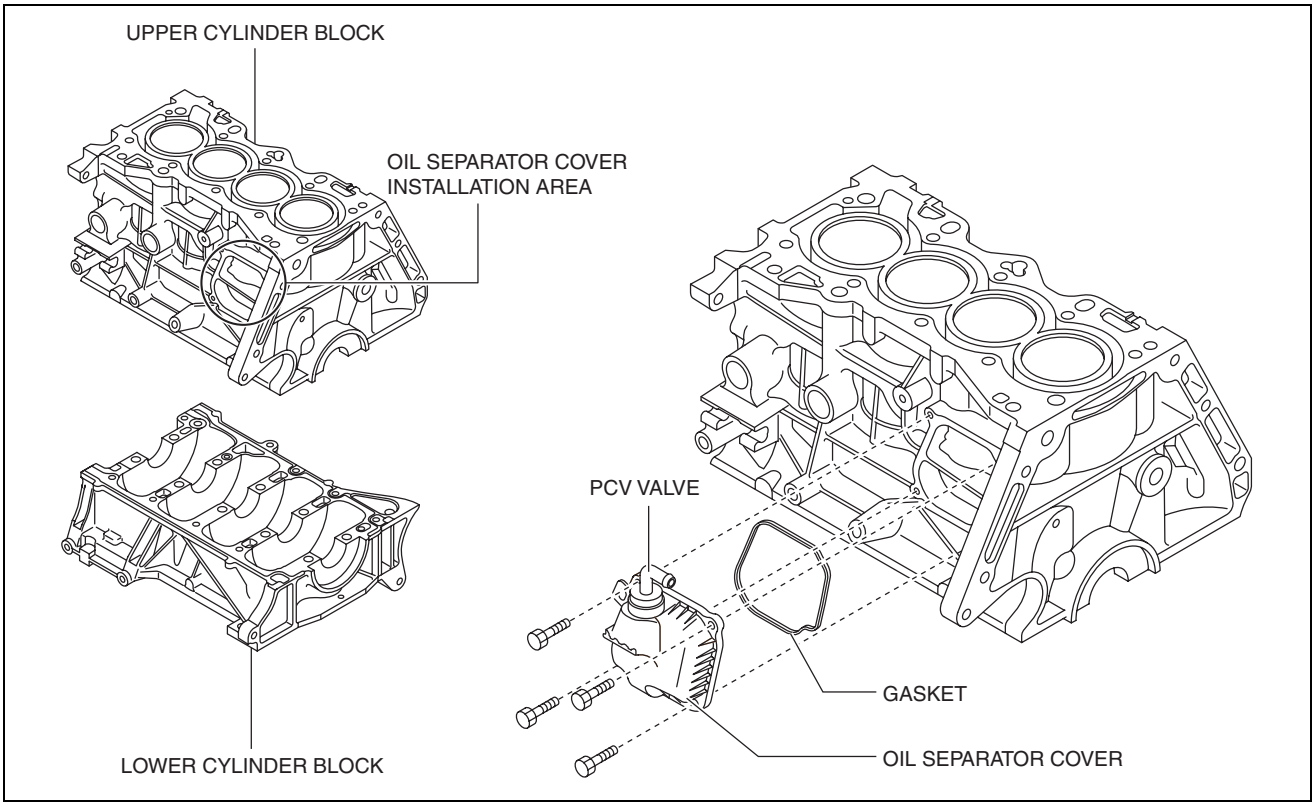
id0110h2000500

Purpose, Function

- The cylinder block forms the cylinder and crankcase.

Construction

- The cylinder block consists of the upper cylinder block and lower cylinder block.
- The cylinder block is an open deck type with excellent cooling performance.
- The lightweight cylinder block is made of aluminum alloy with excellent heat dispersion.
- With the adoption of the lower cylinder block, the coupling rigidity of the transaxle and support rigidity of the crankshaft have been improved reducing engine vibration.
- The oil separator function is set to the upper cylinder block, enhancing ventilation of the blow-by gas.



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MECHANICAL [SKYACTIV-G 2.0]

CRANKSHAFT, MAIN BEARING [SKYACTIV-G 2.0]

id0110h2000600

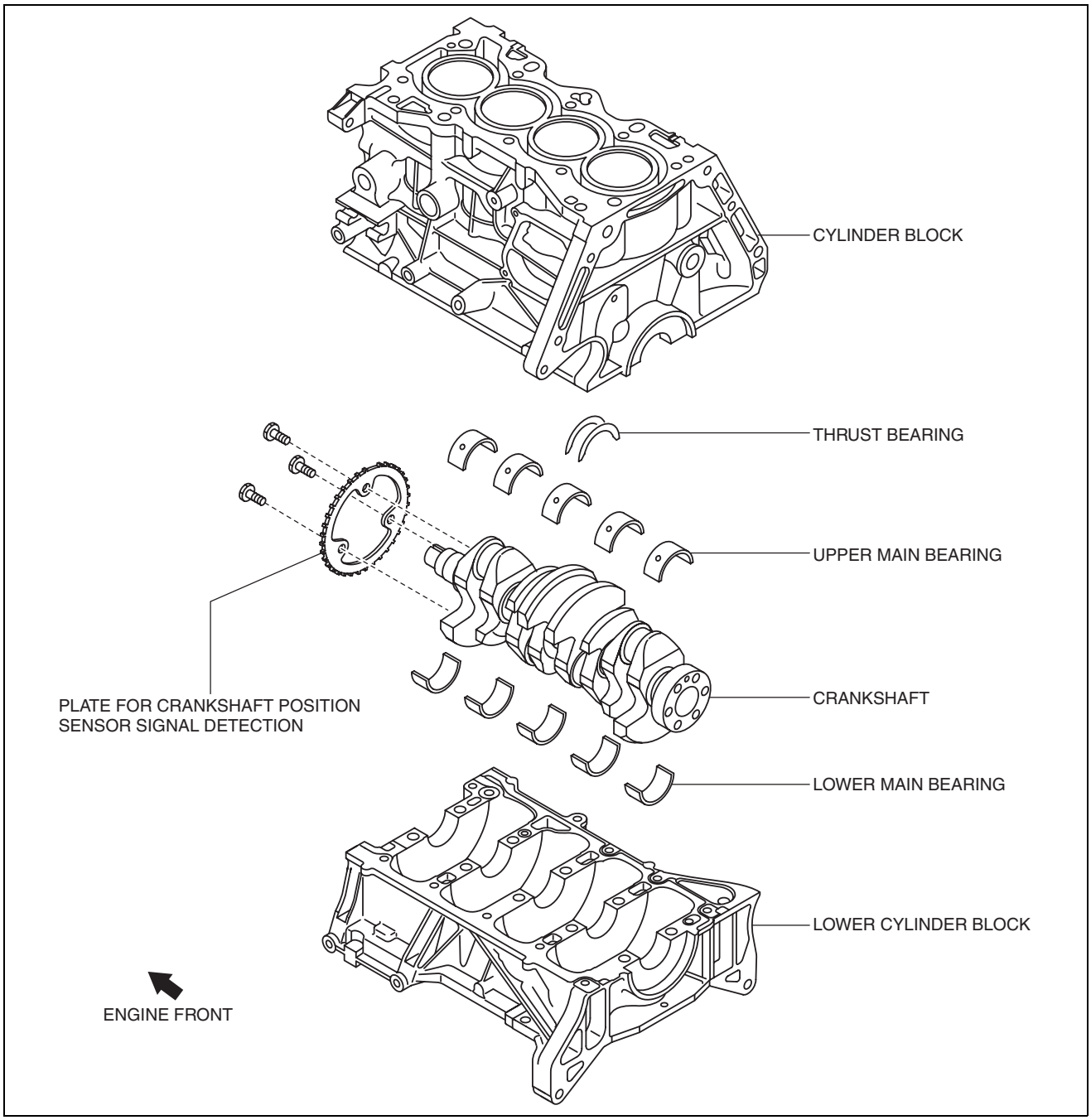
Purpose, Function

- The crankshaft converts the reciprocating movement of the piston to a rotational movement via the connecting rod.
- The main bearing forms an oil film on the outer surface of the crankshaft journal to prevent wear due to sliding.

Construction

Crankshaft

- The crankshaft is installed to the inside (crankcase) of the cylinder block.



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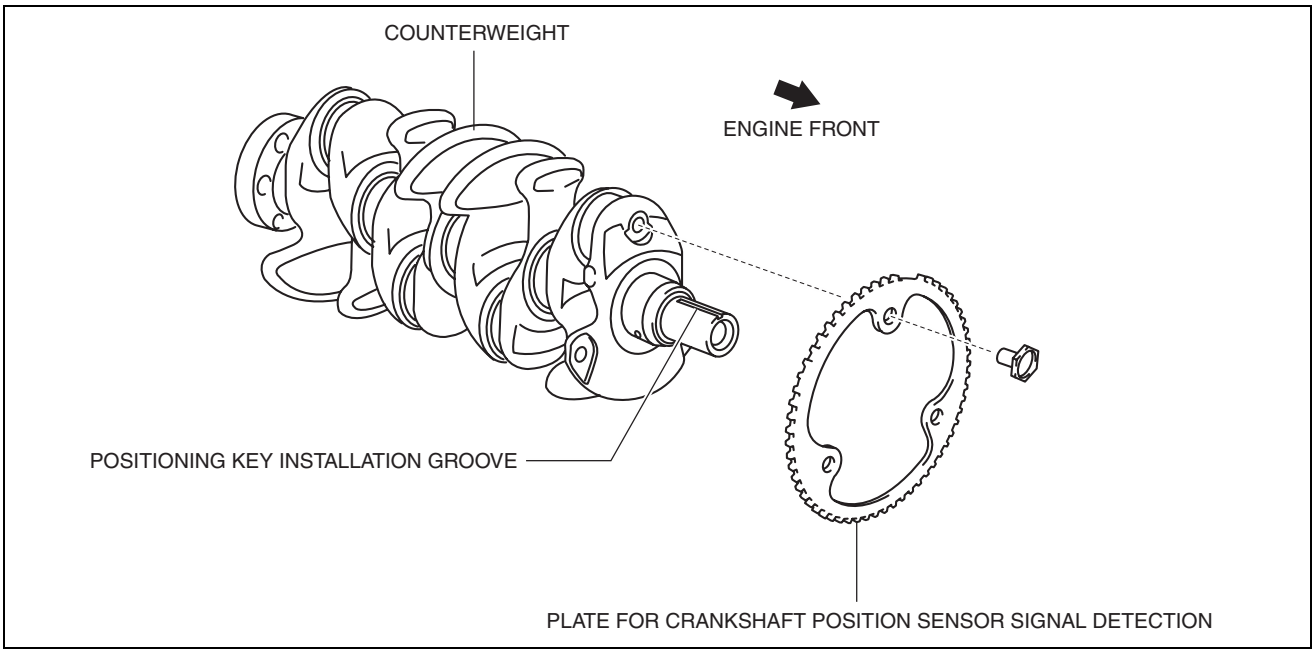
- The crankshaft has a key groove to match timing to the crankshaft pulley.

MECHANICAL [SKYACTIV-G 2.0]

- The crankshaft has the following parts shown in the figure.



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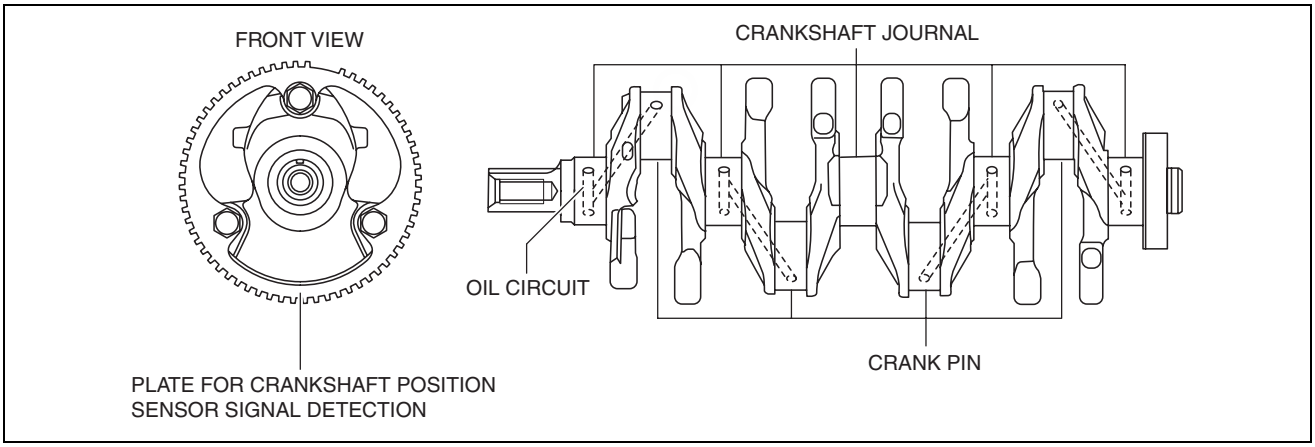
- The optimized shaft diameter ratio of the crankshaft journal and crank pin has reduced sliding resistance while maintaining rigidity.
- The steel crankshaft has five bearings and eight counterweights for improved accuracy in the rotational balance.
- The crankshaft journal and crank pin have been induction hardened* to bear high loads.
- The crankshaft has an oil passage for supplying engine oil to the crankshaft journal and crank pin.



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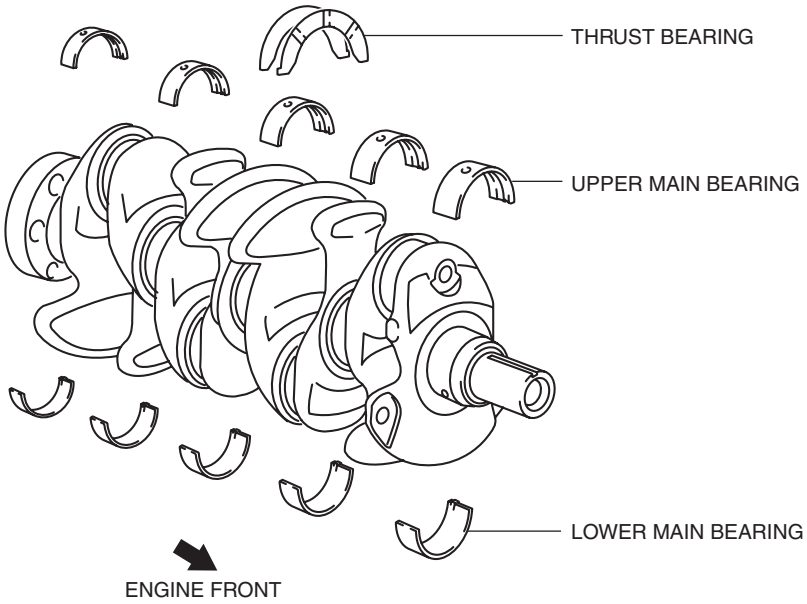
* : A type of heat processing method which improves hardness and strength only at the surface of the metal.

Main bearing

- The main bearing is installed to the outer surface of the crankshaft journal.
- The upper main bearing and lower main bearing are made of aluminum alloy.
- The upper main bearing has an oil groove and oil hole.

- Thrust force is suppressed by the thrust bearings on both sides of the No.3 journal.



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PISTON, PISTON RING, PISTON PIN [SKYACTIV-G 2.0]

id0110h2000700

Purpose, Function

Piston

- The piston in the cylinder of the cylinder block moves reciprocally by the pressure received when the air-fuel mixture combusts.

Piston ring

- The compression ring prevents leakage of pressure in the cylinder from the piston circumference.
- The oil ring clears off extra engine oil adhered to the cylinder wall.
- The piston ring transmits piston heat to the cylinder wall to cool the piston.

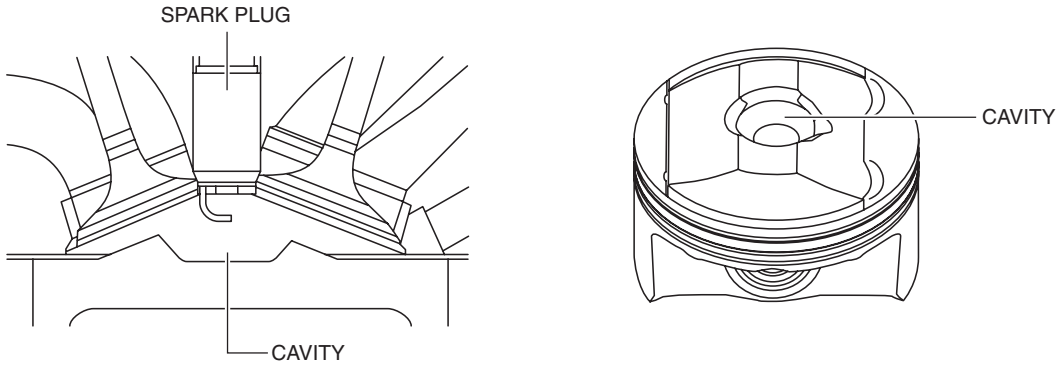
Piston pin

- The reciprocating movement of the piston is transmitted to the connecting rod by the connection of the piston pin to connecting rod.

Construction

Piston

- The high-temperature strength piston is made of aluminum alloy with excellent thermal conductivity.
- The piston has a cavity on the top surface. As a result, the initial combustion flame is prevented from hitting the top surface of the piston to reduce cooling loss.



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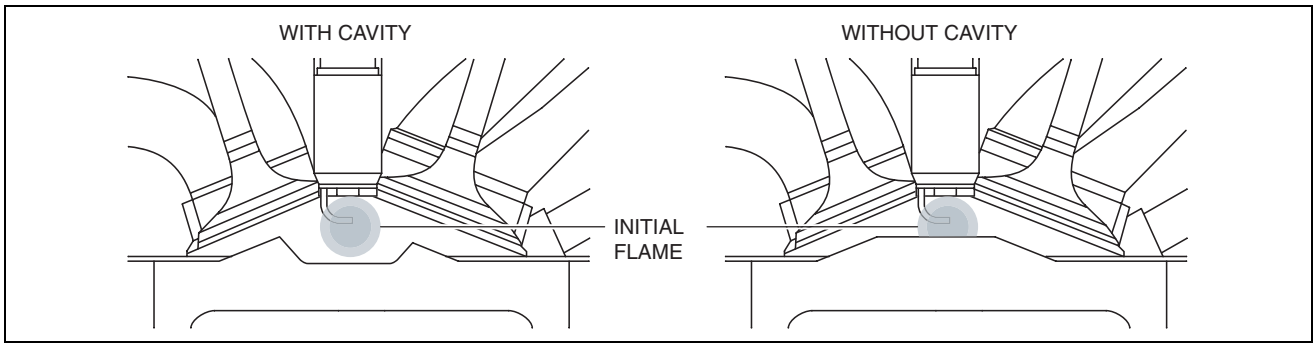
MECHANICAL [SKYACTIV-G 2.0]



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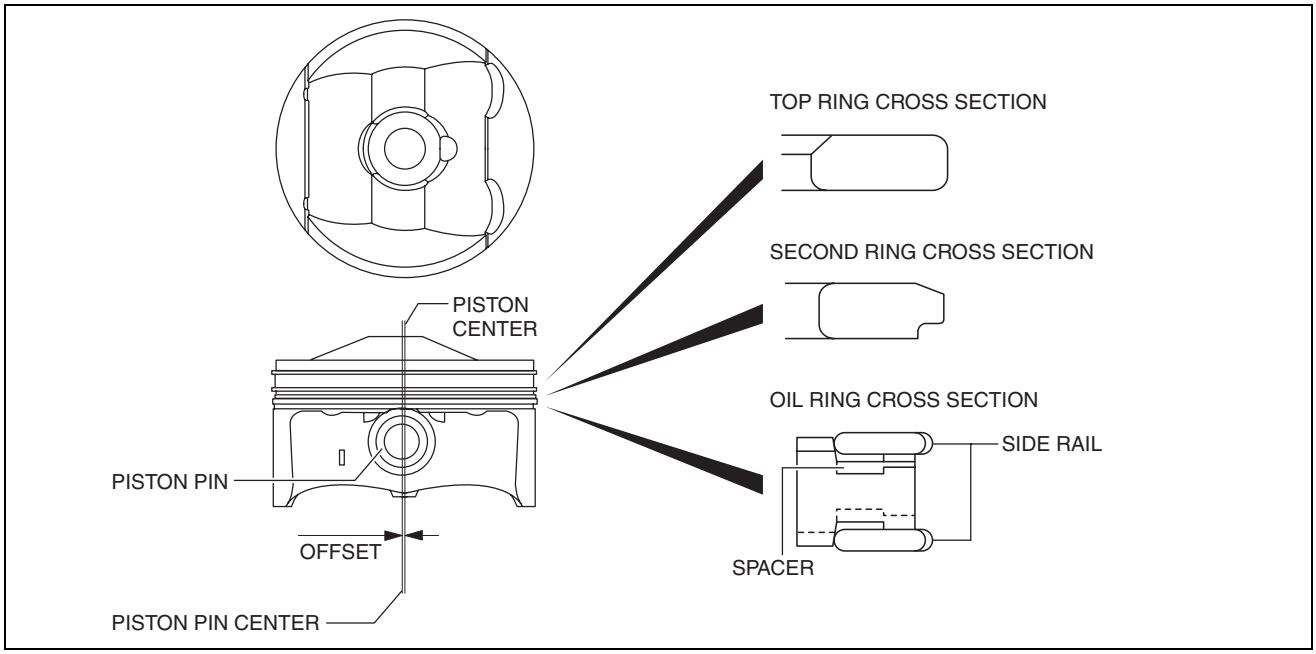
- The sliding resistance has been reduced by optimizing the piston skirt shape.
- A weight reduction is realized by optimizing the piston shape.
- With the adoption of the offset piston, piston slap is suppressed.



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Piston ring

- A barrel-face ring for the top ring and a taper under cut ring for the second ring have been adopted.
- A three-piece oil ring consisting of a side rail and spacer have been adopted for the oil ring.
- Tracking capability to the cylinder wall has been improved by thinning down the piston ring. As a result, a low-tension piston ring has been implemented without increasing the engine oil consumption, and the sliding resistance has been reduced during reciprocating movement.

Piston pin

- The piston is a full-floating type.

CONNECTING ROD, CONNECTING ROD BEARING [SKYACTIV-G 2.0]

id0110h2000800

Purpose, Function

Connecting rod

- The connecting rod transmits the reciprocating movement of the piston to the crankshaft by engaging the piston pin and crank pin.

Connecting rod bearing

- The connecting rod bearing forms an oil film on the outer surface of the crank pin to prevent wear due to sliding.

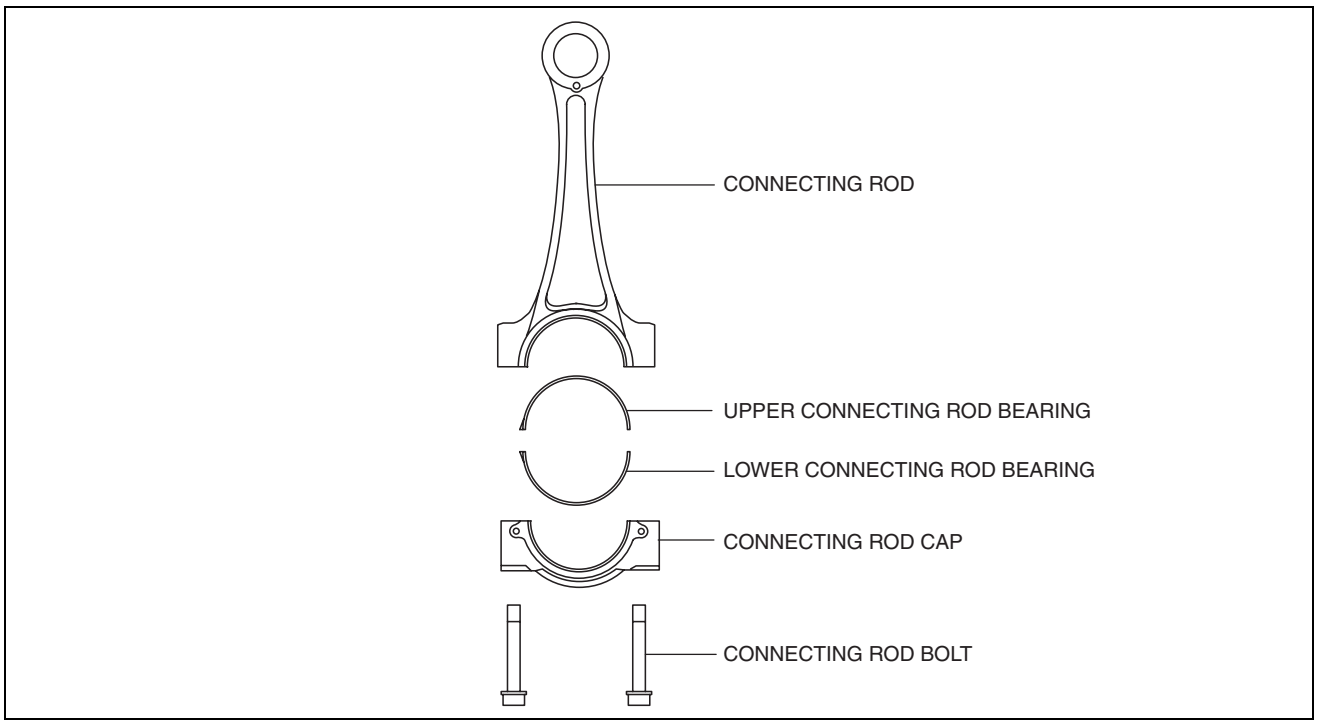
Construction

Connecting rod

- The connecting rod is installed between the piston pin and crank pin.
- High-strength, forged carbon steel has been adopted for weight reduction.

MECHANICAL [SKYACTIV-G 2.0]

- A cracking method*1 for breaking off and separating the connecting rod from the connecting rod cap has been adopted for improved accuracy.
- Weight has been reduced by optimizing the shape from the I shaft to the large end.
- Reciprocating inertial weight, including the piston, has been reduced with the use of a full-float type for the connection with the piston and further tapering of the small end shape.
- With the adoption of the plastic region tightening method*2 for the connecting rod bolt, the stability of the axial force has been improved.



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*1 : Method of breaking off the large end proportion of the connecting rod after it has been integrally molded to separate the connecting rod from the connecting rod cap. When assembling the connecting rod and connecting rod cap, dowel pins are required to use the mating surface shape which was created during breaking process.

*2 : Plastic region tightening is a method of controlling the tightening using the rotation angle of a bolt. By tightening to the region (plastic tightening region) in which bolt deformation does not become irreversible, variation in axial force is suppressed.

Connecting rod bearing
- The connecting rod bearing is installed on the outer surface of the crank pin.
- The upper and lower connecting rod bearings are made of aluminum alloy.

ENGINE FRONT COVER [SKYACTIV-G 2.0]

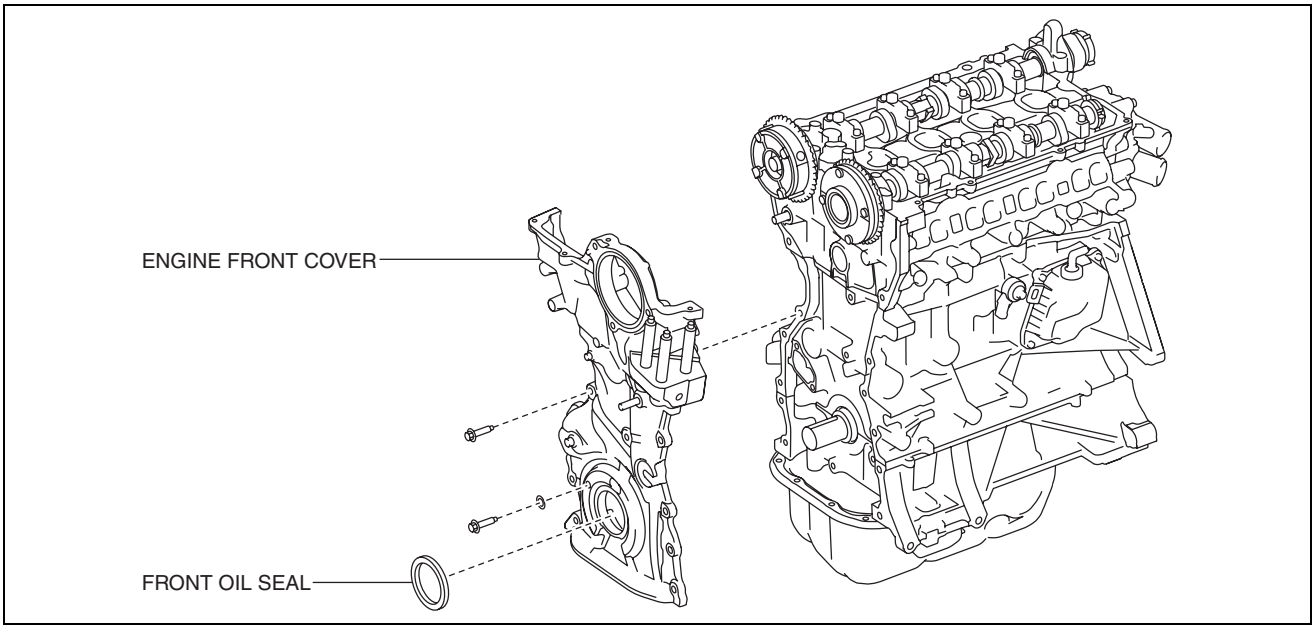
id0110h2000900

Purpose, Function
- The engine front cover covers the front of the engine to prevent engine oil spillage, noise leakage, and foreign material penetration.

MECHANICAL [SKYACTIV-G 2.0]

Construction

- The engine front cover is installed to the front of the engine.



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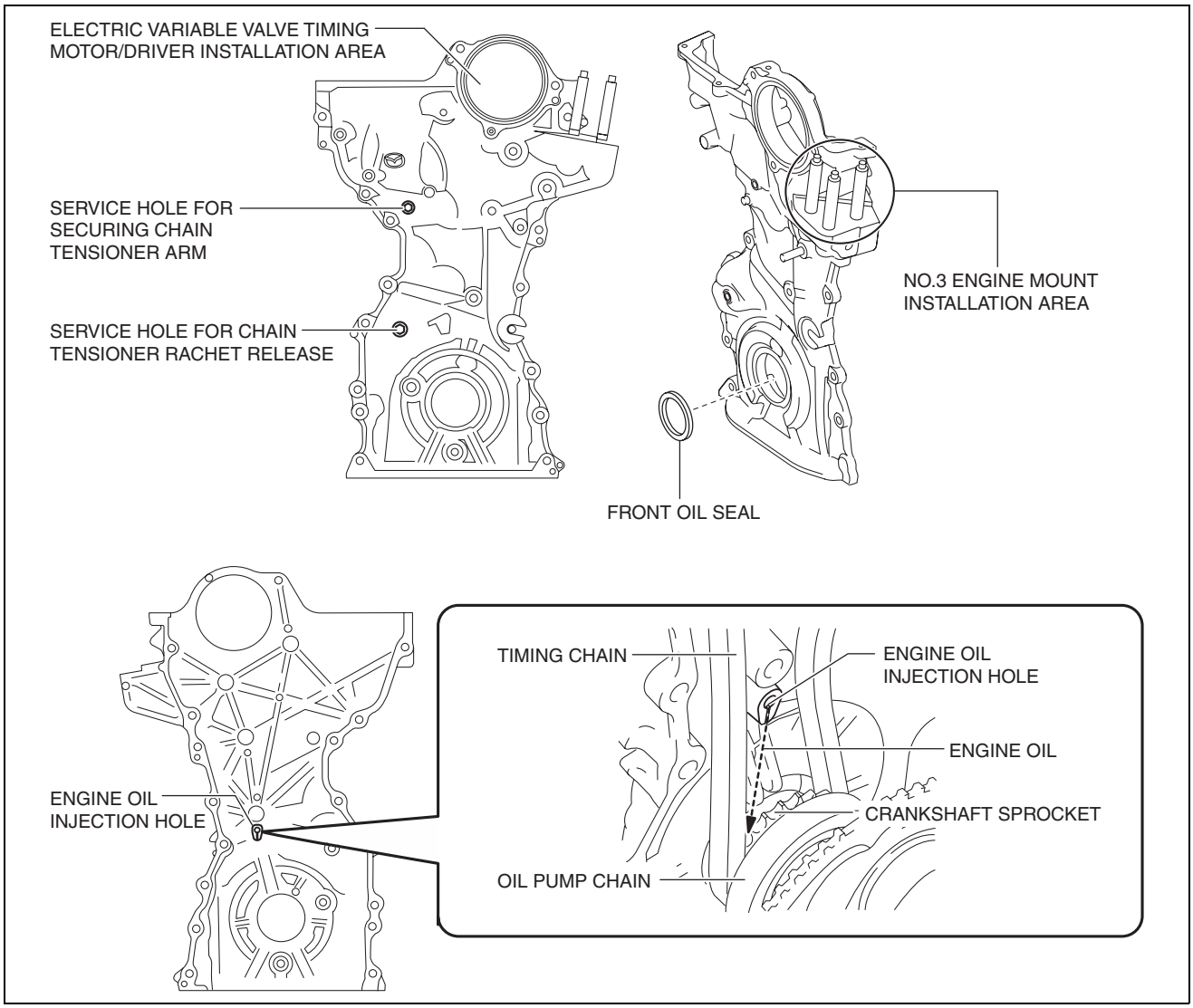
- The lightweight engine front cover is made of aluminum alloy with excellent noise absorption.

MECHANICAL [SKYACTIV-G 2.0]

- The engine front cover has the following parts shown in the figure.



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CRANKSHAFT PULLEY [SKYACTIV-G 2.0]

id0110h2001000

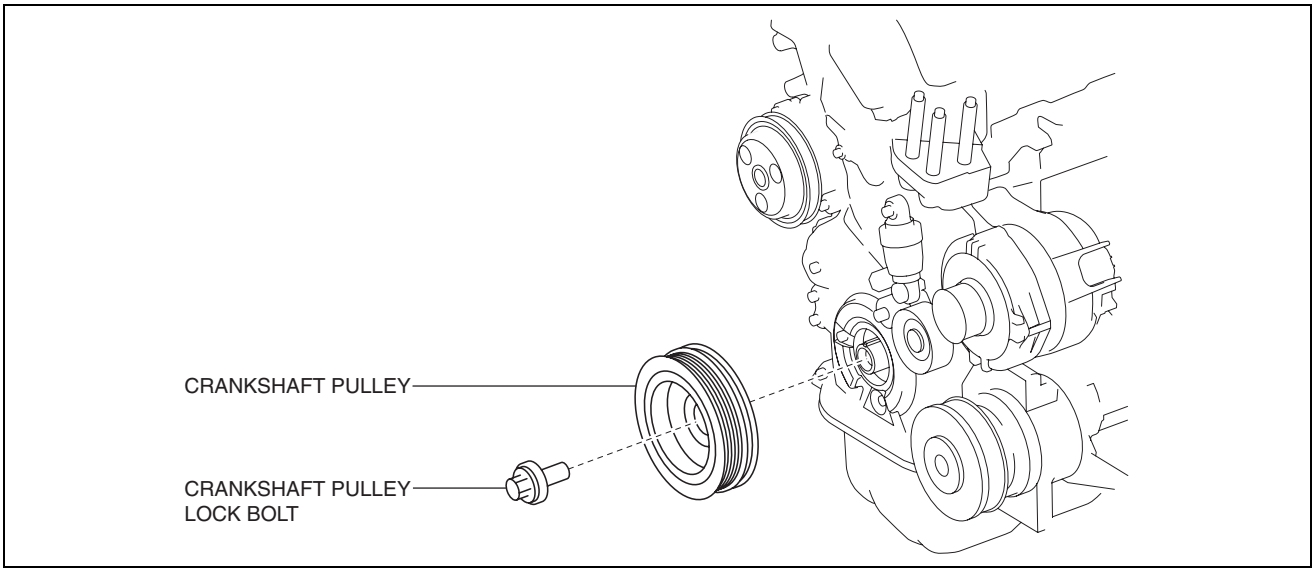
Purpose, Function

- The crankshaft pulley transmits the drive force to the auxiliary parts via the drive belt.
- The crankshaft pulley suppresses torsional vibration of the crankshaft.

MECHANICAL [SKYACTIV-G 2.0]

Construction

- The crankshaft pulley is installed to the front of the crankshaft.



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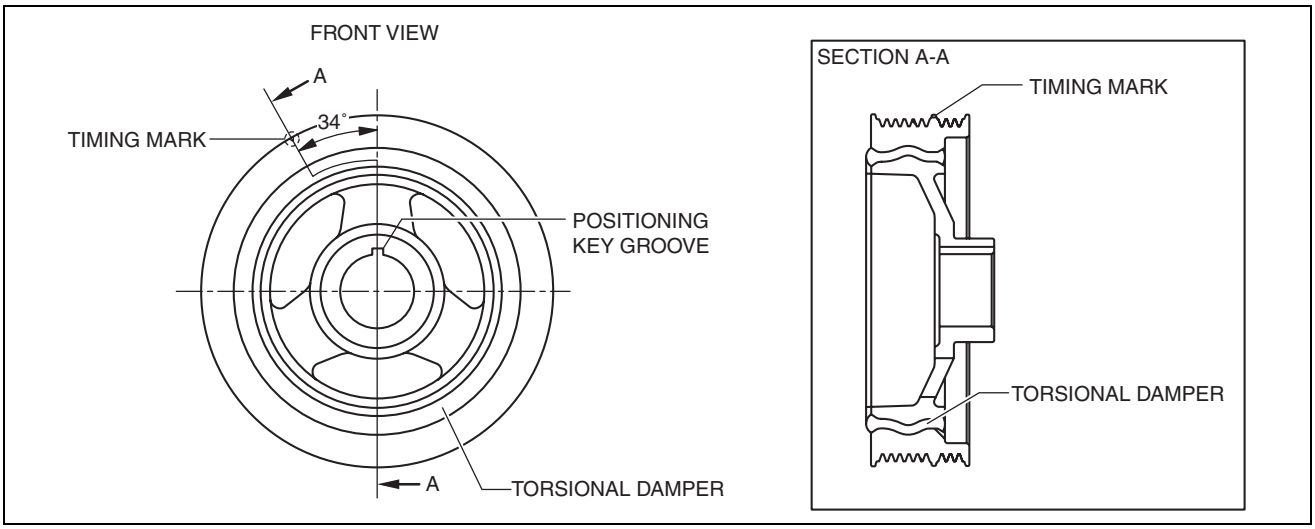
- The crankshaft pulley has a torsional damper for suppressing torsional vibration of the crankshaft.
- The crankshaft pulley has key groove to match the timing to the crankshaft.
- The crankshaft pulley has a timing mark indicating the piston position.



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DRIVE BELT [SKYACTIV-G 2.0]

id0110h2001100

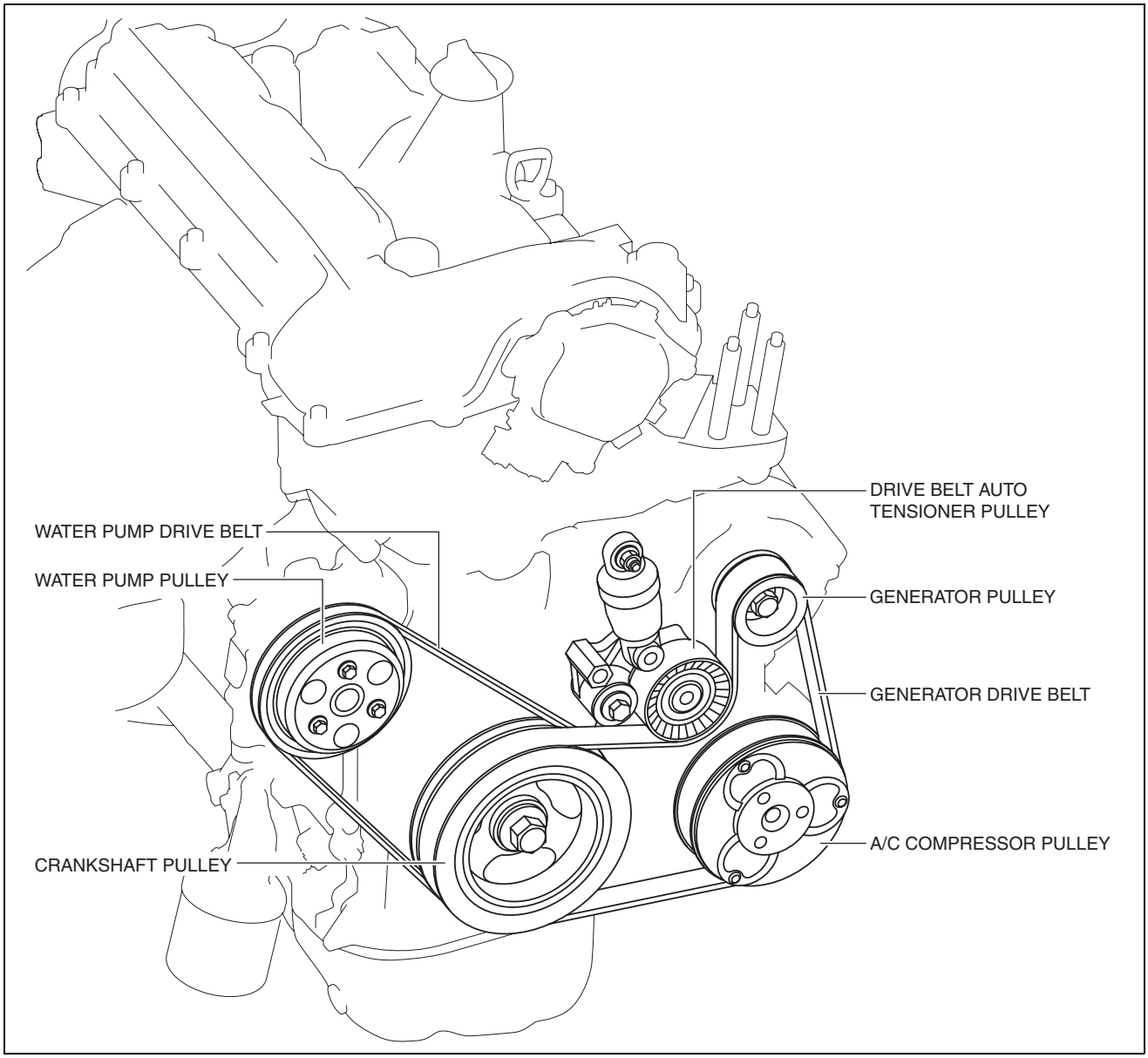
Purpose, Function

- The drive belt transmits rotation force of the crankshaft pulley to the pulley for the auxiliary parts.

MECHANICAL [SKYACTIV-G 2.0]

Construction

- The drive belt is installed to the front of the engine.



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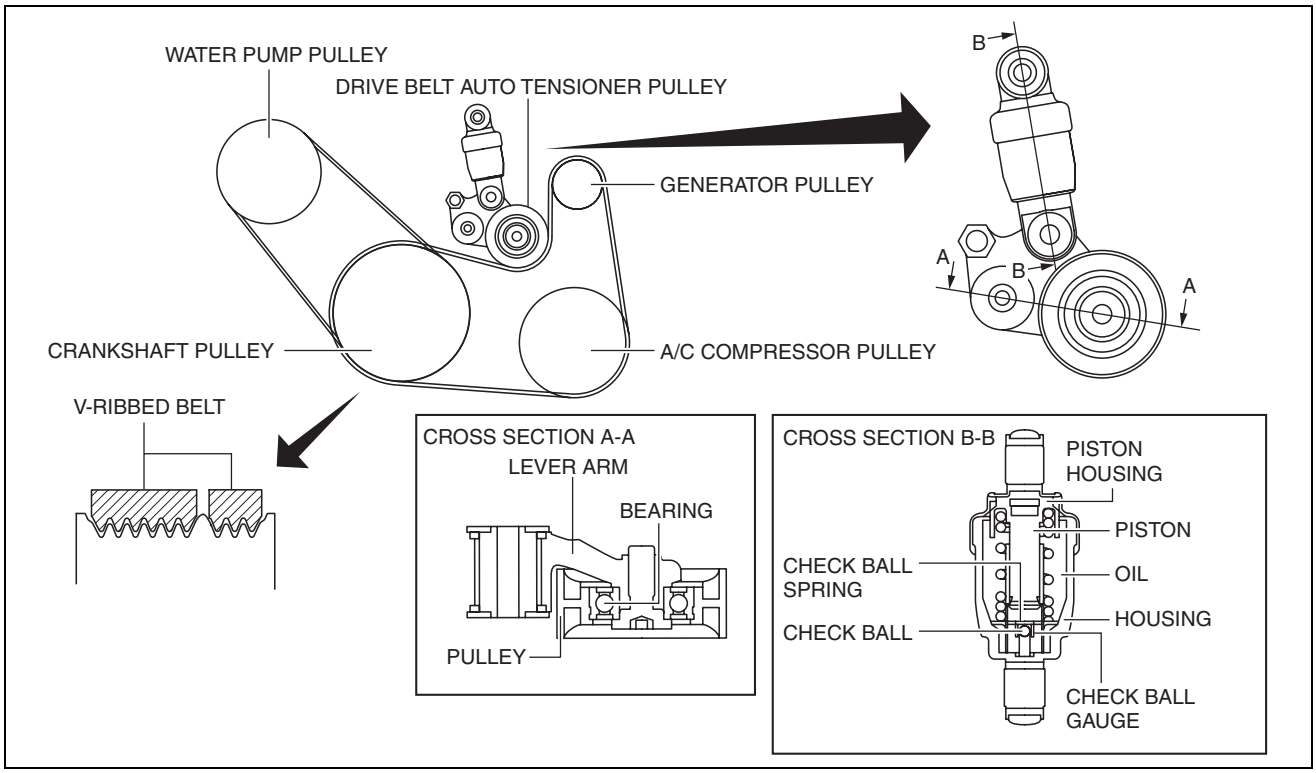
- A V-ribbed belt has been adopted for the drive belt.
- The water pump drive belt is a stretch type.
- Drive belt vibration is suppressed by shortening the distance between each pulley.
- With the adoption of the oil pressure type drive belt auto tensioner, the change in tension by the oil pressure damper operation is absorbed. As a result, the sliding resistance has been reduced by lowering the drive belt tension setting.

MECHANICAL [SKYACTIV-G 2.0]



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VALVE MECHANISM [SKYACTIV-G 2.0]

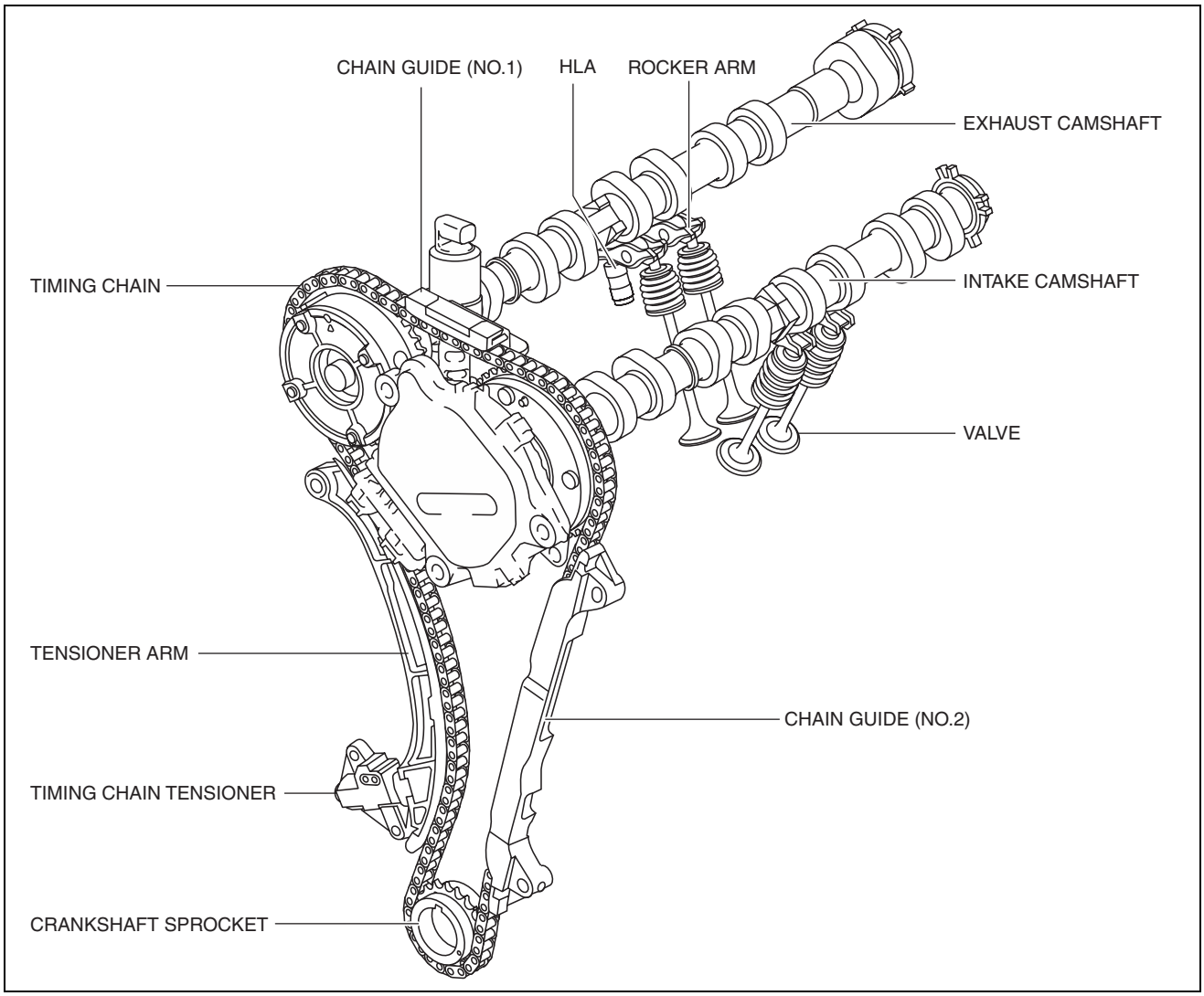
id0110h2001200

Outline

- A DOHC type valve system has been adopted and consists of four valves (two intake valves and two exhaust valves) per cylinder for a total of 16 valves operated by two camshafts.

MECHANICAL [SKYACTIV-G 2.0]

Structural View



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VALVE, VALVE SPRING, VALVE SEAL, VALVE GUIDE [SKYACTIV-G 2.0]

id0110h2001300

Purpose, Function

Valve

- The intake valve is pressed down by the cam, the intake air passage is opened, and air is introduced into the cylinder.
- The exhaust valve is pressed down by the cam, the exhaust air passage is opened, and combustion gas is exhausted from the cylinder.

Valve spring

- The valve spring adheres to the valve seat by pulling up the valve by spring force, and air tightness in the combustion chamber is maintained.

Valve seal

- The valve seal prevents engine oil from entering combustion chamber through the valve guide, and engine oil consumption is suppressed.

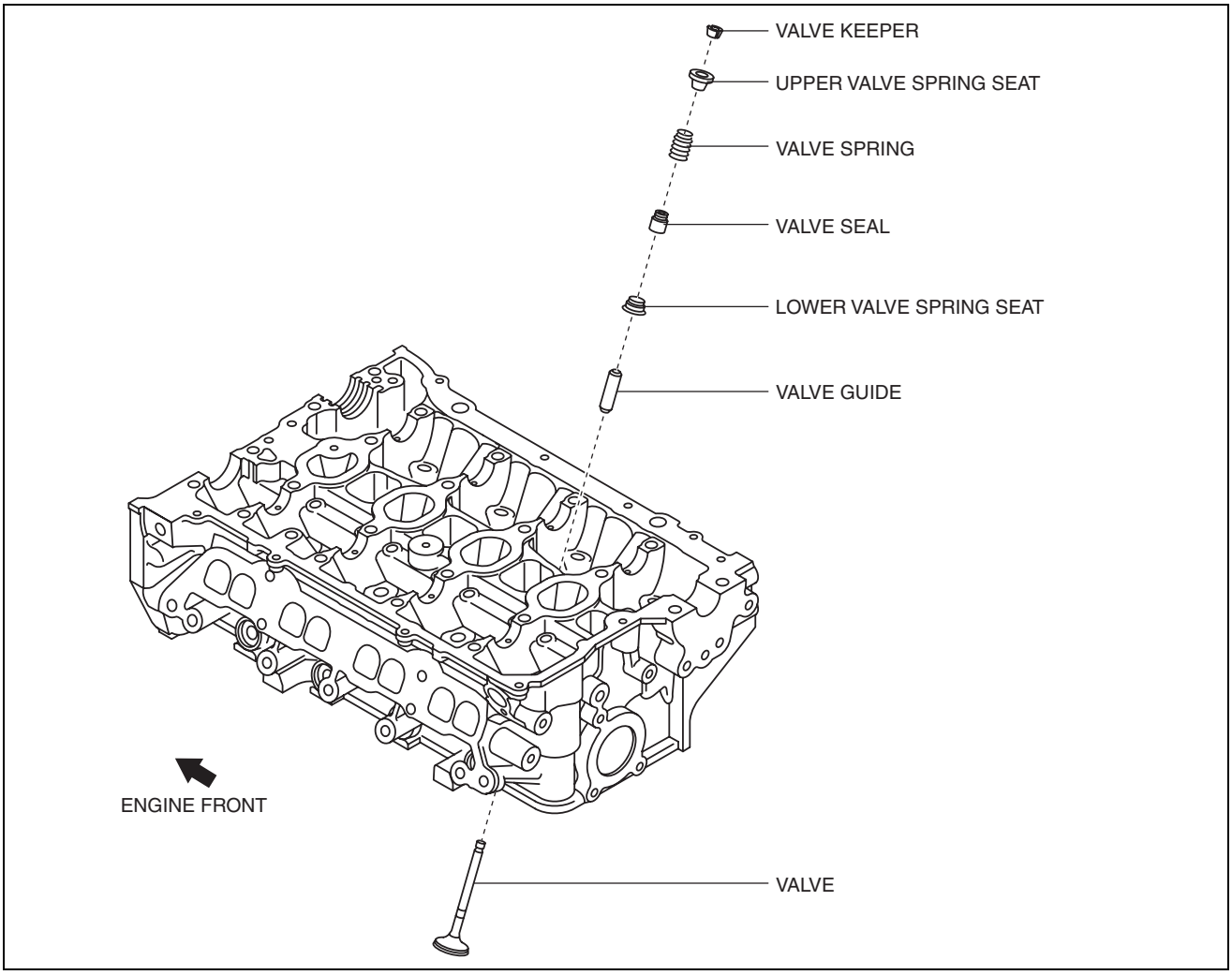
Valve guide

- The valve guide maintains the valve stem to open and close the valve smoothly.
- The valve guide cools the valve by transmitting valve heat to the cylinder head.

MECHANICAL [SKYACTIV-G 2.0]

Construction

- The valve, valve spring, valve seal, and valve guide are assembled to the cylinder head as a single unit.



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- The sliding resistance has been reduced by setting the valve spring load to the required minimum.
- The intake valve and exhaust valve are subjected to a salt-bath, soft-nitriding treatment to enhance wear resistance.
- Unequal pitch valve spring has been adopted. In addition, the upper diameter is smaller compared to the bottom diameter.
- The valve guide is made of sintered alloy with excellent wear resistance.

CAMSHAFT [SKYACTIV-G 2.0]

id0110h2001400

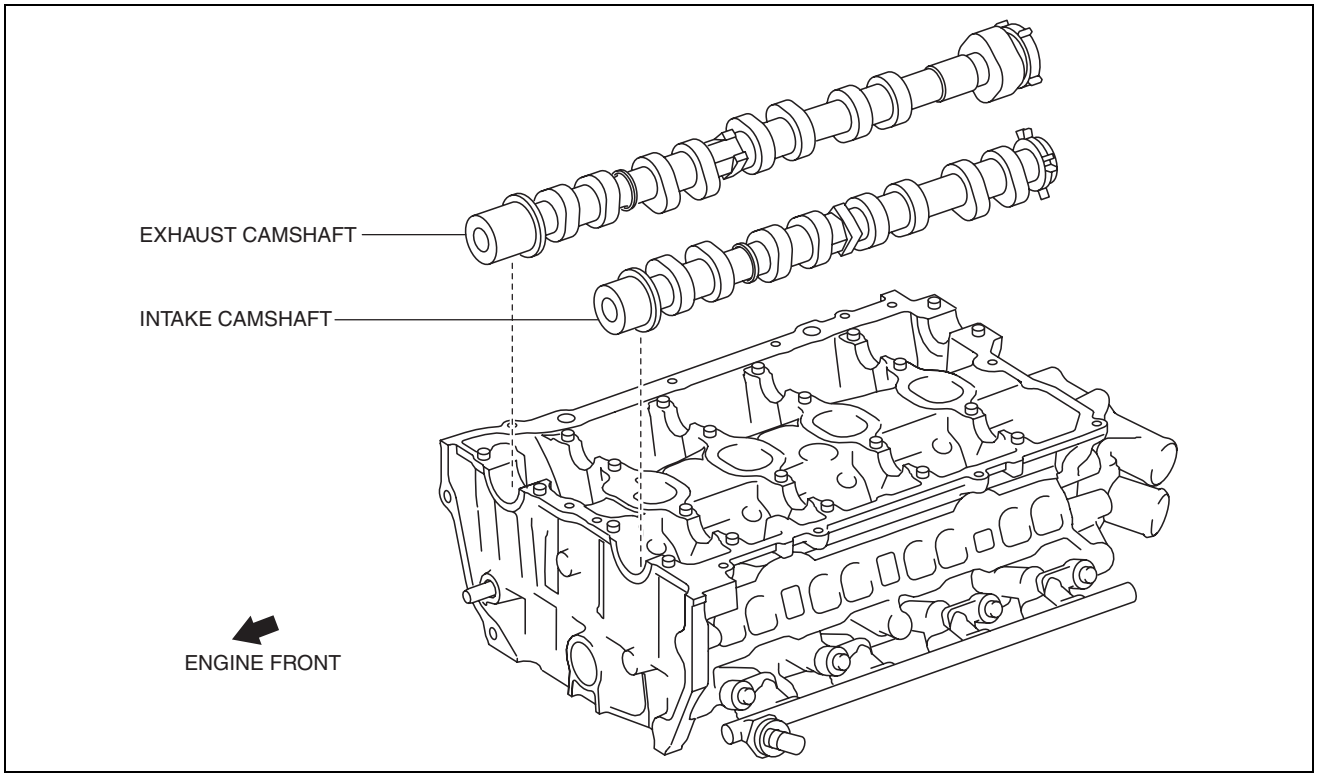
Purpose, Function

- The camshaft is rotated by receiving the rotation force of the crankshaft via the timing chain. The valve is opened and closed according to the cam shape at this time.

MECHANICAL [SKYACTIV-G 2.0]

Construction

- The camshaft is installed to the cylinder head.



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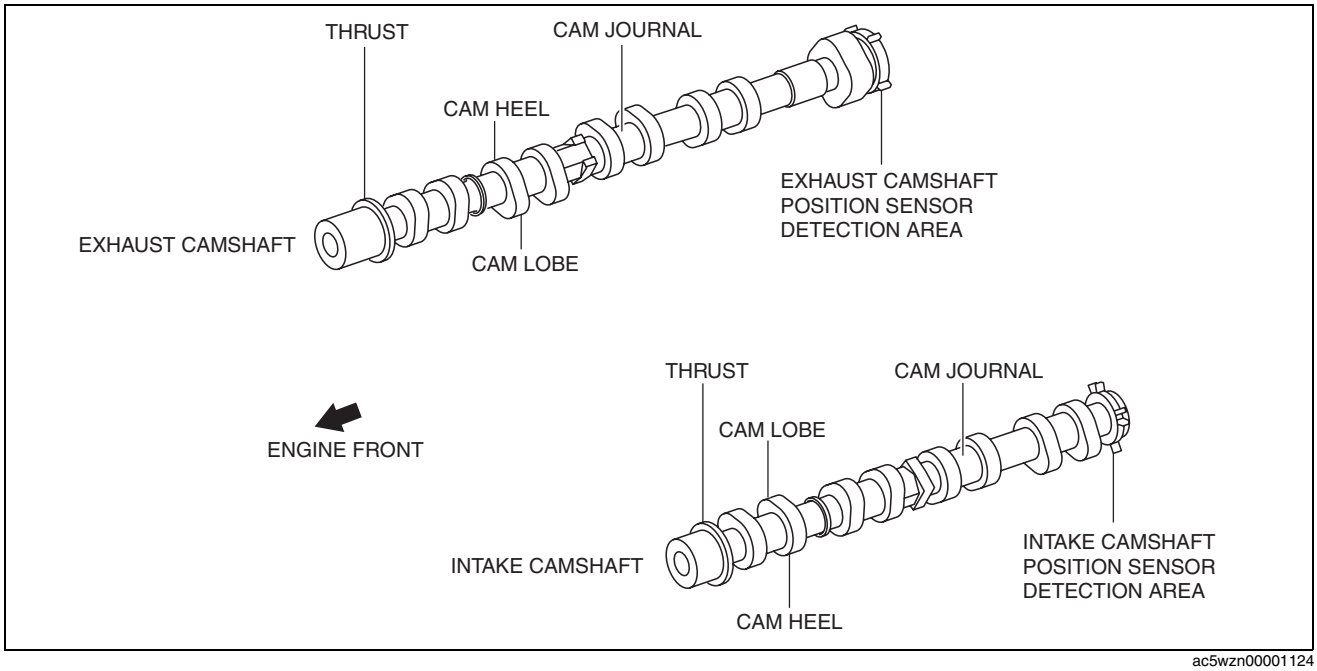
- The intake camshaft is a five-bearing type and the exhaust camshaft is a six-bearing type.
- The camshaft thrust force is suppressed by the No.1 journal.
- The camshaft has the following parts shown in the figure.



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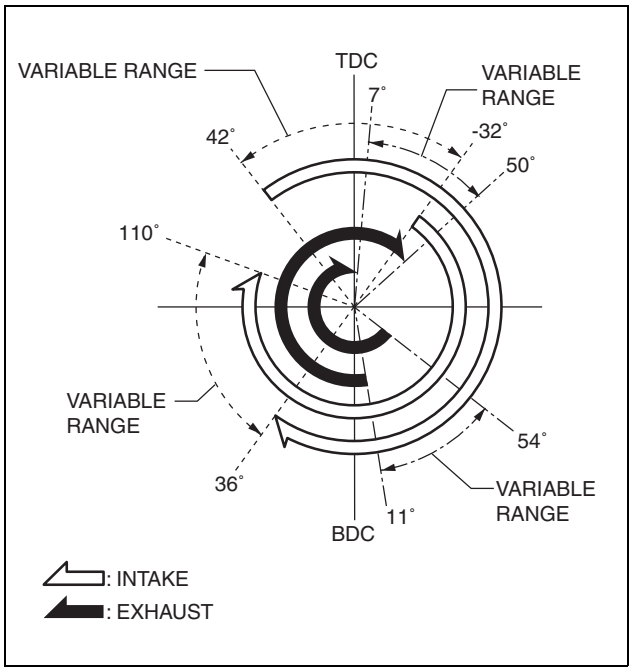
MECHANICAL [SKYACTIV-G 2.0]

Valve timing



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TIMING CHAIN, CHAIN TENSIONER [SKYACTIV-G 2.0]

id0110h2001500

Purpose, Function

Timing chain

- The timing chain transmits the rotation force of the crankshaft to the camshaft to perform the rotation timing of the crankshaft and camshaft.

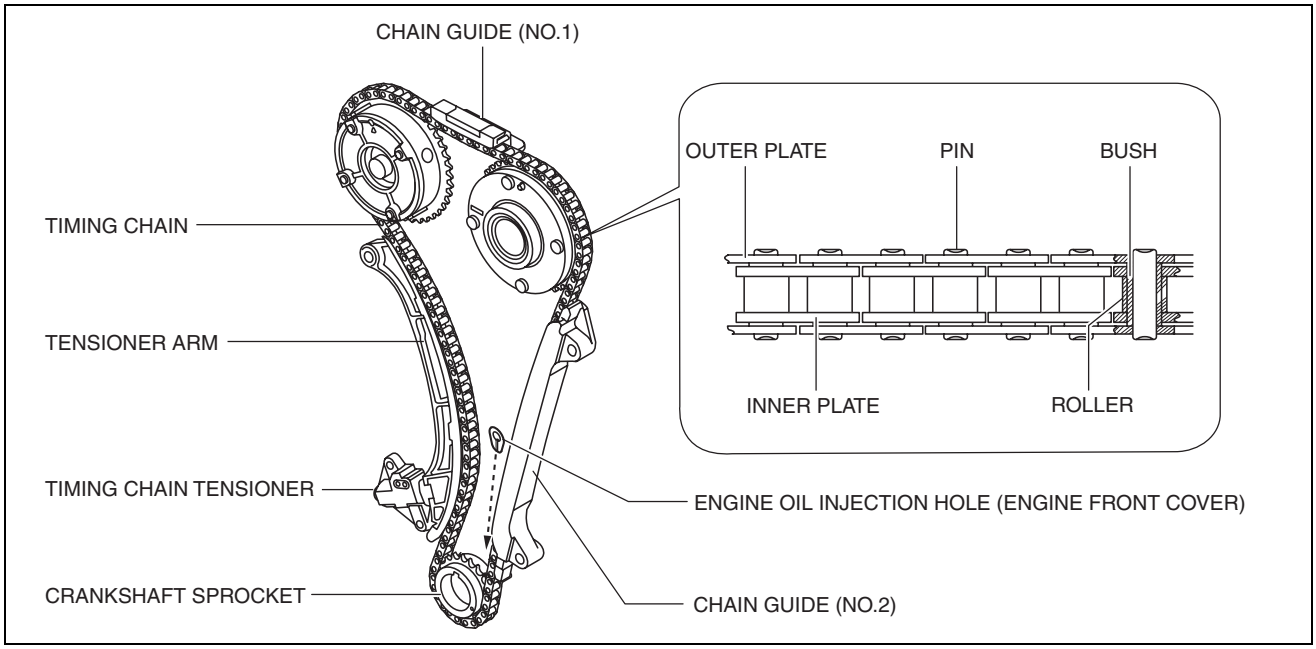
Chain tensioner

- The chain tensioner constantly maintains the timing chain tension and the timing chain operation is stabilized.

Construction

Timing chain

- The timing chain is installed between the camshaft sprocket and crankshaft sprocket.



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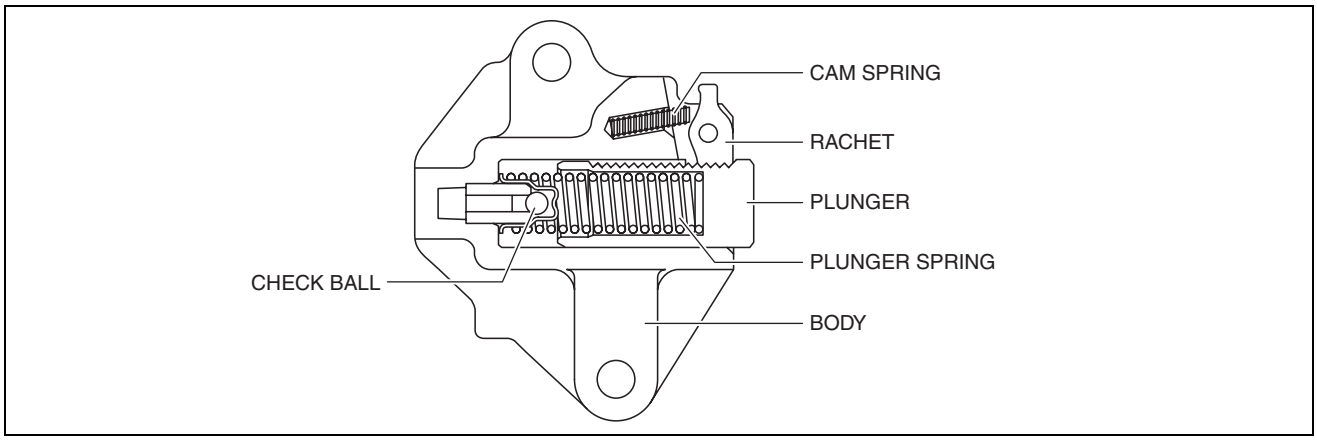
- Lubrication of the timing chain and each sprocket is performed using the engine oil from the engine front cover.
- Improvement of the rigidity of the chain guide and tensioner arm and the stability of the timing chain operation have reduced the sliding resistance.

MECHANICAL [SKYACTIV-G 2.0]

Chain tensioner
- The chain tensioner is installed to the cylinder block (engine front).
- An oil pressure type chain tensioner has been adopted for the chain tensioner.

OPERATION
Chain tensioner
- Fluctuation in the timing chain tension by oil pressure and spring force is suppressed, and the tension is maintained at a constant.



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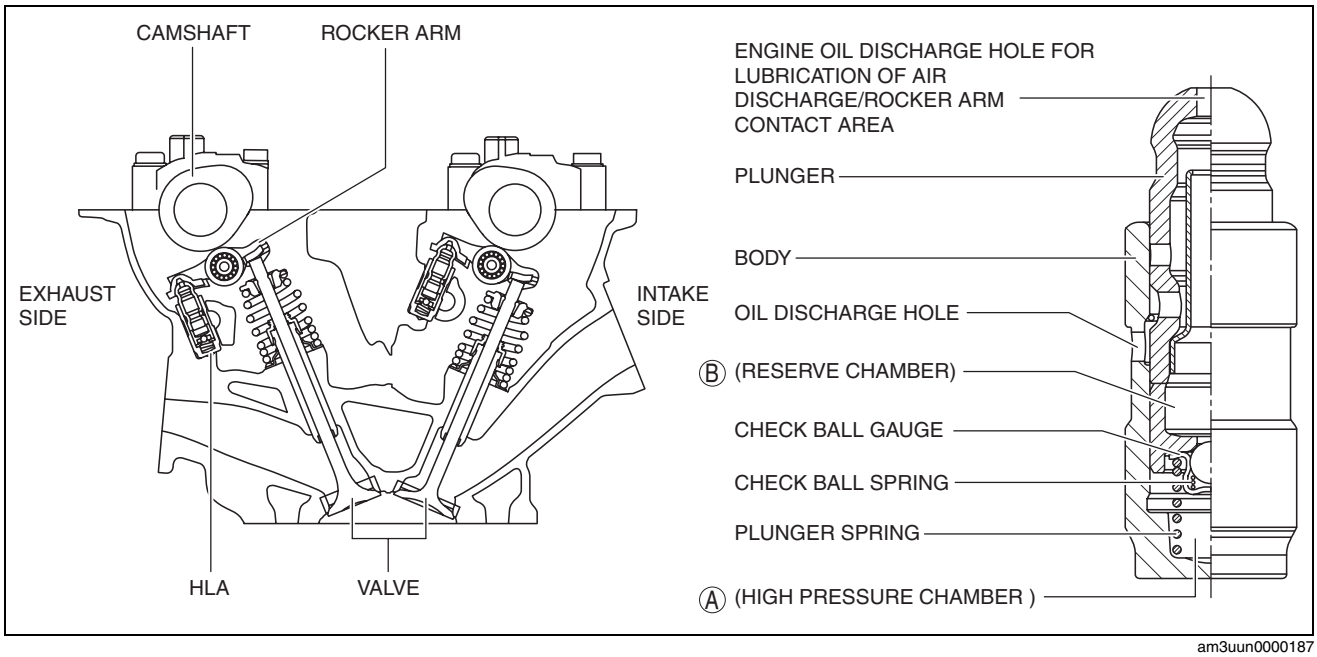
HYDRAULIC LASH ADJUSTER, ROCKER ARM [SKYACTIV-G 2.0]

id0110h2009200

Purpose, Function
HLA
- The HLA maintains the valve clearance at a constant 0 mm and maintenance-free valve clearance is realized.

Rocker arm
- With the adoption of the needle roller bearing built into the rocker arm, the contact to the cam employs rolling contact to reduce sliding resistance.

Construction
HLA
- The HLA is installed to the cylinder head.



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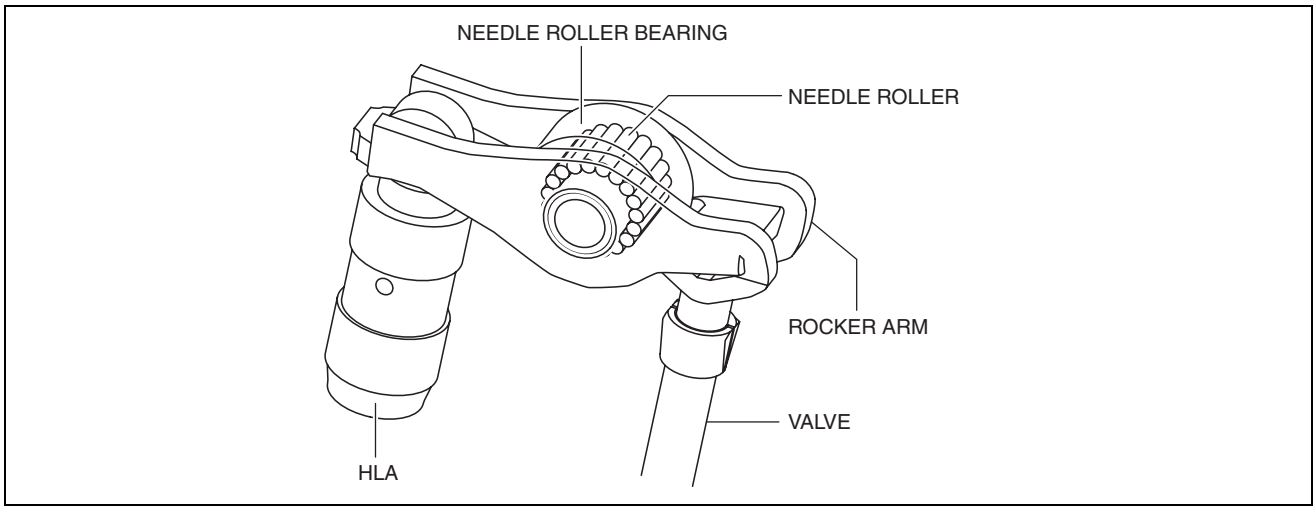
Rocker arm
- The rocker arm is installed to the HLA and upper area of the valve.

- The needle roller bearing is built into the rocker arm.



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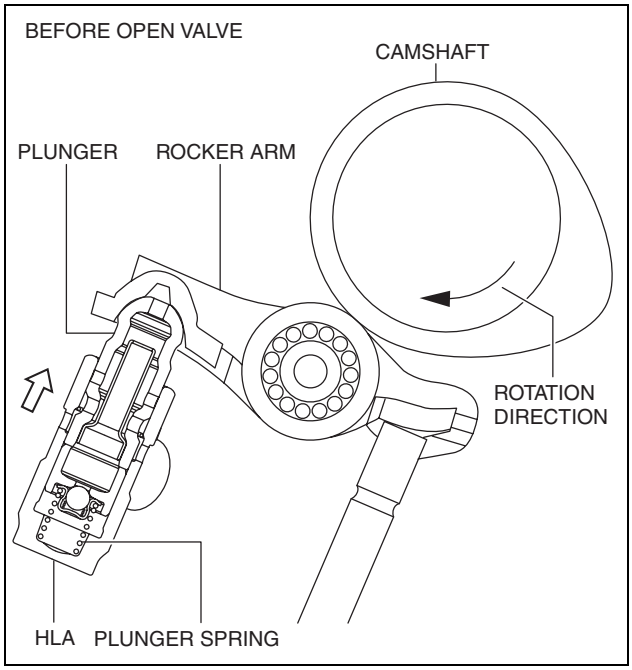
Operation

Before valve opening

1. The plunger presses up the rocker arm by the spring force of the plunger spring to maintain the valve clearance at 0 mm.



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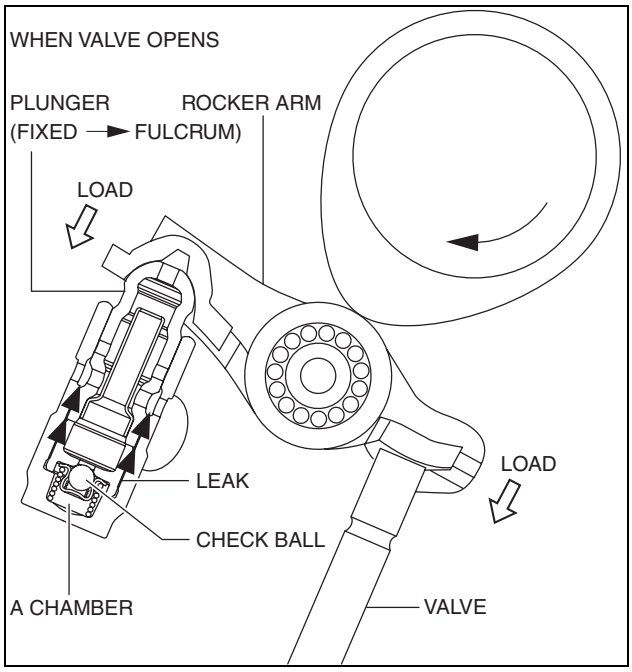
During valve opening

1. If the cam presses down the rocker arm, load is applied to the plunger and valve.
2. If load is applied to the plunger, the hydraulic pressure in the high pressure chamber (A chamber) increases and the check ball closes the hydraulic passage.
3. If the hydraulic passage is closed, the plunger is fixed becoming the rocker arm pivot point because the volume of the engine oil in the high pressure chamber is not changed.

4. The rocker arm presses down the valve.



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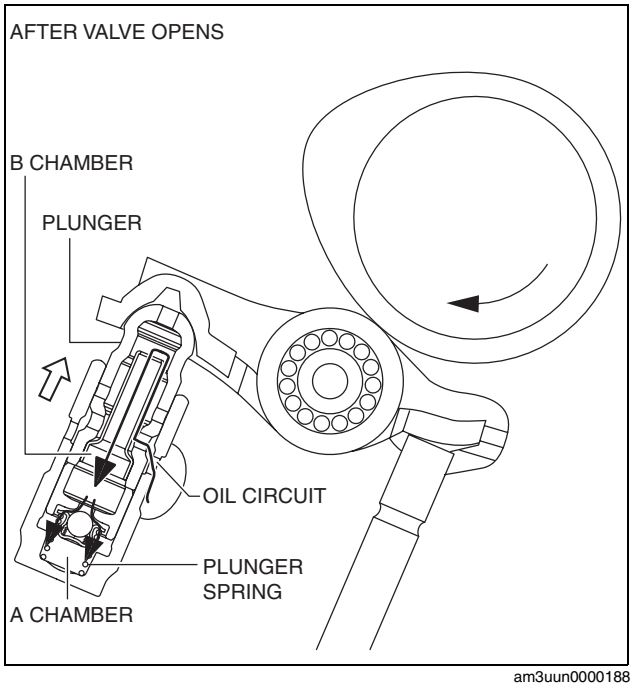
After valve opening

1. If load is not applied to the plunger, the plunger spring presses up the plunger (maintains valve clearance at 0 mm).
2. Because the capacity of the high pressure chamber (A chamber) increases in Step 1, the check ball is opened and engine oil flows from the reserve chamber (B chamber) to the high pressure chamber (A chamber) to prepare for the next step.
3. The oil in the reserve chamber (B chamber) which is decreased by supplying it to the high pressure chamber (A chamber), is supplied from the oil passage of the cylinder head.



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VARIABLE VALVE TIMING MECHANISM [SKYACTIV-G 2.0]

id0110h2002000

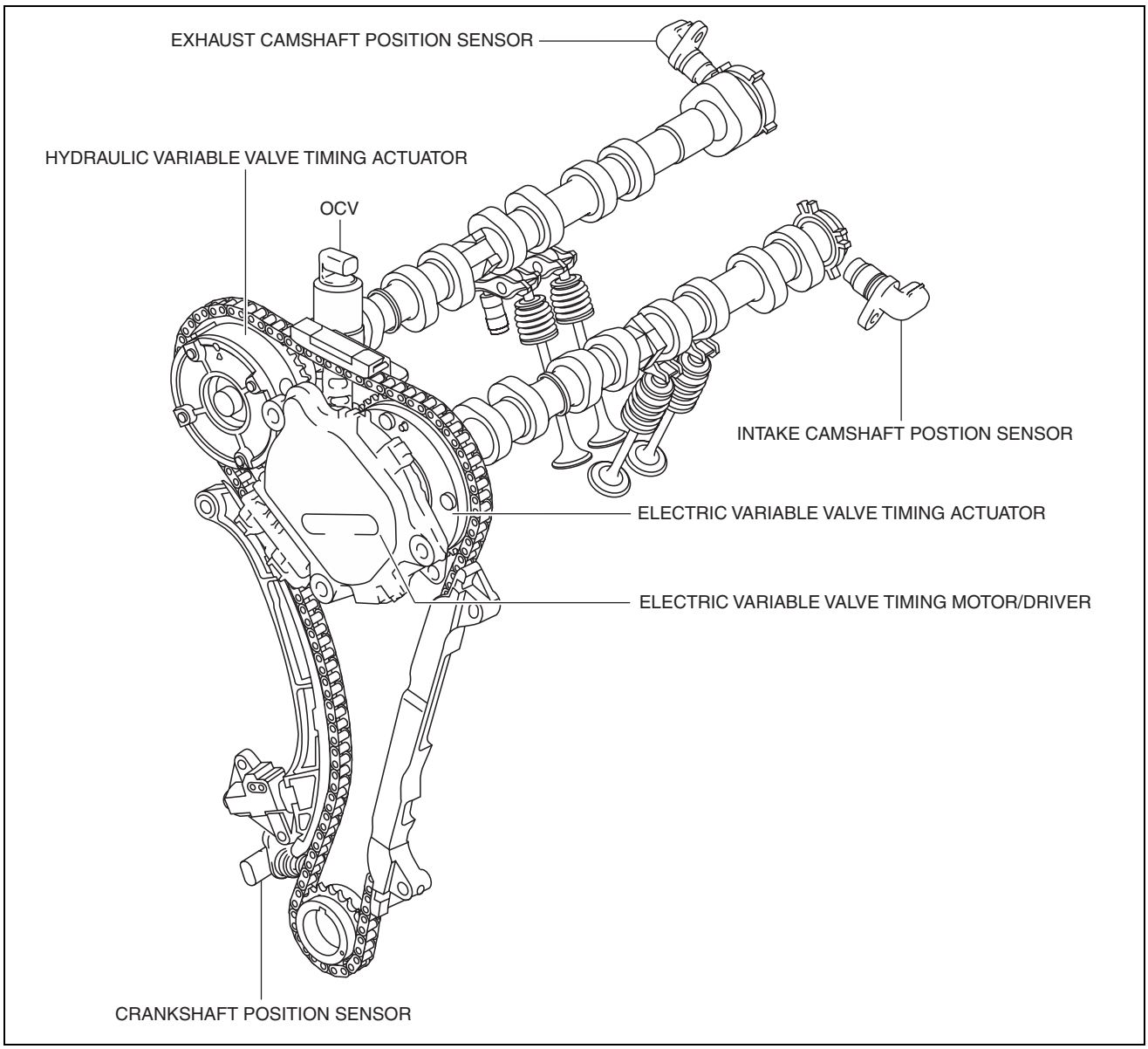
Outline

- Achieves optimum valve timing according to the driving conditions by the variable valve timing mechanism changing the phases of the camshaft.
- An electric type variable valve timing mechanism on the intake side and a hydraulic pressure type on the exhaust side has been adopted. The expansion of the valve opening angle and the accuracy of the intake and exhaust controls have been improved.

MECHANICAL [SKYACTIV-G 2.0]

- The electric variable valve timing mechanism obtains higher response than the hydraulic variable valve timing mechanism. As a result, expansion of overlap and the closing timing of the intake valve are achieved.

Structural View



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Structure

Part name	Function
Hydraulic variable valve timing actuator	The hydraulic variable valve timing actuator operates according to the hydraulic pressure and changes the phases of the exhaust camshaft.
Electric variable valve timing actuator	The electric variable valve timing actuator changes the phases of the intake camshaft.
Electric variable valve timing motor/driver	Operates the electric variable valve timing actuator based on the signals from the PCM.
OCV	Operated by current (duty signal) from the PCM. Controls the hydraulic oil passages to the variable valve timing actuator.
Intake camshaft position sensor	Sends the intake camshaft position signal to the PCM.
Exhaust camshaft position sensor	Sends the exhaust camshaft position signal to the PCM.
Crankshaft position sensor	Sends the crankshaft position signal to the PCM.

MECHANICAL [SKYACTIV-G 2.0]

Operation
At engine start
- Engine startability has been improved by utilizing the features of the operable electric VVT even under the engine stop condition and controlling the optimal timing according to engine conditions.

Light/medium load range
- Pumping loss* is reduced by properly controlling the timing of intake and exhaust, improving the fuel consumption rate.

* : Energy loss which occurs from each type of resistance corresponding to intake and exhaust is called pumping loss.

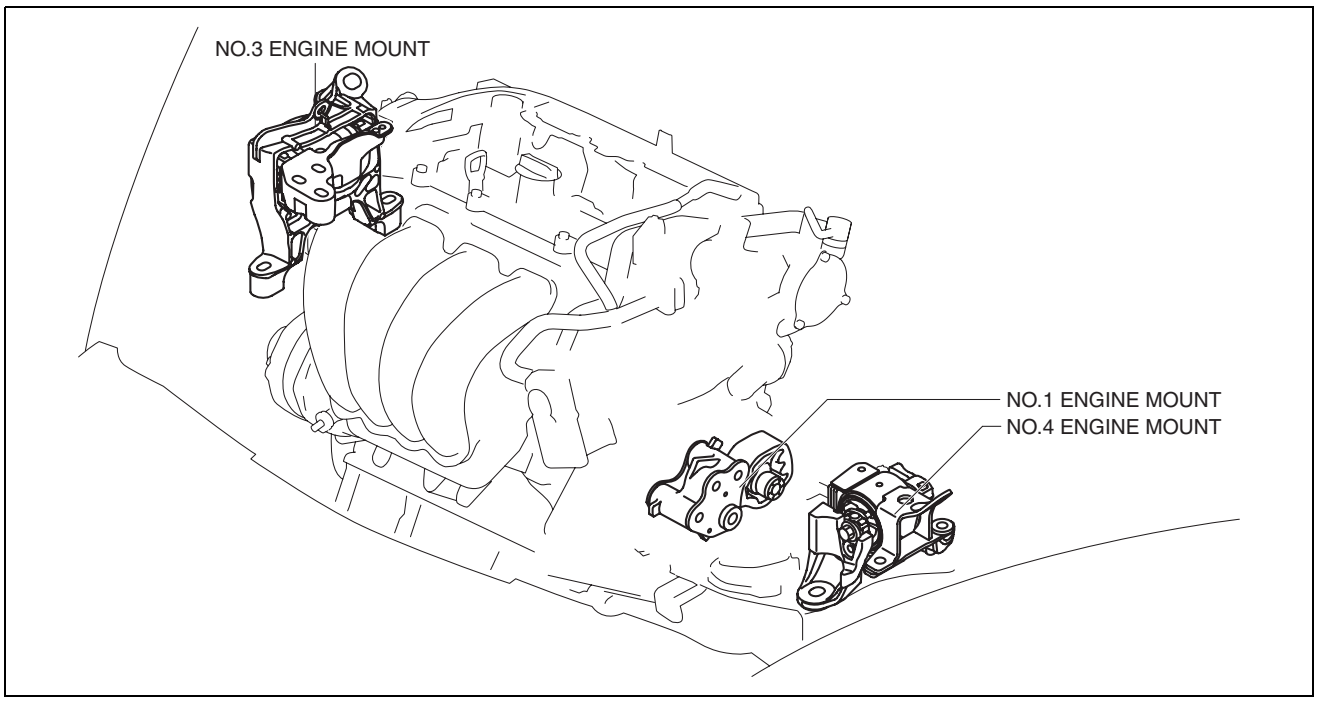
High load range
- By properly controlling the timing of the intake and exhaust and using the effect of scavenging residual gas in the cylinder and the inertia charging effect, the volumetric efficiency and the output are improved.

ENGINE MOUNT [SKYACTIV-G 2.0]

id0110h2001800

Purpose, Function
- The engine mount secures the engine and transaxle to the vehicle body, reducing vibration and noise.

Construction
- The three points at the engine front (No.3 engine mount), one side of the transaxle (No.1 engine mount), and the rear upper part of the transaxle (No.4 engine mount) are supported.



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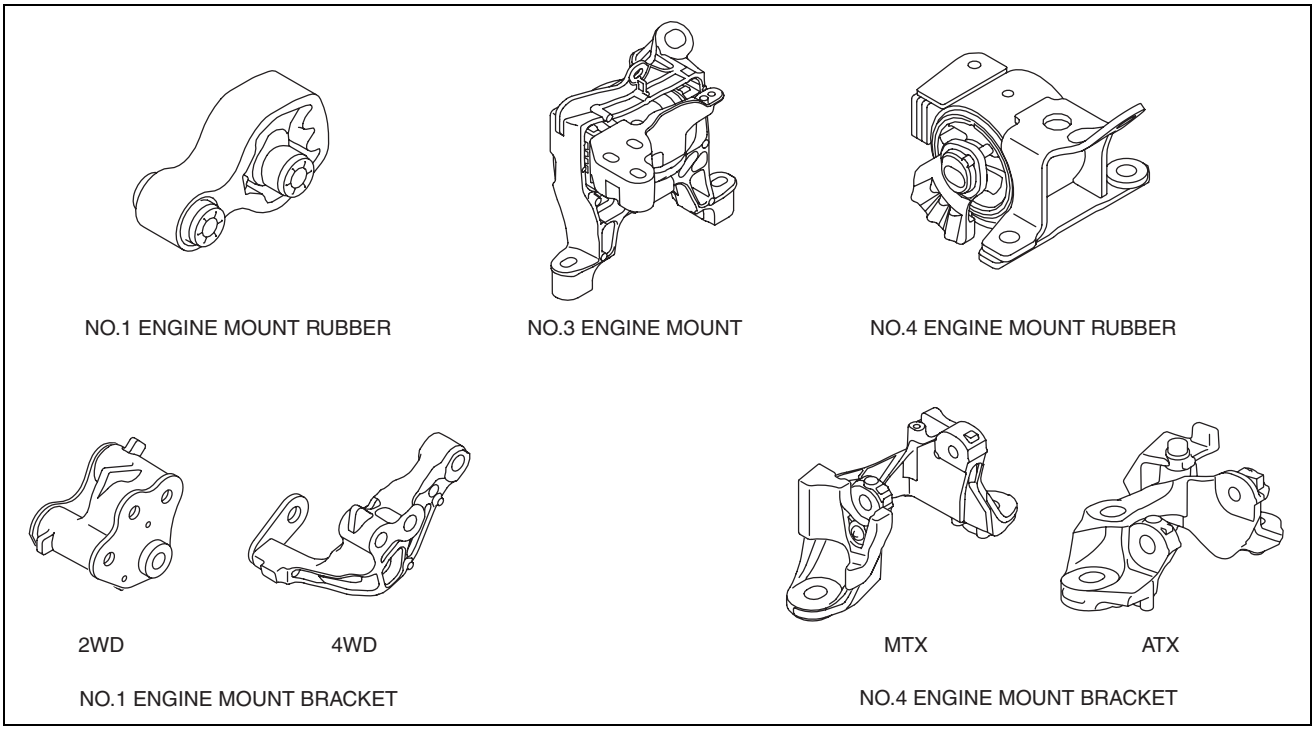
MECHANICAL [SKYACTIV-G 2.0]

- With the adoption of the oil-filled bushing type for the No.3 engine mount and No.4 engine mount rubber, the damper effect has been improved.



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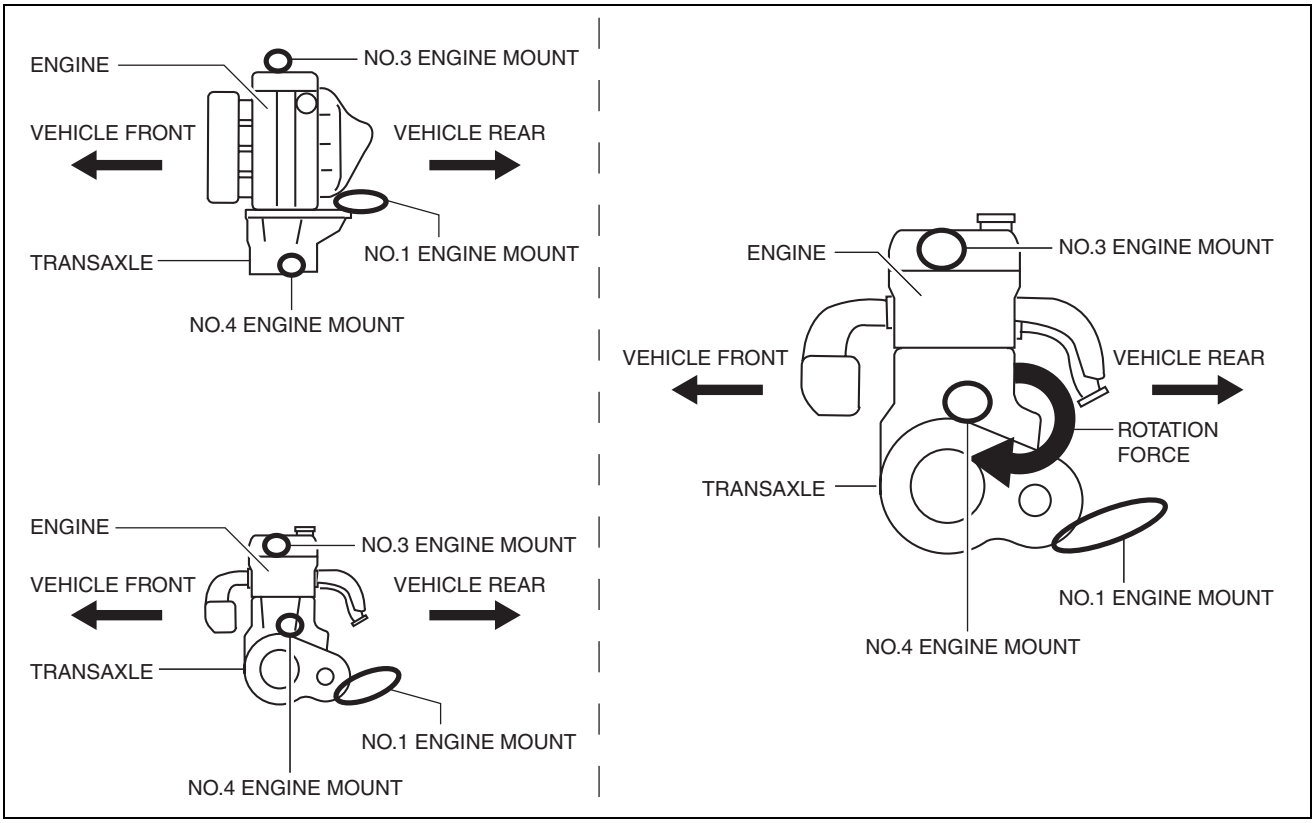
Operation

- By locating the one side of the transaxle (No.1 engine mount) to the transaxle lower end, the No.1 engine mount absorbs the rotation force to the powertrain generated during engine torque fluctuation. The layout is designed to disperse the rotation force to the front/back directions of the engine.



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MECHANICAL [SKYACTIV-G 2.0]

OIL CONTROL VALVE (OCV) [SKYACTIV-G 2.0]

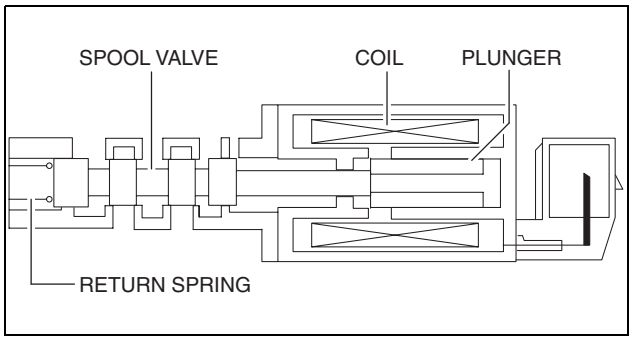
id0110h2001600

Purpose, Function

- The OCV switches the oil passage to the hydraulic variable valve timing actuator to control the opening/closing period of the exhaust valve.

Construction

- The OCV is installed to the exhaust camshaft cap (No.1).
- The OCV consists of a spool valve which switches the engine oil passage and a plunger, coil, and return spring which operate the spool valve.



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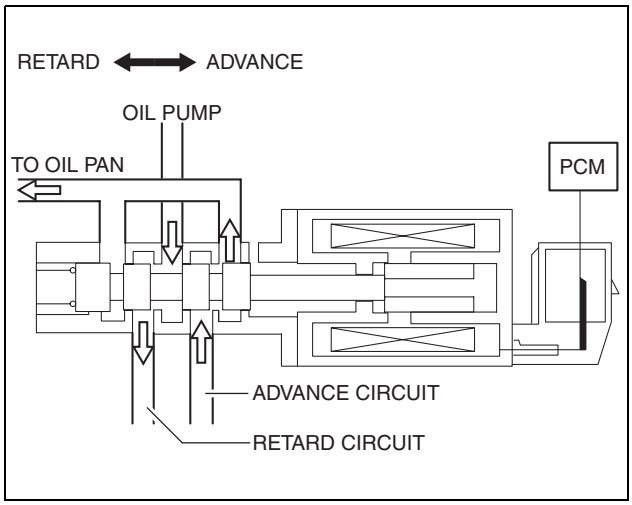
Operation

At retard

- The spool valve is moved to the retard side by the signal from the PCM and engine oil is lead to the retard oil passage of the exhaust camshaft.



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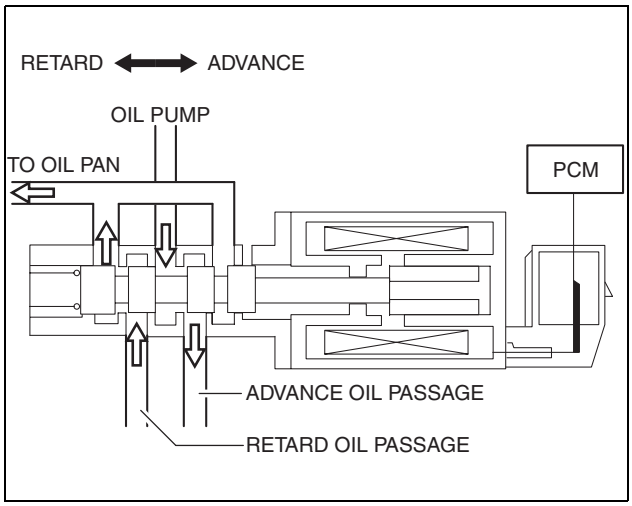
At advance

- The spool valve is moved to the advance side by the signal from the PCM and engine oil is lead to the advance oil passage of the exhaust camshaft.



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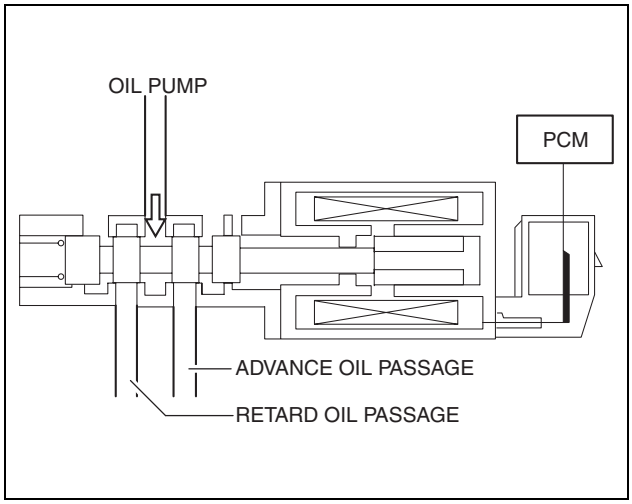
MECHANICAL [SKYACTIV-G 2.0]

Middle point maintenance

- The spool valve is moved to the closed position of the oil passage to the exhaust camshaft by the signal from the PCM.
- The construction is designed to supply a small amount of oil to the advance oil passage even while the middle point is maintained, improving holding stability while at low oil pressure.



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Fail-safe

DTC	Fail-safe
P0014:00	• Performs the exhaust variable valve timing control with a maximum cam retard request.
P0015:00	• Performs the exhaust variable valve timing control with a maximum cam retard request.
P2090:00	• Performs the exhaust variable valve timing control with a maximum cam retard request.
P2091:00	• Performs the exhaust variable valve timing control with a maximum cam retard request.

HYDRAULIC VARIABLE VALVE TIMING ACTUATOR [SKYACTIV-G 2.0]

id0110h2001700

Purpose, Function

- The hydraulic variable valve timing actuator operates according to the hydraulic pressure and changes the phases of the exhaust camshaft. As a result, the open/close period of the exhaust valve is changed, optimized valve timing in accordance with driving conditions is realized, and the output and combustion efficiency is improved.

Construction

- The hydraulic variable valve timing actuator is installed to the exhaust camshaft.
- The hydraulic variable valve timing actuator has an assist spring to move the rotor in the advance direction while the engine is stopped.

Operation

At engine start

- Because the stopper pin in the hydraulic variable valve timing actuator is engaged with the rotor at the maximum advance position by the spring force, the camshaft sprocket and camshaft are rotated as a single unit.

Retarding valve timing

- Engine oil is lead to the retard oil passage by the OCV to apply oil pressure to the stopper pin and retard chamber. As a result, the engagement of the stopper pin is released, the rotor connected to the camshaft rotates in the retard direction against the camshaft sprocket driven by the crankshaft, and the valve timing is retarded.

Advancing valve timing

- Engine oil is lead to the advance oil passage by the OCV to apply oil pressure to the advance chamber. As a result, the rotor connected to the camshaft rotates in the advance direction against the camshaft sprocket driven by the crankshaft, and the valve timing is advanced.

MECHANICAL [SKYACTIV-G 2.0]

Maintaining intermediate valve timing

- The retard and advance oil passages is closed by the OCV. As a result, the relative angle of the rotor and camshaft sprocket is maintained at a constant to hold the valve timing.

ELECTRIC VARIABLE VALVE TIMING ACTUATOR [SKYACTIV-G 2.0]

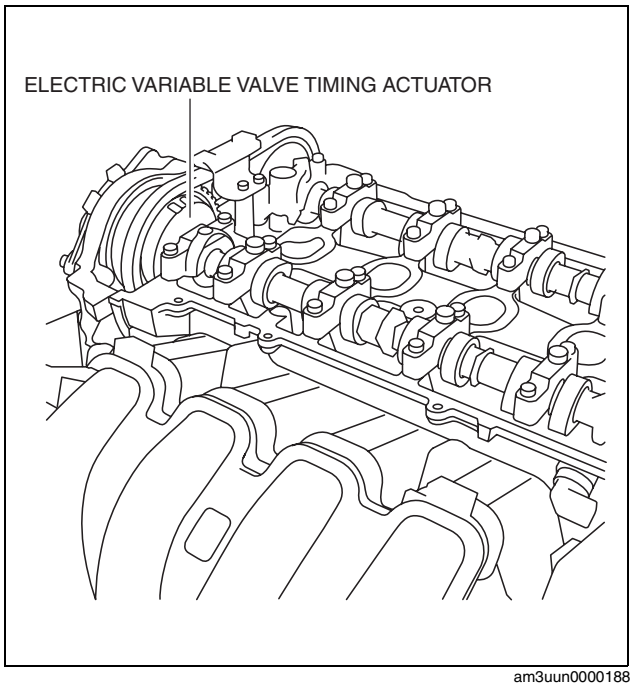
id0110h2002100

Purpose, Function

- The electric variable valve timing actuator changes the phases of the intake camshaft relative to the crankshaft. As a result, the open/close period of the intake valve is changed, optimized valve timing in accordance with driving conditions is realized, output is improved, and emission reduction is realized.

Construction

- The electric variable valve timing actuator is installed to the intake camshaft.
- The electric variable valve timing actuator



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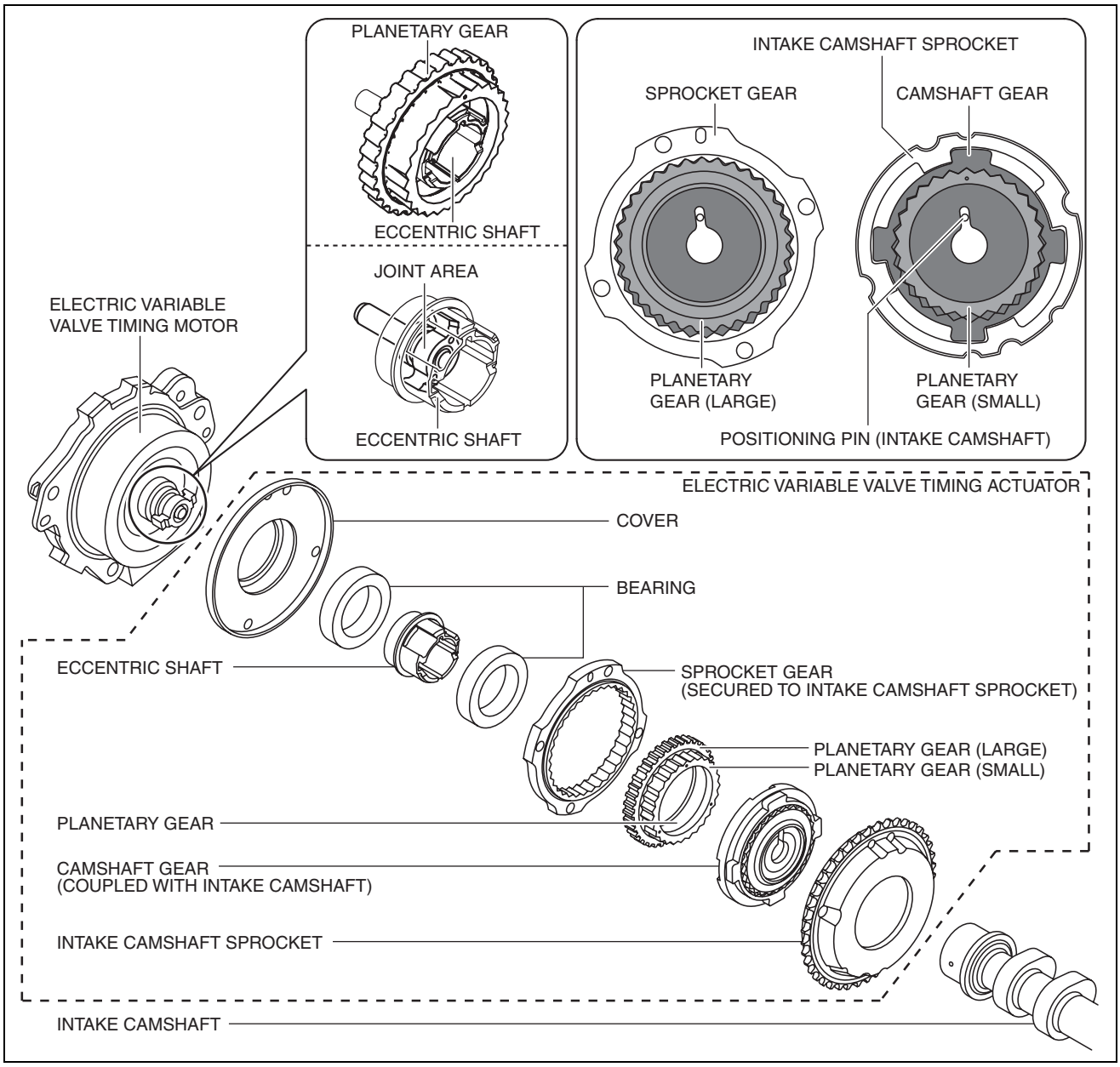
consists of the following parts:



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— The sprocket gear rotates together with the intake camshaft sprocket.
— The camshaft gear rotates together with the intake camshaft.
— The eccentric shaft is an eccentric shape relative to the rotation axis of the intake camshaft.
— The planetary gear is engaged with the eccentric shaft. In addition, the planetary gear is engaged with the sprocket gear and the camshaft gear.
— The number of teeth for the planetary gear (large) is one tooth fewer than the number of teeth for the sprocket gear.
— The number of teeth for the planetary gear (small) is one tooth fewer than the number of teeth for the camshaft gear.
— The planetary gear rotates by receiving the rotation force from the eccentric shaft.
— The camshaft gear rotates by receiving the rotation force from the planetary gear.

Operation
Advancing valve timing

- The electric variable valve timing motor rotation speed is faster than the intake camshaft sprocket rotation speed. As a result, the camshaft gear rotates in the advance direction relative to the intake camshaft sprocket, and the valve timing is advanced.

MECHANICAL [SKYACTIV-G 2.0]

Retarding valve timing

- The electric variable valve timing motor rotation speed is slower than the intake camshaft sprocket rotation speed. As a result, the camshaft gear rotates in the retard direction relative to the intake camshaft sprocket, and the valve timing is retarded. (If engine rotation speed is slow, the electric variable valve timing motor may be rotating in reverse and the camshaft gear may be rotating in the retard direction.)

Maintaining intermediate valve timing

- The electric variable valve timing motor rotation speed is the same as the intake camshaft sprocket rotation speed. As a result, the phase difference of the camshaft gear relative to the intake camshaft sprocket is maintained, the camshaft gear rotation speed is the same as the intake camshaft sprocket rotation speed, and the valve timing is maintained.

Fail-safe

DTC	Fail-safe
P0011:00	• Stops activation of the electric variable valve timing driver.
P0012:00	• Stops activation of the electric variable valve timing driver.
P1380:00	• Stops activation of the electric variable valve timing driver.

ELECTRIC VARIABLE VALVE TIMING RELAY [SKYACTIV-G 2.0]

id0110h2198500

Purpose, Function

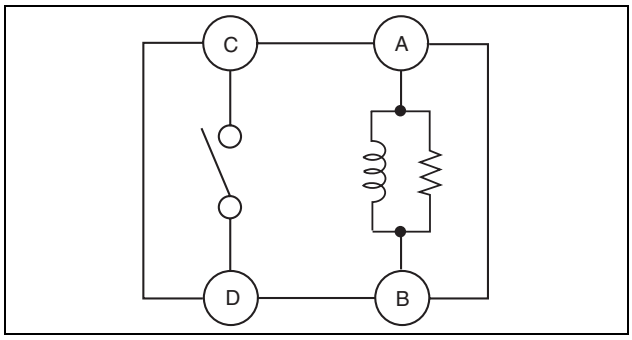
- The electric variable valve timing actuator relay supplies power to the electric variable valve timing motor/driver after receiving the signal from the PCM.

Construction

- The electric variable valve timing actuator relay is installed to the relay block. (See 09-21-2 RELAY AND FUSE BLOCK.)

Operation

1. When current flows between A—B shown in the figure, electromagnetic power is generated, the switch between C—D is turned on, and the current flows between C—D.
2. Current flows between C—D and power is supplied to the electric variable valve timing motor/driver.



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Fail-safe

- Function not equipped.

01-10B MECHANICAL [SKYACTIV-D 2.2]

MECHANICAL [SKYACTIV-D 2.2]

MECHANICAL [SKYACTIV-D 2.2]

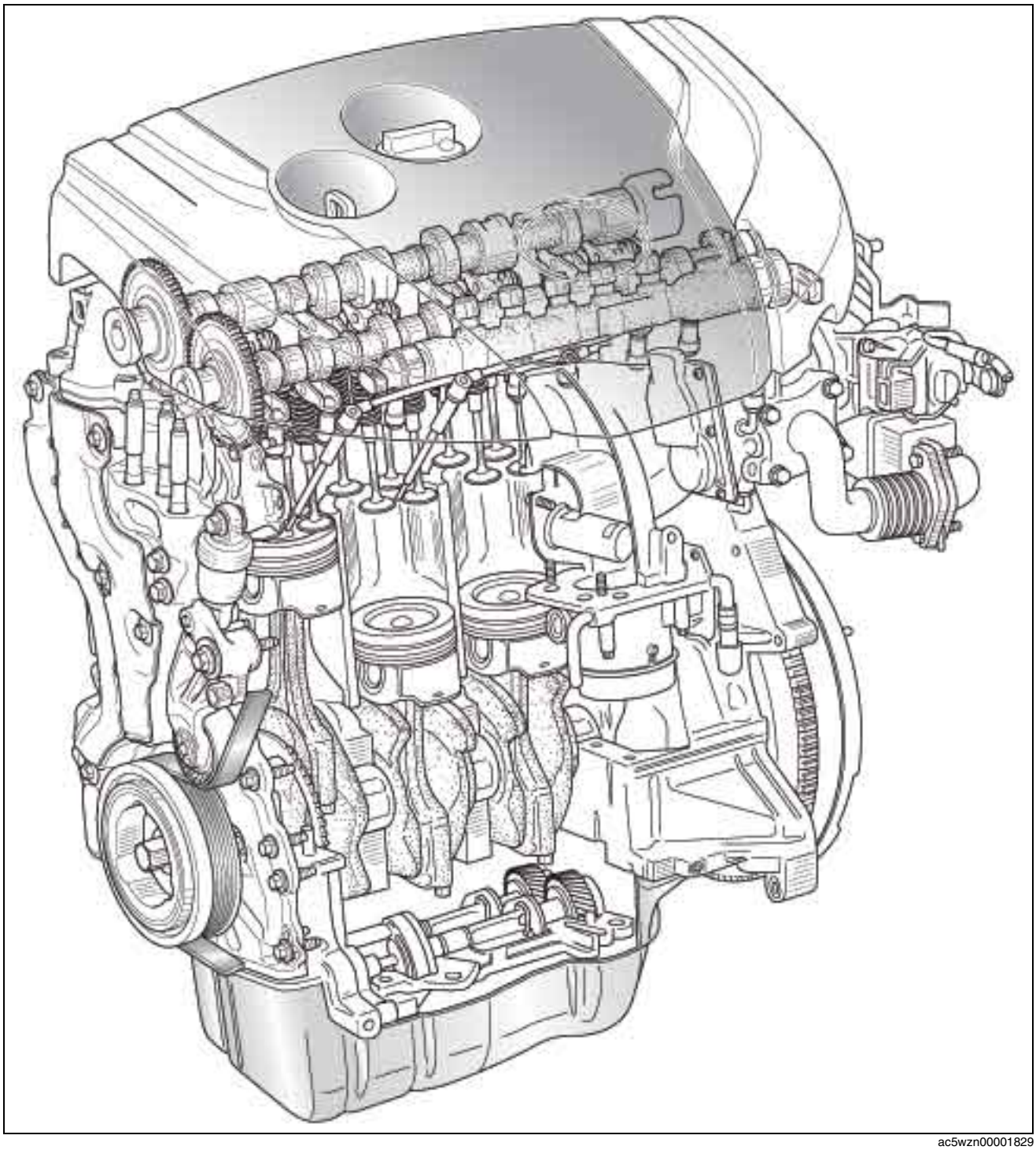
id0110s5000100

Outline

- For SKYACTIV-D 2.2, the following is performed to lower fuel consumption.
  - — Low compression ratio
    - Combustion efficiency by lower compression ration (14.0)
  - — Weight reductions
    - Aluminum alloy cylinder block adopted
    - Exhaust manifold integrated cylinder heads adopted
  - — Weight reduction and mechanical resistance loss improvements
    - Piston shape optimized
    - Narrowed down crankshaft journal
- The SKYACTIV-D 2.2 has adopted a variable valve lift function for improved ignition stability during cold engine starts.
- A maintenance-free design for valve clearance has been achieved with the adoption of the HLA.

MECHANICAL [SKYACTIV-D 2.2]

Structural View



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Structure

- Consists of the following parts:

Cylinder head cover	(See 01-10B-3 CYLINDER HEAD COVER [SKYACTIV-D 2.2].)
Cylinder head	(See 01-10B-4 CYLINDER HEAD [SKYACTIV-D 2.2].)
Cylinder head gasket	(See 01-10B-5 CYLINDER HEAD GASKET [SKYACTIV-D 2.2].)
Cylinder block	(See 01-10B-5 CYLINDER BLOCK [SKYACTIV-D 2.2].)
Crankshaft	(See 01-10B-6 CRANKSHAFT, MAIN BEARING [SKYACTIV-D 2.2].)
Piston	(See 01-10B-8 PISTON, PISTON RING, PISTON PIN [SKYACTIV-D 2.2].)
Connecting rod	(See 01-10B-10 CONNECTING ROD, CONNECTING ROD BEARING [SKYACTIV-D 2.2].)

MECHANICAL [SKYACTIV-D 2.2]

Engine front cover	(See 01-10B-11 ENGINE FRONT COVER [SKYACTIV-D 2.2].)
Crankshaft pulley	(See 01-10B-12 CRANKSHAFT PULLEY [SKYACTIV-D 2.2].)
Drive belt	(See 01-10B-13 DRIVE BELT [SKYACTIV-D 2.2].)
Valve	(See 01-10B-15 VALVE, VALVE SPRING, VALVE SEAL, VALVE GUIDE [SKYACTIV-D 2.2].)
HLA	(See 01-10B-19 HYDRAULIC LASH ADJUSTER, ROCKER ARM [SKYACTIV-D 2.2].)
Camshaft	(See 01-10B-16 CAMSHAFT [SKYACTIV-D 2.2].)
Timing chain	(See 01-10B-18 TIMING CHAIN, CHAIN TENSIONER [SKYACTIV-D 2.2].)
OCV	(See 01-10B-26 OIL CONTROL VALVE (OCV) [SKYACTIV-D 2.2].)
Balancer unit	(See 01-10B-31 BALANCER UNIT [SKYACTIV-D 2.2].)
Engine mount	(See 01-10B-25 ENGINE MOUNT [SKYACTIV-D 2.2].)

CYLINDER HEAD COVER [SKYACTIV-D 2.2]

id0110s5105000

Purpose, Function

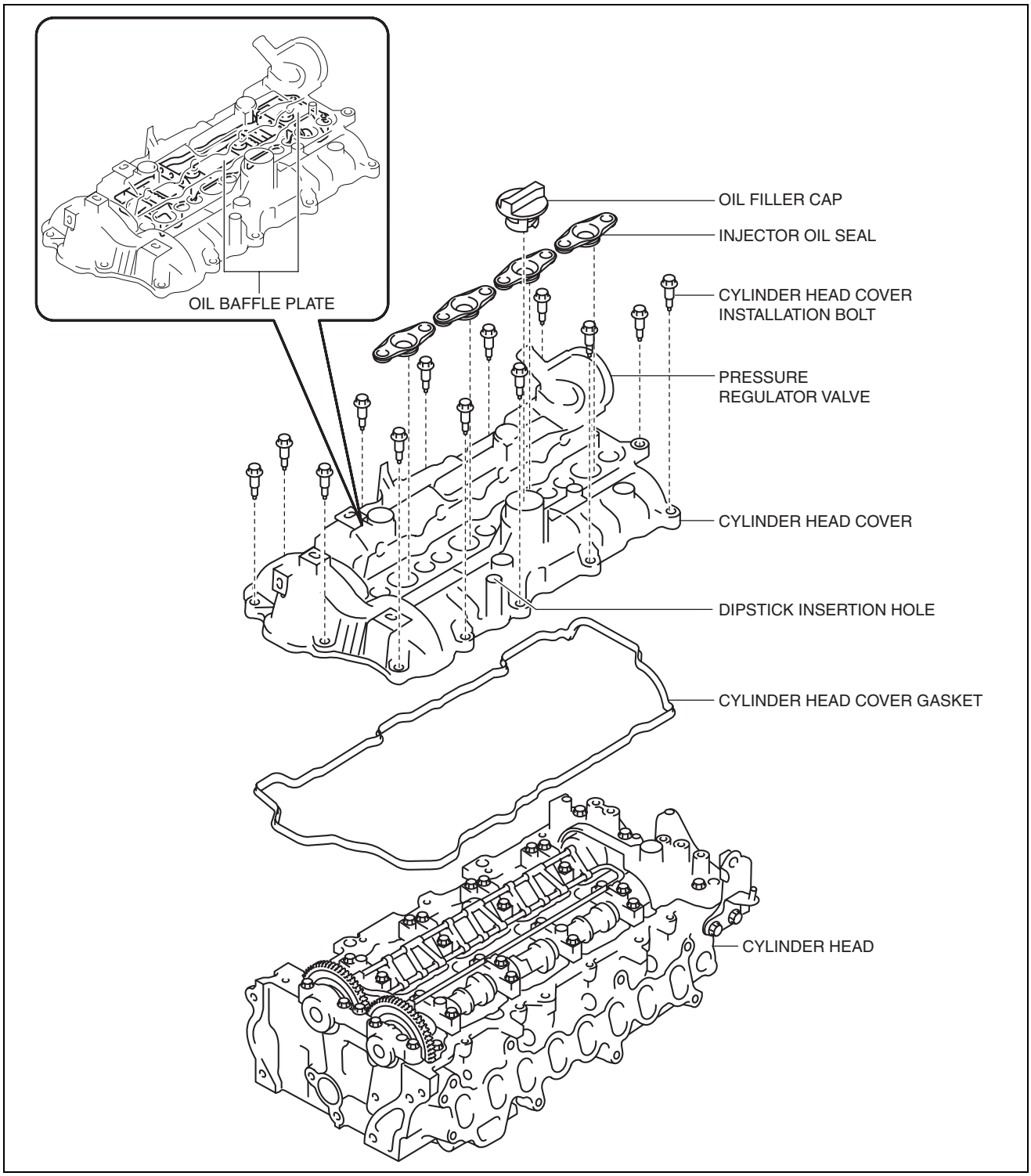
- The cylinder head cover prevents foreign material penetration and engine oil spatter.
- The oil baffle plate reduces engine oil consumption by separating the engine oil from the blow-by gas.

Construction

- The cylinder head cover is installed to the upper part of the cylinder head.
- The lightweight cylinder head cover is made of hard plastic with excellent noise absorption.

MECHANICAL [SKYACTIV-D 2.2]

- The cylinder head cover has the following parts:



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CYLINDER HEAD [SKYACTIV-D 2.2]

id0110s5000400

Purpose, Function

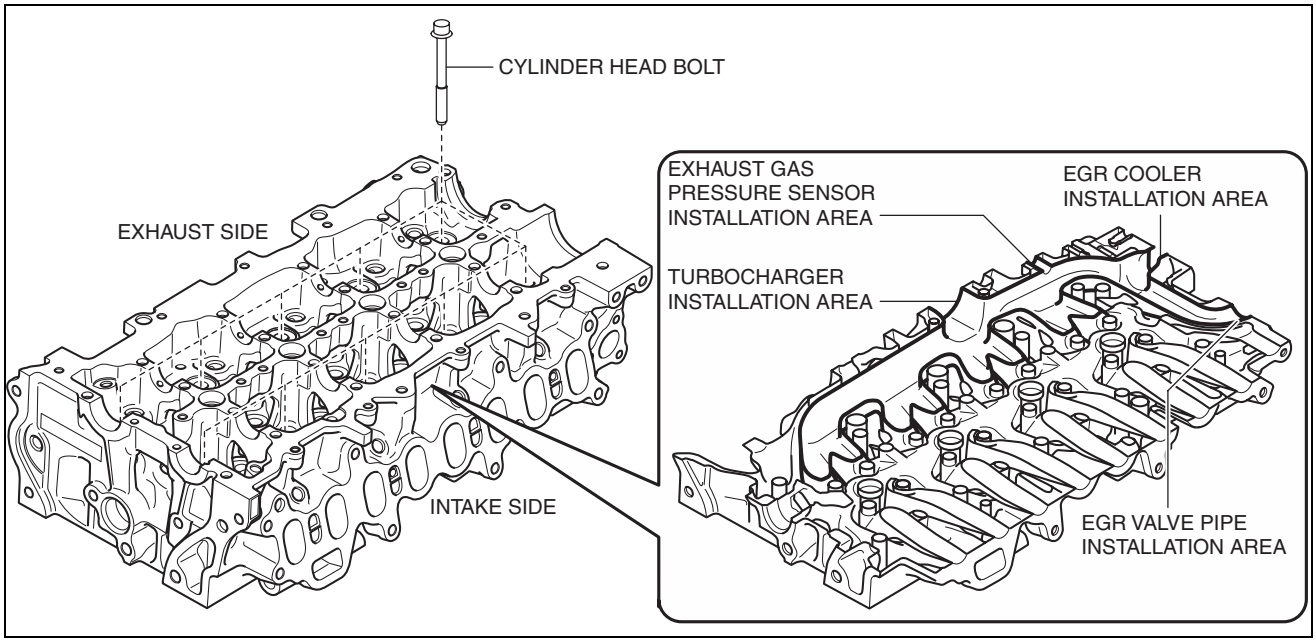
- The cylinder head forms the combustion chamber and intake and exhaust ports.

Construction

- The cylinder head is installed to the upper area of the cylinder block.
- The lightweight cylinder head is made of aluminum alloy with excellent thermal conductivity.
- There are two intake valves and two exhaust valves per cylinder for a total of four valves and the intake/exhaust type has been changed to a cross-flow type, improving intake and exhaust efficiency.

MECHANICAL [SKYACTIV-D 2.2]

- With the adoption of plastic region tightening* for the cylinder head bolts, axial force has been stabilized.
- By incorporating an exhaust gas passage in the cylinder, the exhaust manifold is unnecessary, the engine weight is reduced and a compact layout is realized.



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* : Plastic region tightening is a method of controlling the tightening using the rotation angle of a bolt. By tightening to the region (plastic tightening region) in which bolt deformation does not become irreversible, variation in axial force is suppressed.

CYLINDER HEAD GASKET [SKYACTIV-D 2.2]

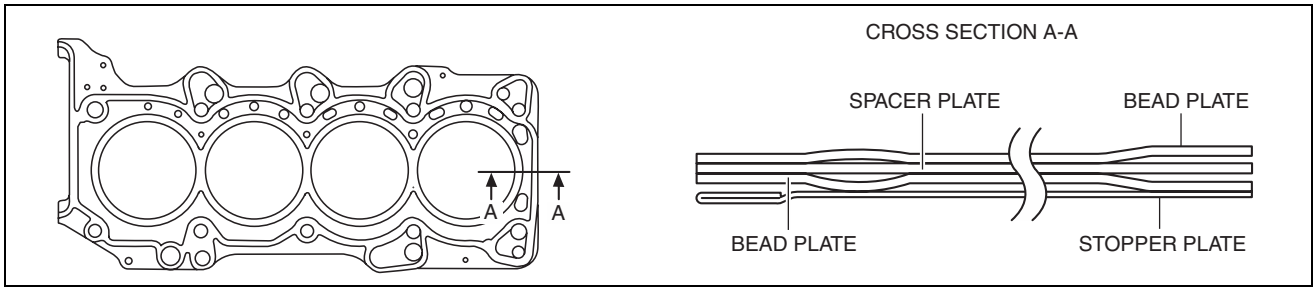
id0110s5000300

Purpose, Function

- The cylinder head gasket covers the area between the cylinder heads and cylinder block to prevent leakage of air-fuel mixture, combustion gas, engine oil, and engine coolant.

Construction

- The cylinder head gasket is installed between the cylinder heads and cylinder block.
- A four-layer type metal gasket has been adopted for the cylinder head gasket.



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CYLINDER BLOCK [SKYACTIV-D 2.2]

id0110s5000500

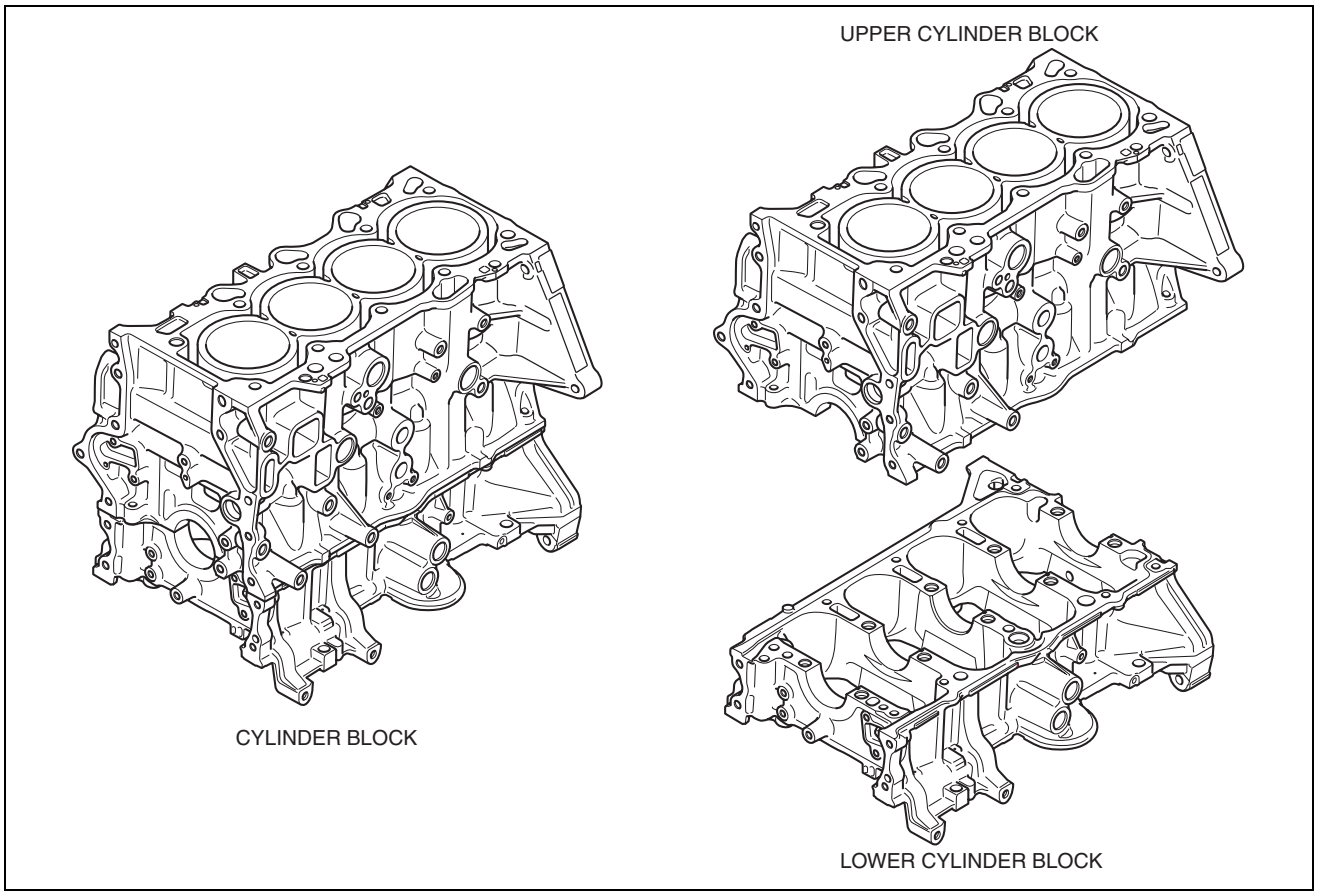
Purpose, Function

- The cylinder block forms the cylinder and crankcase.

Construction

- The cylinder block consists of the upper cylinder block and lower cylinder block.
- The lightweight cylinder block is made of aluminum alloy with excellent heat dispersion.
- The cylinder block is an open deck type with excellent cooling performance.
- With the adoption of the lower cylinder block, the coupling rigidity of the transaxle and support rigidity of the crankshaft have been improved reducing engine vibration.

MECHANICAL [SKYACTIV-D 2.2]



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CRANKSHAFT, MAIN BEARING [SKYACTIV-D 2.2]

id0110s5000600

Purpose, Function

- The crankshaft converts the reciprocating movement of the piston to a rotational movement via the connecting rod.
- The main bearing forms an oil film on the outer surface of the crankshaft journal to prevent wear due to sliding.

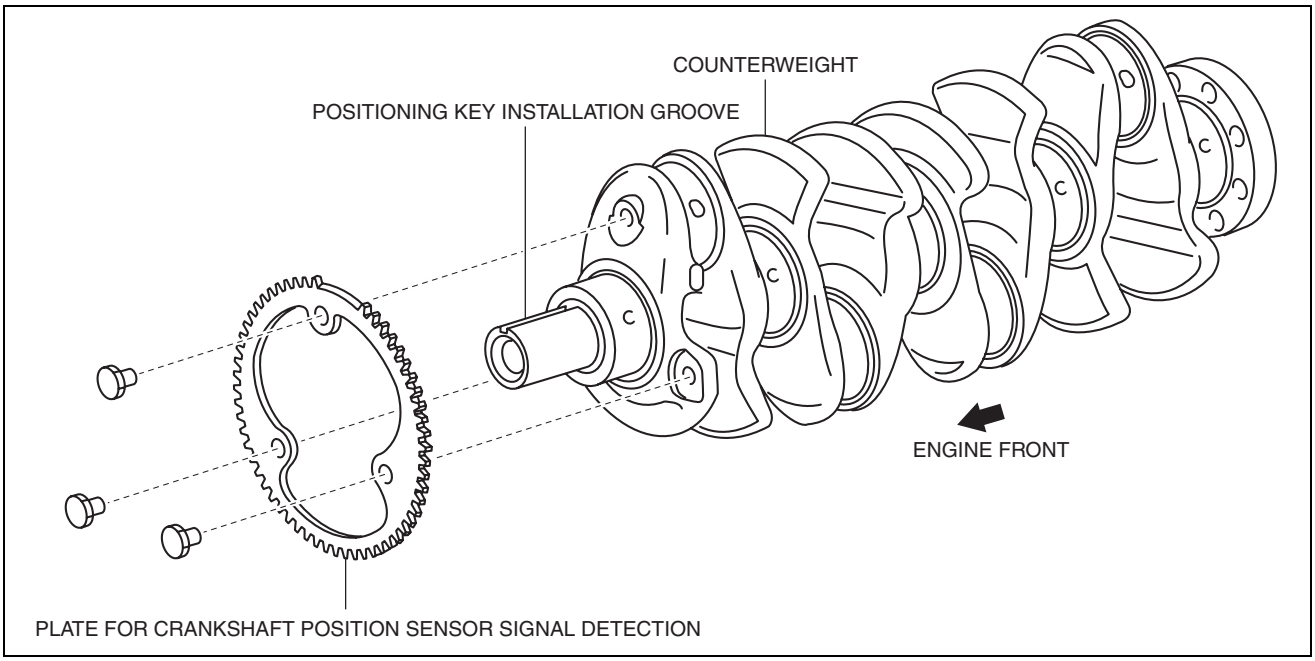
Construction

Crankshaft

- The crankshaft is installed to the inside (crankcase) of the cylinder block.
- The crankshaft has a key groove to match timing to the crankshaft pulley.

MECHANICAL [SKYACTIV-D 2.2]

- The crankshaft has the following parts shown in the figure.



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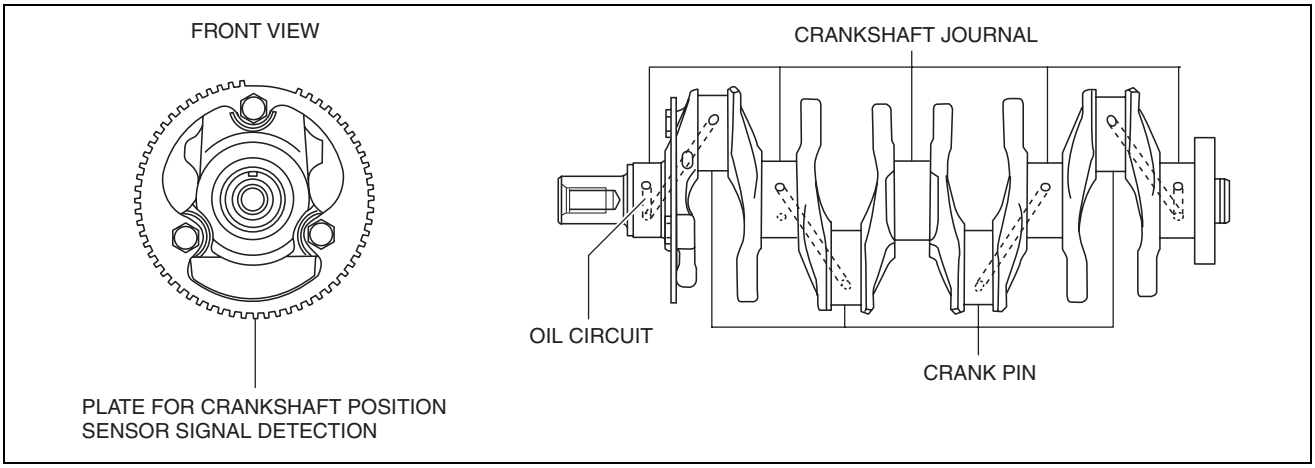
- The sliding resistance and the part mass have been reduced by reducing the crankshaft journal diameter. In addition, rigidity is maintained by optimizing the shaft diameter ratio of the crankshaft journal and crankpin diameters.
- The crankshaft has five bearings and eight counterweights (full counterweights) for improved accuracy in the rotational balance.
- The crankshaft journal and crank pin have been induction hardened* to bear high loads.
- The crankshaft has an oil passage for supplying engine oil to the crankshaft journal and crank pin.



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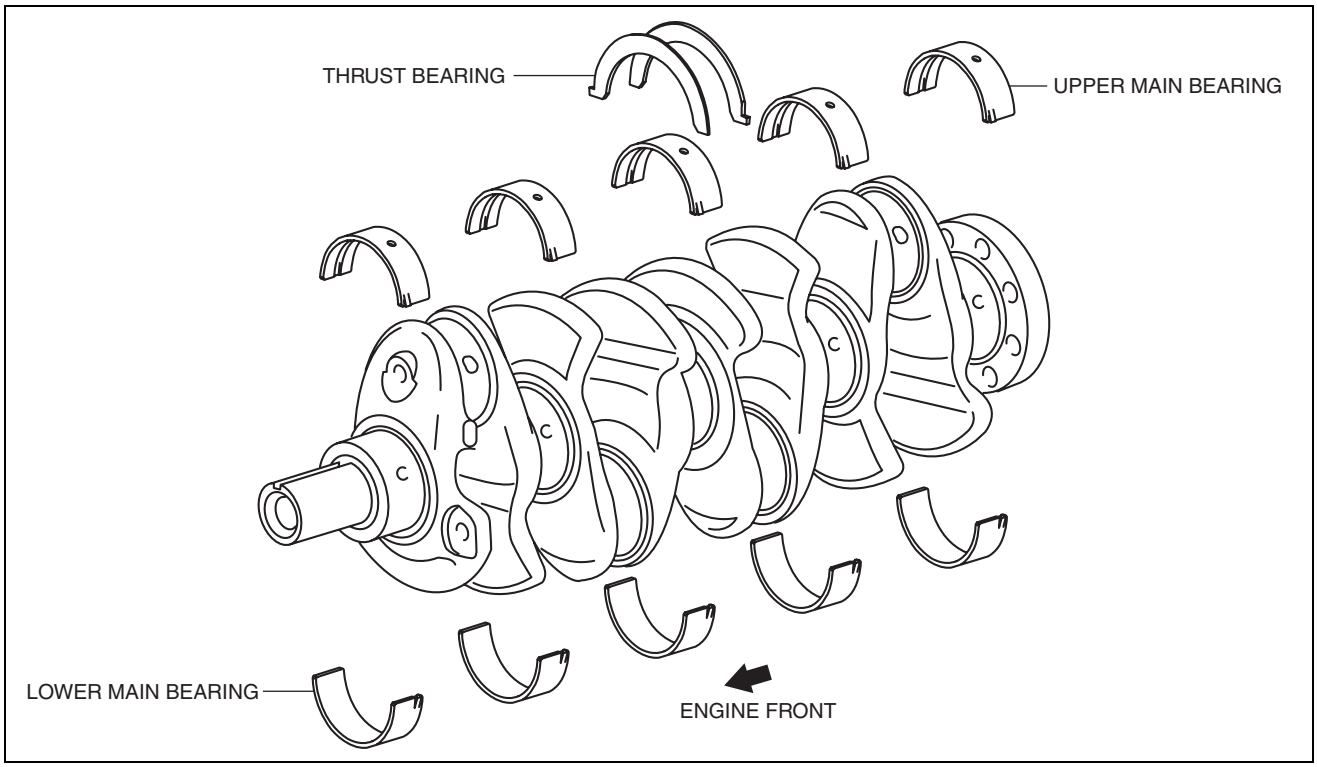
* : A type of heat processing method which improves hardness and strength only at the surface of the metal.

Main bearing

- The main bearing is installed to the outer surface of the crankshaft journal.
- The upper main bearing and lower main bearing are made of aluminum alloy.
- The upper main bearing has an oil groove and oil hole.

- Thrust force is suppressed by the thrust bearings on both sides of the No.3 journal.



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PISTON, PISTON RING, PISTON PIN [SKYACTIV-D 2.2]

id0110s5000700

Purpose, Function

Piston

- The piston in the cylinder of the cylinder block moves reciprocally by the pressure received when the air-fuel mixture combusts.

Piston ring

- The compression ring prevents leakage of pressure in the cylinder from the piston circumference.
- The oil ring clears off extra engine oil adhered to the cylinder wall.
- The piston ring transmits piston heat to the cylinder wall to cool the piston.

Piston pin

- The reciprocating movement of the piston is transmitted to the connecting rod by the connection of the piston pin to connecting rod.

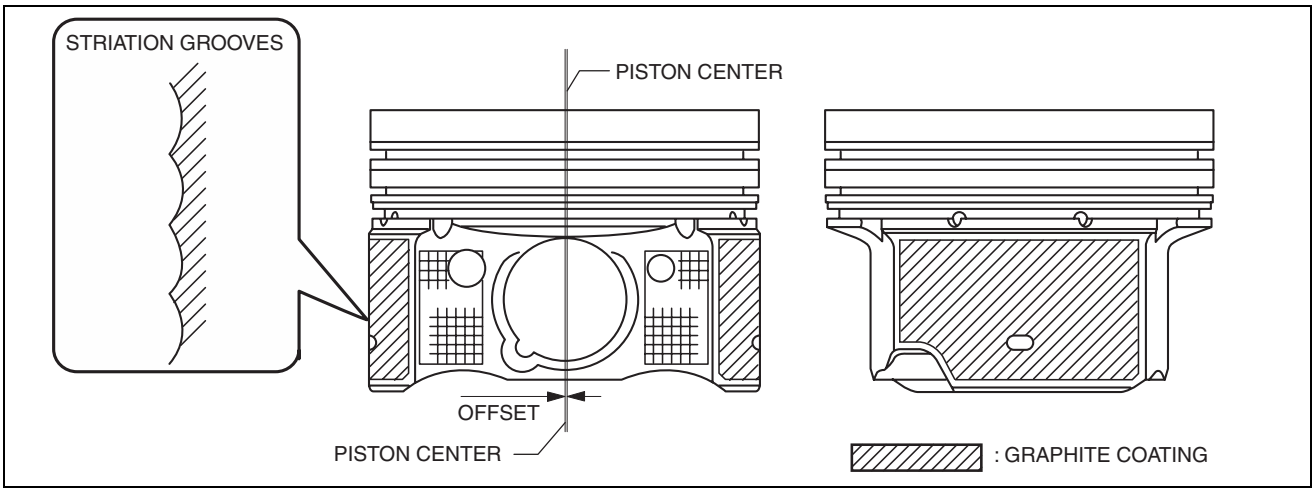
Construction

Piston

- An offset piston has been adopted in which the center of the piston has been offset from the piston center. As a result, piston slap is suppressed.
- Striation processing is employed on the piston skirt. As a result, engine oil is retained in the striation grooves so that an oil film is maintained between the piston skirt and the cylinder.

MECHANICAL [SKYACTIV-D 2.2]

- A graphite coating is applied to the piston skirt. As a result, sliding resistance is reduced.



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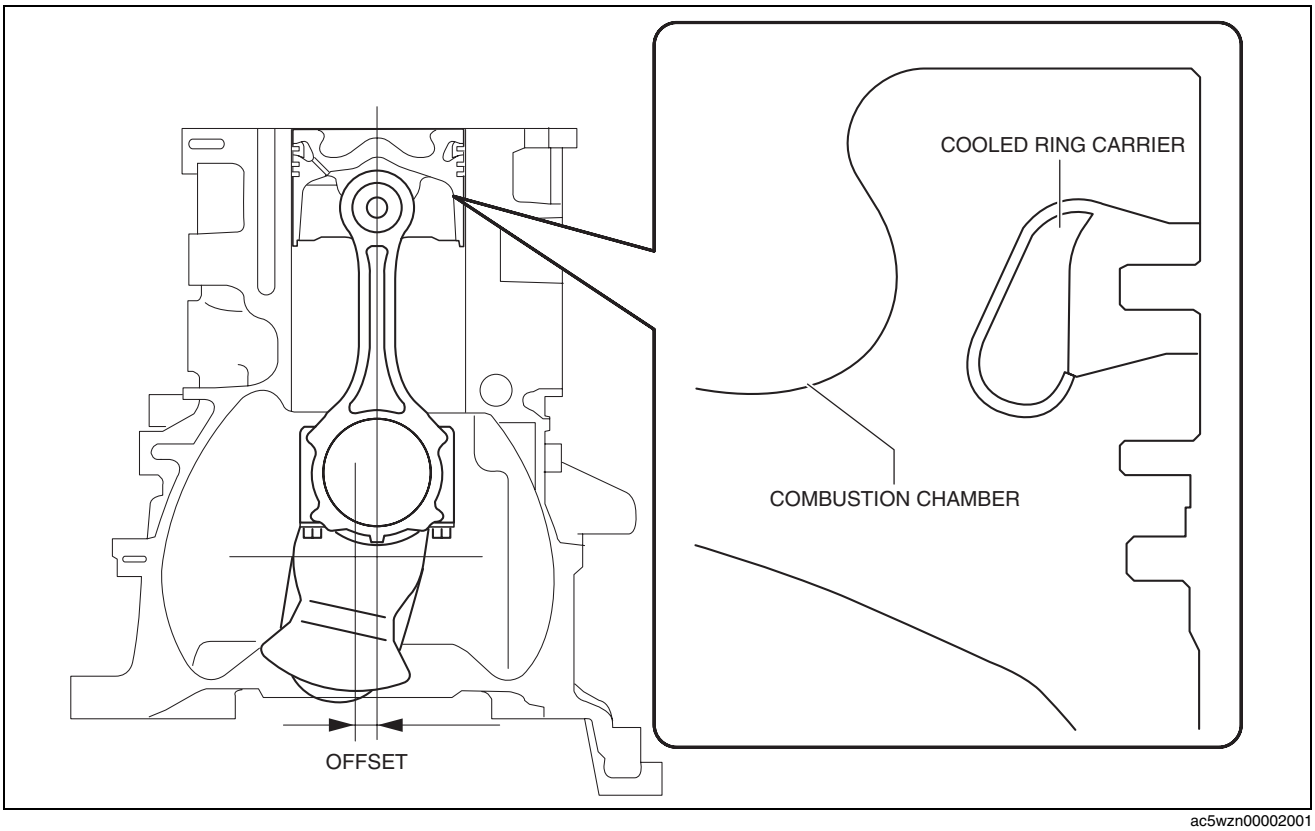
- The sliding resistance and part mass have been reduced by decreasing the surface area of the piston and the thickness, and reducing the piston pin diameter.
- With the adoption of a wide diameter combustion chamber for the piston, high engine output, low emission, and low fuel consumption have been realized.
- A cooled ring carrier has been adopted to the cooling grooves of the piston corresponding to the wide diameter combustion chamber. As a result, the temperature around the combustion chamber decreases efficiently.
- An offset crank has been adopted in which the center of the cylinder bore and the center of the crankshaft axle have been offset. As a result, the sliding resistance has been reduced by decreasing the piston-side force at the expansion stroke.



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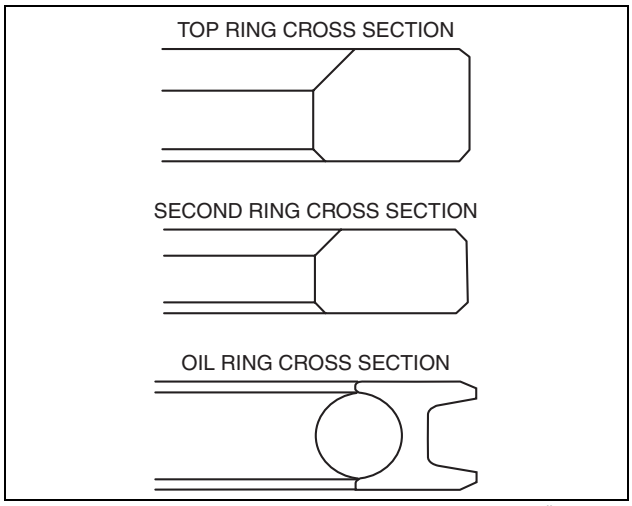
Piston ring

- A barrel-face ring for the top ring and a taper-face ring for the second ring have been adopted.
- A two-piece oil ring for the oil ring have been adopted.
- Tracking capability to the cylinder wall has been improved by thinning down the piston ring. As a result, a low-tension piston ring has been implemented without worsening the engine oil consumption, and the sliding resistance has been reduced during reciprocating movement.

- The sliding surfaces of the top ring and oil ring are subjected to PVD treatment to reduce the sliding resistance and improve engine oil consumption.



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Piston pin
- The piston is a full-floating type.

CONNECTING ROD, CONNECTING ROD BEARING [SKYACTIV-D 2.2]

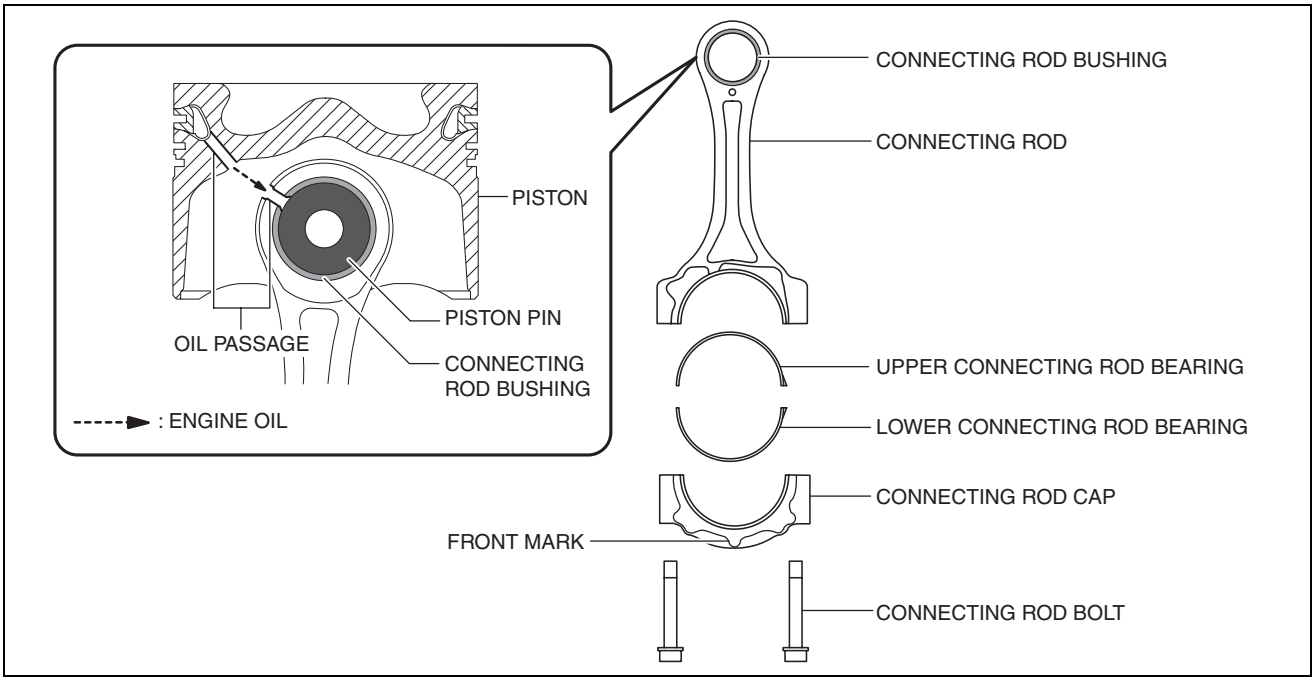
id0110s5000800

Purpose, Function
Connecting rod
- The connecting rod transmits the reciprocating movement of the piston to the crankshaft by engaging the piston pin and crank pin.

Connecting rod bearing
- The connecting rod bearing forms an oil film on the outer surface of the crank pin to prevent wear due to sliding.

Construction
Connecting rod
- The connecting rod is installed between the piston pin and crank pin.
- High-strength, forged carbon steel has been adopted for weight reduction.
- A cracking method[*1] for breaking off and separating the connecting rod from the connecting rod cap has been adopted for improved accuracy.
- Reciprocating inertial weight, including the piston, has been reduced with the use of a full-float type for the connection with the piston and further tapering of the small end shape.
- An oil film is formed on the inner surface of the connecting rod bushing by the engine oil supplied from the piston.
- With the adoption of the plastic region tightening method[*2] for the connecting rod bolt, the stability of the axial

force has been improved.



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*1 : Method of breaking off the large end proportion of the connecting rod after it has been integrally molded to separate the connecting rod from the connecting rod cap. When assembling the connecting rod and connecting rod cap, dowel pins are required to use the mating surface shape which was created during breaking process.

*2 : Plastic region tightening is a method of controlling the tightening using the rotation angle of a bolt. By tightening to the region (plastic tightening region) in which bolt deformation does not become irreversible, variation in axial force is suppressed.

Connecting rod bearing
- The connecting rod bearing is installed on the outer surface of the crank pin.
- The upper connecting rod bearing and lower connecting rod bearing are made of aluminum alloy.

ENGINE FRONT COVER [SKYACTIV-D 2.2]

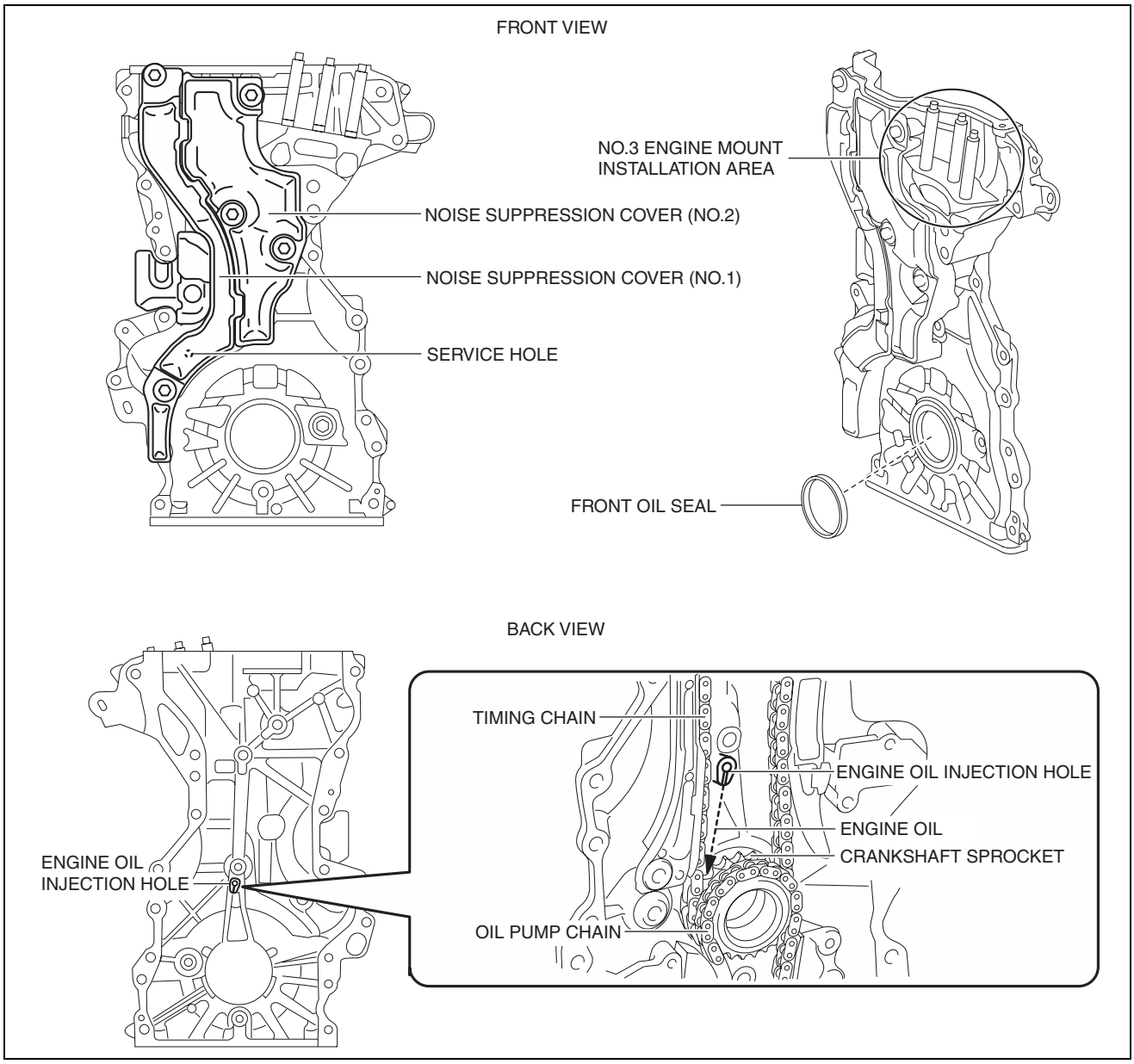
id0110s5000900

Purpose, Function
- The engine front cover covers the engine front to prevent engine oil spillage, noise leakage, and foreign material penetration.

Construction
- The engine front cover is installed to the engine front.
- The lightweight engine front cover is made of aluminum alloy with excellent noise absorption.

MECHANICAL [SKYACTIV-D 2.2]

- The engine front cover has the following parts shown in the figure.



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CRANKSHAFT PULLEY [SKYACTIV-D 2.2]

id0110s5001000

Purpose, Function

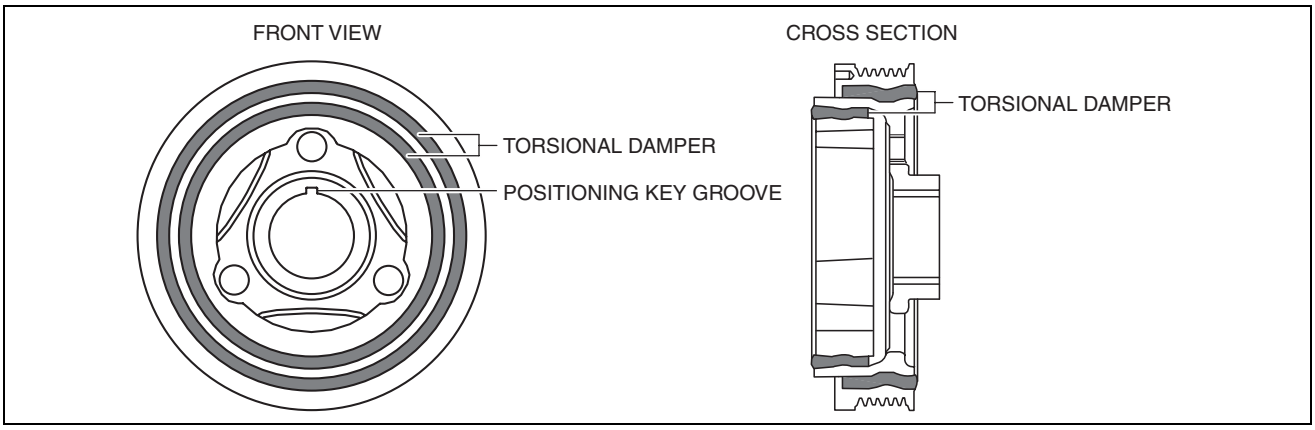
- The crankshaft pulley transmits the drive force to the auxiliary parts via the drive belt.
- The crankshaft pulley suppresses torsional vibration of the crankshaft.

Construction

- The crankshaft pulley is installed to the crankshaft front.
- The crankshaft pulley has key groove to match the timing to the crankshaft.

MECHANICAL [SKYACTIV-D 2.2]

- The crankshaft pulley has a torsional damper for suppressing torsional vibration of the crankshaft.



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DRIVE BELT [SKYACTIV-D 2.2]

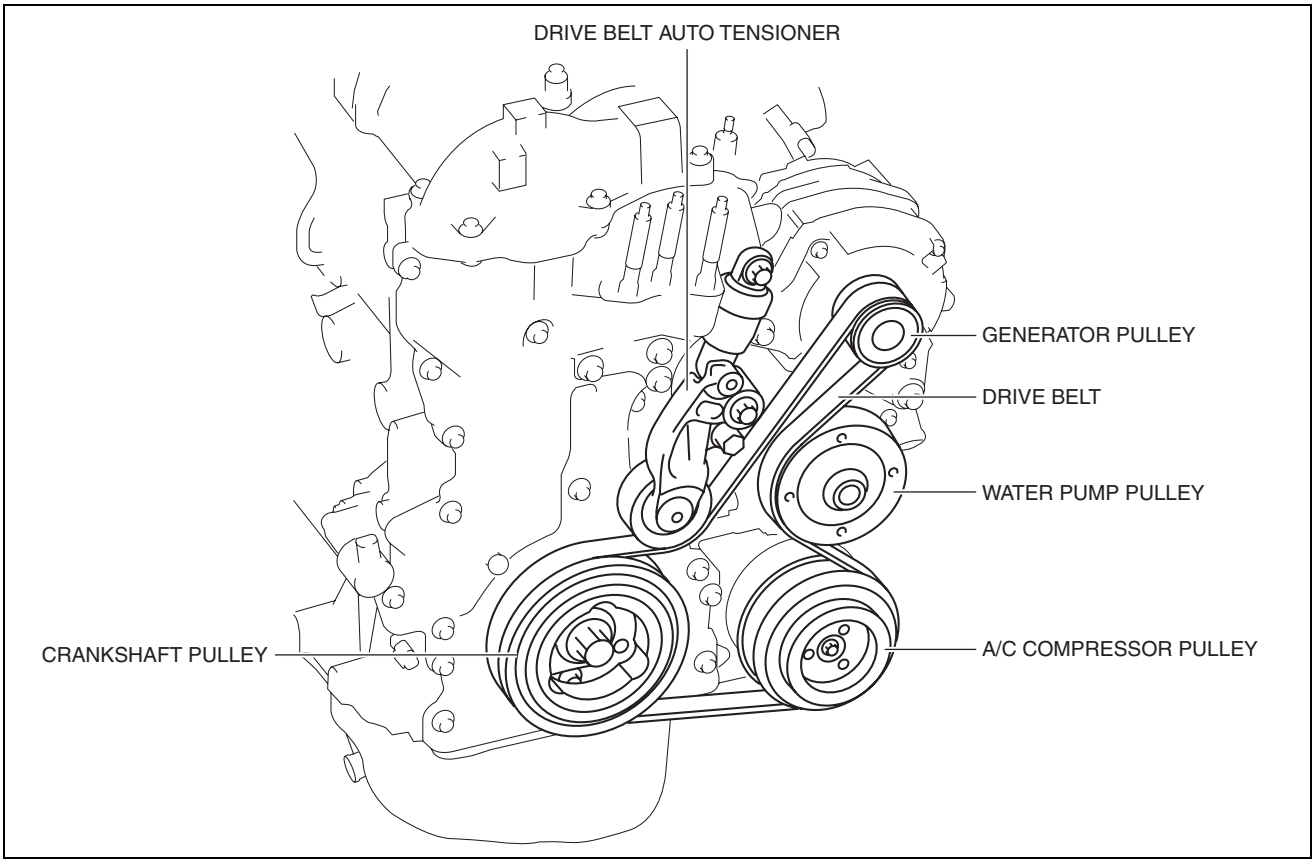
id0110s5001100

Purpose, Function

- The drive belt transmits rotation force of the crankshaft pulley to the pulley for the auxiliary parts.

Construction

- The drive belt is installed to the engine front.



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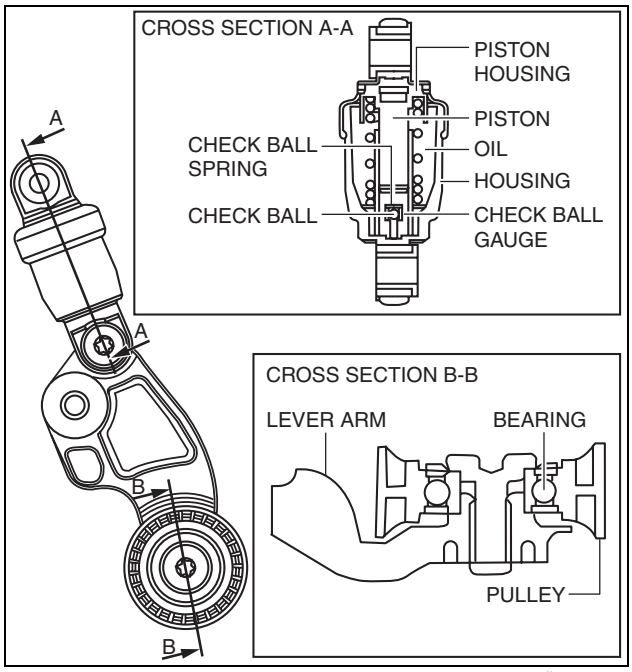
- A V-ribbed belt has been adopted for the drive belt.

- With the adoption of the oil pressure type drive belt auto tensioner, the change in tension by the oil pressure damper operation is absorbed. As a result, the sliding resistance has been reduced by lowering the drive belt tension setting.



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VALVE MECHANISM [SKYACTIV-D 2.2]

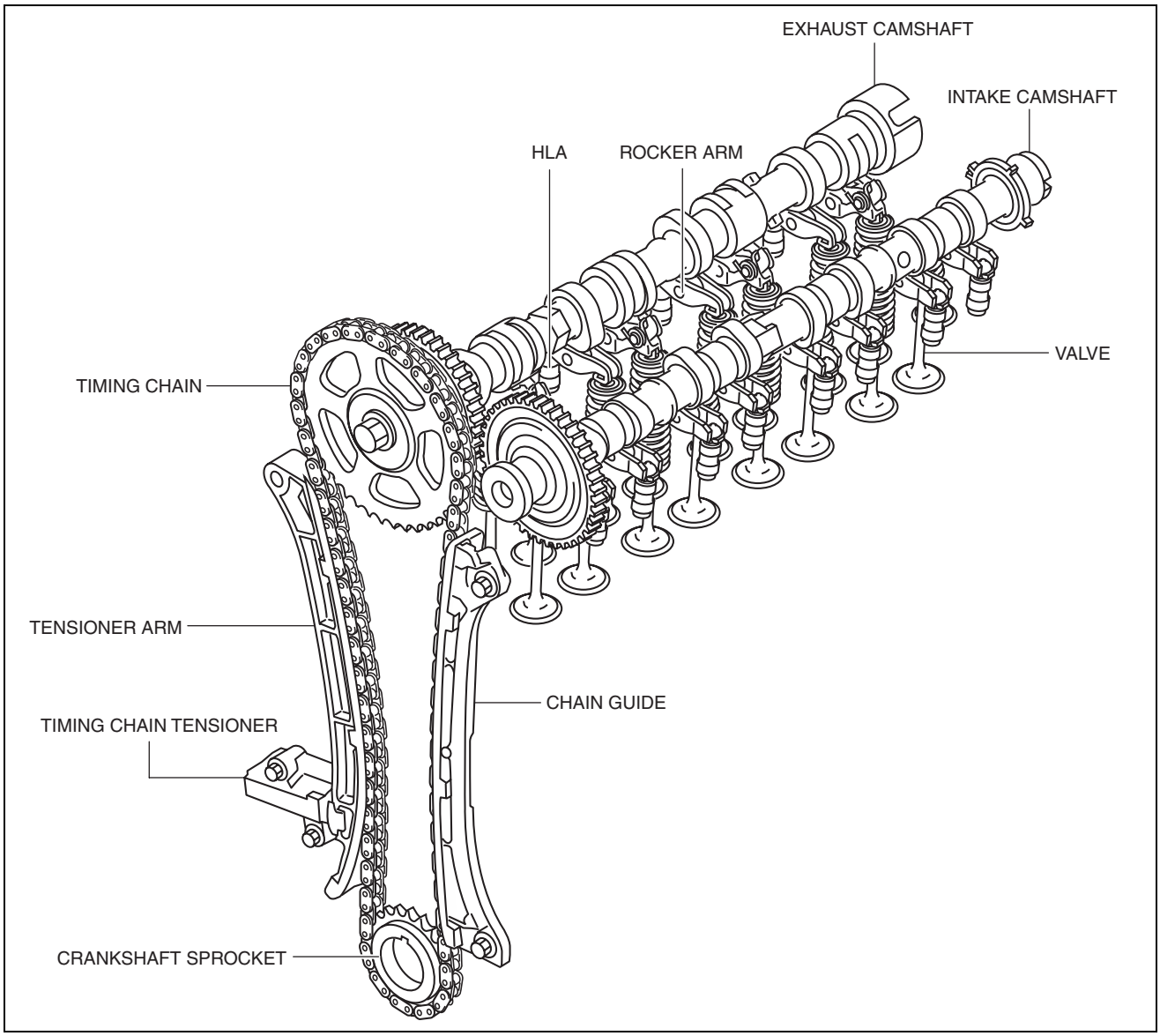
id0110s5001200

Outline

- A DOHC type valve system has been adopted and consists of four valves (two intake valves and two exhaust valves) per cylinder for a total of 16 valves operated by two camshafts.

MECHANICAL [SKYACTIV-D 2.2]

Structural View



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VALVE, VALVE SPRING, VALVE SEAL, VALVE GUIDE [SKYACTIV-D 2.2]

id0110s5001300

Purpose, Function

Valve

- The intake valve is pressed down by the cam, the intake air passage is opened, and air is introduced into the cylinder.
- The exhaust valve is pressed down by the cam, the exhaust air passage is opened, and combustion gas is exhausted from the cylinder.

Valve spring

- The valve spring adheres to the valve seat by pulling up the valve by spring force, and air tightness in the combustion chamber is maintained.

Valve seal

- The valve seal prevents engine oil from entering combustion chamber through the valve guide, and engine oil consumption is suppressed.

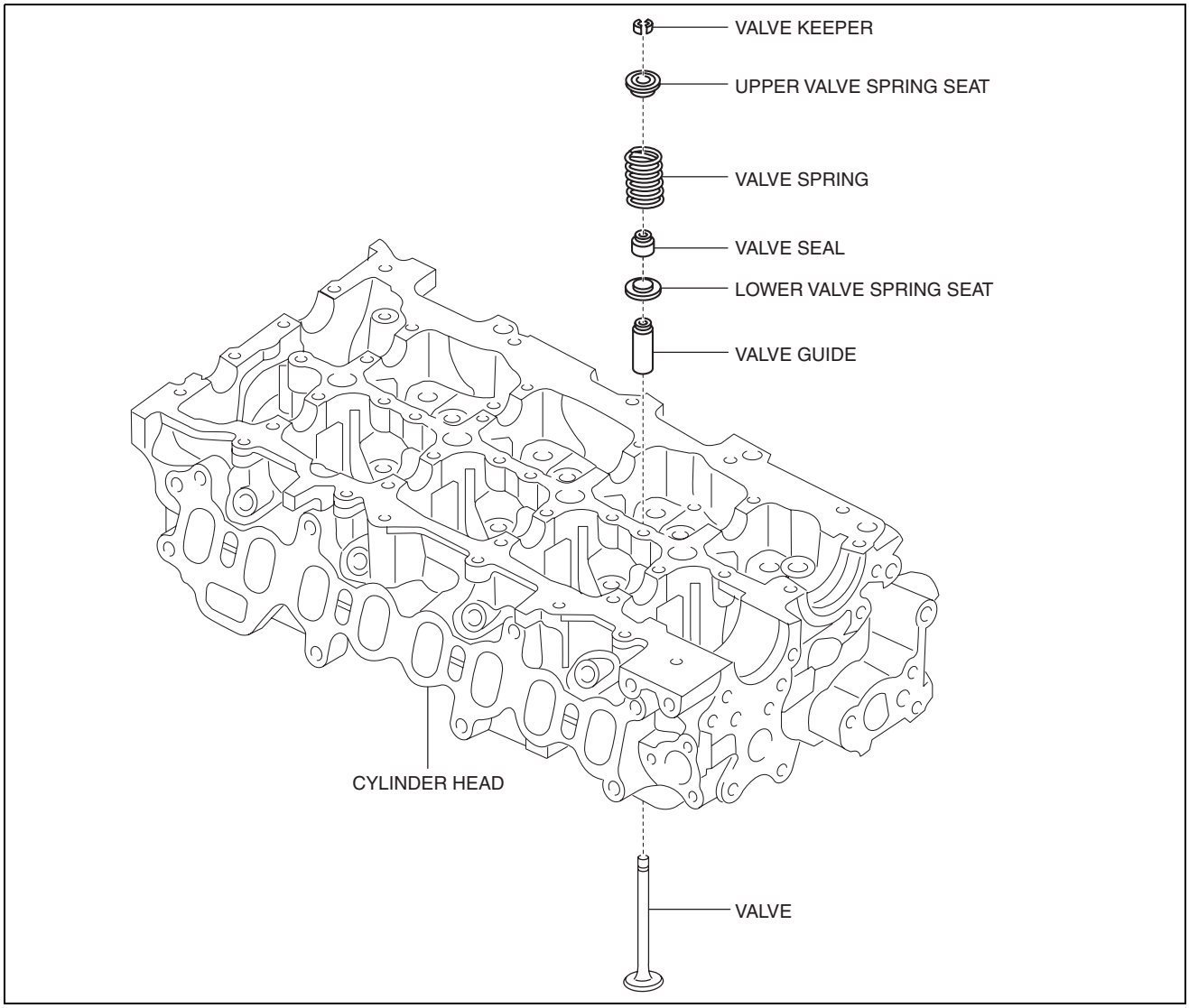
Valve guide

- The valve guide maintains the valve stem to open and close the valve smoothly.
- The valve guide cools the valve by transmitting valve heat to the cylinder head.

MECHANICAL [SKYACTIV-D 2.2]

Construction

- The valve, valve spring, valve seal, and valve guide are assembled to the cylinder head as a single unit.



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- The sliding resistance has been reduced by setting the valve spring load to the required minimum.
- The intake valve and exhaust valve are subjected to a salt-bath, soft-nitriding treatment to enhance wear resistance.
- Unequal pitch valve spring has been adopted.
- The valve guide is made of sintered alloy with excellent wear resistance.

CAMSHAFT [SKYACTIV-D 2.2]

id0110s5001400

Purpose, Function

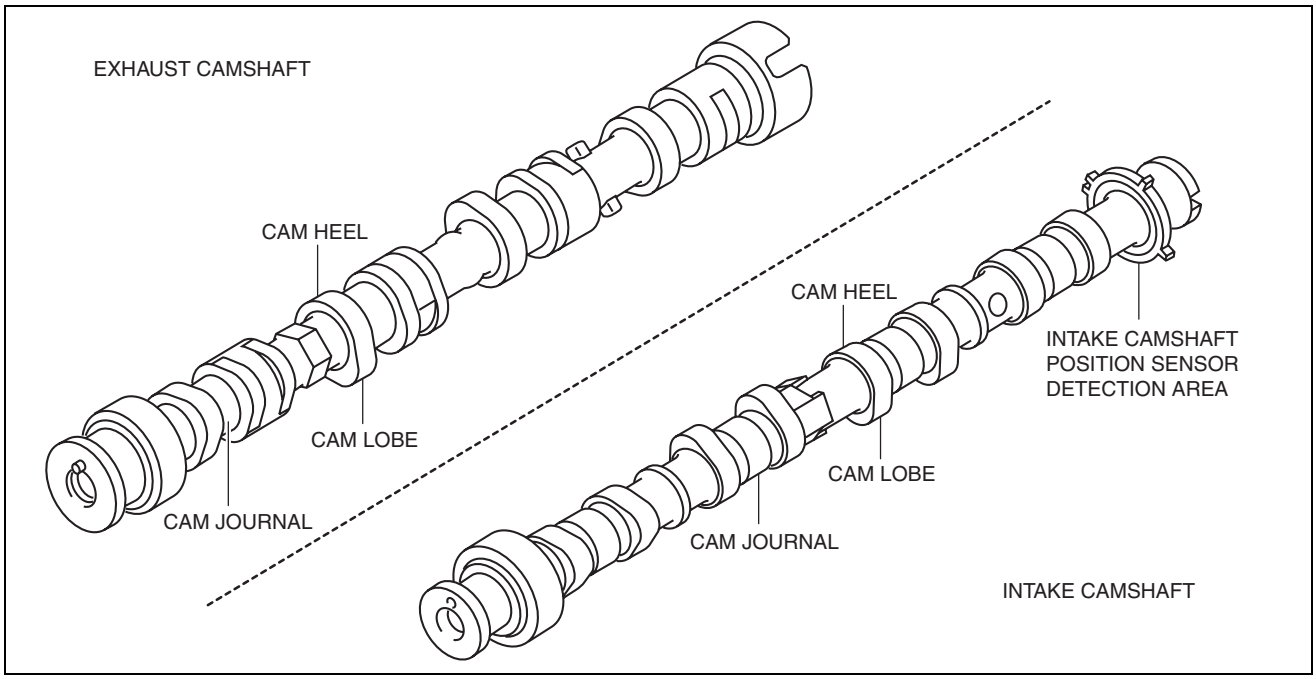
- The camshaft is rotated by receiving the rotation force of the crankshaft via the timing chain. The valve is opened and closed according to the cam shape at this time.

Construction

- The camshaft is installed to the cylinder head.

MECHANICAL [SKYACTIV-D 2.2]

- The cam has been induction hardened. As a result, resistance to abrasion has been enhanced.



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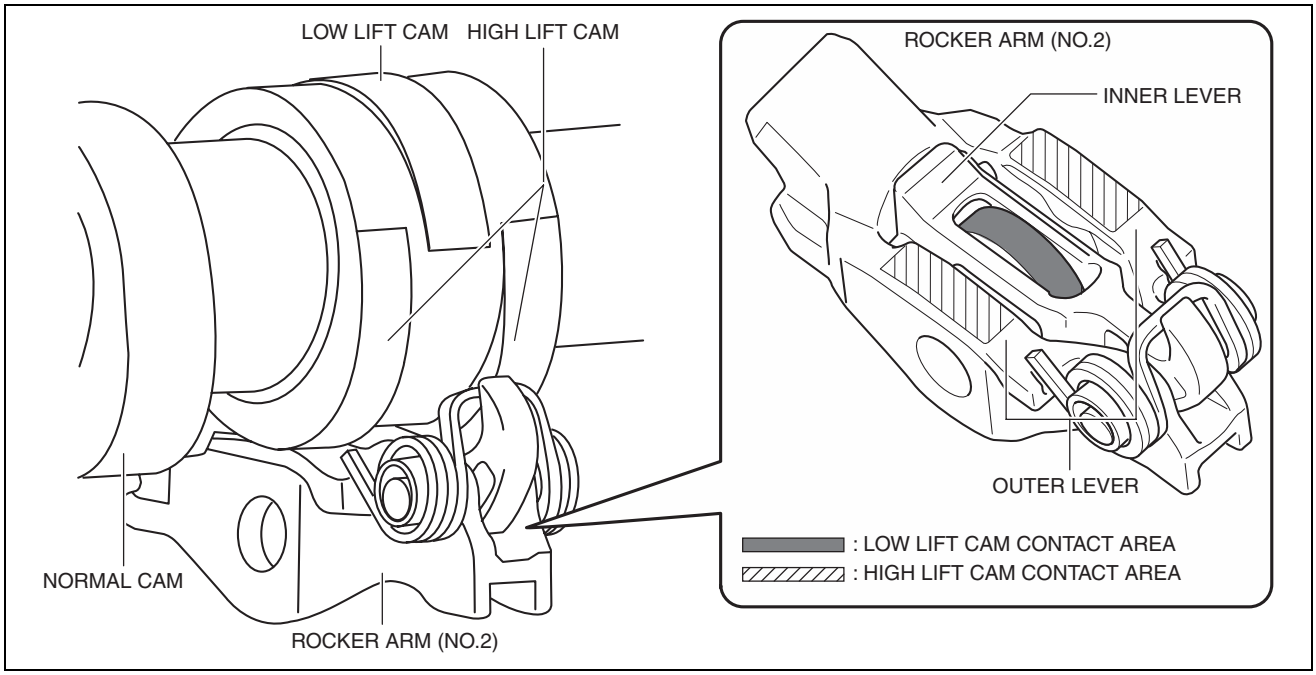
- The exhaust camshaft uses three types of cams (normal cam, high lift cam, low lift cam) with different shapes.
- The normal cam presses the rocker arm (No.1) down, and the high lift cam and low lift cam press the rocker arm (No.2) down. (See 01-10B-19 HYDRAULIC LASH ADJUSTER, ROCKER ARM [SKYACTIV-D 2.2].)
- The phase of the low lift cam deviates because the exhaust valve opens (variable valve lift) two times during 1 cycle. (See 01-10B-29 VARIABLE VALVE LIFT MECHANISM [SKYACTIV-D 2.2].)



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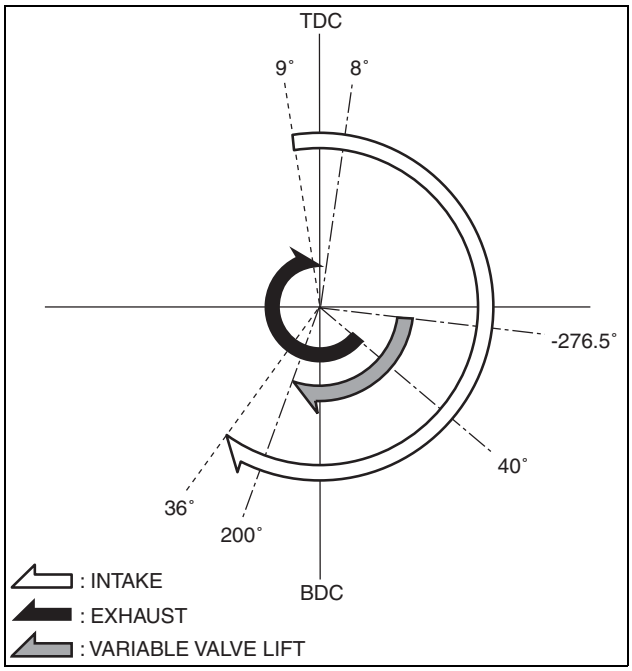
MECHANICAL [SKYACTIV-D 2.2]

Valve timing



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Valve timing	IN	Open	BTDC (°)	9
		Closed	ABDC (°)	36
	EX	Open	BBDC (°)	40 (VARIABLE VALVE LIFT : -276)
		Closed	ATDC (°)	8 (VARIABLE VALVE LIFT : 200)

TIMING CHAIN, CHAIN TENSIONER [SKYACTIV-D 2.2]

id0110s5001500

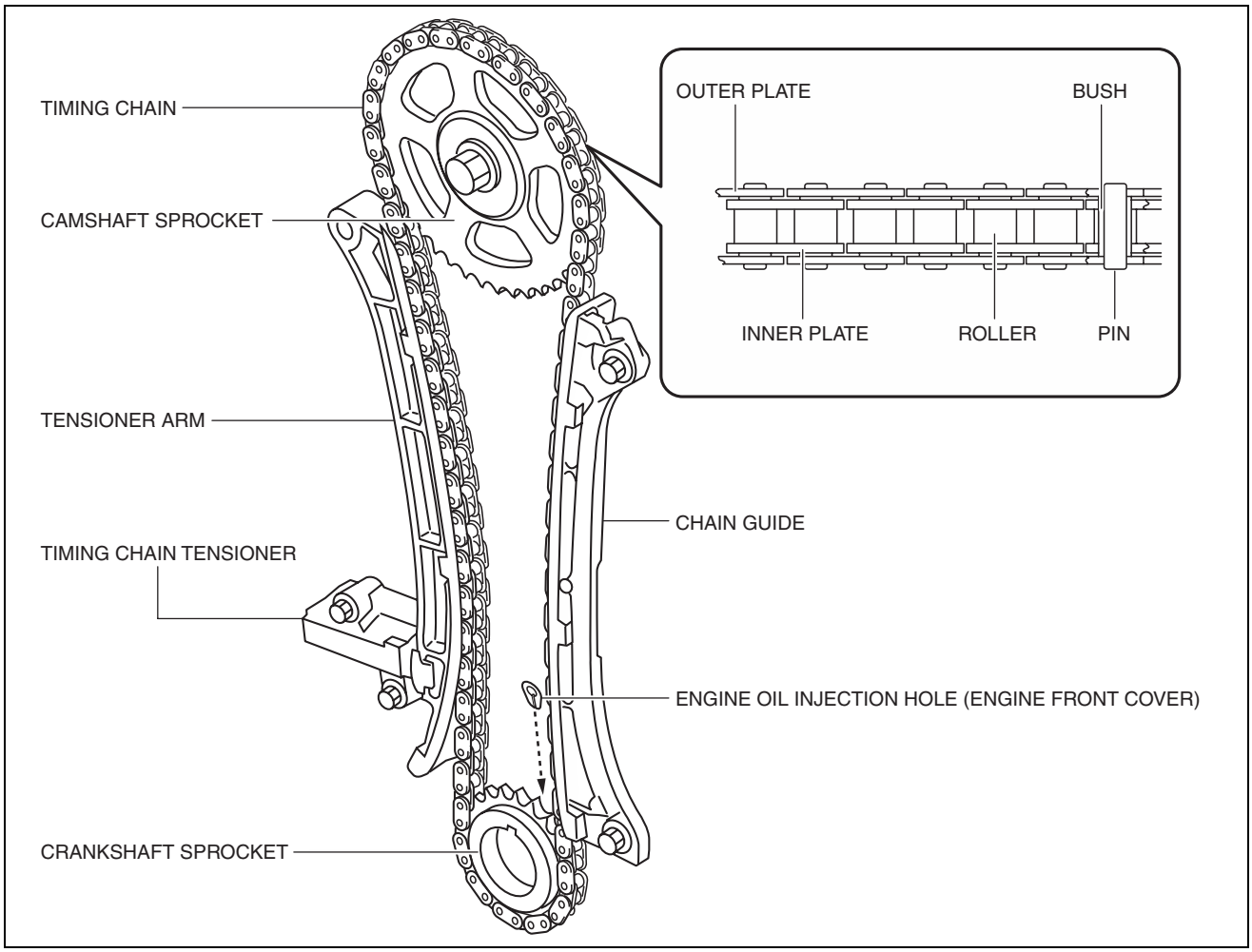
Purpose, Function
Timing chain
- The timing chain transmits the rotation force of the crankshaft to the camshaft to perform the rotation timing of the crankshaft and camshaft.

Chain tensioner
- The chain tensioner constantly maintains the timing chain tension and the timing chain operation is stabilized.

Construction
Timing chain
- The timing chain is installed between the camshaft sprocket and crankshaft sprocket.

MECHANICAL [SKYACTIV-D 2.2]

- Lubrication of the timing chain and each sprocket is performed using the engine oil from the engine front cover.



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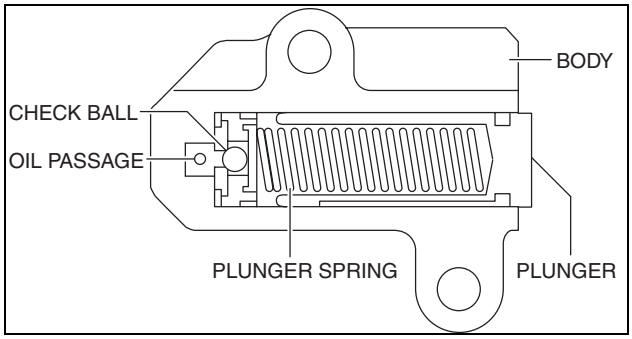
Chain tensioner

- The chain tensioner is installed to the cylinder block (engine front).
- An oil pressure type chain tensioner has been adopted for the chain tensioner.

OPERATION

Chain tensioner

- Tension fluctuation on the timing chain is suppressed by hydraulic pressure and tension is held constant by spring force.



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HYDRAULIC LASH ADJUSTER, ROCKER ARM [SKYACTIV-D 2.2]

id0110s5009200

Purpose, Function

HLA

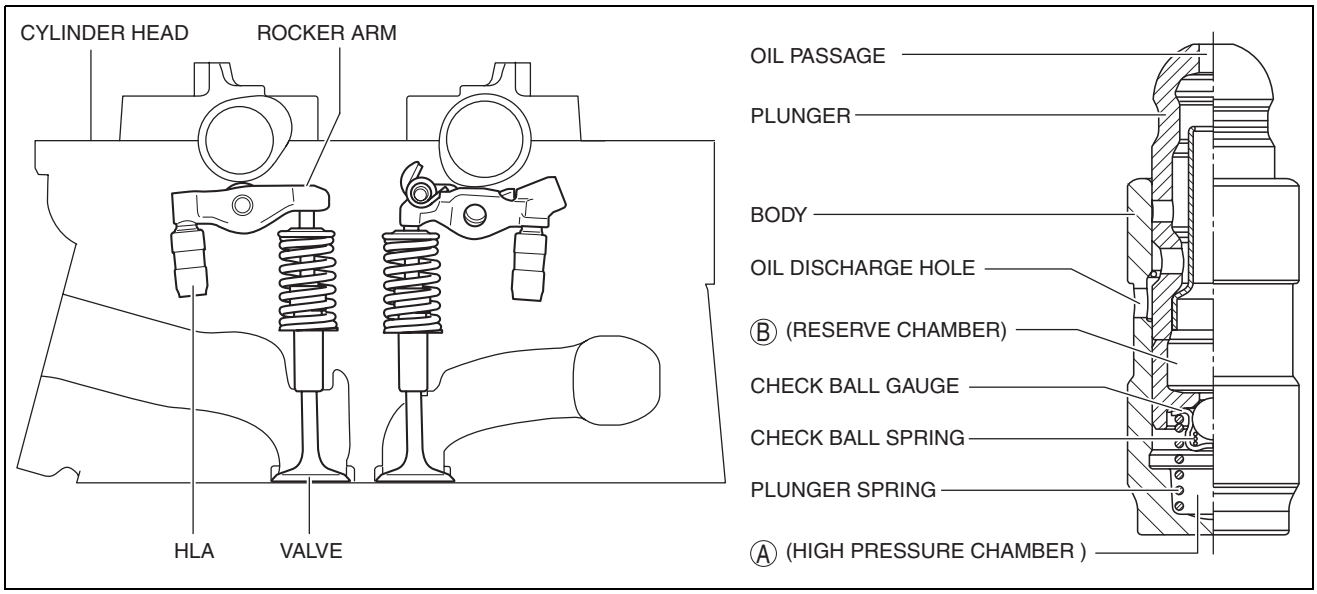
- The HLA maintains the valve clearance at a constant 0 mm and maintenance-free valve clearance is realized.

Rocker arm

- With the adoption of the rocker arm built into the needle roller bearing, the contact to the cam employs rolling

contact to reduce sliding resistance.
- The rocker arm (No.2) is a constituent part of the exhaust valve lift mechanism. Opens the exhaust valve of the cylinder on the intake stroke to re-circulate a part of the exhaust gas into the cylinder.

Construction
HLA
- The HLA is installed to the cylinder head.



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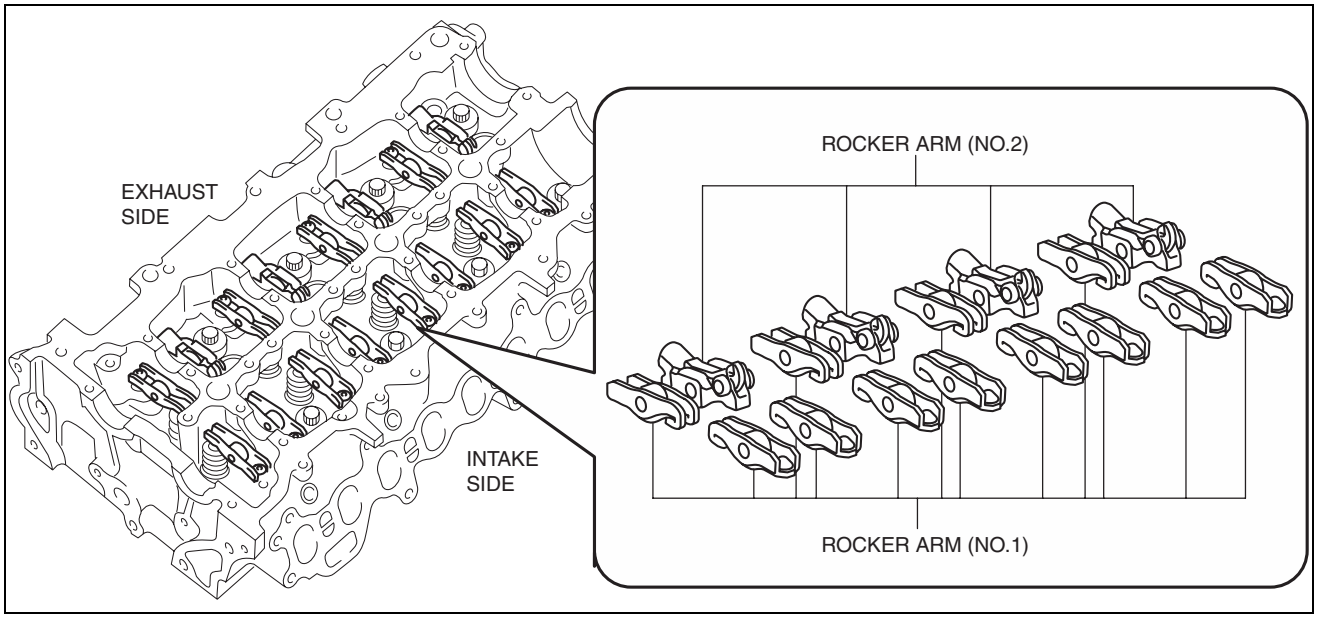
Rocker arm
- The rocker arm is installed to the HLA and upper area of the valve.
- The rocker arm (No.2) is a constituent part of the exhaust valve lift mechanism. Opens the exhaust valve of the cylinder on the intake stroke to re-circulate a part of the exhaust gas into the cylinder.



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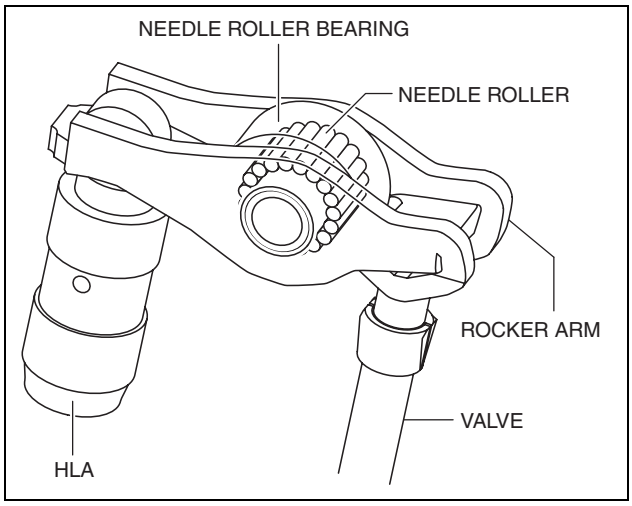
MECHANICAL [SKYACTIV-D 2.2]

- The needle roller bearing is built into the rocker arm.



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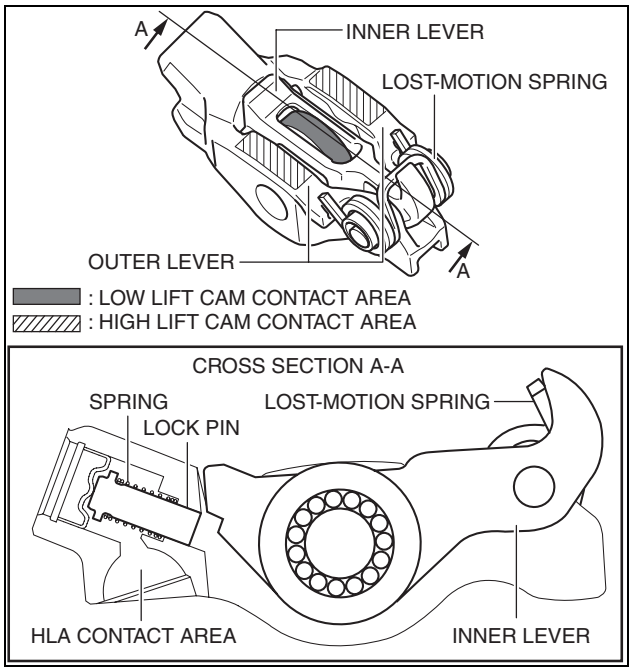
- The rocker arm consists of the following parts:



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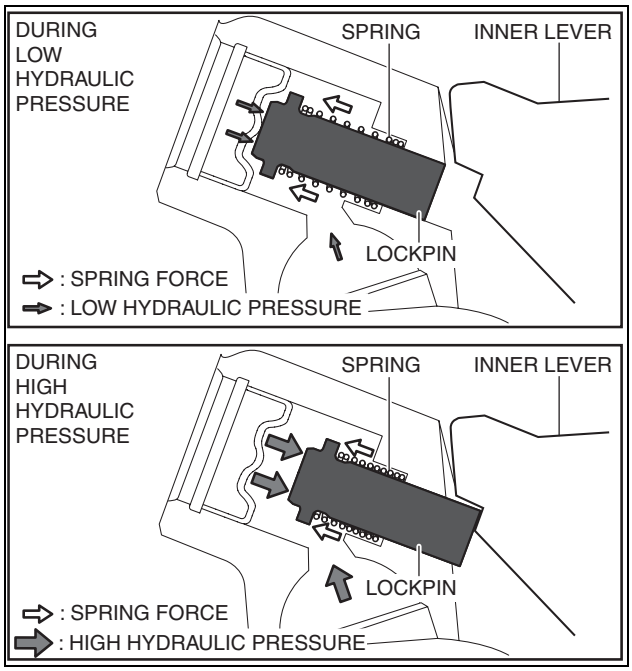
Part name	Function
Outer lever	The outer lever is pressed to the down position by contact with the high lift cam of the exhaust camshaft.
Inner lever	The inner lever is pressed to the down position by contact with the low lift cam of the exhaust camshaft. By fixing the inner lever with the lock pin, power is transmitted to the outer lever.
Lock pin	Fixes the inner lever to the outer lever.
Spring	Presses the lock pin back.
Lost-motion spring	Lifts up the inner lever by spring force when the inner lever is pressed down while not being fixed.

MECHANICAL [SKYACTIV-D 2.2]

- The rocker arm (No.2) operates by hydraulic pressure. This hydraulic pressure is switched in two steps (low hydraulic pressure, high hydraulic pressure) by the OCV. (See 01-10B-26 OIL CONTROL VALVE (OCV) [SKYACTIV-D 2.2].)



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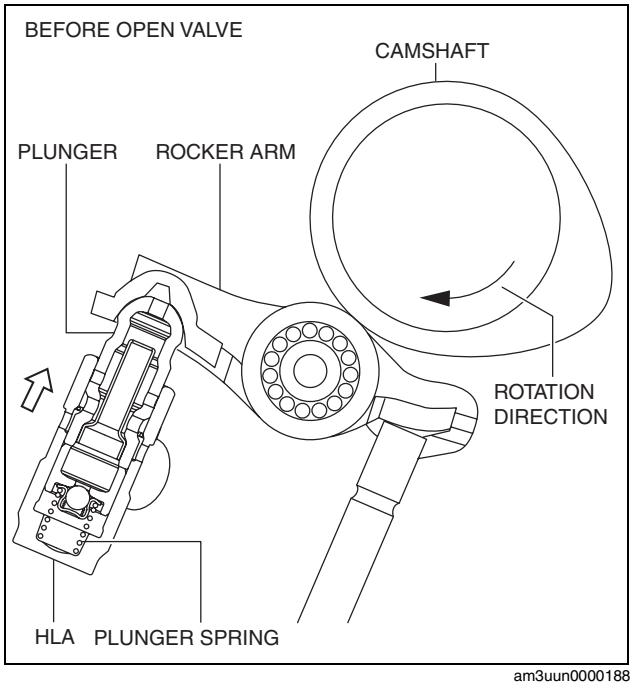
During low hydraulic pressure	The lock pin does not move because the spring force is greater than the hydraulic pressure.
During high hydraulic pressure	Because the hydraulic pressure is greater than the spring force, the lock pin is pressed out.

Operation

Before opening

1. The plunger presses up the rocker arm by the spring force of the plunger spring to maintain the valve clearance at 0 mm.



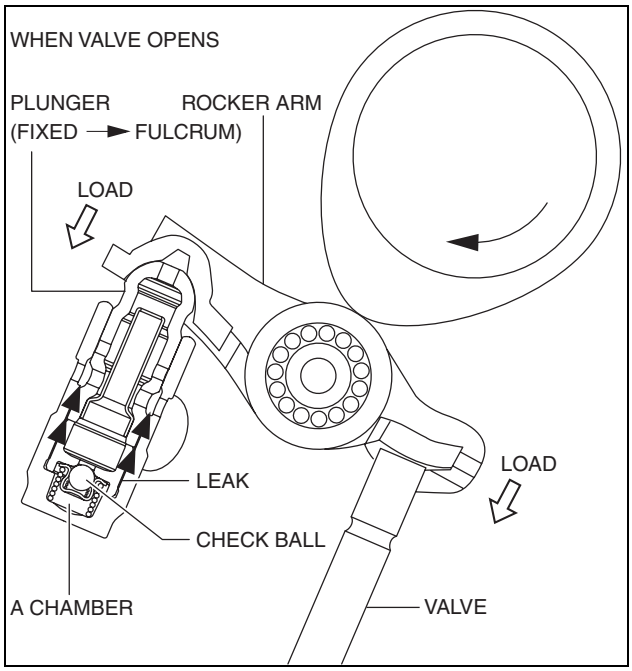
am3uun0000188

When opening

1. If the cam presses down the rocker arm, load is applied to the plunger and valve.
2. If load is applied to the plunger, the hydraulic pressure in the high pressure chamber (A chamber) increases and the check ball closes the hydraulic passage.
3. If the hydraulic passage is closed, the plunger is fixed becoming the rocker arm pivot point because the volume of the engine oil in the high pressure chamber is not changed.

MECHANICAL [SKYACTIV-D 2.2]

4. The rocker arm presses down the valve.



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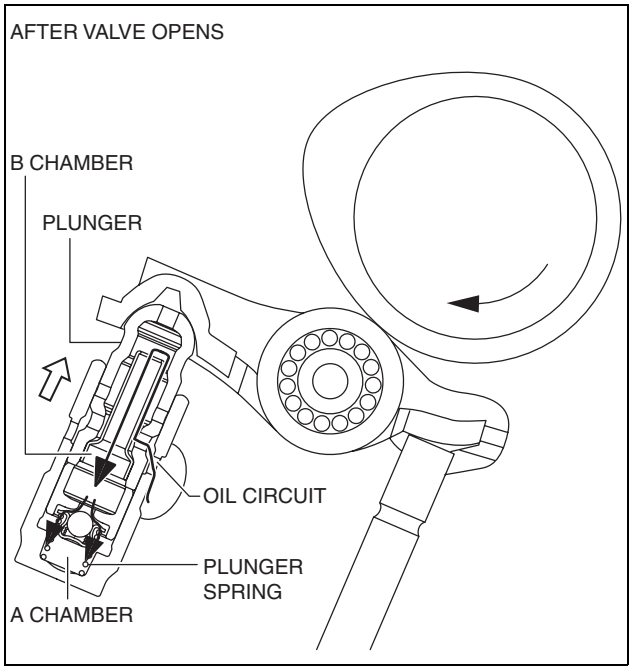
After opening

1. If load is not applied to the plunger, the plunger spring presses up the plunger (maintains valve clearance at 0 mm).
2. Because the capacity of the high pressure chamber (A chamber) increases in Step 1, the check ball is opened and engine oil flows from the reserve chamber (B chamber) to the high pressure chamber (A chamber) to prepare for the next step.
3. The oil in the reserve chamber (B chamber) which is decreased by supplying it to the high pressure chamber (A chamber), is supplied from the oil passage of the cylinder head.



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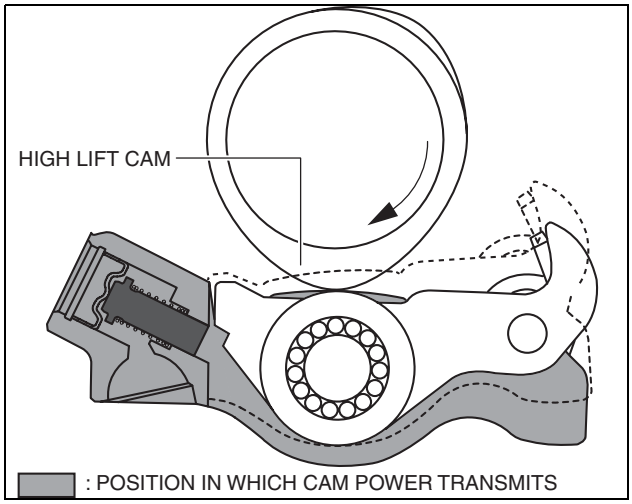
MECHANICAL [SKYACTIV-D 2.2]

Rocker arm (No.2)
OCV OFF

1. The high lift cam of the exhaust camshaft presses down the outer lever.



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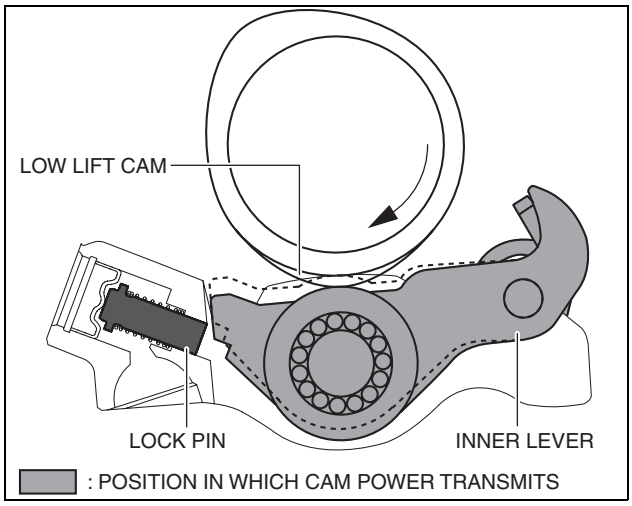
2. When the OCV is not operating, the inner lever is not fixed. For this reason, the low lift cam of the exhaust camshaft only presses down the inner lever.

OCV ON



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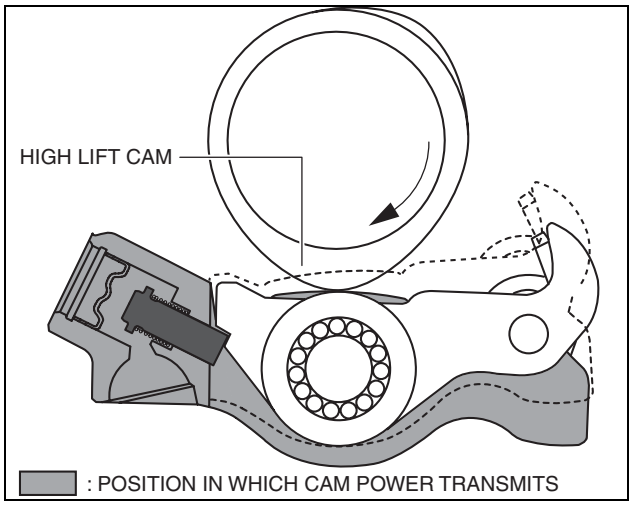
1. The high lift cam of the exhaust camshaft presses down the outer lever.



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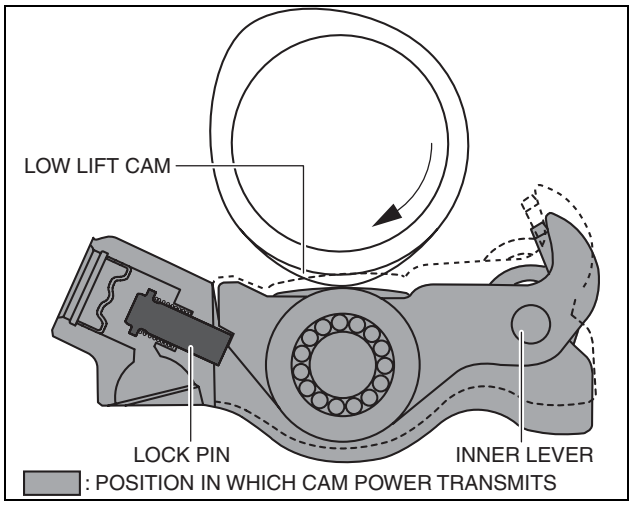
MECHANICAL [SKYACTIV-D 2.2]

2. When the OCV is operating, the inner lever is fixed to the outer lever. For this reason, the entire rocker arm (No.2) is pressed down when the low lift cam of the exhaust camshaft presses the inner lever.



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ENGINE MOUNT [SKYACTIV-D 2.2]

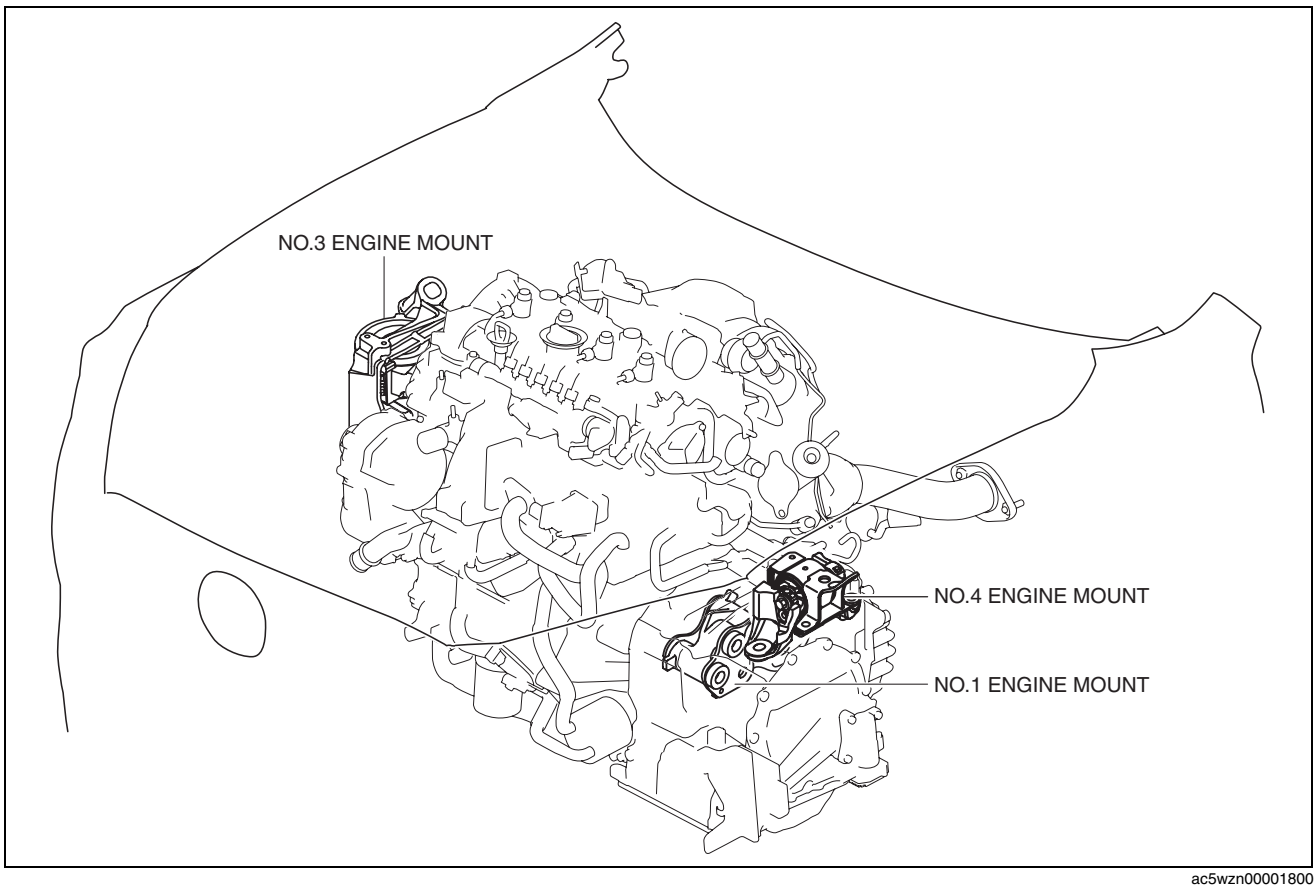
id0110s5001800

Purpose, Function

- The engine mount secures the engine and transaxle to the vehicle body, reducing vibration and noise.

Construction

- The three points at the engine front (No.3 engine mount), one side of the transaxle (No.1 engine mount), and the rear upper part of the transaxle (No.4 engine mount) are supported.



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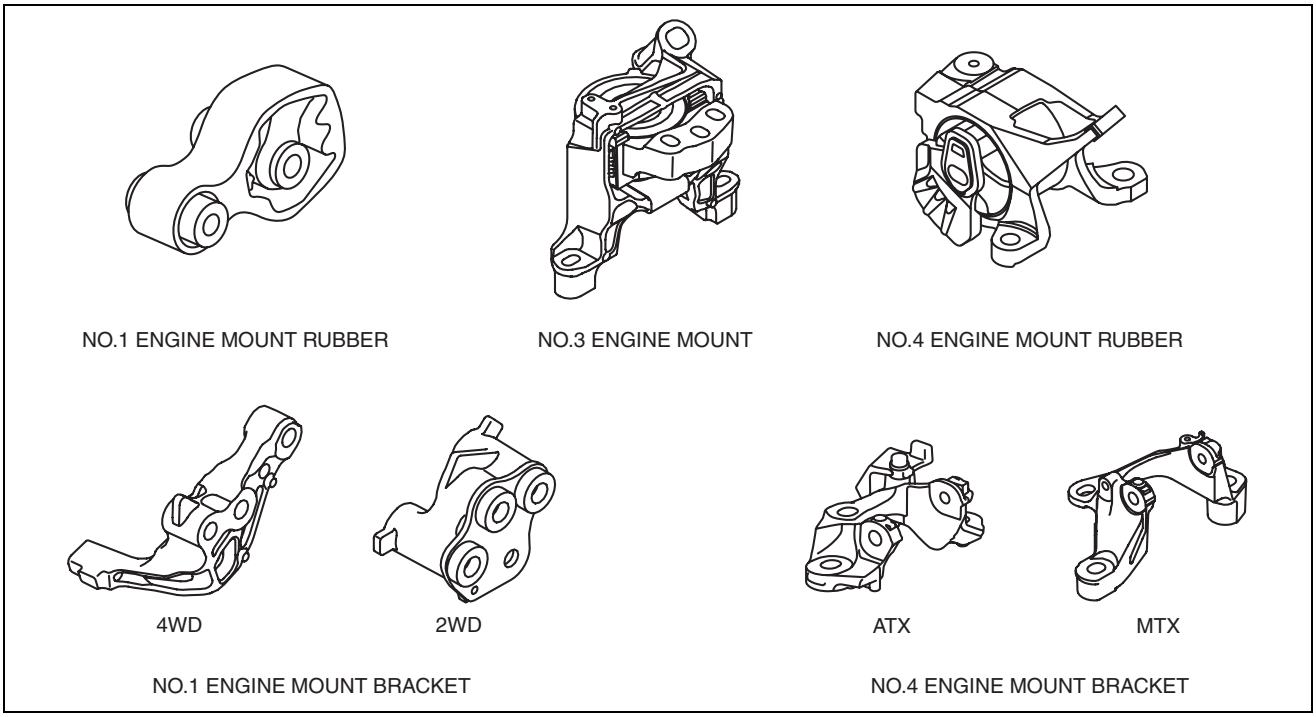
- With the adoption of the oil-filled bushing type for the No.3 engine mount, the damper effect has been

improved.



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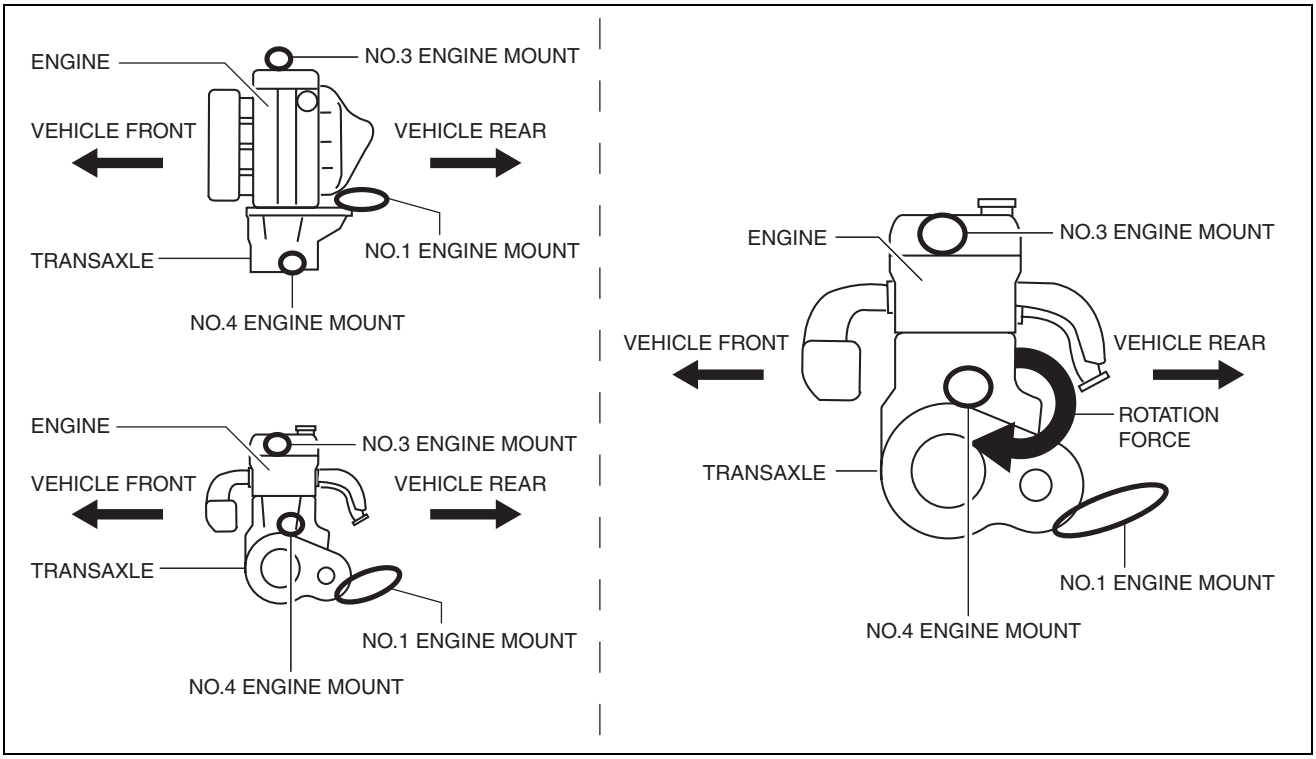
Operation

- By locating the one side of the transaxle (No.1 engine mount) to the transaxle lower end, the No.1 engine mount absorbs the rotation force to the powertrain generated during engine torque fluctuation, and the layout is designed to disperse the rotation force to the front/back directions of the engine.



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OIL CONTROL VALVE (OCV) [SKYACTIV-D 2.2]

id0110s5001600

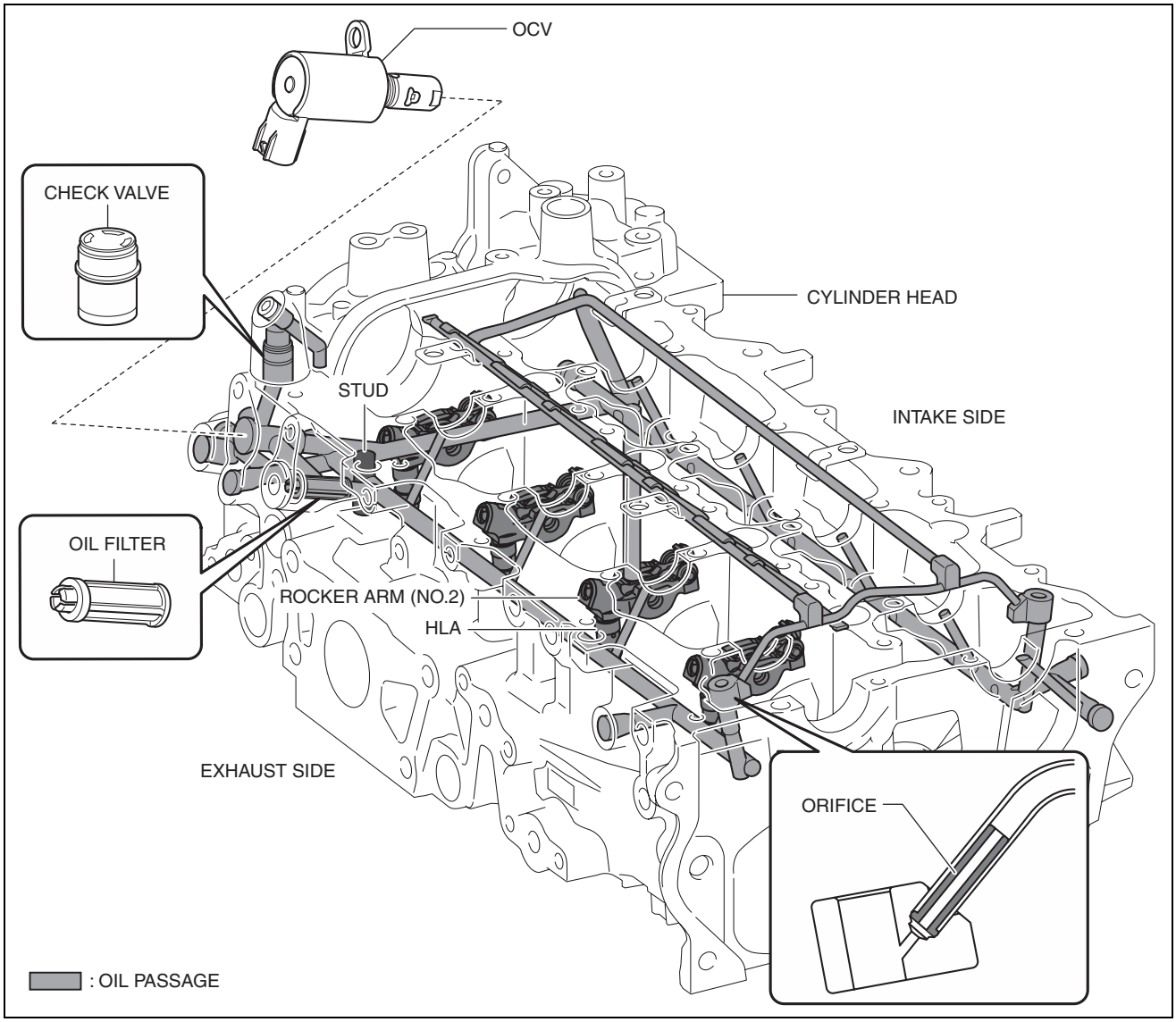
Purpose, Function

- The OCV switches the hydraulic transmission passage in the cylinder head to change the hydraulic pressure applied to lock pin of the rocker arm (No.2).

MECHANICAL [SKYACTIV-D 2.2]

Construction

- The OCV is installed to the rear right side of the cylinder head.



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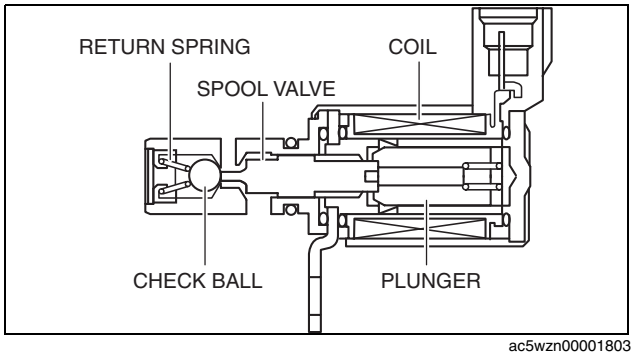
- The OCV consists of the following parts:
  - — Return spring
  - — Check ball
  - — Spool valve
  - — Coil
  - — Plunger



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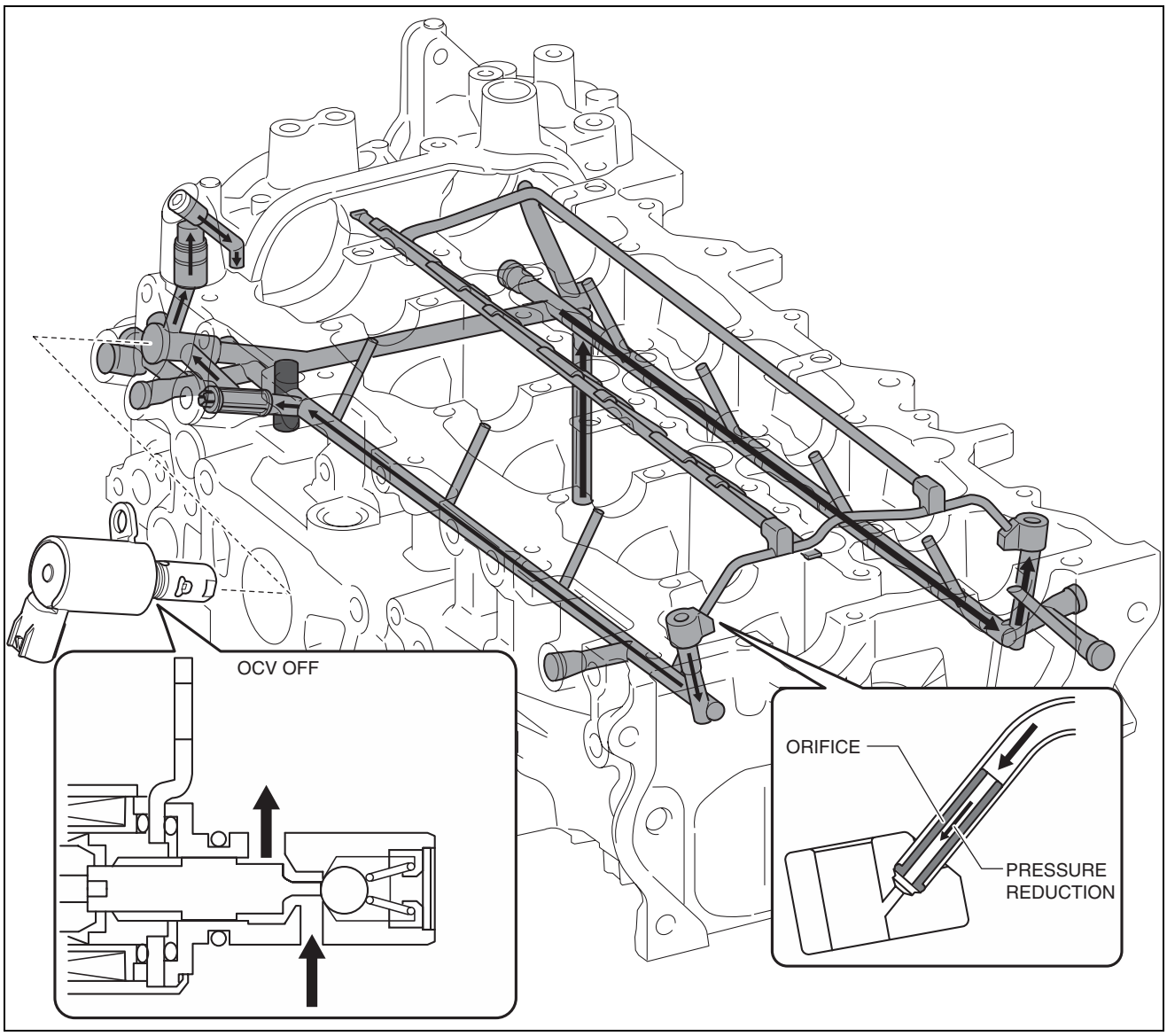
MECHANICAL [SKYACTIV-D 2.2]

Operation
OCV OFF

- Engine oil (low hydraulic pressure) flows through the orifice in the hydraulic passage on the exhaust side.



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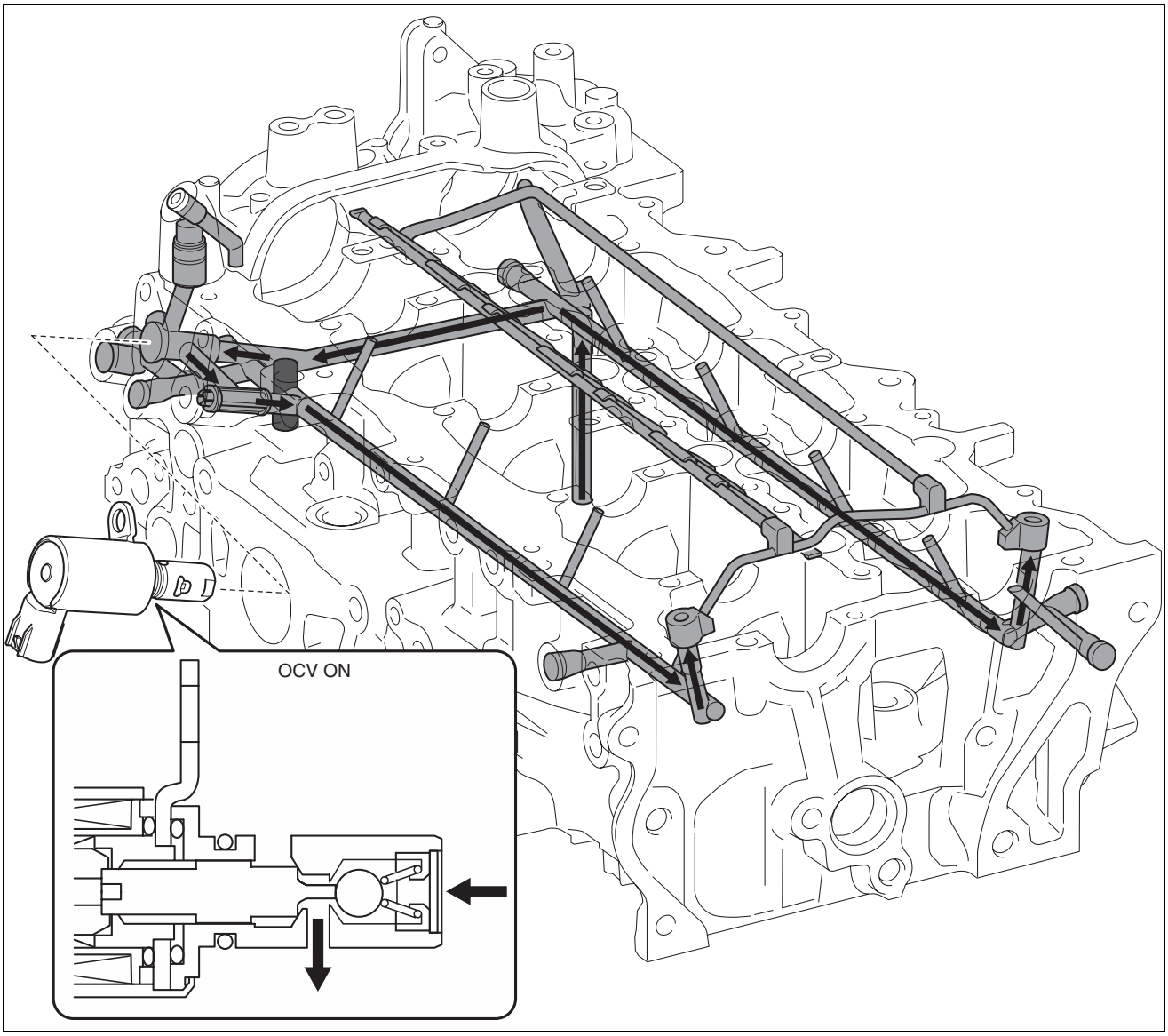
OCV ON

- Engine oil (high hydraulic pressure) not passing through the orifice flows in the hydraulic passage on the

exhaust side.



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VARIABLE VALVE LIFT MECHANISM [SKYACTIV-D 2.2]

id0110s5020000

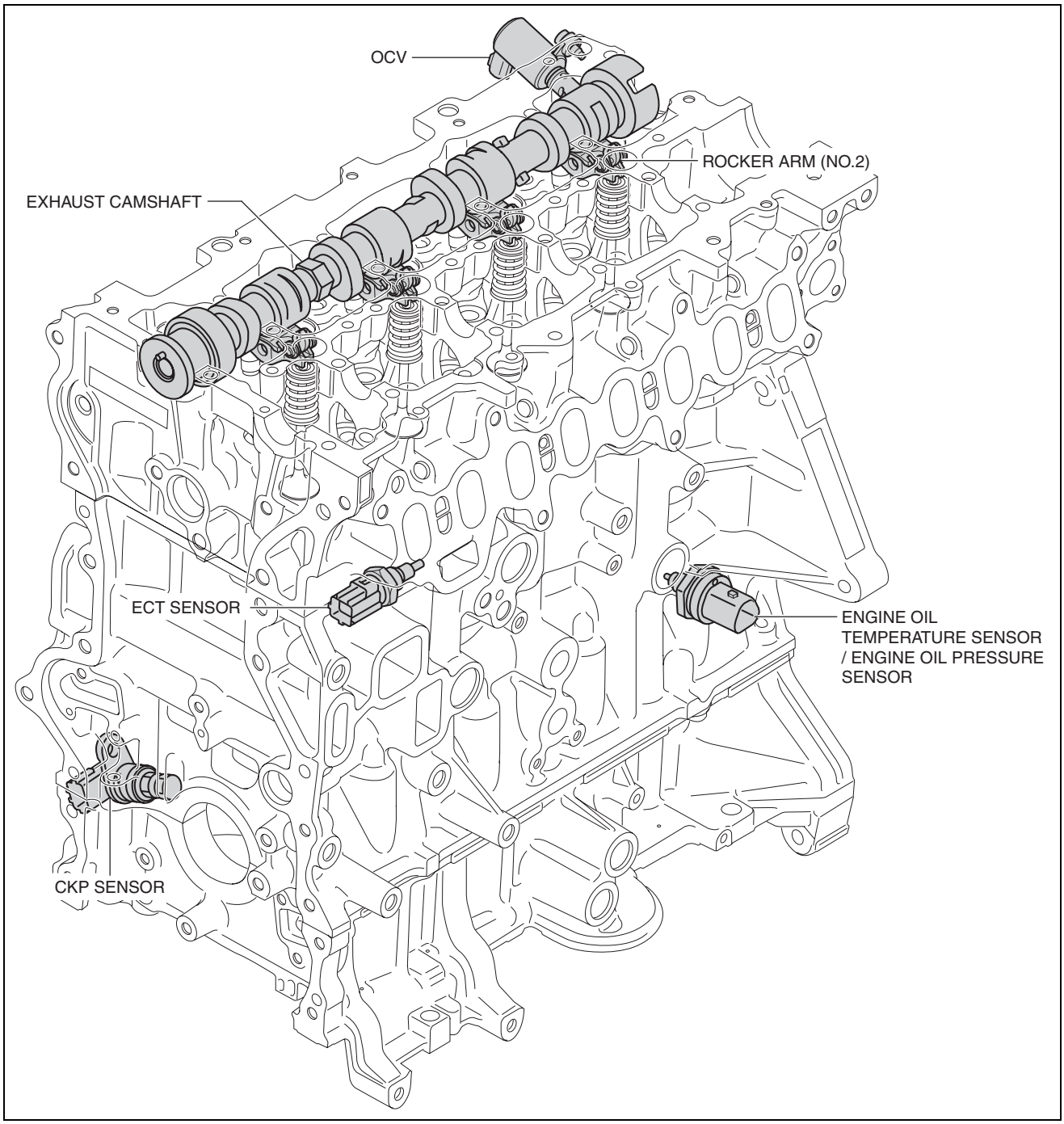
Outline

- A variable valve lift mechanism has been adopted to the SKYACTIV-D 2.2 in line with the lowering of the engine compression ratio to prevent ignition instability when the engine is cold.*1
- The variable valve lift mechanism re-circulates the exhaust gas back into the cylinder which increases the air temperature in the cylinder and improves the ignition stability of the engine during cold temperatures.

*1 : In the diesel engine, intake air is pressurized and fuel is injected at the point when the intake air is at high-temperature, and the fuel then self-ignites to produce combustion. Lowering the compression ratio makes it difficult for the fuel to self-ignite because the power (heating ability) to pressurize the intake air in the cylinder weakens causing misfire during cold engine starting.

MECHANICAL [SKYACTIV-D 2.2]

Structural View



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Structure

Part name	Function
OCV	(See 01-10B-26 OIL CONTROL VALVE (OCV) [SKYACTIV-D 2.2].)
Rocker arm (No.2)	(See 01-10B-19 HYDRAULIC LASH ADJUSTER, ROCKER ARM [SKYACTIV-D 2.2].)
Exhaust camshaft	(See 01-10B-16 CAMSHAFT [SKYACTIV-D 2.2].)
CKP sensor	
ECT sensor	
Engine oil temperature sensor / Engine oil pressure sensor	

Operation

1. The PCM switches the hydraulic transmission passage in the cylinder heads by operating the OCV. (See 01-

10B-26 OIL CONTROL VALVE (OCV) [SKYACTIV-D 2.2].)
2. Hydraulic pressure is applied to the lock pin of the rocker arm (No.2) and the lock pin fixes the inner lever that has been pressed out. (See 01-10B-19 HYDRAULIC LASH ADJUSTER, ROCKER ARM [SKYACTIV-D 2.2].)
3. The low lift cam of the exhaust camshaft presses down the rocker arm (No.2) of the intake stroke cylinder. (See 01-10B-16 CAMSHAFT [SKYACTIV-D 2.2].)
4. The exhaust valve of the intake stroke cylinder opens slightly to allow back flow of the exhaust gas into the cylinder.

BALANCER UNIT [SKYACTIV-D 2.2]

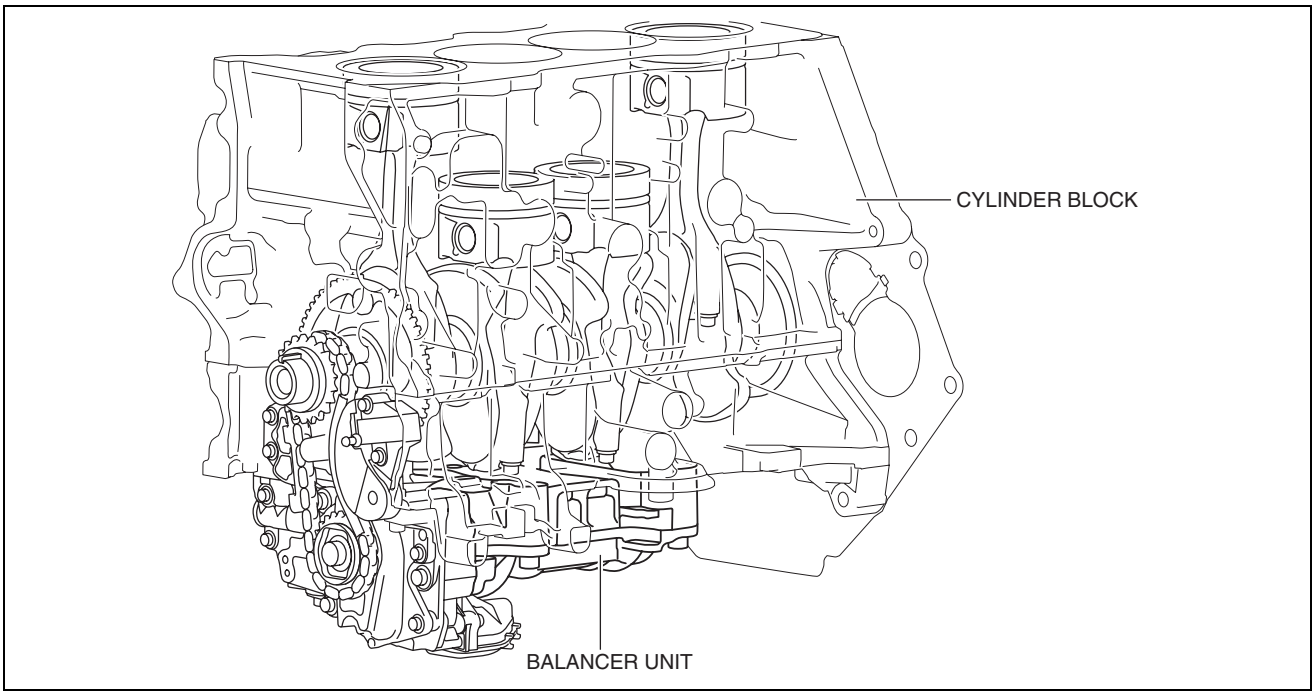
id0110s5104900

Purpose, Function

- The balancer unit eliminates the secondary inertia force occurring in the in-line 4-cylinder engine which reduces engine vibration.

Construction

- The balancer unit is installed on the lower part of the cylinder block.



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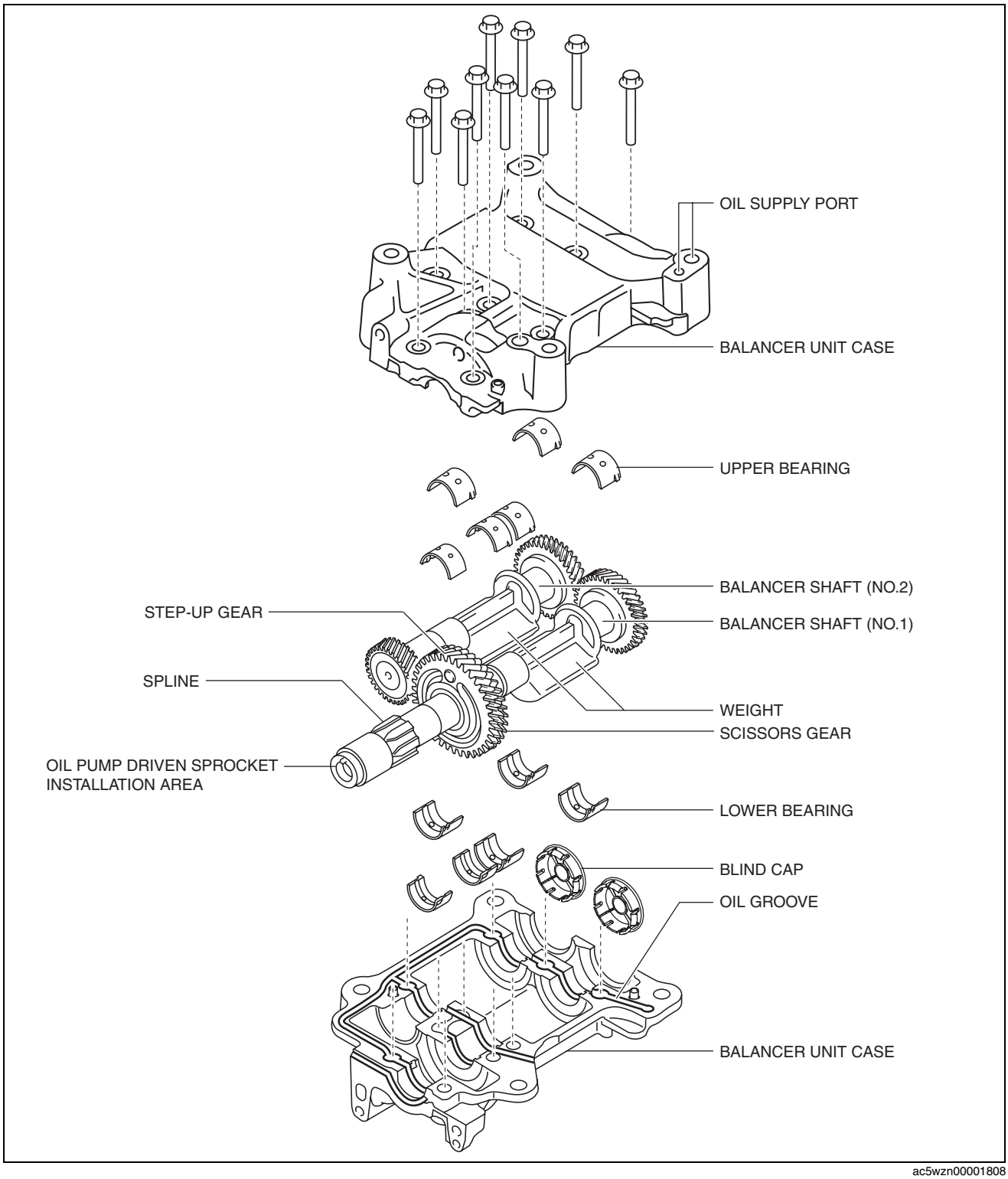
- The balancer unit consists of two balancer shafts with weights (No.1 and No.2), step-up gear, scissors gear and the balancer unit case.
- A scissors gear has been added to the step-up gear for improved noise reduction.

MECHANICAL [SKYACTIV-D 2.2]

- Agitation resistance has been reduced by covering the balancer shafts and gears with the balancer unit case.



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Operation

- The balancer shaft rotates by receiving the crankshaft rotation force via the oil pump driven sprocket.
- The balancer shaft rotation speed is twice the rotation speed of the crankshaft. As a result, the balancer shaft can generate inertia force (eliminates secondary inertia force) in the opposite direction in response to the occurrence of secondary inertia force.

01-11A LUBRICATION [SKYACTIV-G 2.0]

LUBRICATION [SKYACTIV-G 2.0]

LUBRICATION SYSTEM [SKYACTIV-G 2.0]

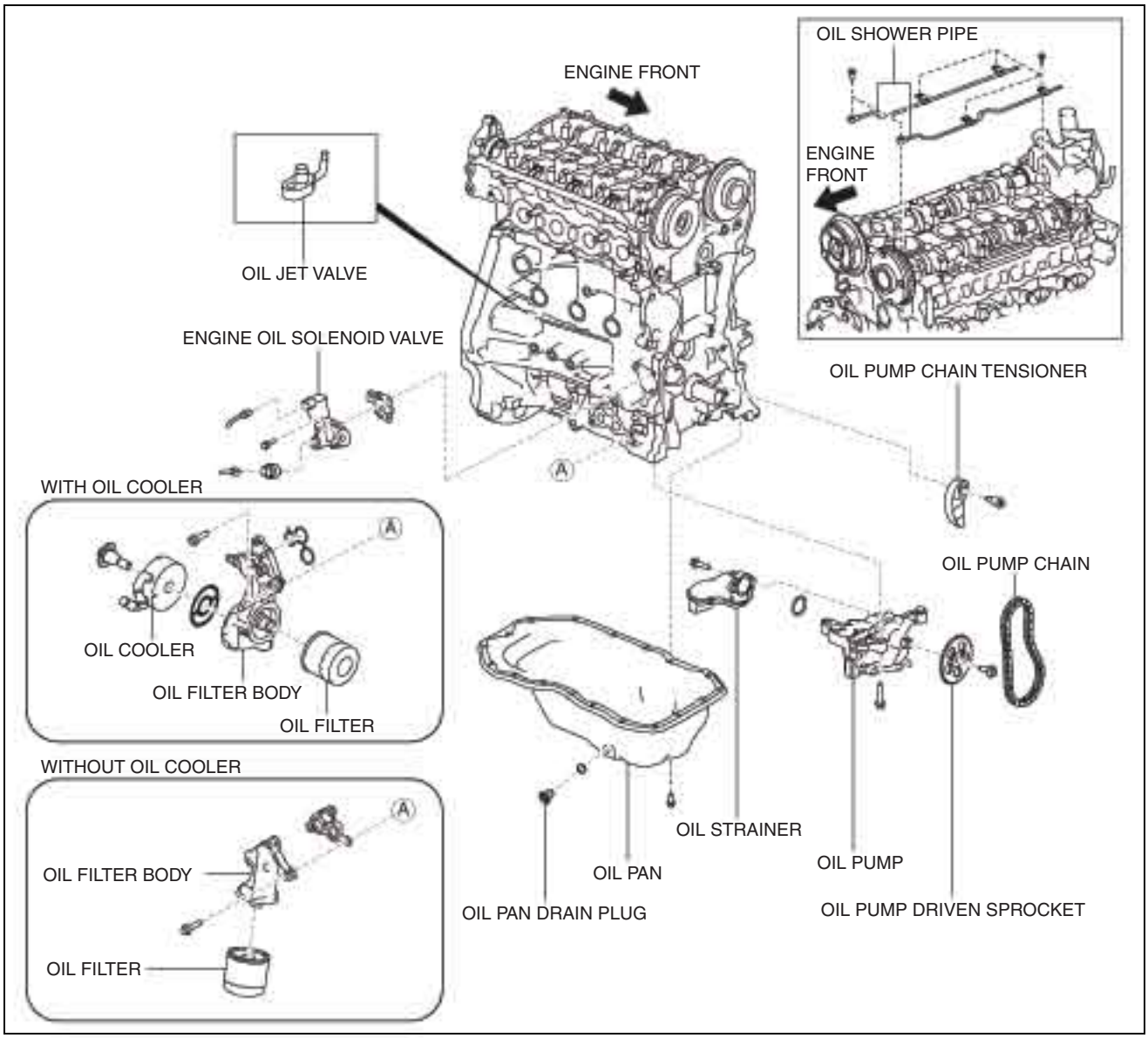
id0111h3002100

Outline

- Pressure loss is reduced by optimizing the oil passage.
- With the adoption of the chain drive type oil pump, oil pump drive force has been reduced.
- With the adoption of the oil shower pipe, sliding resistance has been reduced.
- With the adoption of the engine oil solenoid valve, oil pump discharge pressure can be controlled (hydraulic two-step control).

LUBRICATION [SKYACTIV-G 2.0]

Structural View



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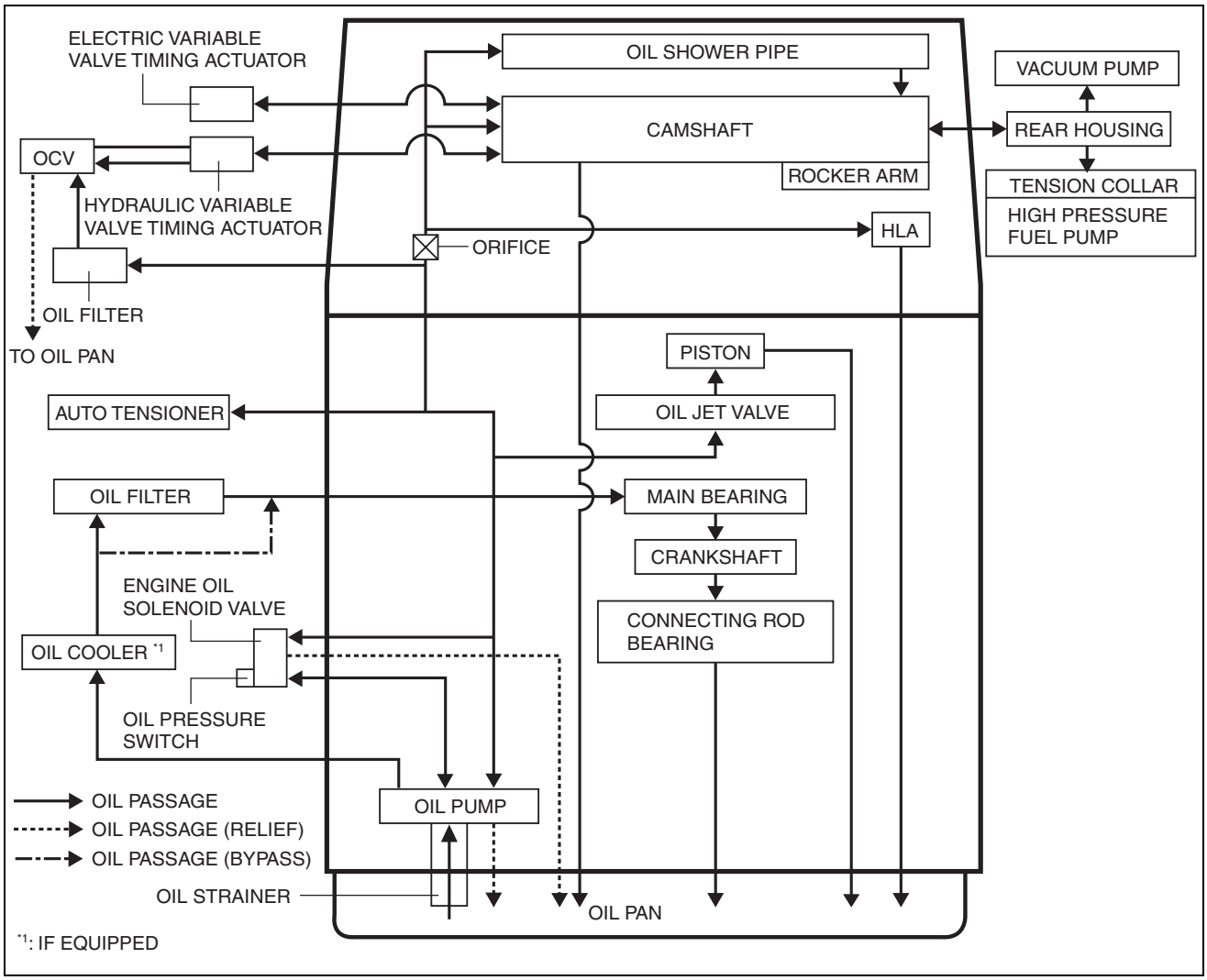
LUBRICATION [SKYACTIV-G 2.0]

Flow View



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Structure

- Consists of the following parts:

Oil filter	(See 01-11A-3 OIL FILTER [SKYACTIV-G 2.0].)
Oil cooler	(See 01-11A-4 OIL COOLER [SKYACTIV-G 2.0].)
Oil pan	(See 01-11A-5 OIL PAN [SKYACTIV-G 2.0].)
Oil strainer	(See 01-11A-6 OIL STRAINER [SKYACTIV-G 2.0].)
Oil pump	(See 01-11A-7 OIL PUMP [SKYACTIV-G 2.0].)
Oil jet valve	(See 01-11A-10 OIL JET VALVE [SKYACTIV-G 2.0].)
Engine oil solenoid valve	(See 01-11A-12 ENGINE OIL SOLENOID VALVE [SKYACTIV-G 2.0].)
Oil shower pipe	(See 01-11A-14 OIL SHOWER PIPE [SKYACTIV-G 2.0].)

OIL FILTER [SKYACTIV-G 2.0]

id0111h3002200

Purpose, Function

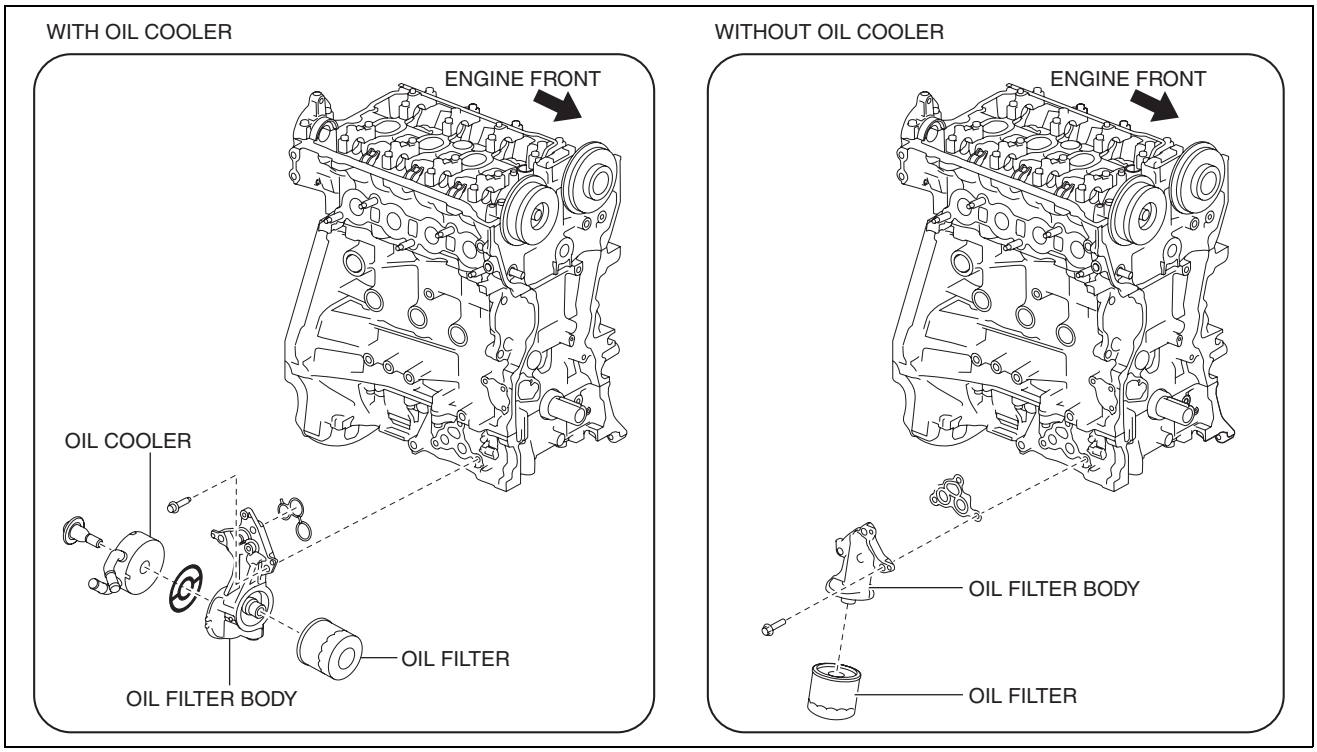
- Engine oil is filtered by passing engine oil through the oil filter element.

Construction

- The oil filter is installed on the right side surface of the cylinder block.

LUBRICATION [SKYACTIV-G 2.0]

- A spin-on type (full-flow type) oil filter has been adopted.



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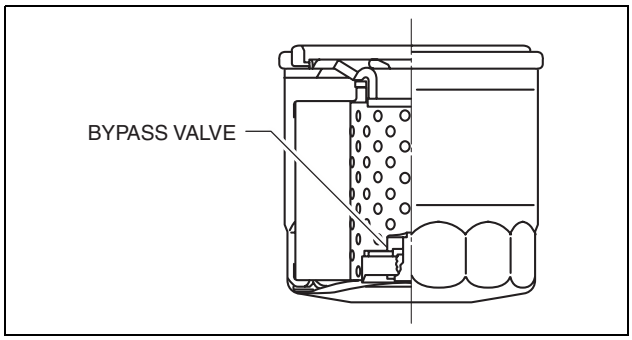
- The bypass valve is equipped as a detour if the oil filter element becomes clogged.



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OIL COOLER [SKYACTIV-G 2.0]

id0111h3101100

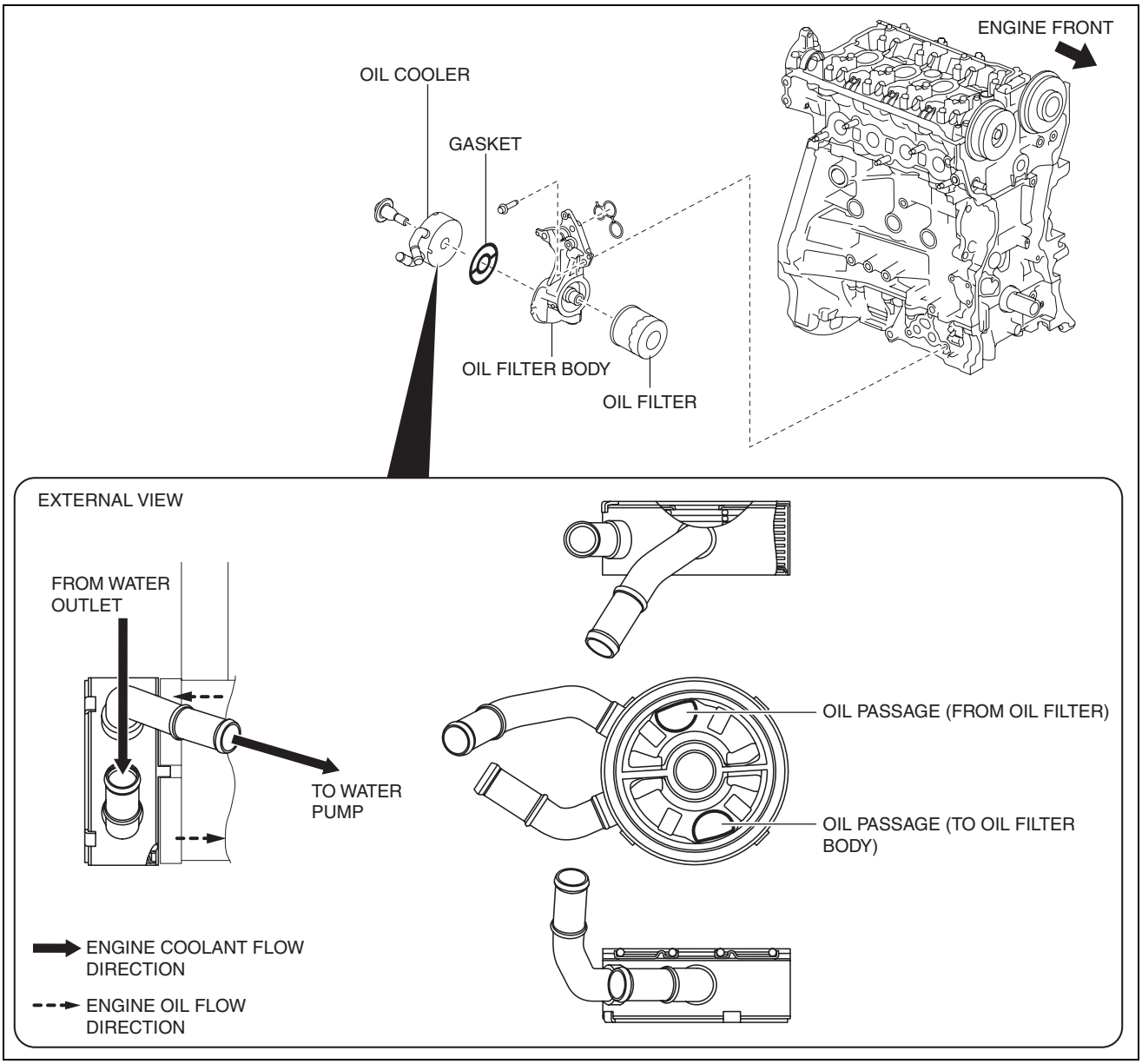
Purpose, Function

- The oil cooler routes engine oil and engine coolant through the interior and disperses the engine oil heat using the engine coolant. As a result, the oil temperature is maintained properly to reduce the engine oil deterioration.

Construction

- A 9-layered type water-cooled has been adopted.
- The oil cooler is attached to the oil filter body.

LUBRICATION [SKYACTIV-G 2.0]



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OIL PAN [SKYACTIV-G 2.0]

id0111h3002300

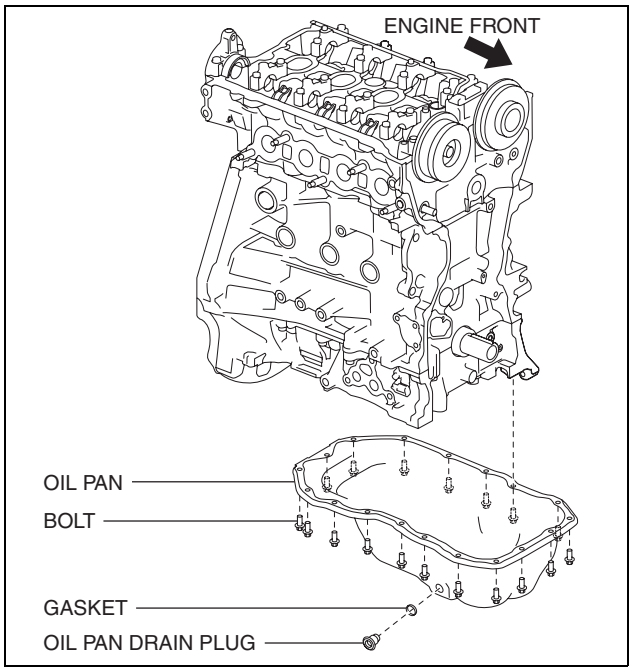
Purpose, Function

- The engine oil required for lubrication in the engine accumulates in the oil pan.

LUBRICATION [SKYACTIV-G 2.0]

Construction

- The oil pan is installed on the lower part of the cylinder block.
- Silicone sealant with excellent sealing has been adopted for the oil pan gasket.



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OIL STRAINER [SKYACTIV-G 2.0]

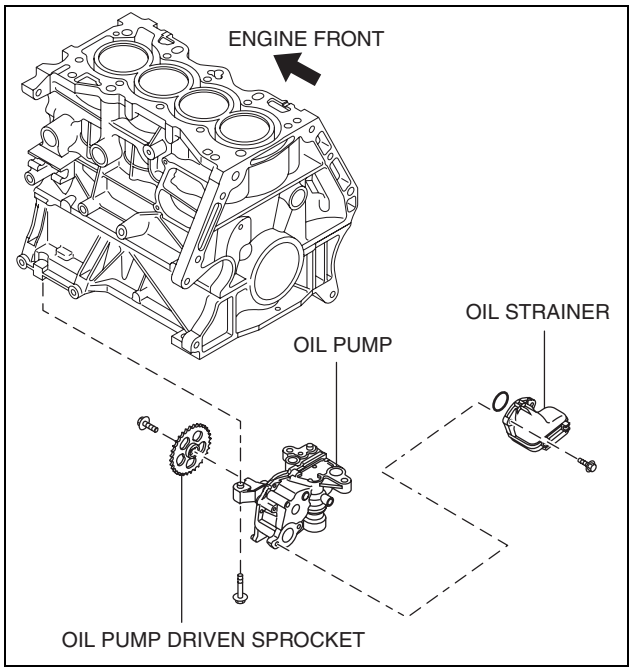
id0111h3002400

Purpose, Function

- The oil strainer suctions the engine oil in the oil pan using the oil pump vacuum. The engine oil is filtered by the internal filter at that time.

Construction

- The oil strainer is installed on the suction port of the oil pump.



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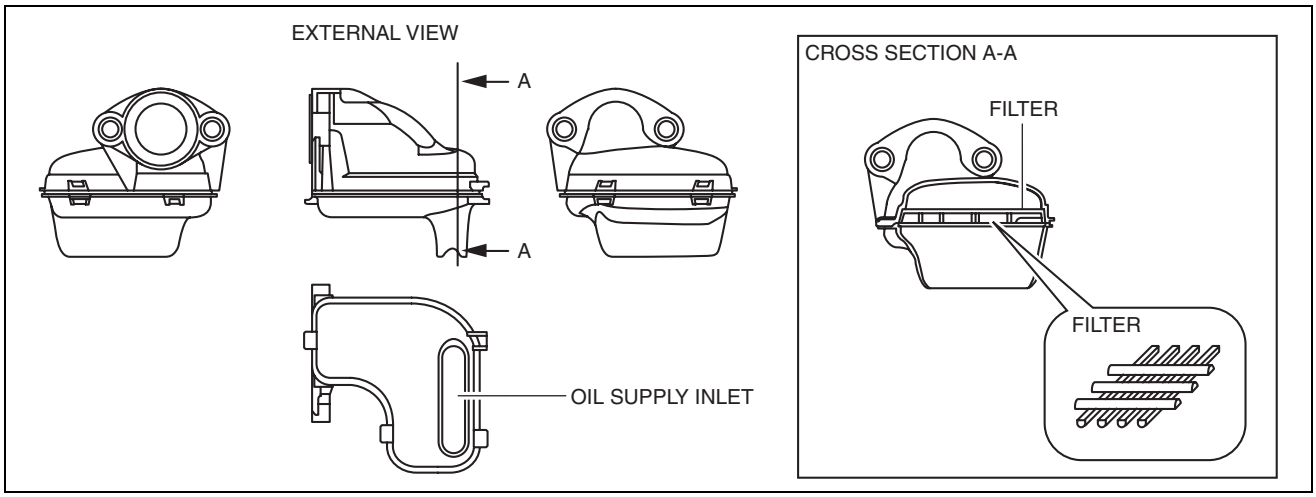
LUBRICATION [SKYACTIV-G 2.0]

- The oil strainer has a filter in the inside.



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OIL PUMP [SKYACTIV-G 2.0]

id0111h3002500

Outline

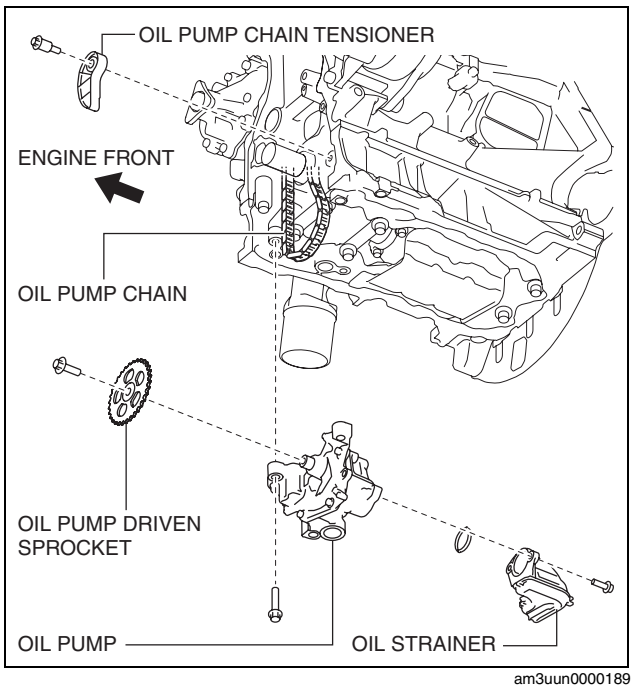
- The oil pump has a mechanism for feedback control of oil pressure. As a result, an oil pressure increase of more than the set pressure is suppressed and oil pump drive resistance is reduced. In addition, because the set pressure can be changed (oil pressure two-step control) by operating the engine oil solenoid valve, the oil pump drive resistance is reduced even during low speed/low to medium loads.

Purpose, Function

- The oil pump suctions the engine oil in the oil pan through the oil strainer and pumps engine oil into the engine.

Construction

- The oil pump is installed on the lower part of the cylinder block (in oil pan).
- With the adoption of the chain drive type oil pump, the diameter of the rotor is reduced. As a result, the oil pump drive resistance has been reduced.



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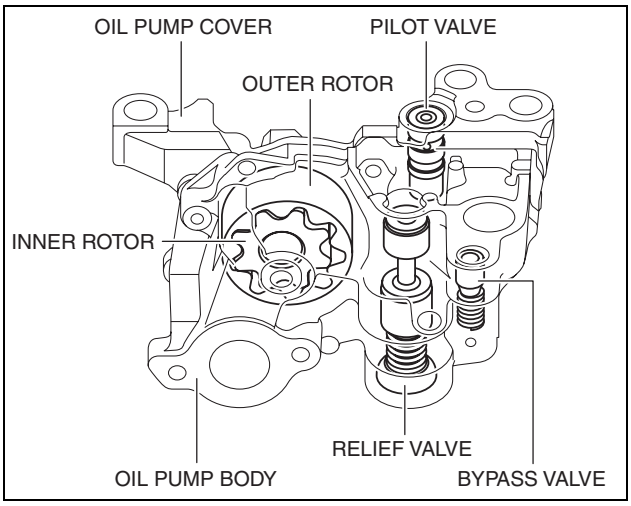
LUBRICATION [SKYACTIV-G 2.0]

- The oil pump consists of the following parts:
- The relief valve and bypass valve is pushed and opened if oil pressure increases excessively when starting an extremely cold engine. As a result, the engine oil flows and excessive oil pressure increase is suppressed.
- When the relief valve is pushed and opened, engine oil flows. As a result, the oil pressure decreases and the oil pump drive resistance is reduced.



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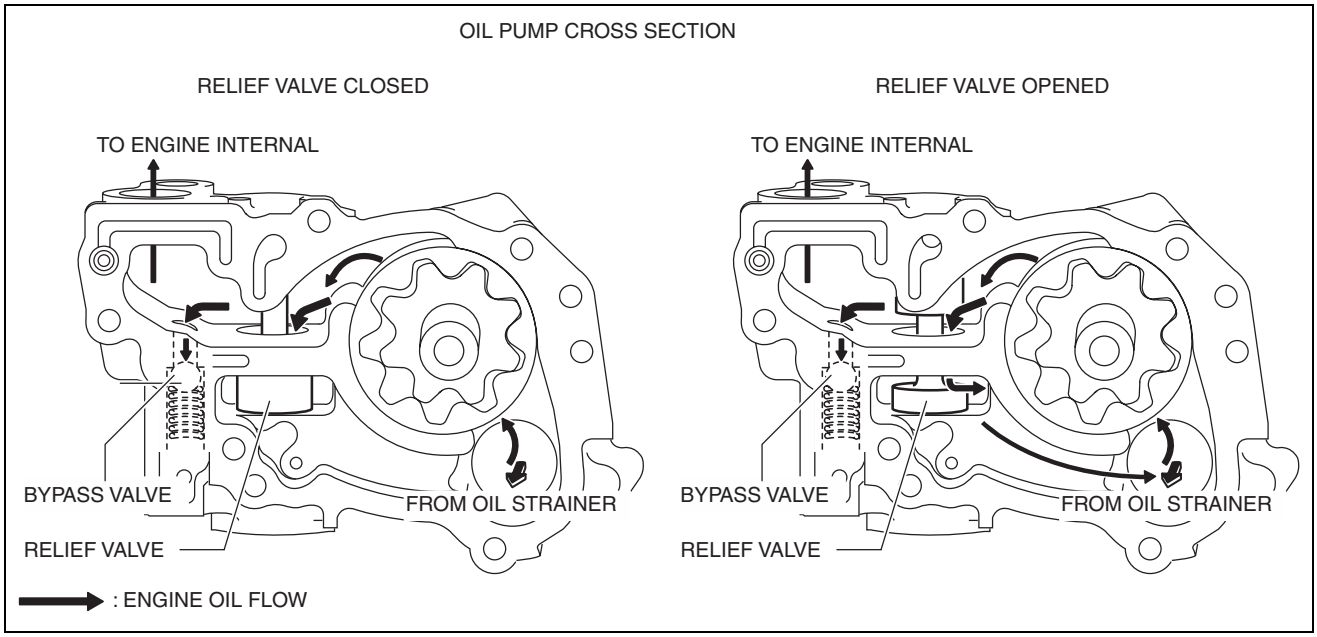

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Operation

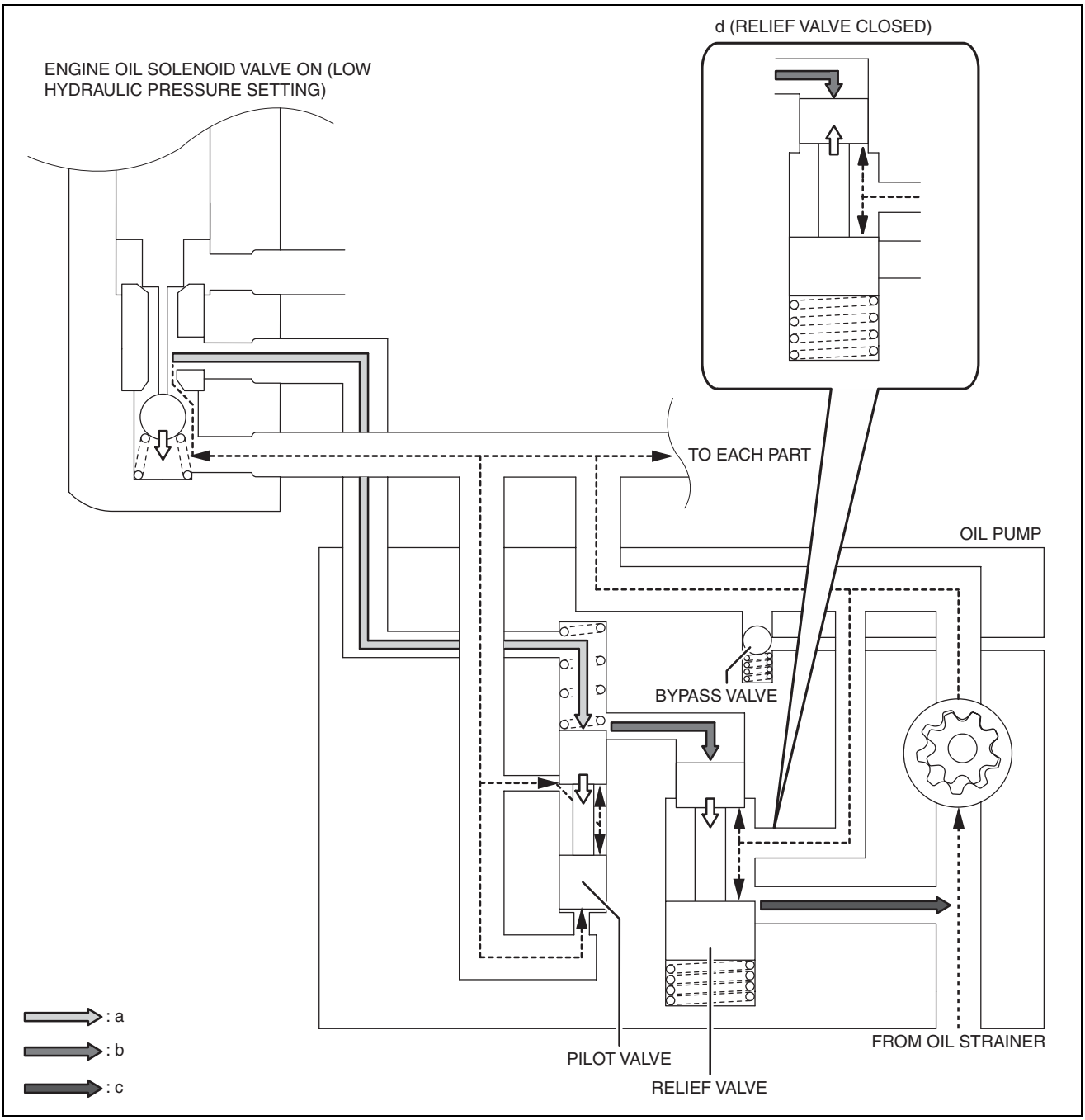
- The oil pump adjusts oil pressure in two steps (low oil pressure setting, high oil pressure setting) by switching the oil passage with the operation of the engine oil solenoid valve. For the operation condition of the engine oil solenoid valve, refer to CONTROL SYSTEM. (See 01-40-56 ENGINE OIL CONTROL [SKYACTIV-G 2.0].)

Engine oil flow when setting low oil pressure (engine oil solenoid valve ON)

a. When the engine oil solenoid valve is turned ON, oil pressure is also applied to the upper part of the pilot valve. Because the oil pressure applied to the upper and lower parts of the pilot valve is almost same, the pilot valve is pressed up by the spring force.
b. Oil pressure is applied to the upper part of the relief valve.
c. When oil pressure exceeds the relief valve opening pressure, the relief valve is pressed down and engine oil flows (oil pressure decrease).
d. When oil pressure is less than the relief valve opening pressure, the relief valve closes. As a result, engine oil flowing stops (oil pressure increase).

LUBRICATION [SKYACTIV-G 2.0]

e. Oil pressure is adjusted by repeating Step (c) to (d).



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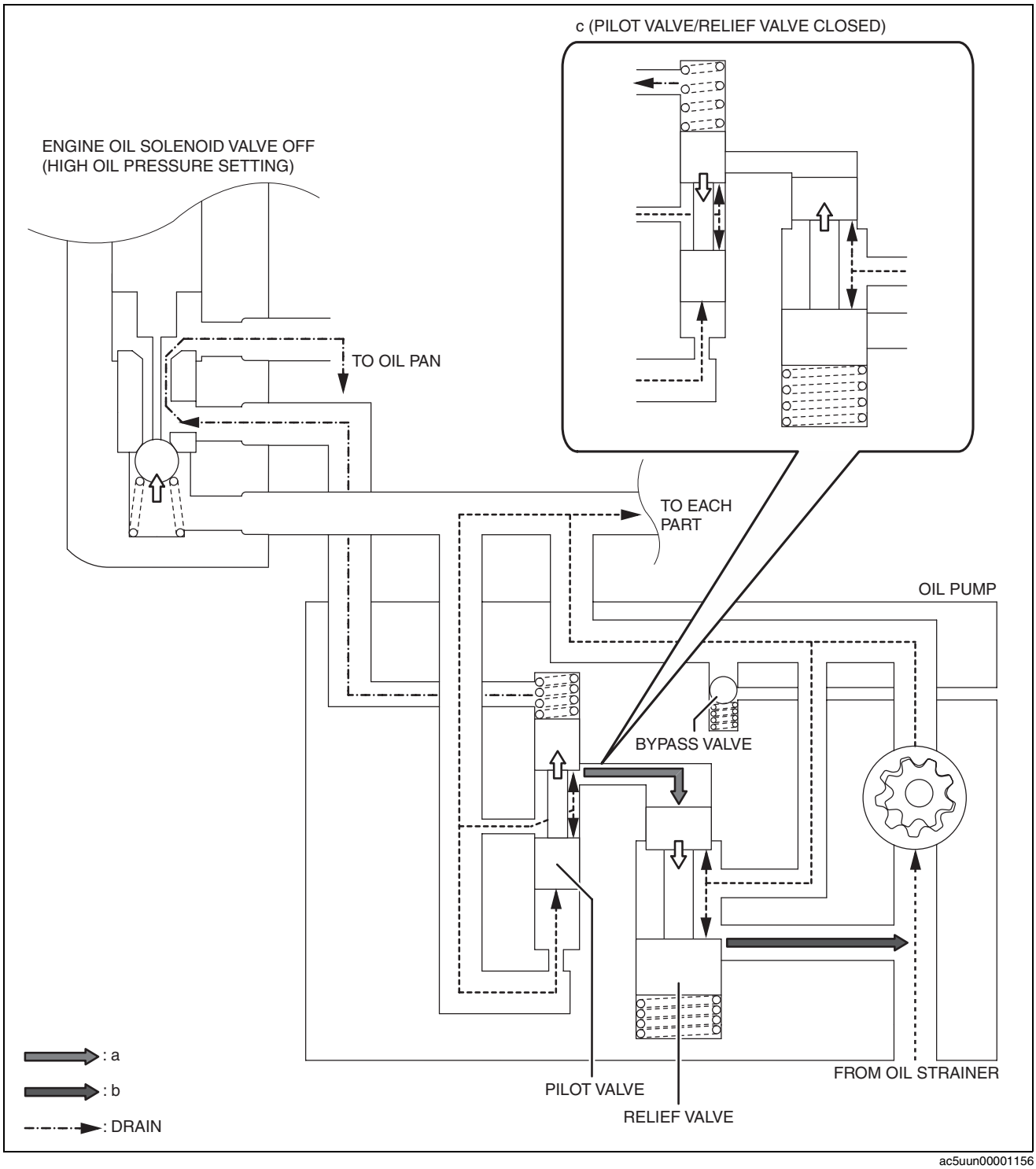
Engine oil flow when setting high oil pressure (engine oil solenoid valve OFF)

a. When oil pressure exceeds the pilot valve opening pressure, the pilot valve is pressed up and oil pressure is applied to the upper part of the relief valve.
b. Because the relief valve opening pressure is exceeded by applying oil pressure to the upper part of the relief valve, the relief valve is pressed down and engine oil flows (oil pressure decrease).
c. When oil pressure is less than the pilot valve opening pressure, the pilot valve closes. As a result, the relief valve closes and engine oil flow stops (oil pressure increase).

LUBRICATION [SKYACTIV-G 2.0]

d. Oil pressure is adjusted by repeating Step (b) to (c).



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OIL JET VALVE [SKYACTIV-G 2.0]

id0111h3002600

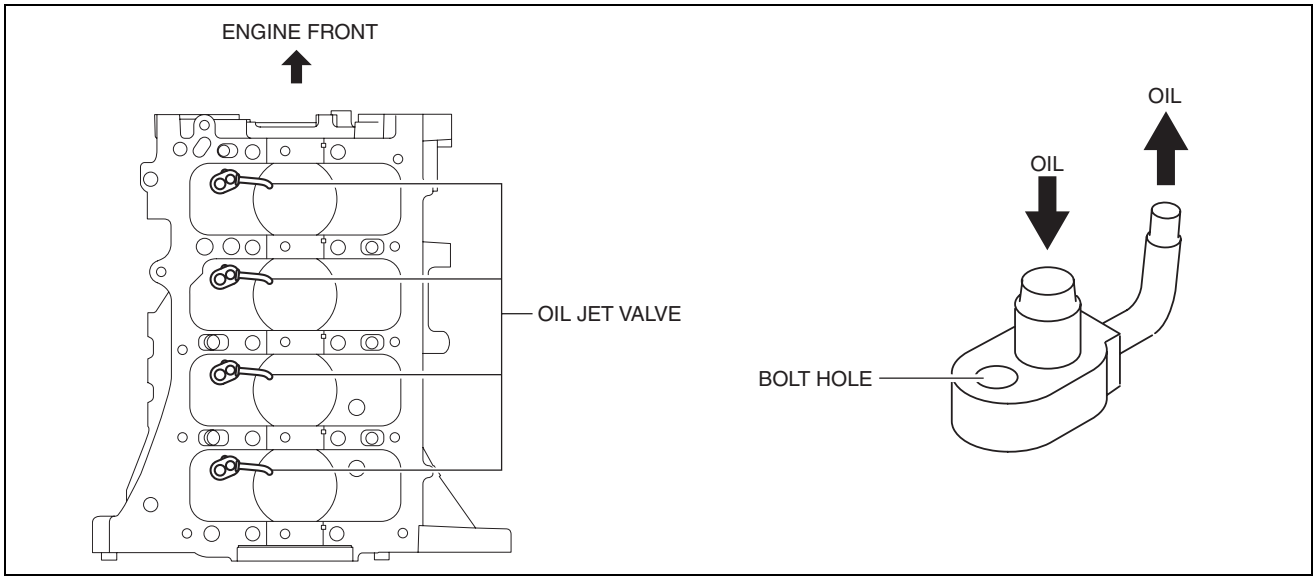
Purpose, Function

- The oil jet valve injects engine oil on the back of the piston to cool the piston.

LUBRICATION [SKYACTIV-G 2.0]

Construction

- The oil jet valve is installed into the cylinder block.



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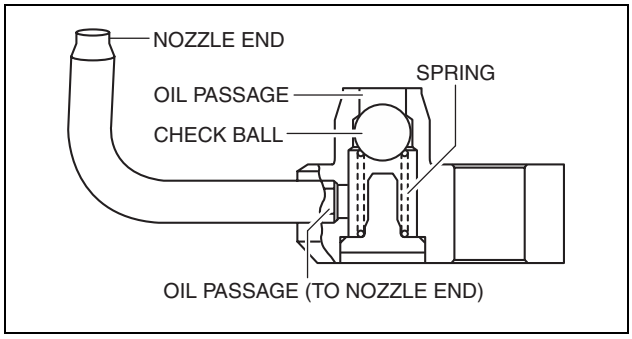
- The oil jet valve is built into the check ball and spring.



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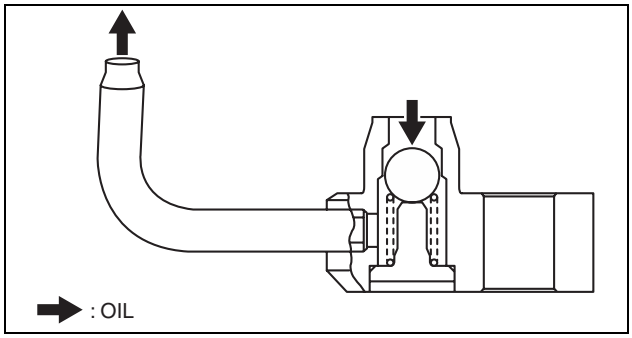
Operation

1. When the oil pressure applied to the check ball exceeds the spring force, the check ball and spring are pressed down.
2. The oil passage is opened to the nozzle and engine oil is injected to the back side of the piston.
3. When the oil pressure applied to the check ball is lower than the spring force, the spring presses up the check ball.



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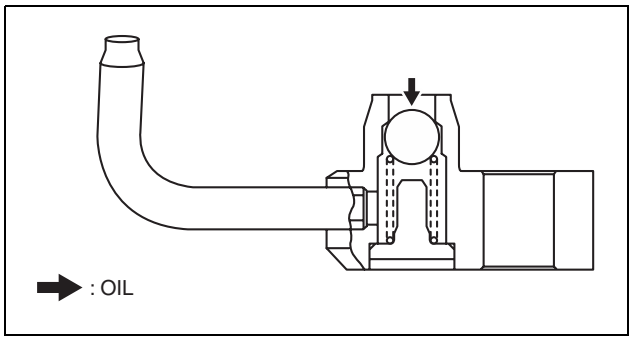
LUBRICATION [SKYACTIV-G 2.0]

4. The oil passage to the nozzle is closed and the injection of engine oil stops.



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ENGINE OIL SOLENOID VALVE [SKYACTIV-G 2.0]

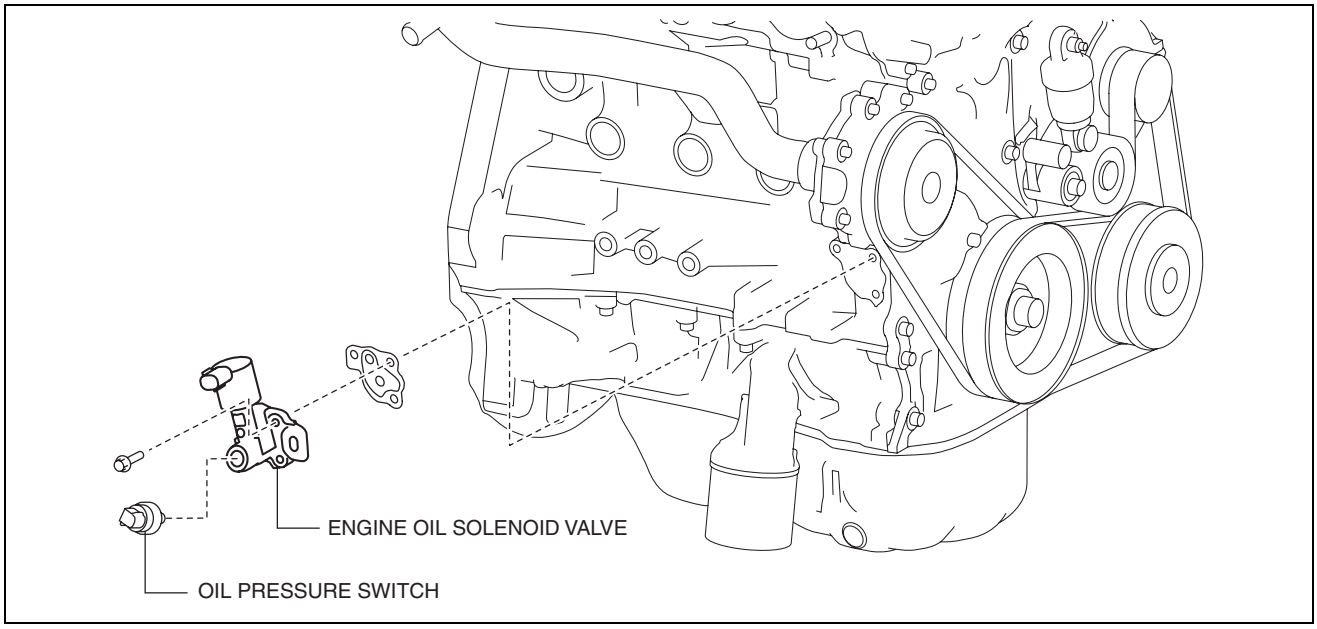
id0111h3002700

Purpose, Function

- The engine oil solenoid valve switches the hydraulic transmission passage in accordance with the driving conditions and the oil pump drive resistance is reduced by controlling oil pump discharging pressure in two steps.

Construction

- The engine oil solenoid valve is installed on the right side of the cylinder block.



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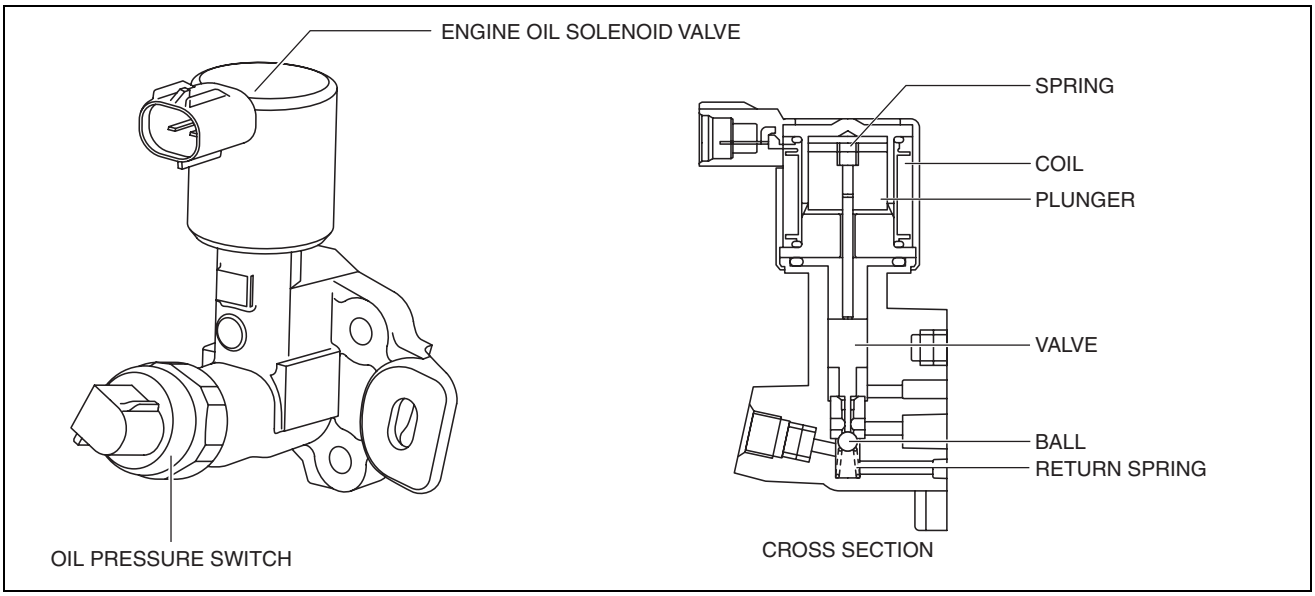
LUBRICATION [SKYACTIV-G 2.0]

- The engine oil solenoid valve has the following parts:



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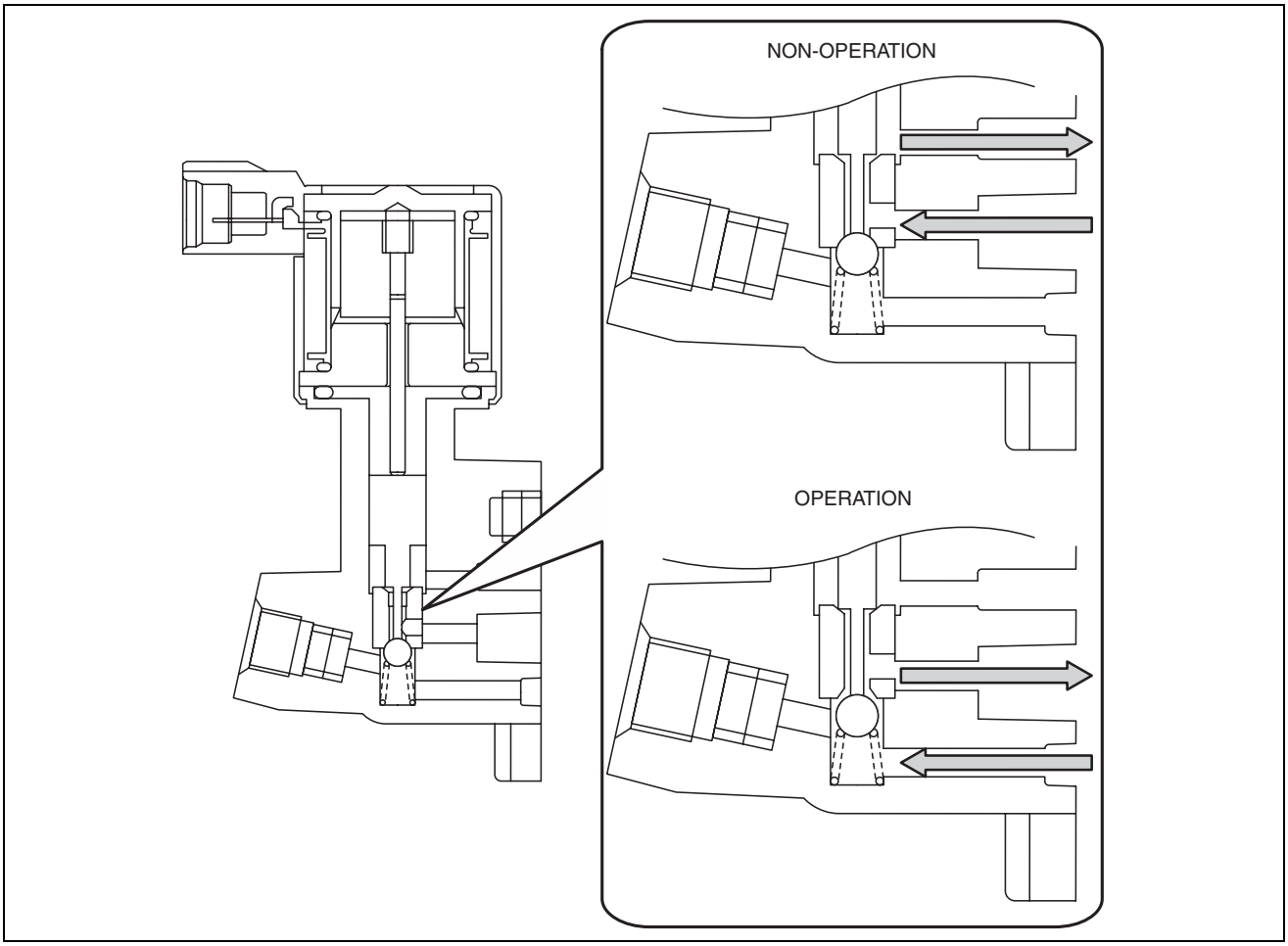
- A duty drive type has been adopted.

Operation

- The oil passage in the solenoid valve is switched according to the control signal (duty signal) from the PCM.



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Fail-safe

- Function not equipped.

LUBRICATION [SKYACTIV-G 2.0]

OIL SHOWER PIPE [SKYACTIV-G 2.0]

id0111h3002800

Outline

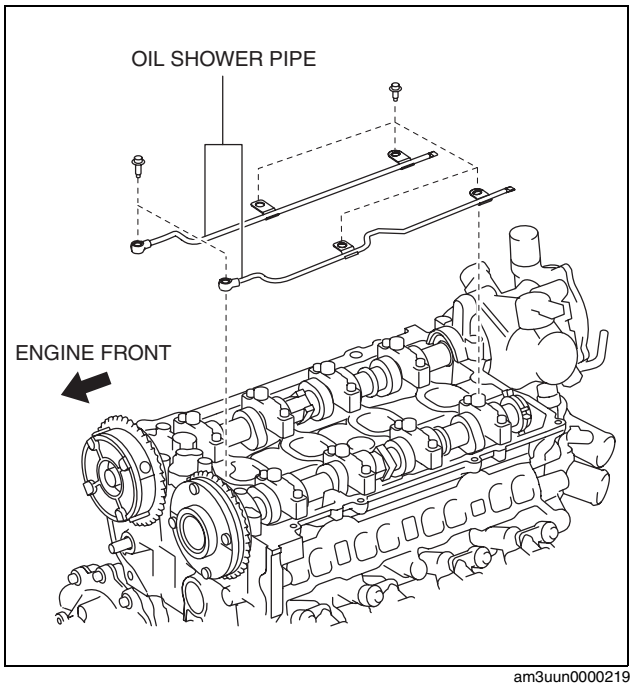
- Mechanical resistance loss has been reduced through structural changes to achieve optimum fuel economy. An oil shower pipe has been adopted as a part of this structural change.

Purpose, Function

- The oil shower pipe injects engine oil to lubricate the contact points of the cam and rocker arm. As a result, wear resistance of sliding part is reduced.

Construction

- The oil shower pipe is installed to the camshaft cap.
- The oil shower pipe utilizes the engine oil injection



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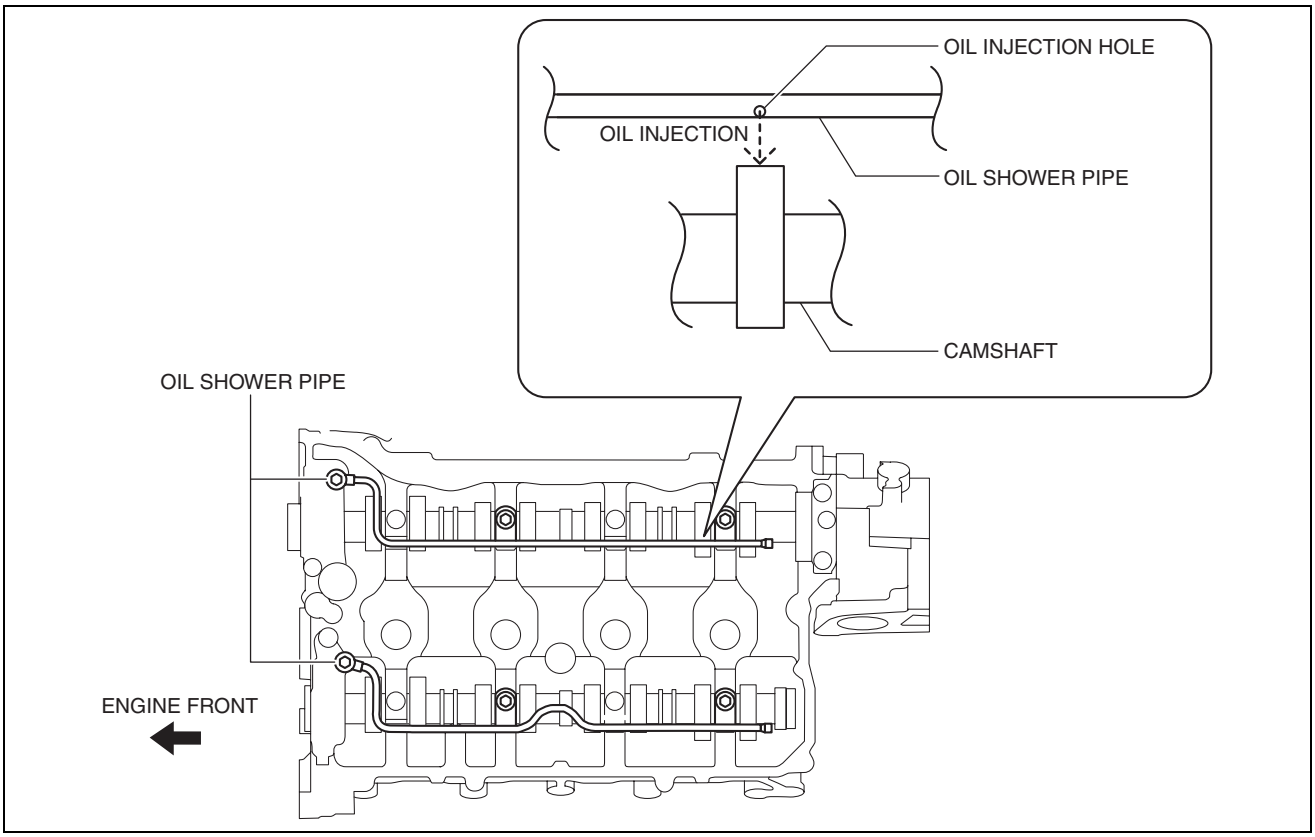
LUBRICATION [SKYACTIV-G 2.0]

holes at the top of the camshaft.



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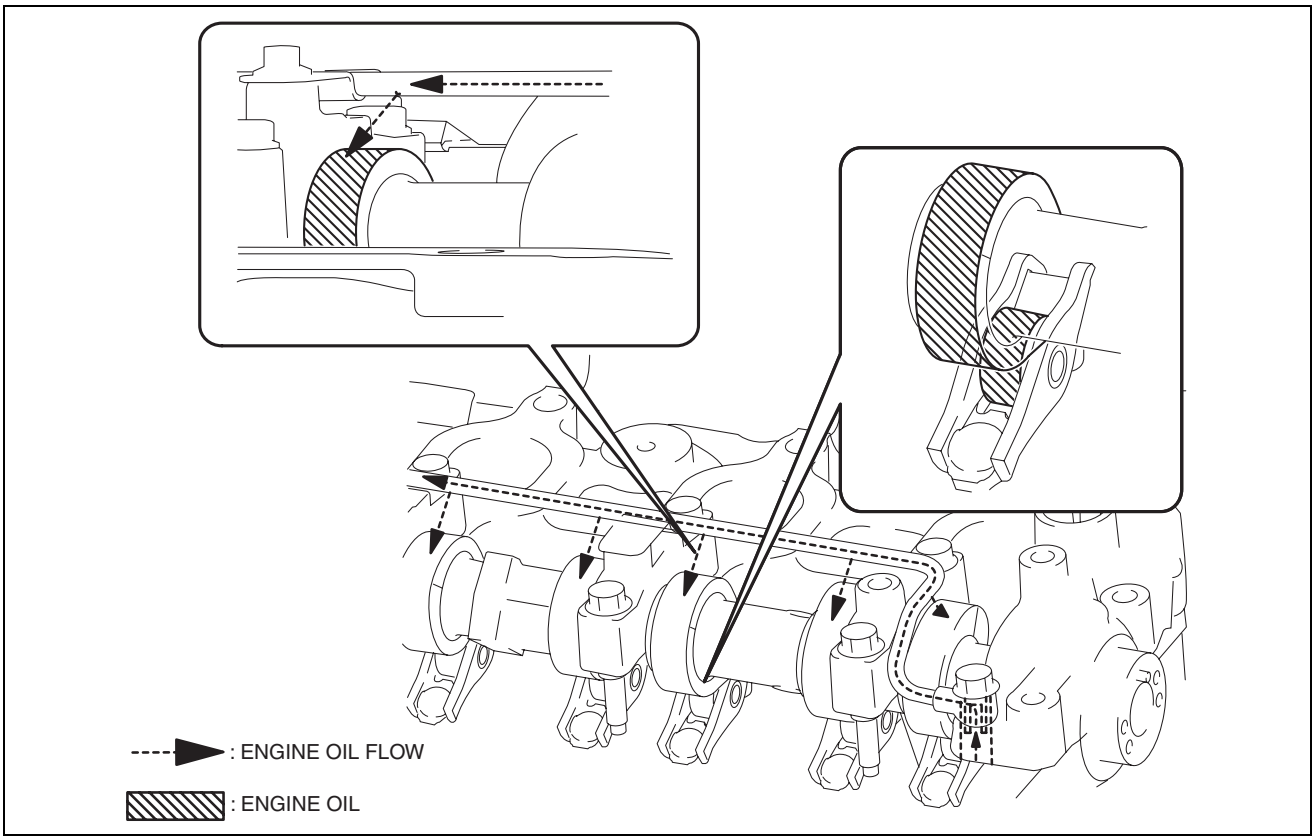
Operation

- The oil shower pipe injects engine oil from the engine oil injection holes using hydraulic pressure.



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01-11B LUBRICATION [SKYACTIV-D 2.2]

LUBRICATION [SKYACTIV-D 2.2]

LUBRICATION SYSTEM [SKYACTIV-D 2.2]

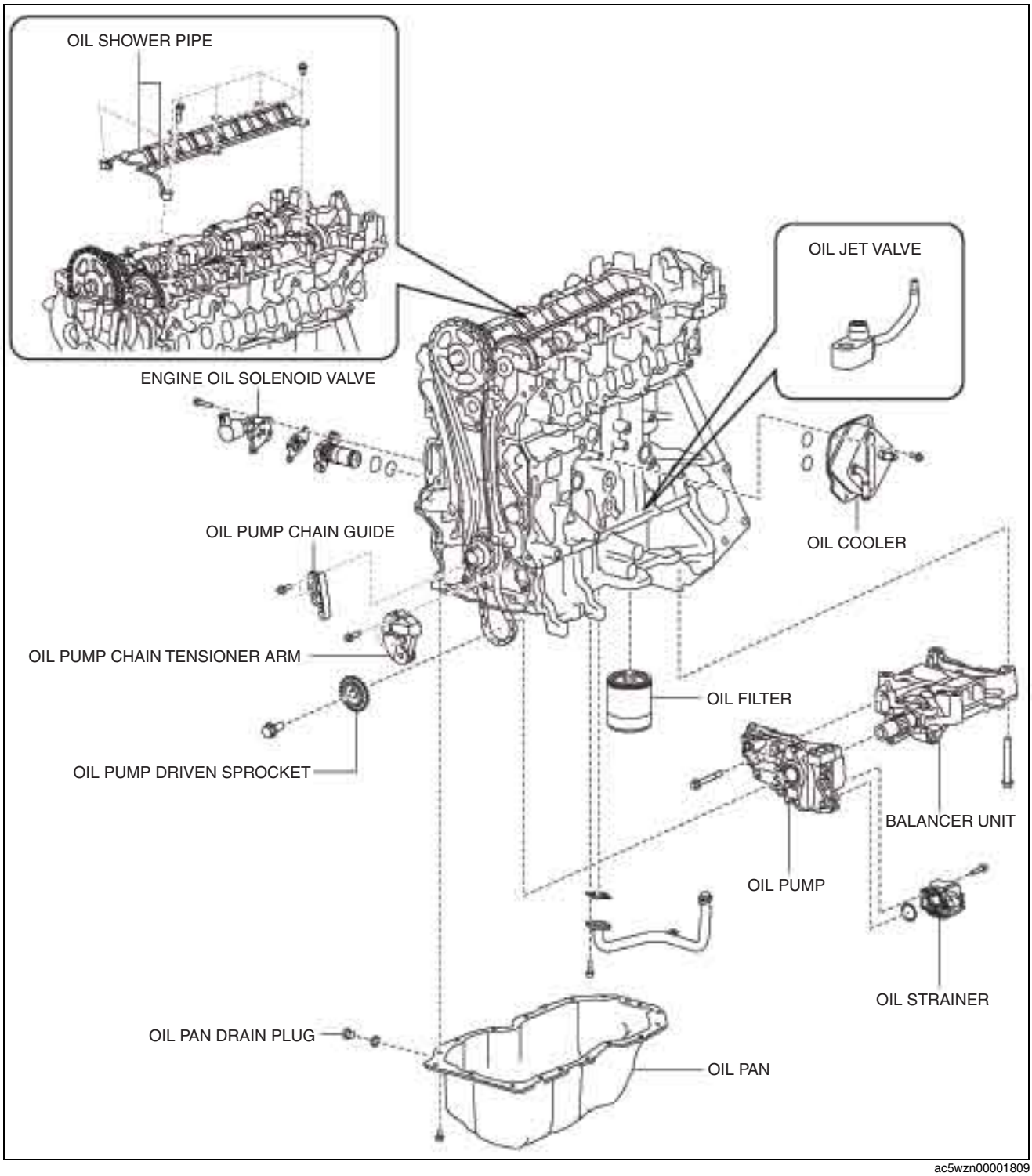
id0111s6002100

Outline

- With the adoption of the chain drive type oil pump, oil pump drive force has been reduced.
- With the adoption of the oil shower pipe, sliding resistance has been reduced.
- With the adoption of the engine oil solenoid valve, oil pump discharge pressure can be controlled (hydraulic two-step control).

LUBRICATION [SKYACTIV-D 2.2]

Structural View



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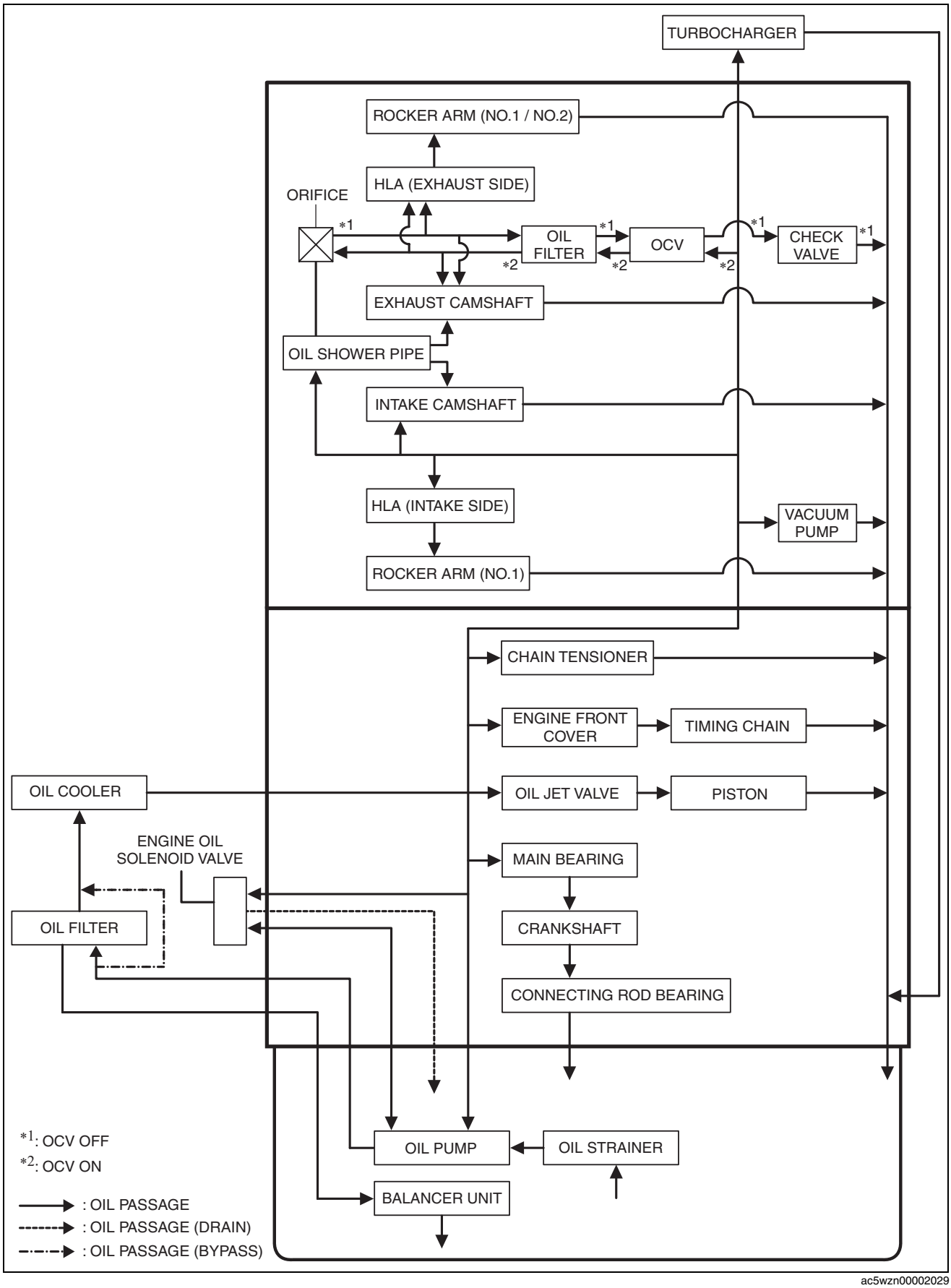
LUBRICATION [SKYACTIV-D 2.2]

Flow View



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LUBRICATION [SKYACTIV-D 2.2]

Structure
- Consists of the following parts:

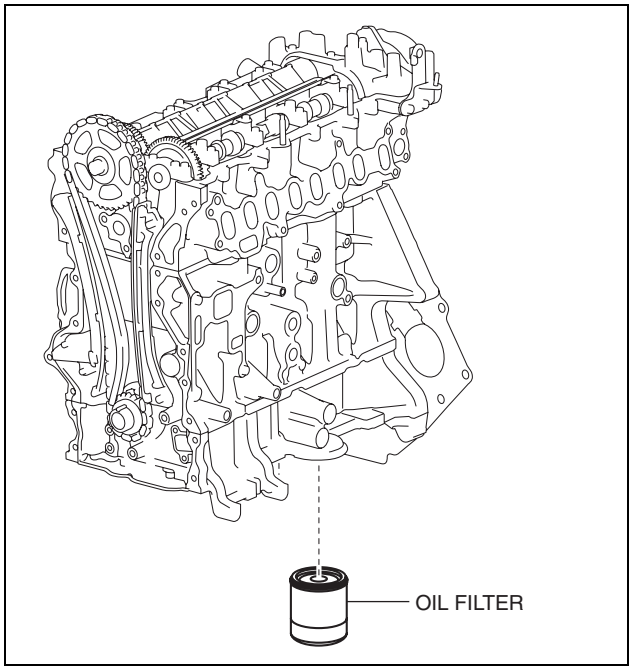
Oil shower pipe	(See 01-11B-13 OIL SHOWER PIPE [SKYACTIV-D 2.2].)
Oil jet valve	(See 01-11B-10 OIL JET VALVE [SKYACTIV-D 2.2].)
Engine oil solenoid valve	(See 01-11B-12 ENGINE OIL SOLENOID VALVE [SKYACTIV-D 2.2].)
Oil filter	(See 01-11B-4 OIL FILTER [SKYACTIV-D 2.2].)
Oil cooler	(See 01-11B-4 OIL COOLER [SKYACTIV-D 2.2].)
Oil pump	(See 01-11B-7 OIL PUMP [SKYACTIV-D 2.2].)
Oil strainer	(See 01-11B-6 OIL STRAINER [SKYACTIV-D 2.2].)
Oil pan	(See 01-11B-5 OIL PAN [SKYACTIV-D 2.2].)

OIL FILTER [SKYACTIV-D 2.2]

id0111s6002200

Purpose, Function
- Engine oil is filtered by passing engine oil through the oil filter element.

Construction
- The oil filter is installed on the left side surface of the cylinder block.
- A spin-on type (full-flow type) oil filter has been adopted.



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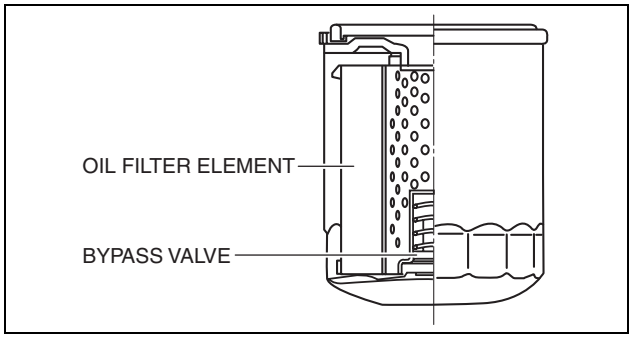
- The bypass valve is equipped as a detour if the oil filter element becomes clogged.



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OIL COOLER [SKYACTIV-D 2.2]

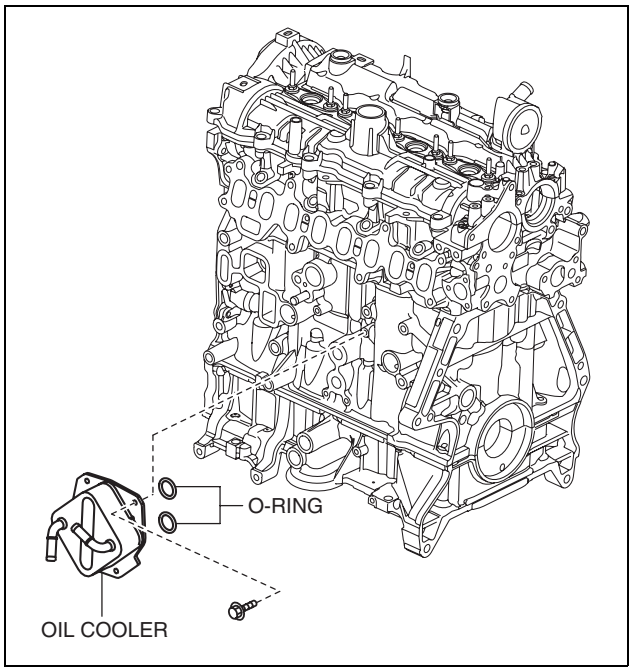
id0111s6101100

Purpose, Function
- The oil cooler routes engine oil and engine coolant through the interior and disperses the engine oil heat using the engine coolant. As a result, the oil temperature is maintained properly to reduce the engine oil deterioration.

LUBRICATION [SKYACTIV-D 2.2]

Construction

- The oil cooler is installed on the left side surface of the cylinder block.



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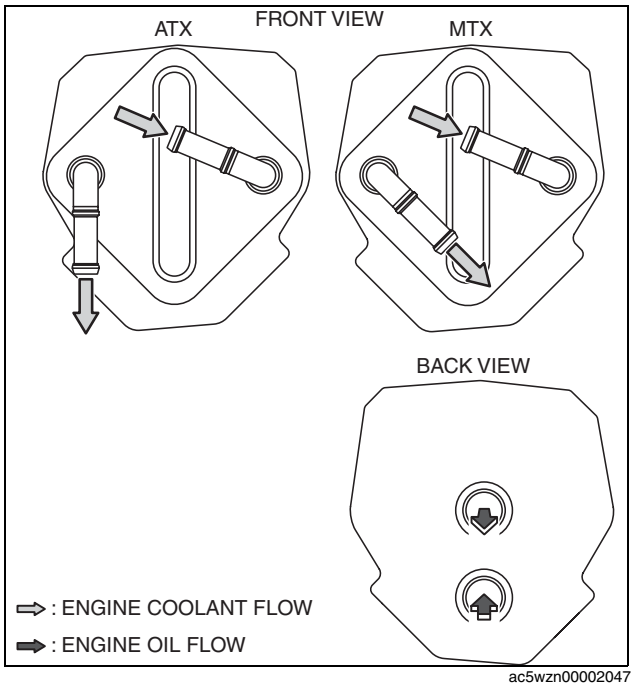
- A water-cooled, 8-layer-type oil cooler has been adopted.



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OIL PAN [SKYACTIV-D 2.2]

id0111s6002300

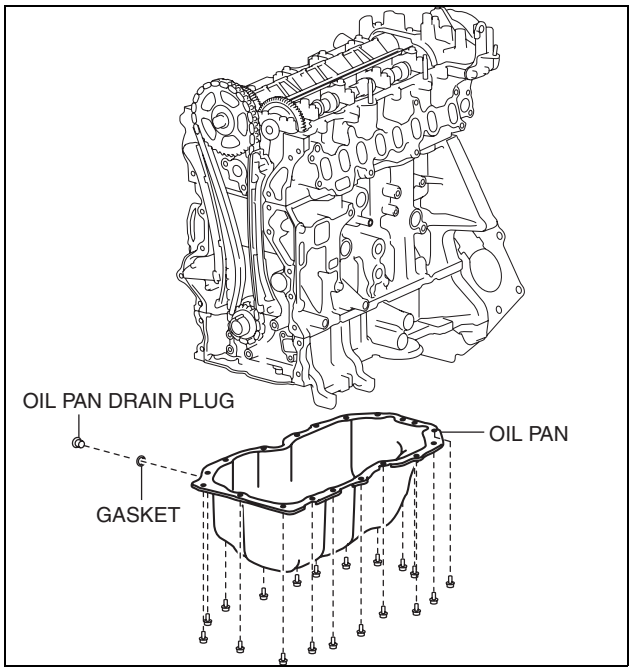
Purpose, Function

- The engine oil required for lubrication in the engine accumulates in the oil pan.

LUBRICATION [SKYACTIV-D 2.2]

Construction

- The oil pan is installed on the lower part of the cylinder block.
- Silicone sealant with excellent sealing has been adopted for the oil pan gasket.



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OIL STRAINER [SKYACTIV-D 2.2]

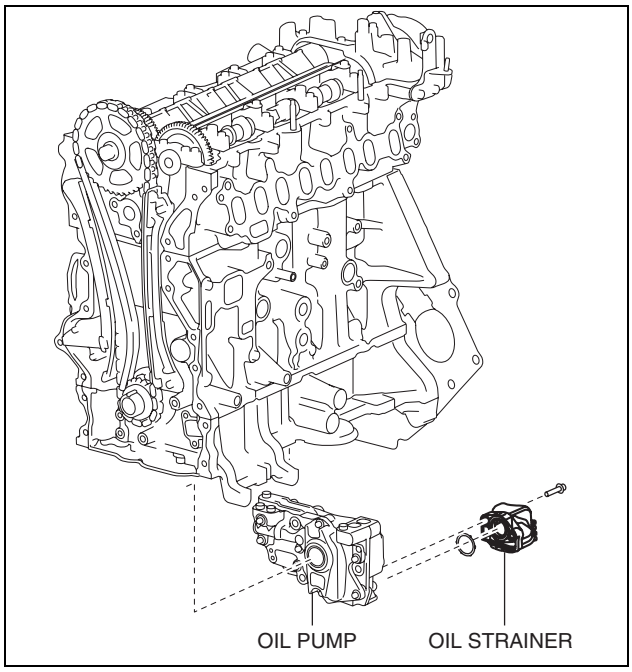
id0111s6002400

Purpose, Function

- The oil strainer suctions the engine oil in the oil pan using the oil pump vacuum. The engine oil is filtered by the internal filter at that time.

Construction

- The oil strainer is installed on the suction port of the oil pump.



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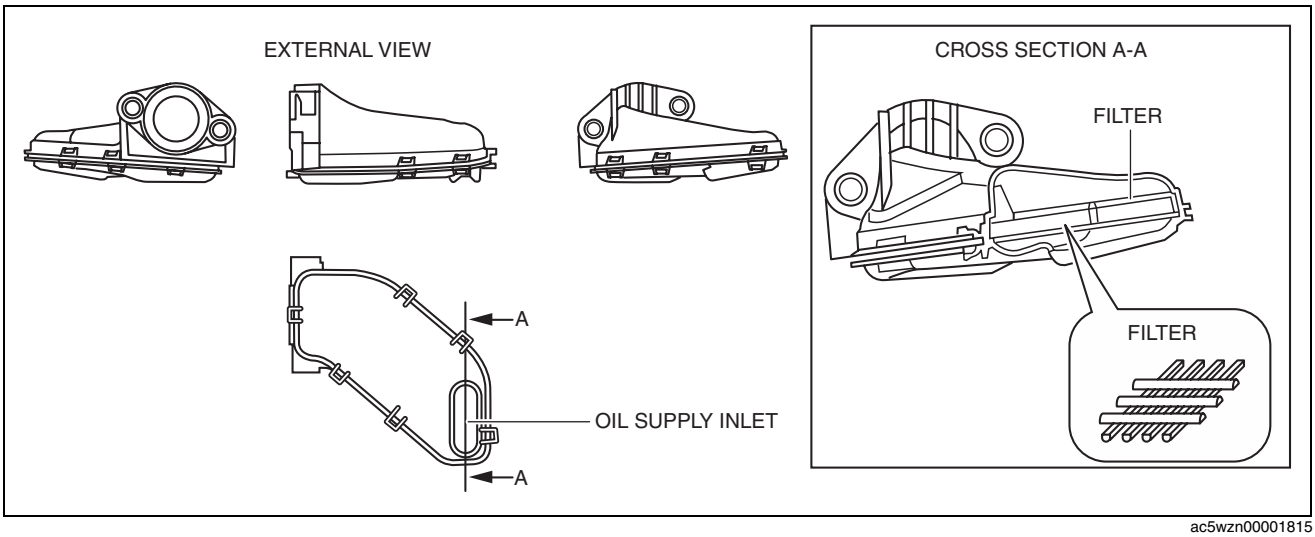
LUBRICATION [SKYACTIV-D 2.2]

- The oil strainer has a filter in the inside.



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OIL PUMP [SKYACTIV-D 2.2]

id0111s6002500

Outline

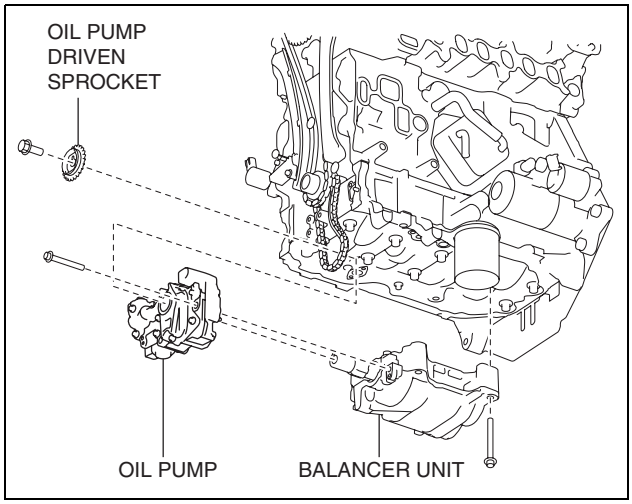
- The oil pump has a mechanism for feedback control of oil pressure. As a result, an oil pressure increase of more than the set pressure is suppressed and oil pan drive resistance is reduced. In addition, because the set pressure can be changed (oil pressure two-step control) by operating the engine oil solenoid valve, the oil pump drive resistance is reduced even during low speed/low to medium loads.

Purpose, Function

- The oil pump suctions the engine oil in the oil pan through the oil strainer and pumps engine oil into the engine.

Construction

- The oil pump is installed on the lower part of the cylinder block (in oil pan).
- With the adoption of the chain drive type oil pump, the diameter of the rotor is reduced. As a result, the oil pump drive resistance has been reduced.



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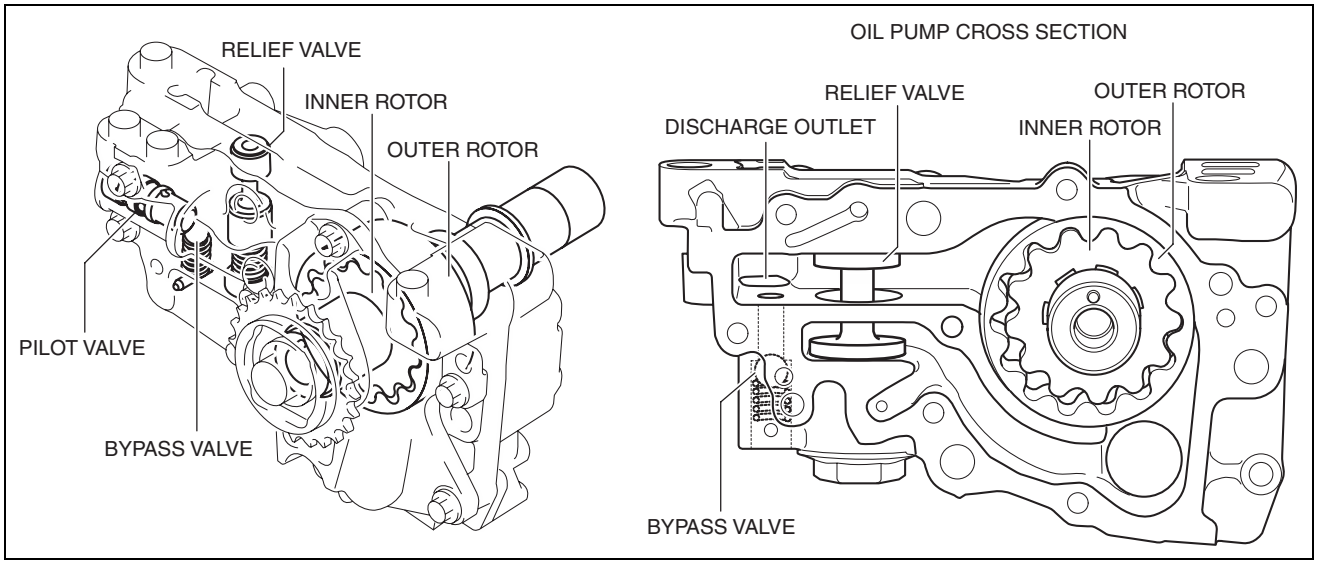
LUBRICATION [SKYACTIV-D 2.2]

- The relief valve and bypass valve is pushed and opened if oil pressure increases excessively when starting an extremely cold engine. As a result, the engine oil flows and excessive oil pressure increase is suppressed.



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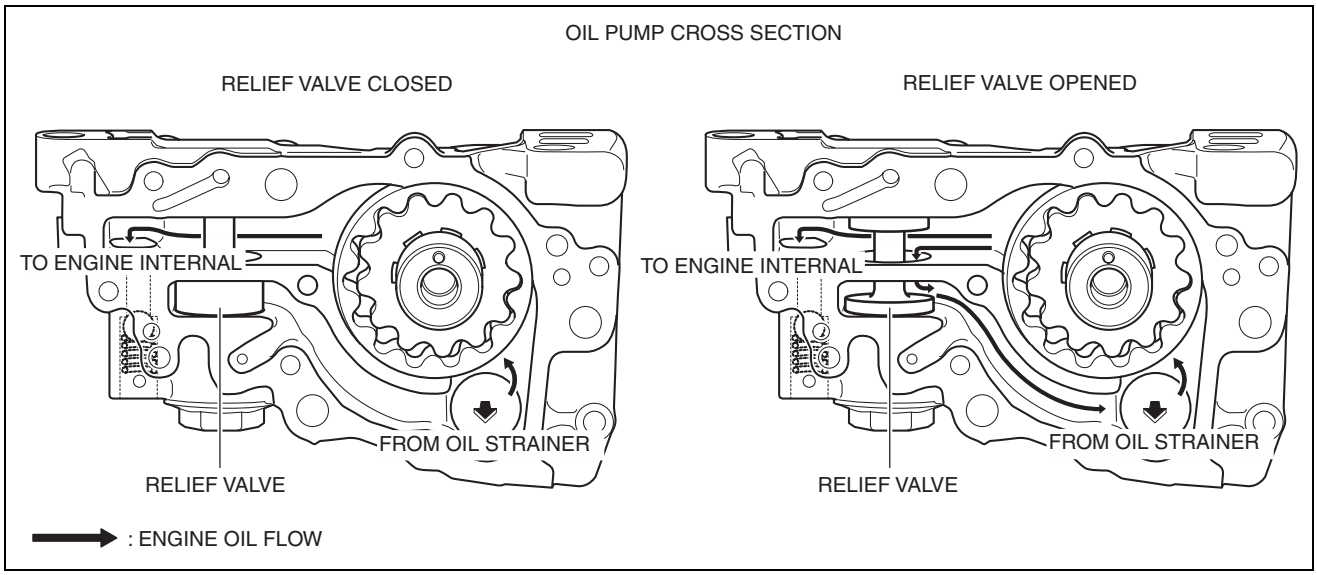
- When the relief valve is pushed and opened, engine oil flows. As a result, the oil pressure decreases and the oil pump drive resistance is reduced.



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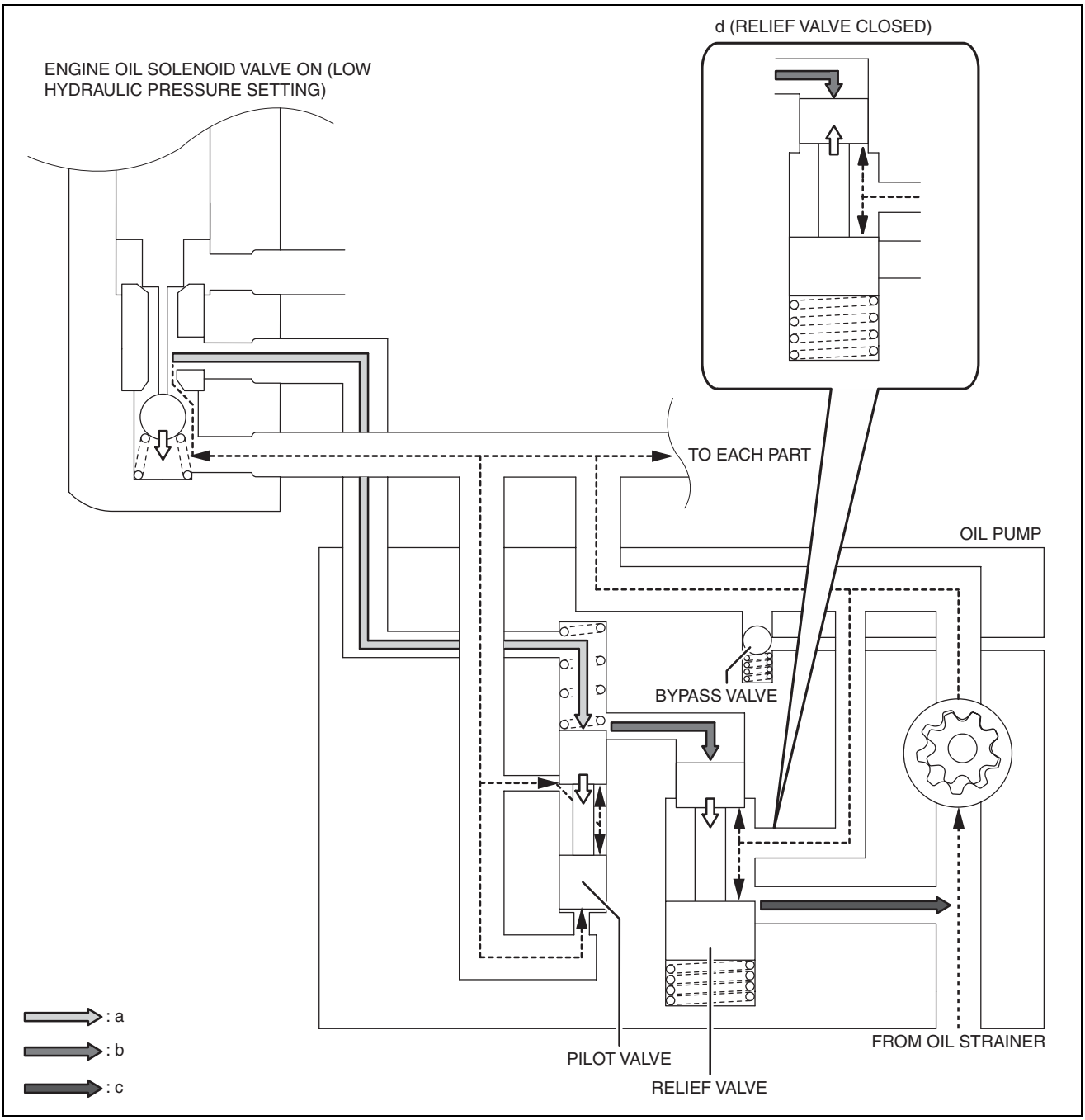
Operation

- The oil pump adjusts oil pressure in two steps (low oil pressure setting, high oil pressure setting) by switching the oil passage with the operation of the engine oil solenoid valve. For the operation condition of the engine oil solenoid valve, refer to CONTROL SYSTEM. (See 01-40-56 ENGINE OIL CONTROL [SKYACTIV-G 2.0].)
  Engine oil flow when setting low oil pressure (engine oil solenoid valve ON)
  a. When the engine oil solenoid valve is turned ON, oil pressure is also applied to the upper part of the pilot valve. Because the oil pressure applied to the upper and lower parts of the pilot valve is almost same, the pilot valve is pressed up by the spring force.
  b. Oil pressure is applied to the upper part of the relief valve.
  c. When oil pressure exceeds the relief valve opening pressure, the relief valve is pressed down and engine oil flows.
  d. When oil pressure is less than the relief valve opening pressure, the relief valve closes. As a result, engine oil flowing stops (oil pressure increase).

LUBRICATION [SKYACTIV-D 2.2]

e. Oil pressure is adjusted by repeating Step (c) to (d).



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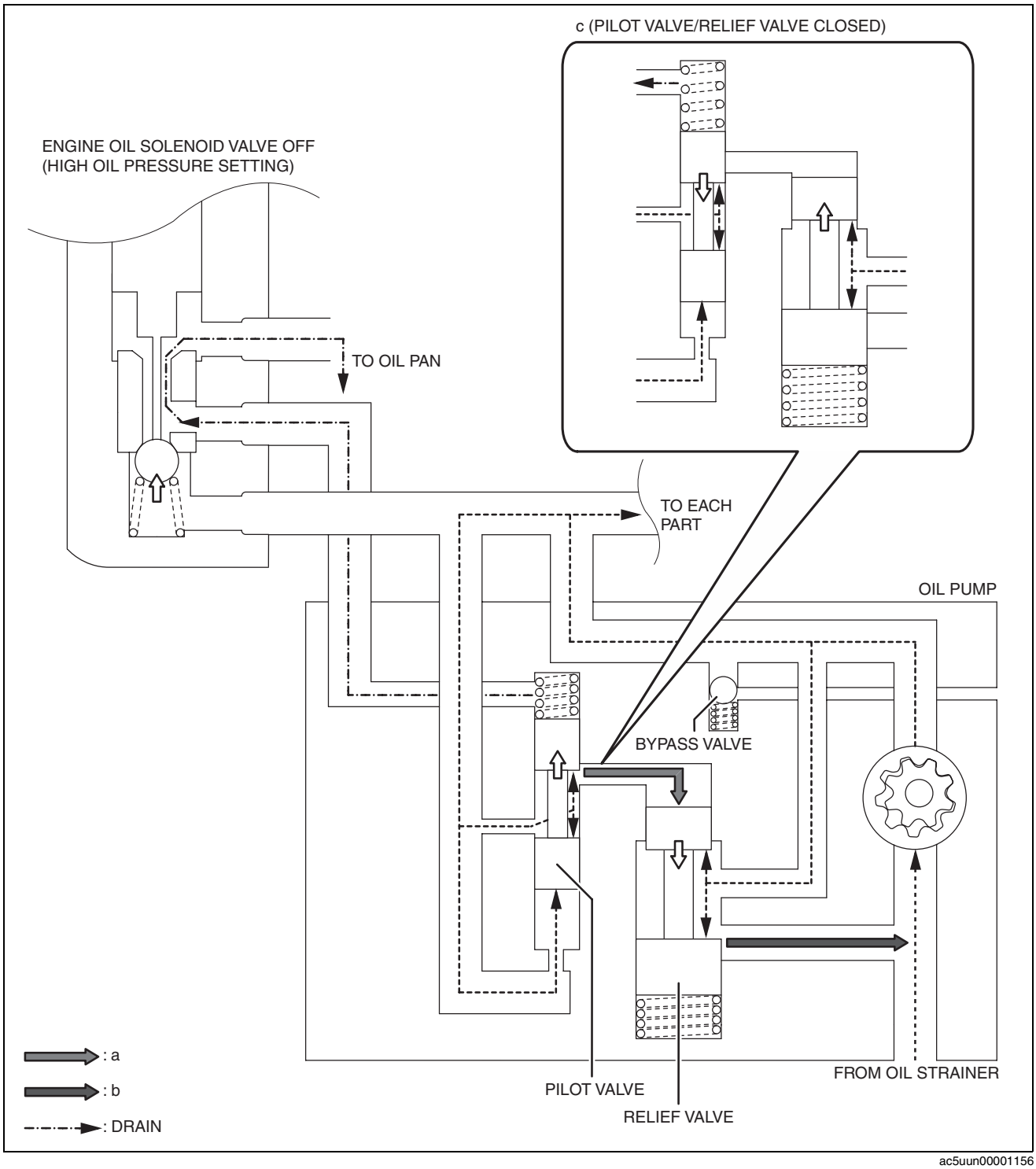
Engine oil flow when setting high oil pressure (engine oil solenoid valve OFF)

a. When oil pressure exceeds the pilot valve opening pressure, the pilot valve is pressed up and oil pressure is applied to the upper part of the relief valve.
b. Because the relief valve opening pressure is exceeded by applying oil pressure to the upper part of the relief valve, the relief valve is pressed down and engine oil flows (oil pressure decrease).
c. When oil pressure is less than the pilot valve opening pressure, the pilot valve closes. As a result, the relief valve closes and engine oil flow stops (oil pressure increase).

LUBRICATION [SKYACTIV-D 2.2]

d. Oil pressure is adjusted by repeating Step (c) to (d).



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OIL JET VALVE [SKYACTIV-D 2.2]

id0111s6002600

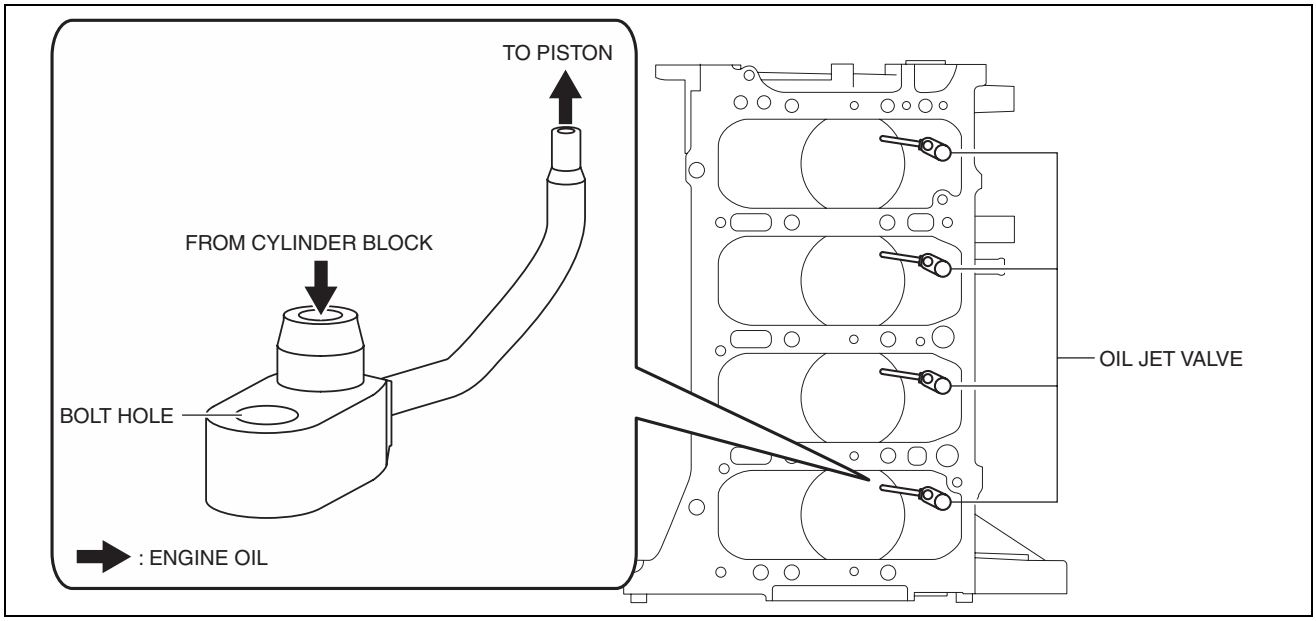
Purpose, Function

- The oil jet valve injects engine oil on the back of the piston to cool the piston.

LUBRICATION [SKYACTIV-D 2.2]

Construction

- The oil jet valve is installed into the cylinder block.



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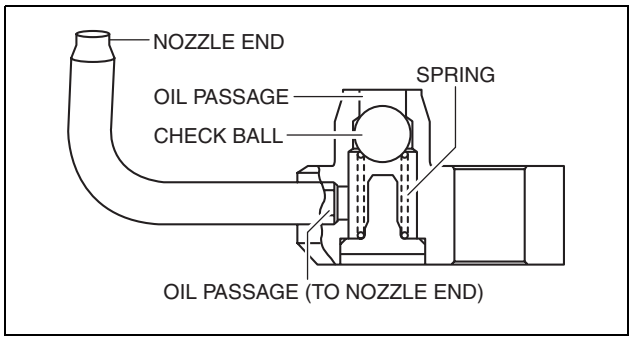
- The oil jet valve is built into the check ball and spring.



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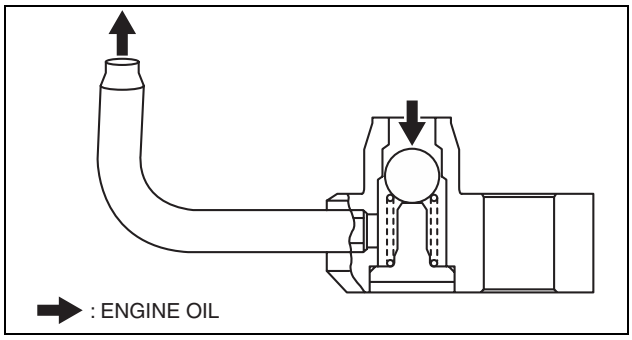
Operation

1. When the oil pressure applied to the check ball exceeds the spring force, the check ball and spring are pressed down.
2. The oil passage is opened to the nozzle and engine oil is injected to the back side of the piston.
3. When the oil pressure applied to the check ball is lower than the spring force, the spring presses up the check ball.



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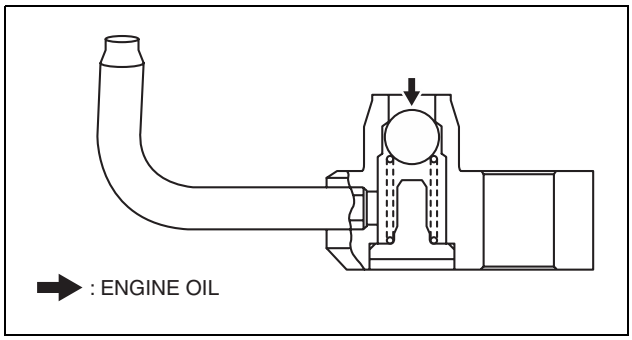
LUBRICATION [SKYACTIV-D 2.2]

4. The oil passage to the nozzle is closed and the injection of engine oil stops.



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ENGINE OIL SOLENOID VALVE [SKYACTIV-D 2.2]

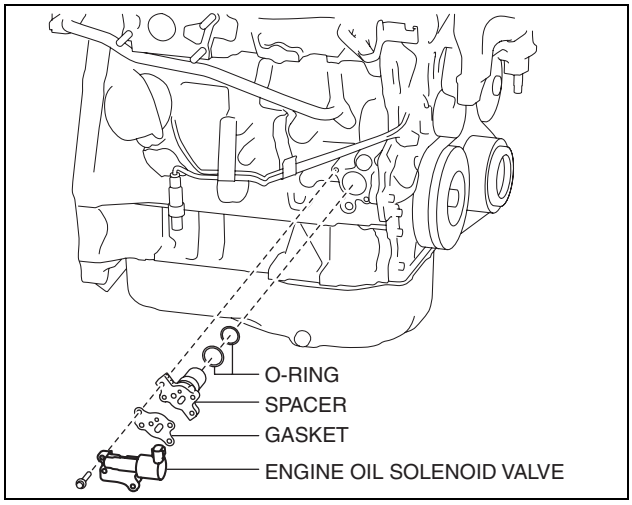
id0111s6002700

Purpose, Function

- The engine oil solenoid valve switches the hydraulic transmission passage in accordance with the driving conditions and the oil pump drive resistance is reduced by controlling oil pump discharging pressure in two steps.

Construction

- The engine oil solenoid valve is installed on the right side of the cylinder block.



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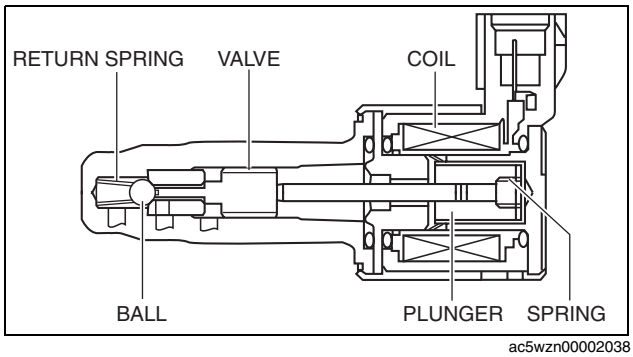
- The engine oil solenoid valve has the following parts:



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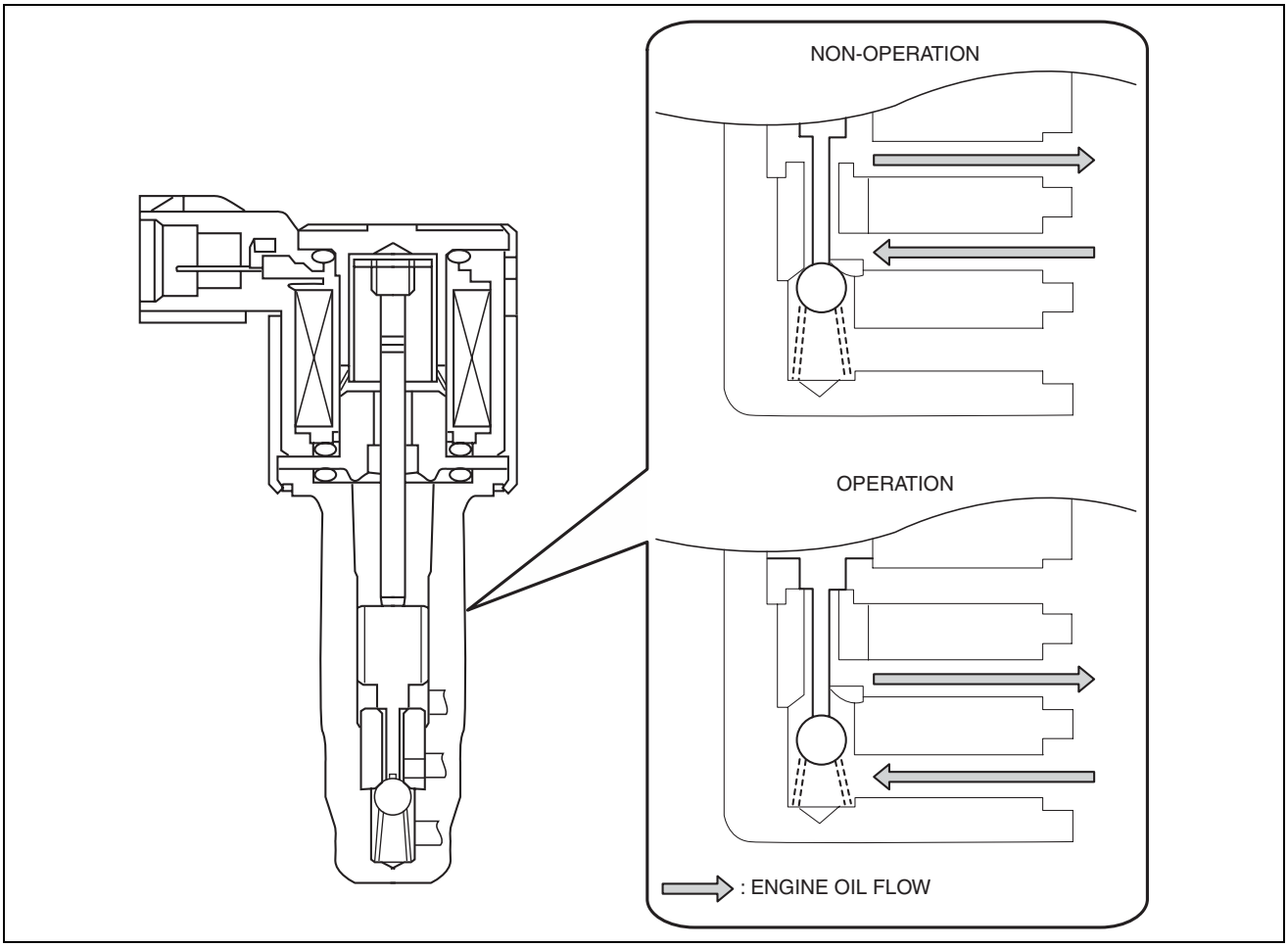
LUBRICATION [SKYACTIV-D 2.2]

Operation
- The oil passage in the solenoid valve is switched according to the control signal (duty signal) from the PCM.



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Fail-safe
- Function not equipped.

OIL SHOWER PIPE [SKYACTIV-D 2.2]

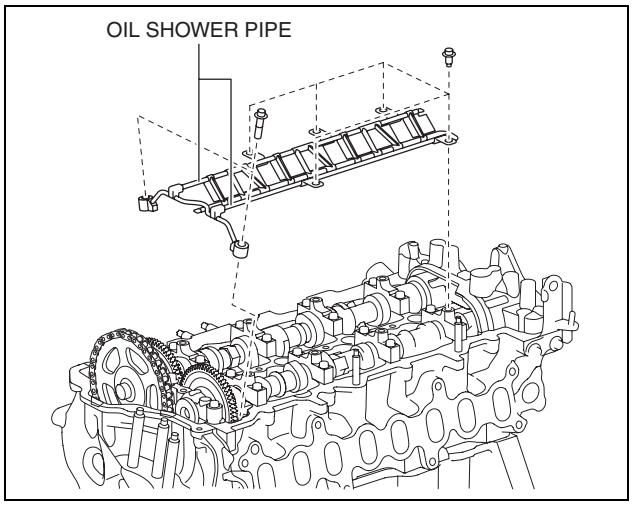
id0111s6002800

Purpose, Function
- The oil shower pipe injects engine oil to lubricate the contact points of the cam and rocker arm. As a result, wear resistance of sliding part is reduced.

Construction
- The oil shower pipe is installed to the camshaft cap.

LUBRICATION [SKYACTIV-D 2.2]

- The oil shower pipe utilizes the engine oil injection holes at the top of the camshaft.



ac5wzn00002040

Operation

- The oil shower pipe injects engine oil from the engine oil injection holes using hydraulic pressure.

01-12A COOLING SYSTEM [SKYACTIV-G 2.0]

COOLING SYSTEM [SKYACTIV-G 2.0]

COOLING SYSTEM [SKYACTIV-G 2.0]

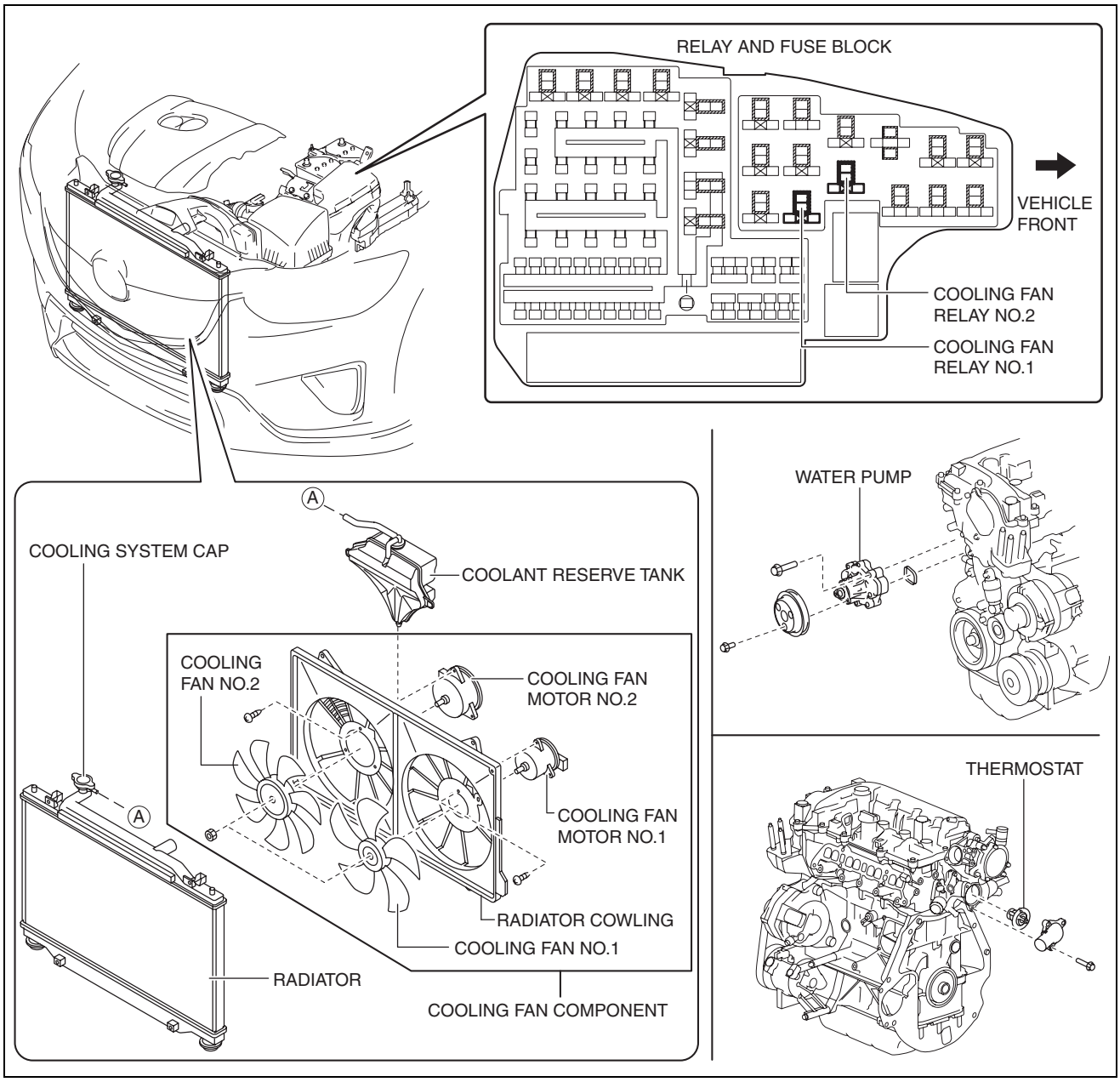
id0112h4002800

Outline

- Passing water resistance is reduced by improvement of the engine coolant passage shape.
- Pump efficiency is improved by changing the water pump impeller to the closed impeller.

COOLING SYSTEM [SKYACTIV-G 2.0]

Structural View



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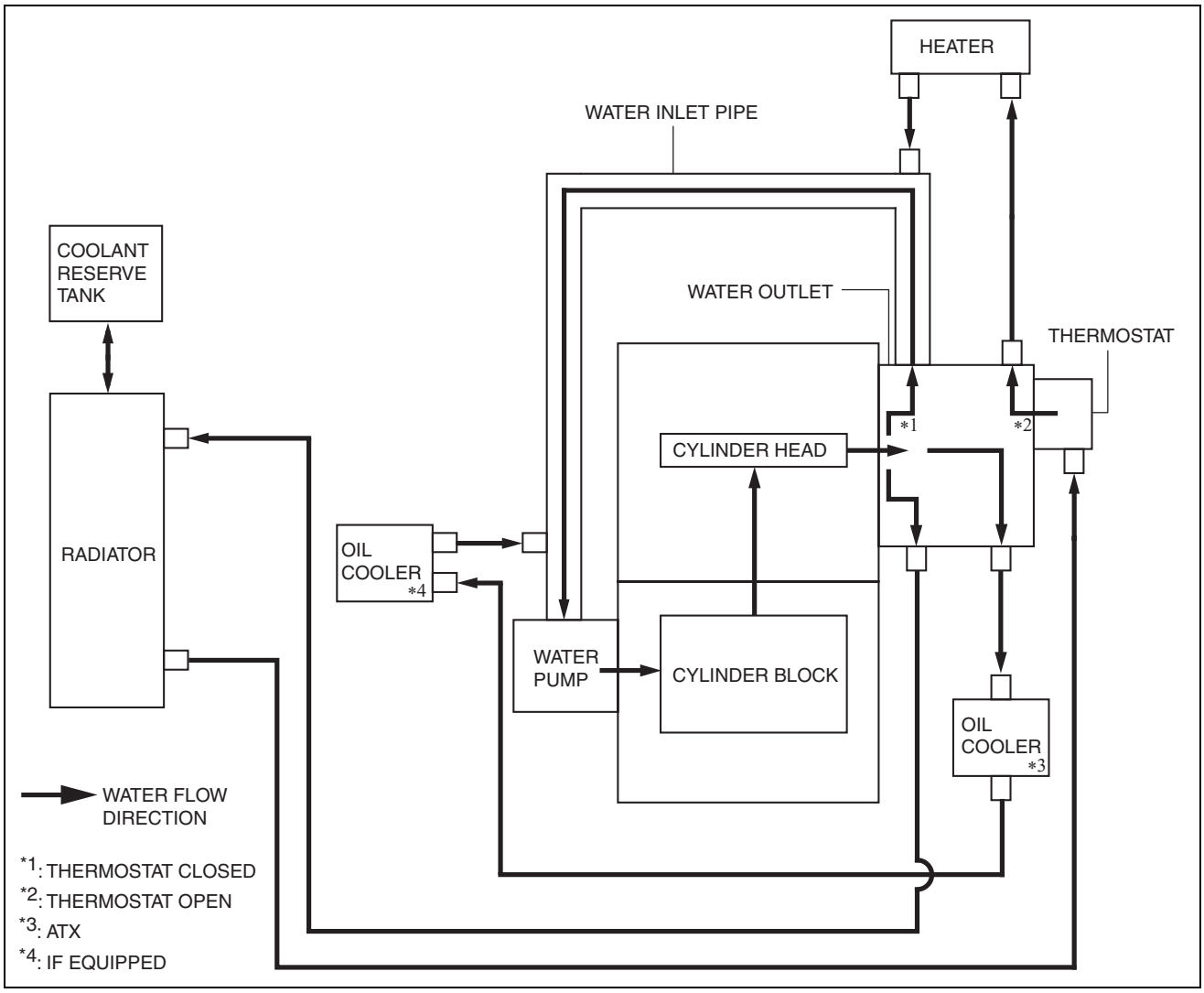
COOLING SYSTEM [SKYACTIV-G 2.0]

Flow Chart



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Structure

- Consists of the following parts:

Radiator	(See 01-12A-3 RADIATOR [SKYACTIV-G 2.0].)
Cooling system cap	(See 01-12A-4 COOLING SYSTEM CAP [SKYACTIV-G 2.0].)
Thermostat	(See 01-12A-6 THERMOSTAT [SKYACTIV-G 2.0].)
Water pump	(See 01-12A-7 WATER PUMP [SKYACTIV-G 2.0].)
Cooling fan component	(See 01-12A-9 COOLING FAN COMPONENT [SKYACTIV-G 2.0].)
Cooling fan relay	(See 01-12A-9 COOLING FAN RELAY [SKYACTIV-G 2.0].)

RADIATOR [SKYACTIV-G 2.0]

id0112h4158500

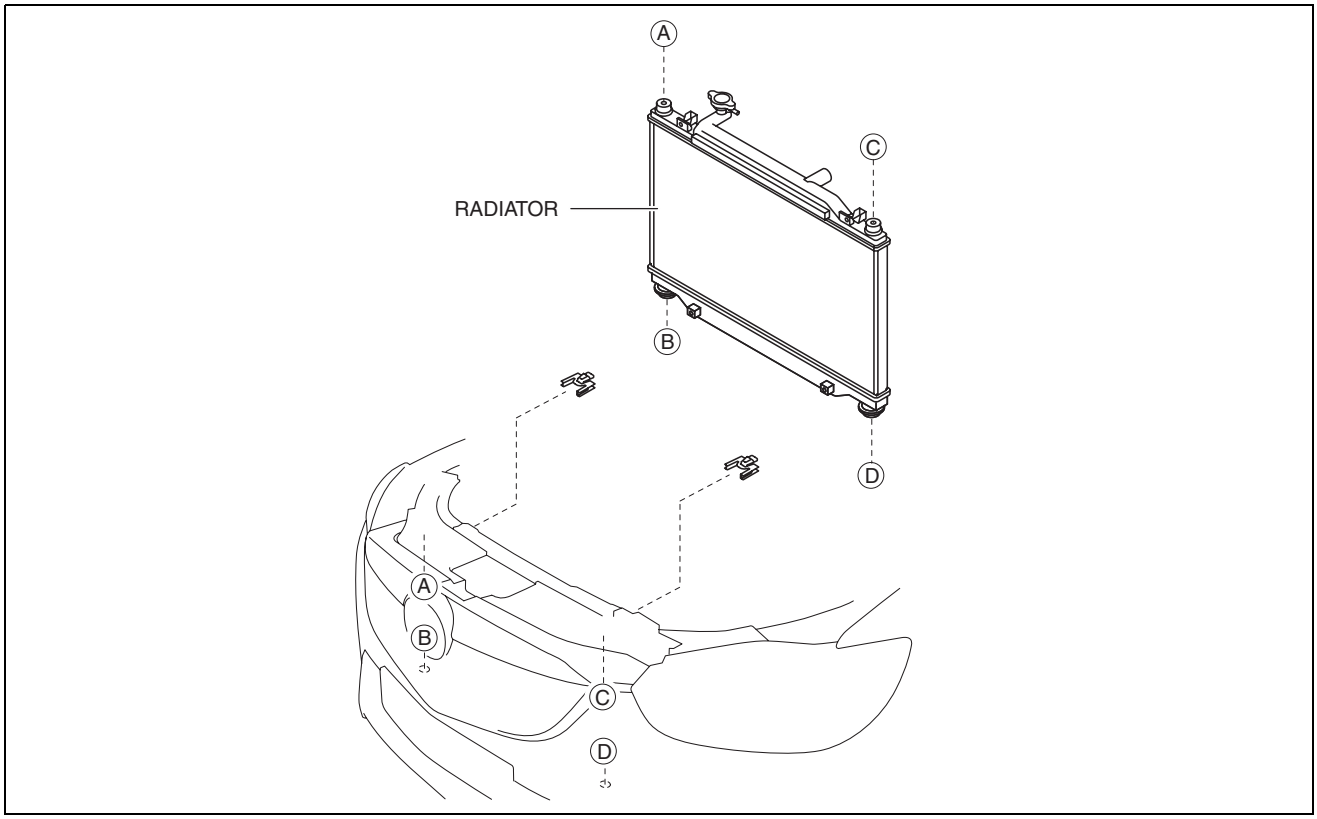
Purpose, Function

- The radiator disperses the engine coolant heat flowing internally by receiving against the vehicle while it is driven or air flow produced by the cooling fan.

COOLING SYSTEM [SKYACTIV-G 2.0]

Construction

- The radiator is installed to the front of the engine compartment.



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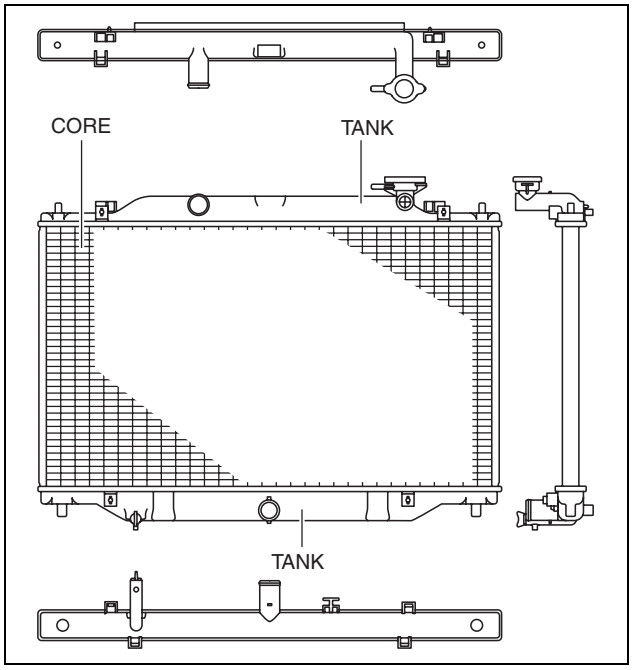
- A down-flow radiator with corrugated fins has been adopted.
- The radiator tanks are made of plastic and the core is made of aluminum for weight reduction.
- Four mounting rubbers are utilized to decrease vibration.



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COOLING SYSTEM CAP [SKYACTIV-G 2.0]

id0112h4158600

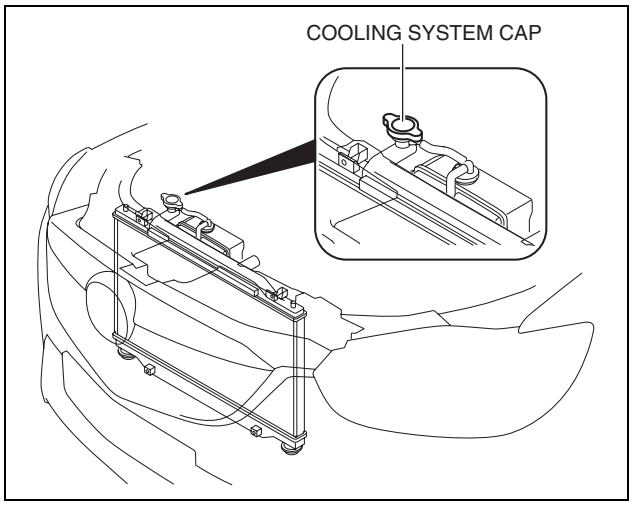
Purpose, Function

- The cooling system cap maintains appropriate pressure in the engine coolant passage. In addition, cooling efficiency has been improved by increasing the engine coolant boiling point.

COOLING SYSTEM [SKYACTIV-G 2.0]

Construction

- The cooling system cap is installed to the upper part of the radiator.



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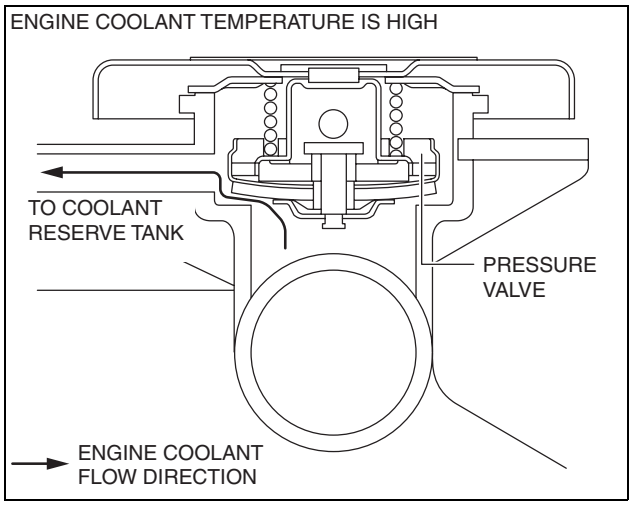
Operation

When engine coolant temperature is high

1. When the engine coolant temperature is high, the pressure in the engine coolant passage increases and the pressure valve is pressed and opened.
2. Engine coolant flows into the coolant reserve tank when the pressure valve is open.



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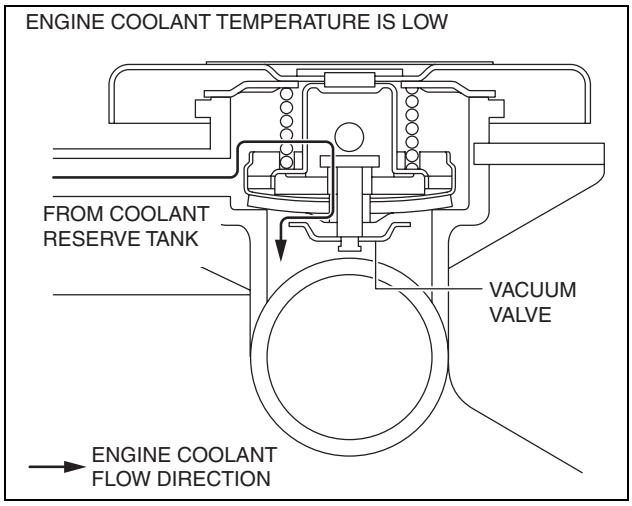
When engine coolant temperature is low

1. When the engine coolant temperature is low, the pressure in the engine coolant passage decreases and the vacuum valve is opened.

COOLING SYSTEM [SKYACTIV-G 2.0]

2. Engine coolant in the coolant reserve tank flows into the engine coolant passage when the vacuum valve is open.



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THERMOSTAT [SKYACTIV-G 2.0]

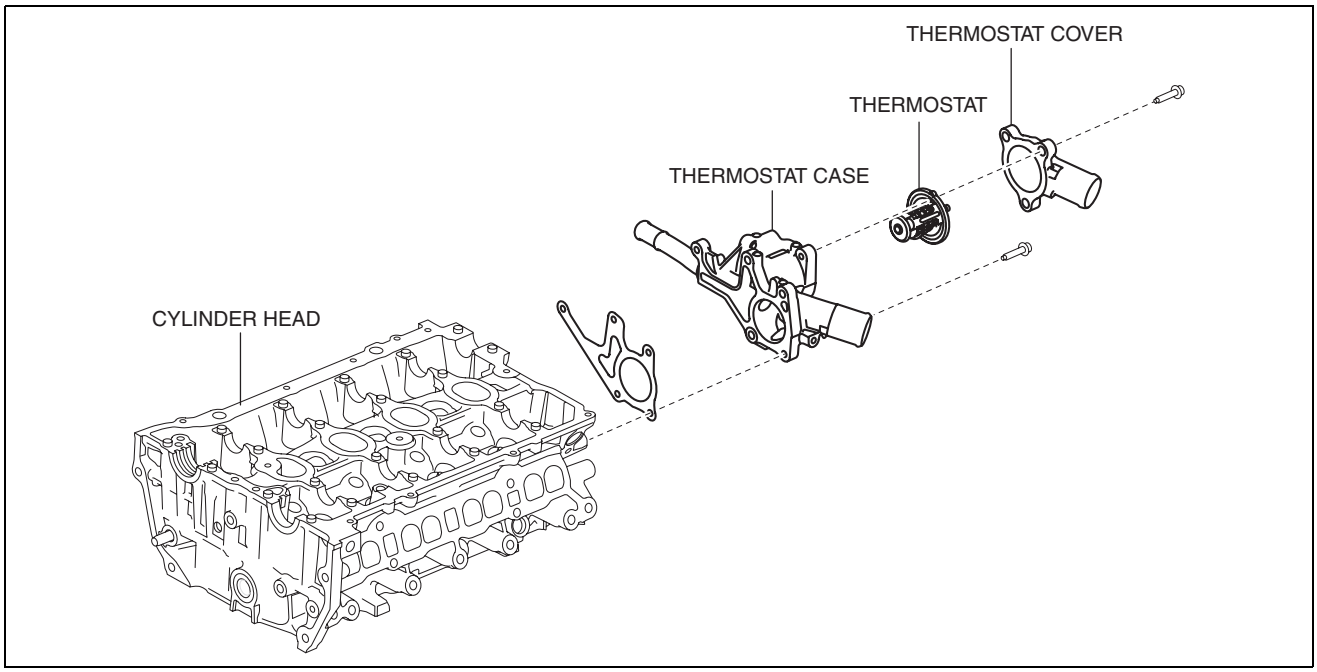
id0112h4003000

Purpose, Function

- When the engine coolant temperature is low, the thermostat blocks the engine coolant passage between the radiator and engine. As a result, because engine coolant cycles without passing through the radiator, warming is promoted.

Construction

- The thermostat is installed to the rear part of the cylinder head.



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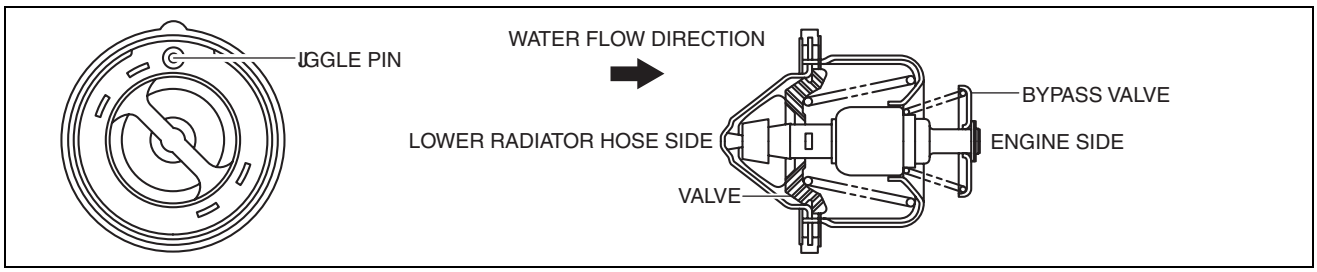
- The thermostat has the following parts:



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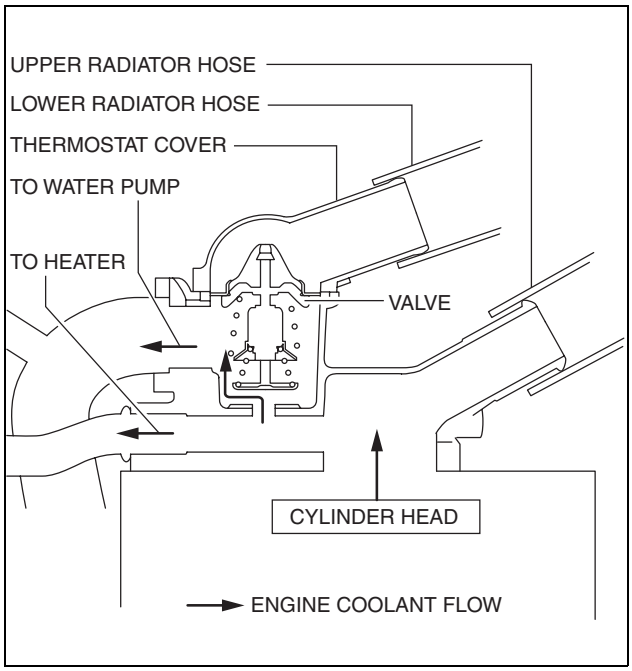
COOLING SYSTEM [SKYACTIV-G 2.0]

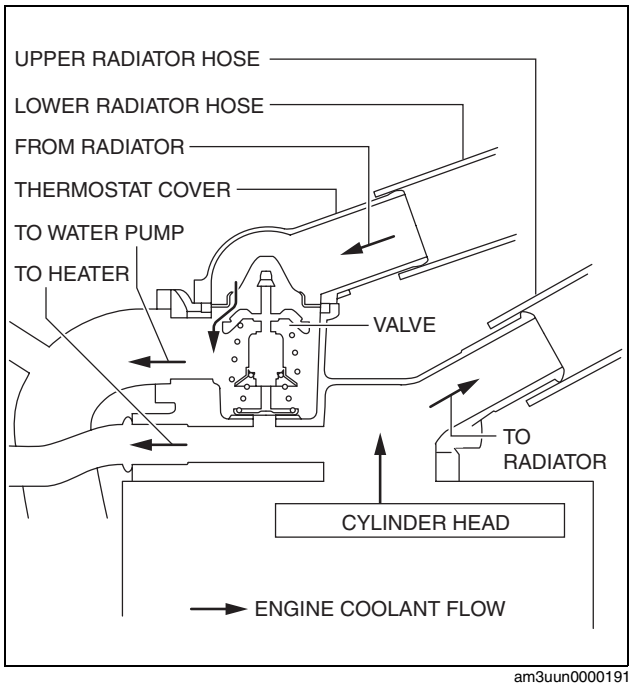
Operation

1. When the engine coolant temperature decreases, the thermostat valve closes and engine coolant circulates without passing through the radiator.



am3uun0000191

2. When the engine coolant temperature is 80.5—83.5°C, the thermostat valve starts to open and the engine coolant passed through the radiator flows to the engine.



am3uun0000191

WATER PUMP [SKYACTIV-G 2.0]

id0112h4003100

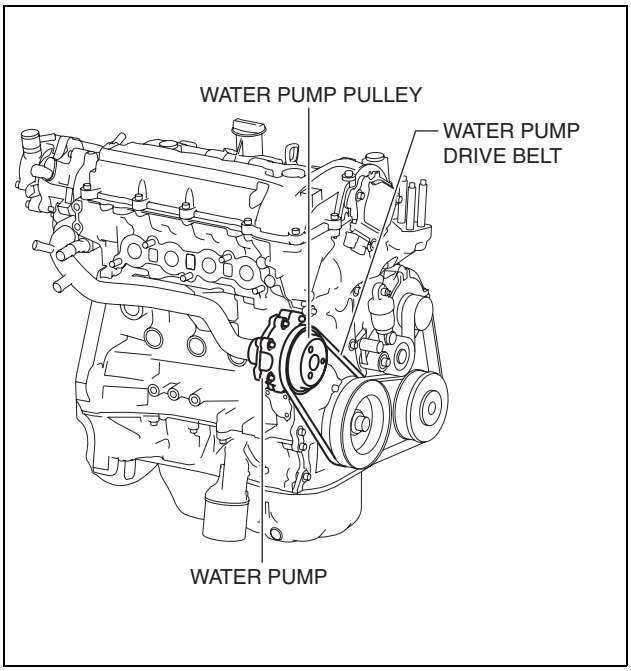
Purpose, Function

- The water pump operates by obtaining drive force from the engine via the drive belt to pump engine coolant.

COOLING SYSTEM [SKYACTIV-G 2.0]

Construction

- The water pump is installed to the engine front.
- The water pump consists of the following parts:



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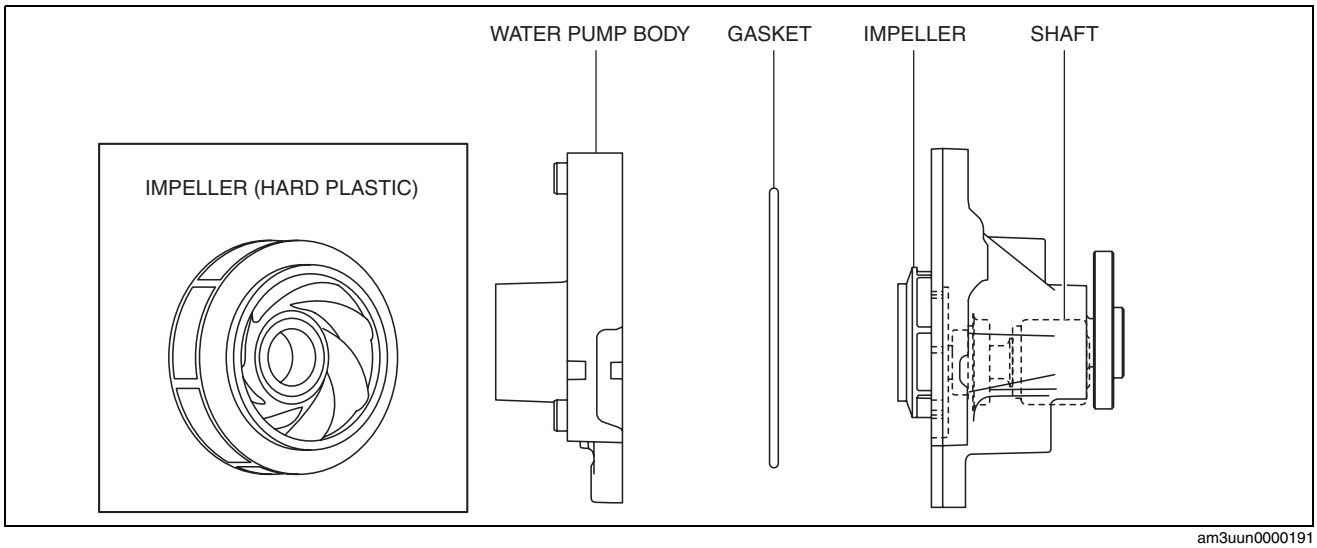

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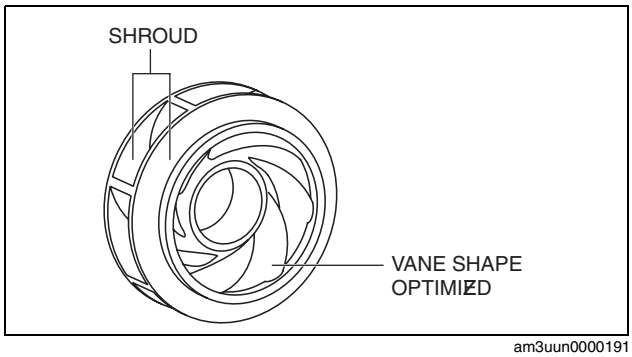
- With the adoption of a hard-plastic closed impeller, pump efficiency has been improved.



am3uun0000191

Operation

1. The water pump pulley rotates by obtaining drive force from the engine via the drive belt.
2. The impeller with the water pump pulley and shaft connected rotates to pump engine coolant.

COOLING SYSTEM [SKYACTIV-G 2.0]

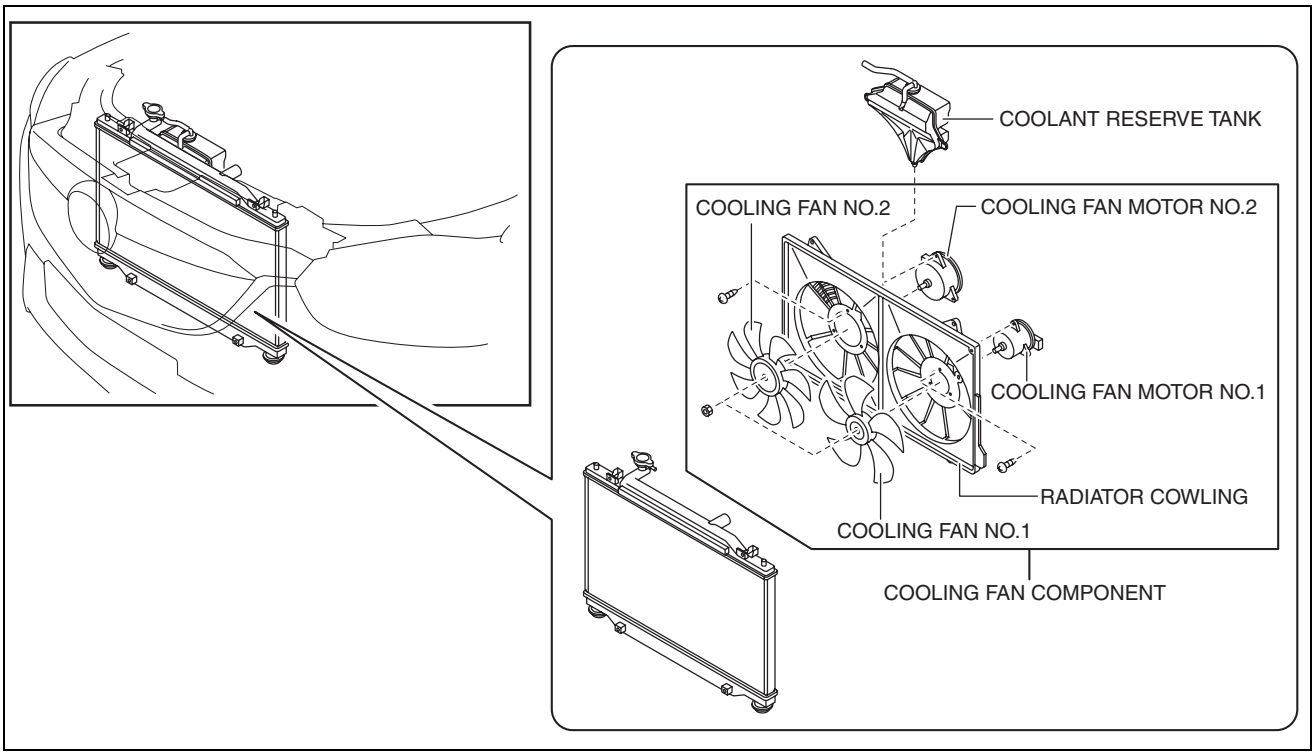
COOLING FAN COMPONENT [SKYACTIV-G 2.0]

id0112h4003200

Purpose, Function

- The cooling fan rotates according to vehicle conditions and enhances the cooling efficiency of the radiator.

Structural View



ac5wzn00001014

Operation

- For the operation, refer to CONTROL SYSTEM. (See 01-40-38 ELECTRICAL FAN CONTROL [SKYACTIV-G 2.0].)

Fail-safe

- Function not equipped.

COOLING FAN RELAY [SKYACTIV-G 2.0]

id0112h4158700

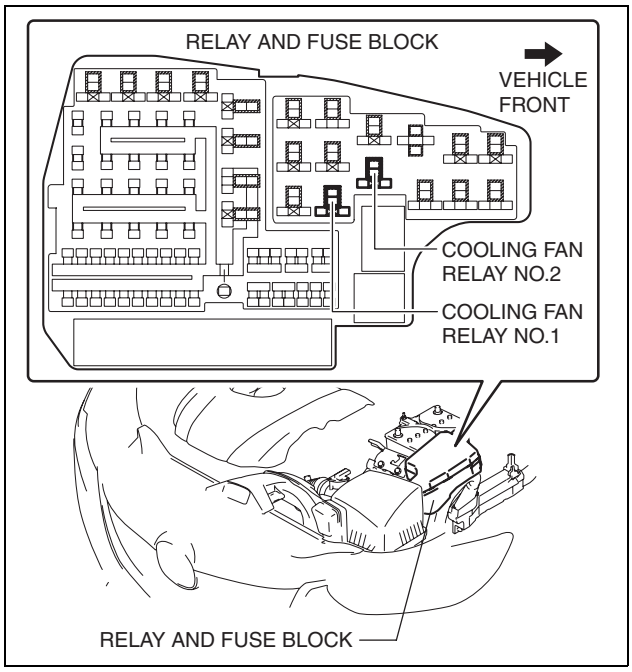
Purpose, Function

- The cooling fan relay operates by receiving the signal from the PCM to supply power to the cooling fan motor.

COOLING SYSTEM [SKYACTIV-G 2.0]

Construction

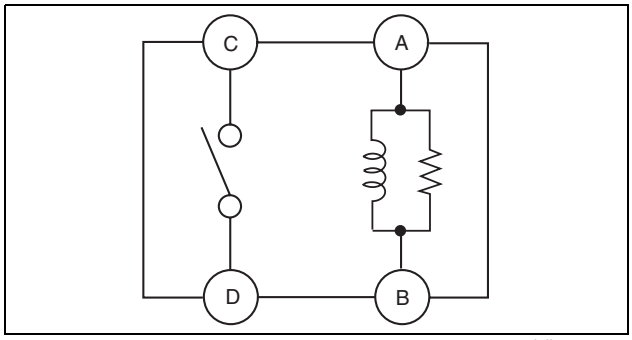
- The cooling fan relay is installed on the relay and fuse block.



ac5wzn00001020

Operation

1. When current flows between A-B shown in the figure, electromagnetic power is generated and the switch between C-D is turned on.
2. Current flows between C-D and power is supplied to the cooling fan motor.



adejjn00002037

Fail-safe

- Function not equipped.

01-12B COOLING SYSTEM [SKYACTIV-D 2.2]

COOLING SYSTEM [SKYACTIV-D 2.2]

COOLING SYSTEM [SKYACTIV-D 2.2]

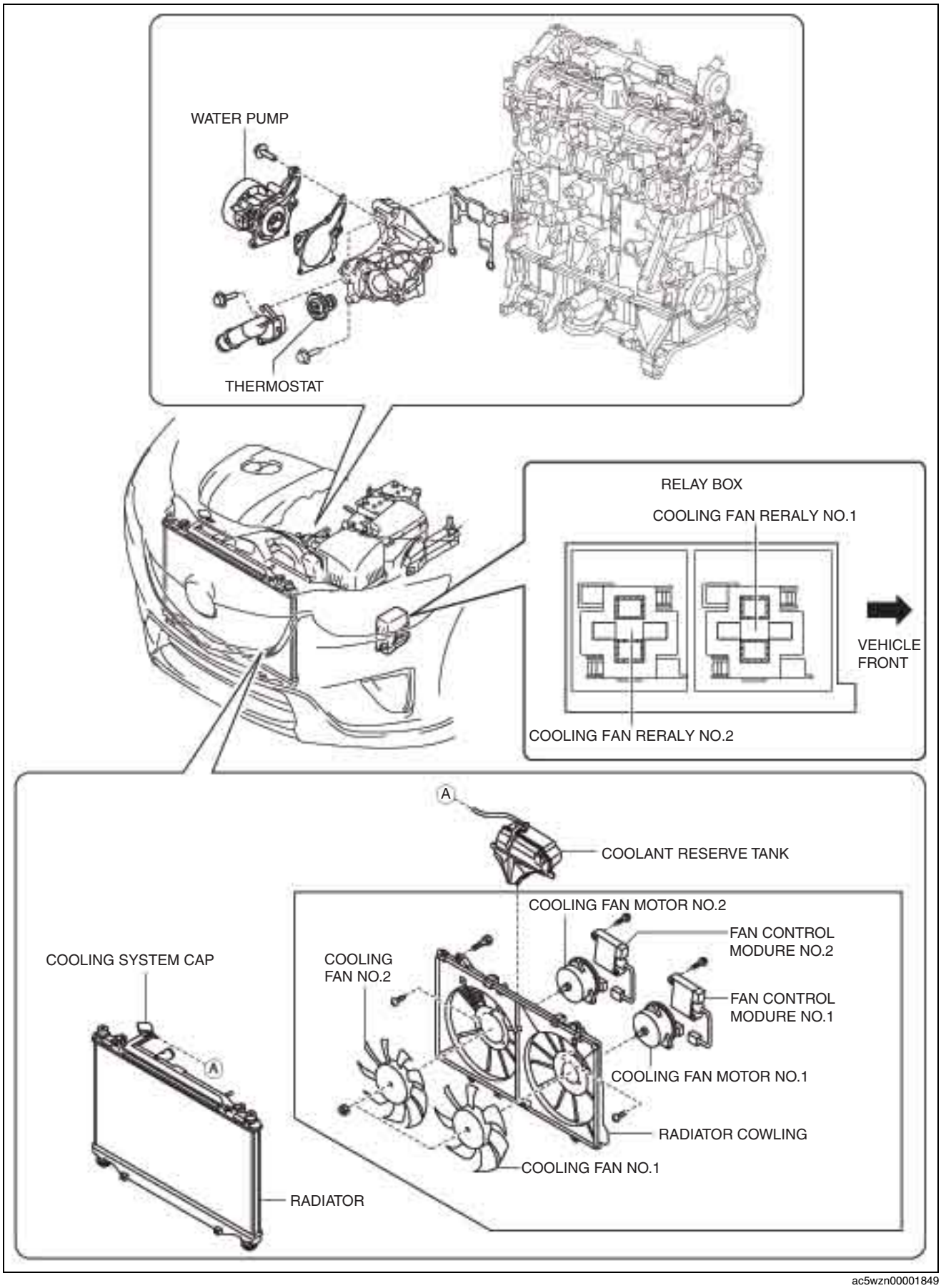
id0112s6002800

Outline

- Pump efficiency is improved by changing the water pump impeller to a shroud impeller.

COOLING SYSTEM [SKYACTIV-D 2.2]

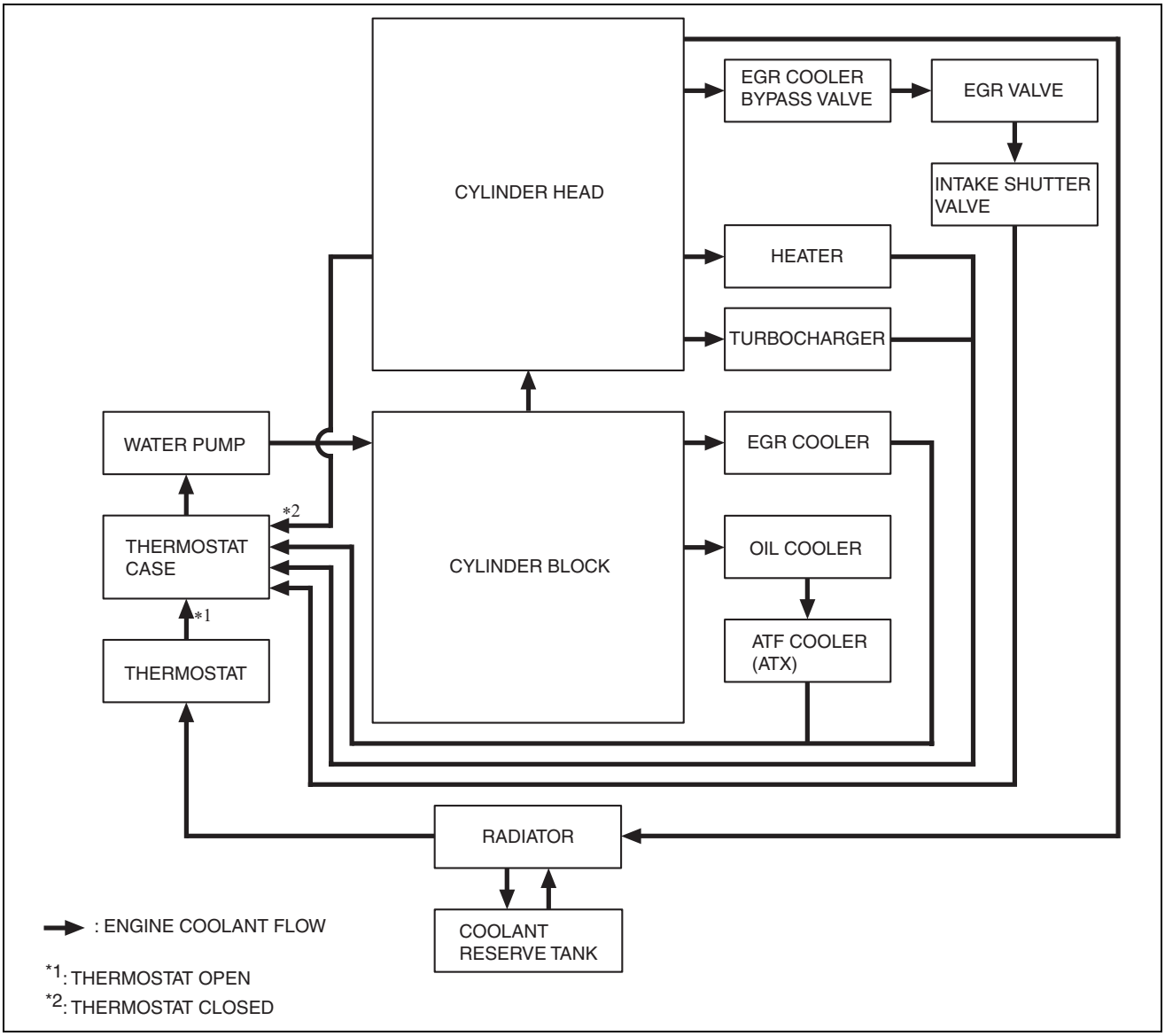
Structural Vew



ac5wzn00001849

COOLING SYSTEM [SKYACTIV-D 2.2]

Flow Chart



ac5wzn00001850

Structure

- Consists of the following parts:

Thermostat	(See 01-12B-6 THERMOSTAT [SKYACTIV-D 2.2].)
Water pump	(See 01-12B-7 WATER PUMP [SKYACTIV-D 2.2].)
Cooling fan relay	(See 01-12B-10 COOLING FAN RELAY [SKYACTIV-D 2.2].)
Cooling fan component	(See 01-12B-9 COOLING FAN COMPONENT [SKYACTIV-D 2.2].)
Fan control module	(See 01-12B-11 FAN CONTROL MODULE [SKYACTIV-D 2.2].)
Cooling system cap	(See 01-12B-4 COOLING SYSTEM CAP [SKYACTIV-D 2.2].)
Radiator	(See 01-12B-3 RADIATOR [SKYACTIV-D 2.2].)

RADIATOR [SKYACTIV-D 2.2]

id0112s6158500

Purpose, Function

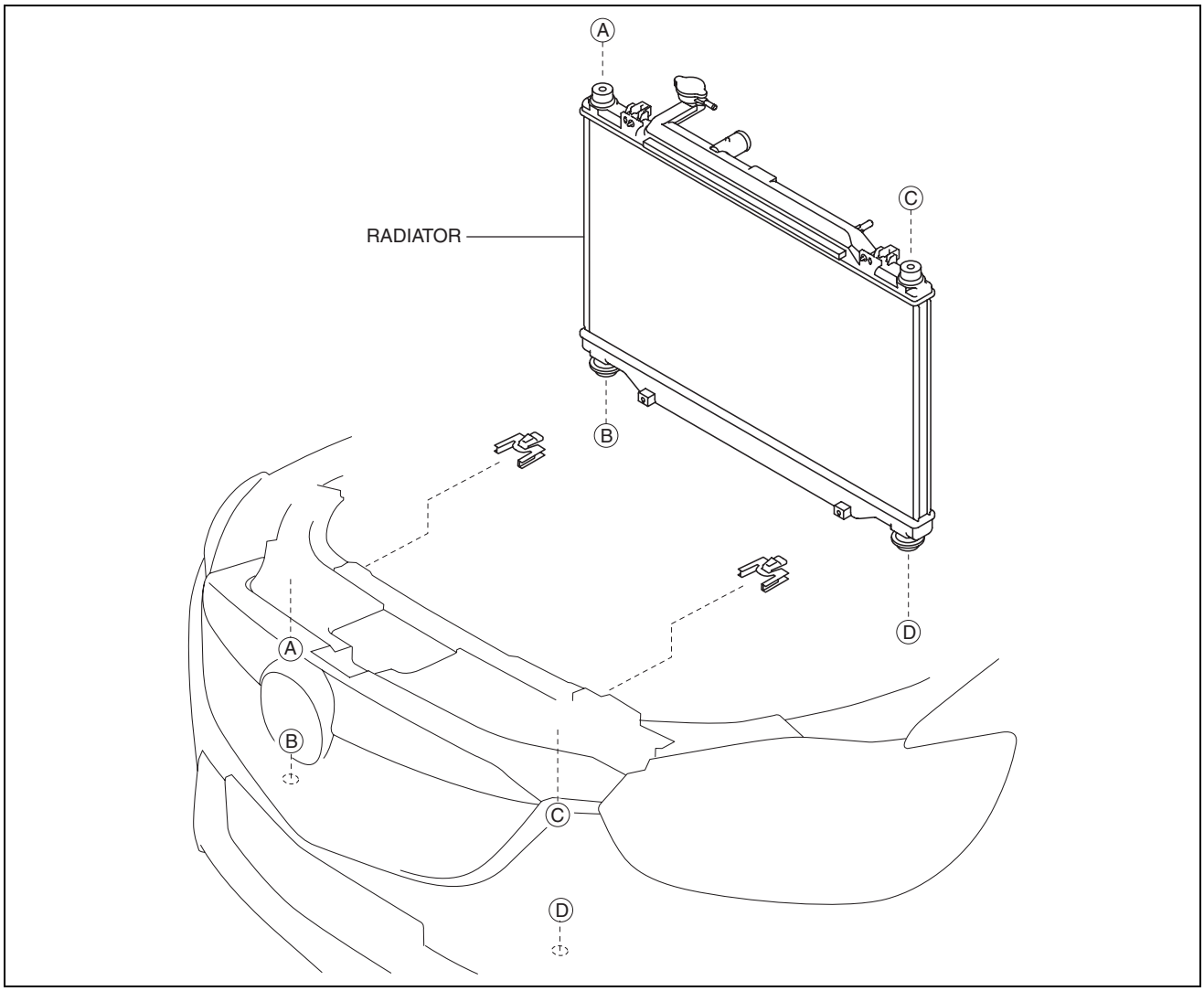
- The radiator disperses the engine coolant heat flowing internally by receiving wind blown against the vehicle while it is driven or wind produced by the cooling fan.

Construction

- The radiator is installed to the front of the engine compartment.

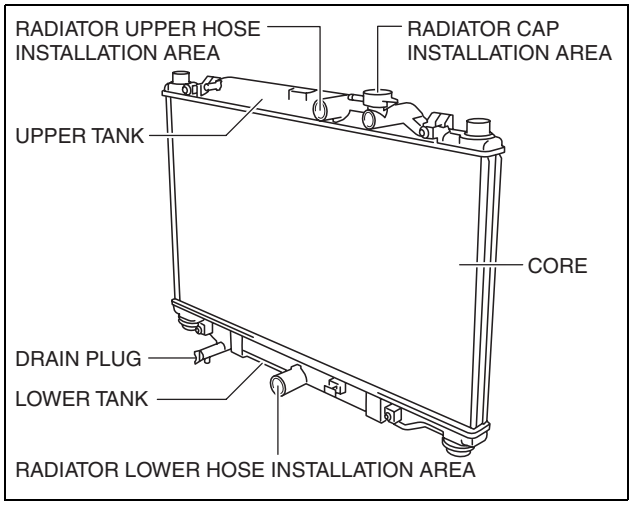
COOLING SYSTEM [SKYACTIV-D 2.2]

- Four mounting rubbers are utilized to decrease vibration.



ac5wzn00001842

- A down-flow radiator with corrugated fins is used to improve cooling performance.
- The radiator tanks are made of plastic and the core is made of aluminum for weight reduction.



ac5wzn00001843

COOLING SYSTEM CAP [SKYACTIV-D 2.2]

id0112s6158600

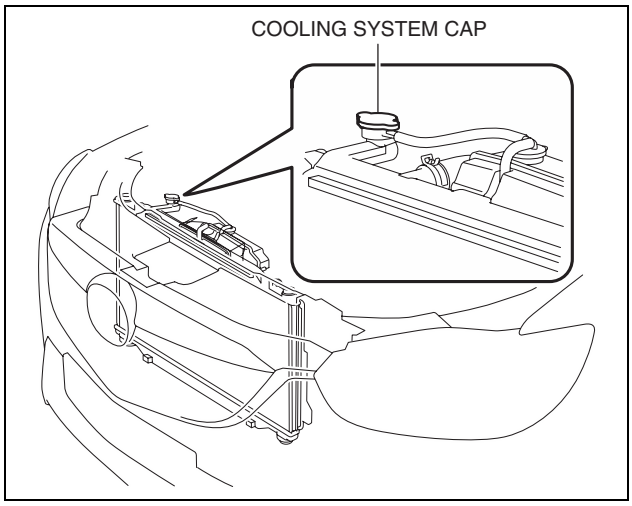
Purpose, Function

- The cooling system cap maintains appropriate pressure in the engine coolant passage. In addition, cooling efficiency has been improved by increasing the engine coolant boiling point.

COOLING SYSTEM [SKYACTIV-D 2.2]

Construction

- The cooling system cap is installed to the upper part of the radiator.

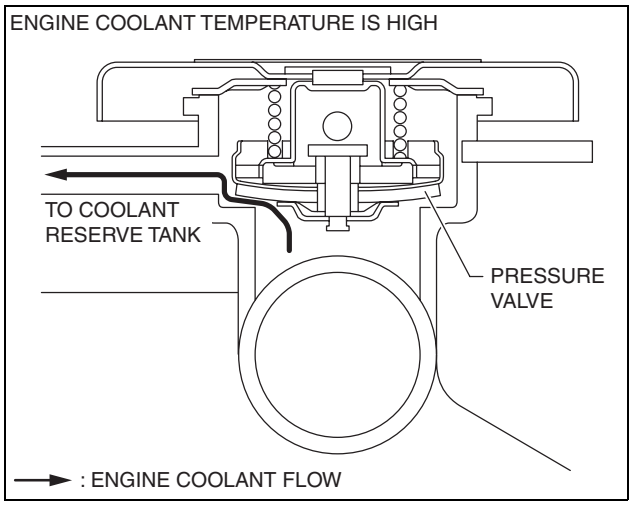


ac5wzn00001830

Operation

When engine coolant temperature is high

1. When the engine coolant temperature is high, the pressure in the engine coolant passage increases and the pressure valve is pressed and opened.
2. Engine coolant flows into the coolant reserve tank when the pressure valve is open.



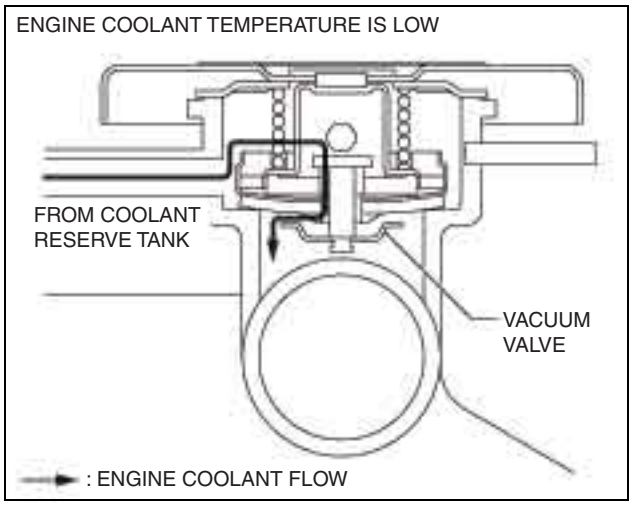
ac5wzn00001831

When engine coolant temperature is low

1. When the engine coolant temperature is low, the pressure in the engine coolant passage decreases and the vacuum valve is opened.

COOLING SYSTEM [SKYACTIV-D 2.2]

2. Engine coolant in the coolant reserve tank flows into the engine coolant passage when the vacuum valve is open.



ac5wzn00001832

THERMOSTAT [SKYACTIV-D 2.2]

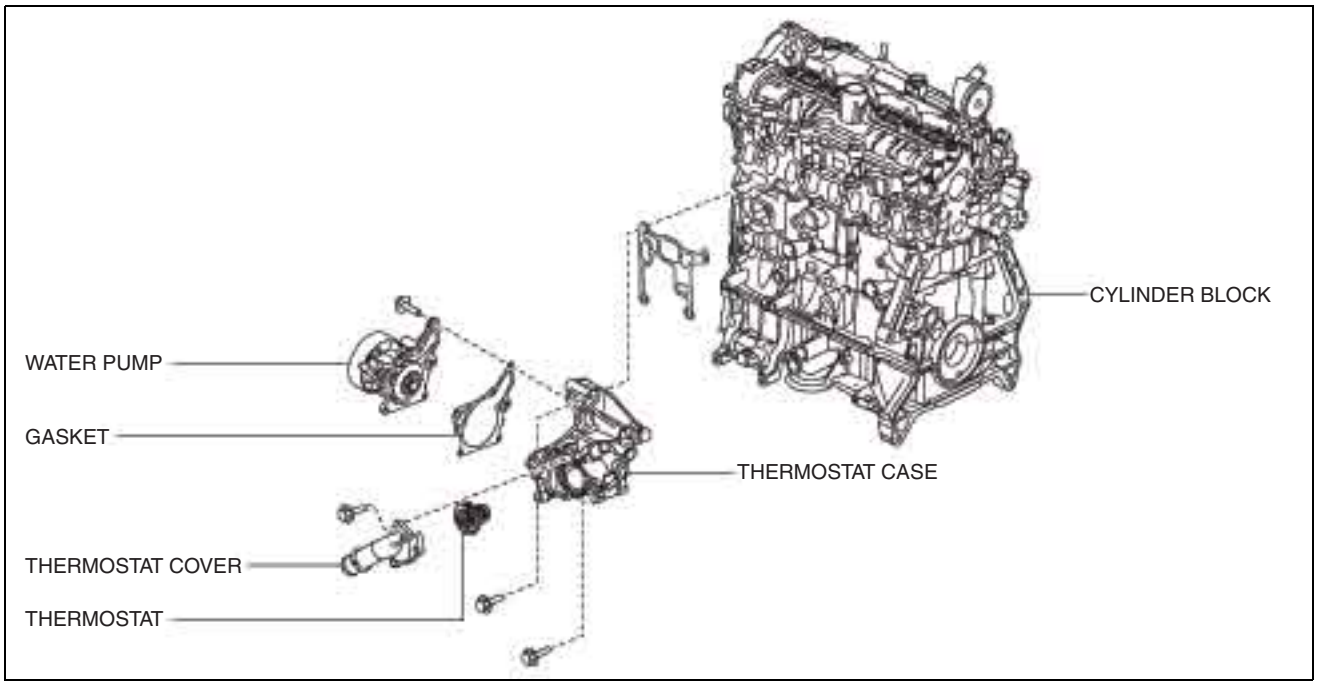
id0112s6003000

Purpose, Function

- When the engine coolant temperature is low, the thermostat blocks the engine coolant passage between the radiator and engine. As a result, because engine coolant cycles without passing through the radiator, warming is promoted.

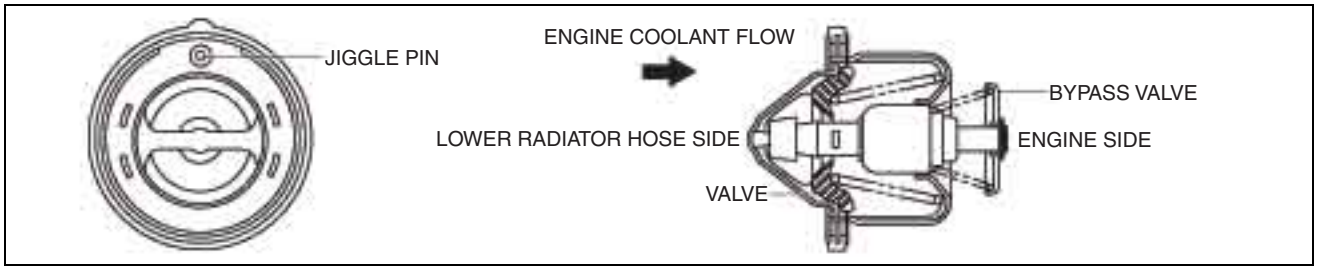
Construction

- The thermostat is installed to the thermostat case on the left front side of the engine.



ac5wzn00002024

- The thermostat has the following parts:

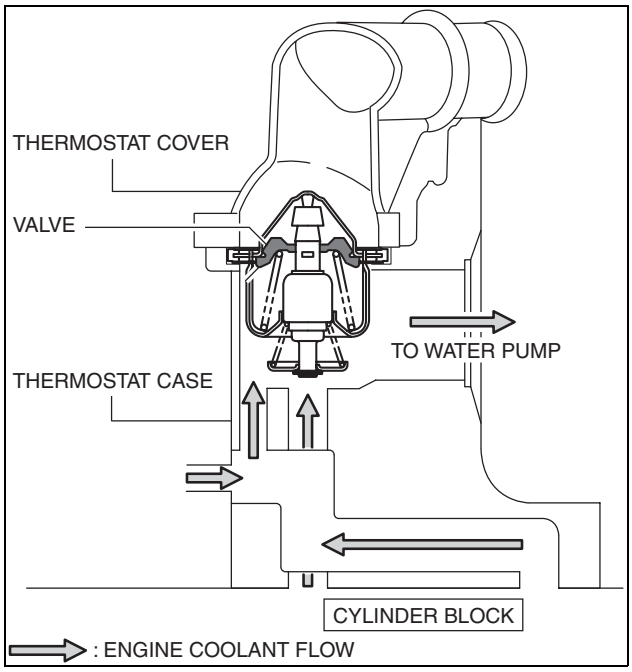


ac5wzn00000126

COOLING SYSTEM [SKYACTIV-D 2.2]

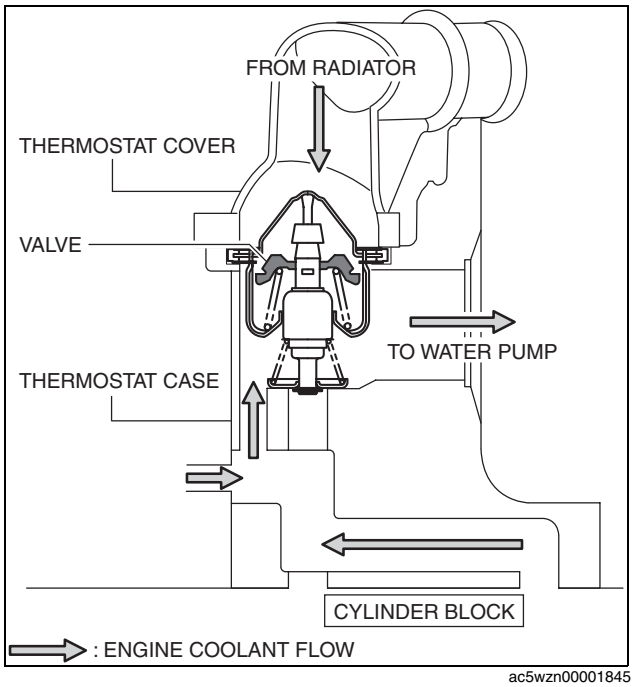
Operation

1. When the engine coolant temperature decreases, the thermostat valve closes and engine coolant circulates without passing through the radiator.



ac5wzn00001844

2. When the engine coolant temperature is **80—84°C**, the thermostat valve starts to open and the engine coolant passed through the radiator flows to the engine.



ac5wzn00001845

WATER PUMP [SKYACTIV-D 2.2]

id0112s6003100

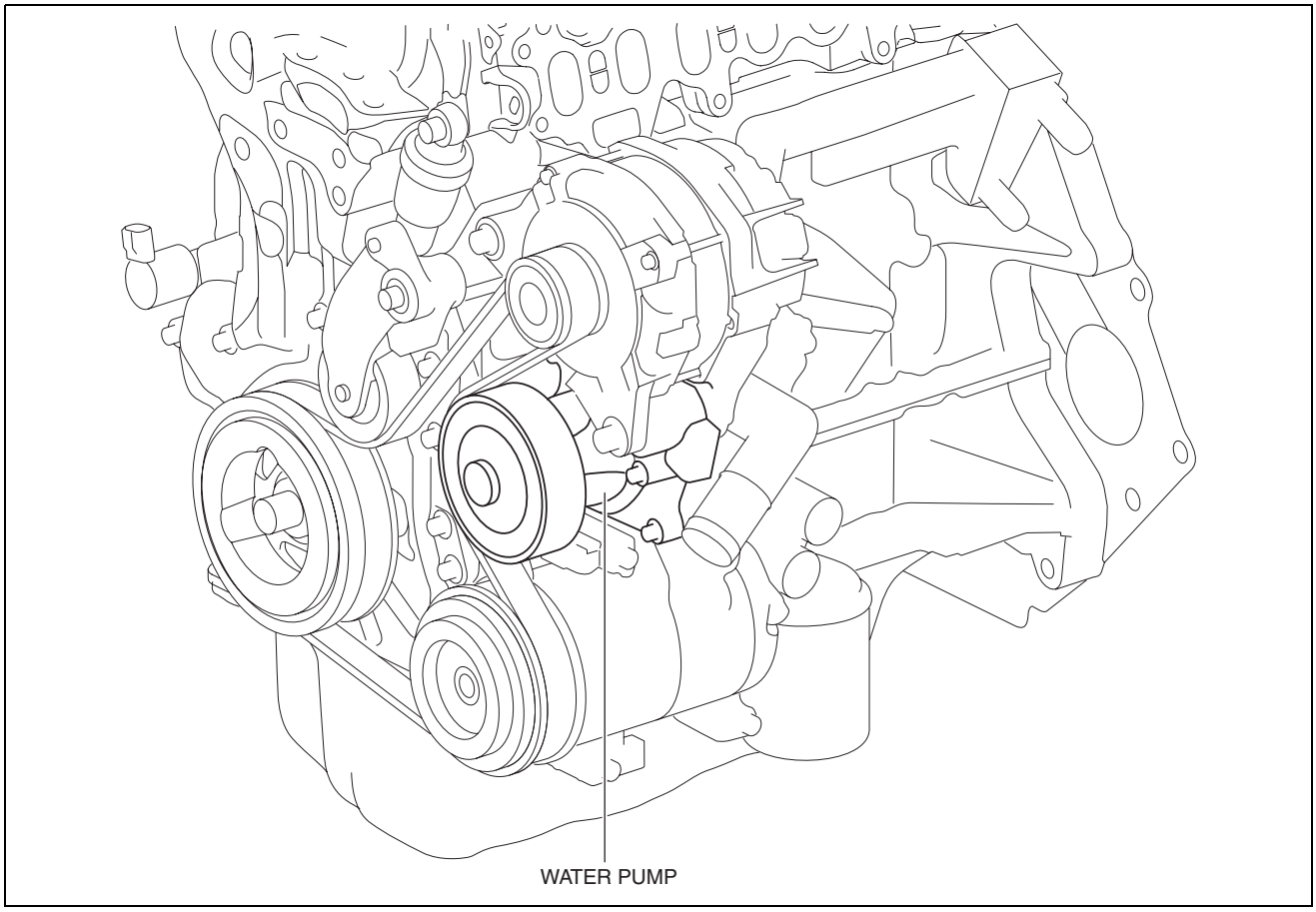
Purpose, Function

- The water pump operates by obtaining drive force from the engine via the drive belt to pump engine coolant.

COOLING SYSTEM [SKYACTIV-D 2.2]

Construction

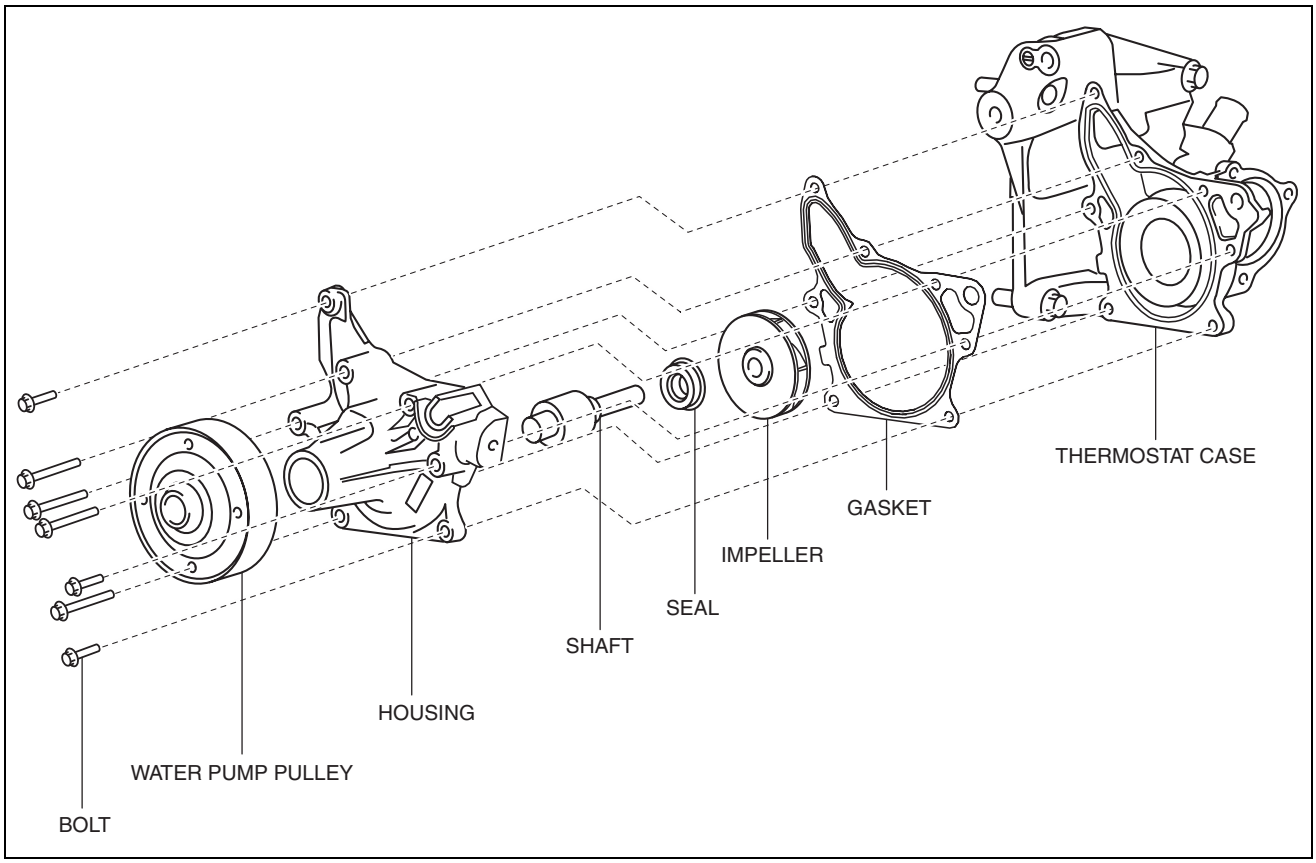
- The water pump is installed to the engine front.



ac5wzn00001846

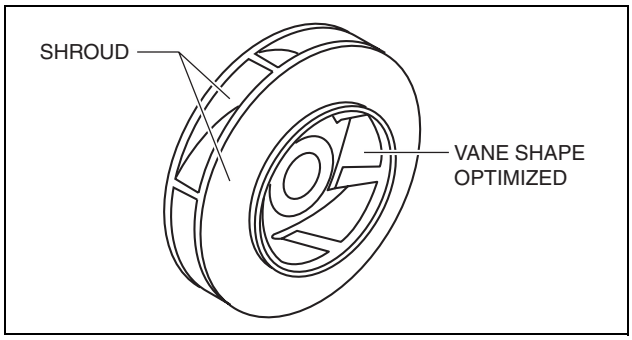
COOLING SYSTEM [SKYACTIV-D 2.2]

- The water pump consists of the following parts:



ac5wzn00001847

- With the adoption of a hard-plastic shroud impeller, pump efficiency has been improved.



ac5wzn00002025

Operation

1. The water pump pulley rotates by obtaining drive force from the engine via the drive belt.
2. The impeller with the water pump pulley and shaft connected rotates to pump engine coolant.

COOLING FAN COMPONENT [SKYACTIV-D 2.2]

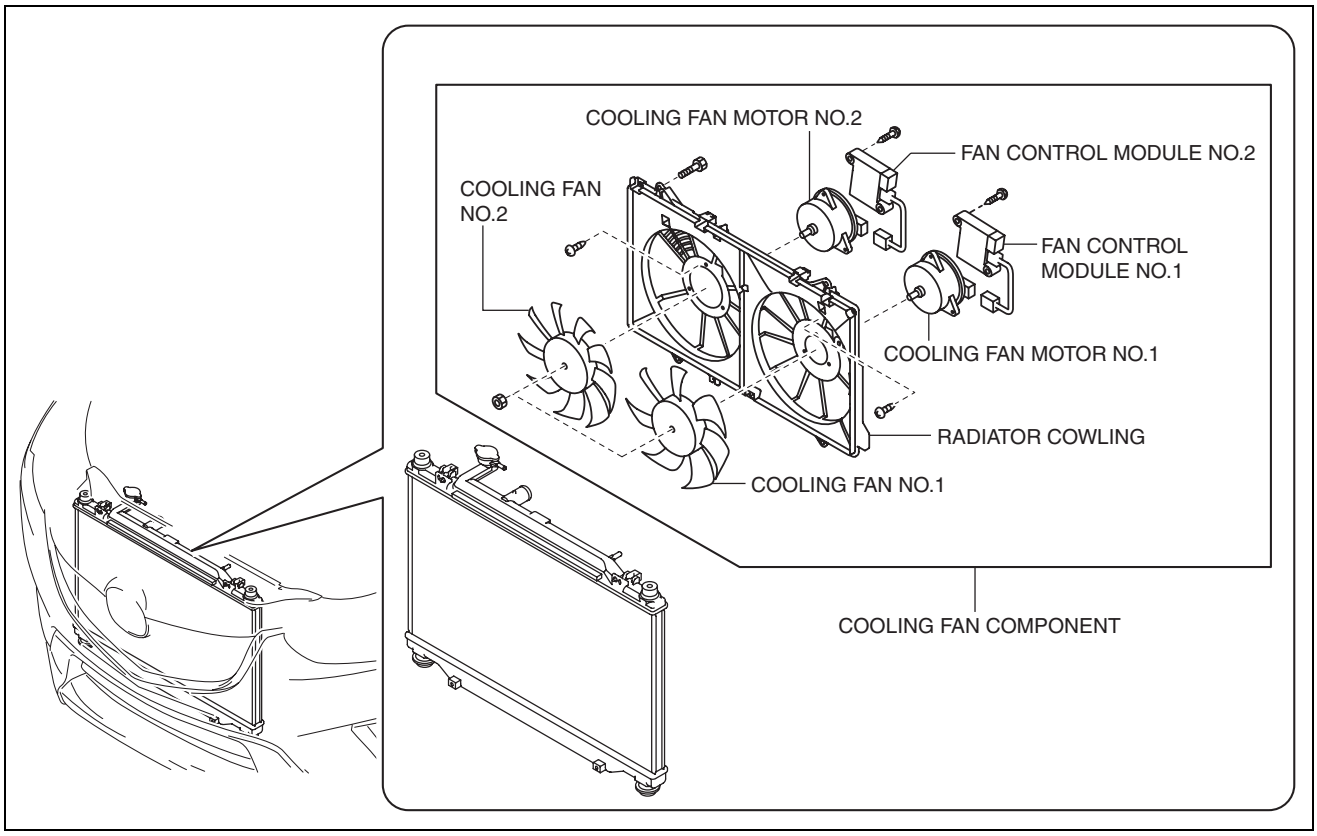
id0112s6003200

Purpose, Function

- The cooling fan rotates according to vehicle conditions and enhances the cooling efficiency of the radiator.

COOLING SYSTEM [SKYACTIV-D 2.2]

Structural View



ac5wzn00001851

Operation

- For the operation, refer to CONTROL SYSTEM.

Fail-safe

- Function not equipped.

COOLING FAN RELAY [SKYACTIV-D 2.2]

id0112s6158700

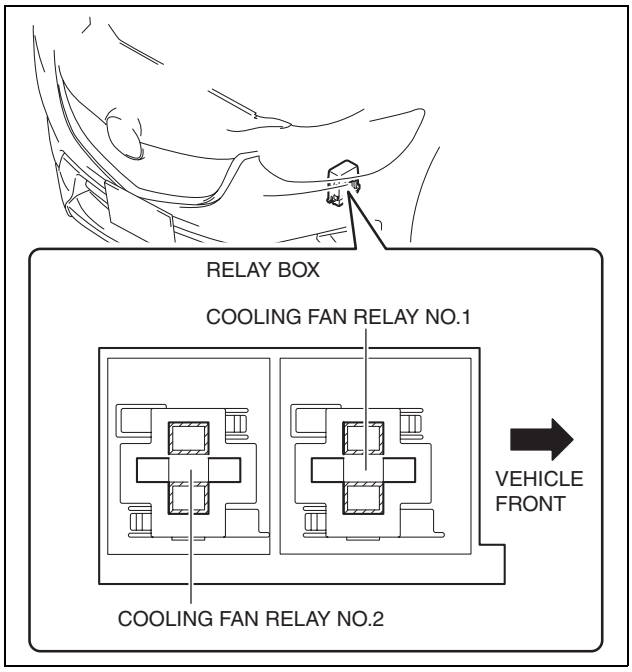
Purpose, Function

- The cooling fan relay operates by receiving the signal from the PCM to supply power to the cooling fan motor.

COOLING SYSTEM [SKYACTIV-D 2.2]

Construction

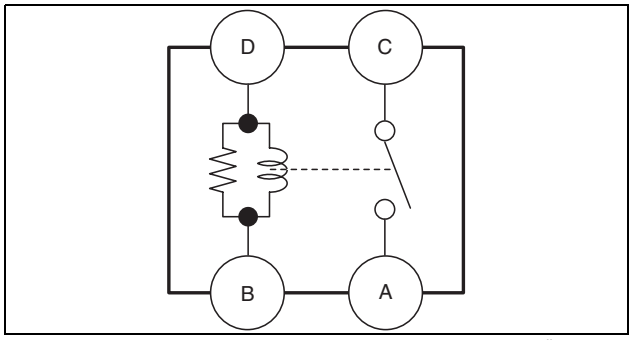
- The cooling fan relay is installed on the relay box.



ac5wzn00001833

Operation

1. When current flows between D-B shown in the figure, electromagnetic power is generated and the switch between C-A is turned on.
2. Current flows between C-A and power is supplied to the cooling fan motor.



ac5jjn00002123

Fail-safe

- Function not equipped.

FAN CONTROL MODULE [SKYACTIV-D 2.2]

id0112s6101200

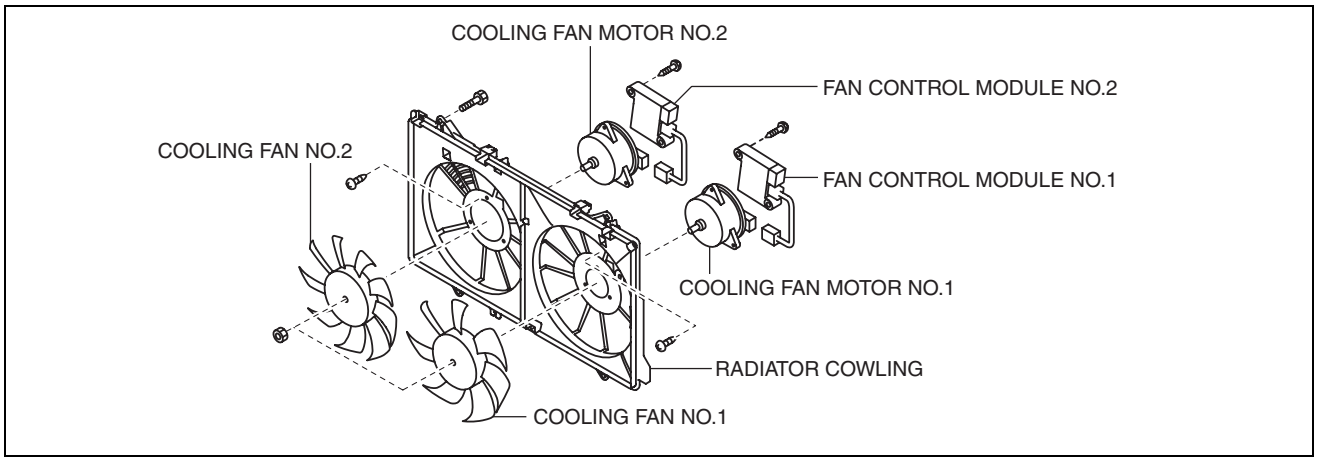
Purpose, Function

- The fan control module operates by receiving the signal from the PCM to supply power to the cooling fan motor.

Construction

- Fan control module is installed on the radiator cowling.

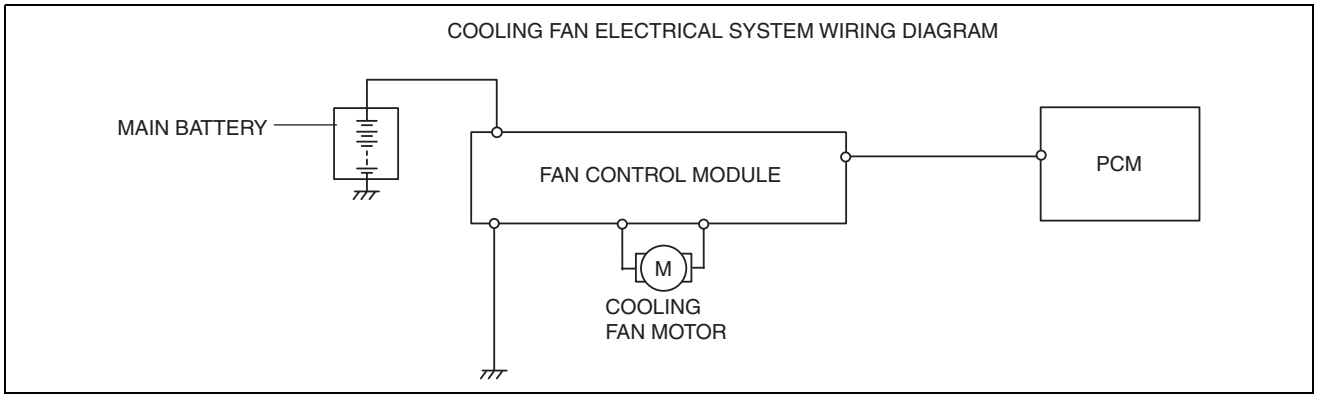
COOLING SYSTEM [SKYACTIV-D 2.2]



ac5wzn00001848

Operation

- The fan control module allows continuously variable control of the cooling fan motor rotation rate, reducing fan operation noise and power consumption.
- Based on the input signals from the control parts, the cooling fan may remain operational for several seconds or minutes after the ignition is switched off.



ac5wzn00002026

Fail-safe

The fan control module has a power supply function to operate the cooling fan motor and the following protection functions.

1. Over-current fail-safe
   — If the electrical current to the cooling fan motor exceeds a certain value, the excess-current protection function of the fan control module operates, and the current value to the cooling fan motor is controlled at less than a specified value.
2. Over heat fail-safe
   — If the temperature inside the fan control module reaches a certain temperature or more, the overheating protection function of the fan control module operates in the following order.
     1. The rotation speed of the cooling fan motor is increased to increase cool air flow to the fan control module.
     2. If the temperature increases further, the cooling fan motor is stopped to suppress heat generation from energization.
3. Input signal open circuit fail-safe
   — If an open circuit occurs in the wiring harness between the PCM and fan control module, the input signal open circuit protection function of the fan control module operates to increase the rotation speed of the cooling fan motor to avoid engine overheating.

01-13A INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

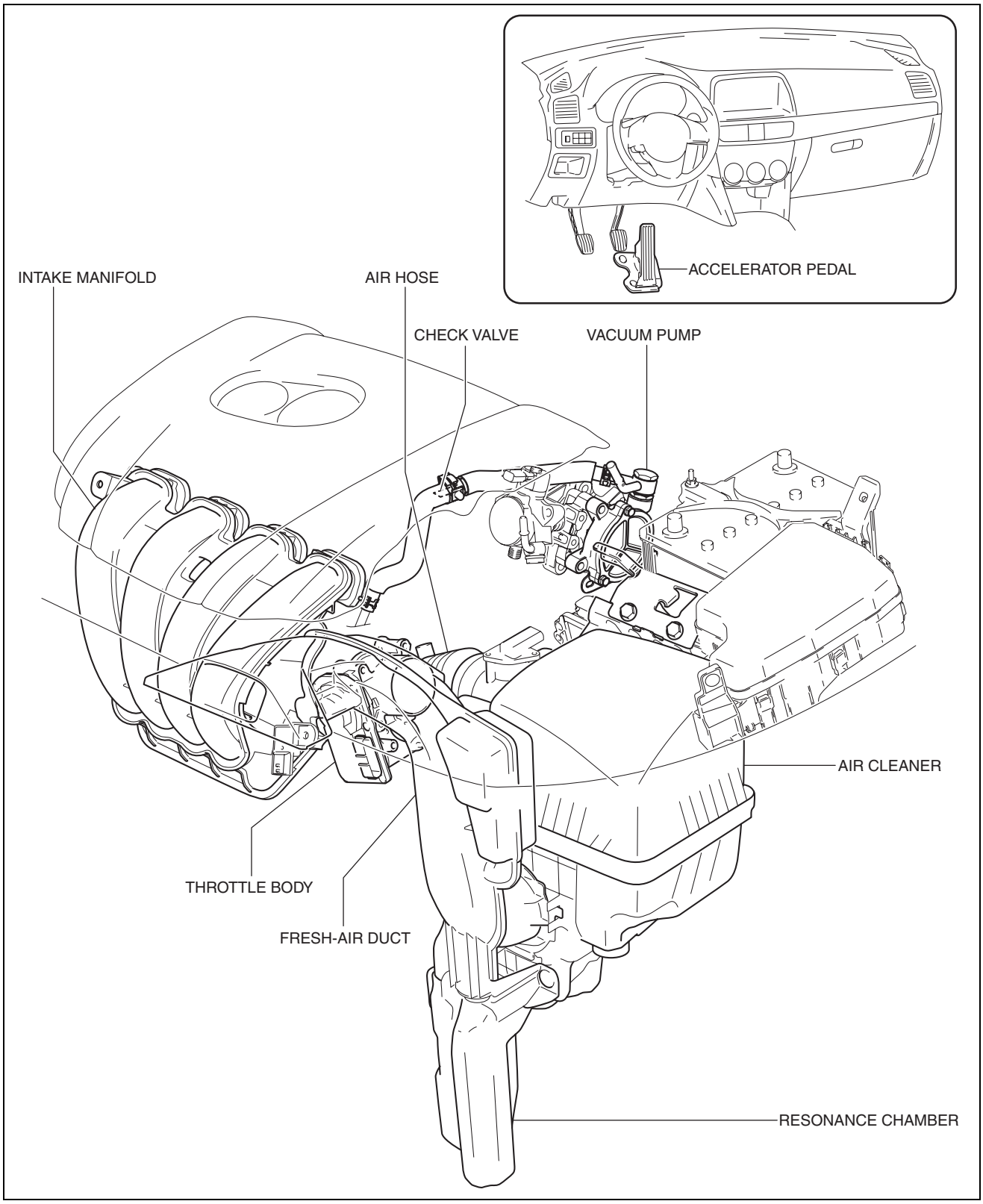
id0113z5003300

Purpose, Outline

- A vacuum pump has been adopted which supplies stable vacuum to the power brake unit.

INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

Structural View



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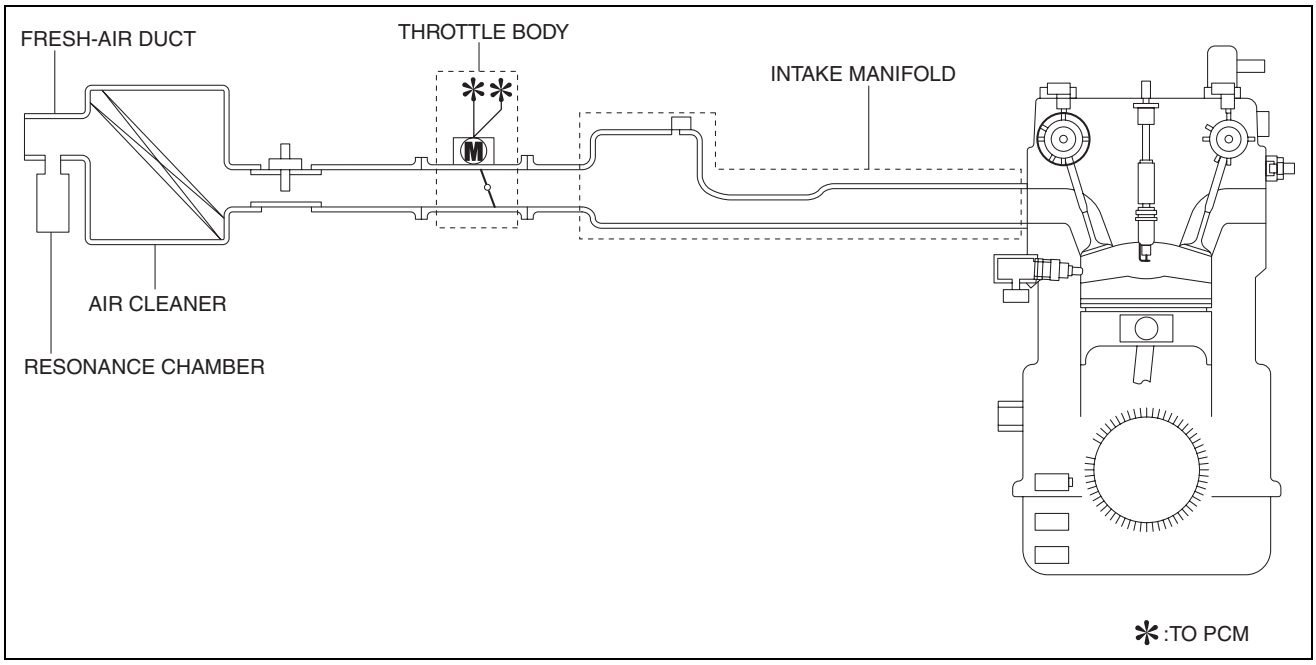
INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

System Diagram



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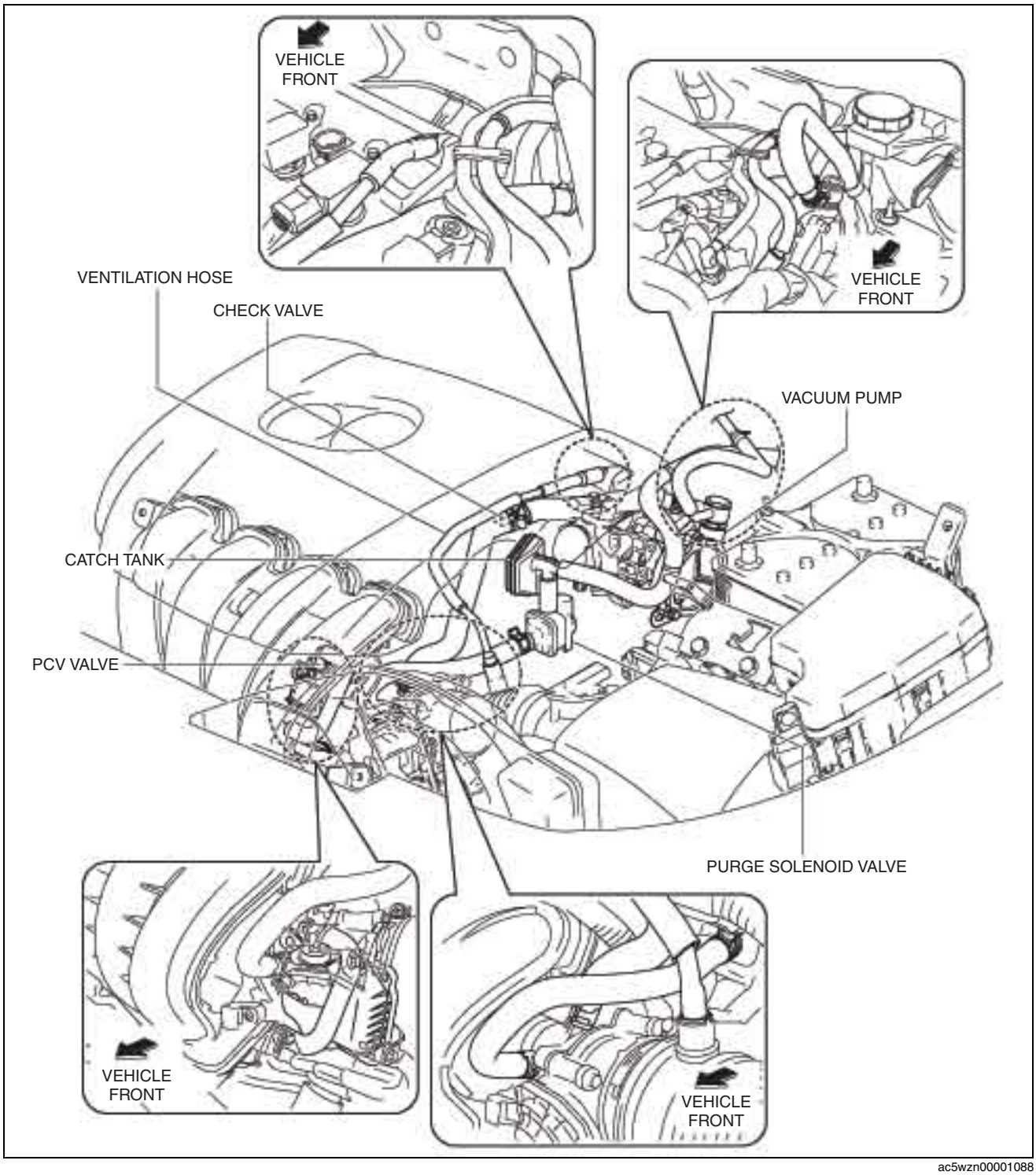
INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

Vacuum Hose Routing Diagram



ac5wzn00001088

Structure

- The intake air system consists of the following parts:

Part name	Reference
Fresh-air duct	(See 01-13A-5 FRESH-AIR DUCT [SKYACTIV-G 2.0].)
Resonance chamber	(See 01-13A-5 RESONANCE CHAMBER [SKYACTIV-G 2.0].)
Air cleaner	(See 01-13A-6 AIR CLEANER [SKYACTIV-G 2.0].)
Throttle body	(See 01-13A-7 THROTTLE BODY [SKYACTIV-G 2.0].)
Vacuum pump	(See 01-13A-9 VACUUM PUMP [SKYACTIV-G 2.0].)
Intake manifold	(See 01-13A-11 INTAKE MANIFOLD [SKYACTIV-G 2.0].)

INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

Part name	Reference
Accelerator pedal	(See 01-13A-12 ACCELERATOR PEDAL [SKYACTIV-G 2.0].)

FRESH-AIR DUCT [SKYACTIV-G 2.0]

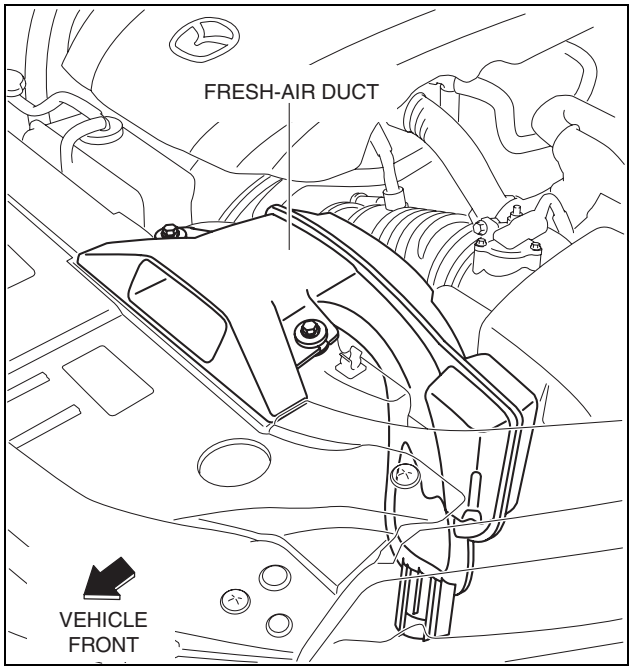
id0113z5675400

Purpose, Function

- Conducts fresh air from outside the engine compartment.
- Increases air density by taking fresh air, which is cooler than the engine compartment, to enhance the charging efficiency, ensuring the combustion stability.

Construction

- The fresh-air duct is installed to the air cleaner.



ac5uun00000034

RESONANCE CHAMBER [SKYACTIV-G 2.0]

id0113z5003400

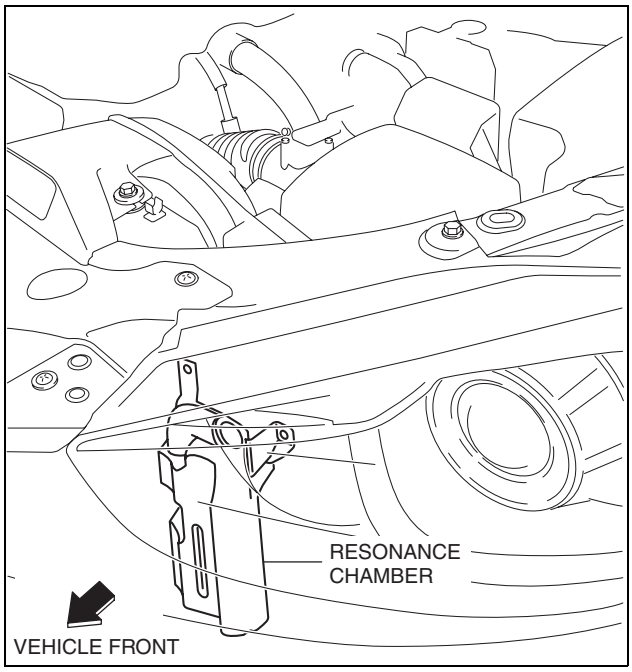
Purpose, Function

- Pulsation of intake air is controlled and intake air noise is reduced by adding an intake air passage.

INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

Construction

- The resonance chamber is installed to fresh-air duct.



ac5uun00000025

AIR CLEANER [SKYACTIV-G 2.0]

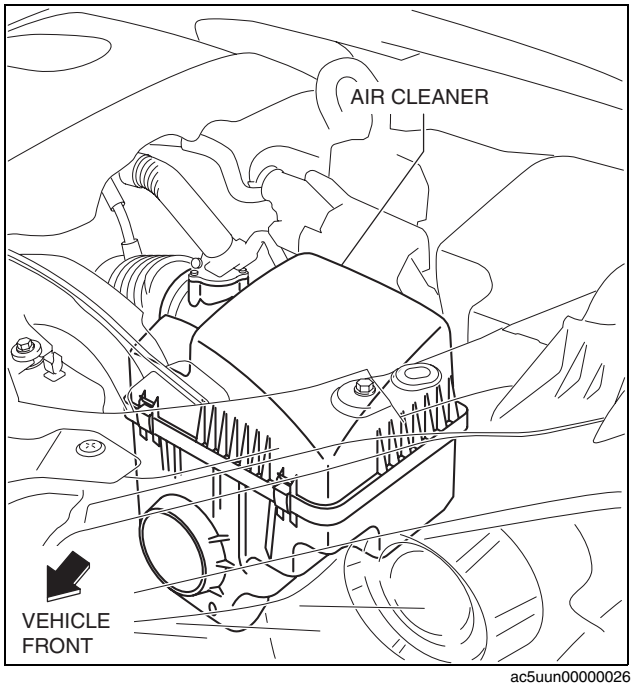
id0113z5003500

Purpose, Function

- Prevents engine internal damage caused by penetration of dust or foreign material.

Construction

- The air cleaner is installed in front of the battery.



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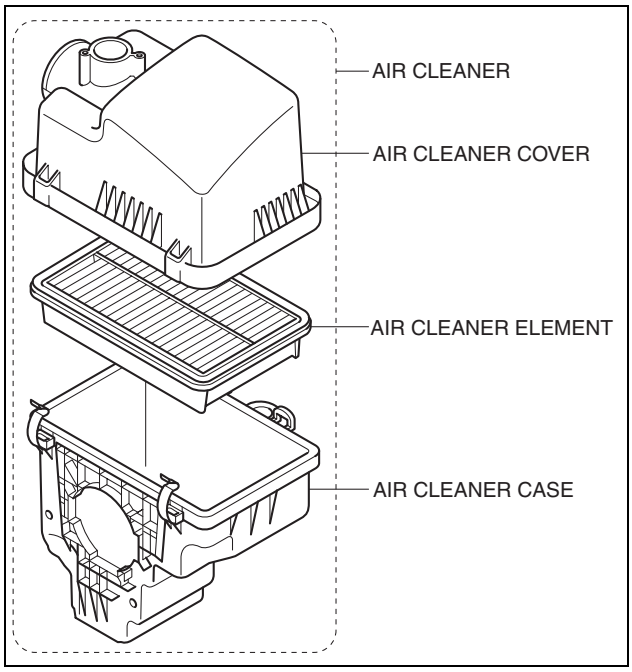
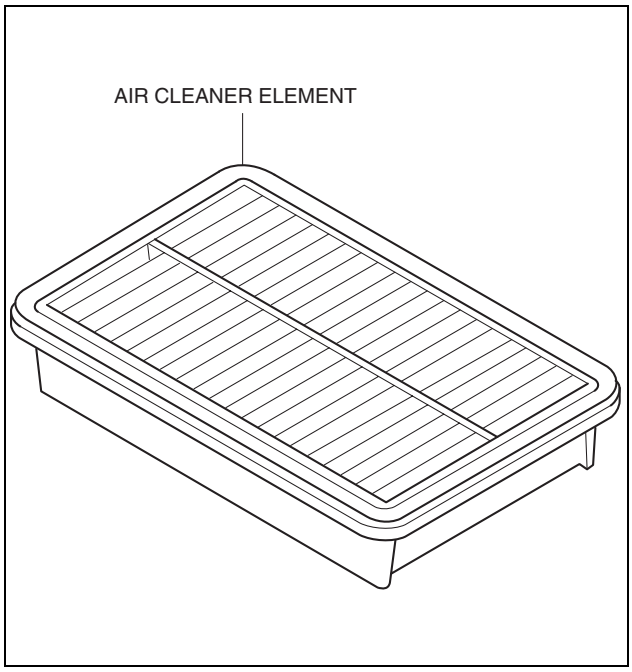
INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

- The air cleaner consists of the air cleaner case, air cleaner cover, and air cleaner element.



ac5uun00000027

- Non-woven fabric (dry type) air cleaner element has been adopted to remove dust and foreign material in the intake air.



ac5uun00000028

THROTTLE BODY [SKYACTIV-G 2.0]

id0113z5003600

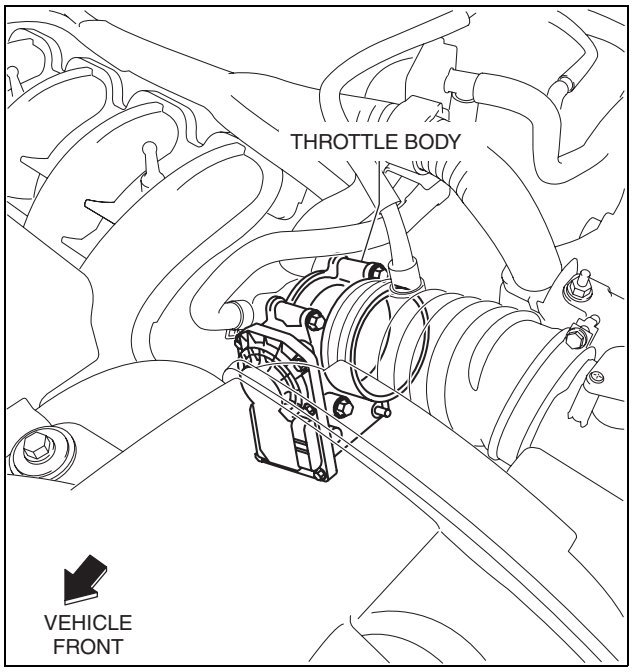
Purpose, Function

- Opens/closes the throttle valve to adjust the amount of air supplied to the cylinder.
- Opens/closes the throttle valve according to the control signal from the PCM.

INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

Construction

- The throttle body is installed to the intake manifold.



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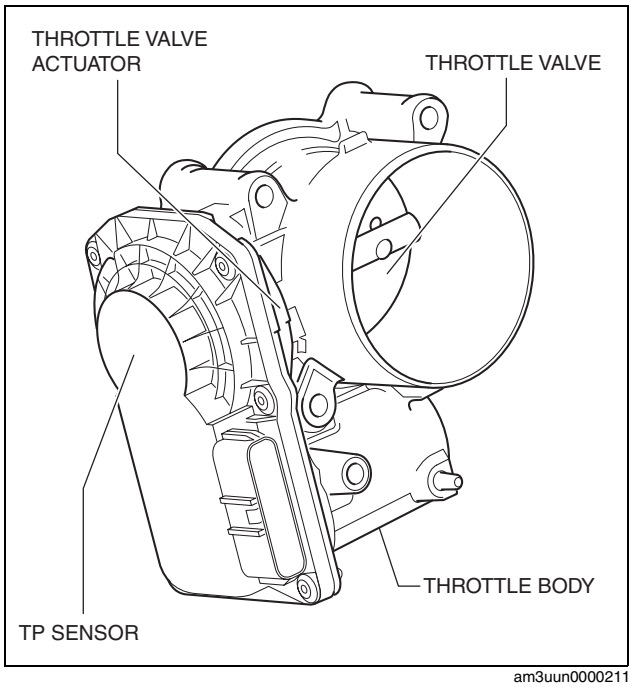
- The throttle body consists of a throttle valve, throttle valve actuator, TP sensor, and return spring.
- For the TP sensor, refer to CONTROL SYSTEM. (See 01-40-81 THROTTLE POSITION (TP) SENSOR [SKYACTIV-G 2.0].)



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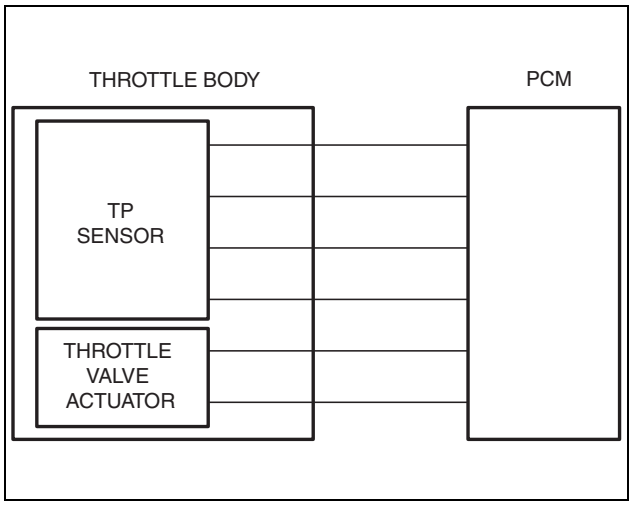
INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

Operation

- The throttle valve actuator opens/closes the throttle valve according to the control signal from the PCM. If there is a malfunction in the throttle valve actuator, the throttle valve is closed by the return spring in the throttle body.
- For the drive-by-wire control, refer to CONTROL SYSTEM. (See 01-40-16 DRIVE-BY-WIRE CONTROL [SKYACTIV-G 2.0].)



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Fail-safe

DTC	Fail-safe
P2101:00	• Stops the idle air control. • Stops the drive-by-wire control and sets to a throttle valve opening angle necessary for minimum driveability.
P2107:00	• Stops the idle air control. • Stops the drive-by-wire control and sets to a throttle valve opening angle necessary for minimum driveability.
P2110:00	• Stops the idle air control. • Stops the drive-by-wire control and sets to a throttle valve opening angle necessary for minimum driveability.
P2112:00	• Stops the idle air control. • Stops the drive-by-wire control and sets to a throttle valve opening angle necessary for minimum driveability.
P2119:00	• Restricts the upper limit of the engine speed.

VACUUM PUMP [SKYACTIV-G 2.0]

id0113z5003800

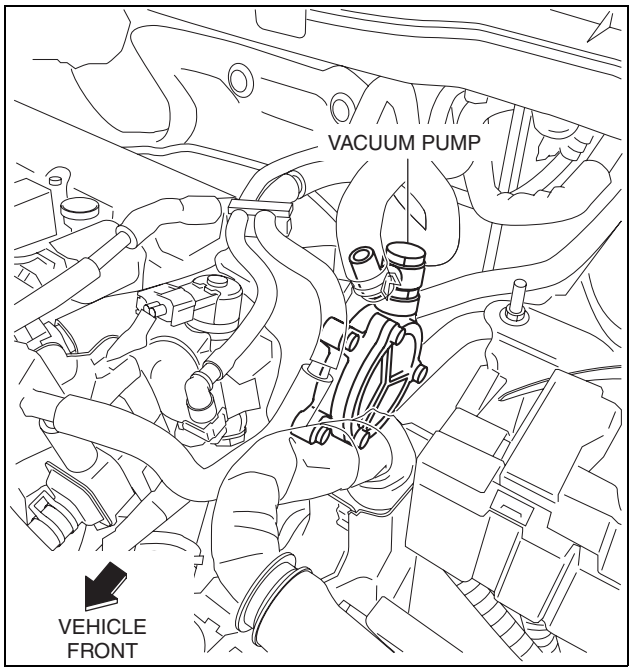
Purpose, Function

- Ensures vacuum required for braking force to compensate for the decrease in intake manifold vacuum applied to the power brake unit caused by the retard intake valve closing.

INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

Construction

- The vacuum pump is installed to the rear housing.



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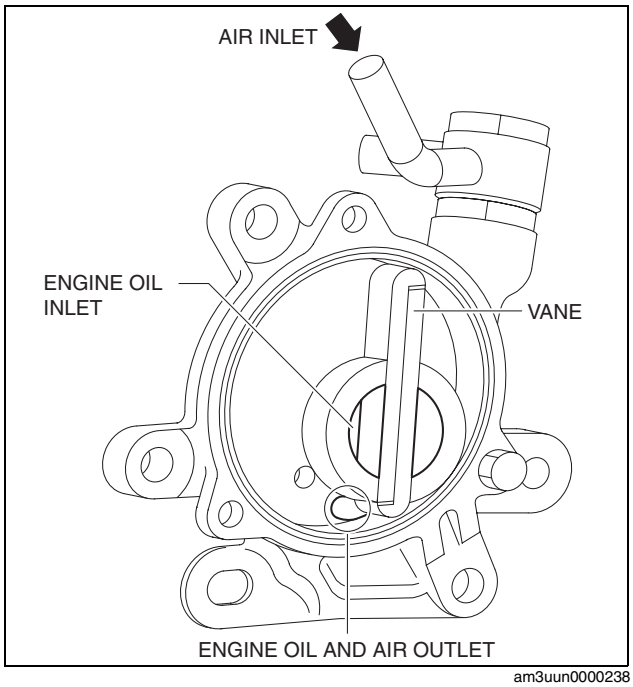
- For smooth vane rotation, a single-vane type vacuum pump has been adopted which is equipped with an engine oil lubrication passage.



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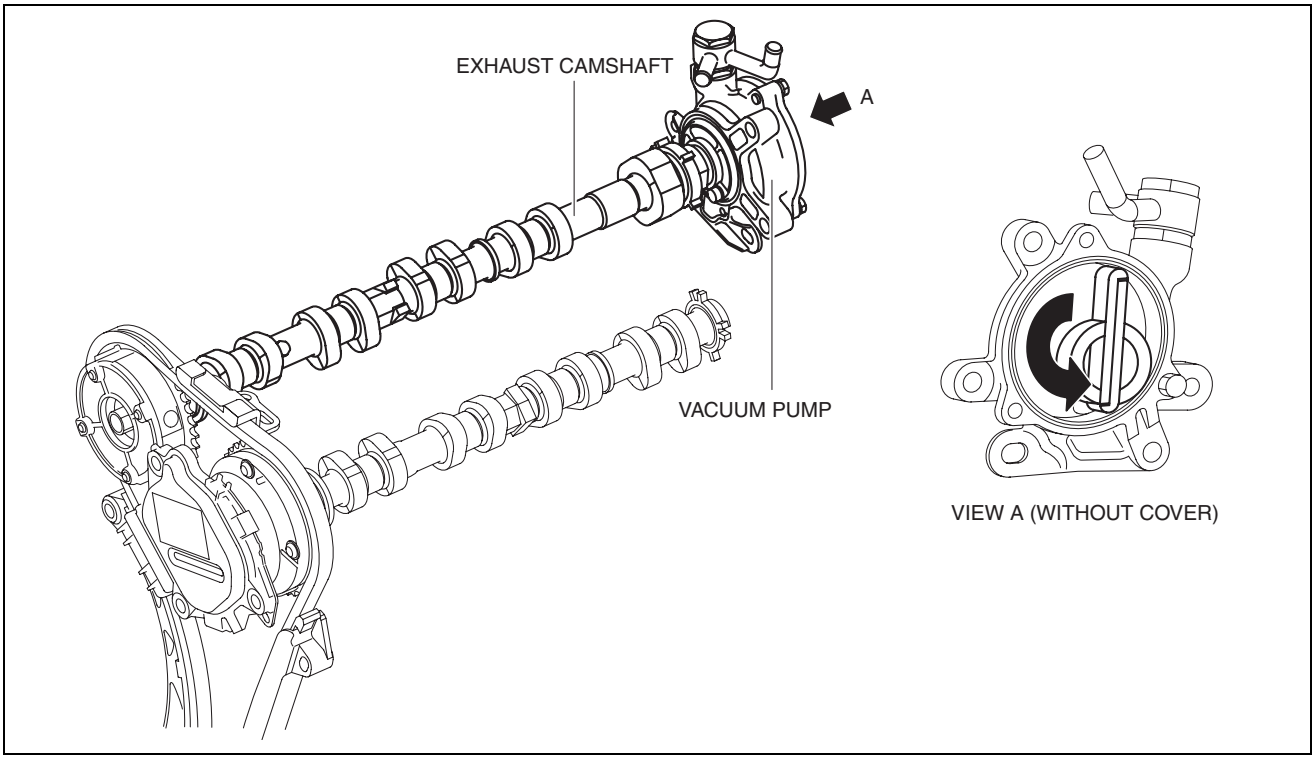
INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

Operation

- Because the vacuum pump is directly engaged with the exhaust camshaft, the vane in the vacuum pump rotates together with the exhaust camshaft, and the vacuum chamber is expanded and vacuum is generated.



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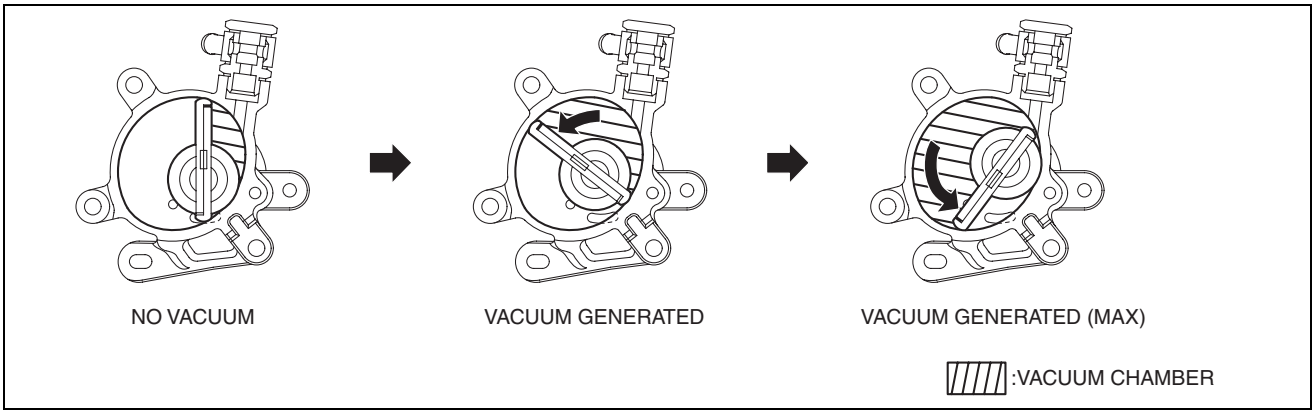
Vacuum generation mechanism



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INTAKE MANIFOLD [SKYACTIV-G 2.0]

id0113z5003700

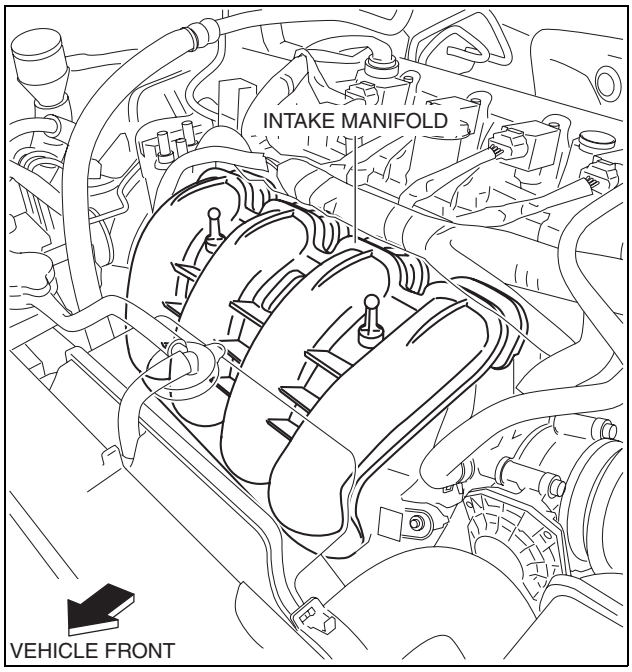
Purpose, Function

- Distributes intake air to each cylinder evenly.
- Optimizes the combustion efficiency and performance of the engine by distributing intake air to each cylinder.

INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

Construction

- The intake manifold is installed to the cylinder head.



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ACCELERATOR PEDAL [SKYACTIV-G 2.0]

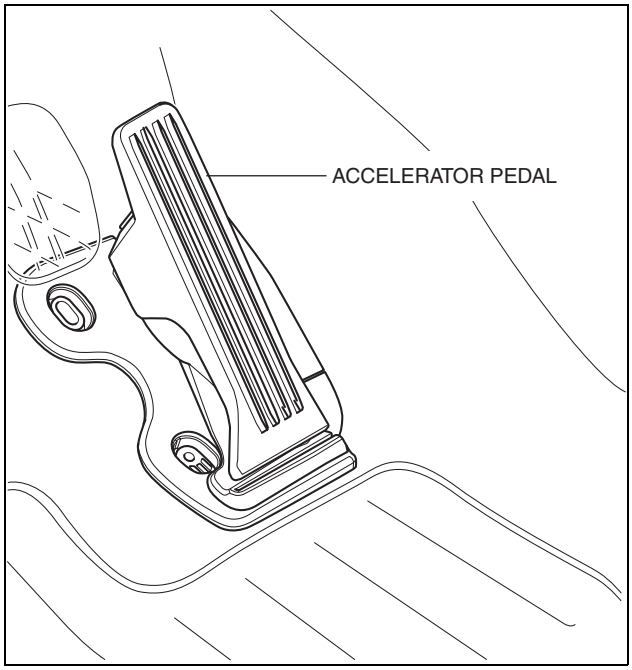
id0113z5105000

Purpose, Function

- Driver's intention is transmitted to the PCM via the accelerator pedal.

Construction

- The accelerator pedal is installed to the foot area of the driver's seat.



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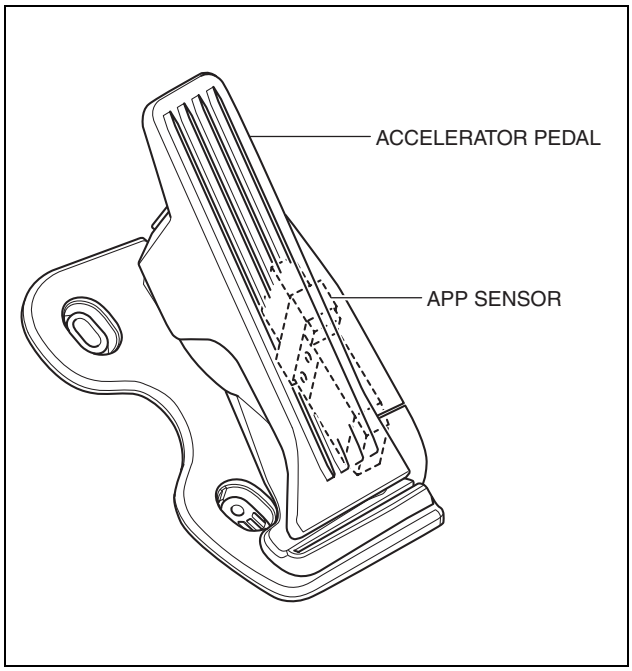
INTAKE-AIR SYSTEM [SKYACTIV-G 2.0]

- The accelerator pedal has a built-in APP sensor.
- For the APP sensor, refer to CONTROL SYSTEM. (See 01-40-82 ACCELERATOR PEDAL POSITION (APP) SENSOR [SKYACTIV-G 2.0].)



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01-13B INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

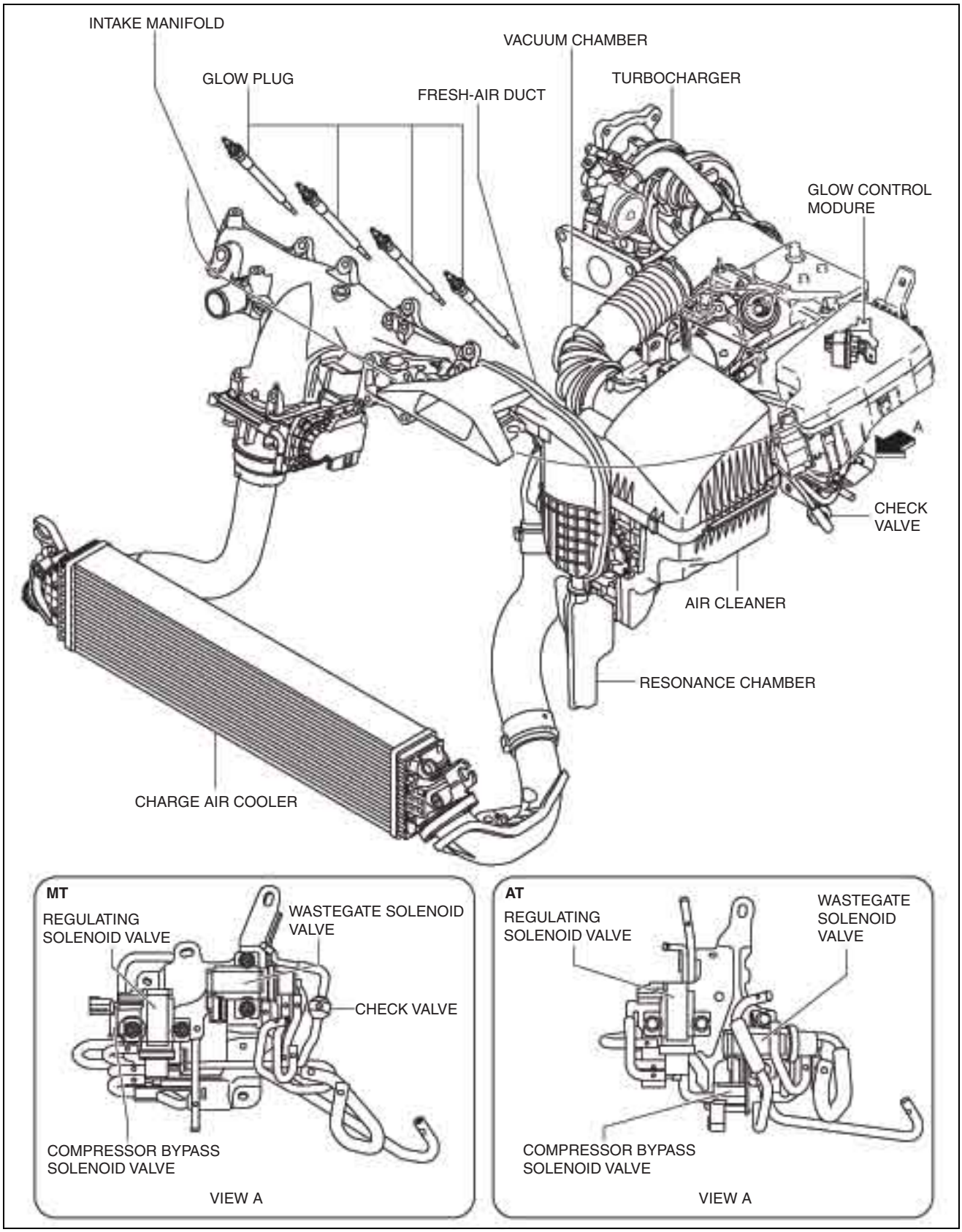
id0113z7003300

Purpose, Outline

- A vacuum pump has been adopted which supplies stable vacuum to the power brake unit.
- With the adoption of a 2-stage turbocharger, high torque at low engine speeds, high response, and high output at high engine speeds have been achieved as well as suppression of NOx and PM emissions.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Structural view



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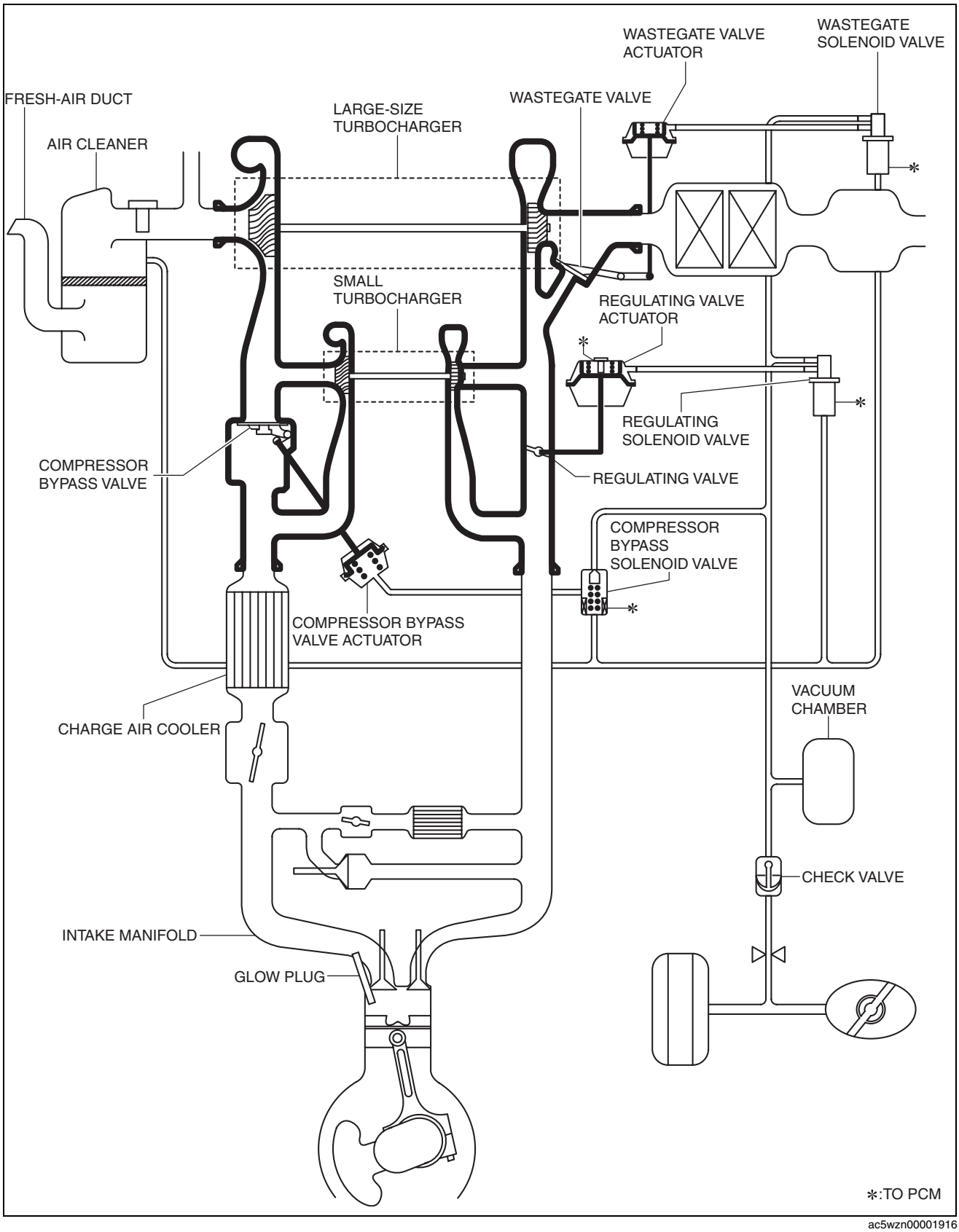
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

System diagram



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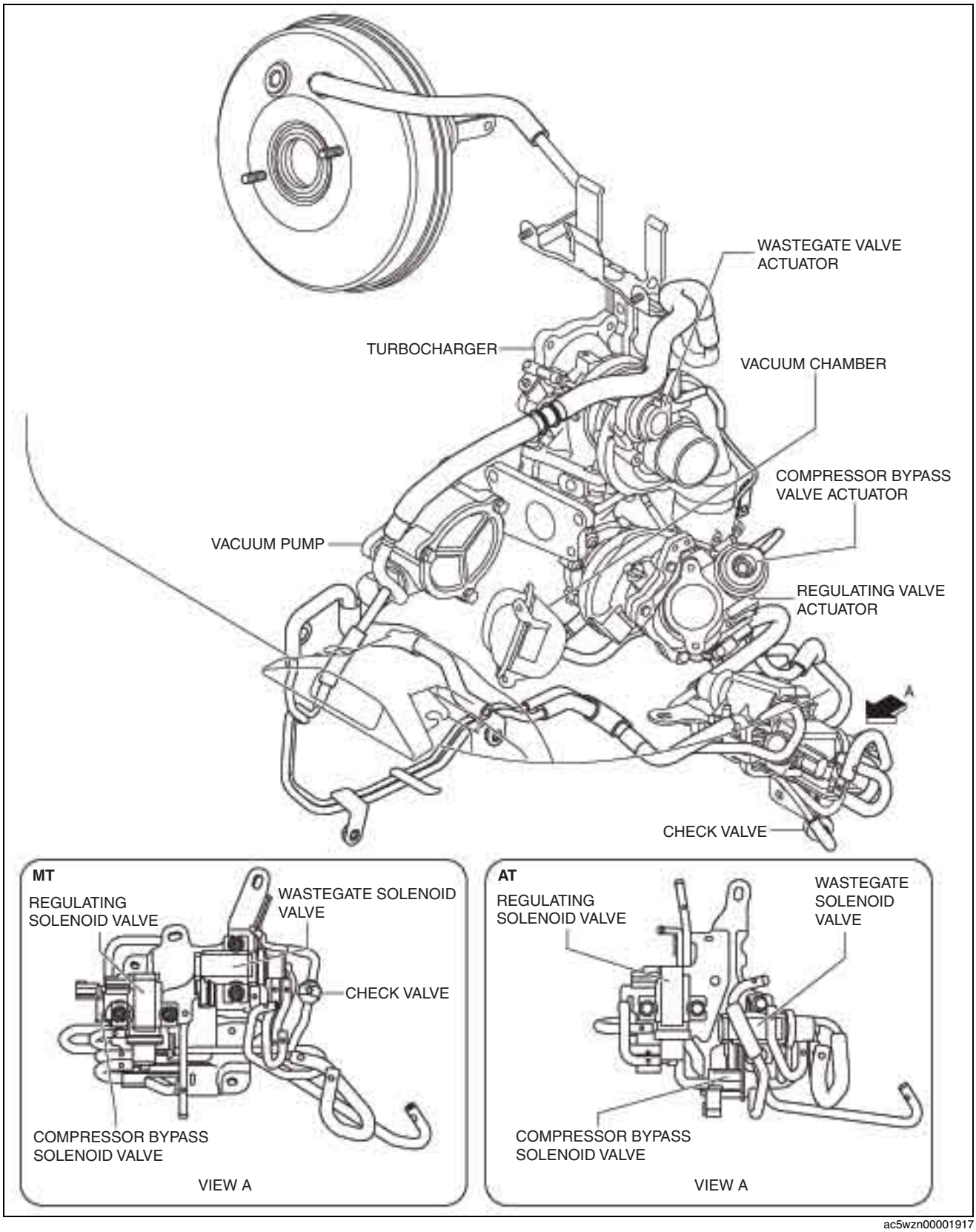
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Vacuum piping diagram



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Structure

- The intake air system consists of the following parts:

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Part/System name			Reference
Fresh-air duct			(See 01-13B-5 FRESH-AIR DUCT [SKYACTIV-D 2.2].)
Resonance chamber			(See 01-13B-6 RESONANCE CHAMBER [SKYACTIV-D 2.2].)
Air cleaner			(See 01-13B-6 AIR CLEANER [SKYACTIV-D 2.2]..)
Intake manifold			(See 01-13B-7 INTAKE MANIFOLD [SKYACTIV-D 2.2].)
Air charging system (See 01-13B-14 AIR CHARGING SYSTEM [SKYACTIV-D 2.2].)	Turbocharger	Compressor bypass valve actuator	(See 01-13B-21 TURBOCHARGER [SKYACTIV-D 2.2].)
		Compressor bypass valve	
		Wastegate valve actuator	
		Wastegate valve	
		Regulating valve actuator	
		Regulating valve	
		Regulating valve position sensor	
	Compressor bypass solenoid valve		(See 01-13B-8 COMPRESSOR BYPASS SOLENOID VALVE [SKYACTIV-D 2.2].)
	Wastegate solenoid valve		(See 01-13B-25 WASTEGATE SOLENOID VALVE [SKYACTIV-D 2.2].)
	Regulating solenoid valve		(See 01-13B-9 REGULATING SOLENOID VALVE [SKYACTIV-D 2.2].)
	Vacuum chamber		(See 01-13B-25 VACUUM CHAMBER [SKYACTIV-D 2.2].)
	Check valve		(See 01-13B-10 CHECK VALVE [SKYACTIV-D 2.2].)
	Charge air cooler		(See 01-13B-26 CHARGE AIR COOLER [SKYACTIV-D 2.2].)
Glow system (See 01-13B-11 GLOW SYSTEM [SKYACTIV-D 2.2].)		Glow plug	(See 01-13B-13 GLOW PLUG [SKYACTIV-D 2.2].)
		Glow control module	(See 01-13B-12 GLOW CONTROL MODULE [SKYACTIV-D 2.2].)
Accelerator pedal			(See 01-13B-27 ACCELERATOR PEDAL [SKYACTIV-D 2.2].)

FRESH-AIR DUCT [SKYACTIV-D 2.2]

id0113z7675400

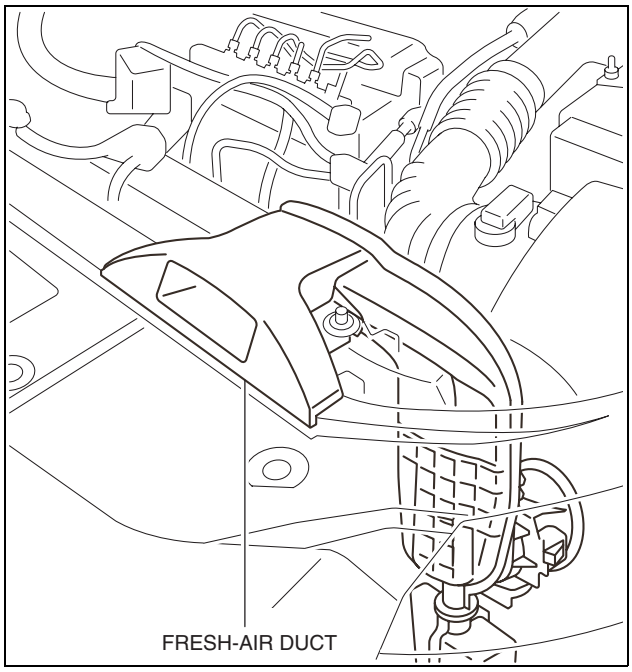
Purpose, Function

- Conducts fresh air from outside the engine compartment.
- Increases air density by taking fresh air, which is cooler than the engine compartment, to enhance the charging efficiency, ensuring the combustion stability.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Construction

- The fresh-air duct is installed to the air cleaner.



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RESONANCE CHAMBER [SKYACTIV-D 2.2]

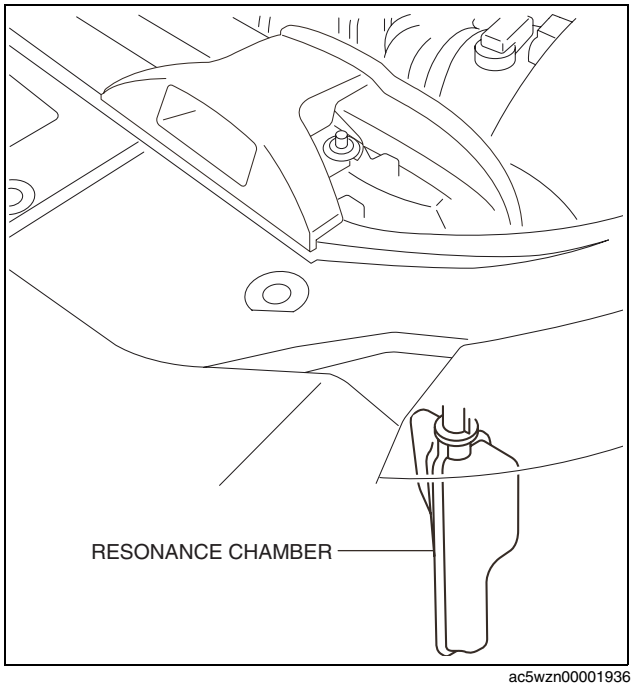
id0113z7003400

Purpose, Function

- Pulsation of intake air is controlled and intake air noise is reduced by adding an intake air passage.

Construction

- The resonance chamber is installed to fresh-air duct.



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AIR CLEANER [SKYACTIV-D 2.2]

id0113z7003500

Purpose, Function

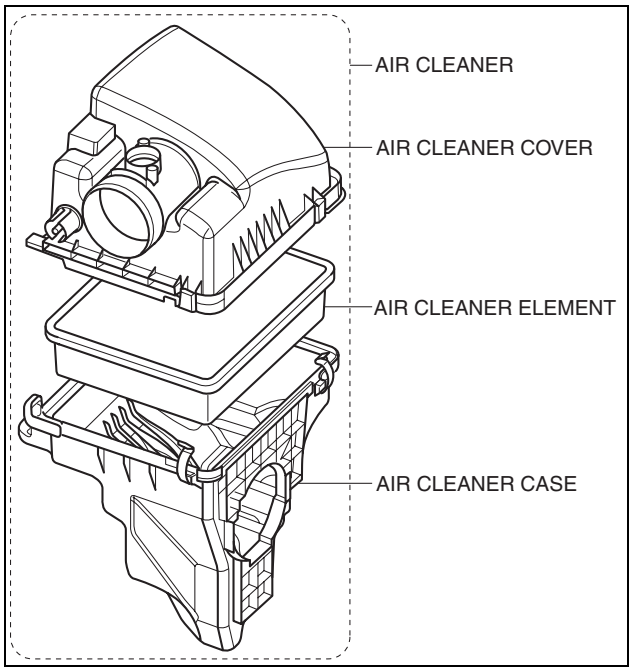
- Prevents engine internal damage caused by penetration of dust or foreign material.

Construction

- The air cleaner is installed in front of the battery.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

- The air cleaner consists of the air cleaner case, air cleaner cover, and air cleaner element.



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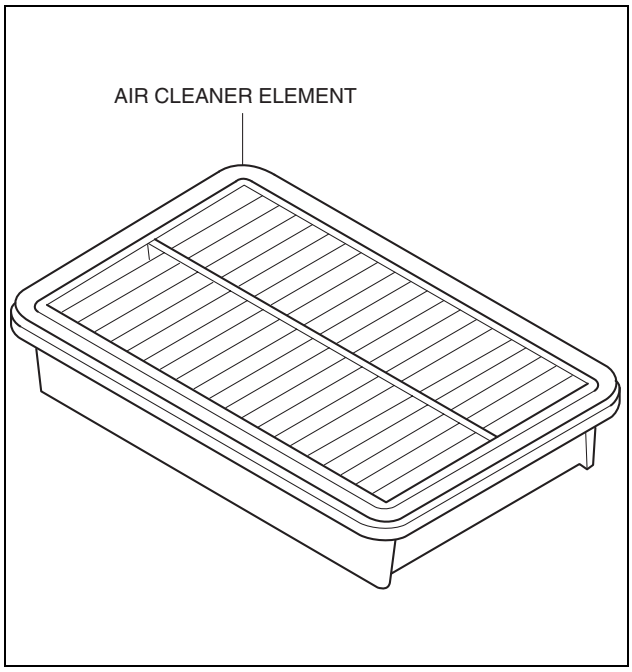
- Non-woven fabric (dry type) air cleaner element has been adopted to remove dust and foreign material in the intake air.



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INTAKE MANIFOLD [SKYACTIV-D 2.2]

id0113z7003700

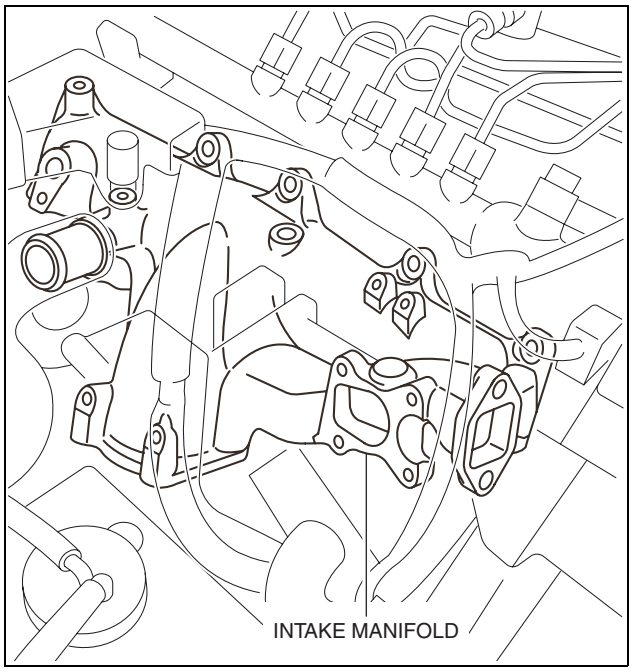
Purpose, Function

- Distributes intake air to each cylinder evenly.
- Optimizes the combustion efficiency and performance of the engine by distributing intake air to each cylinder.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Construction

- The intake manifold is installed to the cylinder head.



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COMPRESSOR BYPASS SOLENOID VALVE [SKYACTIV-D 2.2]

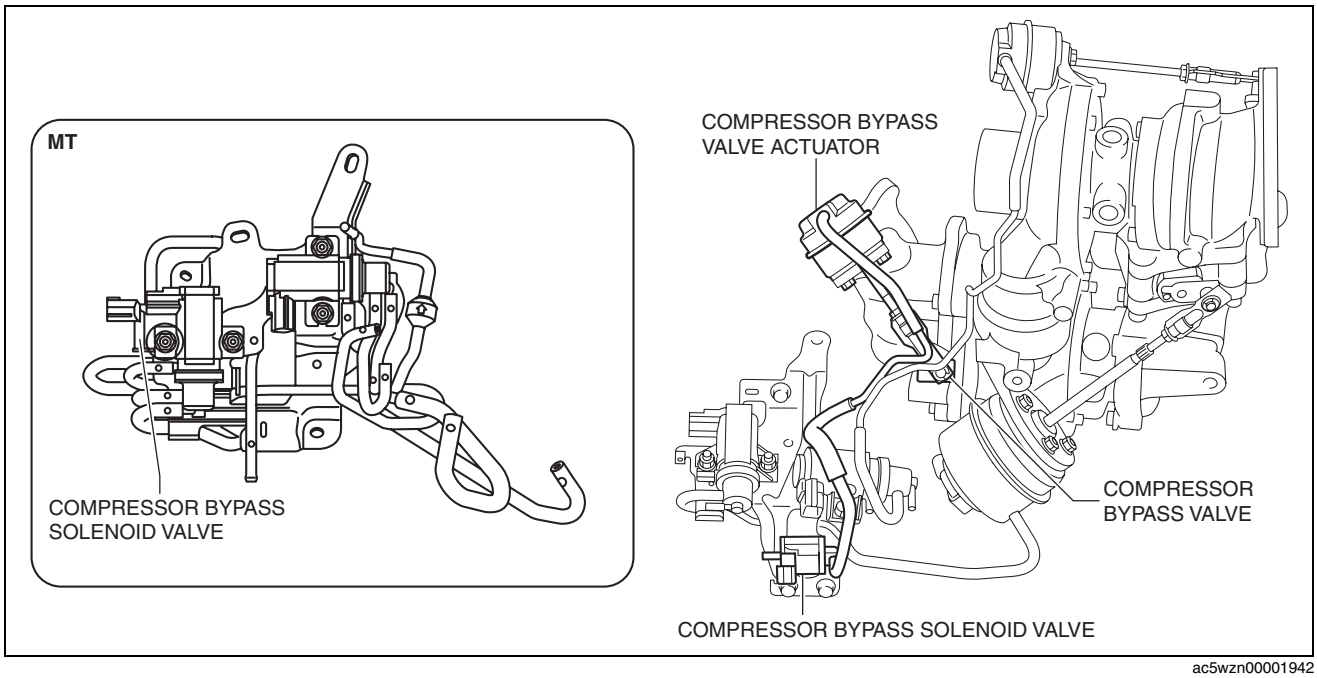
id0113z7265200

Purpose, Function

- Introduces intake manifold vacuum to the compressor bypass valve actuator.
- The compressor bypass valve opens according to the control signal from the PCM.

Construction

- The compressor bypass solenoid valve is installed to the vacuum pipe bracket on the side of the turbocharger.



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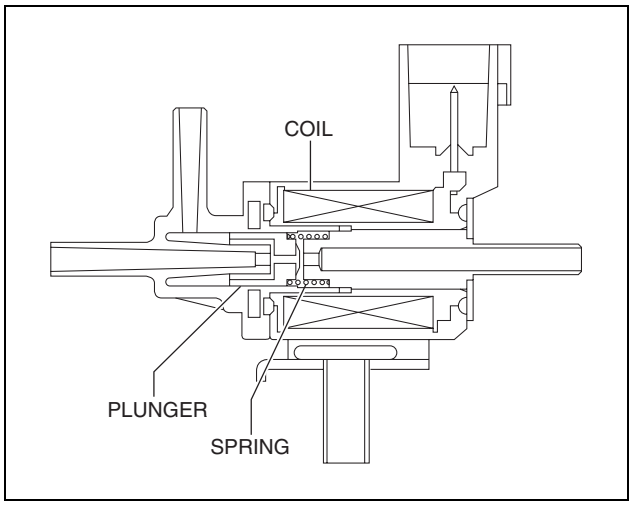
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

- The compressor bypass solenoid valve consists of a coil, spring, and plunger.



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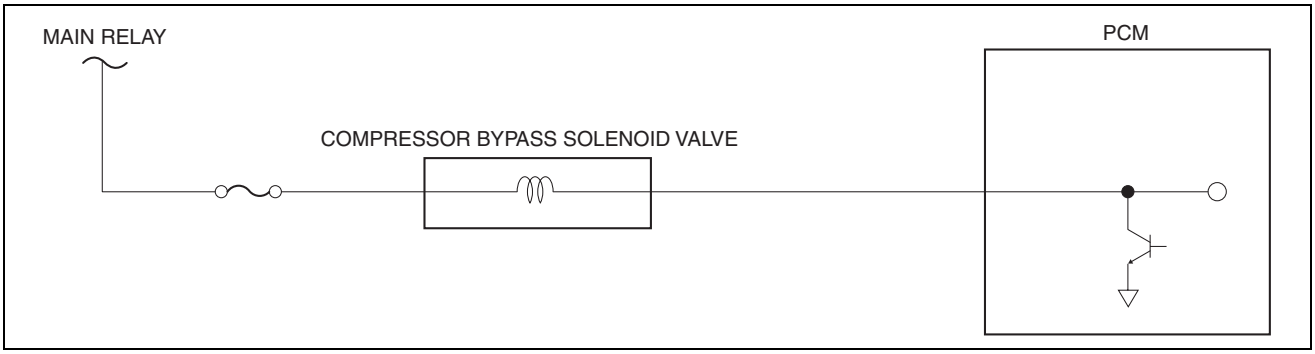
Operation

- According to the control signal from the PCM, the coil is energized and the plunger is operated to open/close the compressor bypass solenoid valve.



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- By opening the compressor bypass solenoid valve, intake manifold vacuum is introduced to the compressor bypass valve actuator.

REGULATING SOLENOID VALVE [SKYACTIV-D 2.2]

id0113z7265100

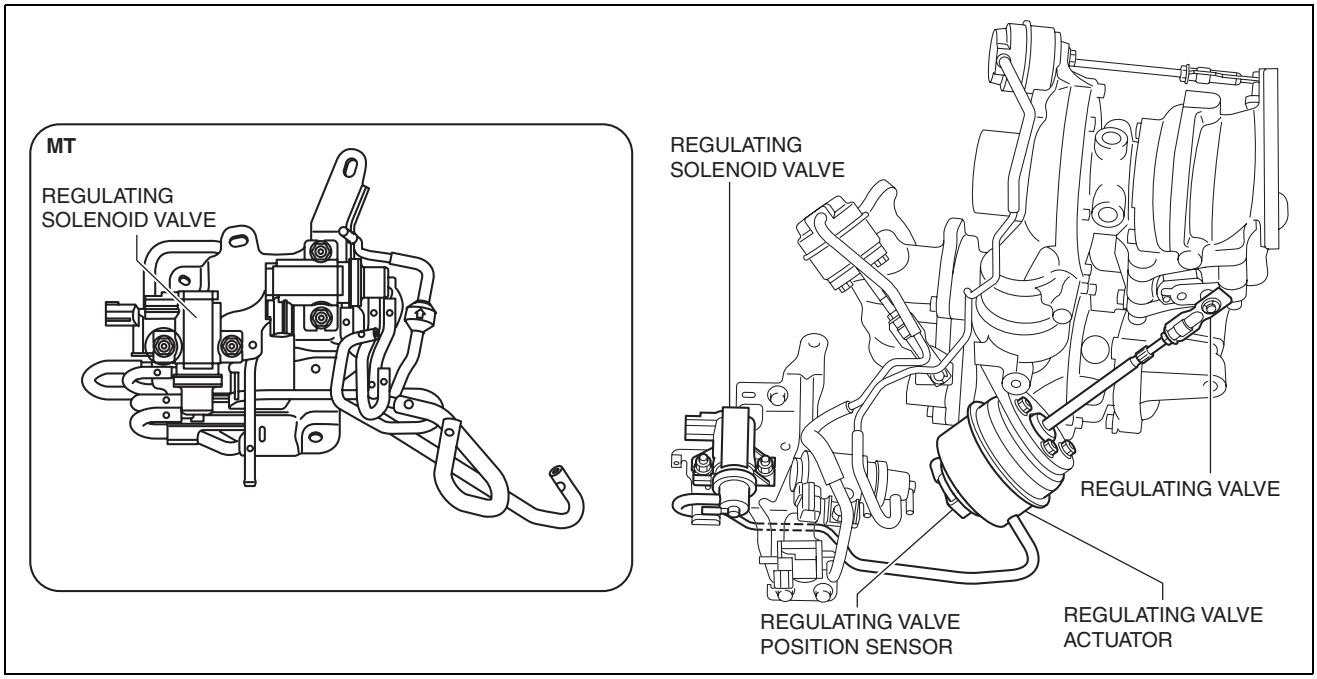
Purpose, Function

- Introduces intake manifold vacuum to the regulating valve actuator.
- The regulating valve opens according to the control signal from the PCM.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Construction

- Installed to the vacuum pipe bracket on the side of the turbocharger.



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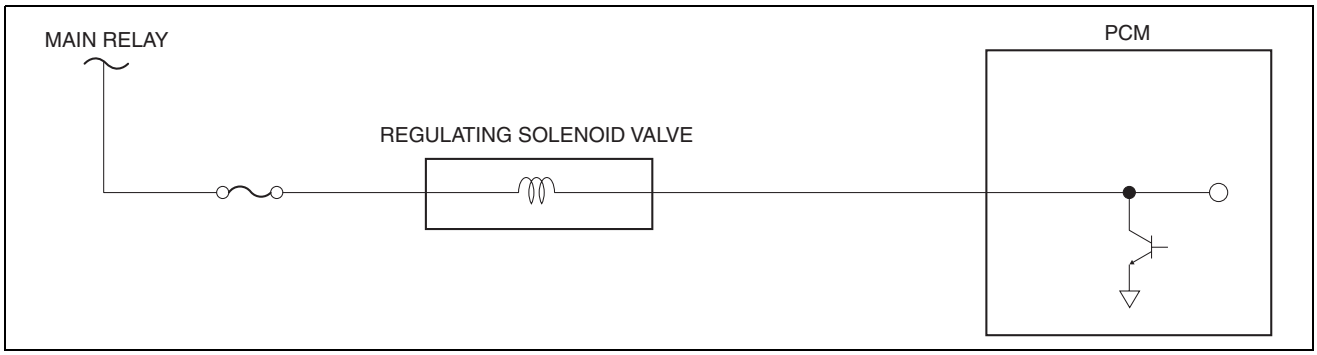
- The regulating solenoid valve consists of a coil, spring, and plunger.

Operation

- According to the control signal from the PCM, the coil is energized and the plunger is operated to open/close the regulating solenoid valve.



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- By opening the regulating solenoid valve, intake manifold vacuum is introduced to the regulating valve actuator.

CHECK VALVE [SKYACTIV-D 2.2]

id0113z7266200

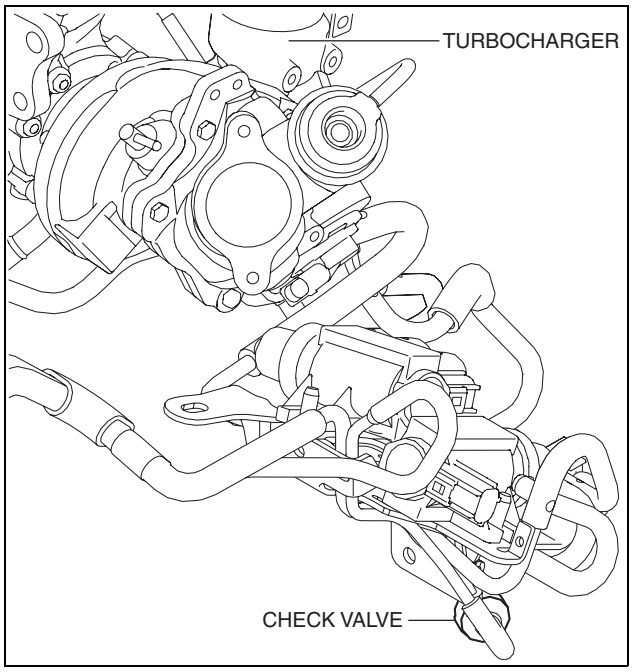
Purpose, Function

- Introduces vacuum in the vacuum pump to the vacuum chamber and prevents pressure leakage from the vacuum chamber.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Construction

- The check valve is installed to the vacuum pipe bracket on the side of the turbocharger.



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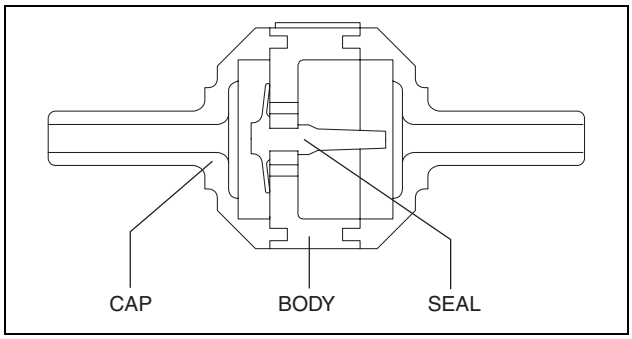
- The check valve consists of the body, cover, and umbrella seal.
- A one-way valve is integrated in the check valve.



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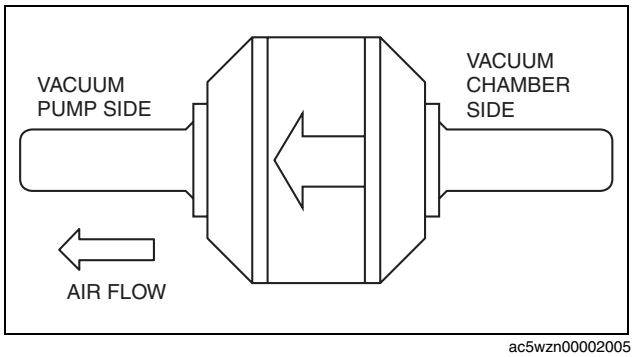
Operation

- The one-way valve opens by the vacuum from the vacuum pump to introduce vacuum to the vacuum chamber.
- Pressure from the vacuum chamber does not leak because of the one-way valve effect.



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GLOW SYSTEM [SKYACTIV-D 2.2]

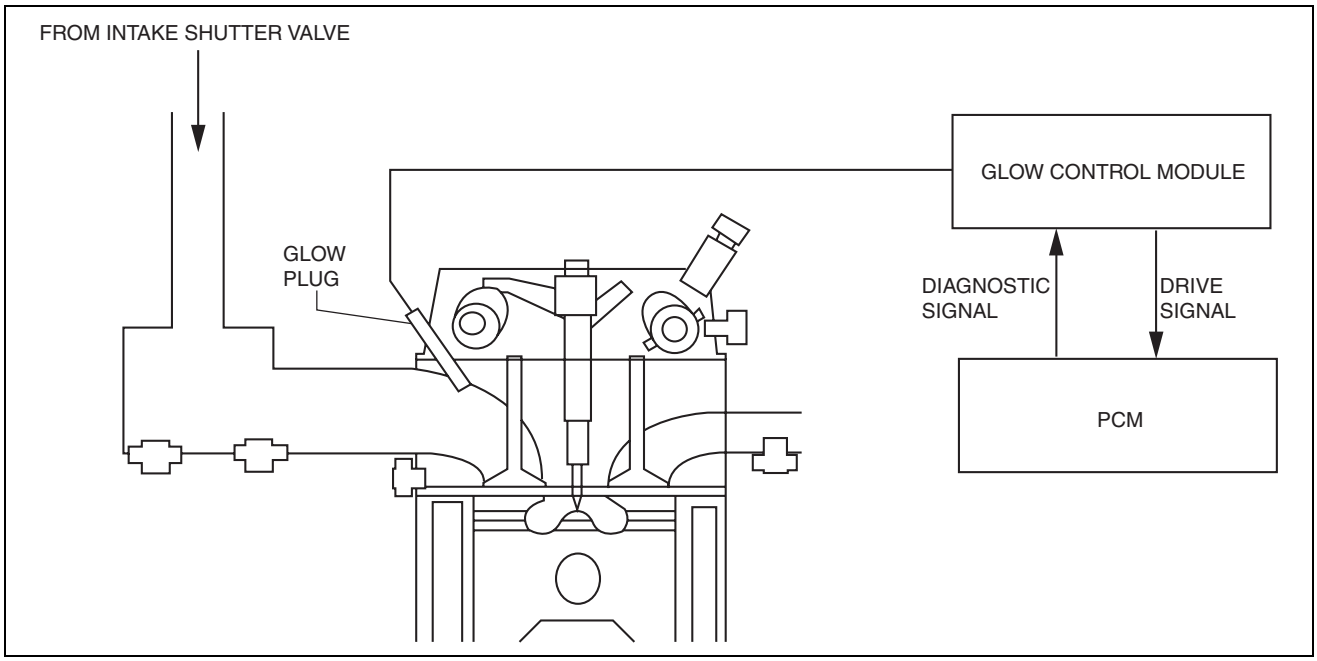
id0113z7706000

Purpose, Function

- The SKYACTIV-D 2.2 has a comparatively low compression temperature because of its low compression. The glow system raises the compression temperature by warming the intake air temperature at the glow plug to assure engine startability at low temperatures.
- The glow plugs are controlled by the glow control module.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

System Diagram



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Structure

- The glow control system consists of the following parts:

Part name	Reference
Glow plug	(See 01-13B-13 GLOW PLUG [SKYACTIV-D 2.2].)
Glow control module	(See 01-13B-12 GLOW CONTROL MODULE [SKYACTIV-D 2.2].)

GLOW CONTROL MODULE [SKYACTIV-D 2.2]

id0113z7706100

Purpose, Function

- Controls the voltage applied to the glow plugs for improved startability during cold temperatures.
- Controls the voltage applied to the glow plugs based on the control signal from the PCM.

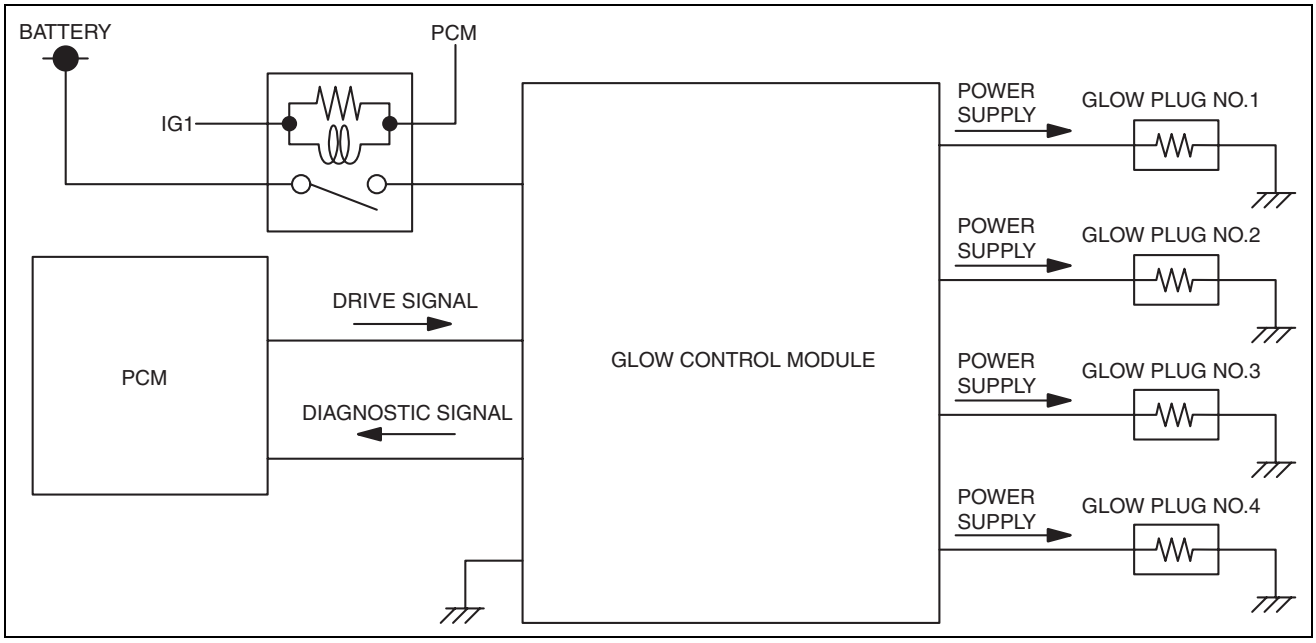
Construction

- The glow control module is installed to the engine compartment.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Operation

- Controls the voltage applied to the glow plugs based on the control signal from the PCM. In addition, the on-board diagnostic function is equipped and if there is a malfunction in the glow control module, a diagnostic signal is sent to the PCM. The PCM stores a DTC if necessary according to the received diagnostic signal.



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GLOW PLUG [SKYACTIV-D 2.2]

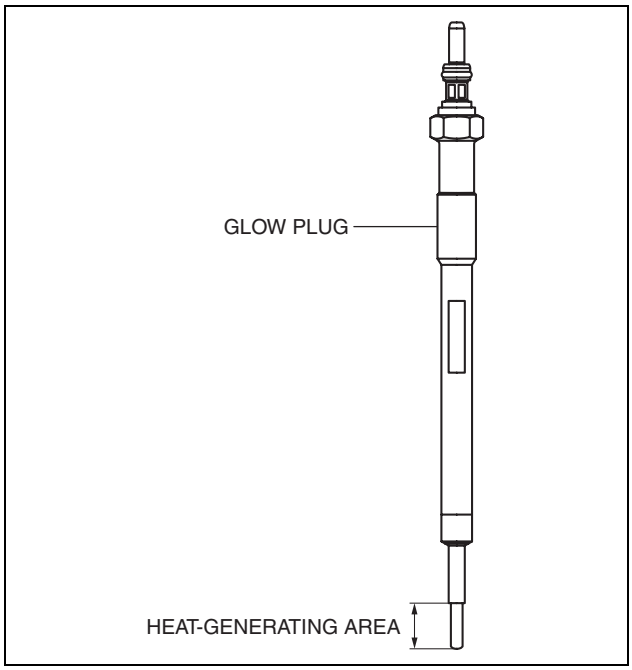
id0113z7706200

Purpose, Function

- The glow plugs warm up the air induced to the combustion chamber by generating heat.

Construction

- The glow plugs are installed to the cylinder heads.
- Quick warming-type ceramic glow plugs have been adopted which reduce the time required to start the engine by quickly increasing the temperature.w



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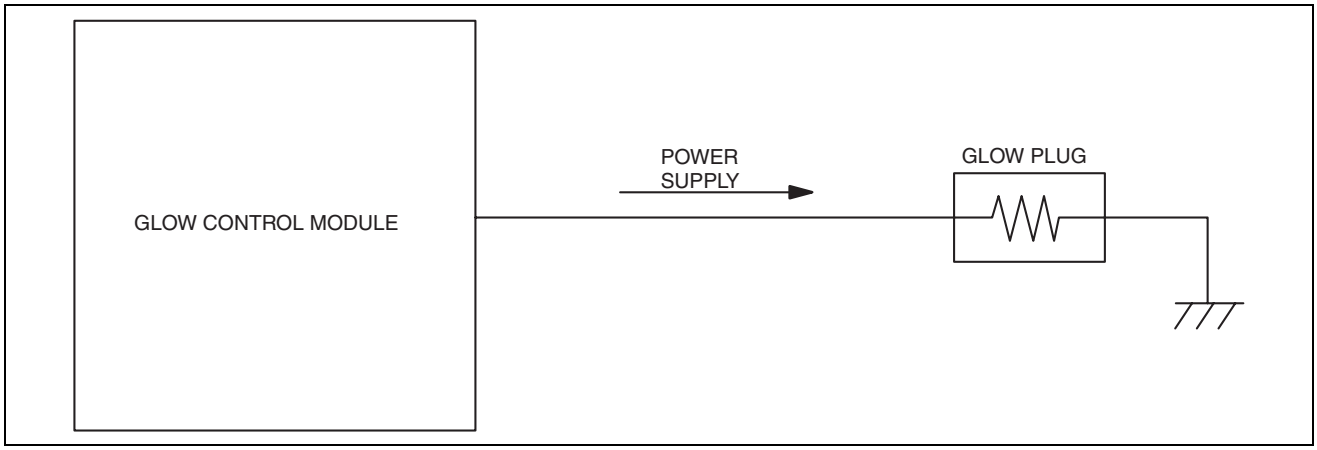
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Operation

- The glow plugs generate heat by the power supplied from the glow control module.



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AIR CHARGING SYSTEM [SKYACTIV-D 2.2]

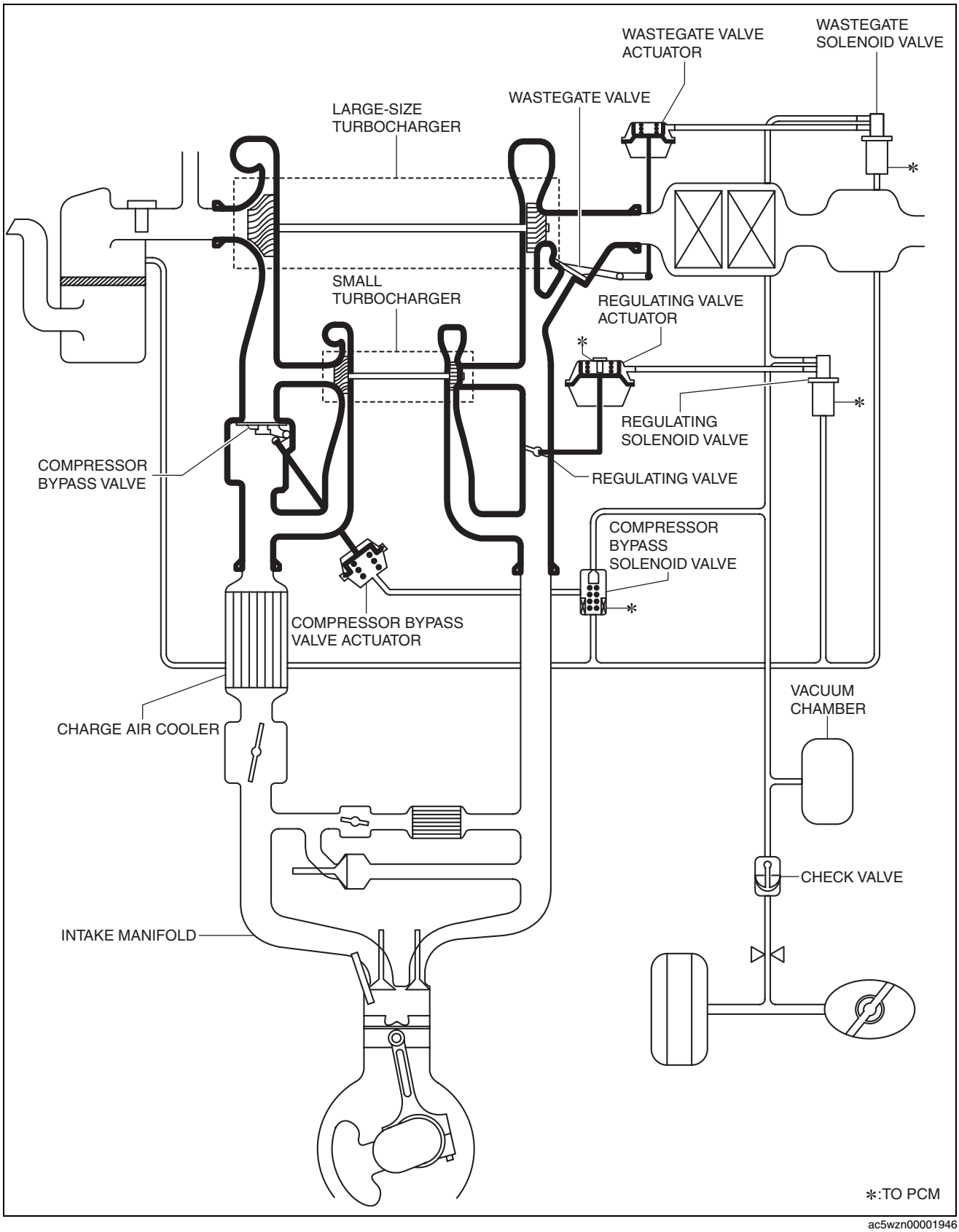
id0113z7706400

Purpose, Outline

- By charging the intake air from the 2-stage turbocharger, the following effects are advanced.
  - — To reduce NOx generated during complete combustion, it is necessary to recirculate the exhaust gas to the combustion chamber and lower the combustion temperature. However, PM is generated by incomplete combustion due to a lack of oxygen. With the SKYACTIV-D 2.2, NOx and PM emissions are suppressed by highly efficient air charging which enables delivery of a sufficient amount of oxygen to the combustion chamber even during exhaust gas recirculation.
  - — By use of either the large-type turbocharger or small-type turbocharger depending on the driving conditions, high torque at low engine speed range, high response, and high output at high engine speed range is achieved.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

System diagram



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Structure

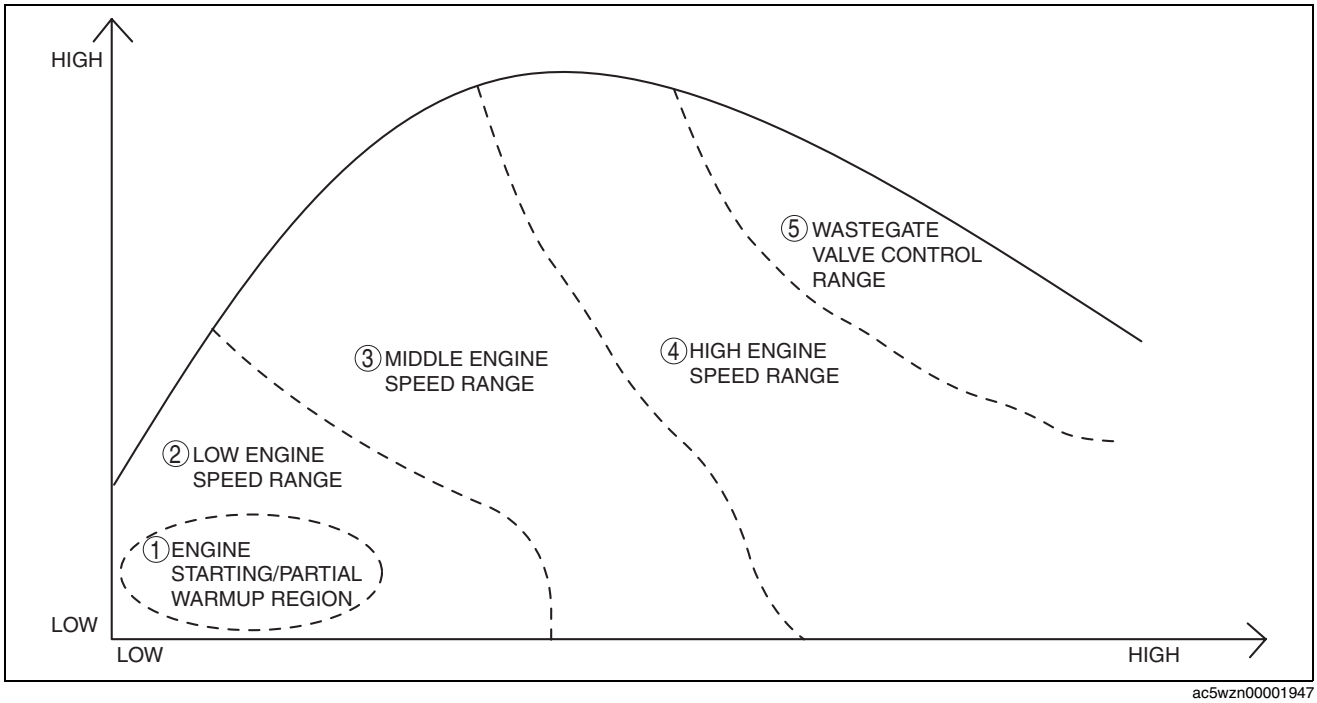
- The air charging system consists of the following parts.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Part name		Reference
Turbocharger	Large-type turbocharger	(See 01-13B-21 TURBOCHARGER [SKYACTIV-D 2.2].)
	Small-type turbocharger	
	Compressor bypass valve	
	Compressor bypass valve actuator	
	Regulating valve	
	Regulating valve actuator	
	Regulating valve position sensor	
	Wastegate valve	
	Wastegate valve actuator	
Compressor bypass solenoid valve		(See 01-13B-8 COMPRESSOR BYPASS SOLENOID VALVE [SKYACTIV-D 2.2].)
Regulating solenoid valve		(See 01-13B-9 REGULATING SOLENOID VALVE [SKYACTIV-D 2.2].)
Wastegate solenoid valve		(See 01-13B-25 WASTEGATE SOLENOID VALVE [SKYACTIV-D 2.2].)
Vacuum chamber		(See 01-13B-25 VACUUM CHAMBER [SKYACTIV-D 2.2].)
Check valve		(See 01-13B-10 CHECK VALVE [SKYACTIV-D 2.2].)
Charge air cooler		(See 01-13B-26 CHARGE AIR COOLER [SKYACTIV-D 2.2].)

Operation

- The 2-stage turbocharger control is divided between the large-type turbocharger and small-type turbocharger for control in mainly 5 regions.



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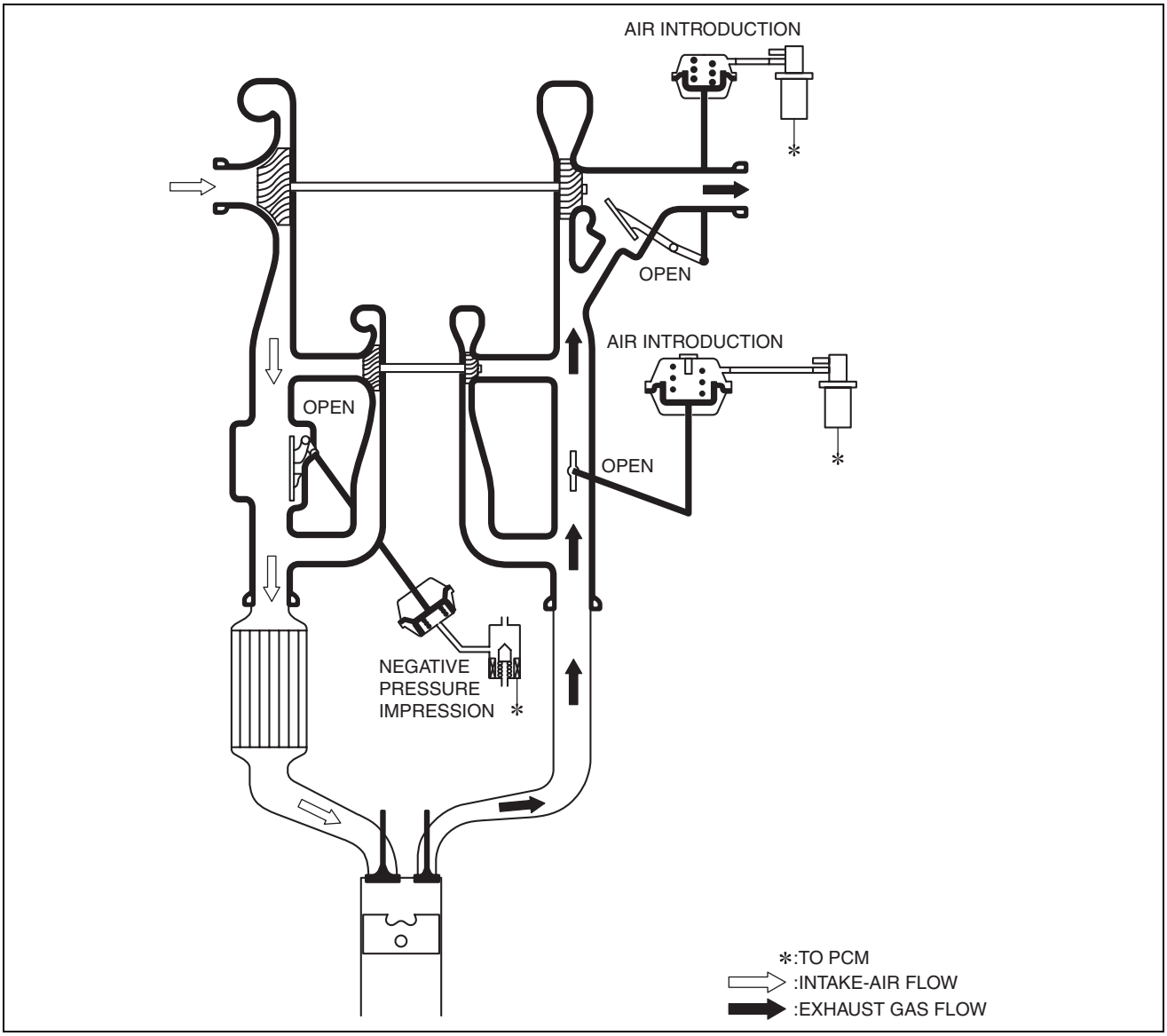
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

1. Engine starting/partial warmup region

- For the purpose of earlier activation of the catalytio converter, air charging by the small-type turbocharger and large-type turbocharger is stopped. By stopping the air charging, the exhaust gas arrives at the catalytic converter as is with no loss of exhaust heat because it does not contact the turbine.



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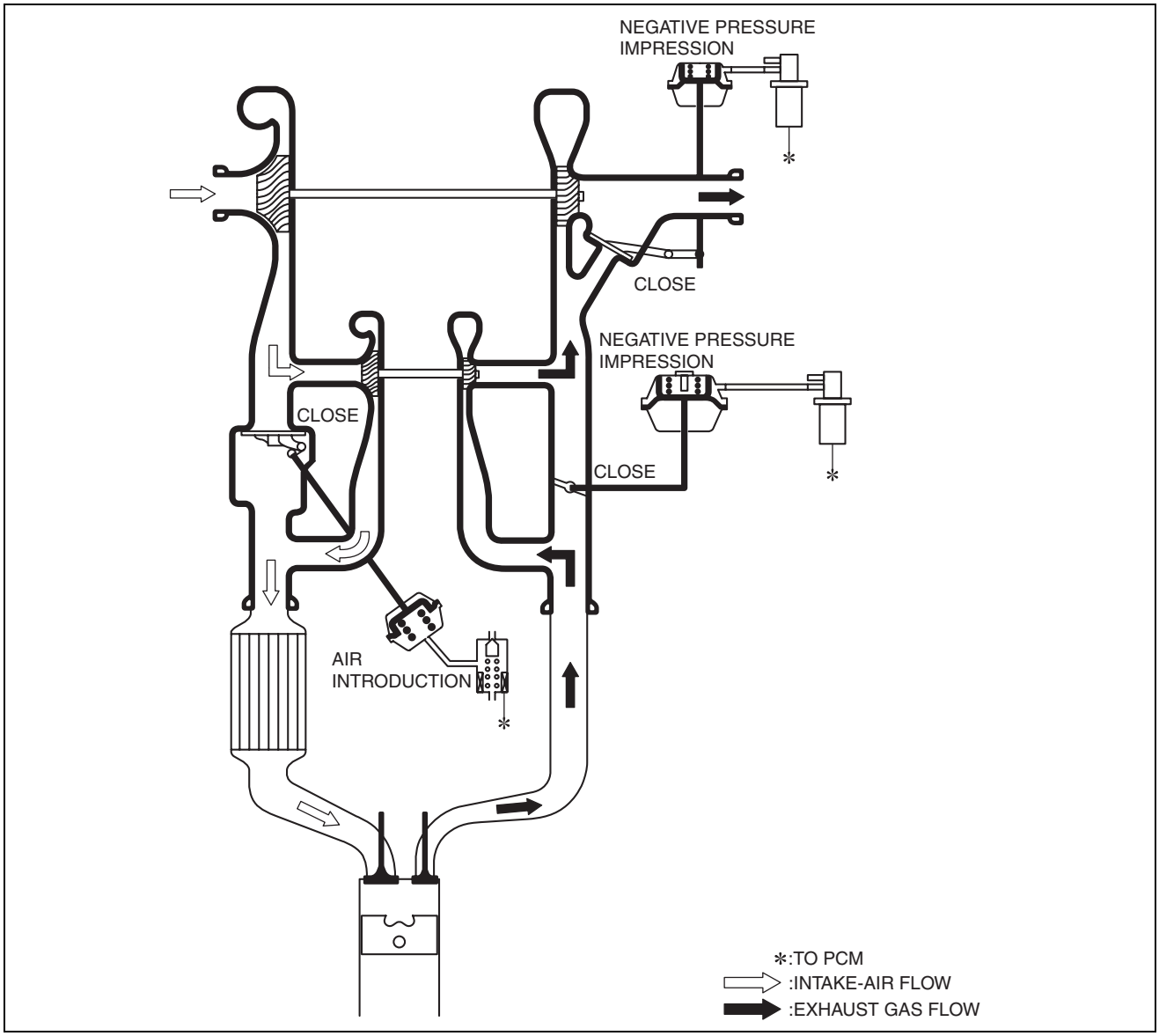
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

2. Low engine speed range

- At low engine speeds, the air charging effect by the large-type turbocharger is small because the force of the exhaust gas is small. By connecting the small-type turbocharger and large-type turbocharger in tandem and having the air charged by the large-type turbocharger further charged at the small-type turbocharger, air charging pressure is assured and high torque at the low engine speed range and high response are achieved.



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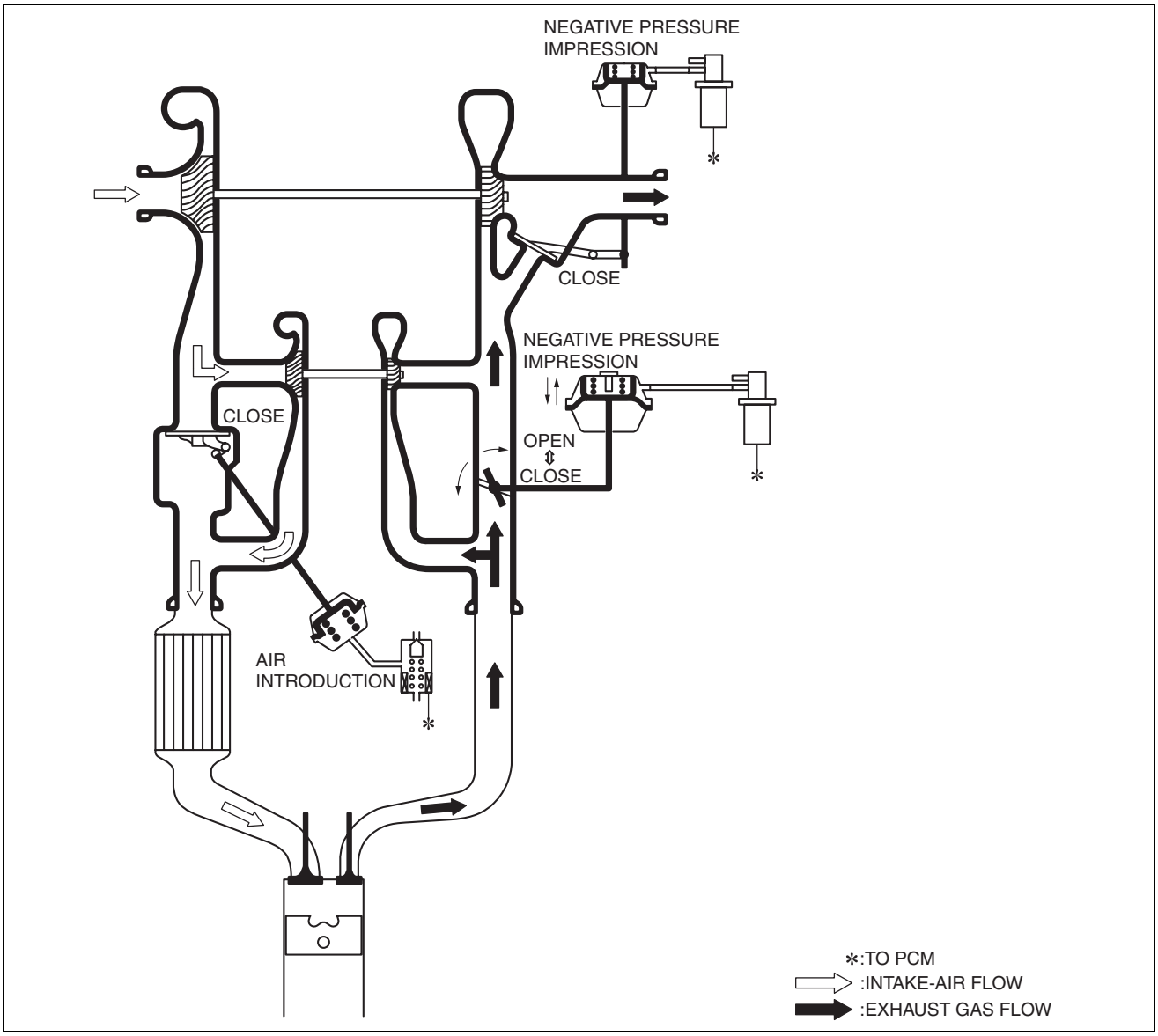
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

3. Middle engine speed range

- In the range bordering between the low engine speed range and the high engine speed range, the regulating valve opens and closes according to the conditions. By opening and closing the valve, generation of turbocharger lag is suppressed by switching the operation of the small-type turbocharger.



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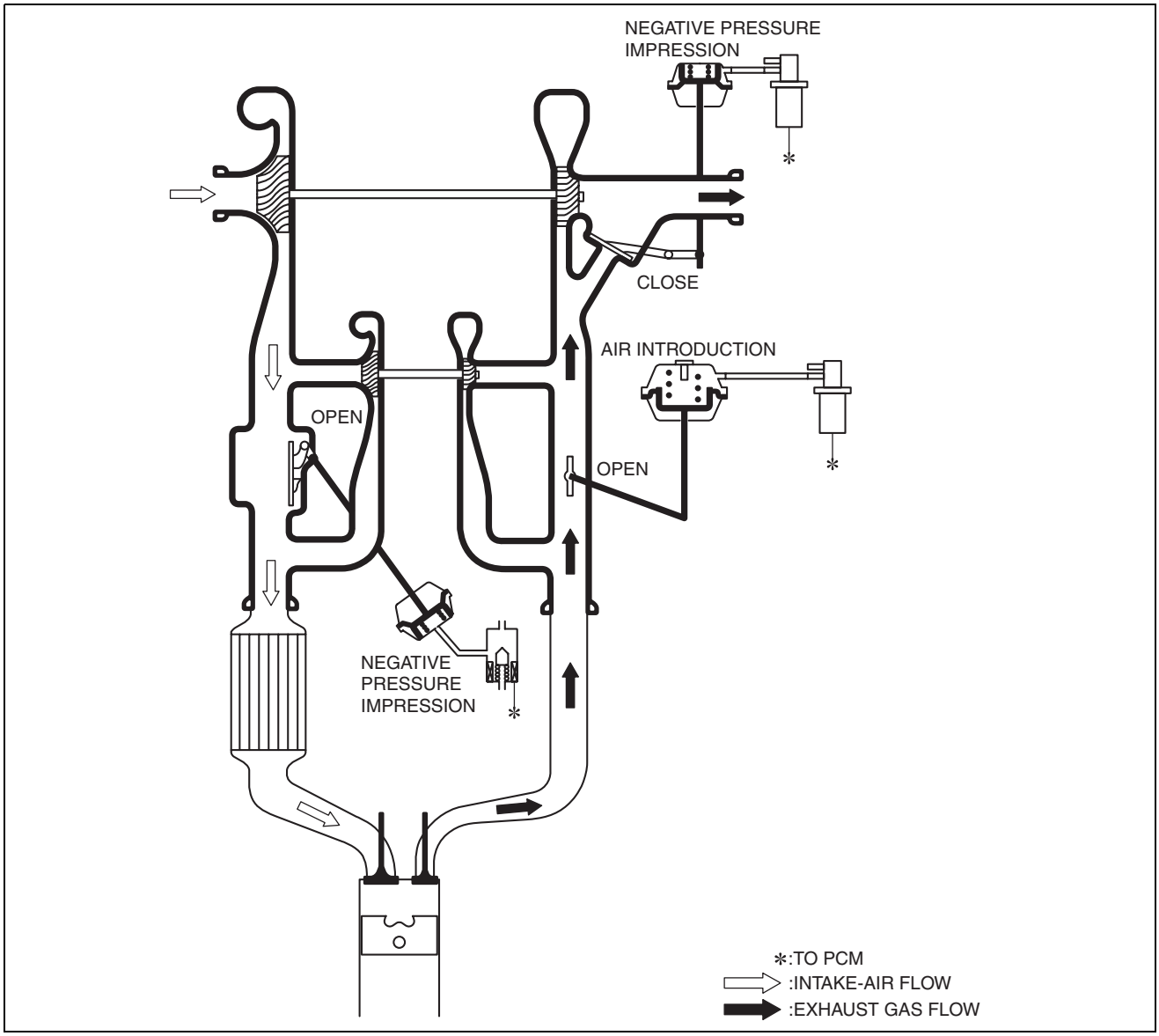
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

4. High engine speed range

- In the high engine speed range, the small-type turbocharger is avoided because a larger amount of air is required, and only the large-type turbocharger performs air charging. By circumventing the small-type turbocharger, intake air resistance is small, and the charged air is efficiently taken in.



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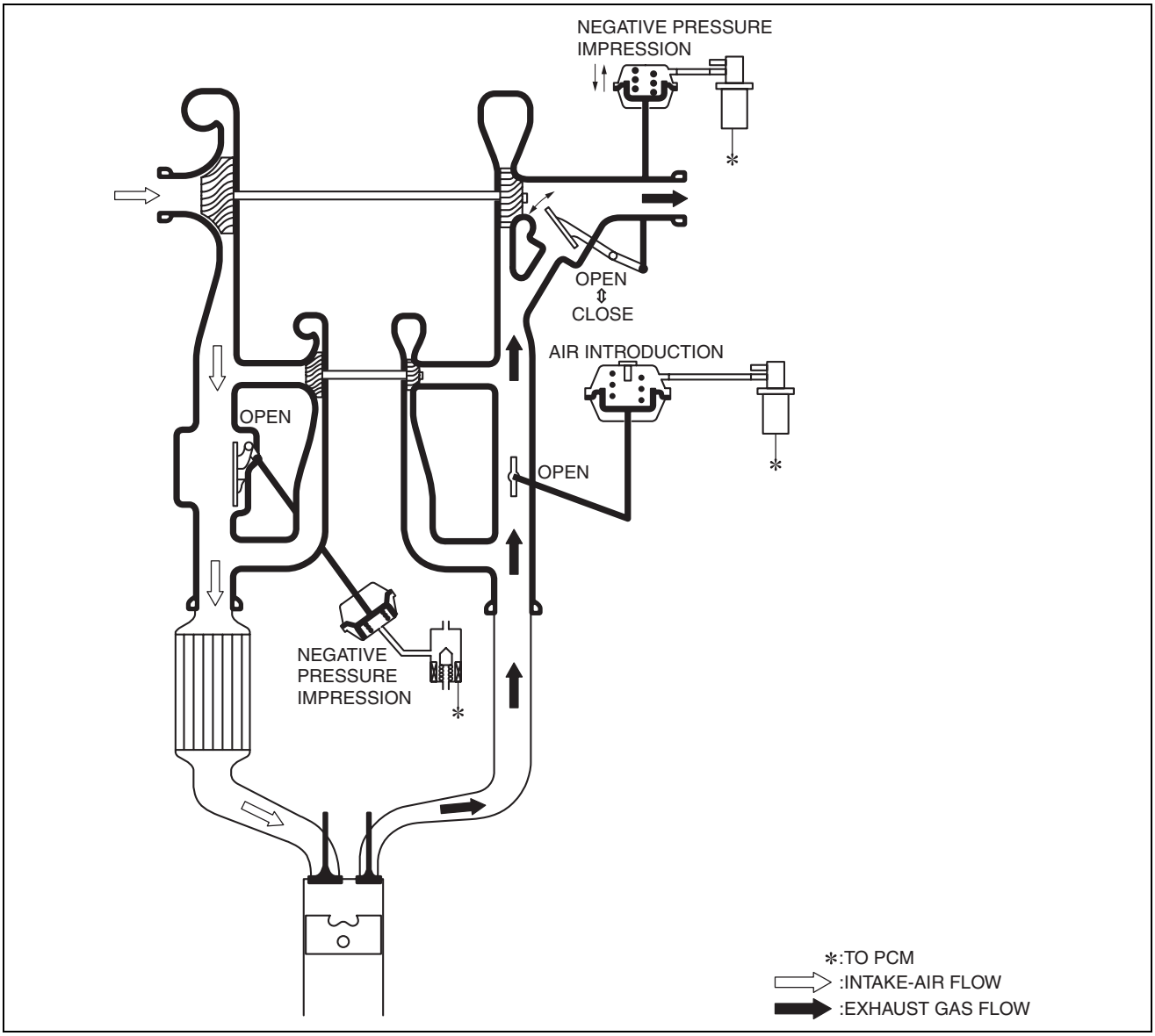
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

5. Air charging pressure excess region

- In the region where air charging pressure increases, the rise in air charging pressure is suppressed by opening and closing the wastegate valve to switch the air charging of the large-type turbocharger.



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TURBOCHARGER [SKYACTIV-D 2.2]

id0113z7706500

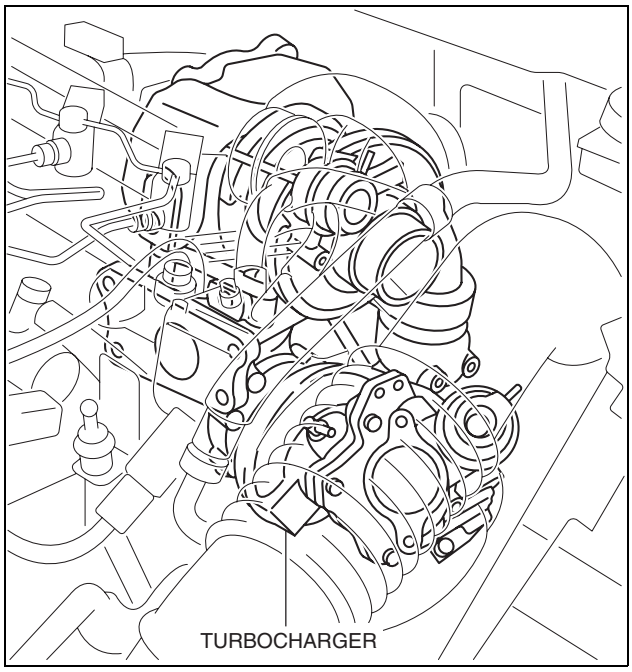
Purpose, Function

- The small-type turbocharger and large-type turbocharger are arranged in tandem enabling switching of the air charging between stage 1 and stage 2 by switching the intake/exhaust passages using each type of valve.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Construction

- The turbochargers are installed behind the engine compartment.
- The turbochargers consist of a large-type turbocharger, small-type turbocharger, each type of valve, and each type of actuator.



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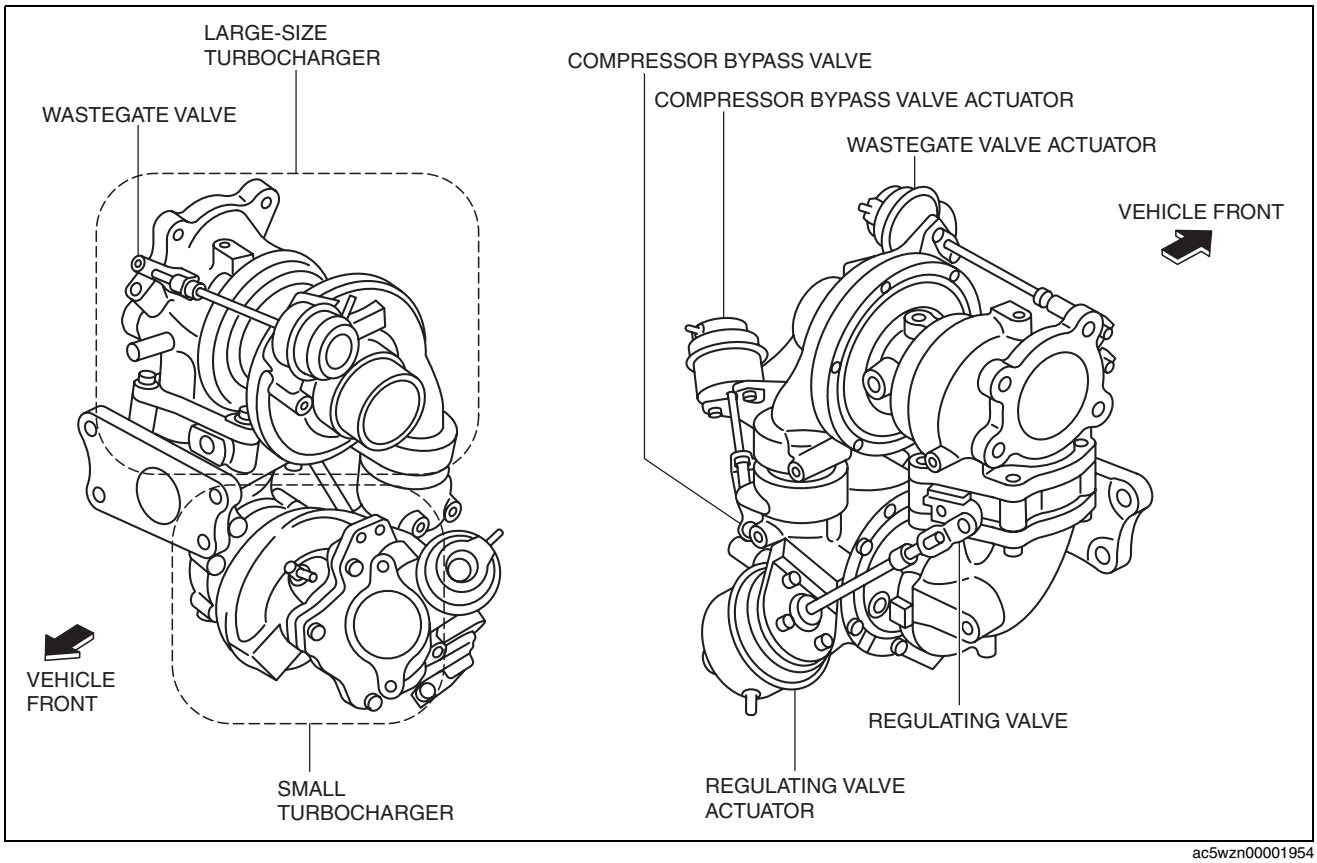

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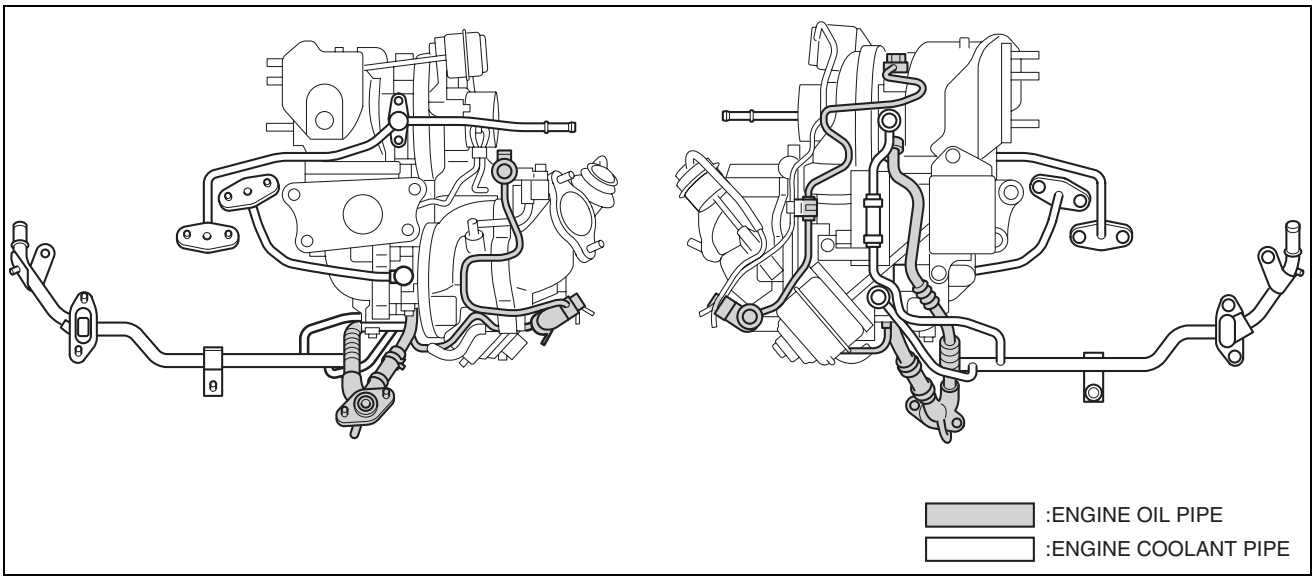
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

- To assure turbocharger functionality, a cooling pipe and engine oil pipe are installed.



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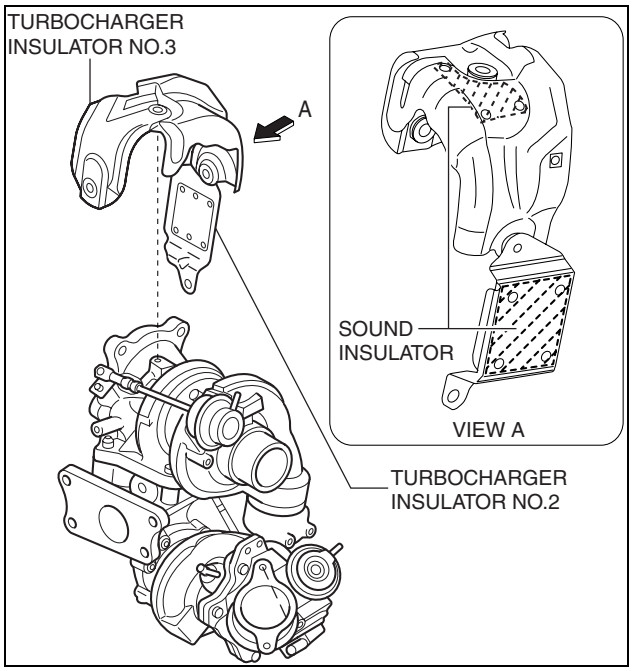
- Noise suppression material is employed on turbocharger insulator No.2 and No.3 to reduce engine noise transmitted to the vehicle cabin.



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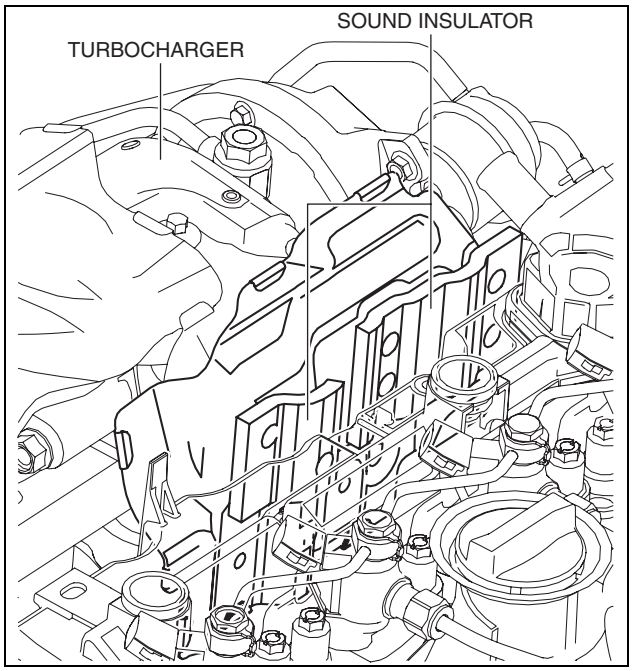
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

- Noise suppression material is employed between the turbochargers and the engine to reduce engine noise transmitted to the vehicle cabin.



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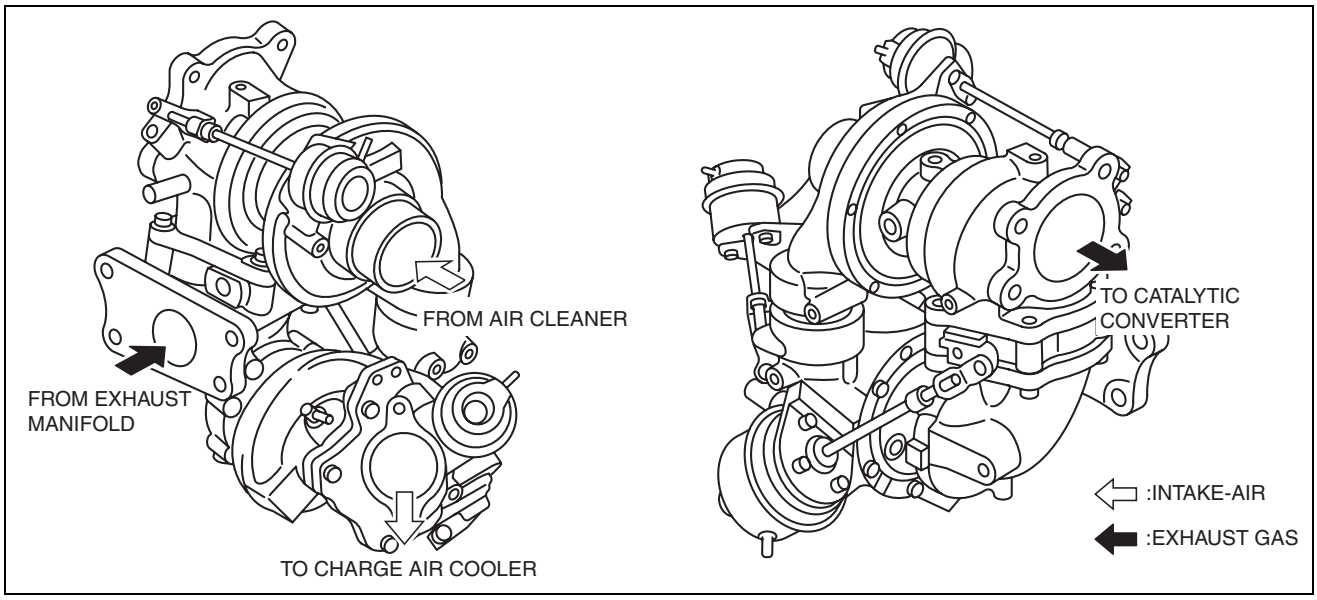
Operation

- When exhaust gas flows from the turbine impeller of the turbocharger, the compressor impeller on the same axle as the turbine impeller rotates to compress the intake air.



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- By the opening/closing of the compressor bypass valve, regulating valve, wastegate valve according to the engine operation conditions, air charging by the large-type turbocharger and small-type turbocharger is controlled in two stages.

Compressor bypass valve

- Normally, the spring force presses against the rod, keeping the compressor bypass valve closed. When intake manifold vacuum is applied to the diaphragm chamber of the compressor bypass valve actuator, the rod is pulled to open the compressor bypass valve.

Regulating valve

- Normally, the spring force presses against the rod, keeping the regulating valve open. When intake manifold vacuum is applied to the diaphragm chamber of the regulating valve actuator, the rod is pulled to close the regulating valve.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

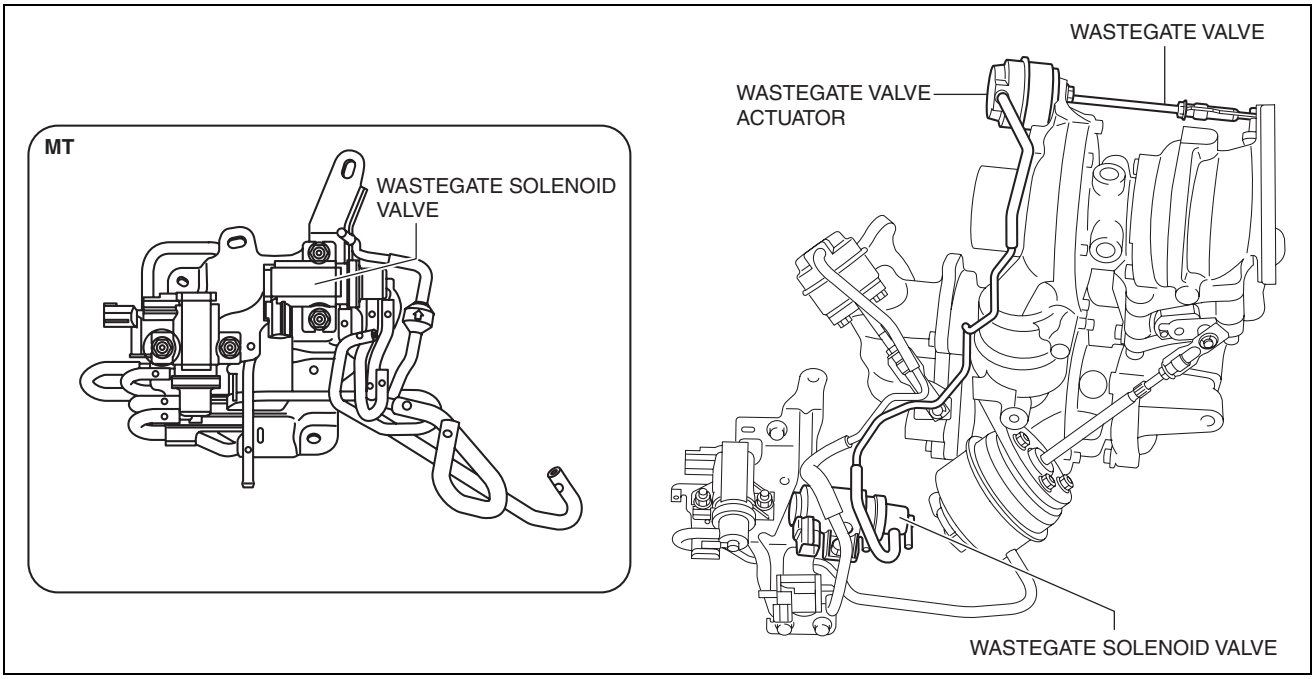
Wastegate valve
- Normally, the spring force presses against the rod, keeping the wastegate valve open. When intake manifold vacuum is applied to the diaphragm chamber of the wastegate valve actuator, the rod is pulled to close the wastegate valve.

WASTEGATE SOLENOID VALVE [SKYACTIV-D 2.2]

id0113z7256000

Purpose, Function
- Introduces intake manifold vacuum to the wastegate valve actuator.
- The wastegate valve opens according to the control signal from the PCM.

Construction
- Installed to the vacuum pipe bracket on the side of the turbocharger.



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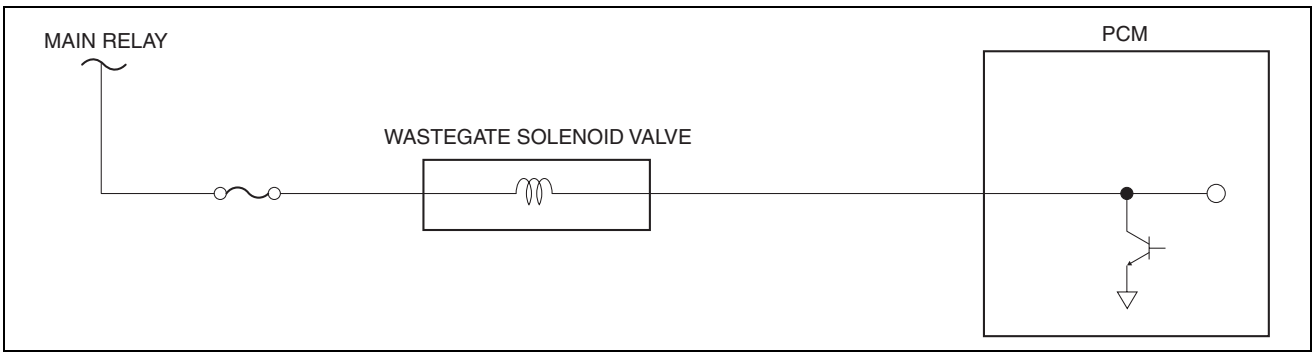
- The wastegate solenoid valve consists of a coil, spring, and plunger.

Operation
- According to the control signal from the PCM, the coil is energized and the plunger is operated to open/close the wastegate solenoid valve.



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- By opening the wastegate solenoid valve, the intake manifold vacuum is introduced to the wastegate valve actuator.

VACUUM CHAMBER [SKYACTIV-D 2.2]

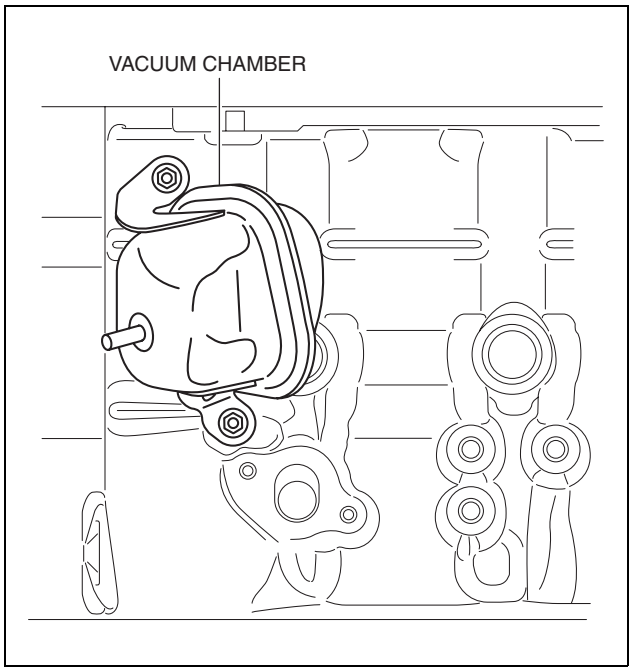
id0113z7265300

Purpose, Function
- Vacuum generated by the vacuum pump operation is stored to perform smooth boost control.

INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Construction

- The vacuum chamber is installed to the cylinder block.



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CHARGE AIR COOLER [SKYACTIV-D 2.2]

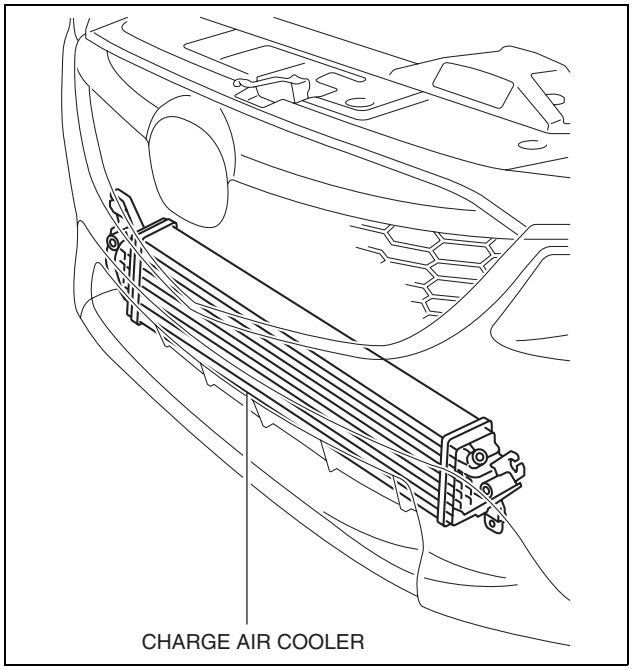
id0113z7706800

Purpose, Function

- Cools the compressed/heated intake air.

Construction

- The charge air cooler is installed to the backside of the front bumper.



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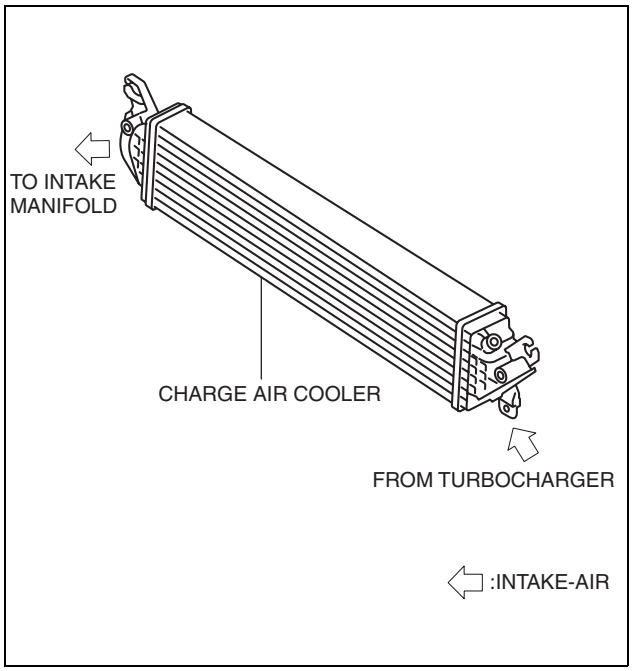
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

Operation

- To concentrate the air density of the compressed/ heated intake air, it is cooled by the charge air cooler for enhanced intake air efficiency.



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ACCELERATOR PEDAL [SKYACTIV-D 2.2]

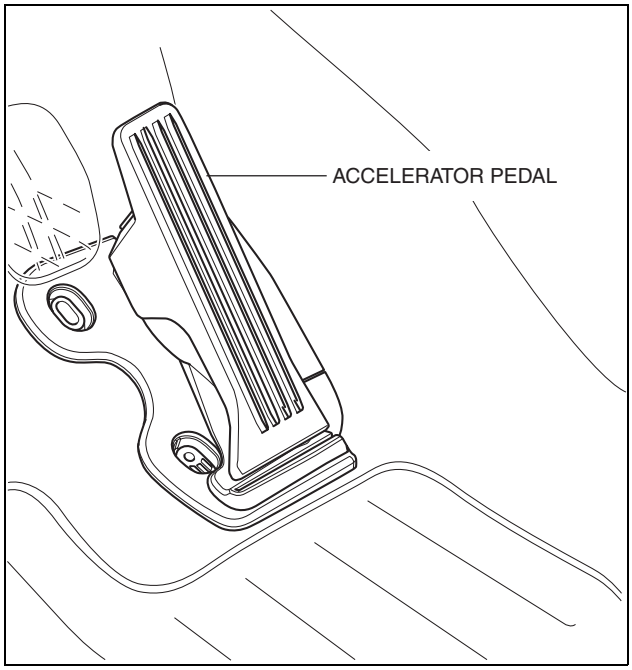
id0113z7105000

Purpose, Function

- Driver's intention is transmitted to the PCM via the accelerator pedal.

Construction

- The accelerator pedal is installed to the foot area of the driver's seat.



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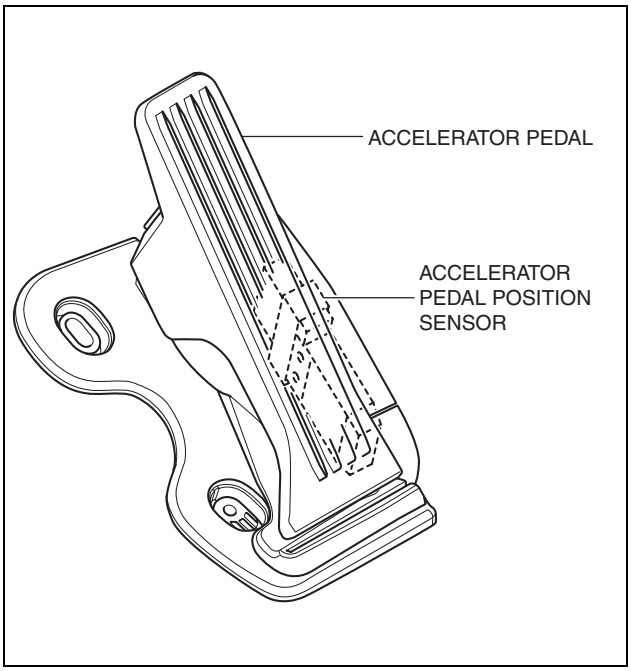
INTAKE-AIR SYSTEM [SKYACTIV-D 2.2]

- The accelerator pedal has a built-in APP sensor.
- For the APP sensor, refer to CONTROL SYSTEM.



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01-14A FUEL SYSTEM [SKYACTIV-G 2.0]

FUEL SYSTEM [SKYACTIV-G 2.0]

FUEL SYSTEM [SKYACTIV-G 2.0]

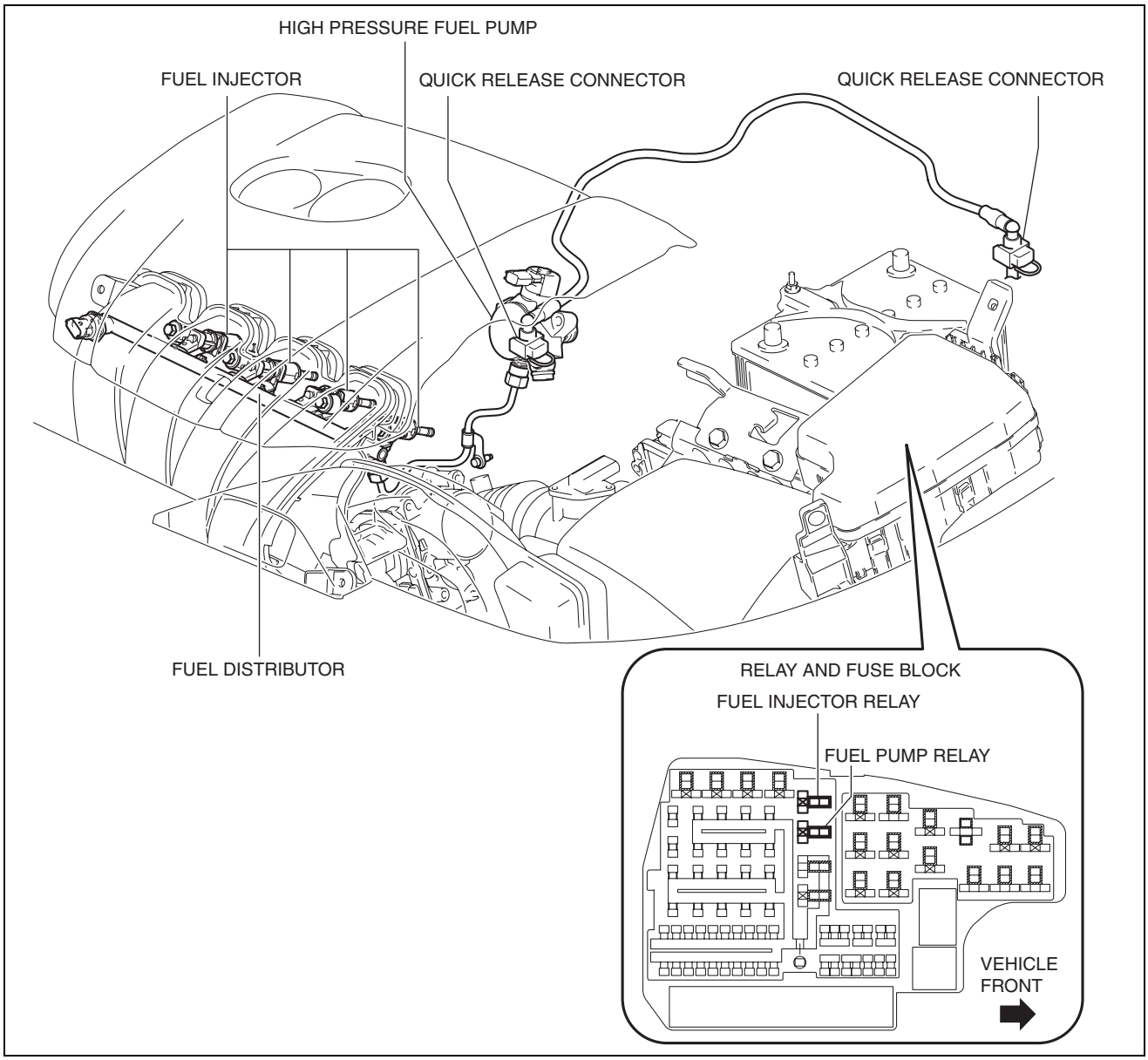
id0114z5002600

Outline

- A multiple hole type fuel injector has been adopted which provides higher fuel injection accuracy for improved fuel efficiency and output.
- Piston movement-compression by the 4-head cam inside the high pressure fuel pump heightens the fuel pressure, achieving improved fuel efficiency and output.

FUEL SYSTEM [SKYACTIV-G 2.0]

Structural View
Engine compartment side



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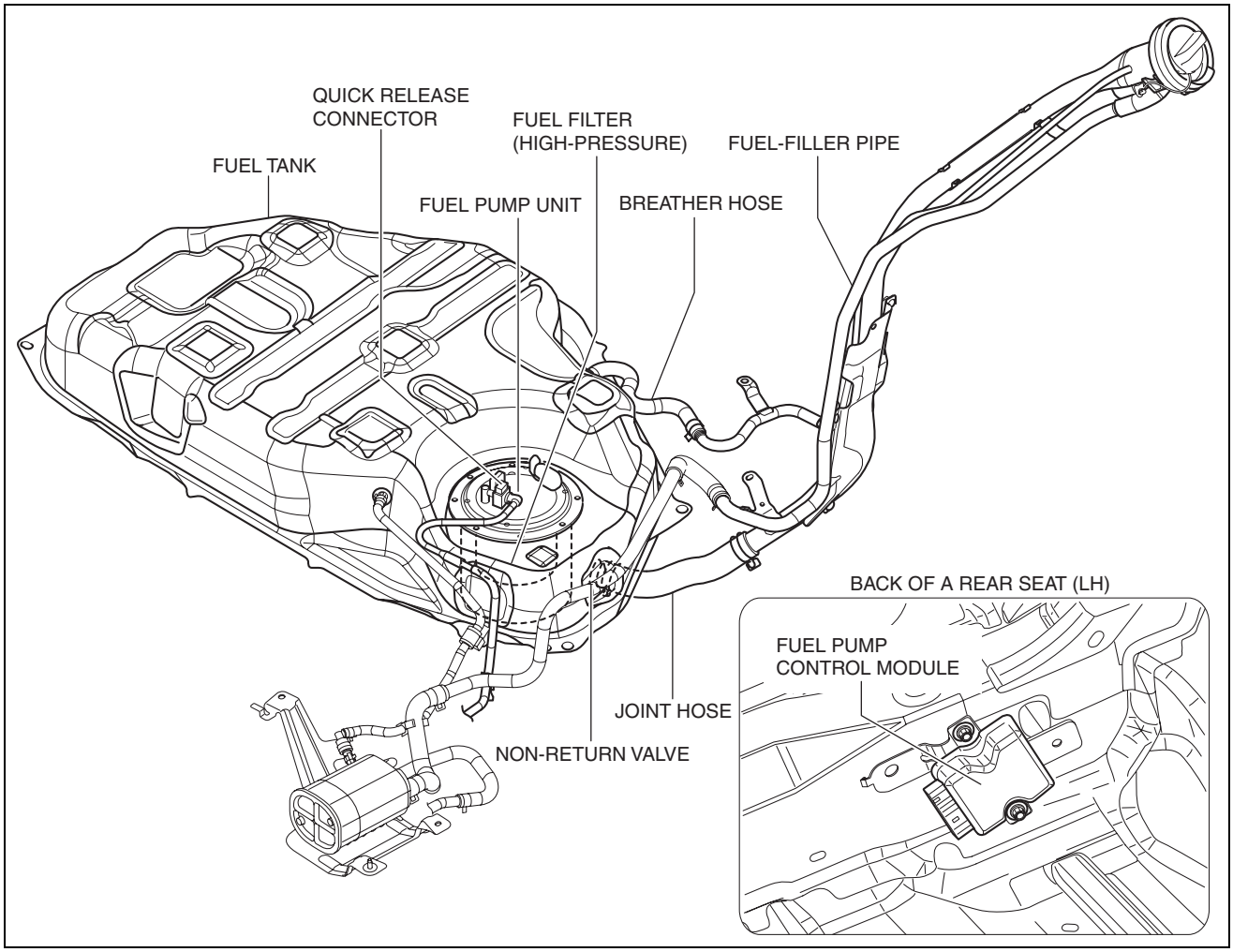
FUEL SYSTEM [SKYACTIV-G 2.0]

Fuel tank side
2WD



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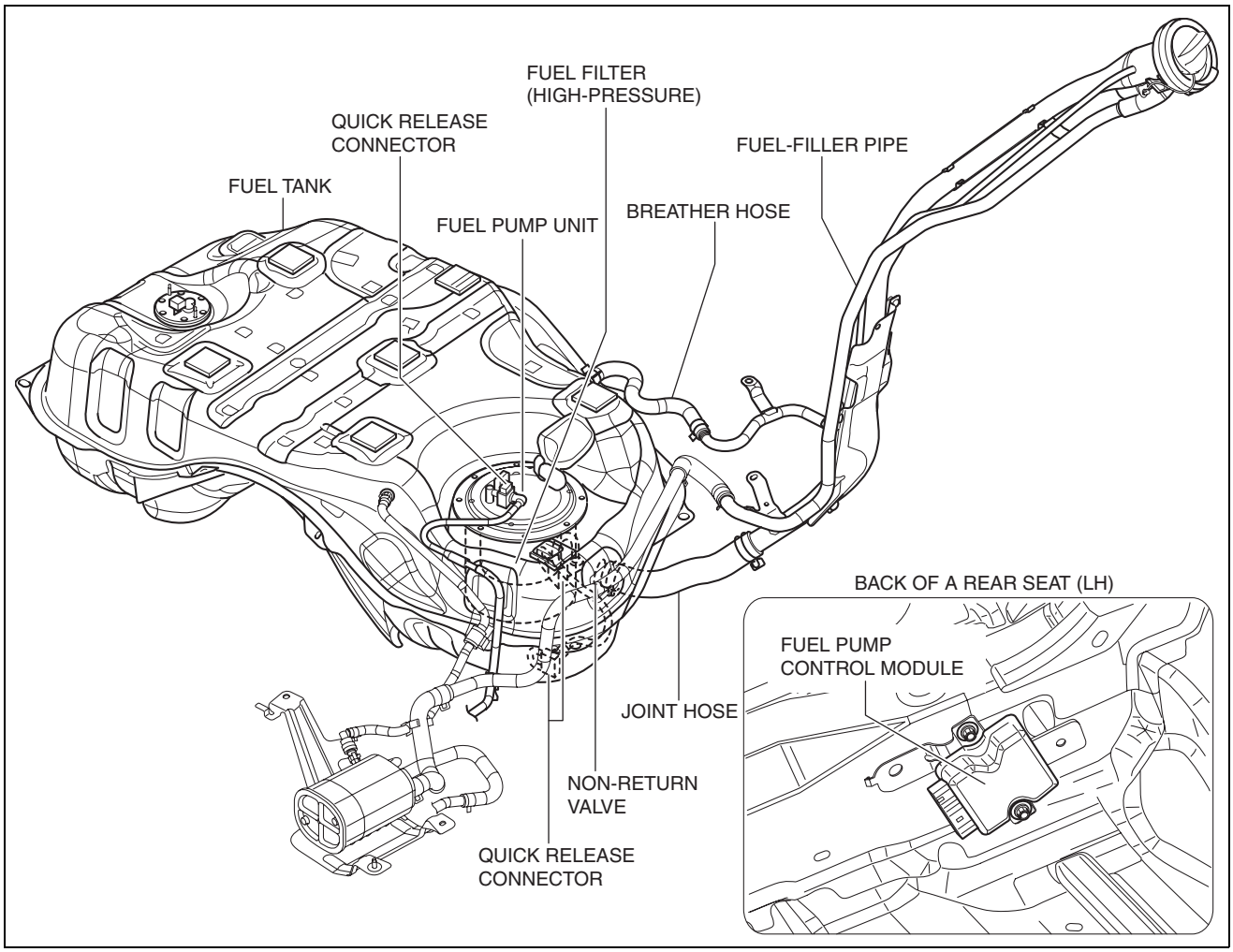
FUEL SYSTEM [SKYACTIV-G 2.0]

4WD



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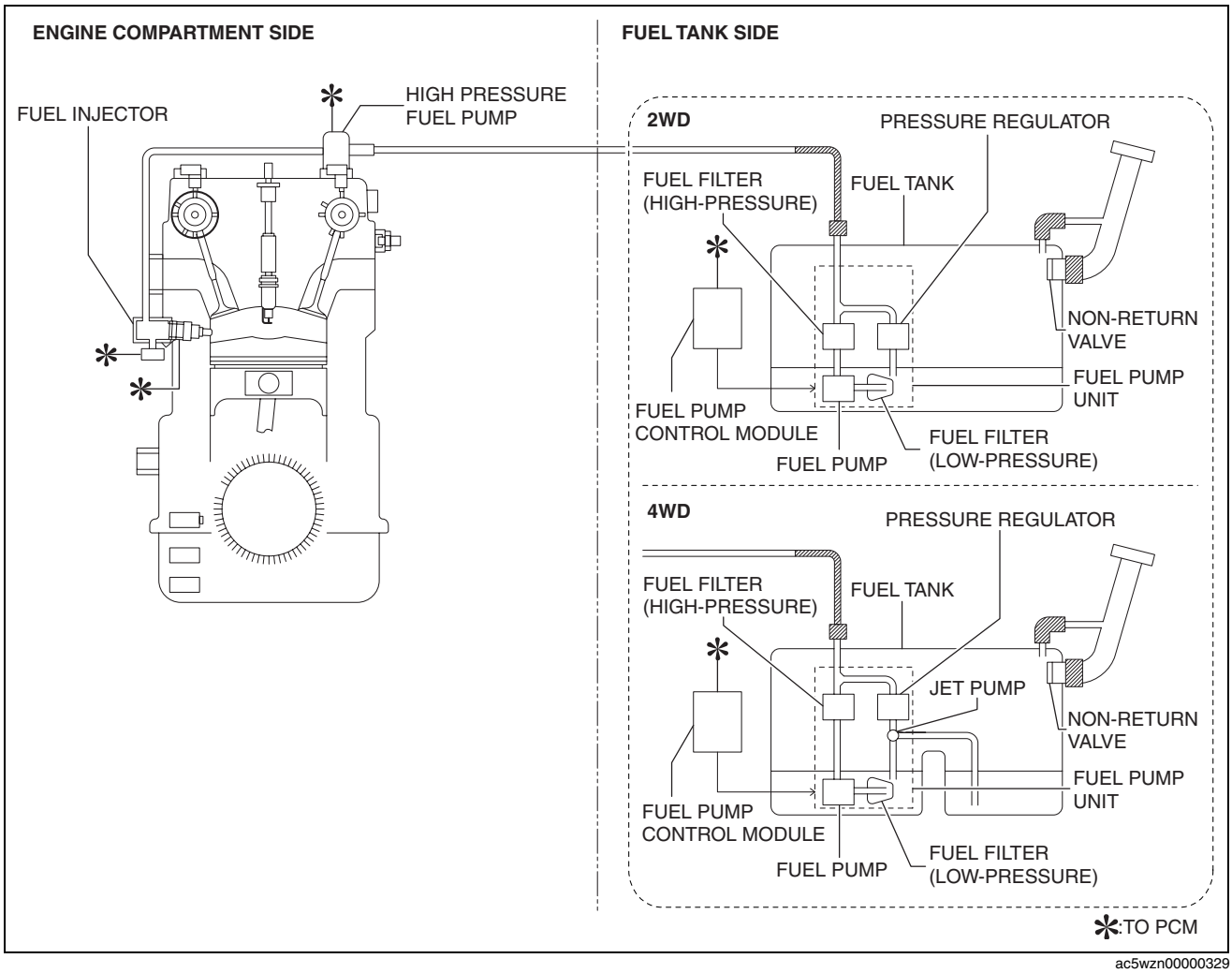
FUEL SYSTEM [SKYACTIV-G 2.0]

System Diagram



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Structure

- The fuel system consists of the following parts:

Part/System name		Reference
Return-less fuel system (See 01-14A-6 RETURNLESS FUEL SYSTEM [SKYACTIV-G 2.0].)	Fuel pump unit	(See 01-14A-12 FUEL PUMP UNIT [SKYACTIV-G 2.0].)
Direct fuel injection system (See 01-14A-20 DIRECT FUEL INJECTION SYSTEM [SKYACTIV-G 2.0].)	High pressure fuel pump	(See 01-14A-21 HIGH PRESSURE FUEL PUMP [SKYACTIV-G 2.0].)
	Fuel distributor	(See 01-14A-15 FUEL DISTRIBUTOR [SKYACTIV-G 2.0].)
	Fuel injector	(See 01-14A-16 FUEL INJECTOR [SKYACTIV-G 2.0].)
Fuel tank		(See 01-14A-8 FUEL TANK [SKYACTIV-G 2.0].)
Non-return valve		(See 01-14A-10 NON-RETURN VALVE [SKYACTIV-G 2.0].)
Fuel pump relay		(See 01-14A-18 FUEL PUMP RELAY [SKYACTIV-G 2.0].)
Fuel injector relay		(See 01-14A-19 FUEL INJECTOR RELAY [SKYACTIV-G 2.0].)
Fuel pump control module		(See 01-14A-22 FUEL PUMP CONTROL MODULE [SKYACTIV-G 2.0].)
Quick connector (fuel system)		(See 01-14A-18 QUICK RELEASE (FUEL SYSTEM) CONNECTOR [SKYACTIV-G 2.0].)

FUEL SYSTEM [SKYACTIV-G 2.0]

Specification

Item			Specification
Fuel injector	Type		High resistance
	Fuel supply method		Top-feed
	Drive types		Electronic
Pressure regulator control pressure	(kPa {kgf/cm^2, psi})		Approx. 430 {4.38, 62.4}
Fuel pump type			Electric
Fuel tank capacity	(L {US gal, Imp gal})	2WD	56.0 {14.8, 12.3}
		4WD	58.0 {15.3, 12.8}

Fuel type

Fuel	Research Octane Number	Country
Premium unleaded fuel (Conforming to EN 228 and within E10)*1	95 or above	New Caledonia, Turkey, Azerbaijan, Canary Islands, Reunion, Morocco, Austria, Greece, Italy, Switzerland, Belgium, Denmark, Finland, Norway, Portugal, Spain, Sweden, Hungary, Germany, Poland, Bulgaria, Croatia, Slovenia, Luxembourg, Slovakia, Latvia, Lithuania, Russia, Belarus, France, Ukraine, Czech, Estonia, Faeroe, Iceland, Romania, The Netherlands, Macedonia, Bosnia and Herzegovina, Serbia, Montenegro, Albania, Moldova, Martinique, F.Guiana, Guadeloupe, Cyprus, Malta, Ireland, UK, Tahiti, Vanuatu, Iran, UAE, Lebanon, Israel, Algeria, Libya, Tunisia, Madagascar, Guatemala, Bolivia, Honduras, Nicaragua, Aruba, Singapore, Hong Kong, Malaysia, Macau, Mauritius, Jamaica, Barbados, Grenada, St. Lucia, St. Vincent, Antigua
Regular unleaded fuel (Conforming to Fuel Quality Standards Act 2000)*2	90 or above	Taiwan, Vietnam, The Philippines, Marshall Islands, Ustt*3, Kuwait, Oman, Qatar, Saudi Arabia, Syria, Bahrain, Jordan, Nigeria, Angola, Chile, El Salvador, Costa Rica, Ecuador, Haiti, Colombia, Dominican Republic (LHD), Panama, Peru, B. Virgin, Curacao, St. Martin, Indonesia, Thailand, Brunei, Nepal, Sri Lanka, Fiji, Papua New Guinea, Zimbabwe, South Africa, Trinidad and Tobago, Commonwealth of Dominica, Australia
	92 or above	Egypt
	93	China

*1 : Europe

*2 : Australia

*3 : Republic of Palau & Federated States of Micronesia

RETURNLESS FUEL SYSTEM [SKYACTIV-G 2.0]

id0114z5103900

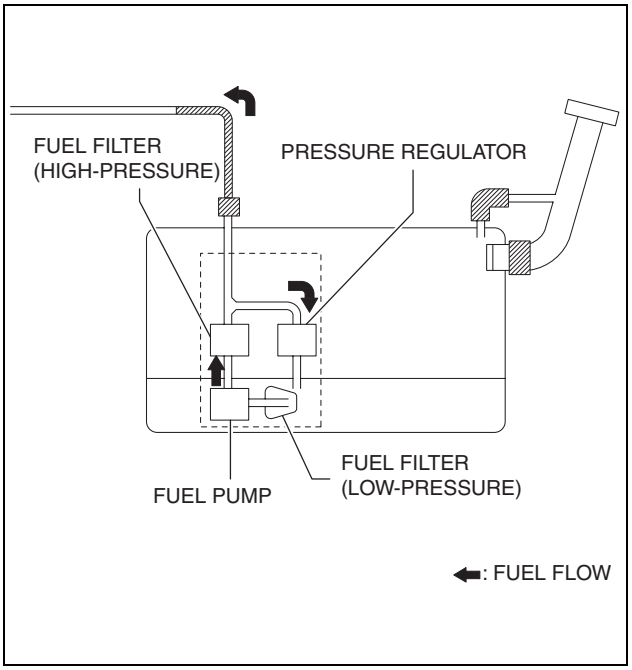
Purpose, Outline

- Fuel evaporation in the fuel tank is reduced by adjusting the fuel amount (fuel pressure) ejected from the fuel pump and preventing fuel warmed in the engine compartment from returning.

FUEL SYSTEM [SKYACTIV-G 2.0]

System Diagram

2WD



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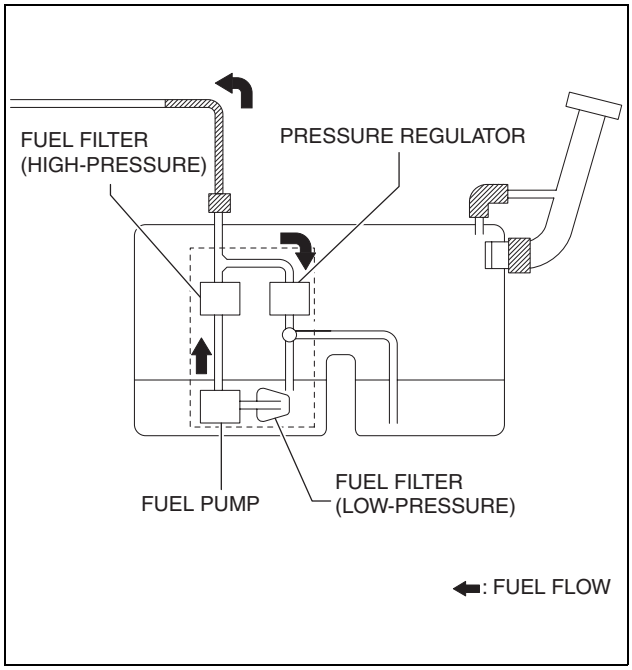
4WD



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Structure

- The returnless fuel system consists of the following parts:

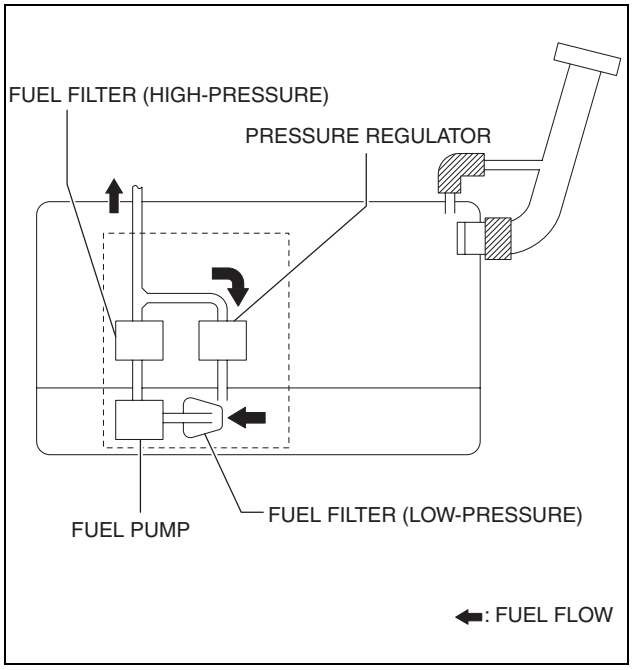
Part name	Reference
Fuel filter (low-pressure)	(See 01-14A-12 FUEL PUMP UNIT [SKYACTIV-G 2.0].)
Fuel filter (high-pressure)	
Pressure regulator	
Fuel pump	

FUEL SYSTEM [SKYACTIV-G 2.0]

Operation

- Fuel in the fuel tank is pumped out through the fuel filter (low-pressure) by the fuel pump, filtered by the fuel filter (high-pressure), and then regulated to a specified pressure by the pressure regulator. The regulated fuel is sent to the high pressure fuel pump, and unnecessary regulated fuel is returned from the pressure regulator to the fuel tank.

2WD



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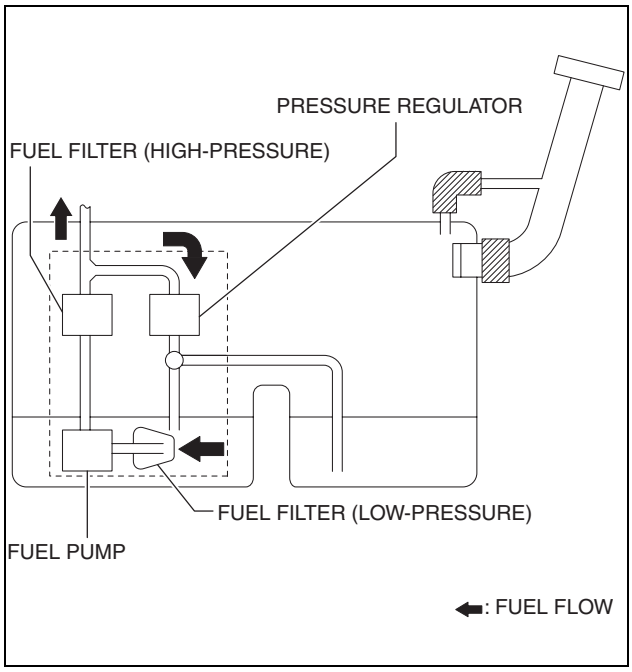
4WD



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FUEL TANK [SKYACTIV-G 2.0]

id0114z5104100

Purpose, Function

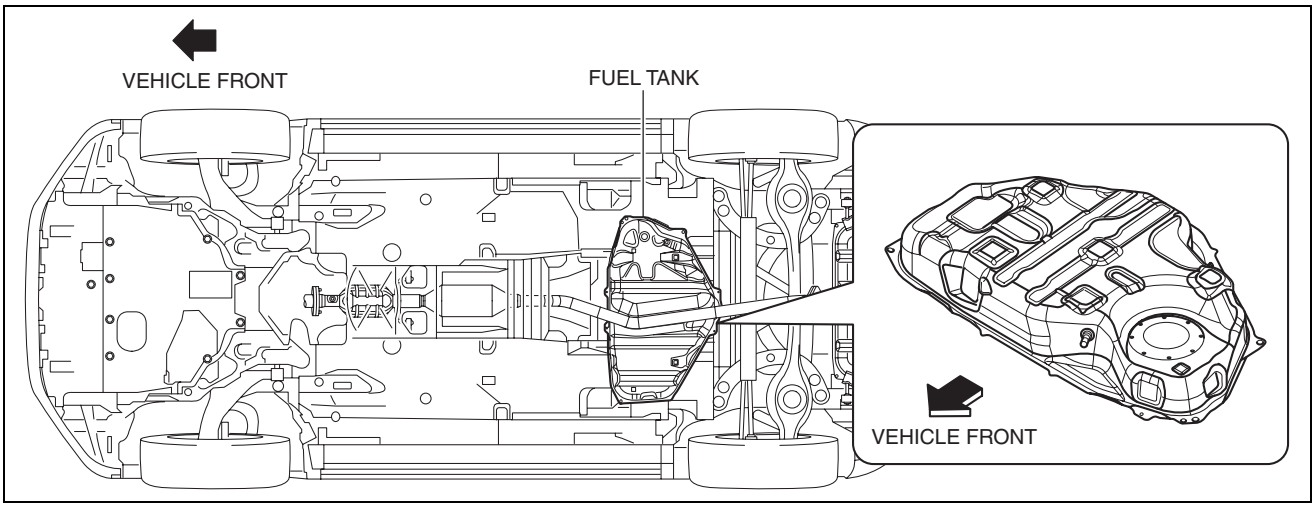
- Store fuel safely and supply fuel to the engine.

Construction

- The fuel tank is installed below the rear seat.

FUEL SYSTEM [SKYACTIV-G 2.0]

2WD



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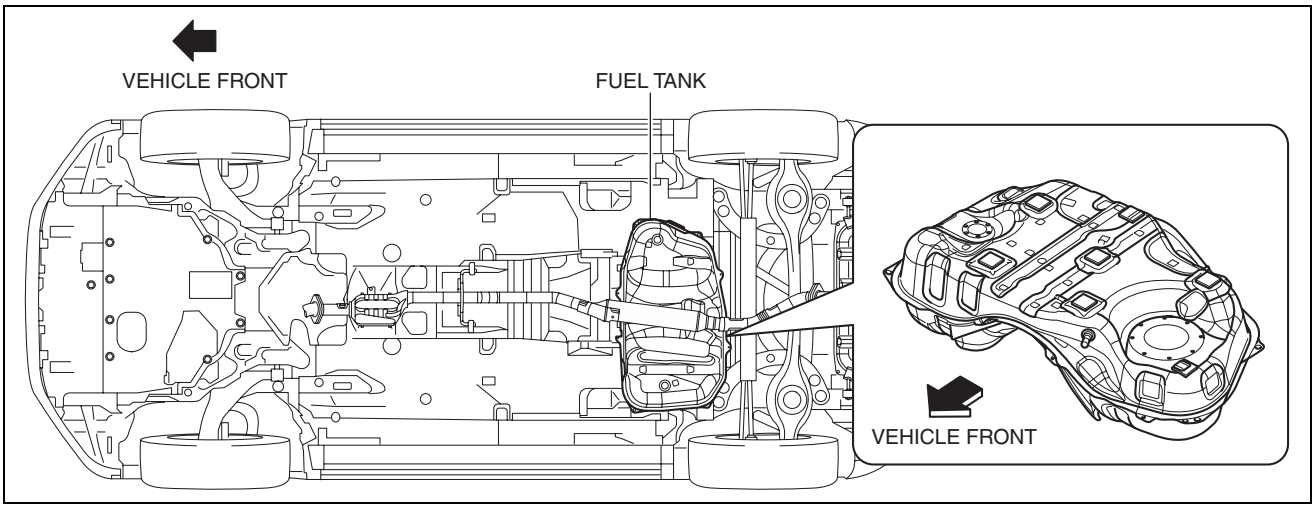
4WD



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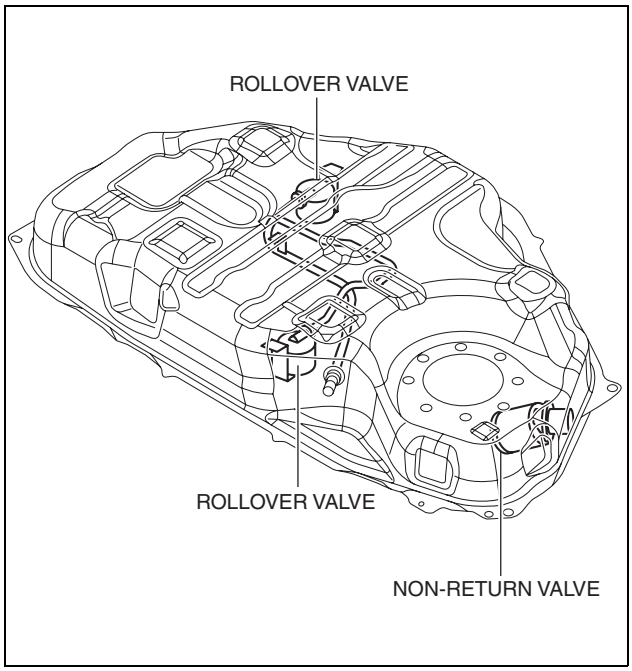
- The fuel tank is made of steel.
- The following parts are integrated in the fuel tank.
  - — Non-return valve
    (See 01-14A-10 NON-RETURN VALVE [SKYACTIV-G 2.0].)
  - — Rollover valve
    (See 01-16A-18 ROLLOVER VALVE [SKYACTIV-G 2.0].)

FUEL SYSTEM [SKYACTIV-G 2.0]

2WD



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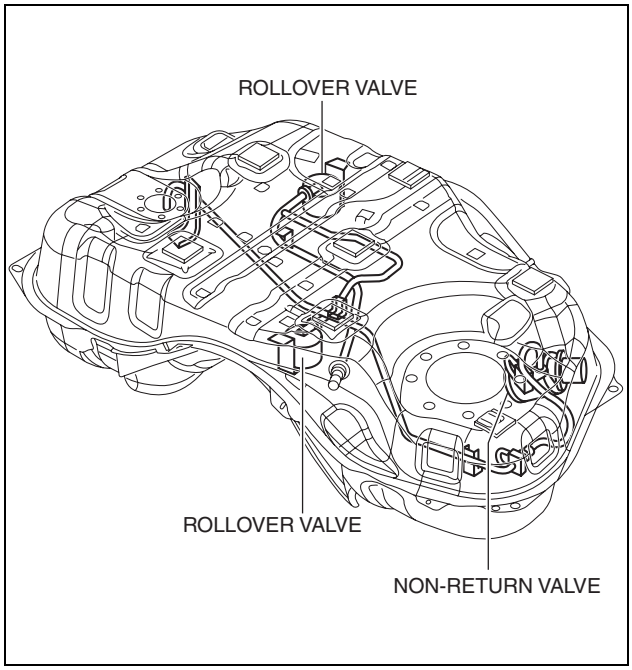
4WD



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NON-RETURN VALVE [SKYACTIV-G 2.0]

id0114z5188800

Purpose, Function

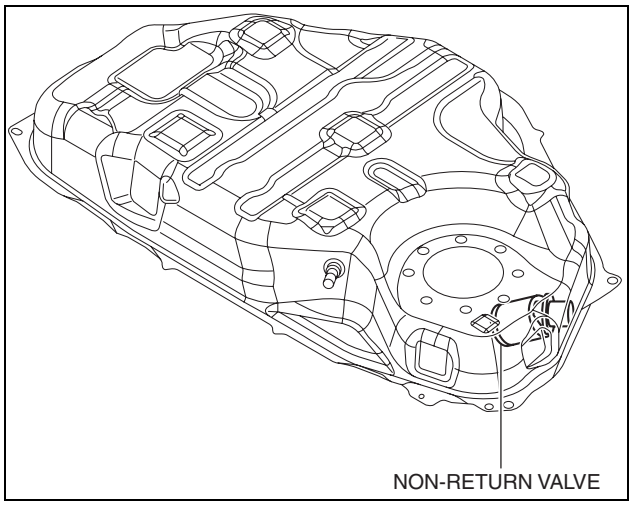
- Assures safety by preventing fuel from returning to the fuel filler opening.

Construction

- The non-return valve cannot be removed as it is installed inside the fuel tank.

FUEL SYSTEM [SKYACTIV-G 2.0]

2WD



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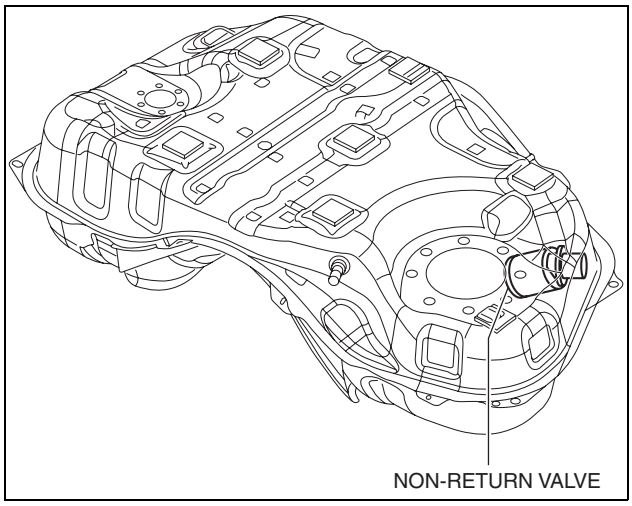
4WD



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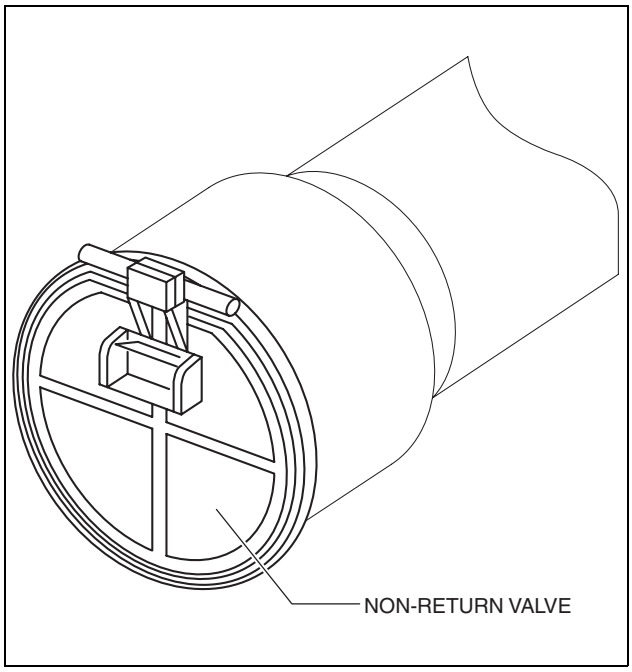
- A single valve type has been adopted for the non-return valve.



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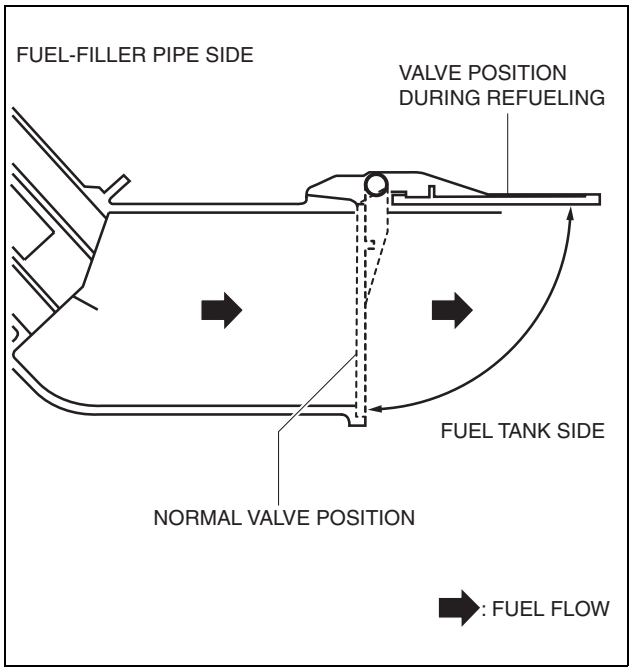
FUEL SYSTEM [SKYACTIV-G 2.0]

Operation

- Normally, the valve is closed as shown by the dotted line in the figure. When refueling, it opens as shown by the solid line due to the force caused by the flow of fuel. When refueling is finished, the valve returns to the normal valve position by spring force.



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FUEL PUMP UNIT [SKYACTIV-G 2.0]

id0114z5103600

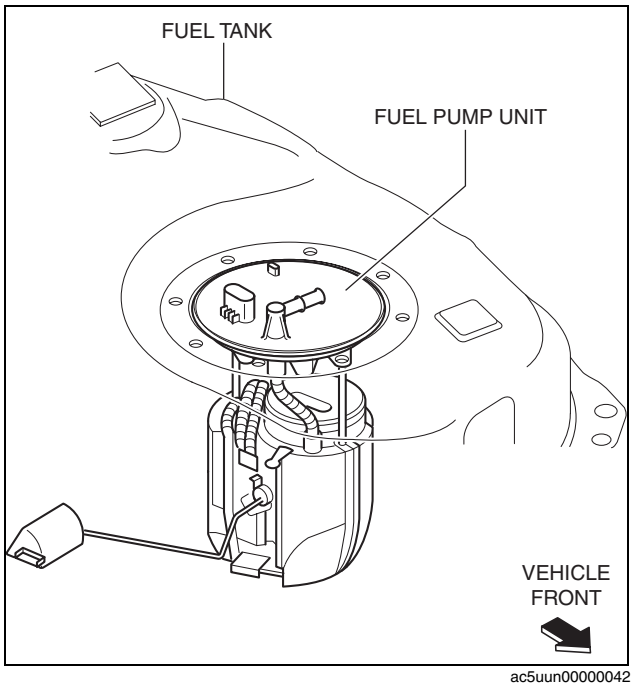
Purpose, Function

- Supplies fuel in the fuel tank to the high pressure fuel pump.
- Based on the control signal from the PCM, the fuel pump operates by the operation of the fuel pump relay and the fuel pump control module.

Construction

2WD

- The fuel pump unit is installed to the fuel tank.



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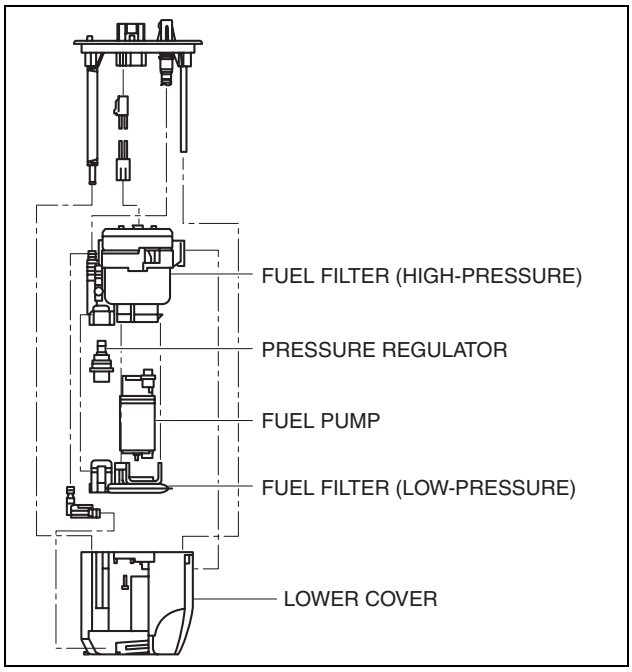
FUEL SYSTEM [SKYACTIV-G 2.0]

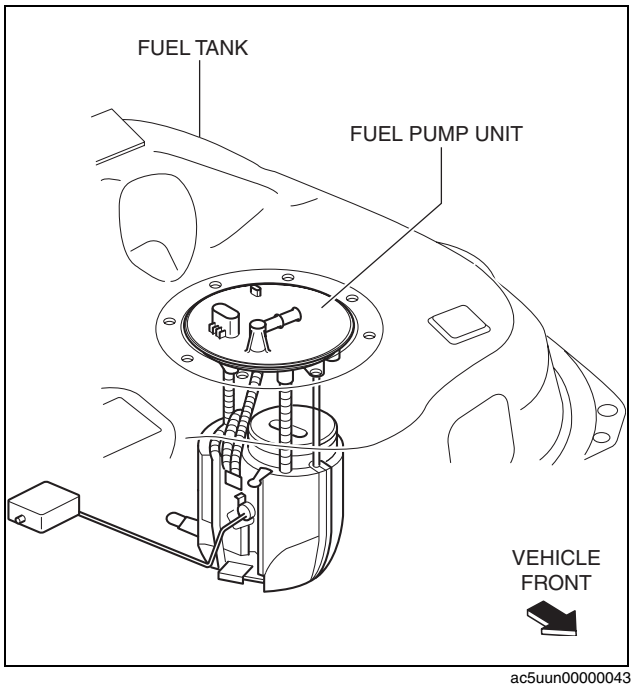
- The fuel pump unit consists of a fuel pump, fuel filter (low-pressure) fuel filter (high-pressure), pressure regulator, and lower cover.



am3uun0000243

4WD

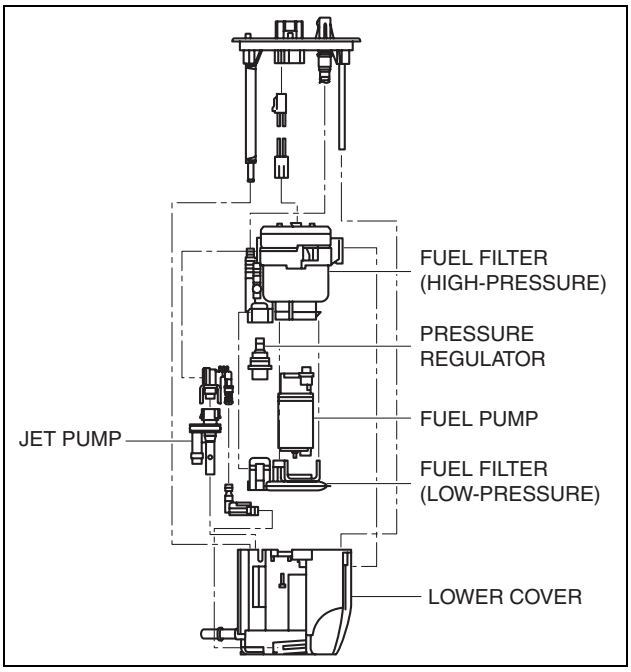
- The fuel pump unit is installed to the fuel tank.



ac5uun00000043

FUEL SYSTEM [SKYACTIV-G 2.0]

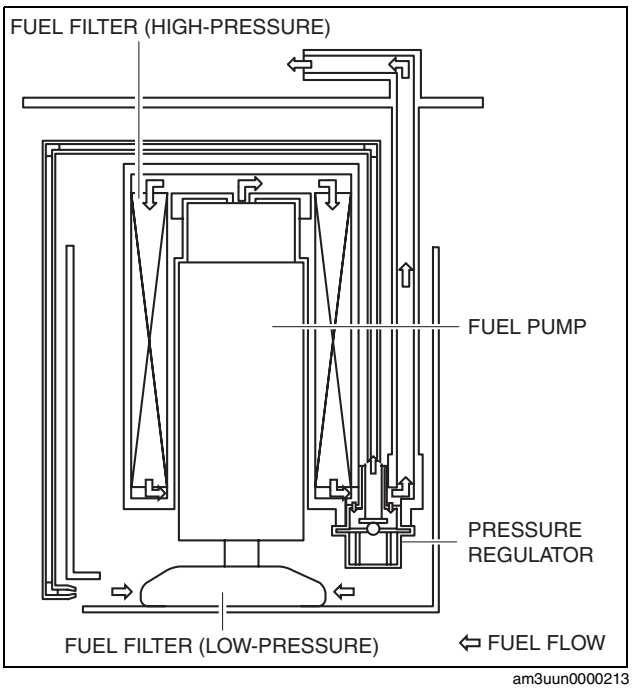
- The fuel pump unit consists of a fuel pump, fuel filter (low-pressure) fuel filter (high-pressure), pressure regulator, lower cover, and jet pump.



ac5wzn00001091

Operation
2WD

- Based on the control signal from the PCM, the fuel pump suctions fuel in the lower cover and pumps it to the high pressure fuel pump. After fuel is sufficiently filtered through the fuel filter (low-pressure) and fuel filter (high-pressure), fuel pressure is adjusted to **approx. 430 kPa {4.38 kgf/cm^2, 62.4 psi}** by the pressure regulator.

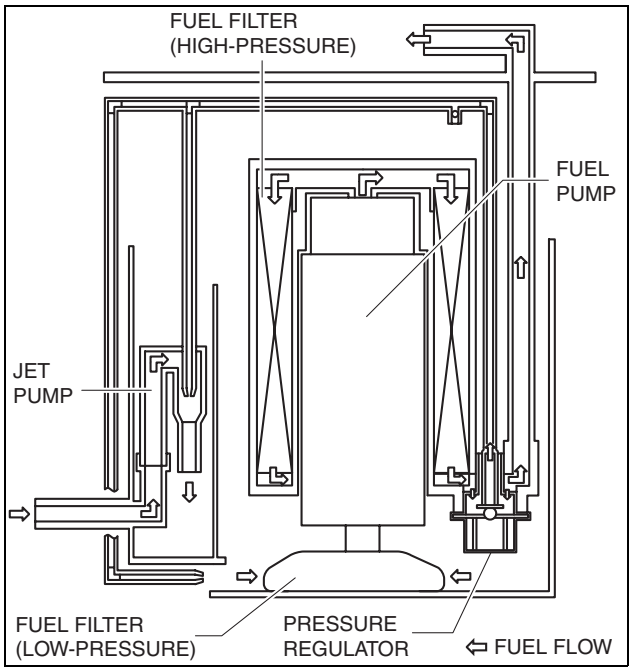


am3uun0000213

FUEL SYSTEM [SKYACTIV-G 2.0]

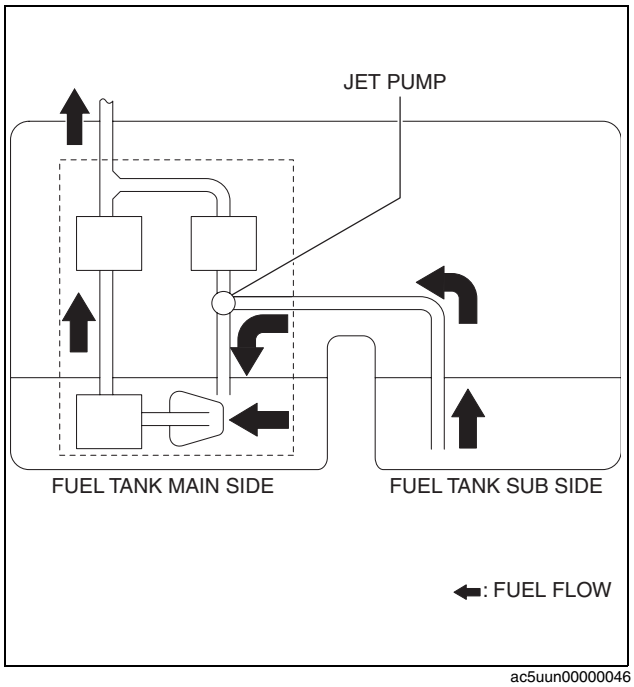
4WD

- Based on the control signal from the PCM, the fuel pump suctions fuel in the lower cover and pumps it to the high pressure fuel pump. After fuel is sufficiently filtered through the fuel filter (low-pressure) and fuel filter (high-pressure), fuel pressure is adjusted to **approx. 430 kPa {4.38 kgf/cm^2, 62.4 psi}** by the pressure regulator.



ac5uun00000045

- Positions the venturi pipe in the return path from the pressure regulator and sends fuel from the fuel tank sub side to the main side using vacuum generated in that area.
- For fuel pump control details, refer to CONTROL SYSTEM. (See 01-40-28 FUEL PUMP CONTROL [SKYACTIV-G 2.0].)



ac5uun00000046

Fail-safe

- —

FUEL DISTRIBUTOR [SKYACTIV-G 2.0]

id0114z5160000

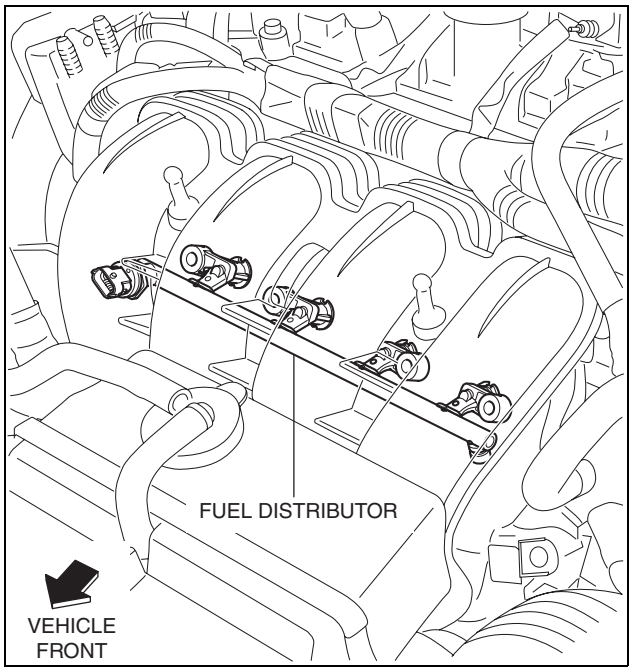
Purpose, Function

- Distributes fuel pumped from the high pressure fuel pump to each fuel injector.

FUEL SYSTEM [SKYACTIV-G 2.0]

Construction

- The fuel distributor is installed to the cylinder head.



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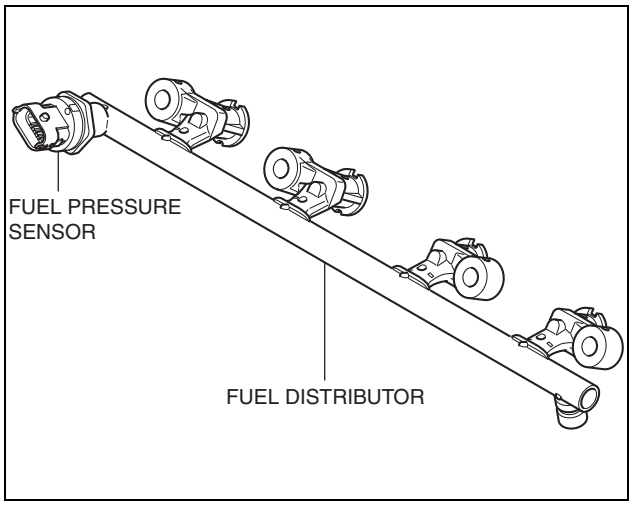
- The fuel distributor is integrated with the fuel pressure sensor.



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FUEL INJECTOR [SKYACTIV-G 2.0]

id0114z5108200

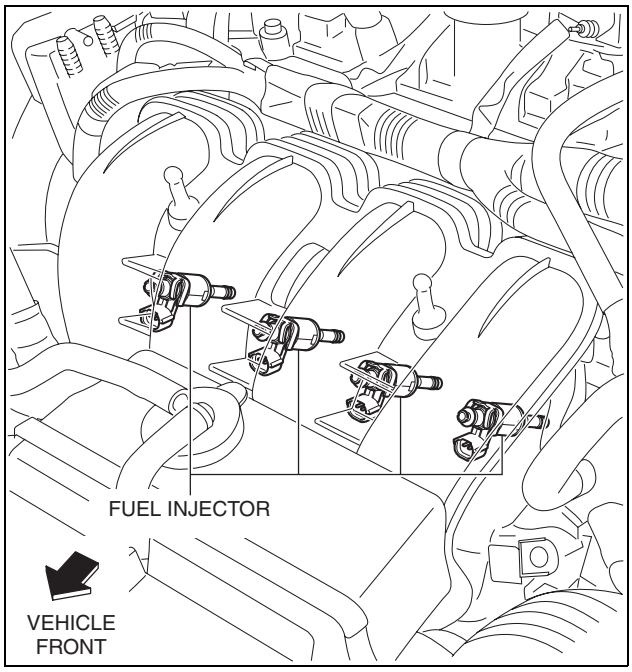
Purpose, Function

- Promotes atomization of fuel by injecting it from the multiple holes.
- Injects fuel according to the control signal from the PCM.

FUEL SYSTEM [SKYACTIV-G 2.0]

Construction

- The fuel injector is installed to the cylinder head.



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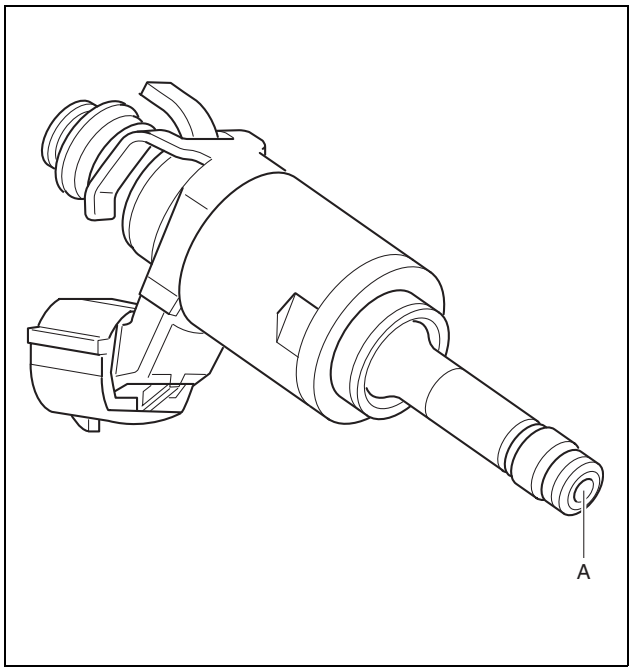
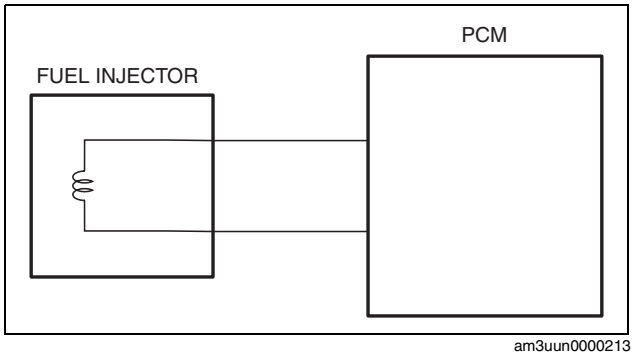
- The fuel injector has multiple injection holes in area A shown in the figure.



am3uun0000213

Operation

- Injects fuel according to the signal from the PCM. The fuel injection time is determined by the energization time of the coil.
- For fuel injection control details, refer to CONTROL SYSTEM. (See 01-40-23 FUEL INJECTION CONTROL SYSTEM [SKYACTIV-G 2.0].)



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FUEL SYSTEM [SKYACTIV-G 2.0]

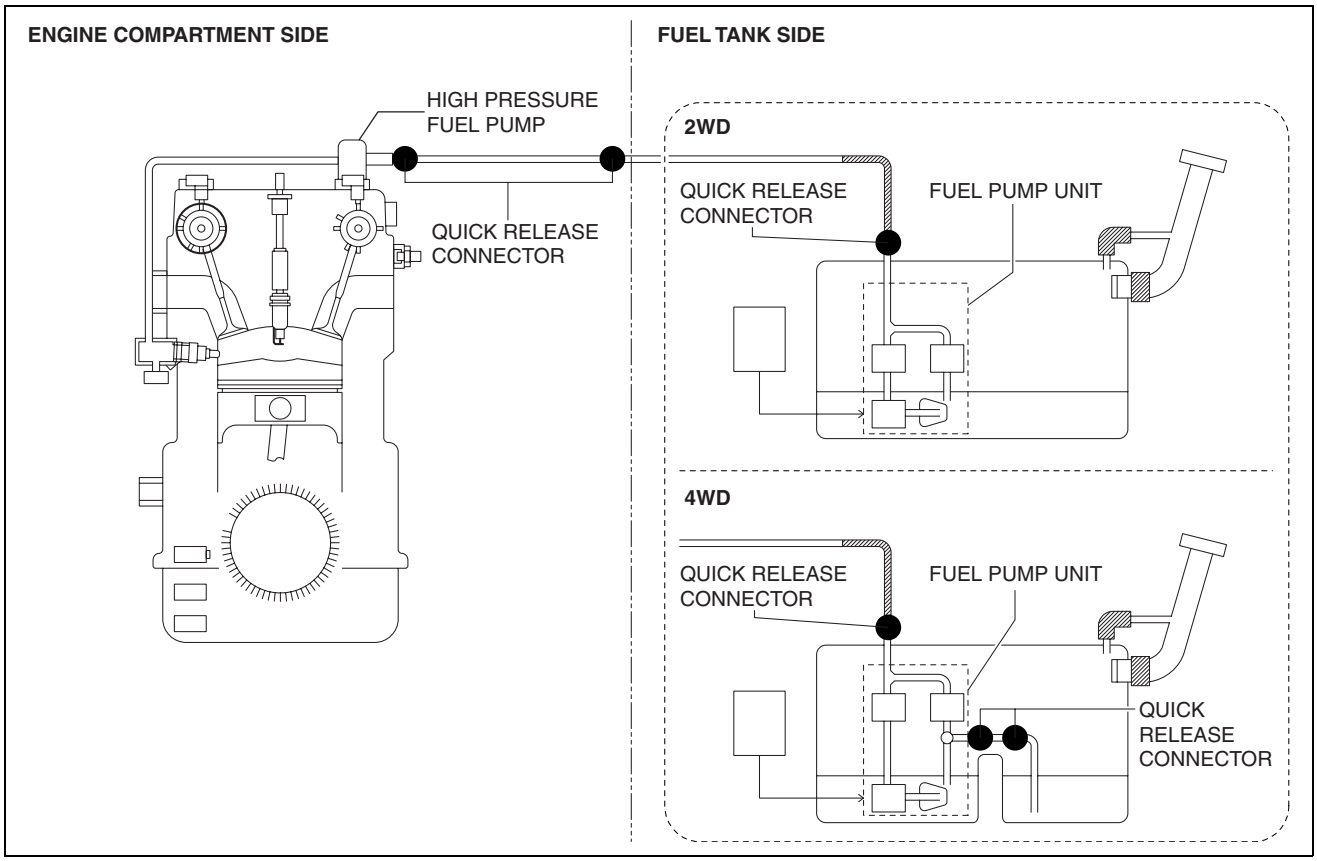
Fail-safe
- —

QUICK RELEASE (FUEL SYSTEM) CONNECTOR [SKYACTIV-G 2.0]

id0114z5003800

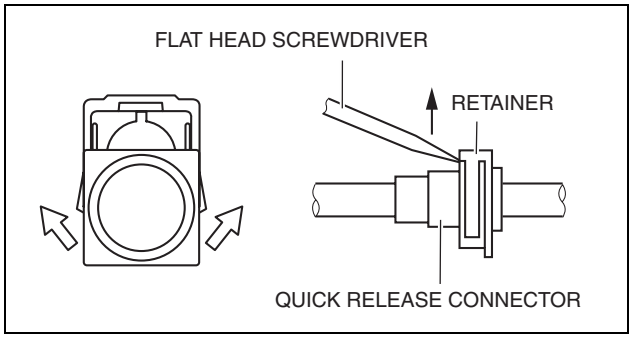
Purpose, Function
- Serviceability has been improved by the easy disconnection/connection.

Construction
- The quick connectors are in the following positions:



ac5uun00000039

- An SST is not used with this type.
- Mainly consists of a retainer and O-ring. The quick release connector is integrated with the fuel hose and therefore cannot be disassembled.
- When the quick release connector is connected, the fuel pipe projection is locked at the clamp lock point. To release the quick connector lock for each type, follow the procedure in the order shown in each figure.



am3uun0000212

FUEL PUMP RELAY [SKYACTIV-G 2.0]

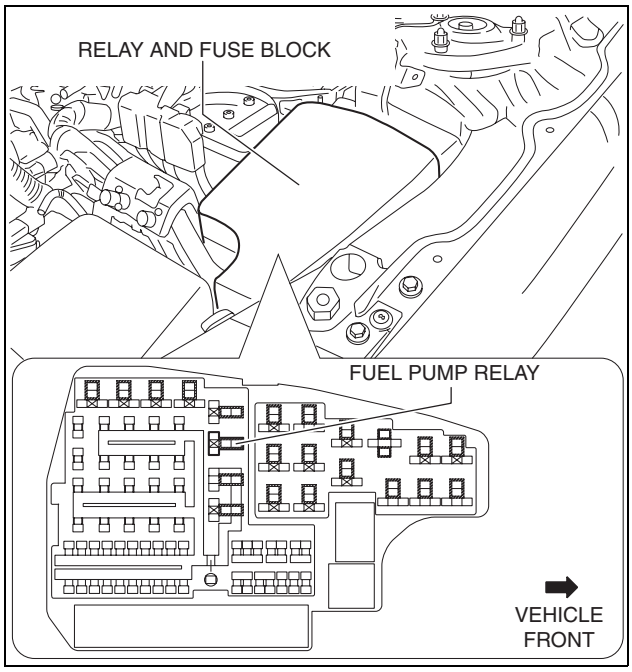
id0114z5129100

Purpose, Function
- Controls the fuel pump on/off according to control signals from the PCM.
- The fuel pump is operated only at engine start or when the engine is running to improve safety.

FUEL SYSTEM [SKYACTIV-G 2.0]

Construction

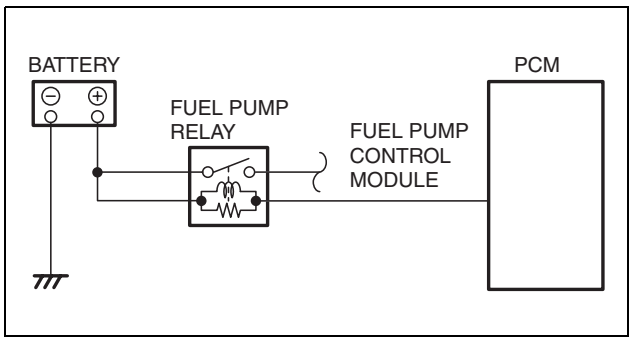
- The fuel pump relay is installed in the relay and fuse block.



ac5uun00000055

Operation

- The contact point is on when the battery voltage is supplied to the coil based on the signal from the PCM, and the battery voltage is supplied to the fuel pump control module.



am3uun0000214

Fail-safe

- —

FUEL INJECTOR RELAY [SKYACTIV-G 2.0]

id0114z5135000

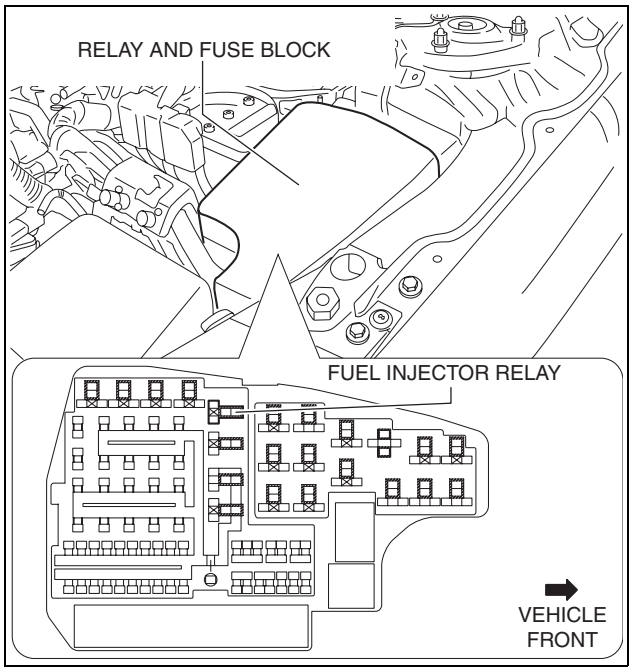
Purpose, Function

- Supplies power to the PCM for the fuel injector and spill valve control solenoid valve operation.

FUEL SYSTEM [SKYACTIV-G 2.0]

Construction

- The fuel injector relay is installed in the relay and fuse block.



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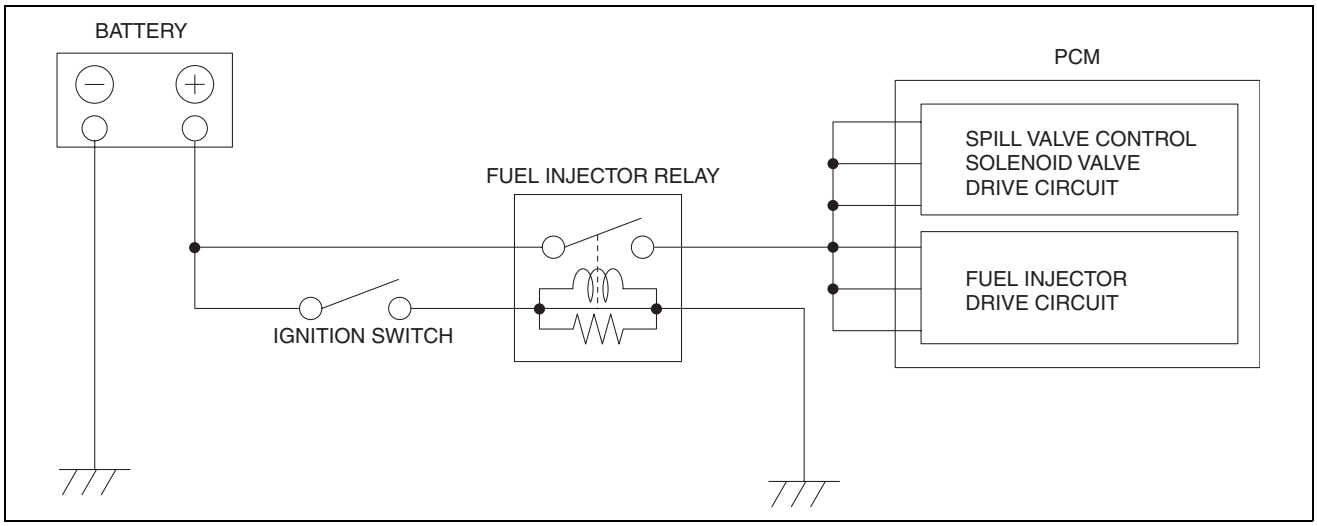
Operation

- When the ignition is switched ON, the battery voltage is supplied to the coil and the contact point is on, thus the battery voltage is supplied to the PCM.



am3uun0000239

Fail-safe

- —

DIRECT FUEL INJECTION SYSTEM [SKYACTIV-G 2.0]

id0114z5005400

Purpose, Outline

- Engine output has been improved through the direct injection of fuel into the combustion chamber.
- High response can be because there is no time lag from when the fuel injection starts until the fuel is provided to the combustion chamber.

Structure

- The direct fuel injection system consists of the following parts.

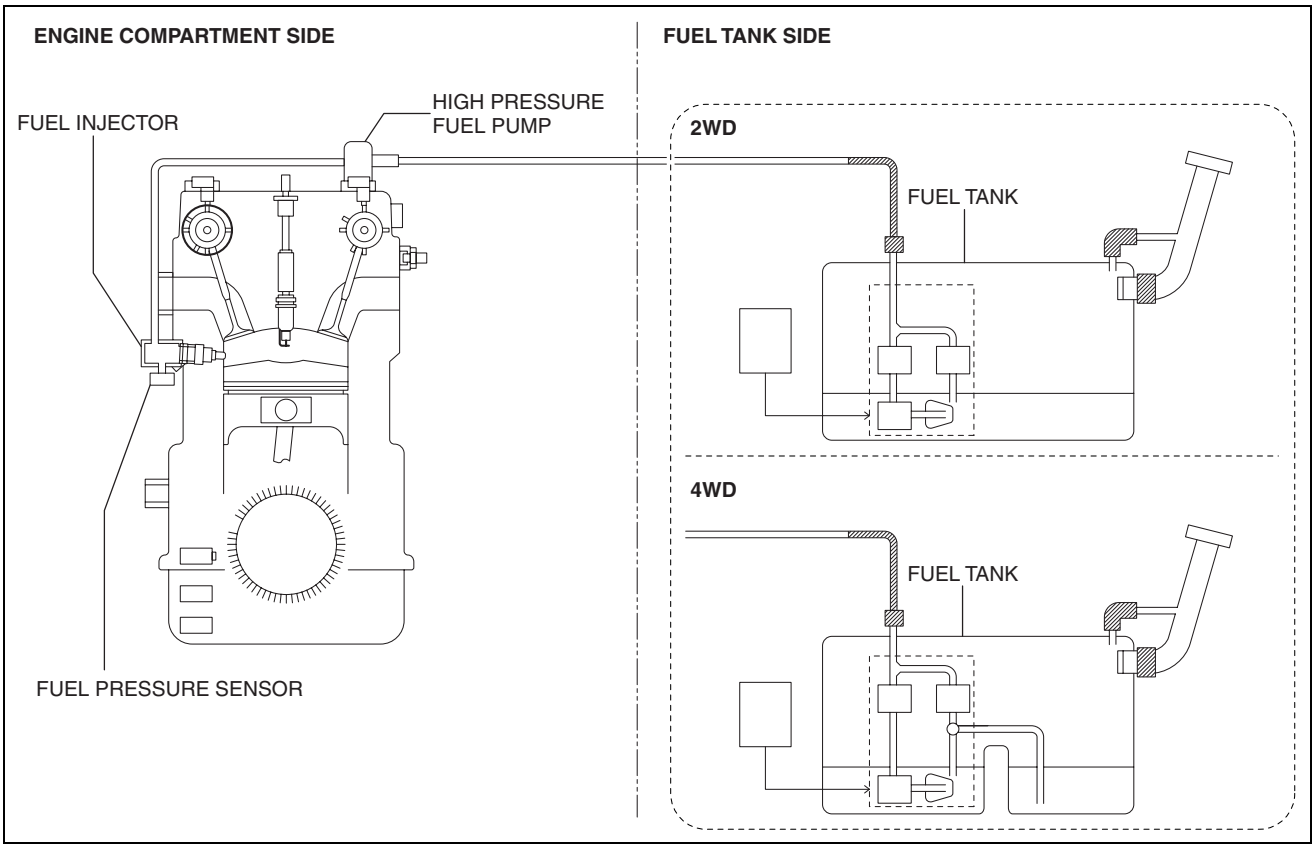
Part name	Reference
High pressure fuel pump	(See 01-14A-21 HIGH PRESSURE FUEL PUMP [SKYACTIV-G 2.0].)
Fuel injector	(See 01-14A-16 FUEL INJECTOR [SKYACTIV-G 2.0].)

FUEL SYSTEM [SKYACTIV-G 2.0]

Part name	Reference
Fuel distributor	(See 01-14A-15 FUEL DISTRIBUTOR [SKYACTIV-G 2.0].)
Fuel pressure sensor	(See 01-40-89 FUEL PRESSURE SENSOR [SKYACTIV-G 2.0].)
Relief valve	—

Operation

- Fuel is supplied from the high pressure fuel pump into the fuel distributor, and the fuel injector injects the fuel into the cylinder. Fuel is injected during the intake stroke and diffused uniformly in the combustion chamber by the flow of intake air. For the fuel injection control, refer to the CONTROL SYSTEM. (See 01-40-23 FUEL INJECTION CONTROL SYSTEM [SKYACTIV-G 2.0].)
- The fuel pressure sensor detects the fuel pressure in the fuel distributor and sends a fuel pressure signal to the PCM. Based on the signal from the fuel pressure sensor, the PCM controls the high pressure fuel pump so that the fuel pressure is in accordance with the driving conditions. For the high pressure fuel pump control, refer to CONTROL SYSTEM. (See 01-40-23 FUEL INJECTION CONTROL SYSTEM [SKYACTIV-G 2.0].)
- Fuel pressure is adjusted by the spill valve control solenoid valve, and a relief valve is equipped to ensure safety in case of a malfunction. If the fuel pressure in the high pressure fuel pump reaches the set pressure, the relief valve is mechanically opened and fuel is returned to the fuel tank side.



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HIGH PRESSURE FUEL PUMP [SKYACTIV-G 2.0]

id0114z5731400

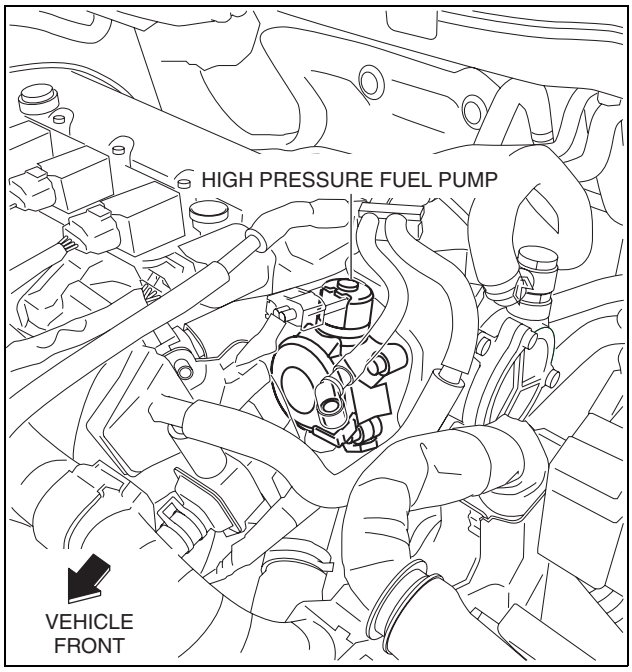
Purpose, Function

- Applies pressure to fuel sent from the fuel pump equipped on the fuel tank, and then pumps it to the fuel delivery pipe.
- Fuel is sectioned and pumped by the up and down movement of the piston caused by the rotation of the cam installed to the rear end of the exhaust camshaft.

FUEL SYSTEM [SKYACTIV-G 2.0]

Construction

- The high pressure fuel pump is installed to the exhaust camshaft with the vacuum pump.
- The high pressure fuel pump consists of a spill valve control solenoid valve, spill valve, piston, and spring.



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Operation

- Based on the control signal from the PCM, the spill valve solenoid valve opens and closes in the high pressure fuel pump.
- For the high pressure fuel pump control details, refer to CONTROL SYSTEM. (See 01-40-29 HIGH PRESSURE FUEL PUMP CONTROL [SKYACTIV-G 2.0].)

Fail-safe

DTC	Fail-safe
P0089:00	• Limits the intake air amount. • Stops the high pressure fuel pump control. • The upper limit of the engine speed is 2,500 rpm.
P0091:00	• Limits the intake air amount. • Stops the high pressure fuel pump control.
P0092:00	• Limits the intake air amount. • Stops the high pressure fuel pump control.

FUEL PUMP CONTROL MODULE [SKYACTIV-G 2.0]

id0114z5003900

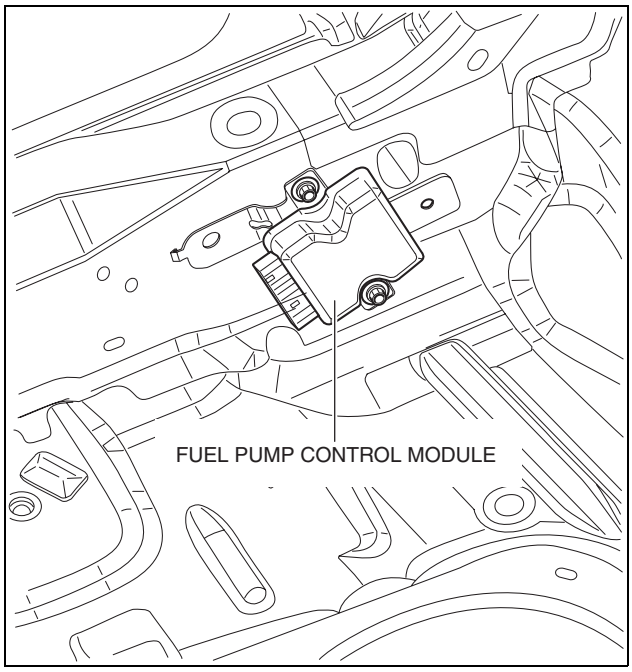
Purpose, Function

- Controls the voltage applied to the fuel pump for reducing fuel pump load and improving fuel economy.
- Controls the voltage applied to the fuel pump based on the control signal from the PCM.

FUEL SYSTEM [SKYACTIV-G 2.0]

Construction

- The fuel pump control module is installed below the rear seat.



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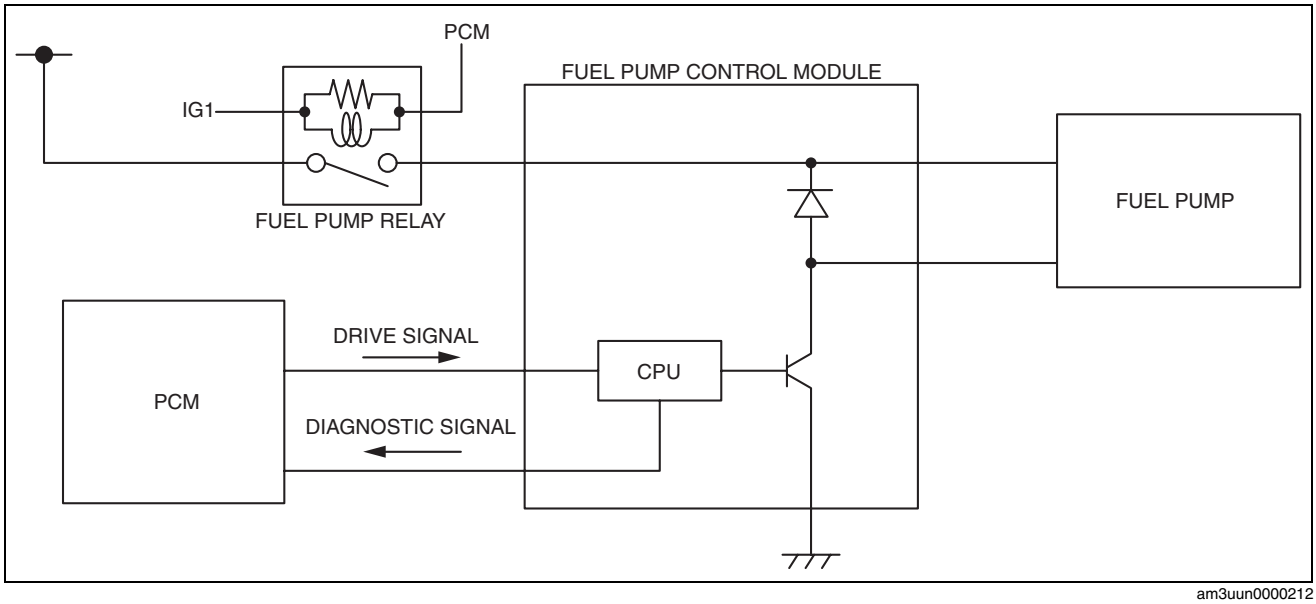
Operation

- Controls the voltage applied to the fuel pump based on the control signal from the PCM. In addition, the on-board diagnostic function is equipped and if there is a malfunction in the fuel pump control module, a diagnostic signal is sent to the PCM. The PCM stores a DTC if necessary according to the received diagnostic signal.



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- For the fuel pump control module, refer to CONTROL SYSTEM. (See 01-40-28 FUEL PUMP CONTROL [SKYACTIV-G 2.0].)

Fail-safe

P025B:00	• Stops the fuel pump control (when overheating is detected).
P0629:00	• Stops the fuel pump control.

01-14B FUEL SYSTEM [SKYACTIV-D 2.2]

FUEL SYSTEM [SKYACTIV-D 2.2]

FUEL SYSTEM [SKYACTIV-D 2.2]

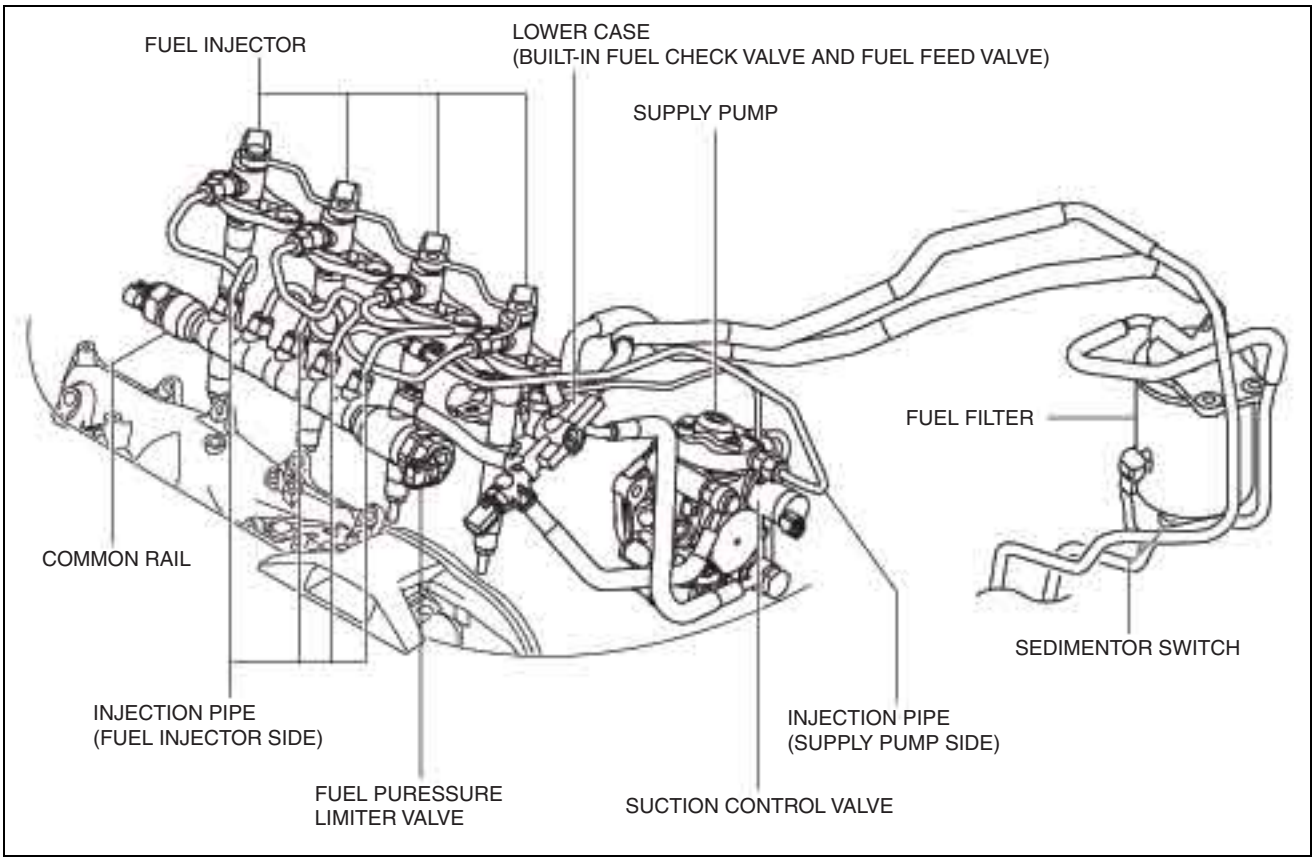
id0114z7002600

Outline

- Fast-response, Piezo-electric type fuel injectors have been adopted which achieve highly precise fuel injection control.

FUEL SYSTEM [SKYACTIV-D 2.2]

Structural view
Engine compartment side
R.H.D.



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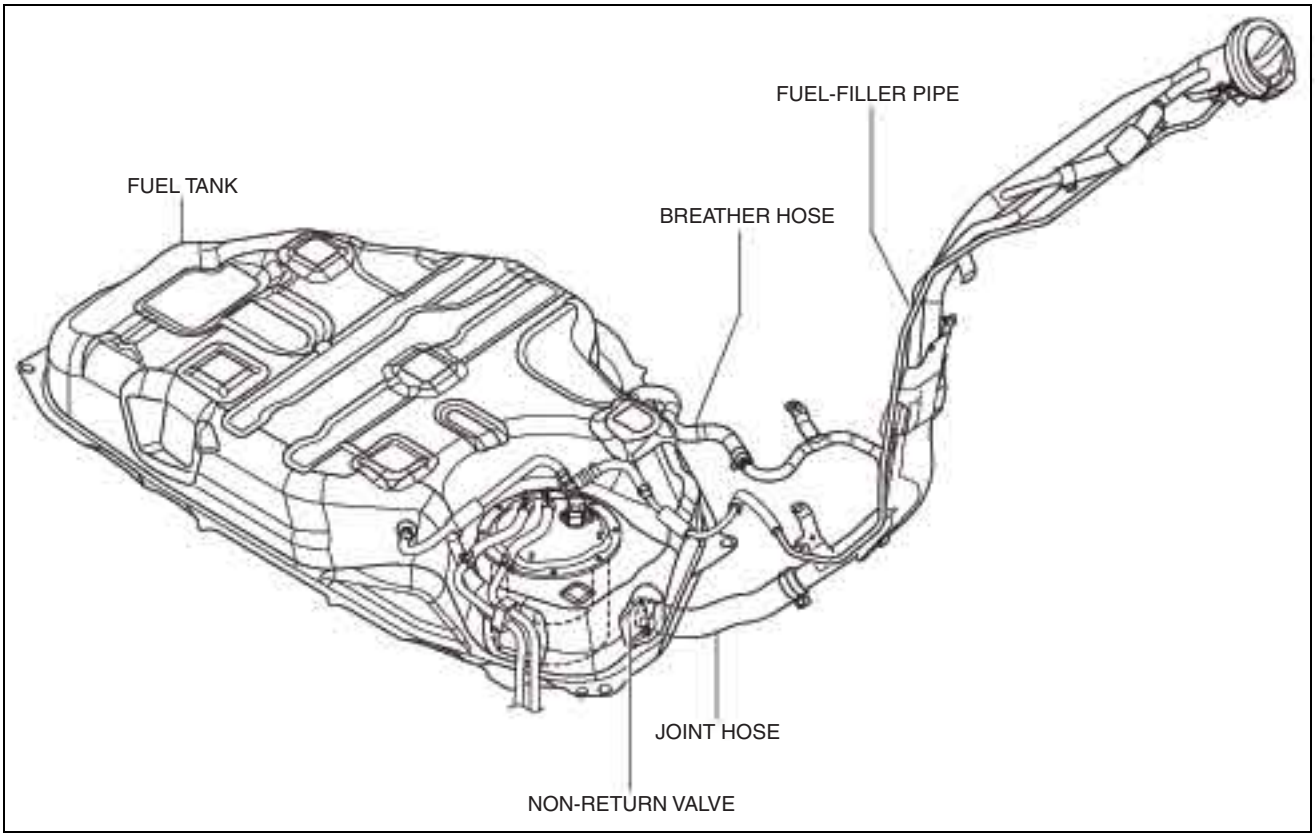
Fuel tank side
2WD



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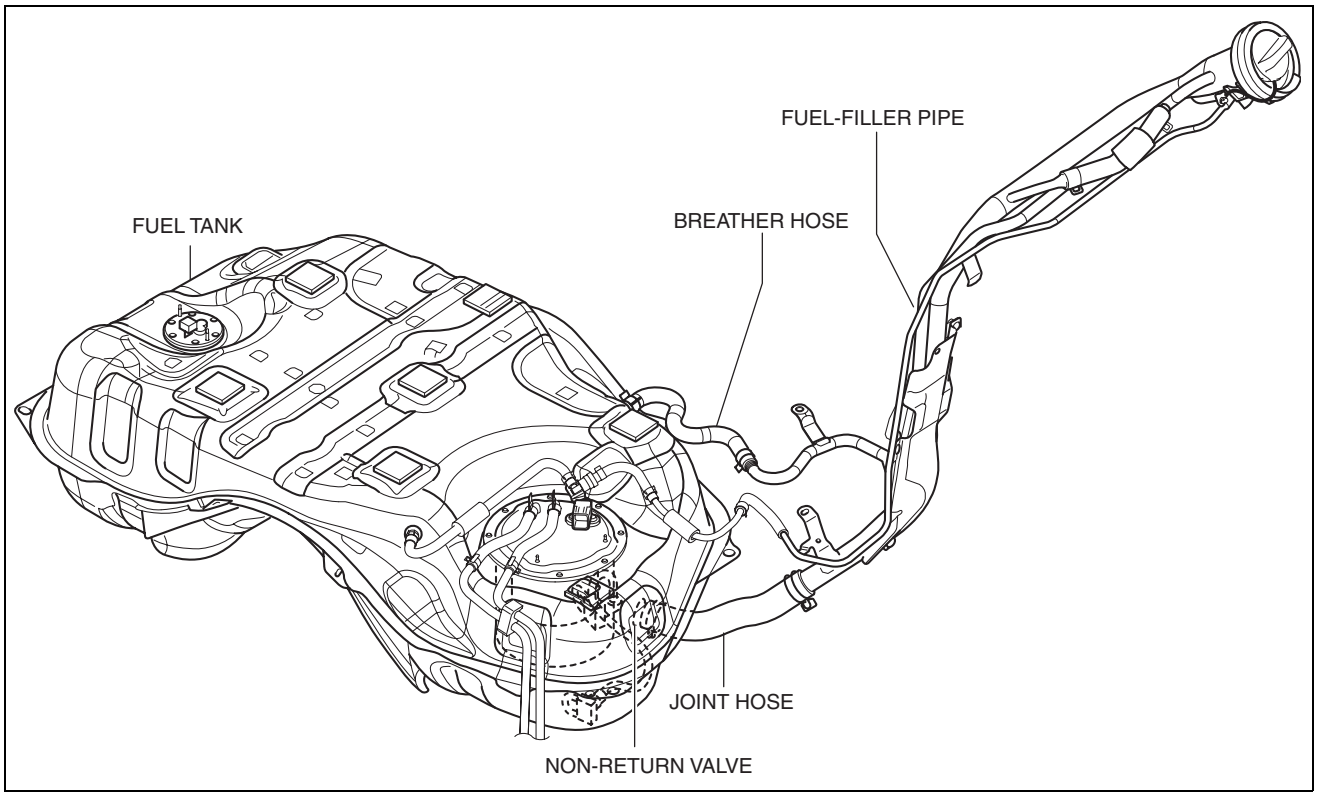
FUEL SYSTEM [SKYACTIV-D 2.2]

4WD



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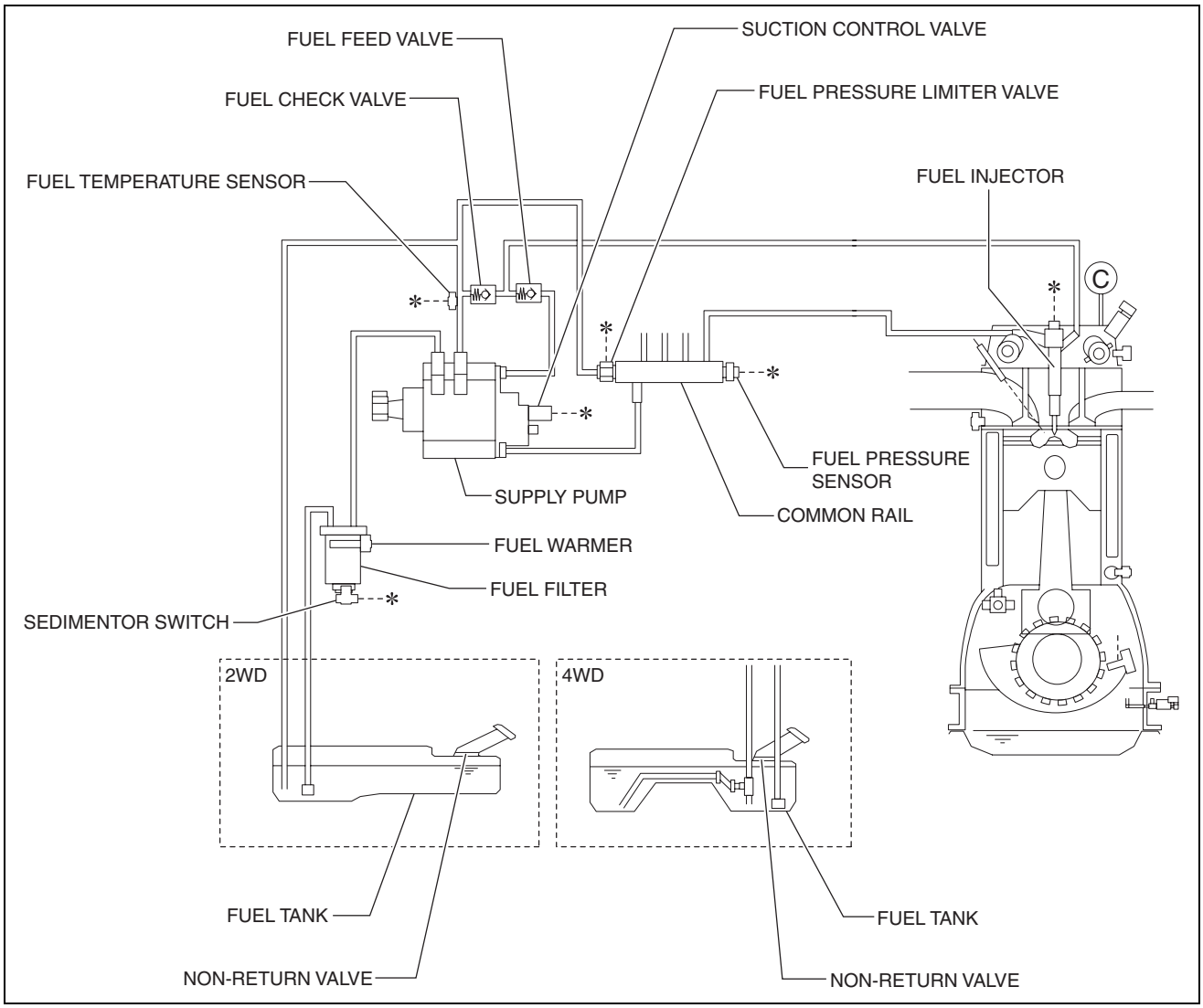
FUEL SYSTEM [SKYACTIV-D 2.2]

System diagram



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Structure

- The fuel system consists of the following parts:

Part/System name		Reference
Common rail injection system (See 01-14B-6 COMMON RAIL INJECTION SYSTEM [SKYACTIV-D 2.2].)	Fuel tank	(See 01-14B-7 FUEL TANK [SKYACTIV-D 2.2].)
	Fuel filter	(See 01-14B-10 FUEL FILTER [SKYACTIV-D 2.2].)
	Fuel warmer	(See 01-14B-23 FUEL WARMER [SKYACTIV-D 2.2].)
	Supply pump	(See 01-14B-15 SUPPLY PUMP [SKYACTIV-D 2.2].)
	Suction control valve	(See 01-14B-15 SUCTION CONTROL VALVE [SKYACTIV-D 2.2].)
	Fuel check valve	(See 01-14B-17 FUEL CHECK VALVE [SKYACTIV-D 2.2].)
	Fuel feed valve	(See 01-14B-19 FUEL FEED VALVE [SKYACTIV-D 2.2].)
	Common rail	(See 01-14B-12 COMMON RAIL [SKYACTIV-D 2.2].)
	Fuel pressure limiter valve	(See 01-14B-20 FUEL PRESSURE LIMITER VALVE [SKYACTIV-D 2.2].)
	Fuel injector	(See 01-14B-13 FUEL INJECTOR [SKYACTIV-D 2.2].)
	Fuel pressure sensor	
	Fuel temperature sensor	

FUEL SYSTEM [SKYACTIV-D 2.2]

Part/System name	Reference
Non-return valve	(See 01-14B-9 NON-RETURN VALVE [SKYACTIV-D 2.2].)
Sedimentor switch	(See 01-14B-22 SEDIMENTOR SWITCH [SKYACTIV-D 2.2].)

Specification

Item			Specification
Supply pump			Electric control
Fuel injector			Piezo-electric
Fuel tank capacity	(L {US gal, Imp gal})	2WD	56.0 {14.8, 12.3}
		4WD	58.0 {15.3, 12.8}
Fuel pump type			EN590 or the equivalent

COMMON RAIL INJECTION SYSTEM [SKYACTIV-D 2.2]

id0114z7706900

Purpose, Outline

- The common rail fuel injection system stores fuel pressurized by the supply pump in the common rail and injects the fuel into each cylinder using the fuel injectors based on the control by the PCM.
- Fuel is atomized by the extremely high fuel injection pressure, and the generation of particulate matter is reduced by the dissipation of unburnt fuel.
- There is a high degree of flexibility in the fuel injection amount, fuel injection timing and fuel injection pattern, and NOx/PM is reduced by controlling the fuel conditions according to the conditions.

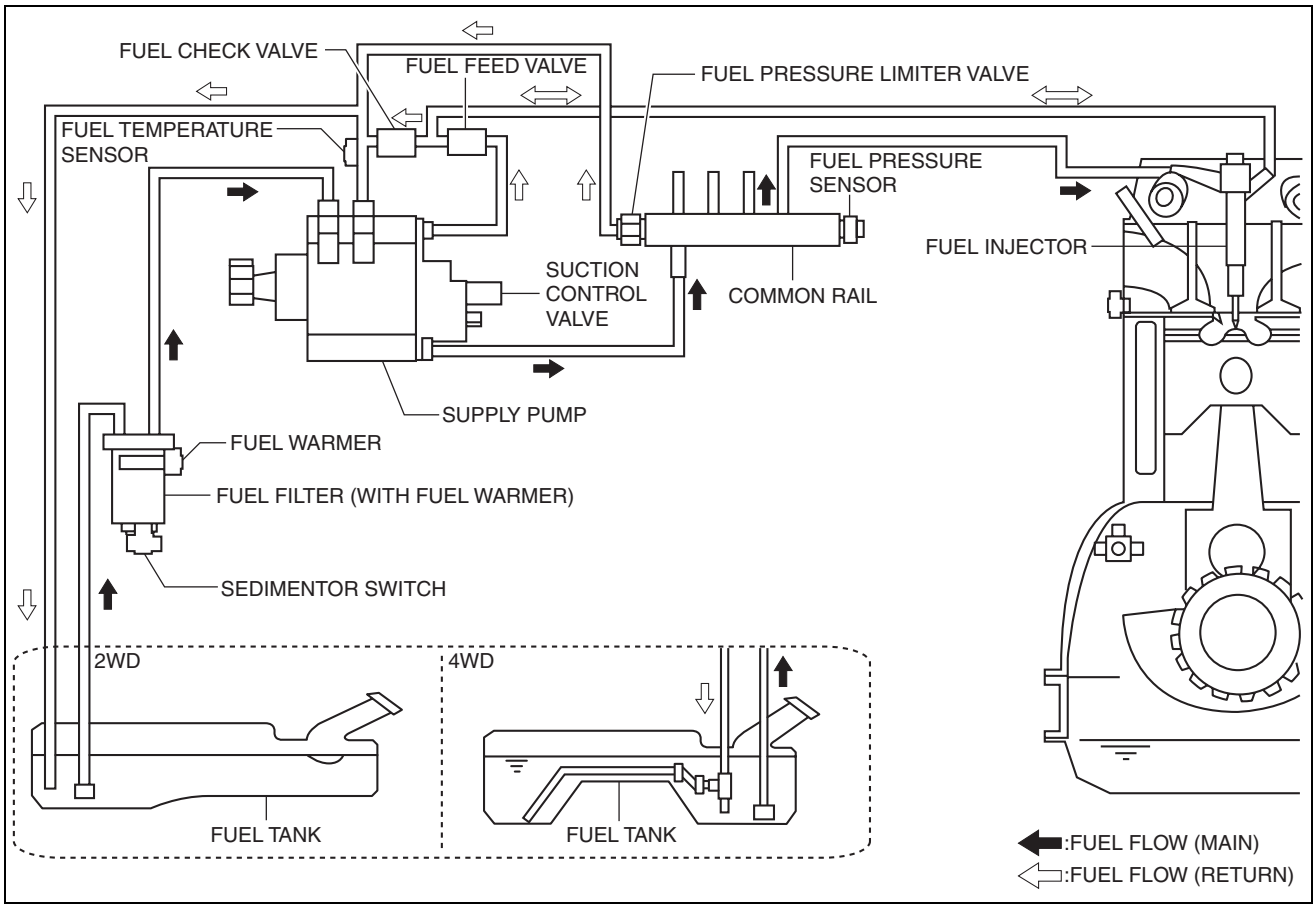
Structure

- The common rail fuel injection system consists of the following parts.

Part name	Reference
Fuel tank	(See 01-14B-7 FUEL TANK [SKYACTIV-D 2.2].)
Fuel filter	(See 01-14B-10 FUEL FILTER [SKYACTIV-D 2.2].)
Fuel warmer	(See 01-14B-23 FUEL WARMER [SKYACTIV-D 2.2].)
Supply pump	(See 01-14B-15 SUPPLY PUMP [SKYACTIV-D 2.2].)
Suction control valve	(See 01-14B-15 SUCTION CONTROL VALVE [SKYACTIV-D 2.2].)
Fuel check valve	(See 01-14B-17 FUEL CHECK VALVE [SKYACTIV-D 2.2].)
Fuel feed valve	(See 01-14B-19 FUEL FEED VALVE [SKYACTIV-D 2.2].)
Common rail	(See 01-14B-12 COMMON RAIL [SKYACTIV-D 2.2].)
Fuel pressure limiter valve	(See 01-14B-20 FUEL PRESSURE LIMITER VALVE [SKYACTIV-D 2.2].)
Fuel injector	(See 01-14B-13 FUEL INJECTOR [SKYACTIV-D 2.2].)
Fuel pressure sensor	
Fuel temperature sensor	

FUEL SYSTEM [SKYACTIV-D 2.2]

Fuel flow



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FUEL TANK [SKYACTIV-D 2.2]

id0114z7104100

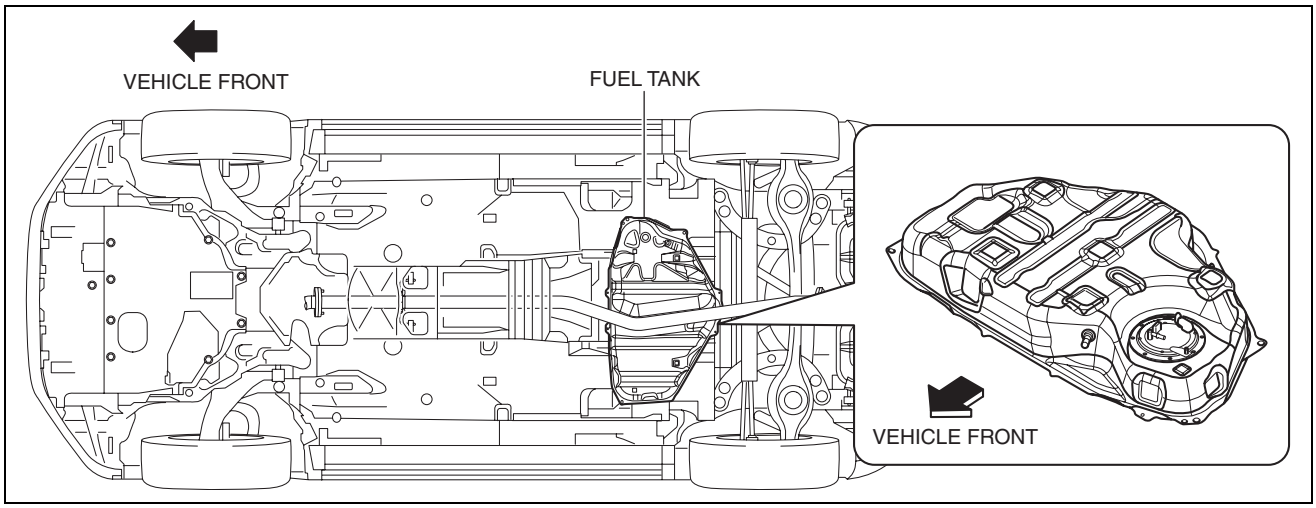
Purpose, Function

- Made of steel for weight reduction.

Construction

- The fuel tank is installed below the rear seat.

2WD



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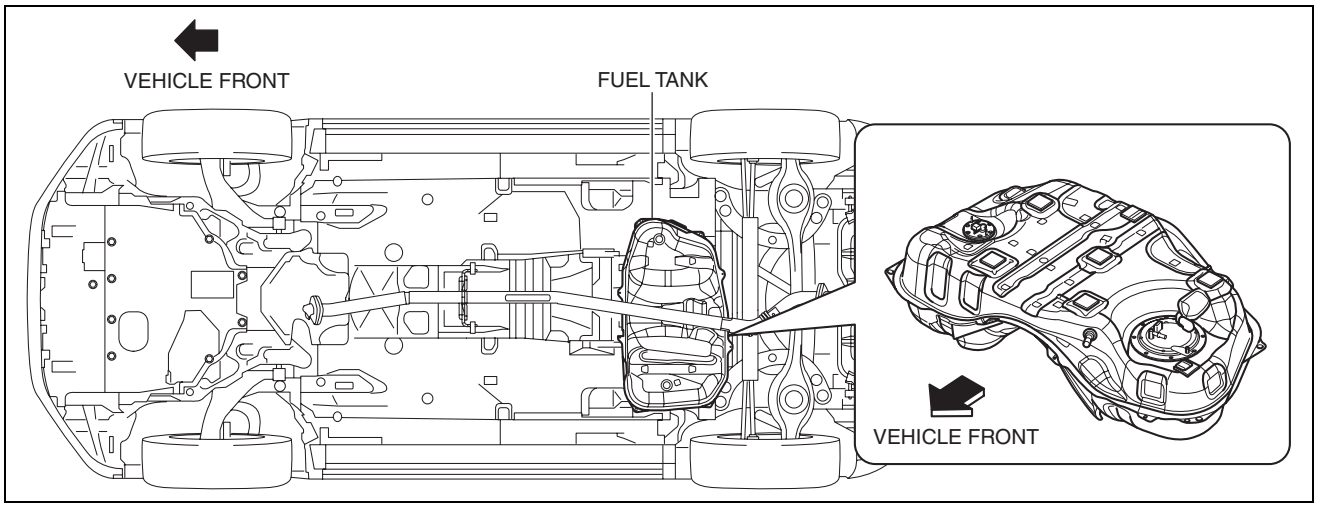
FUEL SYSTEM [SKYACTIV-D 2.2]

4WD



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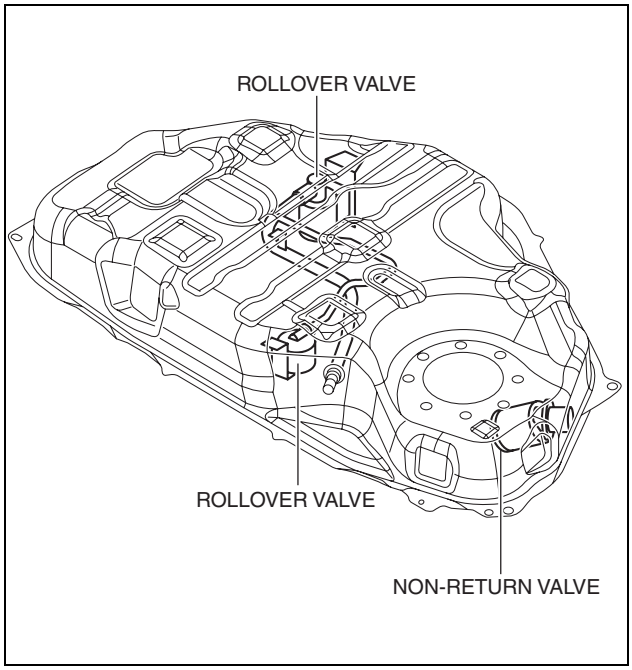
- The fuel tank is made of steel.
- The following parts are integrated in the fuel tank.
  - — Non-return valve
    (See 01-14B-9 NON-RETURN VALVE [SKYACTIV-D 2.2].)
  - — Rollover valve
    (See 01-16B-13 ROLLOVER VALVE [SKYACTIV-D 2.2].)

2WD



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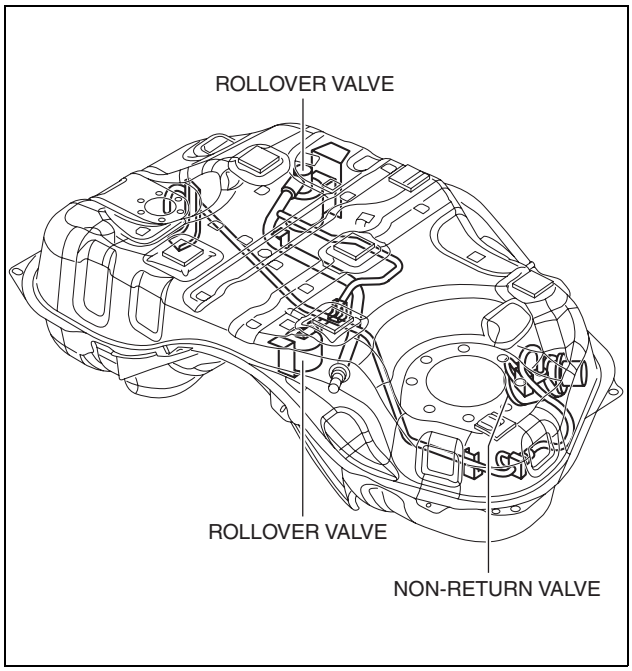
FUEL SYSTEM [SKYACTIV-D 2.2]

4WD



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NON-RETURN VALVE [SKYACTIV-D 2.2]

id0114z7188800

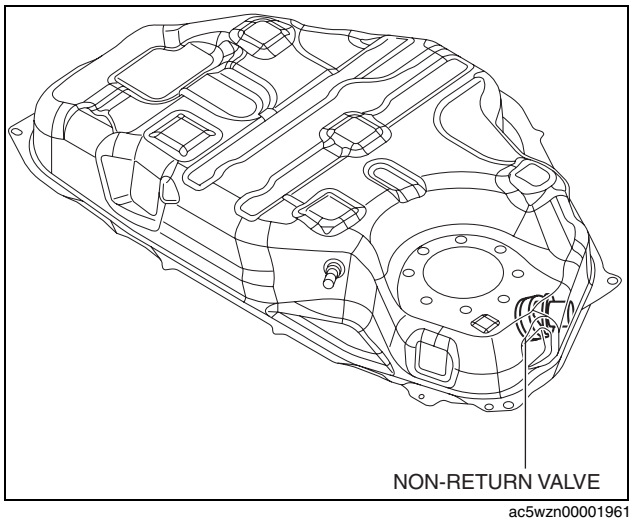
Purpose, Function

- Assures safety by preventing fuel from returning to the fuel filler opening.

Construction

- The non-return valve cannot be removed as it is installed inside the fuel tank.

2WD



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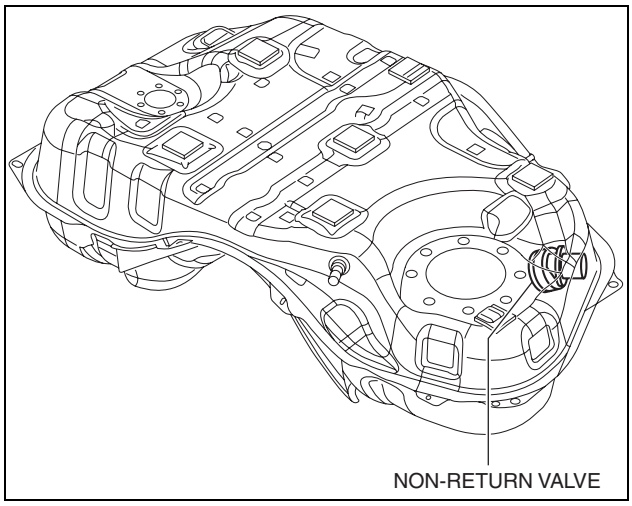
FUEL SYSTEM [SKYACTIV-D 2.2]

4WD

- A single valve type has been adopted for the non-return valve.



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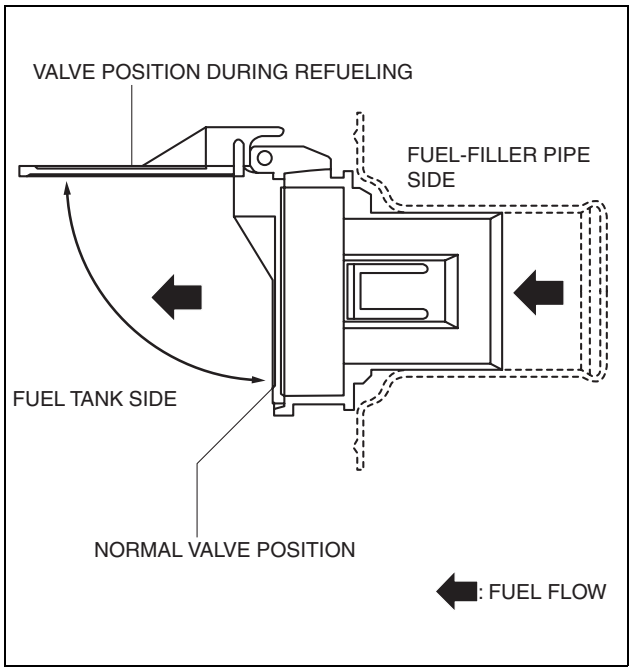
Operation

- Normally, the valve is closed as shown by the dotted line in the figure. When refueling, it opens as shown by the solid line due to the force caused by the flow of fuel. When refueling is finished, the valve returns to the normal valve position by spring force.



ac5wzn00001963

FUEL FILTER [SKYACTIV-D 2.2]

id0114z7707000

Purpose, Function

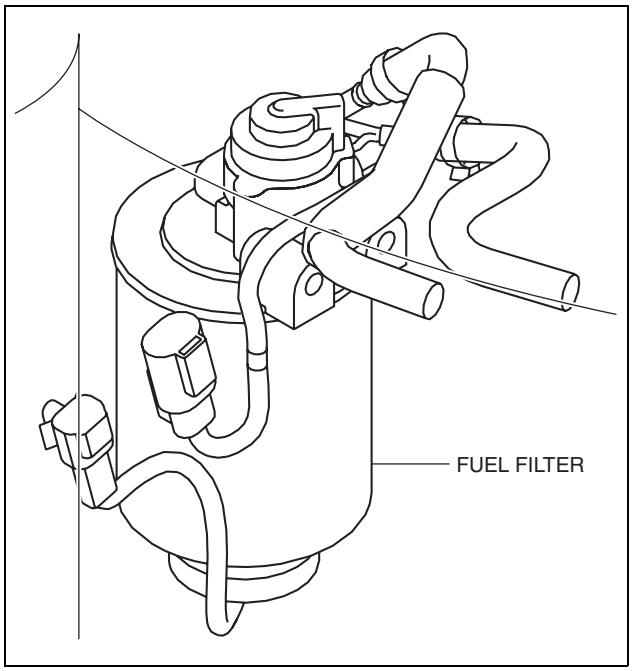
- Remove the alien substance and garbage of fuel.

Construction

- The fuel filter is installed in the engine compartment.

FUEL SYSTEM [SKYACTIV-D 2.2]

L.H.D.



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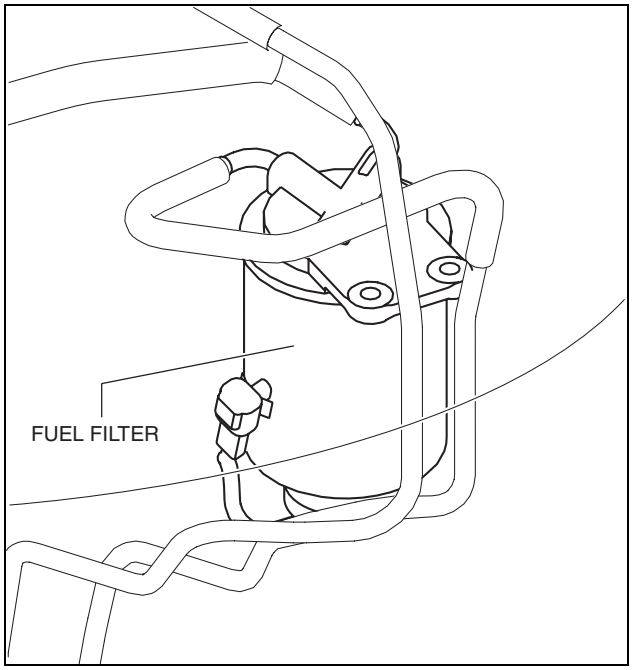
R.H.D.

- Fuel filter is consists of a fuel warmer (with fuel warmer) and sedimentor switch.



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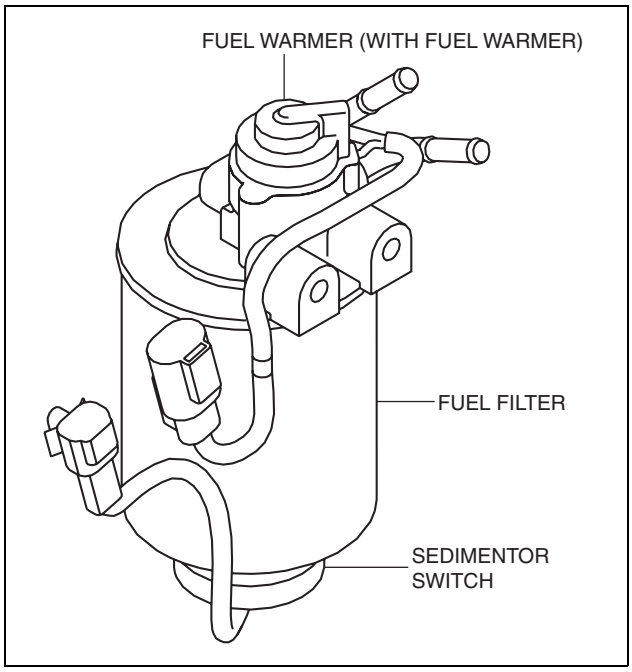
FUEL SYSTEM [SKYACTIV-D 2.2]

L.H.D.



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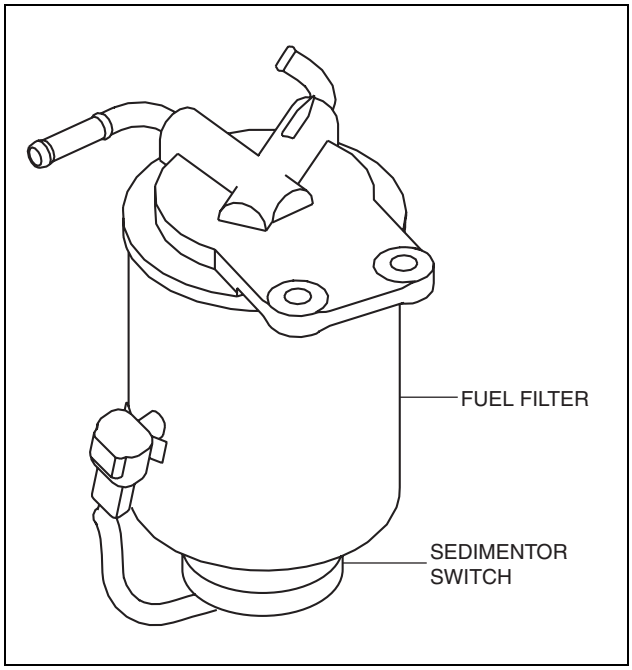
R.H.D.



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COMMON RAIL [SKYACTIV-D 2.2]

id0114z7707300

Purpose, Function

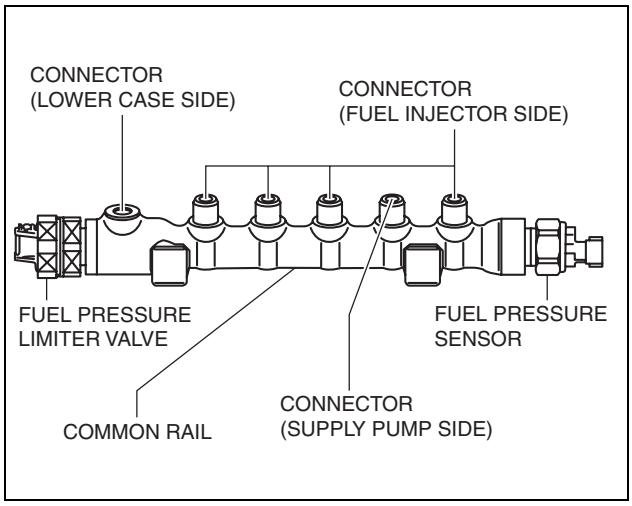
- Stores high pressure fuel from the supply pump and distributes it to the fuel injectors.

Construction

- The common rail is installed to the engine compartment.

FUEL SYSTEM [SKYACTIV-D 2.2]

- The common rail has an integrated fuel pressure limiter valve and fuel pressure sensor.



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Fuel pressure limiter valve
- If the pressure in the common rail exceeds a certain value, fuel is discharged.

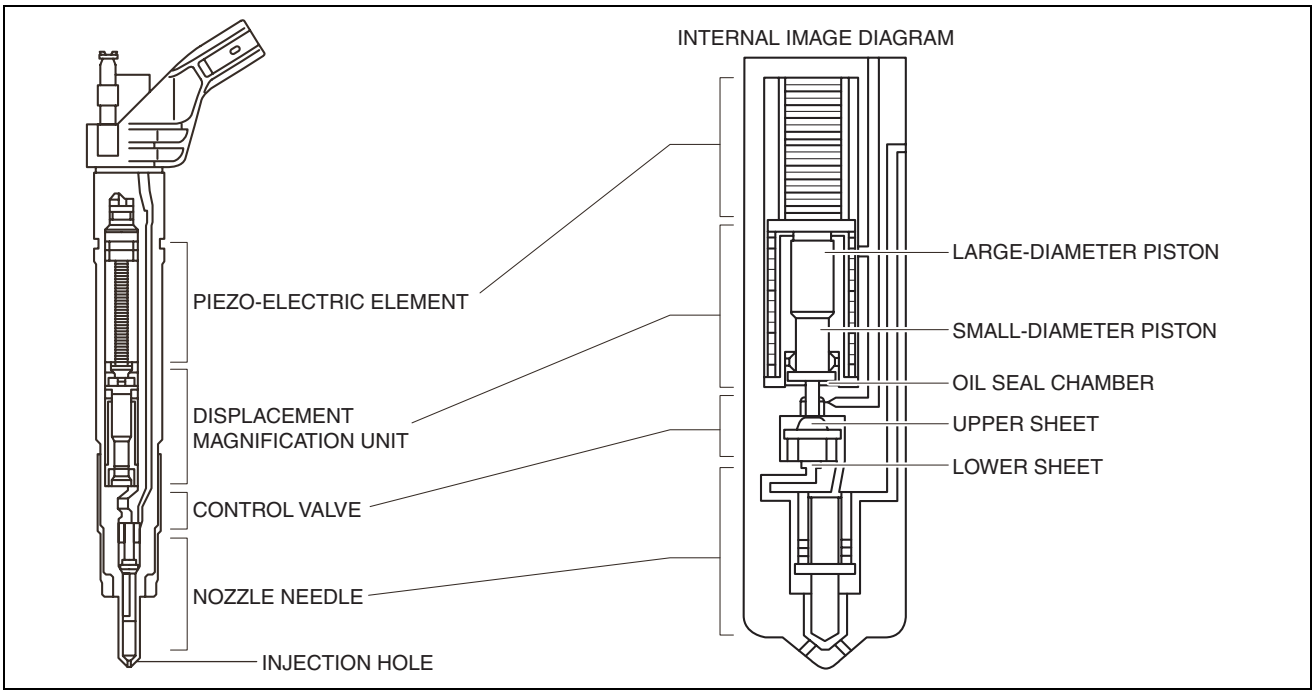
Fuel pressure sensor
- Detects the fuel pressure in the common rail.

FUEL INJECTOR [SKYACTIV-D 2.2]

id0114z7108200

Purpose, Function
- Fast-response, Piezo-electric type fuel injectors have been adopted which achieve highly precise fuel injection control.
- The fuel injection patterns are varied and the concentration of air-fuel mix can be increased according to the conditions because the fuel amount and timing can be precisely controlled.

Construction
- The fuel injectors are installed to the engine compartment.
- The fuel injectors consist of a Piezo-electric element, a displacement magnification unit, control valve, and nozzle needle. In addition, there are a number of injection holes on the tip of the injector.



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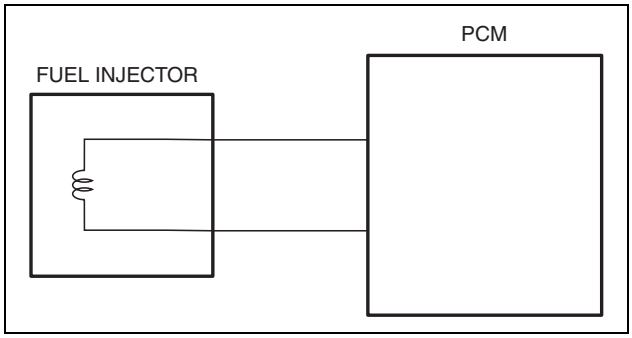
FUEL SYSTEM [SKYACTIV-D 2.2]

Piezo-electric element
— The element possesses a property which generates voltage when a load (displacement) is applied, and load (displacement) when voltage is applied.
Displacement magnification unit
— Consisting of the sliding part (large-diameter piston, small-diameter piston) and the oil seal chamber, it magnifies the displacement of the Piezo-electric element and transmits it to the control valve.
Control valve
— It opens/closes the upper seat and lower seat by the displacement of the Piezo-electric element, and controls the back pressure on the nozzle needle.
Nozzle needle
— Injects fuel by moving up and down based on the opening/closing of the control valve.

Operation
- Injects fuel according to the signal from the PCM. The fuel injection time is determined by the energization time of the coil.



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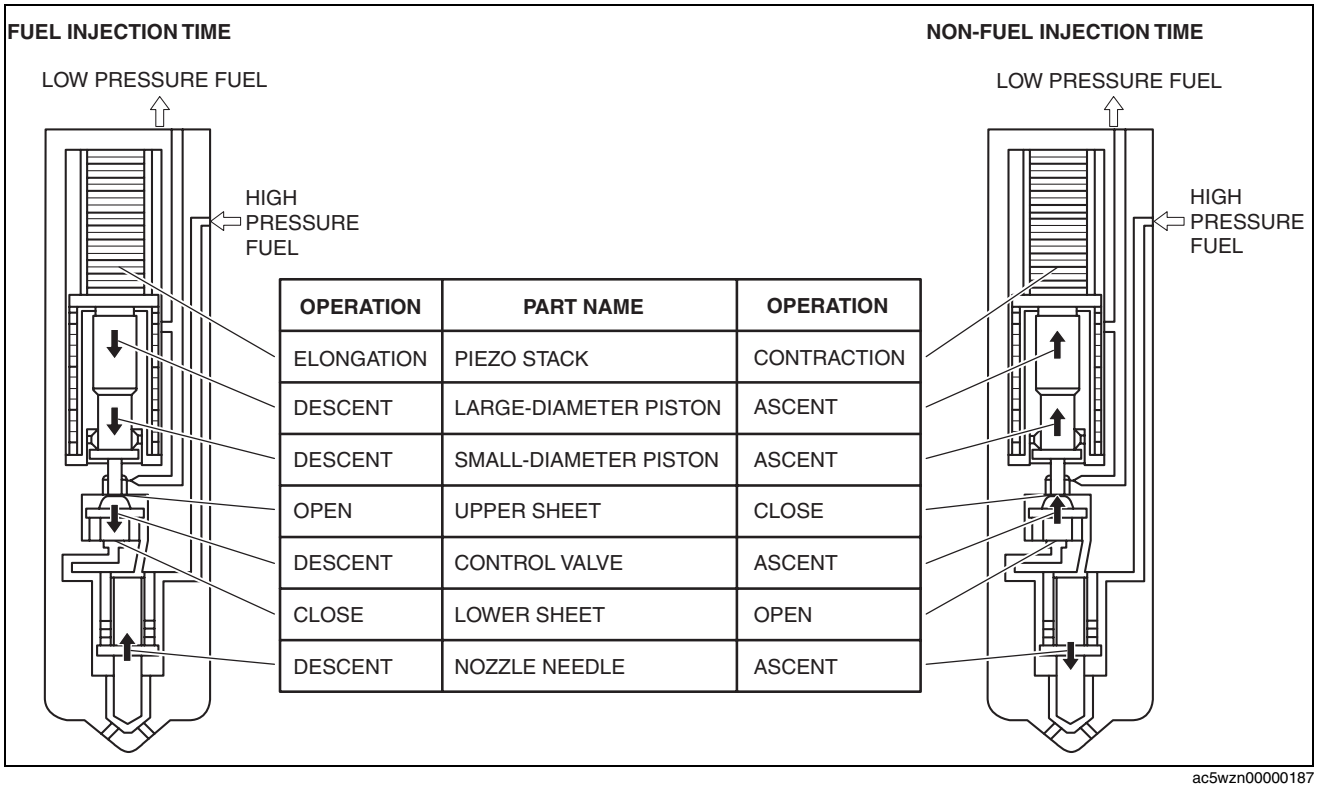
Fuel injection mechanism
1. Applies electric charge to the Piezo-electric element, and utilizes the property of the Piezo-electric element to cause it to expand.
2. The amount that the Piezo-electric element expands is magnified by the displacement magnification unit.
3. The control valve is driven by the magnified expansion amount, causing the upper seat to open and the lower seat to close, which lowers the pressure in the nozzle back pressure chamber.
4. Based on the lowering of the pressure, the fuel injection initiates by the upward movement of the nozzle.



OPERATION	PART NAME	OPERATION
ELONGATION	PIEZO STACK	CONTRACTION
DESCENT	LARGE-DIAMETER PISTON	ASCENT
DESCENT	SMALL-DIAMETER PISTON	ASCENT
OPEN	UPPER SHEET	CLOSE
DESCENT	CONTROL VALVE	ASCENT
CLOSE	LOWER SHEET	OPEN
DESCENT	NOZZLE NEEDLE	ASCENT

ac5wzn00000187

Fail-safe
- —

FUEL SYSTEM [SKYACTIV-D 2.2]

SUPPLY PUMP [SKYACTIV-D 2.2]

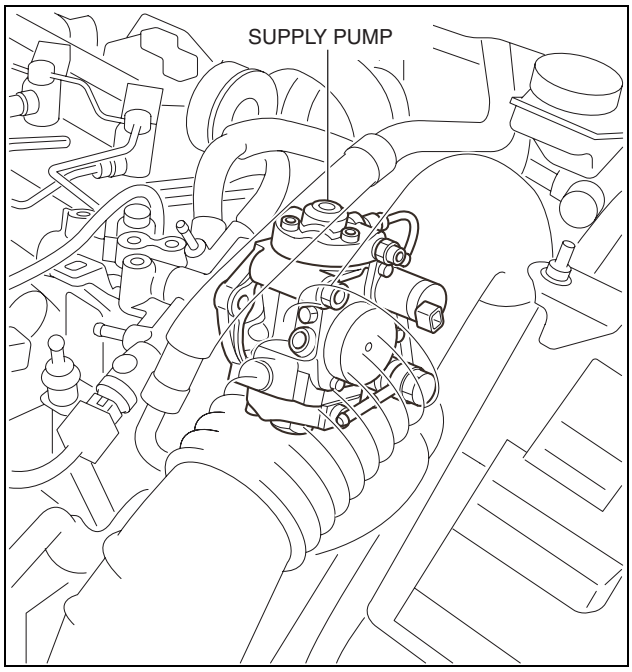
id0114z7707400

Purpose, Function

- An electric supply pump with extremely high output pressure and low drive torque has been adopted.
- The pump mounting is made of aluminum for weight reduction.
- The supply pump pumps the correct amount of fuel and feeds it to the common rail.

Construction

- The supply pump is installed to the engine (backside)



ac5wzn00001964

Operation

- Fuel supplied by the feed pump passes the suction control valve which controls the intake amount. The fuel is then sent to the high pressure chamber formed by the TDC of the plunger and passes through the intake valve.
- When the plunger approaches TDC of the high compression chamber, the fuel sent to the high pressure chamber is passed through a compression pipe and sent to the delivery valve, supplying pressure to the common rail.
- The outer cam is driven eccentrically by the rotation of the camshaft to produce the reciprocating movement of the cam ring. The exterior surface of the outer ring rubs against the plunger and they move together in a reciprocating motion.

SUCTION CONTROL VALVE [SKYACTIV-D 2.2]

id0114z7707500

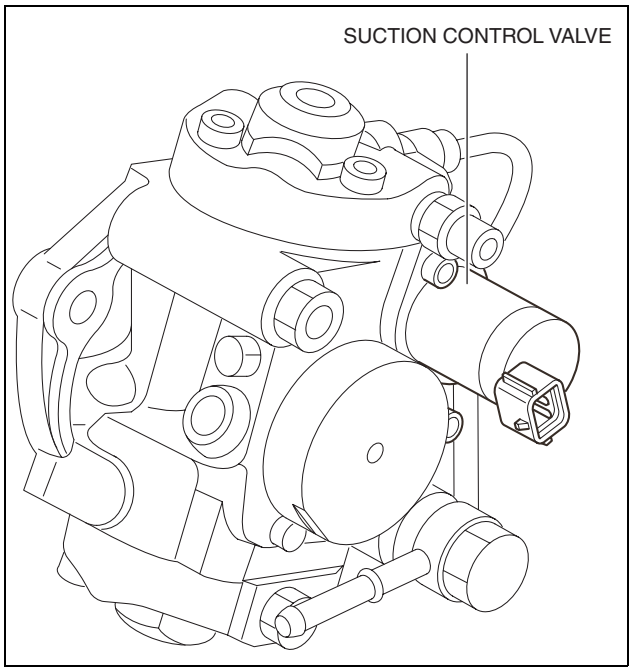
Purpose, Function

- By controlling the supply pump intake amount, the suction control valve controls the pressure pump feed amount and the pressure inside the fuel distribution pipe.

FUEL SYSTEM [SKYACTIV-D 2.2]

Construction

- The suction control valve is built into the supply pump.



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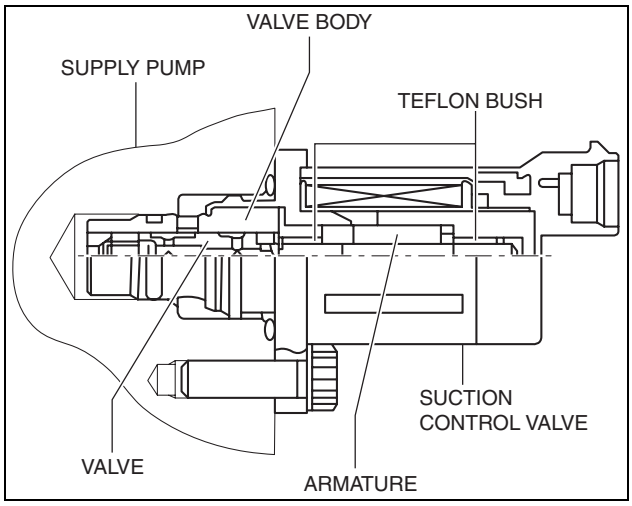
- The suction control valve consists of the valve, valve body, armature, and teflon bush.



ac5wzn00000194

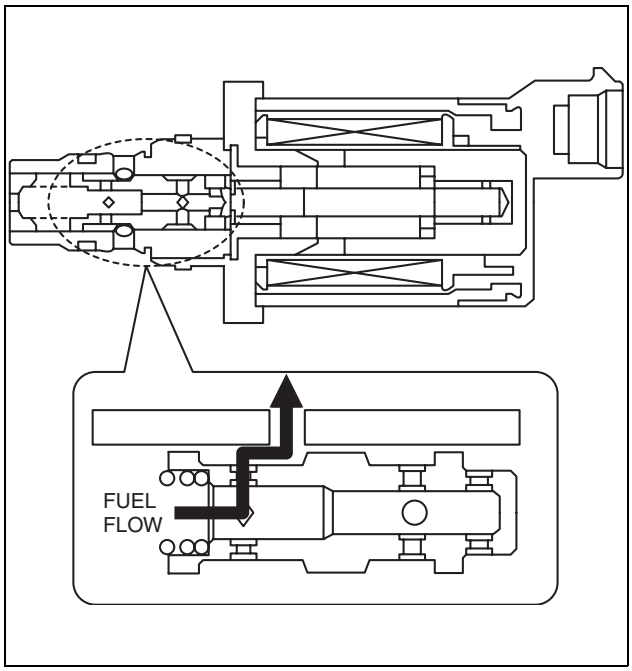
Operation

- The intake amount is determined by the total opening size of the valve as controlled by the duty value of the solenoid actuation current.
- The duty solenoid can adjust the open and close time ratio to control the intake amount by changing the ON time during a single cycle. For a normally open type suction control valve, making the duty ratio smaller increases the intake amount and, conversely, making the duty value larger decreases the intake amount.

FUEL SYSTEM [SKYACTIV-D 2.2]

De-energized (open)

- The solenoid inner port is opened and fuel is sent into the control chamber.



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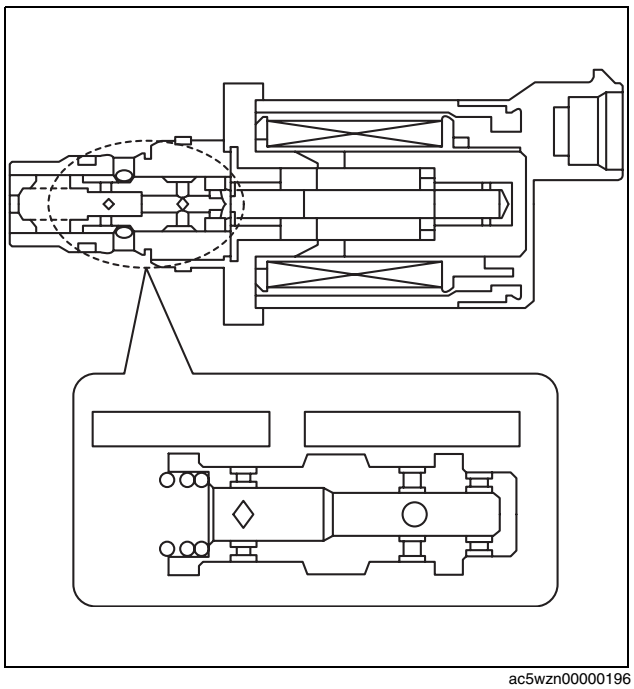
Energized (closed)

- The solenoid inner port is closed. Fuel siphoned by the feed pump is returned to the fuel tank through the regulator valve.



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FUEL CHECK VALVE [SKYACTIV-D 2.2]

id0114z7707600

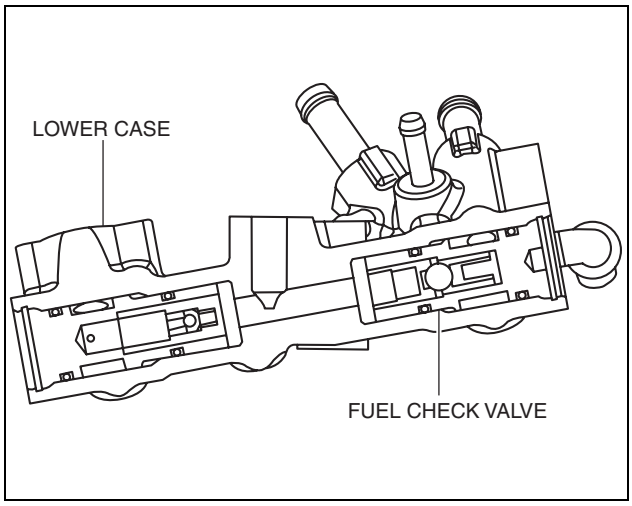
Purpose, Function

- The fuel returned from the fuel injectors is introduced to the fuel tank and the return pressure is controlled.

FUEL SYSTEM [SKYACTIV-D 2.2]

Construction

- The fuel check valve is built into the lower case.



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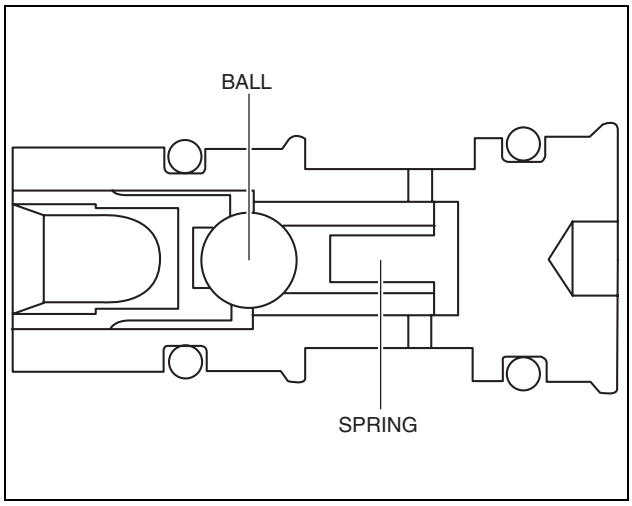
- The fuel check valve consists of the spring and ball.



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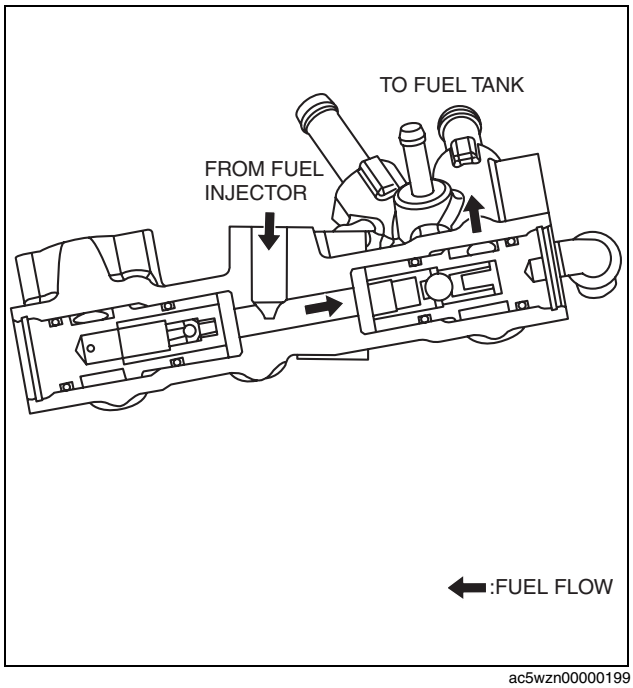
Operation

- When the pressure of the fuel returned from the fuel injectors exceeds a certain value, the fuel circuit on the fuel tank side opens by the ball pressing the spring.



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FUEL SYSTEM [SKYACTIV-D 2.2]

FUEL FEED VALVE [SKYACTIV-D 2.2]

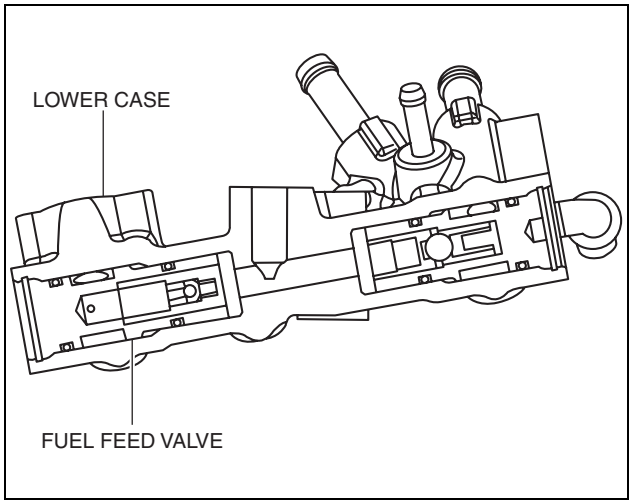
id0114z7707700

Purpose, Function

- When the pressure in the lower case decreases, fuel from the supply pump is introduced to the lower case.

Construction

- The fuel feed valve is integrated with the lower case.



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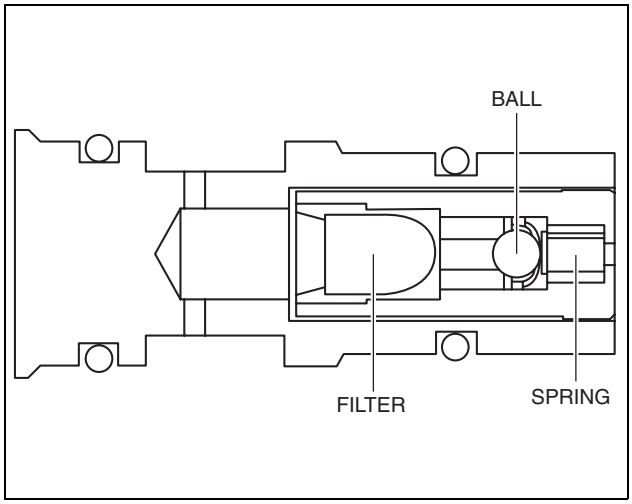
- The fuel feed valve consists of the spring, ball and filter.



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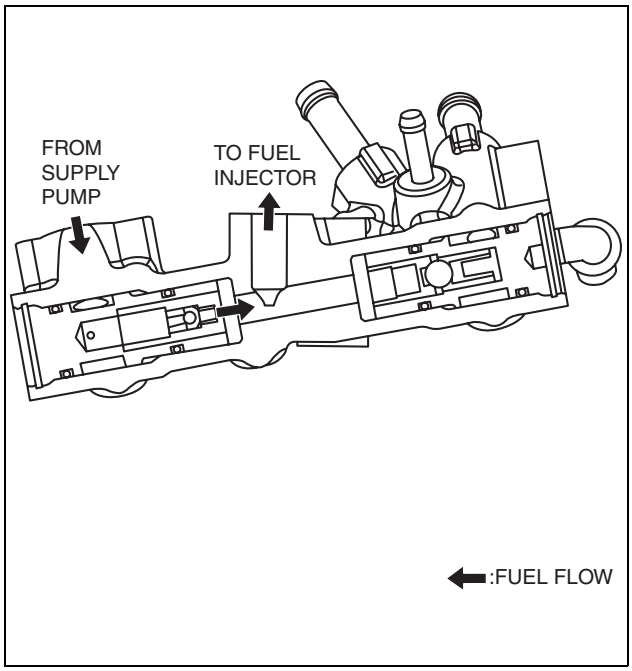
FUEL SYSTEM [SKYACTIV-D 2.2]

Operation

- When the pressure in the lower case decreases to a certain value, the fuel from the supply pump flows into the lower case (on fuel injector side) by the ball pressing the spring.



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FUEL PRESSURE LIMITER VALVE [SKYACTIV-D 2.2]

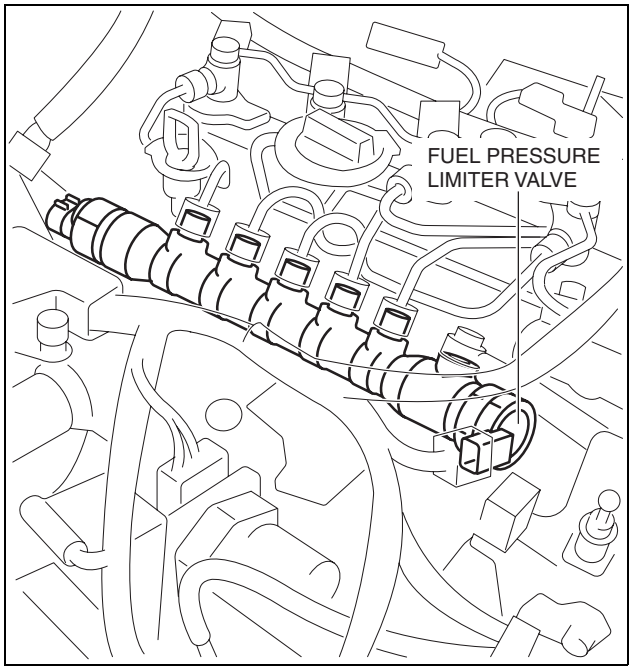
id0114z7707800

Purpose, Function

- If the pressure in the common rail exceeds a certain value, fuel is discharged to assure safety.

Construction

- The fuel pressure limiter valve is installed to the common rail.



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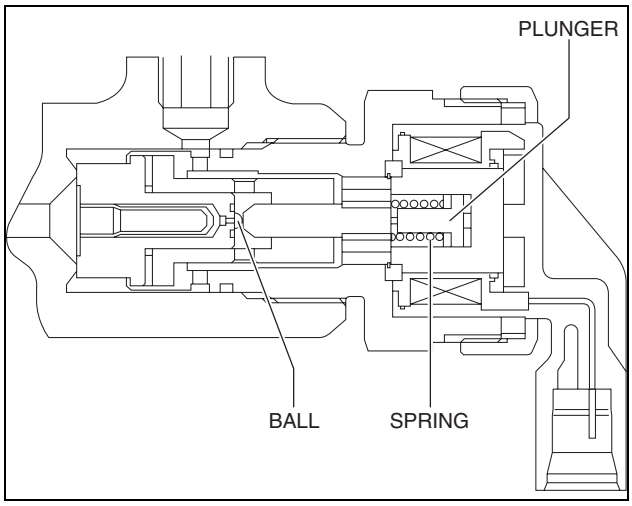
FUEL SYSTEM [SKYACTIV-D 2.2]

- The fuel pressure limiter valve consists of a spring, ball, and plunger.



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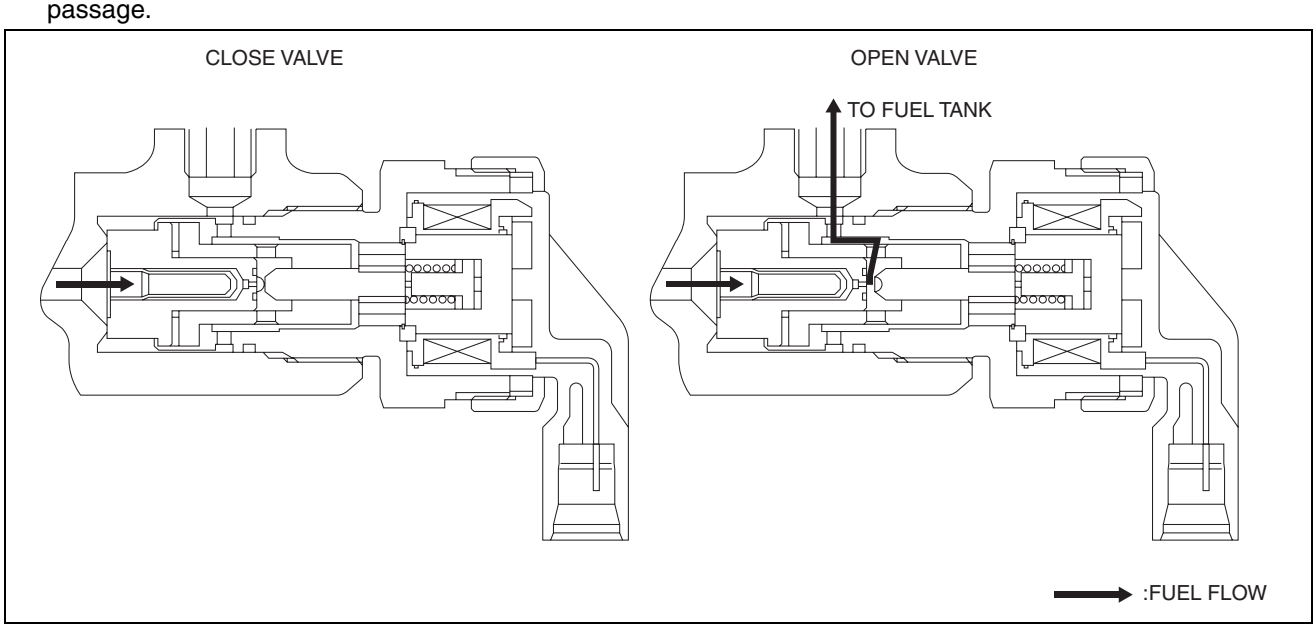
Operation

- According to the control signal from the PCM, the coil is energized and the plunger is operated to open the fuel passage.



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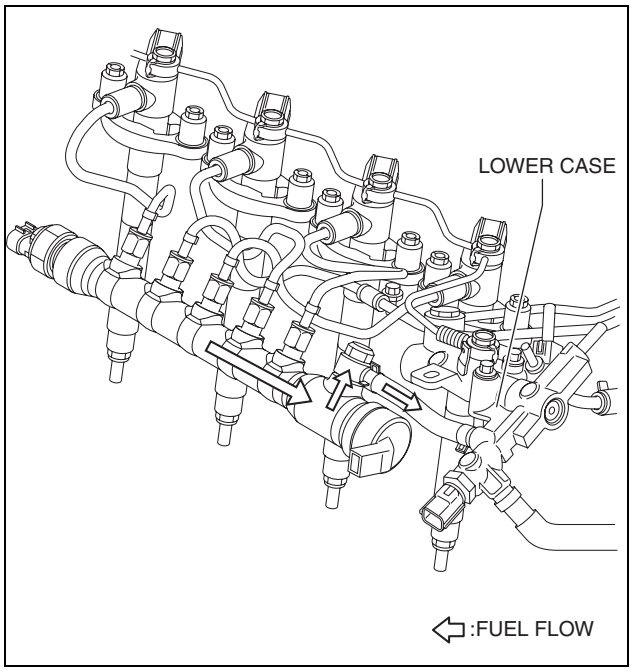
FUEL SYSTEM [SKYACTIV-D 2.2]

- The fuel passage opens and the pressure in the common rail flows to the lower case side.



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SEDIMENTOR SWITCH [SKYACTIV-D 2.2]

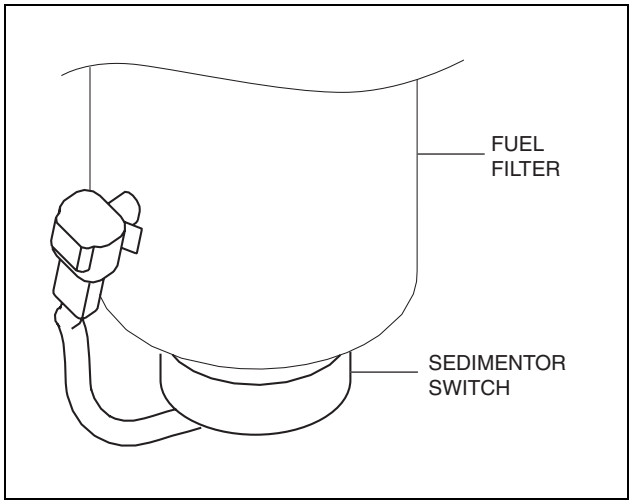
id0114z7707900

Purpose, Function

- Detects the water level in the sedimentor. The float rises according to the level of accumulated water. If the water level exceeds the specification, the circuit for the sedimentor switch is completed.

Construction

- The sedimentor switch is installed to the fuel filter.



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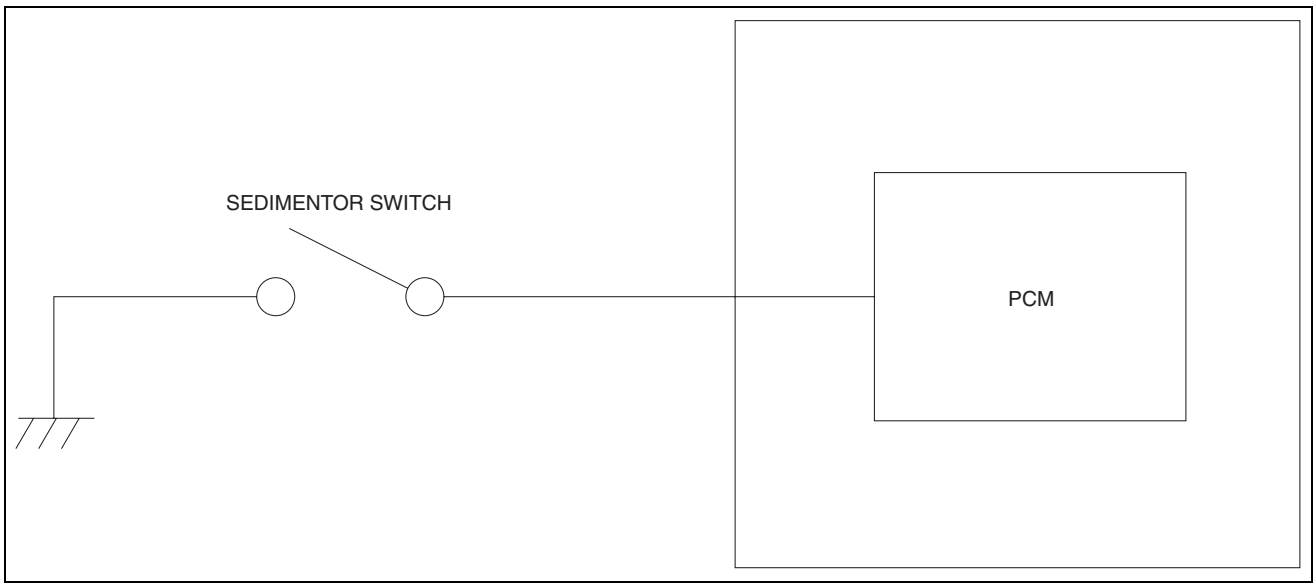
FUEL SYSTEM [SKYACTIV-D 2.2]

Operation

- If the water level in the sedimentor exceeds a certain level, the sedimentor switch turns on, which is input to the PCM.



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FUEL WARMER [SKYACTIV-D 2.2]

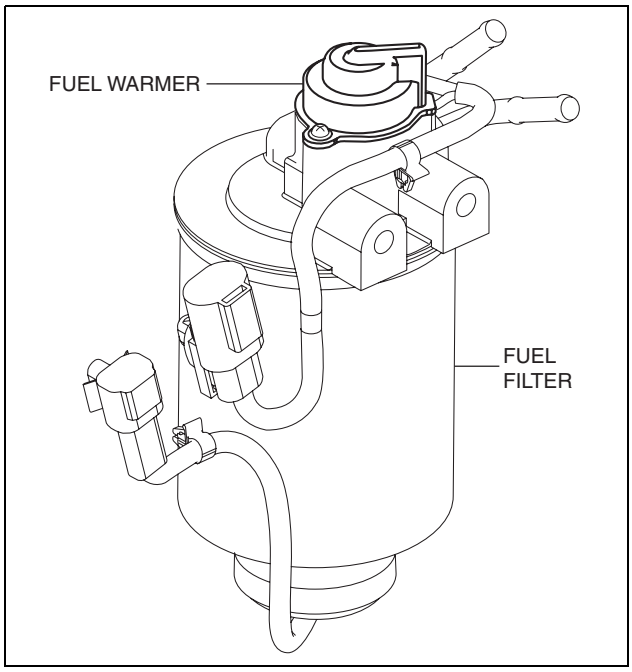
id0114z7707200

Purpose, Function

- If fuel for the summer season is used in the winter season, the wax component in the fuel may become greasy when the temperature is cold. After the engine is started, the fuel warmer melts the greasy wax component to prevent a clogging in the fuel filter.

Construction

- Consists of the vacuum switch and the fuel warmer.



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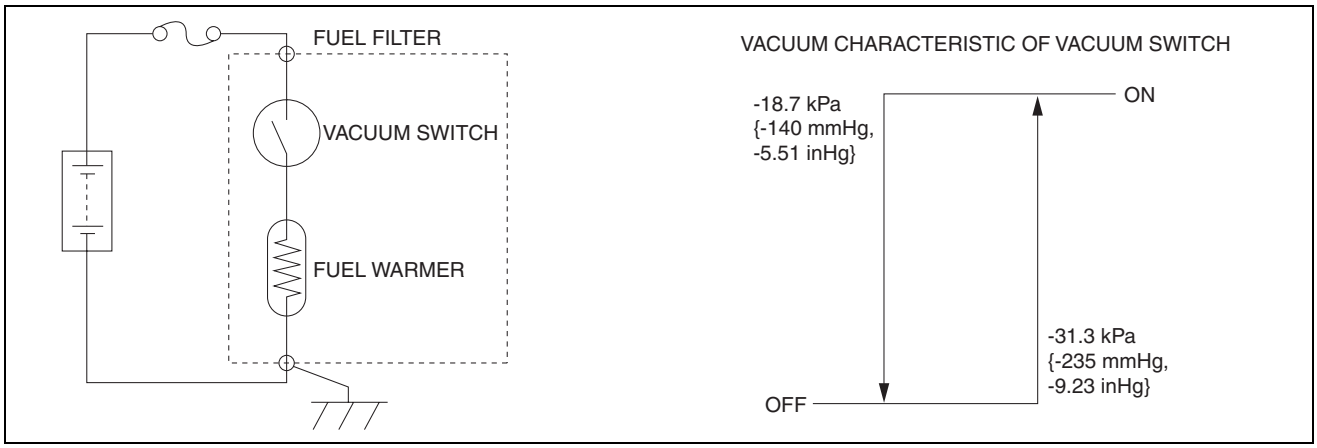
FUEL SYSTEM [SKYACTIV-D 2.2]

Operation

- If the wax component in the fuel becomes greasy and clogging occurs in the fuel filter, a vacuum is generated in the fuel passage between the fuel filter and the injection pump. If the pressure inside the fuel passage decreases to approx. -31.3 kPa {-235 mmHg, -9.23 inHg} or less, the vacuum switch is turned on and power is supplied to the fuel warmer heater. The greasy wax component is heated and melted by the fuel warmer heater. When the pressure inside the fuel passage increases to approx. -18.7 kPa {-140 mmHg, -5.51 inHg} or more, the vacuum switch is turned off and the power to the fuel warmer heater is cut.



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01-15A EXHAUST SYSTEM [SKYACTIV-G 2.0]

EXHAUST SYSTEM [SKYACTIV-G 2.0]

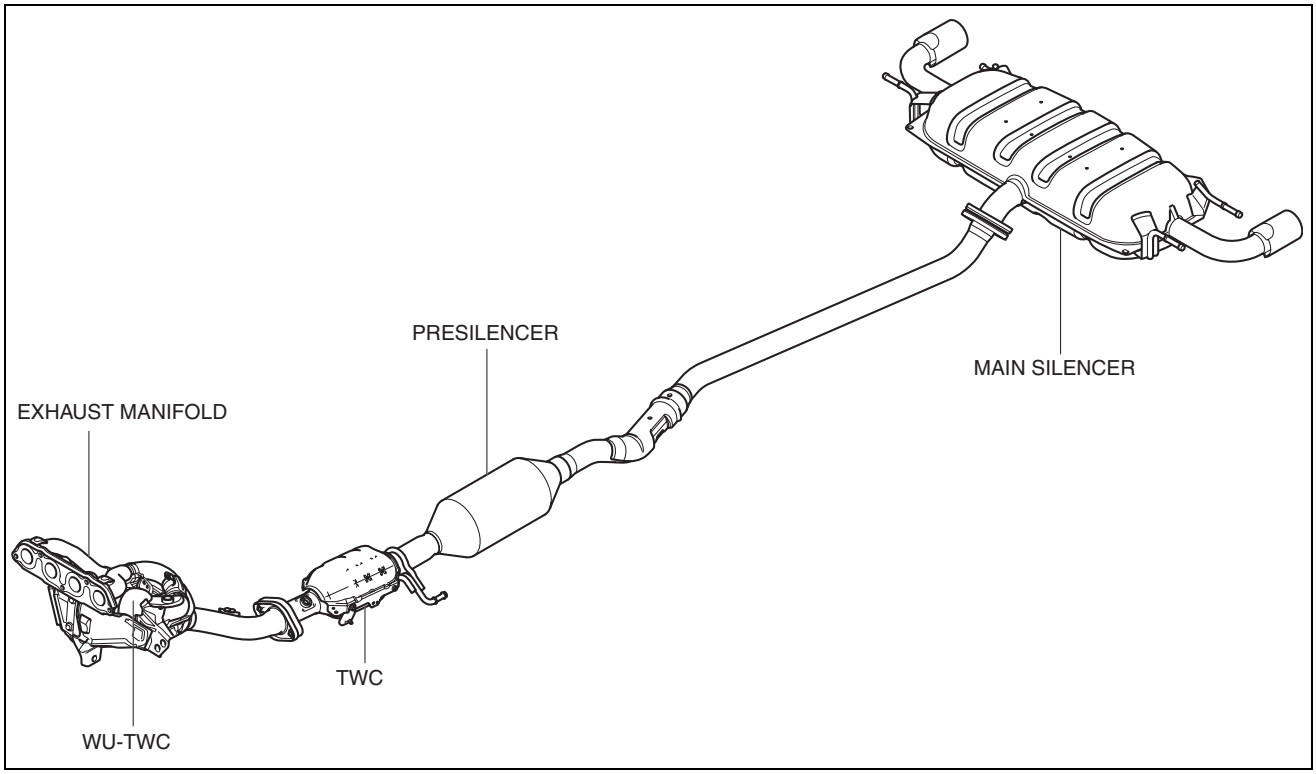
EXHAUST SYSTEM [SKYACTIV-G 2.0]

id0115z5125800

Outline

- A 4-2-1 exhaust system has been adopted which reduces residual gas in the cylinders using the scavenging effect and contributes to a high compression ratio.
- The loop structure of the exhaust pipes for the 4-2-1 system takes up less space.

Structural View
2WD



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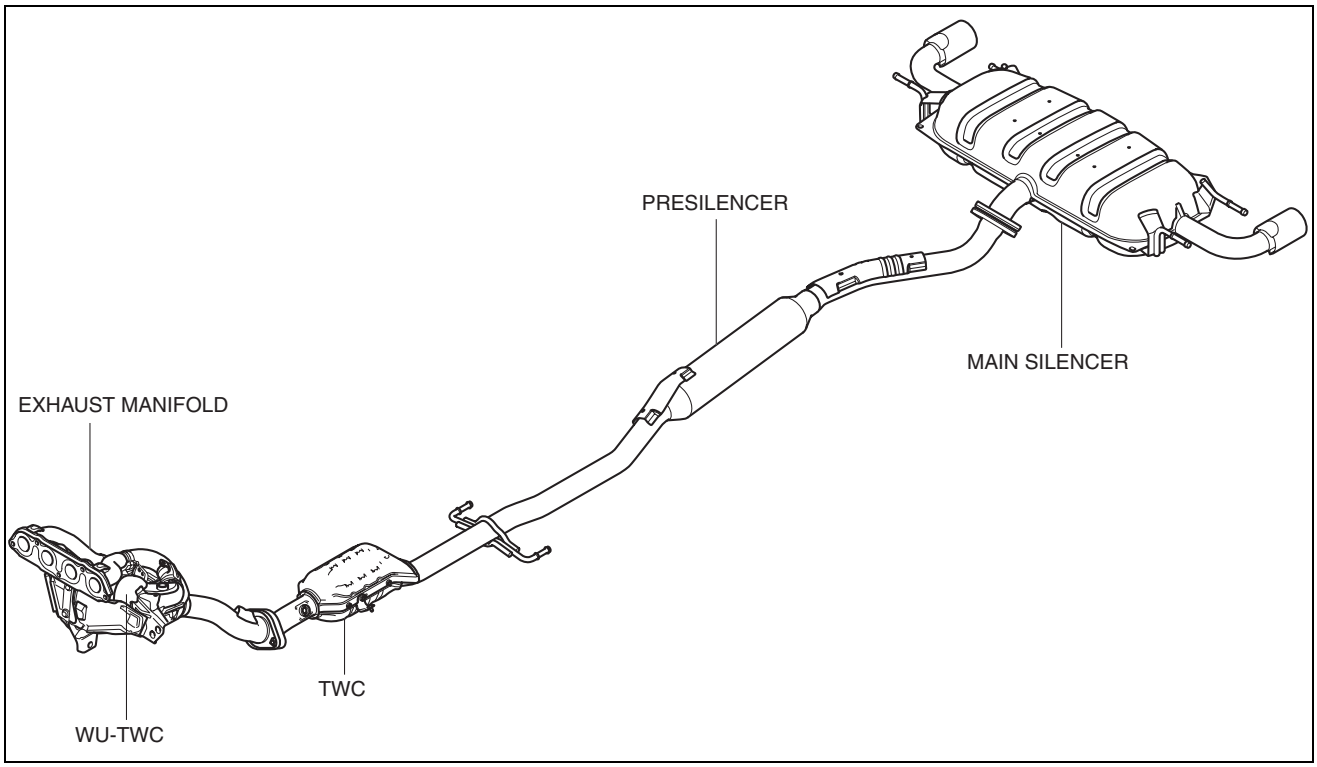
EXHAUST SYSTEM [SKYACTIV-G 2.0]

4WD



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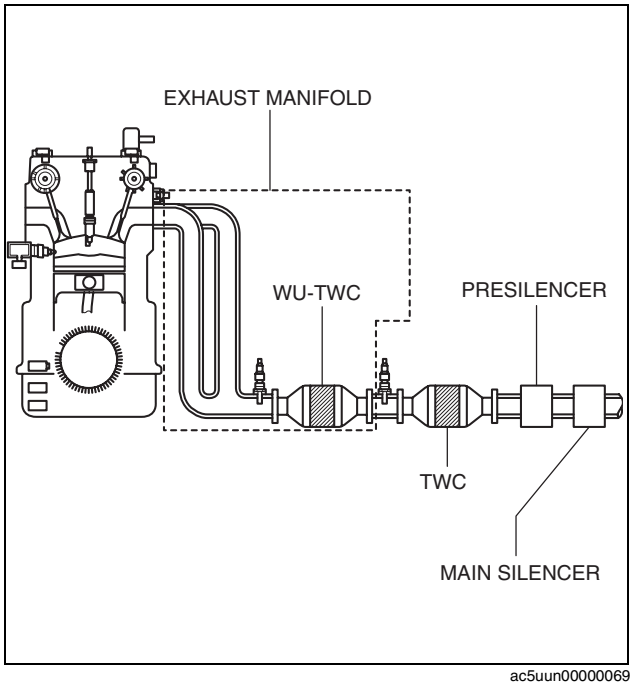
System Diagram



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Structure

- The exhaust system consists of the following parts:

Part name	Reference
Main silencer	(See 01-15A-3 MAIN SILENCER [SKYACTIV-G 2.0].)
Presilencer	(See 01-15A-5 PRESILENCER [SKYACTIV-G 2.0].)
TWC	(See 01-16A-7 CATALYTIC CONVERTER [SKYACTIV-G 2.0].)
WU-TWC	
Exhaust manifold	(See 01-15A-3 EXHAUST MANIFOLD [SKYACTIV-G 2.0].)

EXHAUST SYSTEM [SKYACTIV-G 2.0]

EXHAUST MANIFOLD [SKYACTIV-G 2.0]

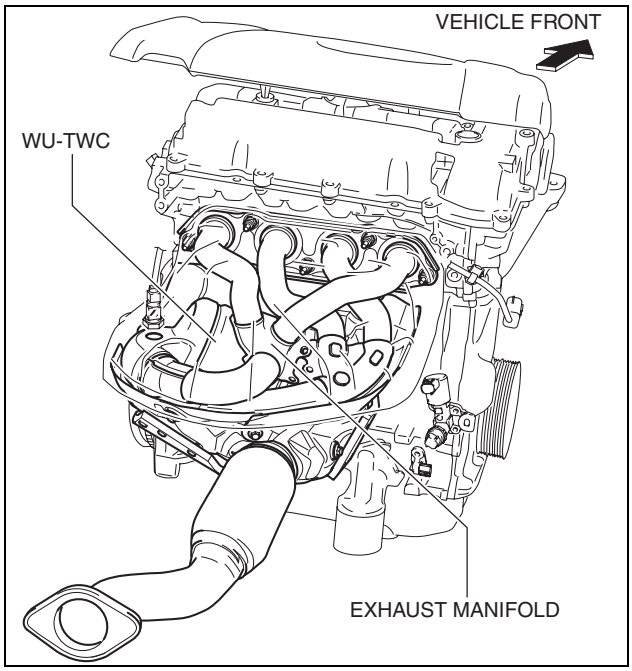
id0115z5101100

Purpose, Function

- By lengthening the exhaust passage, the transmission of exhaust pressure waves to other cylinders can be delayed, and the amount of gas exhausted from a cylinder and forced back inside the combustion chamber is reduced By reducing the residual gas, the temperature inside the combustion chamber is reduced and the occurrence of knocking even at a high compression ratio is inhibited.

Construction

- The exhaust manifold is installed to the rear of the engine. In addition, the catalytic converter (WU-TWC) is integrated (WU-TWC).
- When the No.1 cylinder is at the intake stroke, the No.3 cylinder is at the exhaust stroke. By inducing the high temperature gas exhausted from the No.3 cylinder into the No.1 cylinder, the high temperature gas in the No.1 cylinder remains. If the amount of residual gas is high, the temperature in the combustion chamber rises and knocking can easily occur. With the 4-2-1 exhaust system, the transmission of exhaust pressure waves between each cylinder is delayed by the long exhaust pipes.



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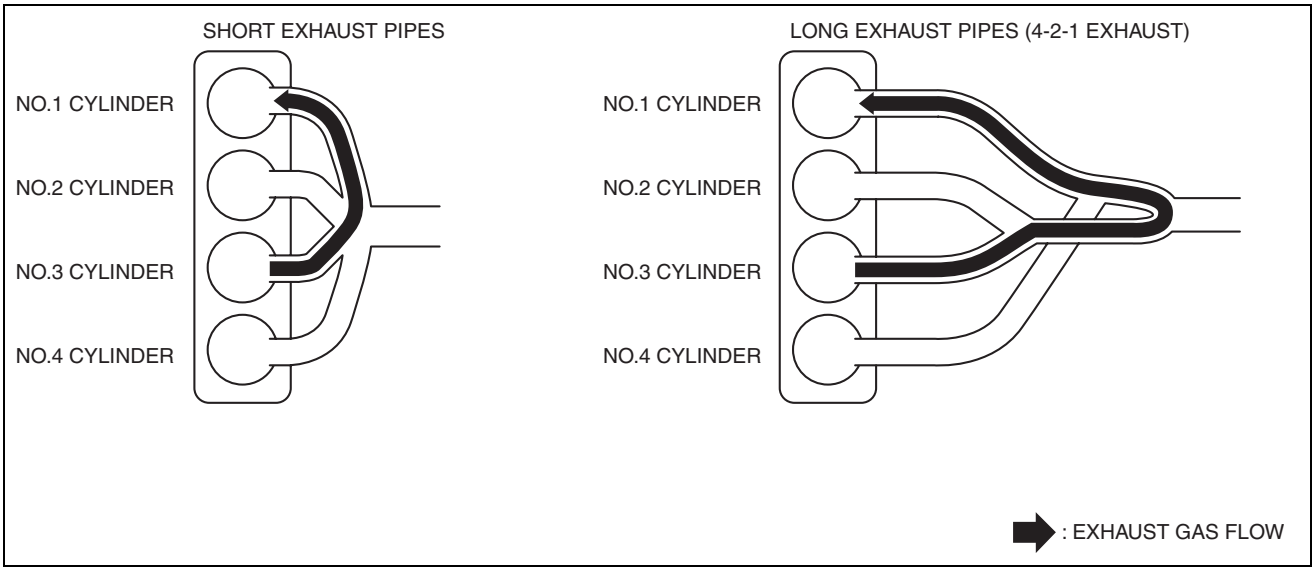

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MAIN SILENCER [SKYACTIV-G 2.0]

id0115z5101000

Purpose, Function

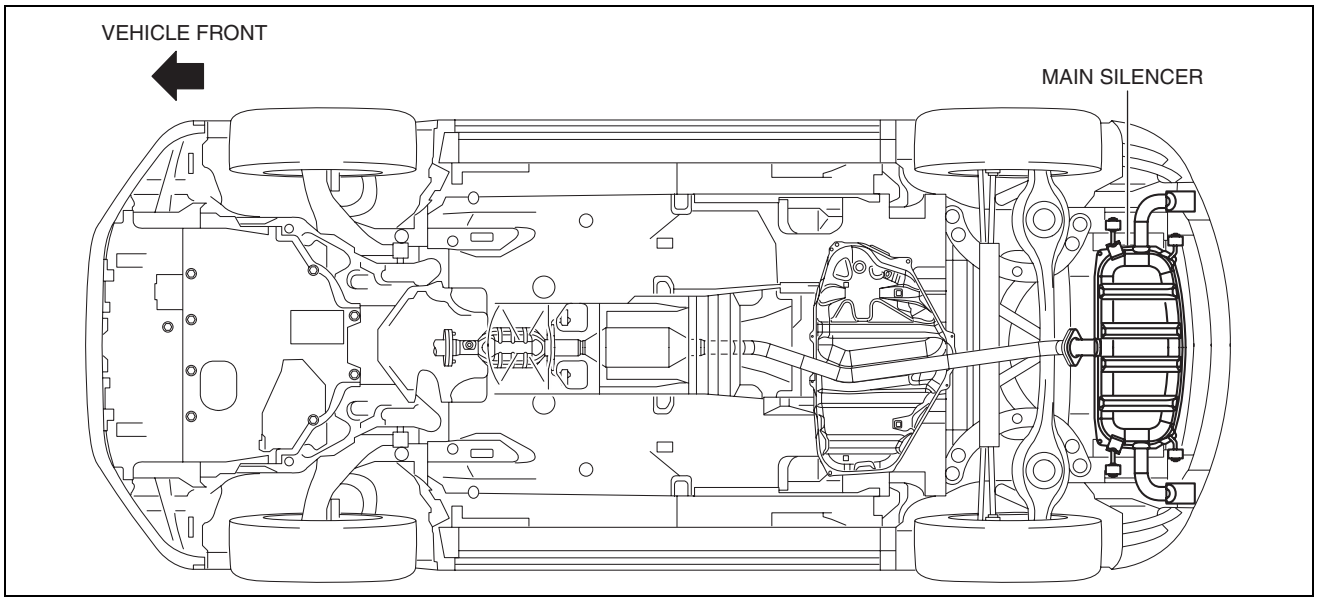
- Reduces the exhaust noise.

Construction

- The main silencer is installed to the vehicle rear, under the trunk compartment.

EXHAUST SYSTEM [SKYACTIV-G 2.0]

2WD



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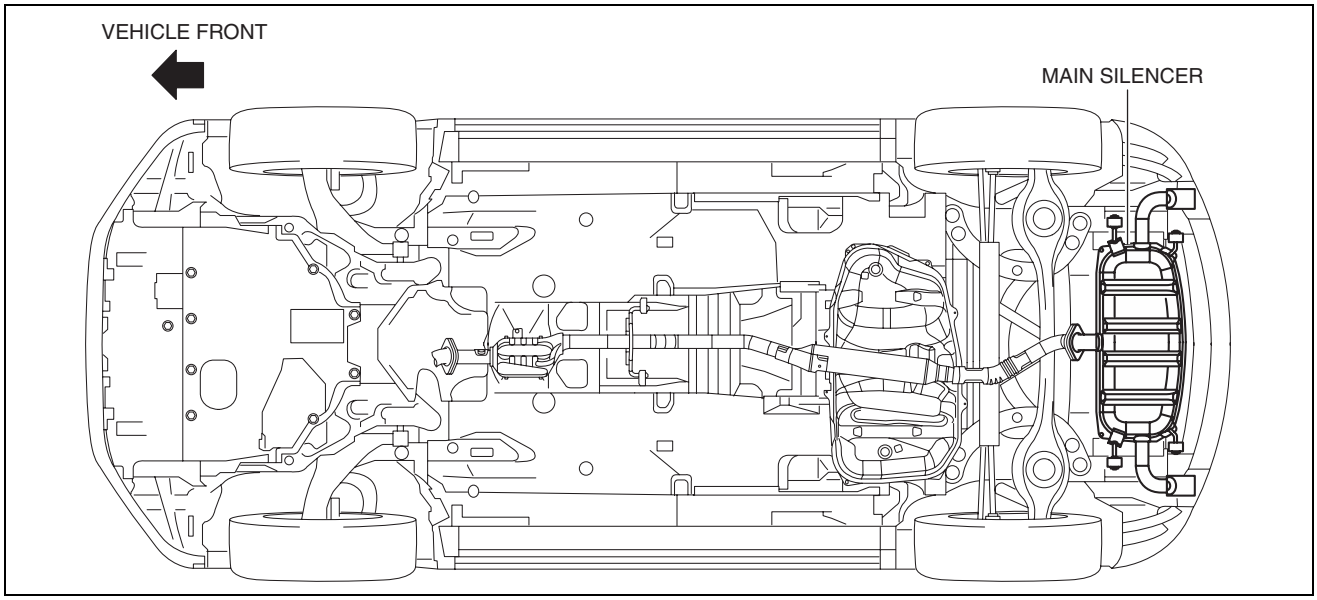
4WD



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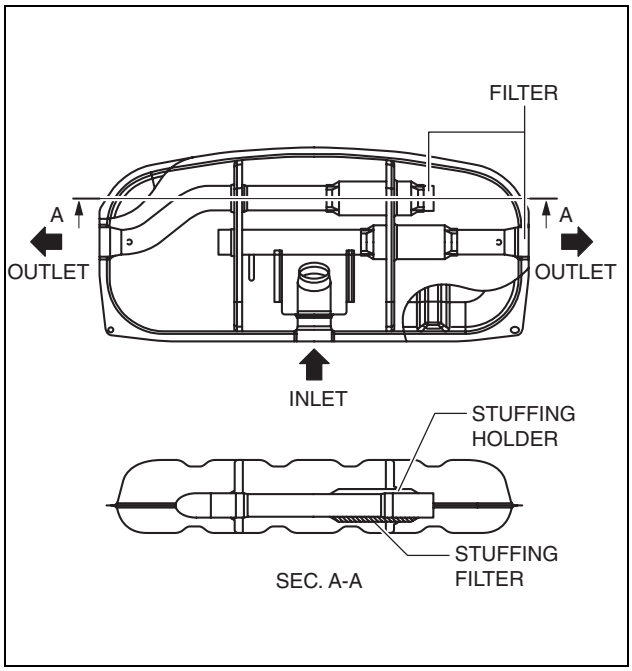
EXHAUST SYSTEM [SKYACTIV-G 2.0]

- The main silencer consists of the filters, holder, set plates and stiffener.



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PRESILENCER [SKYACTIV-G 2.0]

id0115z5808800

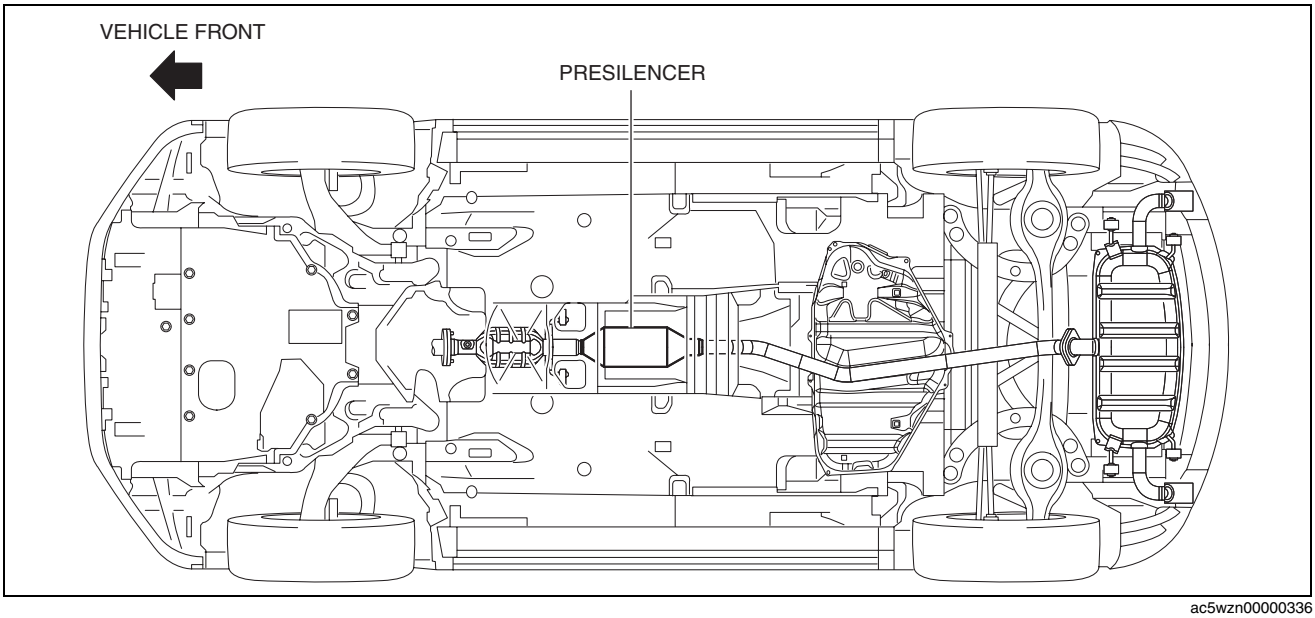
Purpose, Function

- Reduces the exhaust noise.

Construction

- The presilencer is installed to the rear of the TWC.

2WD



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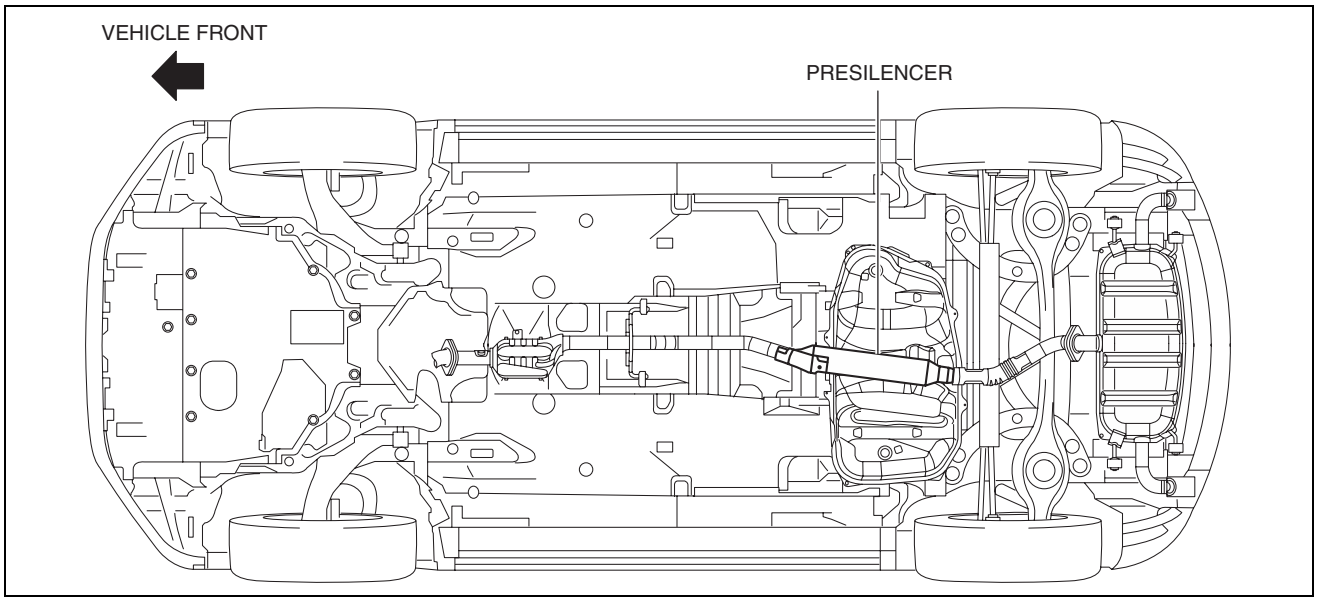
EXHAUST SYSTEM [SKYACTIV-G 2.0]

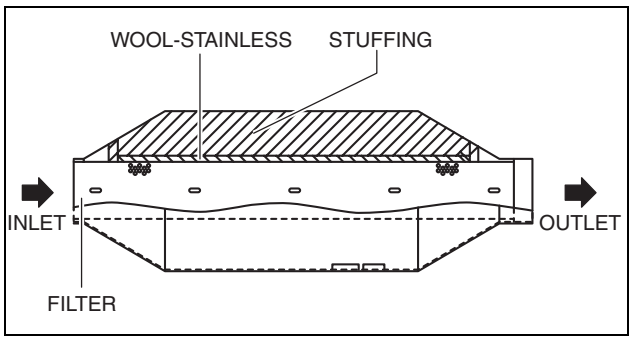
4WD



ac5wzn00000337

- The presilencer consists of the filters, stuffing and wool-stainless.

2WD



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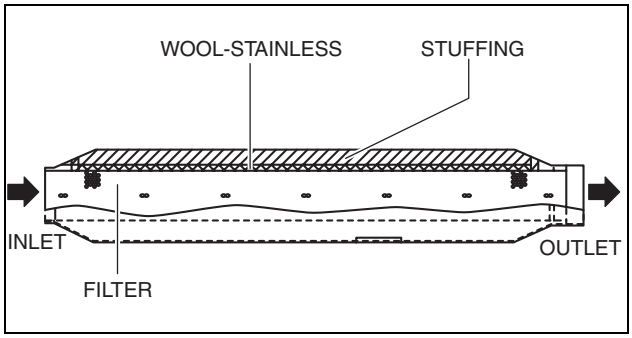
4WD



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01-15B EXHAUST SYSTEM [SKYACTIV-D 2.2]

EXHAUST SYSTEM [SKYACTIV-D 2.2]

EXHAUST SYSTEM [SKYACTIV-D 2.2]

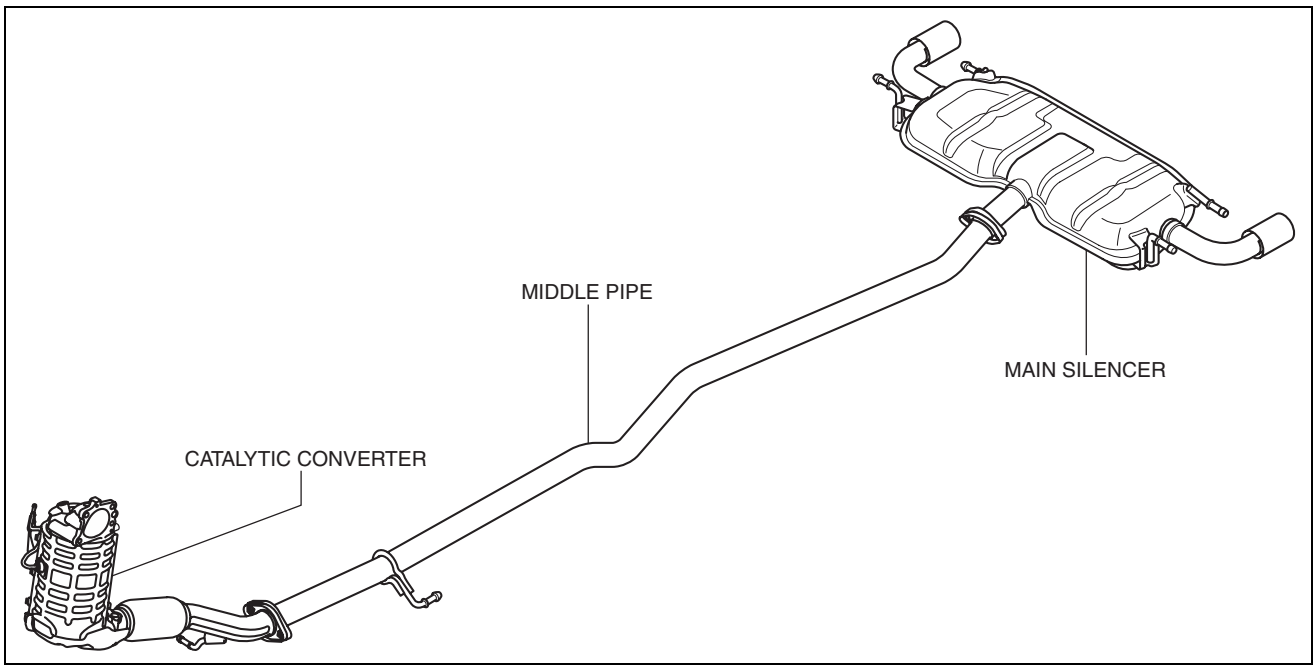
id0115z7125800

Outline

- By employing an exhaust gas passage in the cylinder head, the exhaust manifold has been eliminated.

Structural view

2WD



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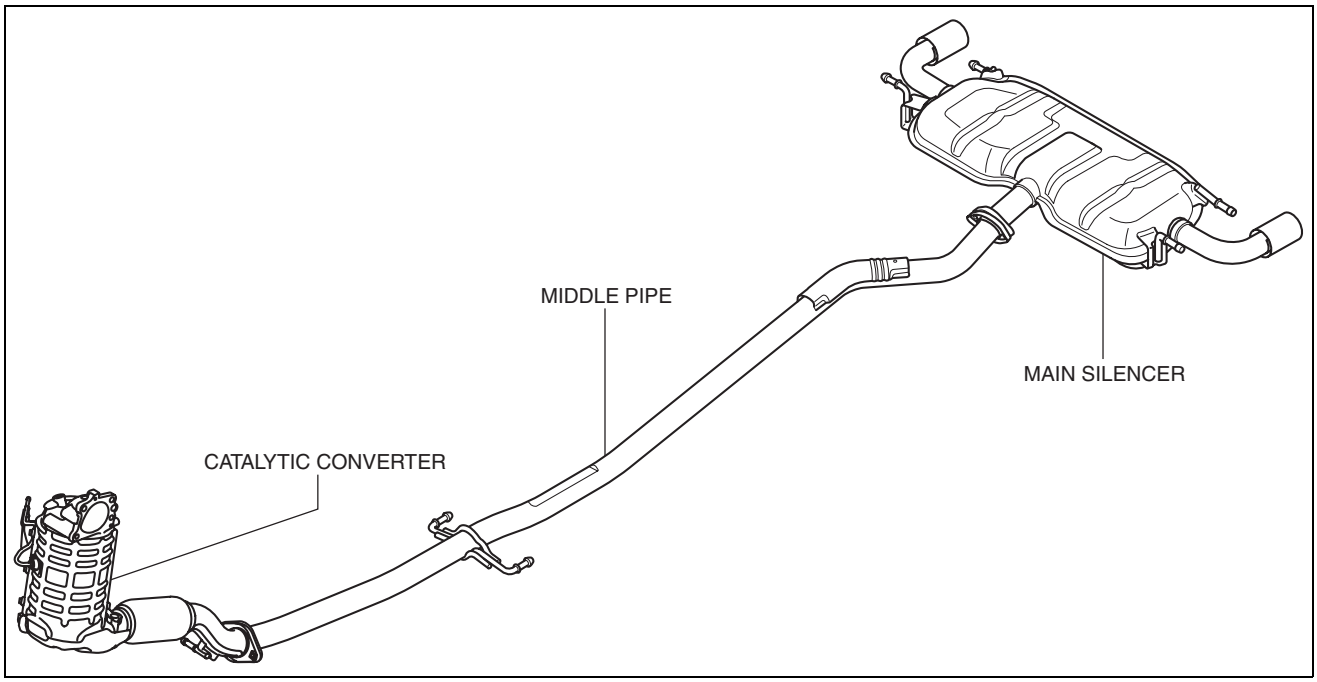
EXHAUST SYSTEM [SKYACTIV-D 2.2]

4WD



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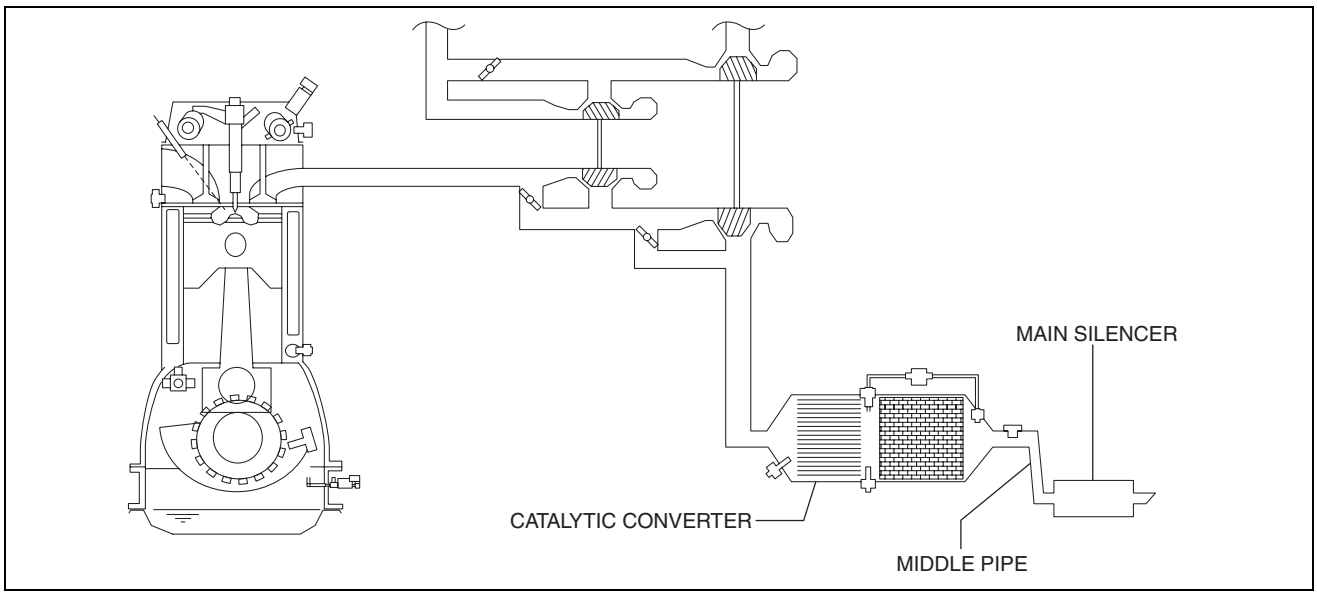
System diagram



ac5wzn00001973

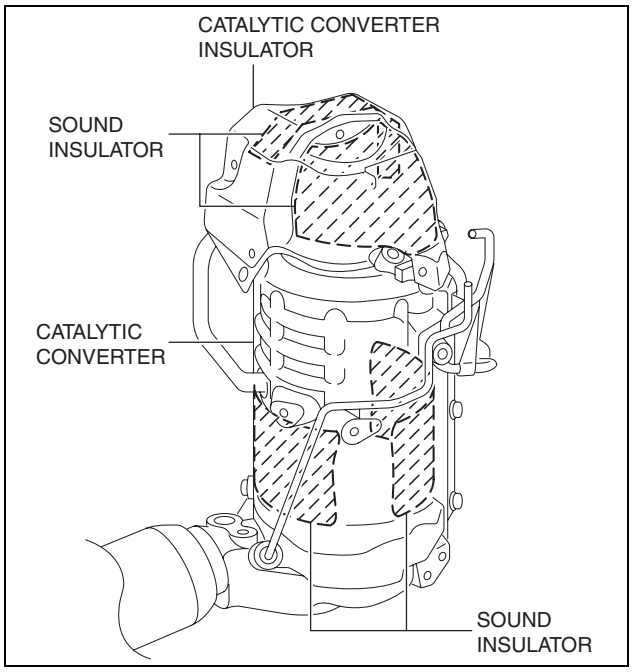
Structure

- The exhaust system consists of the following parts:

Part name	Reference
Main silencer	(See 01-15B-3 MAIN SILENCER [SKYACTIV-D 2.2].)
Middle pipe	—
Catalytic converter	(See 01-16B-7 CATALYTIC CONVERTER [SKYACTIV-D 2.2].)

EXHAUST SYSTEM [SKYACTIV-D 2.2]

- Noise suppression material is employed on the inside of the catalytic converter insulator and the internal surface of the catalytic converter to reduce noise.



ac5wzn00001974

MAIN SILENCER [SKYACTIV-D 2.2]

id0115z7101000

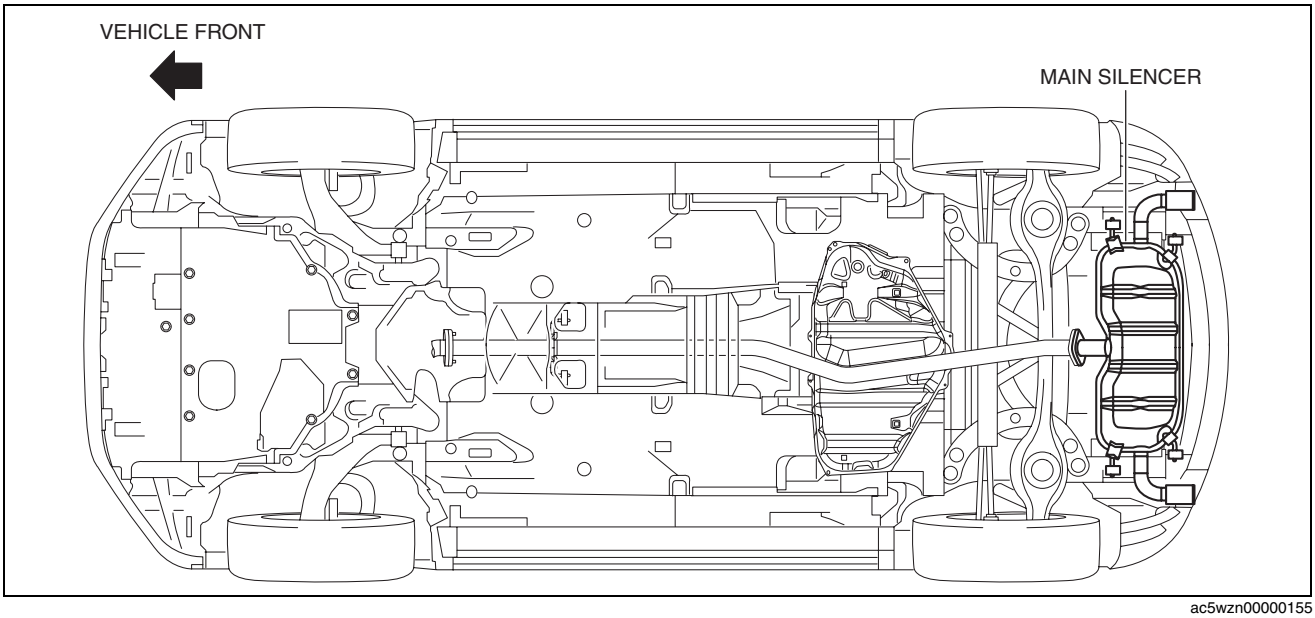
Purpose, Function

- Reduces the exhaust noise.

Construction

- The main silencer is installed to the vehicle rear, under the trunk compartment.

2WD



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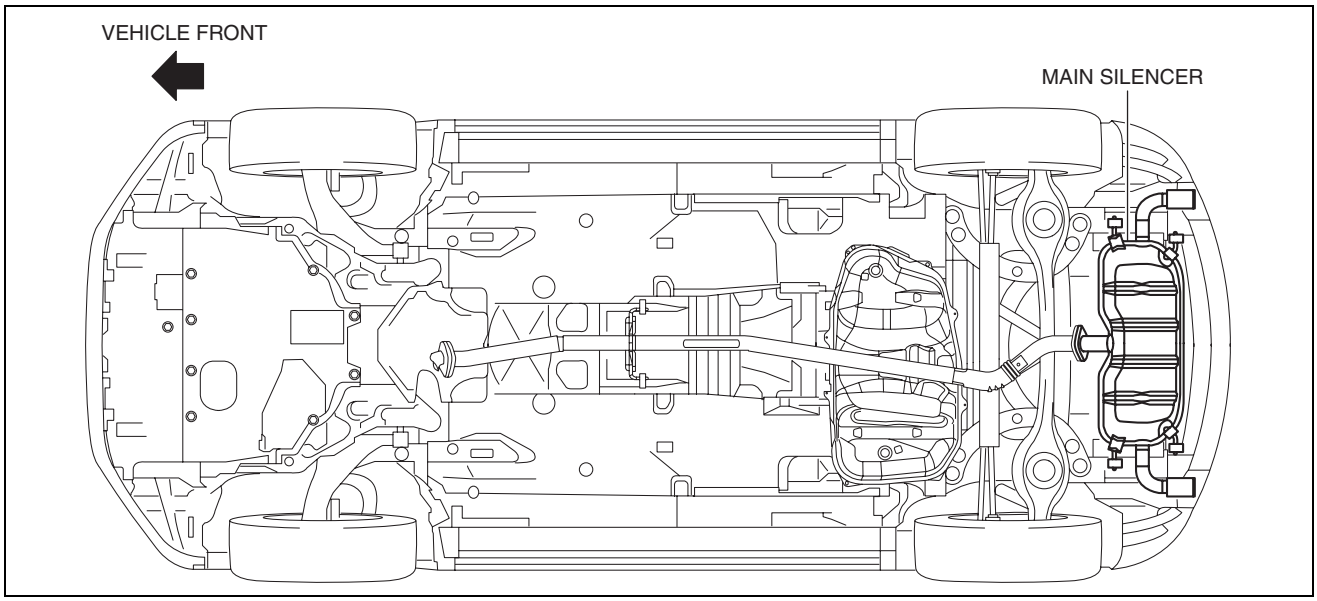
EXHAUST SYSTEM [SKYACTIV-D 2.2]

AWD



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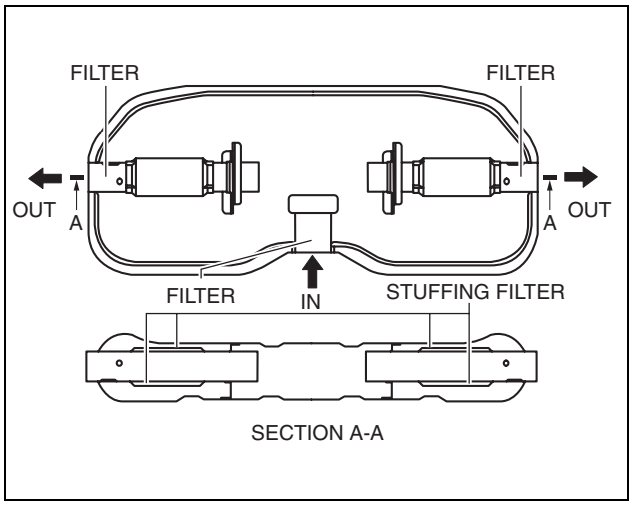
- The main silencer consists of the filters and stuffing filters.



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01-16A EMISSION SYSTEM [SKYACTIV-G 2.0]

EMISSION SYSTEM [SKYACTIV-G 2.0]

EMISSION SYSTEM [SKYACTIV-G 2.0]

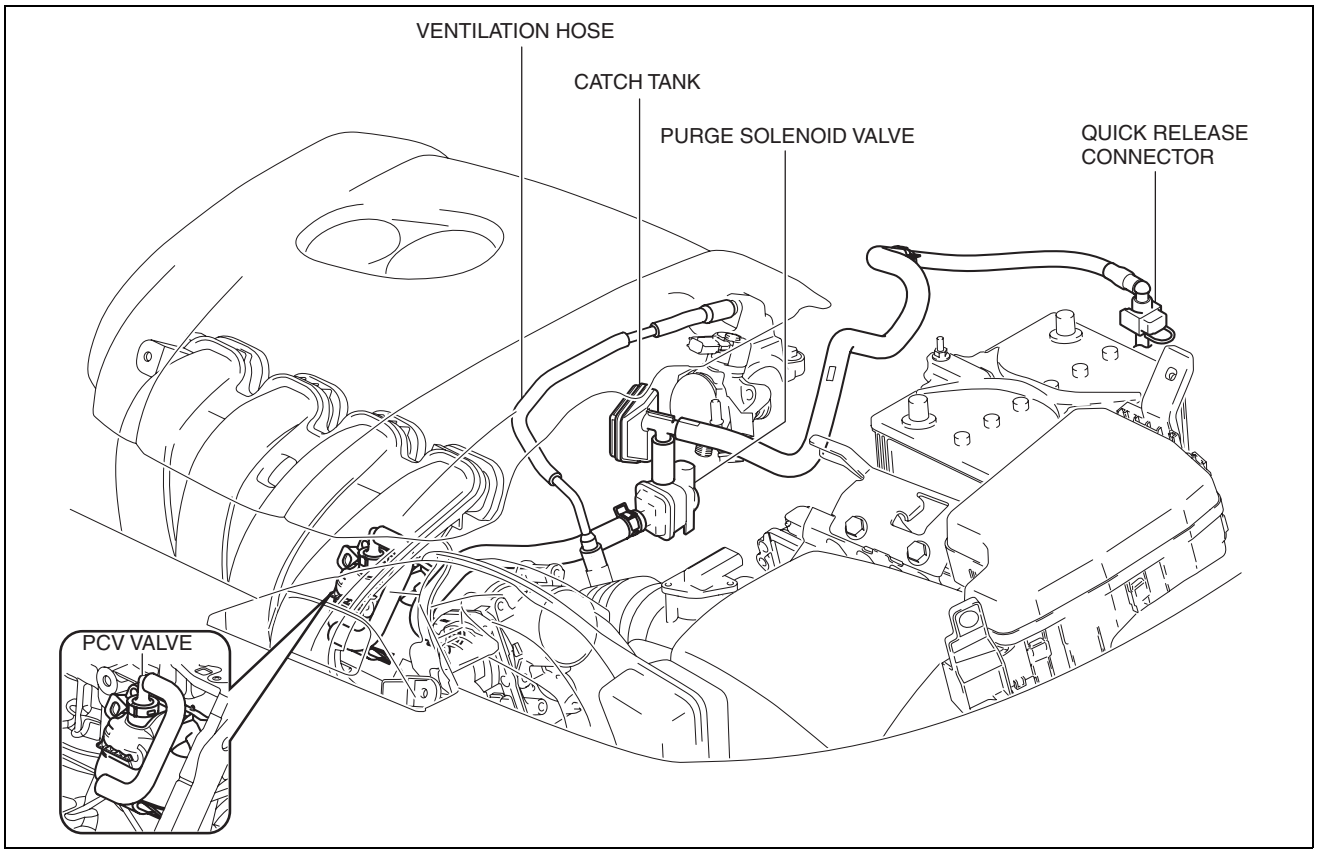
id0116z8110100

Outline

- A single-nano catalyst has been adopted for the under-floor, three-way catalyst to improve emission gas purification efficiency.

EMISSION SYSTEM [SKYACTIV-G 2.0]

Structural View
Engine compartment side



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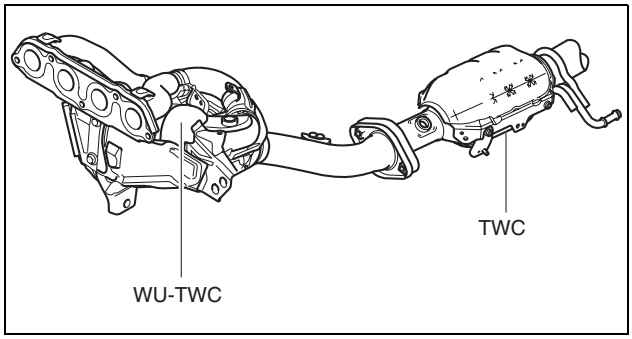
Exhaust system side
2WD



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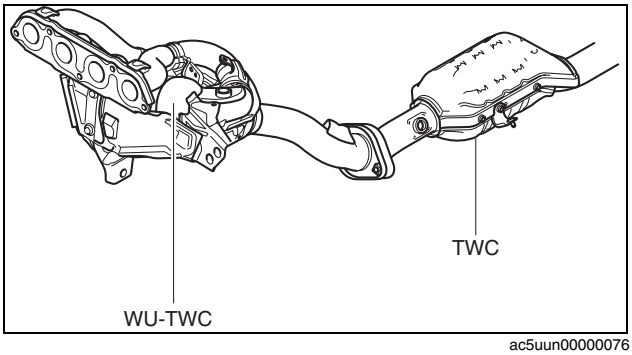
4WD



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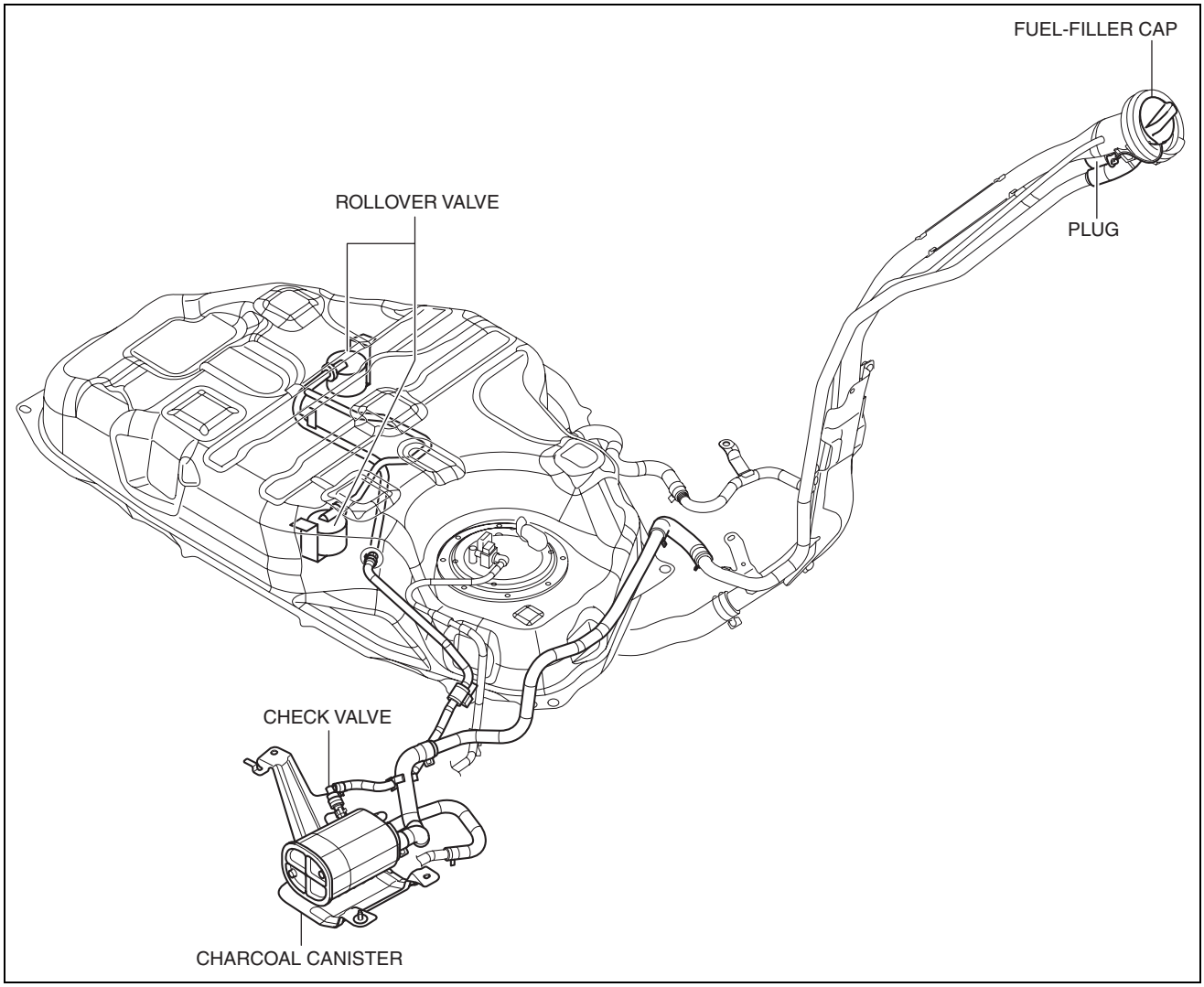
EMISSION SYSTEM [SKYACTIV-G 2.0]

Fuel tank side
2WD



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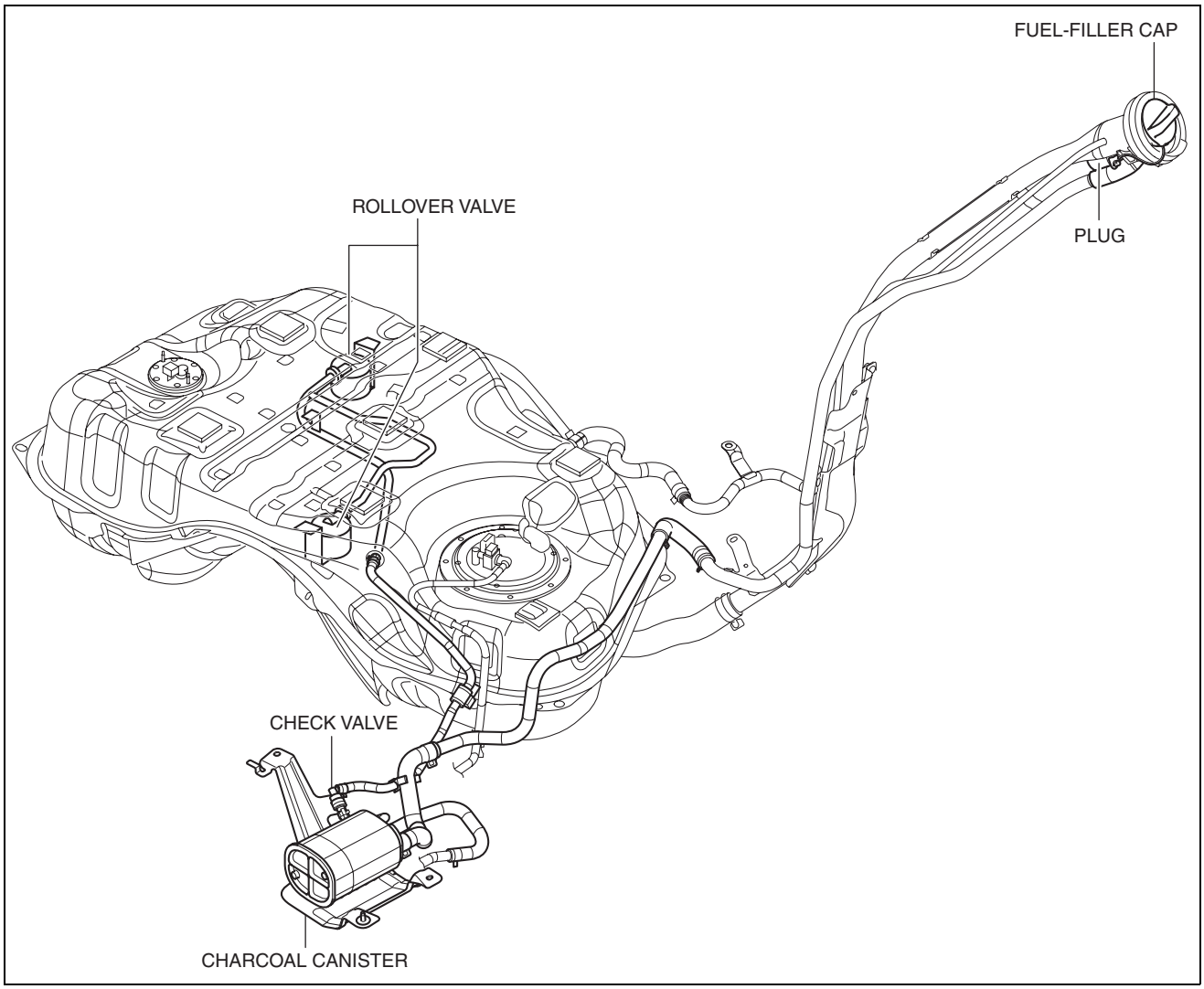
EMISSION SYSTEM [SKYACTIV-G 2.0]

4WD



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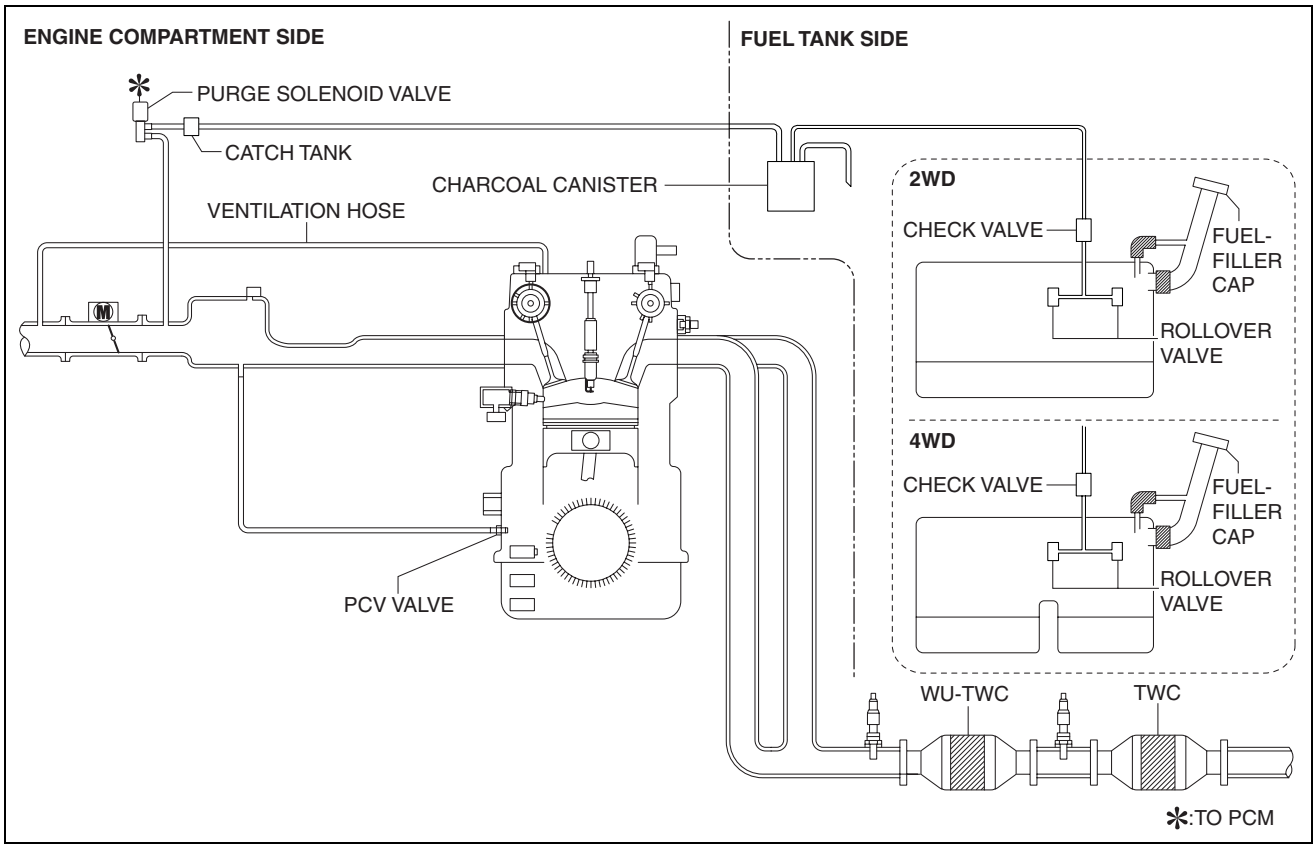
EMISSION SYSTEM [SKYACTIV-G 2.0]

System Diagram



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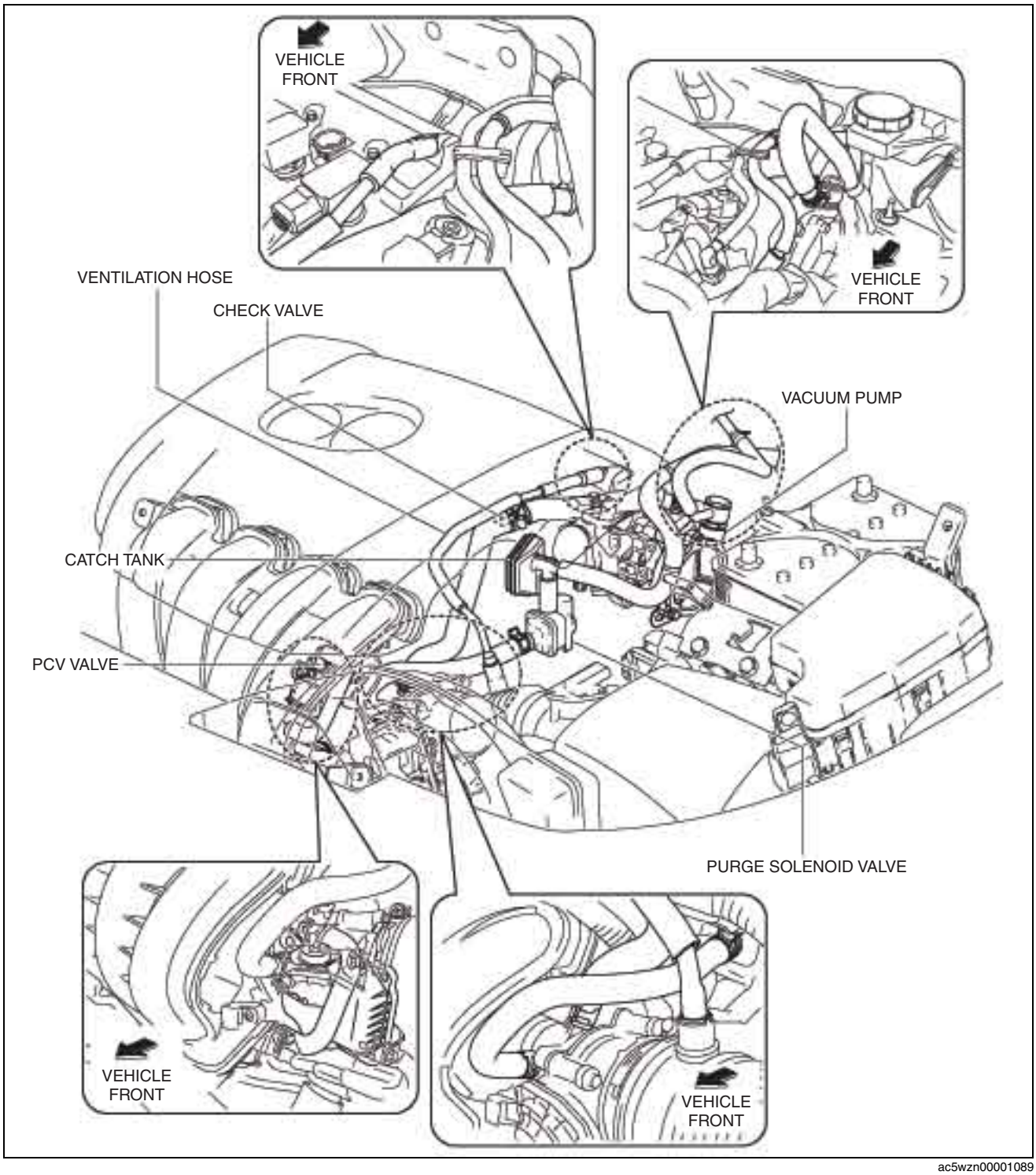
EMISSION SYSTEM [SKYACTIV-G 2.0]

Vacuum Hose Routing Diagram



ac5wzn00001089

Structure

- The emission system consists of the following parts:

Part/System name		Reference
Exhaust gas purification system (See 01-16A-7 EXHAUST GAS PURIFICATION SYSTEM [SKYACTIV-G 2.0].)	Catalytic converter	(See 01-16A-7 CATALYTIC CONVERTER [SKYACTIV-G 2.0].)
Positive crankcase ventilation system (See 01-16A-10 POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM [SKYACTIV-G 2.0].)	PCV valve	(See 01-16A-10 POSITIVE CRANKCASE VENTILATION (PCV) VALVE [SKYACTIV-G 2.0].)

EMISSION SYSTEM [SKYACTIV-G 2.0]

Part/System name		Reference
Evaporative emission control system (See 01-16A-12 EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM [SKYACTIV-G 2.0].)	Purge solenoid valve	(See 01-16A-13 PURGE SOLENOID VALVE [SKYACTIV-G 2.0].)
	Catch tank	(See 01-16A-15 CATCH TANK [SKYACTIV-G 2.0].)
	Charcoal canister	(See 01-16A-17 CHARCOAL CANISTER [SKYACTIV-G 2.0].)
	Check valve	(See 01-16A-19 CHECK VALVE [SKYACTIV-G 2.0].)
	Rollover valve	(See 01-16A-18 ROLLOVER VALVE [SKYACTIV-G 2.0].)
	Fuel-filler cap	(See 01-16A-16 FUEL-FILLER CAP [SKYACTIV-G 2.0].)
Quick release connector (emission system)		(See 01-16A-20 QUICK RELEASE CONNECTOR (EMISSION SYSTEM) [SKYACTIV-G 2.0].)

Specification

Item	Specification
Catalyst form	WU-TWC (monolith) TWC (monolith)
EVAP control system	Charcoal canister type
PCV system	Closed type

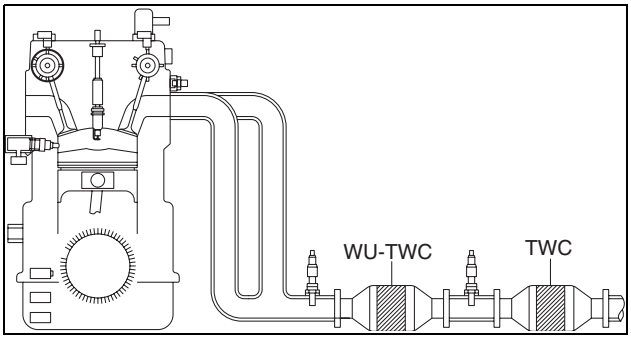
EXHAUST GAS PURIFICATION SYSTEM [SKYACTIV-G 2.0]

id0116z8113400

Purpose, Outline

- Purifies contaminants (HC, CO, NOx) in the exhaust gas by utilizing the chemical reactions of the three-way catalytic converter.

System Diagram



ac5uun00000083

Structure

- The exhaust gas purification system consists of the following parts:

Part name	Reference
WU-TWC	(See 01-16A-7 CATALYTIC CONVERTER [SKYACTIV-G 2.0].)
TWC	

CATALYTIC CONVERTER [SKYACTIV-G 2.0]

id0116z8814400

Purpose, Function

- Purifies contaminants in the exhaust gas by utilizing the chemical reactions of the three-way catalytic converter.
- A WU-TWC and a TWC have been adopted.

WU-TWC

— The three-way catalyst is integrated with the exhaust manifold.
— Because the catalyst receives the high temperature exhaust gas just after the gas is exhausted, it activates quickly and achieves an improved purification performance.

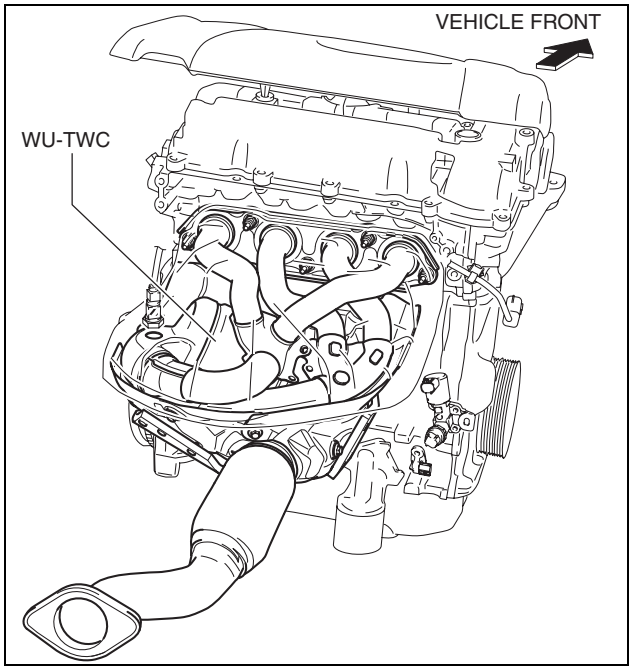
TWC

— A single-nano catalyst has been adopted in which the purification performance can be maintained using less precious metal materials than conventional catalysts.

EMISSION SYSTEM [SKYACTIV-G 2.0]

Construction
WU-TWC

- The WU-TWC is installed to the rear of the engine.
- The WU-TWC is integrated with the exhaust manifold.



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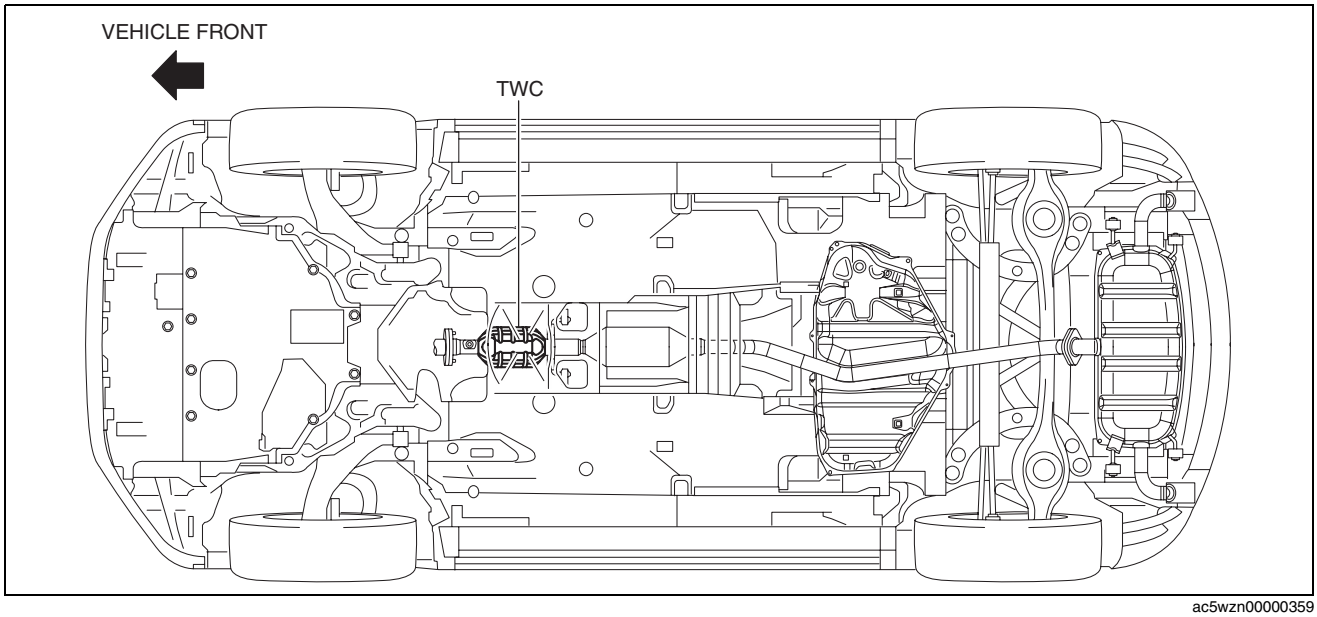
TWC

- The TWC is installed to the rear of the WU-TWC.

2WD



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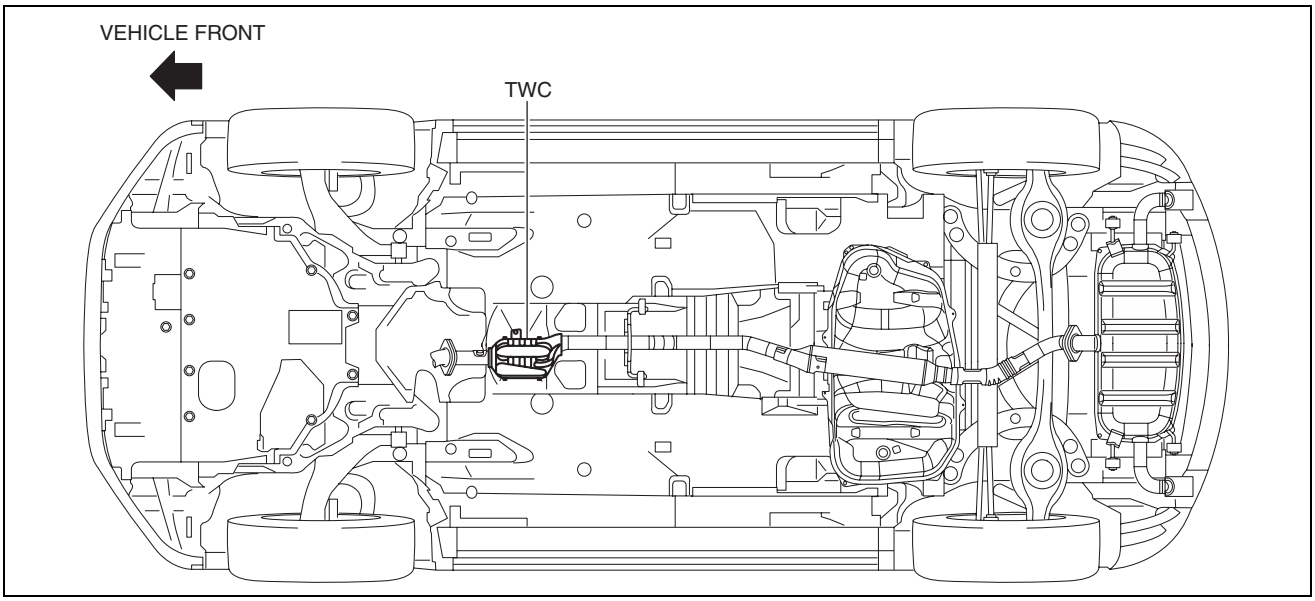
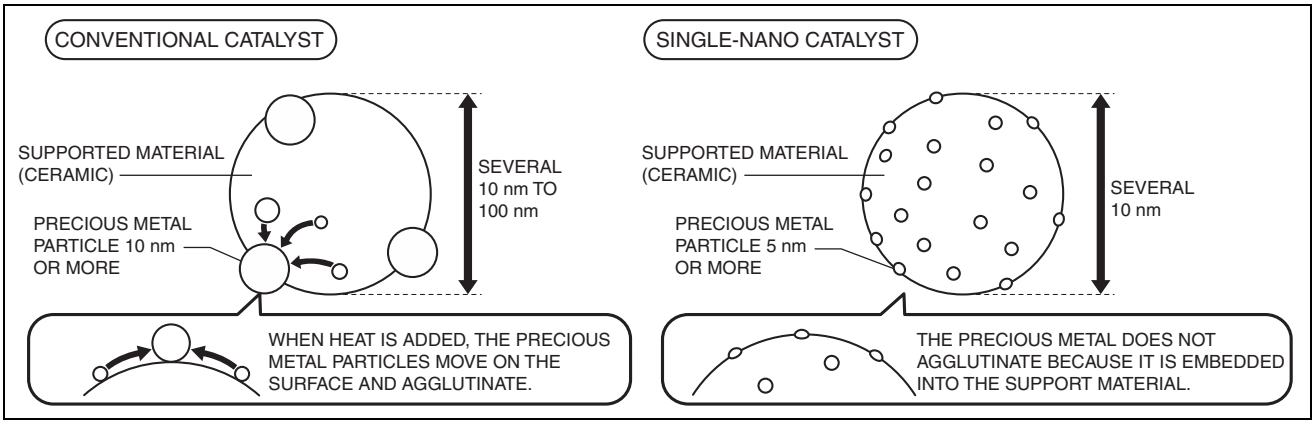
EMISSION SYSTEM [SKYACTIV-G 2.0]

4WD



ac5wzn00000360

- A single-nano catalyst has been adopted for the under-floor three-way catalyst. With a conventional three-way catalyst, the precious metals move and agglutinate to each other by the heat of the exhaust gas because they are structured such that they adhere on catalyst material. Therefore, it was necessary to use a large amount of precious metal because it is estimated that the purification performance lowers due to the decrease in the surface area of the precious metals. The single-nano catalyst is structured such that it embeds small precious metal particles into the catalyst material. Because the precious metal particles do not agglutinate on the surface of the three-way catalyst, it can maintain superior purification performance using less precious metal than the conventional system.



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Operation

- Contaminants in the exhaust gas (HC, CO, NOx) are purified by oxidization and deoxidization while they are passing through the catalytic converter.
  - — Oxidization process
    - Noxious hydrocarbon (HC) and carbon monoxide (CO) are bound with oxygen and converted to non-noxious carbon dioxide and water.
      $O_2+HC+CO \rightarrow CO_2+H_2O$
  - — Deoxidization process
    - Noxious nitrogen oxide (NOx) is converted to non-noxious nitrogen and oxygen. A part of the oxygen generated in this process is used in the oxidization process.
      $NOx \rightarrow N_2+O_2$

EMISSION SYSTEM [SKYACTIV-G 2.0]

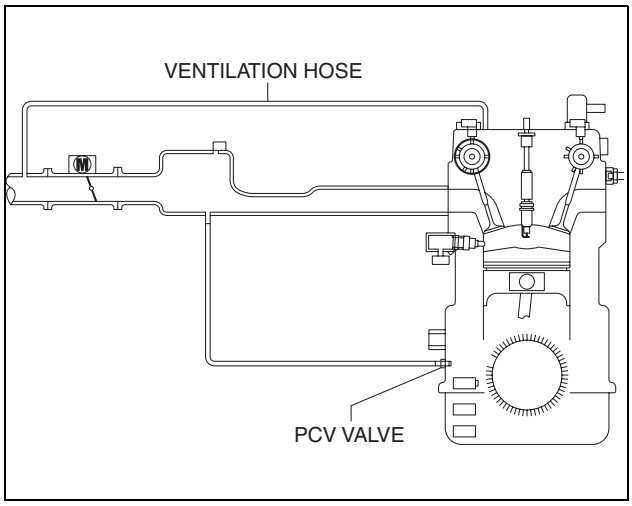
POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM [SKYACTIV-G 2.0]

id0116z8148900

Purpose, Outline

- Prevents release of blow-by gas (unburnt gas) into the atmosphere.
- The intake manifold vacuum introduces blow-by gas to the intake manifold via the PCV valve and the ventilation hose.

System Diagram



ac5uun00000087

Structure

- The positive crankcase ventilation system consists of the following parts:

Part name	Reference
PCV valve	(See 01-16A-10 POSITIVE CRANKCASE VENTILATION (PCV) VALVE [SKYACTIV-G 2.0].)
Ventilation hose	—

POSITIVE CRANKCASE VENTILATION (PCV) VALVE [SKYACTIV-G 2.0]

id0116z8153200

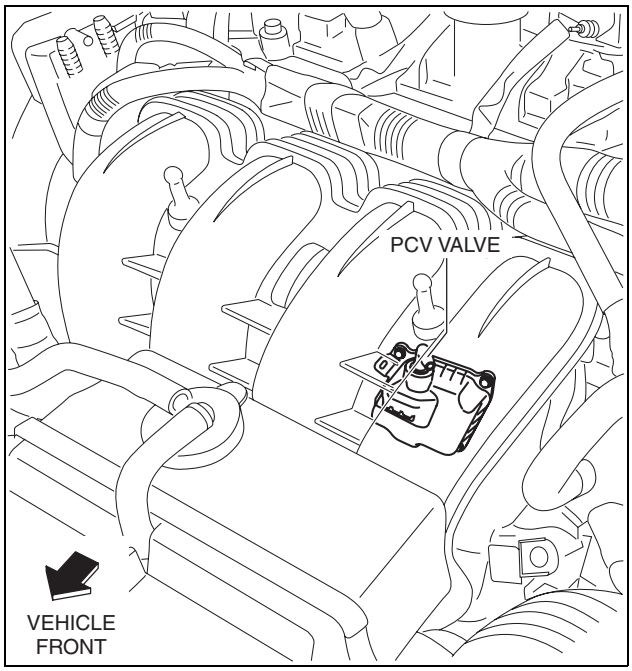
Purpose, Function

- Prevents release of blow-by gas (unburnt gas) into the atmosphere.
- The PCV valve is open/closed by the intake manifold vacuum.

EMISSION SYSTEM [SKYACTIV-G 2.0]

Construction

- The PCV valve is installed to the oil separator.



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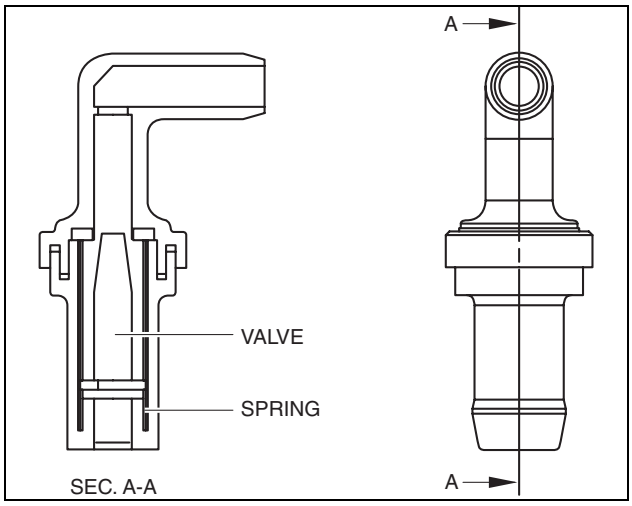
- The PCV valve consists of a spring and valve.



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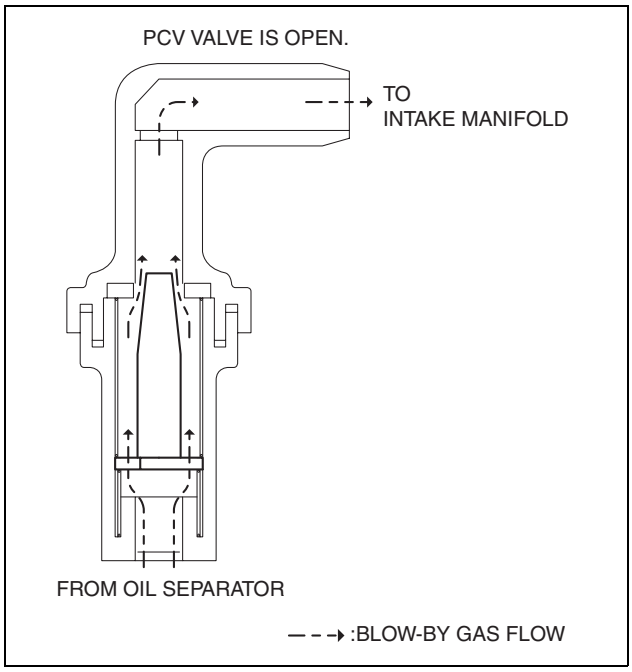
EMISSION SYSTEM [SKYACTIV-G 2.0]

Operation

- When the valve is pulled by the intake manifold vacuum, blow-by gas flows to the intake manifold.
- Blow-by gas flow amount is adjusted by the spring according to the intake manifold vacuum.



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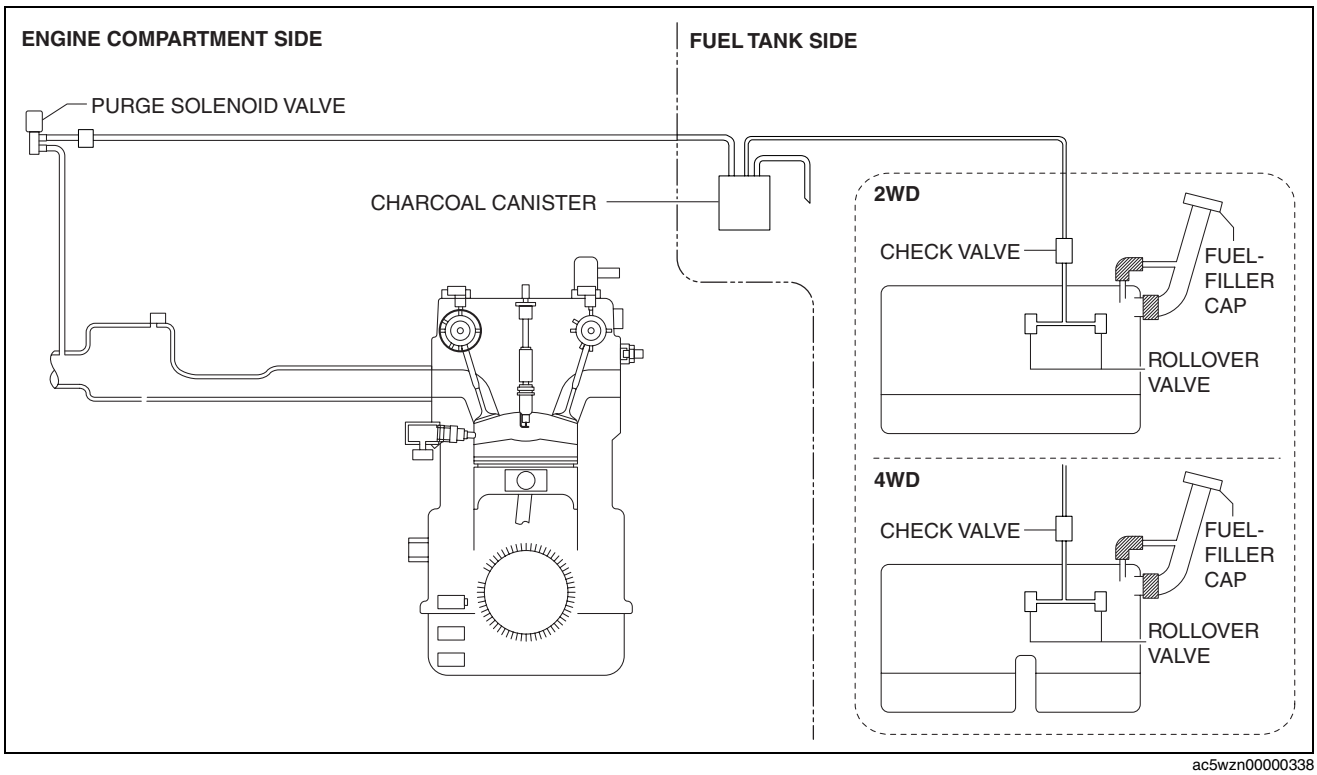
EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM [SKYACTIV-G 2.0]

id0116z8108800

Purpose, Outline

- Prevents release of evaporative gas into the atmosphere.
- The intake manifold vacuum introduces evaporative gas to the intake manifold via the charcoal canister and the purge solenoid valve.

System Diagram



ac5wzn00000338

Structure

- The evaporative emission control system consists of the following parts:

EMISSION SYSTEM [SKYACTIV-G 2.0]

Part name	Reference
Purge solenoid valve	(See 01-16A-13 PURGE SOLENOID VALVE [SKYACTIV-G 2.0].)
Catch tank	(See 01-16A-15 CATCH TANK [SKYACTIV-G 2.0].)
Charcoal canister	(See 01-16A-17 CHARCOAL CANISTER [SKYACTIV-G 2.0].)
Check valve	(See 01-16A-19 CHECK VALVE [SKYACTIV-G 2.0].)
Rollover valve	(See 01-16A-18 ROLLOVER VALVE [SKYACTIV-G 2.0].)
Fuel-filler cap	(See 01-16A-16 FUEL-FILLER CAP [SKYACTIV-G 2.0].)

PURGE SOLENOID VALVE [SKYACTIV-G 2.0]

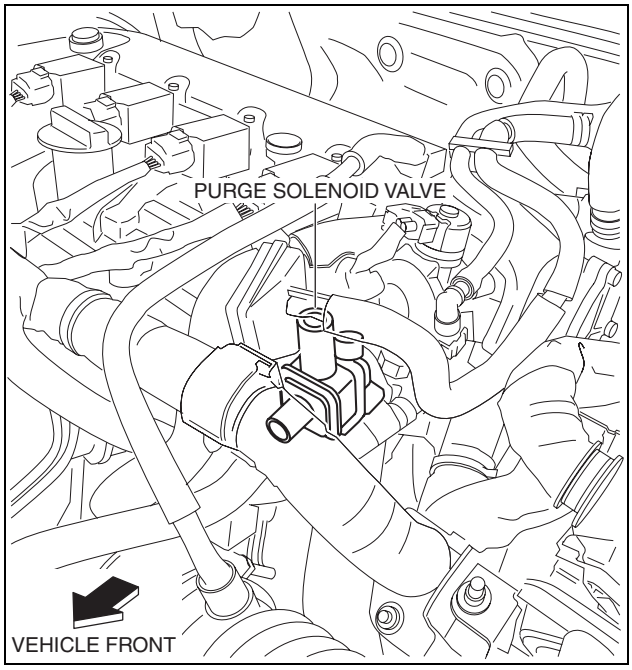
id0116z8112300

Purpose, Function

- Introduces evaporative gas absorbed by the charcoal canister to the intake manifold.
- The purge solenoid valve opens according to the control signal from the PCM.

Construction

- The purge solenoid valve is installed in the engine compartment.



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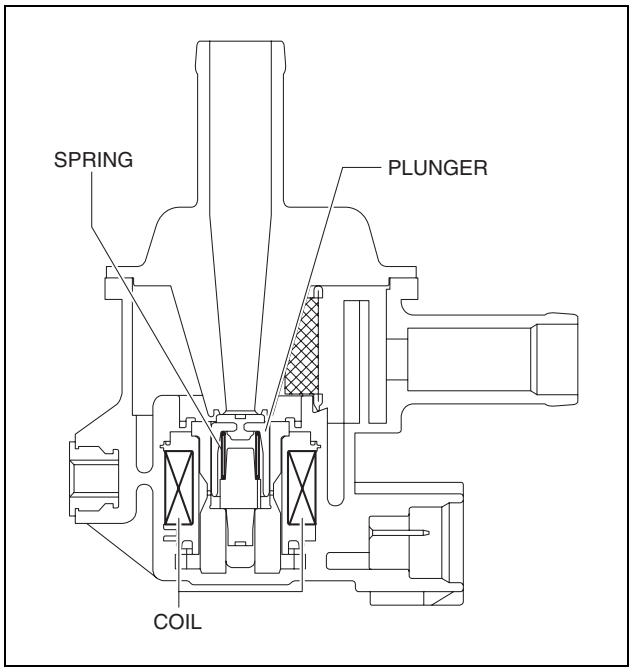
EMISSION SYSTEM [SKYACTIV-G 2.0]

- The purge solenoid valve consists of a coil, spring, and plunger.



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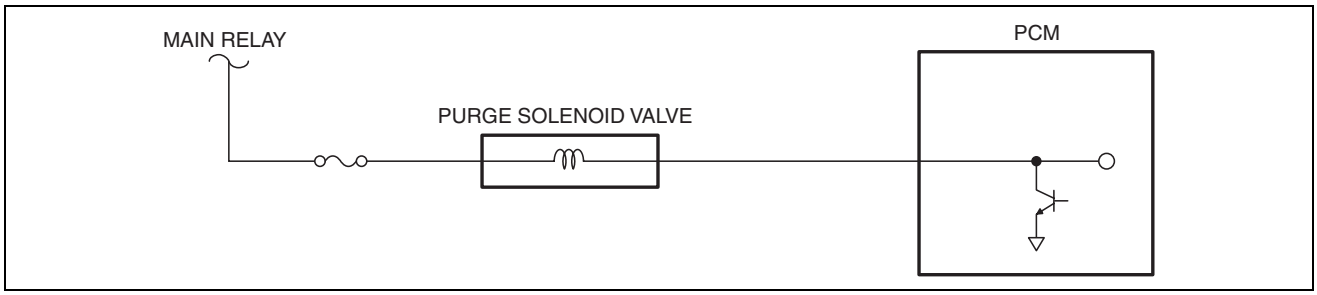
Operation

- According to the control signal from the PCM, the coil is energized and the plunger is operated to open/close the purge solenoid valve.



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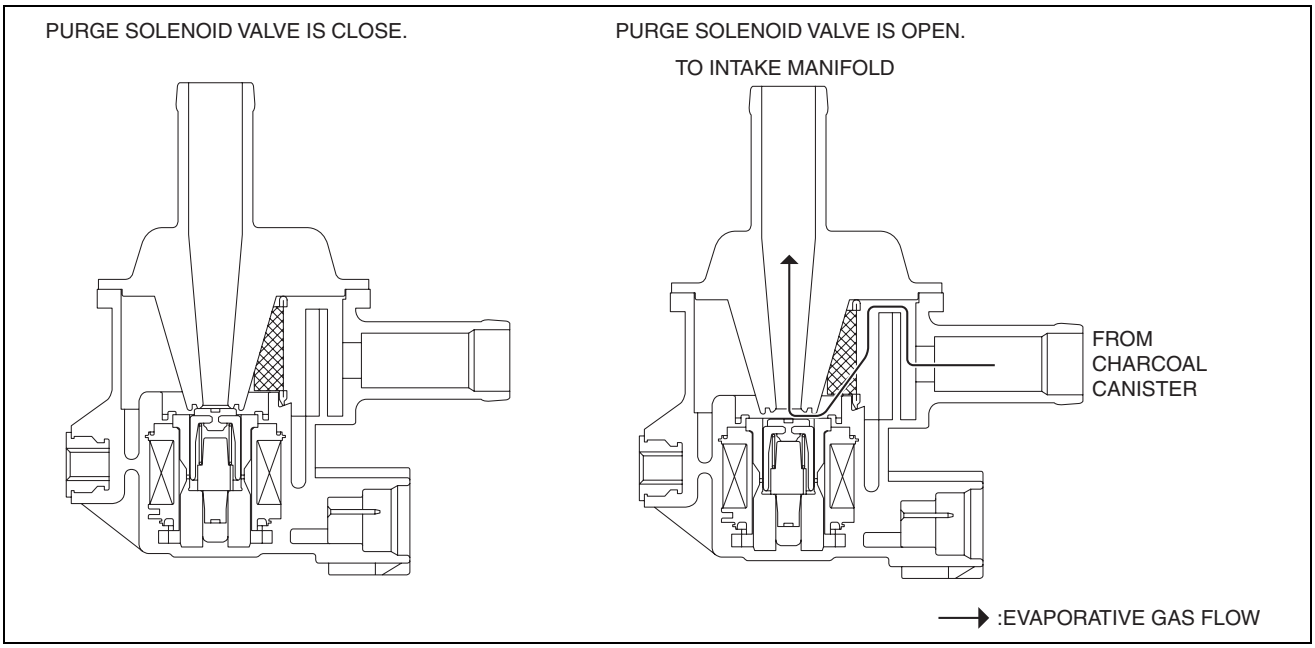
- When the purge solenoid valve is open, evaporative gas flows from the charcoal canister to the intake manifold side.

EMISSION SYSTEM [SKYACTIV-G 2.0]

Purge solenoid valve open/closed view



am3uun0000215

- For evaporative purge control details, refer to CONTROL SYSTEM. (See 01-40-34 PURGE CONTROL [SKYACTIV-G 2.0].)

Fail-safe

- —

CATCH TANK [SKYACTIV-G 2.0]

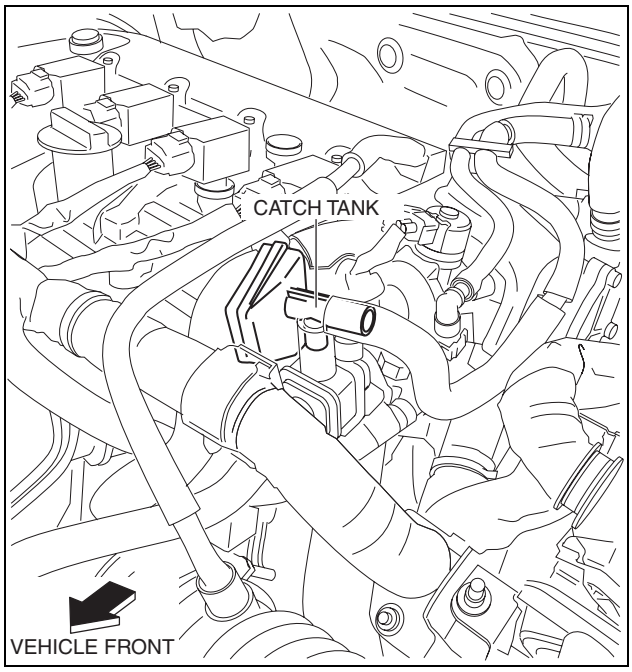
id0116z8174500

Purpose, Function

- Suppresses pulsation occurring before evaporative gas is inducted into the intake manifold.

Construction

- The catch tank is installed in the engine compartment.

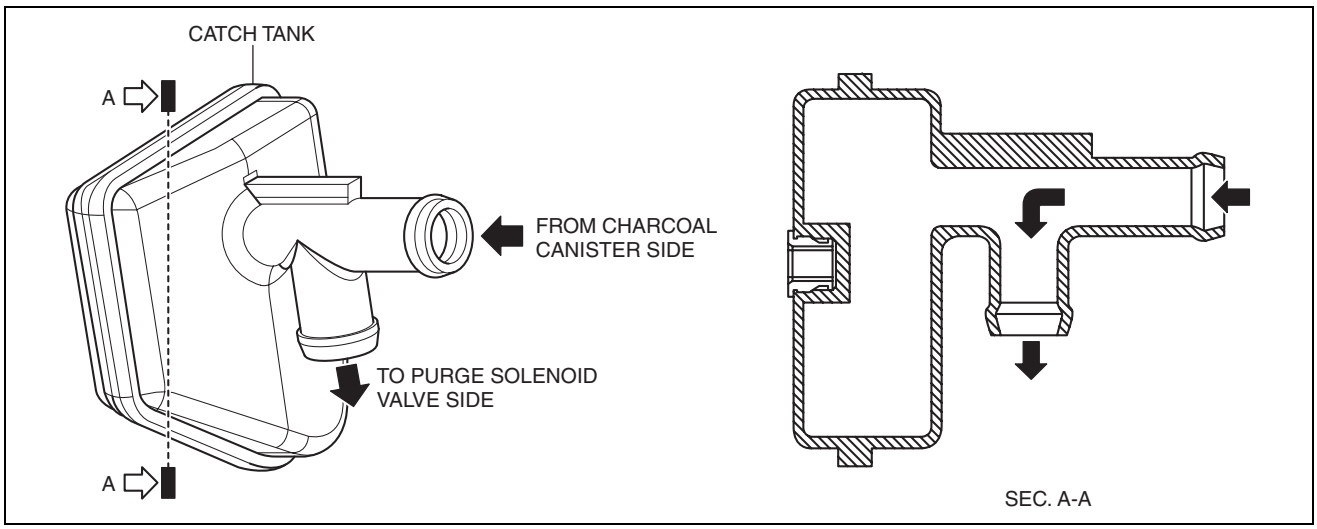


ac5uun00000092

EMISSION SYSTEM [SKYACTIV-G 2.0]

Operation

- When evaporative gas flows from the charcoal canister to the purge solenoid valve, pulsation is suppressed by passing the evaporative gas through the hollowing of the catch tank.



am3uun0000217

FUEL-FILLER CAP [SKYACTIV-G 2.0]

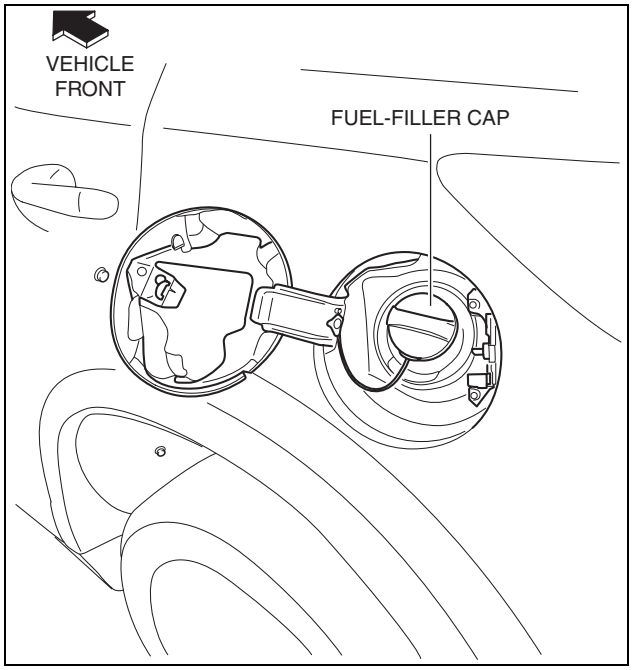
id0116z8112700

Purpose, Function

- Releases evaporative gas from the fuel tank if there is a malfunction in the evaporative gas passage between the fuel tank and the intake manifold. As a result, deformation of the fuel tank caused by evaporative gas pressure is prevented.

Construction

- The fuel-filler cap is installed to the fuel filler opening.



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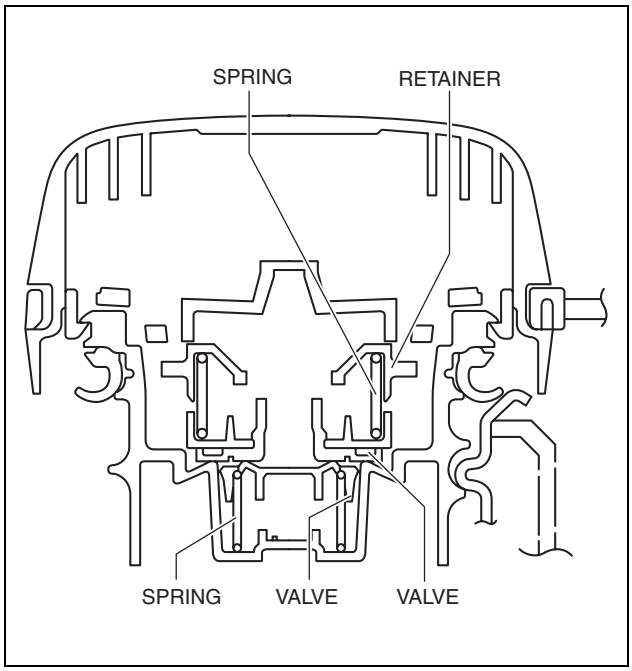
EMISSION SYSTEM [SKYACTIV-G 2.0]

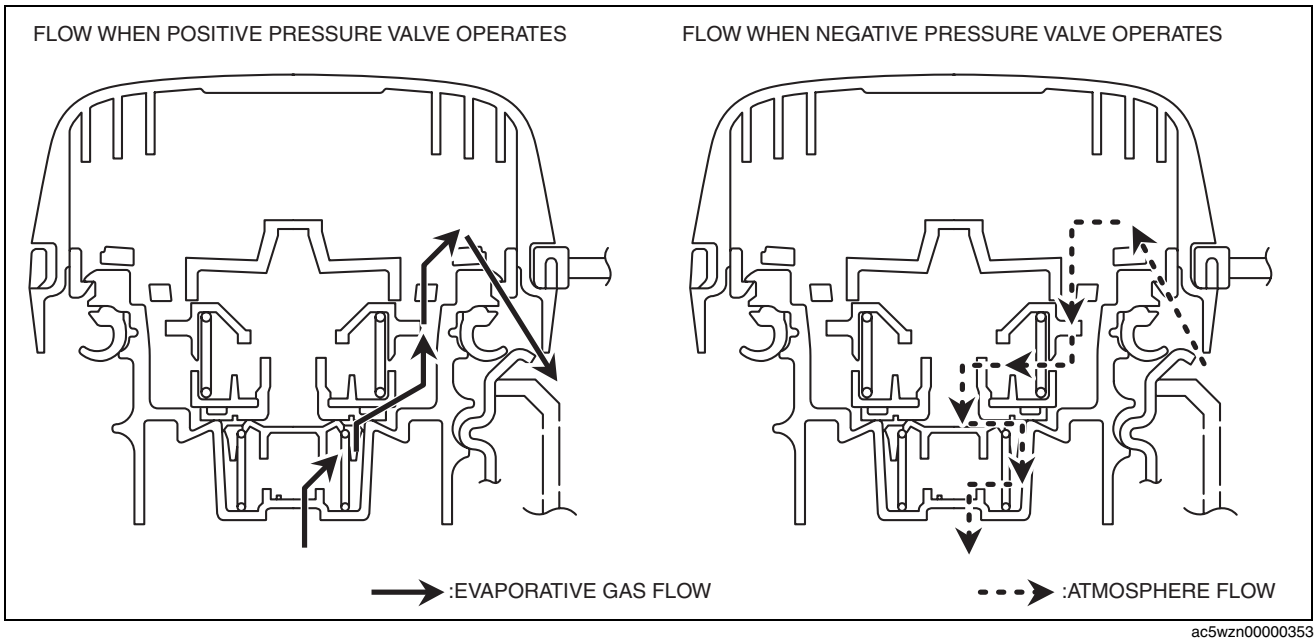
- The fuel-filler cap consists of a valves, retainer, and springs.



ac5wzn00000352

Operation

- When there is positive pressure in the fuel tank due to evaporative gas, evaporative gas is released into the atmosphere. When there is negative pressure, air is introduced to the fuel tank.



ac5wzn00000353

CHARCOAL CANISTER [SKYACTIV-G 2.0]

id0116z8121900

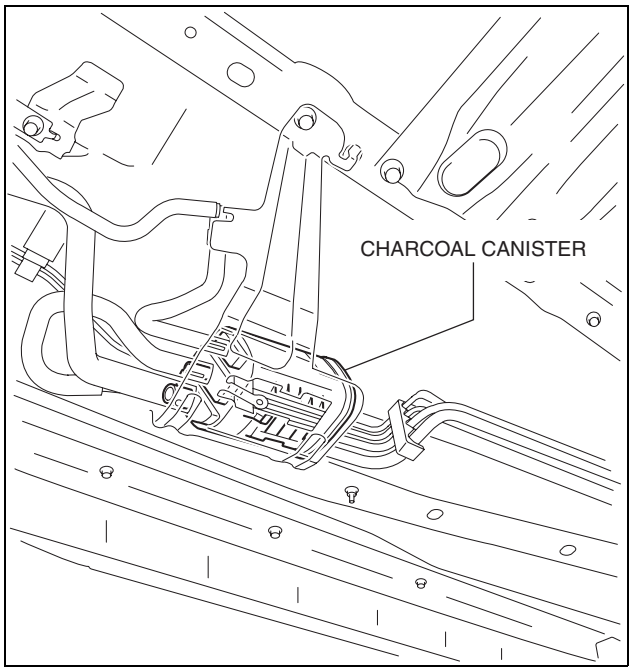
Purpose, Function

- Absorbs evaporative gas flowing from the fuel tank to prevent release of the gas into the atmosphere.

EMISSION SYSTEM [SKYACTIV-G 2.0]

Construction

- The charcoal canister is installed near the fuel tank.
- The charcoal canister has activated charcoal to absorb evaporative gas.



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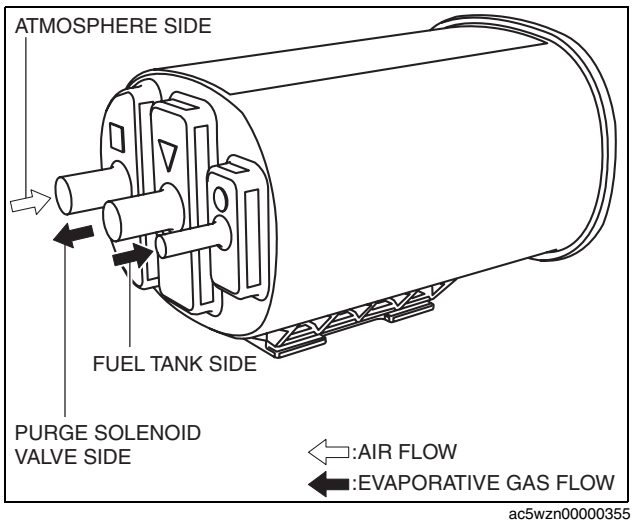
Operation

- When the purge solenoid valve is open, evaporative gas, which is absorbed by the activated charcoal, is released by the intake manifold vacuum and the gas flows to the intake manifold.



ac5wzn00000355

ROLLOVER VALVE [SKYACTIV-G 2.0]

id0116z8122900

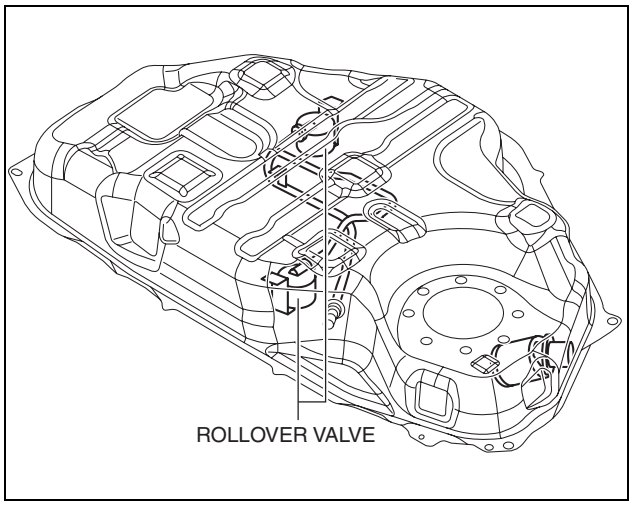
Purpose, Function

- Prevents fuel from flowing into the evaporative gas passage during sudden cornering or vehicle rollover.

EMISSION SYSTEM [SKYACTIV-G 2.0]

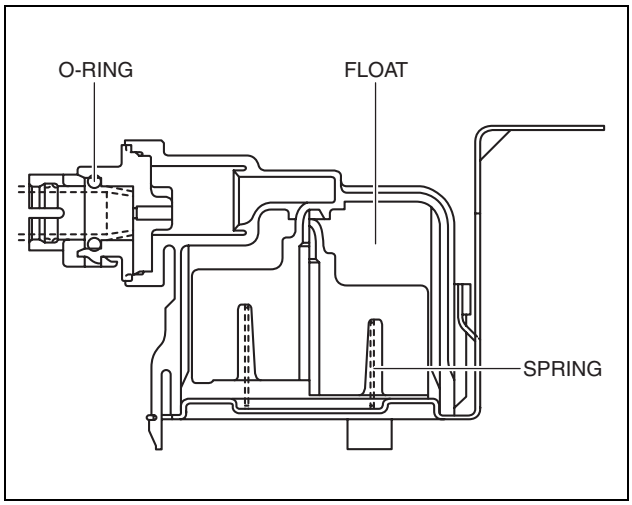
Construction

- The rollover valve is built into the fuel tank.



ac5wzn00000356

- The rollover valve consists of a float, O-ring and spring.



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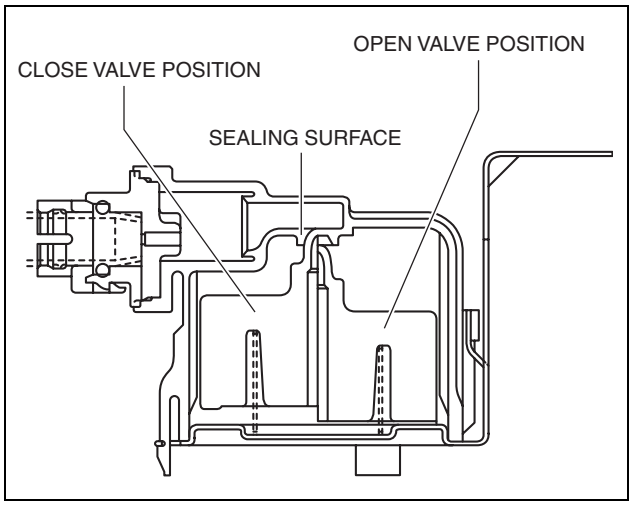
Operation

- The rollover valve utilizes a combination of float weight, spring force, and buoyancy. When the float is immersed in the fuel, the float (valve) closes to block the sealing surface of the passage.



am3uun0000216

CHECK VALVE [SKYACTIV-G 2.0]

id0116z8196900

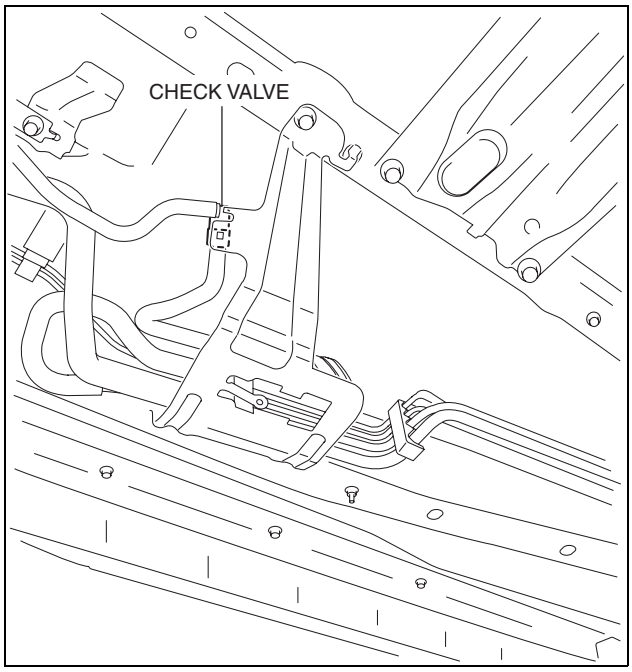
Purpose, Function

- The check valve maintain the pressure in the fuel tank at constant pressure.

EMISSION SYSTEM [SKYACTIV-G 2.0]

Construction

- The check valve is installed to the side of the charcoal canister.



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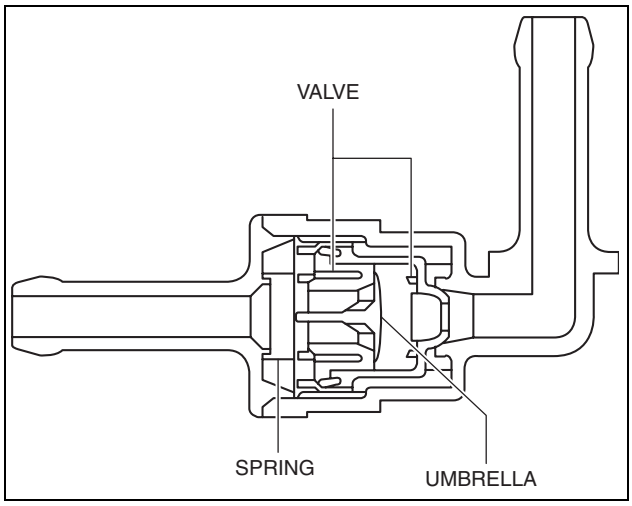
- Mainly consists of valve, umbrella, and spring.



ac5wzn00000358

Operation

- The valve moves in response to the difference in air pressure between the fuel tank side and the atmospheric side, thereby changing the path of airflow.
- When the pressure in the fuel tank becomes negative due to fuel consumption or other factors, the path opens, drawing atmospheric air into the fuel tank.

QUICK RELEASE CONNECTOR (EMISSION SYSTEM) [SKYACTIV-G 2.0]

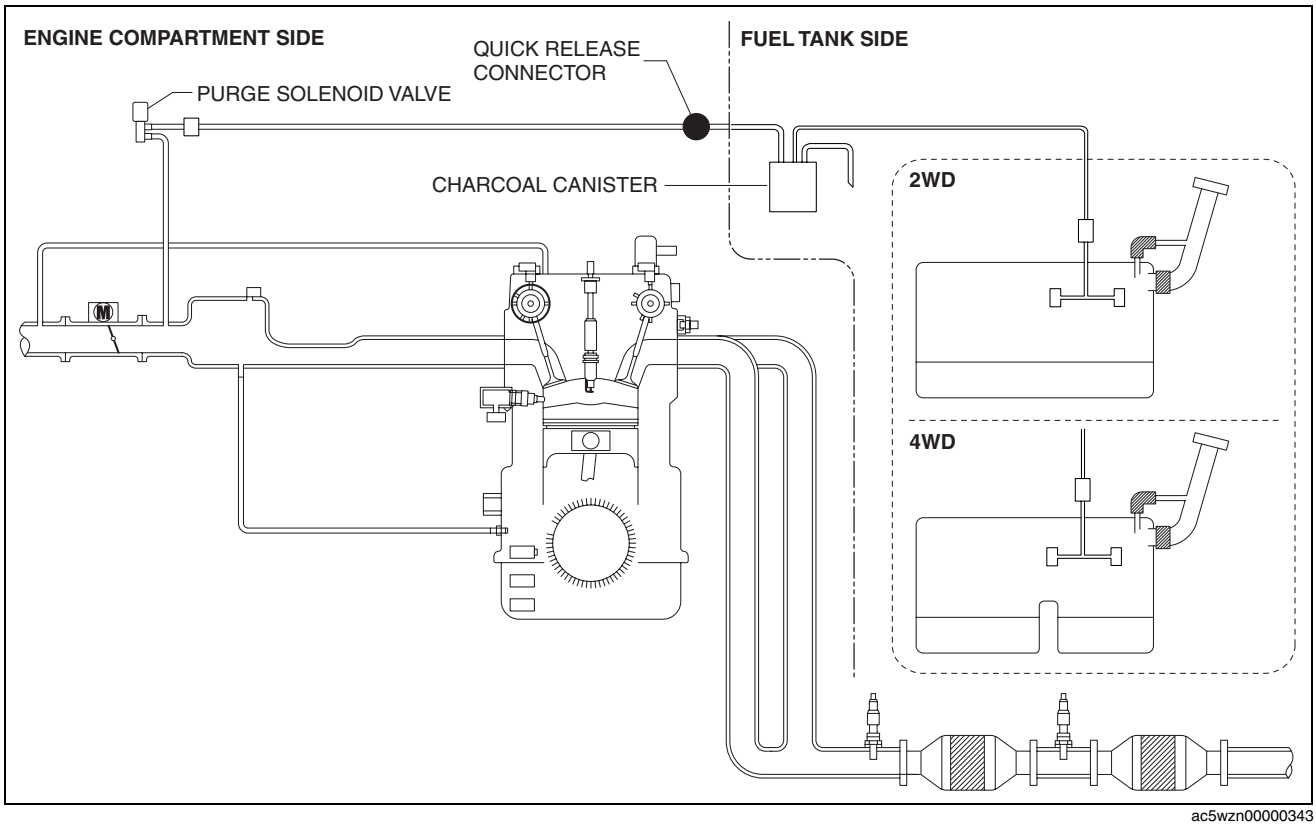
id0116z8153000

Purpose, Function

- Serviceability has been improved by the easy disconnection/connection.

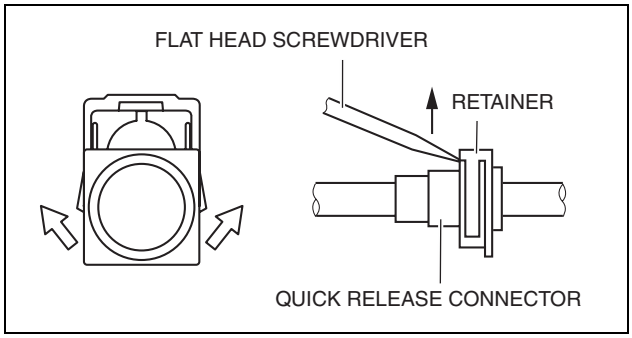
EMISSION SYSTEM [SKYACTIV-G 2.0]

Construction



ac5wzn00000343

- An SST is not used with this type.
- Mainly consists of a retainer and O-ring. The quick release connector is integrated with the evaporative hose and therefore cannot be disassembled.
- When the quick release connector is connected, the evaporative pipe projection is locked at the clamp lock point. To release the quick connector lock for each type, follow the procedure in the order shown in each figure.



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01-16B EMISSION SYSTEM [SKYACTIV-D 2.2]

EMISSION SYSTEM [SKYACTIV-D 2.2]

EMISSION SYSTEM [SKYACTIV-D 2.2]

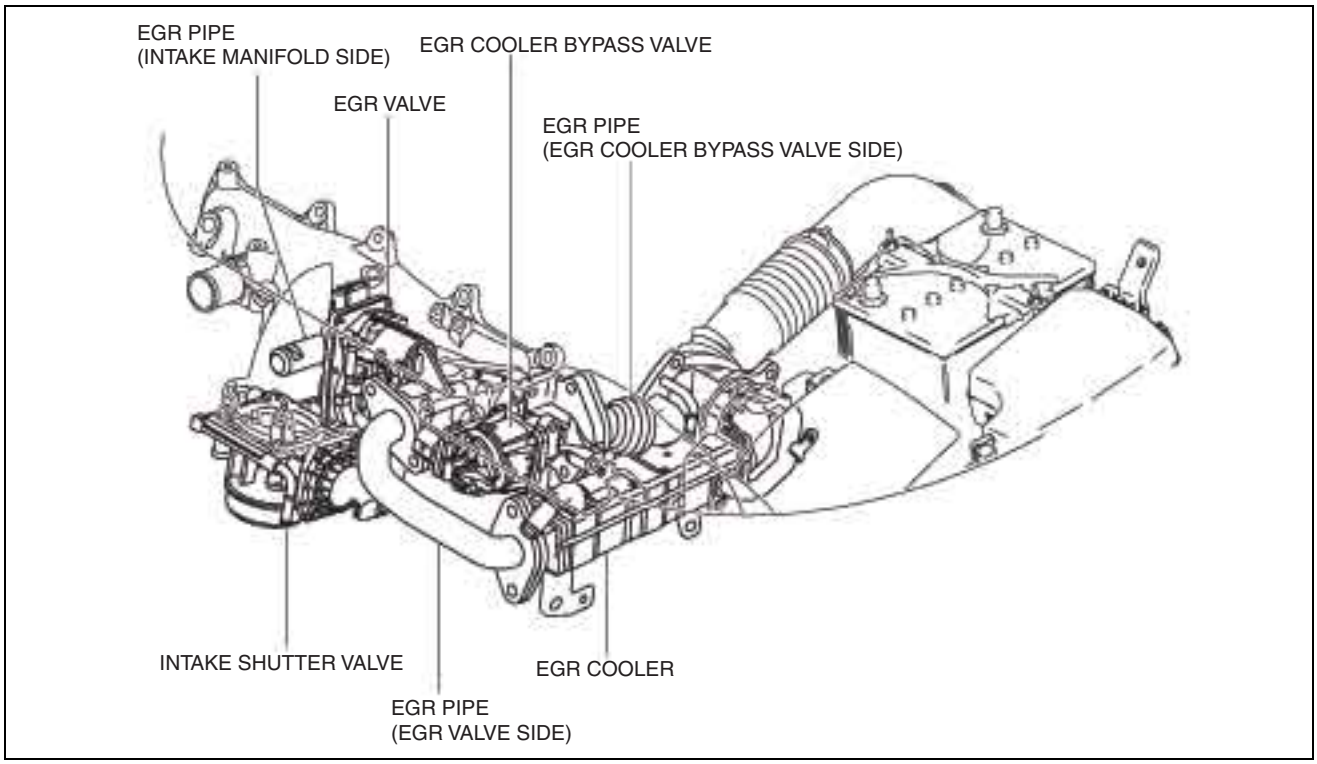
id0116e1110100

Outline

- Diesel particulate elimination equipment (Diesel Particulate Filter (DPF) has been adopted which eliminates PM from the exhaust gas.

EMISSION SYSTEM [SKYACTIV-D 2.2]

Structural view
Engine compartment side



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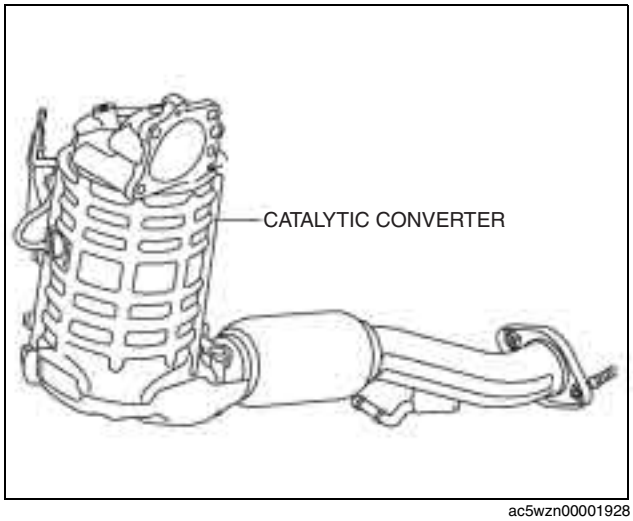
Exhaust system side
2WD



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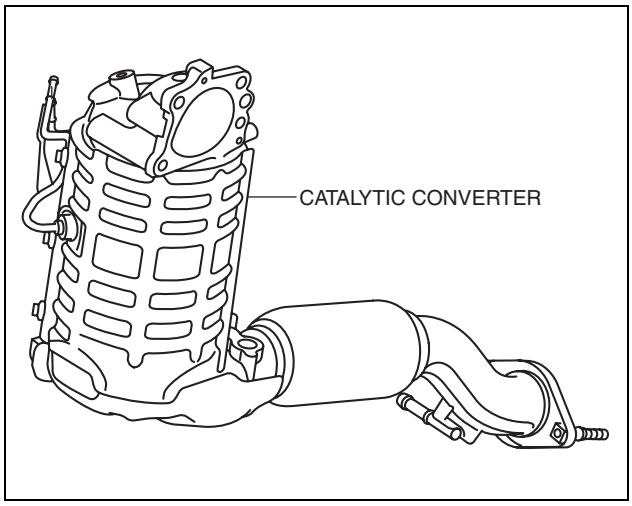
EMISSION SYSTEM [SKYACTIV-D 2.2]

4WD



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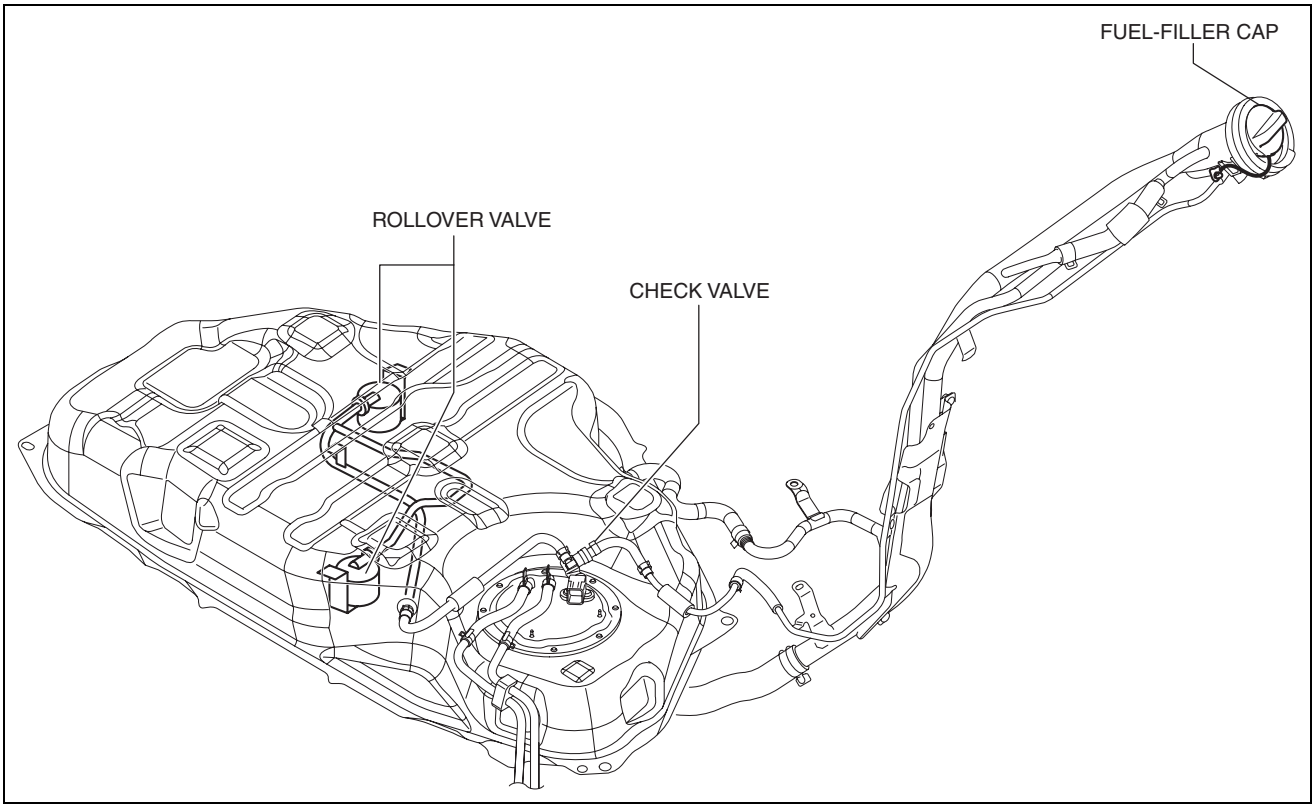
Fuel tank side
2WD



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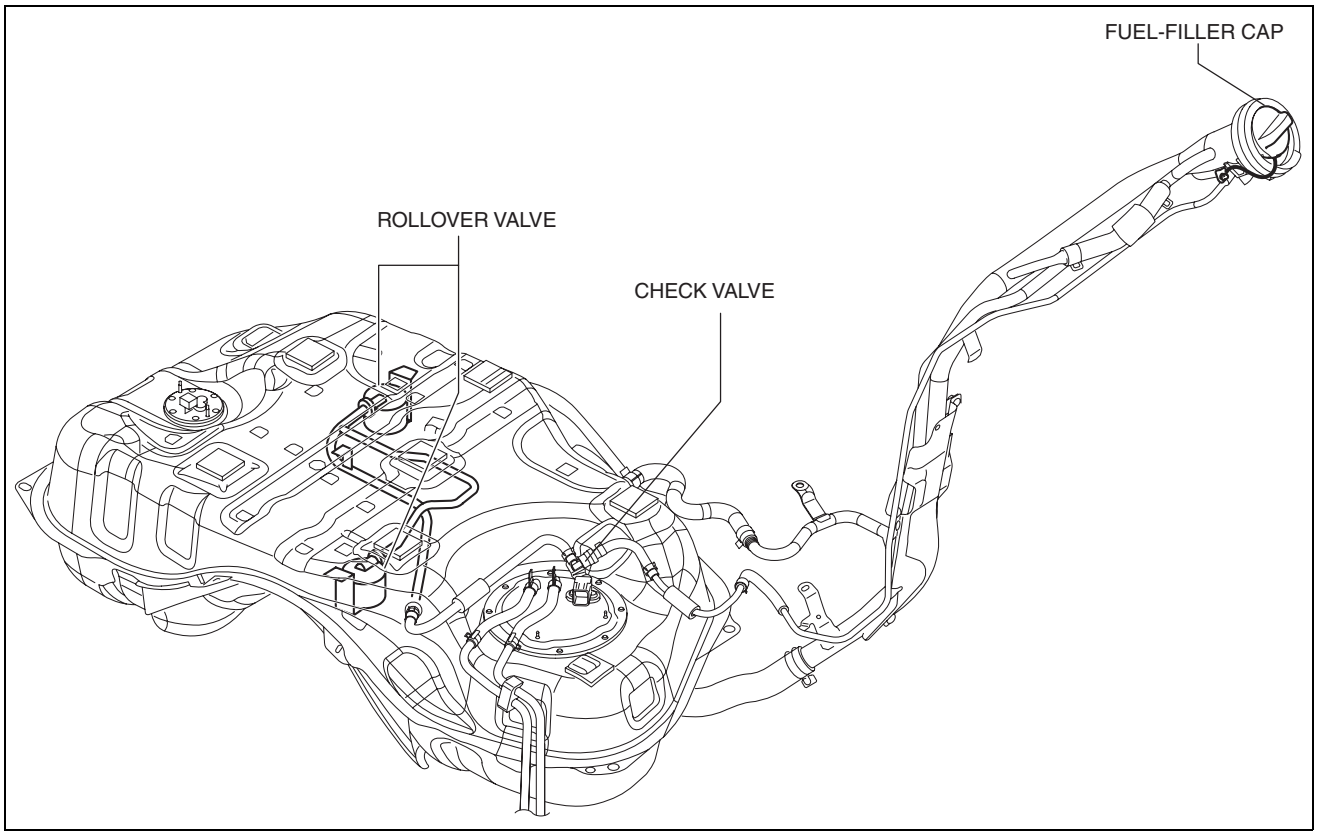
EMISSION SYSTEM [SKYACTIV-D 2.2]

4WD



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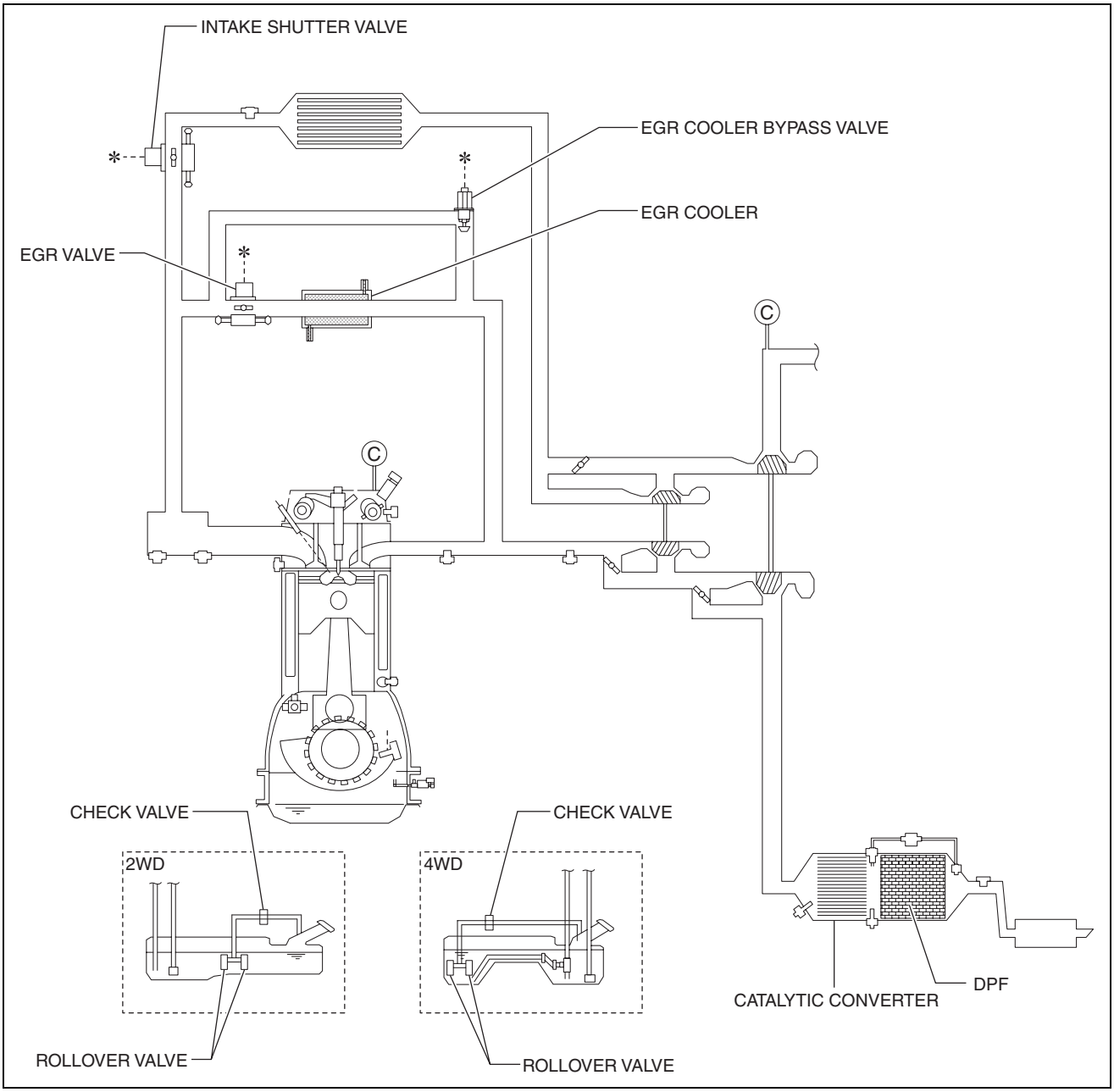
EMISSION SYSTEM [SKYACTIV-D 2.2]

System diagram



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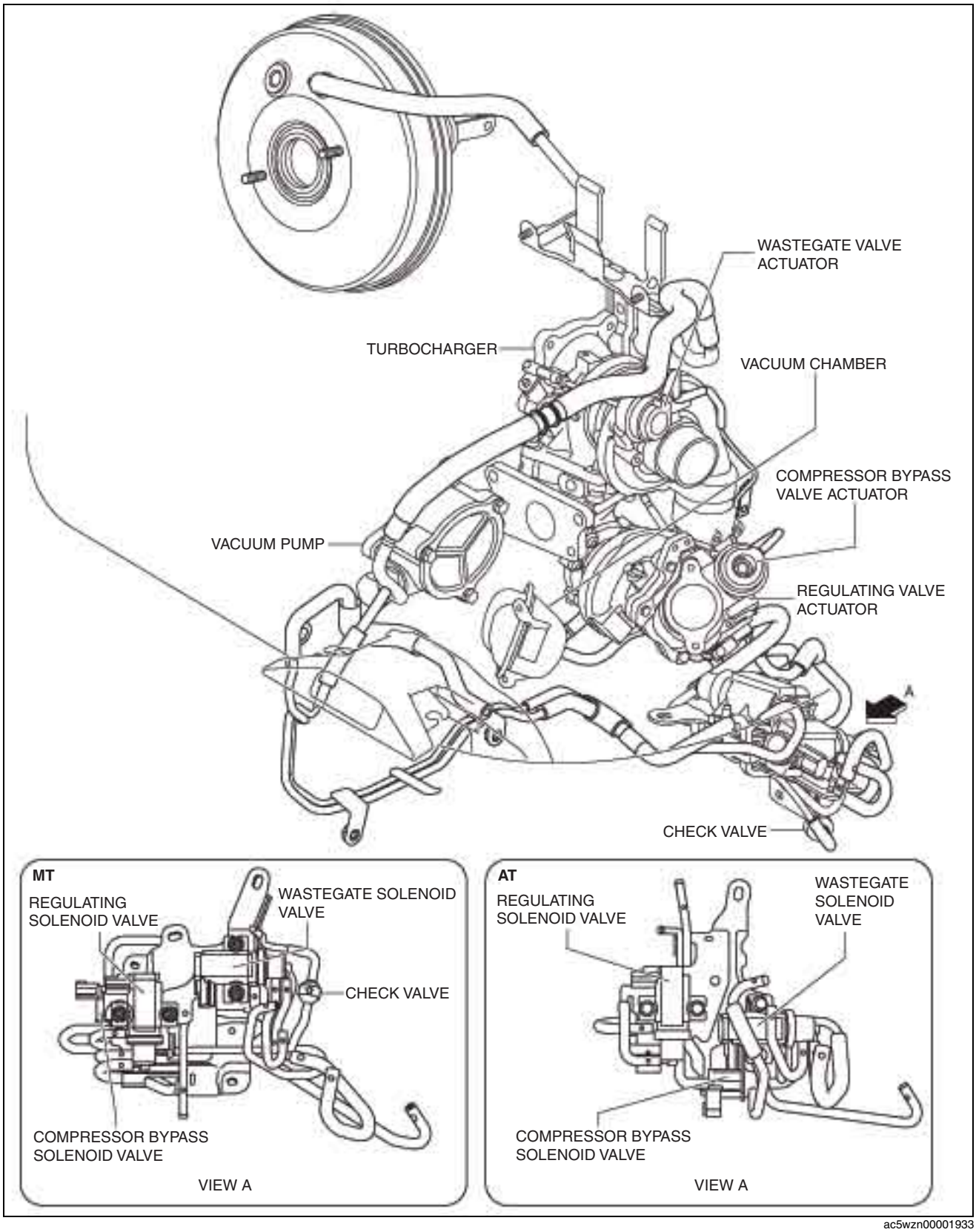
EMISSION SYSTEM [SKYACTIV-D 2.2]

Vacuum piping diagram



ac5wzn00001933

Structure

- The emission system consists of the following parts:

EMISSION SYSTEM [SKYACTIV-D 2.2]

Part/System name		Reference
Exhaust gas purification system (See 01-16B-7 EXHAUST GAS PURIFICATION SYSTEM [SKYACTIV-D 2.2].)	Catalytic converter	(See 01-16B-7 CATALYTIC CONVERTER [SKYACTIV-D 2.2].)
Exhaust gas recirculation system (See 01-16B-8 EXHAUST GAS RECIRCULATION SYSTEM [SKYACTIV-D 2.2].)	EGR valve	(See 01-16B-9 EGR VALVE [SKYACTIV-D 2.2].)
	EGR cooler	(See 01-16B-10 EGR COOLER [SKYACTIV-D 2.2].)
	EGR cooler bypass valve	(See 01-16B-11 EGR COOLER BYPASS VALVE [SKYACTIV-D 2.2].)
Fuel-filler cap		(See 01-16B-12 FUEL-FILLER CAP [SKYACTIV-D 2.2].)
Rollover valve		(See 01-16B-13 ROLLOVER VALVE [SKYACTIV-D 2.2].)
Check valve		(See 01-16B-15 CHECK VALVE [SKYACTIV-D 2.2].)
Diesel particulate filter (DPF)		(See 01-16B-15 DIESEL PARTICULATE FILTER [SKYACTIV-D 2.2].)
Intake shutter valve		(See 01-16B-16 INTAKE SHUTTER VALVE [SKYACTIV-D 2.2].)

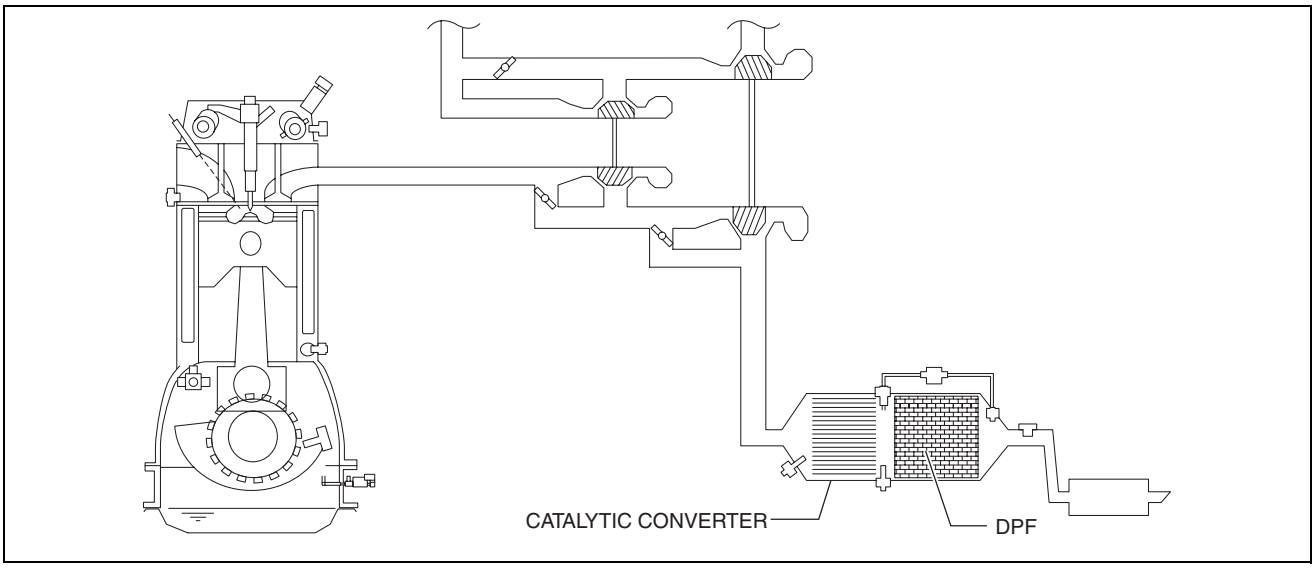
EXHAUST GAS PURIFICATION SYSTEM [SKYACTIV-D 2.2]

id0116e1113400

Purpose, Outline

- Purifies contaminants in the exhaust gas by utilizing chemical reactions.

System diagram



ac5wzn00001934

Structure

- The exhaust gas purification system consists of the following parts:

Part name	Reference
Catalytic converter	(See 01-16B-7 CATALYTIC CONVERTER [SKYACTIV-D 2.2].)

CATALYTIC CONVERTER [SKYACTIV-D 2.2]

id0116e1814400

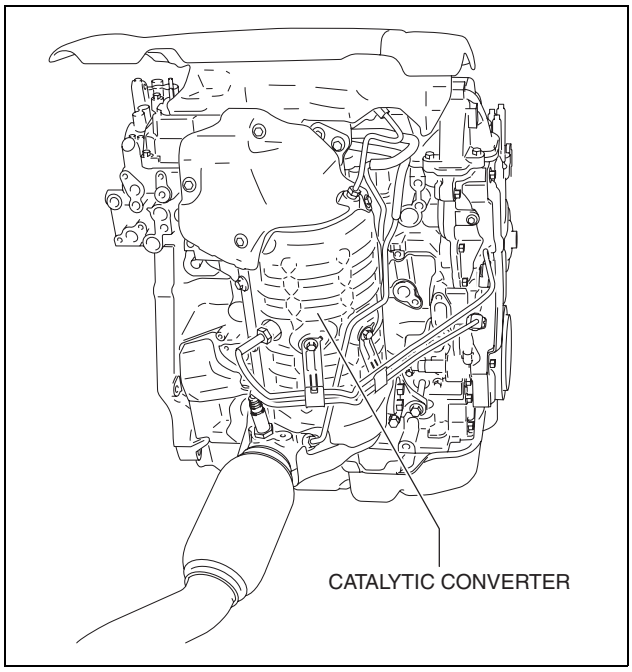
Purpose, Function

- Purifies contaminants in the exhaust gas by utilizing chemical reactions.

EMISSION SYSTEM [SKYACTIV-D 2.2]

Construction

- The catalytic converter is installed to the rear of the engine.



ac5wzn00001982

Operation

- The catalytic converter converts the noxious carbon monoxide and hydrocarbon in the exhaust gas to non-noxious carbon dioxide and water.
  Oxidization process
  — $O_2 + HC + CO = CO_2 + H_2O$

EXHAUST GAS RECIRCULATION SYSTEM [SKYACTIV-D 2.2]

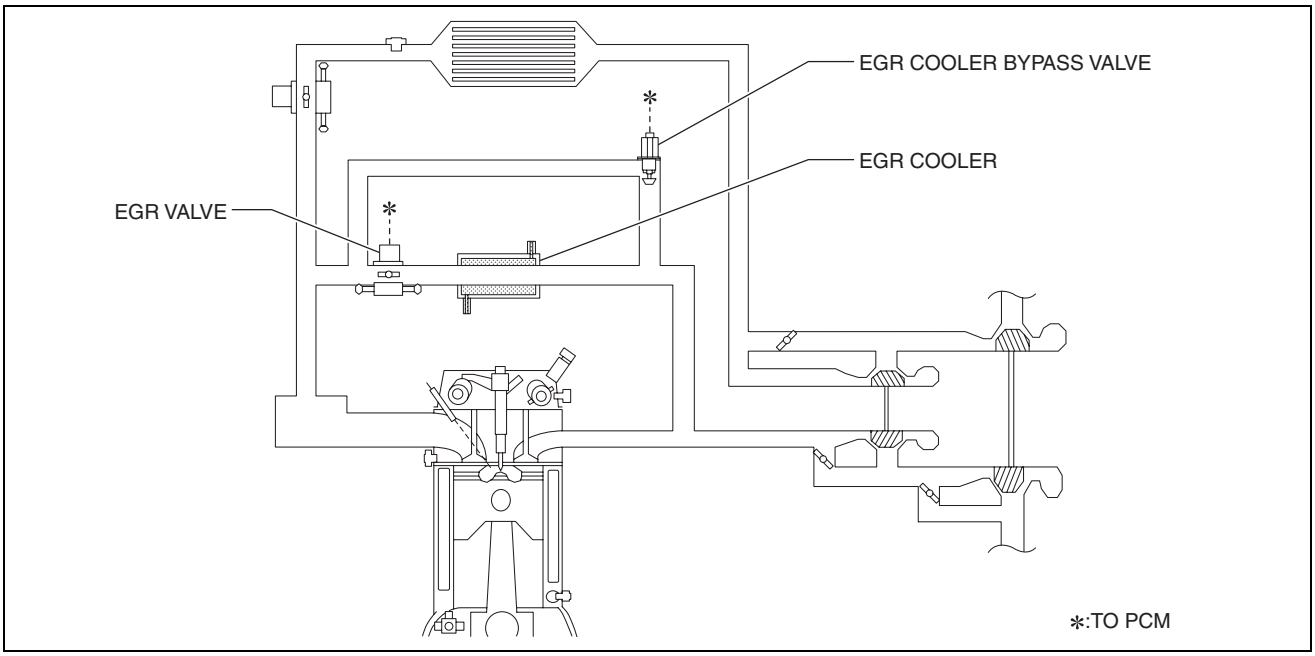
id0116e1159300

Purpose, Outline

- The high occurrence of NOx at high temperatures has been reduced by recirculating exhaust gas to the combustion chamber in order to lower the combustion temperature.
- An EGR valve with a stepping motor has been adopted for optimum control according to engine operation conditions.

EMISSION SYSTEM [SKYACTIV-D 2.2]

System diagram



ac5wzn00001935

Structure

- The exhaust gas recirculation system consists of the following parts:

Part name	Reference
EGR valve	(See 01-16B-9 EGR VALVE [SKYACTIV-D 2.2].)
EGR cooler	(See 01-16B-10 EGR COOLER [SKYACTIV-D 2.2].)
EGR cooler bypass valve	(See 01-16B-11 EGR COOLER BYPASS VALVE [SKYACTIV-D 2.2].)
EGR pipe	—

EGR VALVE [SKYACTIV-D 2.2]

id0116e1112500

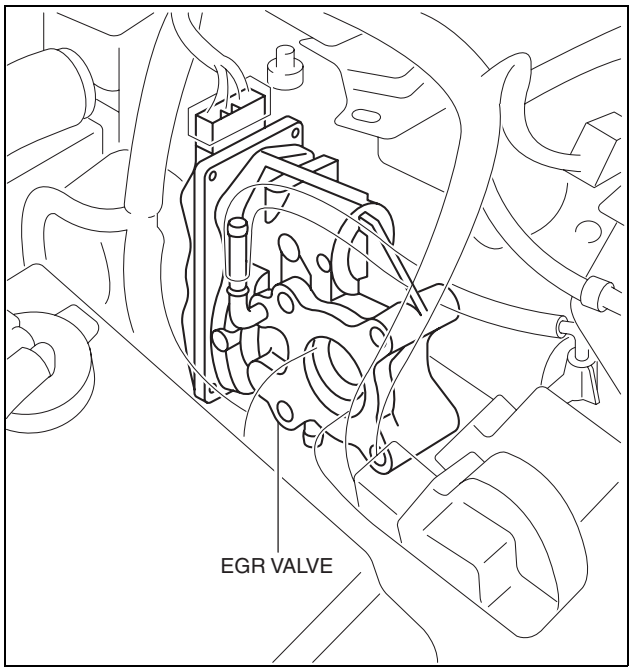
Purpose, Function

- Recirculates the exhaust gas back to the intake manifold.

EMISSION SYSTEM [SKYACTIV-D 2.2]

Construction

- The EGR valve is installed to the intake manifold.



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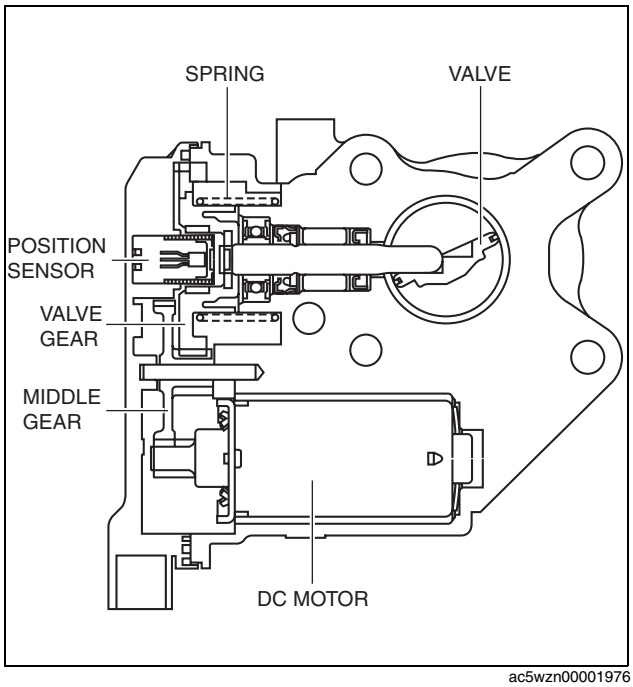
- The EGR valve consists of the DC motor, plug, valve, and spring.



ac5wzn00001976

Operation

- The PCM drives the DC motor of the EGR valve by the pulse-width modulation signal.
- By using the EGR valve DC motor, a high precision EGR system is assured.

EGR COOLER [SKYACTIV-D 2.2]

id0116e1189100

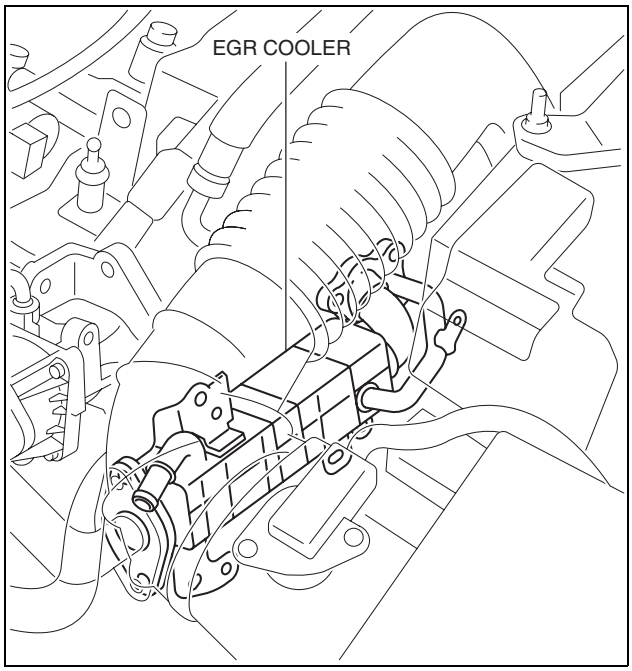
Purpose, Function

- By cooling the exhaust gas recirculated to the intake manifold using the engine coolant, intake air changing efficiency is improved and more exhaust gas can be recirculated, suppressing black smoke emission. Due to this, NOx is reduced.

EMISSION SYSTEM [SKYACTIV-D 2.2]

Construction

- The EGR cooler is installed to the top of the transmission.
- The EGR cooler consists of an EGR passage and an engine coolant passage.



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EGR COOLER BYPASS VALVE [SKYACTIV-D 2.2]

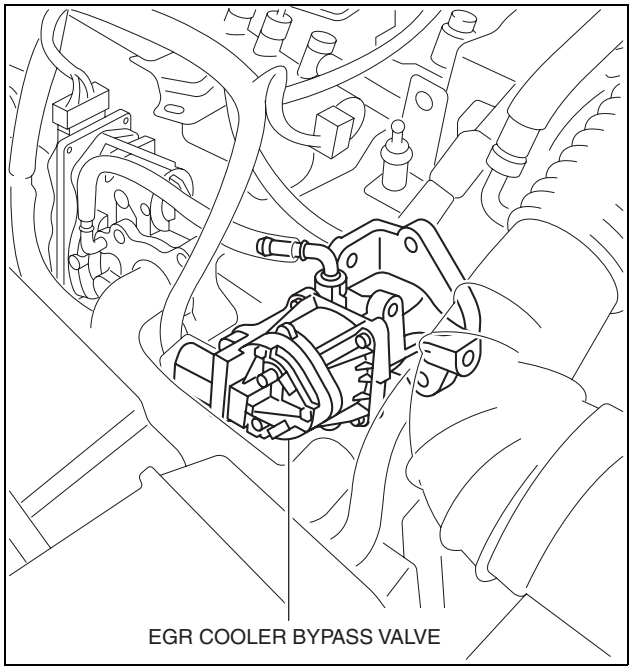
id0116e1707800

Purpose, Function

- Adjusts the EGR cooler bypass valve rod.

Construction

- The EGR cooler bypass valve is installed to the intake manifold.



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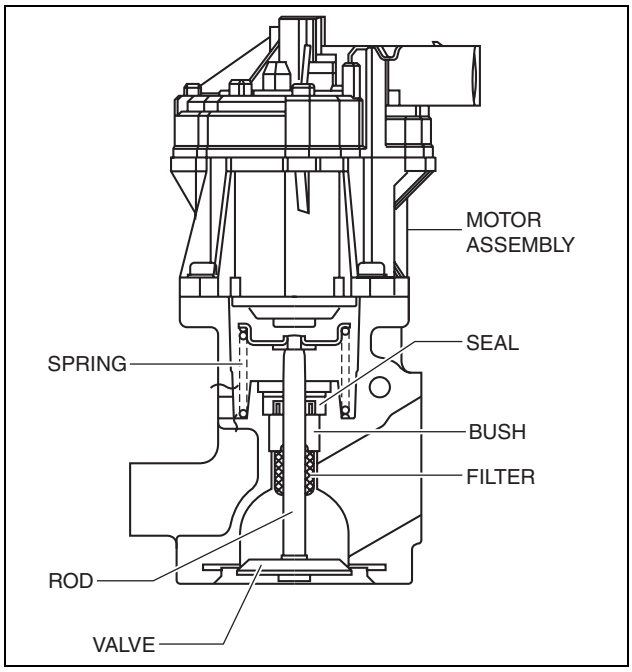
EMISSION SYSTEM [SKYACTIV-D 2.2]

- Consists of the valve, spring, rod, filter, plug, and motor component.



ac5wzn00001979

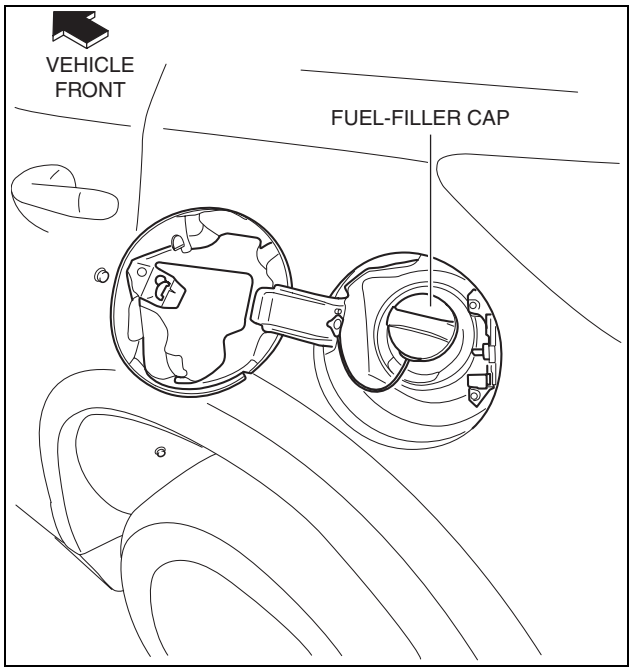
Operation
- While the engine is cool, the passage on the EGG cooler side is closed to control the generation of CO and HC.
- While the engine is warm, the passage on the EGR cooler side is open to control the generation of NOx.

FUEL-FILLER CAP [SKYACTIV-D 2.2]

id0116e1112700

Purpose, Function
- Releases evaporative gas from the fuel tank if there is a malfunction in the evaporative gas passage between the fuel tank and the intake manifold. As a result, deformation of the fuel tank caused by evaporative gas pressure is prevented.

Construction
- The fuel-filler cap is installed to the fuel filler opening.



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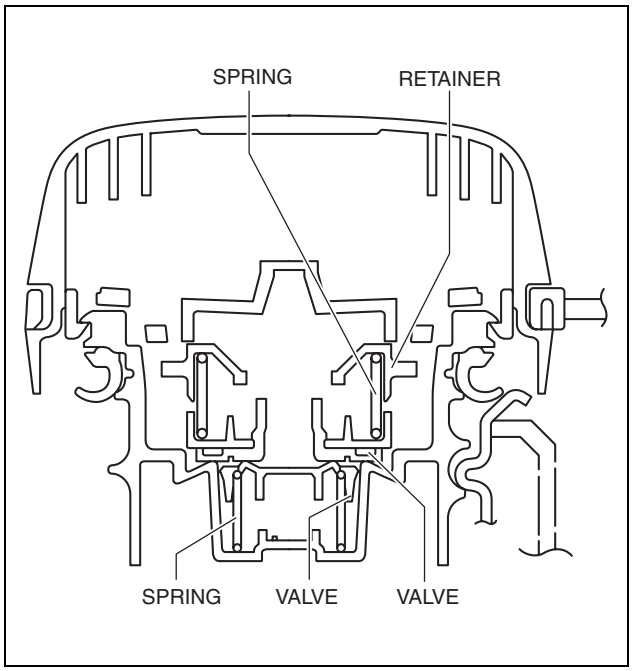
EMISSION SYSTEM [SKYACTIV-D 2.2]

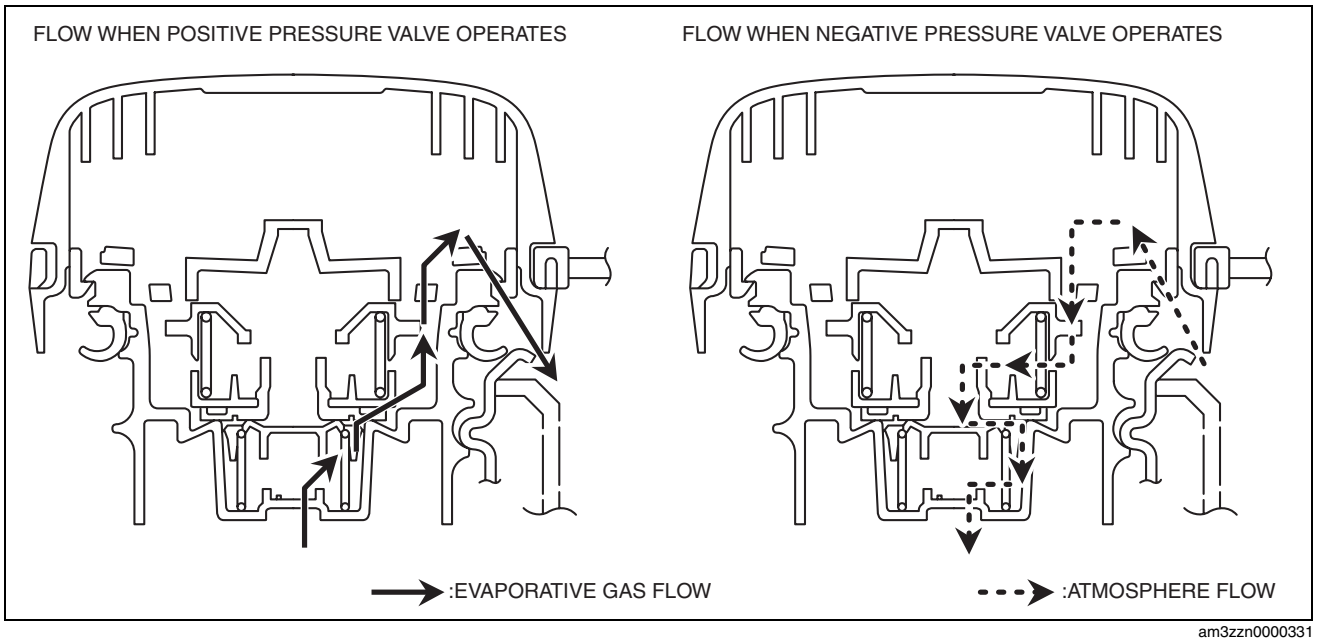
- The fuel-filler cap consists of valves, retainer, and springs.



am3zzn0000331

Operation

- When there is positive pressure in the fuel tank due to evaporative gas, evaporative gas is released into the atmosphere. When there is negative pressure, air is introduced to the fuel tank.



am3zzn0000331

ROLLOVER VALVE [SKYACTIV-D 2.2]

id0116e1122900

Purpose, Function

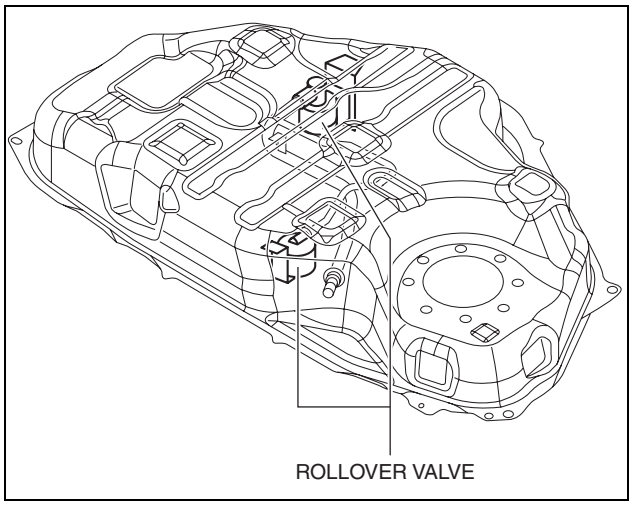
- Prevents fuel from flowing into the evaporative gas passage during sudden cornering or vehicle rollover.

Construction

- The rollover valve is built into the fuel tank.

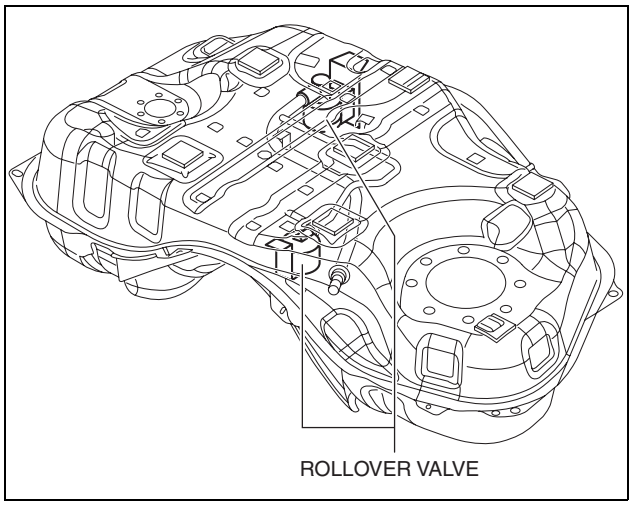
EMISSION SYSTEM [SKYACTIV-D 2.2]

2WD



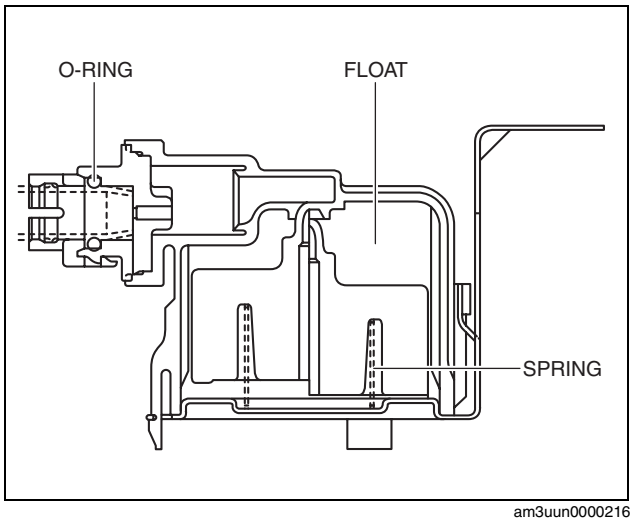
ac5wzn00000208

AWD



ac5wzn00000209

- The rollover valve consists of a float, O-ring and spring.

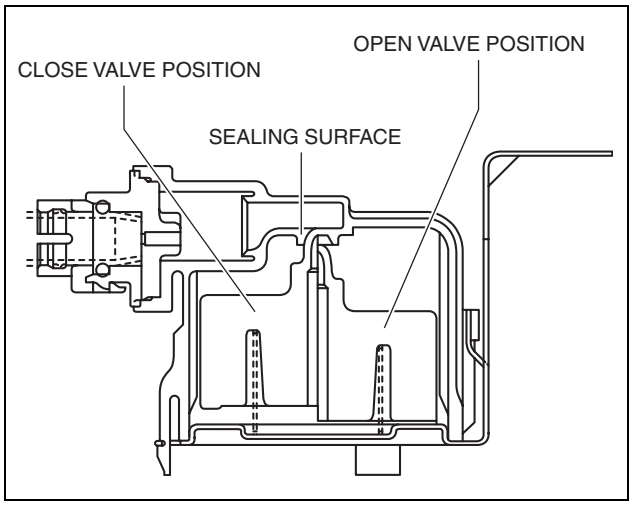


am3uun0000216

EMISSION SYSTEM [SKYACTIV-D 2.2]

Operation

- The rollover valve utilizes a combination of float weight, spring force, and buoyancy. When the float is immersed in the fuel, the float (valve) closes to block the sealing surface of the passage.



am3uun0000216

DIESEL PARTICULATE FILTER [SKYACTIV-D 2.2]

id0116e1707900

Purpose, Function

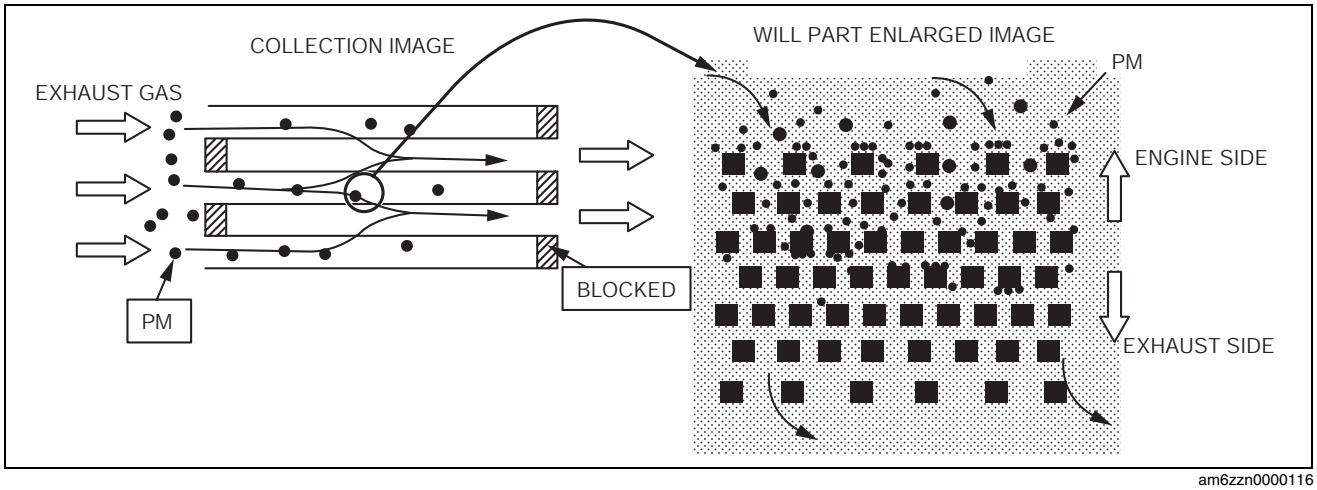
- The diesel particulate filter collects and removes particulate matter (PM) in the exhaust gas.

Construction

- DPF is built-in catalytic converter.

Operation

- Diesel particulate filter is a silicon carbide honey-comb type filter. The filter ends are blocked in sequence and small holes on the wall inside the filter collect PM, and the collected PM is burned and eliminated.



am6zzn0000116

CHECK VALVE [SKYACTIV-D 2.2]

id0116e1196900

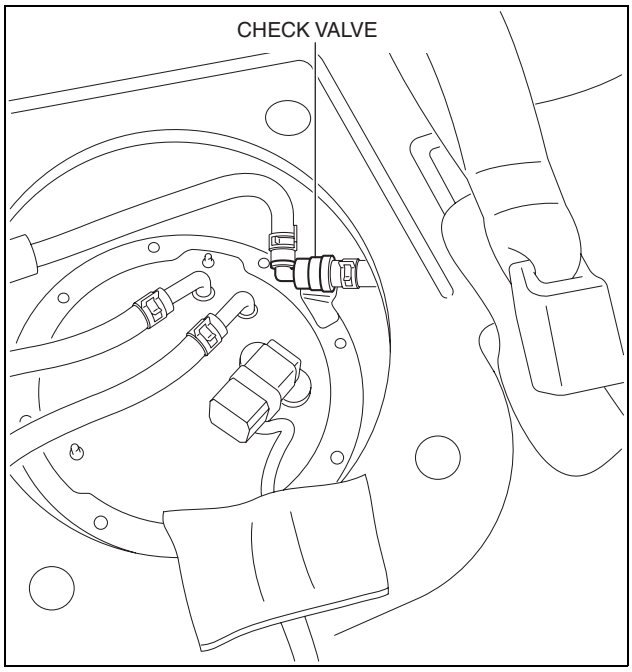
Purpose, Function

- The check valve maintain the pressure in the fuel tank at constant pressure.

EMISSION SYSTEM [SKYACTIV-D 2.2]

Construction

- The check valve is installed to the fuel tank.



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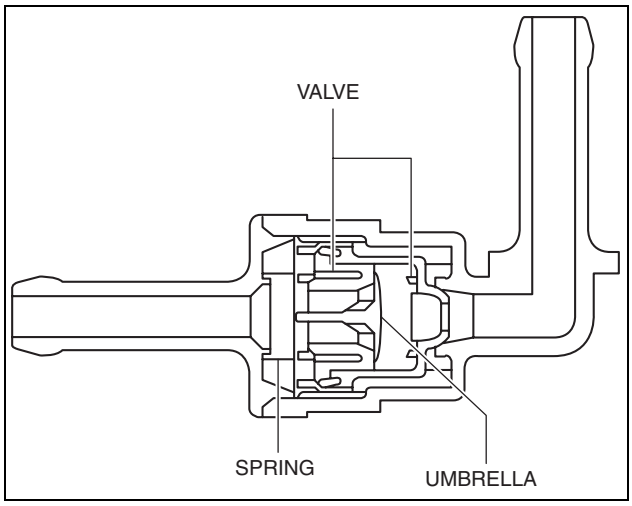
- Mainly consists of valve, umbrella, and spring.



ac5wzn00002007

Operation

- The valve moves in response to the difference in air pressure between the fuel tank side and the atmospheric side, thereby changing the path of airflow.
- When the pressure in the fuel tank becomes negative due to fuel consumption or other factors, the path opens, drawing atmospheric air into the fuel tank.

INTAKE SHUTTER VALVE [SKYACTIV-D 2.2]

id0116e1708000

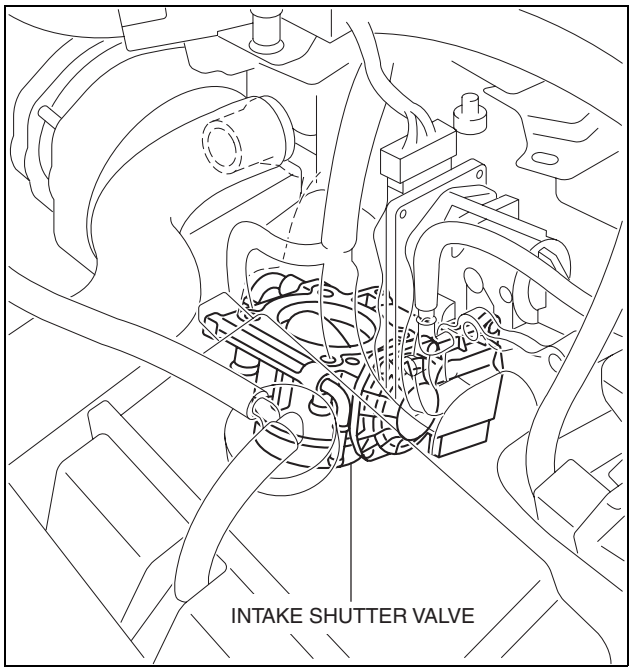
Purpose, Function

- The intake air amount is controlled to provide better recirculation of the exhaust gas.
- The intake air amount to the engine is reduced to increase the exhaust gas temperature easily while the DPF is carrying out combustion. Due to this, the particulate matter (PM) collected in the DPF is burned and eliminated.
- The valve is closed to cut the intake air when the engine switch is off to reduce the shock when the engine is turned off.

EMISSION SYSTEM [SKYACTIV-D 2.2]

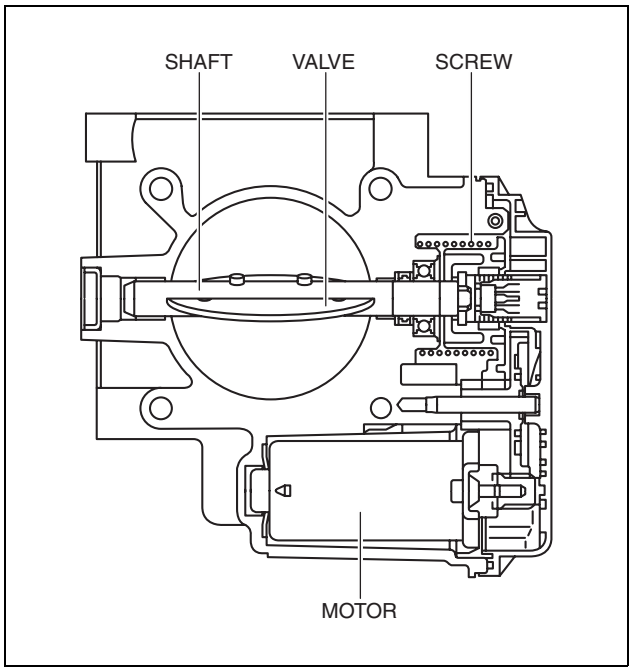
Construction

- The intake shutter valve is installed to the intake manifold.



ac5wzn00001980

- The intake shutter valve consists of the motor, screw, valve, and shaft.



ac5wzn00001981

Operation

- The DC motor operates according to the signal from the PCM. The driving force is transmitted to the motor gear, mid gear, and shutter gear, which opens/closes the shutter valve.
- The shutter valve opening angle is detected by the throttle position sensor and controlled to an appropriate opening angle according to the feedback from the built-in drive circuit.
- If the shutter valve has a malfunction and the DC motor control is disabled, the shutter valve is fully opened by the return spring. Due to this, the air amount necessary to move the vehicle is assured.

01-17A CHARGING SYSTEM [SKYACTIV-G 2.0]

CHARGING SYSTEM [SKYACTIV-G 2.0]

CHARGING SYSTEM [SKYACTIV-G 2.0]

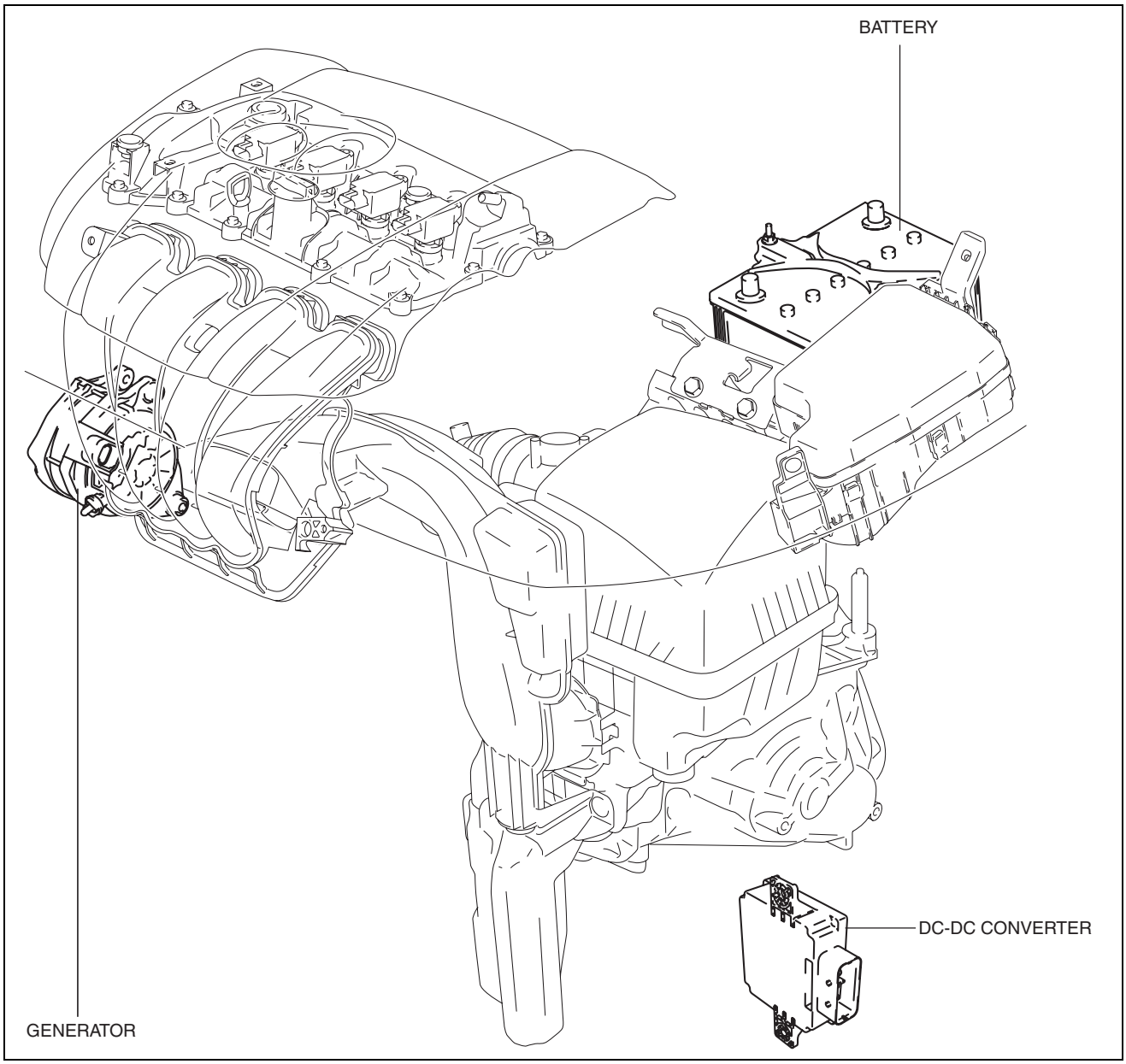
id0117h5102900

Outline

- Regulator-less generator (built-in power transistor) has been adopted.
- A generator using two delta connection type stator coils has been adopted.

CHARGING SYSTEM [SKYACTIV-G 2.0]

Structural View



ac5wzn00001984

Structure

- Consists of the following parts:

Battery	(See 01-17A-2 BATTERY [SKYACTIV-G 2.0].)
Generator	(See 01-17A-3 GENERATOR [SKYACTIV-G 2.0].)
DC-DC converter (Vehicle with i-stop)	(See 01-17A-6 DC-DC CONVERTER [SKYACTIV-G 2.0].)
Charging system warning light	(See 01-17A-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-G 2.0].)

BATTERY [SKYACTIV-G 2.0]

id0117h5185200

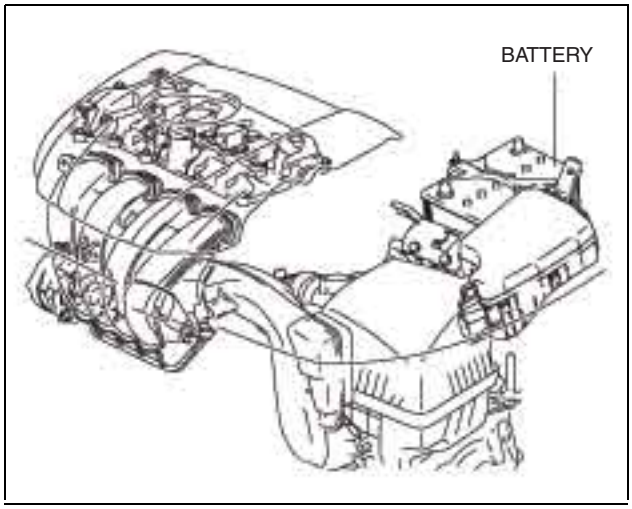
Purpose, Function

- The battery stores electricity generated by the generator. In addition, it supplies power to electronic devices if necessary.

CHARGING SYSTEM [SKYACTIV-G 2.0]

Construction

- The battery is installed in the engine compartment. (vehicle left)



ac5wzn00001027

Fail-safe

DTC	Fail-safe
P057F:00	• Inhibits engine-stop by operating the i-stop function. (Vehicle with i-stop) • Inhibits a part of the generator output control.

GENERATOR [SKYACTIV-G 2.0]

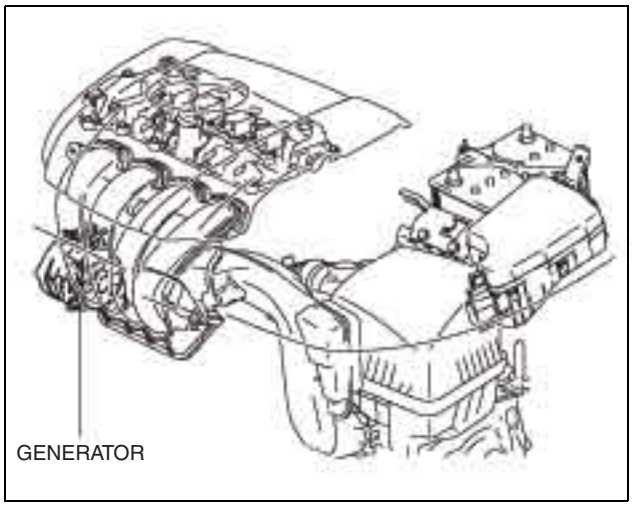
id0117h5104300

Purpose, Function

- The generator operates by obtaining drive force from the engine via the drive belt and generates the required electricity for electronic devices.

Construction

- The generator is installed on the engine left front side.
- Output control is performed by the PCM resulting in the elimination of the IC regulator and the simplification of the construction.



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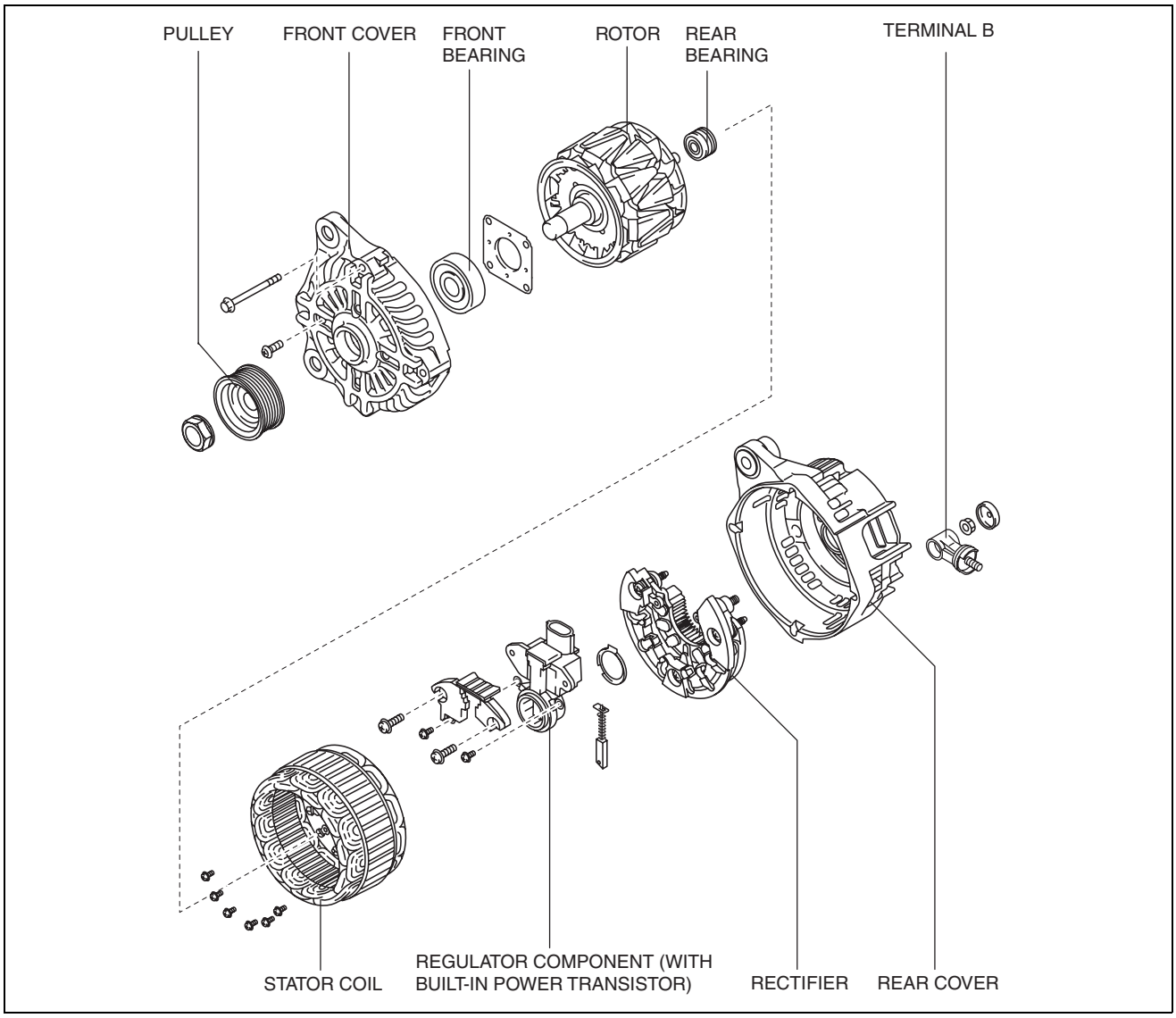
CHARGING SYSTEM [SKYACTIV-G 2.0]

- Two delta connection type stator coils have been adopted.



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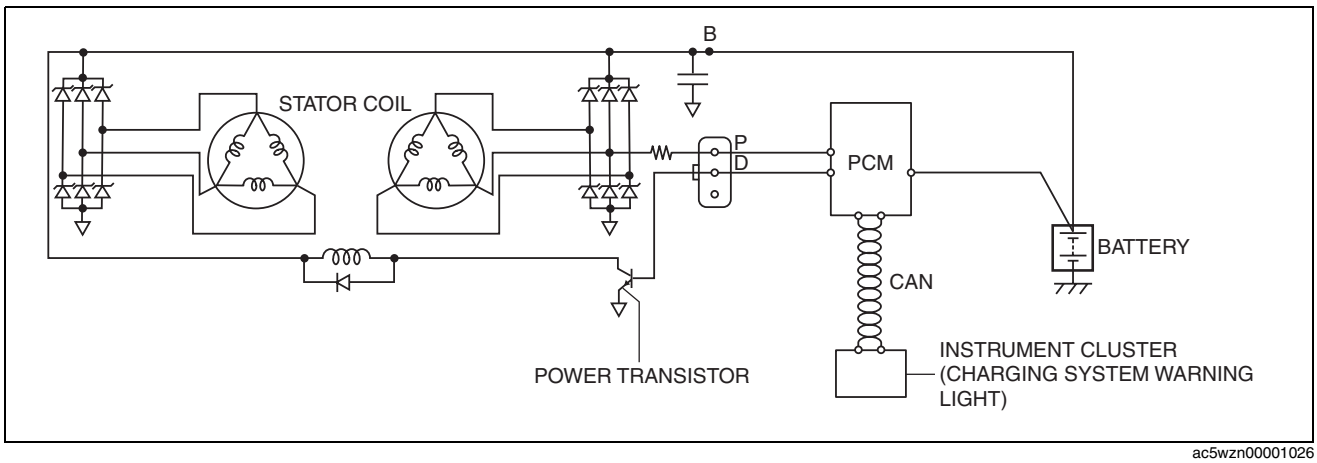

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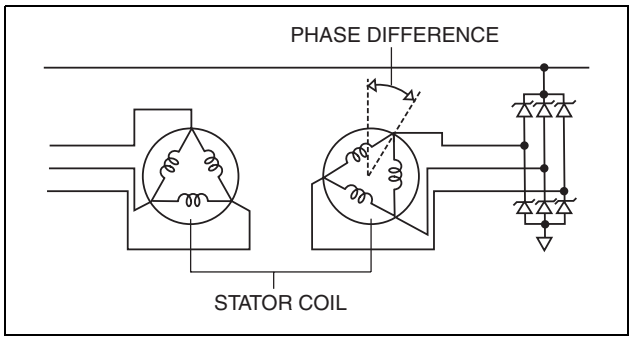
CHARGING SYSTEM [SKYACTIV-G 2.0]

- The two stator coils form the circuit having a phase difference, and magnetic pull, which operates between the rotor and stator coil by the phase difference, is theoretically eliminated. Due to this, electromagnetic vibration and generator operation noise (electromagnetic noise) have been reduced.
- Pulsation occurring through voltage rectifying using two stator coils having a phase difference is minimized and stable voltage output is supplied.



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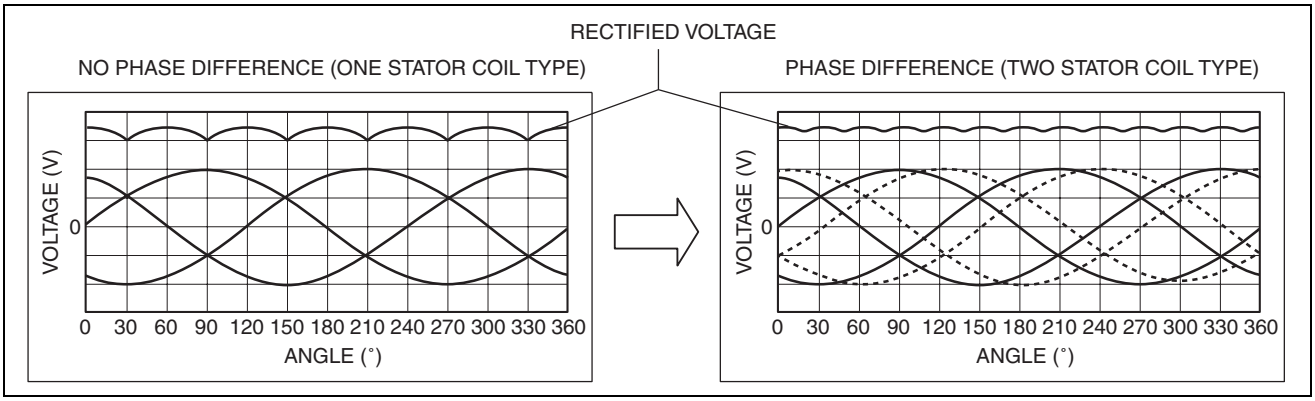


am0000219

Operation

- For the operation, refer to CONTROL SYSTEM. (See 01-40-41 GENERATOR CONTROL [SKYACTIV-G 2.0].)

Fail-safe

- Function not equipped.

CHARGING SYSTEM WARNING LIGHT [SKYACTIV-G 2.0]

id0117h5308400

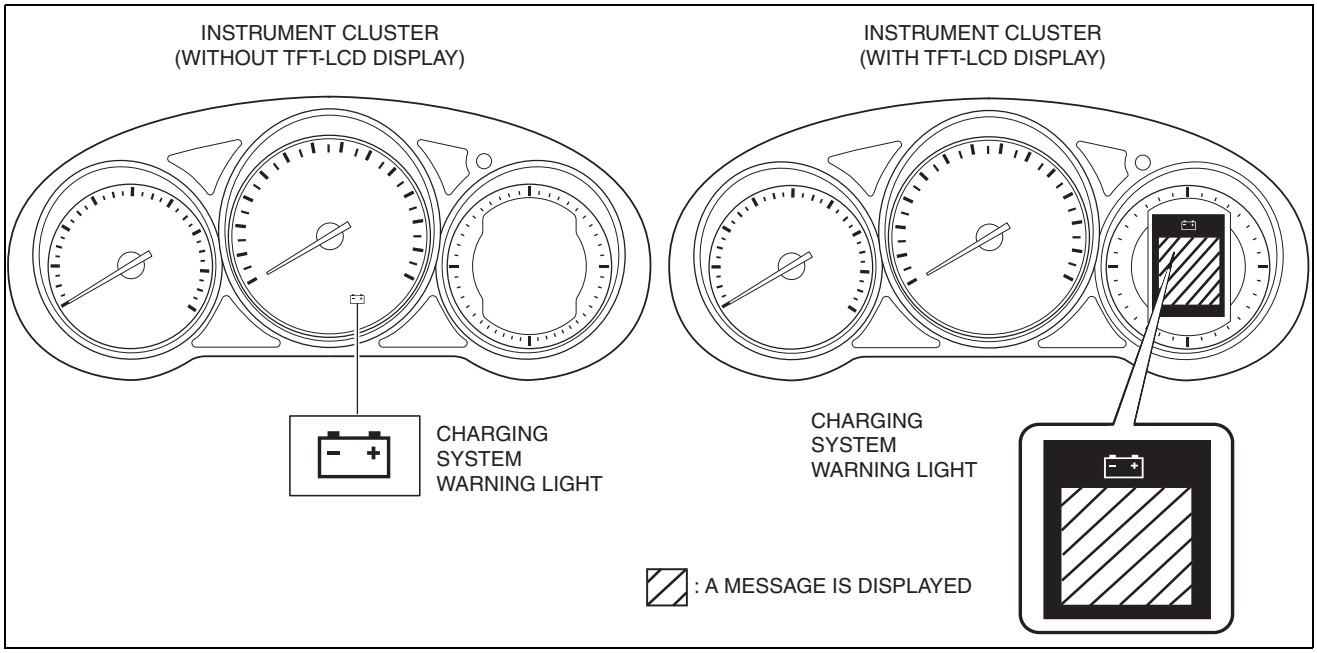
Purpose, Function

- Warns the driver of a charging system malfunction.

CHARGING SYSTEM [SKYACTIV-G 2.0]

Construction

- The charging system warning light is built into the instrument cluster. (See 09-22-9 INSTRUMENT CLUSTER.)



ac5wzn00001985

Operation

- Illuminates when a malfunction occurs in the charging system and a DTC is stored in the PCM.

DC-DC CONVERTER [SKYACTIV-G 2.0]

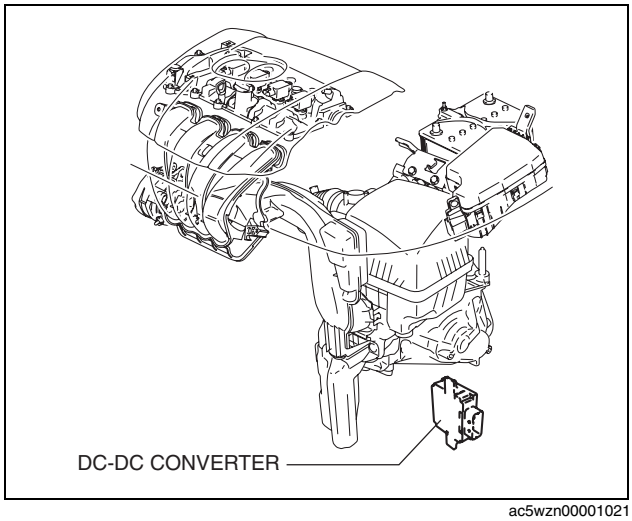
id0117h5004500

Vehicle With i-stop
Purpose, Function

- When the engine is restarted by the i-stop control, the battery voltage temporarily decreases to operate the starter. Pressure is increased to maintain the voltage for vehicle electrical devices at that time.

Construction

- The DC-DC converter is installed on the vehicle's left front part (lower part of front combination light).

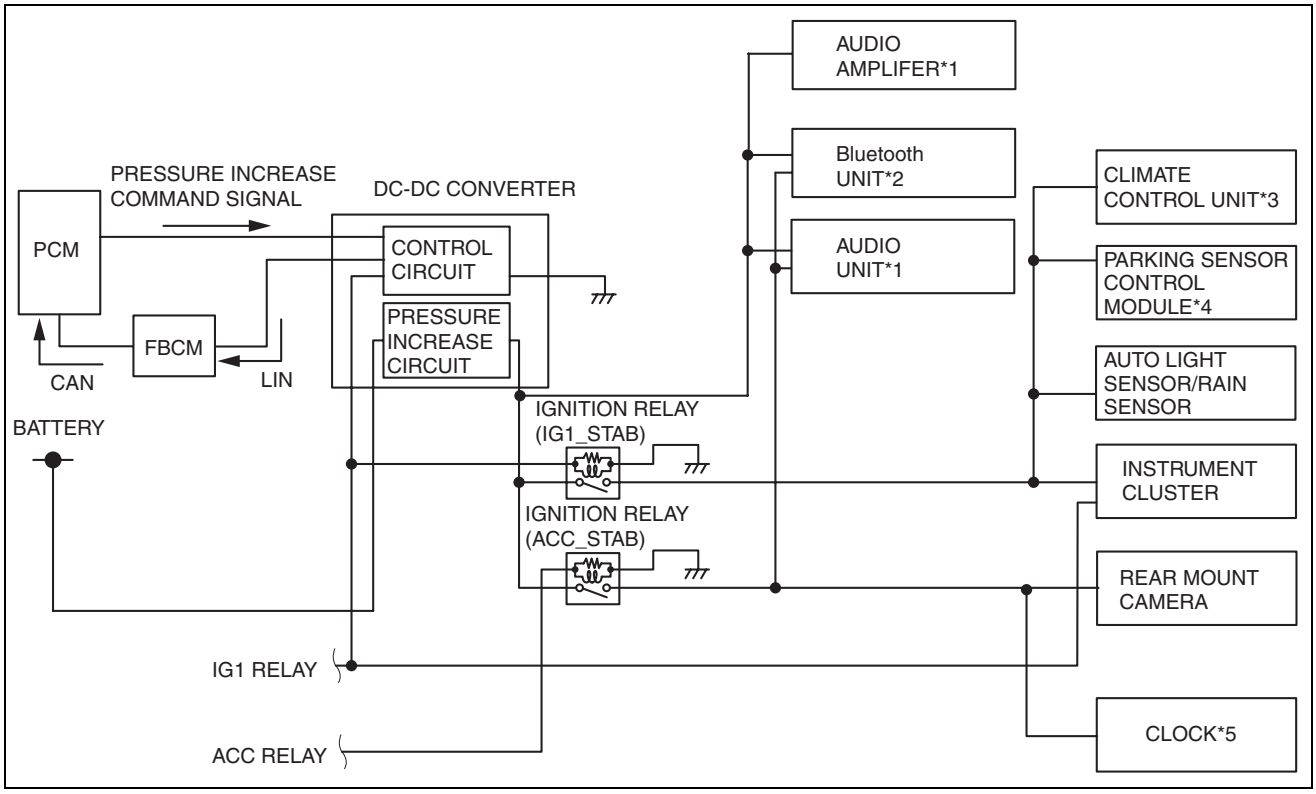


ac5wzn00001021

CHARGING SYSTEM [SKYACTIV-G 2.0]

Operation

- The battery voltage increases based on the control signal from the PCM.



ac5wzn00001022

*1 : Vehicles with audio system.
*2 : Vehicles with bluetooth system.
*3 : Vehicles with auto A/C.
*4 : Vehicles with parking sensor system.
*5 : Vehicles with manual A/C.

- For details of the DC-DC converter control, refer to CONTROL SYSTEM (See 01-40-54 DC-DC CONVERTER CONTROL [SKYACTIV-G 2.0].).

Fail-safe

DTC	Fail-safe
P0A8D:00	• Inhibits engine-stop by operating the i-stop function. • Inhibits a part of the generator output control.
P0A94:00	• Inhibits engine-stop by operating the i-stop function.

01-17B CHARGING SYSTEM [SKYACTIV-D 2.2]

CHARGING SYSTEM [SKYACTIV-D 2.2]

CHARGING SYSTEM [SKYACTIV-D 2.2]

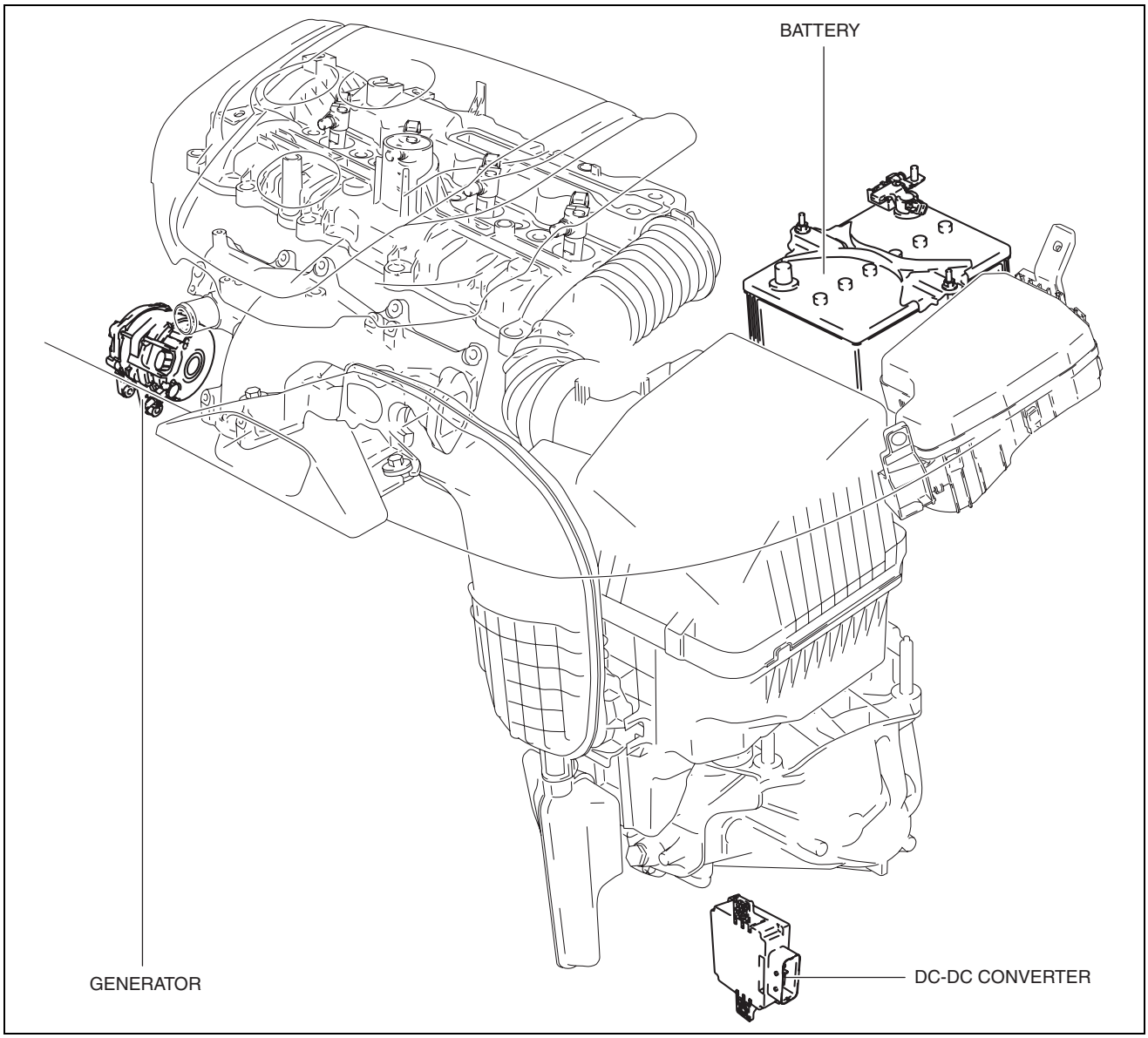
id0117h6102900

Outline

- Regulator-less generator (built-in power transistor) has been adopted.
- A generator using two delta connection type stator coils has been adopted.

CHARGING SYSTEM [SKYACTIV-D 2.2]

Structural View



ac5wzn00001988

Structure

- Consists of the following parts:

Battery	(See 01-17B-2 BATTERY [SKYACTIV-D 2.2].)
Generator	(See 01-17B-3 GENERATOR [SKYACTIV-D 2.2].)
DC-DC converter	(See 01-17B-6 DC-DC CONVERTER [SKYACTIV-D 2.2].)
Charging system warning light	(See 01-17B-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-D 2.2].)

BATTERY [SKYACTIV-D 2.2]

id0117h6185200

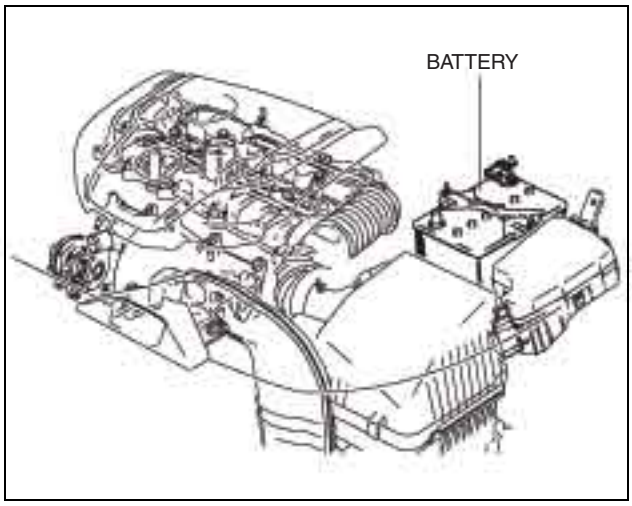
Purpose, Function

- The battery stores electricity generated by the generator. In addition, it supplies power to electronic devices if necessary.

CHARGING SYSTEM [SKYACTIV-D 2.2]

Construction

- The battery is installed in the engine compartment. (vehicle left)



ac5wzn00001992

Fail-safe

DTC	Fail-safe
P057F:00	• Inhibits engine-stop by operating the i-stop function. • Inhibits a part of the generator output control.

GENERATOR [SKYACTIV-D 2.2]

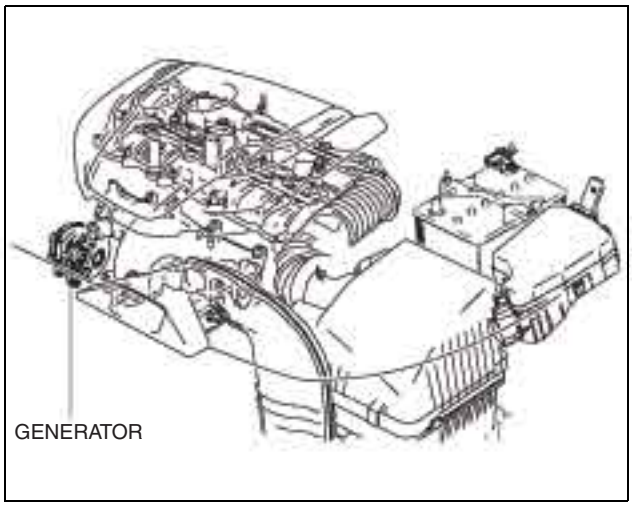
id0117h6104300

Purpose, Function

- The generator operates by obtaining drive force from the engine via the drive belt and generates the required electricity for electronic devices.

Construction

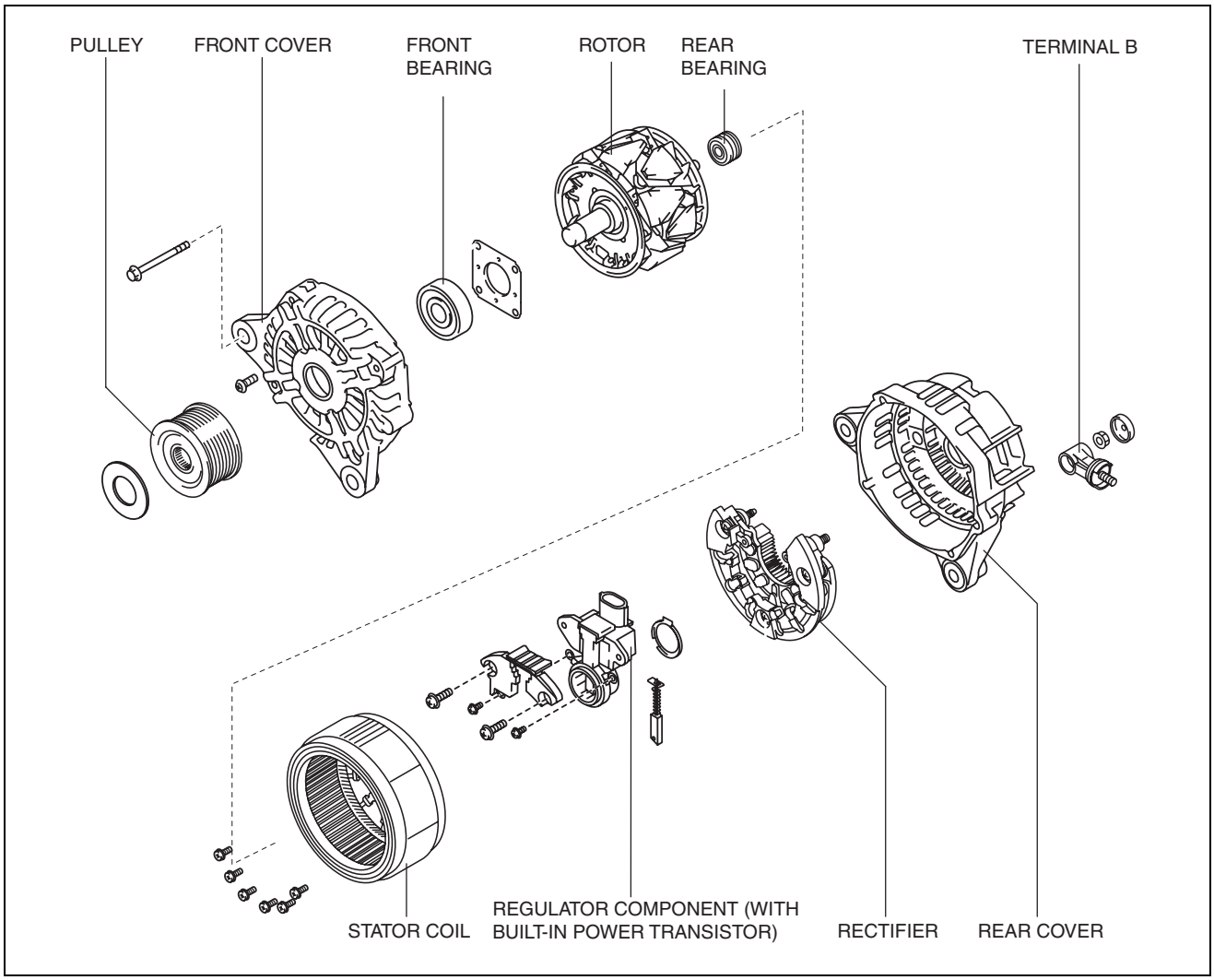
- The generator is installed on the engine left front side.
- Output control is performed by the PCM resulting in the elimination of the IC regulator and the simplification of the construction.



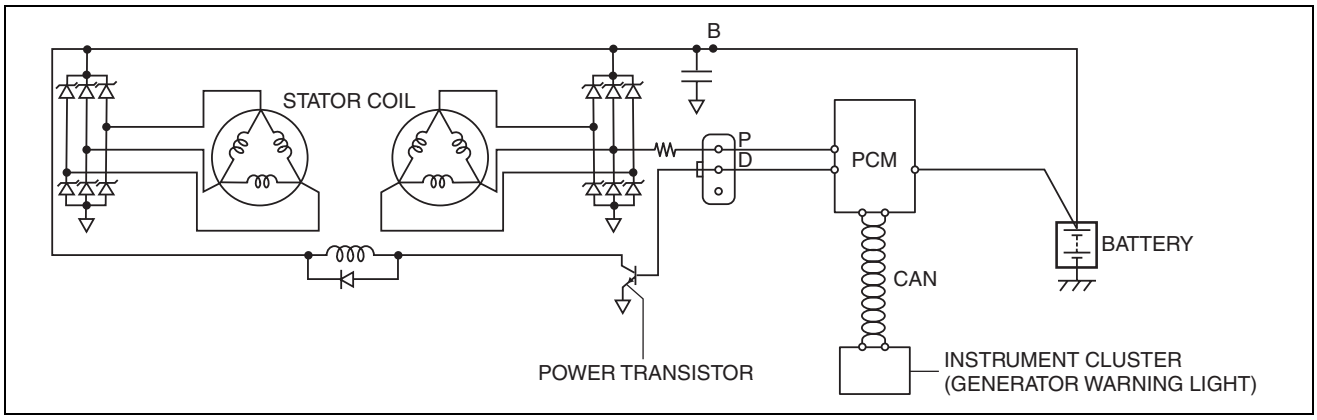
ac5wzn00001989

CHARGING SYSTEM [SKYACTIV-D 2.2]

- Two delta connection type stator coils have been adopted.



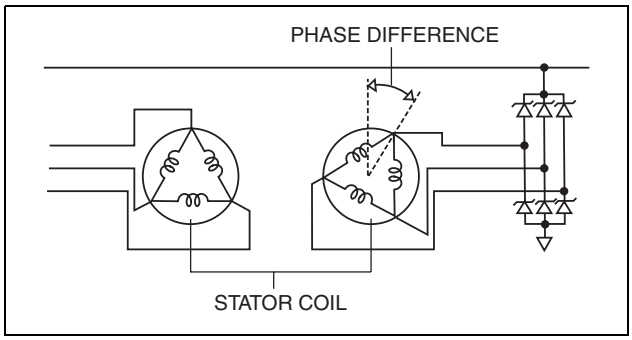
ac5wzn00001990



ac5wzn00001991

CHARGING SYSTEM [SKYACTIV-D 2.2]

- The two stator coils form the circuit having a phase difference, and magnetic pull, which operates between the rotor and stator coil by the phase difference, is theoretically eliminated. Due to this, electromagnetic vibration and generator operation noise (electromagnetic noise) have been reduced.
- Pulsation occurring through voltage rectifying using two stator coils having a phase difference is minimized and stable voltage output is supplied.



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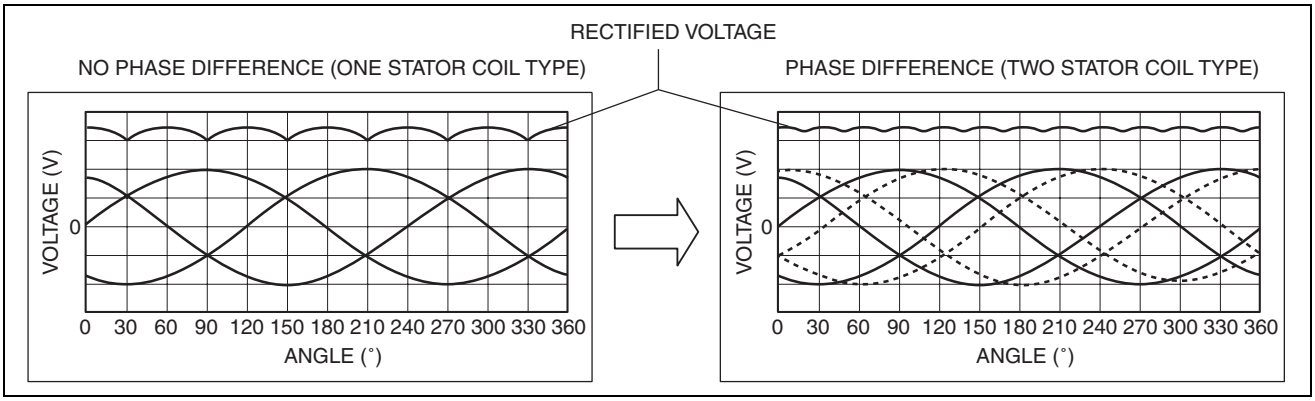


am0000219

Operation
- For the operation, refer to CONTROL SYSTEM.

Fail-safe
- Function not equipped.

CHARGING SYSTEM WARNING LIGHT [SKYACTIV-D 2.2]

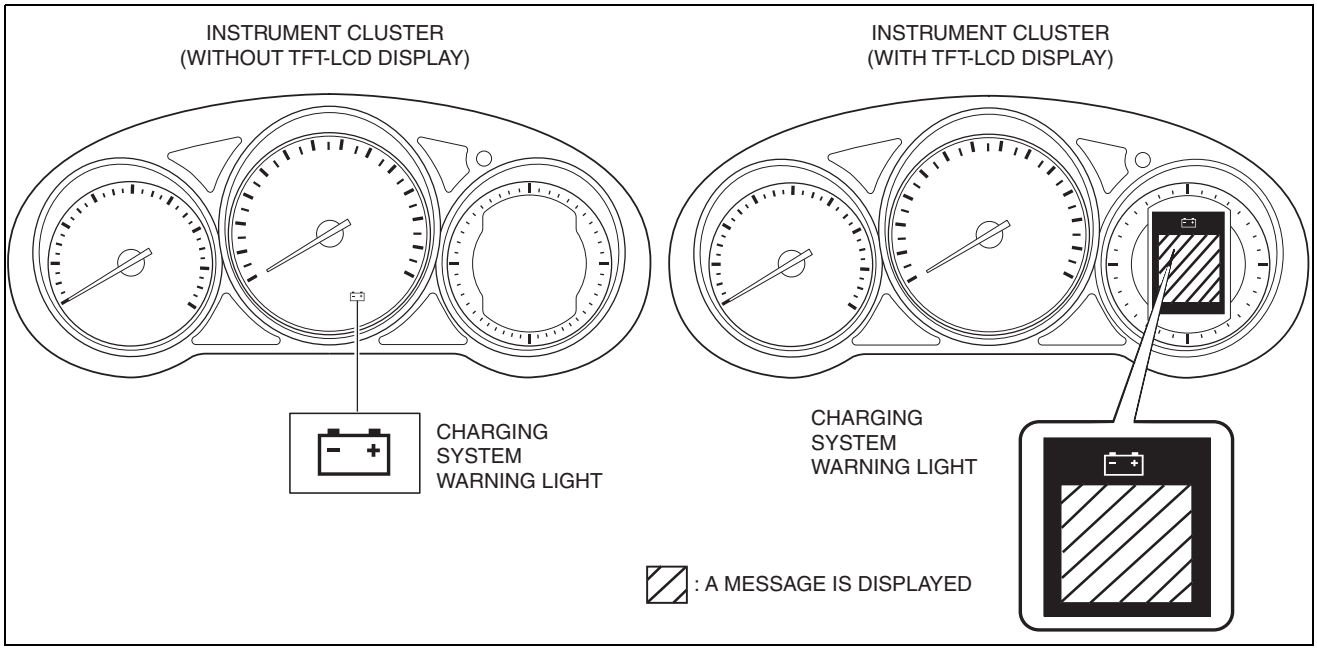
id0117h6308400

Purpose, Function
- Warns the driver of a charging system malfunction.

CHARGING SYSTEM [SKYACTIV-D 2.2]

Construction

- The Charging system warning light is built into the instrument cluster. (See 09-22-9 INSTRUMENT CLUSTER.)



ac5wzn00001996

Operation

- Illuminates when a malfunction occurs in the charging system and a DTC is stored in the PCM.

DC-DC CONVERTER [SKYACTIV-D 2.2]

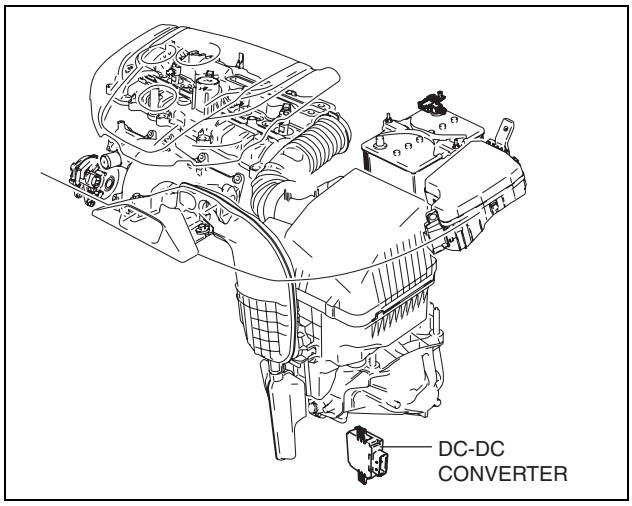
id0117h6004500

Purpose, Function

- When the engine is restarted by the i-stop control, the battery voltage temporarily decreases to operate the starter. Pressure is increased to maintain the voltage for vehicle electrical devices at that time.

Construction

- The DC-DC converter is installed on the vehicle's left front part (lower part of front combination light).

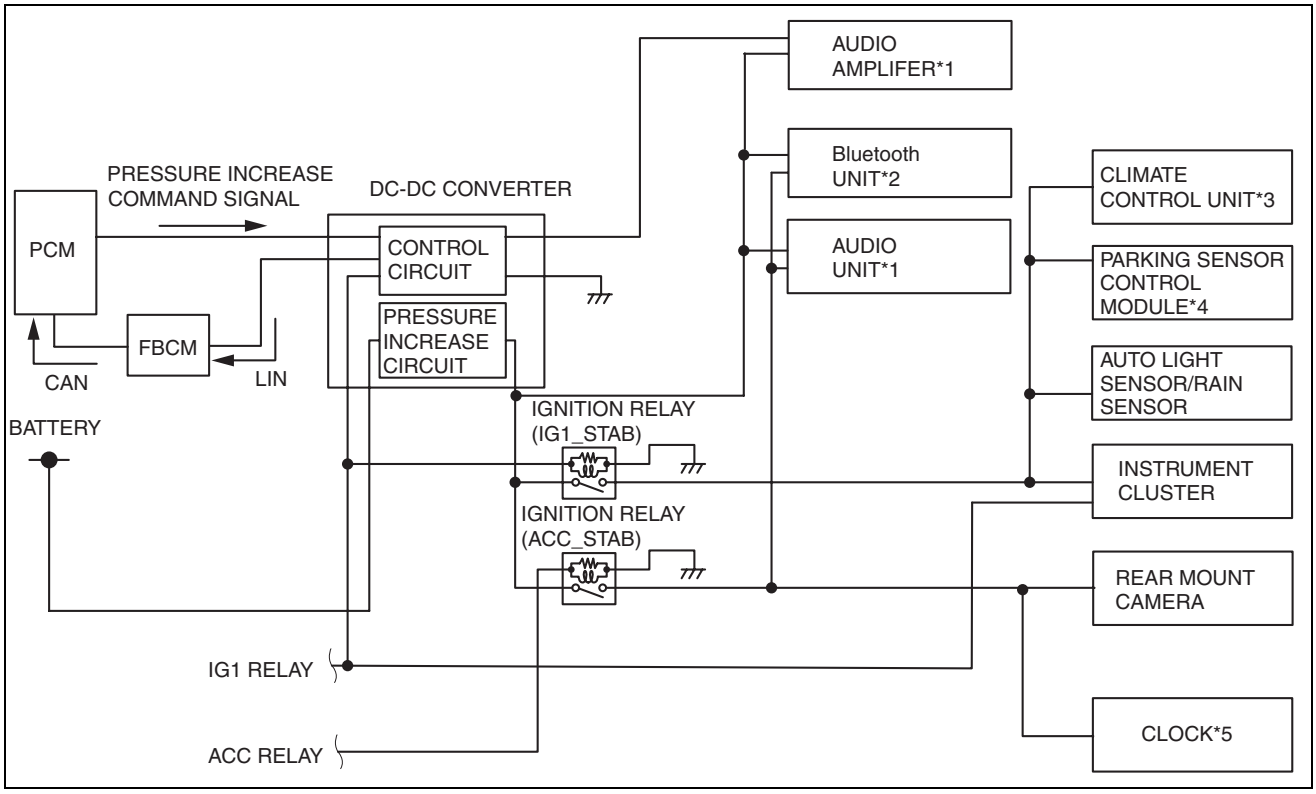


ac5wzn00001986

CHARGING SYSTEM [SKYACTIV-D 2.2]

Operation

- The battery voltage increases based on the control signal from the PCM.



ac5wzn00001987

*1 : Vehicles with audio system
*2 : Vehicles with Bluetooth system
*3 : Vehicles with auto A/C
*4 : Vehicles with parking sensor system
*5 : Vehicles with manual A/C

- For details of the DC-DC converter control, refer to CONTROL SYSTEM.

Fail-safe

DTC	Fail-safe
P0A8D:00	• Inhibits engine-stop by operating the i-stop function. • Inhibits a part of the generator output control.
P0A94:00	• Inhibits engine-stop by operating the i-stop function.

01-18 IGNITION SYSTEM [SKYACTIV-G 2.0]

IGNITION SYSTEM [SKYACTIV-G 2.0]

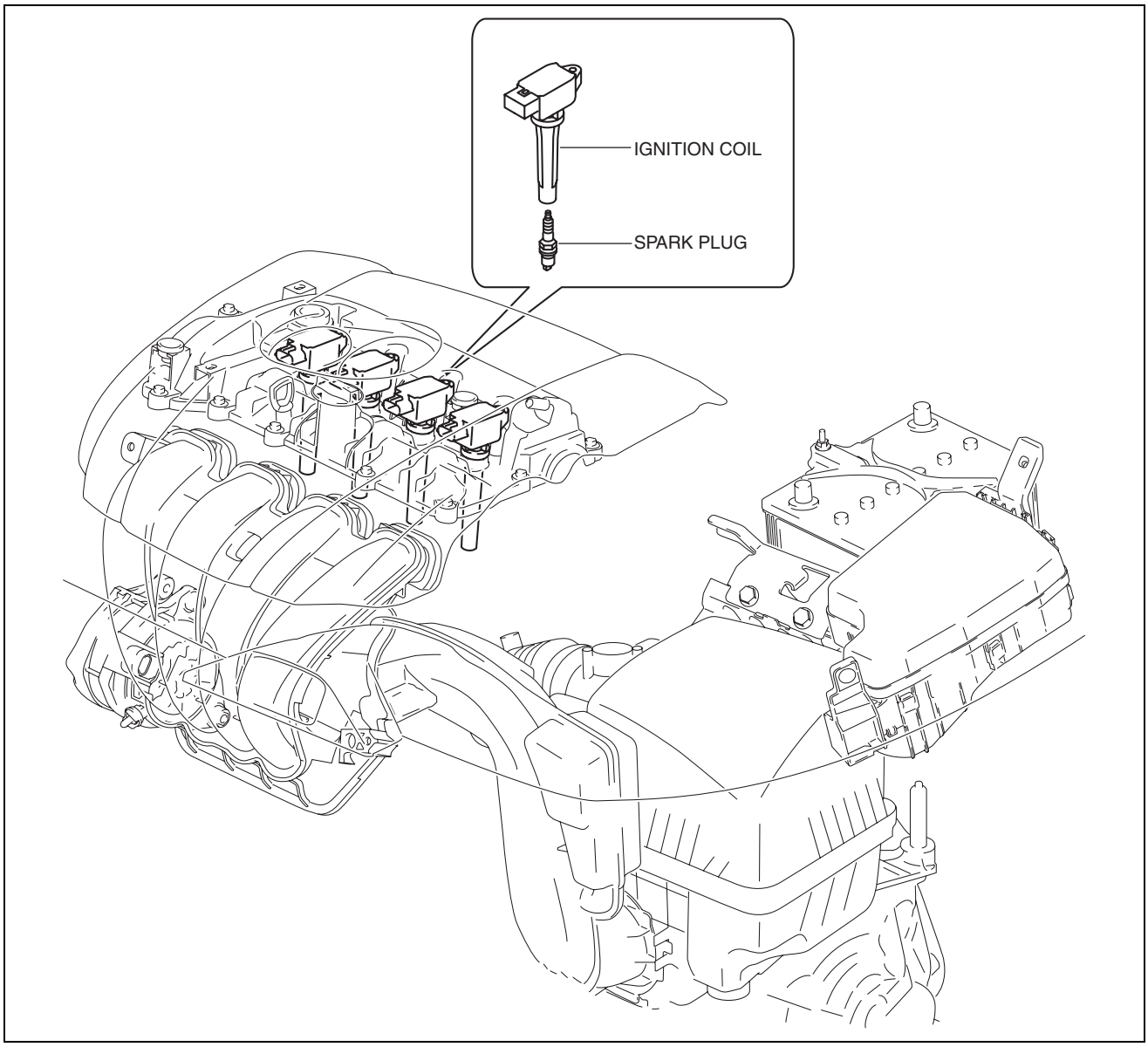
IGNITION SYSTEM [SKYACTIV-G 2.0]

id0118h6108200

Outline

- A direct ignition coil for independent ignition control has been adopted.
- An ignition coil built-into the ion sensor has been adopted.
- An iridium spark plug has been adopted.

Structural View



ac5wzn00001030

Structure

- Consists of the following parts:

IGNITION SYSTEM [SKYACTIV-G 2.0]

Spark plug	(See 01-18-2 SPARK PLUG [SKYACTIV-G 2.0].)
Ignition coil	(See 01-18-2 IGNITION COIL [SKYACTIV-G 2.0].)

SPARK PLUG [SKYACTIV-G 2.0]

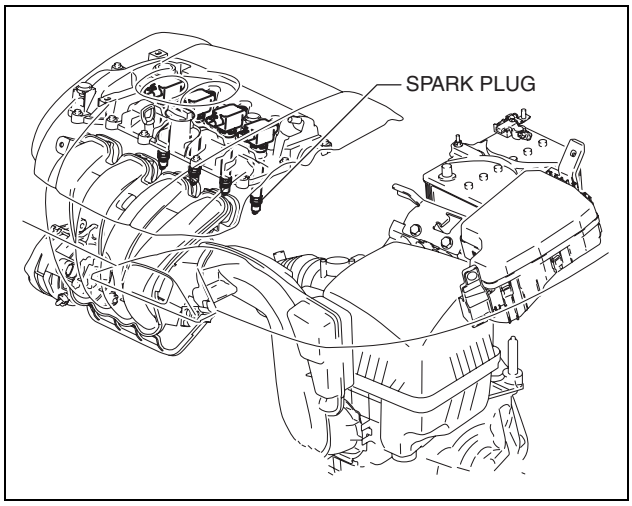
id0118h6101400

Purpose, Function

- The spark plug generates spark, ignition of the air-fuel mixture occurs, and combustion of the air-fuel mixture is triggered.

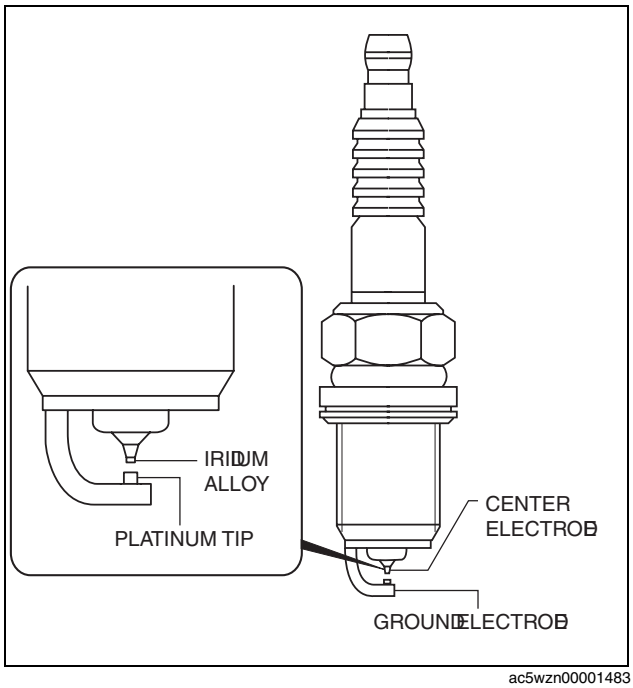
Construction

- The spark plug is installed to the cylinder head.
- Iridium on the center electrode and platinum on the ground electrode are used (iridium spark plug).
- Because iridium has excellent durability, extreme thinning on the center electrode is achieved.



ac5wzn00001029

- The area contacting flame is decreased by extremely thinning the center and setting electrodes, and extinction action is reduced. Therefore, excellent ignition performance is achieved.



ac5wzn00001483

IGNITION COIL [SKYACTIV-G 2.0]

id0118h6000100

Purpose, Function

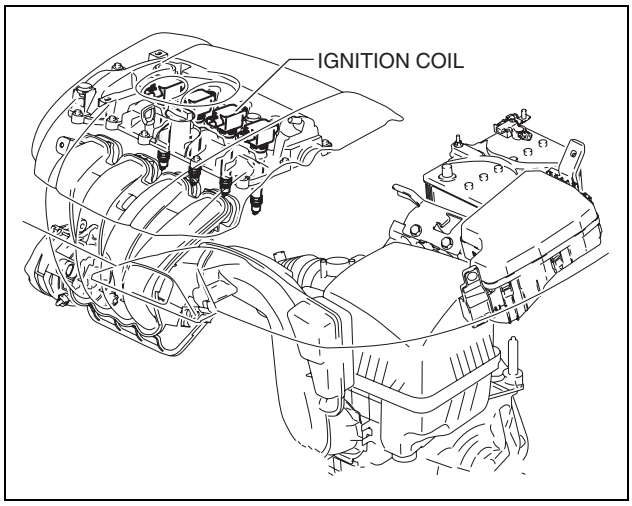
- The ignition coil generates high voltage by electromagnetic induction to discharge the spark plug.

Construction

- The ignition coil is installed to the upper part of the spark plug (direct ignition coil).

IGNITION SYSTEM [SKYACTIV-G 2.0]

- With the adoption of the direct ignition coil, the ignition system parts have been simplified. As a result, voltage decrease is suppressed and ignition performance for the spark plug is stabilized.
- The ignition coil is built into the igniter and ion sensor. For the ion sensor, refer to CONTROL SYSTEM. (See 01-40-97 ION SENSOR [SKYACTIV-G 2.0].)

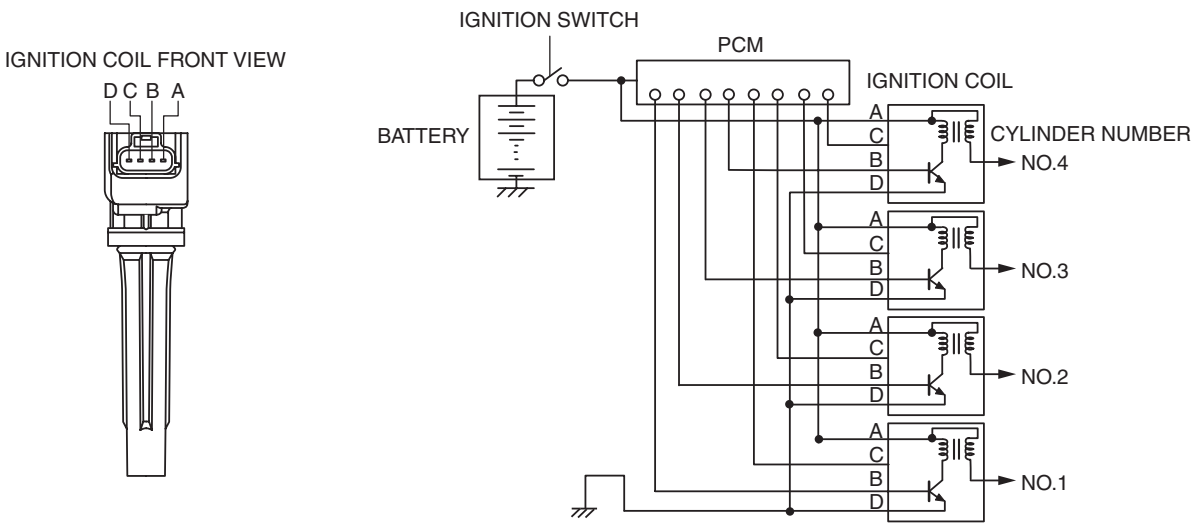


ac5wzn00001028

Operation

- Optimum ignition timing is performed according to the driving conditions by integrating the ignition control function into the PCM.

IGNITION COIL SYSTEM WIRING DIAGRAM



ac5wzn00001482

Fail-safe

DTC	Fail-safe
P0300:00	• Limits the intake air amount.
P0301:00 P0302:00 P0303:00 P0304:00	• Stops the fuel injection to the misfiring cylinder. • Limits the intake air amount.

01-19A STARTING SYSTEM [SKYACTIV-G 2.0]

STARTING SYSTEM [SKYACTIV-G 2.0]

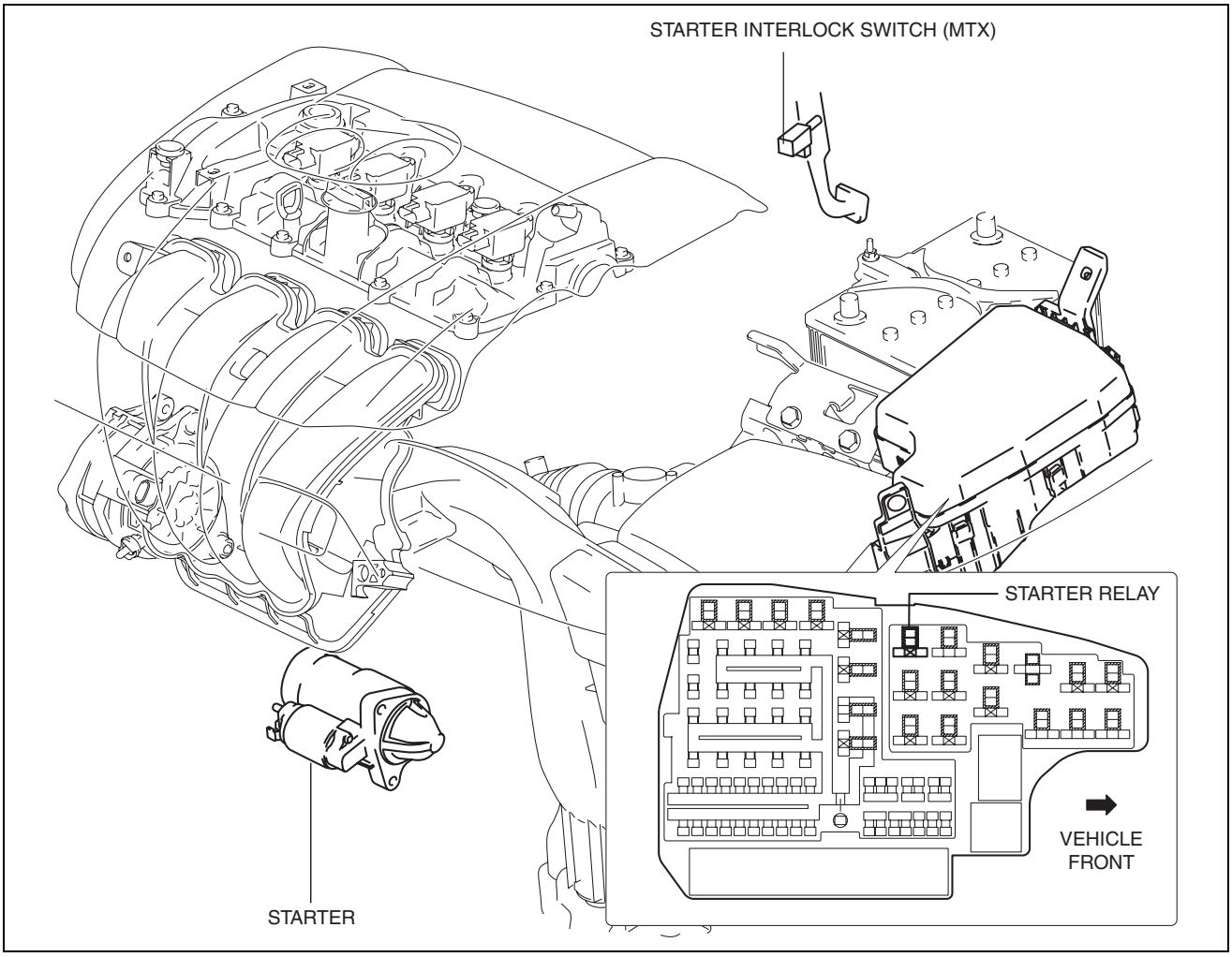
STARTING SYSTEM [SKYACTIV-G 2.0]

id0119h7105200

Outline

- A coaxial reduction type starter has been adopted.

Structural View



ac5wzn00001031

Structure

- Consists of the following parts:

Starter	(See 01-19A-2 STARTER [SKYACTIV-G 2.0].)
Starter relay	(See 01-19A-2 STARTER RELAY [SKYACTIV-G 2.0].)
Starter interlock switch (MTX)	(See 01-19A-3 STARTER INTERLOCK SWITCH [SKYACTIV-G 2.0].)

STARTING SYSTEM [SKYACTIV-G 2.0]

STARTER [SKYACTIV-G 2.0]

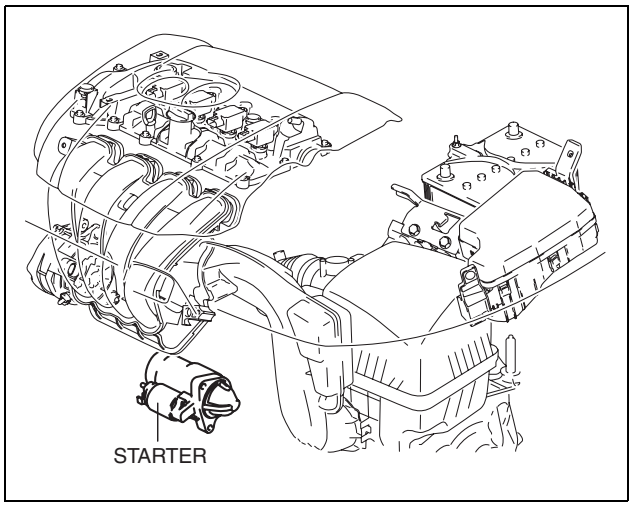
id0119h7108300

Purpose, Function

- The starter rotates the crankshaft via the ring gear and it serves as a trigger to start the engine.

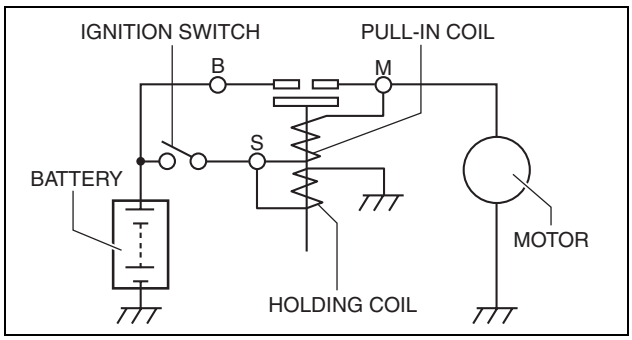
Construction

- The starter is installed to the rear part of the engine on the left side.



ac5wzn00001032

- The starter is a coaxial reduction type which can obtain high torque.



ac5wzn00001033

Operation

- For the operation, refer to CONTROL SYSTEM. (See 01-40-40 STARTER CUT-OFF CONTROL [SKYACTIV-G 2.0].)

Fail-safe

DTC	Fail-safe
P0A0F:00	• Inhibits engine-stop by operating the i-stop function.(Vehicle with i-stop)

STARTER RELAY [SKYACTIV-G 2.0]

id0119h7112500

Purpose, Function

- The starter relay supplies power to the starter by receiving the signal from the PCM.

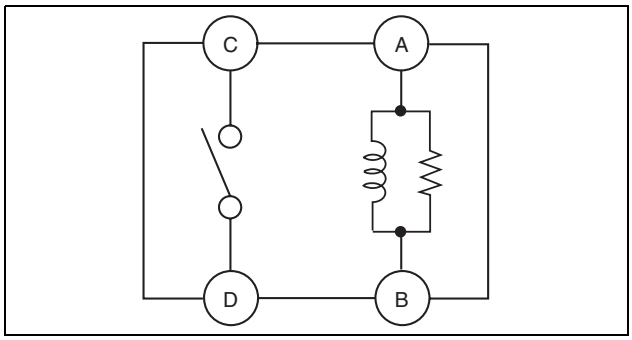
Construction

- The starter relay is installed to the relay and fuse block.

Operation

1. When current flows between A—B shown in the figure, electromagnetic power is generated and the switch between C—D is turned on.
2. Current flows between C—D and power is supplied to the starter.

STARTING SYSTEM [SKYACTIV-G 2.0]



am3uun0000194

Fail-safe

DTC	Fail-safe
P0A0F:00	• Inhibits engine-stop by operating the i-stop function.

STARTER INTERLOCK SWITCH [SKYACTIV-G 2.0]

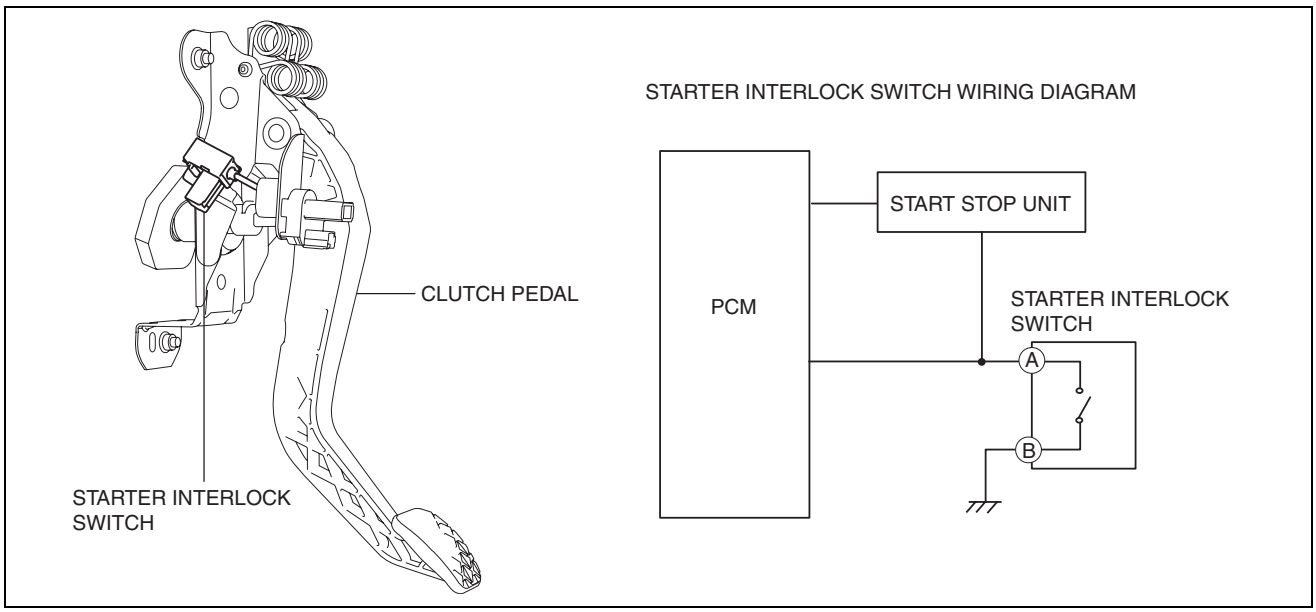
id0119h7133000

Purpose, Function

- The starter interlock switch mechanism prevents vehicle surge when the engine is started, enhancing safety. The engine cannot be started unless the clutch is depressed.

Construction

- The mechanism is provided with a starter interlock switch on the circuit under the START STOP UNIT and the PCM.

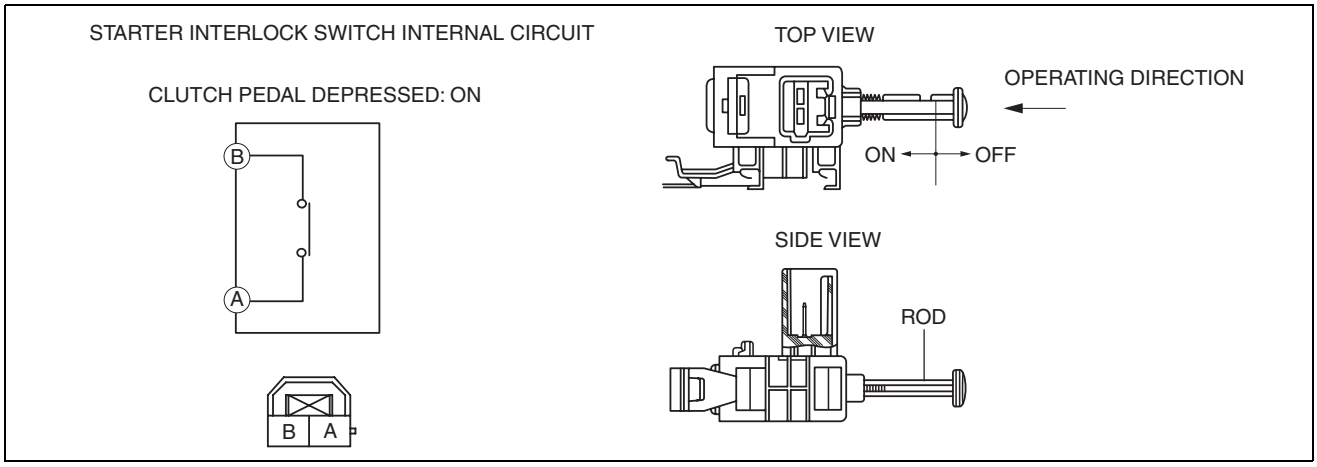


ac5wzn00001556

STARTING SYSTEM [SKYACTIV-G 2.0]

Operation

- Depressing the clutch pedal presses the starter interlock switch rod. At this time, the starter interlock switch is on, and the power circuit to starter closes. Accordingly, the starter operates only when the clutch is depressed and the engine can be started.



am3uun0000240

Fail-safe

- Function not equipped.

01-19B STARTING SYSTEM [SKYACTIV-D 2.2]

STARTING SYSTEM [SKYACTIV-D 2.2]

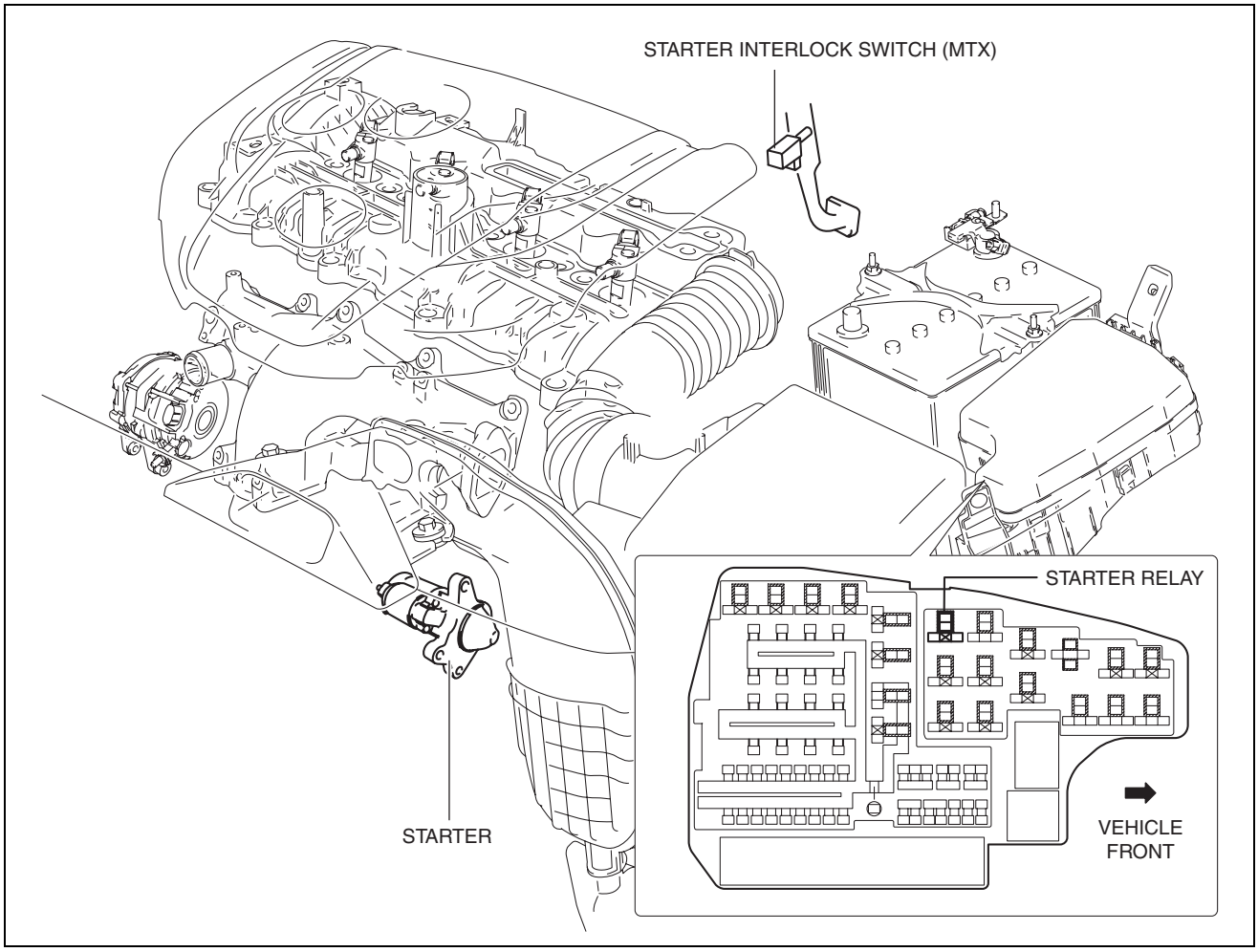
STARTING SYSTEM [SKYACTIV-D 2.2]

id0119h8105200

Outline

- A coaxial reduction type starter has been adopted.

Structural View



ac5wzn00001993

Structure

- Consists of the following parts:

Starter	(See 01-19B-2 STARTER [SKYACTIV-D 2.2].)
Starter relay	(See 01-19B-2 STARTER RELAY [SKYACTIV-D 2.2].)

STARTING SYSTEM [SKYACTIV-D 2.2]

Starter interlock switch (MTX)	(See 01-19B-3 STARTER INTERLOCK SWITCH [SKYACTIV-D 2.2].)

STARTER [SKYACTIV-D 2.2]

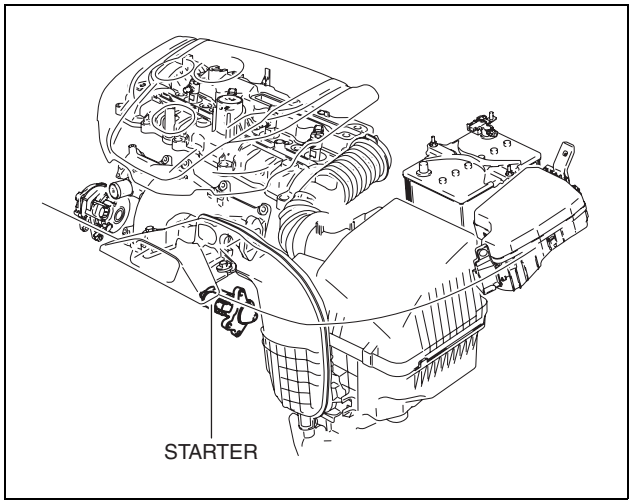
id0119h8108300

Purpose, Function

- The starter rotates the crankshaft via the ring gear and it serves as a trigger to start the engine.

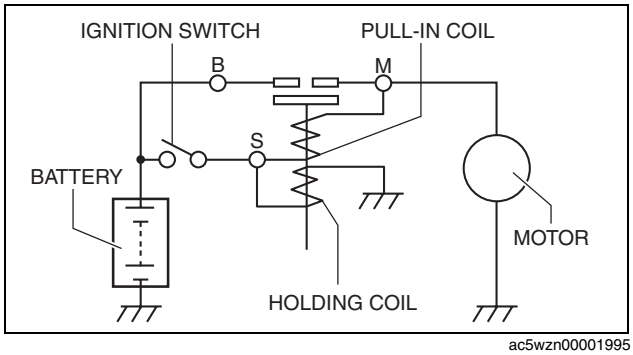
Construction

- The starter is installed to the rear part of the engine on the left side.



ac5wzn00001994

- The starter is a coaxial reduction type which can obtain high torque.



ac5wzn00001995

Operation

- For the operation, refer to CONTROL SYSTEM.

Fail-safe

DTC	Fail-safe
P0A0F:00	• Inhibits engine-stop by operating the i-stop function.

STARTER RELAY [SKYACTIV-D 2.2]

id0119h8112500

Purpose, Function

- The starter relay supplies power to the starter by receiving the signal from the PCM.

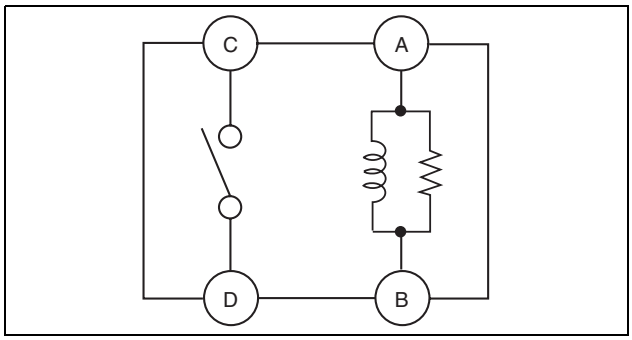
Construction

- The starter relay is installed to the relay and fuse block.

Operation

1. When current flows between A—B shown in the figure, electromagnetic power is generated and the switch between C—D is turned on.
2. Current flows between C—D and power is supplied to the starter.

STARTING SYSTEM [SKYACTIV-D 2.2]



am3uun0000194

Fail-safe

DTC	Fail-safe
P0A0F:00	• Inhibits engine-stop by operating the i-stop function.

STARTER INTERLOCK SWITCH [SKYACTIV-D 2.2]

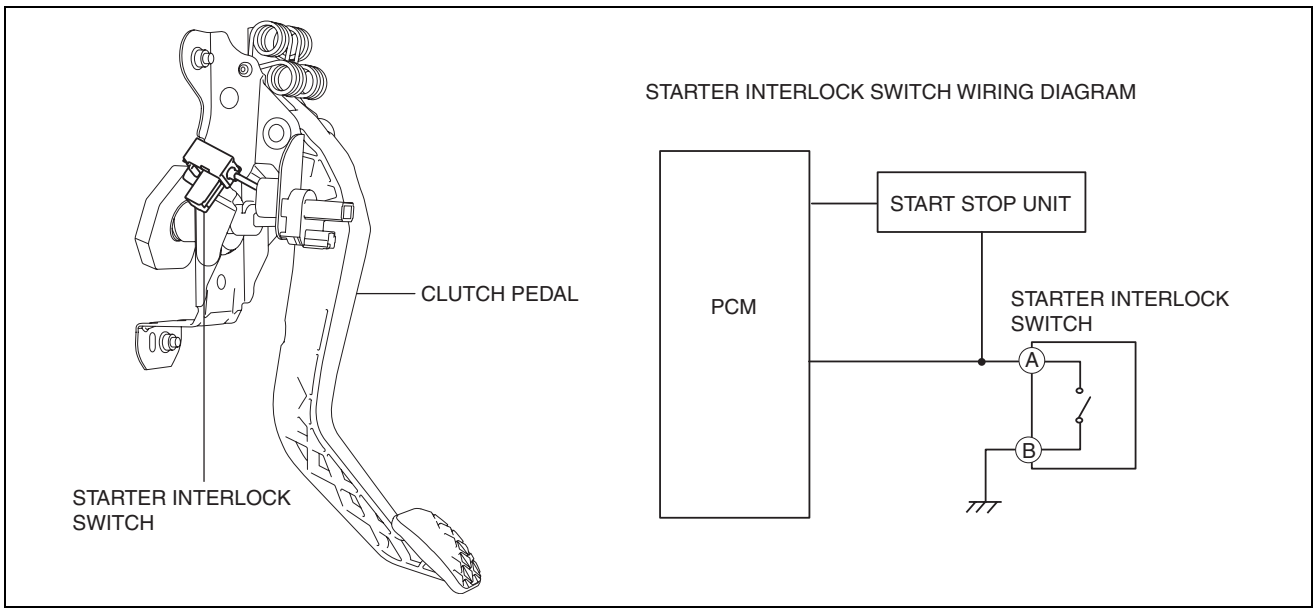
id0119h8133000

Purpose, Function

- The starter interlock switch mechanism prevents vehicle surge when the engine is started, enhancing safety. The engine cannot be started unless the clutch is depressed.

Construction

- The mechanism is provided with a starter interlock switch on the circuit under the START STOP UNIT and the PCM.

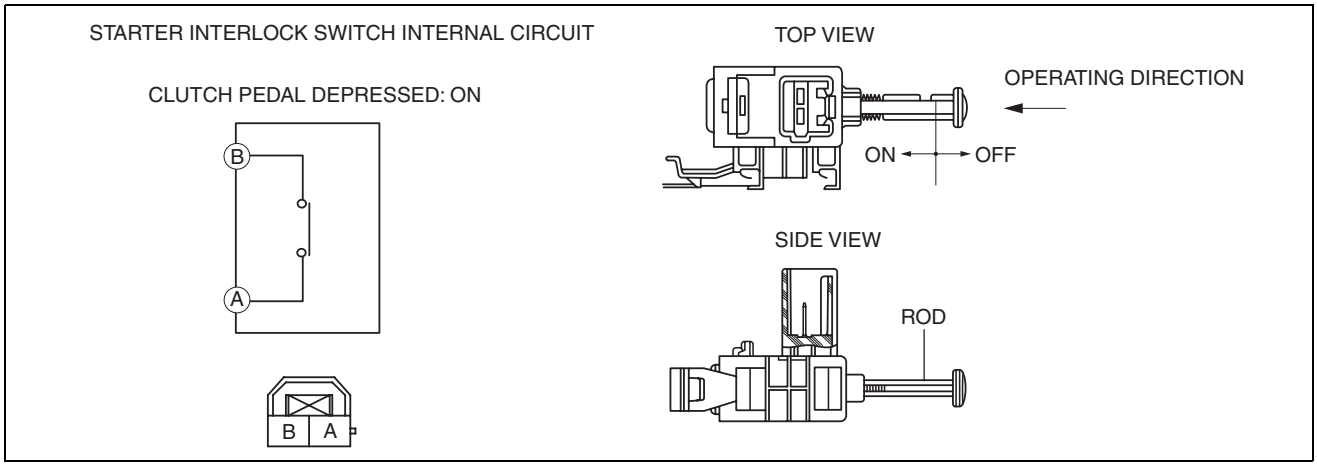


ac5wzn00001556

STARTING SYSTEM [SKYACTIV-D 2.2]

Operation

- Depressing the clutch pedal presses the starter interlock switch rod. At this time, the starter interlock switch is on, and the power circuit to starter closes. Accordingly, the starter operates only when the clutch is depressed and the engine can be started.



am3uun0000240

Fail-safe

- Function not equipped.

01-20A CRUISE CONTROL SYSTEM [SKYACTIV-G 2.0]

CRUISE CONTROL SYSTEM [SKYACTIV-G 2.0]

CRUISE CONTROL SYSTEM [SKYACTIV-G 2.0]

id0120e3903400

Outline

- Enables driving at a constant speed by setting the vehicle speed with the cruise control switch instead of operating the accelerator pedal.
- The PCM controls the throttle valve actuator to maintain the vehicle at a constant speed.

Component and function

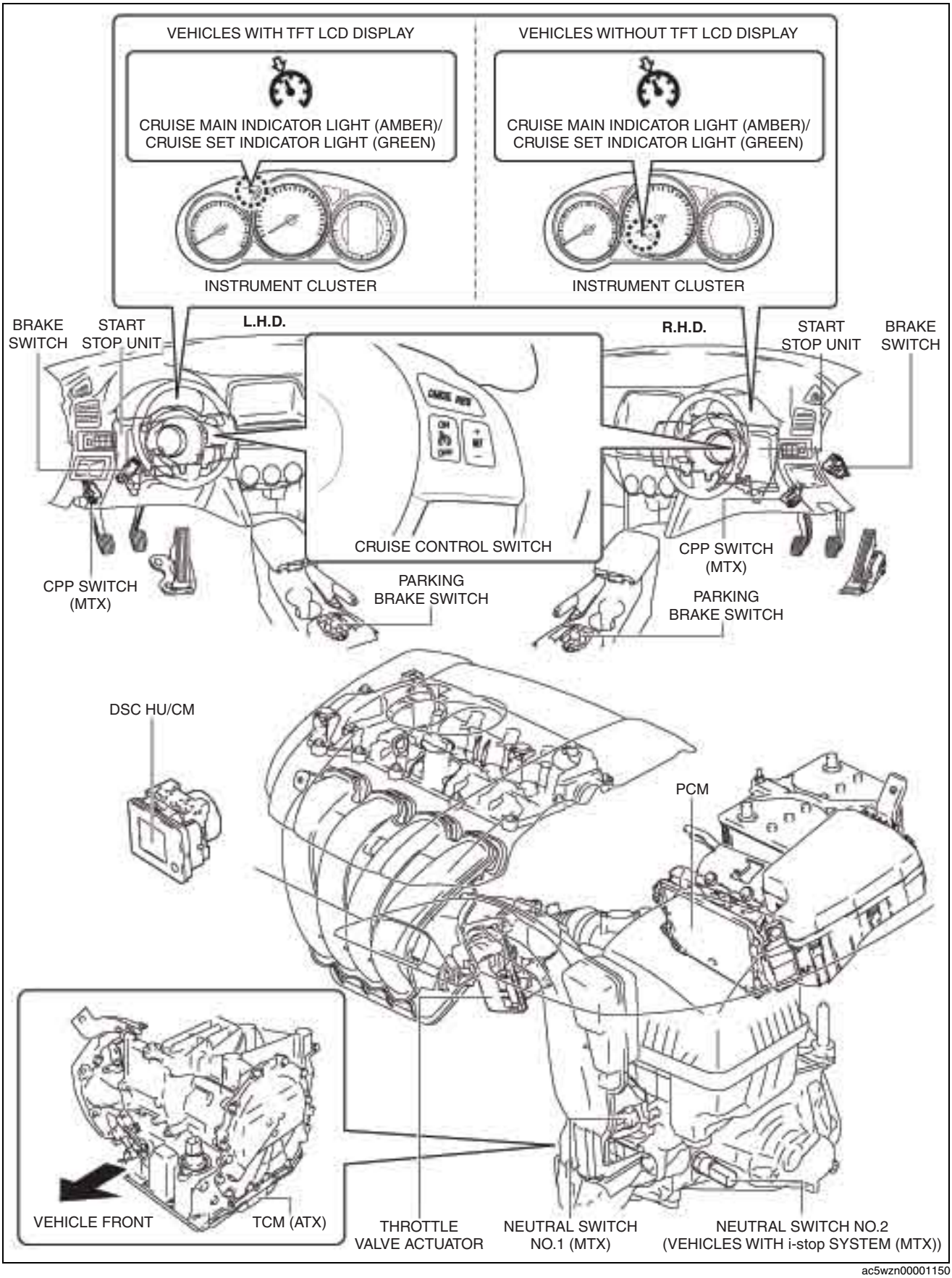
Component		Function
DSC HU/CM (CAN communication: Vehicle speed signal)		The vehicle speed signal is sent to the PCM from the DSC HU/CM.
Cruise control switch	ON	The cruise control system main switch. The cruise control system goes into standby with the operation of the switch.
	OFF	The cruise control system main switch. The cruise control system is turned off with the operation of the switch.
	SET (+)	• If the switch is pressed when the vehicle speed **exceeds 25 km/h {16 mph}** with the system in standby, the vehicle speed at the point when the switch is pressed is stored in the PCM and the system initiates the cruise control. • The PCM controls acceleration by the pressing of the switch (tap-up operation) or when the switch is continuously pressed during cruise control.
	SET (–)	• If the switch is pressed when the vehicle speed **exceeds 25 km/h {16 mph}** with the system in standby, the vehicle speed at the point when the switch is pressed is stored in the PCM and the system initiates the cruise control. • The PCM controls deceleration by the pressing of the switch (tap-down operation) or when the switch is continuously pressed during cruise control.
	RESUME	If the switch is pressed when the vehicle speed **exceeds 25 km/h {16 mph}** with the system in standby and the previous pre-set vehicle speed is stored in the PCM, the system initiates the cruise control so that the vehicle speed is the pre-set vehicle speed stored in the PCM.
	CANCEL	If the switch is pressed during cruise control, the cruise control system goes into standby (pre-set vehicle speed is stored).
Brake switch		Depressing the brake pedal during cruise control switches the cruise control system to standby mode (pre-set vehicle speed is stored).
CPP switch (MTX)		Depressing the clutch pedal during cruise control switches the cruise control system to standby mode (pre-set vehicle speed is stored).
Neutral switch (MTX)		Shifting to neutral during cruise control switches the cruise control system to standby mode (pre-set vehicle speed is stored).
TCM (ATX) (CAN communication: gear signal)		If the following operation is performed during cruise control, the cruise control system goes into standby mode (pre-set vehicle speed is stored). • The selector lever is shifted from D position to N position.
DSC HU/CM (CAN communication: Brake pressure)		If the brake pressure **exceeds 0.3 MPa {3 kgf/cm^2, 44 psi}**, the cruise control system goes into standby mode (pre-set vehicle speed is stored).
Parking brake switch		If the parking brake is applied, the cruise control system goes into standby mode (pre-set vehicle speed is stored).
TCM (ATX) (CAN communication: diagnostic signal)		If there is a malfunction with the AT, the cruise control system goes into standby mode (pre-set vehicle speed is stored).
PCM		The cruise control system is executed or stopped according to the cruise control switch signals. The throttle valve actuator is operated so that the vehicle speed is the pre-set vehicle speed during cruise control system.
Throttle valve actuator		The duty signal sent from the PCM adjusts the throttle valve opening angle.

CRUISE CONTROL SYSTEM [SKYACTIV-G 2.0]

Component	Function
Cruise main indicator light (Amber)	(See 01-20A-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-G 2.0].)
Cruise set indicator light (Green)	(See 01-20A-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].)

CRUISE CONTROL SYSTEM [SKYACTIV-G 2.0]

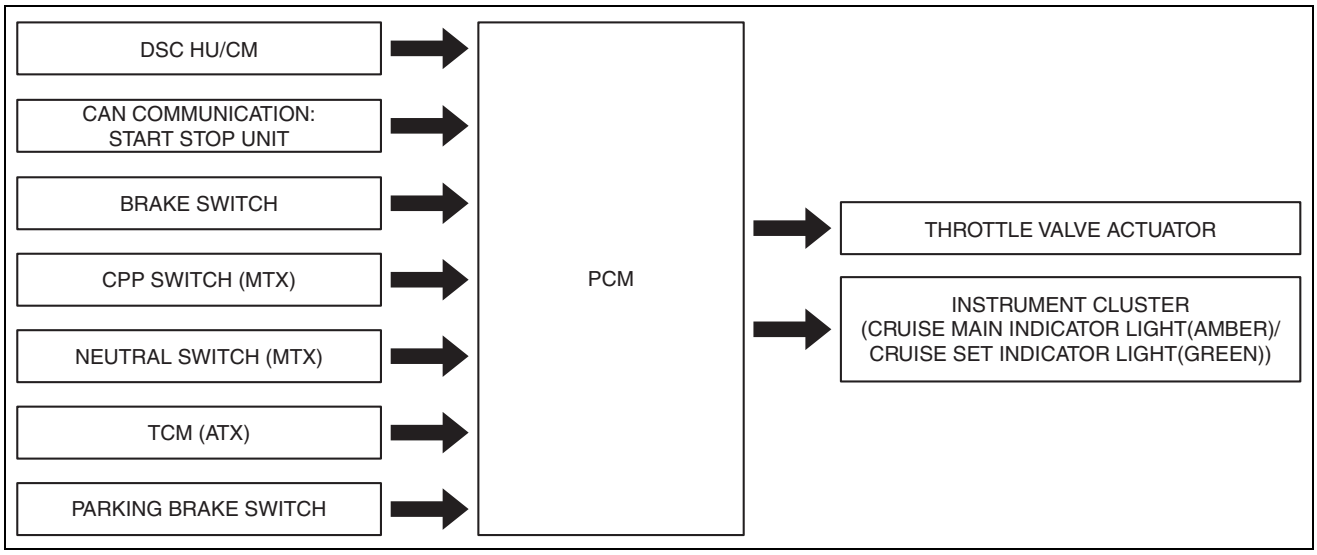
Structural View



ac5wzn00001150

CRUISE CONTROL SYSTEM [SKYACTIV-G 2.0]

Block Diagram



ac5wzn00000048

CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0]

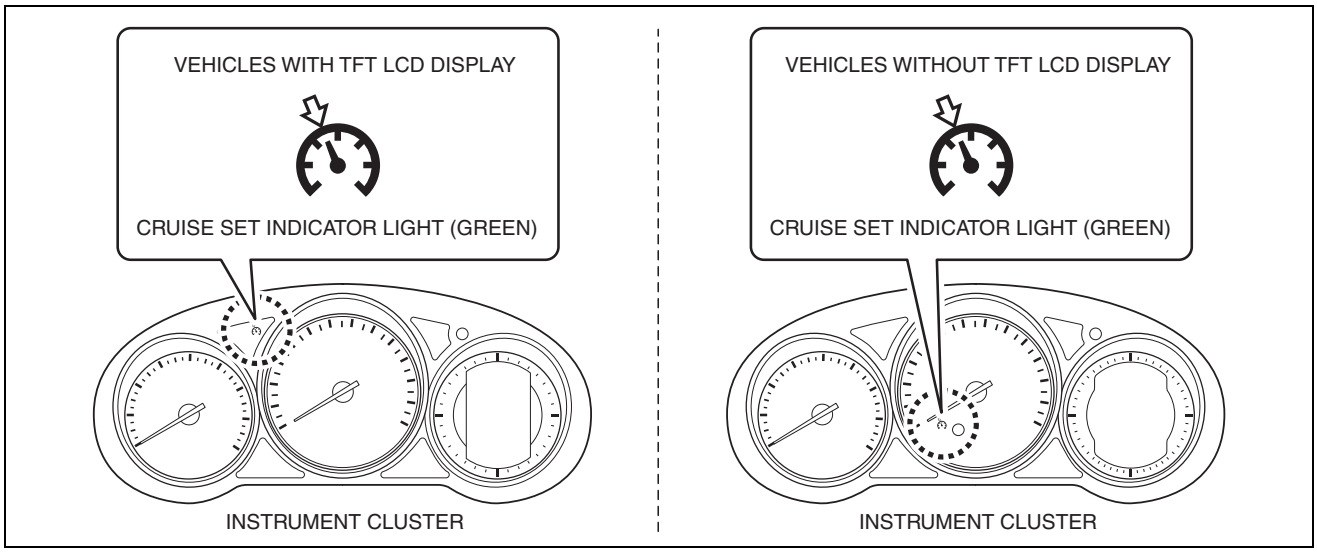
id0120e3903500

Purpose/Function

- Illuminates during the cruise control system operation to inform the driver that the cruise control system is operating.

Construction

- Built into the instrument cluster.



ac5wzn00001151

Operation

- Illuminates during the cruise control system operation.
- The PCM sends a cruise set indicator light (green) illumination request to the instrument cluster via CAN communication.

CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-G 2.0]

id0120e3903600

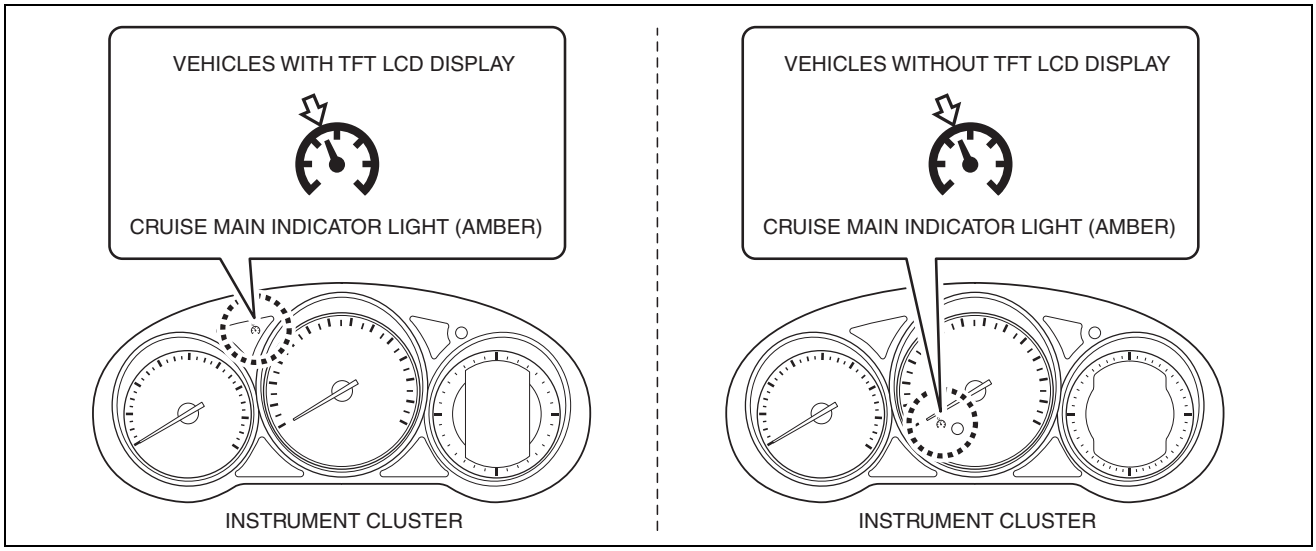
Purpose/Function

- Illuminates while the cruise control system is in standby mode to inform the driver that the cruise control system is on standby.

CRUISE CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

- Built into the instrument cluster.



ac5wzn00001152

Operation

- Illuminates while the cruise control system is on standby.
- The PCM sends a cruise main indicator light (amber) illumination request to the instrument cluster via CAN communication.

01-20B CRUISE CONTROL SYSTEM [SKYACTIV-D 2.2]

CRUISE CONTROL SYSTEM [SKYACTIV-D 2.2]

CRUISE CONTROL SYSTEM [SKYACTIV-D 2.2]

id0120e5903400

Outline

- The cruise control system enables driving at a constant speed by setting the vehicle speed with the cruise control switch instead of operating the accelerator pedal.
- The PCM controls the fuel injection amount to maintain the vehicle at a constant speed.

Component and function

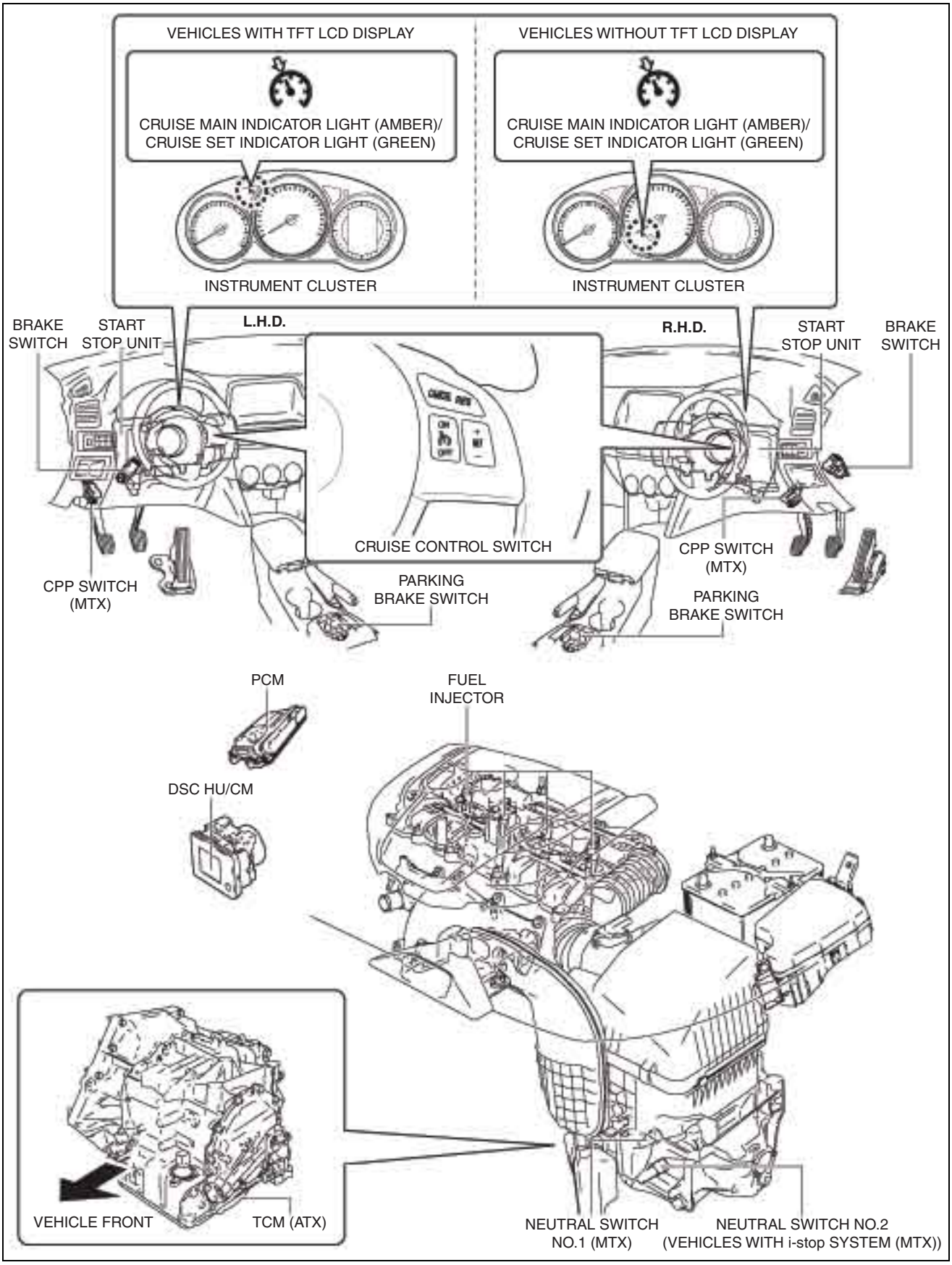
Component		Function
DSC HU/CM (CAN communication: Vehicle speed signal)		The vehicle speed signal is sent to the PCM from the DSC HU/CM.
Cruise control switch	ON	The cruise control system main switch. The cruise control system goes into standby with the operation of the switch.
	OFF	The cruise control system main switch. The cruise control system is turned off with the operation of the switch.
	SET (+)	• If the switch is pressed when the vehicle speed **exceeds 25 km/h {16 mph}** with the system in standby, the vehicle speed at the point when the switch is pressed is stored in the PCM and the system initiates the cruise control. • The PCM controls acceleration by the pressing of the switch (tap-up operation) or when the switch is continuously pressed during cruise control.
	SET (–)	• If the switch is pressed when the vehicle speed **exceeds 25 km/h {16 mph}** with the system in standby, the vehicle speed at the point when the switch is pressed is stored in the PCM and the system initiates the cruise control. • The PCM controls deceleration by the pressing of the switch (tap-down operation) or when the switch is continuously pressed during cruise control.
	RESUME	If the switch is pressed when the vehicle speed **exceeds 25 km/h {16 mph}** with the system in standby and the previous pre-set vehicle speed is stored in the PCM, the system initiates the cruise control so that the vehicle speed is the pre-set vehicle speed stored in the PCM.
	CANCEL	If the switch is pressed during cruise control, the cruise control system goes into standby (pre-set vehicle speed is stored).
Brake switch		Depressing the brake pedal during cruise control switches the cruise control system to standby mode (pre-set vehicle speed is stored).
CPP switch (MTX)		Depressing the clutch pedal during cruise control switches the cruise control system to standby mode (pre-set vehicle speed is stored).
Neutral switch (MTX)		Shifting to neutral during cruise control switches the cruise control system to standby mode (pre-set vehicle speed is stored).
TCM (ATX) (CAN communication: gear signal)		If the following operation is performed during cruise control, the cruise control system goes into standby mode (pre-set vehicle speed is stored). • The selector lever is shifted from D position to N position.
DSC HU/CM (CAN communication: Brake pressure)		If the brake pressure **exceeds 0.3 MPa {3 kgf/cm^2, 44 psi}**, the cruise control system goes into standby mode (pre-set vehicle speed is stored).
Parking brake switch		If the parking brake is applied, the cruise control system goes into standby mode (pre-set vehicle speed is stored).
TCM (ATX) (CAN communication: diagnostic signal)		If there is a malfunction with the AT, the cruise control system goes into standby mode (pre-set vehicle speed is stored).
PCM		The cruise control system is executed or stopped according to the cruise control switch signals.
Fuel injector		The input signal sent from the PCM adjusts the fuel injection amount.
Cruise main indicator light (Amber)		(See 01-20A-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-G 2.0].)

CRUISE CONTROL SYSTEM [SKYACTIV-D 2.2]

Component	Function
Cruise set indicator light (Green)	(See 01-20A-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].)

CRUISE CONTROL SYSTEM [SKYACTIV-D 2.2]

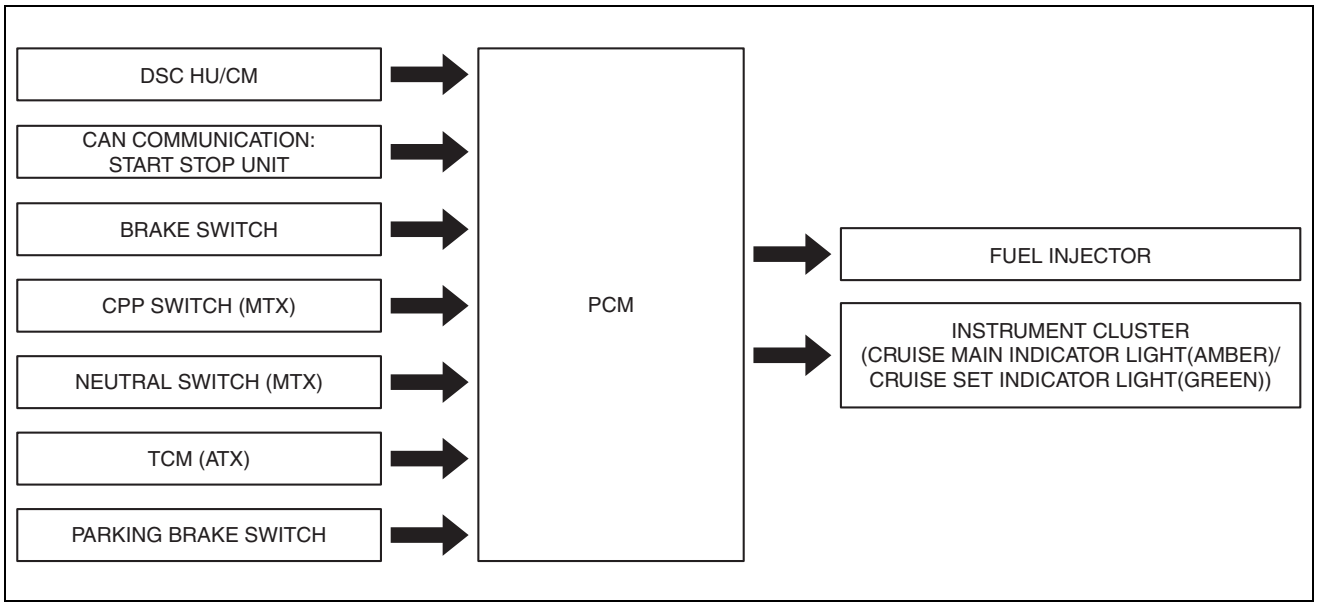
Structural View



ac5wzn00001304

CRUISE CONTROL SYSTEM [SKYACTIV-D 2.2]

Block Diagram



ac5wzn00001305

CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-D 2.2]

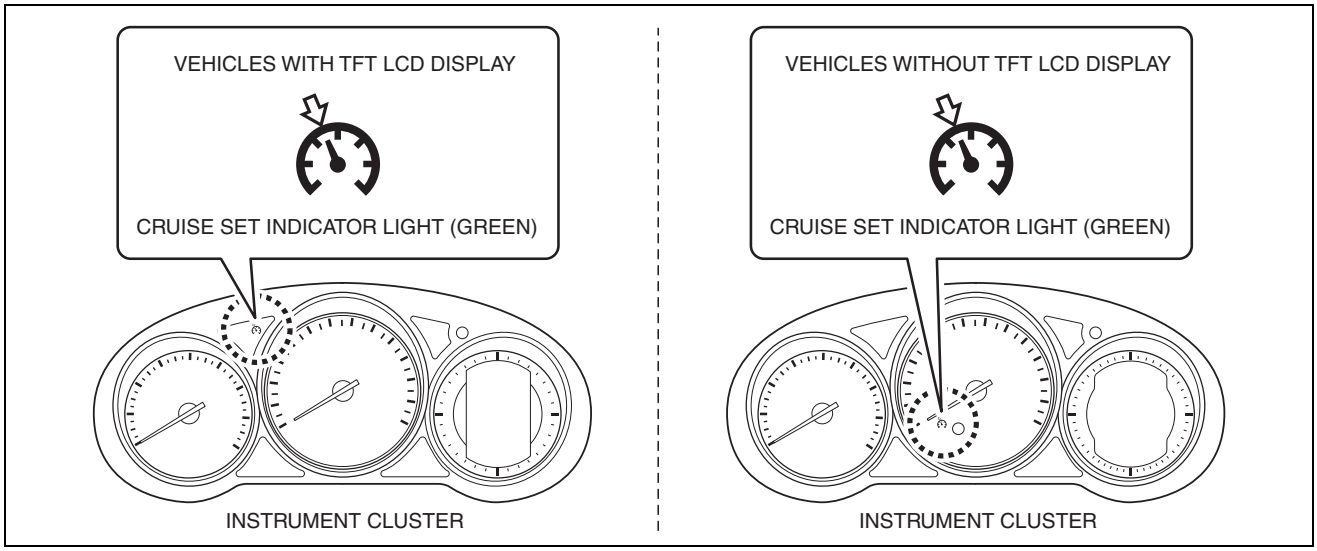
id0120e5903500

Purpose/Function

- Illuminates during the cruise control system operation to inform the driver that the cruise control system is operating.

Construction

- Built into the instrument cluster.



ac5wzn00001151

Operation

- Illuminates during the cruise control system operation.
- The PCM sends a cruise set indicator light (green) illumination request to the instrument cluster via CAN communication.

CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-D 2.2]

id0120e5903600

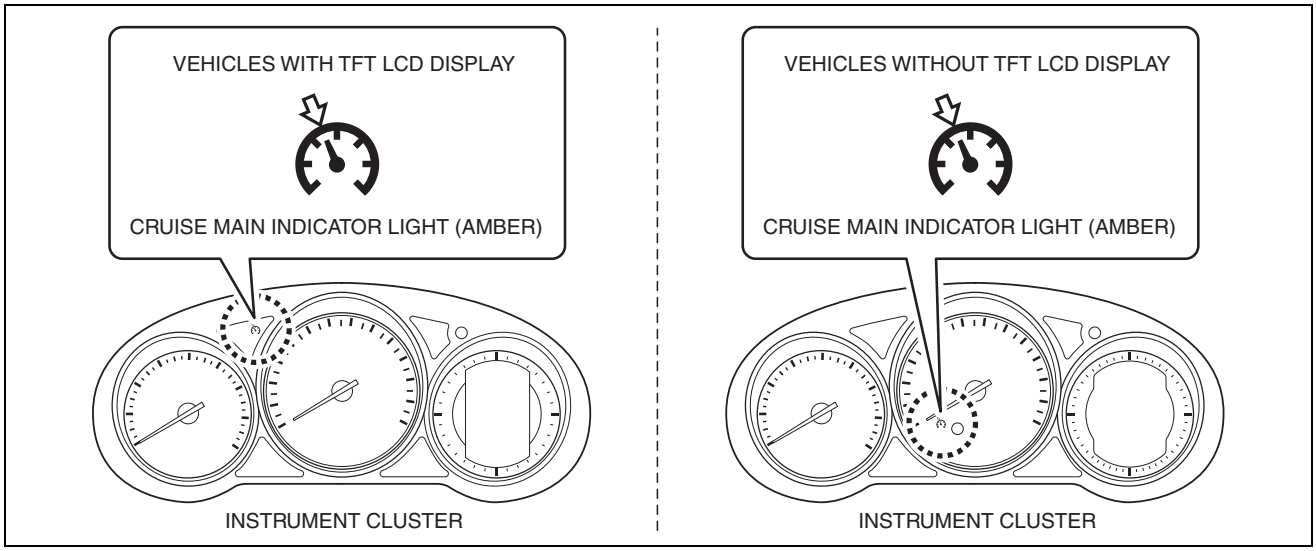
Purpose/Function

- Illuminates while the cruise control system is in standby mode to inform the driver that the cruise control system is on standby.

CRUISE CONTROL SYSTEM [SKYACTIV-D 2.2]

Construction

- Built into the instrument cluster.



ac5wzn00001152

Operation

- Illuminates while the cruise control system is on standby.
- The PCM sends a cruise main indicator light (amber) illumination request to the instrument cluster via CAN communication.

01-40 CONTROL SYSTEM [SKYACTIV-G 2.0]

CONTROL SYSTEM [SKYACTIV-G 2.0]

CONTROL SYSTEM [SKYACTIV-G 2.0]

ENGINE CONTROL SYSTEM [SKYACTIV-G 2.0]

id0140f4139900

Outline

- L-jetronic[*1] and D-jetronic[*2] type detectors have been combined for intake air amount detection, improving the accuracy of the intake air amount measurement.

CONTROL SYSTEM [SKYACTIV-G 2.0]

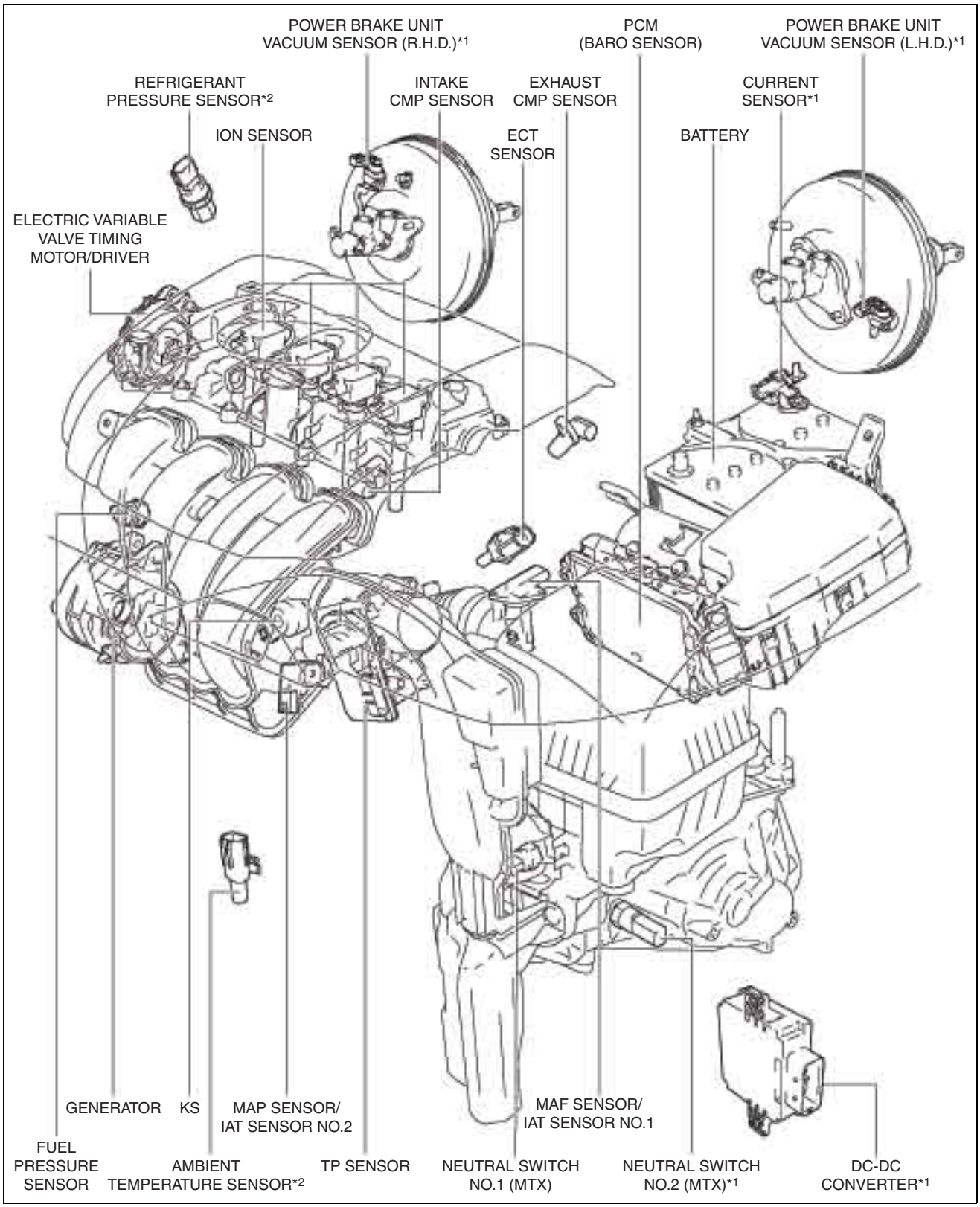
— MAF sensor adopted
— MAP sensor adopted
— IAT sensor No.1 and No.2 adopted

- Valve timing control has been adopted on both sides of the intake and exhaust, improving fuel economy and emission performance.
  Intake side: Electric variable valve timing control
  — Intake CMP sensor adopted
  — Electric variable valve timing motor/driver adopted
  — Electric variable valve timing relay adopted
  Exhaust side: Hydraulic variable valve timing control
  — Exhaust CMP sensor adopted
- Engine oil control has been adopted reducing engine load.
  — Engine oil solenoid valve adopted
- DC-DC converter control has been adopted for improved power supply stability.
  — DC-DC converter adopted
- With the adoption of fuel pump control, fuel pump power consumption has been reduced, improving fuel economy.
  — Fuel pump control module adopted
- Generator output control adopted, fuel economy/idling stability improved.
  — Current sensor adopted
- With the adoption of the ion sensor, which detects pre-ignition, engine reliability has been improved.
- LIN communication has been adopted to the current sensor and DC-DC converter for simplified wiring harnesses.

*1 : Measures the intake air amount directly using the MAF sensor.
*2 : Measures the intake air pressure introduced into the cylinder using the MAP sensor and calculates the intake air amount indirectly.

CONTROL SYSTEM [SKYACTIV-G 2.0]

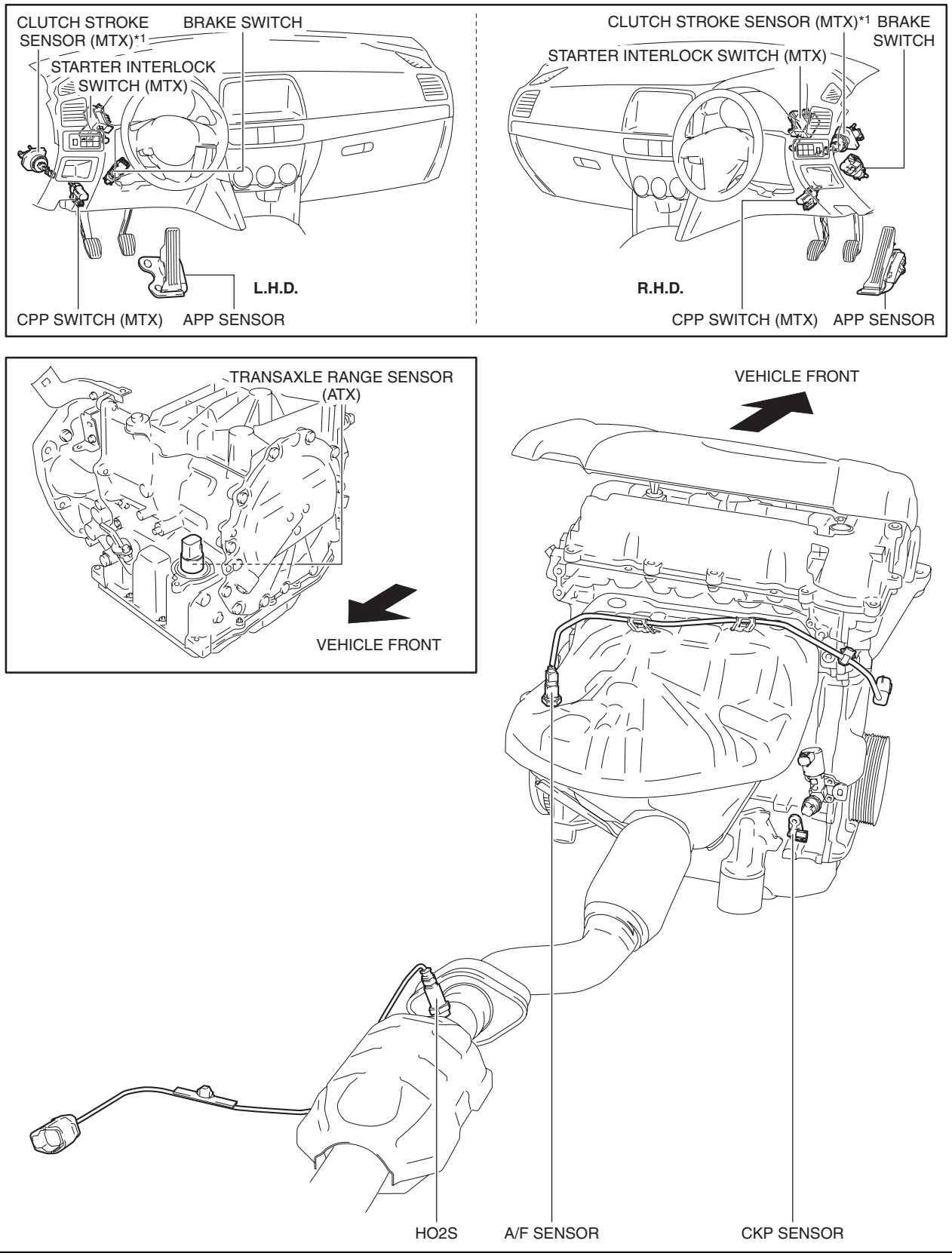
Structural View
Input device



ac5wzn00000036

*1 : Vehicles with i-stop system
*2 : Vehicles with air conditioner

CONTROL SYSTEM [SKYACTIV-G 2.0]

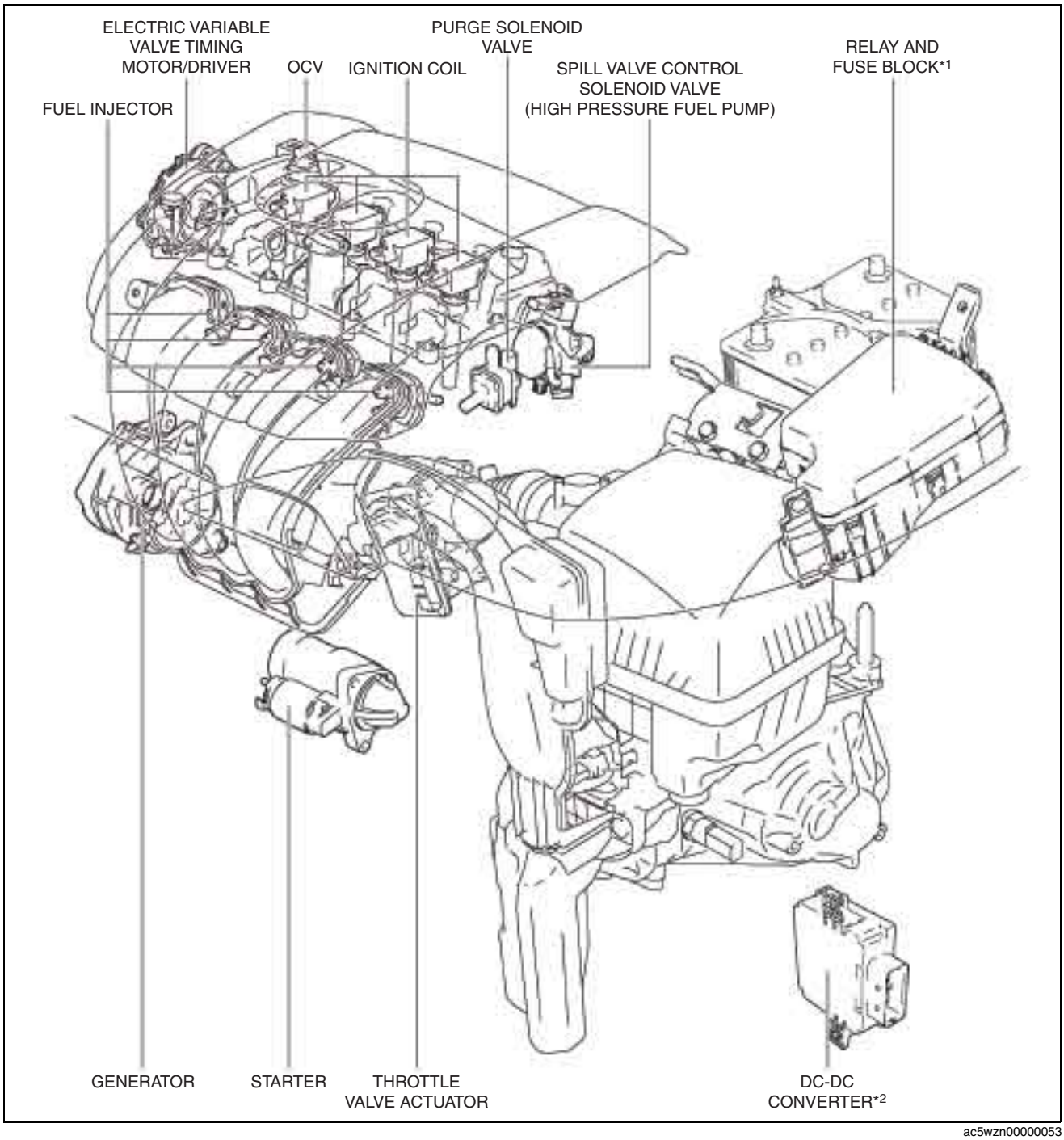


ac5wzn00000052

*1 : Vehicles with i-stop system

CONTROL SYSTEM [SKYACTIV-G 2.0]

Output device

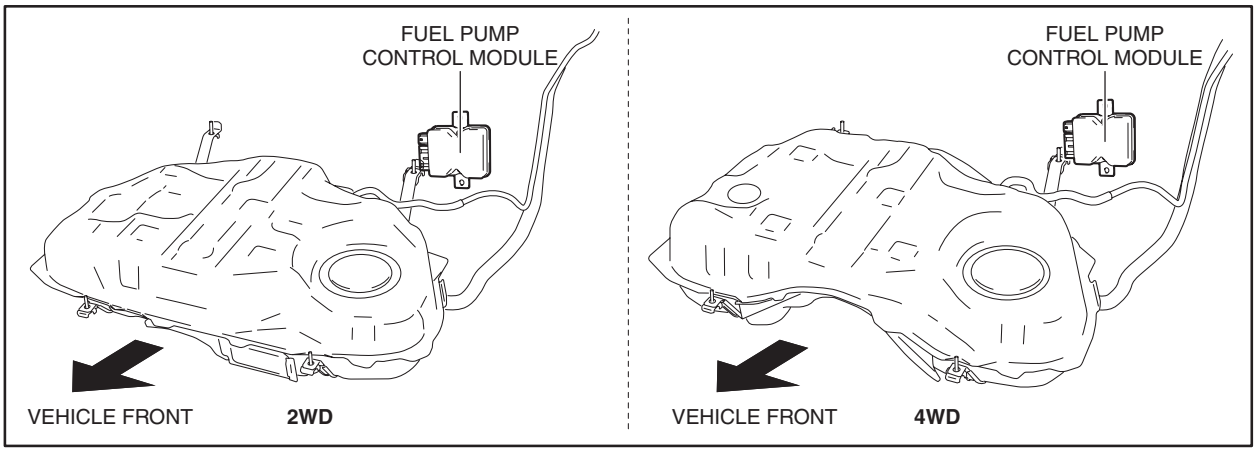


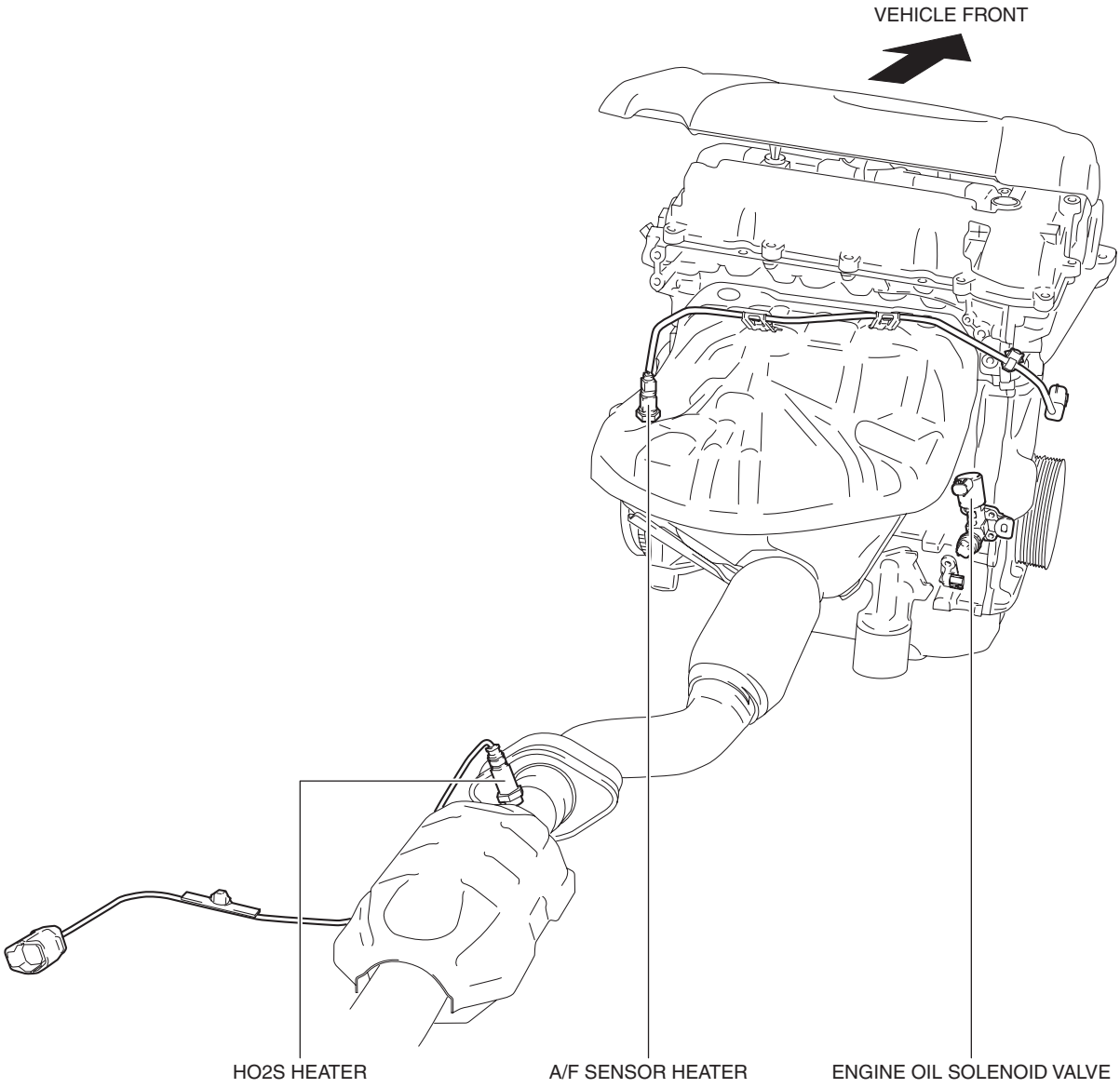
ac5wzn00000053

*1 : Fuel pump relay, starter relay, electric variable valve timing relay, fuel injector relay, main relay, A/C relay, cooling fan relay No.1, cooling fan relay No.2, cooling fan relay No.3

*2 : Vehicles with i-stop system

CONTROL SYSTEM [SKYACTIV-G 2.0]

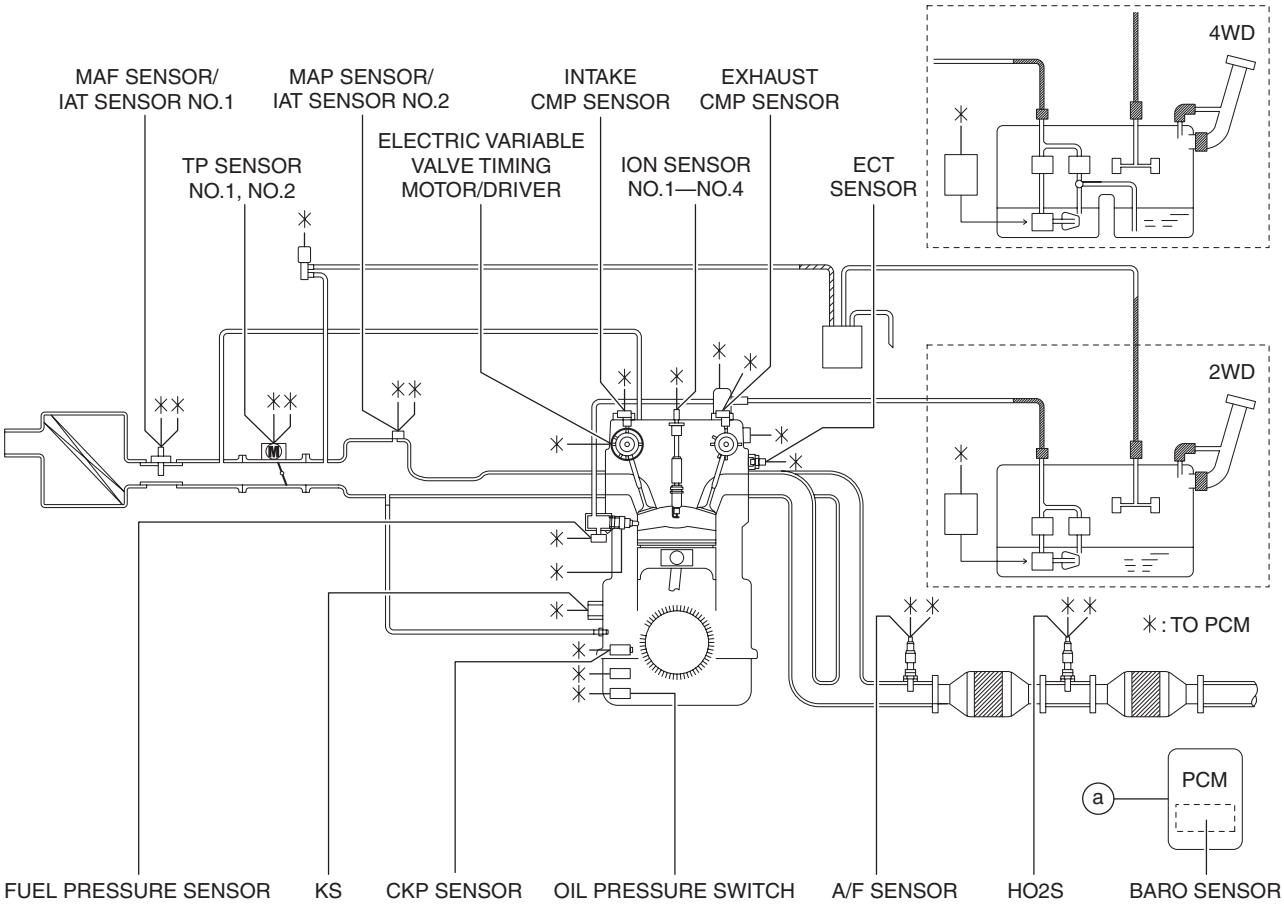




ac5wzn00000039

CONTROL SYSTEM [SKYACTIV-G 2.0]

System Diagram
Input device



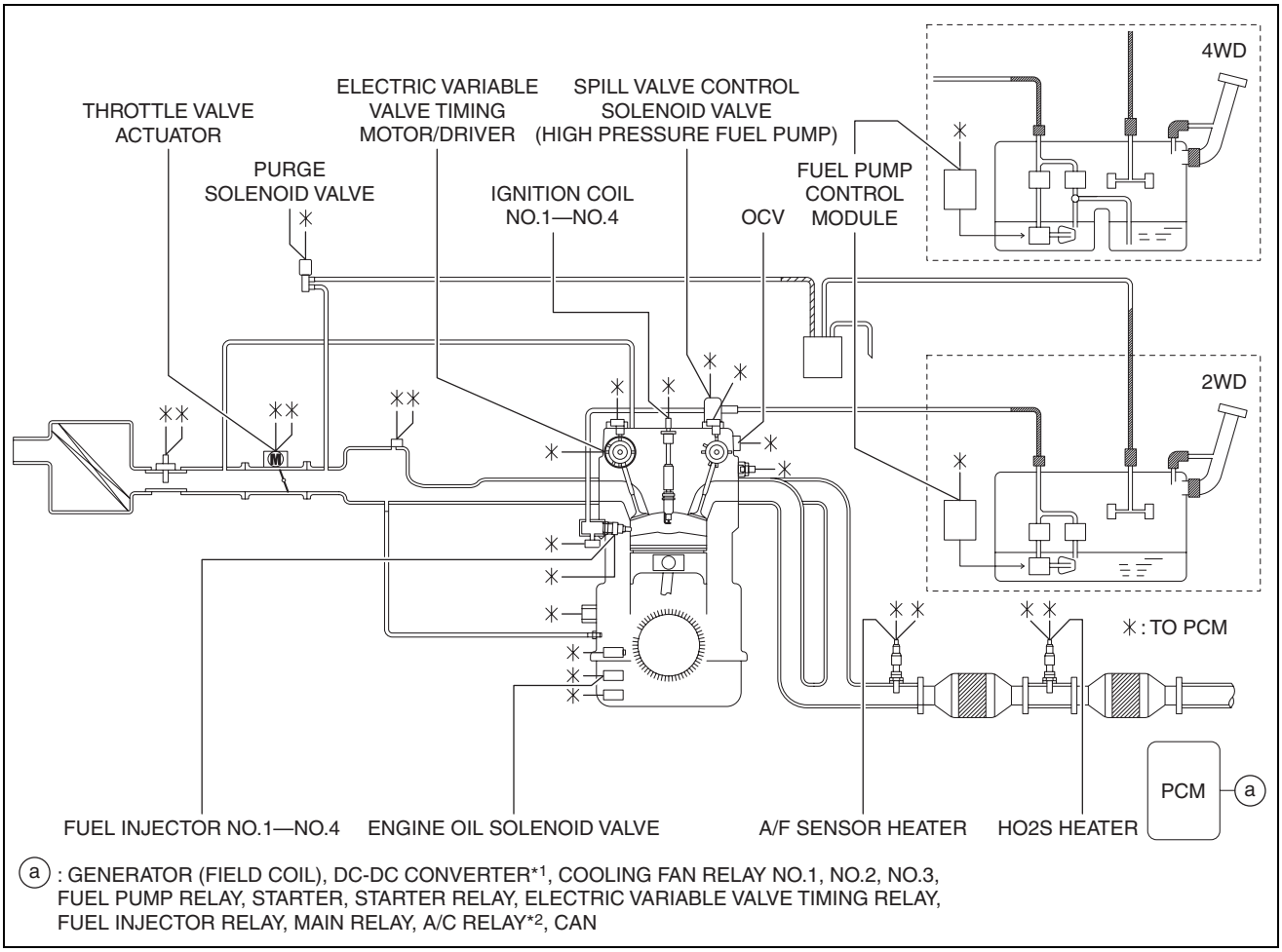
(a) : APP SENSOR NO.1, NO.2, IG1 RELAY, GENERATOR (STATOR COIL),
BRAKE SWITCH (NO.1 SIGNAL), (NO.2 SIGNAL), BATTERY, REFRIGERANT PRESSURE SESNSOR*2,
AMBIENT TEMPERATURE SENSOR*2, TRANSAXLE RANGE SENSOR (ATX), STARTER INTERLOCK SWITCH (MTX),
NEUTRAL SWITCH NO.1 (MTX), NEUTRAL SWITCH NO.2 (MTX)*1,
CPP SWITCH (MTX), CLUTCH STROKE SENSOR (MTX)*1, CAN

ac5wzn00000054

*1 : Vehicles with i-stop system
*2 : Vehicles with air conditioner

CONTROL SYSTEM [SKYACTIV-G 2.0]

Output device



(a) : GENERATOR (FIELD COIL), DC-DC CONVERTER*1, COOLING FAN RELAY NO.1, NO.2, NO.3, FUEL PUMP RELAY, STARTER, STARTER RELAY, ELECTRIC VARIABLE VALVE TIMING RELAY, FUEL INJECTOR RELAY, MAIN RELAY, A/C RELAY*2, CAN

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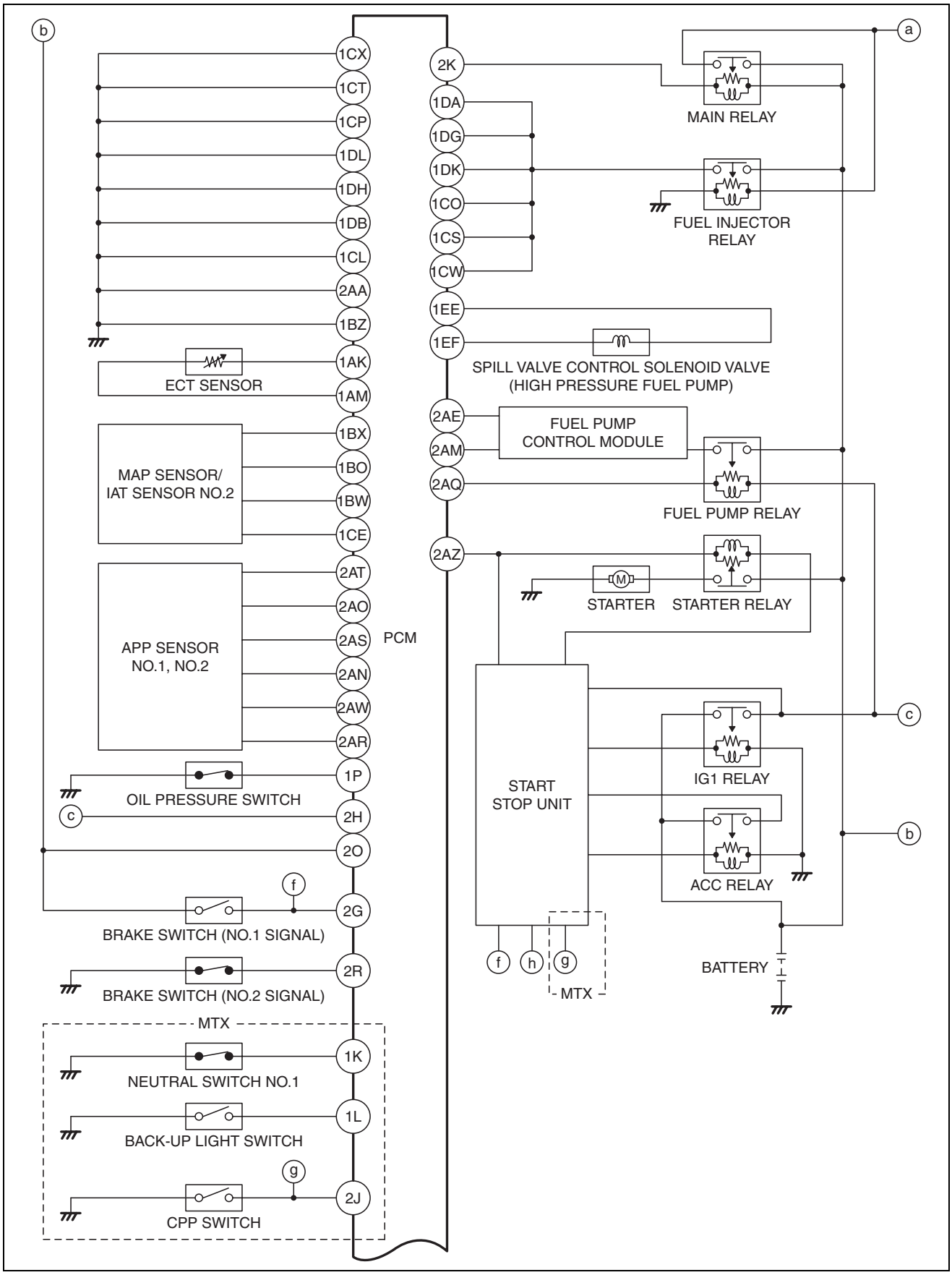
*1 : Vehicles with i-stop system
*2 : Vehicles with air conditioner

CONTROL SYSTEM [SKYACTIV-G 2.0]

System Wiring Diagram



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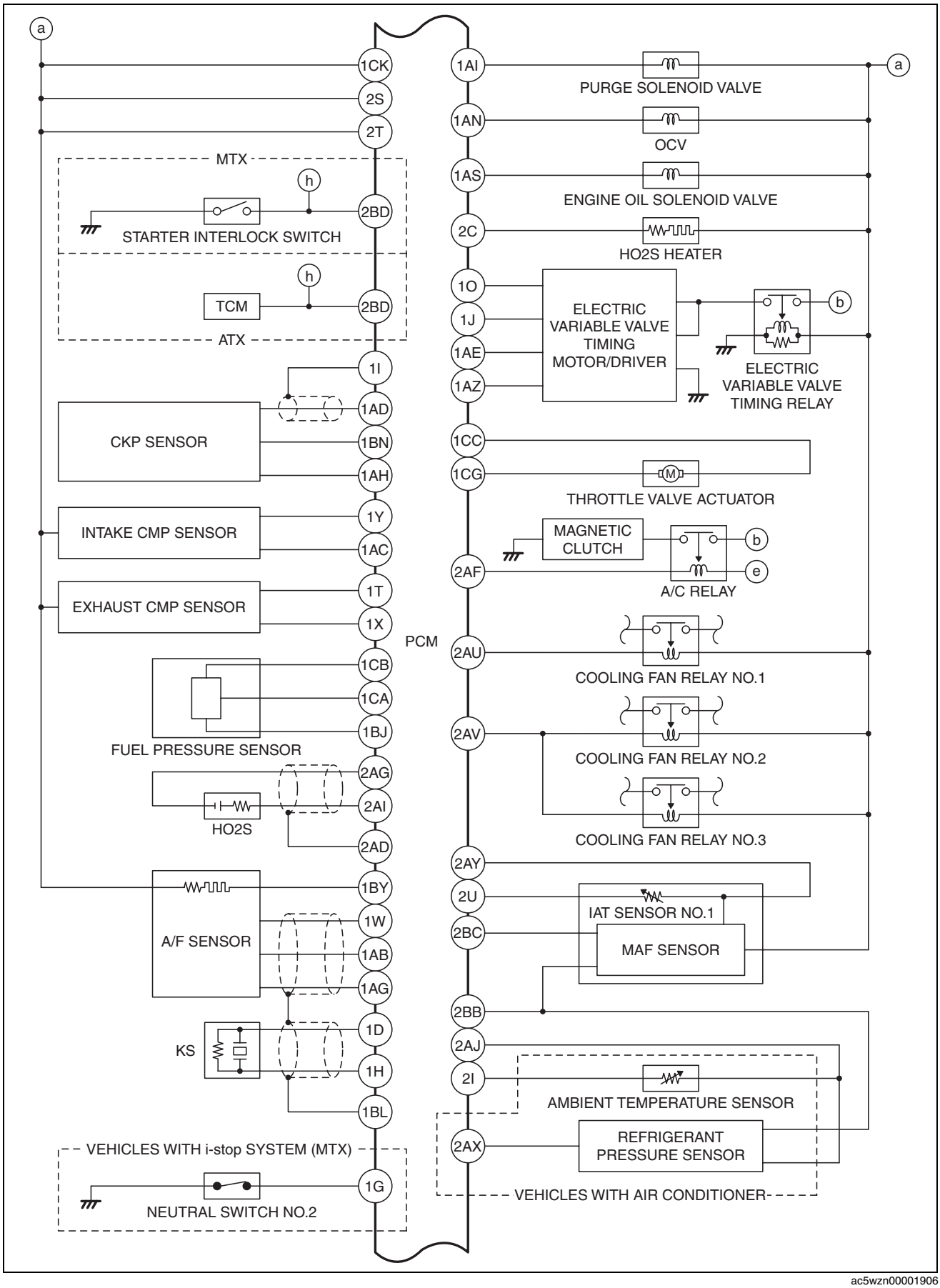
CONTROL SYSTEM [SKYACTIV-G 2.0]



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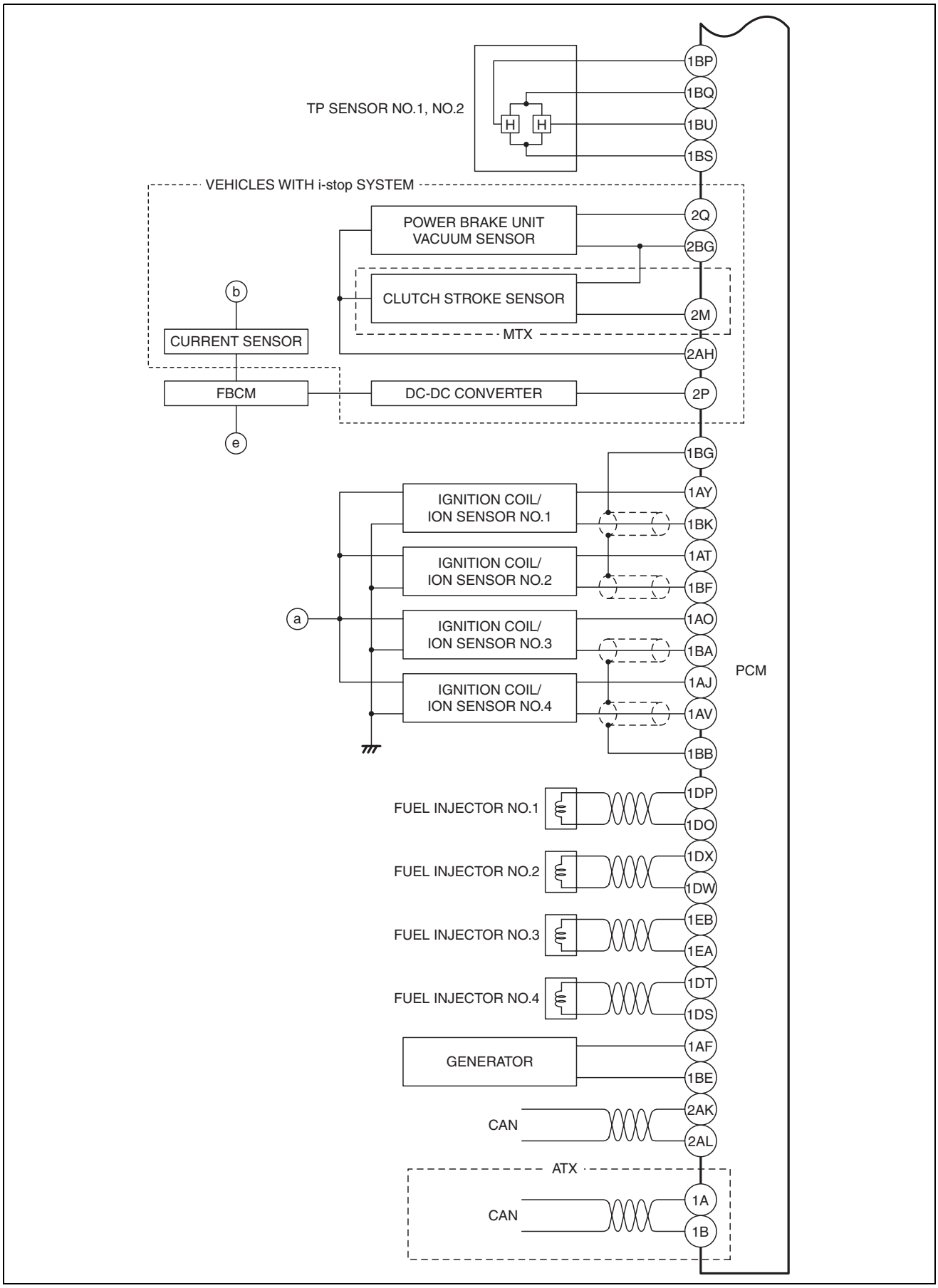
CONTROL SYSTEM [SKYACTIV-G 2.0]



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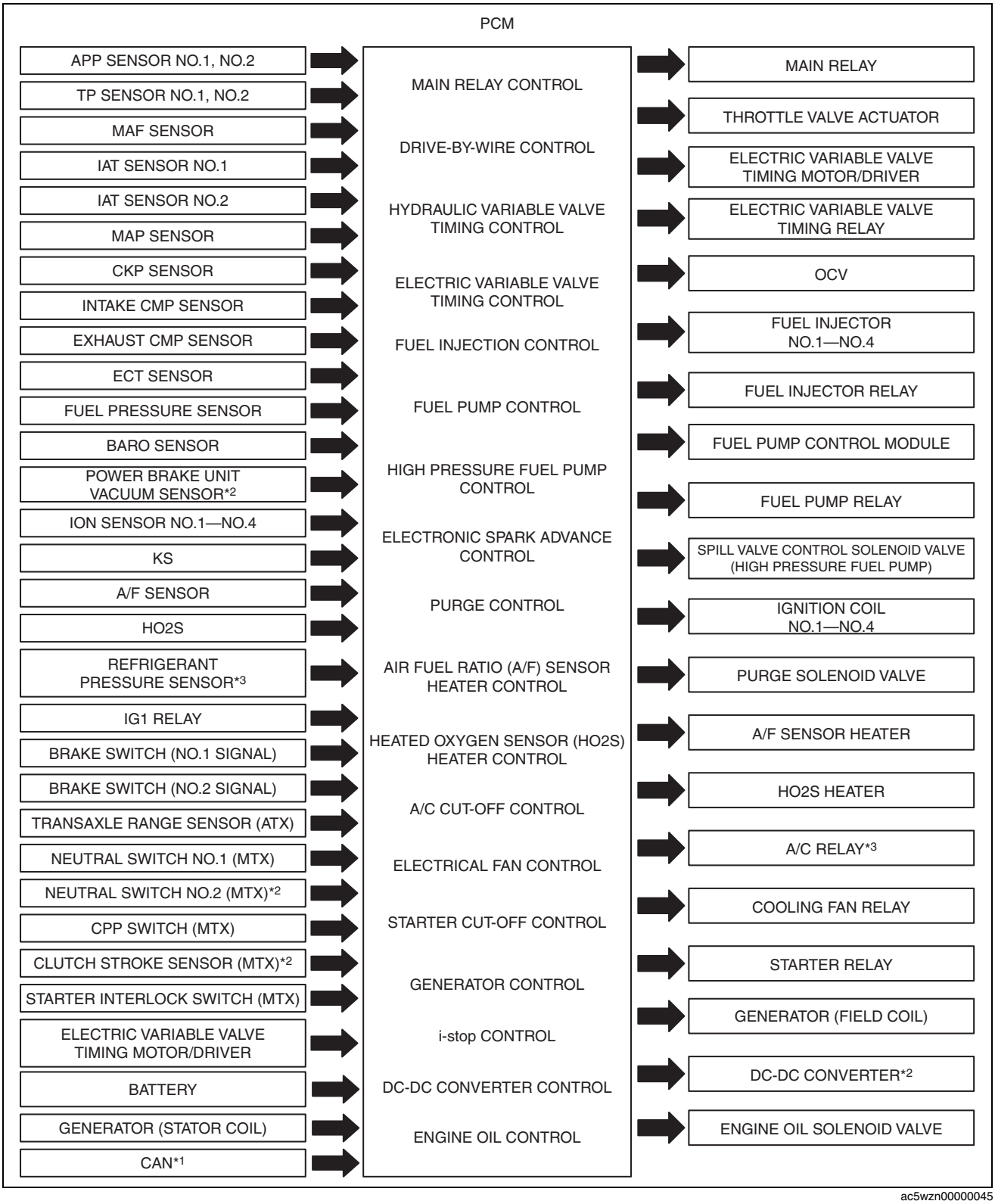
CONTROL SYSTEM [SKYACTIV-G 2.0]

Block Diagram



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*1 : TCM (ATX), DSC HU/CM, front body control module (FBCM), rear body control module (RBCM), instrument cluster, start stop unit, EPS control module
*2 : Vehicles with i-stop system
*3 : Vehicles with air conditioner

CONTROL SYSTEM [SKYACTIV-G 2.0]

Relation Chart

- Each control system and their related input and output parts are as follows.

×: Applicable

Item	MAIN RELAY CONTROL	DRIVE-BY-WIRE CONTROL	HYDRAULIC VARIABLE VALVE TIMING CONTROL	ELECTRIC VARIABLE VALVE TIMING CONTROL	FUEL INJECTION CONTROL	FUEL PUMP CONTROL	HIGH PRESSURE FUEL PUMP CONTROL	ELECTRONIC SPARK ADVANCE CONTROL	PURGE CONTROL	A/F SENSOR HEATER CONTROL HO2S HEATER CONTROL	A/C CUT-OFF CONTROL	ELECTRICAL FAN CONTROL	STARTER CUT-OFF CONTROL	GENERATOR CONTROL	i-stop CONTROL	DC-DC CONVERTER CONTROL	ENGINE OIL CONTROL
Input device																	
APP sensor No.1, No.2		×	×		×			×	×		×	×			×		
TP sensor No.1, No.2		×			×						×				×		
MAF sensor		×	×	×	×		×	×	×	×		×			×		×
IAT sensor No.1		×		×	×			×	×			×		×*3	×		
IAT sensor No.2		×		×	×			×							×		
MAP sensor		×		×	×			×	×						×		×
CKP sensor		×	×	×	×	×	×	×	×	×	×	×	×	×	×		×
Intake CMP sensor		×		×	×			×							×		
Exhaust CMP sensor		×	×		×		×	×							×		
ECT sensor		×	×	×	×		×	×	×	×	×	×	×	×*3	×		×
Fuel pressure sensor		×			×	×	×								×		
BARO sensor		×		×	×	×			×			×			×		
Power brake unit vacuum sensor*2															×		
Ion sensor No.1—No.4				×	×												
KS								×									
A/F sensor					×				×								
HO2S					×												
Refrigerant pressure sensor*4											×	×					
IG1 relay	×		×		×	×		×		×		×	×		×	×	
Brake switch (No.1 signal)		×													×		
Brake switch (No.2 signal)		×															
Transaxle range sensor (ATX)		×			×								×		×		
CPP switch (MTX)		×			×			×			×				×		
Starter interlock switch (MTX)													×				
Clutch stroke sensor (MTX)*2															×		
Neutral switch No.1 (MTX)		×			×			×			×				×		
Neutral switch No.2 (MTX)*2															×		
Electric variable valve timing motor/driver				×											×		
Battery			×			×	×	×	×					×	×		
Generator (Stator coil)		×															
CAN*1		×			×			×			×	×	×	×*2	×	×	
Output device																	
Main relay	×																
Throttle valve actuator		×													×		
Electric variable valve timing motor/driver				×	×										×		

CONTROL SYSTEM [SKYACTIV-G 2.0]

Item	MAIN RELAY CONTROL	DRIVE-BY-WIRE CONTROL	HYDRAULIC VARIABLE VALVE TIMING CONTROL	ELECTRIC VARIABLE VALVE TIMING CONTROL	FUEL INJECTION CONTROL	FUEL PUMP CONTROL	HIGH PRESSURE FUEL PUMP CONTROL	ELECTRONIC SPARK ADVANCE CONTROL	PURGE CONTROL	A/F SENSOR HEATER CONTROL HO2S HEATER CONTROL	A/C CUT-OFF CONTROL	ELECTRICAL FAN CONTROL	STARTER CUT-OFF CONTROL	GENERATOR CONTROL	i-stop CONTROL	DC-DC CONVERTER CONTROL	ENGINE OIL CONTROL
Electric variable valve timing relay				×											×		
OCV			×														
Fuel injector No.1—No.4					×										×		
Fuel injector relay					×										×		
Fuel pump control module						×											
Fuel pump relay						×											
Spill valve control solenoid valve (High pressure fuel pump)							×										
Ignition coil No.1—No.4								×							×		
Purge solenoid valve									×								
A/F sensor heater										×							
HO2S heater										×							
A/C relay*4											×						
Cooling fan relay No.1, No.2, No.3												×					
Starter relay													×		×		
Generator (Field coil)														×	×		
DC-DC converter*2															×	×	
Engine oil solenoid valve																	×

*1 : TCM (ATX), DSC HU/CM, front body control module (FBCM), rear body control module (RBCM), instrument cluster, start stop unit, EPS control module
*2 : Vehicles with i-stop system
*3 : Vehicles without i-stop system
*4 : Vehicles with air conditioner

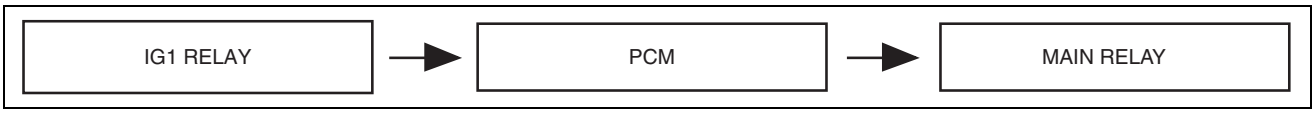
MAIN RELAY CONTROL [SKYACTIV-G 2.0]

id0140f4168700

Outline

- Supplies power to each part by switching the main relay on/off at the optimal timing according to the vehicle conditions.

Block Diagram



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Operation

- When the ignition is switched ON, the main relay turns on and electrical power is supplied to each sensor and device.
- When the ignition is switched off from ON, an on-request signal is received from each control (such as drive-by-wire control, electric variable valve timing control) and the main relay turns on for a specified period.

CONTROL SYSTEM [SKYACTIV-G 2.0]

DRIVE-BY-WIRE CONTROL [SKYACTIV-G 2.0]

id0140f4188400

Outline

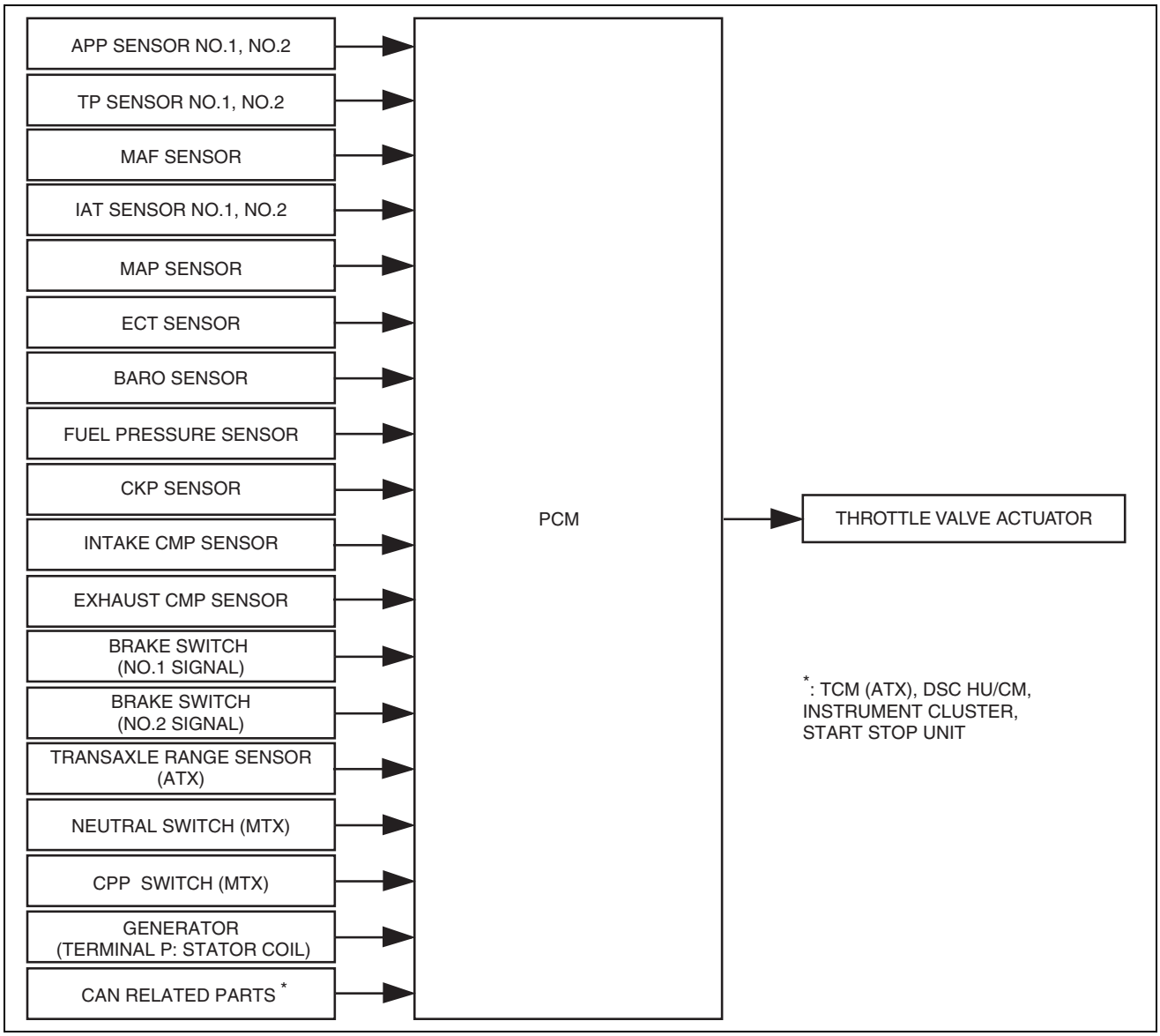
- Calculates the optimum target throttle valve opening angle at all engine speeds and controls the throttle valve actuator.
- The drive-by-wire control is composed of the idle air control, accelerator control, traction control, excess engine speed control, overspeed control, electric variable valve timing cooperation control, brake override system, and the engine oil temperature control.

Control Table

Control name	Control outline
Idle air control	• While idling, the throttle valve opening is controlled so that the idle speed is at the target idle speed.
Accelerator control	• The throttle valve opening angle is controlled according to the amount the accelerator pedal is depressed. In addition, there is a fully closed learning function for learning deterioration over time and constant correction of the optimum throttle opening angle.
Traction control	• The throttle valve opening angle is controlled by the torque reduction request signal from the DSC HU/CM and TCM.
Excess engine speed control	• If the engine reaches a high engine speed, the throttle valve opening angle is controlled to protect the engine.
Overspeed control	• If the vehicle reaches a high speed, the throttle valve is closed to keep the vehicle speed below the speed limit.
Electric variable valve timing cooperation control	• Pumping loss is reduced by controlling the throttle valve timing opening angle according to the phase of the intake valve timing.
Cruise control	• Sets the vehicle speed by operation of the cruise control switch and controls the throttle valve opening angle so that it becomes close to the set vehicle speed.
Brake override system	• If the brake pedal is depressed with the accelerator pedal depressed, the vehicle can be stopped safely by closing the throttle valve. As a result, the brake operation takes priority over the accelerator pedal operation.
Engine oil temperature control	• If the PCM determines that the engine oil temperature is too high, the throttle valve opening angle is decreased and the engine speed is reduced.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Block Diagram



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Operation

Idle air control

- The throttle valve opening angle is controlled so that the idle speed is at the target idle speed calculated by the PCM.
- The PCM determines the basic duty value (throttle valve opening angle basic) according to target engine speed. Corrections are added to the basic air amount, the target throttle valve opening angle is calculated, and the duty signal is sent to the throttle valve actuator.
- Corrections are as follows: The throttle valve opening angle increases as the corrections increase.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Correction list

Correction	Purpose	Vehicle condition	Correction amount
Engine coolant temperature correction	Corrects the fluctuation in engine sliding resistance due to change in engine temperature.	Correction amount is determined according to engine coolant temperature.	Low engine coolant temperature→large correction
Start correction	Prevents decrease in idle speed during engine start.	Immediately after cranking and engine start	Low engine coolant temperature→large correction
Feedback correction	Sets idle speed close to target engine speed.	• When all of the following conditions are met, feedback correction is performed. — Vehicle parked — Accelerator pedal fully closed	Actual idle speed Target engine speed or less→volume increase correction Target engine speed or more→volume decrease correction
Learning correction	Corrects the changes in the air flow amount caused by engine deterioration over time such as engine sliding resistance and air leakage from the throttle valve.	Correction amount is determined according to the feedback correction amount while external load correction and purge control are stopped.	If the maximum or minimum value of feedback correction exceeds the specified value, learning correction is performed.
Evaporative purge correction	Air increased by purge control is subtracted from the target throttle opening angle.	Correction amount is determined according to purge flow amount during purge control execution.	Large purge flow amount→small correction
External load correction	• Prevents decrease in engine speed due to A/C and electrical load operation. • Prevents sudden increase in engine rotation due to A/C and electrical load operation stop.	• When any of the following signals is input: — A/C amplifier — A/C pressure signal — Generator output current	Large external load→large correction
Fast idle increase correction*	Activates the catalytic converter earlier after starting cold engine.	Integrates warm-up promotion spark retard correction for ignition timing control. (See 01-40-30 ELECTRONIC SPARK ADVANCE CONTROL [SKYACTIV-G 2.0].)	Warm-up promotion spark retard for ignition timing control large→large correction
Hot engine restart correction	Prevents decrease in idle speed due to hot engine restart.	Just after cranking and engine start when the engine coolant temperature is 60 °C {140 °F} or more and intake air temperature is 50 °C {122 °F} or more.	High intake airflow temperature→large correction
D-range correction (ATX)	Prevents decrease in idle speed due to shifting into D-range	When D range signal (transaxle range sensor) is input	Large D range load→large correction

* : Engine speed increases up to approx. 2,000 rpm.

Accelerator control

- The accelerator control controls the throttle valve opening angle according to the accelerator pedal depression amount.
- The PCM controls the throttle valve actuator so that the actual throttle valve opening angle approaches the final target throttle valve opening angle.
- The target throttle valve opening angle is determined by the transmission gear position, accelerator pedal depression amount, and vehicle speed.
- Because deviation in the throttle valve opening angle due to deterioration over time is corrected when the ignition is switched off, the PCM operates the fully-closed learning function. The fully-closed learning function is a function for learning the fully-closed throttle valve position.

Traction control

- The PCM calculates the target throttle valve opening angle based on torque up/reduction request signal and engine speed from the DSC HU/CM and TCM.

Excess engine speed control

- If the engine reaches a high engine speed, the engine speed stabilizes at a lower speed than the excess speed range to protect the engine.

Overspeed control

- If the vehicle reaches a high speed, the throttle valve is closed to keep the vehicle speed below the speed limit.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Electric variable valve timing cooperation control
- The PCM calculates the target throttle valve opening angle according to change in the phase of the intake valve timing due to electrical variable valve timing control.

Cruise Control
- Calculates the throttle valve opening angle based on the deviation of the actual vehicle speed from the set vehicle speed which was set with the cruise control switch and the throttle valve actuator.
- The PCM controls the actual vehicle speed so that it is close to the set vehicle speed.
- The cruise control includes the cruise control operation condition and the cruise control stop condition.

Cruise control operation condition
- When all of the following conditions are met, execution of the cruise control system is enabled (cruise control standby status).
  - ON switch: ON
  - Vehicle speed: Exceeds 25 km/h {16 mph}

Cruise control stop condition
- When any of the following conditions are met even while in cruise control, the PCM stops the cruise control and clears the set vehicle speed.
  - — Ignition: OFF
  - — ON switch: OFF
  - — Cruise control related DTCs (P0571:00) detected
- When any of the following conditions are met even while in cruise control, the PCM stops the cruise control while storing the set vehicle speed.
  - — CANCEL switch: ON
  - — Transaxle range sensor: P/N position (ATX)
  - — CPP switch: ON (clutch pedal depressed) (MTX)
  - — Neutral switch: ON (neutral position) (MTX)
  - — Vehicle speed: Less than 20.5 km/h {12.7 mph}
  - — Brake switch: ON (brake pedal depressed)
  - — The actual vehicle speed is 15 km/h {9.3 mph} or more lower than the set vehicle speed during cruise control (ascending).

Cruise control function
- The cruise control includes accelerating, coasting, resume, tap-down, tap-up and downshift functions.

Function List

Function	Contents
Accelerating	• When any of the following conditions are met while driving in cruise control and when the SET+ switch is continuously pressed, the PCM gradually increases the set vehicle speed. — The SET+ switch is on one time or more during resume operation.
Coasting	• When the SET– switch is continuously pressed, the PCM gradually decreases the set vehicle speed.
Resume	• When the RESUME switch signal is input to the PCM during regular driving (cruise control is stopped) and the previously set vehicle speed is stored in the PCM, the PCM sets the set vehicle speed to the previously set vehicle speed and begins control.
Tap down	• When all of the following conditions are met while driving in cruise control, the PCM decreases the set vehicle speed by 1.6 km/h {0.99 mph}. — SET+ switch off — The SET– switch switches from off to on — When actual vehicle speed is lower (set vehicle speed +2 km/h {+1 mph})
Tap-up	• When all of the following conditions are met, the PCM increases the set vehicle speed by 1.6 km/h {0.99 mph}. — During cruise control — The SET+ switch switches from off to on — When actual vehicle speed is lower (set vehicle speed +2 km/h {+1 mph})
Downshift	• When the following conditions are met, a downshift signal is sent to the TCM (ATX) via CAN. — SET+ switch on — Target vehicle acceleration is not reached • If the increase in vehicle speed on the down slope is high, the PCM sends a down shift signal to the TCM (ATX).

Engine oil temperature control
- If 6 minutes have elapsed with the following condition met, the engine speed is reduced by decreasing the throttle valve opening angle to protect the engine (determination of engine oil temperature is high). DTC P117A:00 is recorded simultaneously.
  - — Transmission in 4th gear or lower gear
  - — Engine speed: 6,100 rpm or more
  - — ECT: 88.5 °C {191 °F} or more

CONTROL SYSTEM [SKYACTIV-G 2.0]

Brake override system

Brake override system operation conditions

- It gives priority to the brake operation if a malfunction occurs with the accelerator pedal such as if the accelerator pedal is depressed and does not return. The throttle valve is closed if the brake pedal is depressed while the accelerator pedal is in a depressed condition until the vehicle is safely decelerated and comes to a complete stop.

Operation start conditions	• If either one of the following conditions is met with the brake pedal depressed for the specified time[*1] or more while the accelerator pedal is depressed, the PCM adjusts the throttle valve opening angle so that the engine speed is at specification[*2]. **While driving vehicle** — Accelerator pedal opening angle: 5% or more from full-close — Vehicle speed: 10 km/h {6.2 mph} or more — Engine speed: 875 rpm or more **While vehicle stopped** — Accelerator pedal opening angle: 5% or more from full-close — Shift position: neutral (MTX) — Selector lever position: N position (ATX) — Engine speed: 875 rpm or more
Operation complete conditions	• If the following conditions are met while operating the brake override system, the PCM stops the operation of the brake override system and controls the throttle valve opening angle in accordance with the accelerator pedal opening angle. — Accelerator pedal not depressed — Brake pedal not depressed **Note** • The brake override system operation stops by switching the ignition off.

[*1] : Specified time is 0.6 to 10 s according to braking force calculated in PCM.
[*2] : Specification is 1,200 rpm while vehicle is stopped and 1,100 rpm while vehicle is driven.

Prevention of brake override system unnecessary operation

- If a servicing procedure requiring the brake pedal and the accelerator pedal to be depressed simultaneously is performed, unnecessary operation of the brake override system can be prevented, if necessary.
- If the cancel condition for preventing unnecessary operation of the brake override system is implemented, the PCM sends a brake override system cancel execution signal to the instrument cluster.
- The instrument cluster flashes the master warning light based on the signal from the PCM.

Cancel conditions	• If the releasing procedure is implemented with the following conditions met within 30 s after switching the ignition ON (KOEO), the brake override system does not operate until the recovery condition is met. — Shift position: neutral (MTX) — Selector lever position: N position (ATX) — Vehicle speed: 0 km/h {0 mph} **Releasing procedure** 1. Depress the brake pedal for 10 s with the accelerator pedal released. 2. Repeatedly depress and release the accelerator pedal fully three times with the brake pedal depressed. 3. Release the brake pedal.
Recovery condition	• The cancel conditions are reset when the ignition is switched off while the brake override system is canceled. As a result, the brake override system can operate.

Master warning light illumination request

- If any of the following conditions is met, the PCM sends the master warning light illumination request signal to the instrument cluster. The master warning light illuminates to alert the driver that there is a malfunction in the brake system.
  - — Brake switch (No.1 signal) has a malfunction
  - — Brake switch (No.2 signal) has a malfunction

HYDRAULIC VARIABLE VALVE TIMING CONTROL [SKYACTIV-G 2.0]

id0140f4318000

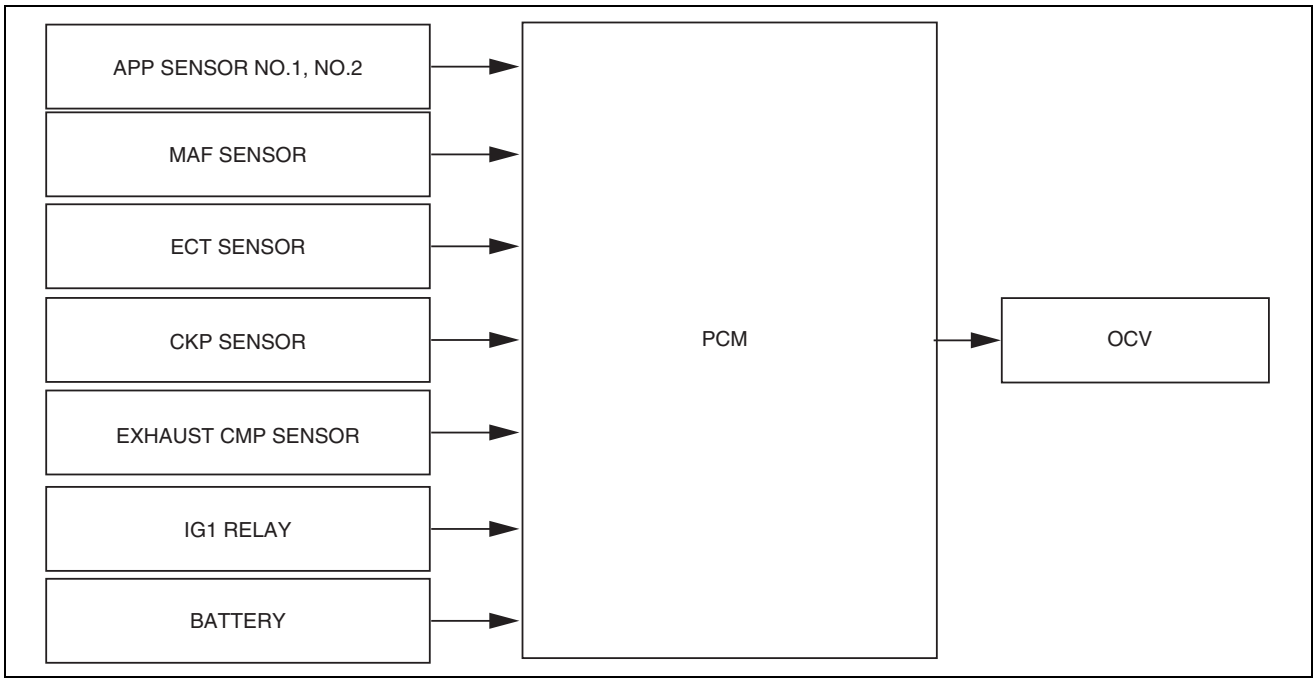
Outline

- Changes the exhaust valve timing according to engine operation conditions to improve engine output, fuel economy, and emission performance.
- Based on each input signal, the PCM determines the optimum exhaust valve timing according to the engine operation conditions. The PCM drives the OCV, and switches the oil passages of the hydraulic variable valve timing actuator to control the exhaust valve timing at optimum.

CONTROL SYSTEM [SKYACTIV-G 2.0]

- Based on the coordination with the electric variable valve timing control and by increasing the amount of overlap during high engine loads, nitrogen oxide (NOx) occurring largely at high temperatures is reduced by re-circulating exhaust gas into the combustion chamber, which also reduces combustion temperature.

Block Diagram



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Operation

Exhaust valve timing determination

- The PCM controls current to the OCV to obtain optimum exhaust valve timing according to the engine operation conditions (target exhaust valve timing).
- In addition to controlling the OCV drive current value to obtain the target exhaust valve timing, the PCM compares the value with the actual exhaust valve timing to correct the OCV drive current value if necessary.

Target exhaust valve timing

- The target exhaust valve timing is determined by the engine speed and the charging efficiency.

Actual exhaust valve timing

- The actual exhaust valve timing is calculated by subtracting the cam maximum advance learning value from the value (retard amount) detected by the exhaust camshaft position sensor and crankshaft position sensor.

Cam maximum advance learning value

- Though the exhaust camshaft valve timing (including maximum advance position) is detected based on the difference in the rise between the exhaust camshaft position sensor and the crankshaft position sensor signals, variation in signals from the assembly of each sensor occurs. As a result, the PCM stores the difference in the rise of the exhaust camshaft position sensor and crankshaft position signals to prevent detection of variations in the exhaust valve timing.

OCV drive current determination

- The PCM divides the oil control valve OCV drive range into three modes according to engine operation conditions. The OCV drive current is determined based on the target current calculated in each mode.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Range mode table

Mode name	Control description
Cleaning mode	• Cleaning mode is to remove foreign material in the OCV oil passages. **Mode execution condition** — During deceleration fuel cut — Engine speed: 2,250—3,500 rpm — Engine coolant temperature: 80°C {176°F} or more
Cam advance mode	• If the cam advance is appropriate according to engine operation conditions such as while in torque down execution during idling, the cam advance mode advances the exhaust valve timing and stabilizes the engine speed. **Mode execution condition** • When any of the following conditions is met: — During engine cranking — Idling — Engine speed: Less than 800 rpm — Engine coolant temperature: Less than 60 °C {140°F}
Feedback mode	• The feedback mode constantly monitors whether the target exhaust valve timing is the determined value according to the engine operation conditions and controls the OCV drive current based on the results. **Mode execution condition** — Except cleaning mode, cam maximum retard mode

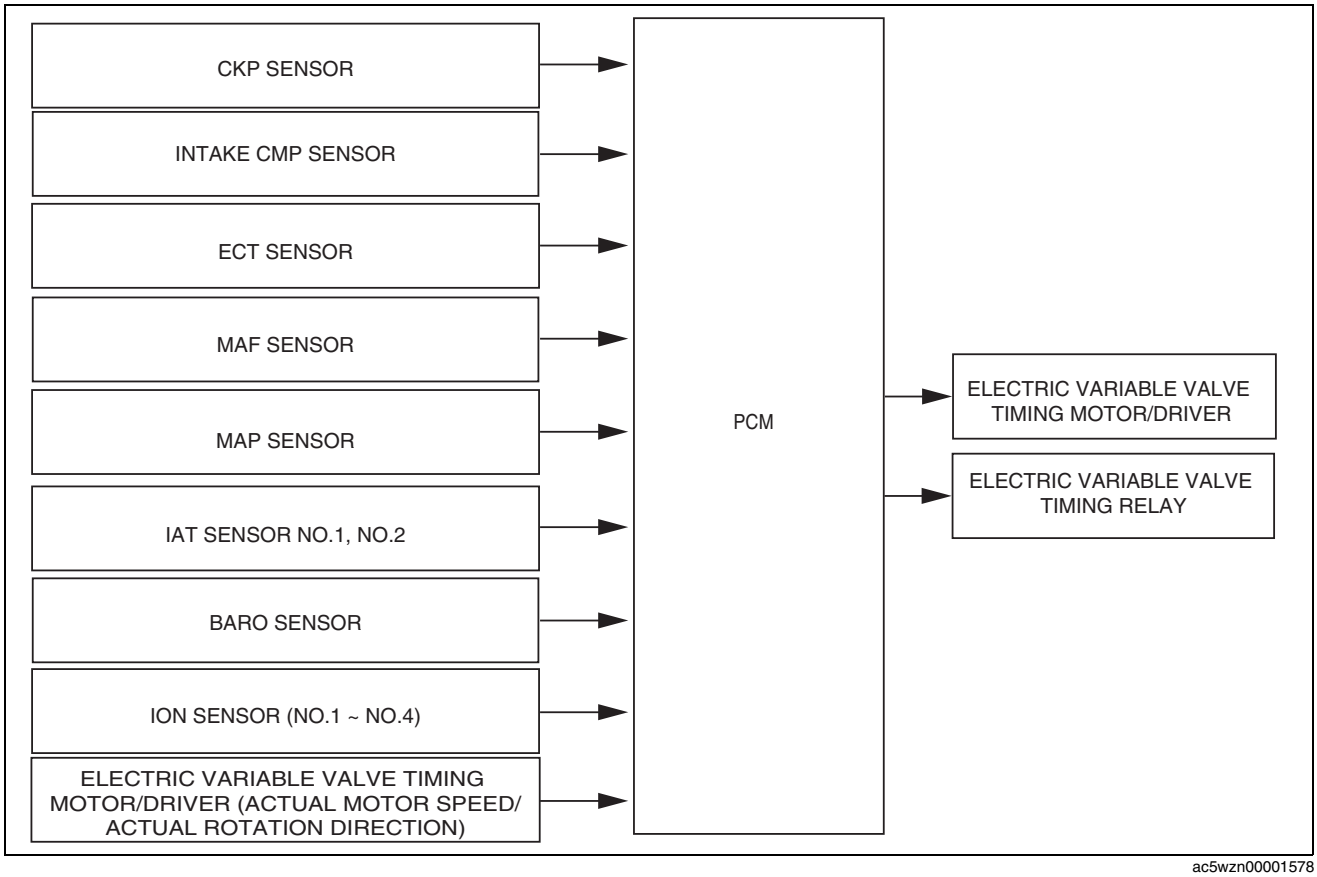
ELECTRIC VARIABLE VALVE TIMING CONTROL [SKYACTIV-G 2.0]

id0140f4318100

Outline

- The PCM determines the optimum intake valve timing according to the engine operation conditions, and sends the motor drive signals to the electric variable valve timing driver. With the adoption of the electric drive system, variable intake valve timing can be controlled without any influence from the engine conditions, thus the fuel economy has been improved and pumping loss has been decreased.
- Based on the coordination with the hydraulic variable valve timing control and by increasing the amount of overlap during high engine loads, nitrogen oxide (NOx) occurring largely at high temperatures is reduced by re-circulating exhaust gas into the combustion chamber which reduces combustion temperature.

Block Diagram



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CONTROL SYSTEM [SKYACTIV-G 2.0]

Operation

Intake valve timing determination

- The PCM determines the optimum target intake valve timing according to the engine operation conditions, and controls the output duty ratio to the electric variable valve timing driver so that the actual intake valve timing approaches close to the target intake valve timing.

Target valve timing

- The target intake valve timing is determined according to the engine speed, charging efficiency, and engine coolant temperature.

Actual valve timing

- The actual intake valve timing is calculated by adding a correction, which is based on the electric variable valve timing actuator signal value, to the value calculated by subtracting the cam maximum retard learning value from the standard intake valve timing.
- The standard intake valve timing is calculated based on the signals from the crankshaft position and camshaft position sensors.

Cam maximum retard learning value

- The cam maximum retard learning value is determined by the maximum retard indication output from the PCM and the standard intake valve timing when the standard intake valve timing is stabilized.

Output duty ratio determination

- The PCM divides the electric variable valve timing motor drive range modes according to the engine operation conditions, and determines the output duty ratio to the electric variable valve timing actuator in each mode.

Mode name	Control description	Control conditions
Feedback mode	• Continuously monitors the intake valve timing if it matches the target intake valve timing determined according to the engine operation condition, and controls the output duty ratio based on the result.	• Except for energization cut mode and phase holding mode
Energization cut mode	• If there is any malfunction in the electric variable valve timing driver, the intake valve timing is held at the maximum retard position to stabilize the engine speed.	• Electric variable valve timing driver malfunction
Phase holding mode	• To improve the startability, the phase of the electric variable valve timing actuator is held at the intermediate position after the engine is stopped.	• After the engine is stopped (within a specified time)

FUEL INJECTION CONTROL SYSTEM [SKYACTIV-G 2.0]

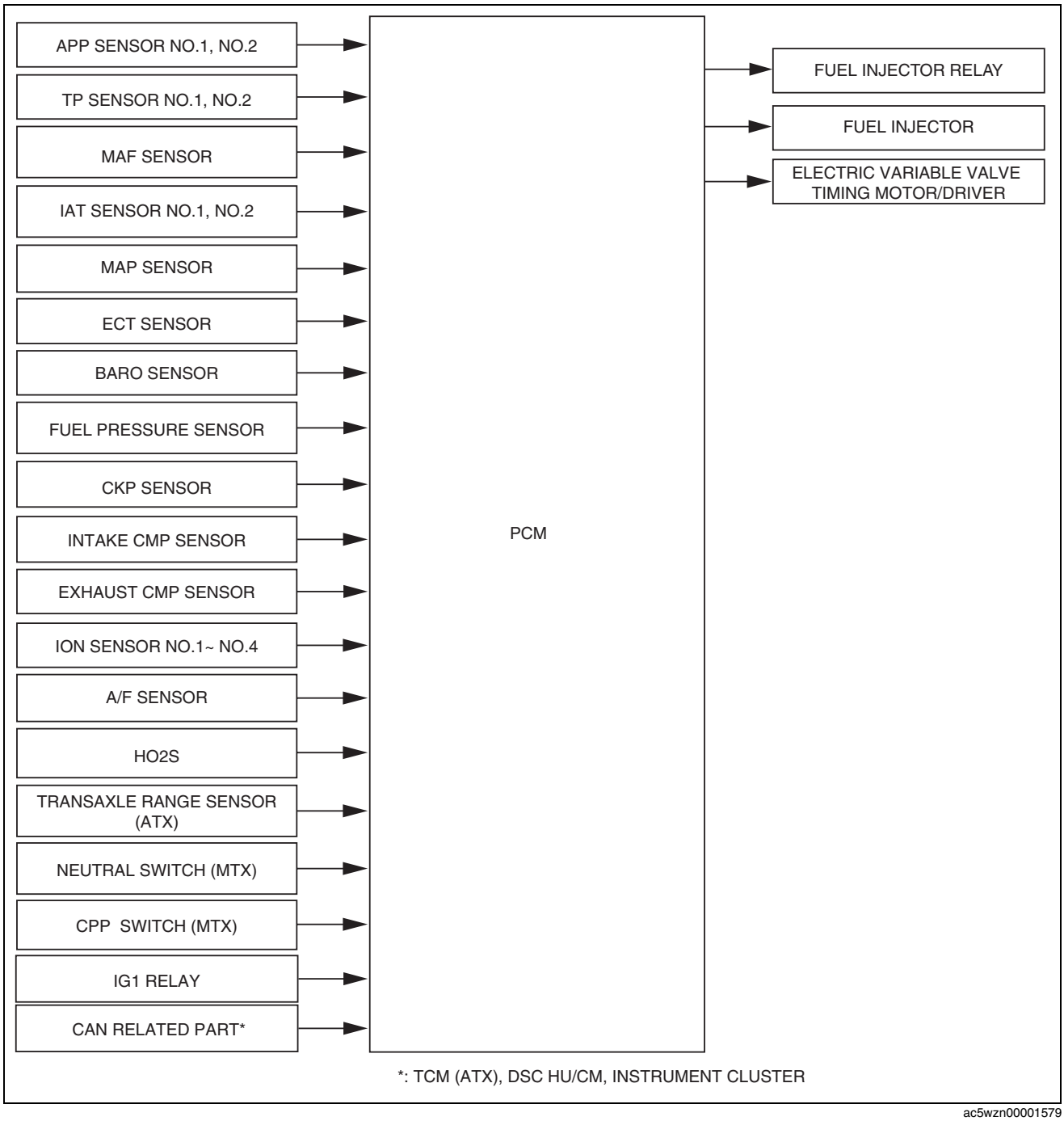
id0140f4138600

Outline

- Performs optimum fuel injection according to engine operation conditions.
- The PCM determines the engine operation conditions based on the signals from each input device and drives the fuel injectors at the optimal fuel injection time (fuel injection amount) and the fuel injection timing to inject fuel.
- Optimally controls combustion based on fuel injection amount, fuel injection timing, number of fuel injections, and the fuel pressure to realize emission performance while the engine is cold and higher engine output.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Block Diagram



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Operation

Injection timing

- Fuel injection timing is switched according to the engine operation conditions.
- Fuel injection is performed at the appropriate injection timing and amount based on the following sensor input signals synchronized with the crankshaft rotation during the intake or compression stroke at each cylinder.
  - — MAF sensor
  - — MAP sensor
  - — IAT sensor No.1
  - — IAT sensor No.2
  - — BARO sensor
  - — CKP sensor
  - — ECT sensor

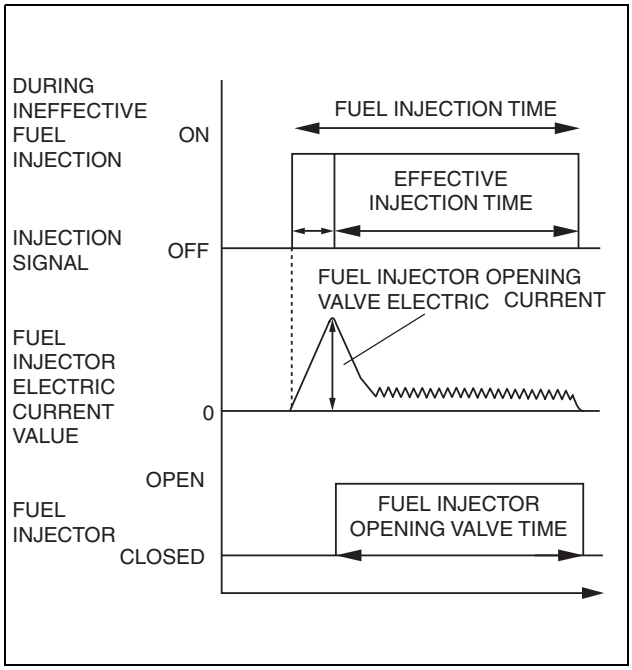
CONTROL SYSTEM [SKYACTIV-G 2.0]

Injection time

- The PCM calculates the fuel injection amount according to the engine operation conditions as the fuel injection time and energizes the fuel injectors.

Fuel injector energization time and operation conditions

- The fuel injectors cause an operation delay with the start of energization from the PCM. The PCM calculates the fuel injection time by adding the non-injection time (ineffective injection time) due to the operation delay to the actual injection time (effective injection time), and energizes the fuel injectors for this time.
- The fuel injection time is based on the following formula:
  Fuel injection time = effective injection time + ineffective injection time
  Ineffective injection time
  — The fuel injectors cause an operation delay with the start of energization due to a delay in the rise of operation current by coil inductance, mass of the needle valve and plunger, and spring resistance. This delay is the ineffective injection time.
  — The non-injection time is affected by the change in fuel pressure and the battery voltage. Accordingly, the PCM sets the non-injection time according to the fuel pressure and the battery voltage.
  Effective injection time
  — The time when the fuel injector valve is open, which is the actual fuel injection time, is called the effective injection time.



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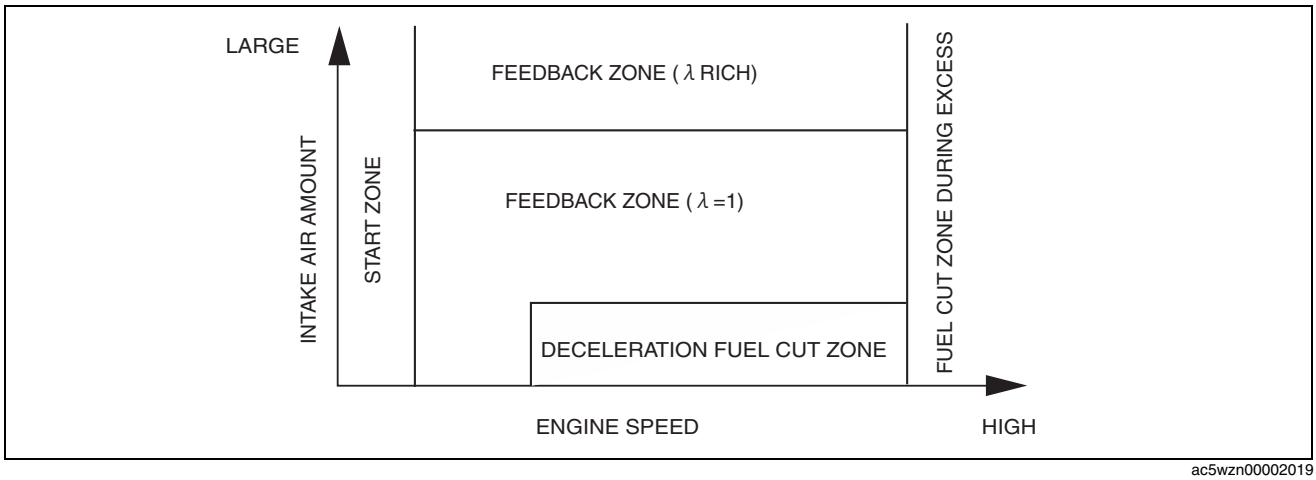
Determination of effective injection time

- The PCM divides the engine operation conditions into control zones according to engine speed and intake air amount, and determines the effective injection time at each control zone to perform optimum air/fuel ratio control in all engine driving ranges.



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CONTROL SYSTEM [SKYACTIV-G 2.0]

Control zone table

Control name	Control outline
Start zone	**Purpose** • Improved startability **Control condition** • When engine speed is less than 500 rpm **Determination of fuel injection time** • According to engine coolant temperature and engine speed and fuel pressure
Feedback zone (λ = 1)	**Purpose** • Improved fuel economy • Improved exhaust gas purification **Control condition** • During engine operation condition except for engine start zone and feedback zone (λ rich) and fuel cut zone **Determination of fuel injection time** • During normal driving, the various correction amounts are added to the basic injection time during normal driving to obtain a ratio that is close to the theoretical air/fuel ratio.
Feedback zone (λ rich)	**Purpose** • Improved driveability **Control condition** • The accelerator pedal opening angle is the specified value or more **Determination of fuel injection time** • Fuel amount increases according to accelerator pedal opening angle
	Purpose • Protection of catalytic converter and exhaust system components (suppression of gas temperature) **Control condition** • The estimated exhaust temperature and estimated catalytic converter temperature are the specified value or more. **Determination of fuel injection time** • Fuel amount increases according to estimated exhaust gas temperature and estimated catalytic converter temperature (promotion of cooling efficiency from vaporization heat)
Excessive speed fuel cut zone	**Purpose** • Engine protection **Control condition** • When engine speed is 6,500 rpm or more • When engine speed is 2,500 rpm or more (When DTC P0089:00 is stored) **Determination of fuel injection time** • Fuel injection stopped.
Deceleration fuel cut zone	**Purpose** • Improved fuel economy **Control condition** • If all of the following conditions are met while the vehicle is decelerating — Accelerator pedal is fully closed — Engine speed is specified value or more — Vehicle speed is specified value or more **Determination of fuel injection time** • Fuel injection is stopped.

Fuel injection time calculation method table

(A: Fuel injection time base, B: Correction for fuel injection time)

Contents (Calculation or determination method for fuel injection time and correction)	Control zone				
	START ENGINE	FEEDBACK (λ=1)	FEEDBACK (λ RICH)	ENGINE SPEED AT EXCESSIVE FUEL CUT	DECELERATION FUEL CUT AT

CONTROL SYSTEM [SKYACTIV-G 2.0]

Injection time at engine start	Set value according to engine coolant temperature (low engine coolant temperature→long injection time)	A				
Basic injection time	**Basic injection time = Charging efficiency** *1 × **fuel flow coefficient**[*2] × target equivalent		A	A		
Fuel cut	Fuel injection time = 0				A	A
Ineffective injection time	Set time according to fuel injector performance	A	A	A		
Volume increase correction at engine start	Purpose: Ensures engine speed stability just after engine start **Correction condition** • Specified time according to engine coolant temperature directly after engine start **Correction amount** • Low engine coolant temperature→large correction • Low intake air temperature→large correction	B	B			
Feedback correction (A/F sensor)	Purpose: Controls air/fuel ratio to theoretical air/fuel ratio **Correction amount** • A/F sensor output current is 0 mA or less→volume decrease correction • A/F sensor output current is 0 mA or more→volume increase correction		B	B		
Feedback correction (HO2S)	Purpose: Controls air/fuel ratio to theoretical air/fuel ratio **Correction amount** • HO2S output voltage is approx. 0.7 V or more→volume decrease correction • HO2S output voltage is approx. 0.7 V or less→volume increase correction		B			
Warm-up volume increase correction	Purpose: Ensures combustion stability when engine coolant temperature is low **Correction condition** • When engine coolant temperature is at set value **Correction amount** • High charging efficiency, low engine coolant temperature→large correction		B	B		
Learning correction	Purpose: Corrects deviation in air/fuel ratio from deterioration over time of mechanical devices **Correction amount** • Learned value based on average value of A/F deviation amount (feedback amount)		B	B		
Heavy load volume increase correction	Purpose: Improved engine output, decrease of exhaust gas temperature **Correction condition** • Based on the fixed value when the accelerator pedal opening angle is a certain value or more, otherwise, based on engine speed and charging efficiency. **Correction amount** • High engine speed, high charging efficiency→large correction			B		

*1 : Charging efficiency is the ratio of the actual amount of intake air to the maximum air charging amount (mass volume) of the cylinder. The value increases as the engine load increases.
*2 : Fuel flow coefficient is a coefficient to calculate a fuel injection time from a fuel injection amount required for an intake air amount.

Fuel cut
- Includes fuel cut under the following conditions, except fuel cut at excessive engine speed and deceleration fuel cut according to engine operation.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Fuel cut table

Control name	Control outline
Fuel cut during selector lever shifting in D range (ATX)	**Purpose** • ATX protection **Control conditions** • When shifting while vehicle is stopped and engine raced
Sensor malfunction fuel cut	**Purpose** • To prevent engine damage from abnormal ignition due to a malfunction input of a cylinder identification or the engine speed signal. **Control conditions** • When a malfunction in the crankshaft position sensor or exhaust camshaft position sensor is detected
Dechoke control	**Purpose** • To improve engine startability when spark plugs are flooded (scavenging) **Control conditions** • When cranking close to fully-open throttle valve

Boost Circuit
- The battery positive voltage input via the fuel injector relay is boosted up to 40 V.

Output Circuit
- To improve fuel injection response, the plunger pulling force is strengthened by providing high current (over excitation current) when the fuel injector is open.
- To reduce fuel injector heat generation, the opening of the fuel injector is kept open using low current after it opens.

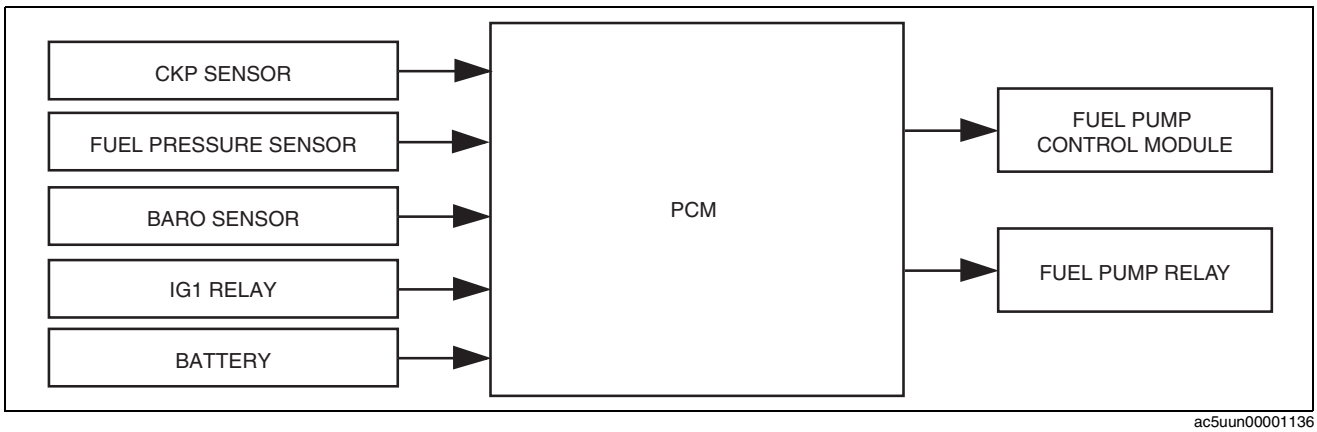
Fuel injector status	PCM operation
Opening starts	1. Provides 40V, boosted by the boost circuit, to the opening transistor (40 V output). 2. Voltage is provided to the fuel injector, the ground transistor is turned on and grounded, and the fuel injector opens. 3. After the fuel injector is opened, the opening transistor is turned off.
Opening held	• Controls the on/off of the holding transistor (12 V output) so that the hold current of the fuel injector is constant.
Closing	• Turns off the holding and ground transistors at the same time the fuel injection signal from the PCM is stopped, and cuts the current.

FUEL PUMP CONTROL [SKYACTIV-G 2.0]

id0140f4004100

Outline
- By switching the fuel pump discharge amount, reduced power consumption and improved fuel economy have been realized.
- The PCM determines the optimum fuel pump drive force according to the engine operation conditions, and sends the fuel pump drive signal to the fuel pump control module.

Block Diagram



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Operation
Fuel pump relay
- The PCM switches the fuel pump relay on/off according to the engine operation conditions.

CONTROL SYSTEM [SKYACTIV-G 2.0]

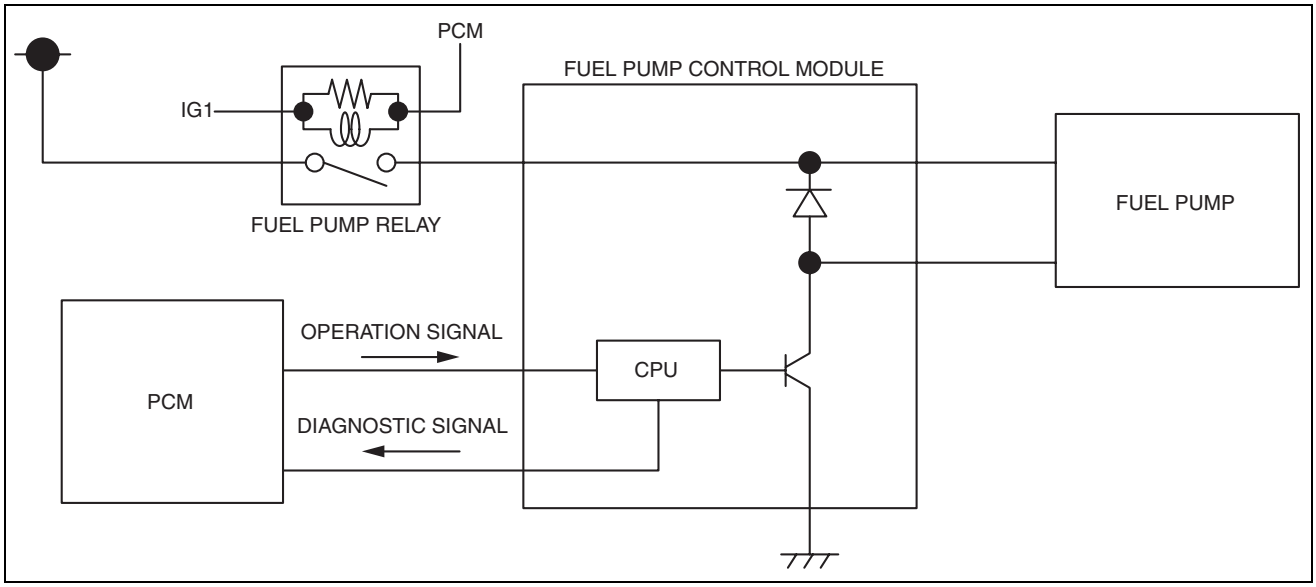
Relay ON/OFF	Control conditions
ON	• When any of the following conditions is met: — When ignition is switched ON (for approx. 1 s) — During engine cranking — While engine is running — When engine is stopped by i-stop control
OFF	• When engine is stopped (excludes engine stop by i-stop control)

Fuel pump control module

- The PCM determines the fuel pump discharge amount according to the engine operation conditions, and controls the output duty ratio to the fuel pump control module according to the discharge amount.

Output duty ratio	Control conditions
95%	• When any of the following conditions is met: — At engine start — Fuel pump control module malfunction (if request voltage is unobtainable)
10—90%	• Feedback value from fuel pressure sensor is the specified value or more (Determined that high pressure fuel pump compression is high.) • Except for control conditions with output duty ratio of 5% or 95%
5%	• When engine is stopped (excludes engine stop by i-stop control)

Fuel pump operation circuit diagram



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HIGH PRESSURE FUEL PUMP CONTROL [SKYACTIV-G 2.0]

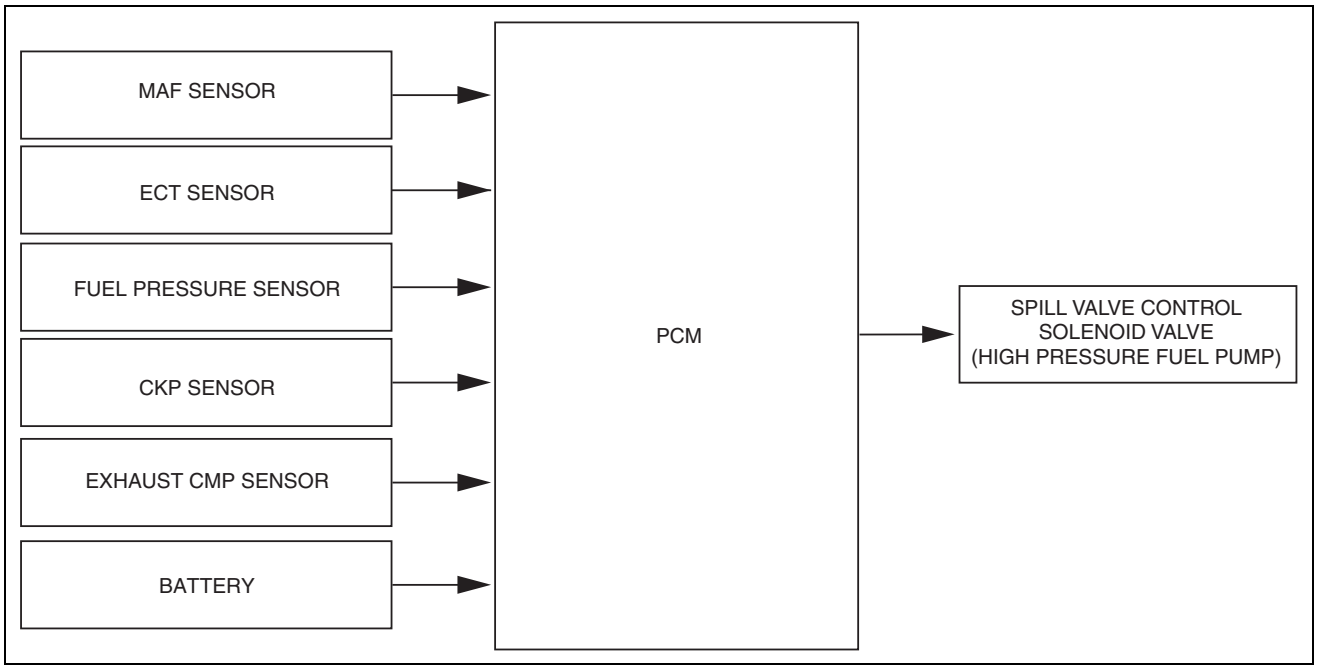
id0140f4005600

Outline

- Changes the fuel pressure applied to the fuel injector according to engine operation conditions to improve engine output and startability.
- The PCM determines the fuel pressure value corresponding to the engine operation conditions based on the each input signal, and drives the spill valve control solenoid valve for optimum control of fuel pressure.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Block Diagram



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OPERATION

Directly after engine start

- During a cold engine start, the fuel pressure is raised to promote fuel atomization.

Basic Control

- The PCM determines the target fuel pressure according to charging efficiency and performs feedback control by monitoring the fuel pressure in the fuel delivery pipe using the fuel pressure sensor.
  - When idling after engine warm up: Approx. 3 MPa {31 kgf/cm^2, 435 psi}
  - After engine warm up, engine speed is 3,000 rpm or more, charging efficiency is 60 % or more: Approx. 15.0 MPa {153 kgf/cm^2, 2176 psi}

ELECTRONIC SPARK ADVANCE CONTROL [SKYACTIV-G 2.0]

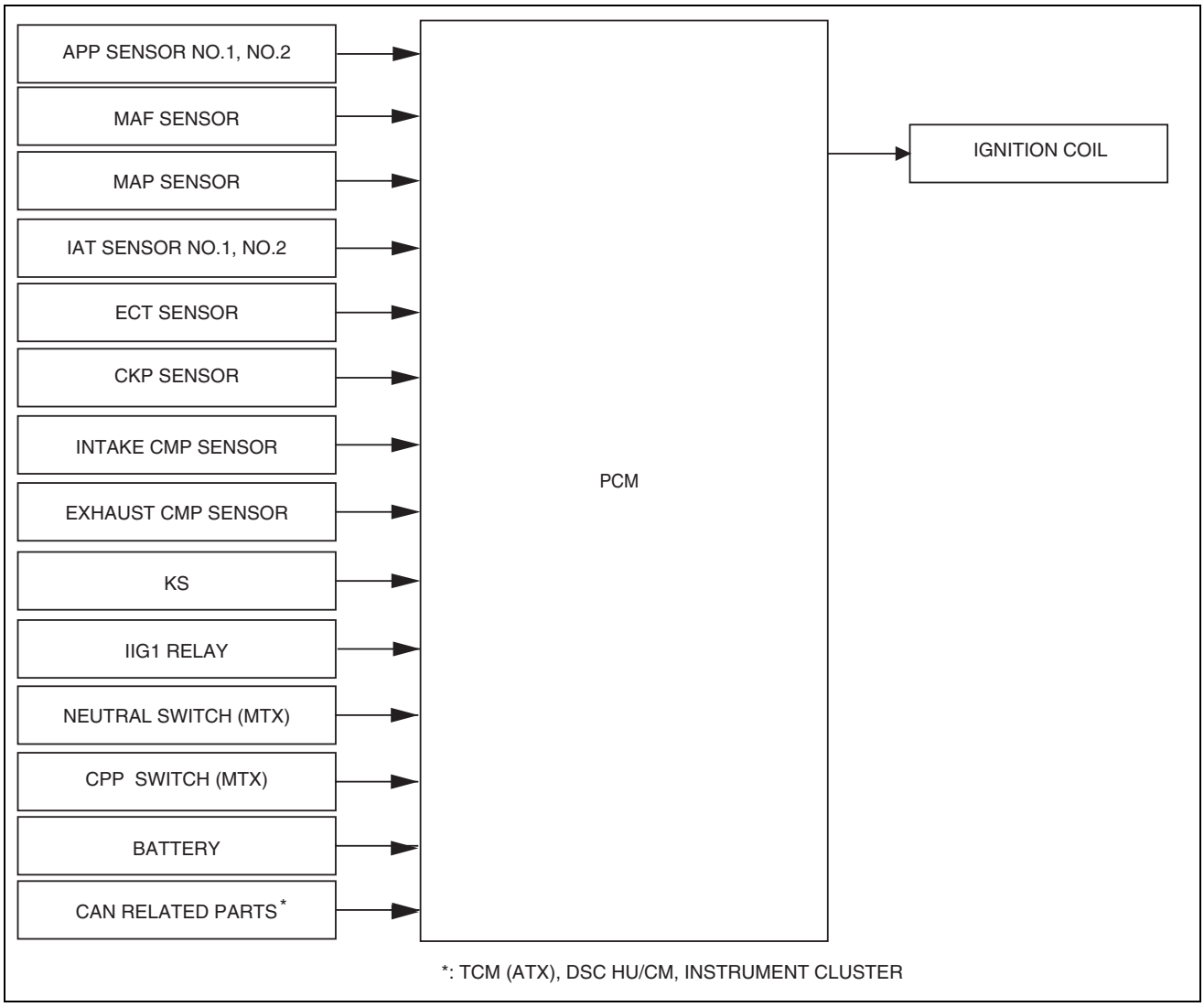
id0140f4188200

Outline

- Controls ignition to optimum timing according to engine operation conditions.
- Serviceability has been improved by eliminating the necessity of ignition timing adjustment.
- The PCM determines the engine operation conditions based on input signals from each sensor and blocks current to the ignition coils at the calculated ignition timing, causing the spark plugs to discharge (ignite) by the effect of electromagnetic mutual induction.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Block Diagram



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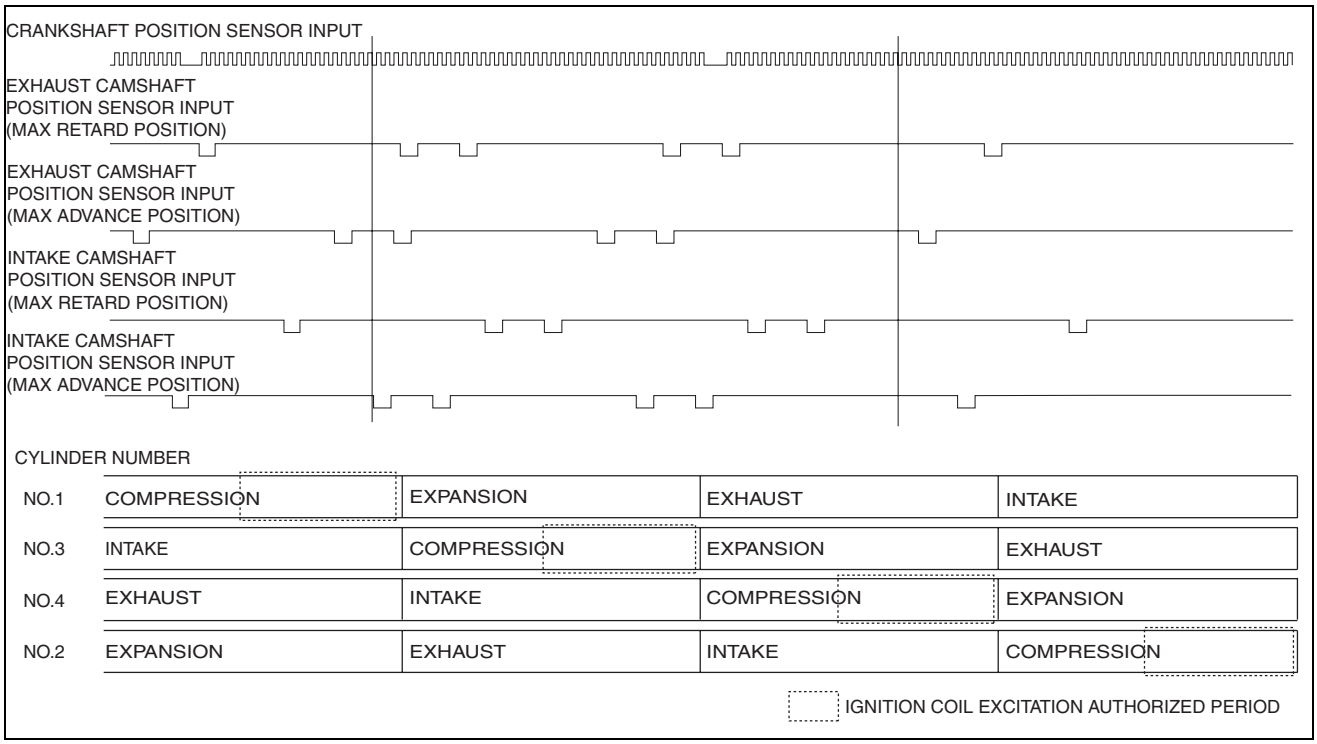
Operation

Ignition method

- The PCM energizes the ignition coils according to the ignition timing calculated from the engine operation conditions and the igniter energization time.
- The igniter energization time (ignition coil energization time) is determined according to battery voltage and engine speed.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Timing chart



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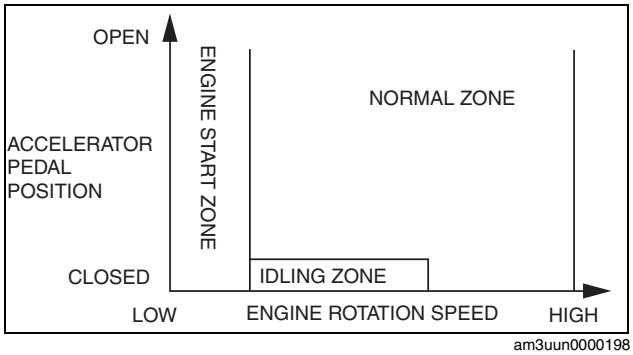
Determination of Ignition Timing

Division of control zones

- To perform optimum ignition control under all engine operation conditions, the PCM:
  - — Divides the engine control operation into each control zone according to the engine speed and accelerator pedal opening angle.
  - — Determines the ignition timing for each control zone.



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Control zone	Control condition	Ignition method
Engine start	Engine speed is less than 500 rpm	Engine starting
Idle zone	Accelerator pedal not depressed	(Cycle estimated ignition) (Determines ignition timing adding each correction to idle spark advance)
Normal zone	Engine operation except start and idling zones	(Cycle estimated ignition) (Determines ignition timing adding each correction to basic spark advance)

CONTROL SYSTEM [SKYACTIV-G 2.0]

Ignition timing calculation method table

A: Ignition timing base, B: Correction for ignition timing

Contents		Calculation method or determination method for ignition timing, spark advance, and correction	Control zone		
			ENGINE START ZONE	IDLING ZONE	NORMAL ZONE
Starting ignition		Determination based on engine coolant temperature	A		
Cycle estimated ignition	**Idle spark advance**	**Set value according to target speed and charging efficiency***		A	
	Basic spark advance	**Set value according to engine speed and charging efficiency***			A
Correction	Engine coolant temperature spark advance correction	Purpose: Ensures combustion stability when engine coolant temperature is low **According to engine coolant temperature** • High charging efficiency*, low engine coolant temperature→large correction		B	B
	Intake air temperature correction	Purpose: Suppresses knocking when engine intake air temperature is high **According to engine intake air temperature and engine coolant temperature** • High engine intake air temperature, high engine intake air temperature→large correction			B
	Warm-up promotion spark retard correction	Purpose: Activates the catalytic converter earlier **Maximum 50 s after engine start** • According to engine coolant temperature→correction		B	
	Idle speed feedback correction	Purpose: Ensures idling stability **While idling (inhibited during test mode)** • Large difference between actual engine speed and target engine speed→large correction • Small difference between actual engine speed and target engine speed→small correction		B	
	Torque reduction correction	Purpose: Such as reduction of shift shock, traction control, or suppression of vehicle vibration **According to torque reduction request from PCM, TCM, or DSC** • Large torque reduction request→large correction			B
	Deceleration fuel cut recovery retard correction	Purpose: Reduces shock during recovery from deceleration fuel cut **Recovery from deceleration fuel cut** • Correction according to time since fuel cut recovery		B	B
	Knocking spark retard correction	Purpose: Knocking suppression **Acceleration when charging efficiency* volume increase (acceleration amount) is given value or more** • Large acceleration amount→large correction			B
	Valve timing correction	Purpose: Ensures combustion stability **When phase difference changes due to electric variable valve timing control and variable valve timing control** • Correction according to change in phase difference			B

* : Charging efficiency is the ratio of the actual amount of intake air to the maximum air charging amount (mass volume) of the cylinder. This value increases proportionately to the increase in engine load.

CONTROL SYSTEM [SKYACTIV-G 2.0]

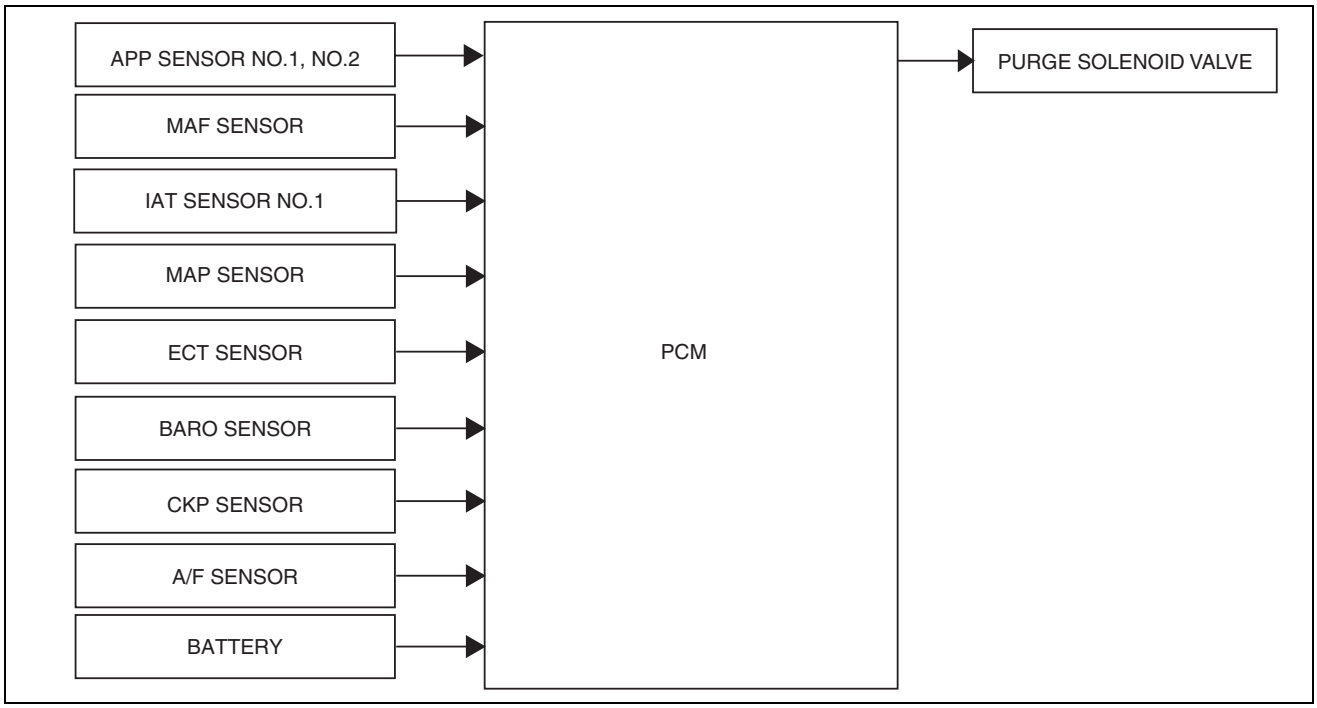
PURGE CONTROL [SKYACTIV-G 2.0]

id0140f4203800

Outline

- An appropriate amount of evaporative gas is fed into the intake manifold by the purge solenoid valve operation according to the engine operation conditions. This ensures driveability and prevents release of evaporative gas into the atmosphere.
- The PCM drives the purge solenoid valve based on the signal from each control part.

Block Diagram



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Operation

Determination of purge solenoid valve energization time

- The PCM determines energization time based on purge flow amount. In addition, it corrects the energization time according to fluctuations in battery positive voltage (the lower the rate of battery positive voltage, the longer the energization time).

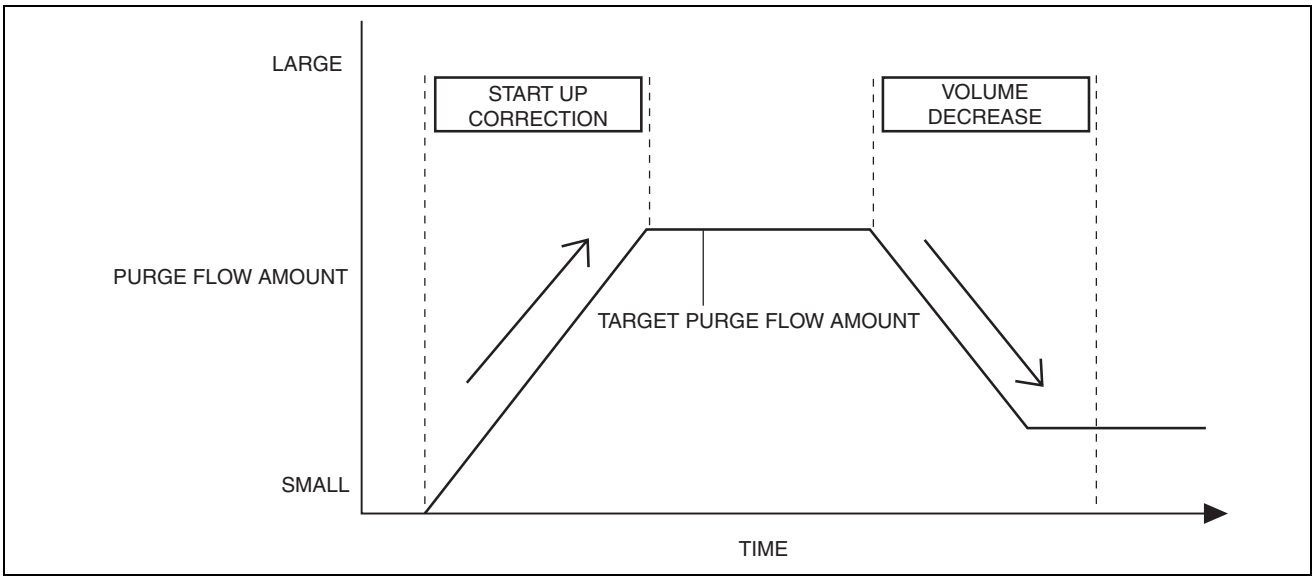
Calculation method for purge flow amount

- The PCM determines the purge flow amount through the addition of each correction to the target purge flow amount.

Contents		Calculation or determination method of purge flow amount and correction
Target purge flow amount		The target purge flow amount is determined by multiplying the correction for the intake air temperature and the fuel evaporative gas concentration with the purge mass volume. The purge mass volume is calculated from the purge intake rate for the intake air mass volume which differs according to engine conditions.
Correction	Startup correction	Purpose: Prevents a change in the air/fuel ratio due to a purge intake lacking evaporative gas concentration in the charcoal canister. **During purge control startup** • Determined according to the target purge flow amount.
	Volume decrease correction	Purpose: Decreases the purge flow amount and stabilizes the air/fuel ratio. **Unstable combustion condition (feedback correction value for fuel injection control is unstable)** • Determined according to the A/F sensor feedback conditions.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Purge control image



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Operation condition

- In evaporative purge control during normal driving, the PCM sends a duty signal to the purge solenoid valve when all of the following conditions are met.
  - — Fuel injection control is in feedback zone (λ=1)
  - — Engine coolant temperature **60 °C {140 °F} or more**

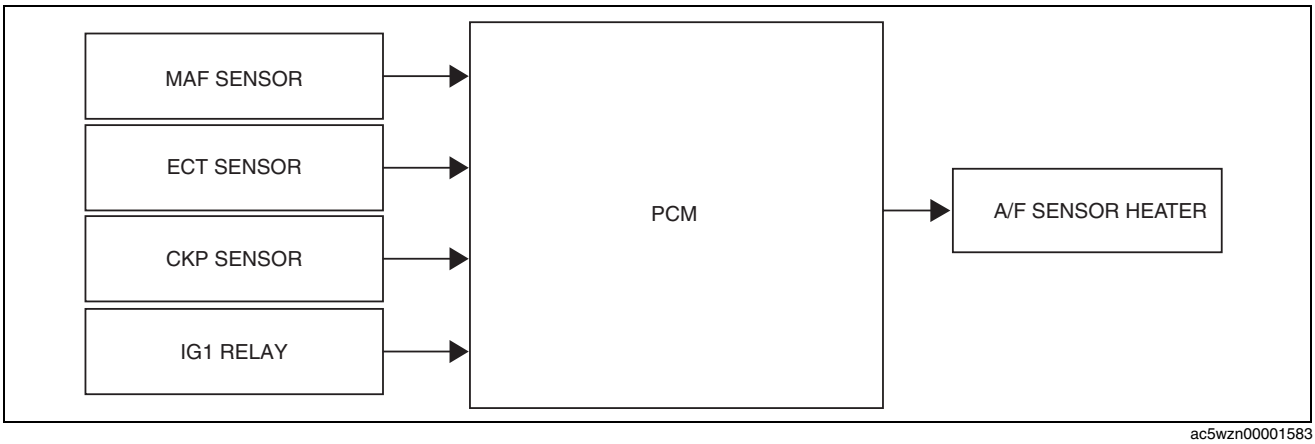
AIR FUEL RATIO (A/F) SENSOR HEATER CONTROL [SKYACTIV-G 2.0]

id0140f4785500

Outline

- Based on the control of the A/F sensor heater, a stabilized oxygen concentration is detected even at low exhaust temperatures, and feedback control of fuel injection even at cold engine start is made possible for improved cold temperature exhaust emission performance.
- Both emission performance and sensor protection have been improved by duty control of the heater according to engine operation conditions (exhaust gas temperature).
- A pre-heater has been adopted to prevent water, produced from the exhaust system when the engine is started, from adhering to the sensor and damaging it.

Block Diagram



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Operation

Pre-heater control

- The A/F sensor heater is operated at a duty ratio of approx. 15% within the specified time directly after the engine is started.

Normal control

- The PCM operates the A/F sensor based on the following control conditions:

CONTROL SYSTEM [SKYACTIV-G 2.0]

Output duty ratio	Control condition
0%	• Ignition switched off • Engine stopped • Engine start (cranking)
0—100% (Duty ratio determined by measuring the element temperature by the A/F sensor heater element impedance)	• After engine warm-up (value fluctuates by battery condition, etc.)

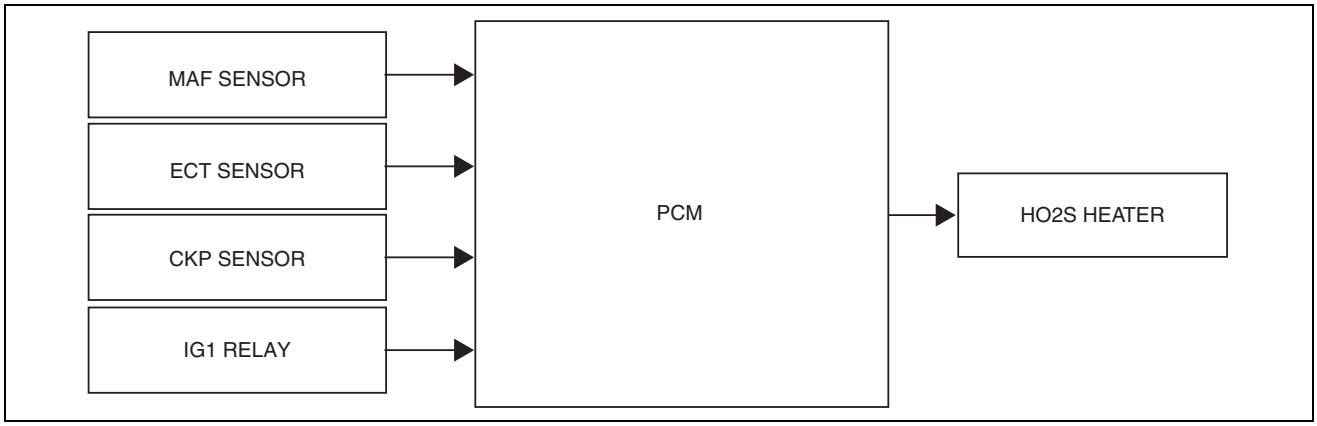
HEATED OXYGEN SENSOR (HO2S) HEATER CONTROL [SKYACTIV-G 2.0]

id0140f4785600

Outline

- Based on the control of the HO2S heater, a stabilized oxygen concentration is detected even at low exhaust temperatures, and feedback control of fuel injection even at cold engine start is made possible for improved cold temperature exhaust emission performance.
- Both emission performance and sensor protection have been improved by duty control of the heater according to engine operation conditions (exhaust gas temperature)

Block Diagram



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Operation

- The PCM operates the HO2S heater based on the following control conditions.

Output duty ratio	Control condition
0%	• Engine stopped • Fuel cut injection control is in engine start zone • Engine coolant temperature is -10 °C {14 °F}or less • Other than battery voltage of 10—16 V • Within a fixed period of time after engine start (varies according to engine coolant temperature)
30%	• HO2S not activated
0—100% (Determined by engine speed and charging efficiency)	• Other than the above

A/C CUT-OFF CONTROL [SKYACTIV-G 2.0]

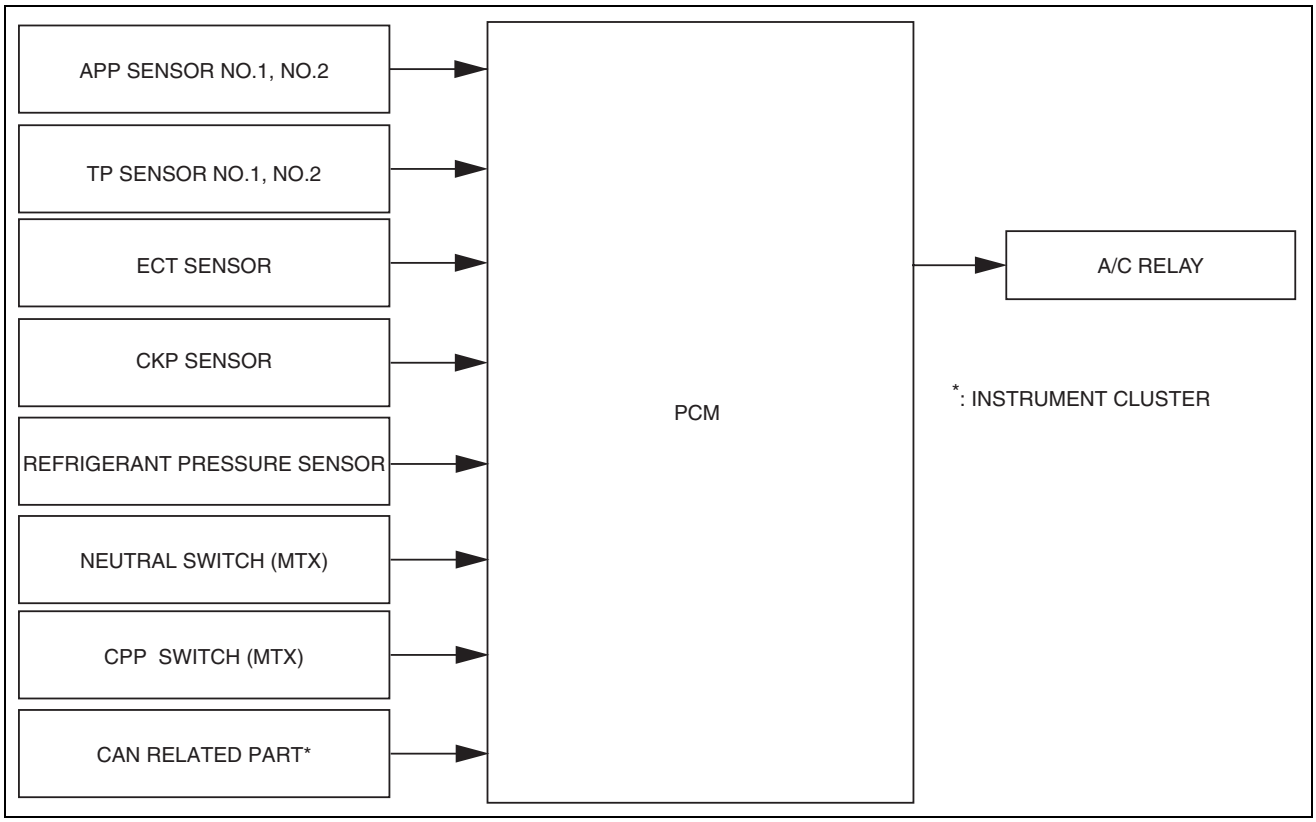
id0140f4206200

Outline

- Controls the A/C operation by switching the A/C relay ON/OFF at the optimal timing according to engine operation conditions. Acceleration performance and A/C compressor reliability have been improved by controlling the A/C operation.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Block Diagram



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Operation

- The PCM stops current to the A/C relay when any of the following conditions are met:

A/C cut-off control operation conditions

Operation condition	While A/C relay not energized	Purpose
At engine start	Approx. 4 s	Improved startability
When engine is restarted by i-stop control	Approx. 3 s	Improved startability
When engine speed is 6,700 rpm or more	Approx. 5 s elapsed since engine speed was 6,200 rpm or less	A/C compressor reliability assurance
Accelerated	3 to 5 s	Acceleration from standstill/ acceleration performance improvement
Time under i-stop control, vehicle speed of 1km/h {0.6 mph} or less	—	i-stop function reliability improvement
Refrigerant pressure 3.14 MPa {32.0 kgf/ cm^2, 455 psi} or more	Refrigerant pressure decreases to 2.55 MPa {26.0 kgf/cm^2, 370 psi} or less	A/C compressor reliability assurance
Refrigerant pressure of 0.196 MPa {2.00 kgf/ cm^2, 28.4 psi} or less continues for 5 s or more	Refrigerant pressure of 0.226 MPa {2.30 kgf/ cm^2, 32.8 psi} or more continues to 5 s or more	A/C compressor reliability assurance
Drive-by-wire control malfunction	—	Reverse driving performance assurance
Panic braking determined	—	Load performance assurance
Misfire determination	—	Catalytic converter protection
ECT sensor malfunction	—	Engine protection
Engine coolant temperature 113 °C {235 °F} or more	Turns on/off repeatedly every 10 s until engine coolant temperature is less than approx. 107 °C {225 °F}	Engine protection
Engine coolant temperature 117 °C {243 °F} or more	Until engine coolant temperature is less than 110 °C {230 °F}	Engine protection

CONTROL SYSTEM [SKYACTIV-G 2.0]

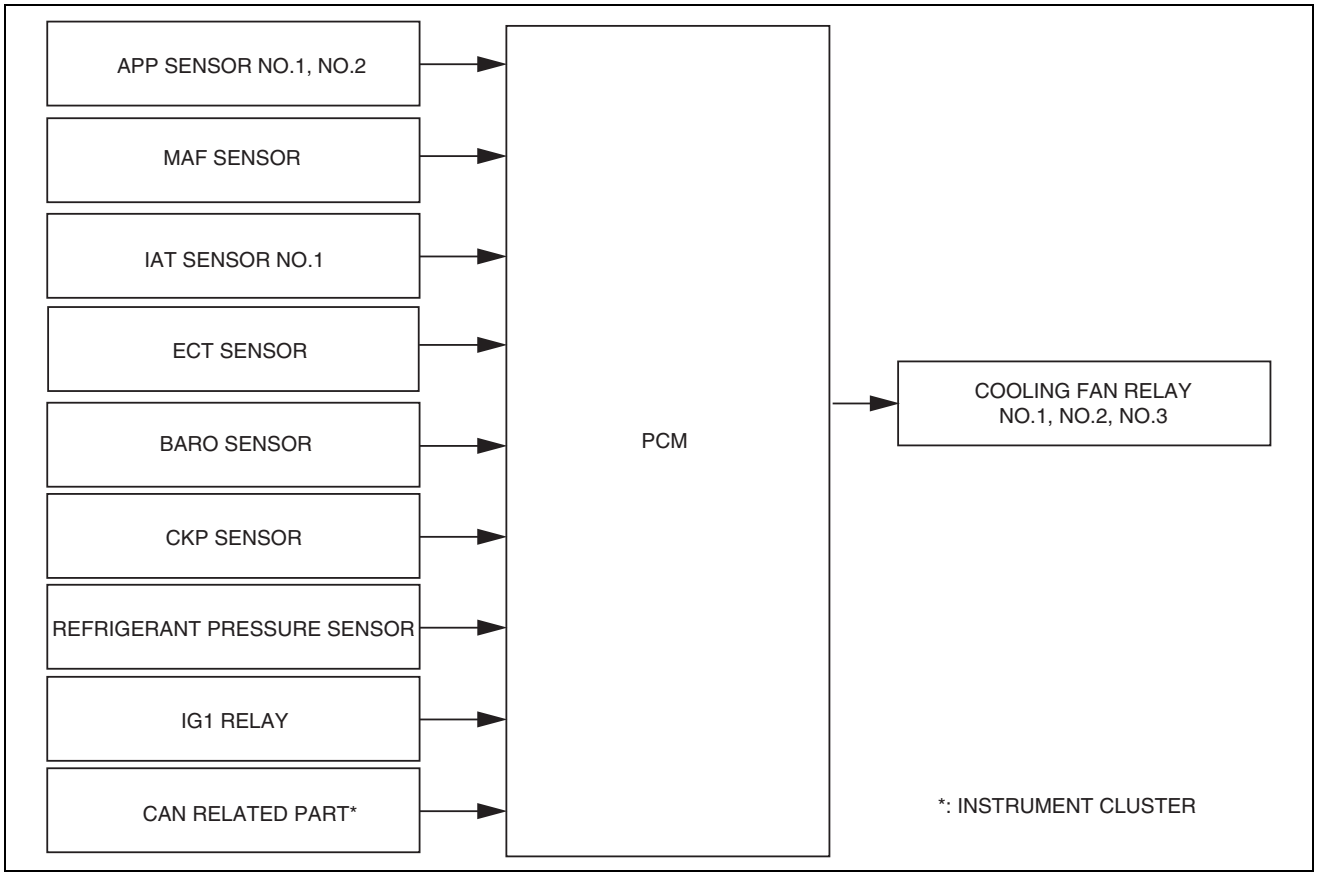
ELECTRICAL FAN CONTROL [SKYACTIV-G 2.0]

id0140f4205000

Outline

- Through cooling of the radiator and condenser by operation of the cooling fan according to vehicle conditions, engine reliability and cooling performance have been improved.

Block Diagram



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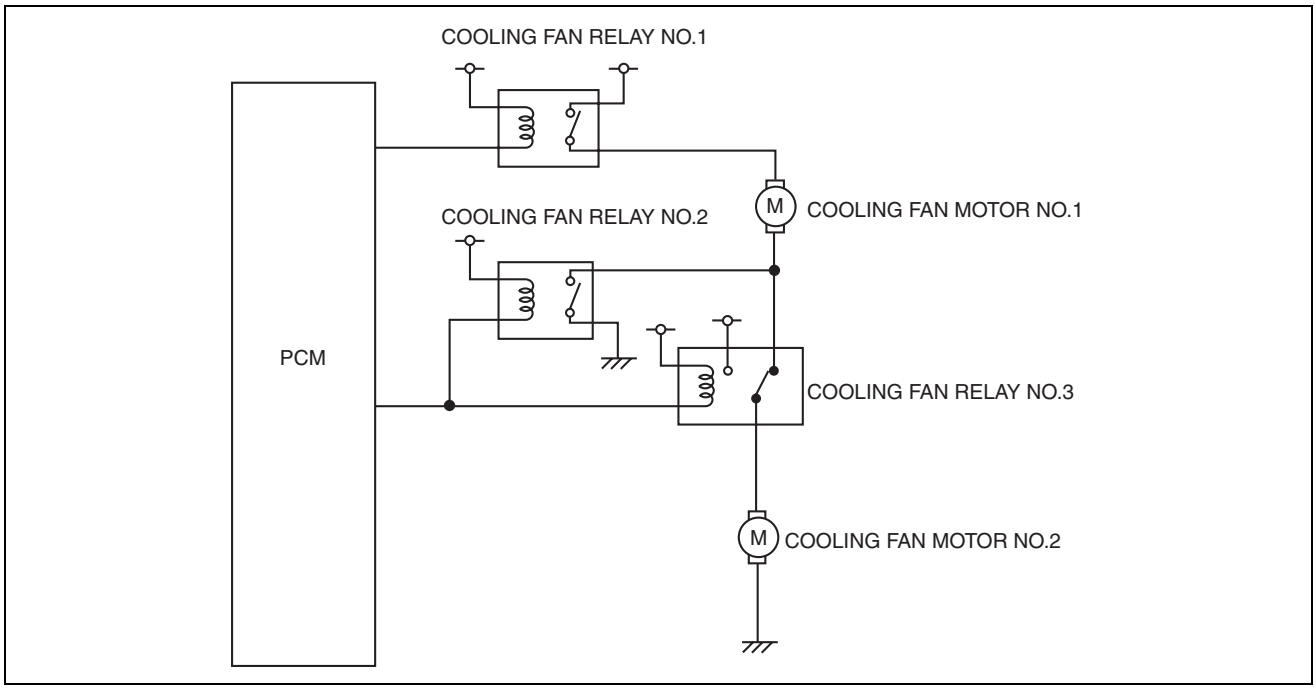
Operation

- The PCM determines the demand airflow volume by the following conditions.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Operation Pattern

Demand airflow volume	Cooling fan relay		Cooling fan motor	
	No.1	No.2/No.3	No.1	No.2
No airflow	OFF	OFF	Stop	Stop
Small	ON	OFF	Low-speed	Low-speed
Large	ON	ON	High-speed	High-speed



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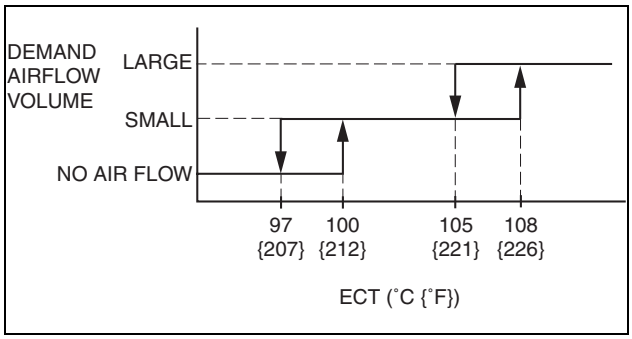
Engine coolant temperature condition

- Controls the PCM output duty ratio according to the engine coolant temperature.
- The control temperature while the engine coolant temperature is decreasing is controlled differently than when it is increasing.



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A/C operation condition

- Controls the demand airflow volume depending on the refrigerant pressure and vehicle speed when the A/C switch is on.

Operation condition	Demand airflow volume
• When all of the following conditions are met. — Refrigerant pressure: 1.3 MPa {13 kgf/cm^2, 189 psi} or less, vehicle speed: 45 km/h {28 mph} or more — Refrigerant pressure: 2.2 MPa {22 kgf/cm^2, 319 psi} or less, vehicle speed: 85 km/h {53 mph} or more	No airflow

CONTROL SYSTEM [SKYACTIV-G 2.0]

Operation condition	Demand airflow volume
• When all of the following conditions are met. — Refrigerant pressure: 1.3 MPa {13 kgf/cm^2, 189 psi} or less, vehicle speed: 45 km/h {28 mph} or less — Refrigerant pressure: 1.3—1.5 MPa {14—15 kgf/cm^2, 189—217 psi}, vehicle speed: 85 km/h {53 mph} or less — Refrigerant pressure: 1.5—2.2 MPa {16—22 kgf/cm^2, 218—319 psi}, vehicle speed: 65—85 km/h {41—52 mph}	Small
• When all of the following conditions are met. — Refrigerant pressure: 1.5—2.2 MPa {16—22 kgf/cm^2, 218—319 psi}, vehicle speed: 65 km/h {40 mph} or less — Refrigerant pressure: 2.2 MPa {22 kgf/cm^2, 319 psi} or more	Large

After Cooling Control

- If the ignition is switched off directly after continuous high engine-load travel, the PCM operates (demand airflow volume: low) the cooling fan for a maximum of 9 minutes when all of the following conditions are met due to the possibility that the engine may not restart as a result of a fuel supply malfunction caused by the high temperature.
  - — Engine coolant temperature: 90°C {194 °F} or more
  - — Accumulated amount of engine heat is extremely large
  - — Driving record for vehicle speed of 25 km/h {16 mph} or more available

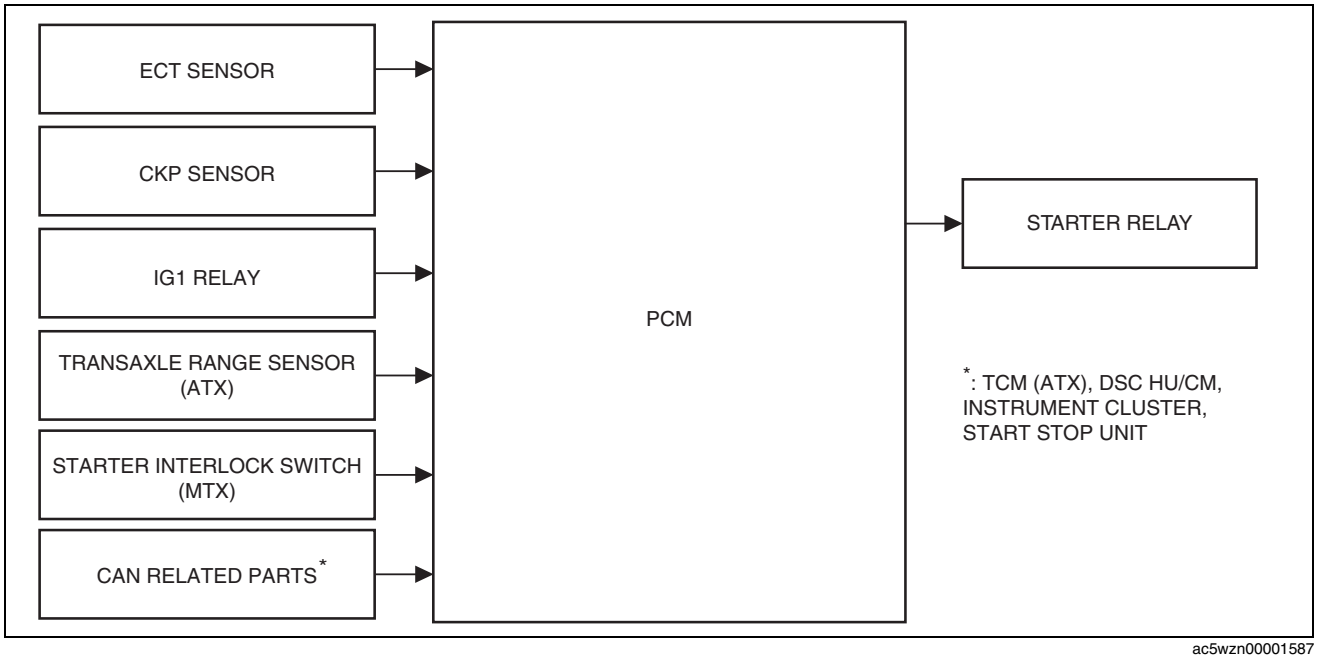
STARTER CUT-OFF CONTROL [SKYACTIV-G 2.0]

id0140f4204700

Outline

- The PCM controls energization to the starter relay according to an immobilizer system request to improve security.
- While not in P or N position, the starter relay energization by the ignition key is inhibited. (ATX)
- While not in neutral, the starter relay energization by the push button start is inhibited. (MTX)

Block Diagram



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Operation

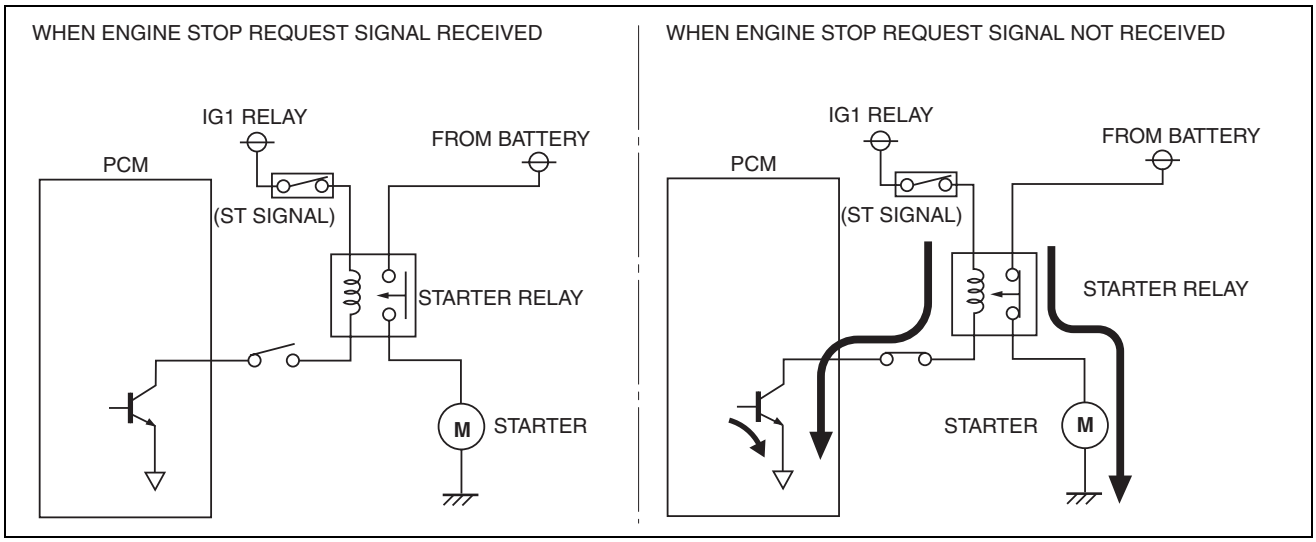
When engine stop request signal is not received

- The PCM establishes a ground to the starter circuit. Therefore when the ignition is switched to START, the starter relay is energized and the starter motor rotates. As a result, the engine starts normally.

When engine stop request signal is received.

- The PCM does not establish a ground to the starter circuit. Therefore, even if the ignition switch is turned to the start position, the starter motor does not rotate because the starter relay does not energize, and the engine does not start.

CONTROL SYSTEM [SKYACTIV-G 2.0]



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- The PCM turns the starter relay off with the engine speed at the set value or more (value from engine coolant temperature fluctuates).

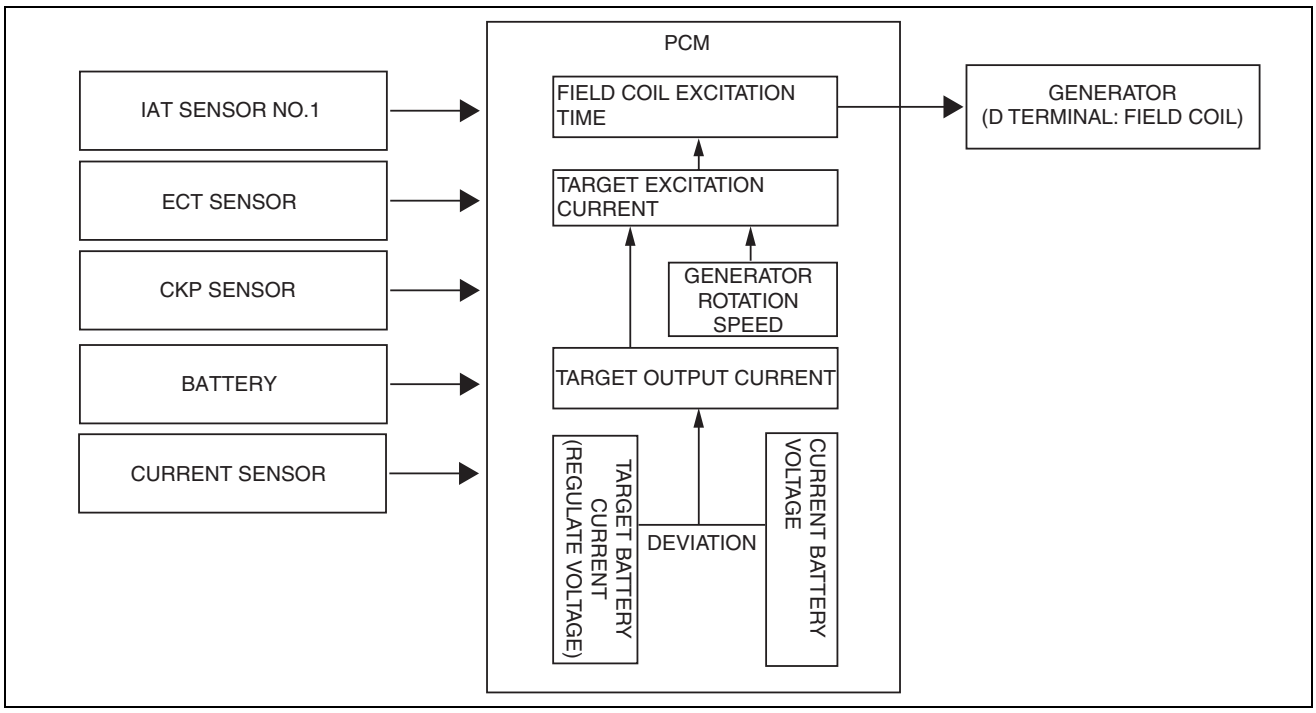
GENERATOR CONTROL [SKYACTIV-G 2.0]

id0140f4208900

Outline

- Idling stability has been improved by optimum control of generator voltage according to engine operation and electrical load conditions.
- The PCM determines the engine operation and electrical load conditions based on the input signals from each control part and controls the energization time of the generator field coils.

Block Diagram



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Operation

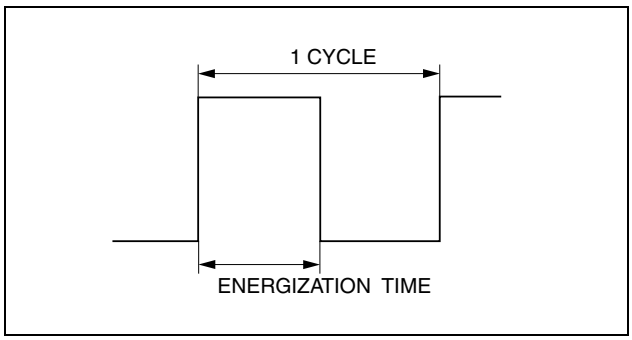
Determination method for target excitation current

- The battery condition is determined based on the current sensor signal and the target excitation current is calculated according to the battery condition. If the current sensor is malfunctioning, the target excitation current is calculated from the generator target output amount (determined by intake air temperature, engine speed, and vehicle speed), and the actual generator rotation speed.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Determination method for field coil excitation time

- The PCM increases or decreases the field coil excitation current by sending a duty signal to the power transistor built into the generator.
- The field coil energization current changes according to changes in the power transistor excitation time by changing the duty signal duty ratio. For example, when the battery positive voltage drops, the duty ratio of the duty signal sent to the power transistor is larger, increasing the field coil excitation current.
- During deceleration fuel-cut, the PCM increases the generator voltage and stores electricity in the battery. At times other than deceleration, the PCM enables electric discharge from the battery to reduce the generator load.
- Directly after the engine is started, the generator load is decreased by charging only to the necessary level according to the battery conditions in which the battery has not been charged to the maximum.



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i-stop CONTROL [SKYACTIV-G 2.0]

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Outline

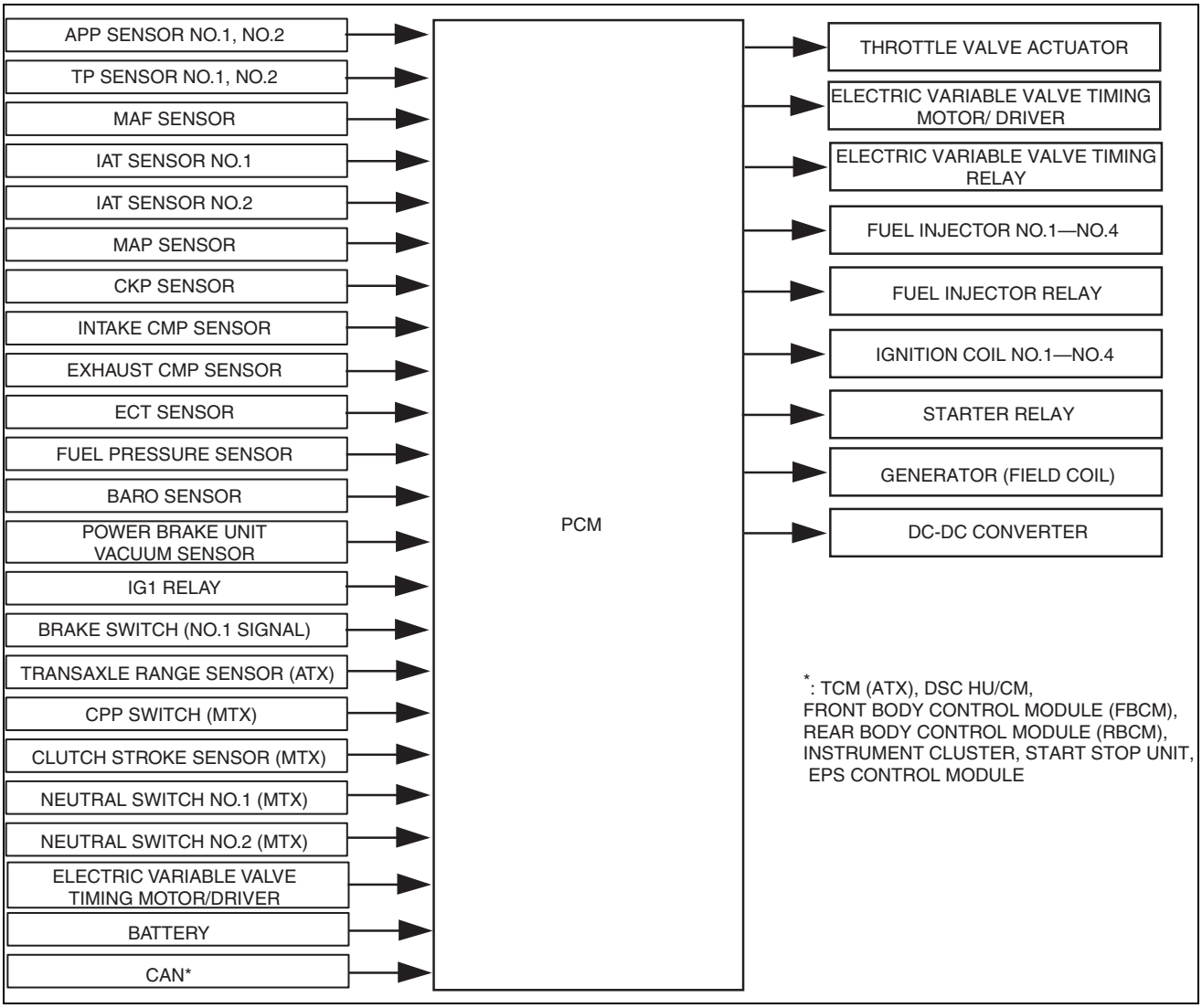
- When the vehicle is stopped such as at a stop light, the i-stop control stops/starts the engine automatically to improve fuel economy and reduce exhaust gas and idling noise.
- The PCM determines whether to permit/inhibit i-stop control based on the signal from each input part and CAN communication.
- The i-stop control includes the engine stop control, engine restart control, electric AT oil pump driver control, and hill launch assist functions.

Control Table

Control name	Control outline
Engine stop control	• The engine is stopped when the i-stop (engine stop control) conditions are met. (See 01-40-43 Engine stop control.)
Engine restart control	• The engine restarts when the i-stop (engine restart control) conditions are met. (See 01-40-46 Engine restart control.)
Electric AT oil pump driver control	• Drives the electric AT oil pump to assure line pressure during an engine stop by the i-stop control.
Hill launch assist function	• Controls the traction control solenoid valve in the DSC HU/CM to maintain or decrease brake fluid pressure.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Block Diagram



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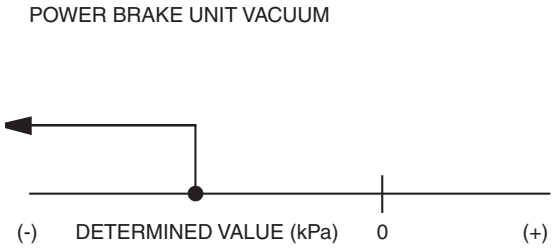
Operation
Engine stop control
i-stop (engine-stop control) permit condition

- The conditions to stop the engine by the i-stop control are as follows:

CONTROL SYSTEM [SKYACTIV-G 2.0]

Purpose	Condition item	ATX	MTX
Driveability	Vehicle speed	0 km/h {0 mph}	3 km/h {2 mph} or less
	Brake pedal	Brake pedal depressed in D position or M position (except 2nd gear fixed mode) (If ABS operates during deceleration, i-stop operation is inhibited.)	Not applicable
	Brake fluid pressure	Brake fluid pressure is 1.25 MPa {12.7 kgf/cm^2, 181 psi} or more in D position or M position (except 2nd gear fixed mode) (pedal force sufficient to suppress vehicle lurch when engine is restarted)	Not applicable
	Accelerator pedal	Released (foot removed from accelerator pedal)	←
	Clutch pedal	Not applicable	30% or less (clutch pedal opening angle)
	Gear position	Not applicable	Neutral
	Vehicle conditions	Vehicle stopped in D position (After vehicle is stopped and shifted into N position, engine stops 0.6 s after operation. In addition, after vehicle is stopped in D position and if shifted into P position, engine stop condition continues by i-stop control	Not applicable
Marketability	Cabin temperature	Difference between target temperature in cabin and temperature in cabin is within a certain value (A/C cabin temperature control is performed)	←
	A/C temperature	Setting other than MAX/MIN	←
	Ambient temperature	-10—50 °C {14—122 °F}	←
	Steering speed	15 deg/sec or less	←
	Steering angle	-65—65 ° (Center) (After EPS control module learned center value)	Not applicable
	Steering torque	1.4 N·m {14 kgf·cm, 12 in·lbf} or less	←
	i-stop OFF switch	OFF	←
	Vehicle speed history	3 km/h {2 mph} or more	4 km/h {2.5 mph} or more

CONTROL SYSTEM [SKYACTIV-G 2.0]

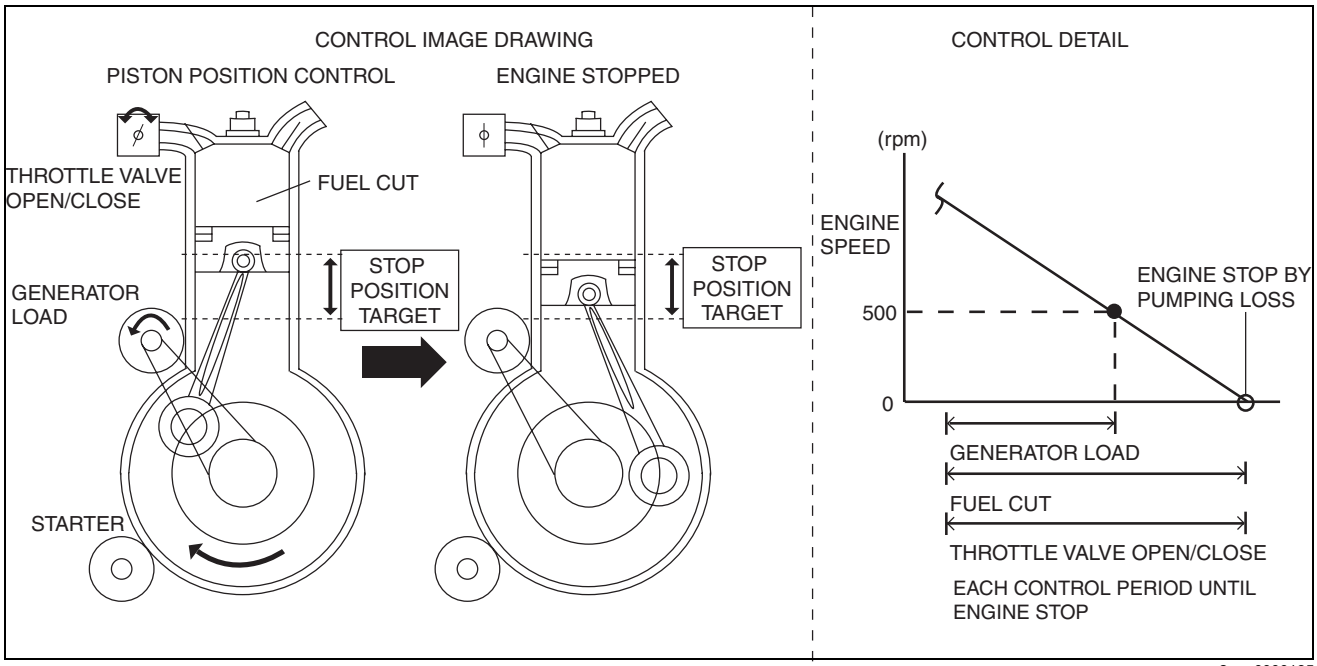
Purpose	Condition item	ATX	MTX
Safety	Battery charge condition	68.4% or more (determined from current sensor signal))	←
	Battery fluid temperature	0—70 °C {32—158 °F}	←
	Battery voltage	11.2 V or more	←
	Estimated battery voltage during engine restart	7.45 or more*1	←
	Defroster switch	OFF	←
	Power brake unit vacuum	-45 kPa {-0.46 kgf/cm^2, -6.5 psi} or less 	
	Door (front, rear)	Closed	←
	Bonnet	Closed*2	←
	Liftgate	Closed	←
	Vehicle inclination angle	When level, less than ± 7%	Not applicable
	Seat belt (driver)	Fastened	←
	Push button start system	Normal	←
	System condition	i-stop related module normal	←
System restriction	Number of starter operations	Within 180,000 times	←
	Number of starter relay operations	Within 180,000 times	←
	Number of i-stop operations	Within 300,000 times	←
	ISC learning	Completed	←
	Battery condition learning setting	Completed	←
	Steering angle sensor initialization setting	Completed	Not applicable
	DSC sensor initialization	Completed	Not applicable
	Elapsed time after engine restart	Maximum 6.4 s or more (Engine stop time fluctuation by i-stop control)	Not applicable
	PCM DTC	DTC except P11A:00 and P117A:00 and P2299:00 not detected	←
Engine condition	Engine coolant temperature	55—110 °C {131—230 °F}	←
	Intake air temperature	100°C {212 °F} or less	←
	ATF temperature	20—120 °C {68—248 °F}	Not applicable
Environment condition	Altitude	**European (L.H.D. U.K.) specs.** • 1,800 m or less **Except for European (L.H.D. U.K.) specs.** • 1,500 m or less	←

*1 : If the i-stop is operated repeatedly with a high-capacity audio system or added electronic device connected to the DC-DC converter, engine stop by the i-stop control is inhibited at a faster timing than normal.
*2 : If the engine is started while the hood is open, i-stop is inhibited until the engine is stopped.

CONTROL SYSTEM [SKYACTIV-G 2.0]

i-stop (engine stop control)

- When the i-stop (engine stop control) permit conditions are met, the PCM stops the engine based on the following controls:
  - — Fuel injection control (fuel cut)
    - Engine speed is reduced by the fuel cut.
  - — Drive-by-wire control (throttle valve open/closed)
    - By adjusting the throttle valve opening angle, the engine speed is reduced and the pumping loss is used to stop the engine.
  - — Electric variable valve timing control (intake valve timing retard)
    - Intake valve timing retard is performed for engine restart by i-stop control.
  - — Generator output control (generator load)
    - Engine speed is reduced by lowering the generator load.



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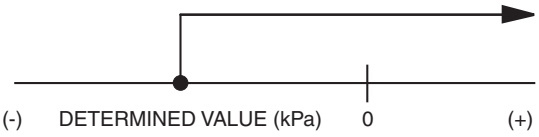
Engine restart control

i-stop (engine restart control) conditions

- Conditions for restarting the engine during i-stop control (engine stopped) are as follows:

Purpose	Condition item	
	ATX	MTX
Driver operation	Not applicable	Clutch pedal depression rate: 86% or more (If the clutch pedal depressed and then it is released while the engine is cranking to restart by the i-stop control, engine stop by the i-stop control continues. If the same operation is repeated several times, the engine will stall.)
	Brake pedal released → depressed while in P or N position	Not applicable
	Brake fluid pressure is 0.35 MPa {3.6 kgf/cm2, 51 psi} or less in D position or M position	Not applicable
	Accelerator pedal depressed while in D or M position	Not applicable
	Steering torque is 2.8 N·m {29 kgf·cm, 25 in·lbf} or more in D position or M position	Not applicable
	Steering angle (D or M position (except 2nd gear fixed mode)): -70° or less or 70° or more (after EPS control module learned center value)	Not applicable
	Engine start by key operation	←
	Shift operation • When changed to the M position (except 2nd gear fixed mode) • P or N position →D or M or R position	Not applicable

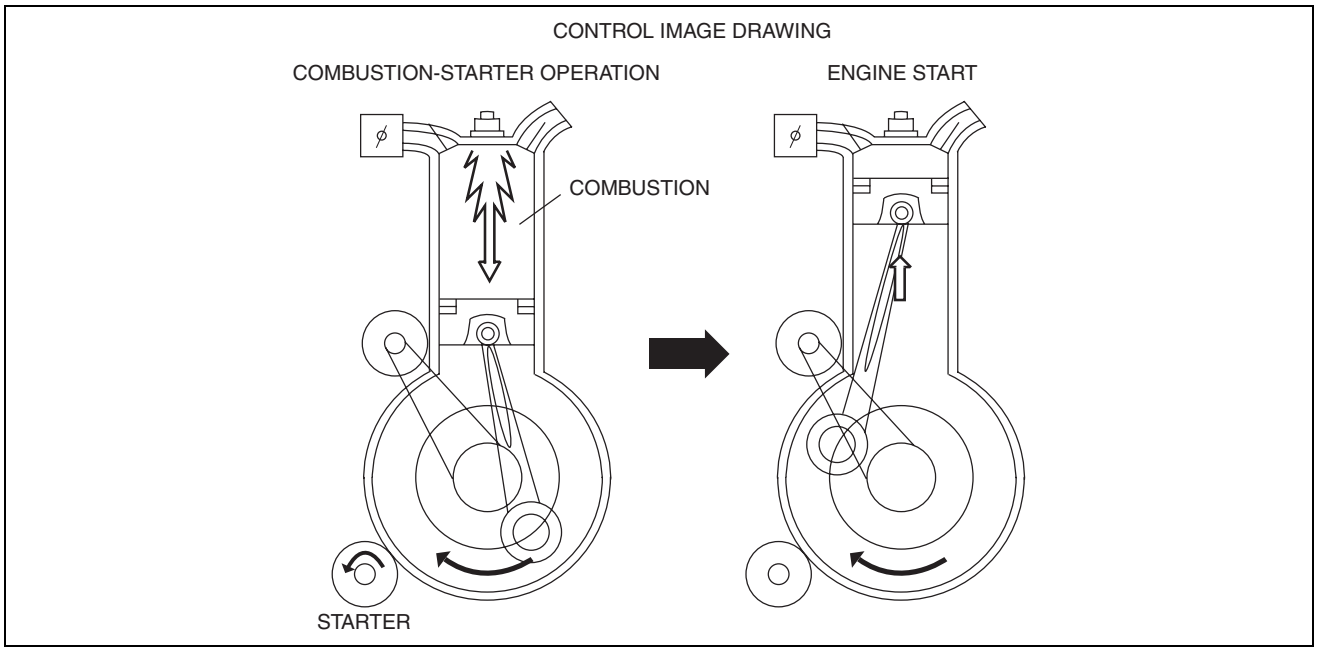
CONTROL SYSTEM [SKYACTIV-G 2.0]

Purpose	Condition item	
	ATX	MTX
Marketability	A/C request	←
	A/C temperature MAX setting, MIN setting	←
	Battery charge 67.9% or less	←
	Battery charge rate is specified value or more	←
	Estimated battery voltage when engine is restarted is 7.25 V or less	←
	i-stop OFF switch on	←
	• The following conditions are met. — Seat belt (driver): Not fastened — Door or liftgate: Open	←
Safety	**Except for European (L.H.D. U.K.) specs.** • The following conditions are met while in P or N position (determined that driver is not in vehicle). — Seat belt (driver): Not fastened — Door (driver): Open	**Except for European (L.H.D. U.K.) specs.** • The following conditions are met while in neutral position (determined that driver is not in vehicle). — Seat belt (driver): Not fastened — Door (driver): Open
	Defroster switch on	←
	Power brake unit vacuum: -43 kPa {-0.44 kgf/cm^2, -6.2 psi} or more POWER BRAKE UNIT VACUUM  	←
	Vehicle speed: 1 km/h {0.6 mph} or more	Vehicle speed: 4 km/h {2.5 mph} or more
	Engine stop time by the i-stop control: 120 s or more	←

i-stop (engine restart control)

- When the i-stop (engine restart control) conditions are met, the PCM restarts the engine by the following controls:
  - — Fuel injection control (from first time, fuel injection to specific cylinders (expansion stroke)
    - Fuel is injected to cylinders which are determined to be stopped at the expansion stroke. During i-stop control (engine stop), cylinders are identified based on the signal from the crankshaft position sensor and fuel injection is enabled to those cylinders which are identified first as being stopped in the expansion stroke.
  - — DC-DC converter control
    - When the engine is restarted by the i-stop control, the battery voltage is decreased to operate the starter by supplying power from the battery. When the starter operates, the supply voltage for electronic devices is increased by the DC-DC converter.

CONTROL SYSTEM [SKYACTIV-G 2.0]



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Indicator illumination request

- The PCM sends an i-stop indicator light (green)/i-stop warning light (amber) illumination or flash request to the instrument cluster according to the vehicle conditions.
- The i-stop indicator light (green)/i-stop warning light (amber) illumination/flash request conditions are as follows:

European (L.H.D. U.K.) specs.

IS: Engine stop by i-stop control
IR: Engine restart by i-stop control
×: Applicable

Vehicle condition		Vehicle condition	i-stop indicator light (green)/i-stop warning light (amber) display			Indicator (other)	Buzzer
			Illumination on	Flash (0.5 s)	Illumination off	Illumination on/ Flash	
Driving	IS conditions not met	—	—	—	×	—	—
	IS conditions met*7	—	—	—	×	—	—
Vehicle parked	IS conditions not met*7	Idle	—	—	×	—	—
	IS conditions met*7	IS	Green	—	—	—	—

CONTROL SYSTEM [SKYACTIV-G 2.0]

Vehicle condition			Vehicle condition	i-stop indicator light (green)/i-stop warning light (amber) display			Indicator (other)	Buzzer
				Illumination on	Flash (0.5 s)	Illumination off	Illumination on/ Flash	
During IS	IS conditions met[*7]		IS	Green	—	—	—	—
	IS continues normally	**ATX** When the following conditions are met: • Brake depressed • D or M position (except 2nd gear fixed mode) • Steering angle less than 70° When the following conditions are met: • Brake released • D or M position (except 2nd gear fixed mode) →N position • D or M position (except 2nd gear fixed mode) →N position →P position • Steering angle less than 70°	IS continues	Green	—	—	—	—
		MTX Clutch pedal depressed→Clutch pedal is released while engine is cranking to restart by i-stop control	IS continues/Engine stall[*11]					
	IR request (driver's operation)	When changed to the M position (except 2nd gear fixed mode)	IR	—	—	×[*2]	—	—
		Engine start by key operation						
		A/C temperature MAX setting, MIN setting						
		ATX • Brake pedal released → depressed while in P or N position • Brake fluid pressure is 0.35 MPa {3.6 kgf/cm2, 51 psi} or less in D position or M position • Accelerator pedal depressed while in D or M position • Steering torque is 2.8 N·m {29 kgf·cm, 25 in·lbf} or more in D position or M position • Steering angle (D or M position (except 2nd gear fixed mode)): -70° or less or 70° or more • Shift operation — When changed to the M position (except 2nd gear fixed mode) — P or N position →D or M or R position						
		MTX • Clutch pedal opening angle is 86% or more						

CONTROL SYSTEM [SKYACTIV-G 2.0]

Vehicle condition			Vehicle condition	i-stop indicator light (green)/i-stop warning light (amber) display			Indicator (other)	Buzzer
				Illumination on	Flash (0.5 s)	Illumination off	Illumination on/ Flash	
During IS	IR request (driver's operation)	When the following conditions are met: • Seat belt (driver): Not fastened • Door (driver): Open • P or N position (ATX) • Neutral position (MTX)	Engine stall	Amber	—	—	Same illumination as normal engine stall condition	0.25 s intervals for 3 s
	Switches to unsafe condition (driver's operation)	Door (driver) open	IS continues	—	Green	—	—	0.25 s intervals
		When the following conditions are met: • Seat belt (driver): Not fastened • Door (driver): Open • D or M position (except 2nd gear fixed mode) (ATX) • In gear (MTX)	Engine stall	Amber	—	—	Same illumination as normal engine stall condition	0.25 s intervals for 3 s
		Bonnet open	Engine stall	Amber	—	—	Same illumination as normal engine stall condition	0.25 s intervals for 3 s
		MTX In gear	IS continues	—	Green	—	—	—
	IR request (vehicle request)	Any of the following conditions are met: • A/C request • Battery charge 67.9% or less • Battery charge rate is specified value or more • Estimated battery voltage when engine is restarted is 7.25 V or less • Defroster switch on • Engine stop time by the i-stop control: 120 s or more	IR	—	Green*9	×*2	—	—
		Any of the following conditions are met: • Vehicle speed: 1 km/h {0.6 mph} or more (ATX) • Vehicle speed: 4 km/h {2.5 mph} or more (MTX) • Power brake unit vacuum reduced	IR	—	—	×*2	—	—
		• Advanced key is carried outside of vehicle	IR*6	—	—	×*2	Keyless warning light (red) flash	Keyless control module normal buzzer
	IR not functional	• Cranking for 3 s or more when engine is restarted	Engine stall	Amber	—	—	Same illumination as normal engine stall condition	—

CONTROL SYSTEM [SKYACTIV-G 2.0]

Vehicle condition		Vehicle condition	i-stop indicator light (green)/i-stop warning light (amber) display			Indicator (other)	Buzzer
			Illumination on	Flash (0.5 s)	Illumination off	Illumination on/ Flash	
IS permit/inhibit implement	• i-stop OFF switch on (long pressed for 0.5 s or more)	IS not authorized*8	Amber*3	—	—	—	Beep sound 1 time
	• i-stop OFF switch off (long pressed for 0.5 s or more)	IS authorized	—	—	×*4	—	Beep sound 1 time
System malfunction		IS not authorized	—	Amber*5	—	×*10	—

*1 : Changes illumination to IS when the conditions are met for driver operation (brake pedal force).
*2 : No flashing, turns off when the engine restarts.
*3 : Illuminates according to the i-stop OFF switch operation (long-press for 0.5 s or longer).
*4 : Turns off according to the i-stop OFF switch operation (long-press for 0.5 s or longer).
*5 : It may illuminate in amber when communication between PCM is cut.
*6 : Only when the advanced key is outside of the vehicle with the doors other than driver's door open.
*7 : The i-stop (engine-stop control) permit conditions differ depending on the driving condition. (See 01-40-59 i-stop INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].)
*8 : If during engine stop by i-stop control, engine restarted by i-stop control.
*9 : IR is performed after the i-stop indicator light (green) flashes for 3 s.
*10 : If there is a battery related malfunction, the master warning light illuminates.
*11 : If the clutch pedal depressed and then it is released while the engine is cranking to restart by the i-stop control, engine stop by the i-stop control continues. If the same operation is repeated several times, the engine will stall.

Except for European (L.H.D. U.K.) specs.

IS: Engine stop by i-stop control
IR: Engine restart by i-stop control
×: Applicable

Vehicle condition		Vehicle condition	i-stop indicator light (green)/i-stop warning light (amber) display			Indicator (other)	Buzzer
			Illumination on	Flash (0.5 s)	Illumination off	Illumination on/ Flash	
Driving	IS conditions not met	—	—	—	×	—	—
	IS conditions met*7	—	Green	—	—	—	—
Vehicle parked	IS conditions not met*7	Idle	—	Green*1	—	—	—
			—	—	×	—	—
	IS conditions met*7	IS	Green	—	—	—	—

CONTROL SYSTEM [SKYACTIV-G 2.0]

Vehicle condition			Vehicle condition	i-stop indicator light (green)/i-stop warning light (amber) display			Indicator (other)	Buzzer
				Illumination on	Flash (0.5 s)	Illumination off	Illumination on/ Flash	
During IS	IS conditions met*7		IS	Green	—	—	—	—
	IS continues normally	**ATX** When the following conditions are met: • Brake depressed • D or M position (except 2nd gear fixed mode) • Steering angle less than 70° When the following conditions are met: • Brake released • D or M position (except 2nd gear fixed mode) →N position • D or M position (except 2nd gear fixed mode) →N position →P position • Steering angle less than 70°	IS continues	Green	—	—	—	—
		MTX Clutch pedal depressed→Clutch pedal is released while engine is cranking to restart by i-stop control	IS continues/Engine stall*10					
	IR request (driver's operation)	When changed to the M position (except 2nd gear fixed mode)	IR	—	—	×*2	—	—
		Engine start by key operation						
		A/C temperature MAX setting, MIN setting						
		ATX • Brake pedal released → depressed while in P or N position • Brake fluid pressure is 0.35 MPa {3.6 kgf/cm2, 51 psi} or less in D position or M position • Accelerator pedal depressed while in D or M position • Steering torque is 2.8 N·m {29 kgf·cm, 25 in·lbf} or more in D position or M position • Steering angle (D or M position (except 2nd gear fixed mode)): -70° or less or 70° or more • Shift operation — When changed to the M position (except 2nd gear fixed mode) — P or N position →D or M or R position						
		MTX • Clutch pedal opening angle is 86% or more						

CONTROL SYSTEM [SKYACTIV-G 2.0]

Vehicle condition			Vehicle condition	i-stop indicator light (green)/i-stop warning light (amber) display			Indicator (other)	Buzzer
				Illumination on	Flash (0.5 s)	Illumination off	Illumination on/ Flash	
During IS	IR request (driver's operation)	When the following conditions are met: • Seat belt (driver): Not fastened • Door (driver): Open • P or N position (ATX) • Neutral position (MTX)	IR	—	—	×*2	—	—
	Switches to unsafe condition (driver's operation)	Door (driver) open	IS continues	Green	—	—	—	0.25 s intervals
		When the following conditions are met: • Seat belt (driver): Not fastened • Door (driver): Open • D or M position (except 2nd gear fixed mode) (ATX) • In gear (MTX)	Engine stall	Amber	—	—	Same illumination as normal engine stall condition	0.25 s intervals for 3 s
		Bonnet open	Engine stall	Amber	—	—	Same illumination as normal engine stall condition	0.25 s intervals for 3 s
		MTX In gear	IS continues	—	Green	—	—	—
	IR request (vehicle request)	Any of the following conditions are met: • A/C request • Battery charge 67.9% or less • Battery charge rate is specified value or more • Estimated battery voltage when engine is restarted is 7.25 V or less • Defroster switch on • Engine stop time by the i-stop control: 120 s or more	IR	—	—	×*2	—	—
		Any of the following conditions are met: • Vehicle speed: 1 km/h {0.6 mph} or more (ATX) • Vehicle speed: 4 km/h {2.5 mph} or more (MTX) • Power brake unit vacuum reduced	IR	—	—	×*2	—	—
		• Advanced key is carried outside of vehicle	IR*6	—	—	×*2	Keyless warning light (red) flash	Keyless control module normal buzzer
	IR not functional	• Cranking for 3 s or more when engine is restarted	Engine stall	Amber	—	—	Same illumination as normal engine stall condition	—

CONTROL SYSTEM [SKYACTIV-G 2.0]

Vehicle condition		Vehicle condition	i-stop indicator light (green)/i-stop warning light (amber) display			Indicator (other)	Buzzer
			Illumination on	Flash (0.5 s)	Illumination off	Illumination on/ Flash	
IS permit/inhibit implement	• i-stop OFF switch on (long pressed for 0.5 s or more)	IS not authorized *8	Amber *3	—	—	—	Beep sound 1 time
	• i-stop OFF switch off (long pressed for 0.5 s or more)	IS authorized	—	—	× *4	—	Beep sound 1 time
System malfunction		IS not authorized	—	Amber *5	—	× *9	—

*1 : Changes illumination to IS when the conditions are met for driver operation (brake pedal force).
*2 : No flashing, turns off when the engine restarts.
*3 : Illuminates according to the i-stop OFF switch operation (long-press for 0.5 s or longer).
*4 : Turns off according to the i-stop OFF switch operation (long-press for 0.5 s or longer).
*5 : It may illuminate in amber when communication between PCM is cut.
*6 : Only when the advanced key is outside of the vehicle with the doors other than driver's door open.
*7 : The i-stop (engine-stop control) permit conditions differ depending on the driving condition. (See 01-40-59 i-stop INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].)
*8 : If during engine stop by i-stop control, engine restarted by i-stop control.
*9 : If there is a battery related malfunction, the master warning light illuminates.
*10 : If the clutch pedal depressed and then it is released while the engine is cranking to restart by the i-stop control, engine stop by the i-stop control continues. If the same operation is repeated several times, the engine will stall.

DC-DC CONVERTER CONTROL [SKYACTIV-G 2.0]

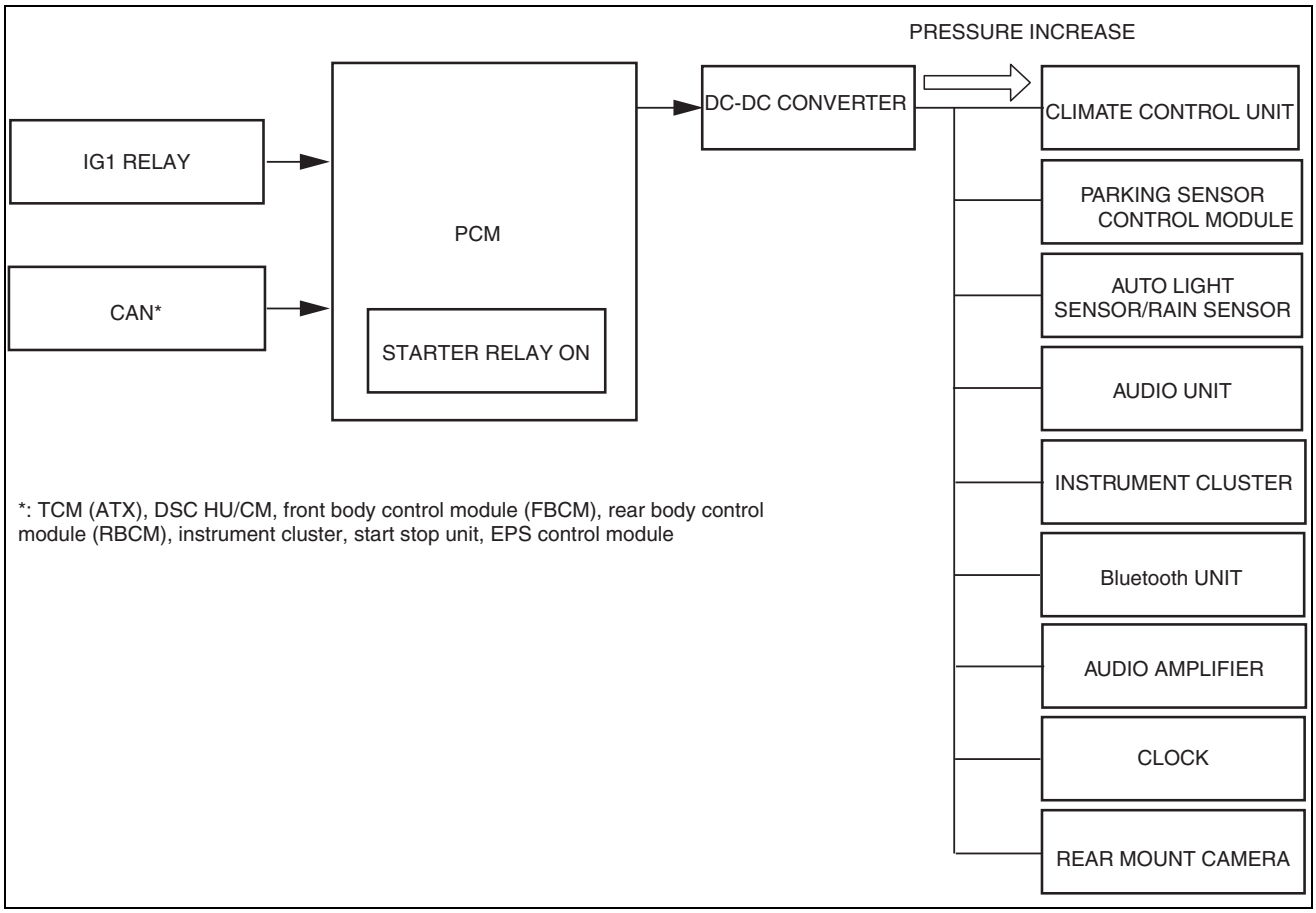
id0140f4004300

Outline

- Stability of the power supply to the cabin has been realized by preventing decreases in the power supply due to battery voltage decreases while the engine is restarted by the i-stop control.
- When the engine is restarted by the i-stop control, the PCM sends a battery voltage (DC-DC converter downstream voltage) boost request signal to the DC-DC converter.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Block Diagram



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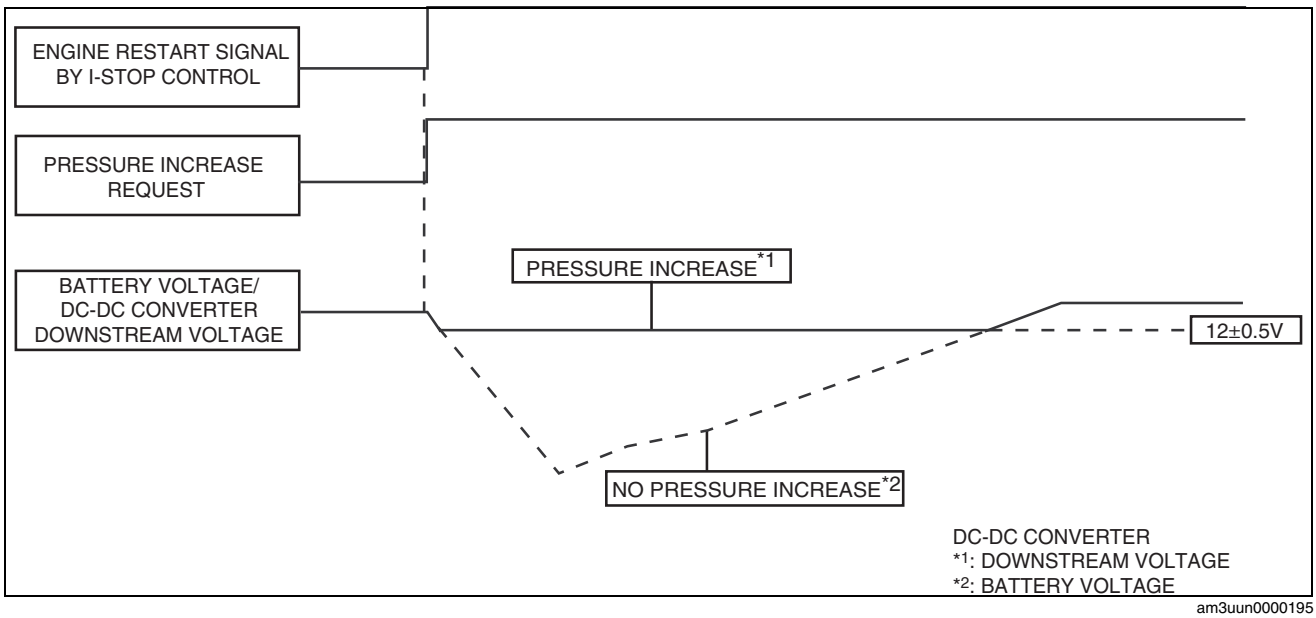
Operation

- When the engine is restarted by the i-stop control, the PCM sends a voltage boost request signal to the DC-DC converter so that the DC-DC converter downstream voltage is maintained at 11.5—12.5 V.



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CONTROL SYSTEM [SKYACTIV-G 2.0]

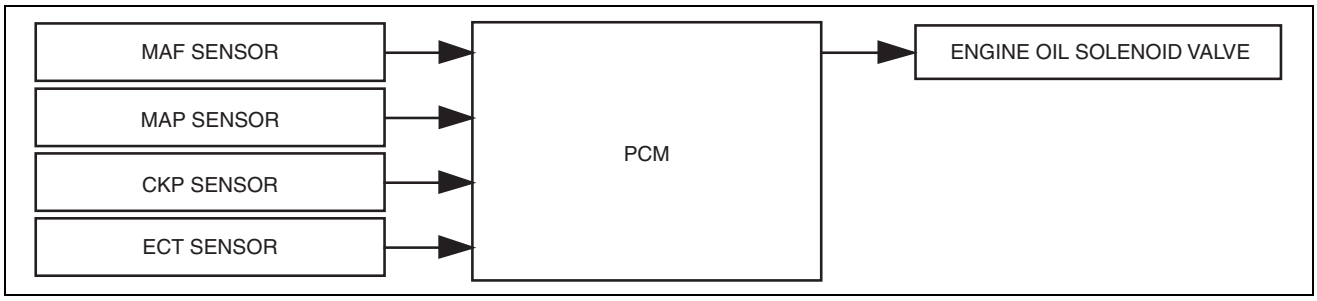
ENGINE OIL CONTROL [SKYACTIV-G 2.0]

id0140f4004200

Outline

- The PCM reduces the oil pump load applied to the engine by controlling the appropriate engine hydraulic pressure according to the engine operation conditions.
- The engine hydraulic pressure switches in two steps. When hydraulic pressure is not needed, the oil pump discharge amount is reduced by the operation of the engine oil solenoid valve.

Block Diagram



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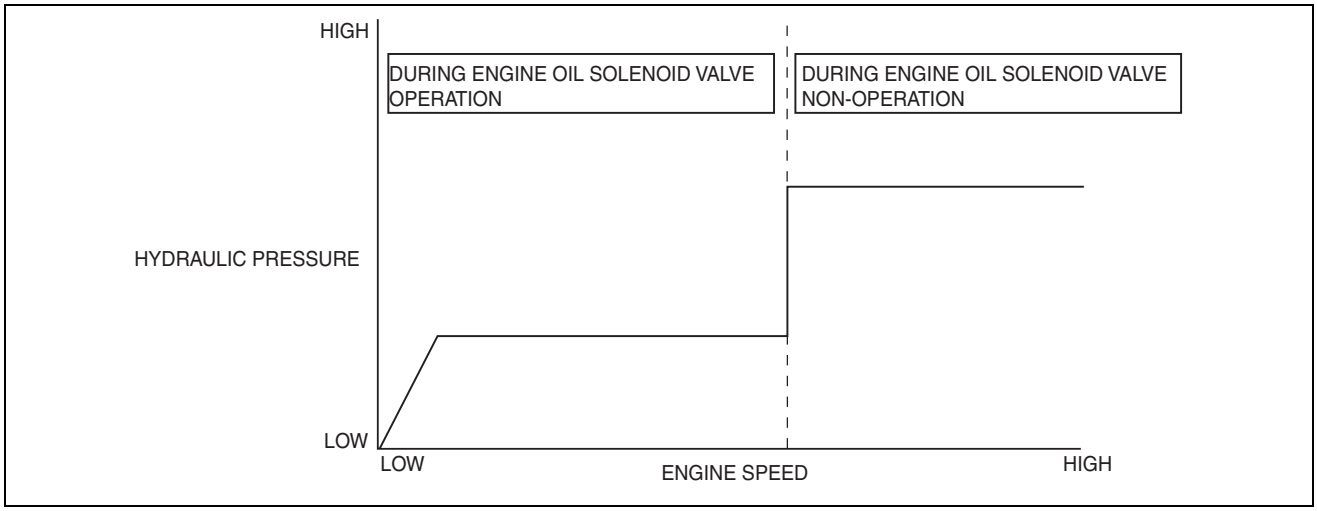
Operation

- The PCM switches the engine oil pressure which lubricates the engine in two steps by driving the engine oil solenoid valve according to the engine operation conditions.



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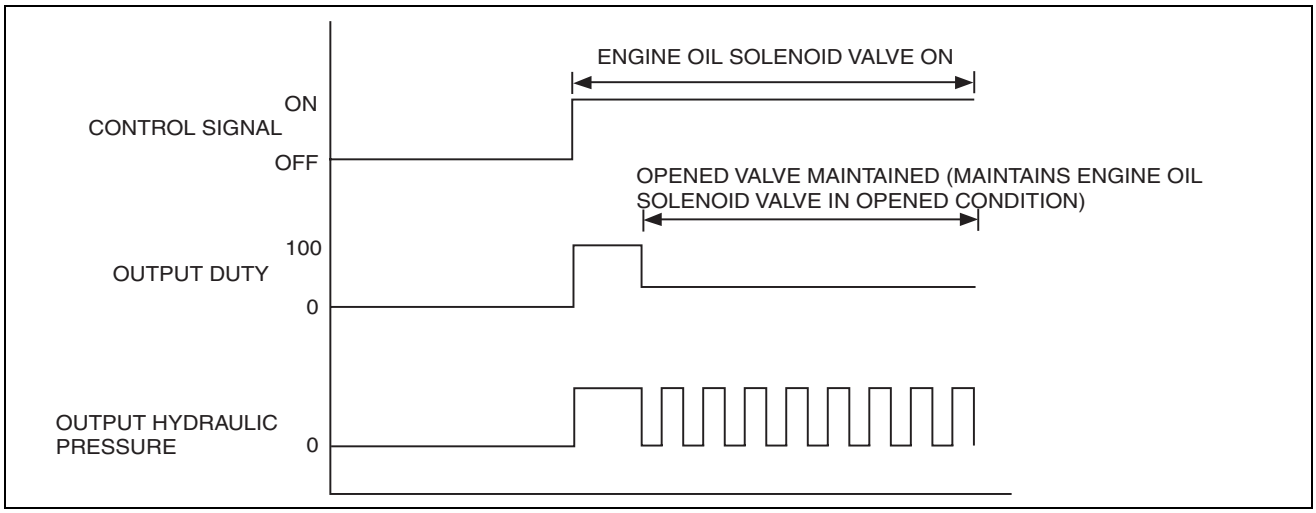
Output duty value determination

- The PCM controls the operational voltage energized to the engine oil solenoid according to the duty signal. After opening the engine oil solenoid valve at the output duty ratio of 100%, load applied to the parts is reduced by lowering the duty value to the output duty value at which the open valve condition can be maintained. The output duty value for maintaining the opening value changes according to the battery voltage.

CONTROL SYSTEM [SKYACTIV-G 2.0]



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Engine oil solenoid valve operation conditions

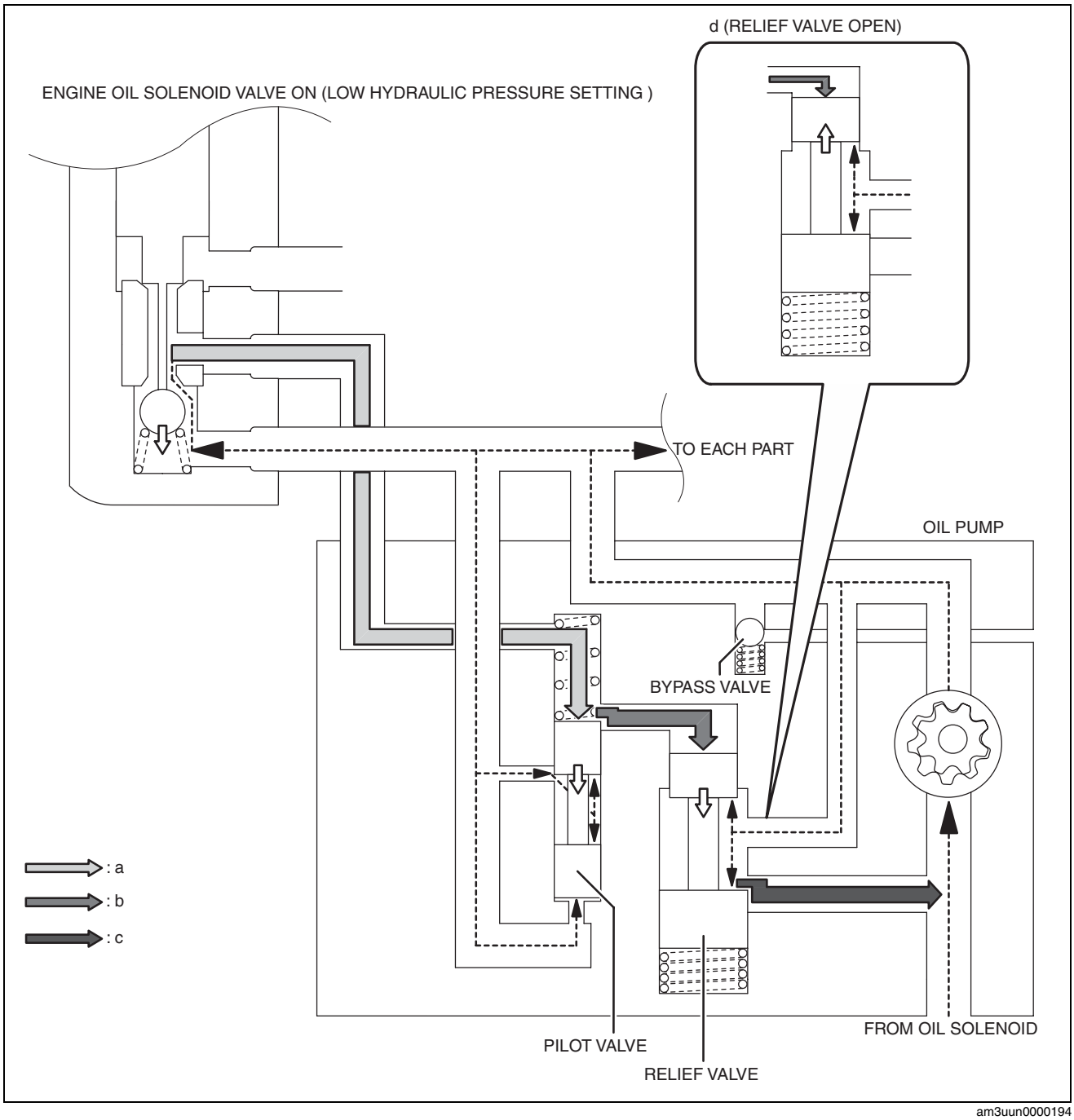
- The PCM operates the engine oil solenoid valve when all of the following conditions is met:
  - — Engine speed: Less than 4,000 rpm
  - — Engine coolant temperature: Less than 98 °C {208 °F}
  - — Charging efficiency: Less than specification (varies according to engine speed.)
- For details on the engine oil solenoid valve, refer to the LUBRICATION SYSTEM. (See 01-11A-12 ENGINE OIL SOLENOID VALVE [SKYACTIV-G 2.0].)

Hydraulic pressure switching mechanism

- When the engine oil solenoid valve operates, the hydraulic circuit changes according to the following. The engine oil supply amount is controlled by changing the hydraulic circuit.
  Engine oil flow during low hydraulic pressure setting (engine oil solenoid valve ON)
  a. When the engine oil solenoid valve turns on, hydraulic pressure is also applied to the top of the pilot valve. The pilot valve presses downward by spring force because the hydraulic pressure applied to the top and bottom of the pilot valve is nearly equal.
  b. Hydraulic pressure is applied to the top of the relief valve.
  c. When the hydraulic pressure exceeds the relief valve opening pressure, the relief valve is pressed downward and engine oil flows out (Hydraulic pressure decrease).
  d. When the hydraulic pressure is less than the relief valve opening pressure, the relief valve closes. As a result, engine oil outflow stops (Hydraulic pressure increase).

CONTROL SYSTEM [SKYACTIV-G 2.0]

e. (c)-(d) is performed repeatedly to adjust the hydraulic pressure.



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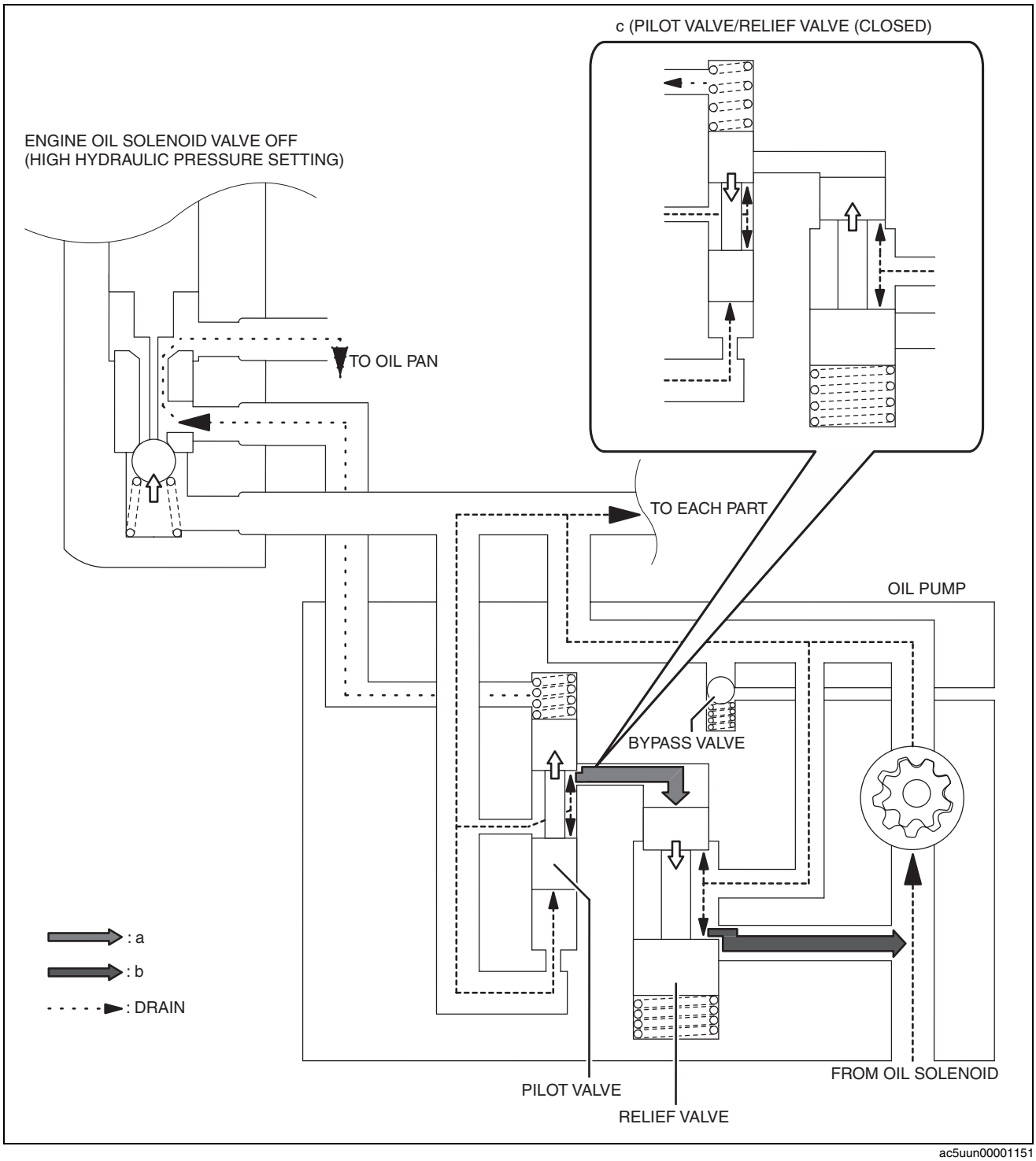
Engine oil flow during high hydraulic pressure setting (engine oil solenoid valve OFF)

a. When the hydraulic pressure exceeds the pilot valve opening pressure, the pilot valve is pressed upward and hydraulic pressure is applied.
b. Because the hydraulic pressure exceeds the relief valve opening pressure by the hydraulic pressure applied to the top of the relief valve, the relief valve is pressed downward and engine oil flows out (Hydraulic pressure decrease).
c. When the hydraulic pressure is less than the pilot valve opening pressure, the pilot valve closes. As a result, the relief valve is closed and engine oil outflow stops (Hydraulic pressure increase).

CONTROL SYSTEM [SKYACTIV-G 2.0]

d. (a)-(c) is performed repeatedly to adjust the hydraulic pressure.



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i-stop INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0]

id0140f4008600

Purpose, Function

- If the i-stop (engine stop control) permit condition is met while the vehicle is being driven, the i-stop indicator light (green) illuminates to inform the driver that an engine-stop by the i-stop control is permitted. In addition, if the engine cannot be stopped by the i-stop control due to insufficient depression of the brake pedal after the vehicle is stopped, the light flashes to warn the driver to further depress the brake pedal.
- The light illuminates based on the i-stop (engine stop control) permit conditions.

Construction

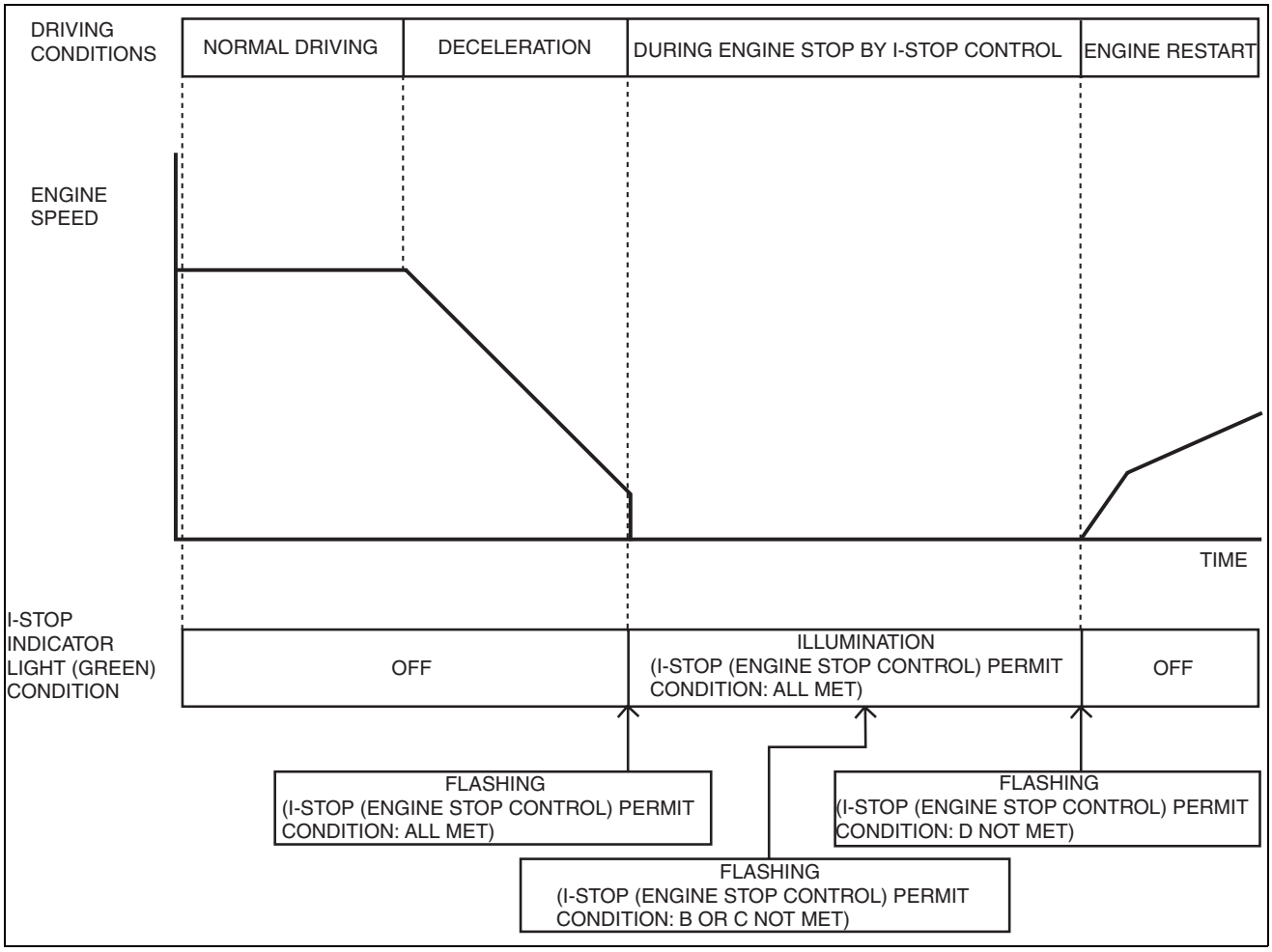
- The i-stop indicator light (green) is built into the instrument cluster.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Operation

- The illumination/flashing conditions of the i-stop indicator light (green) differ depending on the i-stop (engine-stop control) permit condition.
- The illumination/flashing conditions of the i-stop indicator light (green) are as follows:

European (L.H.D. U.K.) specs.



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CONTROL SYSTEM [SKYACTIV-G 2.0]

i-stop indicator light (green) illumination/ flashing condition determination	i-stop (engine-stop control) permit condition item	ATX	MTX
A	i-stop OFF switch	OFF	←
	Vehicle speed history	3 km/h {2 mph} or more	4 km/h {2.5 mph} or more
	Bonnet	Closed *2	←
	Seat belt (Driver)	Fastened	←
	Push button start system	Normal	←
	System condition	i-stop related module is normal	←
	ISC learning	Completed	←
	Battery condition learning	Completed	←
	Steering angle sensor initialization setting	Completed	Not applicable
	DSC sensor initialization	Completed	Not applicable
	Time since engine restarted	6.4 s or more (fluctuates according to engine stop time by i-stop control)	Not applicable
	PCM DTCs	DTC except P11A:00 and P117A:00 and P2299:00 not detected	←
	Number of starter operations	Within 180,000 times	←
	Number of starter relay operations	Within 180,000 times	←
	Number of i-stop operations	Within 300,000 times	←
	Intake air temperature	100°C {212 °F} or less	←
	ATF temperature	20—120 °C {68—248 °F}	Not applicable
	Altitude	1,800 m or less	←
	Vehicle conditions	Vehicle stopped in D position (After vehicle is stopped and shifted into N position, engine stops 0.6 s after operation. In addition, after vehicle is stopped in D position and if shifted into P position, engine stop condition continues by i-stop control	Not applicable
	Brake pedal	Brake pedal depressed in D position or M position (except 2nd gear fixed mode) (If ABS operates during deceleration, i-stop operation is inhibited.)	Not applicable
	Brake fluid pressure	Brake fluid pressure is 1.25 MPa {12.7 kgf/cm^2, 181 psi} or more in D position or M position (except 2nd gear fixed mode) (pedal force sufficient to suppress vehicle lurch when engine is restarted)	Not applicable
	Accelerator pedal	Released (foot is removed from accelerator pedal)	←
	Clutch pedal	Not applicable	30% or less (clutch pedal opening angle)
	Steering speed angle	15 deg/sec or less	←
	Steering angle	-65—65 °(center)	Not applicable

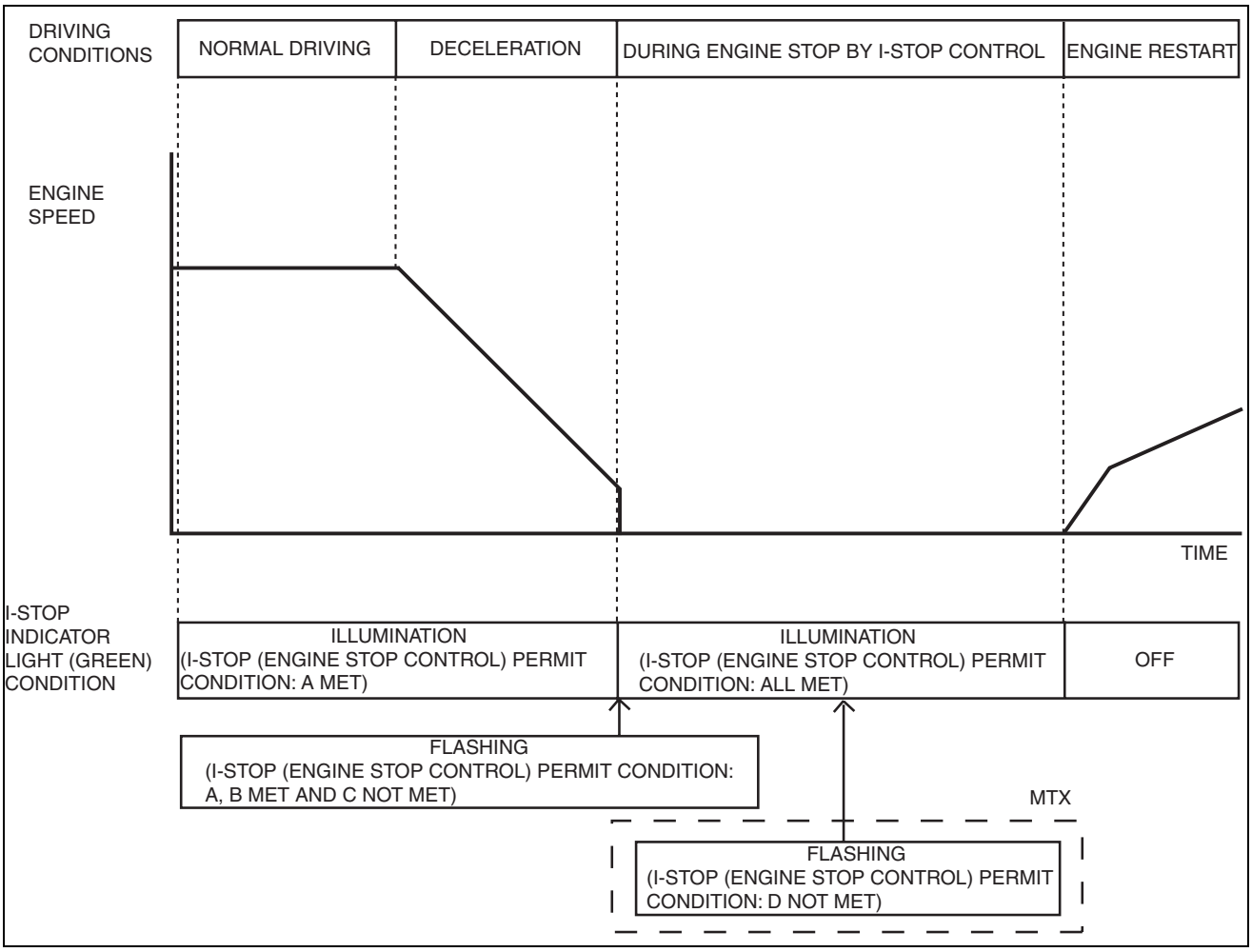
CONTROL SYSTEM [SKYACTIV-G 2.0]

i-stop indicator light (green) illumination/ flashing condition determination	i-stop (engine-stop control) permit condition item	ATX	MTX
A	Steering torque	1.4 N·m {14 kgf·cm, 12 in·lbf} or less	←
	Door (front, rear)	Closed	←
	Liftgate	Closed	←
	Vehicle inclination angle	Less than ±7% when level	Not applicable
	Vehicle speed	0 km/h	3 km/h {2 mph} or less
	Power brake unit vacuum	-45 kPa {-0.46kgf/cm^2, -6.5 psi} or less POWER BRAKE UNIT VACUUM  (-) DETERMINED VALUE (kPa) 0 (+)	
B	Door (passenger's door).	Closed	←
C	Gear position	Not applicable	Neutral
D	Cabin temperature	Difference between target temperature in cabin and temperature in cabin is within a certain value (A/C cabin temperature control is performed)	←
	A/C temperature	Setting other than MAX/MIN	←
	Ambient temperature	-10—50 °C {14—122 °F}	←
	Estimated battery voltage at engine restart	7.45 V or more *1	←
	Engine coolant temperature	55—110 °C {131—230 °F}	←
	Battery charge condition	Charge condition: 68.4% or more (determined by current sensor signal)	←
	Battery fluid temperature	0—70 °C {32—158 °F}	←
	Battery voltage	11.2 V or more	←
	Defroster switch	OFF	←

*1 : With a high capacity audio system or added electronic device connected to the DC-DC converter, engine stop by the i-stop control is inhibited more quickly than normal due to repeated i-stop operation.
*2 : If the engine is started while the hood is open, i-stop is inhibited until the engine is stopped.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Except for European (L.H.D. U.K.) specs.



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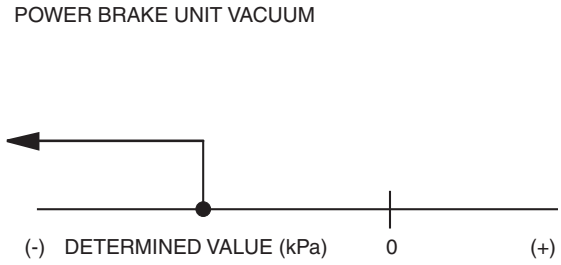
CONTROL SYSTEM [SKYACTIV-G 2.0]

i-stop indicator light (green) illumination/ flashing condition determination	i-stop (engine-stop control) permit condition item	ATX	MTX
A	Cabin temperature	Difference between target temperature in cabin and temperature in cabin is within a certain value (A/C cabin temperature control is performed)	←
	A/C temperature	Setting other than MAX/MIN	←
	Ambient temperature	-10—50 °C {14—122 °F}	←
	i-stop OFF switch	OFF	←
	Vehicle speed history	3 km/h {2 mph} or more	4 km/h {2.5 mph} or more
	Battery charge condition	Charge condition: 68.4% or more (determined by current sensor signal)	←
	Battery fluid temperature	0—70 °C {32—158 °F}	←
	Battery voltage	11.2 V or more	←
	Estimated battery voltage at engine restart	7.45 V or more *1	←
	Defroster switch	OFF	←
	Door (passenger's door).	Closed	←
	Bonnet	Closed *2	←
	Seat belt (Driver)	Fastened	←
	Push button start system	Normal	←
	System condition	i-stop related module is normal	←
	ISC learning	Completed	←
	Battery condition learning	Completed	←
	Steering angle sensor initialization setting	Completed	Not applicable
	DSC sensor initialization	Completed	Not applicable
	Time since engine restarted	6.4 s or more (fluctuates according to engine stop time by i-stop control)	Not applicable
	PCM DTCs	DTC except P11A:00 and P117A:00 and P2299:00 not detected	←
	Number of starter operations	Within 180,000 times	←
	Number of starter relay operations	Within 180,000 times	←
	Number of i-stop operations	Within 300,000 times	←
	Engine coolant temperature	55—110 °C {131—230 °F}	←
	Intake air temperature	100°C {212 °F} or less	←
	ATF temperature	20—120 °C {68—248 °F}	Not applicable
	Altitude	1,500 m or less	←

CONTROL SYSTEM [SKYACTIV-G 2.0]

i-stop indicator light (green) illumination/ flashing condition determination	i-stop (engine-stop control) permit condition item	ATX	MTX
B	Vehicle speed	0 km/h	3 km/h {2 mph} or less
	Vehicle conditions	Vehicle stopped in D position (After vehicle is stopped and shifted into N position, engine stops 0.6 s after operation. In addition, after vehicle is stopped in D position and if shifted into P position, engine stop condition continues by i-stop control	Not applicable
	Brake pedal	Brake pedal depressed in D position or M position (except 2nd gear fixed mode) (If ABS operates during deceleration, i-stop operation is inhibited.)	Not applicable
	Accelerator pedal	Released (foot is removed from accelerator pedal)	←
	Clutch pedal	Not applicable	30% or less (clutch pedal opening angle)
	Steering speed angle	15 deg/sec or less	←
	Steering angle	-65—65 °(center)	Not applicable
	Steering torque	1.4 N·m {14 kgf·cm, 12 in·lbf} or less	←
	Door (front, rear)	Closed	←
	Liftgate	Closed	←
	Power brake unit vacuum	-45 kPa {-0.46kgf/cm^2, -6.5 psi} or less 	
	Vehicle inclination angle	Less than ±7% when level	Not applicable
C	Brake fluid pressure	Brake fluid pressure is 1.25 MPa {12.7 kgf/cm^2, 181 psi} or more in D position or M position (except 2nd gear fixed mode) (pedal force sufficient to suppress vehicle lurch when engine is restarted)	Not applicable
D	Gear position	Not applicable	Neutral

*1 : With a high capacity audio system or added electronic device connected to the DC-DC converter, engine stop by the i-stop control is inhibited more quickly than normal due to repeated i-stop operation.
*2 : If the engine is started while the hood is open, i-stop is inhibited until the engine is stopped.

- The PCM sends an i-stop indicator light (green) illumination/flashing request to the instrument cluster via CAN communication.

i-stop WARNING LIGHT (AMBER) [SKYACTIV-G 2.0]

id0140f4008700

Purpose, Function

- If the i-stop control inhibits the operation, the i-stop warning light (amber) flashes/illuminates to inform the driver that the i-stop control inhibits the operation.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction
- The i-stop warning light (amber) is built into the instrument cluster.

Operation
- The flashing/illumination conditions of the i-stop warning light (amber) are as follows:
  i-stop warning light (amber) flashing condition
  — Any of the following DTCs are stored:
    PCM DTC
    - P0555:00, P057F:00, P058A:00, P0615:00, P0A0F:00, P0A8D:00, P0A94:00, P2502:00, P2503:00, P2504:00, U0101:00, U0121:00, U0131:00, U0140:00, U0151:00, U0155:00, U0214:00, U0298:00, U1007:00
    - For details on DTCs, refer to [Engine On-board Diagnostic System]. (See 01-02-2 ON-BOARD DIAGNOSTIC SYSTEM TEST MODE [SKYACTIV-G 2.0].)

    TCM DTC
    - P0C2C:00, P181F:00, P2712:00
    - For details on DTCs, refer to [Transmission/Transaxle On-board Diagnostic System]. (See 05-02A-2 ON-BOARD DIAGNOSTIC SYSTEM MALFUNCTION DETECTION FUNCTION [FW6A-EL, FW6AX-EL].)

    DSC HU/CM DTC
    - B10DF:46, C0001:01, C0002:01, C0003:01, C0004:01, C0010:01, C0011:01, C0014:01, C0015:01, C0018:01, C0019:01, C001C:01, C001D:01, C0030:07, C0031:11, C0031:15, C0031:29, C0031:2F, C0031:64, C0033:07, C0034:11, C0034:15, C0034:29, C0034:2F, C0034:64, C0036:07, C0037:11, C0037:15, C0037:29, C0037:2F, C0037:64, C0039:07, C003A:11, C003A:15, C003A:29, C003A:2F, C003A:64, C0040:64, C0044:01, C0044:28, C0044:54, C0044:64, C0062:28, C0062:54, C0062:64, C0062:76, C1A08:1C, U0001:88, U0100:00, U0101:00, U0151:00, U0155:00, U0401:00, U0402:00, U0452:86, U2007:46, U2007:62, U2010:00, U2300:52, U2300:54, U2300:55, U2300:56, U2300:64, U3000:49, U3003:16, U3003:17
    - For details on DTCs, refer to [Brake On-board Diagnostic System]. (See 04-02A-1 ON-BOARD DIAGNOSTIC SYSTEM [DYNAMIC STABILITY CONTROL (DSC)].)

    EPS control module DTC
    - C200B:1C, C200C:1C, C200B:62, C200B:85, C200B:02, C200B:16, C200D:1C, C200B:64, U3000:96, U3000:73, U3000:16, U3000:41, U3000:47, U3000:49, U3000:28, U3000:61, U2011:1C, U2011:19, U2011:62, U2011:72, U2011:92, U0121:00, U0415:00, U0001:88
    - For details on DTCs, refer to [Steering On-board Diagnostic System]. (See 06-02-2 ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [ELECTRIC POWER STEERING (EPS)].)

  i-stop warning light (amber) illumination condition
  — Any one of the following conditions is met:
    - Ignition switched ON (check of i-stop control system)
    - i-stop OFF switch is on
    - Engine stalls due to driver's operation while engine is stopped by i-stop control
    - Communication error to PCM and instrument cluster
- The PCM sends an i-stop warning light (amber) flashing/illumination request to the instrument cluster via CAN communication.

GEAR SHIFT INDICATOR [SKYACTIV-G 2.0]

id0140f4559000

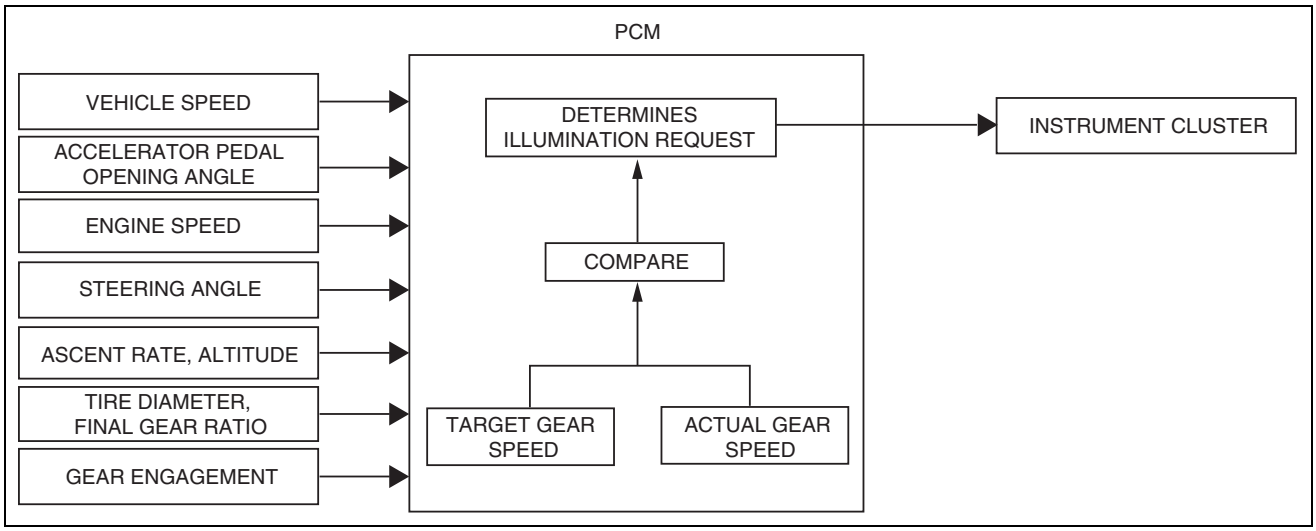
Purpose/Function
- The gear shift indicator, built into the instrument cluster, informs the driver that a gear position and shift up/down operation are recommended according to the driving conditions.
- The PCM sends a gear shift indicator illumination request to the instrument cluster via CAN communication.

Construction
- The gear shift indicator is built into the instrument cluster. (See 09-22-9 INSTRUMENT CLUSTER.)

Operation
- The PCM compares the target gear speed calculated from each signal and the actual gear speed to determine

CONTROL SYSTEM [SKYACTIV-G 2.0]

a gear shift indicator illumination request.



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Target gear speed (recommended gear position)

— The target gear speed is determined by the vehicle speed, accelerator pedal opening angle, ascent rate, altitude, and steering angle.

Actual gear speed (current gear position)

The actual gear speed is determined by the vehicle speed, engine speed, tire diameter, final gear ratio, and gear engagement.

- The gear shift indicator illumination/off conditions are as follows:

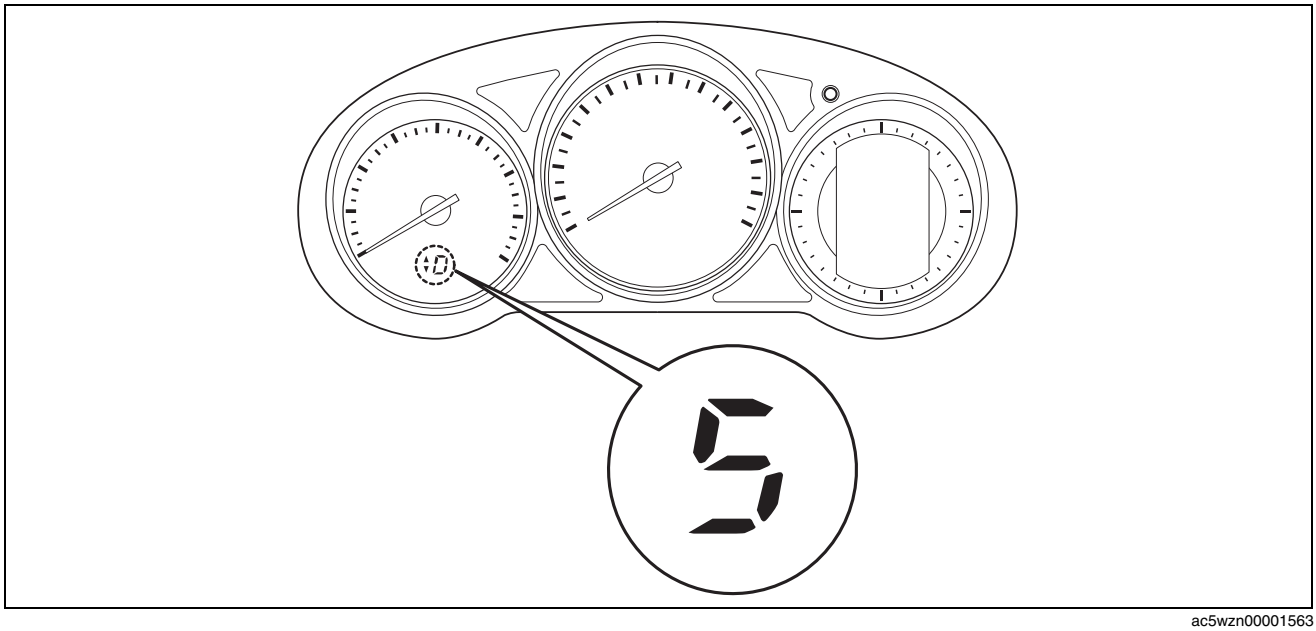
Gear Shift Indicator Illumination Condition

- There are three gear shift indicator illumination patterns; normal operation, shift-down recommended operation, and shift-up recommended operation.

Normal operation

— When the following condition is met, the currently selected gear position is indicated.
  - Target gear speed and actual gear speed are equal

Example: the following figure indicates that the currently selected gear position is 5th gear.



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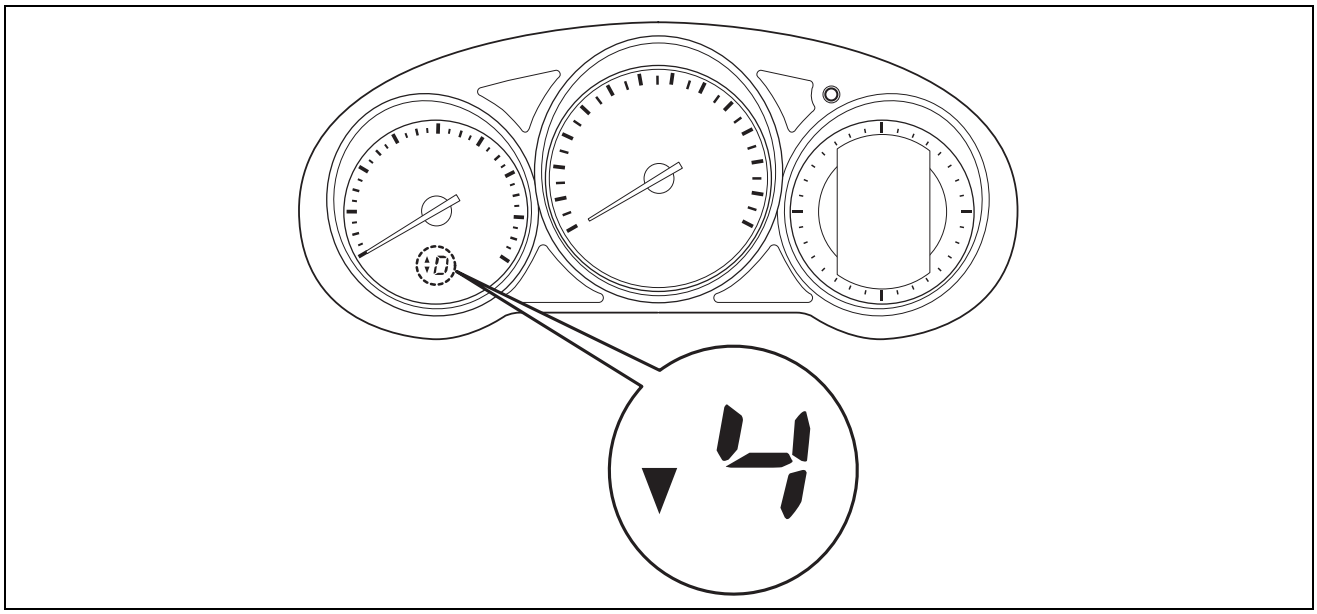
Shift-down recommended operation

— If a shift-down operation is performed when the following condition is met (determines smooth driveability is difficult), the recommended gear position is indicated at the same time.
  - Target gear speed is lower than actual gear speed

Example: The following figure indicates that a shift-down operation to 4th gear is recommended.



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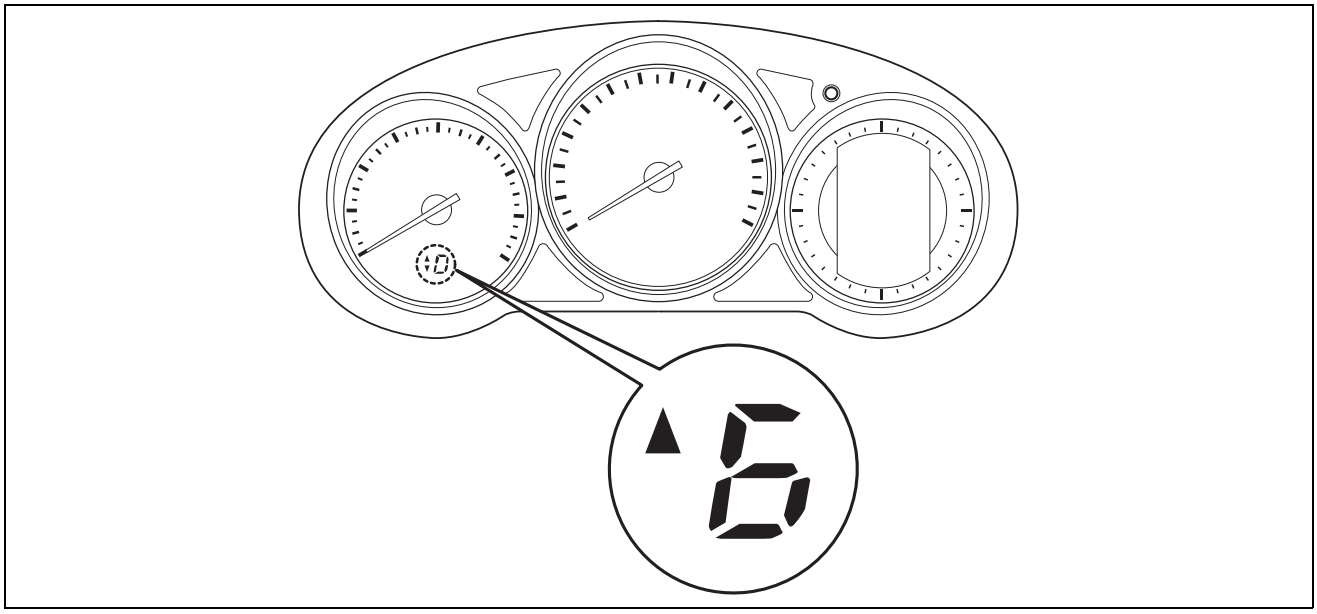
Shift-up recommended operation

— If a shift-down operation is performed when the following condition is met (determines fuel economy worsens), the recommended gear position is indicated at the same time.
  - Target gear speed is higher than actual gear speed

Example: The following figure indicates that a shift-down operation to 6th gear is recommended.



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Gear Shift Indicator Off Condition

- When any one of the following conditions is met, the gear shift indicator turns off.
  — Vehicle is stopped
  — Gear is in neutral position or reverse position
  — Until clutch is completely engaged when vehicle is started
  — Clutch pedal is depressed for 2 s or more while driving
- If the vehicle is driven with the gear not changed when a shift-down/up operation is recommended, the gear shift indicator may temporarily turn off

CONTROL SYSTEM [SKYACTIV-G 2.0]

PCM [SKYACTIV-G 2.0]

id0140f4008400

Purpose/Function

- High-level driveability and lower fuel consumption have been realized by controlling the appropriate engine conditions (fuel injection/ignition timing) according to operation conditions.
- Controls each output part based on the signal from each input part.
- The control descriptions are as shown below.

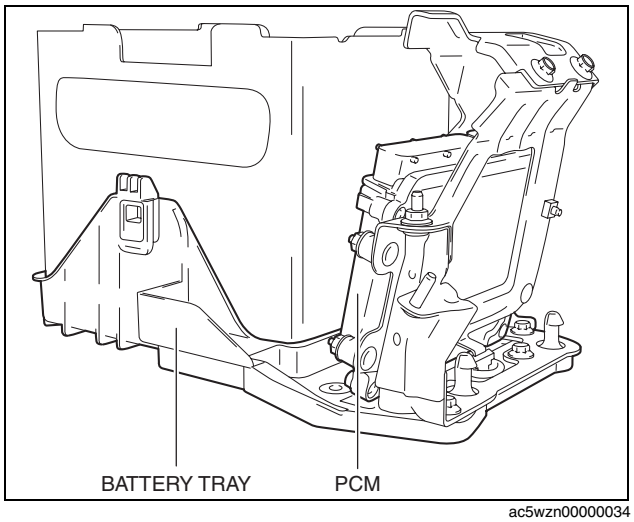
Function	Description
Main relay control	• Supplies power to each part by switching the main relay on/off at the optimal timing according to the vehicle conditions.
Drive-by-wire control	• Calculates the optimum target throttle valve opening angle at all engine speeds and controls the throttle valve actuator. • The drive-by-wire control is composed of the idle air control, accelerator control, traction control, excess engine speed control, overspeed control, electric variable valve timing cooperation control, and the brake override system.
Hydraulic variable valve timing control	• Changes the exhaust valve timing according to engine operation conditions to improve engine output, fuel economy, and emission performance. • Based on each input signal, the PCM determines the optimum exhaust valve timing according to the engine operation conditions. The PCM drives the OCV, and switches the oil passages of the hydraulic variable valve timing actuator to control the exhaust valve timing at optimum. • Based on the coordination with the electric variable valve timing control and by increasing the amount of overlap during high engine loads, nitrogen oxide (NOX) occurring largely at high temperatures is reduced by re-circulating exhaust gas into the combustion chamber, which also reduces combustion temperature.
Electric variable valve timing control	• The PCM determines the optimum intake valve timing according to the engine operation conditions, and sends the motor drive signals to the electric variable valve timing driver. With the adoption of the electric drive system, variable intake valve timing can be controlled without any influence from the engine conditions, thus the fuel economy has been improved and pumping loss has been decreased. • Based on the coordination with the hydraulic variable valve timing control and by increasing the amount of overlap during high engine loads, nitrogen oxide (NOX) occurring largely at high temperatures is reduced by re-circulating exhaust gas into the combustion chamber which reduces combustion temperature.
Fuel injection control	• Performs optimum fuel injection according to engine operation conditions. • The PCM determines the engine operation conditions based on the signals from each input device and drives the fuel injectors at the optimal fuel injection time (fuel injection amount) and the fuel injection timing to inject fuel. • By controlling the combustion conditions between uniform combustion and stratified combustion based on the fuel injection amount, fuel injection timing, and fuel injection times, improved emission performance while the engine is cold and higher engine output have been achieved.
Fuel pump control	• By switching the fuel pump discharge amount, reduced power consumption and improved fuel economy have been realized. • The PCM determines the optimum fuel pump drive force according to the engine operation conditions, and sends the fuel pump drive signal to the fuel pump control module.
High pressure fuel pump control	• Changes the fuel pressure applied to the fuel injector according to engine operation conditions to improve engine output and startability. • The PCM determines the fuel pressure value corresponding to the engine operation conditions based on the each input signal, and drives the spill valve control solenoid valve for optimum control of fuel pressure.
Electronic spark advance	• Controls ignition to the optimum timing according to engine operation conditions. • Serviceability has been improved by eliminating the necessity of ignition timing adjustment. • The PCM determines the engine operation conditions based on input signals from each sensor and blocks current to the ignition coils at the calculated ignition timing, causing the spark plugs to discharge (ignite) by the effect of electromagnetic mutual induction.
Purge control	• An appropriate amount of evaporative gas is fed into the intake manifold by the purge solenoid valve operation according to the engine operation conditions. This ensures driveability and prevents release of evaporative gas into the atmosphere. • The PCM drives the purge solenoid valve based on the signal from each control part.
A/F sensor heater control	• Based on the control of the front and rear A/F sensor heaters, a stabilized oxygen concentration is detected even at low exhaust temperatures, and feedback control of fuel injection even at cold engine start is made possible for improved cold temperature exhaust emission performance. • Both emission performance and sensor protection have been improved by duty control of the heater according to engine operation conditions (exhaust gas temperature). • A pre-heater has been adopted to prevent water, produced from the exhaust system when the engine is started, from adhering to the sensor and damaging it.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Function	Description
HO2S heater control	• Based on the control of the front and rear HO2S heaters, a stabilized oxygen concentration is detected even at low exhaust temperatures, and feedback control of fuel injection even at cold engine start is made possible for improved cold temperature exhaust emission performance. • Both emission performance and sensor protection have been improved by duty control of the heater according to engine operation conditions (exhaust gas temperature).
A/C cut-off control	• Controls the A/C operation by switching the A/C relay ON/OFF at the optimal timing according to engine operation conditions. Acceleration performance and A/C compressor reliability have been improved by controlling the A/C operation.
Electrical fan control	• Through cooling of the radiator and condenser by operation of the cooling fan according to vehicle conditions, engine reliability and cooling performance have been improved.
Starter cut-off control	• The PCM controls energization to the starter relay according to an immobilizer system request to improve security. • While not in P or N position, the starter relay energization by the ignition key is inhibited.
Generator control	• Idling stability has been improved by optimum control of generator voltage according to engine operation and electrical load conditions. • The PCM determines the engine operation and electrical load conditions based on the input signals from each control part and controls the energization time of the generator field coils.
i-stop control	• When the vehicle is stopped such as at a stop light, the i-stop control stops/starts the engine automatically to improve fuel economy and reduce exhaust gas and idling noise. • The PCM determines whether to permit/inhibit i-stop control based on the signal from each input part and CAN communication. • The i-stop control includes the engine stop control, engine restart control, electric AT oil pump driver control, and hill launch assist functions.
DC-DC converter control	• Stability of the power supply to the cabin has been realized by preventing decreases in the power supply due to battery voltage decreases while the engine is restarted by the i-stop control. • When the engine is restarted by the i-stop control, the PCM sends a battery voltage (DC-DC converter downstream voltage) boost request signal to the DC-DC converter.
Engine oil control	• The PCM reduces the load and friction resistance applied to the engine by controlling the appropriate engine oil amount according to the engine operation conditions. The engine oil amount switches in two steps. When hydraulic pressure is not needed, the oil pump discharge amount is reduced by the operation of the engine oil solenoid valve. In addition, if the engine oil solenoid valve is malfunctioning, priority is given to protecting the engine by maximizing the oil pump discharge amount.

Construction

- Installed on the battery tray.



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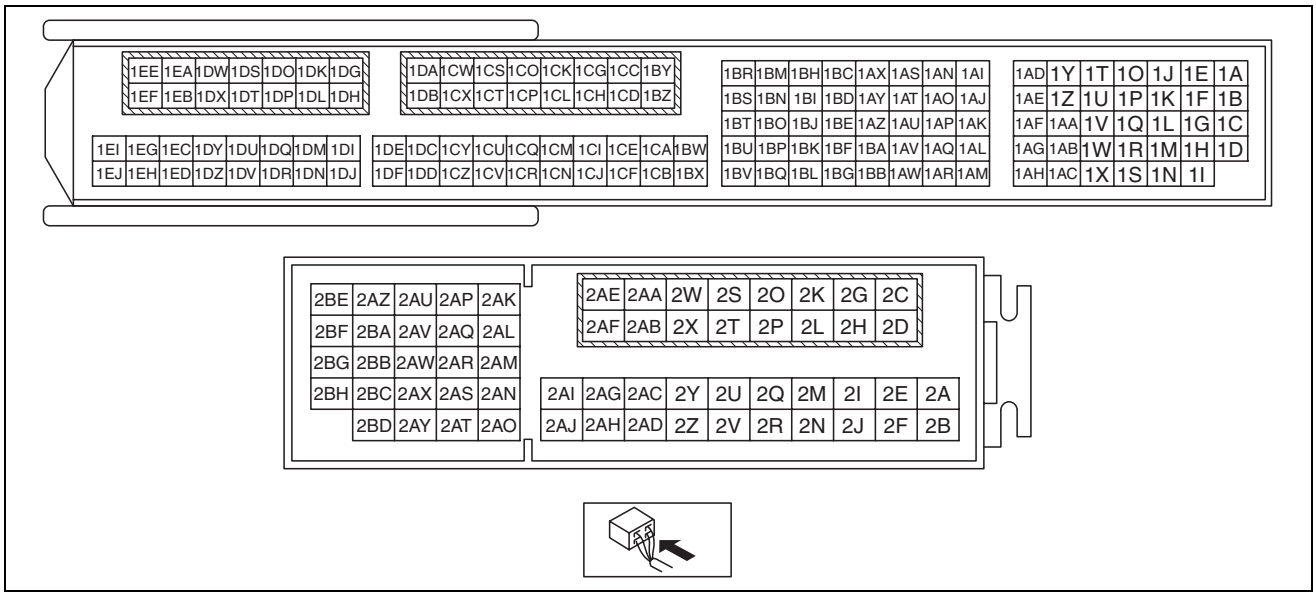
CONTROL SYSTEM [SKYACTIV-G 2.0]

- A 200-pin (two-block) connector has been adopted.



ac5wzn00000035

- BARO sensor is integrated.

Operation

- For operation content, refer to the following references:

Function	Page
Main relay control	(See 01-40-15 MAIN RELAY CONTROL [SKYACTIV-G 2.0].)
Drive-by-wire control	(See 01-40-16 DRIVE-BY-WIRE CONTROL [SKYACTIV-G 2.0].)
Hydraulic variable valve timing control	(See 01-40-20 HYDRAULIC VARIABLE VALVE TIMING CONTROL [SKYACTIV-G 2.0].)
Electric variable valve timing control	(See 01-40-22 ELECTRIC VARIABLE VALVE TIMING CONTROL [SKYACTIV-G 2.0].)
Fuel injection control	(See 01-40-23 FUEL INJECTION CONTROL SYSTEM [SKYACTIV-G 2.0].)
Fuel pump control	(See 01-40-28 FUEL PUMP CONTROL [SKYACTIV-G 2.0].)
High pressure fuel pump control	(See 01-40-29 HIGH PRESSURE FUEL PUMP CONTROL [SKYACTIV-G 2.0].)
Electronic spark advance	(See 01-40-30 ELECTRONIC SPARK ADVANCE CONTROL [SKYACTIV-G 2.0].)
Purge control	(See 01-40-34 PURGE CONTROL [SKYACTIV-G 2.0].)
A/F sensor heater control	(See 01-40-35 AIR FUEL RATIO (A/F) SENSOR HEATER CONTROL [SKYACTIV-G 2.0].)
HO2S heater control	(See 01-40-36 HEATED OXYGEN SENSOR (HO2S) HEATER CONTROL [SKYACTIV-G 2.0].)
A/C cut-off control	(See 01-40-36 A/C CUT-OFF CONTROL [SKYACTIV-G 2.0].)
Electrical fan control	(See 01-40-38 ELECTRICAL FAN CONTROL [SKYACTIV-G 2.0].)
Starter cut-off control	(See 01-40-40 STARTER CUT-OFF CONTROL [SKYACTIV-G 2.0].)
Generator control	(See 01-40-41 GENERATOR CONTROL [SKYACTIV-G 2.0].)
i-stop control	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)
DC-DC converter control	(See 01-40-54 DC-DC CONVERTER CONTROL [SKYACTIV-G 2.0].)
Engine oil control	(See 01-40-56 ENGINE OIL CONTROL [SKYACTIV-G 2.0].)

Fail-safe

DTC No.	Fail-safe function
P0601:00	• Restricts the upper limit of the engine speed. • Stops the drive-by-wire control (throttle valve is open at approx. 8° by return spring force).
P0606:00	• Restricts the upper limit of the engine speed. • Stops the drive-by-wire control (throttle valve is open at approx. 8° by return spring force).
P061B:00	• Restricts the upper limit of the engine speed.
P061D:00	• Restricts the upper limit of the engine speed.
P2107:00	• Restricts the upper limit of the engine speed. • Stops the drive-by-wire control (throttle valve is open at approx. 8° by return spring force).

CONTROL SYSTEM [SKYACTIV-G 2.0]

DTC No.	Fail-safe function
P2110:00	• Restricts the upper limit of the engine speed. • Stops the drive-by-wire control (throttle valve is open at approx. 8° by return spring force).

MAIN RELAY [SKYACTIV-G 2.0]

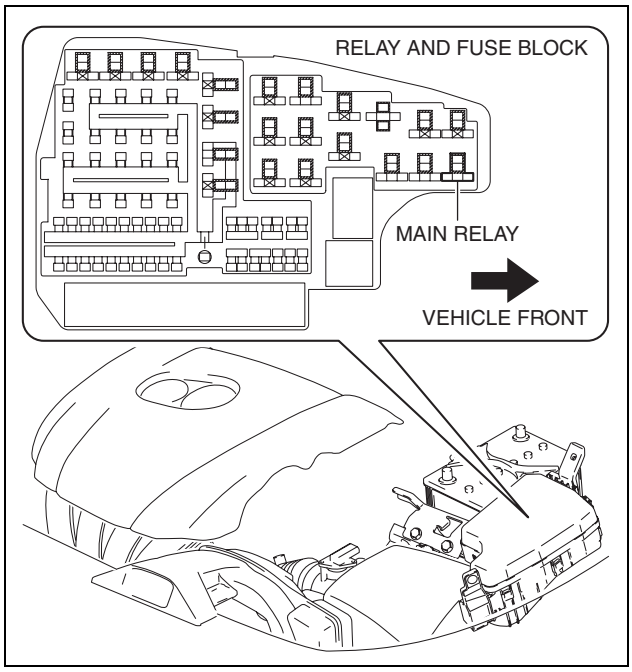
id0140f4008300

Purpose/Function

- Supplies power to each part.
- Supplies battery voltage to each part based on the signals from the PCM even though the ignition is switched on or off.

Construction

- Installed to the relay and fuse block.



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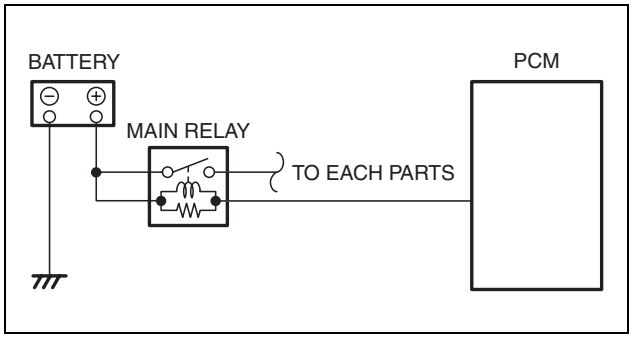
Operation

- After the contact point is on battery voltage is supplied to the coil based on the signals from the PCM.



ac5wzn00000033

Fail-safe

- Function not equipped.

i-stop OFF SWITCH [SKYACTIV-G 2.0]

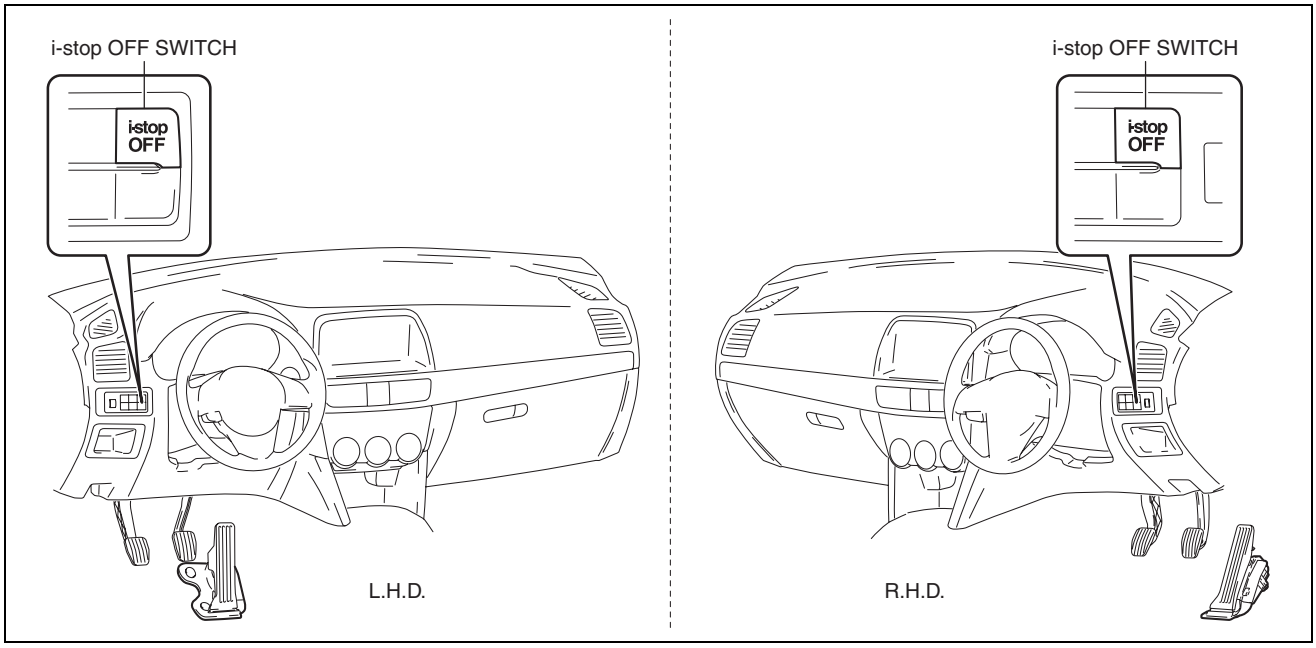
id0140f4008000

Purpose/Function

- i-stop control is inhibited by turning on the i-stop OFF switch.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction
- Installed to the dashboard.



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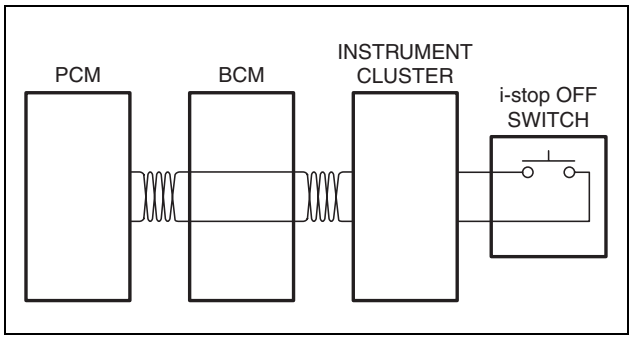
Operation
- The i-stop control is inhibited when the i-stop OFF switch on-signal from the instrument cluster is received.



ac5wzn00000027

Fail-safe
- Function not equipped.

NEUTRAL SWITCH [SKYACTIV-G 2.0]

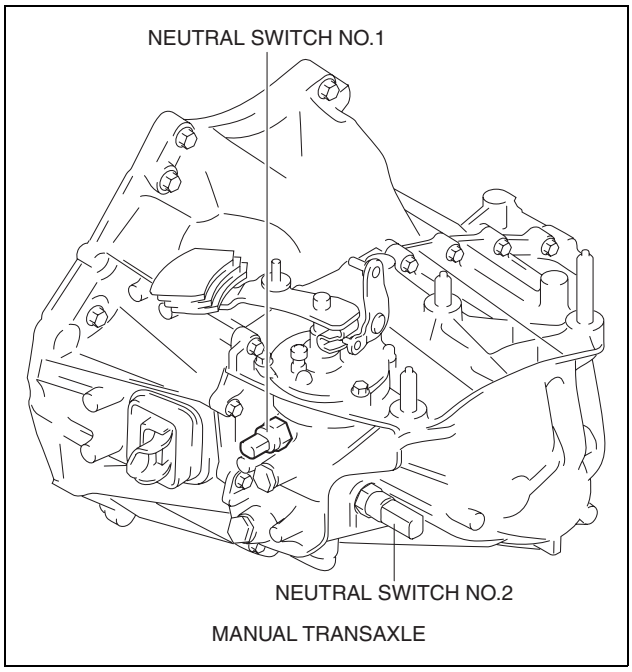
id0140f4008100

Purpose/Function
- Detects the neutral position of the shift lever.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

- Installed to the manual transaxle.
- An ON/OFF type switch has been adopted.



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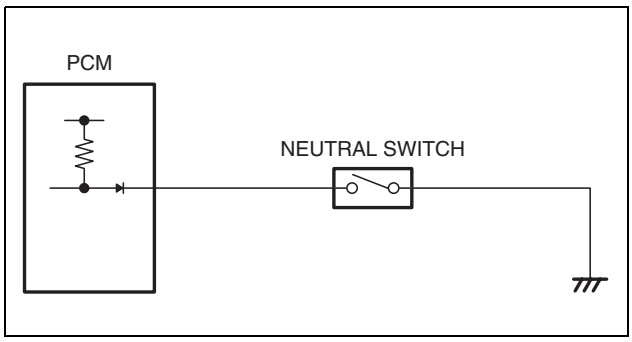
Operation

- Inputs the neutral switch on/off signal to the PCM.



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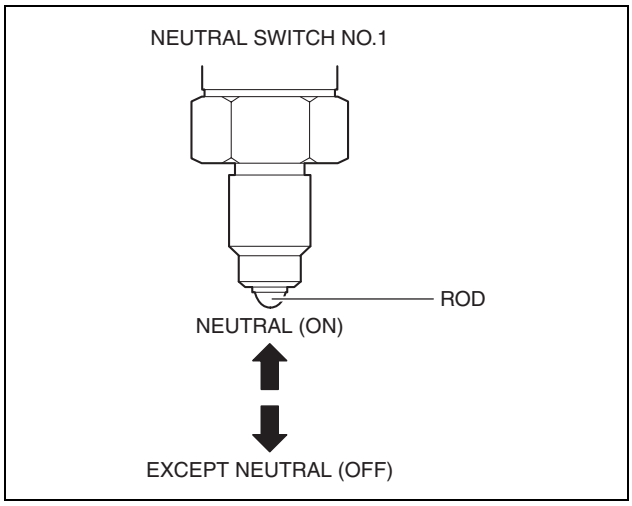
- The contact point is on when in neutral to output voltage and off when not in neutral.



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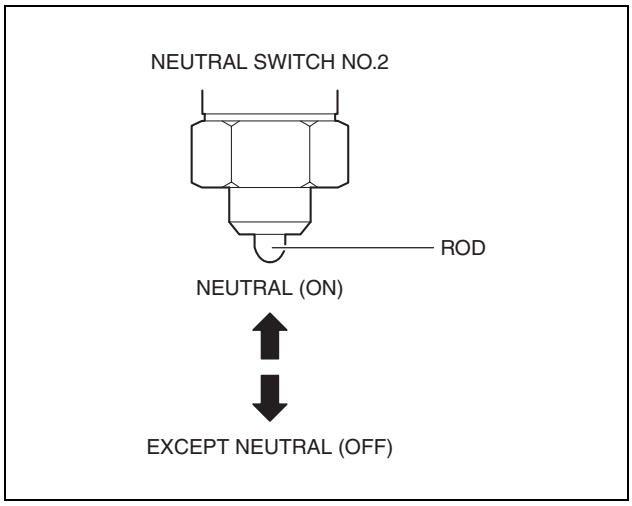
CONTROL SYSTEM [SKYACTIV-G 2.0]



ac5wzn00000031

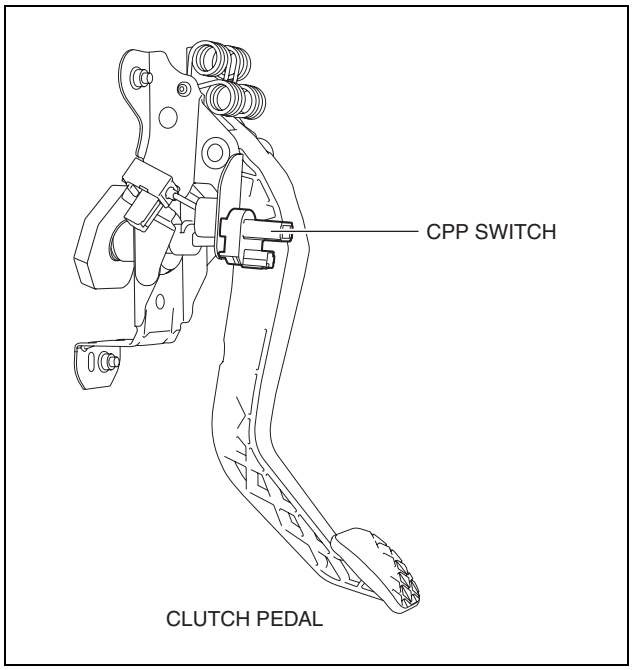
Fail-safe
- Function not equipped.

CLUTCH PEDAL POSITION (CPP) SWITCH [SKYACTIV-G 2.0]

id0140f4008200

Purpose/Function
- Detects the connection status of the clutch.

Construction
- Installed on the clutch pedal.
- An ON/OFF type switch has been adopted.



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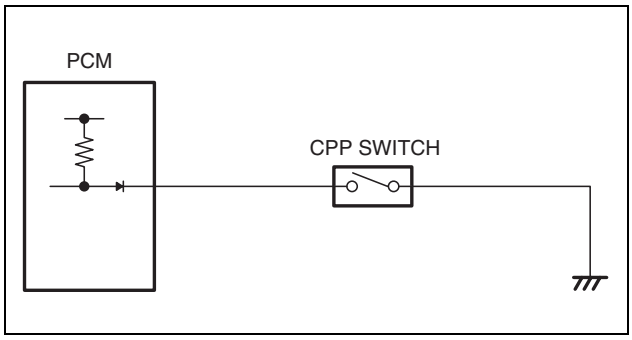
CONTROL SYSTEM [SKYACTIV-G 2.0]

Operation

- Inputs the CPP switch on/off signal to the PCM.



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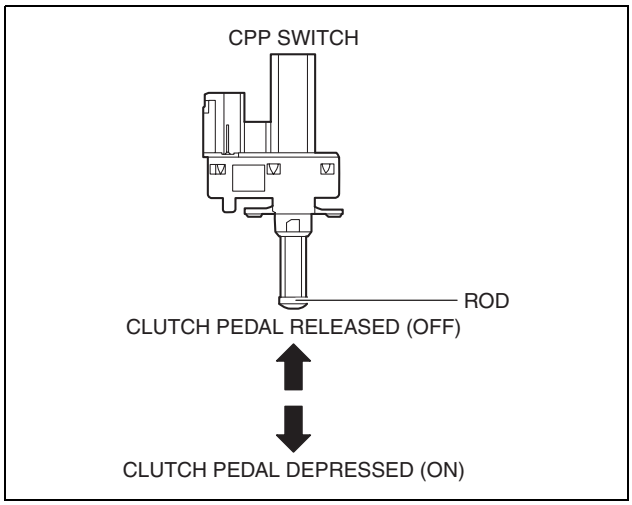
- The contact point is on and voltage is output when the clutch pedal is engaged, and off when the clutch pedal is not engaged.



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Fail-safe

- Function not equipped.

MASS AIR FLOW (MAF) SENSOR [SKYACTIV-G 2.0]

id0140f4007000

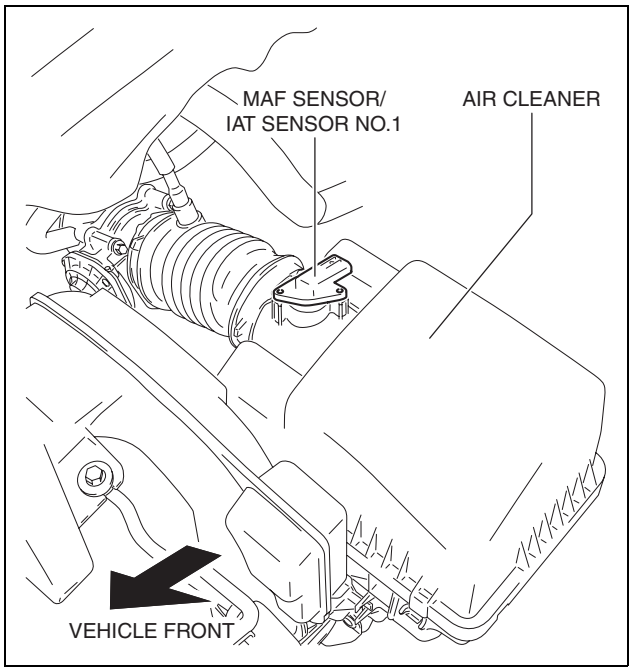
Purpose/Function

- Detects the intake airflow amount introduced into the cylinder as basic information for mainly determining the fuel injection amount.
- Detects the intake airflow amount introduced into the cylinder and inputs it to the PCM as an intake airflow amount signal.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

- Installed on the air cleaner.
- A hot film has been adopted as the detecting element for detecting the intake airflow amount.



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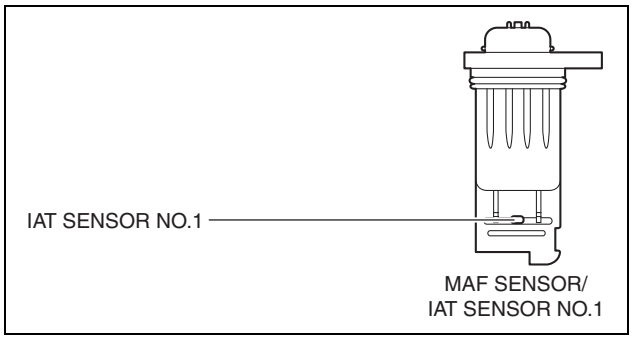
- IAT sensor No.1 is integrated.



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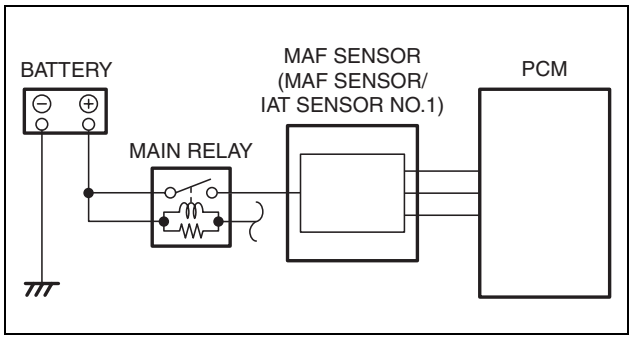
Operation

- Inputs the signal, which fluctuates according to the intake airflow amount, to the PCM.



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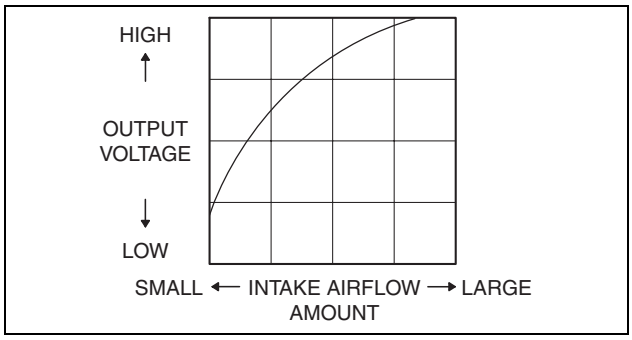
CONTROL SYSTEM [SKYACTIV-G 2.0]

MAF sensor characteristic



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Fail-safe

DTC No.	Fail-safe function
P0102:00	• Restricts the upper limit of the engine speed. • Inhibits the evaporative purge control.
P0103:00	• Restricts the upper limit of the engine speed. • Inhibits the evaporative purge control.

INTAKE AIR TEMPERATURE (IAT) SENSOR [SKYACTIV-G 2.0]

id0140f4007100

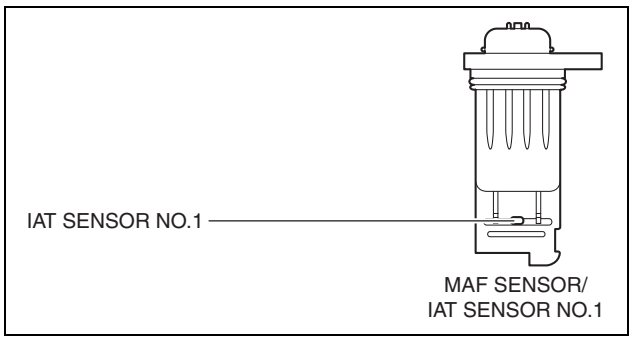
IAT Sensor No.1

Purpose/Function

- Detects the IAT before it passes through the throttle body as basic information for mainly determining the fuel injection amount.
- Detects the IAT before it passes through the throttle body and inputs it to the PCM as an IAT signal.

Construction

- Built into the MAF sensor.
- A cold resistor has been adopted as the detecting element for detecting the IAT.



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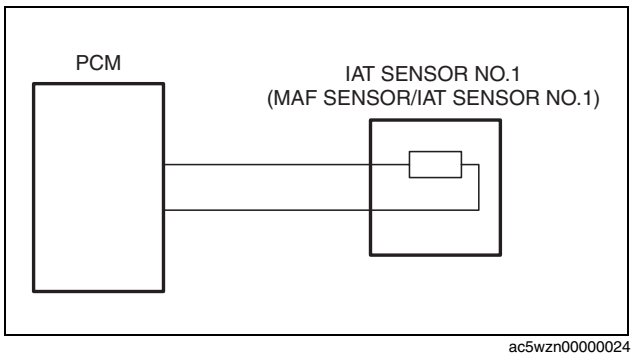
Operation

- Inputs the signal, which fluctuates according to the IAT after passing through the air cleaner, to the PCM.



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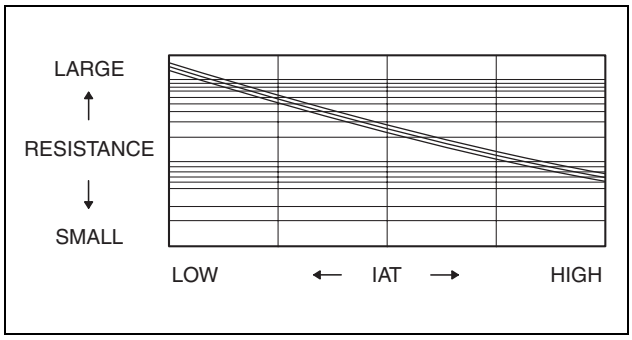
CONTROL SYSTEM [SKYACTIV-G 2.0]

IAT sensor No.1 characteristic



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Fail-safe

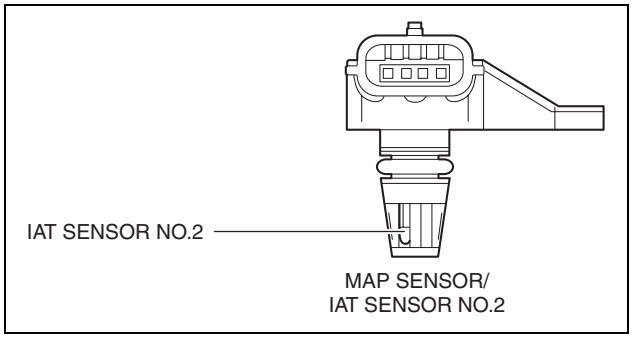
DTC No.	Fail-safe function
P0112:00	• Illuminates the charging system warning light. • Fixes the intake air temperature (for engine control) at 20 °C {68 °F}. • Inhibits the fuel cut control during shift change.
P0113:00	• Illuminates the charging system warning light. • Fixes the intake air temperature (for engine control) at 20 °C {68 °F}. • Inhibits the fuel cut control during shift change.

IAT Sensor No.2
Purpose/Function

- Detects the IAT (in intake manifold) after it passes through the throttle body as basic information for mainly determining the fuel injection amount.
- Detects the IAT (in intake manifold) after it passes through the throttle body and inputs it to the PCM as an intake air temperature signal.

Construction

- Built into the MAP sensor.
- A cold resistor has been adopted as the detecting element for detecting the IAT.



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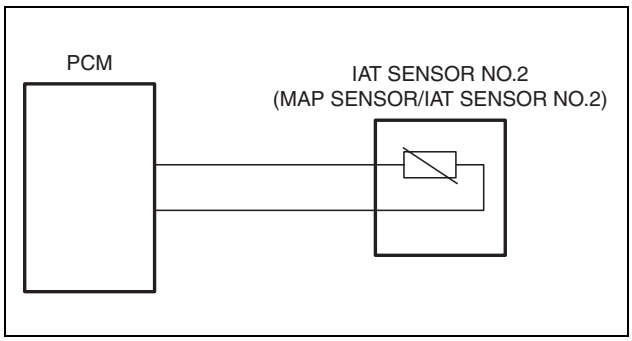
Operation

- Inputs the signal, which fluctuates according to the IAT in the intake manifold, to the PCM.



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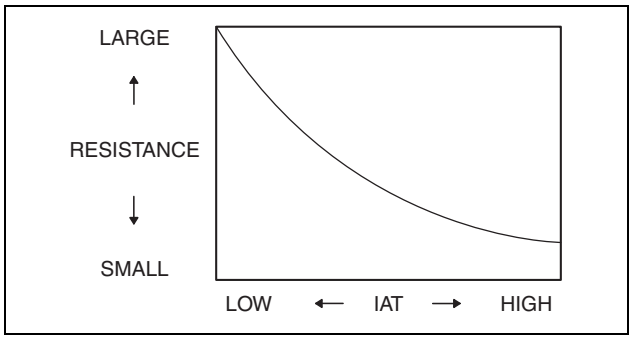
CONTROL SYSTEM [SKYACTIV-G 2.0]

IAT sensor No.2 characteristic



am3uun0000168

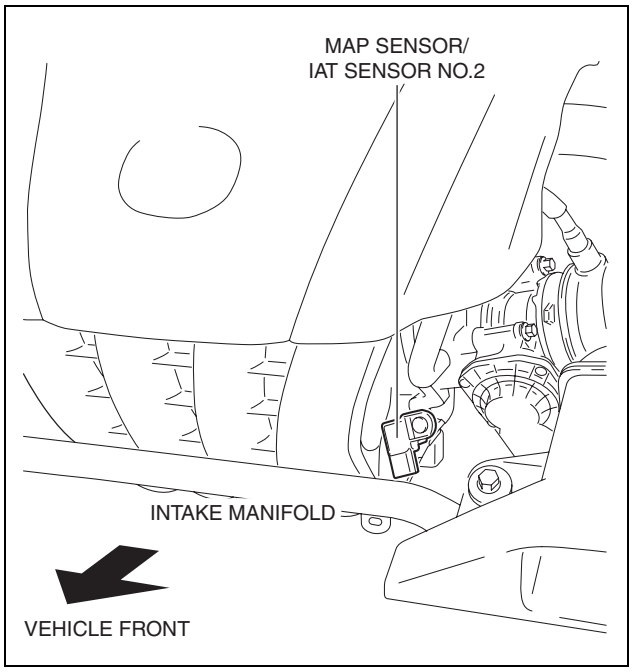
Fail-safe
- Function not equipped.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR [SKYACTIV-G 2.0]

id0140f4006800

Purpose/Function
- Detects the intake air pressure introduced into the cylinder as basic information for mainly determining the fuel injection amount.
- Detects the intake air pressure introduced into the cylinder and inputs it to the PCM as an intake air pressure signal.

Construction
- Installed on the intake manifold.
- A sealant diaphragm has been adopted as the detecting element for detecting the intake air pressure.



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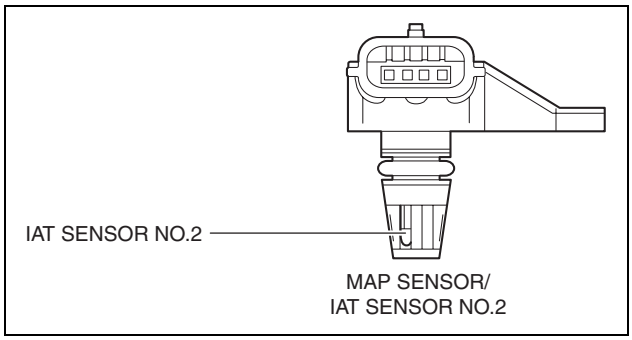
- IAT sensor No.2 is integrated.



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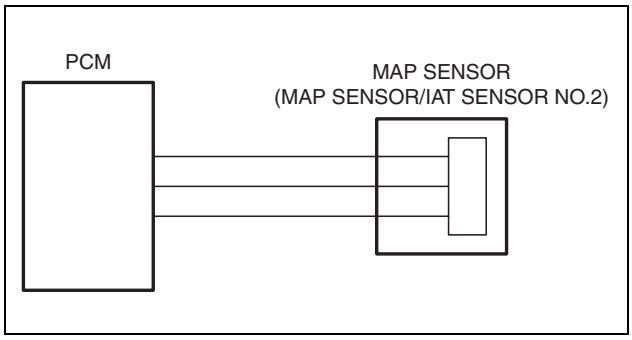
CONTROL SYSTEM [SKYACTIV-G 2.0]

Operation

- Inputs the signal, which fluctuates according to the intake air pressure, to the PCM.



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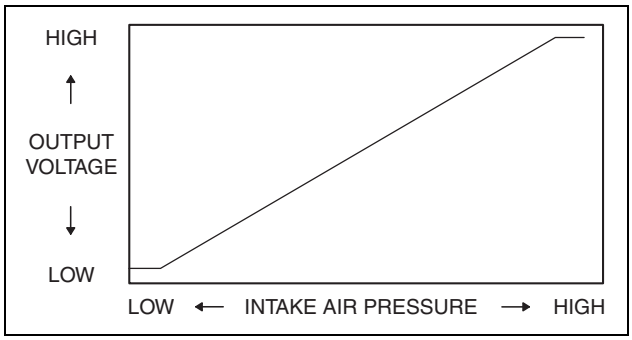
MAP sensor characteristic



ac5wzn00000021

Fail-safe

DTC No.	Fail-safe function
P0107:00	• Estimates MAP using MAF sensor and engine speed. • Restricts the upper limit of the engine speed. • Inhibits the evaporative purge control.
P0108:00	• Estimates MAP using MAF sensor and engine speed. • Restricts the upper limit of the engine speed. • Inhibits the evaporative purge control.

THROTTLE POSITION (TP) SENSOR [SKYACTIV-G 2.0]

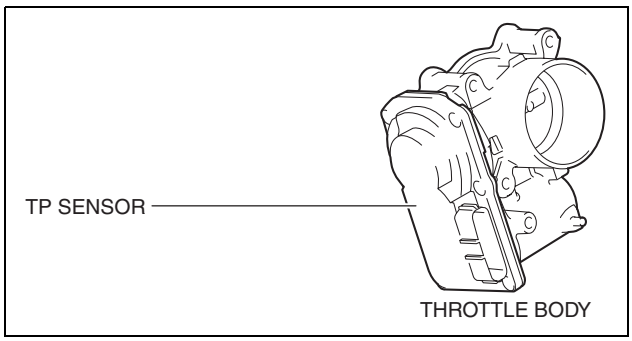
id0140f4006900

Purpose/Function

- Detects the throttle valve opening/closing condition, which operates in accordance with the accelerator pedal operation, as basic information for mainly determining the fuel injection amount.
- Detects the throttle valve opening/closing condition, which operates in accordance with the accelerator pedal operation, and inputs it to the PCM as the throttle valve opening angle signal.

Construction

- Built into the throttle body.
- A hall element has been adopted as the detecting element for detecting the throttle valve opening/closing condition.



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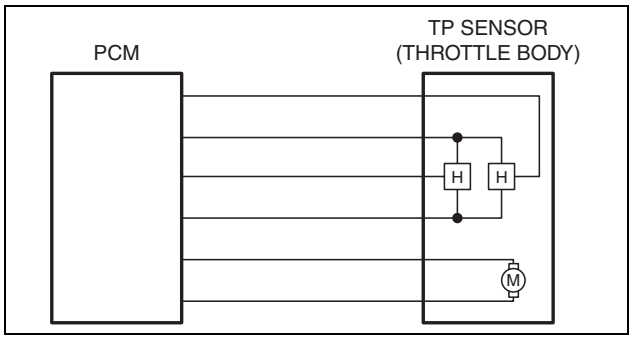
CONTROL SYSTEM [SKYACTIV-G 2.0]

Operation

- Inputs the signal, which fluctuates according to the throttle valve opening/closing, to the PCM.



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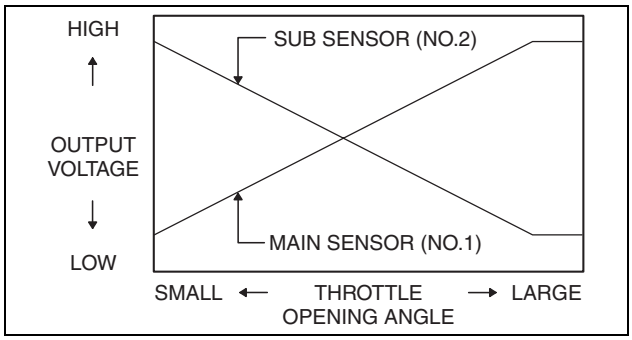
TP sensor characteristic



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Fail-safe

DTC No.	Fail-safe function
P0122:00	• Restricts the upper limit of the engine speed.
P0123:00	• Restricts the upper limit of the engine speed.
P0222:00	• Restricts the upper limit of the engine speed.
P0223:00	• Restricts the upper limit of the engine speed.
P2101:00	• Restricts the upper limit of the engine speed. • Stops the drive-by-wire control (throttle valve is open at approx. 8° by return spring force).
P2109:00	• Restricts the upper limit of the engine speed. • Stops the drive-by-wire control (throttle valve is open at approx. 8° by return spring force).
P2135:00	• Restricts the upper limit of the engine speed. • Stops the drive-by-wire control (throttle valve is open at approx. 8° by return spring force).

ACCELERATOR PEDAL POSITION (APP) SENSOR [SKYACTIV-G 2.0]

id0140f4007300

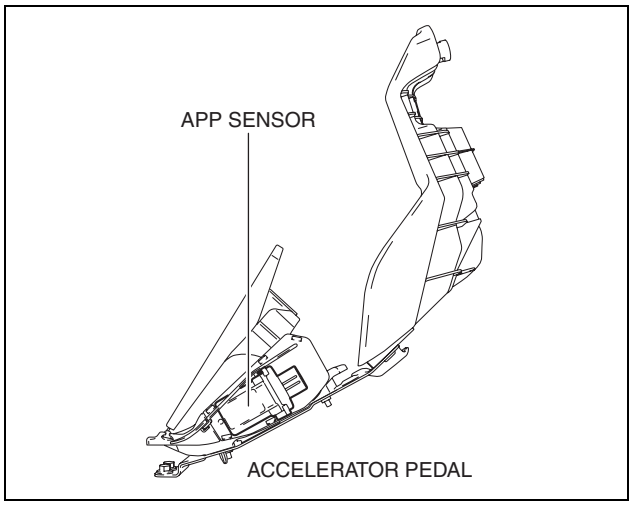
Purpose/Function

- Detects the accelerator pedal depression amount as basic information for mainly determining the throttle valve opening.
- Detects the accelerator pedal depression amount and inputs it to the PCM as an accelerator pedal opening angle signal.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

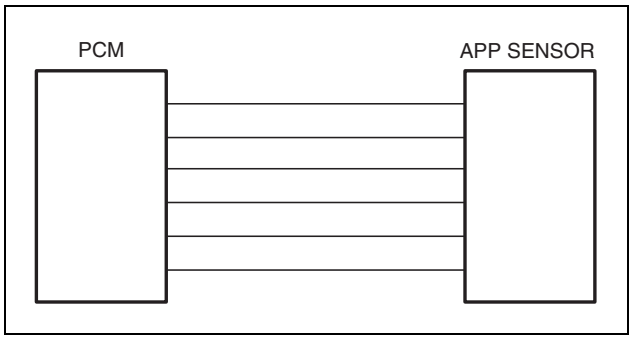
- Built into the accelerator pedal.
- A hall element has been adopted as the detecting element for detecting the accelerator pedal depression amount.



ac5wzn00000025

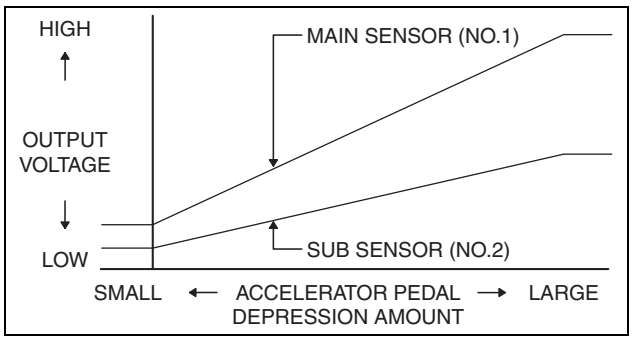
Operation

- Inputs the signal, which fluctuates according to the throttle valve opening/closing, to the PCM.



am3uun0000168

APP sensor characteristic



am3uun0000168

Fail-safe

DTC No.	Fail-safe function
P2122:00	• Regulates the upper limit of the APP sensor output.
P2123:00	• Regulates the upper limit of the APP sensor output.
P2127:00	• Regulates the upper limit of the APP sensor output.
P2128:00	• Regulates the upper limit of the APP sensor output.
P2138:00	• Restricts the upper limit of the engine speed. • Stops the drive-by-wire control (throttle valve is open at approx. 8° by return spring force).

CRANKSHAFT POSITION (CKP) SENSOR [SKYACTIV-G 2.0]

id0140f4006300

Purpose/Function

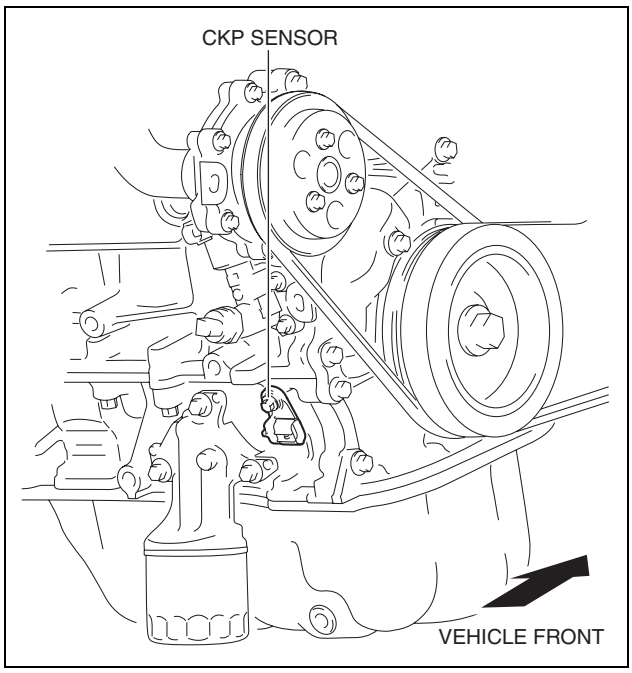
- Detects the crankshaft speed as basic information for mainly determining the fuel injection timing and ignition timing.

CONTROL SYSTEM [SKYACTIV-G 2.0]

- Detects the crankshaft speed and inputs it to the PCM as a CKP signal.

Construction

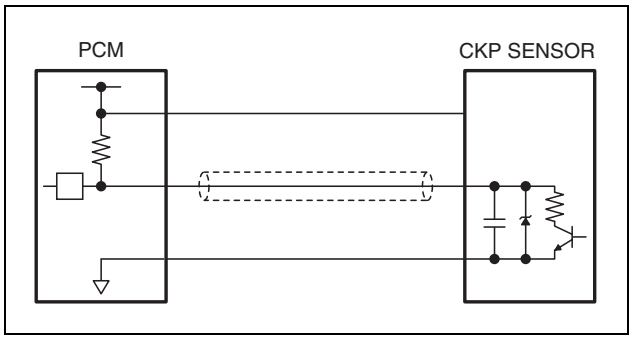
- Installed on the side of the cylinder block (right side).
- An MR (Magnetic Resistance) element has been adopted as the detecting element for detecting the crankshaft speed.



am3uun0000165

Operation

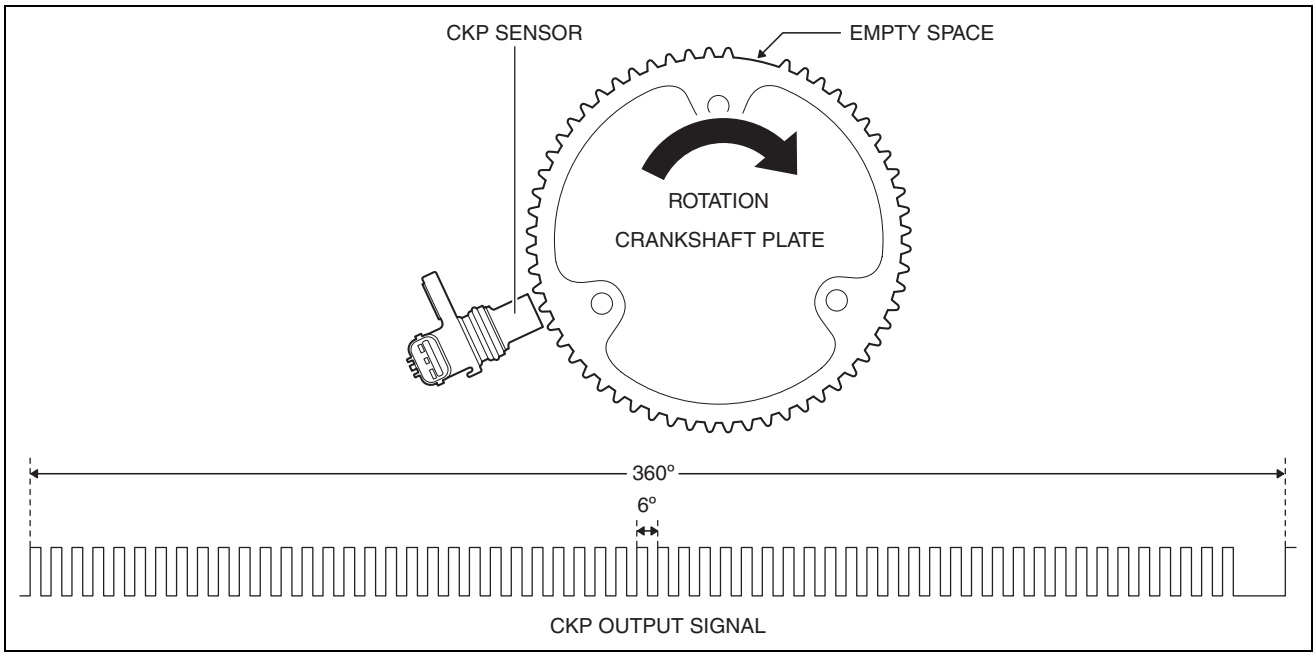
- Inputs the signal, which fluctuates according to the crankshaft speed, to the PCM.



am3uun0000165

CONTROL SYSTEM [SKYACTIV-G 2.0]

CKP sensor characteristic



am3uun0000166

Fail-safe

DTC No.	Fail-safe function
P0335:00	• Stops the fuel injection. • Stops the ignition.

CAMSHAFT POSITION (CMP) SENSOR [SKYACTIV-G 2.0]

id0140f4006700

Purpose/Function

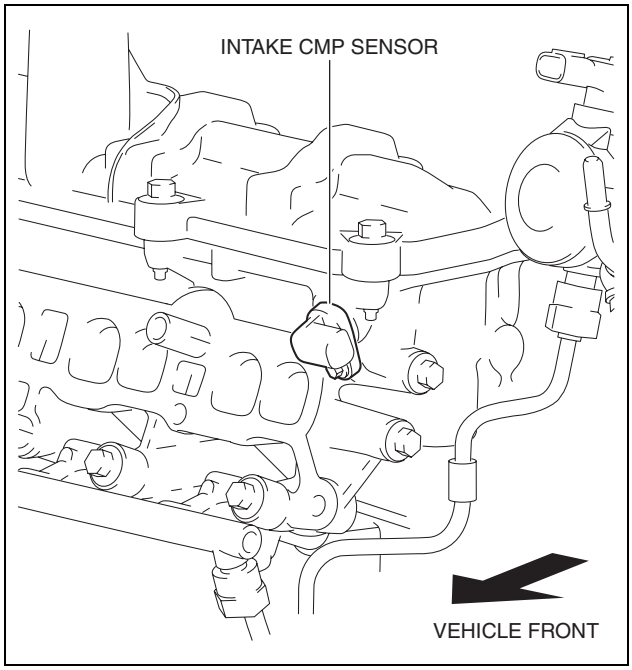
- Detects the camshaft speed as basic information for mainly determining the fuel injection timing and ignition timing.
- Detects the camshaft speed and inputs it to the PCM as a CMP signal.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

Intake CMP sensor

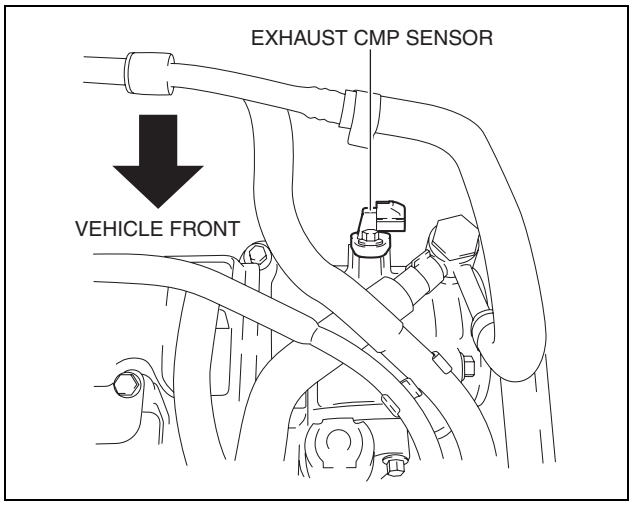
- Installed on the cylinder head.
- A GMR element has been adopted as the detecting element for detecting the intake camshaft speed.



am3uun0000166

Exhaust CMP sensor

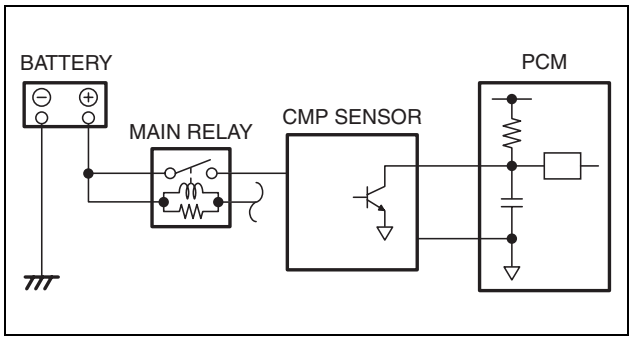
- Installed on the rear housing.
- A GMR element has been adopted as the detecting element for detecting the exhaust camshaft speed.



ac5wzn00001571

Operation

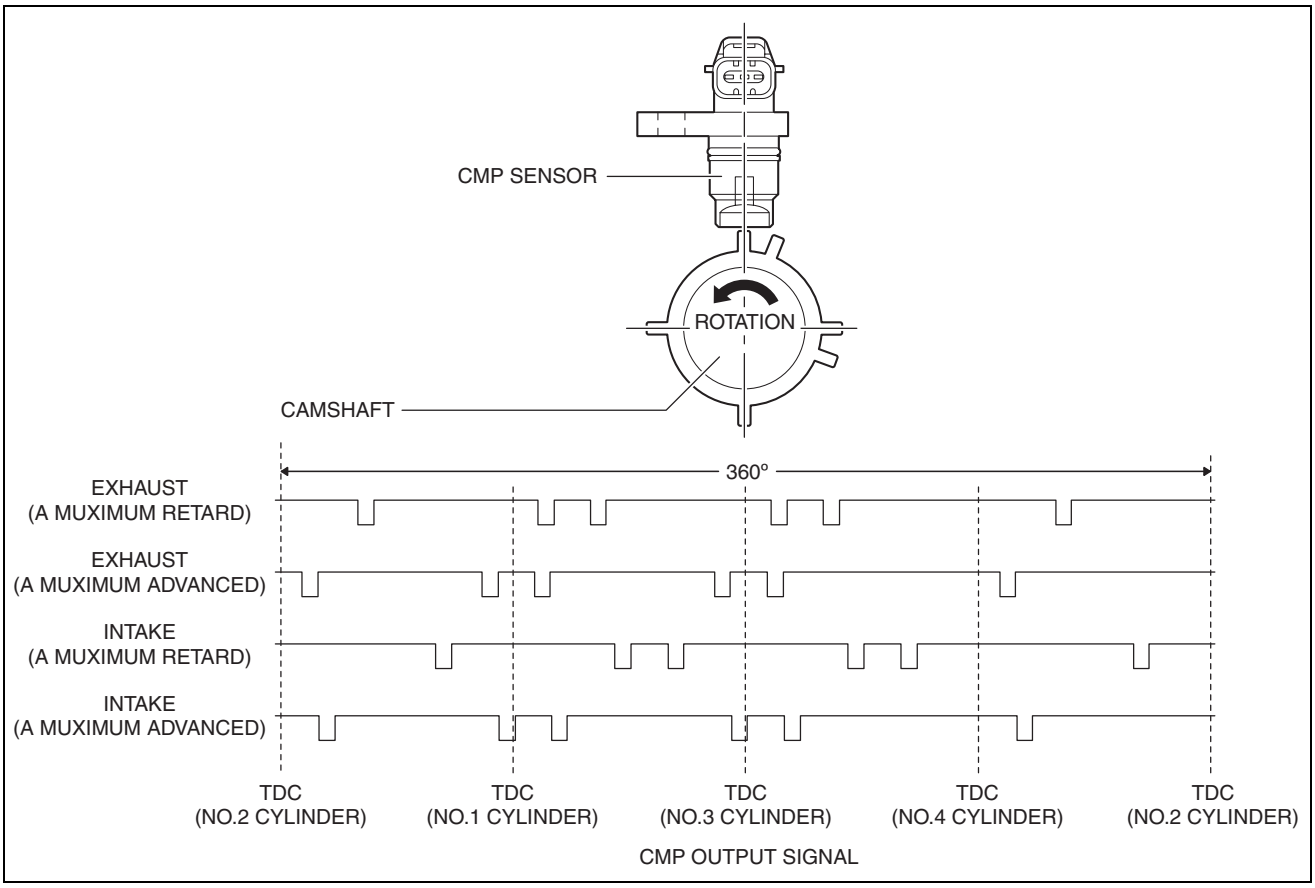
- Inputs the signal, which fluctuates according to the camshaft speed, to the PCM.



ac5wzn00000019

CONTROL SYSTEM [SKYACTIV-G 2.0]

CMP sensor characteristic



am3uun0000166

Fail-safe
Intake CMP sensor

DTC No.	Fail-safe function
P0340:00	• Set the electric variable valve timing control to the maximum cam retard mode.

Exhaust CMP sensor

DTC No.	Fail-safe function
P0365:00	• Stops the fuel injection. • Stops the ignition.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR [SKYACTIV-G 2.0]

id0140f4006200

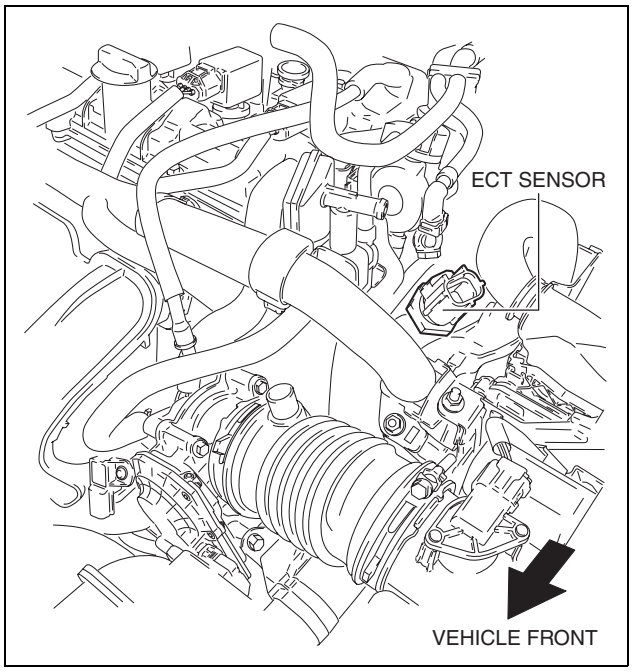
Purpose/Function

- Detects the ECT as basic information for mainly determining the fuel injection amount.
- Detects the ECT and inputs it to the PCM as an ECT signal.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

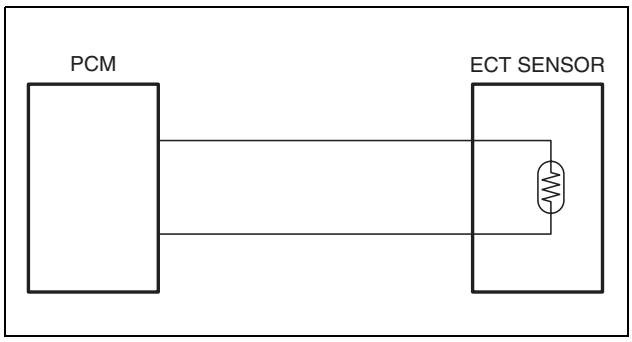
- Installed to the water outlet case.
- A thermistor has been adopted as the detecting element for detecting the ECT.



ac5wzn00000017

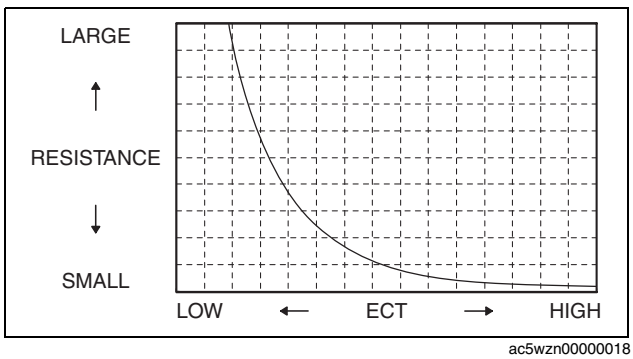
Operation

- Inputs the signal, which fluctuates according to the ECT, to the PCM.



am3uun0000165

ECT sensor characteristic



ac5wzn00000018

Fail-safe

DTC No.	Fail-safe function
P0117:00	• Fixes the water temperature for the engine control at 40 °C {104 °F}, and for the idle air control at 80 °C {176 °F}. • Operates the cooling fan (high speed rotation). • Inhibits the fuel cut control during shift change.

CONTROL SYSTEM [SKYACTIV-G 2.0]

DTC No.	Fail-safe function
P0118:00	• Fixes the water temperature for the engine control at 40 °C {104 °F}, and for the idle air control at 80 °C {176 °F}. • Operates the cooling fan (high speed rotation). • Inhibits the fuel cut control during shift change.

BAROMETRIC PRESSURE (BARO) SENSOR [SKYACTIV-G 2.0]

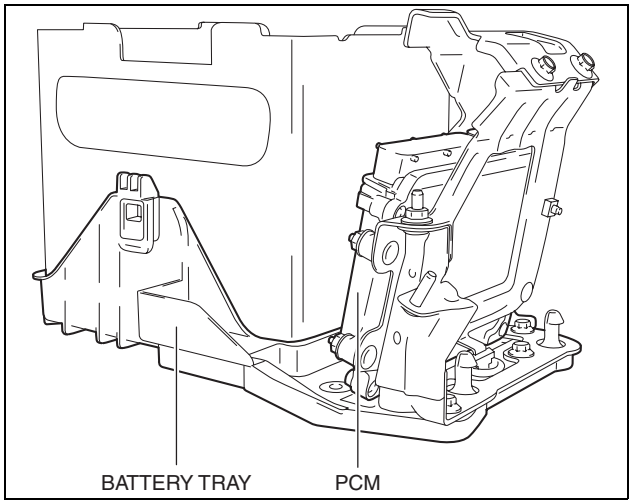
id0140f4006000

Purpose/Function

- Detects the BARO as basic information for mainly determining the fuel injection amount.
- Detects the BARO and inputs it to the PCM as a BARO signal.

Construction

- Built into the PCM.
- A piezoelectric element has been adopted for detecting the BARO.

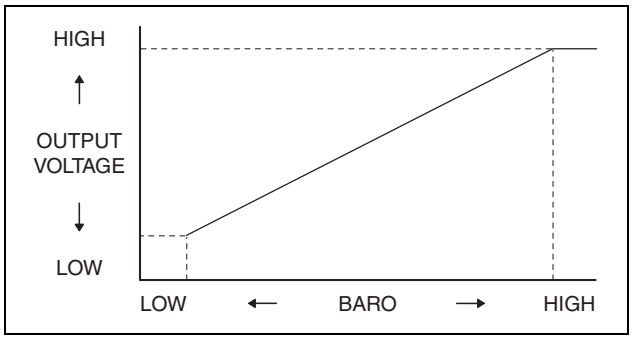


ac5wzn00000015

Operation

- Inputs the signal, which fluctuates according to the BARO, to the PCM.

BARO sensor characteristic



ac5wzn00000016

Fail-safe

DTC No.	Fail-safe function
P2228:00	• Fixes the barometric pressure for the engine control at 101.32 kPa {759.96 mmHg, 29.920 inHg}.
P2229:00	• Fixes the barometric pressure for the engine control at 101.32 kPa {759.96 mmHg, 29.920 inHg}.

FUEL PRESSURE SENSOR [SKYACTIV-G 2.0]

id0140f4006100

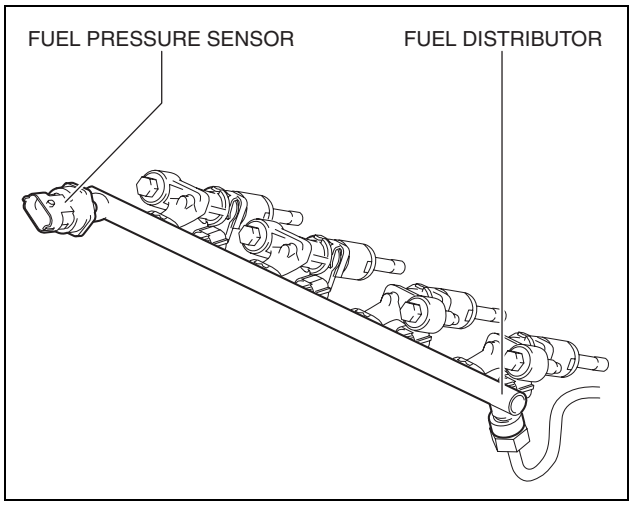
Purpose/Function

- Detects the fuel pressure in the fuel distributor as basic information for mainly determining the fuel injection amount.
- Detects the fuel pressure in the fuel distributor and inputs it to the PCM as a fuel pressure signal.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

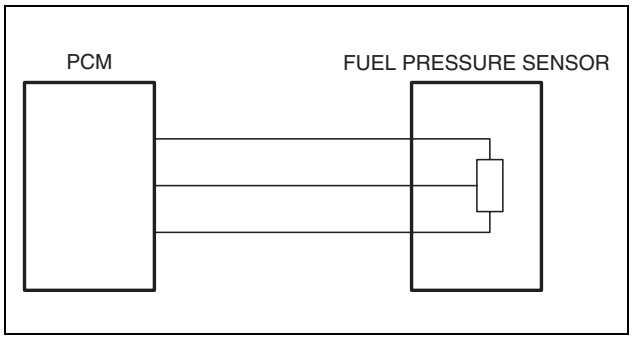
- Installed on the fuel distributor.
- A metal diaphragm thin film distortion gauge has been adopted as the detecting element for detecting the fuel pressure.



am3uun0000172

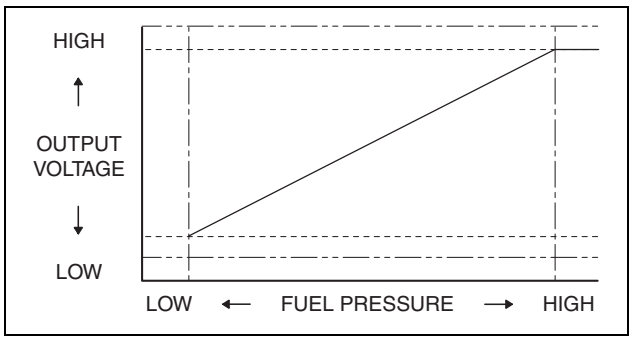
Operation

- Inputs the signal, which fluctuates according to the fuel pressure, to the PCM.



am3uun0000172

Fuel pressure sensor characteristic



am3uun0000220

Fail-safe

DTC No.	Fail-safe function
P0191:00	• Stops the high pressure fuel pump control. • Limits the intake air amount.
P0192:00	• Stops the high pressure fuel pump control. • Limits the intake air amount.
P0193:00	• Stops the high pressure fuel pump control. • Limits the intake air amount.

KNOCK SENSOR (KS) [SKYACTIV-G 2.0]

id0140f4004900

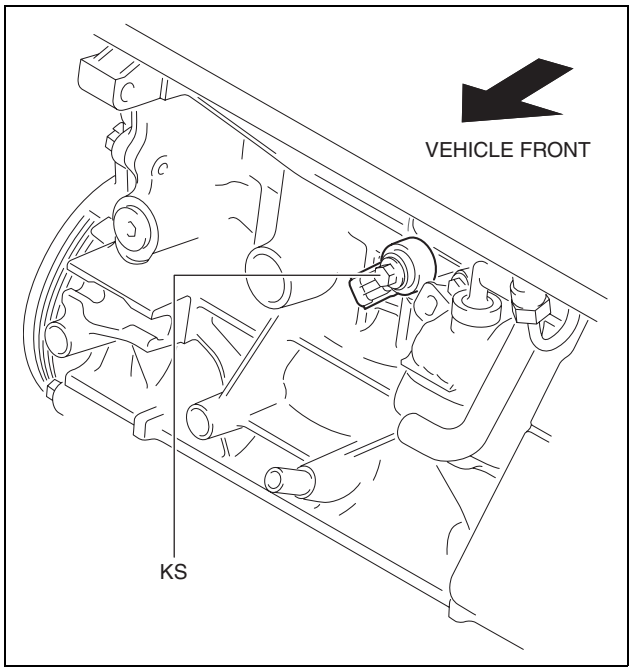
Purpose/Function

- Detects abnormal combustion in the cylinder as basic information for mainly determining the ignition timing.
- Detects abnormal combustion in the combustion chamber and inputs it to the PCM as a knocking signal.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

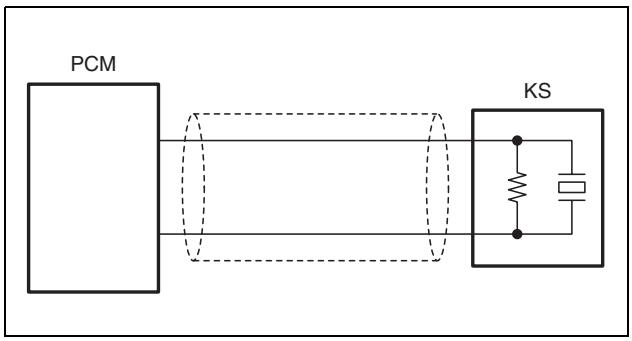
- Installed on the cylinder block.
- A piezoelectric element has been adopted as the detecting element for detecting abnormal combustion.



am3uun0000171

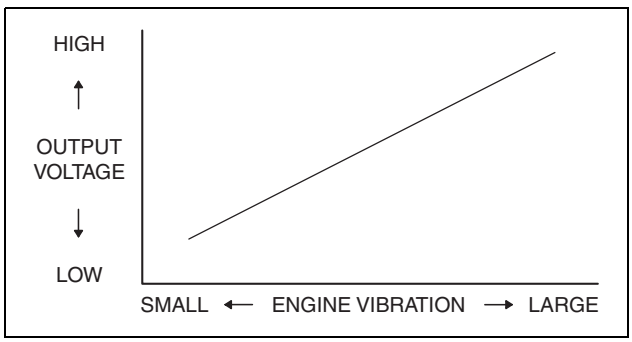
Operation

- Inputs the signal, which fluctuates according to abnormal combustion, to the PCM.



am3uun0000171

KS characteristic



am3uun0000172

Fail-safe

DTC No.	Fail-safe function
P0327:00	• Sets the knocking spark retard correction value of the ignition control to the fixed value.
P0328:00	• Sets the knocking spark retard correction value of the ignition control to the fixed value.

CONTROL SYSTEM [SKYACTIV-G 2.0]

CURRENT SENSOR [SKYACTIV-G 2.0]

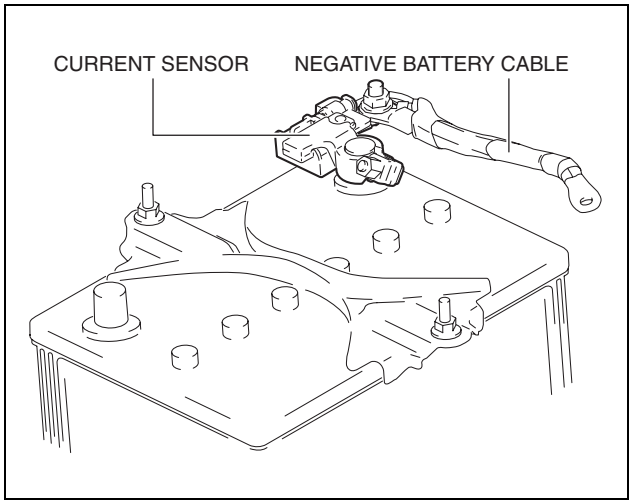
id0140f4005000

Purpose/Function

- The battery conditions are monitored as basic information for determining the generator output current.
- The battery condition is input to the PCM by LIN communication.

Construction

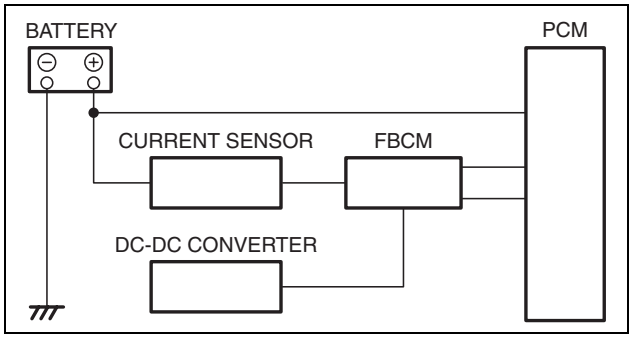
- Installed to the negative battery cable.
- The current sensor has adopted shunt resistance on the detection area and a thermistor for detecting the battery condition.



ac5wzn00000013

Operation

- The battery charge/discharge flow, battery voltage, and the battery terminal temperature are input to the PCM by LIN communication.



ac5wzn00000014

Fail-safe

DTC No.	Fail-safe function
P058A:00	• Inhibits engine-stop by operating the i-stop function. • Inhibits a part of the generator output control.
U1007:00	• Inhibits engine-stop by operating the i-stop function. • Inhibits a part of the generator output control.

AIR FUEL RATIO (A/F) SENSOR [SKYACTIV-G 2.0]

id0140f4004800

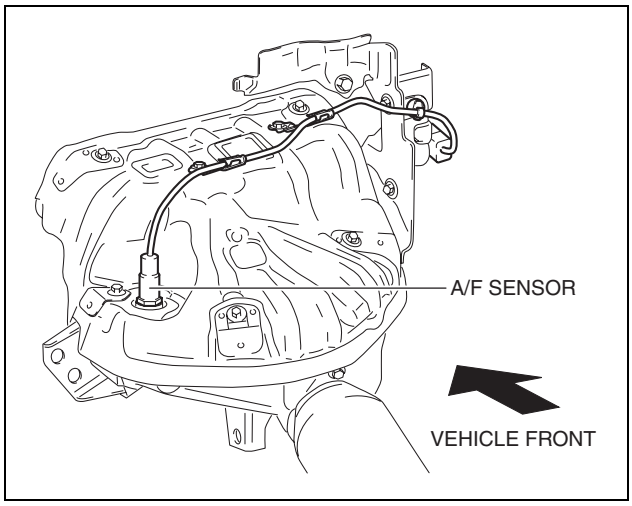
Purpose/Function

- Detects the oxygen concentration (all-range air/fuel ratio) in the exhaust gas as basic information for mainly determining the fuel injection amount.
- Detects the oxygen concentration (all-range air/fuel ratio) in the exhaust gas and inputs it to the PCM as an oxygen concentration (all-range air/fuel ratio) signal.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

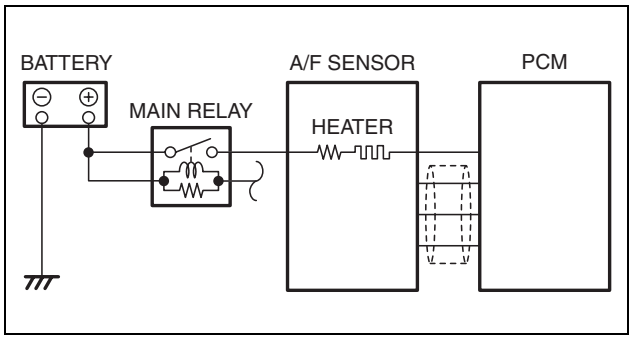
- Installed to the exhaust manifold.
- A zirconium element has been adopted as the detecting element for detecting the oxygen concentration (all-range air/fuel ratio).



ac5wzn00000011

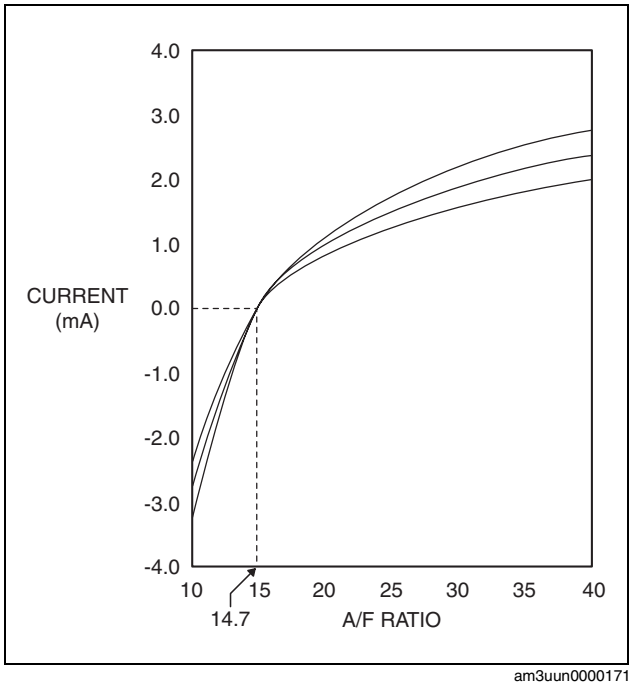
Operation

- Inputs the signal, which fluctuates according to the oxygen concentration (all-range air/fuel ratio), to the PCM.



ac5wzn00000012

A/F sensor characteristic



am3uun0000171

Fail-safe

DTC No.	Fail-safe function
P0031:00	• Stops the fuel feedback control.

CONTROL SYSTEM [SKYACTIV-G 2.0]

DTC No.	Fail-safe function
P0032:00	• Stops the fuel feedback control.
P0130:00	• Fixes the duty value of the A/F sensor heater. • Stops the fuel feedback control.
P0131:00	• Fixes the duty value of the A/F sensor heater. • Stops the fuel feedback control.
P0132:00	• Fixes the duty value of the A/F sensor heater. • Stops the fuel feedback control.
P0134:00	• Fixes the duty value of the A/F sensor heater. • Stops the fuel feedback control.
P064D:00	• Fixes the duty value of the A/F sensor heater. • Stops the fuel feedback control.
P2237:00	• Fixes the duty value of the A/F sensor heater. • Stops the fuel feedback control.
P2243:00	• Fixes the duty value of the A/F sensor heater. • Stops the fuel feedback control.
P2251:00	• Fixes the duty value of the A/F sensor heater. • Stops the fuel feedback control.

HEATED OXYGEN SENSOR (HO2S) [SKYACTIV-G 2.0]

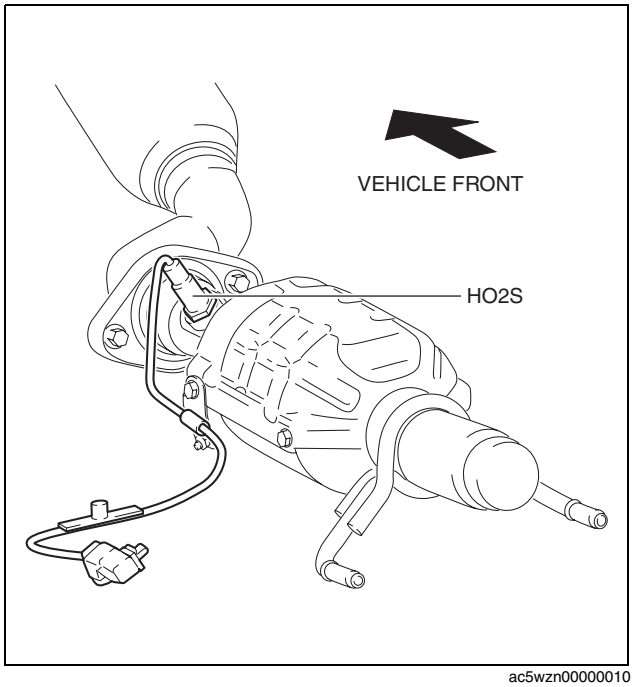
id0140f4004700

Purpose/Function

- Detects the oxygen concentration (theoretical air/fuel ratio) in the exhaust gas as basic information for mainly determining the fuel injection amount and as information for determining the deterioration of catalytic converter.
- Detects the oxygen concentration (theoretical air/fuel ratio) in the exhaust gas and inputs it to the PCM as an oxygen concentration (theoretical air/fuel ratio) signal.

Construction

- Installed to the exhaust manifold.
- A zirconia element has been adopted as the detecting element for detecting the oxygen concentration (theoretical air/fuel ratio).

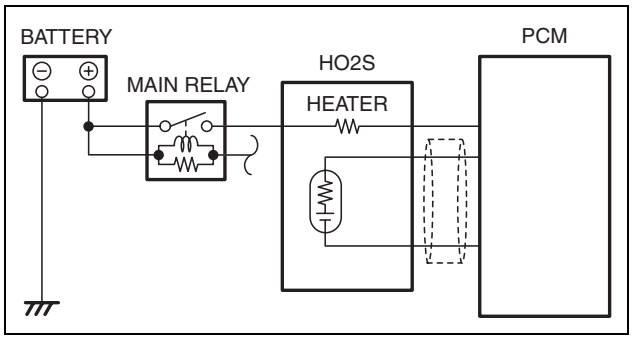


ac5wzn00000010

CONTROL SYSTEM [SKYACTIV-G 2.0]

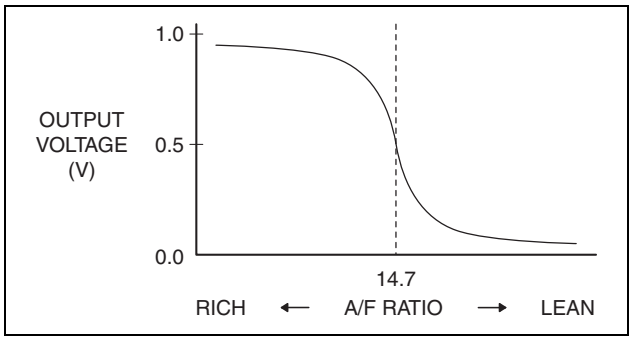
Operation

- Inputs the signal, which fluctuates according to the oxygen concentration (theoretical air/fuel ratio), to the PCM.



ac5wzn00001570

HO2S characteristic



am3uun0000171

Fail-safe

DTC No.	Fail-safe function
P0037:00	• Stops the fuel feedback control of the HO2S.
P0038:00	• Stops the fuel feedback control of the HO2S.

CLUTCH STROKE SENSOR [SKYACTIV-G 2.0]

id0140f4779000

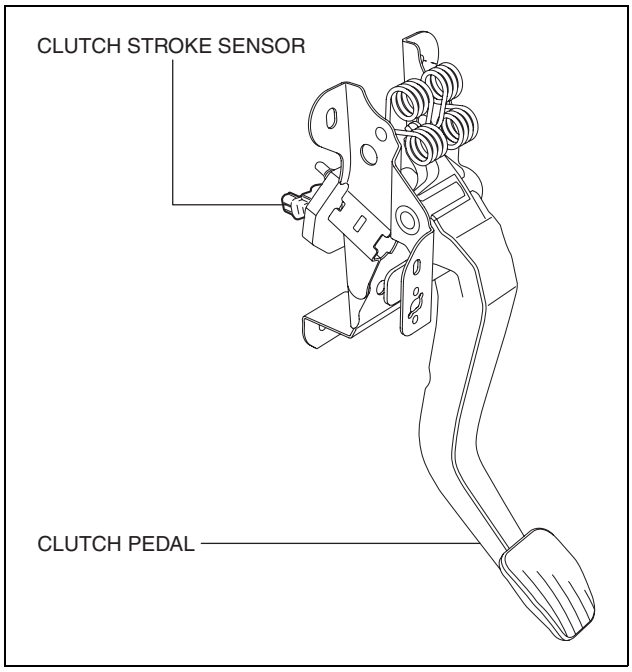
Purpose/Function

- Detects how much the clutch pedal is depressed.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

- Installed on the clutch pedal.

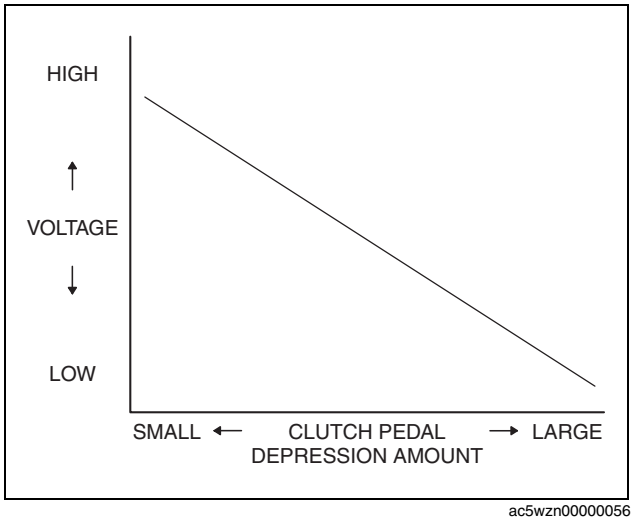


ac5wzn00001573

Operation

- The PCM energizes the coil installed in the sensor to create a magnetic field. Depressing the clutch pedal moves the permanent magnet next to the coil. The PCM detects the amount in which the clutch pedal is depressed by measuring the change in magnetic flux occurring when the permanent magnetic moves.

Clutch stroke sensor characteristic



ac5wzn00000056

Fail-safe

- Function not equipped.

POWER BRAKE UNIT VACUUM SENSOR [SKYACTIV-G 2.0]

id0140f4004600

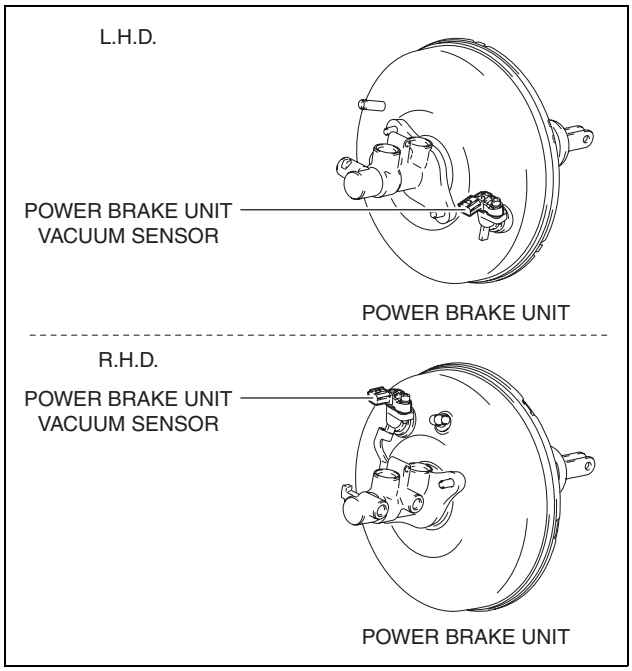
Purpose/Function

- Detects the vacuum in the power brake unit to assure brake performance while the engine is stopped by the i-stop control.
- Detects the vacuum in the power brake unit and inputs it to the PCM as a power brake unit vacuum pressure signal.

CONTROL SYSTEM [SKYACTIV-G 2.0]

Construction

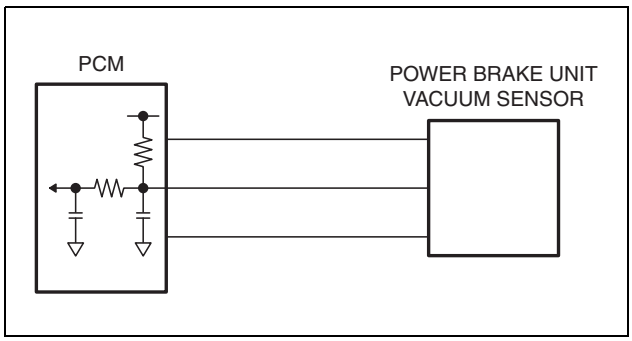
- Installed to the power brake unit.
- The power brake unit vacuum sensor has adopted a Piezo-electric element to the detection area for detection of the vacuum in the power brake unit.



ac5wzn00000009

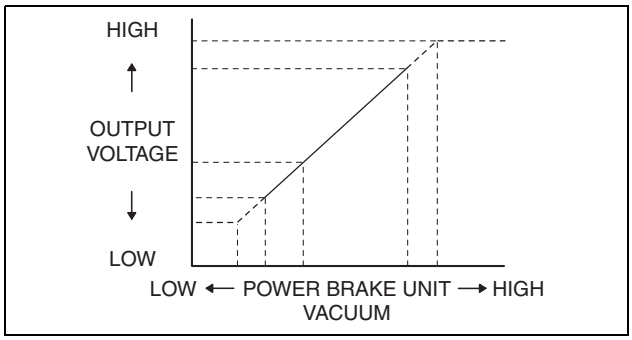
Operation

- The signal, which changes according to the vacuum in the power brake unit, is input to the PCM.



am3zzn0000338

Power brake unit vacuum sensor characteristic



am3zzn0000338

Fail-safe

DTC No.	Fail-safe function
P0555:00	• Inhibits engine-stop by operating the i-stop function.

ION SENSOR [SKYACTIV-G 2.0]

id0140f4004400

Purpose/Function

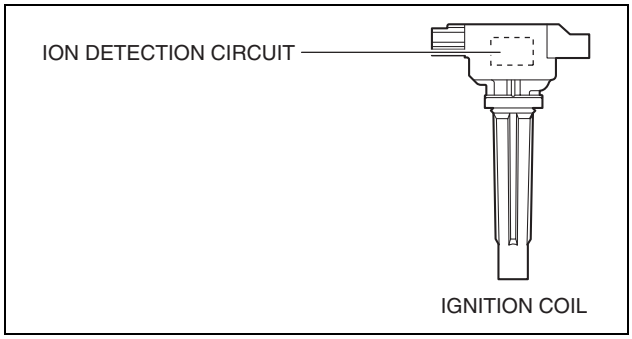
- Detects ion generation in the combustion chamber for detecting pre-ignition.

CONTROL SYSTEM [SKYACTIV-G 2.0]

- Detects ions which occur due to fuel combustion as current by applying bias voltage to the spark plug, which is amplified in the ignition coil internal circuit and input to the PCM.

Construction

- Built into the ignition coil.



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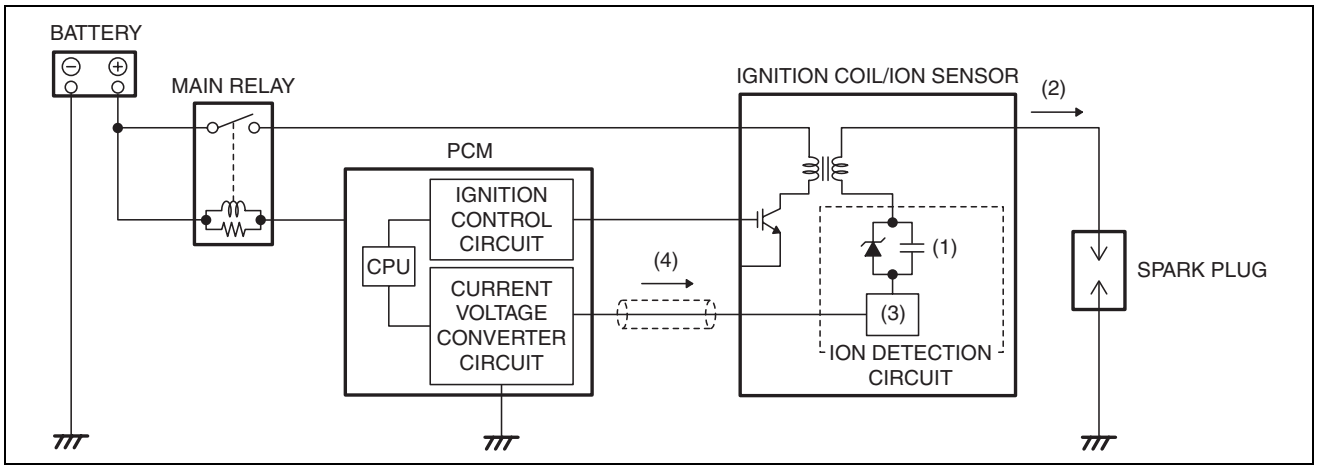
Operation

- Accumulates the secondary current of the ignition coil in bias condenser (1) and detects ion current (2) by applying the bias voltage to the spark plug.
- Pulls in current (4) increased by current amplification circuit (3) to the ignition coil from the PCM.
- The PCM measures/converts the current sent to the ignition coil and monitors.



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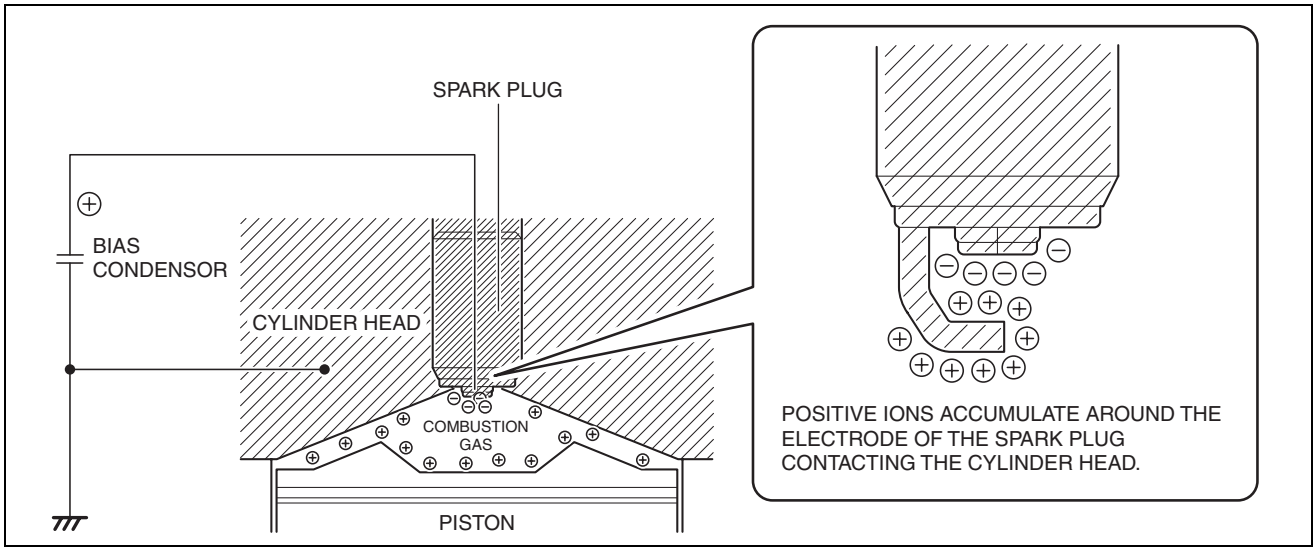
CONTROL SYSTEM [SKYACTIV-G 2.0]

Ion generation mechanism

- Ions are generated based on: fuel combustion = chemical reaction / disassociation. The generated negative ions move to the center electrode of the spark plug to which bias voltage is applied, positive ions move to the grounded engine wall surface, and then current flows from the spark plug to the ignition coil.



am3uun0000171

Fail-safe

- Function not equipped.

SUSPENSION

02
SECTION

02-00 OUTLINE

OUTLINE

SUSPENSION ABBREVIATIONS

id020000100100

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position
CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle
DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
EPS	Electric Power Steering
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System
HBC	High Beam Control
HF/TEL	Hands-Free Telephone
HI	High
HS	High Speed
HU	Hydraulic Unit
IDS	Integrated Diagnostic Software
IG	Ignition

OUTLINE

IN	Intake
INT	Intermittent
KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear
2GR	Second Gear
2WD	2-Wheel Drive
3GR	Third Gear
4GR	Fourth Gear
4WD	4-Wheel Drive
5GR	Fifth Gear
6GR	Sixth Gear

OUTLINE

SUSPENSION FEATURES

id020000100200

Improved rigidity and handling stability	• A strut type front suspension adopted. • E-type multi-link rear suspension adopted • For the front/rear crossmembers, the welded flange has been eliminated (flange-less), the cross-section expanded and the connection rigidity of the welded parts improved to achieve both rigidity and light weight. • By adopting a 6-point rigid mount-type front crossmember, the force generated from the tires is transmitted directly, and an agile vehicle response in low-to-mid speed range has been realized. • The caster angle and caster trail was increased on the front suspension. • The cross-section on the center member of the front crossmember has been expanded and the longitudinal offset of the front lower arm installation position reduced to realize an optimized framework. • The longitudinal span of the rear crossmember has been expanded and the longitudinal offset of the rear lateral link installation position reduced to realize an optimized framework. • By raising the installation position of the rear trailing link, the longitudinal input has been reduced, ride comfort improved, and the sense of safety during braking improved.
Improved handling stability and ride comfort	• Positions of the links and rigidity of the bushes were reviewed to increase toe-in for the lateral force input to the tires. • Grip of the rear tires was increased by the increased toe-in, and a mild vehicle response in high-speed range has been realized.
Improved marketability	• Tire pressure monitoring system adopted • Affixing-type balance weights adopted
Environmental consideration	• Tires with optimized characteristics and low rolling resistance have been adopted.

SUSPENSION SPECIFICATIONS

id020000100300

Suspension

Item					Specification
Front suspension	Type				Strut type
	Spring type				Coil spring
	Shock absorber type				Low-pressure gas charged, cylindrical, double-acting
	Stabilizer	Type			Torsion bar
		Diameter		(mm {in})	21.0 {0.827}
	Maximum steering angle [Tolerance ±3°]			Inner	37°48′
				Outer	30°54′
	Wheel alignment (Unloaded*1)	Total toe-in [Tolerance ±4 {0.2}]	Tire [Tolerance ±4 {0.2}]	(mm {in})	2 {0.08}
			Rim inner [Tolerance ±3 {0.1}]		1.0 {0.04}
				(Degree)	0°10′±0°20′
	Caster angle (Reference) [Tolerance ±1°]				SKYACTIV-G 2.0: 6°29′ SKYACTIV-D 2.2: 6°25′
	Camber angle (Reference) [Tolerance ±1°]				-0°22′
	Steering axis inclination (Reference)				12°00′

OUTLINE

Item					Specification
Rear suspension	Type				Multi-link
	Spring type				Coil spring
	Shock absorber type				Low-pressure gas charged, cylindrical, double-acting
	Stabilizer	Type			Torsion bar
		Diameter		(mm {in})	2WD: 18.0 {0.709} 4WD: 19.0 {0.748}
	Wheel alignment (Unloaded*1)	Total toe-in [Tolerance ±4 {0.2}]	Tire [Tolerance ±4 {0.2}]	(mm {in})	2 {0.08}
			Rim inner [Tolerance ±3 {0.1}]		1.0 {0.04}
				(degree)	0°10′±0°20′
	Camber angle (Reference) [Tolerance ±1°]				-1°01′
	Thrust angle [Tolerance ±0°48′]				0°00′

***1 : Unloaded: Fuel tank is full. Engine coolant and engine oil are at specified level. Spare tire, jack and tools are in designated position.**

Standard tire

Item			Specification	
Tire	Size		225/65R17 102V	225/55R19 99V
Wheel	Size		17 × 7J	19 × 7J
	Inset	(mm)	50 {2.0}	
	Pitch circle diameter	(mm)	114.3 {4.50}	
	Material		Steel Aluminum alloy	Aluminum alloy

Temporary spare tire

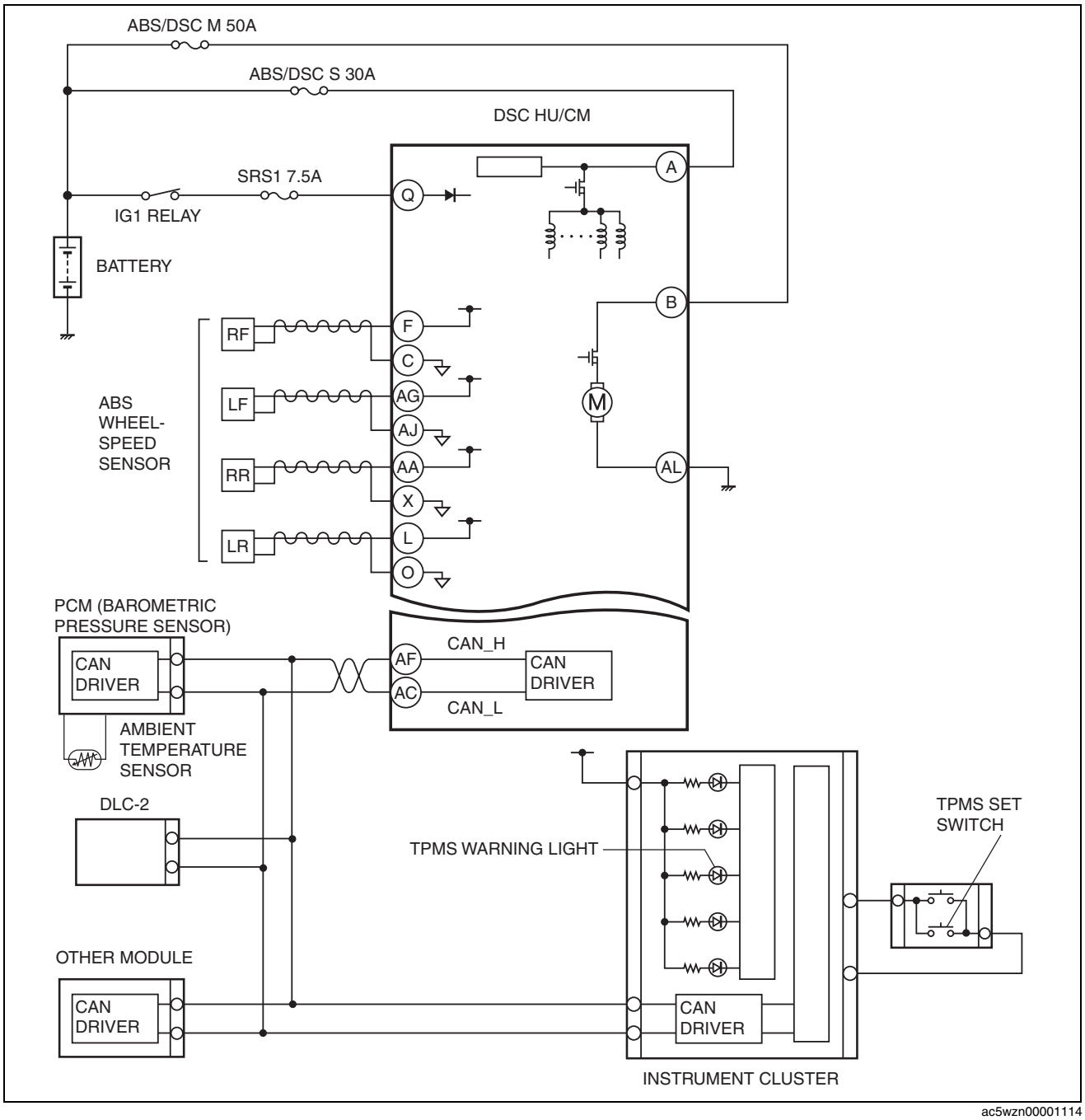
Item			Specification
Tire	Size		185/80R17 95M
Wheel	Size		17 × 5 1/2J
	Inset	(mm)	45 {1.8}
	Pitch circle diameter	(mm)	114.3 {4.50}
	Material		Steel

02-02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC

TIRE PRESSURE MONITORING SYSTEM (TPMS) WIRING DIAGRAM

id020200800100



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ON-BOARD DIAGNOSTIC SYSTEM (TIRE PRESSURE MONITORING SYSTEM)

id020200011000

- For the tire pressure monitoring system on-board diagnostic system, refer to Sec 04 as it is controlled by the DSC CM. (See 04-02A-1 ON-BOARD DIAGNOSTIC SYSTEM [DYNAMIC STABILITY CONTROL (DSC)].)

02-12 WHEEL AND TIRES

WHEEL AND TIRES

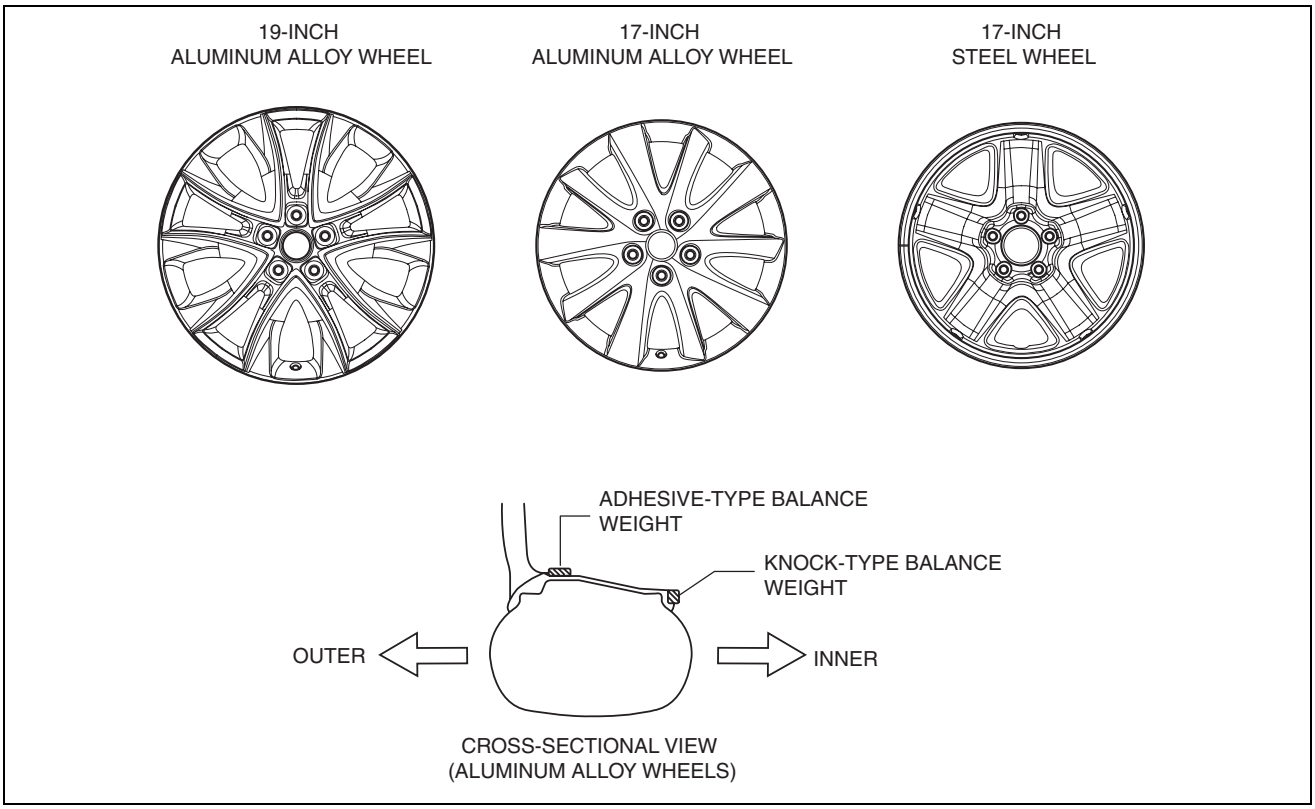
WHEELS AND TIRES

id021200106000

Outline

- An adhesive-type balance weights has been adopted to the outer side of the aluminum alloy wheels. Due to this, a stylish wheel design is realized.
- In consideration of the environment, steel balance weights have been adopted to reduce the use of lead in the vehicle.
- Tires with optimized characteristics and low rolling resistance have been adopted.

Structural view



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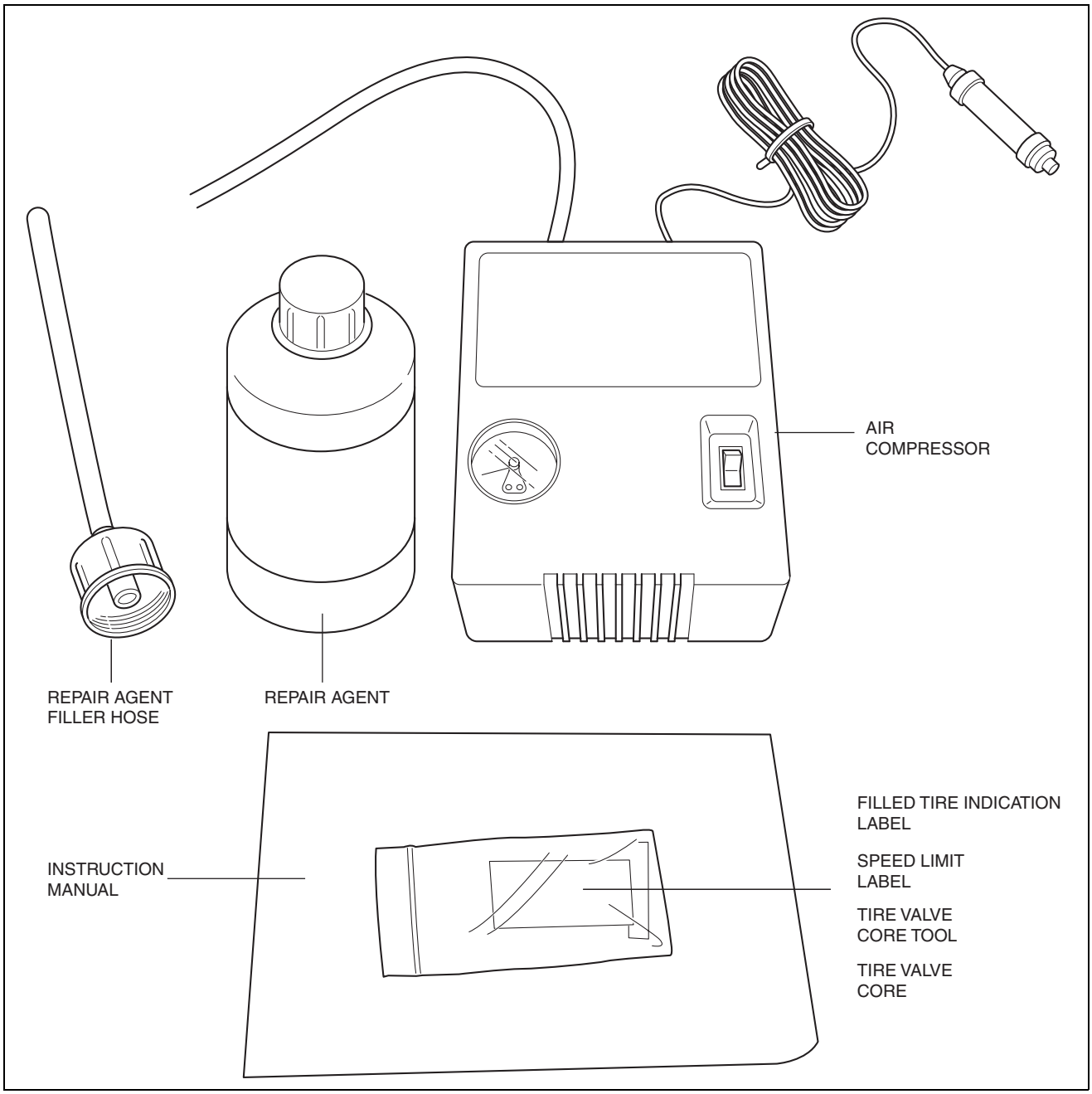
INSTANT MOBILITY SYSTEM

id021200629800

- Instant mobility system enables temporary repair of a puncture without tire removal.

WHEEL AND TIRES

- The instant mobility system is located in trunk compartment and includes the following:



ac5wzn00000901

  - — Repair agent
  - — Repair agent filler hose
  - — Air compressor
  - — Tire valve core
  - — Tire valve core tool
  - — Instruction manual
  - — Speed limit label
  - — Filled tire indication label
- The accessory socket (12 V DC) is used as an input power source for the air compressor and the compressor plug includes a fuse.

Note

- The expiration date of the repair agent is printed on the repair agent bottle. Do not use the repair agent if has passed the expiration date has expired.
- Dispose of repair agent according to local waste disposal law.
- The repair agent consists of the following ingredients:
  - — Deproteinized natural rubber latex

WHEEL AND TIRES

— Emulsified adhesive resin
— Propylene glycol

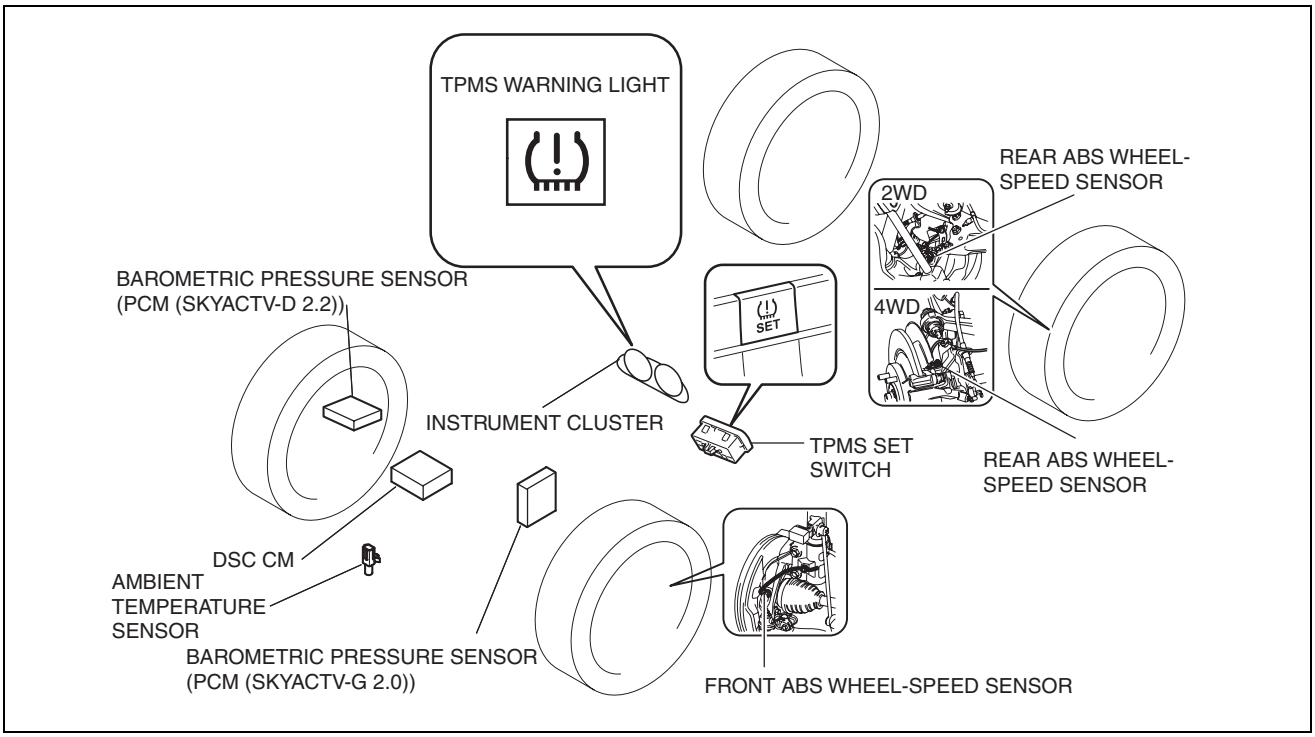
TIRE PRESSURE MONITORING SYSTEM (TPMS)

id021200201000

Purpose, Outline

- The tire pressure monitoring system monitors the tire pressure of all 4 tires. If the tire pressure of 1 tire or more becomes excessively low, the driver is notified.
- A tire pressure monitoring system has been adopted which indirectly inspects the tire pressures and warns the driver.
- A switch for initializing the tire pressure monitoring system after the tire pressures have been adjusted is installed to the instrument cluster. (See 02-12-8 TIRE PRESSURE MONITORING SYSTEM SET SWITCH.)

System structural view
L.H.D.



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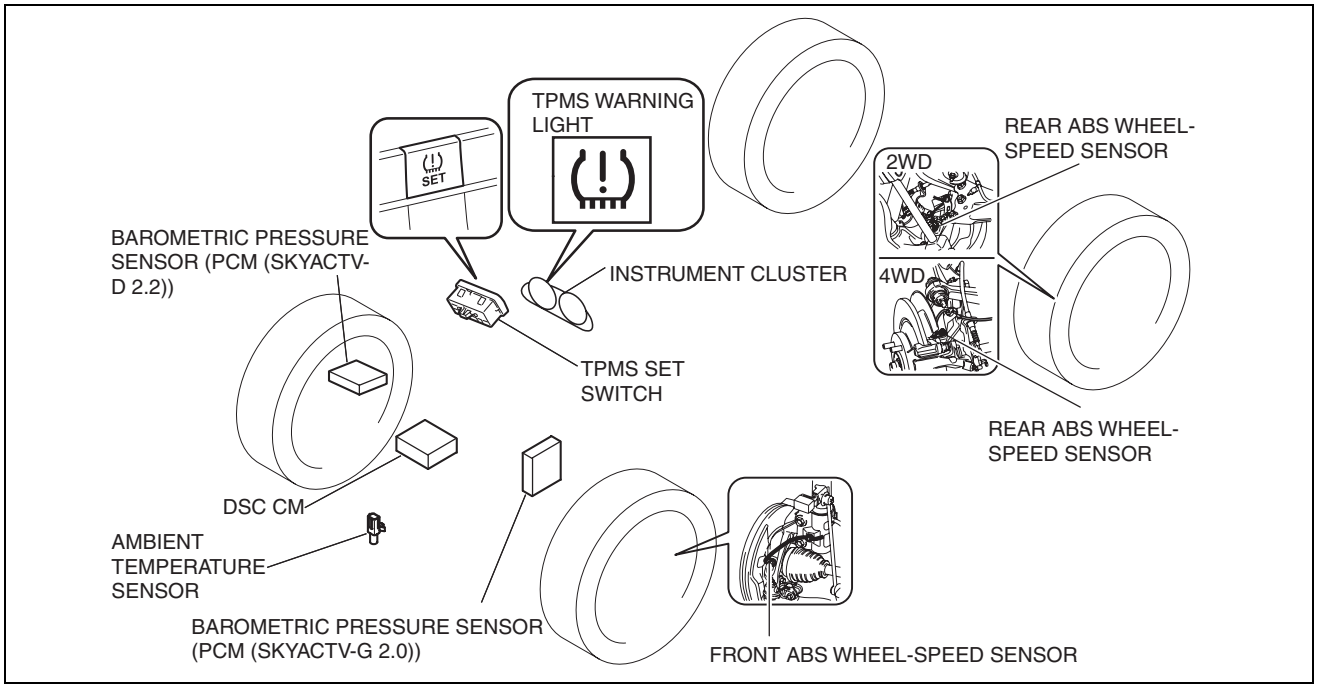
WHEEL AND TIRES

System structural view

R.H.D.



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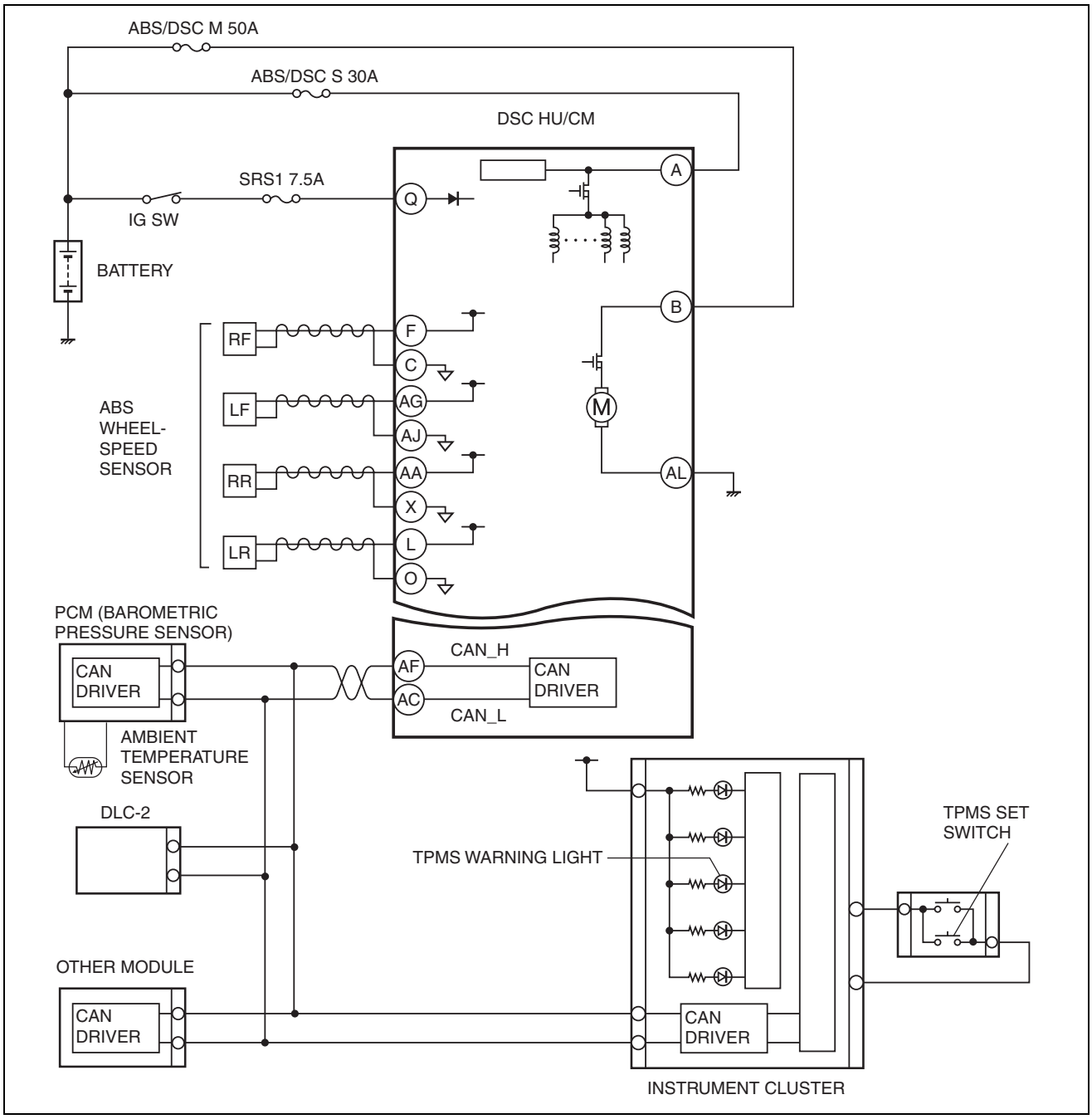
WHEEL AND TIRES

System wiring diagram



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Function

- The tire pressure monitoring system consists of the following parts.

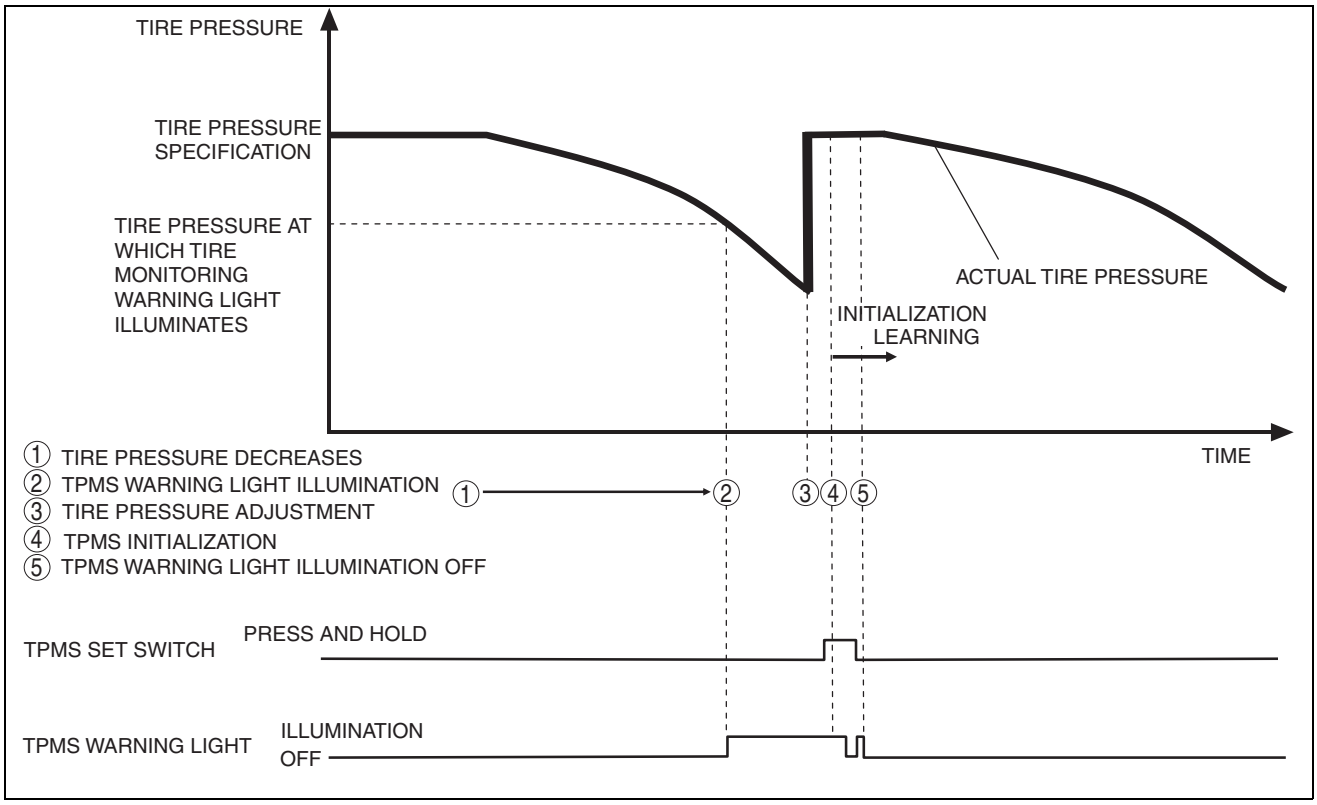
Part name	Function
DSC HU/CM	• Calculates the change in tire pressure based on the signals from each sensor and monitors the change in status. • When it is determined that a tire pressure decreases below the specified value based on the initialization, the tire pressure monitoring system warning light is illuminated. • The tire pressure monitoring system warning light illumination signal is sent to the instrument cluster via a CAN signal. • If a malfunction occurs in the tire pressure monitoring system, determination is made to flash the tire pressure monitoring system warning light. • The tire pressure monitoring system warning light flash signal is sent to the instrument cluster via a CAN signal.
ABS wheel-speed sensor	• The wheel speed is sent to the DSC HU/CM.

WHEEL AND TIRES

Part name		Function
Ambient temperature sensor		• The ambient temperature is sent to the PCM.
PCM		• The ambient temperature is sent to the DSC HU/CM via a CAN signal.
PCM	BARO sensor	• The atmospheric pressure is sent to the DSC HU/CM via a CAN signal.
Instrument cluster	Tire pressure monitoring system system warning light	• The tire pressure monitoring system warning light illuminates by the illumination signal from the DSC HU/CM. • The tire pressure monitoring system warning light flashes for approx. 1 min by the flash signal from the DSC HU/CM, and then it illuminates.
	Tire pressure monitoring system warning alarm	• The tire pressure monitoring system warning alarm sound is triggered by the warning alarm request signal from the DSC HU/CM.
Instrument cluster		• The initialization signal is sent to the DSC HU/CM via a CAN signal.
Tire pressure monitoring system set switch		• The initialization signal is sent to the instrument cluster.

Operation

The tire pressure monitoring system operates as shown in the following figure.



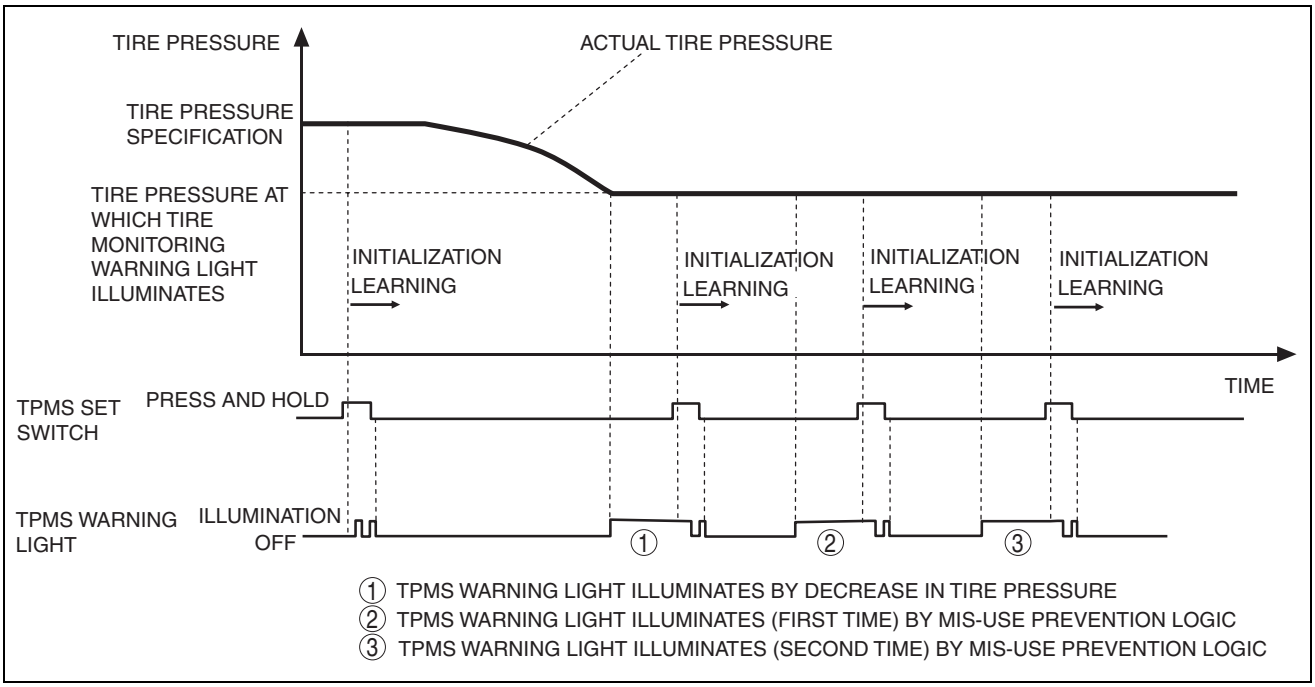
ac5wzn00001072

Mis-use prevention logic

- If the tire pressure monitoring system is initialized without adjusting the tire air pressures even though the tire pressure monitoring system warning light illuminated, the tire pressure monitoring system has a mis-use prevention logic which illuminates the tire pressure monitoring system warning light.
  The data for the tire pressure at the point in time when the tire pressure monitoring system warning light was illuminated is compared to the data for the tire pressure at the point in time when the tire pressure monitoring system initialization was performed.
  If the difference in pressure is within the specification, the tire pressure monitoring system warning light is illuminated.
  This mis-use prevention logic operates two times.

WHEEL AND TIRES

- The mis-use prevention logic operates as shown in the following figure.



ac5wzn00001073

Tire pressure monitoring system warning light does not illuminate

- Even if the tire pressure monitoring system is normal, if the following items apply, the tire pressure monitoring system warning light may not illuminate.
  - — Brake pedal is depressed
  - — DSC is operating
  - — Sudden steering wheel maneuvering
  - — Sudden acceleration/deceleration
  - — When vehicle is parked, stopped

Tire pressure monitoring system does not operate normally

- If the following items apply, the tire pressure monitoring system may not operate correctly.
  - — Initialized using tire pressure outside of tire pressure specification
  - — Tire pressure suddenly decreases (Ex. tire burst)
  - — During tire pressure monitoring system learning

TIRE PRESSURE MONITORING SYSTEM WARNING LIGHT

id021200202000

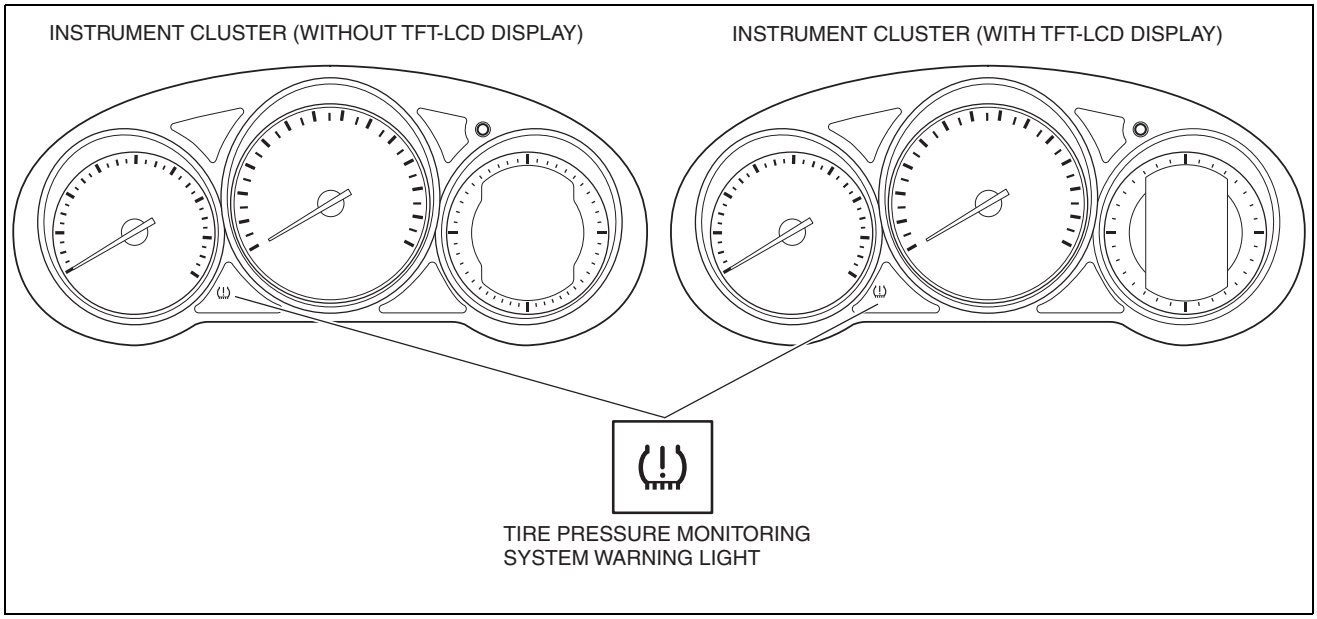
Purpose, Function

- The tire pressure monitoring system warning light notifies the driver that it was determined that a tire pressure has decreased below the specified value based on the initialization.
- The tire pressure monitoring system warning light notifies the driver that a malfunction has occurred in the tire pressure monitoring system.

WHEEL AND TIRES

Construction, Operation

- The tire pressure monitoring system warning light is built into the instrument cluster.



ac5wzn00001828

- The tire pressure monitoring system warning light illuminates/flashes based on the DSC HU/CM command.
- The tire pressure monitoring system warning light illuminates if a tire pressure decreases below the specified value based on the initialization.
- The tire pressure monitoring system warning light flashes for 1 min if a malfunction is detected in the tire pressure monitoring system, and then it illuminates.
- If the tire pressure monitoring system warning light has illuminated, it will turn off by performing the initialization. If the initialization is not performed, the light will illuminate again when the ignition is switched from off to ON.

TIRE PRESSURE MONITORING SYSTEM SET SWITCH

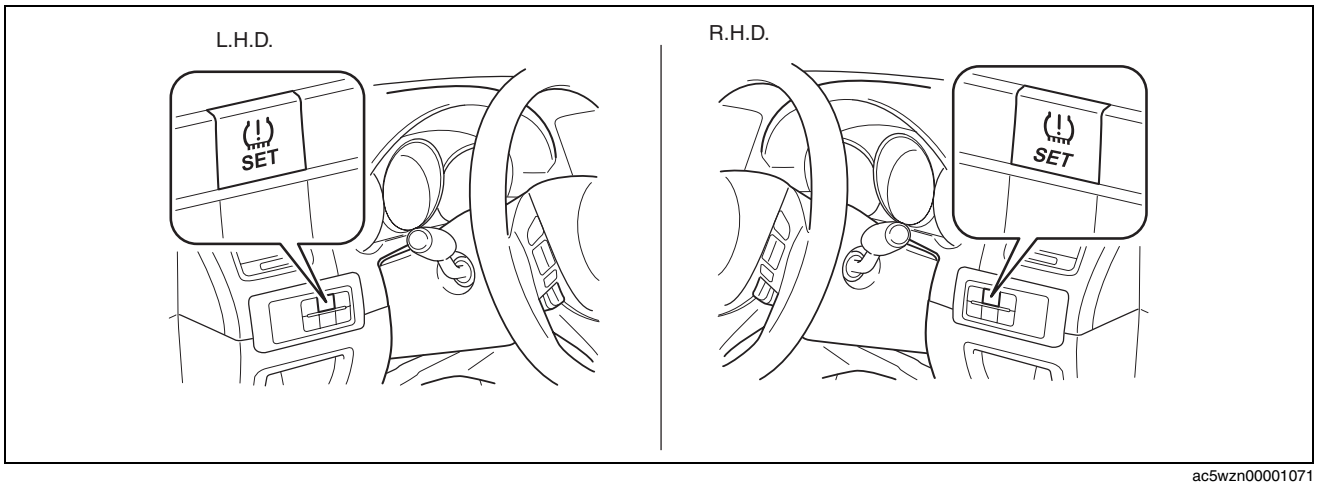
id021200203000

Purpose

- The tire pressure monitoring system set switch is used to initialize the tire pressure monitoring system.

Construction, Operation

- The tire pressure monitoring system set switch is installed to the instrument panel.



ac5wzn00001071

- The tire pressure monitoring system set switch has adopted a monitoring type switch.
- The tire pressure monitoring system set switch sends a tire pressure monitoring system initialization signal to the instrument cluster.

Fail-safe

DTC	Fail-safe
C1031:35	Inhibits the TPMS control.

02-13 FRONT SUSPENSION

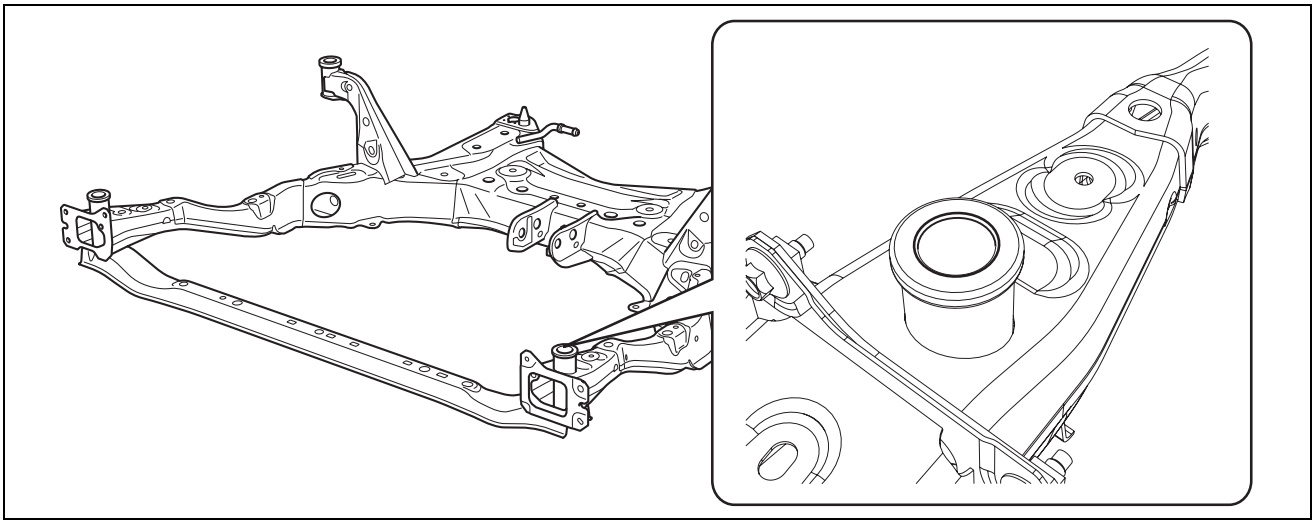
FRONT SUSPENSION

FRONT SUSPENSION

id021300101000

Outline

- A strut type front suspension has been adopted.
- The connection area of the front crossmember and body is a 6-point rigid mount type.



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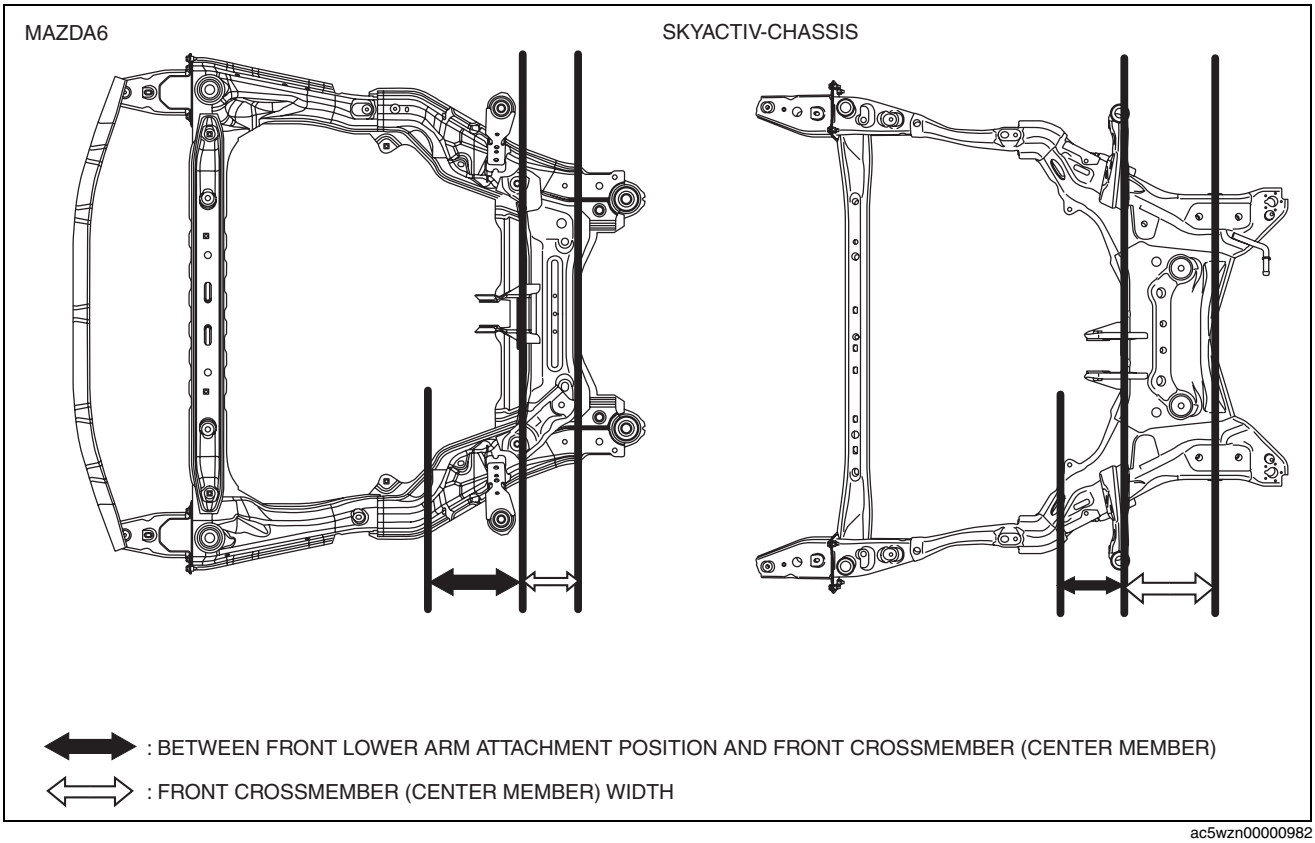
- The cross-section on the center member of the front crossmember has been expanded and the longitudinal offset of the front lower arm installation position reduced to realize an optimized framework.



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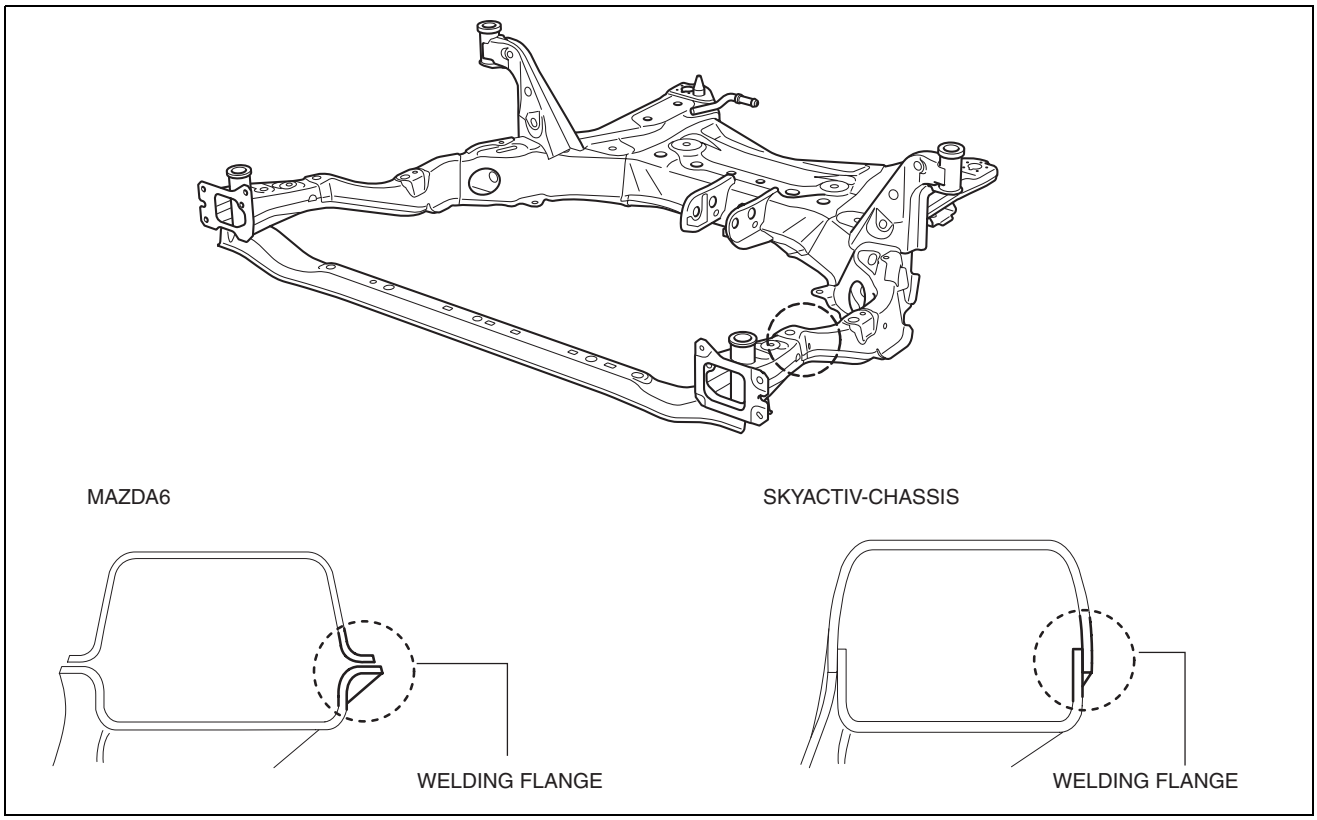
- For the front crossmember, the welded part of the flange has been eliminated (flange-less), the cross-section expanded and the connection rigidity of the welded parts improved to achieve both rigidity and light weight.

FRONT SUSPENSION



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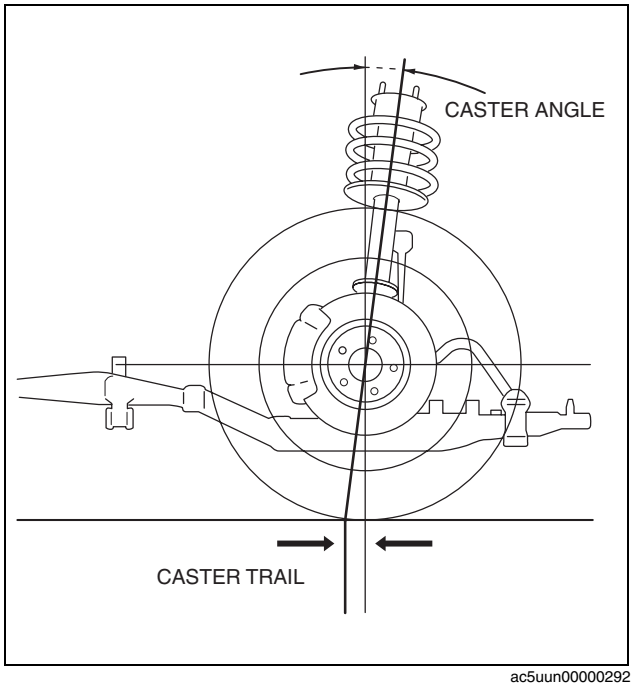
- The caster angle and caster trail of the front suspension have been increased.



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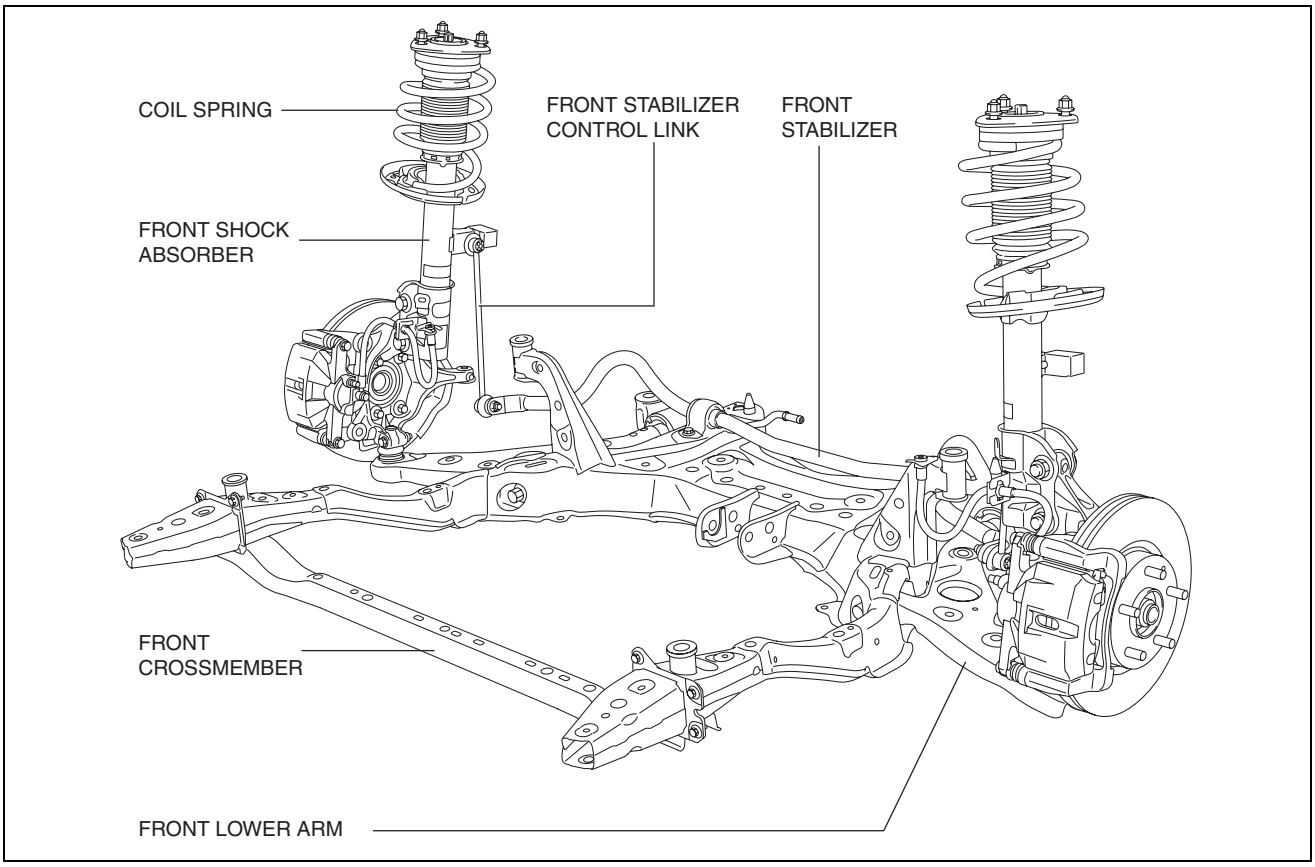
FRONT SUSPENSION

Structural view



ac5uun00000293

02-14 REAR SUSPENSION

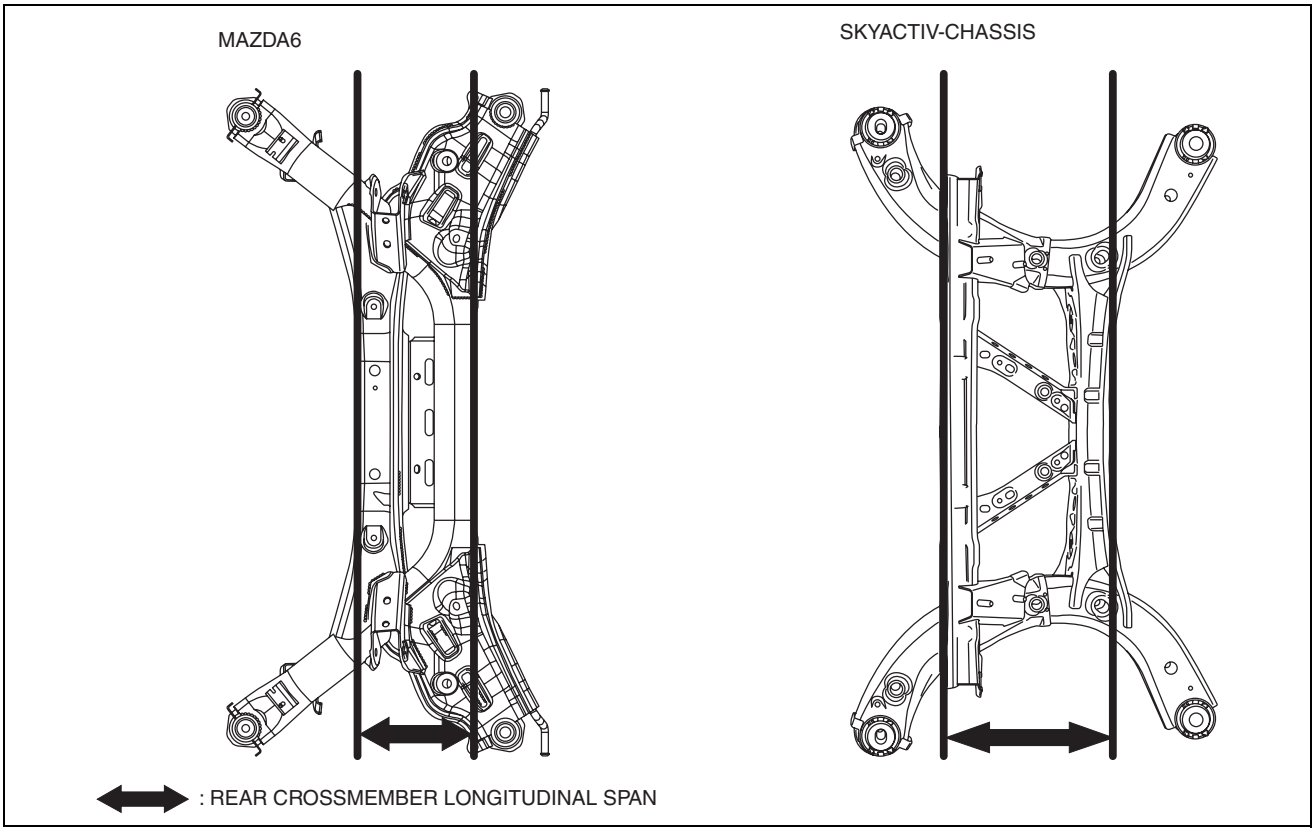
REAR SUSPENSION

REAR SUSPENSION

id021400113000

Outline

- E-type multi-link rear suspension has been adopted.
- The longitudinal span of the rear crossmember was extended and the longitudinal offset of the rear lateral link attachment position was reduced.



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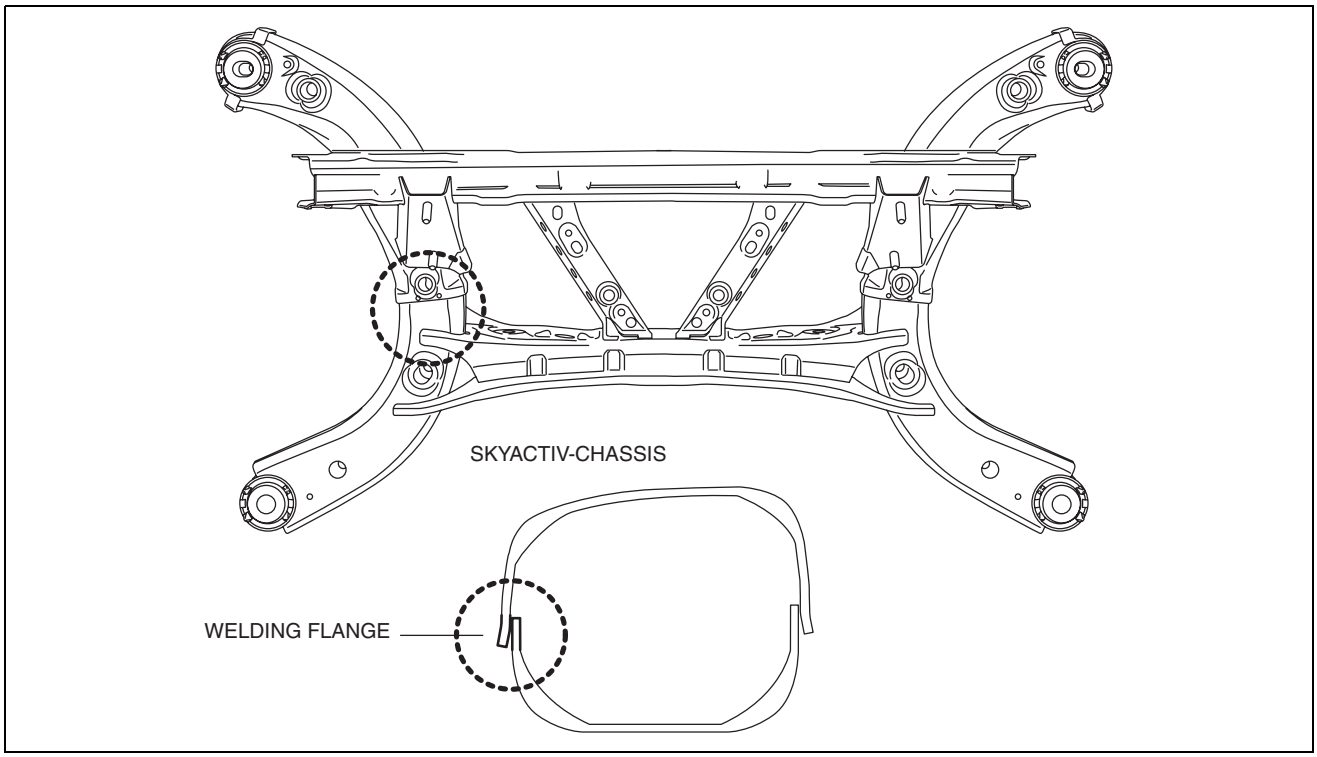
- Welding flanges were removed from the rear crossmember to enhance the coupling rigidity of the welded sections and reduce the weight.

REAR SUSPENSION



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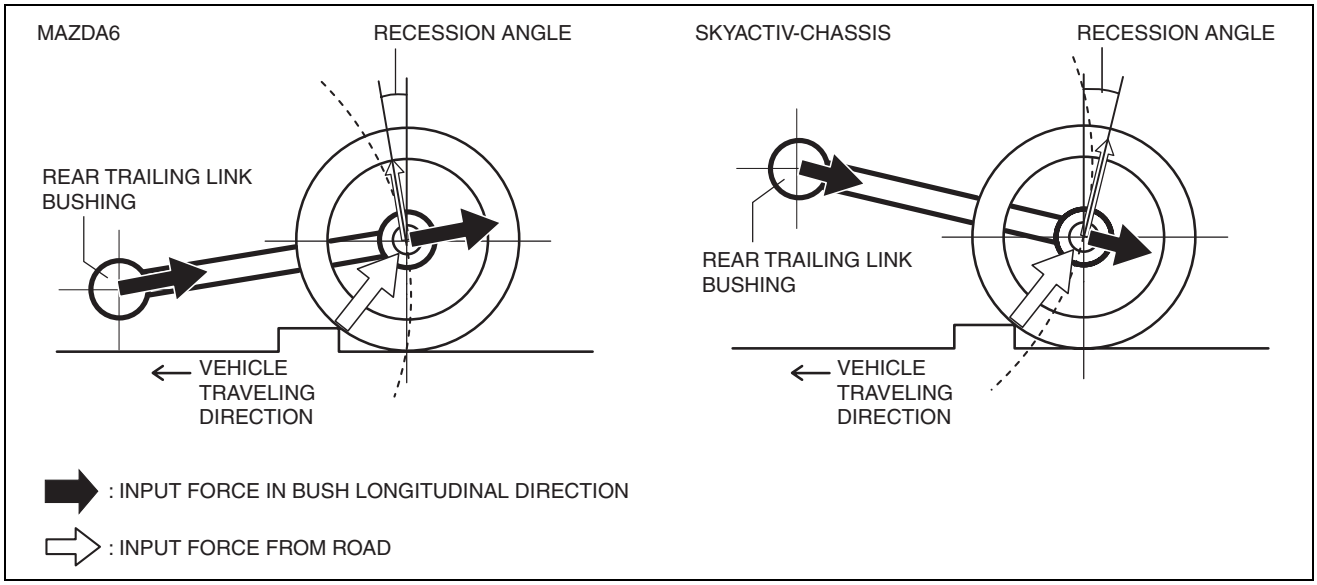
- The installation position of the rear trailing link was moved upward so that the longitudinal impact from the road is more easily absorbed in the vertical movement of the rear trailing link. This reduces the longitudinal force input to the rear trailing link bush, improving the ride comfort.



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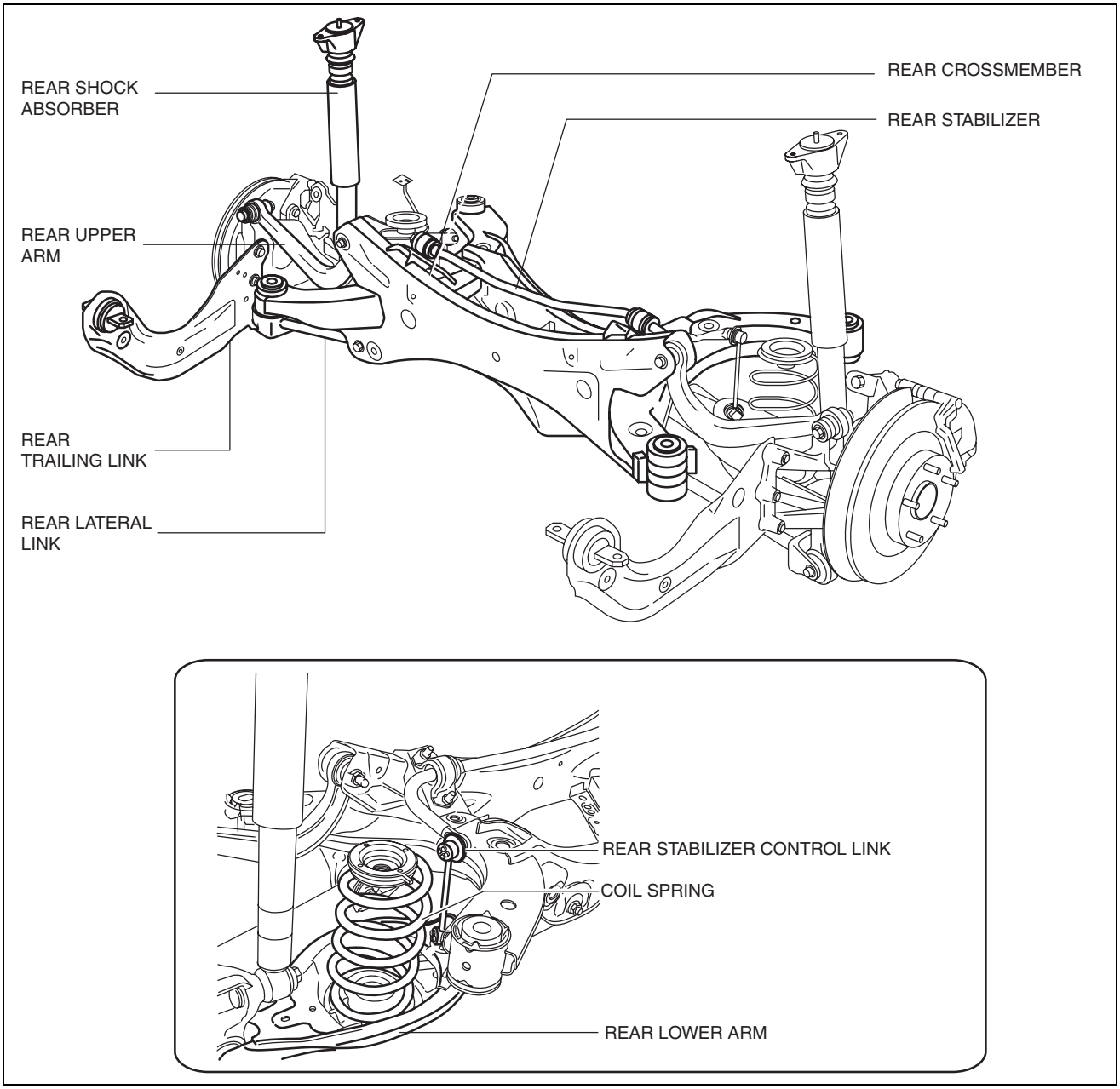
REAR SUSPENSION

STRUCTURAL VIEW
2WD



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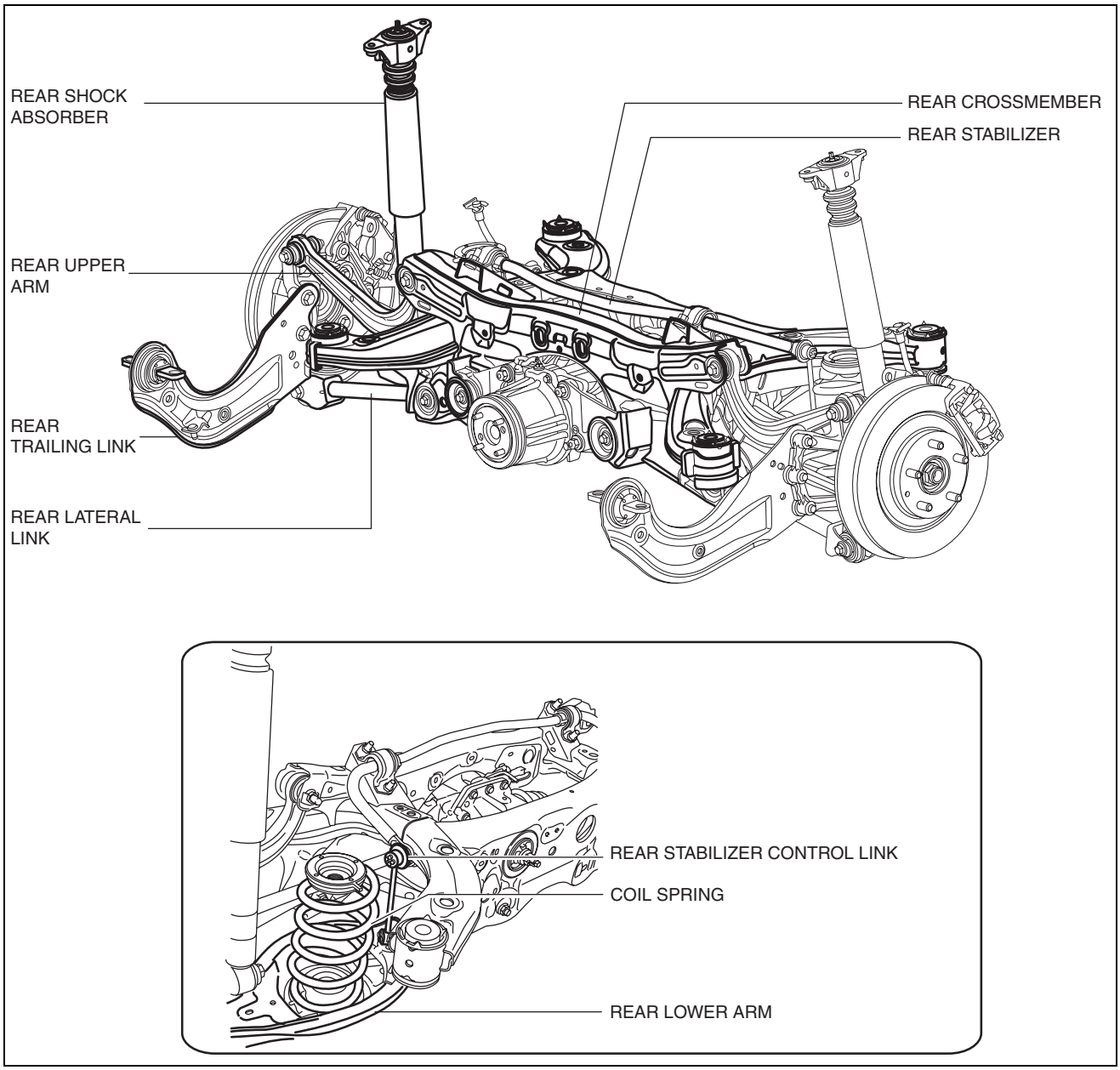
REAR SUSPENSION

4WD



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DRIVELINE/AXLE

03
SECTION

03-00 OUTLINE

OUTLINE

DRIVELINE/AXLE ABBREVIATIONS

id030000150300

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position
CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle
DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
EPS	Electric Power Steering
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System
HBC	High Beam Control
HF/TEL	Hands-Free Telephone
HI	High
HS	High Speed
HU	Hydraulic Unit

OUTLINE

IDS	Integrated Diagnostic Software
IG	Ignition
IN	Intake
INT	Intermittent
KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear
2GR	Second Gear
2WD	2-Wheel Drive
3GR	Third Gear
4GR	Fourth Gear
4WD	4-Wheel Drive

OUTLINE

5GR	Fifth Gear
6GR	Sixth Gear

DRIVELINE/AXLE FEATURES

id030000100100

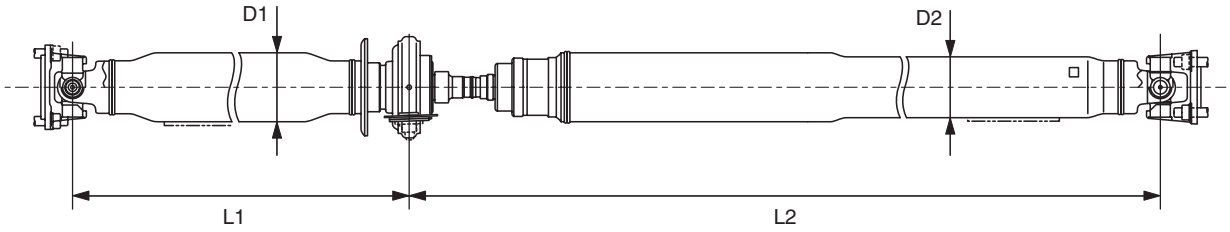
Improved driveability	• Bell-shaped constant velocity joint adopted for wheel-side joint of front and rear drive shaft • Tripod-shaped constant velocity joint adopted for differential-side joint of front drive shaft (ATX) and rear drive shaft • Double offset-shaped constant velocity joint adopted for differential-side joint of front drive shaft (MTX)
Improved rigidity, reduced noise and vibration	• Characteristics of front drive shaft optimized • Constant velocity joint type rear drive shaft adopted (4WD) • 2-part, 1-joint type propeller shaft with middle shaft bearing has been adopted
Improved off-road mobility, handling stability and marketability	• Electronic 4WD control system adopted
Size and weight reduction	• Rear differential with an integrated coupling component adopted • Aluminum differential carrier adopted
Improved serviceability	• Self diagnostic function adopted for electronic 4WD control system • A maintenance-free transfer has been adopted

DRIVELINE/AXLE SPECIFICATIONS

id030000100200

Item			Specification	
			SKYACTIV-G 2.0	SKYACTIV-D 2.2
Front axle				
Bearing type			Angular ball bearing	
Rear axle				
Bearing type			Angular ball bearing	
Front drive shaft				
Front drive shaft joint type	Wheel side		Bell joint	
	Differential side		Tripod joint [ATX] Double offset joint [MTX]	
Front drive shaft diameter	ATX	(mm {in})	LH: 26.0 {1.024} RH: 27.5 {1.08}	LH: 27.0 {1.063} RH: 29.0 {1.142}
	MTX	(mm {in})	LH: 27.0 {1.063} RH: 29.0 {1.142}	
Rear drive shaft (4WD)				
Rear drive shaft joint type	Wheel side		Bell joint	
	Differential side		Tripod joint	
Rear drive shaft diameter		(mm {in})	22.0 {0.866}	
Rear differential (4WD)				
Rear and front wheel torque distribution unit			Electronic control coupling	
Reduction gear			Hypoid gear	
Differential gear			Straight bevel gear	
Ring gear size		(Inches)	7.4	
Final gear ratio			2.928	
Gears: Number of teeth		Drive pinion	14	
		Ring gear	41	
Differential oil	Type	Grade	API service GL-5	
		Viscosity	SAE 80W-90	
	Oil capacity (approx. quantity)	(L {US qt, Imp qt})	0.45 (0.48, 0.40)	
Propeller shaft (4WD)				
Length		(mm {in}) L1	741.5 {29.19}	
		L2	1353.8 {53.299}	

OUTLINE

Item			Specification	
			SKYACTIV-G 2.0	SKYACTIV-D 2.2
Outer diameter (mm {in})		D1	75 {3.0}	
		D1	68 {2.7}	
				
Joint type			Constant velocity joint and cross-shaped joint	
Constant velocity joint			Double offset joint	
Transfer (4WD)				
Transfer oil	Type	Grade	API service GL-5	
		Viscosity	SAE 80W-90	
	Oil capacity (approx. quantity) (L {US qt, Imp qt})		0.45 (0.48, 0.40)	

03-02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC

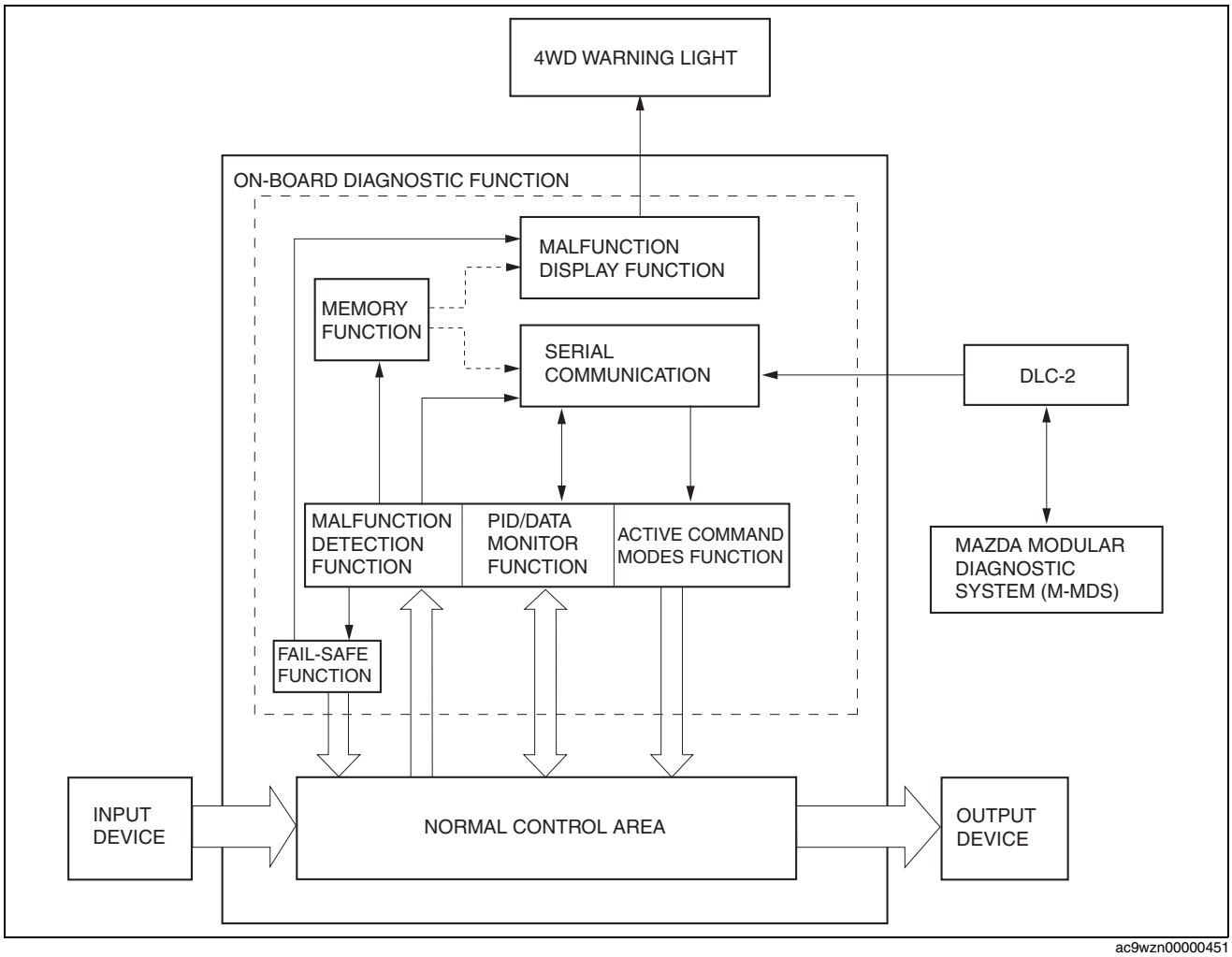
ON-BOARD DIAGNOSTIC SYSTEM OUTLINE

id030200108200

- The on-board diagnostic system consists of a malfunction detection system that detects abnormalities in input/output signals when the ignition switch is at the ON position, a data monitor function that reads out specified input/output signals and a simulation function that allows for override operation of output parts (such as solenoid valves).
- The data link connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis and detecting/repair into a single location, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2.
- In addition to DTC read-out, the M-MDS is used to clear DTCs using the display screen of the diagnostic tester, and to access the parameter identification (PID)/data monitor and simulation functions, providing enhanced malfunction diagnosis and improved serviceability.

ON-BOARD DIAGNOSTIC

Block Diagram



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ON-BOARD DIAGNOSTIC SYSTEM FUNCTION

id030200108300

Malfunction Detection Function

- The failure detection function detects malfunctions in the input/output signal systems of the 4-wheel drive (4WD) control module (CM) and displays them when the ignition switch is at the ON position.
- When the ignition switch is turned to the ON position, the 4WD CM system begins operation, and the 4WD warning light illuminates for 3 seconds while the function checks for open circuits. At the same time the function monitors the condition of the power supply voltage and checks for internal malfunctions (Without TFT LCD display).
- Then, once the system is running, the function checks the operating conditions of the 4WD solenoid and the differential oil temperature sensor at regular intervals to determine whether there is any malfunction.
- If any malfunction is detected during these diagnostic tests, the warning light illuminates according to the malfunction to alert the driver. Also, a DTC is output to DLC-2 via the CAN line. Also, at the same time the failure detection result is sent to the memory and fail-safe functions.

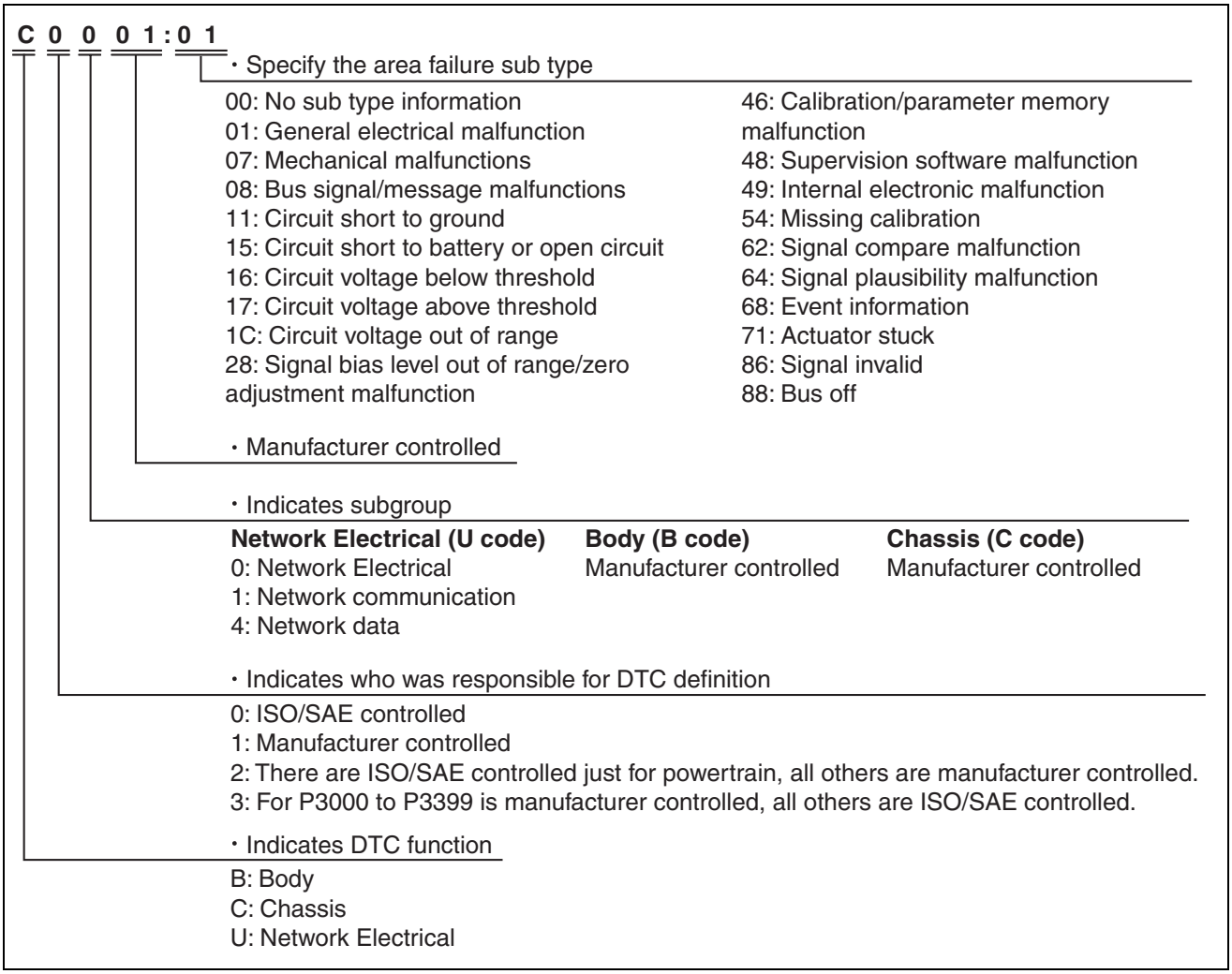
Memory function

- This function stores DTCs for malfunctions of the input/output signal systems as determined by the failure detection function. Once a DTC is stored, it is not cleared even if the input/output signal system malfunction returns to normal when the ignition switch is turned to the LOCK position (engine OFF).
- Since DTCs are stored in the non-volatile memory inside the 4WD CM, they are not cleared even if the battery is disconnected. Therefore, it is necessary to clear the memory when maintenance has been completed. For clearing DTCs, refer to the procedures in the Workshop Manual.

ON-BOARD DIAGNOSTIC

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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DTC Table

- When the failure detection function determines that there is a malfunction, the 4WD warning light illuminates to alert the driver. At this time, the fail-safe function suspends control or takes other measures to ensure that driving stability is not lost.

X: Available
—: Not applicable

DTC	Malfunction location	4WD warning light condition	Fail-safe	Drive cycle	Self test type*1	Memory function
P164D:00	4WD CM configuration	Illuminated	X	—	C	X
P182F:00	4WD CM	Flashed	X	—	C	X
P1886:00	4WD CM	Illuminated	X	—	C	X
P1887:11	4WD solenoid circuit	Illuminated	X	—	C	X
P1887:12	4WD solenoid circuit	Illuminated	X	—	C	X
P1887:13	4WD solenoid circuit	Illuminated	X	—	C	X
P1887:14	4WD solenoid circuit	Illuminated	X	—	C	X
P187B:00	4WD solenoid circuit	Illuminated	X	—	C	X
P1888:11	Differential oil temperature sensor circuit	Illuminated	X	—	C	X

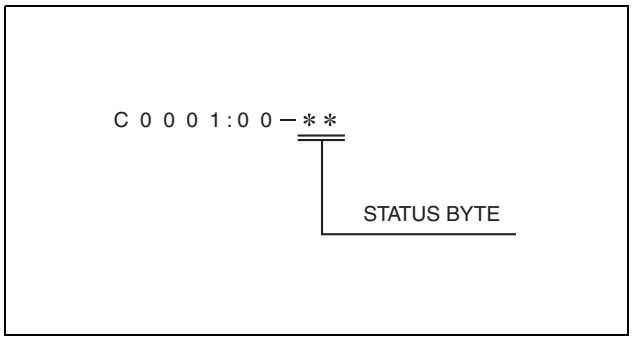
ON-BOARD DIAGNOSTIC

DTC	Malfunction location	4WD warning light condition	Fail-safe	Drive cycle	Self test type*1	Memory function
P1888:15	Differential oil temperature sensor circuit	Illuminated	X	—	C	X
P188A:00	4WD CM	Flashed	X	—	C	X
U0001:88	CAN system communication error	—	X	—	C	X
U0100:00	Communication error to PCM	—	X	—	C	X
U0101:00	CAN system communication error	—	X	—	C	X
U0121:00	CAN system communication error	—	X	—	C	X
U0401:68	Signal error from PCM	—	X	—	C	X
U0402:68	Signal error from TCM	—	X	—	C	X
U0415:68	Signal error from DSC HU/CM	—	X	—	C	X
U2100:00	4WD CM configuration	Illuminated	X	—	C	X

*1 : C: CMDTC self test

Status Byte for DTC

- The status byte is the two-digit code (two digits after hyphen (-)) after the DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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Fail-safe Function

- When the failure detection function determines that there is a malfunction, the 4WD warning light illuminates to alert the driver. At this time, the fail-safe function suspends control or takes other measures to ensure that driving stability is not lost.

DTC	Fail-safe control status
P164D:00	4WD operates by the specified data
P182F:00	4WD protection condition (4WD control paused)
P1886:00	Control disabled
P1887:11	Control disabled
P1887:12	Control disabled
P1887:13	Control disabled
P1887:14	Control disabled
P187B:00	Control disabled
P1888:11	Control disabled
P1888:15	Control disabled
P188A:00	4WD protection condition (4WD control paused)
U0001:88	Control disabled
U0100:00	4WD operates by the specified data
U0101:00	Lost gear position signal: 4WD operates by the specified data Except above: Control disabled
U0121:00	Control disabled
U0401:68	• Gear position signal error (MTX) — 4WD operates by the specified data • Except for gear position signal error — Control disabled
U0402:68	4WD operates by the specified data
U0415:68	Control disabled
U2100:00	4WD operates by the specified data

ON-BOARD DIAGNOSTIC

Snapshot Data Table

Note
- Snapshot data items are not displayed, according to detected DTC.

Snapshot data item	Unit	Definition	Corresponding PID data monitor item
IG-ON_TIMER	hh:mm:ss	Times Since Ignition Switch ON	—
TOTAL_TIME	hh:mm:ss	Total Time	—
TOTAL_DIST	KPH, MPH	Total Distance	—
IC_VPWR	V	Instrument Cluster Power Supply	—
AAT	°C, °F	Ambient Air Temperature	AAT
PWR_MODE_KEY	—	Power Mode Key State	—

External Tester Communication Function
- This function allows for the storing and clearing of DTCs due to a communication link between the 4WD CM and an external tester.

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION

id030200108400

- The parameter identification (PID)/data monitor function is used for optionally selecting input/output signal monitor items preset in the 4-wheel drive (4WD) control module (CM) and reading them out in real-time.

PID/DATA Monitor Table

PID/data monitor item	Input/output part	Unit/Condition (Tester display)
WARN_LAMP	4WD CM	—
AAT	Ambient air temperature	°C, °F
APP	Accelerator pedal position	%
CAL_TABLE	4WD CM	—
CUP_SOL	4WD CM	%
GEAR	PCM	1st/2nd/3rd/4th/5th/6th/7th/ Park/Neutral/Drive/Reverse
OIL_TEMP	Ignition voltage	°C, °F
RPM	PCM	RPM
SHIFT	TCM	P/R/N/D/S/L
VPWR	Ignition voltage	V
WSPD_LF	ABS wheel-speed sensor (LF)	KPH, MPH
WSPD_LR	ABS wheel-speed sensor (LR)	
WSPD_RF	ABS wheel-speed sensor (RF)	
WSPD_RR	ABS wheel-speed sensor (RR)	
TORQUE	4WD CM	Nm

ON-BOARD DIAGNOSTIC SYSTEM ACTIVE COMMAND MODES FUNCTION

id030200108500

- The active command modes function is used for optionally selecting simulation items of input/output parts preset in the 4WD CM, and to operate them regardless of CM control.

ACTIVE COMMAND MODE TABLE

Command name	Output part name	Operation	Operating condition
CUP_SOL	Coupling component	Off/On	Switch the ignition to ON (engine off or on)

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION

id030200108600

- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs, and operation of input/output parts) between the 4-wheel drive (4WD) control module (CM) and an external tester.

ON-BOARD DIAGNOSTIC

Connections and Communication Contents

	External tester	
	Mazda Modular Diagnostic System (M-MDS)	
	Connection	Communication method
On-board diagnostic (malfunction detection) function	Input/output: HS_CAN_H, HS_CAN_L	Serial communication
PID/DATA monitor function	Input/output: HS_CAN_H, HS_CAN_L	Serial communication
Active command modes function	Input/output: HS_CAN_H, HS_CAN_L	Serial communication

Serial communication

- Serial communication (two-way communication) allows for multiple data to be sent and received instantly along the same line.
- By connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2, diagnostic data can be sent and received between the M-MDS and the 4WD CM using the HS_CAN_H and HS_CAN_L terminals (within the DLC-2).
- The 4WD CM receives the command signals of the malfunction detection function, parameter identification (PID)/data monitor function, and the active command modes function from the M-MDS, and sends DTCs and data regarding the operating condition and status of each input/output part to the M-MDS.

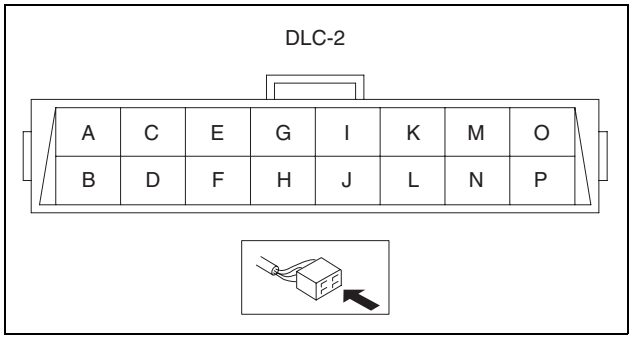
Diagnostic function name	Signal received	Signal sent
Malfunction detection function	DTC verification signal	DTC
PID/data monitor function	Command signal to read selected monitor item	Monitored data for requested monitor item
Active command modes function	Operation command signal for selected active command modes item	Input/output part name

DLC-2 CONSTRUCTION

id030200108700

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been added.
- Shape and terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this connector. The 16-pin connector consists of a CAN_H (HS) terminal, CAN_L (HS) terminal, CAN_H (MS) terminal, CAN_L (MS) terminal, GND1 terminal, GND2 terminal, and B+ terminal.

Terminal	Function
A	Battery power supply terminal
B	-
C	-
D	-
E	Serial communication Lo terminal (HS)
F	Serial communication Hi terminal (HS)
G	-
H	Serial communication ground terminal
I	-
J	Body ground terminal
K	Serial communication Lo terminal (MS)
L	Serial communication Hi terminal (MS)
N	-
M	-
O	-
P	-



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03-11 FRONT AXLE

FRONT AXLE

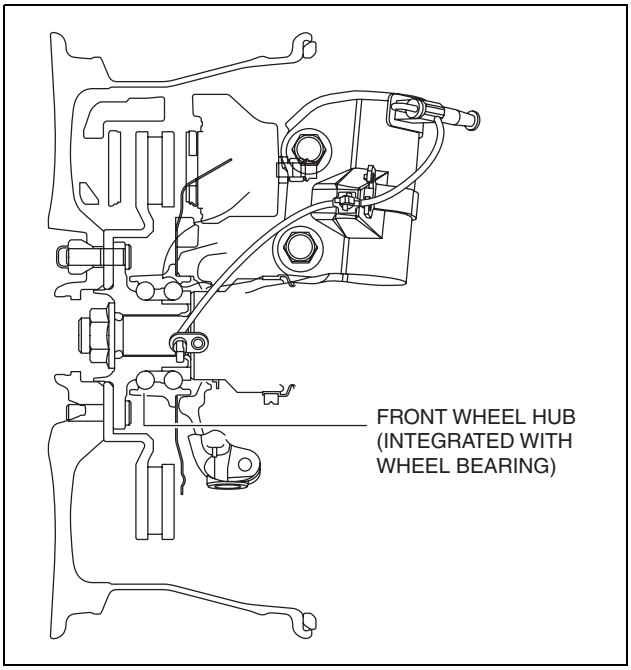
FRONT AXLE

id031100110000

Purpose, Function

- An angular ball bearing, with a low rotational resistance, has been adopted, improving driveability.
- A unit bearing that does not require pre-load setting has been adopted, improving serviceability.

Cross-Sectional View



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03-12 REAR AXLE

REAR AXLE

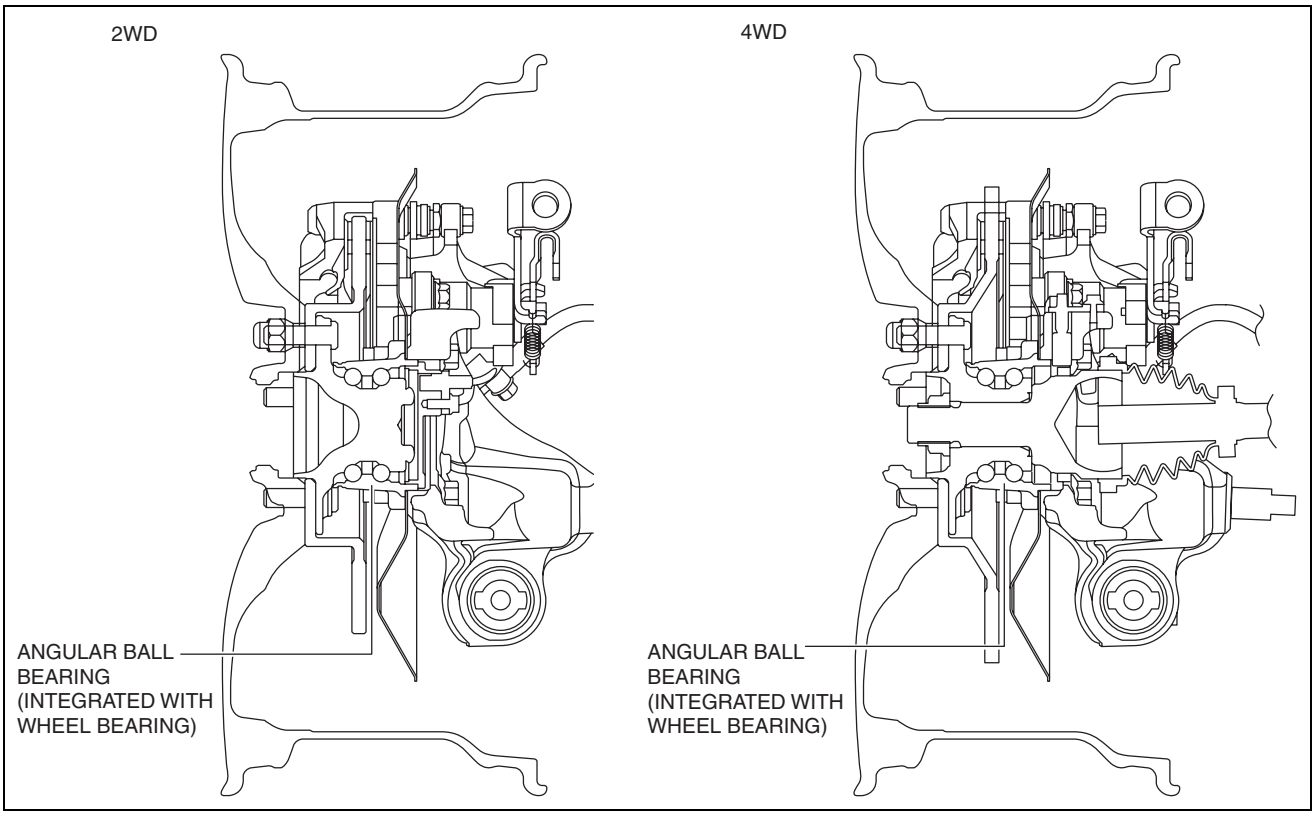
REAR AXLE

id031200110000

Purpose, Function

- An angular ball bearing, with a low rotational resistance, has been adopted, improving driveability.
- A unit bearing that does not require pre-load setting has been adopted, improving serviceability.

Cross-Sectional View



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03-13 DRIVE SHAFT

DRIVE SHAFT

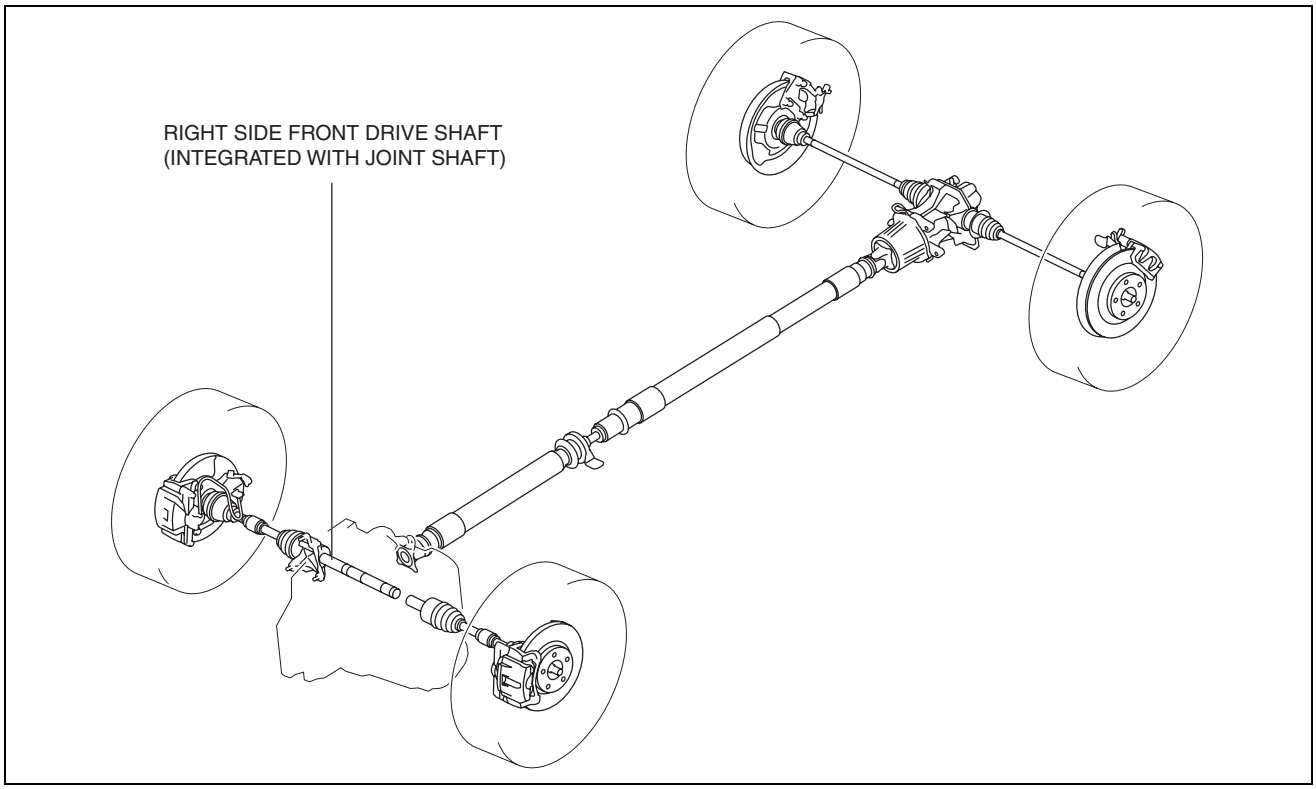
FRONT DRIVE SHAFT

id031300100600

Purpose, Function

- A bell joint has been adopted for the wheel-side constant velocity joint, reducing vibration and noise.
- A tripod joint join have been adopted for the differential side constant velocity joint to reduce booming noise during high-speed driving and vibration when idling (ATX).
- A low noise and vibration double offset joint with low slide resistance has been adopted for the differential side of the constant velocity joint (MTX). Due to this booming resonance at high speed is reduced.
- An extremely durable plastic has been adopted for the wheel side boot.
- By integrating the drive shaft on the right side with the joint shaft, vibration and noise during driving which occurred from the previous spline connection construction has been reduced.

Structural View



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REAR DRIVE SHAFT

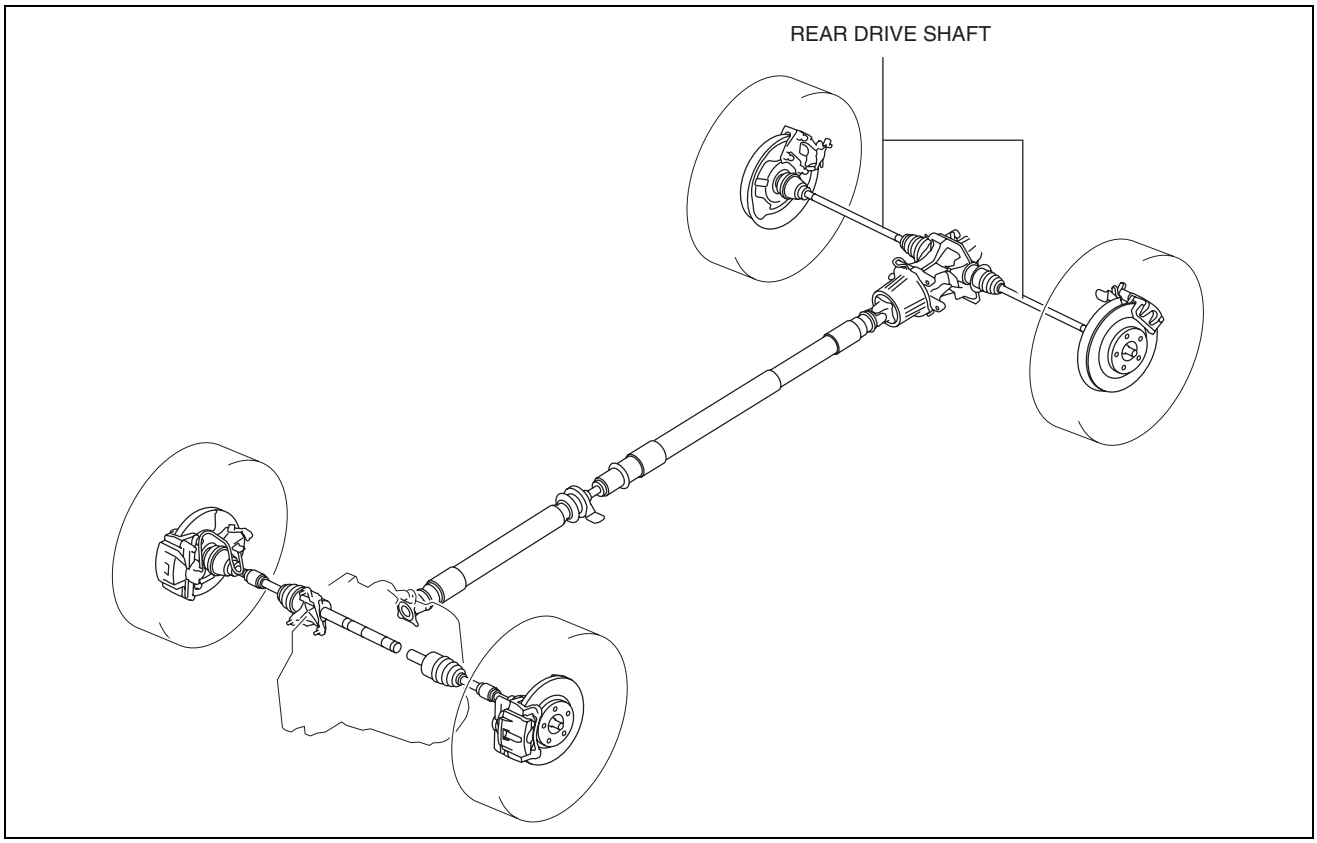
id031300100700

Purpose, Function

- Engine noise and vibration have been reduced due to adoption of a bell joint on the wheel side of the constant velocity joint.
- A tripod joint have been adopted for the differential side constant velocity joint to reduce booming noise during high-speed driving and vibration when idling.
- An extremely durable plastic has been adopted for the wheel side boot.

DRIVE SHAFT

Structural View



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03-14 DIFFERENTIAL

DIFFERENTIAL

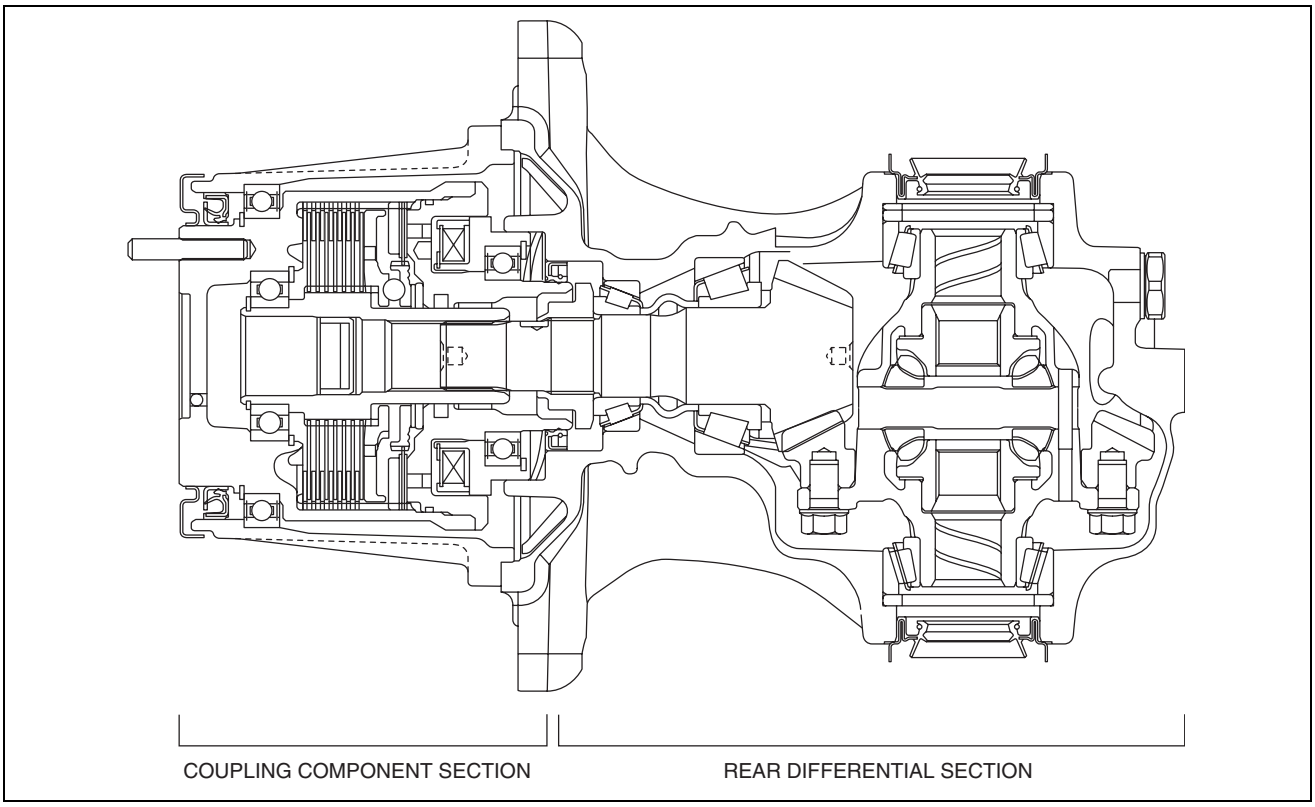
REAR DIFFERENTIAL

id031400100600

Purpose, Function

- A rear differential with an integrated coupling component has been adopted, reducing size and weight.
- An aluminum differential carrier has been adopted, reducing weight.

Cross-Sectional View



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03-16 TRANSFER

TRANSFER

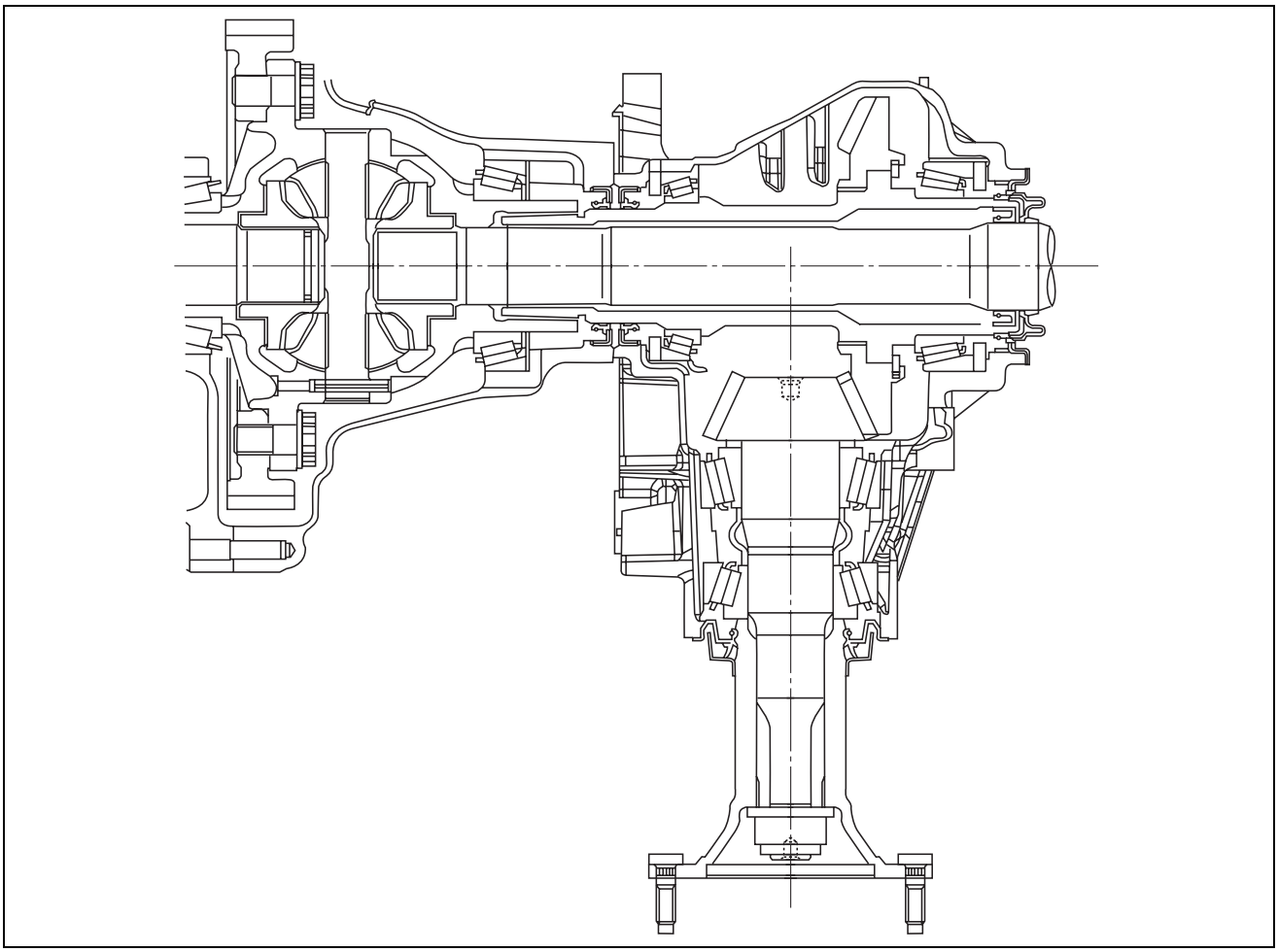
TRANSFER

id031600140100

Purpose, Function

- A transfer with simple, one-axis construction has been adopted for size and weight reduction.
- A thinner transfer case has been adopted for weight reduction.

Cross-sectional View



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03-18 4-WHEEL DRIVE

4-WHEEL DRIVE

ELECTRONIC CONTROL COUPLING

id031800101900

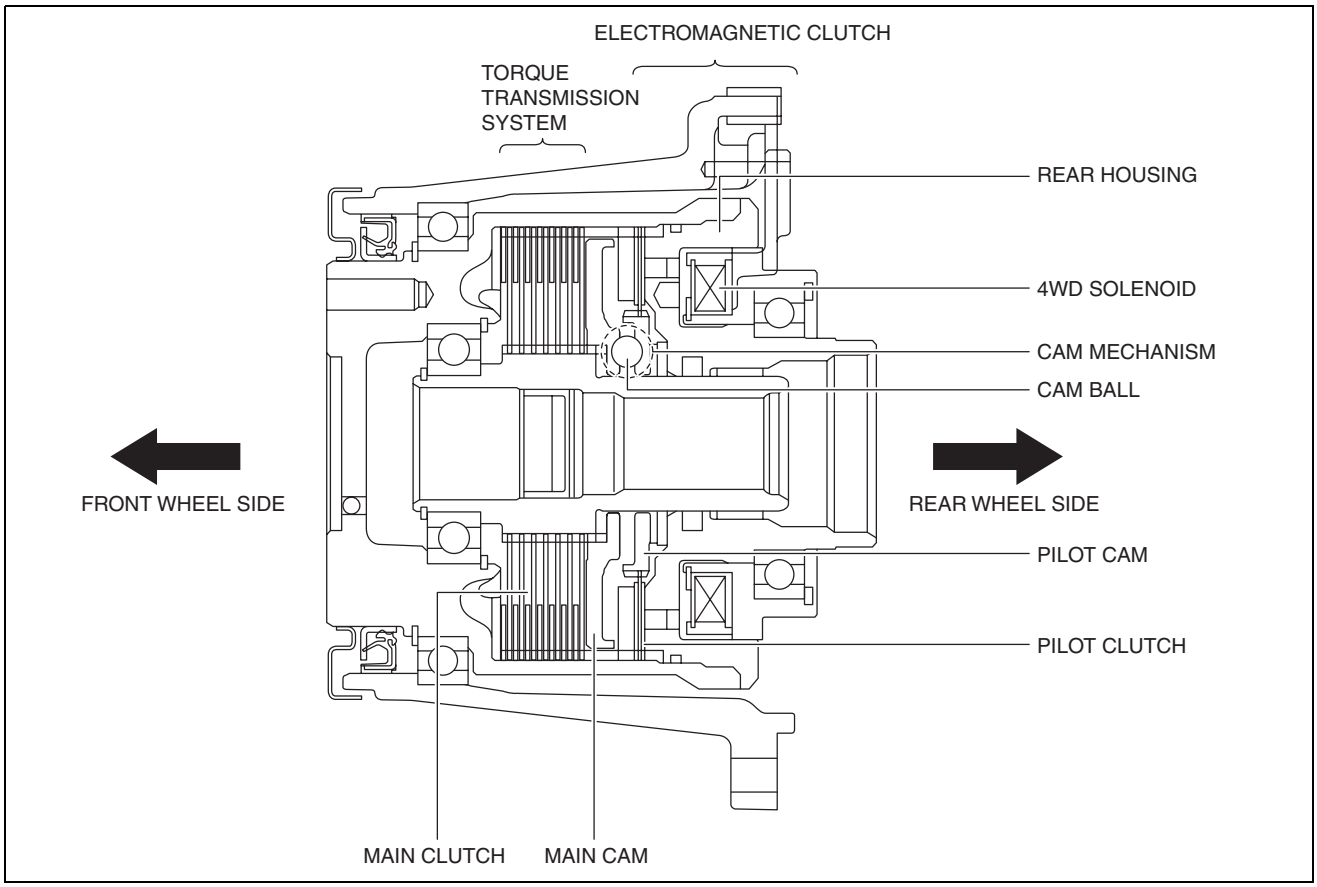
Purpose, Function

- An electromagnetic clutch, which operates smoothly due to the lack influence from the front and rear wheel traction force, has been adopted for the electronic control coupling system.

Construction

- The construction of the coupling enables the torque formed by the pilot clutch to be amplified by the cam mechanism, thus allowing the main clutch to obtain a high degree of torque. Due to this, size and weight reduction of the component parts has been achieved.
- The electronic control coupling basically consists of an electromagnetic clutch, a cam mechanism and a torque transmission system.
- The electromagnetic clutch consists of a 4WD solenoid (electromagnetic coil), rear-housing that forms a magnetic path, pilot clutch, and armature.
- The cam mechanism consists of a pilot cam, balls, and main cam. The torque transmission system consists of a main clutch and hydraulic oil (ATF).

4-WHEEL DRIVE



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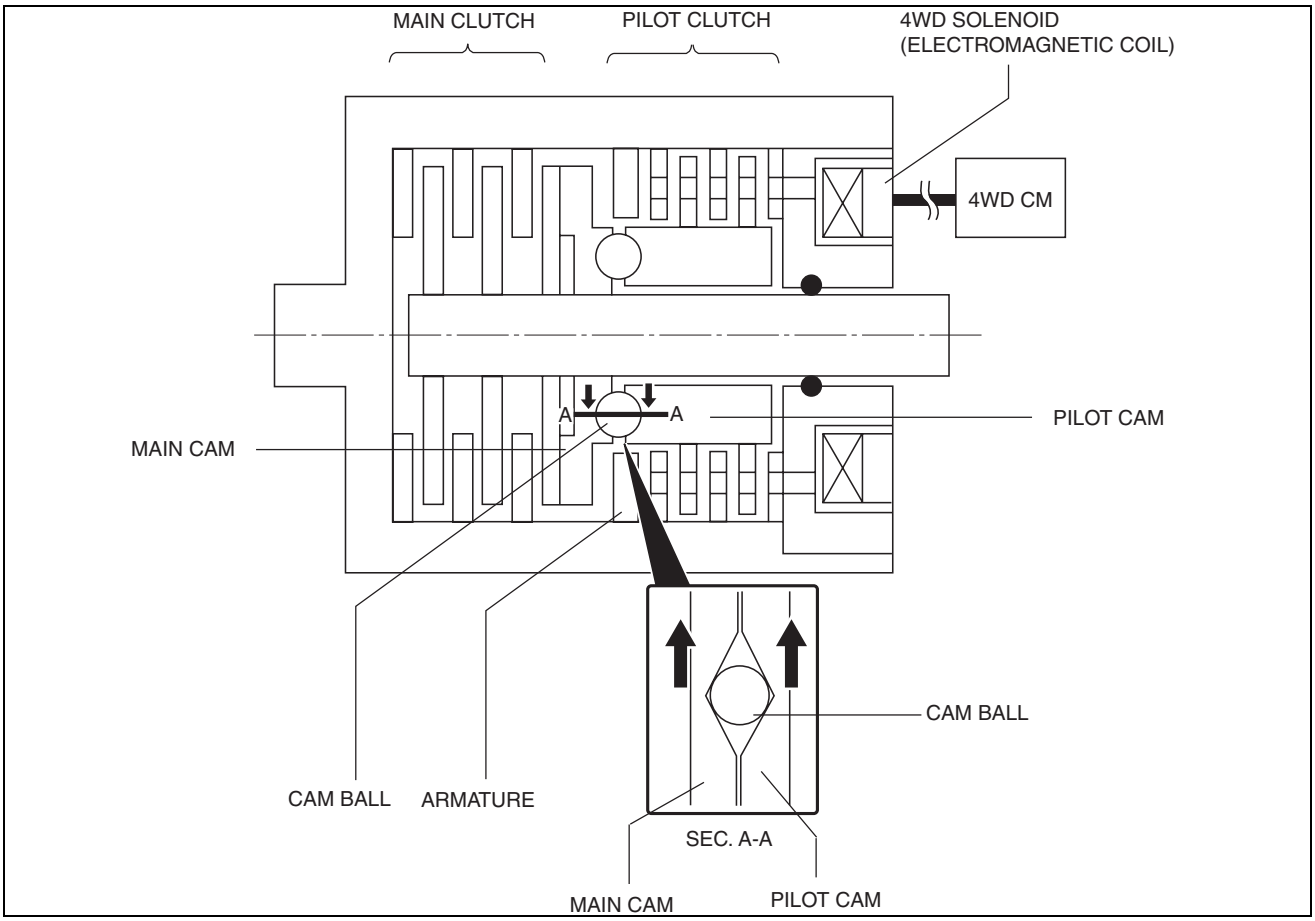
Operation

4WD Solenoid Control Current Is OFF

- When the 4WD solenoid control current is OFF, no torque is generated in the pilot clutch because there is no current flowing to the 4WD solenoid.
- At the same time, the pilot cam and the main cam rotate in the same direction via the balls, and the main cam does not exert any push force on the main clutch side. Therefore, the traction from the front wheels is not transmitted to the rear wheels.

4-WHEEL DRIVE



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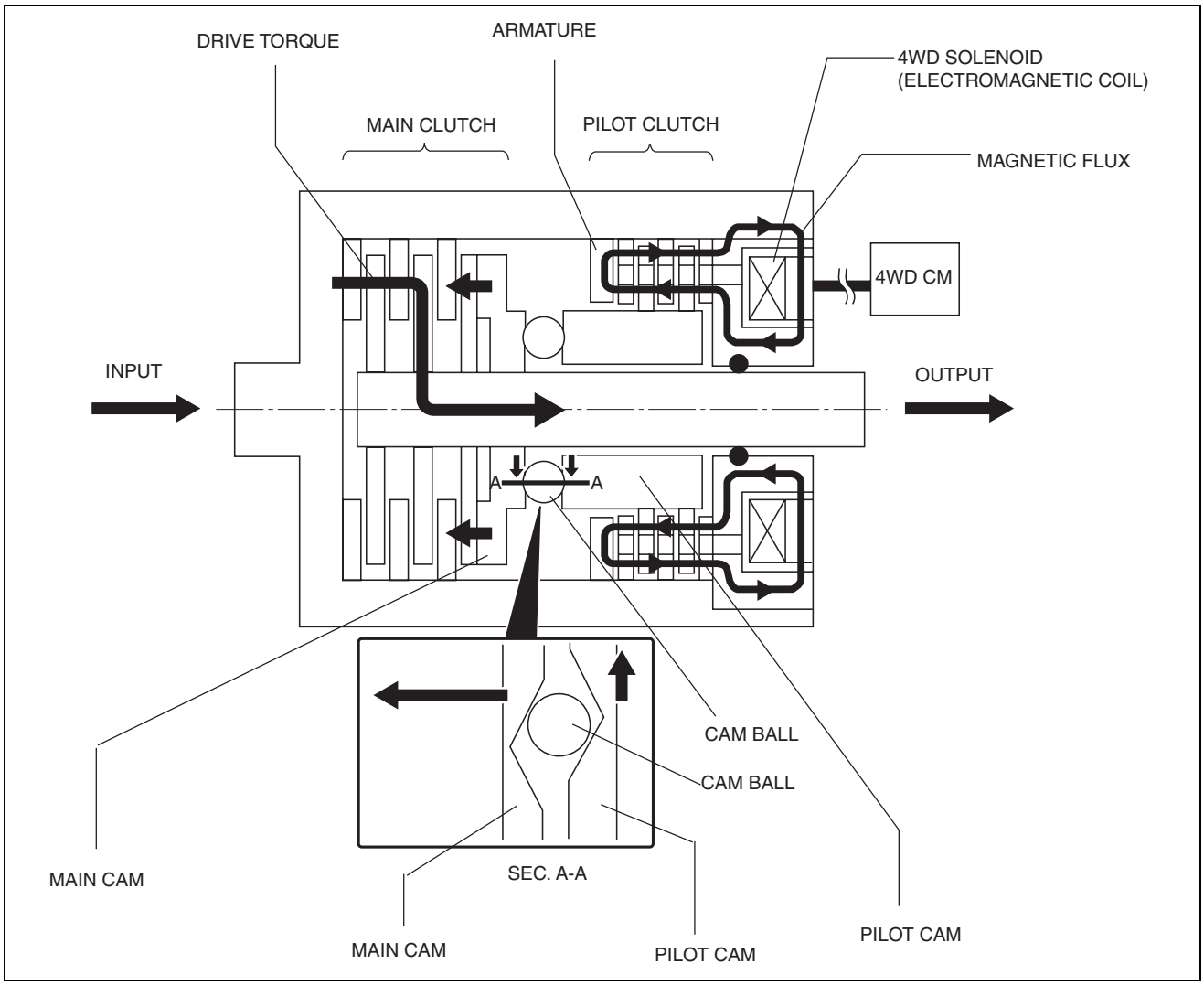
4WD Solenoid Control Current Is ON

- When the 4WD solenoid control current is ON, current flows from the 4WD CM to the 4WD solenoid, and the coupling operates in the following manner.
  1. Magnetic flux forms at the electromagnetic coil of the 4WD solenoid.
  2. Due to the magnetic flux in the armature, the pilot clutch is suctioned towards the magnetic coil side and made to engage. This causes frictional torque to generate in the pilot clutch.
  3. The torque is transmitted to the pilot cam, which is engaged with the pilot clutch.
  4. A rotational difference is created between the pilot cam and the main cam. Due to this relative torsion, the cam mechanism operates, transmitting torque from the pilot cam to the ball and then to the main cam. In this way, the push force exerted on the main clutch is amplified.
  5. As the main clutch engages, the drive torque from the front wheels is transmitted to the rear wheels.
- The amount of push force exerted on the main clutch by the main cam (that is, the strength of the drive torque transmitted to the rear wheels) changes in accordance with the proportion of the force acting upon the pilot cam, engaged with the pilot clutch.
- Therefore, by changing the periodicity of the electric current from the 4WD CM to the 4WD solenoid (ON/OFF rate of the 4WD solenoid = force acting on the pilot cam), the module controls the transmission of drive torque to the rear wheels.

4-WHEEL DRIVE



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Fail-safe

DTC	Fail-safe
P1887:11 P1887:12 P1887:13 P1887:14	Control disabled.

4-WHEEL DRIVE SYSTEM

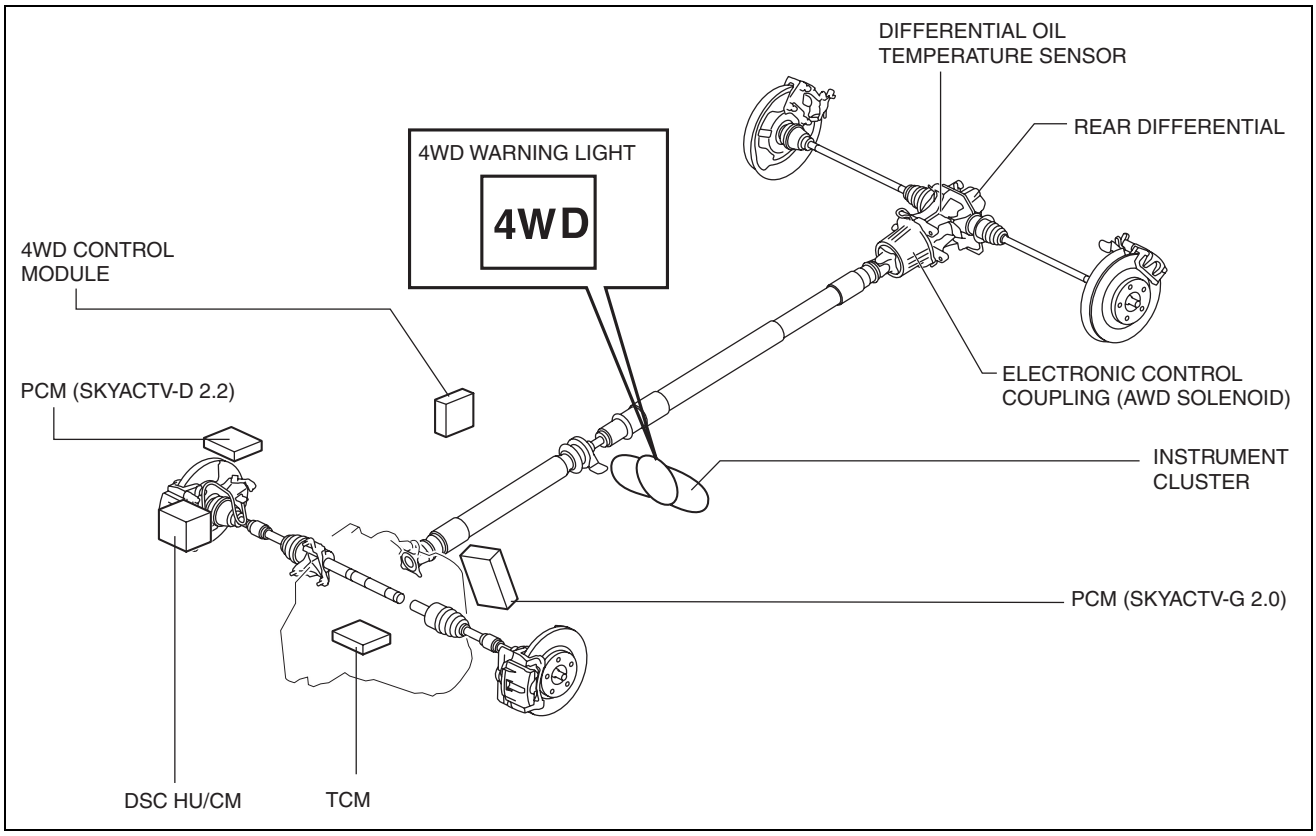
id031800170000

Outline

- The electronic 4-wheel drive (4WD) control system automatically and optimally controls drive torque distribution for the front and rear wheels. Due to this off-road mobility and driving stability are improved.
- Based on the input signals from each sensor, the 4WD control module (CM) determines vehicle driving and road conditions, and controls output current to the electronic control coupling (4WD solenoid) inside the rear differential. This control allows for optimal distribution of the drive torque from the engine to the rear wheels.
- Also, the 4WD CM automatically controls the 4WD, greatly reducing the load on the driver and improving operability.

4-WHEEL DRIVE

Structural View



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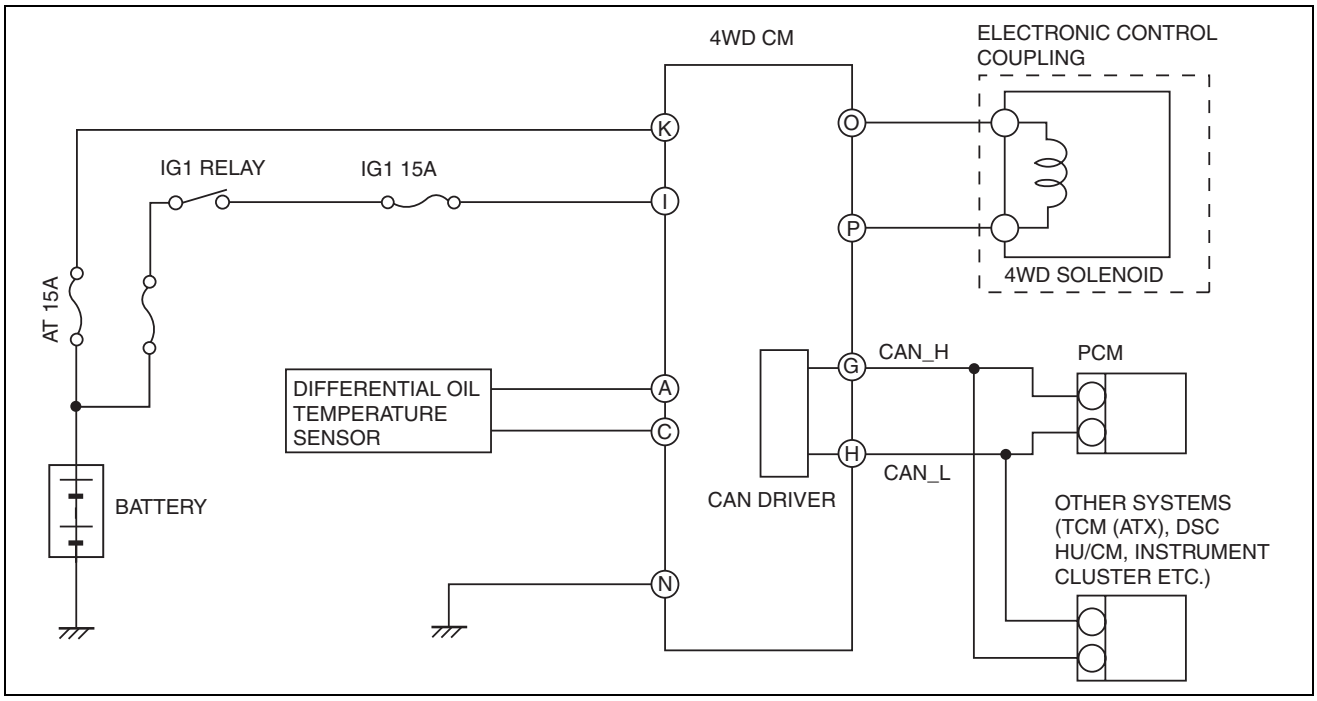
Structure

- Consists of the following parts:

Electronic control coupling (4WD solenoid)	(See 03-18-1 ELECTRONIC CONTROL COUPLING.)
4WD CM	(See 03-18-8 4WD CONTROL MODULE.)
Differential oil temperature sensor	(See 03-18-9 OIL TEMPERATURE SENSOR.)
4WD warning light	(See 03-18-9 4WD WARNING LIGHT.)

4-WHEEL DRIVE

System Diagram



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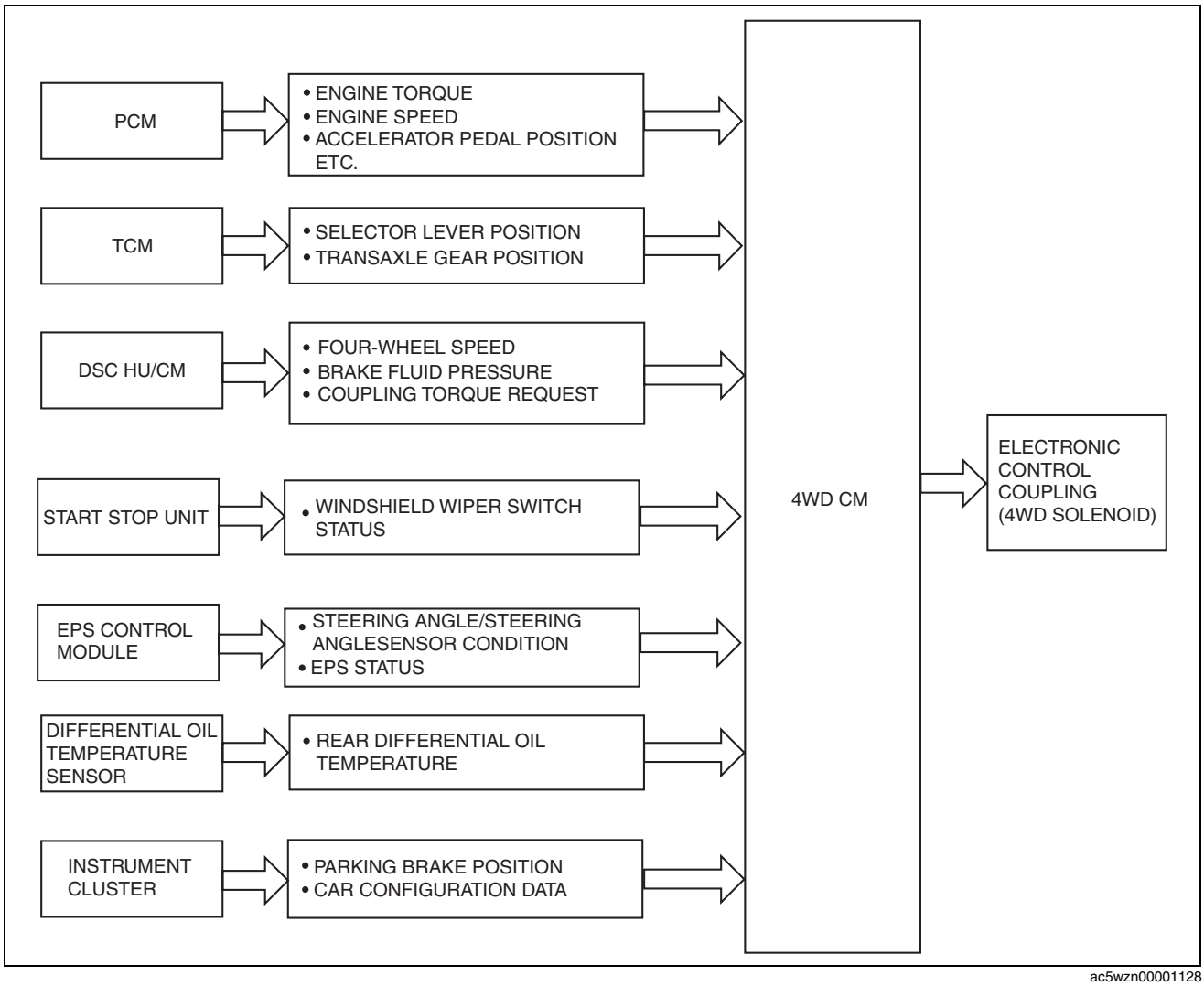
Features

- Based on the inputted signals listed below, the 4WD CM calculates the optimal amount of torque distribution for the rear wheels and outputs a corresponding electric control current to the electronic control coupling (4WD solenoid).
- The module controls the current outputted to the 4WD solenoid by changing the rate of the ON/OFF timing.

Signal output part	Signal name	Note
PCM	Engine speed Engine torque Accelerator pedal position Clutch pedal position Transaxle gear position (MTX) Neutral switch status Cruise control status Engine off time Ambient temperature Car configuration data	Transmitted as a CAN signal
TCM	Selector lever position Transaxle gear position (ATX)	
DSC HU/CM	Four-wheel speed Brake fluid pressure Coupling torque request	
EPS control module	Steering angle/steering angle sensor condition EPS status	
Start stop unit	Windshield wiper switch status	
Instrument cluster	Parking brake position Car configuration data	
Differential oil temperature sensor	Rear differential oil temperature	—

4-WHEEL DRIVE

Block Diagram



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Operation

Normal Control

- When starting off or accelerating during straight-ahead driving, torque transmitted to the rear wheels is optimally controlled to ensure sufficient acceleration performance. Due to this, standing-start and acceleration performance is improved.
- If a parking brake signal input to the 4WD CM indicates, the module controls the torque transmitted to the rear wheels.

Tight Cornering Control

- When the 4WD CM determines that the vehicle is in tight cornering, it reduces the torque transmitted to the rear wheels to avoid tight corner braking characteristics.

Integrated DSC Control

- If a signal from the DSC HU/CM input to the 4WD CM indicates that ABS control is activated, the module controls the torque transmitted to the rear wheels to prevent undue influence on ABS control.
- Also, when a coupling torque request signal is received from the DSC HU/CM, the module controls the torque transmitted to the rear wheels to match the amount of requested torque.

Other Control

- In case the rear differential oil temperature exceeds the specified amount, or when there is an unusually large variation in the rotation speed of the front and rear wheels (ex. when trying to get unstuck), control is temporarily suspended in order to protect the 4WD system. When this occurs the 4WD warning light flashes to indicate the situation to the driver.

4-WHEEL DRIVE

4WD CONTROL MODULE

id031800171000

Purpose, Function

- The 4WD CM calculates the optimal amount of torque distribution for the rear wheels and outputs a corresponding electric current to the electronic control coupling (4WD solenoid). This calculation is based on the accelerator pedal angle, four-wheel speed, engine speed, and other related input signals, matched with the vehicle driving and road surface conditions.

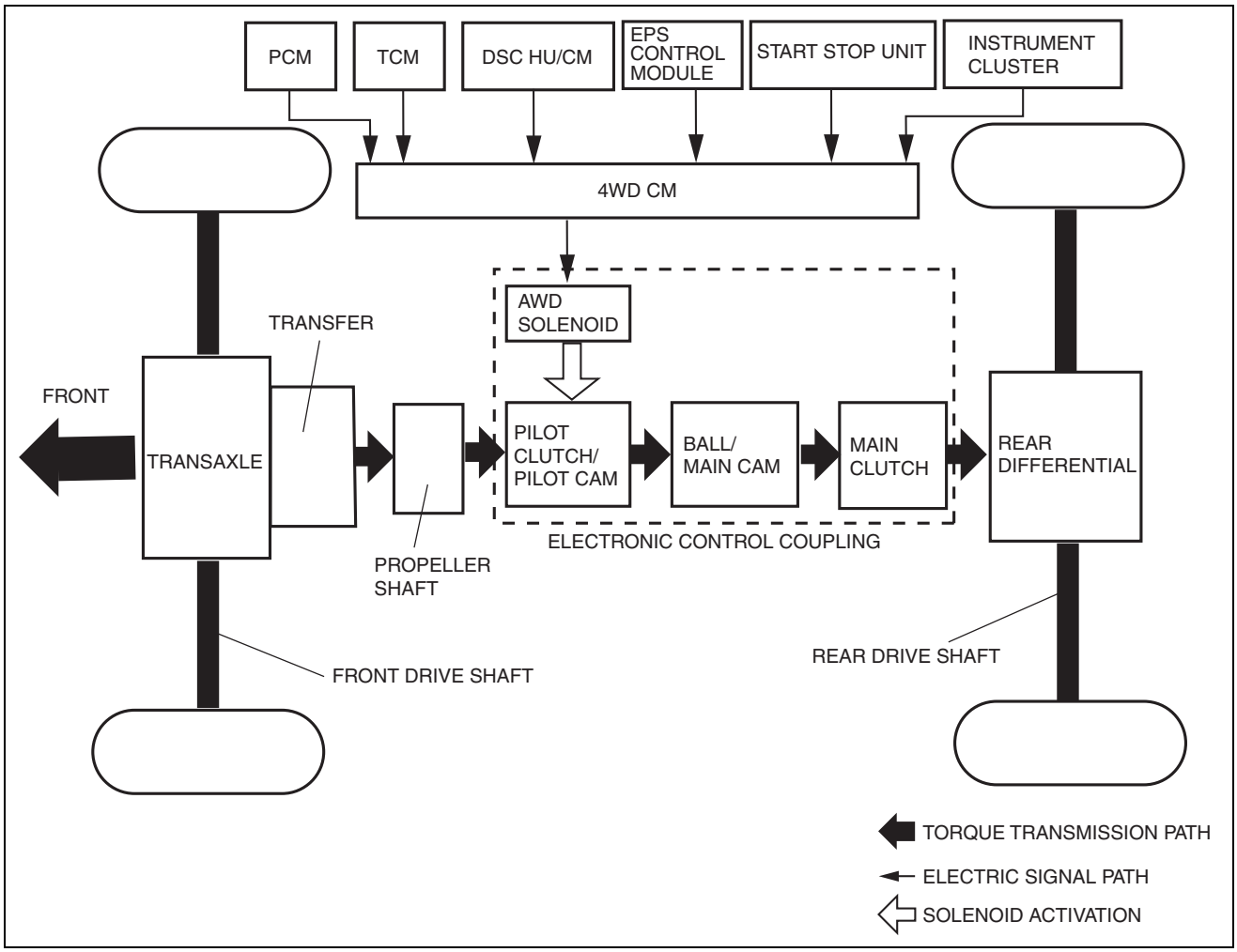
Function table

Function name	Contents
4WD system control function	• Based on each input signal, the electronic control current sent to the electronic control coupling (4WD solenoid) is optimally controlled.
Diagnostic system	• If the self-diagnostic system detects a malfunction, the 4WD warning light illuminates to alert the driver, and at the same time the system suspends control or performs other measures to prevent a loss of driving stability and protect the system. • The detected malfunction is stored as a DTC in the 4WD CM.

Construction

- The 4WD CM is installed to the right of the dashboard. (Passenger side)

Block Diagram



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Fail-safe

DTC	Fail-safe
P164D:00	4WD operates by the specified data.
P182F:00	4WD protection condition (4WD control paused)
P187B:00	Control disabled.
P1886:00	Control disabled.

4-WHEEL DRIVE

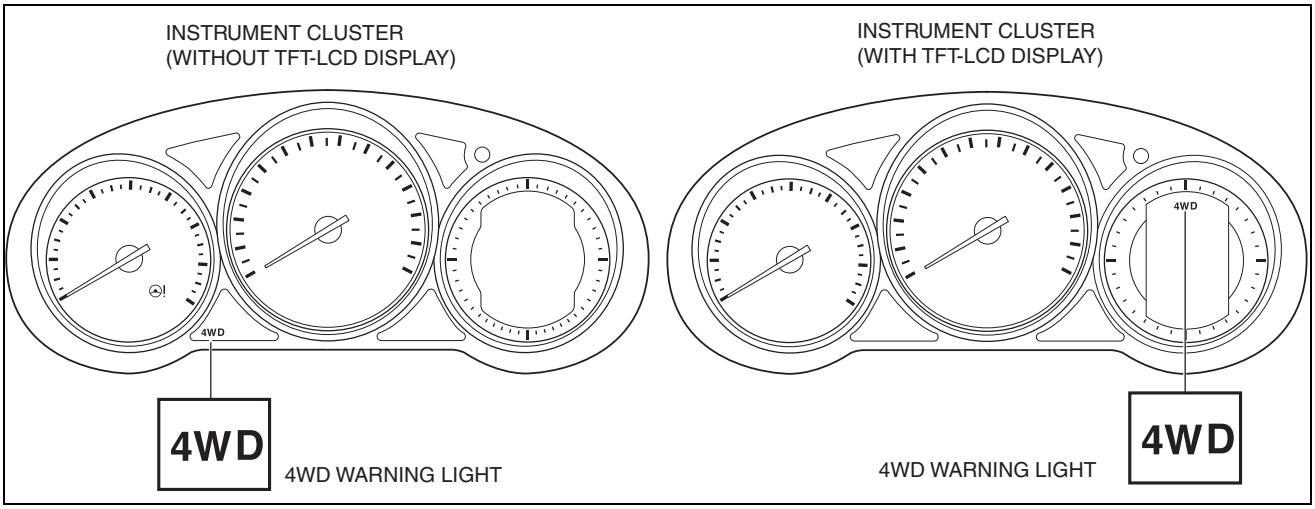
DTC	Fail-safe
P188A:00	4WD protection condition (4WD control paused)
U2100:00	4WD operates by the specified data.

4WD WARNING LIGHT

id031800172000

Purpose, Function
- Warns the driver of a 4WD system malfunction.

Construction
- The 4WD warning light is built into the instrument cluster.



Operation
- If the self-diagnostic function stores a DTC, the warning light illuminates to alert the driver of the malfunction. If system control is temporarily suspended due to the rear differential oil temperature becoming abnormally hot or similar cause, the warning light flashes to alert the driver.
- The 4WD CM controls the operation of the warning light.

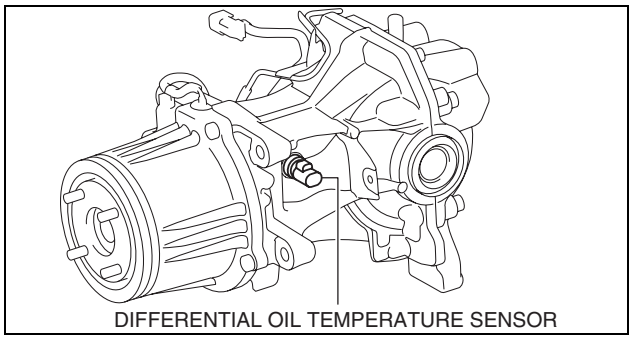
Fail-safe
- Function not equipped.

OIL TEMPERATURE SENSOR

id031800110300

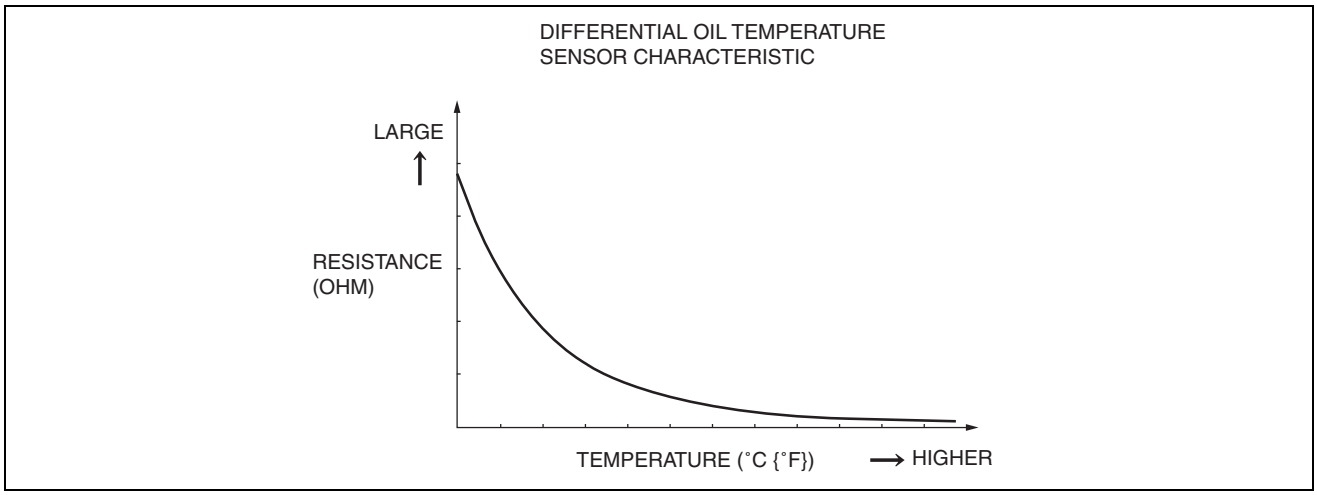
Purpose, Function
- The differential oil temperature sensor detects the rear differential oil temperature based on the resistance of the thermistor, and inputs it to the 4WD CM.

Construction
- The differential oil temperature sensor is installed in the rear differential carrier.



Operation
- The differential oil temperature sensor uses a thermistor whose resistance changes according to changes in the rear differential oil temperature.

- The resistance grows smaller as the oil temperature rises and vice-versa, as shown.



Fail-safe

DTC	Fail-safe
P1888:11 P1888:15	Control disabled.

CONTROLLER AREA NETWORK (CAN)

id031800167100

Outline

- The 4WD control module (CM) sends and receives data to and from other modules via the CAN system. Refer to MULTIPLEX COMMUNICATION SYSTEM for a detailed explanation of the CAN system. (See 10-40-1 CONTROLLER AREA NETWORK (CAN) SYSTEM.)

Data sent

- 4WD system status

Data received

- Engine speed
- Engine torque
- Accelerator pedal opening angle
- Clutch pedal position
- Transaxle gear position
- Neutral switch status
- Engine off time
- Ambient temperature
- Car configuration data
- Selector lever position
- Four-wheel speed
- Brake fluid pressure
- Coupling torque request
- Steering angle/steering angle sensor condition
- EPS status
- Windshield wiper switch status
- Parking brake position

BRAKES

04
SECTION

04-00 OUTLINE

OUTLINE

BRAKES

id040000160800

Abbreviations

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position
CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle
DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System
HBC	High Beam Control
HF/TEL	Hands-Free Telephone
HI	High
HS	High Speed

OUTLINE

HU	Hydraulic Unit
IDS	Integrated Diagnostic Software
IG	Ignition
IN	Intake
INT	Intermittent
KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear
2GR	Second Gear
2WD	2-Wheel Drive
3GR	Third Gear
4GR	Fourth Gear

OUTLINE

4WD	4-Wheel Drive
5GR	Fifth Gear
6GR	Sixth Gear

Features

Improved safety	• Intrusion minimizing brake pedal adopted • ABS adopted • Electronic brakeforce distribution (EBD) control adopted • Dynamic stability control (DSC) adopted • Roll over mitigation (ROM) adopted • Electrical brake assist control adopted • Vehicle roll prevention function adopted (ATX) • Hill launch assist (HLA) adopted • Tire pressure monitoring system (TPMS) adopted • Smart city brake support (SCBS) adopted (vehicles with smart city brake support (SCBS)) • Secondary collision reduction (SCR) adopted
Improved braking force	• Large diameter front disc brakes adopted • Large diameter rear disc brakes adopted • A vacuum pump adopted
Improved serviceability	• Enhanced malfunction diagnosis system for use with Mazda Modular Diagnostic System (M-MDS) • Center lever type parking brake, adjustable from vehicle interior, adopted
Size and weight reduction	• Integrated construction of the hydraulic unit (HU) and control module (CM) adopted for the DSC HU/CM
Improved brake pedal operability	• A master cylinder with smaller diameter long-stroke type has been adopted
Improved reliability	• Semi-conductor element type ABS wheel-speed sensor adopted • Magnetic encoder type ABS sensor rotor adopted • DSC HU/CM with built-in brake fluid pressure sensor • Receives the DSC control signal from the sophisticated air bag sensor (SAS) control module instead of the conventional combined sensor

Specifications

Item		Specification
Brake pedal	Type	Suspended design
	Pedal lever ratio	2.79
	Max. stroke (mm {in})	132.7 {5.224}
Master cylinder	Type	Tandem
	Cylinder bore (mm {in})	20.64 {0.8126}
Front brake (disc)	Type	Ventilated disc
	Cylinder bore (mm {in})	60.3 {2.37}
	Pad dimensions (area x thickness) (mm^2 x mm {in^2 x in})	European (L.H.D. U.K.) specs.: 5,890 × 10 {9.130 × 0.39} Australian, China, and General (L.H.D. R.H.D.) specs.: 6,000 × 10 {9.300 × 0.39}
	Disc plate dimensions (mm {in})	297 × 28 {11.7 × 1.1}
Rear brake (disc)	Type	Solid disc
	Cylinder bore (mm {in})	38.1 {1.50}
	Pad dimensions (area x thickness) (mm^2 x mm {in^2 x in})	2,800 × 8.5 {4.340 × 0.33}
	Disc plate dimensions (mm {in})	303 × 10 {11.9 × 0.39}
Power brake unit	Type	Vacuum multiplier, single diaphragm
	Outer diameter (mm {in})	248.5 {9.783}
Rear wheel braking force control device	Type	Electronic brakeforce distribution (EBD)
Brake piping	Piping layout	X pattern
Parking brake	Type	Mechanical design, rear two-wheel braking
	Operating method (application/release)	Manually operated lever design
	Play adjustment method	Auto-adjusting

OUTLINE

Item		Specification
Brake fluid	Type	European (L.H.D. U.K.) specs.: SAE J1703 or FMVSS116 DOT-3 or DOT-4 Australian, China, and General (L.H.D. R.H.D.) specs.: SAE J1703 or FMVSS116 DOT-3

04-02A ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

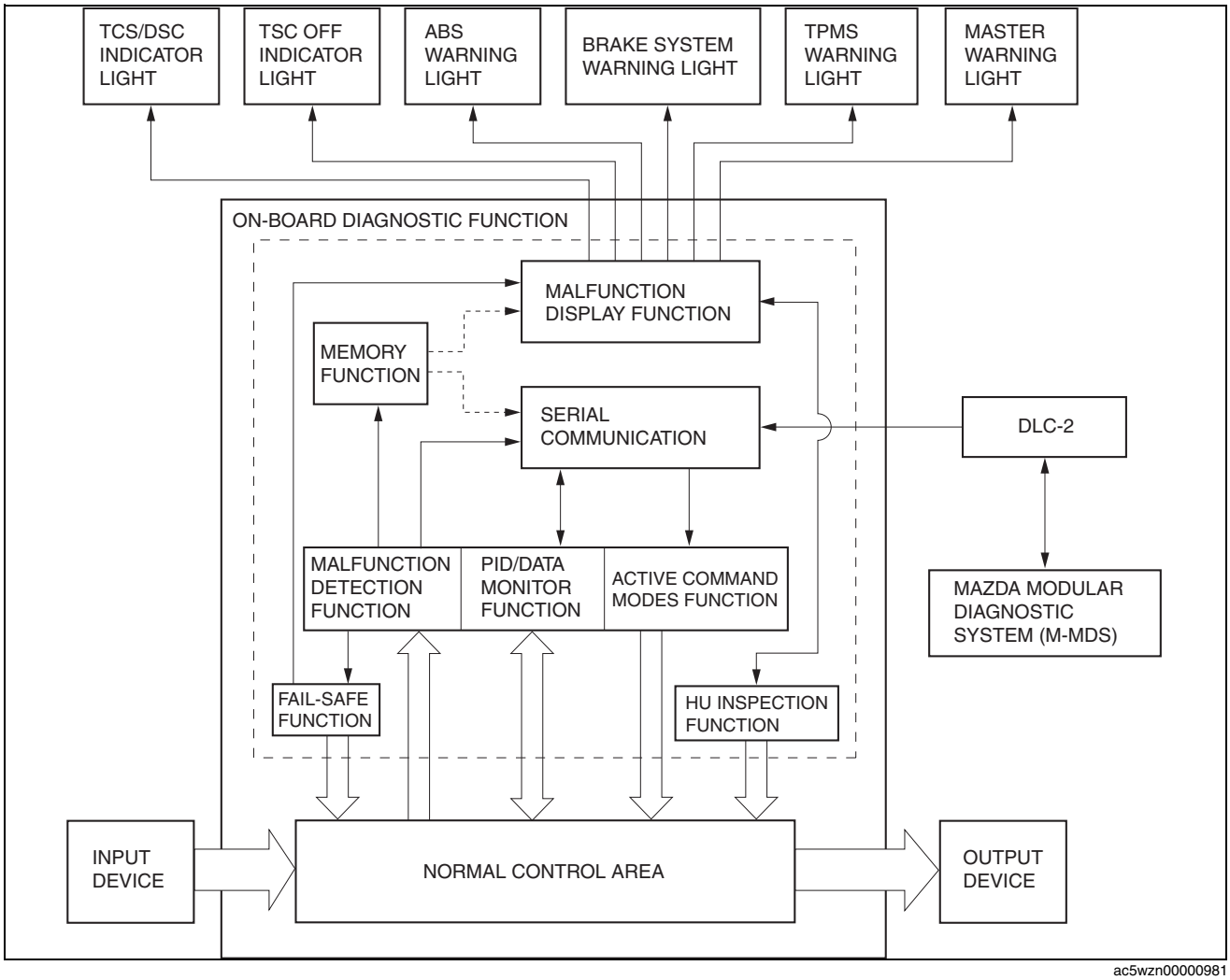
ON-BOARD DIAGNOSTIC SYSTEM [DYNAMIC STABILITY CONTROL (DSC)]

id0402b2181300

OUTLINE

- The on-board diagnostic system consists of a malfunction detection system that detects malfunctions in input/output signals when the ignition is switched to ON, a PID/data monitor function that reads out specified input/output signals, and an active command mode function that allows for override operation of output parts (such as solenoid valves).
- The data link connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis and detecting/repair into a single location, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the Mazda modular diagnostic system (M-MDS) to the DLC-2.
- In addition to DTC read-out, the Mazda modular diagnostic system (M-MDS) is used to clear DTCs using the display screen of the diagnostic tester, and to access the PID/data monitor and active command modes functions, providing enhanced malfunction diagnosis and improved serviceability.

Block diagram



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ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

FUNCTION

Malfunction detection function

- The malfunction detection function detects and displays malfunctions in the input/output signal system of the DSC HU/CM when the ignition is switched to ON.
- When the DSC HU/CM is activated, the following malfunction detection is performed.
  - — The ABS warning light, brake system warning light, TCS/DSC indicator light, TSC OFF indicator light, tire pressure monitoring system warning light and master warning light illuminate for **approx. 3.0 s** when the ignition is switched to ON to inspect for open circuits in the lights. At the same time, the input/output signals of each part is monitored for malfunction diagnosis. After starting to drive, the first time the vehicle speed is **approx. 10 km/h {6.2 mph} or more** the pump motor is operated and malfunction diagnosis is performed again. The input/output signals of each part are then constantly monitored and malfunctions are diagnosed.

Note

- When the pump motor operates, it is sound can be heard.

- If the above malfunctions are detected, the corresponding lights are illuminated to alert the driver. DTCs can be output through the CAN_H and CAN_L of the DLC-2 using the external tester communication function. At the same time, malfunction detection results are sent to the memory and fail-safe functions.

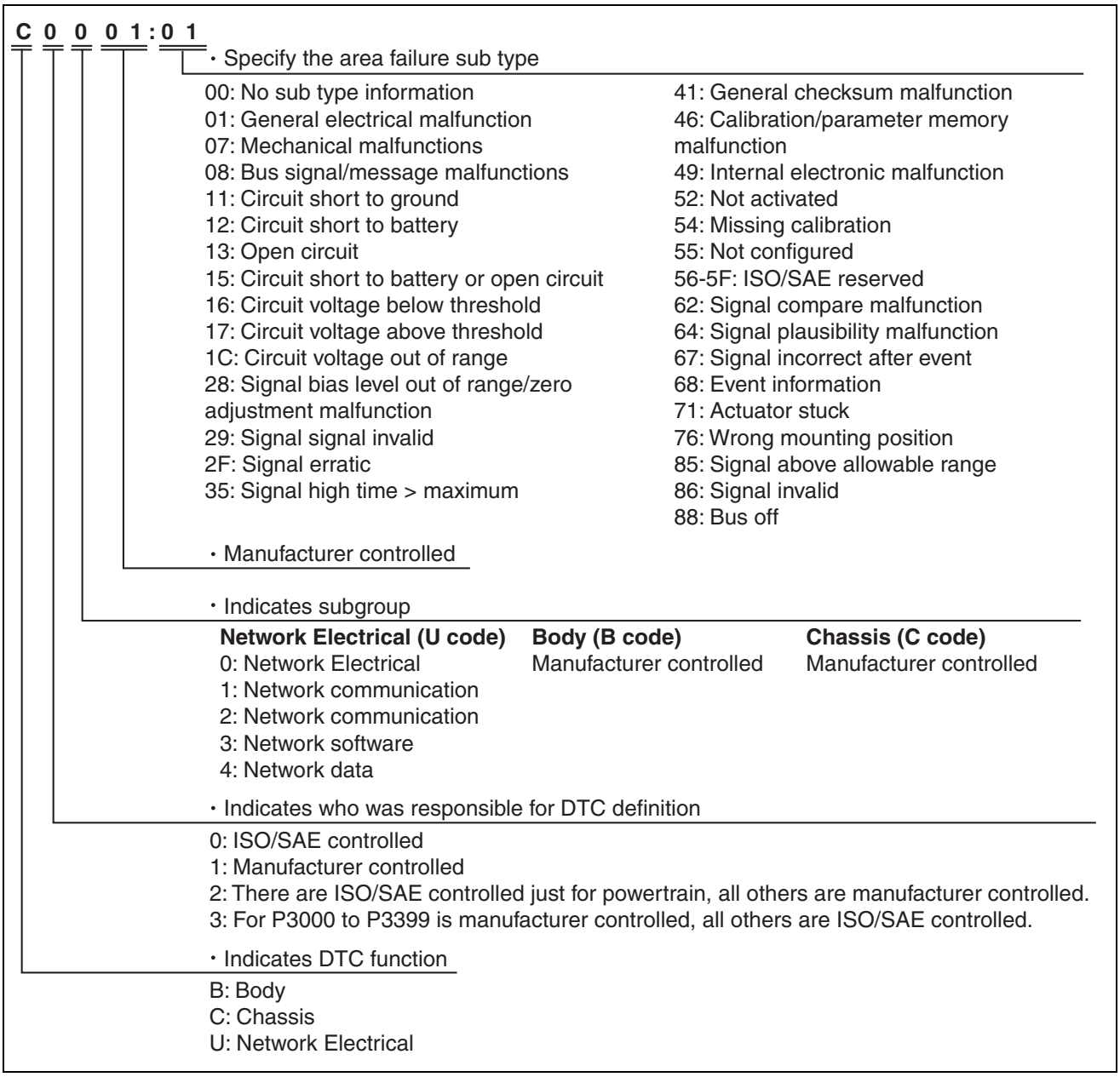
Memory function

- The memory function stores DTCs of malfunctions in input/output signal systems. With this function, once a DTC is stored it is not cleared after the ignition has been switched off, even if the malfunctioning signal system has returned to normal.
- Since the DSC HU/CM has a built-in non-volatile memory, DTCs are not cleared even if the battery is removed. Therefore, it is necessary to clear the memory after performing repairs. Refer to the Workshop Manual for the DTC clearing procedure.

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]



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Fail-safe function

- When the malfunction detection function determines a malfunction, the warning indicator light illuminates to alert the driver. At this time, the fail-safe function controls as indicated in the fail-safe function malfunction contents table.

Warning

- **If EBD control is prohibited, the rear wheels could lock-up before the front wheels. If this occurs, the vehicle could yaw and become unstable. Therefore, always inspect the system immediately if EBD control is prohibited.**

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

DTC table

×: Applicable
-: Not applicable/not illuminated

DTC No.	ABS warning light	Brake system warning light (when parking brake is released)	TCS/DSC indicator light	TCS OFF indicator light	Tire pressure monitoring system warning light	Master warning light*1	Malfunction location	Fail-safe	Drive cycle	Self test type*2	Memory function
B10DF:46	-	-	Illuminated	-	-	Illuminated	DSC HU/CM (internal malfunction)	×	-	C, D	×
B11D4:08*1	-	-	-	-	-	Illuminated	Laser sensor	×	-	C, D	×
C0001:01 C0002:01 C0003:01 C0004:01 C0010:01 C0011:01 C0014:01 C0015:01 C0018:01 C0019:01 C001C:01 C001D:01	Illuminated	Illuminated	Illuminated	-	-	Illuminated	DSC HU/CM internal malfunction (solenoid valve system)	×	-	C, D	×
C0020:11 C0020:12 C0020:13 C0020:71	Illuminated	-	Illuminated	-	-	Illuminated	Pump motor, motor relay	×	-	C, D	×
C0023:62*1	-	-	-	-	-	Illuminated	Brake switch	×	-	C, D	×
C0030:07	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	LF ABS sensor rotor	×	-	C, D	×
C0031:07							LF ABS wheel-speed sensor/ABS sensor rotor				
C0031:11 C0031:15	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	LF ABS wheel-speed sensor	×	-	C, D	×

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

DTC No.	ABS warning light	Brake system warning light (when parking brake is released)	TCS/DSC indicator light	TCS OFF indicator light	Tire pressure monitoring system warning light	Master warning light*1	Malfunction location	Fail-safe	Drive cycle	Self test type*2	Memory function
C0031:29 C0031:2F C0031:64	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	LF ABS wheel-speed sensor/ABS sensor rotor	×	-	C, D	×
C0033:07	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	RF ABS sensor rotor	×	-	C, D	×
C0034:07							RF ABS wheel-speed sensor/ABS sensor rotor				
C0034:11 C0034:15	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	RF ABS wheel-speed sensor	×	-	C, D	×
C0034:29 C0034:2F C0034:64	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	RF ABS wheel-speed sensor/ABS sensor rotor	×	-	C, D	×
C0036:07	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	LR ABS sensor rotor	×	-	C, D	×
C0037:07							LR ABS wheel-speed sensor/ABS sensor rotor				
C0037:11 C0037:15	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	LR ABS wheel-speed sensor	×	-	C, D	×
C0037:29 C0037:2F C0037:64	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	LR ABS wheel-speed sensor/ABS sensor rotor	×	-	C, D	×
C0039:07	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	RR ABS sensor rotor	×	-	C, D	×
C003A:07							RR ABS wheel-speed sensor/ABS sensor rotor				
C003A:11 C003A:15	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	RR ABS wheel-speed sensor	×	-	C, D	×
C003A:29 C003A:2F C003A:64	Illuminated	-*3	Illuminated	-	Flashes*4	Illuminated	RR ABS wheel-speed sensor/ABS sensor rotor	×	-	C, D	×
C0040:64	-	-	Illuminated	-	Flashes*4	Illuminated	Brake switch	×	-	C, D	×

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

DTC No.	ABS warning light	Brake system warning light (when parking brake is released)	TCS/DSC indicator light	TCS OFF indicator light	Tire pressure monitoring system warning light	Master warning light*1	Malfunction location	Fail-safe	Drive cycle	Self test type*2	Memory function
C0044:01	-	-	Illuminated	-	Flashes*4*5	Illuminated*6	Brake fluid pressure sensor	×	-	C, D	×
C0044:28	-	-	Illuminated	-	Flashes*4	Illuminated					
C0044:54	-	-	Illuminated	-	Flashes*4*5	Illuminated*6					
C0044:64	-	-	Illuminated	-	Flashes*4	Illuminated					
C0051:62 C0051:64	-	-	Illuminated	-	Flashes*4	Illuminated	Steering angle sensor	×	-	C, D	×
C0051:67	-	-	Illuminated	-	-	Illuminated					
C0051:85	-	-	Illuminated	-	Flashes*4	Illuminated					
C0061:28	-	-	Illuminated	-	Flashes*4	Illuminated	SAS control module system	×	-	C, D	×
C0061:54	Illuminated*6	-	Illuminated	-	Flashes*4*5	Illuminated*6	DSC HU/CM system (unperformed initialization procedure)	×	-	C, D	×
C0061:64	-	-	Illuminated	-	Flashes*4	Illuminated	SAS control module system	×	-	C, D	×
C0062:28	Illuminated*6	-	Illuminated	-	-	Illuminated*6					
C0062:54	Illuminated*6	-	Illuminated	-	Flashes*4*5	Illuminated*6	DSC HU/CM system (unperformed initialization procedure)	×	-	C, D	×
C0062:64	Illuminated*6	-	Illuminated	-	-	Illuminated*6	SAS control module system	×	-	C, D	×
C0062:76	Illuminated*6	-	Illuminated	-	Flashes*4*5	Illuminated*6	SAS control module system	×	-	C, D	×
C0063:28	-	-	Illuminated	-	Flashes*4	Illuminated	SAS control module system	×	-	C, D	×
C0063:54	Illuminated*6	-	Illuminated	-	Flashes*4*5	Illuminated*6	DSC HU/CM system (unperformed initialization procedure)	×	-	C, D	×
C0063:64	-	-	Illuminated	-	Flashes*4	Illuminated	SAS control module system	×	-	C, D	×
C006B:00	-	-	Illuminated	-	Flashes*4	Illuminated	TCS/DSC control system	×	-	C, D	×
C0072:68			-*9		-	-					
C0089:64	-	-	-	-	-	-	TCS OFF switch	-	-	C, D	×

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

DTC No.	ABS warning light	Brake system warning light (when parking brake is released)	TCS/DSC indicator light	TCS OFF indicator light	Tire pressure monitoring system warning light	Master warning light*1	Malfunction location	Fail-safe	Drive cycle	Self test type*2	Memory function
C1031:35	-	-	-	-	Flashes*4	-	Tire pressure monitoring system (TPMS) set switch	×	-	C, D	×
C1031:41 C1031:54 C1031:68	-	-	-	-	Flashes*4	-	Tire pressure monitoring system (TPMS) system	×	-	C, D	×
C1A08:1C	-	-	Illuminated	-	Flashes*4	Illuminated	DSC HU/CM (internal malfunction)	×	-	C, D	×
U0001:88	Illuminated	-	Illuminated	-	Flashes*4	Illuminated	CAN line	×	-	C, D	×
U0100:00	Illuminated*6	-	Illuminated*6	-	Flashes*4*5	Illuminated*6					
U0101:00*7	-	-	Illuminated	-	Flashes*4	Illuminated					
U0114:00*8	-	-	-	-	Flashes*4	-					
U0131:00	-	-	Illuminated	-	Flashes*4	Illuminated					
U0151:00	-	Illuminated*6	Illuminated	-	Flashes*4*5	Illuminated*6	SAS control module system (CAN2 line malfunction)	×	-	C, D	×
U0154:00	-	-	Illuminated	-	-	-	CAN line	×	-	C, D	×
U0155:00	Illuminated*6	-	Illuminated*6	-	Flashes*4*5	Illuminated*6					
U0235:00*1	-	-	-	-	-	Illuminated					
U0401:00	-	-	Illuminated*6	-	Flashes*4*5	Illuminated*6	Abnormal message from PCM	×	-	C, D	×
U0402:00*7	-	-	Illuminated	-	Flashes*4	Illuminated	Abnormal message from transmission/ transaxle	×	-	C, D	×
U0420:00	-	-	Illuminated	-	Flashes*4	Illuminated	Abnormal message from EPS CM	×	-	C, D	×
U0423:00	-	-	-	-	Flashes*4	Illuminated	Abnormal message from instrument cluster	×	-	C, D	×
U0433:00*1	-	-	-	-	-	Illuminated	Abnormal message from laser sensor	×	-	C, D	×

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

DTC No.	ABS warning light	Brake system warning light (when parking brake is released)	TCS/DSC indicator light	TCS OFF indicator light	Tire pressure monitoring system warning light	Master warning light*1	Malfunction location	Fail-safe	Drive cycle	Self test type*2	Memory function
U0443:00	-	-	-	-	-	Illuminated	Abnormal message from instrument cluster	×	-	C, D	×
U0452:00	-	-	Illuminated	-	-	-	Abnormal message from SAS control module	×	-	C, D	×
U0452:86	Illuminated*6	-	Illuminated	-	Flashes*4*5	Illuminated*6					
U2007:46	-	-	Illuminated	-	-	Illuminated	DSC HU/CM (internal malfunction)	×	-	C, D	×
U2007:62	Illuminated	Illuminated	Illuminated	-	-	Illuminated	DSC HU/CM (internal malfunction)	×	-	C, D	×
U2101:00	Illuminated	-	Illuminated	-	Flashes*4	Illuminated	Configuration data not recorded	×	-	C, D	×
U2107:68*1	-	-	-	-	-	Illuminated	Laser sensor	×	-	C, D	×
U2300:52 U2300:54 U2300:55 U2300:56 U2300:64	Illuminated	-	Illuminated	-	Flashes*4	Illuminated	Configuration data not recorded	×	-	C, D	×
U3000:49	Illuminated*6	Illuminated*6	Illuminated	-	Flashes*4*5	Illuminated	DSC HU/CM (internal malfunction)	×	-	C, D	×
U3003:08	-	-	-	-	-	-	Power supply system	-	-	C, D	×
U3003:16	Illuminated	-*10 Illuminated*11*12	Illuminated	-	Flashes*4	Illuminated		×			
U3003:17	Illuminated	Illuminated	Illuminated	-	Flashes*4	Illuminated					

*1 : Vehicles with smart city brake support (SCBS)
*2 : C: CMDTC self-test, D: ODDTC self-test
*3 : Illuminates when two wheels or more have a malfunction.
*4 : Tire pressure monitoring system warning light illuminates after flashes.
*5 : Not illuminated/flashed depending on malfunction content.
*6 : Not illuminated depending on malfunction content.
*7 : ATX only
*8 : 4WD only
*9 : Turns on if the slip of a specific wheel is **10km/h {6.2 mph} or more**.
*10 : When power supply voltage is **7.9—9.6 V** for **550 ms or more**.
*11 : When power supply voltage is **6.0—7.9 V** for **630 ms or more**.
*12 : When power supply voltage is **below 6 V** for **50 ms or more**.

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

Fail-safe Function Malfunction Contents

DTC No.	Fail-safe function											
	Control status											
	ABS control	EBD control	TCS Control		DSC Control	Roll over mitigation (ROM)	Brake assist control	Vehicle roll prevention function *1	Hill launch assist (HLA)	Tire pressure monitoring system (TPMS)	Smart city brake support (SCBS) *2	Secondary collision reduction (SCR)
			Brake control	Engine control								
B10DF:46	Controlled	Controlled	Control disabled		Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
B11D4:08 *2	Controlled	Controlled	Control enabled		Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
C0001:01 C0002:01 C0003:01 C0004:01 C0010:01 C0011:01 C0014:01 C0015:01 C0018:01 C0019:01 C001C:01 C001D:01	Controlled	Controlled	Control disabled		Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
C0020:11 C0020:12 C0020:13 C0020:71	Controlled	Controlled	Control disabled		Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
C0023:62 *2	Controlled	Controlled	Control enabled		Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
C0030:07 C0031:07 C0031:11 C0031:15 C0031:29 C0031:2F C0031:64	Controlled	Controlled *3	Control disabled		Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
C0033:07 C0034:07 C0034:11 C0034:15 C0034:29 C0034:2F C0034:64	Controlled	Controlled *3	Control disabled		Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
C0036:07 C0037:07 C0037:11 C0037:15 C0037:29 C0037:2F C0037:64	Controlled	Controlled *3	Control disabled		Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

DTC No.	Fail-safe function											
	Control status											
	ABS control	EBD control	TCS Control		DSC Control	Roll over mitigation (ROM)	Brake assist control	Vehicle roll prevention function*1	Hill launch assist (HLA)	Tire pressure monitoring system (TPMS)	Smart city brake support (SCBS) *2	Secondary collision reduction (SCR)
			Brake control	Engine control								
C0039:07 C003A:07 C003A:11 C003A:15 C003A:29 C003A:2F C003A:64	Control disabled	Control enabled*3	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
C0040:64	Control enabled	Control enabled	Control enabled		Control enabled	Control enabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control enabled
C0044:01	Control enabled	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4
C0044:28	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
C0044:54	Control enabled	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4
C0044:64	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
C0051:62 C0051:64	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
C0051:67	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
C0051:85	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
C0061:28	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
C0061:54	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4
C0061:64	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
C0062:28	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled	Control disabled	Control enabled	Control disabled*4	Control disabled*4
C0062:54	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4
C0062:64	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled	Control disabled	Control enabled	Control disabled*4	Control disabled*4
C0062:76	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled	Control disabled	Control disabled*4	Control disabled*4	Control disabled*4

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

DTC No.	Fail-safe function											
	Control status											
	ABS control	EBD control	TCS Control		DSC Control	Roll over mitigation (ROM)	Brake assist control	Vehicle roll prevention function*1	Hill launch assist (HLA)	Tire pressure monitoring system (TPMS)	Smart city brake support (SCBS) *2	Secondary collision reduction (SCR)
			Brake control	Engine control								
C0063:28	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
C0063:54	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4
C0063:64	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
C006B:00	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
C0072:68	Control enabled	Control enabled	Control disabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled
C0089:64	Control enabled											
C1031:35 C1031:41 C1031:54 C1031:68	Control enabled									Control disabled	Control enabled	
C1A08:1C	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
U0001:88	Control disabled	Control enabled	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
U0100:00	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4
U0101:00*1	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
U0114:00*5	Control enabled	Control enabled	Control enabled		Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled	Control enabled	Control enabled
U0131:00	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
U0151:00	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4
U0154:00	Control enabled	Control enabled	Control enabled		Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled
U0155:00	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4
U0235:00*2	Control enabled	Control enabled	Control enabled		Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled	Control enabled
U0401:00	Control enabled	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control enabled	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

DTC No.	Fail-safe function											
	Control status											
	ABS control	EBD control	TCS Control		DSC Control	Roll over mitigation (ROM)	Brake assist control	Vehicle roll prevention function*1	Hill launch assist (HLA)	Tire pressure monitoring system (TPMS)	Smart city brake support (SCBS) *2	Secondary collision reduction (SCR)
			Brake control	Engine control								
U0402:00*1	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
U0420:00	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
U0423:00	Control enabled	Control enabled	Control enabled		Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled	Control enabled
U0433:00*2	Control enabled	Control enabled	Control enabled		Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled	Control enabled
U0443:00	Control enabled	Control enabled	Control enabled		Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled	Control enabled
U0452:00	Control enabled	Control enabled	Control enabled		Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled
U0452:86	Control disabled*4	Control enabled	Control disabled*4		Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4	Control disabled*4
U2007:46	Control enabled	Control enabled	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control enabled	Control disabled	Control disabled
U2007:62	Control disabled	Control disabled	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control enabled	Control disabled	Control disabled
U2101:00	Control disabled	Control enabled	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
U2107:68*2	Control enabled	Control enabled	Control enabled		Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled	Control enabled
U2300:52	Control disabled	Control enabled	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
U2300:54												
U2300:55												
U2300:56												
U2300:64												
U3000:49	Control disabled*4	Control disabled*4	Control disabled		Control disabled	Control disabled	Control disabled*4	Control disabled	Control disabled	Control disabled*4	Control disabled	Control disabled
U3003:08	Control enabled											
U3003:16	Control disabled	Control enabled*6 / Control disabled*7*8	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
U3003:17	Control disabled	Control disabled	Control disabled		Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled

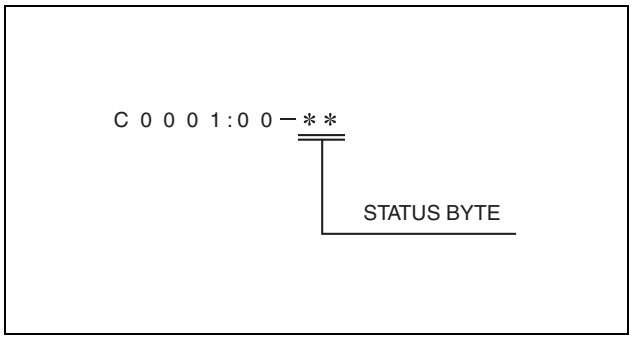
*1 : ATX only
*2 : Vehicles with smart city brake support (SCBS)

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

*3 : Control disabled when two wheels or more have a malfunction.
*4 : Enabled depending on malfunction content.
*5 : 4WD only
*6 : When power supply voltage is **7.9—9.6 V** for **550 ms or more**.
*7 : When power supply voltage is **6.0—7.9 V** for **630 ms or more**.
*8 : When power supply voltage is **below 6 V** for **50 ms or more**.

Status byte for DTC

- The status byte is the two-digit code (two digits after hyphen (-)) after the DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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Snapshot data

- The snapshot data stores the currently detected DTC data

Snapshot data item	Unit	Definition	Corresponding data monitor items
AAT	°C, °F	Ambient air temperature	—
ABS	Inactive/ Active	Antilock braking system	—
APP_STATUS	Accelerator Pedal Off/ Under 20%/ Over 20%/ FAIL	Accelerator pedal position	—
AYC	Inactive/ Active	Active yaw control	—
BRK_F_P_R	Pa, psi	Brake fluid line hydraulic pressure (Raw Value)	BRK_F_P_R
BTCS	Inactive/ Active	Brake traction control system	—
CFG_STATUS	Config Complete/ Not Configured/ Config Error	Configuration status	—
ECT_STATUS	Under 0 degrees C/ 0 - Under 80 degrees C/ Over 80 degrees C/ FAIL	Engine coolant temperature status	—
EDC	Inactive/ Active	Engine drag control	—
IC_VPWR	V	Instrument cluster power supply	—
IG-ON_TIMER	hh:mm:ss	Times since ignition switch ON	—
LAT_ACCL_R	G	Lateral acceleration (Raw Value)	LAT_ACCL_R
LON_ACCL_R	G	Longitudinal acceleration (Raw Value)	LON_ACCL_R
PMP_MT	Off/On	Pump motor	PMP_MT

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

Snapshot data item	Unit	Definition	Corresponding data monitor items
PWR_MODE_KEY	Key Out/ Key Recently Out/ Key Approved(Position 0)/ Post Accessory (Position 0)/ Accessory (Position 1)/ Post Ignition (Position 1)/ Ignition On (Position 2)/ Running (Position 2)/ Running - Starting In Progress (Position 2)/ Crank (Position 3)	Power mode key state	—
RPM_STATUS	Engine Stop/ Under 1500rpm/ Over 1500rpm/ FAIL	Engine RPM status	—
SHIFT_STATUS	P/N D/ R/ FAIL	Shift position status	—
STR_ANG_C	°	Steering wheel angle (Calculated Value)	STR_ANG_C
TCS	Inactive/ Active	Traction control system	—
TOTAL_DIST	km, ft, mi	Total distance	—
TOTAL_TIME	hh:mm:ss	Total time	—
VPWR	V	Power supply	VPWR
VSPD	KPH, MPH	Vehicle speed	VSPD
VSPD_STATUS	Stop/ 0 - 10km/h/ Over 10km/h/ FAIL	Vehicle speed status	—
YAW_RATE_R	°/S	Yaw Rate (Raw Value)	YAW_RATE_R

PID/data monitor function

- The PID/data monitor function is used for optionally selecting input/output signal monitor items preset in the DSC HU/CM and reading them out in real-time.

PID/data monitor table

Mazda Modular Diagnostic System (M-MDS) display	Data contents	Unit/Operation (Mazda Modular Diagnostic System (M-MDS) display)
BRAKE_SW	Brake switch signal	Off/On
BRK_F_P_C	Brake fluid pressure sensor signal (calculated value)	Pa, psi
BRK_F_P_R	Brake fluid pressure sensor signal (raw value)	
DDS_MODE	Deflation detection system mode	Not_Learned/Learning/Learned
DSC_OFF_SW	TCS OFF switch condition	Off/On
DSC_ST	DSC system status	Off/On
LAT_ACCL_C	lateral-G value (calculated Value)	G
LAT_ACCL_R	lateral-G value (raw Value)	
LON_ACCL_C	longitudinal-G value (calculated Value)	G
LON_ACCL_R	longitudinal-G value (raw Value)	
P_BRAKE_SW	Parking brake switch signal	Off/On
PMP_MT	Pump motor condition	Off/On
PMP_MT_SP	Pump motor supply condition	
R_GEAR_SW	Shift/selector lever at R position signal	Off/On

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

Mazda Modular Diagnostic System (M-MDS) display	Data contents	Unit/Operation (Mazda Modular Diagnostic System (M-MDS) display)
STR_ANG_C	Steering wheel angle (Calculated Value)	°
STR_ANG_R	Steering wheel angle (Raw Value)	
TPMS_TYPE	TPMS type	No_DDS/DDS+TOM_EU/ DDS+TOM_US
V_INLET_LF	LF inlet solenoid valve condition	Off/On
V_INLET_LR	LR inlet solenoid valve condition	
V_INLET_RF	RF inlet solenoid valve condition	
V_INLET_RR	RR inlet solenoid valve condition	
V_OUTLET_LF	LF outlet solenoid valve condition	
V_OUTLET_LR	LR outlet solenoid valve condition	
V_OUTLET_RF	RF outlet solenoid valve condition	
V_OUTLET_RR	RR outlet solenoid valve condition	
V_STB_LF/RR	Stability control solenoid valve condition (LF/RR)	Off/On
V_STB_RF/LR	Stability control solenoid valve condition (RF/LR)	
V_TRC_LF/RR	Traction control solenoid valve condition (LF/RR)	Off/On
V_TRC_RF/LR	Traction control solenoid valve condition (RF/LR)	
VPWR_B_SOL	Module supply voltage	V
VSPD	Vehicle speed	KPH, MPH
WSPD_SEN_LF	LF ABS wheel-speed sensor signal	KPH, MPH
WSPD_SEN_LR	LR ABS wheel-speed sensor signal	
WSPD_SEN_RF	RF ABS wheel-speed sensor signal	
WSPD_SEN_RR	RR ABS wheel-speed sensor signal	
YAW_RATE_C	Yaw rate value (calculated Value)	°/s
YAW_RATE_R	Yaw rate value (raw Value)	

Active command modes function

- The active command modes function is used for optionally selecting simulation items of input/output parts preset in the DSC HU/CM, and to operate them regardless of CM control.
- To protect the hydraulic unit interior, operate output related parts for only **2 s or less** when using the active command modes function.

Active command mode table

Command name	Output part	Operation	Operating condition
PMP_MT_SP	Pump motor	Off/On	Switch the ignition to ON
V_INLET_LF	LF inlet solenoid valve		
V_INLET_LR	LR inlet solenoid valve		
V_INLET_RF	RF inlet solenoid valve		
V_INLET_RR	RR inlet solenoid valve		
V_OUTLET_LF	LF outlet solenoid valve		
V_OUTLET_LR	LR outlet solenoid valve		
V_OUTLET_RF	RF outlet solenoid valve		
V_OUTLET_RR	RR outlet solenoid valve		
V_STB_LF/RR	LF/RR stability control solenoid valve		
V_STB_RF/LR	RF/LR stability control solenoid valve		
V_TRC_LF/RR	LF/RR traction control solenoid valve		
V_TRC_RF/LR	RF/LR traction control solenoid valve		

External tester communication function

- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs, operation of input/output parts) between the DSC HU/CM and an external tester.

ON-BOARD DIAGNOSTIC [DYNAMIC STABILITY CONTROL (DSC)]

Connections/communication contents

	External tester	
	Mazda Modular Diagnostic System (M-MDS)	
	Connection	Communication method
On-board diagnostic (malfunction detection) function	Input/output: CAN_H (HS), CAN_L (HS) terminals	Serial communication
PID/data monitor function	Input/output: CAN_H (HS), CAN_L (HS) terminals	Serial communication
Active command modes function	Input/output: CAN_H (HS), CAN_L (HS) terminals	Serial communication

Serial communication

- Serial communication (two-way communication) allows for multiple data to be sent and received instantly along the same line.
- By connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2, diagnostic data can be sent and received between the Mazda Modular Diagnostic System (M-MDS) and the DSC HU/CM using the CAN_H and CAN_L terminals (within the DLC-2).
- The DSC HU/CM receives the command signals of the malfunction detection function, PID/data monitor function, and the active command modes function based on the Mazda Modular Diagnostic System (M-MDS), and sends DTCs and data regarding the operating condition and status of each input/output part to the Mazda Modular Diagnostic System (M-MDS).

Diagnostic function name	Signal received	Signal sent
Malfunction detection function	DTC verification signal	DTC
PID/data monitor function	Command signal to read selected monitor item	Monitored data for requested monitor item
Active command modes function	Operation command signal for selected active command modes item	Output part drive signal

DLC-2 [DYNAMIC STABILITY CONTROL (DSC)]

id0402b2100700

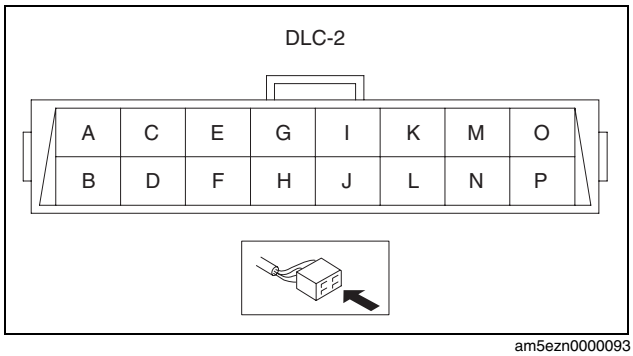
OUTLINE

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been added.

CONSTRUCTION

- Shape and terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this connector. The 16-pin connector consists of a CAN_H (HS) terminal, CAN_L (HS) terminal, CAN_H (MS) terminal, CAN_L (MS) terminal, GND1 terminal, GND2 terminal, and B+ terminal.

Terminal	Function
A	Battery power supply terminal
B	-
C	-
D	-
E	Serial communication Lo terminal (HS)
F	Serial communication Hi terminal (HS)
G	-
H	Serial communication ground terminal
I	-
J	Body ground terminal
K	Serial communication Lo terminal (MS)
L	Serial communication Hi terminal (MS)
N	-
M	-
O	-
P	-



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04-02B ON-BOARD DIAGNOSTIC [LASER SENSOR]

ON-BOARD DIAGNOSTIC [LASER SENSOR]

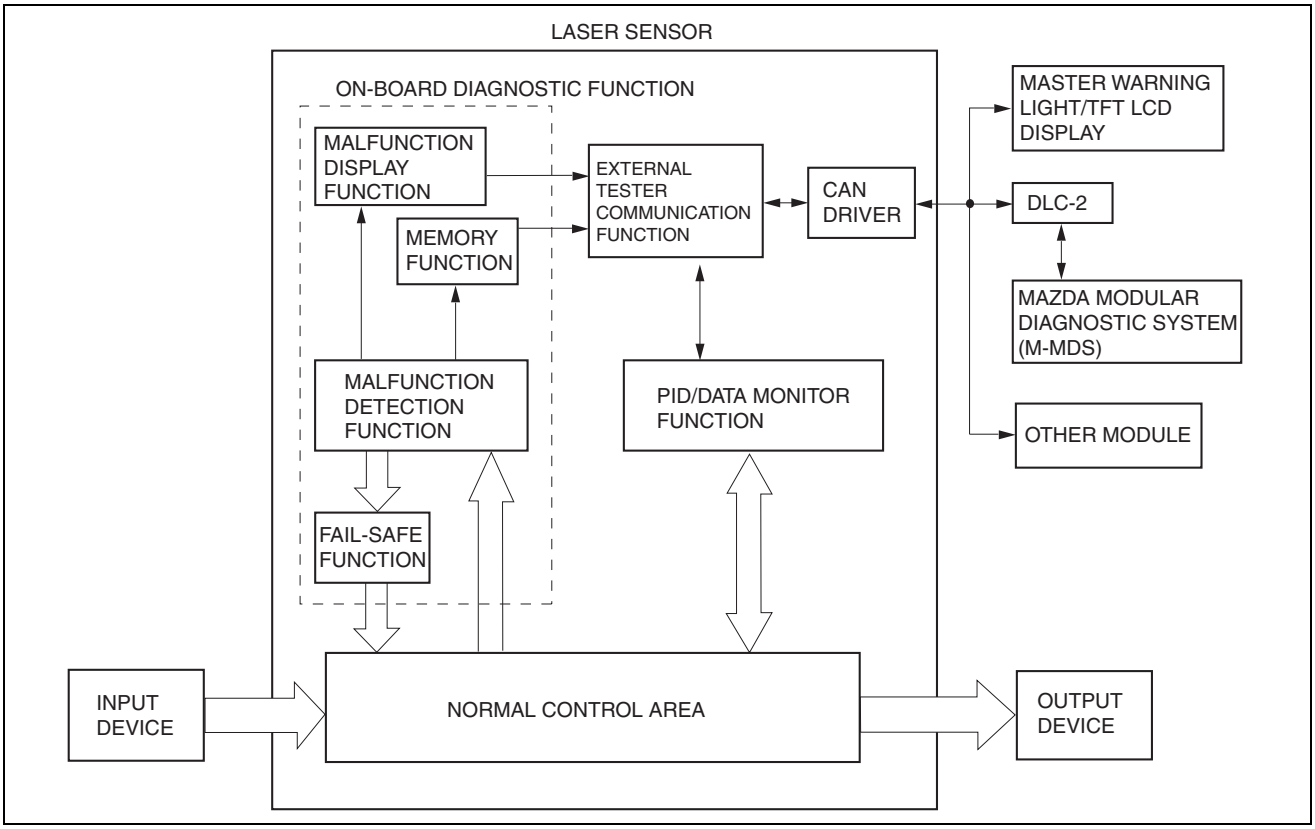
ON-BOARD DIAGNOSTIC SYSTEM [LASER SENSOR]

id0402c4181300

OUTLINE

- The on-board diagnostic system consists of a malfunction detection system that detects malfunctions in input/output signals when the ignition is switched to ON, a PID/data monitor function that reads out specified input/output signals, and an active command mode function that allows for override operation of output parts (such as solenoid valves).
- The data link connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis and detecting/repair into a single location, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the Mazda modular diagnostic system (M-MDS) to the DLC-2.
- In addition to DTC read-out, the Mazda modular diagnostic system (M-MDS) is used to clear DTCs using the display screen of the diagnostic tester, and to access the PID/data monitor and active command modes functions, providing enhanced malfunction diagnosis and improved serviceability.

Block diagram



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FUNCTION

Malfunction detection function

- The malfunction detection function detects and displays malfunctions in the input/output signal system of the laser sensor when the ignition is switched to ON.
- If the laser sensor malfunction is detected, the master warning light is illuminated and the message “SCBS Inspection Required” is indicated in the TFT LCD display. DTCs can be output through the CAN_H and CAN_L of the DLC-2 using the external tester communication function. At the same time, malfunction detection results are sent to the memory and fail-safe functions.

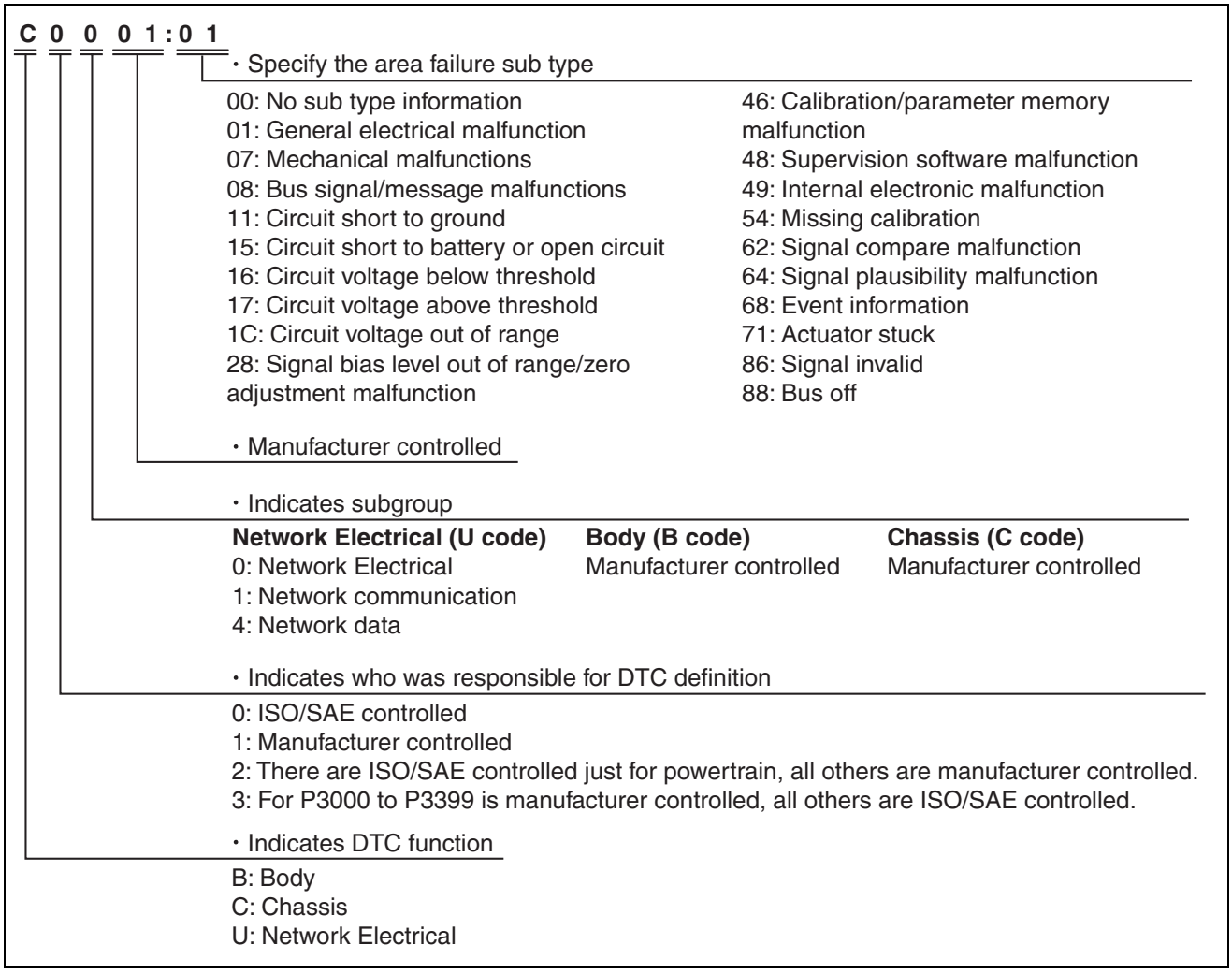
ON-BOARD DIAGNOSTIC [LASER SENSOR]

Memory function

- The memory function stores DTCs of malfunctions in input/output signal systems. With this function, once a DTC is stored it is not cleared after the ignition has been switched off, even if the malfunctioning signal system has returned to normal.
- Since the laser sensor has a built-in non-volatile memory, DTCs are not cleared even if the battery is removed. Therefore, it is necessary to clear the memory after performing repairs. Refer to the Workshop Manual for the DTC clearing procedure.

DTC 7-digit code definition

- When related systems or components have failed, the sensor stores the DTC of the malfunctioning part in the sensor memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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Fail-safe function

- When the malfunction detection function determines a malfunction, the master warning light illuminates and the message “SCBS Inspection Required” is indicated in the TFT LCD display to alert the driver. At this time, the smart city brake support (SCBS) is inhibited.

ON-BOARD DIAGNOSTIC [LASER SENSOR]

DTC table

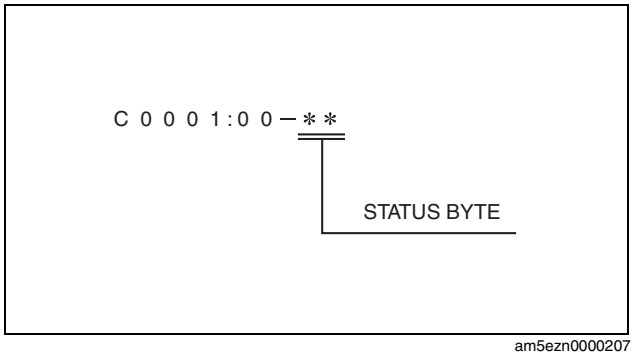
×: Applicable
-: Not applicable

DTC No.	Master warning light	Message in the TFT LCD display	Fail-safe function	Malfunction location	Drive cycle	Self test type*1	Memory function
U0001:00	Illuminated	SCBS Inspection Required	Smart city brake support (SCBS) control disabled	CAN line	-	C	×
U0100:00							
U0121:00							
U0131:00							
U0155:00							
U0401:68	Illuminated	SCBS Inspection Required	Smart city brake support (SCBS) control disabled	Abnormal message from PCM	-	C	×
U0415:68	Illuminated	SCBS Inspection Required	Smart city brake support (SCBS) control disabled	Abnormal message from DSC HU/CM	-	C	×
U0420:68	Illuminated	SCBS Inspection Required	Smart city brake support (SCBS) control disabled	Abnormal message from EPS CM	-	C	×
U0423:68	Illuminated	SCBS Inspection Required	Smart city brake support (SCBS) control disabled	Abnormal message from instrument cluster	-	C	×
U1A14:49	Illuminated	SCBS Inspection Required	Smart city brake support (SCBS) control disabled	Laser sensor	-	C	×
U2300:55	Illuminated	SCBS Inspection Required	Smart city brake support (SCBS) control disabled	Configuration data not recorded or data error	-	C	×
U2300:56			Smart city brake support (SCBS) control disabled		-	C	×
U3000:00	Illuminated	SCBS Inspection Required	Smart city brake support (SCBS) control disabled	Laser sensor (internal malfunction)	-	C	×
U3000:64			Smart city brake support (SCBS) control disabled		-	C	×
U3000:66	Illuminated	SCBS Inspection Required	Smart city brake support (SCBS) control disabled	Laser sensor	-	C	×

*1 : C: CMDTC self-test

Status byte for DTC

- The status byte is the two-digit code (two digits after hyphen (-)) after the DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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Snapshot data

- The snapshot data stores the currently detected DTC data

Snapshot data item	Unit	Definition	Corresponding data monitor items
DSC_R_BRK	OK/Error	DSC response against brake request from SCBS module	—

ON-BOARD DIAGNOSTIC [LASER SENSOR]

Snapshot data item	Unit	Definition	Corresponding data monitor items
DSC_R_BRK_C	OK/Error	DSC response against brake assist threshold change from SCBS module	—
DSC_R_BRK_NOREQ	OK/Error	DSC response while no request from SCBS module	—
DSC_R_PRECH	OK/Error	DSC response against pre-charge request from SCBS module	—
DSC_SYSTEM	OK/Error	DSC system condition	—
ECU_IN_TEMP	°C	ECU internal temperature	—
PCM_R_NOREQ	OK/Error	PCM response while no request from SCBS module	—
PCM_R_REQ	OK/Error	PCM response against request from SCBS module	—
PCM_SYSTEM	OK/Error	PCM system condition	—
TOTAL_DIST	km, ft, mi	Total distance	—
TOTAL_TIME	hh:mm:ss	Total time	—
VPWR	V	Power supply	—
VSPD	KPH, MPH	Vehicle speed	—

PID/data monitor function

- The PID/data monitor function is used for optionally selecting input/output signal monitor items preset in the laser sensor and reading them out in real-time.

PID/data monitor table

Mazda Modular Diagnostic System (M-MDS) display	Data contents	Unit/Operation (Mazda Modular Diagnostic System (M-MDS) display)
DIST_BMP_TGT	Distance from bumper to target that sensor has detected	m
VPWR_IG1	Module supply voltage (IG1)	V
VSPD	Vehicle speed	KPH, MPH

External tester communication function

- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs, operation of input/output parts) between the laser sensor and an external tester.

Connections/communication contents

	External tester	
	Mazda Modular Diagnostic System (M-MDS)	
	Connection	Communication method
On-board diagnostic (malfunction detection) function	Input/output: CAN_H (HS), CAN_L (HS) terminals	Serial communication
PID/data monitor function	Input/output: CAN_H (HS), CAN_L (HS) terminals	Serial communication

Serial communication

- Serial communication (two-way communication) allows for multiple data to be sent and received instantly along the same line.
- By connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2, diagnostic data can be sent and received between the Mazda Modular Diagnostic System (M-MDS) and the laser sensor using the CAN_H and CAN_L terminals (within the DLC-2).
- The laser sensor receives the command signals of the malfunction detection function and PID/data monitor function based on the Mazda Modular Diagnostic System (M-MDS), and sends DTCs and data regarding the operating condition and status of each input/output part to the Mazda Modular Diagnostic System (M-MDS).

Diagnostic function name	Signal received	Signal sent
Malfunction detection function	DTC verification signal	DTC
PID/data monitor function	Command signal to read selected monitor item	Monitored data for requested monitor item

DLC-2 CONSTRUCTION [LASER SENSOR]

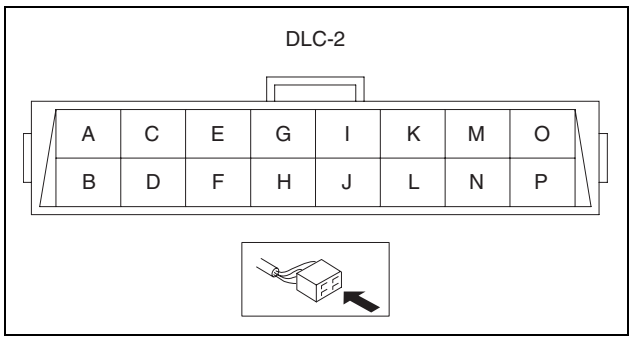
id0402c4180800

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been added.

ON-BOARD DIAGNOSTIC [LASER SENSOR]

- Shape and terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this connector. The 16-pin connector consists of a CAN_H (HS) terminal, CAN_L (HS) terminal, CAN_H (MS) terminal, CAN_L (MS) terminal, GND1 terminal, GND2 terminal, and B+ terminal.

Terminal	Function
A	Battery power supply terminal
B	-
C	-
D	-
E	Serial communication Lo terminal (HS)
F	Serial communication Hi terminal (HS)
G	-
H	Serial communication ground terminal
I	-
J	Body ground terminal
K	Serial communication Lo terminal (MS)
L	Serial communication Hi terminal (MS)
N	-
M	-
O	-
P	-



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04-11 CONVENTIONAL BRAKE SYSTEM

CONVENTIONAL BRAKE SYSTEM

CONVENTIONAL BRAKE SYSTEM

id041100200100

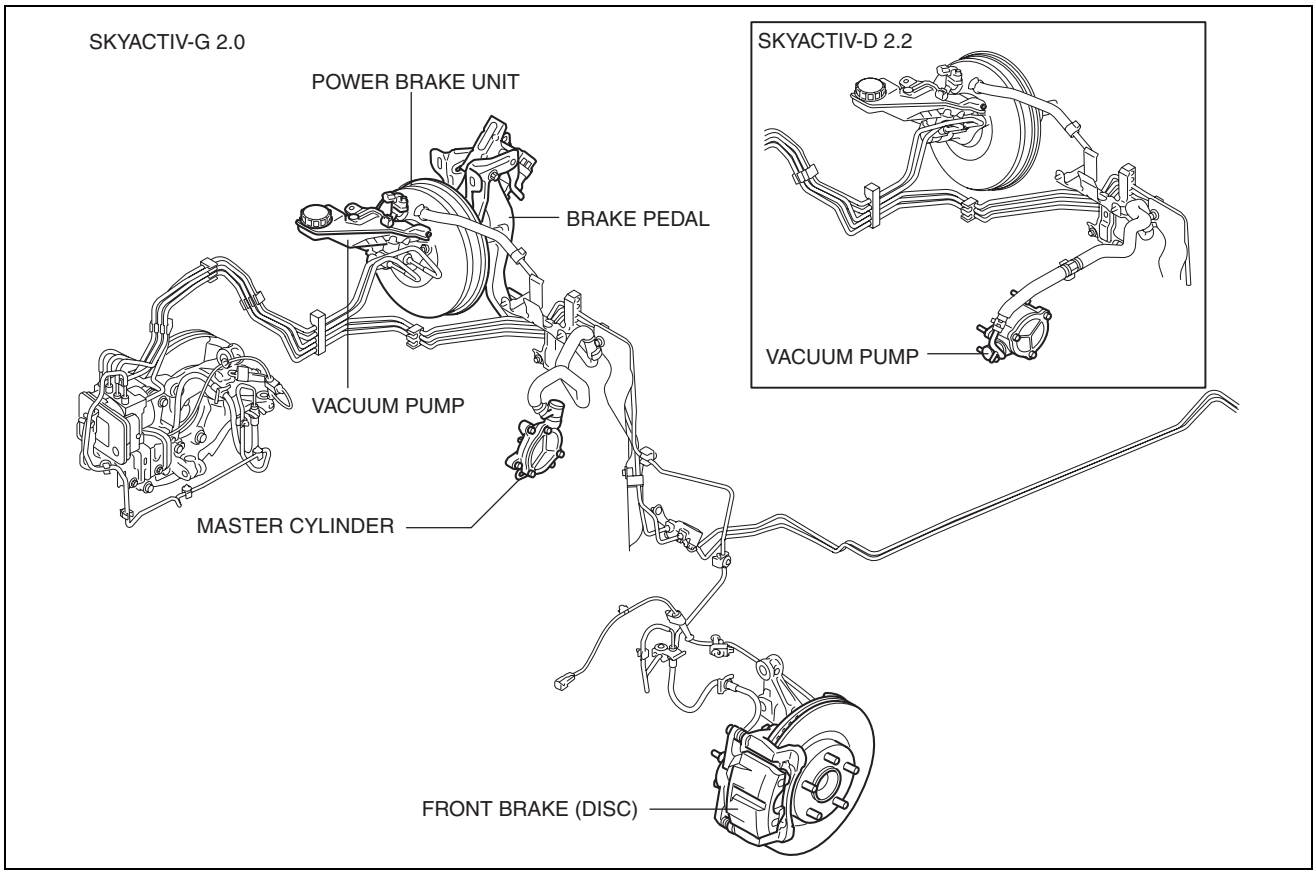
Outline

- A brake pedal with an intrusion minimizing mechanism has been adopted. As a result, driver safety has been improved.
- A small diameter long-stroke type master cylinder has been adopted, improving operability and response.
- A vacuum pump has been adopted, improving braking force.
- A large diameter, ventilated disc-type front brake has been adopted, improving braking force.
- A large diameter, solid disc-type rear brake has been adopted, improving braking force.

CONVENTIONAL BRAKE SYSTEM

Structural View

Vehicle front side (R.H.D.)



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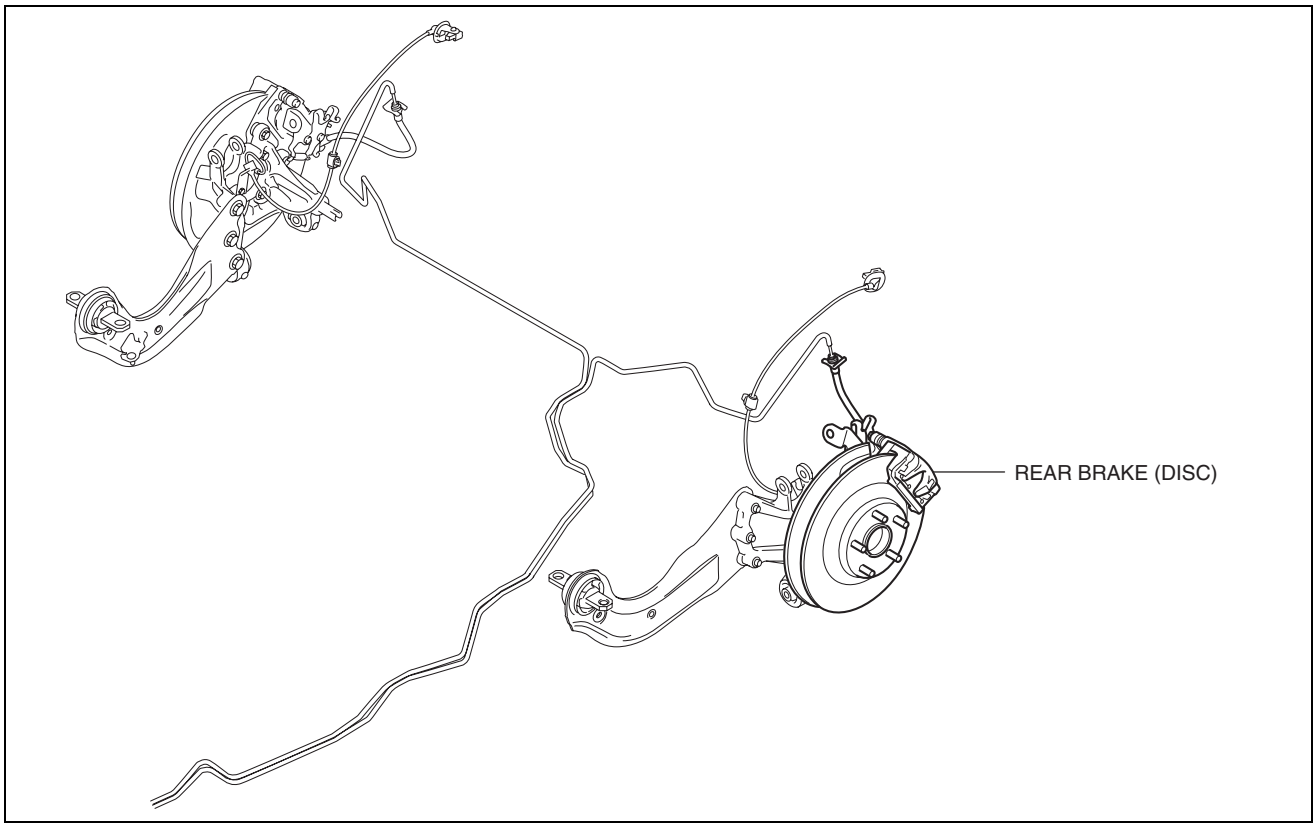
Vehicle rear side



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CONVENTIONAL BRAKE SYSTEM

BRAKE PEDAL

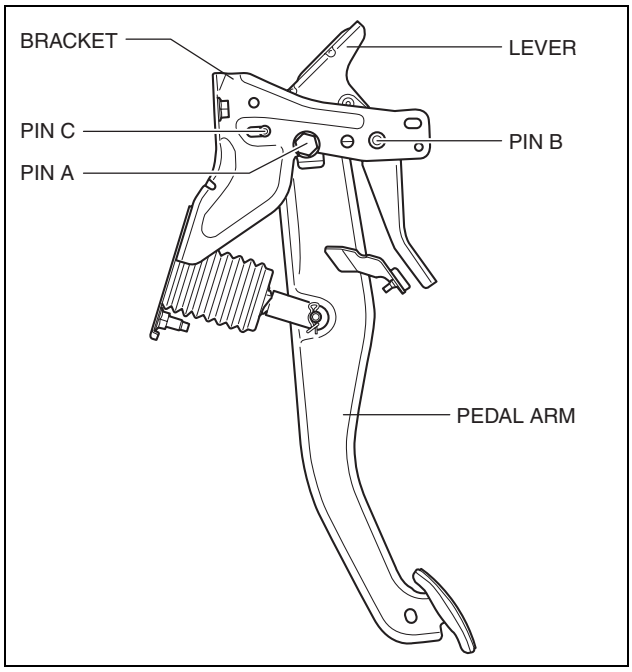
id041100200200

Purpose/Function

- An intrusion-minimizing brake pedal has been adopted to the brake pedal to provide for a measure of safety in the event of an accident.
- The intrusion-minimizing brake pedal mechanism reduces impact to the lower extremities of the driver by minimizing the amount of rearward brake pedal thrust in a frontal collision.

Construction

- The intrusion minimizing brake pedal mechanism is structured on the brake pedal and consists of the following parts.
  - — Pedal arm
  - — Lever
  - — Pin A
  - — Pin B
  - — Pin C
  - — Bracket



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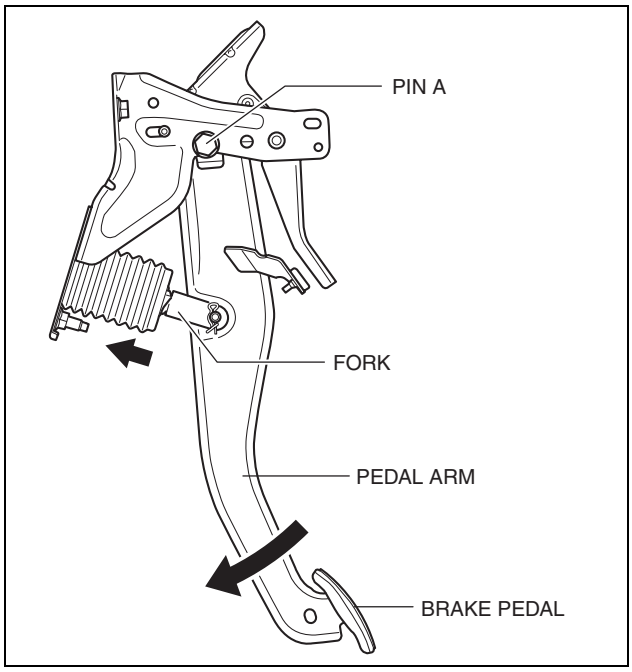
Operation

During normal braking

- When the brake pedal is depressed, the pedal arm rotates at the pin A fulcrum point, and the pedal depression force is transmitted to the fork of the power brake unit.

CONVENTIONAL BRAKE SYSTEM

- This pedal depression force pushes in the fork to operate the brakes.



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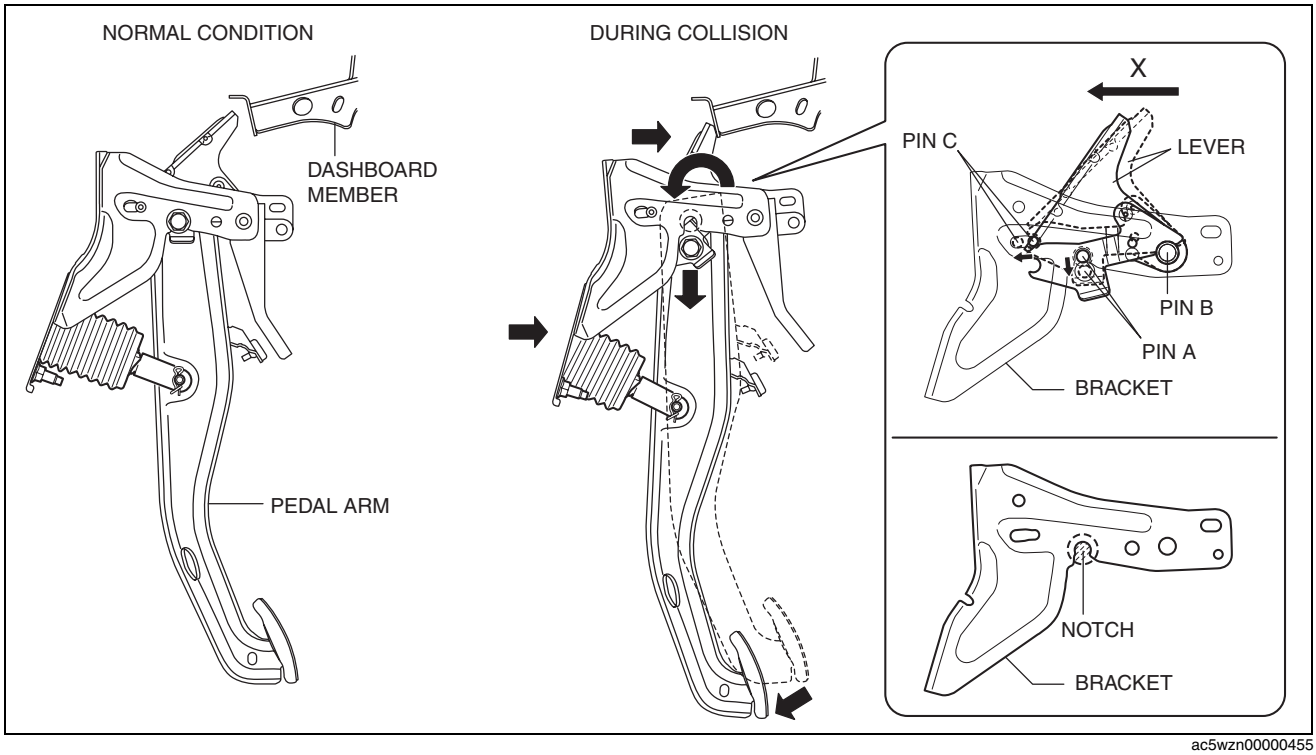
Intrusion-minimizing operation

- In a frontal collision, the brake pedal is forced rearward by the movement of the dashboard.
- In response to this, force in the direction of X is applied to the brake pedal lever because the dashboard member and brake pedal lever interfere.
- With the addition of force in the direction of X, pin C releases from the lever, and the lever rotates around the pin B fulcrum point.
- When the lever rotates, it obstructs pin A at the fulcrum point of the pedal arm.
- If the pedal rotates further, pin A separates from the bracket (notch), and the pedal is freed.
- By freeing the pedal arm, the force applied to the lower extremities is reduced.



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CONVENTIONAL BRAKE SYSTEM

MASTER CYLINDER

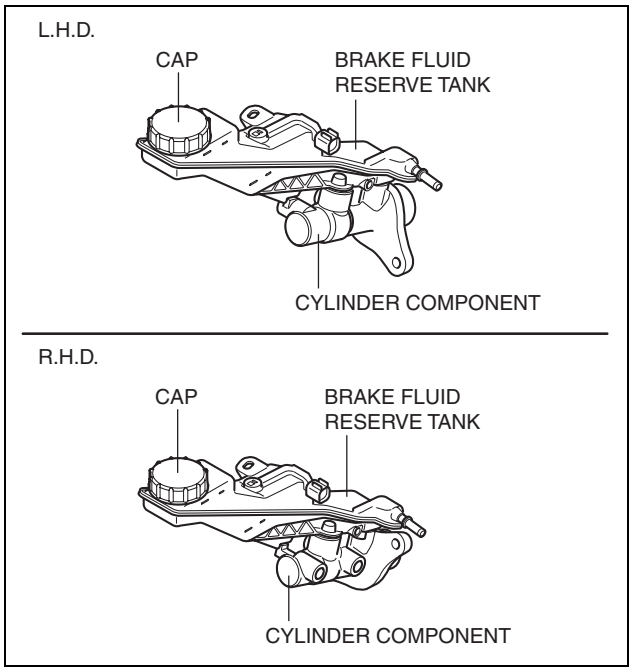
id041100200300

Purpose/Function

- With the adoption of the master cylinder having an enlarged diameter (20.64 mm {0.8126 in}), brake pedal operability has been improved.
- For vehicles with DSC, the diameter of the pipe between the master cylinder and the DSC HU/CM has been increased, improving response during DSC operation.

Construction

- Except for the cap and brake fluid reserve tank, the master cylinder cannot be disassembled. Therefore, if there is any malfunction in the interior of the master cylinder, replace the cylinder component without disassembling.



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Operation

- When the brake pedal is depressed, the push rod of the power brake unit presses in the master cylinder piston. By pressing in the piston, pressure is applied to the brake fluid to operate the brakes.

POWER BRAKE UNIT

id041100200400

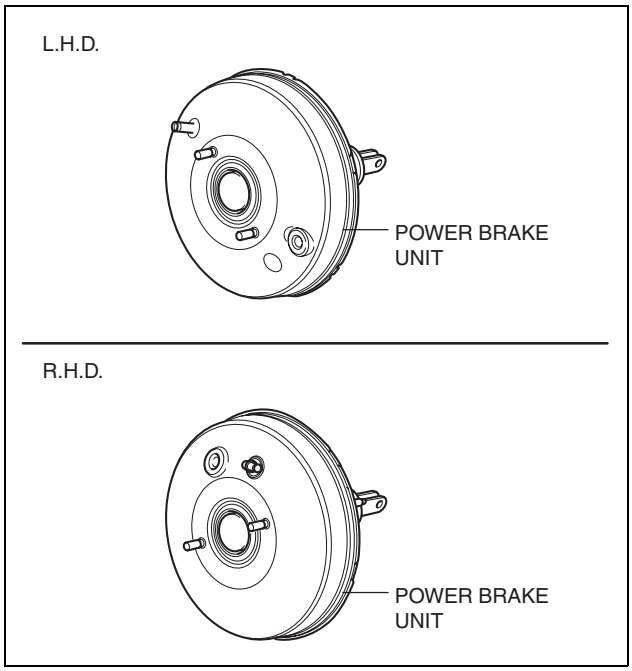
Purpose/Function

- A 9.8-inch, single diaphragm type power brake unit has been adopted, achieving compatibility between high braking performance and excellent brake feeling.

CONVENTIONAL BRAKE SYSTEM

Construction

- The power brake unit cannot be disassembled. Therefore, if there is any malfunction in the power brake unit, replace the power brake unit without disassembling.



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Operation

- The depression force of the brake pedal is increased using the vacuum from the vacuum pump, and the force is transmitted to the master cylinder.

FRONT BRAKE (DISC)

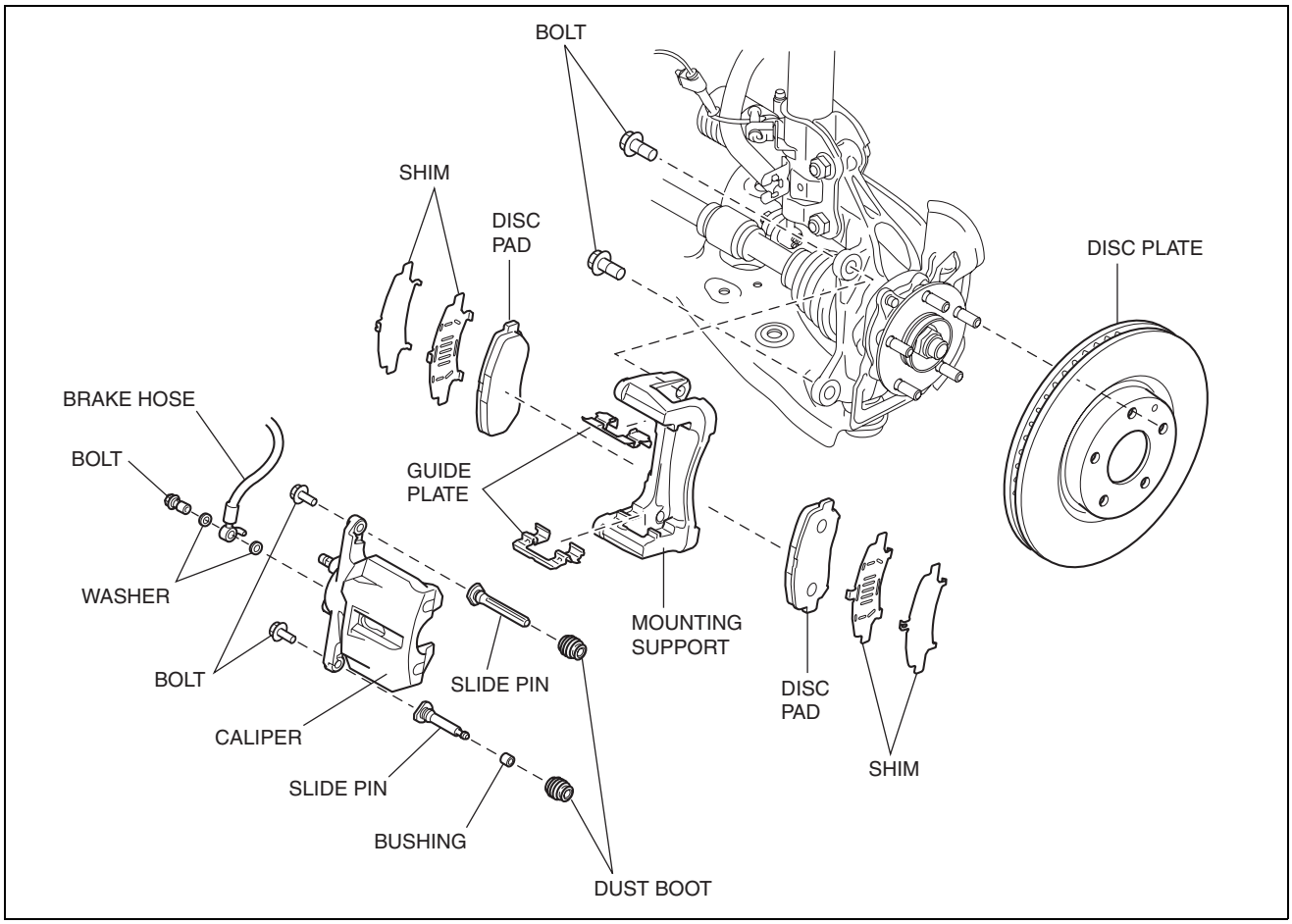
id041100200700

Purpose/Function

- Large diameter, ventilated disc type front brakes with a 297 mm {11.7 in} diameter and 28 mm {1.1 in} thickness have been adopted, improving braking force and fade resistance.

CONVENTIONAL BRAKE SYSTEM

Construction



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Operation

- When brake fluid is applied, the piston equipped on one side of the caliper is pushed out and the brake pad is pushed against the disc plate. At the same time, the caliper body moves in the direction opposite of the direction in which the piston is pushed out so as to push the brake pad on the other side and generate brake force.

REAR BRAKE (DISC)

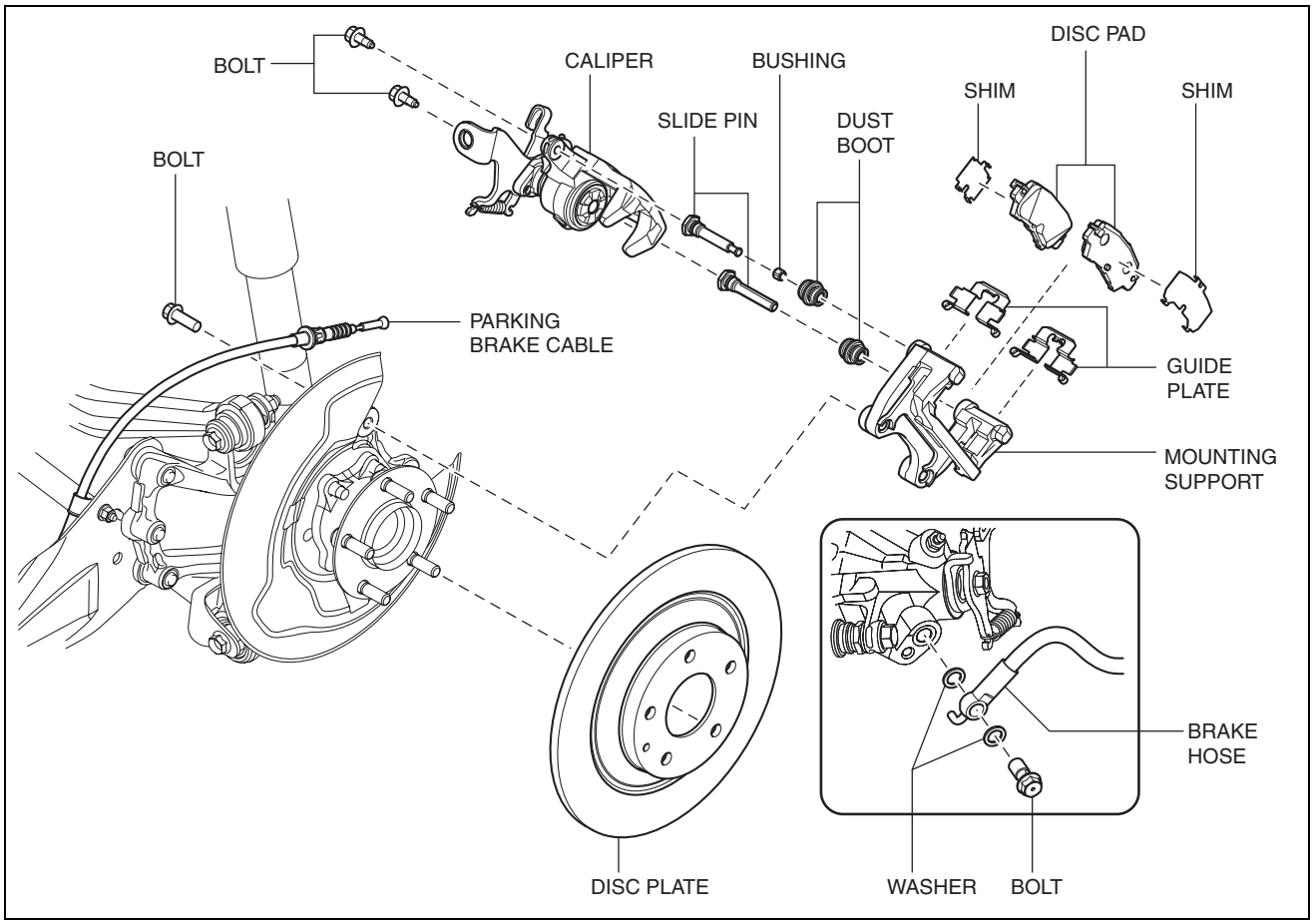
id041100200900

Purpose/Function

- Large diameter, solid-disc type front brakes with a 303 mm {11.9 in} diameter and 10 mm {0.39 in} thickness have been adopted, improving braking force and fade resistance.

CONVENTIONAL BRAKE SYSTEM

Construction



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Operation

- When brake fluid is applied, the piston equipped on one side of the caliper is pushed out and the brake pad is pushed against the disc plate. At the same time, the caliper body moves in the direction opposite of the direction in which the piston is pushed out so as to push the brake pad on the other side and generate brake force.

04-12 PARKING BRAKE SYSTEM

PARKING BRAKE SYSTEM

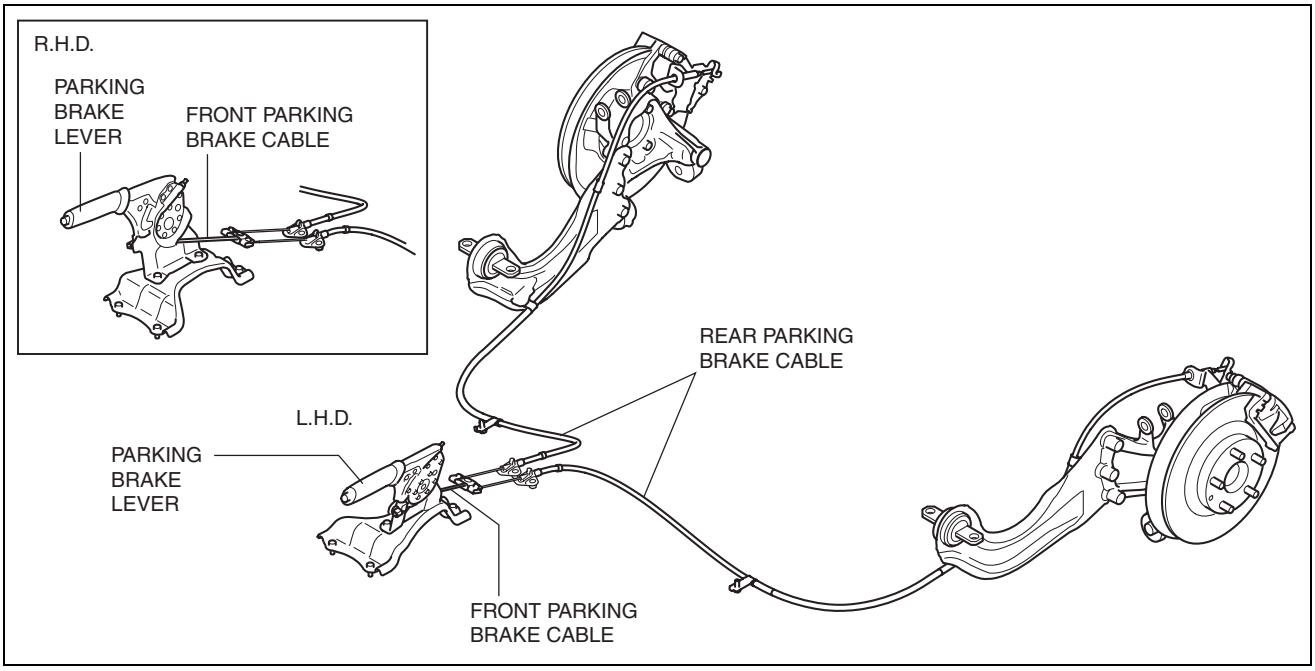
PARKING BRAKE SYSTEM

id041200200100

Outline

- A center lever type parking brake has been adopted, improving operability.
- Serviceability has been improved by enabling adjustment of the parking brake lever from the vehicle interior.

Structural View



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04-15 DYNAMIC STABILITY CONTROL

DYNAMIC STABILITY CONTROL

DYNAMIC STABILITY CONTROL (DSC)

id041500104600

Outline

- Electrical brake assist control has been adopted, improving safety.
- The DSC HU/CM, integrating both the hydraulic unit (HU) and control module (CM), has been adopted, resulting in a size and weight reduction.
- An enhanced malfunction diagnosis system, used with the Mazda Modular Diagnostic System (M-MDS), improving serviceability.
- Serviceability improved by the automatic configuration function.
- Receives the lateral-G and yaw rate signals between the sophisticated air bag sensor (SAS) control module and the DSC HU/CM via controller area network (CAN) lines instead of the conventional combined sensor.
- The vehicle roll prevention function, hill launch assist (HLA), roll over mitigation (ROM), tire pressure monitoring system (TPMS), smart city brake support (SCBS)*, and secondary collision reduction (SCR) have been adopted, improving safety.

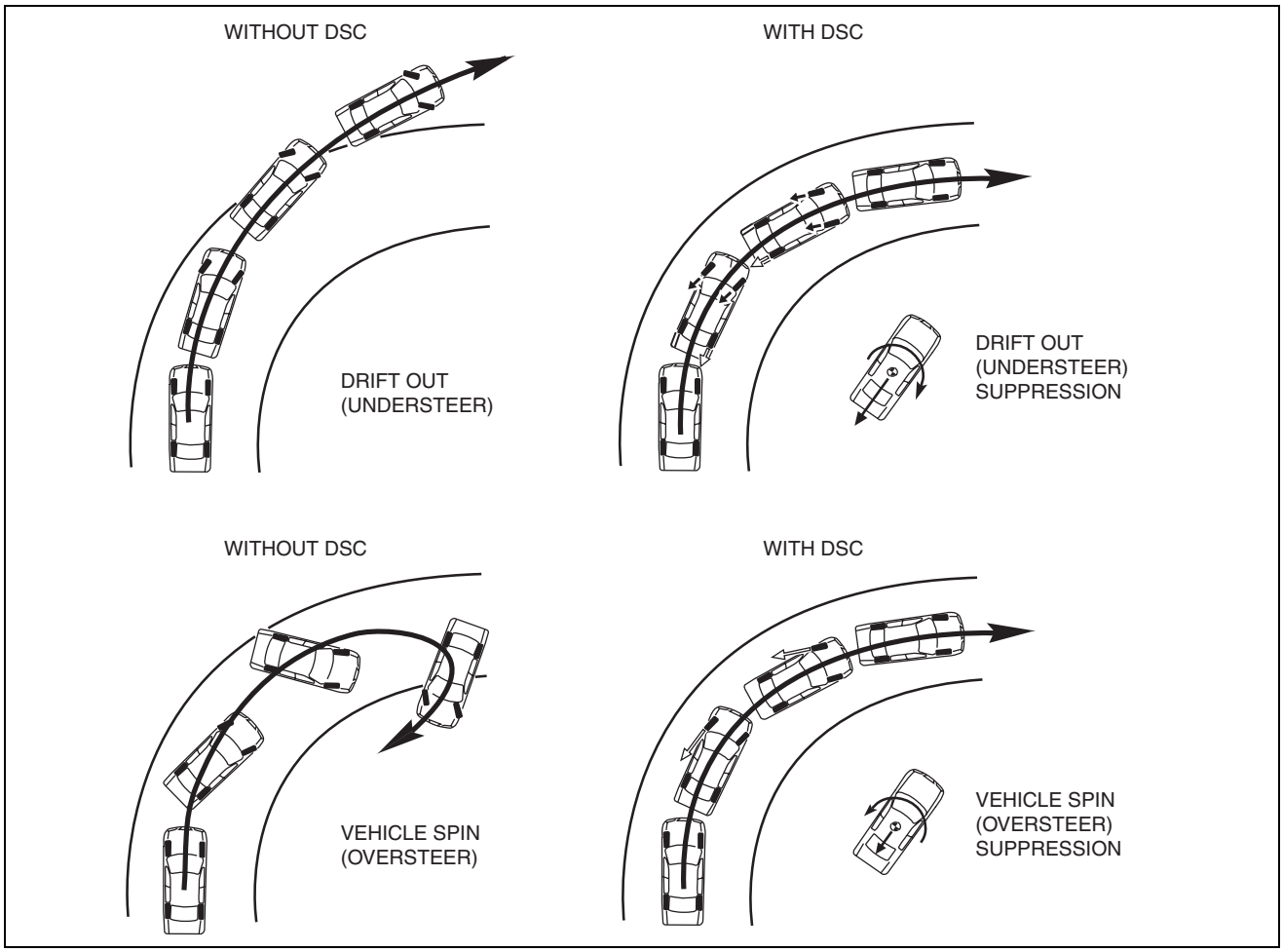
* : Vehicles with smart city brake support (SCBS)

DYNAMIC STABILITY CONTROL

DSC operation outline

- The ABS prevents wheel lock-up during braking. The TCS detects drive wheel spin due to the accelerator pedal being pressed too hard or similar causes and controls engine speed to suppress wheel spin. With these systems, safety is assured when driving or stopping.
- Additionally, sudden changes in vehicle attitude, due to evasive steering or road conditions, are controlled by the DSC. The DSC suppresses vehicle sideslip when driving due to vehicle spin (oversteer) or drift-out (understeer) by controlling braking and engine speed. At this time, the TCS/DSC indicator light illuminates to alert the driver that the DSC is operating due to a dangerous situation. As a result, the driver can calmly react and is provided leeway for the next maneuver, resulting in safe driving conditions.
- In this way the combination of DSC + ABS + TCS ensures driving, stopping and turning safety in all aspects.

Results of DSC operation



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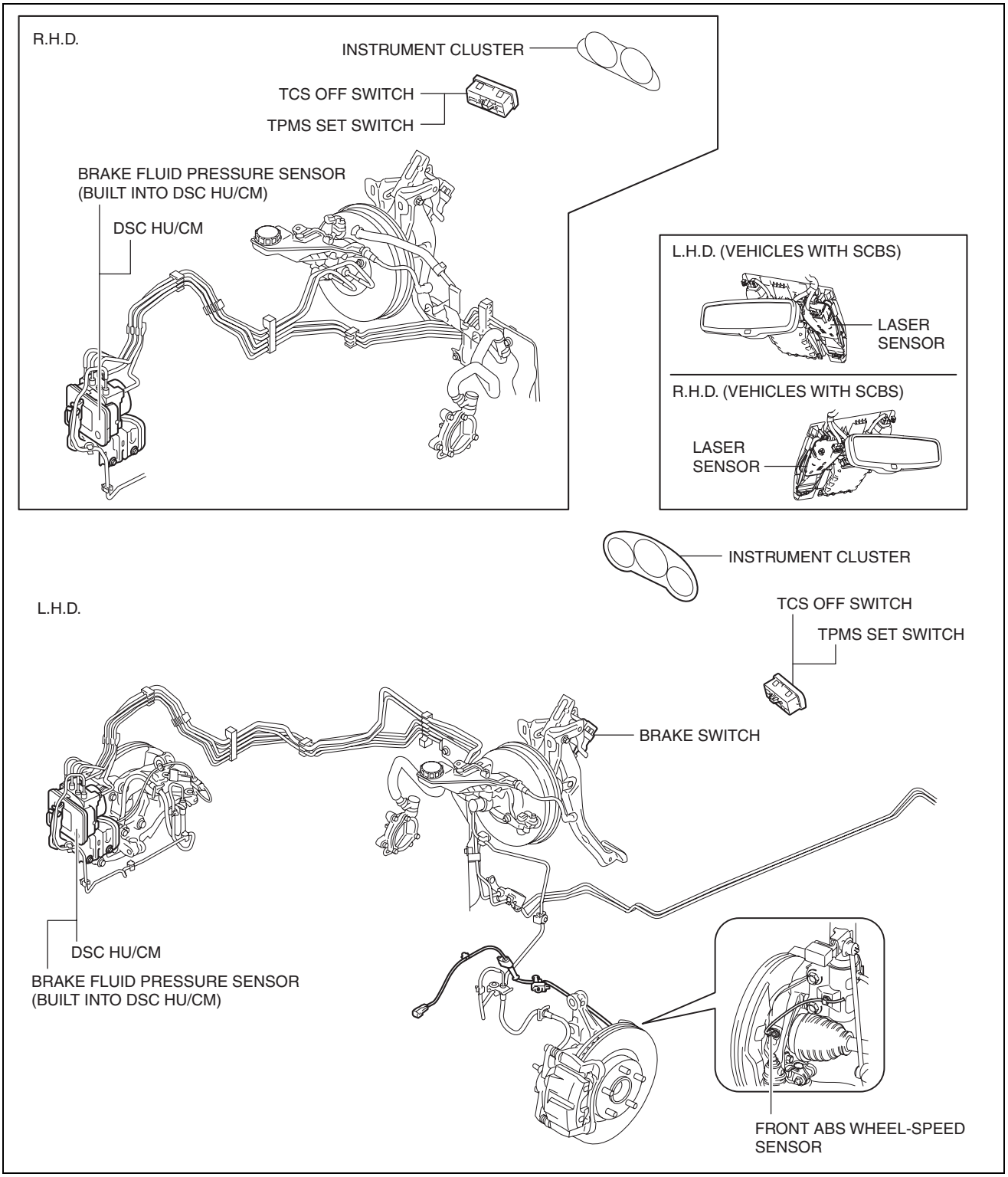
Caution

- **While the DSC is a steering safety system, it does not improve normal steering function. Therefore, always drive carefully, even if the vehicle has DSC, and do not overestimate the DSC capability.**
- **If the initialization procedures for the brake fluid pressure, low-G, and yaw rate sensors are not performed correctly, an incorrectly determined initial point may cause a discrepancy between the actual driving conditions of the vehicle and the signals from the sensors, resulting in improper DSC operation. Therefore, after replacing or removing the following parts, make sure to perform the DSC HU/CM initialization procedures of the sensors with the vehicle stopped on a level ground to insure proper DSC operation. For the initialization procedures of the sensors, refer to the Workshop Manual.**
  - **— DSC HU/CM**
- **The DSC and ABS will not operate normally under the following conditions:**
  - **— With tires that are not of the specified size, manufacturer or tread pattern, or not inflated according to specification**
  - **— With tires that have significant comparative wear variation**
  - **— With tire chains**
  - **— With an emergency spare tire**

DYNAMIC STABILITY CONTROL

Structural View
Vehicle front side



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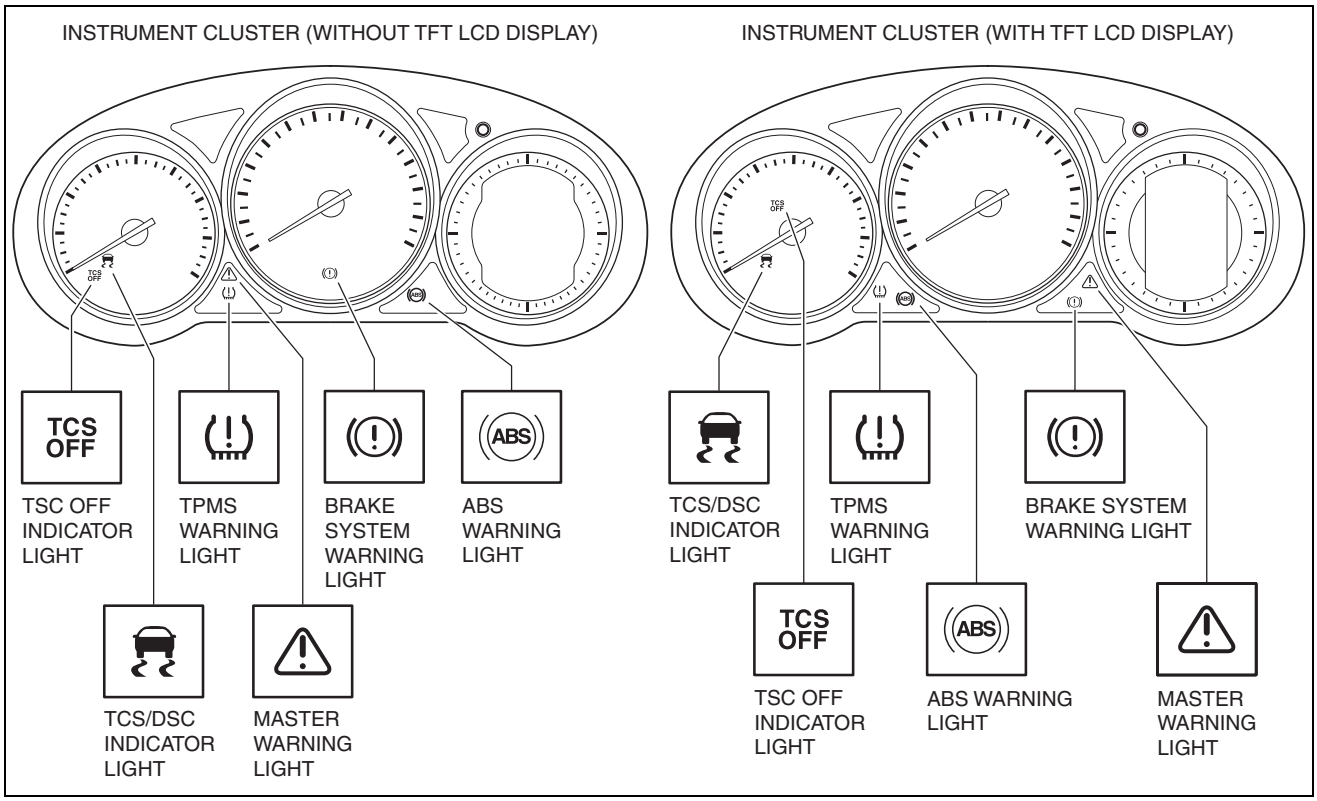
DYNAMIC STABILITY CONTROL

Warning light and indicator light



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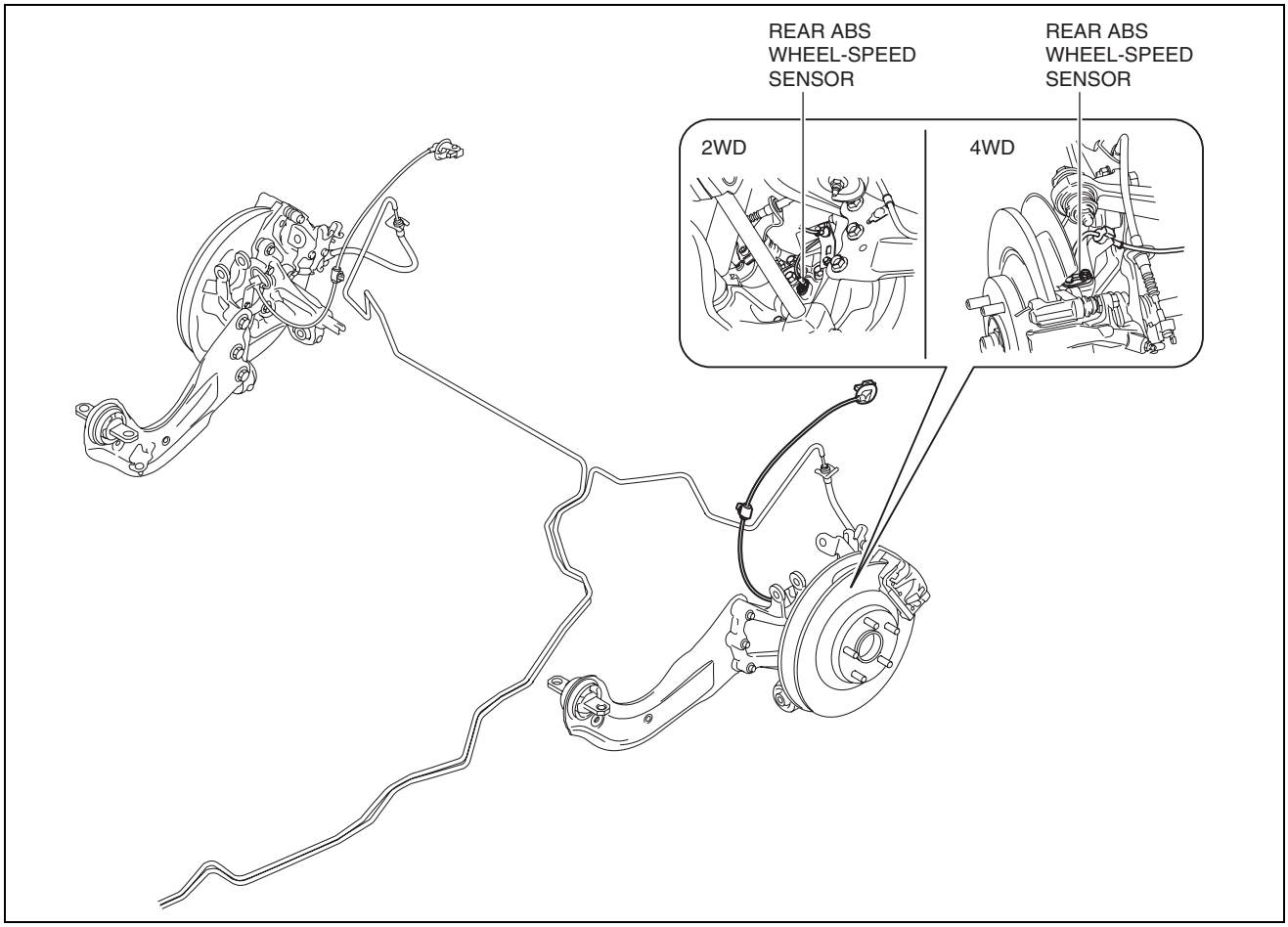
Vehicle rear side



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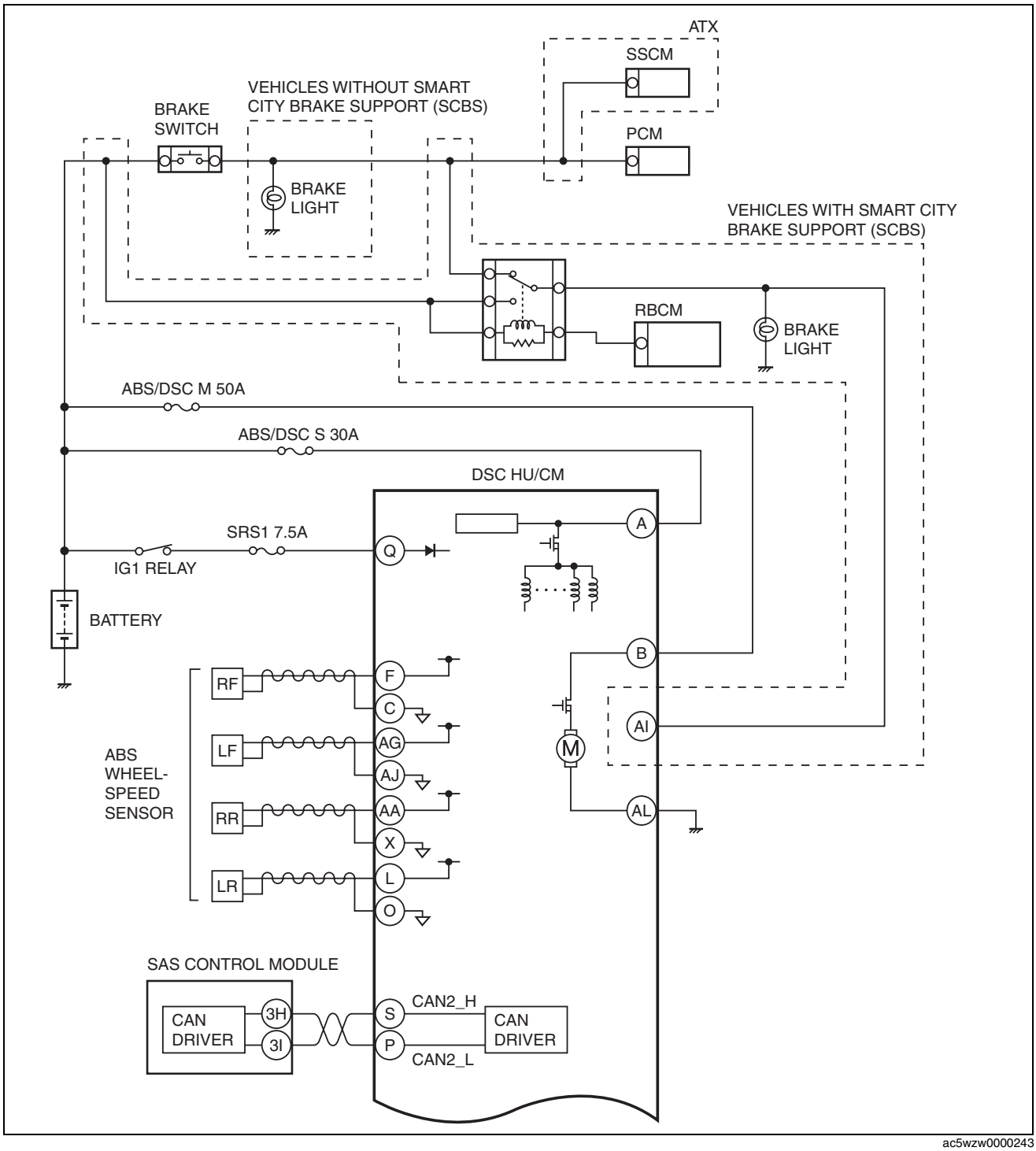
DYNAMIC STABILITY CONTROL

System Wiring Diagram



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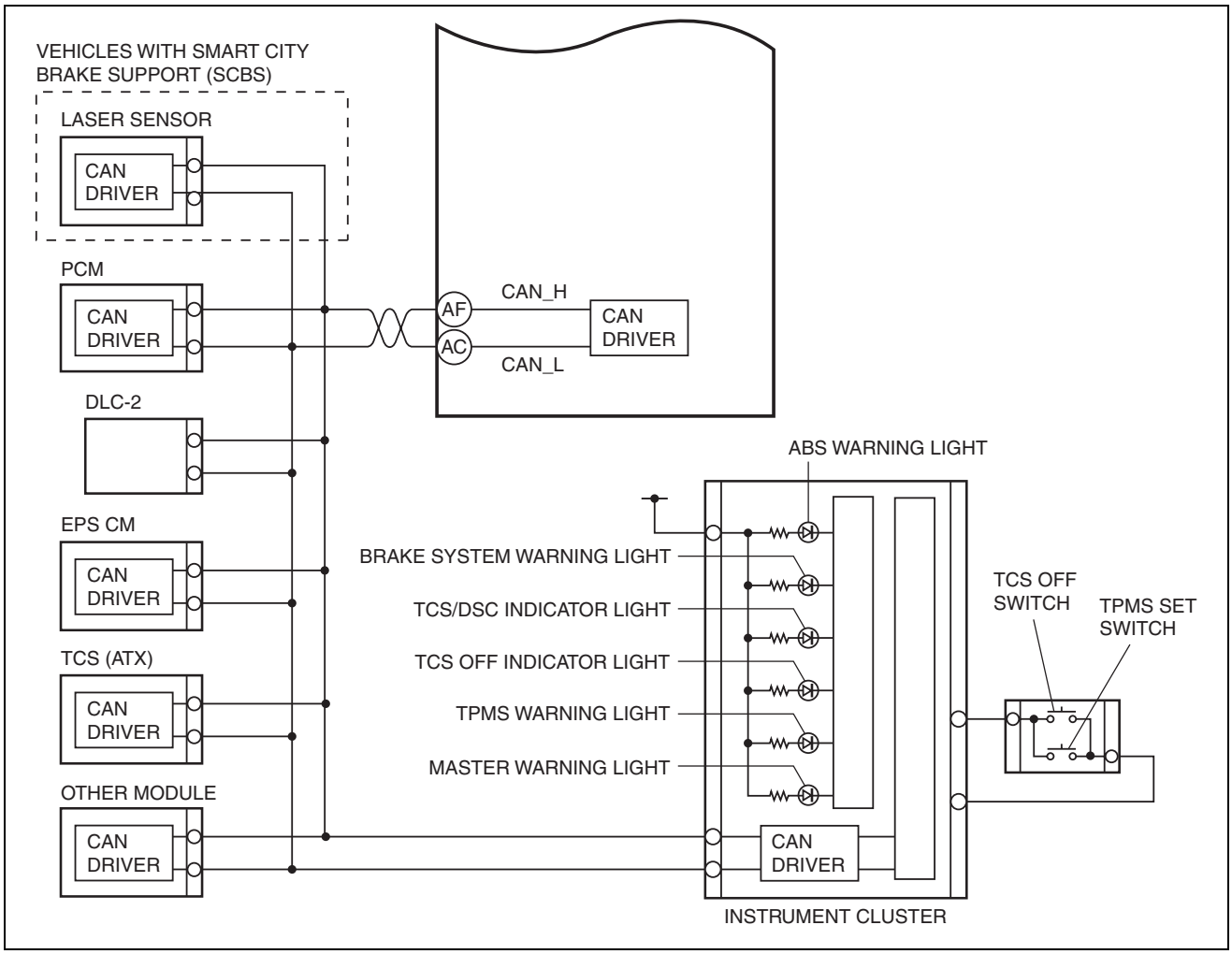
DYNAMIC STABILITY CONTROL



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Construction

- The DSC system consists of the following parts. While each part has a regular function in other systems, only the function during DSC control is listed.

Part name	Function
DSC HU/CM	• Makes calculations using input signals from each sensor, controls brake fluid pressure to each wheel, and actuates function (ABS, EBD, TCS, DSC, brake assist control, vehicle roll prevention function, hill launch assist (HLA), roll over mitigation (ROM), TPMS, smart city brake support (SCBS)*, and secondary collision reduction (SCR)) of the DSC system. • Outputs the torque reduction request signal, wheel speed signal, and DSC system warning control data via CAN lines. • Controls the on-board diagnostic system and fail-safe function when there is a malfunction in the DSC system.
PCM	• Controls engine output based on signals from the DSC HU/CM. • Transmits engine speed, engine torque, brake switch status, and accelerator pedal position data via CAN communication to the DSC HU/CM. • Transmits gear/shift lever position data via CAN communication to the DSC HU/CM. (MTX)
TCM (ATX)	• Transmits gear/selector lever position data via CAN communication to the DSC HU/CM.
EPS CM	• Transmits steering angle data via CAN communication to the DSC HU/CM.
SAS control module	• Detects the lateral-G (vehicle lateral acceleration speed), the yaw rate (vehicle turning angle speed), and the longitudinal-G (vehicle longitudinal acceleration speed) via CAN communication to the DSC HU/CM.
Brake system warning light	• Notifies the driver that the parking brake is applied. • Notifies the driver of an ABS or EBD malfunction.
ABS warning light	• Notifies the driver of an ABS malfunction.

DYNAMIC STABILITY CONTROL

Part name	Function
TCS/DSC indicator light	• Informs the driver that the TCS is operating (drive wheel is spinning). • Informs the driver that the DSC is operating (vehicle sideslip occurring). • Informs the driver that the Roll over mitigation (ROM) is operating. • Informs the driver of DSC system malfunction.
TCS OFF switch	• Transmits driver intention to release TCS control to the DSC HU/CM.
TCS OFF indicator light	• Informs driver that TCS control has been released due to TCS OFF switch operation.
Tire pressure monitoring system (TPMS) set switch	• Data initialization after adjusting the tire pressures can be done.
Tire pressure monitoring system (TPMS) warning light	• Notifies the driver that the tire pressure is not normal. • Notifies the driver of an TPMS malfunction.
Master warning light	• Notifies the driver of an smart city brake support (SCBS) malfunction.
ABS wheel-speed sensor	• Detects the rotation condition of each wheel and transmits it to the DSC HU/CM.
Brake fluid pressure sensor (Built into DSC HU/CM)	• Detects the fluid pressure from the master cylinder.
Laser sensor*	• Emits near-infrared laser and detects the distance between the vehicle and a vehicle or an obstruction ahead based on the reflection.

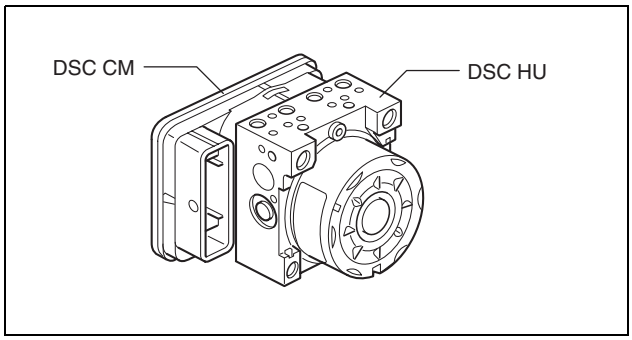
* : Vehicles with smart city brake support (SCBS)

DSC HU/CM

id041500103300

Outline

- A high reliability, reduced size and weight DSC HU/CM, integrating both the DSC HU and the DSC CM, has been adopted.



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DSC HU Part Purpose/Function

- According to DSC CM signals, the DSC HU controls (on/off) each solenoid valve and the pump motor, adjusts fluid pressure in each caliper piston, and actuates each function (ABS, EBD, TCS, DSC, brake assist control, vehicle roll prevention function, hill launch assist (HLA), roll over mitigation (ROM), TPMS, smart city brake support (SCBS)*, and secondary collision reduction (SCR)) of the DSC system.

* : Vehicles with smart city brake support (SCBS)

DSC HU Part Construction

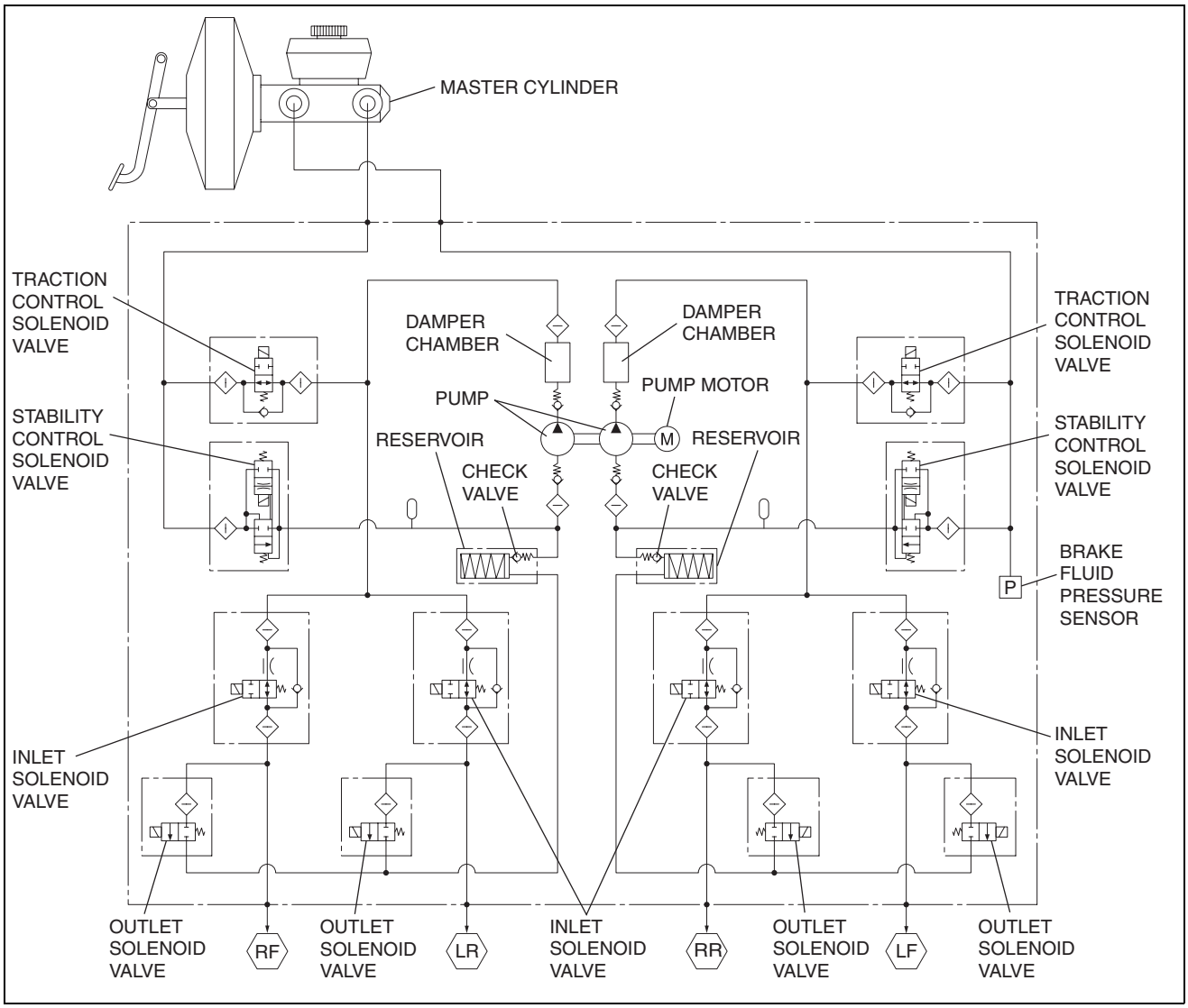
- The DSC HU mainly consists of the inlet/outlet solenoid valves, pump motor (pump), traction control solenoid valves, and stability control solenoid valves.

Function of main component parts

Part name	Function
Inlet solenoid valve	• Adjusts the fluid pressure in each brake system according to DSC HU/CM signals.
Outlet solenoid valve	• Adjusts the fluid pressure in each brake system according to DSC HU/CM signals.
Stability control solenoid valve	• Switches the brake hydraulic circuits during and according to normal braking, ABS and EBD control, TCS control, DSC control, and brake assist control.
Traction control solenoid valve	• Switches the brake hydraulic circuits during and according to normal braking, ABS and EBD control, TCS control, DSC control, and brake assist control.
Reservoir	• Temporarily stores brake fluid from the caliper piston to ensure smooth pressure reduction during ABS and EBD control, TCS control, and DSC control.
Pump	• Returns the brake fluid stored in the reservoir to the master cylinder during ABS and DSC control. • Increases brake fluid pressure and sends brake fluid to each caliper piston during TCS control and DSC control.

DYNAMIC STABILITY CONTROL

Part name	Function
Pump motor	• Operates the pump according to DSC HU/CM signals.



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DSC HU Part Operation

During normal braking

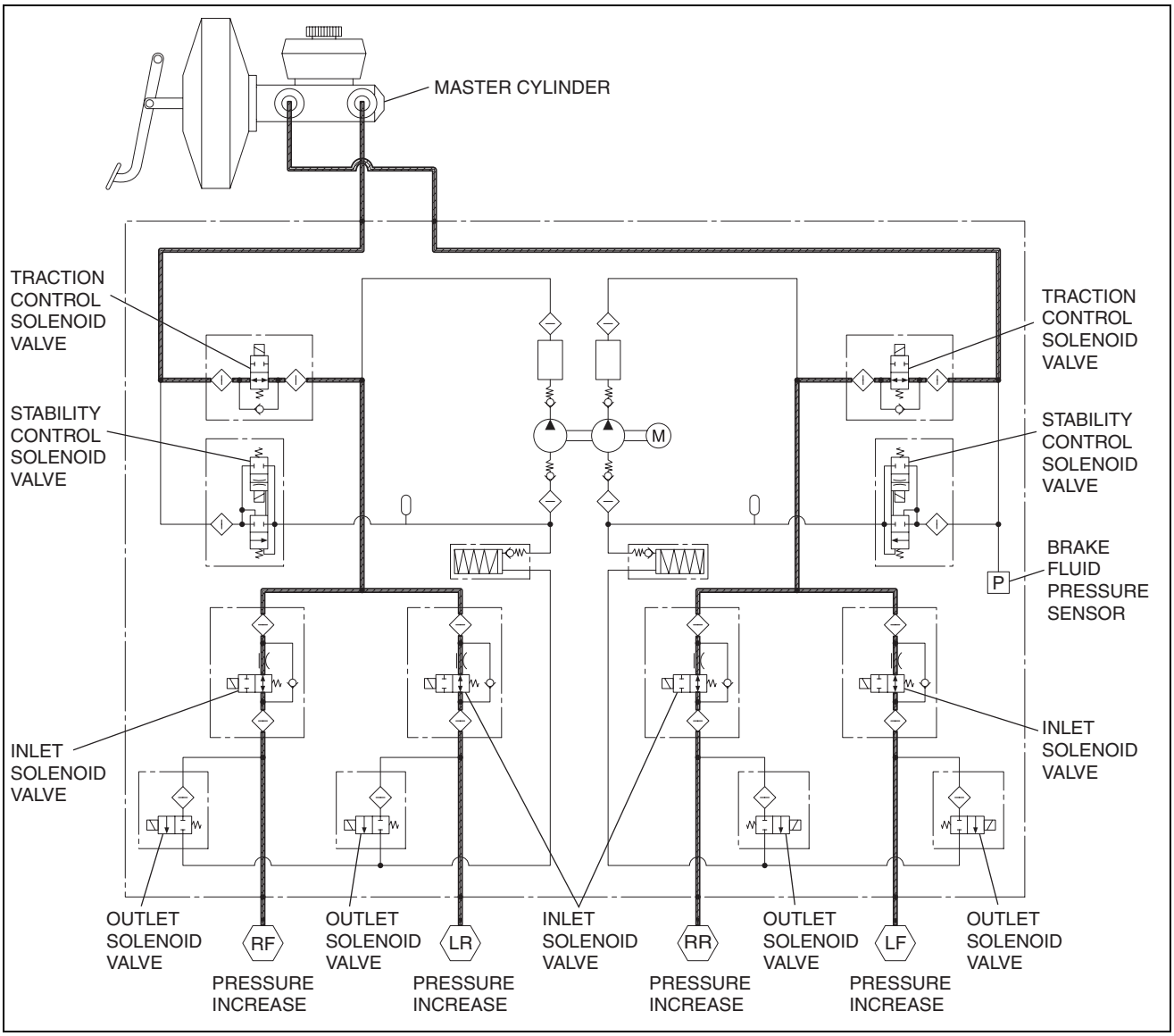
- During normal braking, the solenoid valves are not energized and all of them are off. When the brake pedal is depressed, brake fluid pressure is transmitted from the master cylinder, through the traction control solenoid and inlet solenoid valves, and then to the caliper piston.

Solenoid valve operation table

Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
OFF (open)		OFF (closed)		OFF (open)				OFF (closed)				Stopped

DYNAMIC STABILITY CONTROL

Hydraulic Circuit Diagram



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During ABS and EBD control

- During ABS and EBD control when wheel lock-up is about to occur, the traction control solenoid and stability control solenoid valves are not energized, and the inlet and outlet solenoid valves are energized and controlled in three pressure modes (increase, reduction or maintain), thereby adjusting brake fluid pressure. Brake fluid during pressure reduction is temporarily stored in the reservoir and afterwards the pump motor operates the pump to return the fluid to the master cylinder. (The following figure shows these conditions: right front wheel pressure increased, left front wheel pressure maintained, and both rear wheels pressure decreased.)

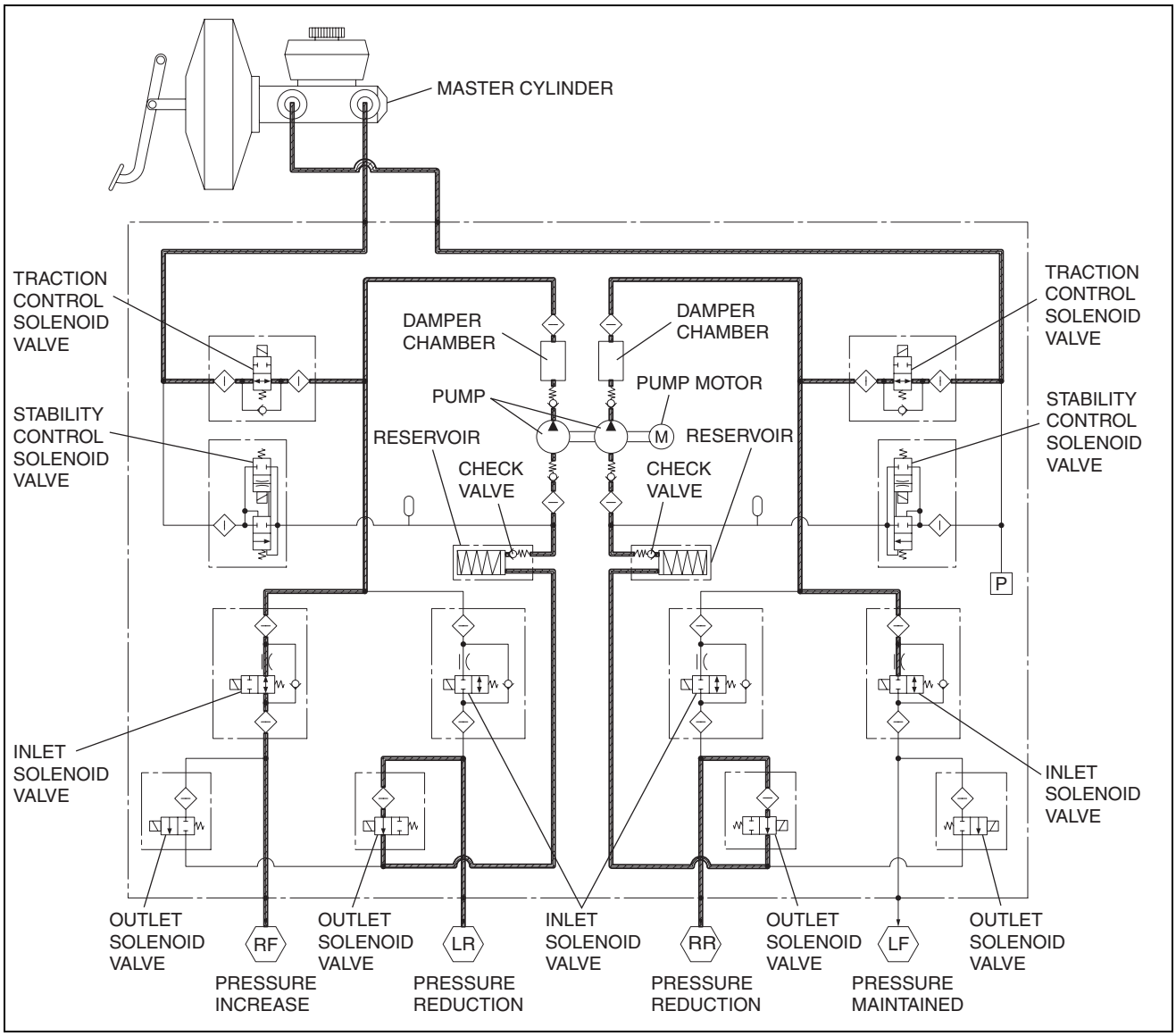
Solenoid valve operation table

	Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
	LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
During pressure increase mode	OFF (open)		OFF (closed)		OFF (open)				OFF (closed)				Stopped
During pressure maintain mode	OFF (open)		OFF (closed)		ON (closed)				OFF (closed)				Stopped

DYNAMIC STABILITY CONTROL

	Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
	LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
During pressure reduction mode	OFF (open)		OFF (closed)		ON (closed)				ON (open)				Operating

Hydraulic Circuit Diagram



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During DSC control (to suppress oversteer tendency) and TCS control

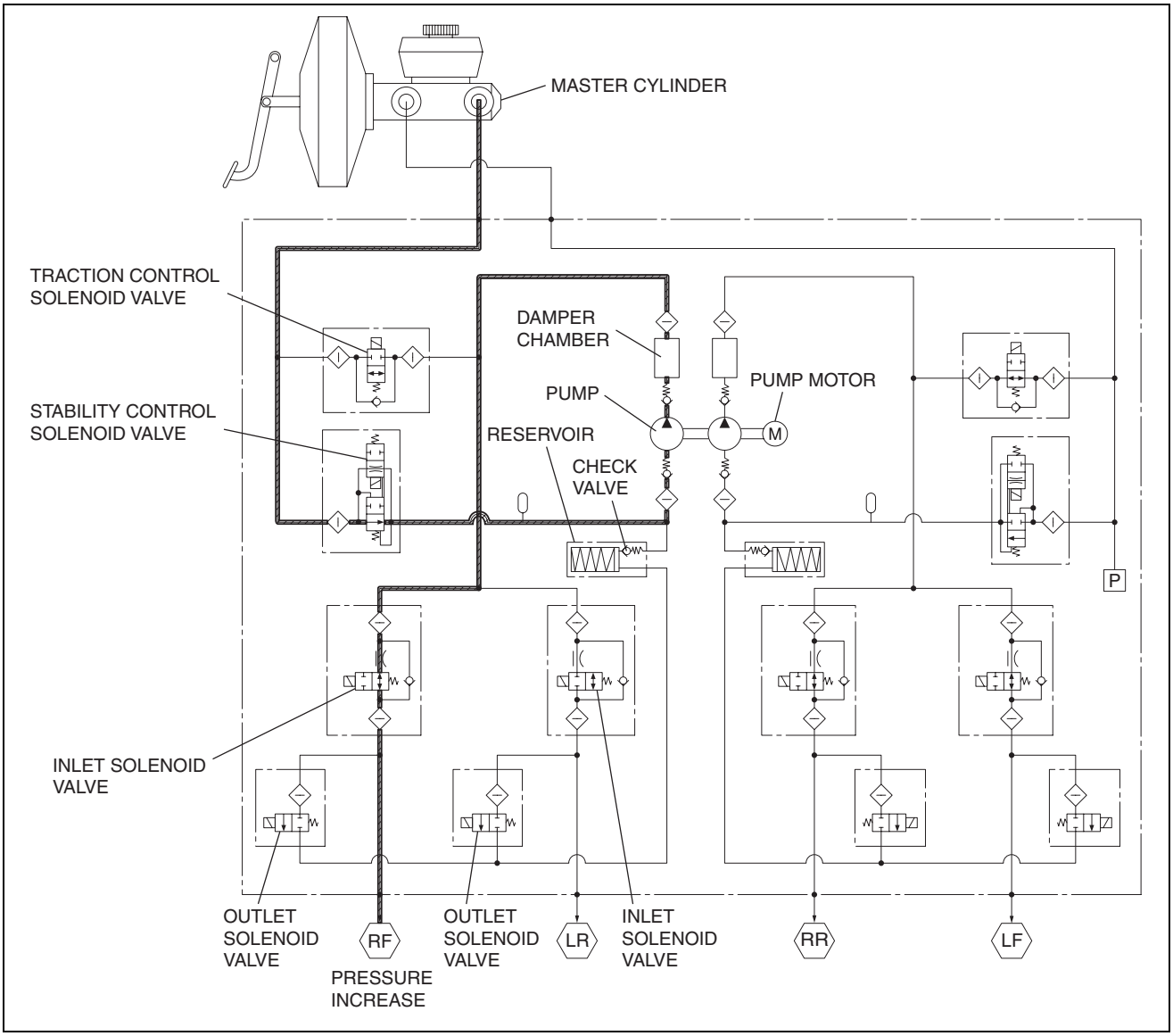
- When a large oversteer tendency or driving wheel spin is determined, the traction control solenoid and stability control solenoid valves are energized, switching the hydraulic circuits. At the same time, the pump motor is actuated to operate the pump, thereby increasing pressure by supplying brake fluid pressure to the caliper piston of the outer front wheel or the slipping driving wheel. Also at this time, the inlet solenoid valve of the inner rear wheel is energized and the hydraulic circuit of this wheel is closed.
- After a pressure increase, brake fluid pressure is adjusted using the three pressure modes (reduction, maintain, increase) so that the target wheel speed is obtained. (The following figure shows a left turn, or control of right front wheel spin (during pressure increase mode).)

DYNAMIC STABILITY CONTROL

Solenoid valve operation table

	Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
	LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
During pressure increase mode	OFF (open)	ON (closed)	OFF (closed)	ON (open)	OFF (open)		ON (closed)	OFF (open)	OFF (closed)				Operating
During pressure maintain mode	OFF (open)	ON (closed)	OFF (closed)		OFF (open)	ON (closed)		OFF (open)	OFF (closed)				Stopped
During pressure reduction mode	OFF (open)	ON (closed)	OFF (closed)		OFF (open)	ON (closed)		OFF (open)	OFF (closed)	ON (open)	OFF (closed)		Operating

Hydraulic Circuit Diagram



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During DSC control (to suppress understeer tendency)

- When a large understeer tendency is determined, the traction control solenoid and stability control solenoid valves are energized, switching the hydraulic circuits. At the same time, the pump motor is actuated to operate the pump, supplying brake fluid pressure from the reservoir to the inner rear caliper piston. Also at this time, the inlet solenoid valve of the outer front wheel is energized and the hydraulic circuit of this wheel is closed.

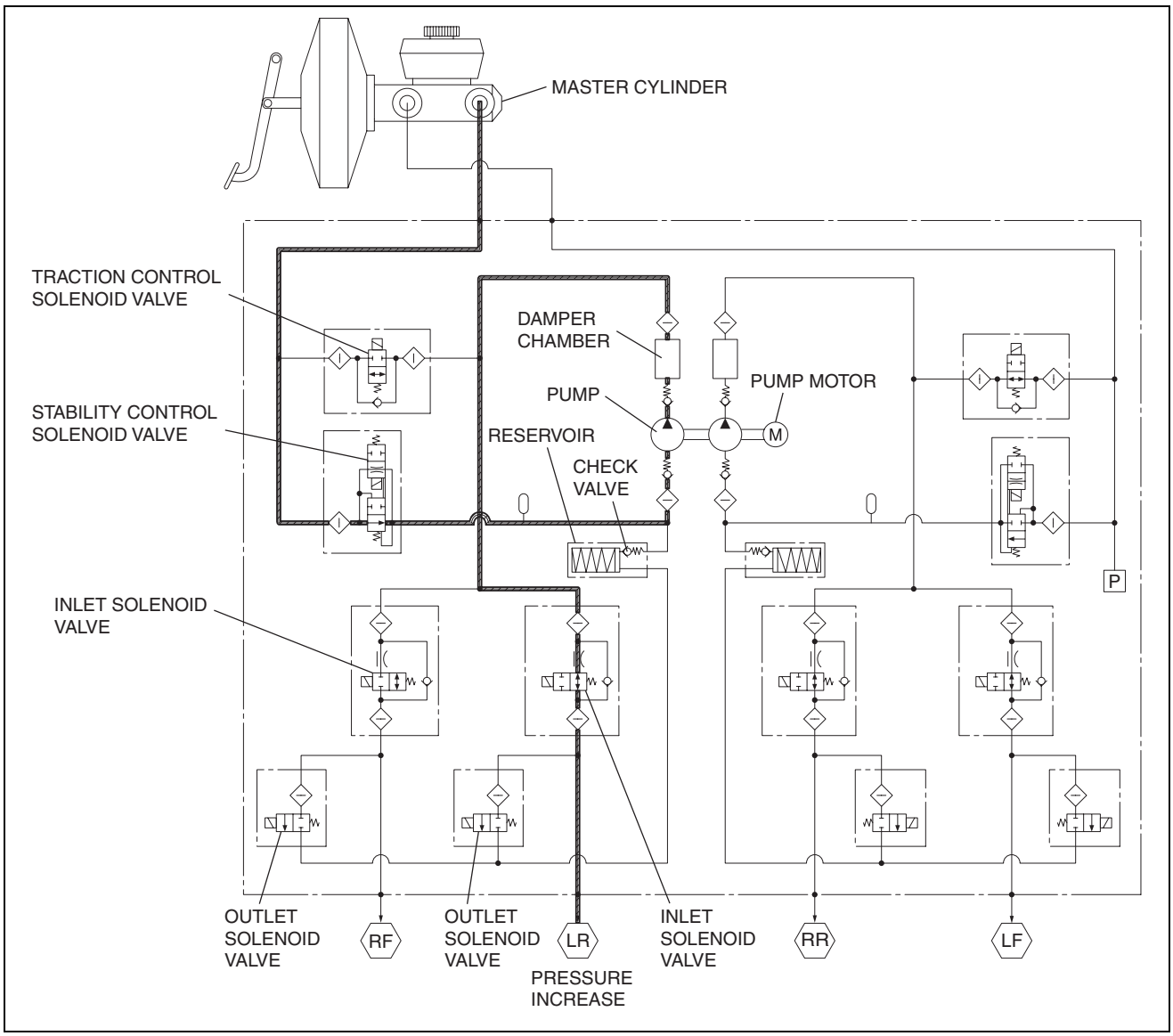
DYNAMIC STABILITY CONTROL

- After a pressure increase, brake fluid pressure is adjusted using the three pressure modes (reduction, maintain, increase) so that the target wheel speed is obtained. (The following figure shows control during a left turn during pressure increase mode.)

Solenoid valve operation table

	Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
	LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
During pressure increase mode	OFF (open)	ON (closed)	OFF (closed)	ON (open)	OFF (open)	ON (closed)	OFF (open)		OFF (closed)				Operating
During pressure maintain mode	OFF (open)	ON (closed)	OFF (closed)		OFF (open)	ON (closed)		OFF (open)	OFF (closed)				Stopped
During pressure reduction mode	OFF (open)	ON (closed)	OFF (closed)		OFF (open)	ON (closed)		OFF (open)	OFF (closed)		ON (open)	OFF (closed)	Operating

Hydraulic Circuit Diagram



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DYNAMIC STABILITY CONTROL

DSC CM Part Function

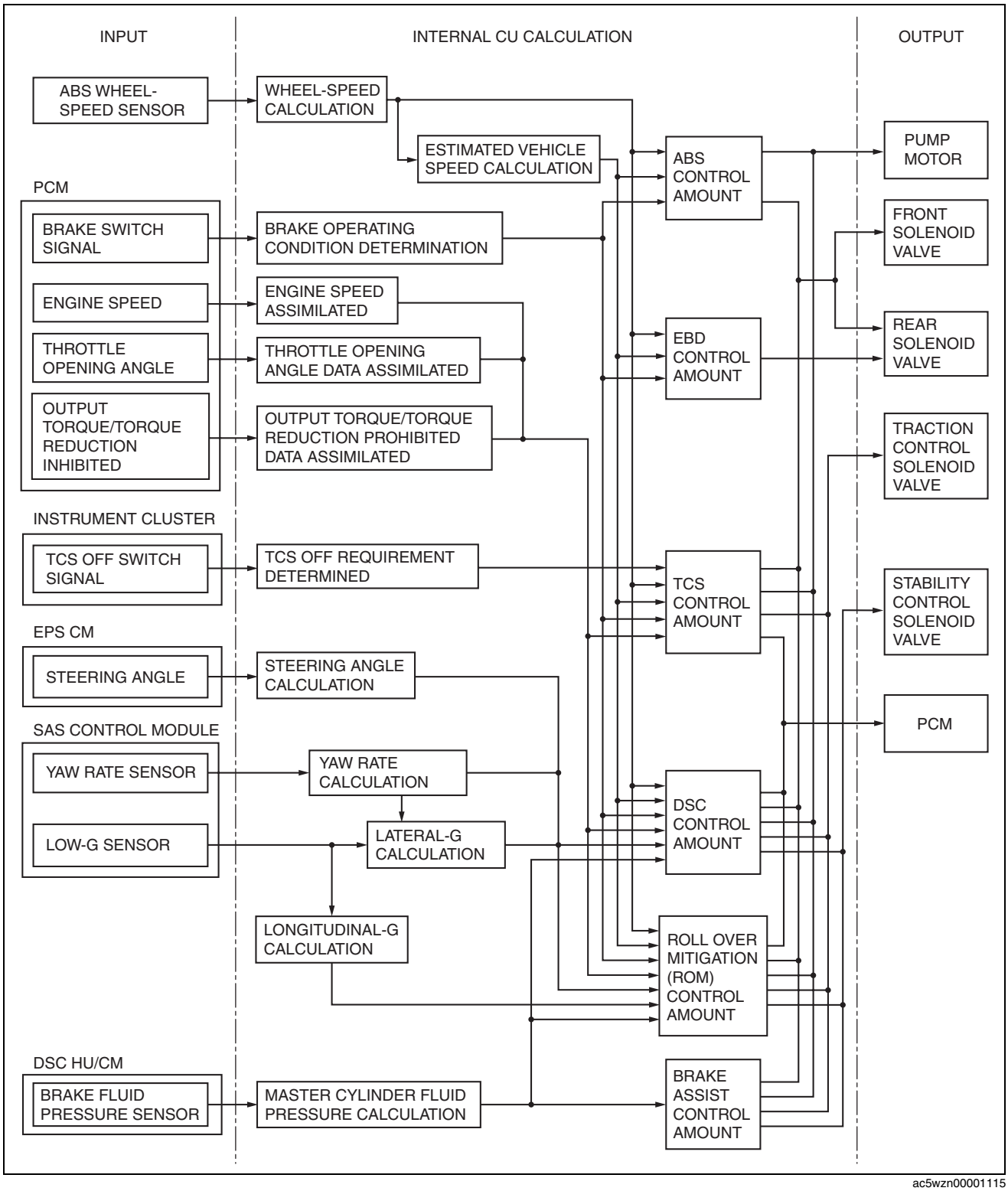
- The DSC CM makes calculations using signals input from each sensor, and outputs a brake fluid pressure control signal to the DSC HU to actuate DSC system functions. It also outputs an engine output control signal to the PCM.
- The DSC HU/CM controls the following functions:

Function table

Function name	Contents
ABS control function	• Controls brake fluid pressure when braking to maintain directional stability, ensure steerability, and reduce stopping distance.
Electronic brakeforce distribution (EBD) control function	• Constantly controls proper distribution of brake fluid pressure to the front and rear wheels according to vehicle load, road surface, and vehicle speed conditions to prevent early lock-up of the rear wheels.
TCS control function	• Controls traction to within the road surface friction limit and according to road and driving conditions to improve starting and acceleration performance, and safety.
DSC control function	• Suppresses strong over-steer and under-steer tendencies when turning by controlling engine output and braking of each wheel to assure driving safety.
Roll over mitigation (ROM) control function	• Suppresses vehicle attitude due to overspeed during evasive steering or cornering by controlling engine speed and wheel braking to improve vehicle stability during cornering.
Brake assist control function	• The brake pedal depression speed and force is calculated from the brake fluid pressure sensor signal. If it exceeds the specification, an emergency braking situation is determined and a higher amount of hydraulic pressure than the normal specified amount is generated in the hydraulic unit and supplied to each wheel based on the activation of each solenoid valve, pump motor, and pump. • If a condition is detected in which emergency braking is anticipated by the change in speed of the accelerator pedal position, the gap between the brake pad and disc plate is reduced to enhance the response when braking.
Vehicle roll prevention function	• For detailed information on the vehicle roll prevention function, refer to VEHICLE ROLL PREVENTION FUNCTION. (See 04-15-21 VEHICLE ROLL PREVENTION FUNCTION.)
Hill launch assist (HLA) control function	• For detailed information on the hill launch assist (HLA), refer to HILL LAUNCH ASSIST (HLA). (See 04-15-24 HILL LAUNCH ASSIST (HLA).)
Tire pressure monitoring system (TPMS) control function	• For detailed information on the TPMS, refer to TIRE PRESSURE MONITORING SYSTEM (TPMS). (See 02-12-3 TIRE PRESSURE MONITORING SYSTEM (TPMS).)
Smart city brake support (SCBS) control function (vehicles with smart city brake support (SCBS))	• For detailed information on the smart city brake support (SCBS), refer to SMART CITY BRAKE SUPPORT (SCBS). (See 04-15-28 SMART CITY BRAKE SUPPORT (SCBS).)
Secondary collision reduction (SCR) control function	• For detailed information on the secondary collision reduction (SCR), refer to SECONDARY COLLISION REDUCTION (SCR). (See 04-15-35 SECONDARY COLLISION REDUCTION (SCR).)
CAN communication function	• Outputs the vehicle speed signal and DSC system warning control data via CAN lines.
On-board diagnostic system	• A function that allows important parts of the DSC control system to perform self-diagnosis. In case a malfunction occurs, the warning lights illuminate to alert the driver, and at the same time a DTC is stored in the DSC HU/CM. • When a malfunction is determined as a result of the on-board diagnostic test, system control is suspended or limited to prevent any dangerous situation while driving.
Automatic configuration function	• When the ignition is switched to ON or the engine is started after the DSC HU/CM have been replaced, the DSC CM reads data from the instrument cluster via CAN communication to perform automatic configuration.

DYNAMIC STABILITY CONTROL

Block diagram



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ABS CONTROL

id041500103200

Outline

- ABS control occurs when wheel slip is determined by the DSC CM (based on the four ABS wheel-speed sensors). Then, the DSC HU inlet and outlet solenoid valves are operated and brake fluid pressure is controlled accordingly to prevent wheel lock-up.

DYNAMIC STABILITY CONTROL

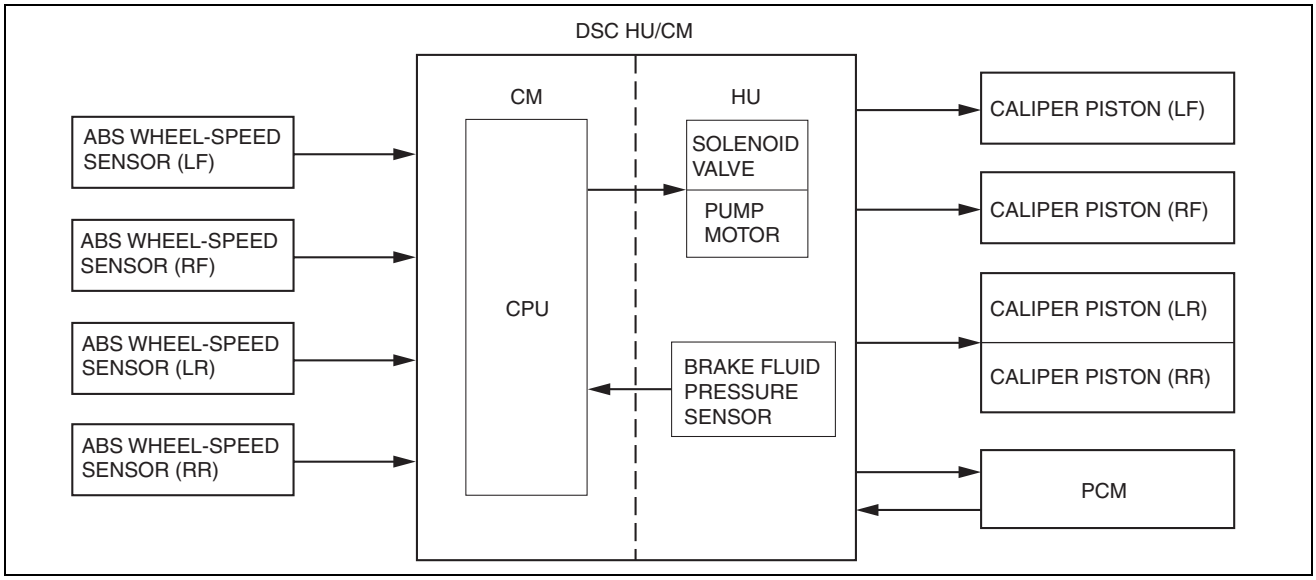
Feature

- Use of ABS control during emergency braking or on slippery road surfaces allows directional stability to be maintained, steerability ensured, and stopping distance to be reduced.
- The ABS control system has independent front wheel control and unified control (select low) for the rear wheels.

Note

- Select low control: A control system in which the left and right vehicle wheel speeds are compared and brake fluid pressure is controlled according to the wheel most likely to lock-up.

Construction
Block Diagram



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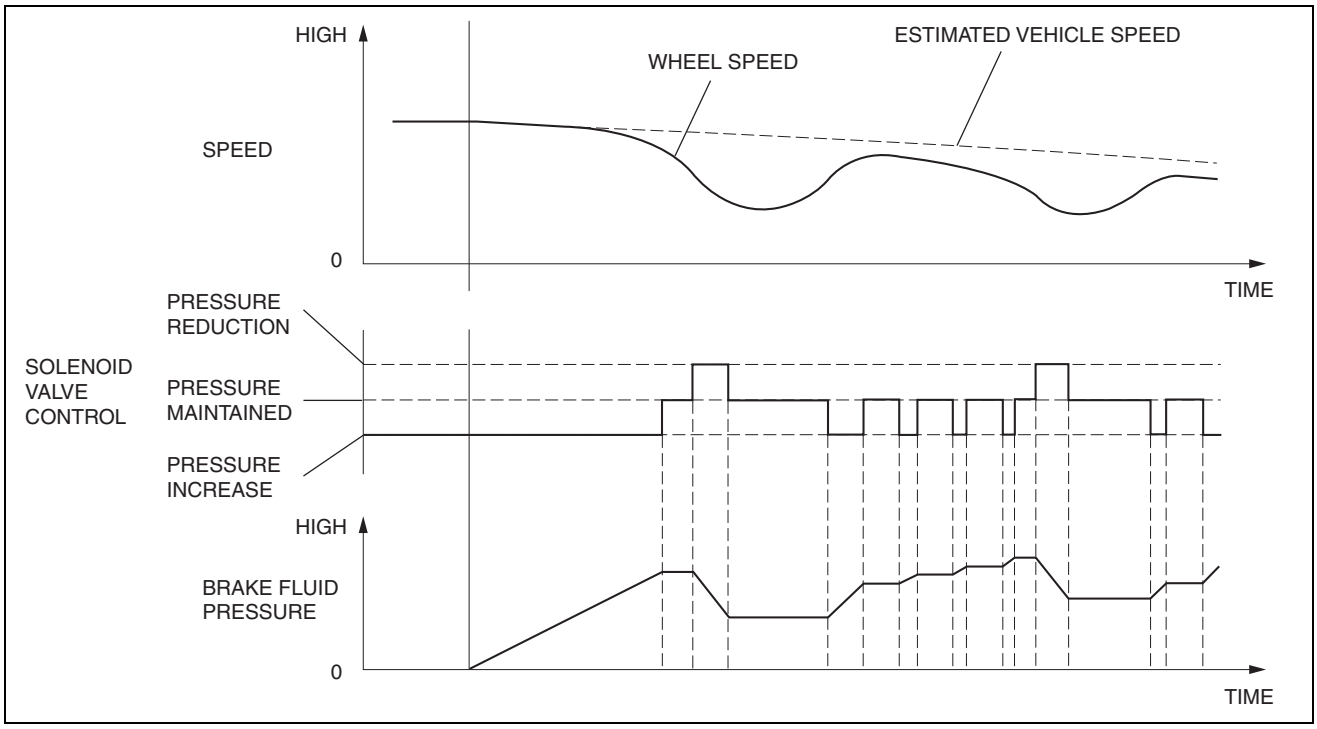
Operation

- When the DSC CM determines wheel slip conditions based on the signals from the ABS wheel-speed sensors during braking, the DSC CM operates the DSC HU inlet and outlet solenoid valves, reducing and maintaining brake fluid pressure in accordance with the wheel slip factors. Then, when the wheel slip condition has passed, brake fluid pressure is increased and maintained, ensuring braking with a constantly stable brake force.

DYNAMIC STABILITY CONTROL

Control condition transition diagram



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EBD CONTROL

id041500103400

Outline

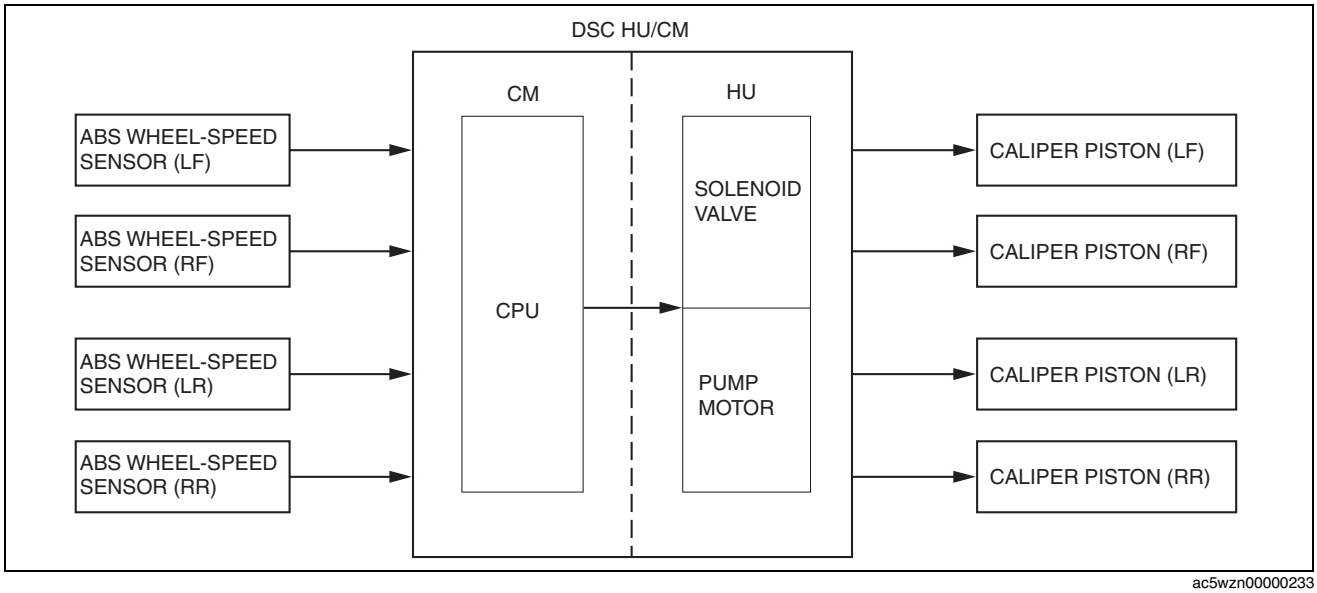
- EBD control uses the ABS system to control brake fluid pressure distribution to the rear wheels so that they do not lock-up prior to the front wheels during braking, thereby preventing the loss of handling stability.

Feature

- EBD control has independent control systems for both the front and rear wheels.
- EBD control constantly and properly distributes brake fluid pressure regardless of vehicle weight.

Construction

Block Diagram



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DYNAMIC STABILITY CONTROL

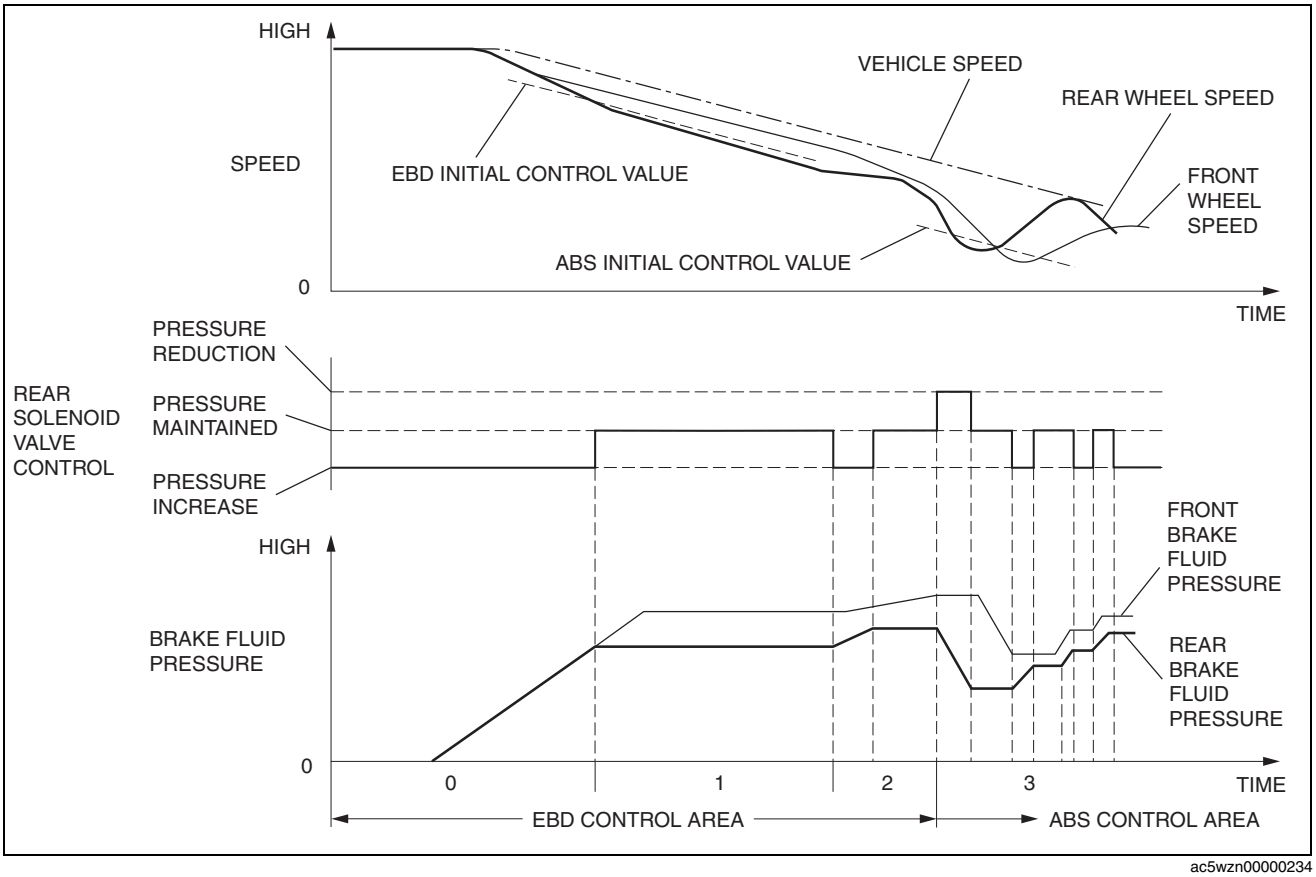
Operation

- EBD control detects the slip ratio between the estimated vehicle speed and rear wheels from the ABS wheel-speed sensor signals. If the slip ratio of the rear wheels as compared to the front wheels is larger than the fixed limit, the DSC HU/CM reduces brake pressure being distributed to the rear wheels. Due to this, brake pressure distribution is constantly controlled in the proper proportion and in relation to vehicle load, road surface conditions, and vehicle speed.
- Determination of the rear wheel slip ratio, based on a comparison of the lowest front wheel speed and the estimated vehicle speed with the rear wheel speeds, is divided into conditions 0-3 shown in the table below.
- The DSC HU outlet and inlet solenoid valves are operated and the brake fluid pressure controlled according to these conditions.
- If ABS control conditions are met during EBD control, EBD control is stopped and ABS control is given priority.

Status	Rear wheel slip ratio determination	EBD control	Solenoid valve	Comment
0	No slip	No control	Pressure increase	—
1	α%—β%	Control	Pressure maintained	—
2	After EBD control, slip ratio is γ%	Control	Increase/maintain	—
3	Front wheel slip ratio is δ% or more	Control	Pressure reduction/ maintained/increase	ABS control operates

α—δ: Specified value

Operating Condition Transition Diagram



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TCS CONTROL

id041500103800

Outline

- The TCS control actuates torque reduction through engine control, as well as using brake control to control traction.

Note

- Engine control: Engine output is lowered by fuel cut and ignition timing control to reduce the traction, preventing driving wheel slip.

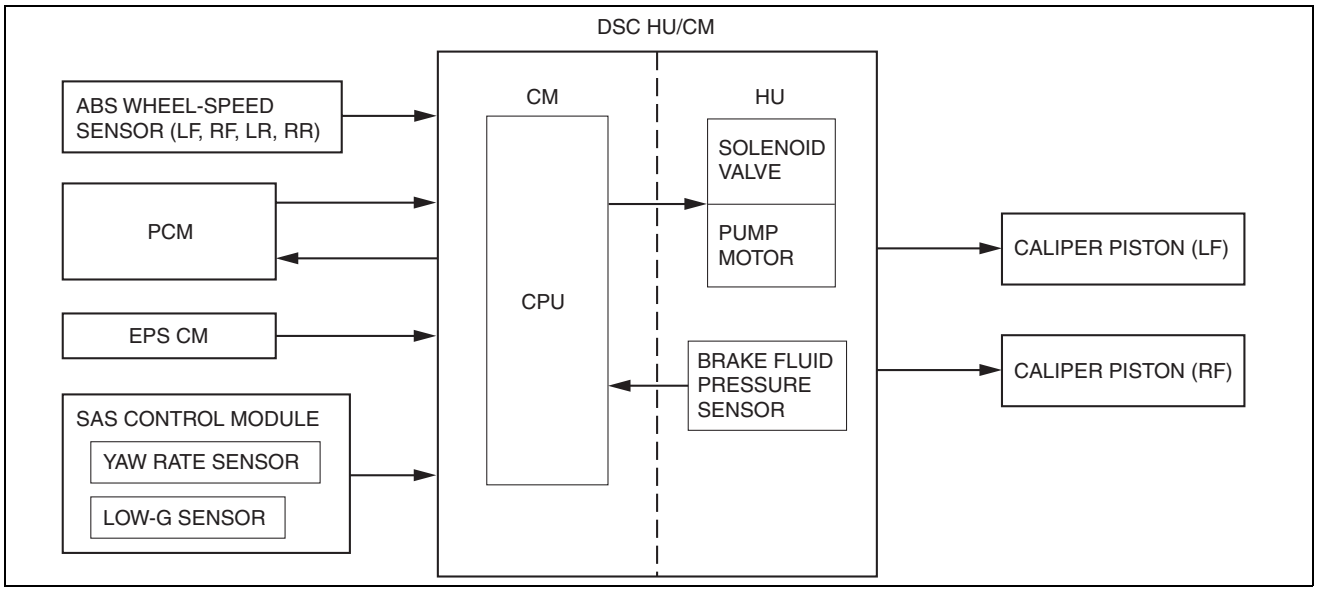
DYNAMIC STABILITY CONTROL

- Brake control: Brake fluid pressure from the hydraulic unit (HU) to the driving wheel that is slipping is increased, operating the brake and preventing driving wheel slip.

Features

- The left and right wheels are controlled at the same time by engine control. Therefore, when the road surface friction coefficients differ between the left and right wheels, proper torque reduction cannot be performed separately for each wheel. When this occurs, torque reduction is performed by independent left and right wheel brake control, providing more stable vehicle control.
- The TCS OFF switch allows the driver to optionally enable/disable the TCS control at the driver's discretion.
  - — When both driving wheels are stuck, traction control according to the driver's operation can be performed by inhibiting the TCS control.
  - — The TCS control returns to normal operation automatically at the next ignition cycle.

Construction
Block Diagram



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Operation

- TCS control detects driving wheel spin based on the signals listed below, sends torque reduction request signals to the PCM, and also controls the solenoid valves and pump motor in the DSC HU/CM.
  - — Vehicle wheel speed signals from the font and rear ABS wheel-speed sensors
  - — Engine torque signal from the PCM
  - — Steering angle signal from the EPS CM
  - — Yaw rate and lateral-G signals from the SAS control module
  - — Fluid pressure signal from the brake fluid pressure sensor (built into the DSC HU/CM)

DSC CONTROL

id041500103900

Outline

- While a vehicle normally turns safely in response to steering operation, there are instances when the limits of tire lateral grip is surpassed due to road surface conditions or vehicle speed, and the influence of evasive steering to avoid an accident or similar situations.
- Tires surpassing lateral grip exhibit one of the following conditions: Strong oversteer tendency (rear wheel grip is less than front wheels) and Strong understeer tendency (front wheel grip is less than rear wheels)
- DSC operates at vehicle speeds of approx. 15 km/h {9.3 mph} or more in the conditions described above, controlling engine output and wheel braking to suppress oversteer and understeer tendencies.

Roll over mitigation (ROM) outline

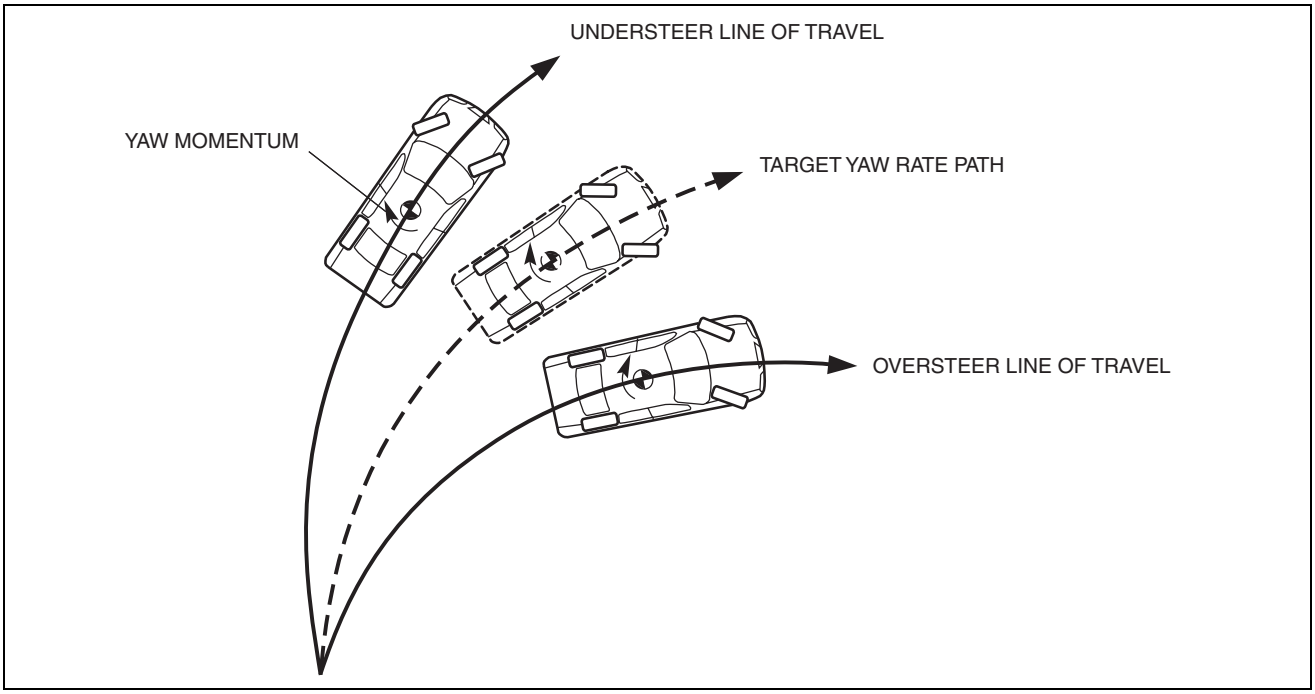
- The DSC system monitors each sensor and calculates if the vehicle may be approaching a situation where rollover is probable. When this occurs, the DSC system applies preemptive action by adjusting the brake force.

DYNAMIC STABILITY CONTROL

Function

Vehicle condition determination

- The vehicle speed, steering angle, lateral-G, and yaw rate are detected by the sensors and used in calculations by the DSC HU/CM to determine the vehicle condition. Then, depending on the difference between the target yaw rate, calculated with the values input from each sensor and the value detected by the yaw rate sensor, an oversteer or understeer tendency can be determined.



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Oversteer tendency determination

- When turning, if the actual vehicle yaw rate is larger than the target yaw rate (the yaw rate that should normally be formed as determined by the steering angle and vehicle speed), it means that the vehicle is in or about to be in a spin. Therefore the vehicle is determined to have an oversteer tendency.

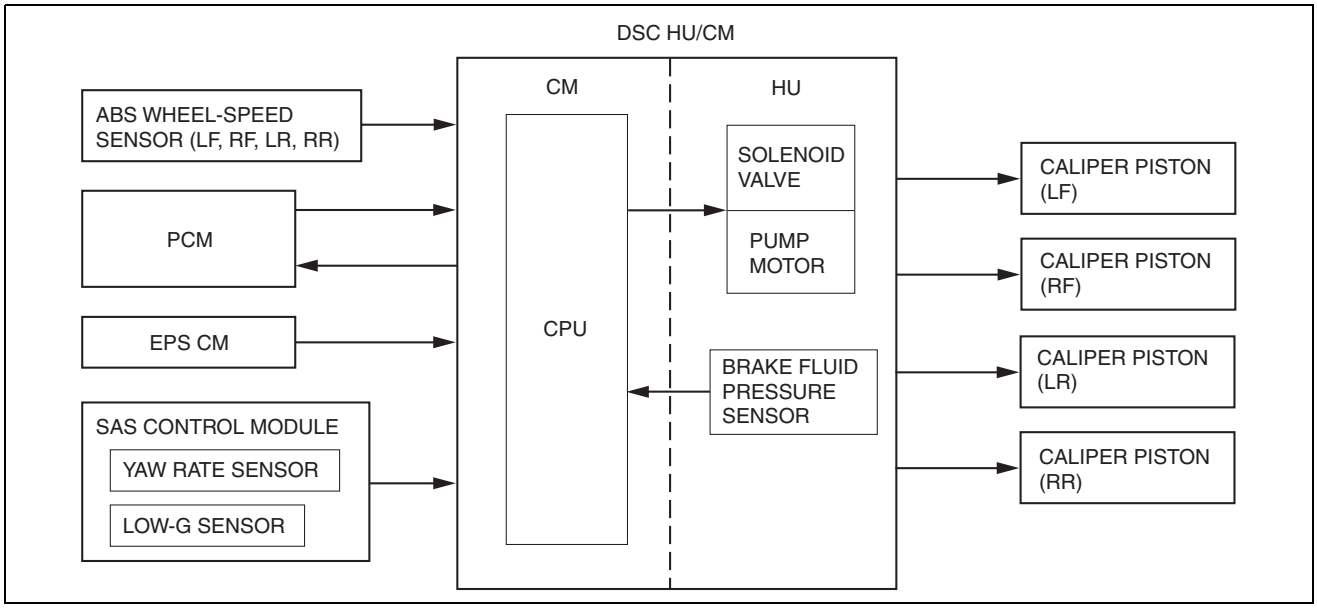
Understeer tendency determination

- When turning, if the actual vehicle yaw rate is less than the target yaw rate (the yaw rate that should normally be formed as determined by the steering angle and vehicle speed), it means that the vehicle is not properly turning. Therefore the vehicle is determined to have an understeer tendency.

DYNAMIC STABILITY CONTROL

Construction

Block diagram



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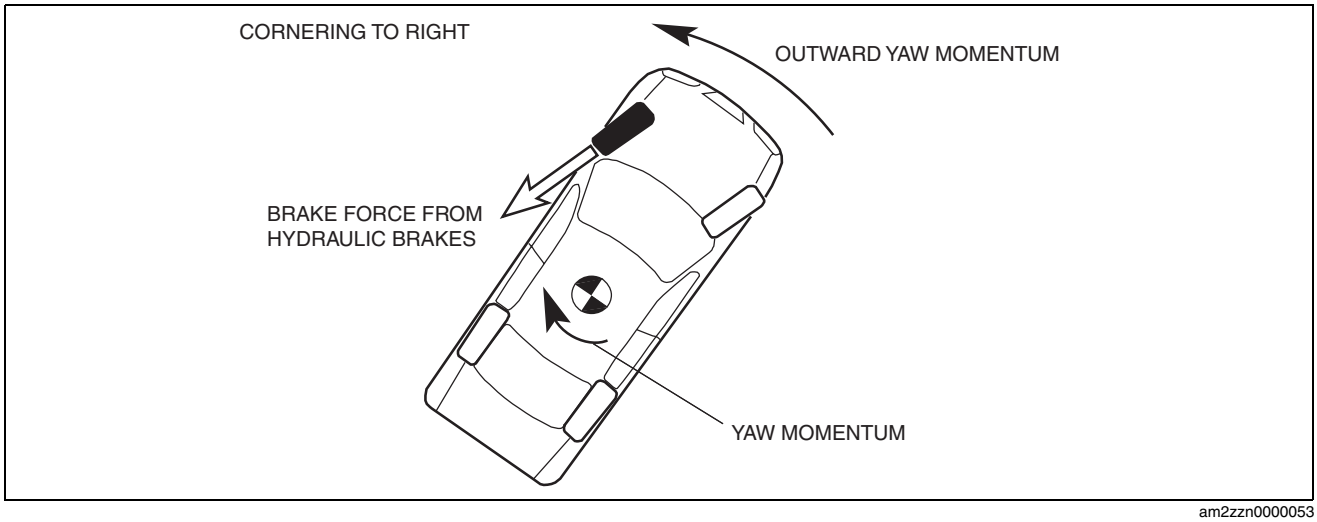
Operation

- When the DSC HU/CM determines that the vehicle has a strong oversteer or understeer tendency, engine output is lowered and, at the same time, it suppresses the yaw moment by affecting the braking of the front or rear wheels to inhibit the oversteer or understeer tendency.

Oversteer tendency suppression

- When a large oversteer tendency is determined, braking is applied to the outer front wheel according to the degree of the tendency. As a result, a yaw moment is formed towards the outer side of the vehicle and the oversteer tendency is suppressed.



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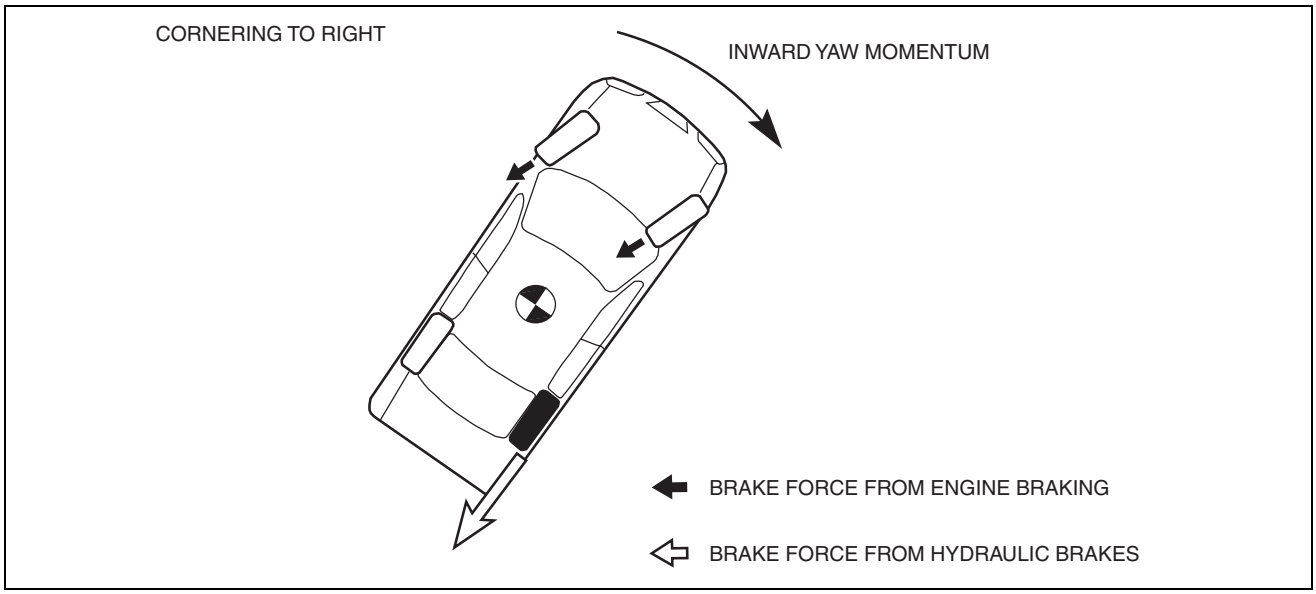
Understeer tendency suppression

- When a large understeer tendency is determined, engine output is controlled and braking is applied to the inner rear wheel according to the degree of the tendency. As a result, a yaw moment is formed towards the inner side of the vehicle and the understeer tendency is suppressed.

DYNAMIC STABILITY CONTROL



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Roll over mitigation (ROM) operation

- The DSC system monitors the signal from yaw rate sensor, low-G sensor, and each sensor, and calculates if the vehicle may be approaching a situation where rollover is probable. When this occur, the DSC system applies preemptive action by roll over mitigation (ROM) function. When the roll over mitigation (ROM) is activated, it adjusts the brake force of specific wheels in response to the direct measurement of the vehicle roll motion. By adjusting the brake force, the DSC system can reduce cornering forces, reducing the total roll moment acting on the vehicle. The DSC system has an additional program within the DSC HU/CM to support the vehicle control during sudden steering operation. The computer uses information from the ABS wheel-speed sensor (wheel speed), EPS CM (steering wheel angle), yaw rate sensor (yaw rate), low-G sensor (lateral-G) and actual engine torque. If the DSC HU/CM determines from all these inputs that conditions exist for a potential rollover, the HU/CM applies one or more brakes and reduces the engine torque to make the vehicle more stable.

VEHICLE ROLL PREVENTION FUNCTION

id041500104400

Note

- The vehicle roll prevention is a control available only on ATX vehicles.

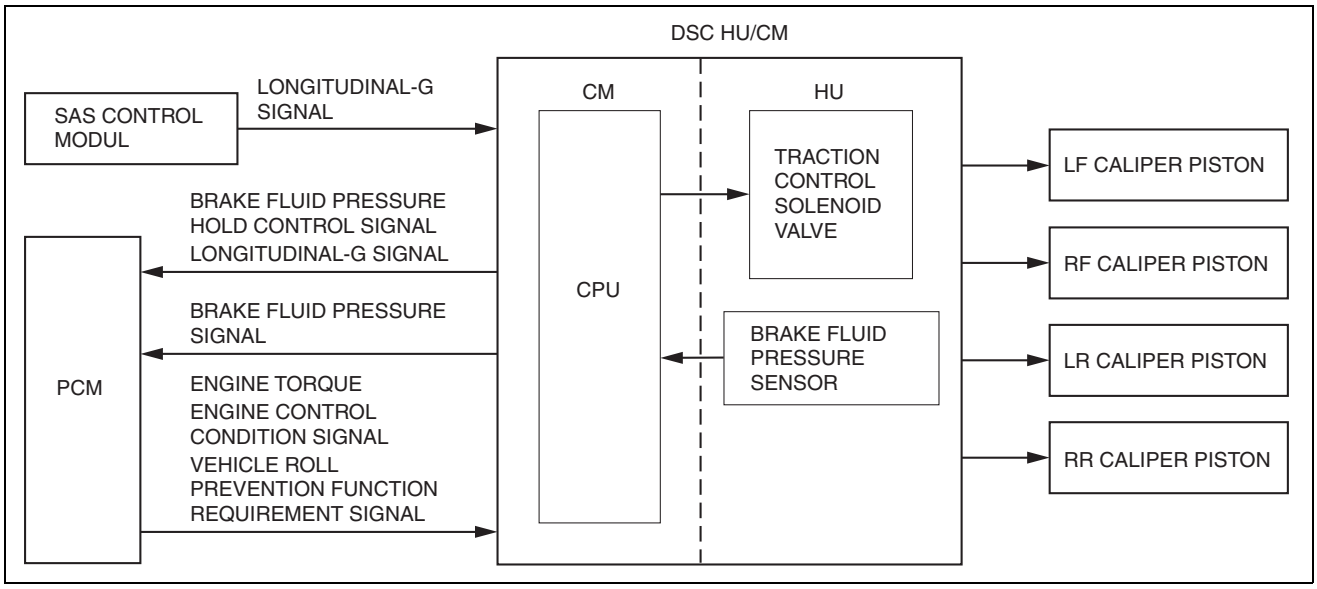
Purpose/Function

- The vehicle roll prevention function operates the traction control solenoid valve in the DSC HU/CM to hold/reduce brake fluid pressure during i-stop control, and controls brake fluid pressure during i-stop control.
- The vehicle roll prevention function controls optimum brake fluid pressure based on each signal sent from the PCM.
  - — Maintains brake fluid pressure to maintain vehicle stop condition while i-stop (engine-stop control) is operating.
  - — Decreases brake fluid pressure according to road slope and engine torque for smooth startability while i-stop (engine-restart control) is operating.
- For details on i-stop, refer to the “i-stop control”. (See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)

DYNAMIC STABILITY CONTROL

Construction

Block diagram



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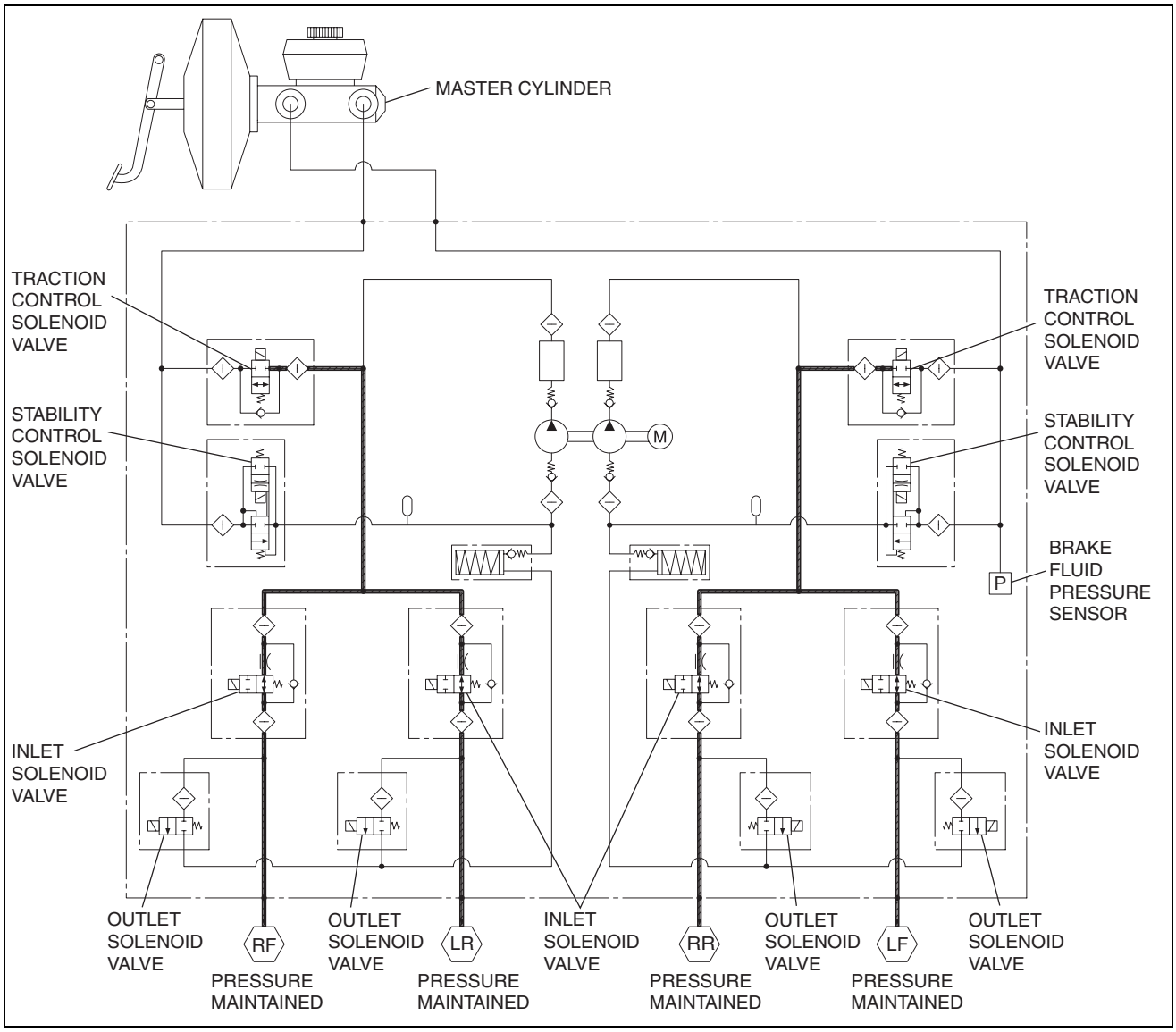
Operation

- The vehicle roll prevention function controls the traction control solenoid valve in the DSC HU/CM to maintain or decrease brake fluid pressure by the following signals sent from the PCM and longitudinal-G signal sent from the SAS control module.
  - — Vehicle roll prevention function control request signal
  - — Engine control condition signal
  - — Engine torque signal
- The vehicle roll prevention function controls as follows according to the i-stop control condition:
  i-stop control (engine stop)
  - — When the DSC HU/CM receives the vehicle roll prevention function control request signal from the PCM, controls the brake fluid pressure hold control (traction control solenoid valve is energized and hydraulic circuit is closed) and maintains the brake fluid pressure while the vehicle is stopped.

DYNAMIC STABILITY CONTROL

Hydraulic circuit diagram



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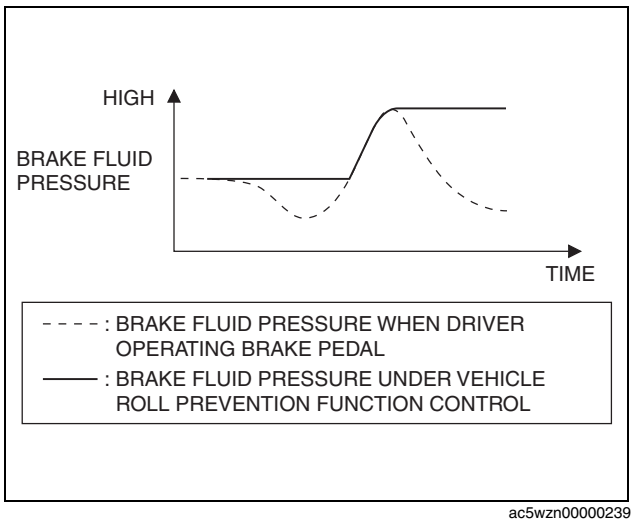
— If the driver depresses the brake pedal and the brake fluid pressure increases, the increased brake fluid pressure is maintained.
— The DSC HU/CM sends hold control signal to the PCM.

i-stop control (engine restart)

— The DSC HU/CM operates brake fluid pressure release control (maintained fluid pressure is controlled by changing energization amount to traction control solenoid valve) according to the engine torque signal sent from the PCM and the longitudinal-G signal from the SAS control module.
— When the engine torque signal sent from the PCM exceeds the specification after the engine restarts, the brake fluid pressure decreases. The time for decreasing changes depending on road slope and the time for decreasing becomes longer than on level road. In addition, when the accelerator pedal is depressed, the time for decreasing becomes shorter.



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DYNAMIC STABILITY CONTROL

HILL LAUNCH ASSIST (HLA)

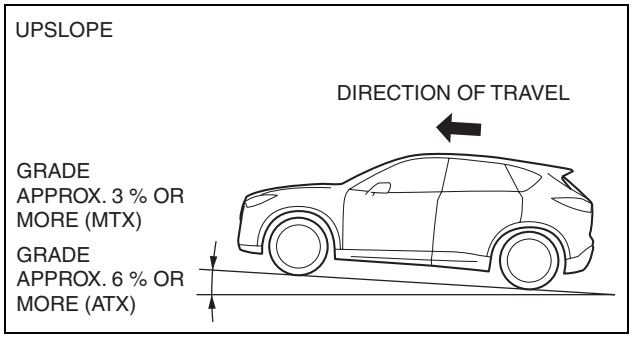
id041500104700

Purpose/Function

- The hill launch assist (HLA) is a function which assists the driver in accelerating the vehicle on a slope by activating the traction control solenoid valve in the DSC HU/CM when the vehicle begins accelerating on a slope, and maintaining/reducing brake fluid pressure to prevent the vehicle from rolling for a specified time.
- The system automatically operates when the vehicle is stopped on a slope of approx. 3 % or more (changes slightly depending on load and vehicle conditions such as tire wear and air pressure). (MTX)
- The system automatically operates when the vehicle is stopped on a slope of approx. 6 % or more (changes slightly depending on load and vehicle conditions such as tire wear and air pressure). (ATX)

Note

- The shift lever position is in the other than R position, the hill launch assist (HLA) operates on a upslope. (MTX)
- The selector lever position is in the D/M position, the hill launch assist (HLA) operates on a upslope. (ATX)



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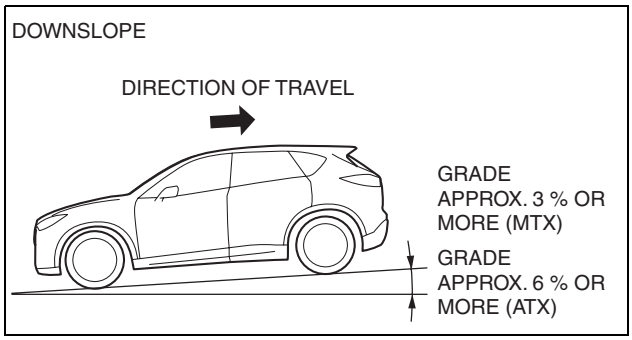
- The selector/shift lever position is in the R position, the hill launch assist (HLA) operates on a downslope.
- The hill launch assist (HLA) operates constantly without affecting the TCS OFF switch operation.
- When the parking brake is applied, the hill launch assist (HLA) does not operate.
- When the DSC indicator light illuminates, the hill launch assist (HLA) does not operate.



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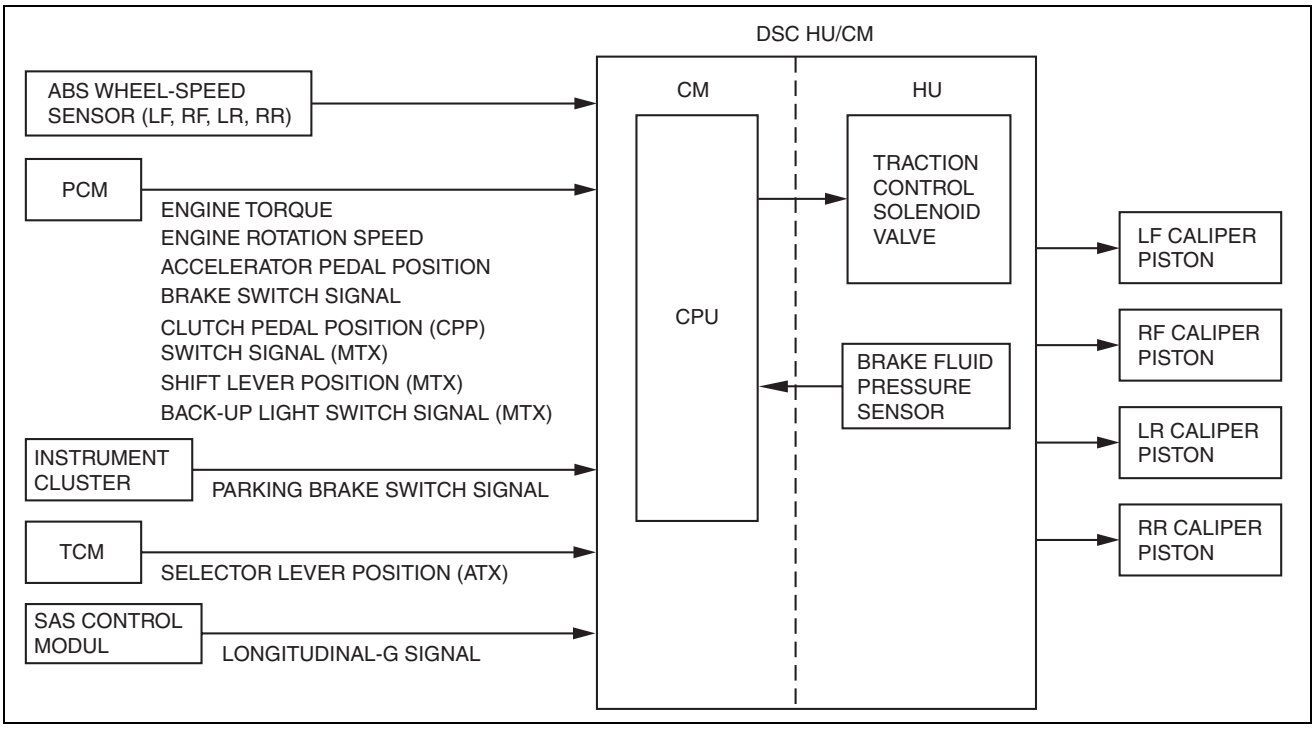
Structure

- The hill launch assist (HLA) constantly controls the brake fluid pressure in accelerating the vehicle on a slope by determining the hill launch assist (HLA) operation based on the signals input from each module via CAN communication, wheel speed signals from the ABS wheel-speed sensor.

DYNAMIC STABILITY CONTROL

Block diagram



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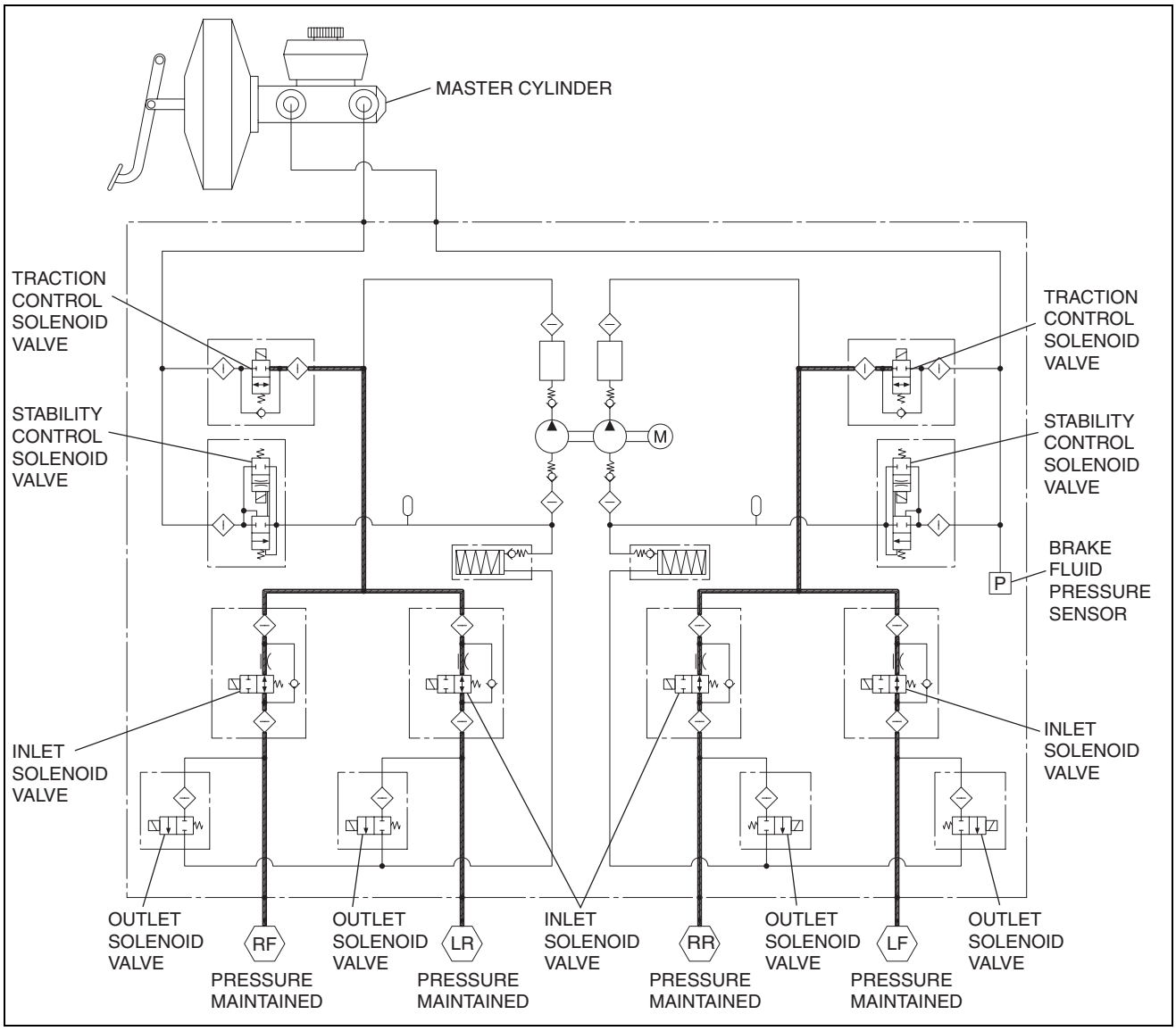
DYNAMIC STABILITY CONTROL

Hydraulic circuit diagram



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Operation

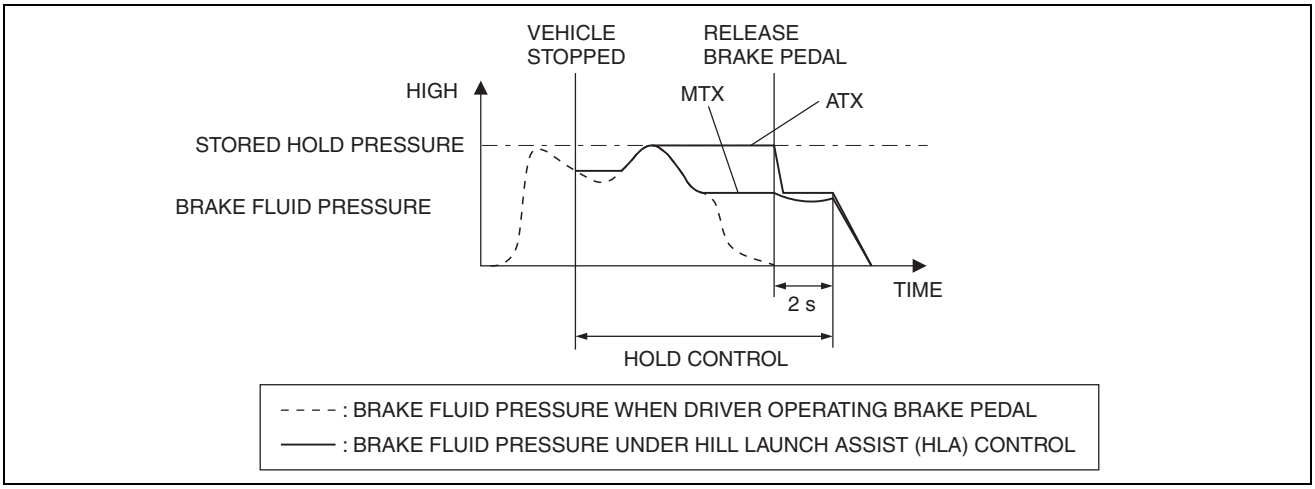
- If all of the following conditions are met while the vehicle is stopped on a slope, the DSC HU/CM performs controls to maintain brake fluid pressure (control the linear control solenoid valve) even if the driver has released the brake pedal.

Hold control

- Control conditions (all of the following conditions met):
  - — Engine speed is at a certain value or more
  - — All doors are fully closed
  - — Slope of approx. 3 % or more (MTX)
  - — Slope of approx. 6 % or more (ATX)
  - — Wheel speed is 0 km/h {0 mph}
  - — Parking brake not operated
  - — Accelerator pedal not depressed
  - — Not fail-safe mode is present
  - — Upslope: The selector lever position is in the D/M position (ATX)
  - — Upslope: The shift lever position is in the position other than R (MTX)
  - — Downslope: The selector/shift lever position is in the R position
  - — Brake pedal is depressed and brake fluid pressure is at a certain value or more
  - — Clutch pedal depressed (MTX)
- Control description

DYNAMIC STABILITY CONTROL

— If all of the control conditions are met, the DSC HU/CM controls the traction control solenoid valve and maintains brake fluid pressure (driver can depress brake pedal more at this time).



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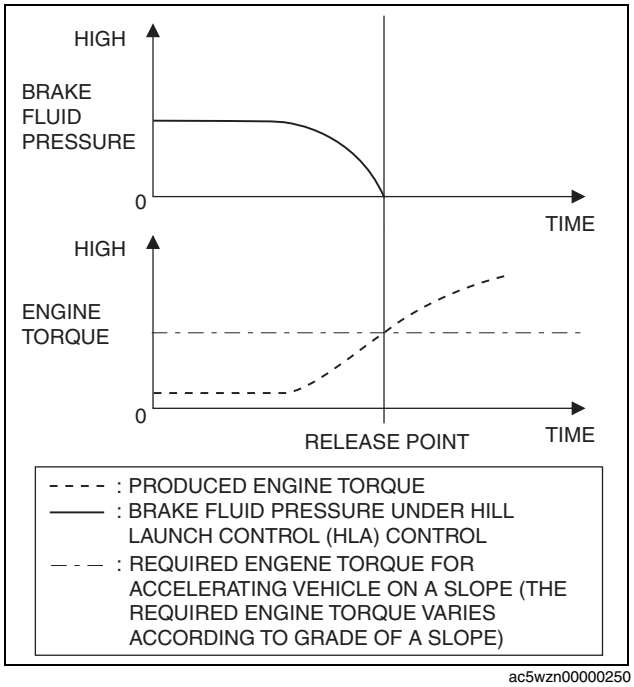
— If the brake pedal is released, brake fluid pressure (hold-pressure stored in memory) is maintained for a maximum of 2 s.

Release control

- Control condition
  — After the accelerator pedal is depressed, the required engine torque for accelerating vehicle on a slope is produced
- Control description
  — Brake fluid pressure being maintained is lowered depending on produced engine torque.



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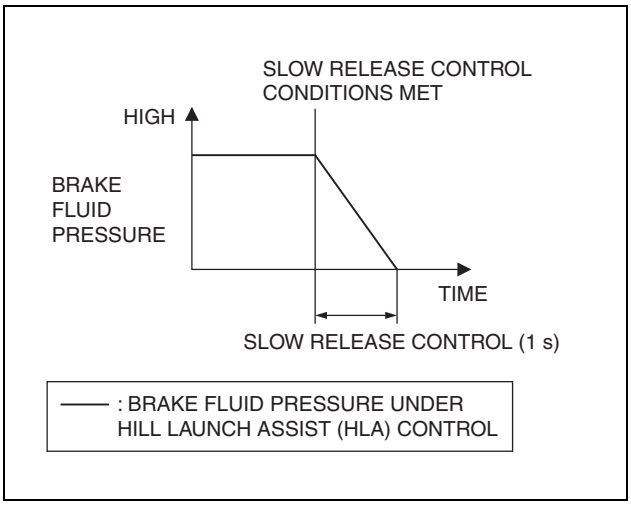
Slow release control

- Control condition (one or more of following conditions are met):
  — Parking brake applied
  — Clutch pedal released (MTX)
  — DSC HU/CM has malfunction (performs slow release control only if solenoid valve control is available)
  — Slope of 1.0 % or less (MTX)
  — Slope of 4.0 % or less (ATX)
  — 2 s have elapsed with brake pedal released
- Control description

DYNAMIC STABILITY CONTROL

— Brake fluid pressure being maintained is lowered in 1 s



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Fast release control

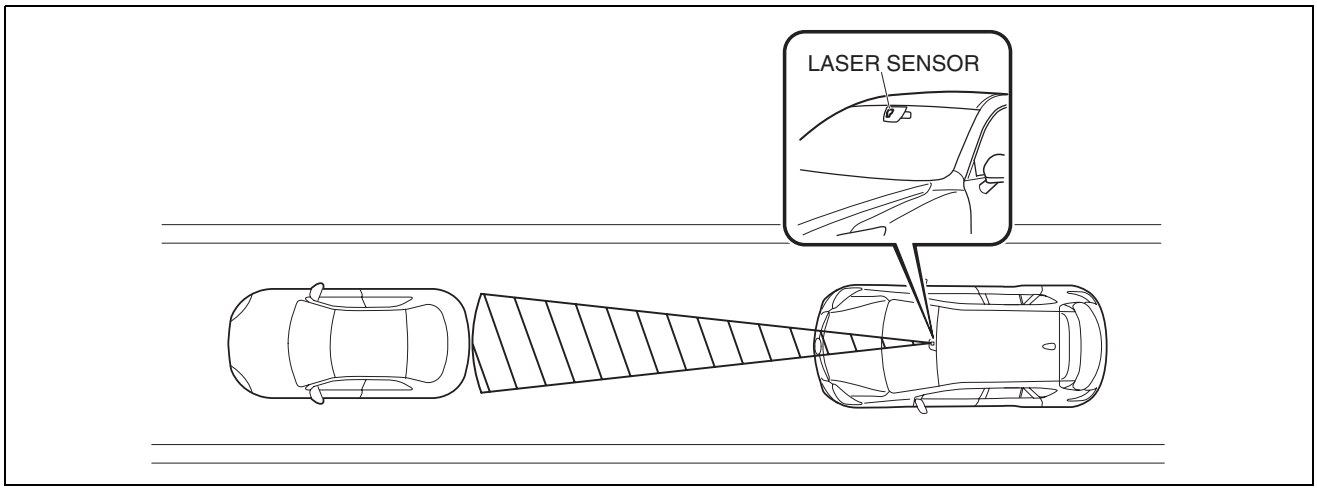
- Control condition
  — DSC HU/CM has malfunction and solenoid valve control is not available
- Control description
  — Brake fluid pressure being maintained is reduced to 0 kPa {0 mmHg, 0 inHg} immediately

SMART CITY BRAKE SUPPORT (SCBS)

id041500200000

Purpose

- The Smart City Brake Support (SCBS) operates the automatic brakes (brake control (SCBS brake)) when the vehicle approaches a vehicle ahead at a vehicle speed between approx. 4 km/h {2 mph} to 30 km/h {19 mph} to reduce collision impact.



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Warning

- **The smart city brake support (SCBS) performs the brake control (SCBS brake), however, it is not a system which guarantees collision prevention under all conditions. Because deceleration by the brake control (SCBS brake) is limited, always verify the safety of the surrounding area and keep a safe distance from a vehicle ahead.**
- **The smart city brake support (SCBS) does not operate when the vehicle speed is less than approx. 4 km {2 mph} or approx. 30 km/h {19 mph} or more. It also does not operate when the vehicle is in reverse.**
- **Do not apply stickers to the surface of the windshield near the laser sensor (including transparent stickers). Otherwise, the laser sensor may not be able to detect vehicles or obstructions in front which could result in an accident.**

DYNAMIC STABILITY CONTROL

Caution

- **Always use tires for all wheels that are of the specified size, and the same manufacture, brand, and tread pattern. In addition, do not use tires with significantly different wear patterns on the same vehicle. If such improper tires are used, the smart city brake support (SCBS) system may not operate normally.**

Note

- The smart city brake support (SCBS) is a system for assisting driver operations. Accordingly, if the conditions for the smart city brake support (SCBS) are met, or even when the smart city brake support (SCBS) is operating, if the driver operates the steering wheel, accelerator pedal, and the brake pedal, the driver's operations take precedence and the smart city brake support (SCBS) operation is canceled.
- Turn off the smart city brake support (SCBS) system to prevent mistaken operation when the vehicle is running on a chassis roller.

Function

- The smart city brake support (SCBS) functions are categorized as follows:
  - — Brake prefill which reduces the clearance between the brake pads and the disc plate when the laser sensor detects the vehicle approaching a vehicle ahead to enable brake force generation immediately when the brake is operated.
  - — Brake control (SCBS brake) which operates the automatic brakes when the laser sensor detects the risk of a collision.
- When the laser sensor detects that the vehicle is approaching a vehicle ahead, the system operates the brake prefill. When the driver depresses the brake pedal, the brakes are applied firmly and quickly to assist, and if the driver does not perform an avoidance maneuver, it operates the brake control (SCBS brake).
- The laser sensor installed on the upper area of the windshield detects a vehicle running ahead within approx. 6 m {20 ft} from the laser sensor.

Construction/Operation

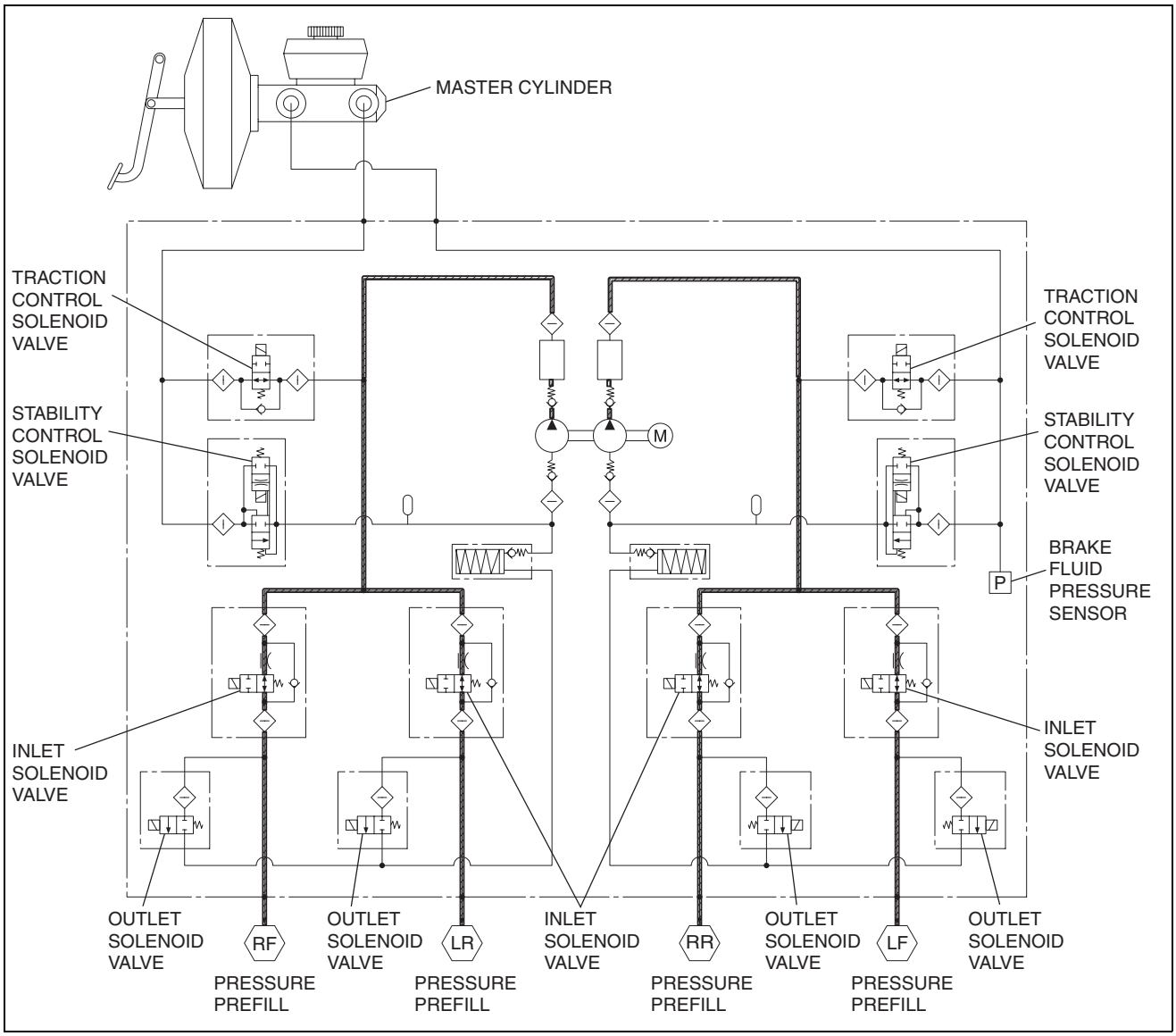
- The smart city brake support (SCBS) system will operate under the following conditions:
  - — The engine running.
  - — The LCD TFT display in the instrument cluster does not indicate that the system requires inspection or it cannot be used.
  - — The vehicle speed is between approx. 4 km/h {2 mph} to 30 km/h {19 mph}.
  - — The relative speed between your vehicle and the vehicle in front is under 15 km/h {9.3 mph}.
  - — The smart city brake support (SCBS) system is not turned off.
  - — The TCS operation is not turned off using the TCS OFF switch.
  - — The DSC is not malfunctioning.
  - — The driver is not deliberately performing driving operations (accelerator pedal, steering wheel, and braking operations).

Brake prefill operation
Solenoid valve operation table

Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
OFF (open)		OFF (close)		OFF (open)				OFF (close)				Operating

DYNAMIC STABILITY CONTROL

Hydraulic circuit diagram



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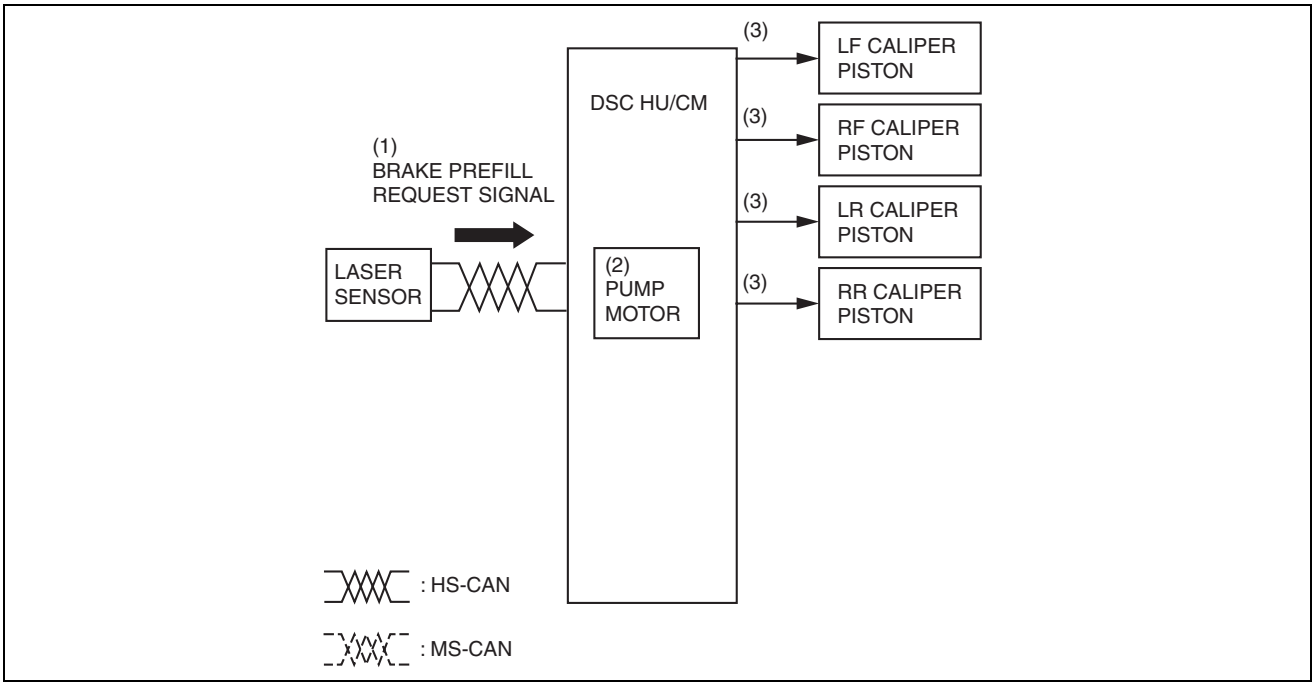
DYNAMIC STABILITY CONTROL

Block diagram



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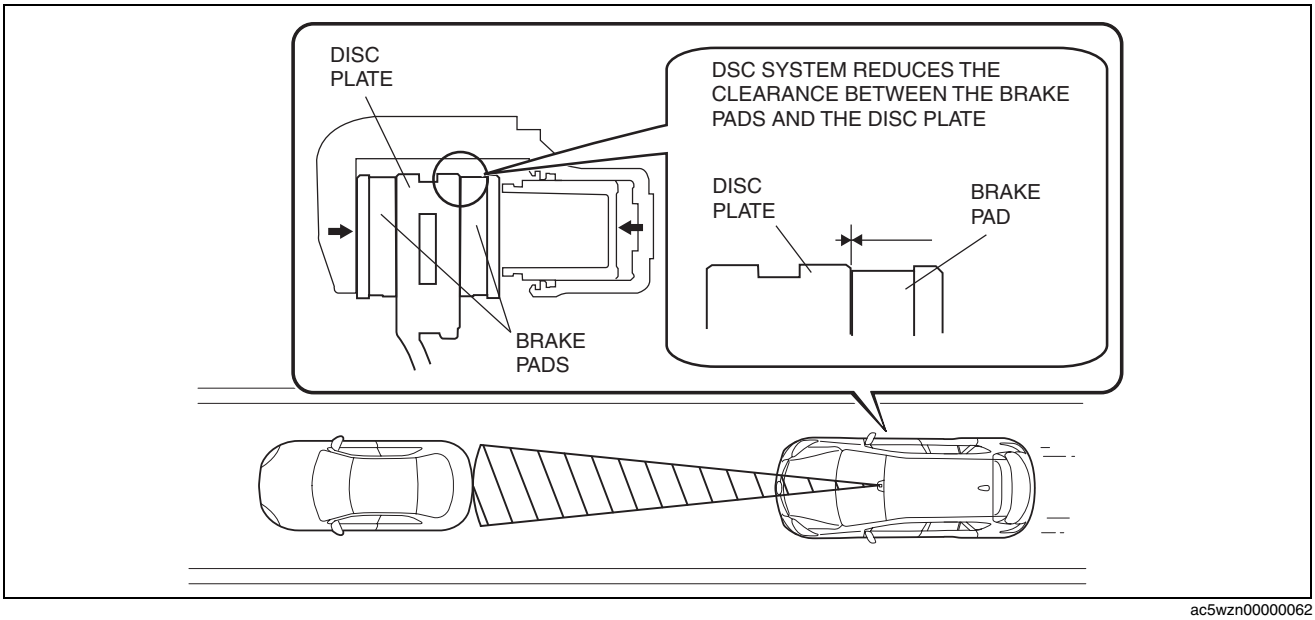
- When the laser sensor detects that the vehicle is approaching a vehicle ahead, it outputs a brake prefill request signal (1) to the DSC HU/CM.
- The DSC HU/CM operates the pump motor (2) to activate the pump so that the brake fluid pressure is lead to the caliper piston (3) and the brake pads are kept near the disc plate.
- As a result, if the driver realizes that he/she is approaching a vehicle ahead and depresses the brake pedal, or if the driver does not perform an avoidance maneuver and the automatic brakes are operated, the brake force is generated immediately and the braking distance is reduced.



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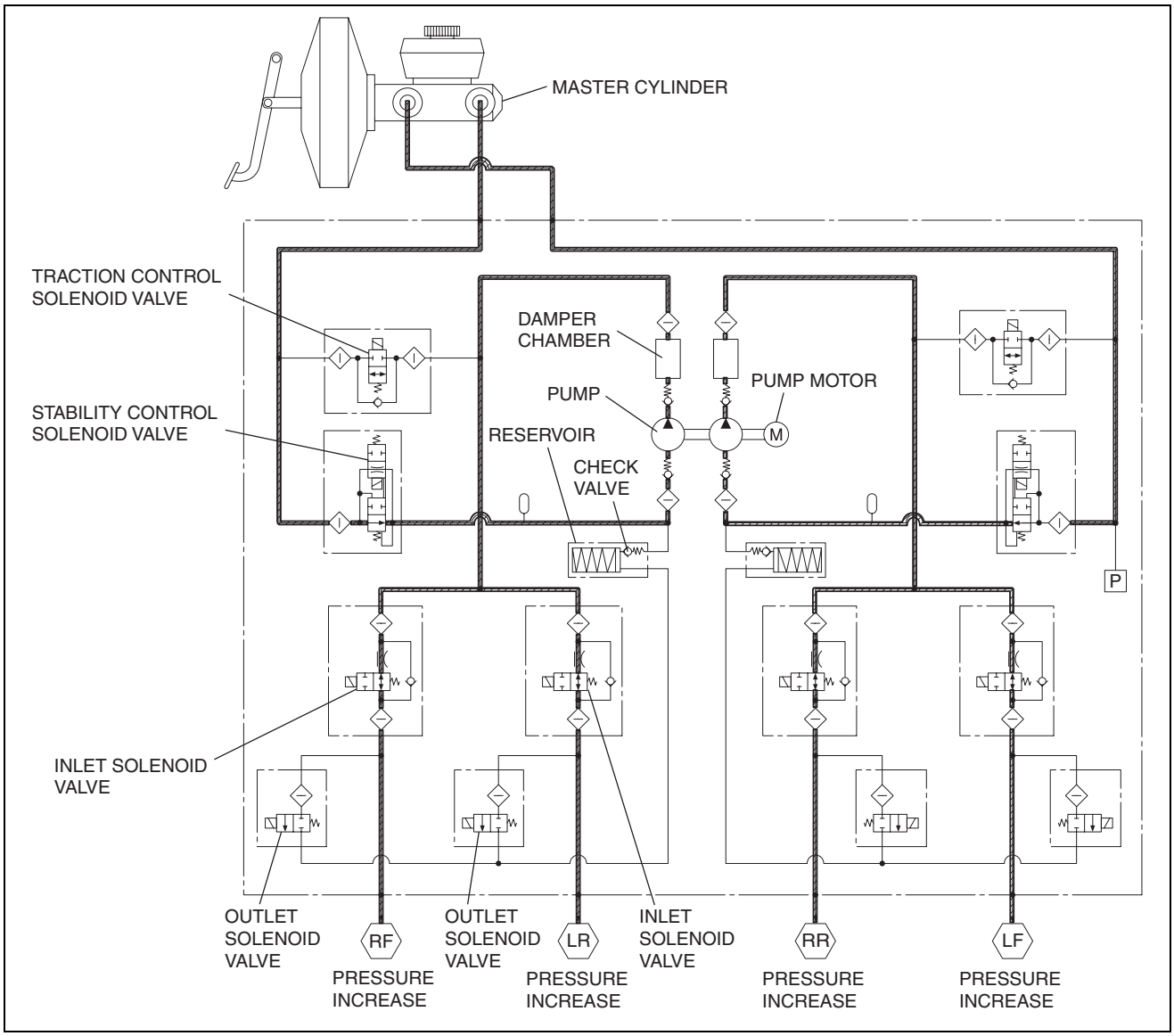
DYNAMIC STABILITY CONTROL

Brake control (SCBS brake) operation

Solenoid valve operation table

Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
ON (close)		ON (open)		OFF (open)				OFF (close)				Operating

Hydraulic circuit



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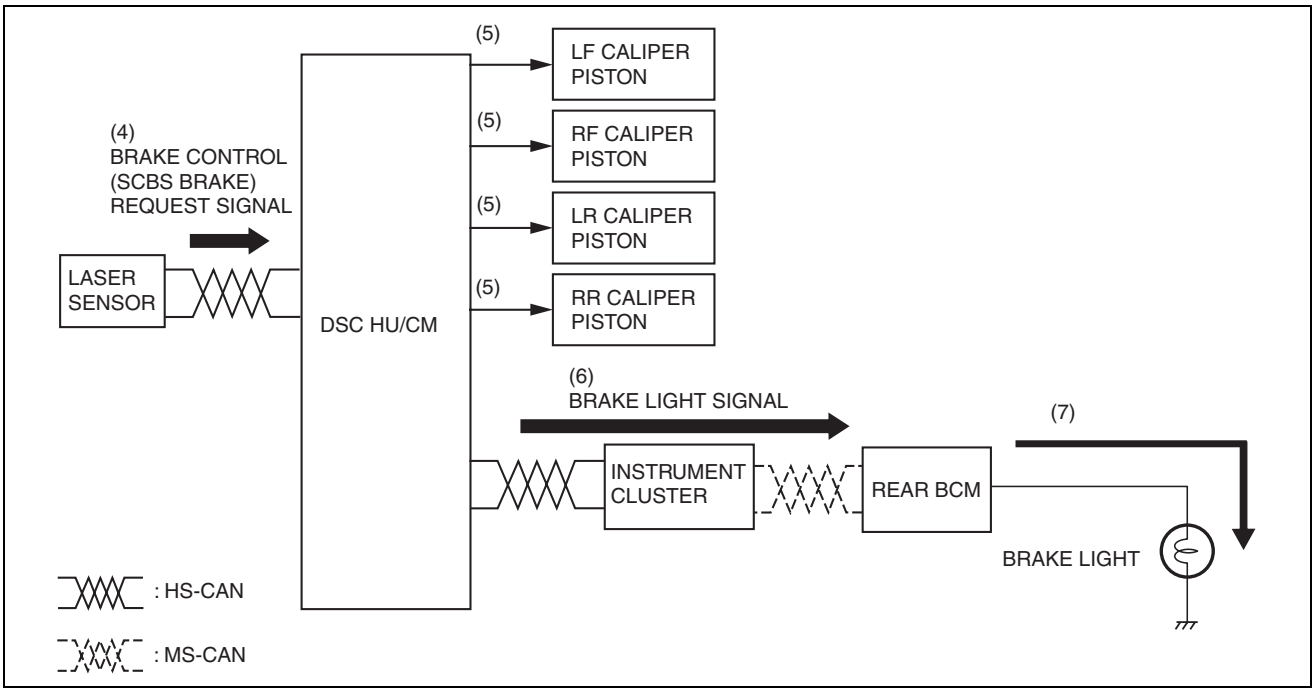
DYNAMIC STABILITY CONTROL

Block diagram



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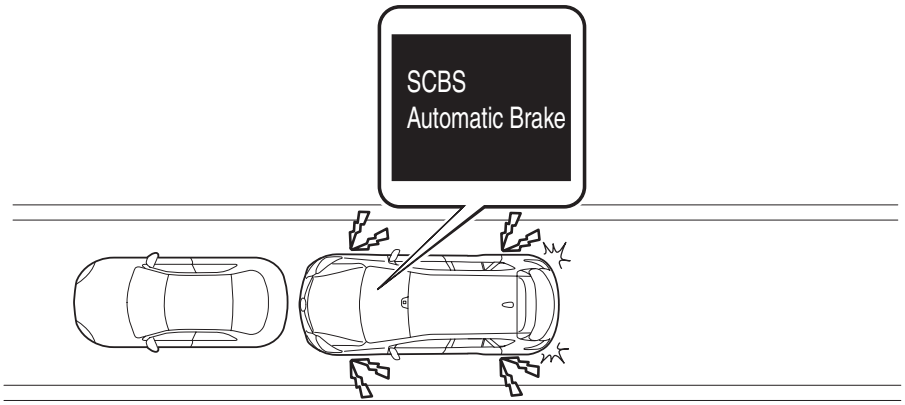
- After the brake prefill operates, if the driver does not perform an avoidance maneuver and the laser sensor determines that a collision may occur, it outputs a brake control (SCBS brake) request signal (4) to the DSC HU/CM.
- The DSC HU/CM energizes the traction control and the stability control solenoid valves to switch the hydraulic circuits and to increase the brake fluid pressure. Therefore the brake is operated automatically (5). At this time, the DSC HU/CM outputs a brake light signal to the rear body control module (RBCM) (6). While the brake control (SCR brake) is operating, turns on the brake lights automatically (7).
- When the Smart City Brake Support (SCBS) operates and the brakes are applied, the message " SCBS Automatic Brake" is indicated in the TFT LCD display.
- The brake control (SCBS brake) is kept operated for 2 s. To keep the vehicle stopped after the brake control (SCBS brake) operation ends, the brake pedal has to be depressed to operate the brake.



BRAKE CONTROL (SCBS BRAKE) OPERATES AND TURNS ON THE BRAKE LIGHTS AUTOMATICALLY

ac5wzn00000063

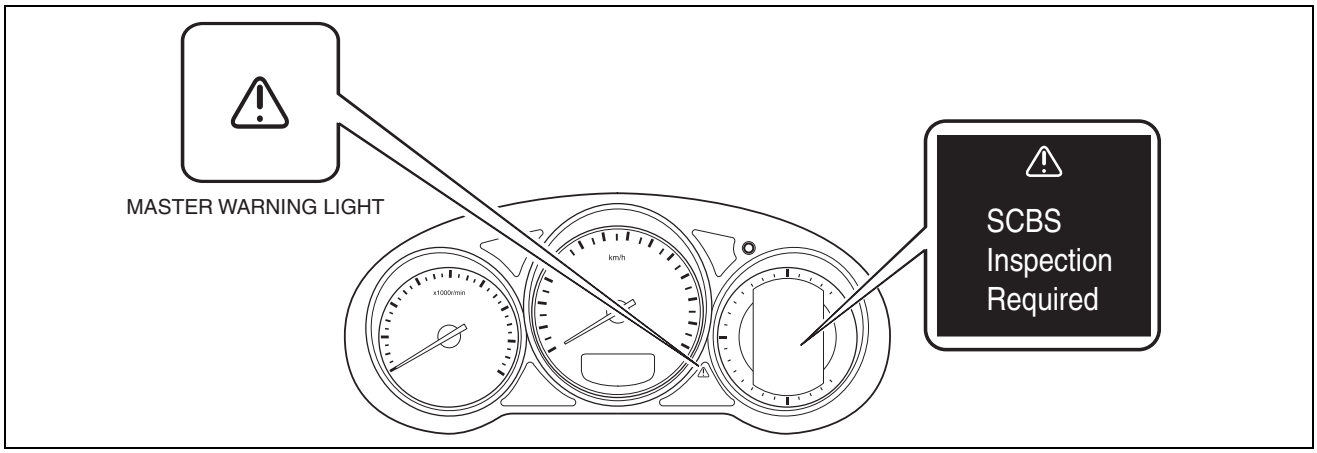
DYNAMIC STABILITY CONTROL

Caution

- **If the DSC system has a malfunction and the DSC control is inhibited, or if the TCS OFF switch is operated and the DSC control is disabled, the smart city brake support (SCBS) does not operate.**
- **When the laser sensor malfunction is determined as a result of the on-board diagnostic test, the smart city brake support (SCBS) is suspended while driving.**
- **When the DTC is stored in the PCM, DSC HU/CM, and/or instrument cluster, the smart city brake support (SCBS) is suspended depending on the malfunctioning situation.**
- **Under the following conditions, the smart city brake support (SCBS) system may not operate normally:**
  - **— Heavy luggage is loaded in the luggage compartment or on the rear seat.**
  - **— When there is the possibility of a partial contact with a vehicle or obstruction in front.**
  - **— When driving on continuously curving roads, entering and existing curves, driving on narrow roads due to construction and lane closures, and driving under erratic conditions in which there is a surrounding accident, vehicle breakdown or your position in the traffic lane changes.**
- **The detection ability of the laser sensor is limited. In the following cases, the smart city brake support (SCBS) may not operate:**
  - **— Exhaust gas from the vehicle in front, sand, snow, and water vapor rising from manholes and grating, and water splashed into the air.**
  - **— The vehicle in front of you is significantly dirty.**
  - **— Under bad weather condition such as rain, fog, and snow.**
  - **— When the window washer is being used or the windshield wipers are not used when it is raining.**
  - **— The windshield is dirty.**
  - **— When the vehicle is accelerated rapidly and comes close to the vehicle in front.**
- **The smart city brake support (SCBS) may not operate with the following objects:**
  - **— Fences, glass.**
  - **— Trucks with low loading platforms, vehicles traveling at extremely low speeds, and high vehicles.**
  - **— A vehicle in front is significantly dirty.**
  - **— Vehicles with certain shapes such as a vehicle carrier.**

Note

- In the following cases, if the laser sensor detects an obstruction, the smart city brake support (SCBS) system may operate:
  - — There is an object in the road at the entrance to a curve.
  - — There is a vehicle passing in the opposite lane while making a curve.
  - — When crossing a narrow bridge.
  - — When passing through a low gate or a narrow gate.
  - — There is a metal object, bump, or a protruding object in the road.
  - — Suddenly come close to the vehicle in front.
  - — When passing through a toll gate.
  - — When passing under a vinyl curtain or flag.
  - — Two-wheeled vehicles.
  - — There are plastic objects such as pylons.
  - — There are pedestrians, animals, or standing trees.
- In case a malfunction occurs, the master warning light is illuminated and the message “SCBS Inspection Required” is indicated in the TFT LCD display to alert the driver.



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DYNAMIC STABILITY CONTROL

SECONDARY COLLISION REDUCTION (SCR)

id041500200100

Purpose

- The Secondary Collision Reduction (SCR) is a part of the DSC system functions which operates the automatic brakes and flashes the hazard warning lights when the vehicle is hit while it is stopped and moved by the impact to avoid the occurrence of a secondary collision.

Warning

- **The secondary collision reduction (SCR) performs the brake control (SCR brake), however, it is not a system which guarantees collision prevention under all conditions. Because deceleration by the brake control (SCR brake) is limited.**

Note

- The secondary collision reduction (SCR) is a system for assisting driver operations. Accordingly, if the conditions for the secondary collision reduction (SCR) are met, or even when the secondary collision reduction (SCR) is operating, if the driver operates the steering wheel, accelerator pedal, and the brake pedal, the driver's operations take precedence and the secondary collision reduction (SCR) operation is canceled.

Function

- The secondary collision reduction (SCR) functions are categorized as follows:
  - — Hazard warning (SCR hazard) which flashes the hazard warning lights to warn surrounding vehicles when the vehicle is collision.
    - The hazard warning (SCR hazard) is equipped as standard.
  - — Brake control (SCR brake) which operates the automatic brakes when the vehicle is hit while it is stopped and moved by the impact.
    - The brake control (SCR brake) is equipped along with smart city brake support (SCBS).

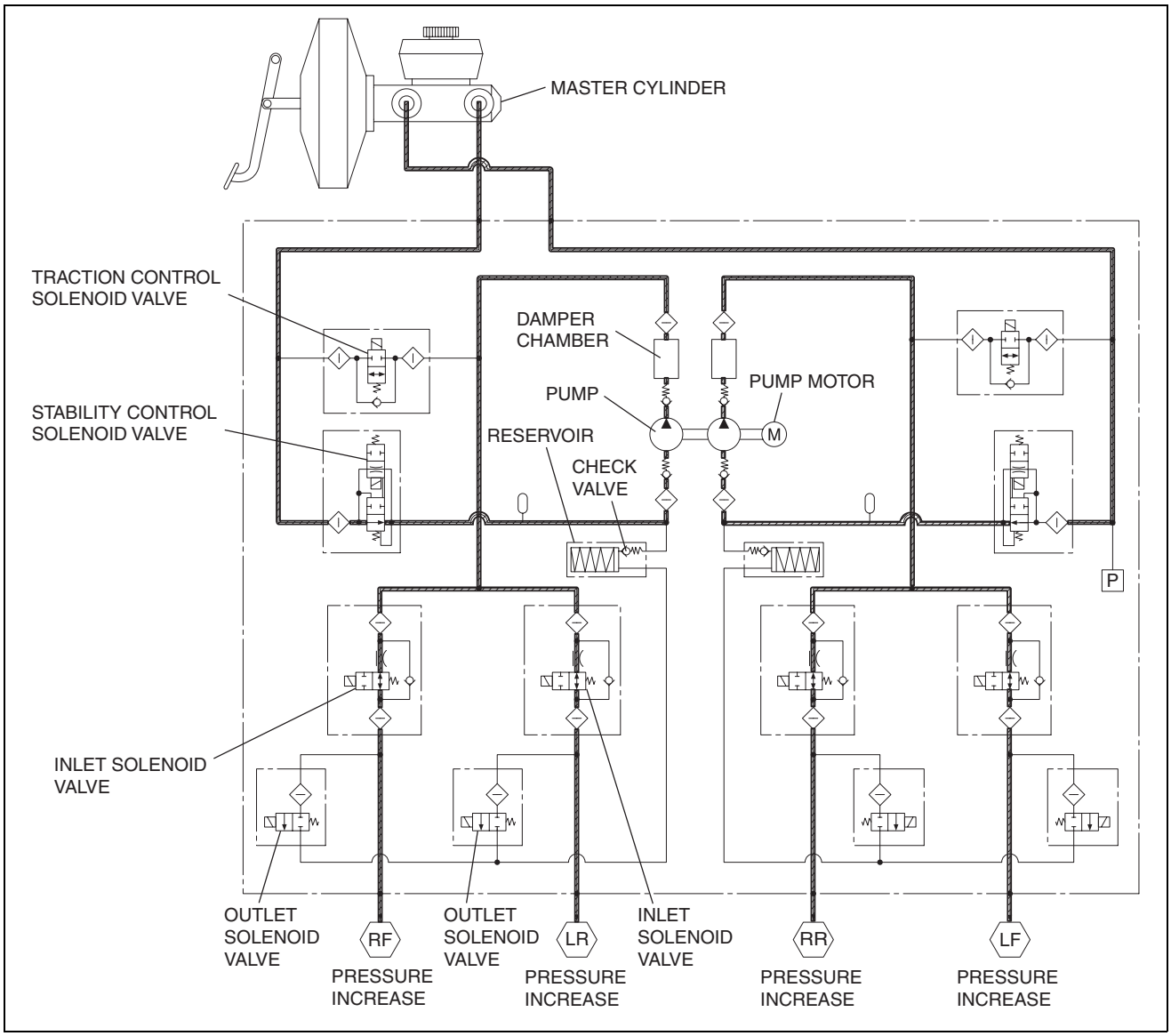
Construction

Solenoid valve operation table

Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
ON (close)		ON (open)		OFF (open)				OFF (close)				Operating

DYNAMIC STABILITY CONTROL

Hydraulic circuit diagram



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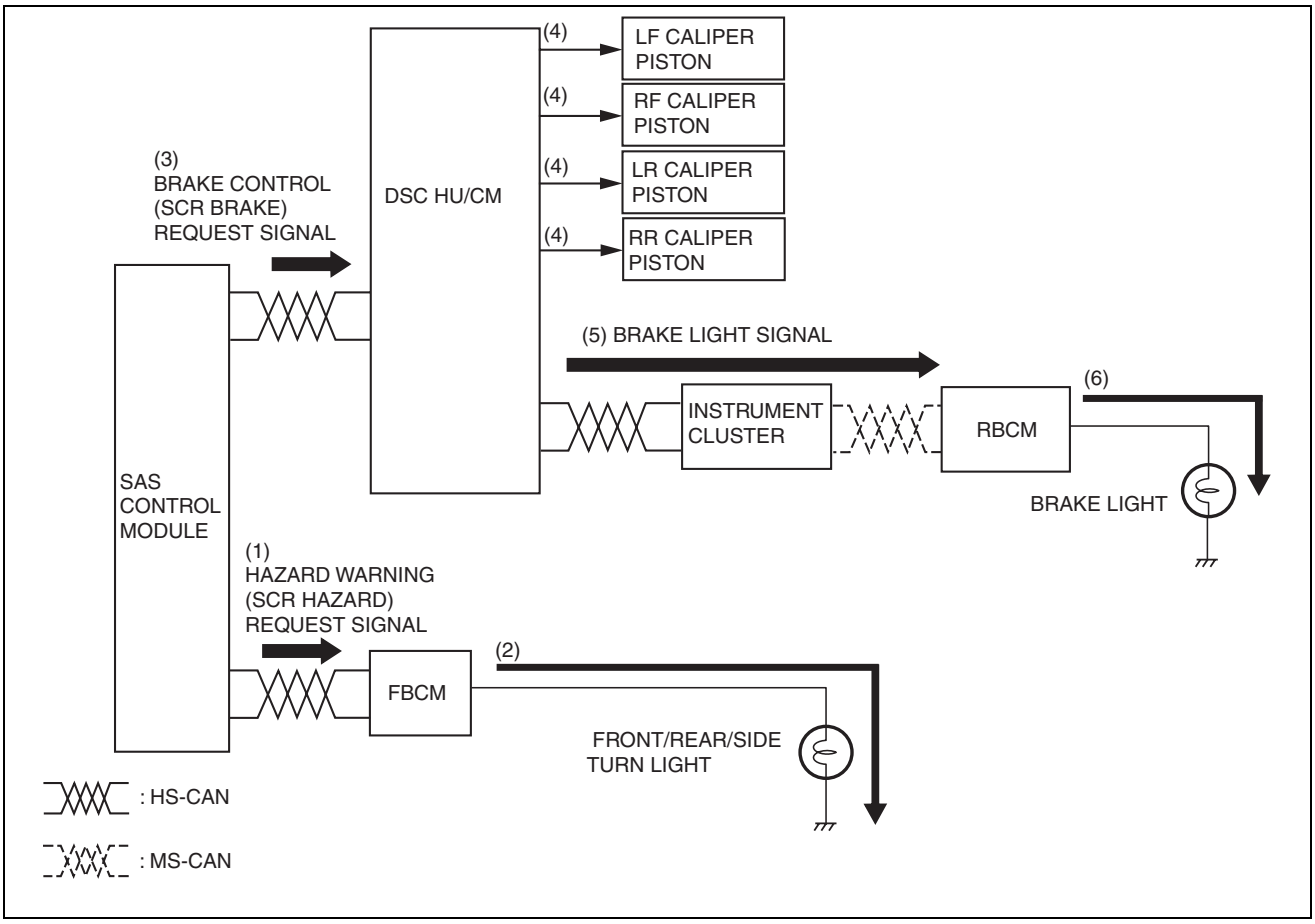
DYNAMIC STABILITY CONTROL

Block diagram



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Operation

Hazard warning (SCR hazard) operation

- The SAS control module detects a collision with another vehicle, it outputs a hazard warning (SCR hazard) request signal (1) to the front body control module (FBCM). The front body control module (FBCM) flashes the turn light (2) during a collision to caution the vehicles surrounding vehicle when it detects a certain amount of impact.
- While the hazard warning (SCR hazard) is operating, all the turn lights are flashed automatically. The system can be turned off by pressing the hazard warning light switch two times.

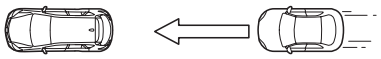
Brake control (SCR brake) operation

- Operation conditions (any of the following conditions must be met):
  - — The selector lever is in the P position. (ATX)
  - — The parking brake is applied.
  - — The brake pedal is depressed. (the DSC HU/CM monitors the brake fluid pressure)
- When any of the operation conditions is met and the SAS control module detects a collision with another vehicle, it outputs a brake control (SCR brake) request signal (3) to the DSC HU/CM. (At the same time, it also outputs a hazard warning (SCR hazard) request signal to the front body control module (FBCM)).
- The DSC HU/CM energizes the traction control and the stability control solenoid valves to switch the hydraulic circuits, and at the same time, it operates the pump motor to activate the pump so that the brake fluid pressure is lead to the caliper piston and the automatic brakes are operated (4). At the same time, the DSC HU/CM outputs a brake light signal to the rear body control module (RBCM) (5).
- While the brake control (SCR brake) is operating, turns on the brake lights automatically (6).
- Cancel condition (any of the following conditions must be met):
  - — The engine is stopped (the ignition is switched off).
  - — Approx. 1.5 s has elapsed since the vehicle was stopped by the brake control (SCR brake).
  - — The accelerator pedal opening angle exceeds approx. 20%.
  - — Brake force greater than that generated by the brake control (SCR brake) is input via the brake pedal.

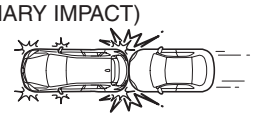
DYNAMIC STABILITY CONTROL

OPERATION SCENARIO (REAR COLLISION USED AS AN EXAMPLE)

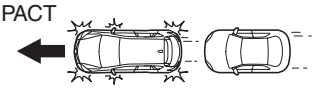
①THE VEHICLE IS STOPPED



②AFTER A COLLISION FROM THE REAR, THE HAZARD WARNING (SCR HAZARD) ACTIVATES (PRIMARY IMPACT)



③THE BRAKE CONTROL (SCR BRAKE) OPERATES WITH THE LURCH FROM THE PRIMARY IMPACT



④THE VEHICLE IS STOPPED

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Caution

- **The secondary collision reduction (SCR) does not operate if the DSC system has a malfunction and the DSC control is inhibited.**
- **The secondary collision reduction (SCR) may not operate in the case of a low-speed collision in which the air bags do not deploy.**
- **The secondary collision reduction (SCR) may not operate if the vehicle speed exceeds approx. 50 km/h because of the first collision.**
- **The secondary collision reduction (SCR) does not operate if the components of the SAS control module and the DSC system are significantly damaged by the first collision.**

CONTROLLER AREA NETWORK (CAN)

id041500104800

Outline

- The DSC HU/CM sends and receives data to and from other modules via the CAN system. Refer to MULTIPLEX COMMUNICATION SYSTEM for a detailed explanation of the CAN system. (See 10-40-1 CONTROLLER AREA NETWORK (CAN) SYSTEM.)

Data sent

- Cruise control system-related information
- DSC system-related information
- Vehicle speed
- Wheel speed (LF, RF, LR, RR)
- Yaw rate

Data received

- 4WD system status
- Accelerator pedal opening angle
- Ambient temperature
- Back-up light on request
- Back-up light switch
- Brake light status
- Brake switch (No.1 signal)
- Clutch pedal stroke sensor
- Collision detection (front, side, roll over)
- Collision detection (rear)
- Cruise control set speed
- Cruise control status
- Cruise control switch
- Cruise control switch signal
- Cruise control system-related information
- Engine displacement

DYNAMIC STABILITY CONTROL

- Engine torque
- Fuel cut request
- Ignition off timer
- i-stop-related information (with i-stop)
- Parking brake status
- Selector lever position
- Steering angle/steering angle sensor status
- TCS OFF switch status
- Tire pressure monitoring system set switch status
- Tire size
- Traveled distance
- Vehicle speed

ABS WHEEL-SPEED SENSOR AND ABS SENSOR ROTOR

id041500104900

Purpose/Function

- The ABS wheel-speed sensor and ABS sensor rotor detect the rotation condition of each wheel and transmit this information to the DSC HU/CM.
- The signal from the ABS wheel-speed sensor is the primary signal that the DSC HU/CM uses when carrying out control.

Construction

- The ABS wheel-speed sensor utilizes a semi-conductor element that contains an active drive circuit (MR element*). The front sensor is installed on the steering knuckle and the rear sensor is installed on the wheel hub (2WD) or hub support (4WD).
- The front ABS sensor rotor utilizes a magnetic encoder system that functions with magnetic rubber, and is integrated into the front wheel hub. Therefore, if there is any malfunction of the front ABS sensor rotor, replace the front wheel hub.
- The rear ABS sensor rotor utilizes a magnetic encoder system that functions with magnetic rubber, and is integrated into the rear wheel hub (2WD) or shaft and ball joint component (4WD). Therefore, if there is any malfunction of the rear ABS sensor rotor, replace the rear wheel hub (2WD) or shaft and ball joint component (4WD).

*: A magneto-resistive force means that an exterior magnetic field acts on the element, changing the resistance of the element.

Caution

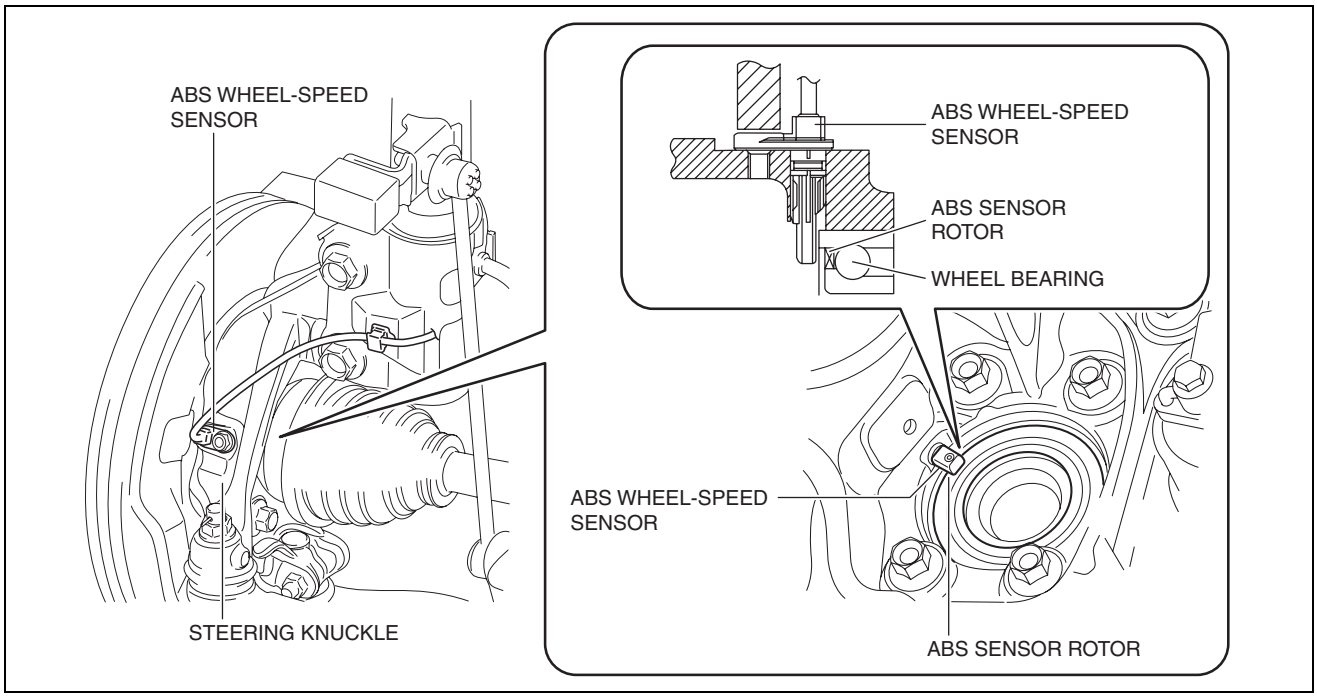
- **When inspecting the ABS wheel-speed sensor, do not use a tester to inspect resistance. It is possible that the voltage from the tester could damage the semiconductor inside the ABS wheel-speed sensor. Inspect using the PID data monitor of the Mazda modular diagnostic system (M-MDS).**

Note

- Magnetic encoder: A plate that has positive and negative poles (marked out) in a continuous, alternating line.

DYNAMIC STABILITY CONTROL

Front ABS wheel-speed sensor and sensor rotor



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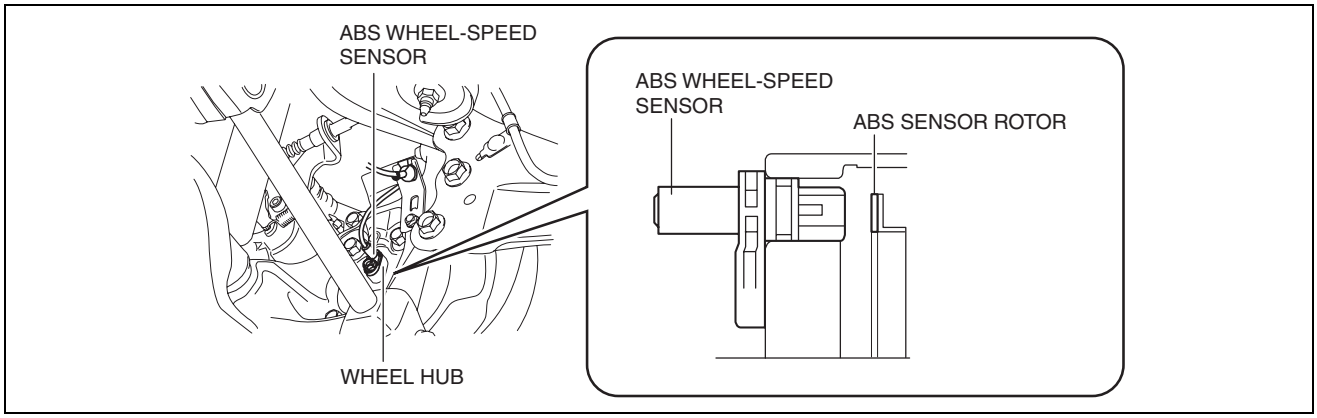
Rear ABS wheel-speed sensor and sensor rotor (2WD)



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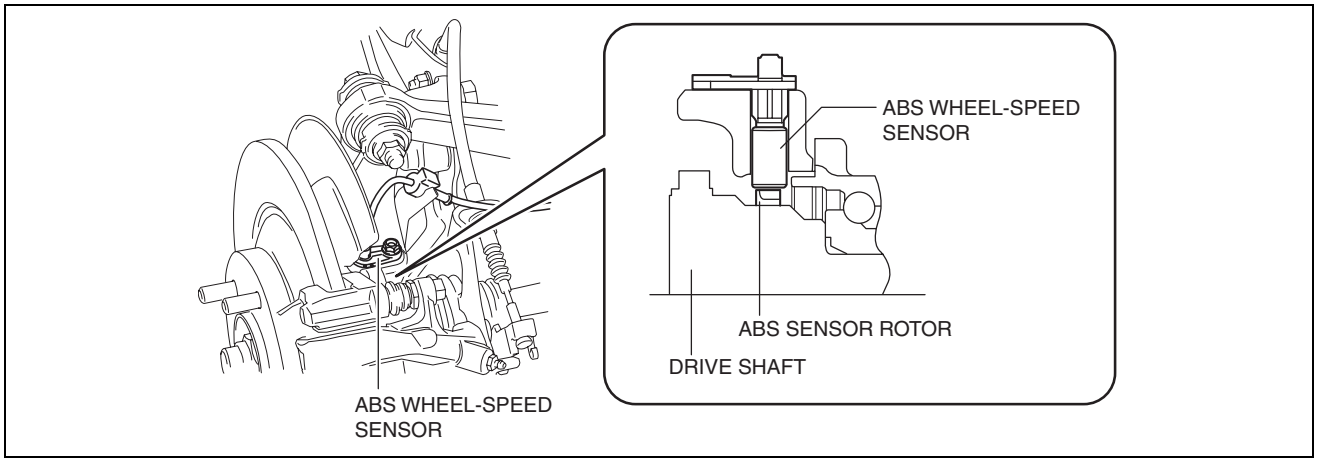
Rear ABS wheel-speed sensor and sensor rotor (4WD)



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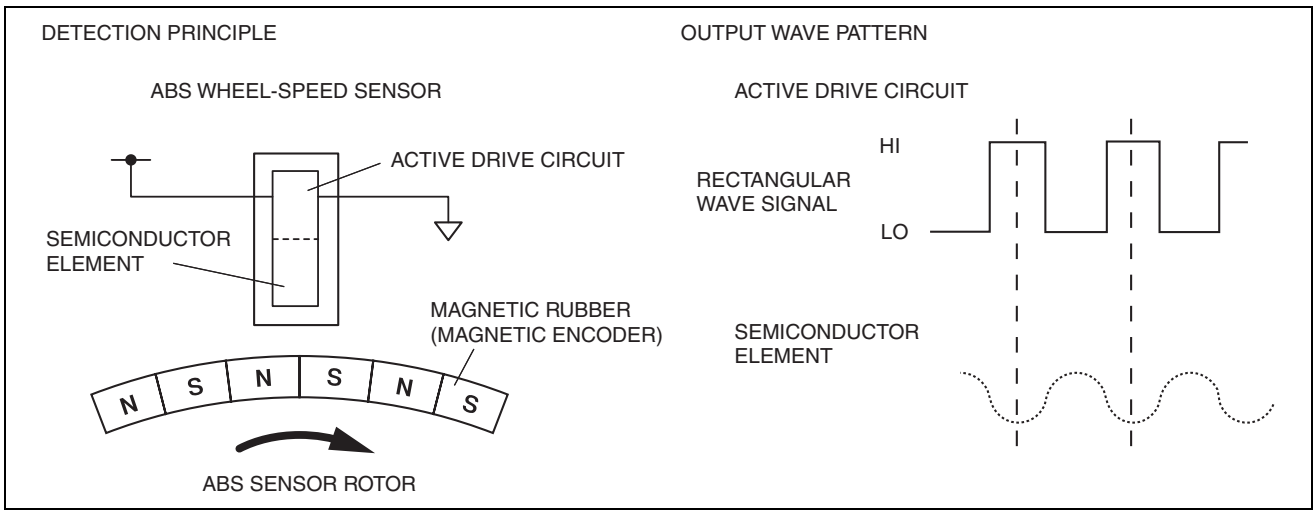
Operation

- As the ABS sensor rotor rotates, the magnetic flux between the ABS wheel-speed sensor and the ABS sensor rotor change periodically. This periodic change is in proportion to the rotation speed.

DYNAMIC STABILITY CONTROL

- The semiconductor element in the wheel speed sensor detects the change in magnetic flux, and the active drive circuit converts it to a rectangular wave signal for the current, which is transmitted to the DSC HU/CM.
- For every single rotation of the ABS sensor rotor, 44 rectangular wave pulse signals are output. The CM in the DSC HU/CM calculates the wheel speed from the periodicity of these pulses.



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Fail-safe

DTC No.	Fail-safe function
C0030:07	• Illuminates the ABS warning light and TCS/DSC indicator light. • Illuminates the master warning light.* • Tire pressure monitoring system warning light illuminates after flashes. • Inhibits the ABS, TCS, DSC, roll over mitigation (ROM), brake assist control, hill launch assist (HLA), TPMS, smart city brake support (SCBS)*, and secondary collision reduction (SCR) controls. (Additionally, when any malfunction is detected in two wheels or more, EBD control is inhibited and the brake system warning light is illuminated.)
C0031:07	
C0031:11	
C0031:15	
C0031:29	
C0031:2F	
C0031:64	
C0033:07	
C0034:07	
C0034:11	
C0034:15	
C0034:29	
C0034:2F	
C0034:64	
C0036:07	
C0037:07	
C0037:11	
C0037:15	
C0037:29	
C0037:2F	
C0037:64	
C0039:07	
C003A:07	
C003A:11	
C003A:15	
C003A:29	
C003A:2F	
C003A:64	

* : Vehicle with smart city brake support (SCBS).

DYNAMIC STABILITY CONTROL

BRAKE FLUID PRESSURE SENSOR

id041500105200

Purpose/Function

- The brake fluid pressure sensor detects the fluid pressure from the master cylinder and transmits it to the DSC HU/CM.

Construction

- The brake fluid pressure sensor is built into the DSC HU/CM. Therefore if there is any malfunction of the brake fluid pressure sensor, replace the DSC HU/CM.

Fail-safe

DTC No.	Fail-safe function
C0044:01	• Illuminates the TCS/DSC indicator light. • Illuminates the master warning light.(Not illuminated depending on malfunction content.)*1 • Tire pressure monitoring system warning light illuminates after flashes. (Not illuminated/flashed depending on malfunction content.) • Inhibits the TCS*2, DSC*2, roll over mitigation (ROM)*2, brake assist control*2, hill launch assist (HLA)*2, TPMS*2, smart city brake support (SCBS)*1*2, and secondary collision reduction (SCR)*2 controls.
C0044:28 C0044:54	• Illuminates the TCS/DSC indicator light. • Illuminates the master warning light.(Not illuminated depending on malfunction content.)*1 • Tire pressure monitoring system warning light illuminates after flashes. • Inhibits the TCS, DSC, roll over mitigation (ROM), brake assist control, hill launch assist (HLA), TPMS, smart city brake support (SCBS), and secondary collision reduction (SCR) controls.
C0044:64	• Illuminates the TCS/DSC indicator light. • Illuminates the master warning light.(Not illuminated depending on malfunction content.)*1 • Tire pressure monitoring system warning light illuminates after flashes. (Not illuminated/flashed depending on malfunction content.) • Inhibits the TCS*2, DSC*2, roll over mitigation (ROM)*2, brake assist control*2, hill launch assist (HLA)*2, TPMS*2, smart city brake support (SCBS)*1*2, and secondary collision reduction (SCR)*2 controls.

*1 : Vehicle with smart city brake support (SCBS).
*2 : Enabled depending on malfunction content.

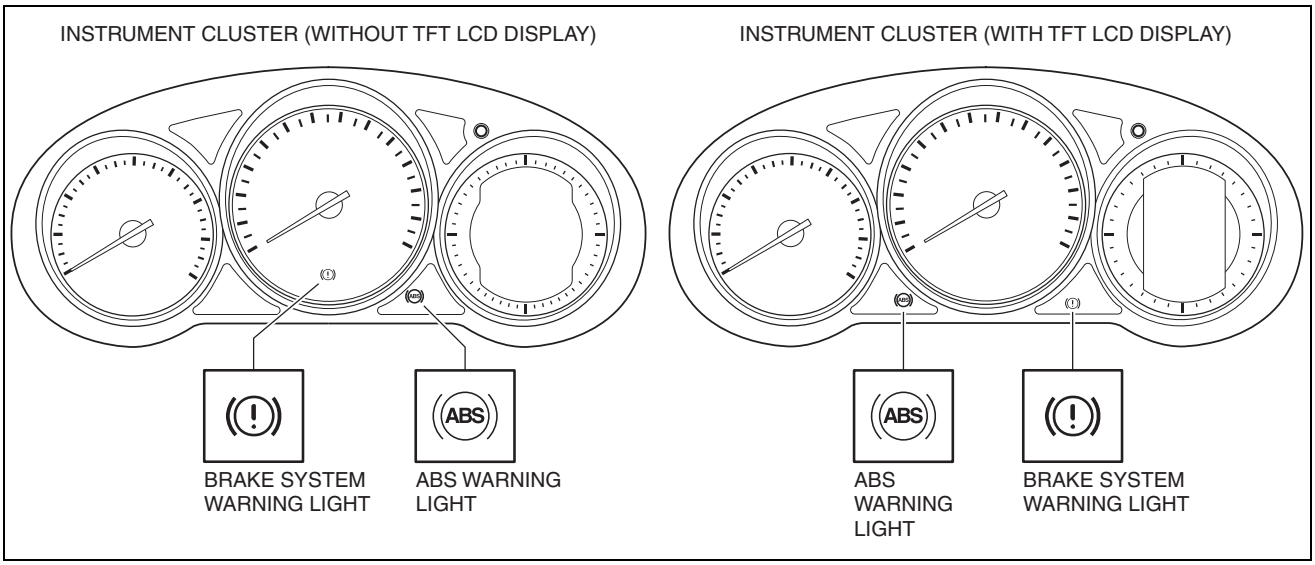
BRAKE SYSTEM/ABS WARNING LIGHT

id041500108800

Purpose/Function

- The brake system/ABS warning light is built into the instrument cluster. If a malfunction is detected in the system with the parking brake released, the warning light illuminates to notify the driver.

DYNAMIC STABILITY CONTROL



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Construction/Operation

- When the DSC system and CAN lines are functioning normally, the brake system/ABS warning light illuminates when the ignition is switched to ON to check for a burned-out bulb, and then turns off after approx. 3 s. At this time, while the parking brake is activated, the brake system warning light remains illuminated, however, it turns off after the parking brake is released.
- The brake system/ABS warning light illuminates during a system malfunction, and the control is as follows:
  ABS warning light illuminated:
  — ABS control disabled.
  ABS warning light and brake system warning light illuminated:
  — ABS and EBD controls disabled.

Fail-safe

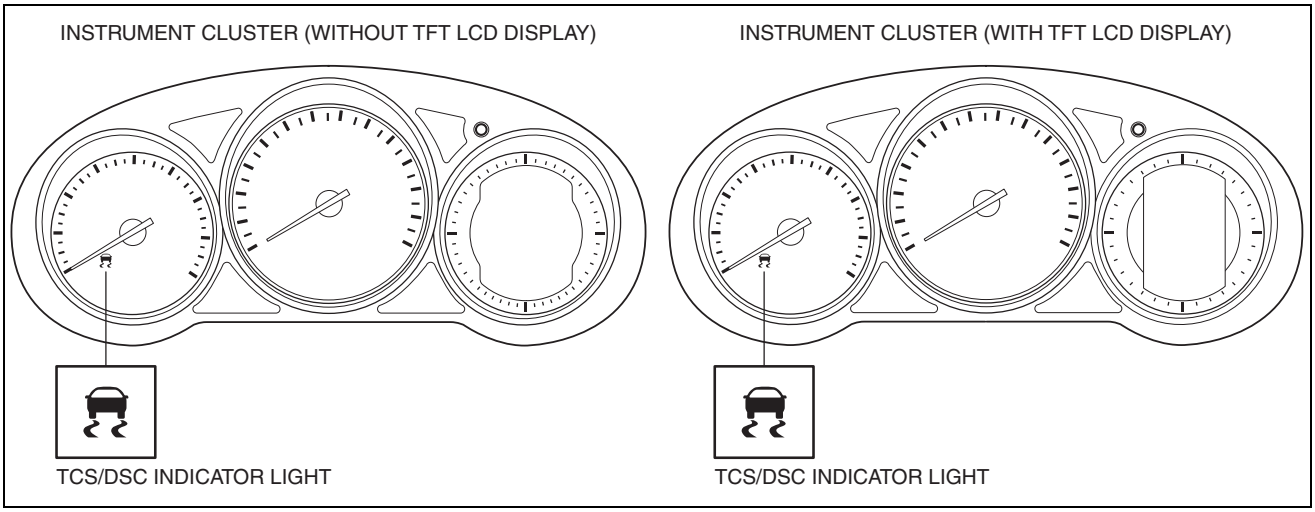
- Function not equipped.

TCS/DSC INDICATOR LIGHT

id041500108900

Purpose/Function

- The TCS/DSC indicator light, built into the instrument cluster, informs the driver of the following vehicle conditions.
  — TCS is operating. (Drive wheel is slipping.)
  — DSC is operating. (Vehicle side-slip condition.)
  — Roll over mitigation (ROM) is operating.
  — DSC system malfunction.



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DYNAMIC STABILITY CONTROL

Operation
- When the DSC system and CAN lines are normal, the TCS/DSC indicator light illuminates for approx. 3.0 s when the ignition is switched to ON to check the light function. When the system is malfunctioning, the TCS/DSC indicator light remains illuminated.
- When the TCS, DSC or roll over mitigation (ROM) are non-operational, operational and malfunctioning, the TCS/DSC indicator light operates according to the following table.

TCS/DSC indicator light operation

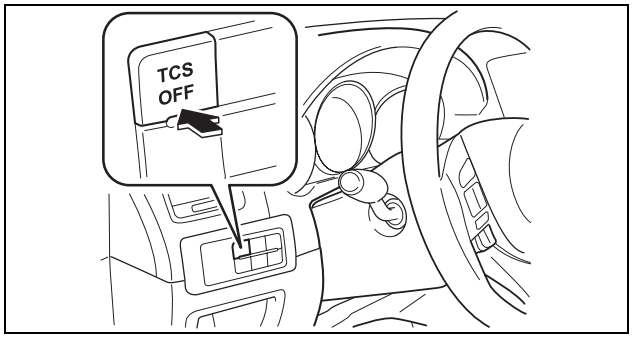
Item	TCS/DSC indicator light
TCS, DSC, and roll over mitigation (ROM) not operating	Not illuminated
TCS operating	Flashes (0.5 s intervals)
DSC operating	
Roll over mitigation (ROM) operating	
DSC system malfunction	Illuminated

Fail-safe
- Function not equipped.

TCS OFF SWITCH, TCS OFF INDICATOR LIGHT

id041500108700

Purpose/Function
- The TCS OFF switch, located on the dashboard, allows for optionally enabling/disabling the TCS control at driver discretion.
- The TCS OFF indicator light, built into the instrument cluster, informs the driver that TCS control has been disabled by operation of the TCS OFF switch.



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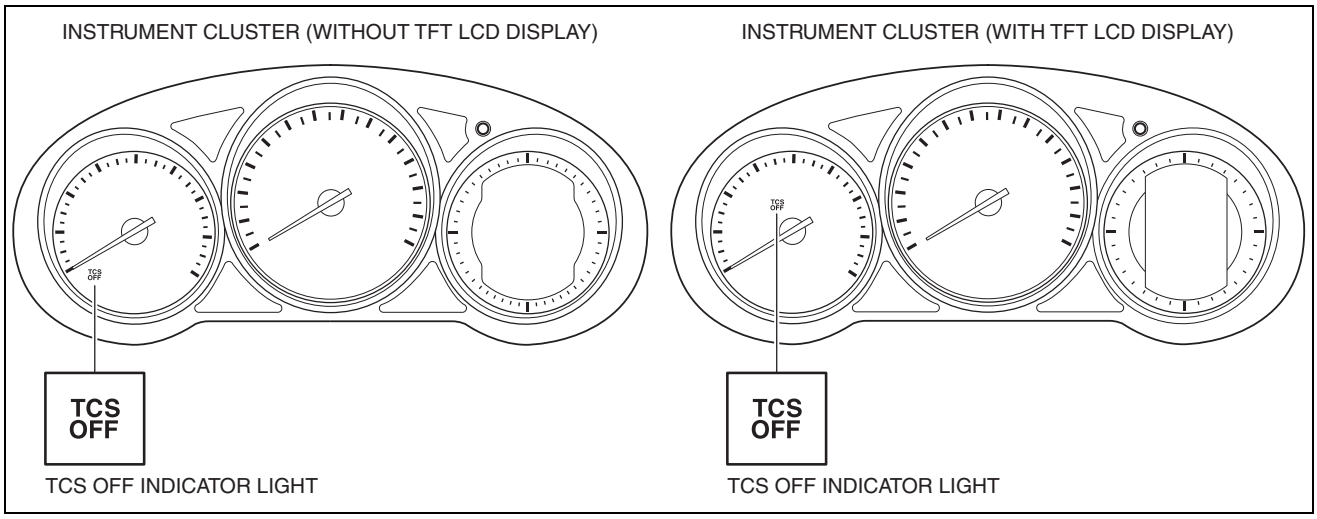

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Operation
- When the DSC system and CAN lines are functionally normally, the TCS OFF indicator light illuminates for approx. 3.0 s when the ignition is switched to ON to check the light function.
- When the TCS OFF switch is pressed to disable TCS control, the TCS OFF indicator light illuminates.

Note
- To inhibit the TCS control, continue to press the TCS OFF switch until the TCS OFF indicator light illuminates.

DYNAMIC STABILITY CONTROL

- The TCS OFF indicator light illumination and TCS/DSC/roll over mitigation (ROM) control conditions while operating the TCS OFF switch are as indicated in the table.

	TCS OFF indicator light illumination conditions	TCS control conditions		DSC control conditions	Roll over mitigation (ROM) control conditions
		Brake control	Engine control		
TCS ON	Not illuminated	Permitted	Permitted	Permitted	Permitted
TCS OFF	Illuminated	Permitted	Inhibited	Permitted	Permitted

Fail-safe

DTC No.	Fail-safe function
C0089:64	• Permits the control and does not illuminate each warning/indicator light.

LASER SENSOR

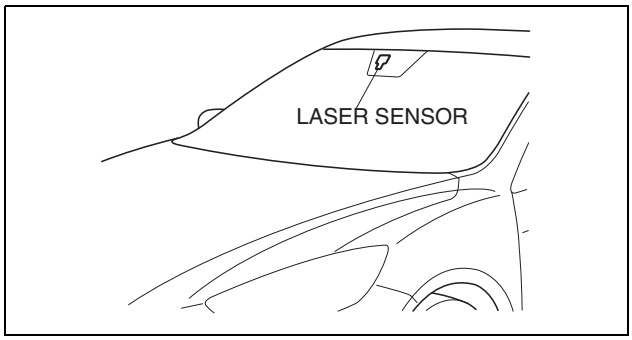
id041500885100

Purpose/Function

Warning

- **As there is the possibility of eye damage occuring from the laser, always heed the following precautions:**
  - **— Do not peer directly into the laser sensor using optical instruments with a magnification such as magnifying glasses, microscopic and objective lens within a distance of 100 mm {3.94 in} from the sensor.**
  - **— Do not disassemble the laser sensor (including the lens). A disassembled sensor will not meet the conditions for a class 1M laser under the IEC 60825-1 specification and therefore eye safety cannot be assured.**

- Installed to the upper area of the windshield and detects a vehicle or an obstruction ahead.
- The laser sensor specification is as follows.
  - — Maximum average power: 45 mW
  - — Pulse duration: 33 ns
  - — Wavelength: 905 nm
  - — Divergence angle (horizontal × vertical): 28°×12°



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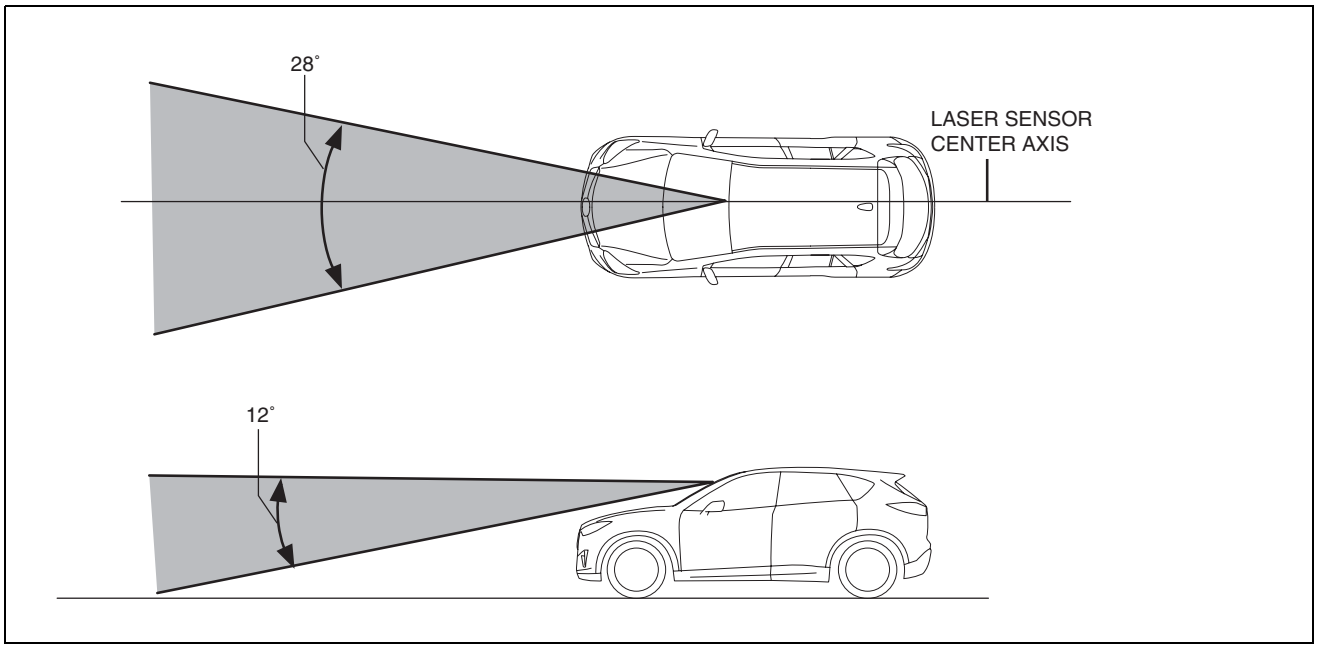
DYNAMIC STABILITY CONTROL



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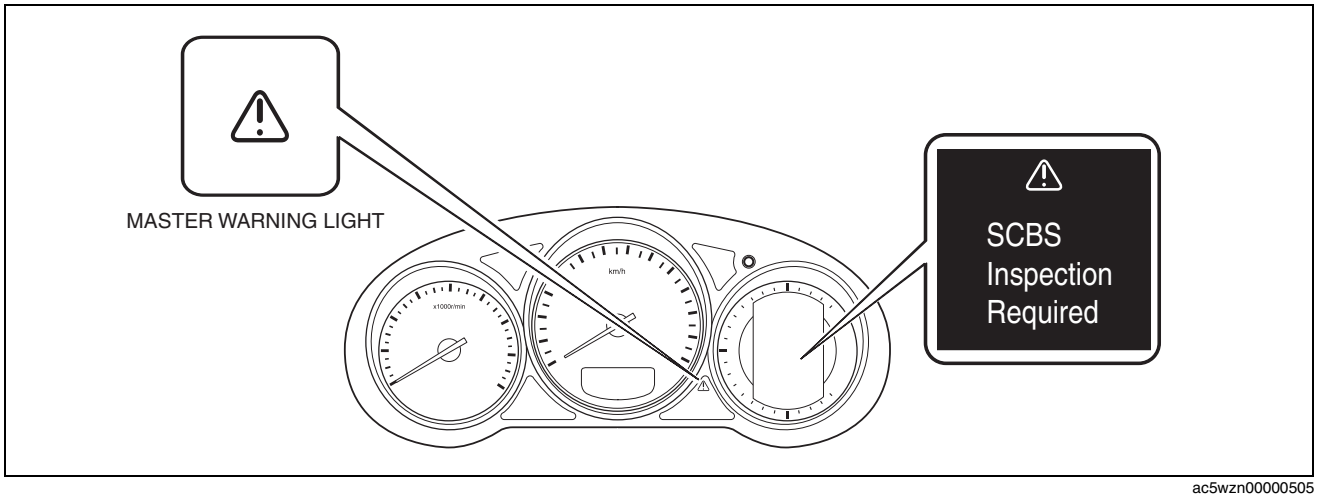
Automatic configuration function

- When the ignition is switched to ON or the engine is started, the laser sensor reads data from the instrument cluster via CAN communication each time to perform automatic configuration.

On-board diagnostic system

- A function that allows the laser sensor to perform self-diagnosis.
- In case a malfunction occurs, the master warning light is illuminated and the message “SCBS Inspection Required” is indicated in the TFT LCD display to alert the driver, and at the same time a DTC is stored in the laser sensor.



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- When a malfunction is determined as a result of the on-board diagnostic test, the smart city brake support (SCBS) is suspended while driving

Construction/Operation

- Emits near-infrared laser and detects the distance between the vehicle and a vehicle or an obstruction ahead based on the reflection.
- A vehicle or an obstruction within approx. 6 m {20 ft} from the laser sensor can be detected.
- Adjustment such as aiming adjustment is not required even if the laser sensor is removed and reinstalled or replaced.

DYNAMIC STABILITY CONTROL

Fail-safe

DTC No.	Fail-safe function
U0001:00	• Illuminates the master warning light. • Inhibits the smart city brake support (SCBS) control.
U0100:00	
U0121:00	
U0131:00	
U0155:00	
U0401:68	
U0415:68	
U0420:68	
U0423:68	
U1A14:49	
U2300:55	
U2300:56	
U3000:00	
U3000:64	
U3000:66	

TRANSMISSION/TRANSAXLE

05
SECTION

05-00 OUTLINE

OUTLINE

TRANSMISSION/TRANSAXLE ABBREVIATIONS

id050000302200

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position
CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle

OUTLINE

DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
EPS	Electric Power Steering
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System
HBC	High Beam Control
HF/TEL	Hands-Free Telephone
HI	High
HS	High Speed
HU	Hydraulic Unit
IDS	Integrated Diagnostic Software
IG	Ignition
IN	Intake
INT	Intermittent
KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear

OUTLINE

SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear
2GR	Second Gear
2WD	2-Wheel Drive
3GR	Third Gear
4GR	Fourth Gear
4WD	4-Wheel Drive
5GR	Fifth Gear
6GR	Sixth Gear

TRANSMISSION/TRANSAXLE FEATURES

id050000302000

Clutch and Manual Transaxle [C66M-R, C66MX-R] [D66M-R, D66MX-R]

- A newly developed, C66M(X)-R-type and D66M(X)-R-type manual transaxle (SKYACTIV-MT) with 6 forward gears and 1 reverse gear has been adopted.

Automatic Transaxle [FW6A-EL, FW6AX-EL] [GW6A-EL, GW6AX-EL]

- A newly developed, FW6A(X)-EL-type and GW6A(X)-EL-type electronically controlled automatic transaxle (SKYACTIV-DRIVE) with 6 forward gears, 1 reverse gear, and a TCC mechanism has been adopted.
- Using the existing automatic transaxle as a base, fuel economy improvement, direct feel, and smooth shifting have been thoroughly pursued to make one of the most optimized automatic transaxle.
  Main features
  — With the adoption of a full range TCC mechanism, a contribution to low fuel consumption and the direct feel of a manual transaxle have been achieved.
  — A control valve body has been adopted with an integrated TCM and improved responsiveness to achieve smooth and precise shifting.

TRANSMISSION/TRANSAXLE SPECIFICATIONS

id050000302100

Clutch [C66M-R, C66MX-R]

Item			Specifications
Engine type			**SKYACTIV-G 2.0**
Clutch control			Hydraulic
Clutch pedal	Type		Suspended
	Pedal ratio		4.88
	Full stroke (reference value)	(mm {in})	146 {5.75}
Clutch master cylinder inner diameter		(mm {in})	15.87 {0.6248}
Clutch release cylinder inner diameter		(mm {in})	20.64 {0.8126}
Clutch cover	Spring type		Diaphragm
	Set load	(N {kgf, lbf})	6400 {652.6, 1439}
Clutch disc	Outer diameter	(mm {in})	230 {9.06}
	Inner diameter	(mm {in})	155 {6.10}
Clutch fluid type			European (L.H.D. U.K.) specs.: SAE J1703 or FMVSS116 DOT-3 or DOT-4 Australian specs.: SAE J1703 or FMVSS116 DOT-3

OUTLINE

Clutch [D66M-R, D66MX-R]

Item			Specifications
Engine type			**SKYACTIV-D 2.2**
Clutch control			Hydraulic
Clutch pedal	Type		Suspended
	Pedal ratio		4.88
	Full stroke (reference value)	(mm {in})	150.3 {5.917}
Clutch master cylinder inner diameter		(mm {in})	15.87 {0.6248}
Clutch release cylinder inner diameter		(mm {in})	20.64 {0.8126}
Clutch cover	Spring type		Diaphragm
	Set load	(N {kgf, lbf})	10900 {1111.5, 2450.4}
Clutch disc	Outer diameter	(mm {in})	250 {9.84}
	Inner diameter	(mm {in})	160 {6.30}
Clutch fluid type			European (L.H.D. U.K.) specs.: SAE J1703 or FMVSS116 DOT-3 or DOT-4 Australian specs.: SAE J1703 or FMVSS116 DOT-3

Manual Transaxle [C66M-R, C66MX-R]

Item			Specifications
Engine type			**SKYACTIV-G 2.0**
Transaxle control			Floor-shift
Operation system			Cable
Shift assist	Forward		Synchromesh
	Reverse		Synchromesh
Gear ratio	1GR		3.700
	2GR		1.947
	3GR		1.300
	4GR		1.029
	5GR		0.837
	6GR		0.680
	Reverse		3.724
Final gear ratio			European (L.H.D.) specs. 2WD, European (U.K.) specs.: 4.388 European (L.H.D.) specs. 4WD, Australian specs.: 4.705
Manual transaxle oil	Grade		API service GL-4
	Viscosity	All season	SAE 75W-80
	Capacity (approx. quantity)	(L {US qt, Imp qt})	1.65 {1.74, 1.45}

Manual Transaxle [D66M-R, D66MX-R]

Item		Specifications
Engine type		**SKYACTIV-D 2.2**
Transaxle control		Floor-shift
Operation system		Cable
Shift assist	Forward	Synchromesh
	Reverse	Synchromesh
Gear ratio	1GR	3.357
	2GR	1.826
	3GR	1.565
	4GR	1.147
	5GR	0.893
	6GR	0.745
	Reverse	4.091
Final gear ratio	1GR/2GR	2WD: 3.120 4WD: 3.291
	Except 1GR/2GR	2WD: 4.105 4WD: 4.388

OUTLINE

Item			Specifications
Engine type			**SKYACTIV-D 2.2**
Manual transaxle oil	Grade		API service GL-4
	Viscosity	All season	SAE 75W-80
	Capacity (approx. quantity)	(L {US qt, Imp qt})	2.40 {2.54, 2.11}

Automatic Transaxle [FW6A-EL, FW6AX-EL]

Item			Specifications
Engine type			**SKYACTIV-G 2.0**
Gear ratio		1GR	3.552
		2GR	2.022
		3GR	1.452
		4GR	1.000
		5GR	0.708
		6GR	0.599
		Reverse	3.893
Final gear ratio			4.624
ATF	Type		ATF FZ
	Capacity (Approx. quantity)	(L {US qt, Imp qt})	7.8 {8.2, 6.9}
Torque converter stall torque ratio			1.82
Hydraulic system (Number of drive/ driven gear plates)	Low clutch		5/5
	High clutch		5/5
	Low and reverse brake		4/4
	2-6 brake		4/4
	R-3-5 brake		3/3
Front planetary gear (Number of teeth)	Front sun gear		38
	Front pinion gear		29
	Front internal gear		97
Rear planetary gear (Number of teeth)	Rear sun gear		40
	Rear pinion gear		27
	Rear internal gear		95
Reduction planetary gear (Number of teeth)	Reduction sun gear		68
	Reduction pinion gear		21
	Reduction internal gear		109
Primary gear (number of teeth)			56
Secondary gear (number of teeth)			59
Output gear (number of teeth)			18
Ring gear (number of teeth)			79

Automatic Transaxle [GW6A-EL, GW6AX-EL]

Item			Specifications
Engine type			**SKYACTIV-D 2.2**
Gear ratio		1GR	3.487
		2GR	1.992
		3GR	1.449
		4GR	1.000
		5GR	0.707
		6GR	0.600
		Reverse	3.990
Final gear ratio			4.090
ATF	Type		ATF FZ
	Capacity (Approx. quantity)	(L {US qt, Imp qt})	8.0 {8.5, 7.0}

OUTLINE

Item		Specifications
Engine type		**SKYACTIV-D 2.2**
Torque converter stall torque ratio		1.88
Hydraulic system (Number of drive/ driven gear plates)	Low clutch	5/5
	High clutch	5/5
	Low and reverse brake	5/5
	2-6 brake	5/5
	R-3-5 brake	4/4
Front planetary gear (Number of teeth)	Front sun gear	39
	Front pinion gear	29
	Front internal gear	97
Rear planetary gear (Number of teeth)	Rear sun gear	41
	Rear pinion gear	27
	Rear internal gear	95
Reduction planetary gear (Number of teeth)	Reduction sun gear	66
	Reduction pinion gear	22
	Reduction internal gear	109
Primary gear (number of teeth)		56
Secondary gear (number of teeth)		59
Output gear (number of teeth)		17
Ring gear (number of teeth)		66

TRANSMISSION/TRANSAXLE IDENTIFICATION

id050000302300

- Each Transmission/Transaxle is assigned a specific Mazda type code. The code can be broken down as follows:

OUTLINE

Manual Transaxle

C66MX-R

- Shift control type
  R: Remote shift control
- Drive type
  N/A: 2-wheel drive
  X: 4-wheel drive
- Transmission/transaxle type
  M: Manual transmission/transaxle
- Transmission/transaxle speed
  6: 6-speed
- Transmission/transaxle model
  C6: C6-type
  D6: D6-type

Automatic Transaxle

FW6AX-EL

- Converter type
  L: With lockup clutch
- Shift control type
  E: Electronic shift control
- Drive type
  N/A: 2-wheel drive
  X: All-wheel drive
- Transmission/transaxle type
  A: Automatic transmission/transaxle
- Transmission/transaxle speed
  6: 6-speed
- Transmission/transaxle model
  FW: FW-type
  GW: GW-type

ac5wzn00000915

05-02A ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [FW6A-EL, FW6AX-EL]

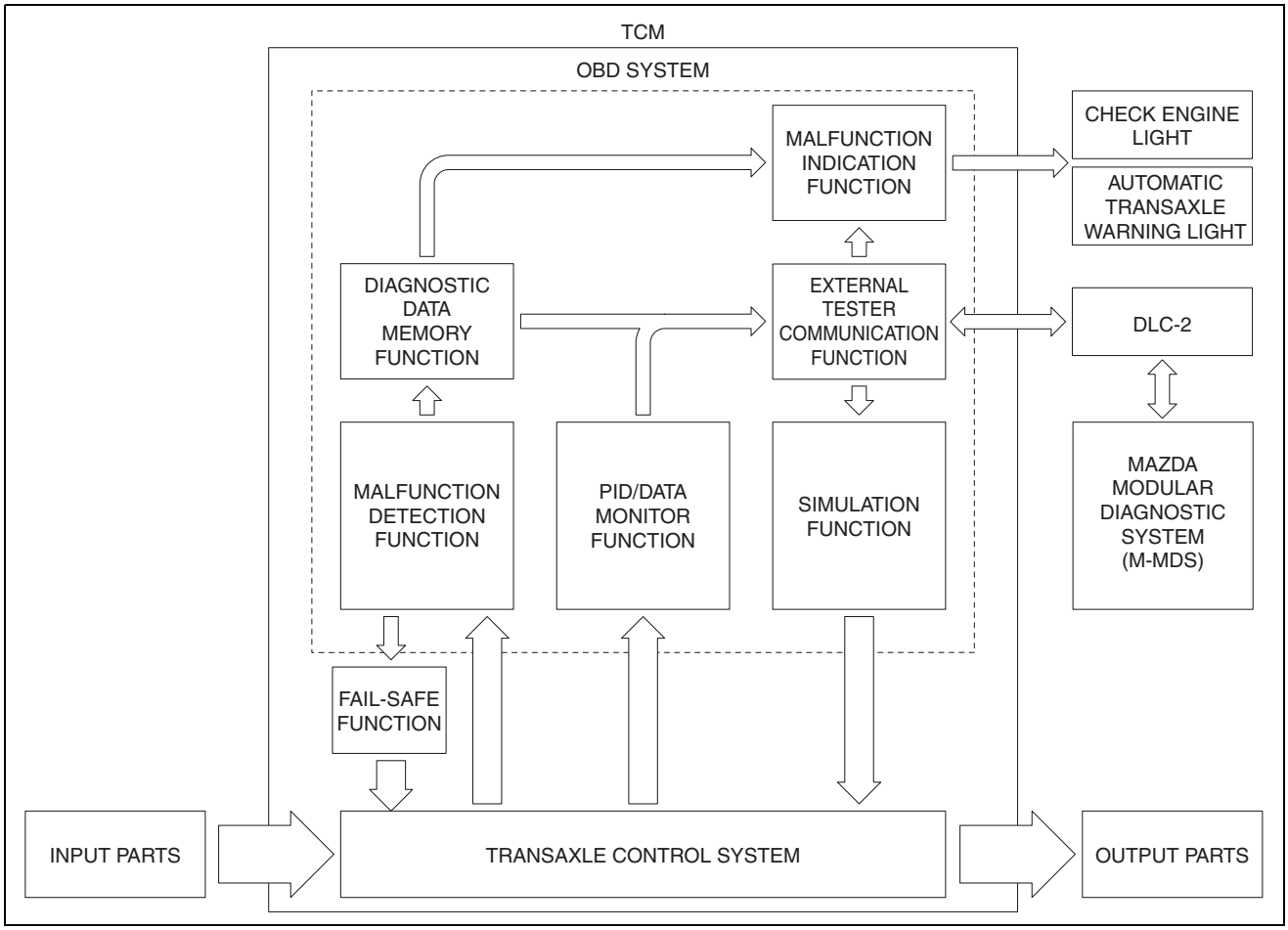
id050227280000

Purpose/Function

- An on-board diagnostic system has been adopted to improve serviceability.
- On-board diagnostic system adopted consisting of the following functions:
  - — Malfunction detection function
  - — Fail-safe function
  - — Diagnostic data memory function
  - — Malfunction indication function
    - Check engine light
    - Automatic transaxle warning light
  - — External tester communication function
    - DLC-2
    - CAN
  - — PID/DATA monitor function
  - — Simulation function

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

Construction/Operation
Block Diagram



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ON-BOARD DIAGNOSTIC SYSTEM MALFUNCTION DETECTION FUNCTION [FW6A-EL, FW6AX-EL]

id050227280100

Purpose/Function

- The malfunction diagnostic function detects transaxle malfunctions.
- Accurate and quick repair/service can be performed to facilitate malfunction cause determination using the malfunction detection function.

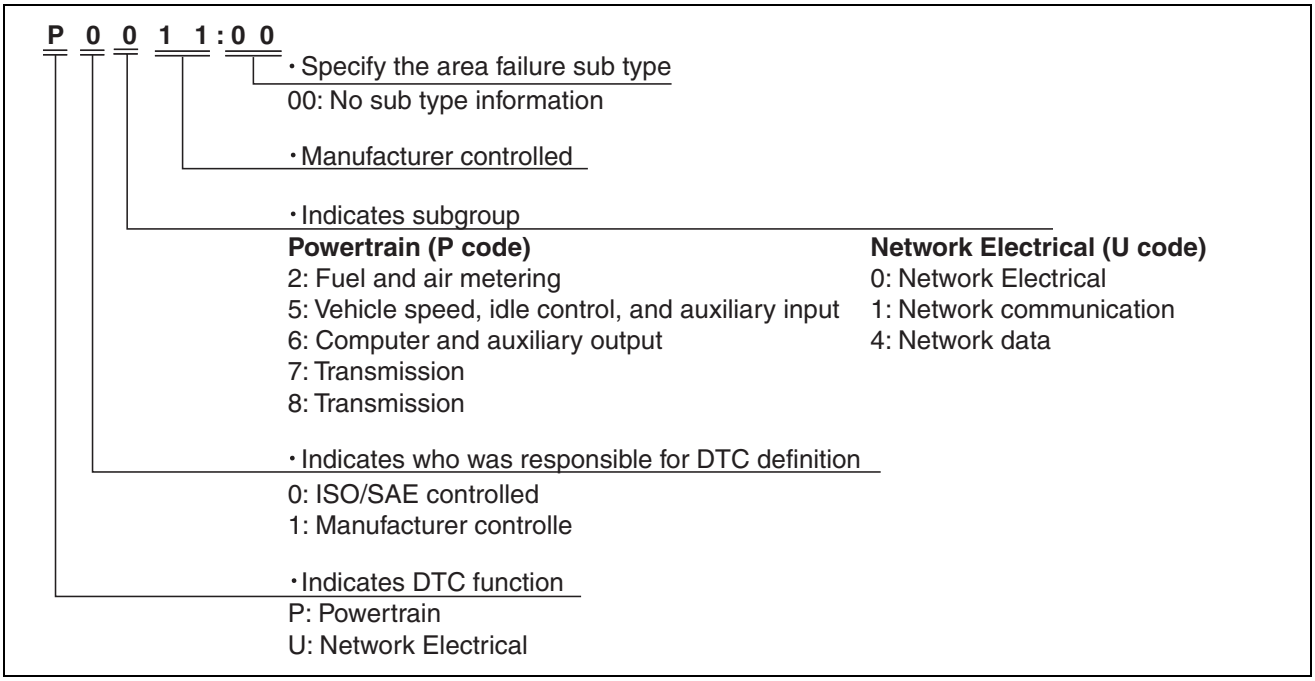
Construction/Operation

- If a malfunction occurs in the transaxle, it is recorded as a DTC. A DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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DTC table

×: Applicable
—: Not applicable

DTC No.	Check engine light	Automatic transaxle warning light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
P0218:00	Illuminate	Illuminate	Automatic transaxle protection control	×	1	C	×
P0500:00	Illuminate	—	Vehicle speed signal circuit malfunction	×	1	C	×
P0666:00	Illuminate	Illuminate	ECU internal temperature sensor circuit(s) malfunction	×	2	C	×
P0667:00	Illuminate	Illuminate	ECU internal temperature sensor two-range/performance problem	×	2	C	×
P06B8:00	Illuminate	—	NVRAM malfunction	—	1	C, O	×
P0706:00	Illuminate	Illuminate	Transaxle range sensor range/ performance problem	×	2	C	×
P0707:00	Illuminate	Illuminate	Transaxle range sensor circuit low input	×	1	C, O	×
P0708:00	Illuminate	Illuminate	Transaxle range sensor circuit high input	×	1	C, O	×
P0711:00	Illuminate	Illuminate	TFT sensor range/performance problem	×	2	C	×
P0712:00	Illuminate	Illuminate	TFT sensor circuit low input	×	1	C, O	×
P0713:00	Illuminate	Illuminate	TFT sensor circuit high input	×	2	C	×
P0716:00	Illuminate	Illuminate	Turbine/Input shaft speed sensor range/performance problem	×	1	C	×
P0717:00	Illuminate	Illuminate	Open circuit in turbine/input shaft speed sensor circuit	×	1	C	×
P0721:00	Illuminate	Illuminate	Output shaft speed sensor range/ performance problem	×	1	C	×

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Check engine light	Automatic transaxle warning light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
P0722:00	Illuminate	Illuminate	Open circuit in output shaft speed sensor circuit	×	1	C	×
P0729:00	—	—	6GR incorrect ratio	×	2	C	×
P0731:00	—	—	1GR incorrect ratio	×	2	C	×
P0732:00	—	—	2GR incorrect ratio	×	2	C	×
P0733:00	—	—	3GR incorrect ratio	×	2	C	×
P0734:00	—	—	4GR incorrect ratio	×	2	C	×
P0735:00	—	—	5GR incorrect ratio	×	2	C	×
P0736:00	—	Illuminate	Gear reverse incorrect ratio	×	2	C	×
P0741:00	Illuminate	Illuminate	TCC control solenoid stuck off	×	2	C	×
P0743:00	Illuminate	Illuminate	TCC control solenoid circuit malfunction	×	1	C, O	×
P0746:00	Illuminate	Illuminate	Pressure control solenoid stuck off	×	2	C	×
P0748:00	Illuminate	Illuminate	Pressure control solenoid circuit malfunction	×	1	C, O	×
P0751:00	Illuminate	Illuminate	Shift solenoid No.1 stuck off	×	2	C	×
P0752:00	Illuminate	Illuminate	Shift solenoid No.1 stuck on	×	2	C	×
P0753:00	Illuminate	Illuminate	Shift solenoid No.1 circuit malfunction	×	1	C, O	×
P0756:00	Illuminate	Illuminate	Shift solenoid No.2 stuck off	×	2	C	×
P0757:00	Illuminate	Illuminate	Shift solenoid No.2 stuck on	×	2	C	×
P0758:00	Illuminate	Illuminate	Shift solenoid No.2 circuit malfunction	×	1	C, O	×
P0761:00	Illuminate	Illuminate	Shift solenoid No.3 stuck off	×	2	C	×
P0762:00	Illuminate	Illuminate	Shift solenoid No.3 stuck on	×	2	C	×
P0763:00	Illuminate	Illuminate	Shift solenoid No.3 circuit malfunction	×	1	C, O	×
P0766:00	Illuminate	Illuminate	Shift solenoid No.4 stuck off	×	2	C	×
P0767:00	Illuminate	Illuminate	Shift solenoid No.4 stuck on	×	2	C	×
P0768:00	Illuminate	Illuminate	Shift solenoid No.4 circuit malfunction	×	1	C, O	×
P0771:00	Illuminate	Illuminate	On/off solenoid stuck off	×	2	C	×
P0772:00	Illuminate	Illuminate	On/off solenoid stuck on	×	2	C	×
P0773:00	Illuminate	Illuminate	On/off solenoid circuit malfunction	×	1	C, O	×
P0780:00	Illuminate	Illuminate	Gear shifting malfunction	×	2	C	×
P079A:00	Illuminate	Illuminate	Shift solenoid No.3 stuck off/On/off solenoid stuck on	×	2	C	×
P0819:00	—	—	M position switch/Up switch/Down switch signal error	×	1	C	×
P0842:00	Illuminate	Illuminate	Oil pressure switch No.1 stuck on	×	2	C	×
P0843:00	Illuminate	Illuminate	Oil pressure switch No.1 stuck off	×	2	C	×
P0847:00	Illuminate	Illuminate	Oil pressure switch No.2 stuck on	×	2	C	×
P0848:00	Illuminate	Illuminate	Oil pressure switch No.2 stuck off	×	2	C	×
P0872:00	Illuminate	Illuminate	Oil pressure switch No.3 stuck on	×	2	C	×
P0873:00	Illuminate	Illuminate	Oil pressure switch No.3 stuck off	×	2	C	×
P0877:00	Illuminate	Illuminate	Oil pressure switch No.4 stuck on	×	2	C	×
P0878:00	Illuminate	Illuminate	Oil pressure switch No.4 stuck off	×	2	C	×
P0882:00	Illuminate	—	TCM power supply voltage low	×	1	C	×
P0883:00	Illuminate	—	TCM power supply voltage high	×	1	C, O	×
P0C2C:00	—	—	Electric AT oil pump rotation malfunction	×	1	C	×
P1728:00	—	—	Clutch slippage	×	2	C	×
P1738:00	—	Illuminate	Automatic transaxle internal malfunction	×	2	C	×

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Check engine light	Automatic transaxle warning light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
P1784:00	—	Illuminate	Hi cut valve stuck off/R-3-5 cut valve stuck on	×	2	C	×
P181F:00	—	—	Electric AT oil pump/Electric AT oil pump relay circuit malfunction	×	1	C	×
P2530:00	—	—	Ignition switch: Stuck off	×	1	C, O	×
P2712:00	—	—	Oil pump shift valve stuck	×	1	C	×
U0073:00	—	—	CAN system communication error (HS CAN)	×	1	C, O	×
U0074:00	—	—	CAN system communication error (local CAN between TCM and PCM)	×	1	C, O	×
U0100:00	Illuminate	—	Communication error to PCM (HS CAN)	×	1	C, O	×
U0115:00	Illuminate	—	Communication error to PCM (local CAN between TCM and PCM)	×	1	C, O	×
U0121:00	Illuminate	—	Communication error to DSC HU/CM	×	1	C, O	×
U0141:00	—	—	Communication error to front body control module (FBCM)	×	1	C, O	×
U0155:00	Illuminate	—	Communication error to instrument cluster	×	1	C, O	×
U0442:00	—	—	Invalid data received from PCM (local CAN between TCM and PCM)	×	1	C, O	×

*1 : C: CMDTC self test, O: KOEO self test, R: KOER self test

DTC separate detection condition

DTC No.	Description	Detection condition
P0218:00	Automatic transaxle protection control	• Under the following conditions, the ATF temperature is **135 °C {275 °F} or more** for **10 s**: — Engine is running. — Battery voltage is **8 V or more**. — TFT sensor related DTC is not recorded.
P0500:00	Vehicle speed signal circuit malfunction	• Under the following conditions, the vehicle speed signal input from DSC HU/CM is incorrect for **10 s**: — Engine is running. — Battery voltage is **8 V or more**. — Vehicle speed is **16 km/h {9.9 mph} or more**. — There is no difference in speed between turbine/input shaft speed sensor and output shaft speed sensor.
P0666:00	ECU internal temperature sensor circuit(s) malfunction	• Under the following condition, there is malfunction in circuits of two or more ECU internal temperature sensors: — Battery voltage is **8 V or more**. • Under the following conditions, one ECU internal temperature sensor has malfunction, with difference in temperature between remaining two ECU internal temperature sensors being **10 °C {18 °F} or more**: — Battery voltage is **8 V or more**. — Soaked for **6 hours or more**.
P0667:00	ECU internal temperature sensor two-range/performance problem	• Under the following conditions, the difference between ECU internal temperatures of three ECU internal temperature sensors is **10 °C {18 °F} or more**: — Engine is running. — Battery voltage is **8 V or more**. — Soaked for **6 hours or more**. — No malfunction in ECU internal temperature sensor circuit
P06B8:00	NVRAM malfunction	• Under the following condition, TCM internal NVRAM data retention/read/write disabled: — Battery voltage is **8 V or more**.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Detection condition
P0706:00	Transaxle range sensor range/ performance problem	• Under the following condition, pattern identification error in switch condition of transaxle range sensors 1 to 4: — Battery voltage is **8 V or more**.
P0707:00	Transaxle range sensor circuit low input	• Under the following condition, incorrect voltage in any of transaxle range sensors 1 to 4: — Battery voltage is **8 V or more**.
P0708:00	Transaxle range sensor circuit high input	• Under the following condition, incorrect voltage in any of transaxle range sensors 1 to 4: — Battery voltage is **8 V or more**.
P0711:00	TFT sensor range/performance problem	• Under the following conditions, the ATF temperature is **40 °C {104 °F} or less**: — Certain period has elapsed since engine start. — Battery voltage is **8 V or more**. — ECU internal temperature sensor related DTC is not recorded. — Soaked for **6 hours or more**. — ECU internal temperature increases above specified temperature.
P0712:00	TFT sensor circuit low input	• Under the following condition, the TFT sensor voltage is **0.12 V or less** for **5 s**: — Battery voltage is **8 V or more**.
P0713:00	TFT sensor circuit high input	• Under the following conditions, the ATF temperature is **–40 °C {–40 °F} or less** for **5 s**: — Battery voltage is **8 V or more**. — IAT is **–25 °C {–13 °F} or more**. — IAT sensor related DTC is not recorded.
P0716:00	Turbine/Input shaft speed sensor range/performance problem	• Under the following conditions, the turbine/input shaft speed is **9,000 rpm or more** for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. — Engine speed is **7,500 rpm or less**.
P0717:00	Open circuit in turbine/input shaft speed sensor circuit	• Under the following conditions, the turbine/input shaft speed sensor signal is not input for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. — Vehicle speed signal related DTC is not recorded. — Vehicle speed is **16 km/h {9.9 mph} or more**. — There is no difference between vehicle speed signal from DSC HU/CM and output shaft speed sensor signal. — DTC U0121:00 is not recorded.
P0721:00	Output shaft speed sensor range/ performance problem	• Under the following conditions, the output shaft speed is **13,560 rpm or more** for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. • Under the following conditions, the vehicle speed signal from the DSC HU/CM and the output shaft speed sensor signal differ by **520 rpm or more** for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. — Vehicle speed signal related DTC is not recorded. — Vehicle speed is **16 km/h {9.9 mph} or more**. — Vehicle speed signal from DSC HU/CM and turbine/input shaft speed sensor signal do not differ. — Output shaft speed sensor signal is input. — Output shaft speed is **13,560 rpm or less**.
P0722:00	Open circuit in output shaft speed sensor circuit	• Under the following conditions, the output shaft speed sensor signal is not input for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. — Vehicle speed signal related DTC is not recorded. — Vehicle speed is **16 km/h {9.9 mph} or more**. — There is no difference between vehicle speed signal from DSC HU/CM and output shaft speed sensor signal. — DTC U0121:00 is not recorded.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Detection condition
P0729:00	6GR incorrect ratio	• In D position, 6GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0731:00	1GR incorrect ratio	• In D position, 1GR, the following phenomenon occurs: — Speed ratio is **0.75 to 1.2** for **2,000 ms** while vehicle is stopped in D position. — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0732:00	2GR incorrect ratio	• In D position, 2GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0733:00	3GR incorrect ratio	• In D position, 3GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0734:00	4GR incorrect ratio	• In D position, 4GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0735:00	5GR incorrect ratio	• In D position, 5GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0736:00	Gear reverse incorrect ratio	• Speed ratio is **0.75 to 1.2** for **2,000 ms** while vehicle is stopped in R position.
P0741:00	TCC control solenoid stuck off	• Under the following conditions, difference in slip amount **over 5 s** compared to target slip amount is **200 rpm or more**, and TCC feedback hydraulic pressure is **200 kPa {2.04 kgf/cm^2, 29.0 psi} or more** occurs: — Battery voltage is **8 V or more**. — Selector lever position is D position. — No electrical malfunction in TCC control solenoid — During TCC or TCC feedback — DTC P0716:00 and P0717:00 are not recorded.
P0743:00	TCC control solenoid circuit malfunction	• Under the following condition, the TCM detects the TCC control solenoid circuit malfunction: — Battery voltage is **8 V or more**.
P0746:00	Pressure control solenoid stuck off	• Under the following conditions, pressure control solenoid stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0748:00	Pressure control solenoid circuit malfunction	• Under the following condition, the TCM detects the pressure control solenoid circuit malfunction: — Battery voltage is **8 V or more**.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Detection condition
P0751:00	Shift solenoid No.1 stuck off	• Under the following conditions, shift solenoid No.1 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0752:00	Shift solenoid No.1 stuck on	• Under the following conditions, shift solenoid No.1 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0753:00	Shift solenoid No.1 circuit malfunction	• Under the following condition, the TCM detects the shift solenoid No.1 circuit malfunction: — Battery voltage is **8 V or more**.
P0756:00	Shift solenoid No.2 stuck off	• Under the following conditions, shift solenoid No.2 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0757:00	Shift solenoid No.2 stuck on	• Under the following conditions, shift solenoid No.2 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0758:00	Shift solenoid No.2 circuit malfunction	• Under the following condition, the TCM detects the shift solenoid No.2 circuit malfunction: — Battery voltage is **8 V or more**.
P0761:00	Shift solenoid No.3 stuck off	• Under the following conditions, shift solenoid No.3 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0762:00	Shift solenoid No.3 stuck on	• Under the following conditions, shift solenoid No.3 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0763:00	Shift solenoid No.3 circuit malfunction	• Under the following condition, the TCM detects the shift solenoid No.3 circuit malfunction: — Battery voltage is **8 V or more**.
P0766:00	Shift solenoid No.4 stuck off	• Under the following conditions, shift solenoid No.4 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0767:00	Shift solenoid No.4 stuck on	• Under the following conditions, shift solenoid No.4 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0768:00	Shift solenoid No.4 circuit malfunction	• Under the following condition, the TCM detects the shift solenoid No.4 circuit malfunction: — Battery voltage is **8 V or more**.
P0771:00	On/off solenoid stuck off	• Under the following conditions, on/off solenoid stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Detection condition
P0772:00	On/off solenoid stuck on	• Under the following conditions, on/off solenoid stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0773:00	On/off solenoid circuit malfunction	• Under the following condition, the TCM detects the on/off solenoid circuit malfunction: — Battery voltage is **8 V or more**.
P0780:00	Gear shifting malfunction	• Under the following conditions, the gear shifting inhibited: — Engine is running. — Battery voltage is **8 V or more**.
P079A:00	Shift solenoid No.3 stuck off/On/ off solenoid stuck on	• Under the following conditions, shift solenoid No.3 stuck-off or on/off solenoid stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0819:00	M position switch/Up switch/Down switch signal error	• Under the following conditions, any of (1) to (4) conditions occurs for **1 s**: — Engine is running. — Battery voltage is **8 V or more**. — Transaxle range sensor related DTC is not recorded. (1) M position switch signal is on even though forward oil pressure switch is on in any position other than D position. (2) M position switch signal is off even though up or down switch signal is on in D position. (3) Up switch signal is on even though M position switch signal is off in any position other than D position. (4) Down switch signal is on even though M position switch signal is off in any position other than D position.
P0842:00	Oil pressure switch No.1 stuck on	• Under the following conditions, oil pressure switch No.1 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0843:00	Oil pressure switch No.1 stuck off	• Under the following conditions, oil pressure switch No.1 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0847:00	Oil pressure switch No.2 stuck on	• Under the following conditions, oil pressure switch No.2 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0848:00	Oil pressure switch No.2 stuck off	• Under the following conditions, oil pressure switch No.2 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0872:00	Oil pressure switch No.3 stuck on	• Under the following conditions, oil pressure switch No.3 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0873:00	Oil pressure switch No.3 stuck off	• Under the following conditions, oil pressure switch No.3 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

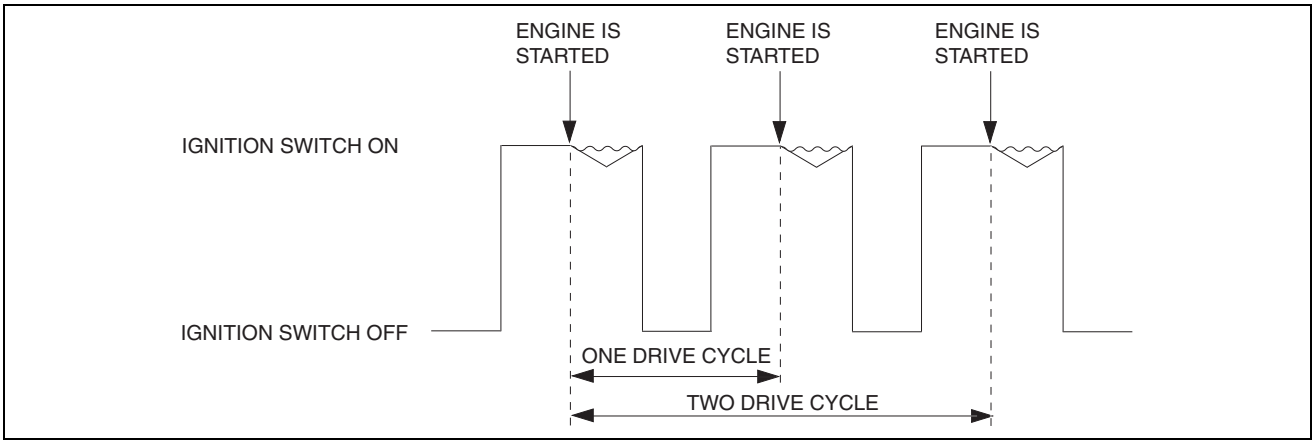
DTC No.	Description	Detection condition
P0877:00	Oil pressure switch No.4 stuck on	• Under the following conditions, oil pressure switch No.4 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0878:00	Oil pressure switch No.4 stuck off	• Under the following conditions, oil pressure switch No.4 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0882:00	TCM power supply voltage low	• Under the following conditions, the TCM power supply voltage is **8—10.5 V or less** (varies with ATF temperature): — **5 s or more** has elapsed or battery voltage exceeds **11 V or more** for **0.2 s** since engine speed increases –**200 rpm or more** of target idle speed. — Selector lever position is D or R position.
P0883:00	TCM power supply voltage high	• TCM power supply voltage is **18 V or more** for **5 s**.
P0C2C:00	Electric AT oil pump rotation malfunction	• The actual electric AT oil pump rotation speed under the following conditions is **100 rpm or less** for a continuous **10 s**: — Electric AT oil pump rotation speed command value is **500 rpm or more**. — Electric AT oil pump relay is ON. — DTC P181F:00 is not recorded.
P1728:00	Clutch slippage	• Under the following conditions, turbine/input shaft speed suddenly increases **300 rpm or more** for **1,450 ms**: — Engine is running. — Battery voltage is **8 V or more**. — Vehicle speed is **5 km/h {3 mph} or more**. — There is no difference between vehicle speed signal from DSC HU/CM and output shaft speed sensor signal. — Not shifting — Selector lever position is D position. — Turbine/Input shaft speed is **1,200 rpm or more**. — Oil pressure switch pattern (1st—6th) is normal.
P1738:00	Automatic transaxle internal malfunction	• Malfunction location cannot be determined based on combination of gear ratio malfunction and oil pressure switch pattern malfunction.
P1784:00	Hi cut valve stuck off/R-3-5 cut valve stuck on	• Under the following conditions, hi cut valve stuck-off or R-3-5 cut valve stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P181F:00	Electric AT oil pump/Electric AT oil pump relay circuit malfunction	• If the TCM detects any of the following conditions for a continuous **5 s**: — Electric AT oil pump circuit has a malfunction. — Electric AT oil pump relay circuit has a malfunction.
P2530:00	Ignition switch stuck off	• If the IG ON time count of the instrument cluster proceeds **5 s** under the following condition: — Ignition switch signal off
P2712:00	Oil pump shift valve stuck	• Under the following conditions, oil pressure switch No.1 OFF output continues for **10 s**: — DTC P0753:00, P0C2C:00 and P181F:00 are not recorded. — During i-stop operation — Selector lever position is D or N position. — During electric AT oil pump operation — Oil pressure switch, low clutch and transaxle range sensor are normal. — Rate of speed change normal
U0073:00	CAN system communication error (HS CAN)	• Under the following condition, a communication error (HS CAN) occurs: — Battery voltage is **10 V or more**.
U0074:00	CAN system communication error (local CAN between TCM and PCM)	• Under the following condition, a communication error (local CAN between TCM and PCM) occurs: — Battery voltage is **10 V or more**.
U0100:00	Communication error to PCM (HS CAN)	• Under the following condition, the TCM cannot receive the signal from PCM (HS CAN): — Battery voltage is **10 V or more**.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Detection condition
U0115:00	Communication error to PCM (local CAN between TCM and PCM)	• Under the following condition, the TCM cannot receive the signal from PCM (local CAN between TCM and PCM): — Battery voltage is **10 V or more**.
U0121:00	Communication error to DSC HU/CM	• Under the following condition, the TCM cannot receive the signal from DSC HU/CM: — Battery voltage is **10 V or more**.
U0141:00	Communication error to front body control module (FBCM)	• Under the following condition, the TCM cannot receive the signal from front body control module (FBCM): — Battery voltage is **10 V or more**.
U0155:00	Communication error to instrument cluster	• Under the following condition, the TCM cannot receive the signal from instrument cluster: — Battery voltage is **10 V or more**.
U0442:00	Invalid data received from PCM (local CAN between TCM and PCM)	• Under the following condition, the TCM detects the invalid PCM signal for **0.5 s**: — Battery voltage is **10 V or more**.

Drive cycle

- The drive cycle is the period of time from when the engine is started to the next time the engine is started.
- One drive cycle, as shown in the figure, indicates the period from the time engine is started to the next time the engine is started. If this period is repeated twice it then becomes two drive cycles.



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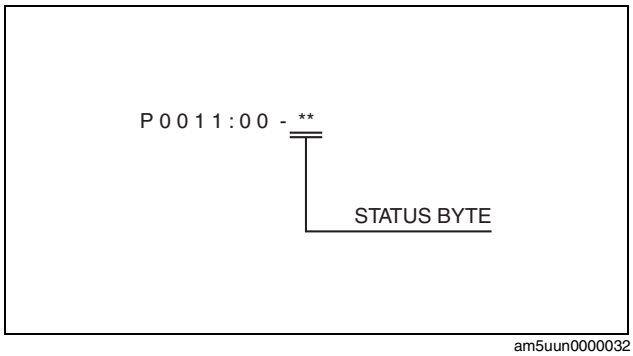
- To detect DTCs, a required number of drive cycles for pre-detection has been set. For the number of drive cycles required for detection, refer to the DTC table.

Pending code

- The pending code is temporary malfunction code which differs from DTCs which are recorded when the TCM detects a transaxle malfunction.
- DTCs are recorded in the TCM according to the number of drive cycles when the TCM detects a transaxle malfunction. At the same time, pending code is recorded in the TCM regardless of the number of drive cycles.
- Pending code recorded in the TCM is erased from the TCM, from the next drive cycle, when the TCM determines that the transaxle is normal.

Status byte for DTC

- The status byte is the two-digit code (two digits after hyphen (-)) after the DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self test using the M-MDS.
- For details on the status byte, refer to the explanation on the M-MDS when reading the DTC.



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ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

Self-test function

- When the self-test is implemented, the TCM performs diagnosis of the transaxle control system. If a malfunction is detected with the results of the diagnosis, an applicable DTC is recorded. A recorded DTC can be read by the M-MDS.
- By implementing the self-test function, verification of the current malfunction and verification after repair is facilitated.

CMDTC (Continuous Memory Diagnostic Trouble Code) self-test

- The CMDTC self-test is a function which reads all DTCs recorded in the TCM after the previous DTCs are erased no matter whether they are past malfunctions or current malfunctions.

KOEO (Key On Engine Off) self-test

- The KOEO self-test can perform malfunction diagnosis of DTCs corresponding to this self-test function when the ignition is switched ON and the engine is stopped. This self-test implements based on the test implementation command signal sent to the TCM from the M-MDS.

Freeze frame data/Snapshot data

Freeze frame data

- The freeze frame data consists of data for vehicle and transaxle control system operation conditions when malfunctions in the transaxle control system are detected and stored in the TCM.
- Freeze frame data is stored at the instant the malfunction indicator lamp illuminates, and only a part of the DTC data is stored.

Snapshot data

- The data for all DTCs currently detected is stored.
  Recorded DTC timing
  — For DTCs with one drive cycle, data is recorded during the malfunction determination period.
  — For DTCs with two drive cycles, data is recorded during non-determination (1st diagnosis) periods.

Freeze frame data item table

—: Not applicable

Freeze frame data item	Unit	Description	Corresponding PID/DATA monitor item
LOAD	%	Calculated engine load	—
ECT	°C {°F}	Engine coolant temperature	ECT
RPM	RPM	Engine speed	RPM
VS	KPH {MPH}	Vehicle speed	VSS
IAT	°C {°F}	Intake air temperature	—
TP	%	Throttle valve position No.1	TP
RUNTM	hh:mm:ss	Time from engine start	—
VPWR	V	Module supply voltage	VPWR
APP_D	%	Accelerator pedal position No.1	—

Snapshot data item table

—: Not applicable

Snapshot data item	Unit	Description	Corresponding PID/DATA monitor item
LOAD	%	Calculated engine load	—
ECT	°C {°F}	Engine coolant temperature	ECT
RPM	RPM	Engine speed	RPM
VSS	KPH {MPH}	Vehicle speed	VSS
IAT	°C {°F}	Intake air temperature	—
EG_RUN_TIME	—	Time from engine start	—
VPWR	V	Module supply voltage	VPWR
APP1	%	Accelerator pedal position No.1	—
GEAR_SEL	1/2/3/4/5/6	Gear shift position	GEAR_SEL
TSS	RPM	Turbine/input shaft speed	TSS
TFT	°C {°F}	ATF temperature	TFT
OSS	RPM	Output shaft speed	OSS
LOCK_UP	Off/SLIP/On	Torque converter (TCC condition)	LOCK_UP
OIL_PRES_SW2	Off/On	Oil pressure switch No.2 condition	OP_SW2
OIL_PRES_SW1	Off/On	Oil pressure switch No.1 condition	OP_SW1
SS_ON_OFF	Off/On	On/off solenoid condition	SS_ON-OFF

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

Snapshot data item	Unit	Description	Corresponding PID/DATA monitor item
TORQUE_DES	Nm	Desired engine torque	TORQUE_DES
APP	%	Accelerator pedal position No.1	—
G_INHIBIT_6	Off/On	6GR is inhibited due to malfunction.	—
G_INHIBIT_5	Off/On	5GR is inhibited due to malfunction.	—
G_INHIBIT_4	Off/On	4GR is inhibited due to malfunction.	—
G_INHIBIT_3	Off/On	3GR is inhibited due to malfunction.	—
G_INHIBIT_2	Off/On	2GR is inhibited due to malfunction.	—
G_INHIBIT_1	Off/On	1GR is inhibited due to malfunction.	—
G_INHIBIT_R	Off/On	R position is inhibited due to malfunction.	—
G_INHIBIT_N	Off/On	N position is inhibited due to malfunction.	—
OIL_PRES_SW4	Off/On	Oil pressure switch No.4 condition	OP_SW4
OIL_PRES_SW3	Off/On	Oil pressure switch No.3 condition	OP_SW3
EOP_RLY	Off/On	Electric AT oil pump relay condition	EOP_RLY
SHIFT_CTRL	DEFAULT/ MANUAL/ C_CONTROL/ HIGH_TEMP/ D_MANUAL/ FAIL_SAFE	Shift control mode	SHIFT_CTRL
SLIP_VALUE	RPM	Actual slip value between TSS and OSS	—
HTM_DIS	km {mile}	Travel distance since determination of ATF high temperature mode	HTM_DIS

ON-BOARD DIAGNOSTIC SYSTEM FAIL-SAFE FUNCTION [FW6A-EL, FW6AX-EL]

id050227280200

Purpose/Function

- If a transaxle malfunction is detected by the malfunction detection function, the fail-safe function limits the transaxle control.
- Even if the transaxle has a malfunction, the fail-safe function assures the minimum vehicle driveability.

Construction/Operation

DTC separate fail-safe function

—: Not applicable

DTC No.	Description	Fail-safe function
P0218:00	Automatic transaxle protection control	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0500:00	Vehicle speed signal circuit malfunction	• Inhibits learning control. • Inhibits neutral idle control. • Inhibits AAS.
P0666:00	ECU internal temperature sensor circuit(s) malfunction	• Inhibits learning control. • Inhibits neutral idle control.
P0667:00	ECU internal temperature sensor two-range/performance problem	• Inhibits learning control. • Inhibits neutral idle control.
P06B8:00	NVRAM malfunction	—
P0706:00	Transaxle range sensor range/ performance problem	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0707:00	Transaxle range sensor circuit low input	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0708:00	Transaxle range sensor circuit high input	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Fail-safe function
P0711:00	TFT sensor range/performance problem	• Inhibits learning control. • Inhibits neutral idle control.
P0712:00	TFT sensor circuit low input	• Inhibits learning control. • Inhibits neutral idle control.
P0713:00	TFT sensor circuit high input	• Inhibits learning control. • Inhibits neutral idle control.
P0716:00	Turbine/Input shaft speed sensor range/performance problem	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.
P0717:00	Open circuit in turbine/input shaft speed sensor circuit	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.
P0721:00	Output shaft speed sensor range/ performance problem	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0722:00	Open circuit in output shaft speed sensor circuit	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0729:00	6GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0731:00	1GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0732:00	2GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0733:00	3GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0734:00	4GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0735:00	5GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0736:00	Gear reverse incorrect ratio	• Inhibits learning control. • Inhibits neutral idle control.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Fail-safe function
P0741:00	TCC control solenoid stuck off	• Inhibits TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0743:00	TCC control solenoid circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0746:00	Pressure control solenoid stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0748:00	Pressure control solenoid circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0751:00	Shift solenoid No.1 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0752:00	Shift solenoid No.1 stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0753:00	Shift solenoid No.1 circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0756:00	Shift solenoid No.2 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0757:00	Shift solenoid No.2 stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0758:00	Shift solenoid No.2 circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0761:00	Shift solenoid No.3 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0762:00	Shift solenoid No.3 stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Fail-safe function
P0763:00	Shift solenoid No.3 circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0766:00	Shift solenoid No.4 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0767:00	Shift solenoid No.4 stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0768:00	Shift solenoid No.4 circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0771:00	On/off solenoid stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0772:00	On/off solenoid stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0773:00	On/off solenoid circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0780:00	Gear shifting malfunction	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P079A:00	Shift solenoid No.3 stuck off/On/ off solenoid stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0819:00	M position switch/Up switch/Down switch signal error	• Inhibits manual mode.
P0842:00	Oil pressure switch No.1 stuck on	• Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0843:00	Oil pressure switch No.1 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0847:00	Oil pressure switch No.2 stuck on	• Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Fail-safe function
P0848:00	Oil pressure switch No.2 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0872:00	Oil pressure switch No.3 stuck on	• Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0873:00	Oil pressure switch No.3 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0877:00	Oil pressure switch No.4 stuck on	• Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0878:00	Oil pressure switch No.4 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0882:00	TCM power supply voltage low	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0883:00	TCM power supply voltage high	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0C2C:00	Electric AT oil pump rotation malfunction	• Inhibits i-stop control.
P1728:00	Clutch slippage	• Inhibits malfunctioning gear. • Limits engine torque. • Maximizes the line pressure. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P1738:00	Automatic transaxle internal malfunction	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P1784:00	Hi cut valve stuck off/R-3-5 cut valve stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits neutral idle control.
P181F:00	Electric AT oil pump/Electric AT oil pump relay circuit malfunction	• Inhibits i-stop control.
P2530:00	Ignition switch stuck off	—
P2712:00	Oil pump shift valve stuck	• Inhibits i-stop control.
U0073:00	CAN system communication error (HS CAN)	• Inhibits learning control. • Inhibits neutral idle control. • Inhibits AAS.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

DTC No.	Description	Fail-safe function
U0074:00	CAN system communication error (local CAN between TCM and PCM)	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.
U0100:00	Communication error to PCM (HS CAN)	• Inhibits learning control. • Inhibits neutral idle control. • Inhibits AAS.
U0115:00	Communication error to PCM (local CAN between TCM and PCM)	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.
U0121:00	Communication error to DSC HU/CM	• Inhibits learning control. • Inhibits neutral idle control. • Inhibits AAS.
U0141:00	Communication error to front body control module (FBCM)	• Inhibits learning control. • Inhibits neutral idle control.
U0155:00	Communication error to instrument cluster	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control.
U0442:00	Invalid data received from PCM (local CAN between TCM and PCM)	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.

Emergency mode
- The emergency mode is a control for preventing transaxle damage or vehicle inoperability.
- If these modes are set, the TCM output is inhibited. Therefore, all solenoids are turned off and the following conditions occur:
  - — When the accelerator pedal is depressed, the engine speed is higher than normal.
  - — When N to D position and N to R position are selected, the shift shock is greater than during normal shifting.

Neutral idle control
- System which automatically switches the transaxle to neutral internally while the vehicle is stopped in the D position.

ON-BOARD DIAGNOSTIC SYSTEM DIAGNOSTIC DATA MEMORY FUNCTION [FW6A-EL, FW6AX-EL]

id050227280300

Purpose/Function
- The on-board diagnostic system diagnostic data memory function records/erases the following diagnostic data:
  - — Number of DTCs
  - — DTCs
  - — Pending code
- Determination of a malfunction cause is facilitated by the on-board diagnostic system data memory function. Therefore, accurate and quick repair/service can be performed.

Construction/Operation
- The conditions for recording/erasing diagnostic data are determined by the number of drive cycles set for each DTC.
- Using the memory deletion function of the M-MDS, diagnostic data can be deleted.

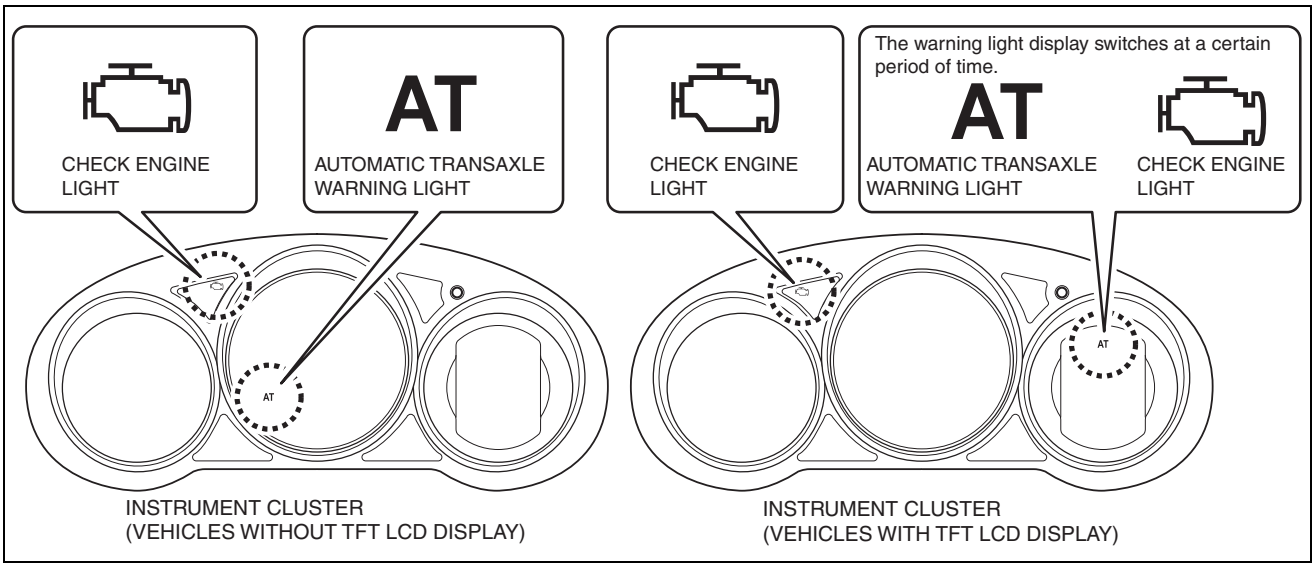
ON-BOARD DIAGNOSTIC SYSTEM MALFUNCTION INDICATION FUNCTION [FW6A-EL, FW6AX-EL]

id050227280400

Purpose/Function
- The on-board diagnostic system malfunction indication function notifies the driver of a transaxle malfunction.
- The malfunction indication function notifies the driver of a transaxle malfunction by illuminating the check engine light and automatic transaxle warning light.

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

Construction/Operation



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ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION [FW6A-EL, FW6AX-EL]

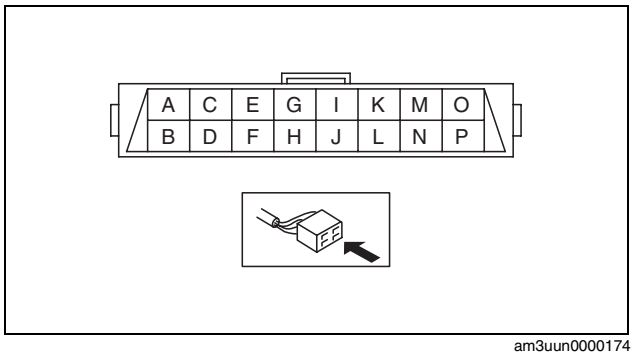
id050227280500

Purpose/Function

- The on-board diagnostic system external tester communication function transmits data between an external tester and each control module of the vehicle.
- Because the DTCs recorded in the vehicle can be read by an external tester, determination of a malfunction location is facilitated.

Construction/Operation

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been adopted.
- A connector shape and 16-pin terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this DLC-2.



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Terminal	Function
A	Battery positive voltage
B	AFS control module (Vehicle with headlight auto leveling system)
C	SAS control module
D	—
E	HS CAN communication line Lo
F	HS CAN communication line Hi
G	—
H	Serial communication ground
I	—
J	Body ground
K	MS CAN communication line Lo
L	MS CAN communication line Hi
M	—
N	—
O	—
P	—

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [FW6A-EL, FW6AX-EL]

id050227280600

Purpose/Function

- The PID/DATA monitor function can monitor control data such as input signals/internal calculation values/output signals using the M-MDS.
- The module control condition can be verified in real-time by the PID/DATA monitor function.

Construction/Operation

PID/DATA monitor item table

—: Not applicable

Item	Unit/Condition	Definition
DGP_DIS_1	km {mile}	Traveled distance after differential protection control operated
DGP_DIS_2	km {mile}	Traveled distance after DGP_MAX_DIF updated
DGP_MAX_DIF	RPM	Maximum rotation difference after differential protection control operated due to excessive rotation difference between left/right drive wheels
DGP_SPD	KPH {MPH}	Vehicle speed with trailing wheels after differential protection control operated due to excessive rotation difference between left/right drive wheels
ECT	°C {°F}	Engine coolant temperature
ECU_A	°C {°F}	ECU internal temperature A
ECU_B	°C {°F}	ECU internal temperature B
ECU_C	°C {°F}	ECU internal temperature C
EOP_DUTY	%	Electric AT oil pump duty cycle
EOP_RLY	Off/On	Electric AT oil pump relay condition
GEAR_RA	Ratio	Gear ratio
GEAR_SEL	1/2/3/4/5/6	Gear shift position
HI_TEMP	—	ATF high temperature mode determination amount
HTM_CNT	—	ATF high temperature mode counter
HTM_DIS	km {mile}	Travel distance since determination of ATF high temperature mode
LINEDES	kPa {kgf/cm^2, psi}	Target modifier pressure/Target pressure control solenoid pressure
LN_C_CLUTCH	kPa {kgf/cm^2, psi}	Hydraulic control learning value (engaged)
LN_O_CLUTCH	kPa {kgf/cm^2, psi}	Hydraulic control learning value (released)
LN_OV_SCOPE	—	Hydraulic control learning value (mis-learning)
LN_T_CLUTCH	kPa {kgf/cm^2, psi}	Hydraulic control learning value (torque converter)
LOCK_UP	OFF/SLIP/ON	Torque converter (TCC condition)
LONGI_ACCEL	—	Longitudinal acceleration
OP_SW1	Off/On	Oil pressure switch No.1 condition
OP_SW1_OFF	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW1_ON	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW2	Off/On	Oil pressure switch No.2 condition
OP_SW2_OFF	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW2_ON	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW3	Off/On	Oil pressure switch No.3 condition
OP_SW3_OFF	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW3_ON	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW4	Off/On	Oil pressure switch No.4 condition
OP_SW4_OFF	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW4_ON	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OSS	RPM	Output shaft speed
PUMP_SPEED	RPM	Motor pump unit actual speed
RPM	RPM	Engine speed/min
SHIFT_CTRL	DEFAULT/ MANUAL/ C_CONTROL/ HIGH_TEMP/ D_MANUAL/ FAIL_SAFE	Shift control mode
SS_ON-OFF	Off/On	On/off solenoid condition

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

Item	Unit/Condition	Definition
SS1	A	Shift solenoid No.1 actual current
SS1_C	A	Shift solenoid No.1 target current
SS2	A	Shift solenoid No.2 actual current
SS2_C	A	Shift solenoid No.2 target current
SS3	A	Shift solenoid No.3 actual current
SS3_C	A	Shift solenoid No.3 target current
SS4	A	Shift solenoid No.4 actual current
SS4_C	A	Shift solenoid No.4 target current
SSLU	A	TCC control solenoid actual current
SSLU_C	A	TCC control solenoid target current
SSLU_PRES	kPa {kgf/cm^2, psi}	TCC control solenoid target pressure
SSP	A	Pressure control solenoid actual current
SSP_C	A	Pressure control solenoid target current
SSP_PRES	kPa {kgf/cm^2, psi}	Pressure control solenoid target pressure
TFT	°C {°F}	ATF temperature
THOP	%	Throttle opening angle
TORQUE_ACT	Nm	Actual engine torque
TORQUE_DES	Nm	Desired engine torque
TR	P/SHIFT_DOWN/ SHIFT_UP/M/D/N/ R	Range position
TSS	RPM	Turbine/input shaft speed
UPSHIFT_REV	Off/On	Shift-up record due to engine request
VPWR	V	TCM power supply voltage
VSS	KPH {MPH}	Vehicle speed

ON-BOARD DIAGNOSTIC SYSTEM SIMULATION FUNCTION [FW6A-EL, FW6AX-EL]

id050227280700

Purpose/Function

- The simulation function can drive output parts based on use of the M-MDS.
- Inspection of an individual output part is facilitated by the simulation function because the output part is driven forcibly.

Construction/Operation

Simulation item table

Item	Output part name	Unit/Condition	Operation condition
EOP	Electric AT oil pump condition	Off/On	Under the following conditions: • Vehicle stopped • Accelerator pedal fully closed
EOP_DUTY	Electric AT oil pump duty cycle	%	Under the following conditions: • Vehicle stopped • Accelerator pedal fully closed
EOP_RLY	Electric AT oil pump relay condition	Off/On	Under the following conditions: • Vehicle stopped • Accelerator pedal fully closed
SS_ON-OFF	On/off solenoid condition	Off/On	Under the following conditions: • Vehicle stopped • Idling at P or N position
SS1_C	Shift solenoid No.1 target current	A	Under the following conditions: • Vehicle stopped • Idling at P or N position
SS2_C	Shift solenoid No.2 target current	A	Under the following conditions: • Vehicle stopped • Idling at P or N position
SS3_C	Shift solenoid No.3 target current	A	Under the following conditions: • Vehicle stopped • Idling at P or N position

ON-BOARD DIAGNOSTIC [FW6A-EL, FW6AX-EL]

Item	Output part name	Unit/Condition	Operation condition
SS4_C	Shift solenoid No.4 target current	A	Under the following conditions: • Vehicle stopped • Idling at P or N position
SSLU_C	TCC control solenoid target current	A	Under the following conditions: • ATF temperature (PID: TFT) is 20 °C {68 °F} or more. • Output shaft rotation speed (PID: OSS) is 10 rpm or more. • Turbine shaft rotation speed (PID: TSS) is 1,000 rpm or more. • Brake pedal released
SSP_C	Pressure control solenoid target current	A	Idling at P or N position

05-02B ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [GW6A-EL, GW6AX-EL]

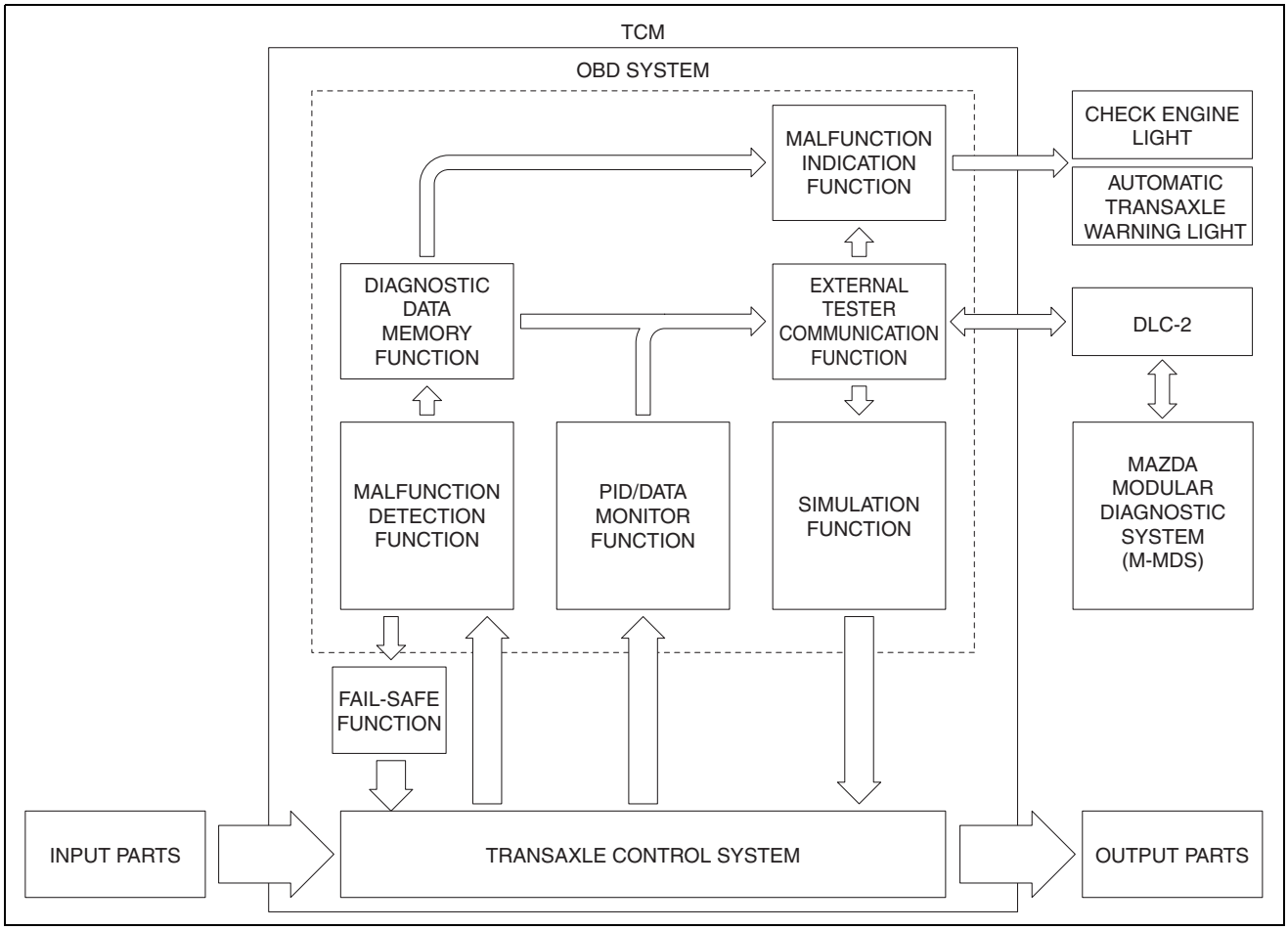
id050230280000

Purpose/Function

- An on-board diagnostic system has been adopted to improve serviceability.
- On-board diagnostic system adopted consisting of the following functions:
  - — Malfunction detection function
  - — Fail-safe function
  - — Diagnostic data memory function
  - — Malfunction indication function
    - Check engine light
    - Automatic transaxle warning light
  - — External tester communication function
    - DLC-2
    - CAN
  - — PID/DATA monitor function
  - — Simulation function

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

Construction/Operation
Block Diagram



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ON-BOARD DIAGNOSTIC SYSTEM MALFUNCTION DETECTION FUNCTION [GW6A-EL, GW6AX-EL]

id050230280100

Purpose/Function

- The malfunction diagnostic function detects transaxle malfunctions.
- Accurate and quick repair/service can be performed to facilitate malfunction cause determination using the malfunction detection function.

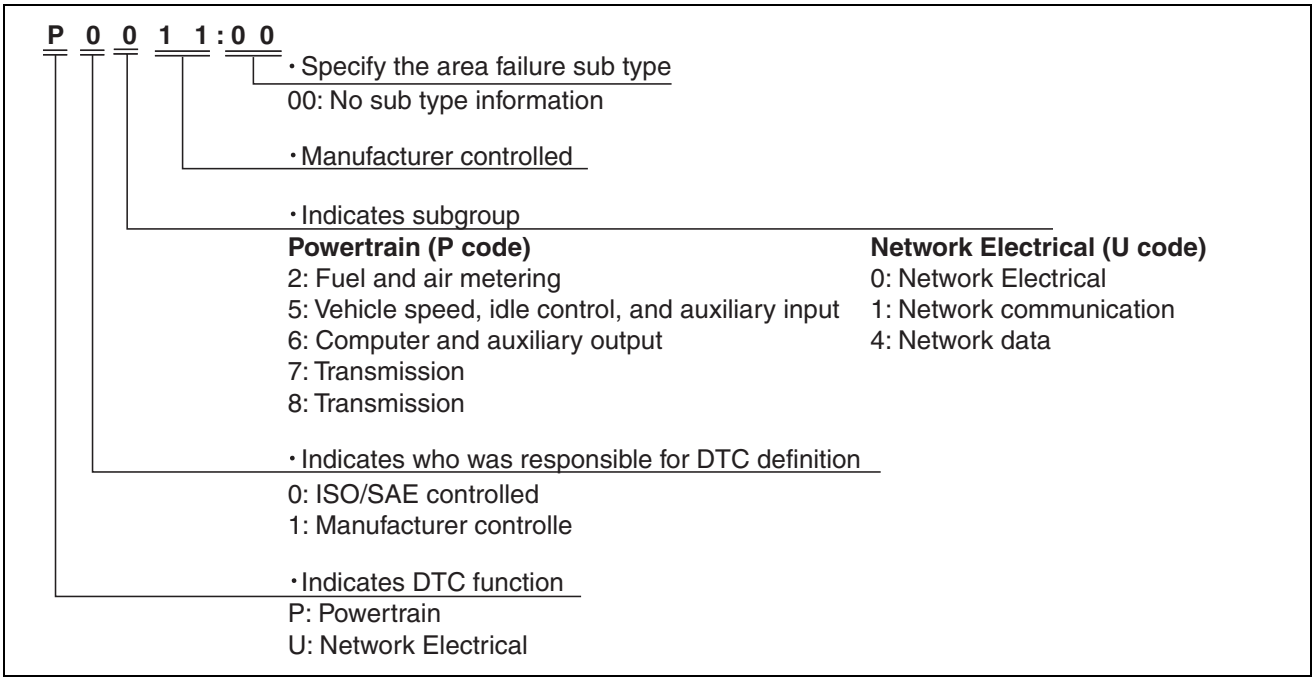
Construction/Operation

- If a malfunction occurs in the transaxle, it is recorded as a DTC. A DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



am3uun0000175

DTC table

×: Applicable
—: Not applicable

DTC No.	Check engine light	Automatic transaxle warning light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
P0218:00	Illuminate	Illuminate	Automatic transaxle protection control	×	1	C	×
P0500:00	Illuminate	—	Vehicle speed signal circuit malfunction	×	1	C	×
P0666:00	Illuminate	Illuminate	ECU internal temperature sensor circuit(s) malfunction	×	2	C	×
P0667:00	Illuminate	Illuminate	ECU internal temperature sensor two-range/performance problem	×	2	C	×
P06B8:00	Illuminate	—	NVRAM malfunction	—	1	C, O	×
P0706:00	Illuminate	Illuminate	Transaxle range sensor range/ performance problem	×	2	C	×
P0707:00	Illuminate	Illuminate	Transaxle range sensor circuit low input	×	1	C, O	×
P0708:00	Illuminate	Illuminate	Transaxle range sensor circuit high input	×	1	C, O	×
P0711:00	Illuminate	Illuminate	TFT sensor range/performance problem	×	2	C	×
P0712:00	Illuminate	Illuminate	TFT sensor circuit low input	×	1	C, O	×
P0713:00	Illuminate	Illuminate	TFT sensor circuit high input	×	2	C	×
P0716:00	Illuminate	Illuminate	Turbine/Input shaft speed sensor range/performance problem	×	1	C	×
P0717:00	Illuminate	Illuminate	Open circuit in turbine/input shaft speed sensor circuit	×	1	C	×
P0721:00	Illuminate	Illuminate	Output shaft speed sensor range/ performance problem	×	1	C	×

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Check engine light	Automatic transaxle warning light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
P0722:00	Illuminate	Illuminate	Open circuit in output shaft speed sensor circuit	×	1	C	×
P0729:00	—	—	6GR incorrect ratio	×	2	C	×
P0731:00	—	—	1GR incorrect ratio	×	2	C	×
P0732:00	—	—	2GR incorrect ratio	×	2	C	×
P0733:00	—	—	3GR incorrect ratio	×	2	C	×
P0734:00	—	—	4GR incorrect ratio	×	2	C	×
P0735:00	—	—	5GR incorrect ratio	×	2	C	×
P0736:00	—	Illuminate	Gear reverse incorrect ratio	×	2	C	×
P0741:00	Illuminate	Illuminate	TCC control solenoid stuck off	×	2	C	×
P0743:00	Illuminate	Illuminate	TCC control solenoid circuit malfunction	×	1	C, O	×
P0746:00	Illuminate	Illuminate	Pressure control solenoid stuck off	×	2	C	×
P0748:00	Illuminate	Illuminate	Pressure control solenoid circuit malfunction	×	1	C, O	×
P0751:00	Illuminate	Illuminate	Shift solenoid No.1 stuck off	×	2	C	×
P0752:00	Illuminate	Illuminate	Shift solenoid No.1 stuck on	×	2	C	×
P0753:00	Illuminate	Illuminate	Shift solenoid No.1 circuit malfunction	×	1	C, O	×
P0756:00	Illuminate	Illuminate	Shift solenoid No.2 stuck off	×	2	C	×
P0757:00	Illuminate	Illuminate	Shift solenoid No.2 stuck on	×	2	C	×
P0758:00	Illuminate	Illuminate	Shift solenoid No.2 circuit malfunction	×	1	C, O	×
P0761:00	Illuminate	Illuminate	Shift solenoid No.3 stuck off	×	2	C	×
P0762:00	Illuminate	Illuminate	Shift solenoid No.3 stuck on	×	2	C	×
P0763:00	Illuminate	Illuminate	Shift solenoid No.3 circuit malfunction	×	1	C, O	×
P0766:00	Illuminate	Illuminate	Shift solenoid No.4 stuck off	×	2	C	×
P0767:00	Illuminate	Illuminate	Shift solenoid No.4 stuck on	×	2	C	×
P0768:00	Illuminate	Illuminate	Shift solenoid No.4 circuit malfunction	×	1	C, O	×
P0771:00	Illuminate	Illuminate	On/off solenoid stuck off	×	2	C	×
P0772:00	Illuminate	Illuminate	On/off solenoid stuck on	×	2	C	×
P0773:00	Illuminate	Illuminate	On/off solenoid circuit malfunction	×	1	C, O	×
P0780:00	Illuminate	Illuminate	Gear shifting malfunction	×	2	C	×
P079A:00	Illuminate	Illuminate	Shift solenoid No.3 stuck off/On/off solenoid stuck on	×	2	C	×
P0819:00	—	—	M position switch/Up switch/Down switch signal error	×	1	C	×
P0842:00	Illuminate	Illuminate	Oil pressure switch No.1 stuck on	×	2	C	×
P0843:00	Illuminate	Illuminate	Oil pressure switch No.1 stuck off	×	2	C	×
P0847:00	Illuminate	Illuminate	Oil pressure switch No.2 stuck on	×	2	C	×
P0848:00	Illuminate	Illuminate	Oil pressure switch No.2 stuck off	×	2	C	×
P0872:00	Illuminate	Illuminate	Oil pressure switch No.3 stuck on	×	2	C	×
P0873:00	Illuminate	Illuminate	Oil pressure switch No.3 stuck off	×	2	C	×
P0877:00	Illuminate	Illuminate	Oil pressure switch No.4 stuck on	×	2	C	×
P0878:00	Illuminate	Illuminate	Oil pressure switch No.4 stuck off	×	2	C	×
P0882:00	Illuminate	—	TCM power supply voltage low	×	1	C	×
P0883:00	Illuminate	—	TCM power supply voltage high	×	1	C, O	×
P0C2C:00	—	—	Electric AT oil pump rotation malfunction	×	1	C	×
P1728:00	—	—	Clutch slippage	×	2	C	×
P1738:00	—	Illuminate	Automatic transaxle internal malfunction	×	2	C	×

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Check engine light	Automatic transaxle warning light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
P1784:00	—	Illuminate	Hi cut valve stuck off/R-3-5 cut valve stuck on	×	2	C	×
P181F:00	—	—	Electric AT oil pump/Electric AT oil pump relay circuit malfunction	×	1	C	×
P2530:00	—	—	Ignition switch: Stuck off	×	1	C, O	×
P2712:00	—	—	Oil pump shift valve stuck	×	1	C	×
U0073:00	—	—	CAN system communication error (HS CAN)	×	1	C, O	×
U0074:00	—	—	CAN system communication error (local CAN between TCM and PCM)	×	1	C, O	×
U0100:00	Illuminate	—	Communication error to PCM (HS CAN)	×	1	C, O	×
U0115:00	Illuminate	—	Communication error to PCM (local CAN between TCM and PCM)	×	1	C, O	×
U0121:00	Illuminate	—	Communication error to DSC HU/CM	×	1	C, O	×
U0141:00	—	—	Communication error to front body control module (FBCM)	×	1	C, O	×
U0155:00	Illuminate	—	Communication error to instrument cluster	×	1	C, O	×
U0442:00	—	—	Invalid data received from PCM (local CAN between TCM and PCM)	×	1	C, O	×

*1 : C: CMDTC self test, O: KOEO self test, R: KOER self test

DTC separate detection condition

DTC No.	Description	Detection condition
P0218:00	Automatic transaxle protection control	• Under the following conditions, the ATF temperature is **135 °C {275 °F} or more** for **10 s**: — Engine is running. — Battery voltage is **8 V or more**. — TFT sensor related DTC is not recorded.
P0500:00	Vehicle speed signal circuit malfunction	• Under the following conditions, the vehicle speed signal input from DSC HU/CM is incorrect for **10 s**: — Engine is running. — Battery voltage is **8 V or more**. — Vehicle speed is **16 km/h {9.9 mph} or more**. — There is no difference in speed between turbine/input shaft speed sensor and output shaft speed sensor.
P0666:00	ECU internal temperature sensor circuit(s) malfunction	• Under the following condition, there is malfunction in circuits of two or more ECU internal temperature sensors: — Battery voltage is **8 V or more**. • Under the following conditions, one ECU internal temperature sensor has malfunction, with difference in temperature between remaining two ECU internal temperature sensors being **10 °C {18 °F} or more**: — Battery voltage is **8 V or more**. — Soaked for **6 hours or more**.
P0667:00	ECU internal temperature sensor two-range/performance problem	• Under the following conditions, the difference between ECU internal temperatures of three ECU internal temperature sensors is **10 °C {18 °F} or more**: — Engine is running. — Battery voltage is **8 V or more**. — Soaked for **6 hours or more**. — No malfunction in ECU internal temperature sensor circuit
P06B8:00	NVRAM malfunction	• Under the following condition, TCM internal NVRAM data retention/read/write disabled: — Battery voltage is **8 V or more**.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Detection condition
P0706:00	Transaxle range sensor range/ performance problem	• Under the following condition, pattern identification error in switch condition of transaxle range sensors 1 to 4: — Battery voltage is **8 V or more**.
P0707:00	Transaxle range sensor circuit low input	• Under the following condition, incorrect voltage in any of transaxle range sensors 1 to 4: — Battery voltage is **8 V or more**.
P0708:00	Transaxle range sensor circuit high input	• Under the following condition, incorrect voltage in any of transaxle range sensors 1 to 4: — Battery voltage is **8 V or more**.
P0711:00	TFT sensor range/performance problem	• Under the following conditions, the ATF temperature is **40 °C {104 °F} or less**: — Certain period has elapsed since engine start. — Battery voltage is **8 V or more**. — ECU internal temperature sensor related DTC is not recorded. — Soaked for **6 hours or more**. — ECU internal temperature increases above specified temperature.
P0712:00	TFT sensor circuit low input	• Under the following condition, the TFT sensor voltage is **0.12 V or less** for **5 s**: — Battery voltage is **8 V or more**.
P0713:00	TFT sensor circuit high input	• Under the following conditions, the ATF temperature is **–40 °C {–40 °F} or less** for **5 s**: — Battery voltage is **8 V or more**. — IAT is **–25 °C {–13 °F} or more**. — IAT sensor related DTC is not recorded.
P0716:00	Turbine/Input shaft speed sensor range/performance problem	• Under the following conditions, the turbine/input shaft speed is **9,000 rpm or more** for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. — Engine speed is **7,500 rpm or less**.
P0717:00	Open circuit in turbine/input shaft speed sensor circuit	• Under the following conditions, the turbine/input shaft speed sensor signal is not input for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. — Vehicle speed signal related DTC is not recorded. — Vehicle speed is **16 km/h {9.9 mph} or more**. — There is no difference between vehicle speed signal from DSC HU/CM and output shaft speed sensor signal. — DTC U0121:00 is not recorded.
P0721:00	Output shaft speed sensor range/ performance problem	• Under the following conditions, the output shaft speed is **13,560 rpm or more** for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. • Under the following conditions, the vehicle speed signal from the DSC HU/CM and the output shaft speed sensor signal differ by **520 rpm or more** for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. — Vehicle speed signal related DTC is not recorded. — Vehicle speed is **16 km/h {9.9 mph} or more**. — Vehicle speed signal from DSC HU/CM and turbine/input shaft speed sensor signal do not differ. — Output shaft speed sensor signal is input. — Output shaft speed is **13,560 rpm or less**.
P0722:00	Open circuit in output shaft speed sensor circuit	• Under the following conditions, the output shaft speed sensor signal is not input for **1 s**: — Engine is running. — Battery voltage is **10 V or more**. — Vehicle speed signal related DTC is not recorded. — Vehicle speed is **16 km/h {9.9 mph} or more**. — There is no difference between vehicle speed signal from DSC HU/CM and output shaft speed sensor signal. — DTC U0121:00 is not recorded.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Detection condition
P0729:00	6GR incorrect ratio	• In D position, 6GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0731:00	1GR incorrect ratio	• In D position, 1GR, the following phenomenon occurs: — Speed ratio is **0.75 to 1.2** for **2,000 ms** while vehicle is stopped in D position. — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0732:00	2GR incorrect ratio	• In D position, 2GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0733:00	3GR incorrect ratio	• In D position, 3GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0734:00	4GR incorrect ratio	• In D position, 4GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0735:00	5GR incorrect ratio	• In D position, 5GR, the following phenomenon occurs: — Engine speed and turbine/input shaft speed deviates by **600 rpm** for **230 to 1,980 ms** (varies with ATF temperature and ECT) during shift-up. — Engine speed and turbine/input shaft speed deviates by **300 rpm** for **1,500 to 3,900 ms** (varies with ATF temperature) while driving without shifting.
P0736:00	Gear reverse incorrect ratio	• Speed ratio is **0.75 to 1.2** for **2,000 ms** while vehicle is stopped in R position.
P0741:00	TCC control solenoid stuck off	• Under the following conditions, difference in slip amount **over 5 s** compared to target slip amount is **200 rpm or more**, and TCC feedback hydraulic pressure is **200 kPa {2.04 kgf/cm^2, 29.0 psi} or more** occurs: — Battery voltage is **8 V or more**. — Selector lever position is D position. — No electrical malfunction in TCC control solenoid — During TCC or TCC feedback — DTC P0716:00 and P0717:00 are not recorded.
P0743:00	TCC control solenoid circuit malfunction	• Under the following condition, the TCM detects the TCC control solenoid circuit malfunction: — Battery voltage is **8 V or more**.
P0746:00	Pressure control solenoid stuck off	• Under the following conditions, pressure control solenoid stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0748:00	Pressure control solenoid circuit malfunction	• Under the following condition, the TCM detects the pressure control solenoid circuit malfunction: — Battery voltage is **8 V or more**.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Detection condition
P0751:00	Shift solenoid No.1 stuck off	• Under the following conditions, shift solenoid No.1 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0752:00	Shift solenoid No.1 stuck on	• Under the following conditions, shift solenoid No.1 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0753:00	Shift solenoid No.1 circuit malfunction	• Under the following condition, the TCM detects the shift solenoid No.1 circuit malfunction: — Battery voltage is **8 V or more**.
P0756:00	Shift solenoid No.2 stuck off	• Under the following conditions, shift solenoid No.2 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0757:00	Shift solenoid No.2 stuck on	• Under the following conditions, shift solenoid No.2 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0758:00	Shift solenoid No.2 circuit malfunction	• Under the following condition, the TCM detects the shift solenoid No.2 circuit malfunction: — Battery voltage is **8 V or more**.
P0761:00	Shift solenoid No.3 stuck off	• Under the following conditions, shift solenoid No.3 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0762:00	Shift solenoid No.3 stuck on	• Under the following conditions, shift solenoid No.3 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0763:00	Shift solenoid No.3 circuit malfunction	• Under the following condition, the TCM detects the shift solenoid No.3 circuit malfunction: — Battery voltage is **8 V or more**.
P0766:00	Shift solenoid No.4 stuck off	• Under the following conditions, shift solenoid No.4 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0767:00	Shift solenoid No.4 stuck on	• Under the following conditions, shift solenoid No.4 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0768:00	Shift solenoid No.4 circuit malfunction	• Under the following condition, the TCM detects the shift solenoid No.4 circuit malfunction: — Battery voltage is **8 V or more**.
P0771:00	On/off solenoid stuck off	• Under the following conditions, on/off solenoid stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Detection condition
P0772:00	On/off solenoid stuck on	• Under the following conditions, on/off solenoid stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0773:00	On/off solenoid circuit malfunction	• Under the following condition, the TCM detects the on/off solenoid circuit malfunction: — Battery voltage is **8 V or more**.
P0780:00	Gear shifting malfunction	• Under the following conditions, the gear shifting inhibited: — Engine is running. — Battery voltage is **8 V or more**.
P079A:00	Shift solenoid No.3 stuck off/On/ off solenoid stuck on	• Under the following conditions, shift solenoid No.3 stuck-off or on/off solenoid stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0819:00	M position switch/Up switch/Down switch signal error	• Under the following conditions, any of (1) to (4) conditions occurs for **1 s**: — Engine is running. — Battery voltage is **8 V or more**. — Transaxle range sensor related DTC is not recorded. (1) M position switch signal is on even though forward oil pressure switch is on in any position other than D position. (2) M position switch signal is off even though up or down switch signal is on in D position. (3) Up switch signal is on even though M position switch signal is off in any position other than D position. (4) Down switch signal is on even though M position switch signal is off in any position other than D position.
P0842:00	Oil pressure switch No.1 stuck on	• Under the following conditions, oil pressure switch No.1 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0843:00	Oil pressure switch No.1 stuck off	• Under the following conditions, oil pressure switch No.1 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0847:00	Oil pressure switch No.2 stuck on	• Under the following conditions, oil pressure switch No.2 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0848:00	Oil pressure switch No.2 stuck off	• Under the following conditions, oil pressure switch No.2 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0872:00	Oil pressure switch No.3 stuck on	• Under the following conditions, oil pressure switch No.3 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0873:00	Oil pressure switch No.3 stuck off	• Under the following conditions, oil pressure switch No.3 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

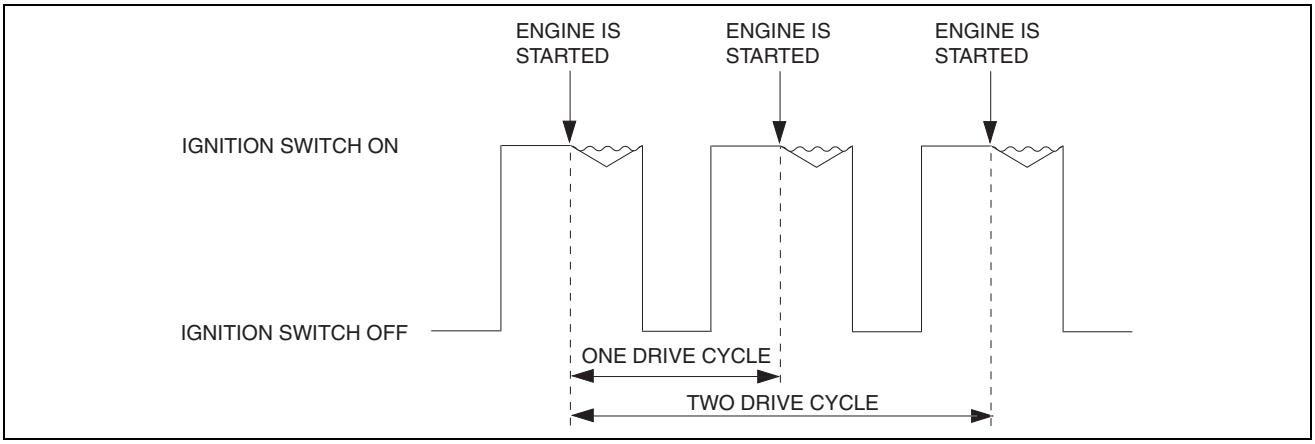
DTC No.	Description	Detection condition
P0877:00	Oil pressure switch No.4 stuck on	• Under the following conditions, oil pressure switch No.4 stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0878:00	Oil pressure switch No.4 stuck off	• Under the following conditions, oil pressure switch No.4 stuck-off detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P0882:00	TCM power supply voltage low	• Under the following conditions, the TCM power supply voltage is **8—10.5 V or less** (varies with ATF temperature): — **5 s or more** has elapsed or battery voltage exceeds **11 V or more** for **0.2 s** since engine speed increases –**200 rpm or more** of target idle speed. — Selector lever position is D or R position.
P0883:00	TCM power supply voltage high	• TCM power supply voltage is **18 V or more** for **5 s**.
P0C2C:00	Electric AT oil pump rotation malfunction	• The actual electric AT oil pump rotation speed under the following conditions is **100 rpm or less** for a continuous **10 s**: — Electric AT oil pump rotation speed command value is **500 rpm or more**. — Electric AT oil pump relay is ON. — DTC P181F:00 is not recorded.
P1728:00	Clutch slippage	• Under the following conditions, turbine/input shaft speed suddenly increases **300 rpm or more** for **1,450 ms**: — Engine is running. — Battery voltage is **8 V or more**. — Vehicle speed is **5 km/h {3 mph} or more**. — There is no difference between vehicle speed signal from DSC HU/CM and output shaft speed sensor signal. — Not shifting — Selector lever position is D position. — Turbine/Input shaft speed is **1,200 rpm or more**. — Oil pressure switch pattern (1st—6th) is normal.
P1738:00	Automatic transaxle internal malfunction	• Malfunction location cannot be determined based on combination of gear ratio malfunction and oil pressure switch pattern malfunction.
P1784:00	Hi cut valve stuck off/R-3-5 cut valve stuck on	• Under the following conditions, hi cut valve stuck-off or R-3-5 cut valve stuck-on detected by combination of gear ratio malfunction and oil pressure switch pattern malfunction: — Engine is running. — Battery voltage is **8 V or more**. — ATF temperature is **20 °C {68 °F} or more**.
P181F:00	Electric AT oil pump/Electric AT oil pump relay circuit malfunction	• If the TCM detects any of the following conditions for a continuous **5 s**: — Electric AT oil pump circuit has a malfunction. — Electric AT oil pump relay circuit has a malfunction.
P2530:00	Ignition switch stuck off	• If the IG ON time count of the instrument cluster proceeds **5 s** under the following condition: — Ignition switch signal off
P2712:00	Oil pump shift valve stuck	• Under the following conditions, oil pressure switch No.1 OFF output continues for **10 s**: — DTC P0753:00, P0C2C:00 and P181F:00 are not recorded. — During i-stop operation — Selector lever position is D or N position. — During electric AT oil pump operation — Oil pressure switch, low clutch and transaxle range sensor are normal. — Rate of speed change normal
U0073:00	CAN system communication error (HS CAN)	• Under the following condition, a communication error (HS CAN) occurs: — Battery voltage is **10 V or more**.
U0074:00	CAN system communication error (local CAN between TCM and PCM)	• Under the following condition, a communication error (local CAN between TCM and PCM) occurs: — Battery voltage is **10 V or more**.
U0100:00	Communication error to PCM (HS CAN)	• Under the following condition, the TCM cannot receive the signal from PCM (HS CAN): — Battery voltage is **10 V or more**.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Detection condition
U0115:00	Communication error to PCM (local CAN between TCM and PCM)	• Under the following condition, the TCM cannot receive the signal from PCM (local CAN between TCM and PCM): — Battery voltage is **10 V or more**.
U0121:00	Communication error to DSC HU/CM	• Under the following condition, the TCM cannot receive the signal from DSC HU/CM: — Battery voltage is **10 V or more**.
U0141:00	Communication error to front body control module (FBCM)	• Under the following condition, the TCM cannot receive the signal from front body control module (FBCM): — Battery voltage is **10 V or more**.
U0155:00	Communication error to instrument cluster	• Under the following condition, the TCM cannot receive the signal from instrument cluster: — Battery voltage is **10 V or more**.
U0442:00	Invalid data received from PCM (local CAN between TCM and PCM)	• Under the following condition, the TCM detects the invalid PCM signal for **0.5 s**: — Battery voltage is **10 V or more**.

Drive cycle

- The drive cycle is the period of time from when the engine is started to the next time the engine is started.
- One drive cycle, as shown in the figure, indicates the period from the time engine is started to the next time the engine is started. If this period is repeated twice it then becomes two drive cycles.



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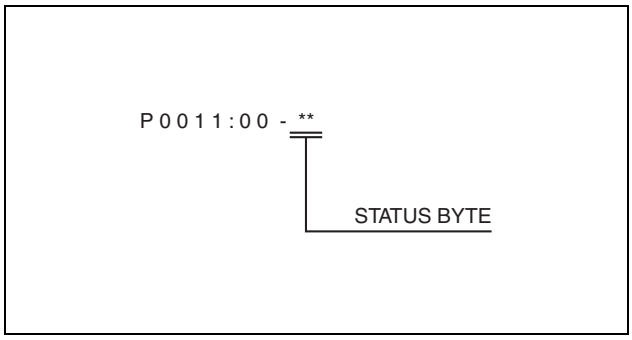
- To detect DTCs, a required number of drive cycles for pre-detection has been set. For the number of drive cycles required for detection, refer to the DTC table.

Pending code

- The pending code is temporary malfunction code which differs from DTCs which are recorded when the TCM detects a transaxle malfunction.
- DTCs are recorded in the TCM according to the number of drive cycles when the TCM detects a transaxle malfunction. At the same time, pending code is recorded in the TCM regardless of the number of drive cycles.
- Pending code recorded in the TCM is erased from the TCM, from the next drive cycle, when the TCM determines that the transaxle is normal.

Status byte for DTC

- The status byte is the two-digit code (two digits after hyphen (-)) after the DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self test using the M-MDS.
- For details on the status byte, refer to the explanation on the M-MDS when reading the DTC.



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ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

Self-test function

- When the self-test is implemented, the TCM performs diagnosis of the transaxle control system. If a malfunction is detected with the results of the diagnosis, an applicable DTC is recorded. A recorded DTC can be read by the M-MDS.
- By implementing the self-test function, verification of the current malfunction and verification after repair is facilitated.

CMDTC (Continuous Memory Diagnostic Trouble Code) self-test

- The CMDTC self-test is a function which reads all DTCs recorded in the TCM after the previous DTCs are erased no matter whether they are past malfunctions or current malfunctions.

KOEO (Key On Engine Off) self-test

- The KOEO self-test can perform malfunction diagnosis of DTCs corresponding to this self-test function when the ignition is switched ON and the engine is stopped. This self-test implements based on the test implementation command signal sent to the TCM from the M-MDS.

Freeze frame data/Snapshot data

Freeze frame data

- The freeze frame data consists of data for vehicle and transaxle control system operation conditions when malfunctions in the transaxle control system are detected and stored in the TCM.
- Freeze frame data is stored at the instant the malfunction indicator lamp illuminates, and only a part of the DTC data is stored.

Snapshot data

- The data for all DTCs currently detected is stored.
  Recorded DTC timing
  — For DTCs with one drive cycle, data is recorded during the malfunction determination period.
  — For DTCs with two drive cycles, data is recorded during non-determination (1st diagnosis) periods.

Freeze frame data item table

—: Not applicable

Freeze frame data item	Unit	Description	Corresponding PID/DATA monitor item
LOAD	%	Calculated engine load	—
ECT	°C {°F}	Engine coolant temperature	ECT
RPM	RPM	Engine speed	RPM
VS	KPH {MPH}	Vehicle speed	VSS
IAT	°C {°F}	Intake air temperature	—
TP	%	Throttle valve position No.1	TP
RUNTM	hh:mm:ss	Time from engine start	—
VPWR	V	Module supply voltage	VPWR
APP_D	%	Accelerator pedal position No.1	—

Snapshot data item table

—: Not applicable

Snapshot data item	Unit	Description	Corresponding PID/DATA monitor item
LOAD	%	Calculated engine load	—
ECT	°C {°F}	Engine coolant temperature	ECT
RPM	RPM	Engine speed	RPM
VSS	KPH {MPH}	Vehicle speed	VSS
IAT	°C {°F}	Intake air temperature	—
EG_RUN_TIME	—	Time from engine start	—
VPWR	V	Module supply voltage	VPWR
APP1	%	Accelerator pedal position No.1	—
GEAR_SEL	1/2/3/4/5/6	Gear shift position	GEAR_SEL
TSS	RPM	Turbine/input shaft speed	TSS
TFT	°C {°F}	ATF temperature	TFT
OSS	RPM	Output shaft speed	OSS
LOCK_UP	Off/SLIP/On	Torque converter (TCC condition)	LOCK_UP
OIL_PRES_SW2	Off/On	Oil pressure switch No.2 condition	OP_SW2
OIL_PRES_SW1	Off/On	Oil pressure switch No.1 condition	OP_SW1
SS_ON_OFF	Off/On	On/off solenoid condition	SS_ON-OFF

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

Snapshot data item	Unit	Description	Corresponding PID/DATA monitor item
TORQUE_DES	Nm	Desired engine torque	TORQUE_DES
APP	%	Accelerator pedal position No.1	—
G_INHIBIT_6	Off/On	6GR is inhibited due to malfunction.	—
G_INHIBIT_5	Off/On	5GR is inhibited due to malfunction.	—
G_INHIBIT_4	Off/On	4GR is inhibited due to malfunction.	—
G_INHIBIT_3	Off/On	3GR is inhibited due to malfunction.	—
G_INHIBIT_2	Off/On	2GR is inhibited due to malfunction.	—
G_INHIBIT_1	Off/On	1GR is inhibited due to malfunction.	—
G_INHIBIT_R	Off/On	R position is inhibited due to malfunction.	—
G_INHIBIT_N	Off/On	N position is inhibited due to malfunction.	—
OIL_PRES_SW4	Off/On	Oil pressure switch No.4 condition	OP_SW4
OIL_PRES_SW3	Off/On	Oil pressure switch No.3 condition	OP_SW3
EOP_RLY	Off/On	Electric AT oil pump relay condition	EOP_RLY
SHIFT_CTRL	DEFAULT/ MANUAL/ C_CONTROL/ HIGH_TEMP/ D_MANUAL/ FAIL_SAFE	Shift control mode	SHIFT_CTRL
SLIP_VALUE	RPM	Actual slip value between TSS and OSS	—
HTM_DIS	km {mile}	Travel distance since determination of ATF high temperature mode	HTM_DIS

ON-BOARD DIAGNOSTIC SYSTEM FAIL-SAFE FUNCTION [GW6A-EL, GW6AX-EL]

id050230280200

Purpose/Function

- If a transaxle malfunction is detected by the malfunction detection function, the fail-safe function limits the transaxle control.
- Even if the transaxle has a malfunction, the fail-safe function assures the minimum vehicle driveability.

Construction/Operation

DTC separate fail-safe function

—: Not applicable

DTC No.	Description	Fail-safe function
P0218:00	Automatic transaxle protection control	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0500:00	Vehicle speed signal circuit malfunction	• Inhibits learning control. • Inhibits neutral idle control. • Inhibits AAS.
P0666:00	ECU internal temperature sensor circuit(s) malfunction	• Inhibits learning control. • Inhibits neutral idle control.
P0667:00	ECU internal temperature sensor two-range/performance problem	• Inhibits learning control. • Inhibits neutral idle control.
P06B8:00	NVRAM malfunction	—
P0706:00	Transaxle range sensor range/ performance problem	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0707:00	Transaxle range sensor circuit low input	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0708:00	Transaxle range sensor circuit high input	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Fail-safe function
P0711:00	TFT sensor range/performance problem	• Inhibits learning control. • Inhibits neutral idle control.
P0712:00	TFT sensor circuit low input	• Inhibits learning control. • Inhibits neutral idle control.
P0713:00	TFT sensor circuit high input	• Inhibits learning control. • Inhibits neutral idle control.
P0716:00	Turbine/Input shaft speed sensor range/performance problem	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.
P0717:00	Open circuit in turbine/input shaft speed sensor circuit	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.
P0721:00	Output shaft speed sensor range/ performance problem	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0722:00	Open circuit in output shaft speed sensor circuit	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0729:00	6GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0731:00	1GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0732:00	2GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0733:00	3GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0734:00	4GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0735:00	5GR incorrect ratio	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0736:00	Gear reverse incorrect ratio	• Inhibits learning control. • Inhibits neutral idle control.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Fail-safe function
P0741:00	TCC control solenoid stuck off	• Inhibits TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0743:00	TCC control solenoid circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0746:00	Pressure control solenoid stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0748:00	Pressure control solenoid circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0751:00	Shift solenoid No.1 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0752:00	Shift solenoid No.1 stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0753:00	Shift solenoid No.1 circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0756:00	Shift solenoid No.2 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0757:00	Shift solenoid No.2 stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0758:00	Shift solenoid No.2 circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0761:00	Shift solenoid No.3 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0762:00	Shift solenoid No.3 stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Fail-safe function
P0763:00	Shift solenoid No.3 circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0766:00	Shift solenoid No.4 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0767:00	Shift solenoid No.4 stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0768:00	Shift solenoid No.4 circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0771:00	On/off solenoid stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0772:00	On/off solenoid stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0773:00	On/off solenoid circuit malfunction	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0780:00	Gear shifting malfunction	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P079A:00	Shift solenoid No.3 stuck off/On/ off solenoid stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0819:00	M position switch/Up switch/Down switch signal error	• Inhibits manual mode.
P0842:00	Oil pressure switch No.1 stuck on	• Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0843:00	Oil pressure switch No.1 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0847:00	Oil pressure switch No.2 stuck on	• Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Fail-safe function
P0848:00	Oil pressure switch No.2 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0872:00	Oil pressure switch No.3 stuck on	• Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0873:00	Oil pressure switch No.3 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0877:00	Oil pressure switch No.4 stuck on	• Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0878:00	Oil pressure switch No.4 stuck off	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0882:00	TCM power supply voltage low	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0883:00	TCM power supply voltage high	• Set to emergency mode. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P0C2C:00	Electric AT oil pump rotation malfunction	• Inhibits i-stop control.
P1728:00	Clutch slippage	• Inhibits malfunctioning gear. • Limits engine torque. • Maximizes the line pressure. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P1738:00	Automatic transaxle internal malfunction	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS.
P1784:00	Hi cut valve stuck off/R-3-5 cut valve stuck on	• Inhibits malfunctioning gear. • Limits engine torque. • Inhibits learning control. • Inhibits neutral idle control.
P181F:00	Electric AT oil pump/Electric AT oil pump relay circuit malfunction	• Inhibits i-stop control.
P2530:00	Ignition switch stuck off	—
P2712:00	Oil pump shift valve stuck	• Inhibits i-stop control.
U0073:00	CAN system communication error (HS CAN)	• Inhibits learning control. • Inhibits neutral idle control. • Inhibits AAS.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

DTC No.	Description	Fail-safe function
U0074:00	CAN system communication error (local CAN between TCM and PCM)	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.
U0100:00	Communication error to PCM (HS CAN)	• Inhibits learning control. • Inhibits neutral idle control. • Inhibits AAS.
U0115:00	Communication error to PCM (local CAN between TCM and PCM)	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits AAS. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.
U0121:00	Communication error to DSC HU/CM	• Inhibits learning control. • Inhibits neutral idle control. • Inhibits AAS.
U0141:00	Communication error to front body control module (FBCM)	• Inhibits learning control. • Inhibits neutral idle control.
U0155:00	Communication error to instrument cluster	• Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control.
U0442:00	Invalid data received from PCM (local CAN between TCM and PCM)	• Set to TCC control. • Inhibits learning control. • Inhibits manual mode. • Inhibits neutral idle control. • Inhibits 5GR and 6GR. • Inhibits shift down when the accelerator pedal is depressed.

Emergency mode
- The emergency mode is a control for preventing transaxle damage or vehicle inoperability.
- If these modes are set, the TCM output is inhibited. Therefore, all solenoids are turned off and the following conditions occur:
  - — When the accelerator pedal is depressed, the engine speed is higher than normal.
  - — When N to D position and N to R position are selected, the shift shock is greater than during normal shifting.

Neutral idle control
- System which automatically switches the transaxle to neutral internally while the vehicle is stopped in the D position.

ON-BOARD DIAGNOSTIC SYSTEM DIAGNOSTIC DATA MEMORY FUNCTION [GW6A-EL, GW6AX-EL]

id050230280300

Purpose/Function
- The on-board diagnostic system diagnostic data memory function records/erases the following diagnostic data:
  - — Number of DTCs
  - — DTCs
  - — Pending code
- Determination of a malfunction cause is facilitated by the on-board diagnostic system data memory function. Therefore, accurate and quick repair/service can be performed.

Construction/Operation
- The conditions for recording/erasing diagnostic data are determined by the number of drive cycles set for each DTC.
- Using the memory deletion function of the M-MDS, diagnostic data can be deleted.

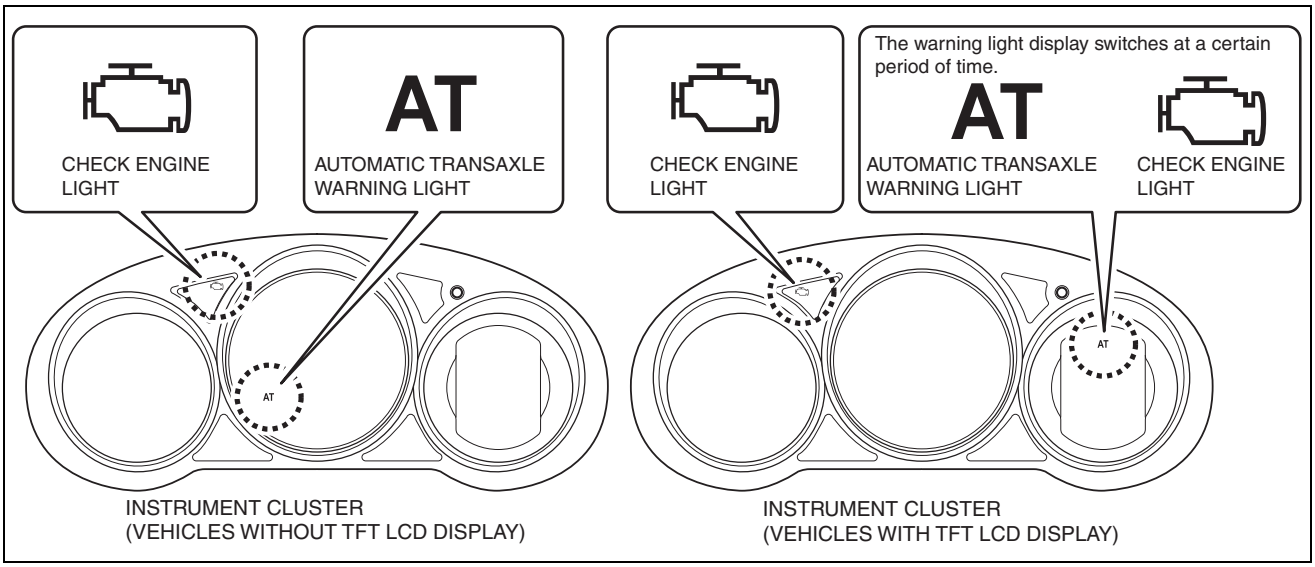
ON-BOARD DIAGNOSTIC SYSTEM MALFUNCTION INDICATION FUNCTION [GW6A-EL, GW6AX-EL]

id050230280400

Purpose/Function
- The on-board diagnostic system malfunction indication function notifies the driver of a transaxle malfunction.
- The malfunction indication function notifies the driver of a transaxle malfunction by illuminating the check engine light and automatic transaxle warning light.

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

Construction/Operation



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ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION [GW6A-EL, GW6AX-EL]

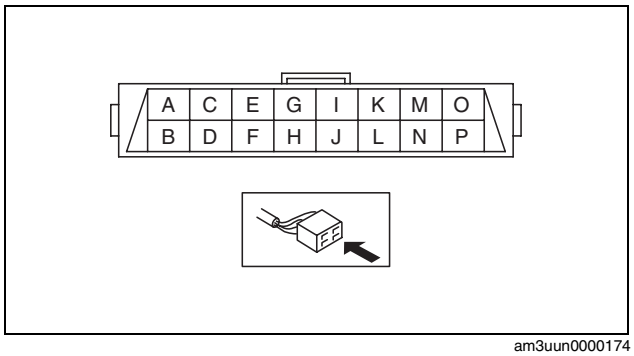
id050230280500

Purpose/Function

- The on-board diagnostic system external tester communication function transmits data between an external tester and each control module of the vehicle.
- Because the DTCs recorded in the vehicle can be read by an external tester, determination of a malfunction location is facilitated.

Construction/Operation

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been adopted.
- A connector shape and 16-pin terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this DLC-2.



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Terminal	Function
A	Battery positive voltage
B	AFS control module (Vehicle with headlight auto leveling system)
C	SAS control module
D	—
E	HS CAN communication line Lo
F	HS CAN communication line Hi
G	—
H	Serial communication ground
I	—
J	Body ground
K	MS CAN communication line Lo
L	MS CAN communication line Hi
M	—
N	—
O	—
P	—

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [GW6A-EL, GW6AX-EL]

id050230280600

Purpose/Function

- The PID/DATA monitor function can monitor control data such as input signals/internal calculation values/output signals using the M-MDS.
- The module control condition can be verified in real-time by the PID/DATA monitor function.

Construction/Operation

PID/DATA monitor item table

—: Not applicable

Item	Unit/Condition	Definition
DGP_DIS_1	km {mile}	Traveled distance after differential protection control operated
DGP_DIS_2	km {mile}	Traveled distance after DGP_MAX_DIF updated
DGP_MAX_DIF	RPM	Maximum rotation difference after differential protection control operated due to excessive rotation difference between left/right drive wheels
DGP_SPD	KPH {MPH}	Vehicle speed with trailing wheels after differential protection control operated due to excessive rotation difference between left/right drive wheels
ECT	°C {°F}	Engine coolant temperature
ECU_A	°C {°F}	ECU internal temperature A
ECU_B	°C {°F}	ECU internal temperature B
ECU_C	°C {°F}	ECU internal temperature C
EOP_DUTY	%	Electric AT oil pump duty cycle
EOP_RLY	Off/On	Electric AT oil pump relay condition
GEAR_RA	Ratio	Gear ratio
GEAR_SEL	1/2/3/4/5/6	Gear shift position
HI_TEMP	—	ATF high temperature mode determination amount
HTM_CNT	—	ATF high temperature mode counter
HTM_DIS	km {mile}	Travel distance since determination of ATF high temperature mode
LINEDES	kPa {kgf/cm^2, psi}	Target modifier pressure/Target pressure control solenoid pressure
LN_C_CLUTCH	kPa {kgf/cm^2, psi}	Hydraulic control learning value (engaged)
LN_O_CLUTCH	kPa {kgf/cm^2, psi}	Hydraulic control learning value (released)
LN_OV_SCOPE	—	Hydraulic control learning value (mis-learning)
LN_T_CLUTCH	kPa {kgf/cm^2, psi}	Hydraulic control learning value (torque converter)
LOCK_UP	OFF/SLIP/ON	Torque converter (TCC condition)
LONGI_ACCEL	—	Longitudinal acceleration
OP_SW1	Off/On	Oil pressure switch No.1 condition
OP_SW1_OFF	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW1_ON	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW2	Off/On	Oil pressure switch No.2 condition
OP_SW2_OFF	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW2_ON	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW3	Off/On	Oil pressure switch No.3 condition
OP_SW3_OFF	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW3_ON	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW4	Off/On	Oil pressure switch No.4 condition
OP_SW4_OFF	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OP_SW4_ON	kPa {kgf/cm^2, psi}	After performing on-board diagnostic test mode
OSS	RPM	Output shaft speed
PUMP_SPEED	RPM	Motor pump unit actual speed
RPM	RPM	Engine speed/min
SHIFT_CTRL	DEFAULT/ MANUAL/ C_CONTROL/ HIGH_TEMP/ D_MANUAL/ FAIL_SAFE	Shift control mode
SS_ON-OFF	Off/On	On/off solenoid condition

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

Item	Unit/Condition	Definition
SS1	A	Shift solenoid No.1 actual current
SS1_C	A	Shift solenoid No.1 target current
SS2	A	Shift solenoid No.2 actual current
SS2_C	A	Shift solenoid No.2 target current
SS3	A	Shift solenoid No.3 actual current
SS3_C	A	Shift solenoid No.3 target current
SS4	A	Shift solenoid No.4 actual current
SS4_C	A	Shift solenoid No.4 target current
SSLU	A	TCC control solenoid actual current
SSLU_C	A	TCC control solenoid target current
SSLU_PRES	kPa {kgf/cm^2, psi}	TCC control solenoid target pressure
SSP	A	Pressure control solenoid actual current
SSP_C	A	Pressure control solenoid target current
SSP_PRES	kPa {kgf/cm^2, psi}	Pressure control solenoid target pressure
TFT	°C {°F}	ATF temperature
THOP	%	Throttle opening angle
TORQUE_ACT	Nm	Actual engine torque
TORQUE_DES	Nm	Desired engine torque
TR	P/SHIFT_DOWN/ SHIFT_UP/M/D/N/ R	Range position
TSS	RPM	Turbine/input shaft speed
UPSHIFT_REV	Off/On	Shift-up record due to engine request
VPWR	V	TCM power supply voltage
VSS	KPH {MPH}	Vehicle speed

ON-BOARD DIAGNOSTIC SYSTEM SIMULATION FUNCTION [GW6A-EL, GW6AX-EL]

id050230280700

Purpose/Function

- The simulation function can drive output parts based on use of the M-MDS.
- Inspection of an individual output part is facilitated by the simulation function because the output part is driven forcibly.

Construction/Operation

Simulation item table

Item	Output part name	Unit/Condition	Operation condition
EOP	Electric AT oil pump condition	Off/On	Under the following conditions: • Vehicle stopped • Accelerator pedal fully closed
EOP_DUTY	Electric AT oil pump duty cycle	%	Under the following conditions: • Vehicle stopped • Accelerator pedal fully closed
EOP_RLY	Electric AT oil pump relay condition	Off/On	Under the following conditions: • Vehicle stopped • Accelerator pedal fully closed
SS_ON-OFF	On/off solenoid condition	Off/On	Under the following conditions: • Vehicle stopped • Idling at P or N position
SS1_C	Shift solenoid No.1 target current	A	Under the following conditions: • Vehicle stopped • Idling at P or N position
SS2_C	Shift solenoid No.2 target current	A	Under the following conditions: • Vehicle stopped • Idling at P or N position
SS3_C	Shift solenoid No.3 target current	A	Under the following conditions: • Vehicle stopped • Idling at P or N position

ON-BOARD DIAGNOSTIC [GW6A-EL, GW6AX-EL]

Item	Output part name	Unit/Condition	Operation condition
SS4_C	Shift solenoid No.4 target current	A	Under the following conditions: • Vehicle stopped • Idling at P or N position
SSLU_C	TCC control solenoid target current	A	Under the following conditions: • ATF temperature (PID: TFT) is 20 °C {68 °F} or more. • Output shaft rotation speed (PID: OSS) is 10 rpm or more. • Turbine shaft rotation speed (PID: TSS) is 1,000 rpm or more. • Brake pedal released
SSP_C	Pressure control solenoid target current	A	Idling at P or N position

05-10A CLUTCH [C66M-R, C66MX-R]

CLUTCH [C66M-R, C66MX-R]

CLUTCH [C66M-R, C66MX-R]

id0510mc283600

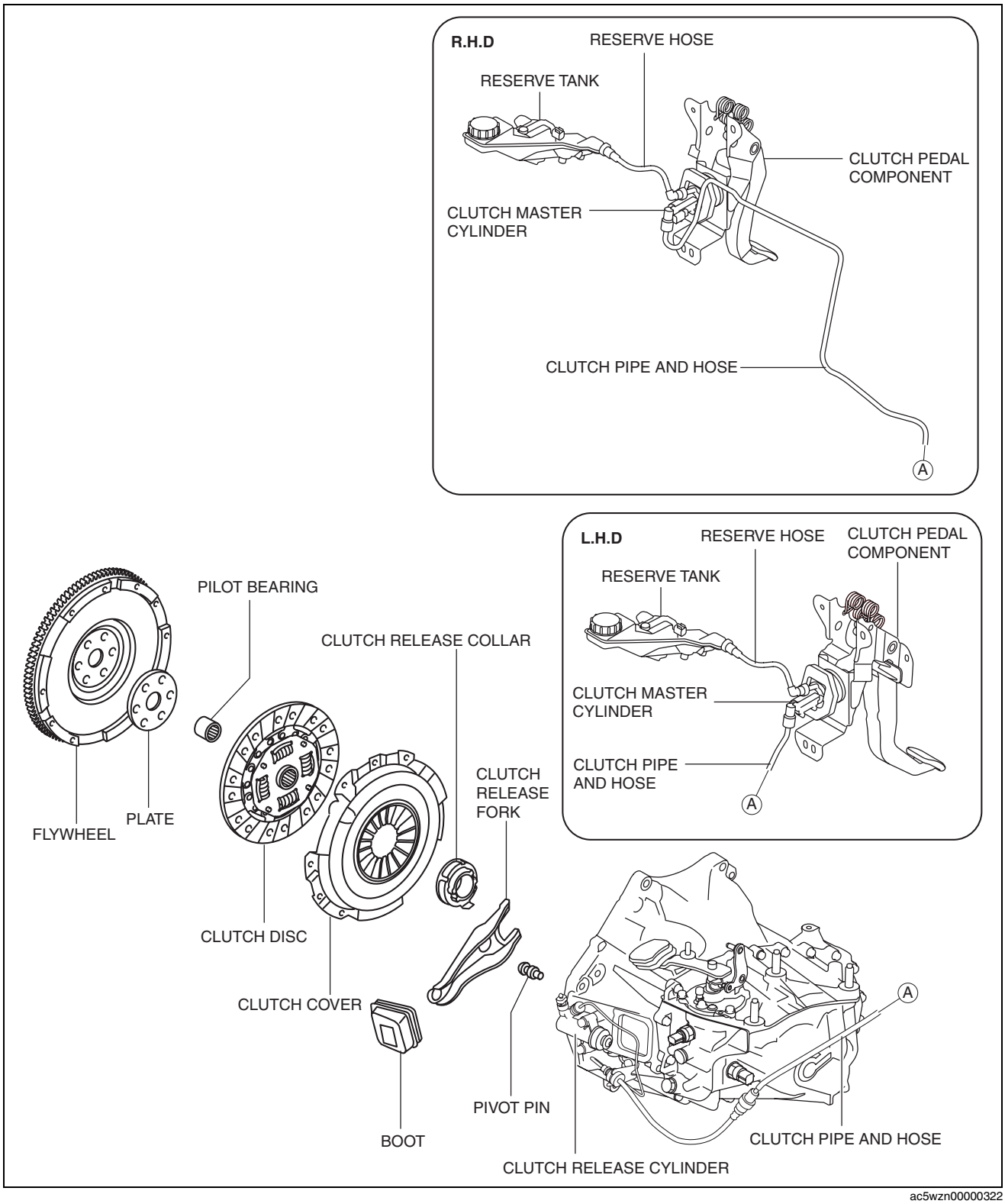
Purpose, Function

- The clutch unit transmits or cuts the drive force between the engine and MTX according to the clutch pedal operation.

Construction/Operation

- The construction/operation of the clutch unit is the same as the original MTX (ex: G66M-R).

CLUTCH [C66M-R, C66MX-R]



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05-10B CLUTCH [D66M-R, D66MX-R]

CLUTCH [D66M-R, D66MX-R]

CLUTCH [D66M-R, D66MX-R]

id0510mf283600

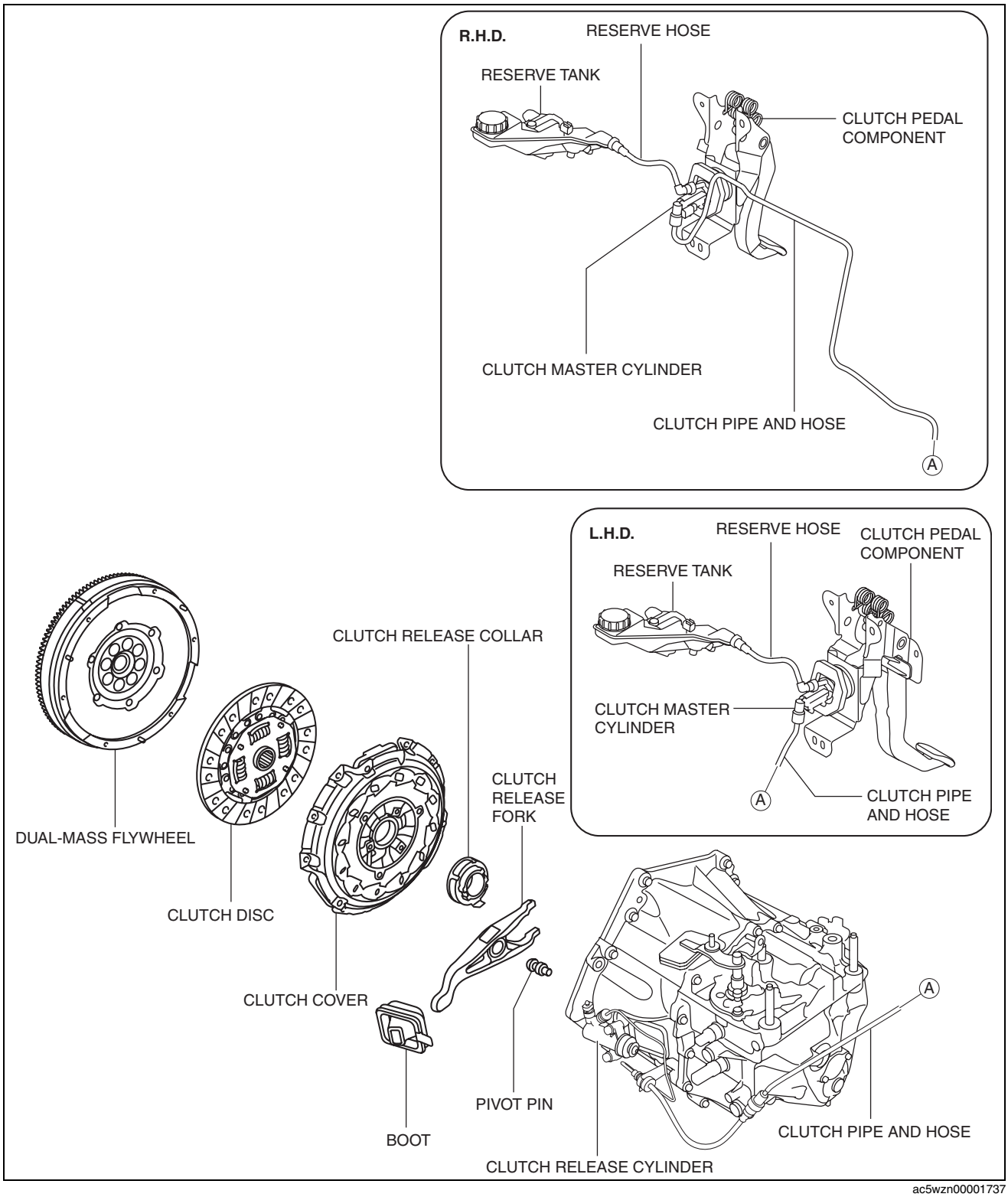
Purpose, Function

- The clutch unit transmits or cuts the drive force between the engine and MTX according to the clutch pedal operation.

Construction/Operation

- The construction/operation of the clutch unit is the same as the original MTX (ex: A26M-R, A26XM-R).
- The wear assurance function of the clutch cover maintains the set load of the clutch cover unchanged even as the clutch disc becomes worn, thereby extending disc life.

CLUTCH [D66M-R, D66MX-R]



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DUAL-MASS FLYWHEEL [D66M-R, D66MX-R]

id0510mf168800

Purpose, Function

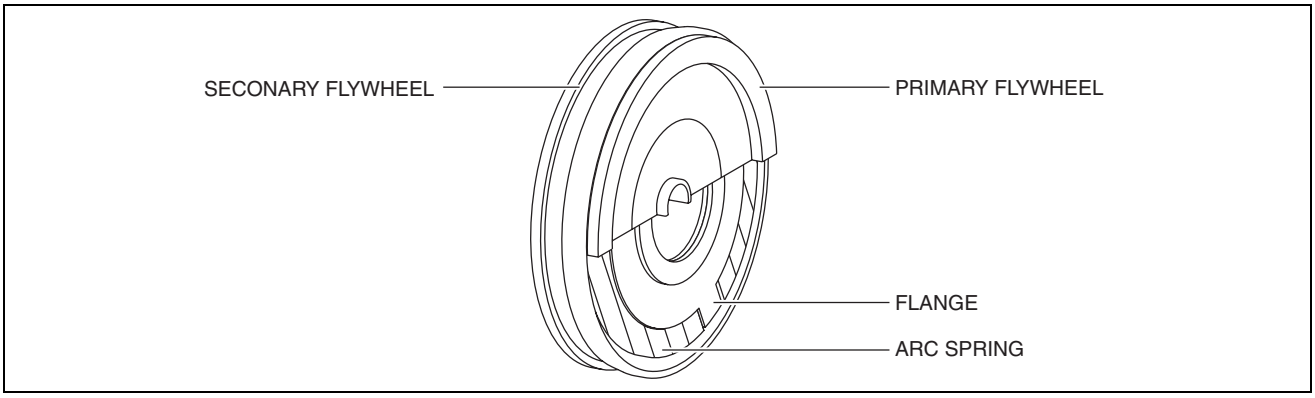
- In addition to its primary function as a flywheel, it reduces vibration and noise related to the drive system by reducing fluctuations in engine speed and stabilizing the rotation of the transmission.

CLUTCH [D66M-R, D66MX-R]

Construction, Operation

Basic Operation of dual-mass flywheel

- The construction consists of arc springs positioned between the two flywheels. Depending on the driving conditions, the springs compress and release repeatedly in accordance with the acceleration torque from the primary flywheel side and the deceleration torque from the secondary flywheel side to reduce engine speed fluctuations.



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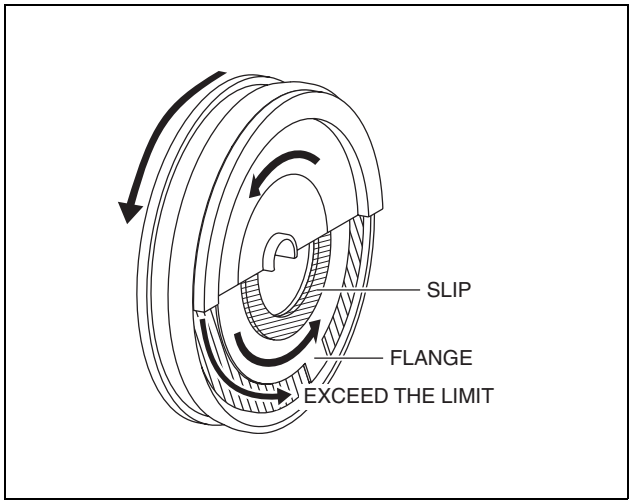
Torque limiter mechanism operation

- If an impact greater than what the spring operation can handle occurs, slipping movement in the flange area occurs to relieve the impact torque. Based on this mechanism, the input of acute damage to internal parts of the dual-mass flywheel is prevented.



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05-15A MANUAL TRANSAXLE [C66M-R, C66MX-R]

MANUAL TRANSAXLE [C66M-R, C66MX-R]

MANUAL TRANSAXLE [C66M-R, C66MX-R]

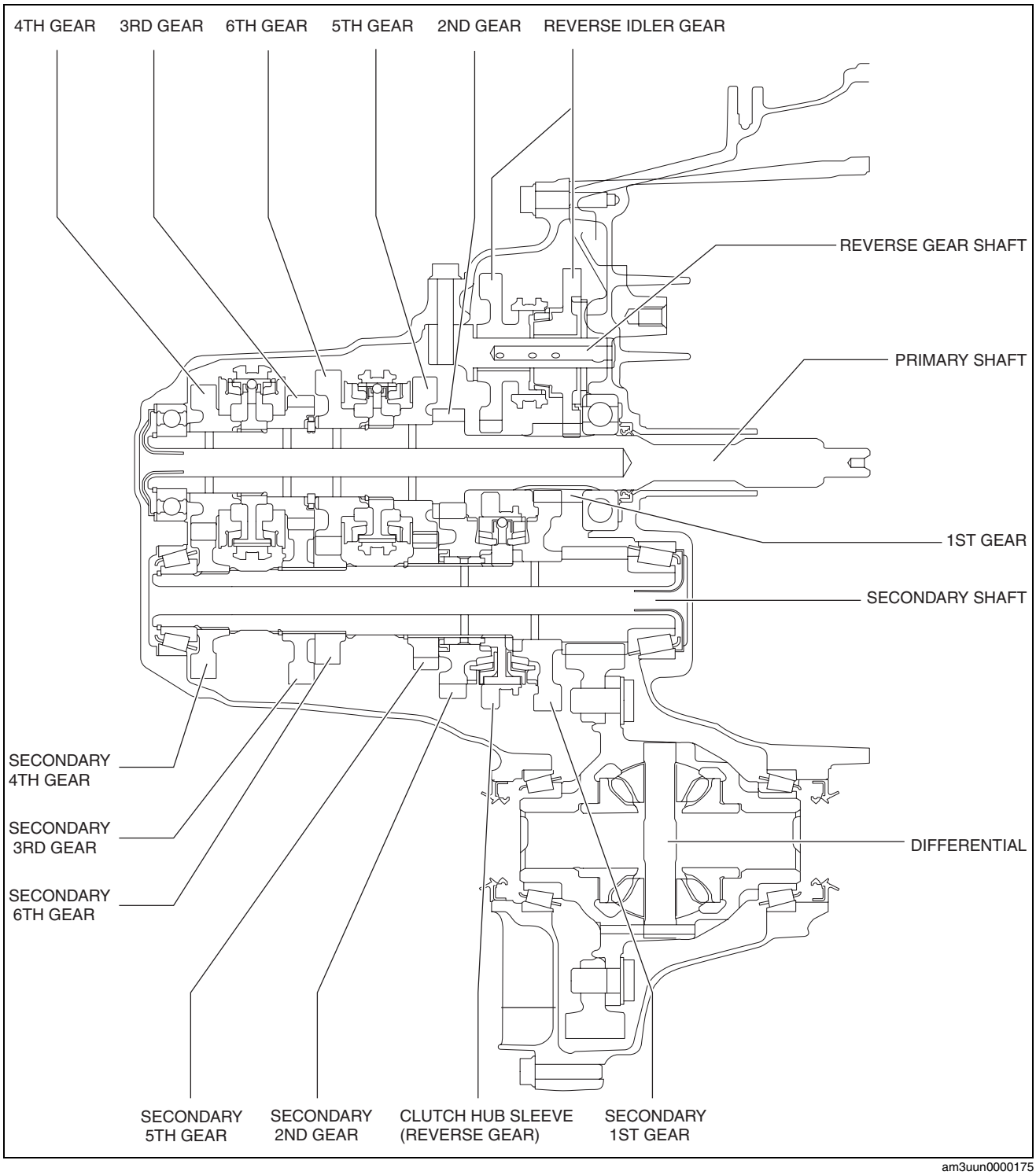
id0515ma283800

Purpose, Function

- The MTX converts the drive force (speed, torque, rotation direction) input from the engine according to the shift lever operation inside the vehicle.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

Construction



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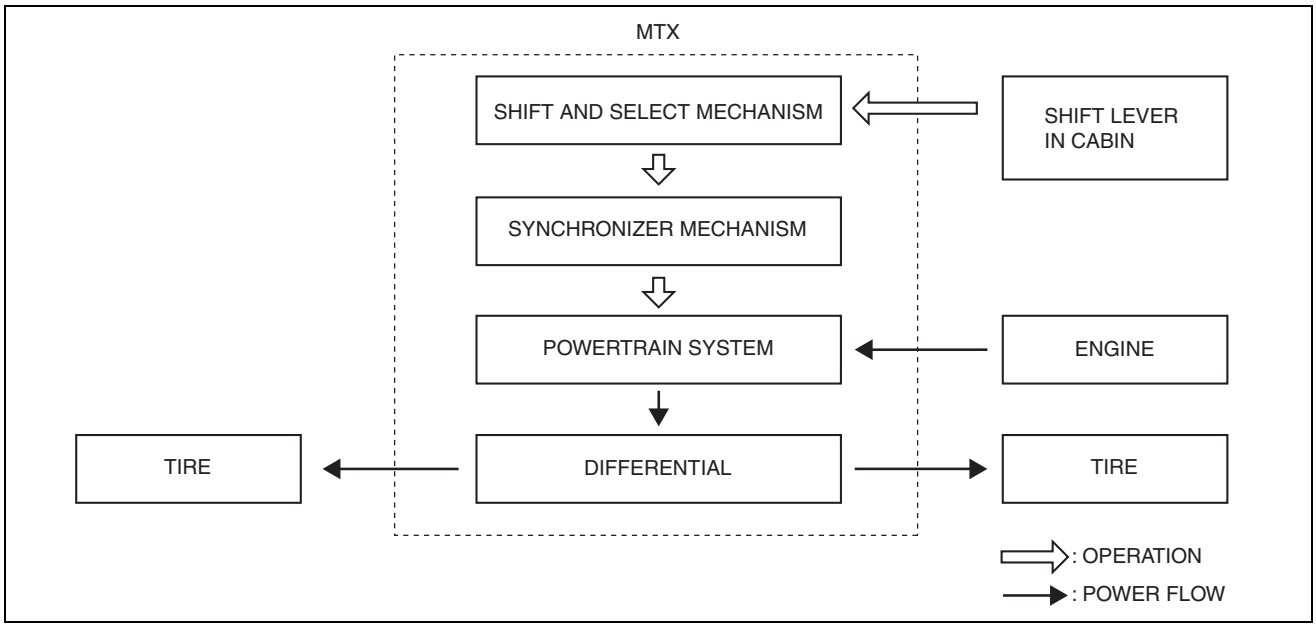
MANUAL TRANSAXLE [C66M-R, C66MX-R]

Operation



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SHIFT AND SELECT MECHANISM [C66M-R, C66MX-R]

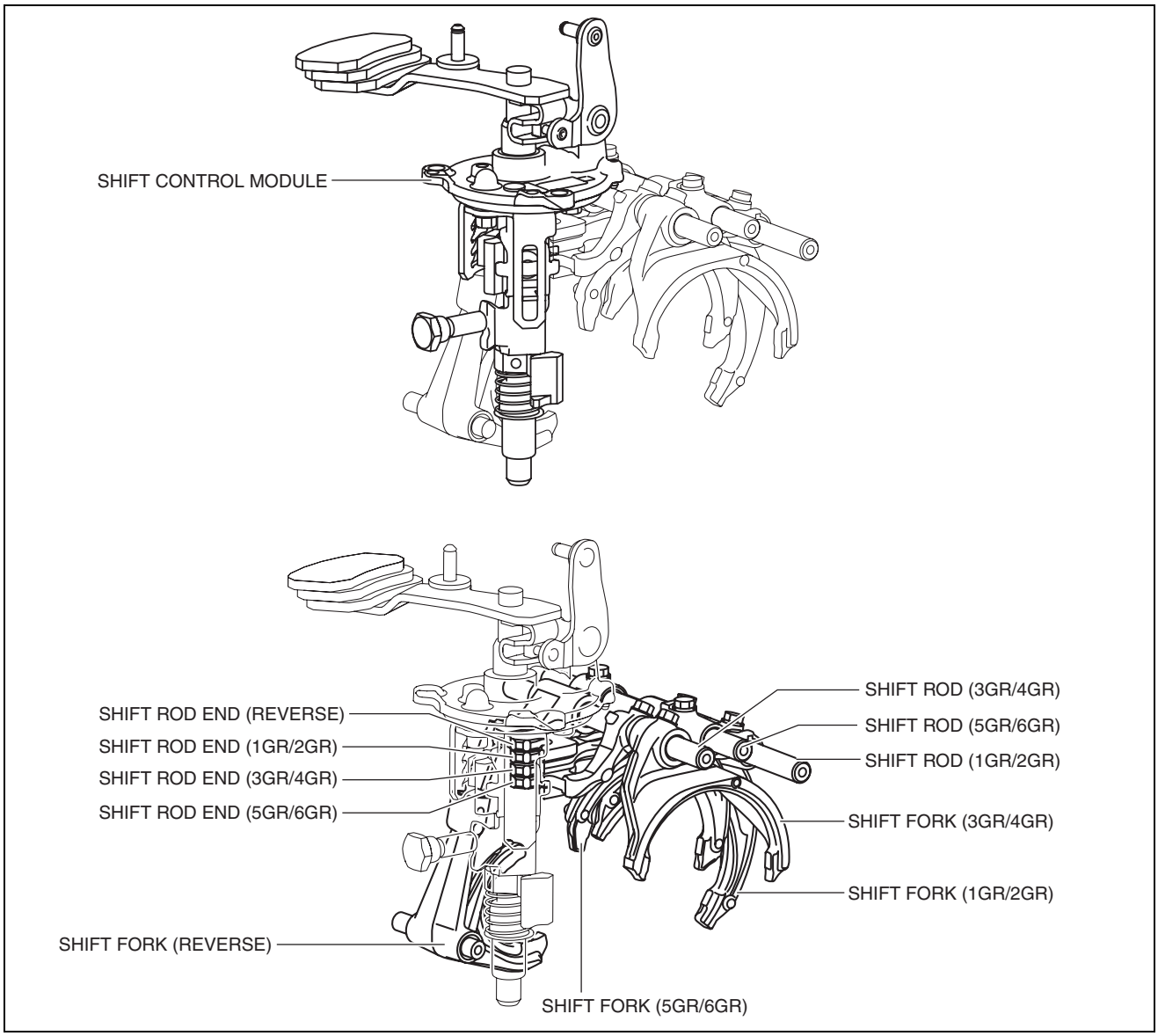
id0515ma283900

Purpose, Function

- The shift and select mechanism moves the shift fork to change gears according to the operation of the shift lever in the cabin.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

Construction



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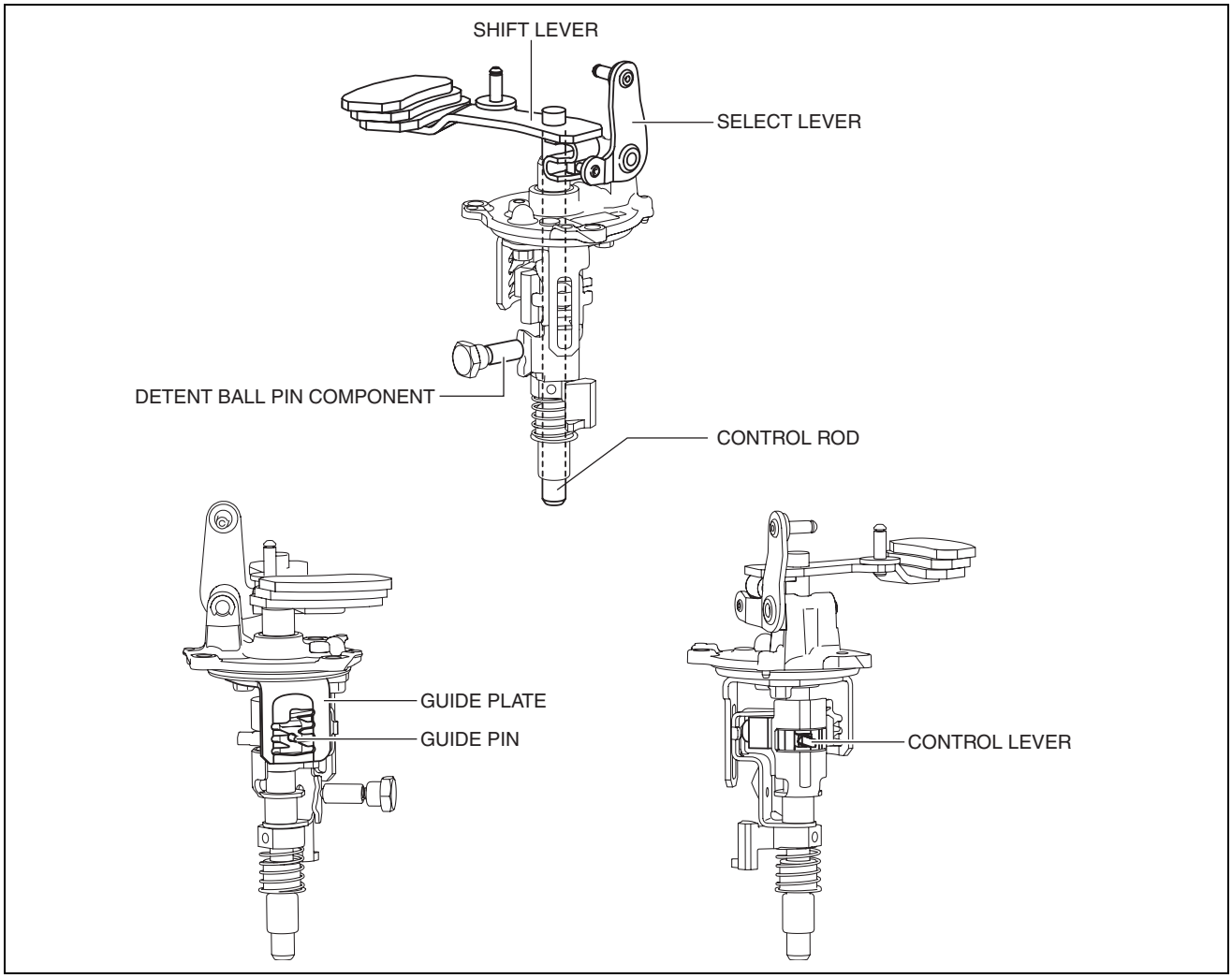
MANUAL TRANSAXLE [C66M-R, C66MX-R]

Shift control module

- The moving parts of the shift control module are vertically positioned..



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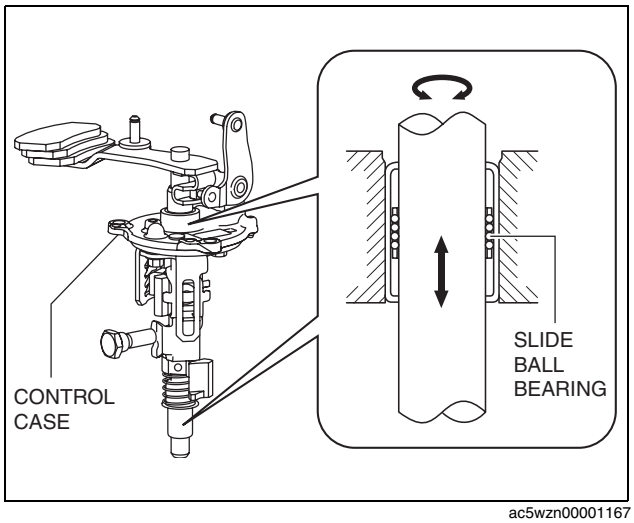
- In this module, the control lever which moves the shift rod end is directly assembled to the control rod. In addition, because the control rod moves up and down, the weight of the control rod is utilized when the control rod moves down.

Slide ball bearing

- A slide ball bearing has been adopted to the sliding area between the control rod and the transaxle case, and between the control rod and the control case.
- In this part, the bearing case moves in the drive and thrust directions.
- Compared to the conventional bushing, sliding resistance between the control rod and the transaxle case, and between the control rod and the control case has been reduced.



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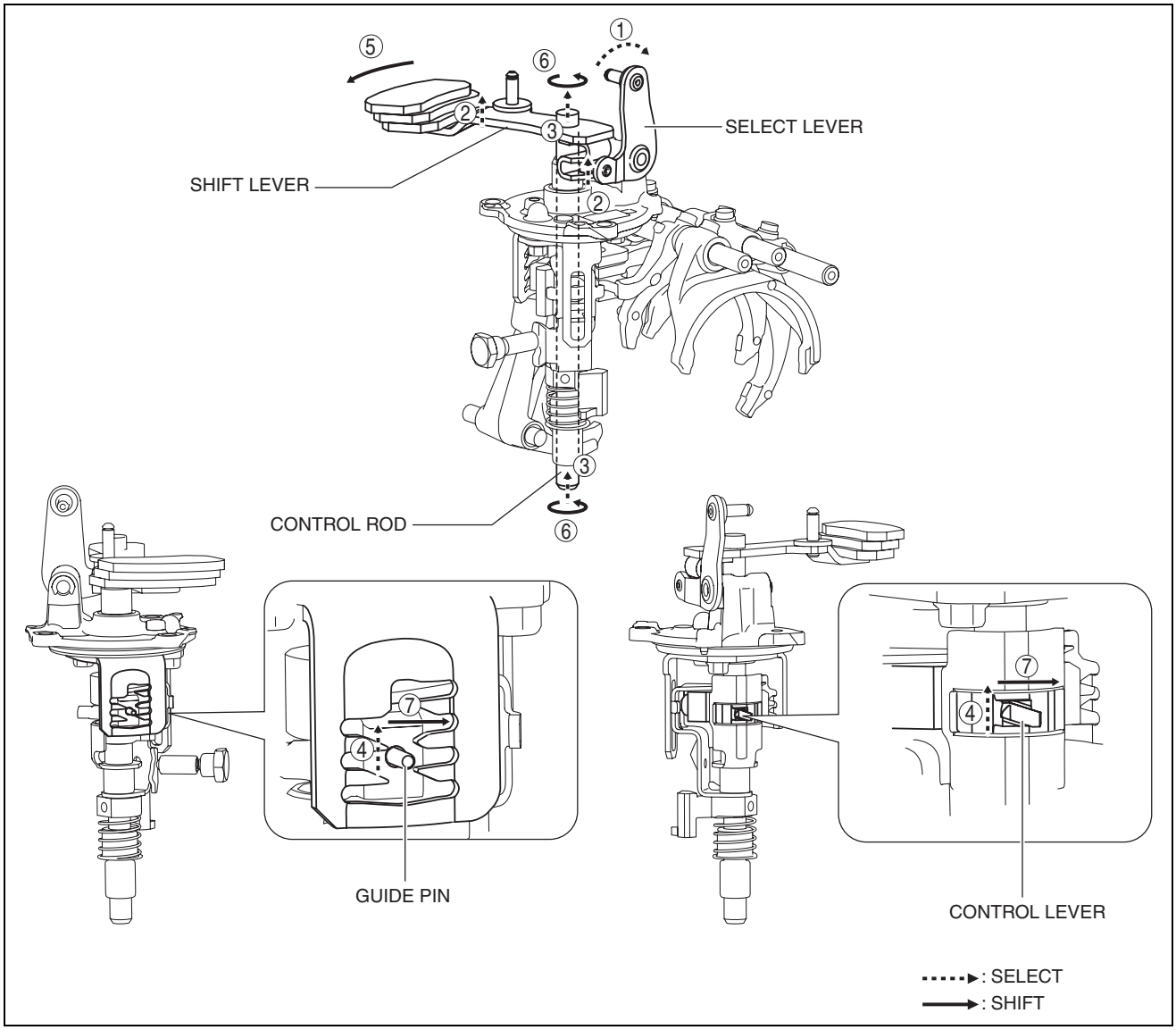
MANUAL TRANSAXLE [C66M-R, C66MX-R]

Operation

Note
- Shifting operations from neutral to each gear are explained in this section.

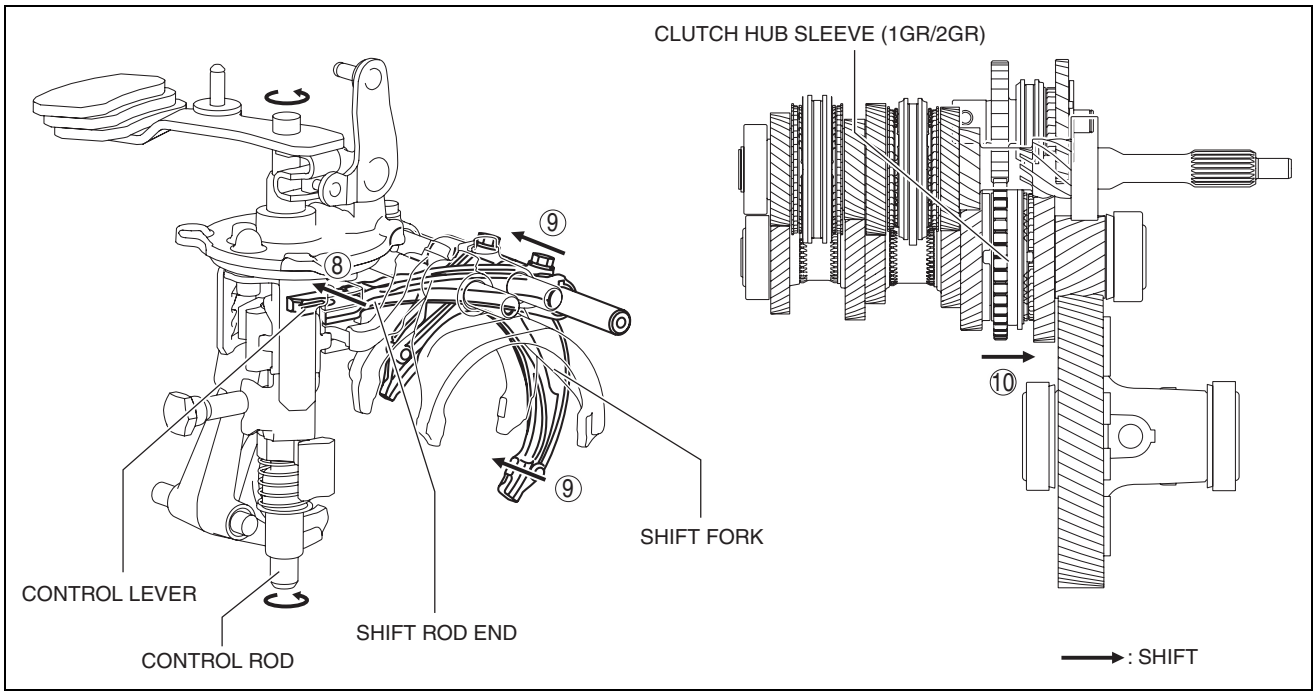
1GR



ac5wzn00001168

1. When the shift lever in the cabin is tilted to the left to shift to 1GR, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the shift lever moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted forward to shift to 1GR, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

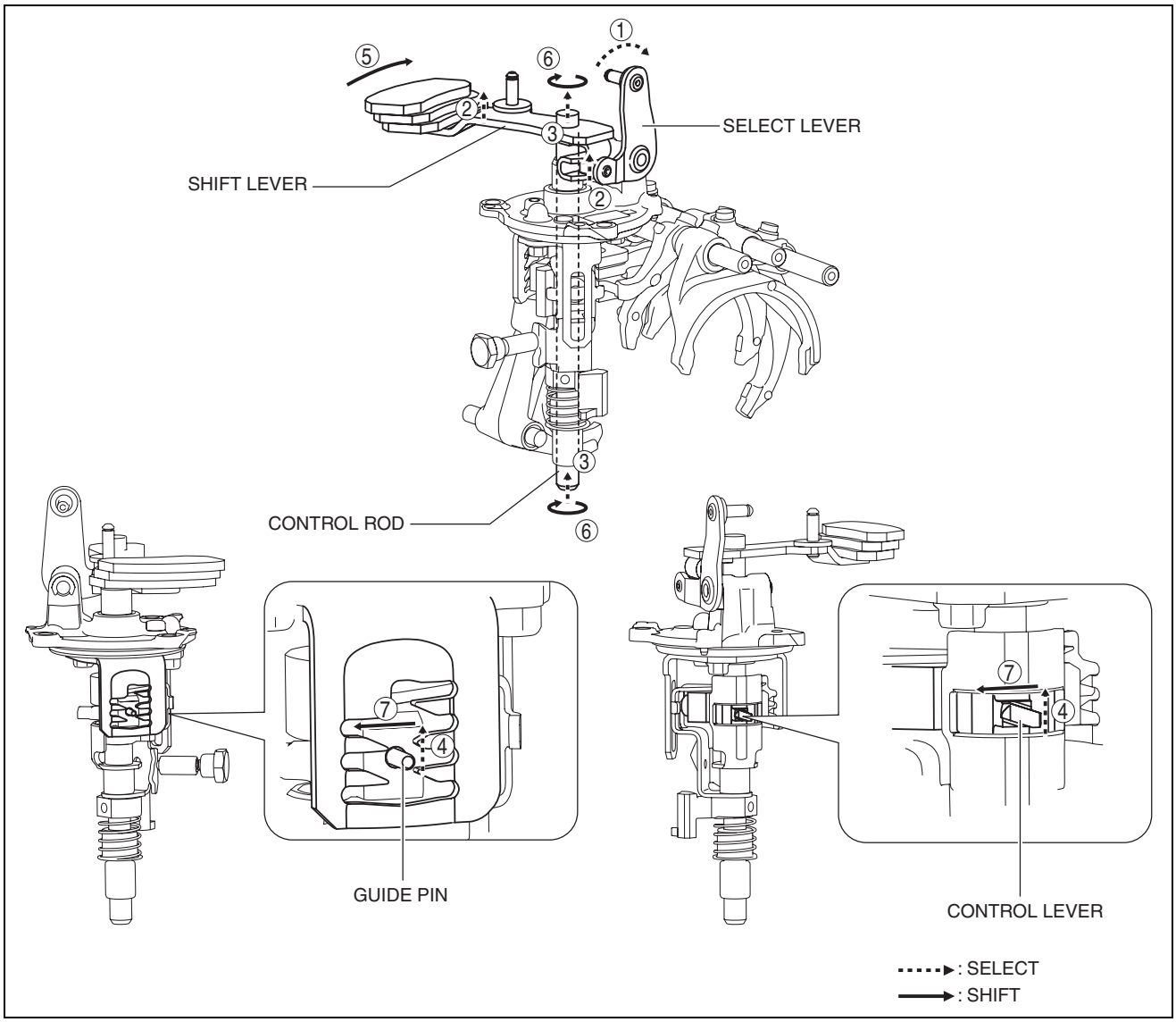


ac5wzn00001169

8. Because the control rod turns with the control lever, the control lever pushes the shift rod end and moves it in the direction of arrow 8 shown in the figure.
9. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 9.
10. The shift fork moves the clutch hub sleeve in the direction of arrow 10 shown in the figure.
11. The shift change to 1GR is completed.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

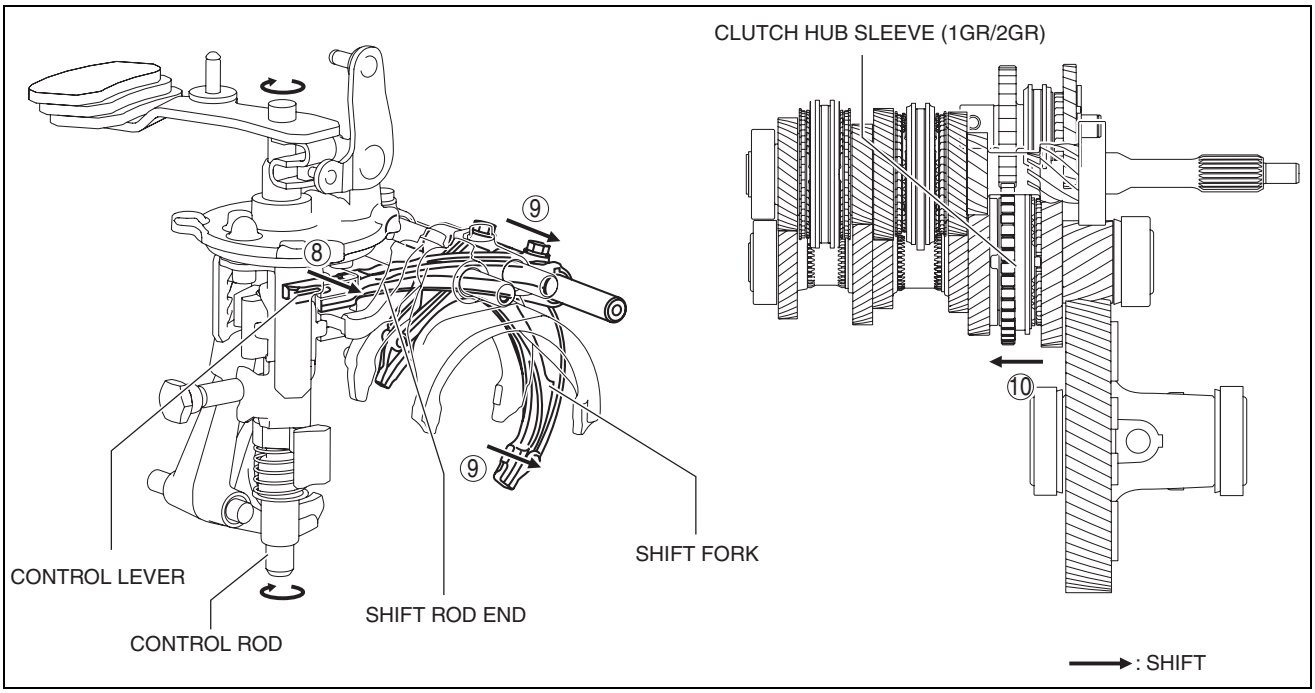
2GR



ac5wzn00001170

1. When the shift lever in the cabin is tilted to the left to shift to 2GR, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the shift lever moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted rearward to shift to 2GR, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

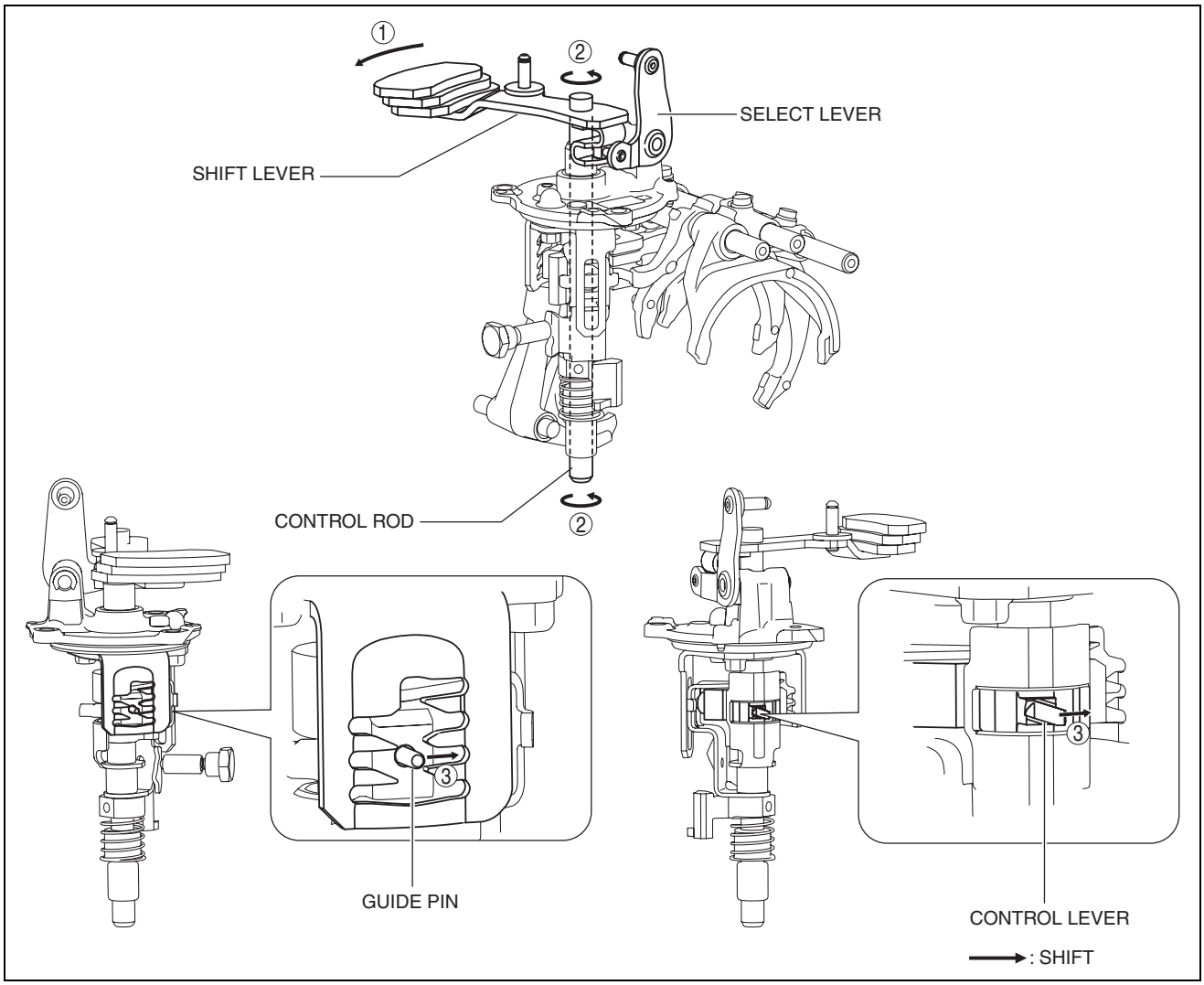


ac5wzn00001171

8. Because the control rod turns with the control lever, the control lever pushes the shift rod end and moves it in the direction of arrow 8 shown in the figure.
9. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 9.
10. The shift fork moves the clutch hub sleeve in the direction of arrow 10 shown in the figure.
11. The shift change to 2GR is completed.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

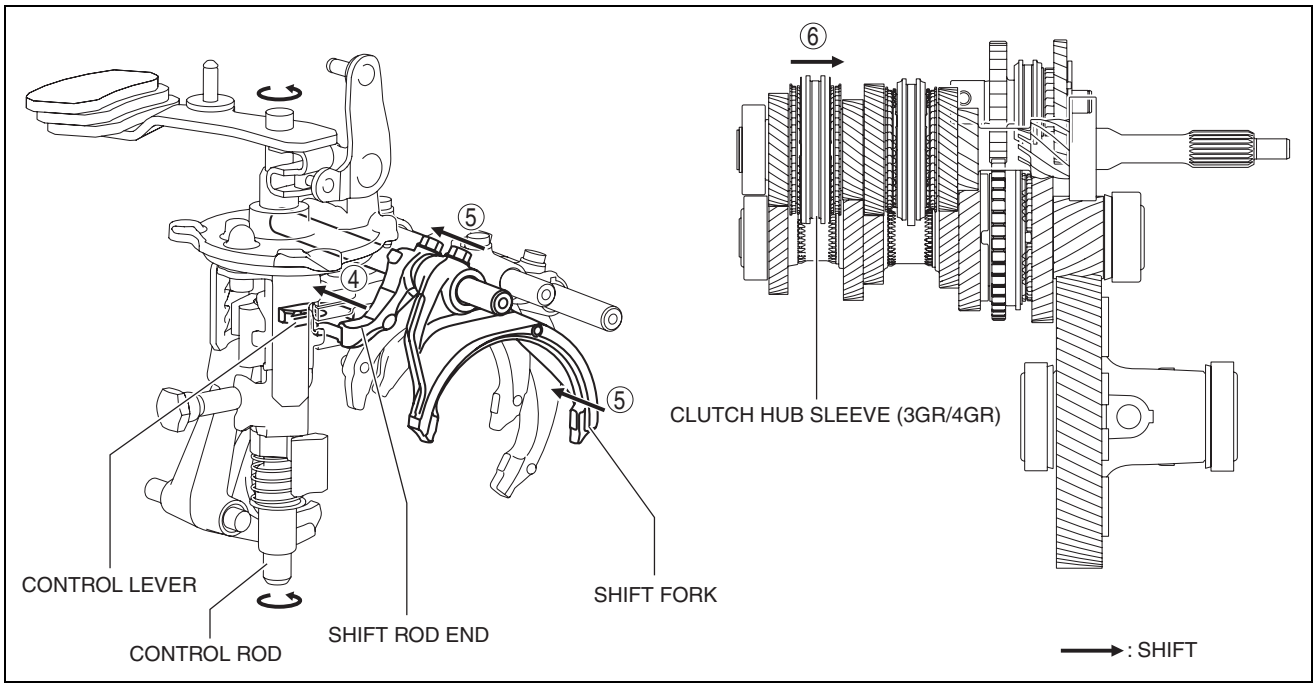
3GR



ac5wzn00001172

1. When the shift lever in the cabin is tilted forward to shift to 3GR, the shift lever in the engine compartment moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the shift lever in the engine compartment, the control lever and the guide pin move in the direction of arrow 3 shown in the figure.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

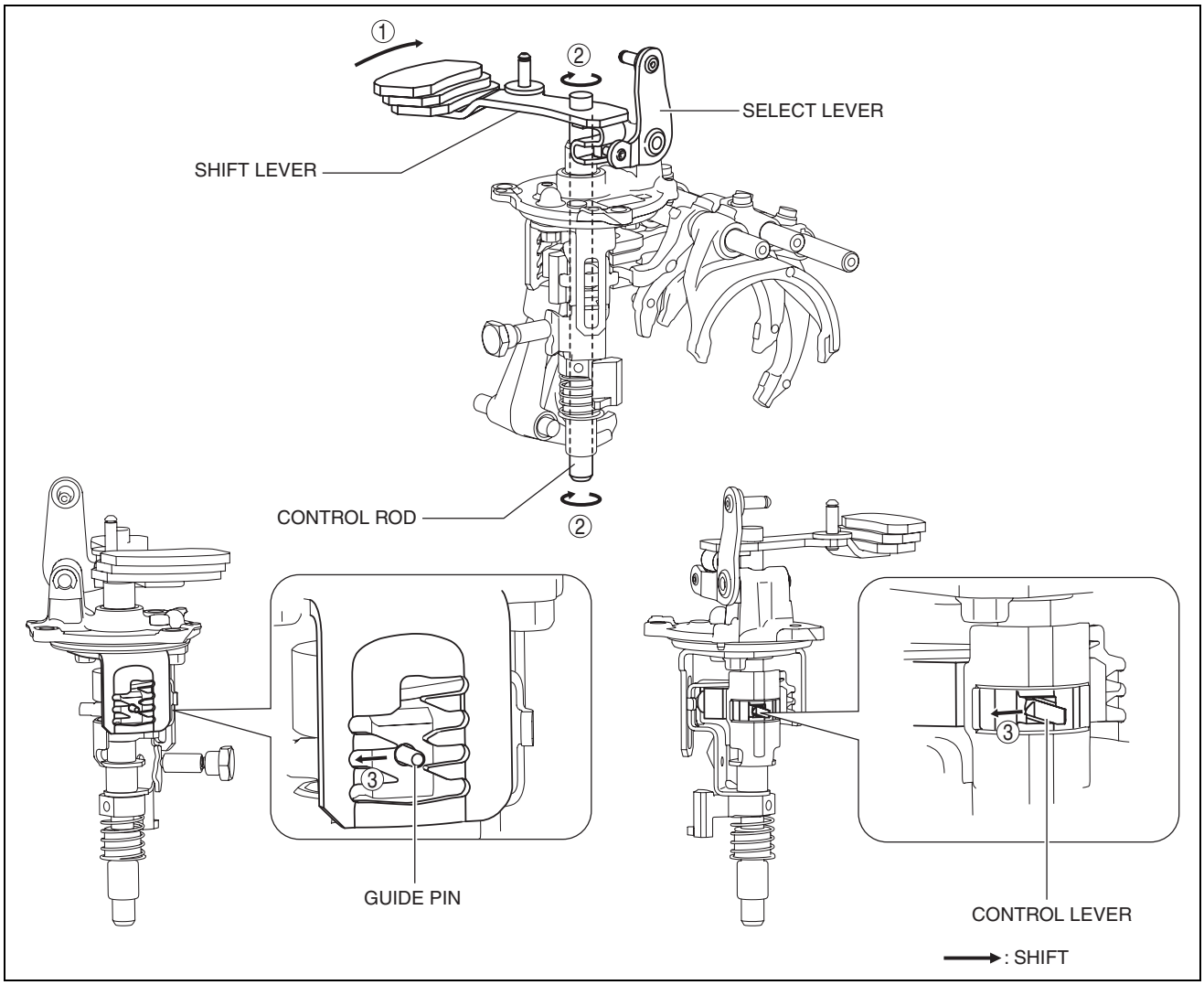


ac5wzn00001173

4. Because the control rod turns with the control lever, the control lever pushes the shift rod end and moves it in the direction of arrow 4 shown in the figure.
5. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 5.
6. The shift fork moves the clutch hub sleeve in the direction of arrow 6 shown in the figure.
7. The shift change to 3GR is completed.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

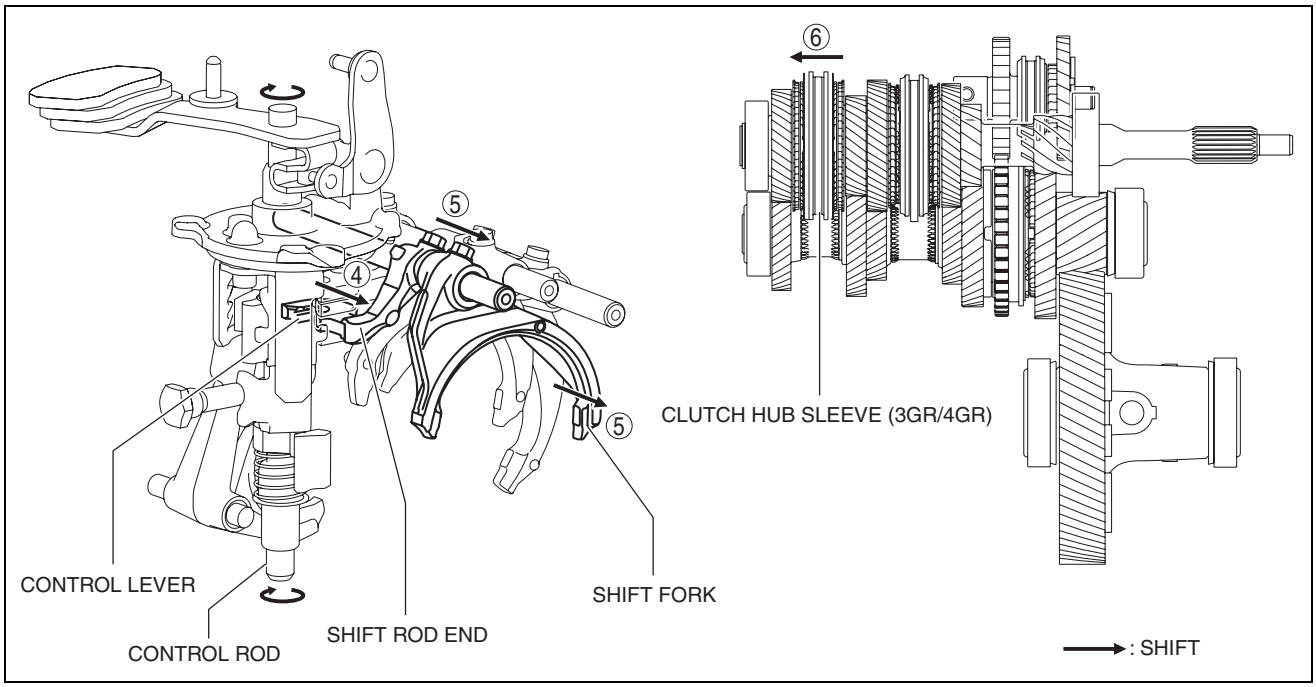
4GR



ac5wzn00001174

1. When the shift lever in the cabin is tilted rearward to shift to 4GR, the shift lever in the engine compartment moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the shift lever in the engine compartment, the control lever and the guide pin move in the direction of arrow 3 shown in the figure.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

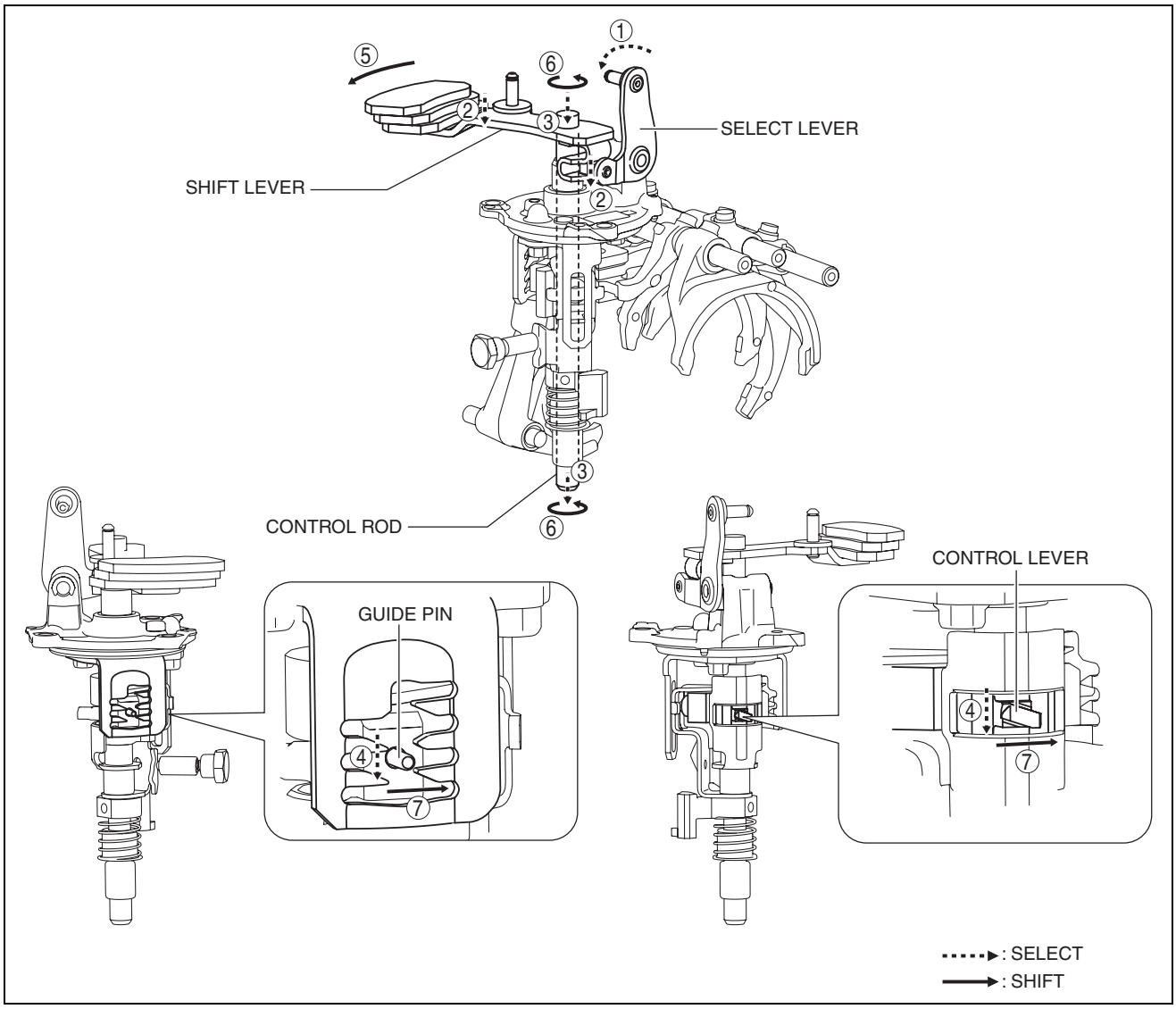


ac5wzn00001175

4. Because the control rod turns with the control lever, the control lever pushes the shift rod end and moves it in the direction of arrow 4 shown in the figure.
5. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 5.
6. The shift fork moves the clutch hub sleeve in the direction of arrow 6 shown in the figure.
7. The shift change to 4GR is completed.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

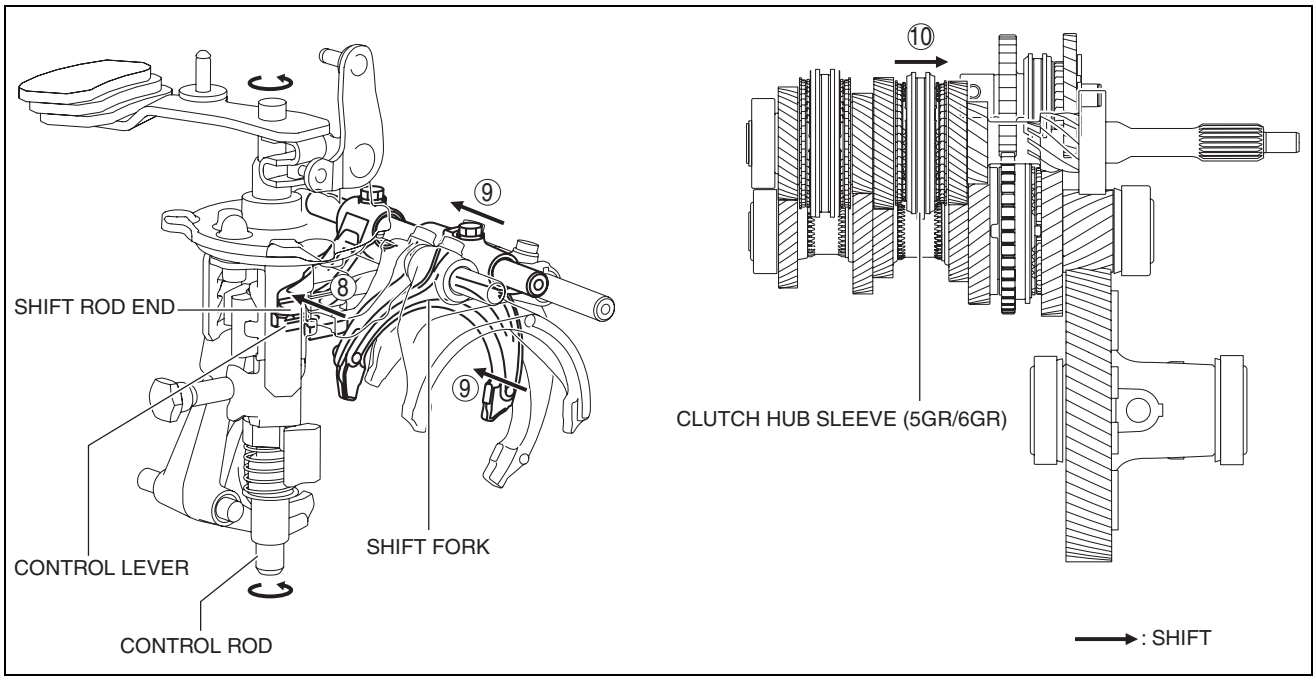
5GR



ac5wzn00001176

1. When the shift lever in the cabin is tilted to the right to shift to 5GR, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the shift lever moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted forward to shift to 5GR, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

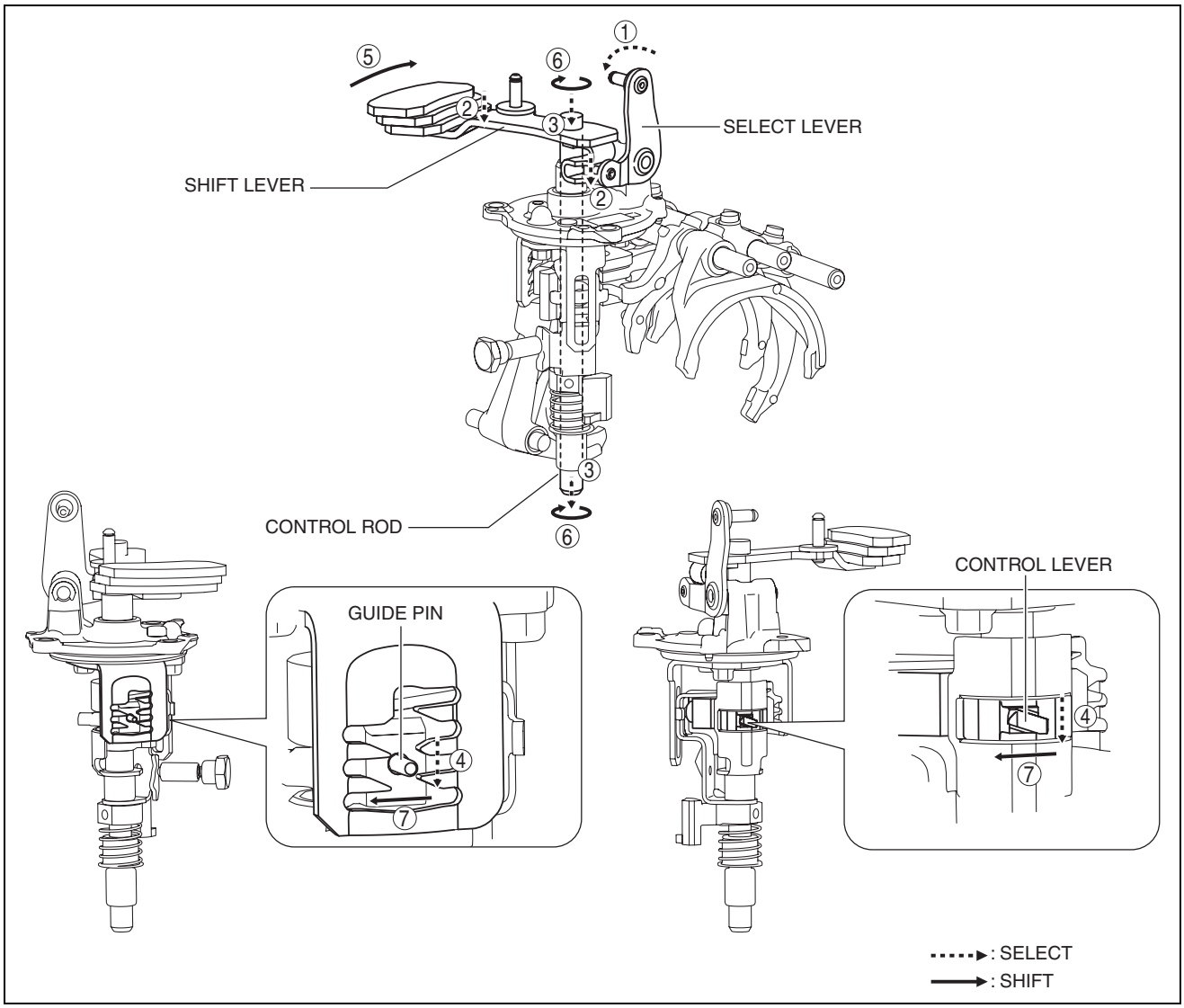


ac5wzn00001177

8. Because the control rod turns with the control lever, the control lever pushes the shift rod end and moves it in the direction of arrow 8 shown in the figure.
9. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 9.
10. The shift fork moves the clutch hub sleeve in the direction of arrow 10 shown in the figure.
11. The shift change to 5GR is completed.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

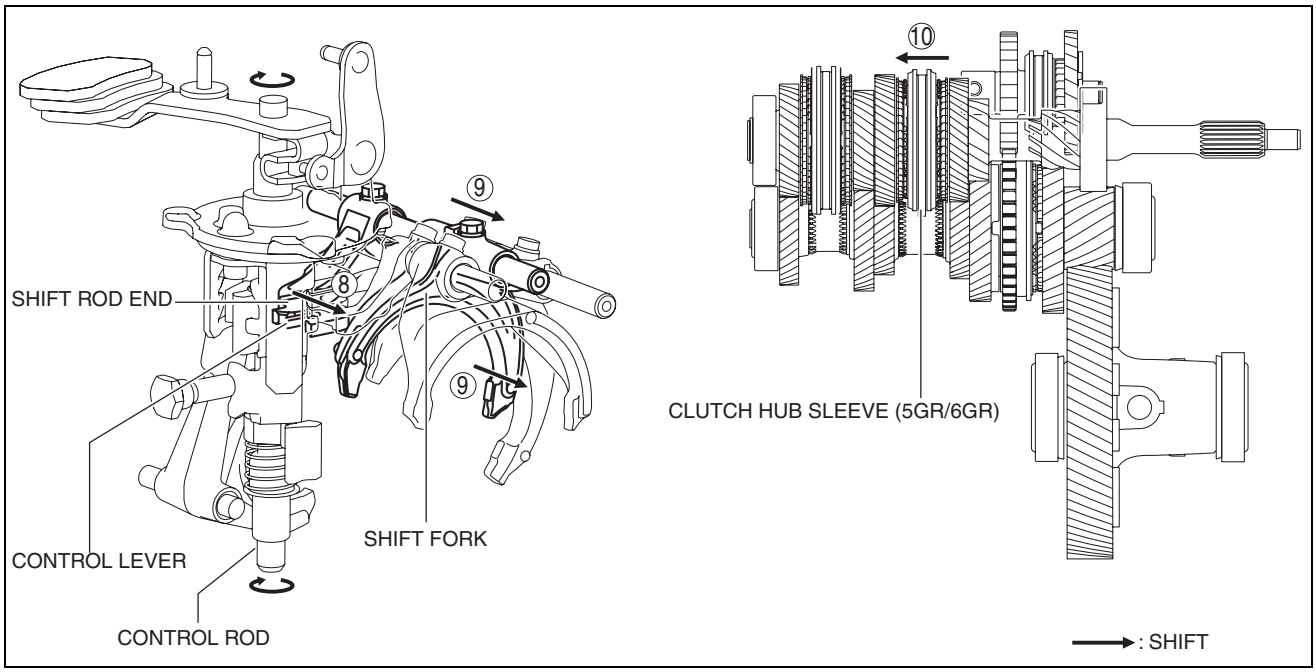
6GR



ac5wzn00001178

1. When the shift lever in the cabin is tilted to the right to shift to 6GR, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the shift lever moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted rearward to shift to 6GR, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

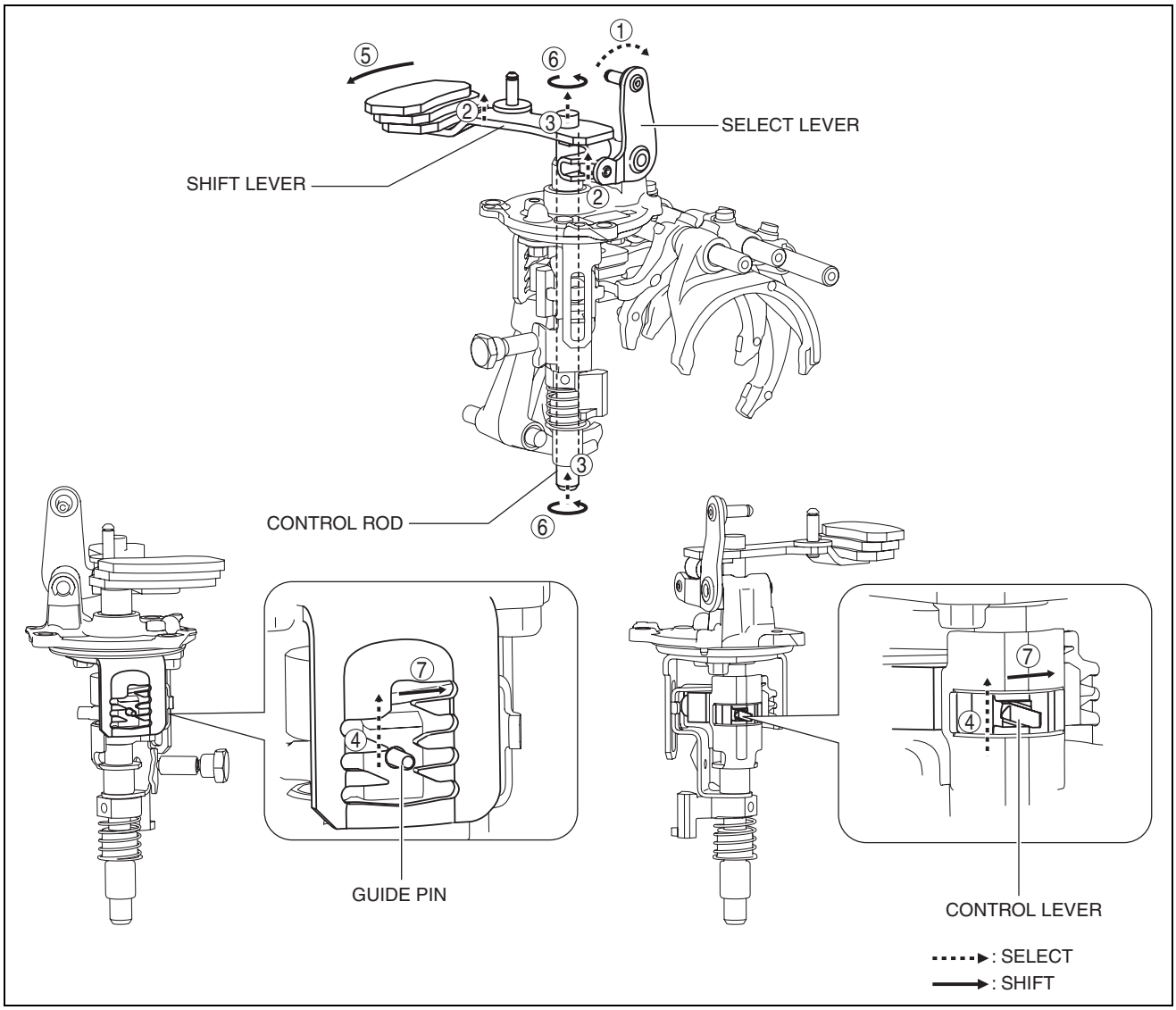


ac5wzn00001179

8. Because the control rod turns with the control lever, the control lever pushes the shift rod end and moves it in the direction of arrow 8 shown in the figure.
9. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 9.
10. The shift fork moves the clutch hub sleeve in the direction of arrow 10 shown in the figure.
11. The shift change to 6GR is completed.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

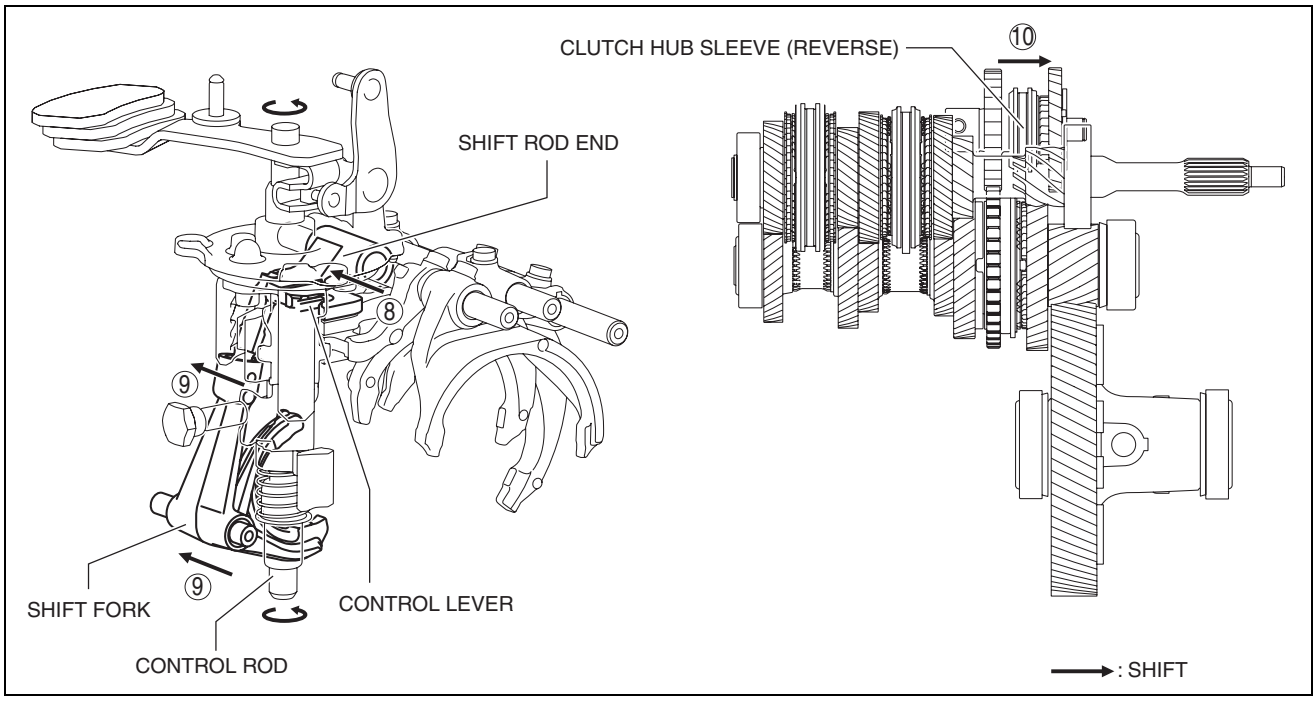
Reverse



ac5wzn00001180

1. When the shift lever in the cabin is tilted to the left to shift to the reverse gear, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the shift lever moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted forward to shift to the reverse gear, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [C66M-R, C66MX-R]



ac5wzn00001181

8. Because the control rod turns with the control lever, the control lever pushes the shift rod end and moves it in the direction of arrow 8 shown in the figure.
9. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 9.
10. The shift fork moves the clutch hub sleeve in the direction of arrow 10 shown in the figure.
11. The shift change to the reverse gear is completed.

SYNCHRONIZER MECHANISM [C66M-R, C66MX-R]

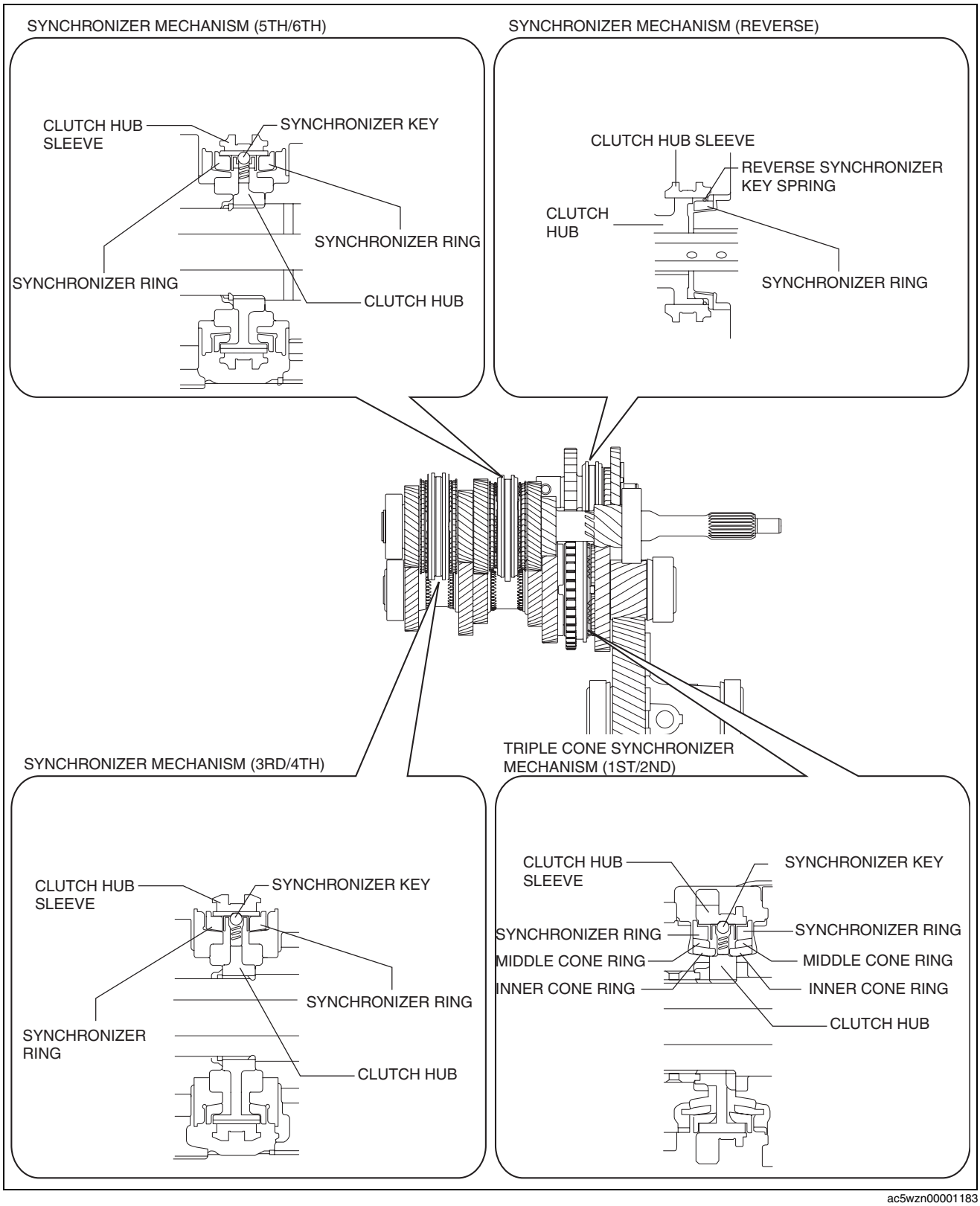
id0515ma284000

Purpose, Function

- For smooth gear changes, the synchronizer mechanism synchronizes the rotation of the engaging area and engages gears.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

Construction



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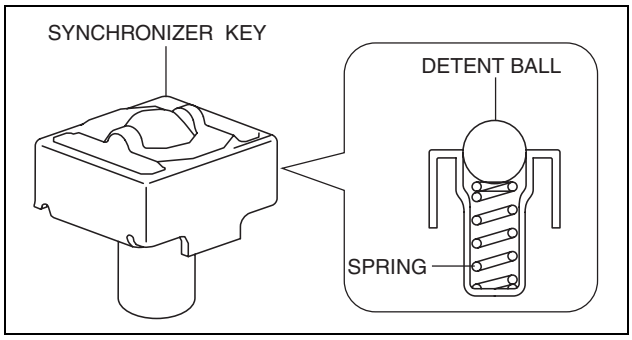
MANUAL TRANSAXLE [C66M-R, C66MX-R]

Detent ball-type synchronizer key

- A detent ball-type synchronizer key has been adopted for the synchronizer mechanism except for the reverse gear.
- The detent ball of this part provides the driver a crisp feel which the driver can realize completed gear changes.
- Because this part is smaller compared to the conventional synchronizer key, it has contributed to the size reduction of the synchronizer mechanism, and also to the shortened length of the primary and secondary shafts.
- Because the smaller synchronizer mechanism has reduced the stroke amount of the clutch hub sleeve, the stroke of the shift lever in the cabin has been shortened.



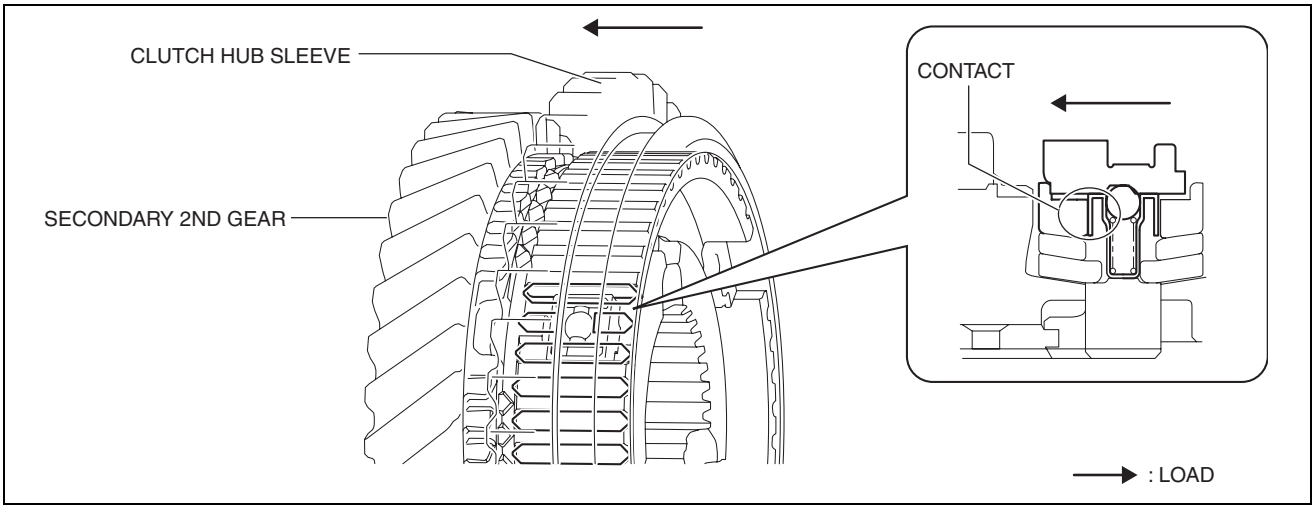
am3uun0000180

Operation
1GR, 2GR operation

Note

- For 1st and 2nd gears, a triple-cone synchronizer mechanism has been adopted with which a stronger synchronizing force is provided to synchronize the rotation of the clutch hub and the gear.
- Here, operation during 2GR operation is described as an example.

1. When the clutch hub sleeve moves toward the 2nd gear side, the synchronizer key follows, and the synchronizer key contacts the end surface of the synchronizer ring.



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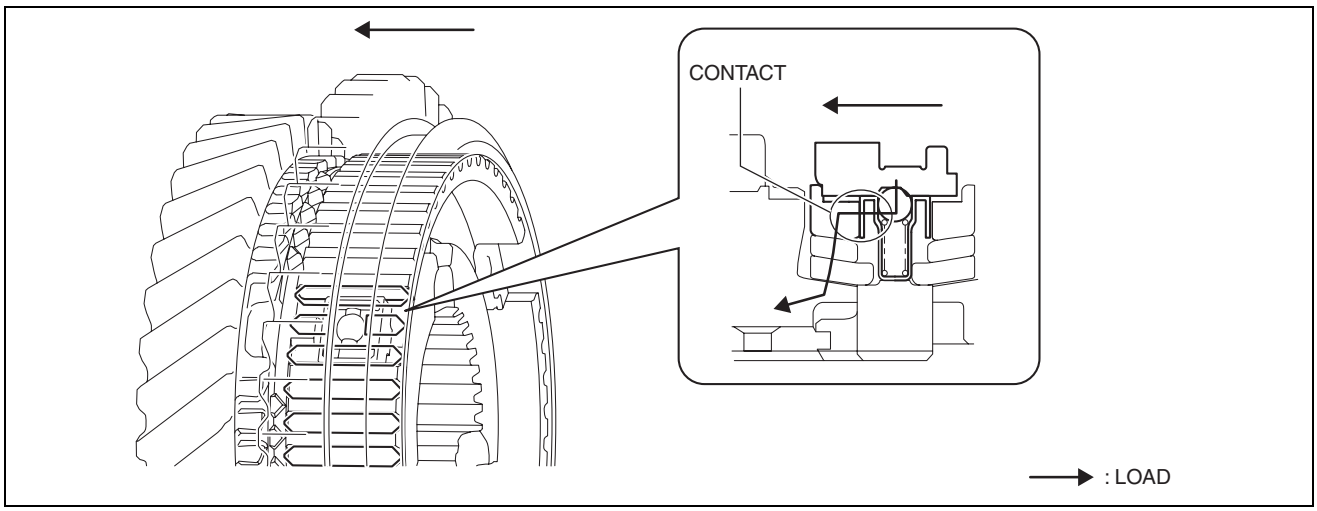
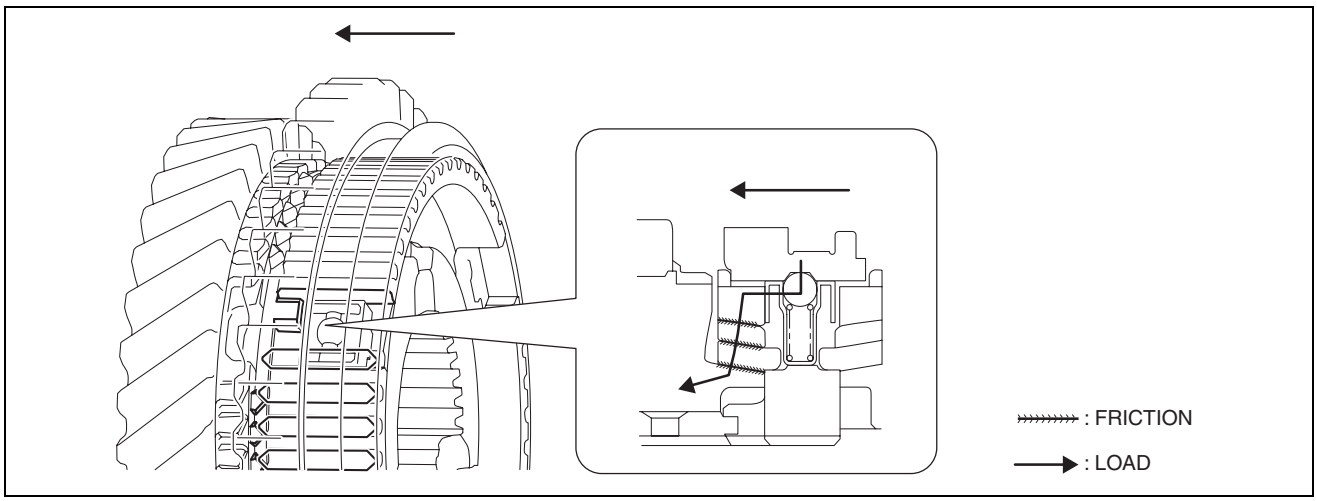
MANUAL TRANSAXLE [C66M-R, C66MX-R]

2. When the clutch hub sleeve moves toward the 2nd gear side, the synchronizer key which follows applies load to the synchronizer ring, and the load is transmitted from the synchronizer ring to the middle cone ring, inner cone ring, and the gear.



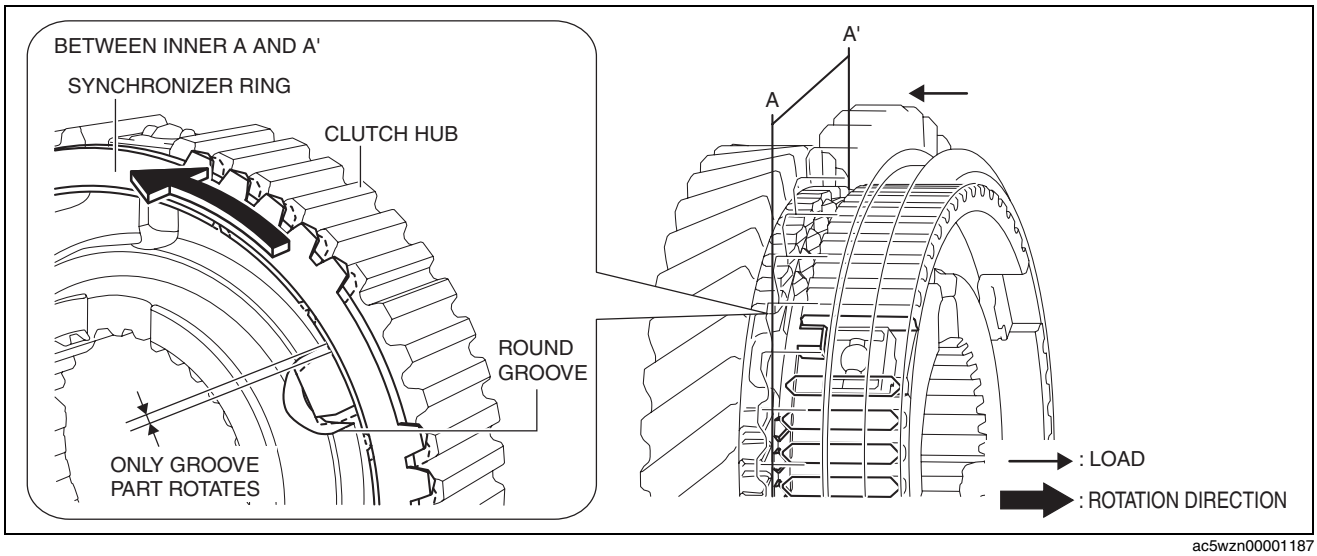
ac5wzn00001185

3. The friction force on the contacting surface of the parts is generated by applying load to the parts between the synchronizer ring and the gear.



ac5wzn00001186

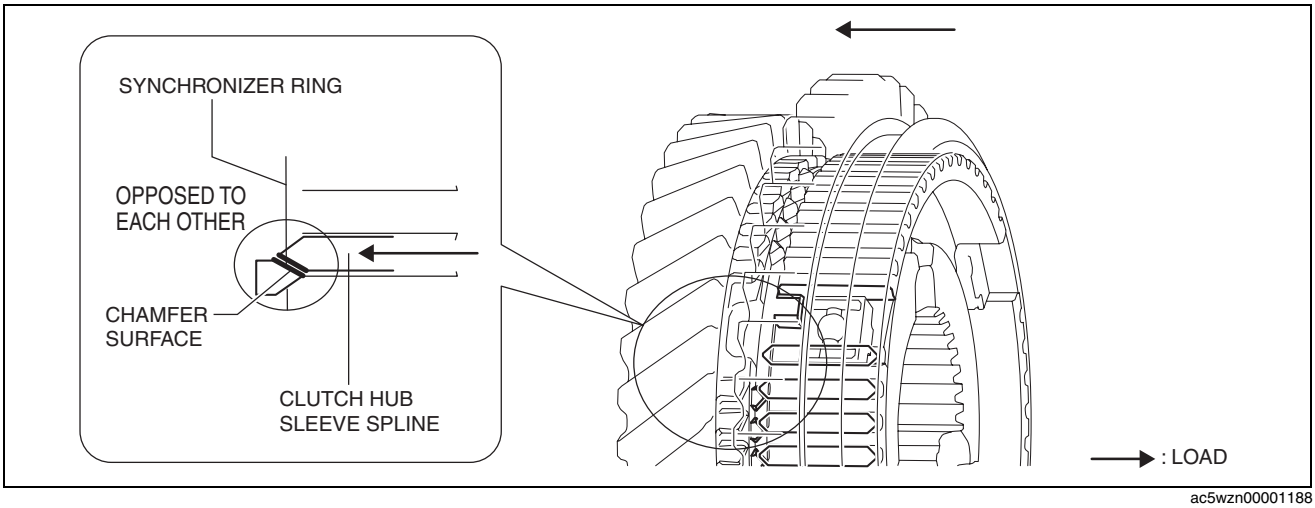
4. For the friction force for the parts, the synchronizer ring rotates only the round groove gap of the clutch hub sleeve.



ac5wzn00001187

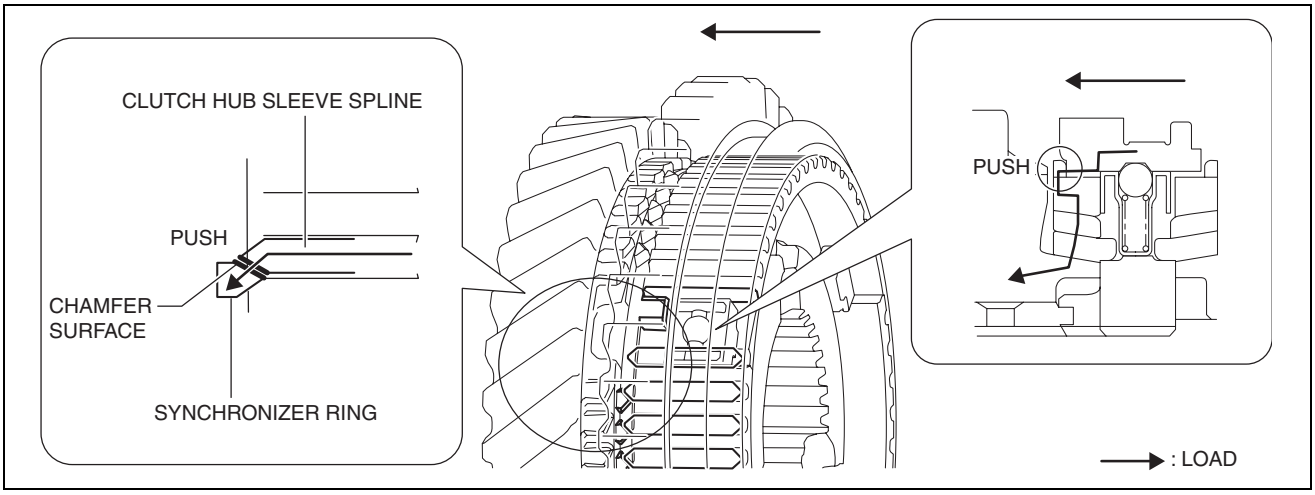
MANUAL TRANSAXLE [C66M-R, C66MX-R]

5. Because the synchronizer ring rotates, the spline of the clutch hub sleeve which moves toward the secondary 2nd gear side and the chamfer of the synchronizer ring are opposed to each other.



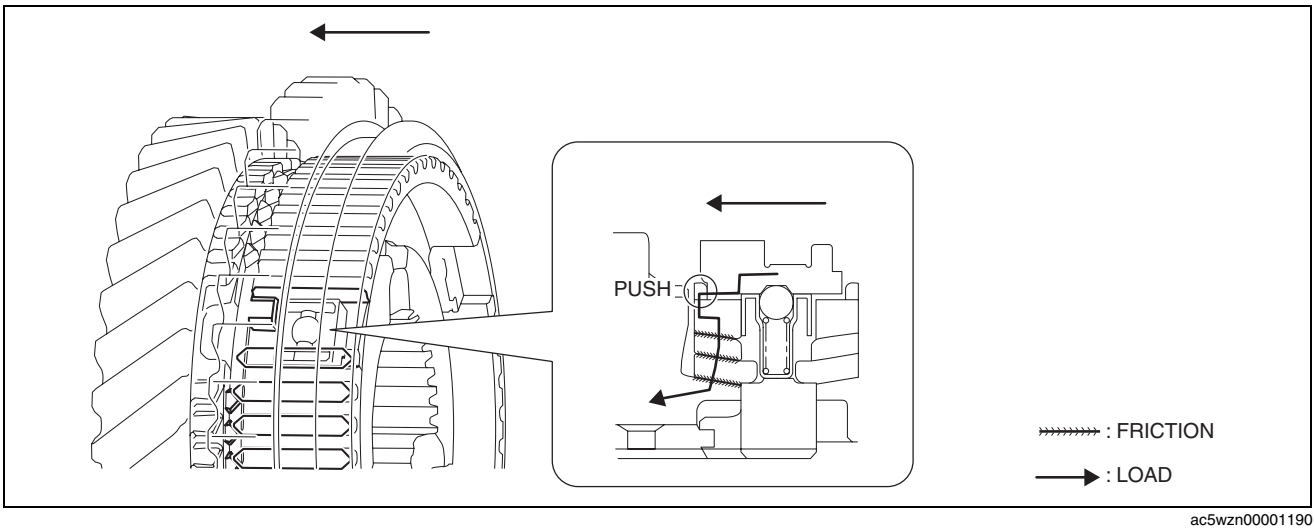
ac5wzn00001188

6. When the clutch hub sleeve moves toward the secondary 2nd gear side, the transmitted load to the gear from the clutch hub sleeve increases because the spline of the clutch hub sleeve pushes the chamfer of the synchronizer ring.



ac5wzn00001189

7. The friction force on the contacting surface of the parts is increased by increasing the load transmitted from the clutch hub sleeve to the gear.

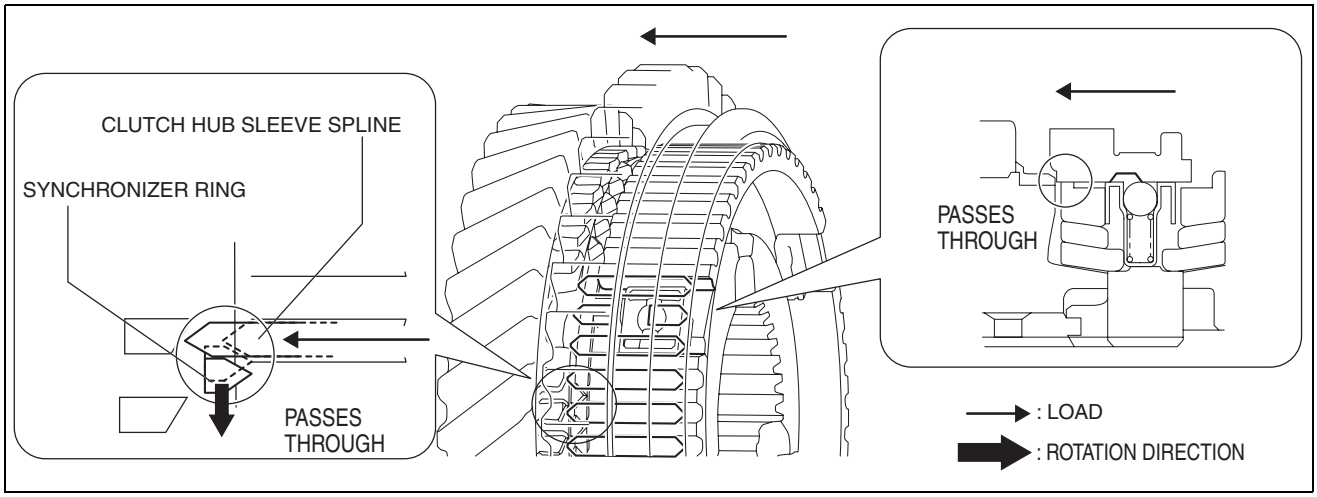


ac5wzn00001190

8. The increased friction force decreases the difference in rotation speed between the synchronizer ring, middle cone ring, inner cone ring, and the gear and the rotation speed for the parts is synchronized.

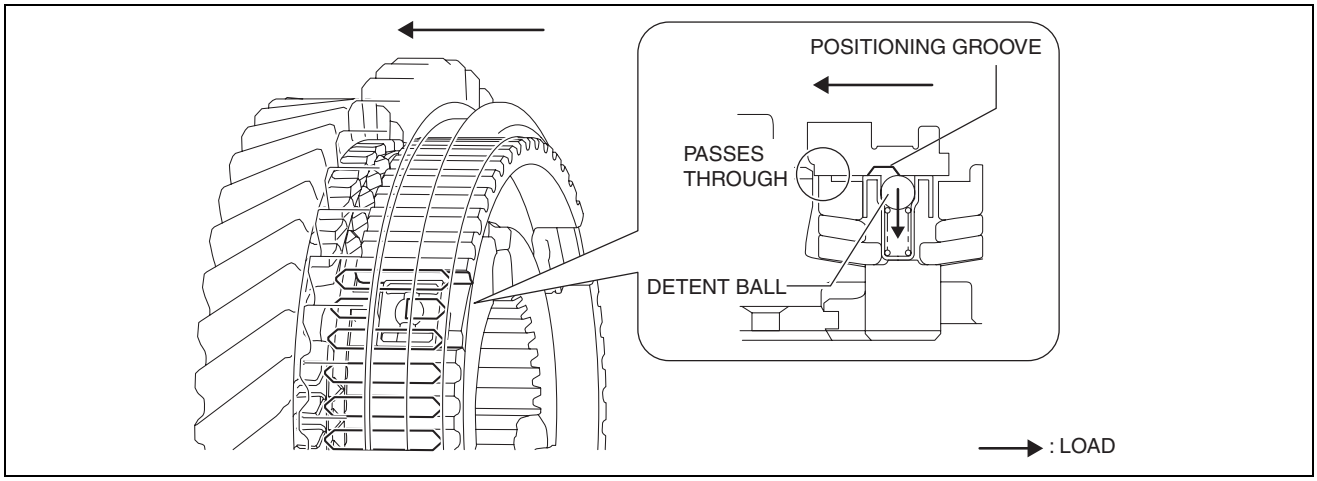
MANUAL TRANSAXLE [C66M-R, C66MX-R]

9. When synchronization in rotation speed of the gear and the clutch hub sleeve is performed, the spline of the clutch hub sleeve passes through the synchronizer ring.



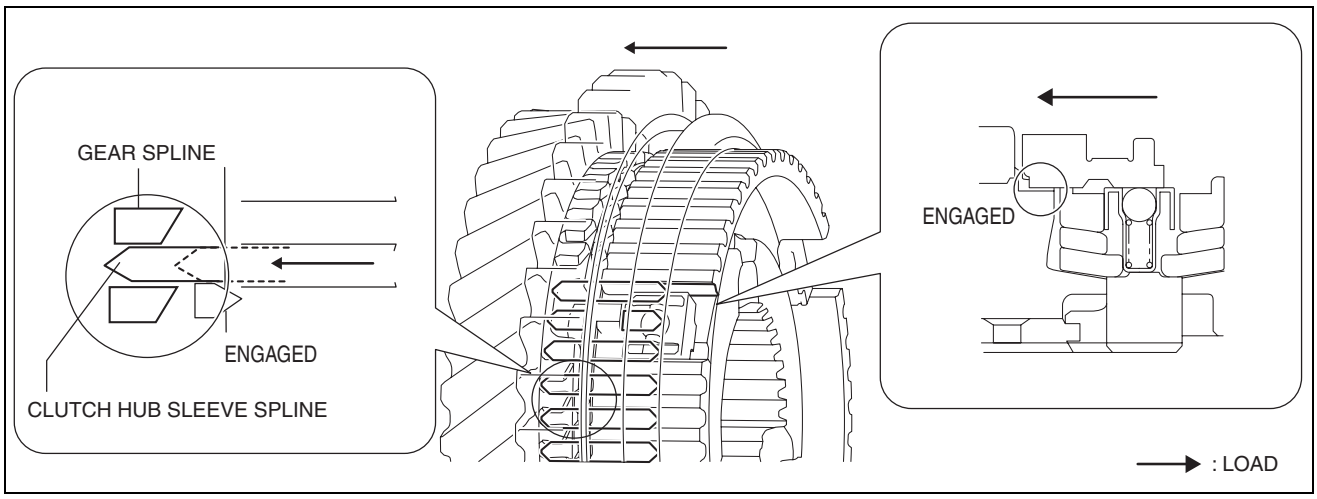
ac5wzn00001191

10. When the spline of the clutch hub sleeve passes through the synchronizer ring, the clutch hub sleeve presses down the detent ball and the detent ball is removed from the positioning groove of the clutch hub sleeve because the clutch hub sleeve moves toward the secondary 2nd gear side.



ac5wzn00001192

11. When the clutch hub sleeve moves toward the secondary 2nd gear side, the spline of the clutch hub sleeve and the spline of the gear are engaged, and the shifting operation is completed.



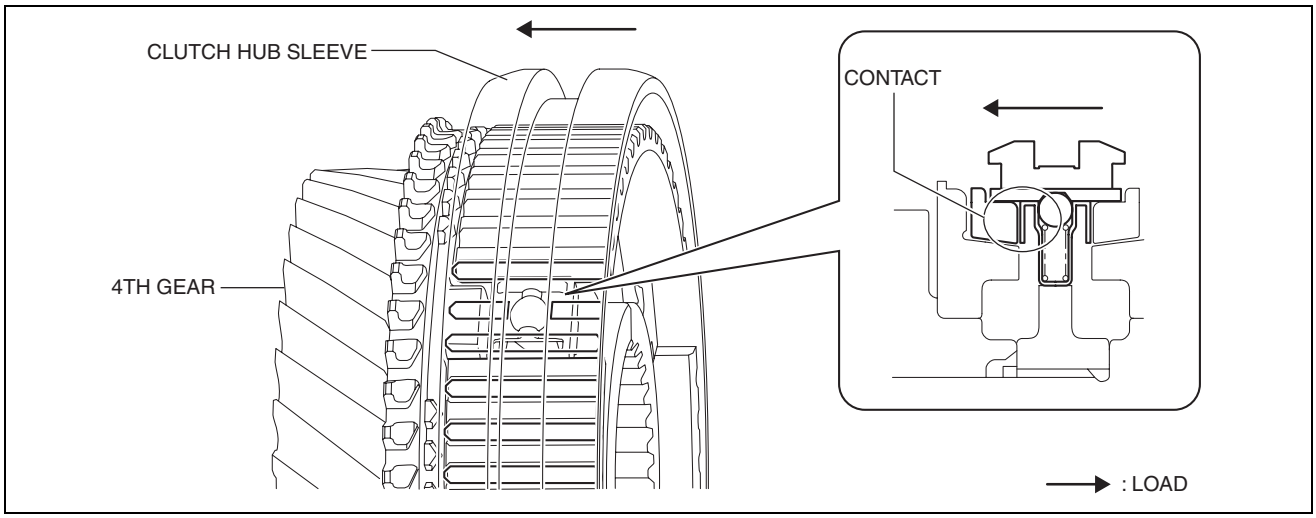
ac5wzn00001193

MANUAL TRANSAXLE [C66M-R, C66MX-R]

3GR, 4GR, 5GR, 6GR, reverse operation

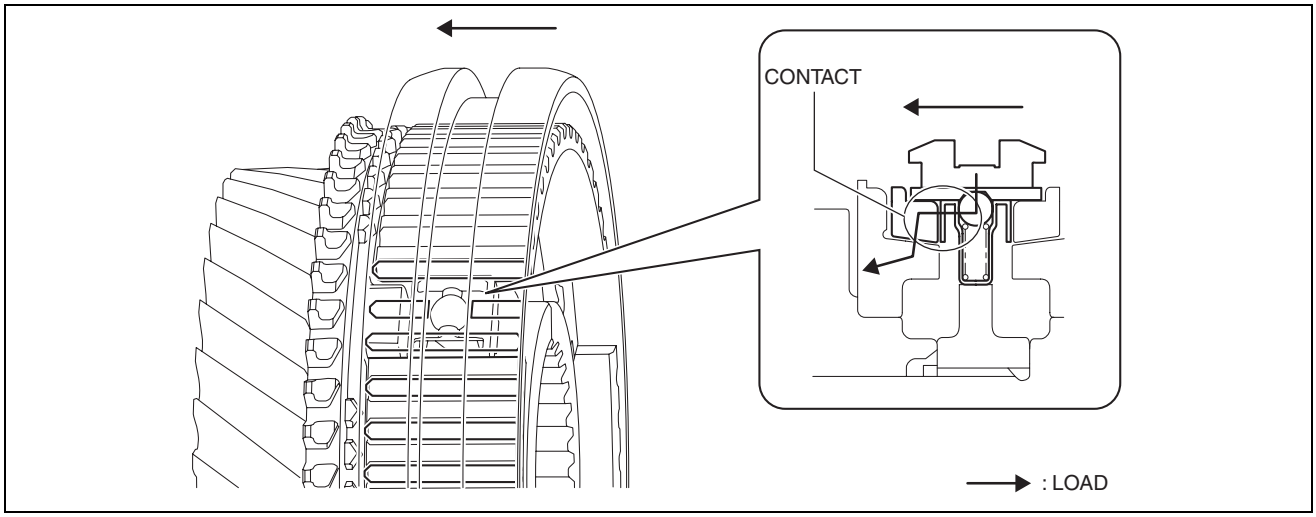
Note
- Here, operation during 4GR operation is described as an example.

1. When the clutch hub sleeve moves toward the 4th gear side, the synchronizer key follows, and the synchronizer key contacts the end surface of the synchronizer ring.



ac5wzn00001194

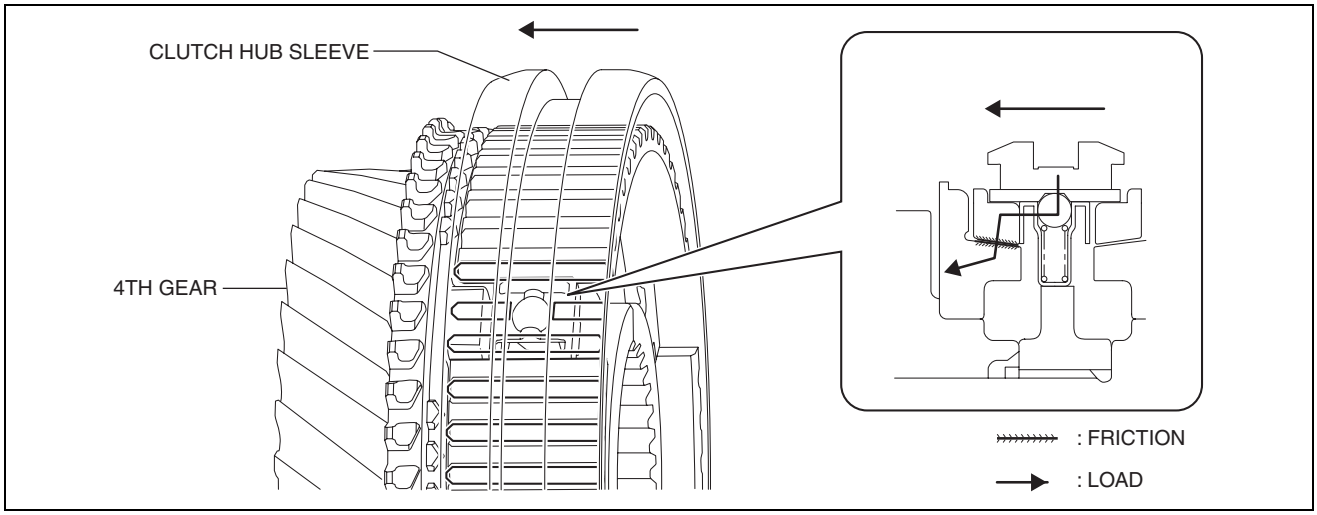
2. When the clutch hub sleeve moves toward the 4th gear side, the following synchronizer key applies load to the synchronizer ring, and the load is transmitted from the synchronizer ring to the gear.



ac5wzn00001195

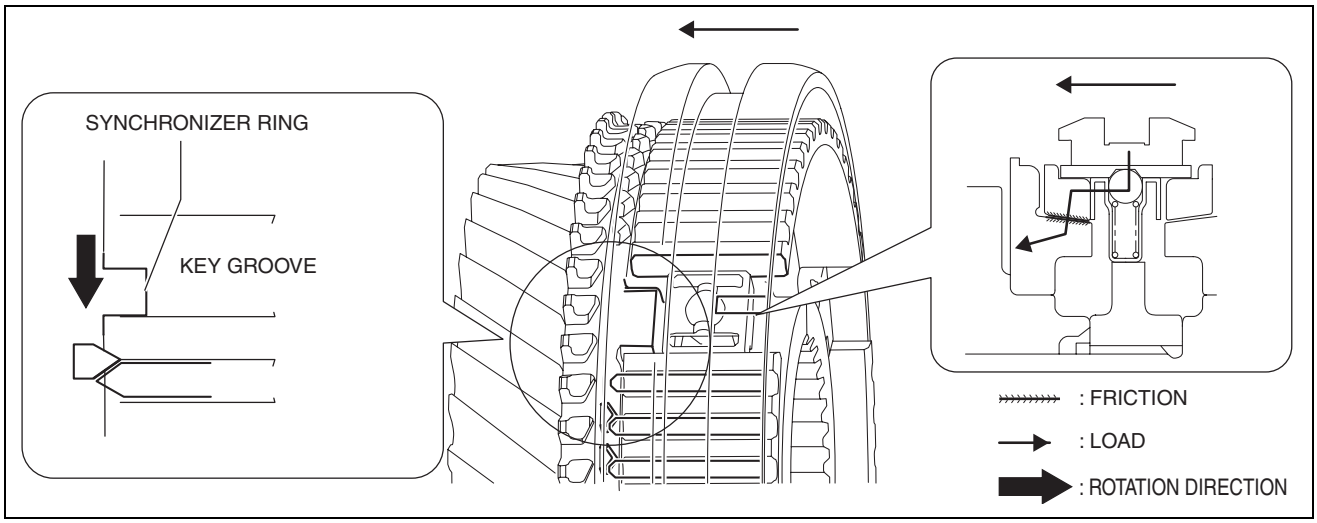
MANUAL TRANSAXLE [C66M-R, C66MX-R]

3. The friction force on the contacting surface of the synchronizer ring and the gear is generated by applying load to the parts between the synchronizer ring and the gear.



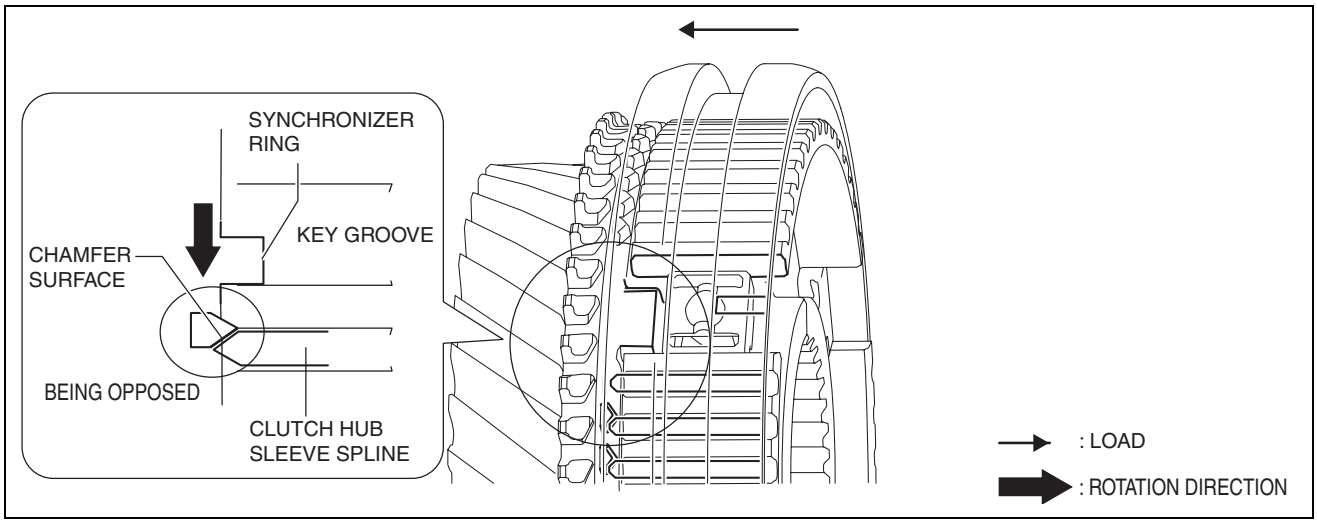
ac5wzn00001196

4. For the friction force of the synchronizer ring and the gear, synchronizer ring rotates only the key groove gap of the clutch hub sleeve.



ac5wzn00001197

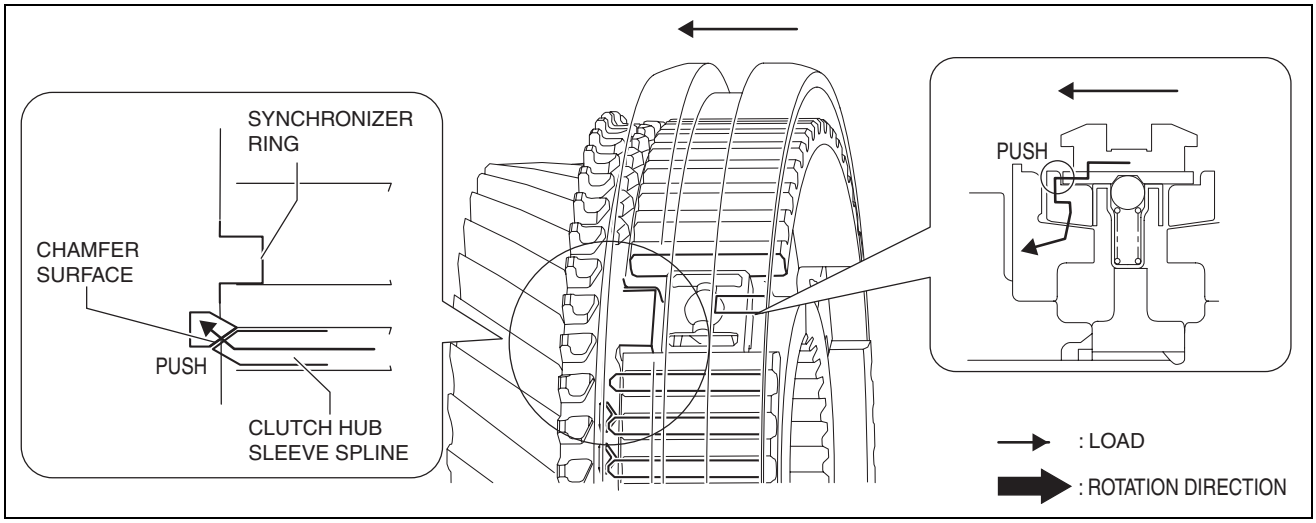
5. Because the synchronizer ring rotates, the spline of the clutch hub sleeve which moves toward the 4th gear side and the chamfer of the synchronizer ring are opposed to each other.



ac5wzn00001198

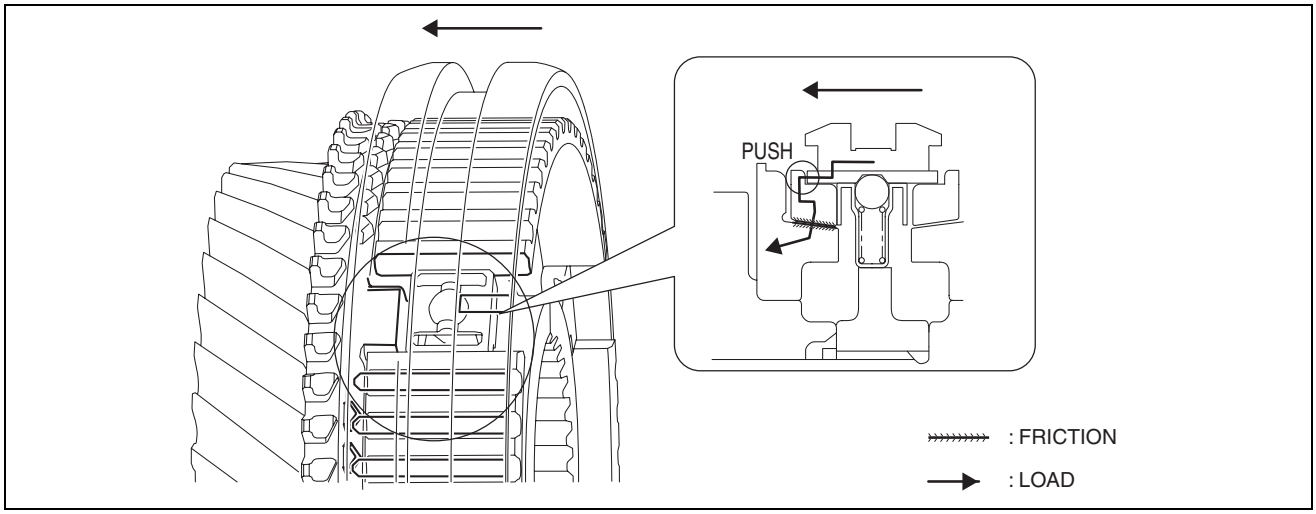
MANUAL TRANSAXLE [C66M-R, C66MX-R]

6. When the clutch hub sleeve moves toward the 4th gear, the load transmitted from the clutch hub sleeve to the gear increases because the spline of the clutch hub sleeve pushes the chamfer of the synchronizer ring.



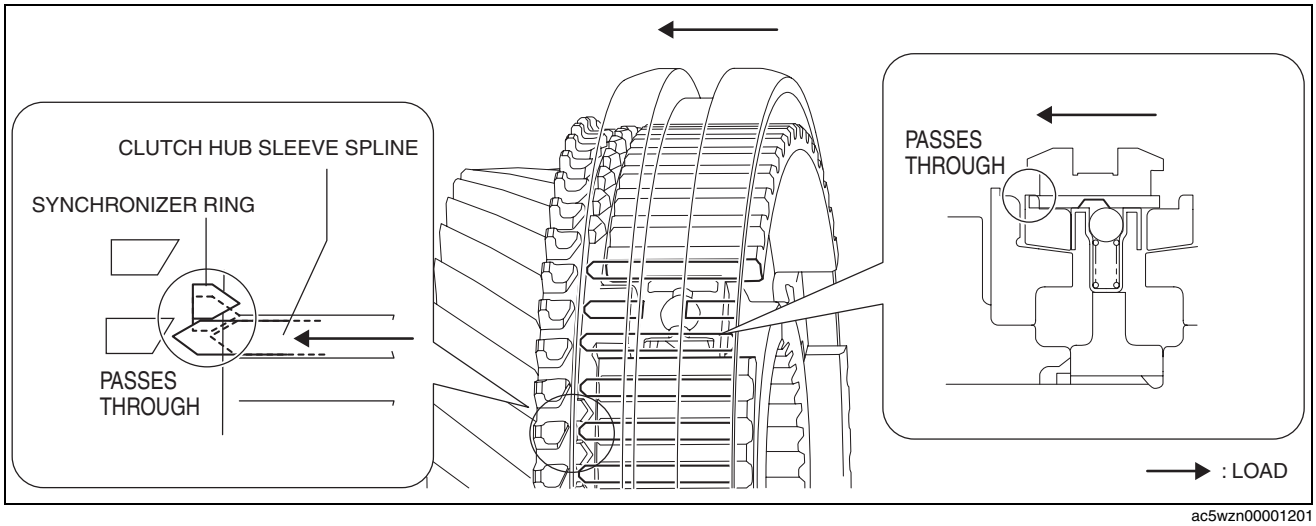
ac5wzn00001199

7. The friction force on the contacting surface of the parts is increased by increasing the load transmitted from the clutch hub sleeve to the gear.



ac5wzn00001200

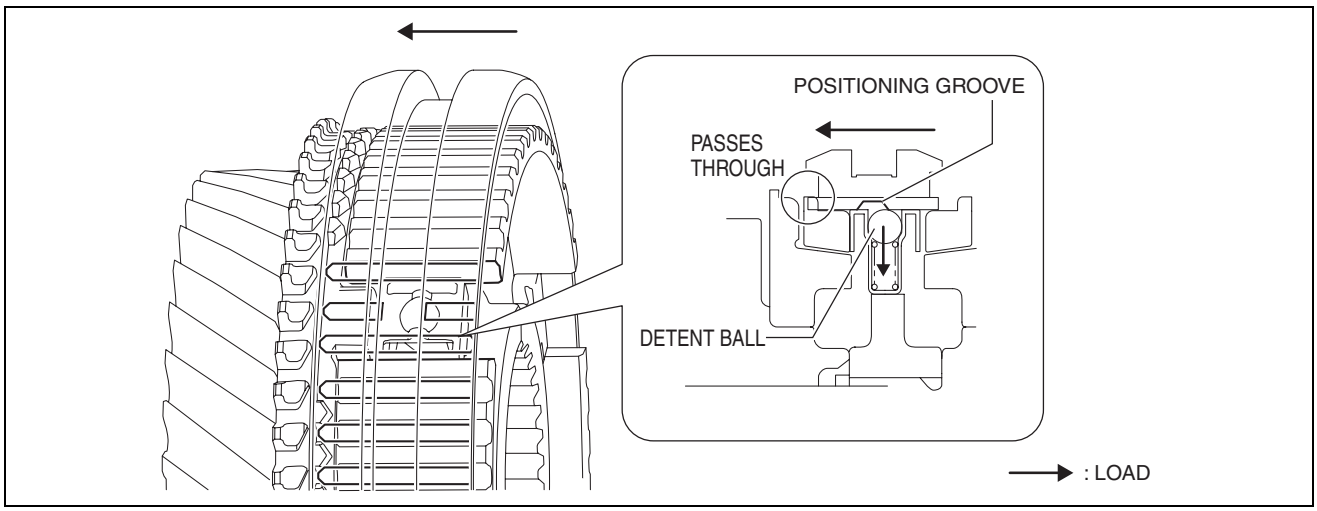
8. The increased friction force disappears the difference in the rotation speed between the synchronizer ring and the gear, and the rotation is synchronized.
9. When synchronization in rotation speed of the gear and the clutch hub sleeve is performed, the spline of the clutch hub sleeve passes through the synchronizer ring.



ac5wzn00001201

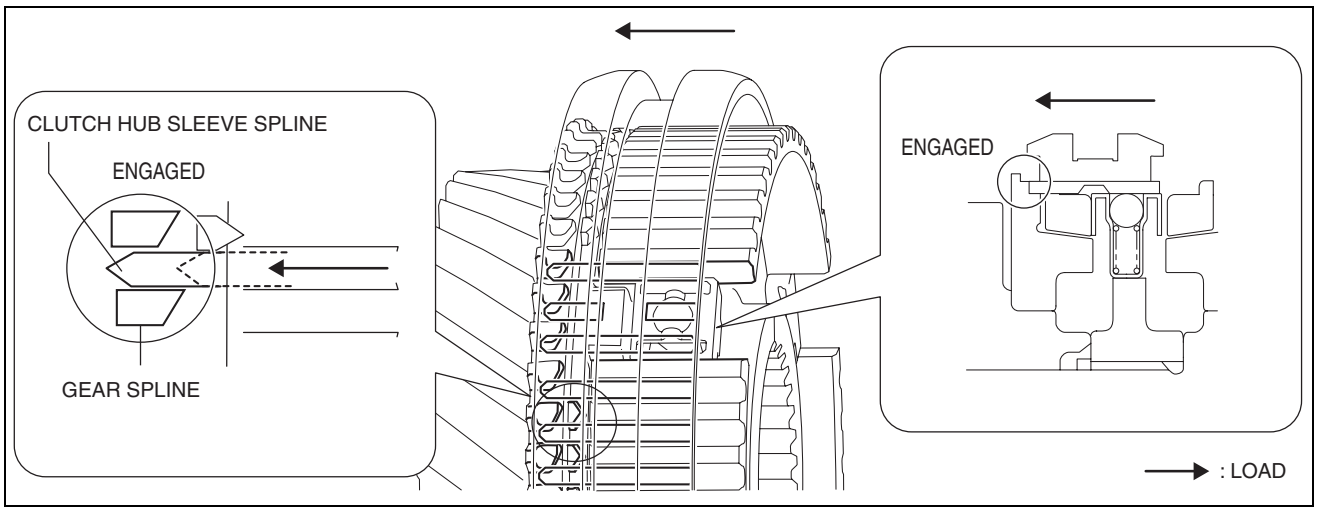
MANUAL TRANSAXLE [C66M-R, C66MX-R]

10. When the spline of the clutch hub sleeve passes through the synchronizer ring, the clutch hub sleeve presses down the ball and the ball is removed from the positioning groove of the clutch hub sleeve because the clutch hub sleeve moves toward the secondary 4th gear side.



ac5wzn00001202

11. When the clutch hub sleeve moves toward the secondary 4th gear side, the spline of the clutch hub sleeve and the spline of the gear are engaged, and the shifting operation is completed.



ac5wzn00001203

POWERTRAIN SYSTEM [C66M-R, C66MX-R]

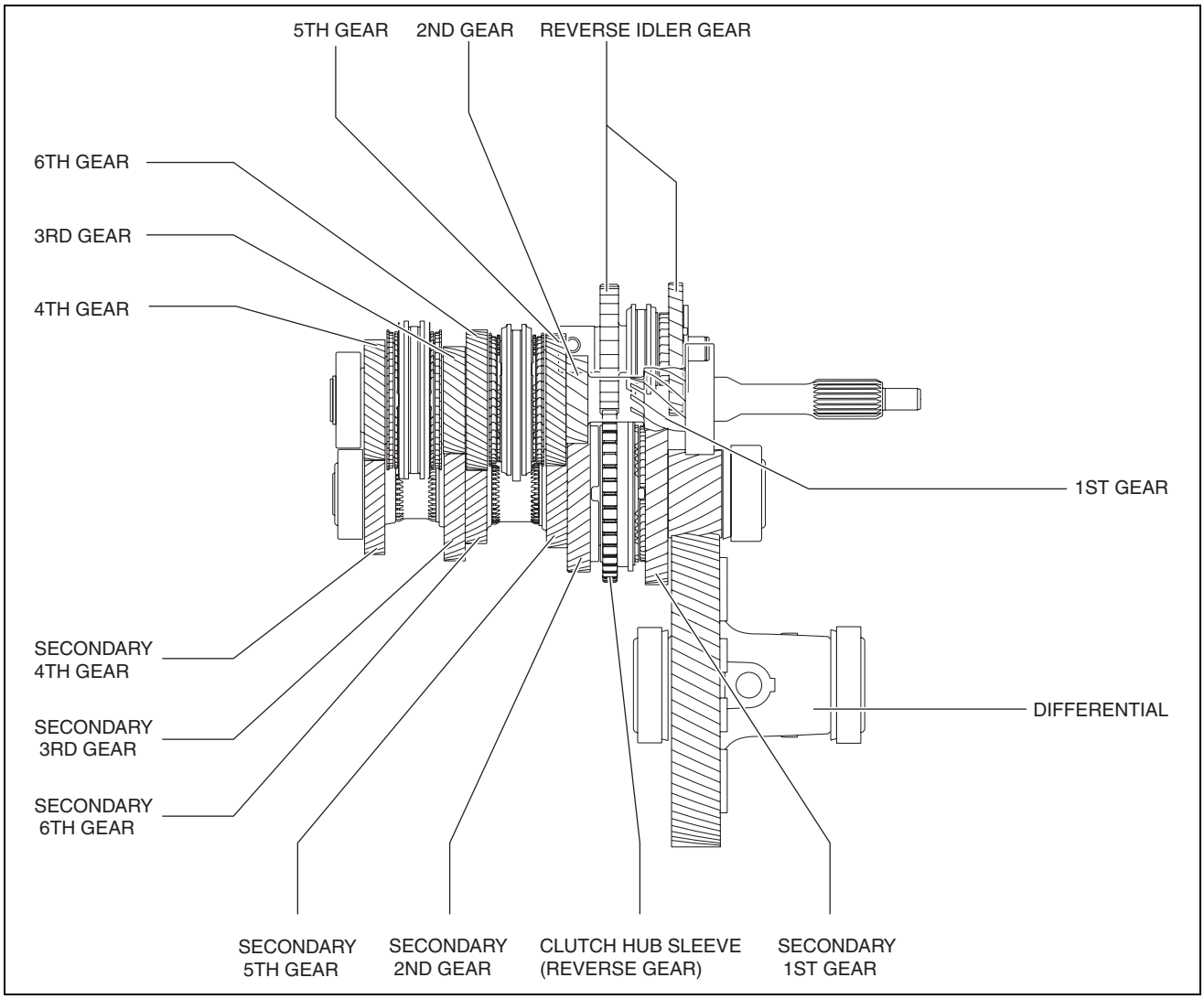
id0515ma284100

Purpose, Function

- The powertrain mechanism changes the gear combination by engaging or releasing the clutch hub and gear, and changes the power transmission route. Because of the change in the power transmission route, the drive force (speed, torque, rotation direction) input from the engine is converted.

MANUAL TRANSAXLE [C66M-R, C66MX-R]

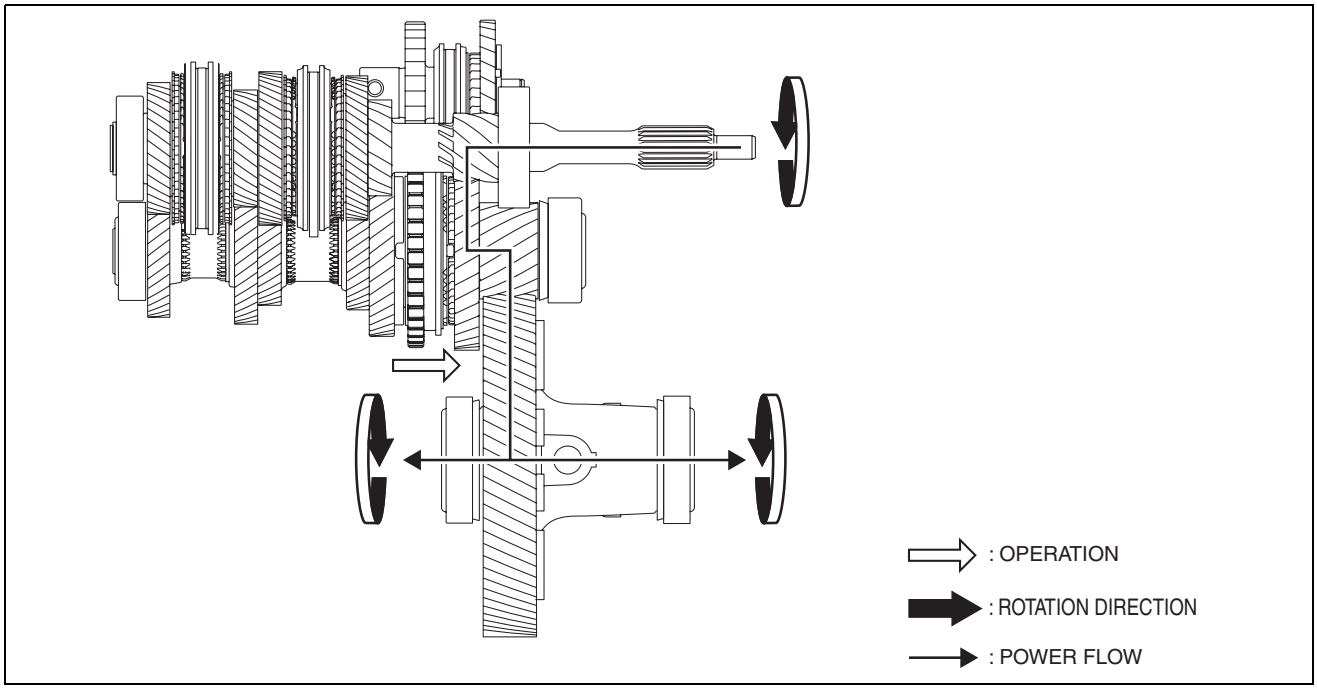
Construction



am3uun0000179

MANUAL TRANSAXLE [C66M-R, C66MX-R]

Operation
1GR



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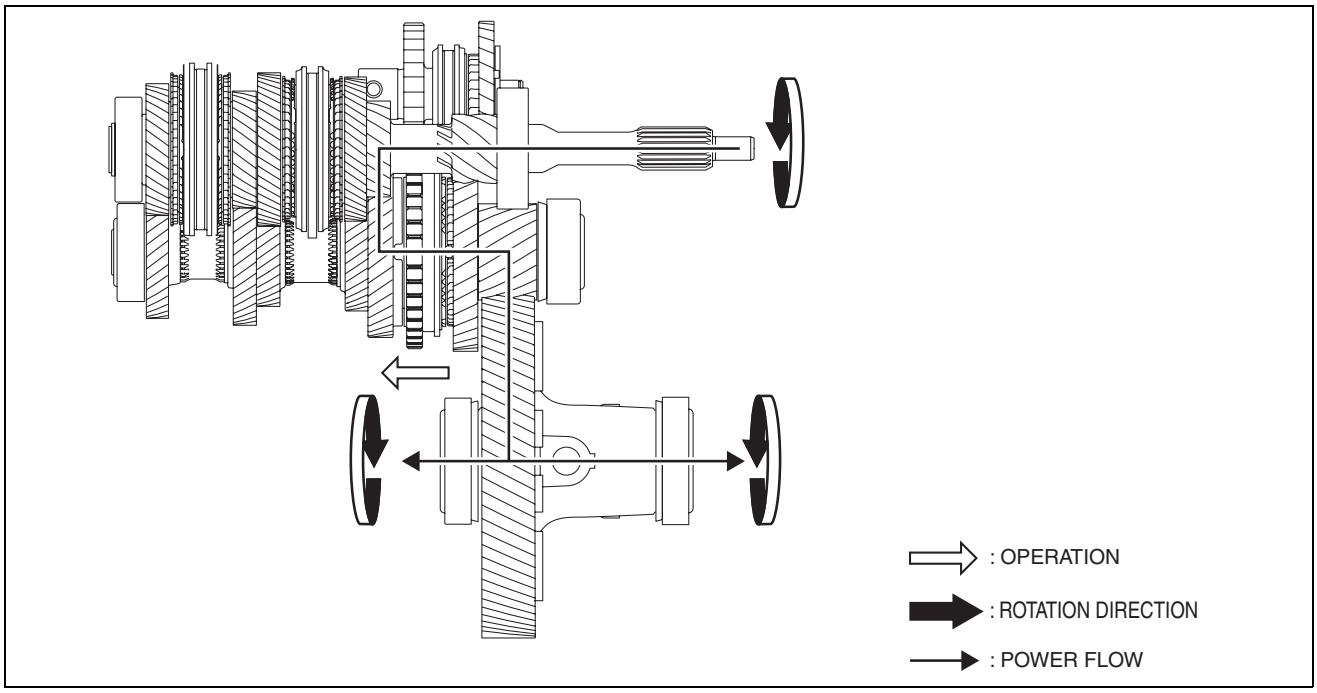
2GR



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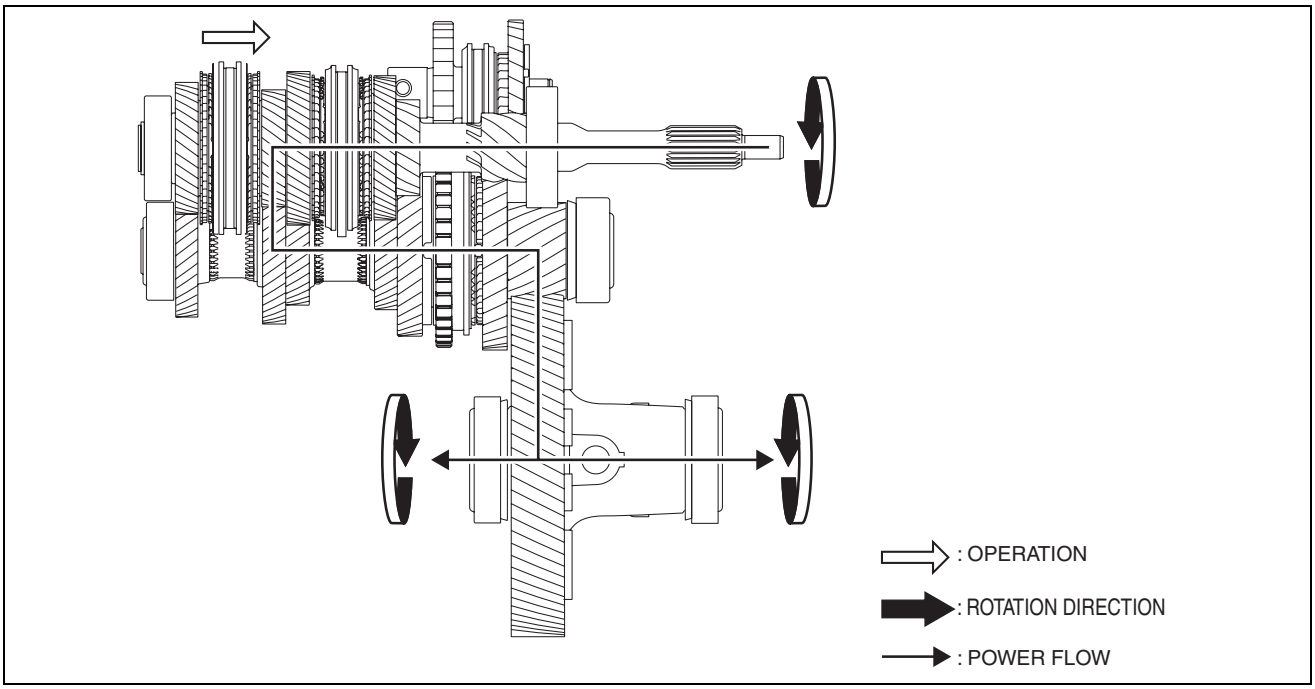
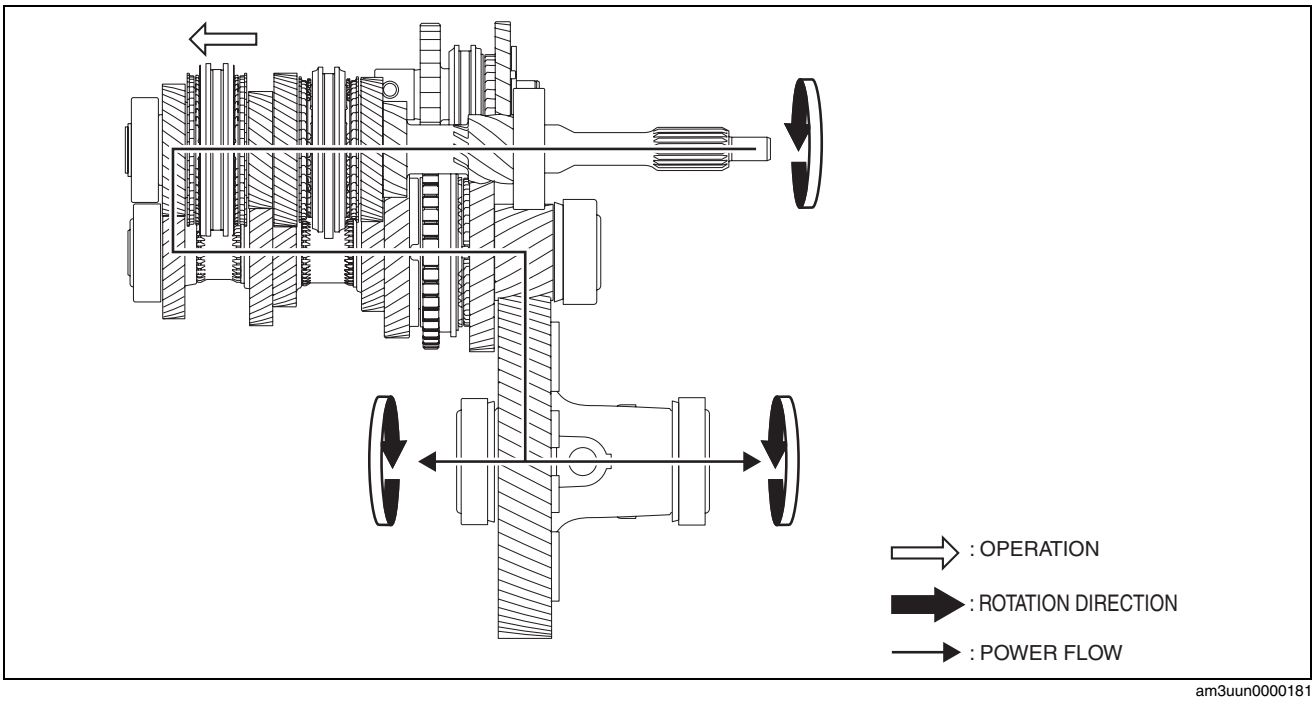
MANUAL TRANSAXLE [C66M-R, C66MX-R]

3GR



am3uun0000179

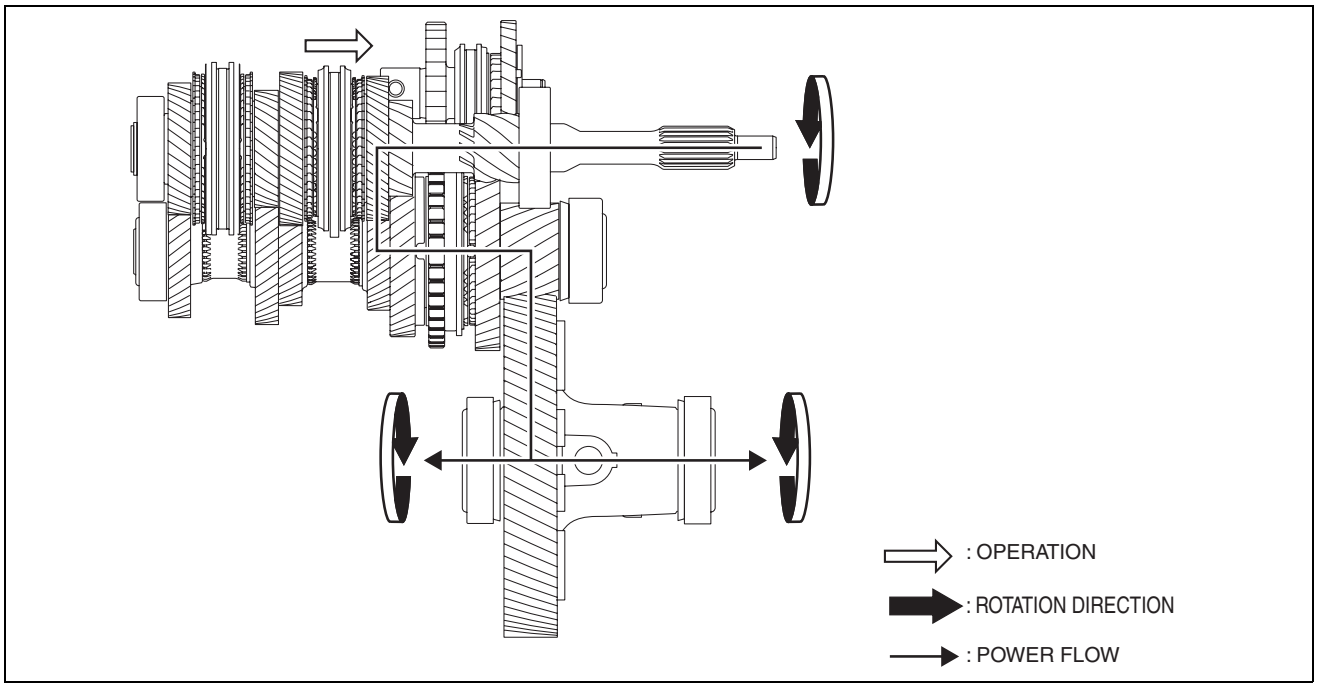
4GR



am3uun0000181

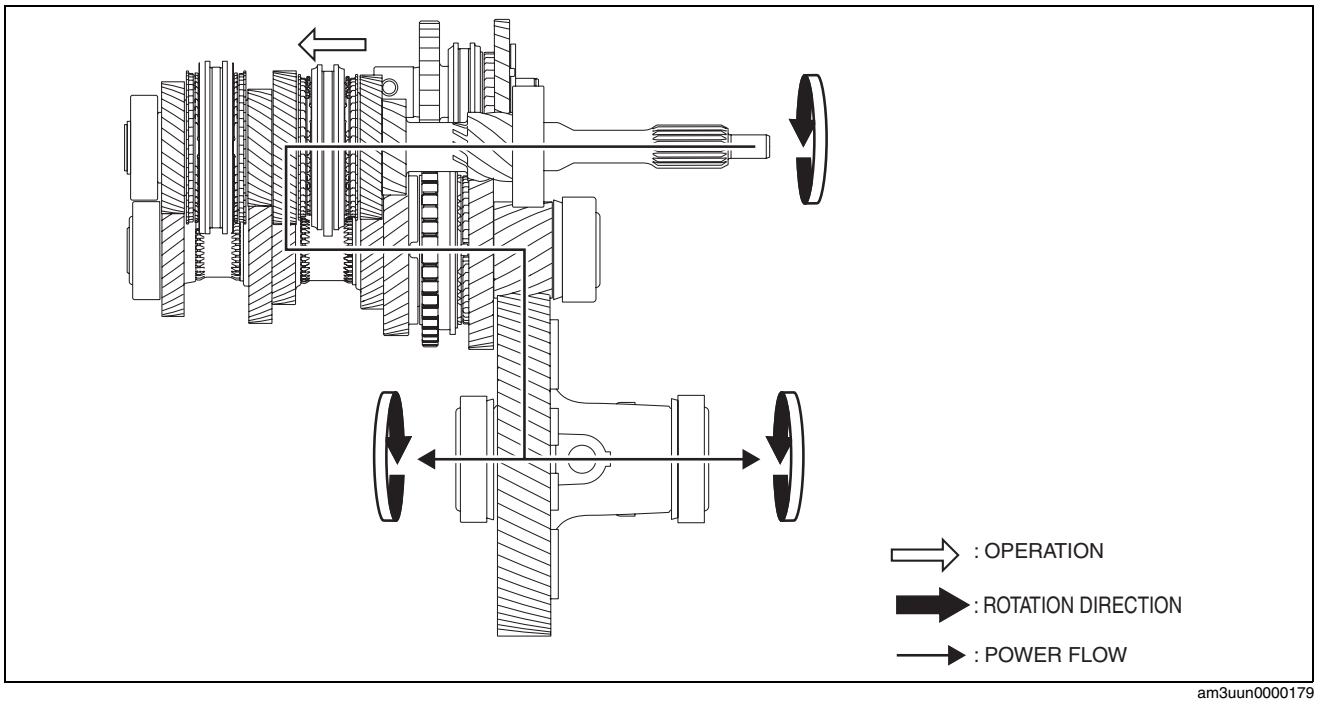
MANUAL TRANSAXLE [C66M-R, C66MX-R]

5GR



am3uun0000179

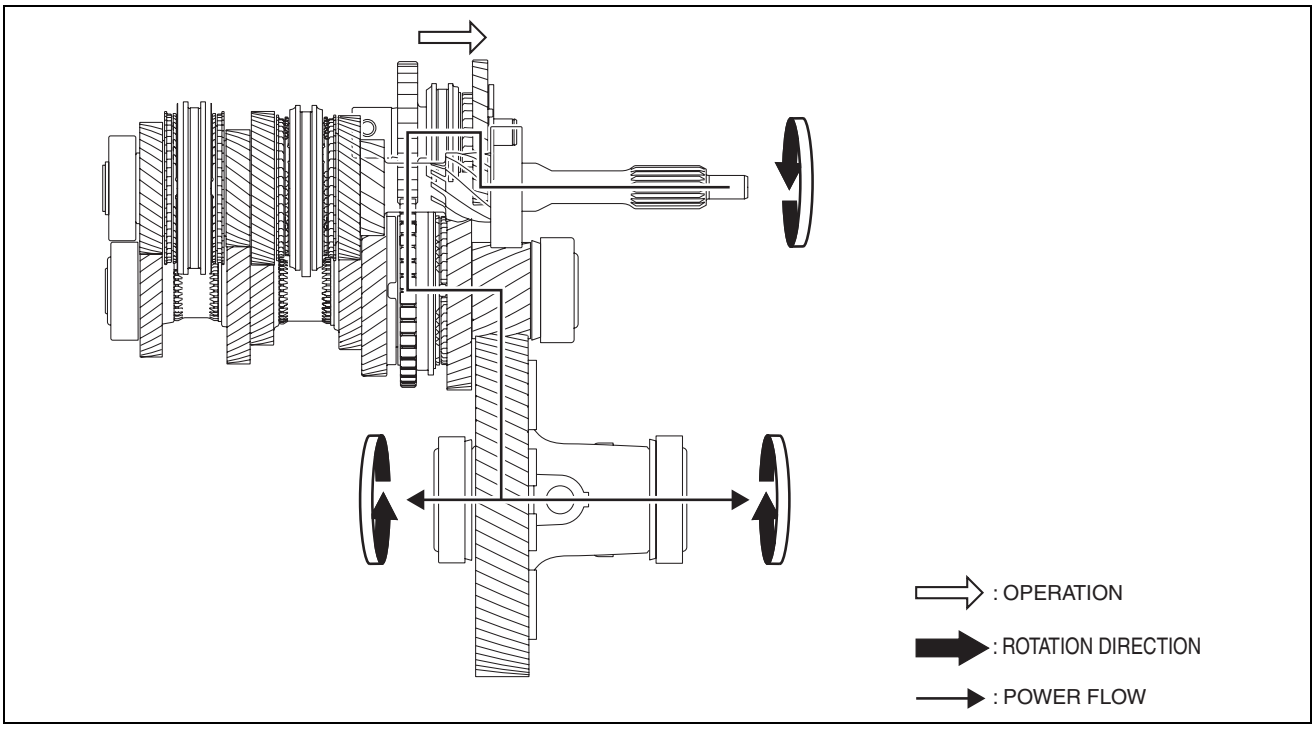
6GR



am3uun0000179

MANUAL TRANSAXLE [C66M-R, C66MX-R]

Reverse



am3uun0000180

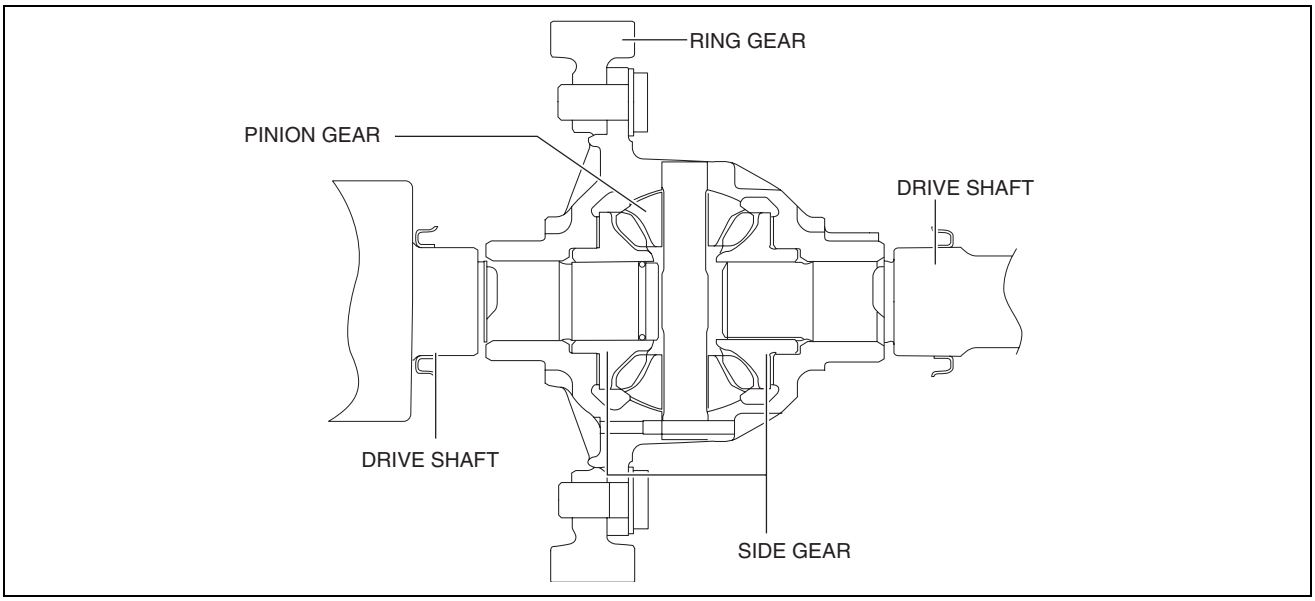
DIFFERENTIAL [C66M-R, C66MX-R]

id0515ma284200

Purpose, Function

- The differential absorbs the rotation speed of the inside and outside wheel of a wheel set when the vehicle is cornering.

Construction



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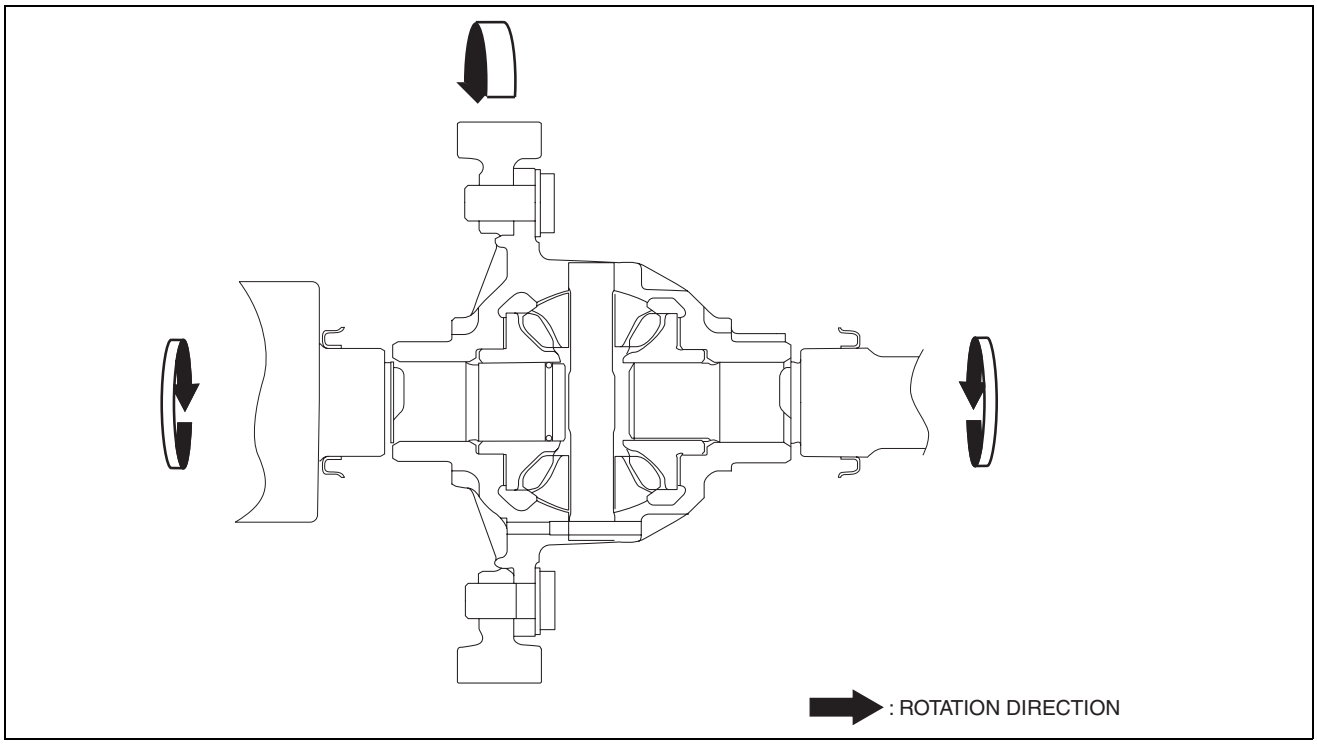
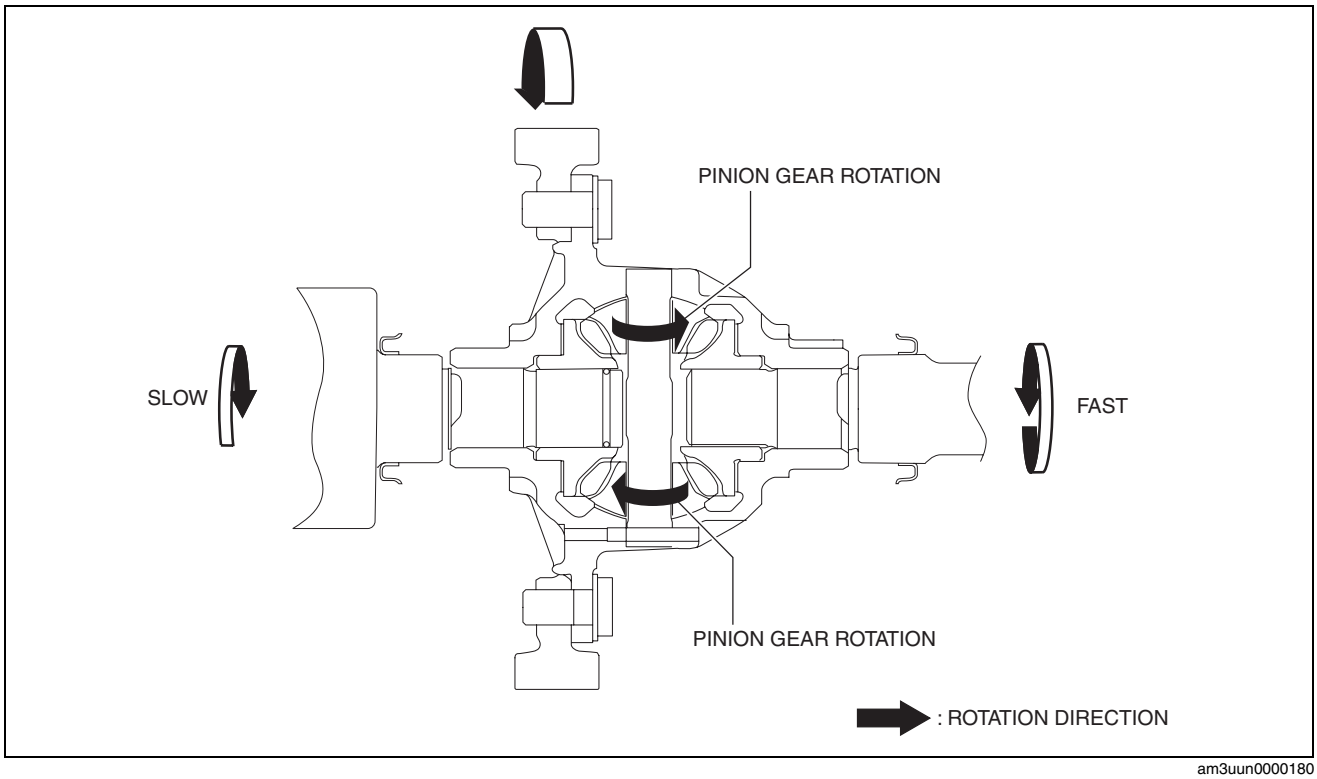
MANUAL TRANSAXLE [C66M-R, C66MX-R]

Operation
Driving in a straight line



am3uun0000180

Cornering



am3uun0000180

05-15B MANUAL TRANSAXLE [D66M-R, D66MX-R]

MANUAL TRANSAXLE [D66M-R, D66MX-R]

MANUAL TRANSAXLE [D66M-R, D66MX-R]

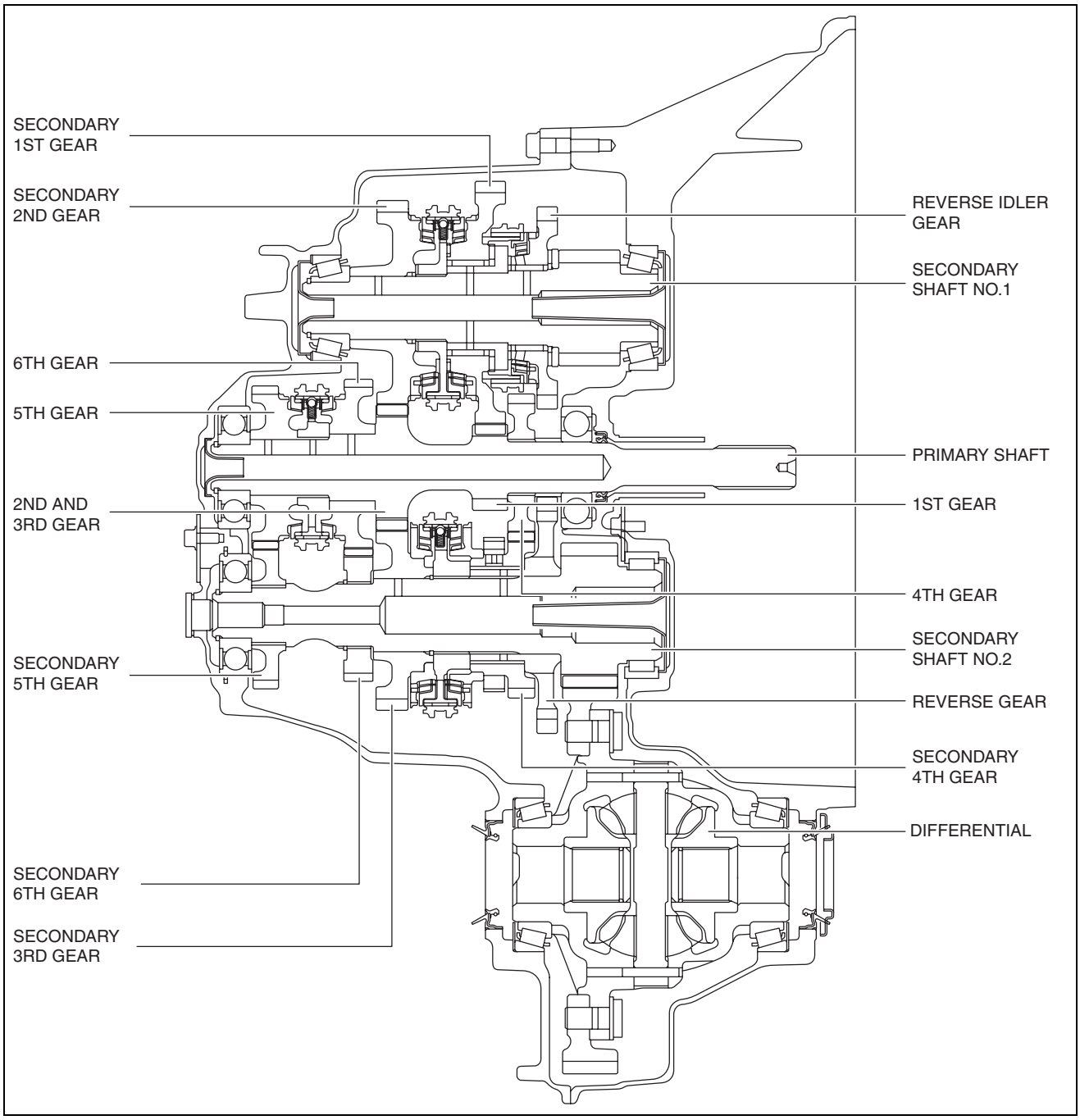
id0515md283800

Purpose, Function

- The MTX converts the drive force (speed, torque, rotation direction) input from the engine according to the shift lever operation inside the vehicle.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

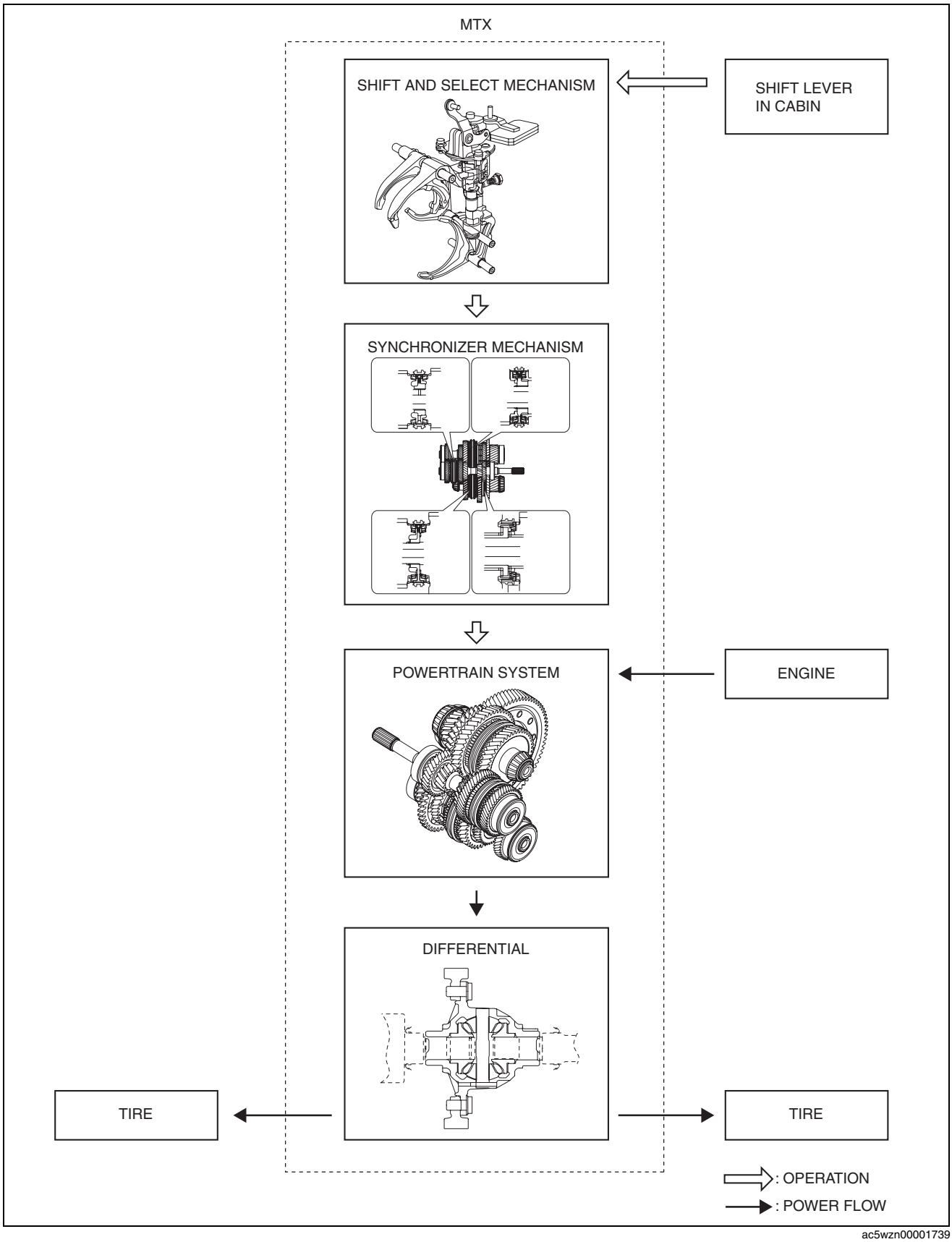
Construction



ac5wzn00001997

MANUAL TRANSAXLE [D66M-R, D66MX-R]

Operation



ac5wzn00001739

MANUAL TRANSAXLE [D66M-R, D66MX-R]

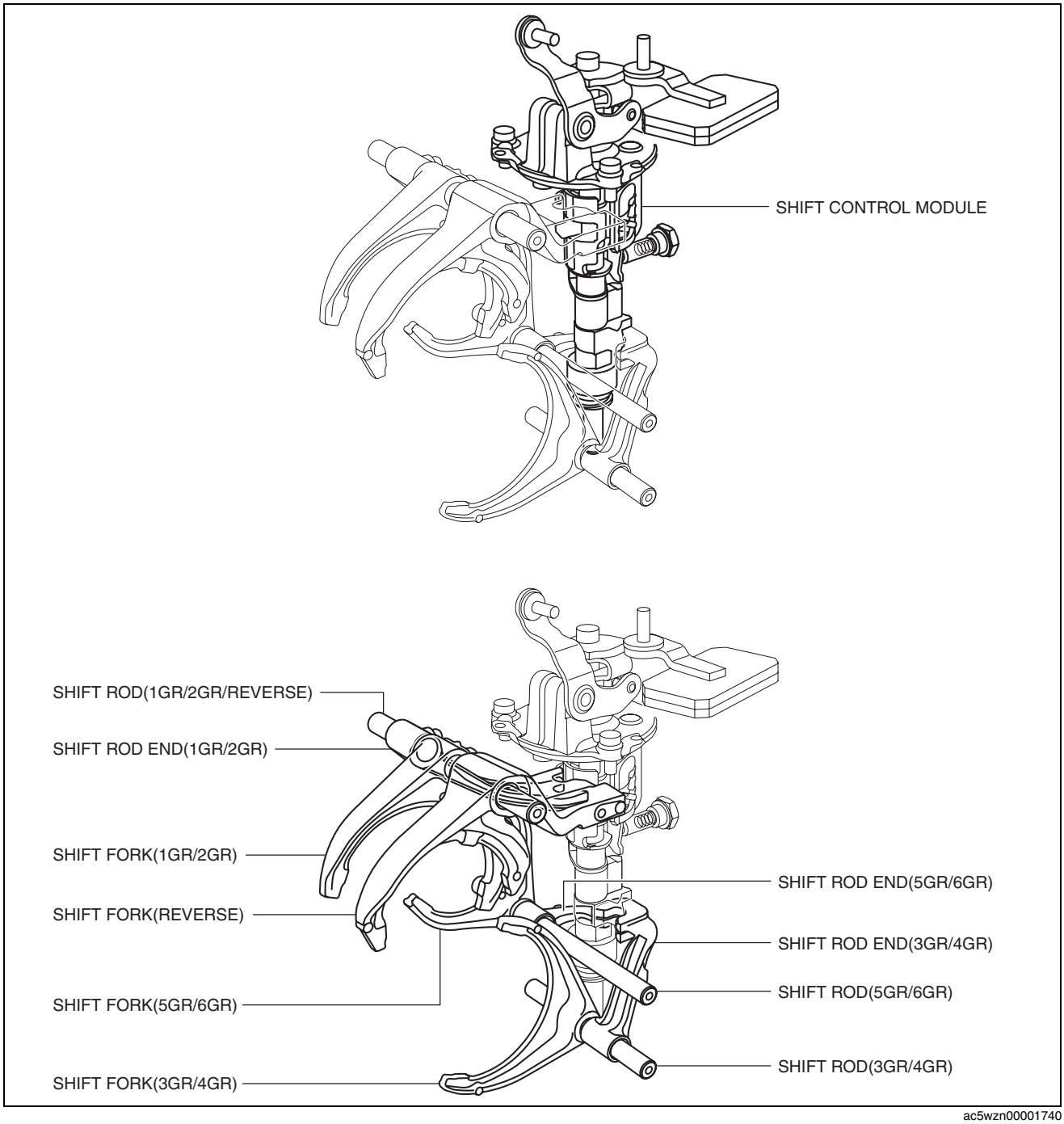
SHIFT AND SELECT MECHANISM [D66M-R, D66MX-R]

id0515md283900

Purpose, Function

- The shift and select mechanism moves the shift fork to change gears according to the operation of the shift lever in the cabin.

Construction

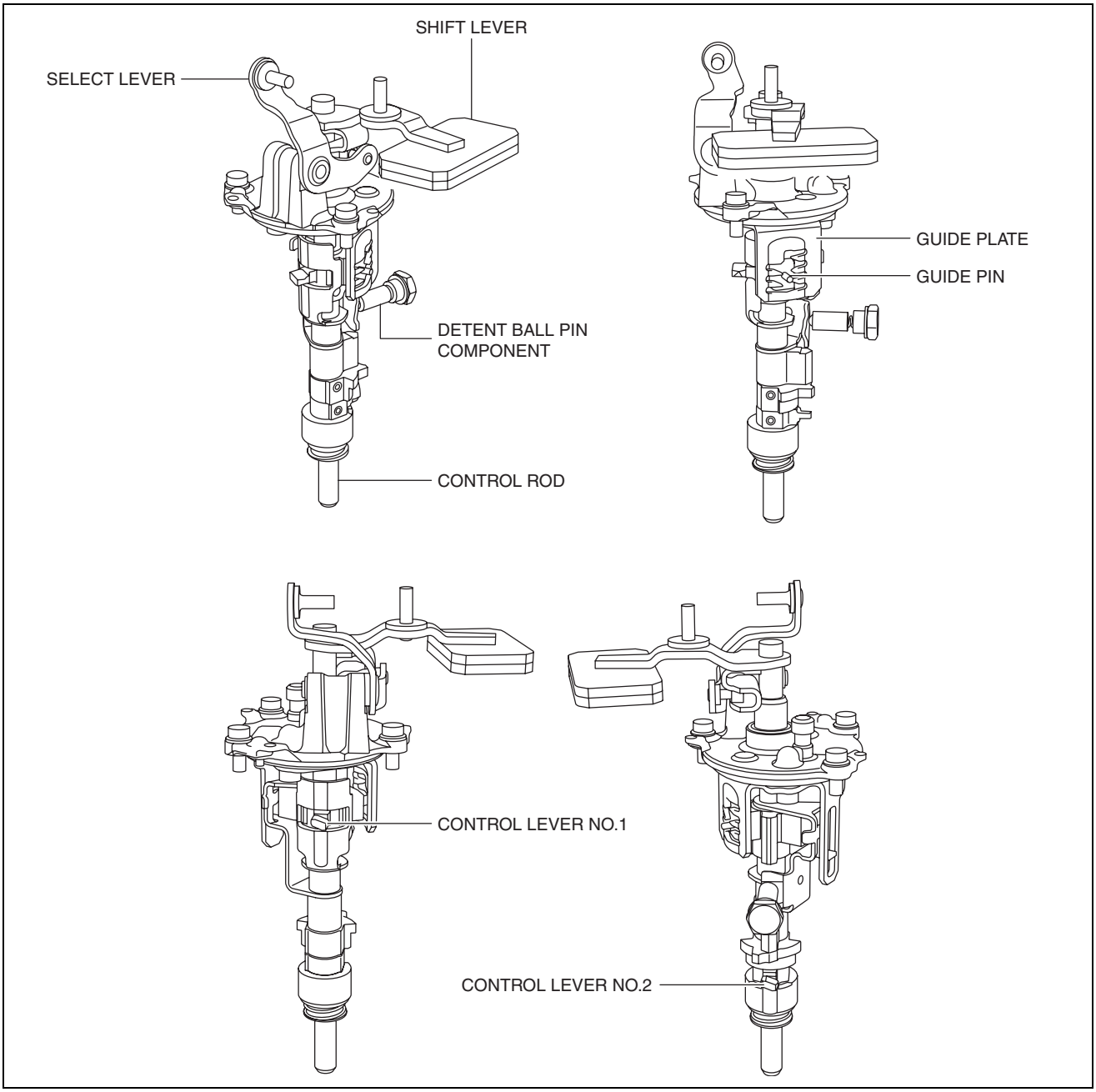


ac5wzn00001740

MANUAL TRANSAXLE [D66M-R, D66MX-R]

Shift control module

- The moving parts of the shift control module are vertically positioned.



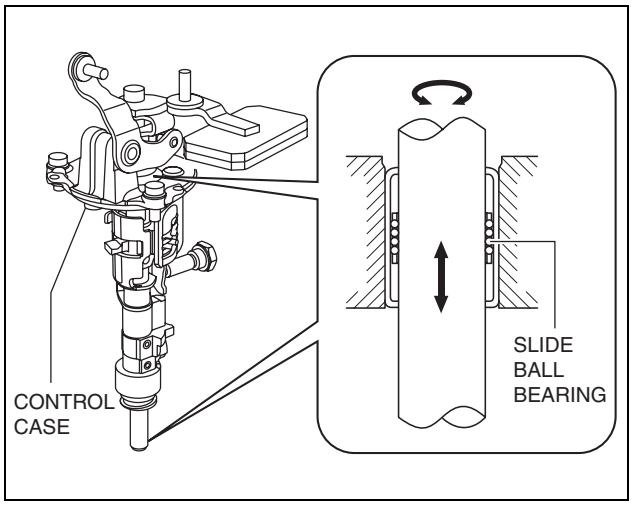
ac5wzn00001741

- In this module, the control lever No.1 and No.2 which moves the shift rod end is directly assembled to the control rod. In addition, because the control rod moves up and down, the weight of the control rod is utilized when the control rod moves down.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

Slide ball bearing

- A slide ball bearing has been adopted to the sliding area between the control rod and the transaxle case, and between the control rod and the control case.
- In this part, the bearing case moves in the drive and thrust directions.
- Compared to the conventional bushing, sliding resistance between the control rod and the transaxle case, and between the control rod and the control case has been reduced.



ac5wzn00001742

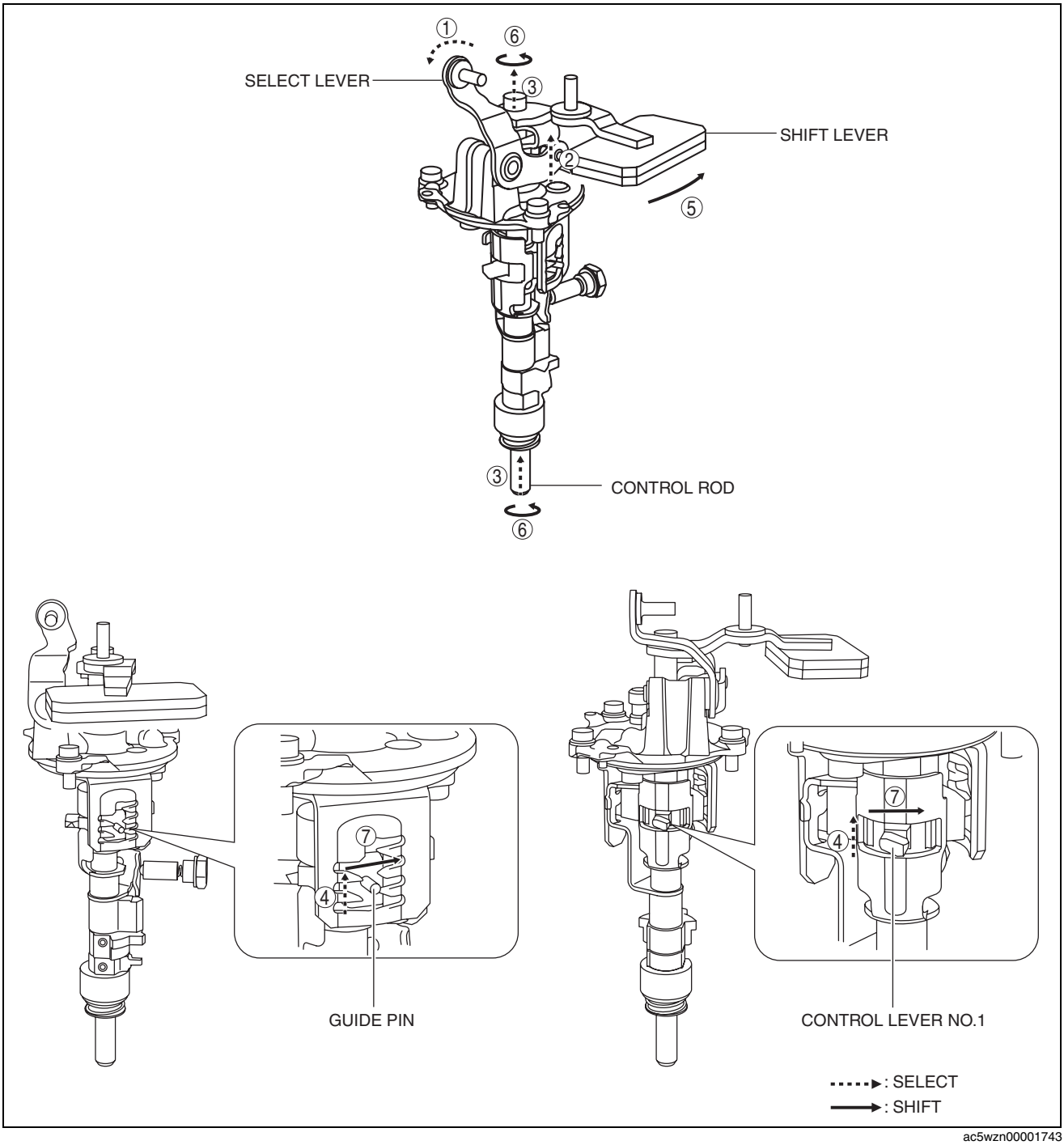
Operation

Note

- Shifting operations from neutral to each gear are explained in this section.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

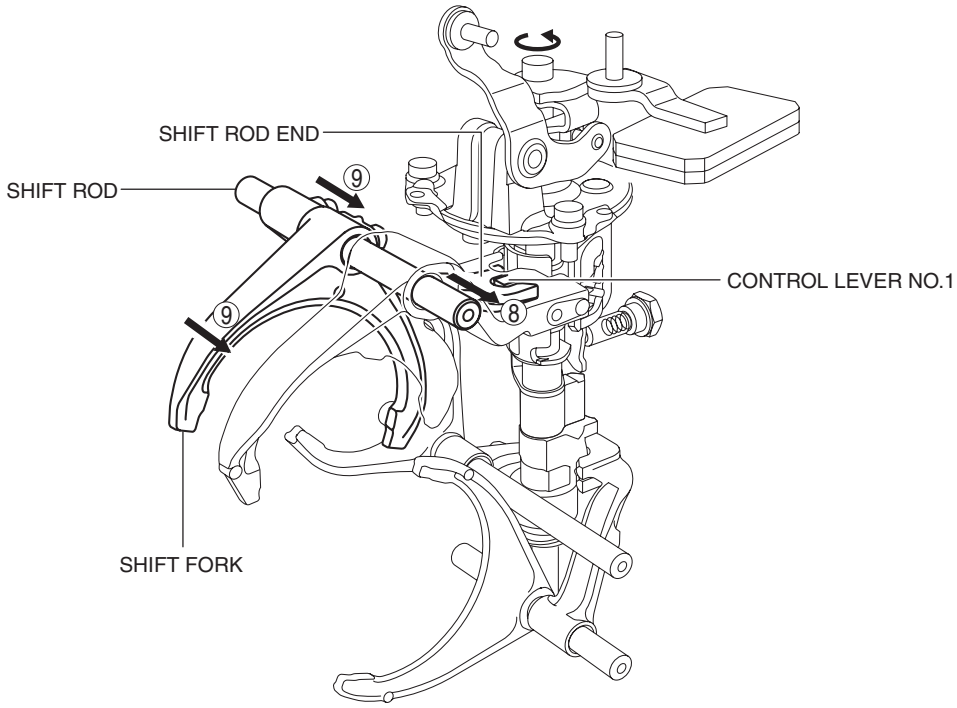
1GR



ac5wzn00001743

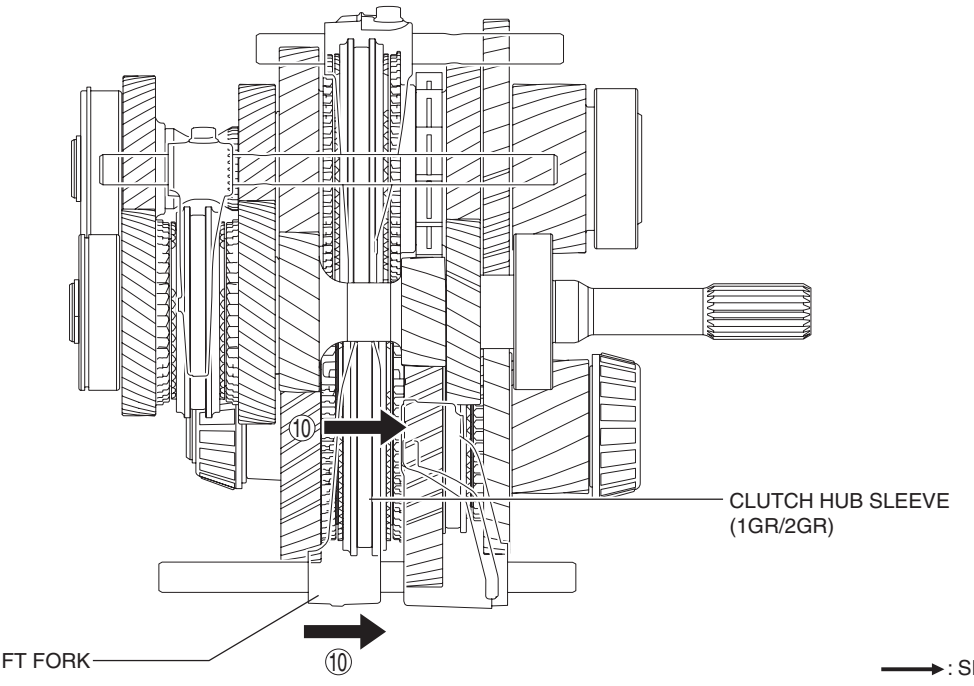
1. When the shift lever in the cabin is tilted to the left to shift to 1GR, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the control rod moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever No.1 and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted forward to shift to 1GR, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever No.1 and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [D66M-R, D66MX-R]



ac5wzn00001744

8. Because the control rod turns with the control lever No.1, the control lever No.1 pushes the shift rod end and moves it in the direction of arrow 8 shown in the figure.
9. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 9.

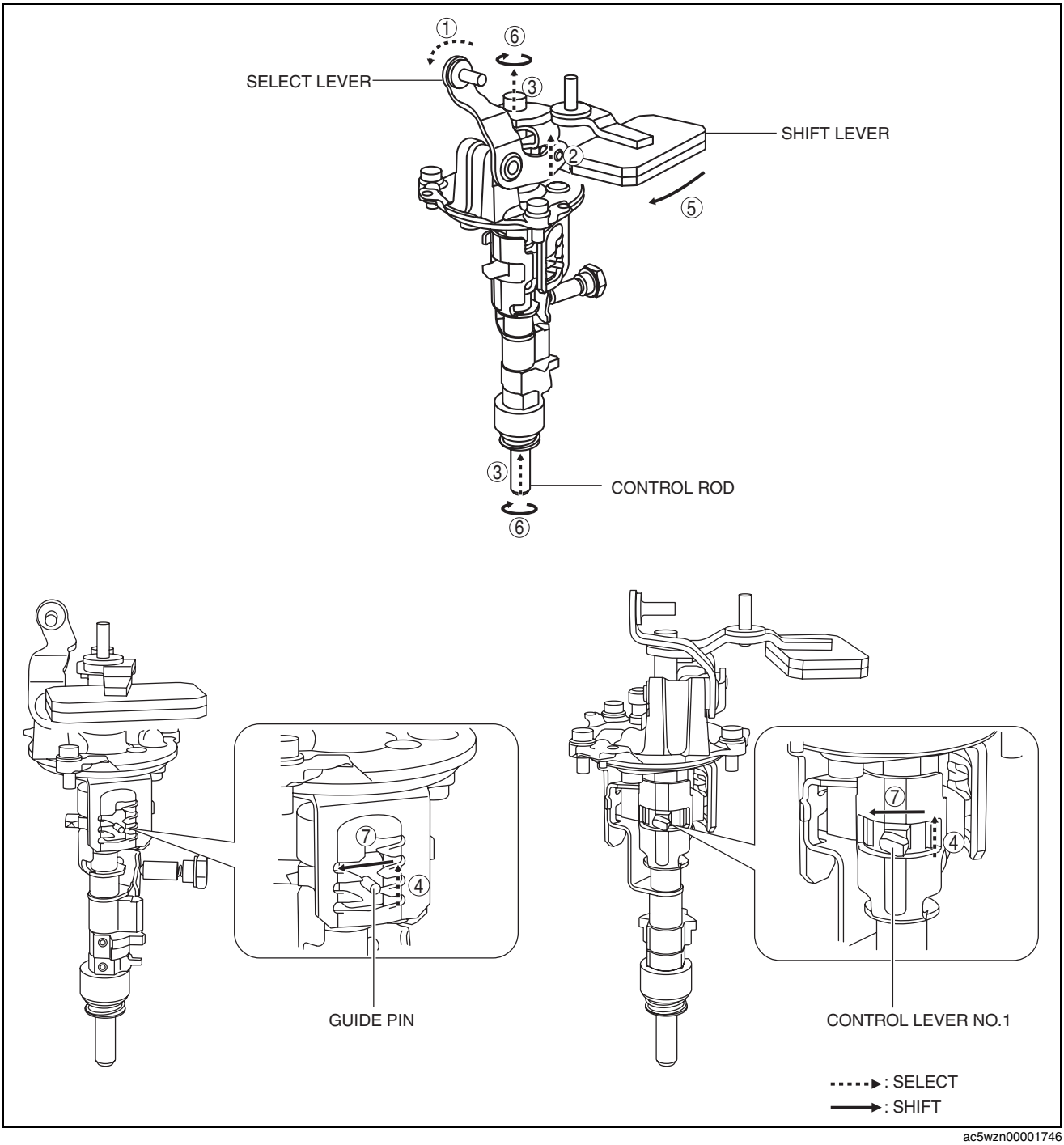


ac5wzn00001745

10. The shift fork moves the clutch hub sleeve in the direction of arrow 10 shown in the figure.
11. The shift change to 1GR is completed.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

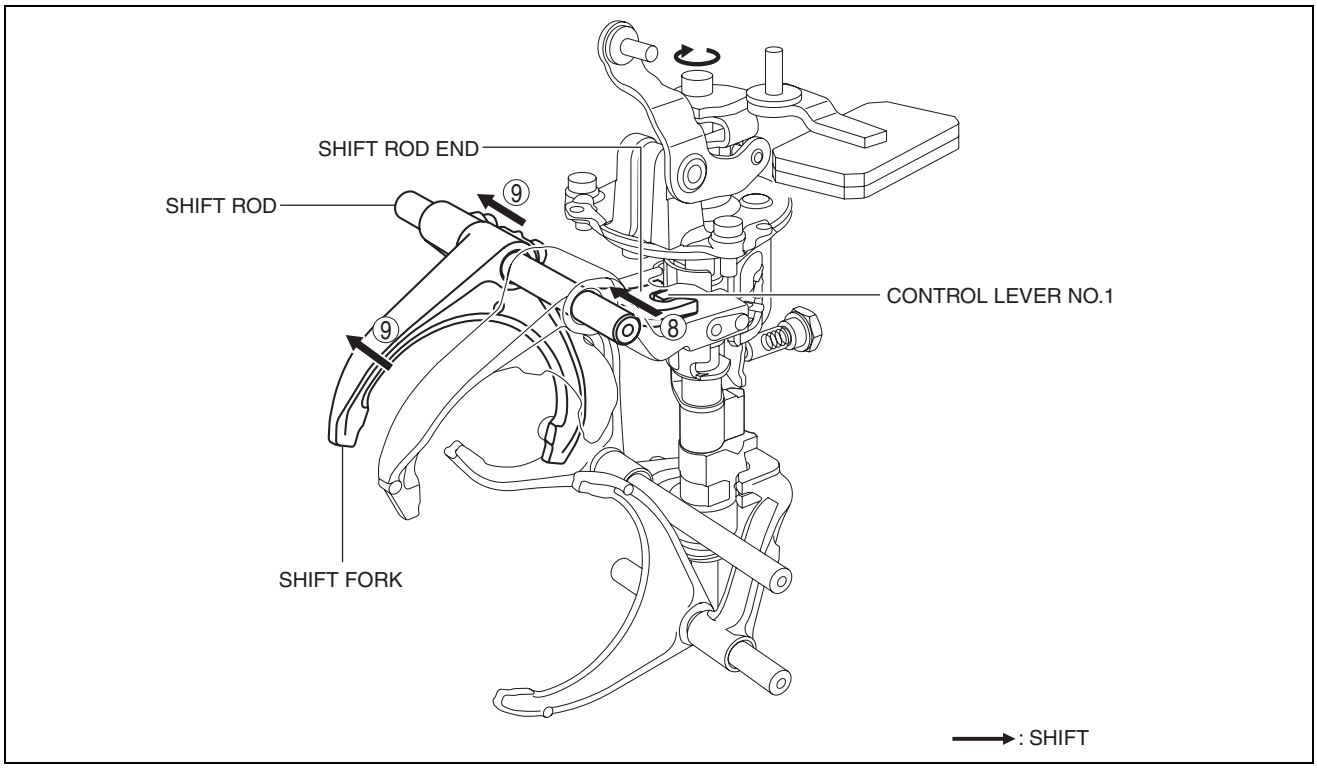
2GR



ac5wzn00001746

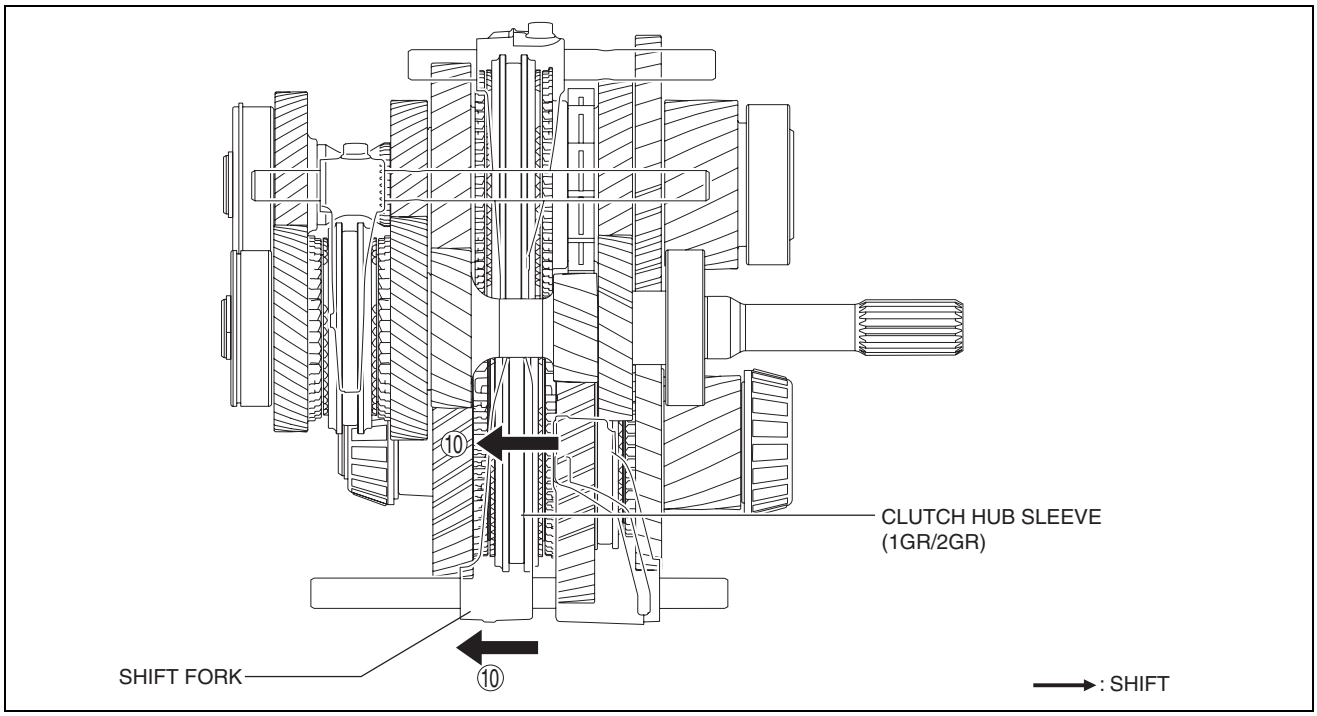
1. When the shift lever in the cabin is tilted to the left to shift to 2GR, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the control rod moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever No.1 and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted rearward to shift to 2GR, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever No.1 and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [D66M-R, D66MX-R]



ac5wzn00001747

8. Because the control rod turns with the control lever No.1, the control lever No.1 pushes the shift rod end and moves it in the direction of arrow 8 shown in the figure.
9. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 9.

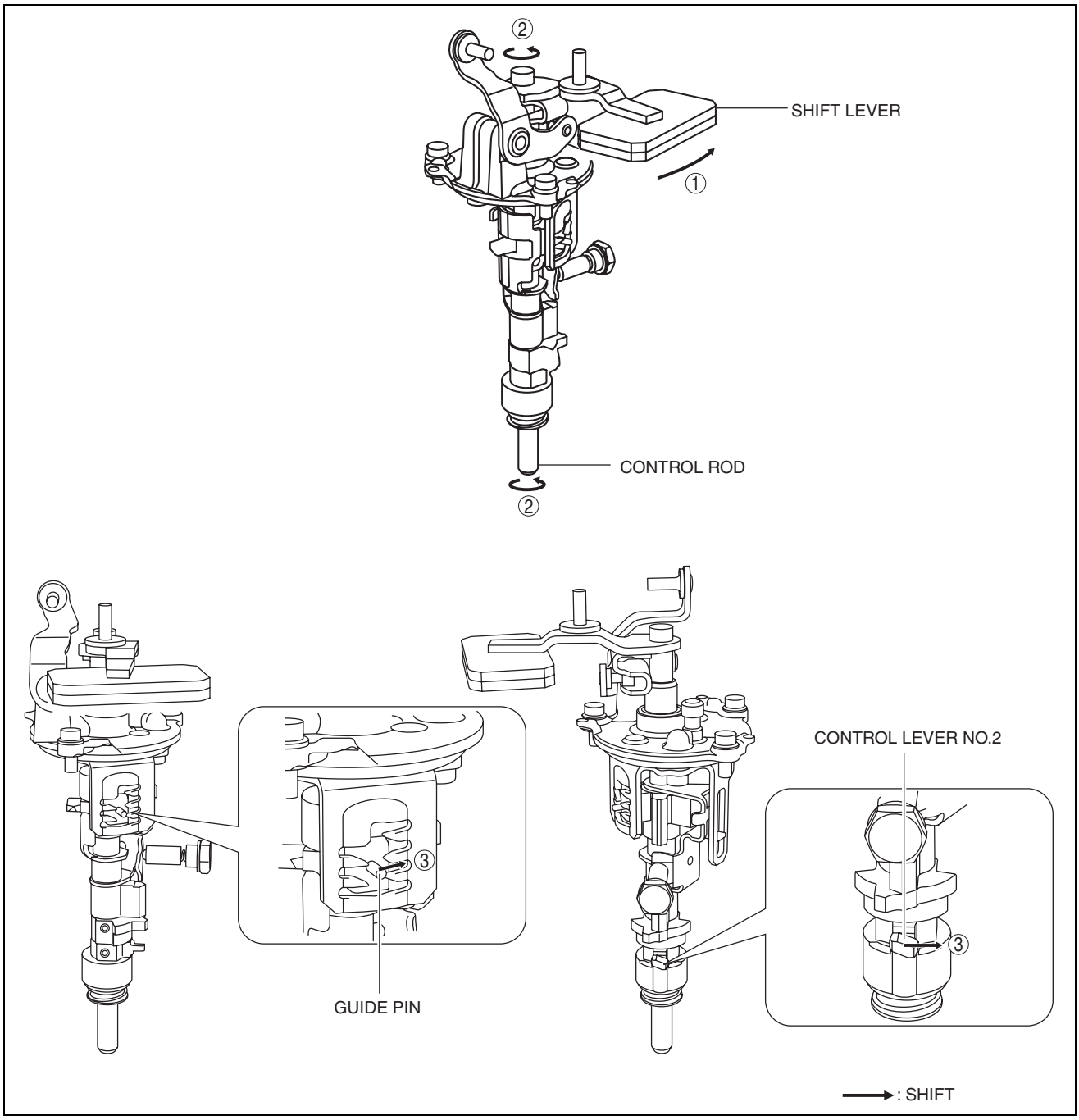


ac5wzn00001748

10. The shift fork moves the clutch hub sleeve in the direction of arrow 10 shown in the figure.
11. The shift change to 2GR is completed.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

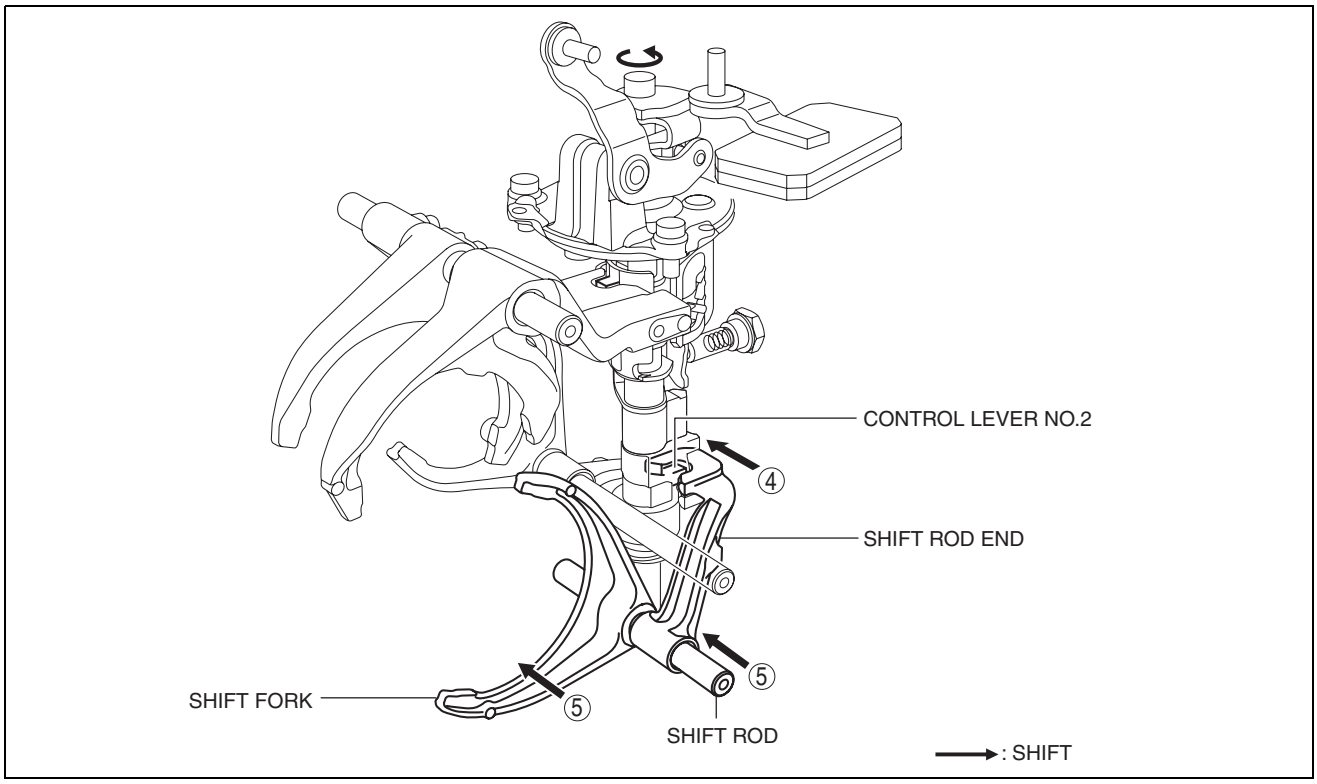
3GR



ac5wzn00001749

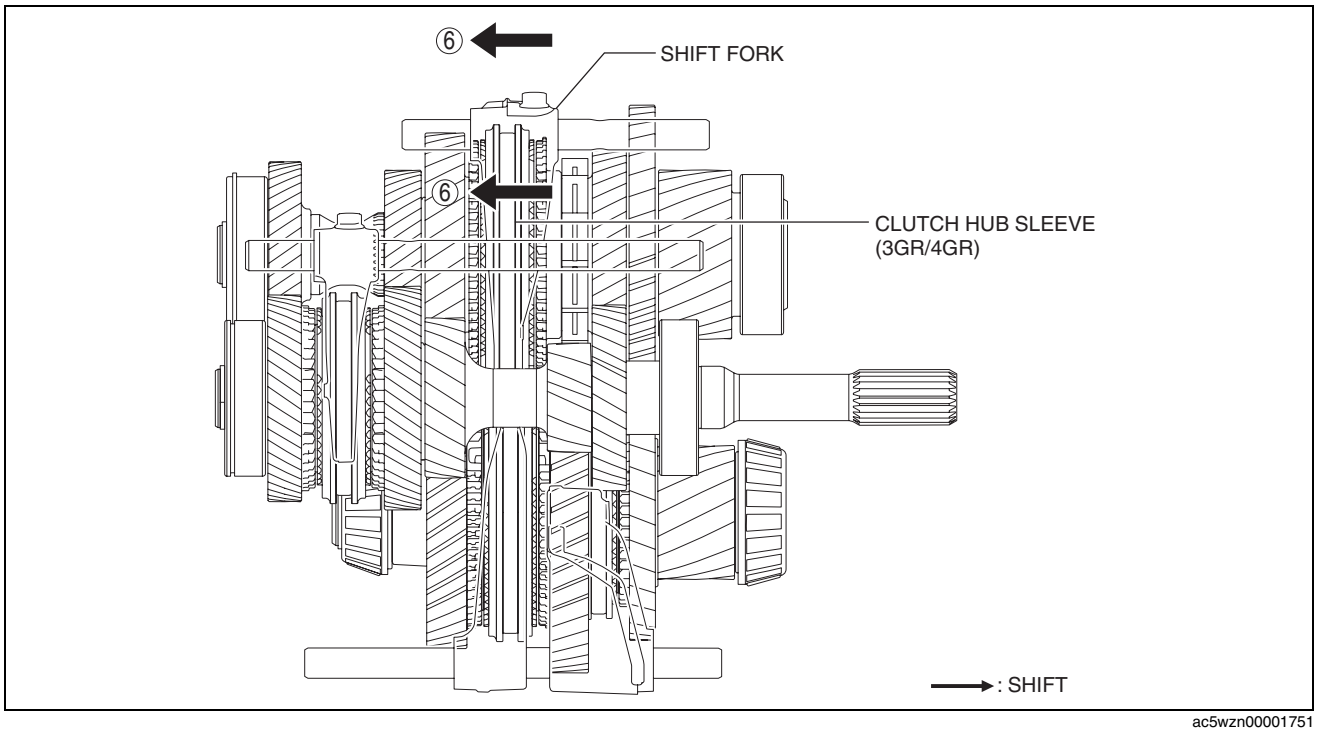
1. When the shift lever in the cabin is tilted forward to shift to 3GR, the shift lever in the engine compartment moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the shift lever in the engine compartment, the control lever No.2 and the guide pin move in the direction of arrow 3 shown in the figure.

MANUAL TRANSAXLE [D66M-R, D66MX-R]



ac5wzn00001750

4. Because the control rod turns with the control lever No.2, the control lever No.2 pushes the shift rod end and moves it in the direction of arrow 4 shown in the figure.
5. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 5.

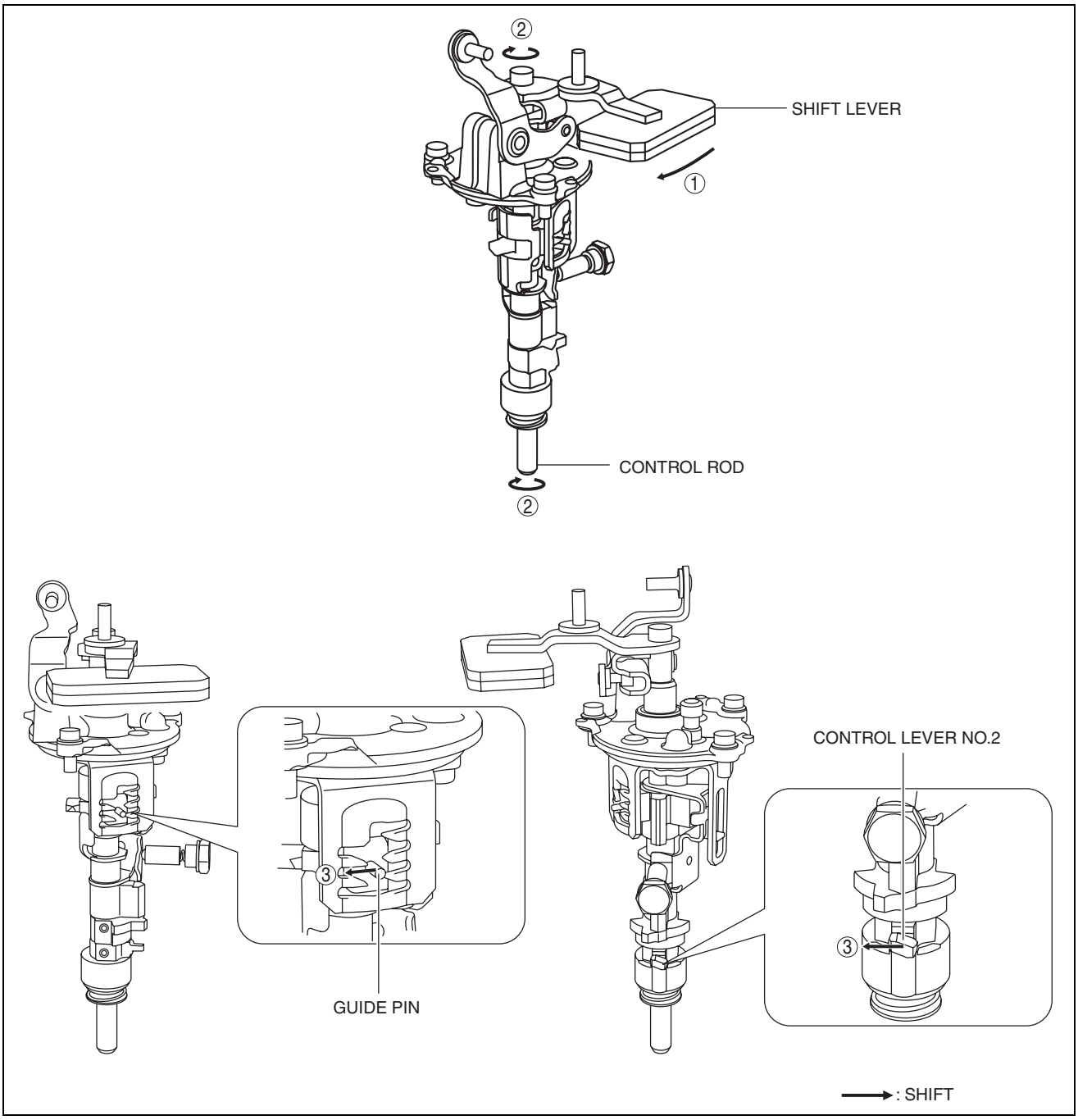


ac5wzn00001751

6. The shift fork moves the clutch hub sleeve in the direction of arrow 6 shown in the figure.
7. The shift change to 3GR is completed.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

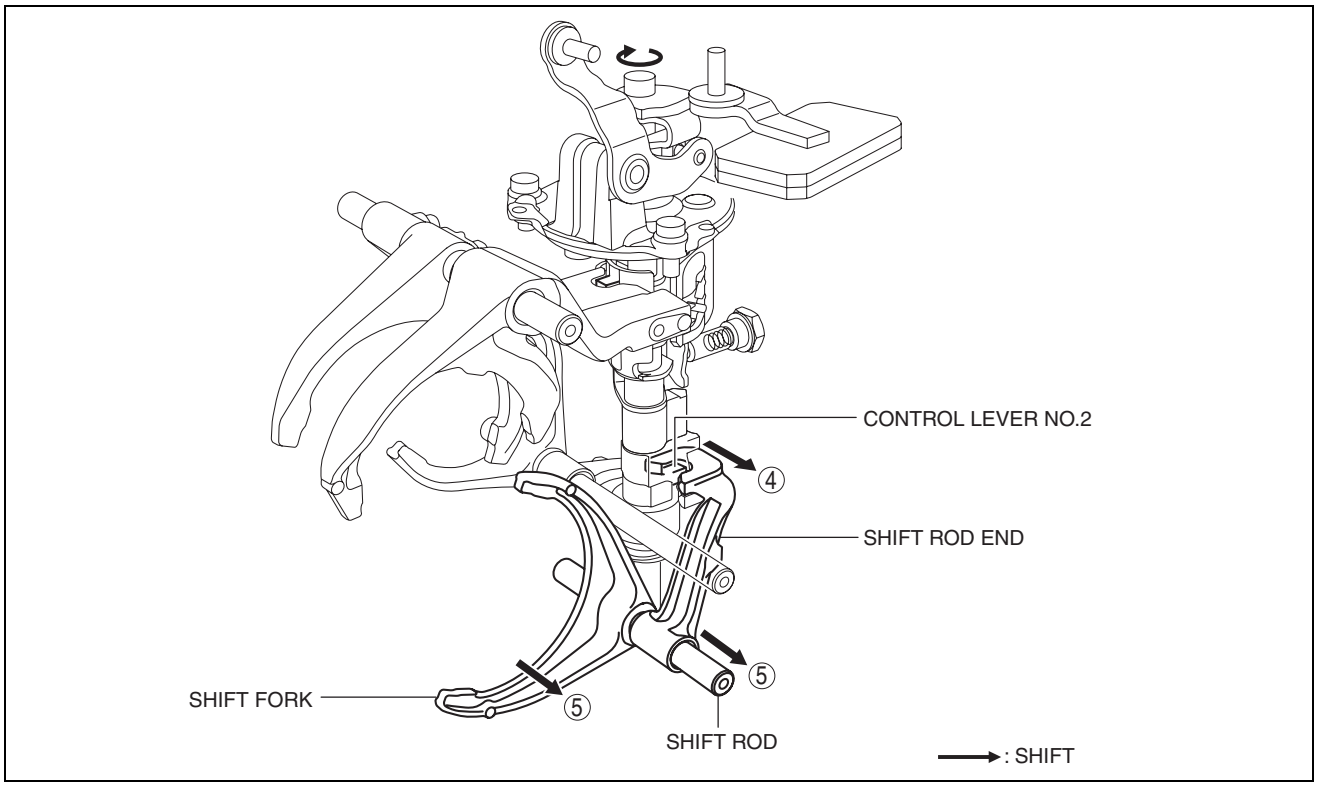
4GR



ac5wzn00001752

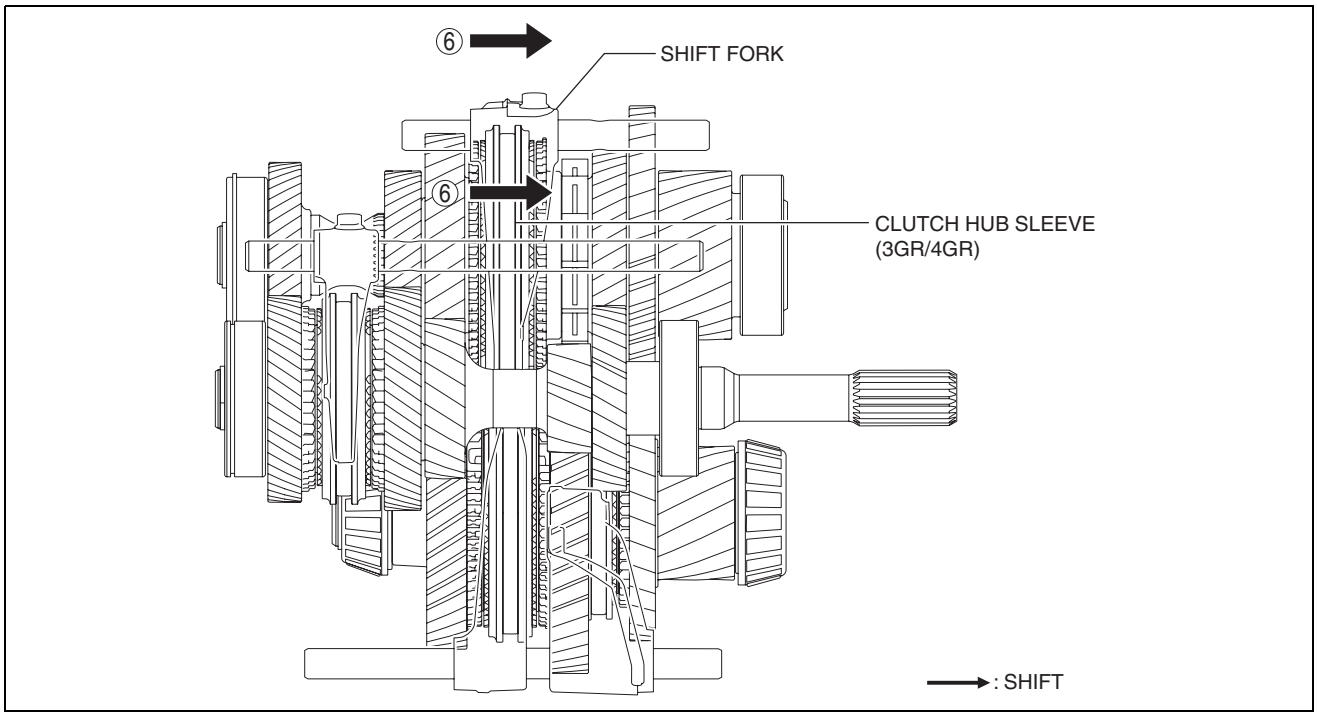
1. When the shift lever in the cabin is tilted rearward to shift to 4GR, the shift lever in the engine compartment moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the shift lever in the engine compartment, the control lever No.2 and the guide pin move in the direction of arrow 3 shown in the figure.

MANUAL TRANSAXLE [D66M-R, D66MX-R]



ac5wzn00001753

4. Because the control rod turns with the control lever No.2, the control lever No.2 pushes the shift rod end and moves it in the direction of arrow 4 shown in the figure.
5. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 5.

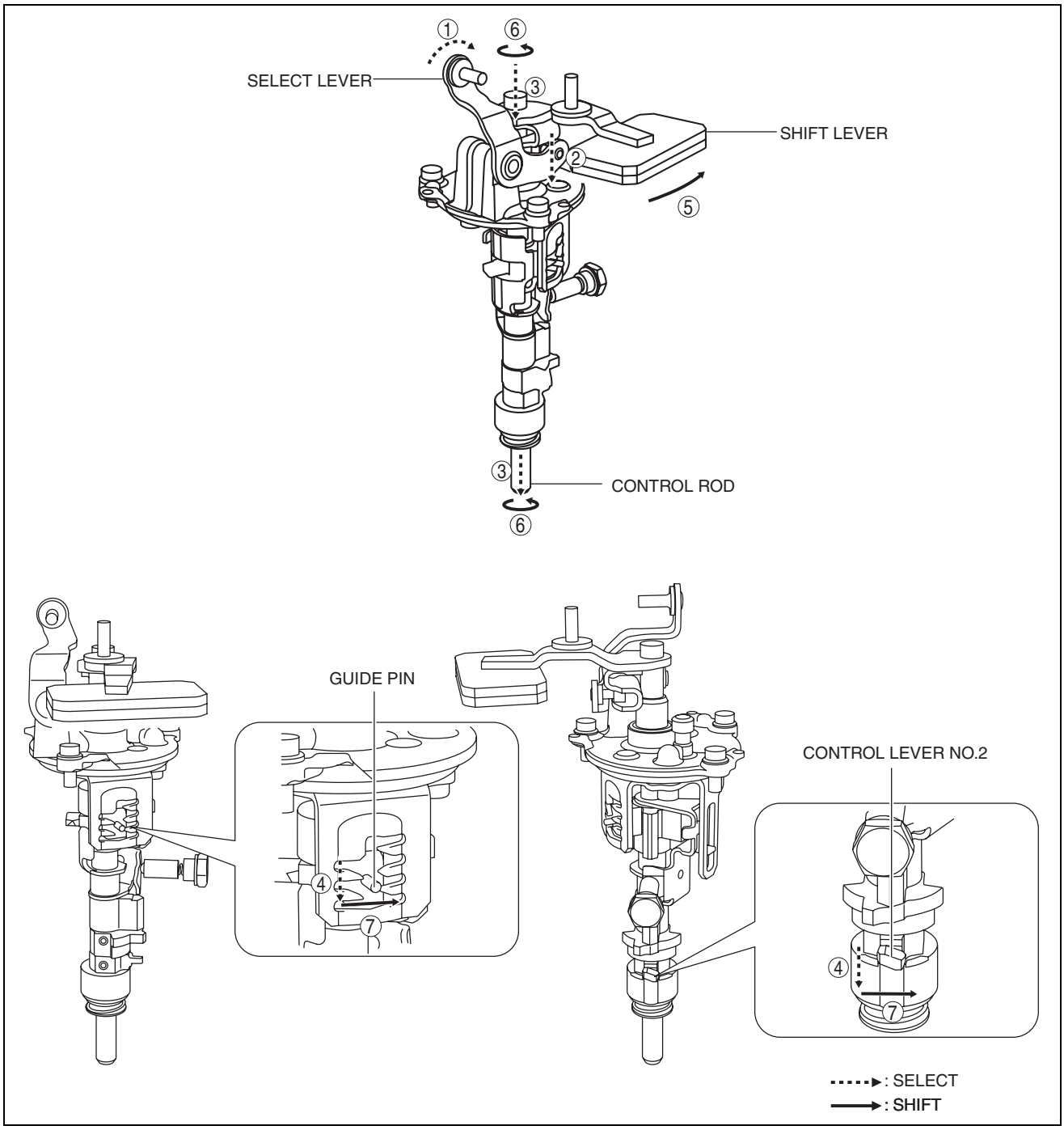


ac5wzn00001754

6. The shift fork moves the clutch hub sleeve in the direction of arrow 6 shown in the figure.
7. The shift change to 4GR is completed.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

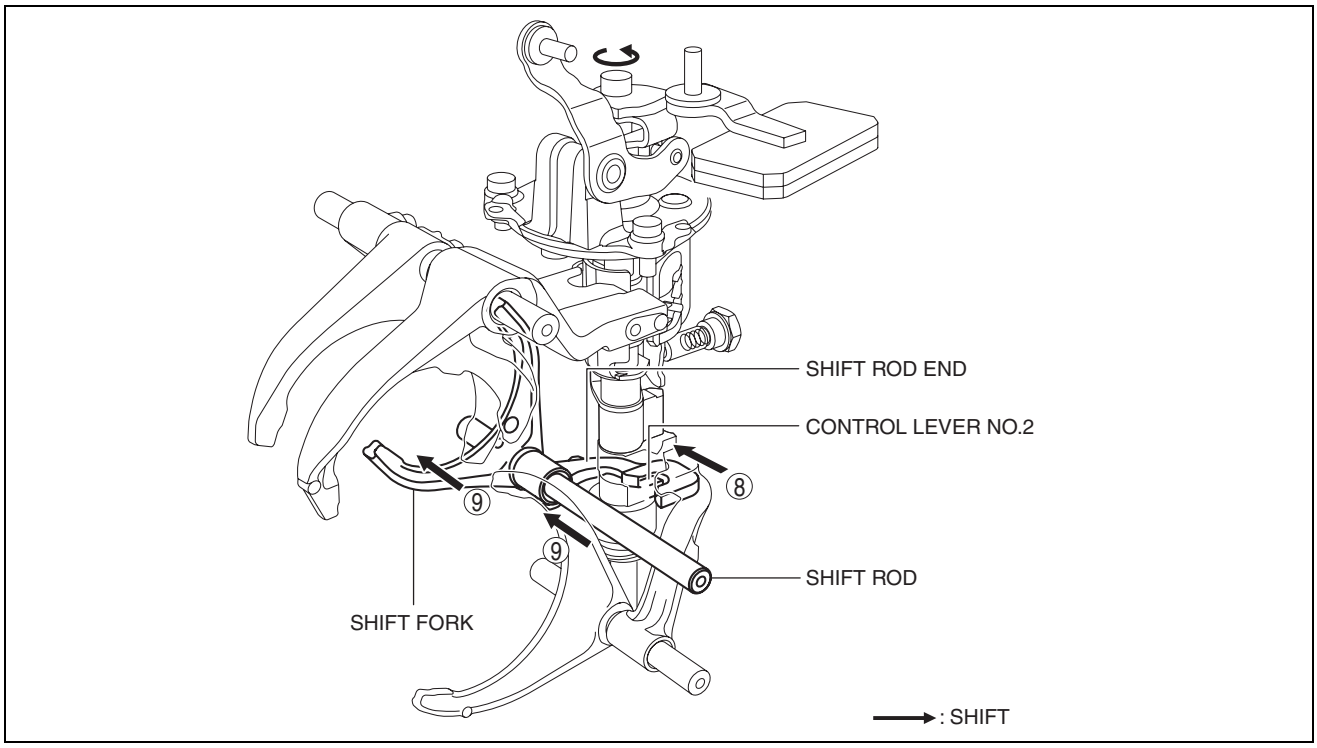
5GR



ac5wzn00001755

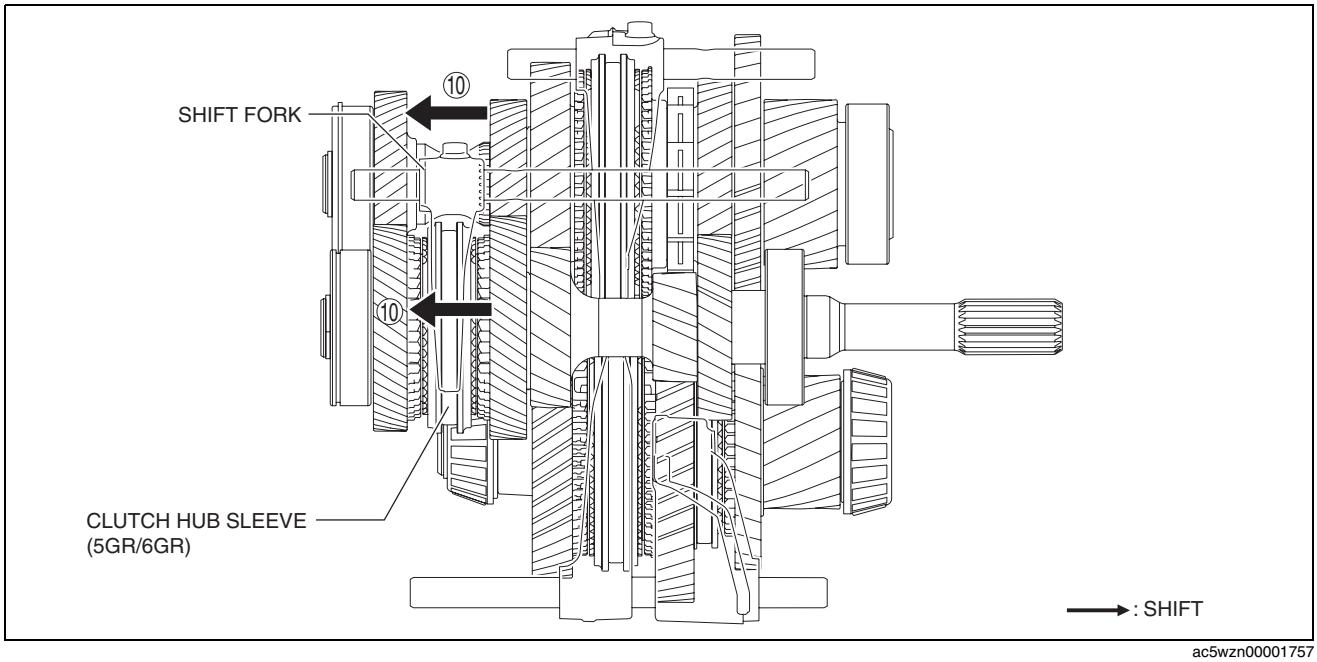
1. When the shift lever in the cabin is tilted to the right to shift to 5GR, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the control rod moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever No.2 and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted forward to shift to 5GR, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever No.2 and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [D66M-R, D66MX-R]



ac5wzn00001756

8. Because the control rod turns with the control lever No.2, the control lever No.2 pushes the shift rod end and moves it in the direction of arrow 8 shown in the figure.
9. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 9.

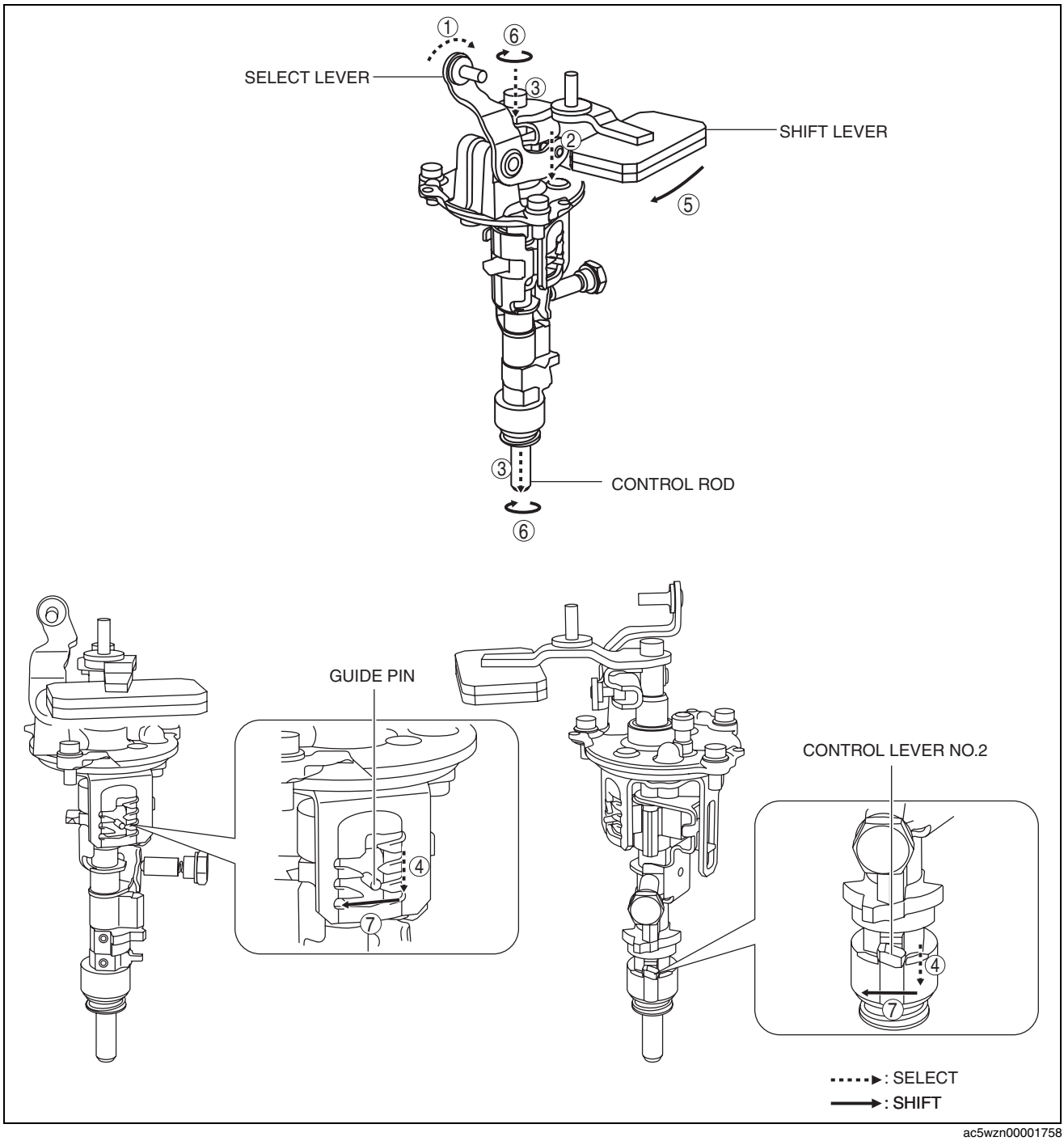


ac5wzn00001757

10. The shift fork moves the clutch hub sleeve in the direction of arrow 10 shown in the figure.
11. The shift change to 5GR is completed.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

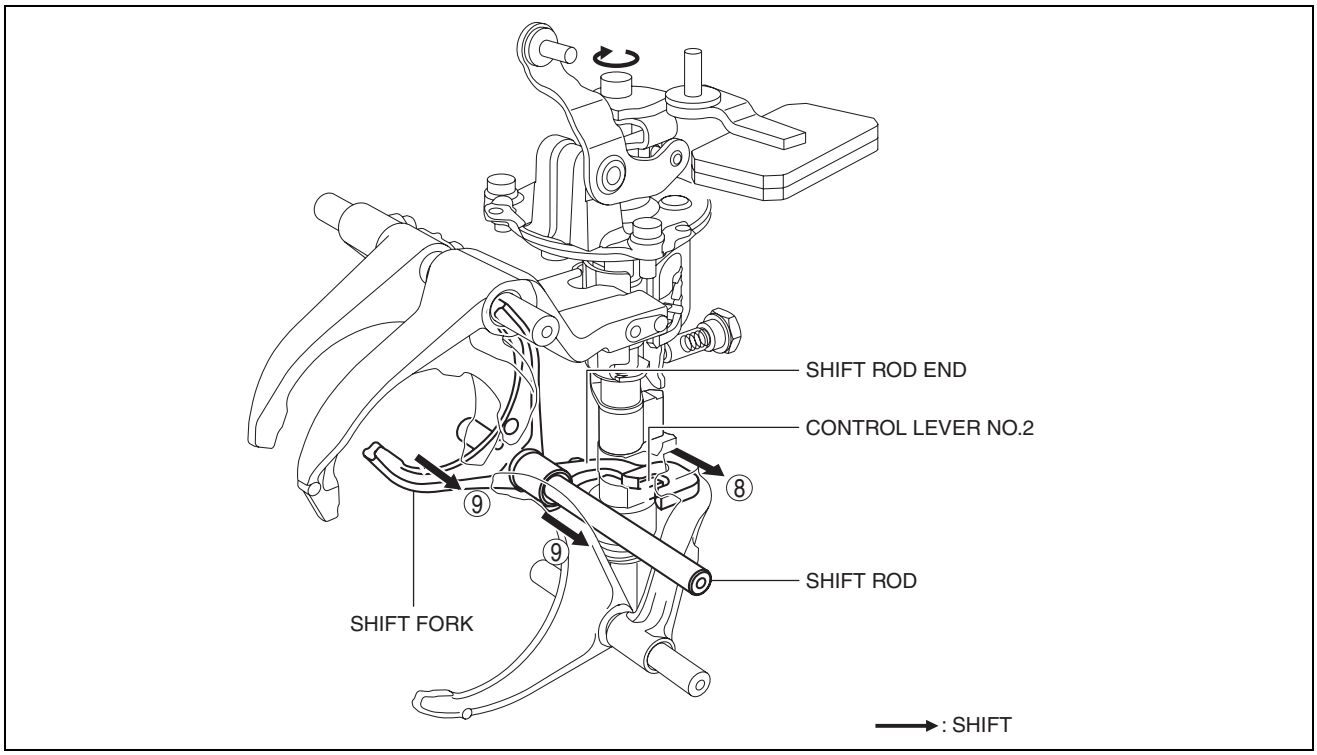
6GR



ac5wzn00001758

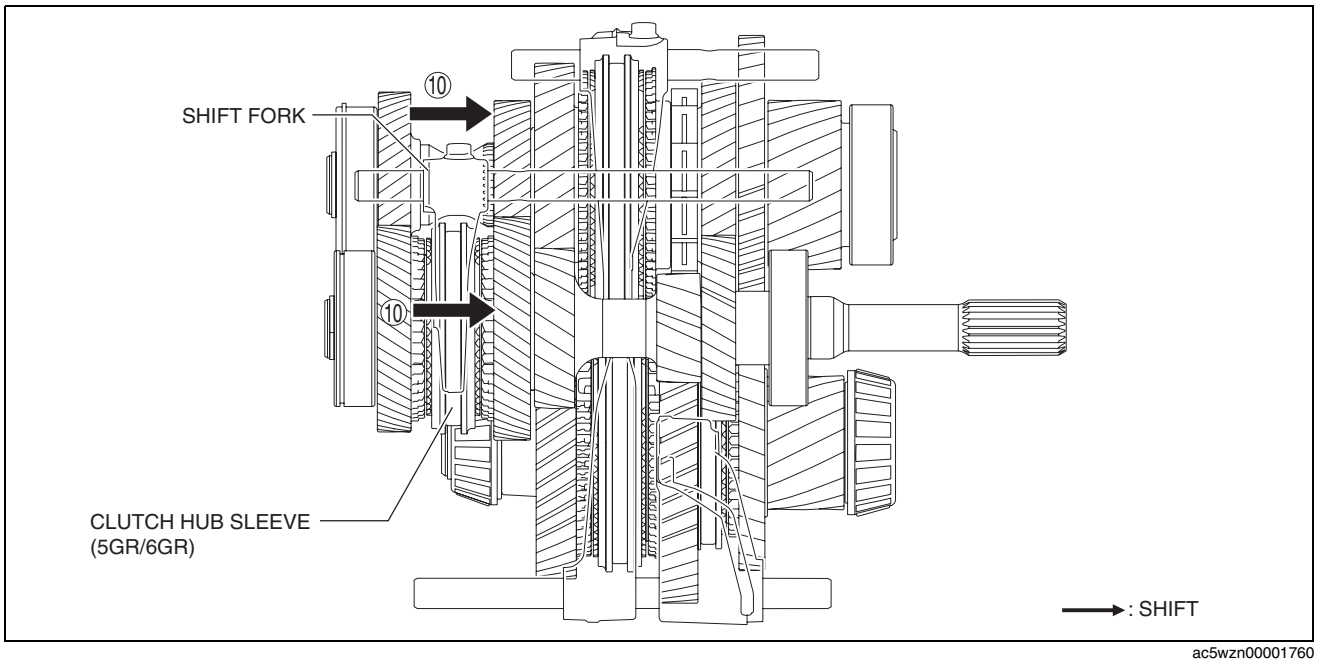
1. When the shift lever in the cabin is tilted to the right to shift to 6GR, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the control rod moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever No.2 and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted rearward to shift to 6GR, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever No.2 and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [D66M-R, D66MX-R]



ac5wzn00001759

8. Because the control rod turns with the control lever No.2, the control lever No.2 pushes the shift rod end and moves it in the direction of arrow 8 shown in the figure.
9. The shift rod end and the shift fork are integrated with the shift rod. Therefore, the movement of the shift rod end is transmitted to the shift fork via the shift rod, and the shift fork moves in the direction of arrow 9.

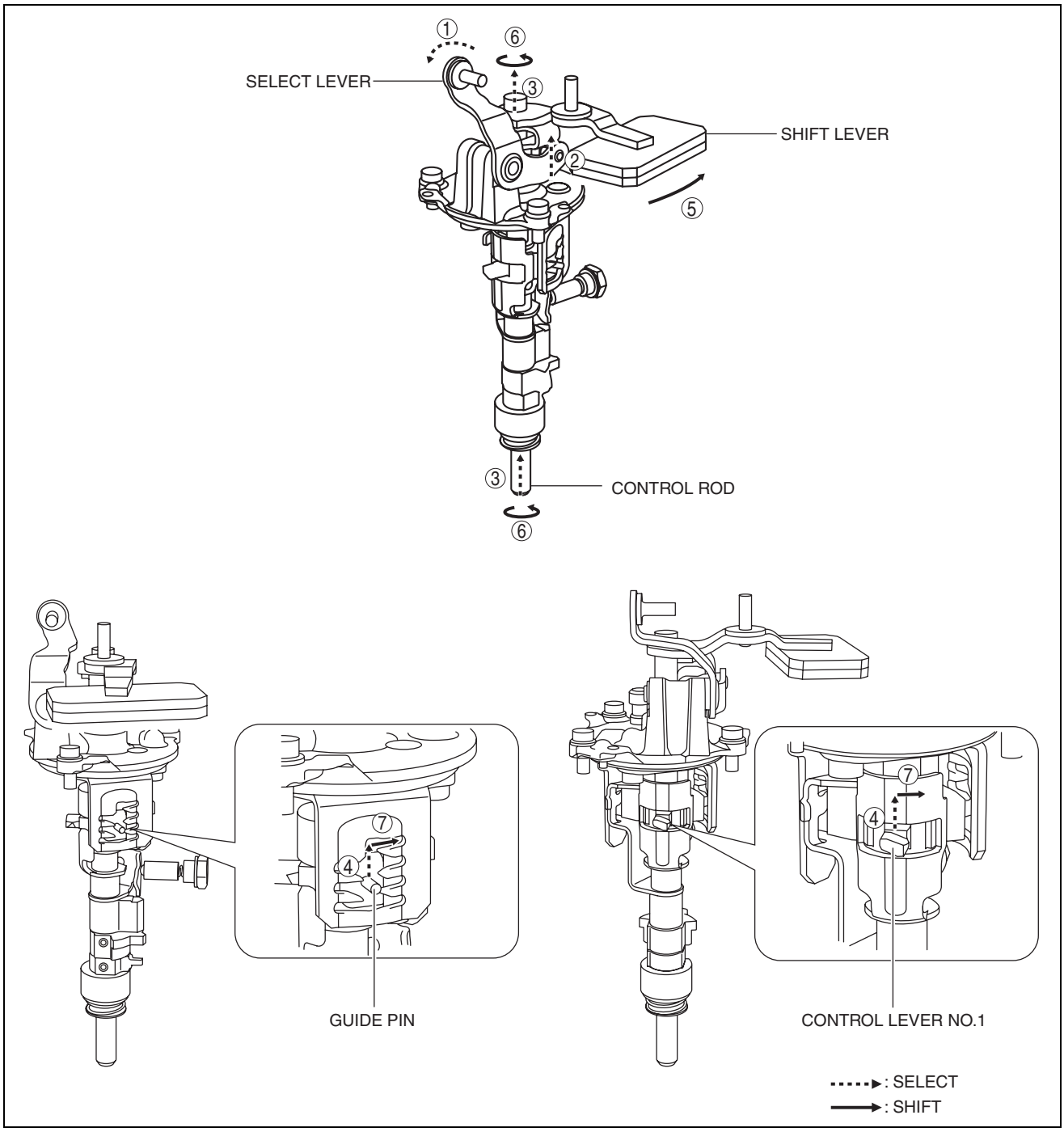


ac5wzn00001760

10. The shift fork moves the clutch hub sleeve in the direction of arrow 10 shown in the figure.
11. The shift change to 6GR is completed.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

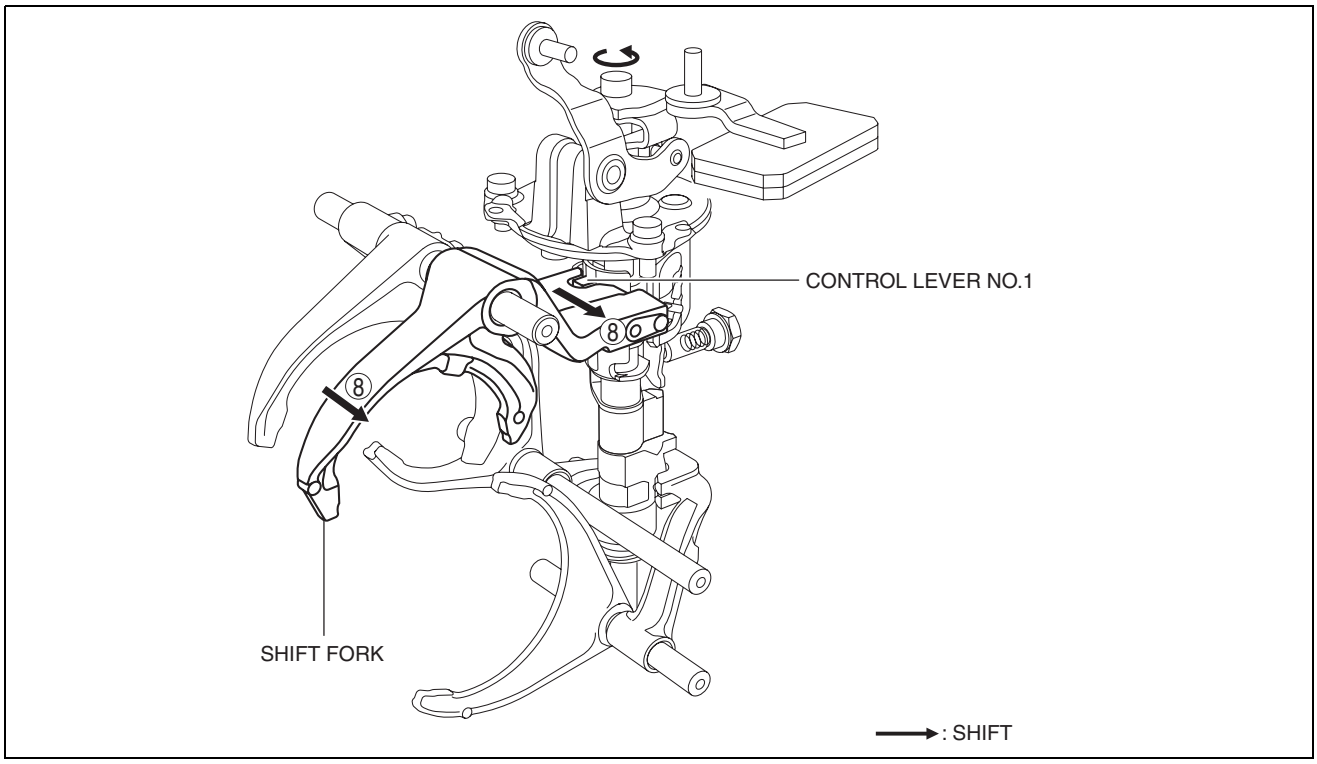
Reverse



ac5wzn00001761

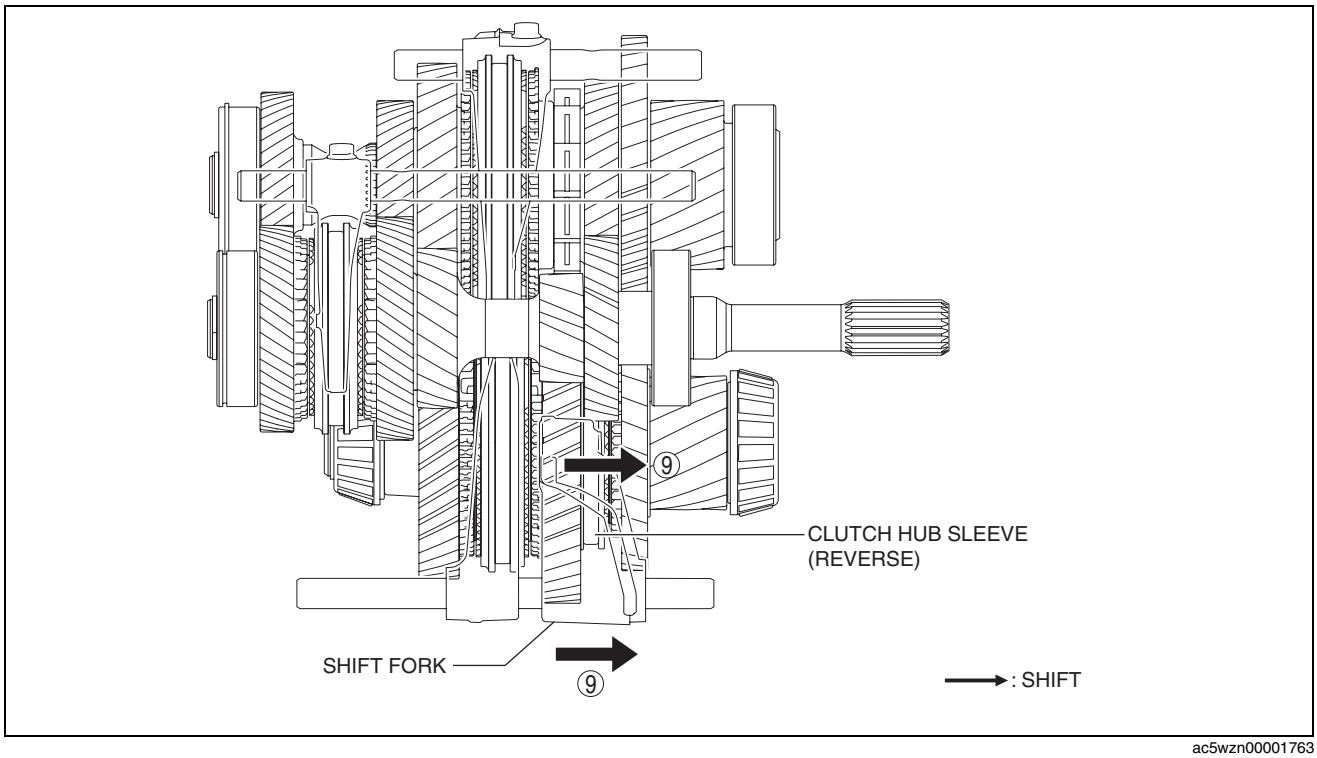
1. When the shift lever in the cabin is tilted to the left to shift to the reverse gear, the select lever moves in the direction of arrow 1 shown in the figure.
2. Following the movement of the select lever, the shift lever moves in the direction of arrow 2 shown in the figure.
3. Following the movement of the select lever, the control rod moves in the direction of arrow 3 shown in the figure.
4. Following the movement of the select lever, the control lever No.1 and the guide pin move in the direction of arrow 4 shown in the figure.
5. When the shift lever in the cabin is tilted forward to shift to the reverse gear, the shift lever in the engine compartment moves in the direction of arrow 5 shown in the figure.
6. Following the movement of the shift lever in the engine compartment, the control rod moves in the direction of arrow 6 shown in the figure.
7. Following the movement of the shift lever in the engine compartment, the control lever No.1 and the guide pin move in the direction of arrow 7 shown in the figure.

MANUAL TRANSAXLE [D66M-R, D66MX-R]



ac5wzn00001762

8. Because the control rod turns with the control lever No.1, the control lever No.1 pushes the shift fork and moves it in the direction of arrow 8 shown in the figure.



ac5wzn00001763

9. The shift fork moves the clutch hub sleeve in the direction of arrow 9 shown in the figure.
10. The shift change to the reverse gear is completed.

SYNCHRONIZER MECHANISM [D66M-R, D66MX-R]

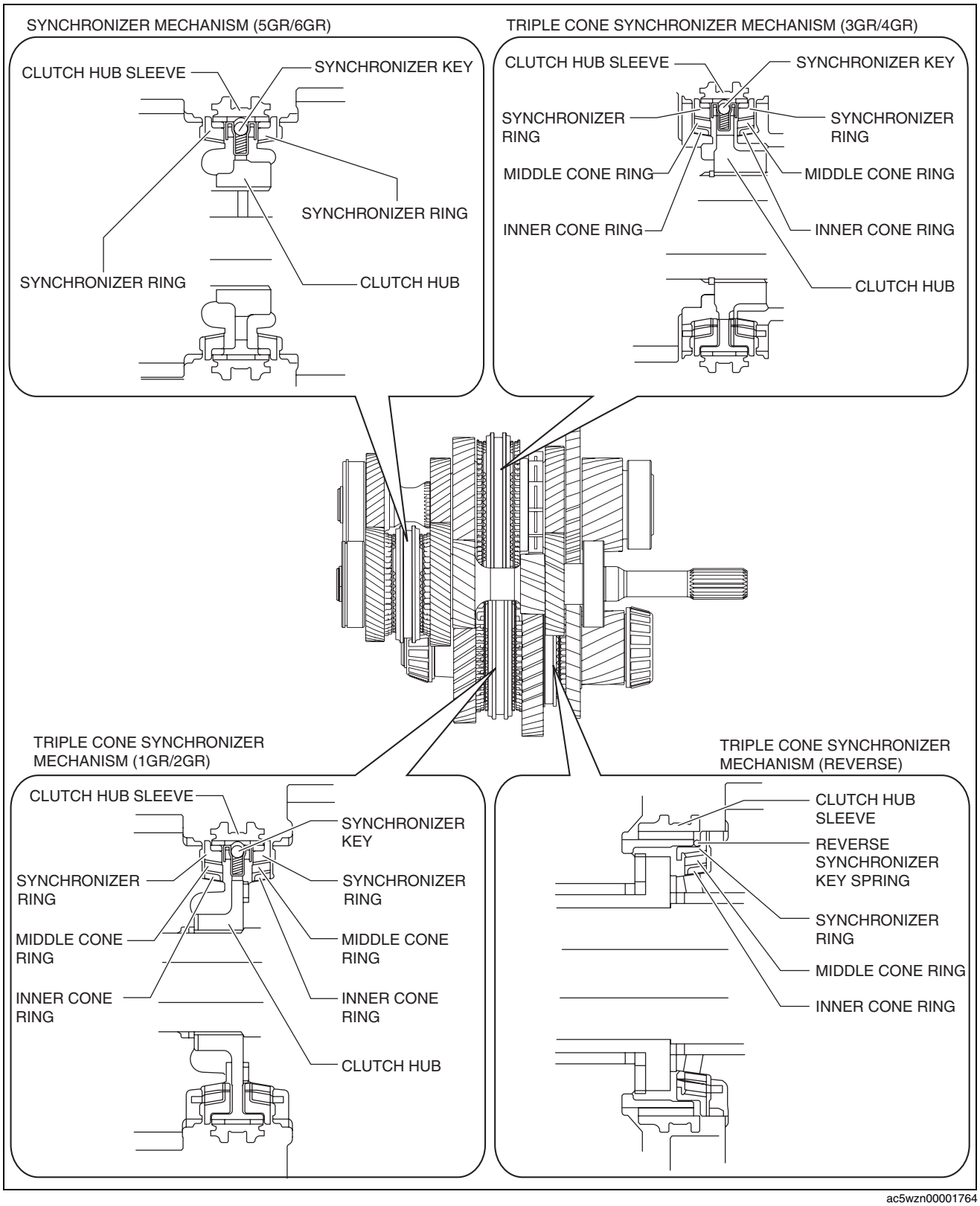
id0515md284000

Purpose, Function

- For smooth gear changes, the synchronizer mechanism synchronizes the rotation of the engaging area and engages gears.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

Construction



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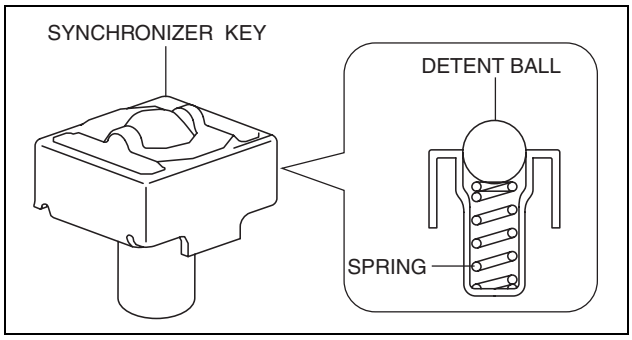
MANUAL TRANSAXLE [D66M-R, D66MX-R]

Detent ball-type synchronizer key

- A detent ball-type synchronizer key has been adopted for the synchronizer mechanism except for the reverse gear.
- The detent ball of this part provides the driver a crisp feel which the driver can realize completed gear changes.
- Because this part is smaller compared to the conventional synchronizer key, it has contributed to the size reduction of the synchronizer mechanism, and also to the shortened length of the primary and secondary shafts.
- Because the smaller synchronizer mechanism has reduced the stroke amount of the clutch hub sleeve, the stroke of the shift lever in the cabin has been shortened.



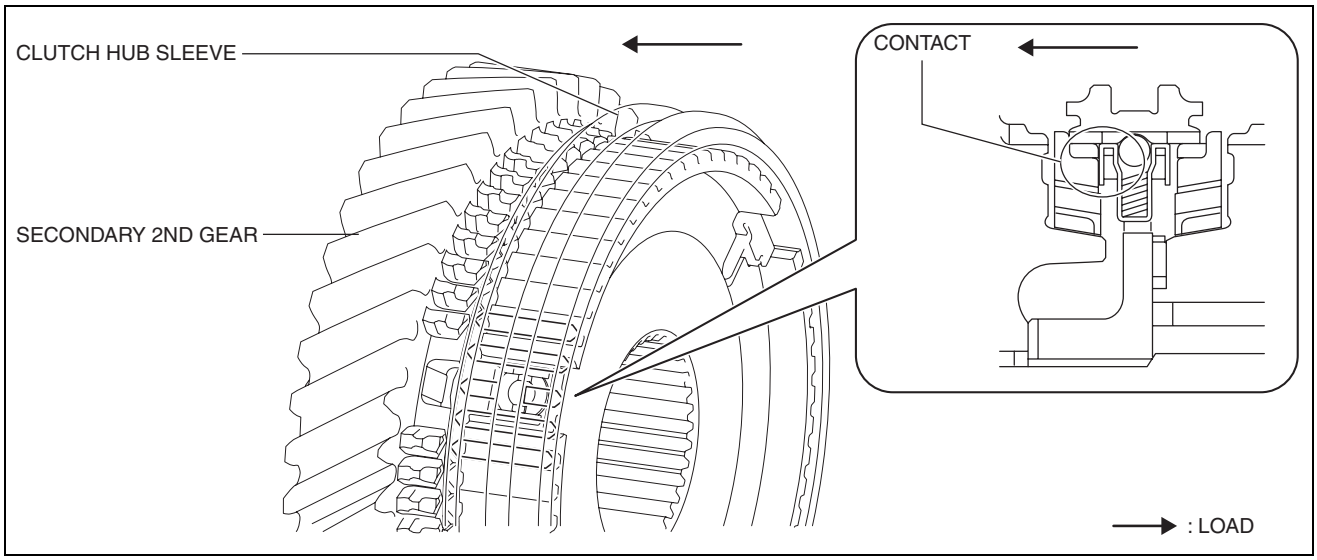
am3uun0000180

Operation
1GR, 2GR, 3GR, 4GR, reverse operation

Note

- For 1GR, 2GR, 3GE, 4GR and reverse, a triple-cone synchronizer mechanism has been adopted with which a stronger synchronizing force is provided to synchronize the rotation of the clutch hub and the gear.
- Here, operation during 2GR operation is described as an example.

1. When the clutch hub sleeve moves toward the secondary 2nd gear side, the synchronizer key follows, and the synchronizer key contacts the end surface of the synchronizer ring.



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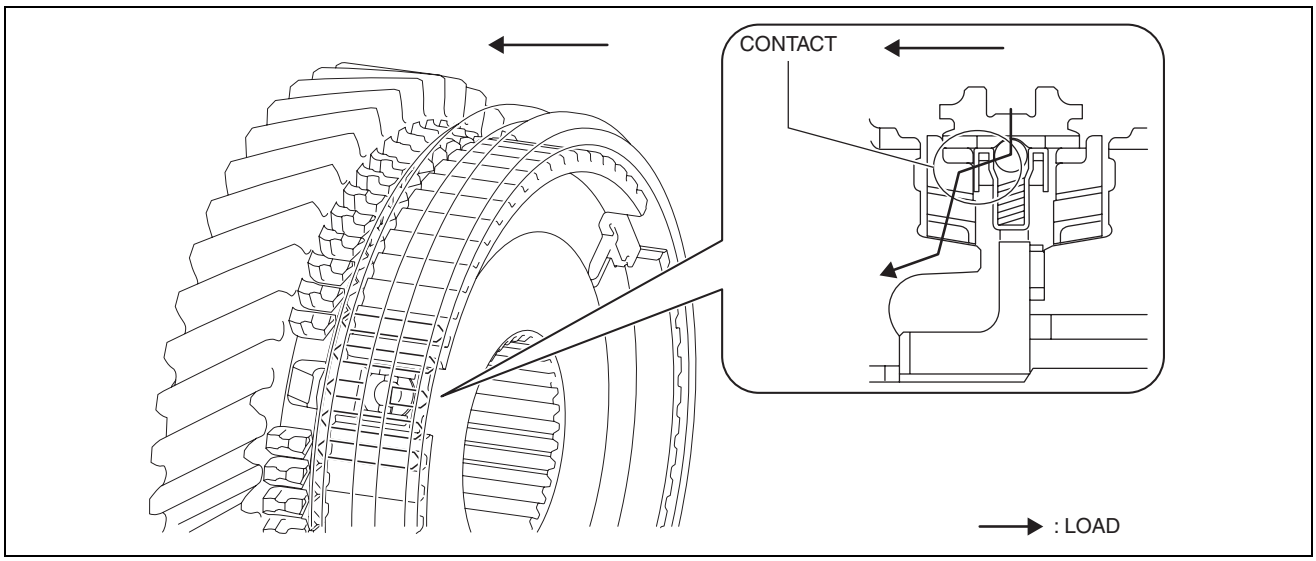
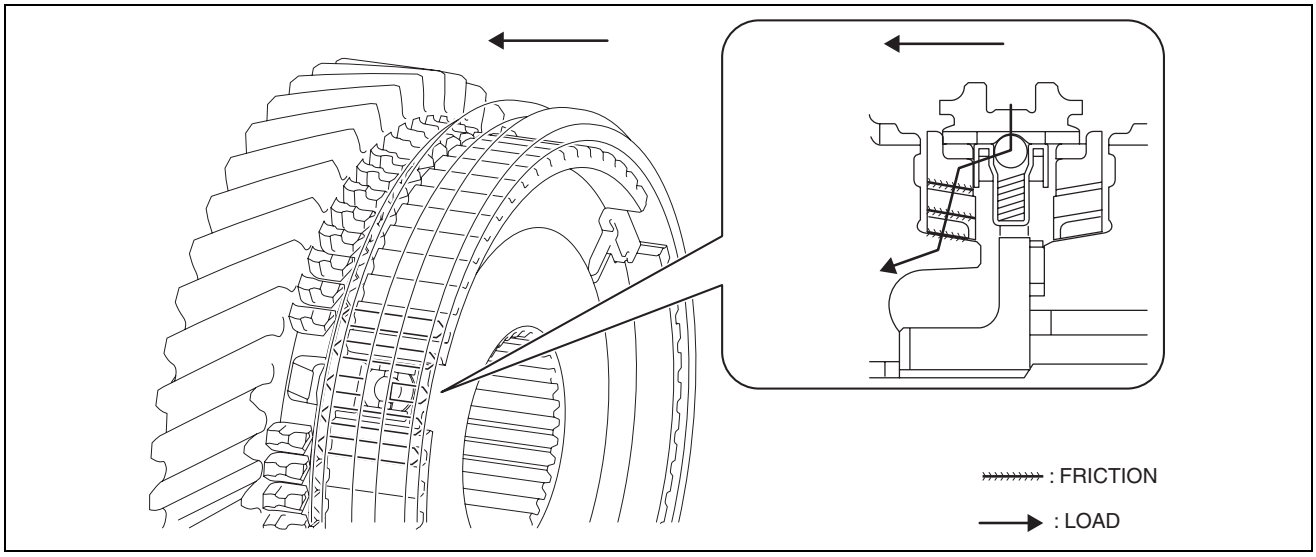
MANUAL TRANSAXLE [D66M-R, D66MX-R]

2. When the clutch hub sleeve moves toward the secondary 2nd gear side, the synchronizer key which follows applies load to the synchronizer ring, and the load is transmitted from the synchronizer ring to the middle cone ring, inner cone ring, and the gear.



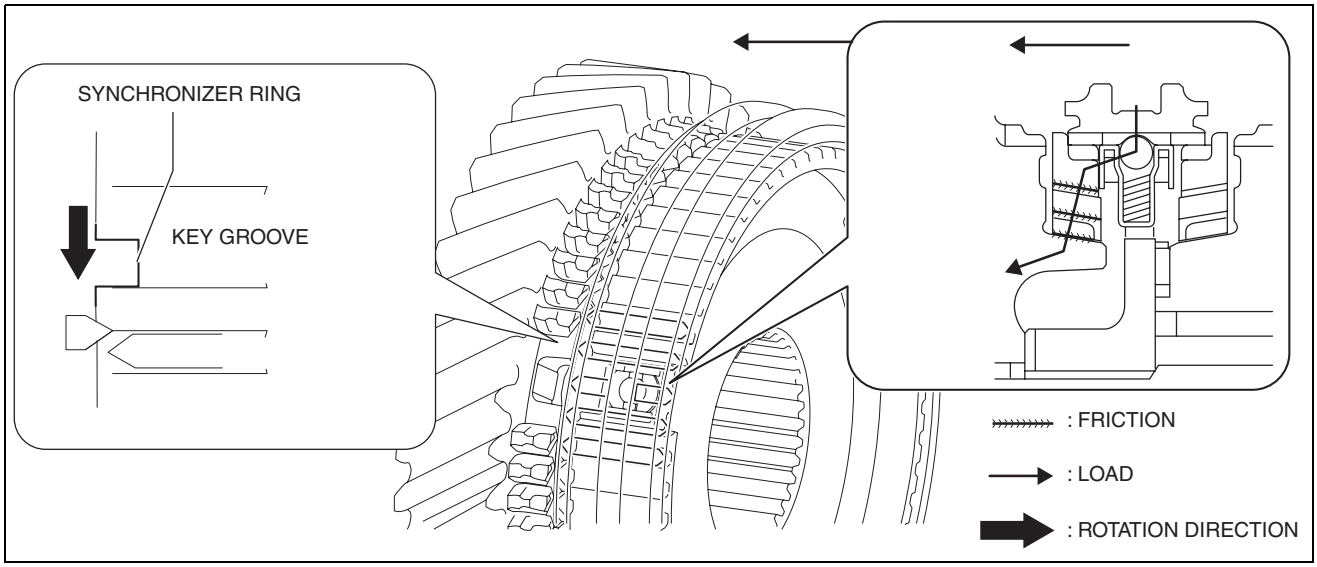
ac5wzn00001766

3. The friction force on the contacting surface of the parts is generated by applying load to the parts between the synchronizer ring and the gear.



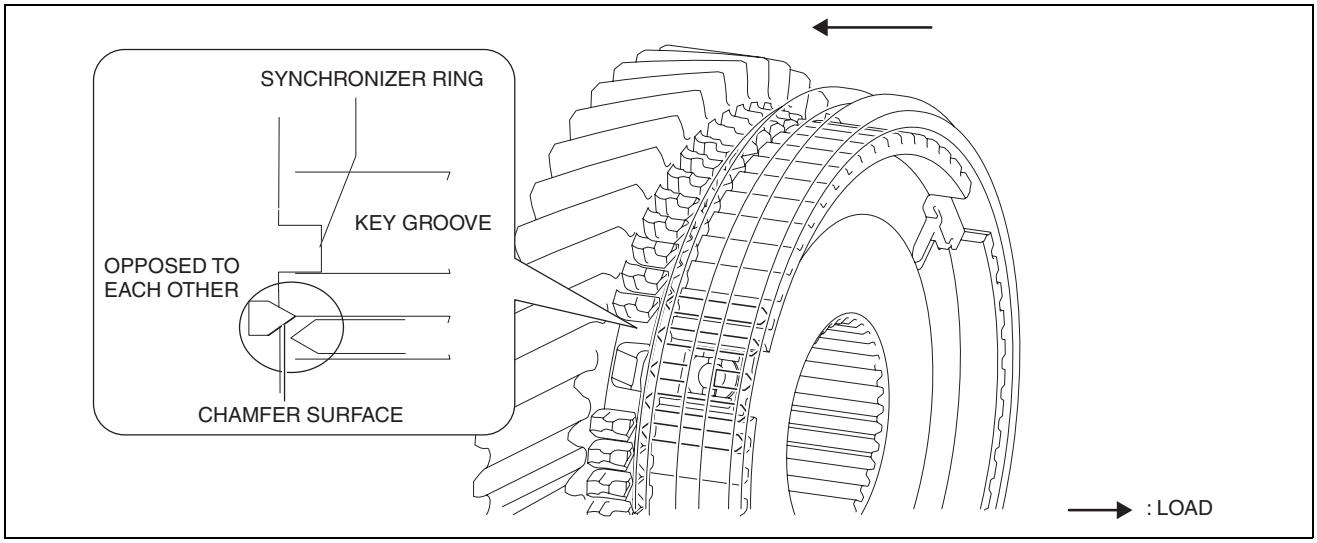
ac5wzn00001767

4. For the friction force for the parts, the synchronizer ring rotates only the key groove gap of the clutch hub sleeve.



ac5wzn00001768

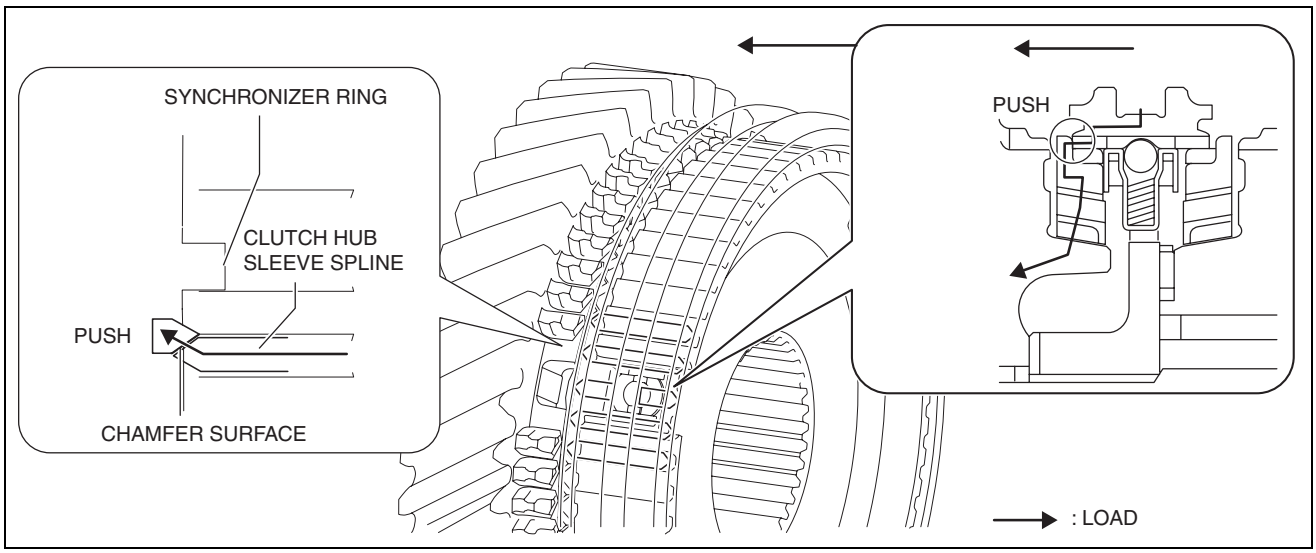
5. Because the synchronizer ring rotates, the spline of the clutch hub sleeve which moves toward the secondary 2nd gear side and the chamfer of the synchronizer ring are opposed to each other.



ac5wzn00001769

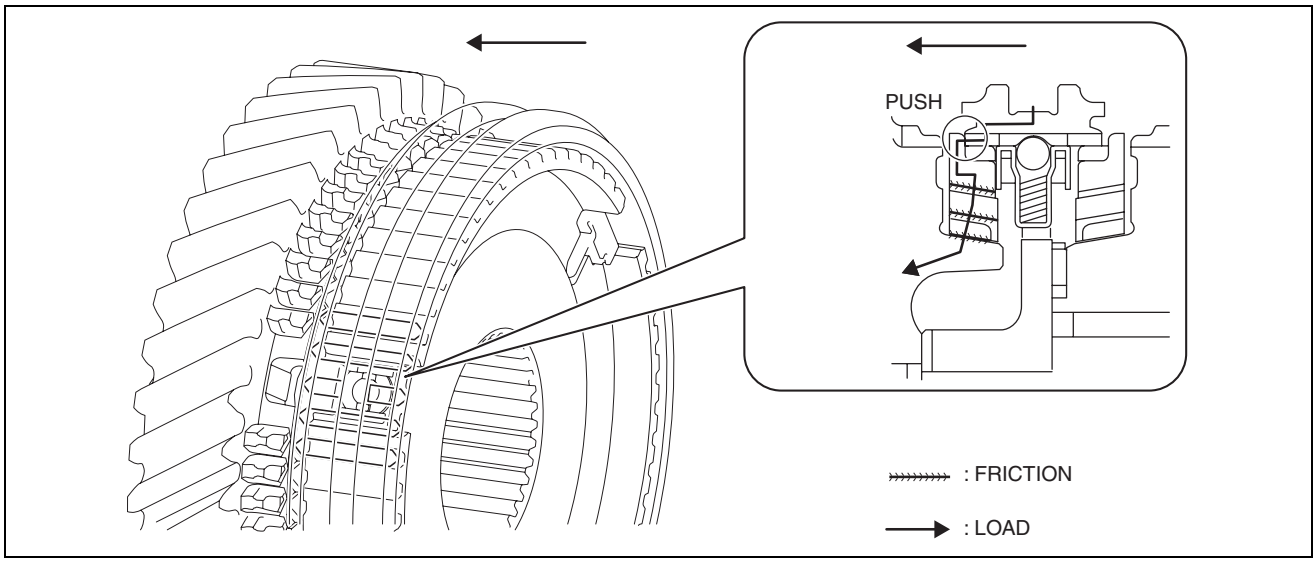
MANUAL TRANSAXLE [D66M-R, D66MX-R]

6. When the clutch hub sleeve moves toward the secondary 2nd gear side, the transmitted load to the gear from the clutch hub sleeve increases because the spline of the clutch hub sleeve pushes the chamfer of the synchronizer ring.



ac5wzn00001770

7. The friction force on the contacting surface of the parts is increased by increasing the load transmitted from the clutch hub sleeve to the gear.

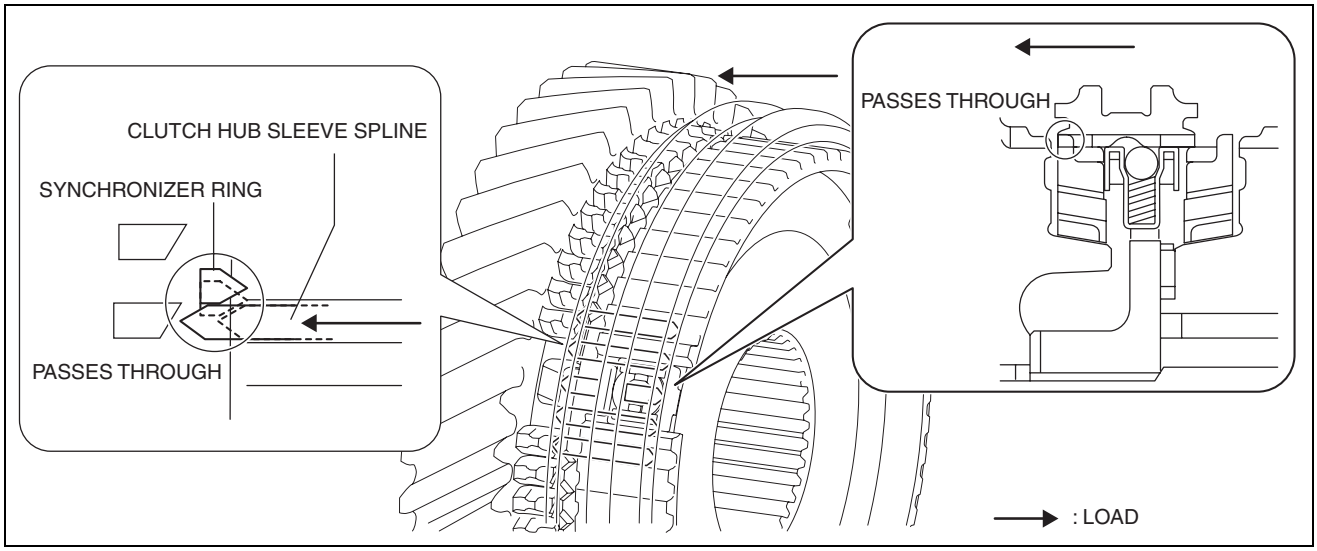


ac5wzn00001771

8. The increased friction force decreases the difference in rotation speed between the synchronizer ring, middle cone ring, inner cone ring, and the gear and the rotation speed for the parts is synchronized.

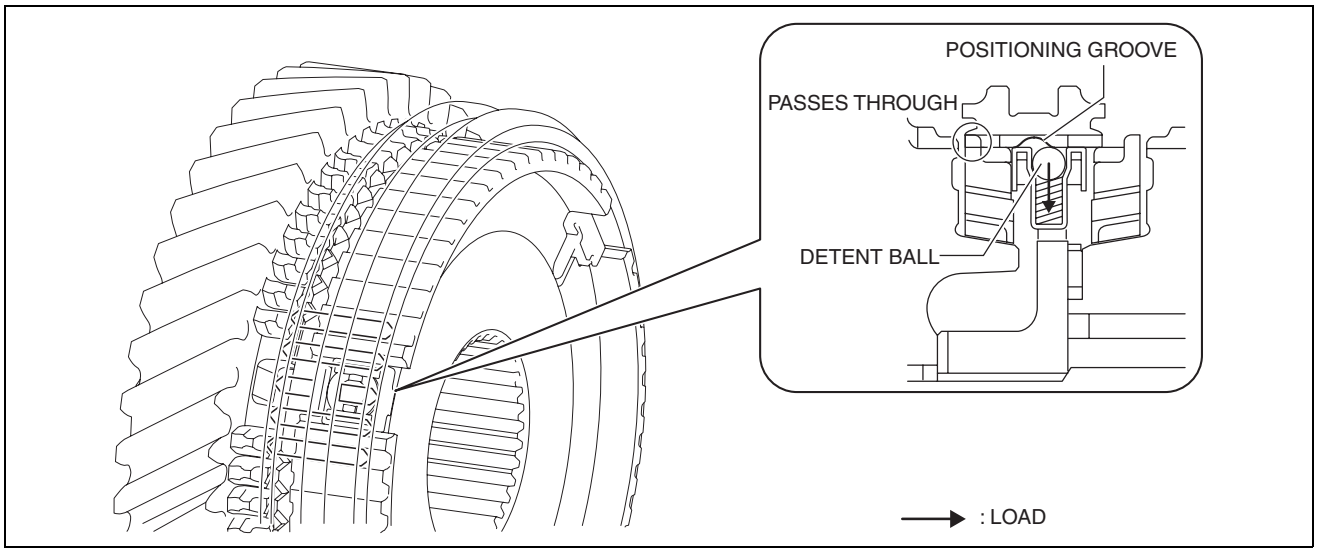
MANUAL TRANSAXLE [D66M-R, D66MX-R]

9. When synchronization in rotation speed of the gear and the clutch hub sleeve is performed, the spline of the clutch hub sleeve passes through the synchronizer ring.



ac5wzn00001772

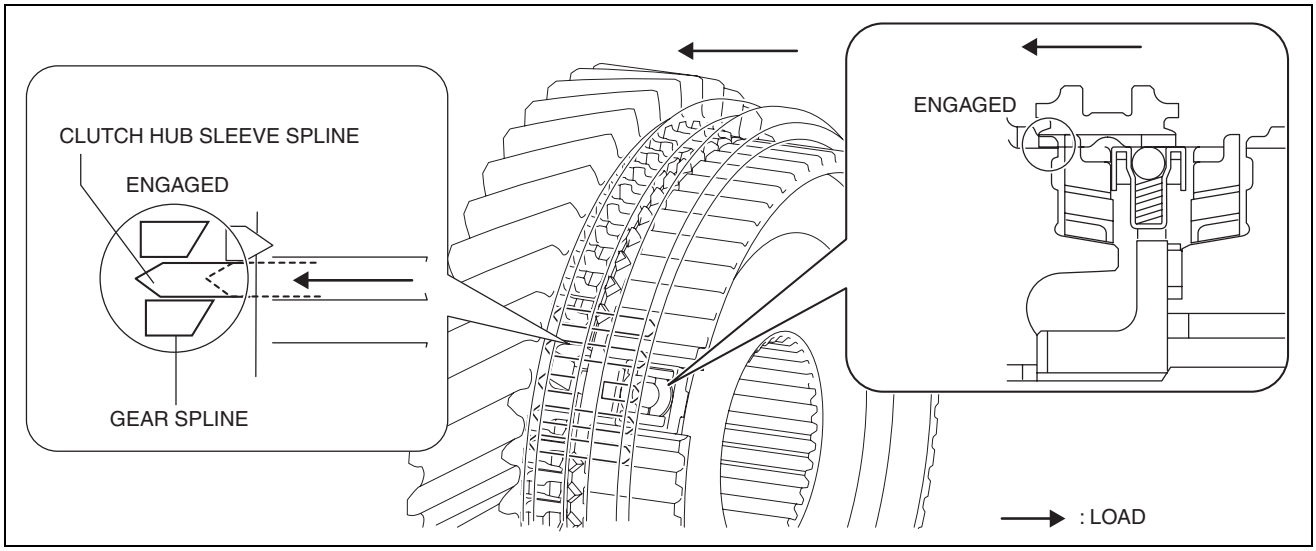
10. When the spline of the clutch hub sleeve passes through the synchronizer ring, the clutch hub sleeve presses down the detent ball and the detent ball is removed from the positioning groove of the clutch hub sleeve because the clutch hub sleeve moves toward the secondary 2nd gear side.



ac5wzn00001773

MANUAL TRANSAXLE [D66M-R, D66MX-R]

11. When the clutch hub sleeve moves toward the secondary 2nd gear side, the spline of the clutch hub sleeve and the spline of the gear are engaged, and the shifting operation is completed.

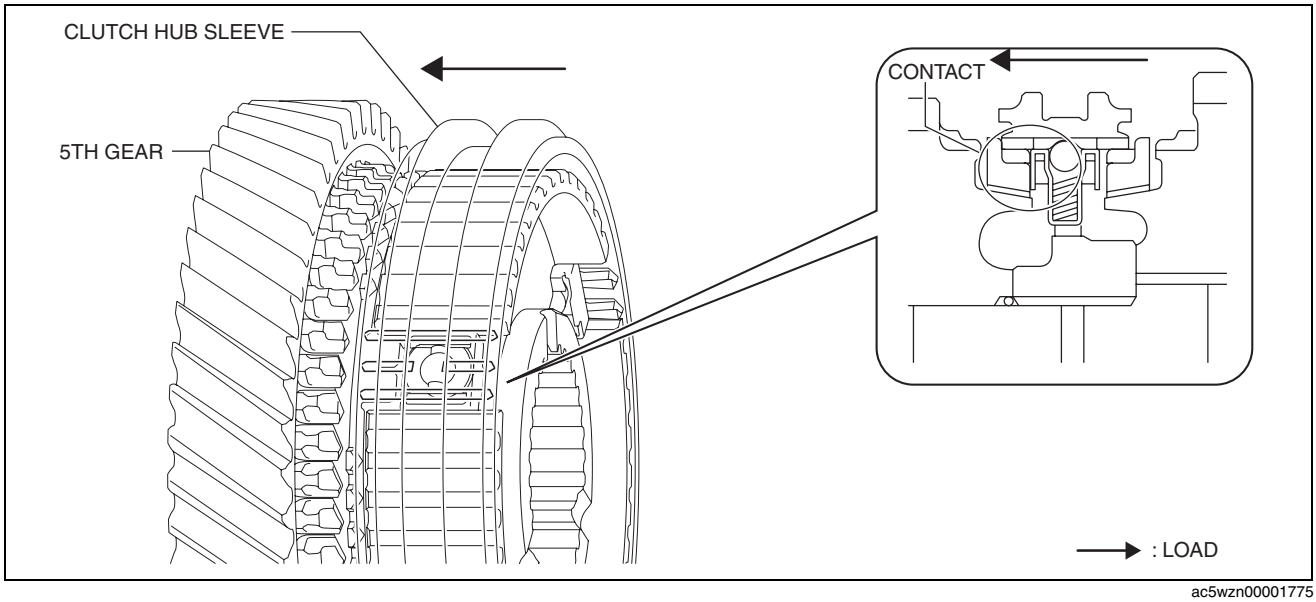


ac5wzn00001774

5GR, 6GR operation

Note
- Here, operation during 5GR operation is described as an example.

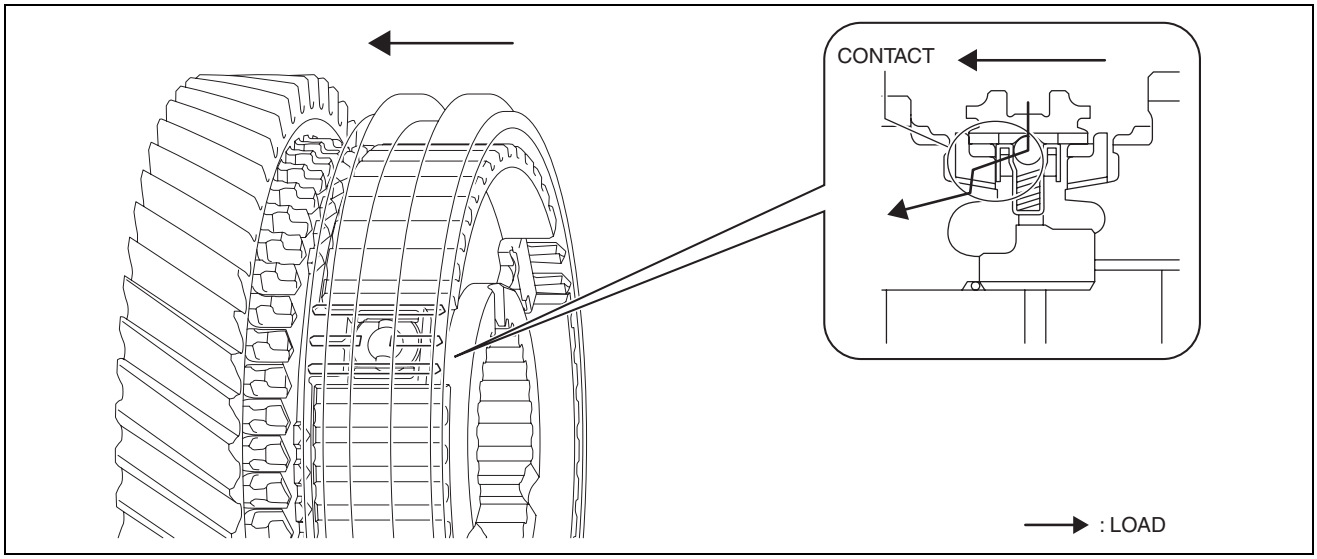
1. When the clutch hub sleeve moves toward the 5th gear side, the synchronizer key follows, and the synchronizer key contacts the end surface of the synchronizer ring.



ac5wzn00001775

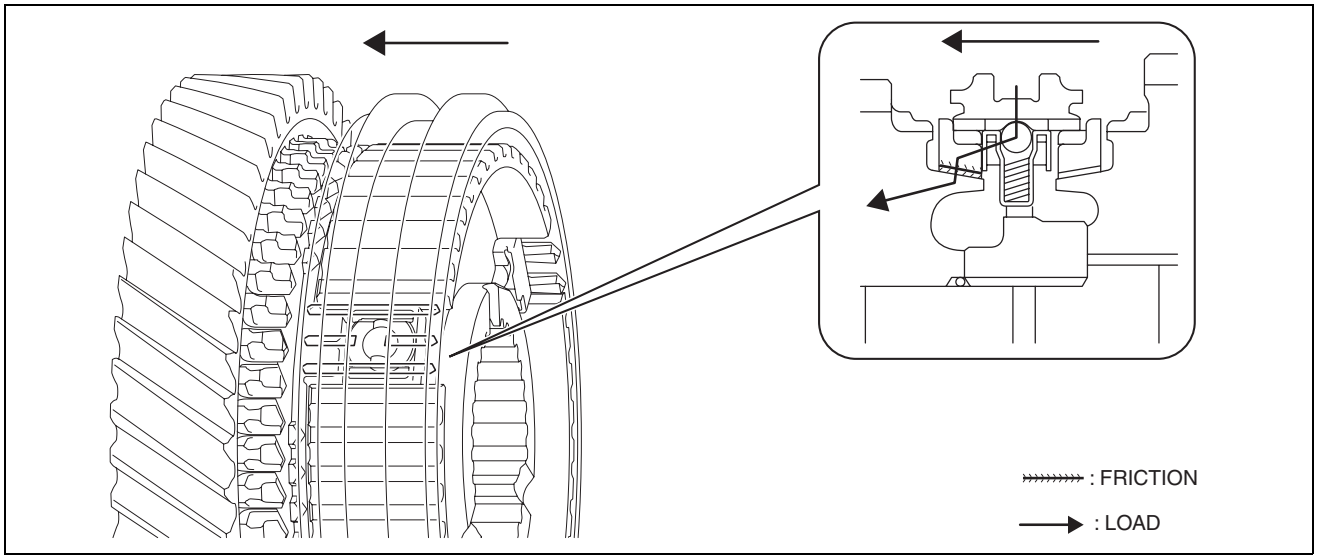
MANUAL TRANSAXLE [D66M-R, D66MX-R]

2. When the clutch hub sleeve moves toward the 5th gear side, the following synchronizer key applies load to the synchronizer ring, and the load is transmitted from the synchronizer ring to the gear.



ac5wzn00001776

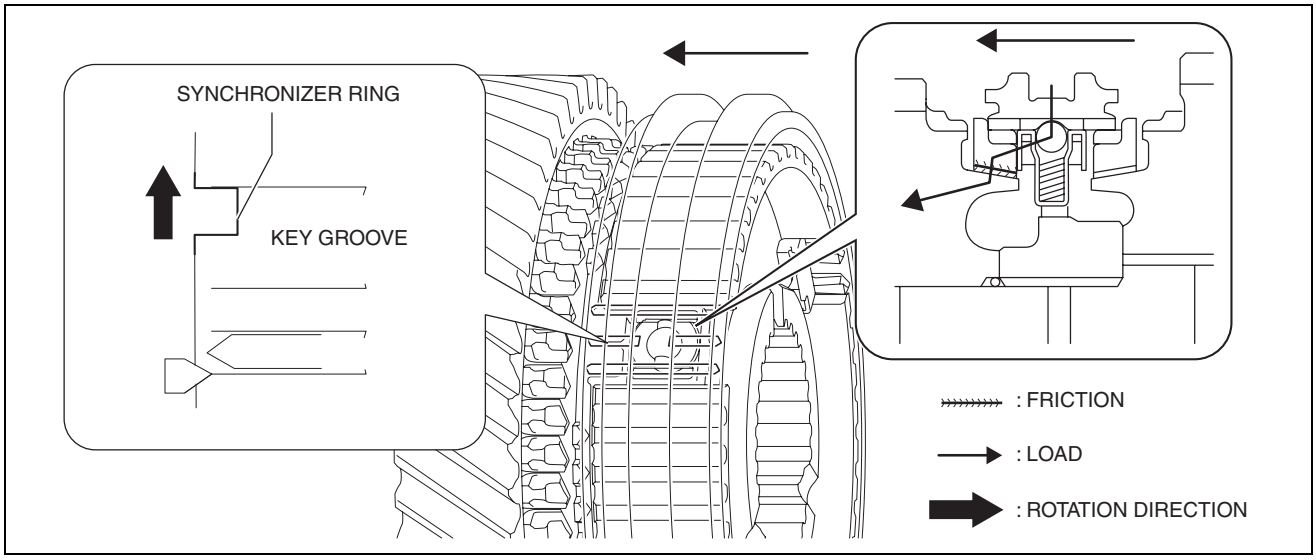
3. The friction force on the contacting surface of the synchronizer ring and the gear is generated by applying load to the parts between the synchronizer ring and the gear.



ac5wzn00001777

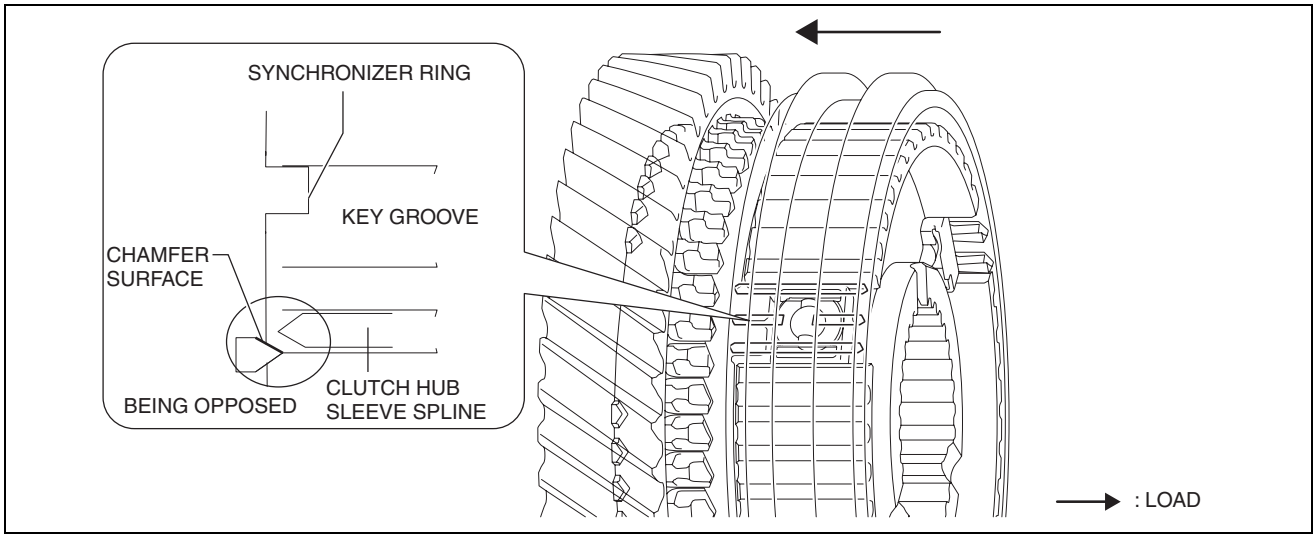
MANUAL TRANSAXLE [D66M-R, D66MX-R]

4. For the friction force of the synchronizer ring and the gear, synchronizer ring rotates only the key groove gap of the clutch hub sleeve.



ac5wzn00001778

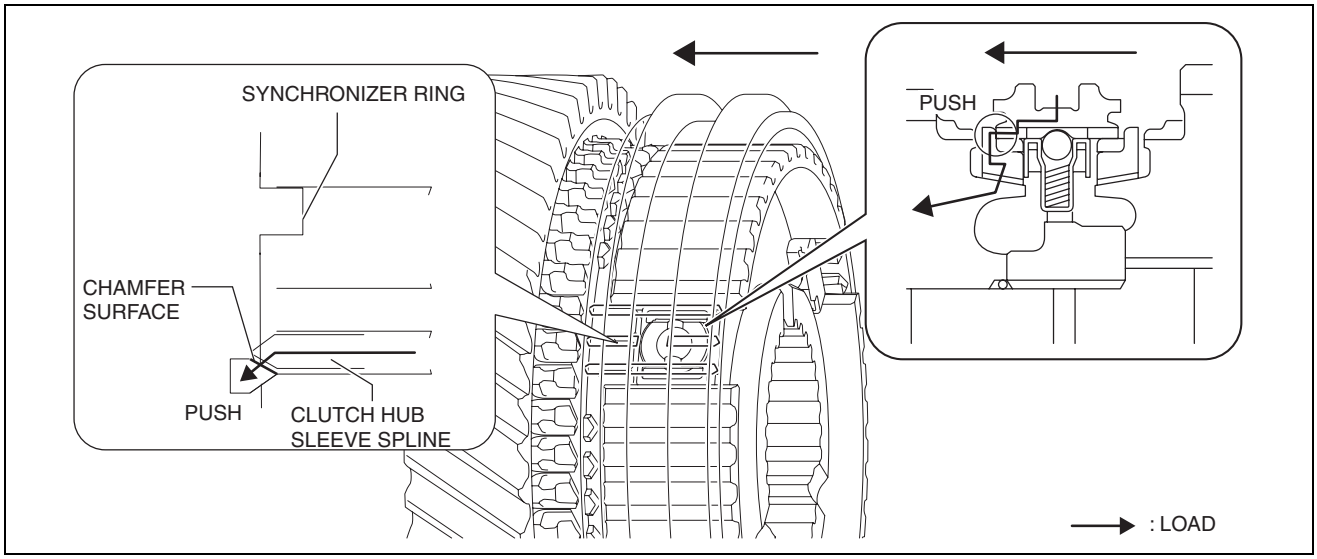
5. Because the synchronizer ring rotates, the spline of the clutch hub sleeve which moves toward the 5th gear side and the chamfer of the synchronizer ring are opposed to each other.



ac5wzn00001779

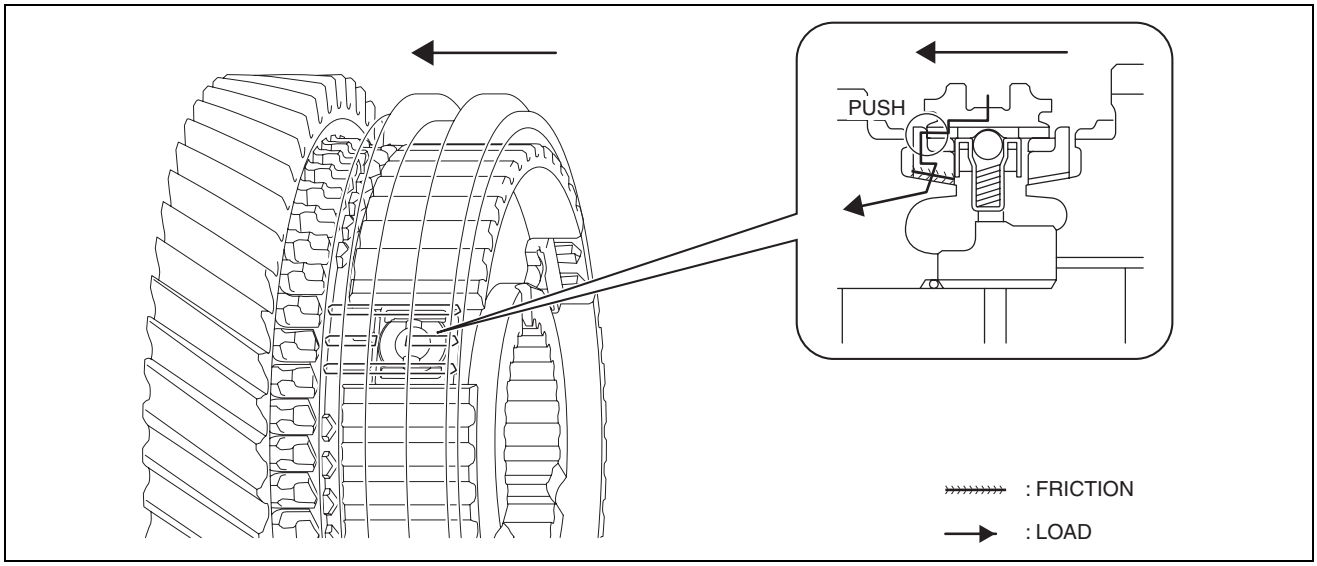
MANUAL TRANSAXLE [D66M-R, D66MX-R]

6. When the clutch hub sleeve moves toward the 5th gear, the load transmitted from the clutch hub sleeve to the gear increases because the spline of the clutch hub sleeve pushes the chamfer of the synchronizer ring.



ac5wzn00001780

7. The friction force on the contacting surface of the parts is increased by increasing the load transmitted from the clutch hub sleeve to the gear.

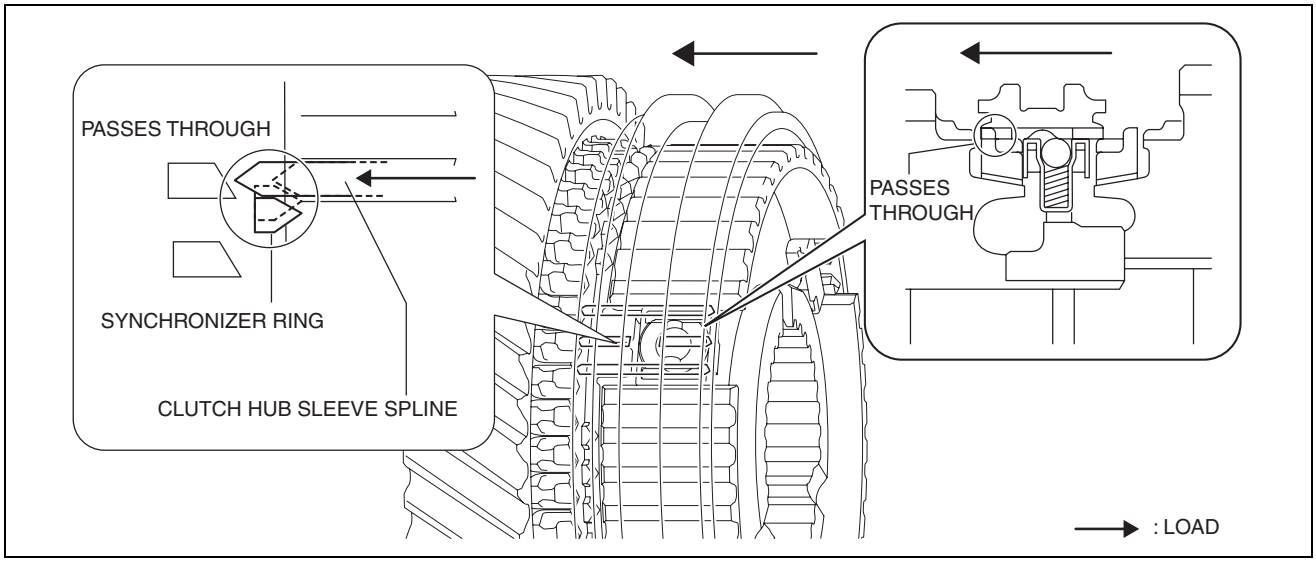


ac5wzn00001781

8. The increased friction force disappears the difference in the rotation speed between the synchronizer ring and the gear, and the rotation is synchronized.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

9. When synchronization in rotation speed of the gear and the clutch hub sleeve is performed, the spline of the clutch hub sleeve passes through the synchronizer ring.



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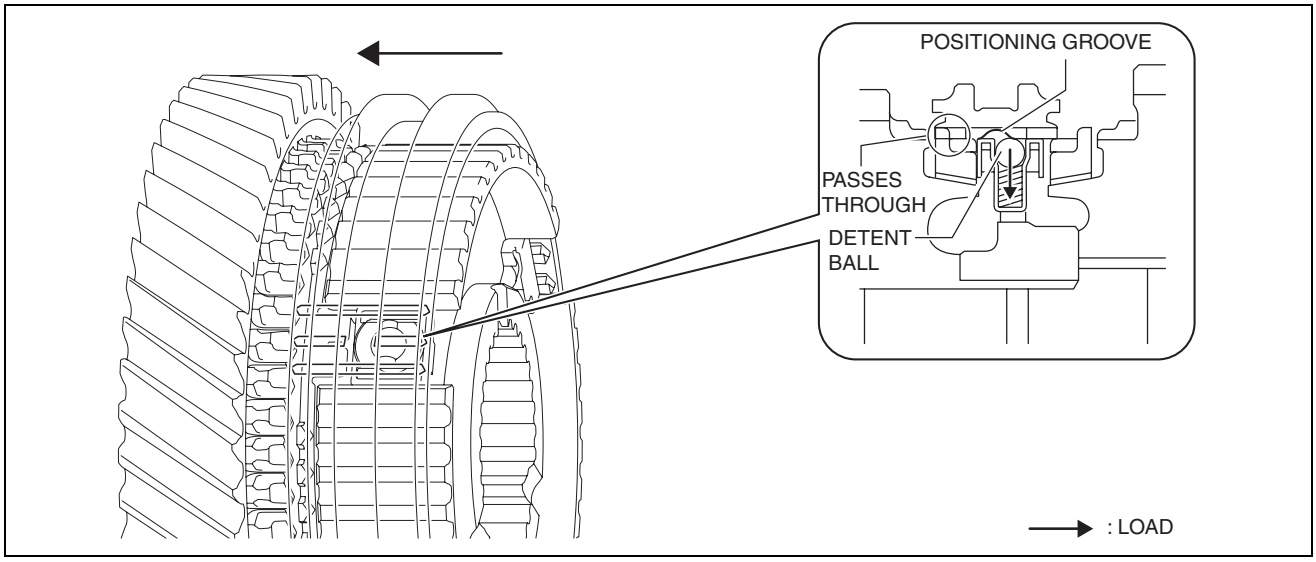
10. When the spline of the clutch hub sleeve passes through the synchronizer ring, the clutch hub sleeve presses down the ball and the ball is removed from the positioning groove of the clutch hub sleeve because the clutch hub sleeve moves toward the secondary 5th gear side.



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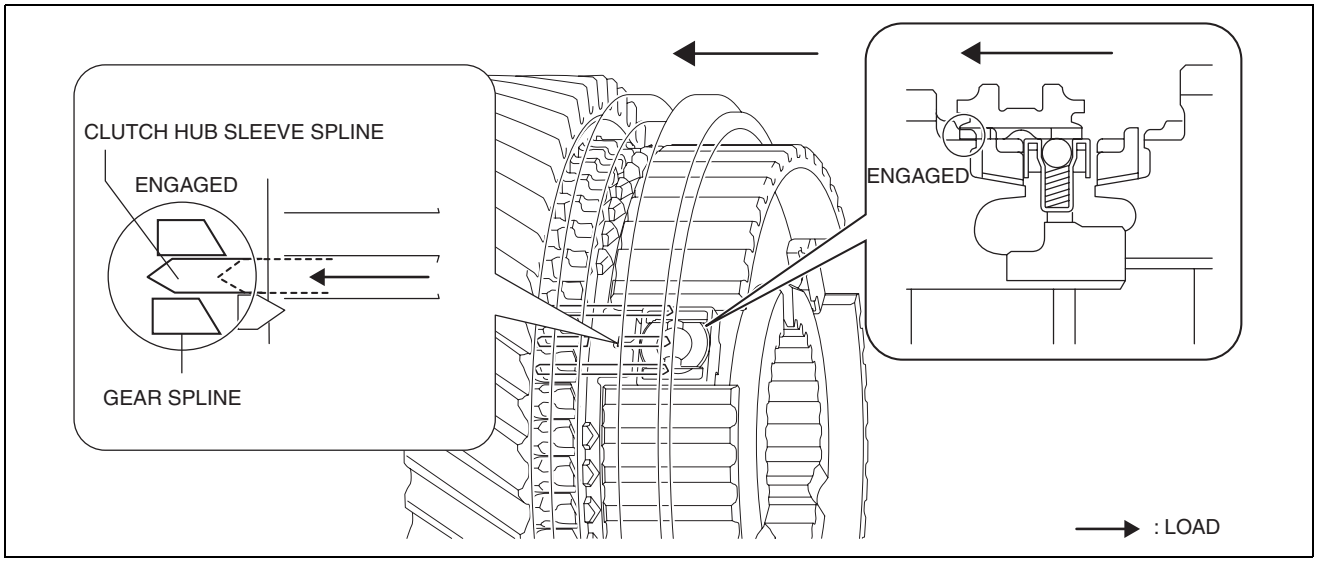
11. When the clutch hub sleeve moves toward the secondary 5th gear side, the spline of the clutch hub sleeve and the spline of the gear are engaged, and the shifting operation is completed.



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POWERTRAIN SYSTEM [D66M-R, D66MX-R]

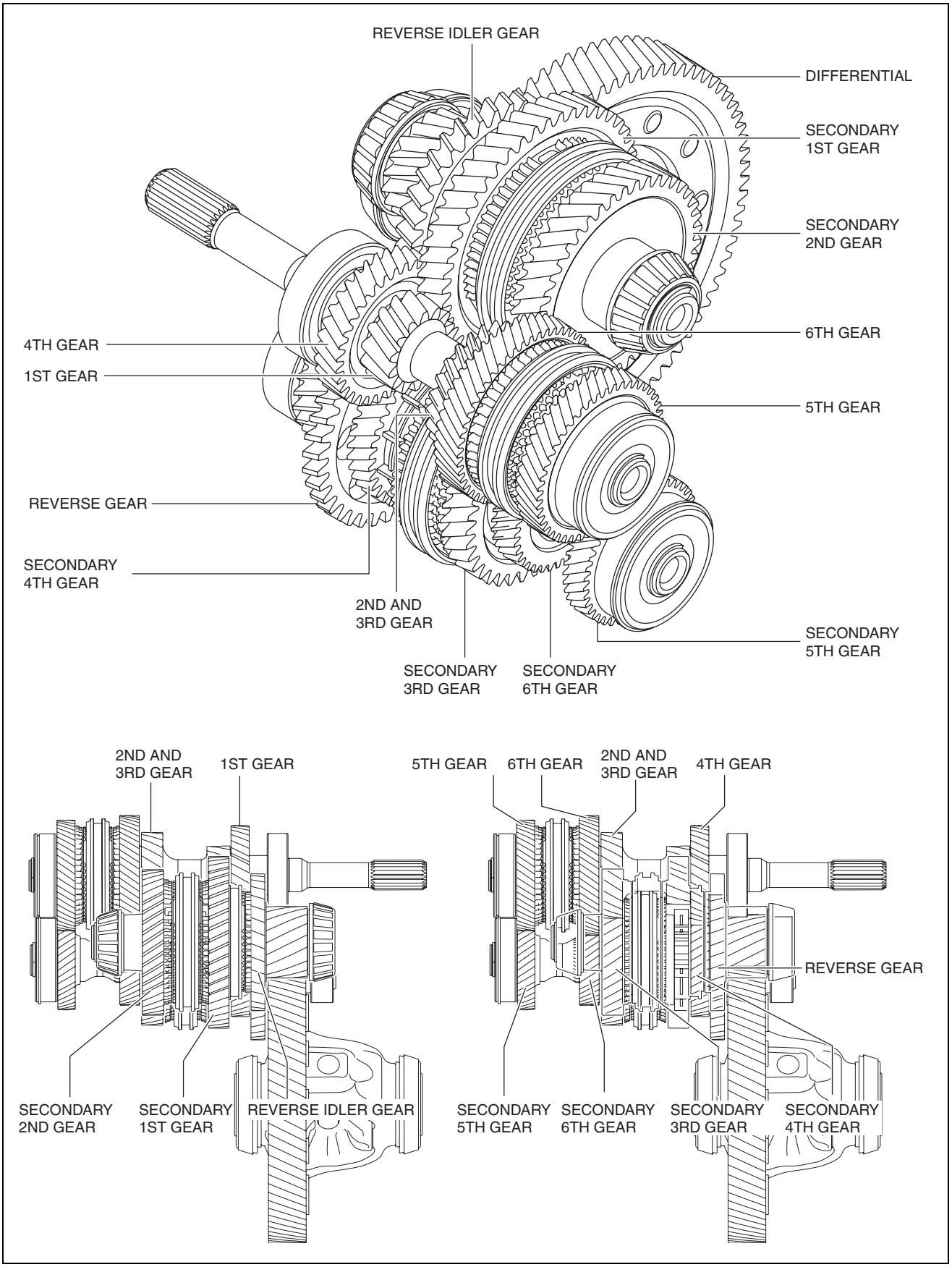
id0515md284100

Purpose, Function

- The powertrain mechanism changes the gear combination by engaging or releasing the clutch hub and gear, and changes the power transmission route. Because of the change in the power transmission route, the drive force (speed, torque, rotation direction) input from the engine is converted.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

Construction



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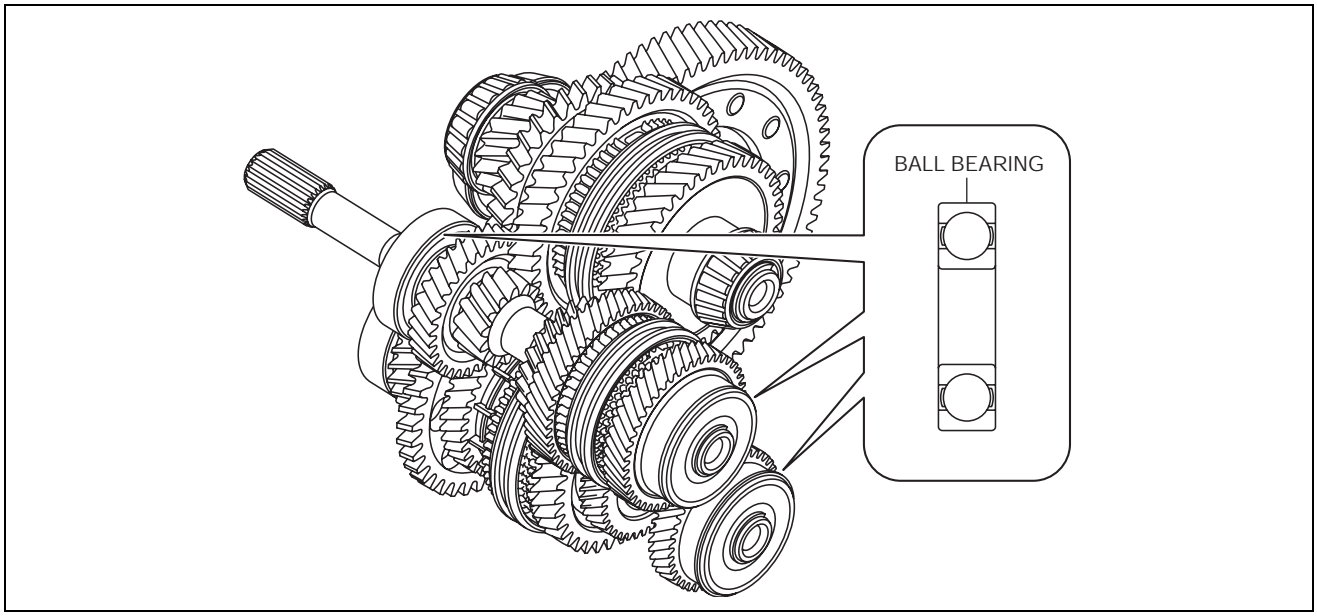
MANUAL TRANSAXLE [D66M-R, D66MX-R]

Ball bearing

- The powertrain mechanism has adopted ball bearing to the locations shown in the figure.



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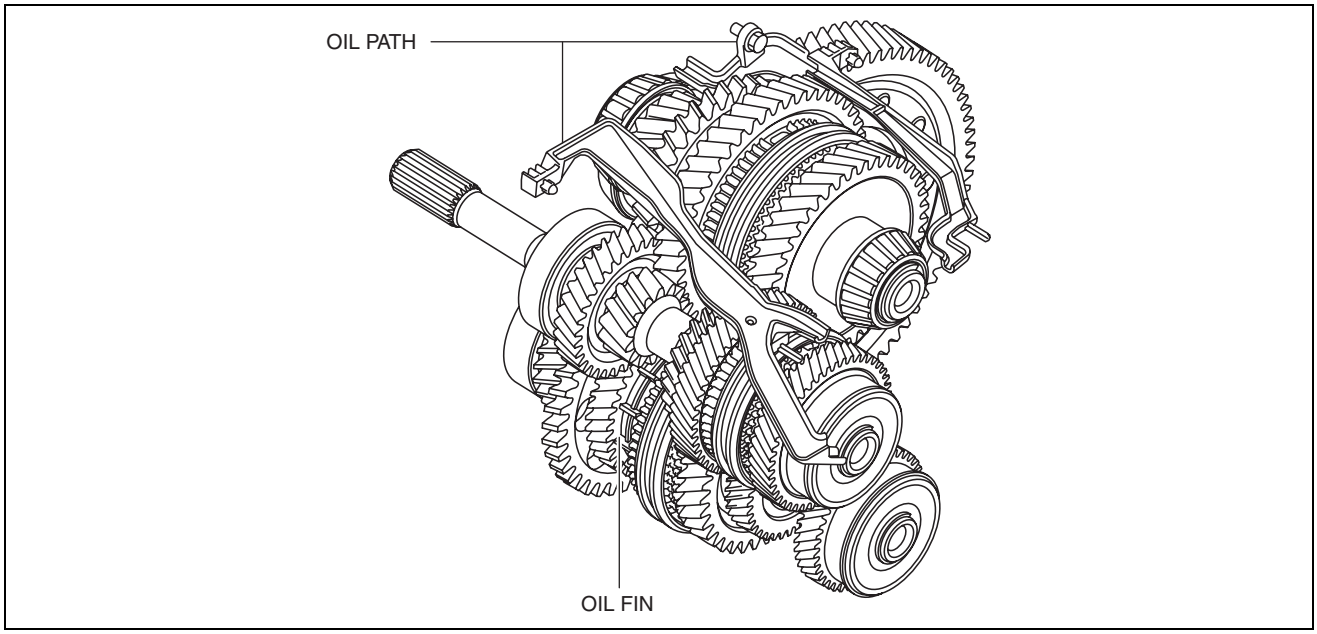
- In comparison to the previous bearing, this part reduces rotational friction resistance of the primary shaft and secondary shaft.

Oil fin, oil path

- The powertrain mechanism has adopted an oil fin and oil path.



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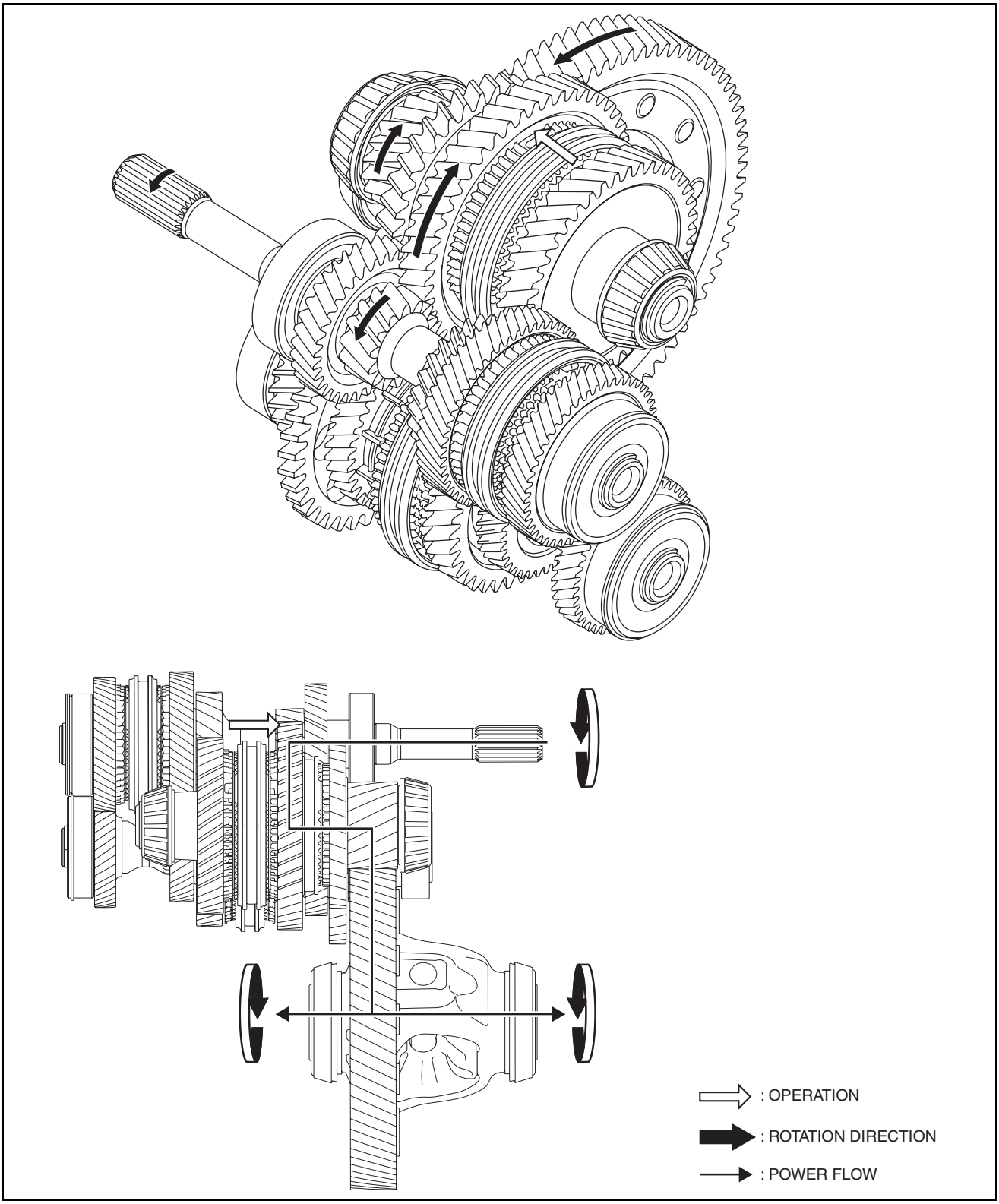
- This mechanism is an splash lubrication-type which is the same as the previous one, however, by adopting the oil fin, the amount of transaxle oil that is raised up has been increased.
- The oil passage uniformly distributes raised transaxle oil and supplies it to each part.
- The powertrain mechanism can operate with a lesser amount of transaxle oil due to the oil fin and oil passage, and flowing resistance from the powertrain mechanism transaxle oil is reduced.

MANUAL TRANSAXLE [D66M-R, D66MX-R]

Operation
1GR



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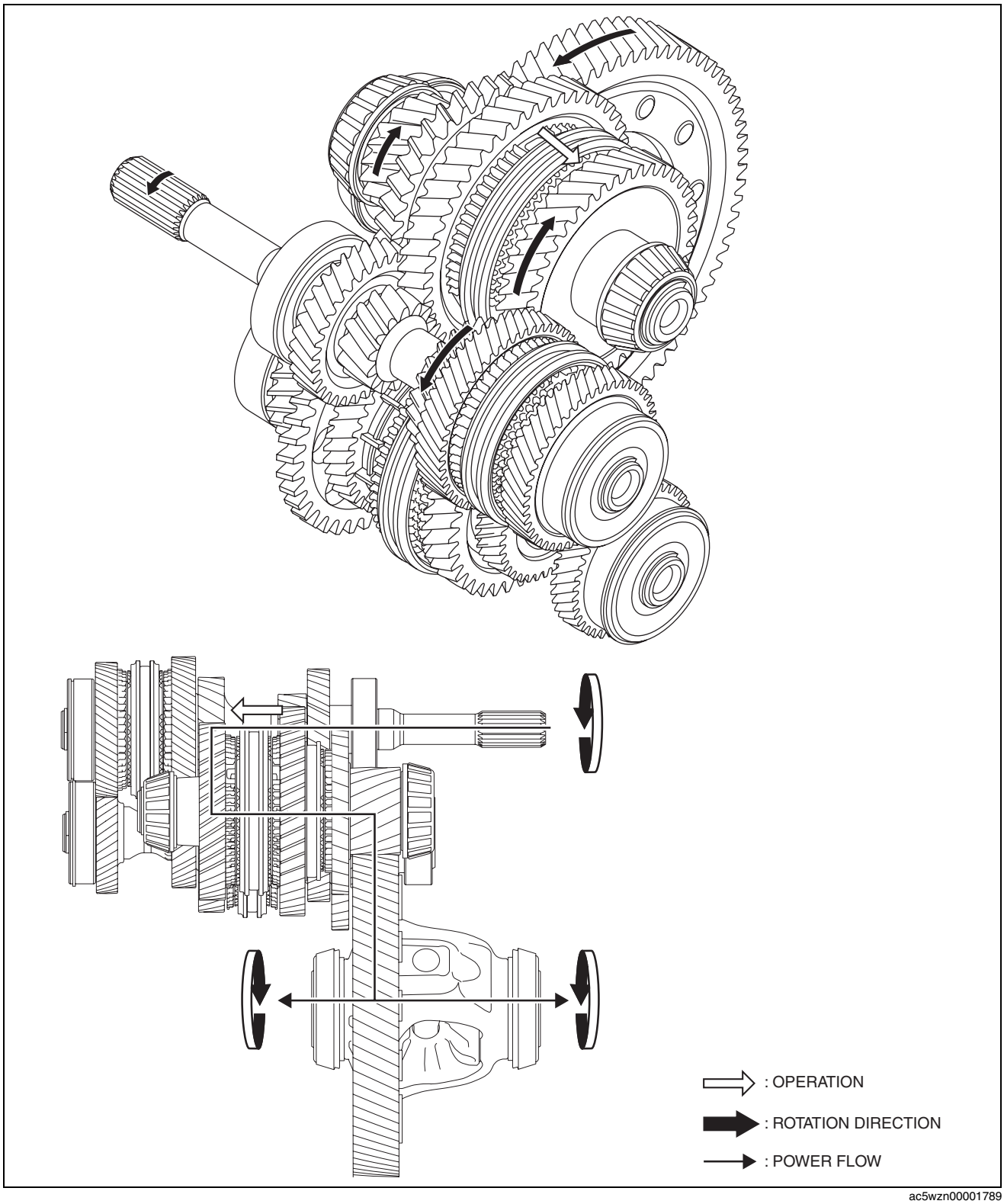
MANUAL TRANSAXLE [D66M-R, D66MX-R]

2GR



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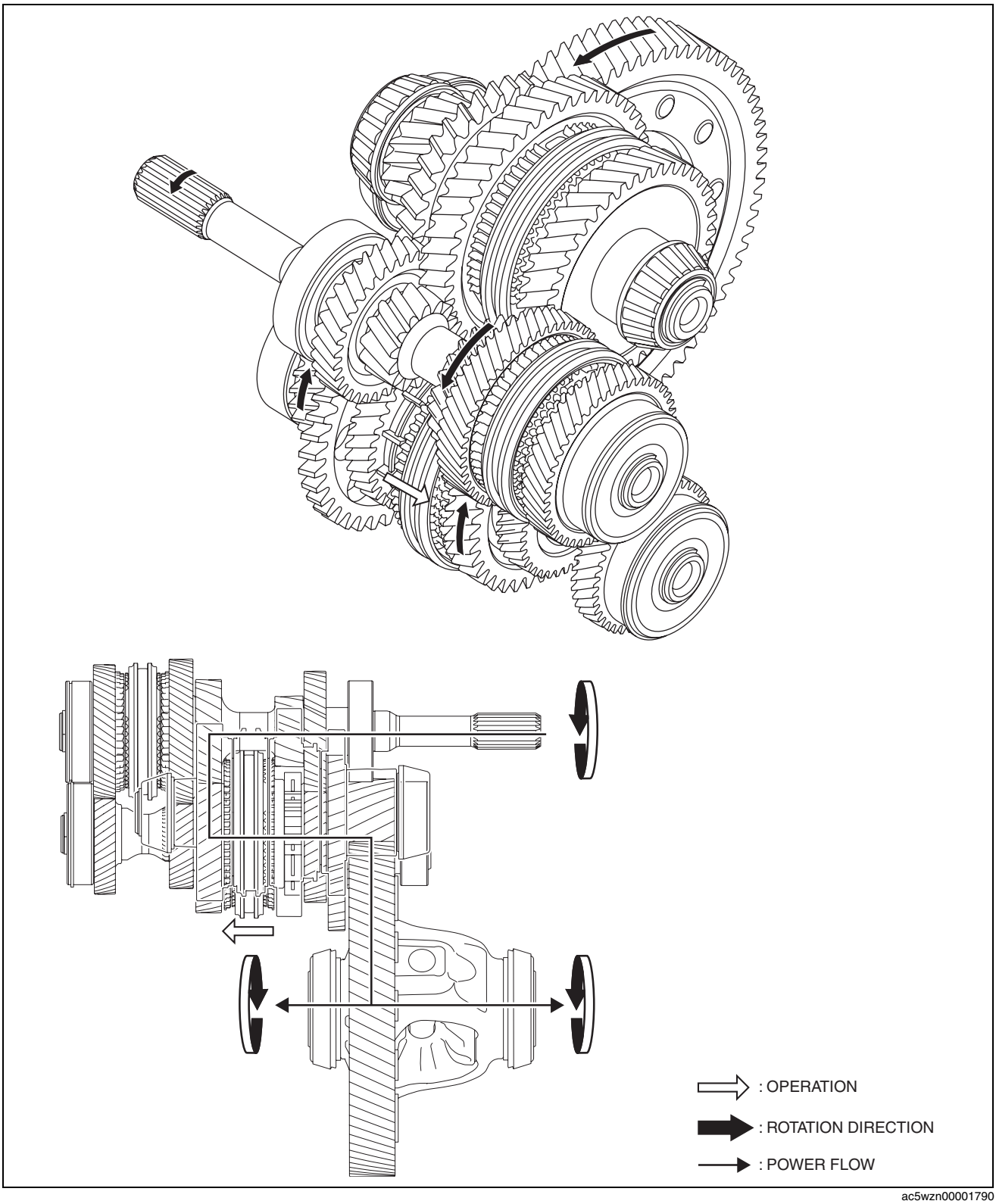
MANUAL TRANSAXLE [D66M-R, D66MX-R]

3GR



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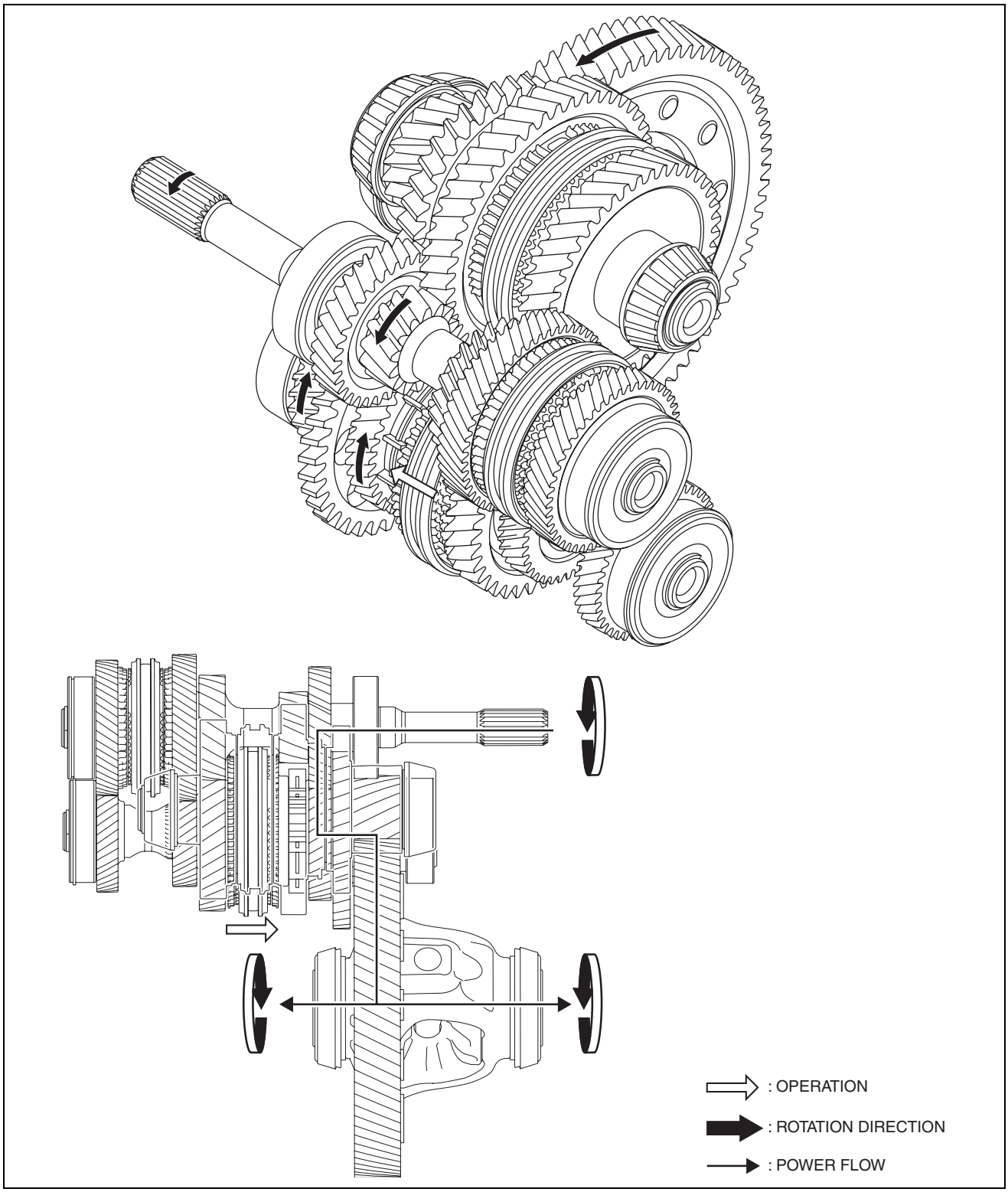
MANUAL TRANSAXLE [D66M-R, D66MX-R]

4GR



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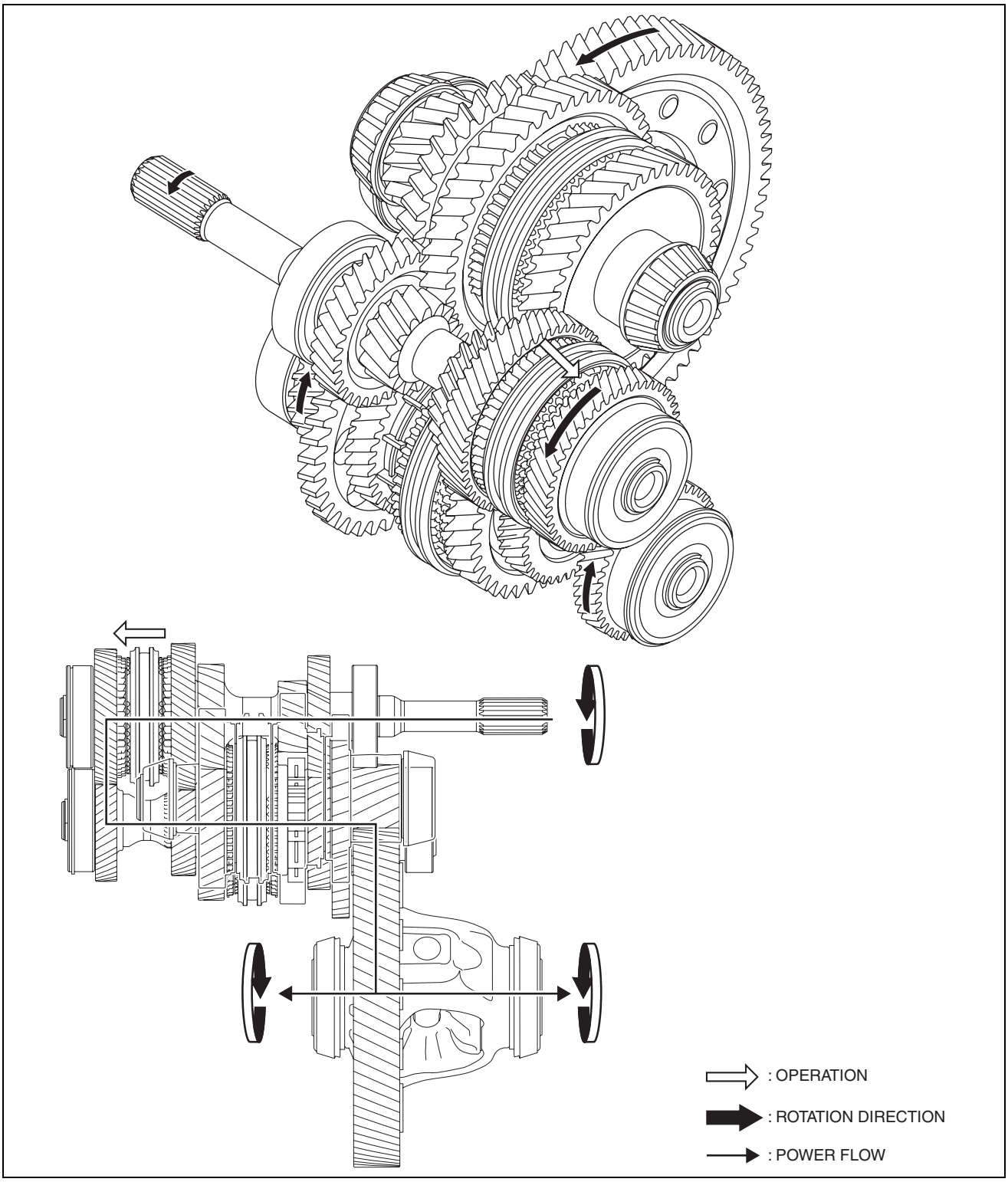
MANUAL TRANSAXLE [D66M-R, D66MX-R]

5GR



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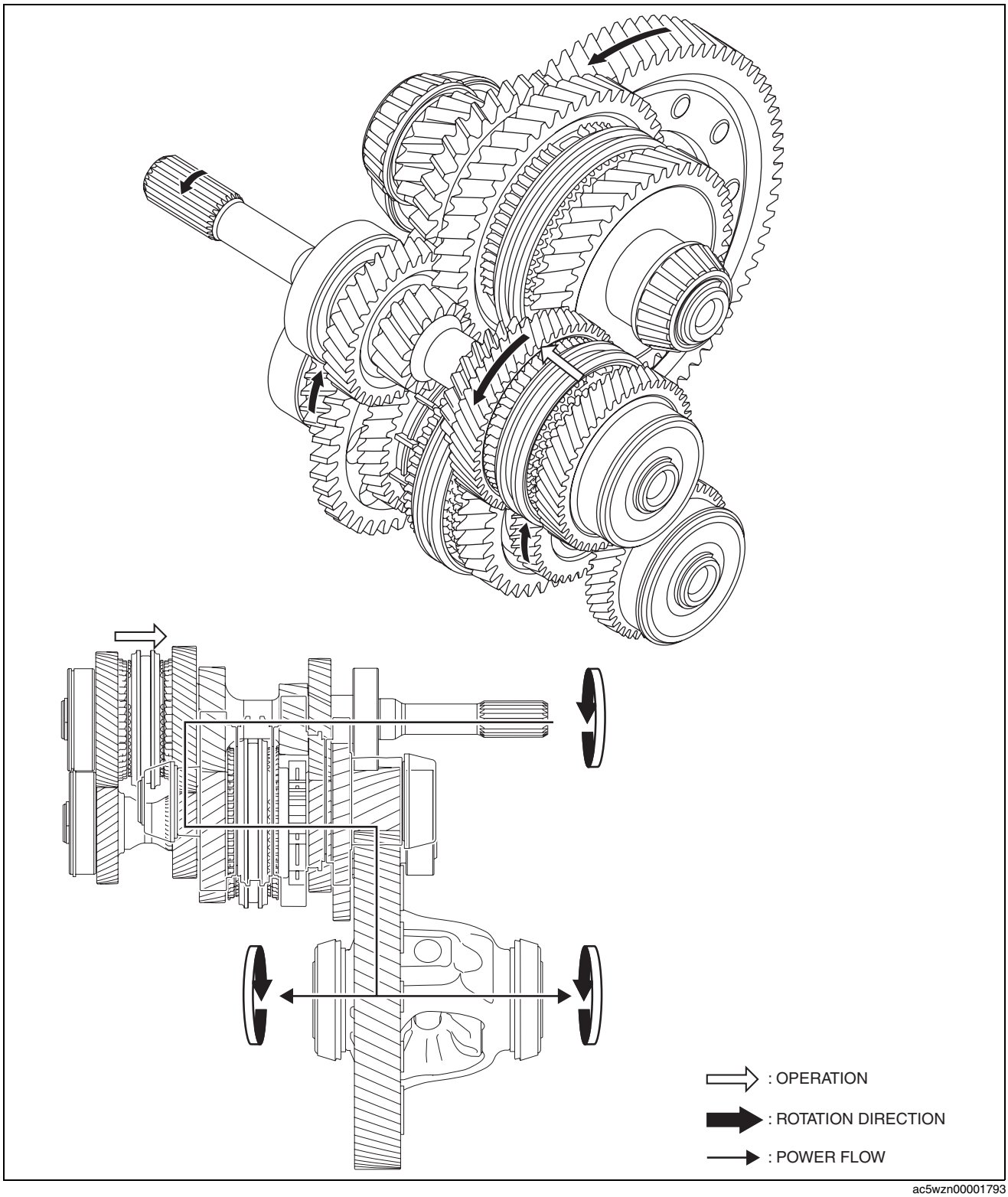
MANUAL TRANSAXLE [D66M-R, D66MX-R]

6GR



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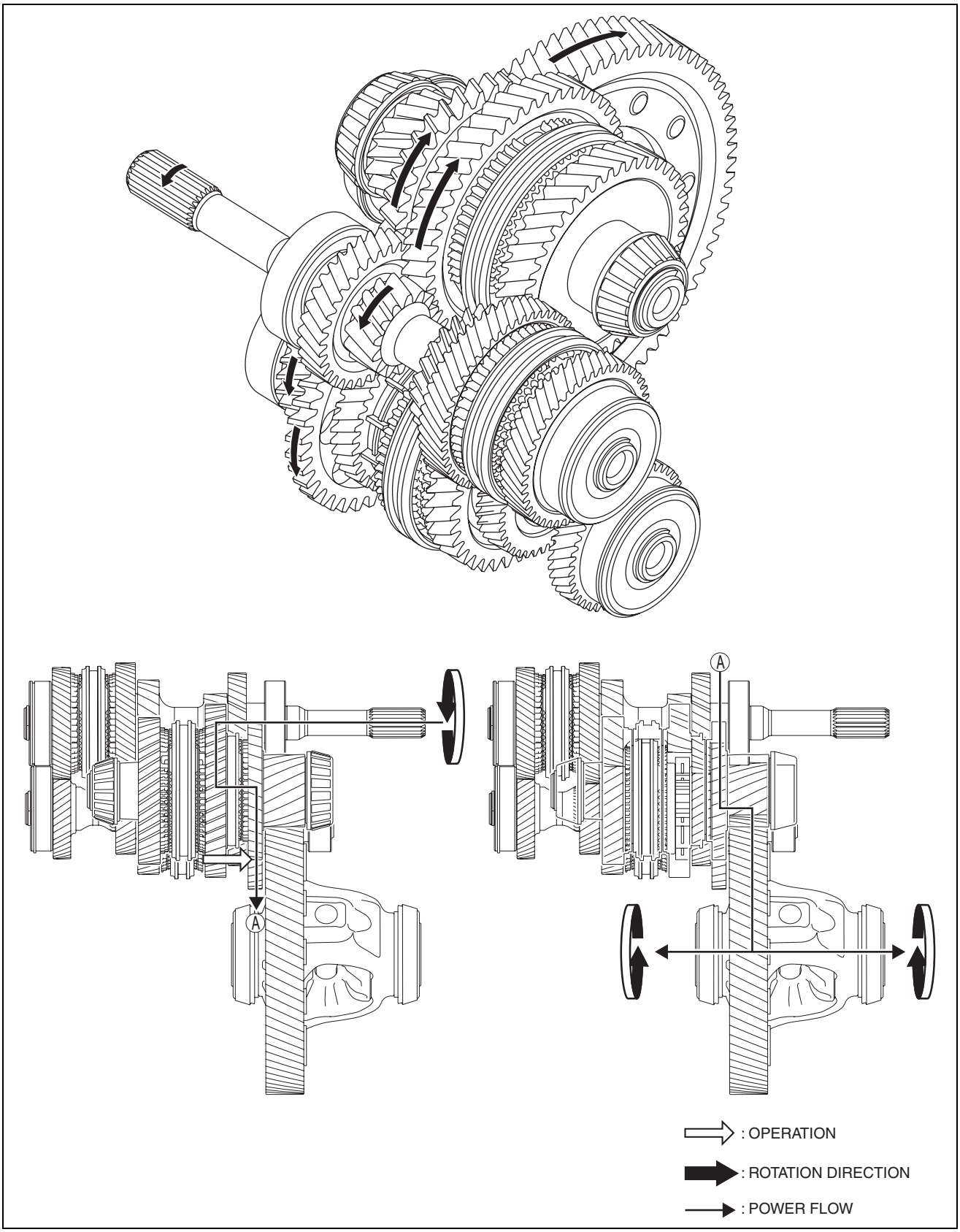
MANUAL TRANSAXLE [D66M-R, D66MX-R]

Reverse



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MANUAL TRANSAXLE [D66M-R, D66MX-R]

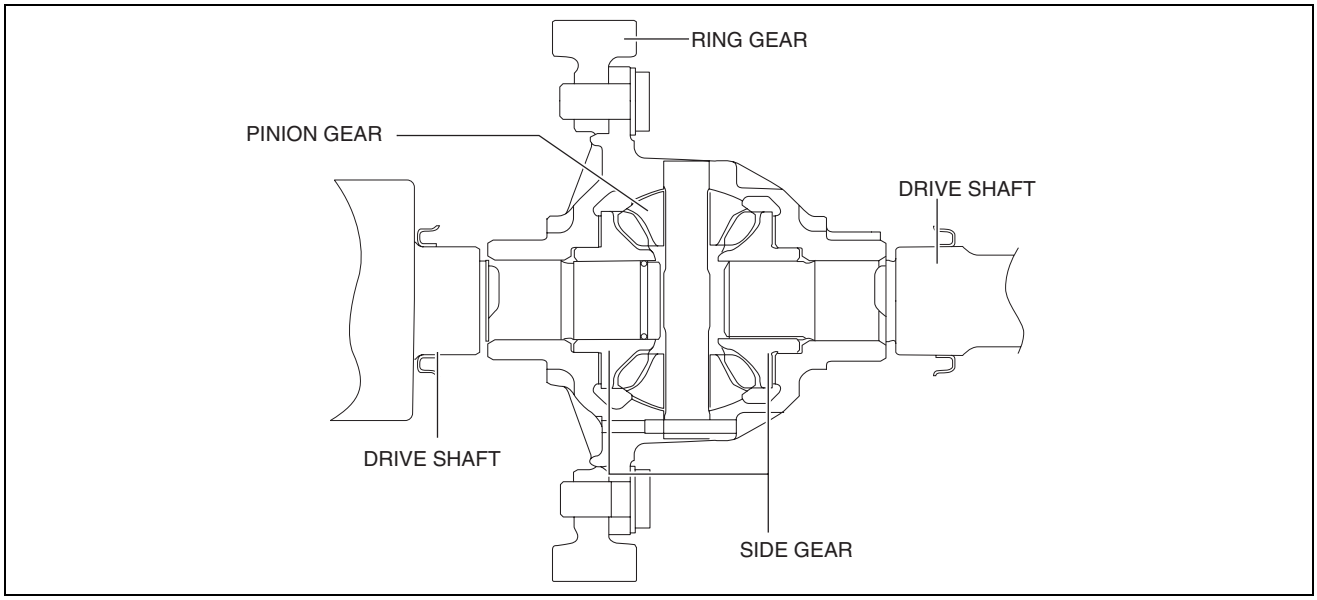
DIFFERENTIAL [D66M-R, D66MX-R]

id0515md284200

Purpose, Function

- The differential absorbs the rotation speed of the inside and outside wheel of a wheel set when the vehicle is cornering.

Construction



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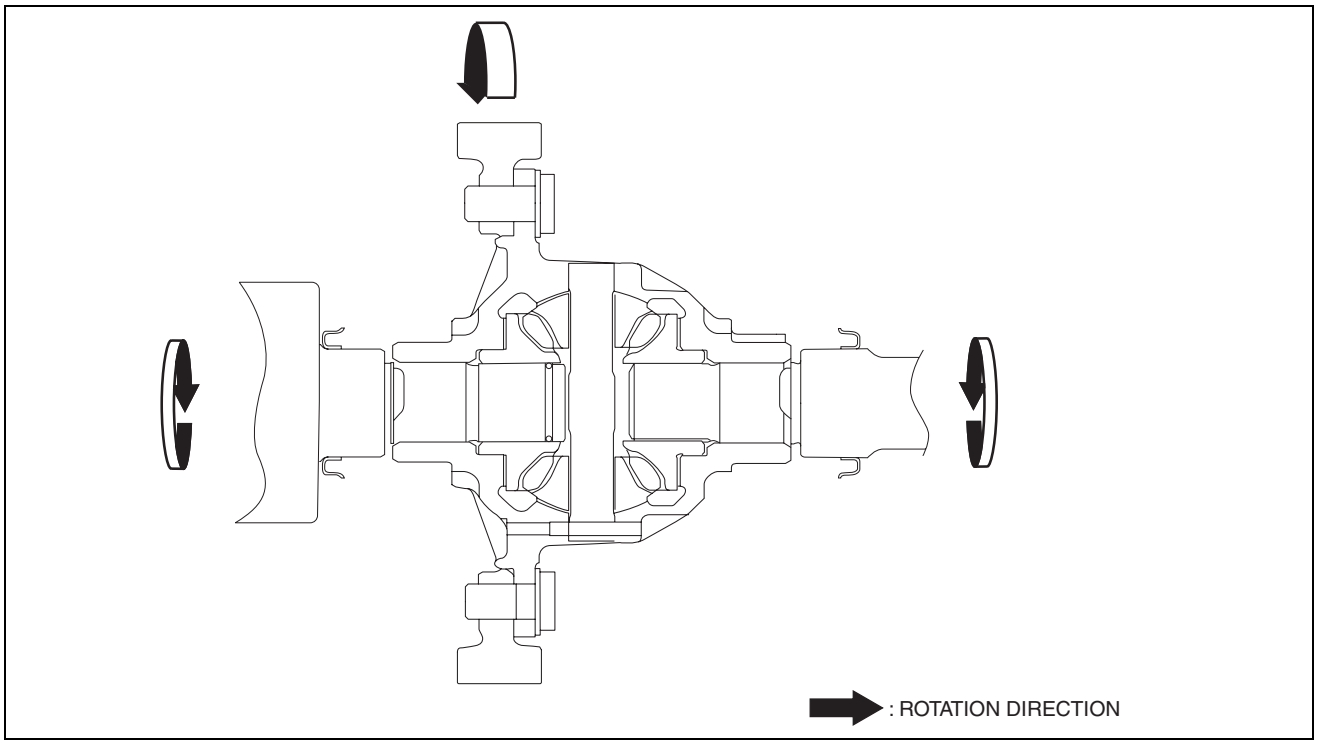
Operation

Driving in a straight line



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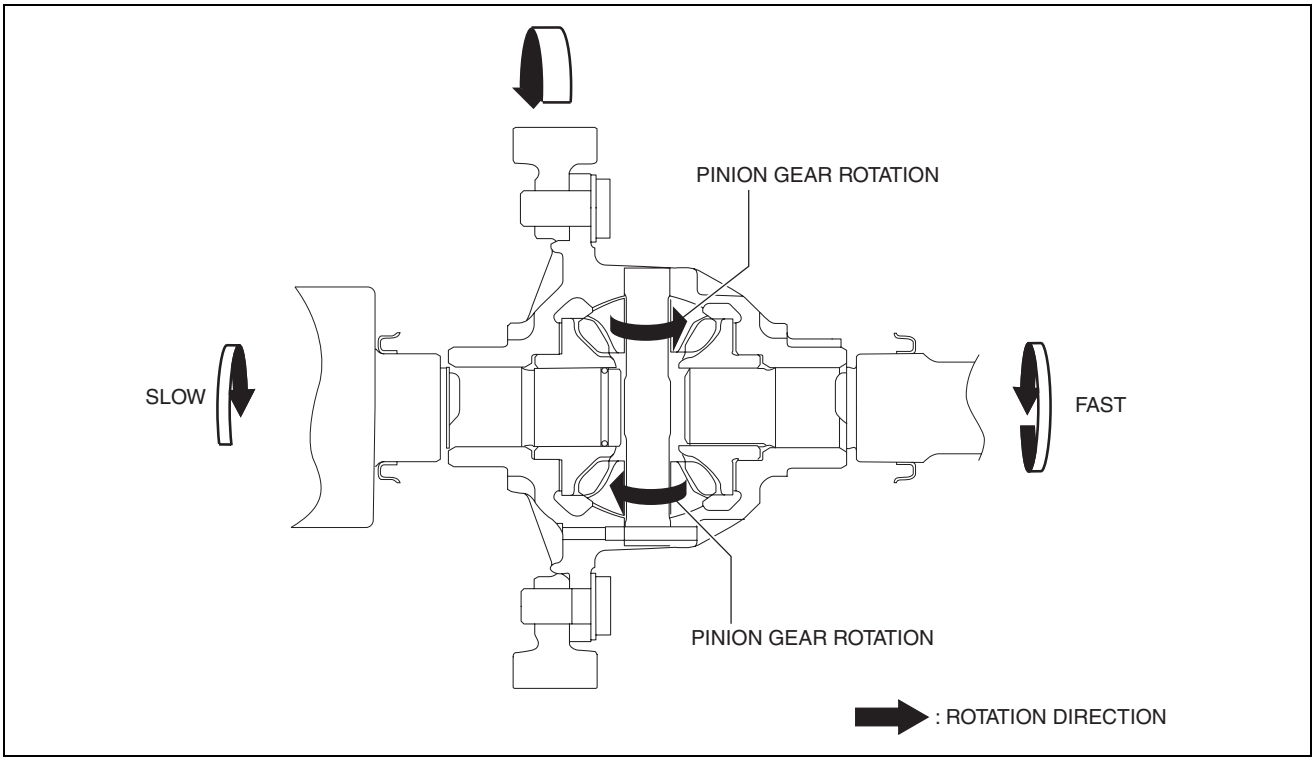
MANUAL TRANSAXLE [D66M-R, D66MX-R]

Cornering



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05-16A MANUAL TRANSAXLE SHIFT MECHANISM [C66M-R, C66MX-R]

MANUAL TRANSAXLE SHIFT MECHANISM [C66M-R, C66MX-R]

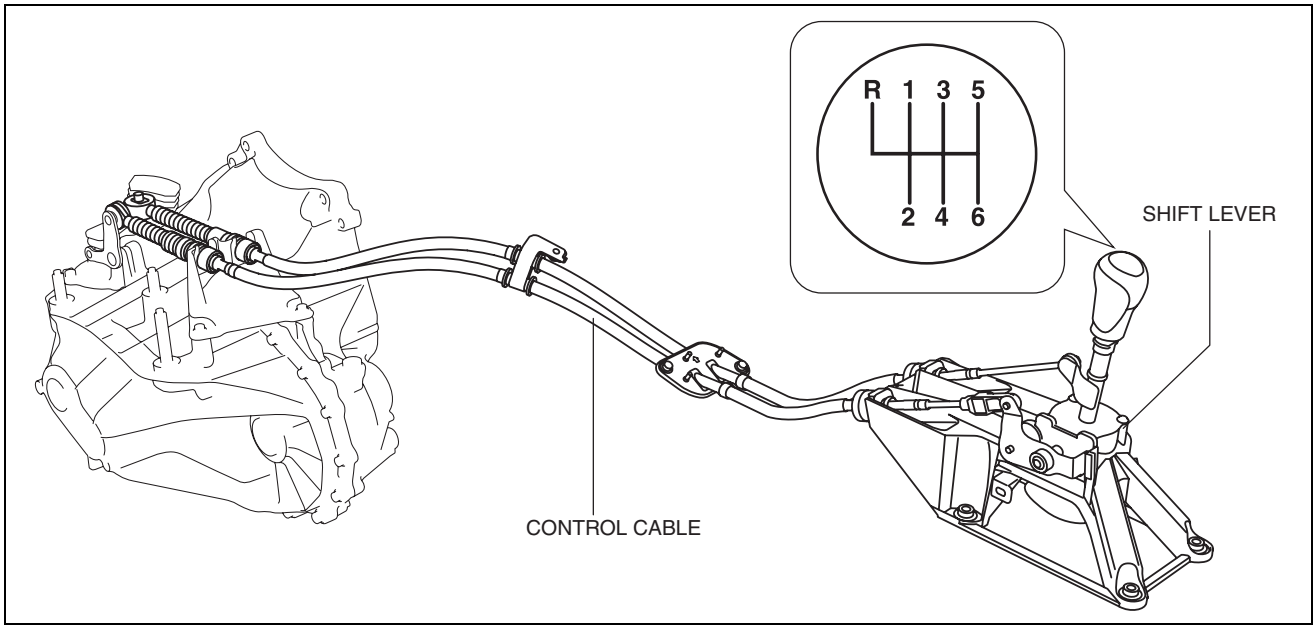
SHIFT LEVER [C66M-R, C66MX-R]

id0516c8283700

Purpose, Function

- The shift lever operates the MTX via the control cable.

Construction



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Shift lever

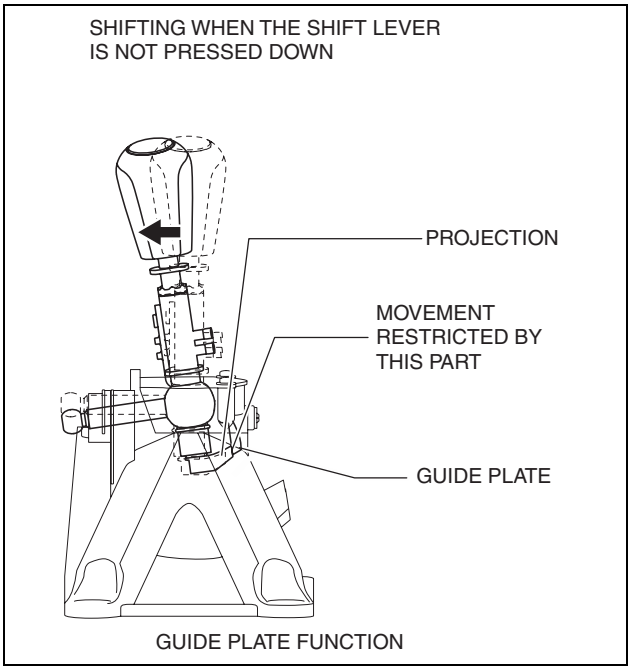
- The shift lever is designed to prevent improper shifting to 1st gear and reverse.

MANUAL TRANSAXLE SHIFT MECHANISM [C66M-R, C66MX-R]

Operation

1 GR shifting

- A guide plate, attached to the shift lever assembly, prevents accidental shifting into reverse when shifting into 1st gear by restricting the movement of the shift lever.



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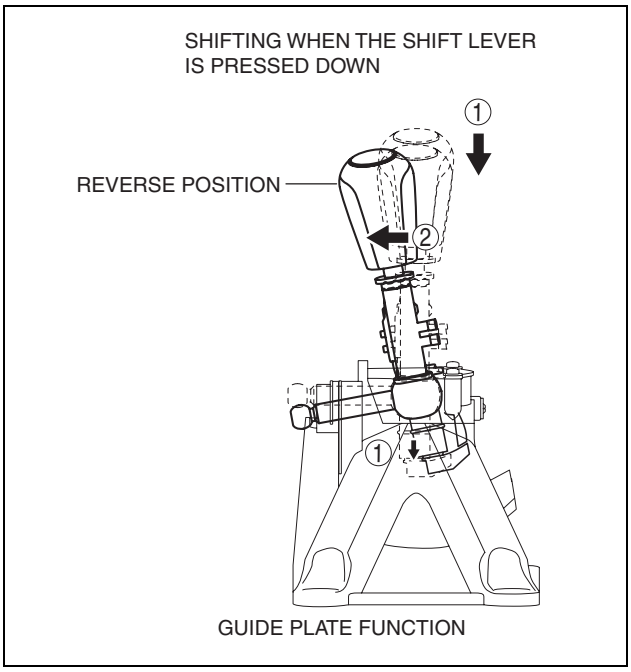
Reverse shifting

- When shifting into reverse, once the shift lever is pressed down and moved towards the reverse position.
- The projection on the lever goes under the guide plate, releasing the reverse shift restriction and allowing for shifting into reverse.



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05-16B MANUAL TRANSAXLE SHIFT MECHANISM [D66M-R, D66MX-R]

MANUAL TRANSAXLE SHIFT MECHANISM [D66M-R, D66MX-R]

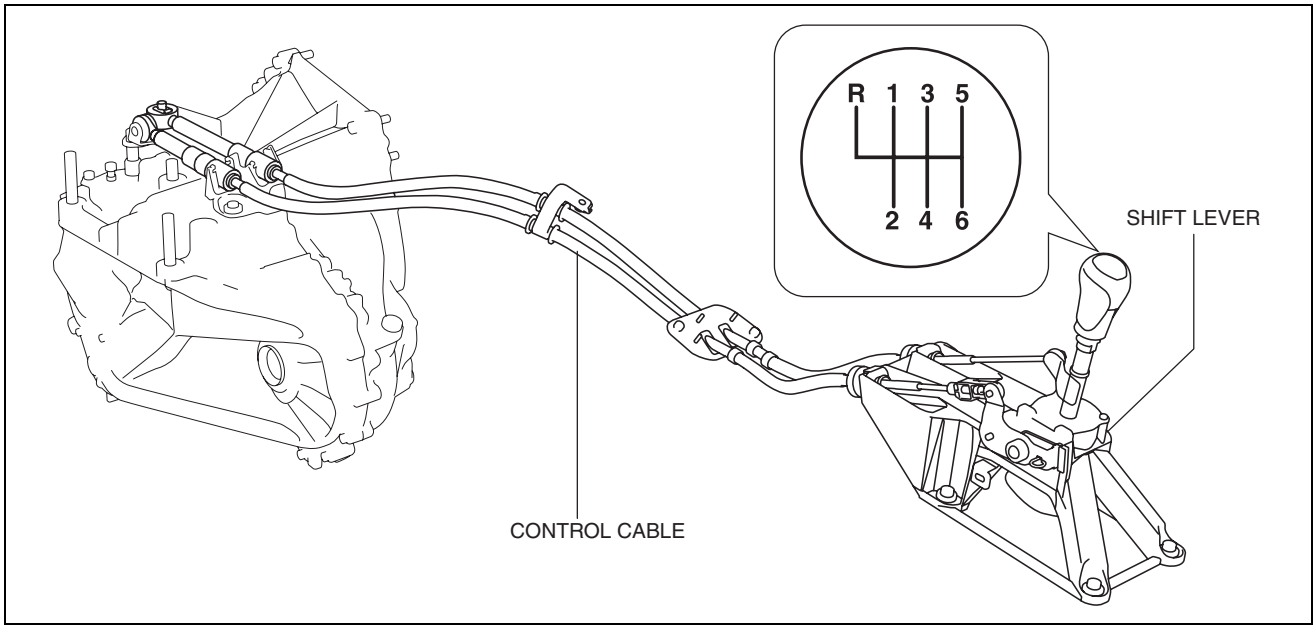
SHIFT LEVER [D66M-R, D66MX-R]

id0516cb283700

Purpose, Function

- The shift lever operates the MTX via the control cable.

Construction



ac5wzn00001796

Shift lever

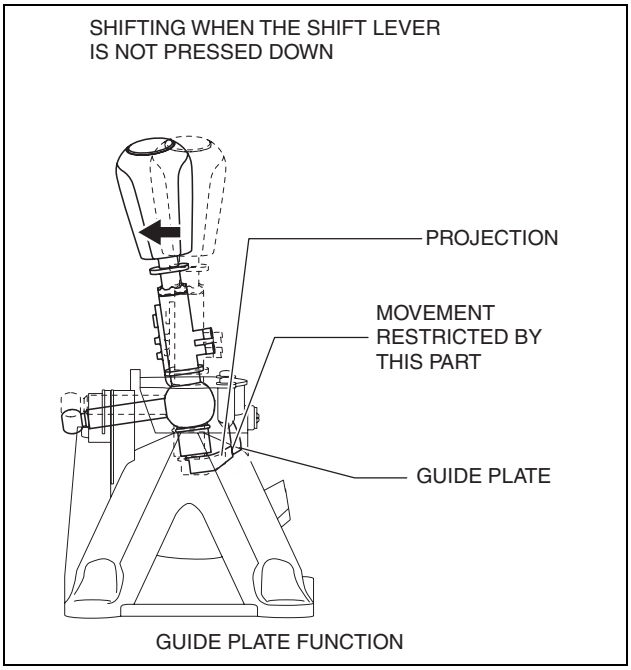
- The shift lever is designed to prevent improper shifting to 1st gear and reverse.

MANUAL TRANSAXLE SHIFT MECHANISM [D66M-R, D66MX-R]

Operation

1 GR shifting

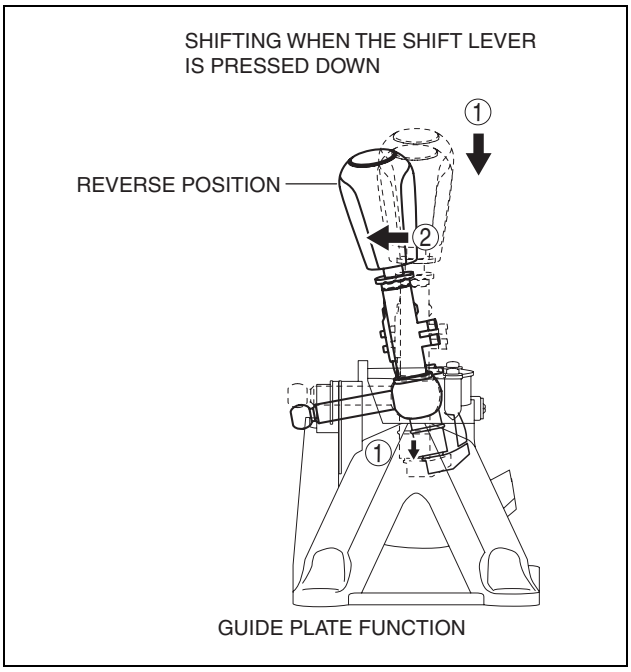
- A guide plate, attached to the shift lever assembly, prevents accidental shifting into reverse when shifting into 1st gear by restricting the movement of the shift lever.



ac5uun00000003

Reverse shifting

- When shifting into reverse, once the shift lever is pressed down and moved towards the reverse position, the projection on the lever goes under the guide plate, releasing the reverse shift restriction and allowing for shifting into reverse.



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05-17A AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

AUTOMATIC TRANSAXLE OUTLINE [FW6A-EL, FW6AX-EL]

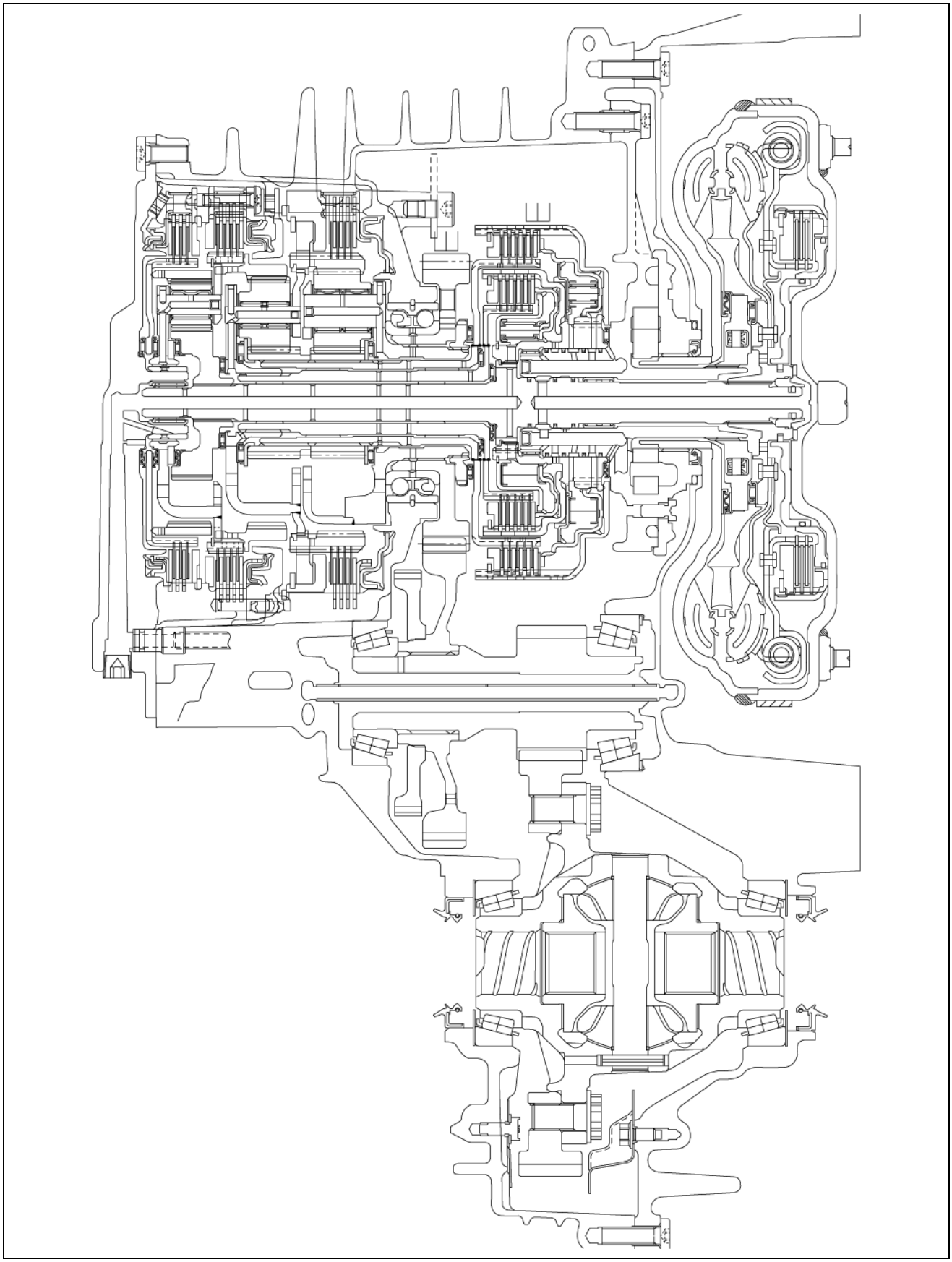
id0517h2350000

Outline

Contribution to low fuel economy	• Wide TCC range • Clutch/brake resistance reduction
Realized direct feel and quick shifting	• Oil passage resistance reduction and improved clutch/brake response by optimizing clutch rigidity • Improved solenoid valve response
Smooth and powerful start-up	• Torque converter characteristics when accelerating and optimized range
Smooth shifting	• Control valve body integrated with TCM adopted • Direct linear solenoid valve has been adopted to improve shift accuracy

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction
Cross-sectional view



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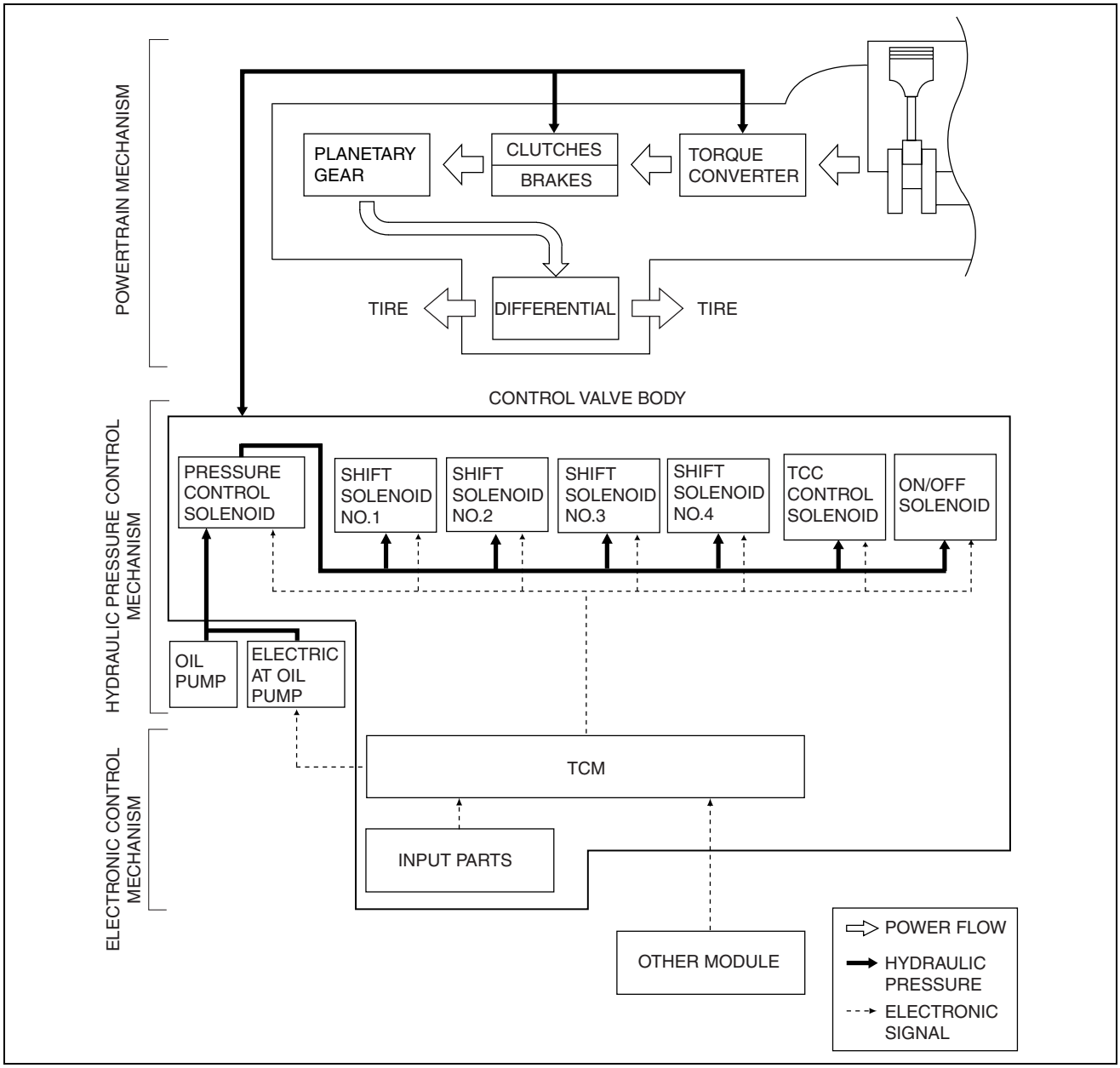
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The electronic control automatic transaxle consists of three systems which are divided into the powertrain with a torque converter, the hydraulic control mechanism, and the electronic control mechanism.



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AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Operation
Automatic transaxle operation chart

Position	Mode	Gear position	Gear ratio	TCC	Operation of powertrain parts						Operation of shift solenoid					
					Low clutch	High clutch	Low and reverse brake	2-6 brake	R-3-5 brake	One-way clutch	Shift solenoid No.1	Shift solenoid No.2	Shift solenoid No.3	Shift solenoid No.4	TCC control solenoid	ON/OFF solenoid
P	-	-	-				×				CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OFF
R	-	Reverse	3.893				×		×		CLOSE	CLOSE	OPEN	OPEN	CLOSE	OFF
N		-	-				×				CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OFF
D/M	NORMAL	1GR	3.552	×	×		×			⊗	OPEN	CLOSE	CLOSE	OPEN	OPEN	OFF
		2GR	2.022	×	×			×			OPEN	OPEN	CLOSE	CLOSE	OPEN	ON
		3GR	1.452	×	×				×		OPEN	CLOSE	OPEN	CLOSE	OPEN	ON
		4GR	1.000	×	×	×					OPEN	CLOSE	CLOSE	OPEN	OPEN	ON
		5GR	0.708	×		×			×		CLOSE	CLOSE	OPEN	OPEN	OPEN	ON
		6GR	0.599	×		×		×			CLOSE	OPEN	CLOSE	OPEN	OPEN	ON

× : Operating
⊗ : Transmits torque only during driving operation
OPEN: Engages the line pressure to the clutch pressure
CLOSE: Drains the clutch pressure
ON: Engages the output port and the supply port
OFF: Engages the output port and the drain port (Drains the output port)

am3uun0000245

POWERTRAIN SYSTEM OUTLINE [FW6A-EL, FW6AX-EL]

id0517h2351000

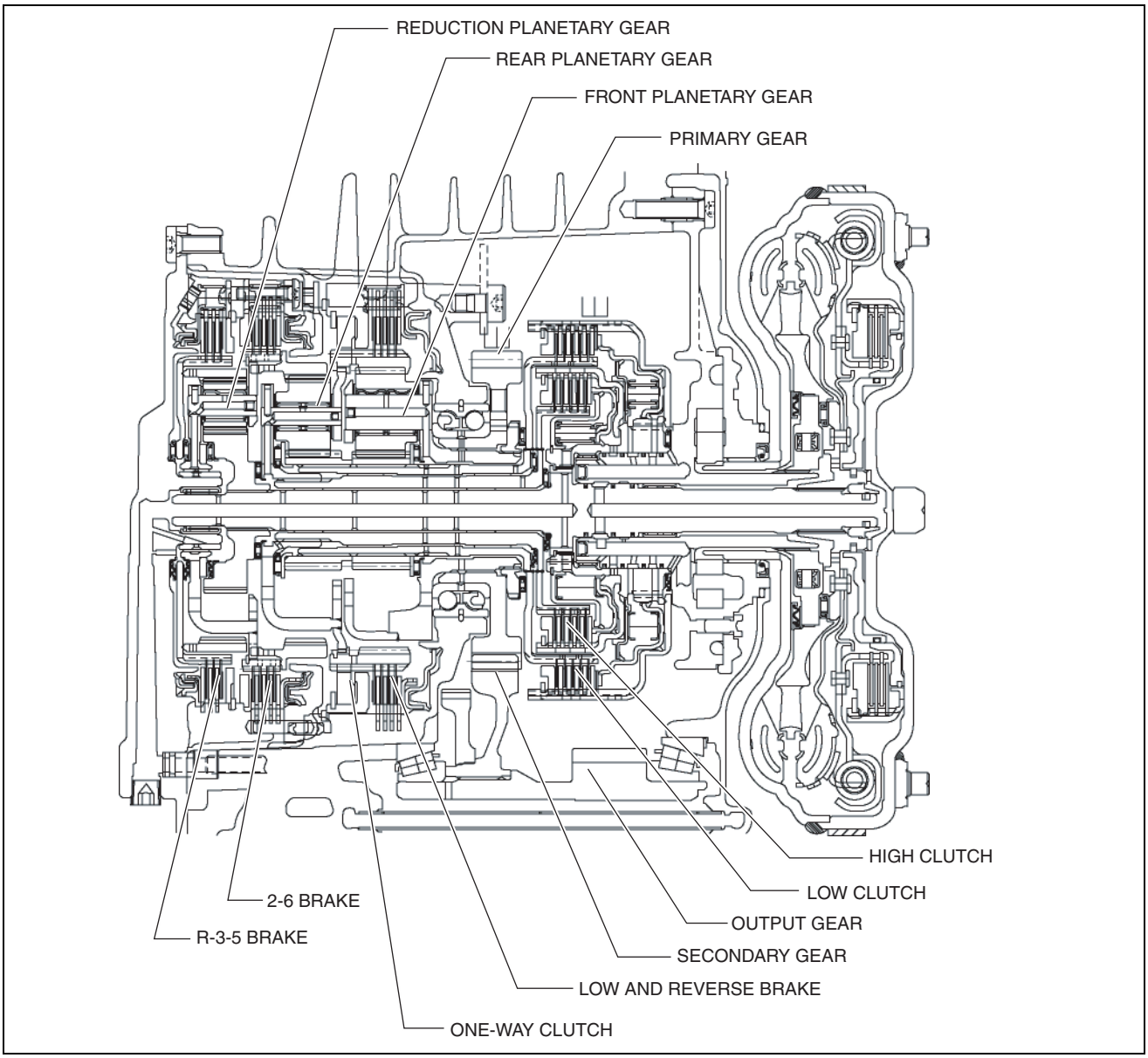
Outline
- The powertrain consists of a 2-piece multi-plate clutch, 3-piece multi-plate brake, a one-way clutch, and a 3-piece single-type planetary gear.

Construction
Component parts list

Component parts		Movement
Multi-plate clutch	Low clutch	Transmits drive force from turbine shaft to front and rear sun gears
	High clutch	Transmits drive force from turbine shaft to rear planetary carrier
Multi-plate brake	R-3-5 brake	Locks reduction internal gear against rotation
	2-6 brake	Locks rear internal gear and reduction planetary gear against rotation
	Low and reverse brake	Locks front internal gear and rear planetary gear against rotation
One-way clutch		Restricts counterclockwise rotation (when viewed from torque converter side) of front internal gear
Single type planetary gear	Front planetary gear	Converts drive force transmitted from engine by operation of each clutch and brake, and transmits it to primary gear. (Operates transaxle.)
	Rear planetary gear	
	Reduction planetary gear	

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Cross-sectional view



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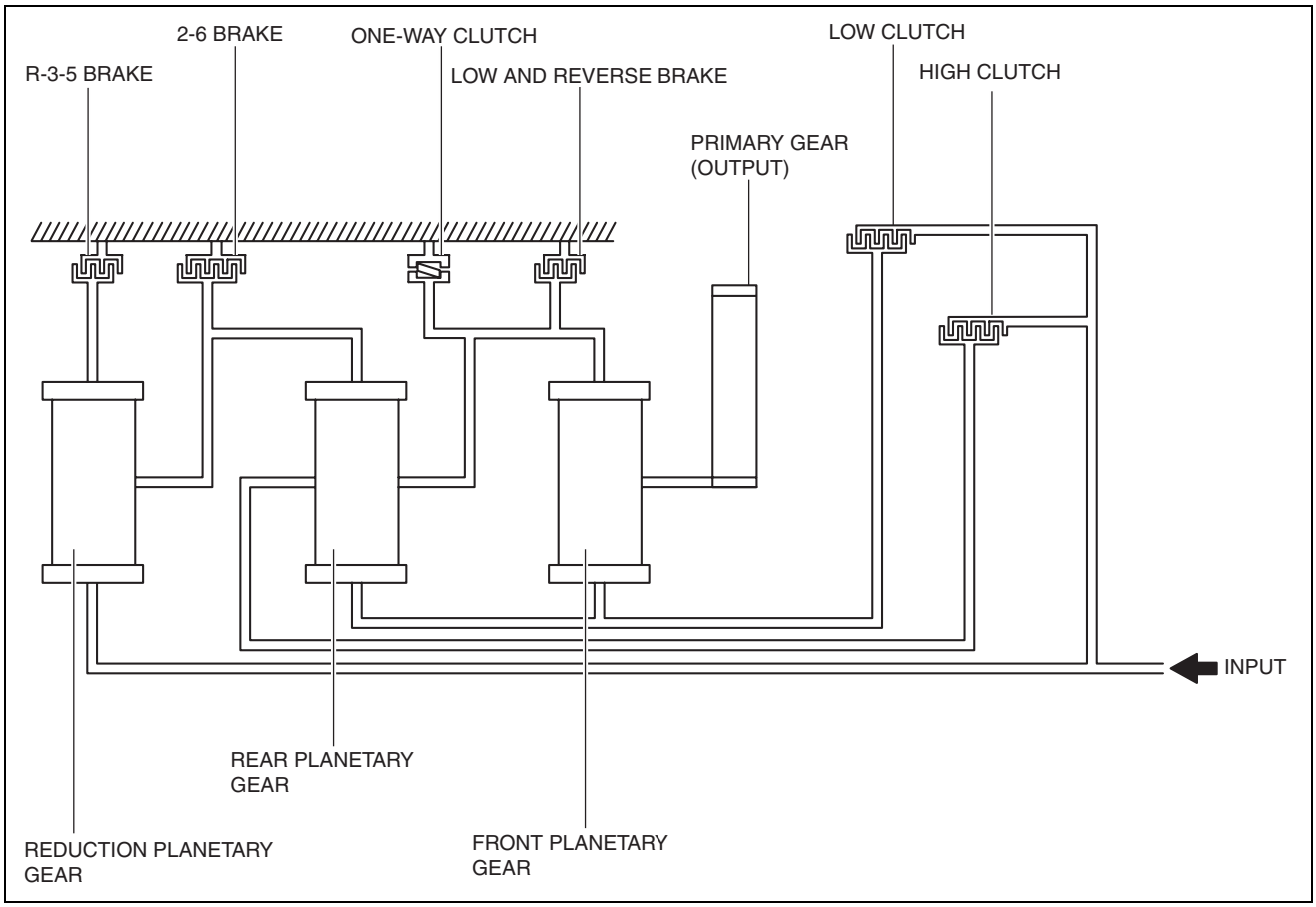
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Skeleton diagram



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TORQUE CONVERTER [FW6A-EL, FW6AX-EL]

id0517h2351100

Purpose/Function

- By use of an optimized torus shape (wing) matching the output characteristics of the engine, the torque converter achieves efficient force transmission and reduced fuel consumption.

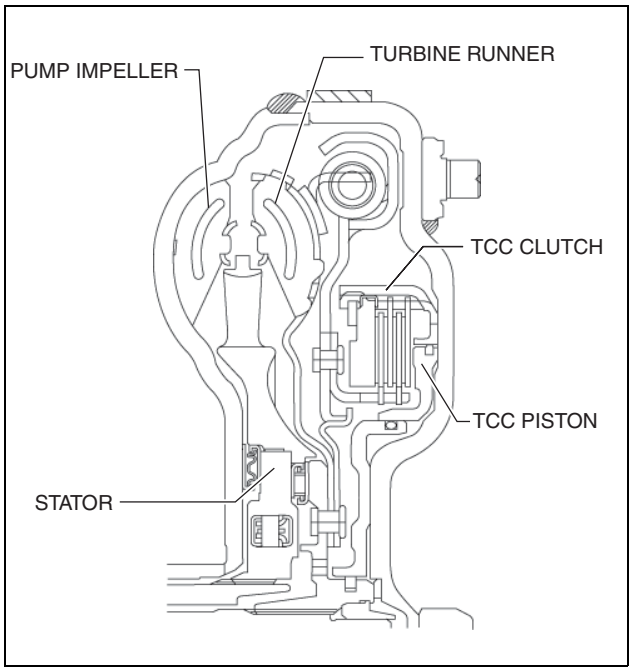
Construction/Operation

- A three-member, single-stage two-phase type torque converter with a torque converter clutch (TCC) mechanism has been adopted.
  - — Three-member: Indicates that the torque converter consists of a pump impeller, turbine runner, and stator.
  - — Single stage: Indicates the number of turbine runners.
  - — Two-phase: Indicates that there are two conditions; torque converter range and fluid coupling range.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

TCC mechanism

- A TCC piston built into the torque converter operates during TCC control. When hydraulic pressure is applied to the TCC piston, the TCC clutch engages to mechanically connect the pump impeller to the turbine runner. The TCC mechanism achieves excellent fuel economy as a result of no loss in drive force transmission due to torque converter slippage. In addition, precise hydraulic control is made possible by a multi-plate clutch equipped with an independent piston housing. With the adoption of this mechanism, the achievable range of TCC control has widened dramatically.



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LOW CLUTCH [FW6A-EL, FW6AX-EL]

id0517h2351200

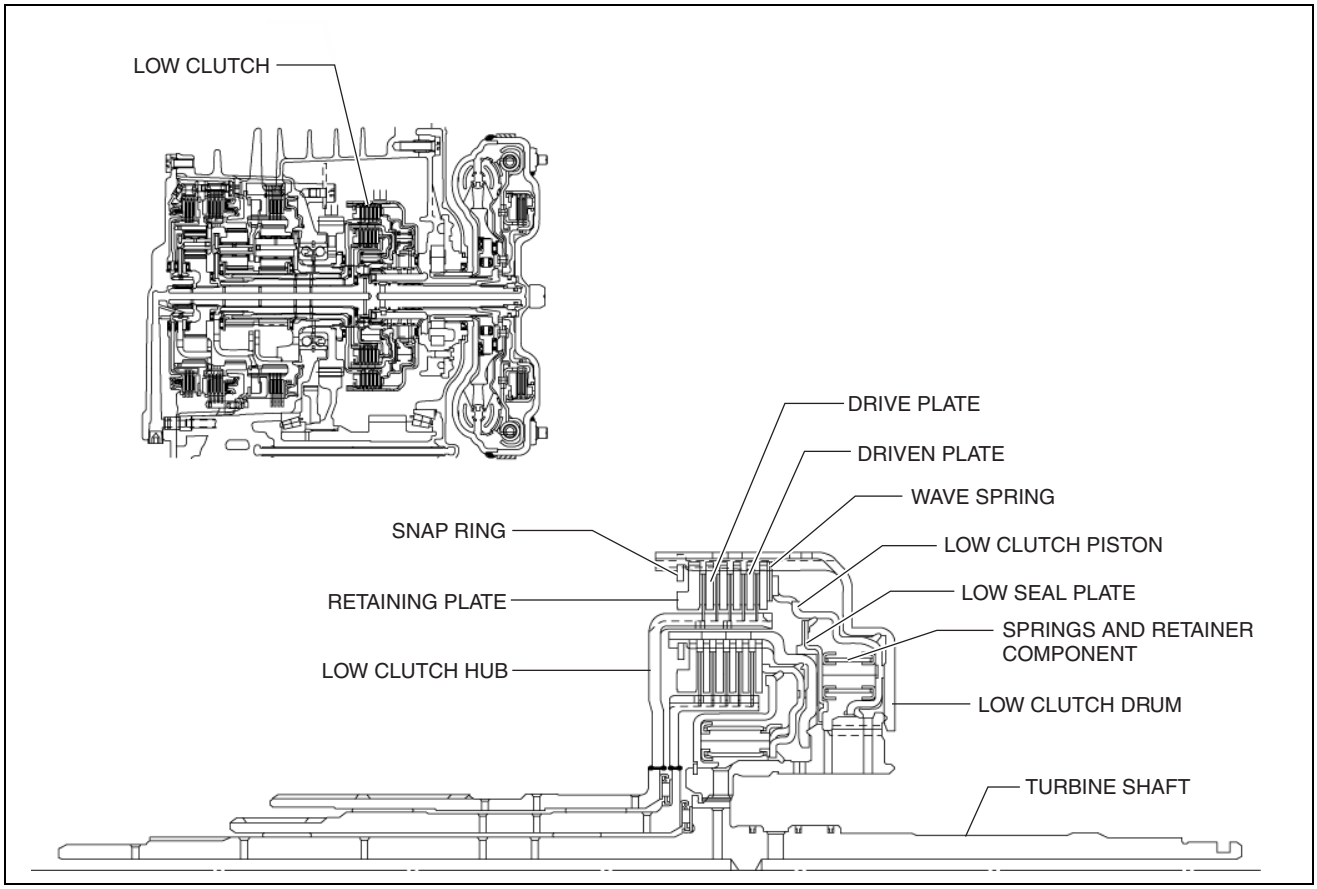
Purpose/Function

- The low clutch operates in 1GR, 2GR, 3GR and 4GR and intermittently operates the sun gear by drive force from the turbine shaft.
- For the low clutch, a centrifugal balance clutch has been adopted to prevent clutch drag and to assure stabilized piston thrust in all engine speed ranges.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction

- The low clutch consists of the following parts shown in the figure.



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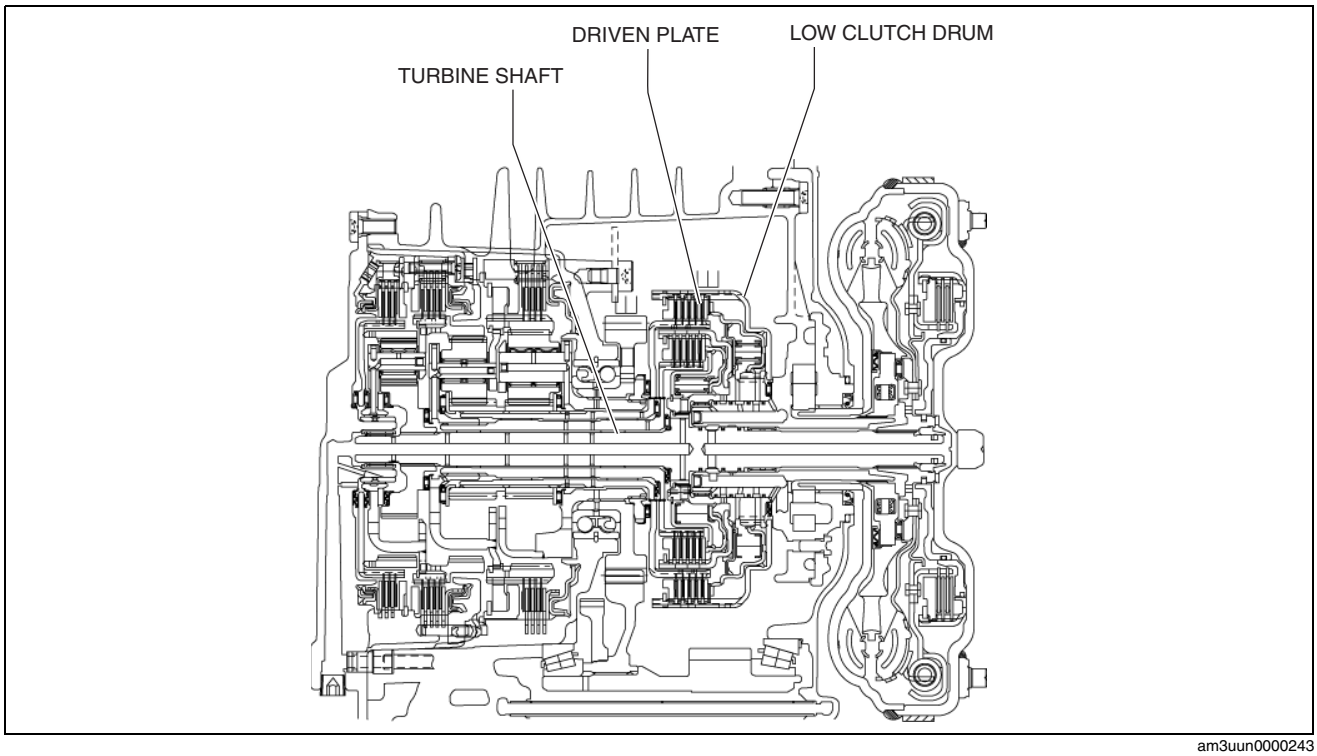
- The driven plate of the low clutch is engaged with the low clutch drum. The low clutch drum is engaged with the turbine shaft and spline, and when the turbine shaft rotates, the low clutch drum and driven plate rotate as a single unit.



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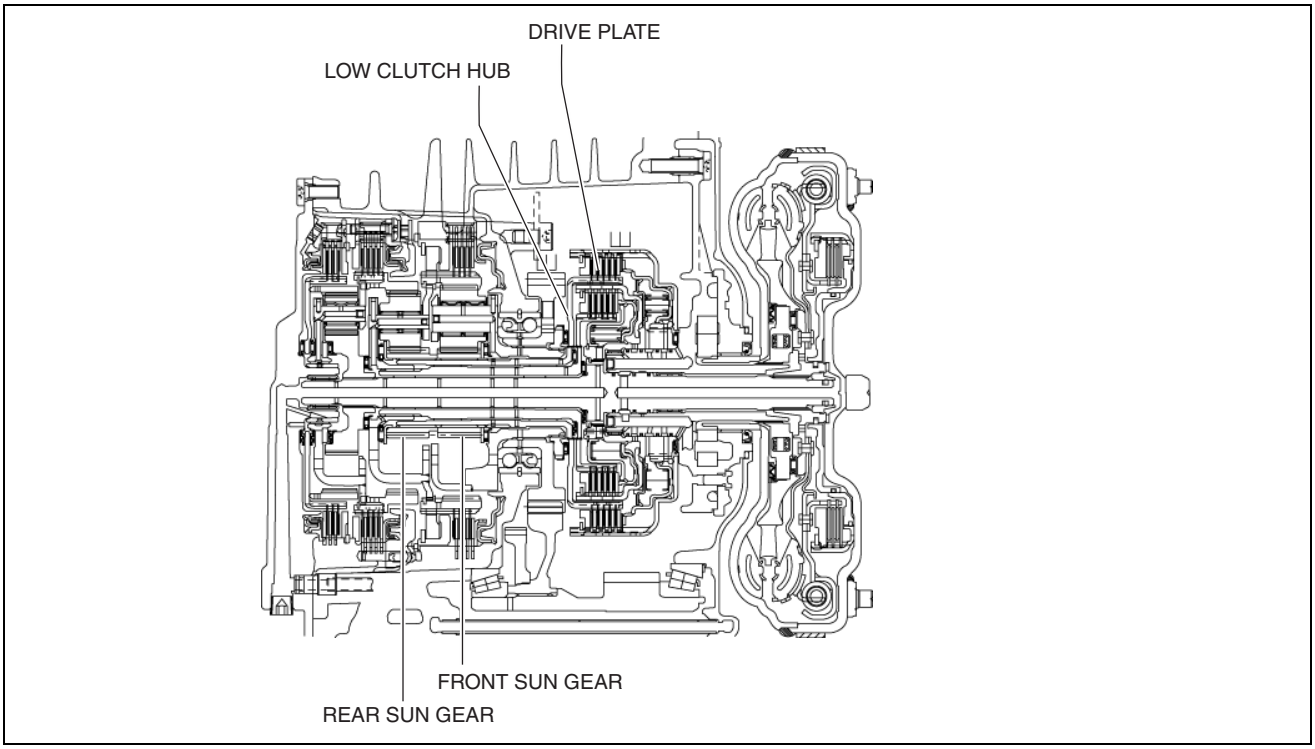
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The low clutch drive plate is engaged with the low clutch hub. The low clutch hub is engaged with the front and rear sun gears, and the drive plate, low clutch hub, front sun gear and rear sun gear rotate as a single unit.



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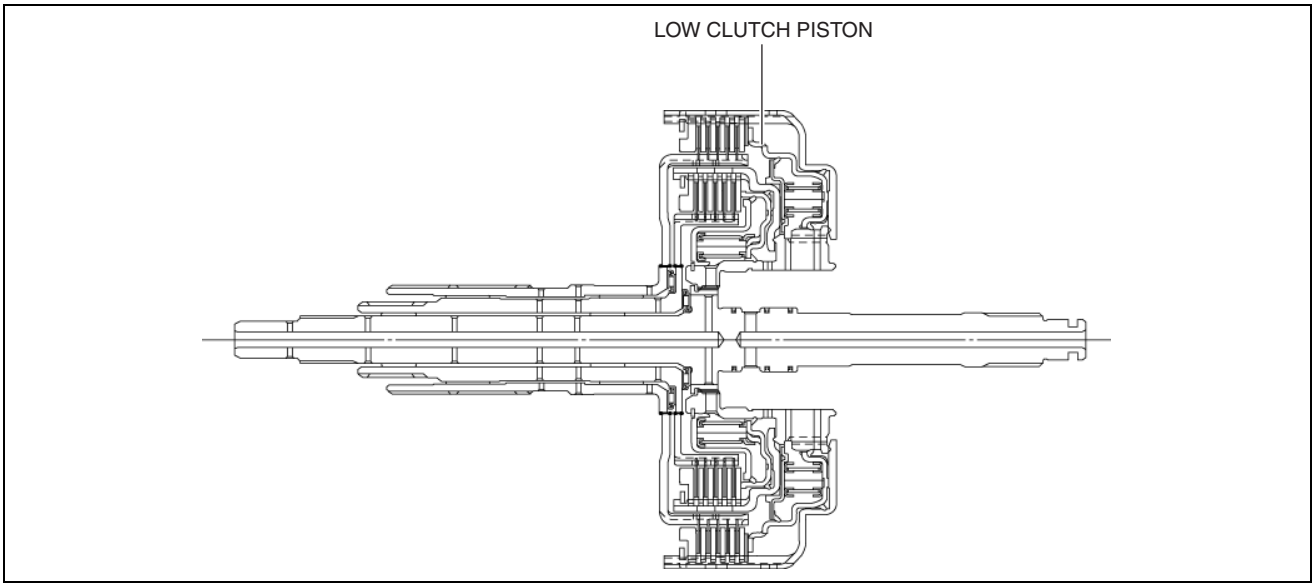
- For the low clutch piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.



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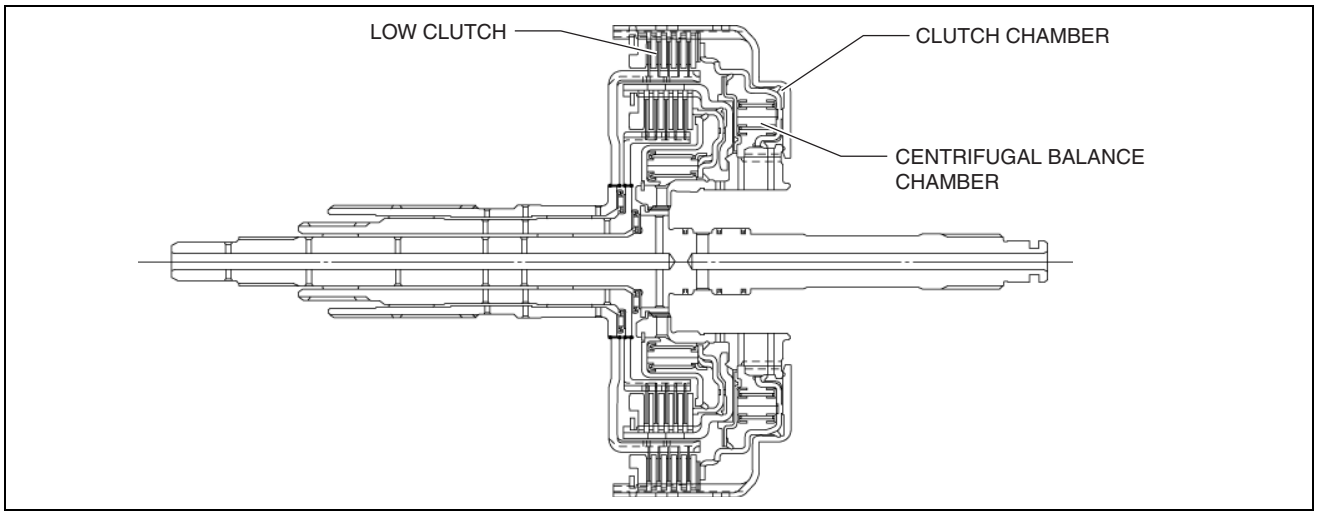
Centrifugal balance clutch

- The centrifugal balance clutch is built into the low clutch.The centrifugal balance chamber is positioned opposing the clutch chamber for the low clutch.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- In the centrifugal balance chamber, ATF is constantly charged through a specialized hydraulic circuit.



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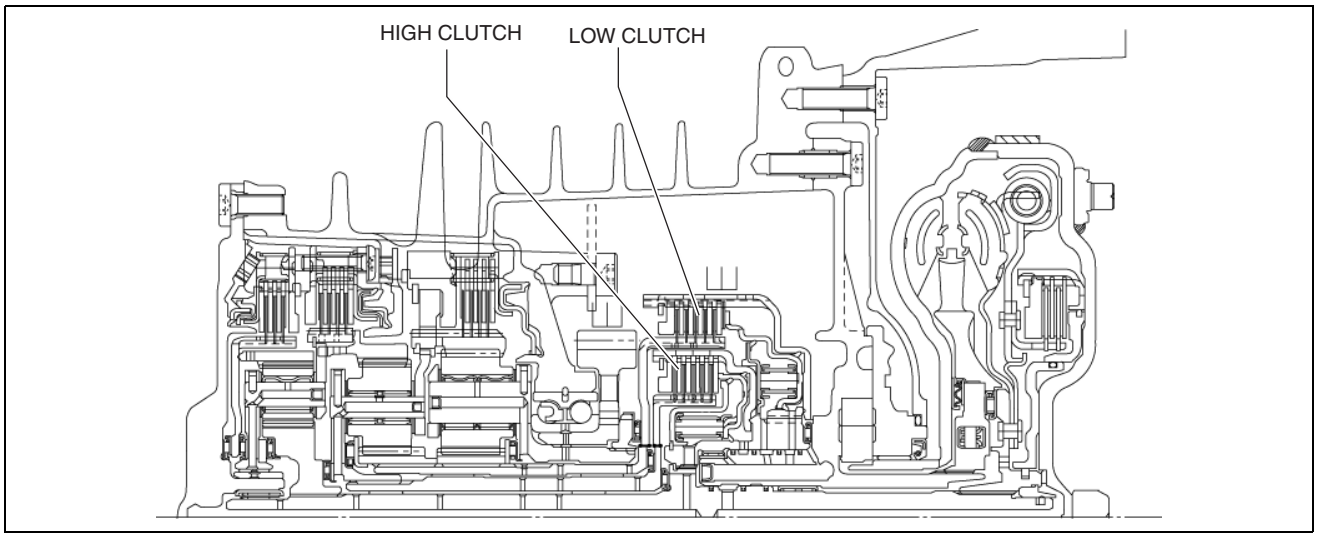
Operation

- If hydraulic pressure is applied to the low clutch piston, the drive plate and driven plate are pressure bonded and drive force from the turbine shaft is transmitted to the front and rear sun gears.
- Therefore, the following gears become the input shafts:
  - 1GR by operation of the front sun gear
  - 2GR by operation of the front and rear sun gears
  - 3GR by operation of the front and rear sun gears and the reduction planetary carrier
- In 4GR, the rear planetary carrier also becomes the input shaft by the operation of the high clutch together with both the front and rear sun gears.



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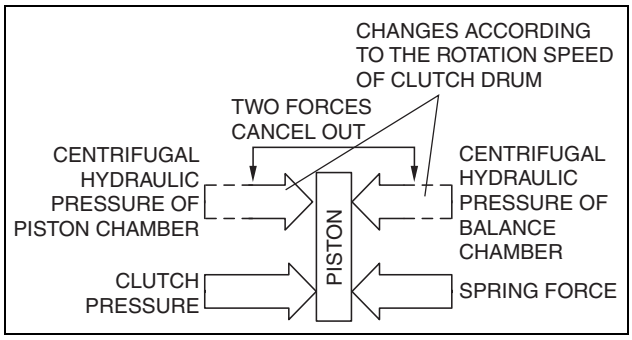
Centrifugal balance clutch
Clutch pressure not applied

- When the clutch drum rotates, centrifugal force is applied to the remaining ATF in the clutch chamber to push the piston, but centrifugal force is also applied to the ATF in the centrifugal balance chamber to force the piston to move back. As a result, the opposing forces of the clutch and balance chambers are offset and the piston does not move, preventing clutch drag.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Clutch pressure applied

- When clutch pressure is applied to the clutch chamber, the piston, which overcomes the opposing centrifugal hydraulic pressure from the balance chamber and the spring force, is pushed in the direction of clutch engagement and the clutch is engaged. At this time, because the centrifugal hydraulic pressure applied to the clutch pressure in the clutch chamber is offset by the centrifugal hydraulic pressure applied to the balance chamber, the effect of piston thrust by the centrifugal force from the clutch drum rotation is eliminated. As a result, stabilized piston force in all engine speed ranges is assured, thus reducing shift shock.



am3uun0000223

HIGH CLUTCH [FW6A-EL, FW6AX-EL]

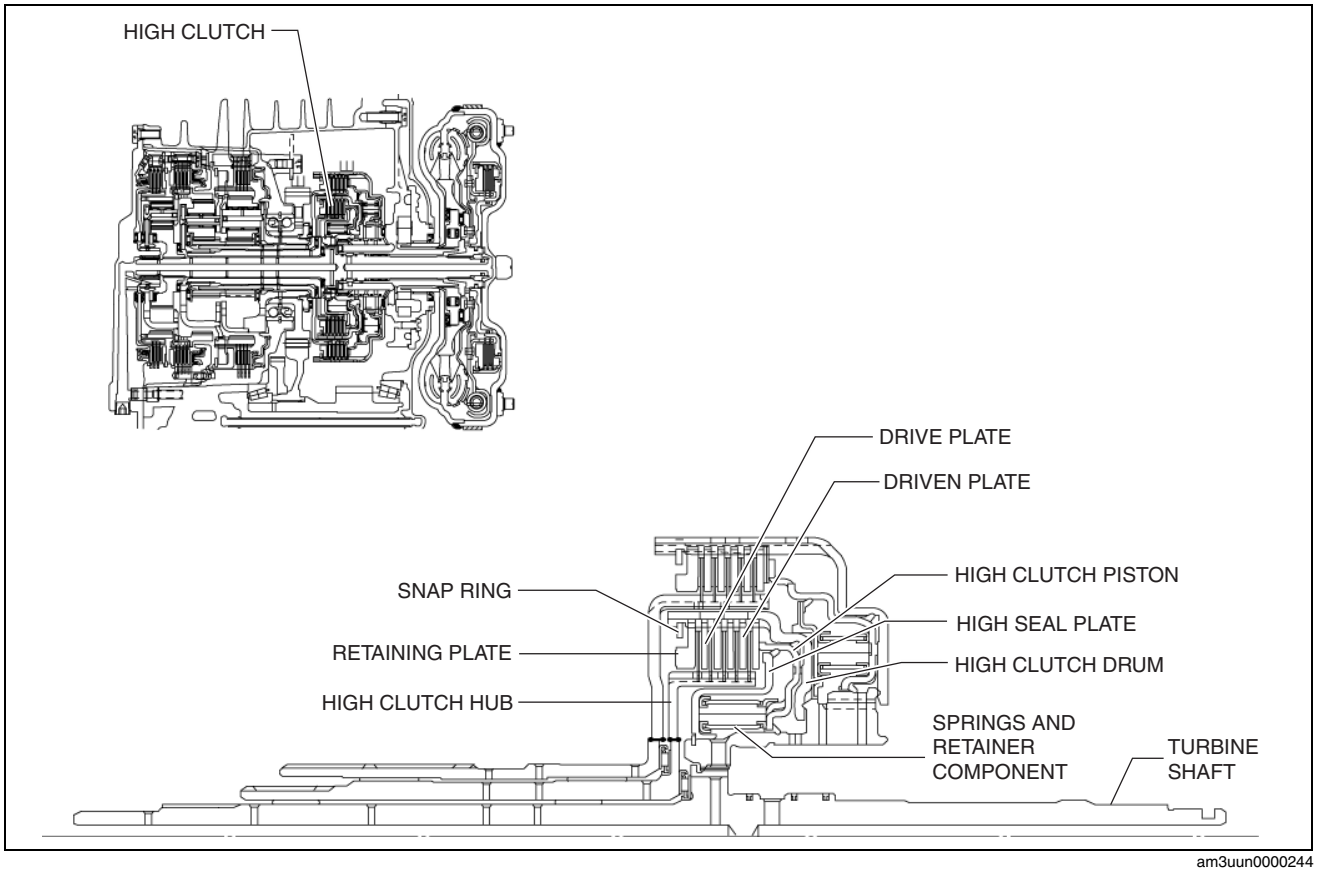
id0517h2351300

Purpose/Function

- The high clutch operates in 4GR, 5GR, and 6GR and intermittently operates the rear carrier by drive force from the turbine shaft.
- For the high clutch, a centrifugal balance clutch has been adopted to prevent clutch drag and to assure stabilized piston thrust in all engine speed ranges.

Construction

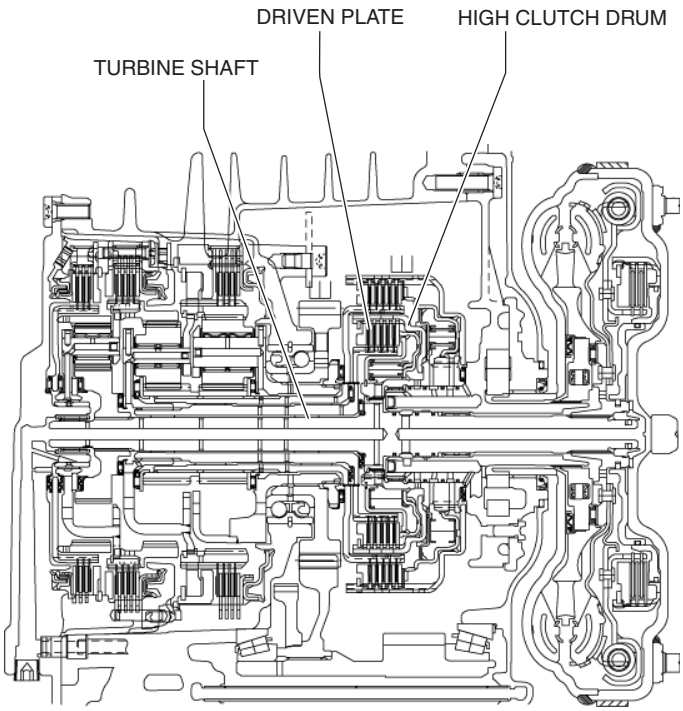
- The high clutch consists of the following parts shown in the figure.



am3uun0000244

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The driven plate of the high clutch is engaged with the high clutch drum. The high clutch drum is engaged with the turbine shaft and spline, and when the turbine shaft rotates, the high clutch drum and driven plate rotate as a single unit.



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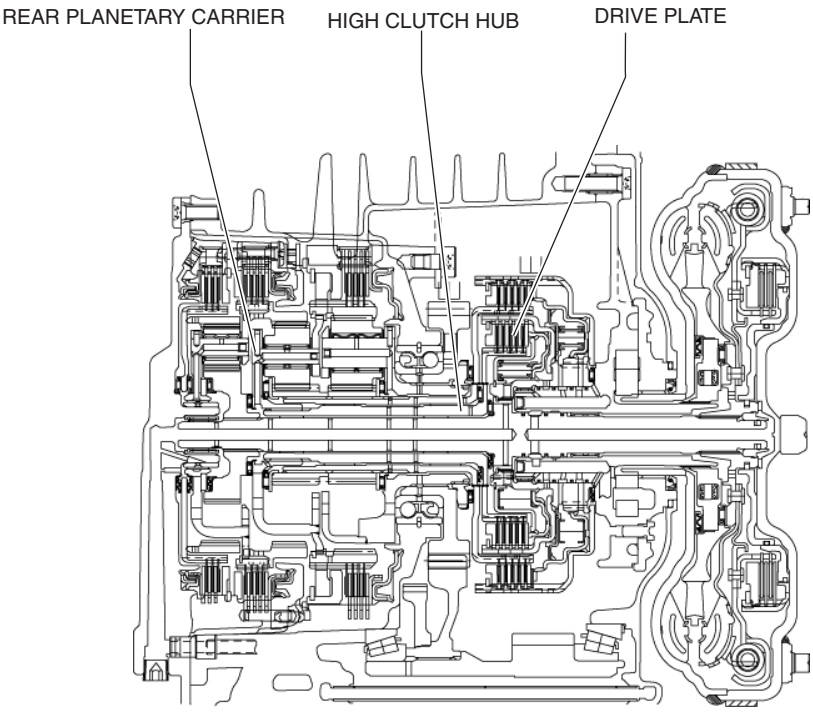
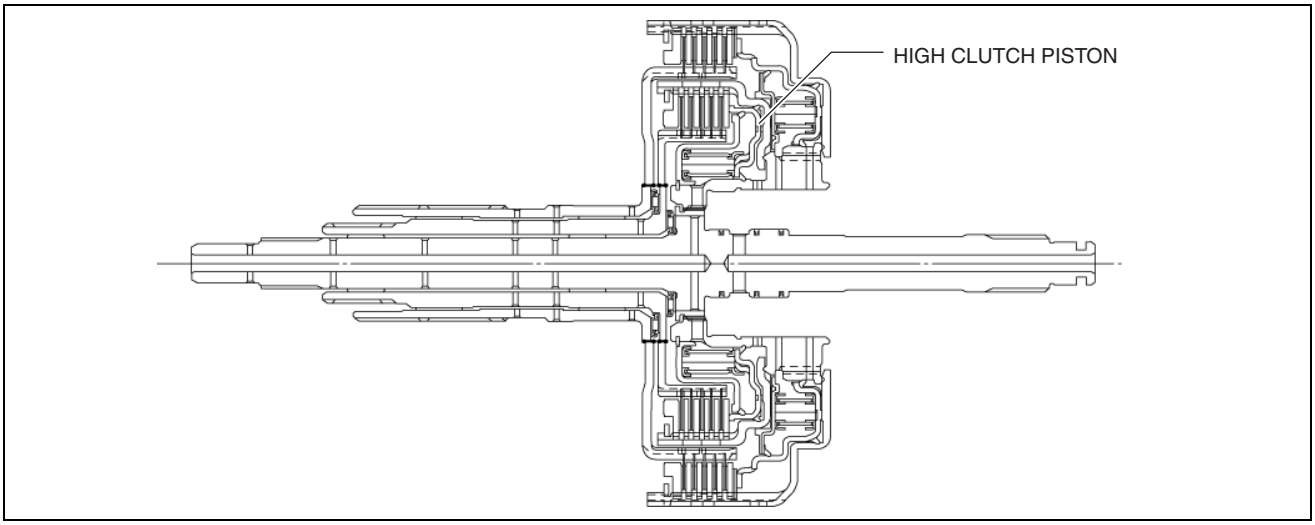
- The drive plate of the high clutch is engaged with the high clutch hub. The high clutch hub is engaged with the rear carrier, and the drive plate, high clutch hub, and rear carrier rotate as a single unit.



am3uun0000244

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- For the high clutch piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.



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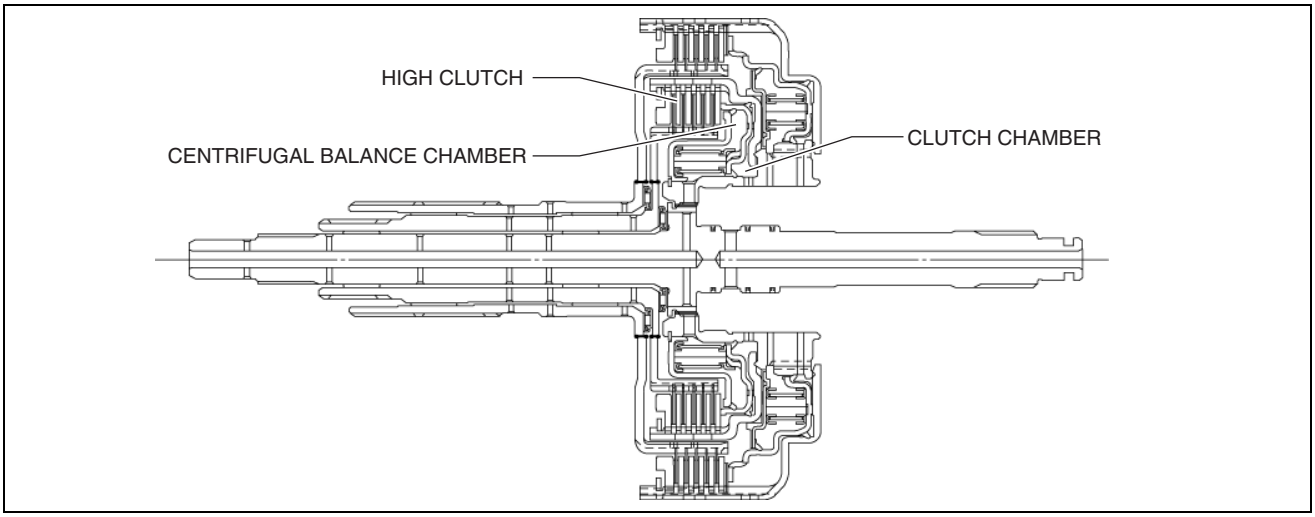
Centrifugal balance clutch

- The centrifugal balance clutch is built into the high clutch.
- The centrifugal balance chamber is positioned opposing the clutch chamber for the high clutch. In the centrifugal balance chamber, ATF is constantly charged through a specialized hydraulic circuit.

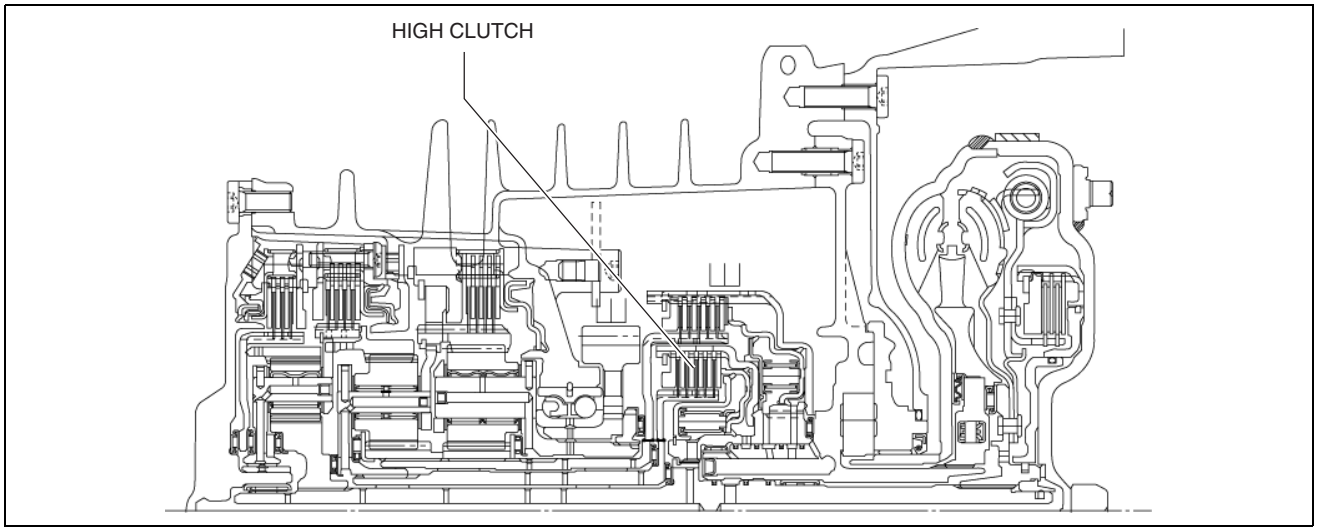


am3uun0000231

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Operation

- If hydraulic pressure is applied to the high clutch piston, the drive plate and driven plate are pressure coupled and drive force from the turbine shaft is transmitted to the rear planetary carrier. In addition, drive force is also transmitted to the front internal gear through the rear planetary gear.



am3uun0000244

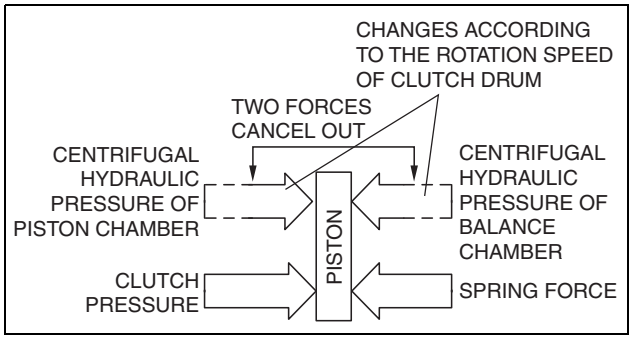
Centrifugal balance clutch

Clutch pressure not applied

- When the clutch drum rotates, centrifugal force is applied to the remaining ATF in the clutch chamber to push the piston, but centrifugal force is also applied to the ATF in the centrifugal balance chamber to force the piston to move back. As a result, the opposing forces of the clutch and balance chambers are offset and the piston does not move, preventing clutch drag.

Clutch pressure applied

- When clutch pressure is applied to the clutch chamber, the piston, which overcomes the opposing centrifugal hydraulic pressure from the balance chamber and the spring force, is pushed in the direction of clutch engagement and the clutch is engaged. At this time, because the centrifugal hydraulic pressure applied to the clutch pressure in the clutch chamber is offset by the centrifugal hydraulic pressure applied to the balance chamber, the effect of piston thrust by the centrifugal force from the clutch drum rotation is eliminated. As a result, stabilized piston force in all engine speed ranges is assured, thus reducing shift shock.



am3uun0000223

R-3-5 BRAKE [FW6A-EL, FW6AX-EL]

id0517h2351400

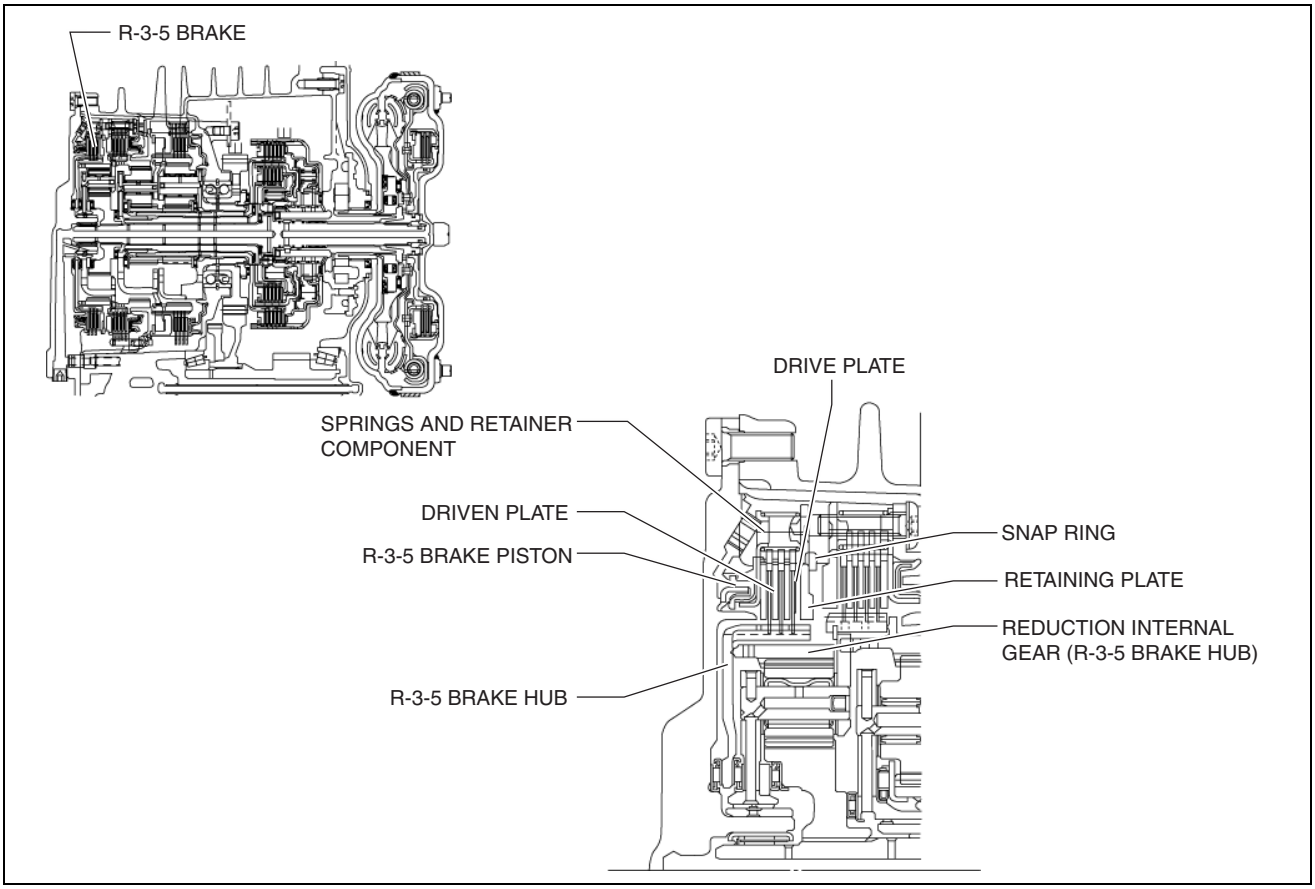
Purpose/Function

- The R-3-5 brake operates in 3GR, 5GR and in reverse to lock the reduction internal gear against rotation.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

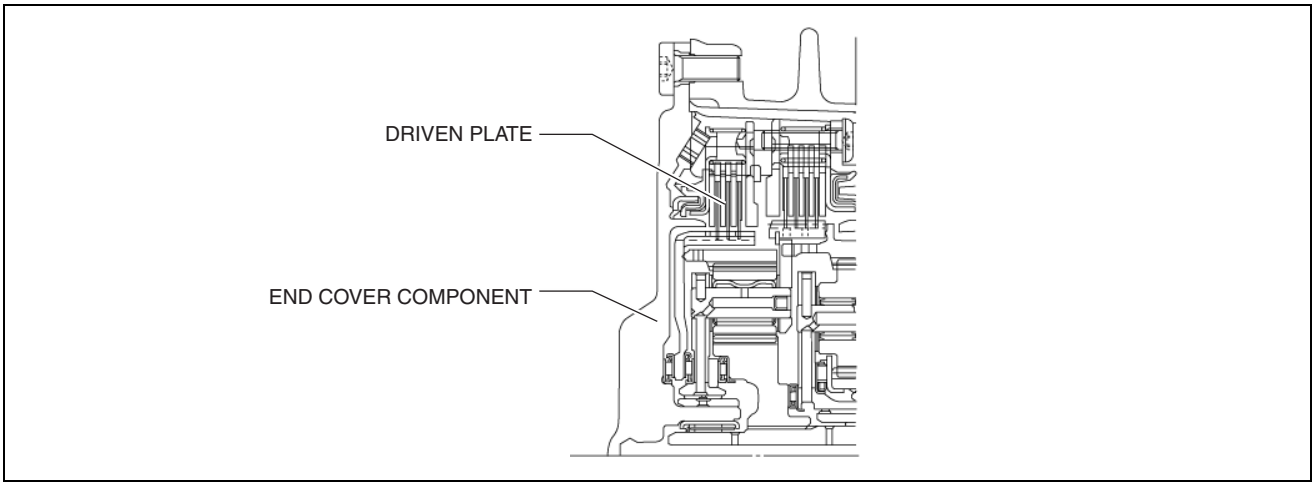
Construction

- The R-3-5 brake consists of the following parts shown in the figure.



am3uun0000244

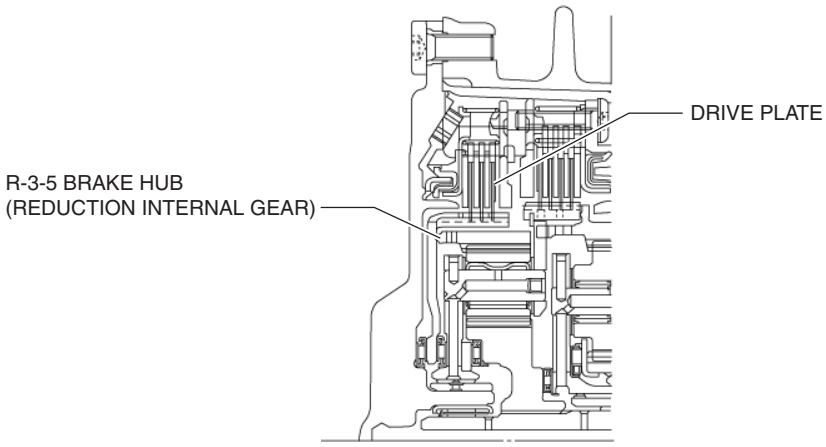
- The driven plate of the R-3-5 brake does not rotate because it is connected to the end cover component.



am3uun0000232

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The R-3-5 brake drive plate is engaged with the R-3-5 brake hub and reduction internal gear, and locks the reduction internal gear.

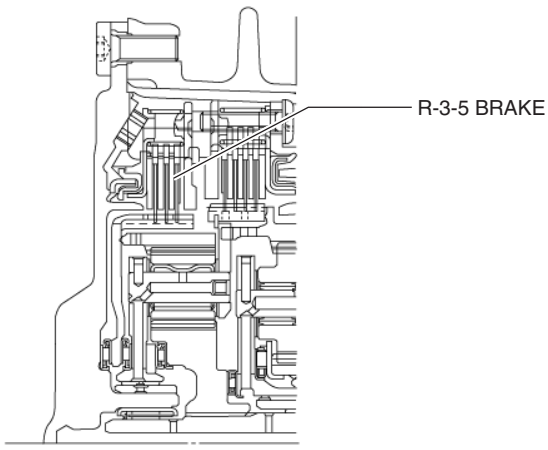


am3uun0000232

- For the R-3-5 brake piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.

Operation

- When hydraulic pressure is applied to the R-3-5 brake piston, the drive plate and driven plate are pressure bonded to lock the reduction internal gear.



am3uun0000232

2-6 BRAKE [FW6A-EL, FW6AX-EL]

id0517h2351500

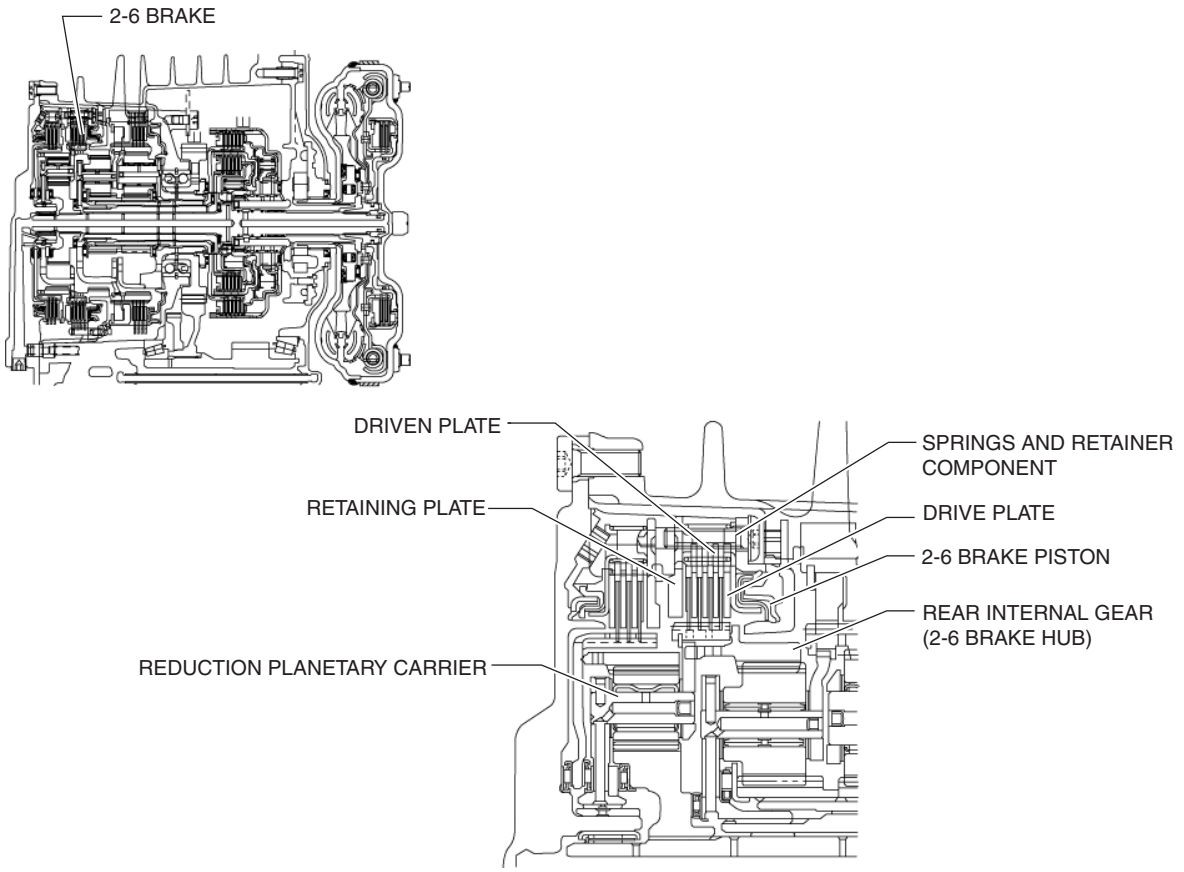
Purpose/Function

- The 2-6 brake locks the rear internal gear and reduction planetary carrier while in 2GR and 6GR.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction

- The 2-6 brake consists of the following parts shown in the figure.



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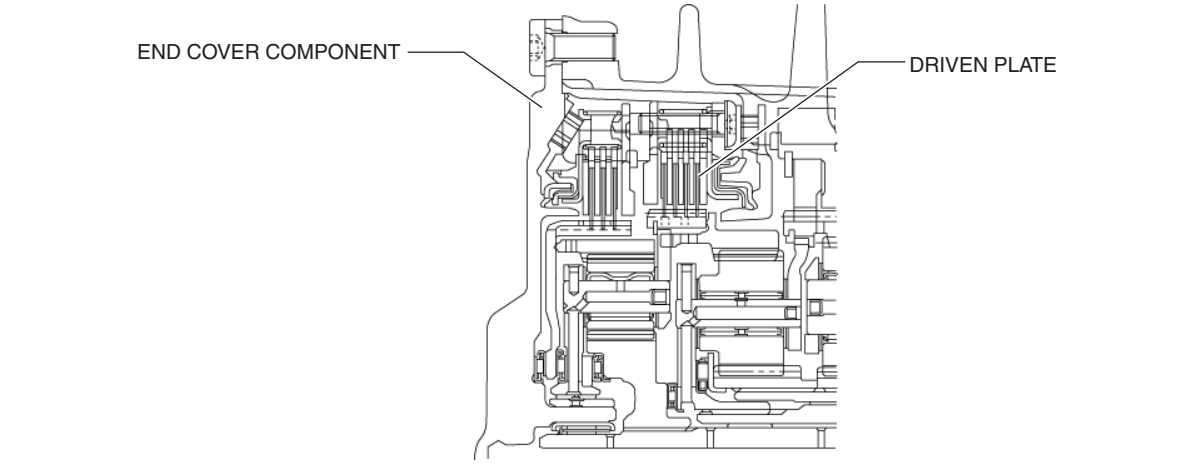
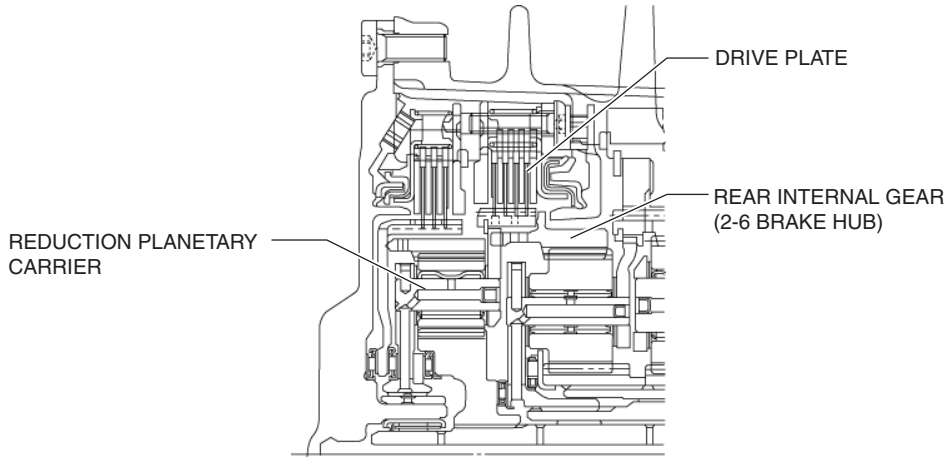
- The driven plate of the 2-6 brake does not rotate because it is connected to the end cover component.



am3uun0000232

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The driven plate of the 2-6 brake is engaged with the 2-6 brake hub and rear internal carrier, and the rear internal carrier is engaged with the reduction planetary carrier through the rear internal gear. Therefore, the rear internal gear and reduction planetary gear are locked by the 2-6 brake.

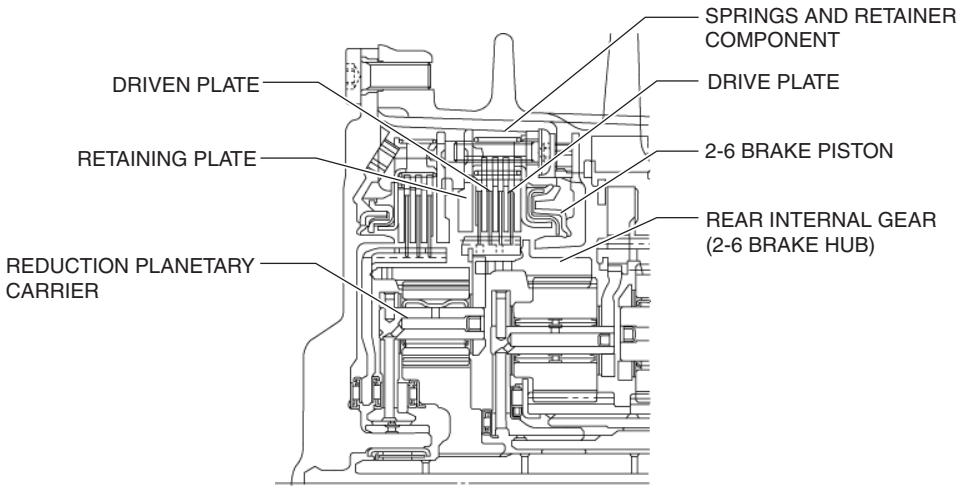


am3uun0000232

- For the 2-6 brake piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.

Operation

- When hydraulic pressure is applied to the 2-6 brake piston, the drive plate and driven plate are pressure bonded to lock the rear internal gear and reduction planetary carrier.



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LOW AND REVERSE BRAKE [FW6A-EL, FW6AX-EL]

id0517h2351600

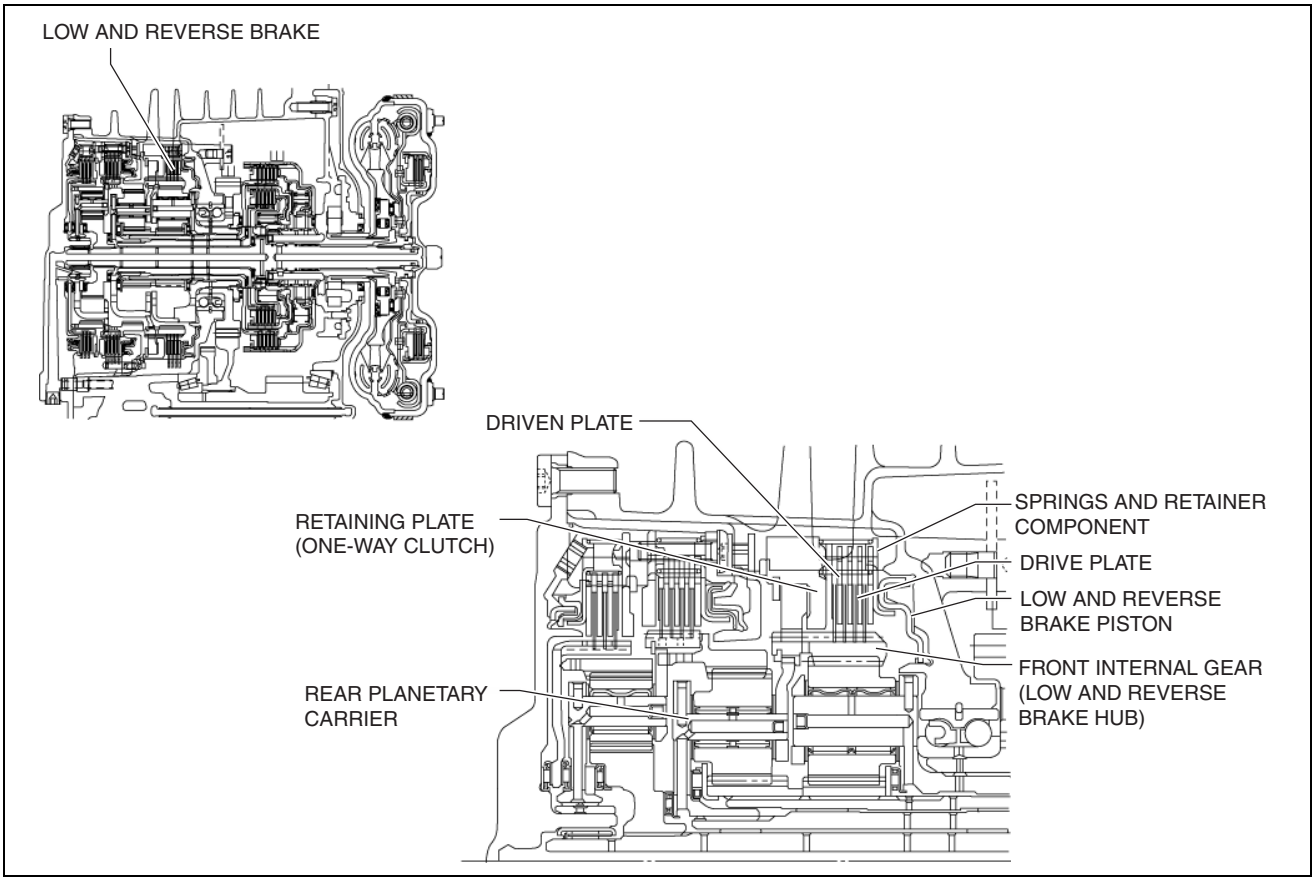
Purpose/Function

- The low and reverse brake stops the rotation of the front internal gear and rear planetary carrier while in 1GR and in reverse, locking them to the transaxle case.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction

- The low and reverse brake consist of the following parts shown in the figure.



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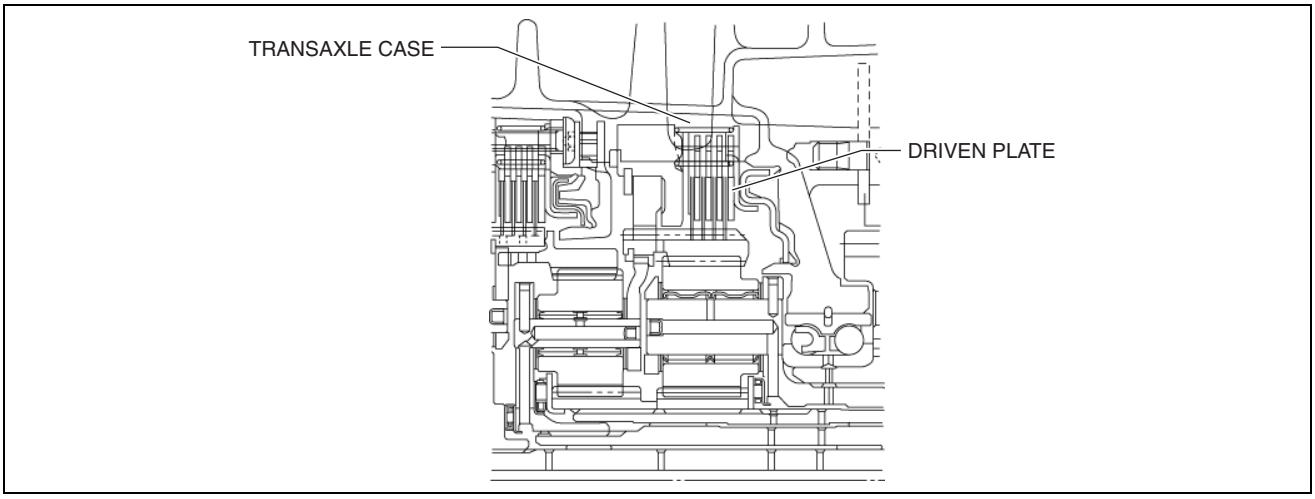
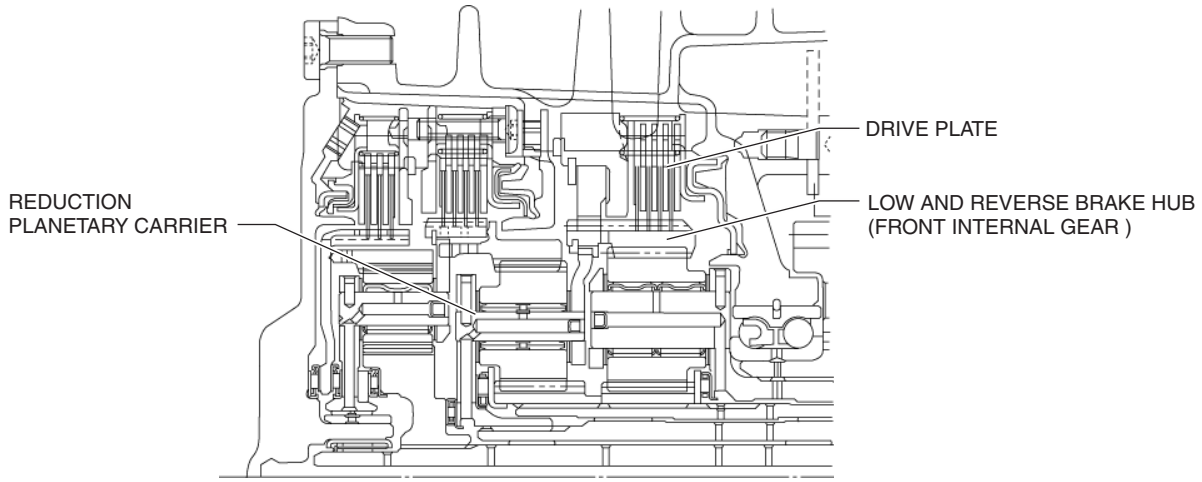
- The driven plate of the low and reverse brake does not rotate because it is connected to the transaxle case.



am3uun0000232

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The drive plate of the low and reverse brake is engaged with the low and reverse brake hub and front internal gear. Therefore, the rear planetary carrier is locked via the front internal gear.

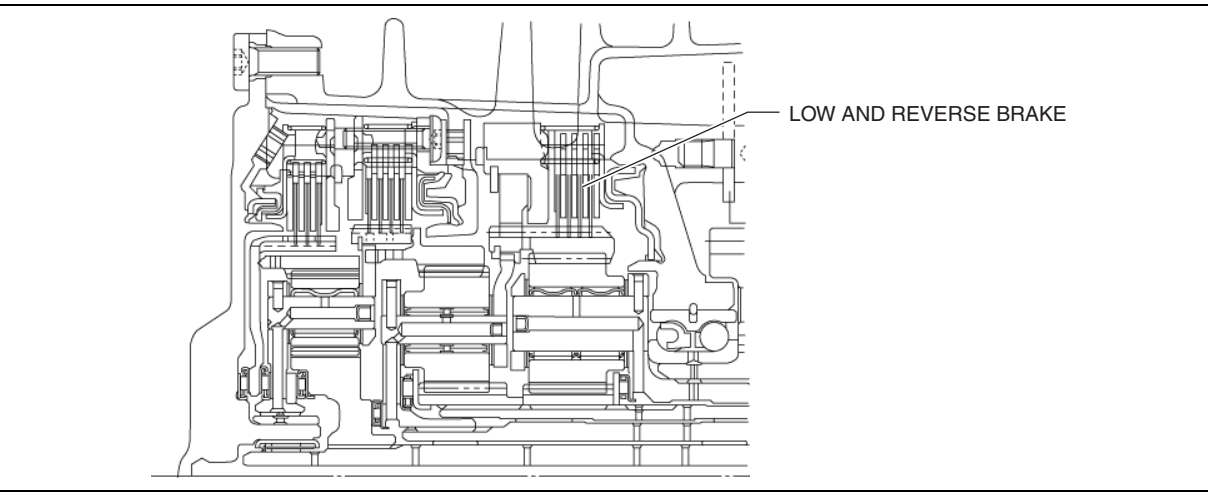


am3uun0000233

- For the low and reverse brake piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.

Operation

- When hydraulic pressure is applied to the low and reverse brake piston, the drive plate and driven plate are pressure bonded to lock the front internal gear and rear planetary gear to the transaxle case.



am3uun0000233

ONE-WAY CLUTCH [FW6A-EL, FW6AX-EL]

id0517h2351700

Purpose/Function

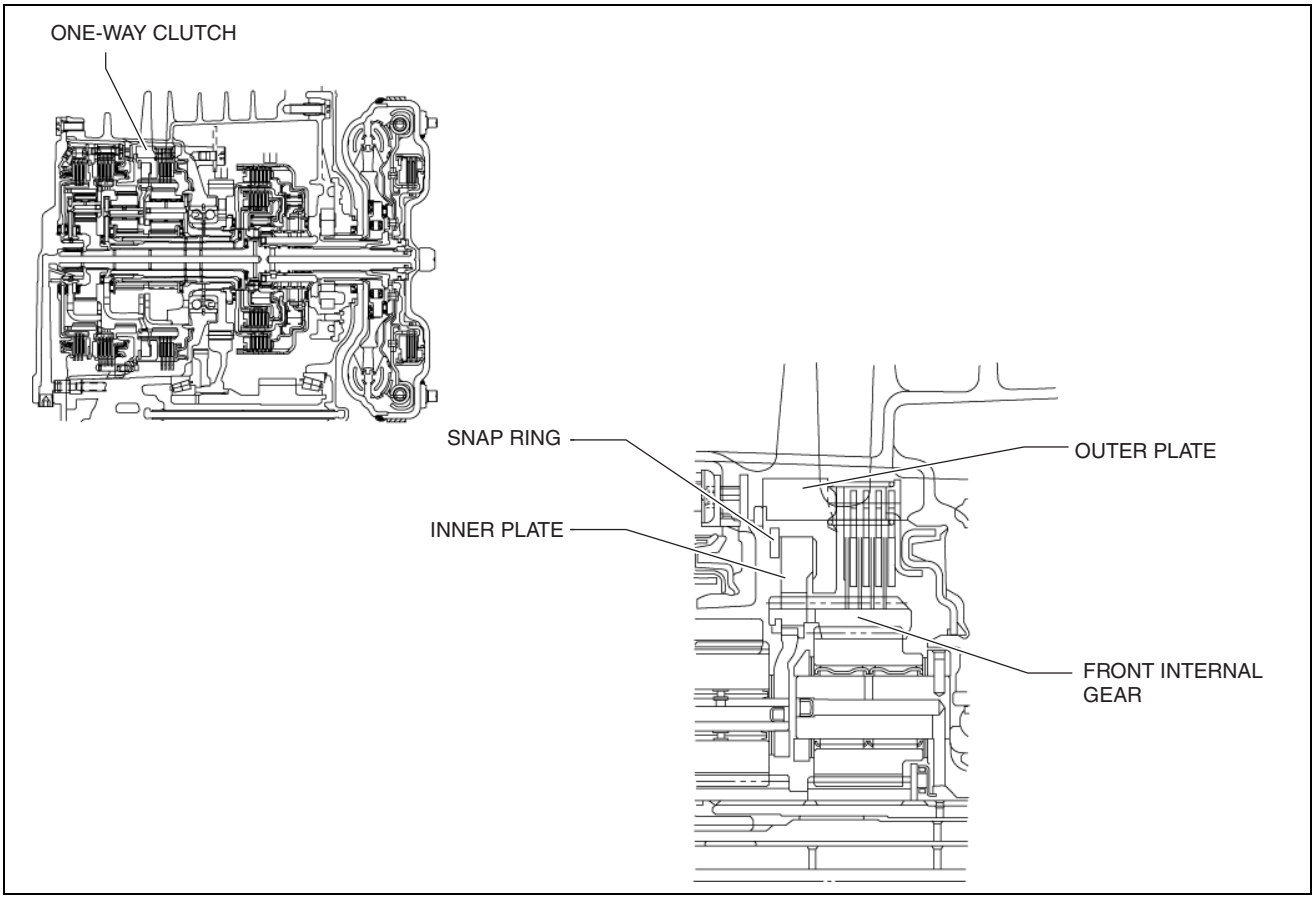
- The one-way clutch operates in 1GR and suppresses the counterclockwise rotation of the front internal gear (as viewed from torque converter side).

Construction

- The one-way clutch consists of a mechanical diode-type one-way clutch, inner plate, and outer plate.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The inner plate for the one-way clutch is connected to the front internal gear and the outer plate is connected to the transaxle.



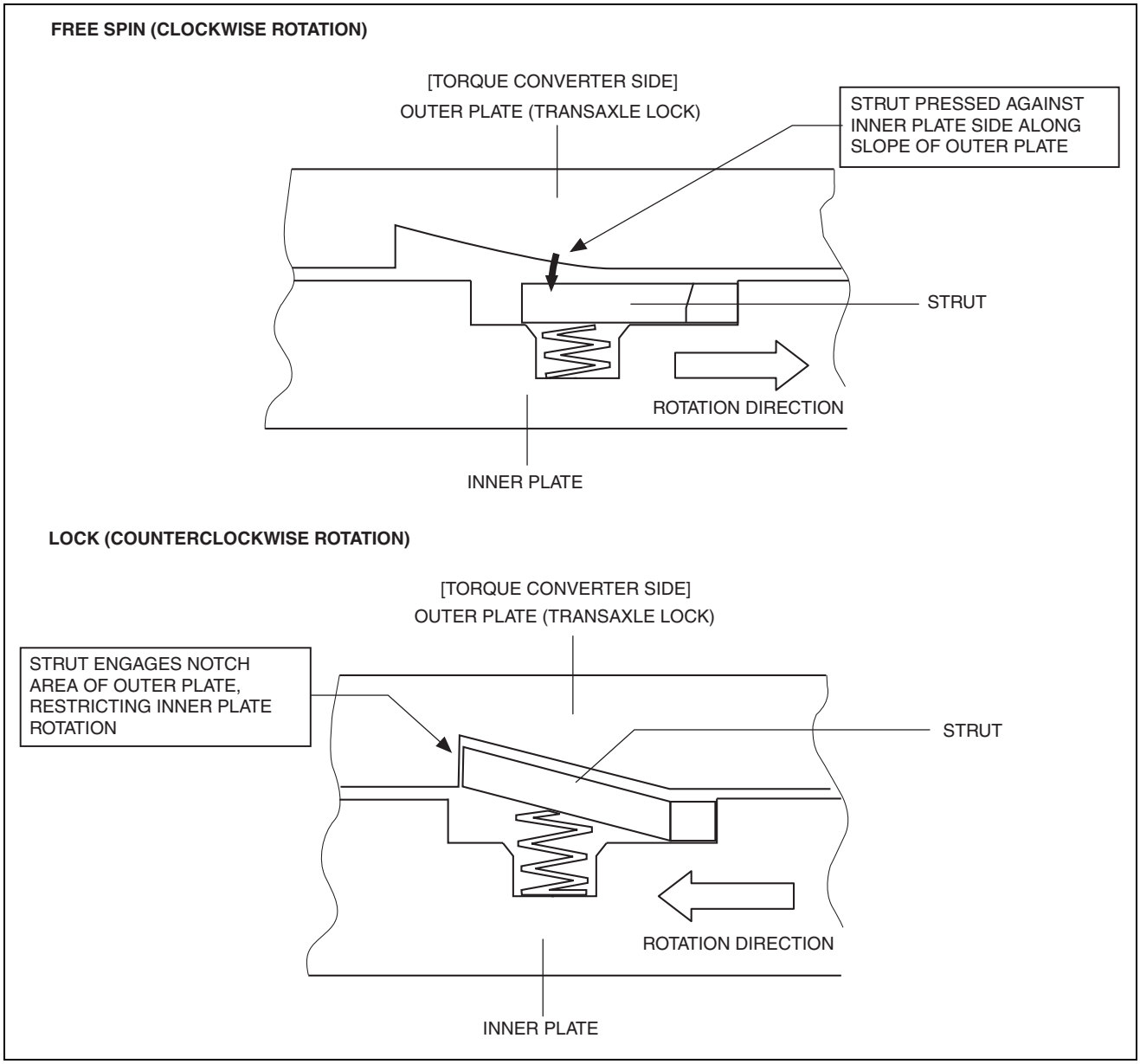
am3uun0000244

Operation

- The connected inner plate also rotates clockwise during the clockwise rotation of the front internal gear. Therefore, the rotation is not regulated and the inner plate spins because the strut installed to the inner plate is pressed toward the inner plate along the slope of the outer plate.
- The strut engages the notch of the outer plate by the rotation of the inner plate which also rotates counterclockwise during the counterclockwise rotation of the front internal gear. Due to this, the rotation of the inner plate is regulated and the rotation of the front internal gear is suppressed.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- As a result, the front internal gear suppresses the counterclockwise rotation of the rear pinion gear via the rear planetary carrier.



am3uun0000223

PLANETARY GEAR [FW6A-EL, FW6AX-EL]

id0517h2351800

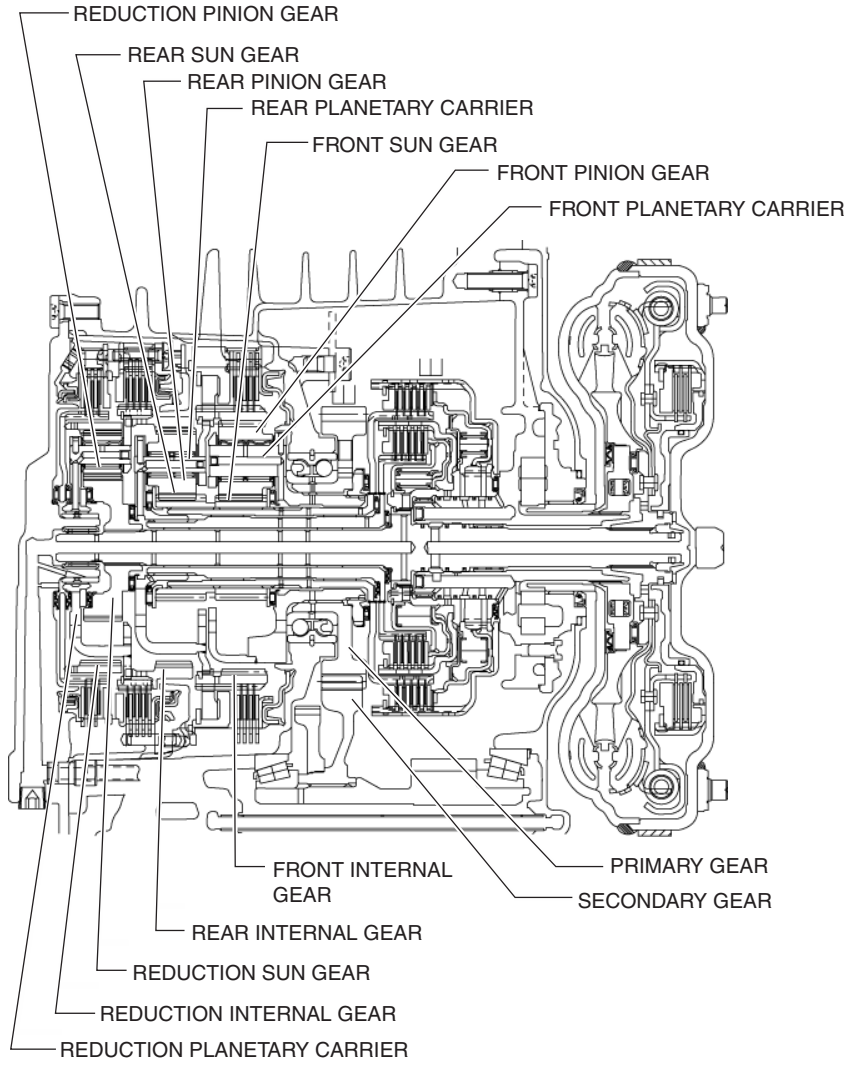
Purpose/Function

- The planetary gear is a mechanism which shifts the drive force from the engine. The planetary gear consists of multiple gears which rotate individually while revolving. By controlling the individual rotation and revolving of the gears, the transaxle performs gear shifting at the optimum gear speed according to the driving conditions.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

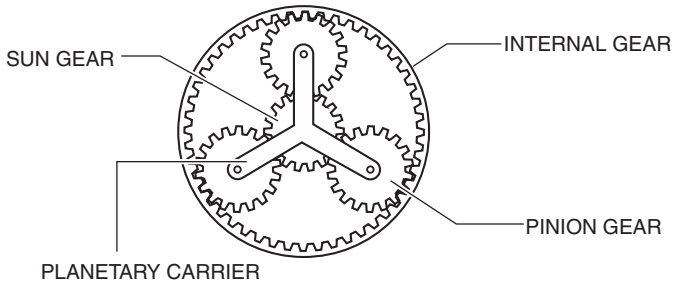
Construction

- The planetary gear is positioned in the order of the front planetary gear, rear planetary gear, and reduction planetary gear from the torque converter side. The planetary gear is a single planetary gear type. For the component parts of each planetary gear, refer to the following figure.



am3uun0000245

- The planetary gear is composed of the sun gear, pinion gear, planetary carrier, and internal gear as shown in the figure.



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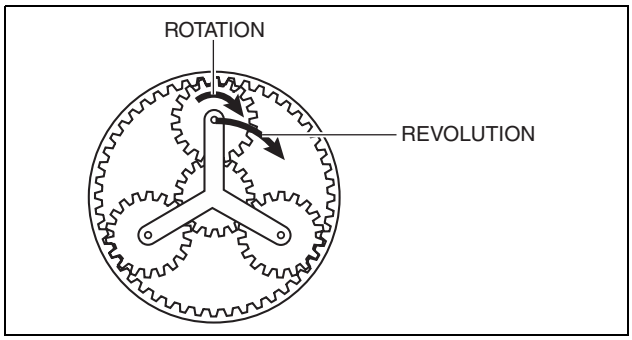
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- There are two types of pinion gear rotation, rotation (rotation) on an axis of the center for each pinion gear and rotation (revolution) on an axis of center for the planetary carrier. The planetary gear operates shifting function by switching the input, fixed, or output of the internal gear, pinion gear, and planetary carrier.
- The relation of rotation speed of each element for the planetary gear set is generally indicated as follows:
  $(Z_R + Z_S)\ N_C = Z_R\ N_R + Z_S\ N_S$: (1)
  Meaning of symbols
  — Z: Number of teeth
  — N: Rotation speed
  — Additional character R: Internal gear
  — Additional character S: Sun gear
  — Additional character C: Planetary carrier (pinion gear)

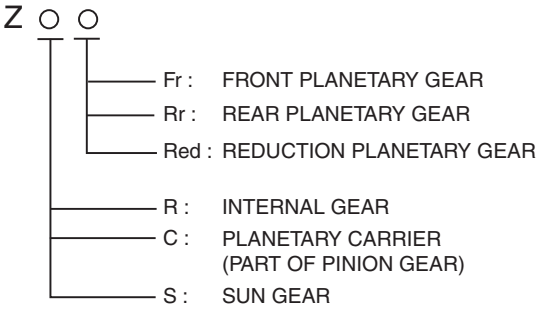


am3uun0000224

Number of teeth and symbols for each gear

Planetary gear unit		Number of teeth	Symbols
Front	Internal gear	97	Z_{RFr}
	Planetary carrier (part of pinion gear)	29	Z_{CFr}
	Sun gear	38	Z_{SFr}
Rear	Internal gear	95	Z_{RRr}
	Planetary carrier (part of pinion gear)	27	Z_{CRr}
	Sun gear	40	Z_{SRr}
Reduction	Internal gear	109	Z_{RRed}
	Planetary carrier (part of pinion gear)	21	Z_{CRed}
	Sun gear	68	Z_{SRed}

Meaning of symbols



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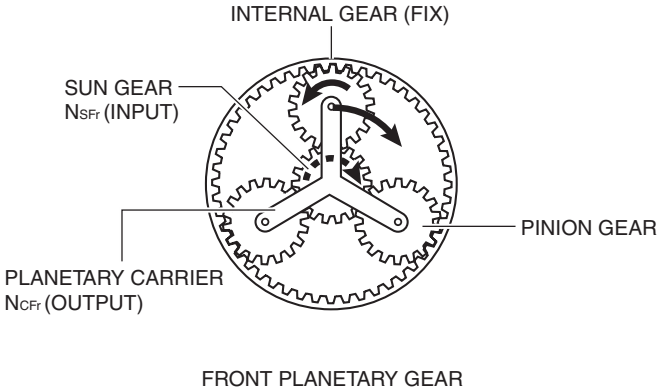
Operation
1GR



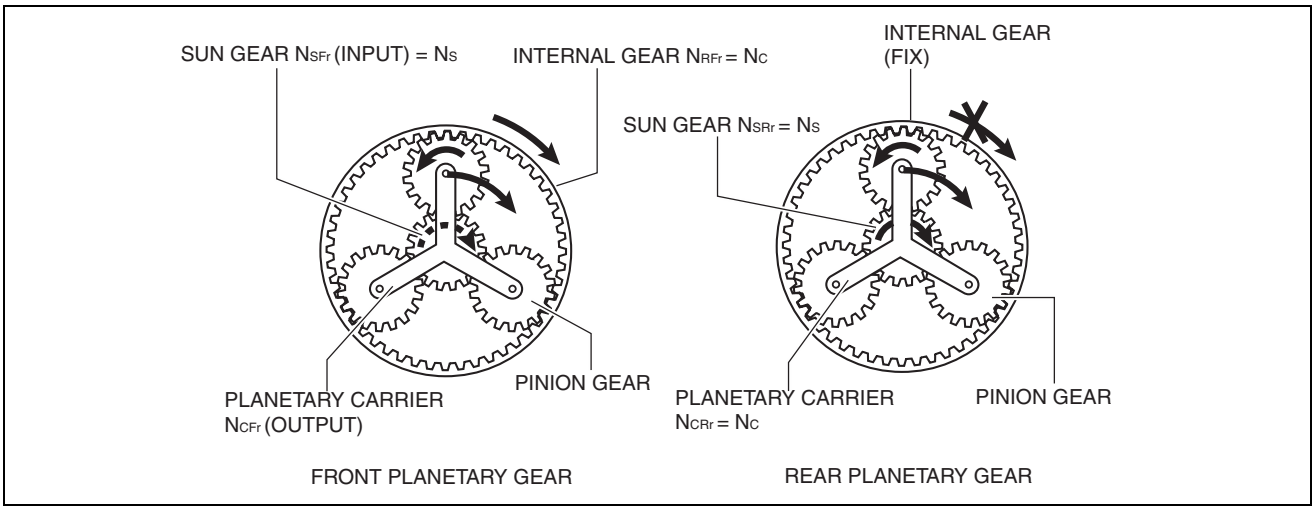
am3uun0000224

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Rotation speed for each gear

Planetary gear unit	Front planetary gear
Internal gear	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)
Sun gear	N_{SFr} (Input)

2GR



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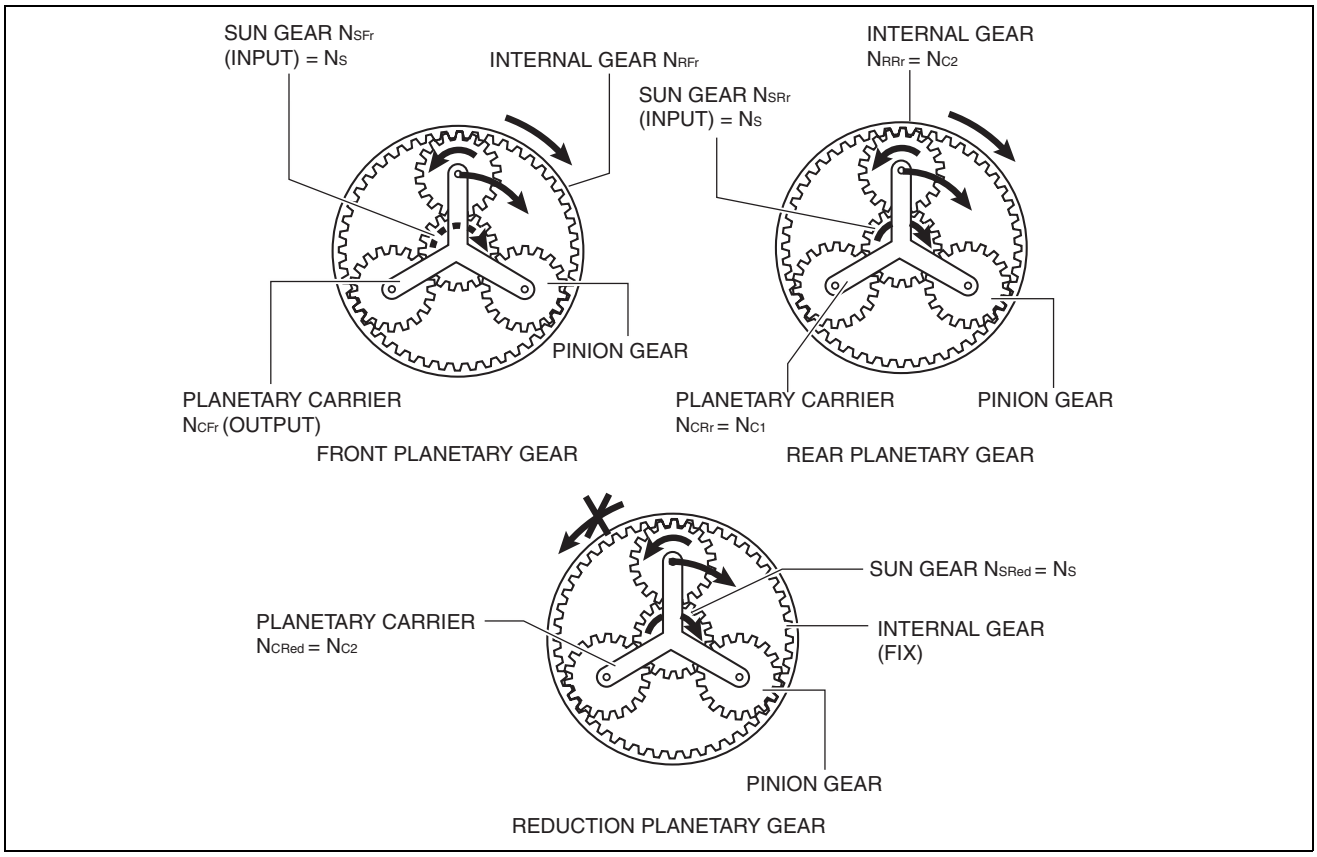
Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear
Internal gear	$N_{RFr}=N_C$	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	$N_{CRr}=N_c$
Sun gear	N_{SFr} (Input)=N_S	$N_{SRr}=N_S$

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

3GR



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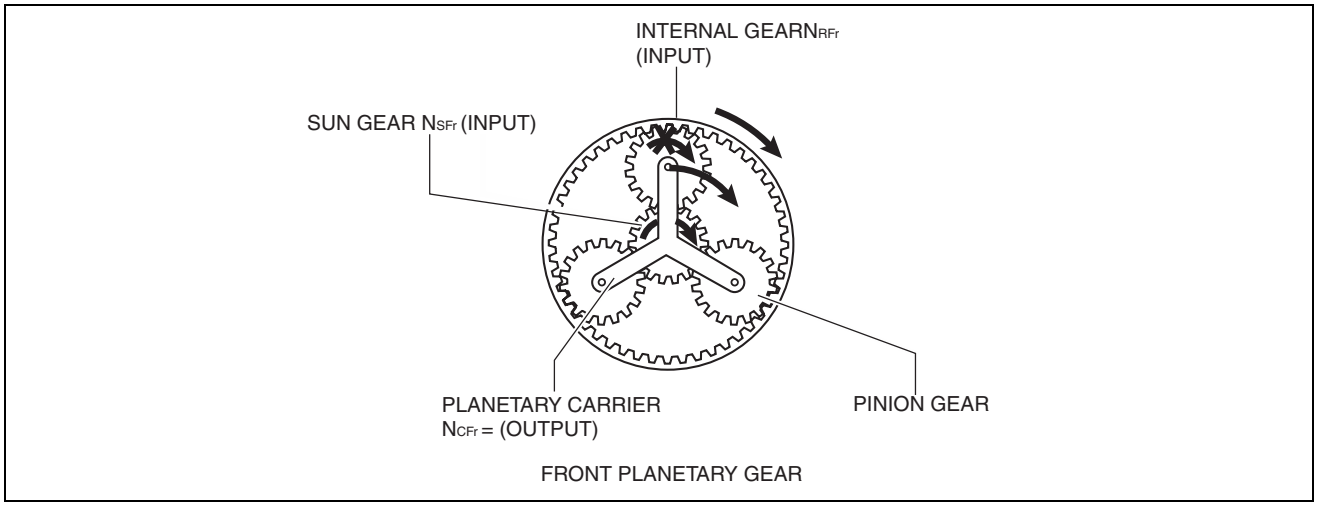
Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear	Reduction
Internal gear	$N_{RFr}=N_{C1}$	$N_{RRr}=N_{c2}$	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	$N_{CRr}=N_{c1}$	$N_{CRed}=N_{c2}$
Sun gear	N_{SFr} (Input)=N_S	$N_{SRr}=N_S$	$N_{SRed}=N_S$

4GR



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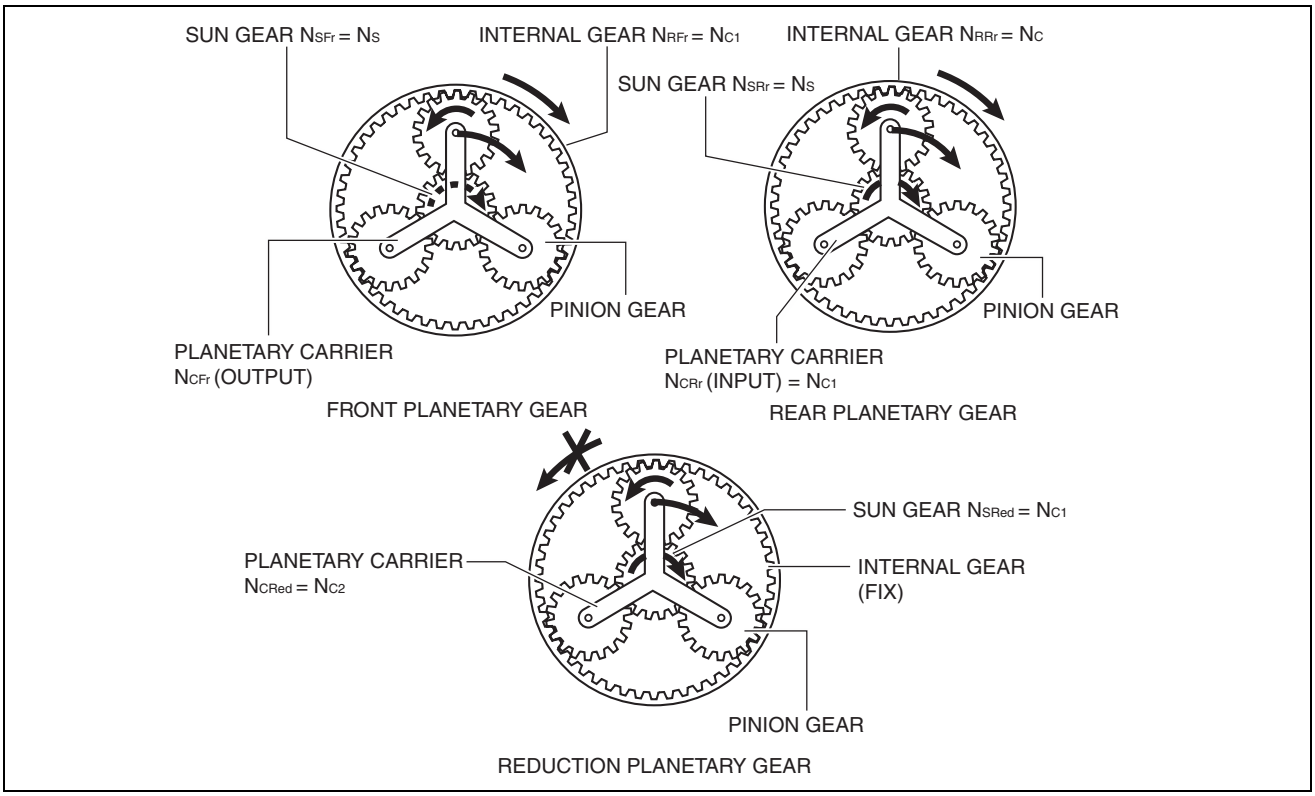
Rotation speed for each gear

Planetary gear unit	Front planetary gear
Internal gear	N_{RFr} (Input)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Planetary gear unit	Front planetary gear
Sun gear	N_{SFr} (Input)

5GR



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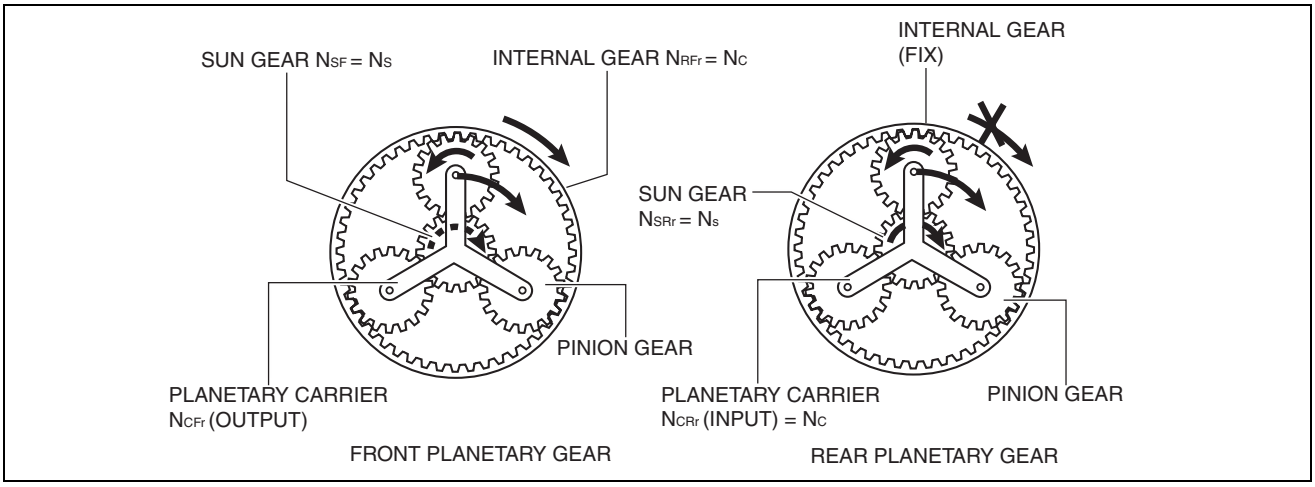
Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear	Reduction
Internal gear	$N_{RFr}=N_{C1}$	$N_{RRr}=N_{c2}$	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	N_{CRr} (Input)$=N_{c1}$	$N_{CRed}=N_{c2}$
Sun gear	$N_{SFr}=N_S$	$N_{SRr}=N_S$	$N_{SRed}=N_{c1}$

6GR



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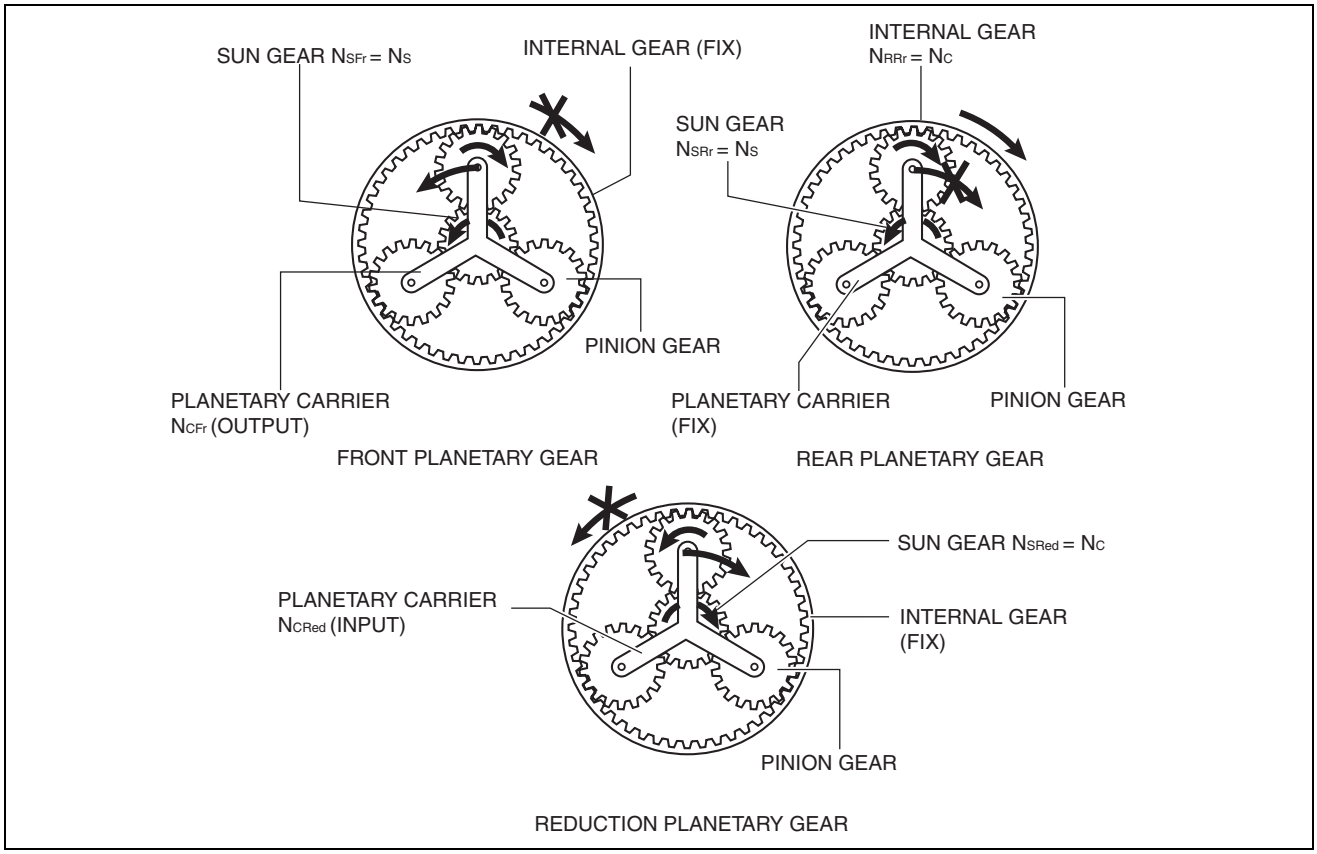
Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear
Internal gear	$N_{RFr}=N_C$	0 (Fix)

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Planetary gear unit	Front planetary gear	Rear planetary gear
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	N_{CRr} (Input)=N_c
Sun gear	N_{SFr}=N_S	N_{SRr}=N_S

Reverse



am3uun0000224

Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear	Reduction
Internal gear	N_{RFr} (Fix)	N_{RRr}=N_c	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	N_{CRr} (Fix)	N_{CRed}=N_c
Sun gear	N_{SFr}=N_S	N_{SRr}=N_S	N_{SRed} (Input)

PRIMARY GEAR [FW6A-EL, FW6AX-EL]

id0517h2351900

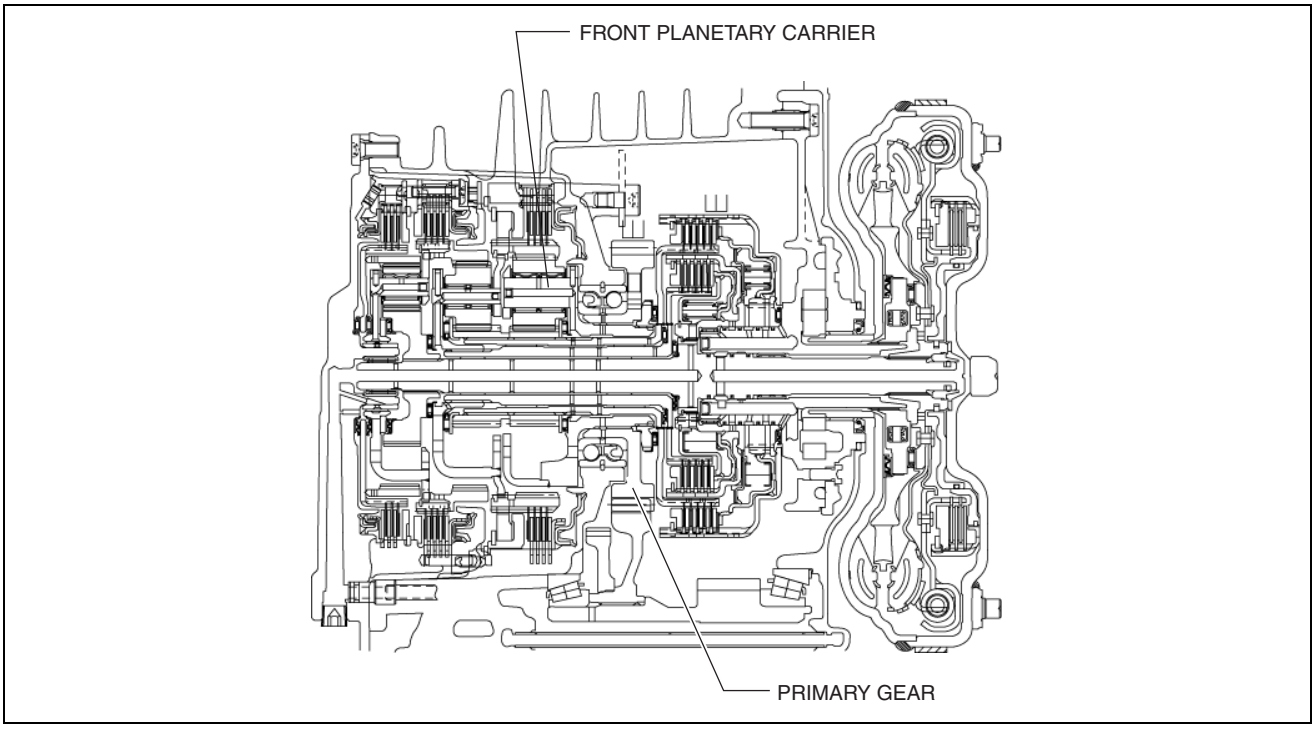
Purpose/Function

- The primary gear transmits the drive force converted by the 3-piece planetary gear to the secondary gear.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction

- The primary gear is engaged with the front planetary carrier and rotates as a single unit.



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SECONDARY GEAR [FW6A-EL, FW6AX-EL]

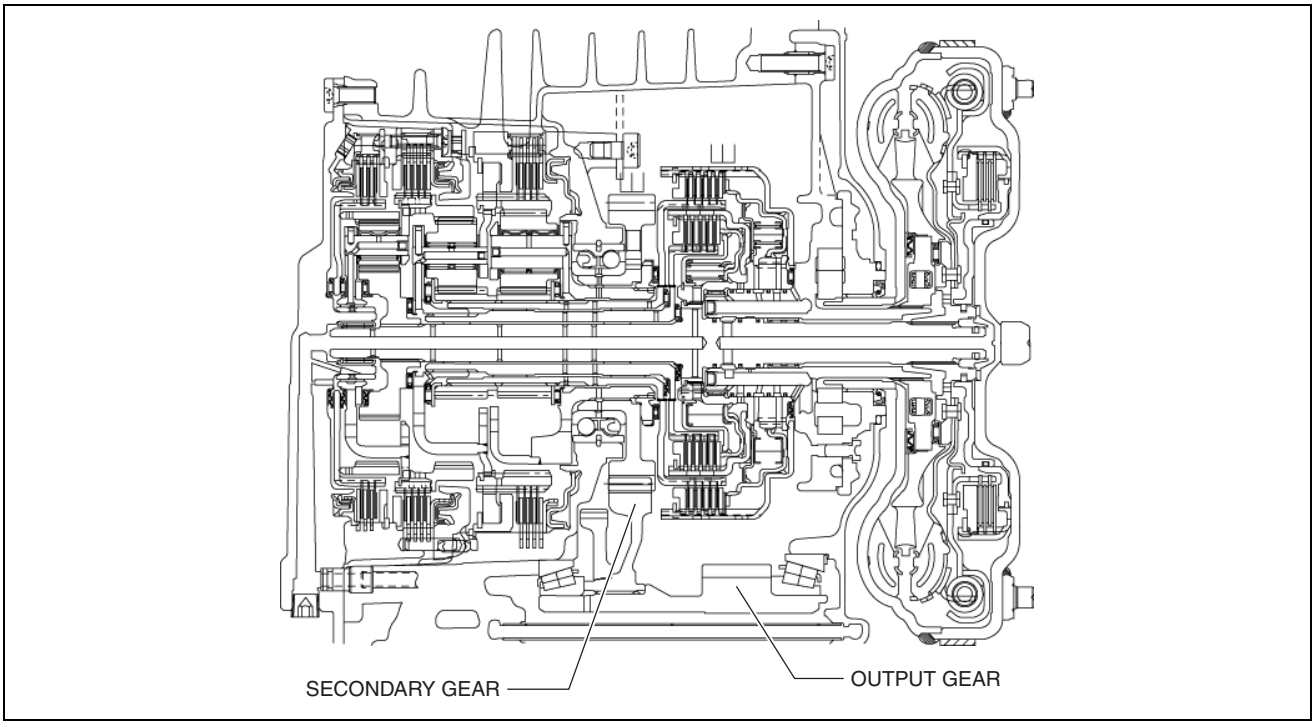
id0517h2352000

Purpose/Function

- The secondary gear transmits the drive force from the primary gear to the output gear.

Construction

- The secondary gear is engaged with the output gear and rotates as a single unit.



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AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

OUTPUT GEAR [FW6A-EL, FW6AX-EL]

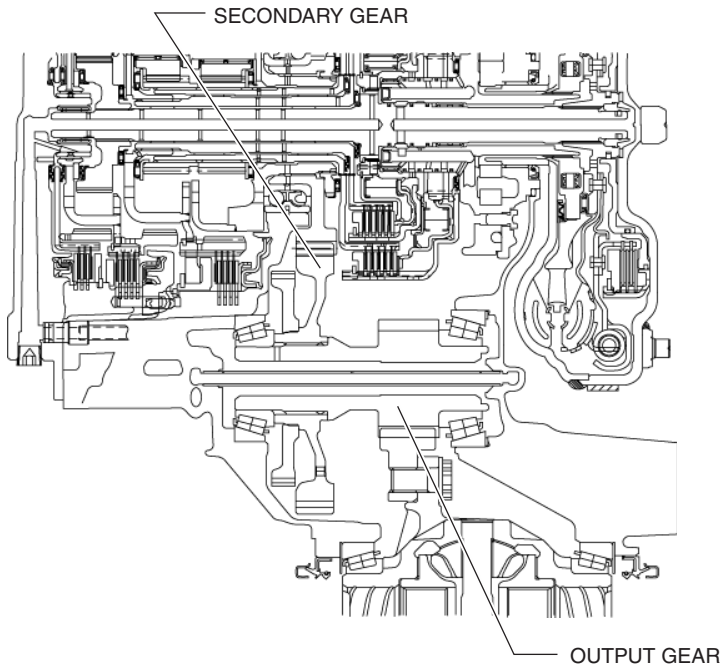
id0517h2352100

Purpose/Function

- The output gear transmits the drive force transmitted from the primary gear and secondary gear to the differential.

Construction

- The output gear is engaged with the secondary gear and rotates as a single unit.



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DIFFERENTIAL [FW6A-EL, FW6AX-EL]

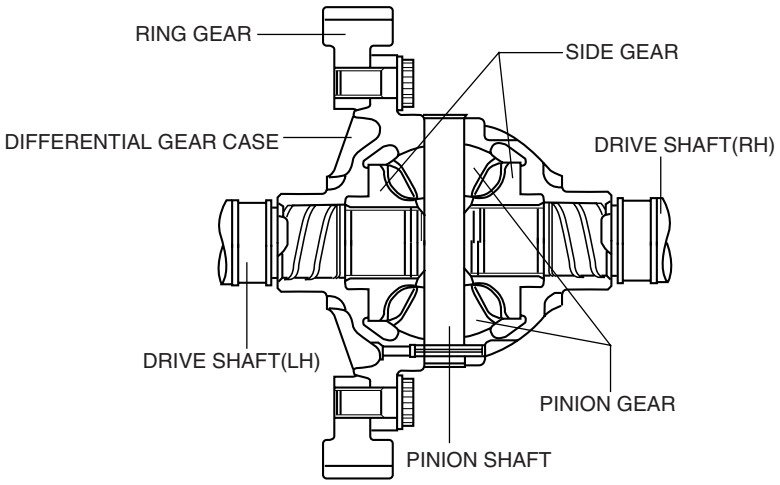
id0517h2352200

Purpose/Function

- The differential absorbs the difference in the rotation speed between the left and right driving wheels so that the vehicle drives smoothly when differences occur due to cornering or driving on rough roads.

Construction

- The differential consists of the ring gear, differential gear case, side gears, pinion gears, and pinion shaft.
- The differential gear case is engaged with the ring gear and rotates as a single unit.
- The side gears are engaged with the drive shaft (LH) and drive shaft (RH) and rotates as a single unit for each.



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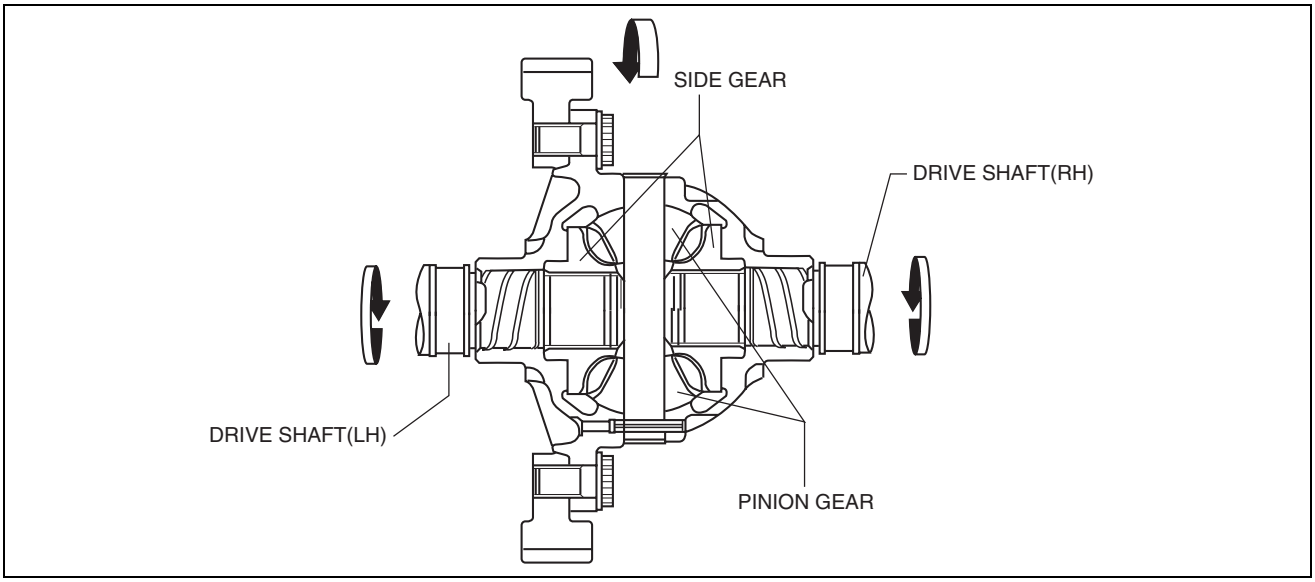
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Operation

- If there is no difference in rotation speed between the left and right driving wheels, the left and right side gears rotate together with the differential gear case and pinion gears.



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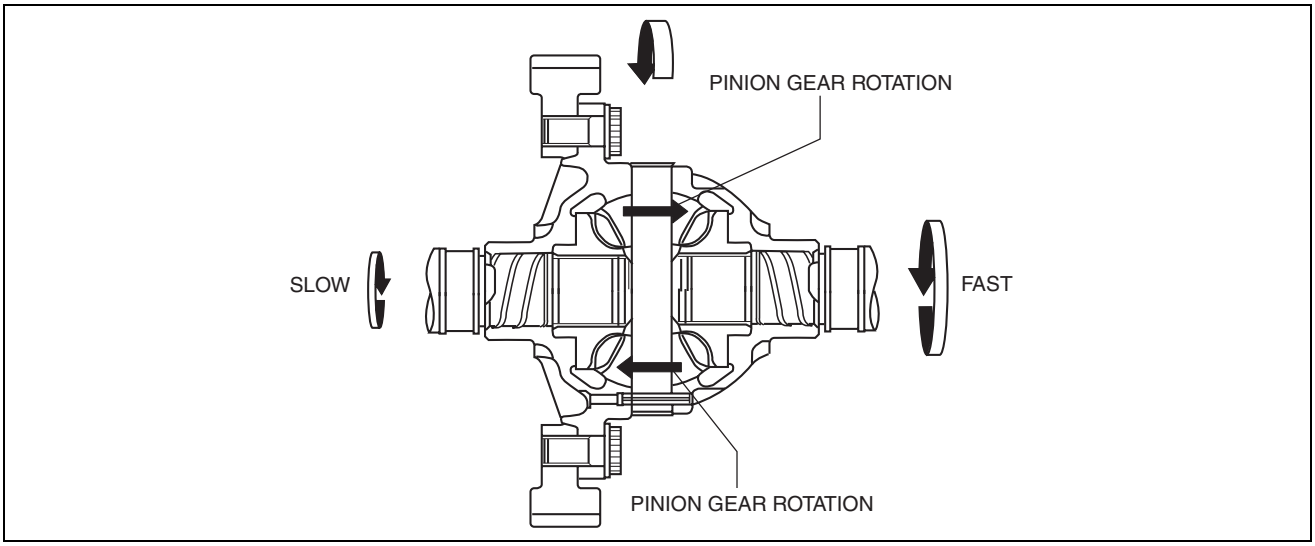
- If there is a difference in the rotation speed between the left and right driving wheels, the difference in the rotation speed between the left and right side gears is absorbed by the pinion gears rotating around the pinion shaft.



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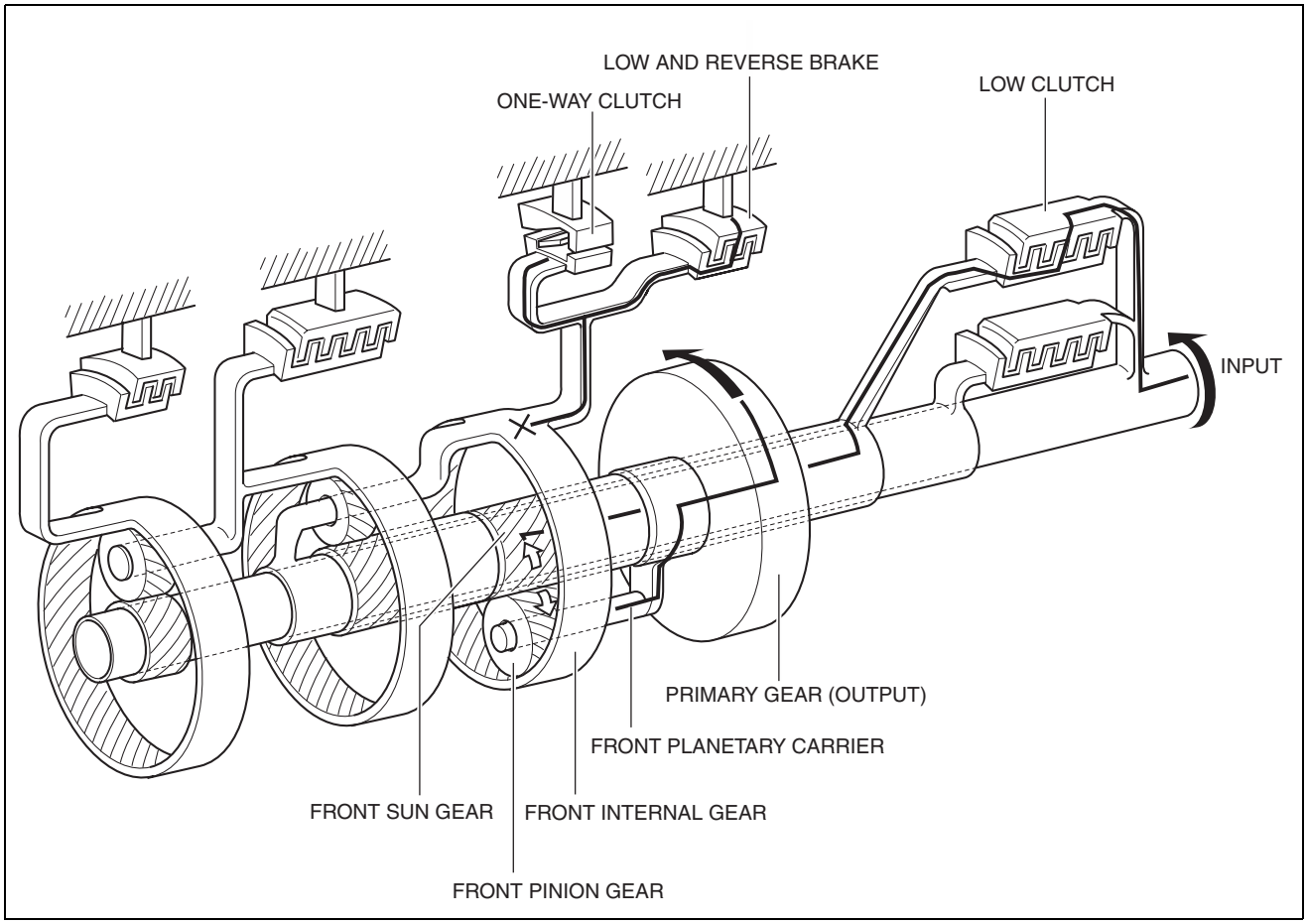
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

POWER FLOW [FW6A-EL, FW6AX-EL]

id0517h2352300

Power flow
1 GR



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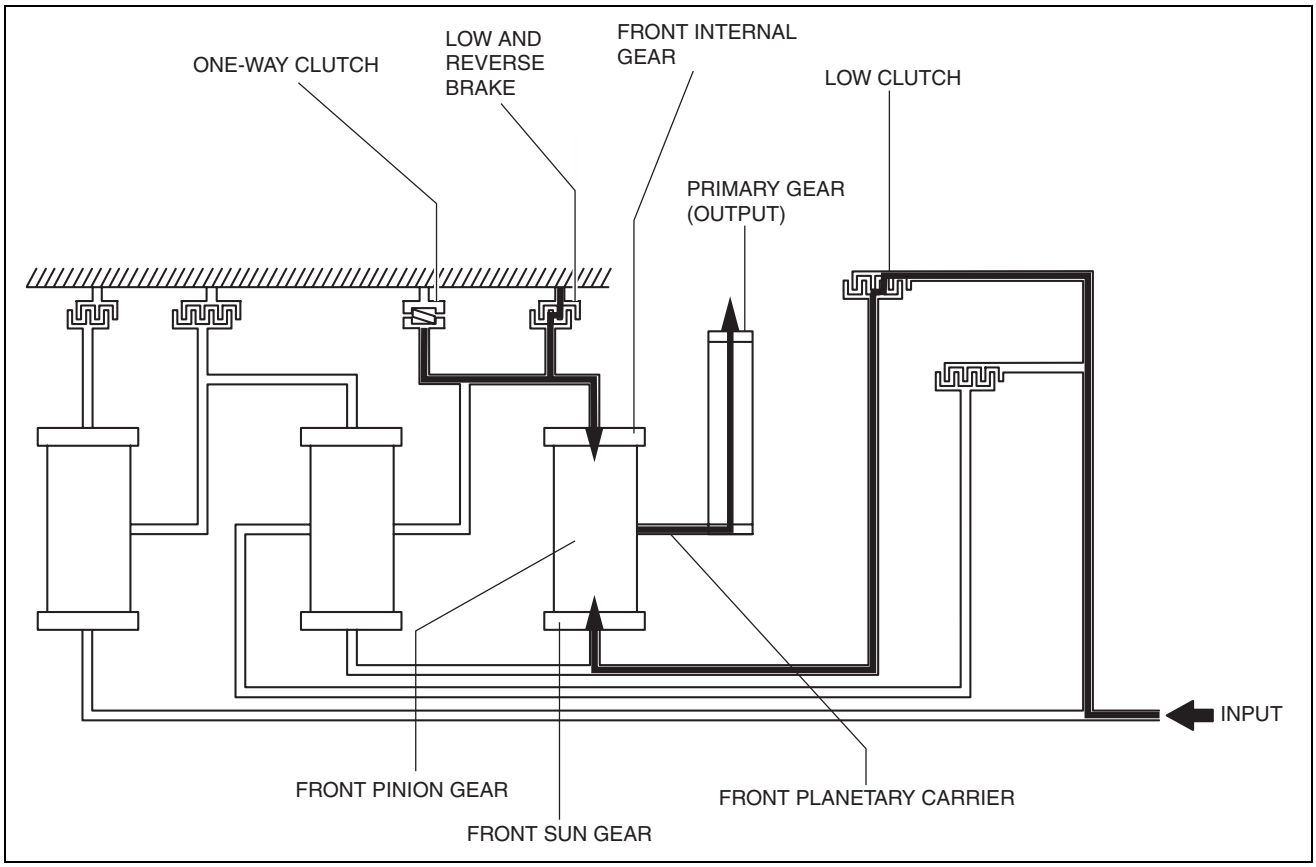
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]



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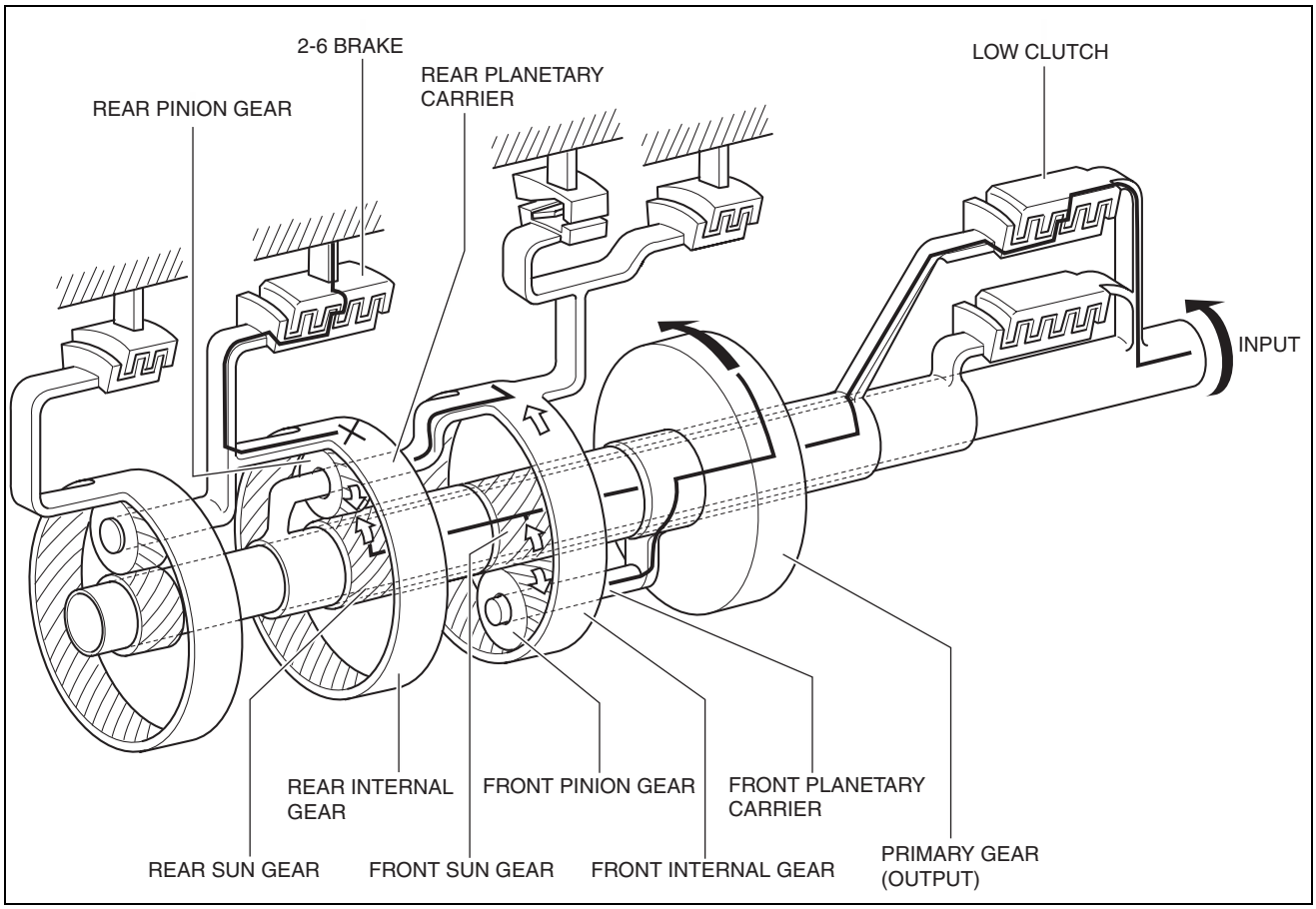
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

2 GR



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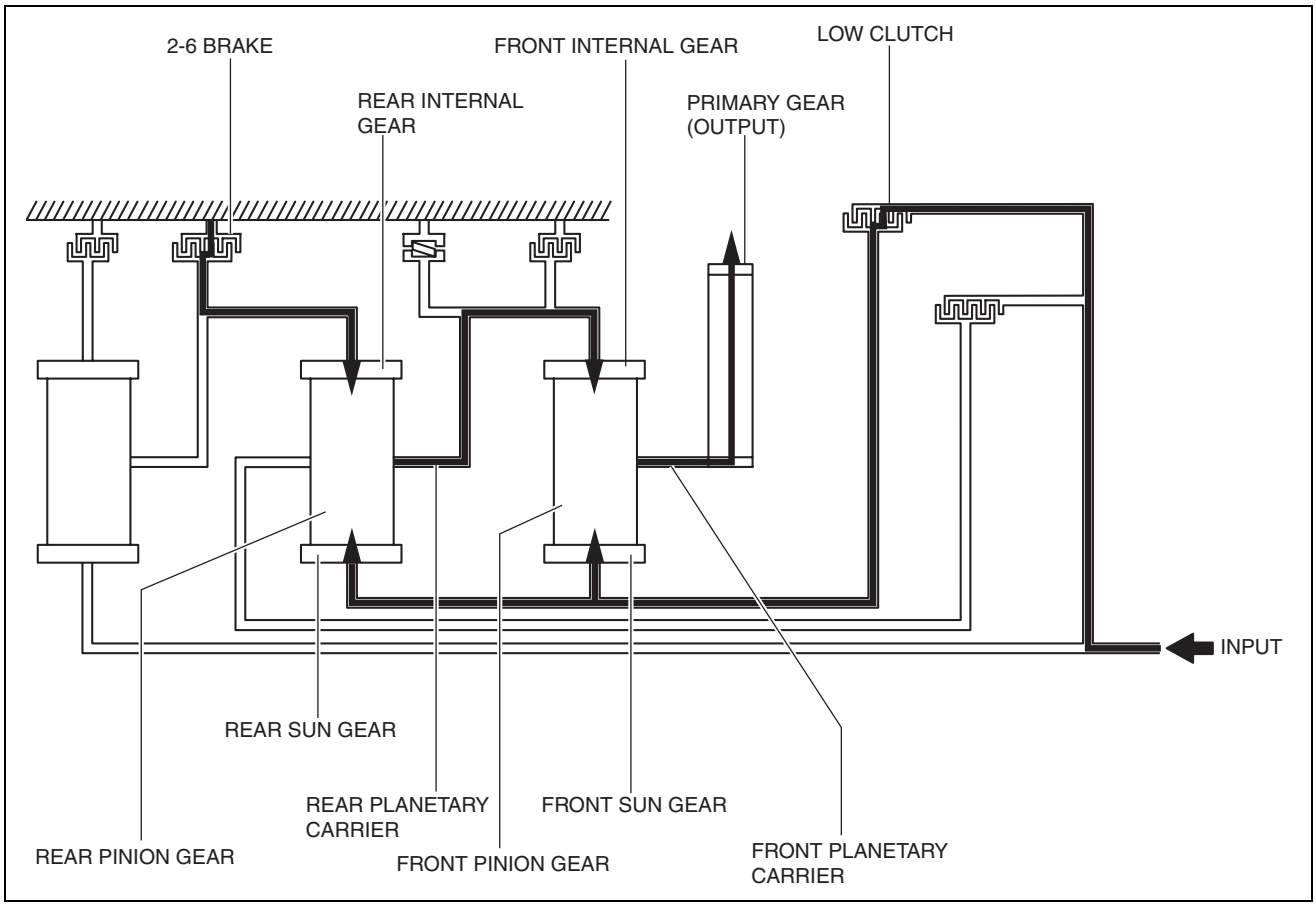
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]



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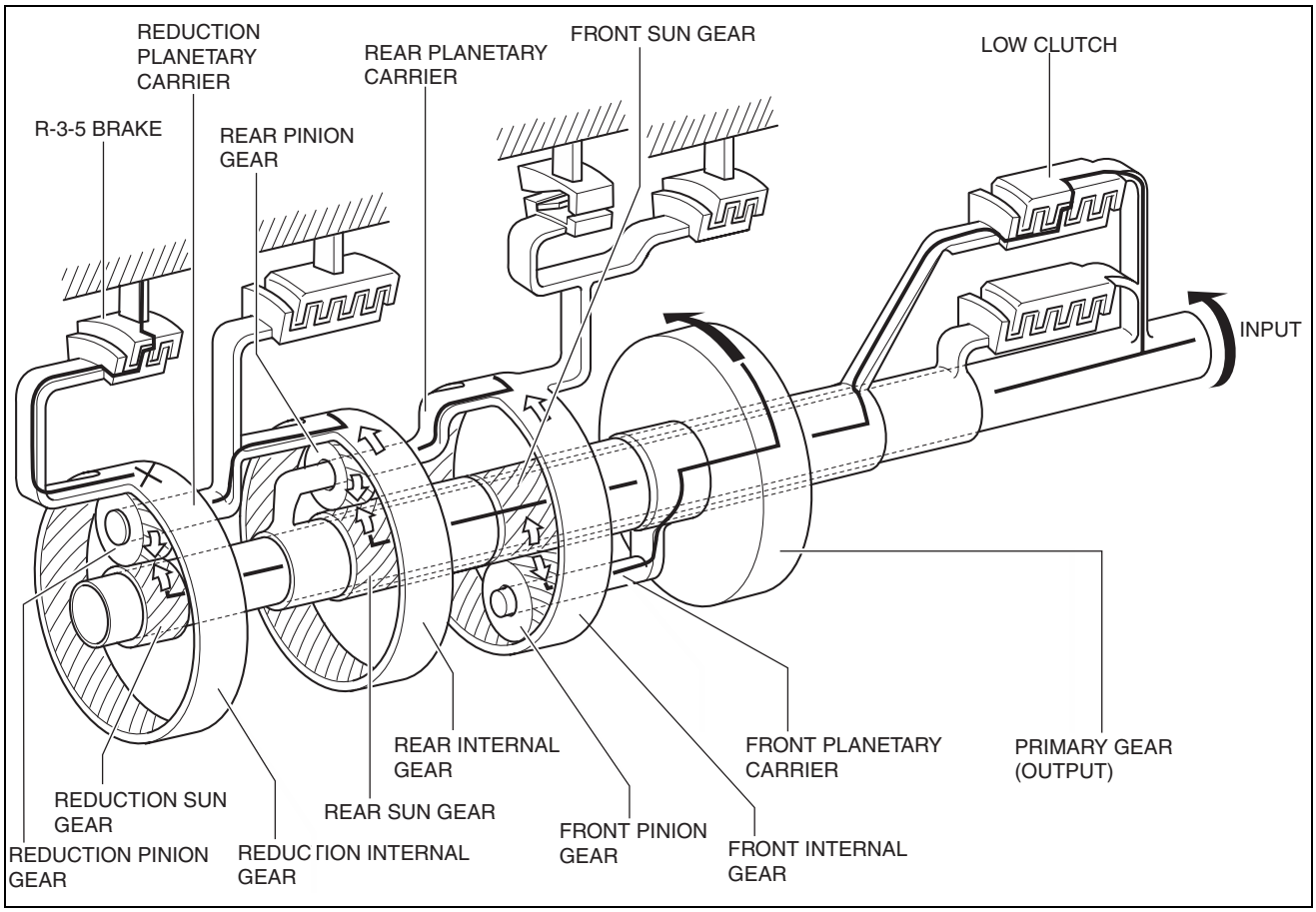
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

3 GR



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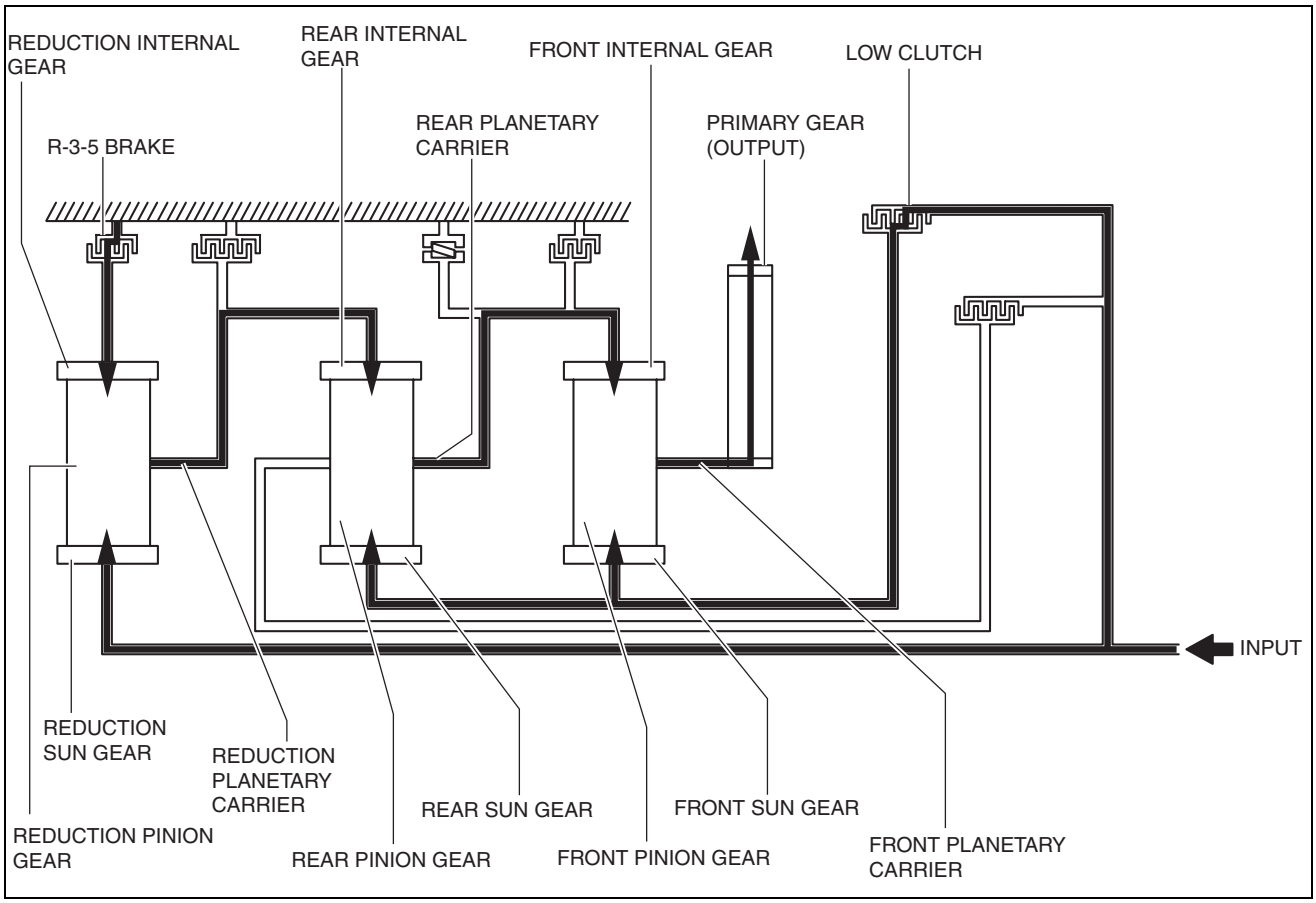
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]



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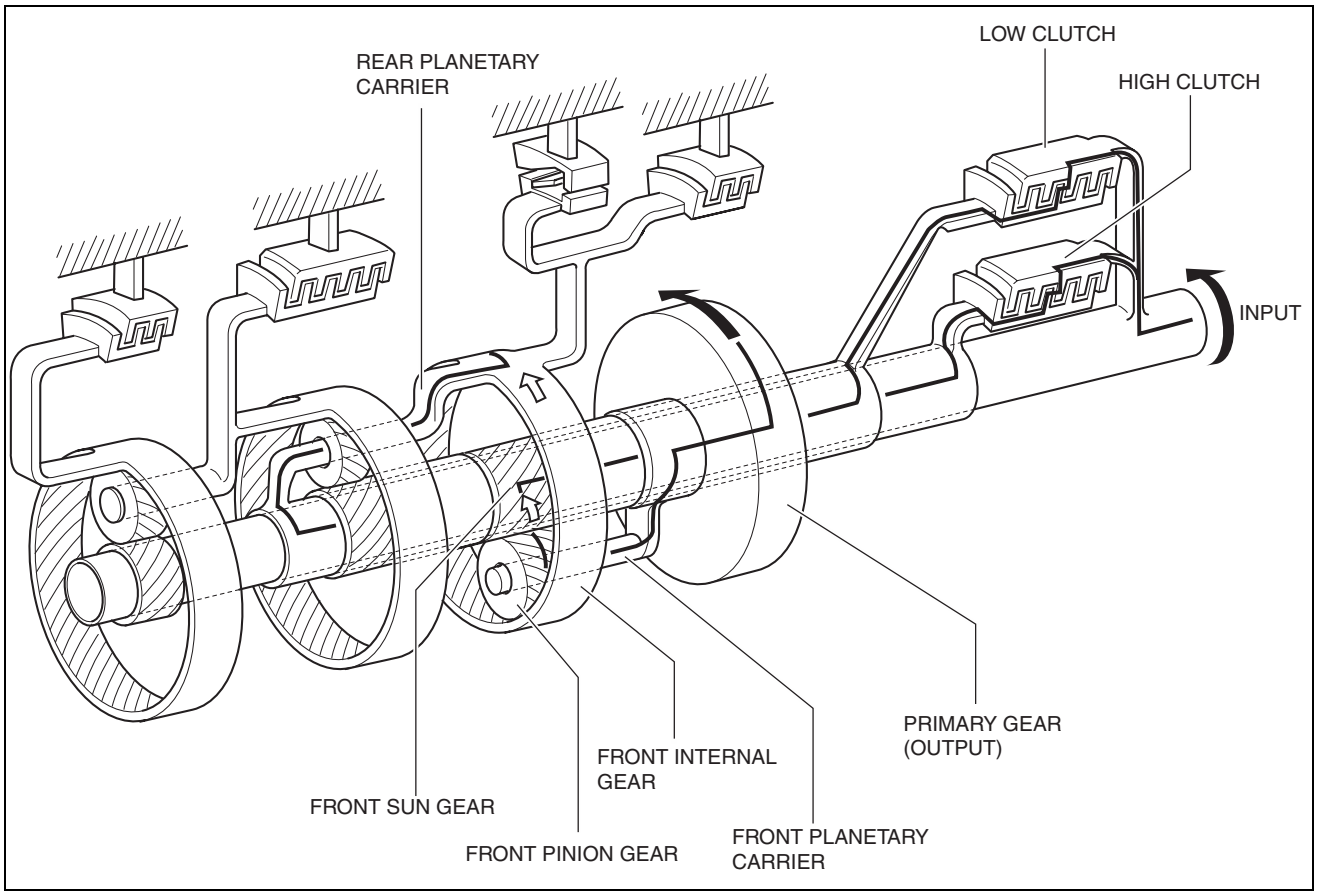
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

4 GR



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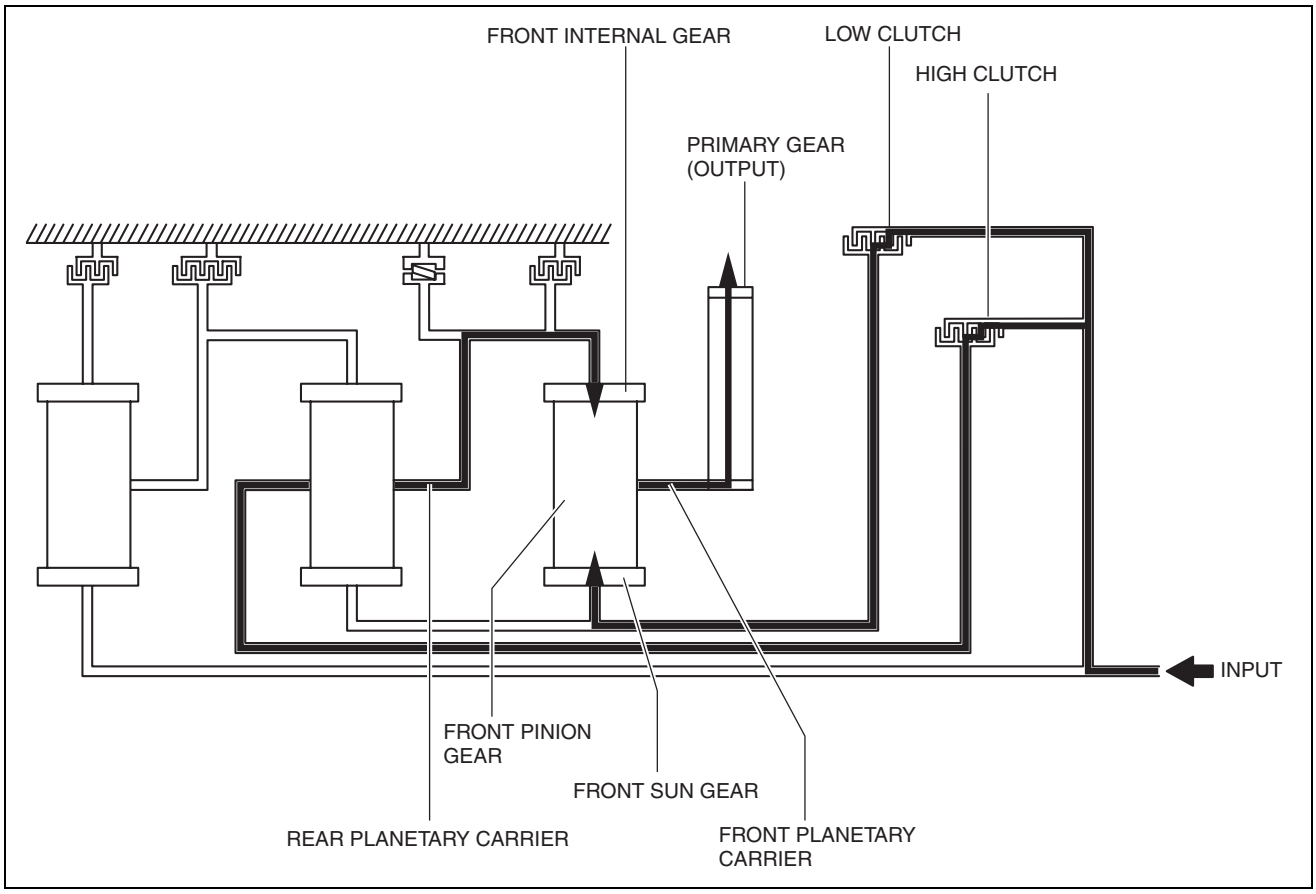
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]



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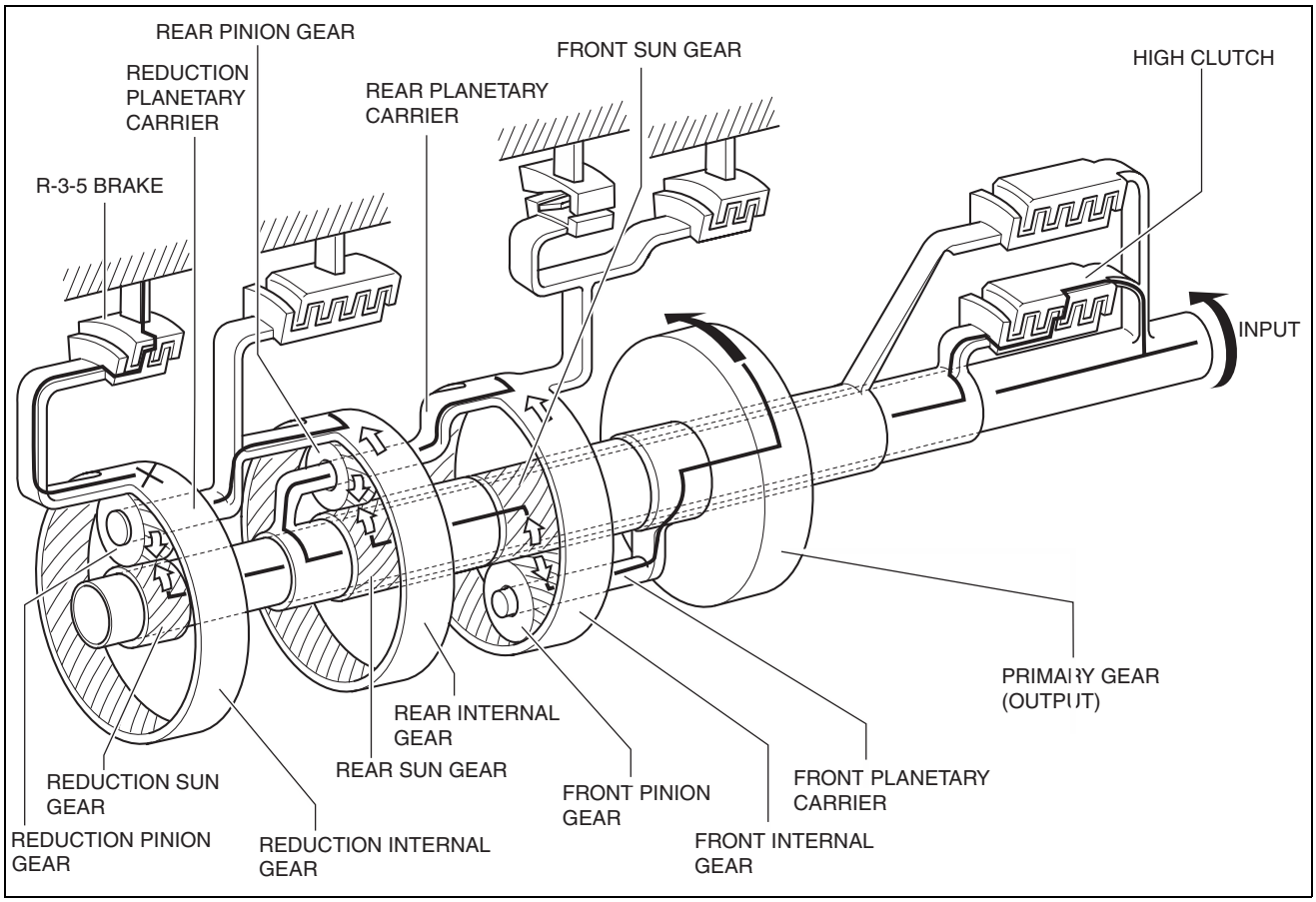
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

5 GR



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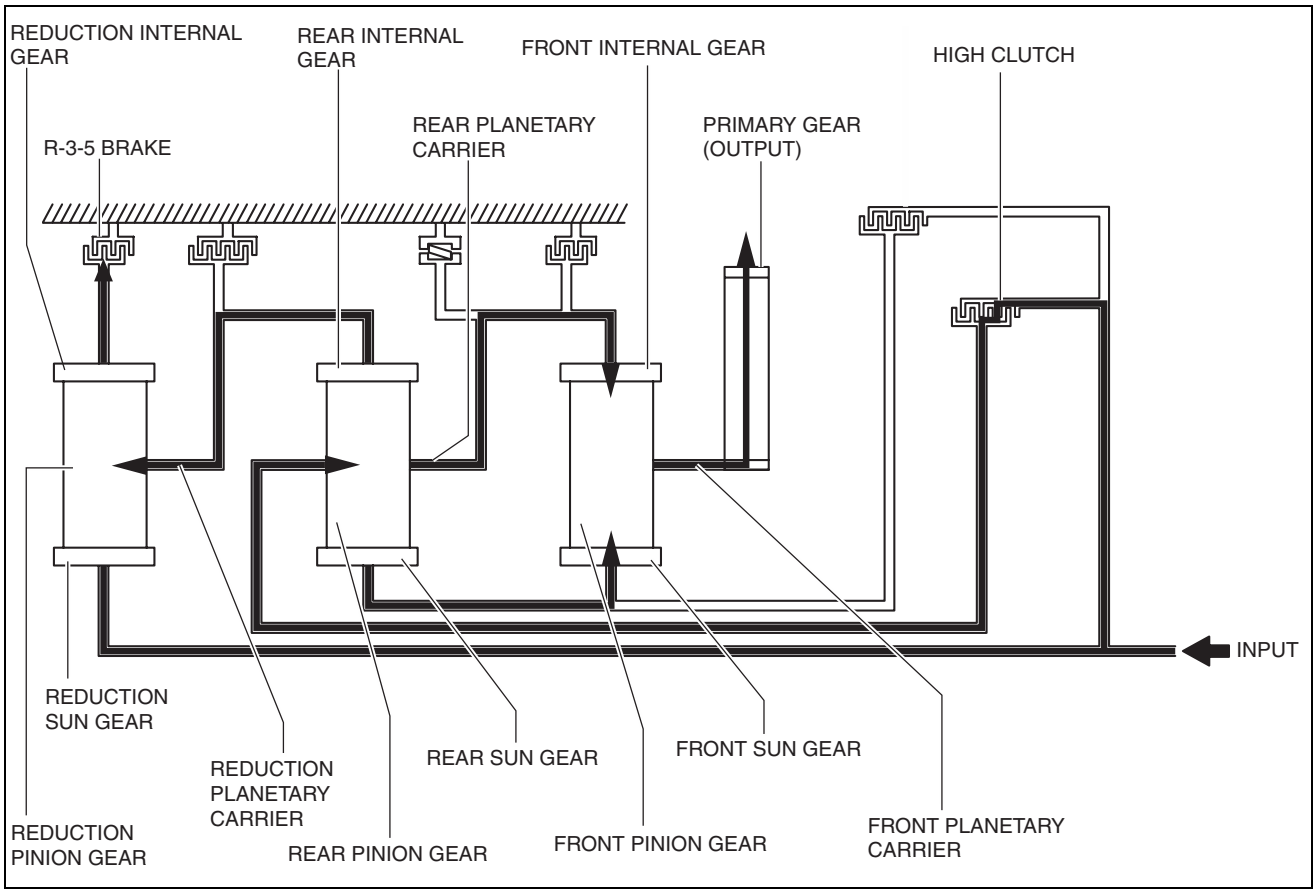
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]



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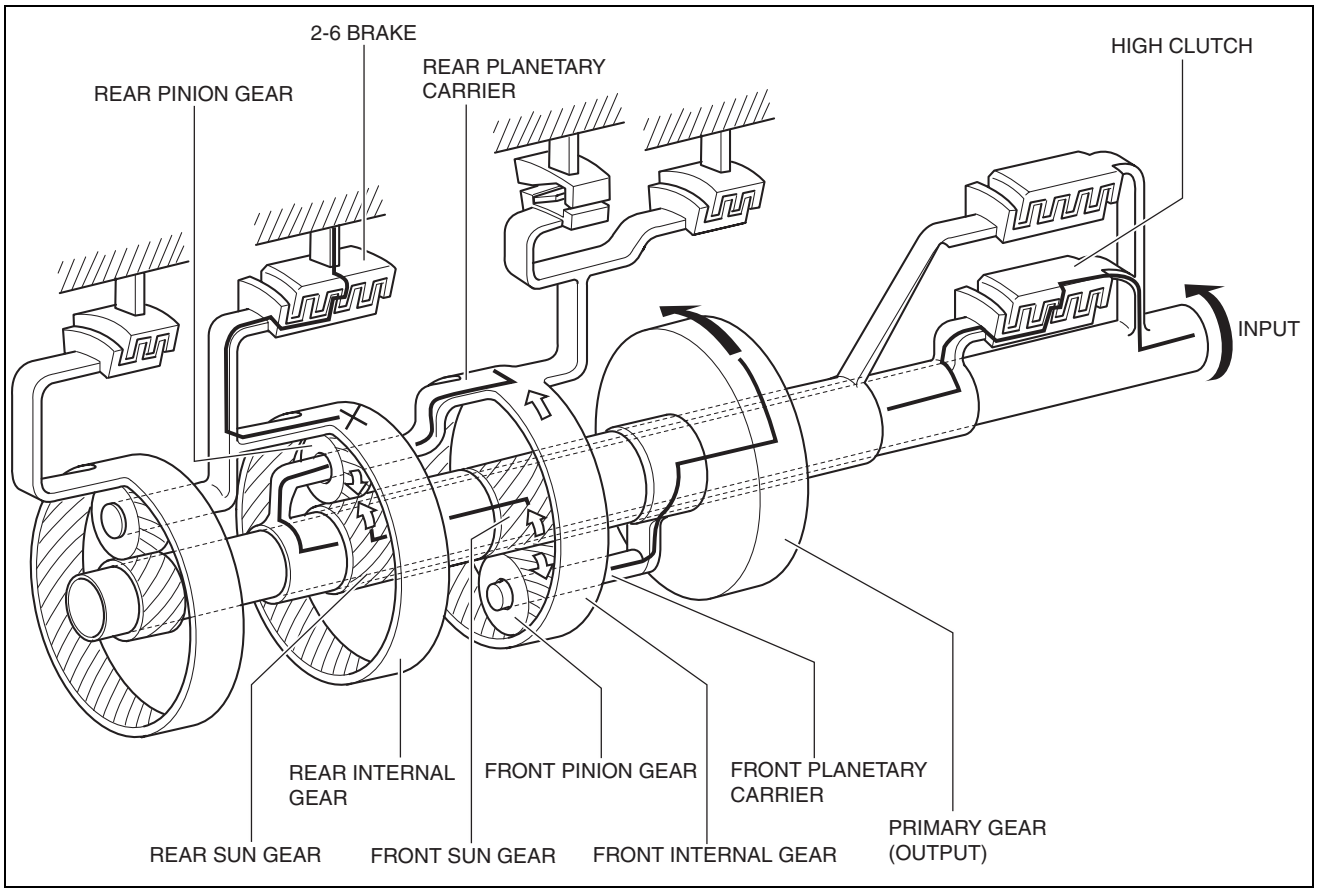
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

6 GR



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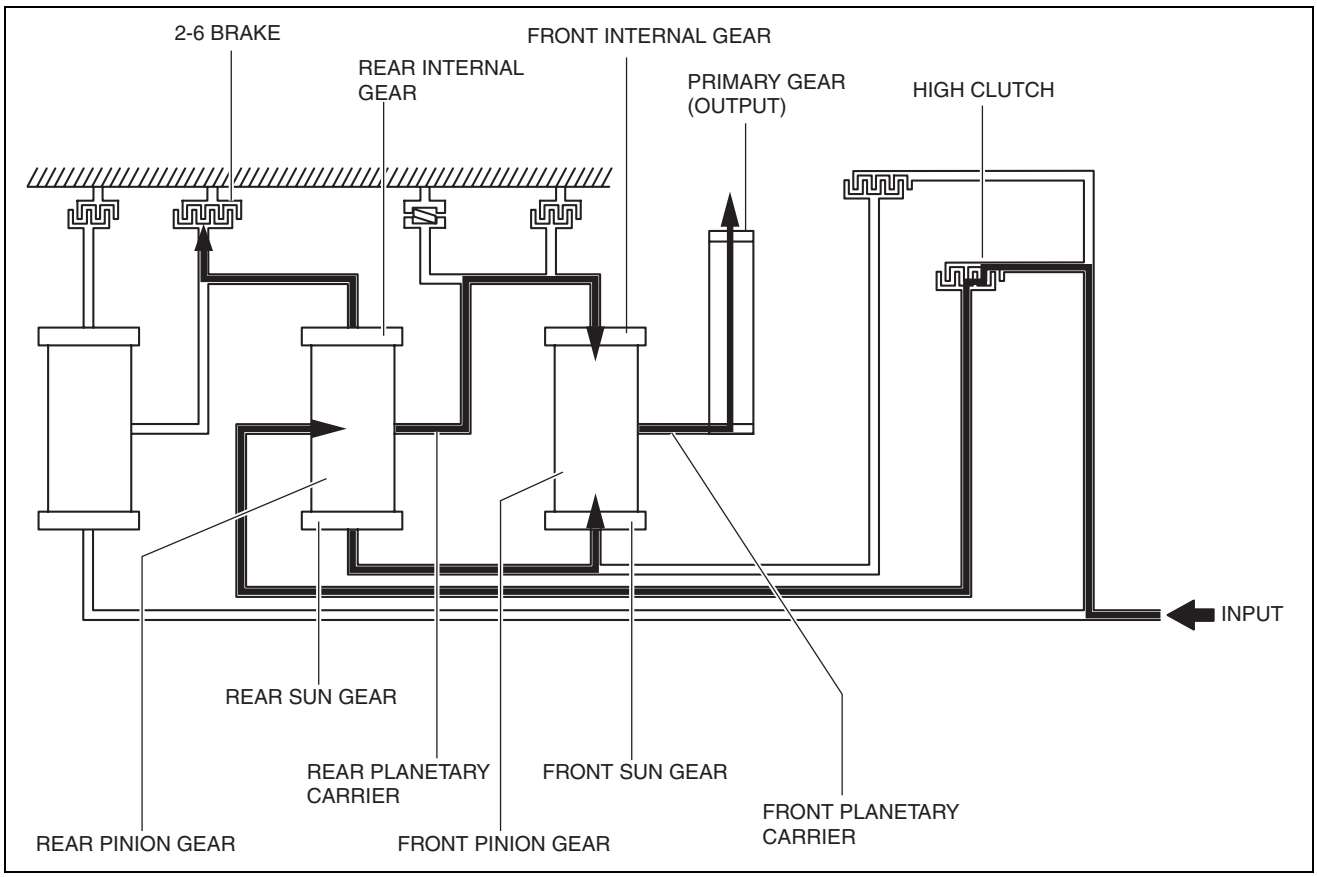

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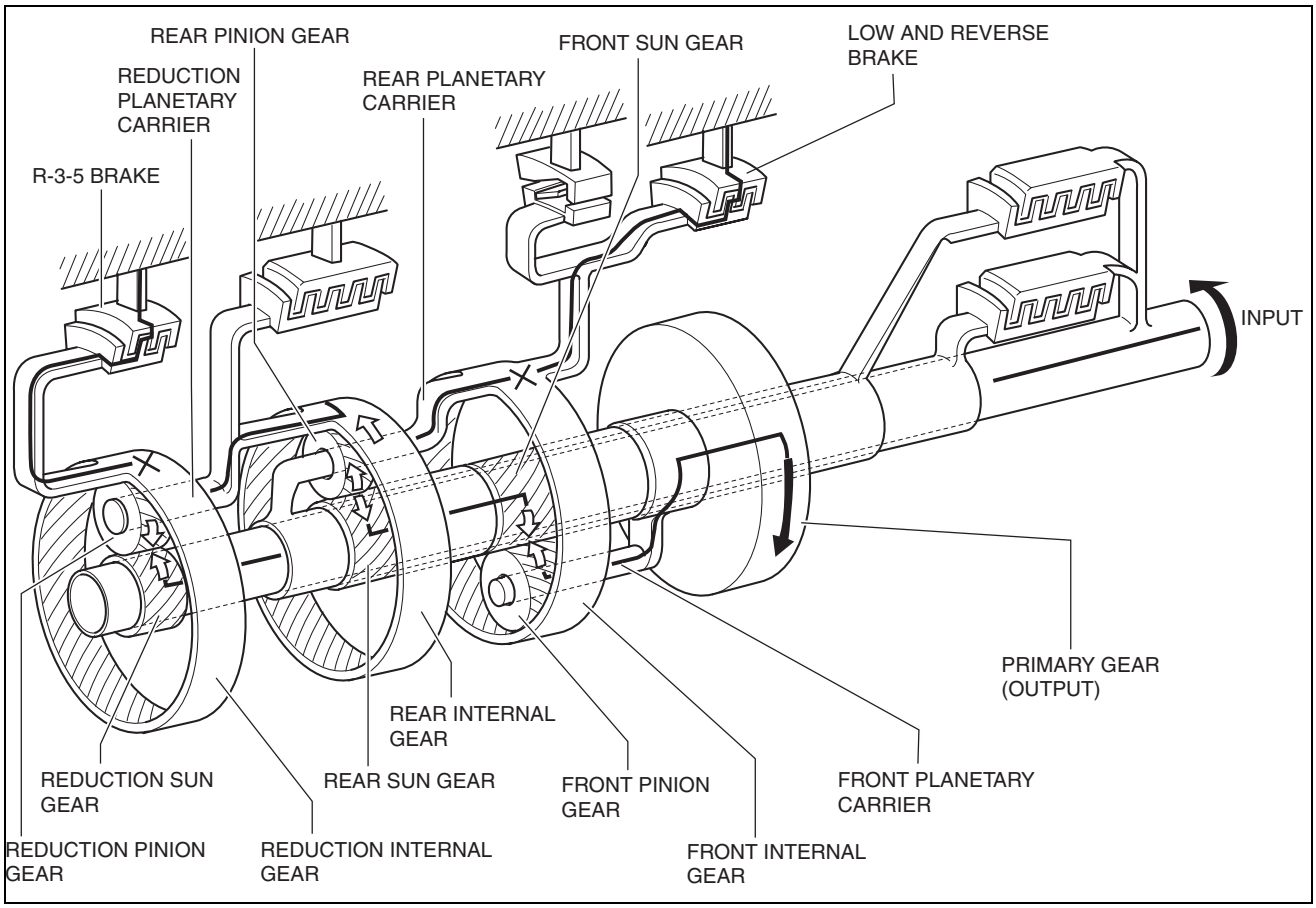
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

REVERSE



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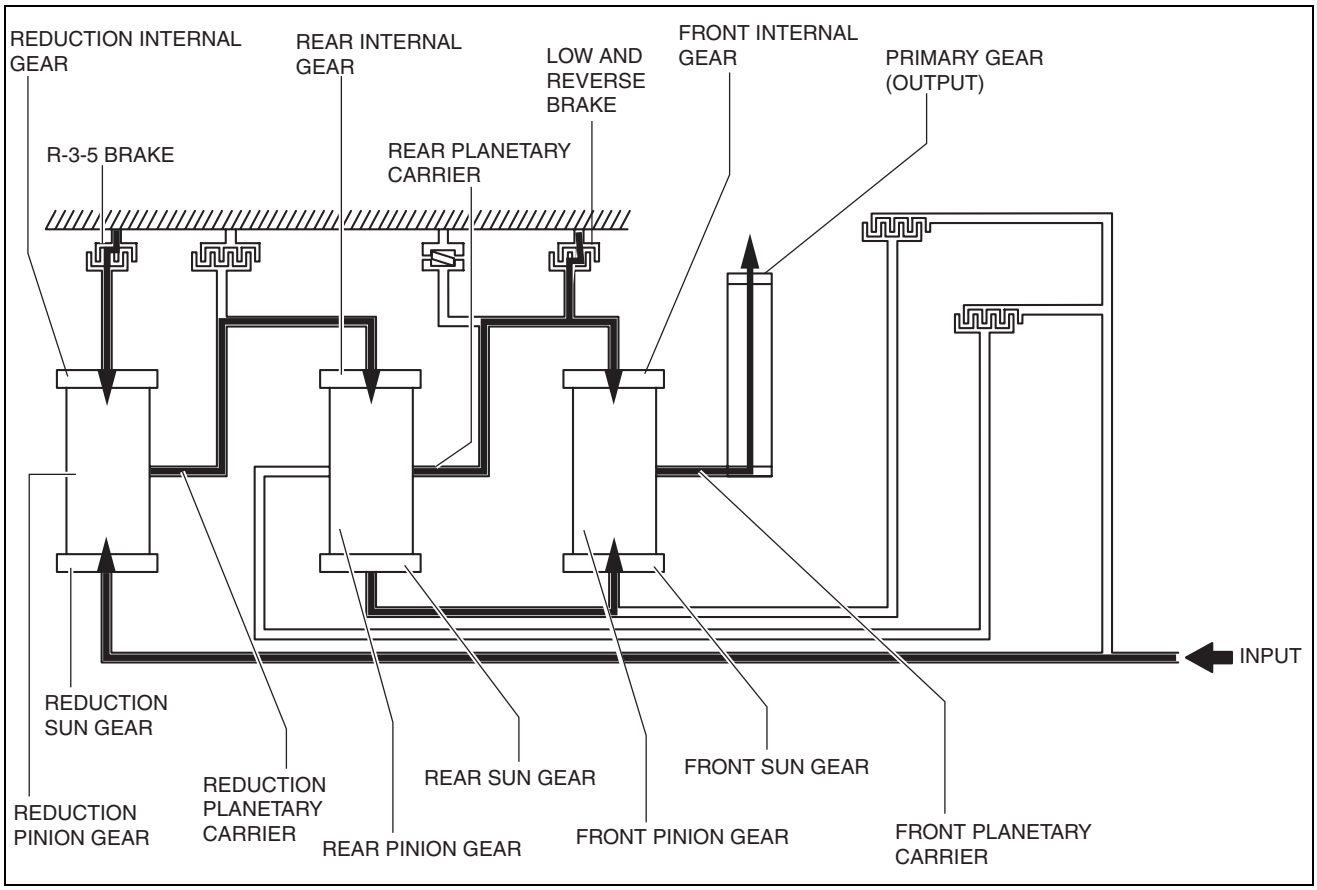
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]



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PARKING MECHANISM [FW6A-EL, FW6AX-EL]

id0517h2352400

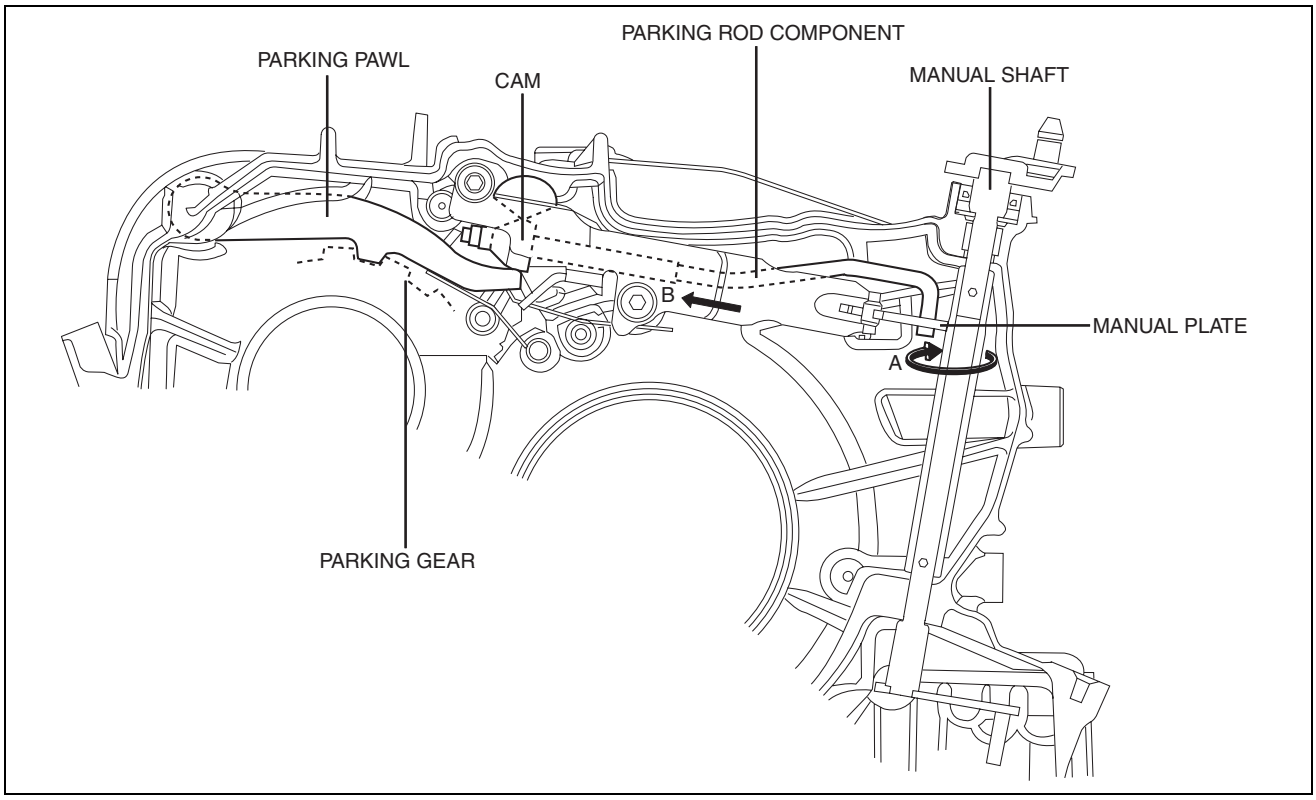
Purpose/Function

- The parking mechanism locks the output gear when the selector lever is shifted to the P position which locks the driving wheels against rotation to prevent coasting when parking the vehicle.

Construction/Operation

- For component parts related to the parking mechanism, refer to the following figure.
- When the selector lever is shifted to the P position, the manual plate is rotated in the direction of arrow A via the manual shaft. As a result, the parking rod component moves in the direction of arrow B. As a result, the cam on the end of the parking rod component presses the parking pawl against the parking gear, the parking pawl and parking gear are engaged, and the rotation of the output gear is locked. Even if the parking pawl is positioned at the projection of the parking gear and cannot be engaged, the driving wheels together with the parking gear are rotated by moving the vehicle slightly so that the parking pawl and parking gear engage.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]



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HYDRAULIC PRESSURE CONTROL SYSTEM OUTLINE [FW6A-EL, FW6AX-EL]

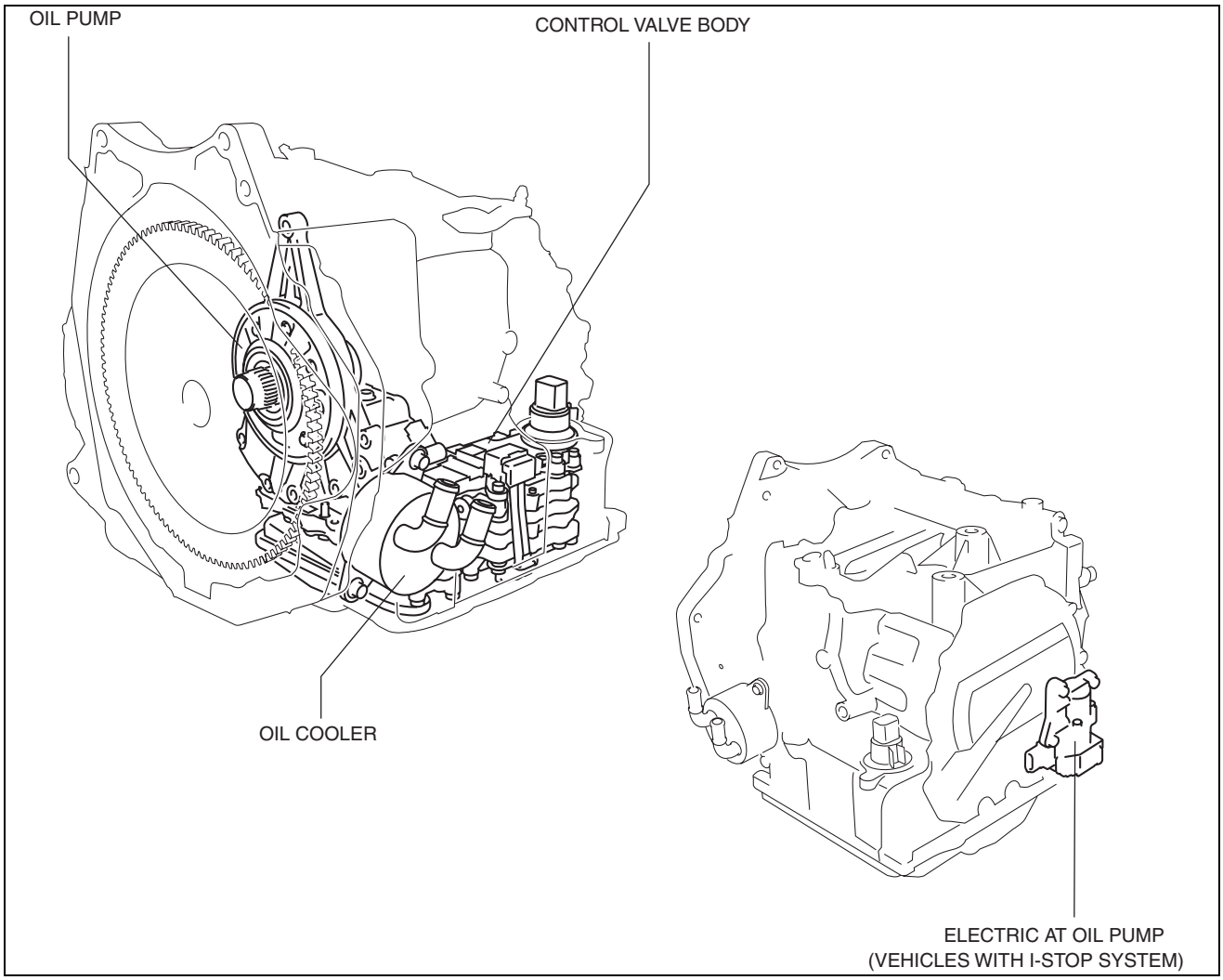
id0517h2355000

Outline

- The hydraulic control mechanism consists of an oil cooler which maintains the hydraulic pressure at the optimum temperature, a control valve body and each shift valve which perform adjustment and circuit switching of the hydraulic pressure based on the control content calculated by the TCM, and the oil pump which generates the hydraulic pressure of each clutch and brake.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction
Structural view



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OIL PUMP [FW6A-EL, FW6AX-EL]

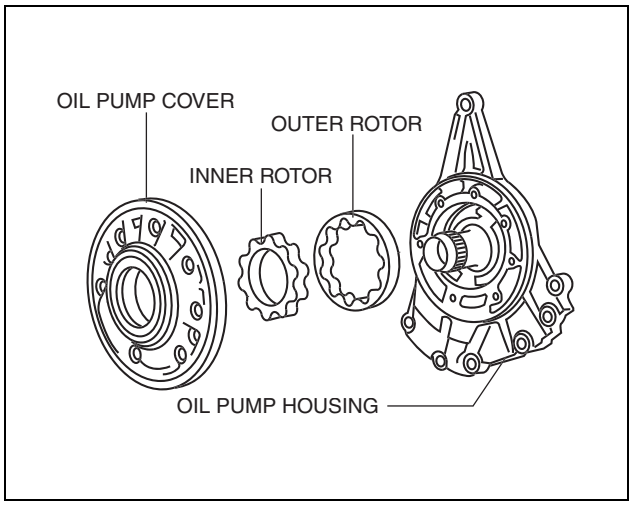
id0517h2355100

Purpose/Function
- The oil pump generates hydraulic pressure in the oil line of the automatic transaxle together with supplying lubrication to powertrain related parts.

Construction
- The oil pump has adopted a gear type with built-in outer and inner rotors.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The inner rotor engages with the torque converter and rotates in conjunction with the rotation of the torque converter.



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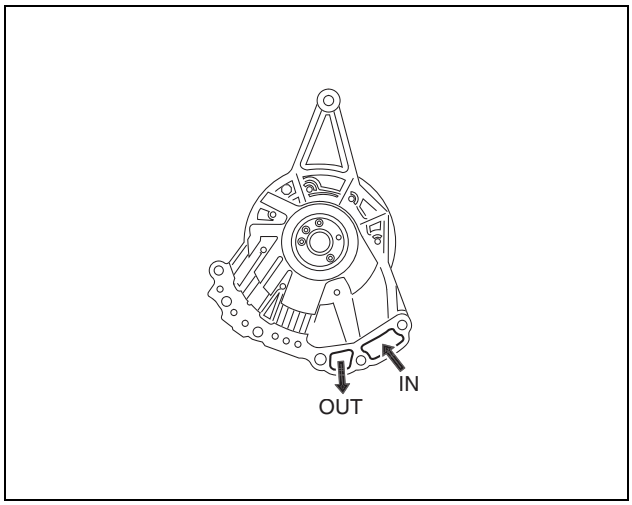
Operation

- When the inner rotor in the oil pump rotates, vacuum is generated in the outer rotor. As a result, ATF in the oil pan is suctioned to the oil pump. Further rotation of the inner rotor causes the inner rotor blades to push the ATF and discharge it from the oil pump.
- The ATF discharge flow amount increases or decreases in proportion to the rotation speed of the inner rotor.



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ELECTRIC AT OIL PUMP [FW6A-EL, FW6AX-EL]

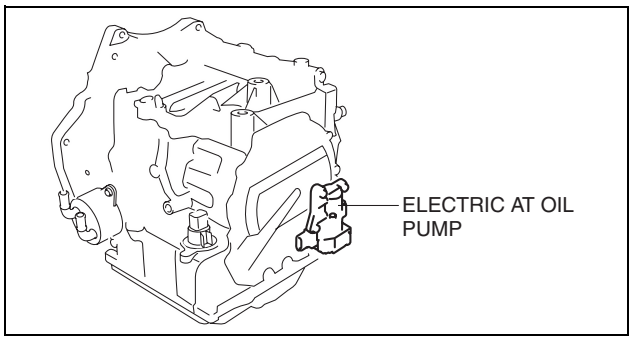
id0517h2355200

Purpose, Function

- The electric AT oil pump generates hydraulic pressure in the oil line of the automatic transaxle when the i-stop (engine-stop control) permit conditions are met and the engine is stopped.
- By ensuring oil pressure while i-stop is operating, smooth startability after the engine is restarted has been realized.

Construction

- The electric oil pump has adopted an axial piston type.
- The electric AT oil pump is installed to the transaxle end cover.



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AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

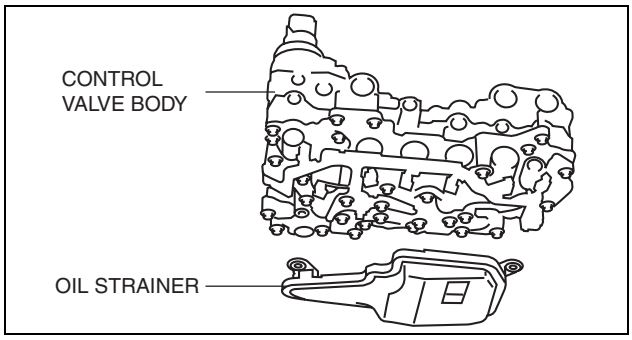
Operation
- The electric oil pump generates hydraulic pressure by the operation of the electric motor based on the operation signal from the TCM.

OIL STRAINER [FW6A-EL, FW6AX-EL]

id0517h2355300

Purpose/Function
- The oil strainer filters particulate matter in the ATF by passing it through the built-in filter.

Construction
- The oil strainer is a built-in, non-woven fabric filter installed to the position shown in the following figure.



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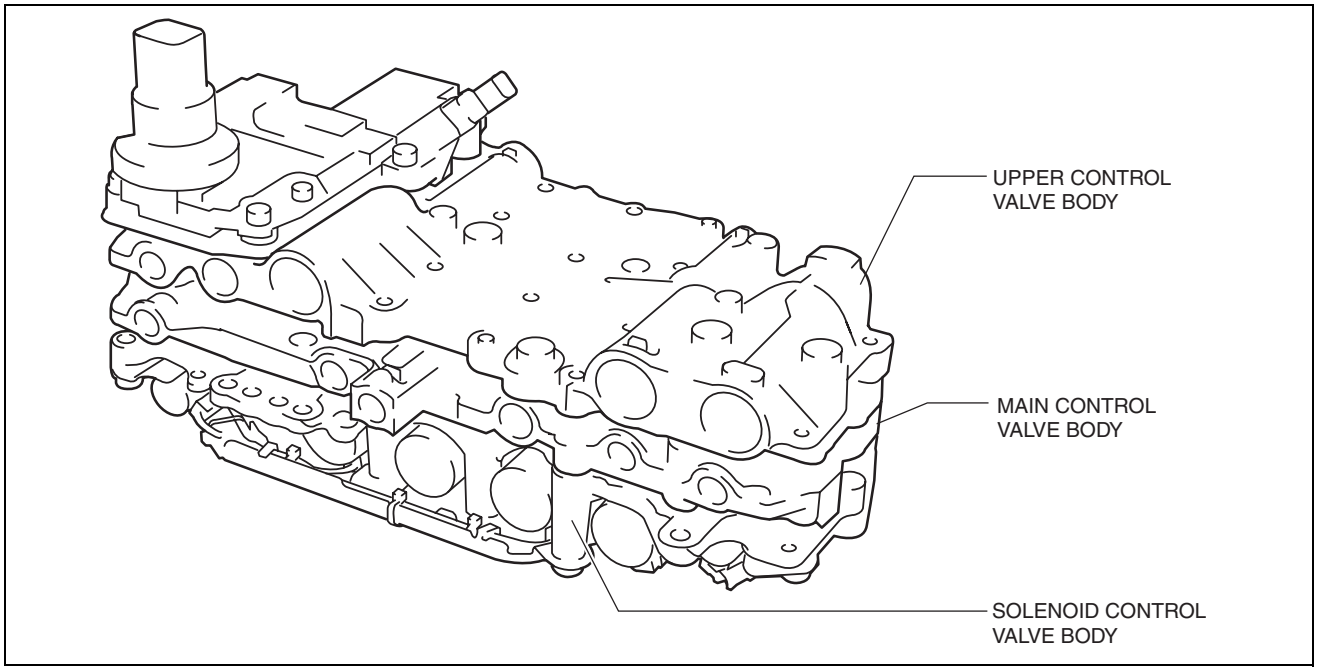
CONTROL VALVE BODY [FW6A-EL, FW6AX-EL]

id0517h2355400

Purpose/Function
- The control valve body controls the hydraulic pressure generated by the oil pump by each solenoid valve. In addition, the oil passages which introduce hydraulic pressure to the pistons for each clutch and brake is formed by the switching of each built-in shift valve.

Construction
- The control valve body consists of integrated hydraulic control related parts and electronic control related parts.
- The hydraulic control related parts basically consist of the upper control valve body and main control valve body each with built-in shift valves, and the solenoid control valve body with built-in solenoid valves.



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OIL COOLER [FW6A-EL, FW6AX-EL]

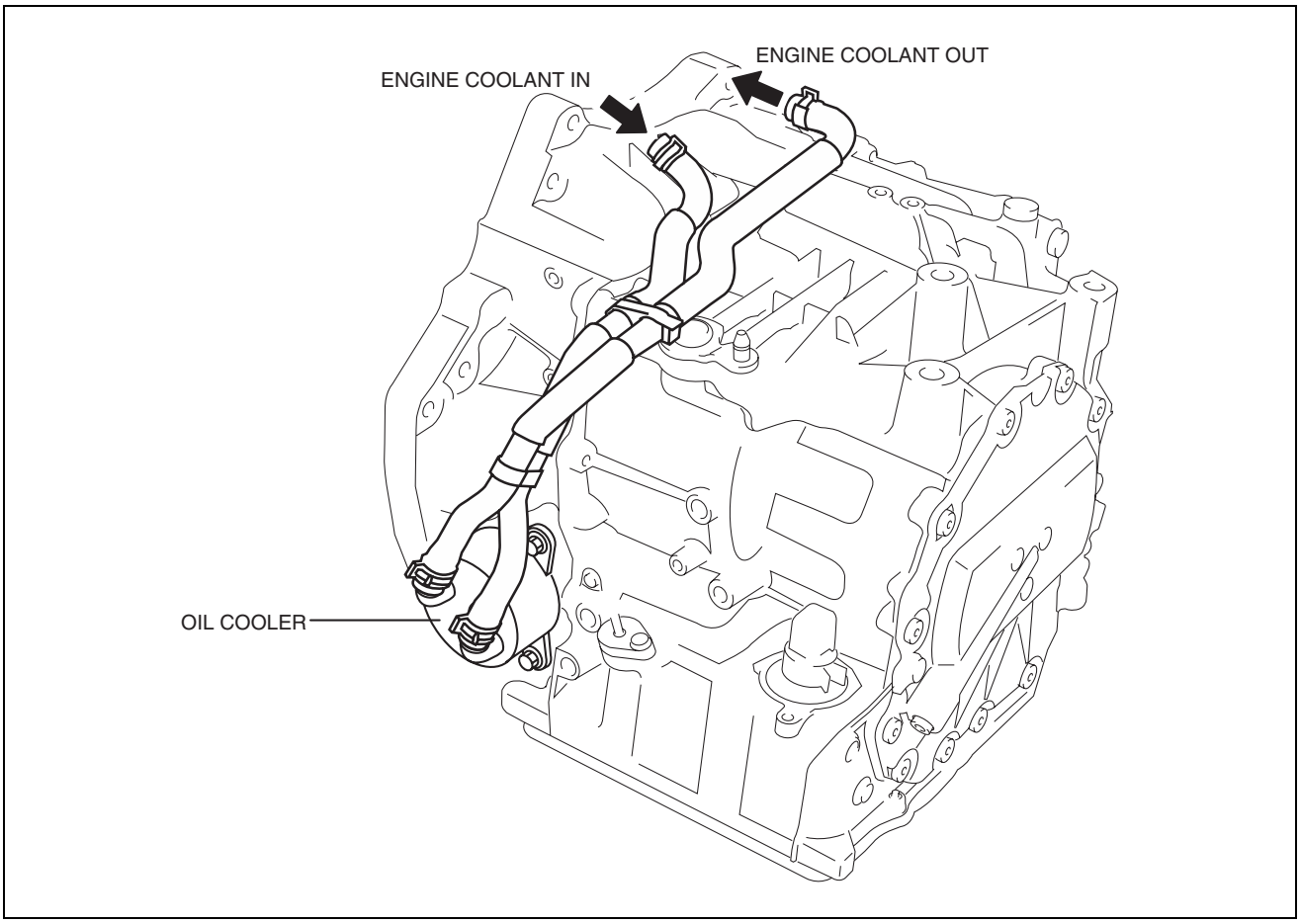
id0517h2358100

Purpose/Function
- The oil cooler constantly maintains maximum ATF performance in the transaxle by maintaining an optimum ATF temperature which has the effect of achieving reduced fuel consumption.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction/Operation

- The oil cooler performs the following operations according to the ATF temperature condition:
  - — Heating function: Warms the ATF using the radiator coolant to promote an earlier increase in the ATF temperature when its temperature is low. As a result of the earlier temperature increase, the ATF viscosity decreases which reduces drag in the transaxle.
  - — Cooling function: Cools the ATF using the radiator coolant to maintain optimum conditions and prevent ATF expansion and deterioration.



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ELECTRONIC CONTROL SYSTEM OUTLINE [FW6A-EL, FW6AX-EL]

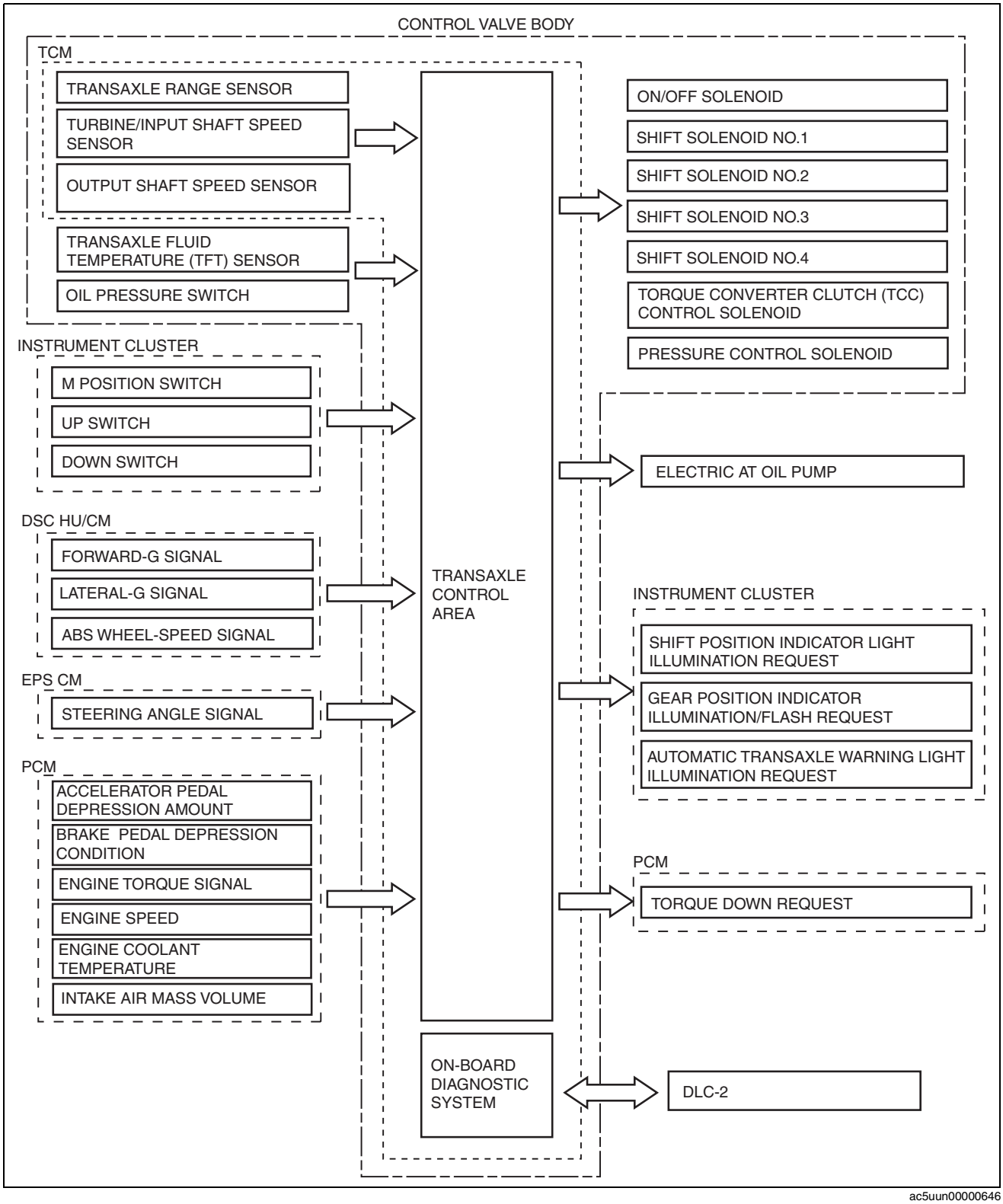
id0517h2360000

Outline

- In the electronic control system, the TCM calculates the control content based on signals from each type of sensor and switch to operate output parts such as each solenoid. In consideration of suppressed shift shock, smooth driving, and improved fuel economy, the TCM performs controls so as to maintain the optimum driving performance in response to the vehicles driving scenario.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction
Block diagram



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CONTROL VALVE BODY [FW6A-EL, FW6AX-EL]

id0517h2360100

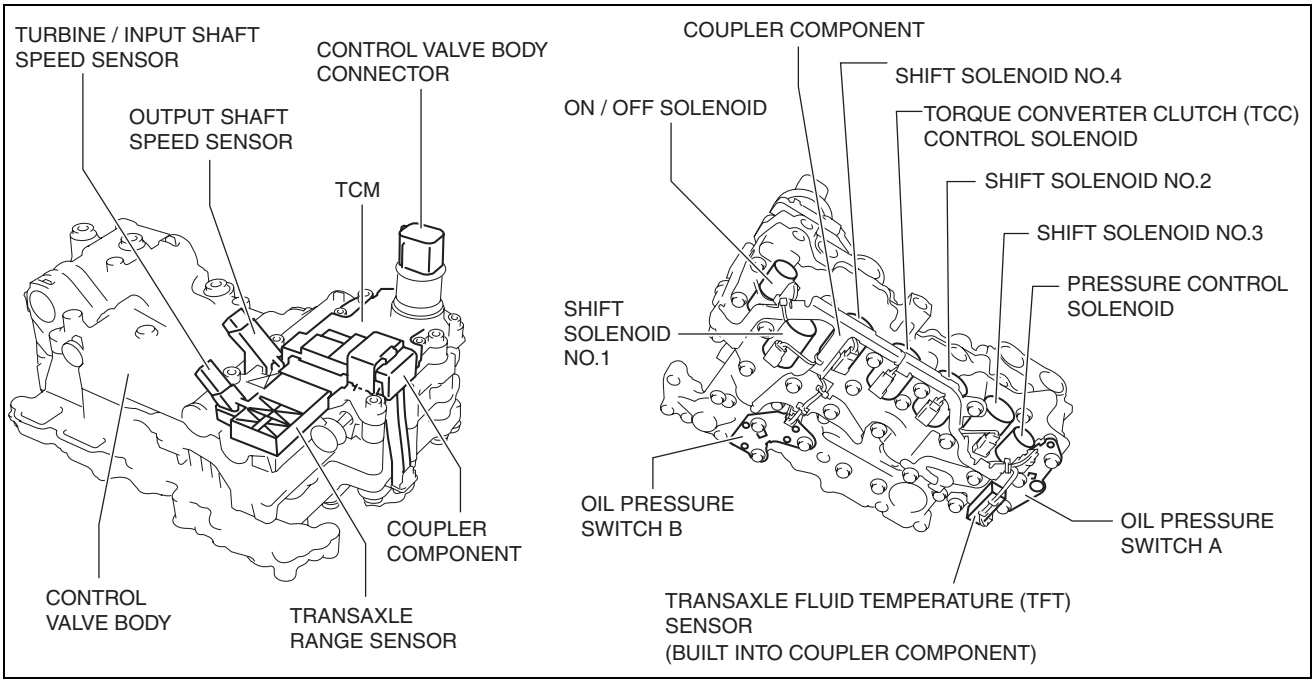
Purpose/Function

- A direct linear solenoid has been adopted for the solenoid valve which contributes to improved shift response, drive feel and reduced shift shock by the improved precision of the hydraulic pressure control.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction

- The control valve body consists of integrated hydraulic control related parts and electronic control related parts.
  - — The transaxle range sensor, output shaft speed sensor, turbine/input shaft speed sensor, and the control valve body connector are built into the TCM and integrated with the automatic transaxle.
  - — The transaxle fluid temperature (TFT) sensor, wiring harness, and the wiring harness cover bracket are built into the coupler component.
- If any of the component parts of the control valve body has a malfunction, the control valve body must be replaced because the replacement of a single part is not possible except for the following parts:
  - — On/off solenoid
  - — Oil pressure switch A, oil pressure switch B
  - — Coupler component (built into transaxle fluid temperature (TFT) sensor)



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TRANSAXLE RANGE SENSOR [FW6A-EL, FW6AX-EL]

id0517h2360200

Purpose/Function

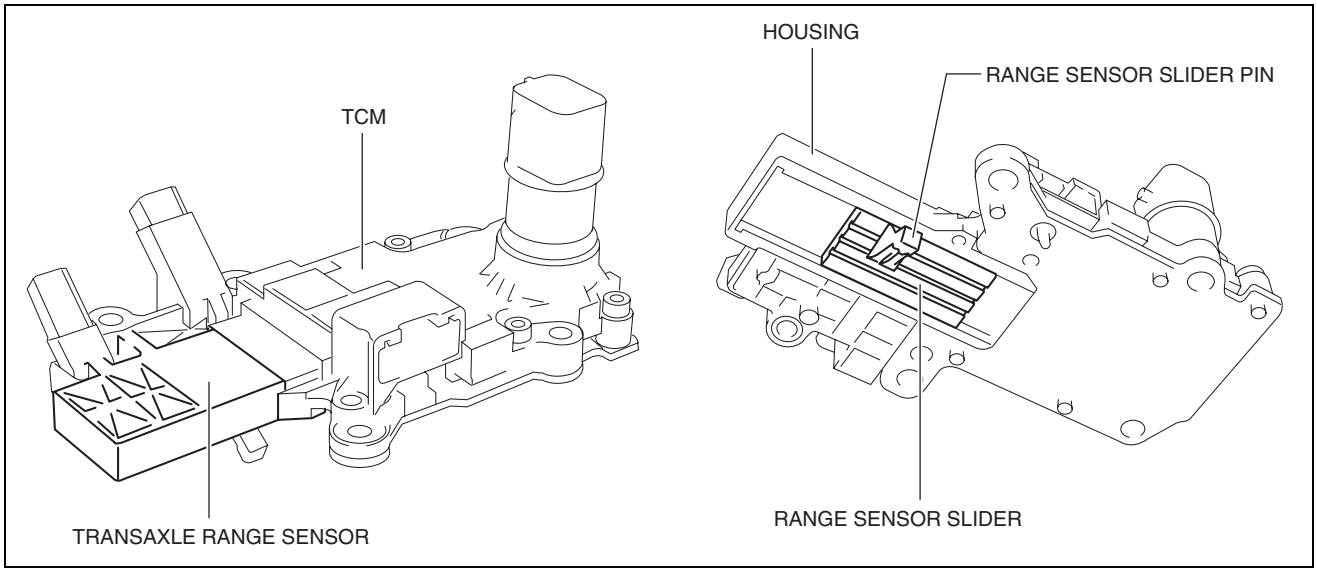
- The transaxle range sensor detects the position of the manual valve and selector lever.
- The transaxle range sensor signal is used for automatic shift control, manual shift control, TCC control, line pressure control, direct electric shift control, learning control, engine-transaxle integration control, and the on-board diagnostic system.

Construction

- The transaxle range sensor consists of a housing and slider which are installed to the control valve body as a part of the TCM.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The slider is assembled to the housing and the pin which projects from the slider and is connected to the manual valve.



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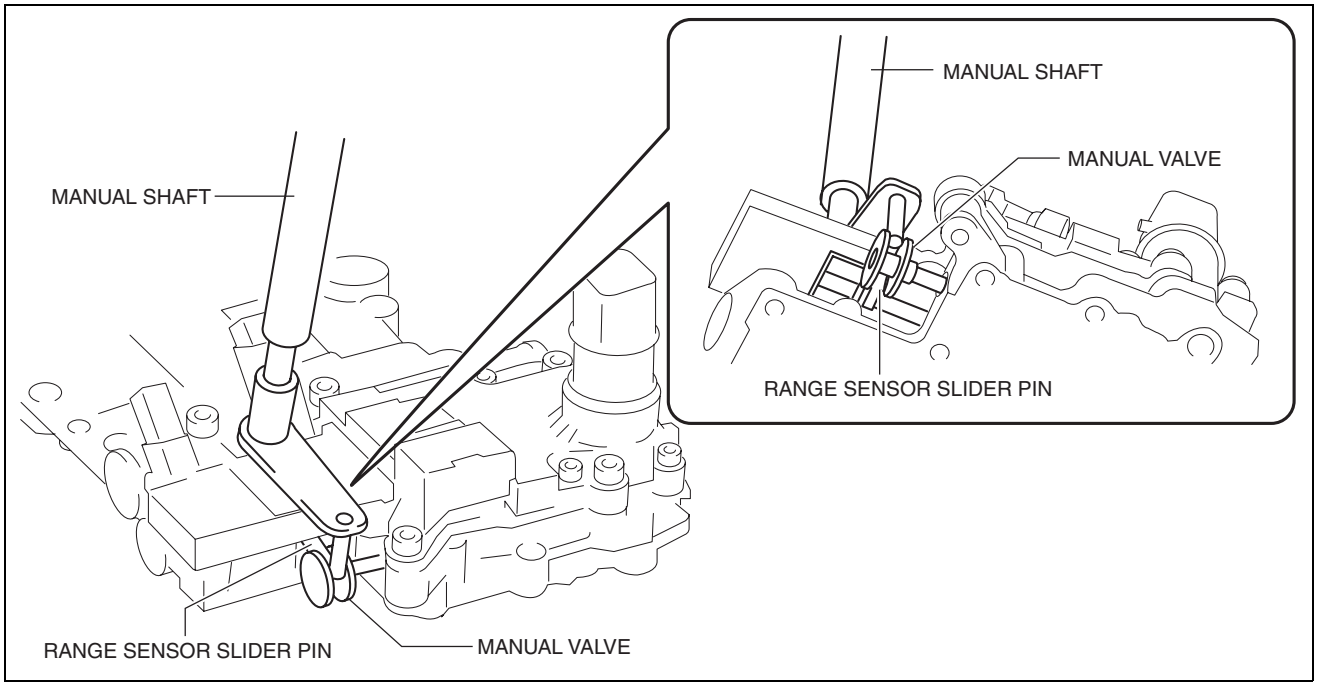
Operation

- When the selector lever is operated, the manual valve strokes via the manual shaft while the slider strokes via the slider pin.
- The transaxle range sensor detects the signal corresponding to the manual valve position according to the slider stroke. This signal is calculated in the TCM and detected as a range position.



am3uun0000242

M POSITION SWITCH [FW6A-EL, FW6AX-EL]

id0517h2360300

Purpose/Function

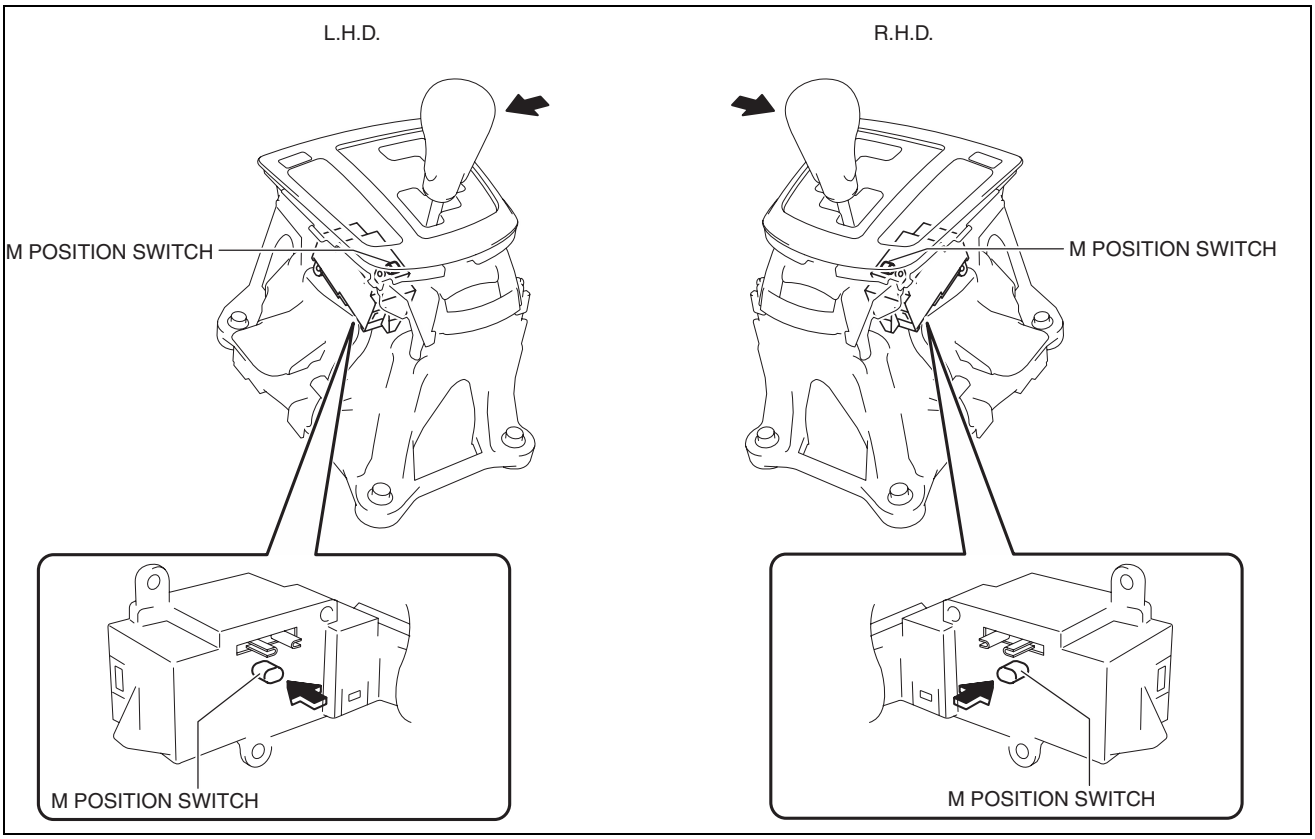
- The M position switch detects that the selector lever is in the M position.
- The M position switch signal is sent to the TCM via CAN, and is used for manual shift control and engine-transaxle integration control.

Construction

- The M position switch is installed to the selector lever.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The M position switch is an on/off type switch.



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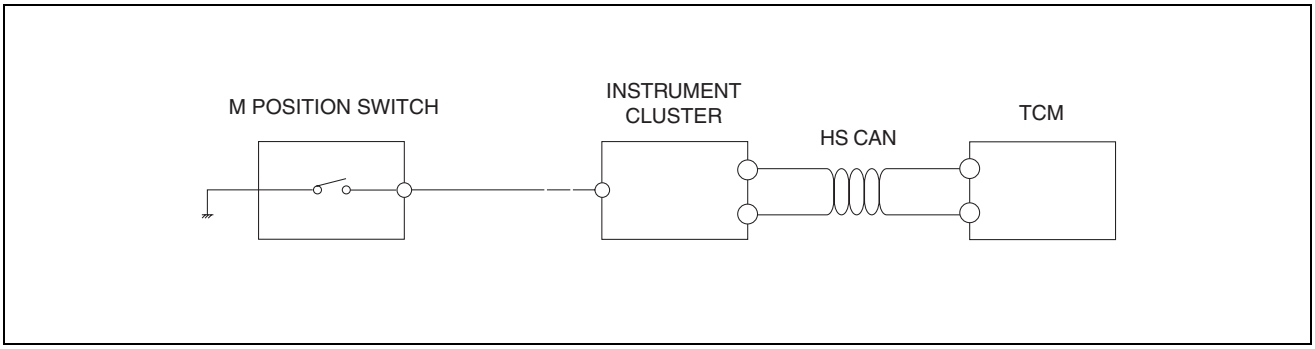
Operation

- When the selector lever is in the M position, the M position switch contact point closes.
- By opening and closing the M position switch contact point, the TCM detects that the selector lever is in the M position.



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UP SWITCH [FW6A-EL, FW6AX-EL]

id0517h2360400

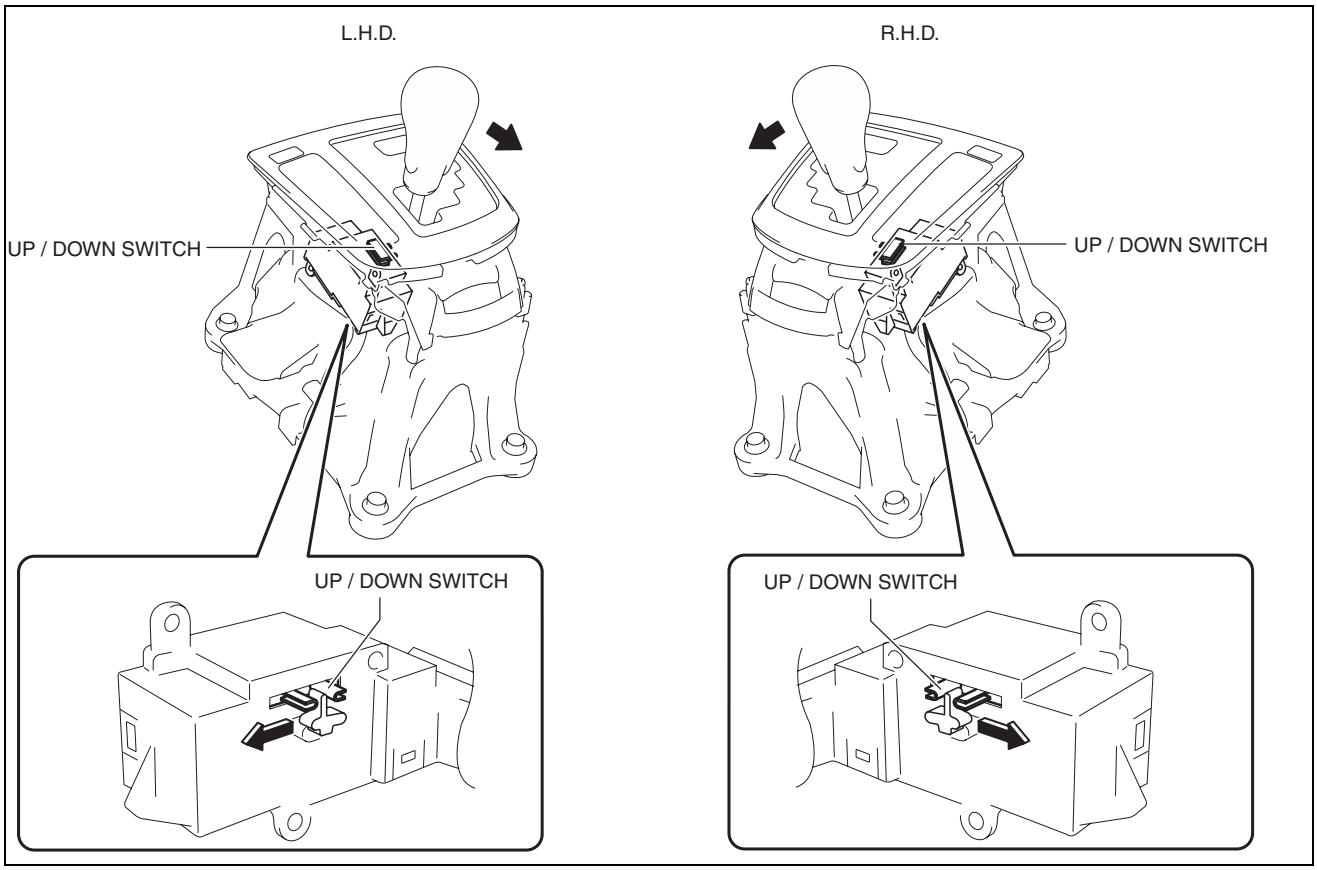
Purpose/Function

- The up switch detects the shift up operation of the selector lever.
- The up switch signal is sent to the TCM via CAN and is used for manual shift control and engine-transaxle integration control.

Construction

- The up switch is installed to the selector lever.

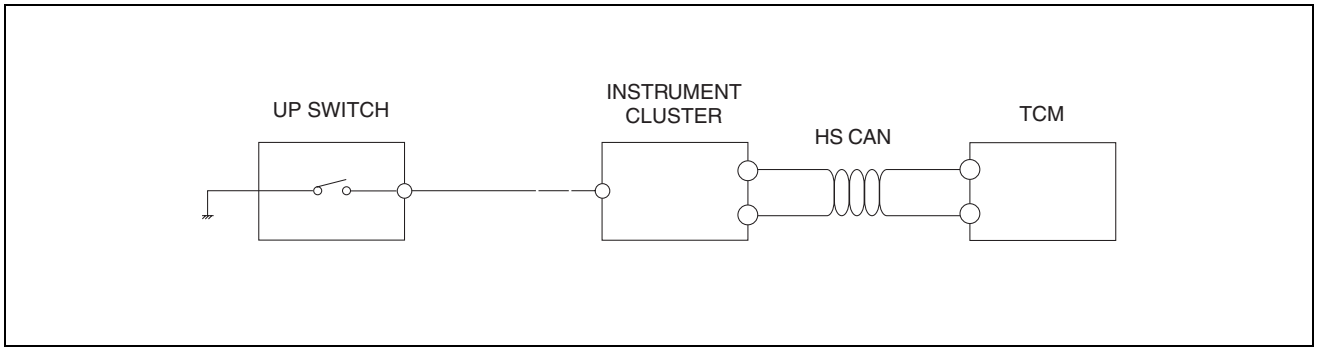
- The up switch is an on/off type switch.



ac5wzn00000918

Operation

- When the selector lever is in the shift up position (+), the up switch contact point closes.
- Based on the opening and closing of the up switch contact point, the TCM detects that the shift up has been operated.



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DOWN SWITCH [FW6A-EL, FW6AX-EL]

id0517h2360500

Purpose/Function

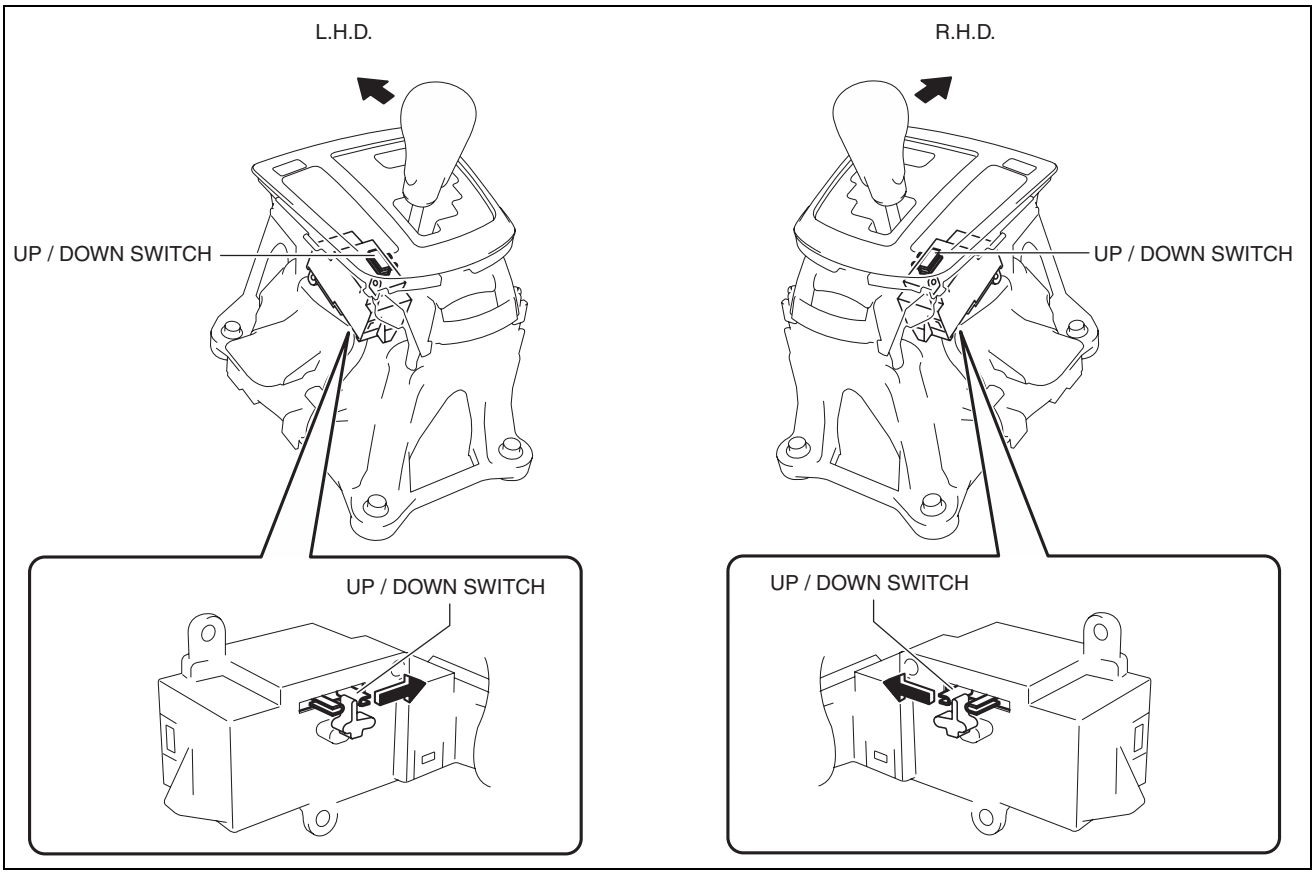
- The down switch detects the shift down operation of the selector lever.
- The down switch signal is sent to the TCM via CAN and is used for manual shift control and engine-transaxle integration control.

Construction

- The down switch is installed to the selector lever.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The down switch is an on/off type switch.



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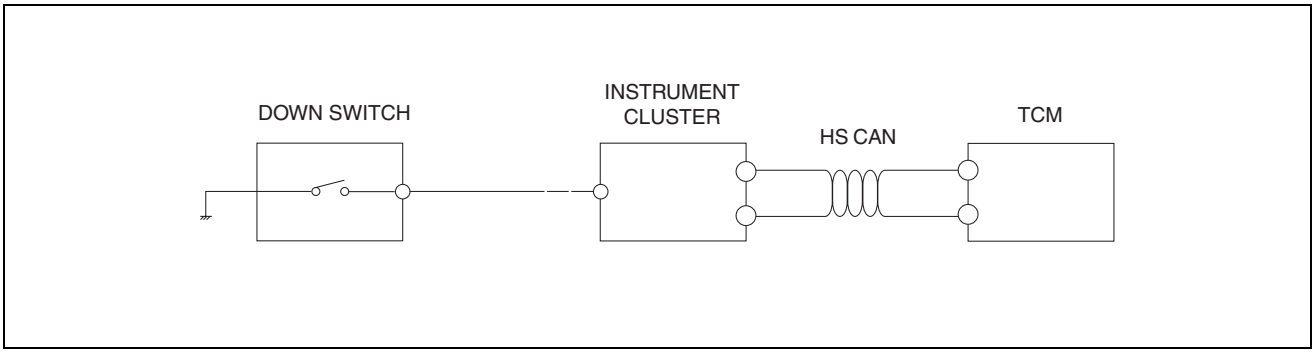
Operation

- When the selector lever is in the shift down position (-), the down switch contact point closes.
- Based on the opening and closing of the down switch contact point, the TCM detects that the shift down has been operated.



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TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR [FW6A-EL, FW6AX-EL]

id0517h2360600

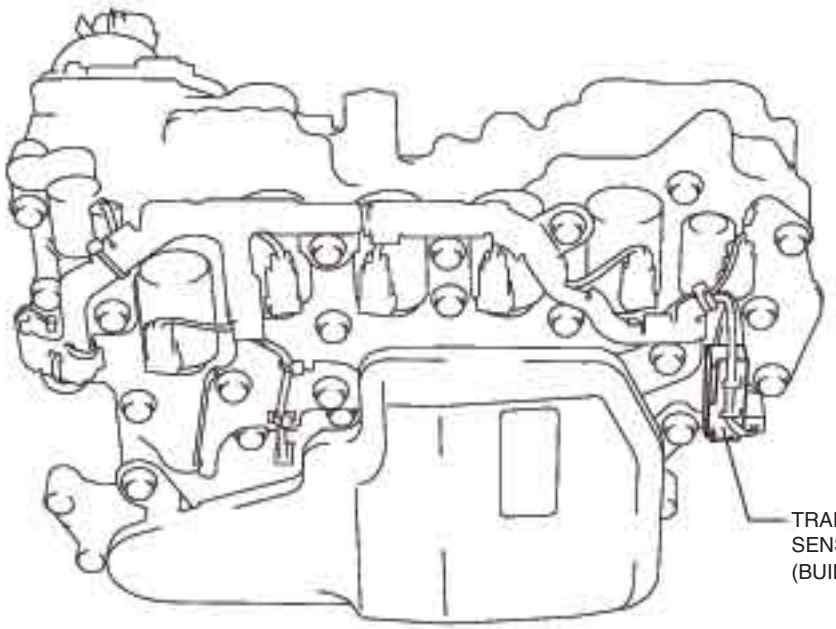
Purpose/Function

- The transaxle fluid temperature (TFT) sensor detects the ATF temperature in the oil pan.
- The transaxle fluid temperature (TFT) sensor signal is used for automatic shift control, TCC control, line pressure control, direct electric shift control, learning control, and the on-board diagnostic system.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction

- The transaxle fluid temperature (TFT) sensor is integrated with the coupler component and installed to the control valve body.



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Operation

- The transaxle fluid temperature (TFT) sensor outputs the signal corresponding to the ATF temperature in the oil pan to the TCM.

OIL PRESSURE SWITCH [FW6A-EL, FW6AX-EL]

id0517h2360700

Purpose/Function

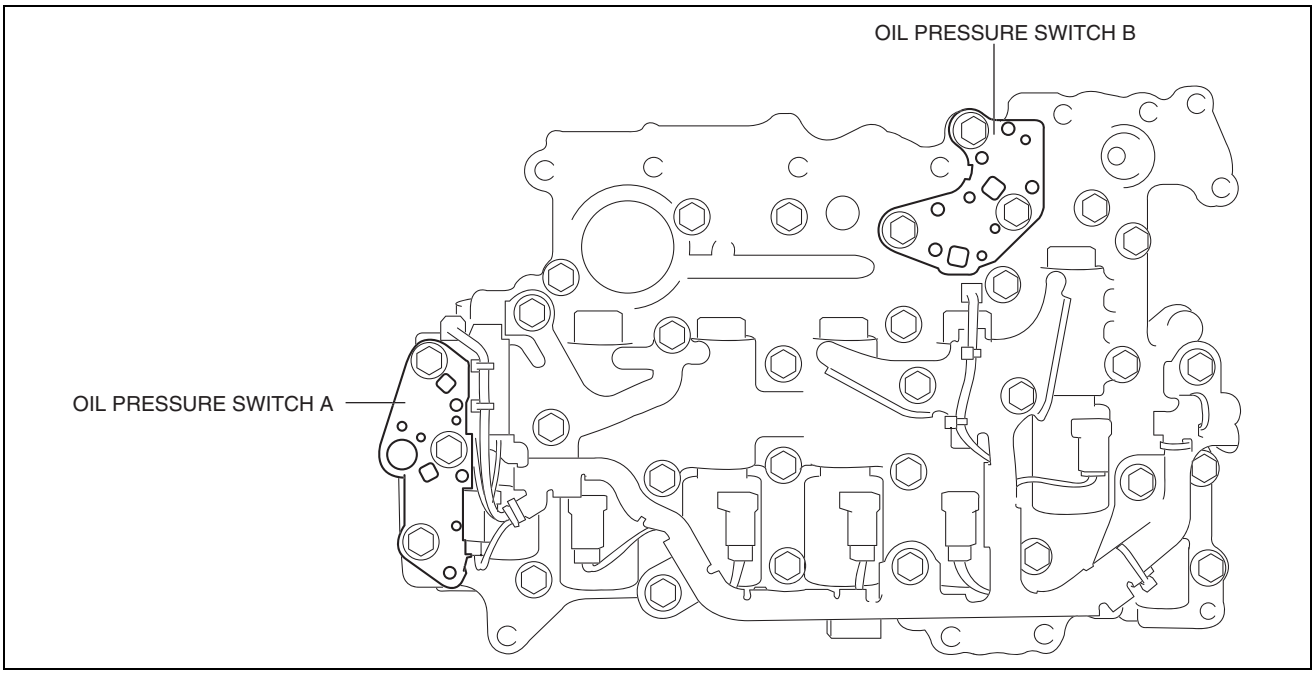
- The oil pressure switch detects the engagement pressures of the low clutch, 2-6 brake, R-3-5 brake, and the high clutch.
- The oil pressure switch signal is used for automatic shift control, manual shift control, TCC control, line pressure control, direct electric shift control, and the on-board diagnostic system.

Construction

- The oil pressure switch contacts the oil passages of the low clutch, 2-6 brake, R-3-5 brake, and the high clutch and is installed to the control valve body.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The oil pressure switch is an on/off type switch.



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Relation of oil pressure switch and engagement pressure detection targets

Oil pressure switch		Clutch/brake
Oil pressure switch A	Oil pressure switch No.2	2-6 brake
	Oil pressure switch No.3	R-3-5 brake
Oil pressure switch B	Oil pressure switch No.1	Low clutch
	Oil pressure switch No.4	High clutch

Operation

- When engagement pressure is supplied to the applicable clutch and brake, the oil pressure switch contact point closes.
- The TCM detects that clutch engagement pressure is supplied to the applicable clutch/brake by opening/closing the oil pressure switch contact point.

X: Contact point is closed

Oil pressure switch	1GR	2GR	3GR	4GR	5GR	6GR
Oil pressure switch No.1	X	X	X	X		
Oil pressure switch No.2		X				X
Oil pressure switch No.3			X		X	
Oil pressure switch No.4				X	X	X

TURBINE/INPUT SHAFT SPEED SENSOR, OUTPUT SHAFT SPEED SENSOR [FW6A-EL, FW6AX-EL]

id0517h2360800

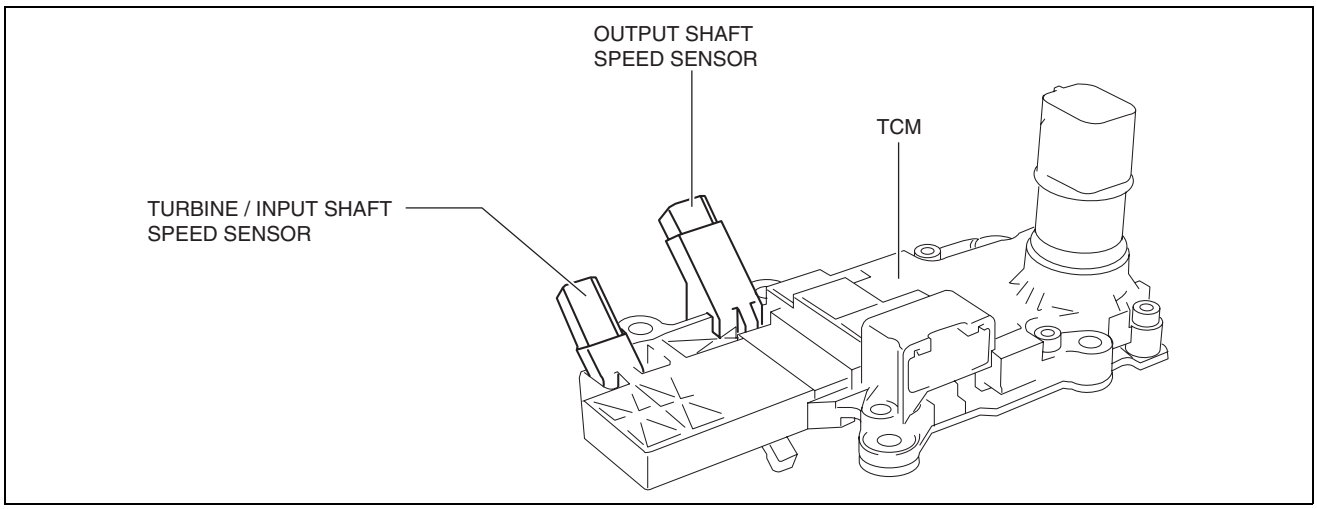
Purpose/Function

- The turbine/input shaft speed sensor detects the rotation speed of the input shaft (low clutch drum).
- The output shaft speed sensor detects the rotation speed of the output shaft (primary gear).
- The turbine/input shaft speed sensor and output shaft speed sensor signals are used for automatic shift control, manual shift control, and the on-board diagnostic system.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction

- The turbine/input shaft speed sensor and output shaft speed sensor are both integrated with the TCM and built-into the control valve body.



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Operation

- The turbine/input shaft speed sensor changes the output signal according to the rotation speed of the low clutch drum.
- The output shaft speed sensor changes the output signal according to the rotation speed of the primary gear.

PRESSURE CONTROL SOLENOID [FW6A-EL, FW6AX-EL]

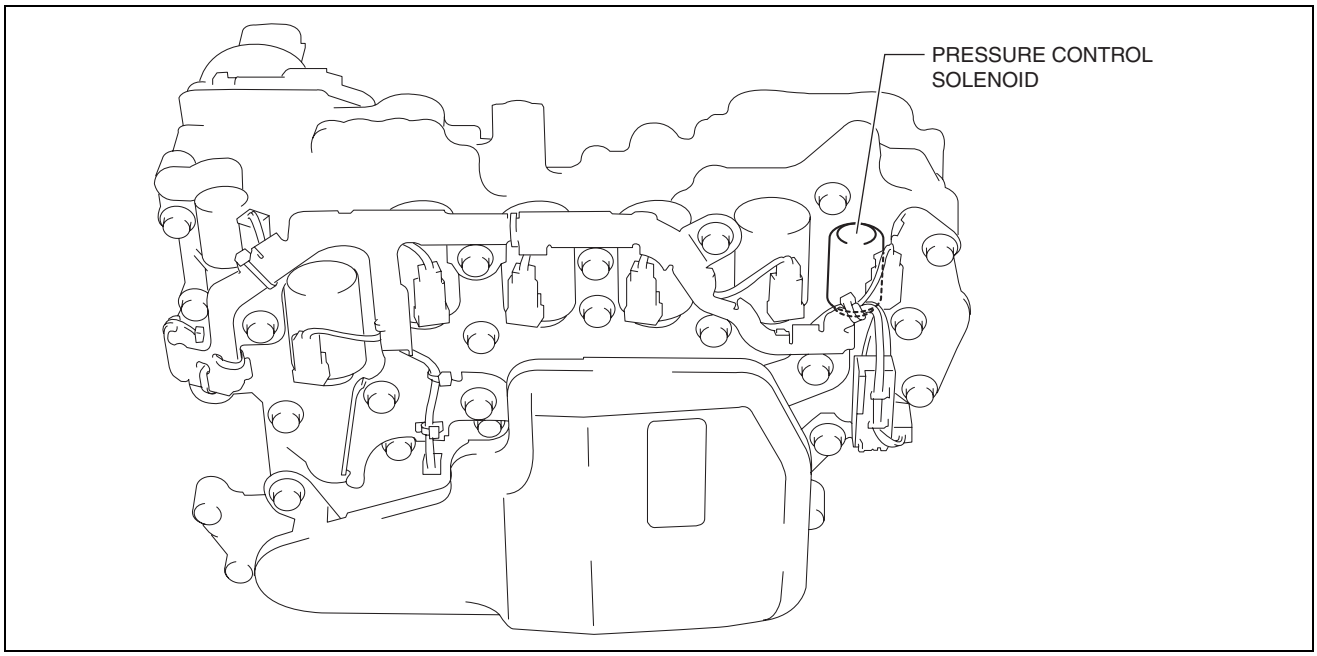
id0517h2361000

Purpose/Function

- The pressure control solenoid adjusts the pressure control solenoid pressure and controls the line pressure based on the control signal from the TCM.

Construction

- The pressure control solenoid is installed to the solenoid control valve body.
- The pressure control solenoid is a normal open-type linear solenoid.



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Operation

- Adjusts the pressure control solenoid pressure by increasing/decreasing the energization current to the pressure control solenoid according to the signal from the TCM.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

SHIFT SOLENOID NO.1 [FW6A-EL, FW6AX-EL]

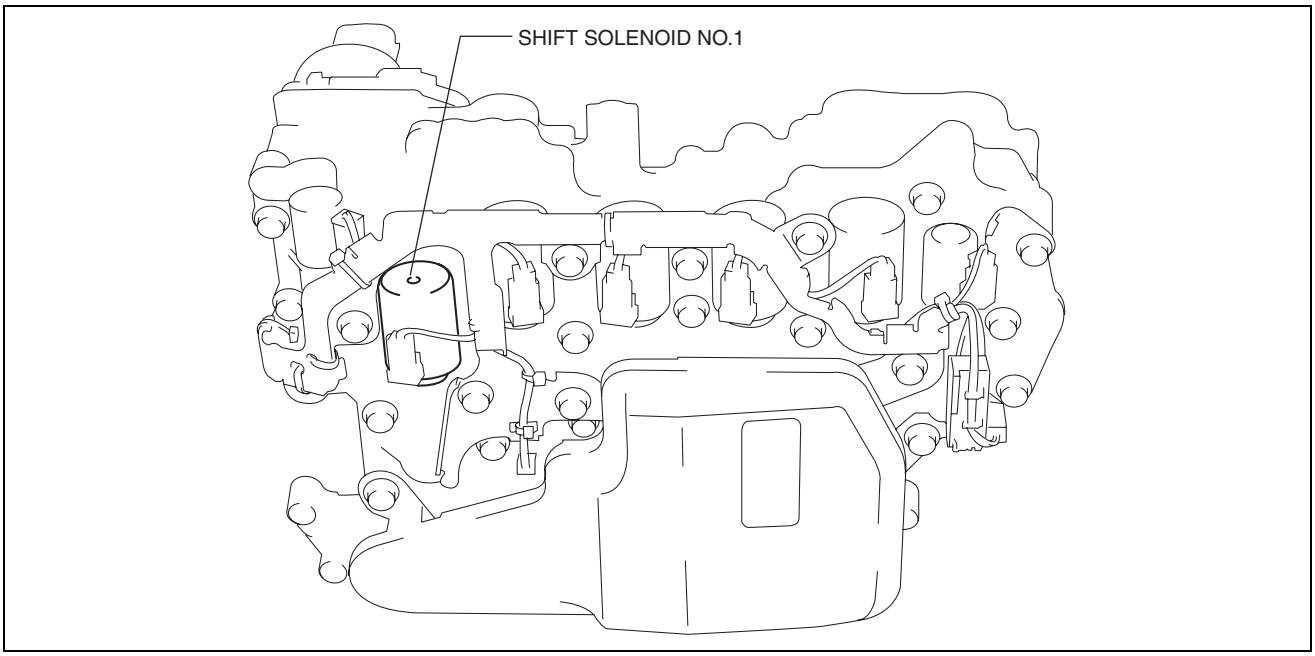
id0517h2361100

Purpose/Function

- Shift solenoid No.1 adjusts the hydraulic pressure in the low clutch circuit based on the current demand from the TCM according to the vehicle conditions.

Construction

- Shift solenoid No.1 is installed to the solenoid control valve body.
- Shift solenoid No.1 is a normal closed-type linear solenoid.



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Operation

- Adjusts the low clutch pressure by increasing/decreasing the energization current to shift solenoid No.1 according to the signal from the TCM.

SHIFT SOLENOID NO.2 [FW6A-EL, FW6AX-EL]

id0517h2361200

Purpose/Function

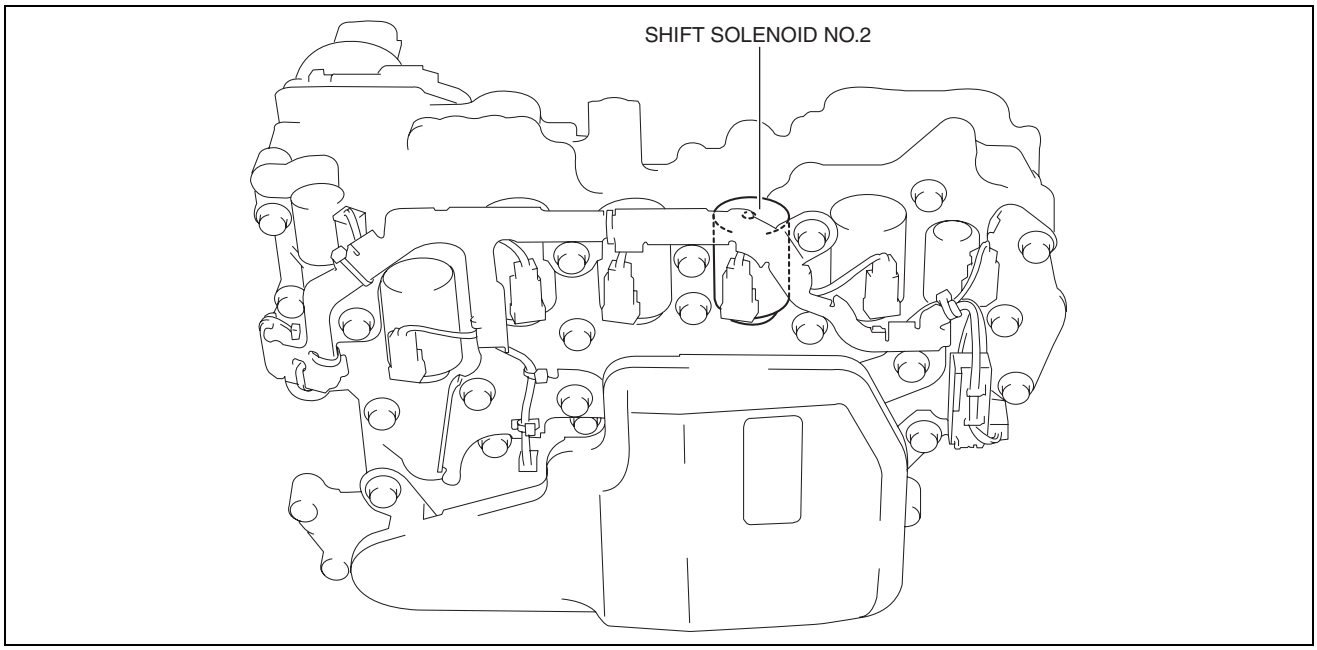
- Shift solenoid No.2 adjusts the hydraulic pressure in the 2-6 brake circuit based on the current demand from the TCM according to the vehicle conditions.

Construction

- Shift solenoid No.2 is installed to the solenoid control valve body.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- Shift solenoid No.2 is a normal closed-type linear solenoid.



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Operation

- Adjusts the 2-6 brake pressure by increasing/decreasing the energization current to shift solenoid No.2 according to the signal from the TCM.

SHIFT SOLENOID NO.3 [FW6A-EL, FW6AX-EL]

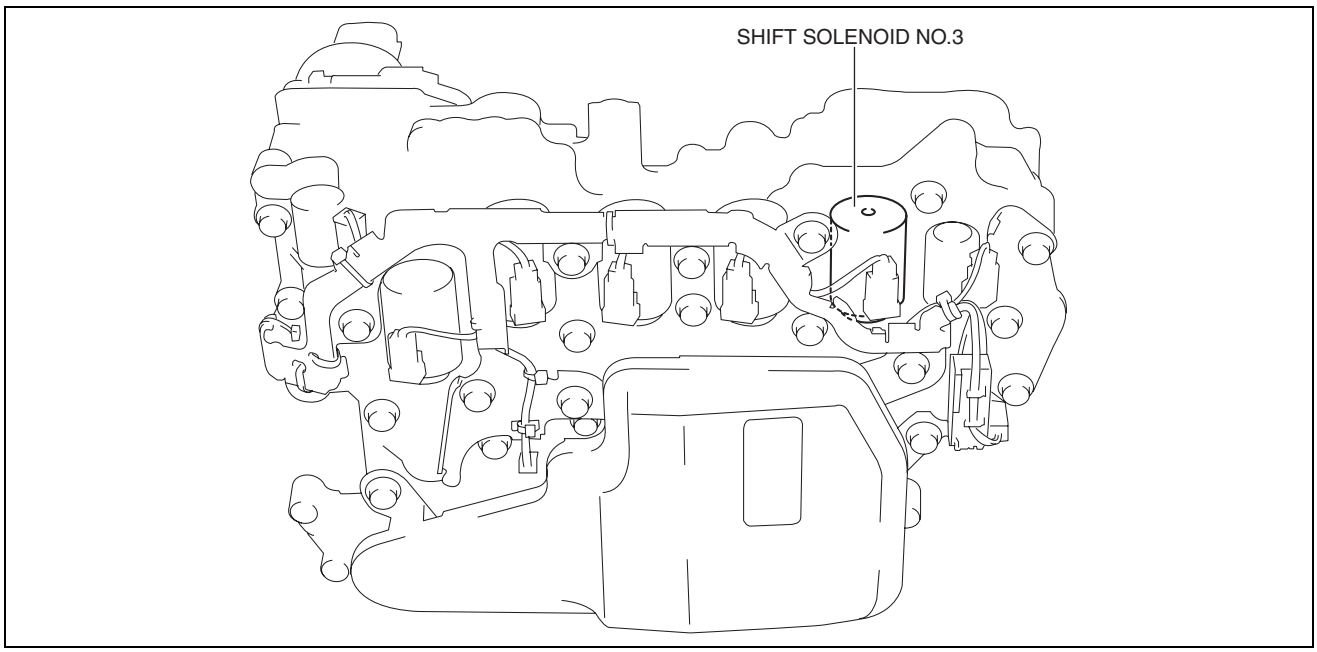
id0517h2361300

Purpose/Function

- Shift solenoid No.3 adjusts the hydraulic pressure in the R-3-5 brake circuit based on the current demand from the TCM according to the vehicle conditions.

Construction

- Shift solenoid No.3 is installed to the solenoid control valve body.
- Shift solenoid No.3 is a normal open-type linear solenoid.



am3uun0035

Operation

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- Adjusts the R-3-5 brake pressure by increasing/decreasing the energization current to shift solenoid No.3 according to the signal from the TCM.

SHIFT SOLENOID NO.4 [FW6A-EL, FW6AX-EL]

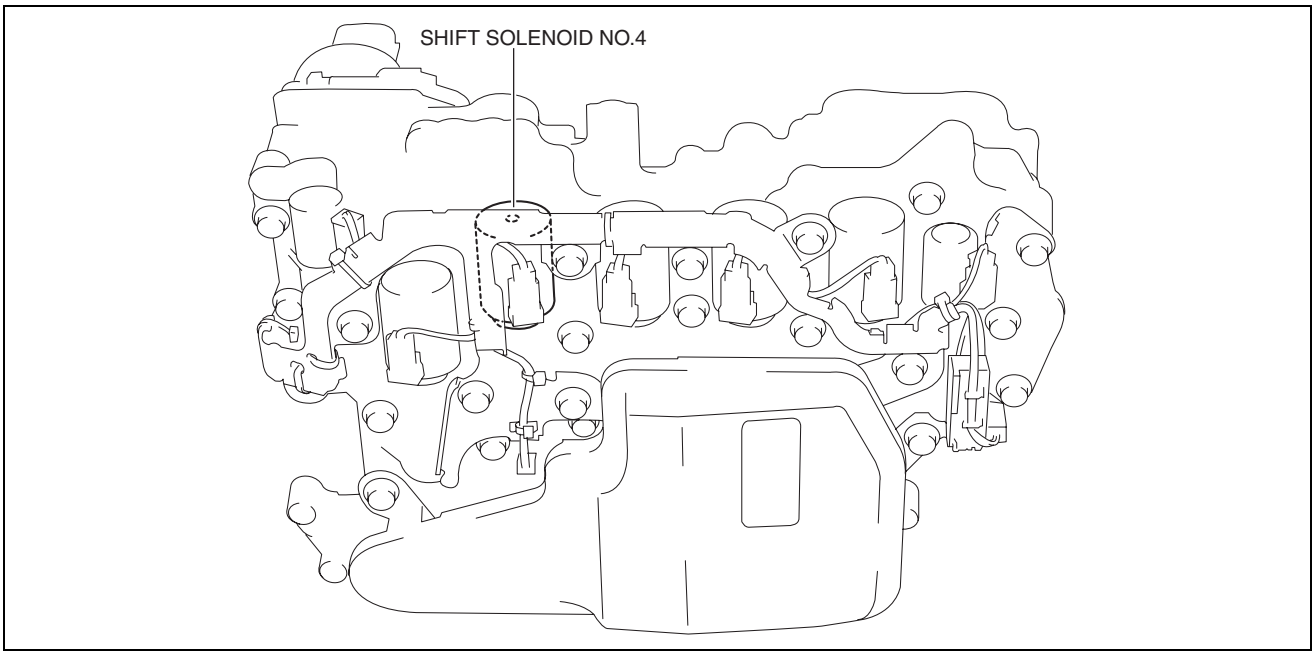
id0517h2361400

Purpose/Function

- Shift solenoid No.4 adjusts the hydraulic pressure in the high clutch circuit and the low and reverse brake circuit based on the current demand from the TCM according to the vehicle conditions.

Construction

- Shift solenoid No.4 is installed to the solenoid control valve body.
- Shift solenoid No.4 is a normal open-type linear solenoid.



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Operation

- Adjusts the high clutch pressure and the low and reverse brake pressure by increasing/decreasing the energization current to shift solenoid No.4 according to the signal from the TCM.

TORQUE CONVERTER CLUTCH (TCC) CONTROL SOLENOID [FW6A-EL, FW6AX-EL]

id0517h2361500

Purpose/Function

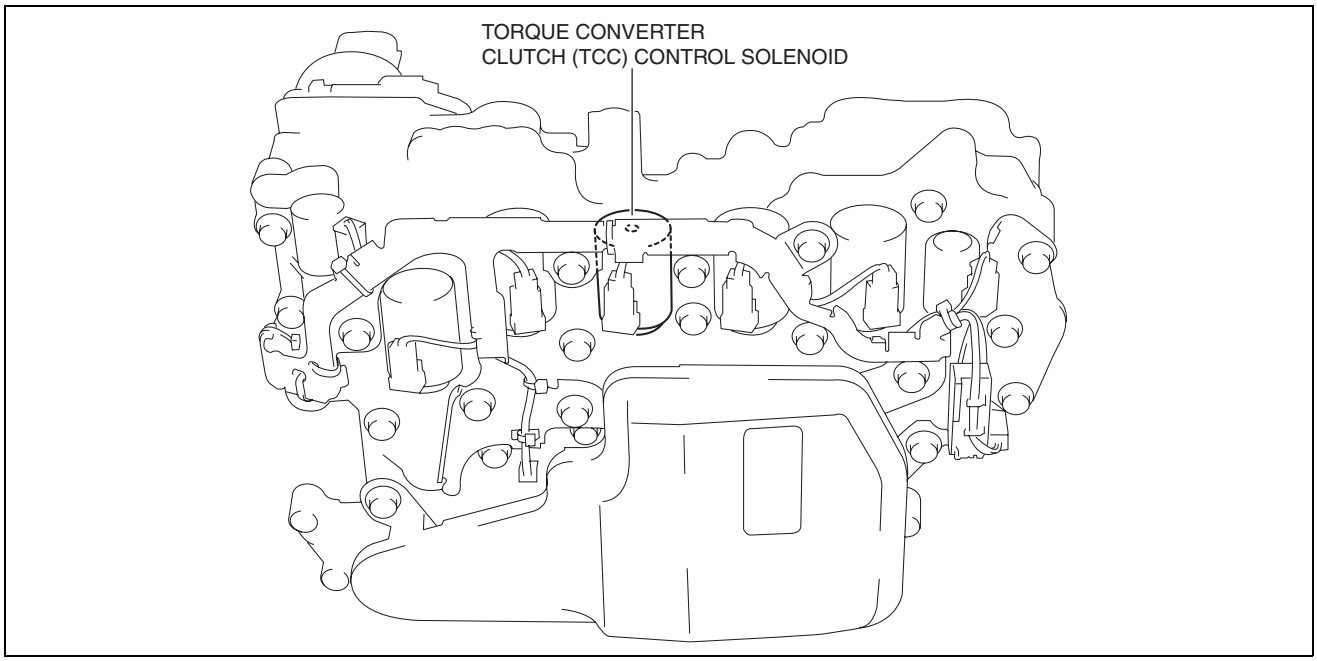
- The torque converter clutch (TCC) control solenoid adjusts the hydraulic pressure in the TCC control circuit based on the current demand from the TCM according to the vehicle conditions.

Construction

- The TCC control solenoid is installed to the solenoid control body.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

- The TCC control solenoid is a normal closed-type linear solenoid.



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Operation

- Adjusts the TCC control clutch pressure by increasing/decreasing the energization current to the TCC control solenoid according to the signal from the TCM.

ON/OFF SOLENOID [FW6A-EL, FW6AX-EL]

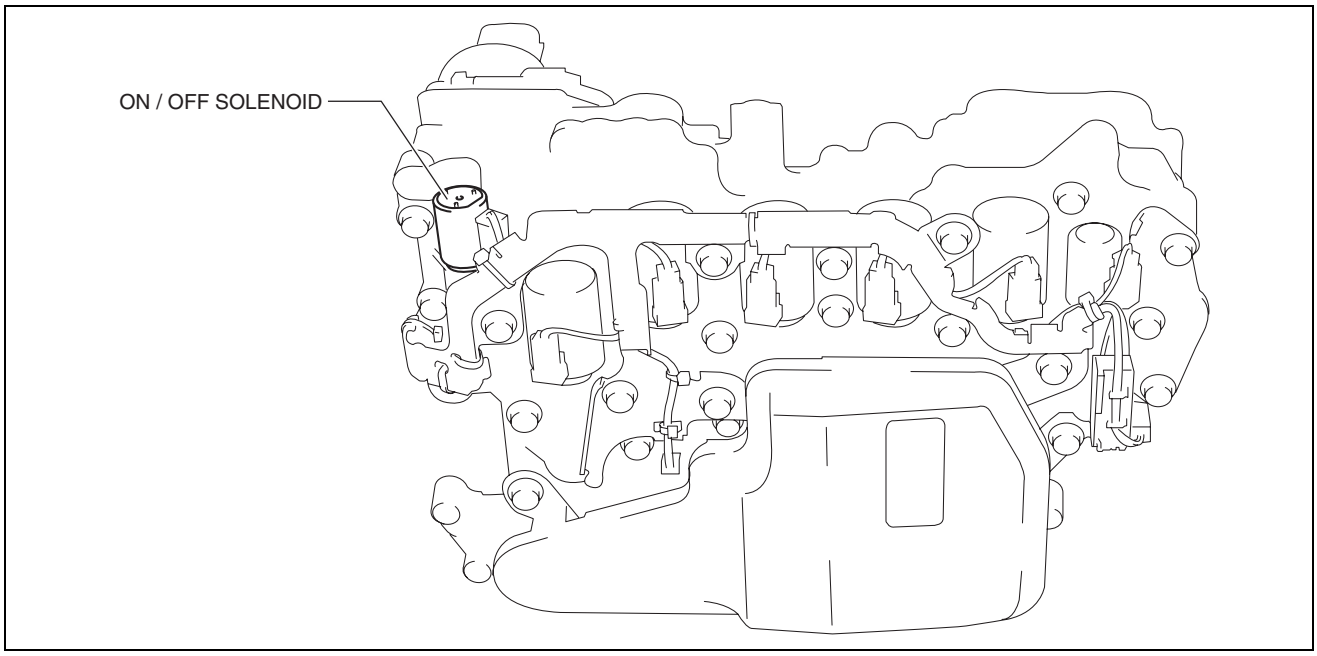
id0517h2361600

Purpose/Function

- The on/off solenoid performs switching of the shift valve in the control valve body according to the vehicle conditions.

Construction

- The on/off solenoid is installed to the solenoid control valve body.
- The on/off solenoid is a normal open-type on/off solenoid.



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AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Operation
Non-energization (OFF)
- When the on/off solenoid is off, the supply port in the solenoid opens. As a result, hydraulic pressure is supplied to operate the shift valve.

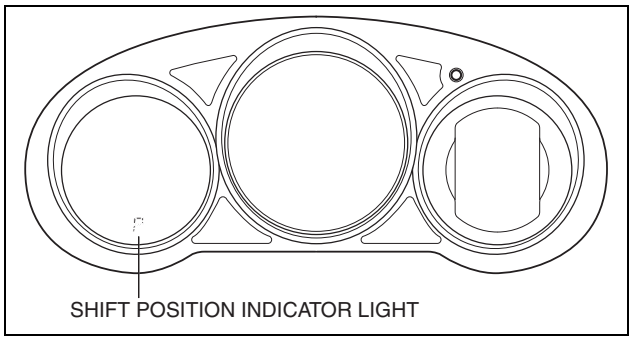
Energized (ON)
- When the on/off solenoid is on, the drain port in the solenoid opens. As a result, hydraulic pressure which operates the shift valve is drained.

SHIFT POSITION INDICATOR LIGHT [FW6A-EL, FW6AX-EL]

id0517h2361700

Purpose/Function
- The shift position indicator light indicates the selector lever position.

Construction
- The shift position indicator light is built into the instrument cluster.



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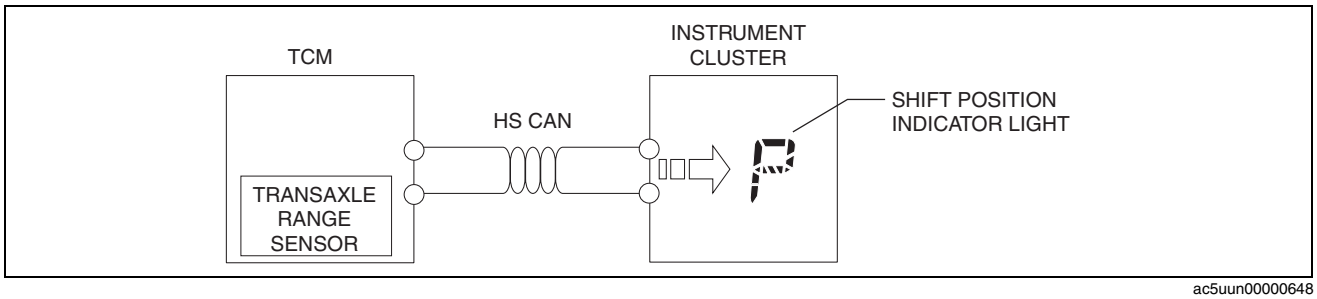
Operation
- The TCM sends a shift position indicator light illumination request signal to the instrument cluster via CAN based on the signal from the integrated transaxle range sensor signal received via CAN.



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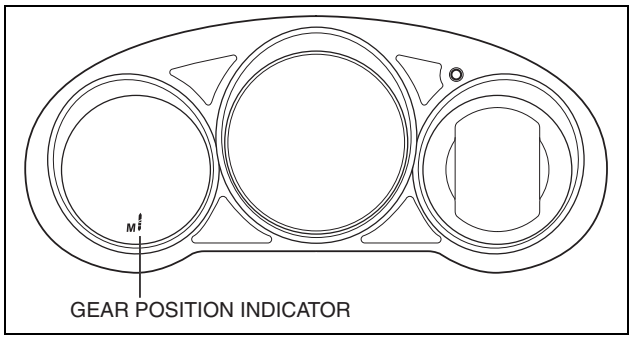
GEAR POSITION INDICATOR [FW6A-EL, FW6AX-EL]

id0517h2361800

Purpose/Function
- The gear position indicator illuminates while under manual shift control and displays the gear number while driving.

Construction
- The gear position indicator is built into the instrument cluster.



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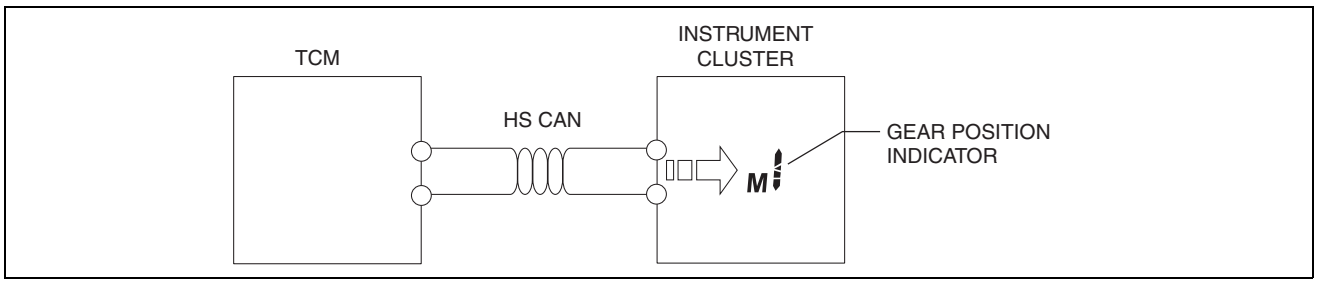
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Operation

- The TCM sends a gear position indicator illumination/flash request signal to the instrument cluster based on the signal from the M position switch, the up switch and the down switch via the CAN.



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- If the shift down operation is inhibited during manual shift control, the TCM flashes the gear position indicator 2 times. As a result, the driver is notified that the shift down operation has been canceled.
- If the ATF temperature is 132 °C {270 °F} or more while in manual shift control, the TCM turns the gear position indicator off and switches to automatic shift control to reduce the transaxle load. When the ATF temperature is 122 °C {252 °F} or less for a specified time, manual shift control is enabled and the gear position indicator is re-illuminated.

AUTOMATIC TRANSAXLE WARNING LIGHT [FW6A-EL, FW6AX-EL]

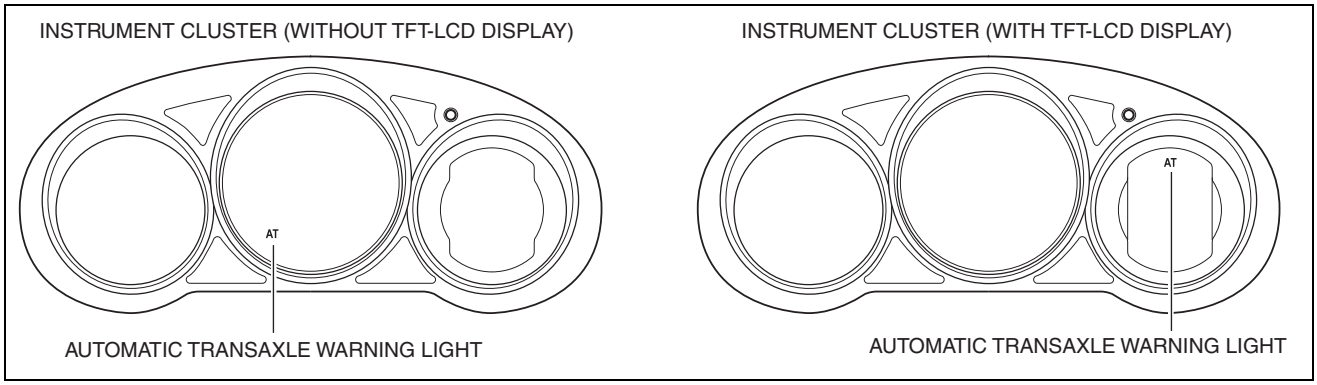
id0517h2361900

Purpose/Function

- The automatic transaxle warning light illuminates when the transaxle has malfunction.

Construction

- The automatic transaxle warning light is built into the instrument cluster.



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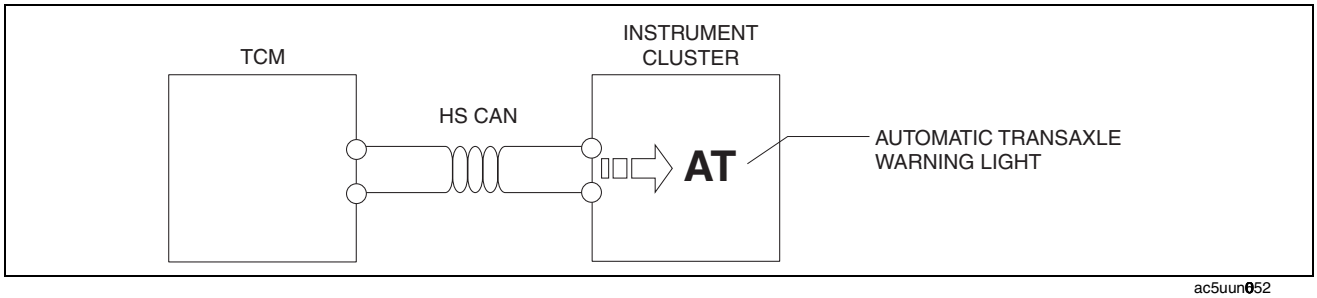
Operation

- If the transmission has a malfunction, the TCM sends an automatic transaxle warning light illumination request signal to the instrument cluster.



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- The TCM illuminates the automatic transaxle warning light for **approx. 2 s** after the ignition is switched ON to perform a bulb check of the automatic transaxle warning light. (Without TFT-LCD display)

TCM [FW6A-EL, FW6AX-EL]

id0517h2362000

Purpose/Function

- The TCM detects the vehicle conditions and performs calculations and processing based on input information from each type of sensor and switch.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

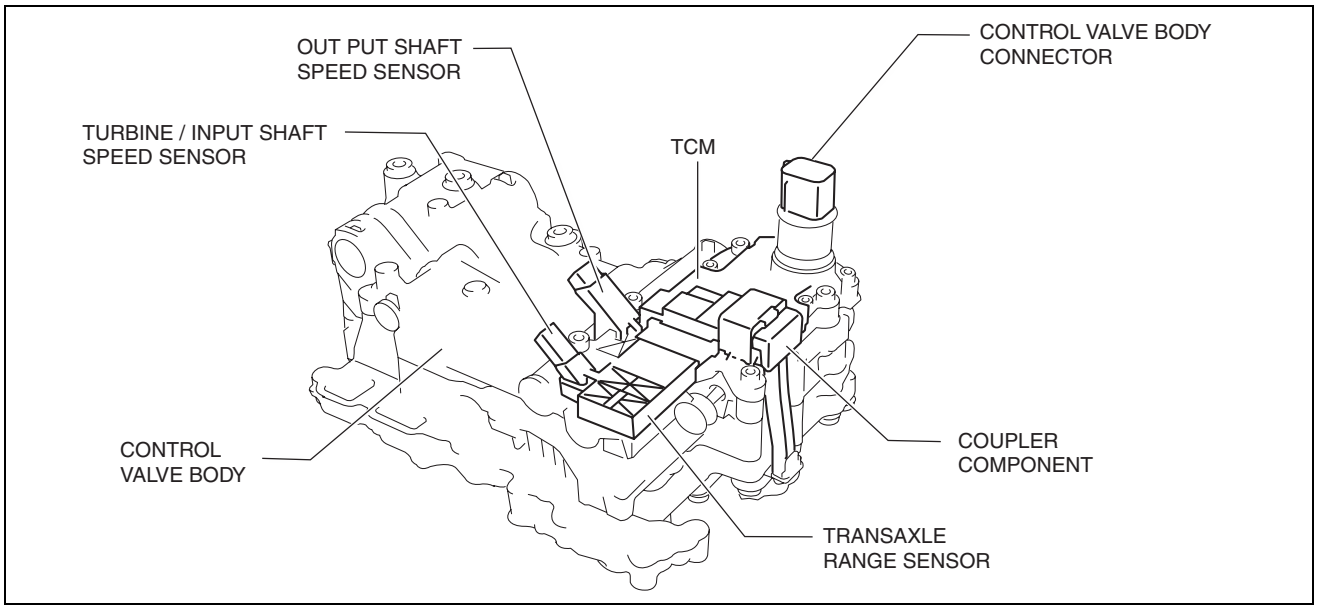
- Outputs control signals to each solenoid valve so that each type of control is optimally implemented according to the vehicle conditions.

Function Table

Control item				Main control content
Shift point control	Automatic shift control (D position)	Driving mode	Normal mode	• Mode selection during normal driving • Performs automatic shift corresponding to vehicle speed and accelerator pedal depression amount
			Active Adaptive Shift (AAS) mode	• Unnecessary shift up is suppressed for several seconds by maintaining the gear corresponding to the operation speed at which the accelerator pedal is released • The optimum gear on the low vehicle-speed side is selected and shift down is executed corresponding to the operation force at which the brake pedal is depressed • During cornering, shift up is suppressed in preparation for acceleration after cornering • In regions of high elevation, the optimum gear is selected corresponding to the environment • The slope is estimated in the TCM to select the appropriate gear for ascent and descent
			High ATF temperature mode	• Controls engine torque when the ATF temperature is high
	Manual shift control (M position)			• When M position is selected, manual shifting is prioritized according to the driver's shift up/shift down operation.
Shift pressure control	Line pressure control			• Controls line pressure with high accuracy and fine control corresponding to engine load conditions and vehicle driving conditions
	Direct electric shift control			• Performs direct, electronic control of clutch engagement pressure appropriate to engine load conditions and vehicle driving conditions
	Learning control			• Learns engine performance changes and transaxle deterioration over time to optimally correct clutch engagement pressure
Torque converter clutch (TCC) control				• Based on adoption of full range TCC control, active TCC control directly after acceleration from stop • By gradually engaging/disengaging TCC piston, shock during operation is reduced • Implements TCC control when accelerator pedal is fully closed for improved fuel economy and emission performance
Engine-transaxle integration control				• Optimally controls engine output torque when shifting • Calculates optimum clutch engagement pressure according to engine output torque
On-board diagnostic system				• Main part of transaxle control includes self-diagnosis function. In case of malfunction, automatic transmission warning light illuminates to alert driver, and DTC is stored in TCM • When transaxle malfunction is determined resulting from on-board diagnostic test, system control is switched to prevent any dangerous situation while driving

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction



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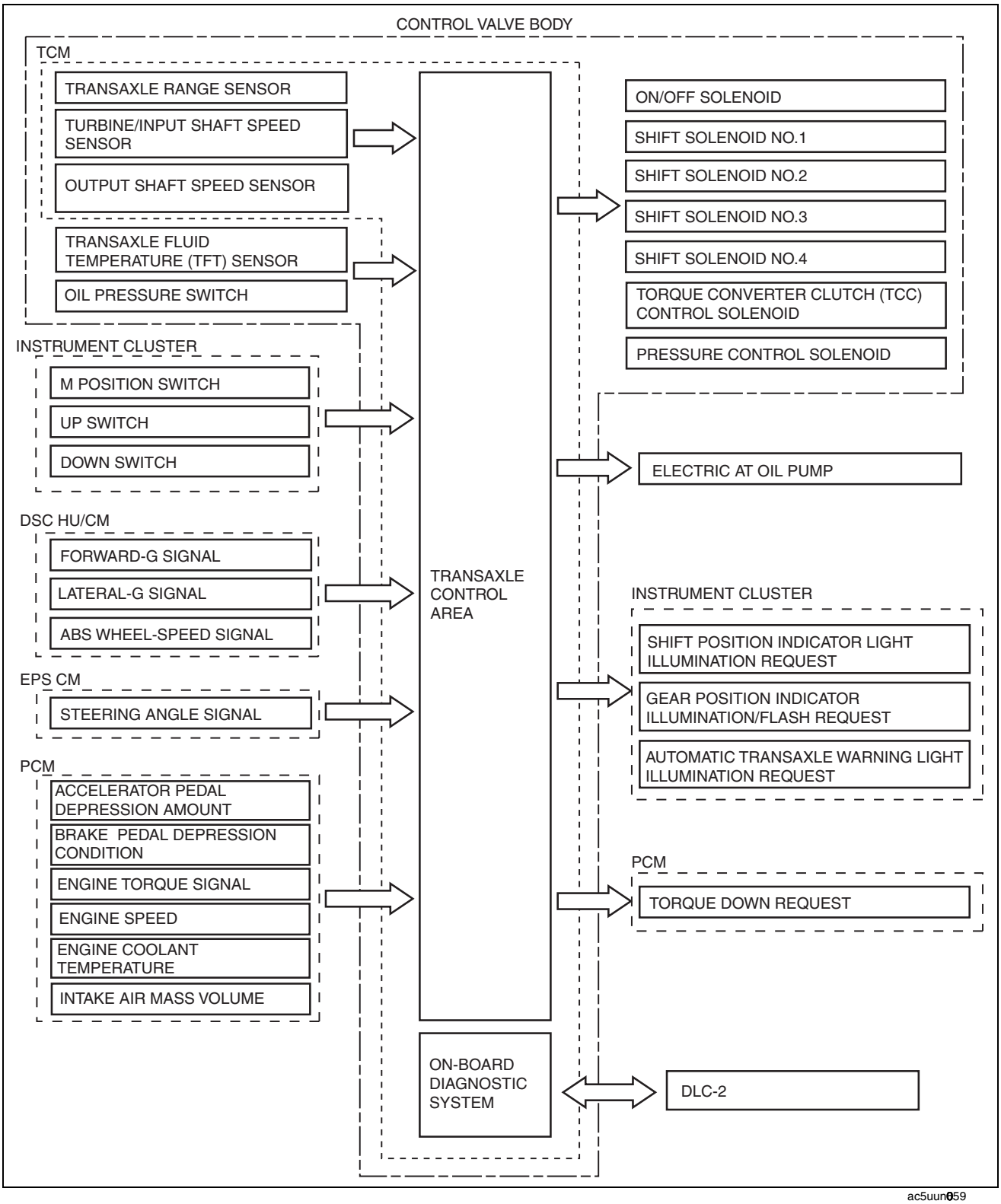
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Block diagram



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AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Operation
Correlation between control and input/output parts

x : AVAILABLE

INPUT/OUTPUT PART \ CONTROL ITEM			SHIFT POINT CONTROL				SHIFT PRESSURE CONTROL					
			AUTOMATIC SHIFT CONTROL (D POSITION)									
			NORMAL MODE	ACTIVE ADAPTIVE SHIFT (AAS) MODE	HIGH ATF TEMPERATURE MODE	MANUAL SHIFT CONTROL (M POSITION)	LINE PRESSURE CONTROL	DIRECT ELECTRIC SHIFT CONTROL	LEARNING CONTROL	TORQUE CONVERTER CLUTCH (TCC) CONTROL	ENGINE-TRANSAXLE INTEGRATION CONTROL	ON-BOARD DIAGNOSTIC SYSTEM
INPUT	TCM	TANSAXLE RANGE SENSOR	x	x	x	x	x	x	x	x	x	x
		TURBINE/INPUT SHAFT SPEED SENSOR	x	x		x	x	x	x	x		x
		OUTPUT SHAFT SPEED SENSOR	x	x		x	x	x		x		x
		TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR			x		x	x	x	x		x
		OIL PRESSURE SWITCH	x	x	x	x	x	x		x		x
	PCM	ACCELERATOR PEDAL DEPRESSION AMOUNT	x	x		x	x	x		x		x
		BRAKE PEDAL DEPRESSION CONDITION	x	x						x		x
		ENGINE TORQUE SIGNAL		x		x	x	x	x	x	x	x
		ENGINE SPEED		x			x	x	x	x	x	x
		ENGINE COOLANT TEMPERATURE								x		x
		INTAKE AIR MASS VOLUME										x
	INSTRUMENT CLUSTER	M POSITION SWITCH				x					x	
		UP SWITCH				x					x	
		DOWN SWITCH				x					x	
	DSC HU/CM	FORWARD-G SIGNAL		x								
		LATERAL-G SIGNAL		x								
		ABS WHEEL-SPEED SIGNAL		x								x
	EPS CM	STEERING ANGLE SIGNAL		x								
OUTPUT	AUTOMATIC TRANSAXLE	ON/OFF SOLENOID	x	x	x	x			x			x
		SHIFT SOLENOID NO.1	x	x	x	x		x	x			x
		SHIFT SOLENOID NO.2	x	x	x	x		x	x			x
		SHIFT SOLENOID NO.3	x	x	x	x		x	x			x
		SHIFT SOLENOID NO.4	x	x	x	x		x	x			x
		TORQUE CONVERTER CLUTCH (TCC) CONTROL SOLENOID	x	x	x	x		x	x	x		x
		PRESSURE CONTROL SOLENOID	x	x	x	x	x	x	x	x		x
	INSTRUMENT CLUSTER	SHIFT POSITION INDICATOR LIGHT ILLUMINATION REQUEST	x	x	x	x						
		GEAR POSITION INDICATOR ILLUMINATION/FLASH REQUEST				x						
		AUTOMATIC TRANSAXLE WARNING LIGHT ILLUMINATION REQUEST			x							x
INPUT/OUTPUT (CAN)			x	x	x	x	x	x		x	x	x

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AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

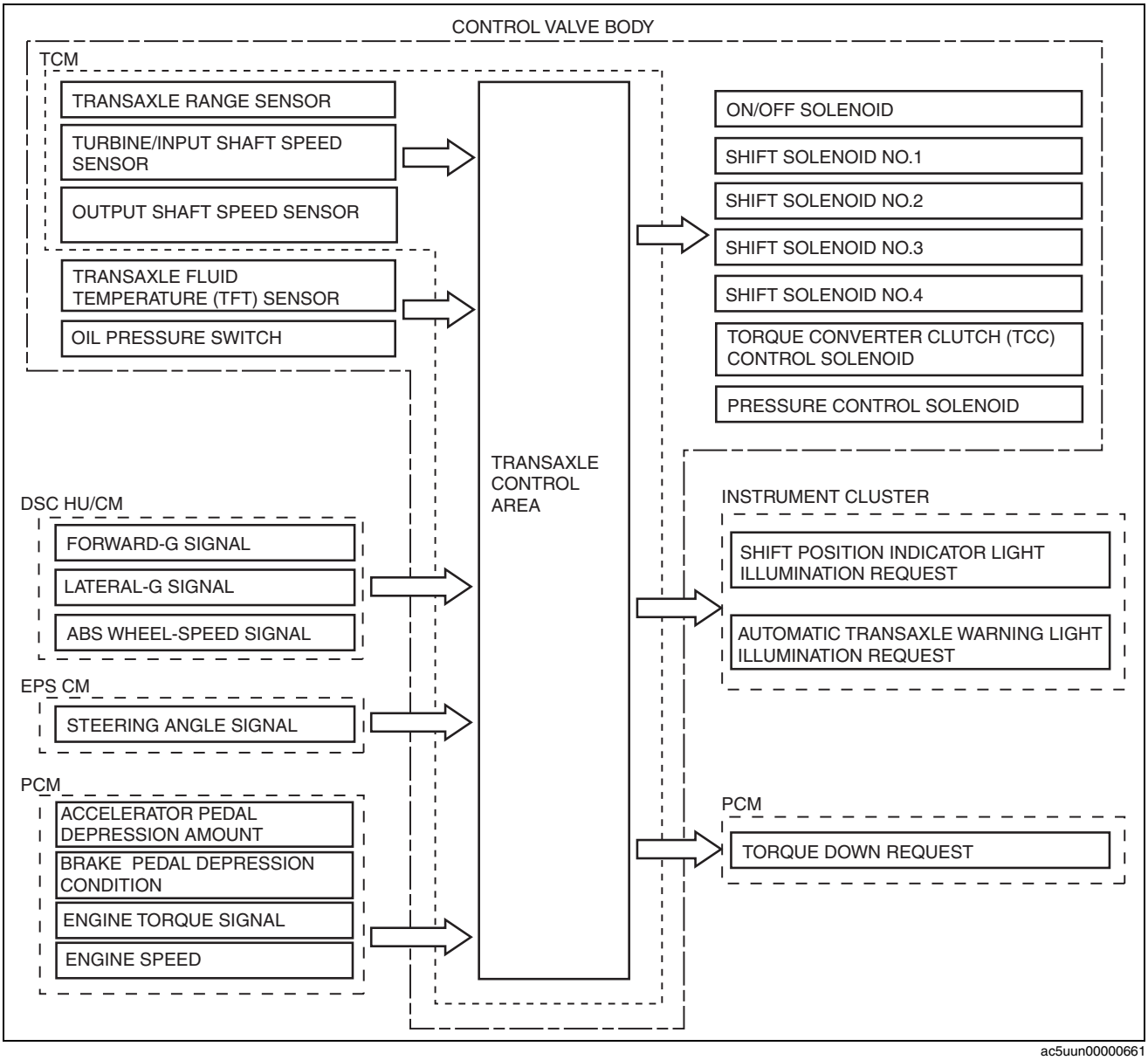
SHIFT POINT CONTROL (AUTOMATIC SHIFT CONTROL) [FW6A-EL, FW6AX-EL]

id0517h2362100

Outline

- The TCM implements auto shift control according to the vehicle speed and accelerator pedal depression amount while in D position.
- When the vehicle is stopped with the selector lever is in the D position and the brake pedal depressed, the neutral idle control is performed which internally controls the automatic transaxle to be in the neutral condition while the selector lever is in the D position. When the brake pedal is being released, the clutch is engaged immediately and the automatic transaxle returns to the normal D position condition.
- When implementing the automatic shift control, the TCM determines the driving conditions based on each input signal and selects the drive mode appropriate to the driving conditions. In addition, information such as torque and gear changes is exchanged via PCM and CAN communication and control is performed so as to achieve optimum drive force according to the driving scenario.

Construction



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Operation

Driving range determination

- If a D position signal is input and an M position signal is not input, the TCM implements auto shift control.

Driving mode determination

- For the auto shift control, NORMAL mode is usually selected, however it automatically switches to driving mode depending on the driving conditions.

— AAS (Active Adaptive Shift) mode: Automatically controls the optimum shift point according to the road conditions and the driver operation.
— High ATF temperature mode: When the ATF temperature rises to a high temperature, the engine torque is restricted so that the increase in ATF temperature is suppressed to protect the transaxle.

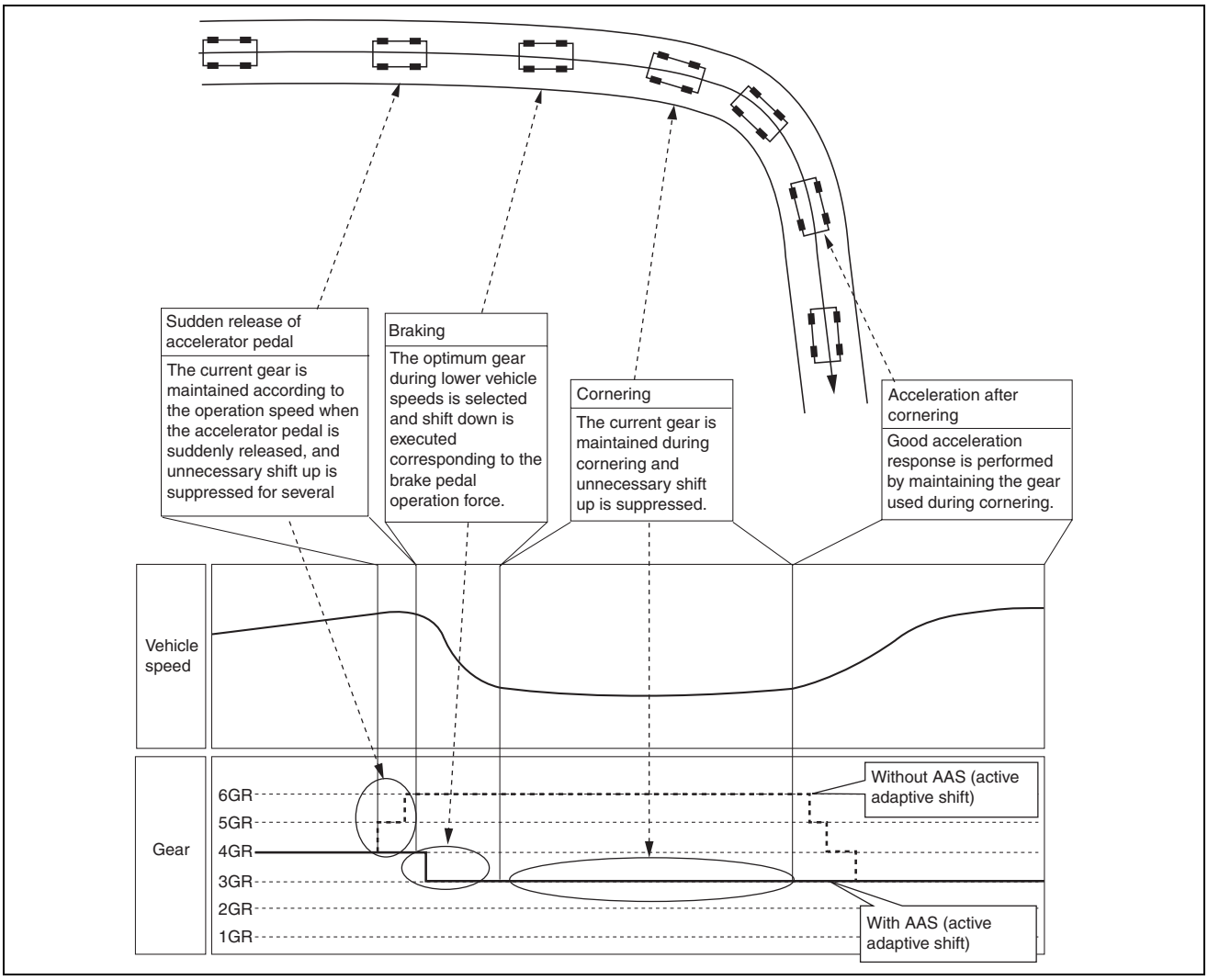
AAS (Active Adaptive Shift) mode operation

- Accelerator pedal fully closed suddenly and returned
  — When the accelerator pedal is fully closed and returned at a certain speed or more, shift-up is inhibited for specified time to improve speed control and reacceleration performance.
- Brake is strongly depressed
  — When decelerating at a certain speed or more, a lower gear is selected so that re-acceleration is performed smoothly.
  — During a shift change with the brake pedal depressed firmly, blipping control (synchronization to engine speed) is performed to shorten the shifting time.
- When cornering
  — While cornering at a turn with a radius of less than a specified value, shift up is suppressed to improve vehicle speed performance while cornering and reacceleration performance after cornering.
- During high degree of vehicle ascent/descent
  — During a certain level of vehicle ascent/descent, gears are selected appropriate to the driving conditions for driving comfort.
- During ascent
  — While ascending a slope of a certain grade or more, slope mode control prevents unnecessary shift-up by maintaining the appropriate gear.
- During descent
  — While descending a slope of a certain grade or more and depressing the brake pedal, the gears are appropriately shifted down according to the estimated slope angle for effective use of engine braking. As a result, frequent brake pedal operation is reduced.

AAS (active adaptive shift) operation scenario and effect

- The AAS (active adaptive shift) is a mode which estimates the driving environment and drive's intentions according to the vehicle driving conditions and the drive's operations, and selects the optimum gear for driving.
  Ex.1: Cornering
  — During cornering, shift up is suppressed to improve acceleration performance after cornering.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]



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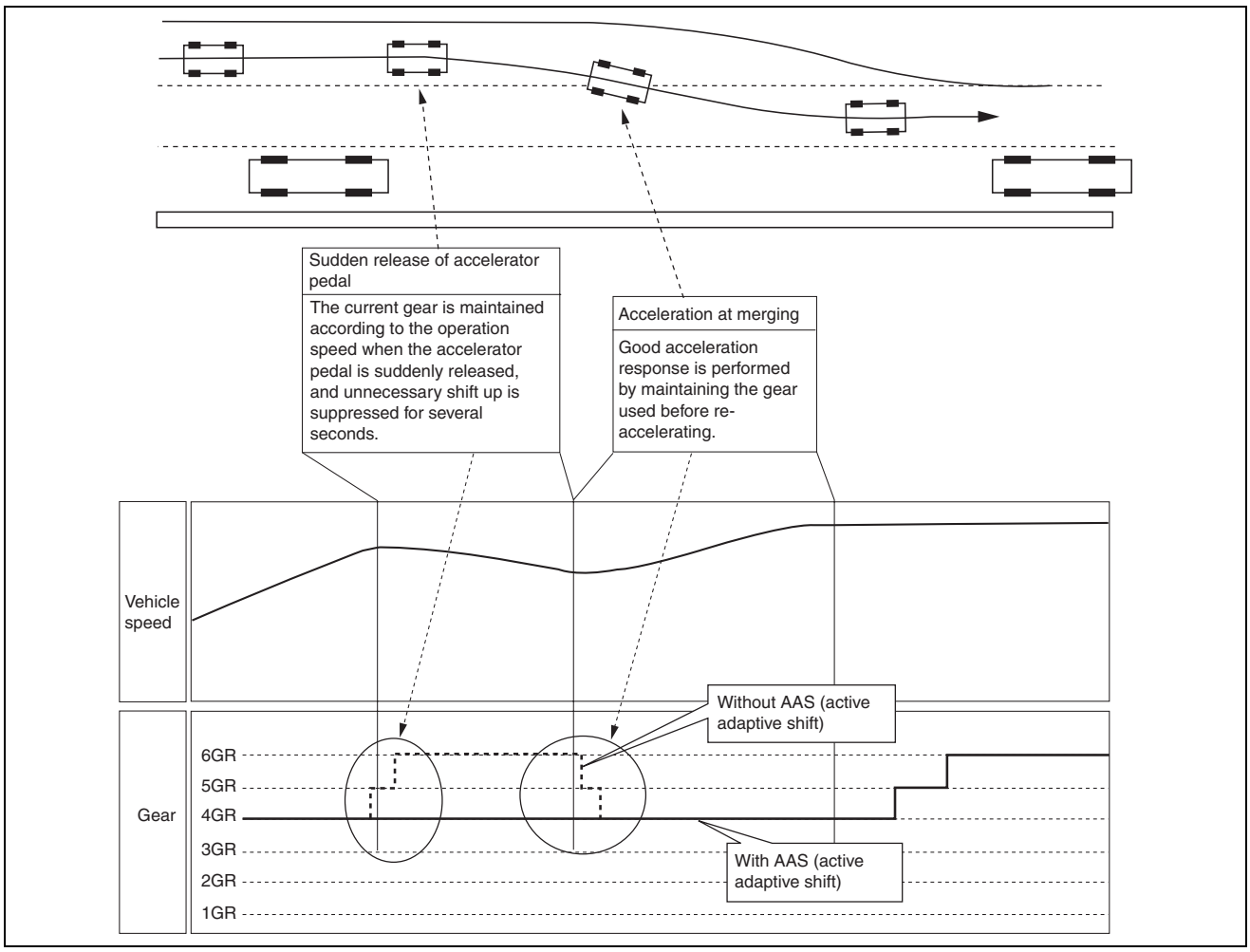
AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Ex. 2) Merging onto high speed expressways

— In a scenario such as temporarily decelerating while merging onto a high speed expressway, shift up is suppressed directly afterwards to improve re-acceleration performance.



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AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Automatic transaxle operation chart

Position	Mode	Gear position	Gear ratio	TCC	Operation of powertrain parts						Operation of shift solenoid					
					Low clutch	High clutch	Low and reverse brake	2-6 brake	R-3-5 brake	One-way clutch	Shift solenoid No.1	Shift solenoid No.2	Shift solenoid No.3	Shift solenoid No.4	TCC control solenoid	ON/OFF solenoid
P	-	-	-				×				CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OFF
R	-	Reverse	3.893				×		×		CLOSE	CLOSE	OPEN	OPEN	CLOSE	OFF
N		-	-				×				CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OFF
D/M	NORMAL	1GR	3.552	×	×		×			⊗	OPEN	CLOSE	CLOSE	OPEN	OPEN	OFF
		2GR	2.022	×	×			×			OPEN	OPEN	CLOSE	CLOSE	OPEN	ON
		3GR	1.452	×	×				×		OPEN	CLOSE	OPEN	CLOSE	OPEN	ON
		4GR	1.000	×	×	×					OPEN	CLOSE	CLOSE	OPEN	OPEN	ON
		5GR	0.708	×		×			×		CLOSE	CLOSE	OPEN	OPEN	OPEN	ON
		6GR	0.599	×		×		×			CLOSE	OPEN	CLOSE	OPEN	OPEN	ON

× : Operating

⊗ : Transmits torque only during driving operation

OPEN: Engages the line pressure to the clutch pressure
CLOSE: Drains the clutch pressure
ON: Engages the output port and the supply port
OFF: Engages the output port and the drain port (Drains the output port)

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SHIFT POINT CONTROL (MANUAL SHIFT CONTROL) [FW6A-EL, FW6AX-EL]

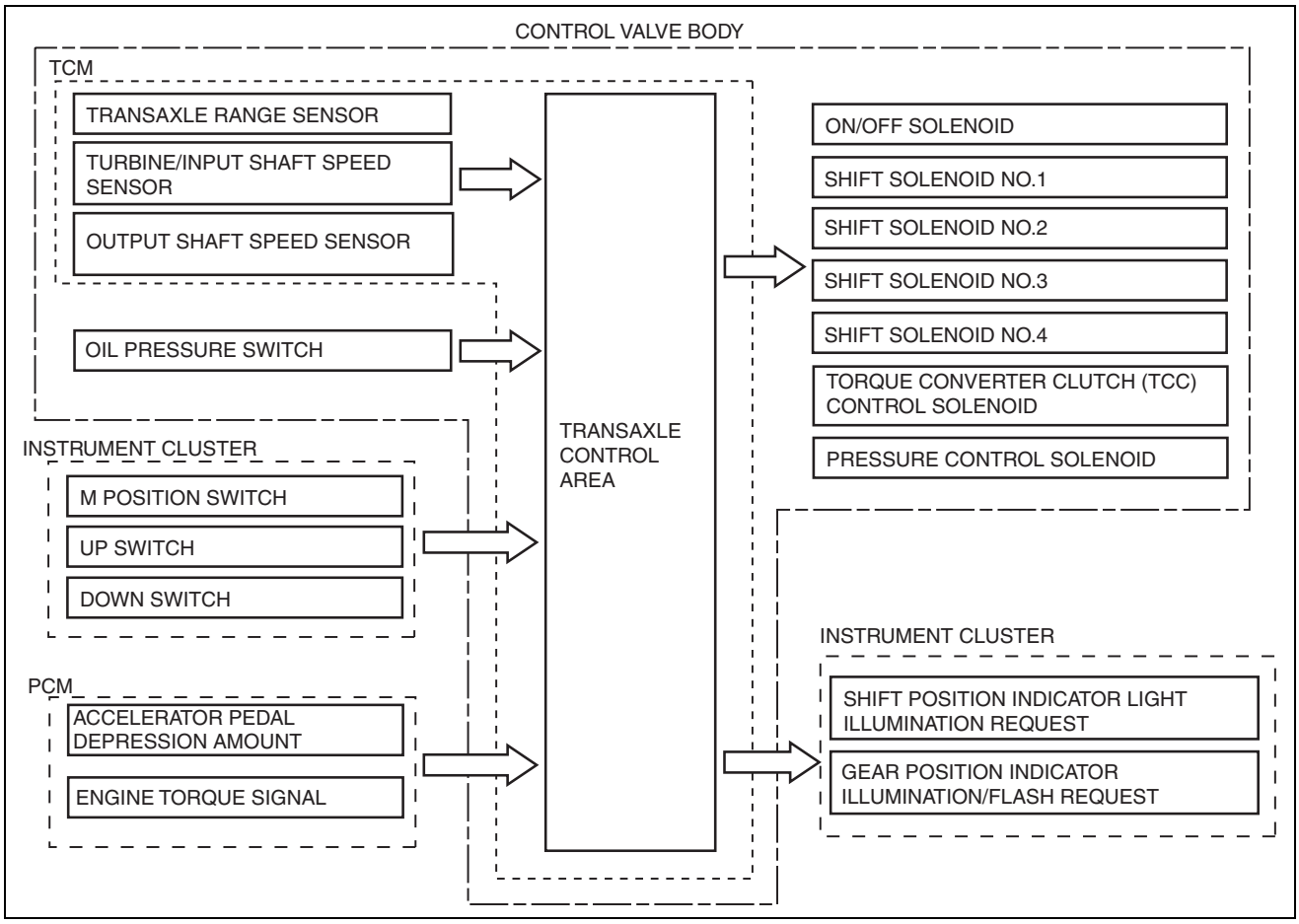
id0517h2362200

Outline

- The TCM operates the manual shift control when the M position is selected.
- If the M position is selected, manual shifting is prioritized according to the driver's shift up/shift down operation. However, to assure driving safety and protect the ATX, minimum automatic shifting may occur.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction



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Operation

- Gears can be selected by moving the selector lever back and forth while driving in the M position.
- When shifting the selector lever from the D to M position while driving, the gear being used while driving in the D position is maintained. For driving in D position 6th gear, however, when shifting the selector lever from the D to M position with the accelerator pedal not depressed, the gear shifts from 6th to 5th gear. For driving in 5th gear, when shifting the selector lever from the D to M position with the accelerator pedal not depressed, the gear shifts from 5th to 4th gear.
- When a shift down is performed using the selector lever with the accelerator pedal not depressed and the selector lever in the M position, blipping control (synchronization to engine speed) is performed.
- If the ATF temperature exceeds the specified temperature while in manual mode, the TCM switches control to automatic shift control and turns the gear position indicator off to reduce the transaxle load. When the ATF temperature decreases to the appropriate temperature, the TCM enables driving in manual mode and re-illuminates the gear position indicator.
- During manual shift control, in every gear speed, engine brake force can be obtained corresponding to the gear ratio. In addition, if the vehicle speed reaches a constant speed or less, shift-down is performed automatically.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Shifting operation and manual transmission

Shift operation		Gear	Gear shift enabled/disabled
Shift-up operation	Operates once	1GR to 2GR	Enabled when both driving and stopped
		2GR to 3GR	Enabled when driving at specified vehicle speed or more
		3GR to 4GR	
		4GR to 5GR	
		5GR to 6GR	
	Operates 2 times consecutively	1GR to 3GR	
		2GR to 4GR	
		3GR to 5GR	
		4GR to 6GR	
	Operates 3 times consecutively	1GR to 4GR	
		2GR to 5GR	
		3GR to 6GR	
	Operates 4 times consecutively	1GR to 5GR	
		2GR to 6GR	
Shift-down operation	Operates once	6GR to 5GR	Enabled when driving at specified vehicle speed or less
		5GR to 4GR	
		4GR to 3GR	
		3GR to 2GR	
		2GR to 1GR	
	Operates 2 times consecutively	6GR to 4GR	
		5GR to 3GR	
		4GR to 2GR	
		3GR to 1GR	
	Operates 3 times consecutively	6GR to 3GR	
		5GR to 2GR	
		4GR to 1GR	
	Operates 4 times consecutively	6GR to 2GR	
		5GR to 1GR	

- The gear shifting operation may cancel depending on the vehicle speed. If a shift-down operation is canceled, the gear position indicator illuminates to alert the driver.
- If the engine reaches a high engine speed, the following controls are performed to protect the engine:
  1. The throttle valve is squeezed so that the engine speed does not exceed the excess speed range and the engine speed is stabilized at a lower speed than the excess speed range.
  2. If the high engine speed condition continues, the engine speed is lowered by a forced shift-up of the gears.

2nd gear fixed mode

- When the vehicle is stopped or the vehicle speed is extremely low, the selector lever is moved to the + side and the transaxle is in 2nd gear.
- On slippery surfaces such as snow-bound roads, forward acceleration and driving is facilitated.While in 2nd gear fixed mode and the selector lever is shifted to gears other than 2nd gear, the 2nd gear fixed mode is canceled.

TORQUE CONVERTER CLUTCH (TCC) CONTROL [FW6A-EL, FW6AX-EL]

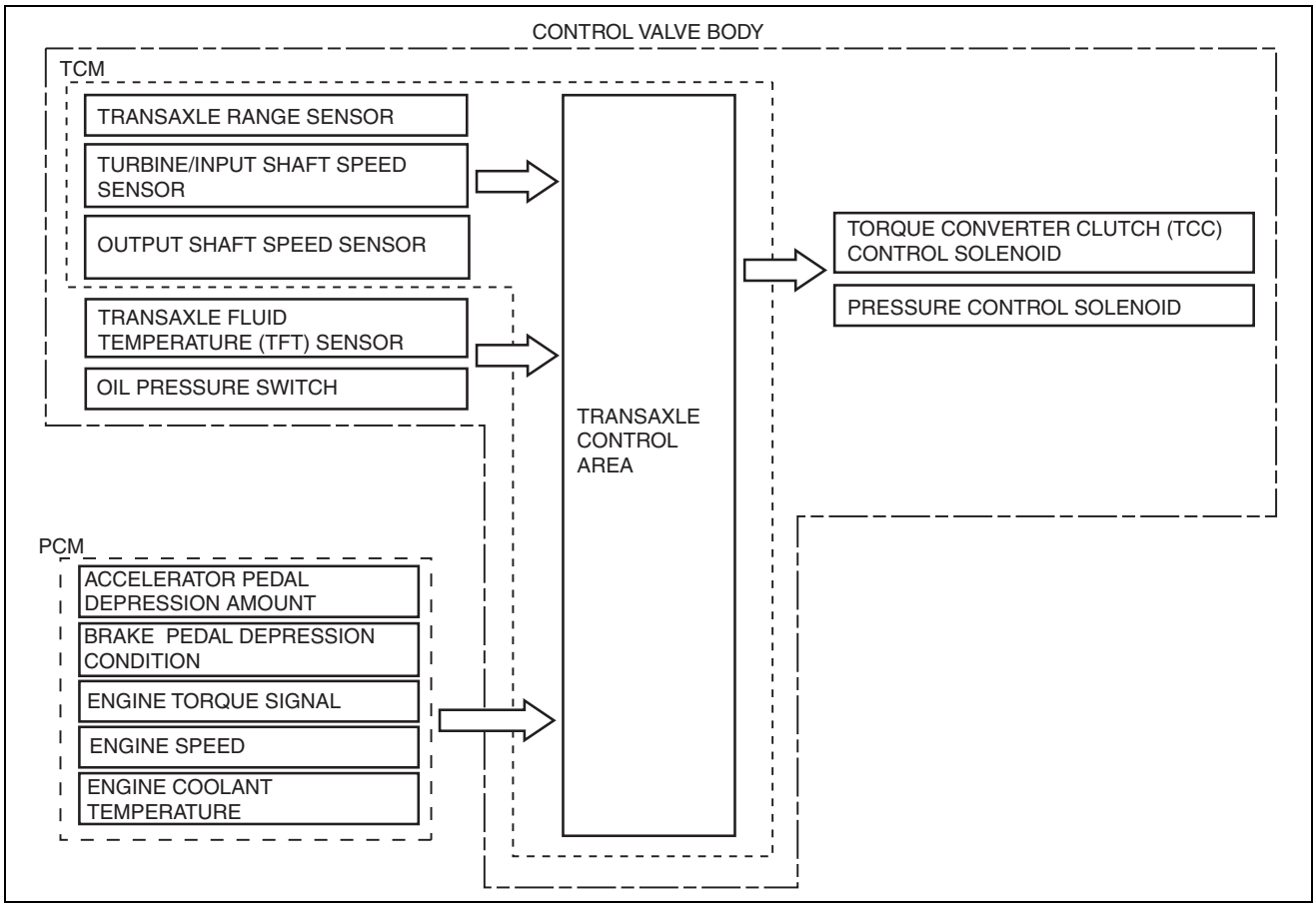
id0517h2362300

Outline

- For TCC control, a newly developed, full range TCC control has been adopted. The TCC range has been significantly widened by having the smoothness unique to the torque converter during acceleration from a stop take precedence and actively controlling TCC directly after acceleration from a stop. Therefore, a contribution to low fuel consumption and vehicle operability with a direct feel have been achieved.
- Lower fuel consumption and improved emission performance have been achieved by performing the TCC control during deceleration with the accelerator pedal fully closed and by fuel-cut during TCC.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction



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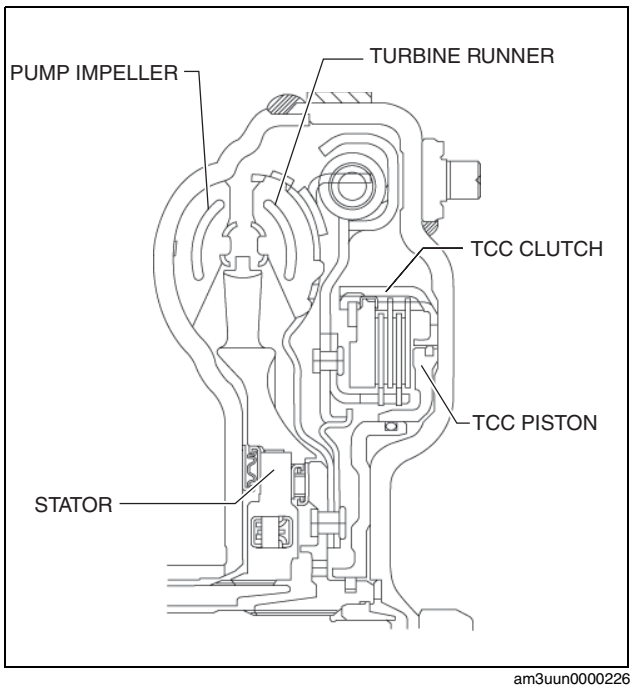
- The TCC mechanism consists of a torque converter clutch, TCC piston, and a damper which are installed inside the torque converter.
- A multi-plate type torque converter clutch has been adopted for improved durability. Also, by reducing the size of the clutch diameter, improved handling is achieved by the ability to respond to the precise control by the full range TCC.
- Vibration during TCC engagement is suppressed by the improved damper performance.



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AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Operation

TCC engagement

- A current signal is sent from the TCM to the TCC control solenoid during TCC engagement. At the same time, the TCC piston engagement pressure is gradually increased.
- As a result, the TCC piston is pressure-bonded to the TCC clutch slowly to perform smooth TCC engagement.

TCC release

- A current signal is sent from the TCM to the TCC control solenoid during TCC release. At the same time, the TCC piston engagement pressure is gradually drained.
- As a result, the TCC piston releases the TCC clutch slowly to release the TCC smoothly.

Inhibition of TCC control

- If any one of the following conditions is met, the torque converter clutch control is inhibited.
  - — TCC solenoid malfunction
  - — ATF temperature is specification or less
  - — Engine speed signal is specification or less
  - — Turbine shaft speed is specification or less
  - — Other than D/M position

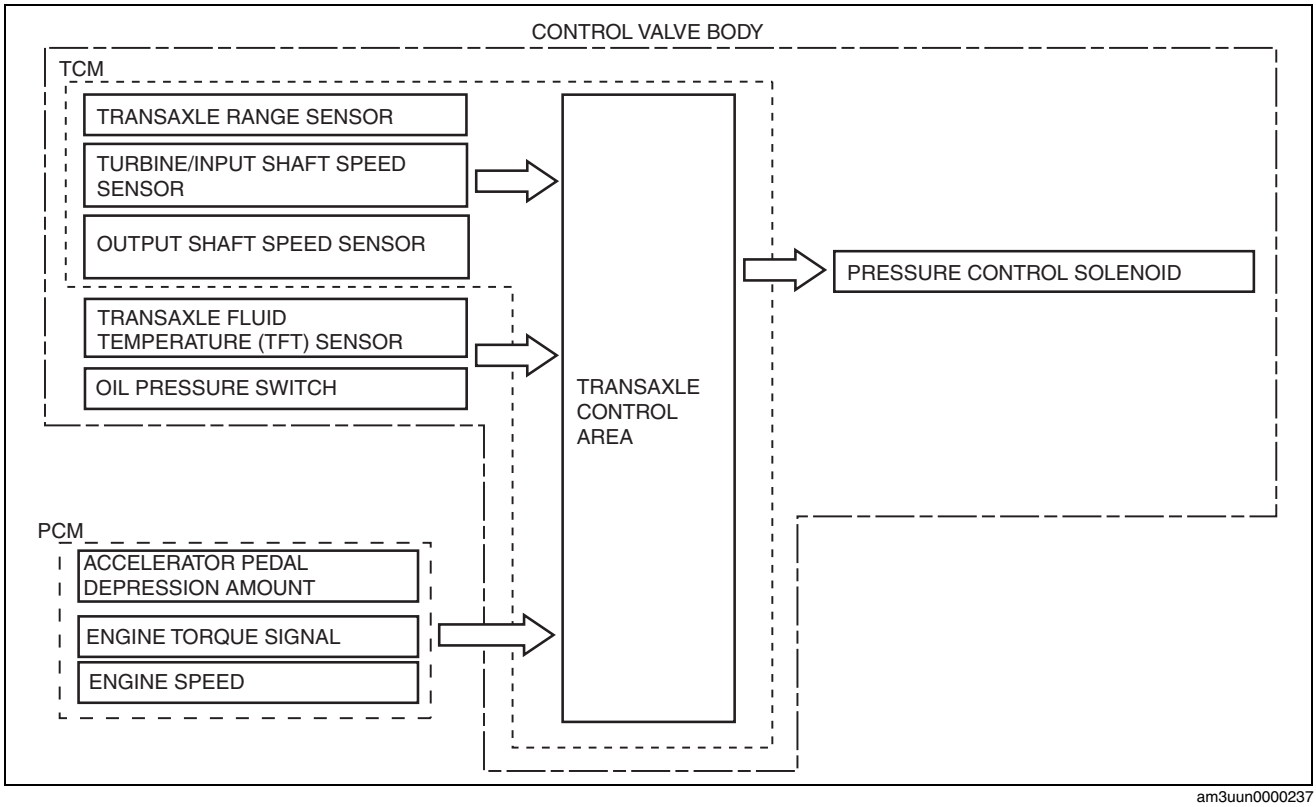
SHIFT PRESSURE CONTROL (LINE PRESSURE CONTROL) [FW6A-EL, FW6AX-EL]

id0517h2362500

Outline

- The TCM drives the pressure control solenoid and adjusts the pressure based on the accelerator pedal depression amount, vehicle speed, ATF temperature, and gear shift signal. As a result, line pressure is controlled finely and with high accuracy according to the engine load condition and vehicle driving conditions.

Construction



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Operation

- The TCM adjusts the pressure control solenoid pressure applied to the pressure regulator valve by increasing/decreasing the energization current to the pressure control solenoid. As a result, the ATF amount passing through the pressure regulator valve is adjusted and the line pressure is adjusted.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

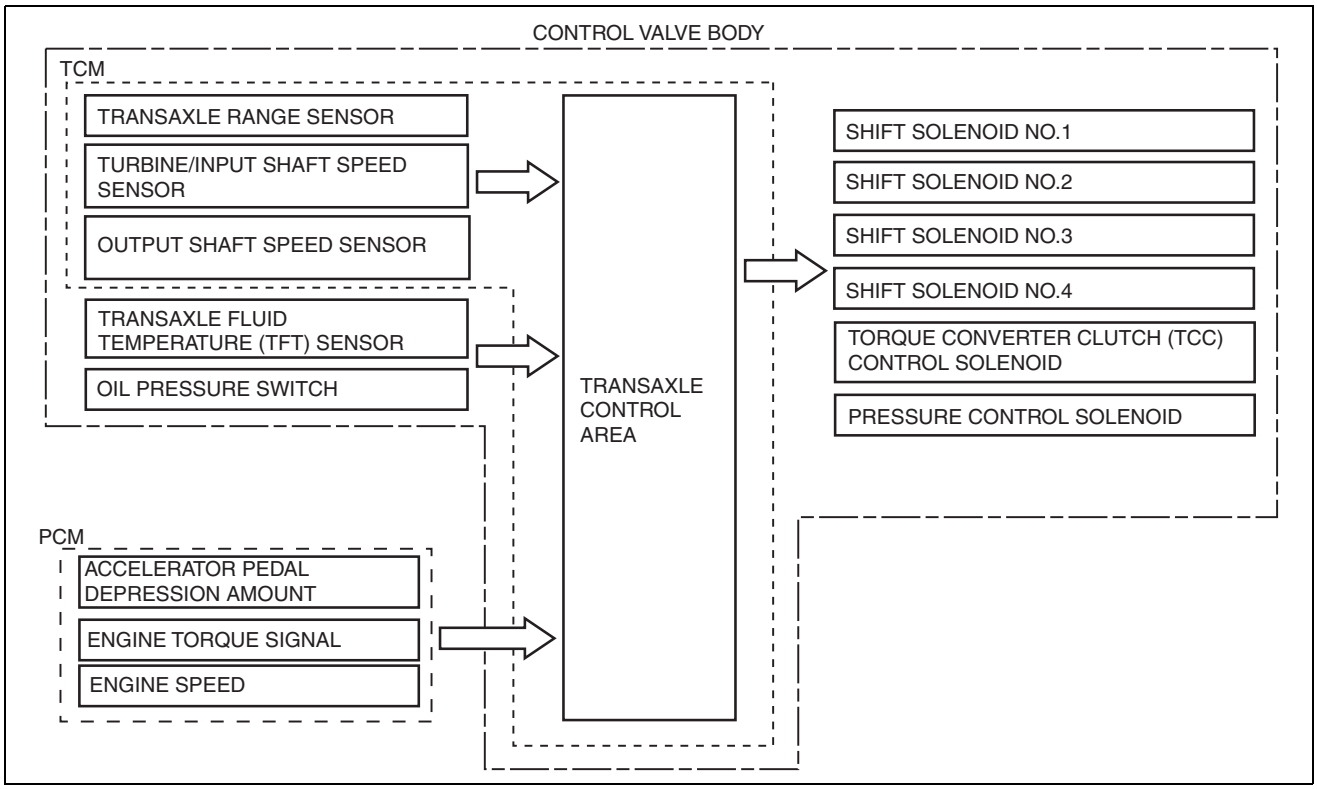
SHIFT PRESSURE CONTROL (DIRECT ELECTRIC SHIFT CONTROL) [FW6A-EL, FW6AX-EL]

id0517h2362600

Outline

- The TCM drives shift solenoids No.1, 2, 3, 4, the pressure control solenoid, and the on/off solenoid based on inputs signals from each switch and sensor, and performs direct electronic control of the clutch engagement pressure. As a result, precise hydraulic pressure control of the clutch engagement, not possible using a conventional accumulator, is achieved.

Construction



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Operation

N to D, and N to R selected

- When N to D, and N to R are selected, the TCM drives the pressure control solenoid and shift solenoids No. 1 and 3 for optimum clutch engagement pressure control.

Shifting

- During shifting, the TCM drives shift solenoids No.1, 2, 3, and 4 to directly control the clutch engagement pressure for optimum clutch engagement pressure control.
- During each gear shift, the engagement side clutch pressure and release side clutch pressure are controlled simultaneously. As a result, the torque capacities of both clutches can be controlled in connection to each other when switching clutches, engine over-speed during shifting and interlock among clutches is prevented, and smooth and responsive shifting is achieved.

SHIFT PRESSURE CONTROL (LEARNING CONTROL) [FW6A-EL, FW6AX-EL]

id0517h2362700

Outline

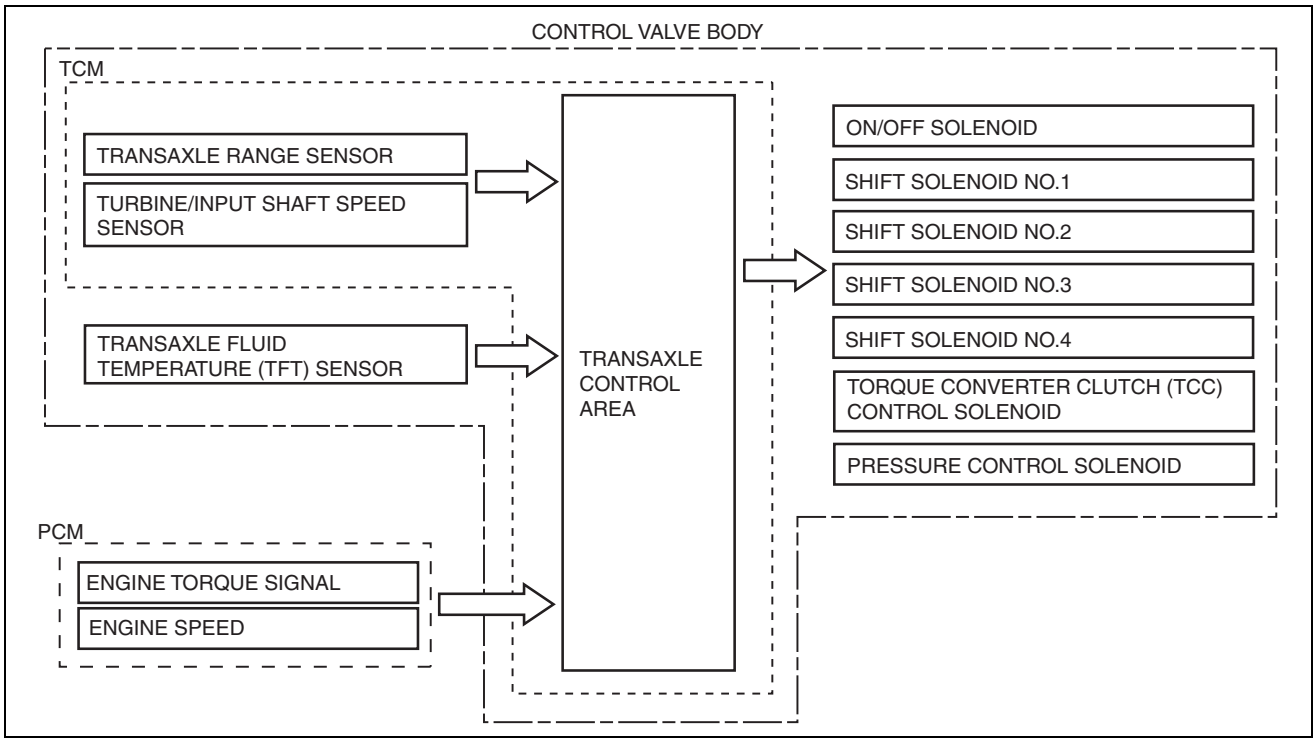
- The TCM optimizes the hydraulic pressure for clutch engagement and disengagement through learning correction of the clutch engagement pressure.

Note

- The clutch engagement pressure learning value stored in the TCM is not cleared even if the negative battery terminal is disconnected. Therefore, if the control valve body is replaced, the learning value stored in the TCM and the control valve body specification are incompatible and engine rev-up may occur or shift shock may increase. Due to this, if the control valve body is replaced, it is necessary to perform the initial learning.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction



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Operation

- The TCM learns engine performance changes resulting from past shifting and deterioration over time of the transaxle and performs learning correction for optimum clutch engagement pressure during initial shifting.

ENGINE-TRANSAXLE INTEGRATION CONTROL [FW6A-EL, FW6AX-EL]

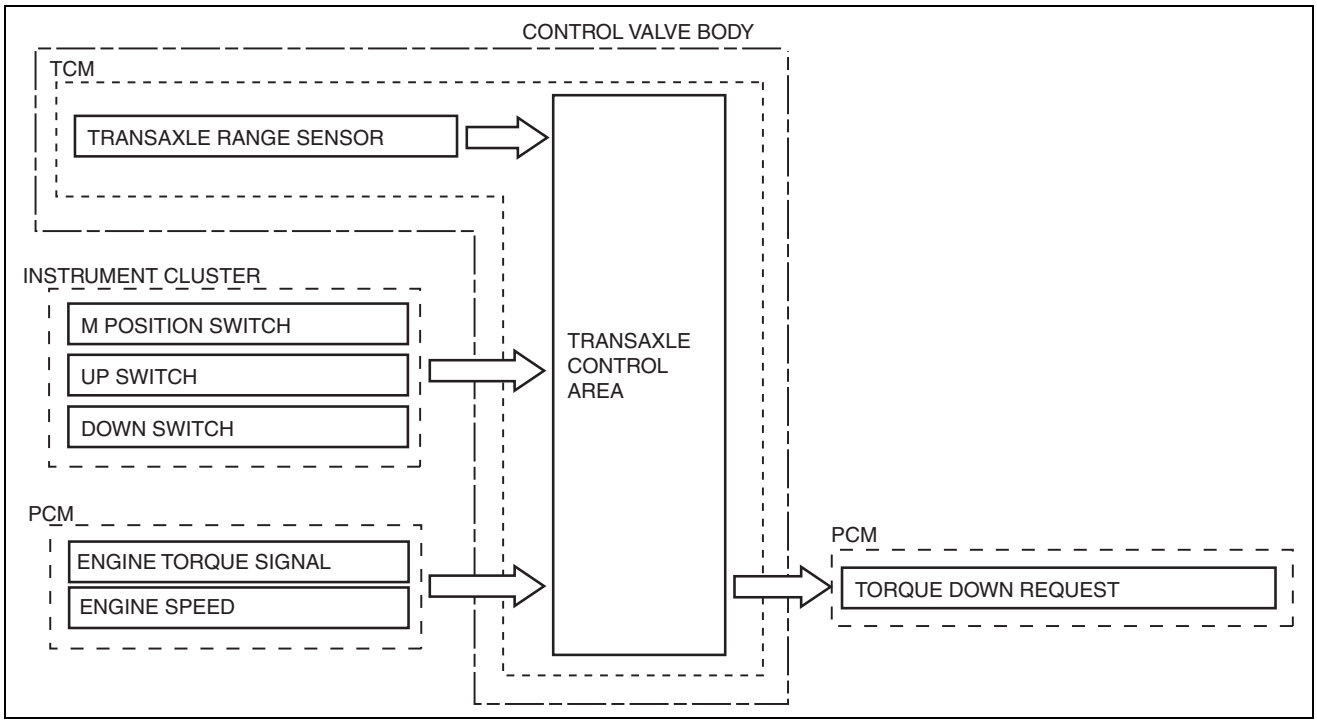
id0517h2362800

Outline

- The TCM controls engine output torque and reduces transaxle output shaft torque fluctuation during auto shifting, and reduces shock occurring from the vehicle during shifting.

AUTOMATIC TRANSAXLE [FW6A-EL, FW6AX-EL]

Construction



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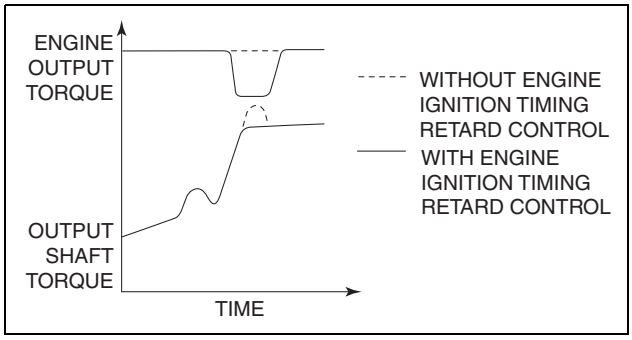
Operation

- During auto shifting, the TCM sends the torque reduction request signal using the CAN system and temporarily reduces the engine output torque by the engine ignition timing retard control. As a result, transaxle output shaft torque fluctuation is reduced during auto shifting by smooth engagement of the clutch.
- In addition, the TCM receives the engine output torque from the PCM via the CAN signal to determine the clutch engagement pressure according to the engine output torque. As a result, the clutch hydraulic control setting accuracy is increased and smooth shift performance is achieved.



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05-17B AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

AUTOMATIC TRANSAXLE OUTLINE [GW6A-EL, GW6AX-EL]

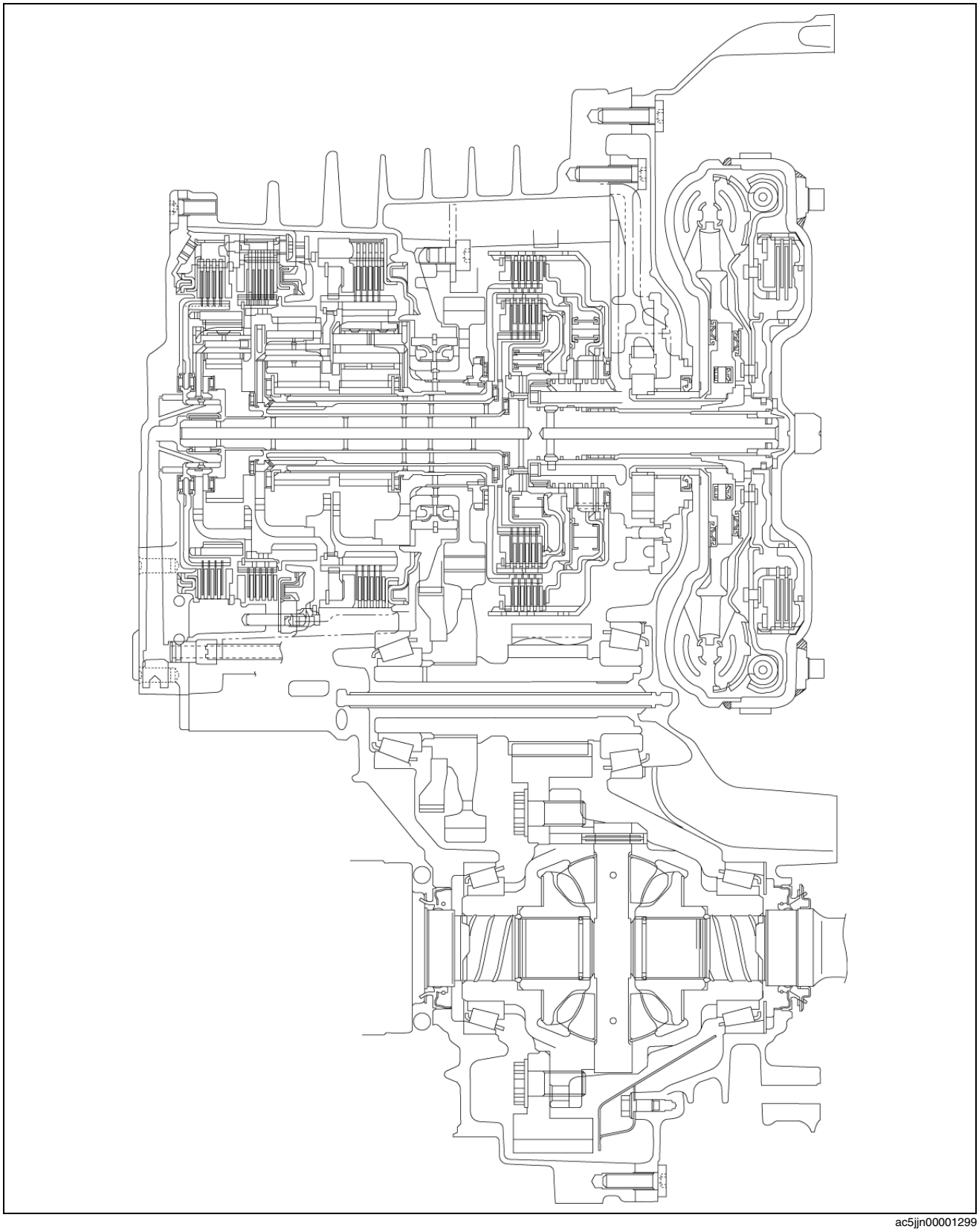
id0517i2350000

Outline

Contribution to low fuel economy	• Wide TCC range • Clutch/brake resistance reduction
Realized direct feel and quick shifting	• Oil passage resistance reduction and improved clutch/brake response by optimizing clutch rigidity • Improved solenoid valve response
Smooth and powerful start-up	• Torque converter characteristics when accelerating and optimized range
Smooth shifting	• Control valve body integrated with TCM adopted • Direct linear solenoid valve has been adopted to improve shift accuracy

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction
Cross-sectional view



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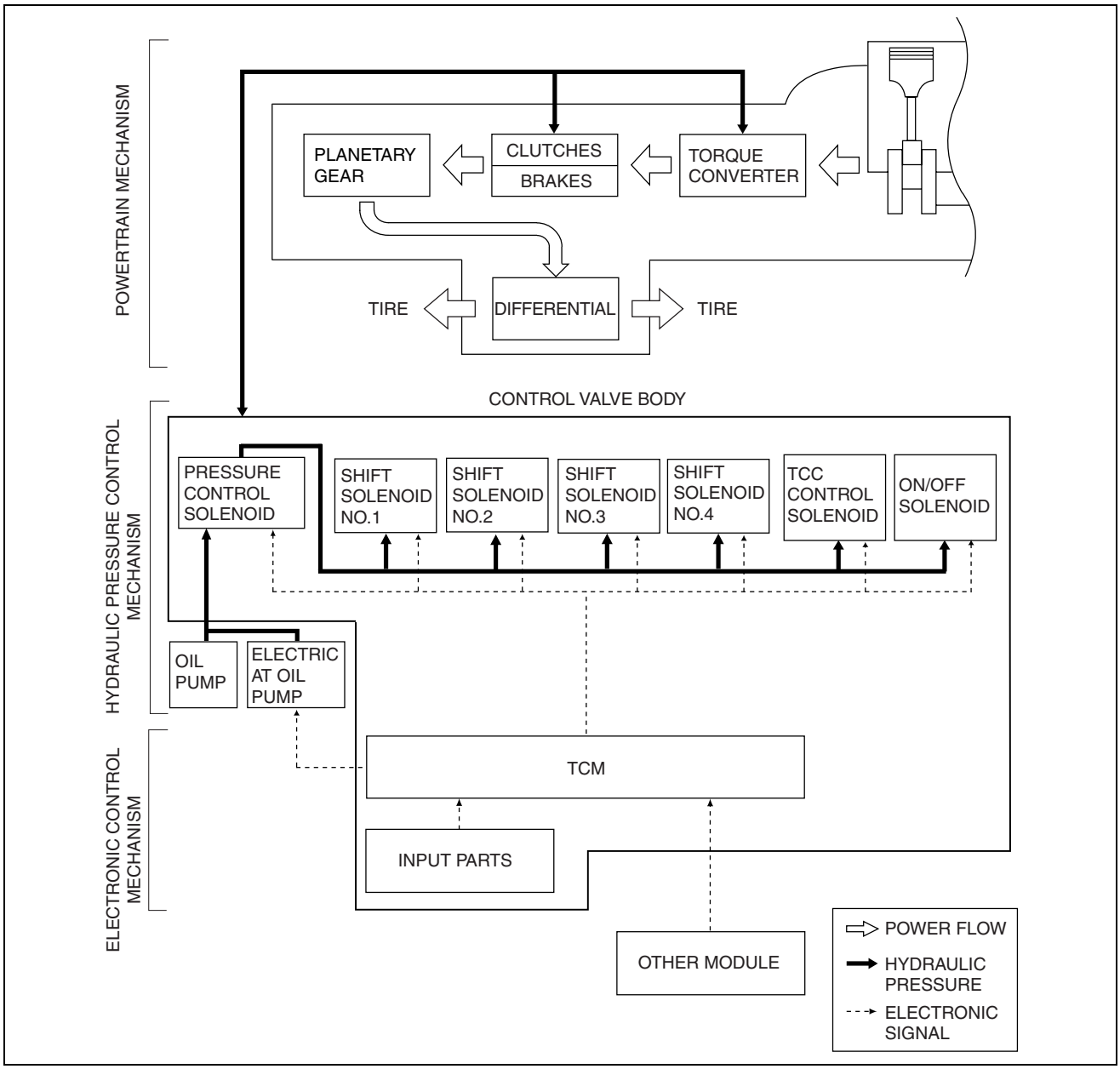
- The electronic control automatic transaxle consists of three systems which are divided into the powertrain with

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

a torque converter, the hydraulic control mechanism, and the electronic control mechanism.



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Operation
Automatic transaxle operation chart

Position	Mode	Gear position	Gear ratio	TCC	Operation of powertrain parts						Operation of shift solenoid					
					Low clutch	High clutch	Low and reverse brake	2-6 brake	R-3-5 brake	One-way clutch	Shift solenoid No.1	Shift solenoid No.2	Shift solenoid No.3	Shift solenoid No.4	TCC control solenoid	ON/OFF solenoid
P	-	-	-				×				CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OFF
R	-	Reverse	3.990				×		×		CLOSE	CLOSE	OPEN	OPEN	CLOSE	OFF
N		-	-				×				CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OFF
D/M	NORMAL	1GR	3.487	×	×		×			⊗	OPEN	CLOSE	CLOSE	OPEN	OPEN	OFF
		2GR	1.992	×	×			×			OPEN	OPEN	CLOSE	CLOSE	OPEN	ON
		3GR	1.449	×	×				×		OPEN	CLOSE	OPEN	CLOSE	OPEN	ON
		4GR	1.000	×	×	×					OPEN	CLOSE	CLOSE	OPEN	OPEN	ON
		5GR	0.707	×		×			×		CLOSE	CLOSE	OPEN	OPEN	OPEN	ON
		6GR	0.600	×		×		×			CLOSE	OPEN	CLOSE	OPEN	OPEN	ON

× : Operating
⊗ : Transmits torque only during driving operation
OPEN: Engages the line pressure to the clutch pressure
CLOSE: Drains the clutch pressure
ON: Engages the output port and the supply port
OFF: Engages the output port and the drain port (Drains the output port)

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POWERTRAIN SYSTEM OUTLINE [GW6A-EL, GW6AX-EL]

id0517i2351000

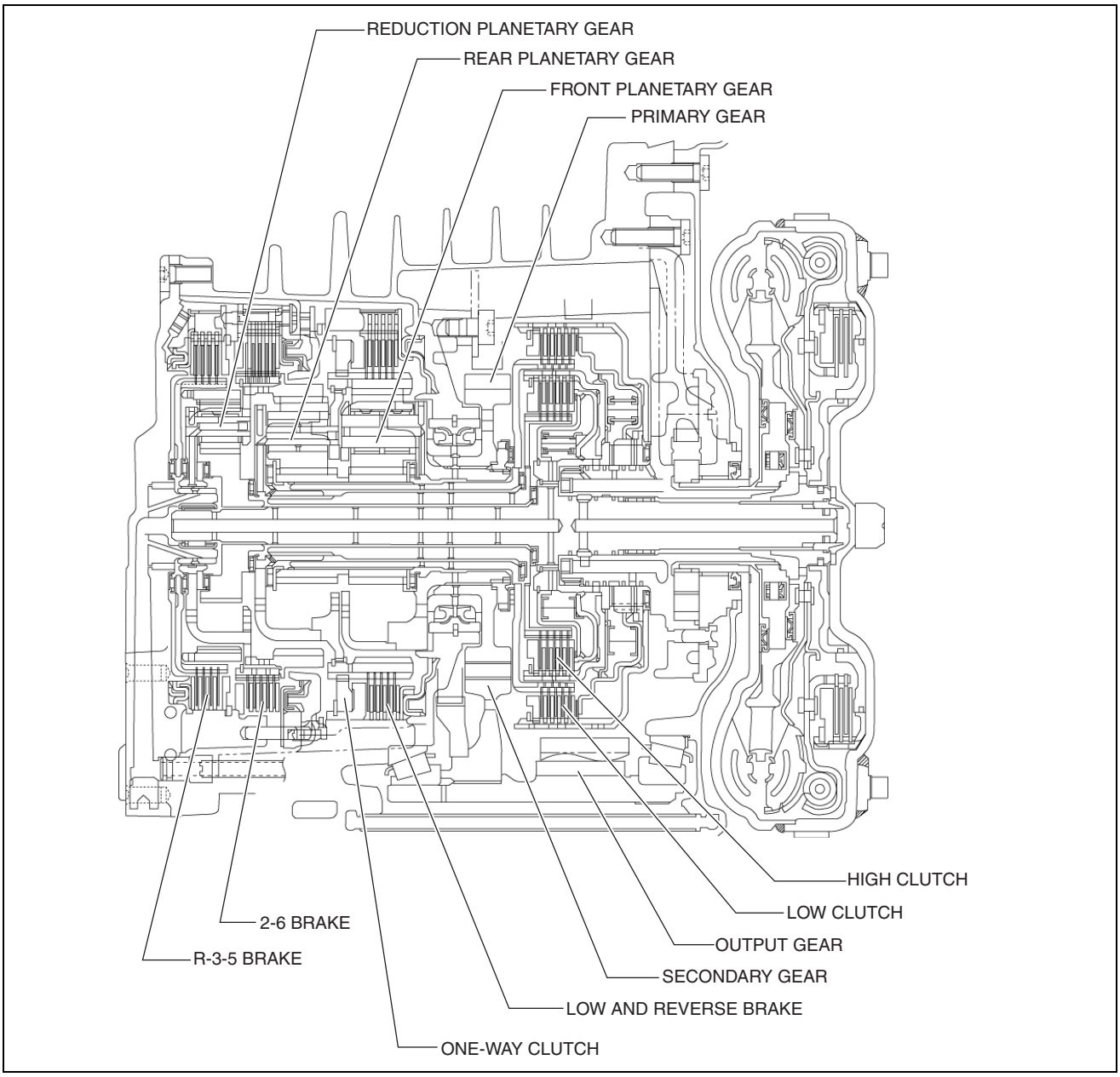
Outline
- The powertrain consists of a 2-piece multi-plate clutch, 3-piece multi-plate brake, a one-way clutch, and a 3-piece single-type planetary gear.

Construction
Component parts list

Component parts		Movement
Multi-plate clutch	Low clutch	Transmits drive force from turbine shaft to front and rear sun gears
	High clutch	Transmits drive force from turbine shaft to rear planetary carrier
Multi-plate brake	R-3-5 brake	Locks reduction internal gear against rotation
	2-6 brake	Locks rear internal gear and reduction planetary gear against rotation
	Low and reverse brake	Locks front internal gear and rear planetary gear against rotation
One-way clutch		Restricts counterclockwise rotation (when viewed from torque converter side) of front internal gear
Single type planetary gear	Front planetary gear	Converts drive force transmitted from engine by operation of each clutch and brake, and transmits it to primary gear. (Operates transaxle.)
	Rear planetary gear	
	Reduction planetary gear	

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Cross-sectional view



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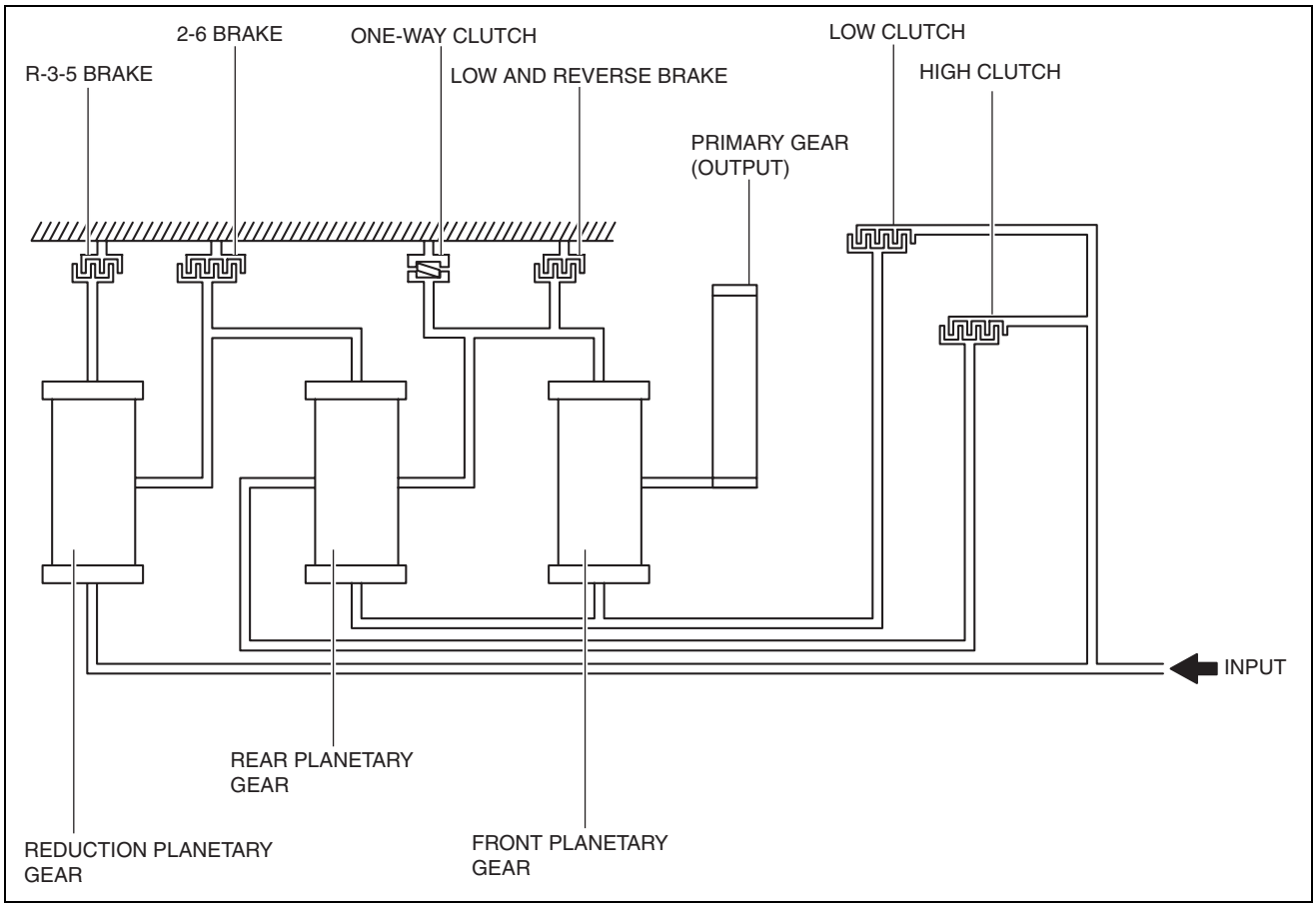
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Skeleton diagram



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TORQUE CONVERTER [GW6A-EL, GW6AX-EL]

id0517i2351100

Purpose/Function

- By use of an optimized torus shape (wing) matching the output characteristics of the engine, the torque converter achieves efficient force transmission and reduced fuel consumption.

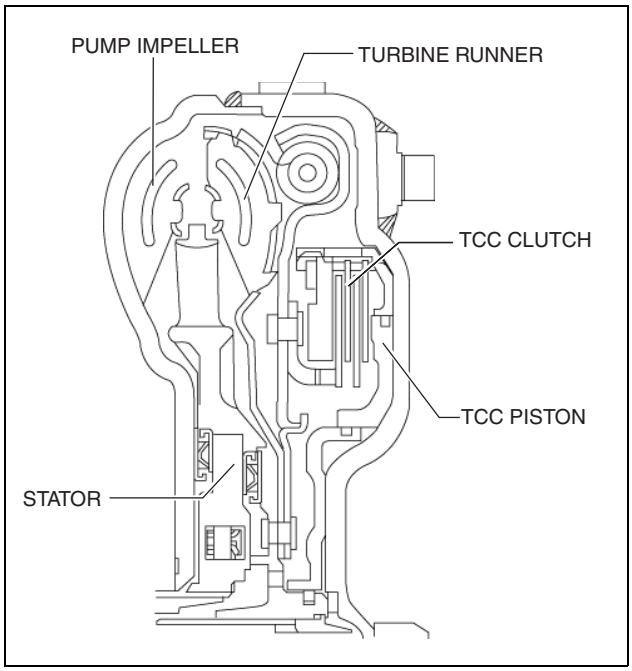
Construction/Operation

- A three-member, single-stage two-phase type torque converter with a torque converter clutch (TCC) mechanism has been adopted.
  - — Three-member: Indicates that the torque converter consists of a pump impeller, turbine runner, and stator.
  - — Single stage: Indicates the number of turbine runners.
  - — Two-phase: Indicates that there are two conditions; torque converter range and fluid coupling range.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

TCC mechanism

- A TCC piston built into the torque converter operates during TCC control. When hydraulic pressure is applied to the TCC piston, the TCC clutch engages to mechanically connect the pump impeller to the turbine runner. The TCC mechanism achieves excellent fuel economy as a result of no loss in drive force transmission due to torque converter slippage. In addition, precise hydraulic control is made possible by a multi-plate clutch equipped with an independent piston housing. With the adoption of this mechanism, the achievable range of TCC control has widened dramatically.



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LOW CLUTCH [GW6A-EL, GW6AX-EL]

id0517i2351200

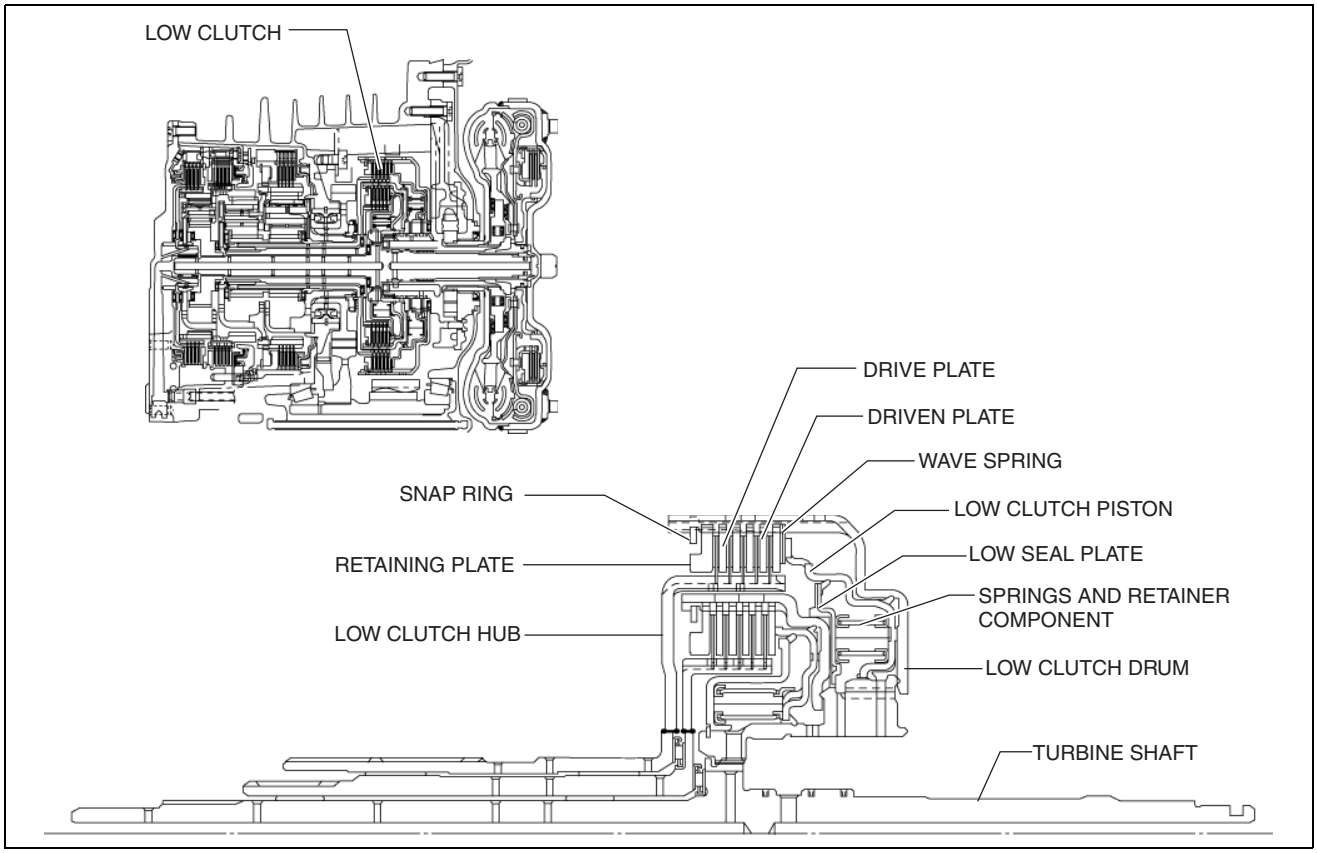
Purpose/Function

- The low clutch operates in 1GR, 2GR, 3GR and 4GR and intermittently operates the sun gear by drive force from the turbine shaft.
- For the low clutch, a centrifugal balance clutch has been adopted to prevent clutch drag and to assure stabilized piston thrust in all engine speed ranges.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction

- The low clutch consists of the following parts shown in the figure.



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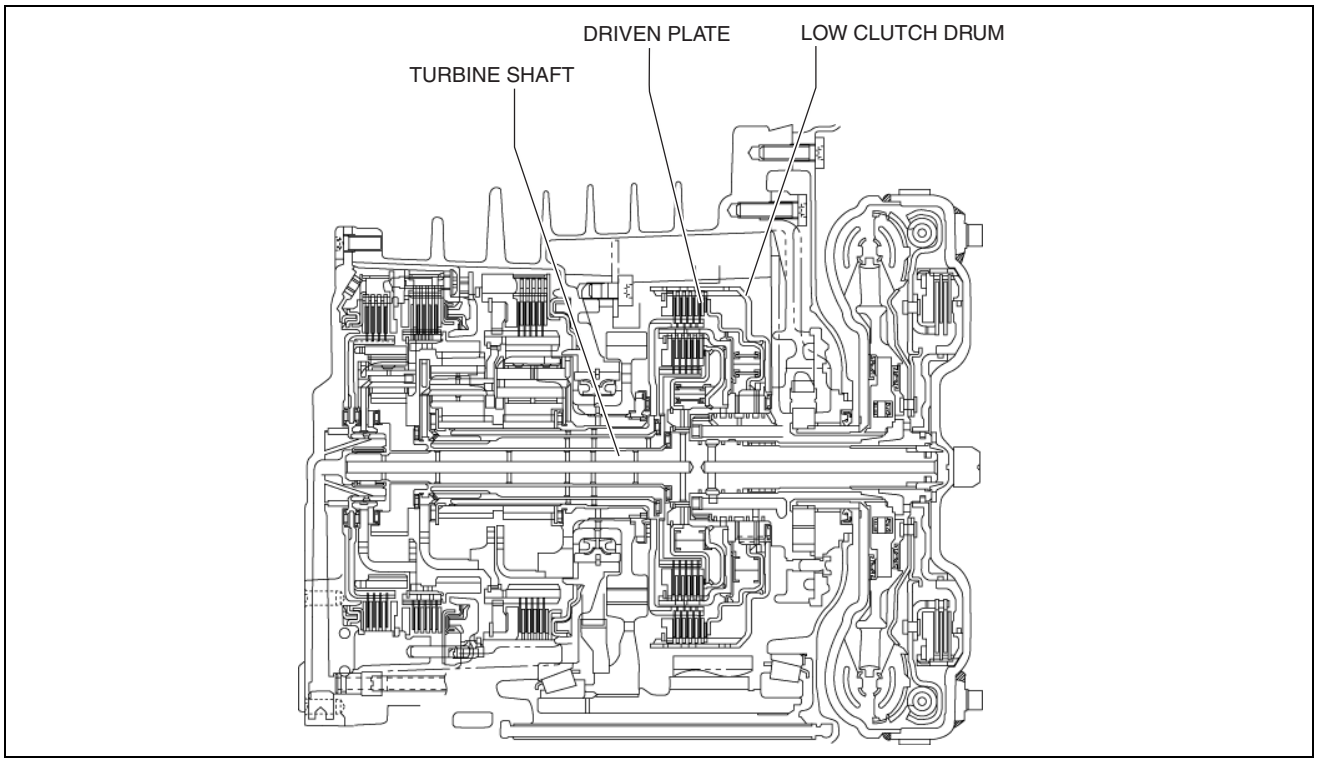
- The driven plate of the low clutch is engaged with the low clutch drum. The low clutch drum is engaged with the turbine shaft and spline, and when the turbine shaft rotates, the low clutch drum and driven plate rotate as a single unit.



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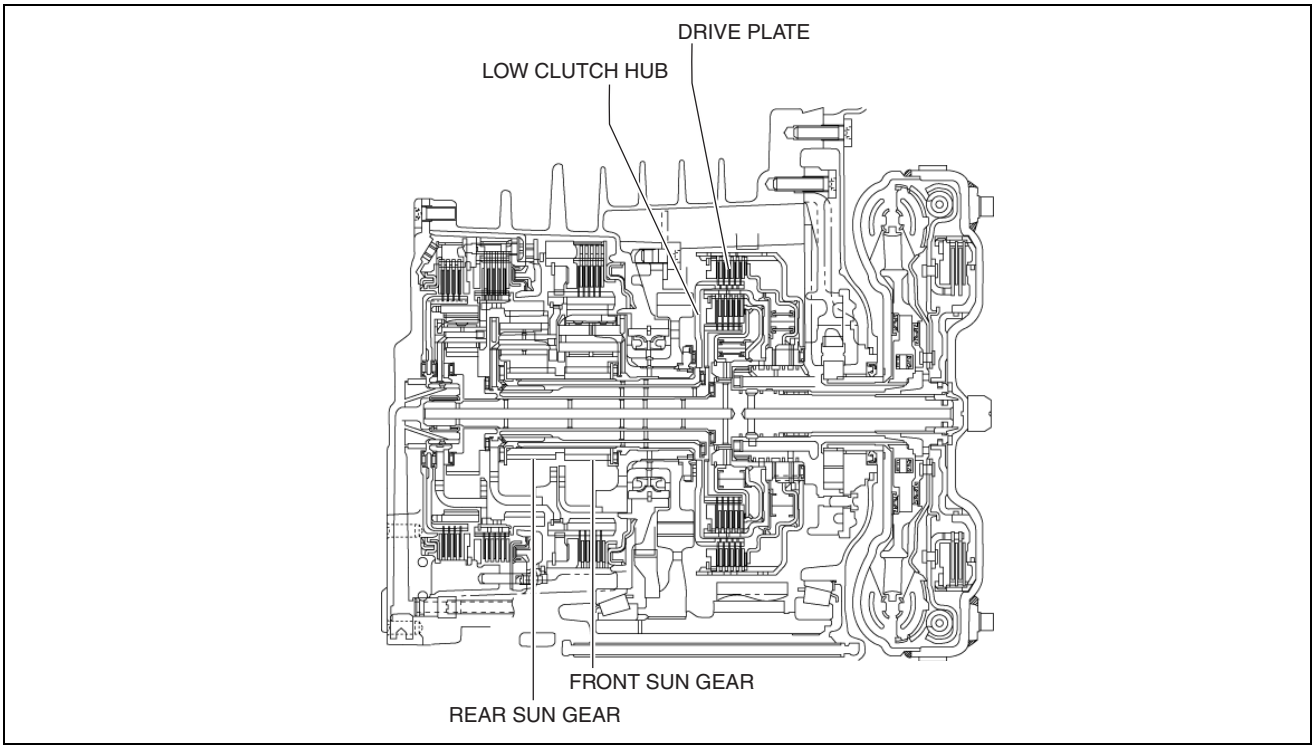
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The low clutch drive plate is engaged with the low clutch hub. The low clutch hub is engaged with the front and rear sun gears, and the drive plate, low clutch hub, front sun gear and rear sun gear rotate as a single unit.



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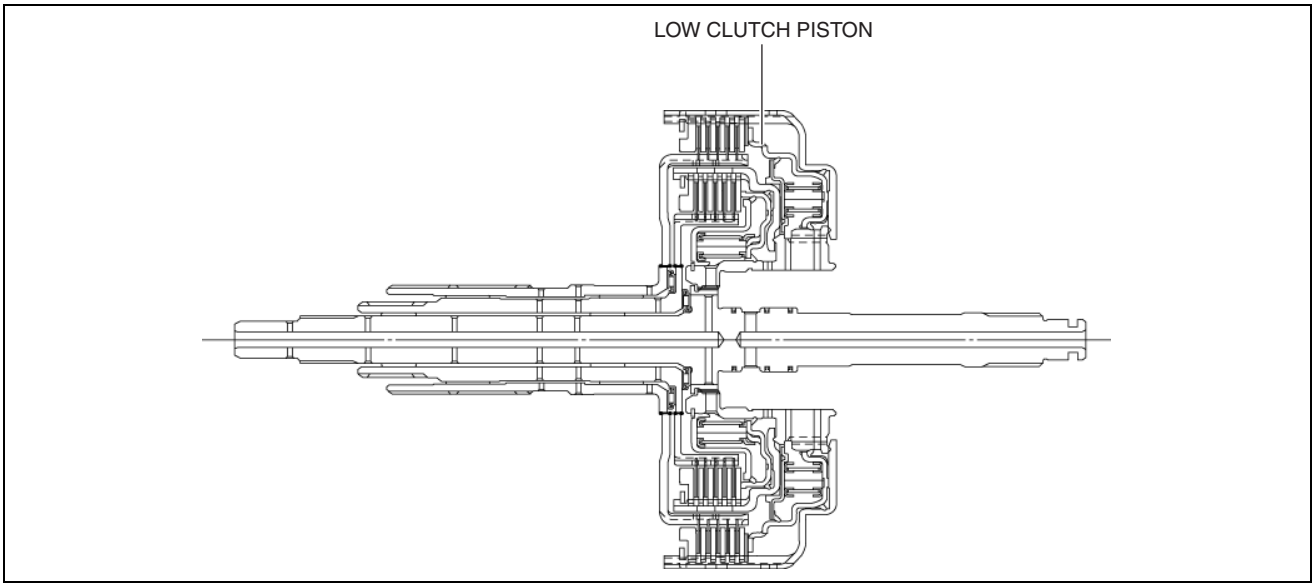
- For the low clutch piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.



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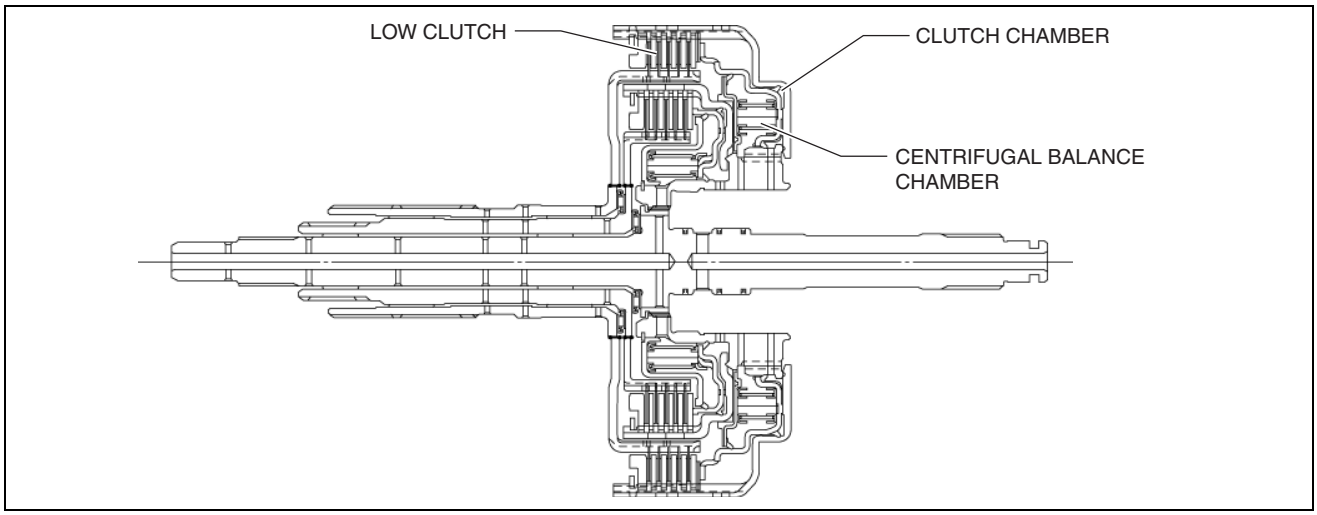
Centrifugal balance clutch

- The centrifugal balance clutch is built into the low clutch.The centrifugal balance chamber is positioned opposing the clutch chamber for the low clutch.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- In the centrifugal balance chamber, ATF is constantly charged through a specialized hydraulic circuit.



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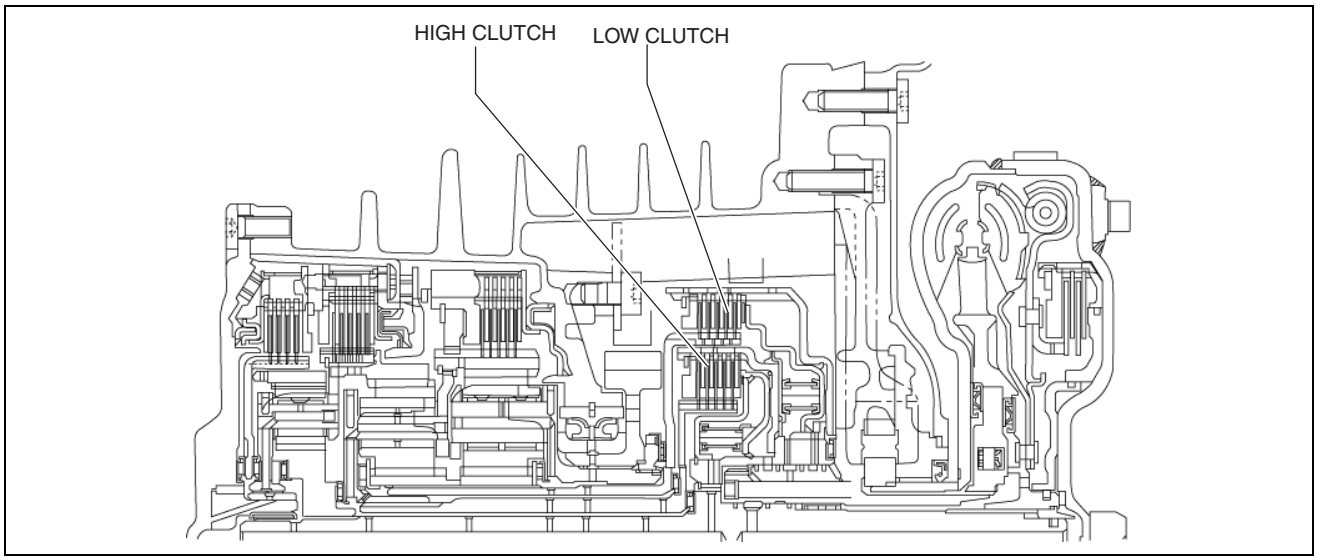
Operation

- If hydraulic pressure is applied to the low clutch piston, the drive plate and driven plate are pressure bonded and drive force from the turbine shaft is transmitted to the front and rear sun gears.
- Therefore, the following gears become the input shafts:
  - 1GR by operation of the front sun gear
  - 2GR by operation of the front and rear sun gears
  - 3GR by operation of the front and rear sun gears and the reduction planetary carrier
- In 4GR, the rear planetary carrier also becomes the input shaft by the operation of the high clutch together with both the front and rear sun gears.



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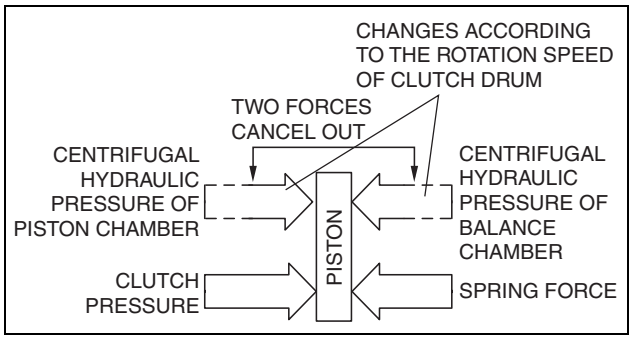
Centrifugal balance clutch
Clutch pressure not applied

- When the clutch drum rotates, centrifugal force is applied to the remaining ATF in the clutch chamber to push the piston, but centrifugal force is also applied to the ATF in the centrifugal balance chamber to force the piston to move back. As a result, the opposing forces of the clutch and balance chambers are offset and the piston does not move, preventing clutch drag.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Clutch pressure applied

- When clutch pressure is applied to the clutch chamber, the piston, which overcomes the opposing centrifugal hydraulic pressure from the balance chamber and the spring force, is pushed in the direction of clutch engagement and the clutch is engaged. At this time, because the centrifugal hydraulic pressure applied to the clutch pressure in the clutch chamber is offset by the centrifugal hydraulic pressure applied to the balance chamber, the effect of piston thrust by the centrifugal force from the clutch drum rotation is eliminated. As a result, stabilized piston force in all engine speed ranges is assured, thus reducing shift shock.



am3uun0000223

HIGH CLUTCH [GW6A-EL, GW6AX-EL]

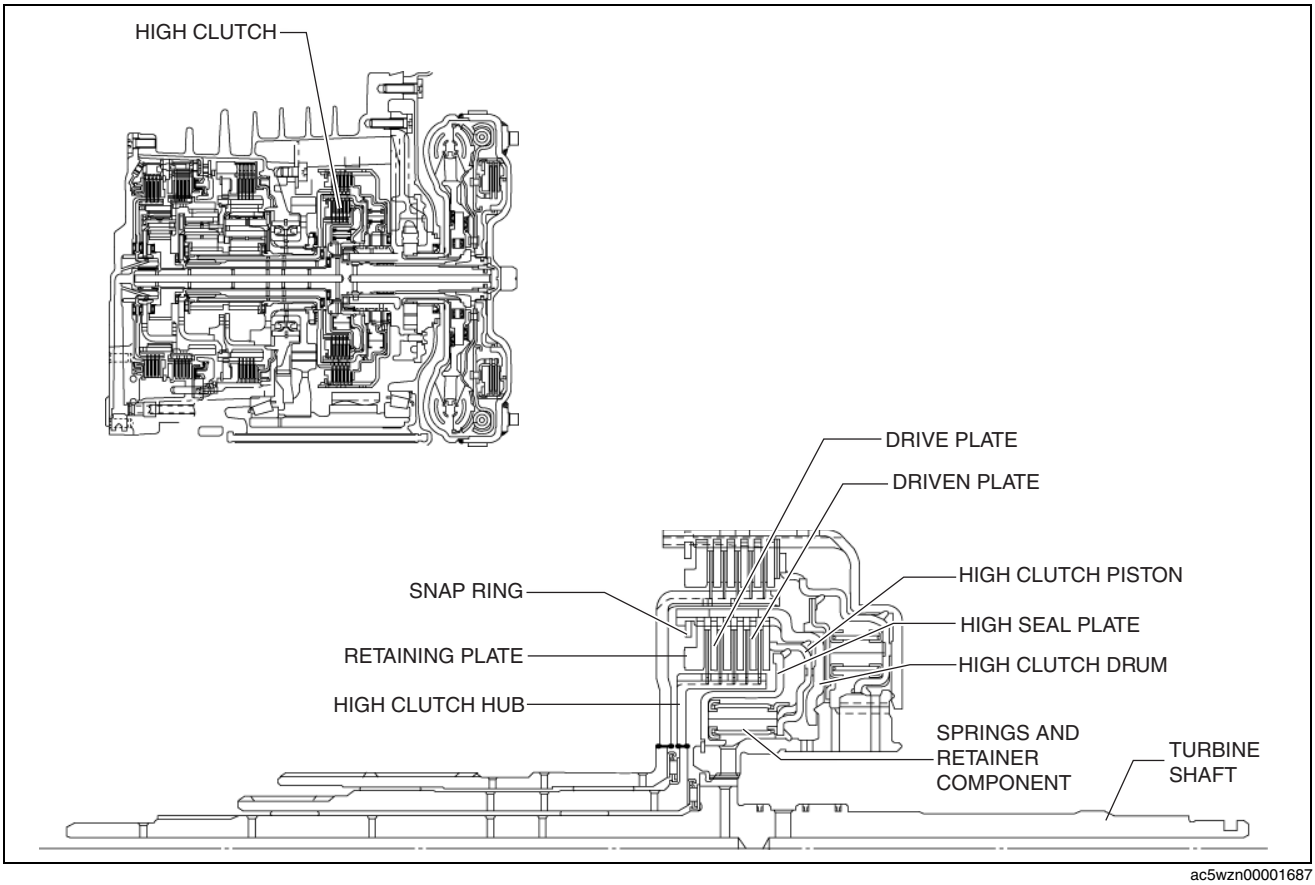
id0517i2351300

Purpose/Function

- The high clutch operates in 4GR, 5GR, and 6GR and intermittently operates the rear carrier by drive force from the turbine shaft.
- For the high clutch, a centrifugal balance clutch has been adopted to prevent clutch drag and to assure stabilized piston thrust in all engine speed ranges.

Construction

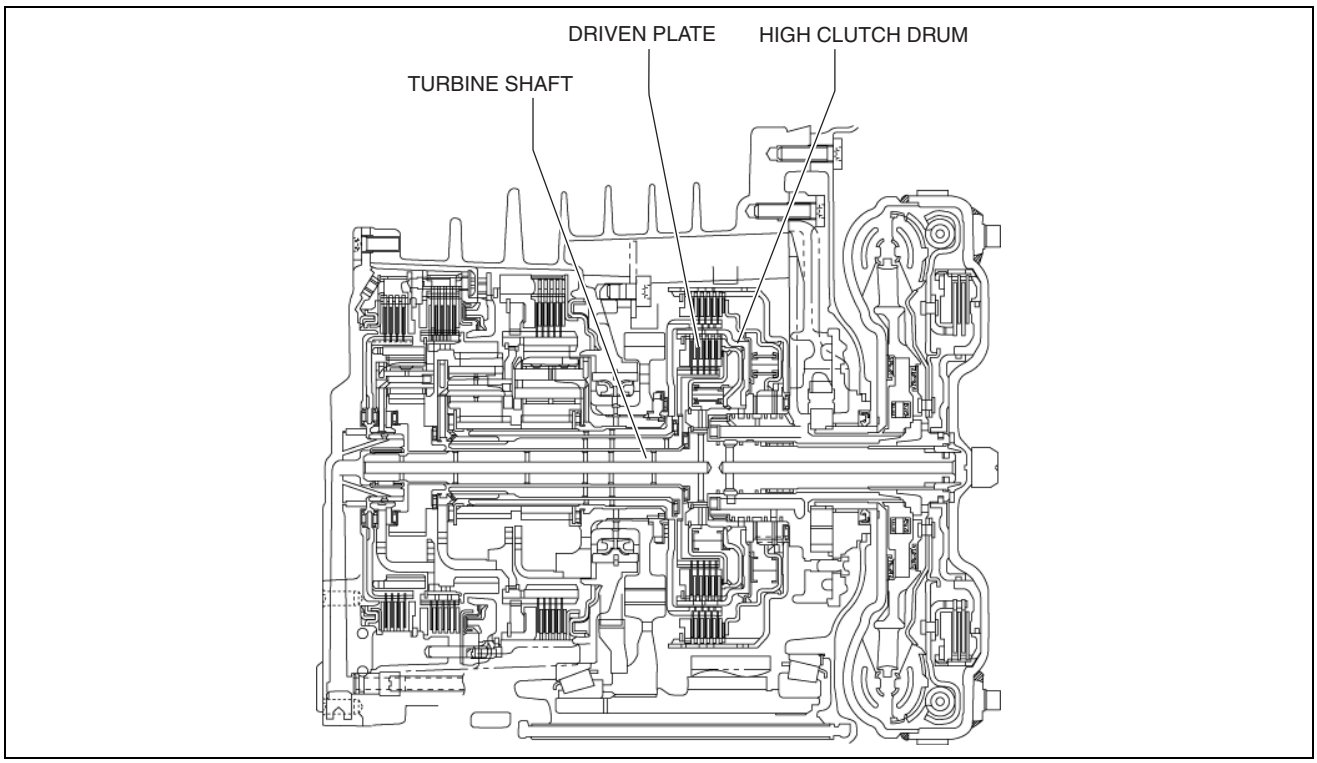
- The high clutch consists of the following parts shown in the figure.



ac5wzn00001687

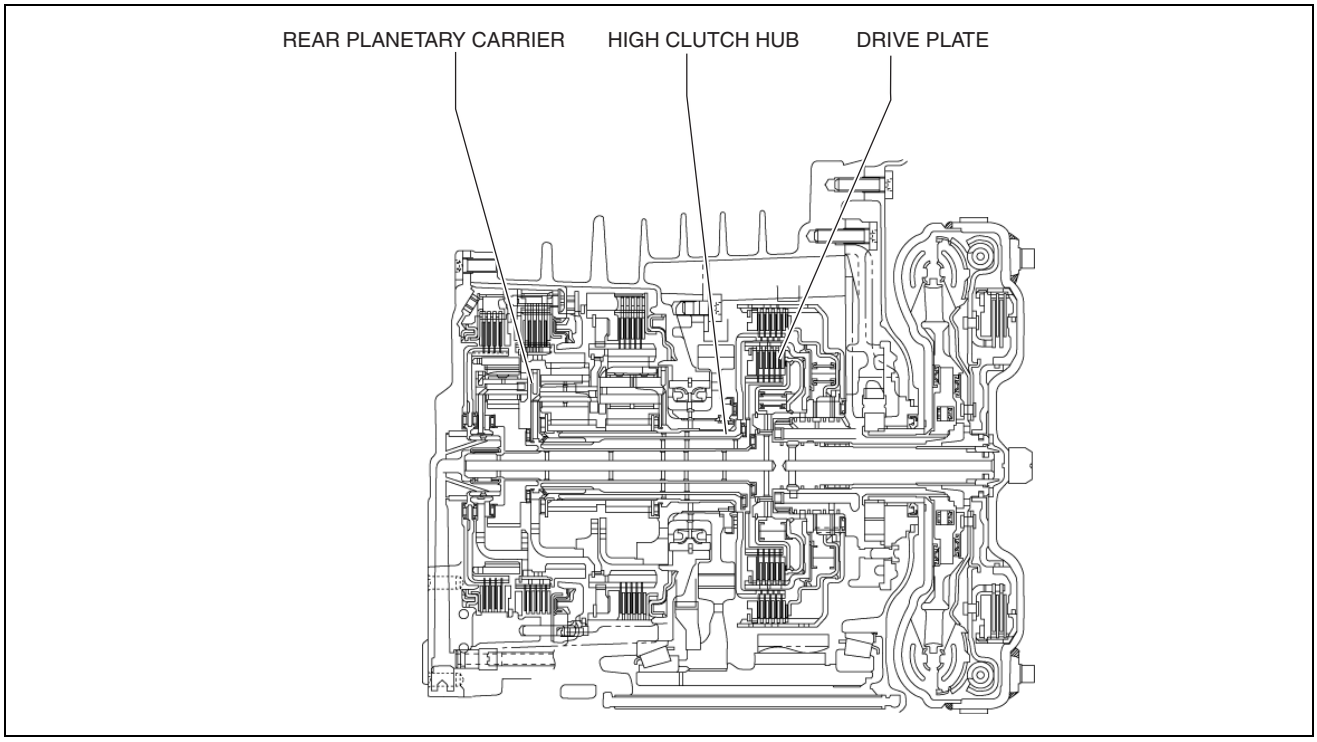
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The driven plate of the high clutch is engaged with the high clutch drum. The high clutch drum is engaged with the turbine shaft and spline, and when the turbine shaft rotates, the high clutch drum and driven plate rotate as a single unit.



ac5wzn00001688

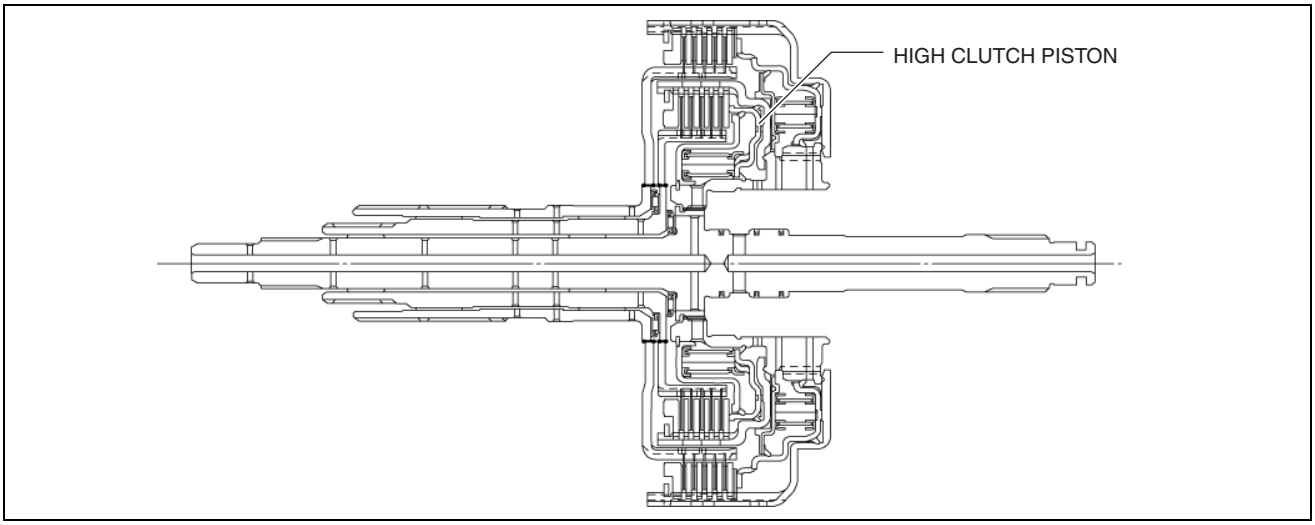
- The drive plate of the high clutch is engaged with the high clutch hub. The high clutch hub is engaged with the rear carrier, and the drive plate, high clutch hub, and rear carrier rotate as a single unit.



ac5wzn00001689

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

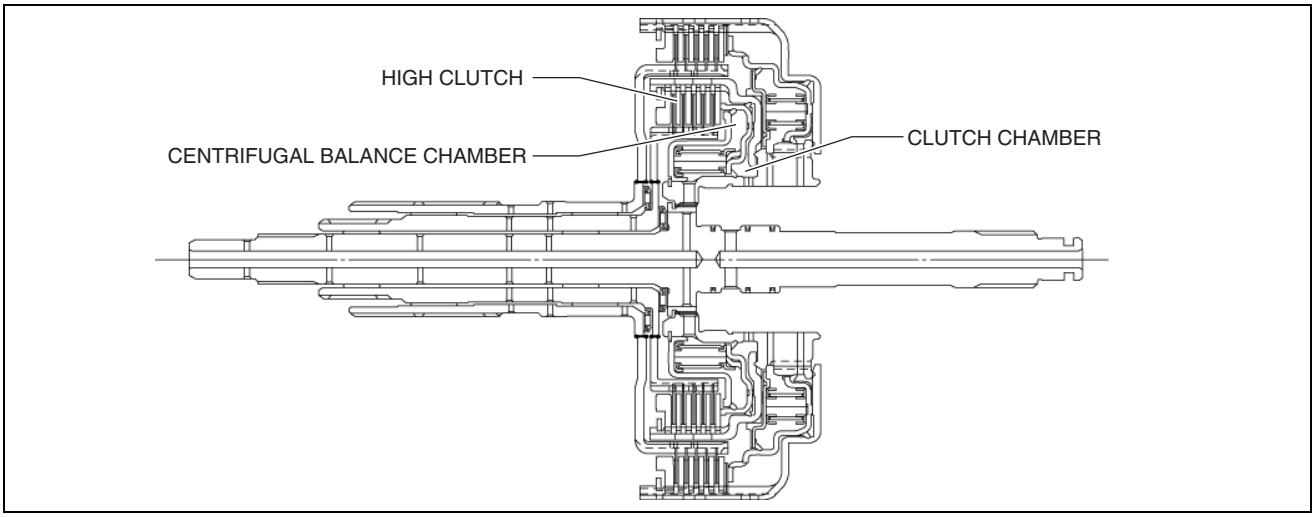
- For the high clutch piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.



am3uun0000231

Centrifugal balance clutch

- The centrifugal balance clutch is built into the high clutch.
- The centrifugal balance chamber is positioned opposing the clutch chamber for the high clutch. In the centrifugal balance chamber, ATF is constantly charged through a specialized hydraulic circuit.

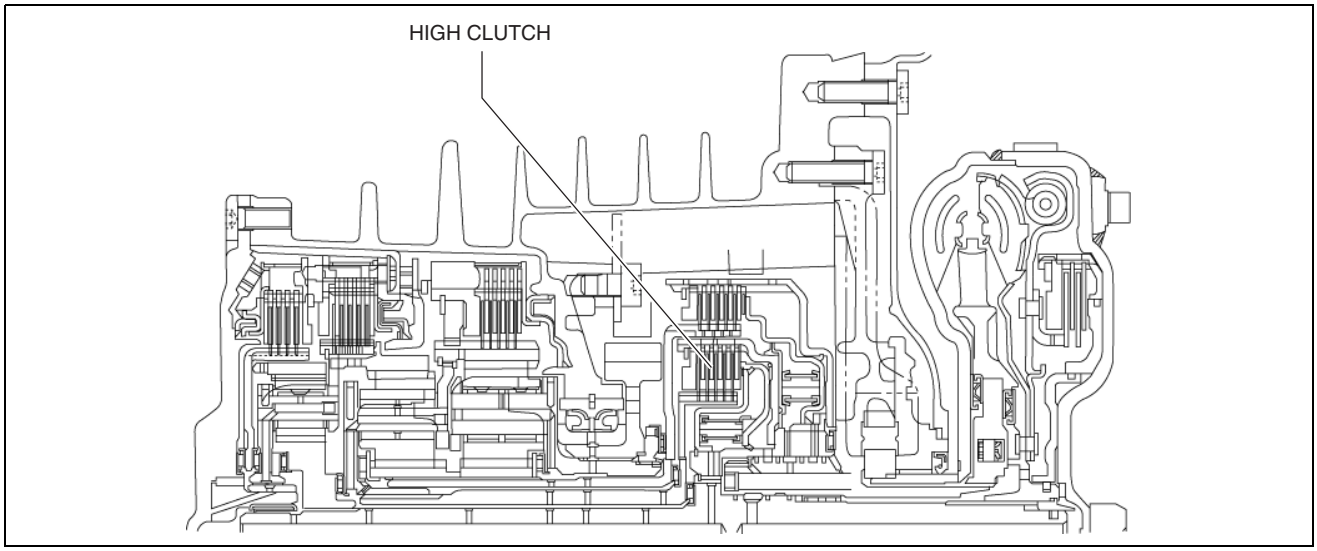


am3uun0000231

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Operation

- If hydraulic pressure is applied to the high clutch piston, the drive plate and driven plate are pressure coupled and drive force from the turbine shaft is transmitted to the rear planetary carrier. In addition, drive force is also transmitted to the front internal gear through the rear planetary gear.



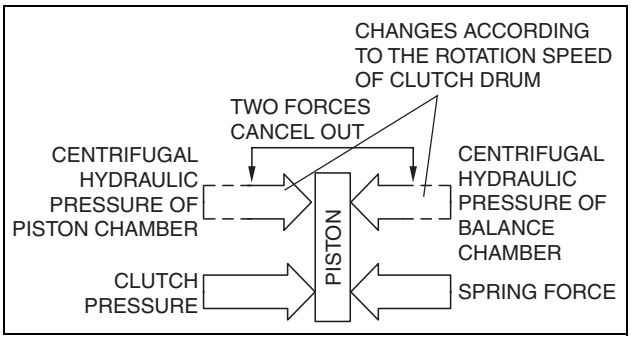
ac5wzn00001690

Centrifugal balance clutch
Clutch pressure not applied

- When the clutch drum rotates, centrifugal force is applied to the remaining ATF in the clutch chamber to push the piston, but centrifugal force is also applied to the ATF in the centrifugal balance chamber to force the piston to move back. As a result, the opposing forces of the clutch and balance chambers are offset and the piston does not move, preventing clutch drag.

Clutch pressure applied

- When clutch pressure is applied to the clutch chamber, the piston, which overcomes the opposing centrifugal hydraulic pressure from the balance chamber and the spring force, is pushed in the direction of clutch engagement and the clutch is engaged. At this time, because the centrifugal hydraulic pressure applied to the clutch pressure in the clutch chamber is offset by the centrifugal hydraulic pressure applied to the balance chamber, the effect of piston thrust by the centrifugal force from the clutch drum rotation is eliminated. As a result, stabilized piston force in all engine speed ranges is assured, thus reducing shift shock.



am3uun0000223

R-3-5 BRAKE [GW6A-EL, GW6AX-EL]

id0517i2351400

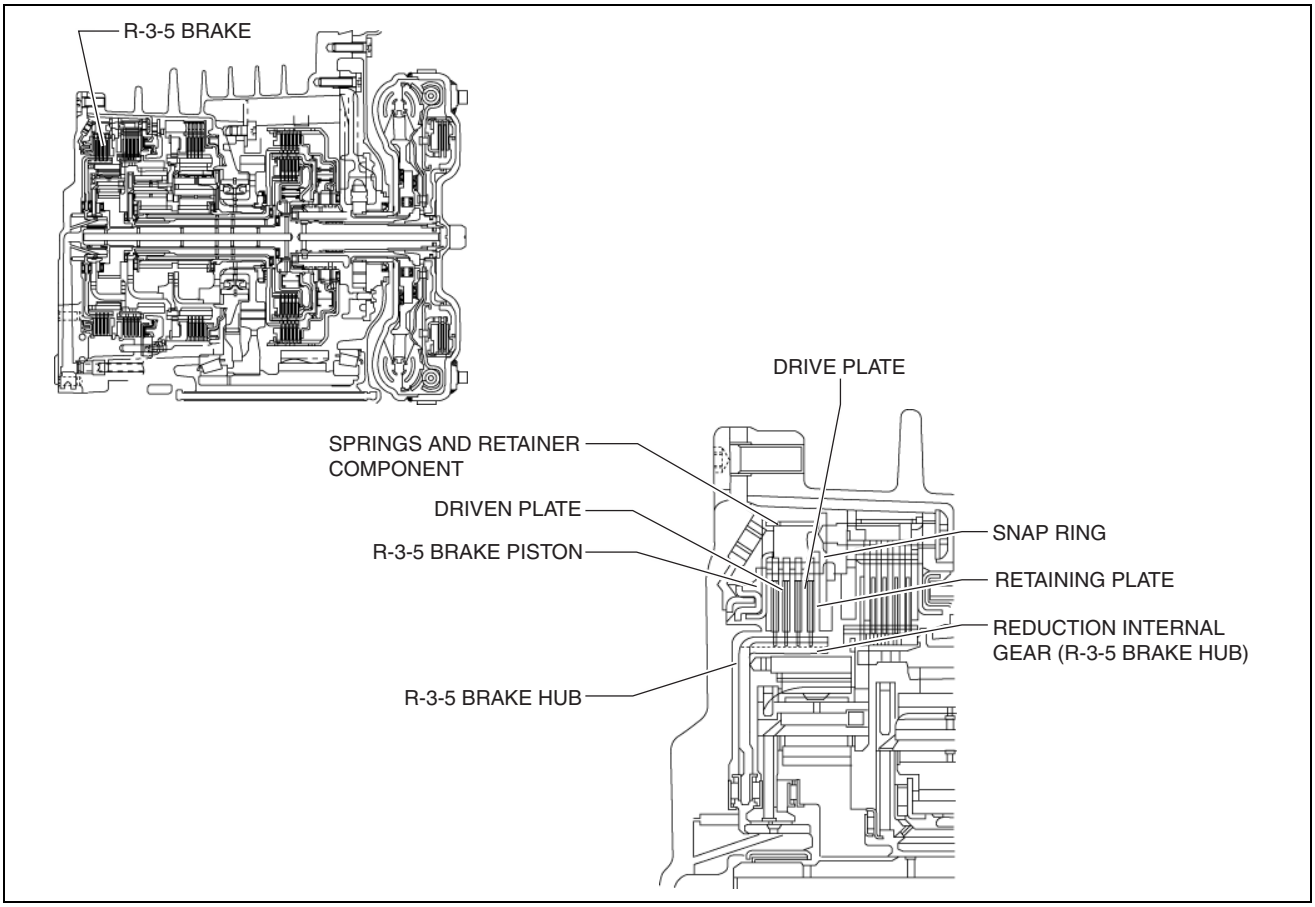
Purpose/Function

- The R-3-5 brake operates in 3GR, 5GR and in reverse to lock the reduction internal gear against rotation.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

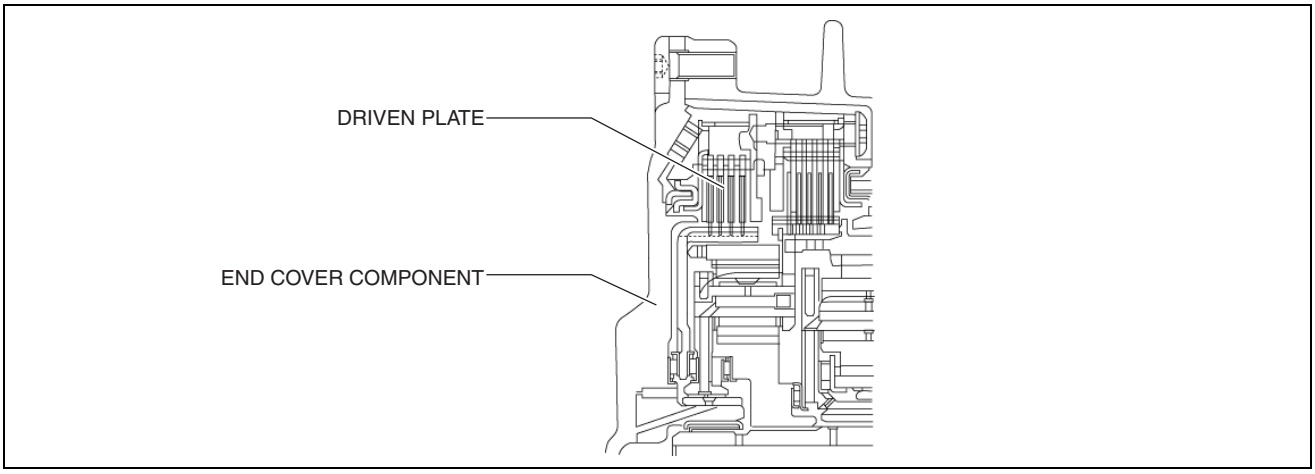
Construction

- The R-3-5 brake consists of the following parts shown in the figure.



ac5wzn00001691

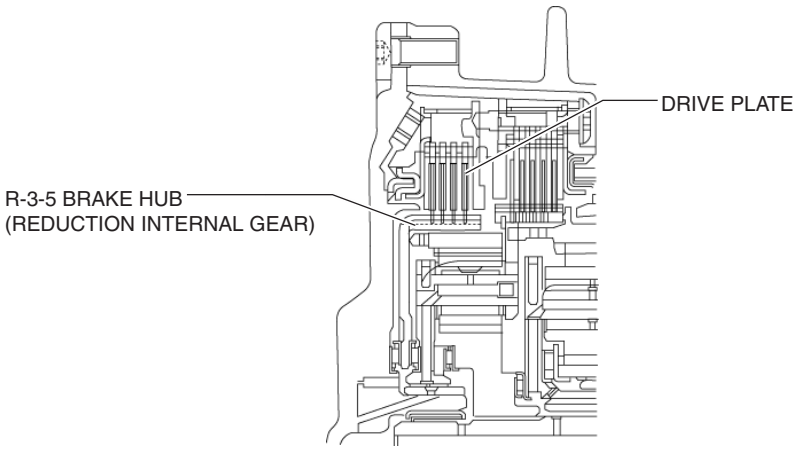
- The driven plate of the R-3-5 brake does not rotate because it is connected to the end cover component.



ac5wzn00001692

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The R-3-5 brake drive plate is engaged with the R-3-5 brake hub and reduction internal gear, and locks the reduction internal gear.

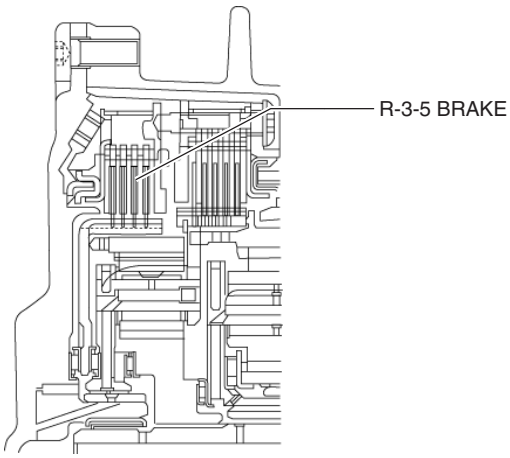


ac5wzn00001693

- For the R-3-5 brake piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.

Operation

- When hydraulic pressure is applied to the R-3-5 brake piston, the drive plate and driven plate are pressure bonded to lock the reduction internal gear.



ac5wzn00001694

2-6 BRAKE [GW6A-EL, GW6AX-EL]

id0517i2351500

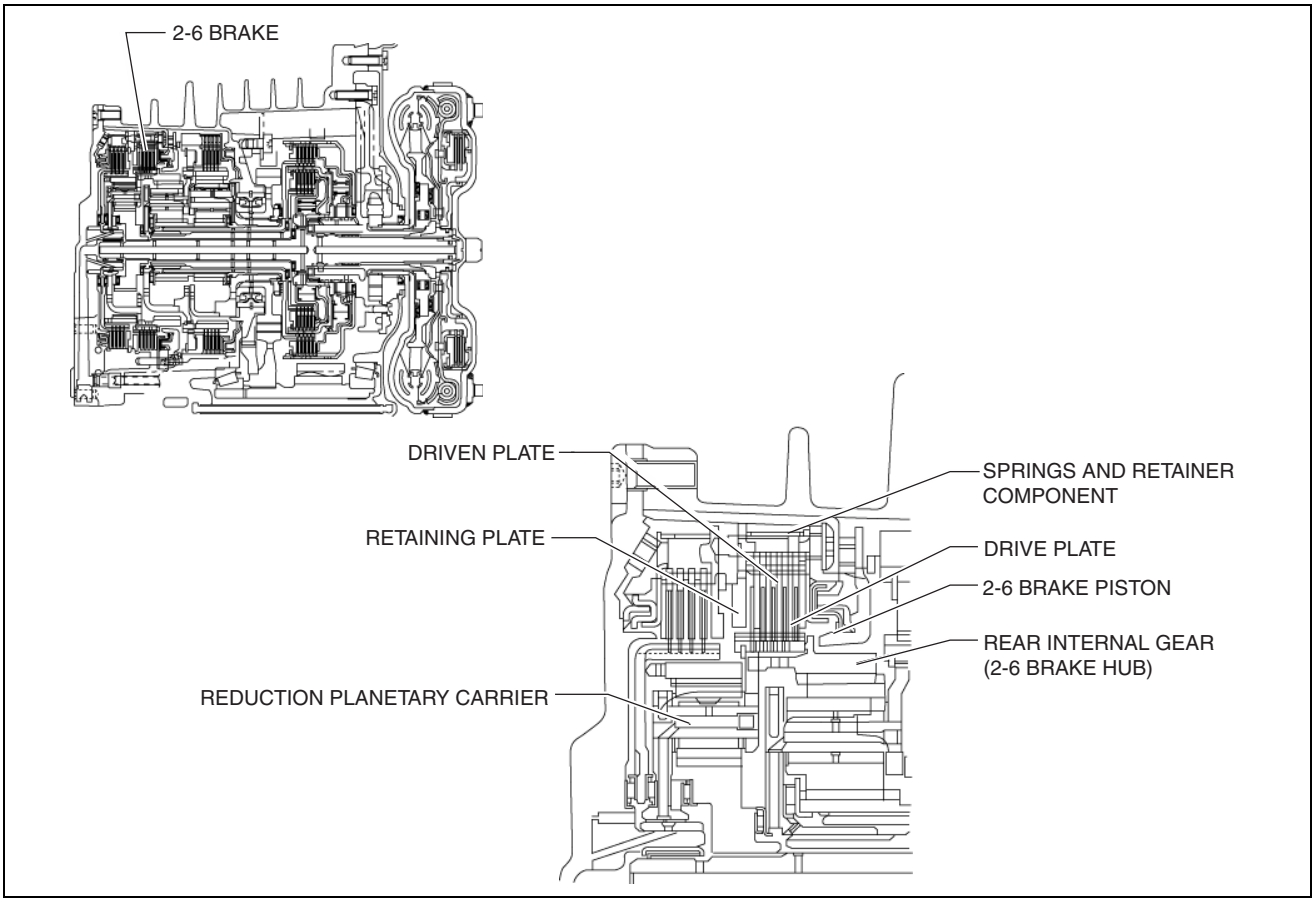
Purpose/Function

- The 2-6 brake locks the rear internal gear and reduction planetary carrier while in 2GR and 6GR.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

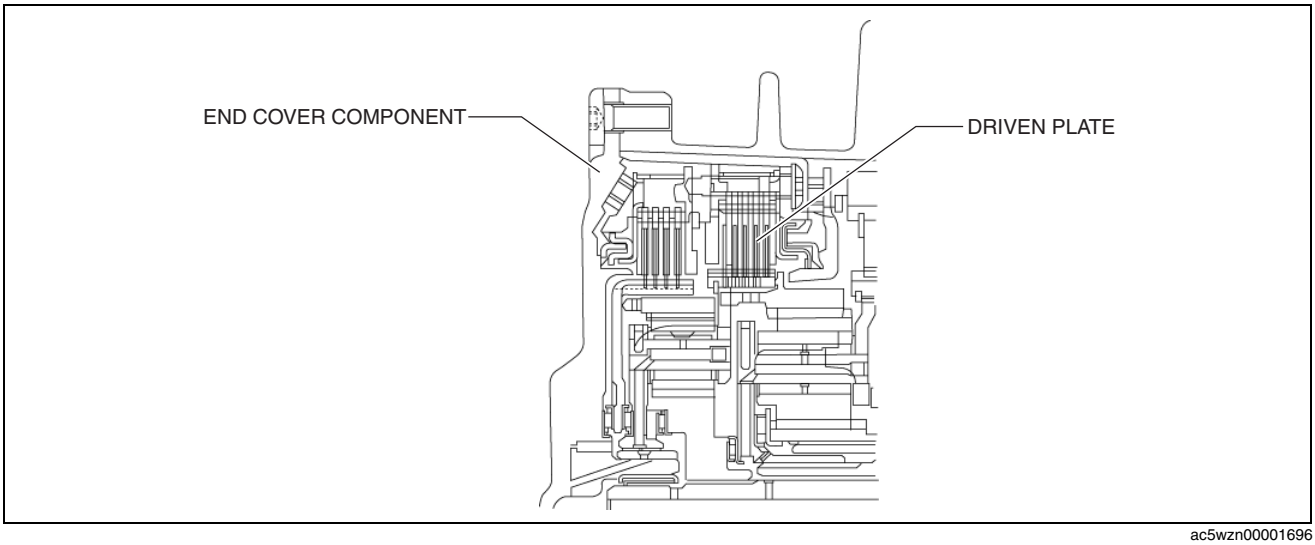
Construction

- The 2-6 brake consists of the following parts shown in the figure.



ac5wzn00001695

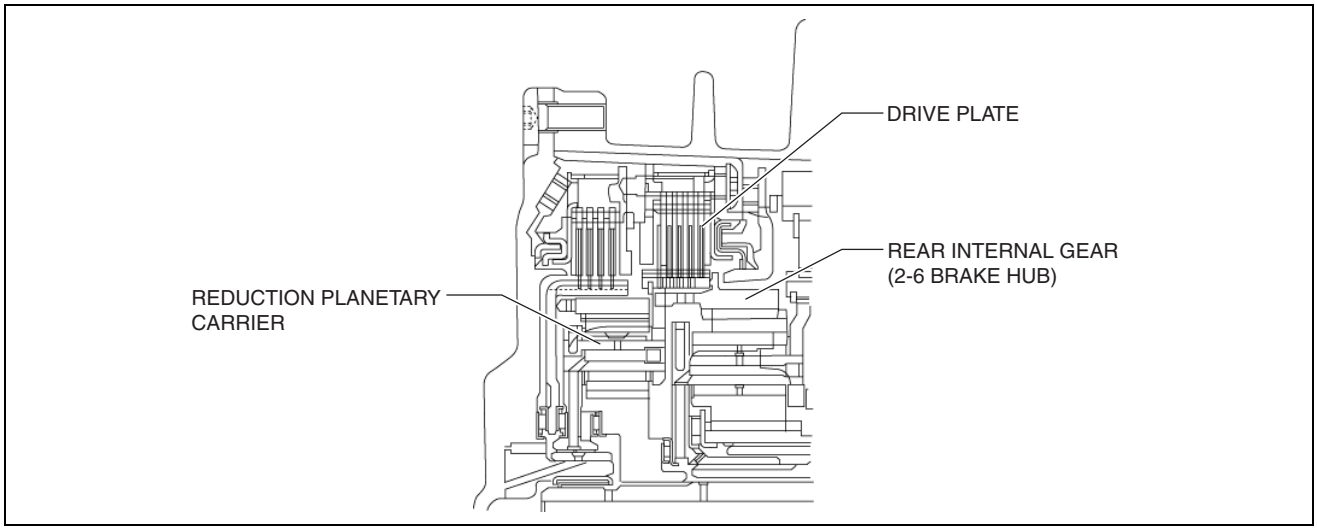
- The driven plate of the 2-6 brake does not rotate because it is connected to the end cover component.



ac5wzn00001696

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The driven plate of the 2-6 brake is engaged with the 2-6 brake hub and rear internal carrier, and the rear internal carrier is engaged with the reduction planetary carrier through the rear internal gear. Therefore, the rear internal gear and reduction planetary gear are locked by the 2-6 brake.

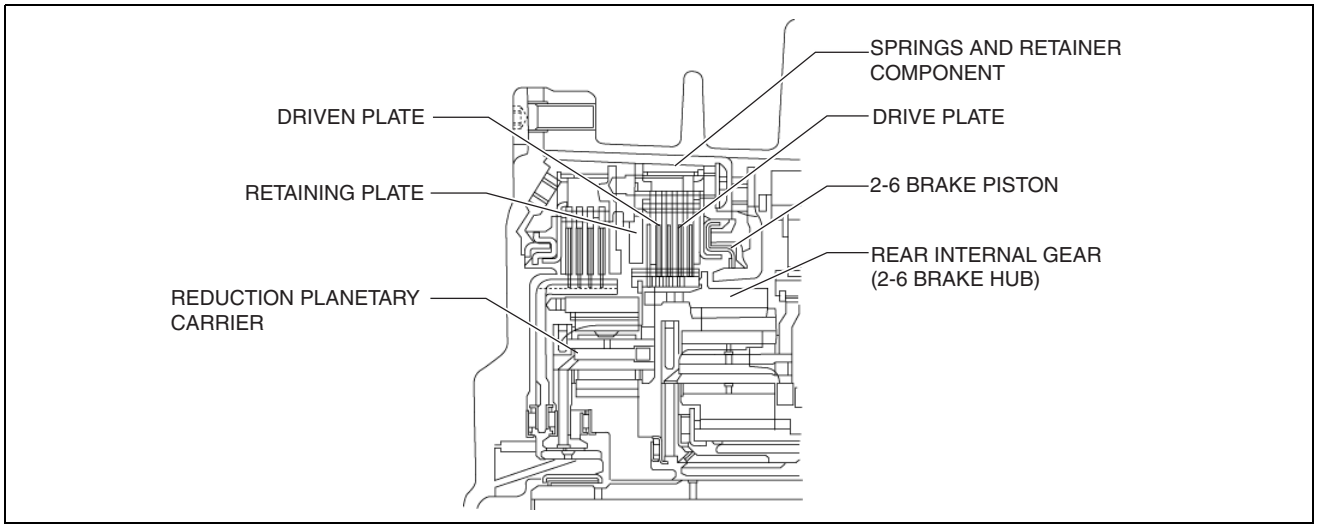


ac5wzn00001697

- For the 2-6 brake piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.

Operation

- When hydraulic pressure is applied to the 2-6 brake piston, the drive plate and driven plate are pressure bonded to lock the rear internal gear and reduction planetary carrier.



ac5wzn00001698

LOW AND REVERSE BRAKE [GW6A-EL, GW6AX-EL]

id0517i2351600

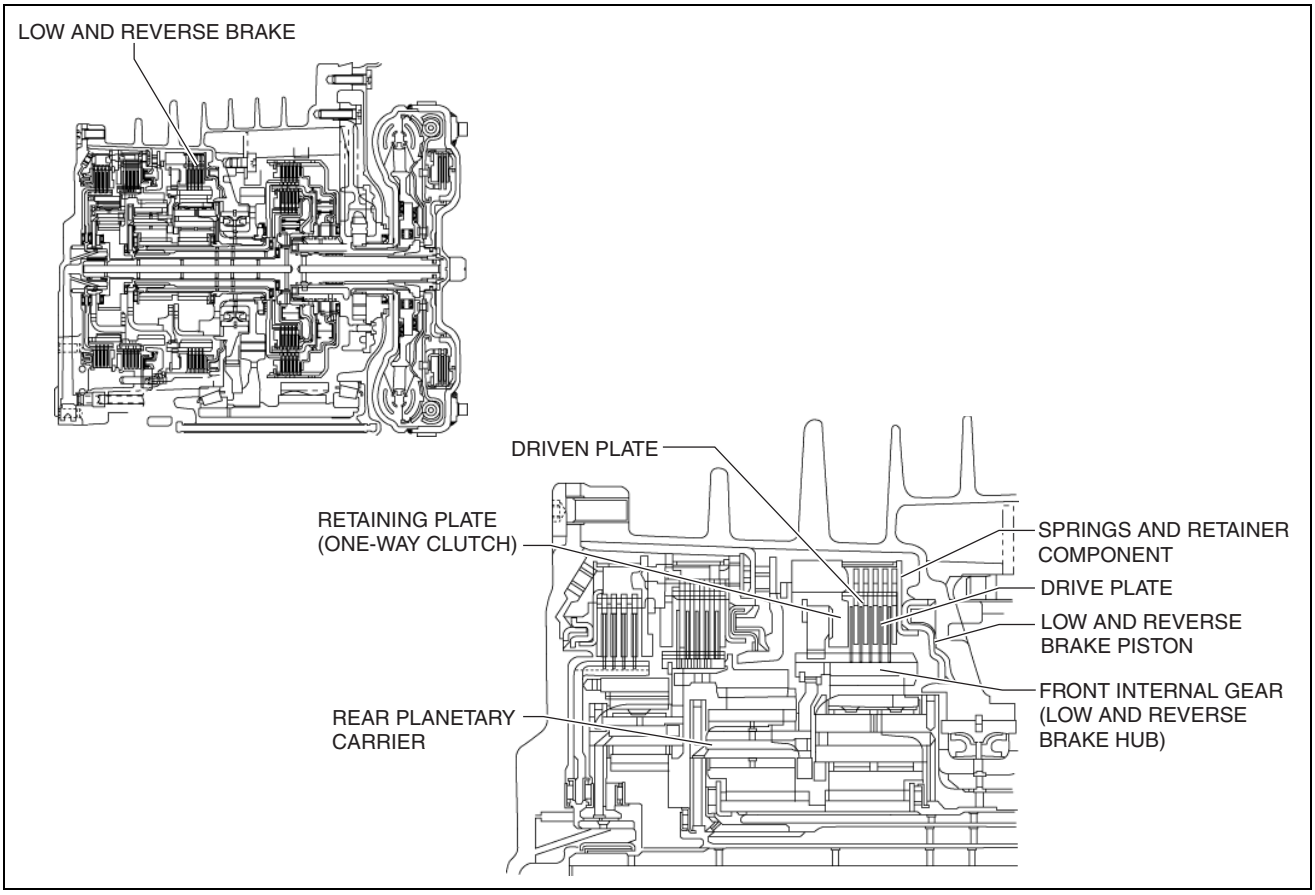
Purpose/Function

- The low and reverse brake stops the rotation of the front internal gear and rear planetary carrier while in 1GR and in reverse, locking them to the transaxle case.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

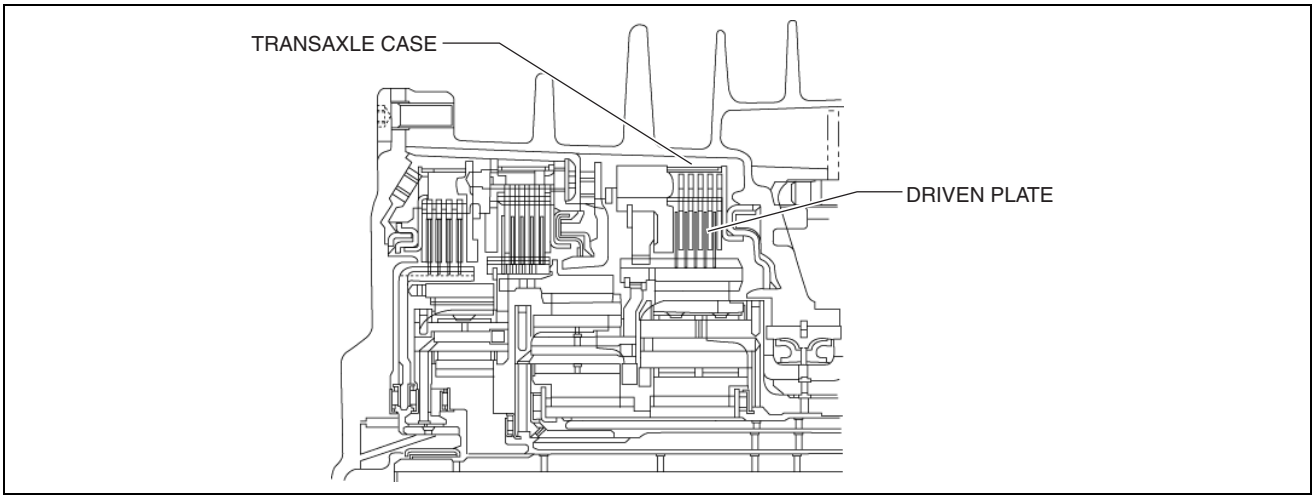
Construction

- The low and reverse brake consist of the following parts shown in the figure.



ac5wzn00001699

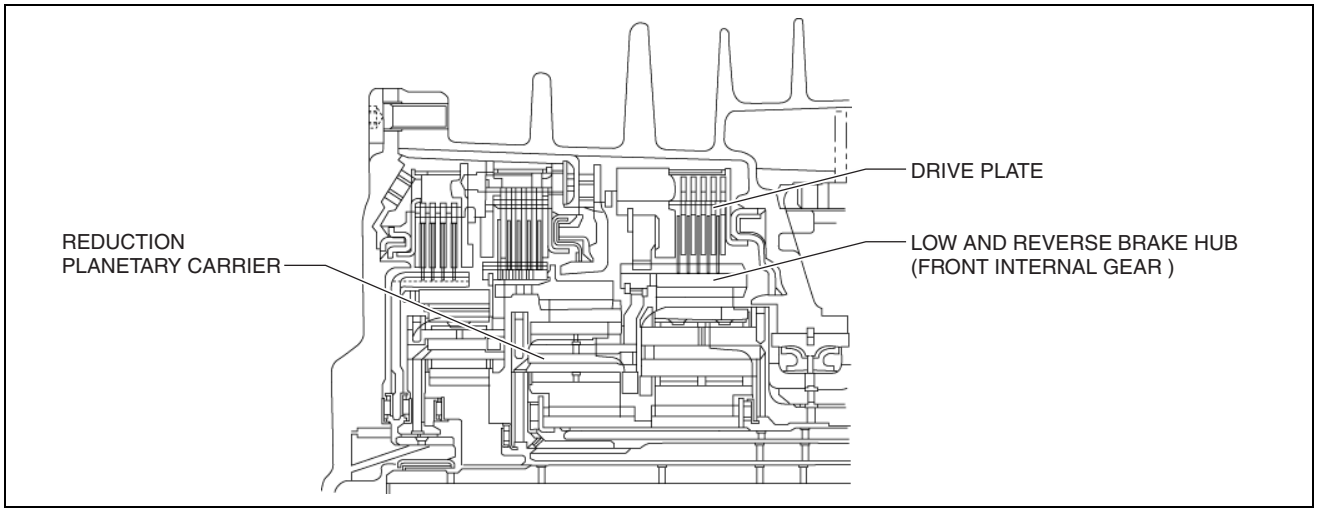
- The driven plate of the low and reverse brake does not rotate because it is connected to the transaxle case.



ac5wzn00001700

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The drive plate of the low and reverse brake is engaged with the low and reverse brake hub and front internal gear. Therefore, the rear planetary carrier is locked via the front internal gear.

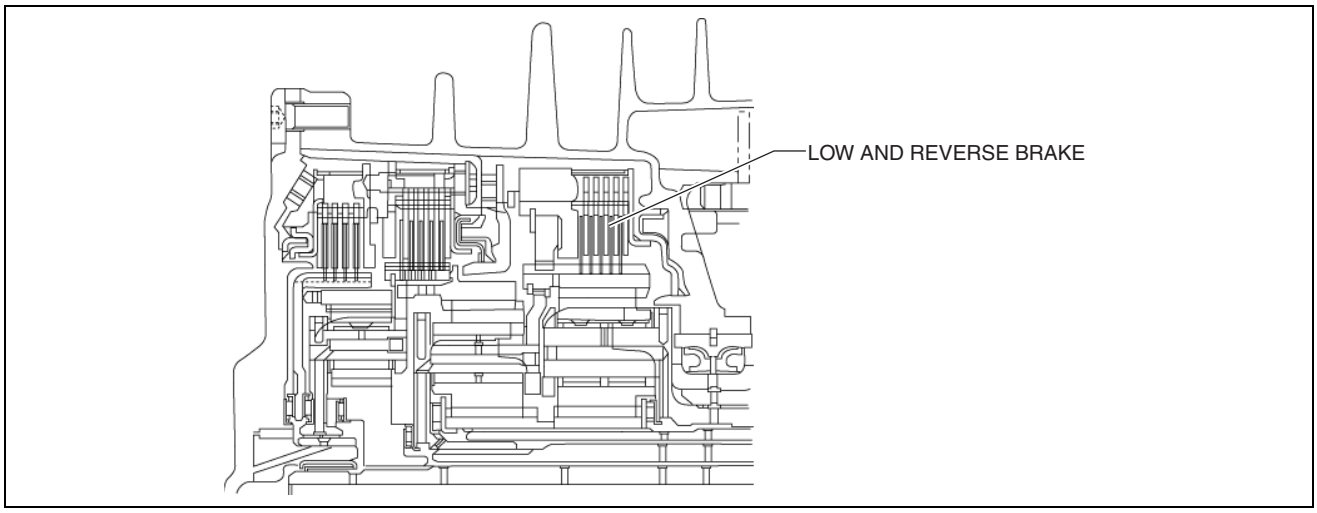


ac5wzn00001701

- For the low and reverse brake piston, a compact and highly reliable bonded seal piston has been adopted in which the piston and seal are molded together.

Operation

- When hydraulic pressure is applied to the low and reverse brake piston, the drive plate and driven plate are pressure bonded to lock the front internal gear and rear planetary gear to the transaxle case.



ac5wzn00001702

ONE-WAY CLUTCH [GW6A-EL, GW6AX-EL]

id0517i2351700

Purpose/Function

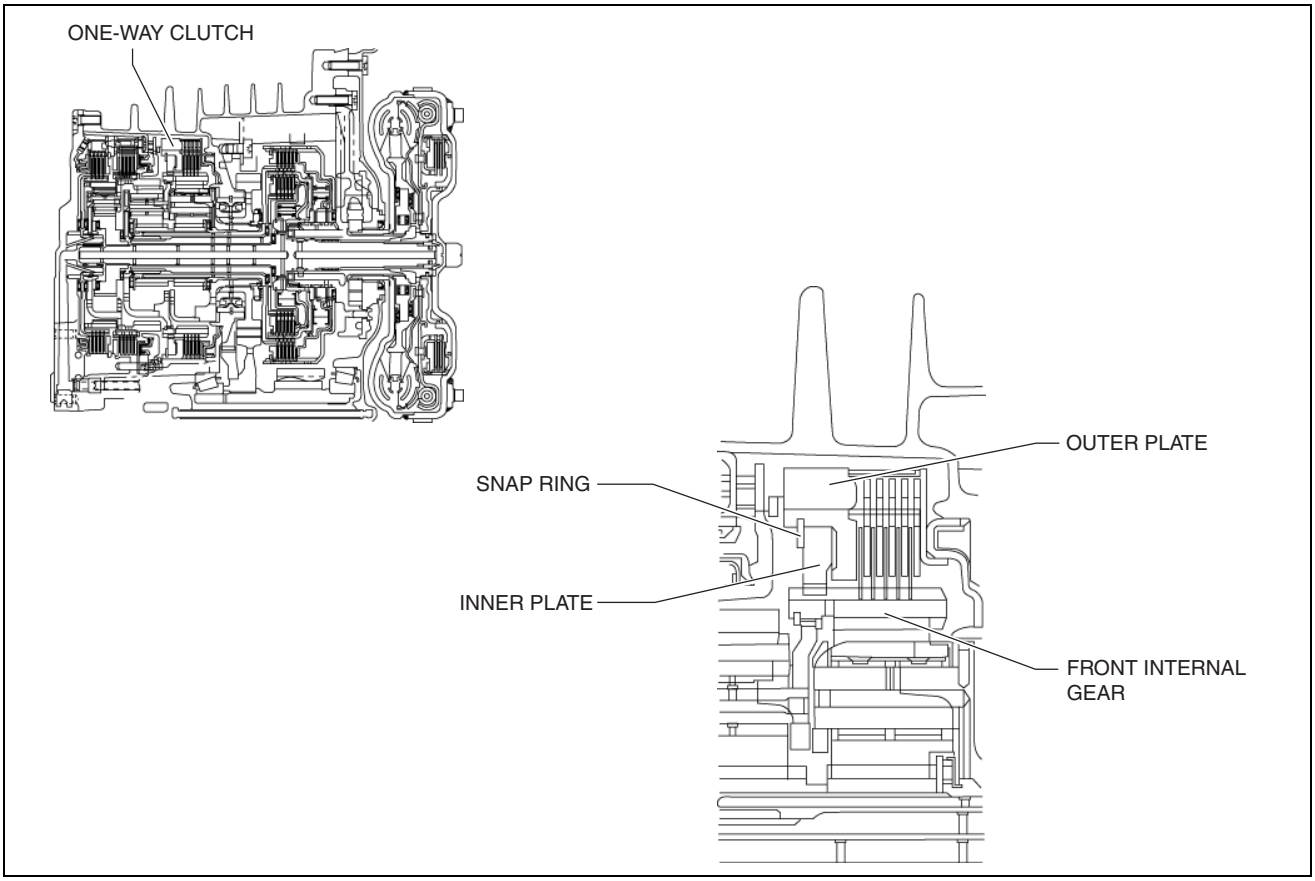
- The one-way clutch operates in 1GR and suppresses the counterclockwise rotation of the front internal gear (as viewed from torque converter side).

Construction

- The one-way clutch consists of a mechanical diode-type one-way clutch, inner plate, and outer plate.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The inner plate for the one-way clutch is connected to the front internal gear and the outer plate is connected to the transaxle.



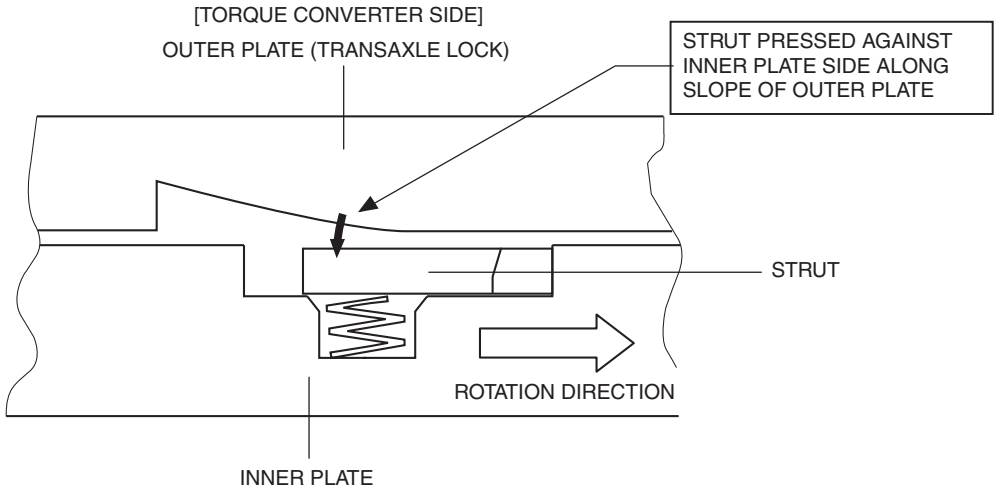
ac5wzn00001703

Operation

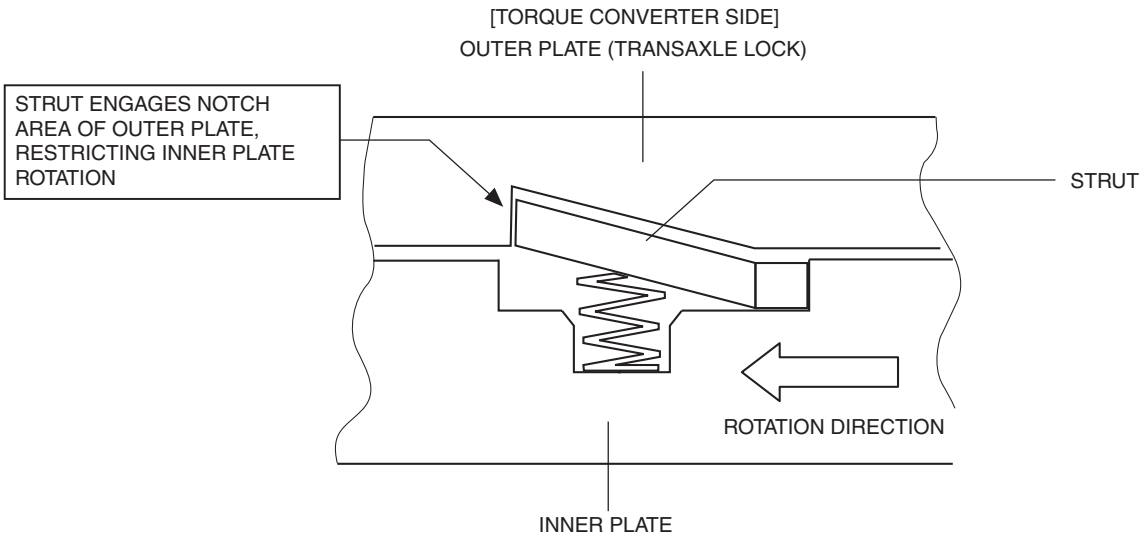
- The connected inner plate also rotates clockwise during the clockwise rotation of the front internal gear. Therefore, the rotation is not regulated and the inner plate spins because the strut installed to the inner plate is pressed toward the inner plate along the slope of the outer plate.
- The strut engages the notch of the outer plate by the rotation of the inner plate which also rotates counterclockwise during the counterclockwise rotation of the front internal gear. Due to this, the rotation of the inner plate is regulated and the rotation of the front internal gear is suppressed.

- As a result, the front internal gear suppresses the counterclockwise rotation of the rear pinion gear via the rear planetary carrier.

FREE SPIN (CLOCKWISE ROTATION)



LOCK (COUNTERCLOCKWISE ROTATION)



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PLANETARY GEAR [GW6A-EL, GW6AX-EL]

id0517i2351800

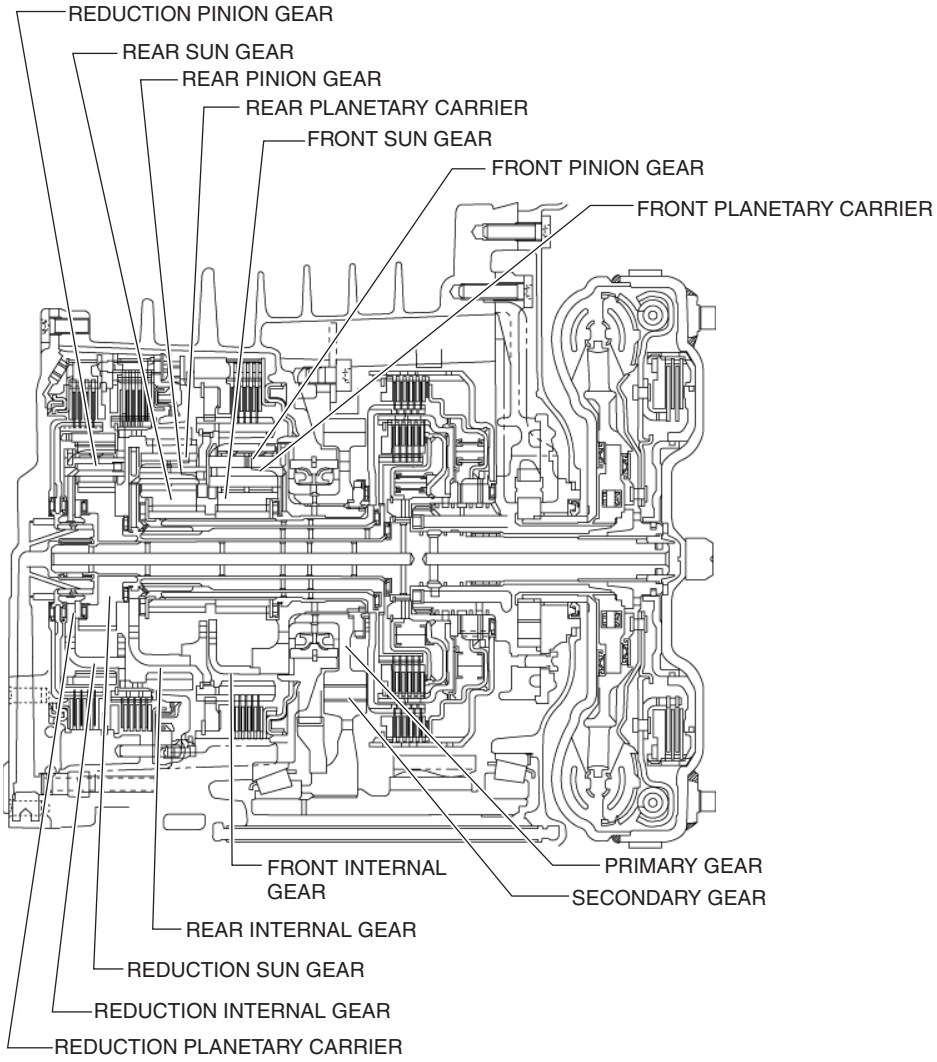
Purpose/Function

- The planetary gear is a mechanism which shifts the drive force from the engine. The planetary gear consists of multiple gears which rotate individually while revolving. By controlling the individual rotation and revolving of the gears, the transaxle performs gear shifting at the optimum gear speed according to the driving conditions.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

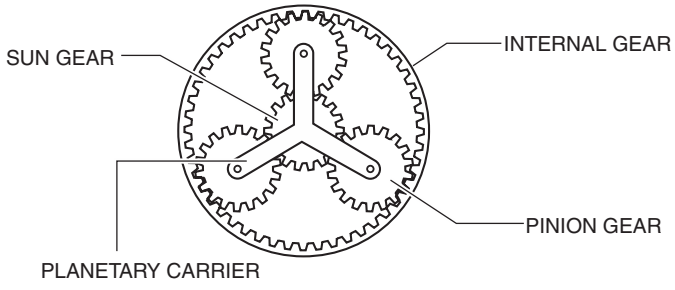
Construction

- The planetary gear is positioned in the order of the front planetary gear, rear planetary gear, and reduction planetary gear from the torque converter side. The planetary gear is a single planetary gear type. For the component parts of each planetary gear, refer to the following figure.



ac5wzn00001704

- The planetary gear is composed of the sun gear, pinion gear, planetary carrier, and internal gear as shown in the figure.



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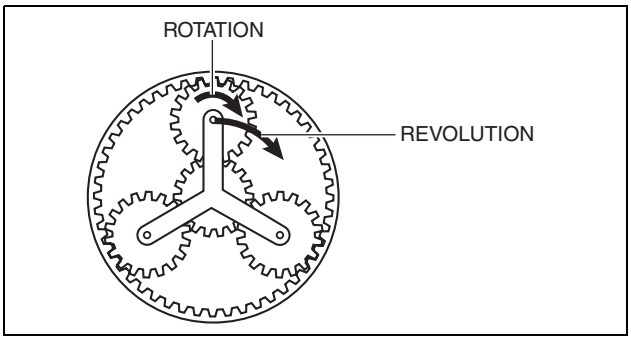
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- There are two types of pinion gear rotation, rotation (rotation) on an axis of the center for each pinion gear and rotation (revolution) on an axis of center for the planetary carrier. The planetary gear operates shifting function by switching the input, fixed, or output of the internal gear, pinion gear, and planetary carrier.
- The relation of rotation speed of each element for the planetary gear set is generally indicated as follows:
  $(Z_R + Z_S)\ N_C = Z_R\ N_R + Z_S\ N_S$: (1)
  Meaning of symbols
  — Z: Number of teeth
  — N: Rotation speed
  — Additional character R: Internal gear
  — Additional character S: Sun gear
  — Additional character C: Planetary carrier (pinion gear)



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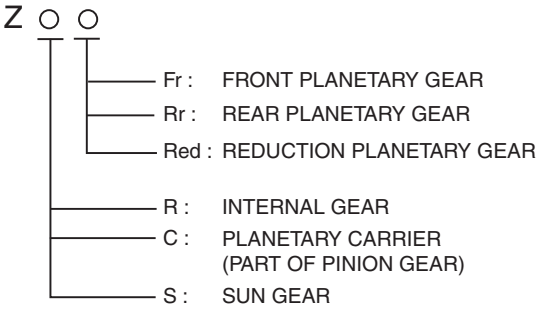
Number of teeth and symbols for each gear

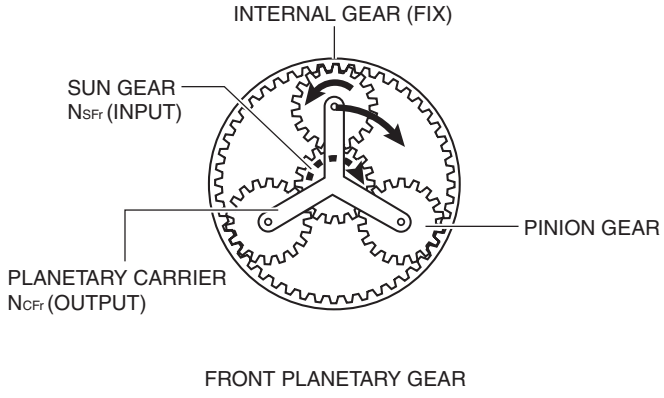
Planetary gear unit		Number of teeth	Symbols
Front	Internal gear	97	Z_{RFr}
	Planetary carrier (part of pinion gear)	29	Z_{CFr}
	Sun gear	39	Z_{SFr}
Rear	Internal gear	95	Z_{RRr}
	Planetary carrier (part of pinion gear)	27	Z_{CRr}
	Sun gear	41	Z_{SRr}
Reduction	Internal gear	109	Z_{RRed}
	Planetary carrier (part of pinion gear)	22	Z_{CRed}
	Sun gear	66	Z_{SRed}

Meaning of symbols



am3uun0000233

Operation
1GR



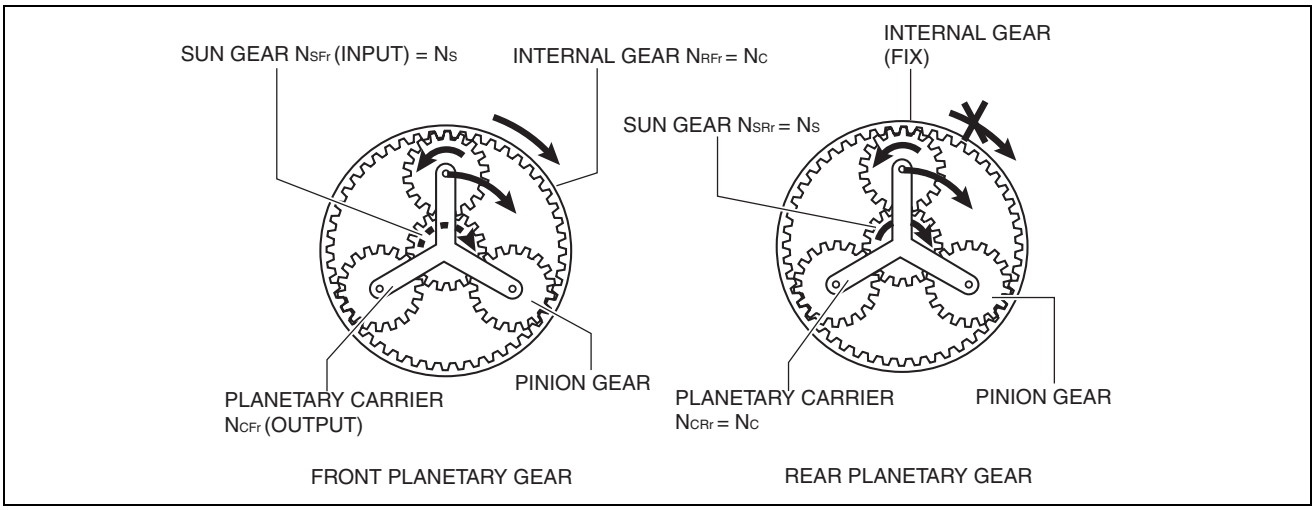
am3uun0000224

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Rotation speed for each gear

Planetary gear unit	Front planetary gear
Internal gear	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)
Sun gear	N_{SFr} (Input)

2GR



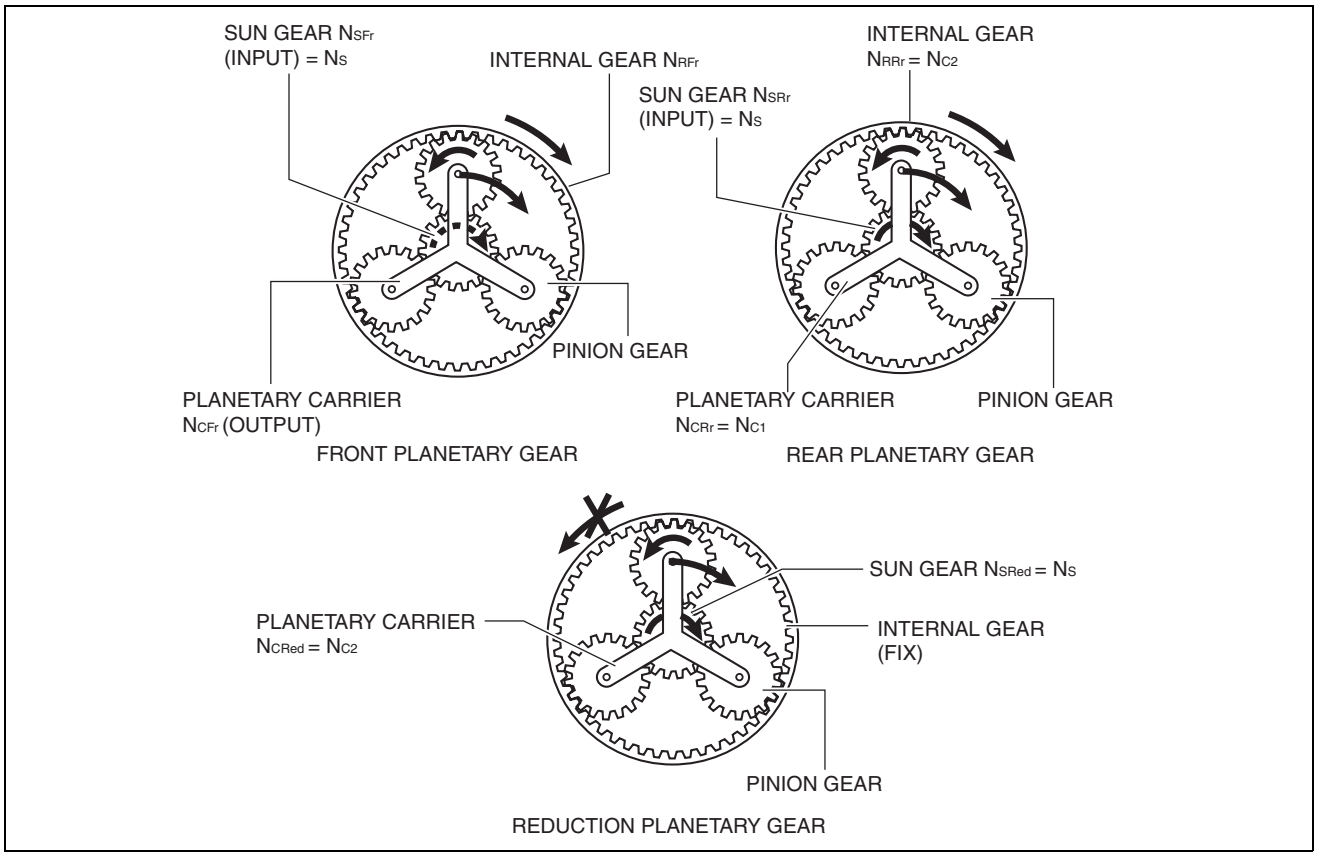
am3uun0000224

Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear
Internal gear	$N_{RFr}=N_C$	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	$N_{CRr}=N_c$
Sun gear	N_{SFr} (Input)=N_S	$N_{SRr}=N_S$

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

3GR



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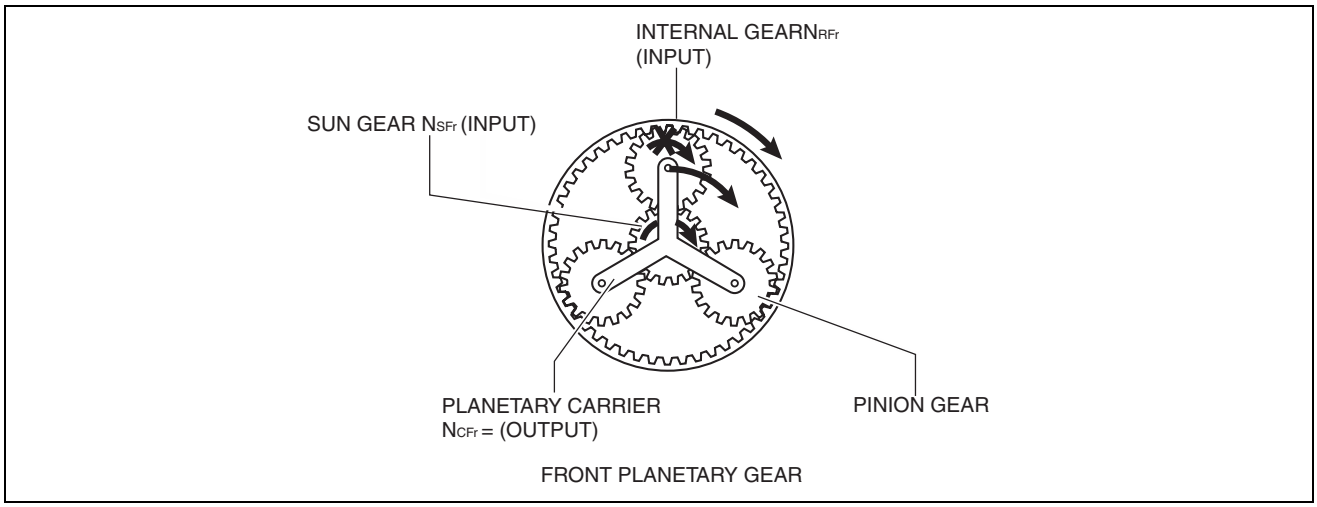
Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear	Reduction
Internal gear	$N_{RFr}=N_{C1}$	$N_{RRr}=N_{c2}$	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	$N_{CRr}=N_{c1}$	$N_{CRed}=N_{c2}$
Sun gear	N_{SFr} (Input)=N_S	$N_{SRr}=N_S$	$N_{SRed}=N_S$

4GR



am3uun0000224

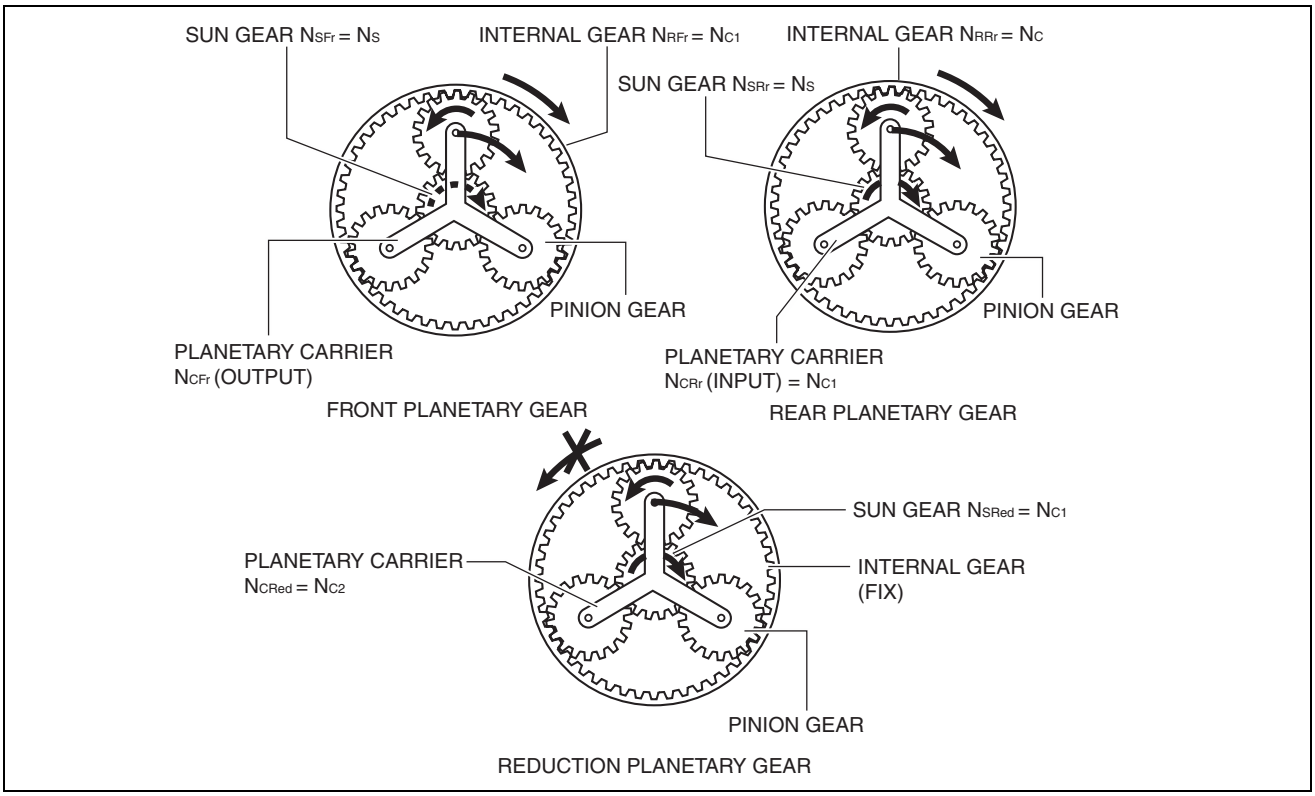
Rotation speed for each gear

Planetary gear unit	Front planetary gear
Internal gear	N_{RFr} (Input)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Planetary gear unit	Front planetary gear
Sun gear	N_{SFr} (Input)

5GR



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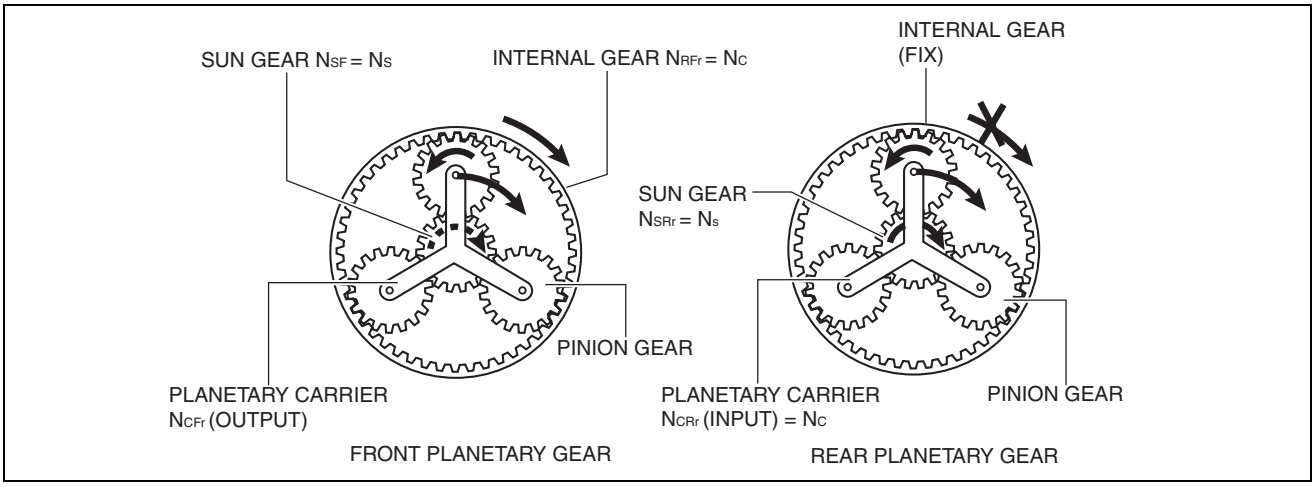
Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear	Reduction
Internal gear	$N_{RFr}=N_{C1}$	$N_{RRr}=N_{c2}$	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	N_{CRr} (Input)$=N_{c1}$	$N_{CRed}=N_{c2}$
Sun gear	$N_{SFr}=N_S$	$N_{SRr}=N_S$	$N_{SRed}=N_{c1}$

6GR



am3uun0000224

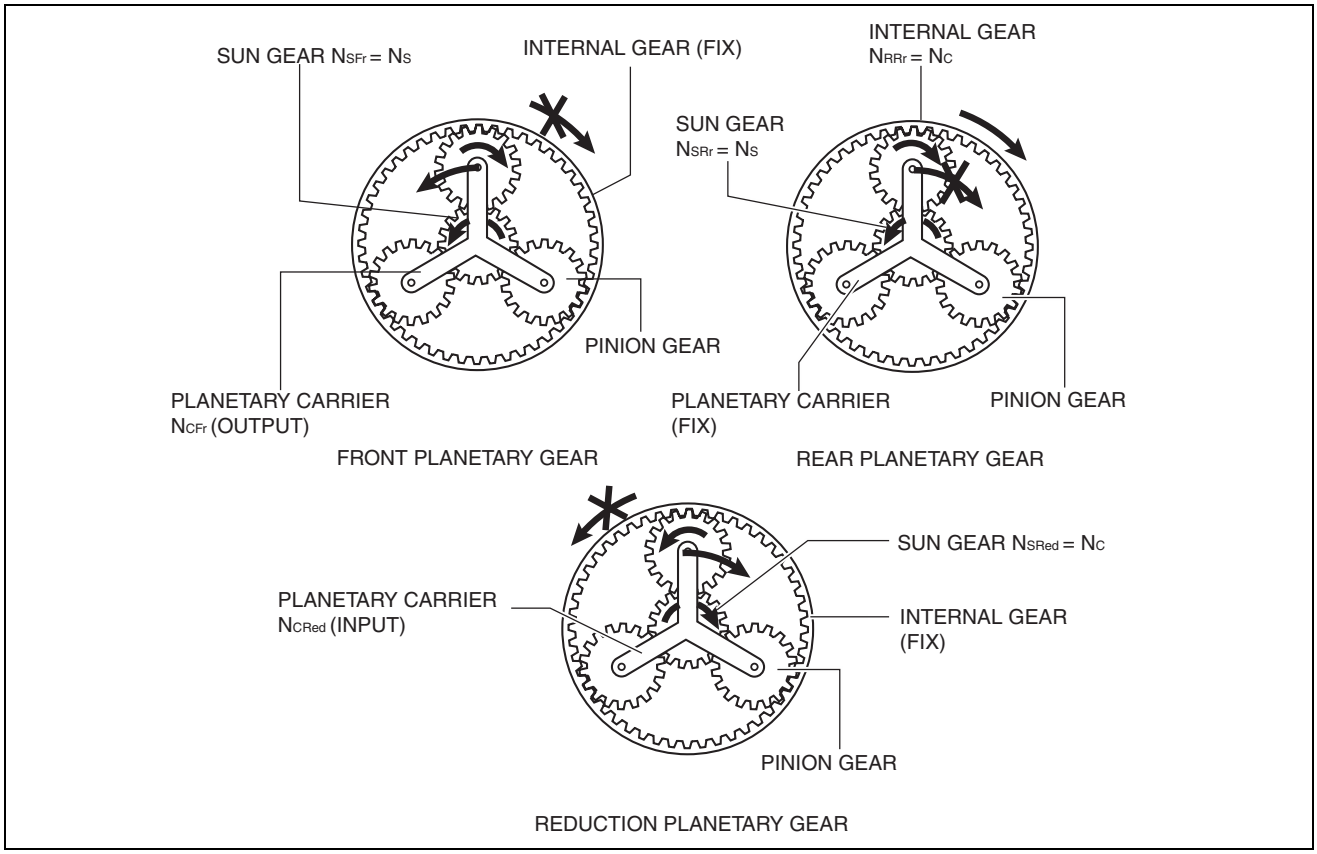
Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear
Internal gear	$N_{RFr}=N_C$	0 (Fix)

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Planetary gear unit	Front planetary gear	Rear planetary gear
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	N_{CRr} (Input)=N_c
Sun gear	N_{SFr}=N_S	N_{SRr}=N_S

Reverse



am3uun0000224

Rotation speed for each gear

Planetary gear unit	Front planetary gear	Rear planetary gear	Reduction
Internal gear	N_{RFr} (Fix)	N_{RRr}=N_c	0 (Fix)
Planetary carrier (part of pinion gear)	N_{CFr} (Output)	N_{CRr} (Fix)	N_{CRed}=N_c
Sun gear	N_{SFr}=N_S	N_{SRr}=N_S	N_{SRed} (Input)

PRIMARY GEAR [GW6A-EL, GW6AX-EL]

id0517i2351900

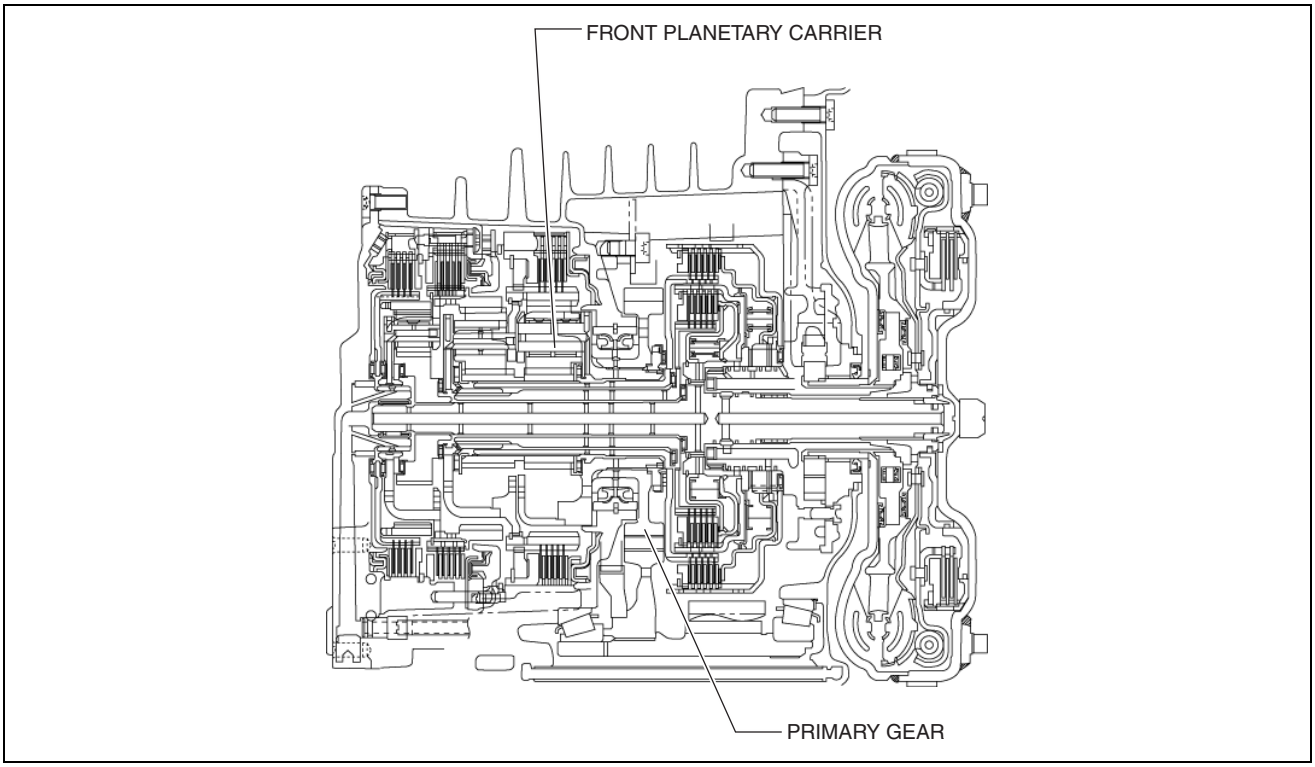
Purpose/Function

- The primary gear transmits the drive force converted by the 3-piece planetary gear to the secondary gear.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction

- The primary gear is engaged with the front planetary carrier and rotates as a single unit.



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SECONDARY GEAR [GW6A-EL, GW6AX-EL]

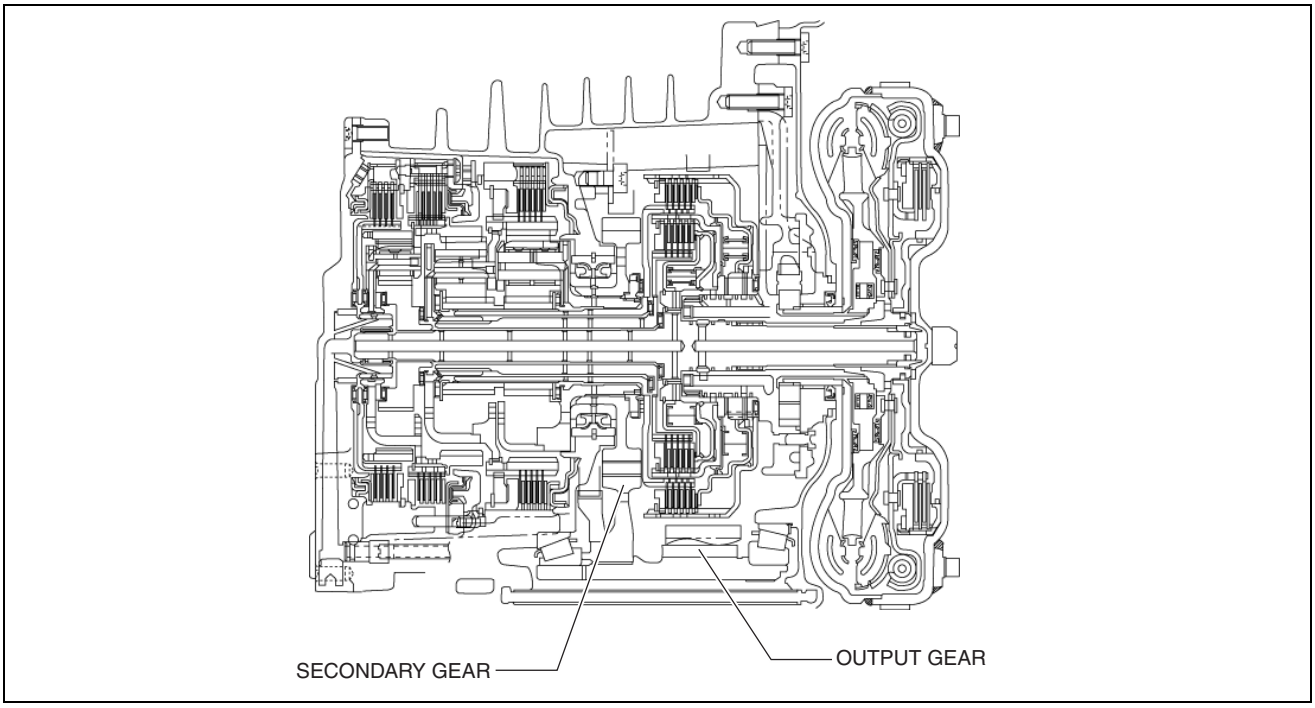
id0517i2352000

Purpose/Function

- The secondary gear transmits the drive force from the primary gear to the output gear.

Construction

- The secondary gear is engaged with the output gear and rotates as a single unit.



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

OUTPUT GEAR [GW6A-EL, GW6AX-EL]

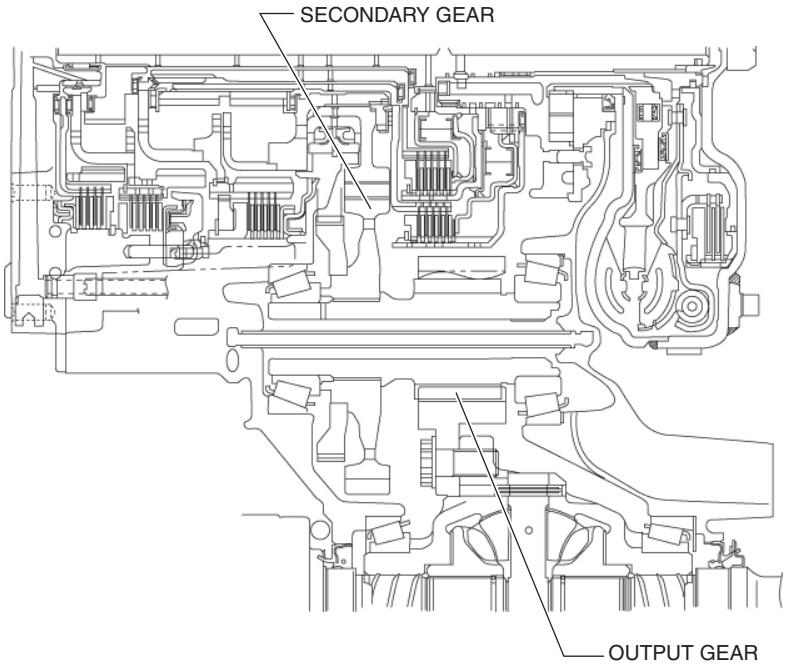
id0517i2352100

Purpose/Function

- The output gear transmits the drive force transmitted from the primary gear and secondary gear to the differential.

Construction

- The output gear is engaged with the secondary gear and rotates as a single unit.



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DIFFERENTIAL [GW6A-EL, GW6AX-EL]

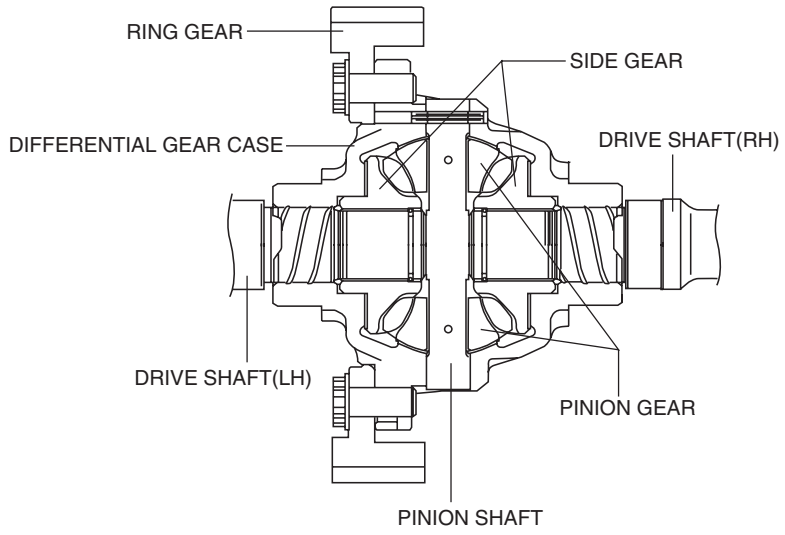
id0517i2352200

Purpose/Function

- The differential absorbs the difference in the rotation speed between the left and right driving wheels so that the vehicle drives smoothly when differences occur due to cornering or driving on rough roads.

Construction

- The differential consists of the ring gear, differential gear case, side gears, pinion gears, and pinion shaft.
- The differential gear case is engaged with the ring gear and rotates as a single unit.
- The side gears are engaged with the drive shaft (LH) and drive shaft (RH) and rotates as a single unit for each.



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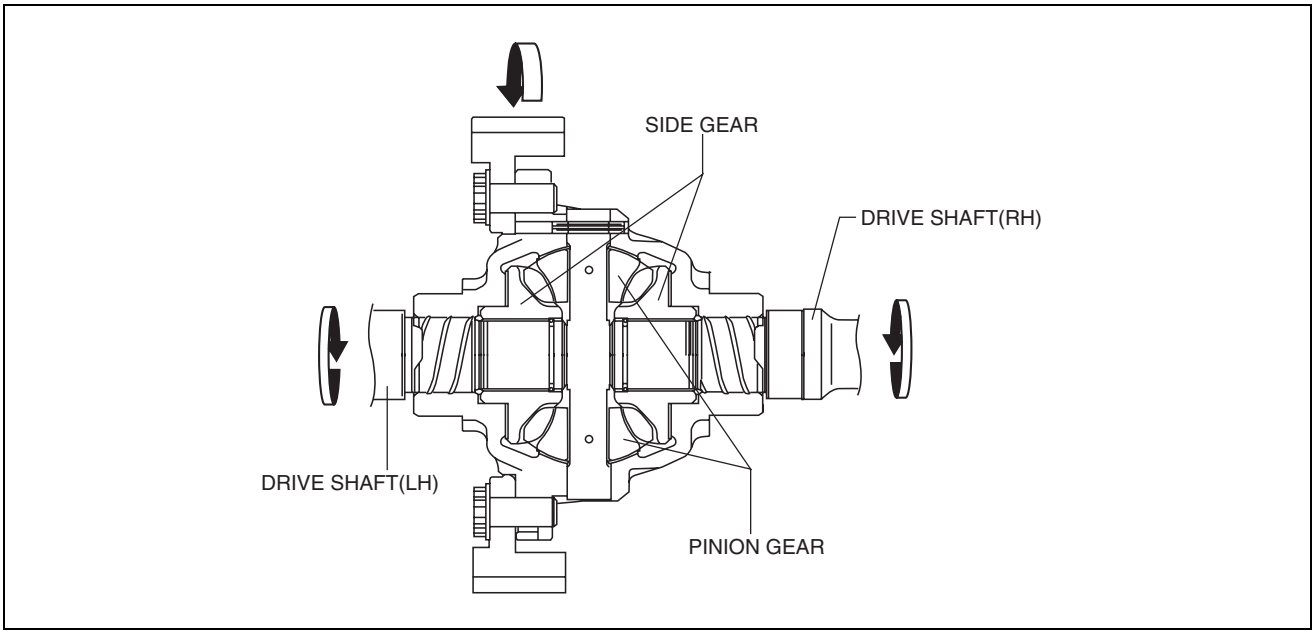
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Operation

- If there is no difference in rotation speed between the left and right driving wheels, the left and right side gears rotate together with the differential gear case and pinion gears.



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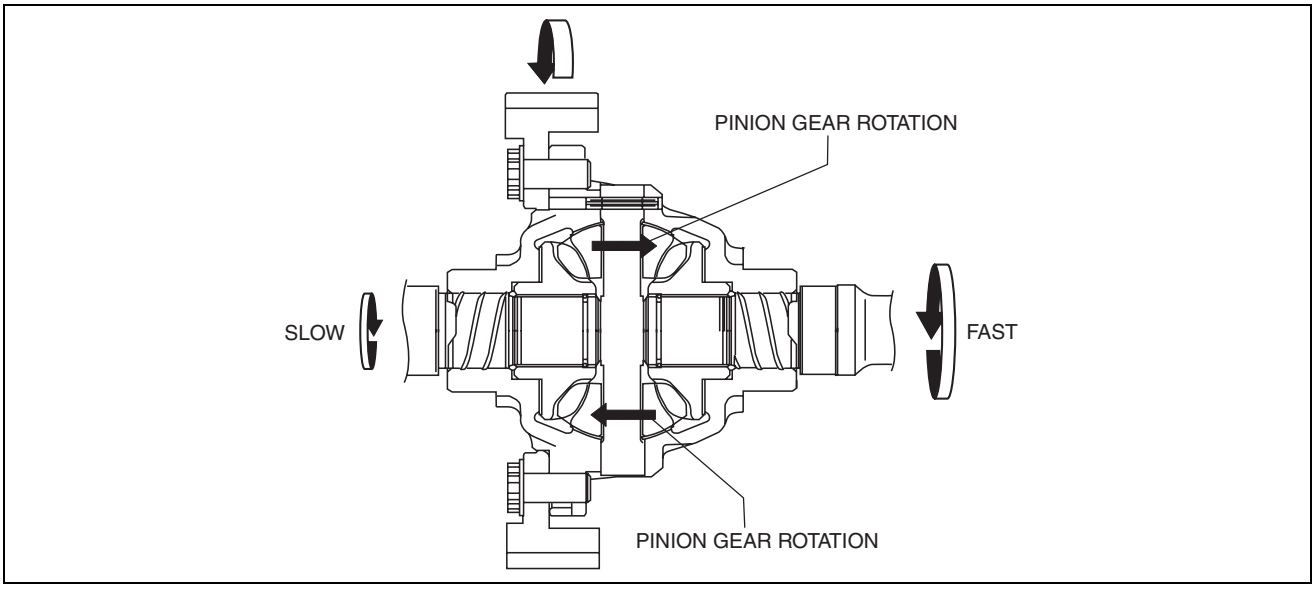
- If there is a difference in the rotation speed between the left and right driving wheels, the difference in the rotation speed between the left and right side gears is absorbed by the pinion gears rotating around the pinion shaft.



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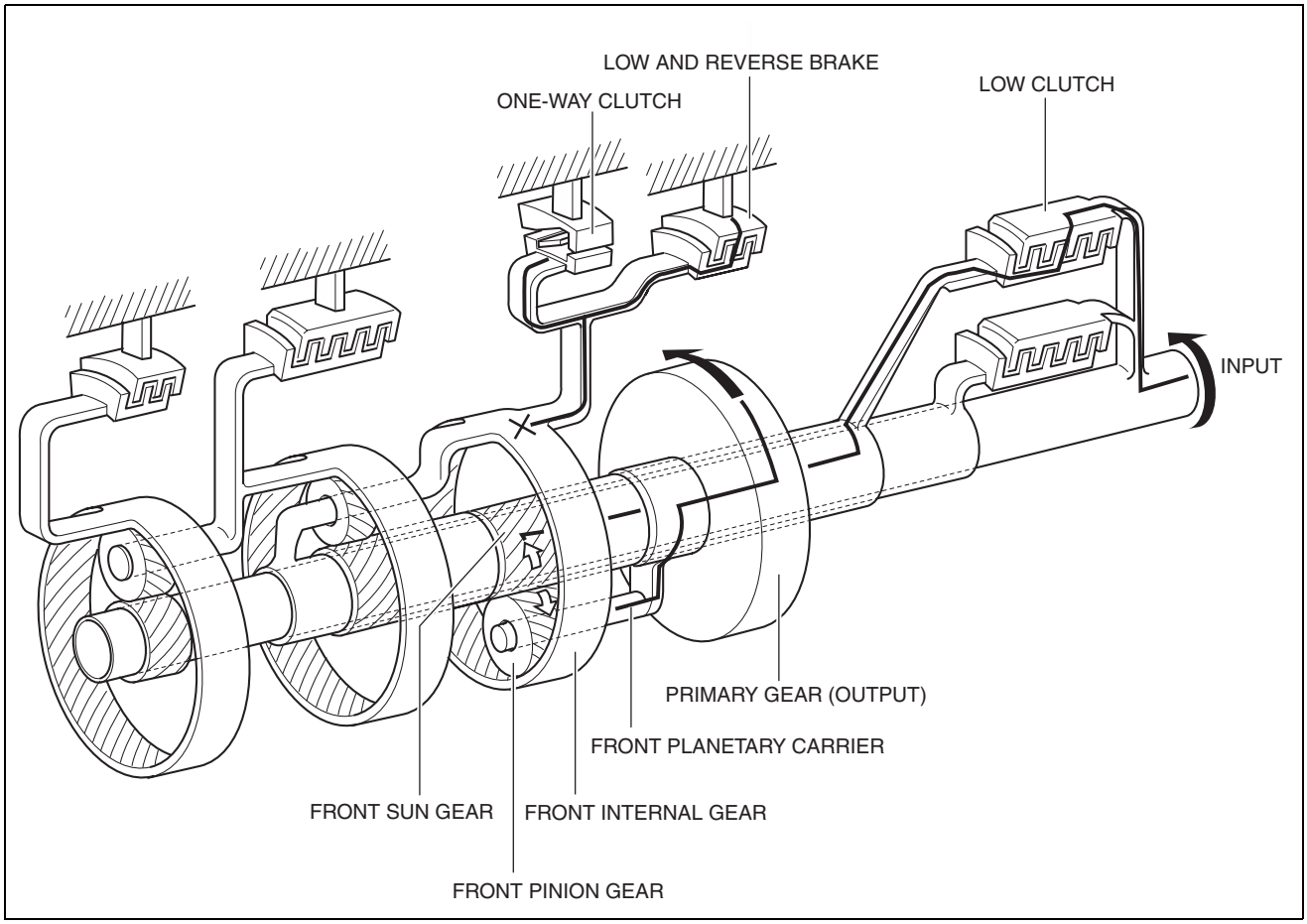
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

POWER FLOW [GW6A-EL, GW6AX-EL]

id0517i2352300

Power flow
1 GR



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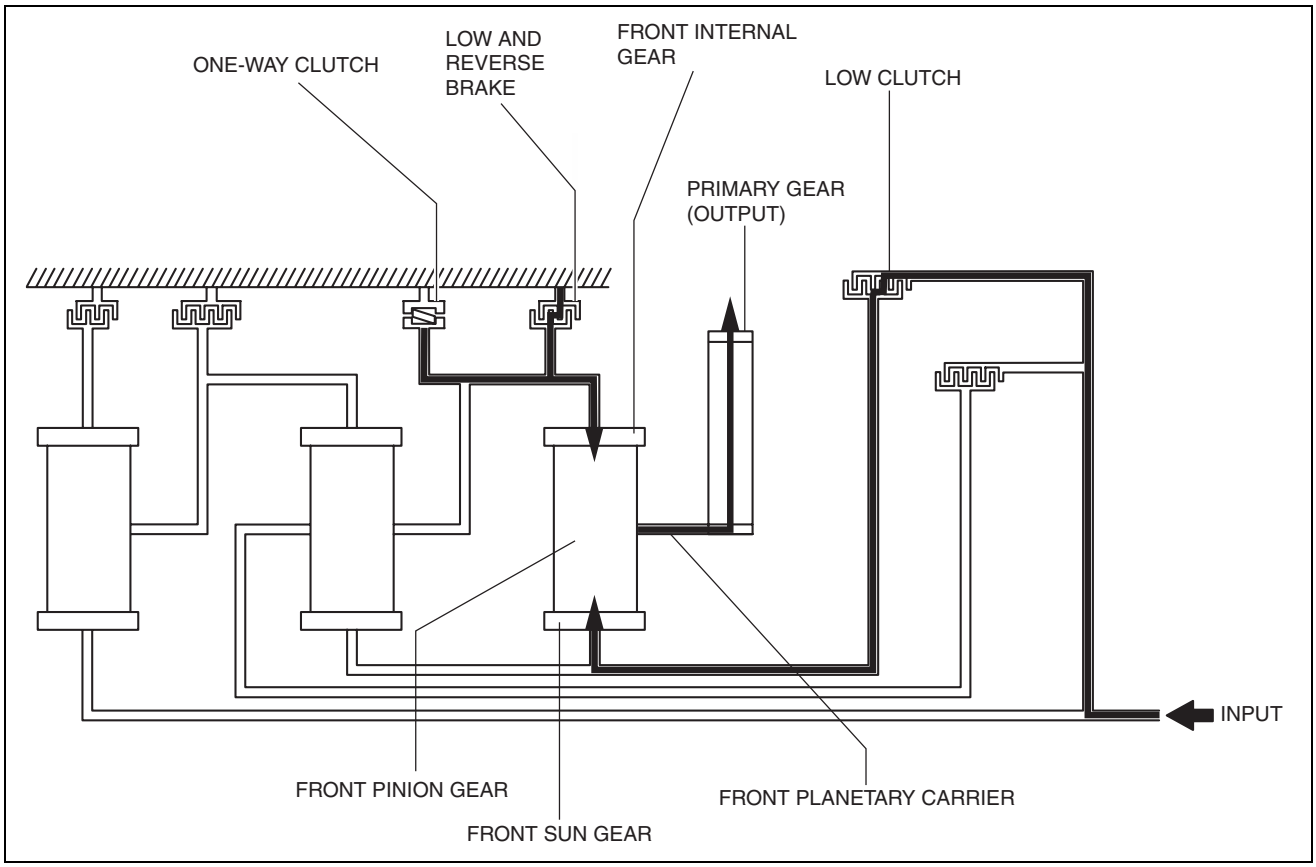
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]



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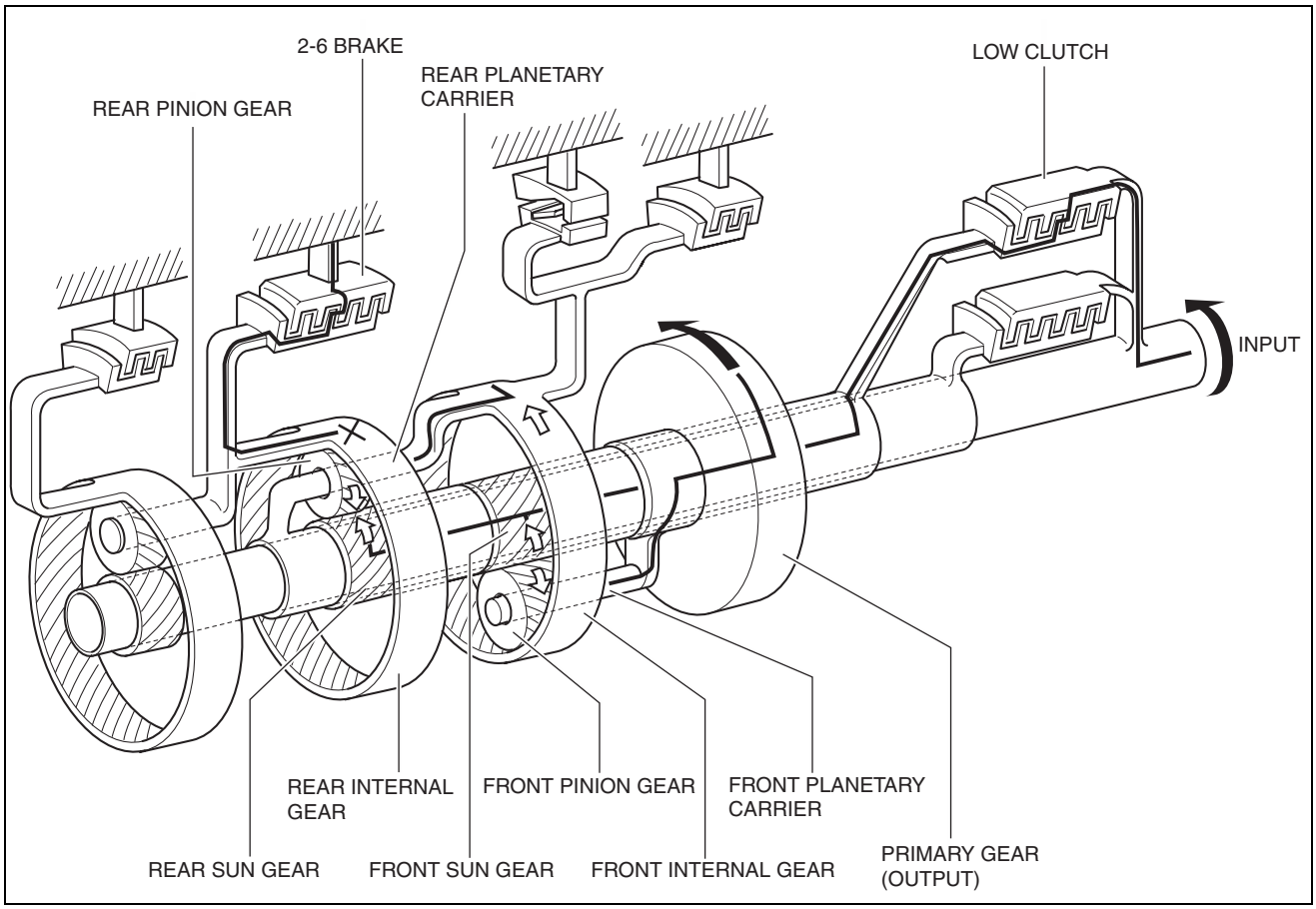
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

2 GR



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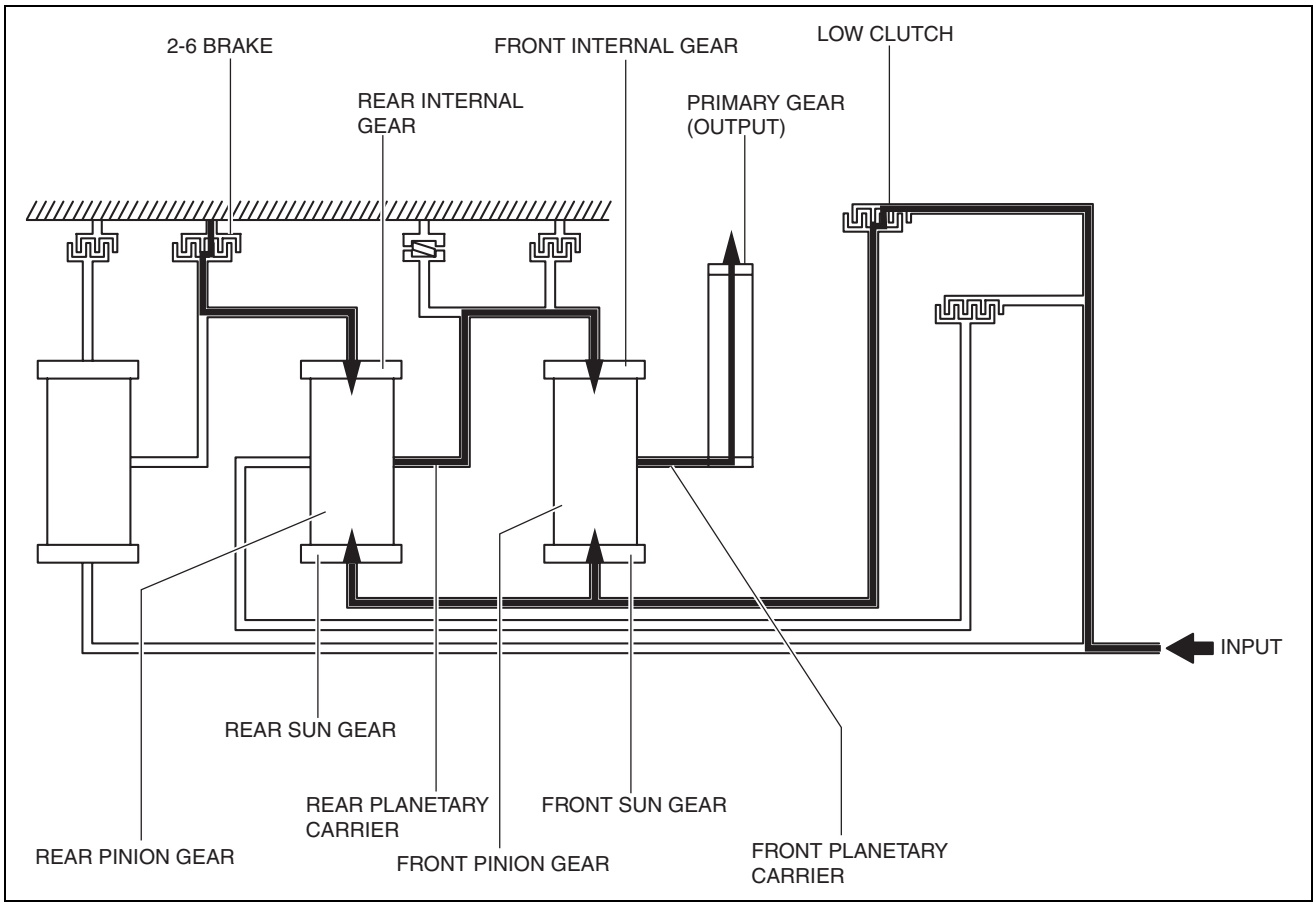
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]



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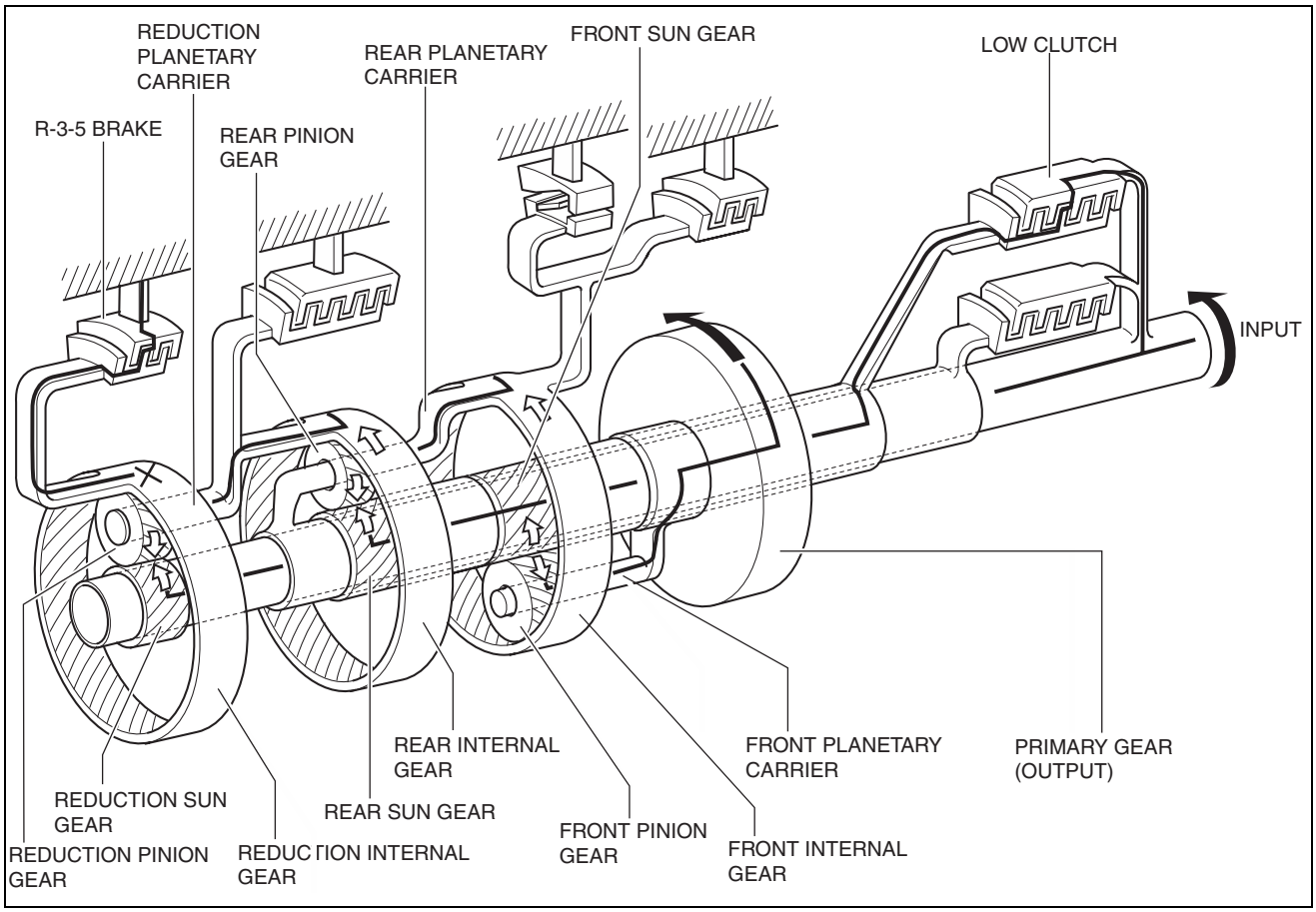
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

3 GR



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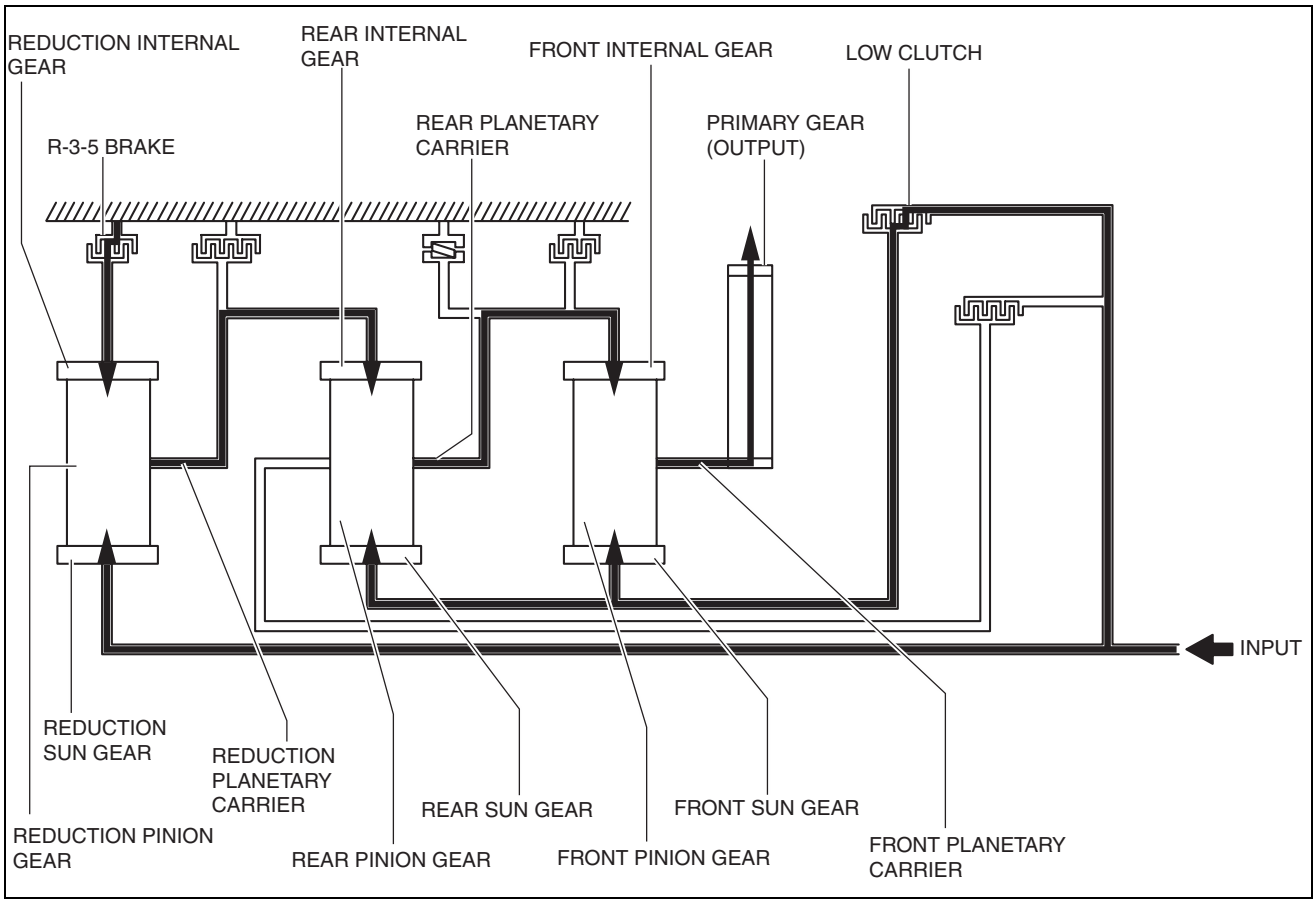
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]



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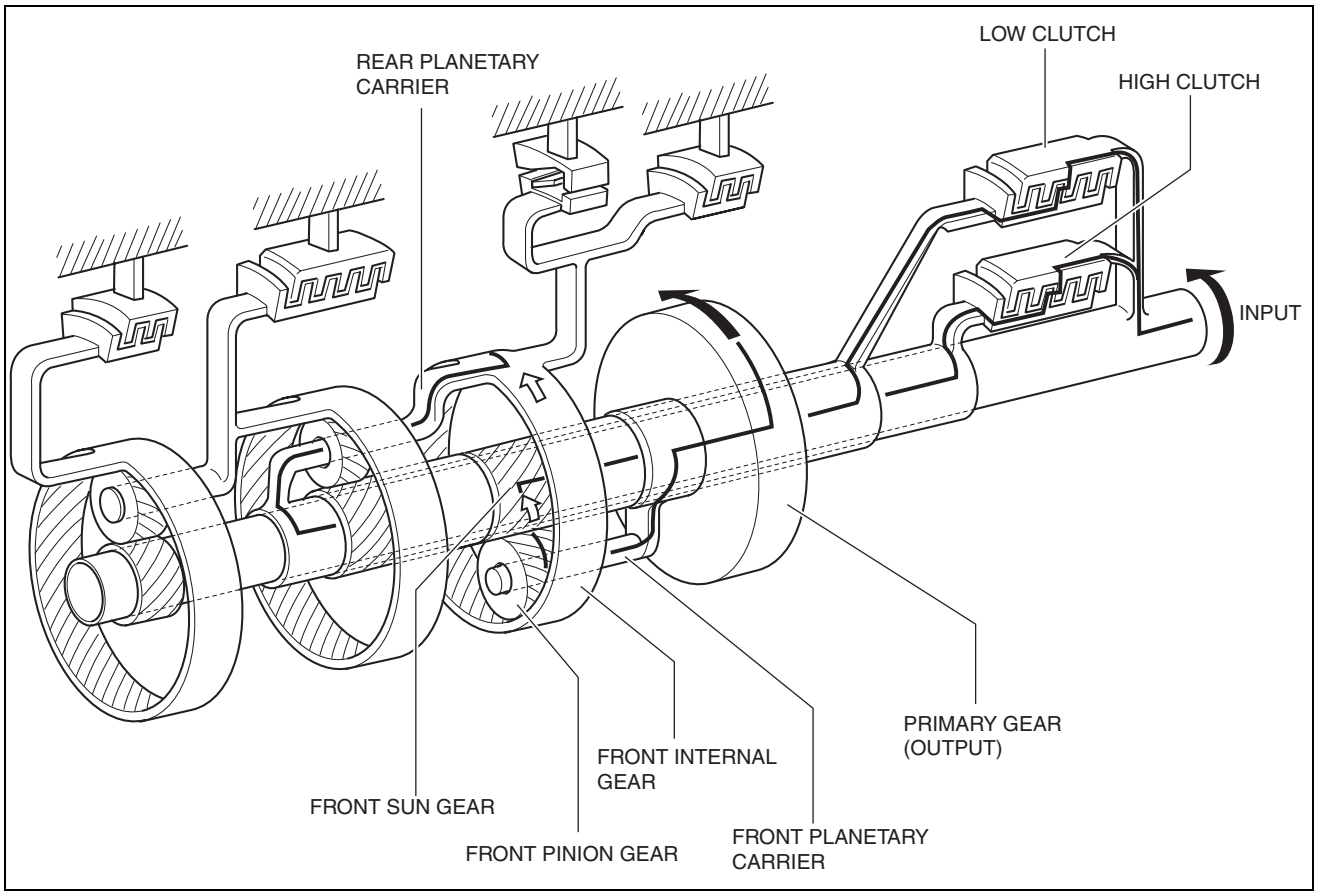
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

4 GR



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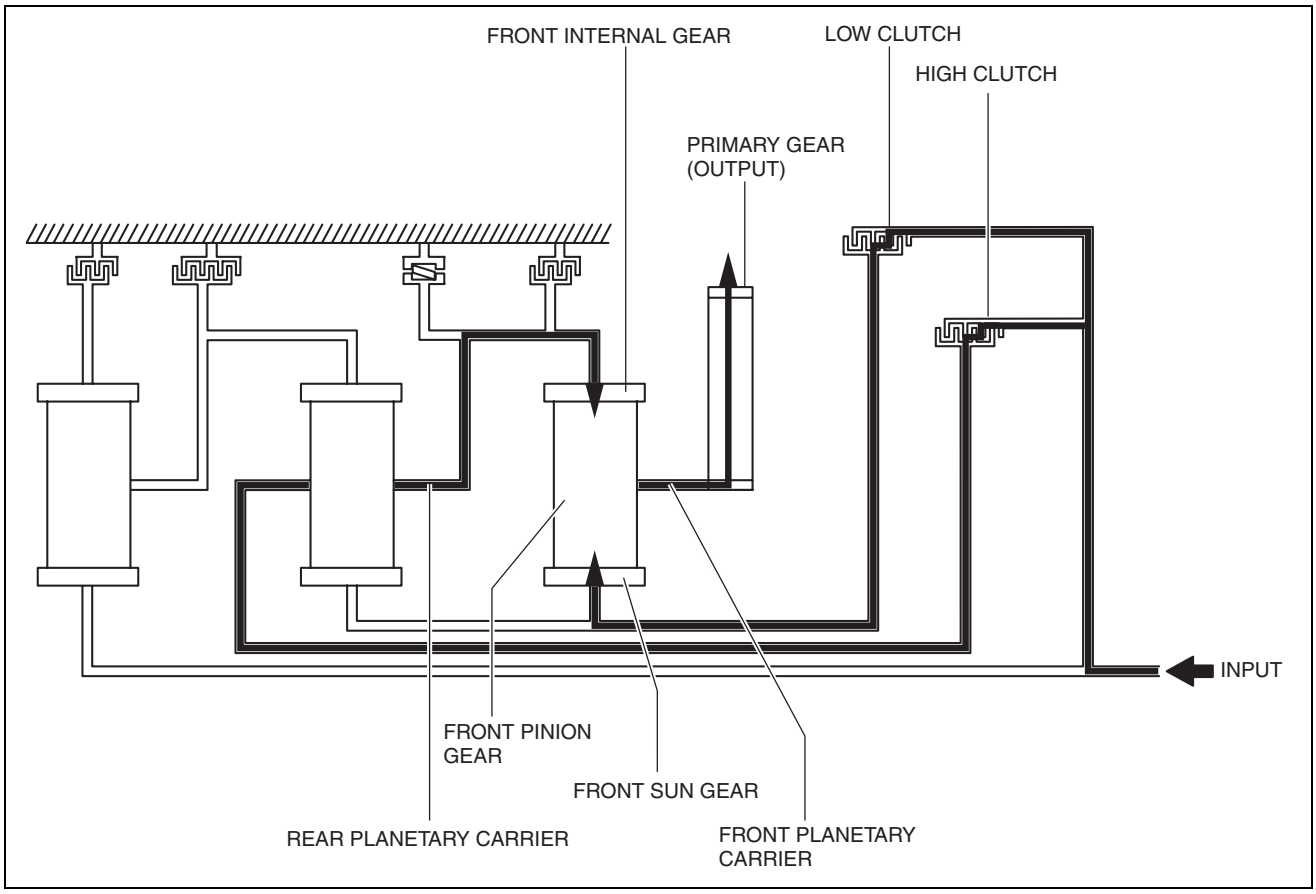
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]



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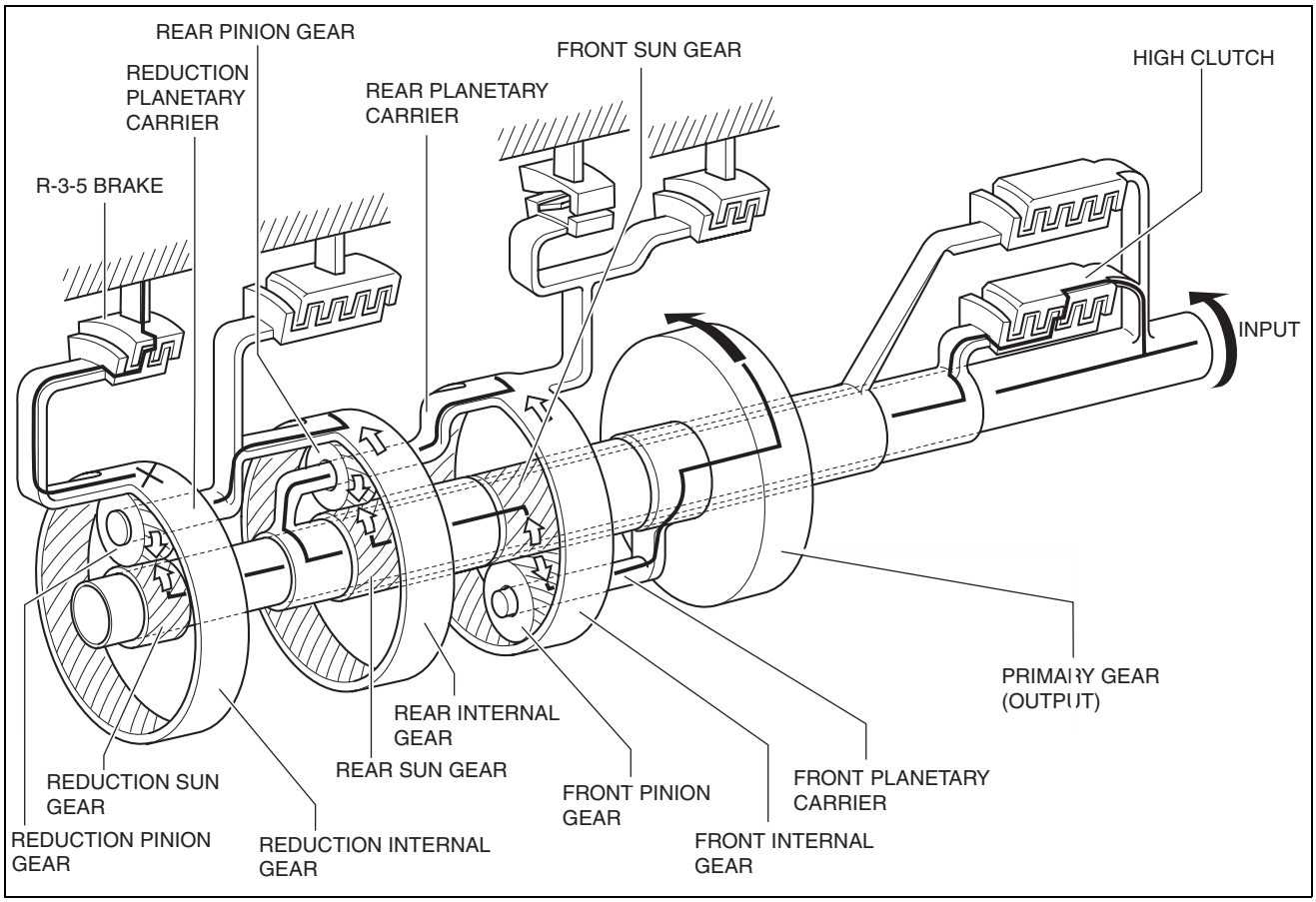
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

5 GR



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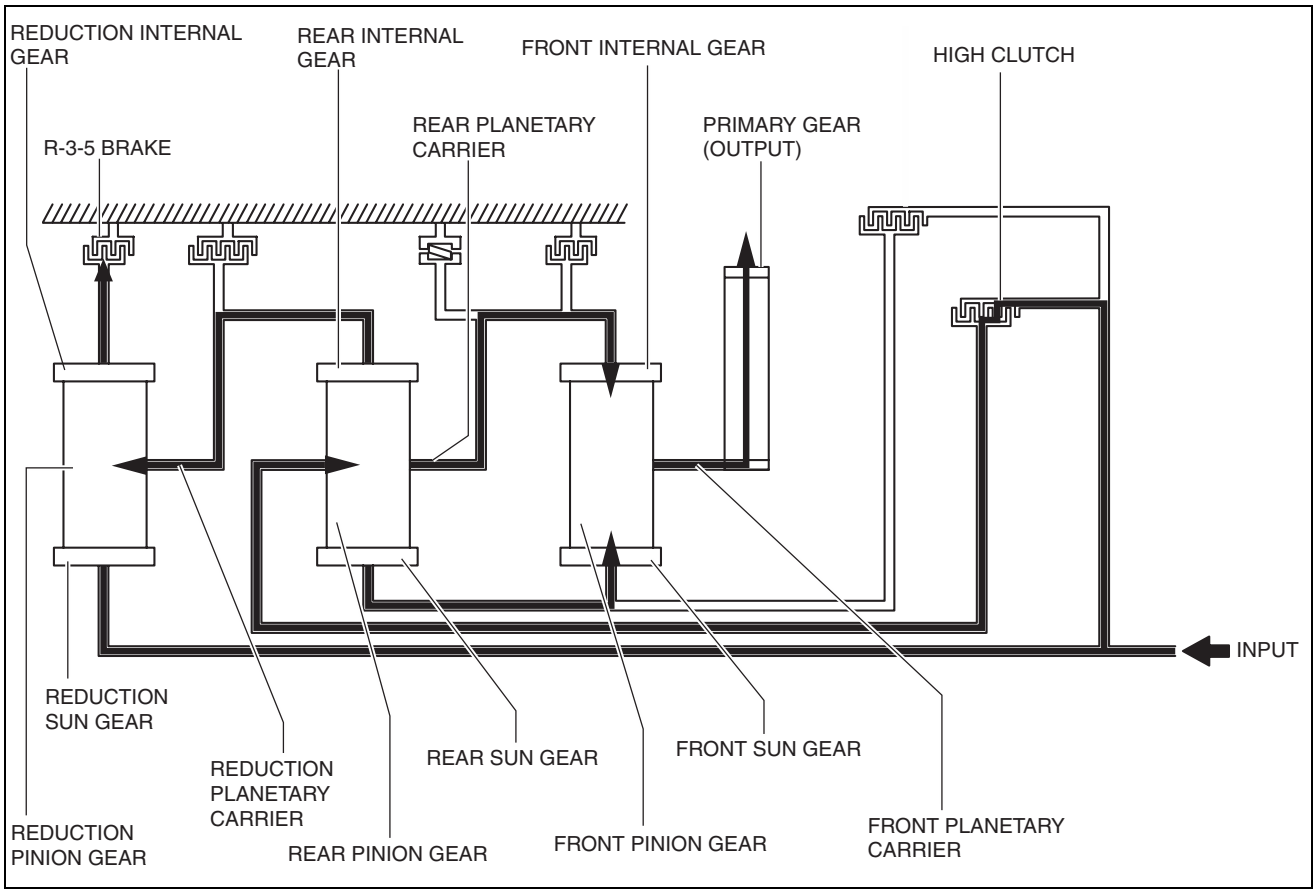
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]



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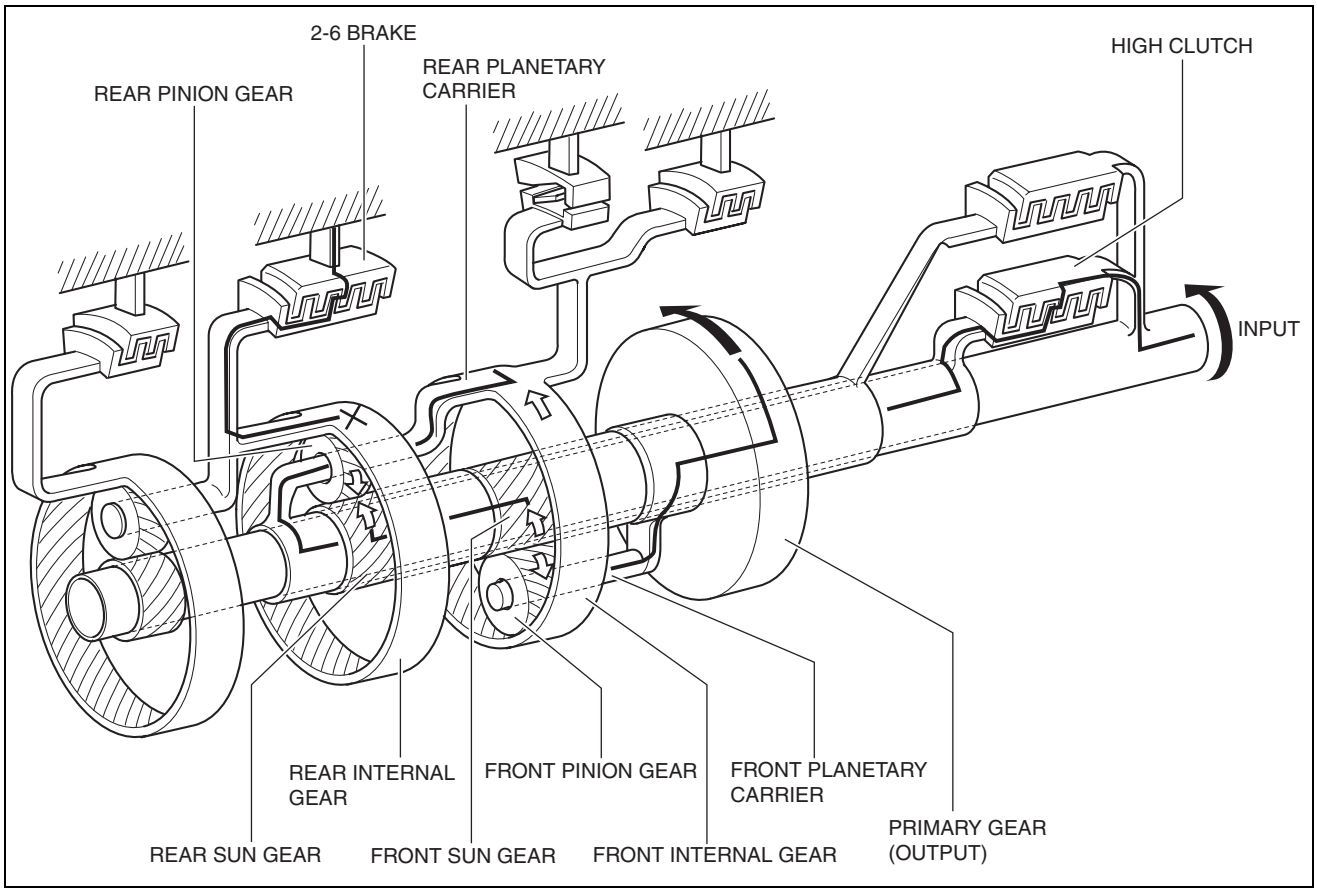
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

6 GR



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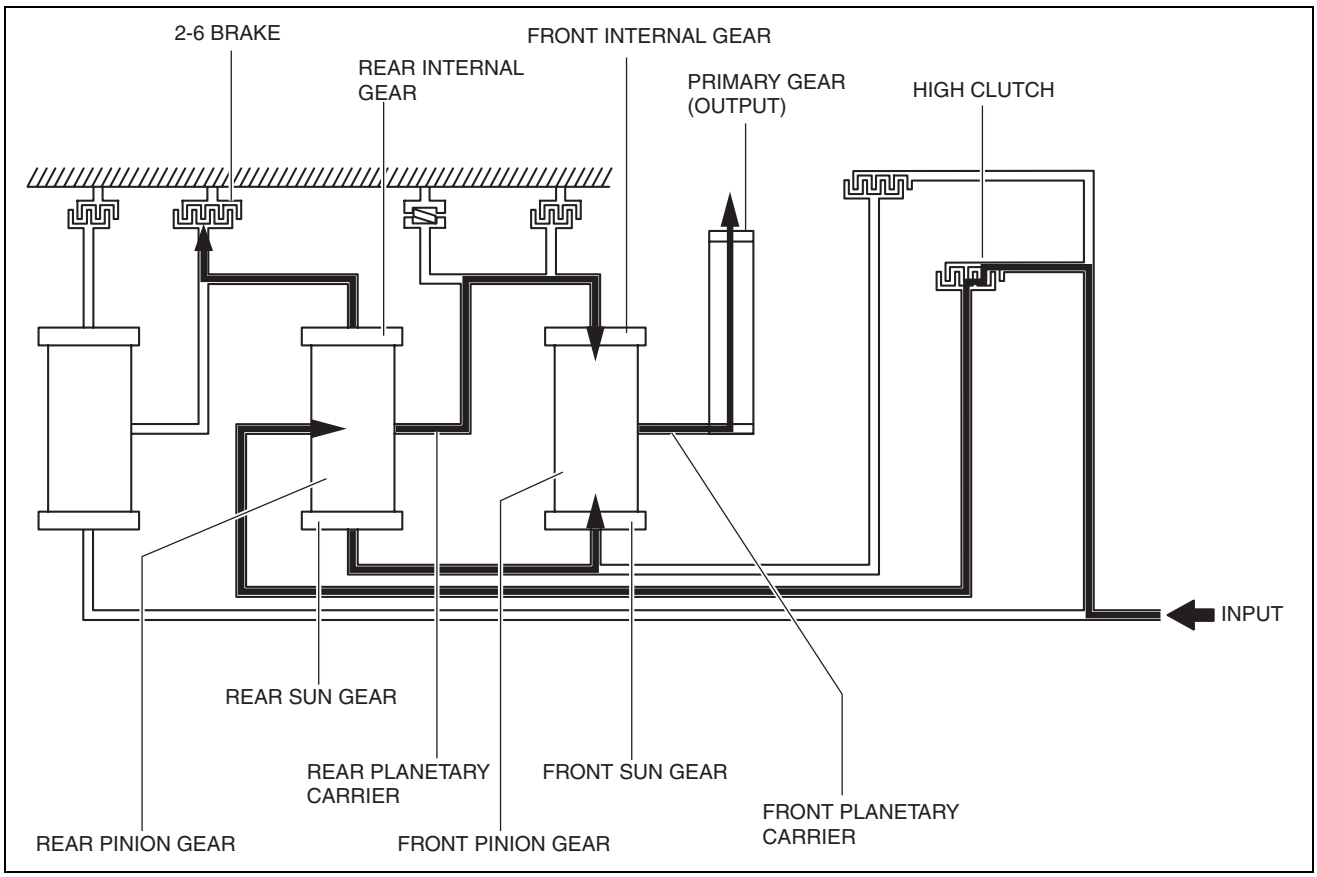

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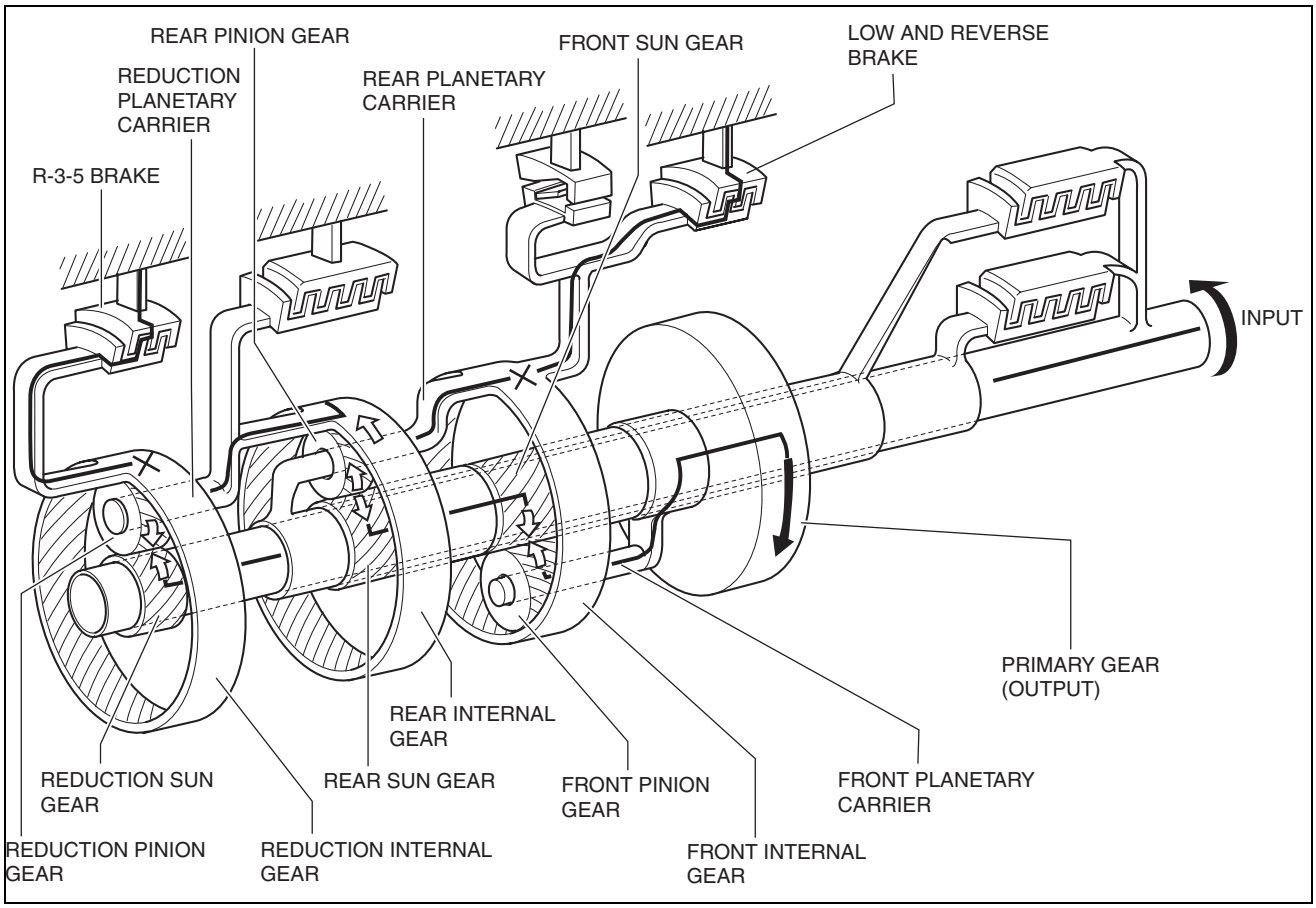
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

REVERSE



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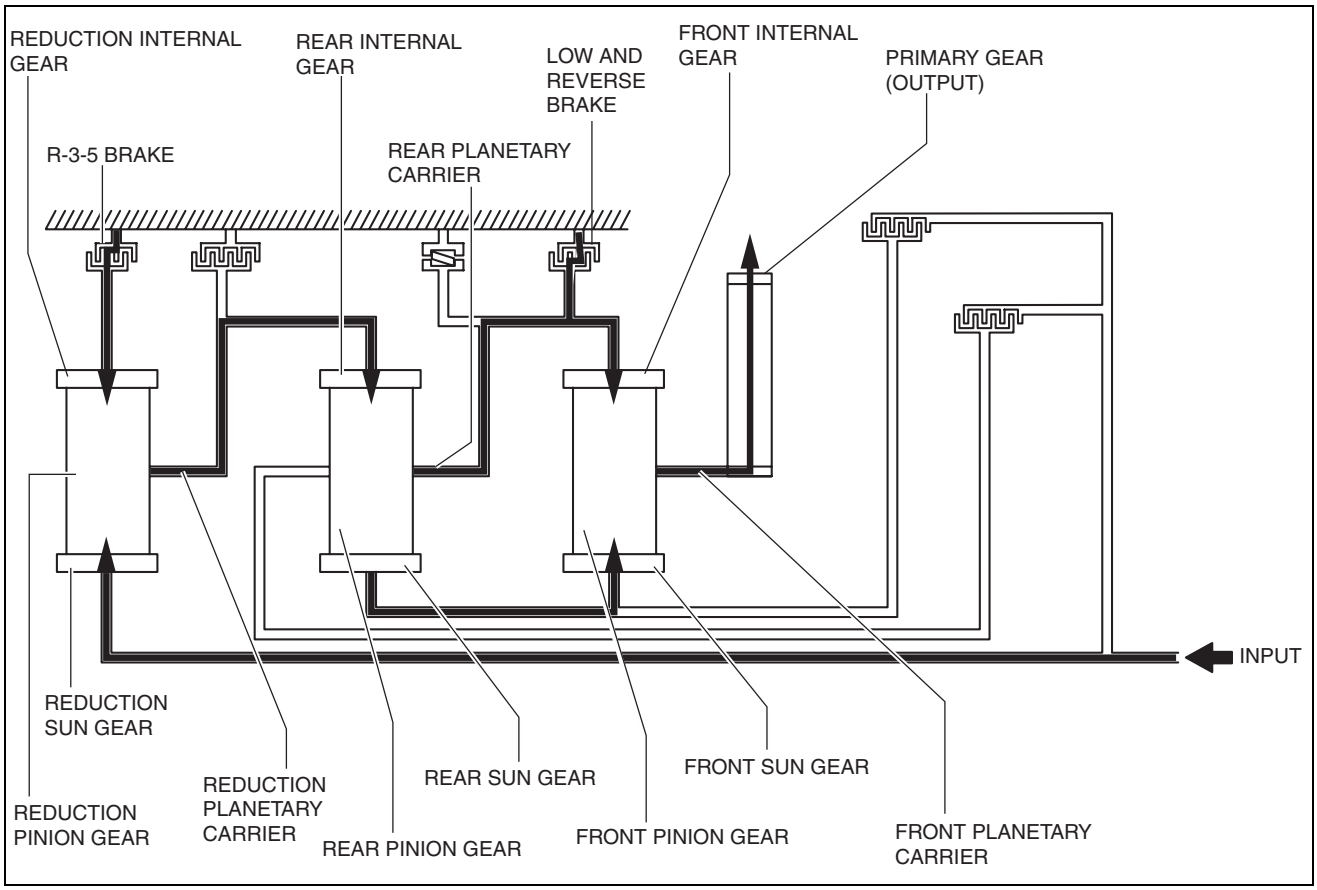
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]



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PARKING MECHANISM [GW6A-EL, GW6AX-EL]

id0517i2352400

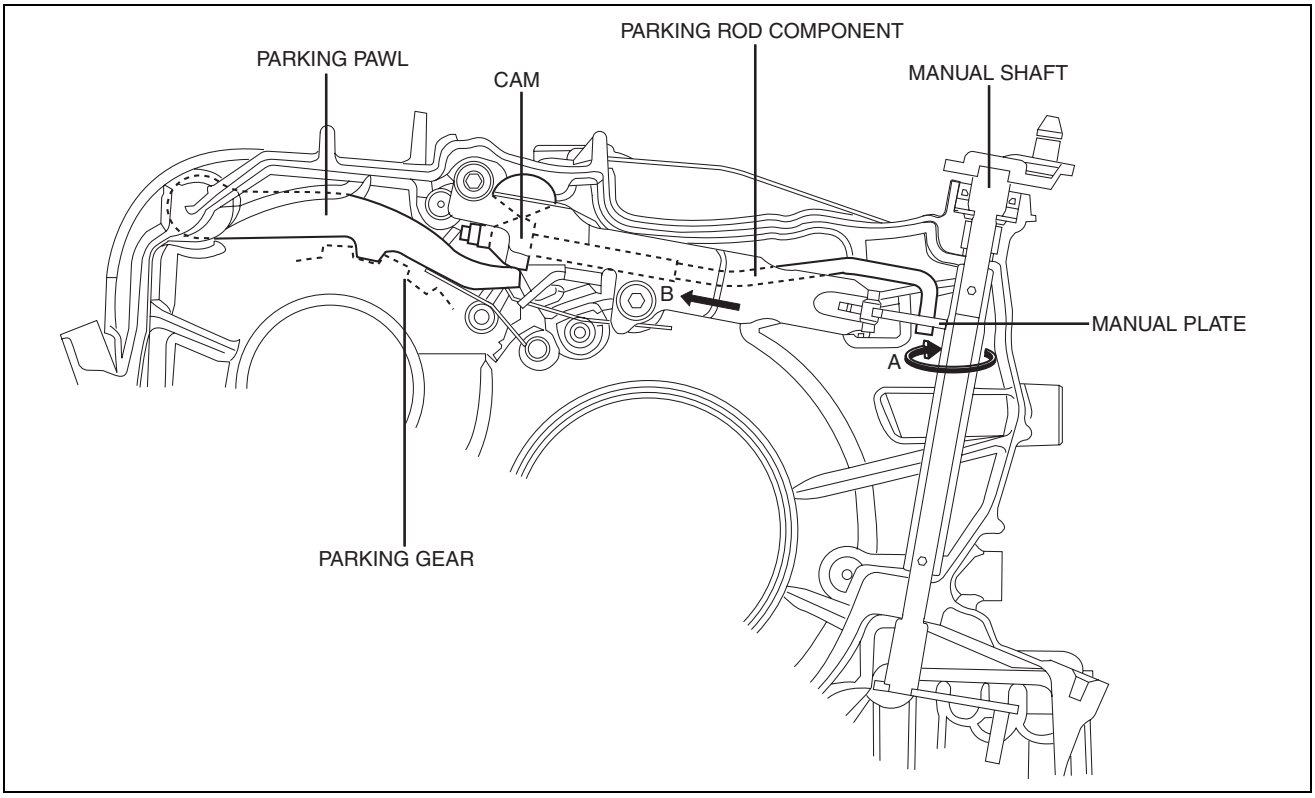
Purpose/Function

- The parking mechanism locks the output gear when the selector lever is shifted to the P position which locks the driving wheels against rotation to prevent coasting when parking the vehicle.

Construction/Operation

- For component parts related to the parking mechanism, refer to the following figure.

- When the selector lever is shifted to the P position, the manual plate is rotated in the direction of arrow A via the manual shaft. As a result, the parking rod component moves in the direction of arrow B. As a result, the cam on the end of the parking rod component presses the parking pawl against the parking gear, the parking pawl and parking gear are engaged, and the rotation of the output gear is locked. Even if the parking pawl is positioned at the projection of the parking gear and cannot be engaged, the driving wheels together with the parking gear are rotated by moving the vehicle slightly so that the parking pawl and parking gear engage.



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HYDRAULIC PRESSURE CONTROL SYSTEM OUTLINE [GW6A-EL, GW6AX-EL]

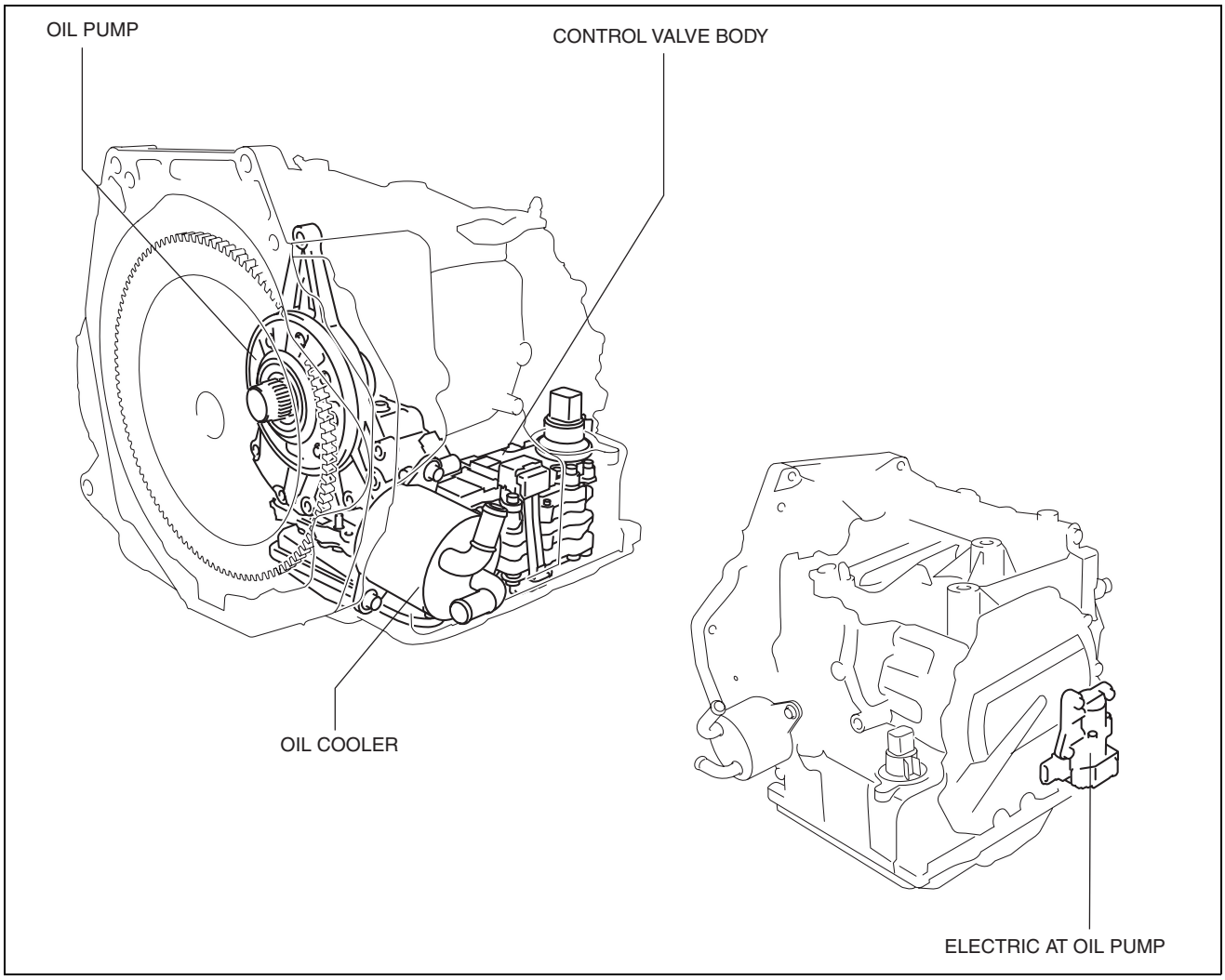
id0517i2355000

Outline

- The hydraulic control mechanism consists of an oil cooler which maintains the hydraulic pressure at the optimum temperature, a control valve body and each shift valve which perform adjustment and circuit switching of the hydraulic pressure based on the control content calculated by the TCM, and the oil pump which generates the hydraulic pressure of each clutch and brake.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction
Structural view



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OIL PUMP [GW6A-EL, GW6AX-EL]

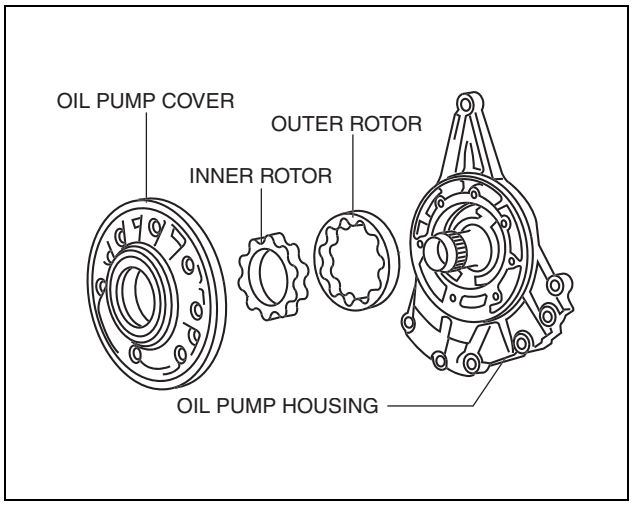
id0517i2355100

Purpose/Function
- The oil pump generates hydraulic pressure in the oil line of the automatic transaxle together with supplying lubrication to powertrain related parts.

Construction
- The oil pump has adopted a gear type with built-in outer and inner rotors.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The inner rotor engages with the torque converter and rotates in conjunction with the rotation of the torque converter.



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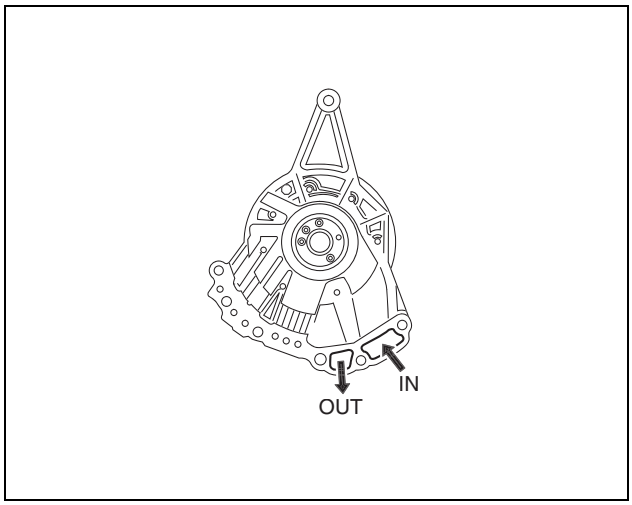
Operation

- When the inner rotor in the oil pump rotates, vacuum is generated in the outer rotor. As a result, ATF in the oil pan is suctioned to the oil pump. Further rotation of the inner rotor causes the inner rotor blades to push the ATF and discharge it from the oil pump.
- The ATF discharge flow amount increases or decreases in proportion to the rotation speed of the inner rotor.



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ELECTRIC AT OIL PUMP [GW6A-EL, GW6AX-EL]

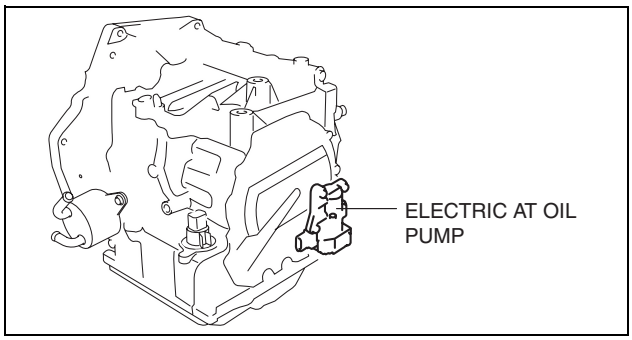
id0517i2355200

Purpose, Function

- The electric AT oil pump generates hydraulic pressure in the oil line of the automatic transaxle when the i-stop (engine-stop control) permit conditions are met and the engine is stopped.
- By ensuring oil pressure while i-stop is operating, smooth startability after the engine is restarted has been realized.

Construction

- The electric oil pump has adopted an axial piston type.
- The electric AT oil pump is installed to the transaxle end cover.



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

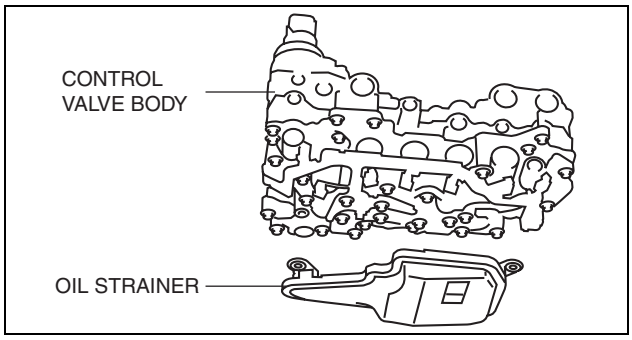
Operation
- The electric oil pump generates hydraulic pressure by the operation of the electric motor based on the operation signal from the TCM.

OIL STRAINER [GW6A-EL, GW6AX-EL]

id0517i2355300

Purpose/Function
- The oil strainer filters particulate matter in the ATF by passing it through the built-in filter.

Construction
- The oil strainer is a built-in, non-woven fabric filter installed to the position shown in the following figure.



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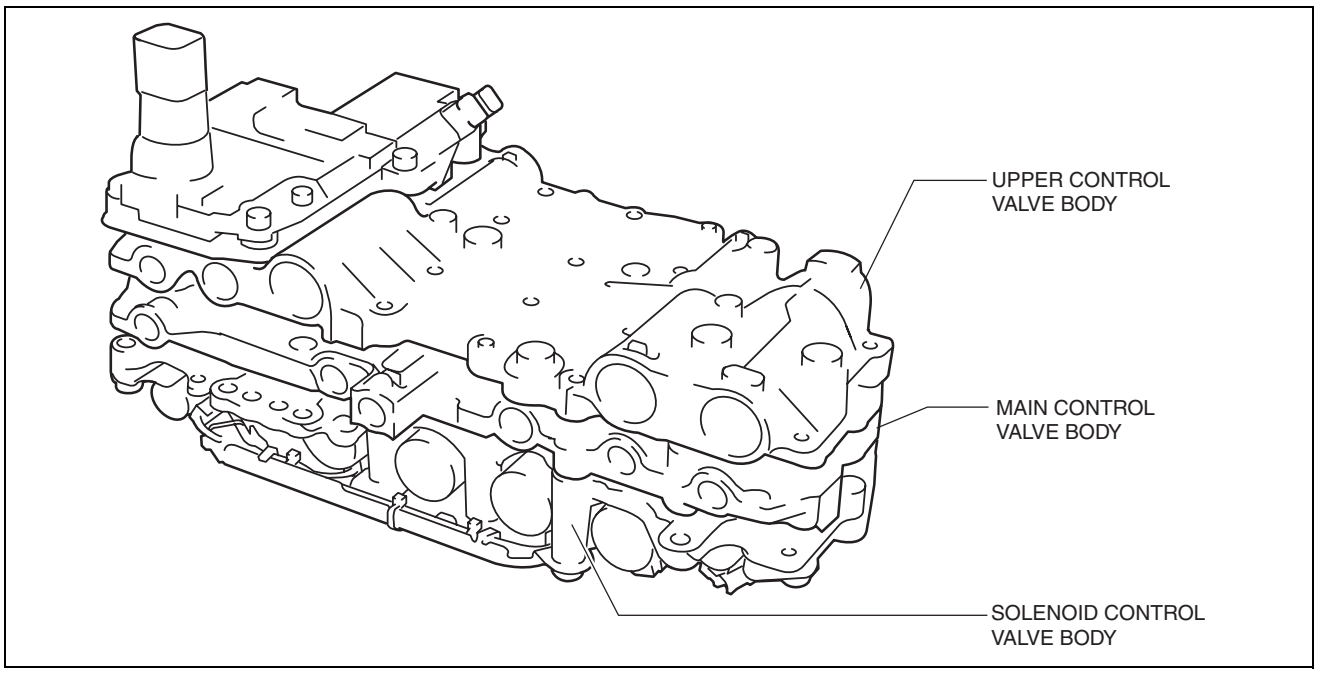
CONTROL VALVE BODY [GW6A-EL, GW6AX-EL]

id0517i2355400

Purpose/Function
- The control valve body controls the hydraulic pressure generated by the oil pump by each solenoid valve. In addition, the oil passages which introduce hydraulic pressure to the pistons for each clutch and brake is formed by the switching of each built-in shift valve.

Construction
- The control valve body consists of integrated hydraulic control related parts and electronic control related parts.
- The hydraulic control related parts basically consist of the upper control valve body and main control valve body each with built-in shift valves, and the solenoid control valve body with built-in solenoid valves.



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OIL COOLER [GW6A-EL, GW6AX-EL]

id0517i2358100

Purpose/Function
- The oil cooler constantly maintains maximum ATF performance in the transaxle by maintaining an optimum ATF temperature which has the effect of achieving reduced fuel consumption.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

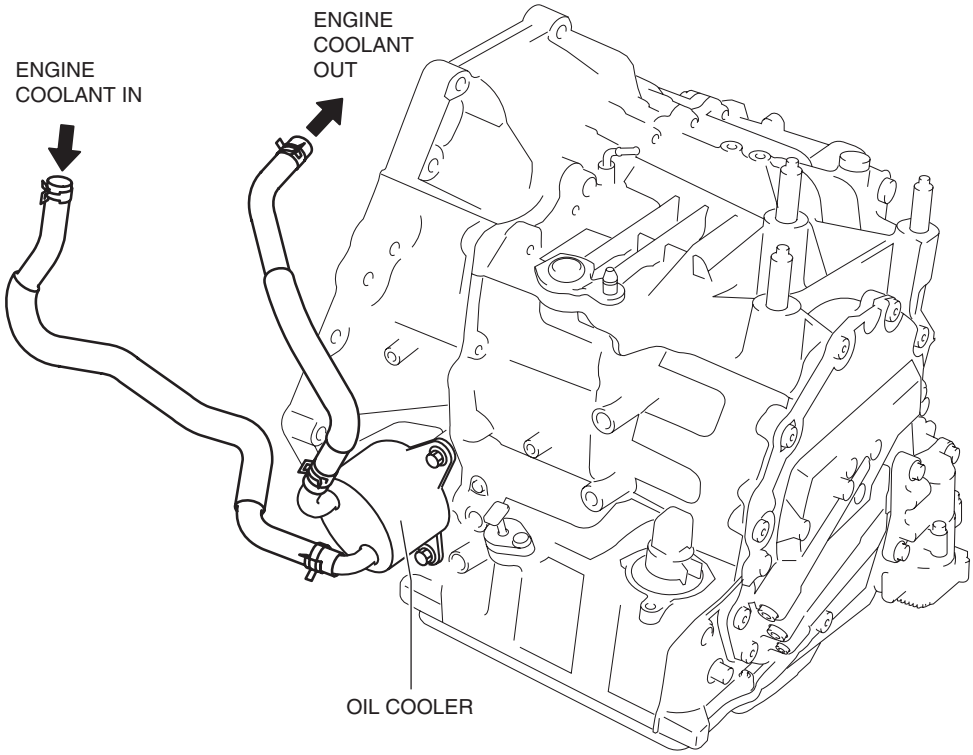
Construction/Operation

- The oil cooler performs the following operations according to the ATF temperature condition:
  - — Heating function: Warms the ATF using the radiator coolant to promote an earlier increase in the ATF temperature when its temperature is low. As a result of the earlier temperature increase, the ATF viscosity decreases which reduces drag in the transaxle.

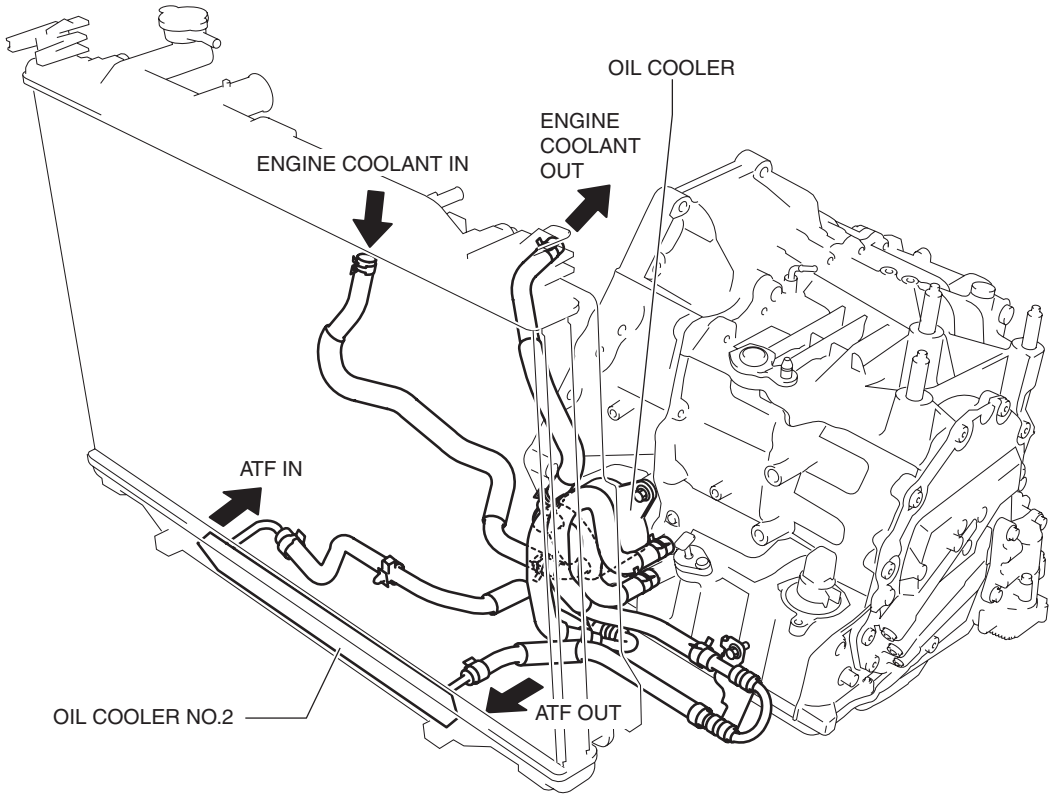
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

— Cooling function: Cools the ATF using the radiator coolant to maintain optimum conditions and prevent ATF expansion and deterioration.

WITHOUT OIL COOLER NO.2



WITH OIL COOLER NO.2



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

ELECTRONIC CONTROL SYSTEM OUTLINE [GW6A-EL, GW6AX-EL]

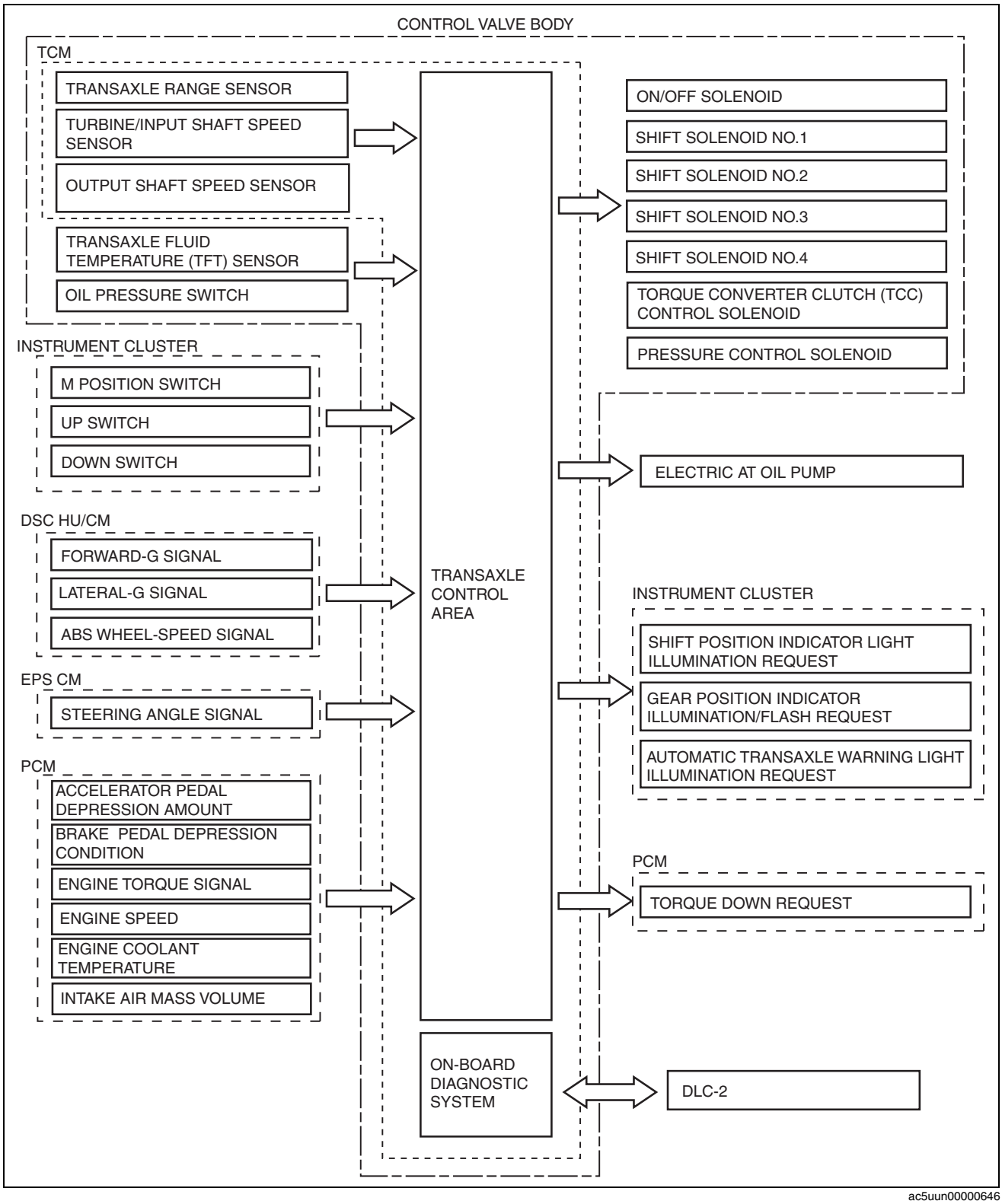
id0517i2360000

Outline

- In the electronic control system, the TCM calculates the control content based on signals from each type of sensor and switch to operate output parts such as each solenoid. In consideration of suppressed shift shock, smooth driving, and improved fuel economy, the TCM performs controls so as to maintain the optimum driving performance in response to the vehicles driving scenario.

Construction

Block diagram



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

CONTROL VALVE BODY [GW6A-EL, GW6AX-EL]

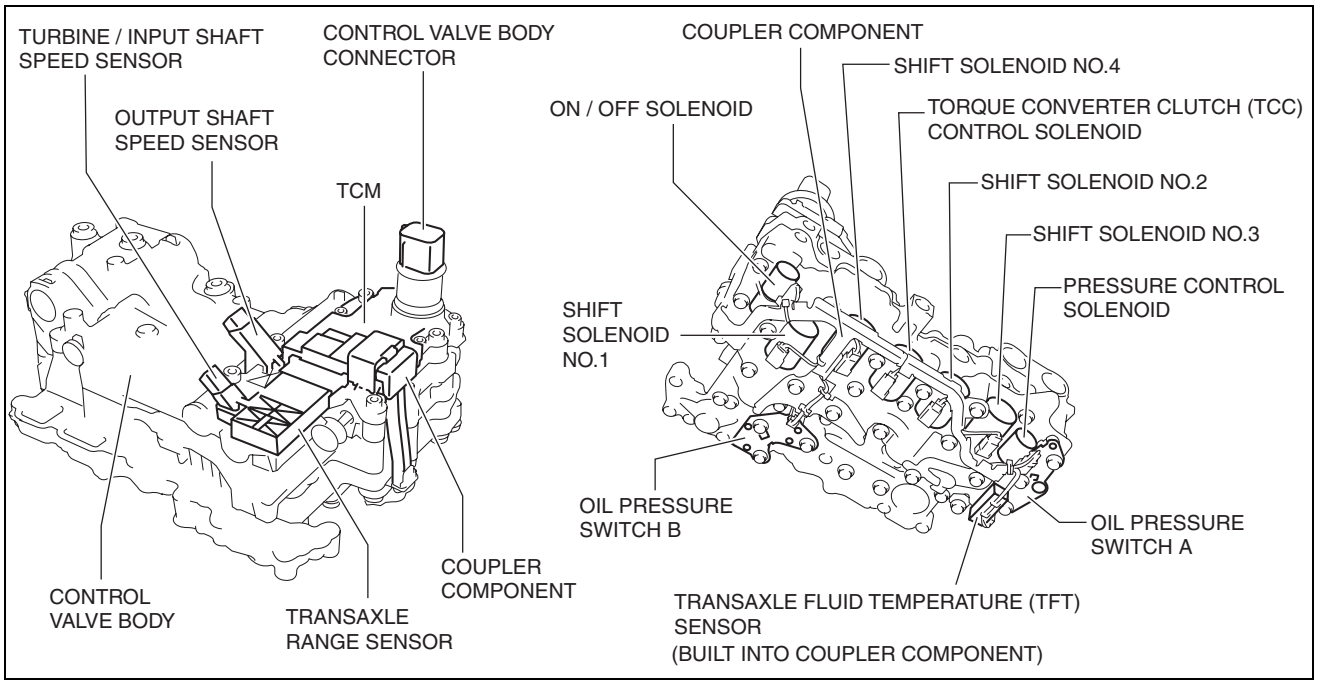
id0517i2360100

Purpose/Function

- A direct linear solenoid has been adopted for the solenoid valve which contributes to improved shift response, drive feel and reduced shift shock by the improved precision of the hydraulic pressure control.

Construction

- The control valve body consists of integrated hydraulic control related parts and electronic control related parts.
  - — The transaxle range sensor, output shaft speed sensor, turbine/input shaft speed sensor, and the control valve body connector are built into the TCM and integrated with the automatic transaxle.
  - — The transaxle fluid temperature (TFT) sensor, wiring harness, and the wiring harness cover bracket are built into the coupler component.
- If any of the component parts of the control valve body has a malfunction, the control valve body must be replaced because the replacement of a single part is not possible except for the following parts:
  - — On/off solenoid
  - — Oil pressure switch A, oil pressure switch B
  - — Coupler component (built into transaxle fluid temperature (TFT) sensor)



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TRANSAXLE RANGE SENSOR [GW6A-EL, GW6AX-EL]

id0517i2360200

Purpose/Function

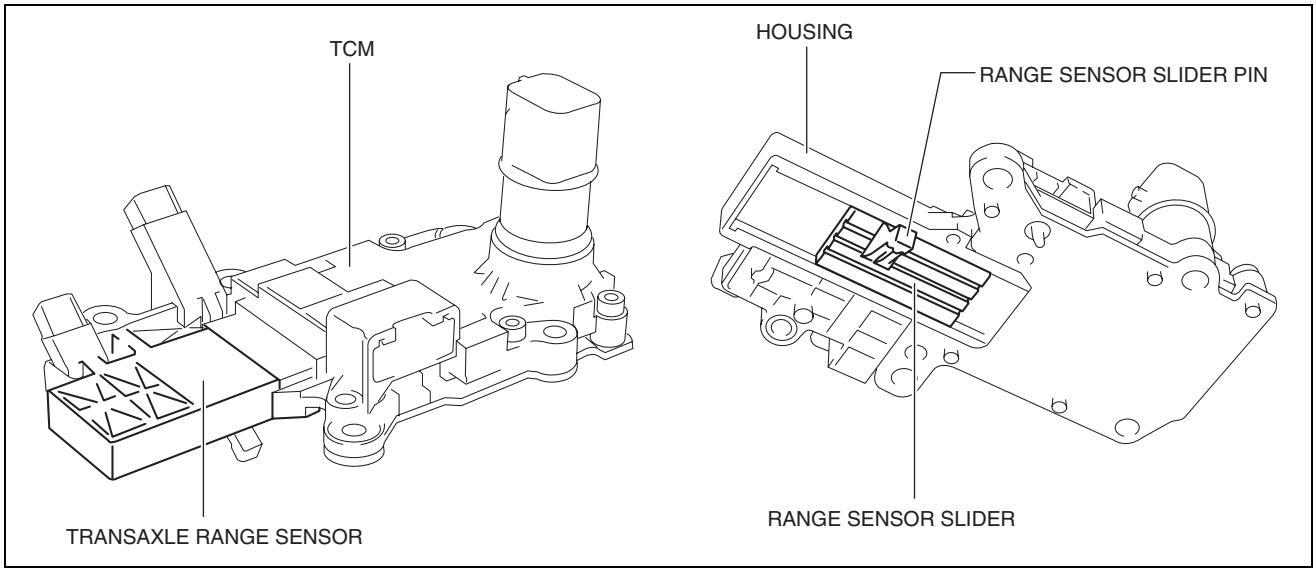
- The transaxle range sensor detects the position of the manual valve and selector lever.
- The transaxle range sensor signal is used for automatic shift control, manual shift control, TCC control, line pressure control, direct electric shift control, learning control, engine-transaxle integration control, and the on-board diagnostic system.

Construction

- The transaxle range sensor consists of a housing and slider which are installed to the control valve body as a part of the TCM.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The slider is assembled to the housing and the pin which projects from the slider and is connected to the manual valve.



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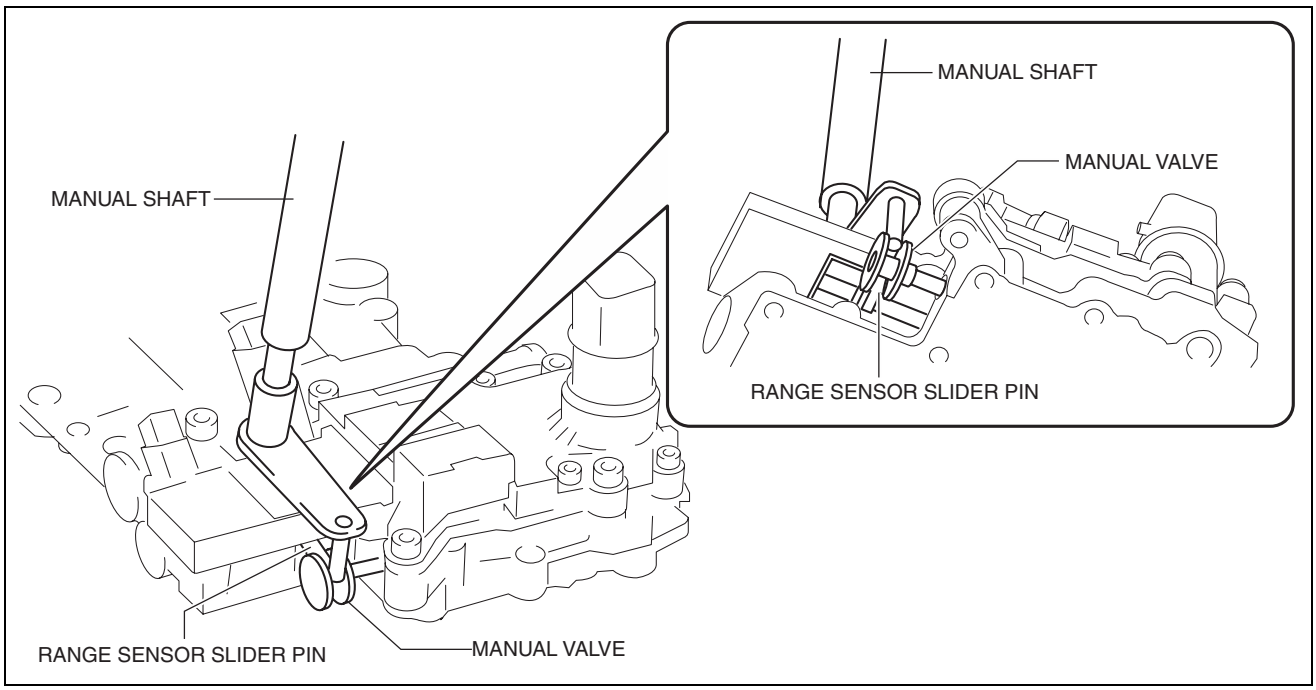
Operation

- When the selector lever is operated, the manual valve strokes via the manual shaft while the slider strokes via the slider pin.
- The transaxle range sensor detects the signal corresponding to the manual valve position according to the slider stroke. This signal is calculated in the TCM and detected as a range position.



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M POSITION SWITCH [GW6A-EL, GW6AX-EL]

id0517i2360300

Purpose/Function

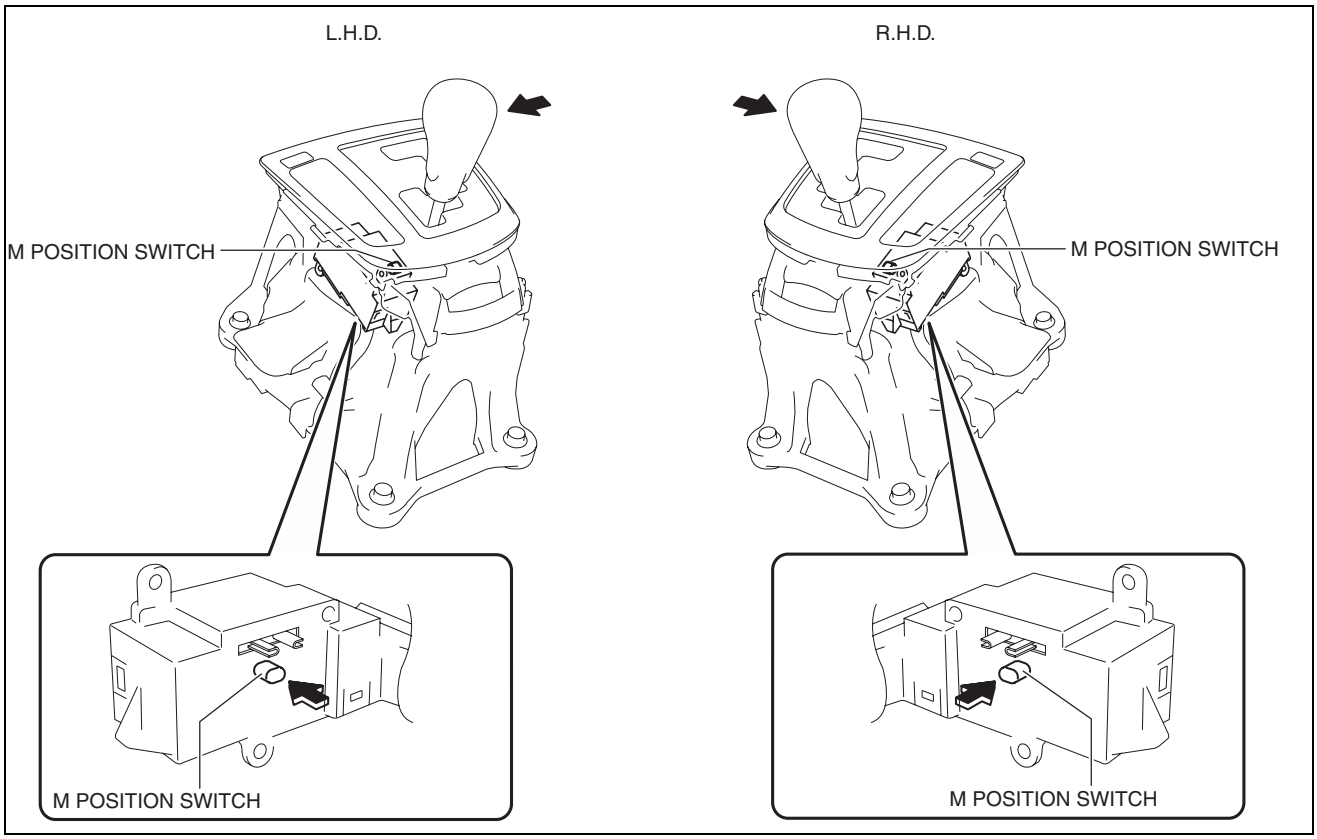
- The M position switch detects that the selector lever is in the M position.
- The M position switch signal is sent to the TCM via CAN, and is used for manual shift control and engine-transaxle integration control.

Construction

- The M position switch is installed to the selector lever.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The M position switch is an on/off type switch.



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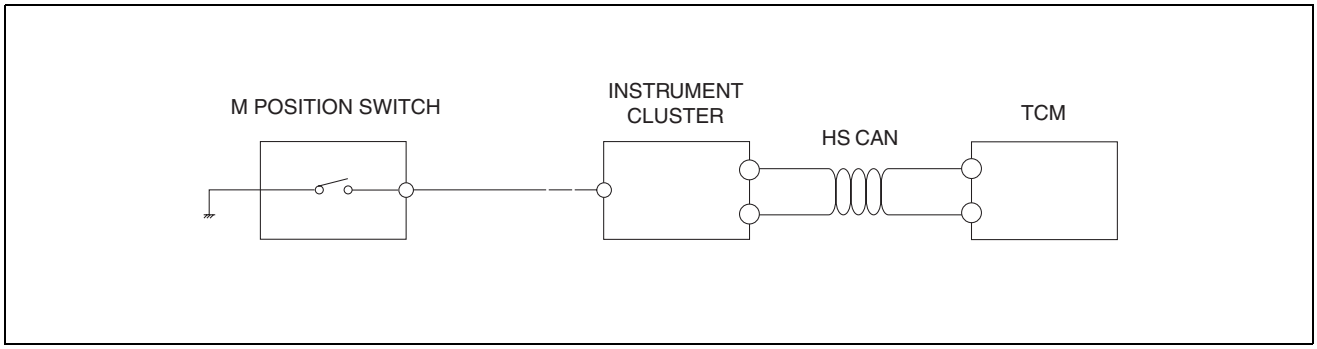
Operation

- When the selector lever is in the M position, the M position switch contact point closes.
- By opening and closing the M position switch contact point, the TCM detects that the selector lever is in the M position.



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UP SWITCH [GW6A-EL, GW6AX-EL]

id0517i2360400

Purpose/Function

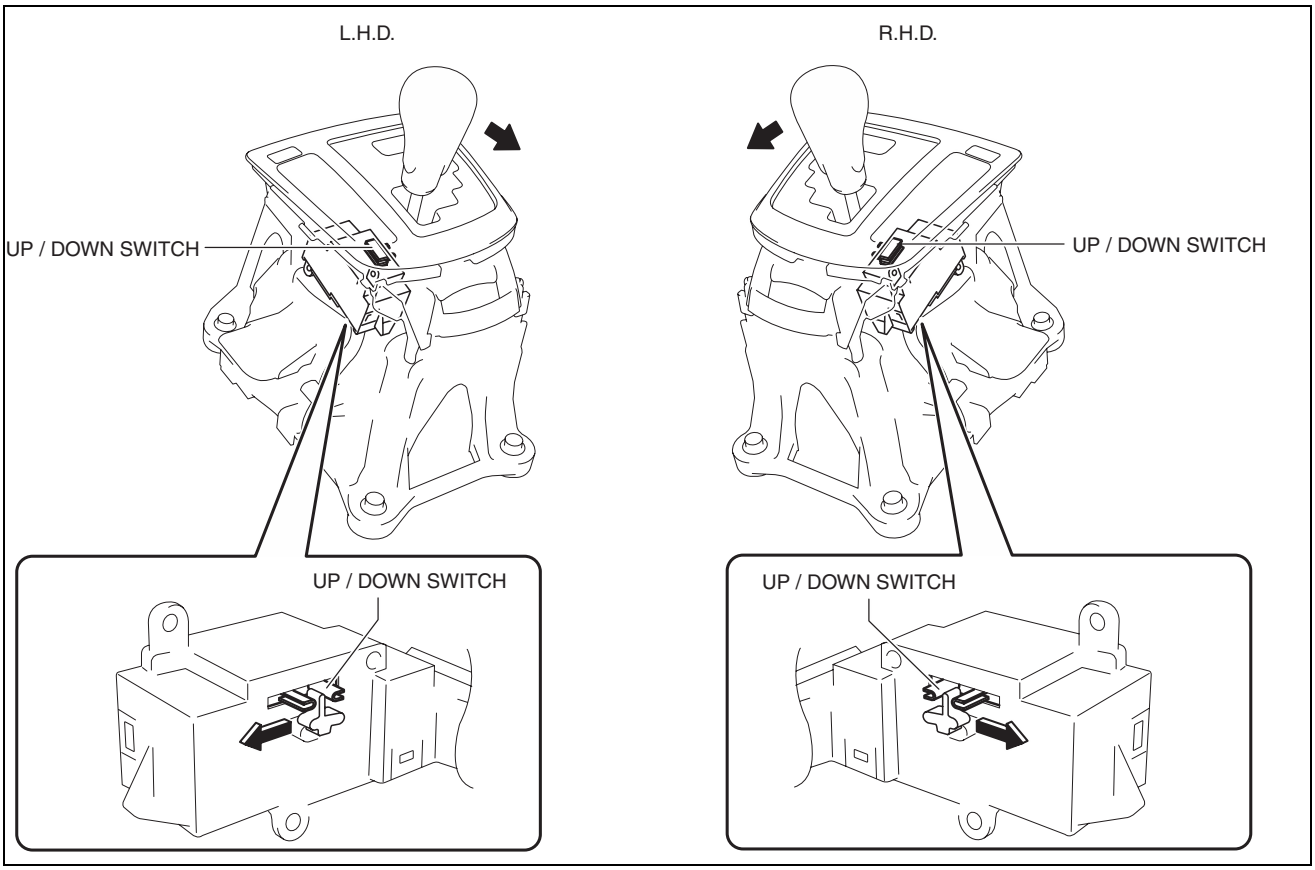
- The up switch detects the shift up operation of the selector lever.
- The up switch signal is sent to the TCM via CAN and is used for manual shift control and engine-transaxle integration control.

Construction

- The up switch is installed to the selector lever.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

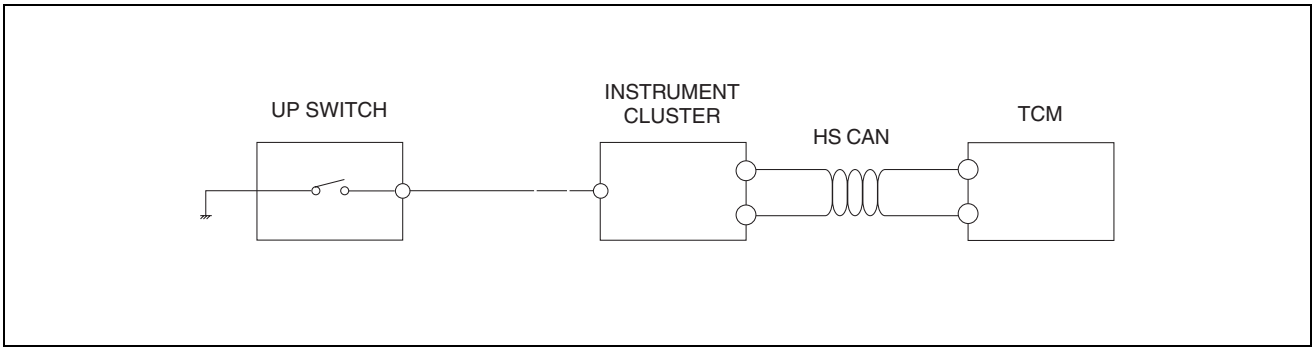
- The up switch is an on/off type switch.



ac5wzn00000918

Operation

- When the selector lever is in the shift up position (+), the up switch contact point closes.
- Based on the opening and closing of the up switch contact point, the TCM detects that the shift up has been operated.



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DOWN SWITCH [GW6A-EL, GW6AX-EL]

id0517i2360500

Purpose/Function

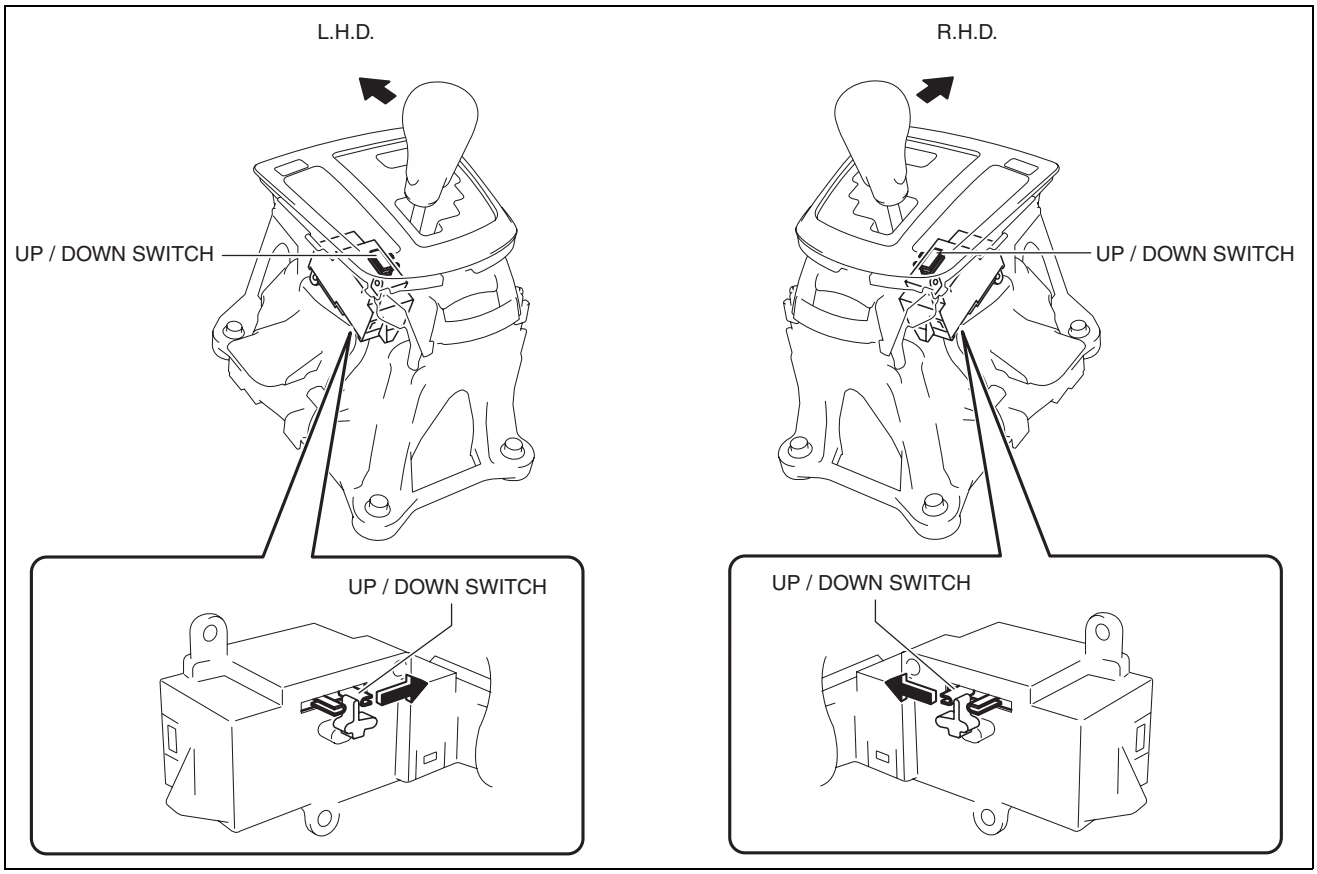
- The down switch detects the shift down operation of the selector lever.
- The down switch signal is sent to the TCM via CAN and is used for manual shift control and engine-transaxle integration control.

Construction

- The down switch is installed to the selector lever.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

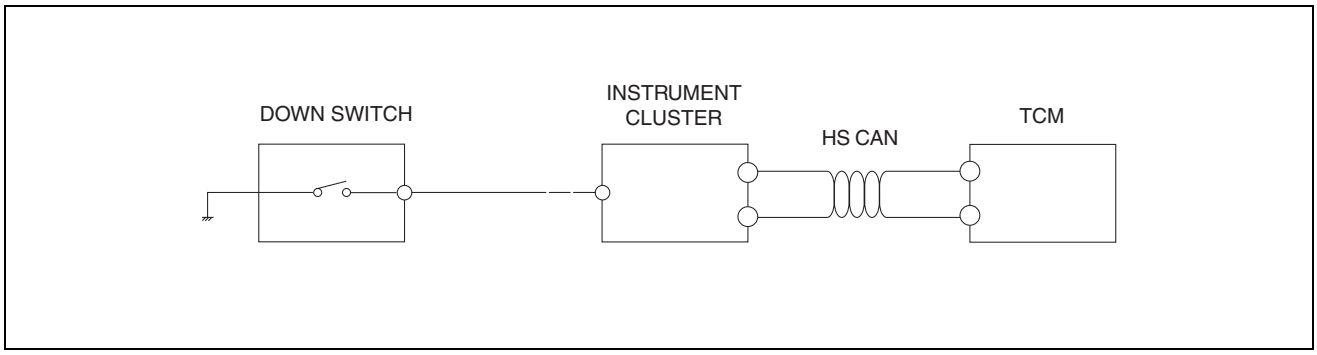
- The down switch is an on/off type switch.



ac5wzn00000919

Operation

- When the selector lever is in the shift down position (-), the down switch contact point closes.
- Based on the opening and closing of the down switch contact point, the TCM detects that the shift down has been operated.



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TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR [GW6A-EL, GW6AX-EL]

id0517i2360600

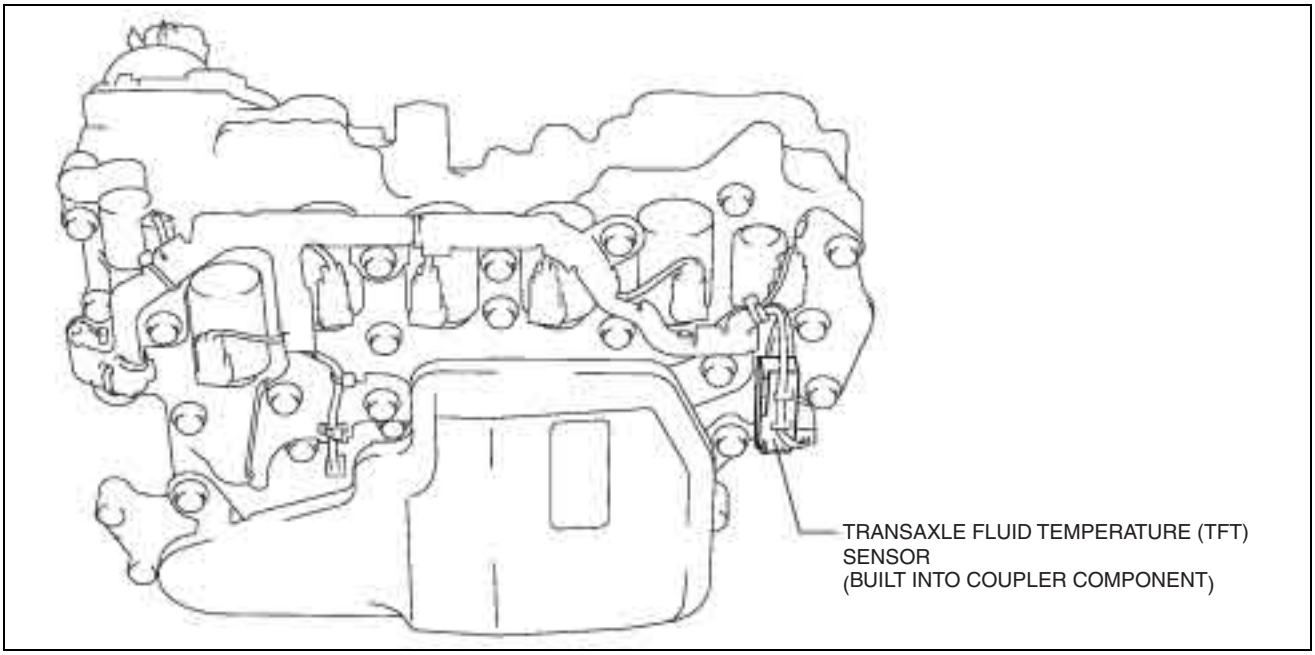
Purpose/Function

- The transaxle fluid temperature (TFT) sensor detects the ATF temperature in the oil pan.
- The transaxle fluid temperature (TFT) sensor signal is used for automatic shift control, TCC control, line pressure control, direct electric shift control, learning control, and the on-board diagnostic system.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction

- The transaxle fluid temperature (TFT) sensor is integrated with the coupler component and installed to the control valve body.



am3uun0000235

Operation

- The transaxle fluid temperature (TFT) sensor outputs the signal corresponding to the ATF temperature in the oil pan to the TCM.

OIL PRESSURE SWITCH [GW6A-EL, GW6AX-EL]

id0517i2360700

Purpose/Function

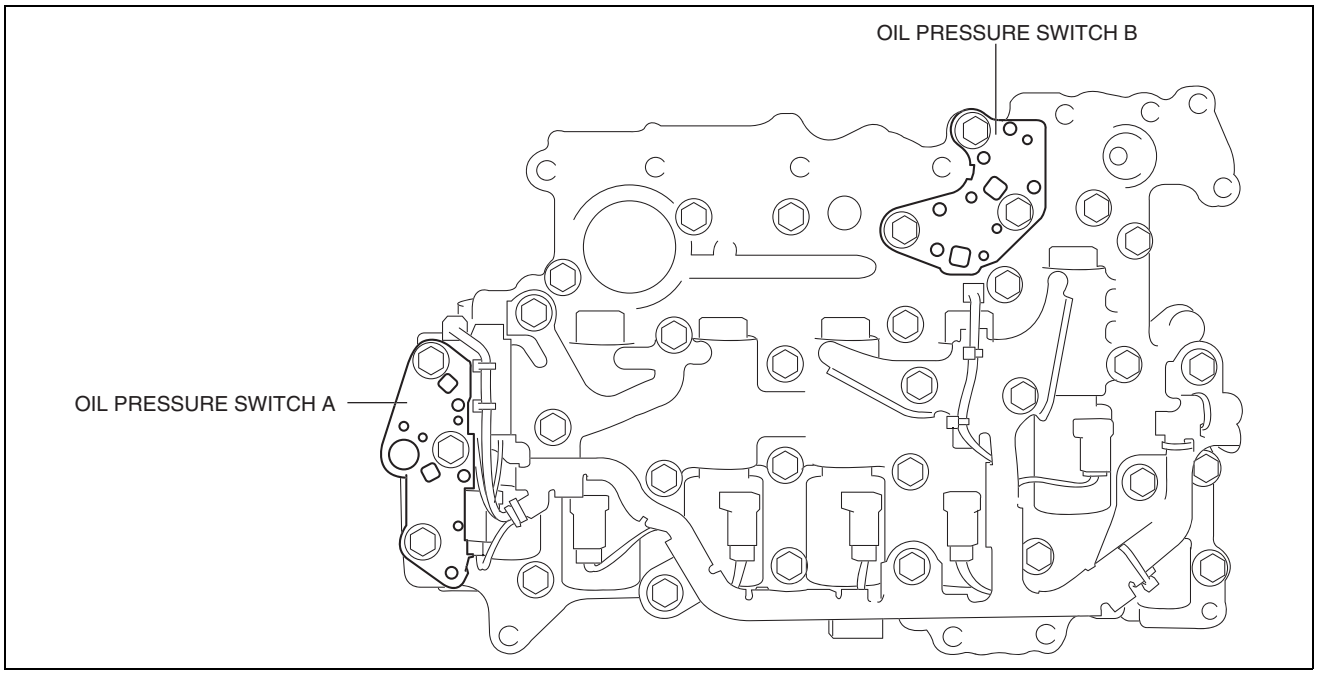
- The oil pressure switch detects the engagement pressures of the low clutch, 2-6 brake, R-3-5 brake, and the high clutch.
- The oil pressure switch signal is used for automatic shift control, manual shift control, TCC control, line pressure control, direct electric shift control, and the on-board diagnostic system.

Construction

- The oil pressure switch contacts the oil passages of the low clutch, 2-6 brake, R-3-5 brake, and the high clutch and is installed to the control valve body.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The oil pressure switch is an on/off type switch.



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Relation of oil pressure switch and engagement pressure detection targets

Oil pressure switch		Clutch/brake
Oil pressure switch A	Oil pressure switch No.2	2-6 brake
	Oil pressure switch No.3	R-3-5 brake
Oil pressure switch B	Oil pressure switch No.1	Low clutch
	Oil pressure switch No.4	High clutch

Operation

- When engagement pressure is supplied to the applicable clutch and brake, the oil pressure switch contact point closes.
- The TCM detects that clutch engagement pressure is supplied to the applicable clutch/brake by opening/closing the oil pressure switch contact point.

X: Contact point is closed

Oil pressure switch	1GR	2GR	3GR	4GR	5GR	6GR
Oil pressure switch No.1	X	X	X	X		
Oil pressure switch No.2		X				X
Oil pressure switch No.3			X		X	
Oil pressure switch No.4				X	X	X

TURBINE/INPUT SHAFT SPEED SENSOR, OUTPUT SHAFT SPEED SENSOR [GW6A-EL, GW6AX-EL]

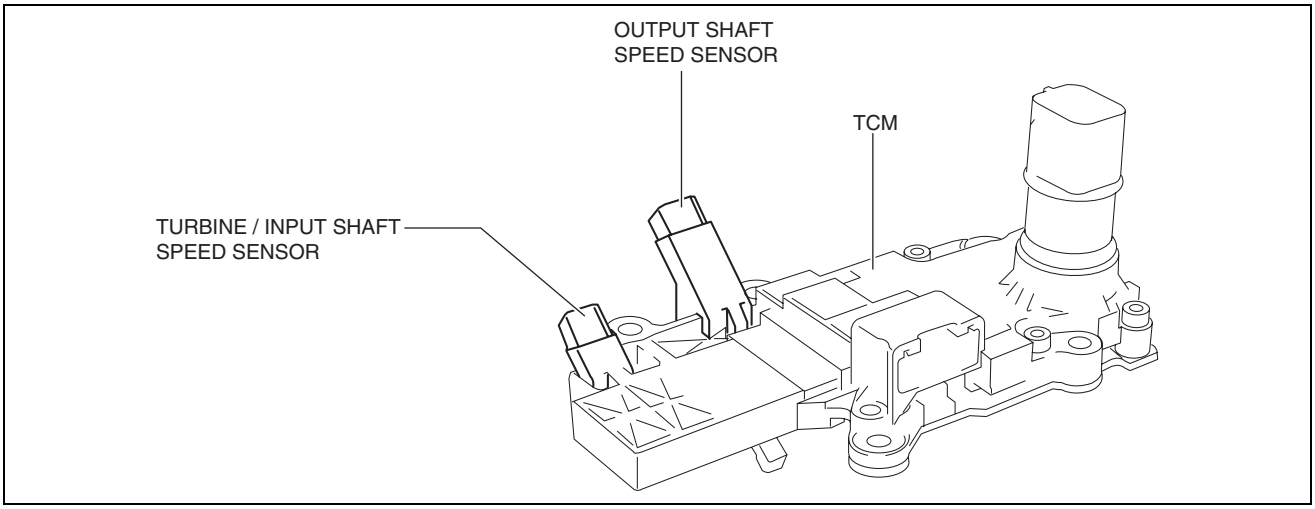
id0517i2360800

Purpose/Function

- The turbine/input shaft speed sensor detects the rotation speed of the input shaft (low clutch drum).
- The output shaft speed sensor detects the rotation speed of the output shaft (primary gear).
- The turbine/input shaft speed sensor and output shaft speed sensor signals are used for automatic shift control, manual shift control, and the on-board diagnostic system.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction
- The turbine/input shaft speed sensor and output shaft speed sensor are both integrated with the TCM and built-into the control valve body.



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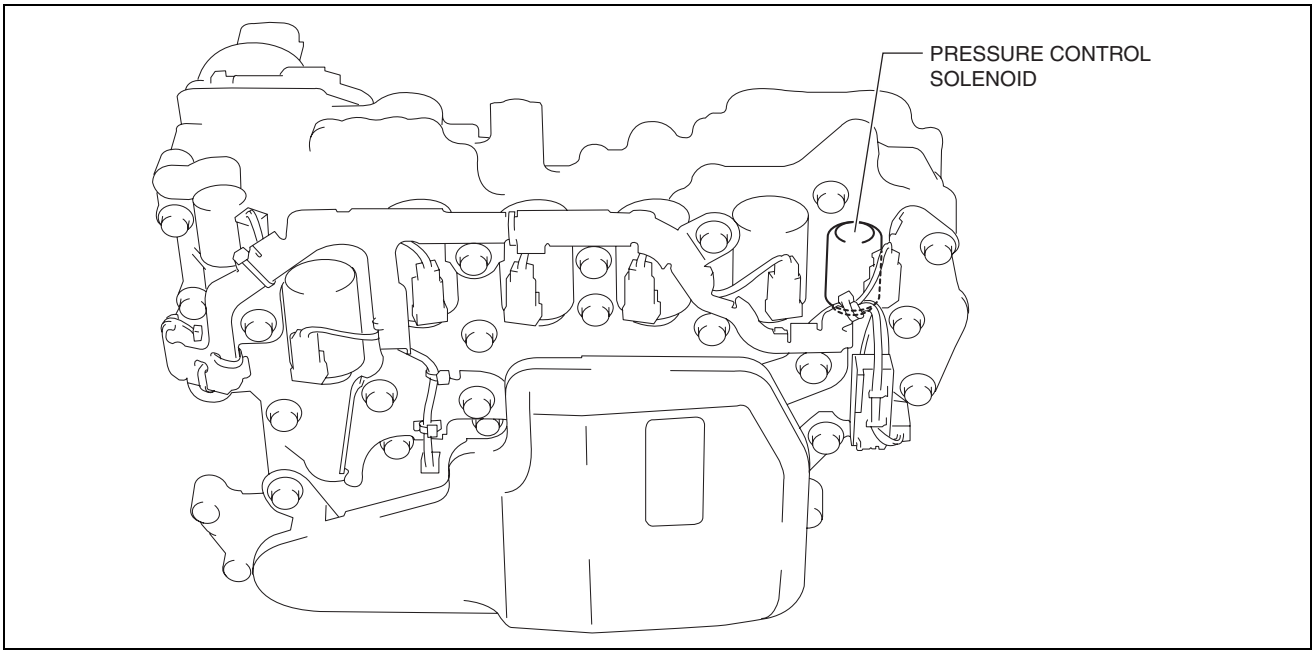
Operation
- The turbine/input shaft speed sensor changes the output signal according to the rotation speed of the low clutch drum.
- The output shaft speed sensor changes the output signal according to the rotation speed of the primary gear.

PRESSURE CONTROL SOLENOID [GW6A-EL, GW6AX-EL]

id0517i2361000

Purpose/Function
- The pressure control solenoid adjusts the pressure control solenoid pressure and controls the line pressure based on the control signal from the TCM.

Construction
- The pressure control solenoid is installed to the solenoid control valve body.
- The pressure control solenoid is a normal open-type linear solenoid.



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Operation
- Adjusts the pressure control solenoid pressure by increasing/decreasing the energization current to the pressure control solenoid according to the signal from the TCM.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

SHIFT SOLENOID NO.1 [GW6A-EL, GW6AX-EL]

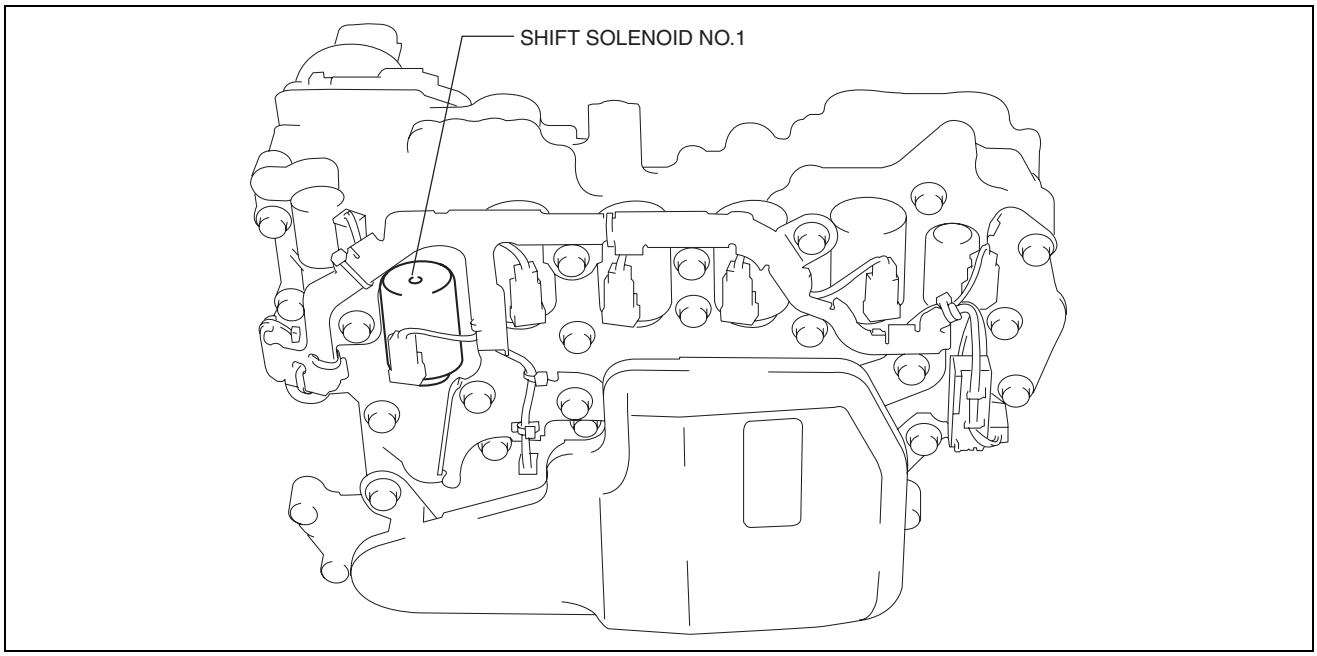
id0517i2361100

Purpose/Function

- Shift solenoid No.1 adjusts the hydraulic pressure in the low clutch circuit based on the current demand from the TCM according to the vehicle conditions.

Construction

- Shift solenoid No.1 is installed to the solenoid control valve body.
- Shift solenoid No.1 is a normal closed-type linear solenoid.



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Operation

- Adjusts the low clutch pressure by increasing/decreasing the energization current to shift solenoid No.1 according to the signal from the TCM.

SHIFT SOLENOID NO.2 [GW6A-EL, GW6AX-EL]

id0517i2361200

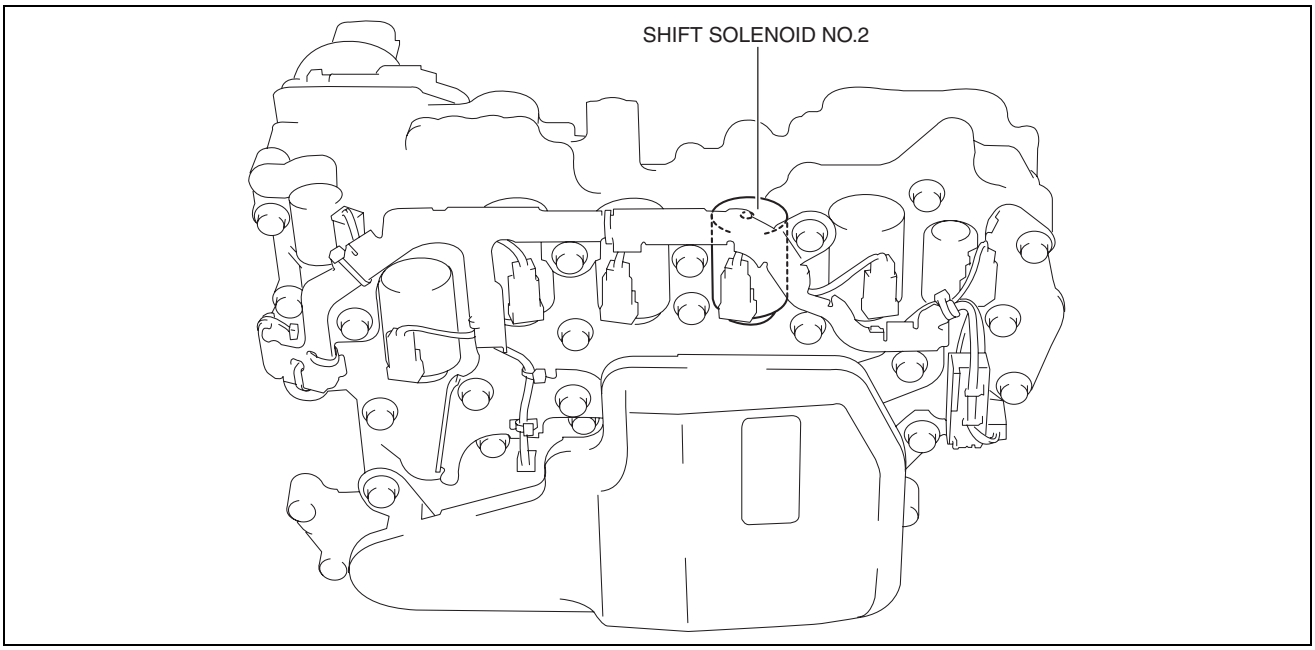
Purpose/Function

- Shift solenoid No.2 adjusts the hydraulic pressure in the 2-6 brake circuit based on the current demand from the TCM according to the vehicle conditions.

Construction

- Shift solenoid No.2 is installed to the solenoid control valve body.

- Shift solenoid No.2 is a normal closed-type linear solenoid.



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Operation

- Adjusts the 2-6 brake pressure by increasing/decreasing the energization current to shift solenoid No.2 according to the signal from the TCM.

SHIFT SOLENOID NO.3 [GW6A-EL, GW6AX-EL]

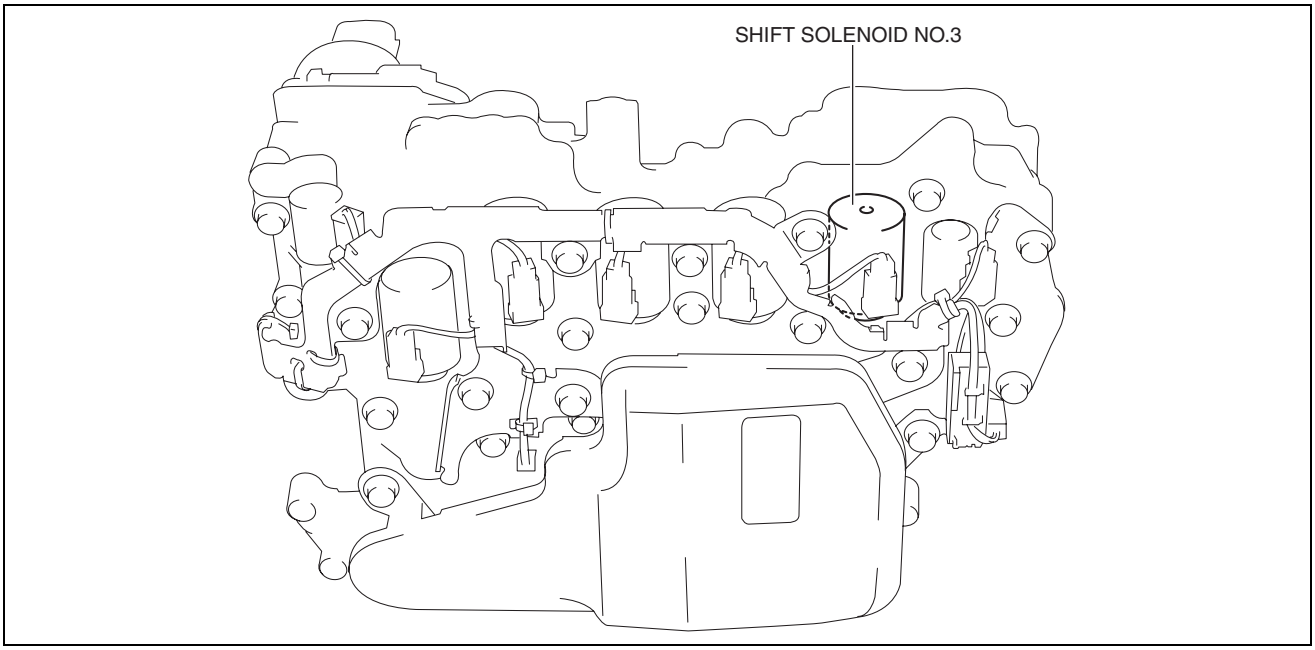
id0517i2361300

Purpose/Function

- Shift solenoid No.3 adjusts the hydraulic pressure in the R-3-5 brake circuit based on the current demand from the TCM according to the vehicle conditions.

Construction

- Shift solenoid No.3 is installed to the solenoid control valve body.
- Shift solenoid No.3 is a normal open-type linear solenoid.



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

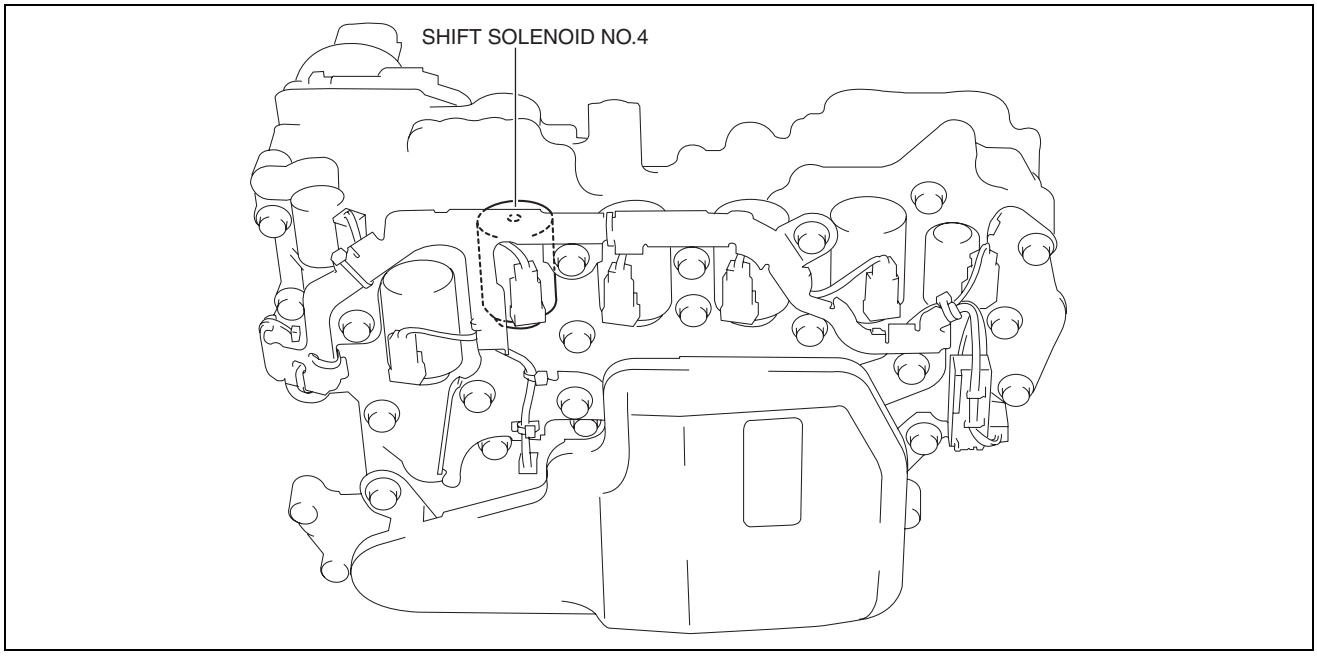
Operation
- Adjusts the R-3-5 brake pressure by increasing/decreasing the energization current to shift solenoid No.3 according to the signal from the TCM.

SHIFT SOLENOID NO.4 [GW6A-EL, GW6AX-EL]

id0517i2361400

Purpose/Function
- Shift solenoid No.4 adjusts the hydraulic pressure in the high clutch circuit and the low and reverse brake circuit based on the current demand from the TCM according to the vehicle conditions.

Construction
- Shift solenoid No.4 is installed to the solenoid control valve body.
- Shift solenoid No.4 is a normal open-type linear solenoid.



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Operation
- Adjusts the high clutch pressure and the low and reverse brake pressure by increasing/decreasing the energization current to shift solenoid No.4 according to the signal from the TCM.

TORQUE CONVERTER CLUTCH (TCC) CONTROL SOLENOID [GW6A-EL, GW6AX-EL]

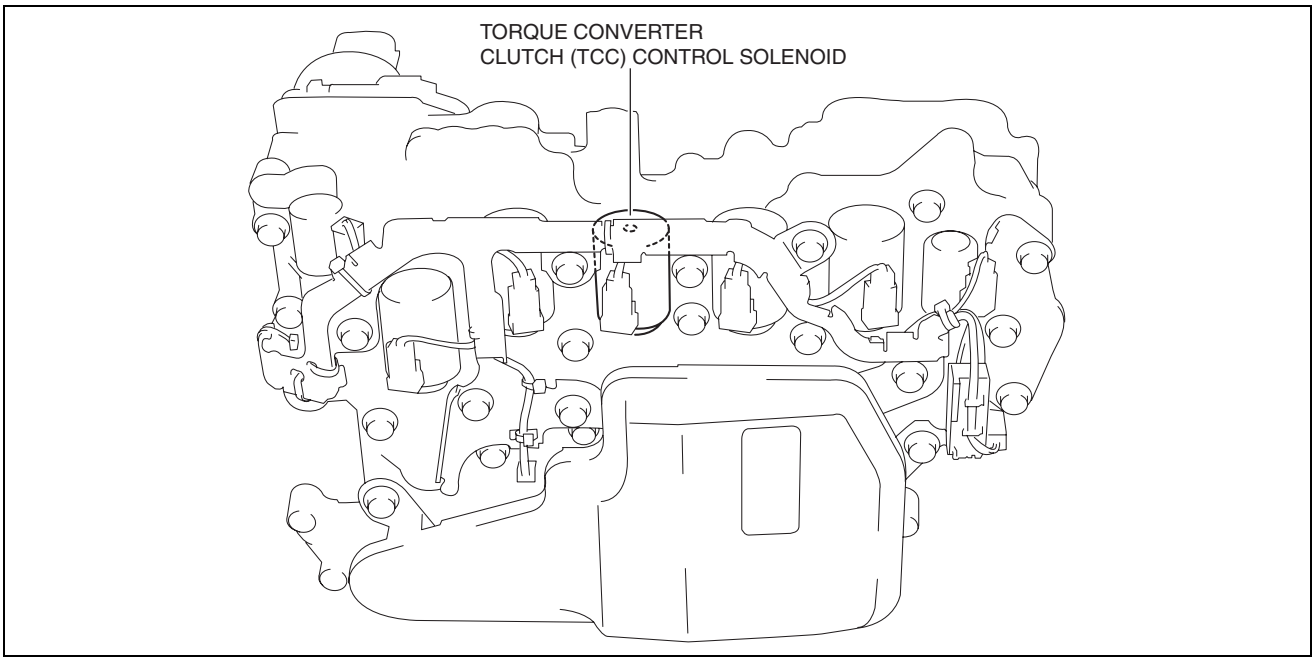
id0517i2361500

Purpose/Function
- The torque converter clutch (TCC) control solenoid adjusts the hydraulic pressure in the TCC control circuit based on the current demand from the TCM according to the vehicle conditions.

Construction
- The TCC control solenoid is installed to the solenoid control body.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

- The TCC control solenoid is a normal closed-type linear solenoid.



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Operation

- Adjusts the TCC control clutch pressure by increasing/decreasing the energization current to the TCC control solenoid according to the signal from the TCM.

ON/OFF SOLENOID [GW6A-EL, GW6AX-EL]

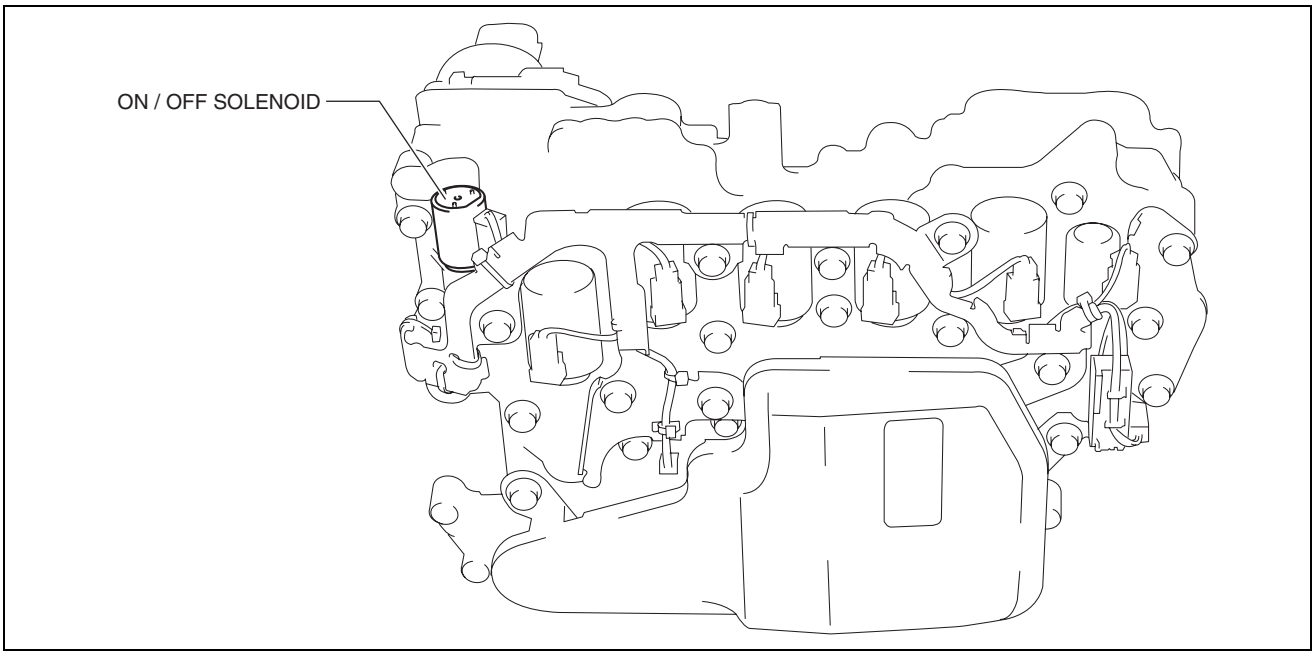
id0517i2361600

Purpose/Function

- The on/off solenoid performs switching of the shift valve in the control valve body according to the vehicle conditions.

Construction

- The on/off solenoid is installed to the solenoid control valve body.
- The on/off solenoid is a normal open-type on/off solenoid.



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Operation
Non-energization (OFF)
- When the on/off solenoid is off, the supply port in the solenoid opens. As a result, hydraulic pressure is supplied to operate the shift valve.

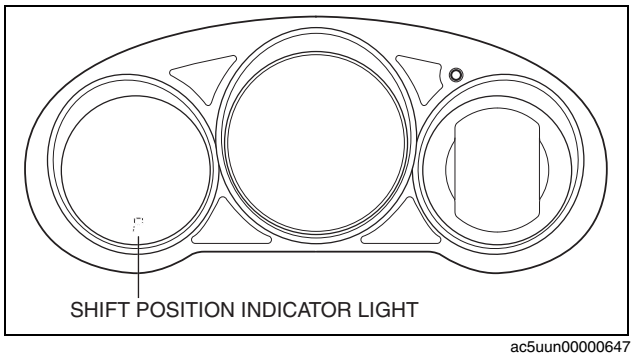
Energized (ON)
- When the on/off solenoid is on, the drain port in the solenoid opens. As a result, hydraulic pressure which operates the shift valve is drained.

SHIFT POSITION INDICATOR LIGHT [GW6A-EL, GW6AX-EL]

id0517i2361700

Purpose/Function
- The shift position indicator light indicates the selector lever position.

Construction
- The shift position indicator light is built into the instrument cluster.



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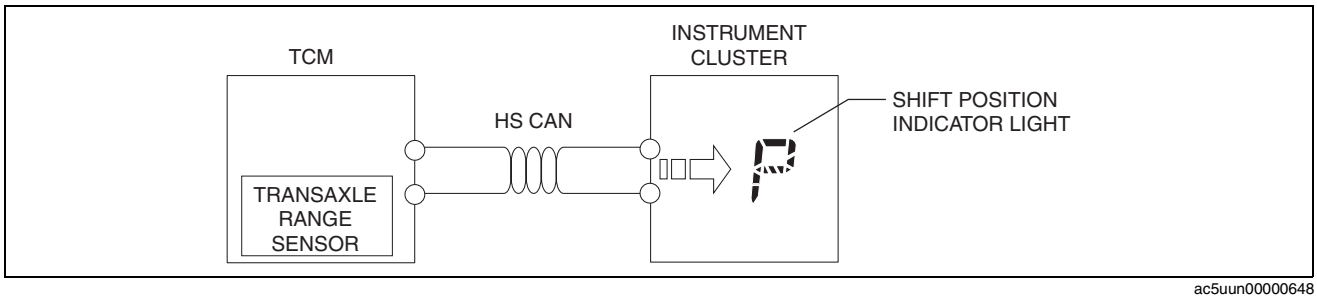
Operation
- The TCM sends a shift position indicator light illumination request signal to the instrument cluster via CAN based on the signal from the integrated transaxle range sensor signal received via CAN.



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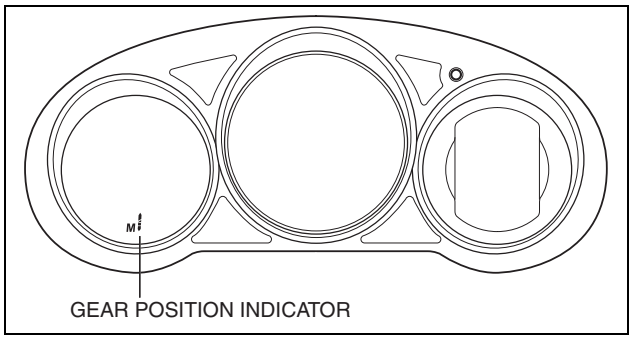
GEAR POSITION INDICATOR [GW6A-EL, GW6AX-EL]

id0517i2361800

Purpose/Function
- The gear position indicator illuminates while under manual shift control and displays the gear number while driving.

Construction
- The gear position indicator is built into the instrument cluster.



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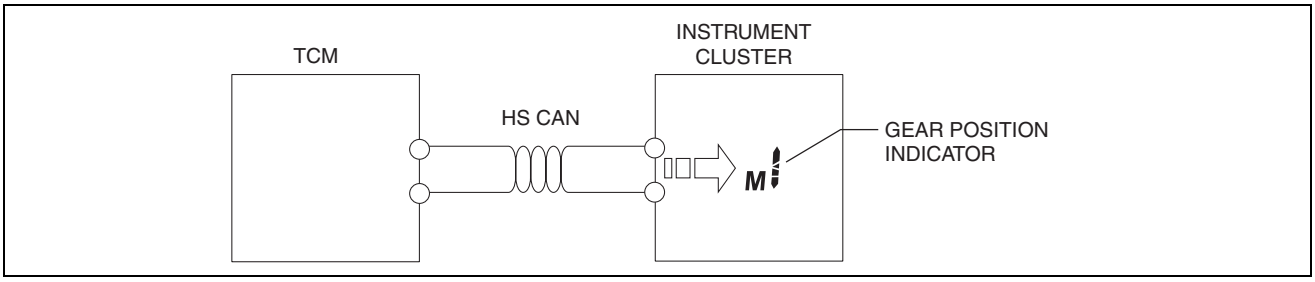
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Operation

- The TCM sends a gear position indicator illumination/flash request signal to the instrument cluster based on the signal from the M position switch, the up switch and the down switch via the CAN.



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- If the shift down operation is inhibited during manual shift control, the TCM flashes the gear position indicator 2 times. As a result, the driver is notified that the shift down operation has been canceled.
- If the ATF temperature is 132 °C {270 °F} or more while in manual shift control, the TCM turns the gear position indicator off and switches to automatic shift control to reduce the transaxle load. When the ATF temperature is 122 °C {252 °F} or less for a specified time, manual shift control is enabled and the gear position indicator is re-illuminated.

AUTOMATIC TRANSAXLE WARNING LIGHT [GW6A-EL, GW6AX-EL]

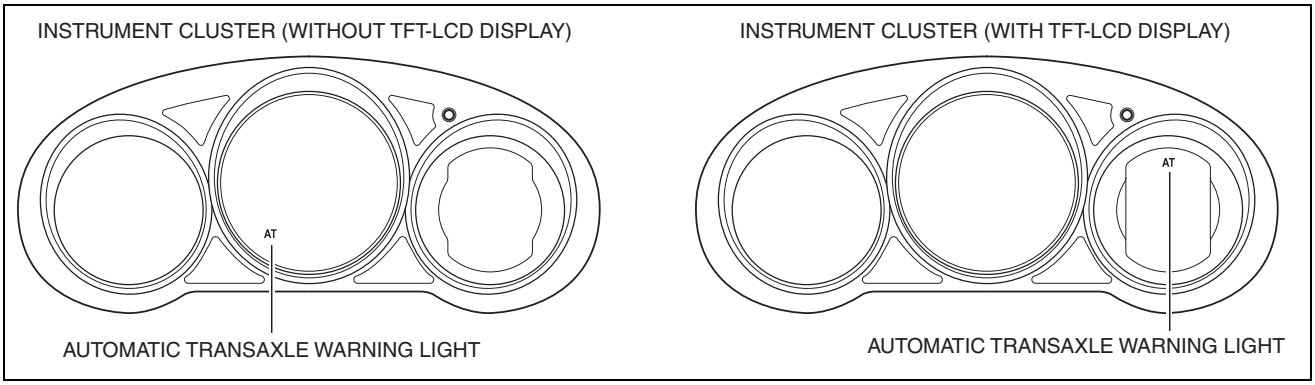
id0517i2361900

Purpose/Function

- The automatic transaxle warning light illuminates when the transaxle has malfunction.

Construction

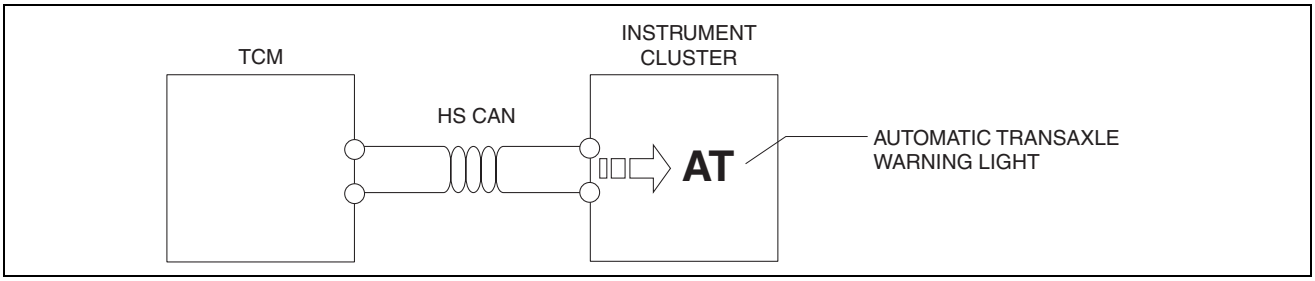
- The automatic transaxle warning light is built into the instrument cluster.



ac5wzn00000942

Operation

- If the transmission has a malfunction, the TCM sends an automatic transaxle warning light illumination request signal to the instrument cluster.



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- The TCM illuminates the automatic transaxle warning light for **approx. 2 s** after the ignition is switched ON to perform a bulb check of the automatic transaxle warning light. (Without TFT-LCD display)

TCM [GW6A-EL, GW6AX-EL]

id0517i2362000

Purpose/Function

- The TCM detects the vehicle conditions and performs calculations and processing based on input information from each type of sensor and switch.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

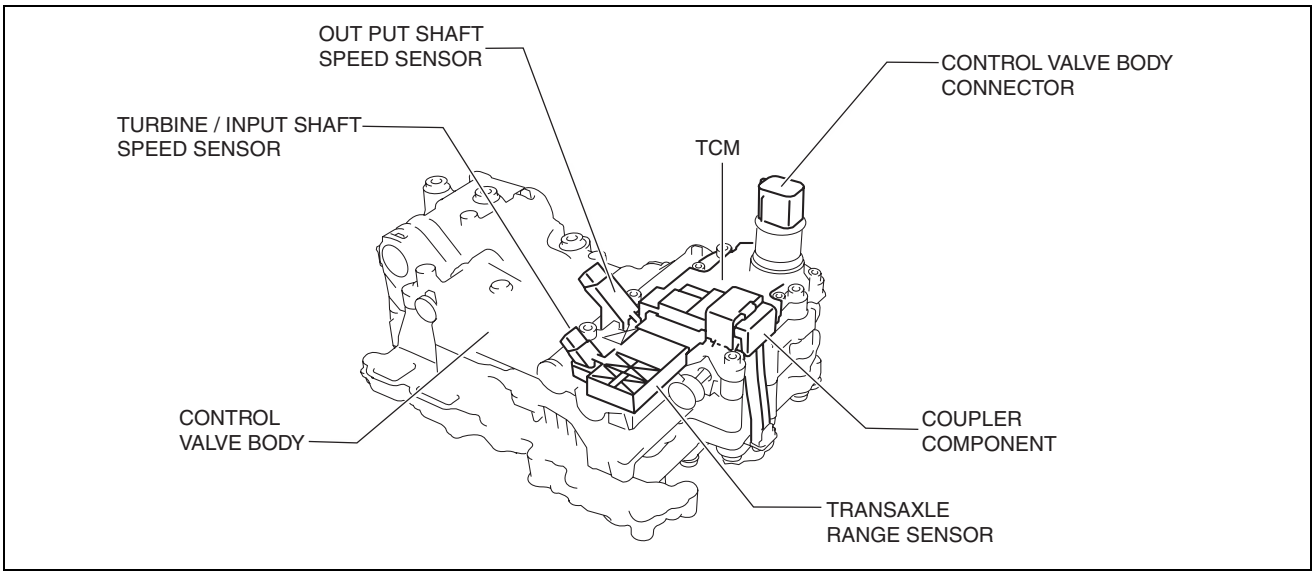
- Outputs control signals to each solenoid valve so that each type of control is optimally implemented according to the vehicle conditions.

Function Table

<table>
<tr><th colspan="4">Control item</th><th>Main control content</th></tr>
<tr><td rowspan="4">Shift point control</td><td rowspan="3">Automatic shift control
(D position)</td><td rowspan="3">Driving mode</td><td>Normal mode</td><td>• Mode selection during normal driving
• Performs automatic shift corresponding to vehicle speed and accelerator pedal depression amount</td></tr>
<tr><td>Active Adaptive Shift (AAS) mode</td><td>• Unnecessary shift up is suppressed for several seconds by maintaining the gear corresponding to the operation speed at which the accelerator pedal is released
• The optimum gear on the low vehicle-speed side is selected and shift down is executed corresponding to the operation force at which the brake pedal is depressed
• During cornering, shift up is suppressed in preparation for acceleration after cornering
• In regions of high elevation, the optimum gear is selected corresponding to the environment
• The slope is estimated in the TCM to select the appropriate gear for ascent and descent</td></tr>
<tr><td>High ATF temperature mode</td><td>• Controls engine torque when the ATF temperature is high</td></tr>
<tr><td colspan="3">Manual shift control
(M position)</td><td>• When M position is selected, manual shifting is prioritized according to the driver's shift up/shift down operation.</td></tr>
<tr><td rowspan="3">Shift pressure control</td><td colspan="3">Line pressure control</td><td>• Controls line pressure with high accuracy and fine control corresponding to engine load conditions and vehicle driving conditions</td></tr>
<tr><td colspan="3">Direct electric shift control</td><td>• Performs direct, electronic control of clutch engagement pressure appropriate to engine load conditions and vehicle driving conditions</td></tr>
<tr><td colspan="3">Learning control</td><td>• Learns engine performance changes and transaxle deterioration over time to optimally correct clutch engagement pressure</td></tr>
<tr><td colspan="4">Torque converter clutch (TCC) control</td><td>• Based on adoption of full range TCC control, active TCC control directly after acceleration from stop
• By gradually engaging/disengaging TCC piston, shock during operation is reduced
• Implements TCC control when accelerator pedal is fully closed for improved fuel economy and emission performance</td></tr>
<tr><td colspan="4">Engine-transaxle integration control</td><td>• Optimally controls engine output torque when shifting
• Calculates optimum clutch engagement pressure according to engine output torque</td></tr>
<tr><td colspan="4">On-board diagnostic system</td><td>• Main part of transaxle control includes self-diagnosis function. In case of malfunction, automatic transmission warning light illuminates to alert driver, and DTC is stored in TCM
• When transaxle malfunction is determined resulting from on-board diagnostic test, system control is switched to prevent any dangerous situation while driving</td></tr>
</table>

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction



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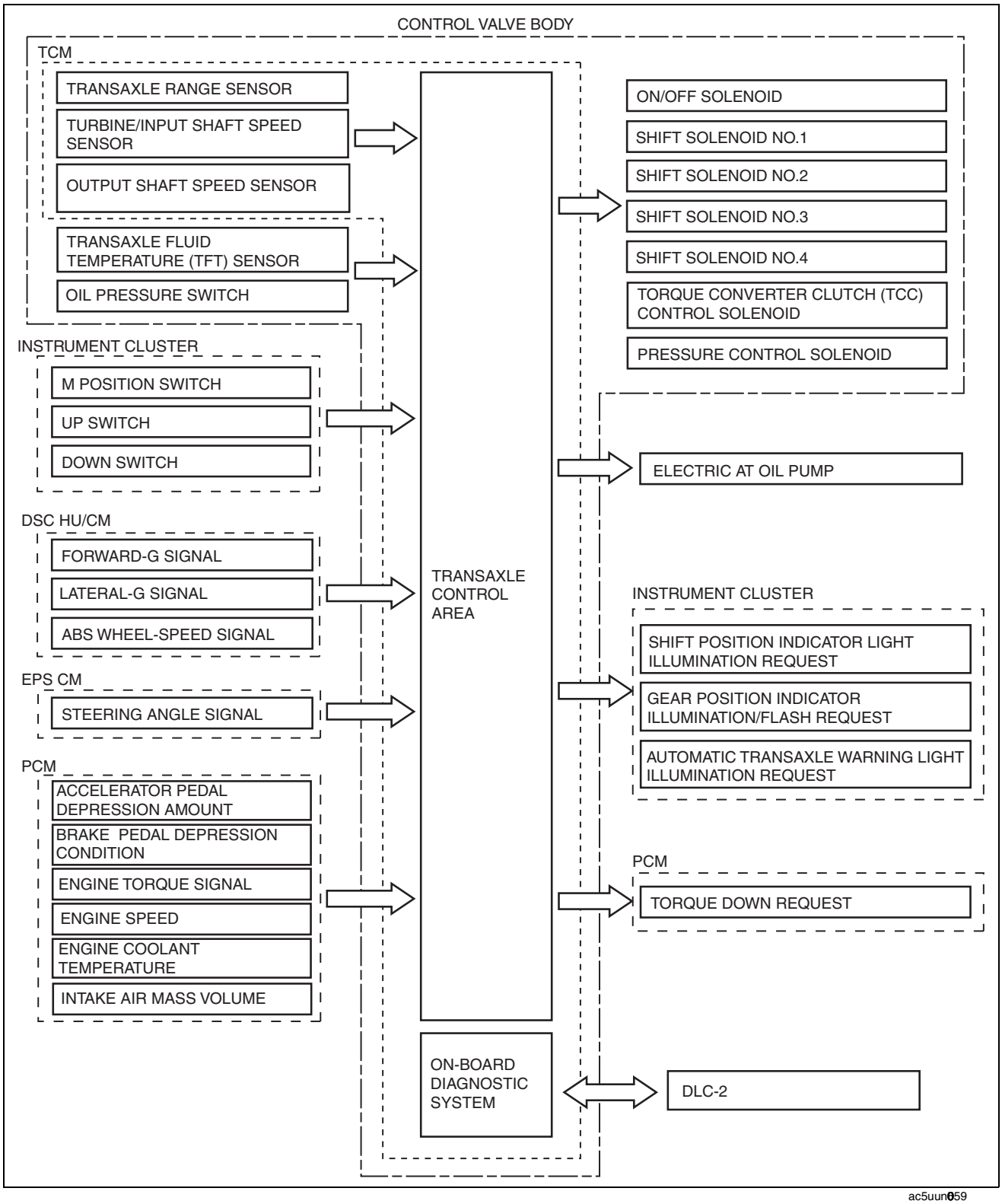
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Block diagram



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Operation
Correlation between control and input/output parts

x : AVAILABLE

INPUT/OUTPUT PART		CONTROL ITEM	SHIFT POINT CONTROL				SHIFT PRESSURE CONTROL			TORQUE CONVERTER CLUTCH (TCC) CONTROL	ENGINE-TRANSAXLE INTEGRATION CONTROL	ON-BOARD DIAGNOSTIC SYSTEM
			AUTOMATIC SHIFT CONTROL (D POSITION)									
			NORMAL MODE	ACTIVE ADAPTIVE SHIFT (AAS) MODE	HIGH ATF TEMPERATURE MODE	MANUAL SHIFT CONTROL (M POSITION)	LINE PRESSURE CONTROL	DIRECT ELECTRIC SHIFT CONTROL	LEARNING CONTROL			
INPUT	TCM	TANSAXLE RANGE SENSOR	x	x	x	x	x	x	x	x	x	x
		TURBINE/INPUT SHAFT SPEED SENSOR	x	x		x	x	x	x	x		x
		OUTPUT SHAFT SPEED SENSOR	x	x		x	x	x		x		x
		TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR			x		x	x	x	x		x
		OIL PRESSURE SWITCH	x	x	x	x	x	x		x		x
	PCM	ACCELERATOR PEDAL DEPRESSION AMOUNT	x	x		x	x	x		x		x
		BRAKE PEDAL DEPRESSION CONDITION	x	x						x		x
		ENGINE TORQUE SIGNAL		x		x	x	x	x	x	x	x
		ENGINE SPEED		x			x	x	x	x	x	x
		ENGINE COOLANT TEMPERATURE								x		x
		INTAKE AIR MASS VOLUME										x
	INSTRUMENT CLUSTER	M POSITION SWITCH				x					x	
		UP SWITCH				x					x	
		DOWN SWITCH				x					x	
	DSC HU/CM	FORWARD-G SIGNAL		x								
		LATERAL-G SIGNAL		x								
		ABS WHEEL-SPEED SIGNAL		x								x
	EPS CM	STEERING ANGLE SIGNAL		x								
OUTPUT	AUTOMATIC TRANSAXLE	ON/OFF SOLENOID	x	x	x	x			x			x
		SHIFT SOLENOID NO.1	x	x	x	x		x	x			x
		SHIFT SOLENOID NO.2	x	x	x	x		x	x			x
		SHIFT SOLENOID NO.3	x	x	x	x		x	x			x
		SHIFT SOLENOID NO.4	x	x	x	x		x	x			x
		TORQUE CONVERTER CLUTCH (TCC) CONTROL SOLENOID	x	x	x	x		x	x	x		x
		PRESSURE CONTROL SOLENOID	x	x	x	x	x	x	x	x		x
	INSTRUMENT CLUSTER	SHIFT POSITION INDICATOR LIGHT ILLUMINATION REQUEST	x	x	x	x						
		GEAR POSITION INDICATOR ILLUMINATION/FLASH REQUEST				x						
		AUTOMATIC TRANSAXLE WARNING LIGHT ILLUMINATION REQUEST			x							x
INPUT/OUTPUT (CAN)			x	x	x	x	x	x		x	x	x

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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

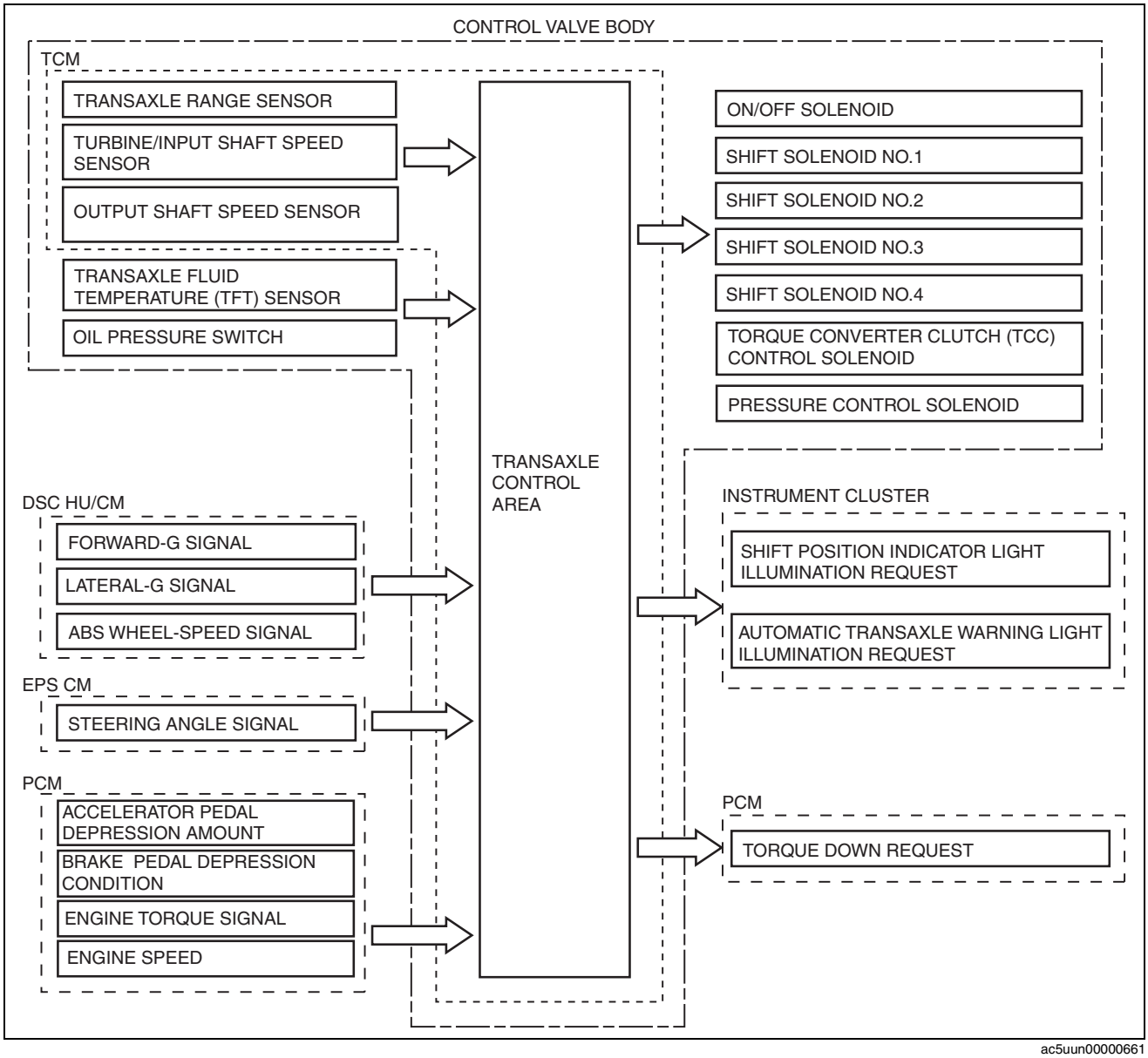
SHIFT POINT CONTROL (AUTOMATIC SHIFT CONTROL) [GW6A-EL, GW6AX-EL]

id0517i2362100

Outline

- The TCM implements auto shift control according to the vehicle speed and accelerator pedal depression amount while in D position.
- When the vehicle is stopped with the selector lever is in the D position and the brake pedal depressed, the neutral idle control is performed which internally controls the automatic transaxle to be in the neutral condition while the selector lever is in the D position. When the brake pedal is being released, the clutch is engaged immediately and the automatic transaxle returns to the normal D position condition.
- When implementing the automatic shift control, the TCM determines the driving conditions based on each input signal and selects the drive mode appropriate to the driving conditions. In addition, information such as torque and gear changes is exchanged via PCM and CAN communication and control is performed so as to achieve optimum drive force according to the driving scenario.

Construction



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Operation

Driving range determination

- If a D position signal is input and an M position signal is not input, the TCM implements auto shift control.

Driving mode determination

- For the auto shift control, NORMAL mode is usually selected, however it automatically switches to driving mode depending on the driving conditions.

— AAS (Active Adaptive Shift) mode: Automatically controls the optimum shift point according to the road conditions and the driver operation.
— High ATF temperature mode: When the ATF temperature rises to a high temperature, the engine torque is restricted so that the increase in ATF temperature is suppressed to protect the transaxle.

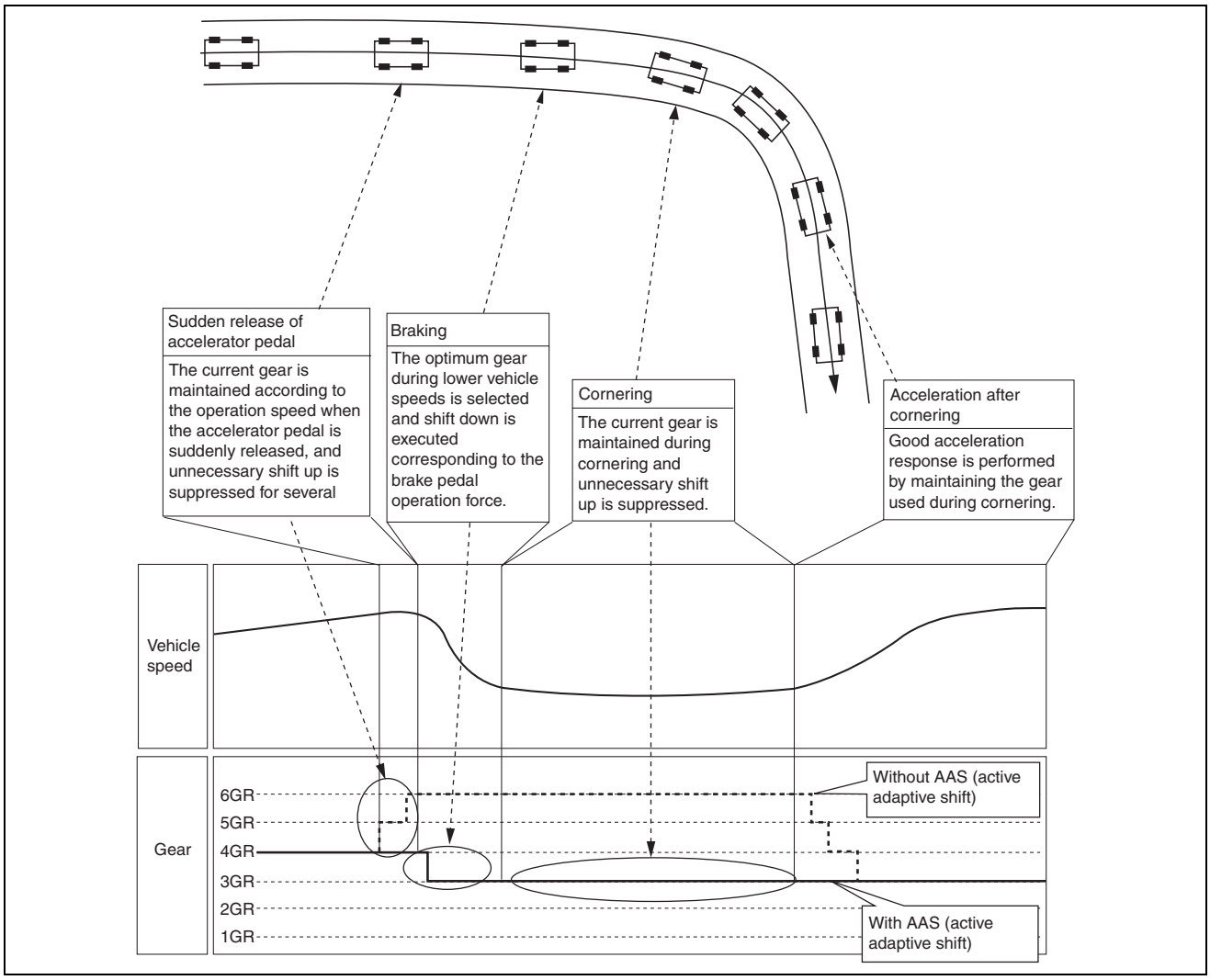
AAS (Active Adaptive Shift) mode operation

- Accelerator pedal fully closed suddenly and returned
  — When the accelerator pedal is fully closed and returned at a certain speed or more, shift-up is inhibited for specified time to improve speed control and reacceleration performance.
- Brake is strongly depressed
  — When decelerating at a certain speed or more, a lower gear is selected so that re-acceleration is performed smoothly.
  — During a shift change with the brake pedal depressed firmly, blipping control (synchronization to engine speed) is performed to shorten the shifting time.
- When cornering
  — While cornering at a turn with a radius of less than a specified value, shift up is suppressed to improve vehicle speed performance while cornering and reacceleration performance after cornering.
- During high degree of vehicle ascent/descent
  — During a certain level of vehicle ascent/descent, gears are selected appropriate to the driving conditions for driving comfort.
- During ascent
  — While ascending a slope of a certain grade or more, slope mode control prevents unnecessary shift-up by maintaining the appropriate gear.
- During descent
  — While descending a slope of a certain grade or more and depressing the brake pedal, the gears are appropriately shifted down according to the estimated slope angle for effective use of engine braking. As a result, frequent brake pedal operation is reduced.

AAS (active adaptive shift) operation scenario and effect

- The AAS (active adaptive shift) is a mode which estimates the driving environment and drive's intentions according to the vehicle driving conditions and the drive's operations, and selects the optimum gear for driving.
  Ex.1: Cornering
  — During cornering, shift up is suppressed to improve acceleration performance after cornering.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]



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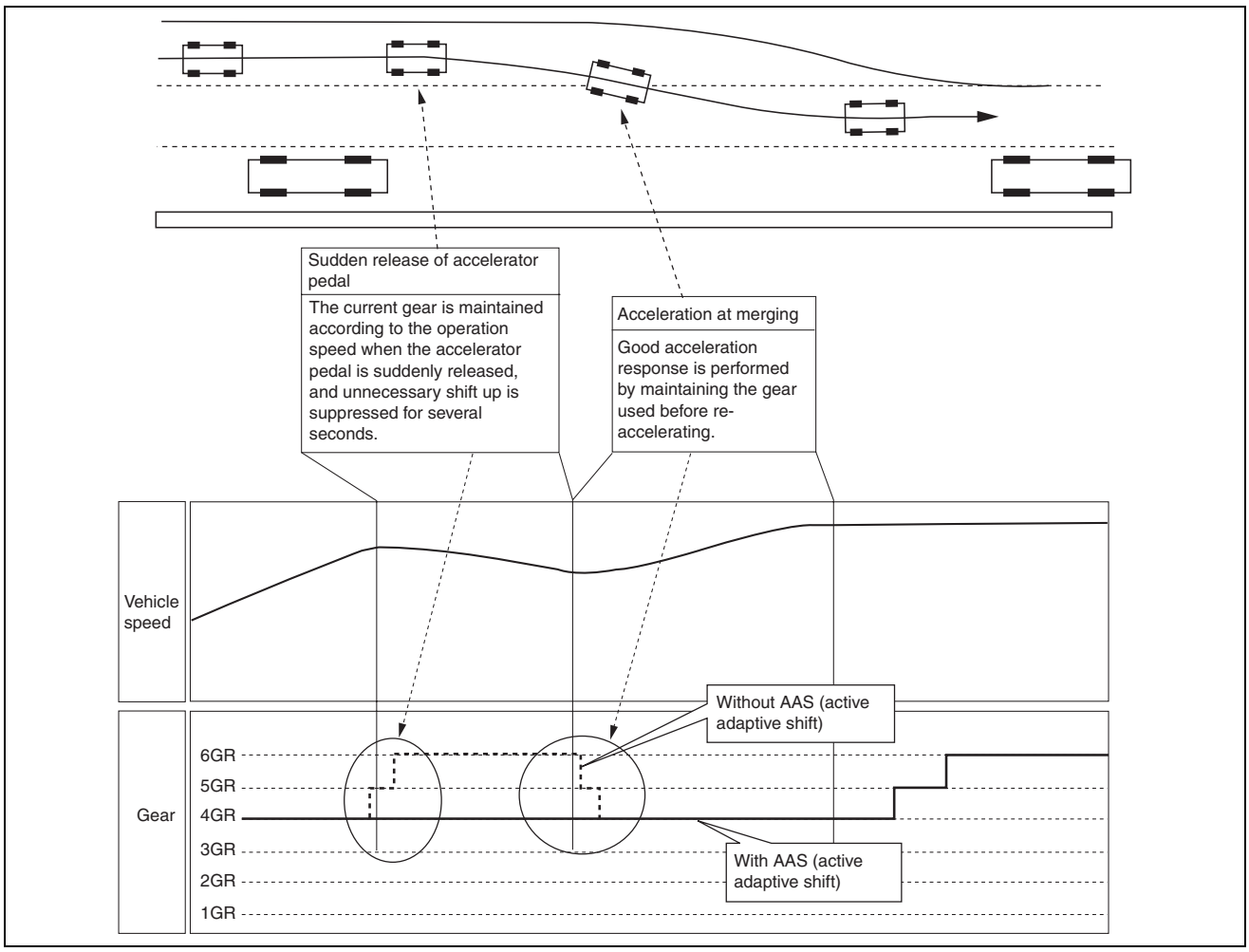
AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Ex. 2) Merging onto high speed expressways

— In a scenario such as temporarily decelerating while merging onto a high speed expressway, shift up is suppressed directly afterwards to improve re-acceleration performance.



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Automatic transaxle operation chart

Position	Mode	Gear position	Gear ratio	TCC	Operation of powertrain parts						Operation of shift solenoid					
					Low clutch	High clutch	Low and reverse brake	2-6 brake	R-3-5 brake	One-way clutch	Shift solenoid No.1	Shift solenoid No.2	Shift solenoid No.3	Shift solenoid No.4	TCC control solenoid	ON/OFF solenoid
P	-	-	-				×				CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OFF
R	-	Reverse	3.990				×		×		CLOSE	CLOSE	OPEN	OPEN	CLOSE	OFF
N		-	-				×				CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OFF
D/M	NORMAL	1GR	3.487	×	×		×			⊗	OPEN	CLOSE	CLOSE	OPEN	OPEN	OFF
		2GR	1.992	×	×			×			OPEN	OPEN	CLOSE	CLOSE	OPEN	ON
		3GR	1.449	×	×				×		OPEN	CLOSE	OPEN	CLOSE	OPEN	ON
		4GR	1.000	×	×	×					OPEN	CLOSE	CLOSE	OPEN	OPEN	ON
		5GR	0.707	×		×			×		CLOSE	CLOSE	OPEN	OPEN	OPEN	ON
		6GR	0.600	×		×		×			CLOSE	OPEN	CLOSE	OPEN	OPEN	ON

× : Operating
⊗ : Transmits torque only during driving operation
OPEN: Engages the line pressure to the clutch pressure
CLOSE: Drains the clutch pressure
ON: Engages the output port and the supply port
OFF: Engages the output port and the drain port (Drains the output port)

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SHIFT POINT CONTROL (MANUAL SHIFT CONTROL) [GW6A-EL, GW6AX-EL]

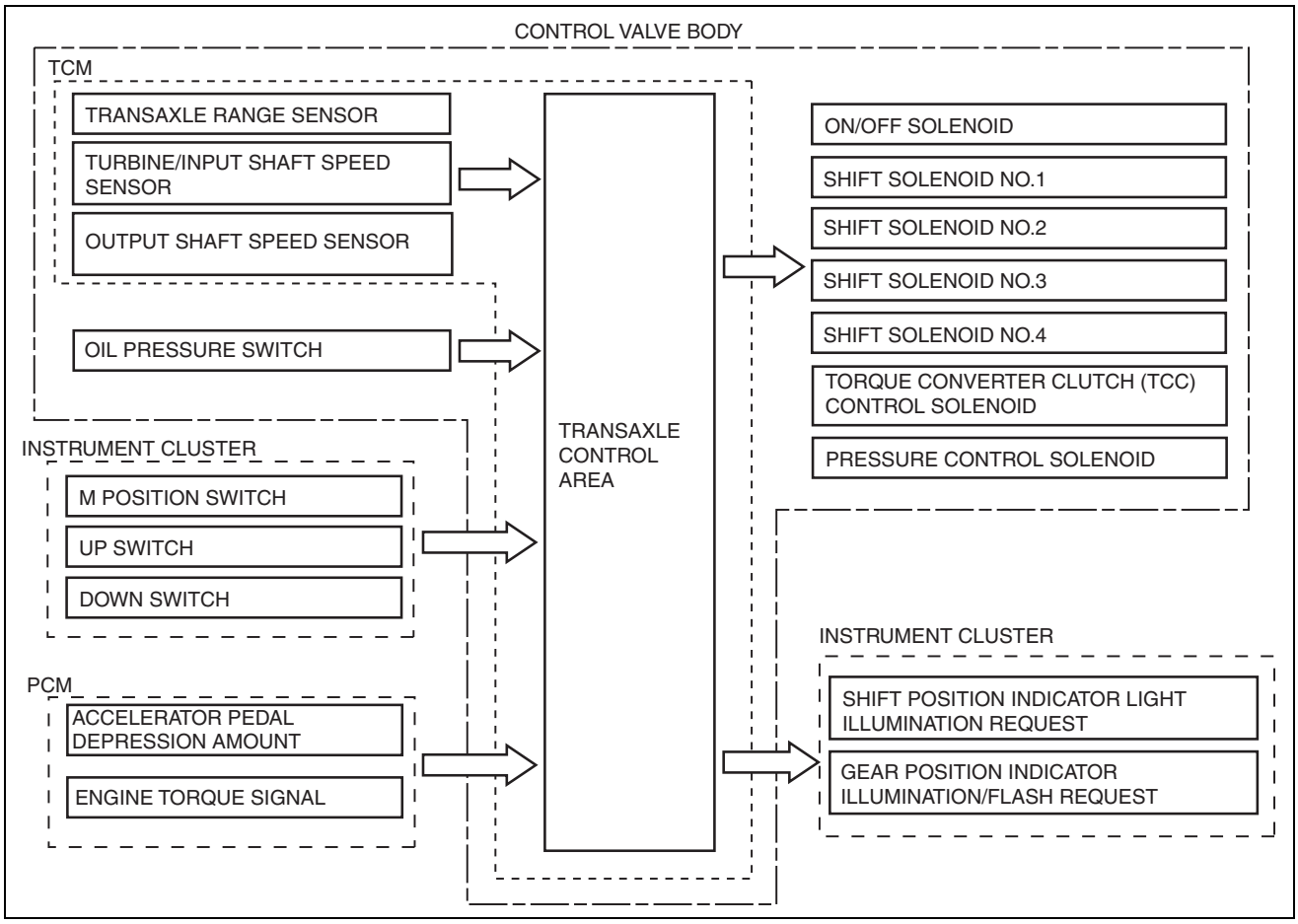
id0517i2362200

Outline

- The TCM operates the manual shift control when the M position is selected.
- If the M position is selected, manual shifting is prioritized according to the driver's shift up/shift down operation. However, to assure driving safety and protect the ATX, minimum automatic shifting may occur.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction



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Operation

- Gears can be selected by moving the selector lever back and forth while driving in the M position.
- When shifting the selector lever from the D to M position while driving, the gear being used while driving in the D position is maintained. For driving in D position 6th gear, however, when shifting the selector lever from the D to M position with the accelerator pedal not depressed, the gear shifts from 6th to 5th gear. For driving in 5th gear, when shifting the selector lever from the D to M position with the accelerator pedal not depressed, the gear shifts from 5th to 4th gear.
- When a shift down is performed using the selector lever with the accelerator pedal not depressed and the selector lever in the M position, blipping control (synchronization to engine speed) is performed.
- If the ATF temperature exceeds the specified temperature while in manual mode, the TCM switches control to automatic shift control and turns the gear position indicator off to reduce the transaxle load. When the ATF temperature decreases to the appropriate temperature, the TCM enables driving in manual mode and re-illuminates the gear position indicator.
- During manual shift control, in every gear speed, engine brake force can be obtained corresponding to the gear ratio. In addition, if the vehicle speed reaches a constant speed or less, shift-down is performed automatically.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Shifting operation and manual transmission

Shift operation		Gear	Gear shift enabled/disabled
Shift-up operation	Operates once	1GR to 2GR	Enabled when both driving and stopped
		2GR to 3GR	Enabled when driving at specified vehicle speed or more
		3GR to 4GR	
		4GR to 5GR	
		5GR to 6GR	
	Operates 2 times consecutively	1GR to 3GR	
		2GR to 4GR	
		3GR to 5GR	
		4GR to 6GR	
	Operates 3 times consecutively	1GR to 4GR	
		2GR to 5GR	
		3GR to 6GR	
	Operates 4 times consecutively	1GR to 5GR	
		2GR to 6GR	
Shift-down operation	Operates once	6GR to 5GR	Enabled when driving at specified vehicle speed or less
		5GR to 4GR	
		4GR to 3GR	
		3GR to 2GR	
		2GR to 1GR	
	Operates 2 times consecutively	6GR to 4GR	
		5GR to 3GR	
		4GR to 2GR	
		3GR to 1GR	
	Operates 3 times consecutively	6GR to 3GR	
		5GR to 2GR	
		4GR to 1GR	
	Operates 4 times consecutively	6GR to 2GR	
		5GR to 1GR	

- The gear shifting operation may cancel depending on the vehicle speed. If a shift-down operation is canceled, the gear position indicator illuminates to alert the driver.
- If the engine reaches a high engine speed, the following controls are performed to protect the engine:
  1. The throttle valve is squeezed so that the engine speed does not exceed the excess speed range and the engine speed is stabilized at a lower speed than the excess speed range.
  2. If the high engine speed condition continues, the engine speed is lowered by a forced shift-up of the gears.

2nd gear fixed mode

- When the vehicle is stopped or the vehicle speed is extremely low, the selector lever is moved to the + side and the transaxle is in 2nd gear.
- On slippery surfaces such as snow-bound roads, forward acceleration and driving is facilitated.While in 2nd gear fixed mode and the selector lever is shifted to gears other than 2nd gear, the 2nd gear fixed mode is canceled.

TORQUE CONVERTER CLUTCH (TCC) CONTROL [GW6A-EL, GW6AX-EL]

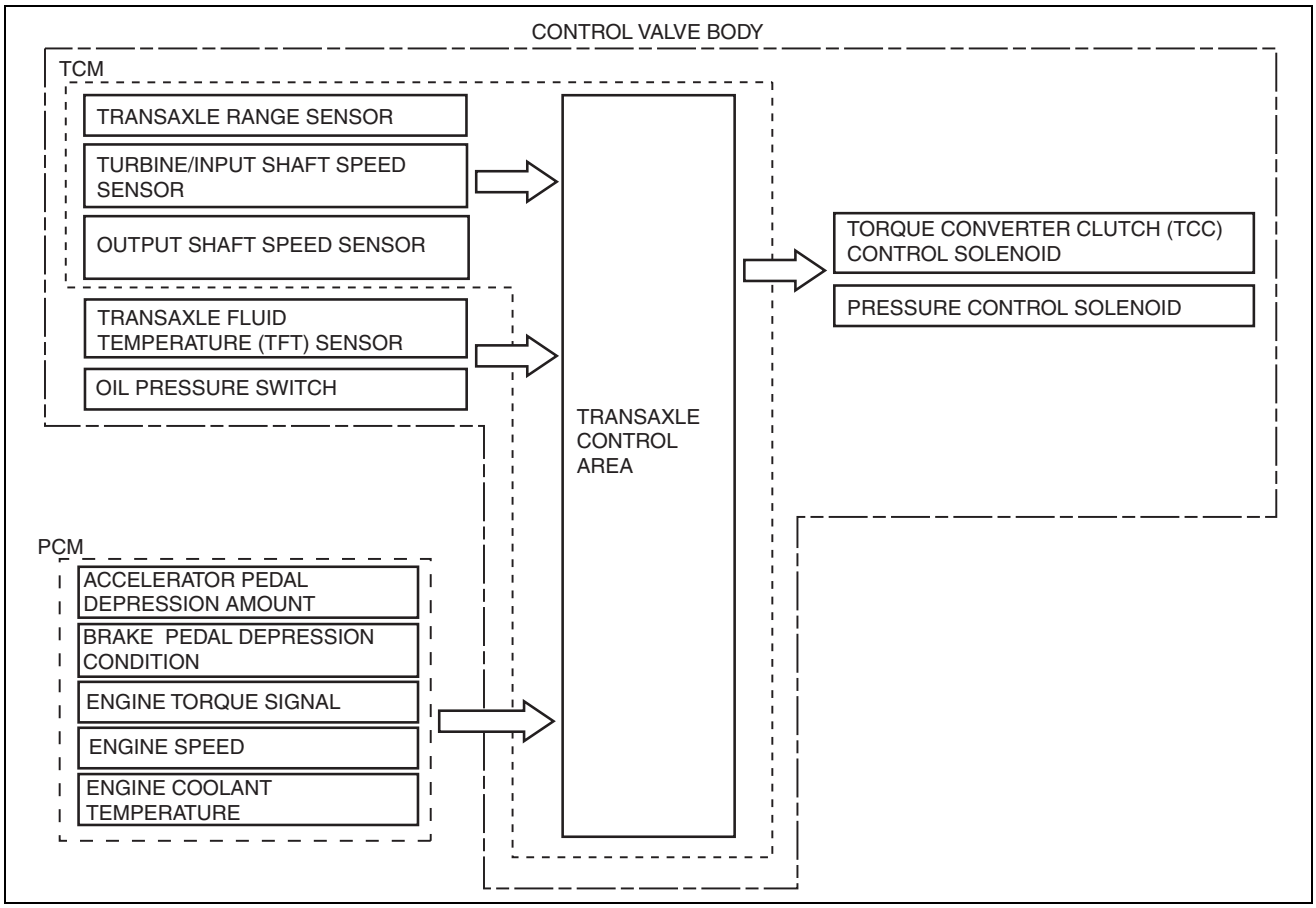
id0517i2362300

Outline

- For TCC control, a newly developed, full range TCC control has been adopted. The TCC range has been significantly widened by having the smoothness unique to the torque converter during acceleration from a stop take precedence and actively controlling TCC directly after acceleration from a stop. Therefore, a contribution to low fuel consumption and vehicle operability with a direct feel have been achieved.
- Lower fuel consumption and improved emission performance have been achieved by performing the TCC control during deceleration with the accelerator pedal fully closed and by fuel-cut during TCC.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction



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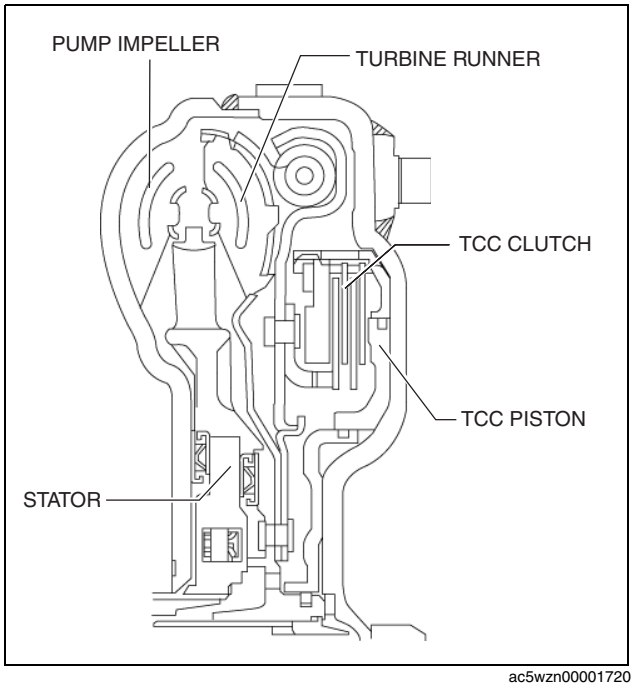
- The TCC mechanism consists of a torque converter clutch, TCC piston, and a damper which are installed inside the torque converter.
- A multi-plate type torque converter clutch has been adopted for improved durability. Also, by reducing the size of the clutch diameter, improved handling is achieved by the ability to respond to the precise control by the full range TCC.
- Vibration during TCC engagement is suppressed by the improved damper performance.



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AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Operation

TCC engagement

- A current signal is sent from the TCM to the TCC control solenoid during TCC engagement. At the same time, the TCC piston engagement pressure is gradually increased.
- As a result, the TCC piston is pressure-bonded to the TCC clutch slowly to perform smooth TCC engagement.

TCC release

- A current signal is sent from the TCM to the TCC control solenoid during TCC release. At the same time, the TCC piston engagement pressure is gradually drained.
- As a result, the TCC piston releases the TCC clutch slowly to release the TCC smoothly.

Inhibition of TCC control

- If any one of the following conditions is met, the torque converter clutch control is inhibited.
  - — TCC solenoid malfunction
  - — ATF temperature is specification or less
  - — Engine speed signal is specification or less
  - — Turbine shaft speed is specification or less
  - — Other than D/M position

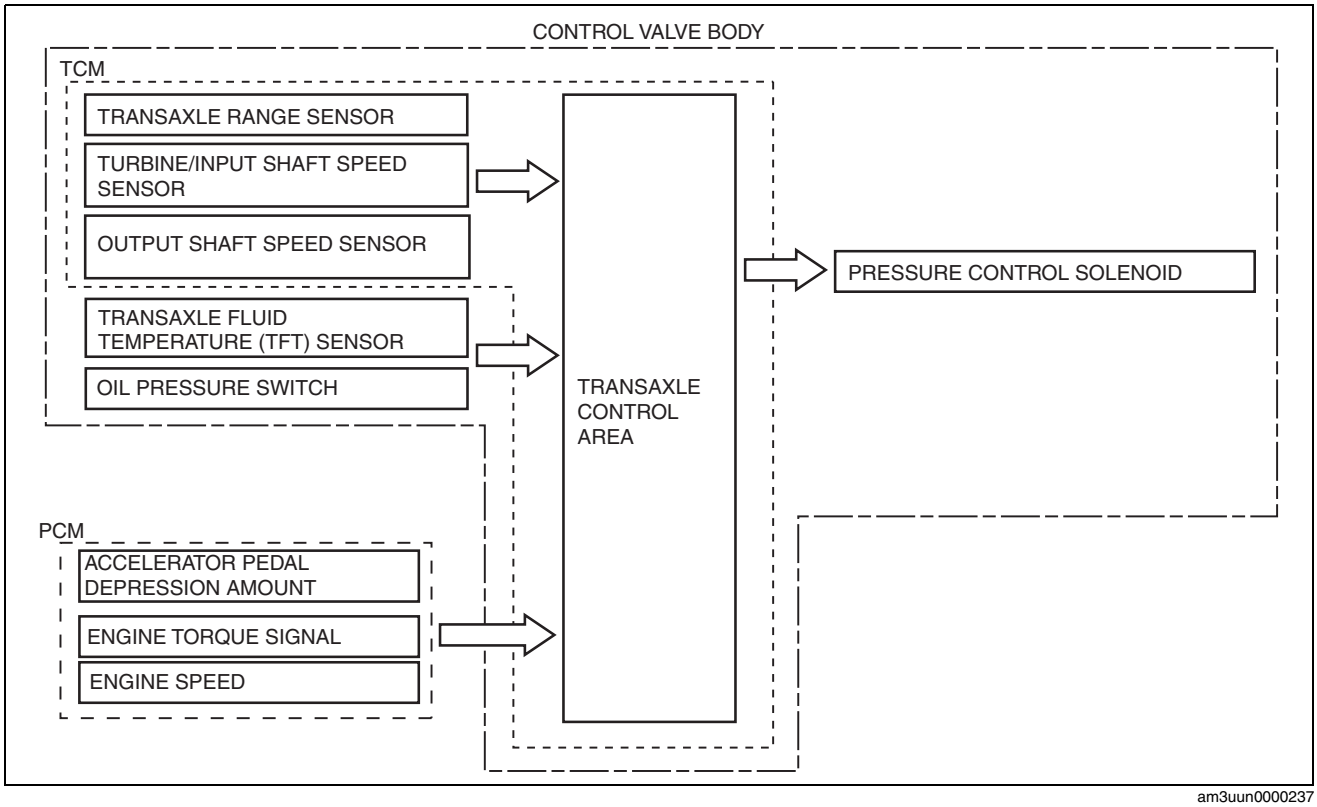
SHIFT PRESSURE CONTROL (LINE PRESSURE CONTROL) [GW6A-EL, GW6AX-EL]

id0517i2362500

Outline

- The TCM drives the pressure control solenoid and adjusts the pressure based on the accelerator pedal depression amount, vehicle speed, ATF temperature, and gear shift signal. As a result, line pressure is controlled finely and with high accuracy according to the engine load condition and vehicle driving conditions.

Construction



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Operation

- The TCM adjusts the pressure control solenoid pressure applied to the pressure regulator valve by increasing/decreasing the energization current to the pressure control solenoid. As a result, the ATF amount passing through the pressure regulator valve is adjusted and the line pressure is adjusted.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

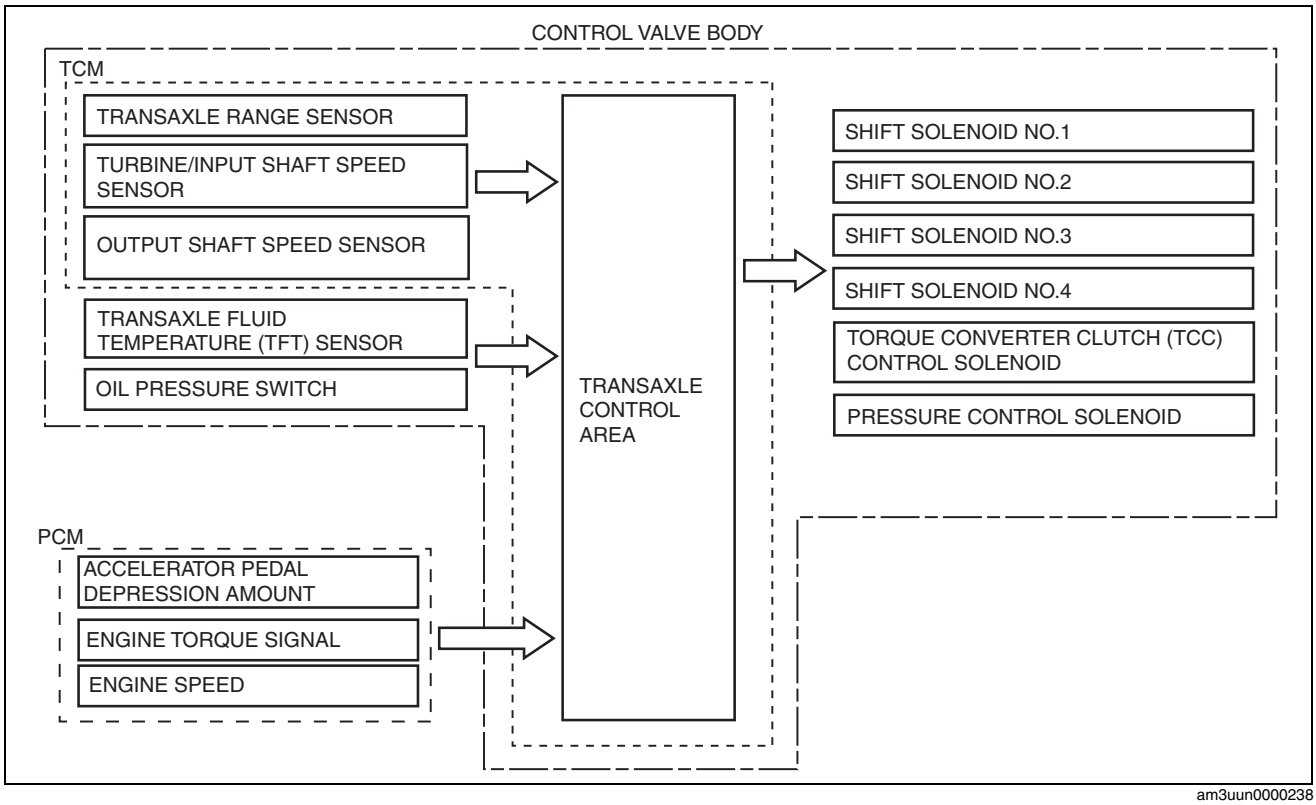
SHIFT PRESSURE CONTROL (DIRECT ELECTRIC SHIFT CONTROL) [GW6A-EL, GW6AX-EL]

id0517i2362600

Outline

- The TCM drives shift solenoids No.1, 2, 3, 4, the pressure control solenoid, and the on/off solenoid based on inputs signals from each switch and sensor, and performs direct electronic control of the clutch engagement pressure. As a result, precise hydraulic pressure control of the clutch engagement, not possible using a conventional accumulator, is achieved.

Construction



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Operation

N to D, and N to R selected

- When N to D, and N to R are selected, the TCM drives the pressure control solenoid and shift solenoids No. 1 and 3 for optimum clutch engagement pressure control.

Shifting

- During shifting, the TCM drives shift solenoids No.1, 2, 3, and 4 to directly control the clutch engagement pressure for optimum clutch engagement pressure control.
- During each gear shift, the engagement side clutch pressure and release side clutch pressure are controlled simultaneously. As a result, the torque capacities of both clutches can be controlled in connection to each other when switching clutches, engine over-speed during shifting and interlock among clutches is prevented, and smooth and responsive shifting is achieved.

SHIFT PRESSURE CONTROL (LEARNING CONTROL) [GW6A-EL, GW6AX-EL]

id0517i2362700

Outline

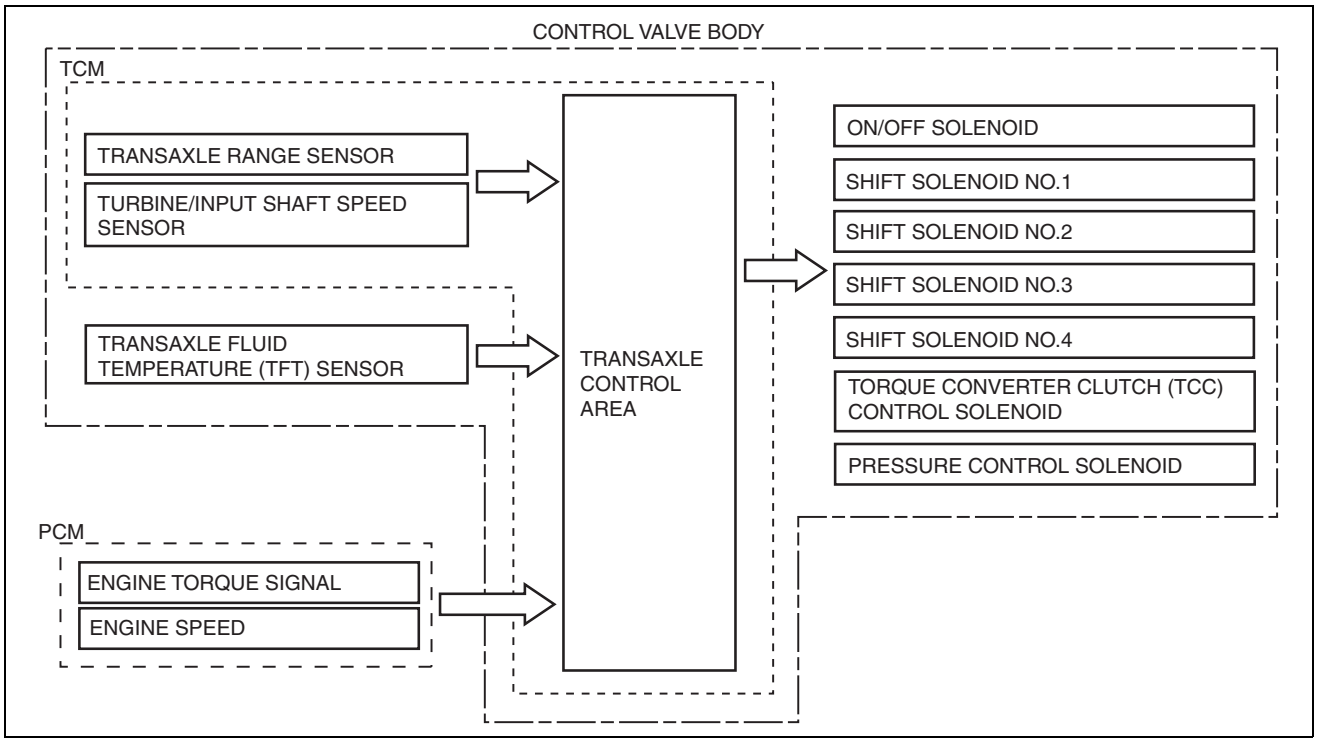
- The TCM optimizes the hydraulic pressure for clutch engagement and disengagement through learning correction of the clutch engagement pressure.

Note

- The clutch engagement pressure learning value stored in the TCM is not cleared even if the negative battery terminal is disconnected. Therefore, if the control valve body is replaced, the learning value stored in the TCM and the control valve body specification are incompatible and engine rev-up may occur or shift shock may increase. Due to this, if the control valve body is replaced, it is necessary to perform the initial learning.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction



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Operation

- The TCM learns engine performance changes resulting from past shifting and deterioration over time of the transaxle and performs learning correction for optimum clutch engagement pressure during initial shifting.

ENGINE-TRANSAXLE INTEGRATION CONTROL [GW6A-EL, GW6AX-EL]

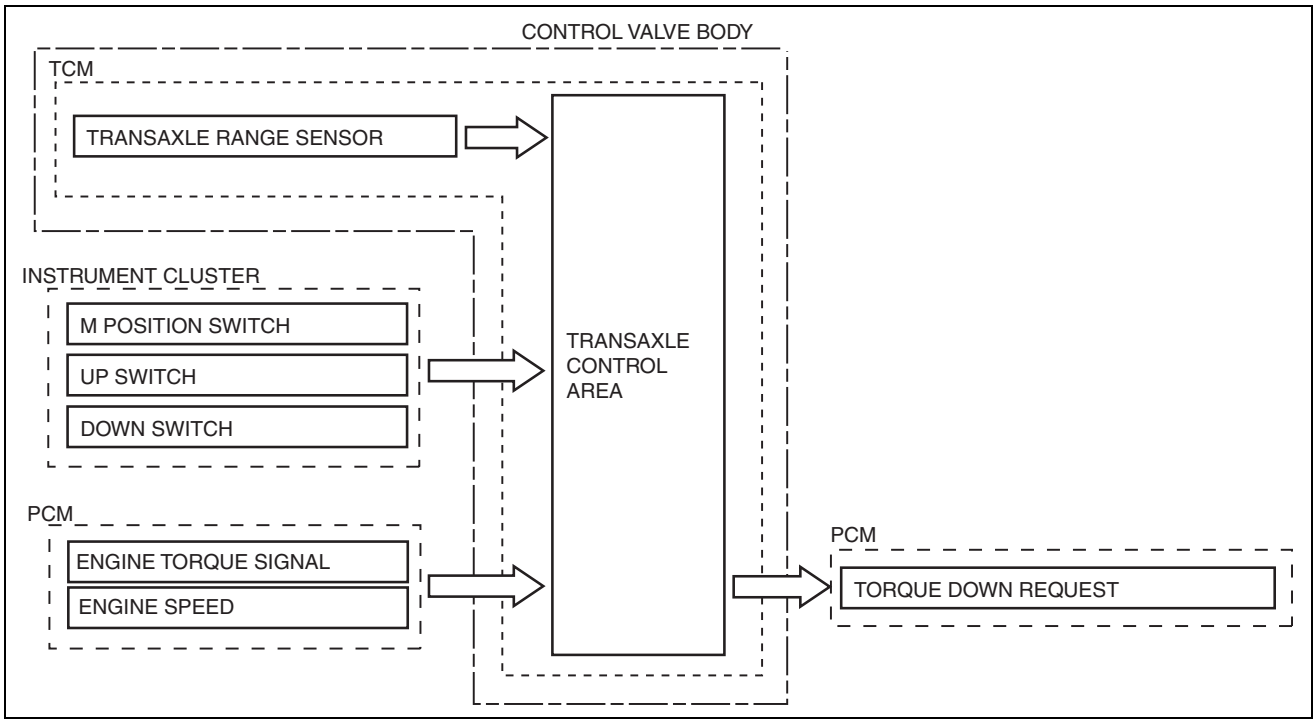
id0517i2362800

Outline

- The TCM controls engine output torque and reduces transaxle output shaft torque fluctuation during auto shifting, and reduces shock occurring from the vehicle during shifting.

AUTOMATIC TRANSAXLE [GW6A-EL, GW6AX-EL]

Construction



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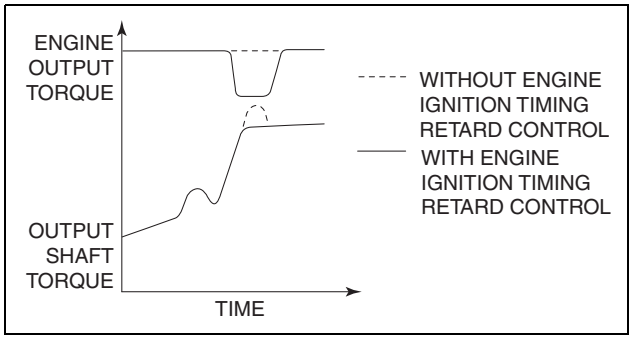
Operation

- During auto shifting, the TCM sends the torque reduction request signal using the CAN system and temporarily reduces the engine output torque by the engine ignition timing retard control. As a result, transaxle output shaft torque fluctuation is reduced during auto shifting by smooth engagement of the clutch.
- In addition, the TCM receives the engine output torque from the PCM via the CAN signal to determine the clutch engagement pressure according to the engine output torque. As a result, the clutch hydraulic control setting accuracy is increased and smooth shift performance is achieved.



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05-18 AUTOMATIC TRANSAXLE SHIFT MECHANISM

AUTOMATIC TRANSAXLE SHIFT MECHANISM

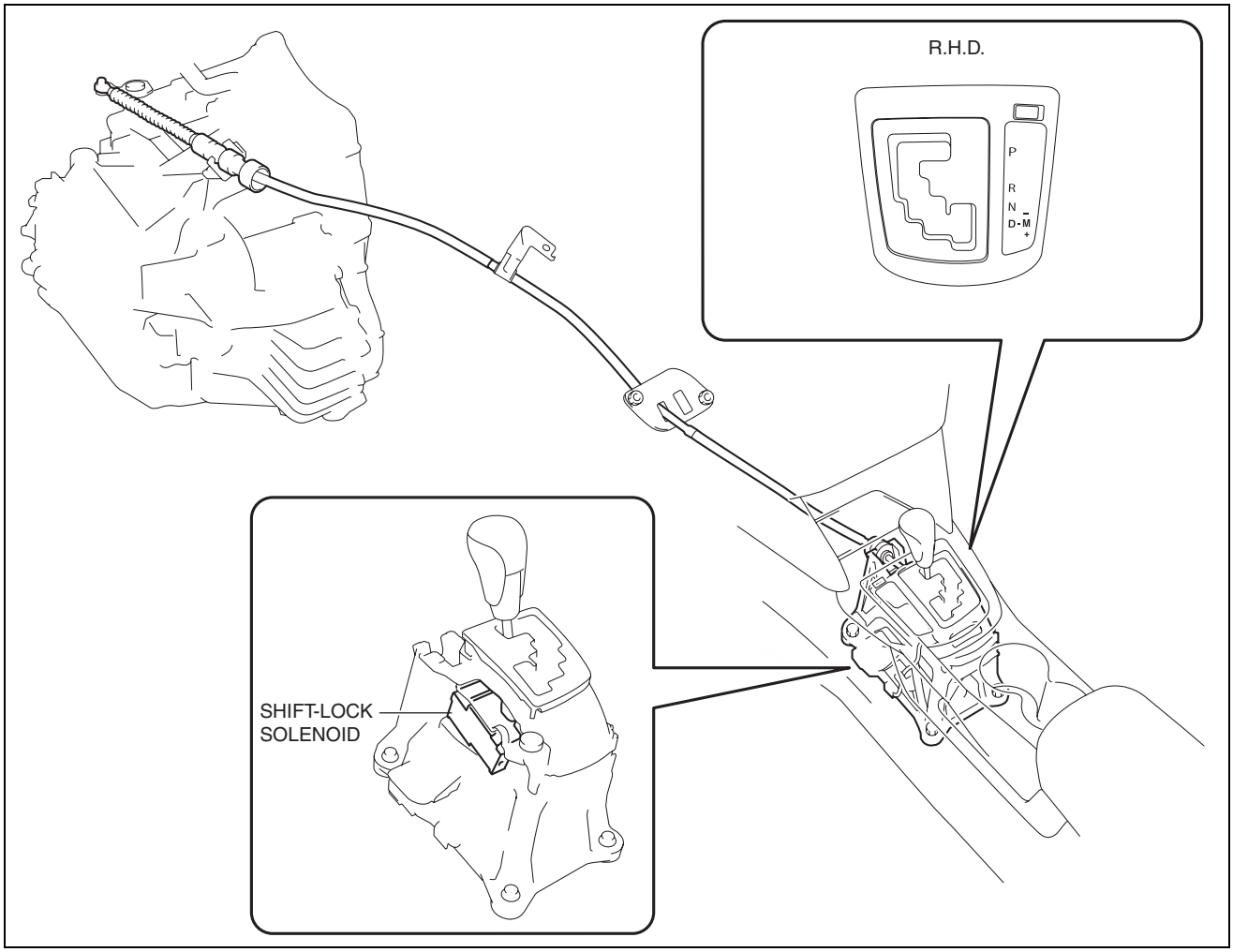
AUTOMATIC TRANSAXLE SHIFT MECHANISM

id051800140200

Outline

- A sport AT-type shift mechanism has been adopted for all models.
- An electric shift-lock system has been adopted to prevent driver mis-operation.
- An emergency manual shift-lock release system has been adopted to ensure emergency bypass if shifting operations cannot be performed.

Structural view



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SHIFT-LOCK SYSTEM

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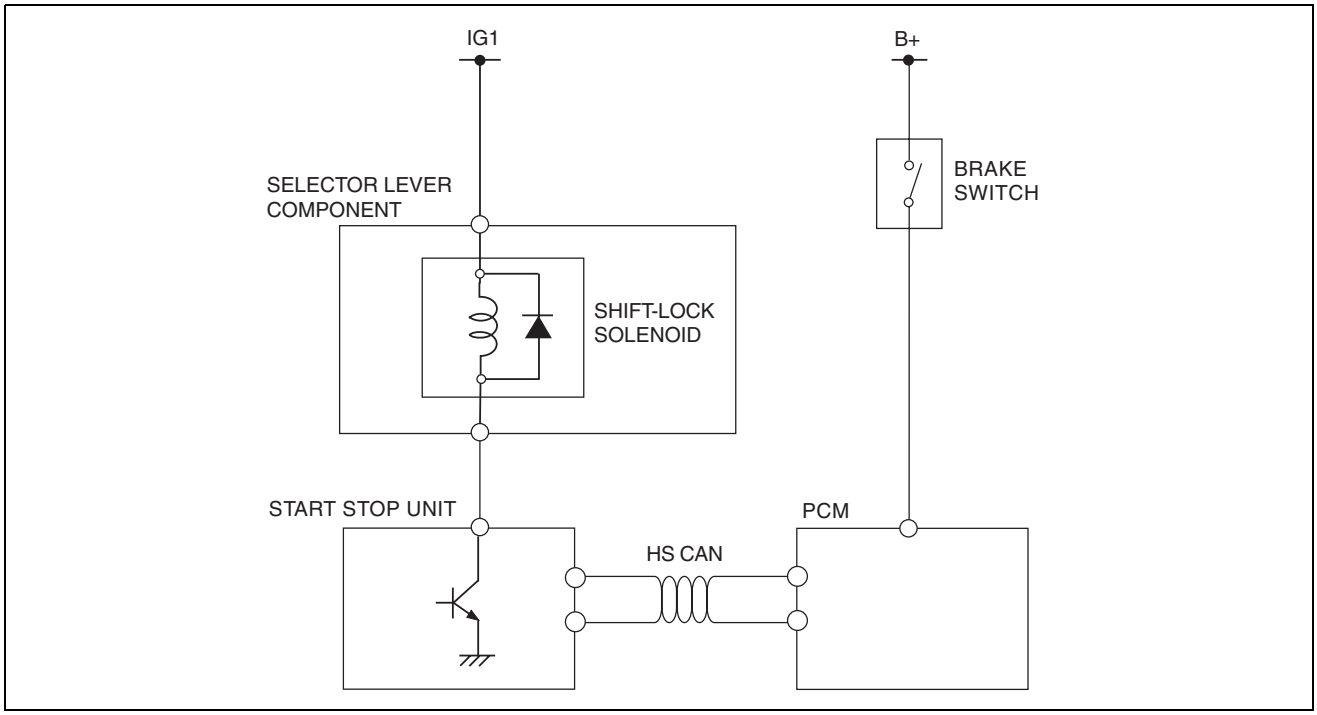
Purpose, Function

- The shift-lock system operates when the ignition is switched to ON and the brake pedal is not depressed, and inhibits the selector lever from being shifted from the P position to other positions.
- If the shift-lock cannot be released by the normal operation, it can be released manually by inserting a flathead screwdriver into the shift-lock release hole (emergency manual shift-lock release system).

AUTOMATIC TRANSAXLE SHIFT MECHANISM

Construction

Wiring diagram



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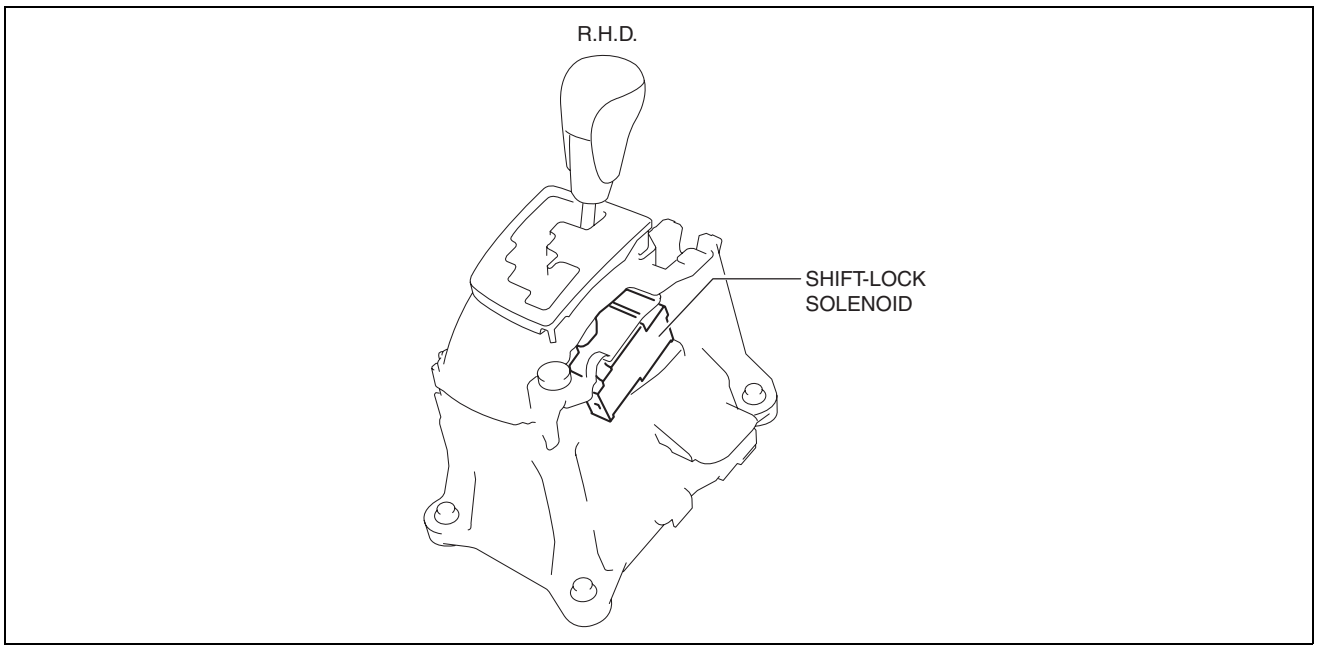
Structural view



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Operation

Shift-lock Release Conditions

- The shift-lock is released when all of the following conditions are met (except emergency manual shift-lock release system is operated).
  - — Selector lever is in P position
  - — Ignition is switched to ON
  - — Brake pedal is depressed (brake light switch is on)

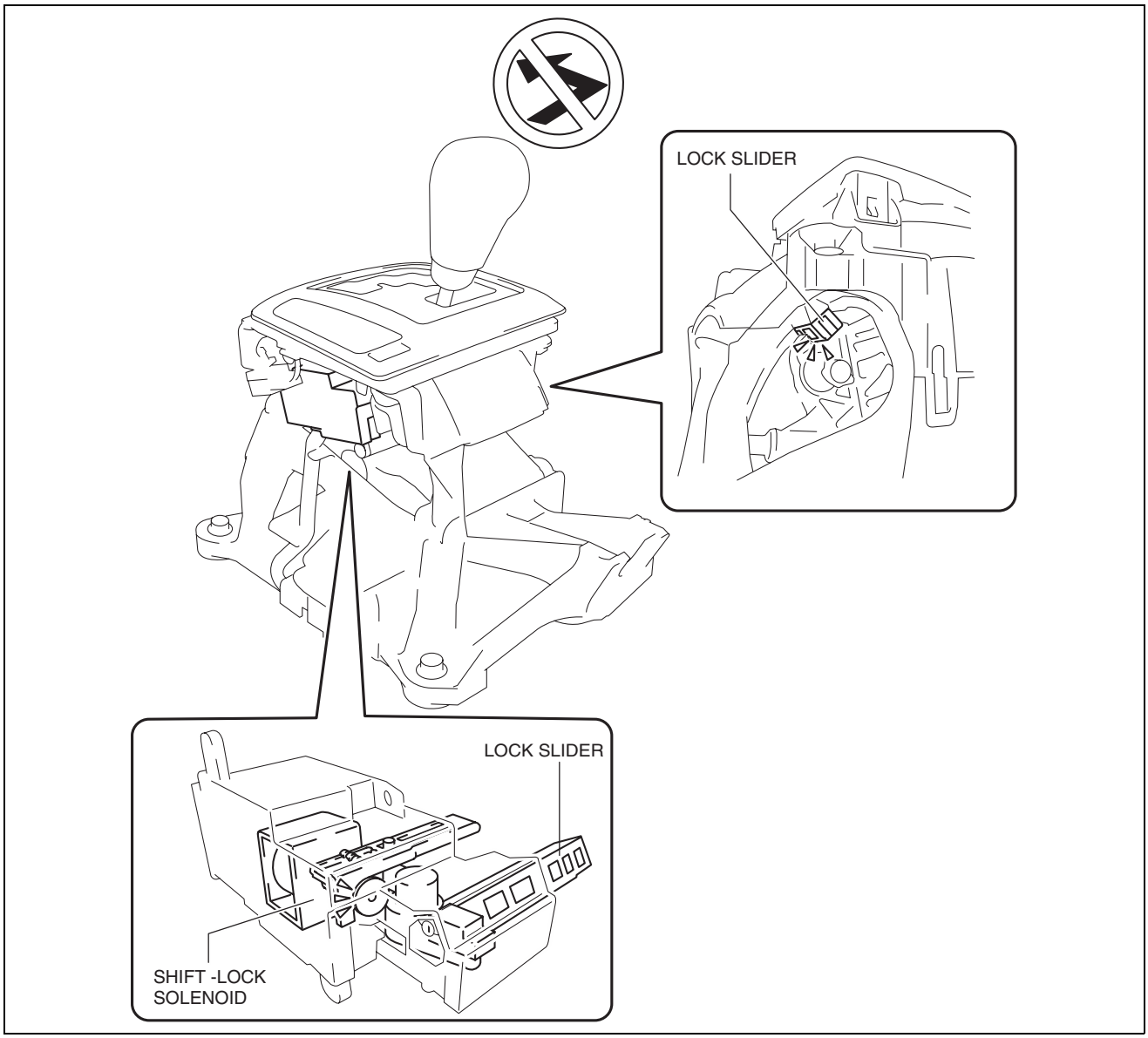
Shift-lock operation conditions (shift-lock release conditions not satisfied)

- When the shift-lock release conditions are not met, the shift-lock operates.
- Because there is no energization to the shift-lock solenoid at this time, the shift-lock solenoid is not energized.

AUTOMATIC TRANSAXLE SHIFT MECHANISM

- As a result, the lock slider is positioned where it restricts the selector lever movement and the selector lever cannot be moved to any position other than P.

R.H.D.



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Shift-lock release (Shift-lock release conditions are satisfied)

- When the shift-lock release conditions are met, the shift-lock does not operate.
- At this time, the shift-lock solenoid is energized because there is energization to the shift-lock solenoid.
- As a result, the selector lever can be moved to any position other than P by moving the lock slider to a position where it does not restrict the selector lever movement.

AUTOMATIC TRANSAXLE SHIFT MECHANISM

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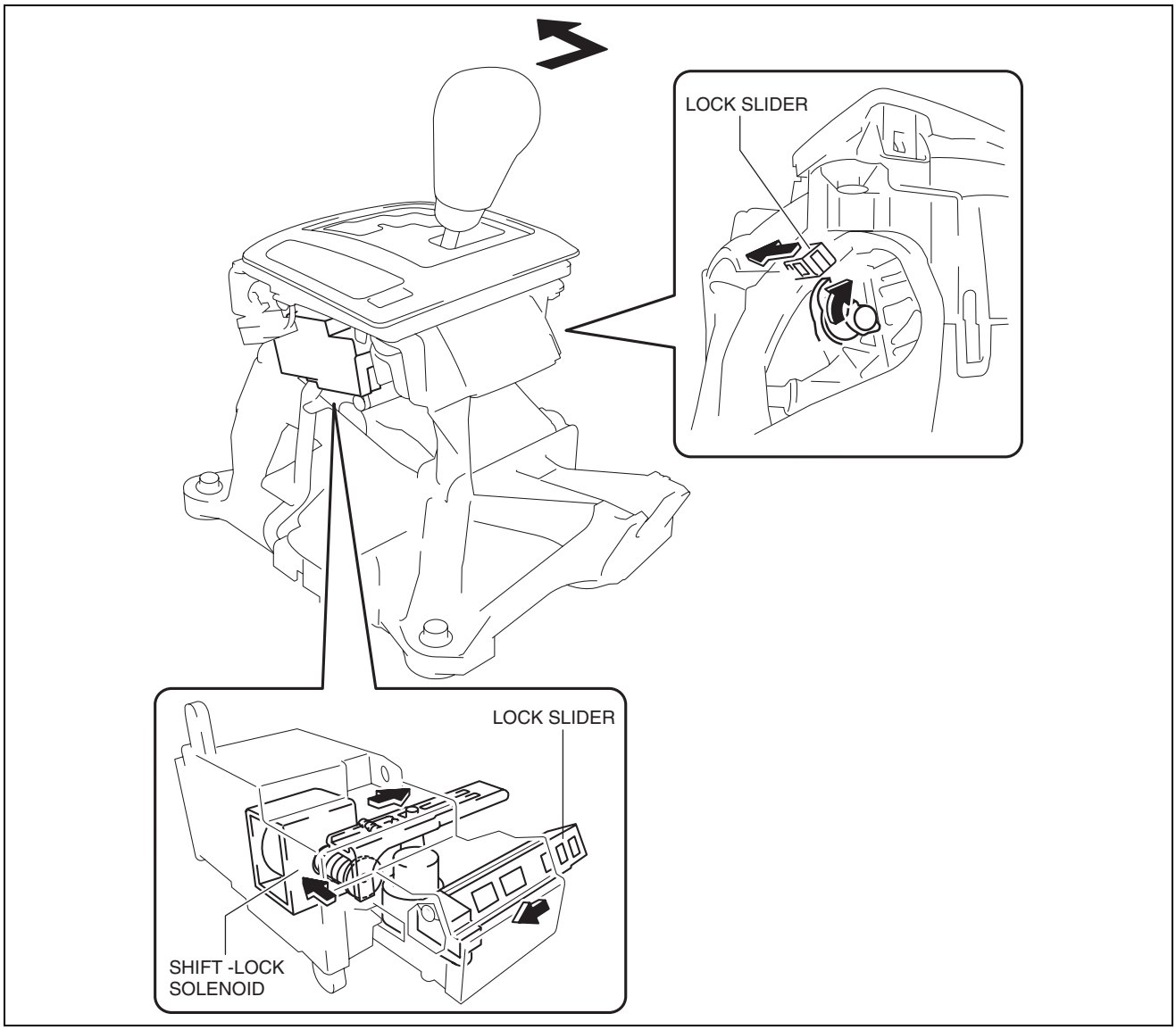

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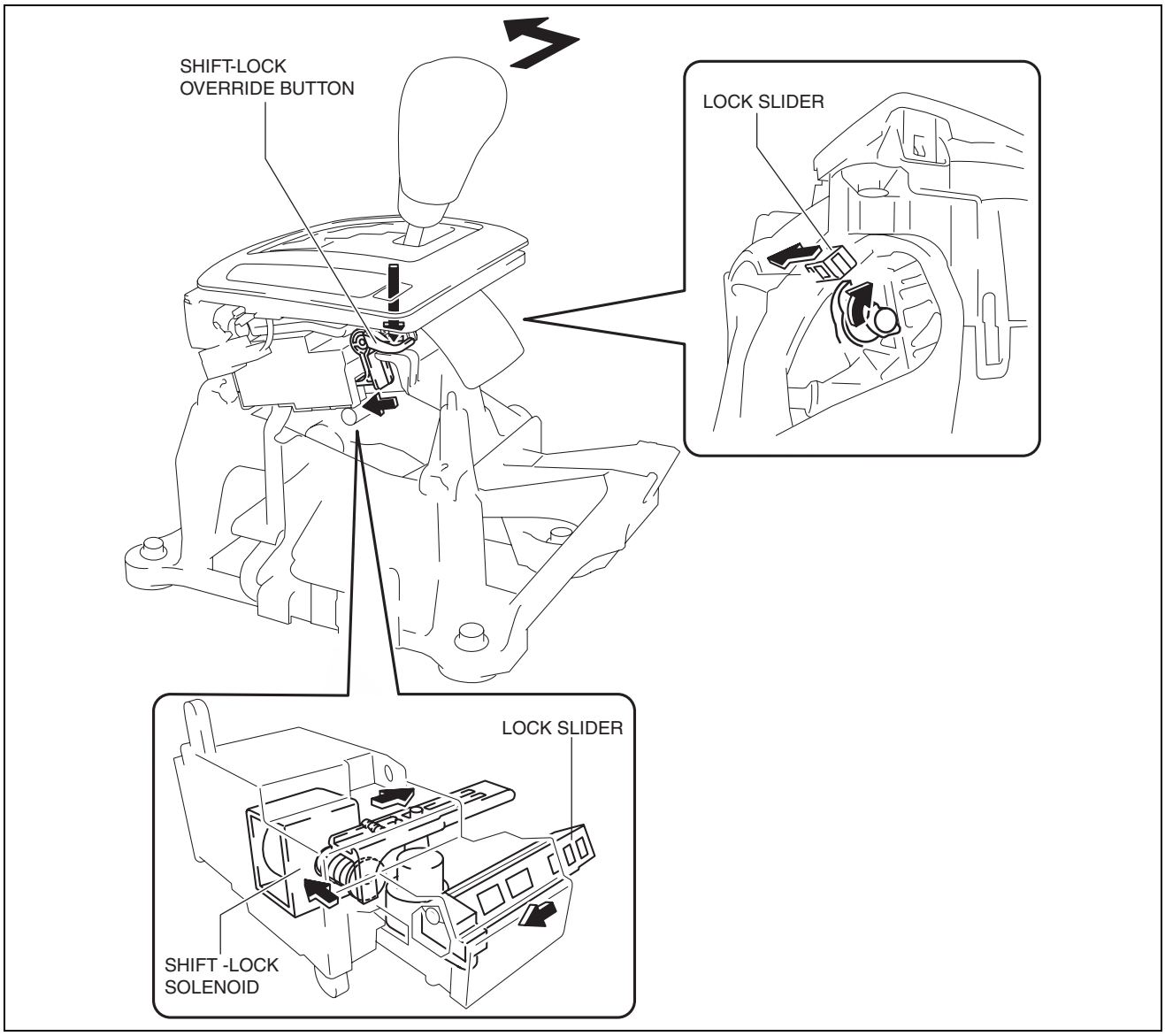
Emergency manual shift-lock release system operation

- The emergency manual shift-lock release system can be released manually even if the shift-lock release conditions are not met.
- The lock slider restriction can be cancelled forcibly by pressing the shift-lock override button using a flathead screwdriver.
- As a result, the selector lever can be moved to any position other than P.

AUTOMATIC TRANSAXLE SHIFT MECHANISM

R.H.D.



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STEERING

06
SECTION

06-00 OUTLINE

OUTLINE

STEERING ABBREVIATIONS

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AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position
CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle
DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System
HBC	High Beam Control
HF/TEL	Hands-Free Telephone
HI	High
HS	High Speed
HU	Hydraulic Unit
IDS	Integrated Diagnostic Software
IG	Ignition
IN	Intake
INT	Intermittent

OUTLINE

KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear
2GR	Second Gear
2WD	2-Wheel Drive
3GR	Third Gear
4GR	Fourth Gear
4WD	4-Wheel Drive
5GR	Fifth Gear
6GR	Sixth Gear

OUTLINE

STEERING FEATURES

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Improved handling, fuel economy, marketability	• Column assist-type Electric Power Steering (EPS) adopted
Improved handling	• By using a higher steering gear ratio (15.5), the steerability has been improved
Improved operability	• Steering column with tilt/telescope mechanism adopted
Improved safety	• Steering column and shaft with energy absorbing mechanism adopted
Improved serviceability	• Enhanced malfunction diagnosis system for use with Mazda modular diagnostic system (M-MDS)

STEERING SPECIFICATIONS

id060000246000

Item			Specification
Steering wheel	Outer diameter	(mm {in})	372 {14.6}
	Lock to lock	(turns)	2.69
Steering column and shaft	Shaft type		Collapsible
	Joint type		Cross-shaped joint
	Tilt amount	(mm {in})	45 {1.8}
	Telescope amount	(mm {in})	50 {2.0}
Steering gear and linkage	Type		Rack-and-pinion
	Rack stroke	(mm {in})	151.4 {5.961}
Power steering system	Power assist type		Electric motor assist (Column assist type)

06-02 ON-BOARD DIAGNOSTIC

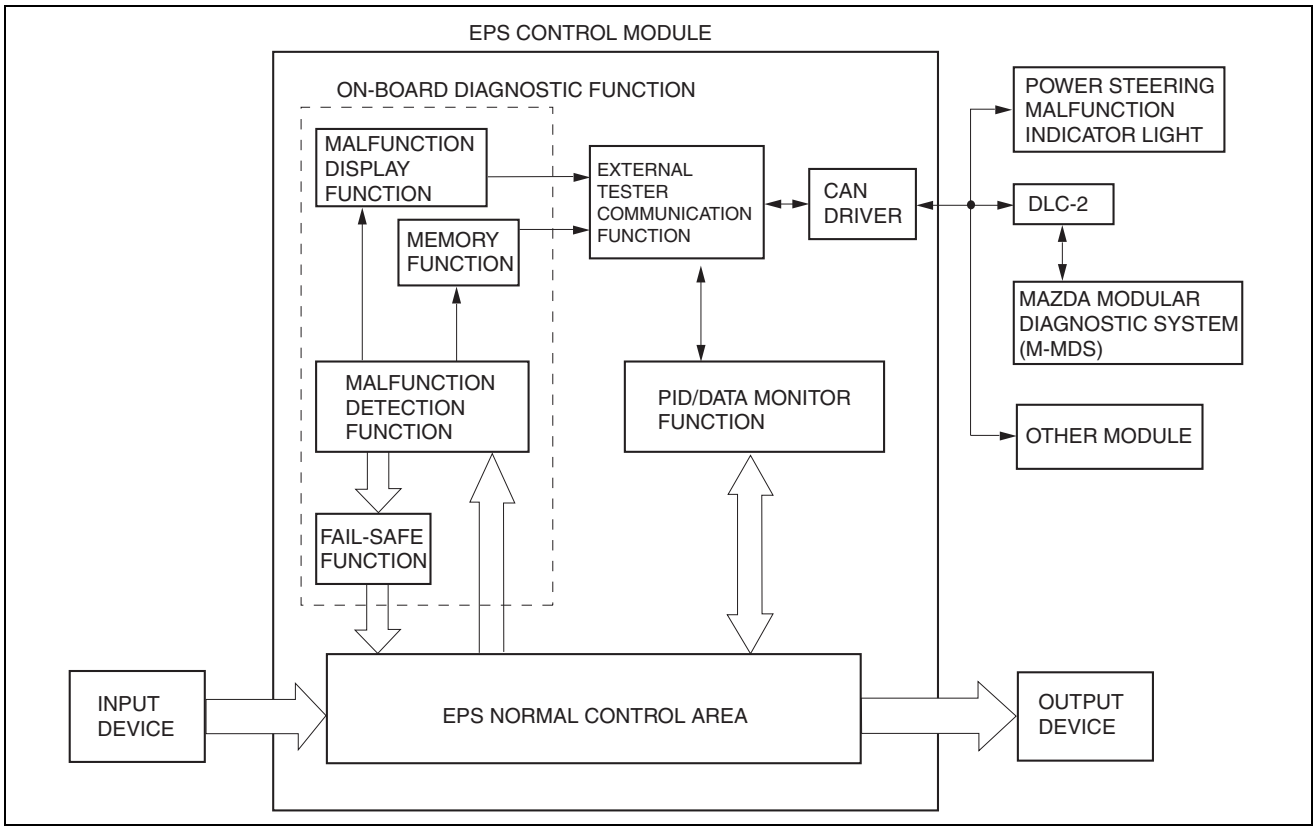
ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [ELECTRIC POWER STEERING (EPS)]

id0602001010a1

- The on-board diagnostic system consists of a malfunction detection system that detects abnormalities in input/output signals when the ignition switch is at the ON position, a data monitor function that reads out specified input/output signals.
- The data link connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis into a single location, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2.
- In addition to DTC read-out, the Mazda Modular Diagnostic System (M-MDS) is used to clear DTCs using the display screen of the diagnostic tester, and to access the PID/data monitor, providing enhanced malfunction diagnosis and improved serviceability.

Block Diagram



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ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [ELECTRIC POWER STEERING (EPS)]

id0602001011a1

Malfunction Detection Function

- The malfunction detection function detects malfunctions in the input/output signal system of the EPS control module when the ignition switched ON or driving the vehicle.

Malfunction Display Function

- When the malfunction detection function detects a malfunction, the power steering malfunction indicator light illuminates or flashes to advise the driver. Using the external tester communication function, DTCs can be output to the DLC-2 via the CAN line. At the same time, malfunction detection results are sent to the memory and fail-safe functions.
- The power steering malfunction indicator light may not illuminate depending on the detected malfunction.

Memory Function

- The memory function stores DTCs of malfunctions in input/output signal systems. With this function, once a DTC is stored it is not cleared after the ignition switch has been switched OFF, even if the malfunctioning signal system has returned to normal.
- Since the EPS control module has a built-in non-volatile memory, DTCs are not cleared even if the battery is removed. Therefore, it is necessary to clear the memory after performing repairs. Refer to the Workshop Manual for the DTC clearing procedure.

DTC Table

×: Applicable
—: Not applicable

DTC M-MDS	Power steering malfunction indicator light illumination status	Diagnosis system component	Fail-safe	Drive cycle	Self test type*1	Memory function
C200B:02	Illuminated	Torque sensor	×	—	C, D	×
C200B:16	Illuminated	Torque sensor	×	—	C, D	×
C200B:1C	Illuminated	Torque sensor	×	—	C, D	×
C200B:62	Illuminated	Torque sensor	×	—	C, D	×
C200B:85	Illuminated	Torque sensor	×	—	C, D	×
C200C:1C	Illuminated	Torque sensor	×	—	C, D	×
C200D:1C	Illuminated	Resolver sensor	×	—	C, D	×
C200D:64	Illuminated	Resolver sensor	×	—	C, D	×
U0001:88	Illuminated	CAN system communication error	×	—	C, D	×
U0100:00	Illuminated	Communication error to PCM	×	—	C, D	×
U0121:00	—	Communication error to DSC CM	×	—	C, D	×
U0155:00	—	Communication error to instrument cluster	×	—	C, D	×
U0338:00	—	Signal error from start stop unit	×	—	C, D	×
U0401:00	Illuminated	Signal (vehicle speed) error from PCM	×	—	C, D	×
	—	Signal (engine speed) error from PCM	×	—	C, D	×
	—	Signal (i-stop status) error from PCM	×	—	C, D	×
U0415:00	—	Signal error from DSC CM	×	—	C, D	×
U0515:00	—	Signal error from start stop unit	×	—	C, D	×
U2011:19	Illuminated	EPS motor	×	—	C, D	×
U2011:1C	Illuminated	EPS motor	×	—	C, D	×
U2011:62	Illuminated	EPS motor	×	—	C, D	×
U2011:72	Illuminated	EPS motor	×	—	C, D	×
U2011:92	Illuminated	EPS motor	×	—	C, D	×
U2300:54	—	EPS configuration	×	—	C, D	×
U2300:55	Illuminated	EPS configuration	×	—	C, D	×
U2300:56	—	EPS configuration	×	—	C, D	×
U3000:16	Illuminated	EPS CM	×	—	C, D	×
U3000:1C	Illuminated	EPS CM	×	—	C, D	×
U3000:28	Illuminated	EPS CM	×	—	C, D	×

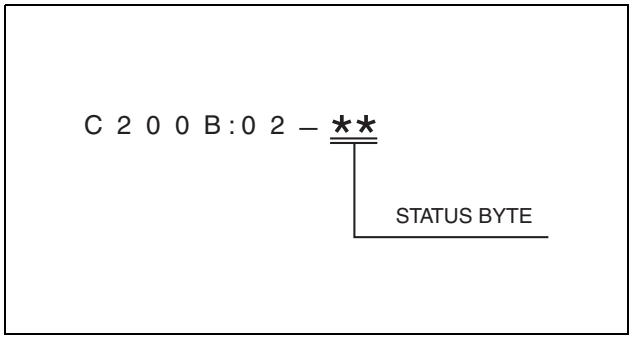
ON-BOARD DIAGNOSTIC

DTC M-MDS	Power steering malfunction indicator light illumination status	Diagnosis system component	Fail-safe	Drive cycle	Self test type*1	Memory function
U3000:41	Illuminated	EPS CM	×	—	C, D	×
U3000:46	—	EPS CM	×	—	C, D	×
U3000:47	Illuminated	EPS CM	×	—	C, D	×
U3000:49	Illuminated	EPS CM	×	—	C, D	×
U3000:4B	—	EPS CM	×	—	C, D	×
U3000:61	Illuminated	EPS CM	×	—	C, D	×
U3000:73	Illuminated	EPS CM	×	—	C, D	×
U3000:96	Illuminated	EPS CM	×	—	C, D	×
U3003:16	Illuminated	Battery power supply	×	—	C, D	×
U3003:17	Illuminated	Battery power supply	×	—	C, D	×

*1 : C: CMDTC self test, D: ODDTC self test

Status Byte for DTC

- The status byte is the two-digit code (two digits after hyphen (-)) after the DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the M-MDS when reading the DTC.



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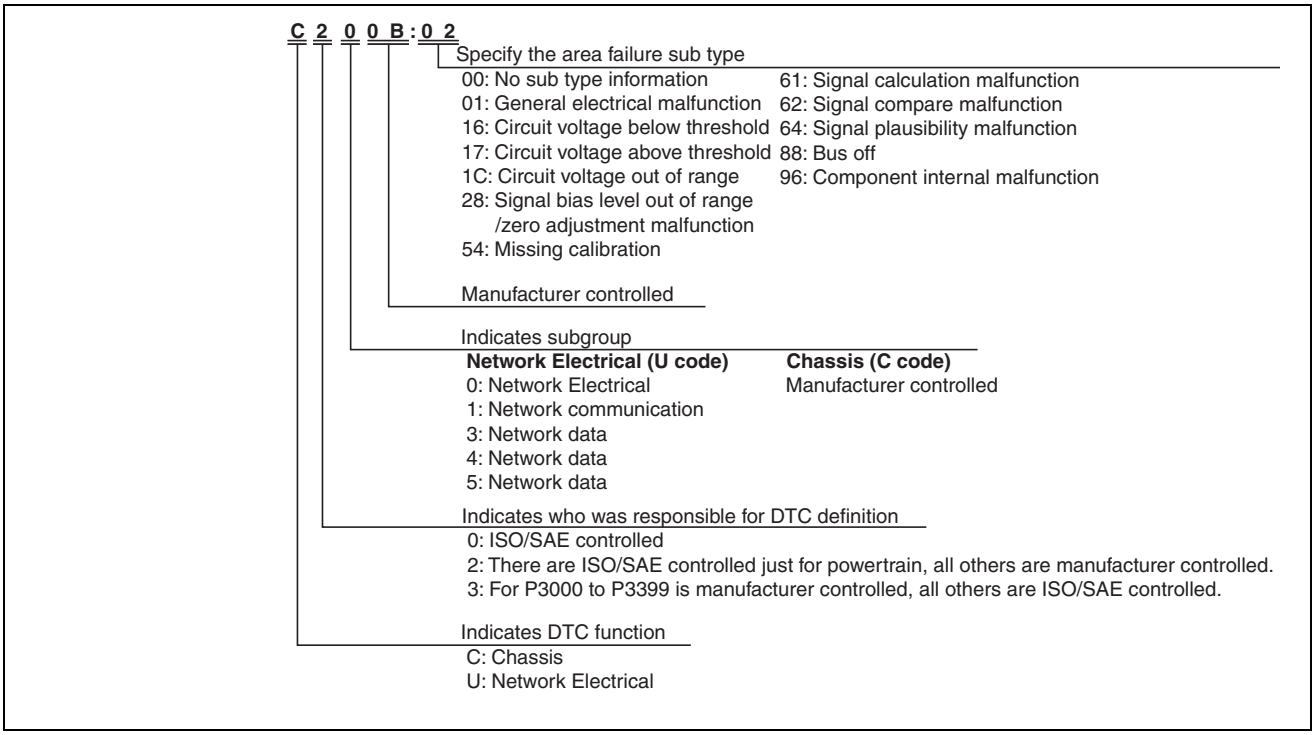
DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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ON-BOARD DIAGNOSTIC

Fail-safe Function

- When the malfunction detection function determines a malfunction, the power steering malfunction indicator light illuminates to advise the driver. At this time, the fail-safe function disables system control or gradually reduces the assist power.

Fail-safe Function Table

DTC M-MDS	Fail-safe control status
C200B:02	Control disabled
C200B:16	Control disabled
C200B:1C	Control disabled
C200B:62	Control disabled
C200B:85	Control disabled
C200C:1C	Control disabled
C200D:1C	Control disabled
C200D:64	Control disabled
U0001:88	Control enabled
U0100:00	Control is maintained by gradually changing the controlled vehicle speed and setting it to **120 km/h {74.6 mph}**
U0121:00	Control enabled
U0155:00	Control enabled
U0338:00	Control enabled
U0401:00	• Vehicle speed signal malfunction — Control is maintained by gradually changing the controlled vehicle speed and setting it to **120 km/h** {74.6 mph} • Engine speed signal malfunction — Control enabled • i-stop status signal malfunction — EPS i-stop control is not operated, and normal control is maintained
U0415:00	Control enabled
U0515:00	Control enabled
U2011:19	Control disabled
U2011:1C	Control disabled
U2011:62	Control disabled
U2011:72	• Phase 1 open circuit malfunction is detected in the EPS motor — Control is maintained in the backup control • Other malfunction detected in EPS motor internal circuit — Control disabled
U2011:92	Control disabled
U2300:54	Control enabled
U2300:55	Control enabled
U2300:56	Control enabled
U3000:16	Control disabled
U3000:1C	Control disabled
U3000:28	Control disabled
U3000:41	Control disabled
U3000:46	Control is maintained in fail mode
U3000:47	Control disabled
U3000:49	Control disabled
U3000:4B	Control is maintained in fail mode
U3000:61	Control disabled
U3000:73	Control disabled
U3000:96	Control disabled
U3003:16	Control is maintained by gradually decreasing the motor control current However, control is inhibited if the power supply voltage is the specified value of less.
U3003:17	Control disabled

Snapshot Data

- The snapshot data stores the currently detected DTC data.

ON-BOARD DIAGNOSTIC

Snapshot data item	Unit	Definition	Corresponding data monitor items
AAT	°C, °F	Ambient air temperature	—
APP_STATUS	Accelerator Pedal Off/ Under 20%/ Over 20%/ FAIL	Accelerator pedal position	—
CEN_TRQ_S	Nm	Center value of torque sensor	CEN_TRQ_S
CFG_STATUS	Config Complete/ Not Configured/ Config Error	Configuration status	—
ECT_STATUS	Under 0 degrees C/ 0 - Under 80 degrees C/ Over 80 degrees C/ FAIL	Engine coolant temperature status	—
ECU_IN_TMP	°C, °F	ECU internal temperature	ECU_IN_TMP
ENG_RPM	RPM	Engine speed	ENG_RPM
IC_VPWR	V	Instrument cluster power supply	—
IG-ON_TIMER	hh:mm:ss	Times since ignition switch ON	—
MT_CURRENT	A	Motor current	MT_CURRENT
OH_CR_C	No/Yes	Current complete overheat protection	OH_CR_C
OH_CR_M	No/Yes	Current middle overheat protection	OH_CR_M
OH_HIST_C	No/Yes	History of complete overheat protection	OH_HIST_C
OH_HIST_M	No/Yes	History of middle overheat protection	OH_HIST_M
OH_IG_CNT_C	—	IG ON counter after complete overheat protection	OH_IG_CNT_C
OH_IG_CNT_M	—	IG ON counter after middle overheat protection	OH_IG_CNT_M
PWR_MODE_KEY	Key Out/ Key Recently Out/ Key Approved(Position 0)/ Post Accessory (Position 0)/ Accessory (Position 1)/ Post Ignition (Position 1)/ Ignition On (Position 2)/ Running (Position 2)/ Running - Starting In Progress (Position 2)/ Crank (Position 3)	Power mode key state	—
RPM_STATUS	Engine Stop/ Under 1500rpm/ Over 1500rpm/ FAIL	Engine RPM status	—
SHIFT_STATUS	P/N D/ R/ FAIL	Shift position status	—
STR_ANG	°	Steering wheel angle	STR_ANG
STR_ROT_SPD	°/s	Steering wheel rotation speed	STR_ROT_SPD
STR_TRQ_S_M	Nm	Steering shaft torque (Main)	STR_TRQ_S_M
STR_TRQ_S_S	Nm	Steering shaft torque (Sub)	STR_TRQ_S_S
TOTAL_DIST	km, ft, mi	Total distance	—
TOTAL_TIME	hh:mm:ss	Total time	—
VPWR	V	Power supply	VPWR
VSPD	KPH, MPH	Vehicle speed	VSPD

ON-BOARD DIAGNOSTIC

Snapshot data item	Unit	Definition	Corresponding data monitor items
VSPD_STATUS	Stop/ 0 - 10km/h/ Over 10km/h/ FAIL	Vehicle speed status	—

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [ELECTRIC POWER STEERING (EPS)]

id0602001012a1

- The PID/data monitor function is used for optionally selecting input/output signal monitor items preset in the EPS control module (CM) and reading them out in real-time.

Monitor item (Mazda Modular Diagnostic System (M-MDS) display)	Data contents	Unit/operation
CEN_TRQ_S	• Torque sensor neutral position: Near 0 Nm	Nm
ECU_IN_TMP	• Displays temperature of board in EPS control module: -40°C—+215°C {-40°F—419°F}	°C, °F
ENG_RPM	• Engine stopped: 0 RPM • Engine rotating at **3,000 RPM**: 3,000 RPM	RPM
MT_CURRENT	• When not steered: Near 0 A • Steered: Changes to positive or negative	A
OH_CR_C	• Is the overheating prevention control (Complete) operating?	Yes/No
OH_CR_M	• Is the overheating prevention control (Middle) operating?	Yes/No
OH_HIST_C	• Has the overheating prevention control (Complete) operated before?	Yes/No
OH_HIST_M	• Has the overheating prevention control (Middle) operated before?	Yes/No
OH_IG_CNT_C	• History of overheating prevention control (Complete) • Number of times vehicle is driven (ignition switched ON (engine off or on)) after overheating prevention control operates	—
OH_IG_CNT_M	• History of overheating prevention control (Middle) • Number of times vehicle is driven (ignition switched ON (engine off or on)) after overheating prevention control operates	—
STR_ANG	• Steering in neutral position • Steered left: Changes to 0°—Positive • Steered right: Changes to 0°—Negative	°
STR_ROT_SPD	• Not steered: Near 0 °/s • Steered: Changes according to steering speed	°/s
STR_TRQ_S_M	• Not steered: Near 0 Nm • Steered left: Changes to 0 Nm—Positive • Steered right: Changes to 0 Nm—Negative	Nm
STR_TRQ_S_S	• Not steered: Near 0 Nm • Steered left: Changes to 0 Nm—Positive • Steered right: Changes to 0 Nm—Negative	Nm
VPWR	• Engine stopped: Approx. **12 V** • Idling: Approx. **14 V**	V
VSPD	• Vehicle stopped: 0 KPH, 0 MPH • Vehicle speed **20 km/h {12 mph}**: 20 KPH, 12 MPH	KPH, MPH

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION [ELECTRIC POWER STEERING (EPS)]

id0602001013a1

Outline

- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs) between the EPS control module (CM) and an external tester.

ON-BOARD DIAGNOSTIC

Connections/Communication Contents

	External tester	
	Mazda modular diagnostic system (M-MDS)	
	Connection	Communication method
On-board diagnostic (malfunction detection) function	Input/output: CAN_H (HS), CAN_L (HS)	Serial communication
PID/DATA monitor function	Input/output: CAN_H (HS), CAN_L (HS)	Serial communication

Serial communication

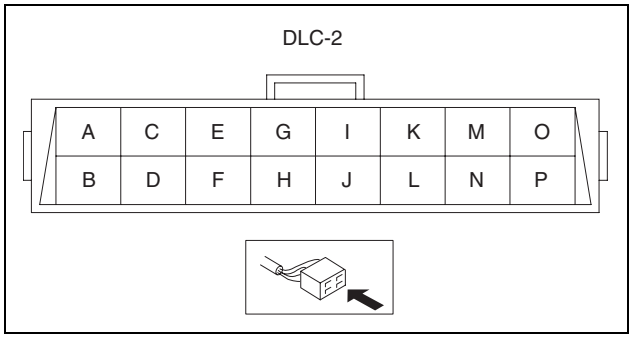
- Serial communication (two-way communication) allows for multiple data to be sent and received instantly along the same line.
- By connecting the Mazda modular diagnostic system (M-MDS) to the DLC-2, diagnostic data can be sent and received between the Mazda modular diagnostic system (M-MDS) and the EPS CM via CAN lines.
- The EPS CM receives the command signals of the malfunction detection function and PID/data monitor function from the Mazda modular diagnostic system (M-MDS), and sends DTCs and data regarding the operating status of each input/output part to the Mazda modular diagnostic system (M-MDS).

Diagnostic function name	Signal received	Signal sent
Malfunction detection function	DTC verification signal	Diagnostic trouble code
PID/DATA monitor function	Command signal to read selected monitor item	Monitored data for requested monitor item

DLC-2 CONSTRUCTION [ELECTRIC POWER STEERING (EPS)]

id0602001001a1

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been added.
- Shape and terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this connector. The connector has a 16-pin construction that includes the CAN_H (HS), CAN_L (HS), CAN_H (MS), CAN_L (MS), GND1, GND2 and B+ terminals.



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Terminal	Function
A	Battery power supply terminal
B	—
C	—
D	—
E	Serial communication Lo terminal (HS)
F	Serial communication Hi terminal (HS)
G	—
H	Serial communication GND terminal
I	—
J	Body GND terminal
K	Serial communication Lo terminal (MS)
L	Serial communication Hi terminal (MS)
M	—
N	—
O	—
P	—

06-13 ELECTRIC POWER STEERING (EPS)

ELECTRIC POWER STEERING (EPS)

ELECTRIC POWER STEERING SYSTEM

id061300245900

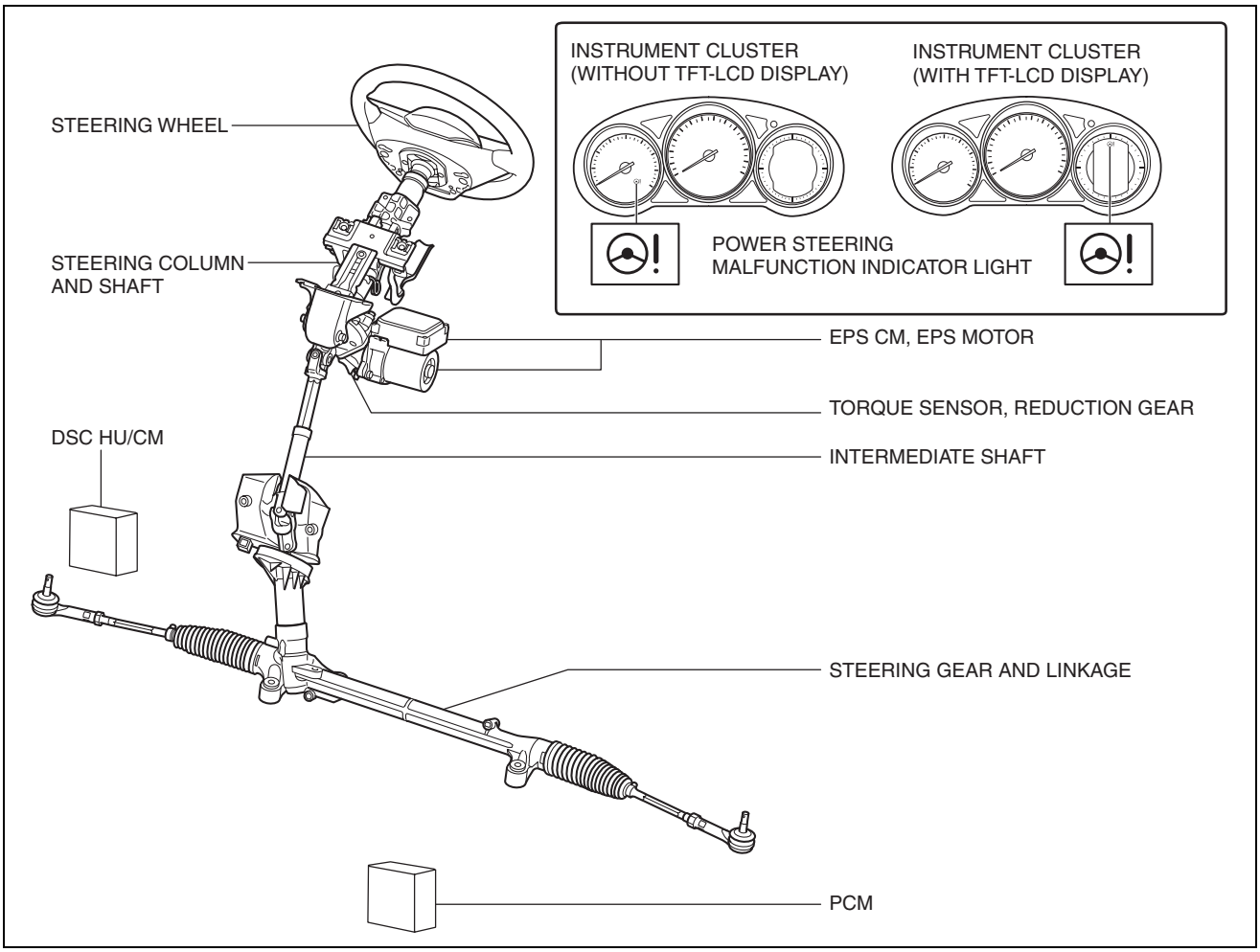
Outline

- A column assist type EPS has been adopted for all models.
- EPS provides smooth handling from low to high speeds as a result of the excellent steering feel provided by the electronic control and the vehicle-speed responsive control.
- EPS does not require a power steering oil pump and generates assist force only when the steering wheel is steered. As a result, engine load is lowered and fuel efficiency is improved.
- Serviceability improved by the automatic configuration function and the steering angle neutral position auto-learning function.

ELECTRIC POWER STEERING (EPS)

Structural View

R.H.D.



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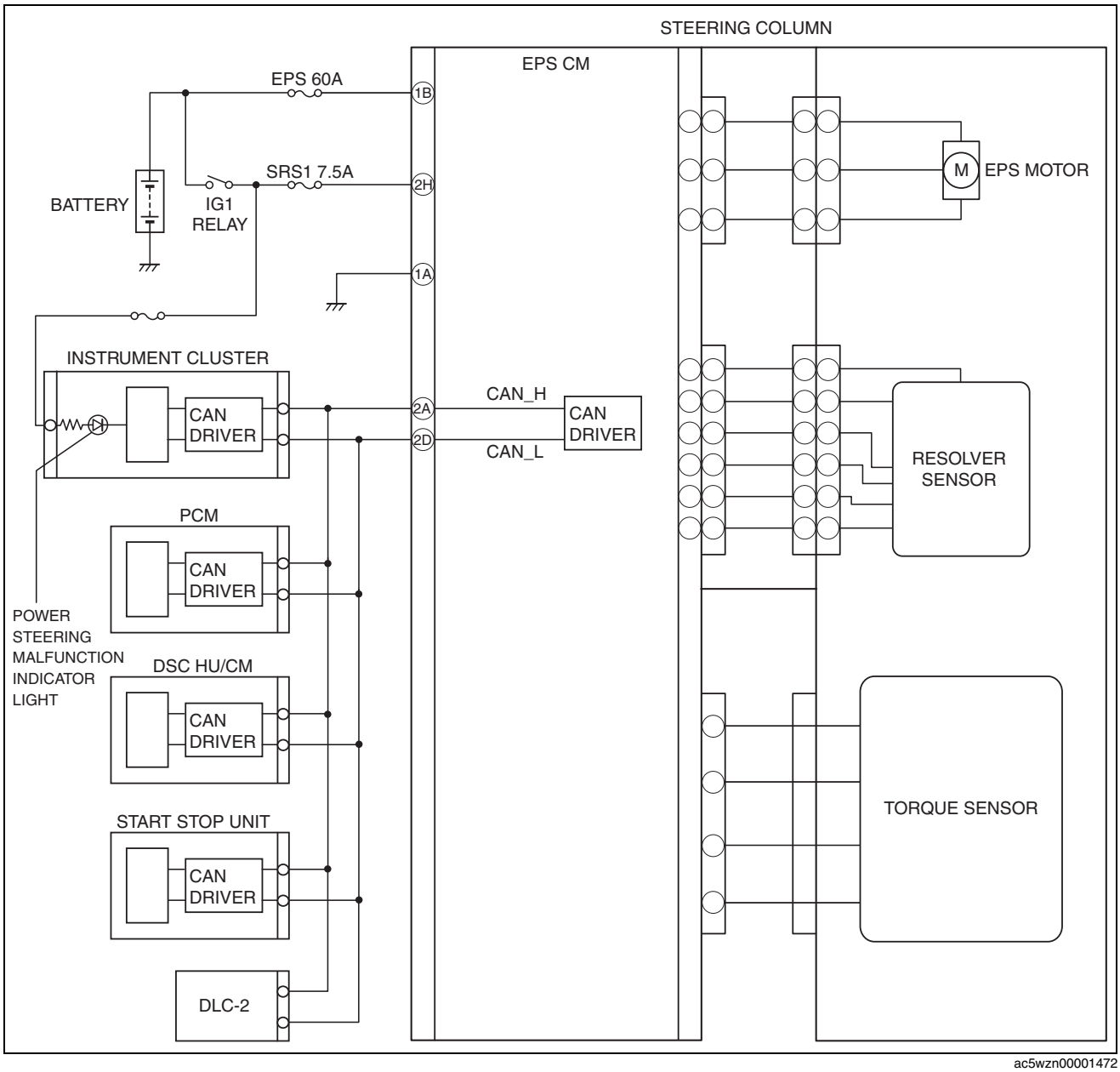
ELECTRIC POWER STEERING (EPS)

System Wiring Diagram



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Purpose/Function

- The EPS assists the manual steering mechanism operation using the EPS motor to provide supplemental manual power during steering operation, reducing the load on the driver.

Construction

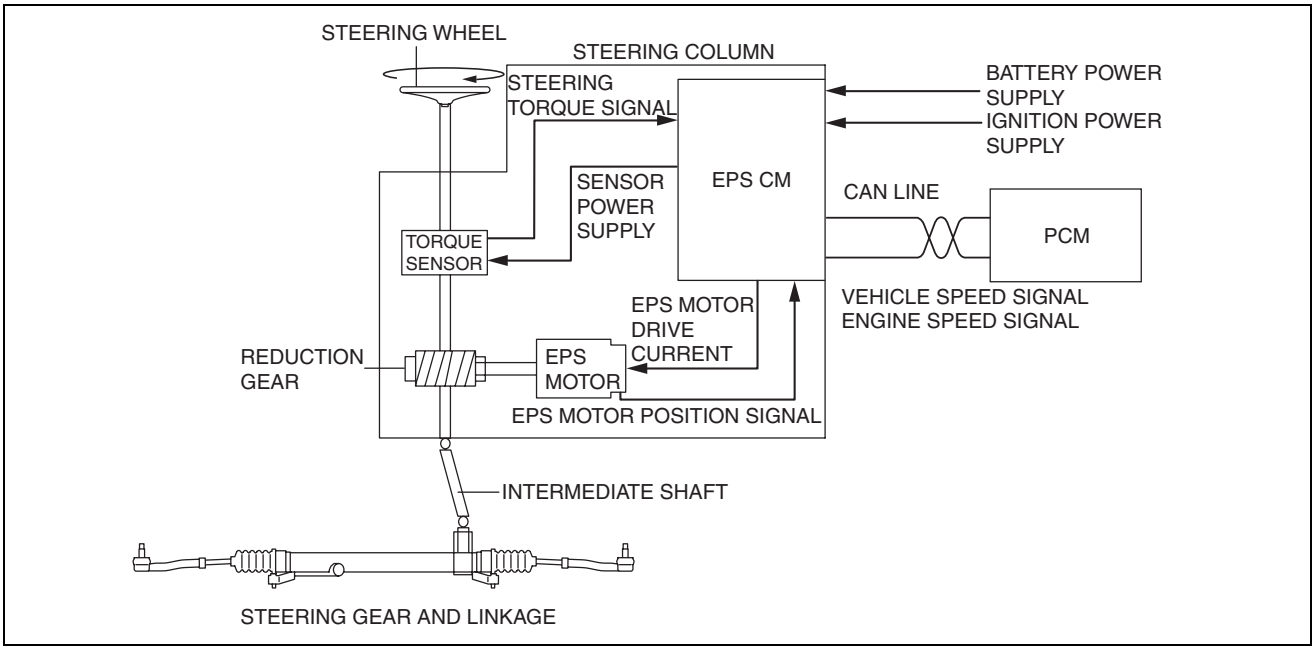
- The EPS consists of the following parts:
  - — Manual steering mechanism
    Consists of the steering wheel, steering column, steering column and shaft, steering gear and linkage.
  - — Electric assist mechanism
    Consists of the EPS CM (control module) built in the steering column, torque sensor, reduction gear, and EPS motor integrated in the EPS CM.
  - — Control system
    Controls based on the EPS CM, torque sensor, reduction gear, EPS motor, and vehicle speed and engine speed signals input from the PCM.

Operation

1. Steering force generated by the driver's steering wheel operation is detected by the torque sensor which is built in the steering column and shaft, and is output to the EPS CM as a steering torque signal.

ELECTRIC POWER STEERING (EPS)

2. The EPS CM calculates optimum assist force based on the steering torque signal from the torque sensor and the vehicle speed and engine speed signals from the PCM, and outputs electric current to drive the EPS motor.
3. The EPS motor is driven by the current from the EPS CM and the force is transmitted to the intermediate shaft via the reduction gears, thus assisting steering operation of the driver.



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STEERING COLUMN AND SHAFT

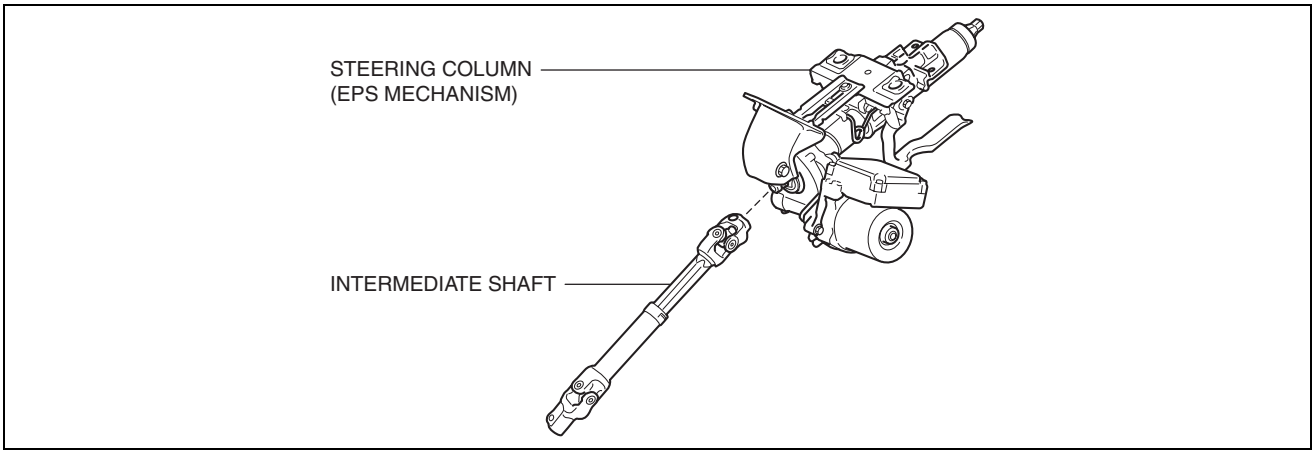
id061300245800

Purpose/Function

- The steering input force, generated when the driver operates the steering wheel, is transmitted to the steering gear.

Construction

- The steering column and shaft consists of the steering column with a built-in EPS mechanism and the intermediate shaft.
- As a result of impact absorbing mechanisms on the steering column and intermediate shaft, when a collision occurs, the steering shaft effectively absorbs the impact energy that would be transmitted to the driver, thereby reducing injury.
- Due to the adoption of a tilt/telescope mechanism for the steering shaft on all vehicles, operability has been improved.



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Operation

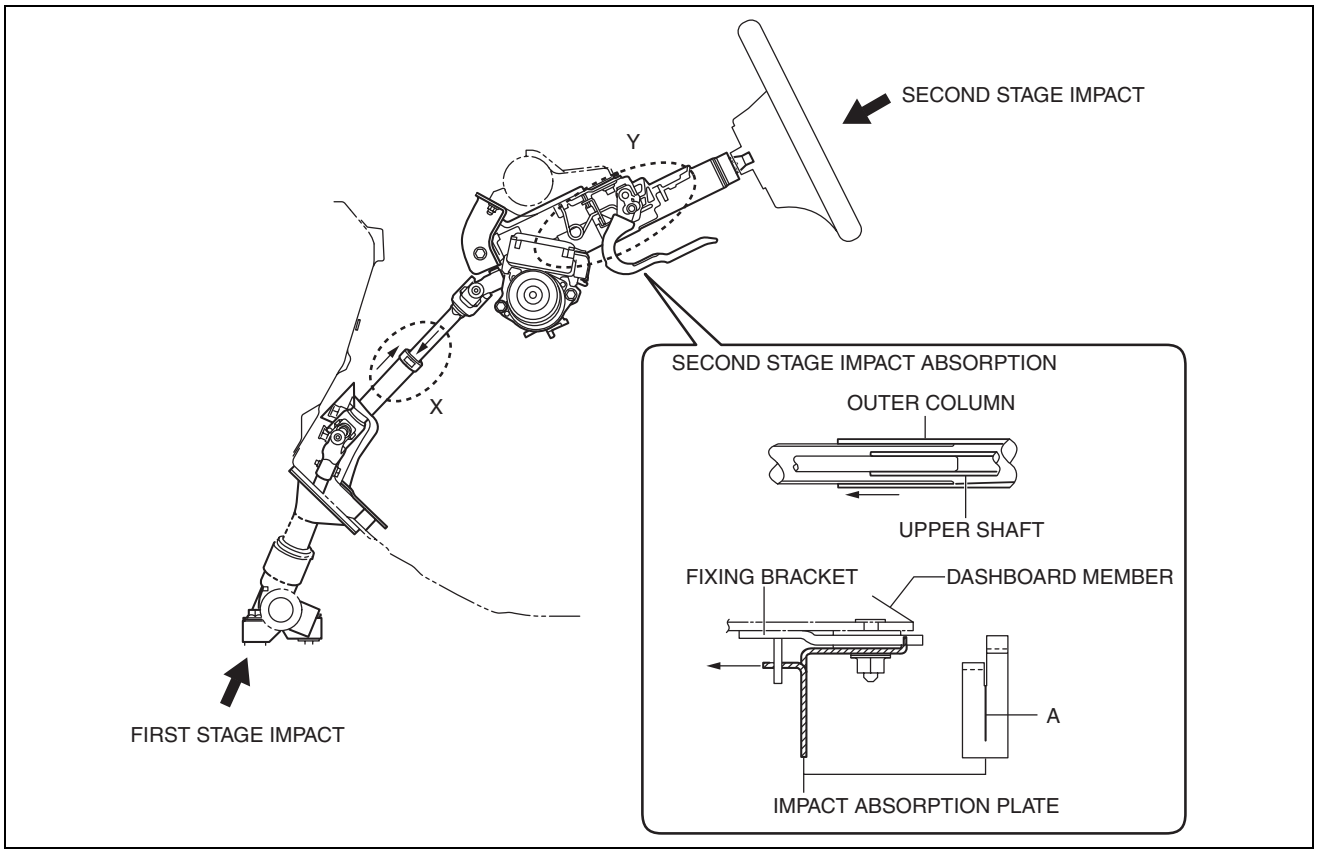
EPS mechanism

- Based on the steering torque signal from the torque sensor and the vehicle speed and engine speed signals from the PCM, the EPS CM drives the EPS motor and transmits the assist torque to the intermediate shaft via the deceleration mechanism.

ELECTRIC POWER STEERING (EPS)

Energy absorbing system

- At the moment of a collision, when impact energy (first stage impact) is input from the vehicle front due to the rearward collapse of the steering gear, the intermediate shaft contracts to absorb the impact from the driver. (Section X in the figure)
- When the body of the driver contacts the steering wheel (second stage impact), the fixing bracket comes off the dashboard member, and the upper shaft and the outer column slide forward. At this time, the impact absorption plate (one part secured to instrument panel member, another part to fixing bracket) deforms (area A shown in figure cracks) to absorb the impact to the driver. (Section Y in the figure)



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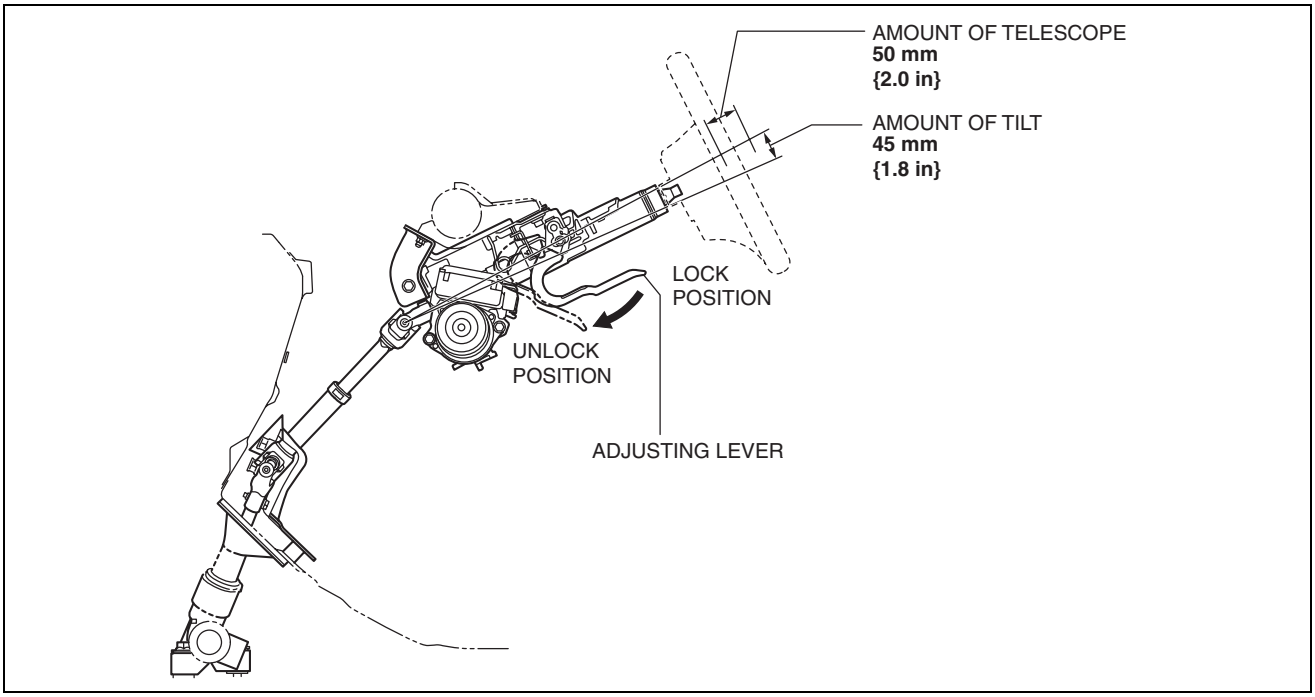
Tilt/telescope mechanism

- The steering wheel can be moved in the up/down and forward/backward direction when the adjusting lever is pressed towards the front of the vehicle to release the lock of the tilt/telescope system.

ELECTRIC POWER STEERING (EPS)

- The tilt/telescope mechanism has a movement range of **45 mm {1.8 in}** (tilt)/ **50 mm {2.0 in}** (telescope) and can be adjusted, without steps, to anywhere in this range.



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Fail-safe

- Function not equipped.

STEERING GEAR AND LINKAGE

id061300245700

Purpose/ Function

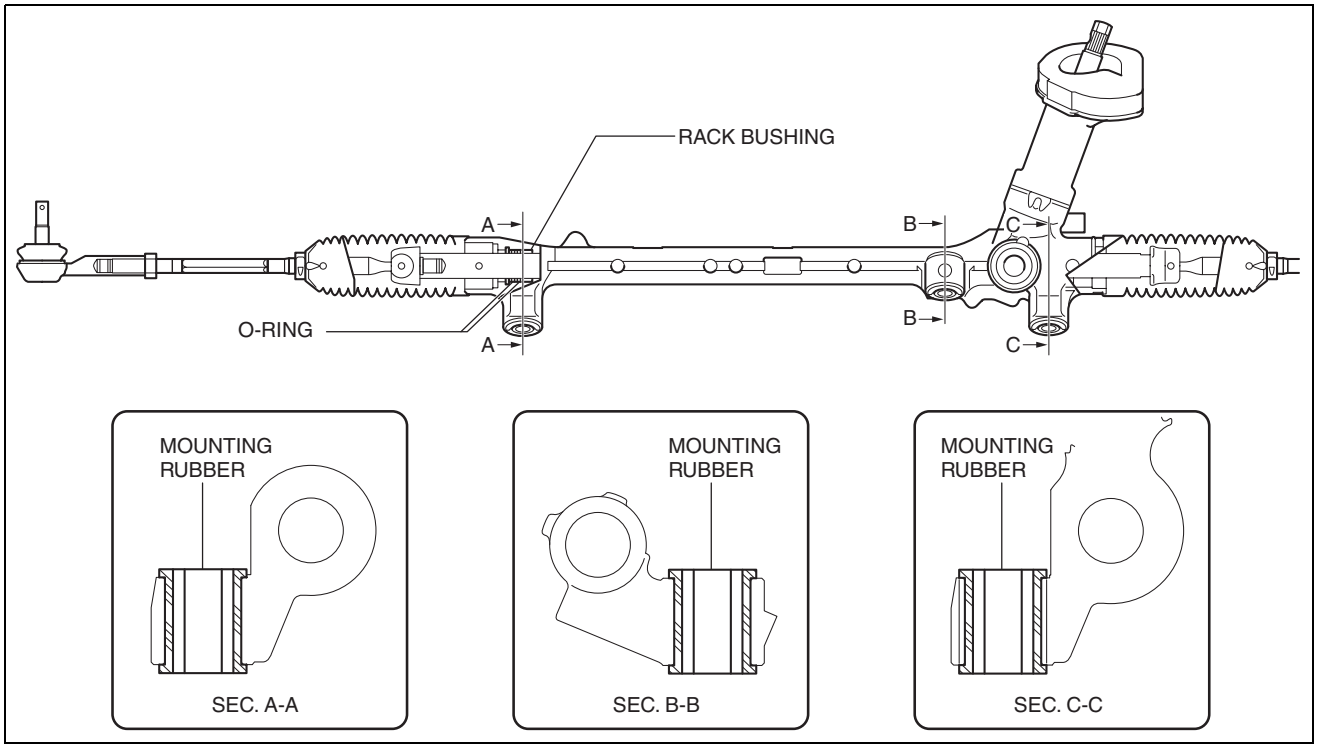
- The rotational movement input from the intermediate shaft is converted to a linear movement in the horizontal direction of the steering rack by the rack and pinion mechanism, and then transmitted to the tires and wheels.

Construction

- A size and weight-reduced rack and pinion system steering gear has been adopted.
- Response and handling stability have been improved by the heightened support rigidity due to the integration of the steering gear mounts (three locations) and gear housing.
- By using a higher steering gear ratio (15.5), the steerability has been improved.
- By using O-rings on the support yoke and rack bushing, quietness has been improved.

ELECTRIC POWER STEERING (EPS)

R.H.D.



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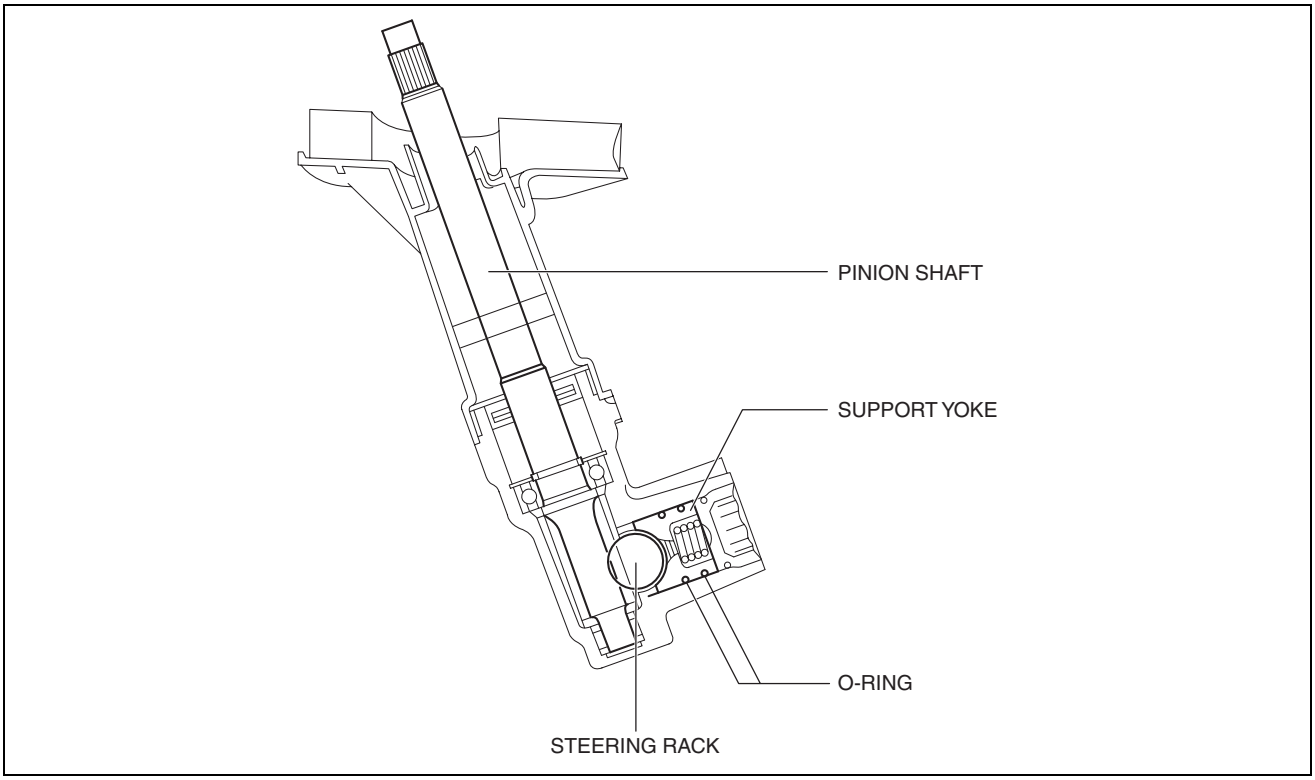
ELECTRIC POWER STEERING (EPS)

Operation

- The rotational movement input from the steering shaft is converted to a linear movement in the horizontal direction of the steering rack by engaging the pinion shaft connected to the steering shaft and teeth of the steering rack. This linear movement is transmitted via the inner and outer ball joints to the steering knuckle to steer the tires left or right.



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Fail-safe

- Function not equipped.

ELECTRIC POWER STEERING (EPS) CONTROL MODULE

id061300245500

Purpose/ Function

- The EPS control module (CM) calculates the optimum assist current based on the steering torque signal from the torque sensor installed to the steering column and the vehicle speed signal sent via CAN transmission from the PCM.
- The EPS CM controls the following functions:

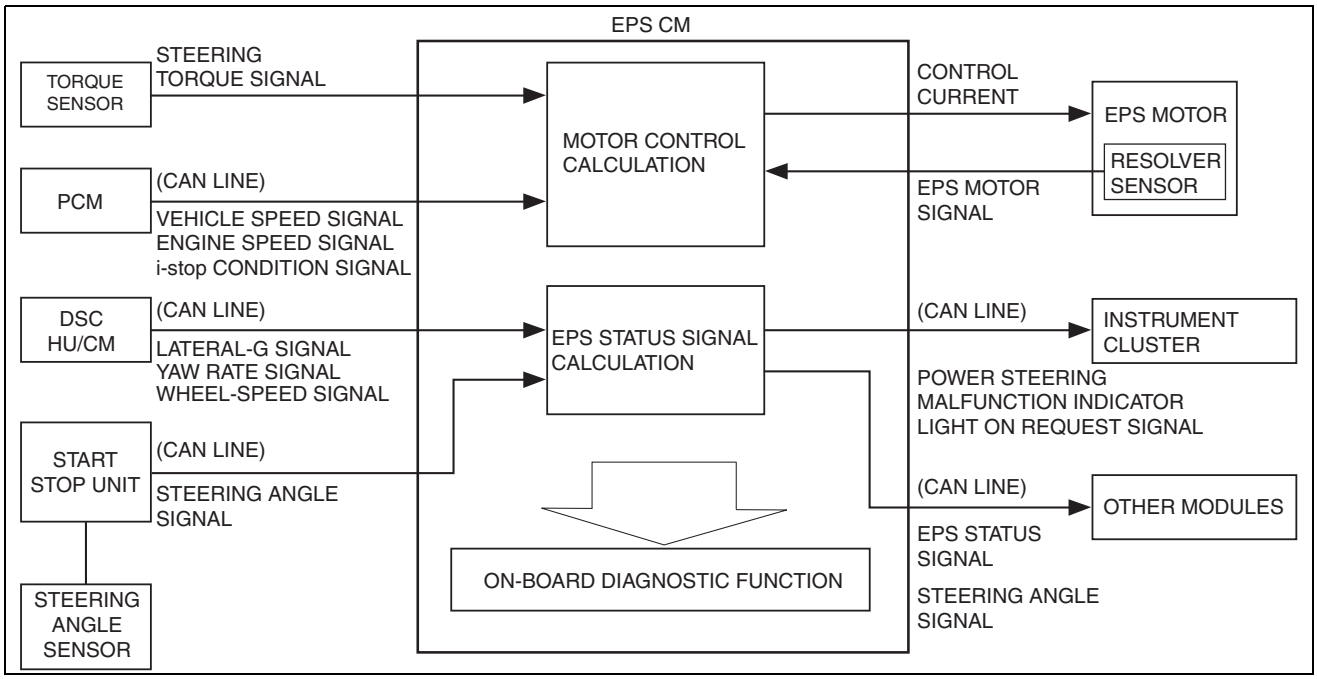
Function Table

Control item	Function
EPS motor current control	• Normal control — Calculates the proper assist current based on the steering torque, and the vehicle and engine speeds, and outputs a target current to the EPS motor. • System overheating protection control — Monitors the temperature of the motherboard in the EPS CM and controls the motor voltage gradually to prevent overheating of the system. • Backup control — Even if a phase 1 open circuit malfunction in the EPS motor occurs, output current to the EPS motor is controlled so that steering assist is maintained. • EPS i-stop control — Control current to the EPS motor is increased or decreased according to the operation status of the i-stop system.
On-board diagnostic function	• The main part of the system control includes the self-diagnosis function. In case a malfunction occurs, the power steering malfunction indicator light/master warning light illuminates to alert the driver, and a DTC is stored in the EPS CM at the same time. • As a result of the on-board diagnosis, when a malfunction is determined, system control is suspended or limited to assure safety while driving.
CAN communication function	• Outputs the EPS status signal and power steering malfunction indicator light illuminates on request via CAN lines.

ELECTRIC POWER STEERING (EPS)

Control item	Function
Automatic configuration function	• When the ignition is switched to ON or the engine is started after the EPS CM have been replaced, the EPS CM reads data from the instrument cluster via CAN communication to perform automatic configuration.
Steering wheel angle neutral position automatic learning function	• When the ignition is switched from OFF to ON and the vehicle is driven normally, the steering wheel angle neutral position is detected automatically based on the signal from the torque sensor.

Block Diagram



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Note

- Before the steering angle neutral position auto learning is completed, the EPS CM receives a steering angle signal from the steering angle sensor via the start stop unit and outputs the signal to the other modules through the CAN communication.
- After the steering angle neutral position auto learning is completed, the EPS CM outputs an EPS status signal, which is calculated by EPS CM itself, through the CAN communication.

Construction

- The EPS CM is installed to the steering column and integrated with the EPS motor.

Operation

EPS Motor Current Control

Normal control

- The optimum assist current is calculated based on the steering force signal from the torque sensor and the vehicle and engine speeds signal from the PCM, and then the control current is output to the EPS motor.

System overheating protection control

- The system overheating protection control lowers the current output to the EPS motor if the steering mechanism is turned from lock to lock continuously or the steering rack turning limit is reached repeatedly.

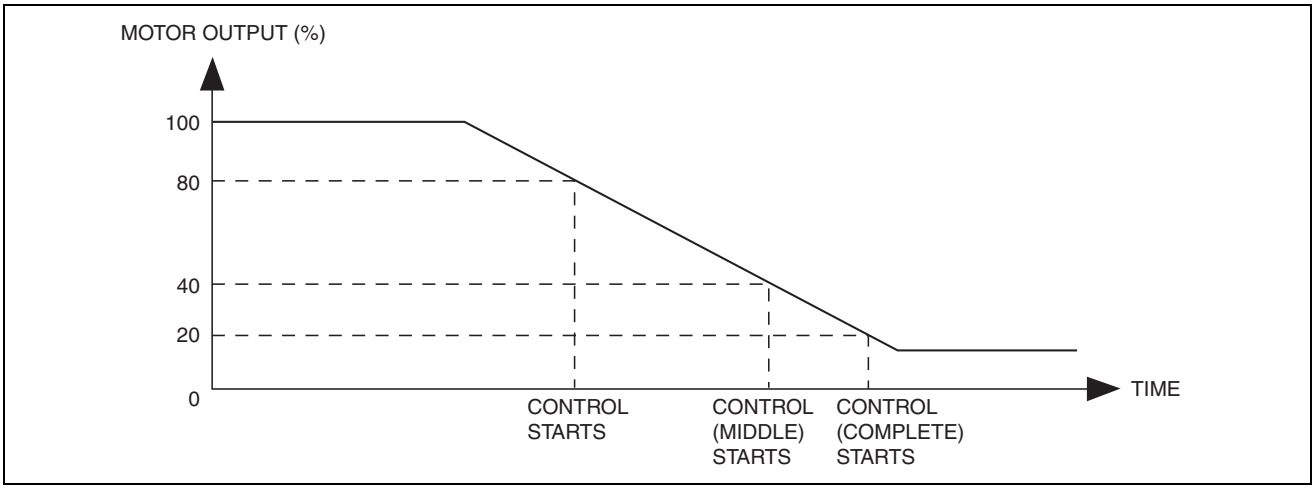
Note

- During system overheating protection control, the assist force will feel weaker due to a decrease in the control current. This is normal for the EPS CM to prevent the EPS motor from burning or seizure, and it does not indicate a malfunction.
- While the assist force weakens during this period of time, steering operation can be performed.

- The system overheating protection control has middle and complete steps, and it can verify current conditions and the history using the PID/data monitor function and snap shot data.
  - — System overheating protection control (middle): Motor output is 40 % or less (reference)
  - — System overheating protection control (complete): Motor output is 20 % or less (reference)

ELECTRIC POWER STEERING (EPS)

- The current output returns to normal if the temperature in the system decreases to the normal operation temperature.



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Backup control

- Even if an open circuit malfunction occurs in 1 out of the 3 phases in the EPS motor line, the backup control performs control to maintain steering assist.
- If the EPS CM detects a phase 1 open circuit malfunction in the EPS motor, the EPS CM controls output current to the EPS motor using a calculation method different than during normal EPS CM control. As a result, even with a phase 1 open circuit malfunction, the steering assist can be maintained.

Note

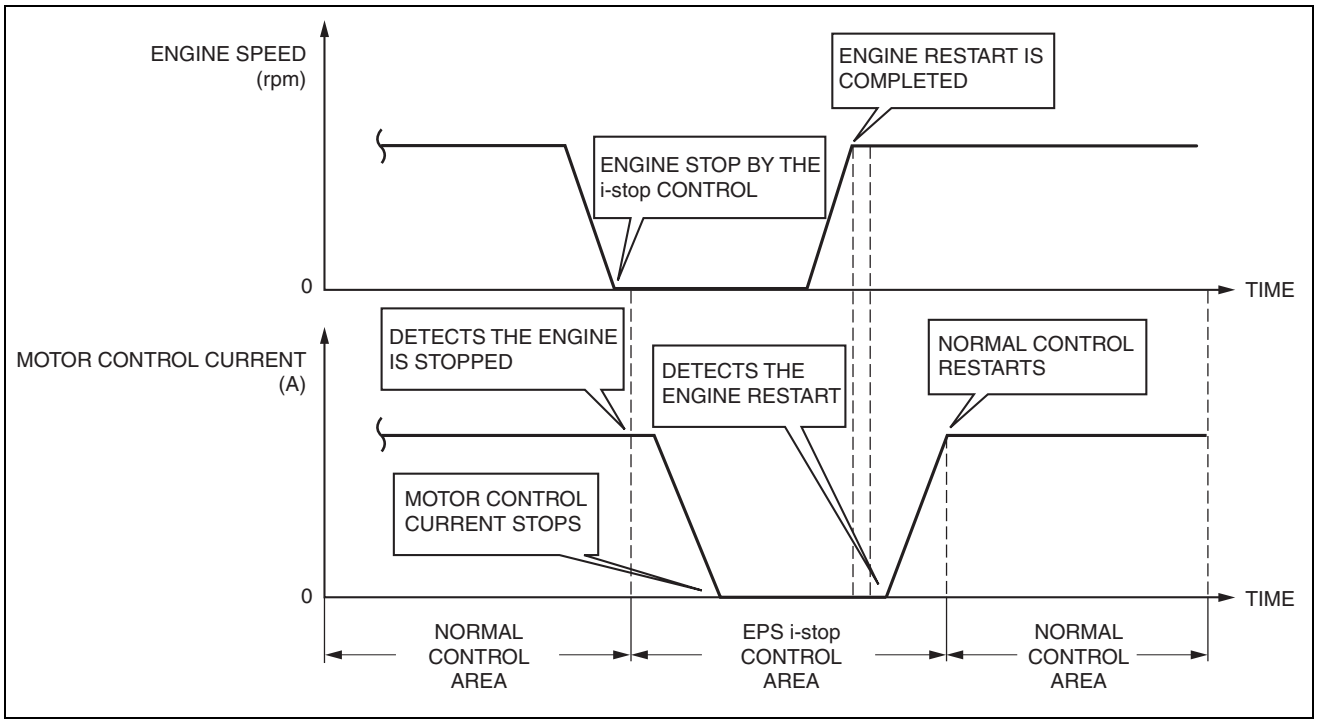
- If a phase 1 open circuit malfunction is detected in the EPS motor, the EPS CM stores DTC U2011:72 and illuminates the electric power steering malfunction indicator light/master warning light.
- If the steering wheel is operated during backup control, the steering wheel operation may feel heavier (resistance).

EPS i-stop control

- If it is detected that the engine is stopped by the i-stop control based on the i-stop condition signal from the PCM, the EPS motor control current is stopped.
- If it is detected that the engine is restarted by the i-stop control, the EPS motor control current is increased and the system returns to normal control.
- If the steering wheel is operated during EPS i-stop control, assist is performed (normal control) according to that steering.
- If a malfunction is detected in the i-stop condition signal from the PCM, EPS i-stop control is not operated, and normal control is performed.

ELECTRIC POWER STEERING (EPS)

- Refer to i-stop for a detailed explanation of the i-stop. (See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)



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Fail-safe

DTC No.	Fail-safe function
U2300:54	• Control enabled • Power steering malfunction indicator light: Not illuminated
U2300:55	• Control enabled • Power steering malfunction indicator light: Illuminated
U2300:56	• Control enabled • Power steering malfunction indicator light: Not illuminated
U3000:16 U3000:1C U3000:28 U3000:41	• Control disabled • Power steering malfunction indicator light: Illuminated
U3000:46	• Control is maintained in fail mode • Power steering malfunction indicator light: Not illuminated
U3000:47 U3000:49	• Control disabled • Power steering malfunction indicator light: Illuminated
U3000:4B	• Control is maintained in fail mode • Power steering malfunction indicator light: Not illuminated
U3000:61 U3000:73 U3000:96	• Control disabled • Power steering malfunction indicator light: Illuminated
U3003:16	• Control is maintained by gradually decreasing the motor control current — However, control is inhibited if the power supply voltage is the specified value of less • Power steering malfunction indicator light: Illuminated

ELECTRIC POWER STEERING (EPS)

DTC No.	Fail-safe function
U3003:17	• Control disabled • Power steering malfunction indicator light: Illuminated

ELECTRIC POWER STEERING (EPS) MOTOR

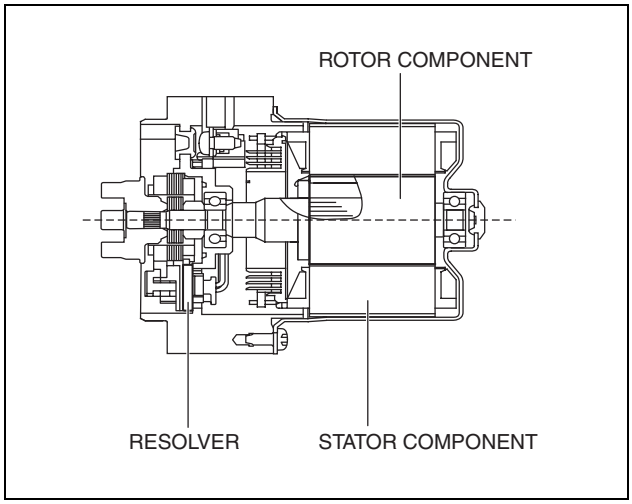
id061300245600

Purpose, Function

- The EPS motor is driven by the control current from the EPS CM (control module) and generates assist torque to manual steering mechanism.

Construction

- The EPS motor is installed to the steering column with an integrated EPS CM.
- The EPS motor is a brushless motor which consists of a three-phase star-connected stator, a permanent magnet rotor, and resolver sensor.



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Operation

- Current flows from the EPS CM to the stator to rotate the motor axis which is integrated with the rotor.
- A resolver sensor for detecting rotation angle is built into the EPS motor and outputs a motor rotation angle signal to the EPS CM.
- The EPS CM switches the current flowing to each stator based on the rotation angle signal from the resolver sensor.

Fail-safe

DTC No.	Fail-safe function
C200D:1C C200D:64 U2011:19 U2011:1C U2011:62	• Control disabled • Power steering malfunction indicator light: Illuminated
U2011:72	• Phase 1 open circuit malfunction is detected in the EPS motor — Control is maintained in the backup control • Other malfunction detected in EPS motor internal circuit — Control disabled
U2011:92	• Control disabled • Power steering malfunction indicator light: Illuminated

TORQUE SENSOR

id061300245400

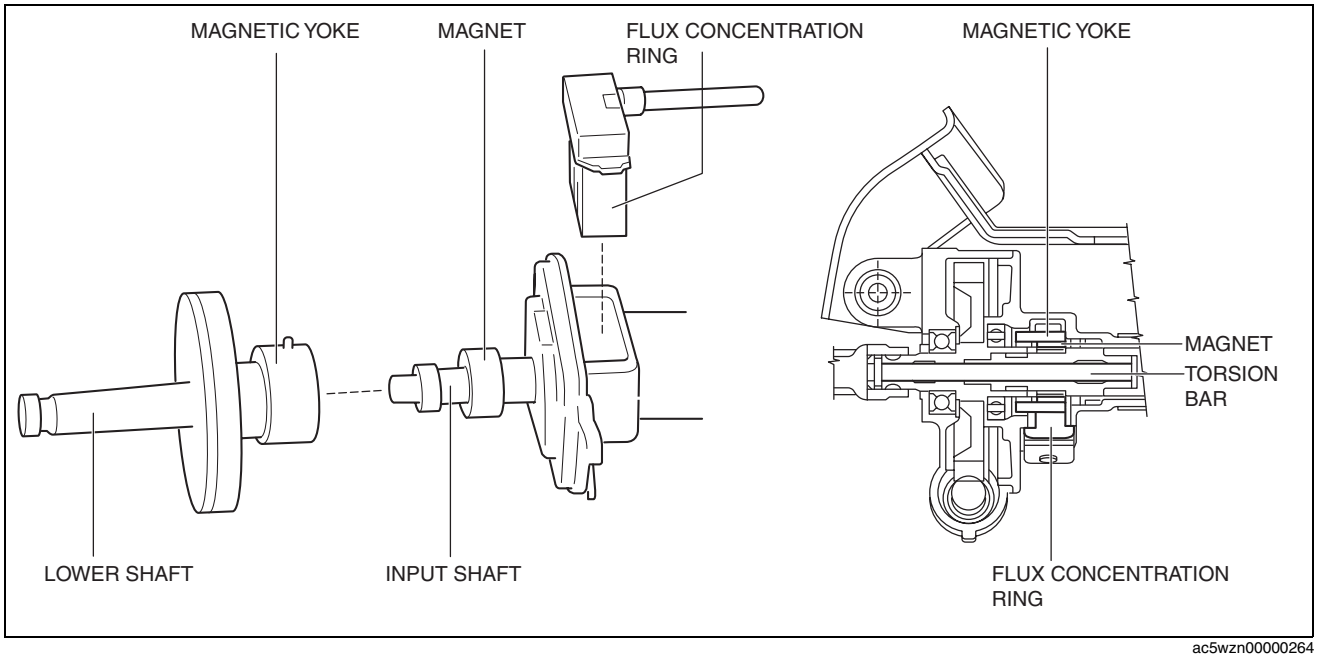
Purpose/ Function

- The torque sensor detects the steering torque and the steering direction, and outputs the signal to the Electric Power Steering (EPS) control module (CM).

ELECTRIC POWER STEERING (EPS)

Construction, Operation

- The Hall IC-type torque sensor is installed to the top of the steering column and consists of the following parts.
  - — Magnet: Assembled in a ring shape to the input shaft, it generates magnetic flux.
  - — Magnetic yoke: Assembled to the lower shaft, it converts magnetic flux transmitted to the flux concentration ring according to the position of the tooth area and the magnet.
  - — Flux concentration ring: Equipped with 2 Hall ICs at the front edge, it reads the change in magnetic flux.



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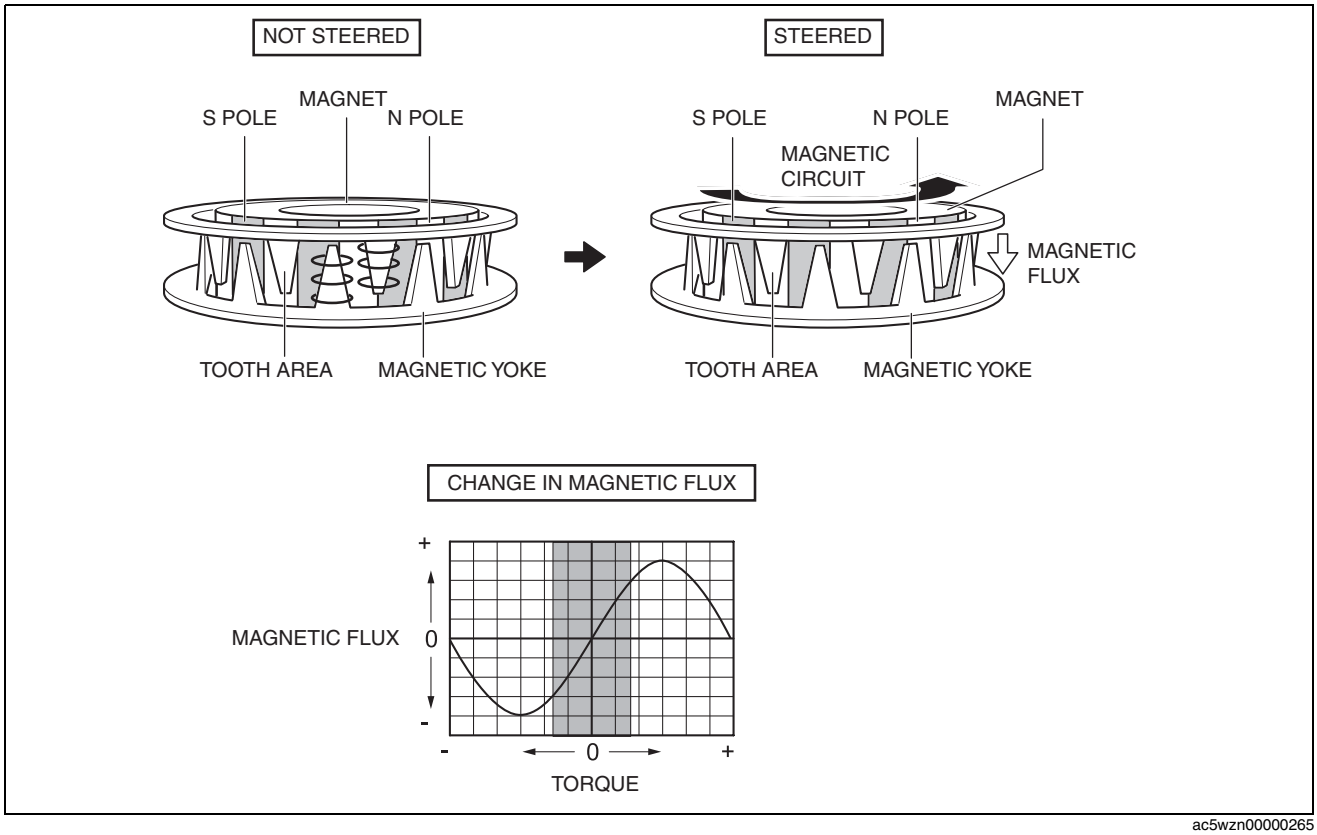
- When the steering wheel is centered (not steered), magnetic flux is not transmitted to the Hall ICs because the tooth area of the magnetic yoke shunts the magnetic flux of the magnet.
- Magnetic flux is transmitted to the Hall ICs when the steering wheel is operated because the positions of the magnet and the tooth area of the magnetic yoke change as the torsion bar connected to the input shaft and lower shaft twists.



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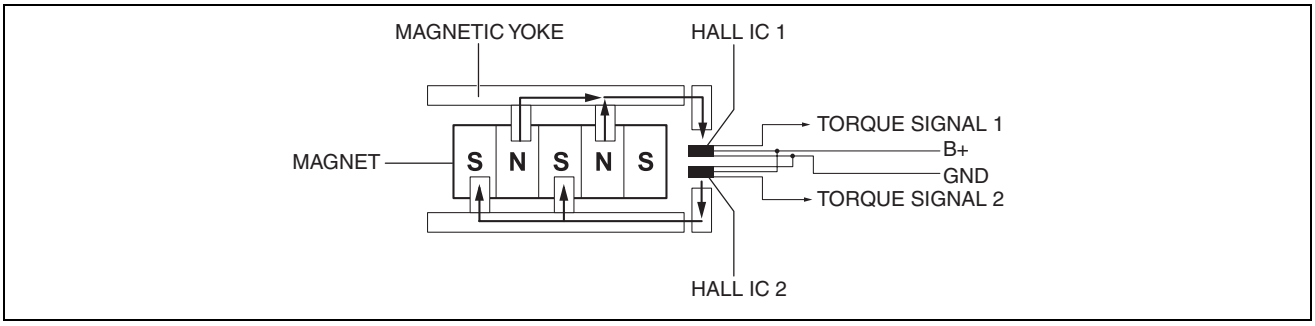
- The Hall ICs convert the change in magnetic flux to an electric signal and output it to the EPS CM.

ELECTRIC POWER STEERING (EPS)

- Electrical signals from each of the two Hall ICs in the torque sensor are calculated in the EPS CM and used for each type of control as steering torque signals.
- By the detection of two signals, the reliability of the steering torque calculated by the EPS CM and the malfunction detection performance of the torque sensor have been improved.



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Fail-safe

DTC No.	Fail-safe function
C200B:02	• Control disabled • Power steering malfunction indicator light: Illuminated
C200B:16	
C200B:1C	
C200B:62	
C200B:85	
C200C:1C	

REDUCTION GEAR

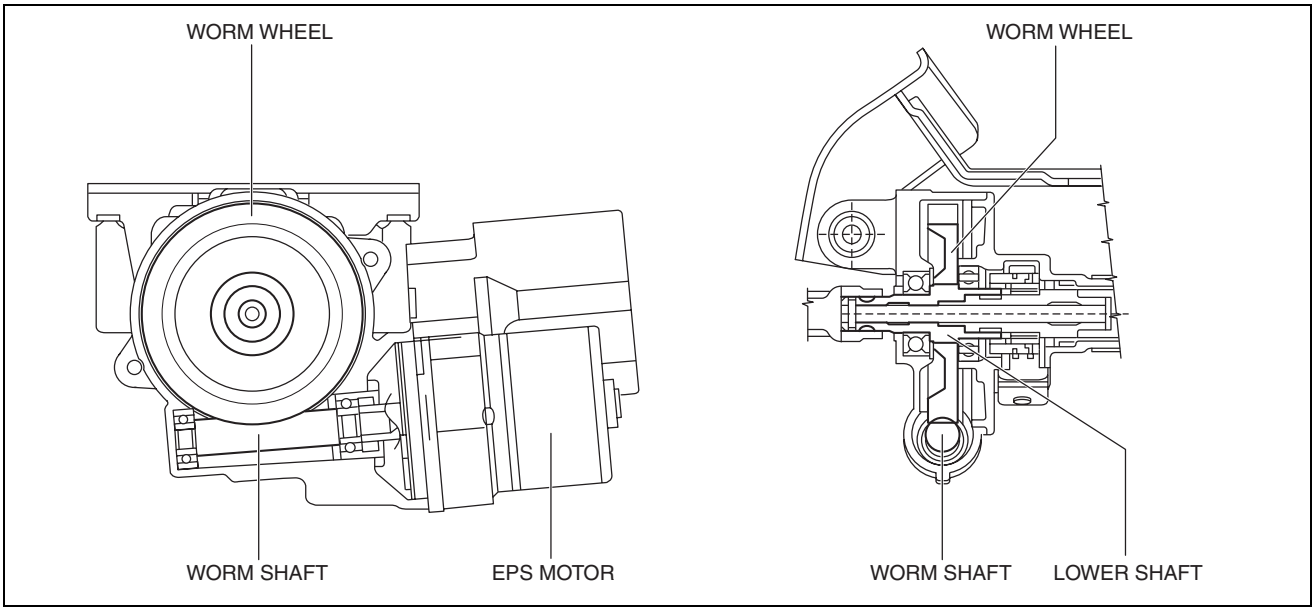
id061300244000

Purpose/ Function

- The reduction gear transmits the rotation input from the EPS motor, decreasing the rotation speed and increasing the torque simultaneously.

Construction

- The reduction gear consists of the worm wheel located on the steering column main shaft and the worm shaft connected to the EPS motor, and is integrated with the steering column.



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Operation

- The assist torque generated by the EPS motor is transmitted to the worm wheel via the worm shaft drives the steering column main shaft.

ELECTRIC POWER STEERING (EPS)

- The assist torque from the EPS motor is amplified by the reduction ratio (20.33:1) between the worm shaft and worm wheel, and is transmitted to the steering column main shaft.

Fale-safe
- Function not equipped.

CONTROLLER AREA NETWORK (CAN) OUTLINE

id061300247400

- The Electric Power Steering (EPS) control module sends and receives data to and from other modules via the CAN. (See 10-40-1 CONTROLLER AREA NETWORK (CAN) SYSTEM.)

Data sent
- EPS status
- Power steering malfunction indicator light on request
- Steering angle

Data received
- Vehicle speed
- Engine speed
- i-stop condition
- Lateral-G
- Yaw rate
- Wheel-speed
- Steering angle

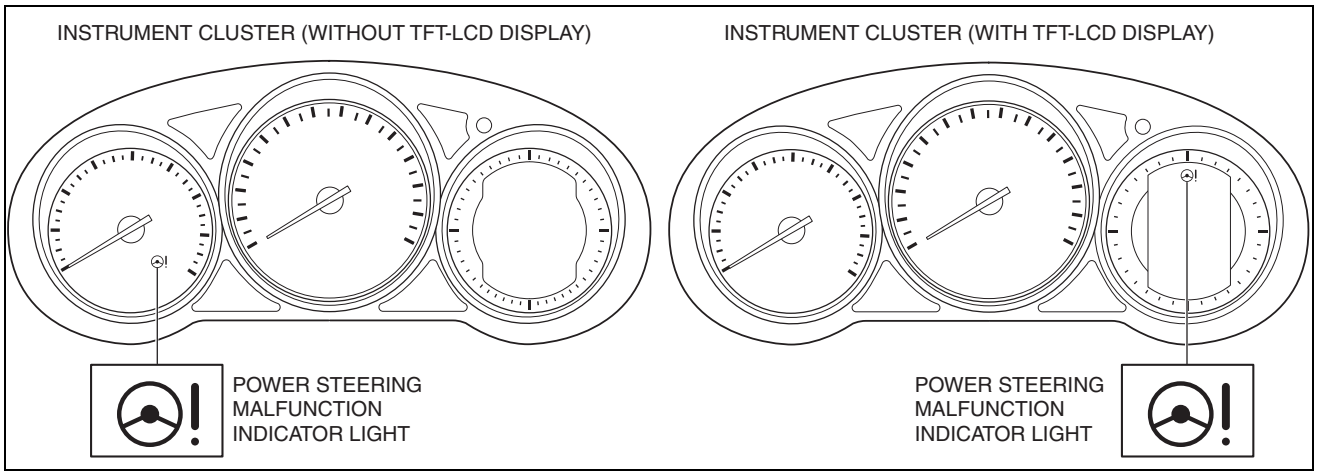
POWER STEERING MALFUNCTION INDICATOR LIGHT

id061300245300

Purpose
- The power steering malfunction indicator light warns the driver that there is a malfunction with the electric power steering (EPS) system.

Function
- If there is a malfunction in the EPS system, the power steering malfunction indicator light illuminates.
- If the EPS system and CAN lines are normal, it illuminates when the ignition is switched ON (engine off), and turns off after the engine is started.

Construction
- The power steering malfunction indicator light is built into the instrument cluster.



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Operation
EPS system malfunction detection
- If the EPS control module (CM) detects a system malfunction, it sends a power steering malfunction indicator light illumination on request signal to the instrument cluster via CAN.
- The instrument cluster illuminates the power steering malfunction indicator light when it receives a power steering malfunction indicator light illumination on request signal.

ELECTRIC POWER STEERING (EPS)

Initial check (Without TFT-LCD display)

- If the EPS system and CAN lines are normal, it illuminates when the ignition is switched ON (engine off), and turns off after the engine is started. If there is a system malfunction, the power steering malfunction indicator light illuminates.

Fail-safe

- Function not equipped.

HEATER, VENTILATION & AIR CONDITIONING (HVAC)

07 SECTION

07-00 OUTLINE

OUTLINE

HEATER, VENTILATION AND AIR CONDITIONING

id070000126400

Abbreviation

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position
CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle
DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
EPS	Electric Power Steering
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System
HBC	High Beam Control
HF/TEL	Hands-Free Telephone

OUTLINE

HI	High
HS	High Speed
HU	Hydraulic Unit
IDS	Integrated Diagnostic Software
IG	Ignition
IN	Intake
INT	Intermittent
KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear
2GR	Second Gear
2WD	2-Wheel Drive

OUTLINE

3GR	Third Gear
4GR	Fourth Gear
4WD	4-Wheel Drive
5GR	Fifth Gear
6GR	Sixth Gear

Outline

- Integrated A/C unit adopted.
- Sub-cooling system to multi-flow condenser adopted.
- PTC heater adopted. (with PTC heater)
- Water pump adopted. (with water pump)
- Refrigerant pressure sensor adopted in which refrigerant pressure is changed into a linear electric signal and precise information is transmitted.
- The climate control unit with built-in the display panel is adopted.
- HFO-1234yf has been adopted as the new refrigerant. HFO-1234yf refrigerant has little effect on global warming. (with HFO-1234yf)

Specifications
Basic System

Item			Specification
Heating capacity		(kW {kcal/h})	5.530 {4,755}
Cooling capacity		(kW {kcal/h})	5.000 {4,299}
Refrigerant	Type		HFO-1234yf HFC-134a
	Regular amount (approx. quantity)	(g {oz})	475—525 {16.8—18.5} (SKYACTIV-G 2.0 (HFO-1234yf)) 445—495 {15.7—17.4} (SKYACTIV-D 2.2 (HFO-1234yf)) 465—515 {16.5—18.1} (HFC-134a)
A/C compressor	Type		Swash plate
	Discharge capacity	(ml {cc, fl oz})	135 {135, 4.56} (SKYACTIV-G 2.0) 160 {160, 5.41} (SKYACTIV-D 2.2)
	Max. allowable speed	(rpm)	8,500 (SKYACTIV-G 2.0) 8,000 (SKYACTIV-D 2.2)
	Lube oil: Type		FD46XG
	Lube oil: Sealed volume (approx. quantity)	(ml {cc, fl oz})	100 {100, 3.38}
Condenser	Type		Multiflow (sub-cooling type)
	Radiated heat	(kW {kcal/h})	7.150 {6,148} (SKYACTIV-G 2.0 (HFO-1234yf)) 7.350 {6,320} (SKYACTIV-G 2.0 (HFC-134a)) 6.700 {5,761} (SKYACTIV-D 2.2 (HFO-1234yf, HFO-1234yf))
	Receiver/drier capacity	(ml {cc, fl oz})	170 {170, 5.75}
	Desiccant		Synthetic zeolite
Expansion valve	Type		External equalizing type
Evaporator	Type		Multi-flow type
Temperature control			Reheat full air mix type

Note

- The refrigerant used for the refrigerant system differs depending on the country. When draining or adding the refrigerant, verify the appropriate refrigerant type and specified amount of refrigerant from the caution label.

OUTLINE

Control System
Full-auto air conditioner

Item			Specification
Airflow volume (during heater operation)	Blower motor	(m^3/h)	310
Electricity consumption (during heater operation)	Blower motor	(W)	150
Heating capacity (SKYACTIV-D 2.2)	PTC heater	(kW {kcal/h})	1.0 {860}
Electricity consumption (during heater operation) (SKYACTIV-D 2.2)	PTC heater	(W)	1,000
Airflow volume (during air conditioner operation)	Blower motor	(m^3/h)	475
Electricity consumption (during air conditioner operation)	Blower motor	(W)	200
	Magnetic clutch	(W)	40
Magnetic clutch clearance		(mm {in})	0.35—0.65 {0.014—0.025}
Fan type	Blower motor		Sirocco fan
Refrigerant pressure sensor	Type		Capacitance type
	Sensor operation		(See 07-40A-20 REFRIGERANT PRESSURE SENSOR [FULL-AUTO AIR CONDITIONER].)
Sensor	Solar radiation sensor		Photodiode
	Ambient temperature sensor		Thermistor
	Cabin temperature sensor		
	Evaporator temperature sensor		
	Heater core temperature sensor*		
Actuator	Air intake actuator		Mechanical lock type
	Air mix actuator		Potentiometer type
	Airflow mode actuator		

* : With i-stop

Control System
Manual air conditioner

Item			Specification
Airflow volume (during heater operation)	Blower motor	(m^3/h)	310
Electricity consumption (during heater operation)	Blower motor	(W)	150
Heating capacity (SKYACTIV-D 2.2)	PTC heater	(kW {kcal/h})	1.0 {860}
Electricity consumption (during heater operation) (SKYACTIV-D 2.2)	PTC heater	(W)	1,000
Airflow volume (during air conditioner operation)	Blower motor	(m^3/h)	475
Electricity consumption (during air conditioner operation)	Blower motor	(W)	200
	Magnetic clutch	(W)	40
Magnetic clutch clearance		(mm {in})	0.35—0.65 {0.014—0.025}
Fan type	Blower motor		Sirocco fan
Refrigerant pressure sensor	Type		Capacitance type
	Sensor operation		(See 07-40A-20 REFRIGERANT PRESSURE SENSOR [FULL-AUTO AIR CONDITIONER].)
Sensor	Ambient temperature sensor		Thermistor
	Evaporator temperature sensor		
Actuator	Air intake actuator		Mechanical lock type

07-02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC

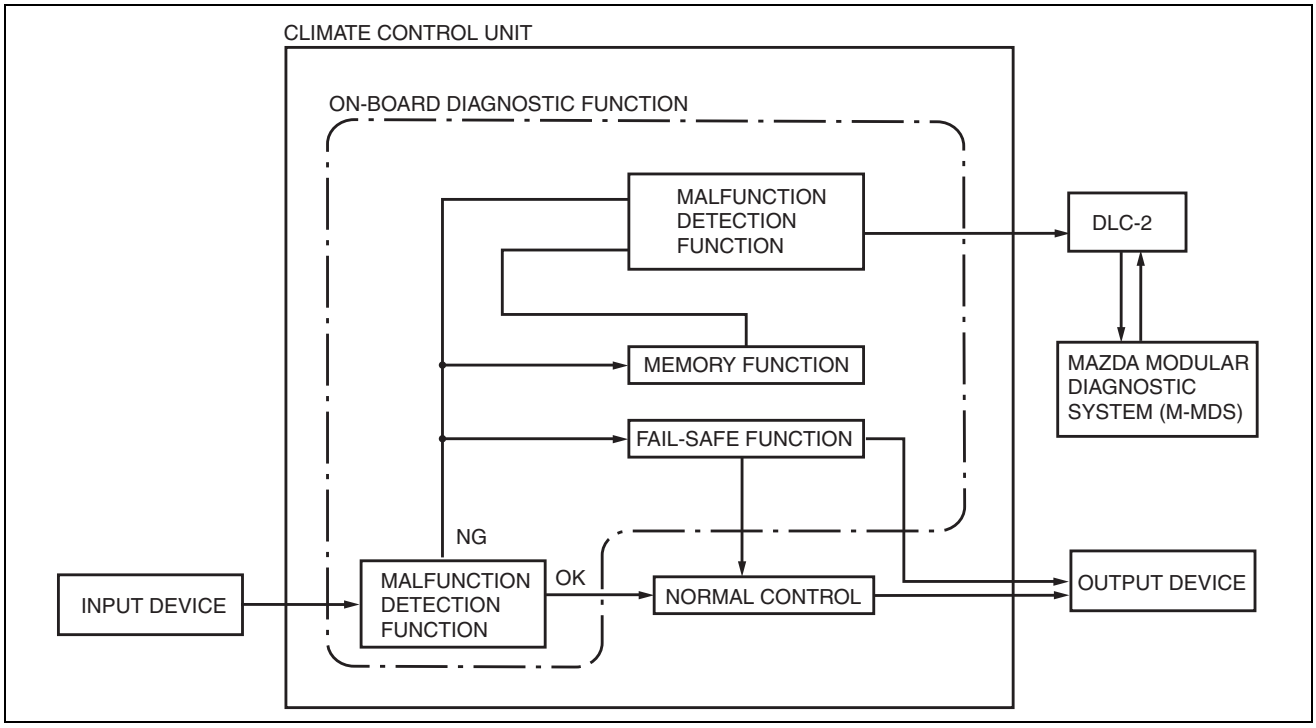
ON-BOARD DIAGNOSTIC

id070200126600

Outline

- The on-board diagnostic system has on-board diagnostic, PID/data monitor, and A/C operation check functions.
- The on-board diagnostic function has the following functions:
  - — Malfunction detection function
    - Detects errors in input and output signals
  - — Memory function
    - Stores detected malfunctions
  - — Malfunction indication function
    - Displays detected malfunctions
- The malfunction indication function, PID/data monitor, and A/C operation check functions can be performed by connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2.

Block Diagram



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Function

Malfunction detection function

- The malfunction detection function detects errors in the input and output signals. (Ignition switched ON or engine is running)
- If a malfunction is detected, a DTC is output to the DLC-2 through the malfunction indication function.
- At the same time, malfunction detection results are sent to the fail-safe and memory functions.

Memory function

- The memory function stores malfunctioning signal systems which are detected to be malfunctioning by the malfunction detection function.
- The stored malfunction information is not cleared even when the ignition is switched off (LOCK) or the malfunction is repaired.
- The stored malfunction information can be cleared by connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2 and operating it.

ON-BOARD DIAGNOSTIC

Malfunction indication function

- The malfunction indication function outputs present or past malfunctions to the DLC-2 as DTCs.
- The DTCs can be read by connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2 and operating it.

Malfunction display mode

- The climate control unit detects present and past malfunctions in the control system circuits (open/short circuits) and indicates the DTCs shown in the table on the Mazda Modular Diagnostic System (M-MDS).
- Clear past malfunctions after completing repairs because once a past malfunction is stored, it will remain stored even after the malfunction has been repaired.
- The stored past malfunction can be cleared by connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2 and operating it.

X: Applicable
–: Not applicable

DTC	Warning lamp	Malfunction location	Detected condition	Fail safe	Drive cycle	Self test type*1	Memory function
B1081:71	—	• Driver-side air mix actuator (L.H.D.) • Passenger-side air mix actuator (R.H.D.)	Motor lock	X	—	C	X
B1082:71	—	• Passenger-side air mix actuator (L.H.D.) • Driver-side air mix actuator (R.H.D.)	Motor lock	X	—	C	X
B1086:71	—	Airflow mode actuator	Motor lock	X	—	C	X
B1A61:11	—	Cabin temperature sensor	Circuit short to ground	X	—	C, D	X
B1A61:13	—		Circuit open	X	—	C, D	X
B1A63:12	—	Solar radiation sensor (RH)	Circuit shot to power supply	—	—	C, D	X
B1A63:13	—		Circuit open	—	—	D	X
B1A64:12	—	Solar radiation sensor (LH)	Circuit shot to power supply	—	—	C, D	X
B1A64:13	—		Circuit open	—	—	D	X
B1B71:11	—	Evaporator temperature sensor	Circuit short to ground	X	—	C, D	X
B1B71:13	—		Circuit open	X	—	C, D	X
B1C1A:12	—	• Driver-side air mix actuator (potentiometer) (L.H.D.) • Passenger-side air mix actuator (potentiometer) (R.H.D.)	Circuit short to power supply	X	—	C, D	X
B1C1A:13	—		Circuit open	X	—	C, D	X
B1C1B:12	—	• Passenger-side air mix actuator (potentiometer) (L.H.D.) • Driver-side air mix actuator (potentiometer) (R.H.D.)	Circuit short to power supply	X	—	C, D	X
B1C1B:13	—		Circuit open	X	—	C, D	X
B1C1C:12	—	Airflow mode actuator (potentiometer)	Circuit short to power supply	X	—	C, D	X
B1C1C:13	—		Circuit open	X	—	C, D	X
B1D22:11	—	Heater core temperature sensor	Circuit short to ground	X	—	C, D	X
B1D22:13	—		Circuit open	X	—	C, D	X
U0010:88	—	CAN communication system	Bus off	X	—	C	X
U0155:00	—	Lost communication with instrument cluster	No sub type information	X	—	C, D	X
U0423:68	—	Invalid date received from Instrument cluster	Event information	X	—	C, D	X
U200D:11	—	Climate control unit circuit voltage (+5V)	Circuit short to ground	—	—	C, D	X

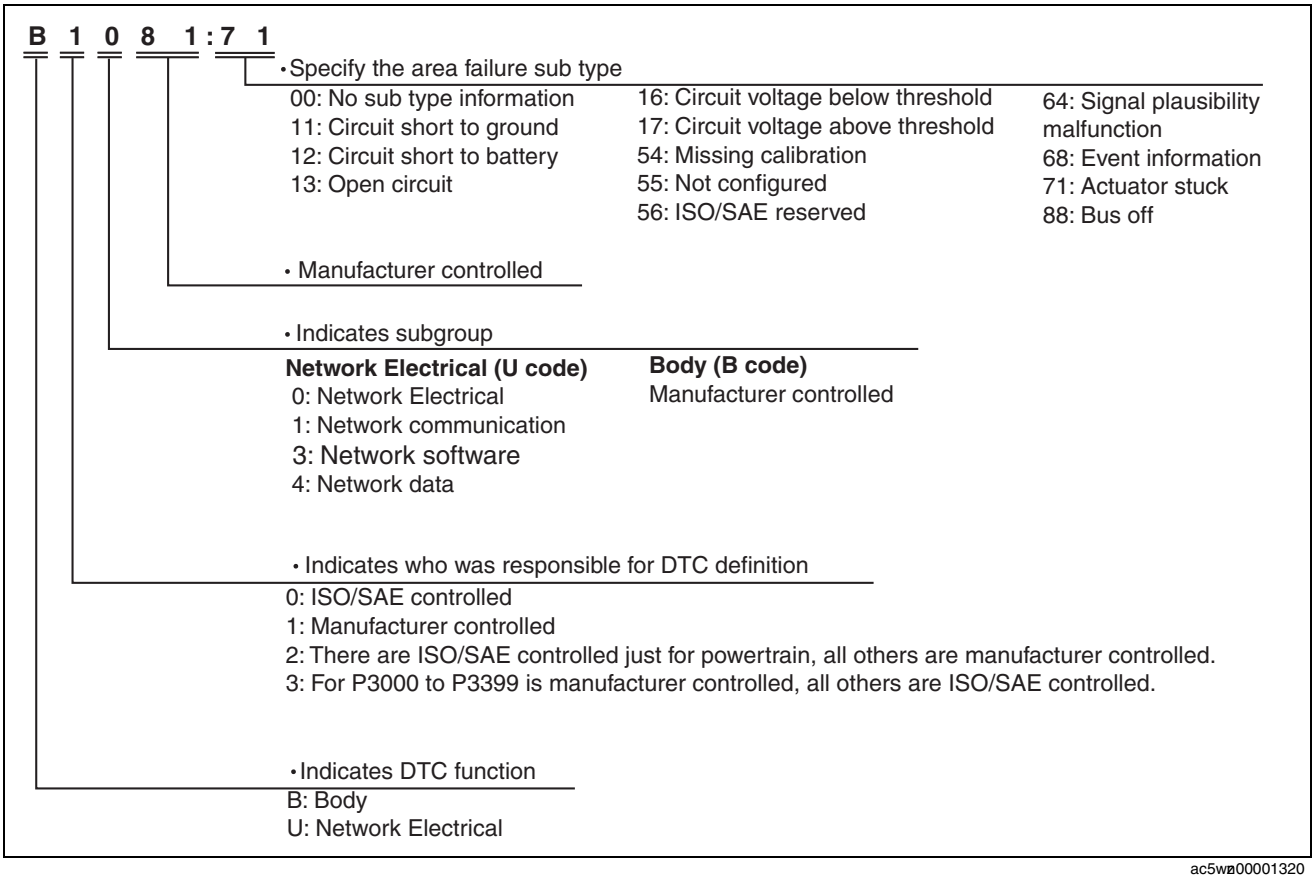
ON-BOARD DIAGNOSTIC

DTC	Warning lamp	Malfunction location	Detected condition	Fail safe	Drive cycle	Self test type*1	Memory function
U2300:54	—	Configuration error	Data not received	—	—	C, D	X
U2300:55	—		Not configured	—	—	C, D	—
U2300:56	—		Ineffective/non-interchangeable data read	—	—	C, D	X
U2300:64	—		Error value read	—	—	C, D	X
U3003:16	—	Climate control unit power supply voltage (B+, IG1)	Power supply voltage decreases (**10 V or less**)	X	—	C, D	X
U3003:17	—	Climate control unit power supply voltage (B+, IG1)	Power supply voltage increases (**17.3 V or more** (B+, IG1))	X	—	C, D	X

*1 : C: CMDTC self test, D: ODDTC self test

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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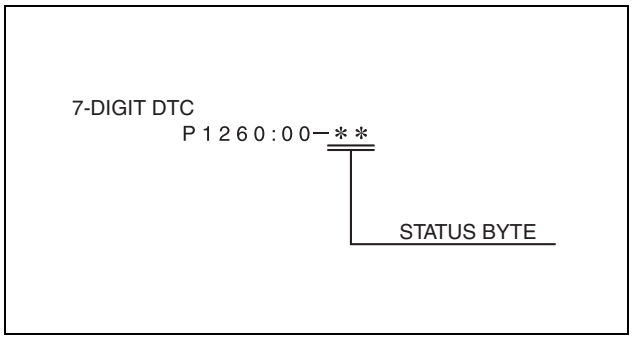
ON-BOARD DIAGNOSTIC

Status byte for DTC

- The status byte is the two digits (after hyphen) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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PID/data monitor

- The PID/data monitor function is used for optionally selecting input signal monitor items preset in the climate control unit/water heater unit and reading them out in real-time.

PID/data monitor table

PID name (definition)	Unit/Condition	Operation Status (Reference)	Input part
A/C_SW	Off/On	• A/C switch OFF: Off • A/C switch ON: On	Climate control unit
AUTO_SW	Off/On	• AUTO switch OFF: Off • AUTO switch ON: On	Climate control unit
B_MT_RLY_CS	Off/On	• Blower relay off: Off • Blower relay on: On	Climate control unit
DEF_SW	Off/On	• DEFROSTER switch OFF: Off • DEFROSTER switch ON: On	Climate control unit
DUAL_SW	Off/On	• DUAL switch OFF: Off • DUAL switch ON: On	Climate control unit
ELE_W/P	Off/On	• Water pump off: Off • Water pump on: On	Water pump
ENG_C_TMP	°C, °F	Engine coolant temperature is displayed	Engine coolant temperature sensor
EVA_TMP_SEN	°C, °F	Evaporator temperature is displayed	Evaporator temperature sensor
F_REC_CS	Off/On	• Forced recirculate control off: Off • Forced recirculate control on: On	Climate control unit
FRE_SW	Off/On	• FRESH switch OFF: Off • FRESH switch ON: On	Climate control unit
HC_TMP_SEN	°C, °F	Heater core temperature is displayed	Heater core temperature sensor
INC_TMP_SEN	°C, °F	Cabin temperature is displayed	Cabin temperature sensor
M_DOWN_SW	Off/On	• MODE switch (DOWN) OFF: Off • MODE switch (DOWN) ON: On	Climate control unit
M_UP_SW	Off/On	• MODE switch (UP) OFF: Off • MODE switch (UP) ON: On	Climate control unit
OFF_SW	Off/On	• OFF switch OFF: Off • OFF switch ON: On	Climate control unit
OUT_CAR_TMP	°C, °F	Ambient temperature is displayed	Ambient temperature sensor
R/DEF_CS	Off/On	• Rear defroster off: Off • Rear defroster on: On	Climate control unit
R/DEF_SW	Off/On	• Rear window defroster switch OFF: Off • Rear window defroster switch ON: On	Climate control unit
REC_SW	Off/On	• RECIRCULATE switch OFF: Off • RECIRCULATE switch ON: On	Climate control unit
S_HT_CUT_CS	No_Request/Cut	• Seat warmer signal cut control off: No_Request • Seat warmer signal cut control on: Cut	Climate control unit
SLR_R_SEN_L	W	Solar radiation amount is displayed	Solar radiation sensor
SLR_R_SEN_R			
STOP_ST	Available/ Not Available/ Error	• i-stop permit condition: Available • i-stop inhibit condition: Not Available • i-stop signal failure: Error	• Climate control unit • PCM

ON-BOARD DIAGNOSTIC

PID name (definition)	Unit/Condition	Operation Status (Reference)	Input part
UNIT_TMP	deg_C/deg_F	• Centigrade: deg_C • Fahrenheit: deg_F	Climate control unit

A/C operation check mode

- The A/C operation check mode forcibly operates the output devices as shown in the operation check table regardless of the signals input to the climate control unit.
- During an A/C operation check mode operation, indication in the display panel and the illumination of the indicator light on the switches are automatically controlled.
- Determine the malfunctioning part by visual inspection, listening to the operation sound, placing a hand on the air vents, or checking that each transition is as indicated in the operation check table.

Mazda Modular Diagnostic System (M-MDS) display	Target part	Reference
Air Mix Actuator	• Air mix actuator • Air mix door	(See 07-02-5 Air mix actuator)
Air conditioning compressor	• A/C compressor	(See 07-02-5 A/C compressor)
Air Intake Actuator	• Air intake actuator • Air intake door	(See 07-02-6 Air intake actuator)
Blower Motor Speed	• Blower motor	(See 07-02-6 Blower motor)
Air Flow Mode Actuator	• Airflow mode actuator • Airflow mode door	(See 07-02-7 Airflow mode actuator)
Illumination of All Indicator Lights	• Climate control unit	(See 07-02-7 Indicator light)
Electrical Water Pump	• Water pump*	(See 07-02-7 Water pump)

* : With water pump

Air mix actuator
Operation

Step	Air mix actuator	Airflow mode actuator	Blower speed	Magnet clutch	Air intake actuator
1	0 %	VENT	5th	ON	FRESH
2	100 %				

Display

Step	Temperature (°C {°F})	Airflow mode	Blower volume	A/C	Recirculate switch indicator light	Fresh switch indicator light
1	20.0 {68}			Displayed	Not illuminated	Illuminated
2	21.0 {70}					

Note

- After approx. 22 s have elapsed the operation step moves to the next step.
- When the last step is finished, the operation is repeated from Step 1.
- To prevent super-cooling, the magnetic clutch turns off despite the A/C forced override.

A/C compressor
Operation

Step	Air mix actuator	Airflow mode actuator	Blower speed	Magnet clutch	Air intake actuator
1	0 %	VENT	5th	ON	FRESH
2				OFF	

Display

Step	Temperature (°C {°F})	Airflow mode	Blower volume	A/C	Recirculate switch indicator light	Fresh switch indicator light
1	4 {39}			Displayed	Not illuminated	Illuminated
2				Not displayed		

ON-BOARD DIAGNOSTIC

Note
- After the following times have elapsed, the operation step moves to the next step.
  - — Step 1: Approx. 5 s
  - — Step 2: Approx. 25 s
- When the last step is finished, the operation is repeated from Step 1.

Air intake actuator
Operation

Step	Air mix actuator	Airflow mode actuator	Blower speed	Magnet clutch	Air intake actuator
1	0 %	VENT	5th	ON	FRESH
2					RECIRCULATE
3				OFF	FRESH
4					RECIRCULATE

Display

Step	Temperature (°C {°F})	Airflow mode	Blower volume	A/C	Recirculate switch indicator light	Fresh switch indicator light
1	4 {39}			Displayed	Not illuminated	Illuminated
2					Illuminated	Not illuminated
3				Not displayed	Not illuminated	Illuminated
4					Illuminated	Not illuminated

Note
- After approx. 11 s have elapsed the operation step moves to the next step.
- When the last step is finished, the operation is repeated from Step 1.
- To prevent super-cooling, the magnetic clutch turns off despite the A/C forced override.

Blower motor
Operation

Step	Air mix actuator	Airflow mode actuator	Blower speed	Magnet clutch	Air intake actuator
1	50 %	VENT	OFF	OFF	FRESH
2			1st	ON	
3			3rd		
4			5th		
5			7th		

Display

Step	Temperature (°C {°F})	Airflow mode	Blower volume	A/C	Recirculate switch indicator light	Fresh switch indicator light
1	1 {34}		Not displayed	Not displayed	Not illuminated	Illuminated
2				Displayed		
3						
4						
5						

Note
- After approx. 4 s have elapsed the operation step moves to the next step.
- When the last step is finished, the operation is repeated from Step 1.
- To prevent super-cooling, the magnetic clutch turns off despite the A/C forced override.

ON-BOARD DIAGNOSTIC

Airflow mode actuator
Operation

Step	Air mix actuator	Airflow mode actuator	Blower speed	Magnet clutch	Air intake actuator
1	50 %	VENT	5th	ON	FRESH
2		BI-LEVEL			
3		HEAT			
4		DEF/HEAT			
5		DEFROSTER			

Display

Step	Temperature (°C {°F})	Airflow mode	Blower volume	A/C	Recirculate switch indicator light	Fresh switch indicator light
1	3 {37}			Displayed	Not illuminated	Illuminated
2						
3						
4						
5						

Note
- After approx. 11 s have elapsed the operation step moves to the next step.
- When the last step is finished, the operation is repeated from Step 1.
- To prevent super-cooling, the magnetic clutch turns off despite the A/C forced override.

Indicator light
Operation

Step	Air mix actuator	Airflow mode actuator	Blower speed	Magnet clutch	Air intake actuator
—	50 %	VENT	OFF	OFF	FRESH

Display

Step	Temperature (°C {°F})	Airflow mode	Blower volume	A/C	Recirculate switch indicator light	Fresh switch indicator light
—	All indicator displayed				Illuminated	Illuminated

Water pump
Operation

Step	Water pump	Air mix actuator	Airflow mode actuator	Blower speed	Magnet clutch	Air intake actuator
—	ON	50 %	VENT	OFF	OFF	FRESH

Display

Step	Temperature (°C {°F})	Airflow mode	Blower volume	A/C	Recirculate switch indicator light	Fresh switch indicator light
—	10 {50}		Not displayed	Not displayed	Not illuminated	Illuminated

A/C operation check stop

Note
- If "Stop" is selected while the A/C operation check is operating, the A/C stops at the conditions shown in the table.

ON-BOARD DIAGNOSTIC

Operation

Step	Water pump (with water pump)	Air mix actuator	Airflow mode actuator	Blower speed	Magnet clutch	Air intake actuator
—	OFF	50 %	VENT	OFF	OFF	FRESH

Display

Step	Temperature (°C {°F})	Airflow mode	Blower volume	A/C	Recirculate switch indicator light	Fresh switch indicator light
—	0 {32}		Not displayed	Not displayed	Not illuminated	Illuminated

07-11 BASIC SYSTEM

BASIC SYSTEM

BASIC SYSTEM

id071100310100

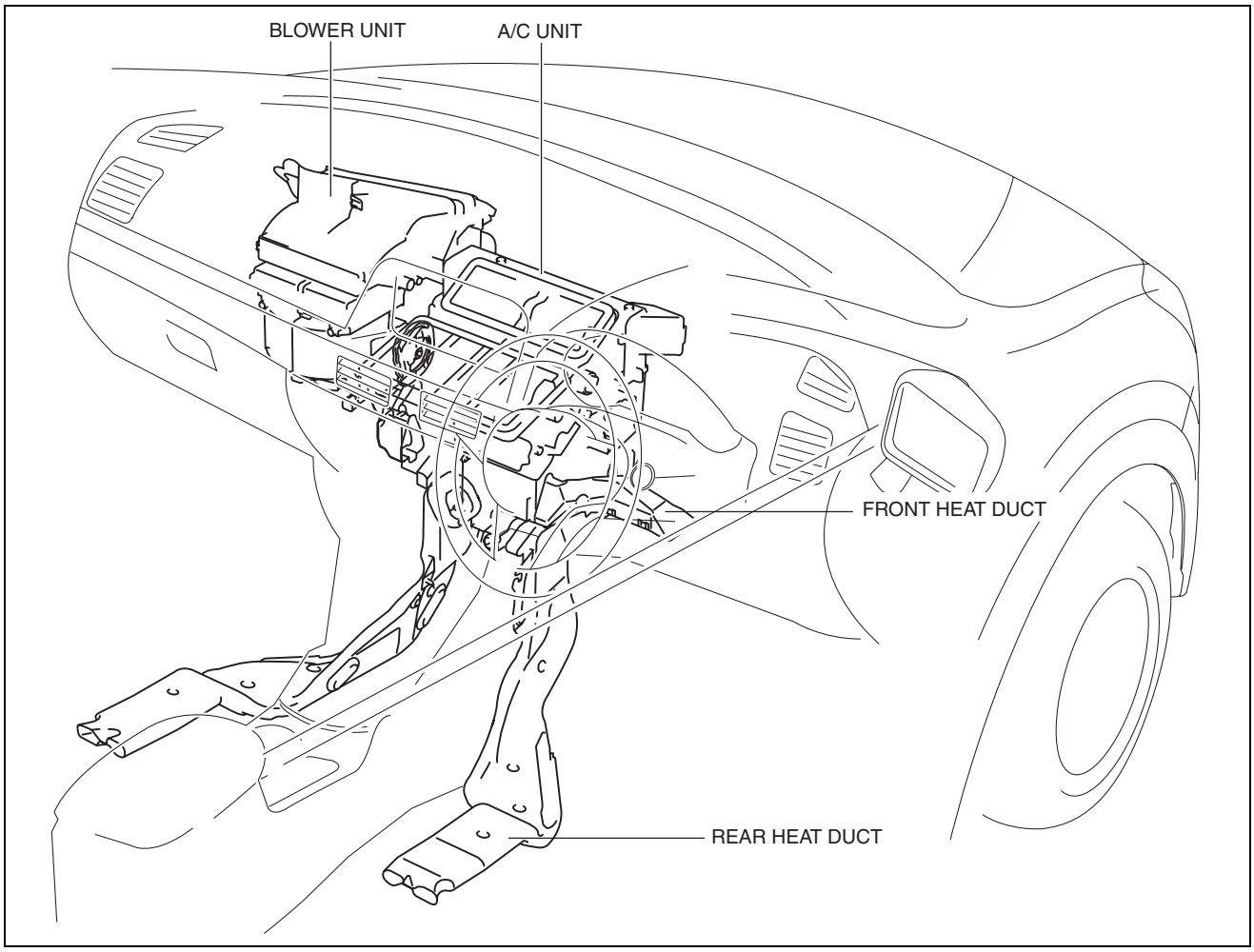
Outline

- Integrated A/C unit adopted.
- Sub-cooling system to multi-flow condenser adopted.

BASIC SYSTEM

Structural View
Ventilation system

R.H.D.



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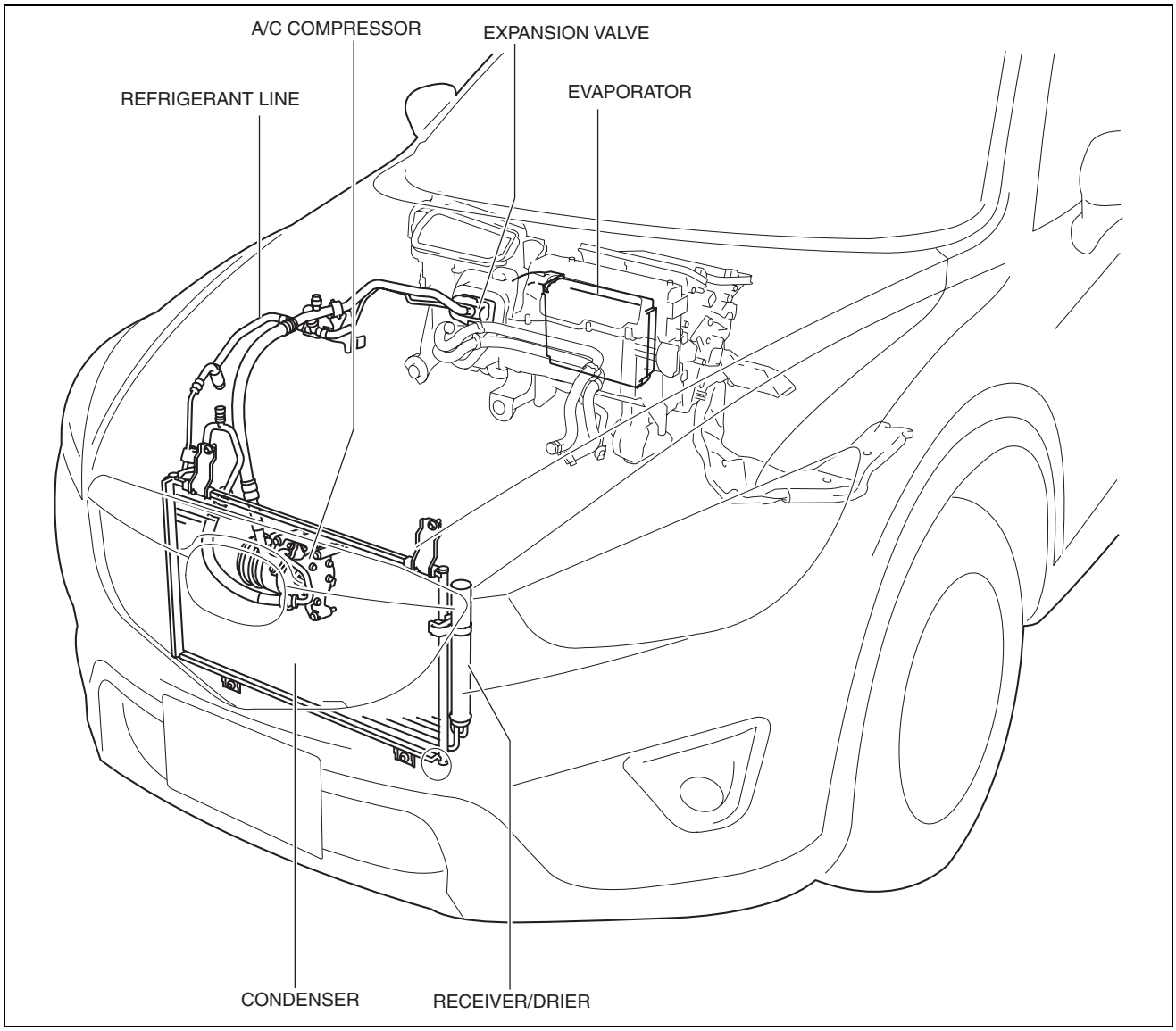
BASIC SYSTEM

Refrigerant system



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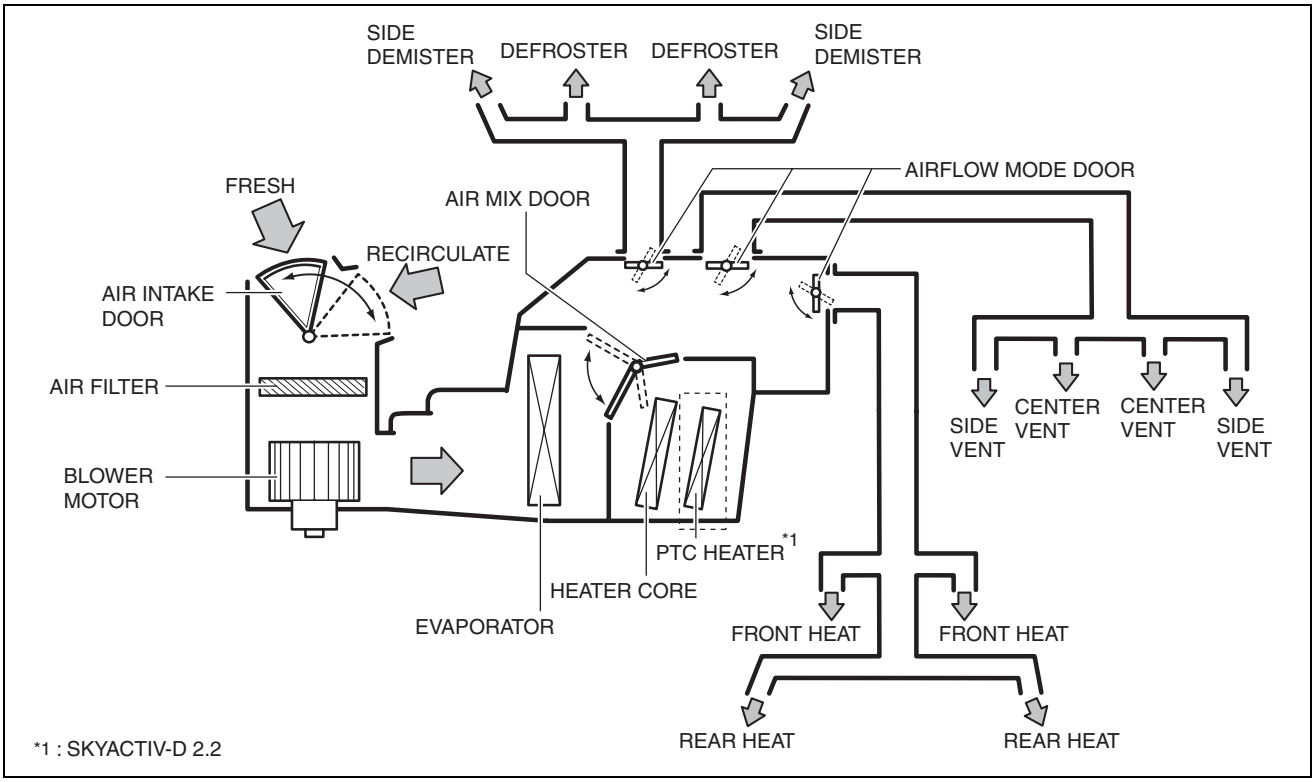
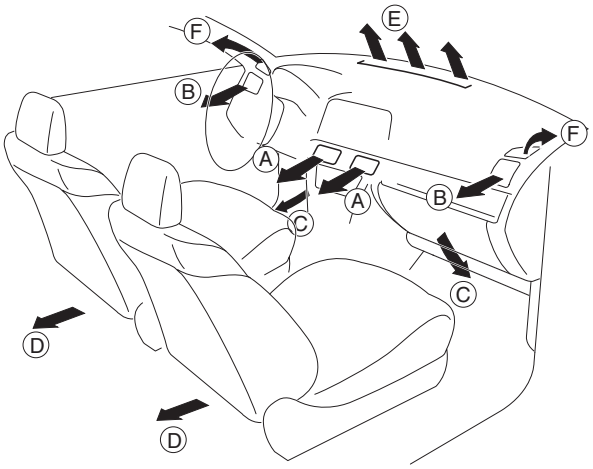
BASIC SYSTEM

Flow Diagram
Ventilation system
A/C unit



Inside the vehicle

MARK	AIR FLOW VOLUME
○	LOW
◯	MIDDLE
◯	HIGH



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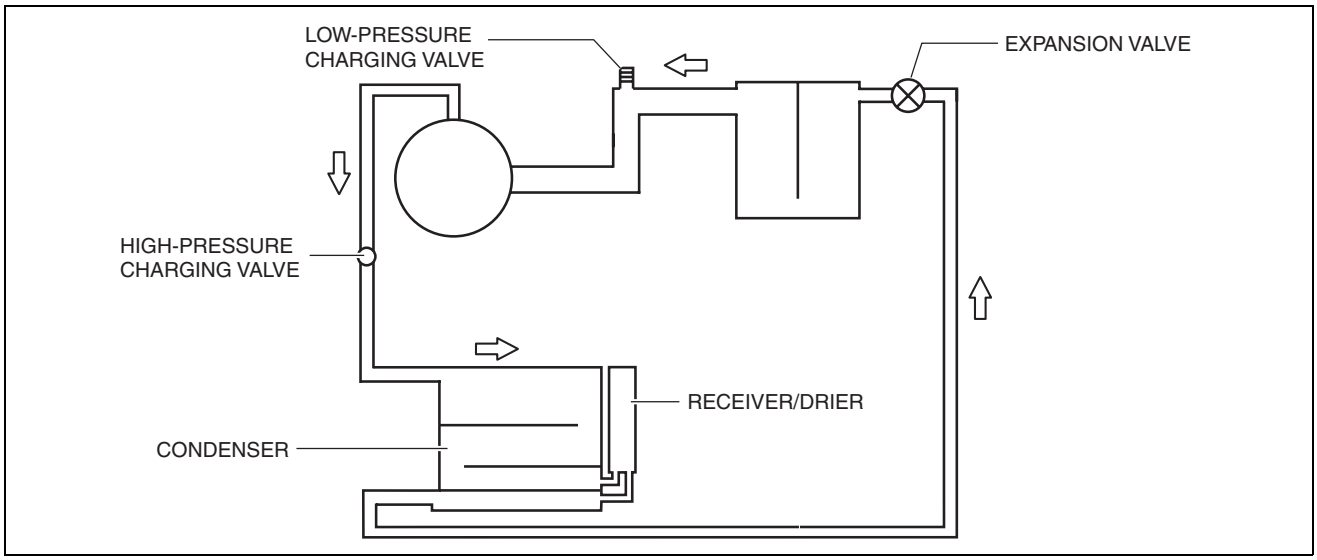
Display	CENTER VENT	SIDE VENT	FOOT VENT		FRONT DEFROSTER	SIDE DEFROSTER
			Front	Rear		
	A	B	C	D	E	F
VENT	◯	◯	—	—	—	—
BI-LEVEL	◯	◯	◯	○	—	—
HEAT	—	○	◯	◯	◯	○
DEF/HEAT	—	○	◯	○	◯	○

BASIC SYSTEM

Display	CENTER VENT	SIDE VENT	FOOT VENT		FRONT DEFROSTER	SIDE DEFROSTER
			Front	Rear		
	A	B	C	D	E	F
DEFROSTER	—	○	—	—	◯	◯

Refrigerant system



ac5wzn00001109

BLOWER UNIT

id071100310200

Purpose

- The blower unit switches between fresh air and recirculated air (FRESH/REC) and sends airflow into the cabin.

Function

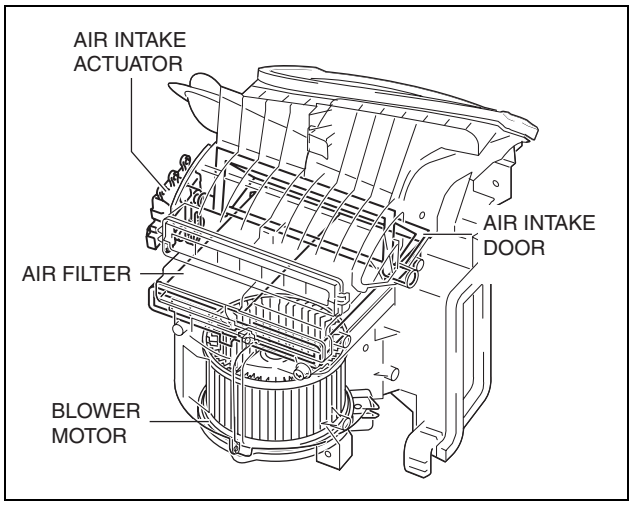
- Air is blown by the blower motor in the blower unit.
- The blower unit switches the air intake port to FRESH or REC based on the position of the air intake door.

Construction

- The blower motor consists of the following parts:
  - — Blower motor
  - — Air intake door
  - — Air intake actuator
  - — Air filter

BASIC SYSTEM

R.H.D.



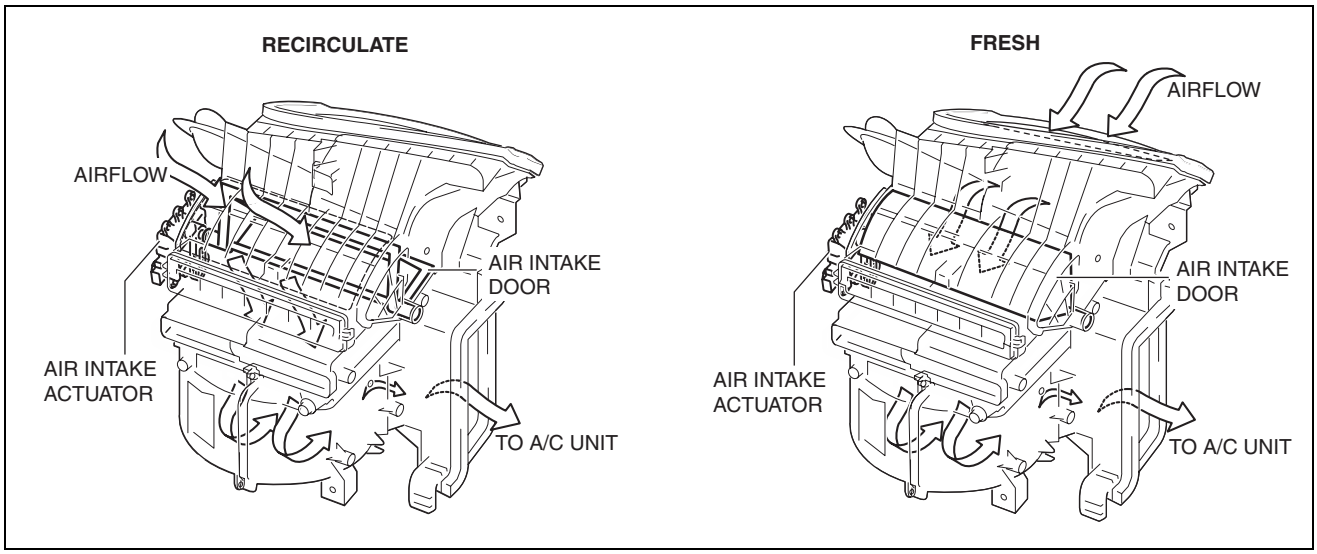
ac5wzn00000669

Operation

- When the blower motor rotates, air is taken in from the outside of the vehicle or the cabin.
- The air taken in flows in the fresh air direction or recirculate direction according to the operation of the air intake link. The air intake port changes by the movement of the air intake door.

BASIC SYSTEM

R.H.D.



ac5wzn00000671

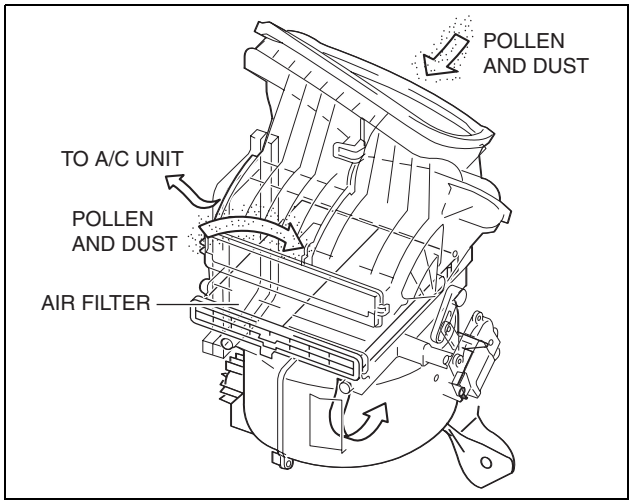
Fail-safe
- Function not equipped.

AIR FILTER

id071100105500

Purpose
- The air filter removes pollen and dust in the intake air and purifies air flowing into the cabin.

Function
- The air filter removes pollen and dust using a dust collecting filter.



ac5wzn00000760

Construction
- The air filter is installed to the blower unit.
- It is necessary to periodically replace the air filter because it cannot be reused by cleaning.

Fail-safe
- Function not equipped.

A/C UNIT

id071100310300

Purpose
- The A/C unit switches the air vent and adjusts the blower air temperature.

Function
- The A/C unit adjusts the blower air temperature based on the position of the air mix door.

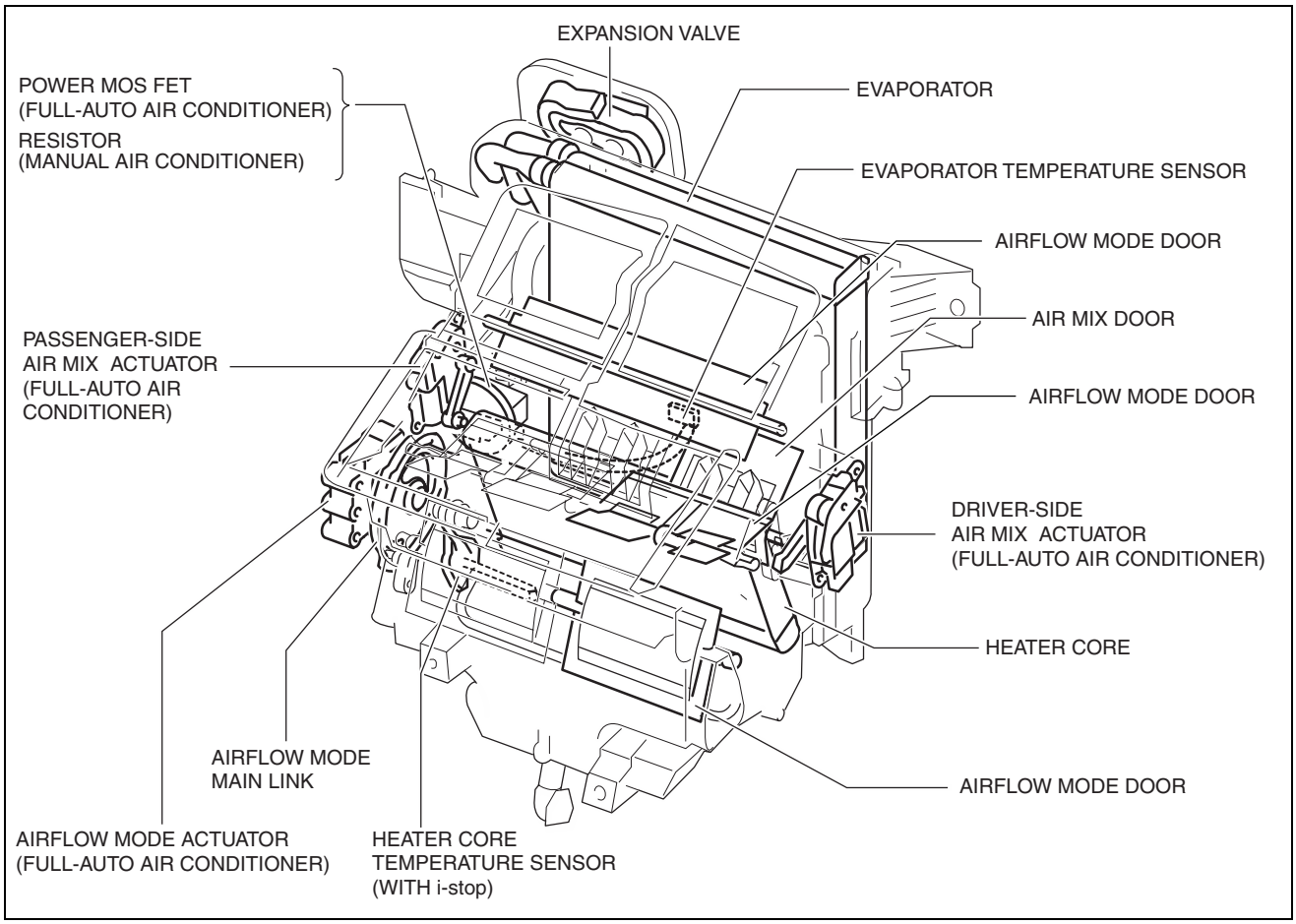
BASIC SYSTEM

- The A/C unit controls the air vent mode based on the position of the mode door.

Construction

- Size and weight reduction is achieved by the integration of the A/C unit, cooling unit, and heater unit.
- The A/C unit consists of the following parts:

R.H.D.



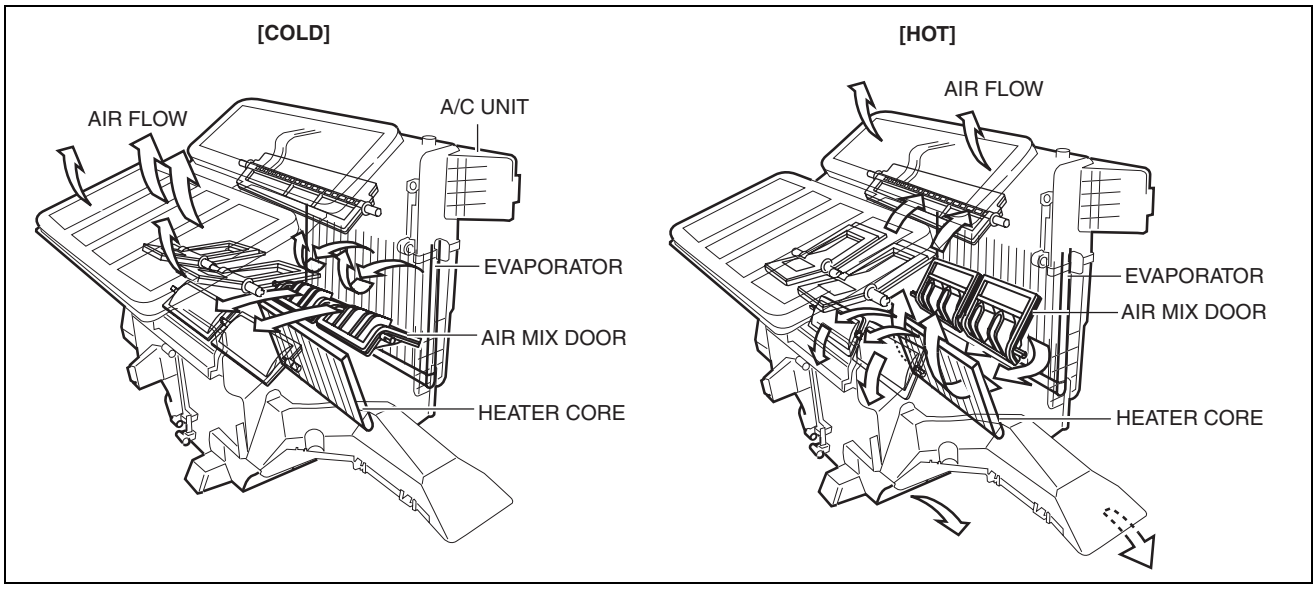
Operation

Air Mix Door

- The air mix door moves in the COLD or HOT direction according to the operation of the air mix link. The airflow volume blowing from the evaporator to the heater core changes by the movement of the air mix door, and the temperature of the air which passes is adjusted.

BASIC SYSTEM

R.H.D.



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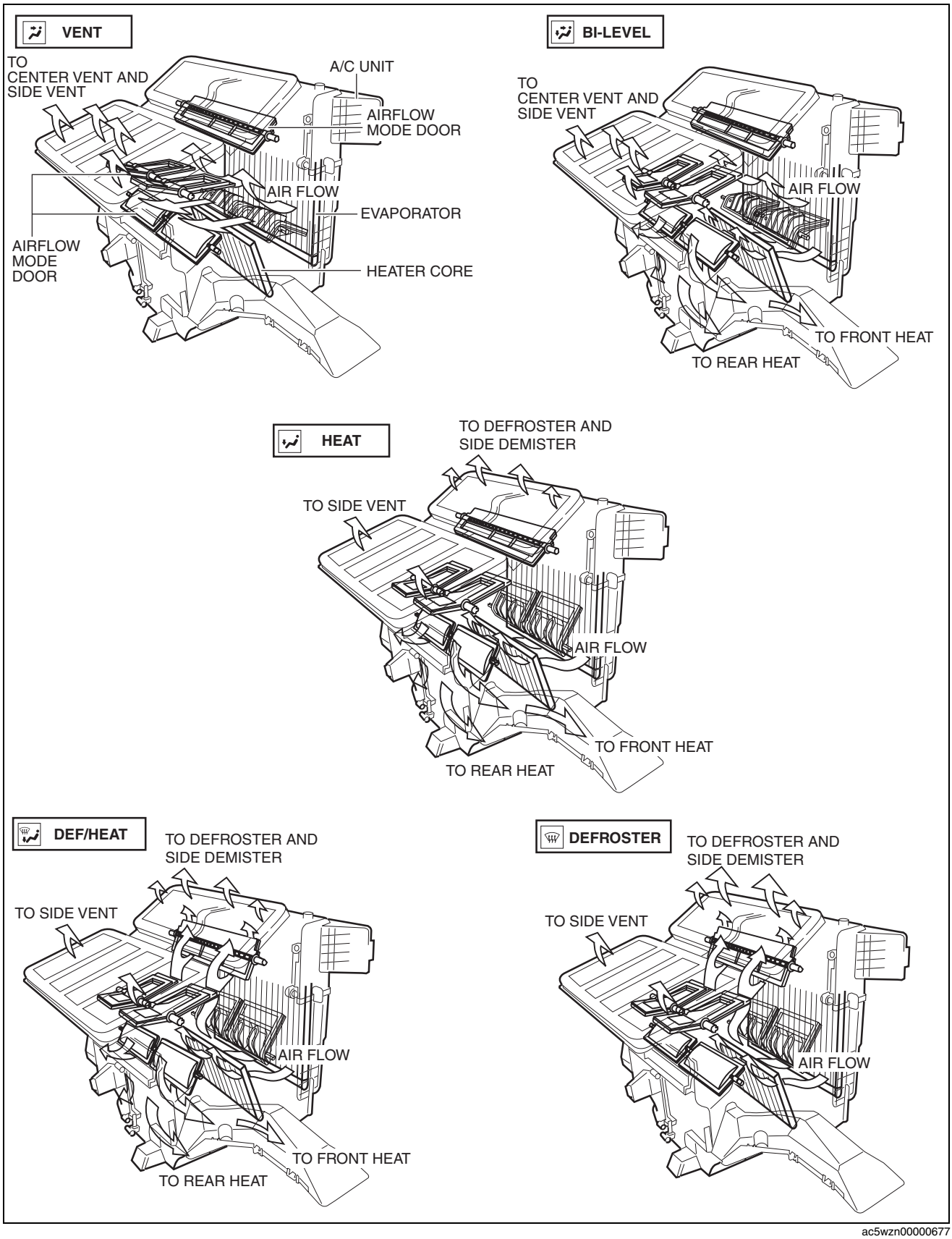
Airflow Mode Door

- The airflow mode door moves in the VENT, BI-LEVEL, HEAT, DEFROSTER/HEAT, or DEFROSTER direction according to the airflow mode main link. The air vent changes by the movement of the mode door.

BASIC SYSTEM

R.H.D.



ac5wzn00000677

Fail-safe

- Function not equipped.

BASIC SYSTEM

EXPANSION VALVE

id071100290300

Purpose

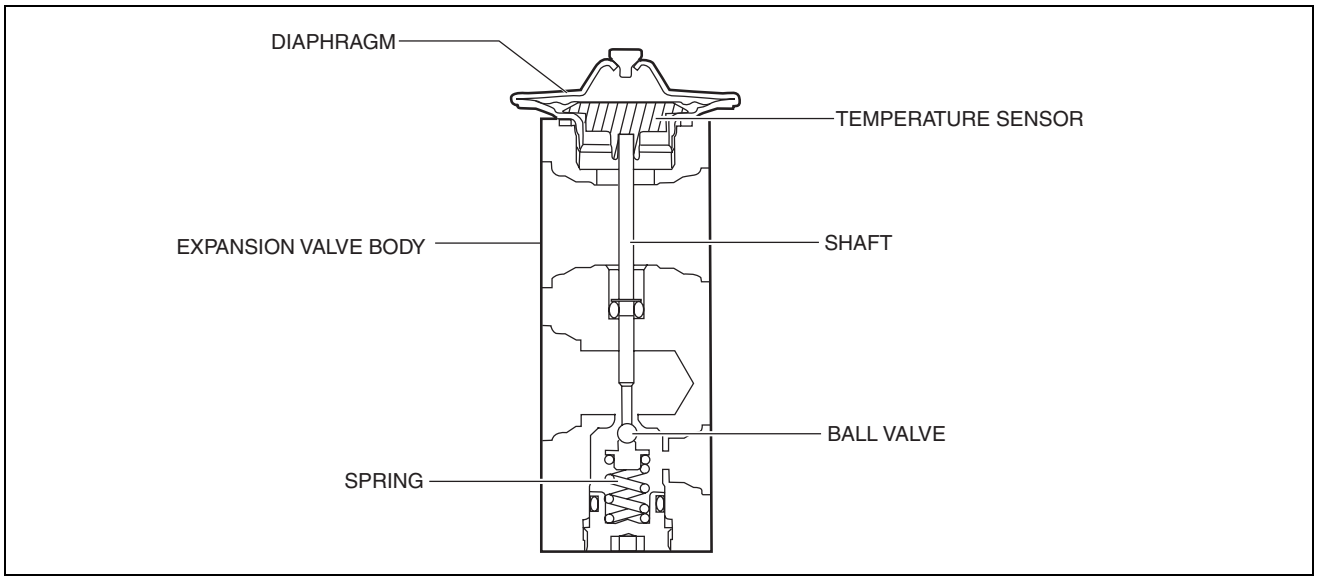
- The expansion valve atomizes liquid refrigerant to facilitate cooling of the evaporator.

Function

- The expansion valve reduces the pressure of liquid refrigerant rapidly to facilitate vaporization of the atomized refrigerant at the evaporator, and adjusts the refrigerant amount sent into the evaporator.

Construction

- The expansion valve consists of the following parts:
  - — Diaphragm
  - — Temperature sensor
  - — Shaft
  - — Expansion valve body
  - — Ball valve
  - — Spring



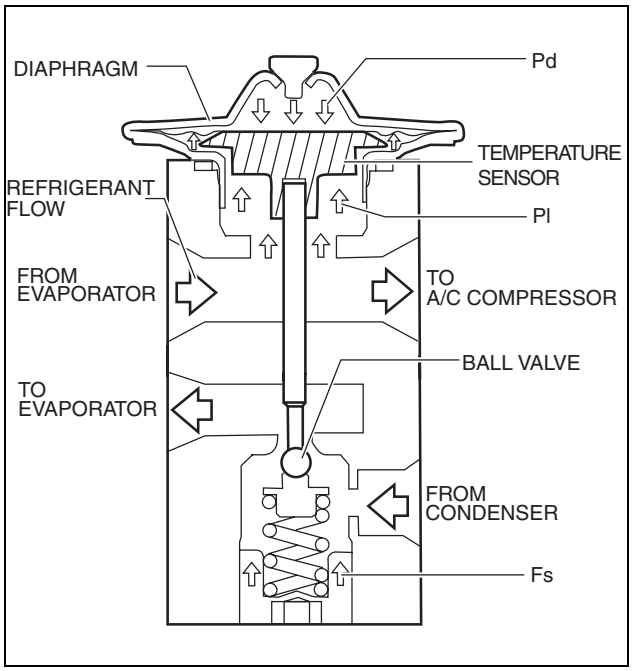
ac5wzn00000768

Operation

- Adjustment of the refrigerant amount supplied to the evaporator is performed by the ball valve opening angle in the expansion valve.

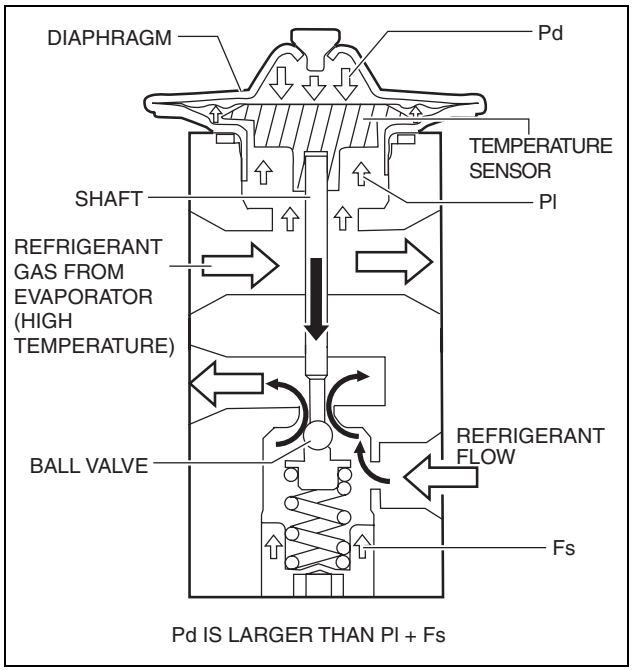
BASIC SYSTEM

- The opening angle adjustment is performed according to the balance of the following forces:
  - — Refrigerant pressure (Pd) in diaphragm
  - — Refrigerant gas pressure (PI) of evaporator under diaphragm
  - — Spring force (Fs) pushing up ball valve



ac5wzn00000769

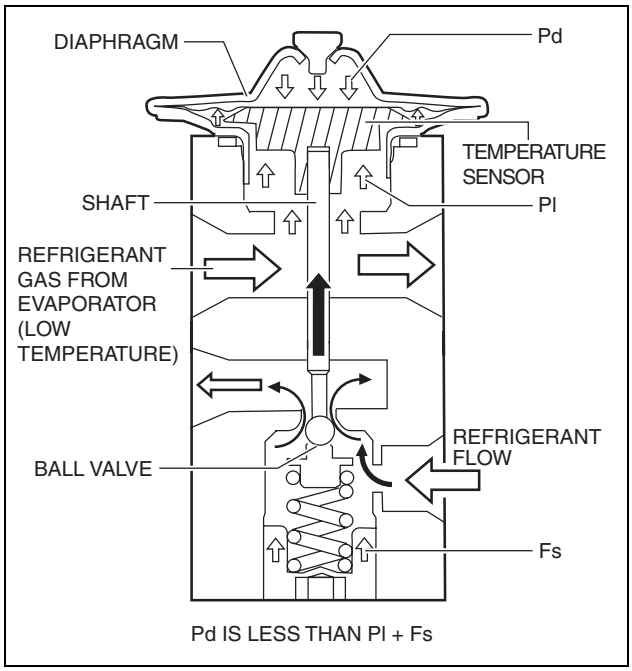
- If the refrigerant gas temperature from the evaporator increases, the expansion valve increases the amount of refrigerant according to the following operations:
  1. The temperature of the temperature sensor tightly sealed against the diaphragm increases.
  2. The refrigerant in the diaphragm warms and the Pd increases.
  3. If this Pd increases more than PI + Fs, the diaphragm is pressed down.
  4. The shaft installed to the temperature sensor end presses down the ball valve.
  5. The amount of refrigerant is increased.



ac5wzn00000770

BASIC SYSTEM

- If the refrigerant gas temperature from the evaporator decreases, the expansion valve decreases the amount of refrigerant flow according to the following operation:
  1. The temperature of the temperature sensor tightly sealed against the diaphragm decreases.
  2. The refrigerant temperature in the diaphragm decreases and the Pd decreases.
  3. The Pd decreases less than PI + Fs.
  4. The ball valve installed to the temperature sensor end is pressed up.
  5. The amount of refrigerant is decreased.



ac5wzn00000771

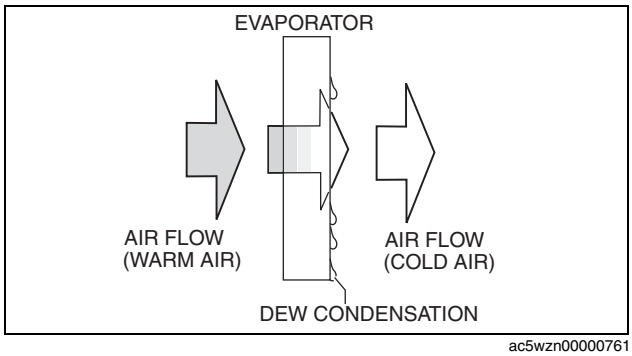
Fail-safe
- Function not equipped.

EVAPORATOR

id071100290100

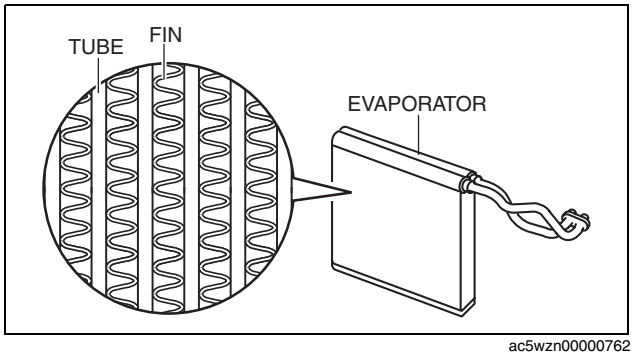
Purpose
- The evaporator cools the passing air.

Function
- The evaporator vaporizes the atomized refrigerant flowing internally, and the air passing through the evaporator is cooled by the release of latent heat. The moisture in the air is condensed at this time and dehumidified air is blown into the cabin.



ac5wzn00000761

Construction
- The evaporator consists of the tube which passes refrigerant, and the heat radiation fin.



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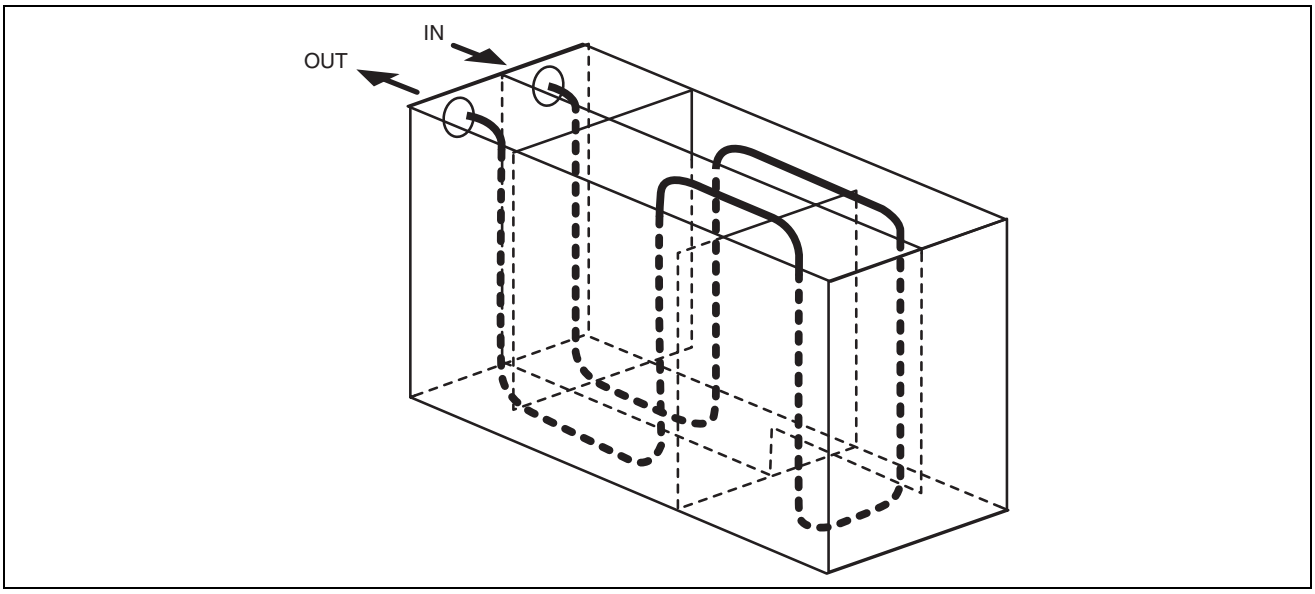
BASIC SYSTEM

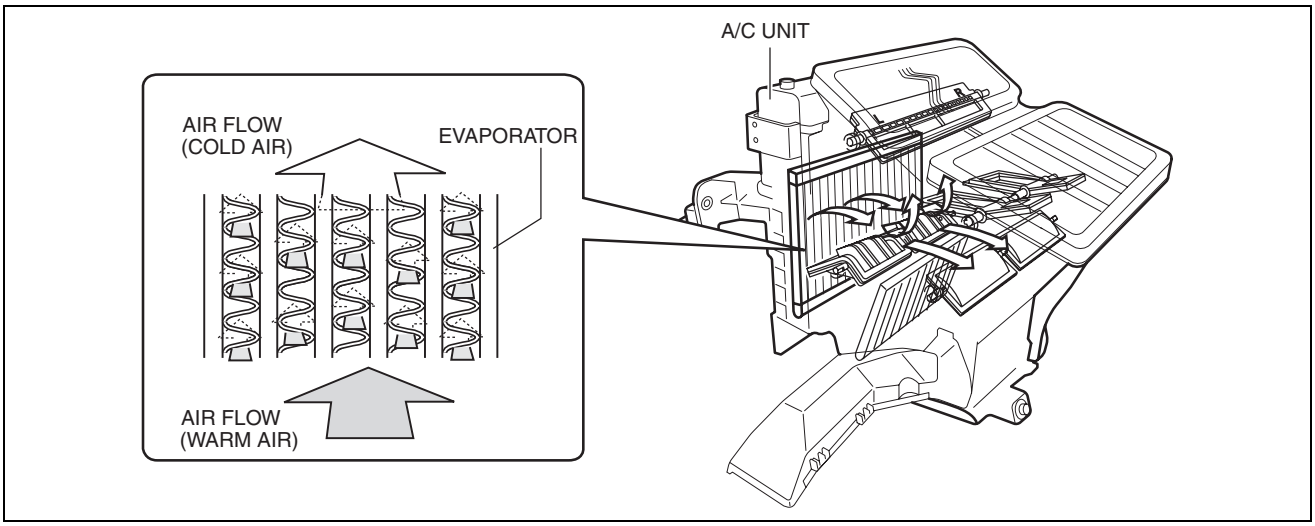
- The cooling medium flow pattern shown in the figure has been adopted for the evaporator.



ac5wzn00000763

Operation

- The atomized refrigerant sent from the expansion valve is captured by heat from the outside. As a result, the evaporator is cooled.
- The air blown by the blower motor is cooled by heat exchange when it passes the heat radiation fin of the heater core.



ac5wzn00000764

Fail-safe

- Function not equipped.

HEATER CORE

id071100290200

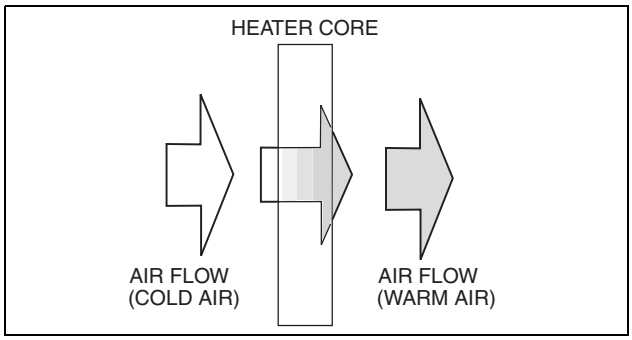
Purpose

- The heater core heats passing air.

Function

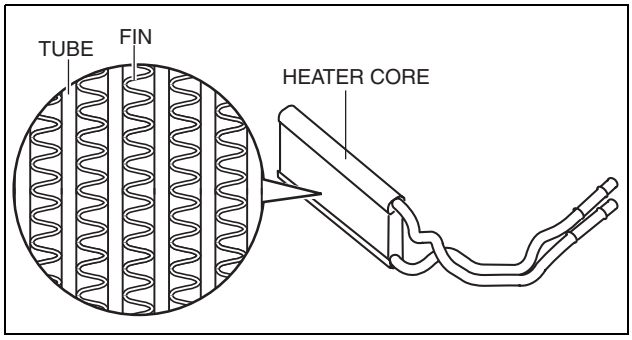
- A portion of the engine coolant is taken into the heater core to heat the air passing through the heater core.

BASIC SYSTEM



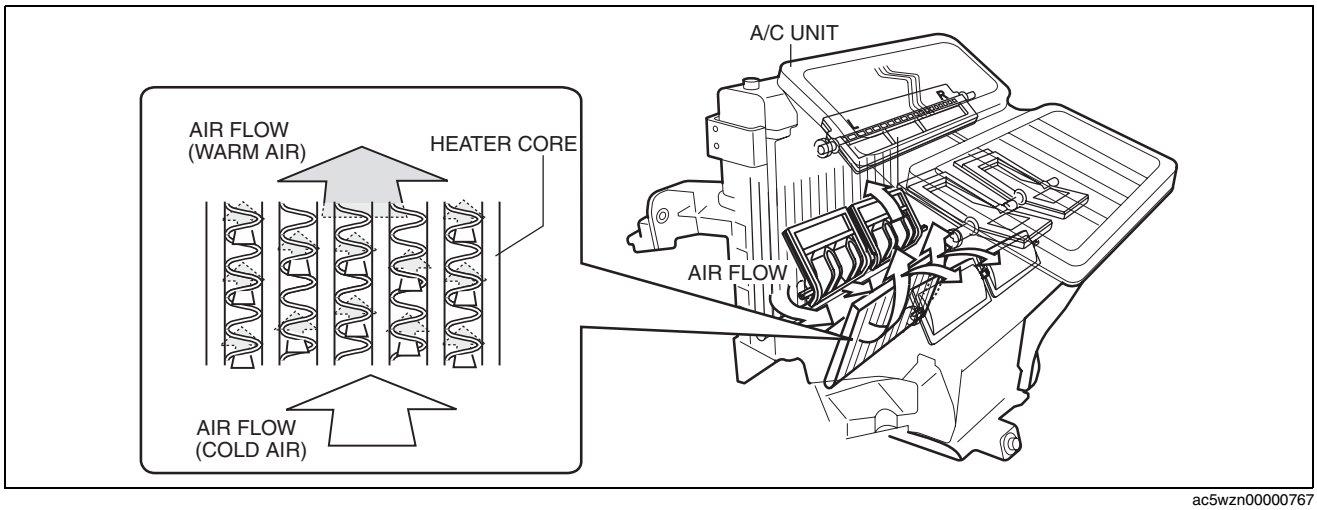
ac5wzn00000765

Construction
- The heater core consists of a tube which passes engine coolant, and the heat radiation fin.



ac5wzn00000766

Operation
- The engine coolant warmed by the engine heat is sent to the heater core.
- The air blown by the blower motor is warmed up by heat exchange when it passes through the heat radiation fin of the heater core.



ac5wzn00000767

Fail-safe
- Function not equipped.

A/C COMPRESSOR

id071100310400

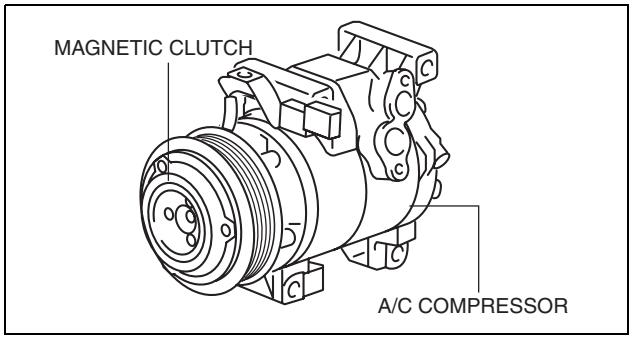
Purpose
- The A/C compressor circulates the refrigerant in the refrigerant cycle.
- The A/C compressor compresses the gaseous refrigerant atomized by the evaporator, and by pressurizing the gaseous refrigerant, liquification by the condenser is facilitated.

Function
- The A/C compressor compresses the gaseous refrigerant by driving the piston in the compressor using the drive force from the engine. In addition, it sends the compressed refrigerant to the condenser.

BASIC SYSTEM

Construction

- The A/C compressor has adopted a swash plate type compressor.
- The A/C compressor consists of the following parts:
  - — Shaft
  - — Swash plate
  - — Cylinder
  - — Piston

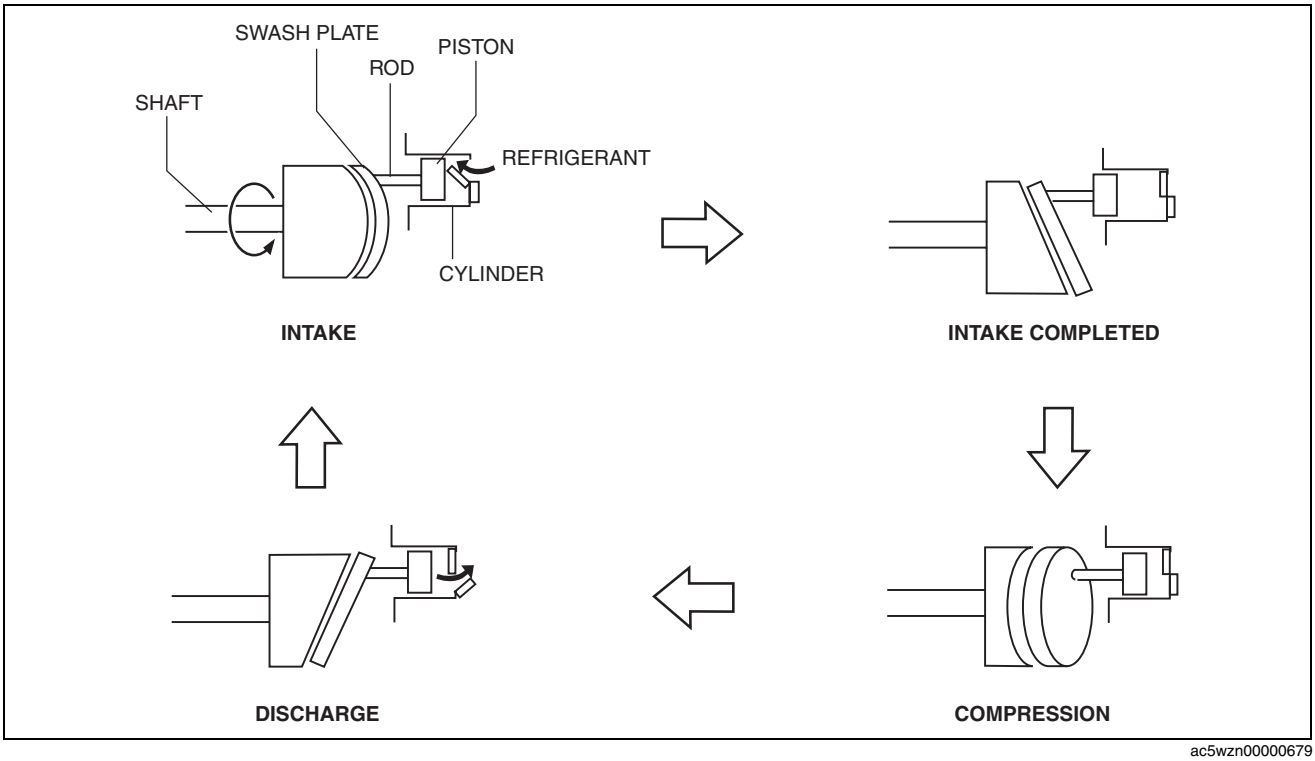


ac5wzn00000678

Operation

- When the drive force from the engine is transmitted to the compressor shaft by the operation of the magnetic clutch, the A/C compressor rotates the swash plate in the compressor. The rotation of the swash plate generates compression in the cylinder by the reciprocating movement of the piston.

1. When the piston moves downward, the suction valve opens and the refrigerant is discharged to the cylinder.
2. When the piston reaches the BDC, refrigerant charging is completed and the suction valve is closed.
3. When the piston moves upward, the refrigerant in the cylinder is compressed.
4. The compressed refrigerant presses open the discharge valve, and the high-temperature, highly pressurized refrigerant from the cylinder is discharged.



ac5wzn00000679

Fail-safe

- Function not equipped.

CONDENSER

id071100310500

Purpose

- The condenser cools the high-temperature, highly pressurized refrigerant.

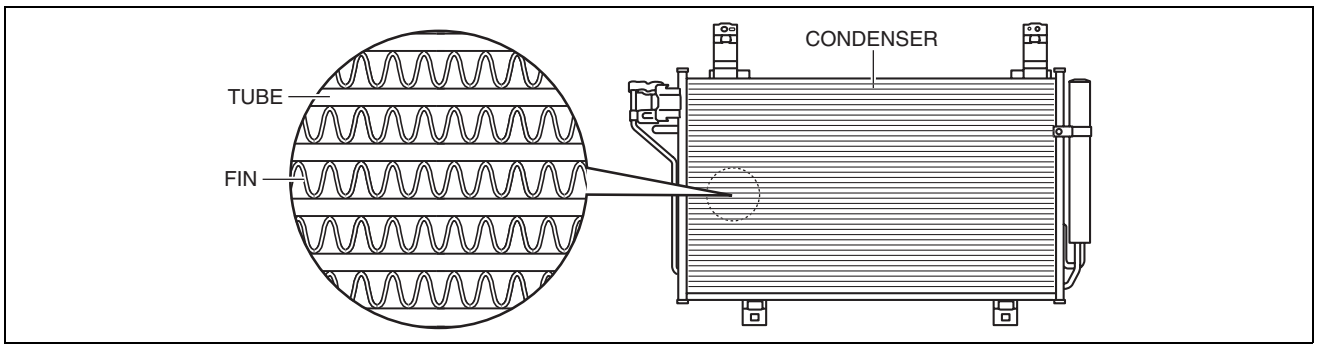
Function

- The condenser cools the high-temperature, highly pressurized gaseous refrigerant compressed by the A/C compressor using the outside air, and changes it to liquid refrigerant.

BASIC SYSTEM

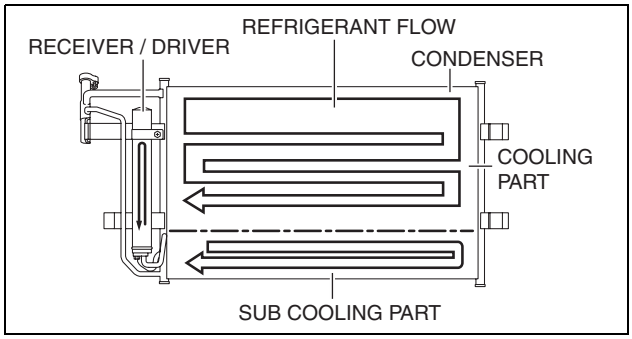
Construction

- The condenser is installed to the front of the radiator.
- The condenser consists of the tube which passes refrigerant, and the heat radiation fin.



ac5wzn00000680

- A sub-cooling condenser has been adopted.
- The sub-cooling condenser is integrated with the multi-flow condenser and the receiver driver.
- The sub-cooling condenser separates the refrigerant, cooled once by the condenser, into vapor and liquid using the receiver/drier, and by returning it to the sub-cooling part of the condenser again to cool.
- As a result, liquefaction of the refrigerant is promoted and cooling performance is improved.



ac5wzn00000681

Operation

- The high-temperature, highly pressurized gaseous refrigerant sent from the A/C compressor passes through the tube in the condenser.
- When the air blown from the outside is exposed to the heat radiation fin, the heat of the refrigerant is captured by heat exchange, and the refrigerant changes from a gas to a liquid.
- The liquid refrigerant is sent to the expansion valve via the receiver/drier.

Fail-safe

- Function not equipped.

RECEIVER/DRIER

id071100290400

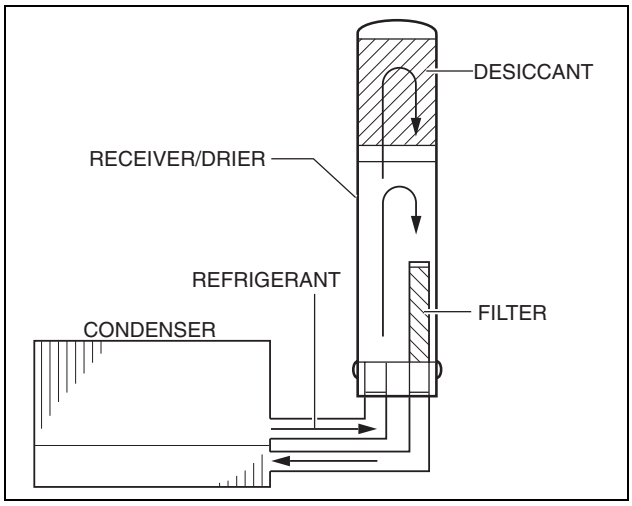
Purpose

- The receiver/drier supplies a stable amount of purified, complete liquid refrigerant to the expansion valve.

BASIC SYSTEM

Function

- The receiver/drier temporarily stores refrigerant and extracts only liquid refrigerant. As a result, outflow to the expansion valve of refrigerant, which could not be liquefied completely by the condenser, is prevented, and the discharge pulsation of the A/C compressor is stopped.
- The refrigerant is purified and moisture is eliminated by desiccant in the receiver/drier and strainer.



ac5wzn00000772

Fail-safe

- Function not equipped.

REFRIGERANT LINE

id071100310600

Purpose

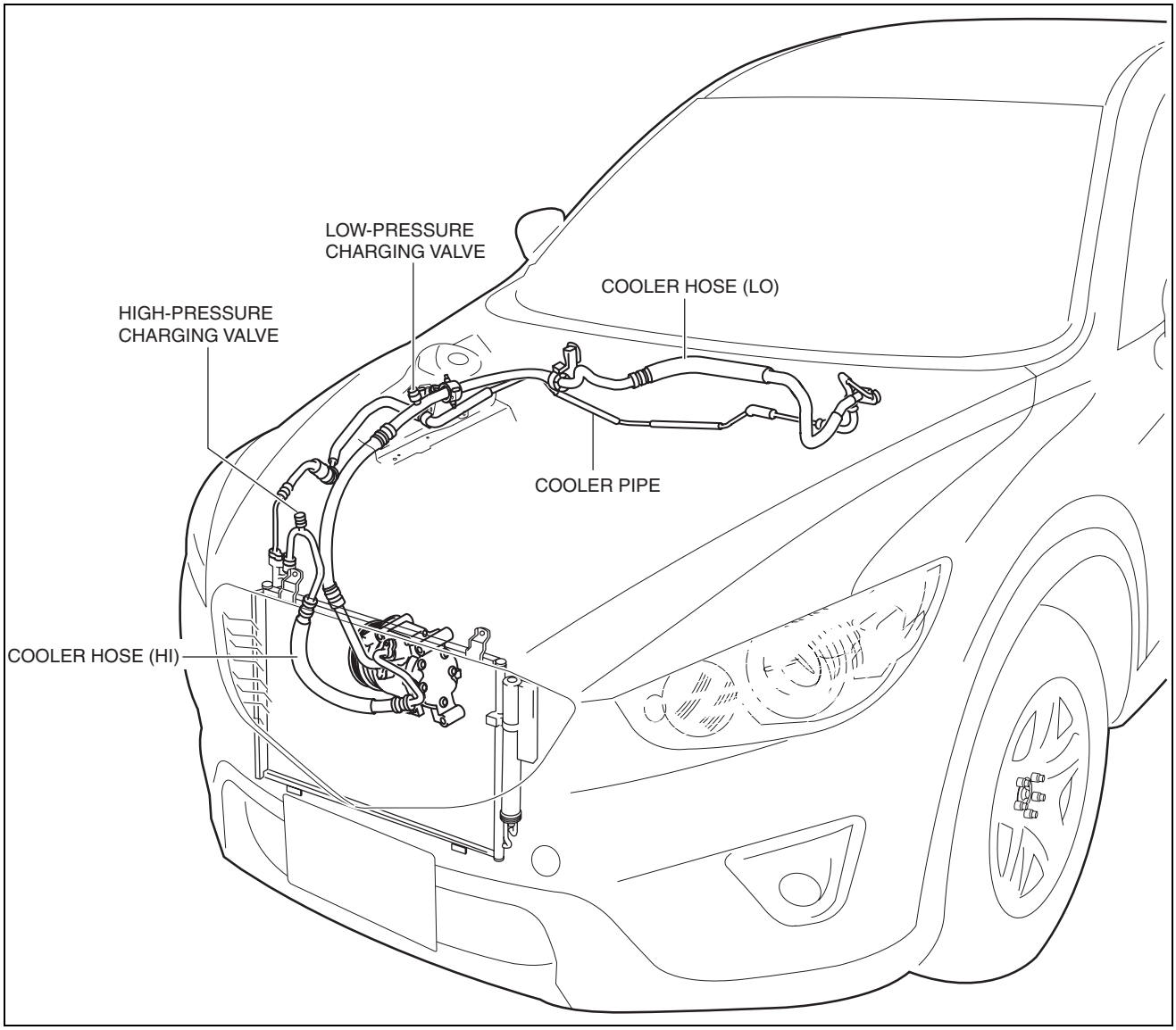
- The system piping connects each related part of the refrigerant system.

Construction

- Block-type piping has been adopted to the pipe connection, improving the efficiency of piping related servicing.
- The pipes in the piping system consist of the following parts.
  - — Cooler hose (HI)
  - — Cooler hose (LO)
  - — Cooler pipe
- The pipes in the piping system are made of aluminum alloy and the hoses are made of rubber (flexible hose).
- A high-pressure charging valve is located on the cooler pipe (HI) and a low-pressure charging valve is located on the cooler pipe (LO).

BASIC SYSTEM

R.H.D.
SKYACTIV-G 2.0



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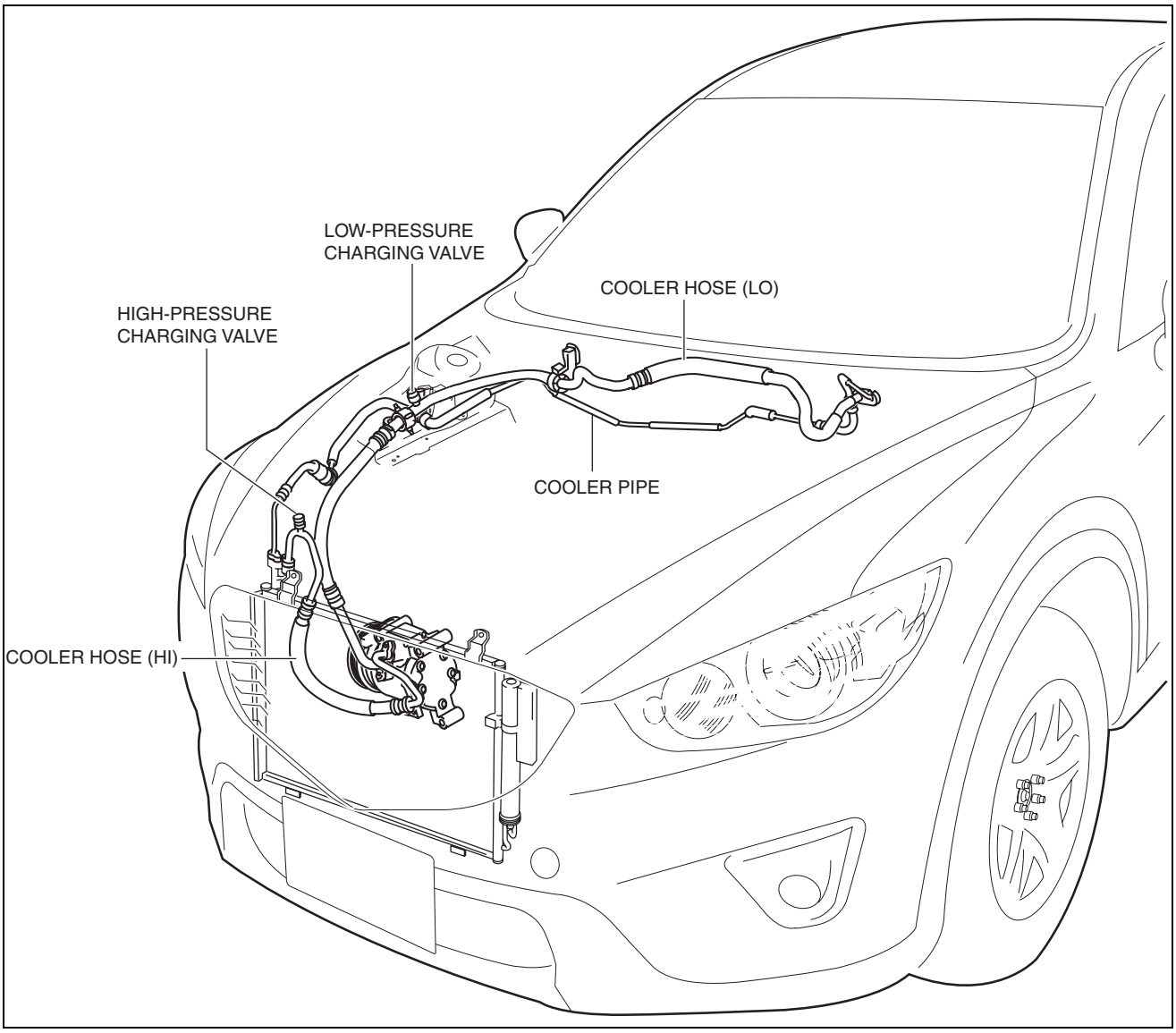
BASIC SYSTEM

SKYACTIV-D 2.2



ac5wzn00000685

Fail-safe

- Function not equipped.

07-40A CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

id0740a1126500

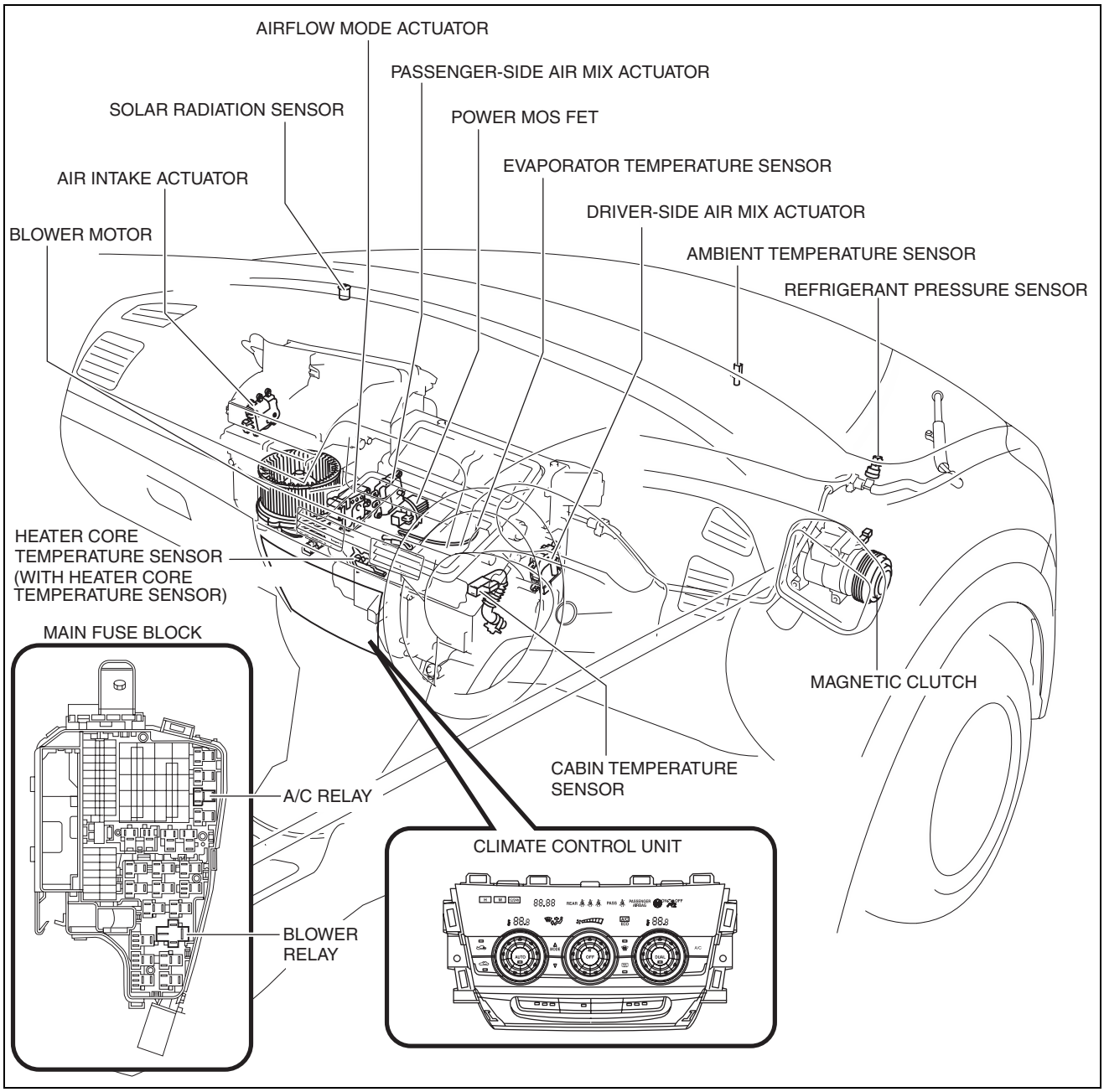
Outline

- Refrigerant pressure sensor adopted in which refrigerant pressure is changed into a linear electric signal and precise information is transmitted.
- MS-CAN for communication between the instrument cluster and climate control unit adopted.
- Climate control unit with enlarged operation dials and switches adopted.
- A climate control unit with an integrated display panel has been adopted.
- A PTC heater has been adopted to temporarily improve the A/C unit heating performance for diesel engine vehicles which have good thermal efficiency (with PTC heater).
- An electric water pump has been adopted which assists with the engine coolant circulation (with water pump).

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Structural View

R.H.D.



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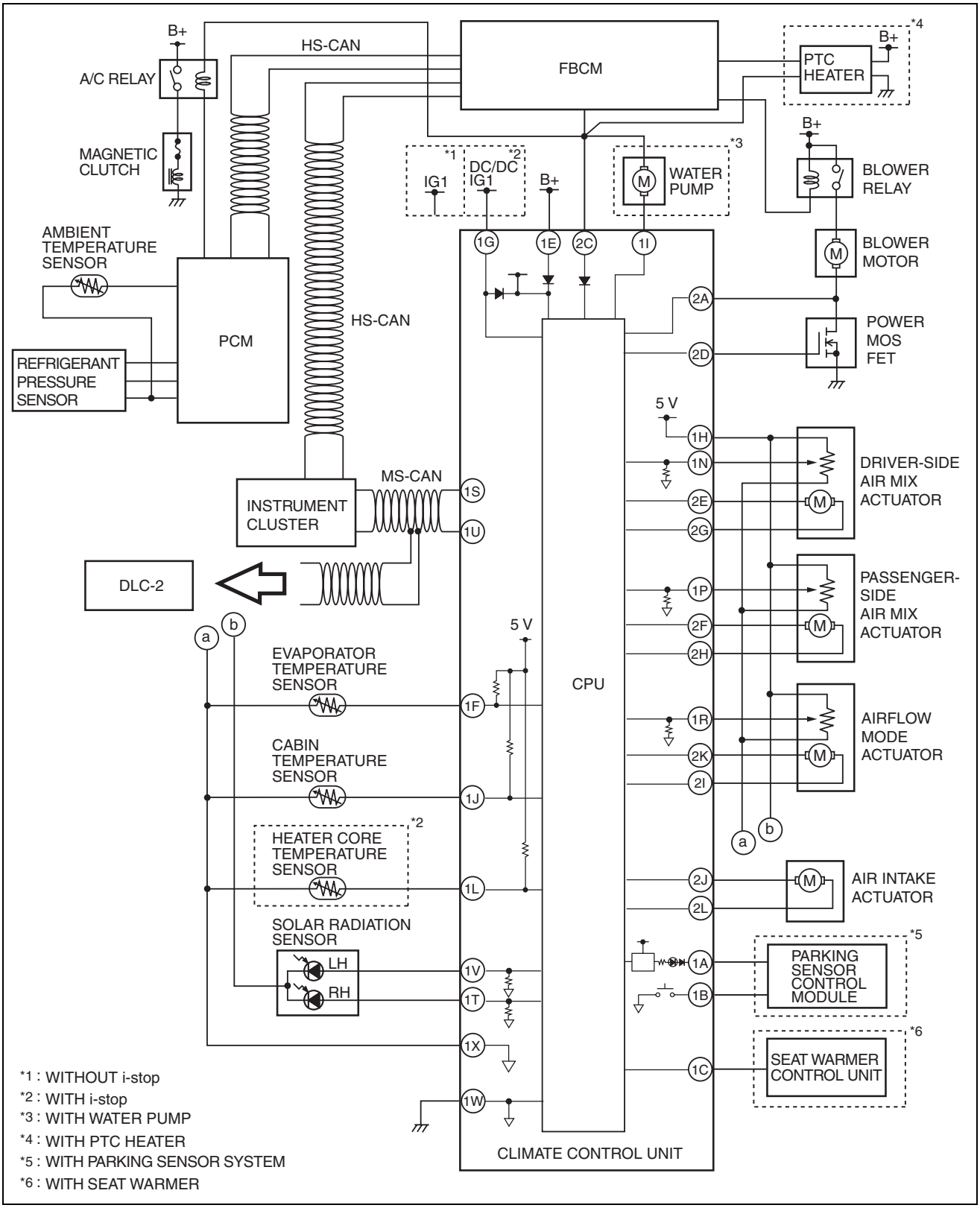
CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

System Wiring Diagram



ac5wzw0000276

AIR INTAKE ACTUATOR [FULL-AUTO AIR CONDITIONER]

id0740a1320400

Purpose

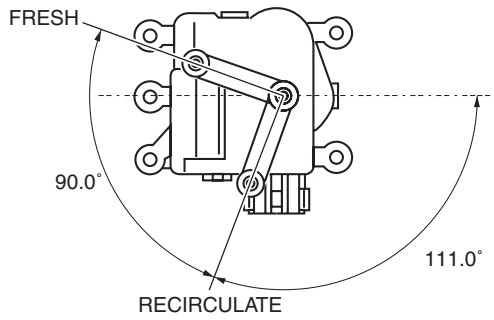
- The air intake actuator moves the air intake door in the blower unit to switch the air intake port.

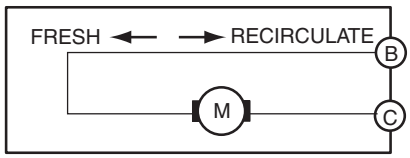
CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Function

- The air intake actuator drives the motor based on the signal from the climate control unit and moves the air intake door to the FRESH or REC position.

R.H.D.





ac5wzn00000712

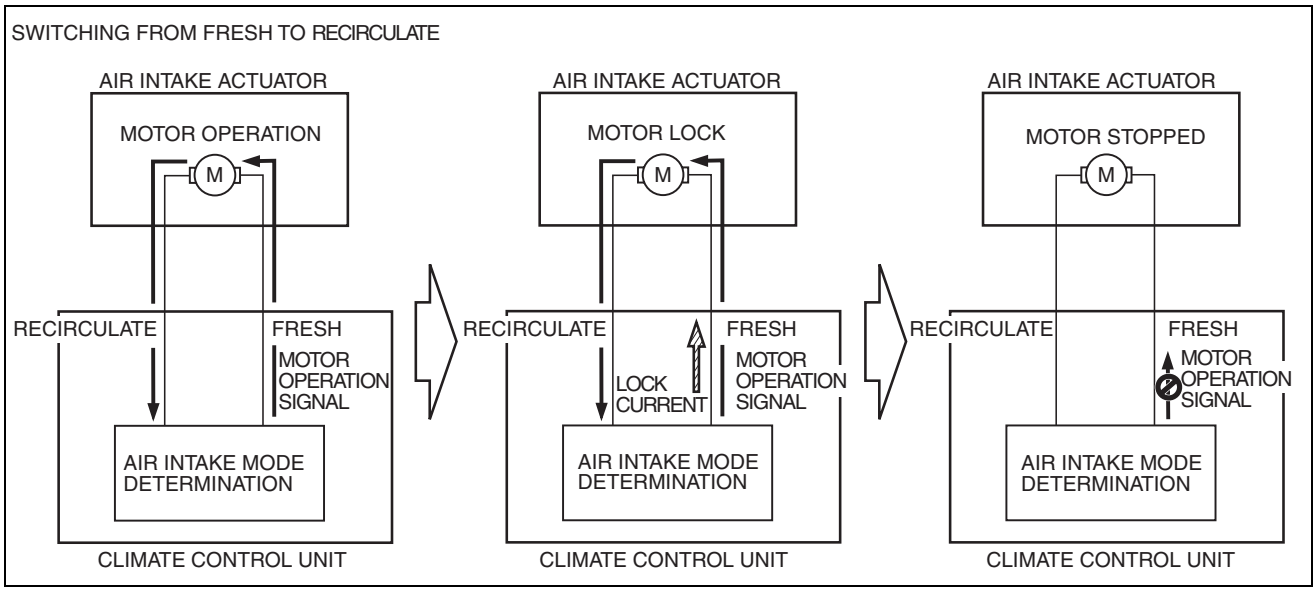
Construction

- A mechanical lock type air intake actuator has been adopted.
- The air intake actuator is installed to the blower unit.

Operation

1. The climate control unit outputs a motor drive signal to the air intake actuator based on the air intake mode determined by the air intake control.
2. When the air intake actuator moves to FRESH or REC, the motor locks.
3. When the motor locks and is under excessive load, the current value flowing from the climate control unit increases more than the specification (lock current).
4. When the lock current is detected, the climate control unit stops the motor drive signal to the air intake actuator.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



ac5wzn00000713

Fail-safe
- Function not equipped.

AIR MIX ACTUATOR [FULL-AUTO AIR CONDITIONER]

id0740a1320600

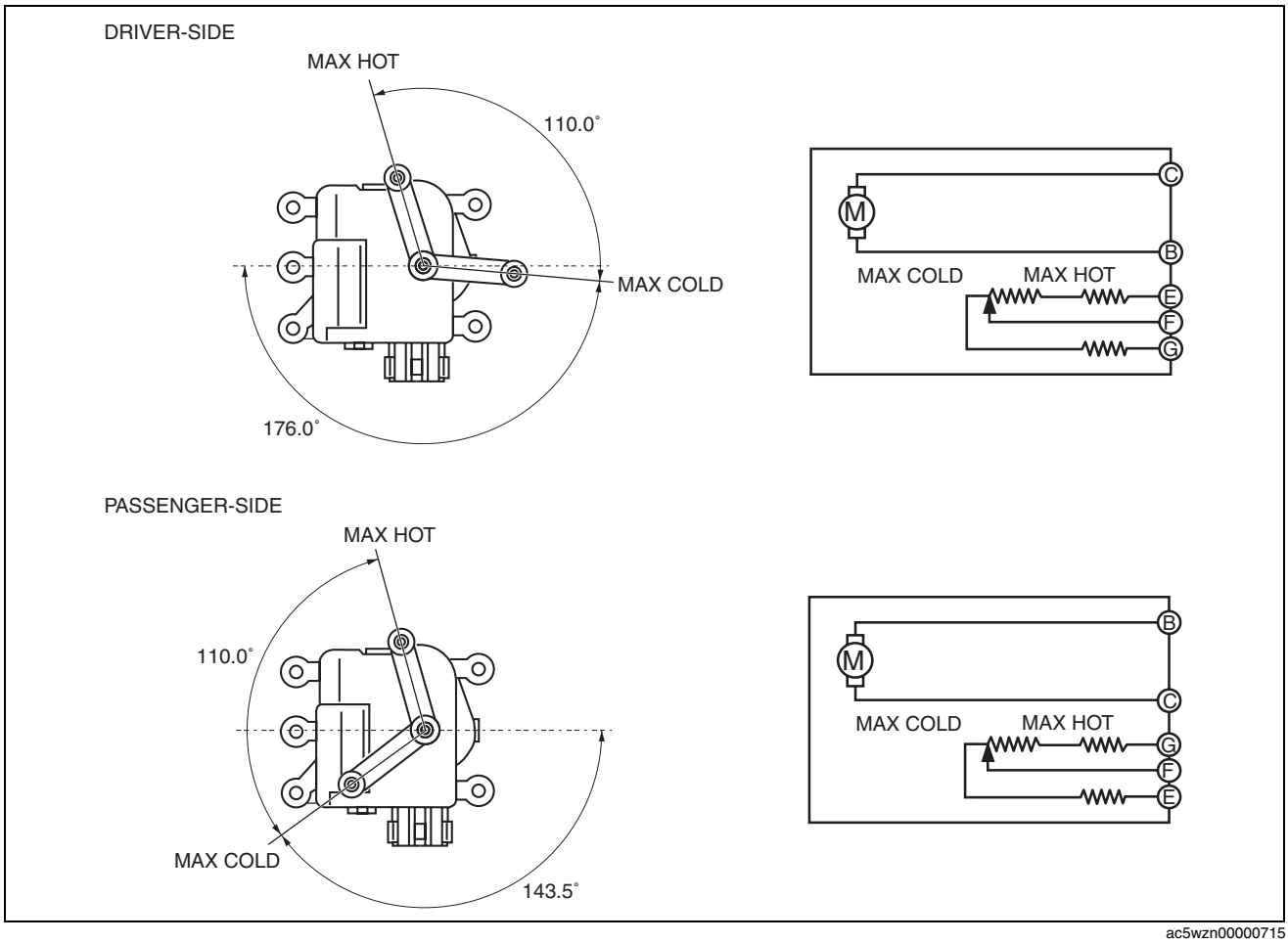
Purpose
- The air mix actuator moves the air mix door in the A/C unit to adjust the temperature of the air blown from the air vent.

Function
Door open/close function
- The air mix actuator drives the motor based on the signals from the climate control unit and moves the air mix door in the HOT or COLD direction.

Door position detection function
- The air mix actuator detects the change in the air mix door position using the potentiometer in conjunction with the motor drive, and gives feedback to the climate control unit based on electric signals.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

R.H.D.



ac5wzn00000715

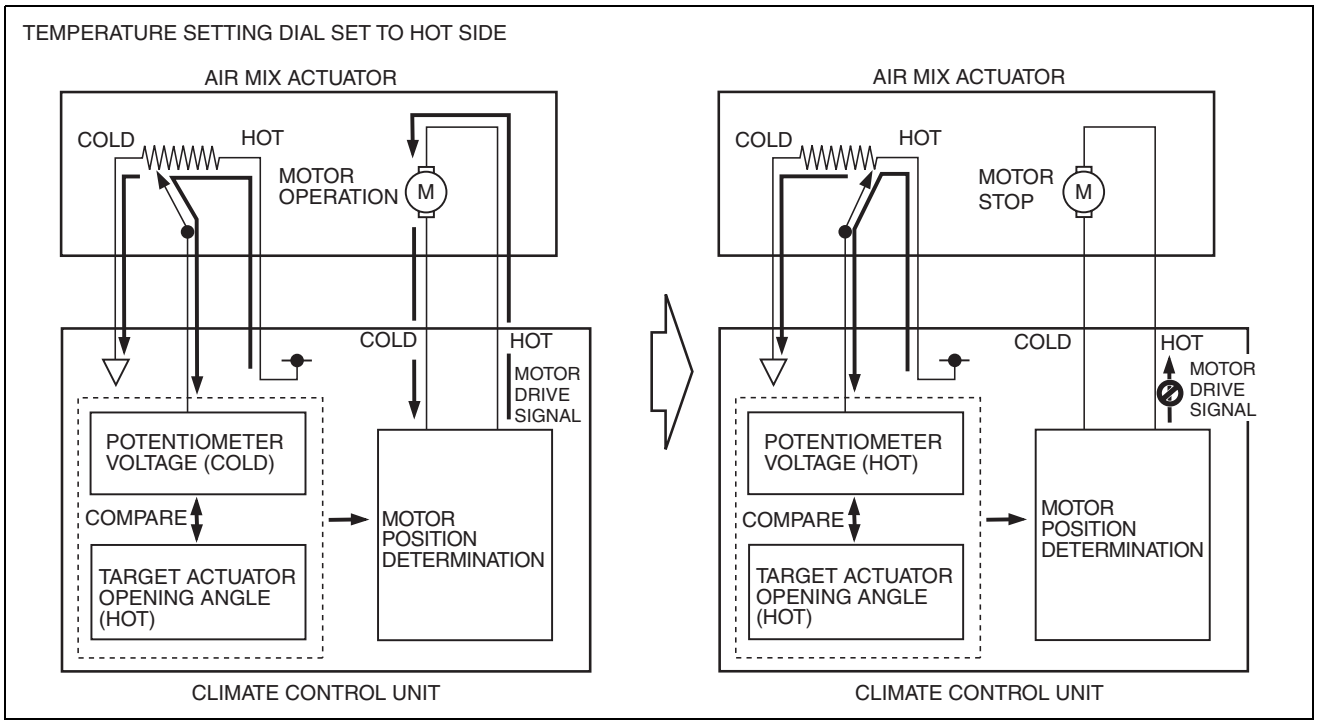
Construction

- A potentiometer-type air mix actuator has been adopted.
- The air mix actuator is installed to both the driver and front passenger sides in the A/C unit.

Operation

1. The climate control unit calculates the target air mix actuator opening angle (target actuator opening angle) according to the airflow temperature control.
2. The climate control unit detects the current air mix actuator opening angle based on the voltage detected by the potentiometer in the air mix actuator.
3. The climate control unit compares the target actuator opening angle with the voltage from the potentiometer.
4. When the voltage detected by the potentiometer differs from the target actuator opening angle, the climate control unit outputs a motor drive signal to the air mix actuator.
5. When the voltage detected by the potentiometer is equal to the target actuator opening angle, the climate control unit stops the motor drive signal to the air mix actuator.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



ac5wzn00000716

Fail-safe
- Function not equipped.

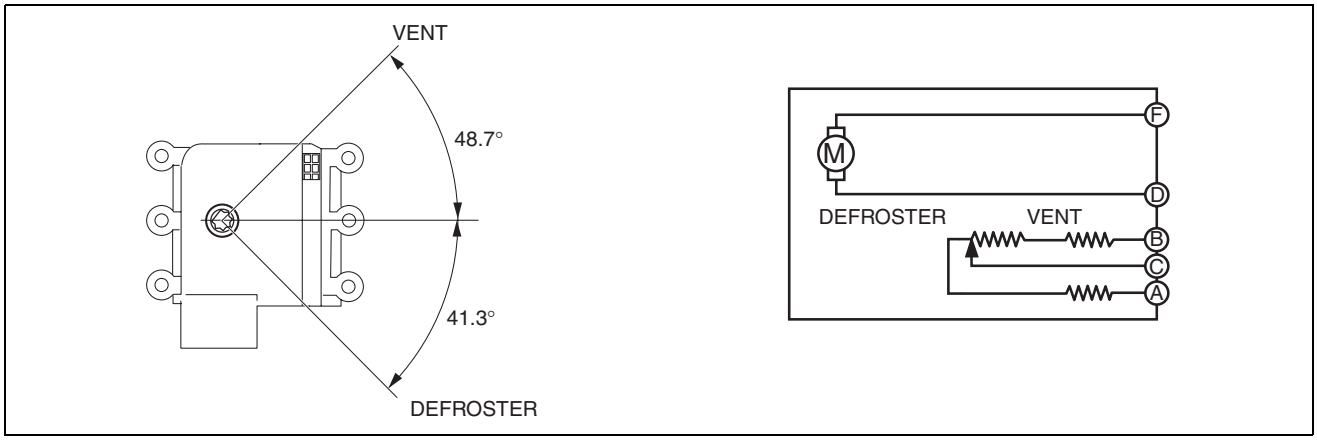
AIRFLOW MODE ACTUATOR [FULL-AUTO AIR CONDITIONER]

id0740a1320700

Purpose
- The airflow mode actuator moves the mode door in the A/C unit to switch the air vent.

Function
Door open/close function
- The airflow mode actuator drives the motor based on the signal from the climate control unit and moves the mode door to the VENT, BI-LEVEL, HEAT, DEF/HEAT, or DEFROSTER position.

Door position detection function
- The airflow mode actuator detects the changes in the mode door position using the potentiometer in conjunction with the motor drive and gives feedback to the climate control unit based on the electric signals.



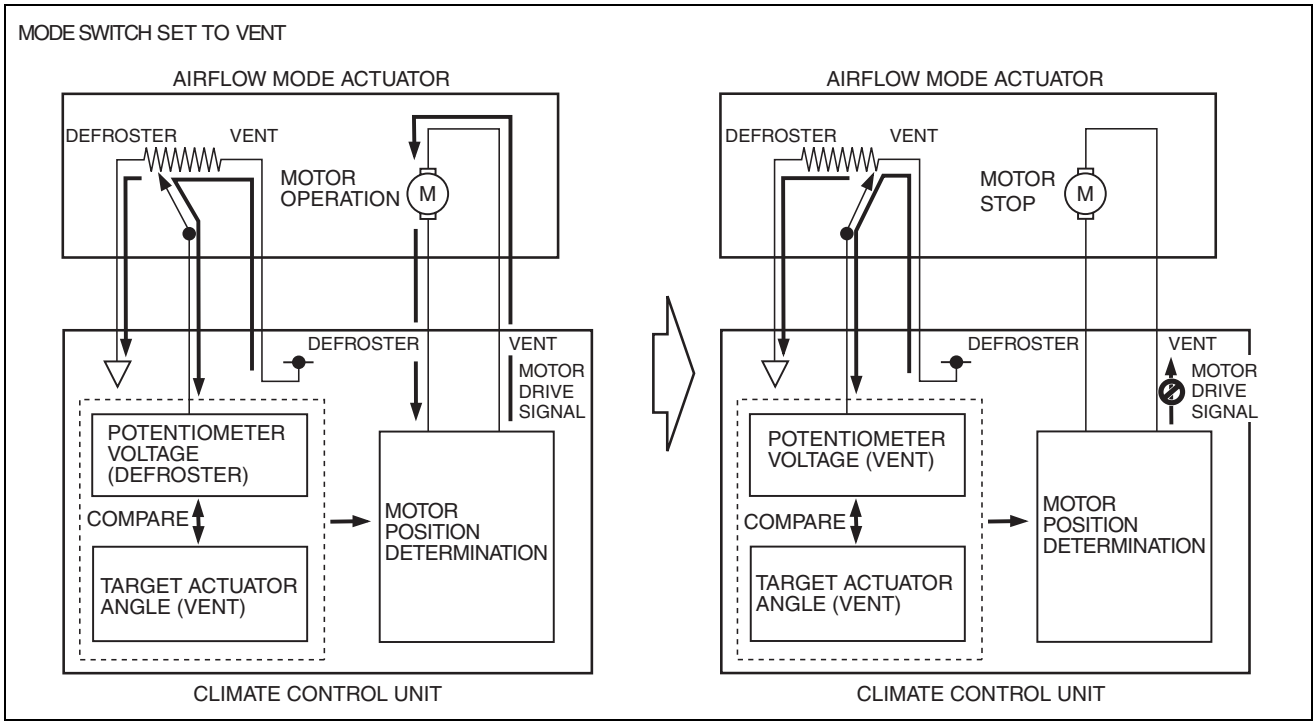
ac5wzn00000717

Construction
- A potentiometer-type airflow mode actuator has been adopted.
- The airflow mode actuator is installed to the passenger's side in the A/C unit.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Operation

1. The climate control unit determines the airflow mode actuator target voltage based on the mode position determined by the airflow mode control.
2. The climate control unit compares the voltage detected by the potentiometer in the airflow mode actuator with the target voltage.
3. When the voltage detected by the potentiometer differs from the target voltage, the climate control unit outputs a motor drive signal.
4. When the voltage detected by the potentiometer is equal to the target voltage, the climate control unit stops the motor drive signal to the airflow mode actuator.



ac5wzn00000718

Fail-safe

- Function not equipped.

BLOWER MOTOR [FULL-AUTO AIR CONDITIONER]

id0740a1320800

Purpose

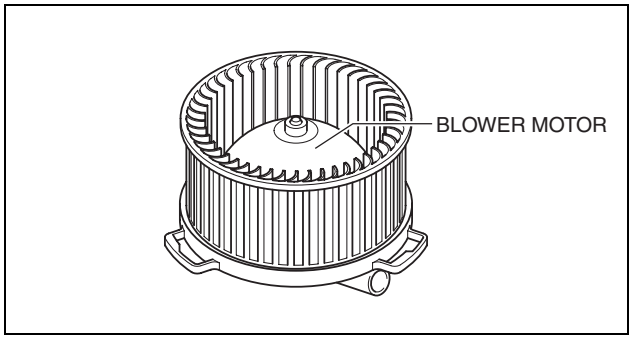
- The blower motor sends airflow into the cabin.

Function

- The blower motor rotates the blower fan to create airflow and sends out the airflow in the blower unit and A/C unit.

Construction

- The blower motor is installed to the blower unit.
- The blower motor consists of the blower fan and motor.
- A sirocco fan has been adopted for the blower fan.

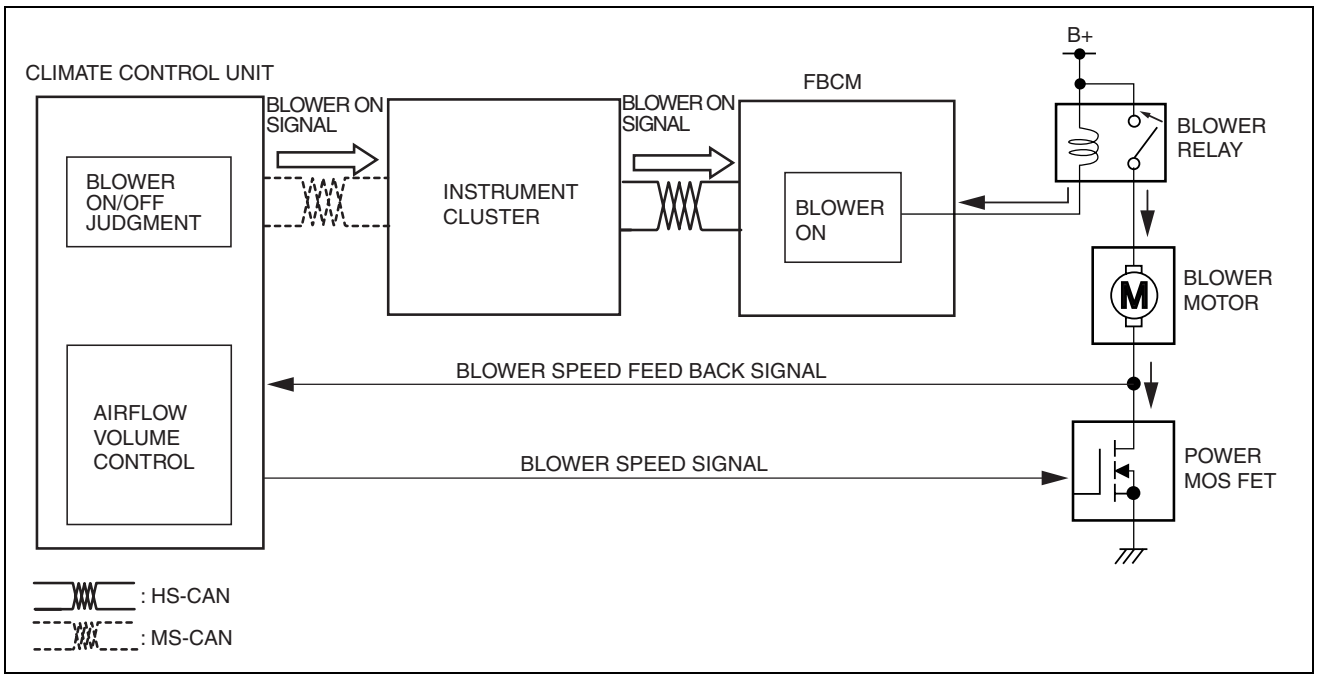


ac5wzn00000719

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Operation

1. The front body control module (FBCM) turns on the blower relay based on the blower ON signal sent from the climate control unit.
2. When the blower relay turns on, the blower motor fan rotates.
3. The rotation speed of the blower fan is determined by the transistor in the power MOS FET. If the current value flowing through the transistor is high, the rotation speed increases, if the current value is low, the speed decreases.



ac5wzn00000720

Fail-safe

- Function not equipped.

MAGNET CLUTCH [FULL-AUTO AIR CONDITIONER]

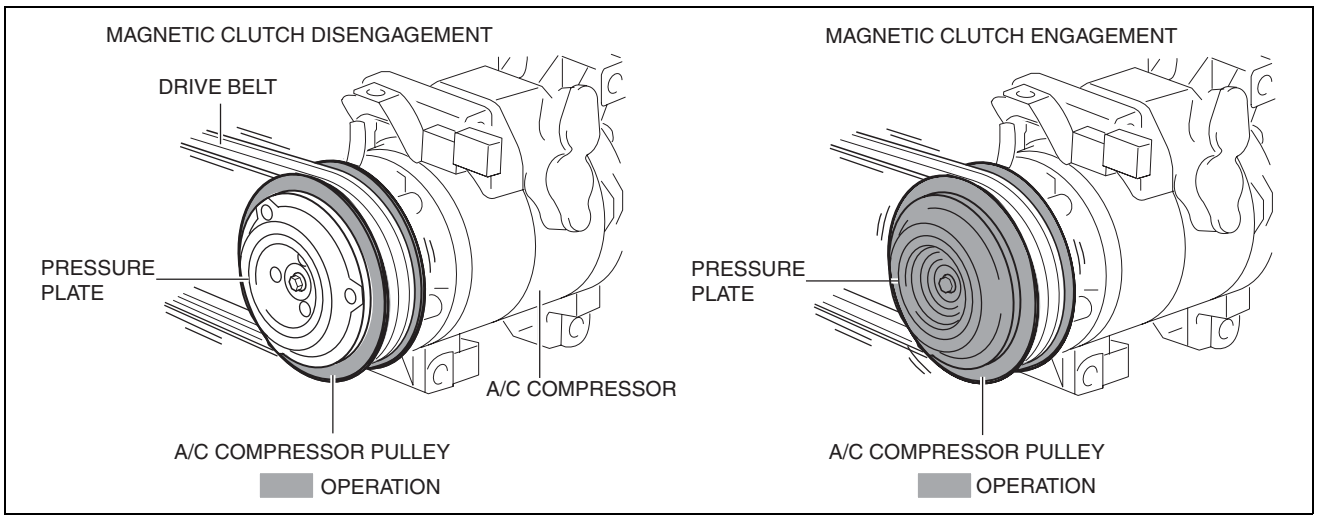
id0740a1320900

Purpose

- The magnetic clutch transmits the rotation force from the engine to the shaft in the A/C compressor.

Function

- The magnetic clutch engages or disengages the magnetic clutch and the A/C turns on or off by switching the power transmission from the engine.

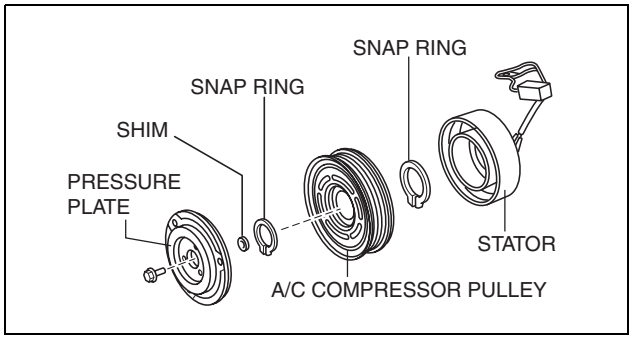


ac5wzn00000721

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Construction

- The magnetic clutch is installed to the A/C compressor.
- The magnetic clutch consists of the following parts:
  - — Pressure plate
  - — A/C compressor pulley
  - — Stator
  - — Snap ring
  - — Shim

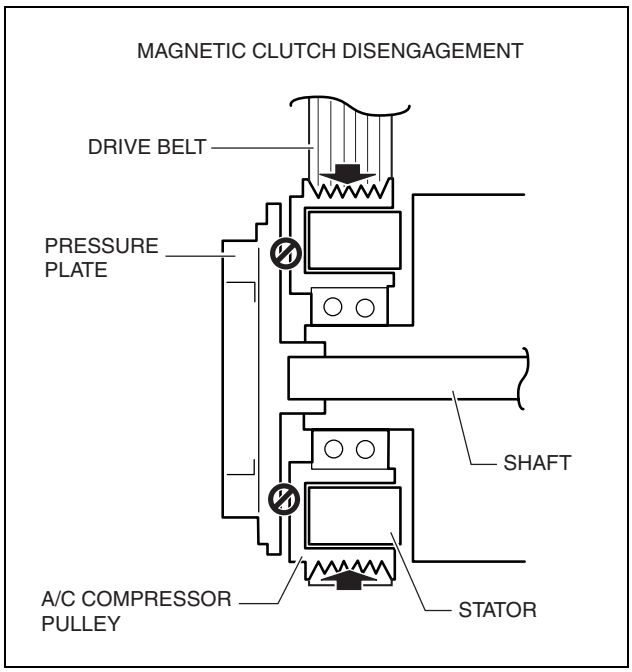


ac5wzn00000722

Operation

Magnetic clutch disengagement

1. If there is no energization in the magnetic clutch stator from the A/C relay, the pressure plate cannot be engaged with the A/C compressor pulley because the magnetic clutch stator does not operate.
2. The rotation force from the drive belt is only transmitted to the A/C compressor pulley and the pulley spins.

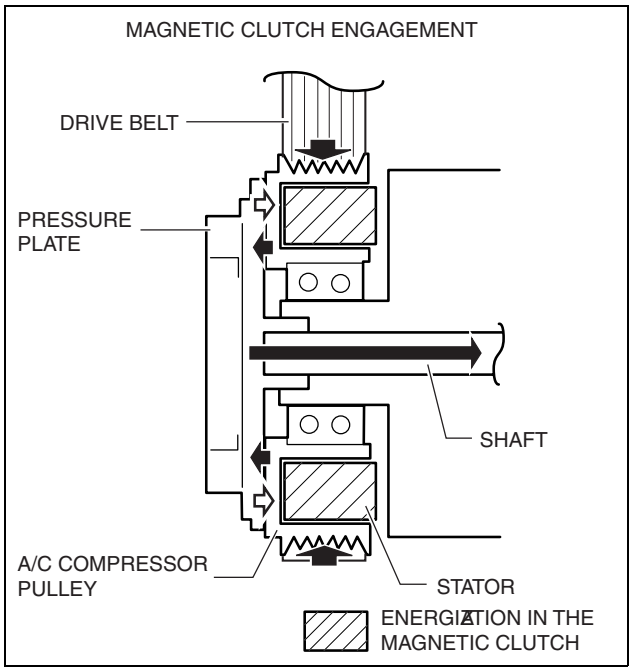


ac5wzn00001235

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Magnetic clutch engagement

1. If there is energization in the magnetic clutch stator from the A/C relay, the magnetic clutch stator operates and the pressure plate is engaged with the A/C compressor pulley.
2. The rotation force from the drive belt is transmitted to the compressor shaft through the pressure plate from the A/C compressor pulley.



ac5wzn00001236

Fail-safe

- Function not equipped.

POWER METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (POWER MOS FET) [FULL-AUTO AIR CONDITIONER]

id0740a1321000

Purpose

- The power MOS FET controls the blower motor rotation speed.

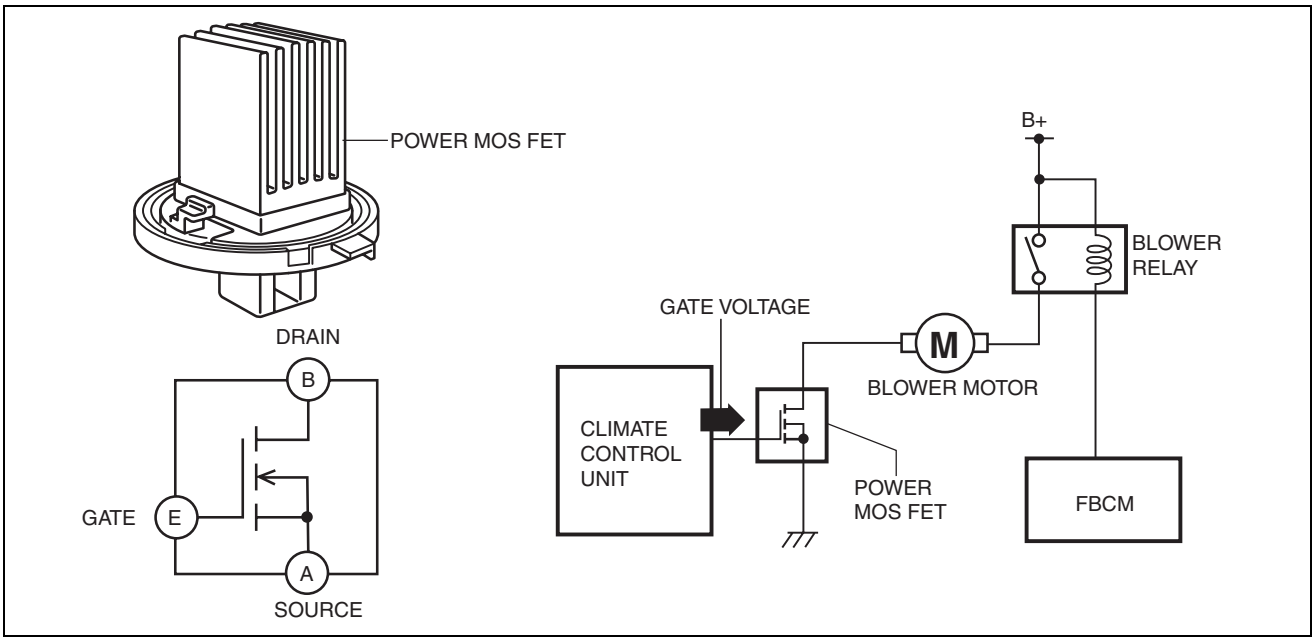
Function

- The power MOS FET controls the supply voltage to the blower motor based on the gate voltage sent from the climate control unit, and adjusts the fan rotation speed (airflow volume)

Construction

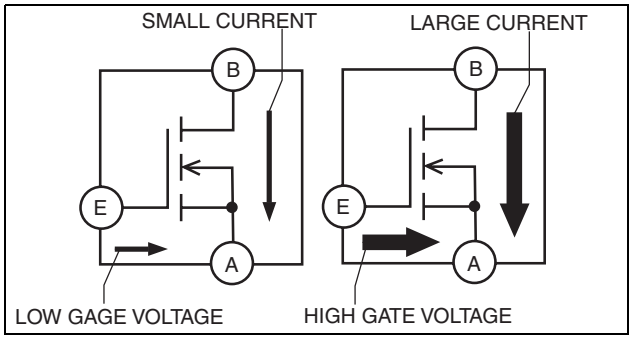
- The power MOS FET is installed to the A/C unit.
- A transistor-type power MOS FET has been adopted and it is equipped with three electrodes, a source, a gate, and a drain.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



Operation

- The resistance between terminals B and A (between drain and source) changes according to the voltage (gate voltage) applied to terminal C (gate).
- When the gate voltage increases, the resistance between terminals B and A decreases, allowing the current to flow easily. Therefore, the blower motor rotation speed increases.
- When the gate voltage decreases, the resistance between terminals B and A increases, making current flow difficult. Therefore, the blower motor rotation speed decreases.



Fail-safe

- Function not equipped.

SOLAR RADIATION SENSOR [FULL-AUTO AIR CONDITIONER]

id0740a1321100

Purpose

- The solar radiation sensor detects the sunlight intensity emitted to the cabin.

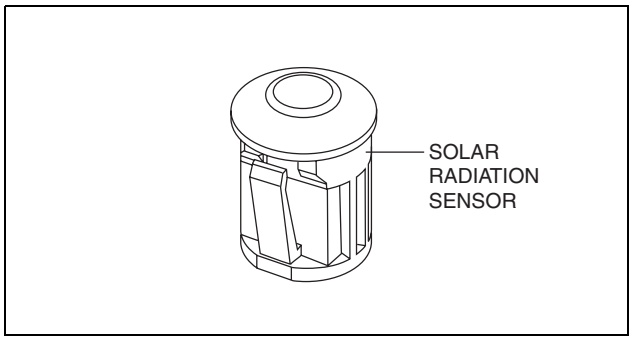
Function

- The solar radiation sensor converts the detected solar radiation amount to an electric signal.

Construction

- A photodiode (light receiving diode) has been adopted for the solar radiation sensor.
- The solar radiation sensor is installed to the passenger's side in the dashboard.

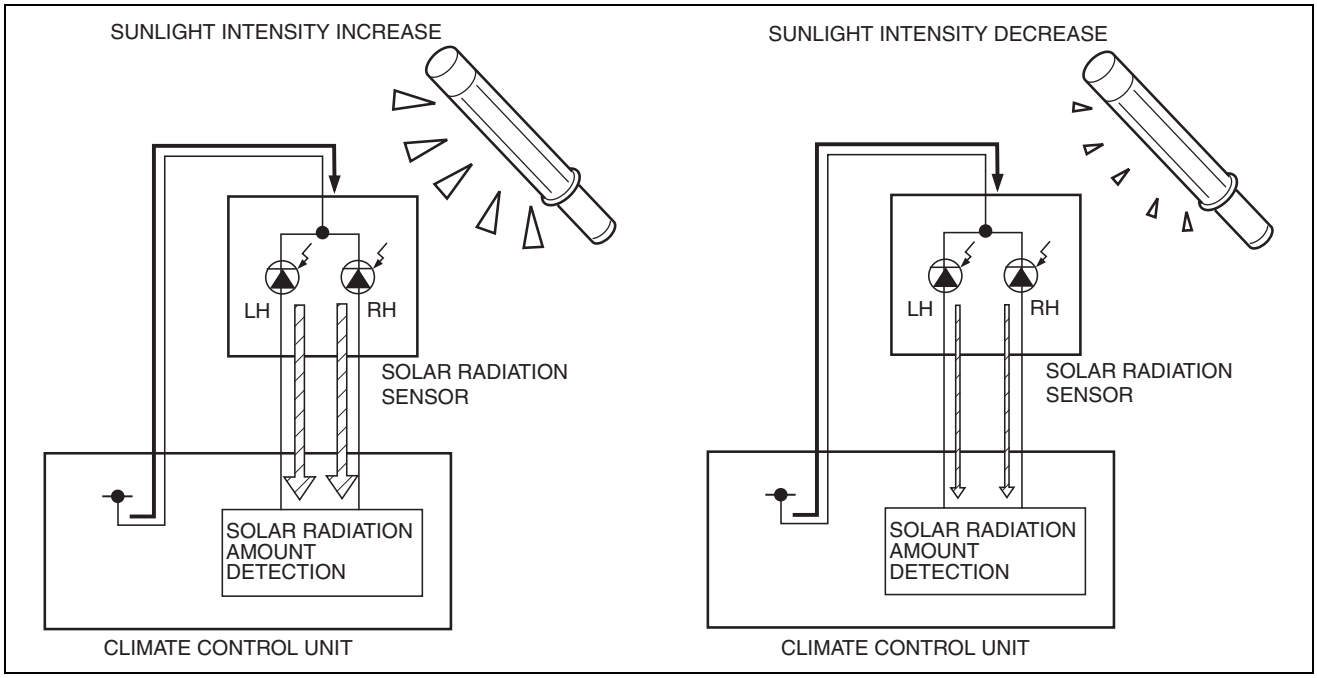
CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



ac5wzn00000726

Operation

- The photodiode (light receiving diode) generates electrical current when light shines on the connecting area of the semiconductor. The generated electrical current increases if the sunlight intensity increases, and conversely decreases if the sunlight intensity decreases.
- The climate control unit determines the sunlight intensity according to the amount of electrical current sent from the solar radiation sensor.



ac5wzn00000727

Fail-safe

- Function not equipped.

AMBIENT TEMPERATURE SENSOR [FULL-AUTO AIR CONDITIONER]

id0740a1321200

Purpose

- The ambient temperature sensor detects the ambient temperature.

Function

- The ambient temperature sensor converts the detected temperature to an electric signal.

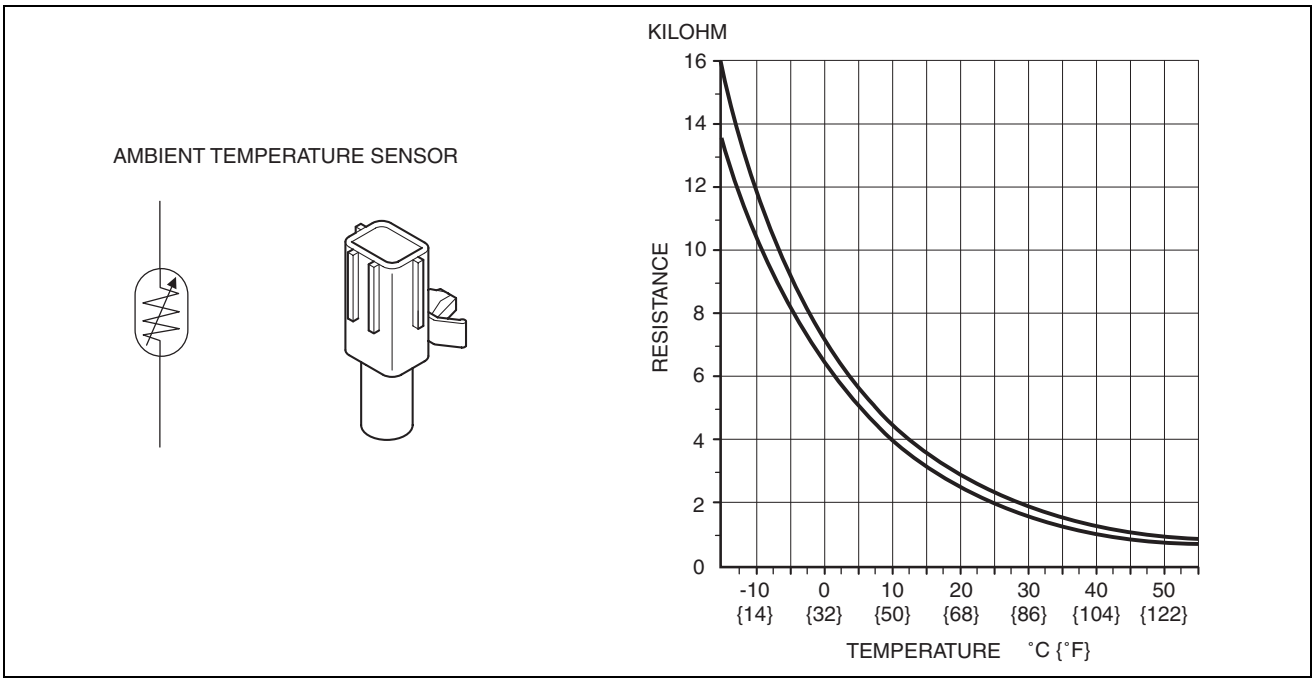
Construction

- A thermistor-type ambient temperature sensor has been adopted.
- The ambient temperature sensor is installed to the shroud panel on the back side of the front bumper.

Operation

- The thermistor changes the resistance according to the surrounding temperature.
- The resistance decreases if the temperature increases, and conversely increases if the temperature decreases as shown in the figure.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



E80000728

Fail-safe
- Function not equipped.

CABIN TEMPERATURE SENSOR [FULL-AUTO AIR CONDITIONER]

id0740a1321300

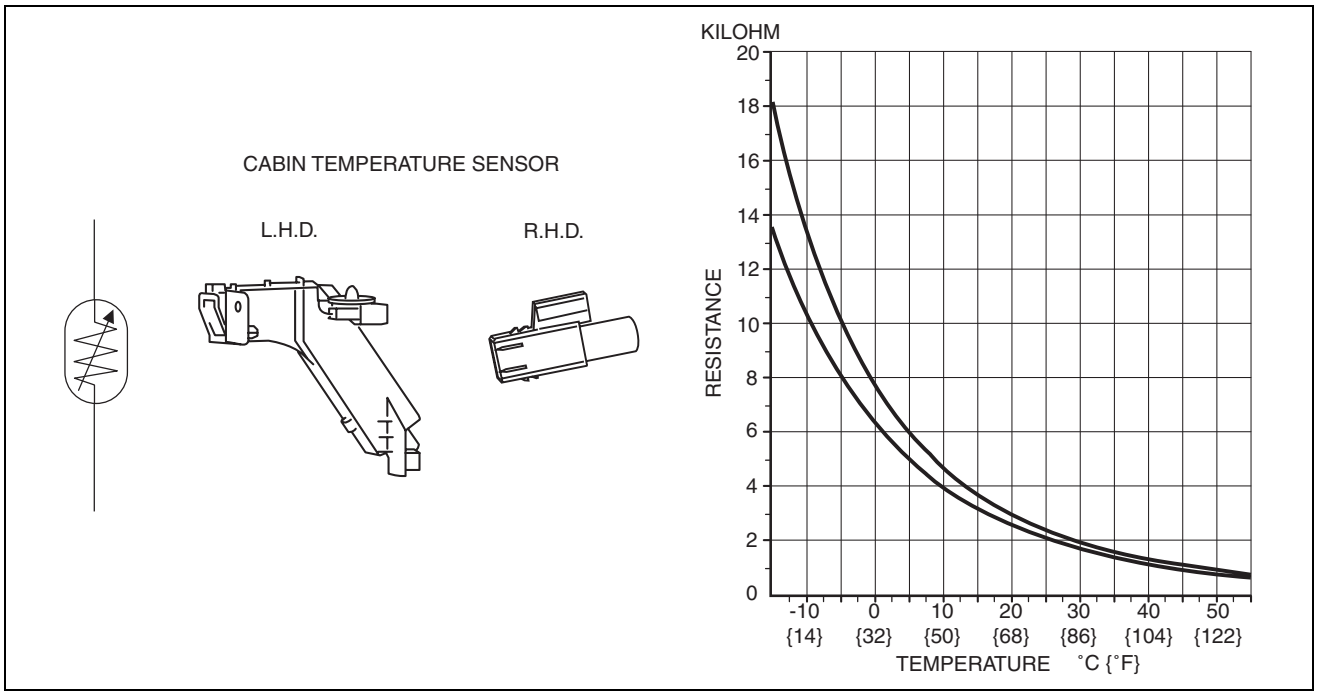
Purpose
- The cabin temperature sensor detects the cabin temperature.

Function
- The cabin temperature sensor converts the detected temperature to an electric signal.

Construction
- A thermistor-type cabin temperature sensor has been adopted.
- The cabin temperature sensor is installed to the lower panel (driver's side).

Operation
- The thermistor changes the resistance according to the surrounding temperature.
- The resistance decreases if the temperature increases, and conversely increases if the temperature decreases as shown in the figure.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



id0000729

Fail-safe
- Function not equipped.

EVAPORATOR TEMPERATURE SENSOR [FULL-AUTO AIR CONDITIONER]

id0740a1321500

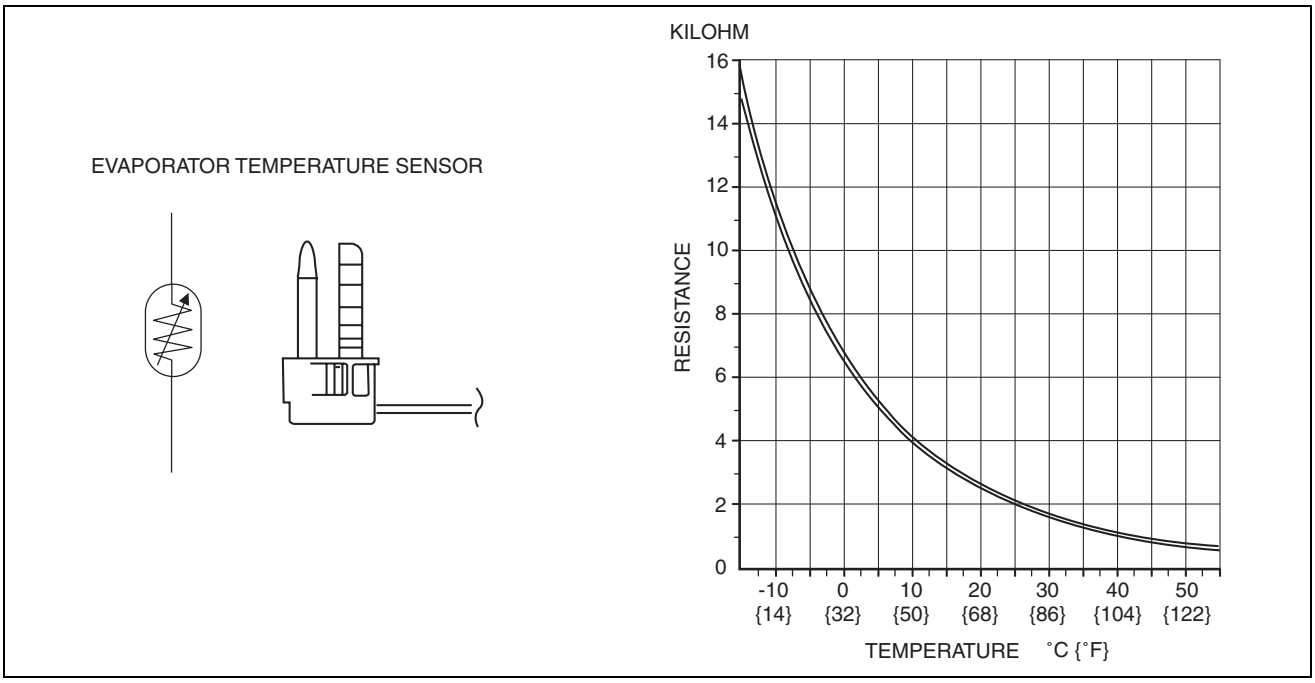
Purpose
- The evaporator temperature sensor detects the airflow temperature passing through the evaporator.

Function
- The evaporator temperature sensor converts the detected temperature to an electric signal.

Construction
- A thermistor-type evaporator temperature sensor has been adopted.
- A fin-thermo-type sensor has been adopted to the sensor area of the evaporator temperature sensor which inserts between the evaporator fins.
- The evaporator temperature sensor is installed to the A/C unit.

Operation
- The thermistor changes the resistance according to the surrounding temperature.
- The resistance decreases if the temperature increases, and conversely increases if the temperature decreases as shown in the figure.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



E80000730

Fail-safe
- Function not equipped.

HEATER CORE TEMPERATURE SENSOR [FULL-AUTO AIR CONDITIONER]

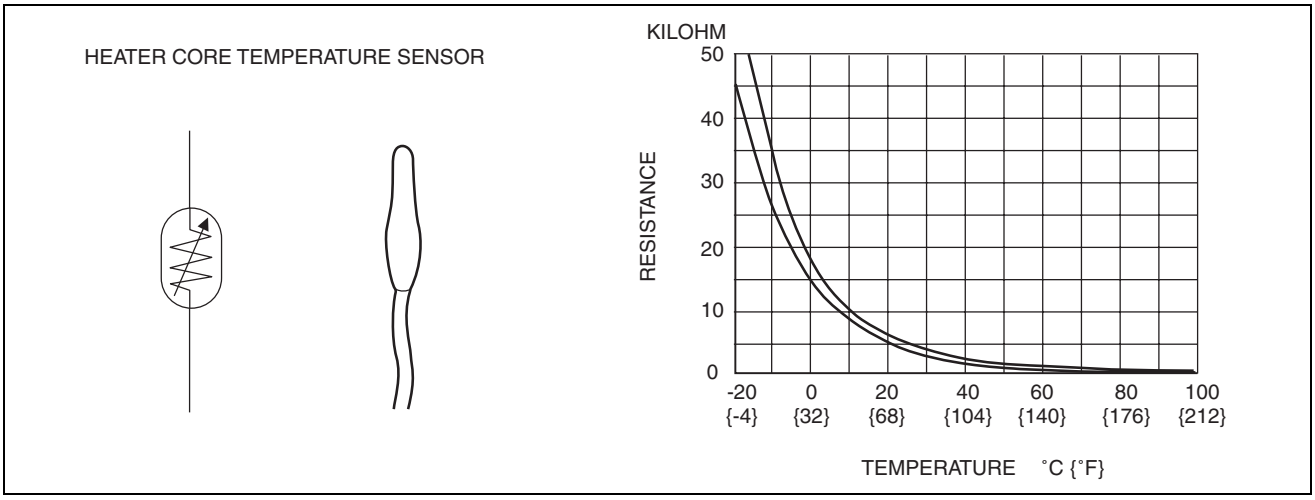
id0740a1126100

Purpose
- The heater core temperature sensor detects the airflow temperature passing through the heater core.
- The heater core temperature sensor signal is used for the i-stop control.

Function
- The heater core temperature sensor converts the detected temperature to an electric signal.

Construction
- A thermistor-type heater core temperature sensor has been adopted.
- The heater core temperature sensor is installed to the A/C unit.

Operation
- The thermistor changes the resistance according to the surrounding temperature.
- The resistance decreases if the temperature increases, and conversely increases if the temperature decreases as shown in the figure.



E80000690

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

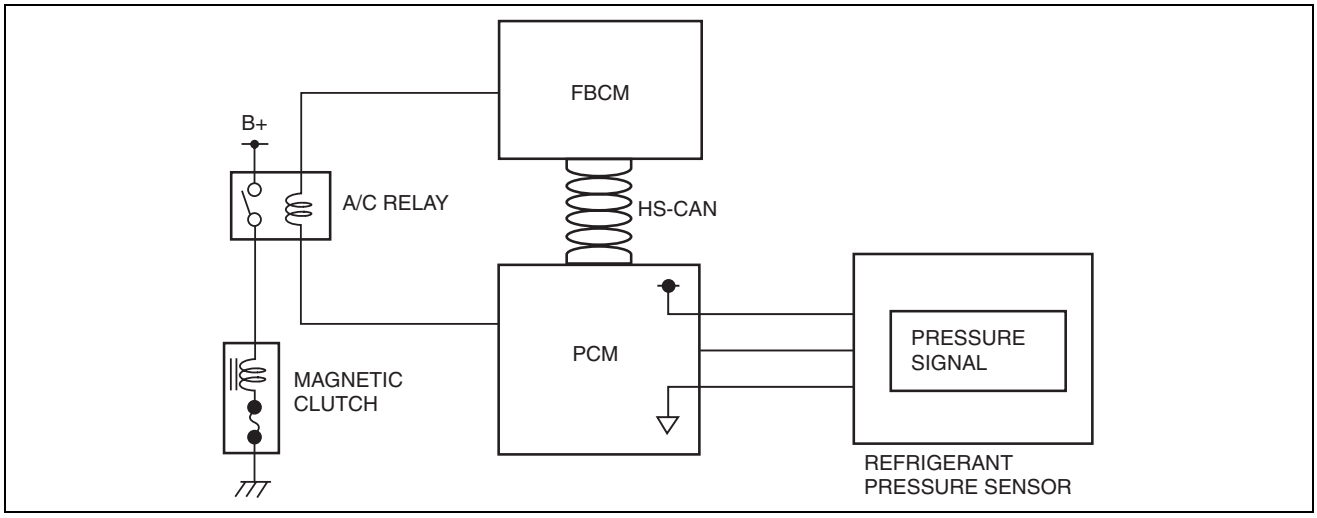
Fail-safe
- Function not equipped.

REFRIGERANT PRESSURE SENSOR [FULL-AUTO AIR CONDITIONER]

id0740a1126200

Purpose
- The refrigerant pressure sensor detects the refrigerant pressure in the refrigerant cycle.

Function
- The refrigerant pressure sensor converts the detected refrigerant pressure to an electric signal and sends it to the PCM.



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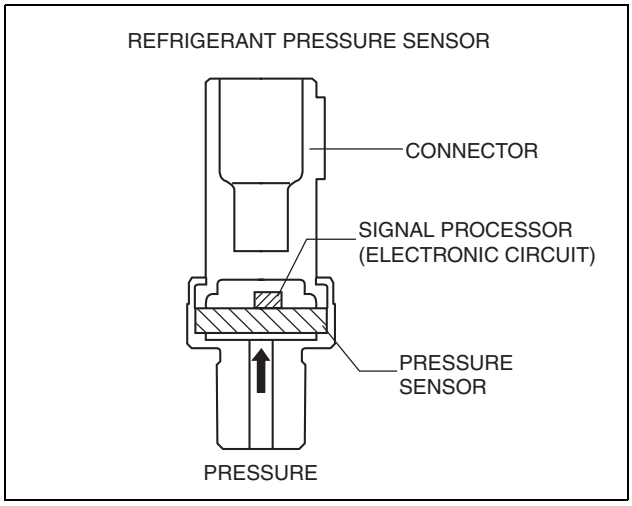
Construction
- The refrigerant pressure sensor is installed on the cooler pipe.
- A capacitance type refrigerant pressure sensor, which converts refrigerant pressure into a linear electric signal, has been adopted.
- Consists of a pressure detecting part and signal processing part.
- The pressure detecting part is a variable capacity condenser, which changes capacitance according to the pressure.
- The signal processing part detects the capacitance of pressure detecting part, converts it to voltage, then outputs it to the climate control unit.



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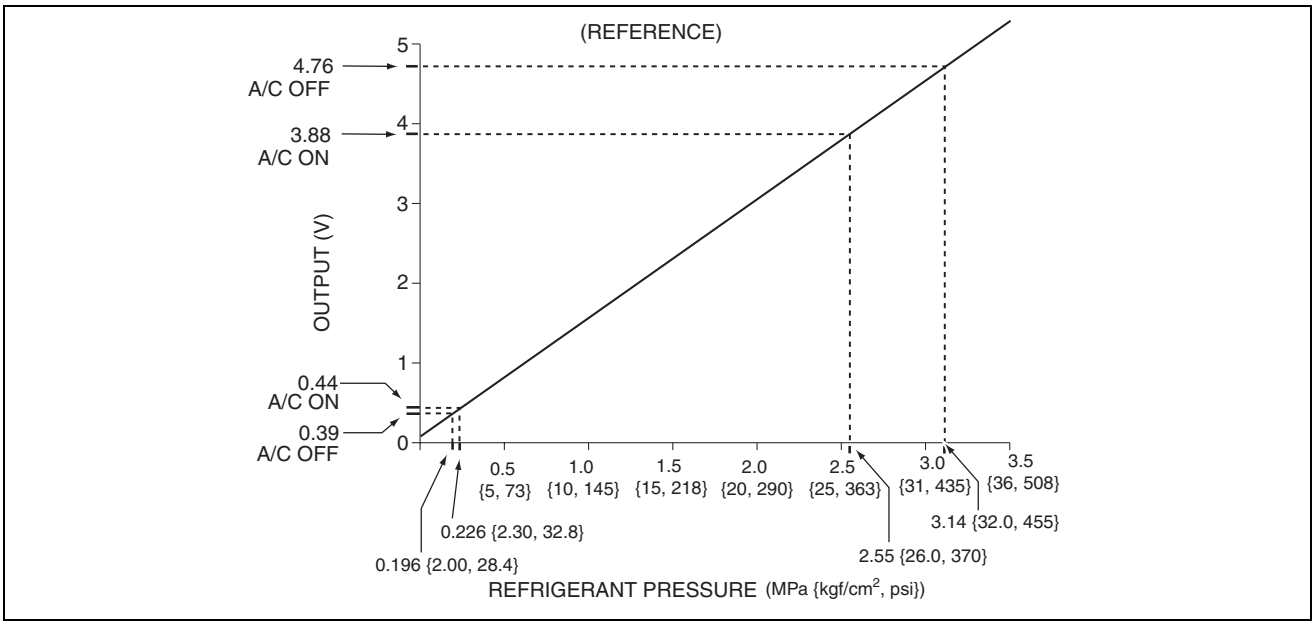
CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

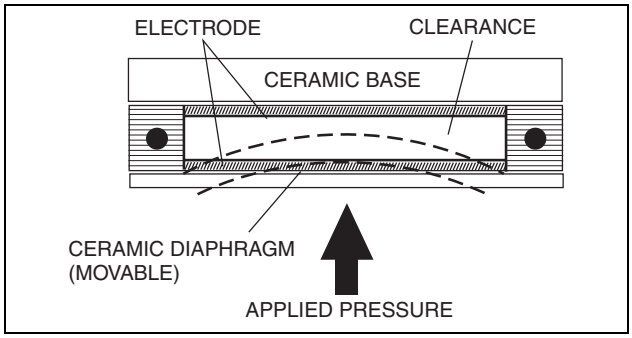


ac5wzn00000693

Operation

Capacitance type

- There is a clearance between the movable ceramic diaphragm and the ceramic base, and each side has an electrode.
- When pressure is applied from the ceramic diaphragm side, the ceramic diaphragm deforms, and the clearance between the electrodes changes. As a result, capacitance is changed and pressure is detected.



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Fail-safe

- Function not equipped.

CLIMATE CONTROL UNIT [FULL-AUTO AIR CONDITIONER]

id0740a1320100

Purpose

- The climate control unit performs air conditioning according to the operation by the users and the driving conditions of the vehicle.

Function

- The climate control unit determines optimum air-conditioning based on the input signals from each sensor and the control module and the operation signals from the control panel, and controls each actuator, A/C compressor, and the blower motor. (See 07-40A-24 FULL AUTO AIR CONDITIONER [FULL-AUTO AIR CONDITIONER].)

Automatic configuration function

- When the ignition is switched ON after the climate control unit is replaced, the climate control unit reads the vehicle specification information sent via CAN transmission from the instrument cluster using the automatic configuration function, and stores it.

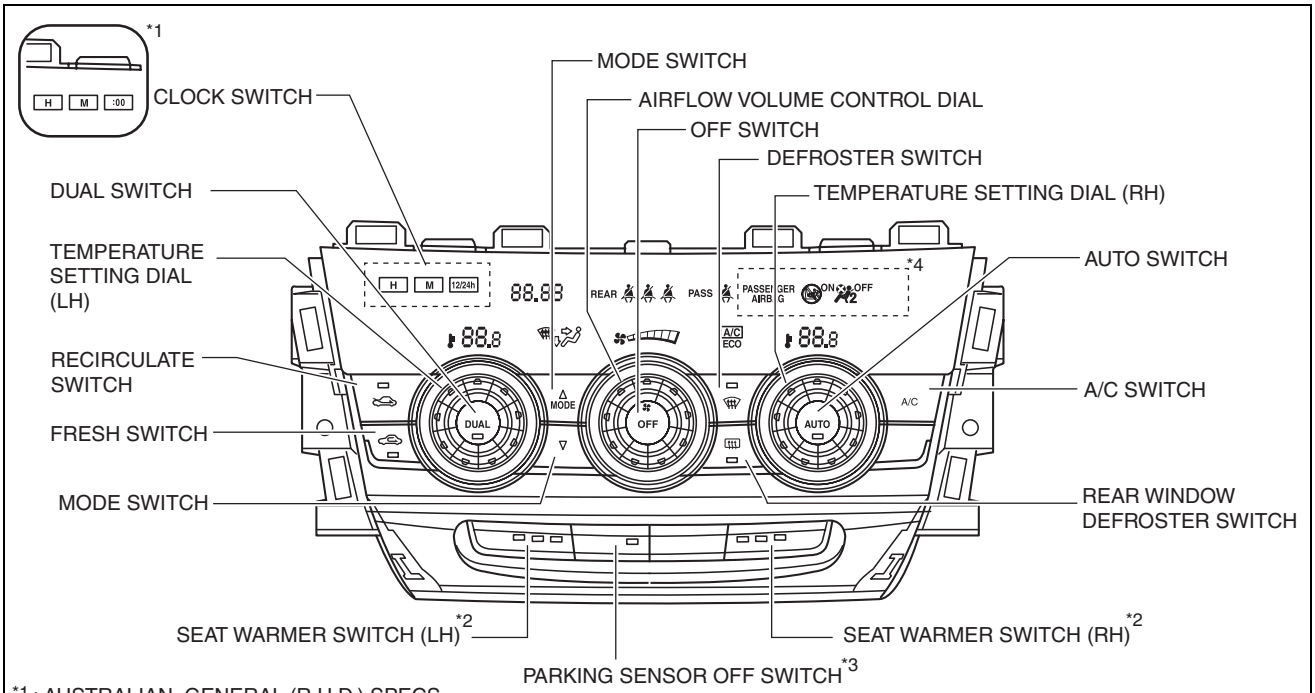
Construction

- A logic-type climate control unit has been adopted.
- The climate control unit consists of a control panel, display panel, and a control unit.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

- The switches and dials shown in the figure are positioned on the control panel.
- The display panel shows the followings:
  - — Air conditioner system display
  - — Ambient temperature display
  - — Clock display

R.H.D.



*1 : AUSTRALIAN, GENERAL (R.H.D.) SPECS.
*2 : WITH SEAT WARMER
*3 : WITH PARKING SENSOR OFF SWITCH
*4 : WITH PAD SWITCH

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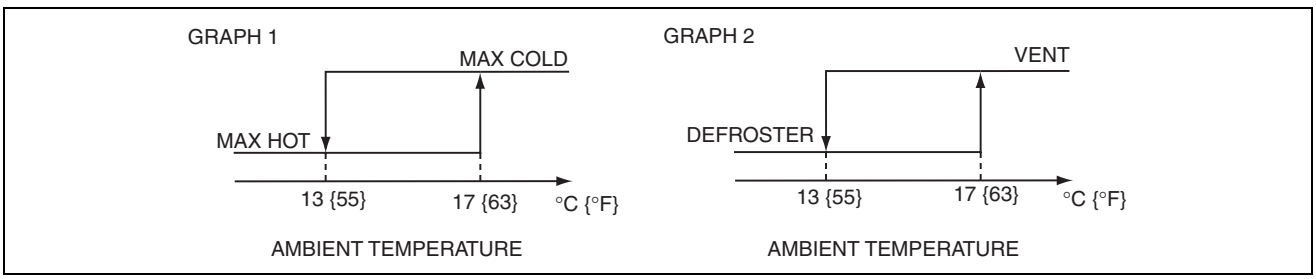
Fail-safe

- If a malfunction is detected by the malfunction detection function, the fail-safe function performs the following controls to prevent an operation malfunction of the full-auto air conditioner and malfunction of output devices.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Fail-safe function table

Part where malfunction is determined	Malfunction determined when IG SW at ON	Malfunction already exists when IG SW turned to ON
Ambient temperature sensor	Ambient temperature sensor input value is fixed at the value right before the malfunction.	Ambient temperature sensor input value is fixed at **15 °C {59 °F}.**
Cabin temperature sensor	Cabin temperature sensor input value is fixed at the value right before the malfunction.	Cabin temperature sensor input value is fixed at **25 °C {77 °F}.**
Evaporator temperature sensor	A/C output OFF is controlled when the evaporator temperature sensor input value is at **0 °C {32 °F}**.	←
Heater core temperature sensor	Heater core temperature sensor input value is fixed at **50 °C {122 °F}**.	←
Solar radiation sensor	The solar radiation sensor input value is fixed at the value directly before the malfunction only when the valve is **1,450 W/m^2 or more**.	Solar radiation sensor value is fixed at **0 W/m^2**.
Engine coolant temperature sensor	Engine coolant temperature sensor input value is fixed at **85 °C {185 °F}**.	←
Air mix actuator (potentiometer)	Air mix actuator drive signal is stopped right when the malfunction is determined. However, it is fixed at MAX COLD when the manually set temperature is at **15°C {60 °F}** and fixed at MAX HOT when the manually set temperature is at **29°C {84 °F}**.	Control based on ambient temperature. (See Graph 1.) However, it is fixed at MAX COLD when the manually set temperature is at **15°C {60 °F}** and fixed at MAX HOT when the manually set temperature is at **29°C {84 °F}**.
Airflow mode actuator (potentiometer)	Airflow mode actuator drive signal is stopped right when the malfunction is determined. • However, change the operation to VENT or DEF when the manual operation selected to VENT or DEF.	Control based on ambient temperature. (See Graph 2.) • However, change the operation to VENT or DEF when the manual operation selected to VENT or DEF.
Air mix actuator (motor lock)	• Air mix actuator drive signal is stopped right when the malfunction is determined.	• Twenty seconds after ignition is switched ON, the air mix actuator drive signal is output normally again. Afterwards, motor output is stopped during malfunction determination.
Airflow mode actuator (motor lock)	• Airflow mode actuator drive signal is stopped right when the malfunction is determined.	• Nine seconds after ignition is switched ON, the airflow mode actuator drive signal is output normally again. Afterwards, motor output is stopped during malfunction determination.



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FULL AUTO AIR CONDITIONER [FULL-AUTO AIR CONDITIONER]

id0740a1320200

Outline

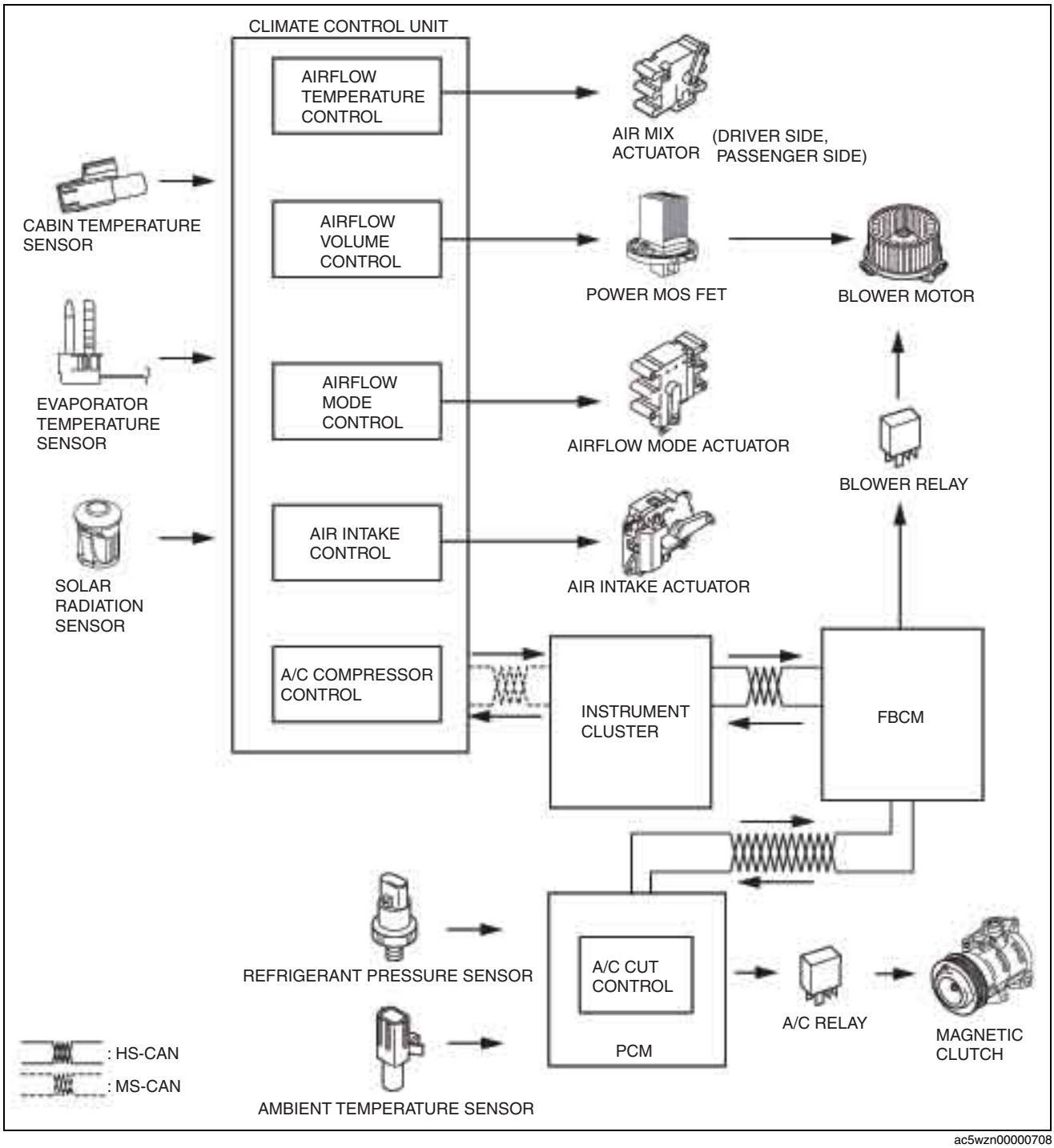
- The climate control unit performs the following controls based on the signals from each switch/dial and the sensor.
  - — Airflow temperature control
  - — Airflow volume control
  - — Airflow mode control
  - — Air intake control
  - — A/C compressor control

A/C cut-off control

- Controls the A/C operation by switching the A/C relay on/off at the optimal timing according to engine operation conditions. (See 01-40-36 A/C CUT-OFF CONTROL [SKYACTIV-G 2.0].)

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Block Diagram



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Control Table

- The full-auto air conditioner system functions based on the five basic types of controls and three supplementary functions.

Basic control	Control description	Correction control
Airflow temperature control	Airflow temperature automatic control	• MAX HOT and MAX COLD correction • Engine coolant temperature correction

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Basic control	Control description	Correction control
Airflow volume control	Airflow volume automatic control	• Engine coolant temperature correction (warm-up correction) • Mild start correction • MAX HOT and MAX COLD correction • Defroster correction • Start-up window fogging prevention correction • Starting compensation correction • Start-up burn-out prevention function
	Airflow volume manual control	• Defroster correction • Start-up burn-out prevention function
Airflow mode control	Airflow mode automatic control	• Engine coolant temperature correction (warm-up correction)
	Airflow mode manual control	—
Air intake control	Air intake automatic control	• Defroster correction • Ambient temperature correction
	Air intake manual control	• Defroster correction
A/C compressor control	A/C compressor automatic control	• Defroster correction
	A/C compressor manual control	

Supplementary function
Fail-safe function
Sensor signal delay function
On-board diagnostic function

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Control Type Transition by Switch Operation
Airflow temperature control, airflow volume control

Operation switch		Airflow temperature control	Airflow volume control								
		Control prior to switch operation	Control prior to switch operation								
		Automatic control	Automatic control	Defroster correction	Manual control						
					OFF	1	2	3	4	5	6	7
OFF switch		Automatic control	OFF	OFF	OFF							
AUTO switch		Automatic control	Automatic control	Automatic control	Automatic control							
Airflow volume control dial	HI	Automatic control	Manual control*4	Manual control*4	1	2	3	4	5	6	7	7
	LO	Automatic control	Manual control*5	Manual control*5	1	1	1	2	3	4	5	6
MODE switch		Automatic control	Automatic control	Automatic control*6	No change							
DEFROSTER switch		Automatic control	Defroster correction	Automatic control*6	Defroster correction							
A/C switch		Automatic control	Automatic control	No change	*7	No change						
RECIRCULATE switch		Automatic control	Automatic control	No change	No change							
FRESH switch		Automatic control	Automatic control	No change	No change							
Driver-side temperature setting dial*1	15.0/60*2 18.0/64*3	MAX COLD	MAX HI	MAX HI	No change							
	15.5—28.5/61—83*2 18.5—31.5/65—89*3	Automatic control	Automatic control	No change	No change							
	29.0/84*2 32.0/90*3	MAX HOT	AUTO HI	AUTO HI	No change							
Passenger-side temperature setting dial*1	15.0/60*2 18.0/64*3	MAX COLD	MAX HI	MAX HI	No change							
	15.5—28.5/61—83*2 18.5—31.5/65—89*3	Automatic control	Automatic control	No change	No change							
	29.0/84*2 32.0/90*3	MAX HOT	AUTO HI	AUTO HI	No change							
Dual switch		Automatic control	No change	No change	No change							

*1 : Adjusted up or down in increments of 0.5 with a range of 15.0—29.0 or 1 with a range of 60—84.
*2 : European (L.H.D. U.K.) specs.
*3 : Except European (L.H.D. U.K.) specs.
*4 : Increases to the manual voltage that is closest to the auto or defroster correction voltage.
*5 : Decreases to the manual voltage that is closest to the auto or defroster correction voltage.
*6 : Returns to condition prior to defroster operation. However, if it had been off prior to defroster operation, it switches to automatic control.
*7 : Returns to fan condition before fan off. However, if it had been defroster correction (manual control) returns to condition as follows.

1. The condition before fan off defroster correction, the fan condition return to the condition before defroster correction.
2. The condition before fan off defroster correction and furthermore the condition before defroster correction is fan off, the fan condition change to the automatic control. (It has higher priority than 1)
3. The condition before fan off defroster correction and fan is manually operated during that defroster correction, the fan condition return to the manually operated condition. (It has higher priority than 1 and 2)

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Airflow mode control, air intake control, A/C compressor control

Operation switch		Airflow mode control		Air intake control		A/C compressor control	
		Control prior to switch operation		Control prior to switch operation		Control prior to switch operation	
		Automatic control	Manual control	Automatic control	Manual control	Automatic control	Manual control
OFF switch		Fixed at mode before turned OFF	No change	Fixed at mode before turned OFF	No change	OFF	OFF
AUTO switch		Automatic control	Automatic control	Automatic control	Automatic control	Automatic control	Automatic control
Airflow volume control dial	HI	Automatic control	No change	Automatic control	No change	Automatic control	No change
	LO	Automatic control	No change	Automatic control	No change	Automatic control	No change
MODE switch	UP 	VENT → BI-LEVEL BI-LEVEL → HEAT HEAT → DEF/HEAT DEF/HEAT → VENT	VENT → BI-LEVEL BI-LEVEL → HEAT HEAT → DEF/HEAT DEF/HEAT → VENT	Automatic control	No change	Automatic control	No change
	DOWN 	VENT → DEF/HEAT DEF/HEAT → HEAT HEAT → BI-LEVEL BI-LEVEL → VENT DEFROSTER (warm-up) → HEAT	VENT → DEF/HEAT DEF/HEAT → HEAT HEAT → BI-LEVEL BI-LEVEL → VENT DEFROSTER (warm-up) → HEAT	Automatic control	No change	Automatic control	No change
DEFROSTER switch		DEFROSTER	DEFROSTER	Defroster correction	Defroster correction	Defroster correction	Defroster correction
A/C switch		Automatic control	No change	Automatic control	No change	A/C→OFF OFF→A/C	A/C→OFF OFF→A/C
RECIRCULATE switch		Automatic control	No change	FRESH→REC	FRESH→REC	Automatic control	No change
FRESH switch		Automatic control	No change	REC→FRESH	REC→FRESH	Automatic control	No change
Driver-side temperature setting dial[*1]	15.0/60[*2] 18.0/64[*3]	Automatic control	No change	Automatic control	No change	Automatic control	No change
	15.5—28.5/61—83[*2] 18.5—31.5/65—89[*3]	Automatic control	No change	Automatic control	No change	Automatic control	No change
	29.0/84[*2] 32.0/90[*3]	Automatic control	No change	Automatic control	No change	Automatic control	No change
Passenger-side temperature setting dial[*1]	15.0/60[*2] 18.0/64[*3]	Automatic control	No change	Automatic control	No change	Automatic control	No change
	15.5—28.5/61—83[*2] 18.5—31.5/65—89[*3]	Automatic control	No change	Automatic control	No change	Automatic control	No change
	29.0/84[*2] 32.0/90[*3]	Automatic control	No change	Automatic control	No change	Automatic control	No change
Dual switch		Automatic control	No change	Automatic control	No change	No change	No change

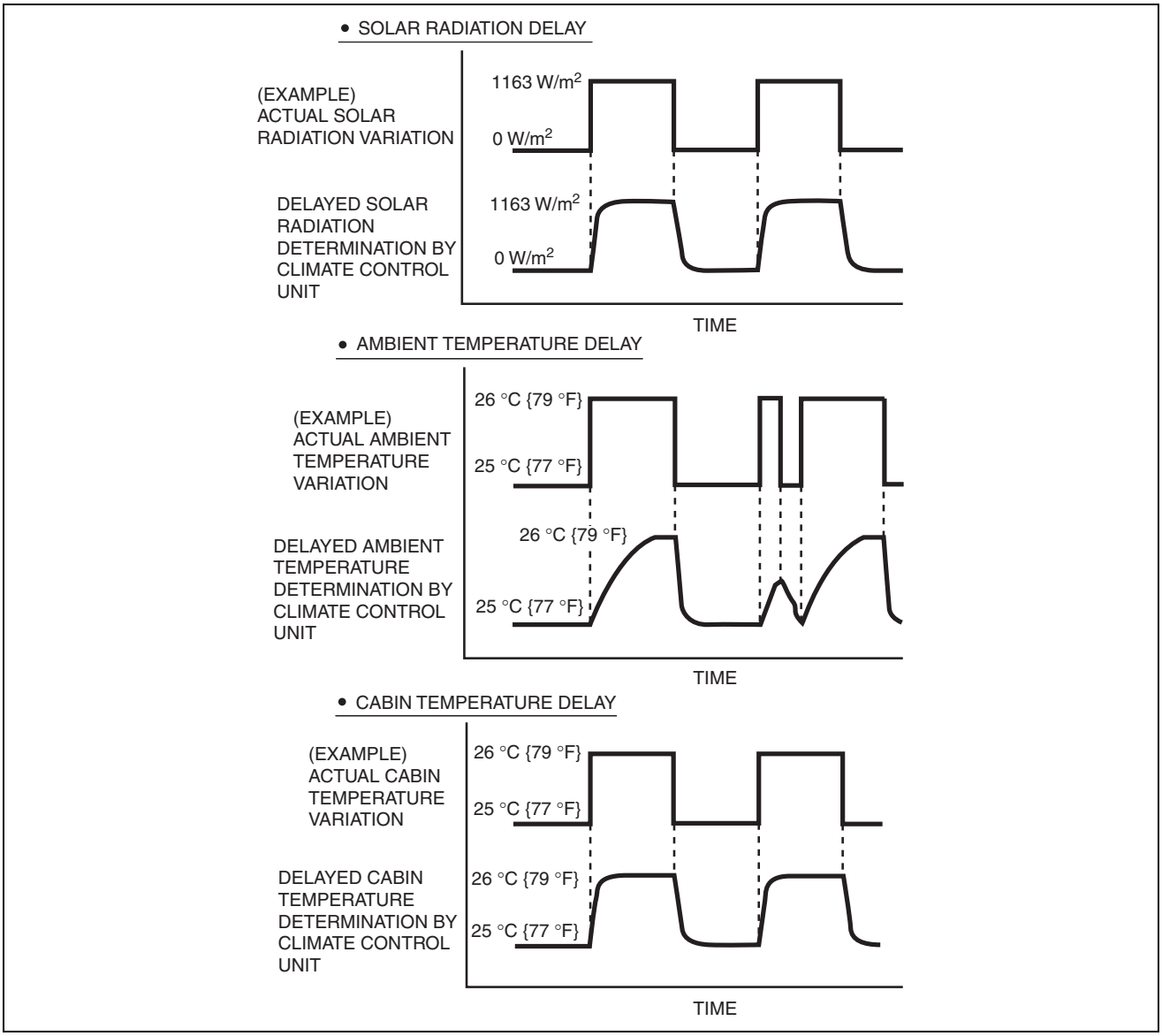
[*1] : Adjusted up or down in increments of 0.5 with a range of 15.0—29.0 or 1 with a range of 60—84.
[*2] : European (L.H.D. U.K.) specs.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

*3 : Except European (L.H.D. U.K.) specs.

Sensor Signal Delay Function

- The amount of solar radiation, and the ambient and cabin temperatures may change due to factors such as direct and intermittent sunlight (traveling through a city or a highway tunnel), or radiant heat from the ground under parked vehicles as well as the opening and closing of doors.
- If control was performed based exactly on these variations, the air conditioning function would be negatively affected and smooth control could not occur.
- In order to prevent this, the climate control unit delays and smoothes the input signals for solar radiation, and the ambient and cabin temperature as shown in the following figure, realizing stable control.



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- When the engine is restarted after being temporarily stopped, the ambient temperature sensor may detect a temperature higher than the actual ambient temperature.
- To prevent this, if the engine coolant temperature exceeds **55 °C {131 °F}**, control of each system is performed based on the ambient temperature data before the engine was stopped, which is stored in the climate control unit.

AIRFLOW TEMPERATURE CONTROL [FULL-AUTO AIR CONDITIONER]

id0740a1310300

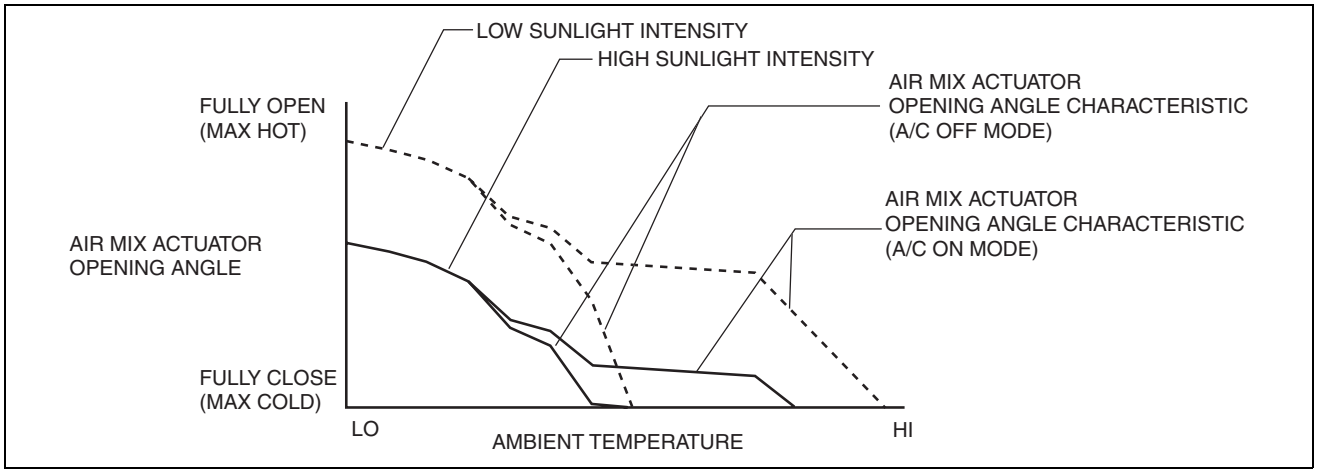
Purpose

- The airflow temperature control changes the airflow temperature according to the vehicle conditions.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Function

- The air mix actuator is driven and the air mix door position is changed according to the set temperature and the vehicle environment.
- The climate control unit calculates the air mix actuator opening angle characteristic based on the set temperature, solar radiation amount, and airflow mode.
- The air mix actuator opening angle characteristic is set lower as the sunlight intensity increases.



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- The airflow temperature is automatically controlled continuously.
- The airflow temperature control performs the following corrections:
  - — MAX HOT and MAX COLD correction
  - — Engine coolant temperature correction

MAX HOT and MAX COLD correction

- Under the MAX HOT and MAX COLD correction, the air mix actuator opening angle is fixed at fully open when the temperature is set to **29.0/84**, and fixed at fully closed when the temperature is set to **15/60**. (European (L.H.D. U.K.) specs.).
- Under the MAX HOT and MAX COLD correction, the air mix actuator opening angle is fixed at fully open when the temperature is set to **32.0/90**, and fixed at fully closed when the temperature is set to **18/64**. (except European (L.H.D. U.K.) specs.).

Engine coolant temperature correction

- The engine coolant temperature correction prevents cold air from coming out of the air vents after the engine is started in winter.
- When the engine coolant temperature is lower than the specified value, the air mix actuator opening angle is corrected to the HOT side.
- The engine coolant temperature correction is not performed when the ambient temperature is **15 °C {59 °F}** or more.

Construction

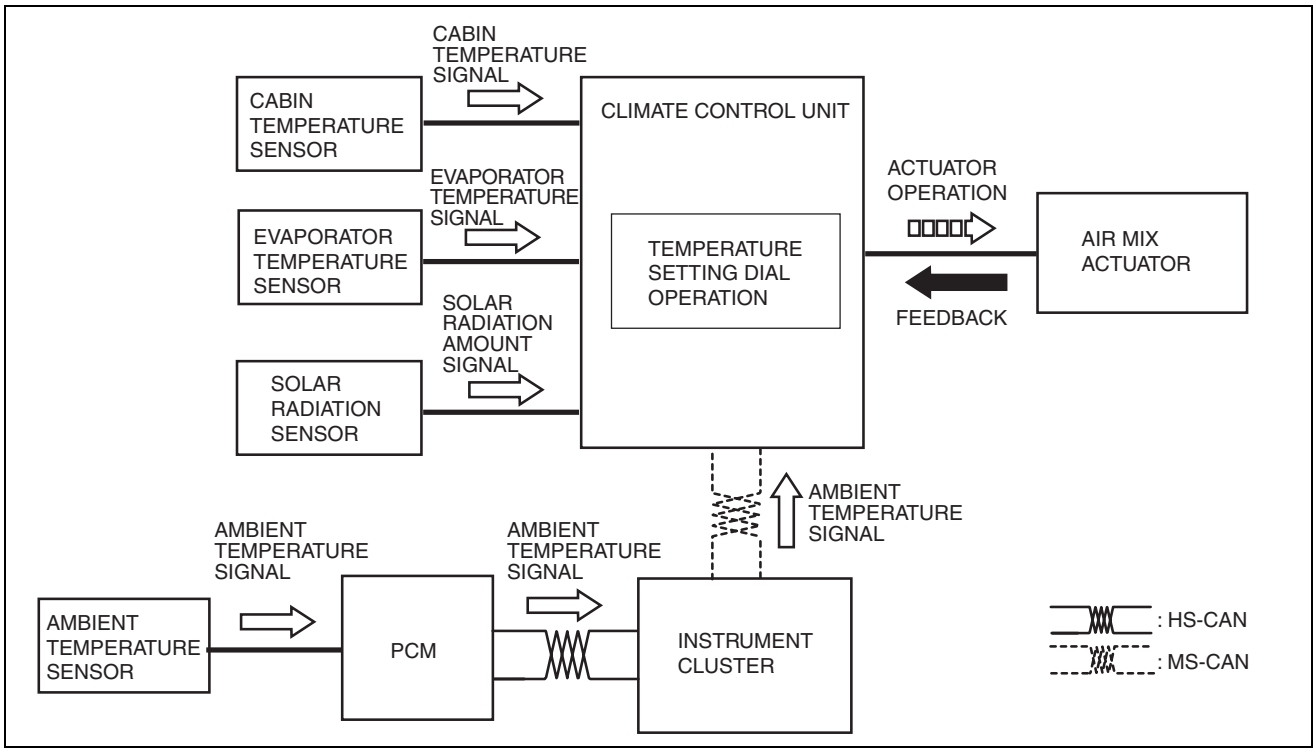
- The airflow temperature control consists of the parts indicated in the following table:

Input device	Control part	Output device
• Temperature setting dial (climate control unit) • Cabin temperature sensor • Solar radiation sensor • Ambient temperature sensor • Evaporator temperature sensor	• Climate control unit • PCM • Instrument cluster	• Air mix actuator • Air mix door

Operation

1. The climate control unit determines the airflow temperature based on the temperature control dial operation and signals from each sensor which changes according to the vehicle environment.
2. The climate control unit drives the air mix actuator according to the results of the airflow temperature determination and corrections.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



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AIRFLOW VOLUME CONTROL [FULL-AUTO AIR CONDITIONER]

id0740a1310400

Purpose

- The airflow volume control changes the airflow volume according to the vehicle environment.

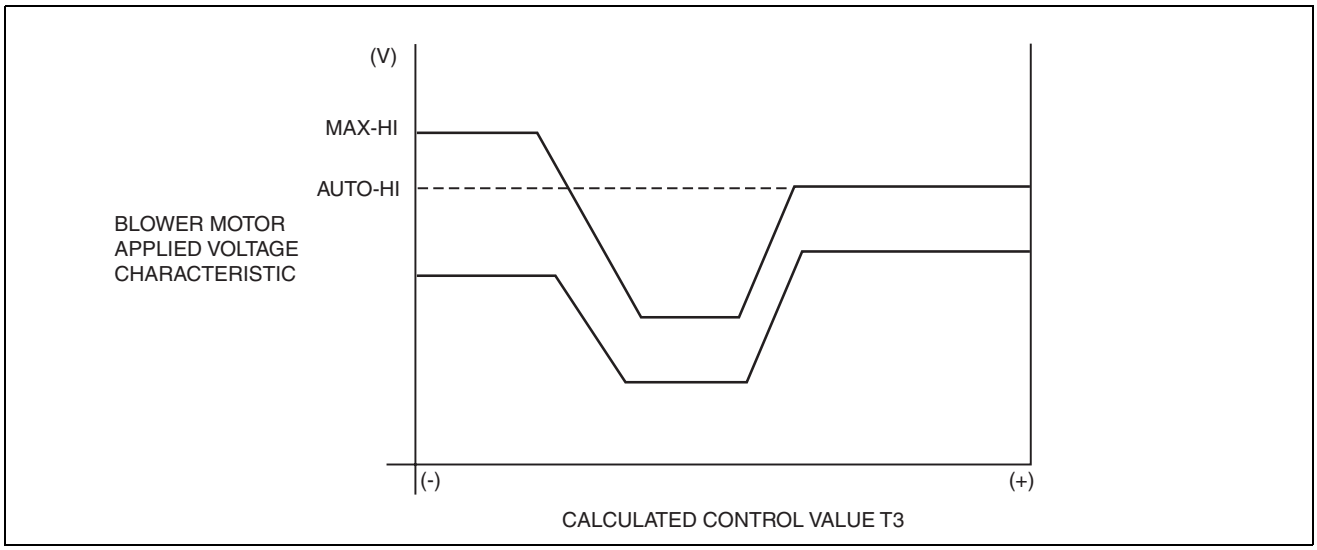
Function

- The airflow volume control changes the operation of the blower motor according to the operations of the airflow volume control dial or temperature control dial and the vehicle environment to change the airflow volume.
- The airflow volume control has automatic and manual controls.
- The airflow volume automatic control performs the following correction:
  - — Engine coolant temperature correction (warm-up correction)
  - — Mild start correction
  - — MAX HOT and MAX COLD correction
  - — Start-up window fogging prevention correction
  - — Starting compensation correction
  - — Defroster correction
  - — Start-up burn-out prevention function

Airflow Volume Automatic Control

- The climate control unit calculates the blower motor applied voltage characteristic based on the set temperature, ambient temperature, and solar radiation amount.
- The climate control unit compares the blower motor applied voltage characteristic with the target temperature (calculated control value T3) and then determines the blower motor applied voltage (AUTO voltage).
- Calculated control value T3 is the target cabin temperature as set by the climate control unit based on differences between the set temperatures and temperatures input from the sensors.
- Calculated control value T3 is constantly calculated according to the changes in the set temperature and the signals input from the sensors.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



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Airflow Volume Manual Control

- The climate control unit changes the blower motor applied voltage (airflow volume) in seven steps according to the operation of the airflow volume control dial.

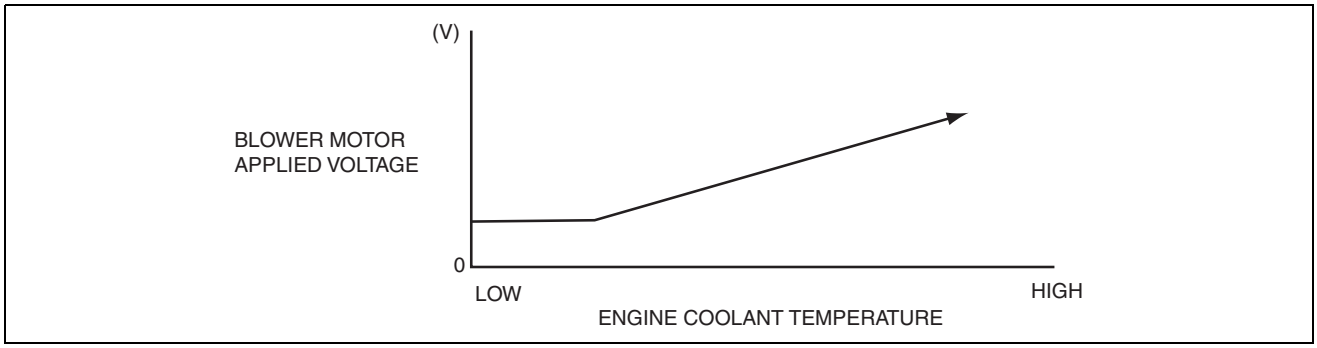
Airflow volume control dial	Blower motor applied voltage
1st	3.5 V
2nd	5.2 V
3rd	6.9 V
4th	8.6 V
5th	10.0 V
6th	12.1 V
7th	14.6 V*1, 13.0V*2

*1 : When the airflow mode is except HEAT.
*2 : When the airflow mode is HEAT.

Correction

Engine coolant temperature correction (warm-up correction)

- The engine coolant temperature correction (warm-up correction) prevents high volume of cold air from coming out of the air vents after engine start in winter.
- The engine coolant temperature correction (warm-up correction) controls the blower motor applied voltage according to the increase in the engine coolant temperature.
- The engine coolant temperature correction is not performed during defroster correction, or when the cabin temperature is **20 °C {68 °F}** or more and the airflow mode is in VENT mode.



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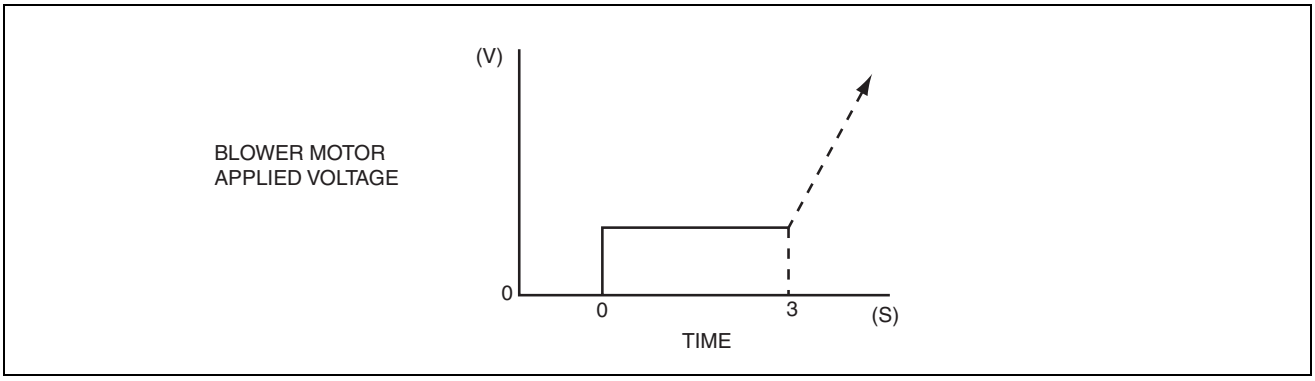
Mild start correction

- The mild start correction prevents a high volume of warm air from coming out of the air vents when the blower motor is started in summer.
- The mild start correction limits the blower motor applied voltage for **3 s** after the blower motor is started.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

- The mild start correction is not performed when the cabin temperature is **20 °C {68 °F}** or less or the airflow is in any mode other than VENT.



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MAX HOT and MAX COLD correction

- The MAX HOT and MAX COLD correction fixes the blower motor applied voltage as indicated in the table when the temperature is set to MAX HOT or MAX COLD.
- The MAX HOT correction is not performed during engine coolant temperature correction.

European (L.H.D. U.K.) specs.

Correction name	Set temperature	Blower motor applied voltage
MAX HOT correction	29.0/84	12.1 (V): AUTO-HI
MAX COLD correction	15.0/60	14.6 (V): MAX-HI

Except European (L.H.D. U.K.) specs.

Correction name	Set temperature	Blower motor applied voltage
MAX HOT correction	32.0/90	12.1 (V): AUTO-HI
MAX COLD correction	18.0/64	14.6 (V): MAX-HI

Start-up window fogging prevention correction

- The start-up window fogging prevention correction prevents the windows from easily fogging when the following conditions are all met.
  - — Right after engine start
  - — Heater is operated
  - — Air is blowing from vents for defrosting
- The start-up window fogging prevention correction fixes the blower motor applied voltage at **0 V** for **6 s** after the ignition is switched ON.
- The start-up window fogging prevention correction is not performed when the airflow mode is in any mode other than HEAT, DEF/HEAT and defroster.

Starting compensation correction

- When the blower motor is started-up from the stopped status at the lowest speed (**3.2 V**), the starting compensation correction fixes the blower motor applied voltage at **4.4 V** for **2 s** to stabilize blower motor start-up operation.

Defroster correction

- When the defroster switch is turned on, the defroster correction adds a correction (**+2 V**) to the blower motor applied voltage to increase airflow volume.

Start-up burn-out prevention function

- The start-up burn-out prevention function prevents the blower motor from being burnt out because of excess current.
- When the blower motor is started-up from the stopped status with a blower motor applied voltage of **4.4 V** or more, the blower motor applied voltage is fixed at **4.4 V** for **1 s**.

Construction

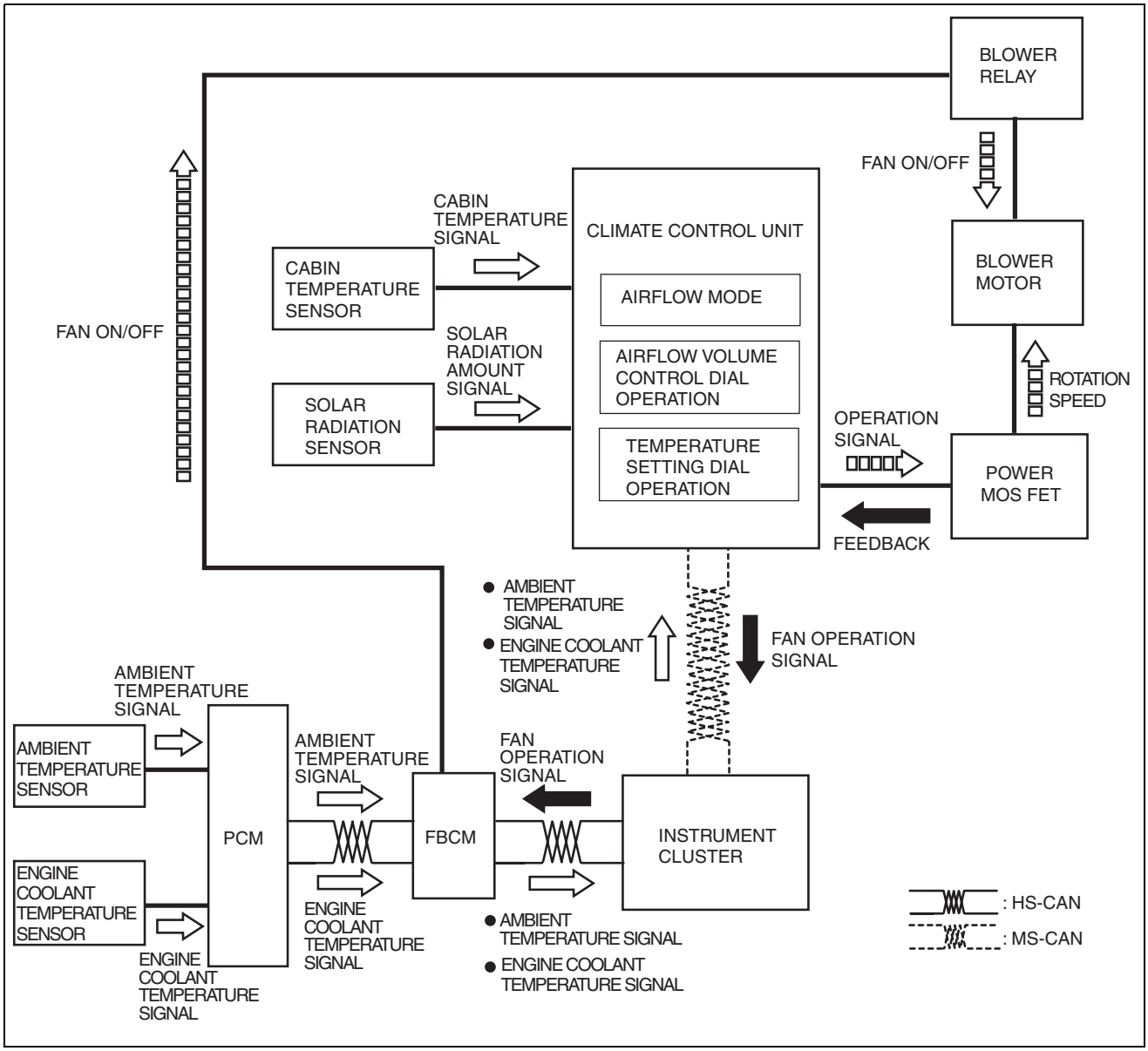
- The airflow volume control consists of the parts indicated in the following table:

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Input device	Control part	Output device
• Airflow volume control dial (climate control unit) • Temperature setting dial (climate control unit) • Cabin temperature sensor • Solar radiation sensor • Ambient temperature sensor • Engine coolant temperature sensor • Airflow mode actuator	• Climate control unit • PCM • Front body control module (FBCM) • Instrument cluster	• Power MOS FET • Blower motor

Operation

1. The climate control unit sends a fan operation signal to the front body control module (FBCM) based on the airflow volume control dial ON operation.
2. When the front body control module (FBCM) turns on the blower relay based on the fan operation signal, the blower motor rotates.
3. The climate control determines the airflow volume based on the operations of the airflow volume control dial and the temperature setting dial, airflow mode condition, and signals from each sensor.
4. Based on the result of the airflow volume determination and correction, the climate control unit control the power MOS FET and changes the airflow volume (blower motor applied voltage).
5. The rotation speed of the blower motor changes according to the applied voltage from the power MOS FET.



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CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

AIRFLOW MODE CONTROL [FULL-AUTO AIR CONDITIONER]

id0740a1310500

Purpose

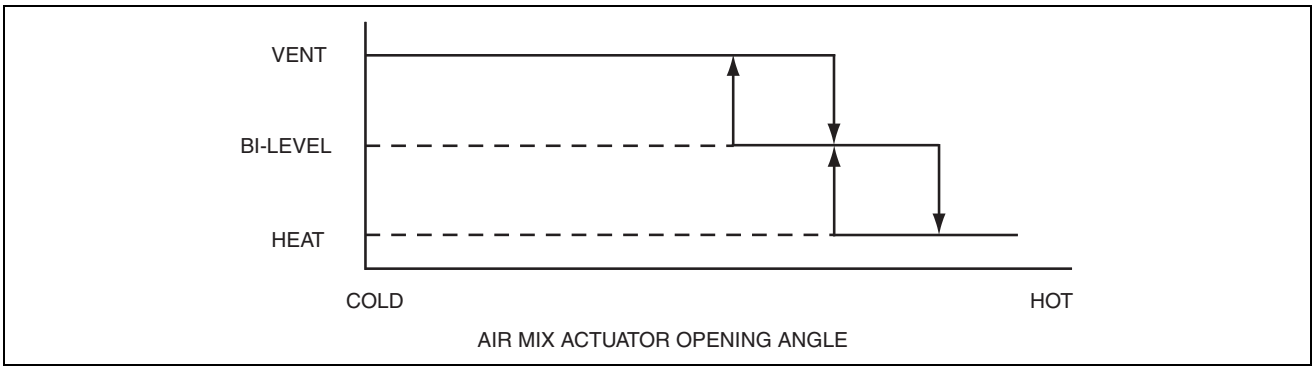
- The airflow mode control changes the airflow mode according to the vehicle environment.

Function

- The airflow mode control drives the airflow mode actuator according to the mode switch, defroster switch, and the vehicle environment and switches the position of the airflow mode door.
- The airflow mode control has automatic and manual controls.
- The airflow mode automatic control performs the following correction:
  — Engine coolant temperature correction (warm-up correction)

Airflow mode automatic control

- The climate control unit determines the airflow mode based on the current air mix actuator opening angle and solar radiation amount.



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- Determined value used for the airflow mode is changed according to the signal from the solar radiation sensor.

Airflow mode manual control

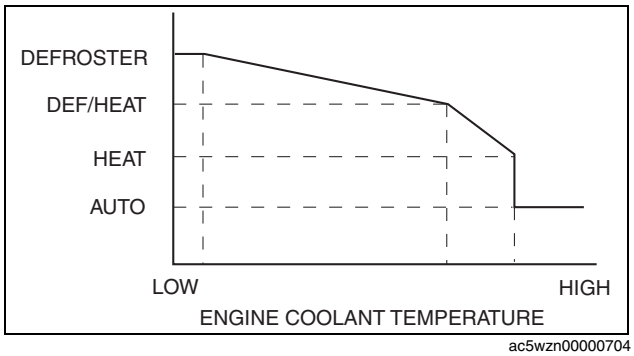
- The climate control unit switches the airflow mode based on the MODE switch operation.

Airflow mode	Operation switch	Air vent
VENT	Mode switch	CENTER VENT, SIDE VENT
BI-LEVEL		CENTER VENT, SIDE VENT, FRONT HEAT, REAR HEAT
HEAT		FRONT HEAT, REAR HEAT, SIDE DEMISTER (low volume), DEFROSTER (low volume), SIDE VENT (low volume)
DEF/HEAT		FRONT HEAT, REAR HEAT, SIDE DEMISTER, DEFROSTER, SIDE VENT (low volume)
DEFROSTER	DEFROSTER switch	SIDE DEMISTER, DEFROSTER, SIDE VENT (low volume)

Correction

Engine coolant temperature correction (warm-up correction)

- The engine coolant temperature correction (warm-up correction) prevents cold air from coming out of the lower vents after engine start in winter.
- The engine coolant temperature correction (warm-up correction) switches the airflow mode according to the increase in the engine coolant temperature.



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Construction

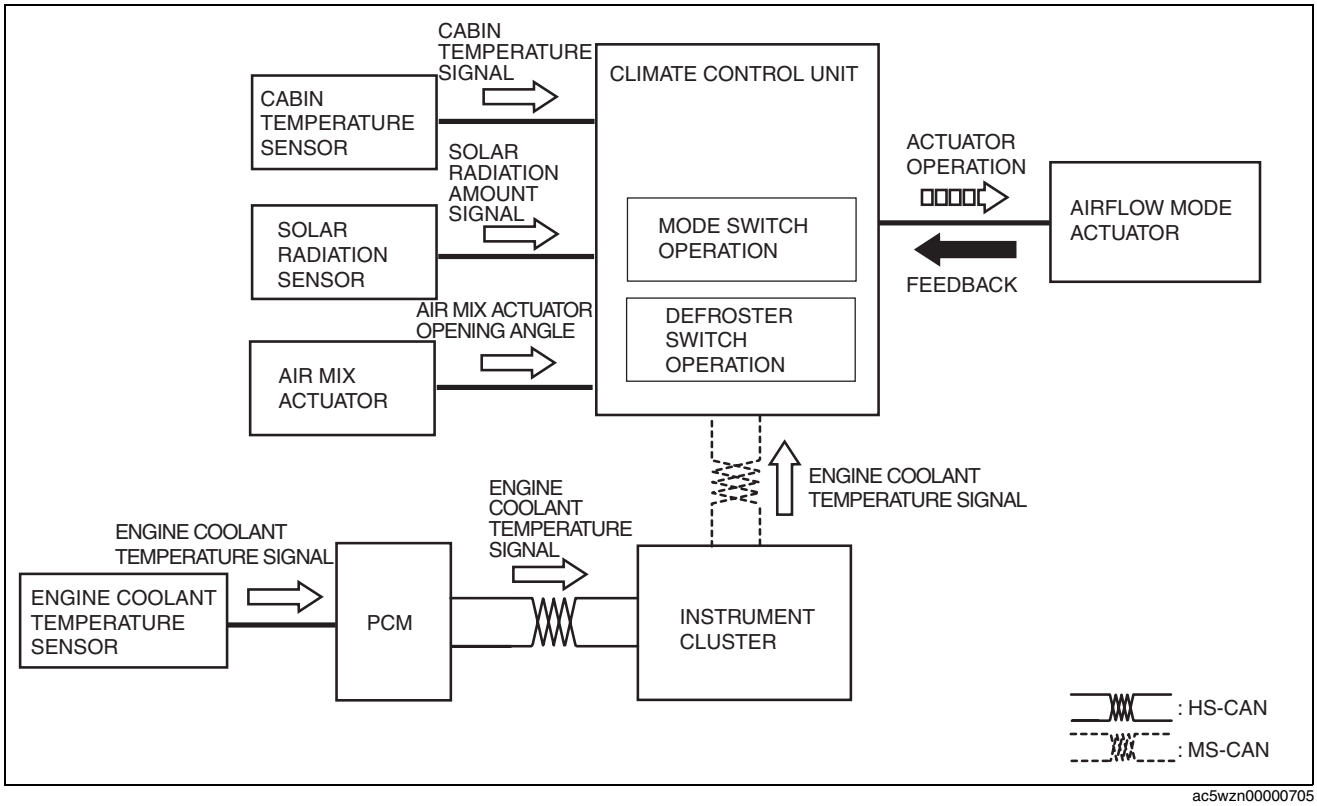
- The airflow volume control consists of the parts indicated in the following table:

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Input device	Control part	Output device
• Defroster switch (climate control unit) • Mode switch (climate control unit) • Cabin temperature sensor • Solar radiation sensor • Air mix actuator • Engine coolant temperature sensor	• Climate control unit • PCM • Instrument cluster	• Airflow mode actuator • Airflow mode door

Operation

1. The climate control unit determines the airflow mode based on the operations of the mode and defroster switches and signals from each sensor which changes according to the vehicle environment.
2. The climate control unit drives the airflow mode actuator according to the results of the airflow mode determination and corrections.



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AIR INTAKE CONTROL [FULL-AUTO AIR CONDITIONER]

id0740a1107000

Purpose

- The air intake control switches the air intake port (FRESH/REC) according to the vehicle environment.

Function

- The air intake control drives the air intake actuator and switches the air intake door position according to the operations of the REC, FRESH and defroster switches and the vehicle environment.
- The air intake control has automatic and manual controls.
- The air intake automatic control performs the following correction:
  - — Defroster correction
  - — Ambient temperature correction

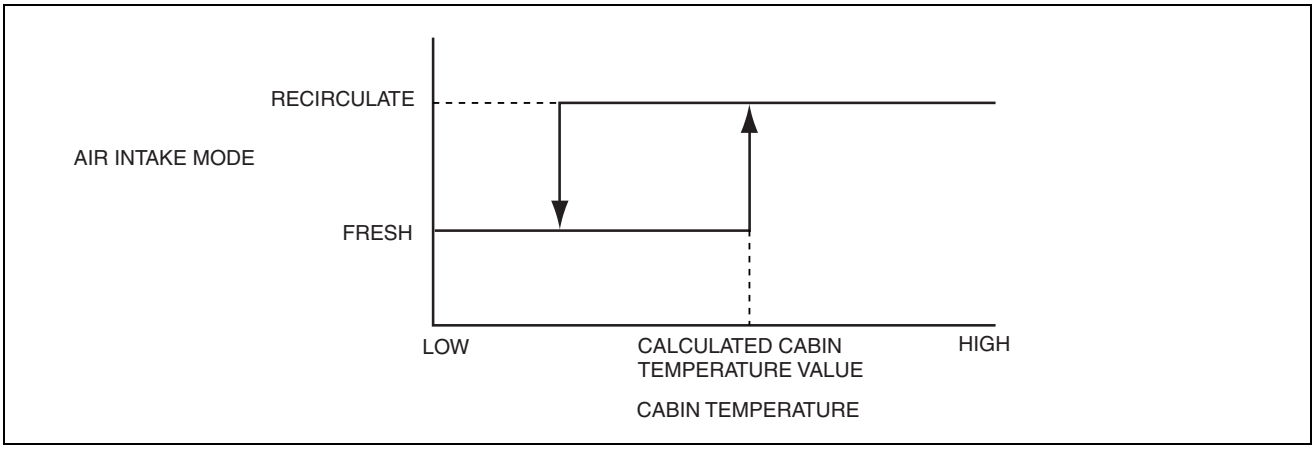
Air intake automatic control

- The climate control unit performs the control as follows so that the cabin temperature lowers quickly according to the cooling conditions.

1. Calculates the cabin temperature value based on the ambient temperature and sunlight intensity.
2. Compares the calculated cabin temperature value and current cabin temperature.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

3. Determines the air intake mode.



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Air intake manual control

- The climate control unit switches the air intake mode based on the REC/FRESH switch operation.

Air intake mode	REC switch operation
FRESH	Fixed to FRESH when the FRESH switch is turned on during REC mode
REC	Fixed to REC when the RECIRCULATE switch is turned on during FRESH mode

REC mode control under severe heat

- When the vehicle is driven at a very low speed with the A/C on under a severe heat condition, the climate control unit may change the air intake mode from FRESH to REC automatically.
- Due to this, load to the A/C compressor is reduced.
- When the air intake mode is switched to REC, the indicator on the REC switch illuminates.

Correction

Defroster correction

- The defroster correction improves the effect of defrosting.
- The air intake is fixed at FRESH when the defroster switch is turned on.
- The air intake is fixed at FRESH even if it has been set to REC manually.

Ambient temperature correction

- When the ambient temperature is **5 °C {41 °F}** or less, the air intake is fixed at FRESH to prevent window fogging. (Australian, General (R.H.D.) specs.)
- When the ambient temperature is **15 °C {59 °F}** or less, the air intake is fixed at FRESH to prevent window fogging. (except Australian, General (R.H.D.) specs.)

Construction

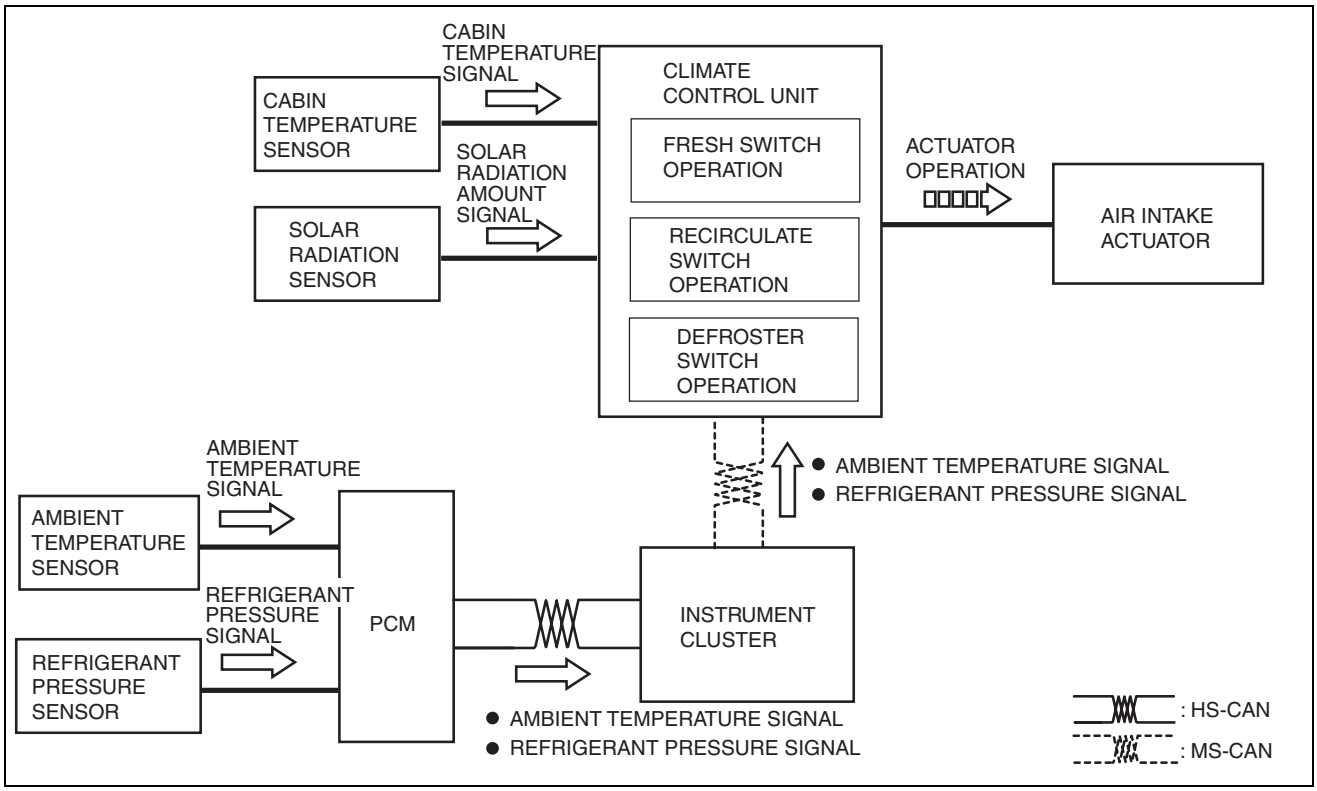
- The air intake control consists of the parts indicated in the following table:

Input device	Control part	Output device
• Recirculate switch (climate control unit) • Fresh switch (climate control unit) • Defroster switch (climate control unit) • Ambient temperature sensor • Cabin temperature sensor • Solar radiation sensor • Refrigerant pressure sensor	• Climate control unit • PCM • Instrument cluster	• Air intake actuator • Air intake door

Operation

1. The climate control determines the air intake mode based on the operations of the REC, FRESH, defroster switches and signals from each sensor which changes according to the vehicle environment.
2. The climate control unit drives the air intake actuator according to the result of the air intake mode determination and corrections.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



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A/C COMPRESSOR CONTROL [FULL-AUTO AIR CONDITIONER]

id0740a1108000

Purpose

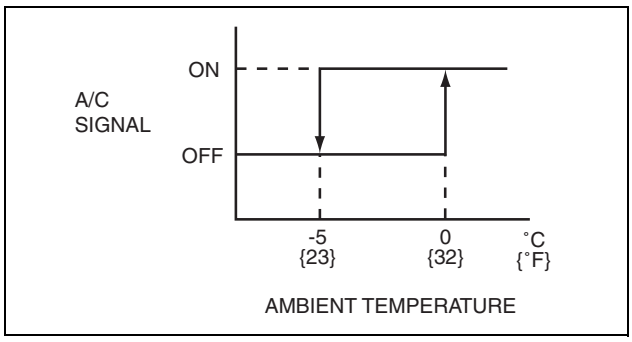
- The A/C compressor control switches the A/C compressor on/off according to the vehicle environment.

Function

- The A/C compressor control turns the A/C compressor on/off based on the climate control unit operation and signals from each sensor.
- The A/C compressor control has automatic and manual controls.
- The A/C compressor automatic control performs the following correction:
  — Defroster correction

A/C compressor automatic control

- The climate control unit determines the A/C ON/OFF mode based on the ambient temperature.
- The climate control unit determines the A/C signal on/off according to the air conditioner operation such as A/C ON mode (A/C switch ON) or AUTO mode (AUTO switch ON).



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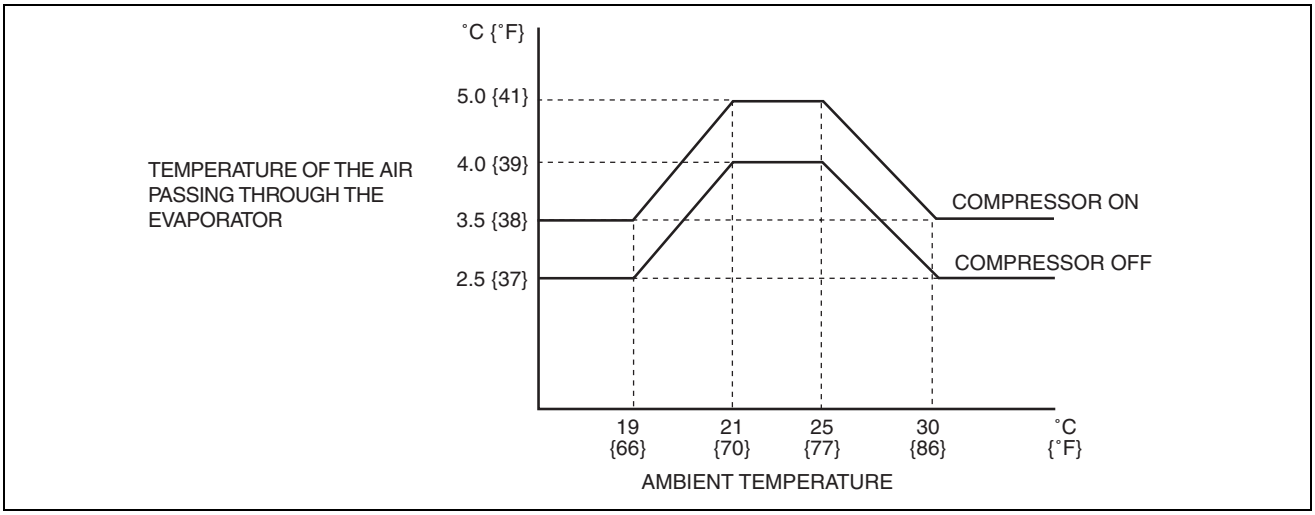
CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

- In A/C ON mode, the A/C signal (magnetic clutch) on/off is determined based on the ambient temperature and the temperature of the air passing through the evaporator.



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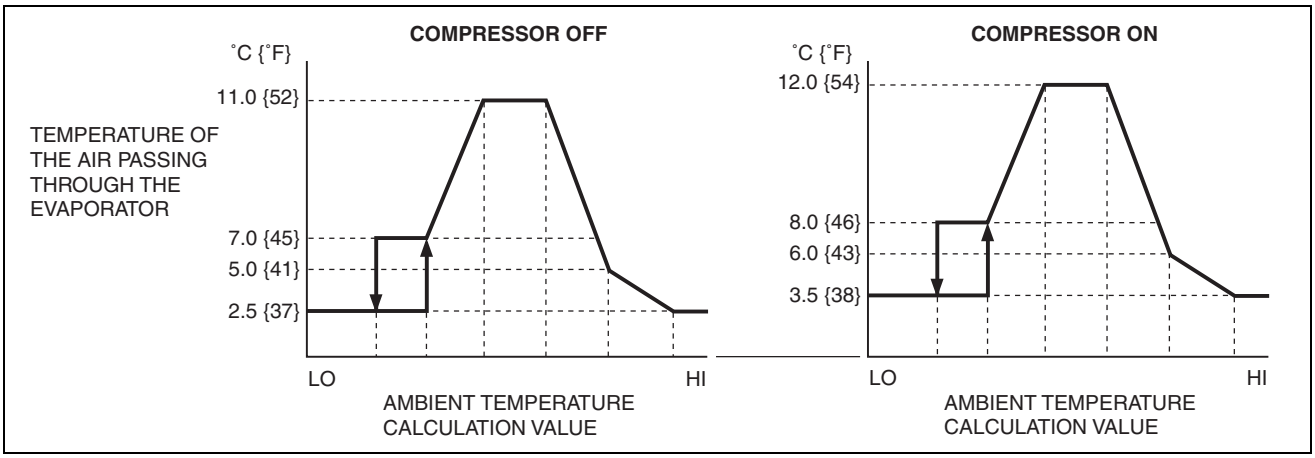
- In AUTO mode, the A/C signal (magnetic clutch) on/off is determined based on the ambient temperature calculation value and the temperature of the air passing through the evaporator.



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- The ambient temperature calculation value is calculated based on the ambient temperature, set temperature, cabin temperature, and sunlight intensity.
- When the ambient temperature is low, the A/C signal (magnetic clutch) OFF temperature is set lower to prevent window fogging.

A/C compressor manual control

- The climate control unit switches the A/C ON/OFF mode and ECO mode according to the A/C switch operation.

A/C mode		Operation condition
A/C ON mode (A/C display)	A/C mode (A/C display)	Fixed in A/C mode.
A/C OFF mode (No display)		Fixed in A/C OFF mode.
A/C ON mode (ECO display)	ECO mode (ECO display)	Fixed in ECO mode.

Correction

Defroster correction

- When the defroster switch is turned on, the system is switched to A/C ON mode to improve defogging.

Construction

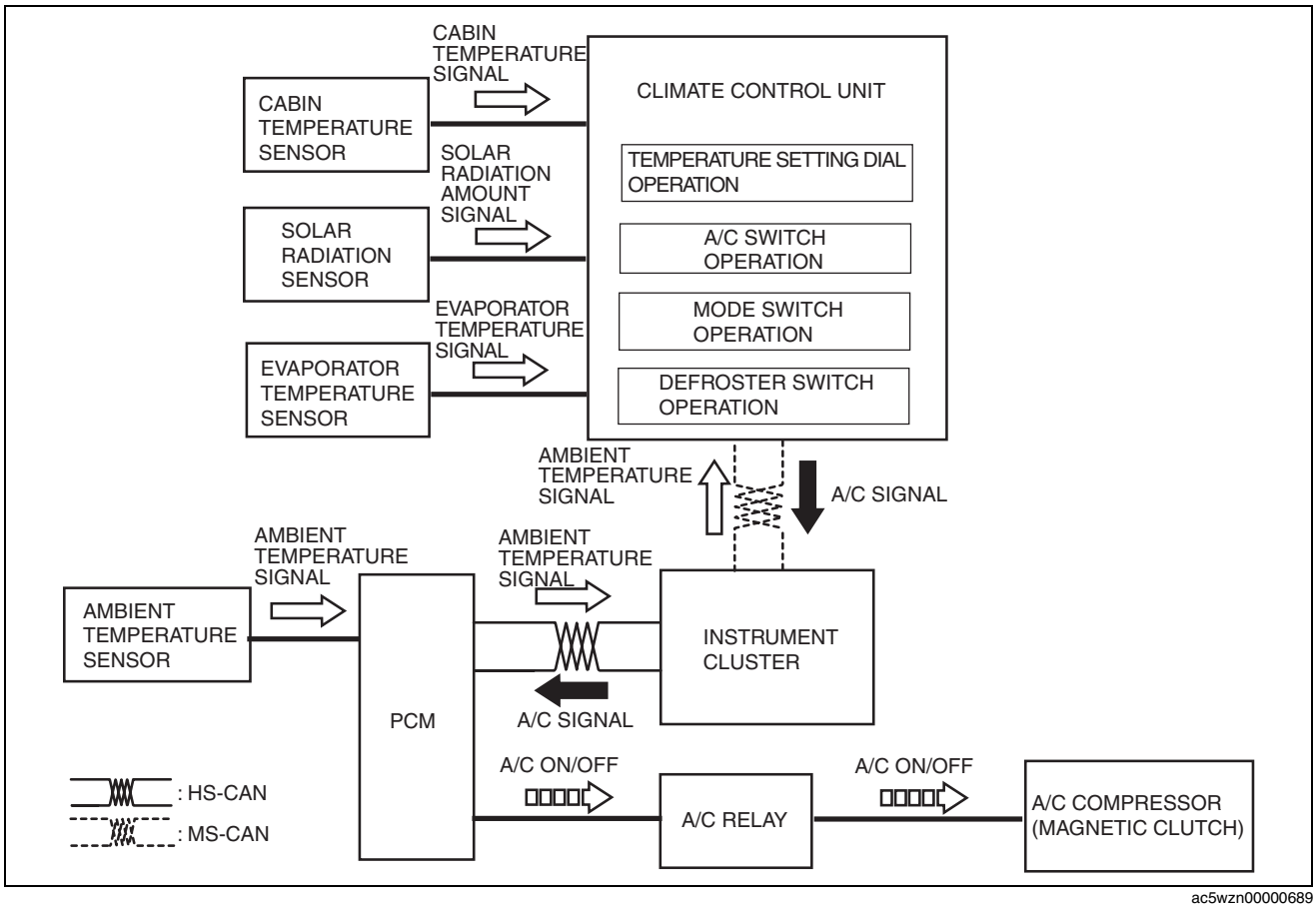
- The A/C compressor control consists of the parts indicated in the following table:

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Input device	Control part	Output device
• A/C switch (climate control unit) • Mode switch (climate control unit) • Temperature setting dial (climate control unit) • Refrigerant pressure sensor • Solar radiation sensor • Cabin temperature sensor • Ambient temperature sensor • Evaporator temperature sensor	• Climate control unit • PCM • Instrument cluster	• A/C relay • Magnetic clutch (A/C compressor)

Operation

1. The climate control determines the A/C ON/OFF based on the operations of each switch/dial and signals from each sensor which changes according to the vehicle environment.
2. The climate control unit sends the A/C signal to the PCM according to the result of the A/C ON/OFF determination and corrections.
3. When the PCM turns the A/C relay on based on the A/C signal, the magnetic clutch of the A/C compressor turns on.



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AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER]

id0740a1126800

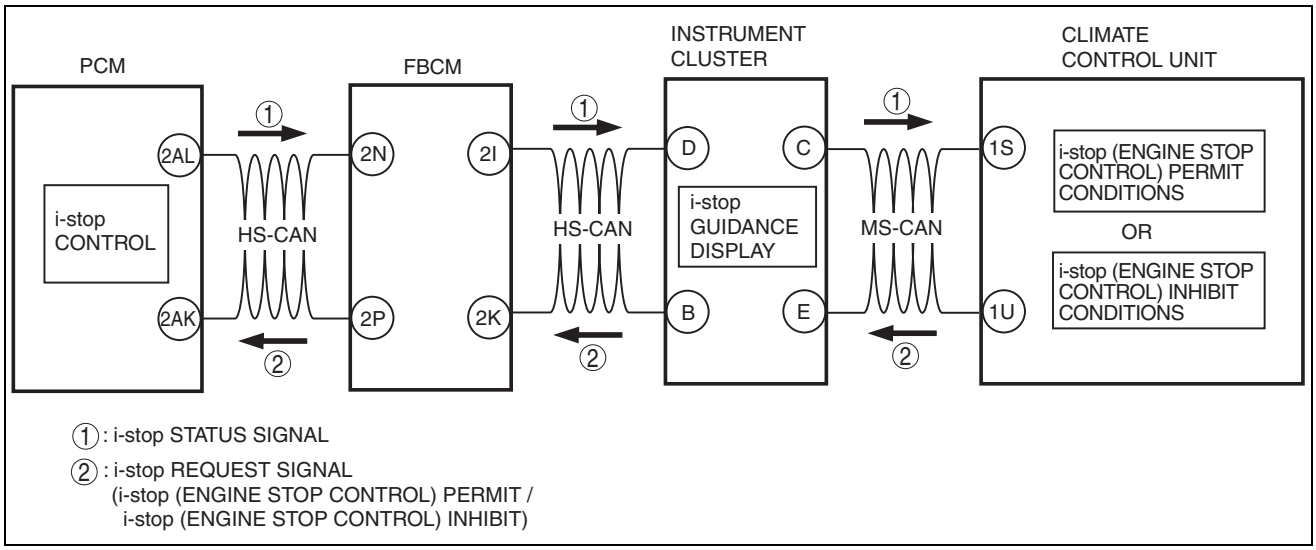
Purpose

- The heater control unit controls i-stop to permit/inhibit its operation (engine stop control) according to the air conditioner system operation conditions.

Function

- The climate control unit determines i-stop control according to the operation condition of the air conditioner system and sends i-stop request signals to the PCM.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



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Operation

i-stop request control (i-stop (engine stop control) permit/ i-stop (engine stop control) inhibit)

- The climate control unit sends i-stop (engine stop control) permit or i-stop (engine stop control) inhibit request signals to the PCM according to the operation condition of the air conditioner system.

i-stop (engine stop control) inhibit request

- The climate control unit sends an i-stop (engine stop control) inhibit request signal to the PCM when it detects any of the following conditions:

i-stop (engine stop control) inhibit conditions

No.	Item	Vehicle condition
1	Climate control unit malfunction determined	A DTC is detected in relation to the following parts: • Solar radiation sensor • Ambient temperature sensor • Cabin temperature sensor • Evaporator temperature sensor • Heater core temperature sensor • Engine coolant temperature sensor • Airflow mode actuator • Air mix actuator
2	CAN line error determined	Signal reception error occurs on climate control unit side in relation to the following signals: • Ambient temperature signal • Engine coolant temperature signal • Engine operation status signal (i-stop status signal)
3	Ambient temperature	Ambient temperature is **-10 °C {14 °F} or below**, or **50 °C {122 °F} or more**
4	Airflow mode control status	During manual defroster control
5	Set temperature, compressor control mode	MAX HOT or MAX COLD (A/C or ECO mode)
6	Auto air conditioner target temperature attainment status	If any of the following signals do not meet the i-stop (engine stop control) permit conditions (Comfortable cabin temperature control not performed): • Cabin temperature (cabin target temperature and cabin temperature relation) • Evaporator temperature • Heater core temperature

i-stop (engine stop control) permit request

- The climate control unit sends an i-stop (engine stop control) permit request signal to the PCM when it detects any of the following conditions:

i-stop (engine stop control) permit conditions

No.	Item	Vehicle condition
1	Blower motor control status	• Blower motor is off • However, i-stop (engine stop control) inhibit conditions No.1 to 3 must not be in effect.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

No.	Item	Vehicle condition
2	Set temperature, compressor control mode	• MAX COLD • Compressor control: Off • Blower motor is ON • However, i-stop (engine stop control) inhibit conditions No.1 to 4 must not be in effect.
3	Auto air conditioner target temperature attainment status	• Blower motor is ON • Compressor control: ON • The relation between the cabin target temperature and cabin temperature meets the i-stop (engine stop control) permit conditions (comfortable cabin temperature control is performed) • However, i-stop (engine stop control) inhibit conditions No.1 to 6 must not be in effect.

A/C control start during i-stop (engine stop control)

- When the A/C operation is stopped by the i-stop control, and while i-stop (engine stop control) permit condition No. 3 is met, the climate control unit starts A/C control corresponding to the engine-stop condition if it detects an engine-stop condition based on the i-stop condition signal sent from the PCM.
- If the engine is stopped during A/C control, the A/C compressor magnetic clutch turns off and the A/C indicator light remains in an illuminated condition. When the engine is restarted, the A/C compressor magnetic clutch turns on again.

Recovery to normal A/C control

- When recovery condition a or b is met while the engine is stopped by the i-stop control, the climate control unit sends an engine restart request signal to the PCM.
- It returns to the normal A/C control when the engine is restarted.

Recovery condition a:

- i-stop cancel determination condition is met

i-stop (engine stop control) cancel determination conditions

Compressor control mode	Airflow mode		
	VENT	BI-LEVEL	HEAT, DEF/HEAT, DEFROSTER
A/C, ECO, OFF	If the following conditions are met: • Evaporator temperature is at i-stop control specification or more	If any one of the following conditions are met: • Evaporator temperature is at i-stop control specification or more • Heater core temperature is at i-stop control specification or less	If the following conditions are met: • Heater core temperature is at i-stop control specification or less

Recovery condition b:

- Any one of the following i-stop (engine stop control) inhibit conditions is met
  - — No.1 climate control unit malfunction determination
  - — No.2 CAN transmission error determination
  - — No.4 mode control status
  - — No.5 set temperature, compressor control mode

PTC HEATER [FULL-AUTO AIR CONDITIONER]

id0740a1701000

Purpose

- The PTC heater is a supplementary heater to temporarily improve the A/C unit heating performance for diesel engine vehicles which have good thermal efficiency.

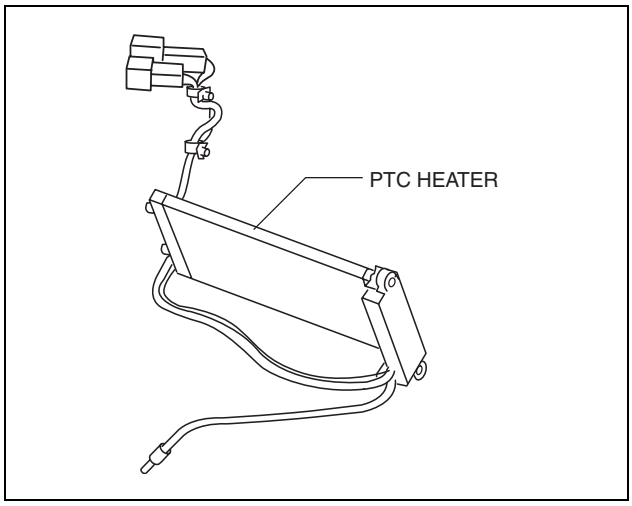
Function

- The PTC heater generates heat based on the operation signal from the front body control module (FBCM) and warms the air passing through the A/C unit.

Construction

- The PTC heater consists of a film heater element, aluminum fin, and brass plate. Heat is generated by the flow of electrical current to the heater element.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



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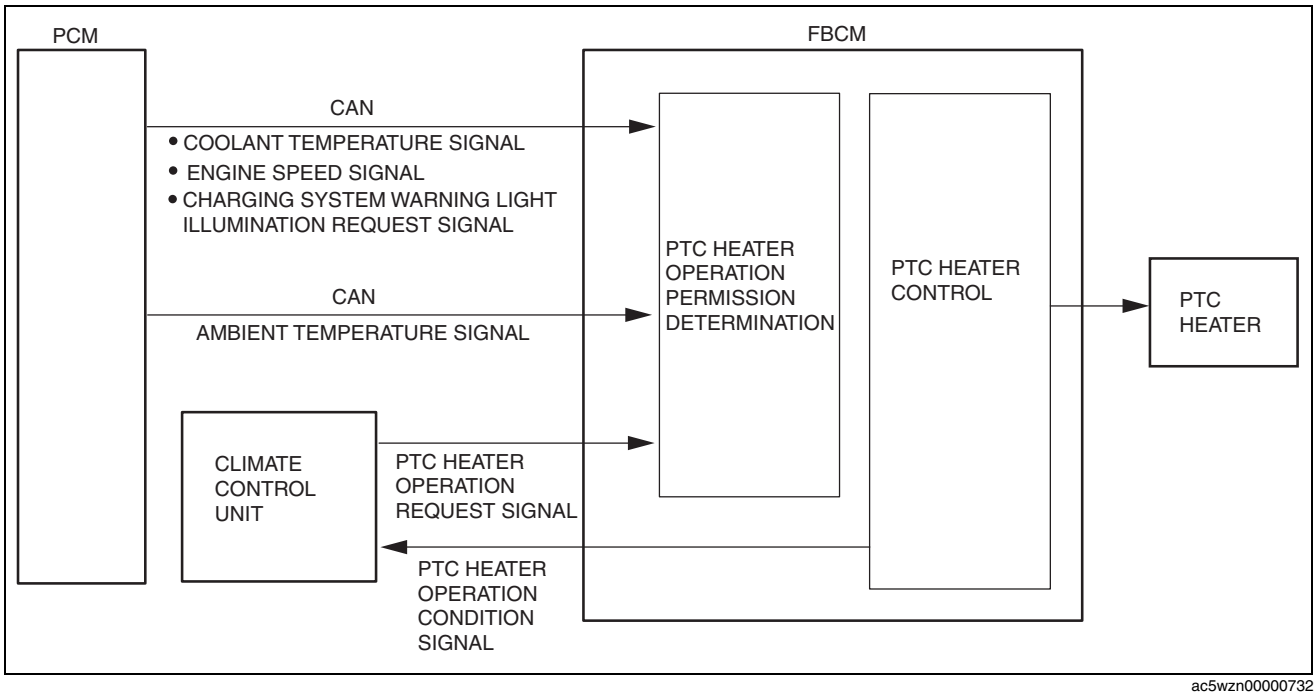
Operation

- The instrument cluster operates the PTC heater when all of the following conditions are met.
  - — During engine start (engine speed is **400 rpm or more**)
  - — Ambient temperature signal is less than **20 °C {68 °F}**
  - — Coolant temperature signal is less than **70 °C {158 °F}**
  - — PTC heater operation request signal is received (See 07-40A-44 PTC Heater Operation Request Signal.)
  - — Charging system warning light illumination request signal is not received



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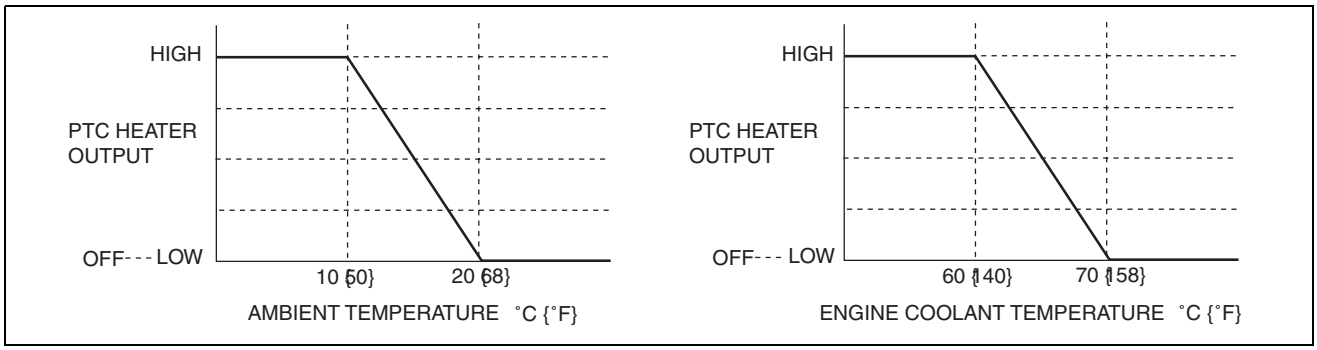
- The front body control module (FBCM) compares the PTC heater output values calculated from the ambient temperature and the engine coolant temperature information, and determines the lower value as the PTC heater output. As a result, the PTC heater generation amount is controlled to switch gradually according to the ambient temperature and the engine coolant temperature.

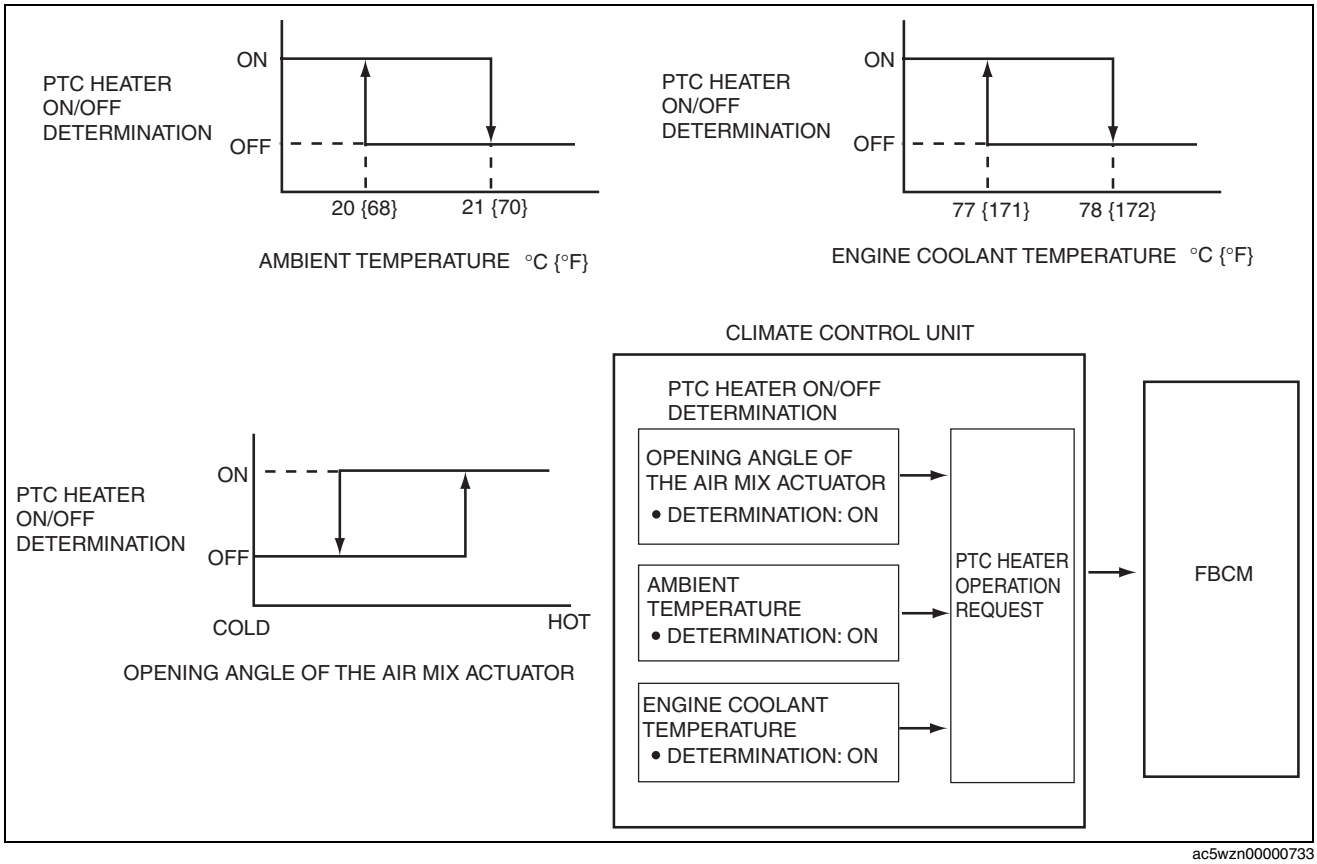
CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



PTC heater output for ambient temperature	PTC heater output for engine coolant temperature	PTC heater output determination
Low	High	Ambient temperature side
High	Low	Engine coolant temperature side

PTC Heater Operation Request Signal

- When all of the PTC heater on/off determinations are determined to be ON based on the opening angle of the air mix actuator, ambient temperature, and engine coolant temperature information with the blower on, the climate control unit outputs a PTC heater operation request signal to the front body control module (FBCM).



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Fail-safe

- If each signal input from the PCM cannot be received or the charging system warning light illumination request signal is received, the front body control module (FBCM) inhibits the PTC heater operation.

WATER PUMP [FULL-AUTO AIR CONDITIONER]

id0740a1718800

Purpose

- While the engine is stopped by the i-stop control in a cold environment, the water pump maintains the heating performance for a certain period.
- By ensuring the heating performance using the water pump, the engine-stop period by the i-stop control is extended (**approx. 120 s**).

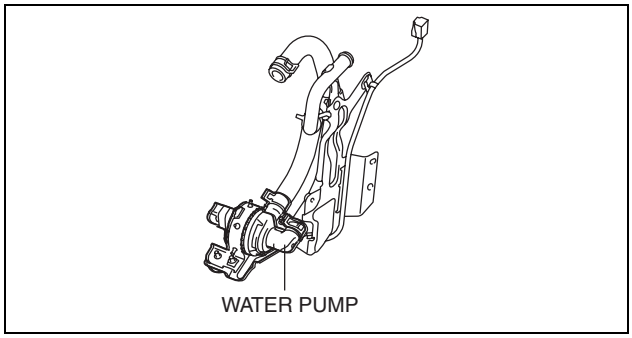
CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]

Function

- The water pump circulates hot engine coolant and sends it to the heater core in the A/C unit.
- When all of the following conditions are met, the climate control unit drives the water pump.
  - — Engine currently stopped by i-stop control
  - — Airflow mode is in either BI-LEVEL, HEAT, DEF/HEAT, or DEFROSTER mode
  - — Ambient temperature is lower than the estimated driver-side airflow temperature (when air intake mode is at FRESH)
  - — Cabin temperature is lower than the estimated driver-side airflow temperature (when air intake mode is at REC)
- The climate control unit calculates the estimated driver-side airflow temperature based on the following signals:
  - — Evaporator temperature signal

Construction

- The water pump is installed in the engine compartment and located between the engine and the A/C unit.



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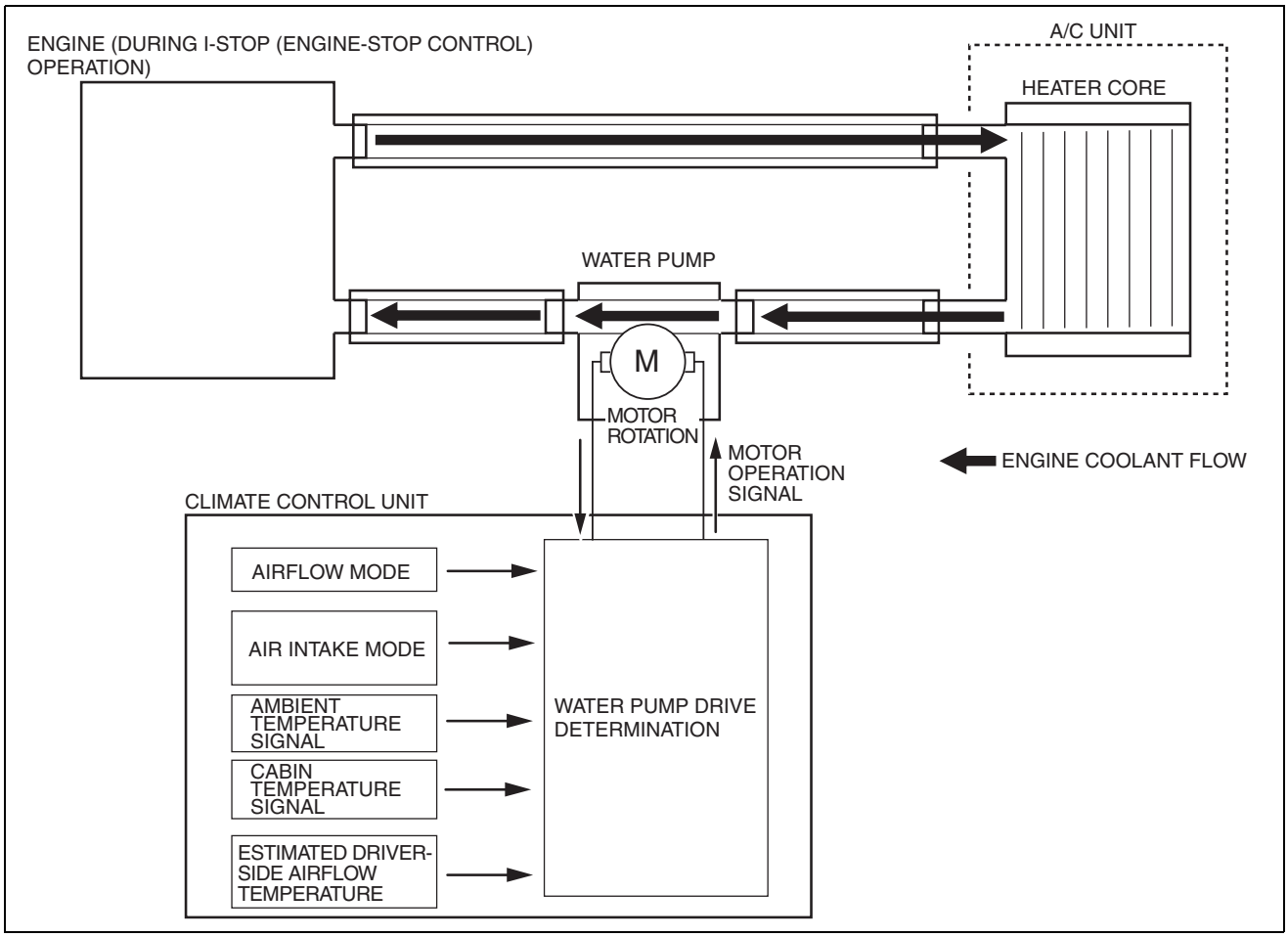
Operation

1. The water pump rotates the motor according to the operation signal from the climate control unit.
2. When the motor rotates, the engine coolant warmed by the engine heat is sent to the heater core.
3. By sending engine coolant to the heater core using the motor even though the engine is stopped, the heating performance is maintained temporarily.

CONTROL SYSTEM [FULL-AUTO AIR CONDITIONER]



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Fail-safe

- Function not equipped.

07-40B CONTROL SYSTEM [MANUAL AIR CONDITIONER]

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

id0740a2126500

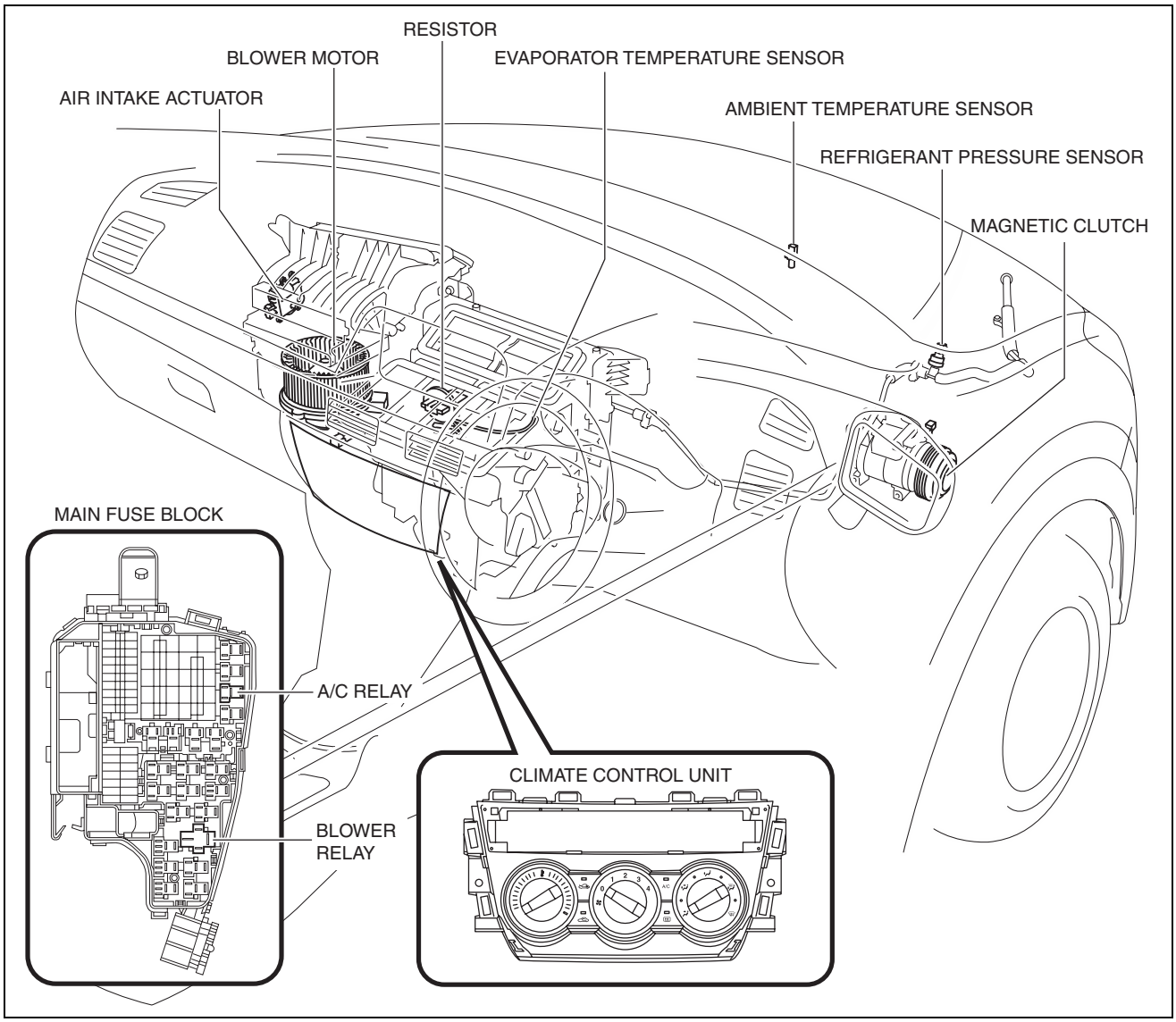
Outline

- Refrigerant pressure sensor adopted in which refrigerant pressure is changed into a linear electric signal and precise information is transmitted.
- Climate control unit with enlarged operation dials and switches adopted
- A PTC heater has been adopted to temporarily improve the A/C unit heating performance for diesel engine vehicles which have good thermal efficiency (with PTC heater).

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

Structural View

R.H.D.



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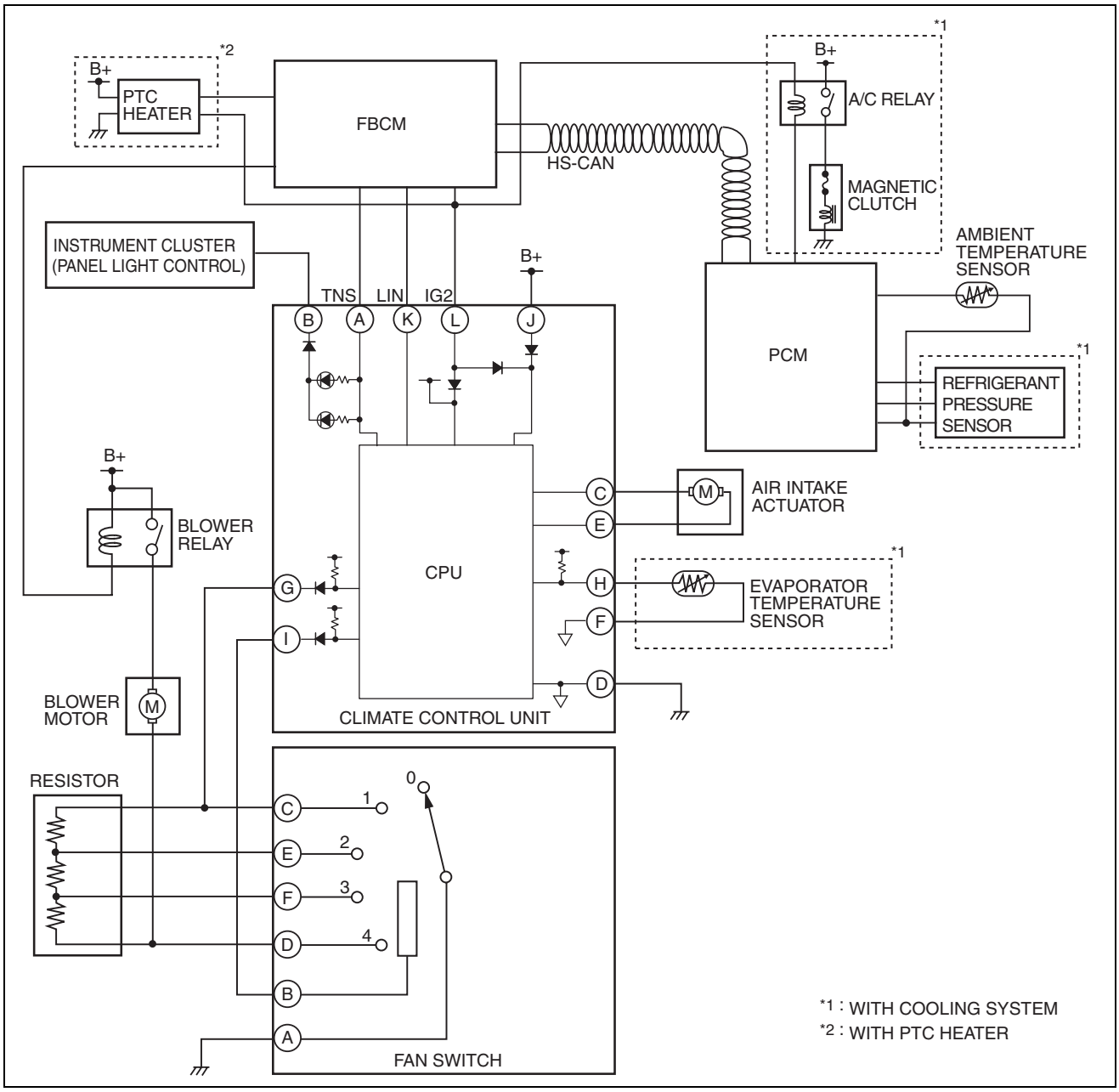
CONTROL SYSTEM [MANUAL AIR CONDITIONER]

System Wiring Diagram



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AIR INTAKE ACTUATOR [MANUAL AIR CONDITIONER]

id0740a2320400

Purpose

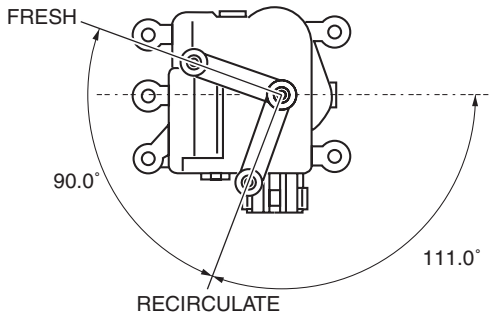
- The air intake actuator moves the air intake door in the blower unit to switch the air intake port.

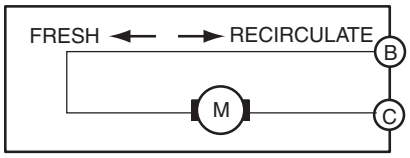
Function

- The air intake actuator drives the motor based on the signal from the climate control unit and moves the air intake door to the FRESH or REC position.

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

R.H.D.





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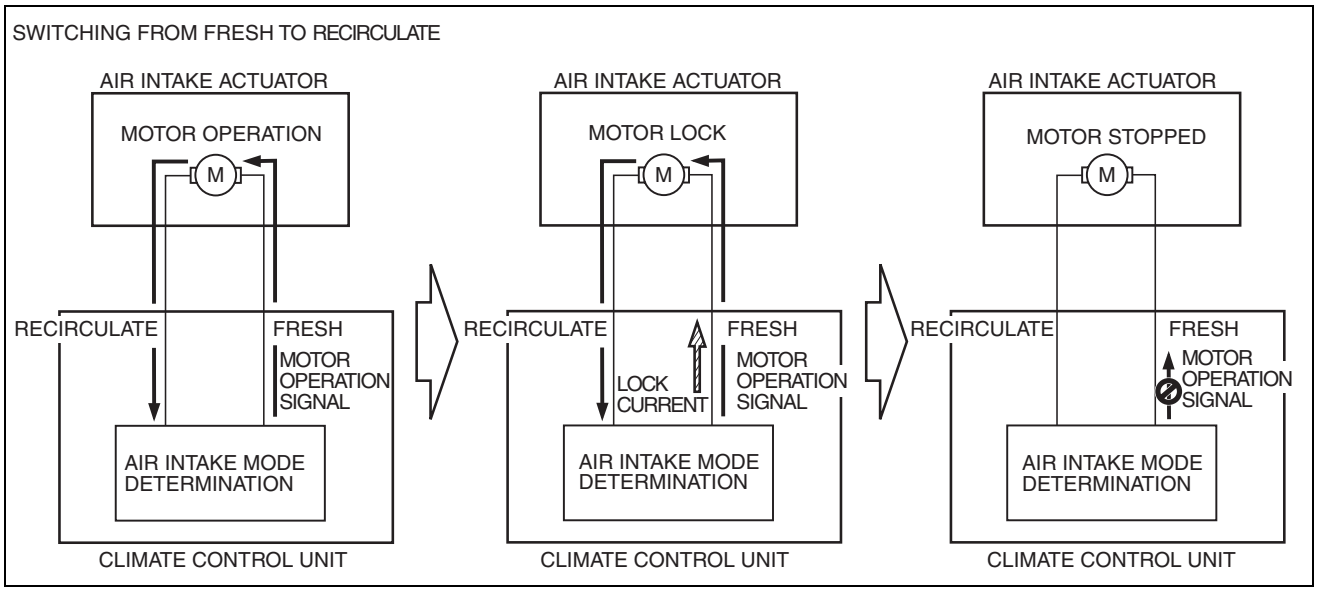
Construction

- A mechanical lock-type air intake actuator has been adopted.
- The air intake actuator is installed to the blower unit.

Operation

1. The climate control unit outputs a motor drive signal to the air intake actuator based on the air intake mode determined by the air intake control.
2. When the air intake actuator moves to FRESH or REC, the motor locks.
3. When the motor locks and is under excessive load, the current value flowing from the climate control unit increases more than the specification (lock current).
4. When the lock current is detected, the climate control unit stops the motor drive signal to the air intake actuator.

CONTROL SYSTEM [MANUAL AIR CONDITIONER]



ac5wzn00000749

Fail-safe
- Function not equipped.

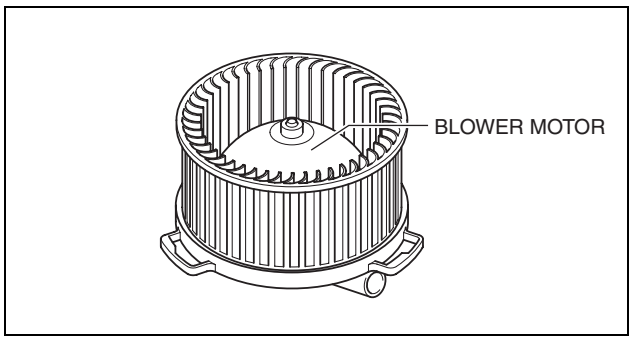
BLOWER MOTOR [MANUAL AIR CONDITIONER]

id0740a2320800

Purpose
- The blower motor sends airflow into the cabin.

Function
- The blower motor rotates the blower fan to create airflow and sends out the airflow in the blower unit and A/C unit.

Construction
- The blower motor is installed to the blower unit.
- The blower motor consists of the blower fan and motor.
- A sirocco fan has been adopted for the blower fan.



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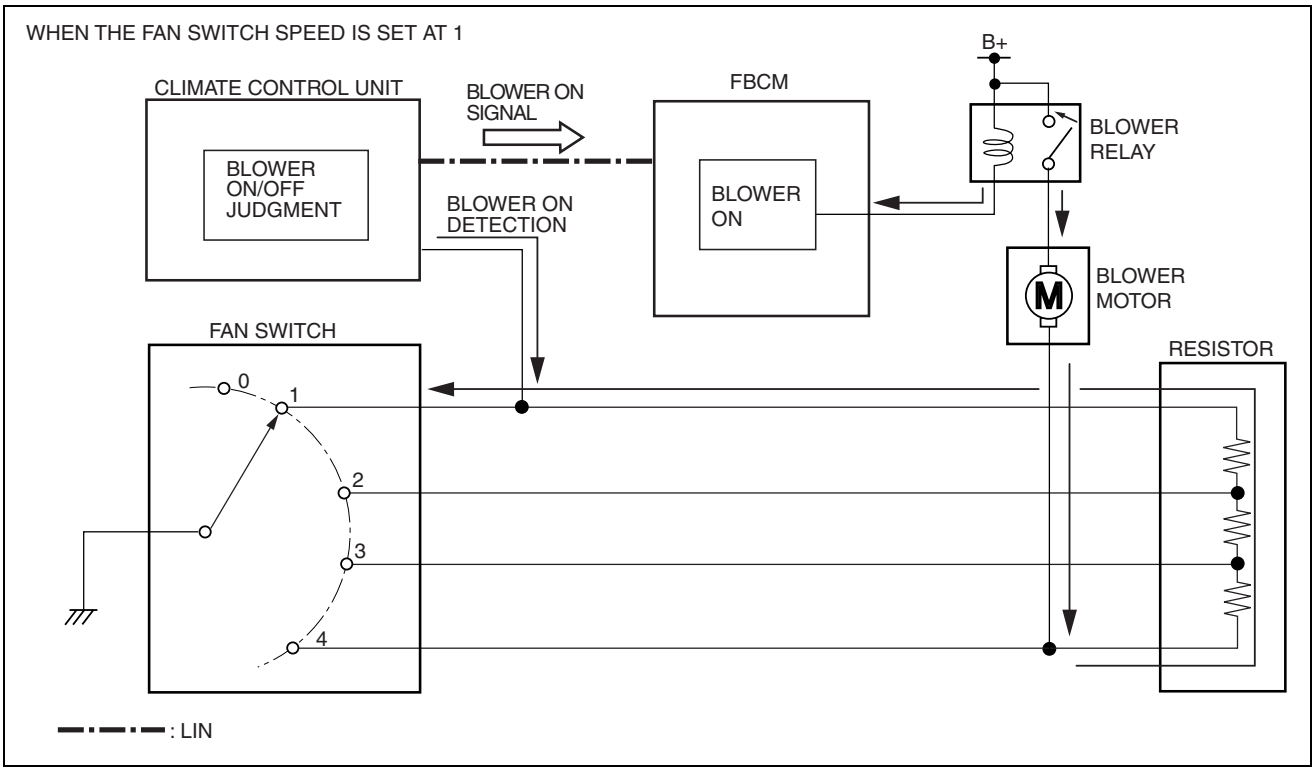
Operation
1. The front body control module (FBCM) turns on the blower relay based on the blower ON signal sent from the climate control unit.
2. When the blower relay turns on, the blower motor fan rotates.
3. The rotation speed of the blower fan is determined by the resistance in the resistor. If the resistance is low, the rotation speed increases, if the resistance is high, the speed decreases.

CONTROL SYSTEM [MANUAL AIR CONDITIONER]



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Fail-safe

- Function not equipped.

MAGNET CLUTCH [MANUAL AIR CONDITIONER]

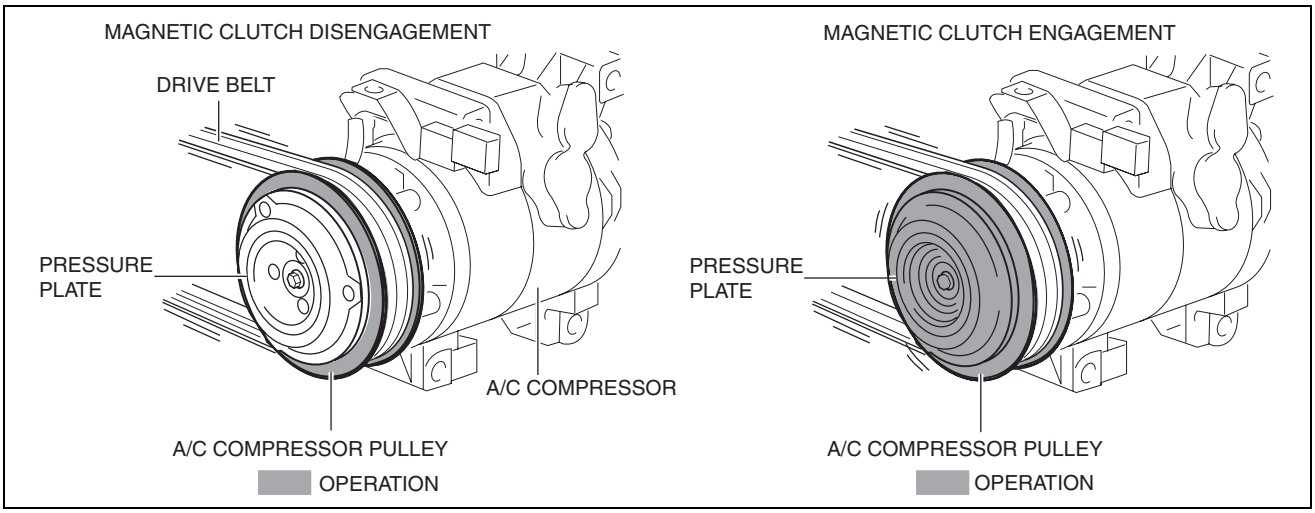
id0740a2320900

Purpose

- The magnetic clutch transmits the rotation force from the engine to the shaft in the A/C compressor.

Function

- The magnetic clutch engages or disengages the magnetic clutch and the A/C turns on or off by switching the power transmission from the engine.



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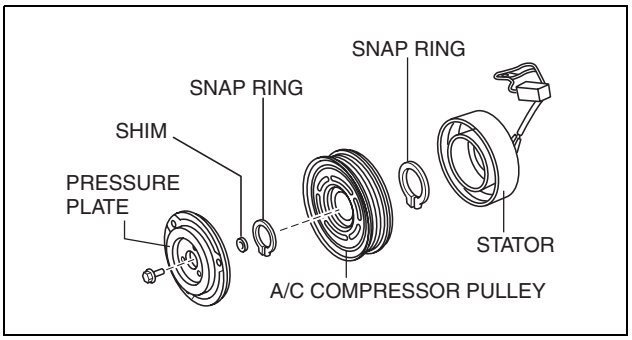
Construction

- The magnetic clutch is installed to the A/C compressor.

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

- The magnetic clutch consists of the following parts:
  - — Pressure plate
  - — A/C compressor pulley
  - — Stator
  - — Snap ring
  - — Shim



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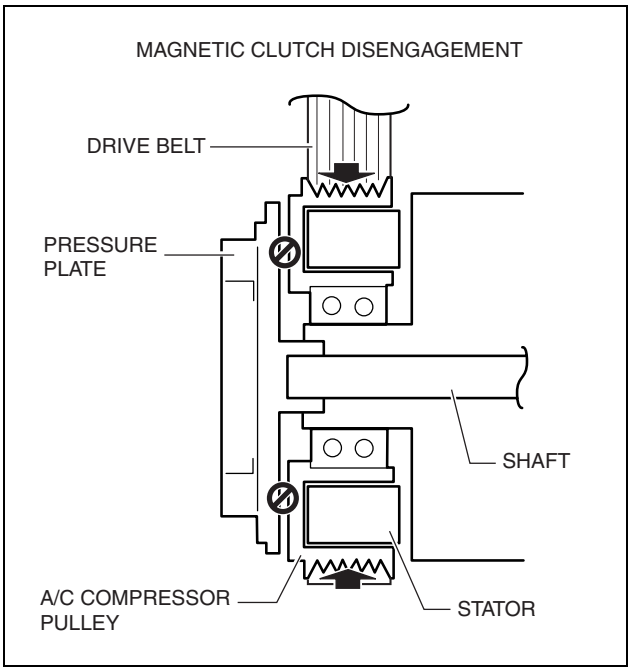
Operation

Magnetic clutch disengagement

1. If there is no energization in the magnetic clutch stator from the A/C relay, the pressure plate cannot be engaged with the A/C compressor pulley because the magnetic clutch stator does not operate.
2. The rotation force from the drive belt is only transmitted to the A/C compressor pulley and the pulley spins.



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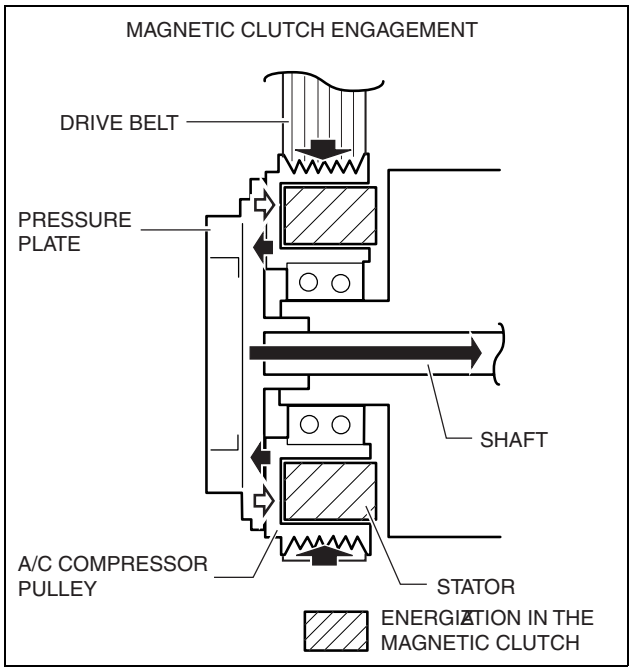
CONTROL SYSTEM [MANUAL AIR CONDITIONER]

Magnetic clutch engagement

1. If there is energization in the magnetic clutch stator from the A/C relay, the magnetic clutch stator operates and the pressure plate is engaged with the A/C compressor pulley.
2. The rotation force from the drive belt is transmitted to the compressor shaft through the pressure plate from the A/C compressor pulley.



ac5wzn00001236

Fail-safe

- Function not equipped.

RESISTOR [MANUAL AIR CONDITIONER]

id0740a2106800

Purpose

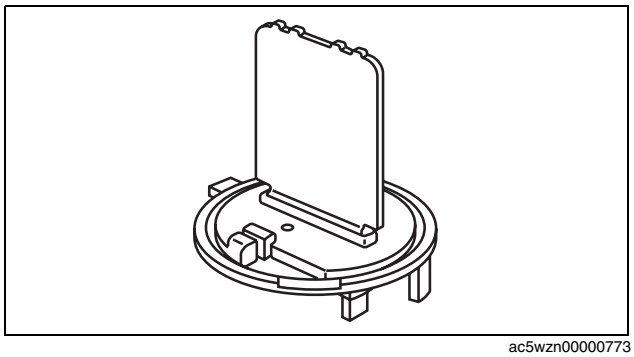
- The resistor controls the blower motor rotation speed.

Function

- The resistor controls the supply voltage to the blower motor according to the fan switch operation, and adjusts the fan rotation speed (airflow volume).

Construction

- The resistor is installed to the A/C unit.
- A thin, card-type resistor has been adopted for weight reduction.

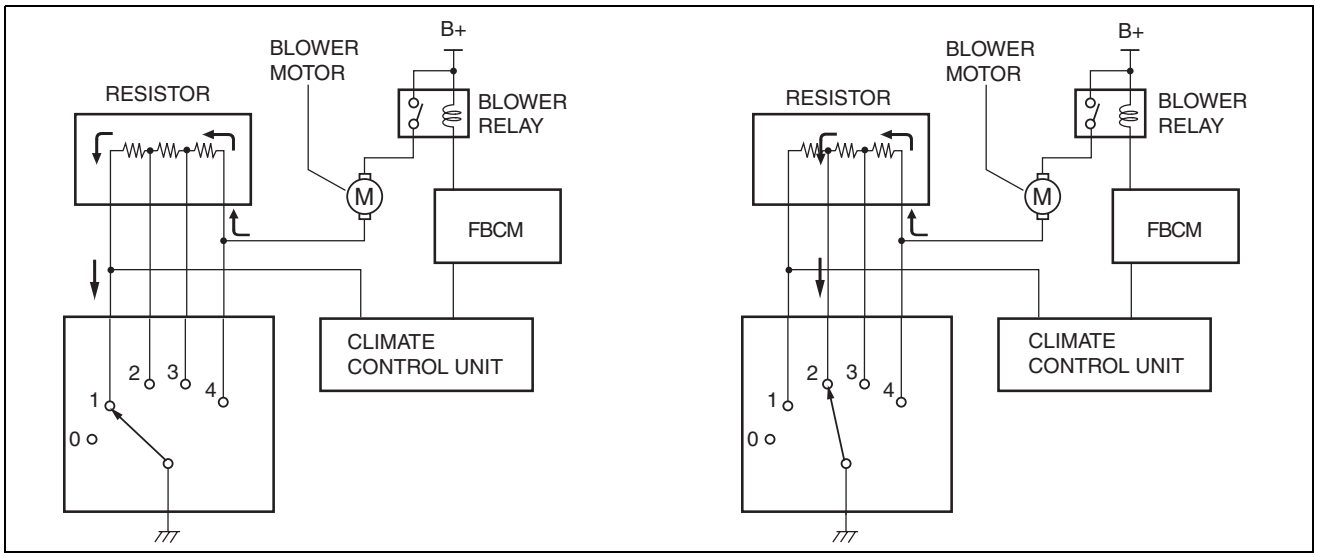


ac5wzn00000773

Operation

1. When the fan switch speed is set at 1, the resistor internal resistance increases and the blower motor applied voltage decreases. Therefore, the blower motor rotation speed decreases.
2. The resistor internal resistance decreases as the voltage applied to the blower motor by the fan switch increases in speed to 2, 3, and 4. Therefore, the blower motor rotation speed increases.

CONTROL SYSTEM [MANUAL AIR CONDITIONER]



ac5wzn00000774

Fail-safe
- Function not equipped.

AMBIENT TEMPERATURE SENSOR [MANUAL AIR CONDITIONER]

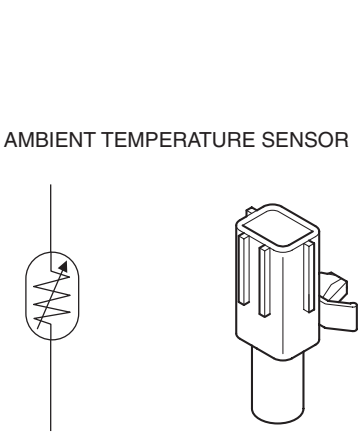
id0740a2321200

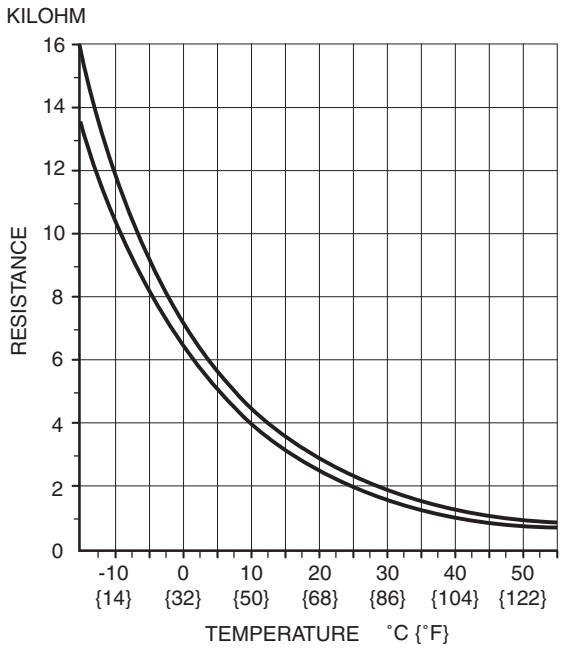
Purpose
- The ambient temperature sensor detects the ambient temperature.

Function
- The ambient temperature sensor converts the detected temperature to an electric signal.

Construction
- A thermistor-type ambient temperature sensor has been adopted.
- The ambient temperature sensor is installed to the shroud panel on the back side of the front bumper.

Operation
- The thermistor changes the resistance according to the surrounding temperature.
- The resistance decreases if the temperature increases, and conversely increases if the temperature decreases as shown in the figure.





ac5wzn00000728

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

Fail-safe
- Function not equipped.

EVAPORATOR TEMPERATURE SENSOR [MANUAL AIR CONDITIONER]

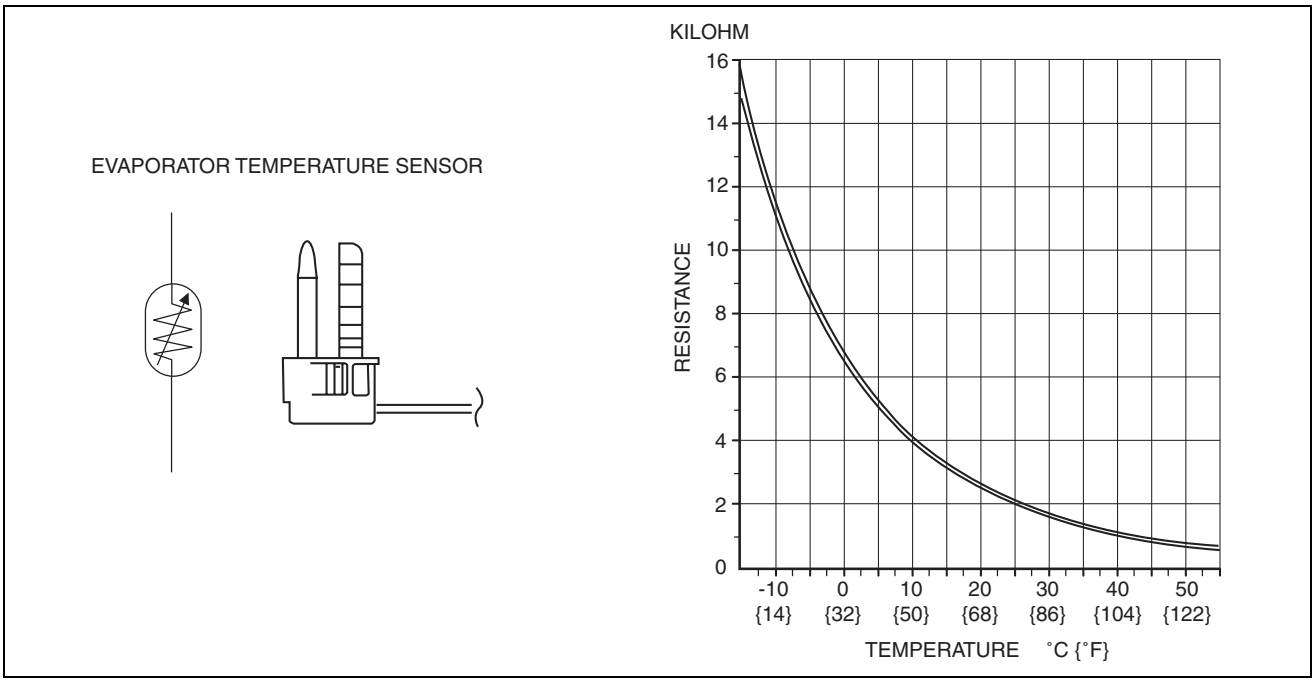
id0740a2321500

Purpose
- The evaporator temperature sensor detects the airflow temperature passing through the evaporator.

Function
- The evaporator temperature sensor converts the detected temperature to an electric signal.

Construction
- A thermistor-type evaporator temperature sensor has been adopted.
- A fin-thermo-type sensor has been adopted to the sensor area of the evaporator temperature sensor which inserts between the evaporator fins.
- The evaporator temperature sensor is installed to the A/C unit.

Operation
- The thermistor changes the resistance according to the surrounding temperature.
- The resistance decreases if the temperature increases, and conversely increases if the temperature decreases as shown in the figure.



Fail-safe
- Function not equipped.

REFRIGERANT PRESSURE SENSOR [MANUAL AIR CONDITIONER]

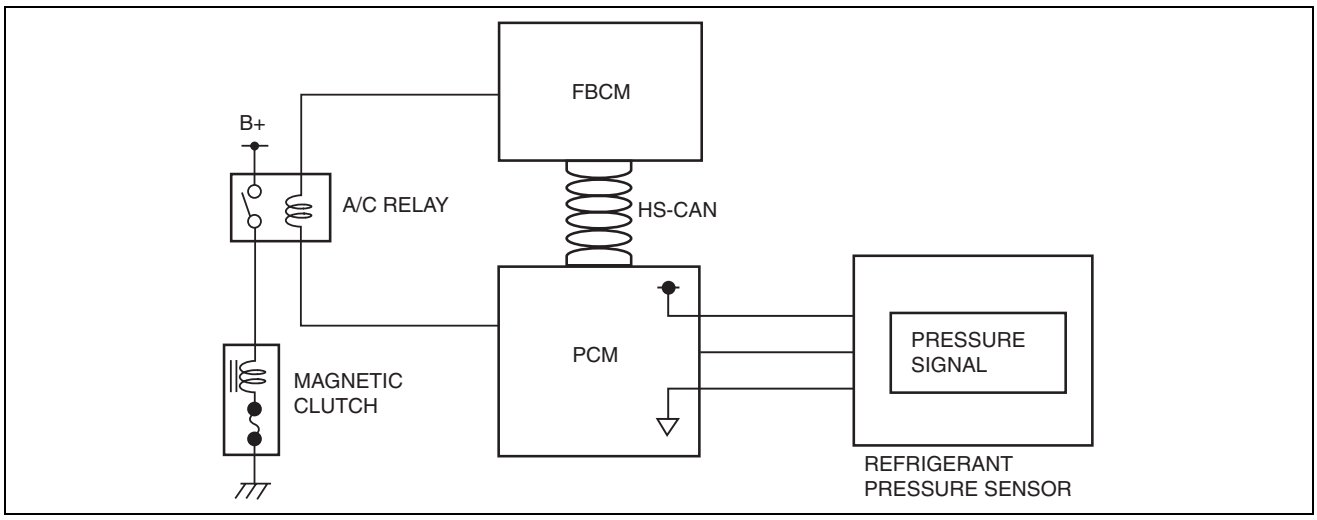
id0740a2126200

Purpose
- The refrigerant pressure sensor detects the refrigerant pressure in the refrigerant cycle.

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

Function

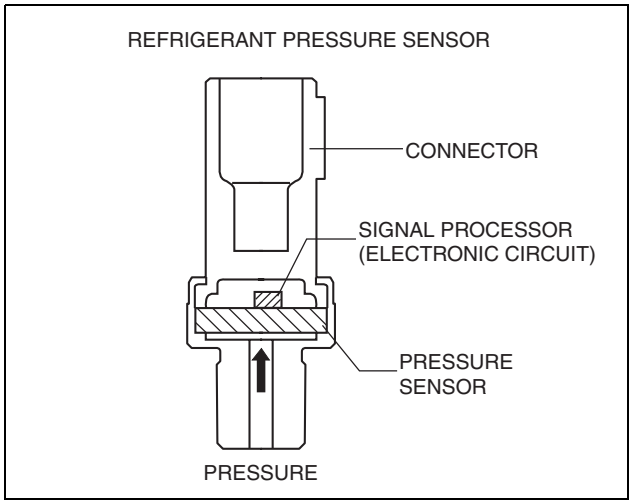
- The refrigerant pressure sensor converts the detected refrigerant pressure to an electric signal and sends it to the PCM.



ac5wzn00000738

Construction

- The refrigerant pressure sensor is installed on the cooler pipe.
- A capacitance type refrigerant pressure sensor, which converts refrigerant pressure into a linear electric signal, has been adopted.
- Consists of a pressure detecting part and signal processing part.
- The pressure detecting part is a variable capacity condenser, which changes capacitance according to the pressure.
- The signal processing part detects the capacitance of pressure detecting part, converts it to voltage, then outputs it to the climate control unit.



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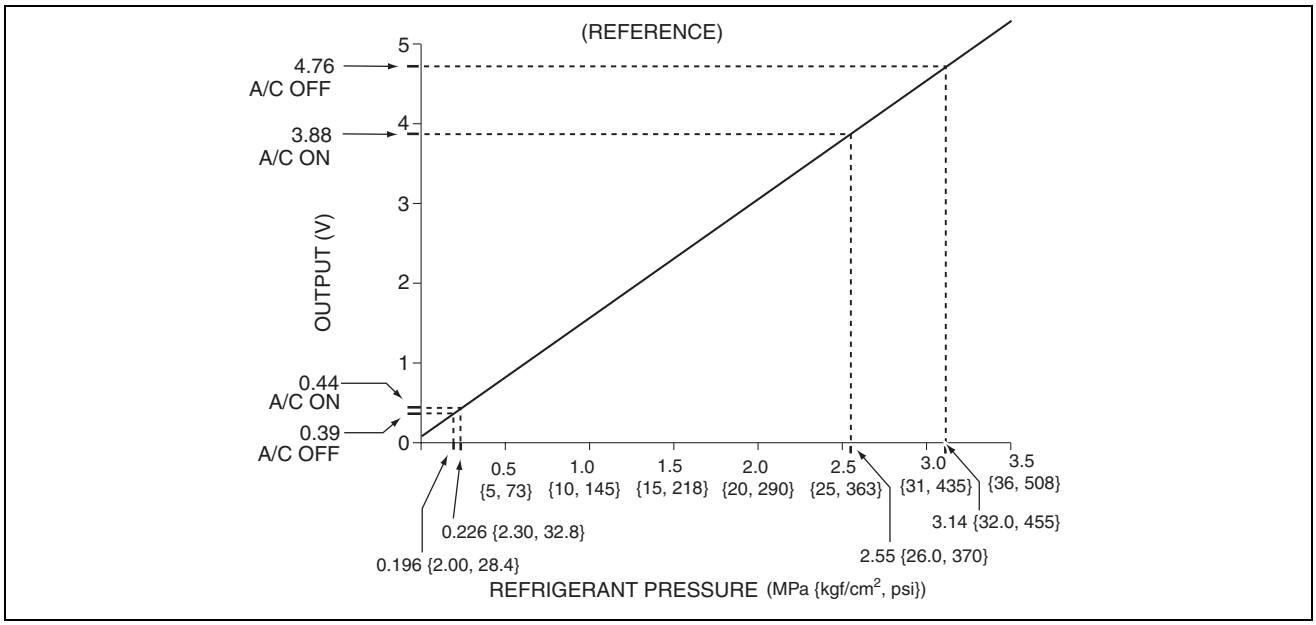
CONTROL SYSTEM [MANUAL AIR CONDITIONER]

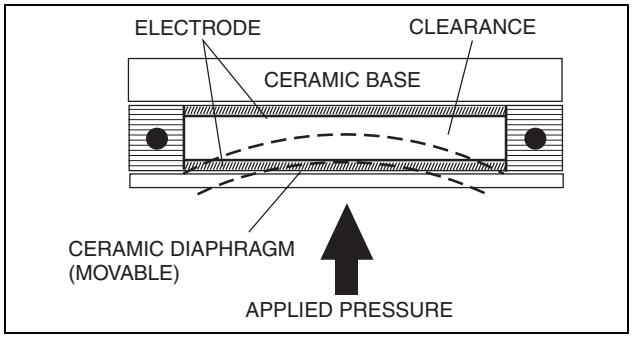


ac5wzn00000740

Operation

Capacitance type

- There is a clearance between the movable ceramic diaphragm and the ceramic base, and each side has an electrode.
- When pressure is applied from the ceramic diaphragm side, the ceramic diaphragm deforms, and the clearance between the electrodes changes. As a result, capacitance is changed and pressure is detected.



ac5wzn00000741

Fail-safe

- Function not equipped.

CLIMATE CONTROL UNIT [MANUAL AIR CONDITIONER]

id0740a2320100

Purpose

- The climate control unit performs air conditioning according to the operation by the users and the driving conditions of the vehicle.

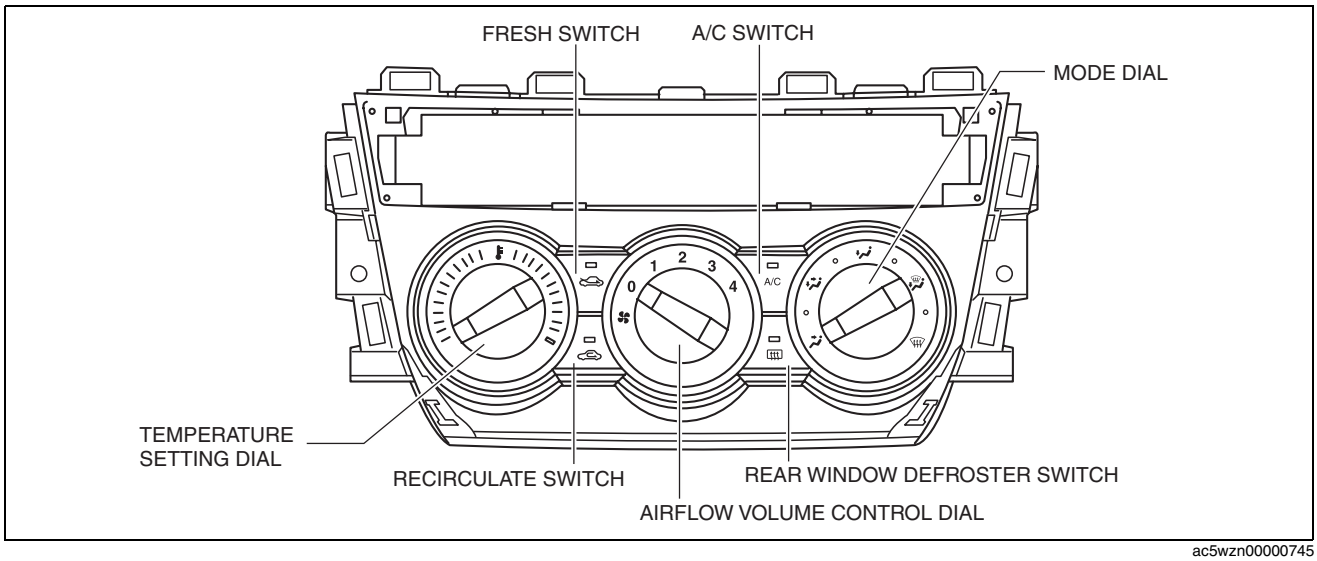
Function

- The climate control unit determines optimum air-conditioning based on the input signals from each sensor and the control module and the operation signals from the control panel, and controls each actuator, A/C compressor, and the blower motor. (See 07-40B-15 MANUAL AIR CONDITIONER CONTROL SYSTEM [MANUAL AIR CONDITIONER].)

Construction

- A wire-type climate control unit has been adopted.
- The climate control unit consists of a control panel and a control unit.
- The switches and dials shown in the figure are positioned on the control panel.

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

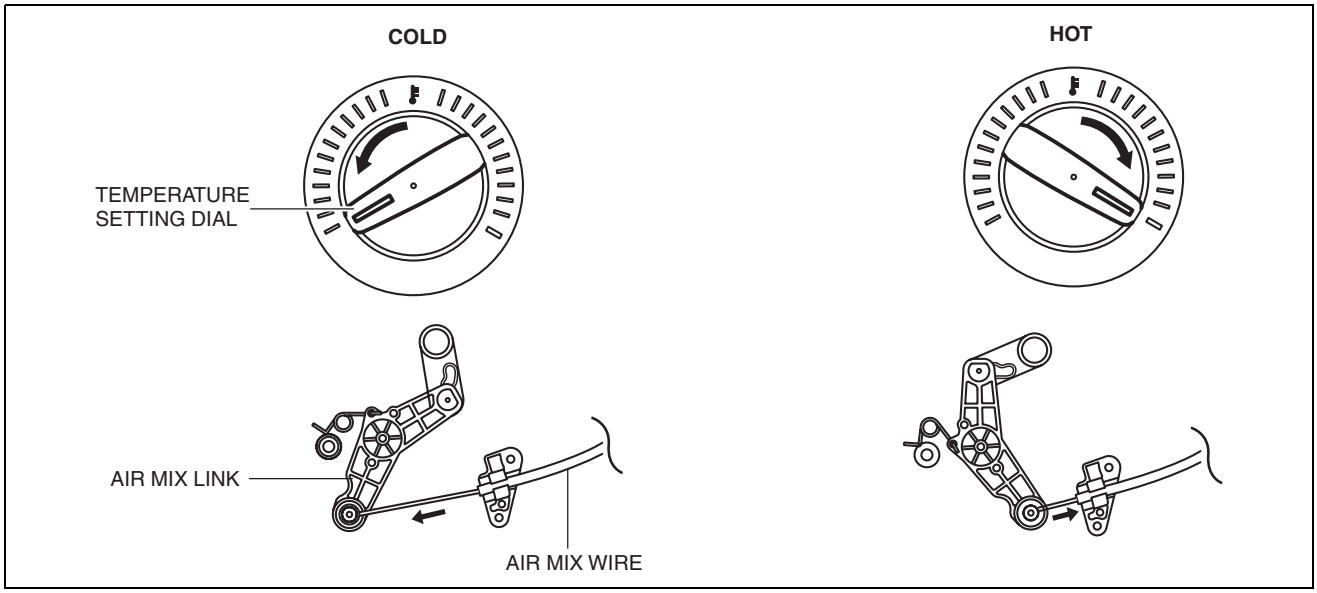


ac5wzn00000745

Operation

Airflow temperature setting

- When the temperature control dial is turned, the length of the air mix wire is changed, and the air mix door position is switched via the air mix link. As a result, the blower air temperature is changed. (See 07-11-8 A/C UNIT.)

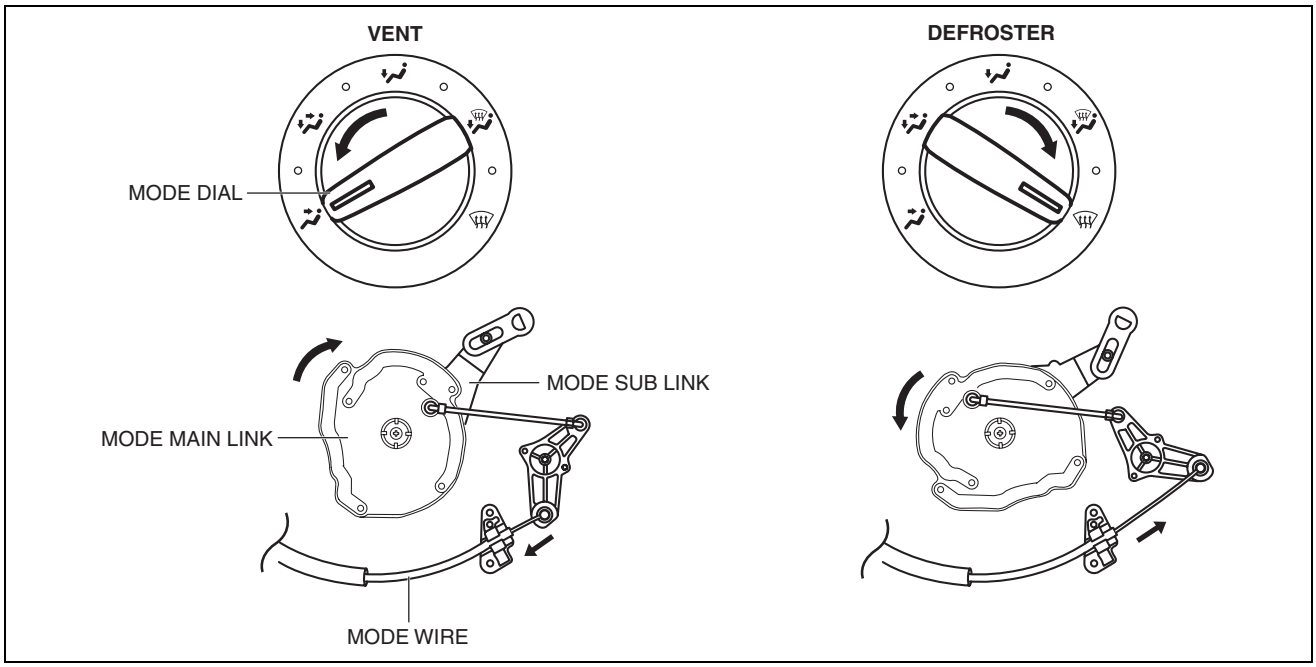


ac5wzn00000746

Airflow mode setting

- When the mode dial is turned, the length of the airflow mode wire is changed, and the airflow mode door position is switched via the airflow mode main link and the airflow mode sub link. As a result, the airflow mode is changed. (See 07-11-8 A/C UNIT.)

CONTROL SYSTEM [MANUAL AIR CONDITIONER]



ac5wzn00000747

Fail-safe

- Function not equipped.

MANUAL AIR CONDITIONER CONTROL SYSTEM [MANUAL AIR CONDITIONER]

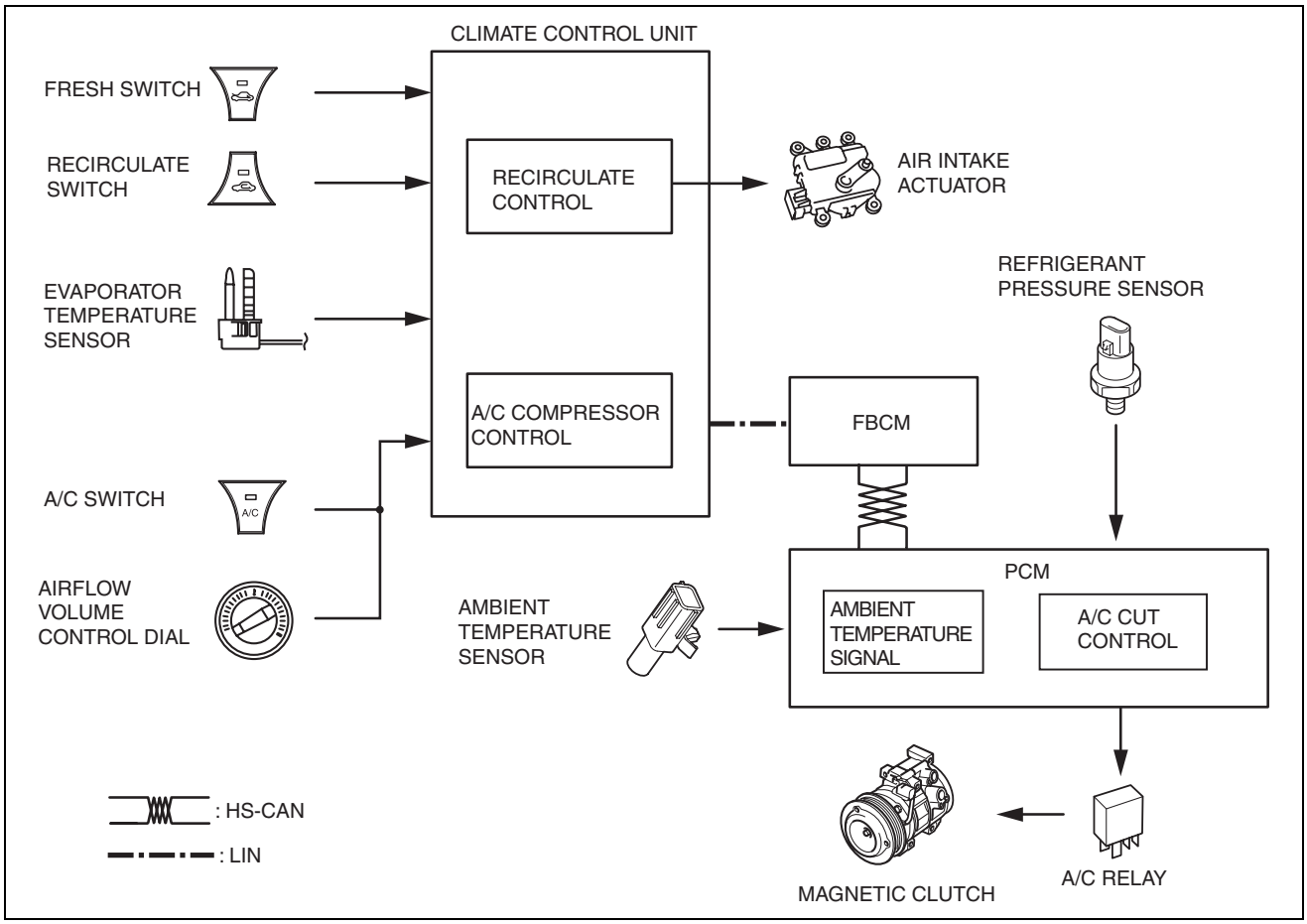
id0740a2101000

Outline

- The climate control unit performs the following controls based on the signals from each switch/dial and the sensor.
  - — A/C compressor control
  - — Defroster control
  - — i-stop control

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

Block Diagram



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Outline of Control System

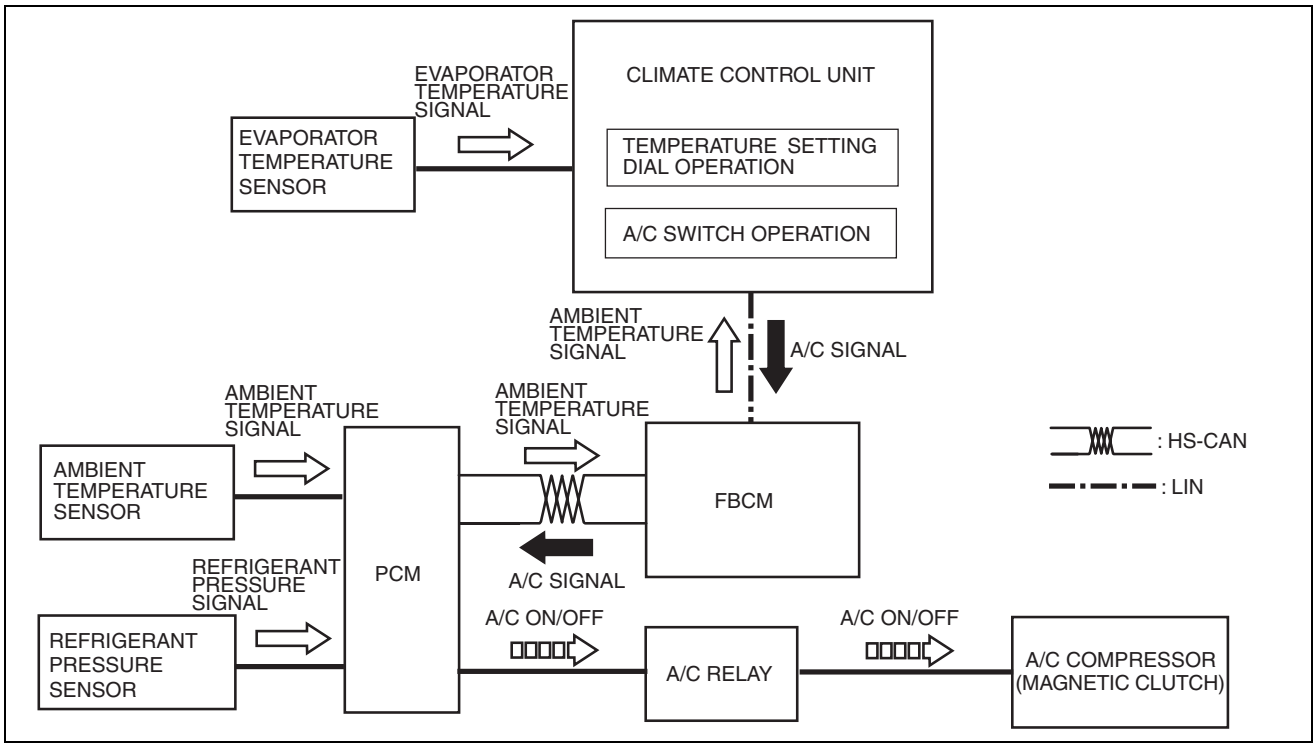
- Manual air conditioner has the following control.

Control name	Control part
• A/C compressor control • Defroster control • i-stop control	Climate control unit

A/C Compressor Control

- The climate control unit sends the A/C signal to the PCM based on the signals sent from the A/C switch, airflow volume control dial, and evaporator temperature sensor.
- The PCM turns the A/C relay on/off based on the input signals from the A/C signal and A/C pressure sensor and controls the A/C compressor (magnetic clutch) operation.

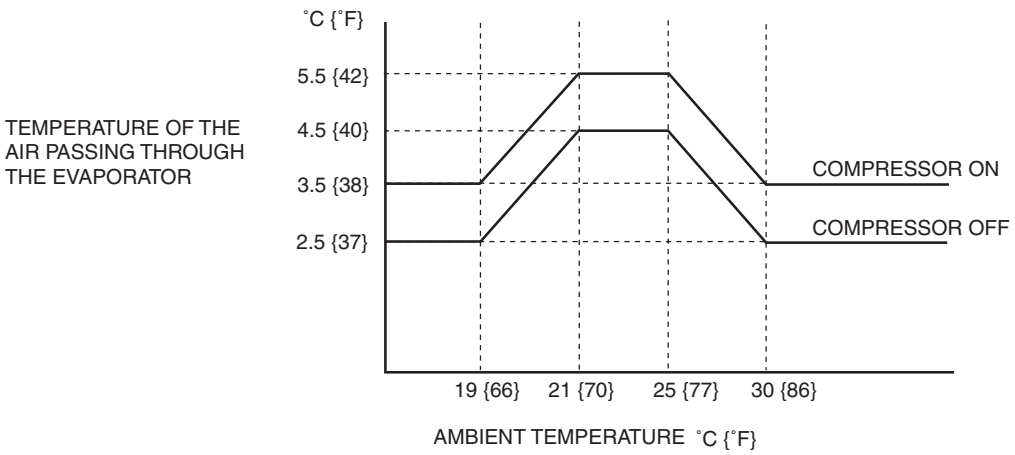
CONTROL SYSTEM [MANUAL AIR CONDITIONER]



ac5wzn00000736

A/C signal on/off control

- When the A/C switch and fan switch are turned on, the climate control unit turns the A/C signal (magnetic clutch) on/off based on the temperature of the air passing through the evaporator.
- When the fan switch and A/C switch are turned on, the climate control unit controls the surface temperature of the evaporator so that it is within a certain range to prevent the evaporator from freezing.
- When the ambient temperature is low, the climate control unit sets the A/C signal (magnetic clutch) off-temperature to low to prevent window fogging.



ac5wzn00000737

Defroster control

- The defroster control improves the defrosting effect.
- When the defroster switch turns on, the climate control unit fixes the air intake mode to FRESH.
- The air intake is fixed at FRESH even if it has been set to REC manually.

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER]

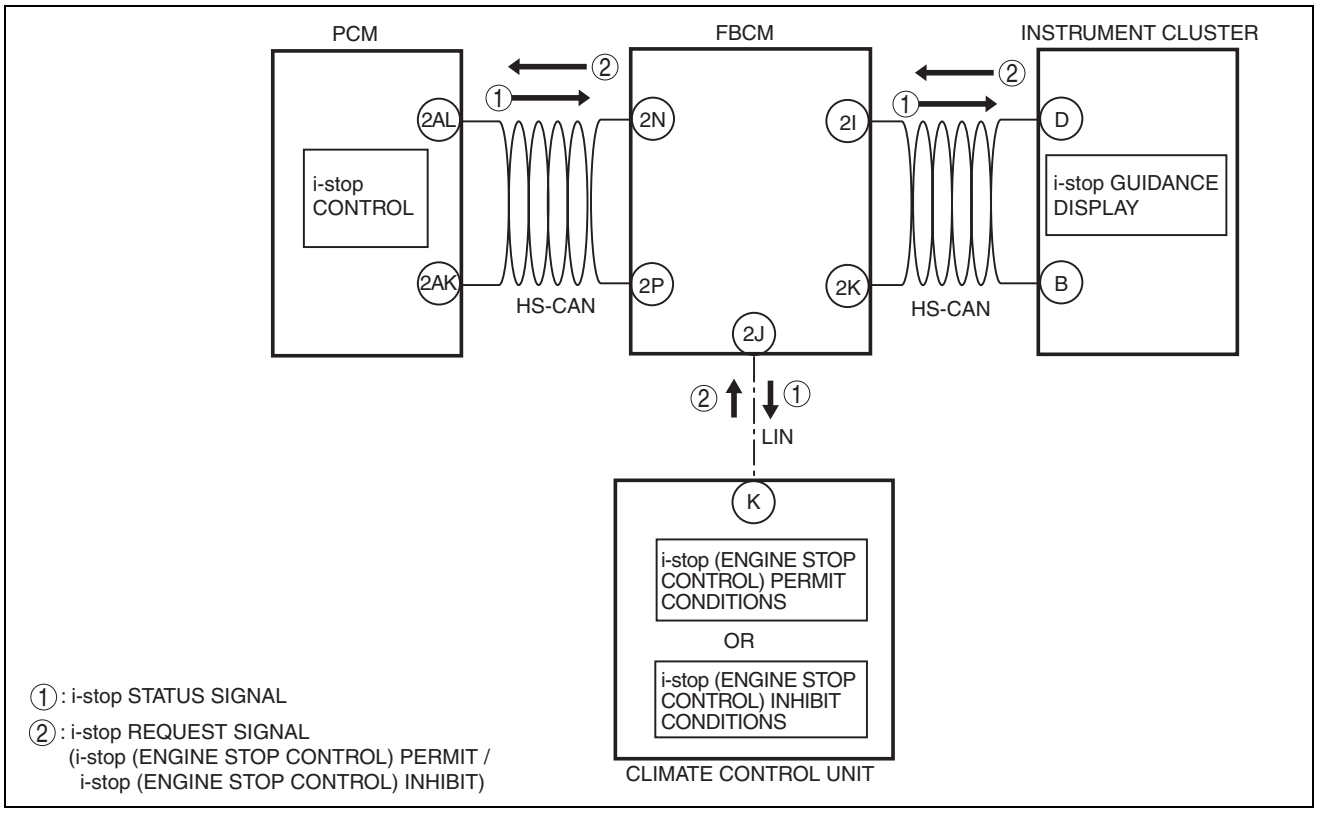
id0740a2126800

Purpose

- The heater control unit controls i-stop to permit/inhibit its operation (engine stop control) according to the air conditioner system operation conditions.

Function

- The climate control unit determines i-stop control according to the operation condition of the air conditioner system and sends i-stop request signals to the front body control module (FBCM).



Operation

i-stop request control (i-stop (engine stop control) permit/ i-stop (engine stop control) inhibit)

- The climate control unit sends i-stop (engine stop control) permit or inhibit request signals to the front body control module (FBCM) according to the operation condition of the air conditioner system.

i-stop (engine stop control) inhibit request

- The climate control unit sends an i-stop (engine stop control) inhibit request signal to the front body control module (FBCM) when it detects any of the following conditions:

i-stop (engine stop control) inhibit conditions

No.	Item	Vehicle condition
1	• Airflow mode • Blower motor	When all of the following conditions have been met, i-stop (engine stop control) inhibit is determined: • Airflow mode during defrost • Blower motor is ON
2	Ambient temperature	Ambient temperature is **-10 °C {14 °F} or below**, or **50 °C {122 °F} or more**
3	Engine coolant temperature	When all of the following conditions are met, i-stop (engine stop control) inhibit is determined: • Engine coolant temperature signal is the specified value or less for i-stop (engine stop control) permit conditions • Blower motor is ON • Ambient temperature is **9 °C {48 °F} or less**

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

No.	Item	Vehicle condition
4	Evaporator temperature	When all of the following conditions have been met, i-stop (engine stop control) inhibit is determined: • Evaporator signal is the specified value or less for i-stop (engine stop control) permit conditions • A/C is ON • Ambient temperature is **30 °C {86 °F} or more**

i-stop (engine stop control) permit request
- When the heater control unit sends an i-stop (engine stop control) permit signal to the front body control module (FBCM) if the i-stop (engine stop control) inhibit conditions are not detected.

A/C control start during i-stop (engine stop control)
- If the climate control unit determines that the engine is stopped based on an i-stop status signal sent from the PCM when A/C is stopped by i-stop control, the climate control unit starts A/C control in conjunction with the engine stop condition.
- If the engine is stopped during A/C control, the A/C compressor magnetic clutch turns off and the A/C indicator light remains in an illuminated condition. When the engine is restarted, the A/C compressor magnetic clutch turns on again.
- If the engine is stopped while the PTC heater is operating, the PTC heater turns off. When the engine is re-started, the PTC heater returns to normal control.

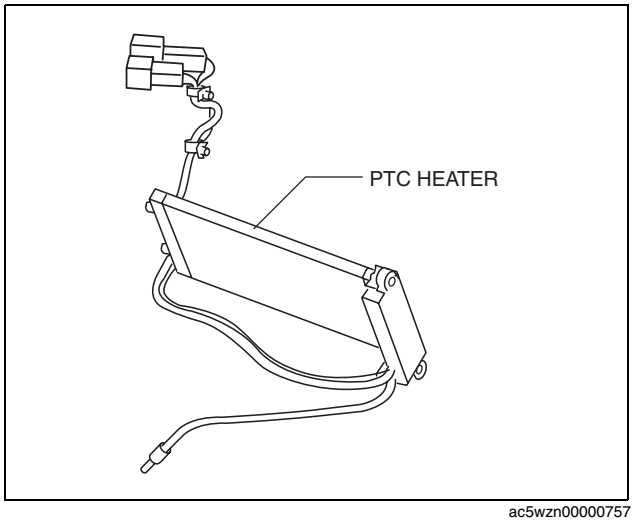
PTC HEATER [MANUAL AIR CONDITIONER]

id0740a2701000

Purpose
- The PTC heater is a supplementary heater to temporarily improve the A/C unit heating performance for diesel engine vehicles which have good thermal efficiency.

Function
- The PTC heater generates heat based on the operation signal from the front body control module (FBCM) and warms the air passing through the A/C unit.

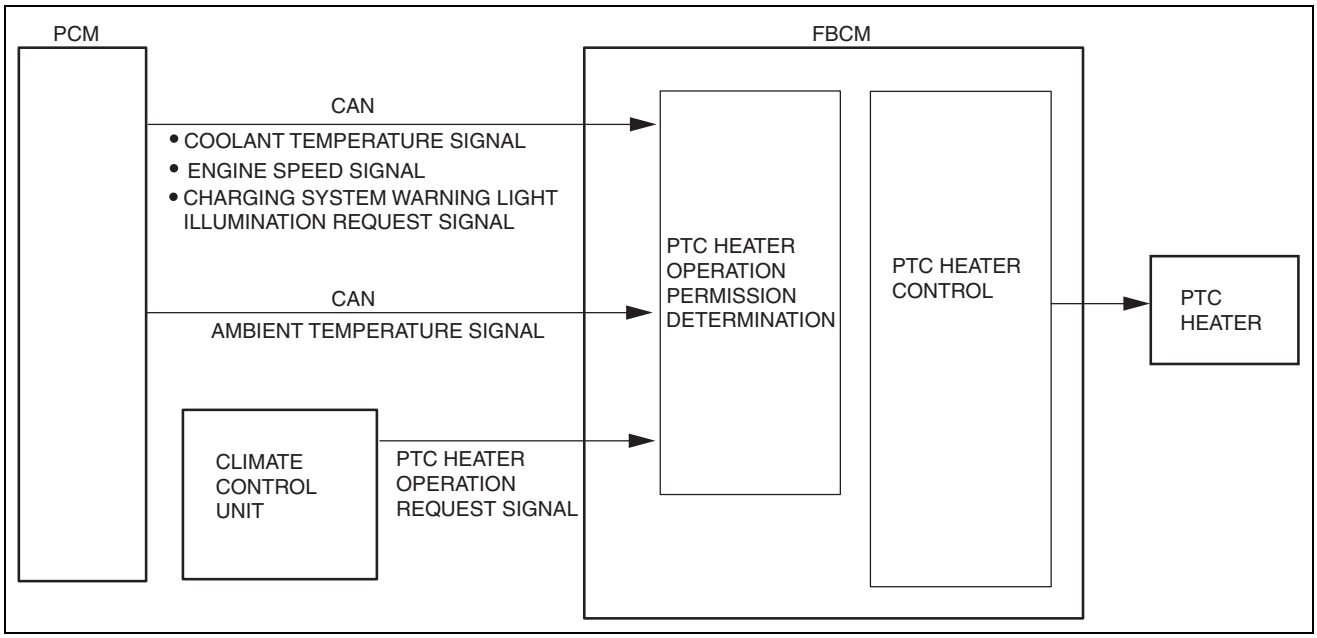
Construction
- The PTC heater consists of a film heater element, aluminum fin, and brass plate. Heat is generated by the flow of electrical current to the heater element.



ac5wzn00000757

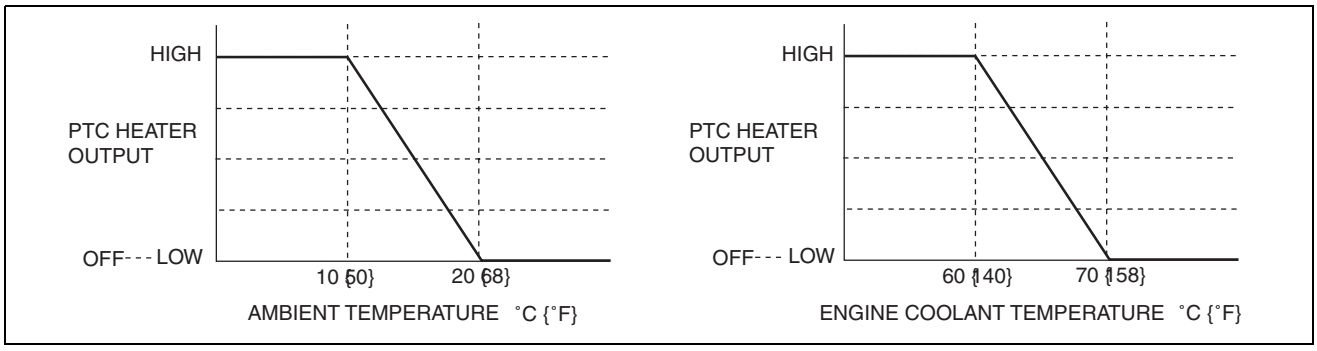
Operation
- The instrument cluster operates the PTC heater when all of the following conditions are met.
  - — During engine start (engine speed is **400 rpm or more**)
  - — Ambient temperature signal is less than **20 °C {68 °F}**
  - — Coolant temperature signal is less than **70 °C {158 °F}**
  - — PTC heater operation request signal is received (See 07-40B-20 PTC heater operation request signal.)
  - — Charging system warning light illumination request signal is not received

CONTROL SYSTEM [MANUAL AIR CONDITIONER]



ac5wzn00000758

- The front body control module (FBCM) compares the PTC heater output values calculated from the ambient temperature and the engine coolant temperature information, and determines the lower value as the PTC heater output. As a result, the PTC heater generation amount is controlled to switch gradually according to the ambient temperature and the engine coolant temperature.

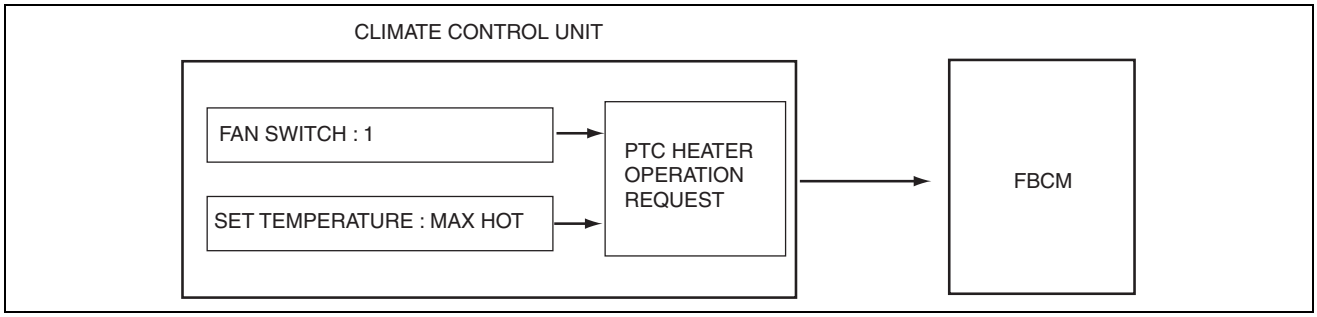


5800018

PTC heater output for ambient temperature	PTC heater output for engine coolant temperature	PTC heater output determination
Low	High	Ambient temperature side
High	Low	Engine coolant temperature side

PTC heater operation request signal

- When the set temperature is at MAX HOT and the fan switch is at 1, the climate control unit outputs a PTC heater operation request signal to the front body control module (FBCM).



ac5wzn00000759

CONTROL SYSTEM [MANUAL AIR CONDITIONER]

Fail-safe

- If each signal input from the PCM cannot be received or the charging system warning light illumination request signal is received, the front body control module (FBCM) inhibits the PTC heater operation.

RESTRAINTS

08
SECTION

08-00 OUTLINE

OUTLINE

RESTRAINTS

id080000001600

Abbreviations

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position
CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle
DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
EPS	Electric Power Steering
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System
HBC	High Beam Control
HF/TEL	Hands-Free Telephone
HI	High
HS	High Speed
HU	Hydraulic Unit
IDS	Integrated Diagnostic Software
IG	Ignition
IN	Intake

OUTLINE

INT	Intermittent
KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear
2GR	Second Gear
2WD	2-Wheel Drive
3GR	Third Gear
4GR	Fourth Gear
4WD	4-Wheel Drive
5GR	Fifth Gear
6GR	Sixth Gear

OUTLINE

Features

- A driver-side air bag module has been adopted.
- A passenger-side air bag module has been adopted.
- A side air bag module has been adopted.
- A curtain air bag module has been adopted.
- Three-point front seat belts with the following functions for front seat passengers adopted.
  - — ELR (Emergency Locking Retractor: emergency locking mechanism)
  - — Load limiter
  - — Pre-tensioner seat belt (See 08-10-15 PRE-TENSIONER SEAT BELT.)
- Three-point seat belts with the following functions for rear seat passengers adopted.
  European (L.H.D. U.K.), General (L.H.D.) specs. Israel
  - — ELR

  Australian, General (R.H.D.) specs. other than Israel
  - — ELR
  - — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism) (left and right seats)

08-02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC

id080200001500

Outline

- The air bag system has an on-board diagnostic function to facilitate the system diagnosis.
- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the air bag system-related parts; a memory function, which stores detected DTCs; a display function, which indicates system malfunctions by DTC display; a PID/data monitoring function, which reads out specific input/output signals.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.
- The system has a fail-safe function to prevent the accidental activation of the air bags in case of an air bag system malfunction.

Function

Self-diagnostic function

Malfunction detection function

- Detects overall malfunctions in the air bag system-related parts.

Memory function

- Stores malfunctions detected in the air bag system-related parts using the malfunction detection function, and the stored malfunction contents are not cleared even if the ignition is switched off or the negative battery cable is disconnected.

Display function

- When the malfunction detection function detects a malfunction, the air bag system warning light illuminates to advise the driver. Using the external tester communication function, DTCs can be output to the DLC-2 via the CAN.

X: Applicable
–: Not applicable

DTC				System malfunction location	Fail safe	Drive cycle	Self test type*1	Memory function
M-MDS display	Air bag system warning light							
	Flashing pattern		Priority ranking					
B0001:11	19		15	Driver-side air bag module circuit short to body ground	—	—	C, D	×
B0001:12				Driver-side air bag module circuit short to power supply	—	—	C, D	×
B0001:13				Driver-side air bag module circuit open circuit or resistance high	—	—	C, D	×
B0001:19				Short circuit to driver-side air bag module and other air bag module circuits	—	—	C, D	×
B0001:1A				Driver-side air bag module circuit resistance low	—	—	C, D	×
B0001:55				Configuration setting error (driver-side air bag module structural malfunction)	—	—	C, D	×

ON-BOARD DIAGNOSTIC

DTC				System malfunction location	Fail safe	Drive cycle	Self test type*1	Memory function
M-MDS display	Air bag system warning light							
	Flashing pattern		Priority ranking					
B0003:53	—	Flashing	4	Operation (deployment) inhibited due to configuration setting	—	—	C, D	×
B0010:11	21		14	Passenger-side air bag module circuit short to body ground	—	—	C, D	×
B0010:12				Passenger-side air bag module circuit short to power supply	—	—	C, D	×
B0010:13				Passenger-side air bag module circuit open circuit or resistance high	—	—	C, D	×
B0010:19				Short circuit to passenger-side air bag module and other air bag module circuits	—	—	C, D	×
B0010:1A				Passenger-side air bag module circuit resistance low	—	—	C, D	×
B0010:55				Configuration setting error (passenger-side air bag module structural malfunction)	—	—	C, D	×
B0094:11	42		9	Driver-side crash zone sensor circuit short to body ground	—	—	C, D	×
B0094:13				Driver-side crash zone sensor circuit open circuit or short to power supply	—	—	C, D	×
B0094:87				Signal reception error from driver-side crash zone sensor	—	—	C, D	×
B0094:96				Driver-side crash zone sensor internal malfunction	—	—	C, D	×
B0094:55				Configuration setting error (driver-side crash zone sensor structural malfunction)	—	—	C, D	×
B00D2:01	14		5	Air bag system warning light malfunction	—	—	C, D	×
B00D2:29				Invalid signal to air bag system warning light	—	—	C, D	×
B00D5:01	18		22	PAD OFF indicator circuit open circuit or short to power supply	—	—	C, D	×
B00D5:29				PAD OFF indicator communication error	—	—	C, D	×

ON-BOARD DIAGNOSTIC

DTC				System malfunction location	Fail safe	Drive cycle	Self test type*1	Memory function
M-MDS display	Air bag system warning light							
	Flashing pattern		Priority ranking					
B1011:95	58		7	SAS control module connectors are poorly connected	—	—	C, D	×
B10FD:11	43		11	Driver-side side air bag sensor No.1 circuit short to power supply or body ground	—	—	C, D	×
B10FD:13				Driver-side side air bag sensor No.1 circuit open circuit or resistance high	—	—	C, D	×
B10FD:87				Signal reception error from driver-side side air bag sensor No.1	—	—	C, D	×
B10FD:96				Driver-side side air bag sensor No.1 internal malfunction	—	—	C, D	×
B10FD:55				Configuration setting error (driver-side side air bag sensor No.1 structural malfunction)	—	—	C, D	×
B10FE:11	44		10	Passenger-side side air bag sensor No.1 circuit short to power supply or body ground	—	—	C, D	×
B10FE:13				Passenger-side side air bag sensor No.1 circuit open circuit or resistance high	—	—	C, D	×
B10FE:87				Signal reception error from passenger-side side air bag sensor No.1	—	—	C, D	×
B10FE:96				Passenger-side side air bag sensor No.1 internal malfunction	—	—	C, D	×
B10FE:55				Configuration setting error (passenger-side side air bag sensor No.1 structural malfunction)	—	—	C, D	×

ON-BOARD DIAGNOSTIC

DTC				System malfunction location	Fail safe	Drive cycle	Self test type*1	Memory function
M-MDS display	Air bag system warning light							
	Flashing pattern		Priority ranking					
B1126:11	22		19	Driver-side side air bag module circuit short to body ground	—	—	C, D	×
B1126:12				Driver-side side air bag module circuit short to power supply	—	—	C, D	×
B1126:13				Driver-side side air bag module circuit open circuit or resistance high	—	—	C, D	×
B1126:19				Short circuit to driver-side side air bag module and other air bag module circuits	—	—	C, D	×
B1126:1A				Driver-side side air bag module circuit resistance low	—	—	C, D	×
B1126:55				Configuration setting error (driver-side side air bag module structural malfunction)	—	—	C, D	×
B1127:11	23		18	Passenger-side side air bag module circuit short to body ground	—	—	C, D	×
B1127:12				Passenger-side side air bag module circuit short to power supply	—	—	C, D	×
B1127:13				Passenger-side side air bag module circuit open circuit or resistance high	—	—	C, D	×
B1127:19				Short circuit to passenger-side side air bag module and other air bag module circuits	—	—	C, D	×
B1127:1A				Passenger-side side air bag module circuit resistance low	—	—	C, D	×
B1127:55				Configuration setting error (passenger-side side air bag module structural malfunction)	—	—	C, D	×

ON-BOARD DIAGNOSTIC

DTC				System malfunction location	Fail safe	Drive cycle	Self test type*1	Memory function
M-MDS display	Air bag system warning light		Priority ranking					
	Flashing pattern							
B1128:11	24		21	Driver-side curtain air bag module circuit short to body ground	—	—	C, D	×
B1128:12				Driver-side curtain air bag module circuit short to power supply	—	—	C, D	×
B1128:13				Driver-side curtain air bag module circuit open circuit or resistance high	—	—	C, D	×
B1128:19				Short circuit to driver-side curtain air bag module and other air bag module circuits	—	—	C, D	×
B1128:1A				Driver-side curtain air bag module circuit resistance low	—	—	C, D	×
B1128:55				Configuration setting error (driver-side curtain air bag module structural malfunction)	—	—	C, D	×
B1129:11	25		20	Passenger-side curtain air bag module circuit short to body ground	—	—	C, D	×
B1129:12				Passenger-side curtain air bag module circuit short to power supply	—	—	C, D	×
B1129:13				Passenger-side curtain air bag module circuit open circuit or resistance high	—	—	C, D	×
B1129:19				Short circuit to passenger-side curtain air bag module and other air bag module circuits	—	—	C, D	×
B1129:1A				Passenger-side curtain air bag module circuit resistance low	—	—	C, D	×
B1129:55				Configuration setting error (passenger-side curtain air bag module structural malfunction)	—	—	C, D	×
B1193:00	13		3	SAS control module operation (deployment)	—	—	C, D	×

ON-BOARD DIAGNOSTIC

DTC				System malfunction location	Fail safe	Drive cycle	Self test type*1	Memory function
M-MDS display	Air bag system warning light							
	Flashing pattern		Priority ranking					
B1196:11	45		13	Driver-side side air bag sensor No.2 circuit short to body ground	—	—	C, D	×
B1196:13				Driver-side side air bag sensor No.2 circuit open circuit or short to power supply	—	—	C, D	×
B1196:87				Signal reception error from driver-side side air bag sensor No.2	—	—	C, D	×
B1196:96				Driver-side side air bag sensor No.2 internal malfunction	—	—	C, D	×
B1196:55				Configuration setting error (driver-side side air bag sensor No.2 structural malfunction)	—	—	C, D	×
B1197:11	46		12	Passenger-side side air bag sensor No.2 circuit short to body ground	—	—	C, D	×
B1197:13				Passenger-side side air bag sensor No.2 circuit open circuit or short to power supply	—	—	C, D	×
B1197:87				Signal reception error from passenger-side side air bag sensor No.2	—	—	C, D	×
B1197:96				Passenger-side side air bag sensor No.2 internal malfunction	—	—	C, D	×
B1197:55				Configuration setting error (passenger-side side air bag sensor No.2 structural malfunction)	—	—	C, D	×
B1202:01	18		22	PAD ON indicator circuit open circuit or short to power supply	—	—	C, D	×
B1206:00	—	—	—	SAS control module operation (deployment) (fuel cut signal output)	—	—	C, D	×

ON-BOARD DIAGNOSTIC

DTC				System malfunction location	Fail safe	Drive cycle	Self test type*1	Memory function
M-MDS display	Air bag system warning light		Priority ranking					
	Flashing pattern							
B1211:11	38		17	Driver-side pre-tensioner seat belt circuit short to body ground	—	—	C, D	×
B1211:12				Driver-side pre-tensioner seat belt circuit short to power supply	—	—	C, D	×
B1211:13				Driver-side pre-tensioner seat belt circuit open circuit or resistance high	—	—	C, D	×
B1211:19				Short circuit to driver-side pre-tensioner seat belt and other air bag module circuits	—	—	C, D	×
B1211:1A				Driver-side pre-tensioner seat belt circuit resistance low	—	—	C, D	×
B1211:55				Configuration setting error (driver-side pre-tensioner seat belt structural malfunction)	—	—	C, D	×
B1214:11	39		16	Passenger-side pre-tensioner seat belt circuit short to body ground	—	—	C, D	×
B1214:12				Passenger-side pre-tensioner seat belt circuit short to power supply	—	—	C, D	×
B1214:13				Passenger-side pre-tensioner seat belt circuit open circuit or resistance high	—	—	C, D	×
B1214:19				Short circuit to passenger-side pre-tensioner seat belt and other air bag module circuits	—	—	C, D	×
B1214:1A				Passenger-side pre-tensioner seat belt circuit resistance low	—	—	C, D	×
B1214:55				Configuration setting error (passenger-side pre-tensioner seat belt structural malfunction)	—	—	C, D	×

ON-BOARD DIAGNOSTIC

DTC				System malfunction location	Fail safe	Drive cycle	Self test type*1	Memory function
M-MDS display	Air bag system warning light							
	Flashing pattern		Priority ranking					
B1417:11	41		8	Passenger-side crash zone sensor circuit short to body ground	—	—	C, D	×
B1417:13				Passenger-side crash zone sensor circuit open circuit or short to power supply	—	—	C, D	×
B1417:87				Signal reception error from passenger-side crash zone sensor	—	—	C, D	×
B1417:96				Passenger-side crash zone sensor internal malfunction	—	—	C, D	×
B1417:55				Configuration setting error (passenger-side crash zone sensor structural malfunction)	—	—	C, D	×
B1D75:55	56		23	Configuration setting error (PAD switch structural malfunction)	—	—	C, D	×
B1D75:62				PAD switch circuit open circuit or short to body ground	—	—	C, D	×
C0061:29	—	—	—	Low-G sensor (lateral-G) in SAS control module (internal circuit disabled)	—	—	C, D	×
C0062:29				Low-G sensor (forward-G) in SAS control module (internal circuit disabled)	—	—	C, D	×
C0063:29				Yaw rate sensor in SAS control module (internal circuit disabled)	—	—	C, D	×
P0666:29				Temperature sensor in SAS control module (internal circuit disabled)	—	—	C, D	×
U0001:88	14		5	CAN communication error	—	—	C, D	×
U0028:88	—	—	—	DSC HU/CM communication fault	—	—	C, D	×
U0155:00	14		5	Instrument cluster communication error	—	—	C, D	×
U2005:68				PCM communication error (vehicle speed signal)	—	—	C, D	×
U0300:00	54		6	Configuration setting invalid	—	—	C, D	×
U2100:00				Configuration not set	—	—	C, D	×

ON-BOARD DIAGNOSTIC

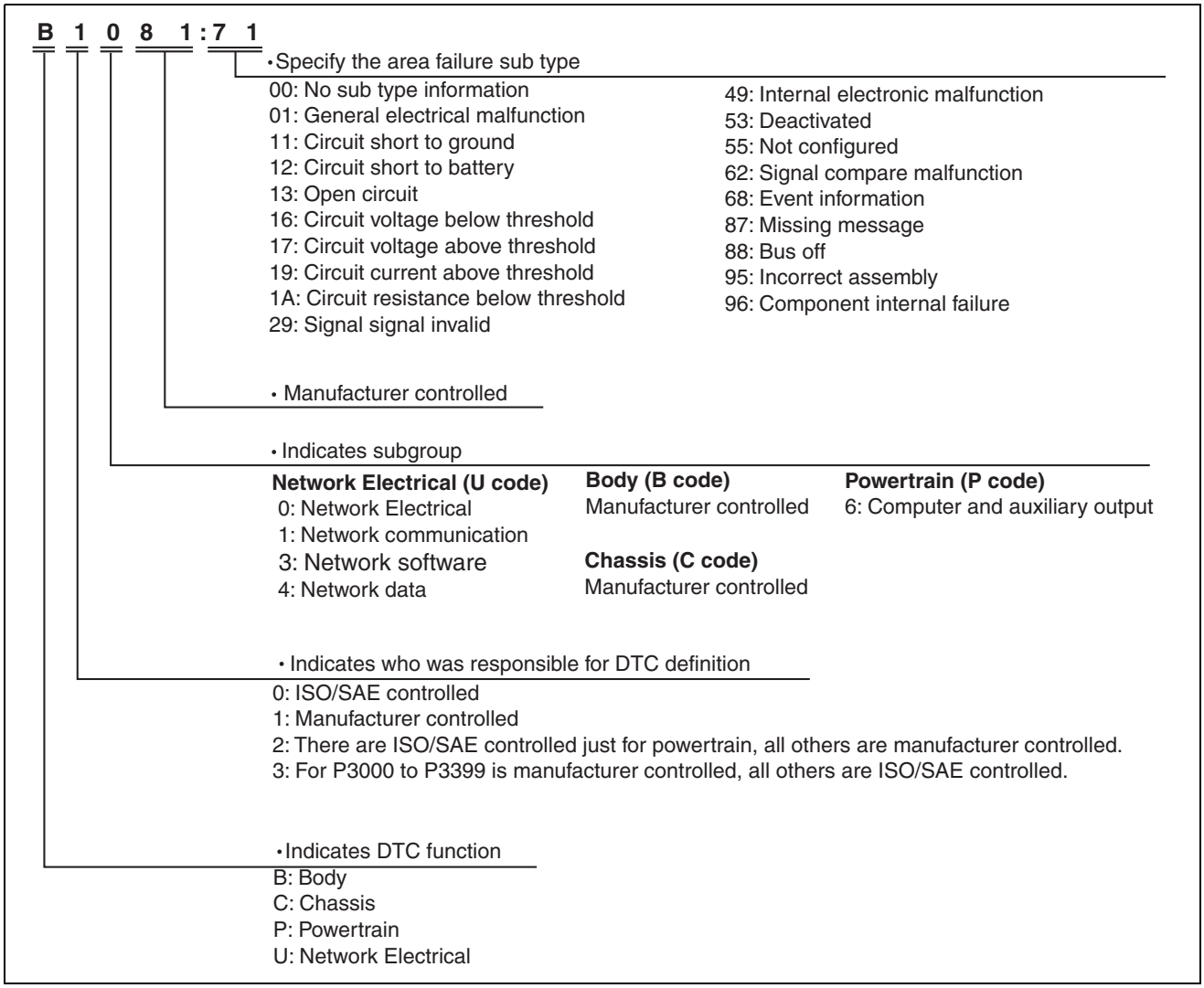
DTC				System malfunction location	Fail safe	Drive cycle	Self test type*1	Memory function
M-MDS display	Air bag system warning light							
	Flashing pattern		Priority ranking					
U2107:00	—	—	—	SAS control module operation (deployment) signal output	—	—	C, D	×
U3000:49	12		2	SAS control module internal malfunction	—	—	C, D	×
U3003:16	—	Continuously illuminated	1	SAS control module power supply voltage decreases (**less than 8 V**).	—	—	C, D	×
U3003:17				SAS control module power supply voltage increases (**18 V or more**)	—	—	C, D	×

*1 : C: CMDTC self test, D: ODDTC self test

ON-BOARD DIAGNOSTIC

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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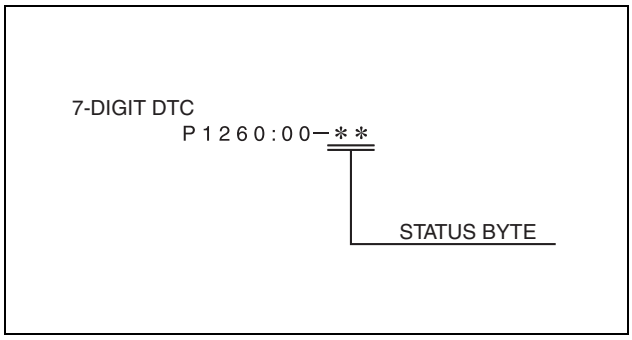
Status byte for DTC

- The status byte is the two digits (after hyphen) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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Snapshot data

- The data for all DTCs currently detected is stored.

Note

- Snapshot data items are not displayed, according to detected DTC.

ON-BOARD DIAGNOSTIC

Snapshot data table

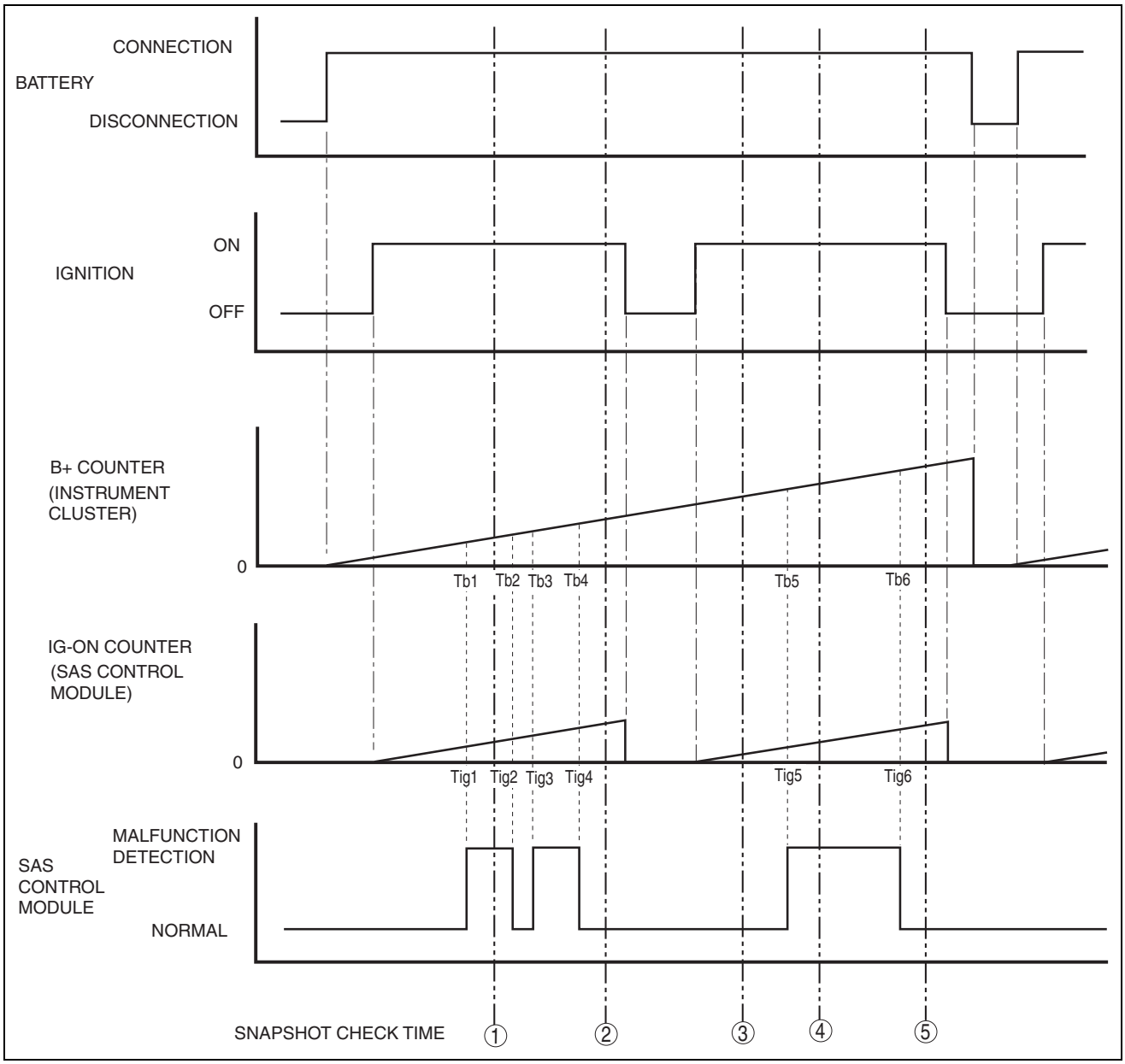
Snapshot data item	Unit	Definition	Corresponding PID data monitor item
AAT	°C / °F	Ambient temperature	—
APP_STATUS	Accelerator Pedal Off/ Under20%/ Over20%/FAIL	Accelerator pedal position status	—
CFG_STATUS	Config Complete/ Not Configured/ Config Error	Configuration status	—
ECT_STATUS	Under 0 degrees C/ 0-Under 80 degrees C/ Over 80 degrees C/ FAIL	Engine coolant temperature status	—
FAULT_CNT	—	Number of malfunction detections	—
FIRST_DET_IG	hh:mm:ss	Time when initial malfunction occurs (IG-ON counter) • Elapsed time from when ignition is switched ON (engine off or on) until SAS control module detects first malfunction (See Snapshot counter pattern.)	—
IC_VPWR	V	Instrument cluster power supply voltage	—
IG-ON_TIMER	hh:mm:ss	Elapsed time since ignition switched ON (engine off or on)	—
LAST_CLR	hh:mm:ss	Repair time for last malfunction (B+ counter) • Elapsed time from when battery is connected until SAS control module detects that last malfunction is repaired (See Snapshot counter pattern.)	—
LAST_CLR_IG	hh:mm:ss	Repair time for last malfunction (IG-ON counter) • Elapsed time from when ignition is switched ON (engine off or on) until SAS control module detects that last malfunction is repaired (See Snapshot counter pattern.)	—
LAST_DET	hh:mm:ss	Time when last malfunction occurs (B+ counter) • Elapsed time from when battery is connected until SAS control module detects last malfunction (See Snapshot counter pattern.)	—
LAST_DET_IG	hh:mm:ss	Time when last malfunction occurs (IG-ON counter) • Elapsed time from when ignition is switched ON (engine off or on) until SAS control module detects last malfunction (See Snapshot counter pattern.)	—
PWR_MODE_KEY	Key Out/ Key Recently Out/ Key Approved (Position 0)/ Post Accessory (Position 0)/ Accessory (Position 1)/ Post Ignition (Position 1)/ Ignition On (Position 2)/ Running (Position 2)/ Running - Starting In Progress (Position 2)/ Crank (Position 3)	Push button start power position switching status	—

ON-BOARD DIAGNOSTIC

Snapshot data item	Unit		Definition	Corresponding PID data monitor item
RPM_STATUS	Engine Stop/ Under1500rpm/ Over1500rpm/ FAIL		Engine speed status	—
SHIFT_STATUS	P/N/ D/ R/ FAIL		Selector lever position status	—
TOTAL_TIME	hh:mm:ss		Time when first malfunction occurs (B+ counter) • Elapsed time from when battery is connected until SAS control module detects first malfunction (See Snapshot counter pattern.)	—
TOTAL_DIST	km	miles	Accumulated total traveled distance since vehicle completion	—
VPWR	V		SAS control module power supply malfunction	VPWR_IGA
VSPD_STATUS	Stop/ 0-10km/h/ Over10km/h/ FAIL		Vehicle speed status	—

ON-BOARD DIAGNOSTIC

Snapshot counter pattern



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Snap-shot check time	FAULT_CNT Number of malfunction detections	FIRST_DET_IG Time when initial malfunction occurs (IG-ON counter)	LAST_CLR Repair time for last malfunction (B+ counter)	LAST_CLR_IG Repair time for last malfunction (IG-ON counter)	LAST_DET Time when last malfunction occurs (B+ counter)	LAST_DET_IG Time when last malfunction occurs (IG-ON counter)	TOTAL_TIME Time when first malfunction occurs (B+ counter)
1	1	Tb1	-	-	Tb1	Tig1	Tig1
2	2	Tb1	Tb4	Tig4	Tb3	Tig3	Tig1
3	2	Tb1	Tb4	Tig4	Tb3	Tig3	Tig1
4	3	Tb1	Tb4	Tig4	Tb5	Tig5	Tig1
5	3	Tb1	Tb6	Tig6	Tb5	Tig5	Tig1

PID/Data monitoring function

- By using the PID/data monitoring function, the monitored item of the input/output signal, as set on the SAS control module, can be freely selected and read out in real-time.
- The Mazda Modular Diagnostic System (M-MDS) is used to read out PID/data monitor information.

ON-BOARD DIAGNOSTIC

PID/data monitor table

PID name (definition)	Unit/ Operation	Operation Status (Reference)	
AB_WL (Air bag system warning light status)	Lamp_Off/ Lamp_On/ Plant_Mode/ Unknown	• Air bag system warning light off: Lamp_Off • Air bag system warning light on: Lamp_On • Air bag system warning light status: Plant_Mode • Air bag system warning light status: Unknown	
P_SEAT_M_S (Occupancy sensor)	Off/On	• Not occupant seated in passenger-side front seat: Off • Occupant seated in passenger-side front seat: On	
PAD_SW_FLT (PAD switch malfunction status)	O.K./FAULT	• PAD switch is normal: O.K. • PAD switch is abnormal: FAULT	
RES_C_AB_D (Driver-side curtain air bag module resistance nominal)	ohm	Continuous: 0.81–6.42 ohms	
RES_C_AB_P (Passenger-side curtain air bag module resistance nominal)	ohm	Continuous: 0.81–6.42 ohms	
RES_F_AB1_D (Driver-side air bag module resistance nominal)	ohm	Continuous: 0.99–6.42 ohms	
RES_F_AB1_P (Passenger-side air bag module resistance nominal)	ohm	Continuous: 0.81–6.42 ohms	
RES_PCD_BAR (Poorly connected detector bar terminals resistance nominal (all of SAS control module connector))	ohm	• Normal connected: 100 ohm or less • Poor connected: 20 kilohm or more	
RES_S_AB_D (Driver-side side air bag module resistance nominal)	ohm	Continuous: 0.81–9.85 ohms	
RES_S_AB_P (Passenger-side side air bag module resistance nominal)	ohm	Continuous: 0.81–9.85 ohms	
RES_SB_P_D (Driver-side pre-tensioner seat belt resistance nominal)	ohm	Continuous: 0.81–6.42 ohms	
RES_SB_P_P (Passenger-side pre-tensioner seat belt resistance nominal)	ohm	Continuous: 0.81–6.42 ohms	
SEAT_B_D (Driver-side buckle switch status)	Unbuckled/ Buckled	• Driver-side front seat belt fastened (Driver-side buckle switch off): Buckled • Driver-side front seat belt not fastened (Driver-side buckle switch on): Unbuckled	
SEAT_B_P (Passenger-side buckle switch status)	Unbuckled/ Buckled	Occupant seated in passenger-side front seat: On	• Passenger-side front seat belt fastened (Passenger-side buckle switch off): Buckled • Passenger-side front seat belt not fastened (Passenger-side buckle switch on): Unbuckled
VPWR_IGA (SAS control module power voltage)	V	Ignition switch is at ON: IG1 voltage	

08-10 AIR BAG SYSTEM

AIR BAG SYSTEM

AIR BAG SYSTEM

id081000500100

Outline

- The air bag system is a device that supplements the passenger restraint function of the seat belts. The air bag system will not have the designed effect if the seat belts are not worn properly.
- The air bag system is composed of the following parts:

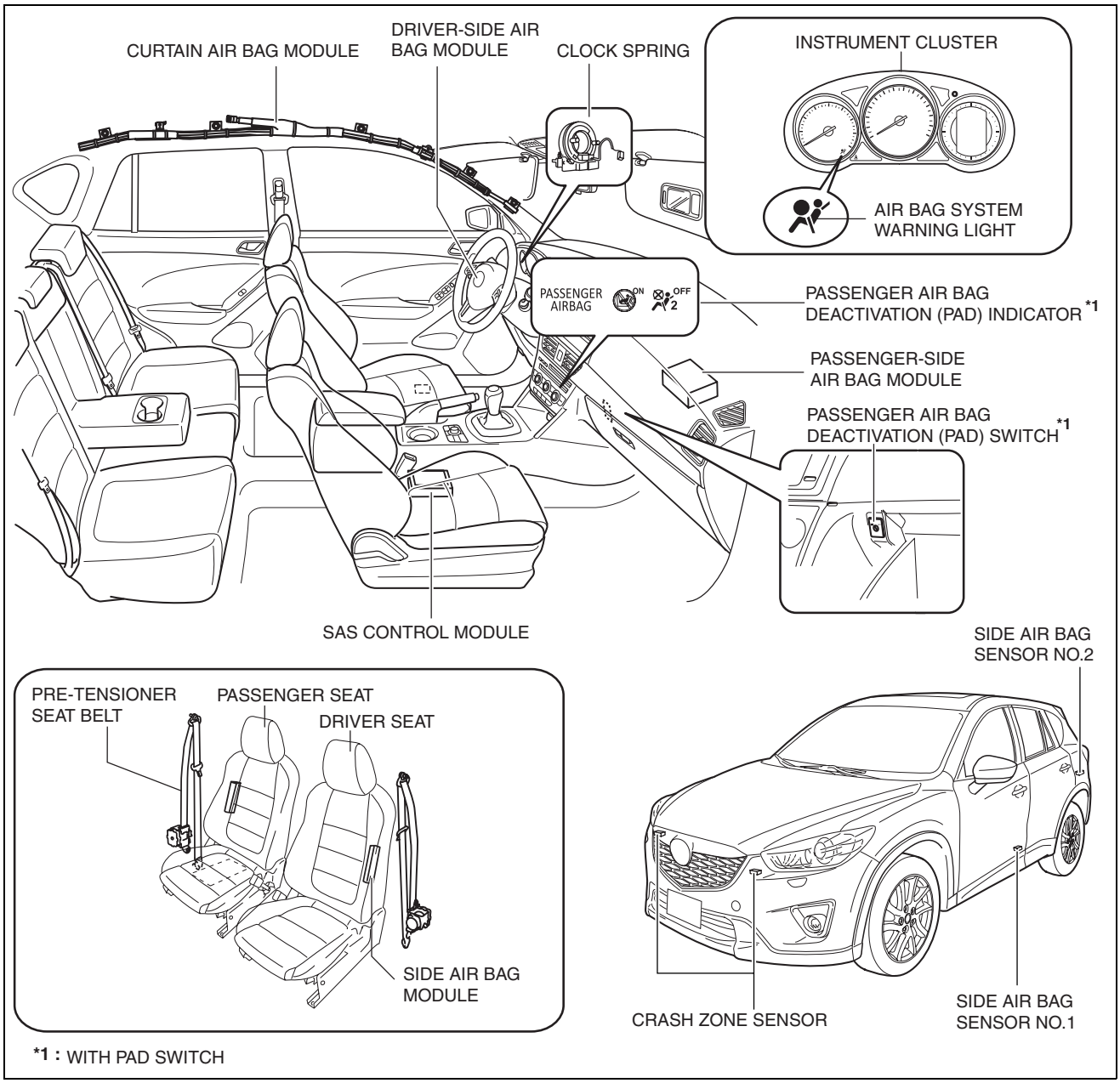
Item	Outline
SAS control module	• A yaw rate sensor and a low-G sensor has been added. • Recognizes actually equipped air bag module or pre-tensioner seat belt based on module configuration.
Crash zone sensor	• Detects degree of impact, converts to an electrical signal, and sends the signal to the SAS control module.
Side air bag sensor	
Driver-side air bag module	• Adopted to improve safety in frontal collisions.
Passenger-side air bag module	
Side air bag module	• Chest-protection type side air bag module is used in accordance with the adoption of the curtain air bag module.
Curtain air bag module	• Adopted to improve safety in lateral collisions.
Pre-tensioner seat belt	• Gear-type pre-tensioner seat belt has been adopted.
PAD switch*1	• PAD switch has been adopted enabling optional deactivation of passenger-side air bag module, passenger-side side air bag module, and passenger-side pre-tensioner seat belt.

AIR BAG SYSTEM

Item	Outline
PAD indicator*1	• PAD indicator has been adopted to inform driver and front passenger of the deployment standby status of the passenger-side air bag module, passenger-side side air bag module, and passenger-side pre-tensioner seat belt.
Air bag system warning light	• LED has been adopted.

*1 : With PAD switch

Structural View



*1 : WITH PAD SWITCH

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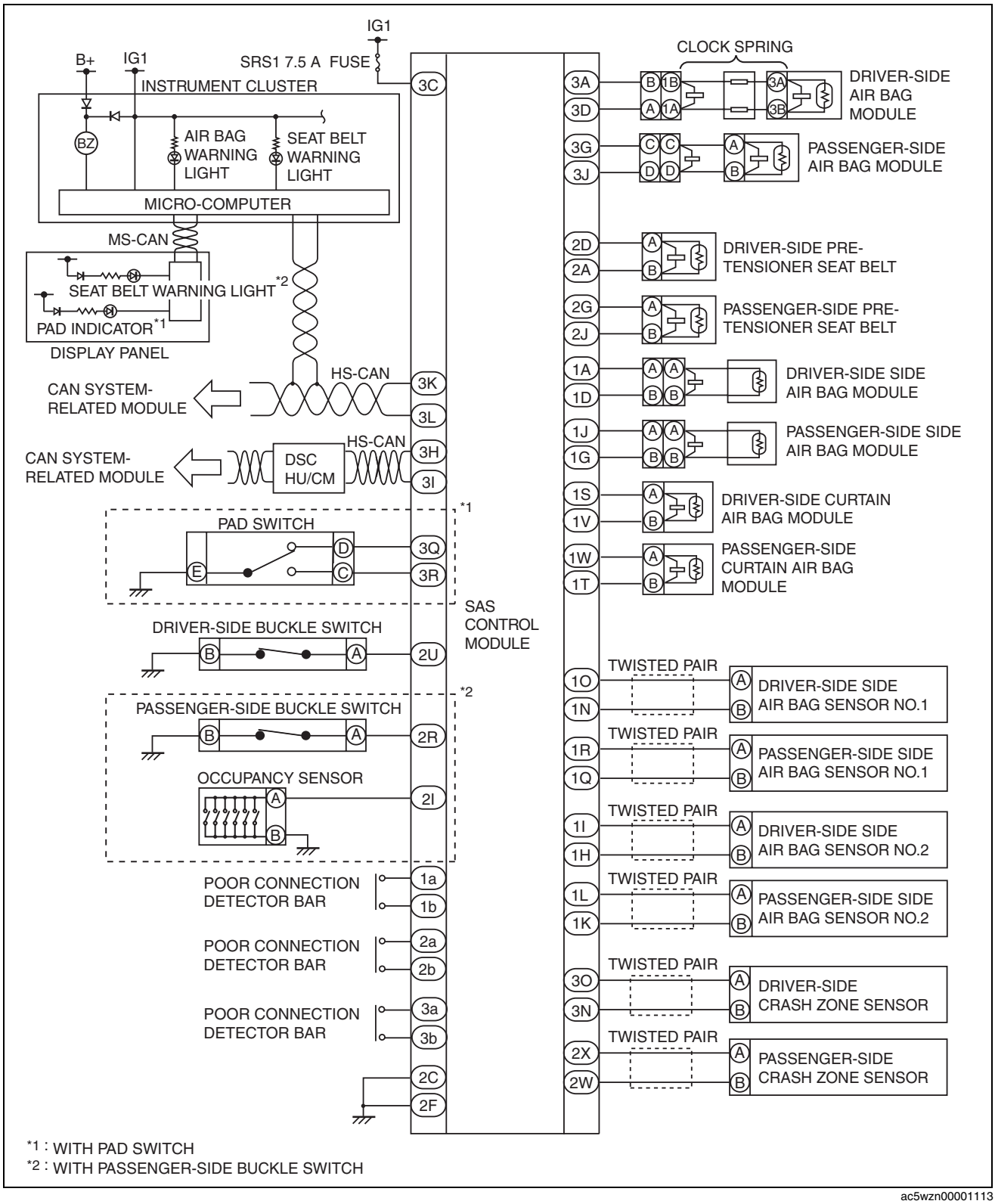
AIR BAG SYSTEM

Wiring Diagram



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SAS CONTROL MODULE

id081000500200

Purpose

- The SAS control module controls the air bag system operation.

Function

- During a frontal collision, the SAS control module controls the following air bag module operation (deployment).

AIR BAG SYSTEM

  - — Driver-side air bag module
  - — Passenger-side air bag module
  - — Driver/passenger-side pre-tensioner seat belt
- During a lateral collision, the SAS control module controls the following air bag module operation (deployment).
  - — Side air bag module on the collision side
  - — Curtain air bag module on the collision side
  - — Driver/passenger-side pre-tensioner seat belt
- If an air bag is deployed due to a vehicle collision, the SAS control module sends an air bag deployment signal to each control module.
- When the signal is received, each control module performs the following controls to reduce secondary injuries caused by the vehicle collision.
  - — Rear body control module (RBCM): Collision detection unlock function (See 09-14-8 POWER DOOR LOCK SYSTEM.)
  - — DSC HU/CM, front body control module (FBCM): Secondary collision reduction (SCR) (See 04-15-35 SECONDARY COLLISION REDUCTION (SCR).)

Backup power supply function
- The backup power supply function enables the condenser to discharge and supply power to assure air bag system operation/deployment properly for a specified time even if the power supply to the SAS control module is cut due to a collision.

Configuration function
- Identifies the variation of the air bag module installed to the vehicle when replacing the SAS control module with a new one.
- If the air bag module installed to the vehicle and the module identified by the SAS control module differ, a DTC is displayed.
- Refer to the Workshop Manual for the configuration setting procedure.

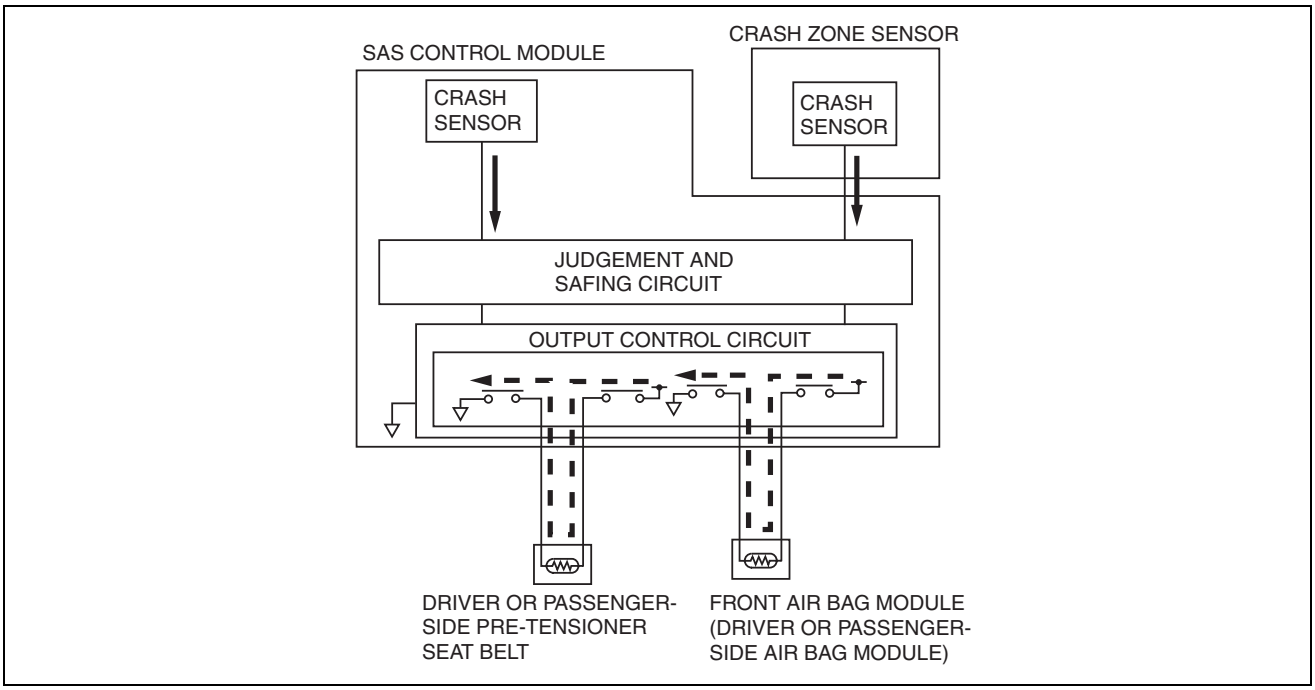
Yaw Rate Sensor
- The yaw rate sensor in the SAS control module detects the vehicle yaw rate (vehicle turning angle speed), and sends the detected rate to the DSC HU/CM via special CAN lines between the SAS control module and the DSC CM.

Low-G sensor
- The low-G sensor in the SAS control module detects the vehicle longitudinal accelerations, and sends the detected accelerations to the DSC HU/CM via special CAN lines between the SAS control module and the DSC CM.

Construction
- SAS control module installed under the rear console.
- The following sensors are built into the SAS control module.
  - — Crash sensor
  - — Yaw rate sensor
  - — Low-G sensor
- If the degree of impact detected by the crash zone sensor and the crash sensor built into the SAS control module exceeds the set value during a frontal collision to the vehicle, the SAS control module sends an operation (deployment) signal to the air bag module and the pre-tensioner seat belts.
- If the degree of impact detected by side air bag sensor No. 1 or No. 2 and the crash sensor built into the SAS control module exceeds the set value during a side collision to the vehicle, the SAS control module sends an operation (deployment) signal to the side air bag module and curtain air bag module.

Operation
Front air bag system (deployment control)
1. During a frontal or frontal offset collision, the crash sensors in the crash zone sensor and the SAS control module detect the impact.
2. The degree of impact detected by the crash sensor in the crash zone sensor is converted to an electrical signal and sent to the SAS control module through the signal amplification circuit.
3. Simultaneously, the SAS control module crash sensor converts the degree of impact detected to an electrical signal.
4. The SAS control module processes the calculations for the two electrical signals at the output control circuit and compares the value to a preset value.
5. The SAS control module completes an ignition circuit for the pre-tensioner seat belts that is synchronized to the deployment of the air bag modules, and an operation signal is sent to the pre-tensioner seat belts.

AIR BAG SYSTEM



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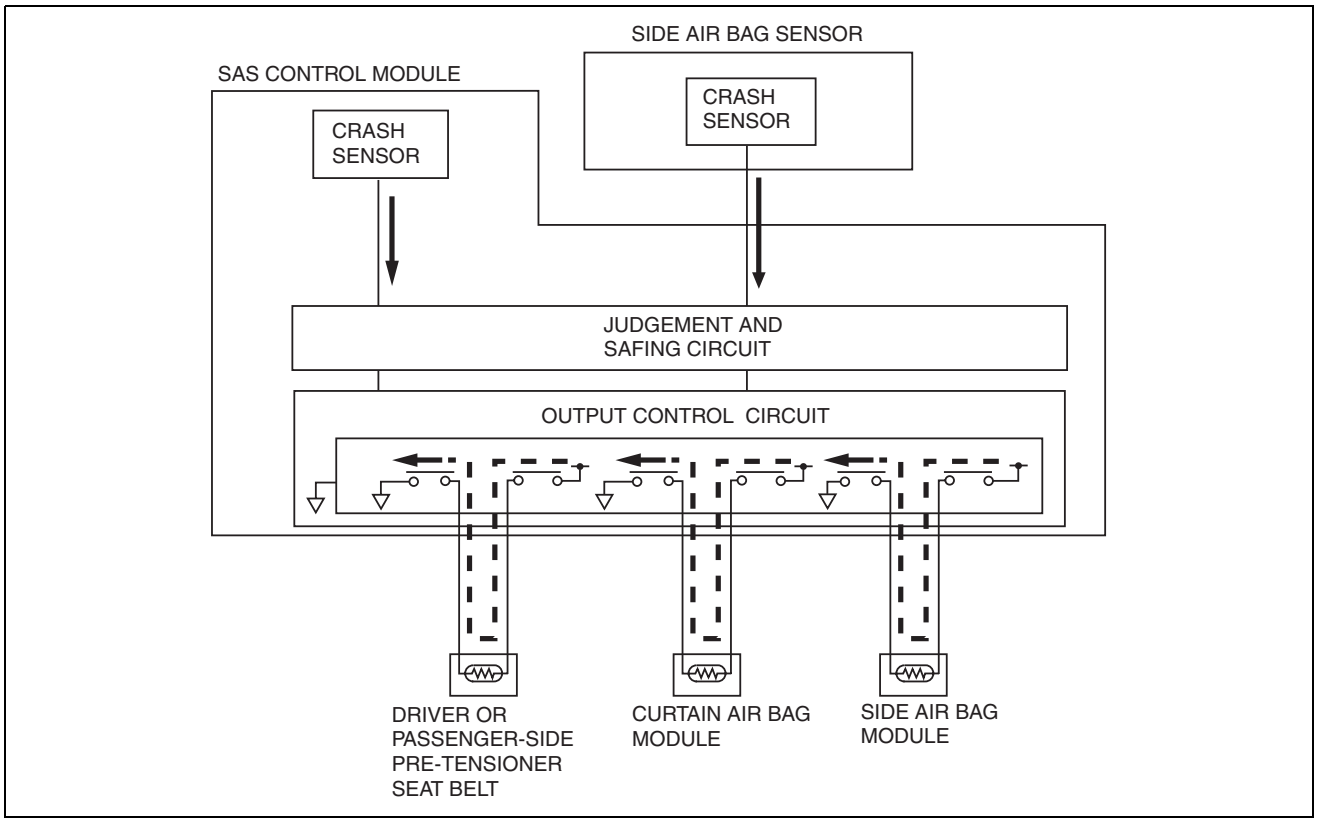
Side air bag system

1. During a lateral collision to the vehicle, the crash sensors in the side air bag sensor and SAS control module detect the collision.
2. The degree of impact detected by the crash sensor in the side air bag sensor is converted to an electrical signal and sent to the SAS control module through the signal amplification circuit.
3. Simultaneously, the SAS control module crash sensor converts the degree of impact detected to an electrical signal.
4. The SAS control module processes the calculations for the two electrical signals at the output control circuit and compares the value to a preset value.
5. The output control circuit determines the degree of impact to the vehicle by the value from the crash sensors, completes a side air bag module and curtain air bag module ignition circuit, and sends the deployment signal to the air bag modules.
6. The SAS control module completes an ignition circuit for the pre-tensioner seat belts that is synchronized to the deployment of the air bag modules, and an operation signal is sent to the pre-tensioner seat belts.

AIR BAG SYSTEM



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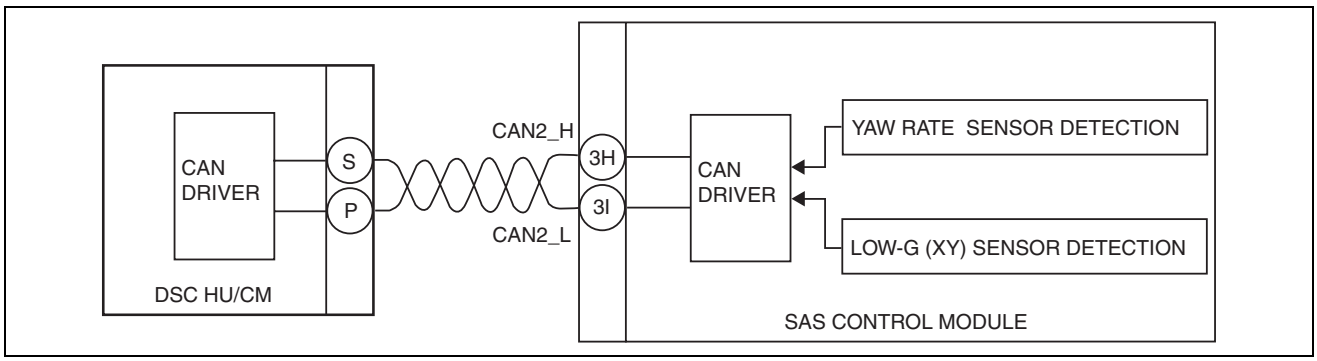
DSC system control

- The vehicle angle speed and accelerations detected by the yaw rate and low-G sensors in the SAS control module are sent to the DSC HU/CM via special CAN lines.
- The DSC system controls based on the signal sent from the SAS control module. For the DSC system operation, refer to the 04-15-7 DSC HU/CM.



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Passenger air bag deactivation (pad) switch operation (deployment) control

- When the PAD switch is turned to the OFF position, the SAS control module inhibits operation (deployment) of the passenger-side air bag module, passenger-side side air bag module, and the passenger-side pre-tensioner seat belt even if the degree of impact from a collision is sufficient for normal air bag module operation (deployment). At the same time, the PAD indicator illuminates to alert the driver and passengers (passenger-side seat) of the inoperational (undeployable) condition of the air bag.
- When the PAD switch turned to the ON position, the passenger-side air bag module, passenger-side side air bag module, and the passenger-side pre-tensioner seat belt operate (deploy) normally during a collision and the PAD indicator goes out.
- When the ignition switch is turned to the ON position, the PAD indicator illuminates for **approx. 6 s** while the SAS control module inspects for malfunctions in the circuit. If a malfunction is detected in the circuit, a DTC is displayed.

AIR BAG SYSTEM

Fail-safe

- If the SAS control module performance/function cannot be maintained due to any cause, the fail-safe function stops air bag system control and flashes the air bag system warning light to prevent the air bags from operating (deploying) accidentally.

AIR BAG SYSTEM WARNING LIGHT

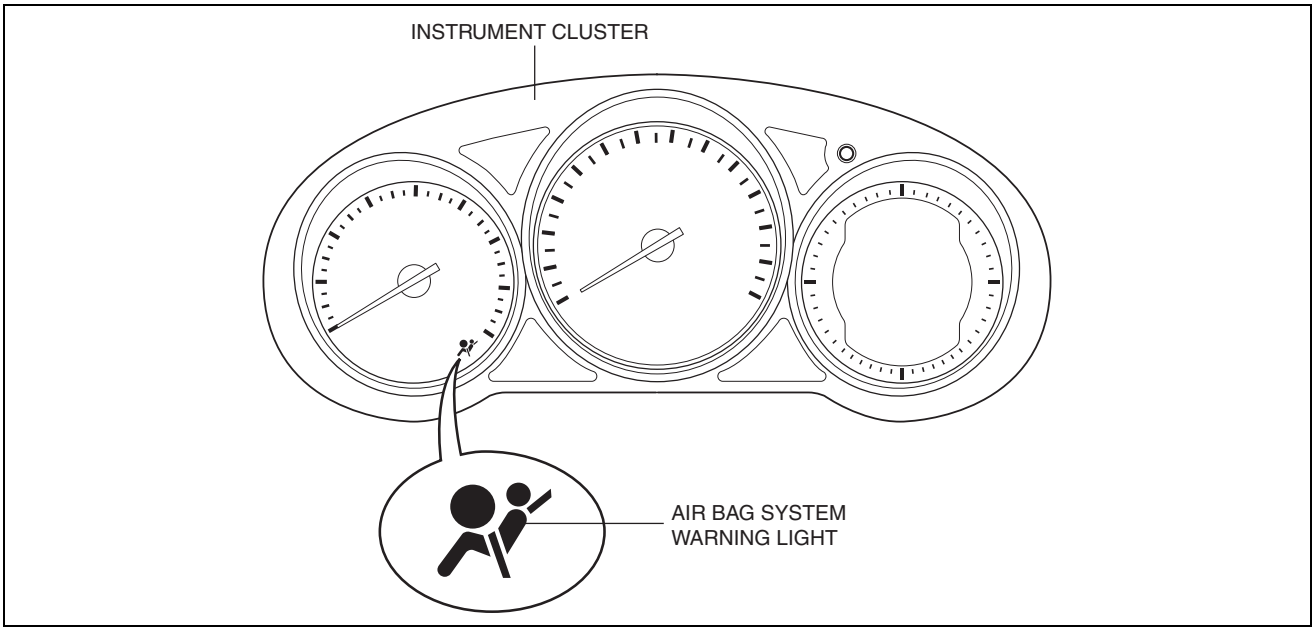
id081000310100

Purpose

- The air bag system warning light notifies the driver of a malfunction in the SRS air bag system.

Function

- If a malfunction occurs in the SRS air bag system, the air bag system warning light illuminates or flashes.



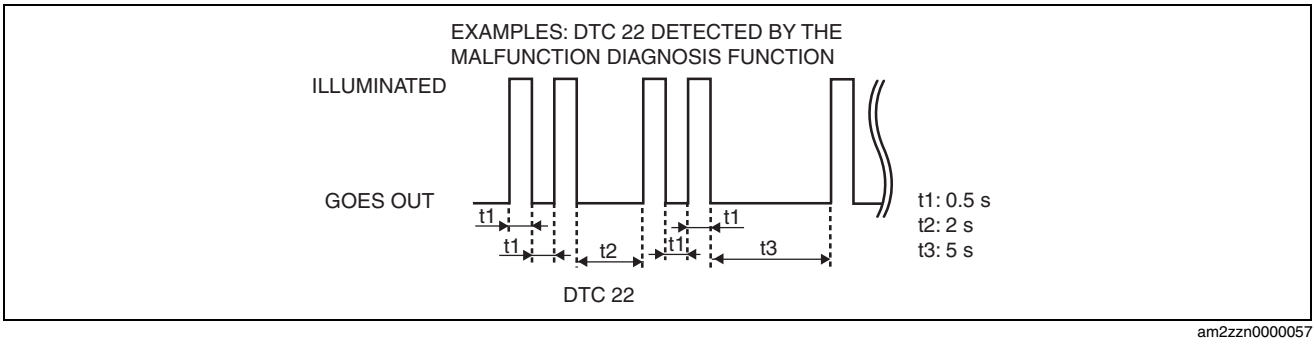
ac5wzn00000797

Construction

- LEDs (light-emitting diode) have been adopted for the air bag system warning light.
- The air bag system warning light is built into the instrument cluster.

Operation

- When the ignition is switched ON, the instrument cluster illuminates the air bag system warning light for a specified period to indicate that the SRS air bag system is performing initialization diagnostics. If there is no malfunction in the SRS air bag system, the indicator light turns off.
- If the SAS control module detects a malfunction in the SRS air bag system, it sends a warning signal to the instrument cluster via CAN communication. The instrument cluster illuminates or flashes the air bag system warning light based on the warning signal it receives to display the DTC.
- If there is a malfunction in the SRS air bag system, the air bag system warning light displays DTCs according to the following patterns:



am2zzn0000057

- If there are several malfunctions in the SRS air bag system, the DTC of the highest priority ranking is displayed first.

AIR BAG SYSTEM

Fail-safe
- Function not equipped.

AIR BAG SYSTEM WARNING ALARM

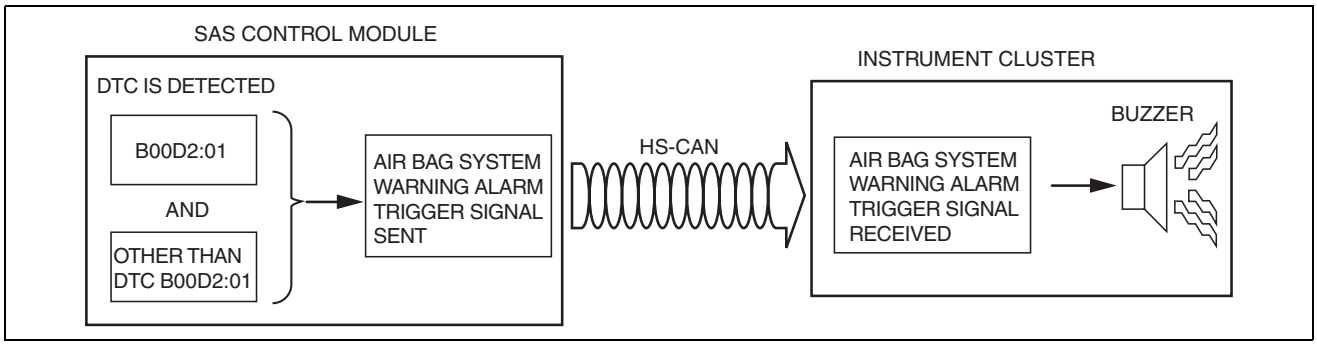
id081000500400

Purpose
- The air bag system warning alarm notifies the driver that a malfunction occurred in the air bag system warning light.

Function
- When a malfunction occurs in the air bag system warning light, the air bag system alarm sounds.

Construction
- The air bag system warning alarm sounds a buzzer in the instrument cluster.

Operation
- The SAS control module sends the air bag system warning alarm trigger signal to the instrument cluster via CAN communication to sound the buzzer in the instrument cluster.
- If all of the following conditions are met, the SAS control module sends the air bag system warning alarm trigger signal to the instrument cluster.
  - — SAS control module detects DTC B00D2:01 (air bag system warning light malfunction)
  - — SAS control module detects DTCs other than DTC B00D2:01



ac5wzn00000802

- Refer to the air bag system warning alarm for the air bag system warning alarm sound interval.

Fail-safe
- Function not equipped.

PASSENGER AIR BAG DEACTIVATION (PAD) SYSTEM

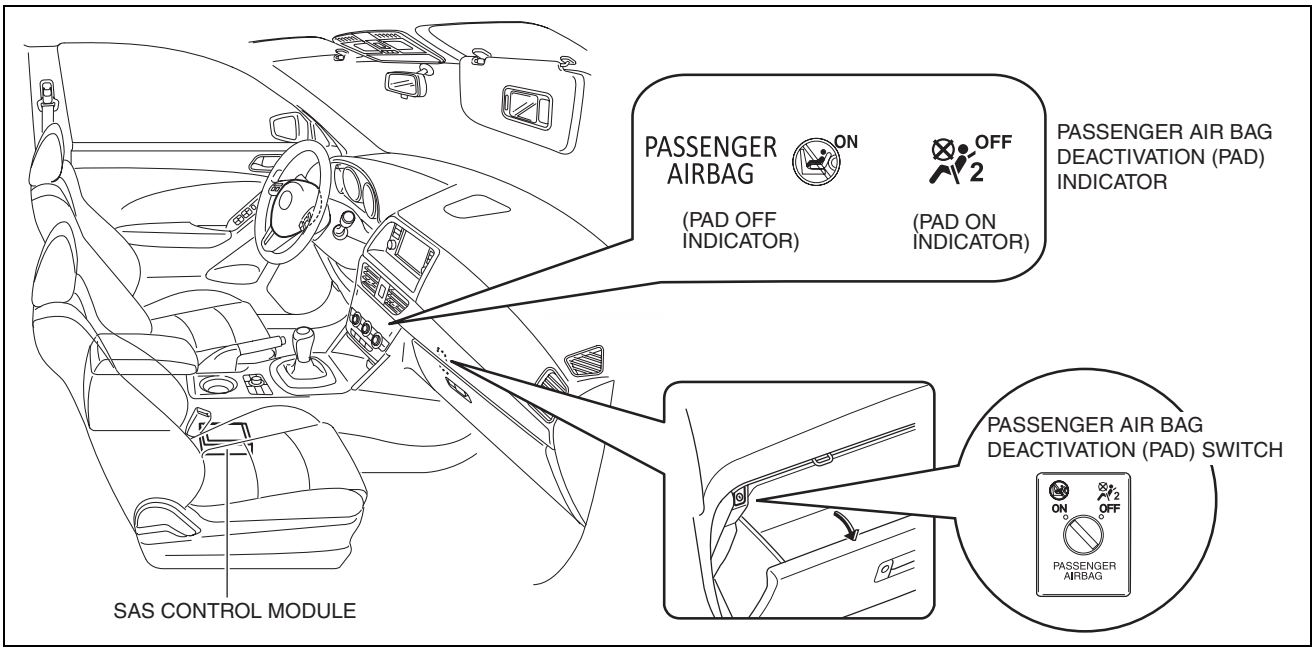
id081000890400

Purpose
- The PAD system can be deactivated to cancel the operation (deployment) of the passenger-side air bag system as desired.

Function
- The PAD system can be switched between operation (deployment)/non-operation (non-deployment) of the passenger-side air bag module, passenger-side side air bag module, and passenger-side pre-tensioner seat belt by operating the PAD switch.
- When the passenger-side air bag system is in a non-operation (non-deployment) condition, the PAD ON indicator illuminates.
- The SAS control module displays a DTC if it detects a malfunction in the PAD switch or PAD indicator circuit.

Construction
- The PAD system consists of the PAD switch and PAD indicator.
- The PAD switch is installed to the passenger-side lower panel.
- The PAD indicator displays in the display panel built into the climate control unit or clock unit.

AIR BAG SYSTEM

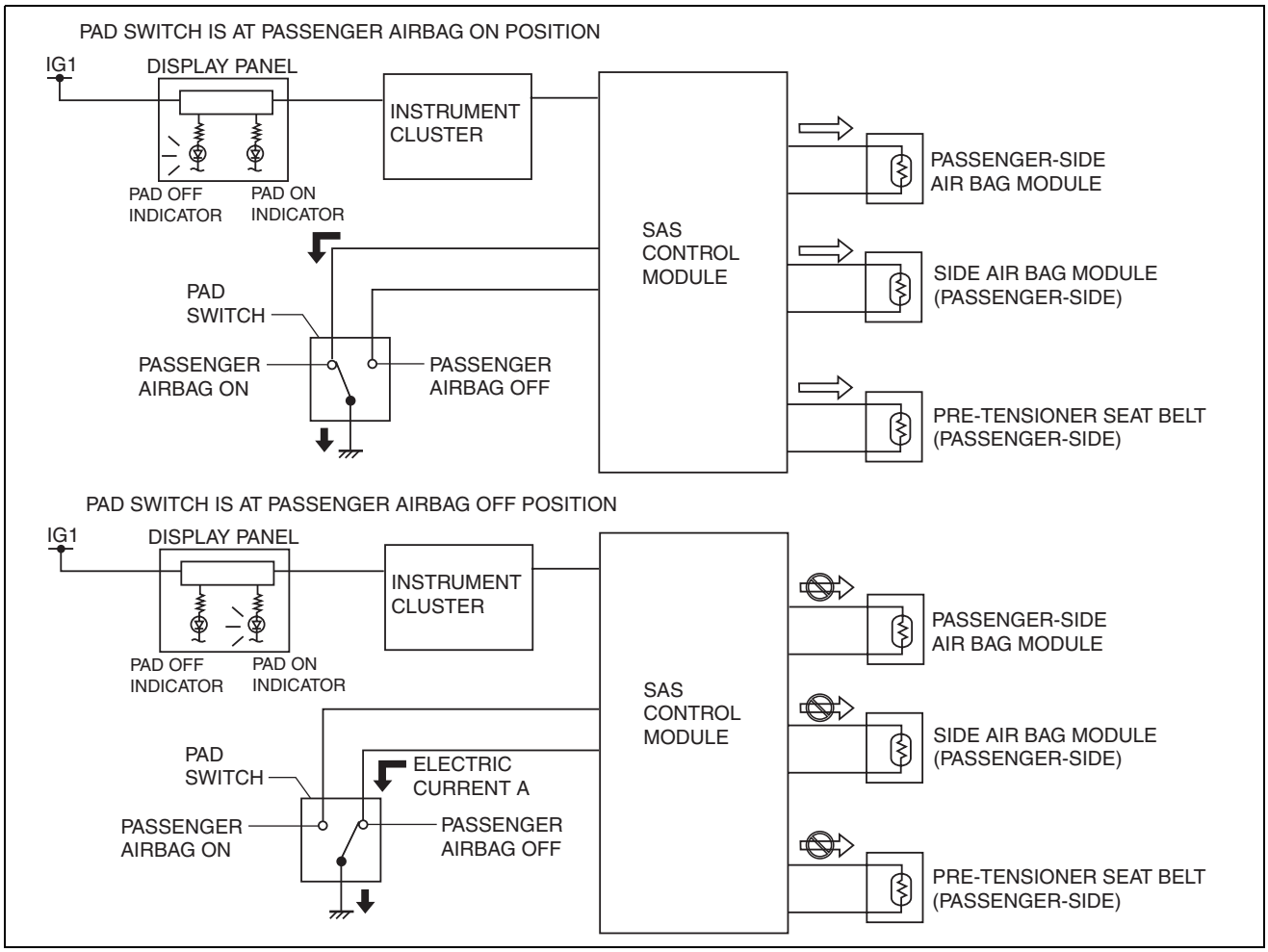


ac5wzn00000822

Operation

- With the key inserted, when the PAD switch is turned to the OFF position, electric current A from the SAS control module passes through the PAD switch to ground, thereby forming an off circuit. At the same time, the PAD ON indicator illuminates and operation (deployment) of the passenger-side air bag module, passenger-side side air bag module, and the passenger-side pre-tensioner seat belt is inhibited.

AIR BAG SYSTEM



ac5wzn00000823

DRIVER-SIDE AIR BAG MODULE

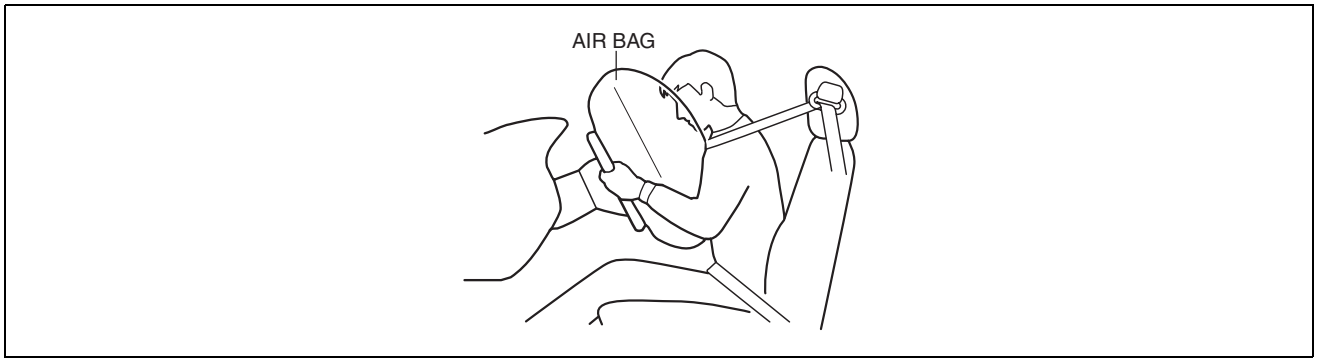
id081000500500

Purpose

- When the driver-side air bag module receives an impact from a frontal or frontal offset collision, the operation (deployment) of the air bag mediates the impact to the head and face of the driver.

Function

- When the driver-side air bag module receives an impact from a frontal or frontal offset collision, the air bag is operated (deployed) by the operation signal sent from the SAS control module.



ac5wzn00000803

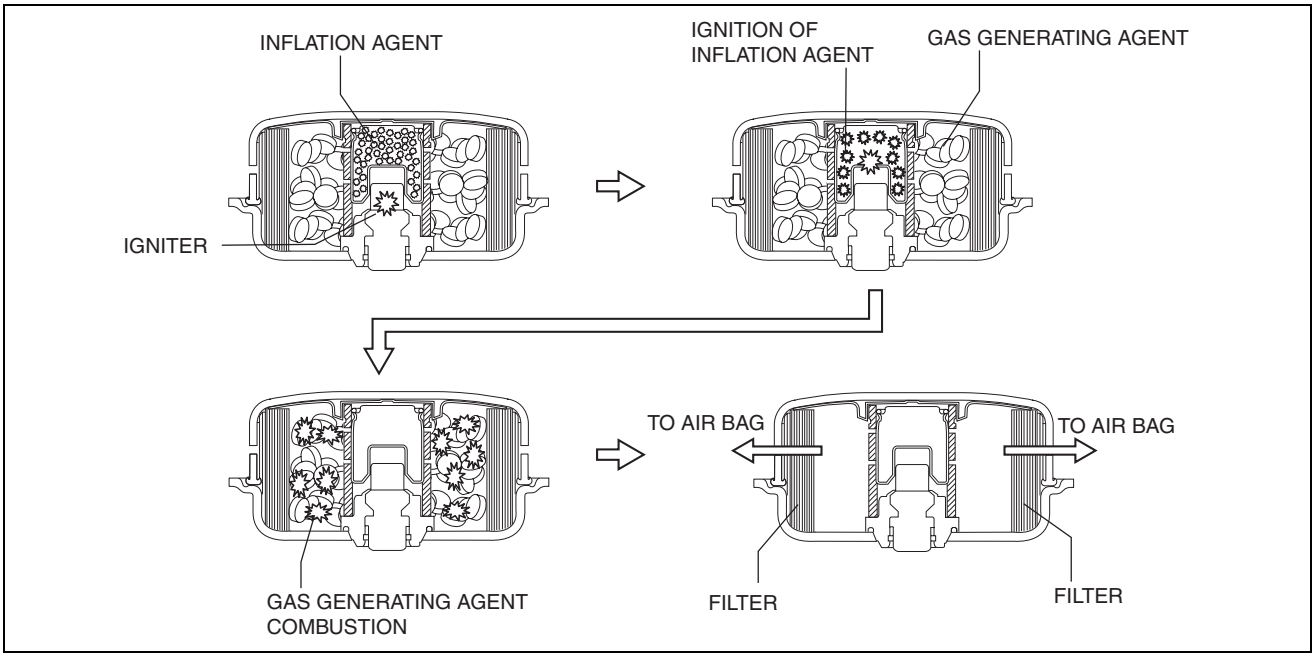
Construction

- The driver-side air bag module is installed to the center area of the steering wheel.

AIR BAG SYSTEM

Operation
Inflator operation
- The driver-side air bag module operates (deploys) the air bag by activating the internal inflator.
- The inflator operates (deploys) in the following order:

1. When an operation (deployment) signal is received from the SAS control module, the igniter built into the inflator generates heat and ignites the ignition agent.



am3zzn0000203

2. The ignition of the ignition agent causes the combustion of a gas generating agent which forms nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.

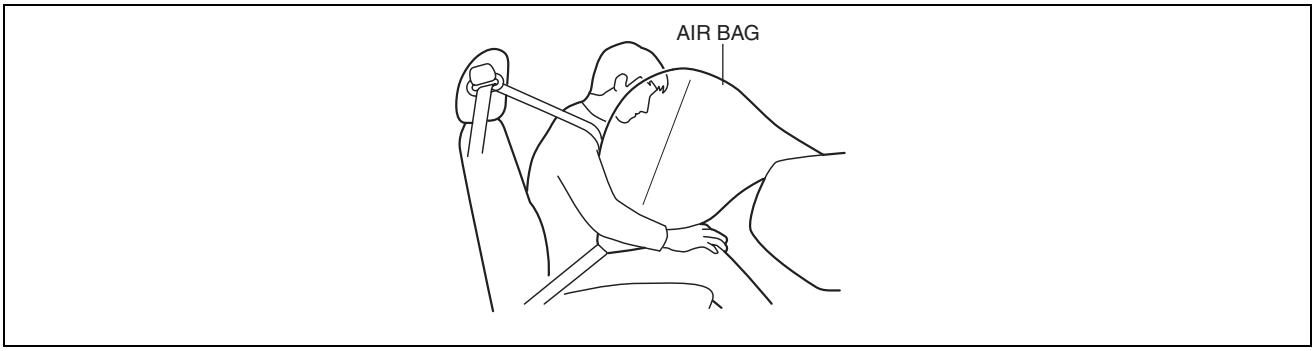
Fail-safe
- Function not equipped.

PASSENGER-SIDE AIR BAG MODULE

id081000500600

Purpose
- When the passenger-side air bag module receives an impact from a frontal or frontal offset collision, the operation (deployment) of the air bag mediates the impact to the head and face of the front passenger.

Function
- When the passenger-side air bag module receives an impact from a frontal or frontal offset collision, the air bag is operated (deployed) by the operation signal sent from the SAS control module.



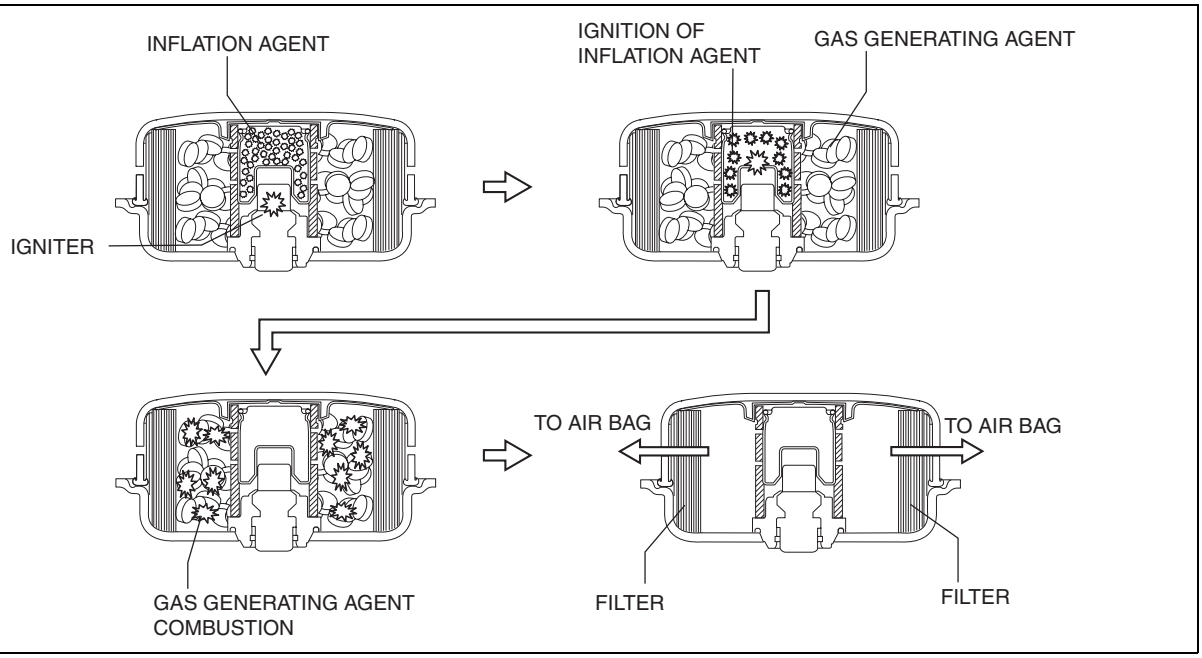
ac5wzn00000804

Construction
- The passenger-side air bag module is installed to the instrument panel.

Operation
- The passenger-side air bag module operates (deploys) the air bag by activating the internal inflator.
- The inflator operates (deploys) in the following order:

AIR BAG SYSTEM

1. When an operation (deployment) signal is received from the SAS control module, the igniter built into the inflator generates heat and ignites the ignition agent.



am3zzn0000203

2. The ignition of the ignition agent causes the combustion of a gas generating agent which forms nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.

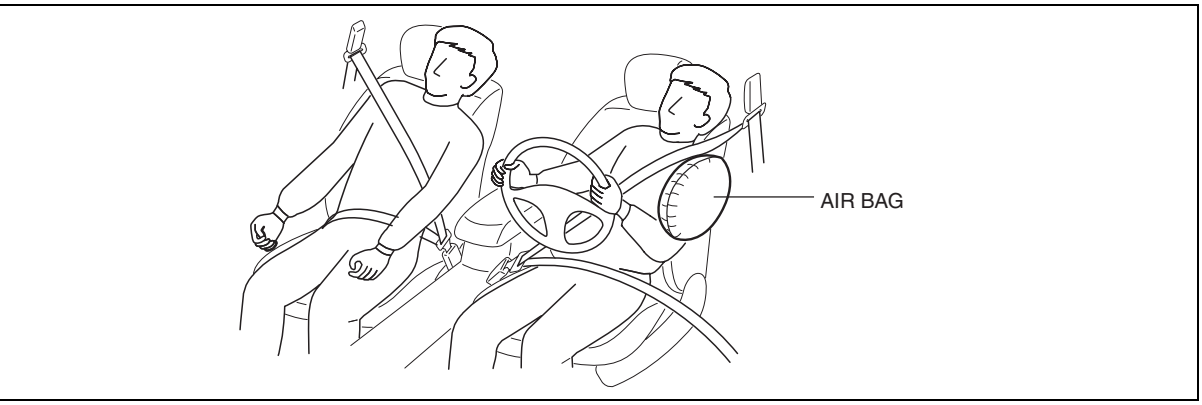
Fail-safe
- Function not equipped.

SIDE AIR BAG MODULE

id081000500700

Purpose
- When a side air bag module receives an impact from a lateral collision, the operation (deployment) of the air bag mediates the impact to the chest of the driver and front passenger.

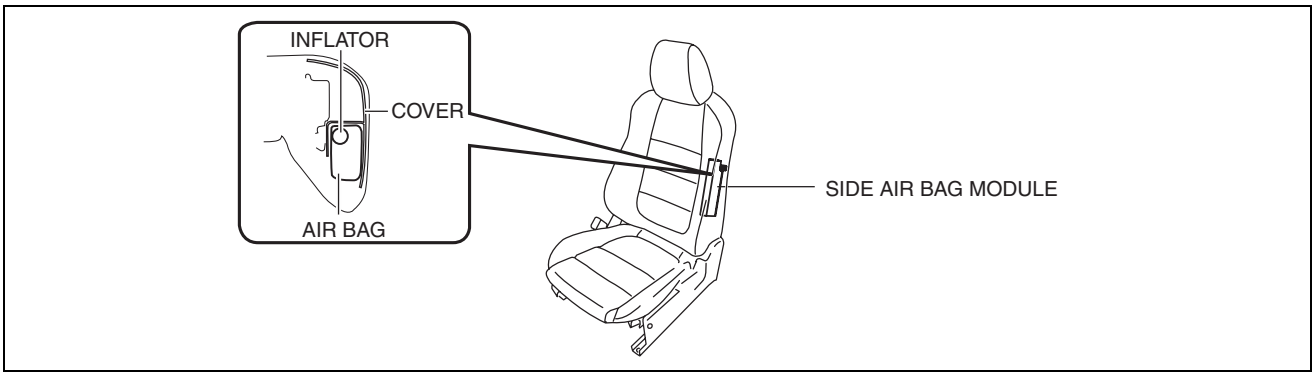
Function
- When a side air bag module receives an impact from a lateral collision, the air bag is operated (deployed) by the operation signal sent from the SAS control module.



ac5wzn00000805

Construction
- The side air bag modules are installed on the door side of the front seat backs.
- The side air bag module consists of the inflator and air bag.

AIR BAG SYSTEM

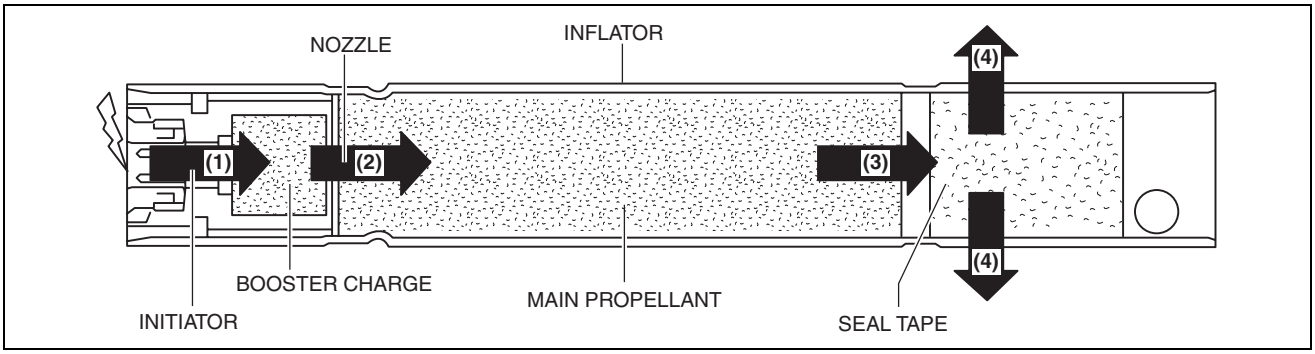


ac5wzn00000806

Operation

- The side air bag module operates (deploys) the air bag by activating the internal inflator.
- The inflator operates (deploys) in the following order:

1. When an operation (deployment) signal is received from the SAS control module, the initiator built into the inflator is ignited which ignites the booster charge.



2. The high temperature gas flows into the combustion chamber from the nozzle to ignite the main propellant.
3. The seal tape is broken by the internal pressure in the combustion chamber, and the gas is sprayed out of the inflator through the diffuser (diffusion devise).
4. When the side air bag module operates (deploys), the air bag operates (deploys) while breaking open the seat back trim by the force of gas generated from the inflator.

Fail-safe

- Function not equipped.

CURTAIN AIR BAG MODULE

id081000500800

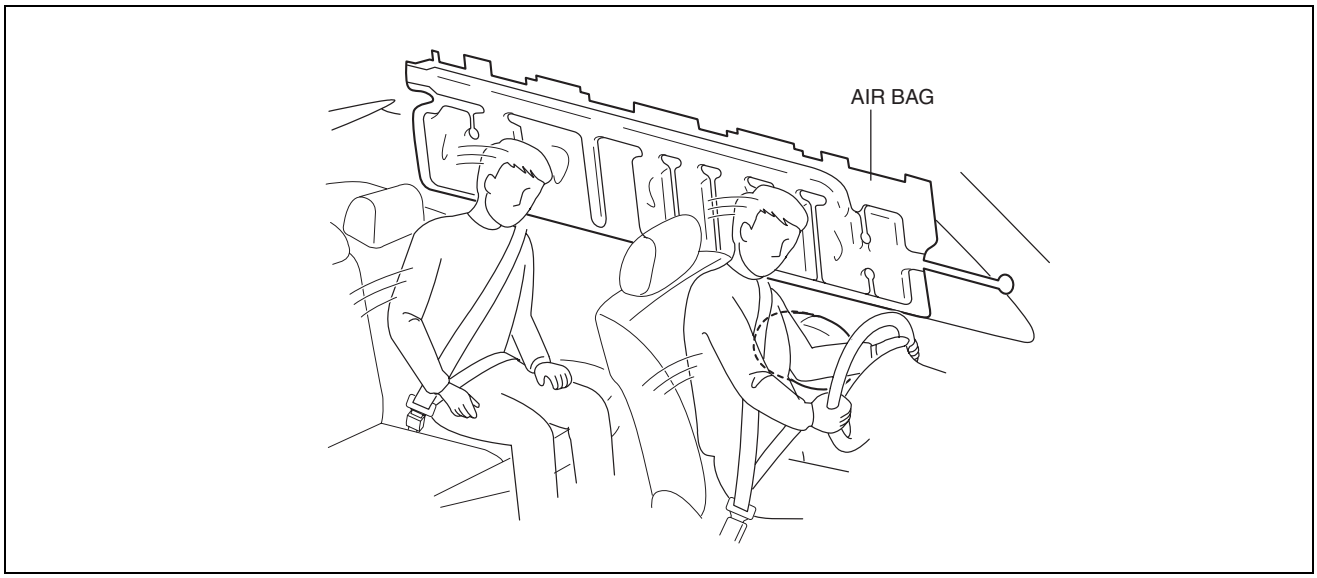
Purpose

- When a curtain air bag module receives an impact from a lateral collision, the operation (deployment) of the air bag mediates the impact to the head of the driver and front passenger.

Function

- When a curtain air bag module receives an impact from a lateral collision, the air bag is operated (deployed) by the operation signal sent from the SAS control module.

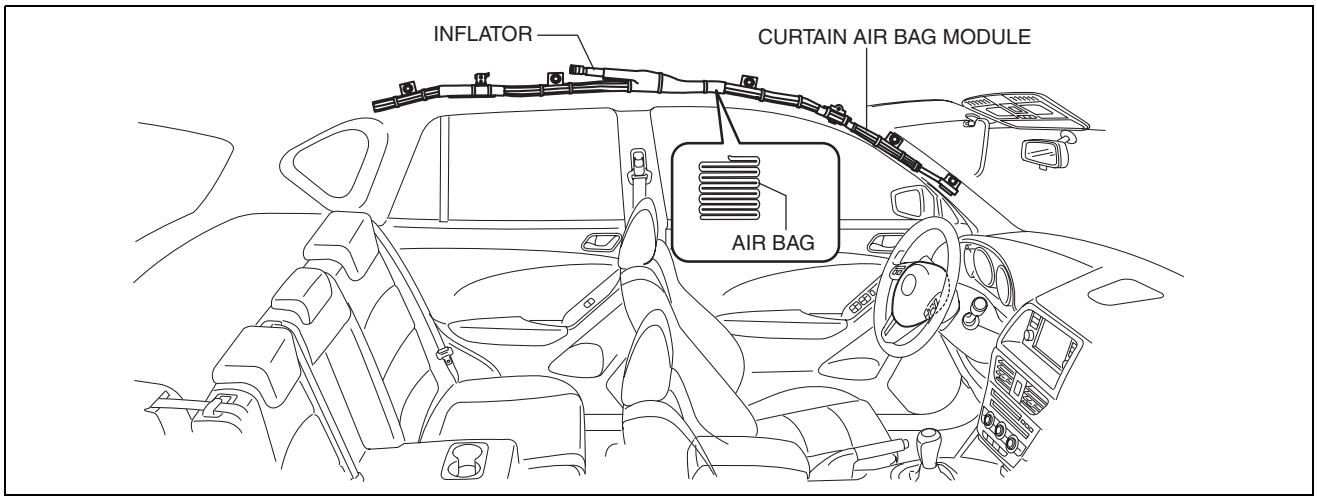
AIR BAG SYSTEM



ac5wzn00000808

Construction

- The curtain air bag module is installed along the roof edge between the A and C pillars.
- The curtain air bag module consists of the inflator and air bag.
- A stored-type curtain air bag has been adopted which does not use an ignition agent for the inflator.

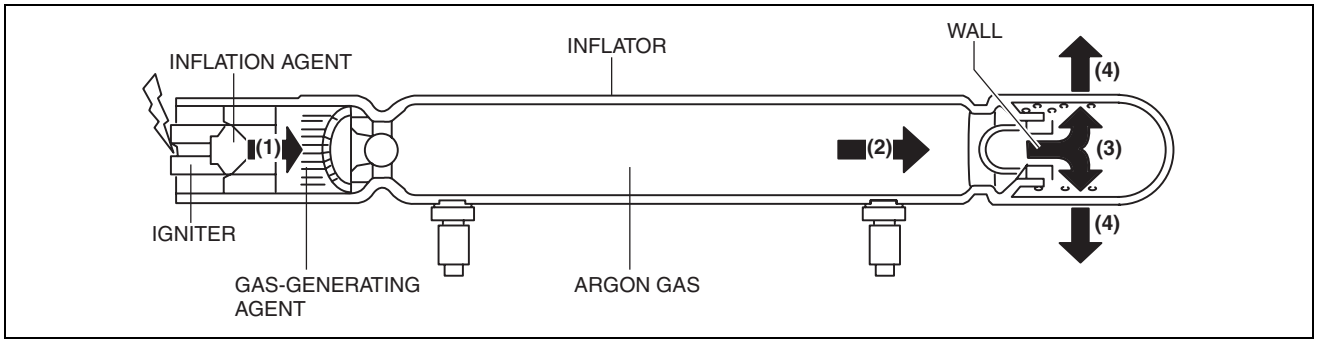


ac5wzn00000809

Operation

- The curtain air bag module operates (deploys) the air bag by activating the internal inflator.
- The inflator operates (deploys) in the following order:

1. When an operation (deployment) signal is received from the SAS control module, the igniter built into the inflator generates heat and ignites the ignition agent.



ac5wzn00000810

AIR BAG SYSTEM

2. The combustion of the ignition agent causes the ignition of a gas agent. The section of the wall from which the air bag deploys is broken by this impact wave.
3. The gas generated by the sealed argon gas and gas-generating agent is cooled at the filter and the filtrate is injected into the air bag.
4. When a curtain air bag operates (deploys), the A-pillar trim and headliner are spread apart by the compressed gas generated from the inflator, inflating the air bag.

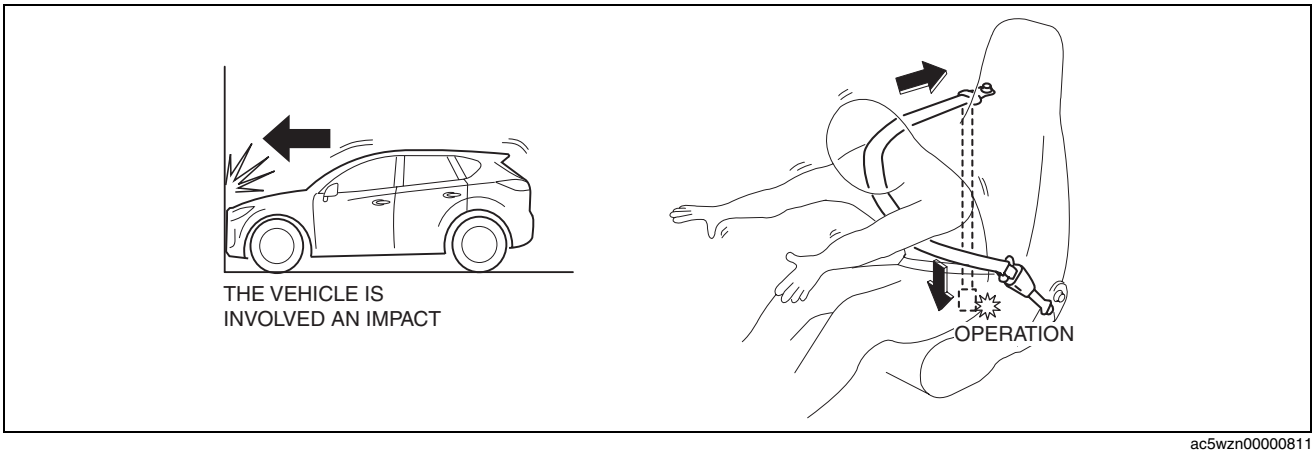
Fail-safe
- Function not equipped.

PRE-TENSIONER SEAT BELT

id081000500900

Purpose
- The pre-tensioner seat belt retracts and tightens the seat belt webbing to protect the front passengers during a collision.

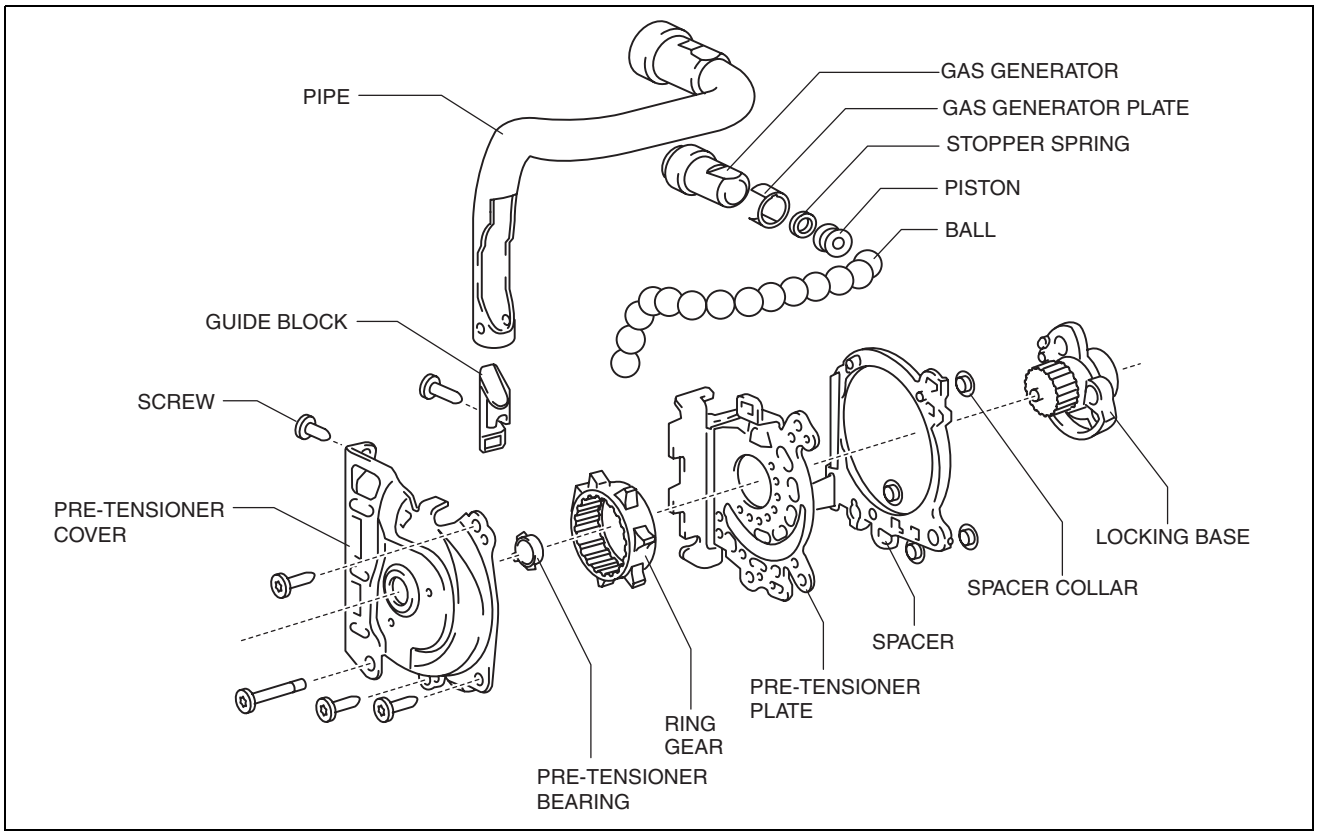
Function
- The pre-tensioner seat belts operate (deploy) based on the operation signal from the SAS control module to instantly retract and tighten the belt webbing, restraining the driver and front passenger.



ac5wzn00000811

Construction
- The pre-tensioner seat belt is installed to the front seat belt retractor.
- The pre-tensioner seat belt consists of the following parts shown in the figure:

AIR BAG SYSTEM

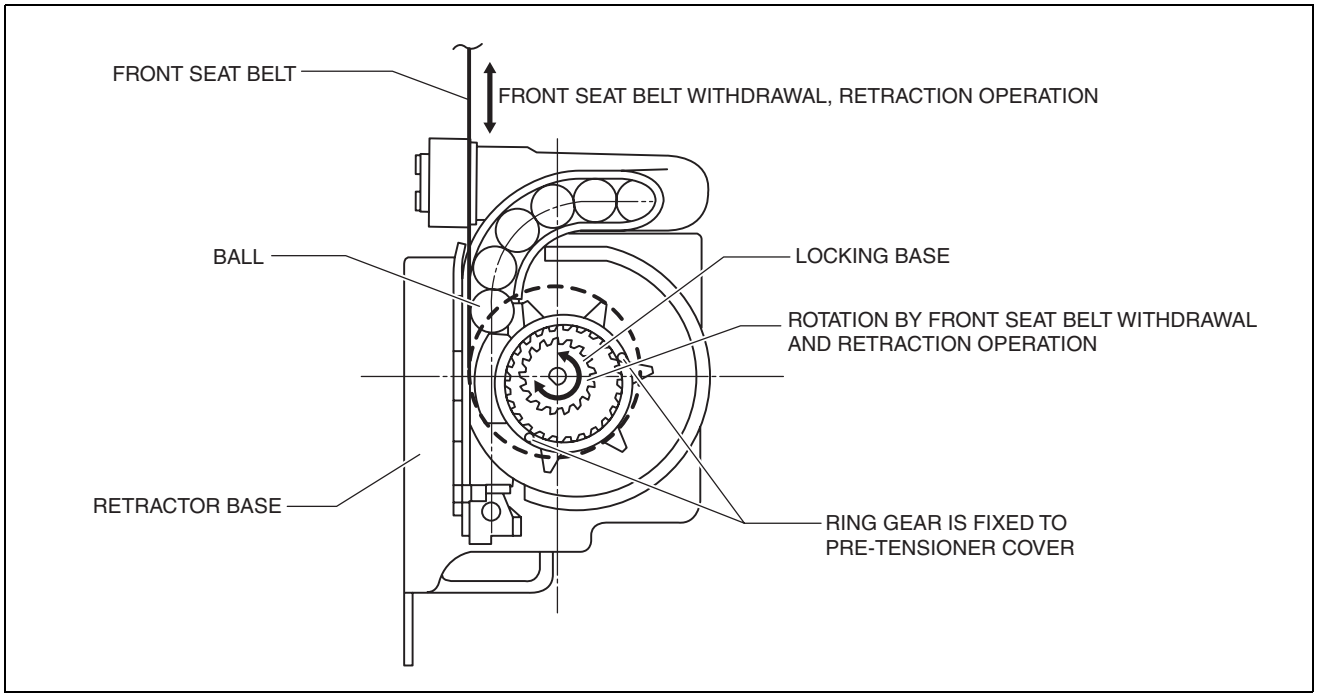


ac5wzn00000812

Operation

Normal operation (pre-tensioner non-operation)

- Normally, there is a gap between the locking base and the ring gear.
- The ring gear rotates in conjunction with the withdrawal and retraction of the front seat belts, however, in the pre-tensioner part it is kept separated.



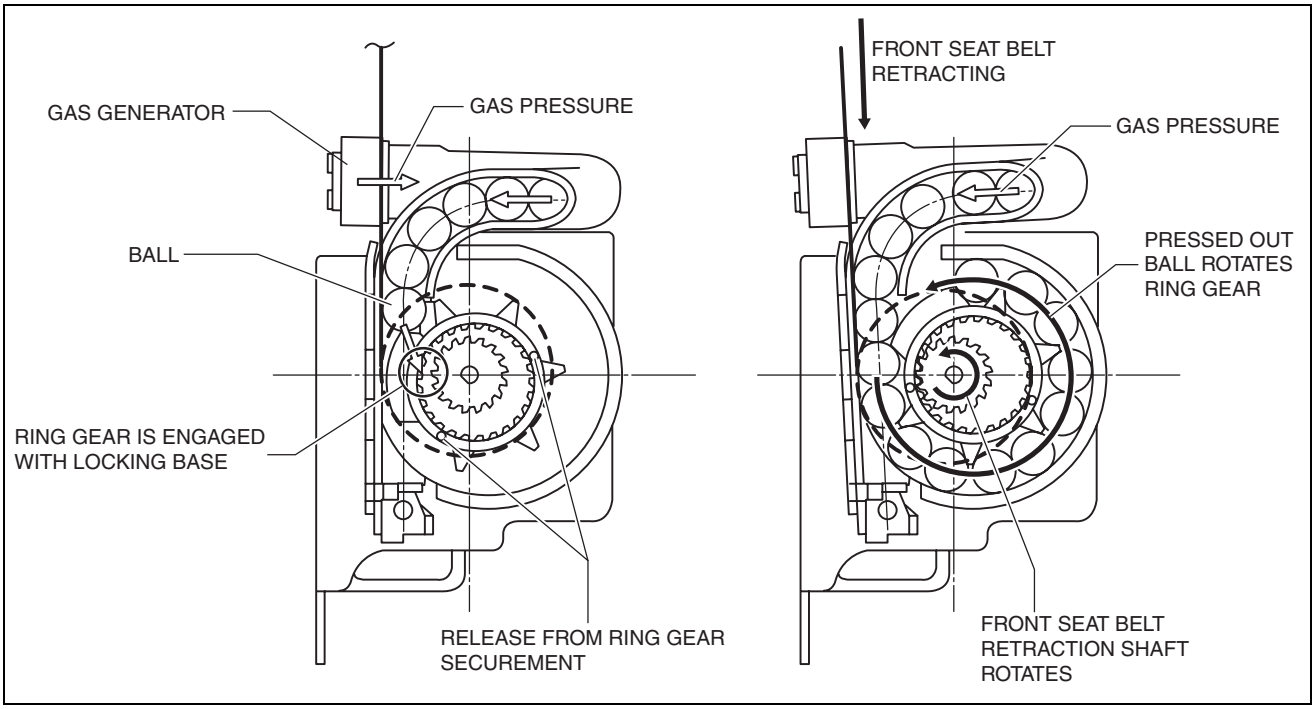
ac5wzn00000813

Pre-tensioner activation

1. The gas generator produces gas when it receives an operation signal from the SAS control module.

AIR BAG SYSTEM

2. The ball in the cylinder is pressed by the gas pressure and the ring gear is removed from its securement.
3. The ring gear is engaged with the locking base and the force of the ball being pressed out is transmitted to the retraction shaft.
4. The front seat belt is retracted in conjunction with the rotation of the retraction shaft.



ac5wzn00000814

Fail-safe
- Function not equipped.

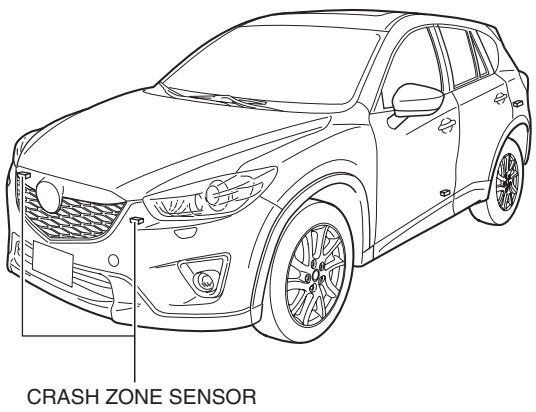
CRASH ZONE SENSOR

id081000511300

Purpose
- The crash zone sensor detects an impact during a frontal or frontal offset collision to the vehicle.

Function
- The crash zone sensor converts the detected impact to an electrical signal.

Construction
- The crash zone sensor is built into the clutch sensor.
- The crash zone sensor is installed to the shroud panel of the front bumper backside.
- Two crash zone sensors are installed for independent impact detection on the left and right.

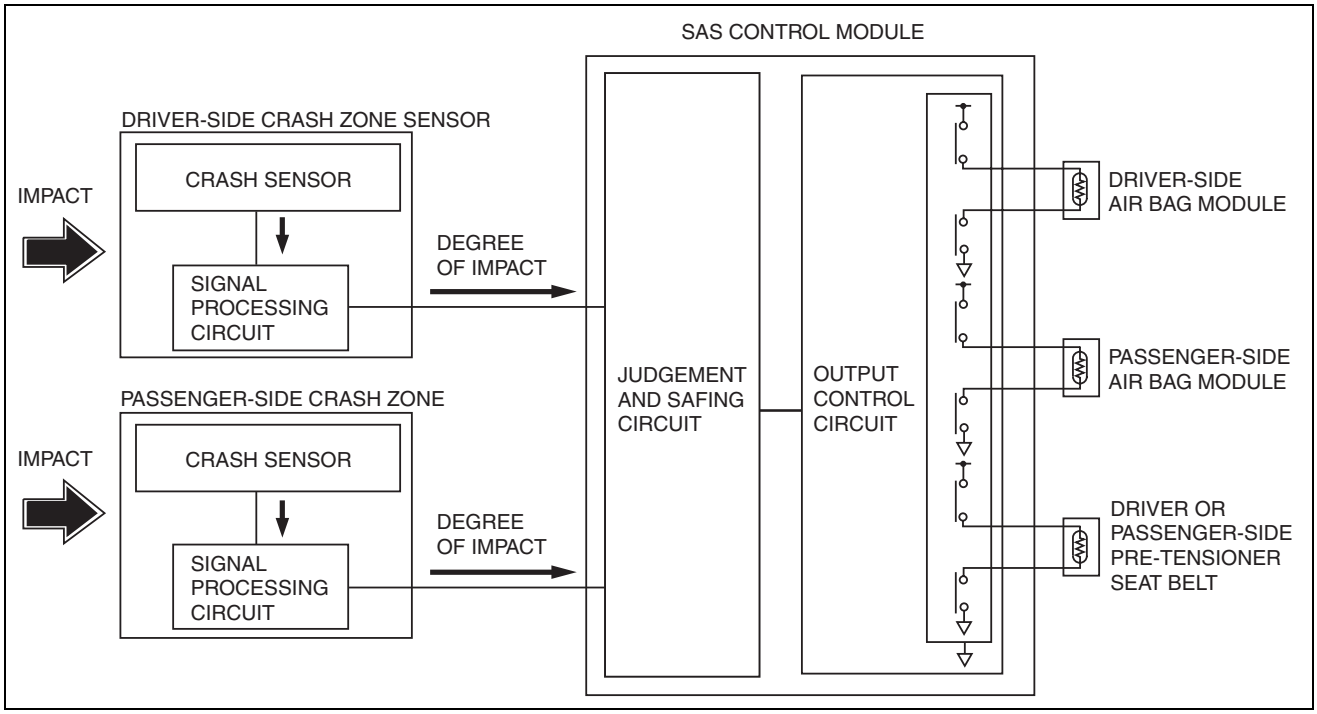


ac5wzn00000820

AIR BAG SYSTEM

Operation

1. The impact from a frontal or frontal offset collision to the vehicle is transmitted to the crash zone sensor.
2. The crash sensor built into the crash zone sensor detects the impact and converts the impact into an electrical signal at the signal processing circuit.
3. The crash zone sensor sends a signal indicating the degree of impact, which is converted to an electrical signal, to the SAS control module.



ac5wzn00000821

Fail-safe

- Function not equipped.

SIDE AIR BAG SENSOR

id081000501300

Purpose

- The side air bag sensor detects an impact during a lateral collision.

Function

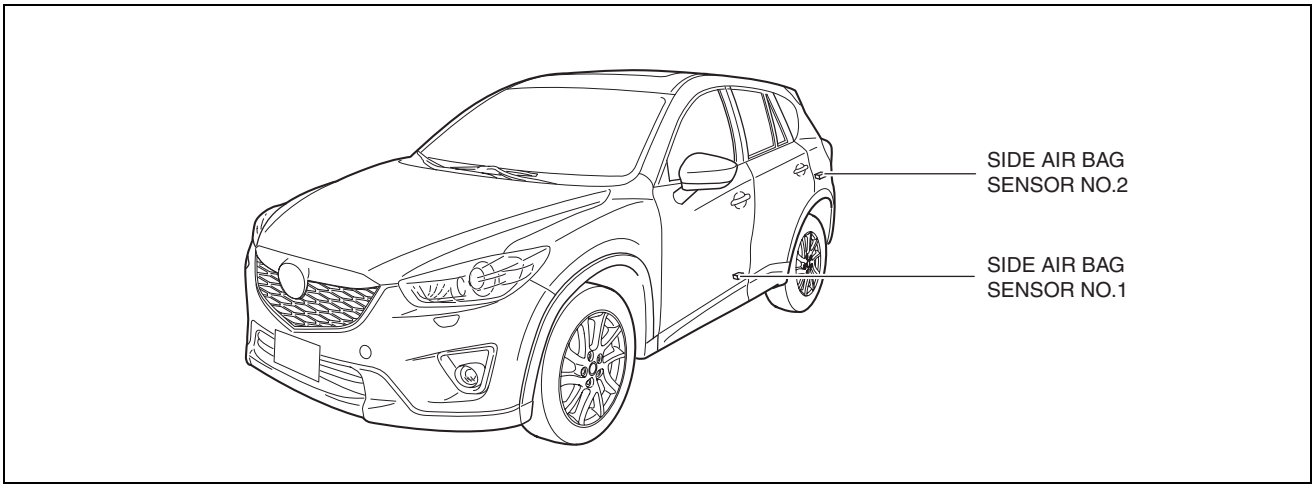
- The side air bag sensor converts the detected impact to an electrical signal.

Construction

- The side air bag sensor is built into the crash sensor.
- Two side air bag sensors are installed on each side for independent impact detection at the forward or the rearward side of the vehicle.
- Side air bag sensor No.1 is placed in the lower part of the B-pillar lower trim.

AIR BAG SYSTEM

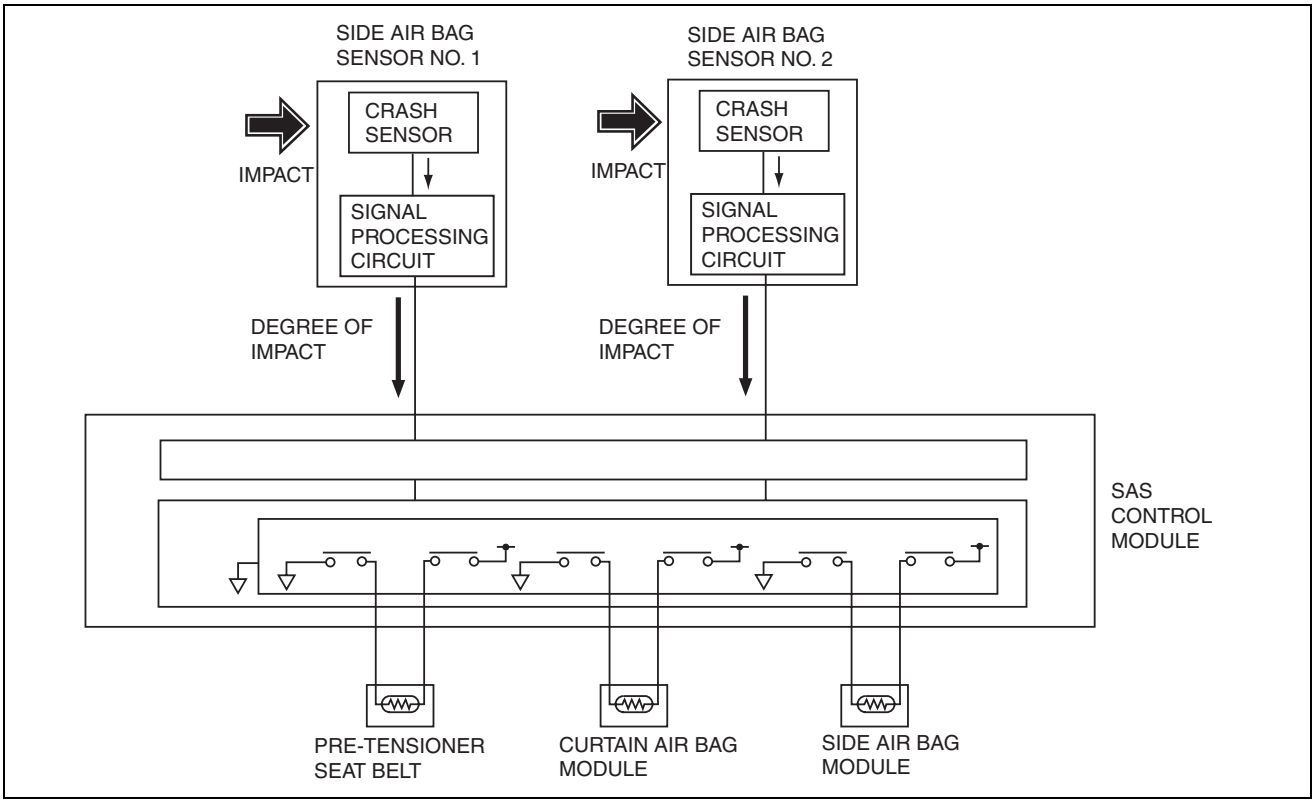
- Side air bag sensor No.2 is placed in the trunk side trim of the C-pillar.



ac5wzn00000815

Operation

1. The side air bag sensor detects an impact during a lateral collision.
2. The crash sensor built into the side air bag sensor detects the impact and converts the impact into an electrical signal at the signal processing circuit.
3. The side air bag sensor sends a signal indicating the degree of impact, which is converted to an electrical signal, to the SAS control module.



ac5wzn00000816

Fail-safe

- Function not equipped.

08-11 SEAT BELT

SEAT BELT

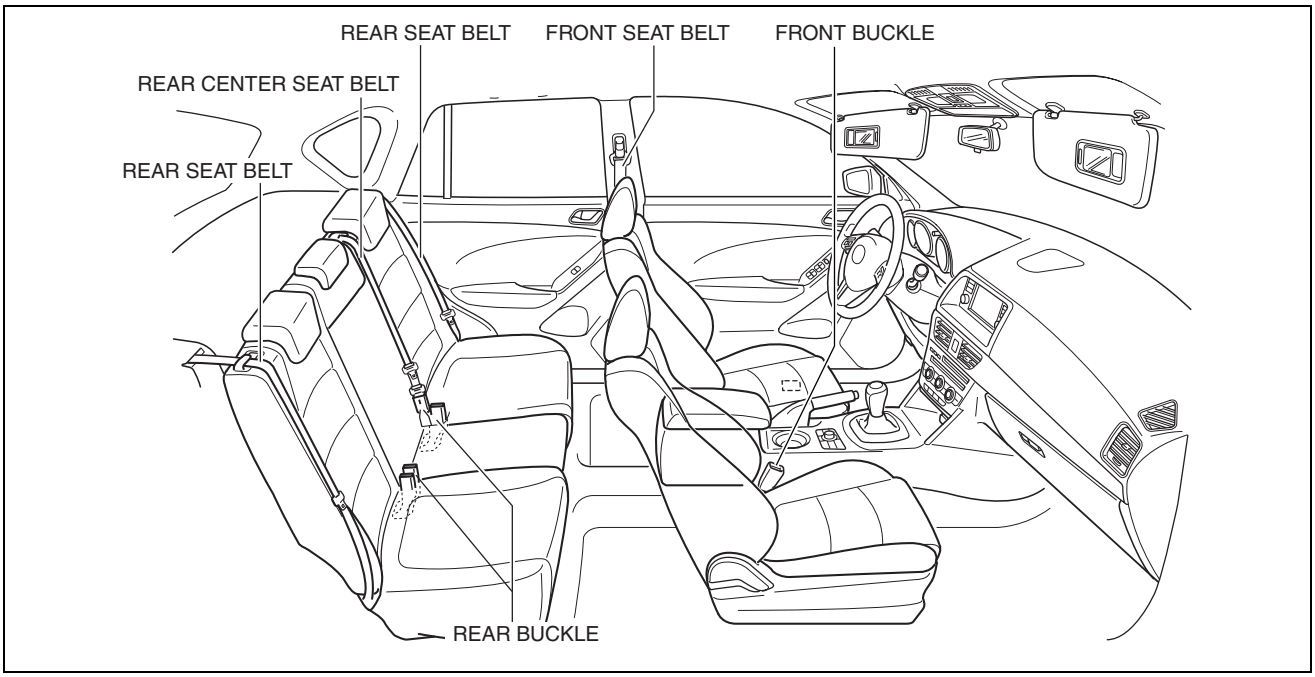
SEAT BELT

id081100500100

Outline

- Three-point front seat belts with the following functions for front seat passengers adopted.
  - — ELR (Emergency Locking Retractor: emergency locking mechanism)
  - — Load limiter
  - — Pre-tensioner seat belt (See 08-10-15 PRE-TENSIONER SEAT BELT.)
- Three-point seat belts with the following functions for rear seat passengers adopted.
  European (L.H.D. U.K.), General (L.H.D.) specs. Israel
  - — ELR
  Australian, General (R.H.D.) specs. other than Israel
  - — ELR
  - — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism) (left and right seats)

Structural View



ac5wzn00000817

Purpose

- The seat belt prevents the driver and the passenger from being thrown from the seat and injured due to an emergency vehicle stop or impact by being hit.

Function

- The seat belts are belt type safety devices which restrain the driver and passengers in their seats.
- The specifications for each seat belt are as indicated in the table.

European (L.H.D. U.K.), General (L.H.D.) specs. Israel

Seat belt	Type	Function
Front seat belt (Driver-side, passenger-side)	Three-point	• Load limiter • ELR (Emergency Locking Retractor) • Pre-tensioner seat belt
Rear seat belt (RH, LH)	Three-point	• ELR (Emergency Locking Retractor))

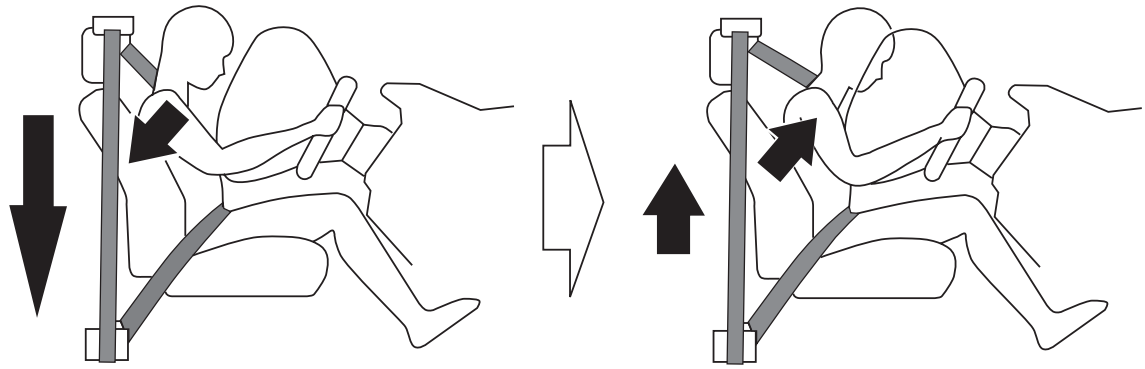
SEAT BELT

Seat belt	Type	Function
Rear center seat belt	Three-point	• ELR (Emergency Locking Retractor)

Australian, General (R.H.D.) specs. other than Israel

Seat belt	Type	Function
Front seat belt (Driver-side, passenger-side)	Three-point	• Load limiter • ELR (Emergency Locking Retractor) • Pre-tensioner seat belt
Rear seat belt (RH, LH)	Three-point	• ELR (Emergency Locking Retractor) • ALR (Automatic Locking Retractor)
Rear center seat belt	Three-point	• ELR (Emergency Locking Retractor)

Load limiter
- The load limiter adjusts the restraint force of the seat belt by slightly loosening the seat belt tightened by the pre-tensioner operation, preventing injury to the driver and passenger from seat belt pressure.



ac5wzn00000818

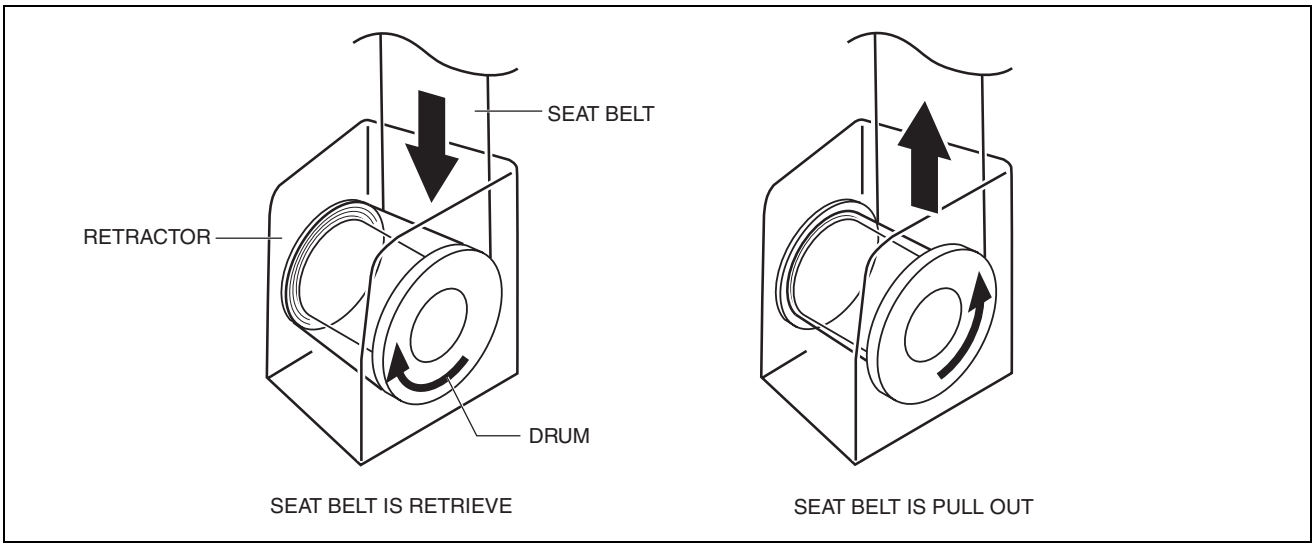
ELR (Emergency Locking Retractor)
- If a sudden force is applied to the seat belt such as by a collision or emergency braking, the ELR locks the seat belt so that it cannot be pulled out any more.

ALR (Automatic Locking Retractor)
- When the seat belt is pulled out and fastened, the ALR locks the seat belt at that length and it cannot be pulled out any more.
- The ALR is mainly used for installing a child-restraint.

Pre-tensioner seat belt
- Refer to PRE-TENSIONER SEAT BELT. (See 08-10-15 PRE-TENSIONER SEAT BELT.)

Construction
- For the three-point seat belt, the seat belt is secured to the drum in the retractor and wrapped.
- The seat belt is pulled out or retrieved by the rotation of the drum to adjust the length of the seat belt.

SEAT BELT



ac5wzn00000819

Fail-safe

- Function not equipped.

BODY & ACCESSORIES

09
SECTION

09-00 OUTLINE

OUTLINE

BODY AND ACCESSORIES

id090000000000

ABBREVIATIONS

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ABDC	After Bottom Dead Center
ACC	Accessories
ALC	Auto Level Control
ALR	Automatic Locking Retractor
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CKP	Crankshaft Position
CM	Control Module
CMDTC	Continuous Memory Diagnostic Trouble Code
CMP	Camshaft Position
CPU	Central Processing Unit
DC	Drive Cycle
DEF	Defroster
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELR	Emergency Locking Retractor
EPS	Electric Power Steering
ESS	Emergency Stop signal System
EX	Exhaust
FBCM	Front Body Control Module
FSC	Forward Sensing Camera
GPS	Global Positioning System

OUTLINE

HBC	High Beam Control
HF/TEL	Hands-Free Telephone
HI	High
HS	High Speed
HU	Hydraulic Unit
IDS	Integrated Diagnostic Software
IG	Ignition
IN	Intake
INT	Intermittent
KOEO	Key On Engine Off
KOER	Key Off Engine Running
LCD	Liquid Crystal Display
LDWS	Lane Departure Warning System
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
L.H.D.	Left Hand Drive
LO	Low
LR	Left Rear
M	Motor
MAX	Maximum
MIN	Minimum
MS	Middle speed
MTX	Manual Transaxle
NVH	Noise, Vibration, Harshness
OCV	Oil Control Valve
ODDTC	On-demand Diagnostic Trouble Code
PAD	Passenger Air Bag Deactivation
PCV	Positive Crankcase Ventilation
PDS	Portable Diagnostic Software
PID	Parameter Identification
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PSD	Power Sliding Door
P/W CM	Power Window Control Module
PTC	Positive Temperature Coefficient
RBCM	Rear Body Control Module
RDS	Radio Data System
REC	Recirculate
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
R.H.D.	Right Hand Drive
RR	Right Rear
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool
SW	Switch
TCS	Traction Control System
TDC	Top Dead Center
TFT	Transaxle Fluid Temperature
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System
VBC	Variable Boost Control
VENT	Ventilation
W/M	Workshop Manual
1GR	First Gear

OUTLINE

2GR	Second Gear
2WD	2-Wheel Drive
3GR	Third Gear
4GR	Fourth Gear
4WD	4-Wheel Drive
5GR	Fifth Gear
6GR	Sixth Gear

FEATURES

- The following systems have been adopted to the headlights.
  - — Discharge headlight system (with discharge headlight system)
  - — Auto light system (with auto light system)
  - — Adaptive front lighting system (AFS) (with AFS)
  - — High Beam Control (HBC) system (with HBC)
  - — Headlight auto leveling system (with headlight auto leveling system)
  - — Headlight manual leveling system (with headlight manual leveling system)
  - — Auto-light OFF system
- Front fog lights have been adopted. (with front fog lights)
- Emergency signal system (ESS) has been adopted.
- LED type side turn lights have been adopted.
- LED type high-mount brake light has been adopted.
- Rear fog lights have been adopted. (With rear fog lights)
- A room light control system has been adopted in which illumination time and illumination level of the interior lights change.
- An LCD has been adopted to the instrument cluster which displays the ambient temperature, trip computer, and odometer/tripmeter. (Without TFT LCD)
- A TFT LCD has been adopted to the instrument cluster which displays the door-ajar warning light, trip computer, and warning messages. (With TFT LCD)
- A rear vehicle monitoring (RVM) system has been adopted which notifies the driver of vehicles approaching from behind and warns the driver if the driver tries to change lanes to the side of the approaching vehicle. (With rear vehicle monitoring (RVM) system)
- A blind spot monitoring (BSM) system has been adopted which notifies the driver of vehicles approaching from behind on the left or right adjacent lanes in the driver's blind spot, and warns the driver if the driver tries to change lanes to the side of the approaching vehicle. (With blind spot monitoring (BSM) system)
- A parking assist system has been adopted which detects obstructions in the blind spot (vehicle front/rear/corners) to a wide extent using ultrasonic sensors and notifies the driver of the obstructions. (With parking sensor system)
- A lane departure warning system (LDWS) has been adopted which recognizes vehicle lane lines on the road using the forward sensing camera (FSC) installed to the windshield and notifies the driver if the vehicle may depart from its lane unbeknownst to the driver. (With lane departure warning system (LDWS))
- A clock has been adopted to the LCD which displays the current time, passenger/rear seat belt warning light, and front passenger air bag deactivation indicator light. (With manual A/C)
- A front body control module (FBCM) has been adopted for the vehicle front which controls systems such as the headlights, windshield wipers, and turn lights.
- A rear body control module (RBCM) has been adopted for the vehicle rear which controls systems such as the power door lock, rear wiper, and interior light.
- The following entertainment system has been adopted.
  - — Audio system (with audio system)
  - — Car-navigation system (with car-navigation system)
  - — Park assist system (with park assist system)
  - — Bluetooth system (with Bluetooth system)
- The following security and locks system has been adopted.
  - — Power door lock system
  - — Liftgate opener system
  - — Keyless entry system
  - — Advanced keyless entry system
  - — Push button start system
  - — Immobilizer system
  - — Theft-deterrent system

09-10 BODY PANELS

BODY PANELS

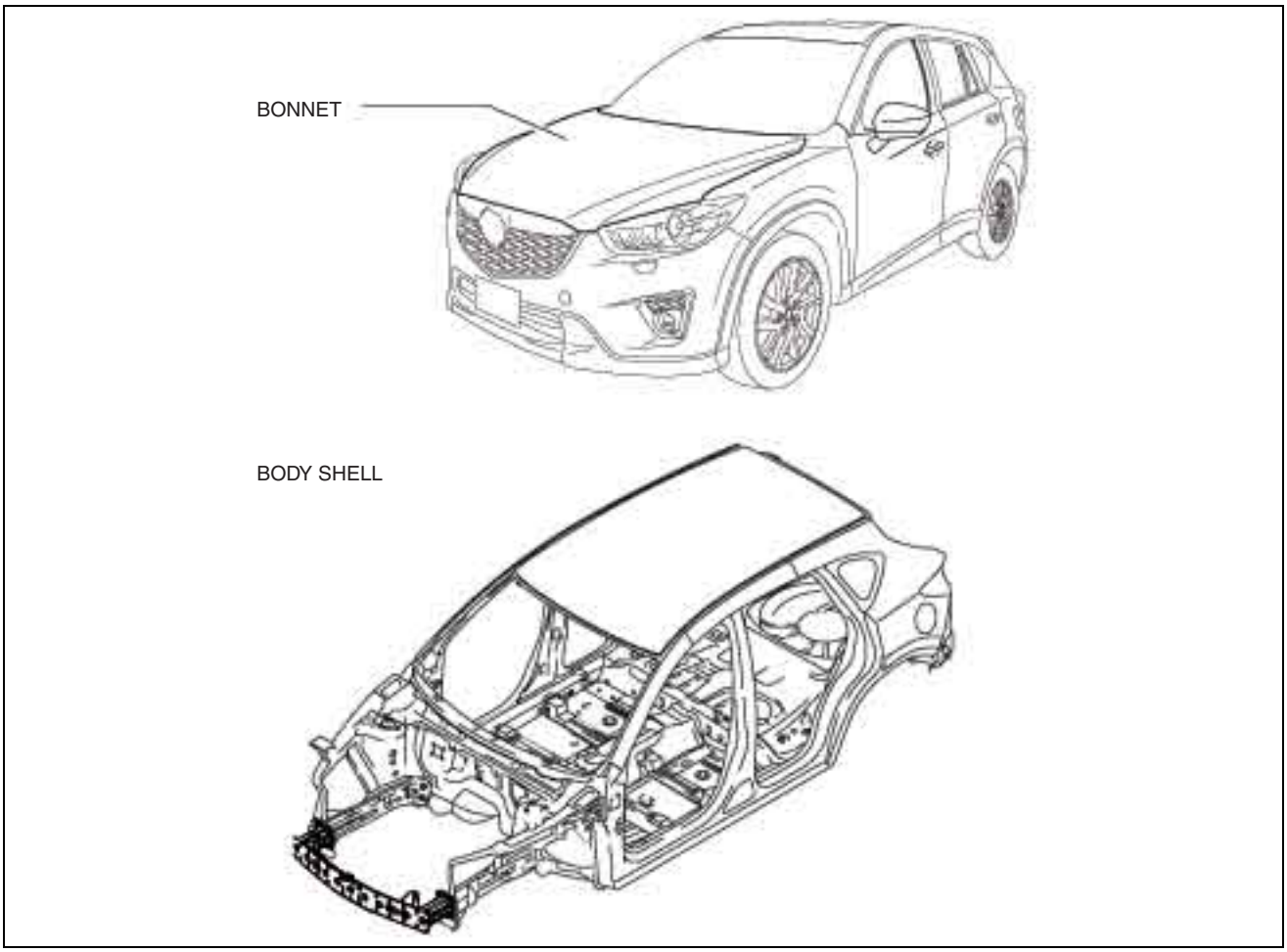
BODY PANEL

id091000009400

Outline

- The multi-load path and triple H-shaped structure of distributing the power absorbed at the collision were used for the body shell.
- A ring structure has been adopted for the triple H structure, realizing top-level crash safety performance.
- Crushable structure from which an engine mounting bracket and suspension crossmember are made to secede at the collision is used for the body frame of an engine room.
- The energy absorption space between a bonnet and engine was secured.

Structure View



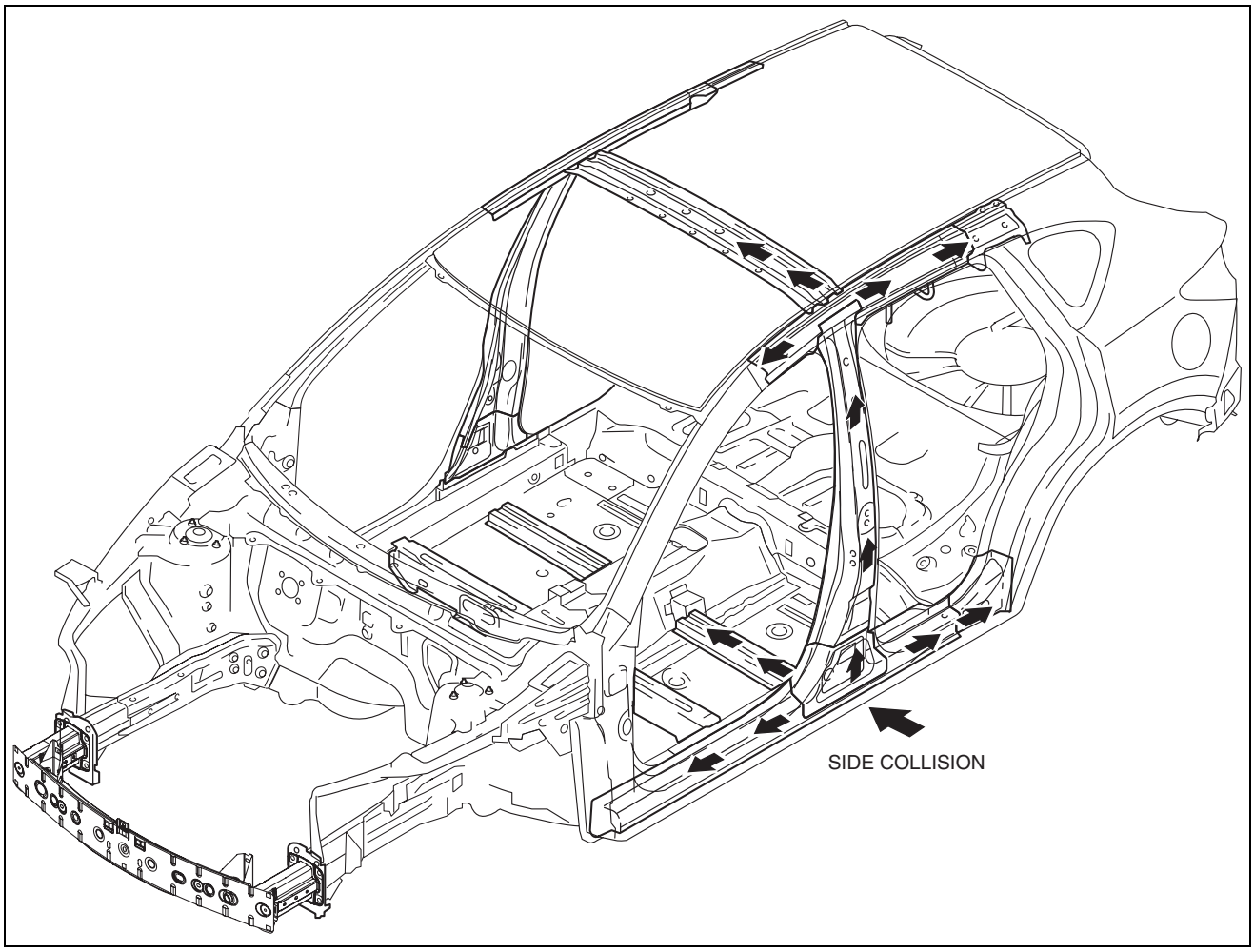
ac5wzn00000300

Construction

Triple H-shaped structure

- An H-shaped structure has been adopted in which reinforcements are equipped in the floor, side frame, and roof, and each connection area is strengthened.
- The combination of these three structural areas provide the strong triple H-shaped structure.
- Triple H structure distributes the impulse force at the side collision to reinforcement of the roof, cabin side frame, and floor.
- Triple H-shaped structure controls the twisting of the cabin while driving.

BODY PANELS



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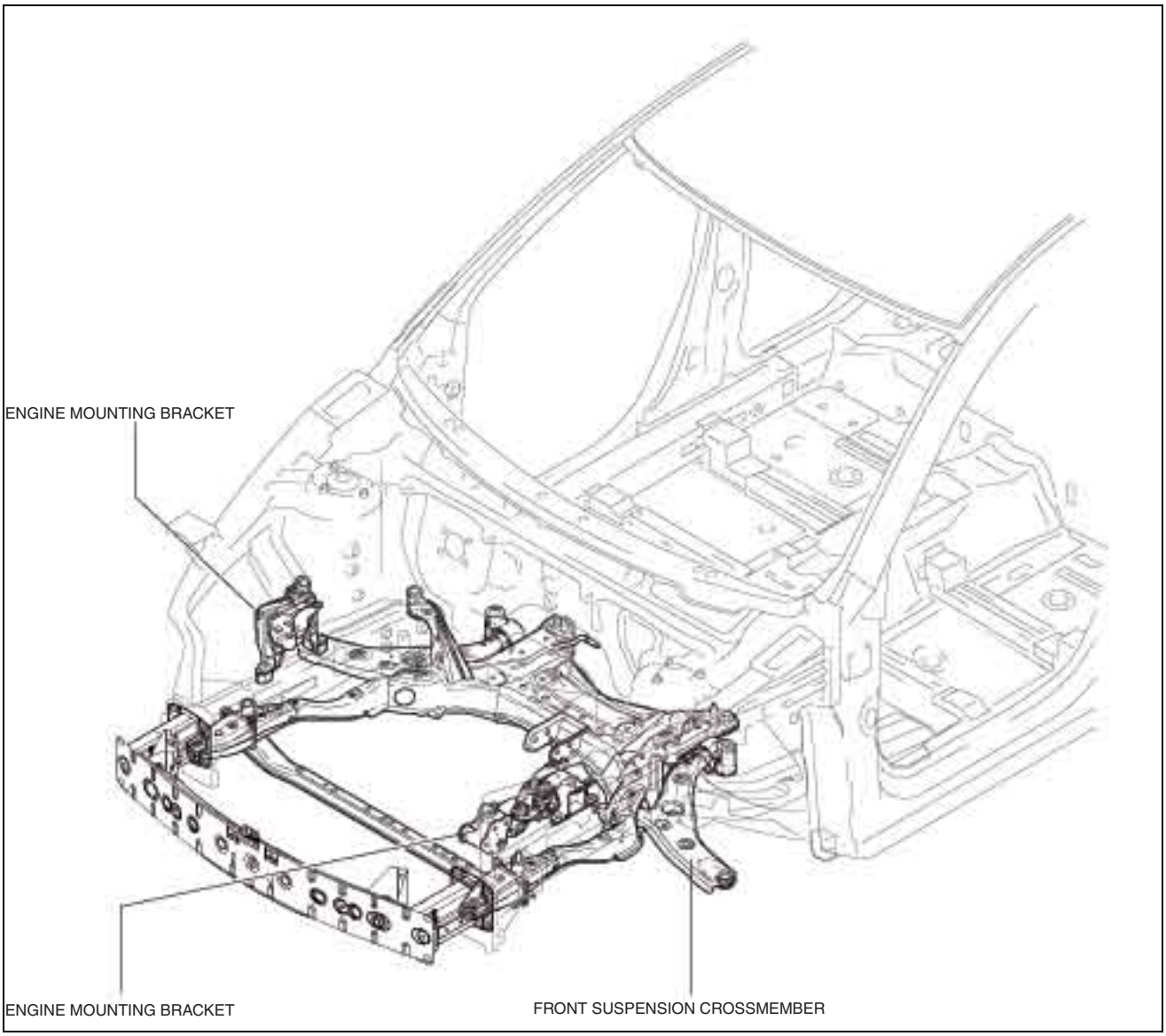
Crushable structure

- Engine mounting brackets and front suspension crossmember are made to break away during a collision.

BODY PANELS



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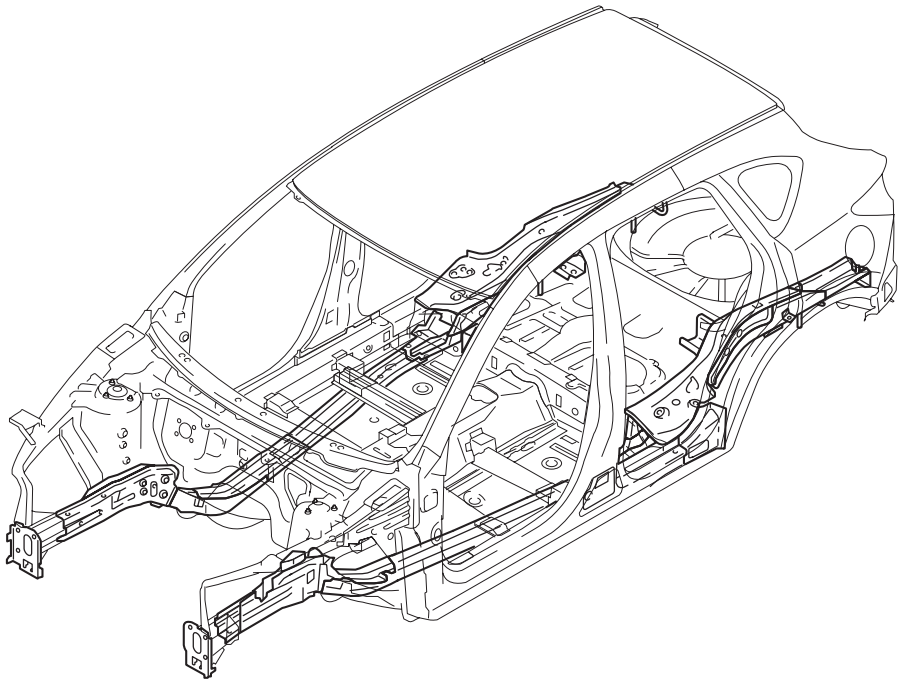
Ring structure

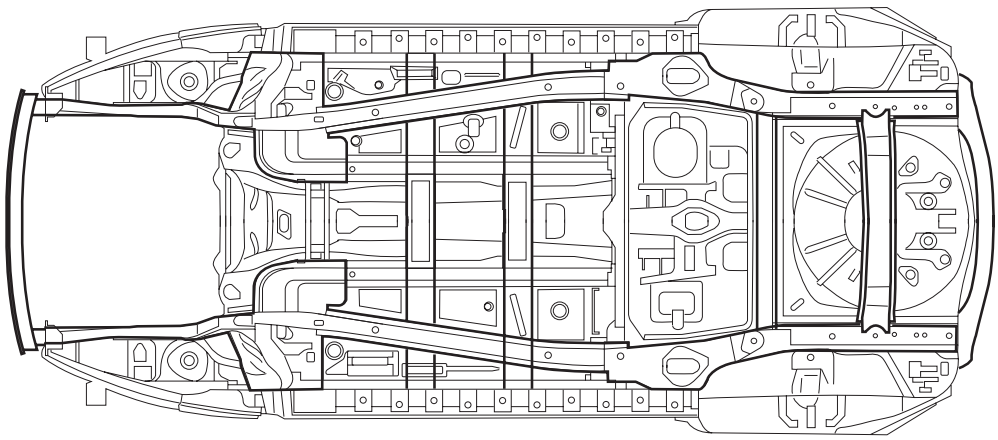
- For the ring structure, the basic framework is thoroughly straightened.
- For the ring structure, the frames are circularly linked.

BODY PANELS

BASIC FRAMEWORK



CIRCULARLY LINK



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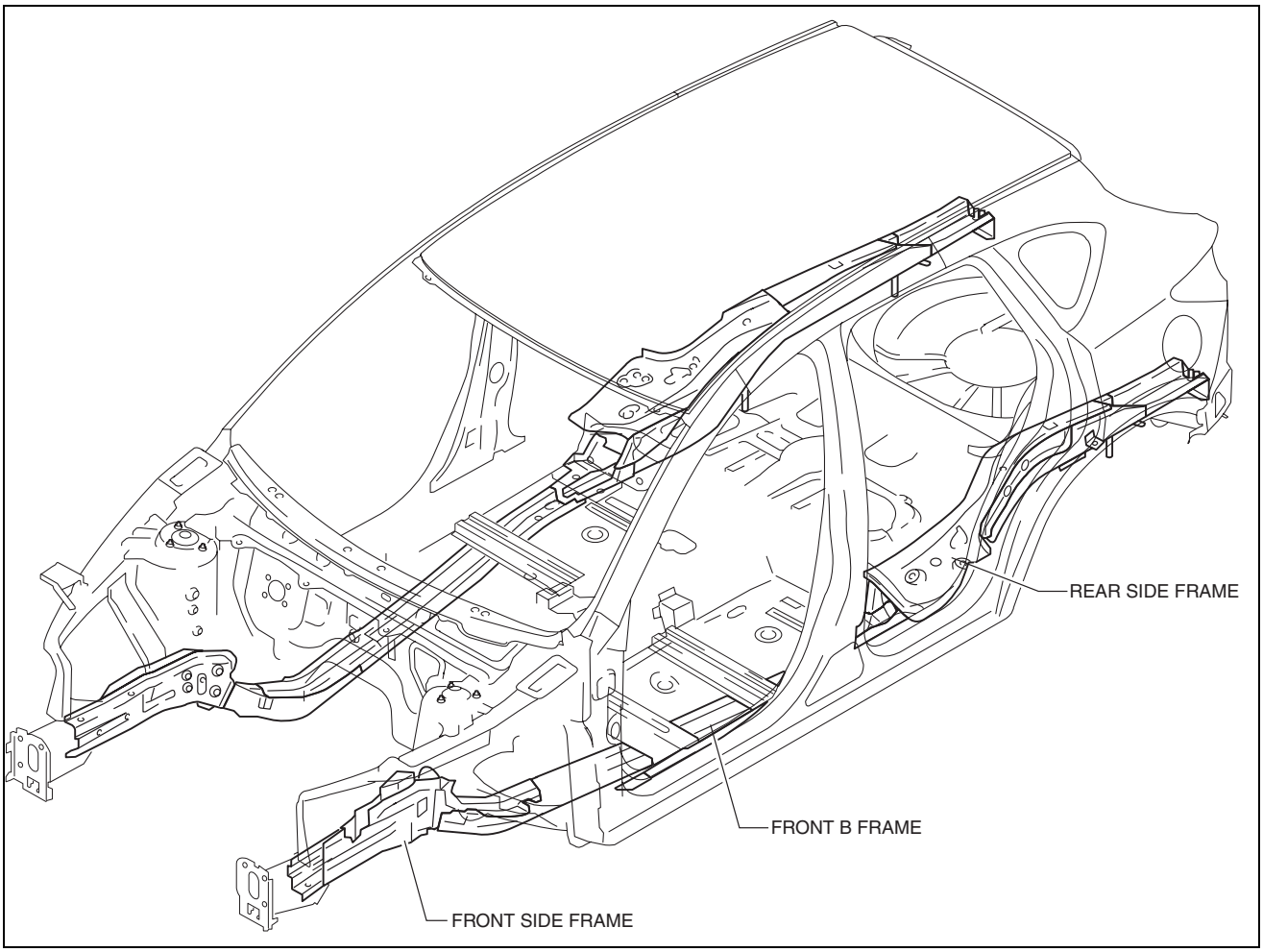
Multi-load path

- The multi-load path is stabilized during a collision, and has set the load distribution load path which carries out energy absorption.

— The front side frame, front B frame and rear side frame are made into straight forms.



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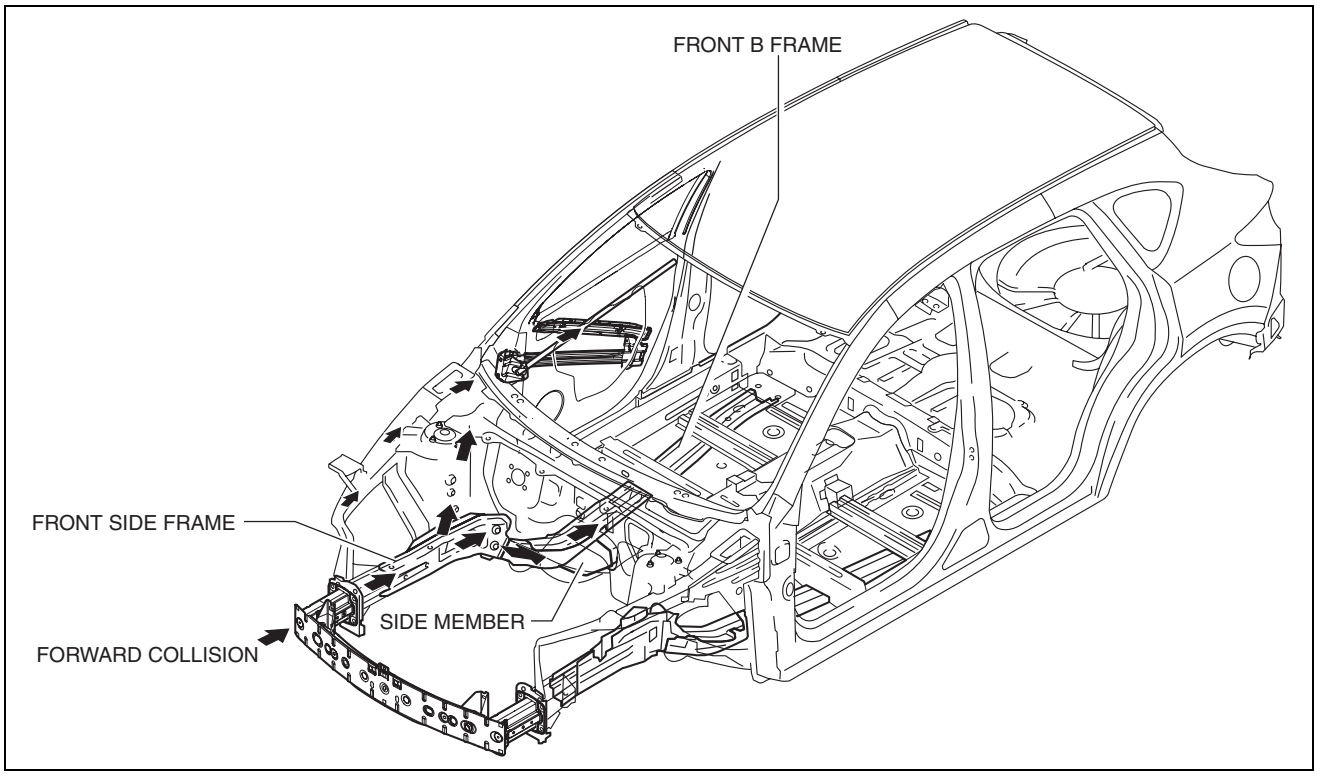
BODY PANELS

— The front side frame is supported by the side sill, front B frame and side member.



ac5wzn00000398

Fail-safe
- Function not equipped.

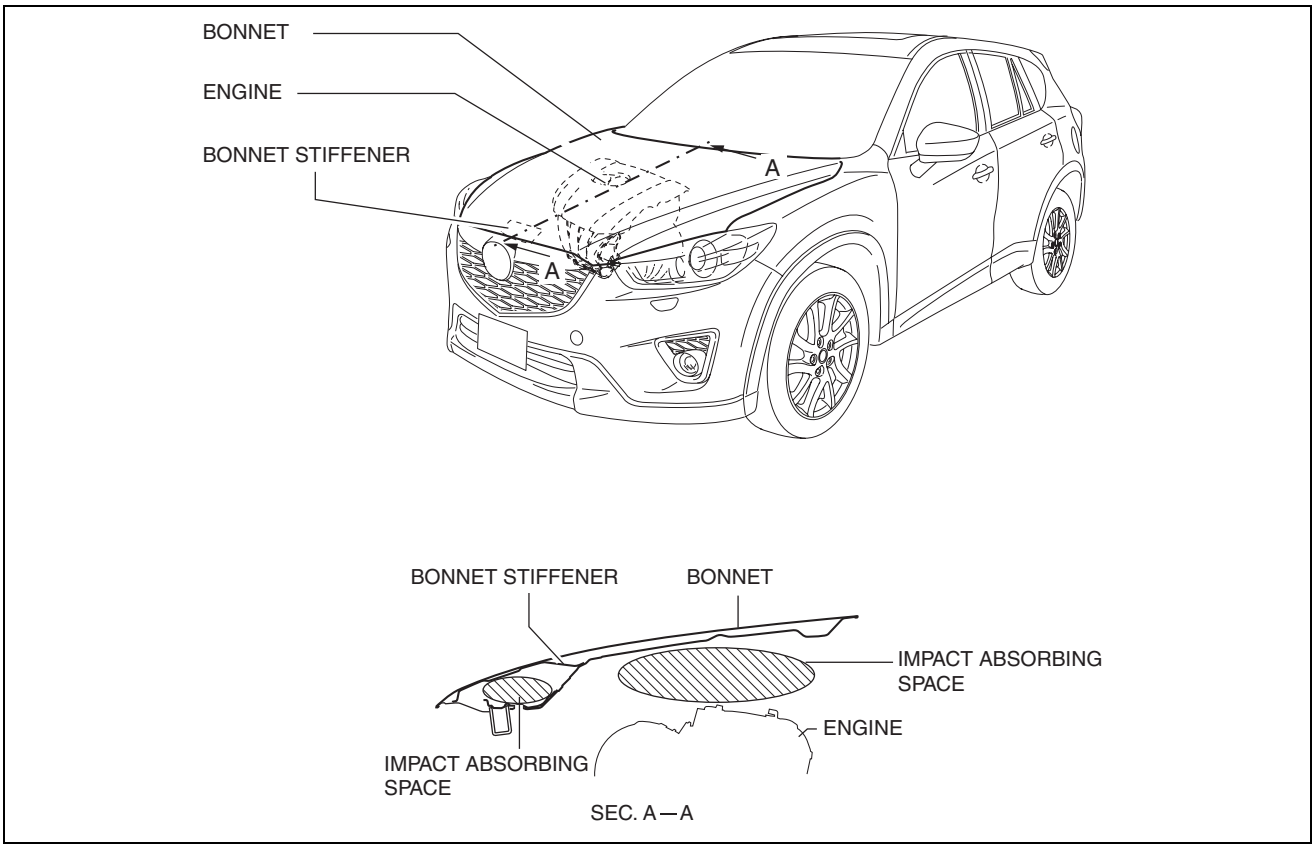
BONNET

id091000010300

Purpose, Function
- The bonnet is constructed with a large space between the front end of the bonnet and the engine to absorb an impact.

Construction
- The bonnet stiffener positioned at the front end of the bonnet is shaped so that it collapses easily during an impact. In addition, there is an impact absorbing space which facilitates impact absorption.
- The large space between the bonnet and the engine facilitates impact absorption.

BODY PANELS



ac5wzn00001058

Fail-safe

- Function not equipped.

09-11 DOORS AND LIFTGATE

DOORS AND LIFTGATE

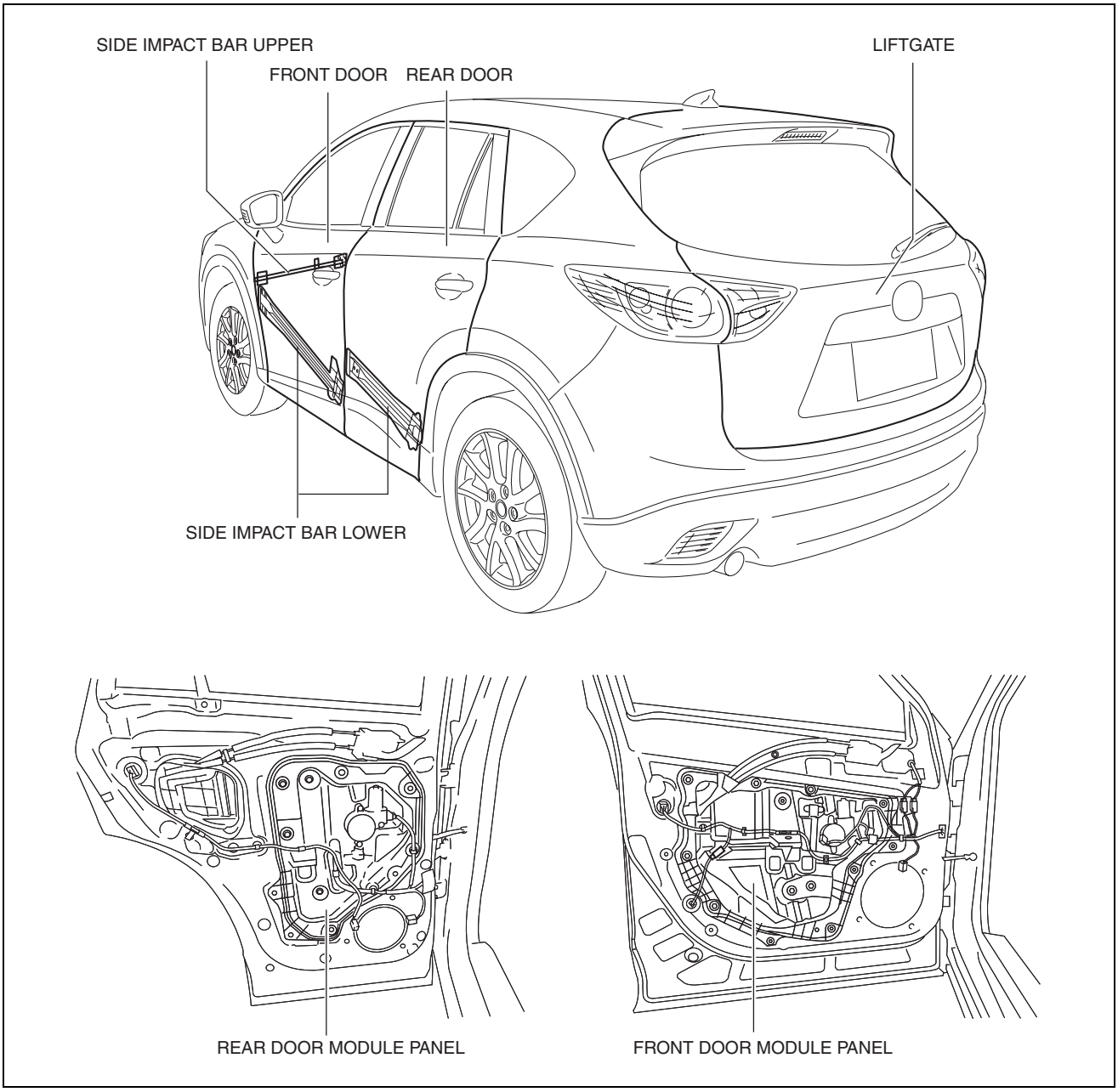
DOORS AND LIFTGATE

id091100413900

Outline

- Side impact bars built into the front and rear doors have been adopted.
- Door modules have been adopted on the front and rear doors.

Structural view



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DOORS AND LIFTGATE

SIDE IMPACT BAR

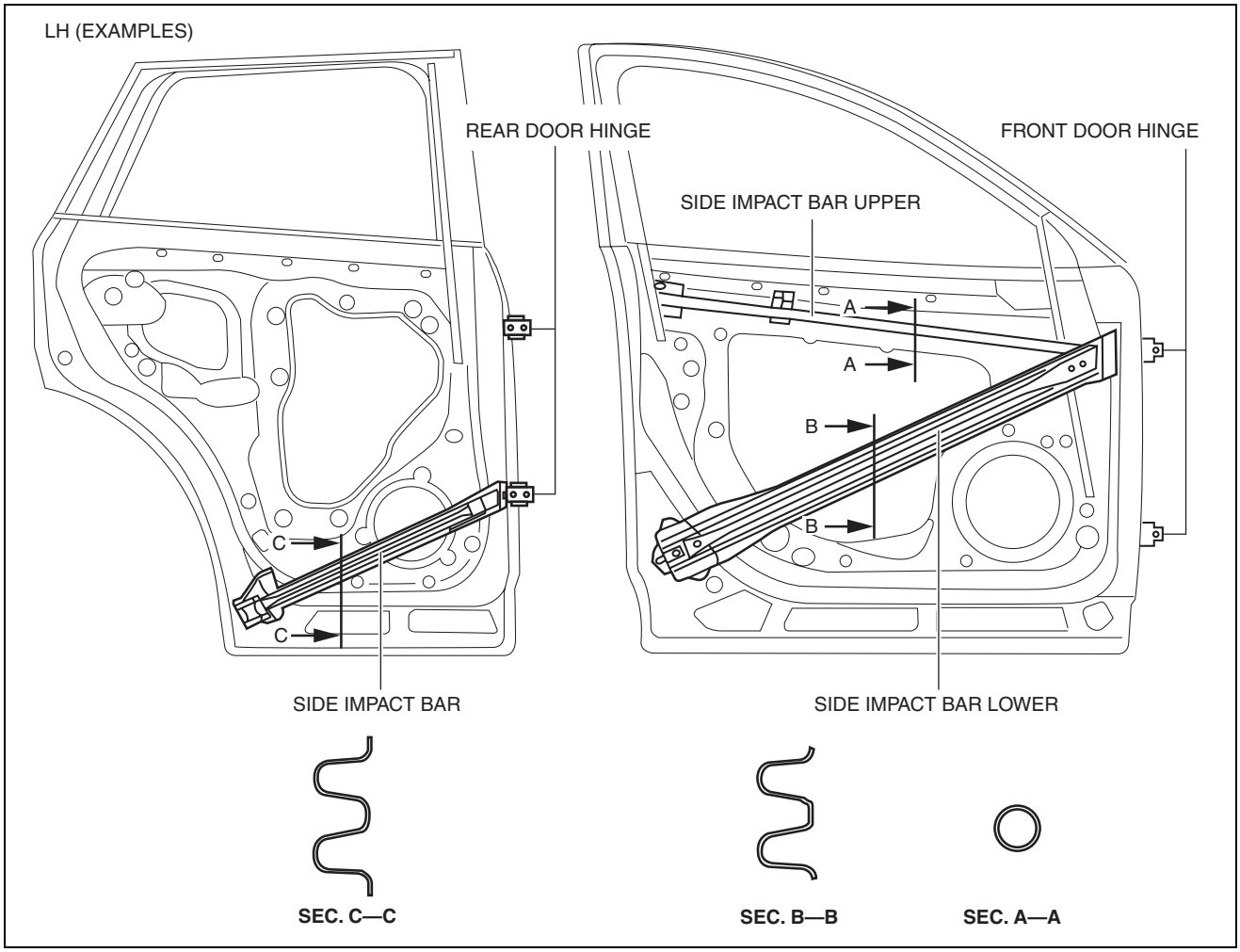
id091100414100

Purpose, Function

- The side impact bars disperse the impact during a side-impact collision and prevent the doors from deforming inward.

Construction

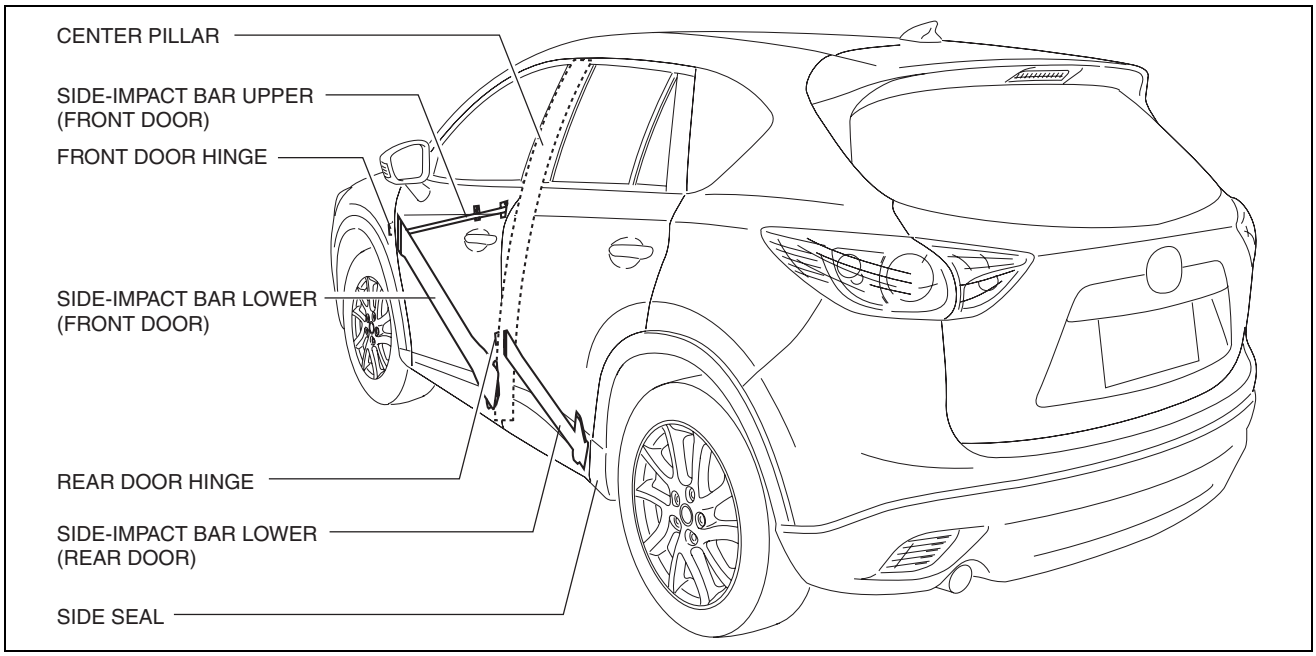
- The front door side-impact bar lower and rear door side-impact bar lower are corrugated in shape to assure high rigidity.
- The side-impact bars are installed in positions which can make use of spring force and tensile force to disperse the impact during a side-impact collision and prevent the doors from deforming inward.



ac5wzn00001535

- The front door side-impact bars upper and lower are connected to the front door hinges, and positioned such that they overlap the center pillar.
- The rear door side-impact bar lower is connected to the rear door hinge and positioned such that it overlaps the side seal.

DOORS AND LIFTGATE



ac5wzn00001853

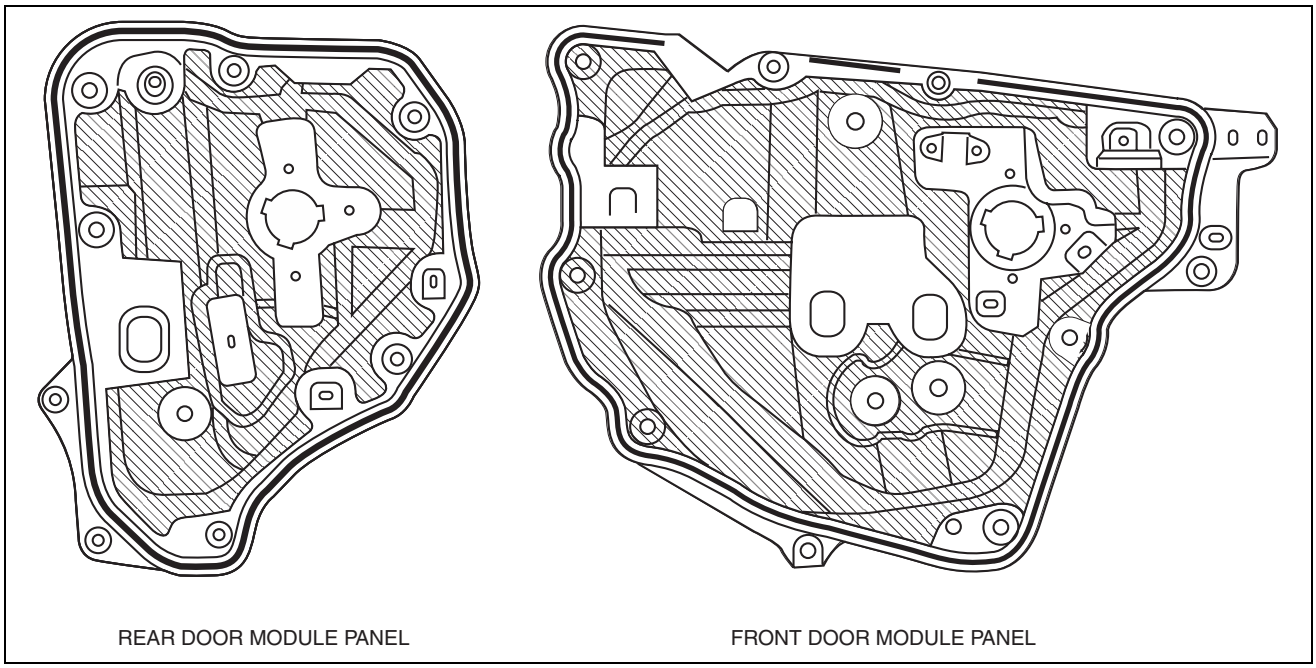
Fail-safe
- Function not equipped.

DOOR MODULE PANEL

id091100000000

Purpose, Function
- Styrofoam door module panels have been adopted for reducing vehicle weight.

Construction
- Styrofoam door module panels have been adopted for reducing vehicle weight and improving absorbing power and vibrational absorption.
- Styrofoam is applied to the door module panels (shaded areas) during manufacture.



ac5wzn00001538

Fail-safe
- Function not equipped.

09-12 GLASS/WINDOWS/MIRRORS

GLASS/WINDOWS/MIRRORS

GLASS/WINDOWS/MIRRORS

id091200012000

Outline

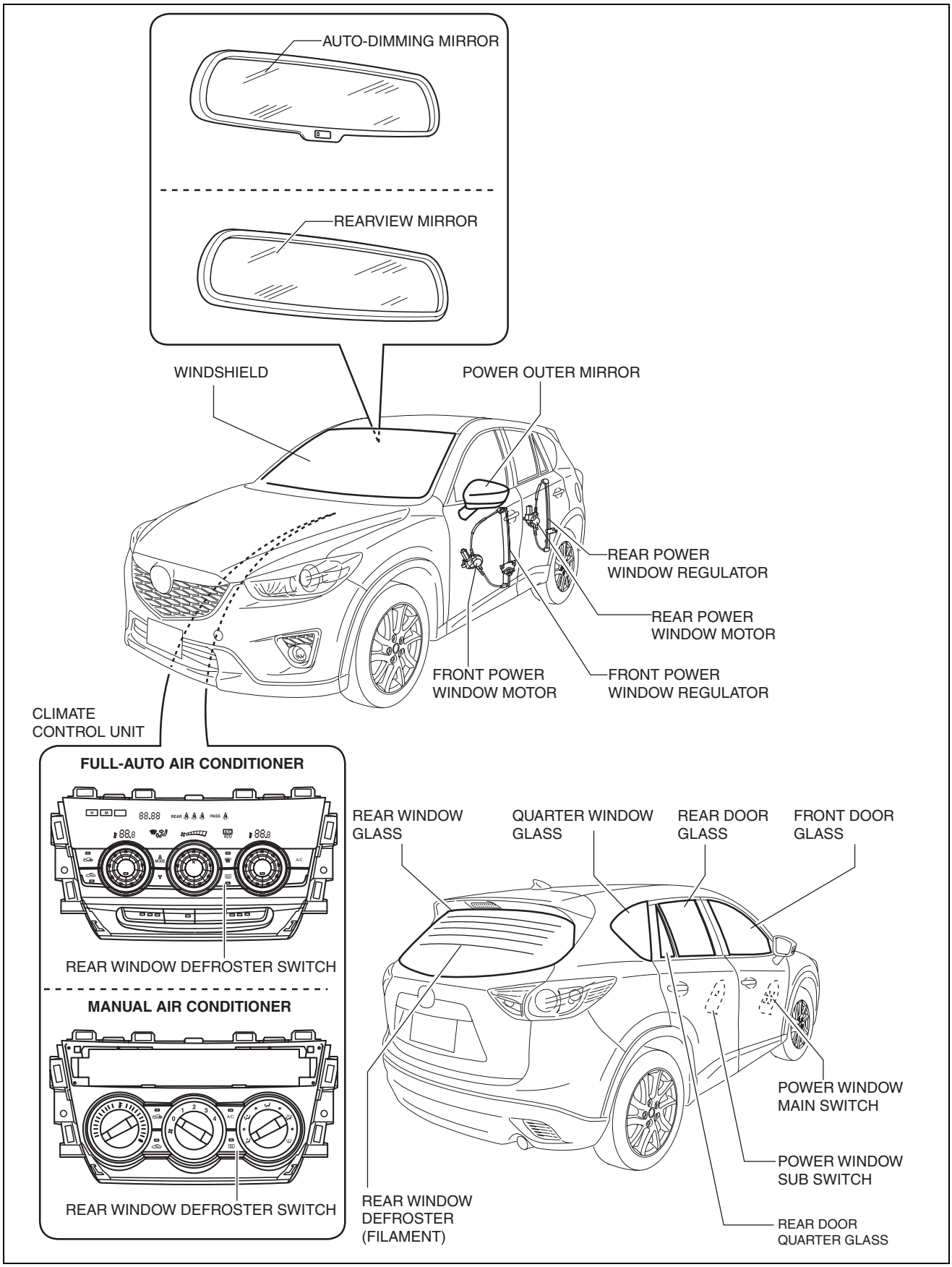
- The following window glass has been adopted.
  - — Windshield
  - — Front door glass
  - — Rear door glass
  - — Rear door quarter glass
  - — Quarter window glass
  - — Rear window glass
  - — Outer mirror glass
- The following mirrors have been adopted.
  - — Power outer mirror
  - — Rearview mirror
  - — Auto-dimming mirror (With auto-dimming mirror)
- Rear window defroster has been adopted on the rear window glass.
- Heated outer mirror has been adopted on the power outer mirrors. (With heated outer mirror system)
- An auto-dimming mirror has been adopted on the rearview mirror. (With auto-dimming mirror)
- UV protection glass has been adopted. (With UV protection glass)

Specification

- Glass is thinner for weight reduction.
  - — Windshield: **4.5 mm {0.18 in}**
  - — Front door glass: **4.0 mm {0.16 in}**
  - — Rear door glass: **3.5 mm {0.14 in}**
  - — Rear door quarter glass: **3.1 mm {0.12 in}**
  - — Quarter window glass: **2.8 mm {0.11 in}**
  - — Rear window glass: **2.8 mm {0.11 in}**

GLASS/WINDOWS/MIRRORS

Structural view



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GLASS/WINDOWS/MIRRORS

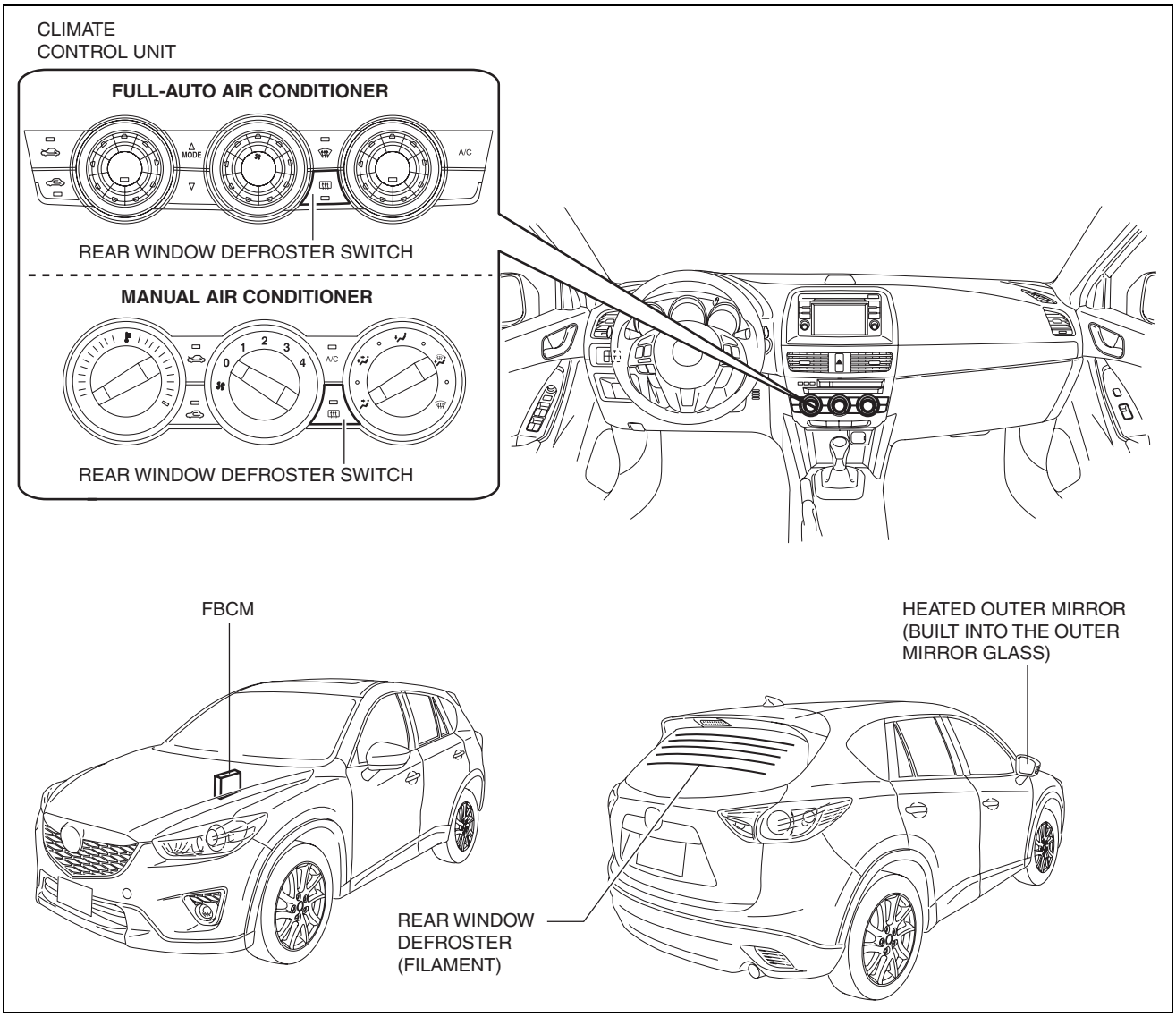
REAR WINDOW DEFROSTER/OUTER MIRROR HEATER

id091200012100

Outline

- Fogging is cleared from the rear window and outer mirror glass by heating of the filament.

Structural view



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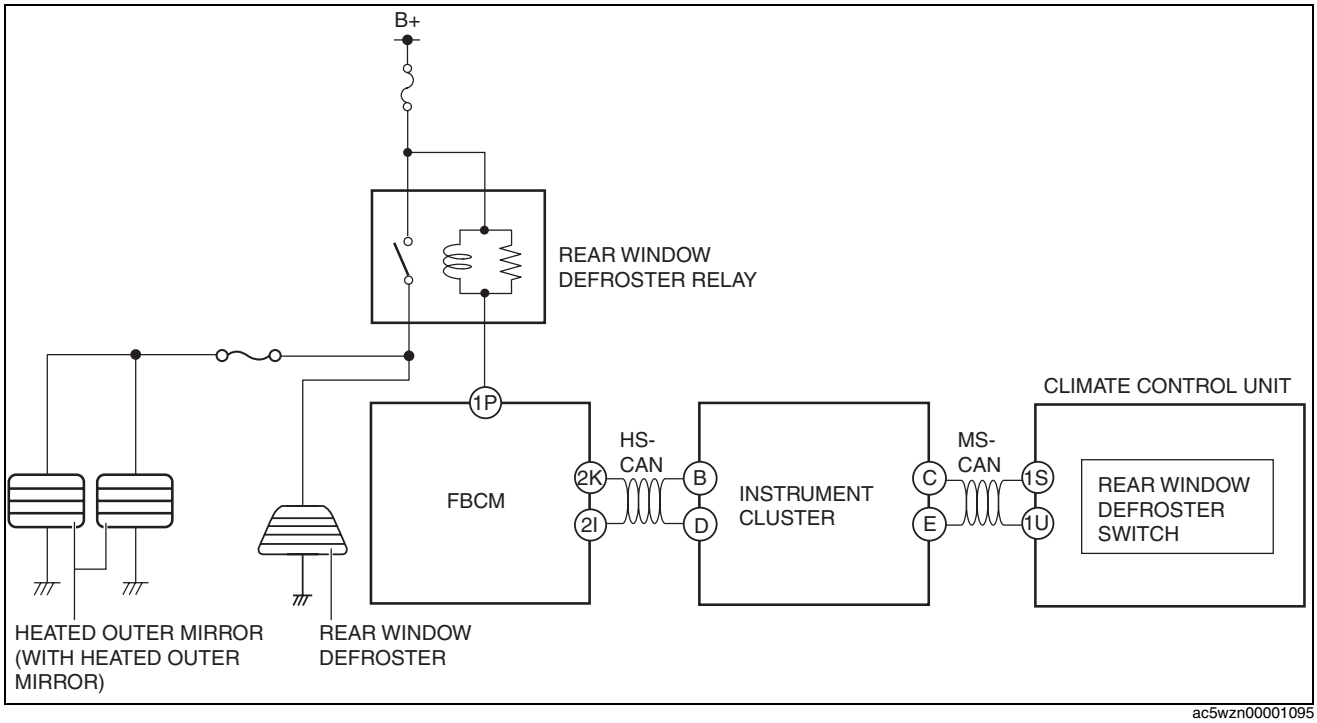
GLASS/WINDOWS/MIRRORS

System wiring diagram
With full-auto air conditioner system



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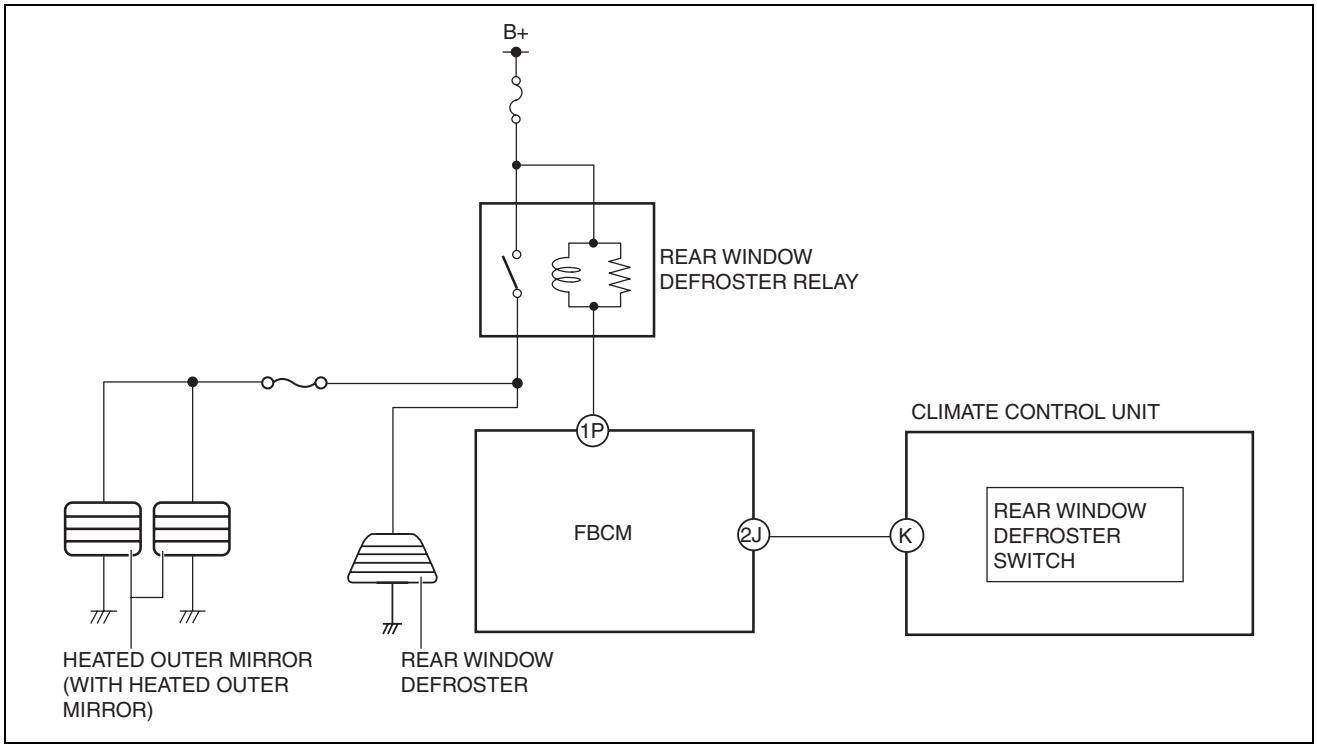
With manual air conditioner system



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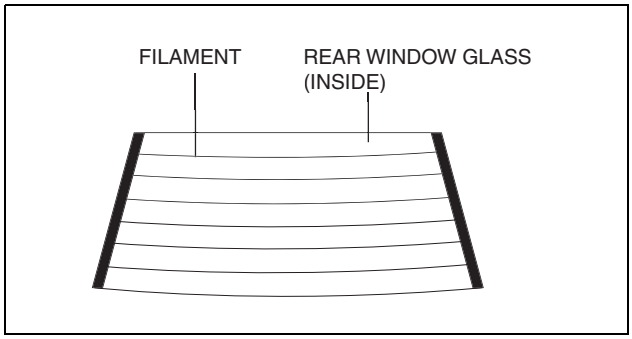
GLASS/WINDOWS/MIRRORS

Construction
Rear window defroster

- The rear window defroster filament is inside the rear window glass.



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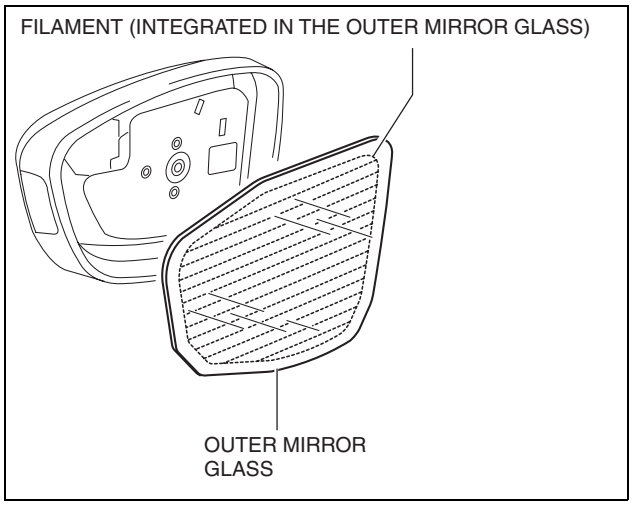
Heated outer mirror

- The heated outer mirror filament is integrated in the outer mirror glass.



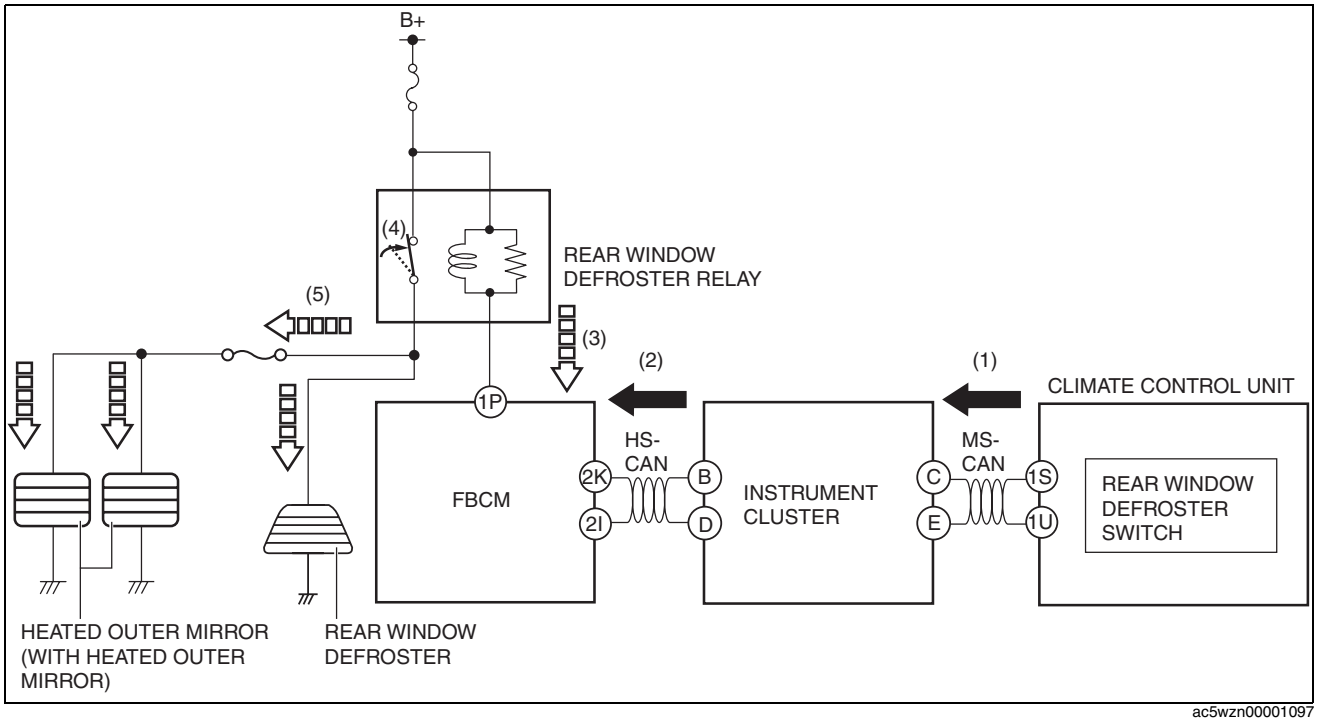
ac5wzn00000294

Operation
With full-auto air conditioner system

1. When the rear window defroster switch on the climate control unit is turned on (1), an ON/OFF control request signal is sent to the front body control module (FBCM) through the instrument cluster as a CAN signal.(2)
2. When the front body control module (FBCM) receives the ON/OFF control request signal, it supplies the battery voltage to the rear window defroster relay.(3)
3. When the battery voltage is supplied to the rear window defroster relay, a switch inside the rear window defroster relay is turned on.(4)

GLASS/WINDOWS/MIRRORS

4. When the switch inside the rear window defroster relay is turned on, the battery voltage is supplied to the rear window defroster/heated outer mirrors to operate them.(5)



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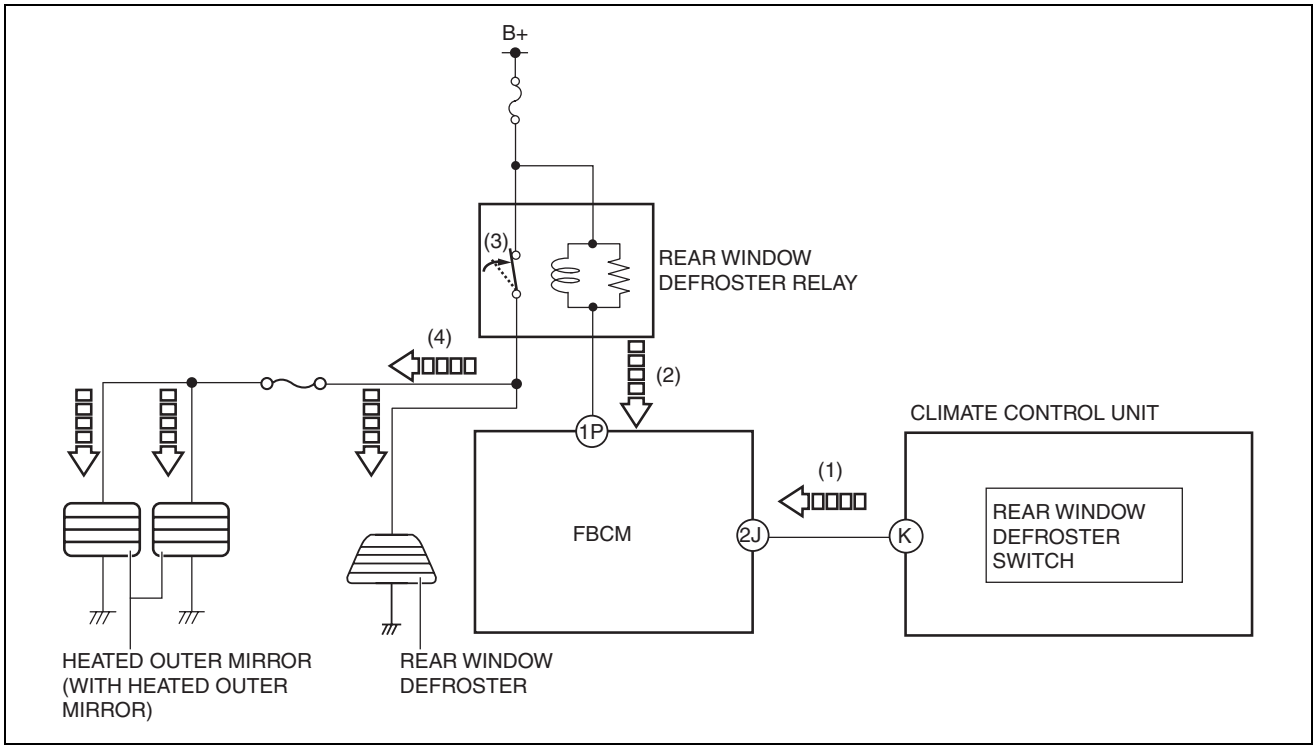
- When **approx. 15 min.** has elapsed after the rear window defroster switch was turned on, the timer control of the front body control module (FBCM) turns off the rear window defroster relay automatically to turn off the rear window defroster/heated outer mirror.
- When the rear window defroster switch is pressed while the rear window defroster/heated outer mirrors are operating, they stop operating.

With manual air conditioner system

1. When the rear window defroster switch on the climate control unit is turned on (1), a signal is sent from the climate control unit to the front body control module (FBCM) and the battery voltage is supplied to the rear window defroster relay.(2)
2. When the battery voltage is supplied to the rear window defroster relay, a switch inside the rear window defroster relay is turned on.(3)

GLASS/WINDOWS/MIRRORS

3. When the switch inside the rear window defroster relay is turned on, the battery voltage is supplied to the rear window defroster/heated outer mirrors to operate them.(4)



ac5wzn00001223

- When **approx. 15 min.** has elapsed after the rear window defroster switch was turned on, the timer control of the front body control module (FBCM) turns off the rear window defroster relay automatically to turn off the rear window defroster/heated outer mirror.
- When the rear window defroster switch is pressed while the rear window defroster/heated outer mirrors are operating, they stop operating.

Fail-safe

- Function not equipped.

POWER WINDOW SYSTEM

id091200012200

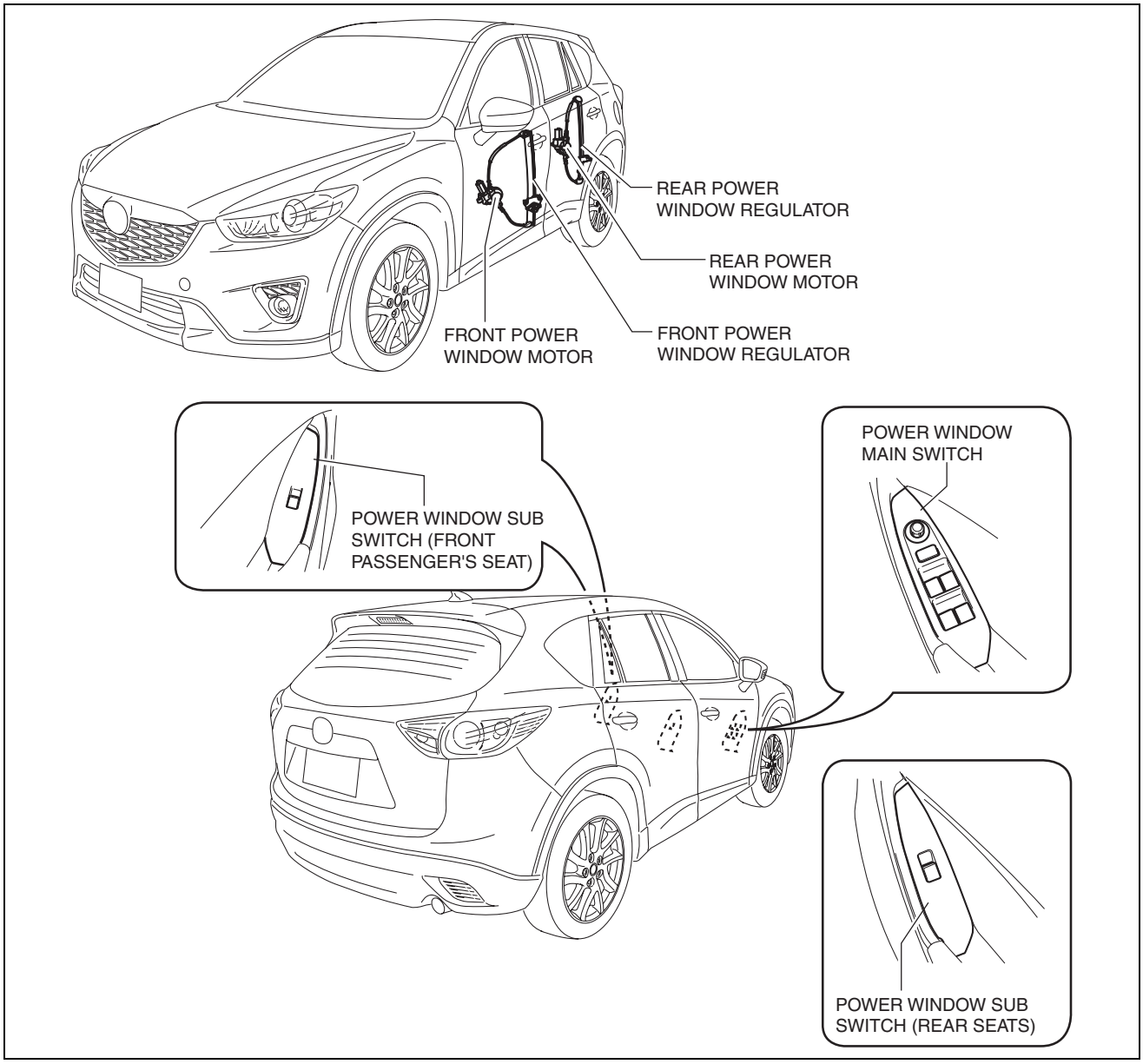
Outline

- A power window system that enables automatic opening/closing of the door glass has been adopted.
- The driver's side door glass can be opened/closed automatically or manually by operating the power window main switch.
- All the door glass can be opened/closed automatically or manually by operating the power window main switch and the power window sub switches.

GLASS/WINDOWS/MIRRORS

Structural view

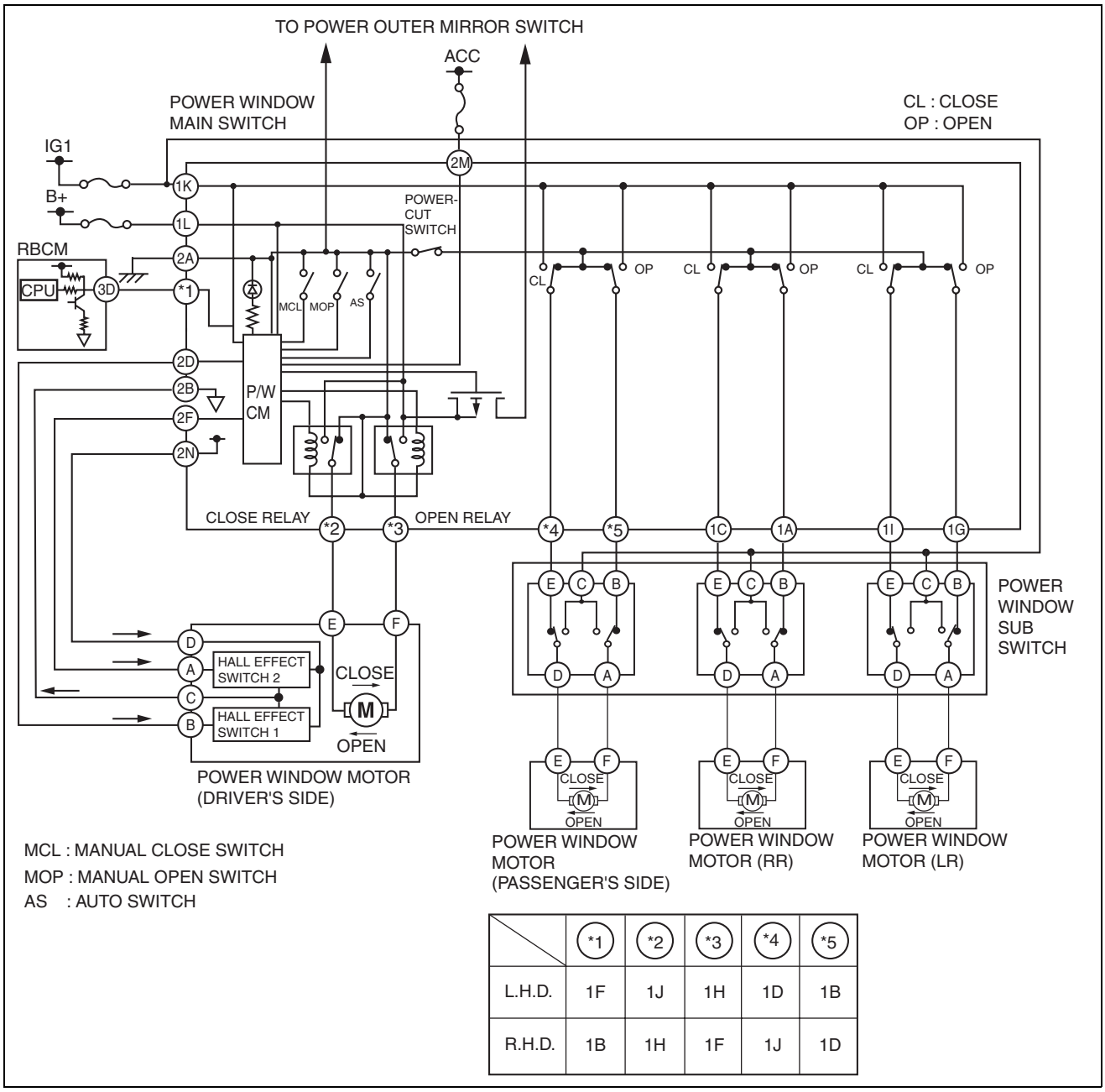
R.H.D.



E200001225

GLASS/WINDOWS/MIRRORS

System wiring diagram
With driver's side window auto open/close

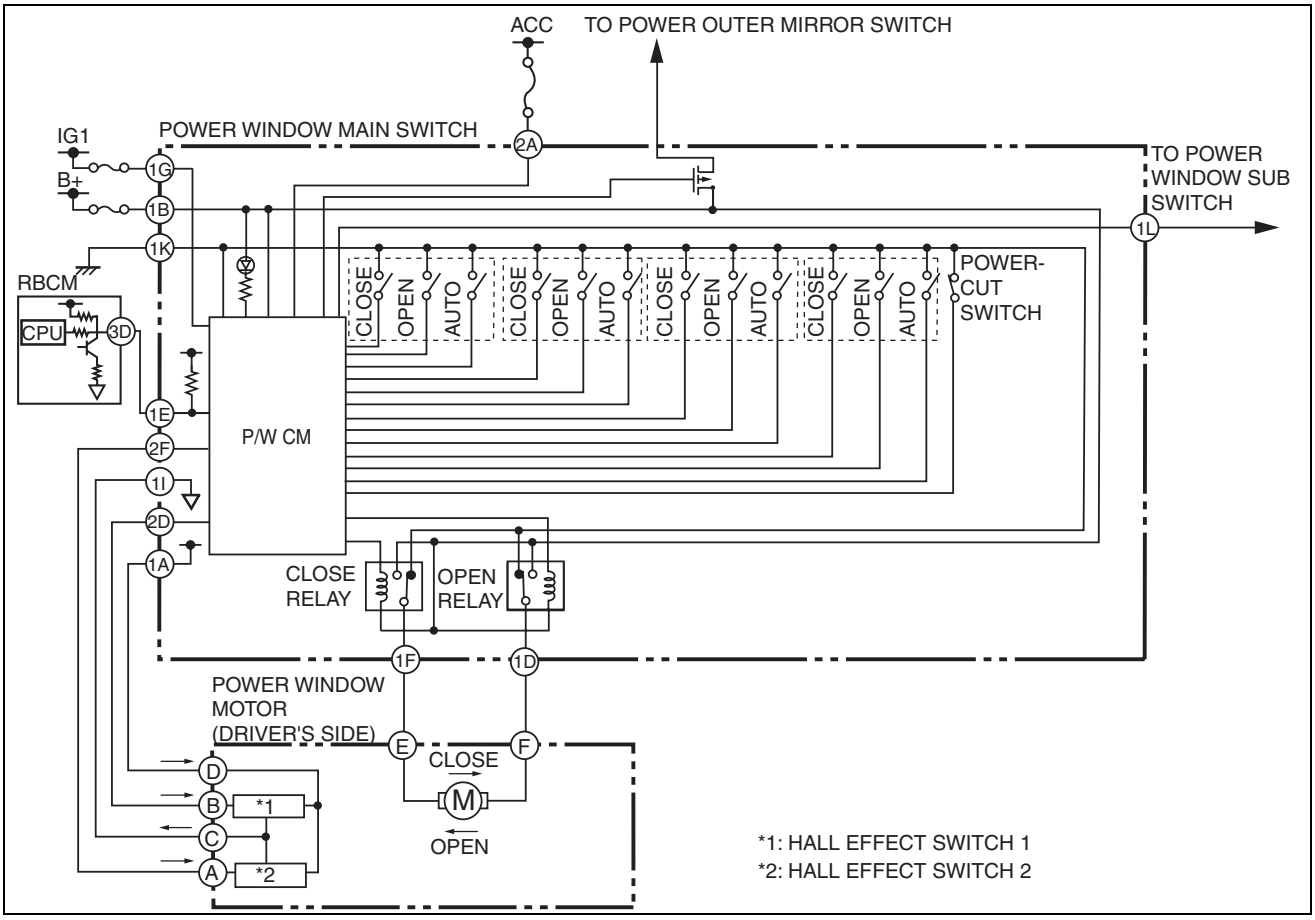


	*1	*2	*3	*4	*5
L.H.D.	1F	1J	1H	1D	1B
R.H.D.	1B	1H	1F	1J	1D

E80001098

GLASS/WINDOWS/MIRRORS

With all window auto open/close
Power window main switch



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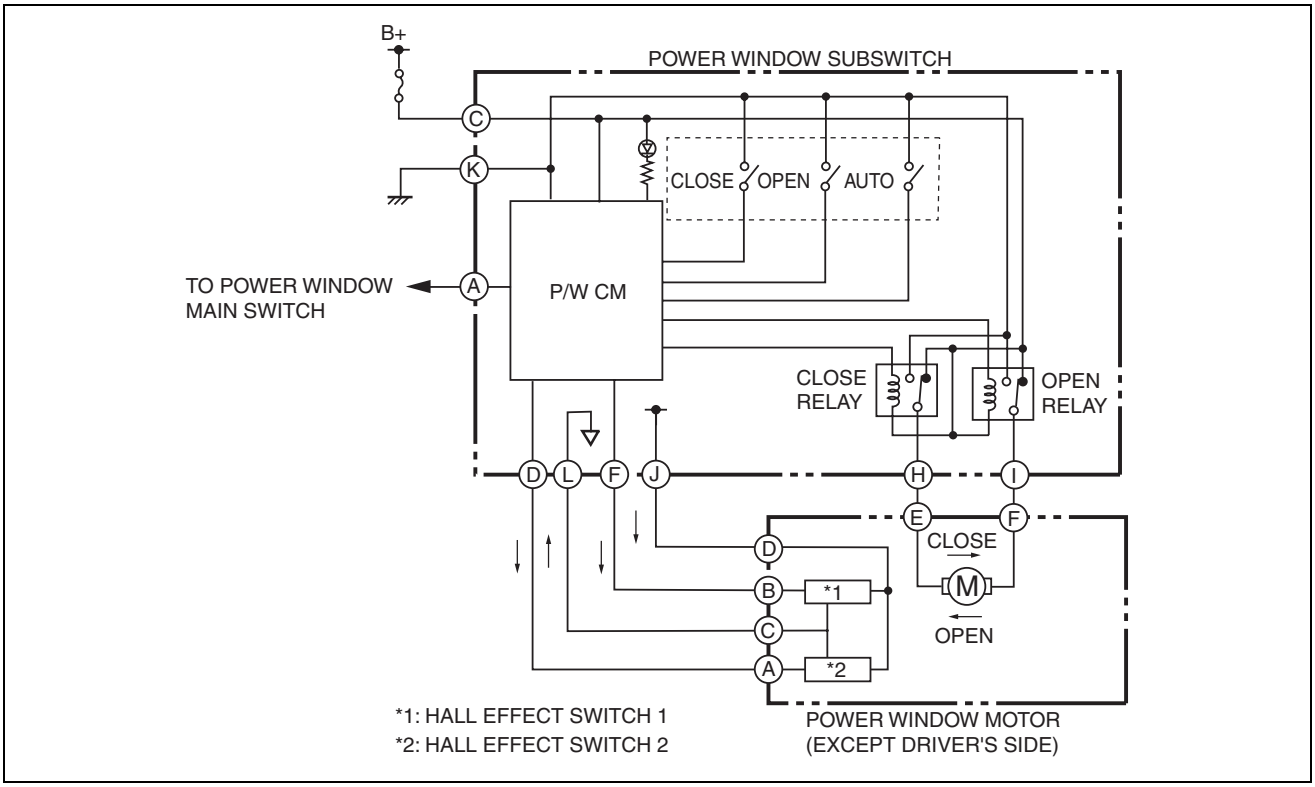
Power window subswitch



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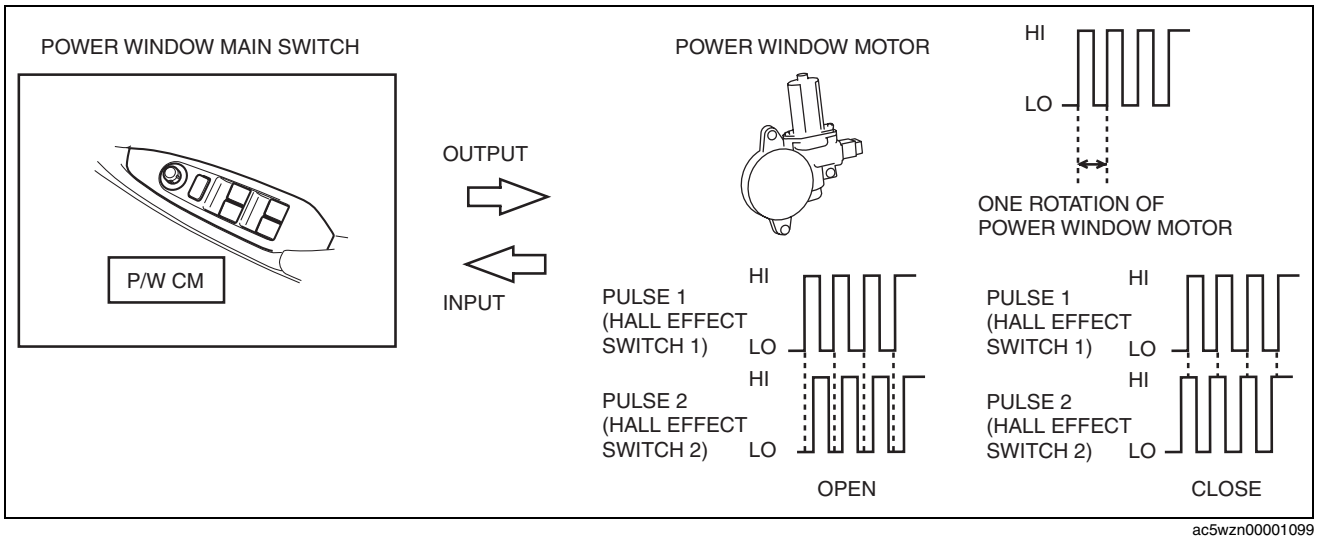
GLASS/WINDOWS/MIRRORS

Function
Driver's seat
- Manual Open/Close
  — When the power window main switch is operated using the manual operation, the door glass opens/closes manually.
- Auto Open/Close
  — When the power window main switch is operated using the auto operation, the door glass opens/closes automatically.
- Power Window System Initial Setting
  — Records the position of the driver's side door glass.
- Auto Reverse Pinch Protection Function
  — If an obstruction by a foreign object is detected during the auto close operation, the operation changes from close to open.
- IG OFF Timer Function
  — The driver's side power window can be operated using the power window main switch for **approx. 40 s** after the ignition is switched from ON (engine on or off) to ACC or OFF.
- IG OFF timer cancel
  — The IG OFF timer is canceled when a**pprox. 40 s** or more have elapsed since the ignition was switched to ACC or OFF or any door is opened during IG OFF timer operation.

Front passenger's seat and rear seats
- Manual Open/Close
  — When the power window main switch or power window subswitches is operated using the manual operation, the door glass opens/closes manually.
- Auto Open/Close (With all window auto open/close)
  — When the power window main switch or power window subswitches is operated using the auto operation, the door glass opens/closes automatically.
- IG OFF Timer Function
  — The front passenger's seat and rear seats power window can be operated using the power window subswitches for **approx. 40 s** after the ignition is switched from ON (engine on or off) to ACC or OFF.
- IG OFF timer cancel
  — The IG OFF timer is canceled when a**pprox. 40 s** or more have elapsed since the ignition was switched to ACC or OFF or any door is opened during IG OFF timer operation.

Construction
- A P/W CM is integrated in the power window main switch.
- The P/W CM controls the power window system based on the pulse signals from the power window motor.

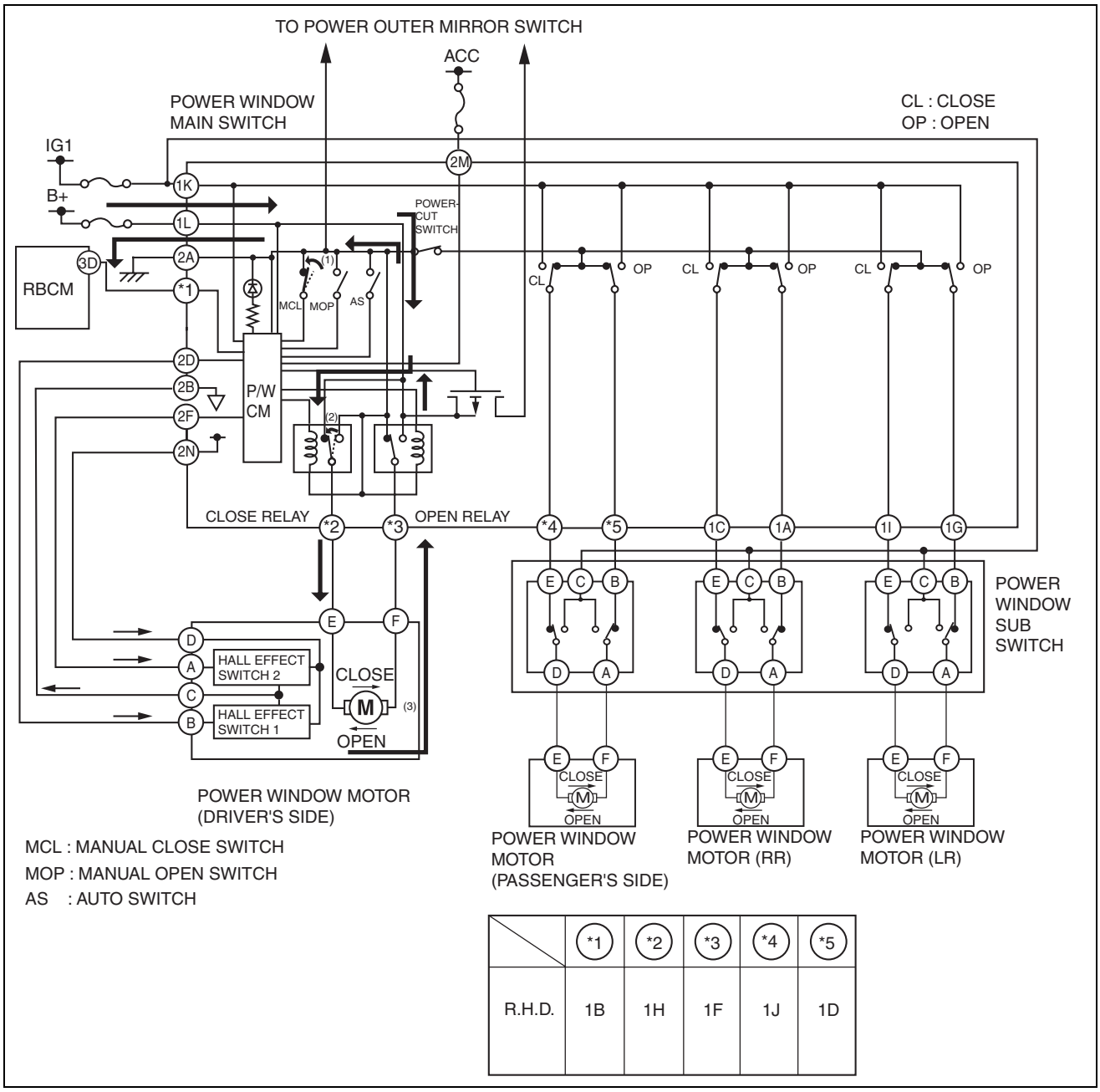


ac5wzn00001099

Operation
Driver's side manual open/close operation (Example: close operation)
1. When the power window main switch is operated for manual close operation, the P/W CM receives a manual close signal. (1)
2. When the P/W CM receives a manual close signal, it turns on the close relay. (2)
3. When the close relay is turned on, the power window motor (RF) starts manual close operation.(3)

GLASS/WINDOWS/MIRRORS

With driver's side window auto open/close

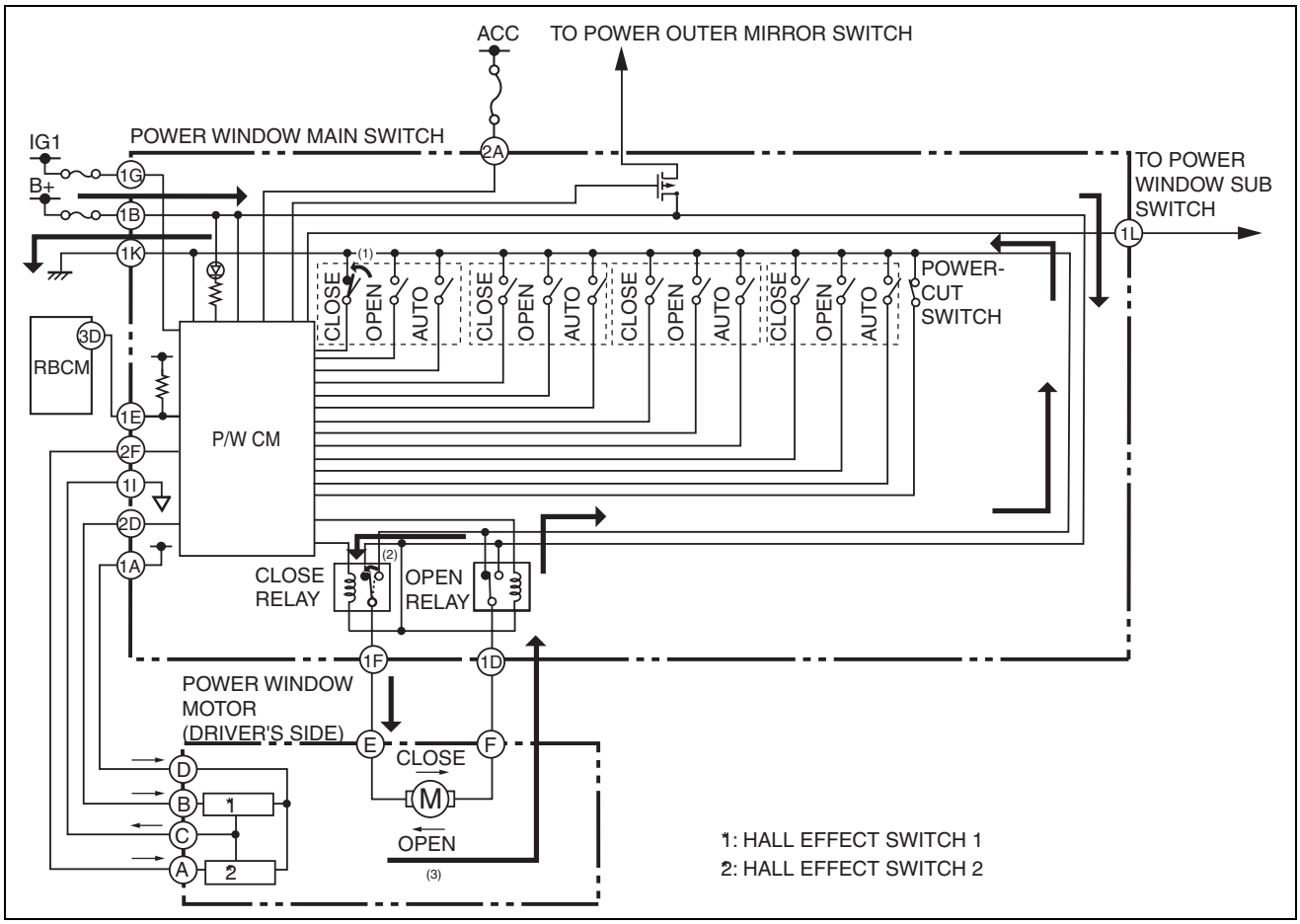


	*1	*2	*3	*4	*5
R.H.D.	1B	1H	1F	1J	1D

E60001100

GLASS/WINDOWS/MIRRORS

With all window auto open/close



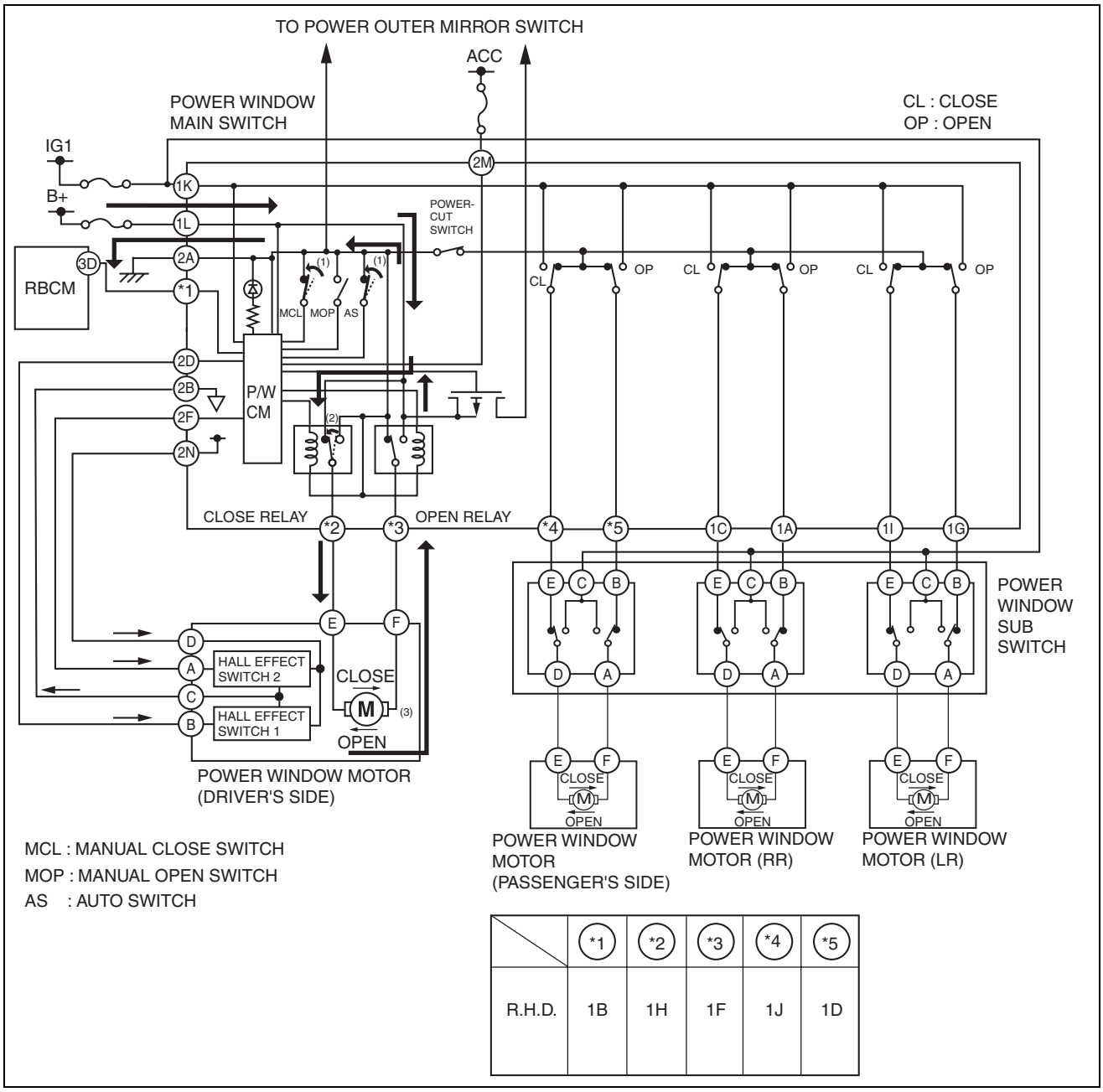
ac5wzn00001037

Driver's side auto open/close operation (Example: close operation)

1. When the power window main switch is operated for auto close operation, the P/W CM receives an auto close signal. (1)
2. When the P/W CM receives an auto close signal, it turns on the close relay. (2)
3. When the close relay is turned on, the power window motor (RF) starts auto close operation.(3)

GLASS/WINDOWS/MIRRORS

With driver's side window auto open/close

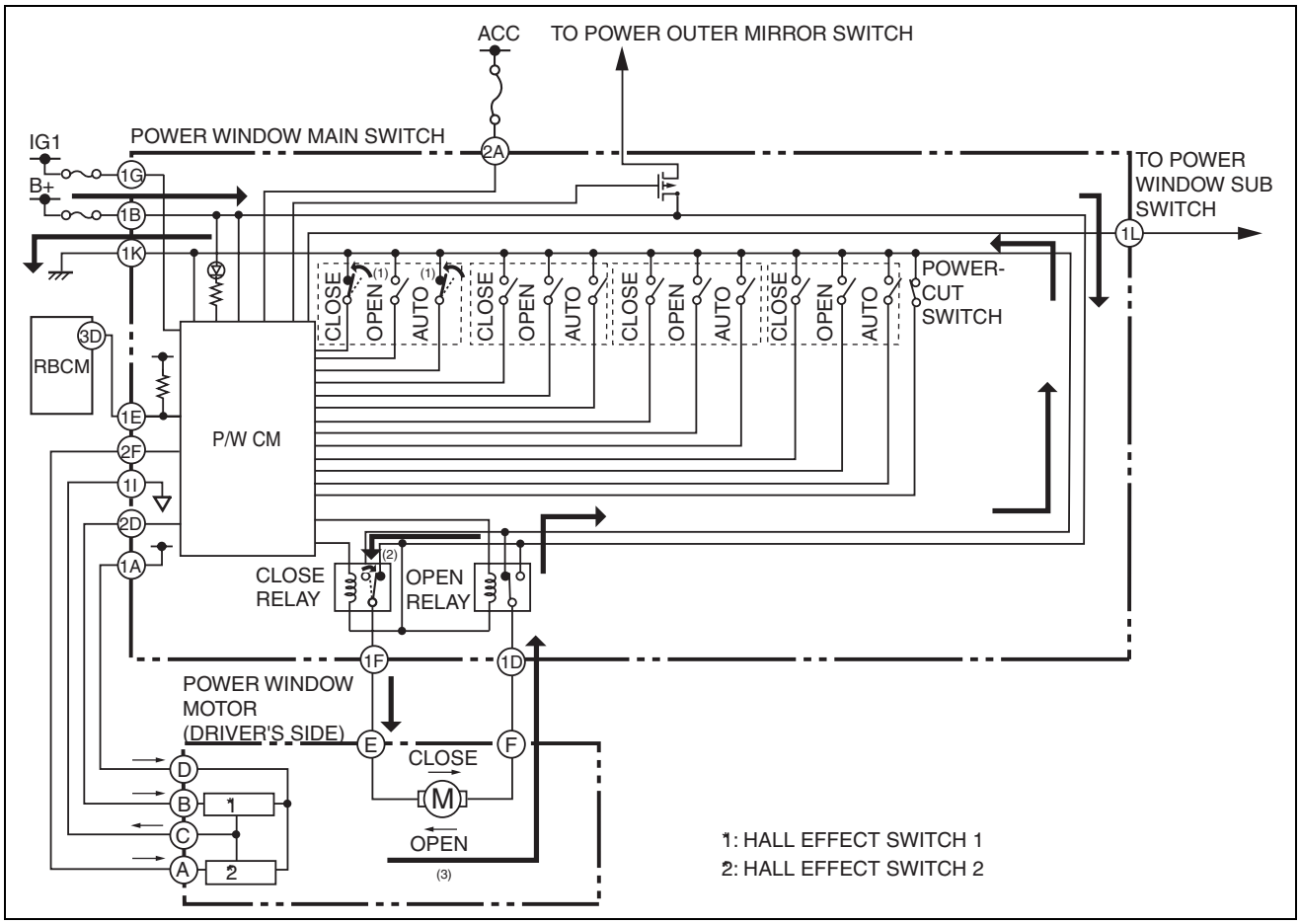


	*1	*2	*3	*4	*5
R.H.D.	1B	1H	1F	1J	1D

E0001101

GLASS/WINDOWS/MIRRORS

With all window auto open/close

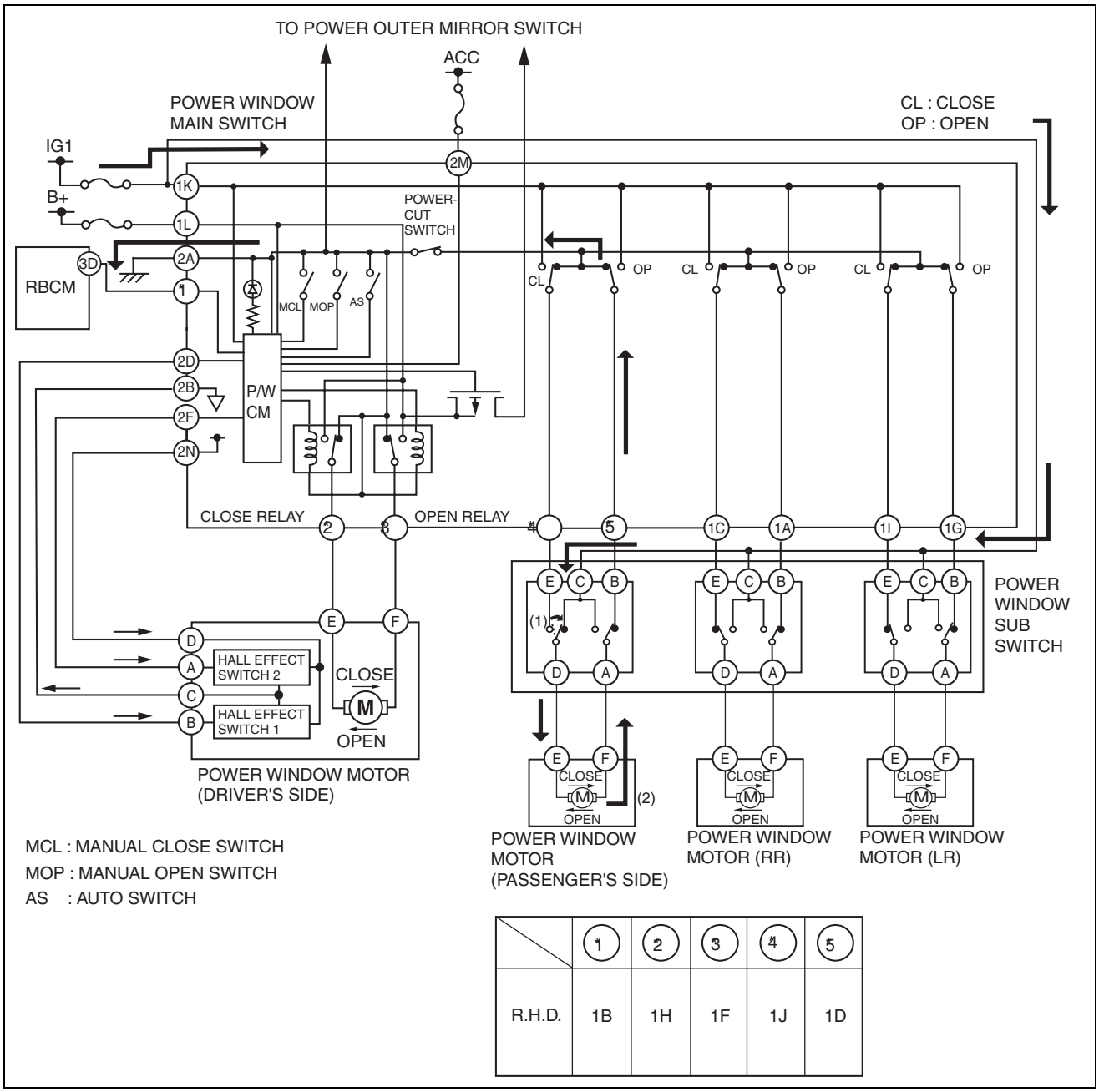


ac5wzn00001038

Passenger's side and rear side manual open/close operation (With driver's side window auto open/close)
(Example: Passenger's side close operation)

1. When the power window subswitch is operated for manual close operation, the power window motor (LF) starts manual close operation.(2)

GLASS/WINDOWS/MIRRORS

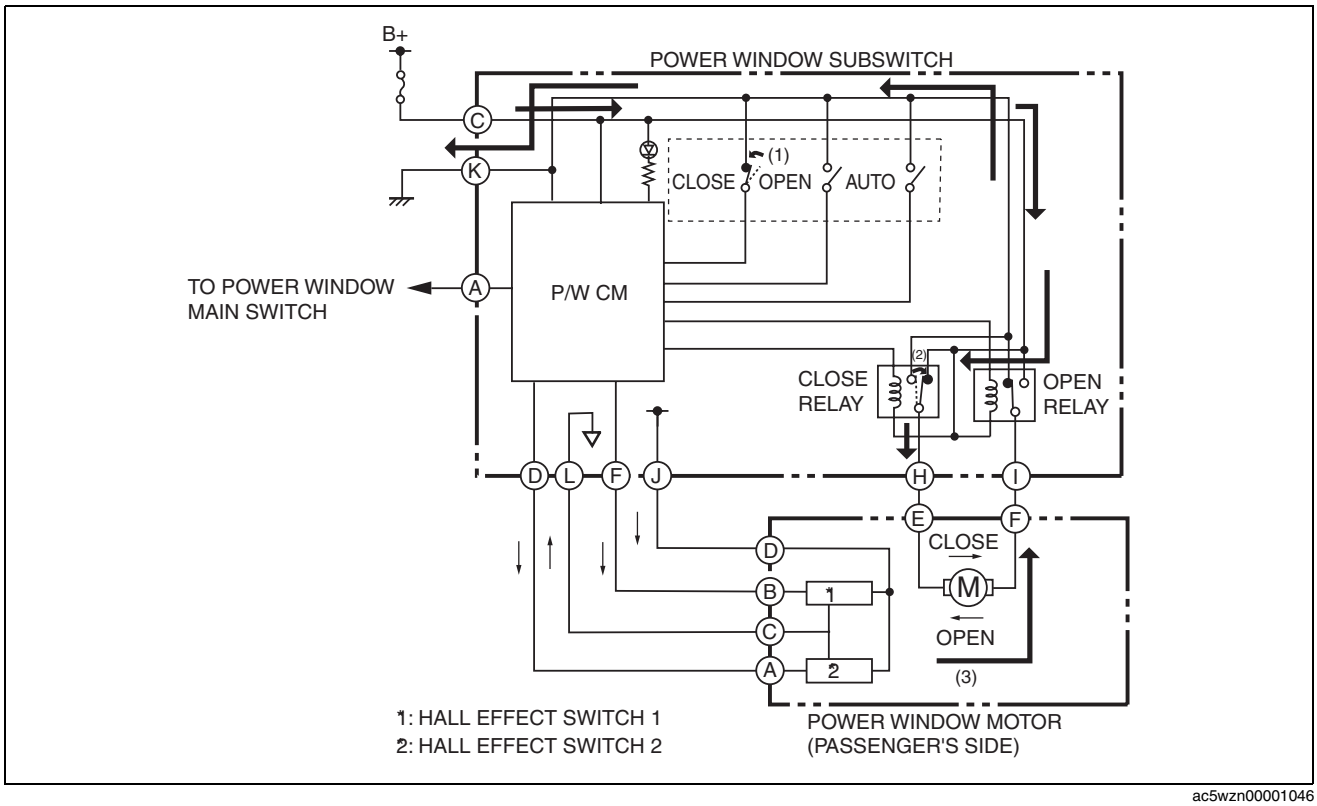


ac5wzn00001102

Passenger's side and rear side manual open/close operation (With all window auto open/close) (Example: Passenger's side close operation)

1. When the power window subswitch is operated for manual close operation, the power window motor (LF) starts manual close operation.(2)
2. When the P/W CM receives a manual close signal, it turns on the close relay. (2)
3. When the close relay is turned on, the power window motor (RF) starts manual close operation.(3)

GLASS/WINDOWS/MIRRORS



ac5wzn00001046

Power Window System Initial Setting

1. The P/W CM records the driver's side door glass position when the switch is pulled and held **approx. 2 s** after the driver's side door glass is fully closed from the fully opened position with the ignition is switched ON (engine off or on).

- Performing the following procedures will reset the initial setting and disables auto operation. Re-perform the initial setting.
  - — Negative battery cable is disconnected
  - — Power window main switch connector is disconnected
  - — Power window system power supply fuse is removed

Auto Reverse Pinch Protection

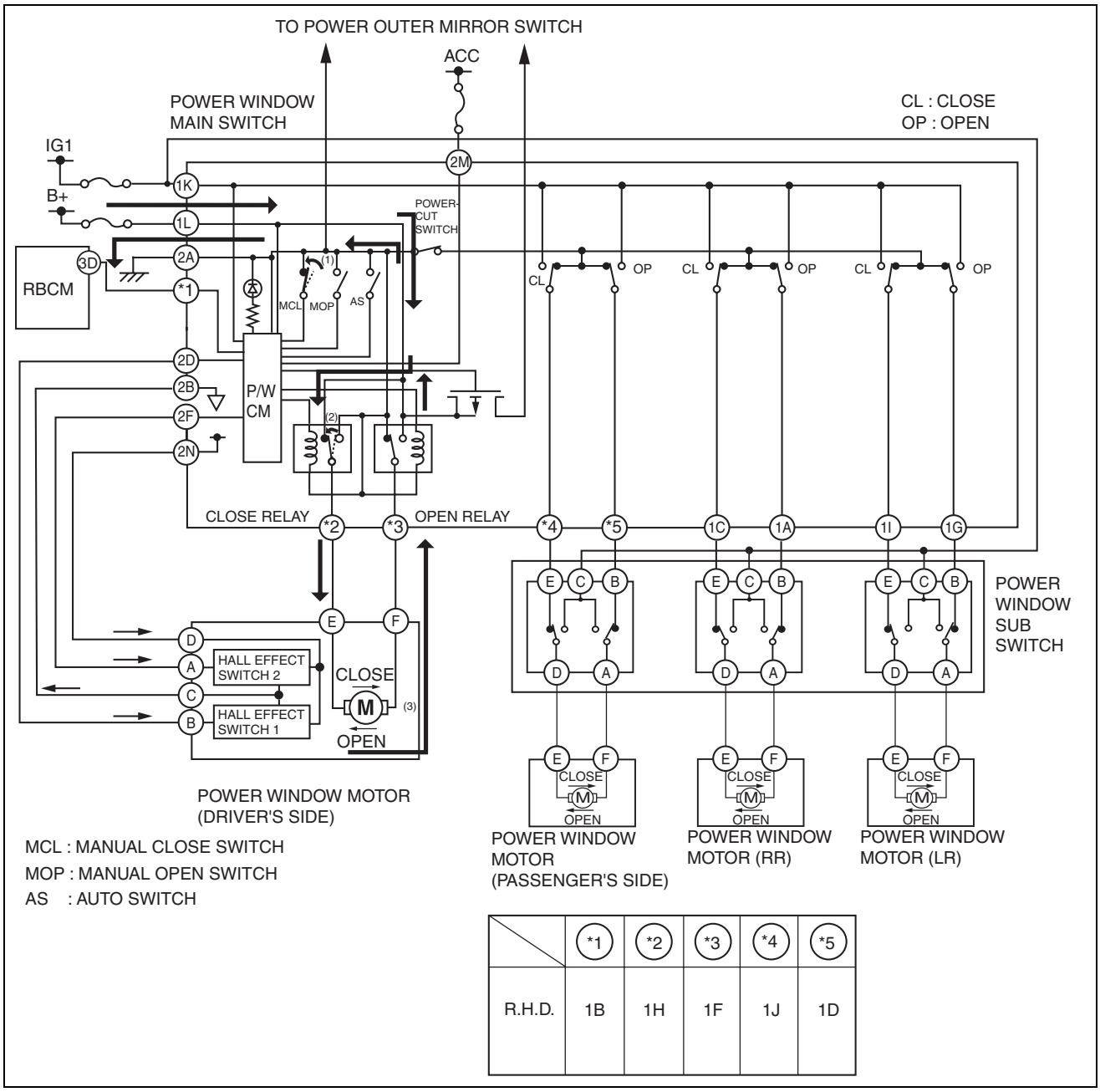
1. When the P/W CM detects a change in the pulse signal from the power window motor for **0.3 s or more** during the auto close operation, it reverses the power window motor and the door glass opens **approx. 200 mm {7.87 in}** automatically.

IG OFF Timer (Example: Manual close operation)

1. When the ignition is switched from ON (engine off or on) to ACC or OFF, the IG OFF timer function of the P/W CM is turned on and the power window main switch can be operated for **approx. 40 s** after IG OFF is detected.
2. When the power window main switch is operated for manual close operation while the IG OFF timer is on, the P/W CM receives a manual close signal.(1)
3. When the P/W CM receives a manual close signal, it turns on the close relay. (2)
4. When the close relay is turned on, the power window motor (RF) starts manual close operation.(3)
5. The P/W CM turns off the IG OFF timer function when **approx. 40 s** has elapsed since IG OFF is detected.

GLASS/WINDOWS/MIRRORS

With driver's side window auto open/close

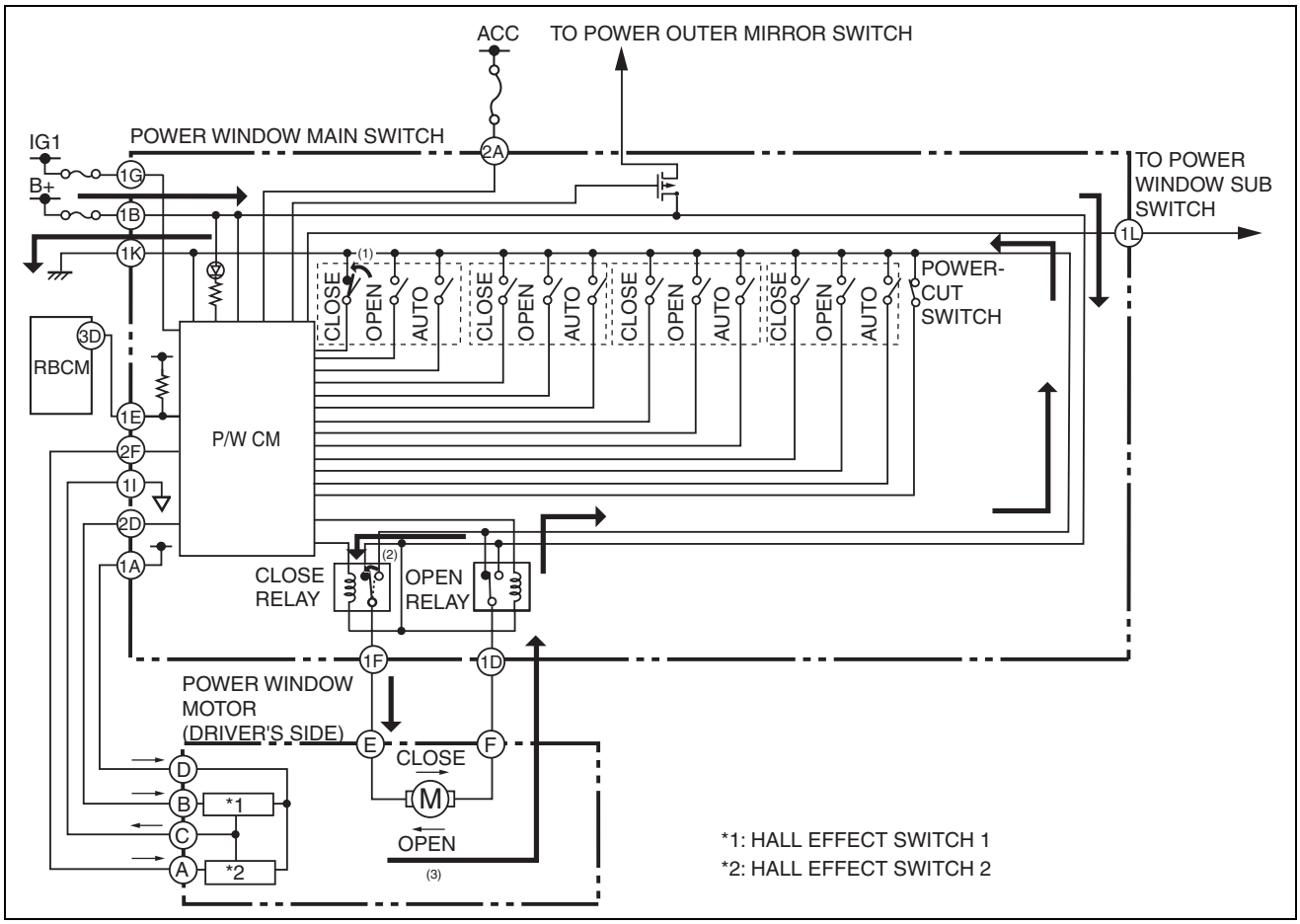


	*1	*2	*3	*4	*5
R.H.D.	1B	1H	1F	1J	1D

E200001100

GLASS/WINDOWS/MIRRORS

With all window auto open/close

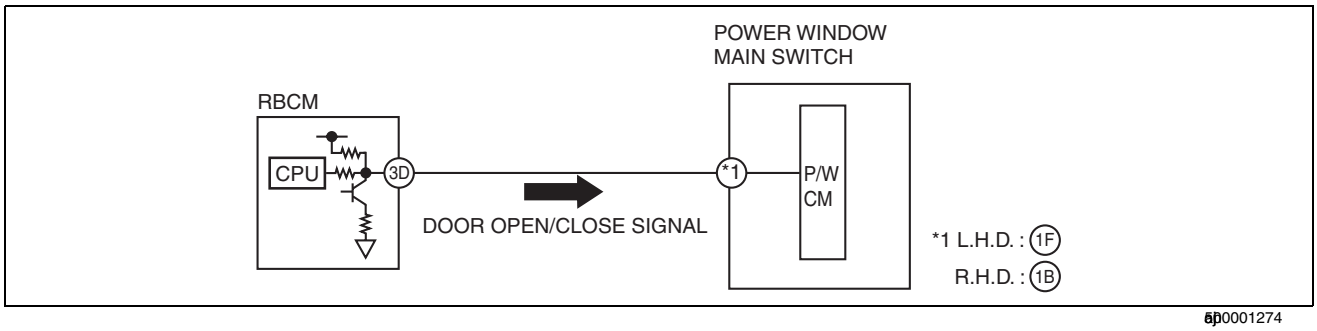


E80001037

IG OFF Timer Cancel

1. The P/W CM detects the open/close conditions of all the doors based on the door open/close signal sent from the rear body control module (RBCM).
2. When a door open signal is sent from the rear body control module (RBCM) while the IG OFF timer is on, the IG OFF timer function is canceled.

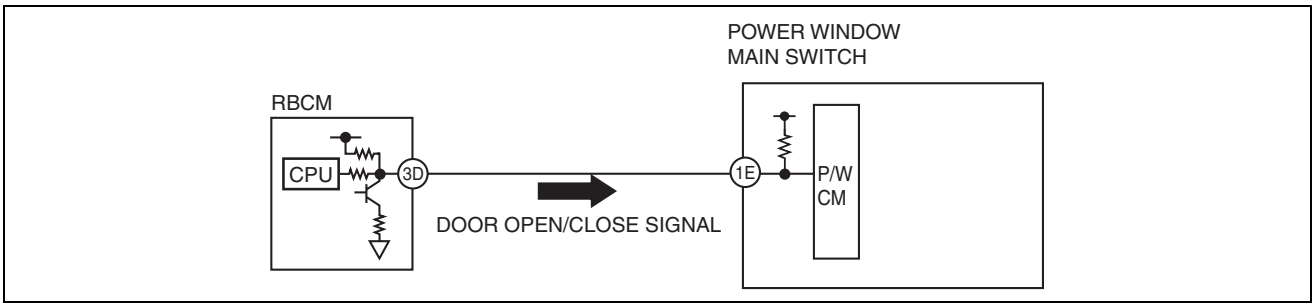
With driver's side window auto open/close



E80001274

GLASS/WINDOWS/MIRRORS

With all window auto open/close



ac5wzn00001532

Fail-safe

- When the P/W CM detects an error in the pulse signal (Hall effect switch), it switches the power window system to fail-safe mode to prevent incorrect operation.

Malfunction condition	Ignition is switched ON (engine on or off)	Ignition switched OFF	Recovery condition
P/W CM detected pulse 1 error (for pinching and door glass position detection) stop malfunction • Pulse 2 detected but pulse 1 is not detected during close or open operation	Auto operation is prohibited (Manual operation is enabled) Operation of power window main switch except for the driver's seat is prohibited	Auto and manual operations are prohibited	Pulse signals 1 and 2 detected normally during close operation, and re-detection of fully-closed position return/non-return ranges
P/W CM detected pulse 2 error (for door glass direction detection) stop malfunction • Pulse 1 detected but pulse 2 is not detected during close or open operation			
P/W CM detected pulse signal error (inversion of pulse 1 and pulse 2 input signals or large phase deviation between pulses 1 and 2) • Difference detected between the direction detected by the signals of pulses 1 and 2, and the actual direction during close or open operation			
P/W CM detected pulse 1 error (Non-return range lowering malfunction) • During close operation, a pulse 1 signal from the power window motor is detected more than the number of set times even after the window reaches the fully-closed position recorded by the power window main switch.			
P/W CM detected pulse 1 and 2 stop malfunction • Pulse signals 1 and 2 are not detected for 1 s after the open operation is started from the fully closed position			

POWER WINDOW MOTOR

id091200012400

Purpose

The power window motor transmits rotation force to the power window regulator to open/close the door glass.

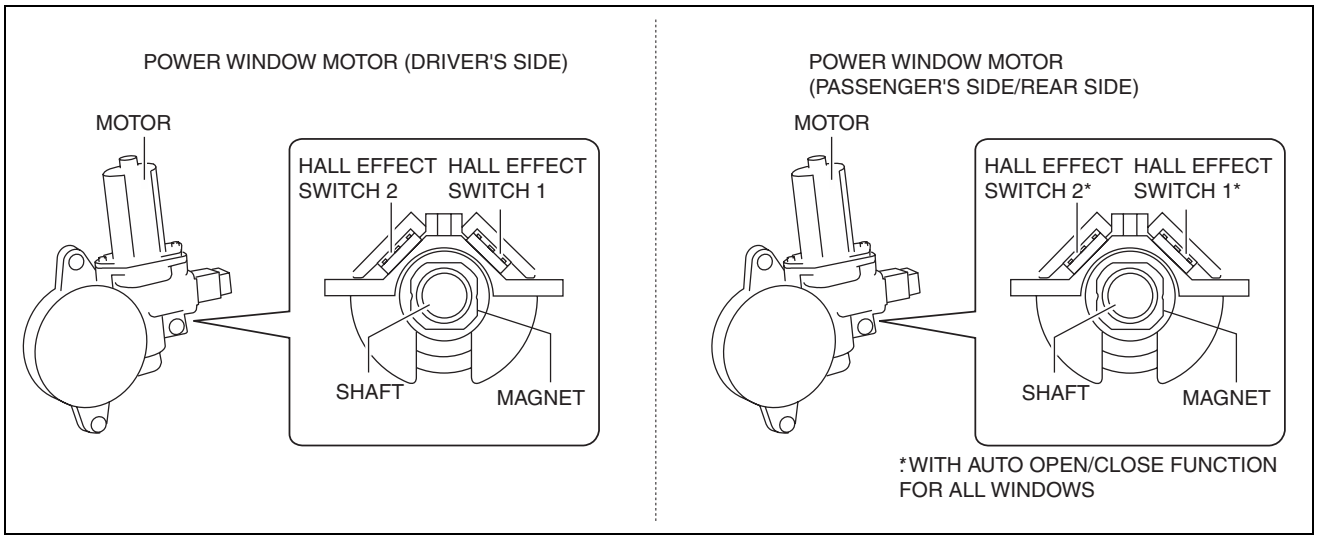
Function

The power window motor rotates clockwise/counterclockwise when it receives an open/close signal from the power window main switch or the power window subswitch.

Construction

- The power window motor consists of the following parts:
  - — Motor
  - — Connector
  - — Gear
- Two Hall effect switches are located in each power window motor connector. (With auto open/close function for all doors)
  - — The Hall effect switches output pulse to the P/W CM.
- Two Hall effect switches are located in the driver's side connector. (With auto open/close function for driver's side door)
  - — The Hall effect switches output pulse to the P/W CM.

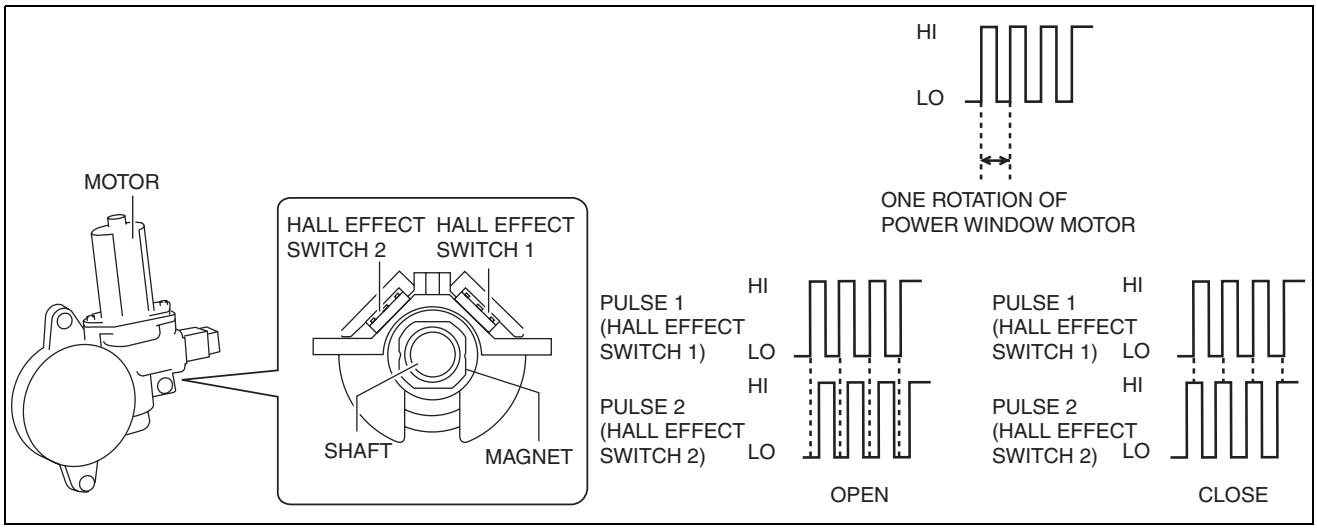
GLASS/WINDOWS/MIRRORS



ac5wzn00000403

Operation

- The Hall effect switch utilizes magnets set on a rotating axis to detect the motor rotation, and outputs a synchronized pulse to the P/W CM.
- The Hall effect switch 1 outputs one pulse cycle for each rotation of the power window motor axle, and the P/W CM detects motor rotation speed.
- Hall effect switch 2 outputs pulse according to the motor rotation in the same manner as Hall effect switch 1. The high and low pulse points of Hall effect switches 1 and 2 are different during opening and closing because the phase difference shifts by 90°, allowing the power window main switch to detect the rotational direction of the power window motor.



ac5wzn00001041

Fail-safe

- Function not equipped.

POWER WINDOW REGULATOR

id091200012500

Purpose

- The power window regulator moves the carrier plate up and down to open/close the door glass using the rotation force transmitted from the power window motor.

Function

- The power window regulator transmits the rotation force from the power window motor to the inner wire and moves the carrier plate up and down.

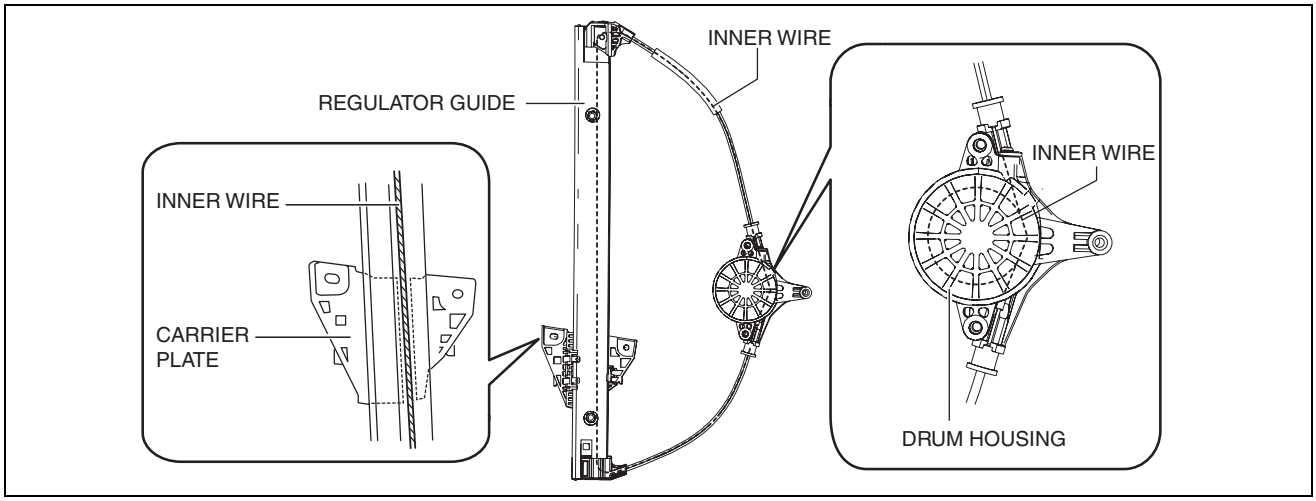
Construction

- The power window regulator consists of the following parts:

GLASS/WINDOWS/MIRRORS

— Drum housing
— Regulator guide
— Carrier plate
— Inner wire

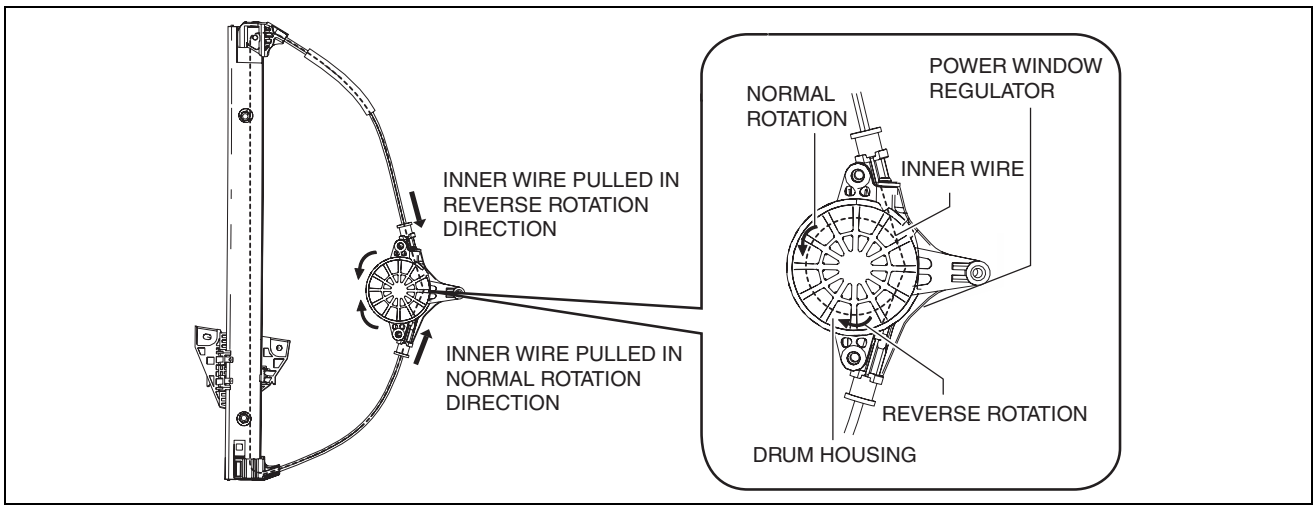
- The inner wire is assembled to the inner side of the regulator guide and wrapped to the drum housing.
- The carrier plate is fixed with the inner wire pinched.



ac5wzn00001042

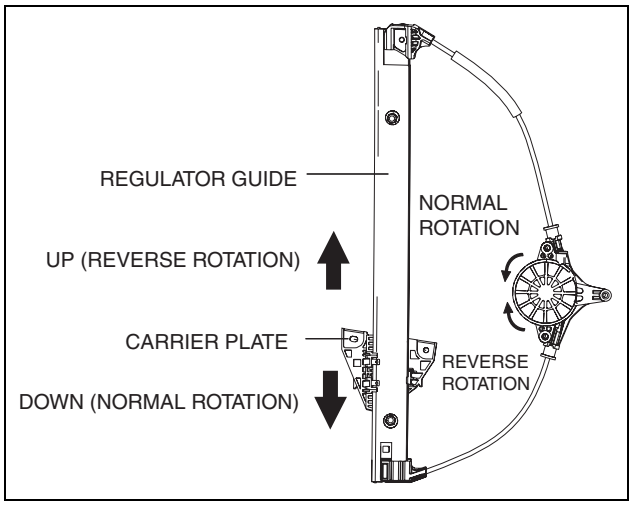
Operation

1. When the drum housing of the power window regulator receives the rotation force from the power window motor, it rotates in the same rotation direction as the power window motor.
2. When the drum housing rotates, the inner wire is pulled in the direction the drum housing rotates.



ac5wzn00000296

3. The carrier plate moves up and down according to the rotational direction of the inner wire.



ac5wzn00000297

Fail-safe
- Function not equipped.

POWER WINDOW MAIN SWITCH

id091200012300

Purpose
- Remote control of door glass open/close and power outer mirror adjustment and retract/return are possible with occupant seated in the cabin (with retractable power outer mirrors).
- Remote control of door glass open/close and power outer mirror adjustment are possible with occupant seated in the cabin (without retractable power outer mirrors).

Function
Power window main switch
- Manual
  - — When the power window main switch is operated for manual open/close operation, it sends a manual open/close signal to the P/W CM (power window control module).
- Auto
  - — When the power window main switch is operated for auto open/close operation, it sends an auto open/close signal to the P/W CM.
- Power cut
  - — When the power-cut switch is pressed, it disables the operation of the power window subswitches for the front and rear passenger seats.

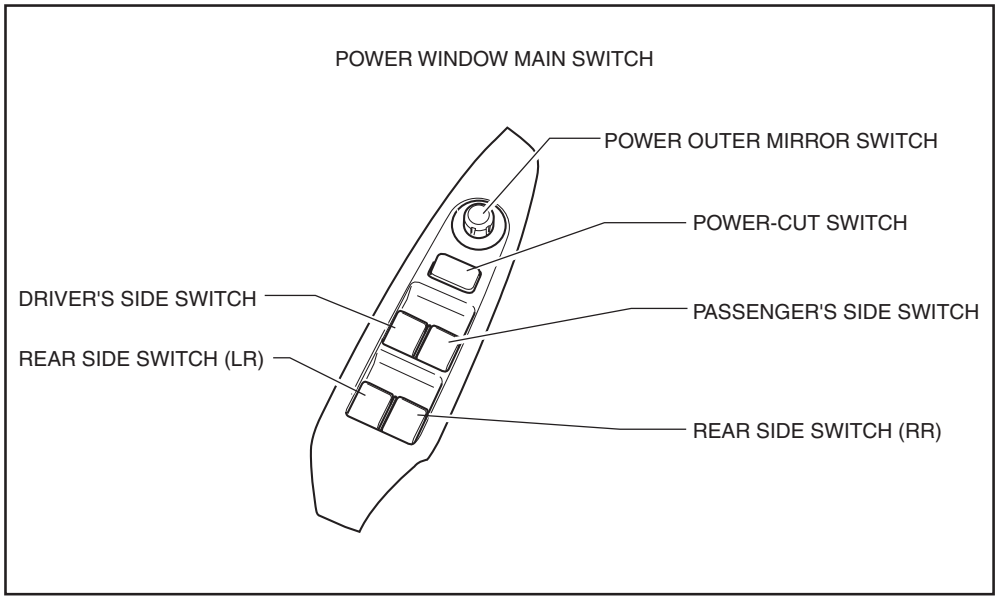
Power outer mirror switch
- Up-down/left-right adjustment
  - — The power outer mirror switch switches the contact point according to the switch operation. As a result, the circuit to the up-down/left-right adjustment motor is switched.
- Retract/Return
  - — The power outer mirror switch switches the contact point according to the switch operation. As a result, the circuit to the retract/return motor is switched.
- Left/right selection
  - — The power outer mirror switch is used to select the side on which adjustment of the power outer mirror glass is desired.

Construction
- The power window main switch consists of the following parts:
  - — Driver's side switch
  - — Front passenger's side switch
  - — Rear passenger switch (LR)
  - — Rear passenger switch (RR)
  - — Power-cut switch
  - — Power outer mirror switch
    - Up/down/left/right adjustment
    - Retract/return
    - Left/right selection

GLASS/WINDOWS/MIRRORS

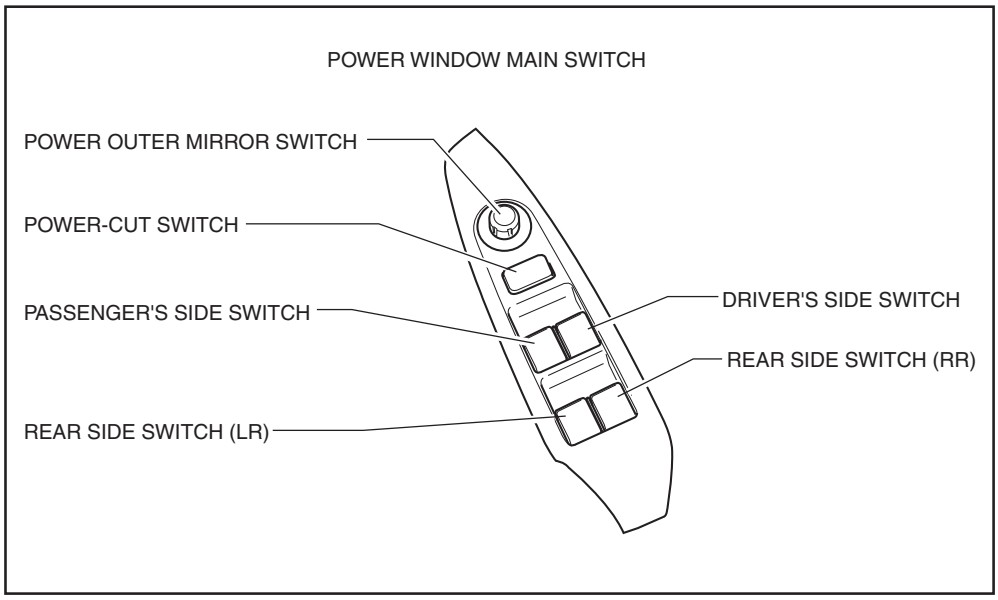
- The power window main switch has a built-in P/W CM, and controls the auto reverse pinch protection, IG OFF timer, and IG OFF timer cancel functions.

L.H.D.



ac5wzn00001103

R.H.D.



ac5wzn00001226

Operation

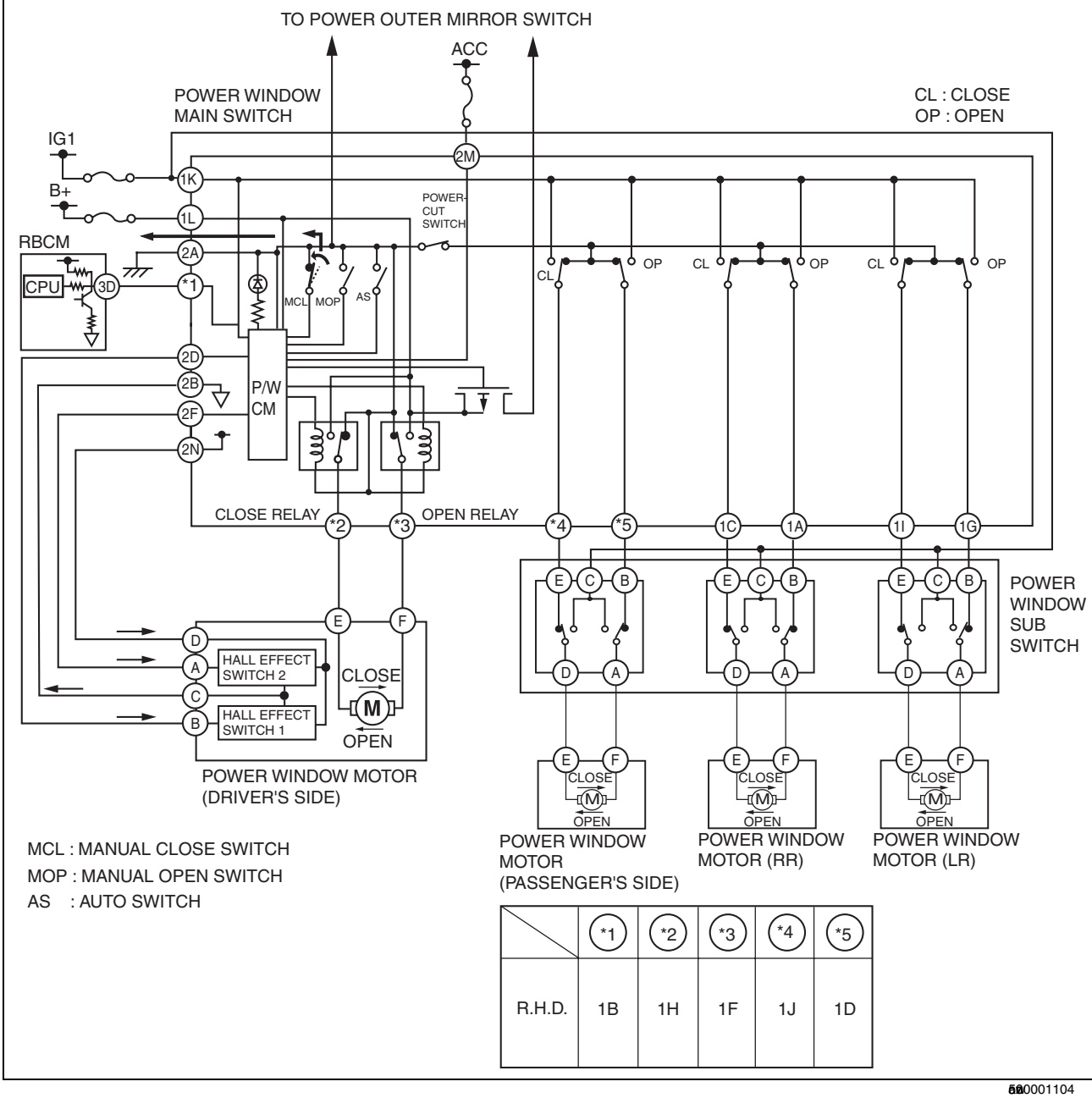
Power window main switch

1. Contact points for door glass opening/closing can be changed by operating the power window main switch. The P/W CM monitors the operation conditions of the driver's side switch and power window motor.

GLASS/WINDOWS/MIRRORS

With driver's side window auto open/close

MANUAL CLOSE (EXAMPLES)



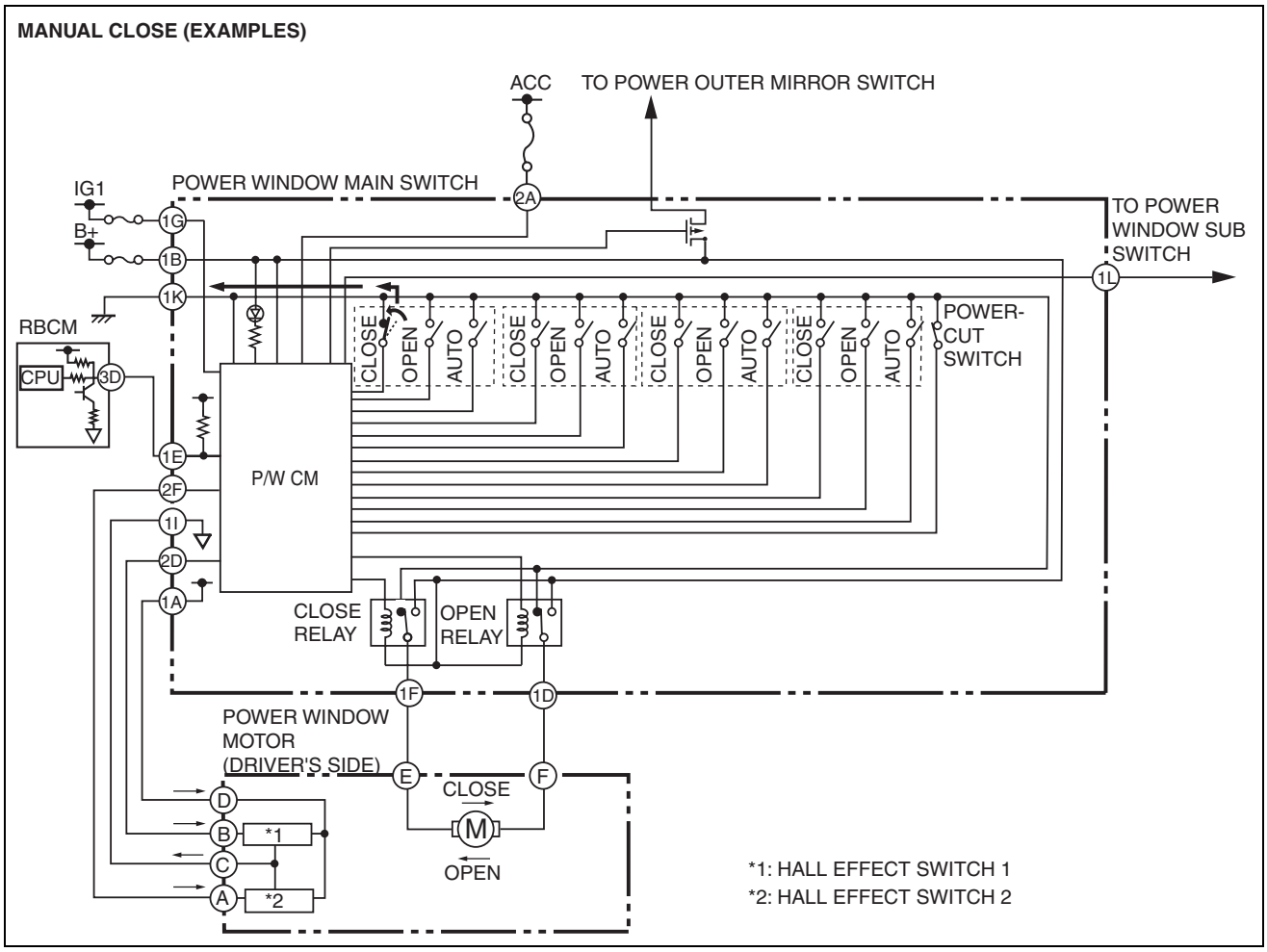
MCL : MANUAL CLOSE SWITCH
MOP : MANUAL OPEN SWITCH
AS : AUTO SWITCH

	*1	*2	*3	*4	*5
R.H.D.	1B	1H	1F	1J	1D

E80001104

GLASS/WINDOWS/MIRRORS

With all window auto open/close

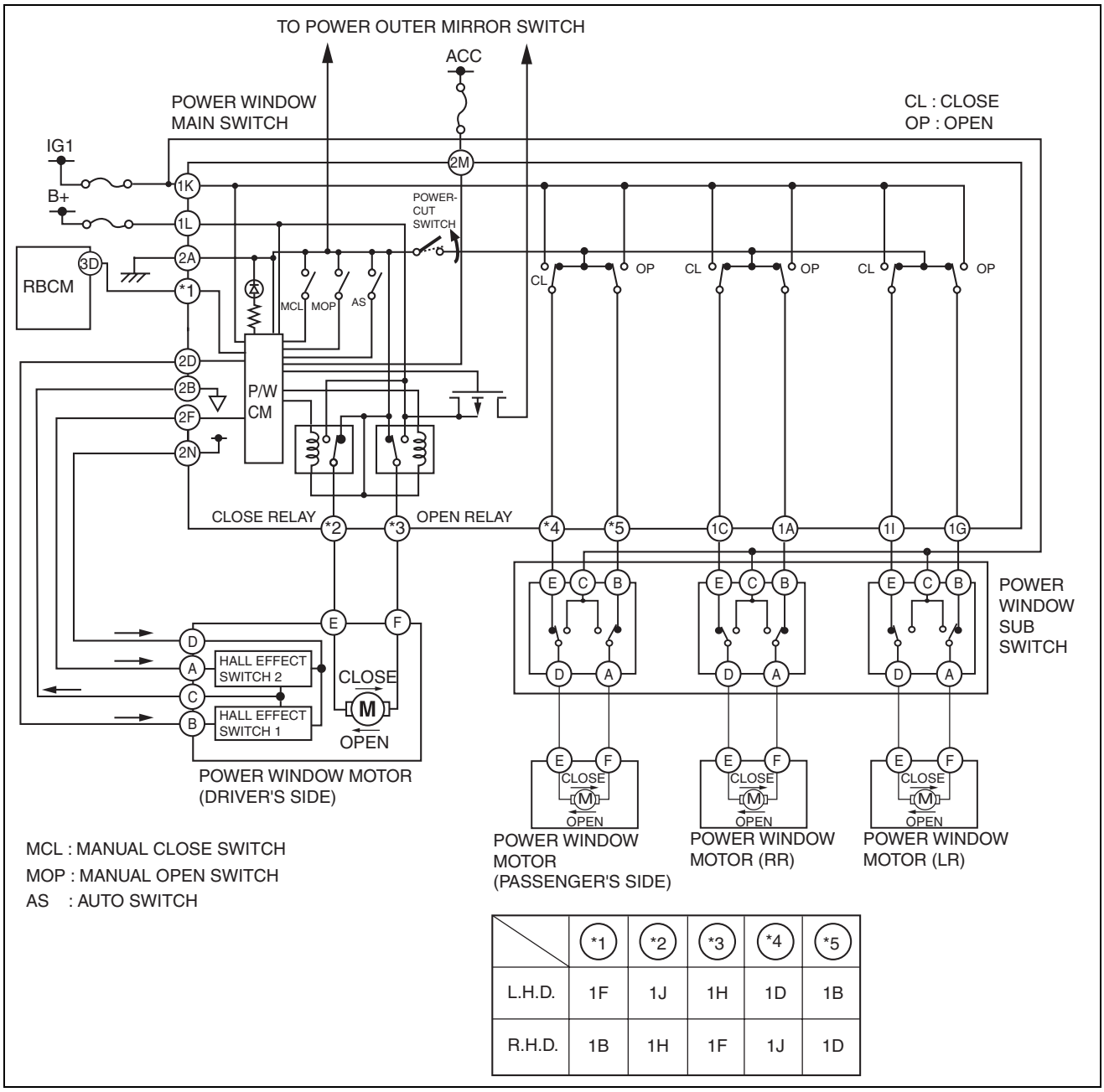


Power-cut switch

1. The power window main switch turns off when the power-cut switch is operated for lock operation.

GLASS/WINDOWS/MIRRORS

With driver's side window auto open/close

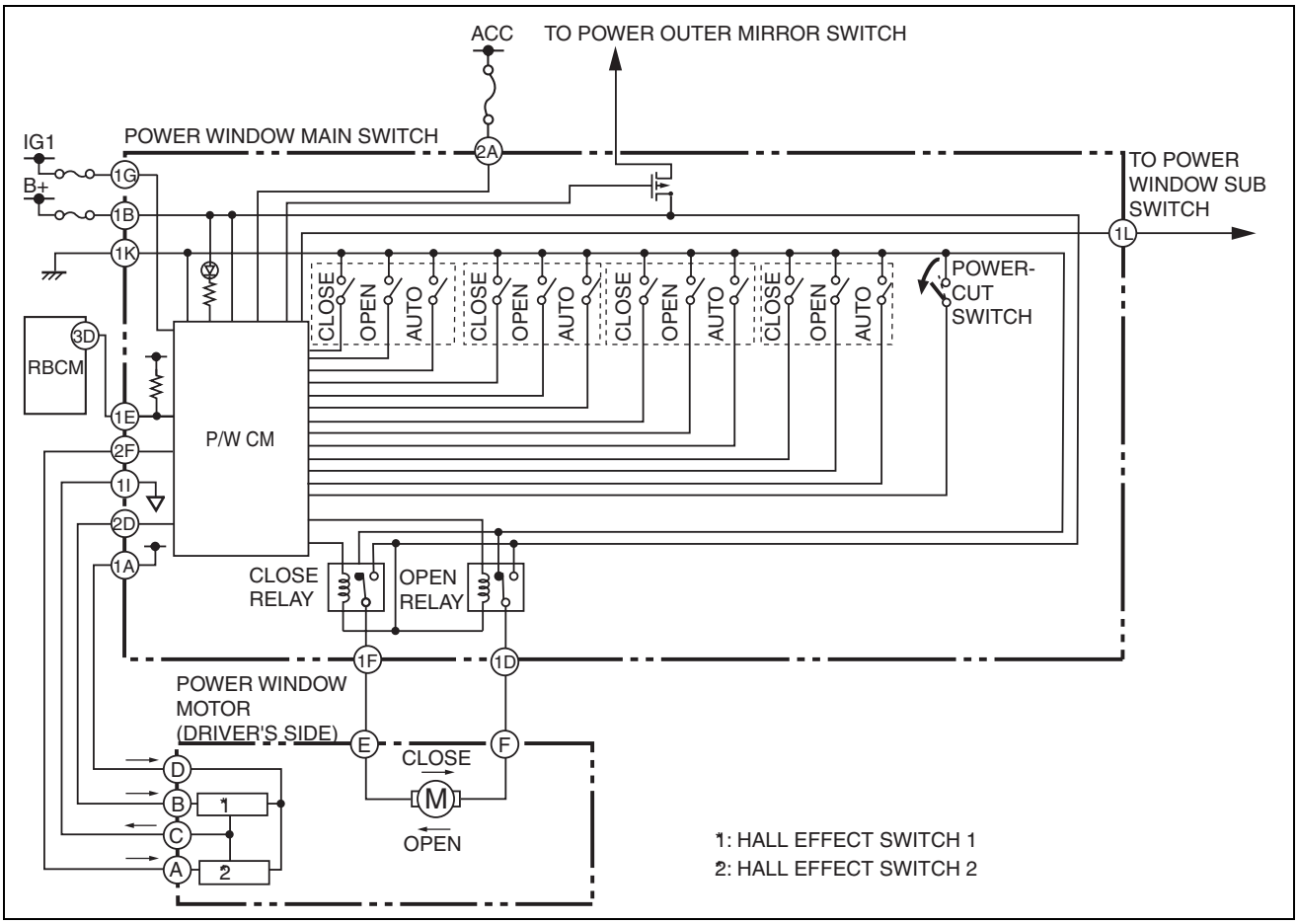


	*1	*2	*3	*4	*5
L.H.D.	1F	1J	1H	1D	1B
R.H.D.	1B	1H	1F	1J	1D

E80001105

GLASS/WINDOWS/MIRRORS

With all window auto open/close



ac5wzn00001040

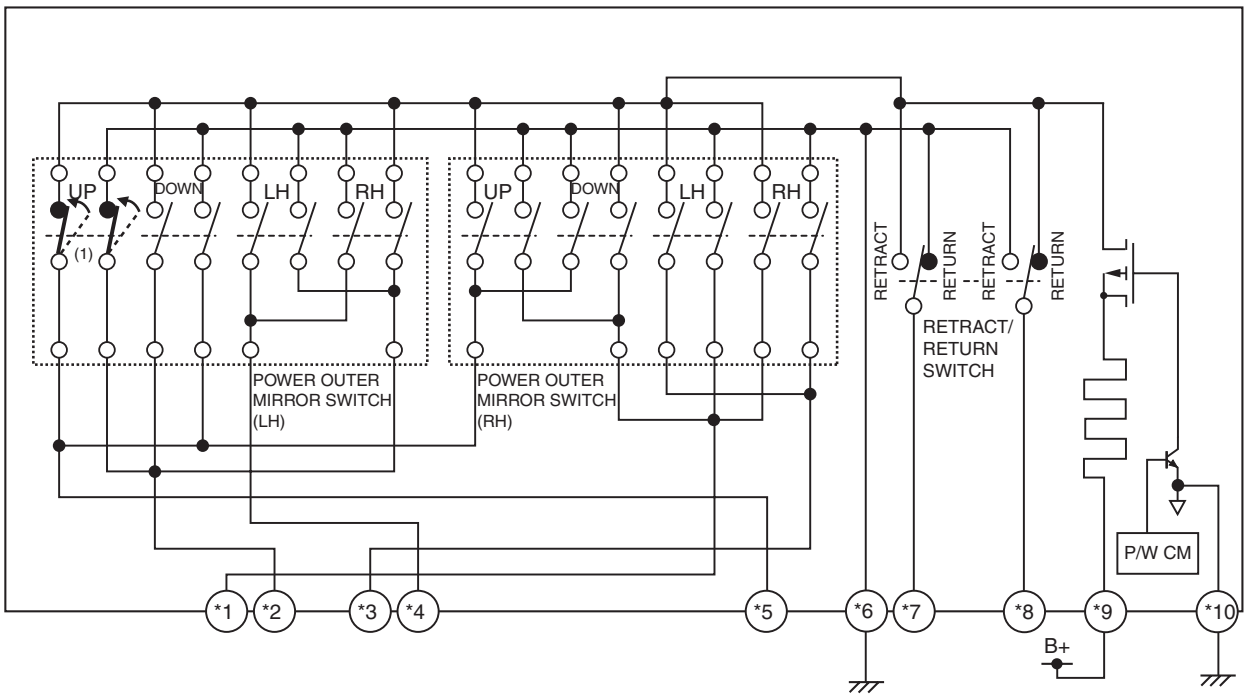
Power outer mirror switch

1. Up/down/left/right contact points for the power outer mirror can be switched by operating the power outer mirror switch.

GLASS/WINDOWS/MIRRORS

With retract/return function

POWER OUTER MIRROR SWITCH IS PRESSED IN THE UPWARD DIRECTION (EXAMPLE)



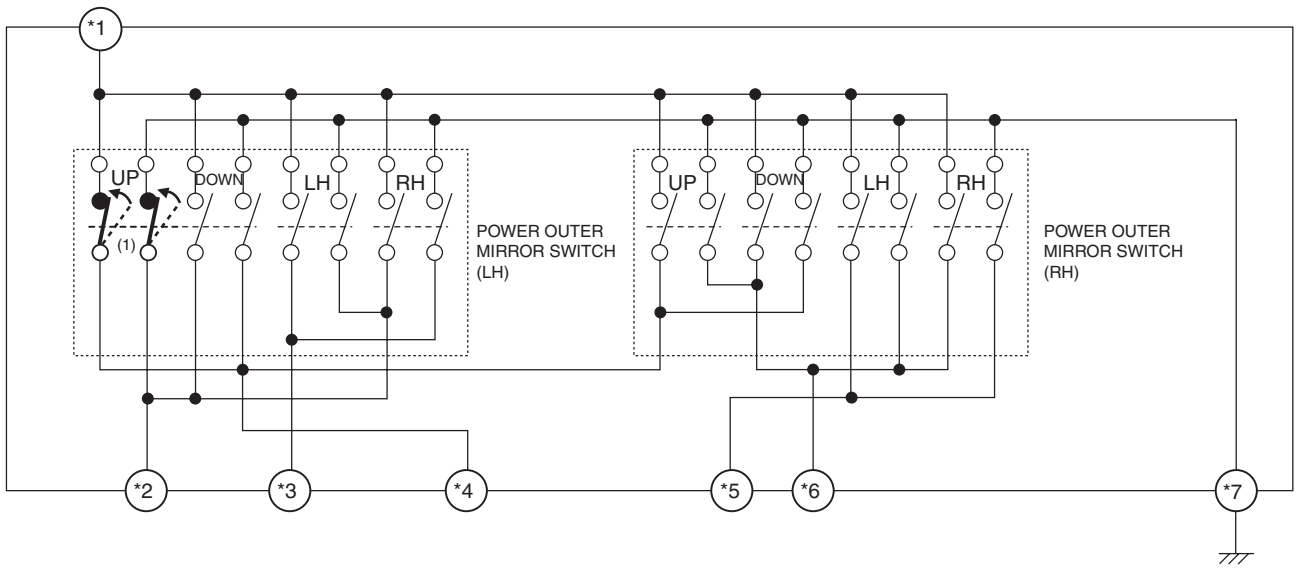
	*1	*2	*3	*4	*5	*6	*7	*8	*9	*10
WITH DRIVER'S SIDE WINDOW AUTO OPEN/CLOSE	2H	2C	2L	2I	2J	2G	2E	2K	1L	2A
WITH ALL WINDOW AUTO OPEN/CLOSE	2E	2B	2J	2G	2H	2N	2C	2I	1B	1K

E80001533

GLASS/WINDOWS/MIRRORS

Without retract/return function

POWER OUTER MIRROR SWITCH IS PRESSED IN THE UPWARD DIRECTION (EXAMPLE)



	*1	*2	*3	*4	*5	*6	*7
WITH DRIVER'S SIDE WINDOW AUTO OPEN/CLOSE	2M	2C	2I	2J	2L	2H	2G
WITH ALL WINDOW AUTO OPEN/CLOSE	2A	2B	2G	2H	2J	2E	2N

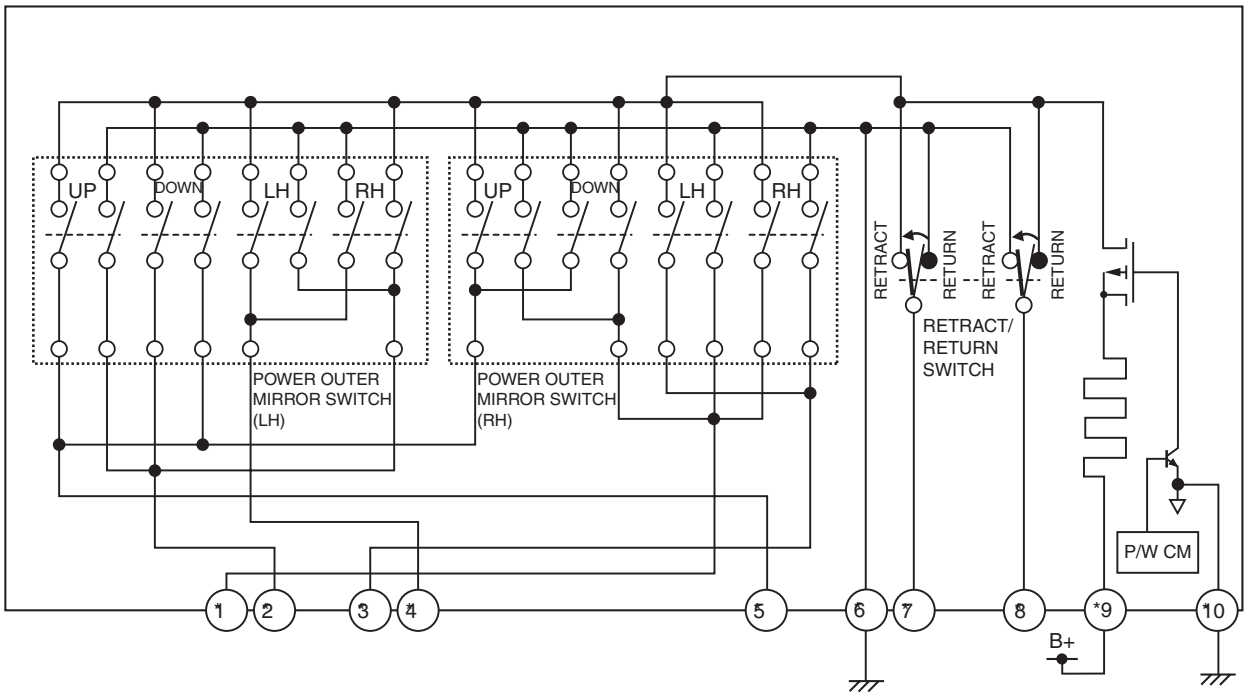
E00001230

GLASS/WINDOWS/MIRRORS

Retract/Return switch

1. Contact points for power outer mirror retract/return can be switched by operating the power outer mirror switch.

SWITCHED FROM RETURN TO RETRACT (EXAMPLE)



	*1	*2	*3	*4	*5	*6	*7	*8	*9	*10
WITH DRIVER'S SIDE WINDOW AUTO OPEN/CLOSE	2H	2C	2L	2I	2J	2G	2E	2K	1L	2A
WITH ALL WINDOW AUTO OPEN/CLOSE	2E	2B	2J	2G	2H	2N	2C	2I	1B	1K

id091200001534

Fail-safe

- Function not equipped.

POWER WINDOW SUBSWITCH

id091200010900

Purpose

- Each door glass except for the driver-side can be opened/closed with occupant seated in the cabin using the power window subswitch.

Function

Manual switch

- The power window subswitch switches the contact point according to the switch operation and switches the circuit to the power window motor.

Auto switch

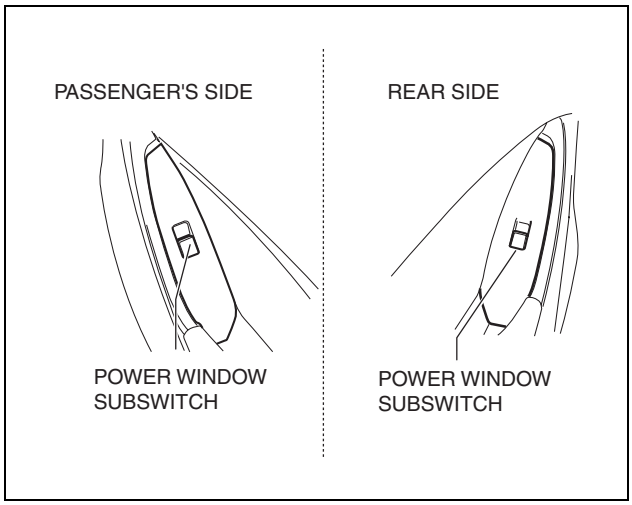
- When the power window subswitch is operated for auto open/close operation, it sends an auto open/close signal to the P/W CM.

Construction

- The power window subswitch is equipped on the front passenger side and the rear passenger sides.

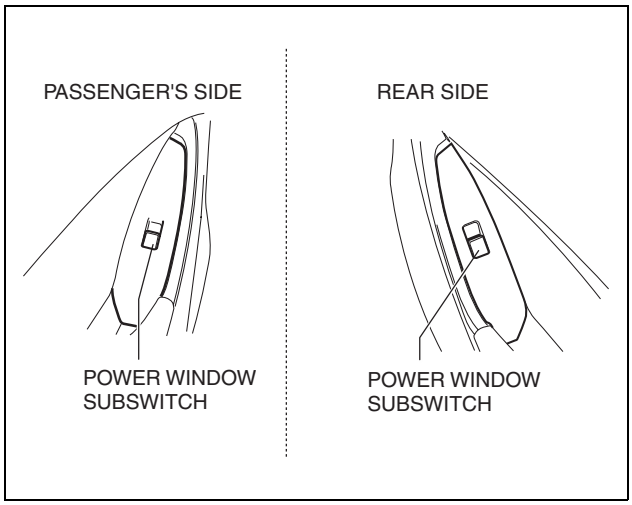
GLASS/WINDOWS/MIRRORS

L.H.D.



ac5jjn00000389

R.H.D.



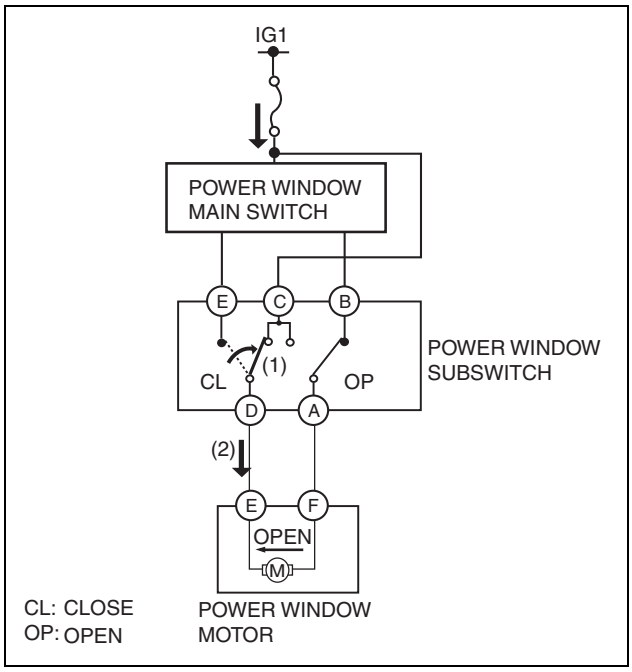
ac5jjn00000390

Operation

Manual operation (With driver's side window auto open/close) (Example: close operation)

1. When the power window subswitch is turned to the manual close position (1), a manual close signal is sent to the power window motor.(2)

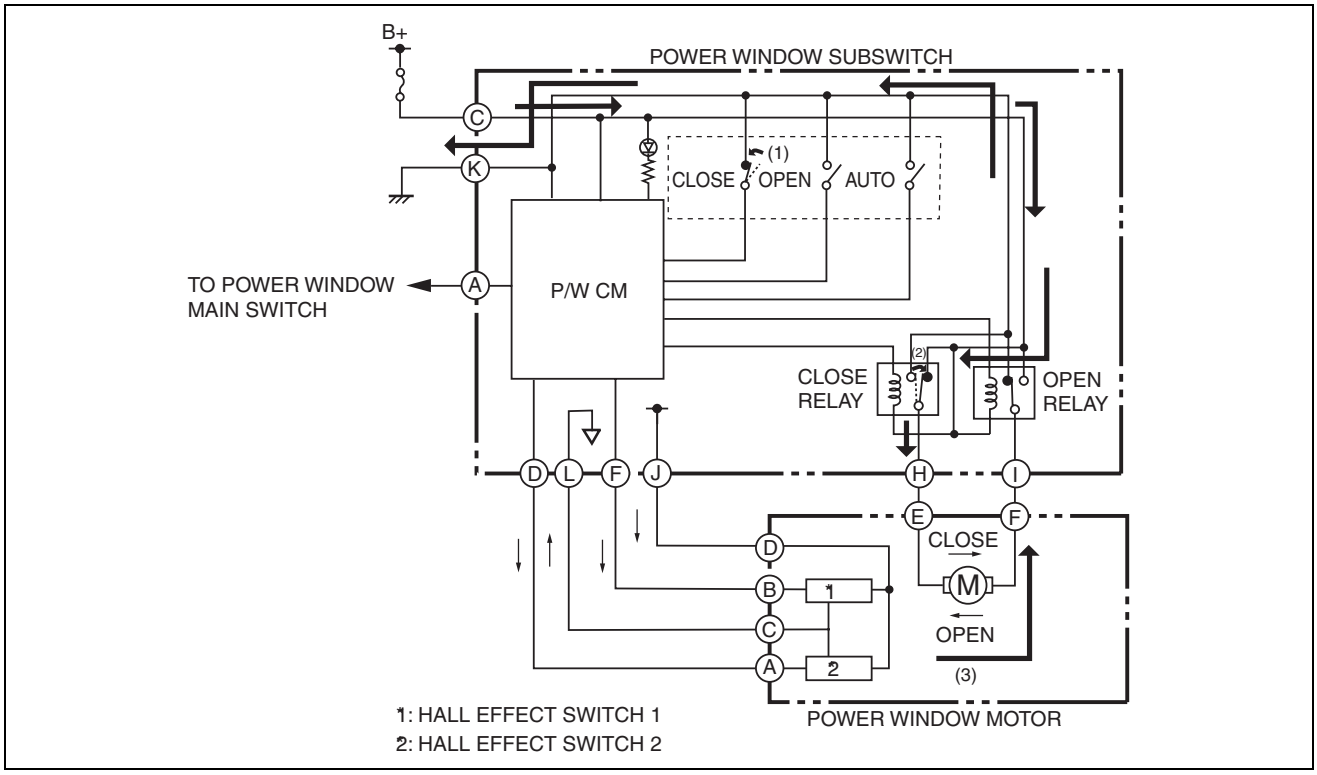
GLASS/WINDOWS/MIRRORS



ac5wzn00001094

Manual operation (With all window auto open/close) (Example: close operation)

1. When the power window subswitch is operated for manual close operation, the power window motor (LF) starts manual close operation.(2)
2. When the P/W CM receives a manual close signal, it turns on the close relay. (2)
3. When the close relay is turned on, the power window motor (RF) starts manual close operation.(3)

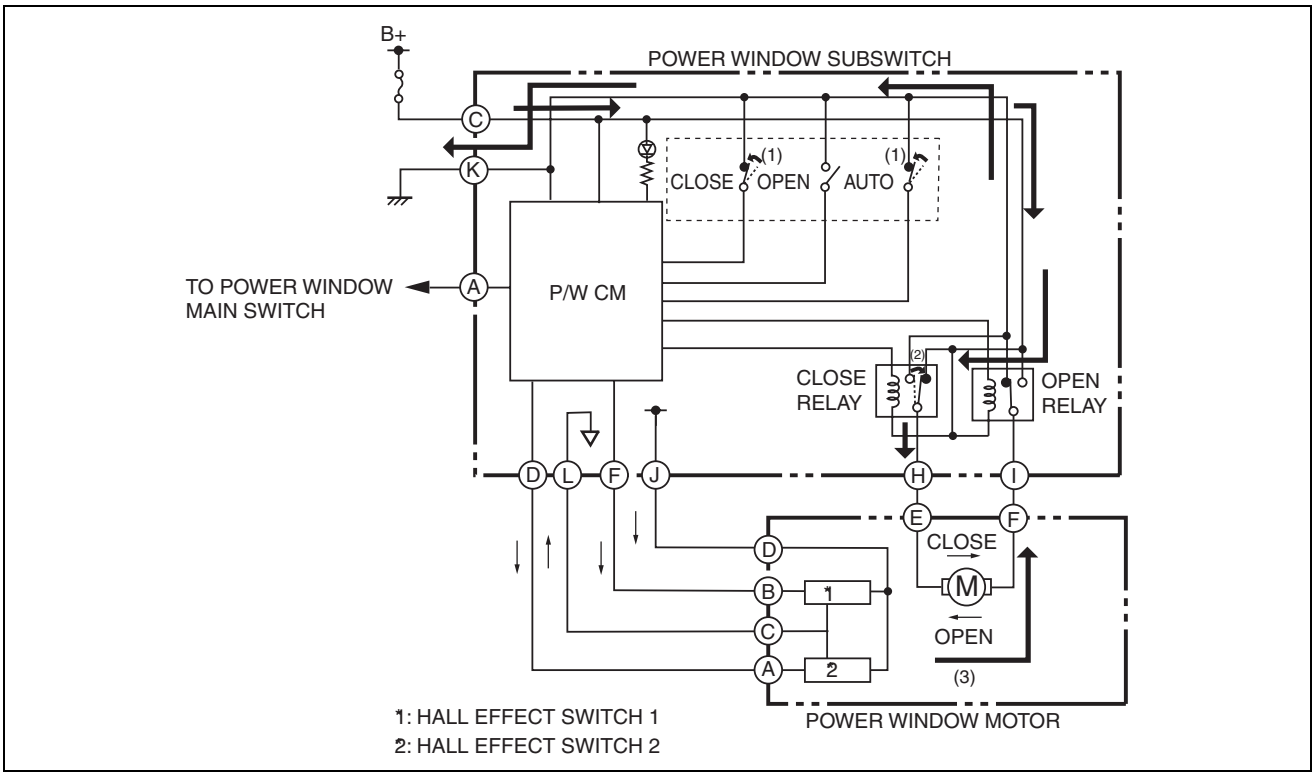


ac5wzn00000312

Auto operation (With all window auto open/close) (Example: close operation)

1. When the power window subswitch is turned to the auto close position (1), it sends an auto close signal to the CPU.
2. When the CPU receives an auto close signal, it turns on the close relay.(2)
3. When the close relay is turned on, the power window motor (LR) starts close operation.(3)

GLASS/WINDOWS/MIRRORS



ac5wzn00001035

Fail-safe

- Function not equipped.

POWER OUTER MIRROR SYSTEM

id091200012700

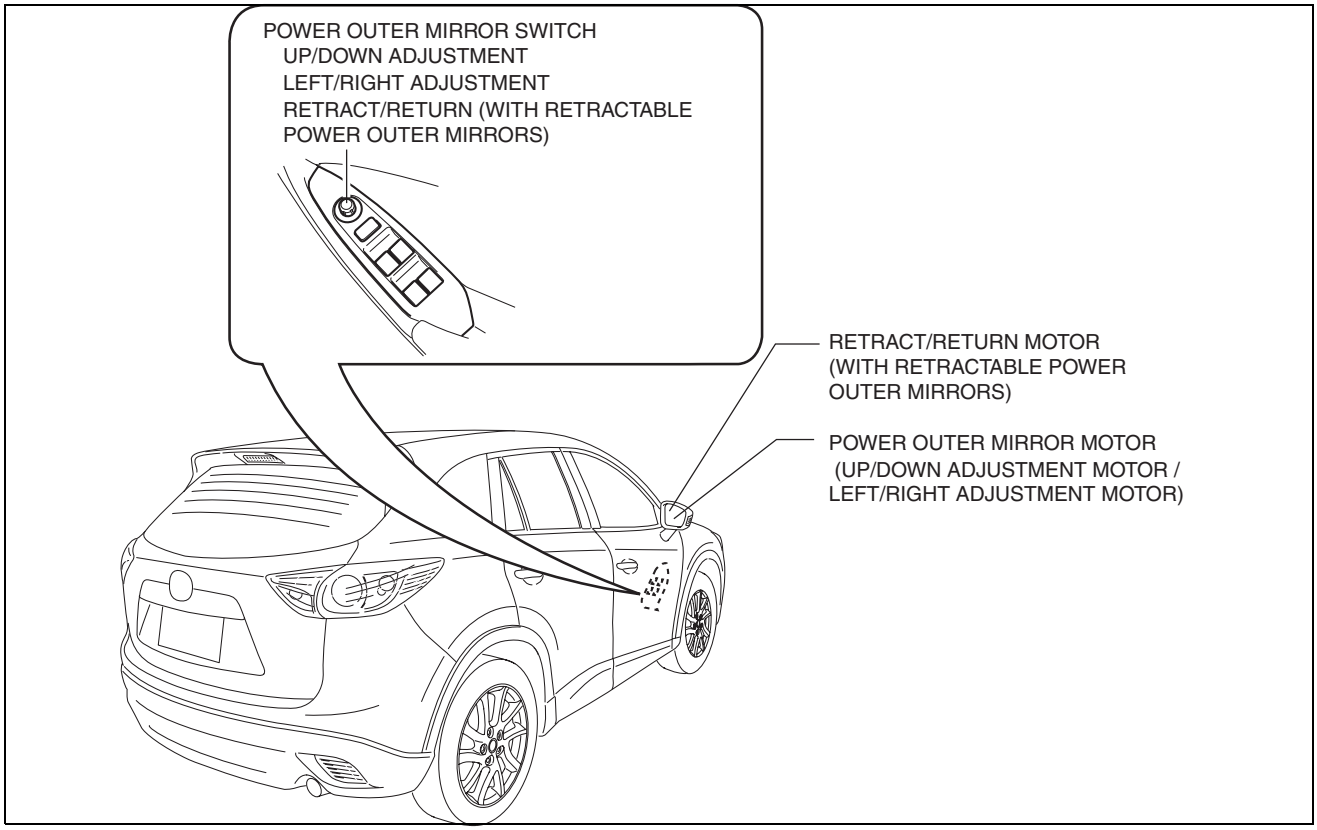
Outline

- Power outer mirrors which can be operated remotely have been adopted.

GLASS/WINDOWS/MIRRORS

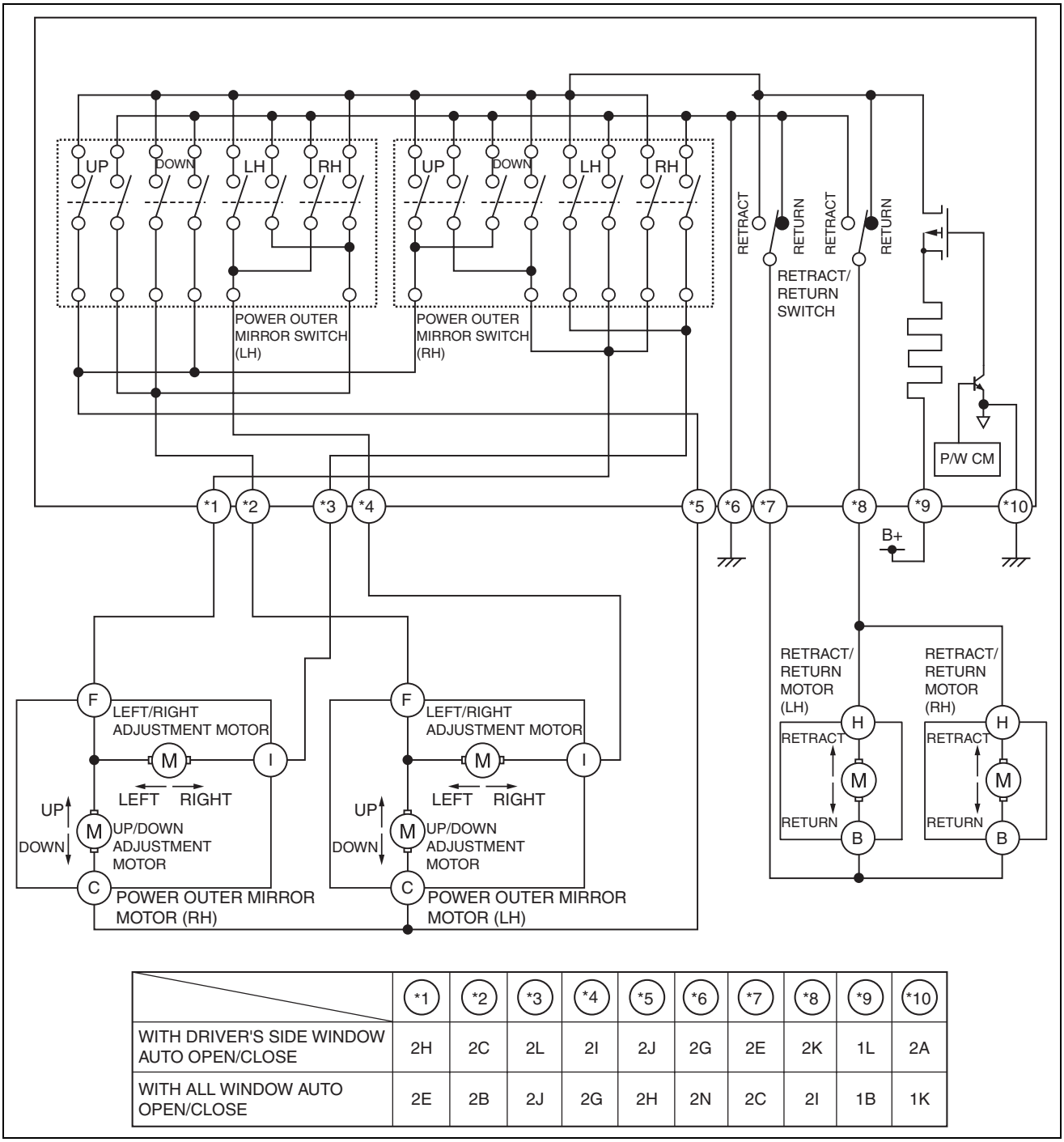
Structural view

R.H.D.



GLASS/WINDOWS/MIRRORS

System wiring diagram
With retract/return function

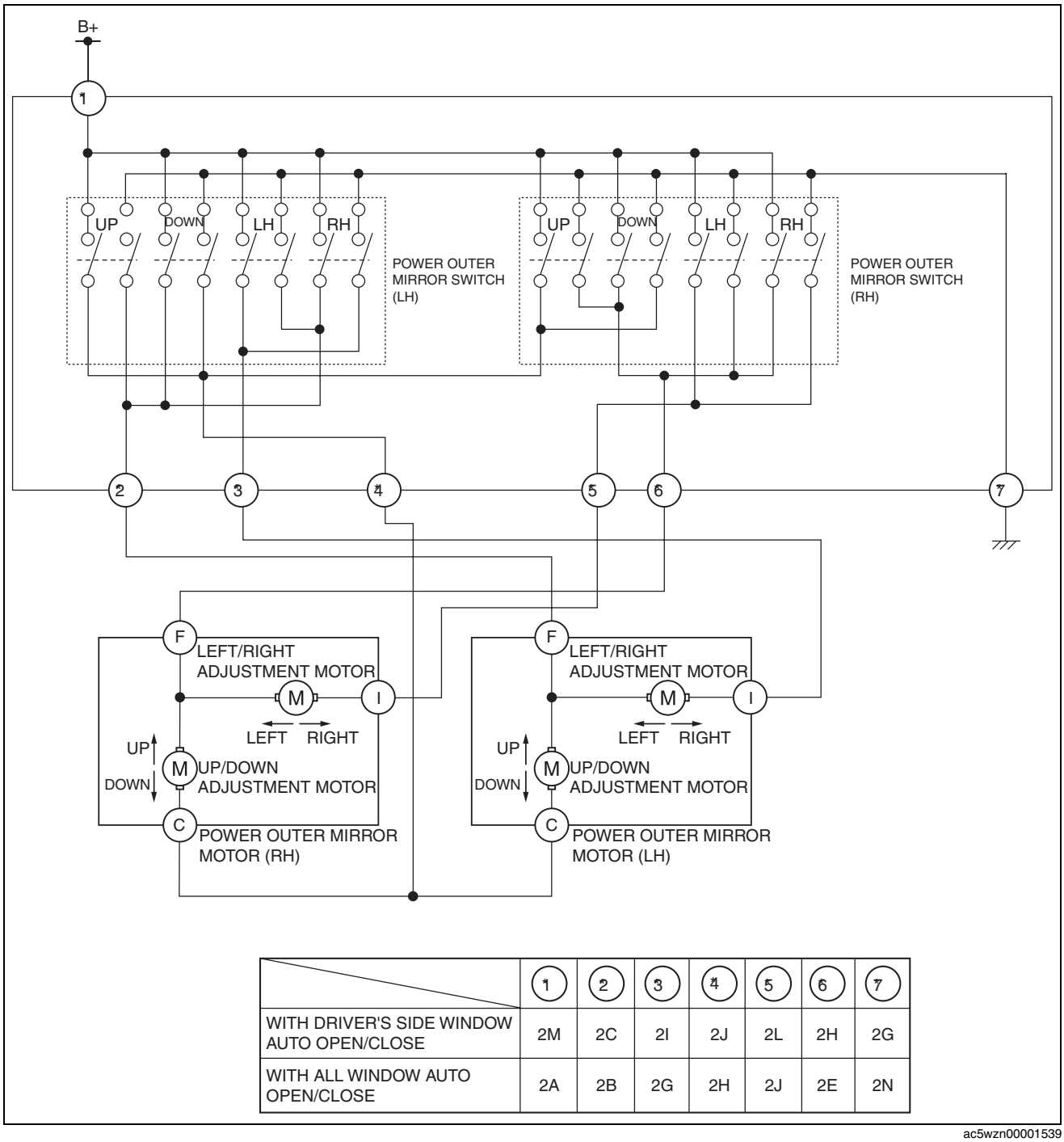


	*1	*2	*3	*4	*5	*6	*7	*8	*9	*10
WITH DRIVER'S SIDE WINDOW AUTO OPEN/CLOSE	2H	2C	2L	2I	2J	2G	2E	2K	1L	2A
WITH ALL WINDOW AUTO OPEN/CLOSE	2E	2B	2J	2G	2H	2N	2C	2I	1B	1K

E200001231

GLASS/WINDOWS/MIRRORS

Without retract/return function



	1	2	3	4	5	6	7
WITH DRIVER'S SIDE WINDOW AUTO OPEN/CLOSE	2M	2C	2I	2J	2L	2H	2G
WITH ALL WINDOW AUTO OPEN/CLOSE	2A	2B	2G	2H	2J	2E	2N

ac5wzn00001539

Function

Mirror glass adjustment function

- Outer mirror glass can be adjusted up/down and left/right electrically.

IG OFF timer function (With retractable power outer mirrors)

- The power outer mirror switch can be operated for **approx. 40 s** after the ignition is switched from ON to ACC or OFF.

IG OFF timer cancel (With retractable power outer mirrors)

- The IG OFF timer is canceled when **approx. 40 s or more** have elapsed since the ignition was switched to ACC or OFF or any door is opened during IG OFF timer operation.

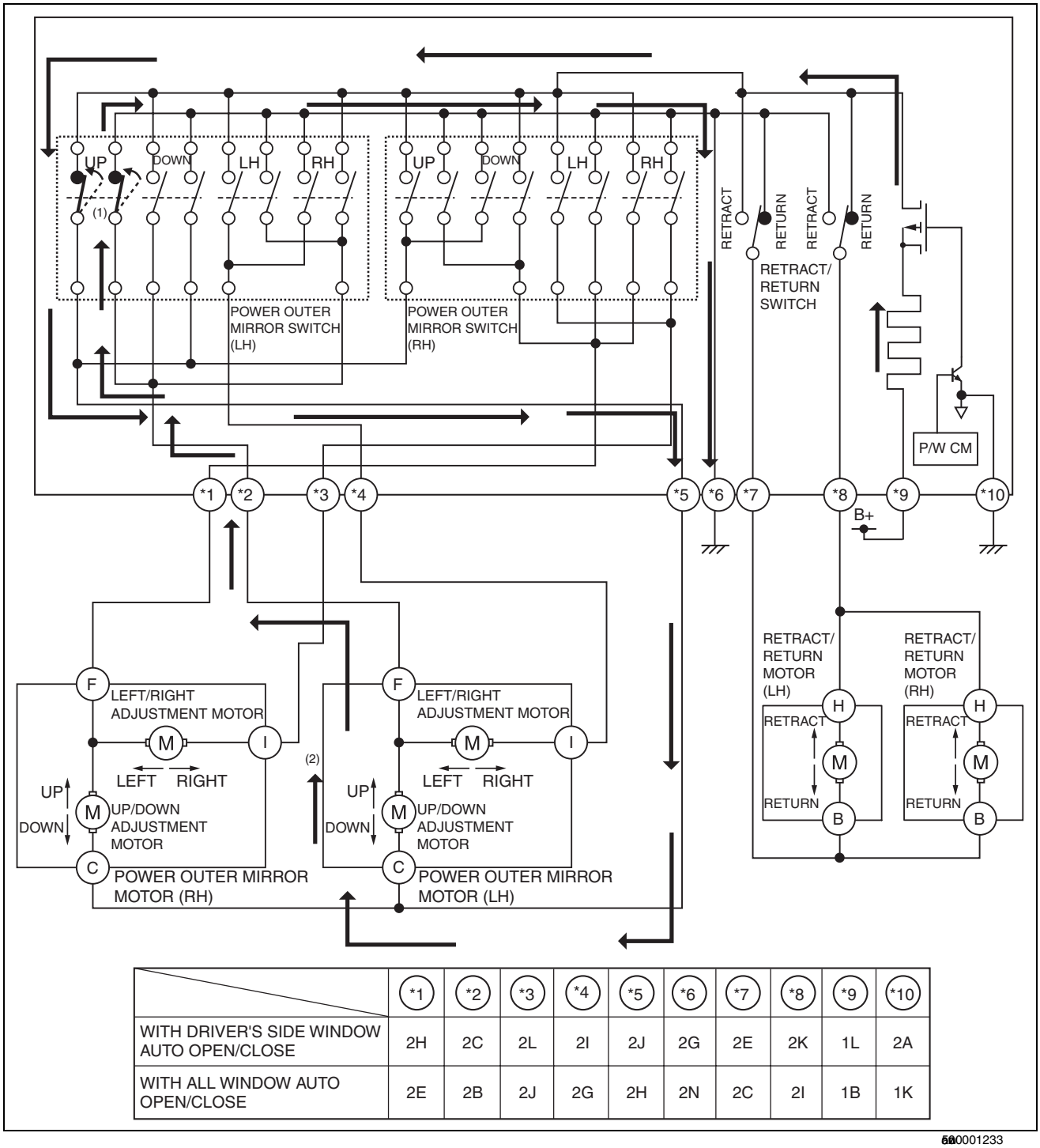
GLASS/WINDOWS/MIRRORS

Operation

Mirror glass adjustment (Example: Left outer mirror is adjusted upward)

1. When the upward switch is turned on, the up/down adjustment motor operates upward.(2)

With retract/return function

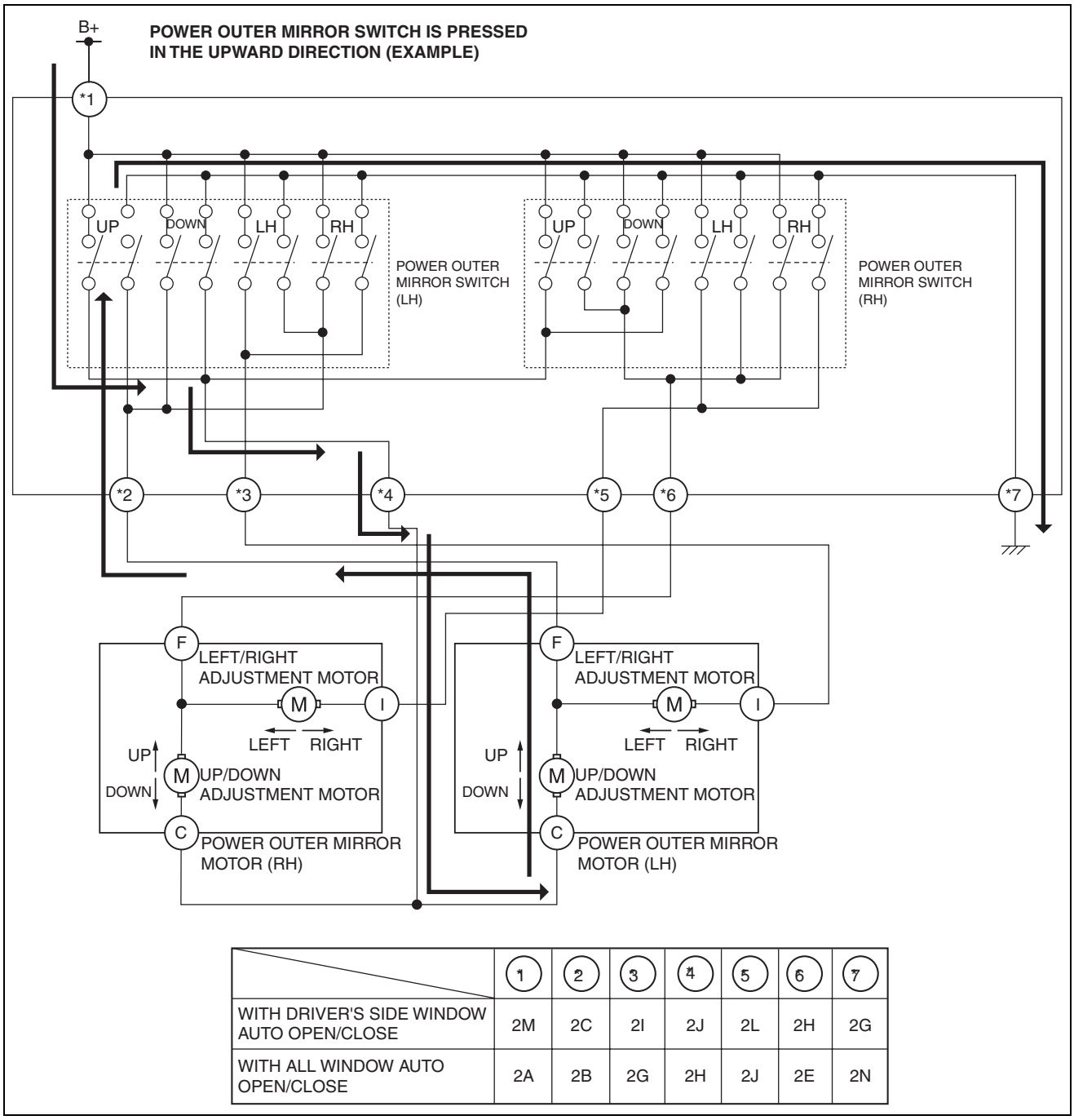


	*1	*2	*3	*4	*5	*6	*7	*8	*9	*10
WITH DRIVER'S SIDE WINDOW AUTO OPEN/CLOSE	2H	2C	2L	2I	2J	2G	2E	2K	1L	2A
WITH ALL WINDOW AUTO OPEN/CLOSE	2E	2B	2J	2G	2H	2N	2C	2I	1B	1K

E00001233

GLASS/WINDOWS/MIRRORS

Without retract/return function



	1	2	3	4	5	6	7
WITH DRIVER'S SIDE WINDOW AUTO OPEN/CLOSE	2M	2C	2I	2J	2L	2H	2G
WITH ALL WINDOW AUTO OPEN/CLOSE	2A	2B	2G	2H	2J	2E	2N

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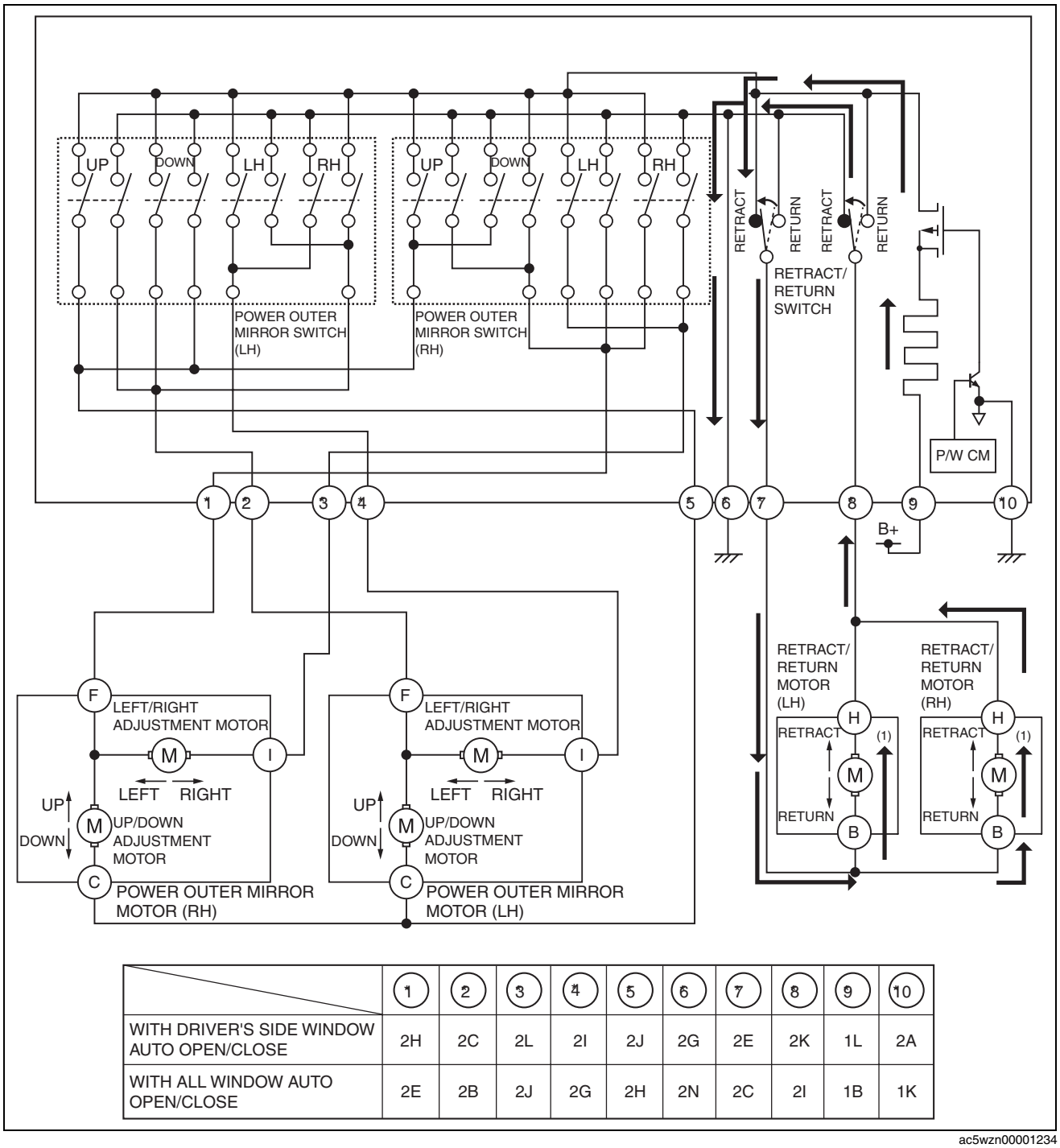
IG OFF timer (Example: retract operation)

1. When the ignition is switched to ACC or OFF from the ON position (engine off or on), the IG OFF timer function in the P/W CM is turned ON and the power outer mirror switch can be operated for **approx. 40 s** after the IG OFF is detected.
2. If retract operation is performed using the power outer mirror switch when the IG OFF timer is ON, the retract/return motor performs a retract operation (1).

GLASS/WINDOWS/MIRRORS

3. If **approx. 40 s** have elapsed after the P/W CM detects IG OFF, the IG OFF timer function turns off.



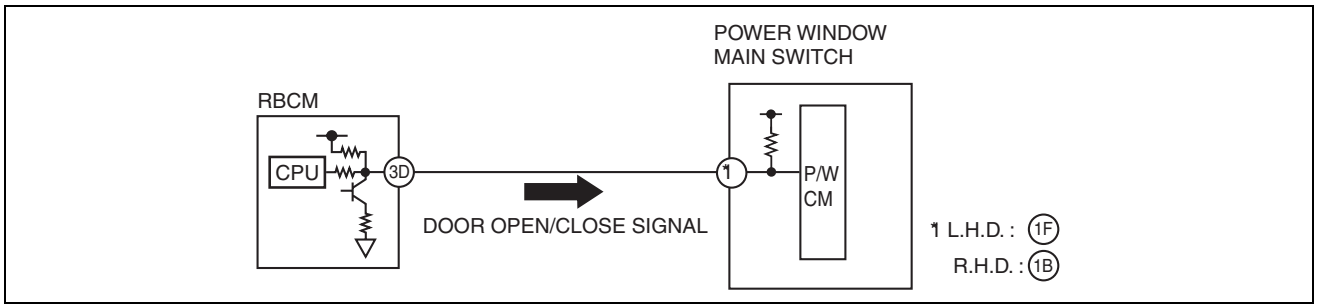
	1	2	3	4	5	6	7	8	9	10
WITH DRIVER'S SIDE WINDOW AUTO OPEN/CLOSE	2H	2C	2L	2I	2J	2G	2E	2K	1L	2A
WITH ALL WINDOW AUTO OPEN/CLOSE	2E	2B	2J	2G	2H	2N	2C	2I	1B	1K

ac5wzn00001234

IG OFF Timer Cancel

1. The P/W CM detects the open/close conditions of all the doors based on the door open/close signal sent from the rear body control module (RBCM).
2. When a door open signal is sent from the rear body control module (RBCM) while the IG OFF timer is on, the IG OFF timer function is canceled.

GLASS/WINDOWS/MIRRORS



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Fail-safe
- Function not equipped.

POWER OUTER MIRROR

id091200011300

Outline
- The power outer mirror adjusts the outer mirror glass position up/down and left/right using the up/down adjustment motor and, left/right adjustment motor and operates retract/return using the retract/return motor.
- The up/down adjustment motor and, left/right adjustment motor turns clockwise (down/right direction) or counterclockwise (up/left direction).
- The retract/return motor turns clockwise (retract direction) or counterclockwise (return direction).

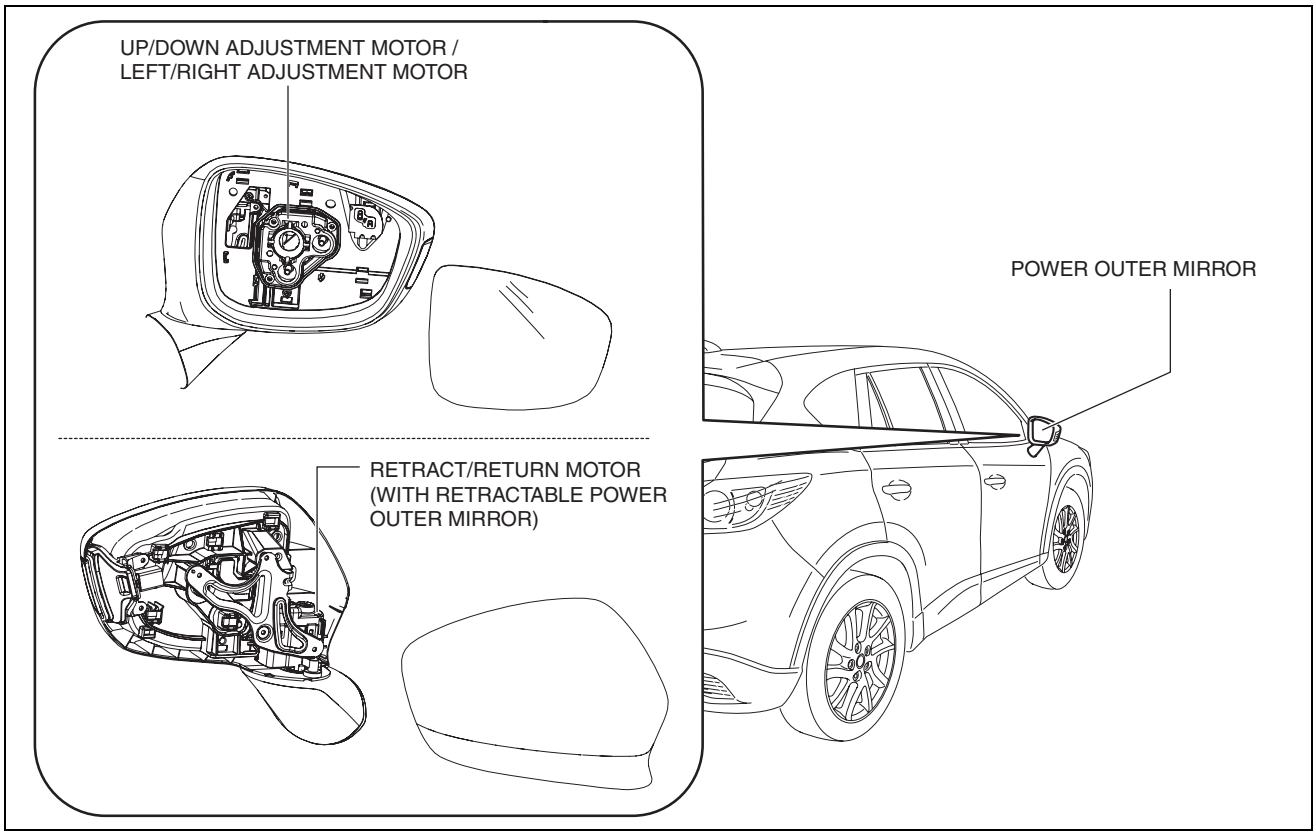
Function
Up/down adjustment
- When the up/down adjustment motor operates, the power outer mirror operates in the up/down directions.

Left/right adjustment
- When the left/right adjustment motor operates, the power outer mirror operates in the left/right directions.

Retract/Return
- When the retract/return motor operates, the power outer mirror operates in the retracting/returning directions.

Construction
- Up/down, left/right, and retract/return motors are inside the power outer mirror.

GLASS/WINDOWS/MIRRORS



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Operation

Up/down adjustment motor (Example: power outer mirror is operated upward)

1. The up/down adjustment motor receives an up signal from the power outer mirror switch, and when the up switch is turned on, it rotates counterclockwise.

Left/right adjustment motor (Example: power outer mirror is operated in left direction)

1. The left/right adjustment motor receives a left signal from the power outer mirror switch, and when the left switch is turned on, it rotates counterclockwise.

Retract/return motor (With retractable power outer mirrors) (Example: retract operation)

1. The retract/return motor receives a retract signal from the power outer mirror switch, and when the retract switch is turned on, it rotates clockwise.

Fail-safe

- Function not equipped.

AUTO-DIMMING MIRROR

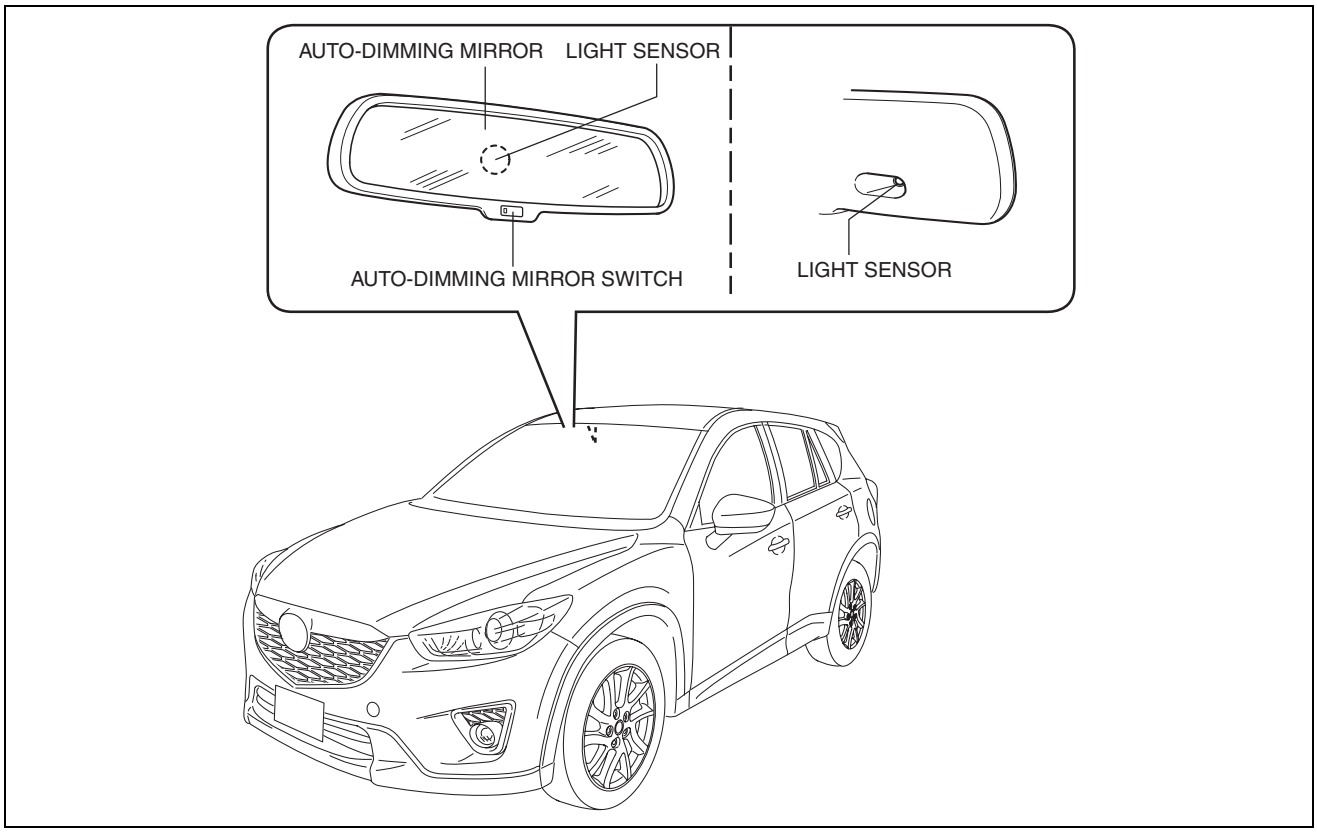
id091200012900

Purpose

- The automatic glare prevention rearview mirror prevents the driver from being dazzled by light from vehicles at the rear.

GLASS/WINDOWS/MIRRORS

Structural view



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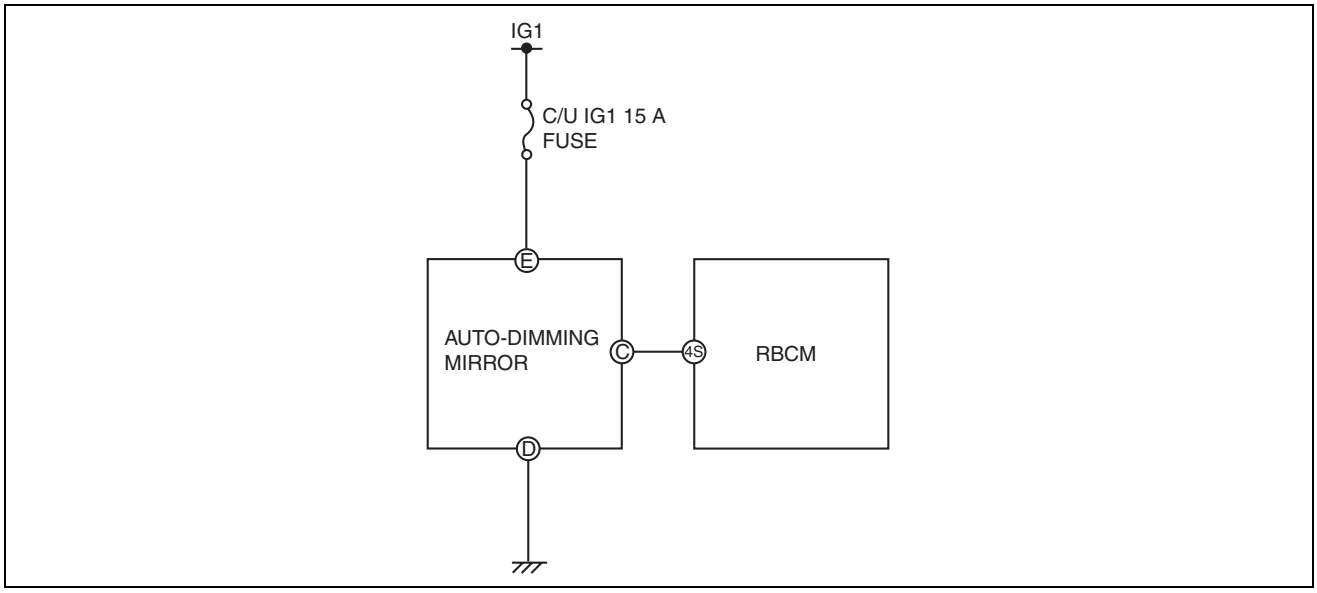
System wiring diagram



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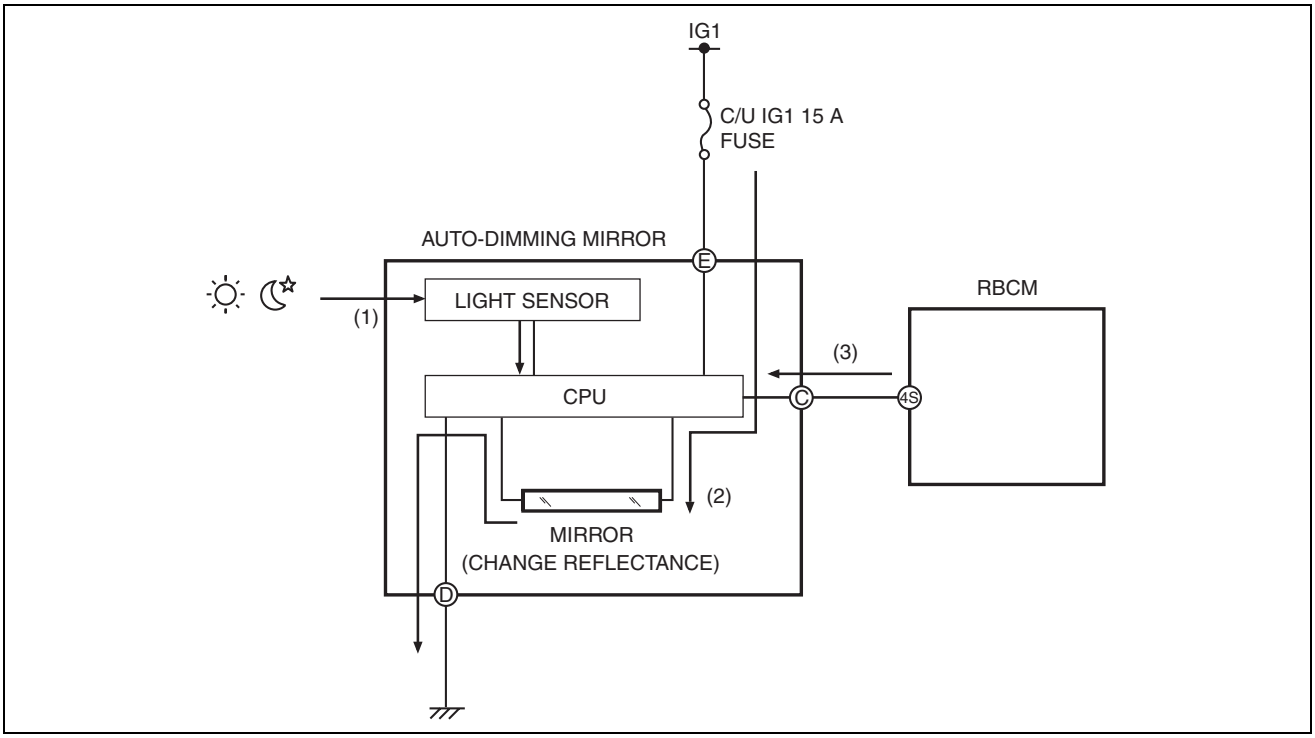
Function

- The automatic glare prevention rearview mirror detects the level of the surrounding light and glare from vehicles at the rear using the light sensor.
- The automatic glare prevention rearview mirror combines the level of the surrounding light and the glare from vehicles at the rear and changes the reflection rate of the mirror between 10% and 60%.
- When the automatic glare prevention rearview mirror receives a reverse signal from the rear body control module (RBCM), the reflection rate of the mirror is fixed at 60% or more.

GLASS/WINDOWS/MIRRORS

Operation

- When the automatic glare prevention rearview mirror switch is turned on, the mirror switches to automatic glare prevention mode.
- While in automatic glare prevention mode, the light sensor detects the level of surrounding light and the glare from vehicles at the rear. (1)
- The automatic glare prevention rearview mirror changes the voltage applied to the mirror according to the level of the surrounding light and the glare from vehicles at the rear. (2)
- The mirror changes the reflection rate between 10% and 60% according to the voltage that is applied.
- However, if it receives a reverse signal from the rear body control module (RBCM) (3), the reflection rate of the mirror is fixed at 60% or more.



ac5wzn00001245

Fail-safe

- Function not equipped.

09-13 SEATS

SEATS

SEAT

id091300009300

Outline

Front seat

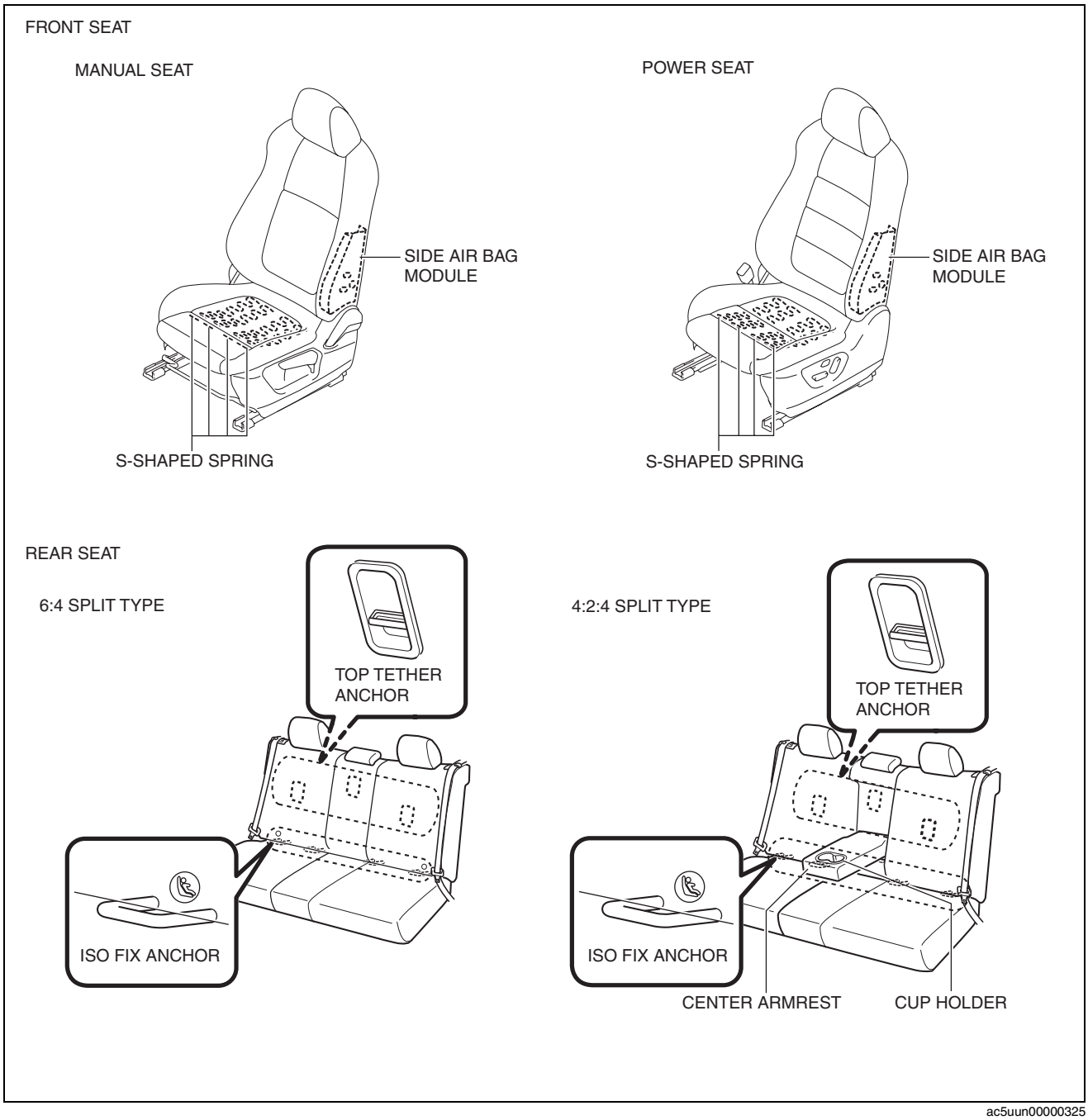
- A manual seat or power seat has been adopted on the driver's seat.
- A seat warmer system has been adopted on the front seats. (with seat warmer system)
- A manual seat has been adopted on the front passenger's seat.
- A side air bag module is built into the front seats.
- S-shaped springs have been adopted in the front seat cushions.

Rear seat

- 6:4 split type or 4:2:4 split type seats have been adopted on the rear seats.
- A center armrest has been adopted on the 4:2:4 split-type rear seat's center seat.
- Large-sized cup holders have been adopted on the center armrest.
- The following two types of child restraint seat anchors have been adopted which enable securing of ISO FIX-applicable child restraint seats on the rear seat.
  - — Top tether anchor
  - — ISO FIX anchor

SEATS

Structural view



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FRONT SEAT

id091300009000

Purpose, Function

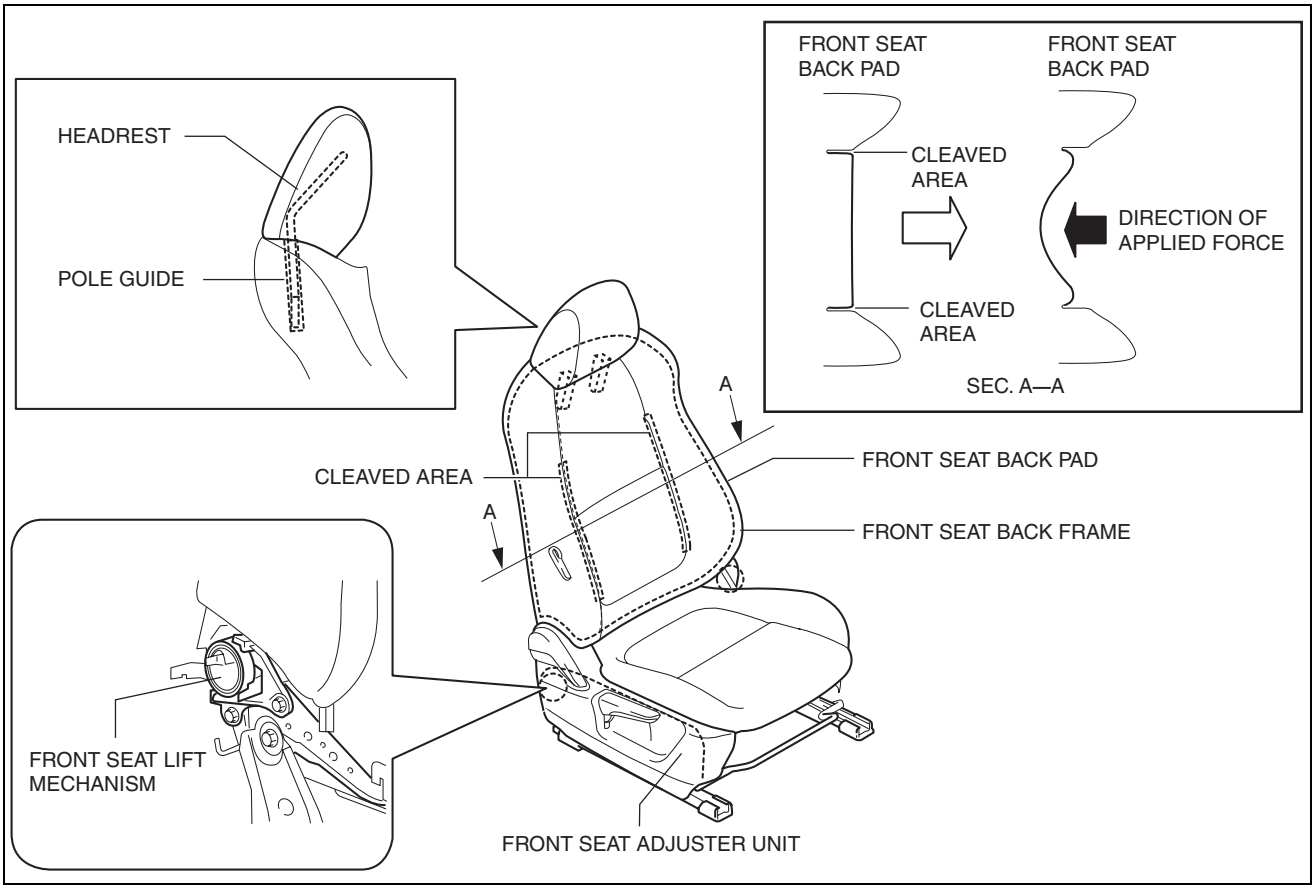
- The front seats are structured to reduce impact force applied to the head of the occupant in a vehicle collision.
- 8WAY power seats have been adopted on the driver's seat. (with power seat system) (See 09-13-8 POWER SEAT SYSTEM.)
- A seat warmer system has been adopted on the front seat backs and front seat cushion. (With seat warmer system) (See 09-13-13 SEAT WARMER SYSTEM.)

Construction

- The front seats reduce impact force applied to the head of the occupant in a vehicle collision by improving the rigidity of the pole guides and setting the headrest so that it tilts to the vehicle front.
- The front seat adjuster unit has improved rigidity by locating the front seat lift mechanism to the area around the connection part on both sides of the front seat back and the front seat cushion, and the backward lean of the front seat back when the occupant's body is pushed backward in a vehicle collision is controlled.

SEATS

- If the occupant's body is pushed backward in a vehicle collision, the front seat back pad separates from the cleaved area and only the center part of the pad is pressed in rearward.



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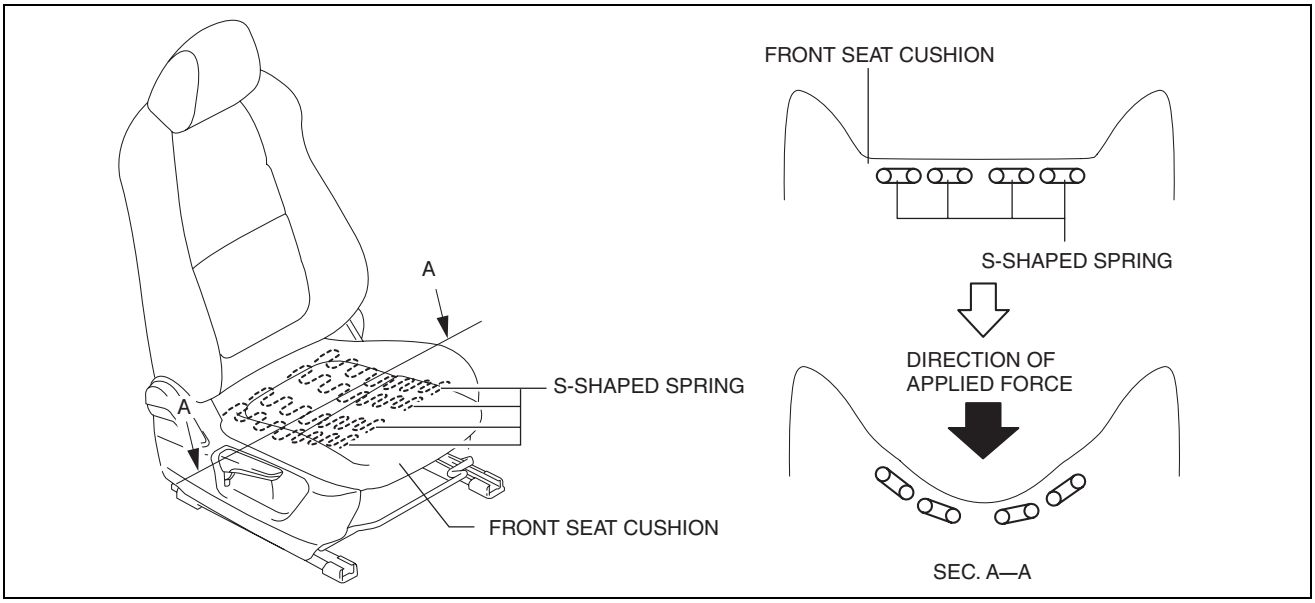
- The front seat cushion is built into the S-shaped springs to absorb the impact when the occupant's body is pushed backward.



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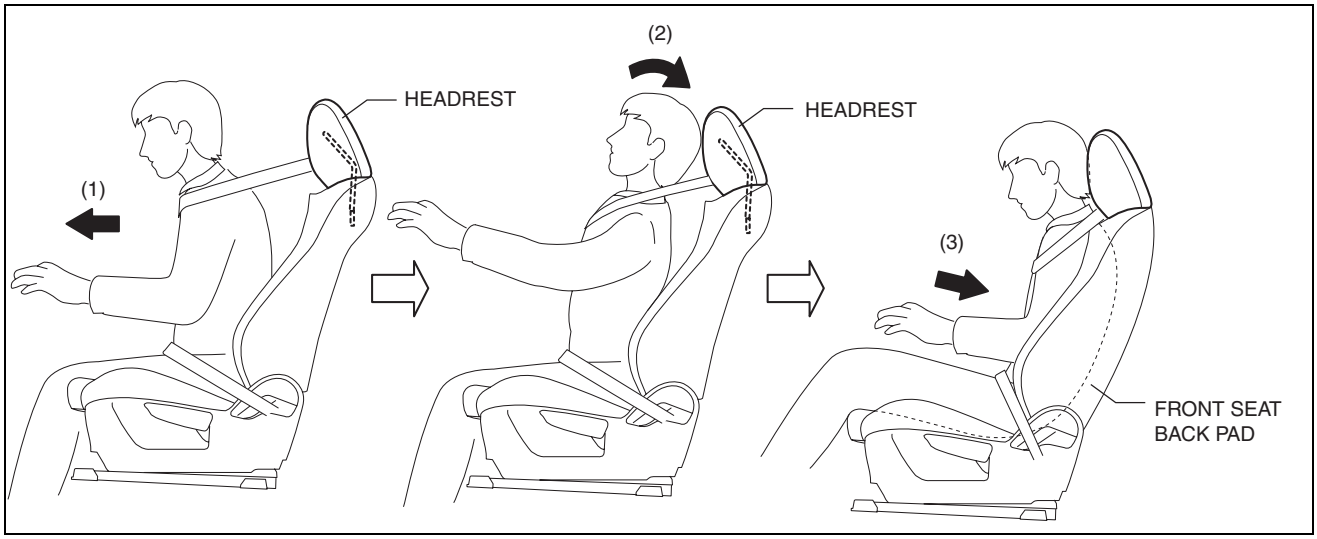
Operation
Operation (deployment) during a collision

1. During a collision, the occupant moves to the vehicle front, is restrained, and the head and body of the occupant are returned back to the front seat side in reaction to that.
2. When the head and body of the occupant are returned back, the front seat absorbs the return of the head by the headrest and pole guides to reduce impact force applied to the head of the occupant.

SEATS

3. When the body of the occupant is returned back to the front seat back after absorbing the return of the head by the head restraint and pole guides, the front seat back pad separates from the cleaved area and only the center part of the pad is pressed in rearward.



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Fail-safe
- Function not equipped.

REAR SEAT

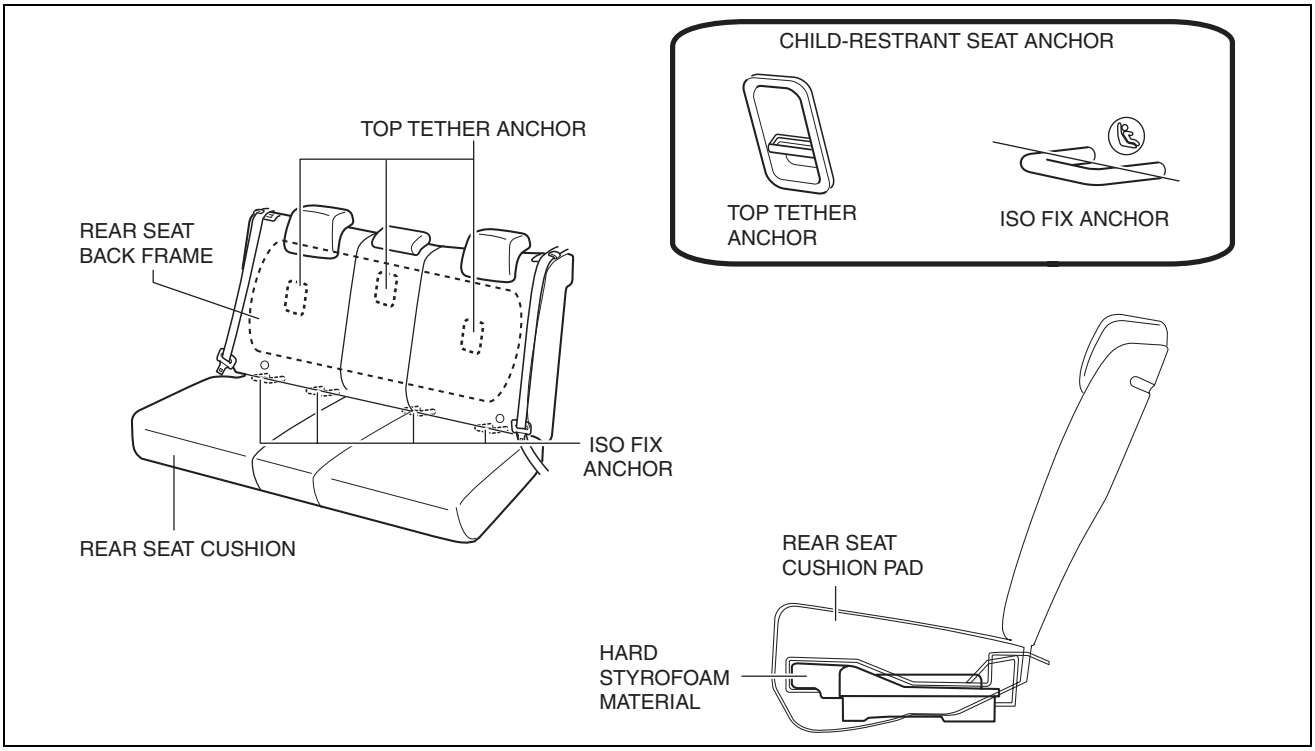
id091300101100

Purpose, Function
- The following two types of rear seats have been adopted.
  — 6:4 split-type seat
  — 4:2:4 split-type seat
- The following functions have been adopted for the rear seat to protect passengers during a collision or emergency braking.
  — Prevention of passenger from slipping off rear seat cushion
  — Prevention of trunk compartment cargo from forward intrusion
- A top tether anchor and ISO FIX anchor have been adopted to enable securing of child-restraint seats on the rear seat.
- Full fold-down rear seat back has been adopted which enlarges occupancy space using a one-touch operation.

Construction
6:4 split-type seat
- Hard styrofoam material is built into the front of the rear seat cushion pad.
- The seating surface made of hard styrofoam material on the rear seat cushion is held by indenting the position which contacts the buttock of the occupant to prevent the lower body of the occupant from slipping off during a collision or emergency braking.

SEATS

- The child-restraint seat anchors include a top tether anchor and ISO FIX anchor to secure the child-restraint seats and prevent them from deviating or falling off the rear seat.



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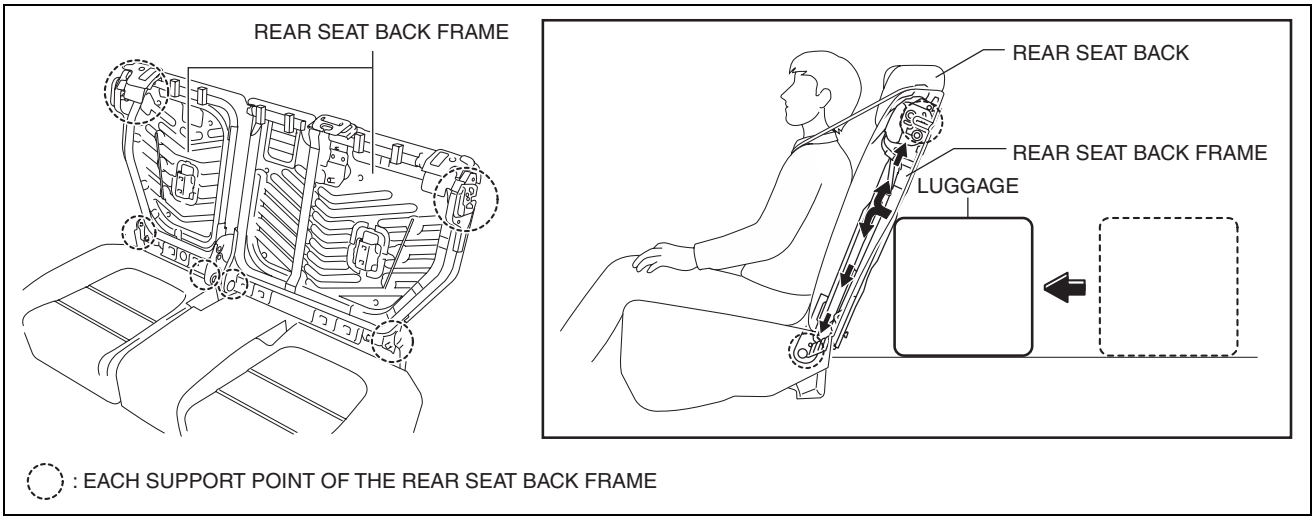
- During a collision, a moving load is stopped by the reinforced rear seat back frame and each support point to prevent the rear seat back from collapsing forward and the luggage intruding into the cabin.



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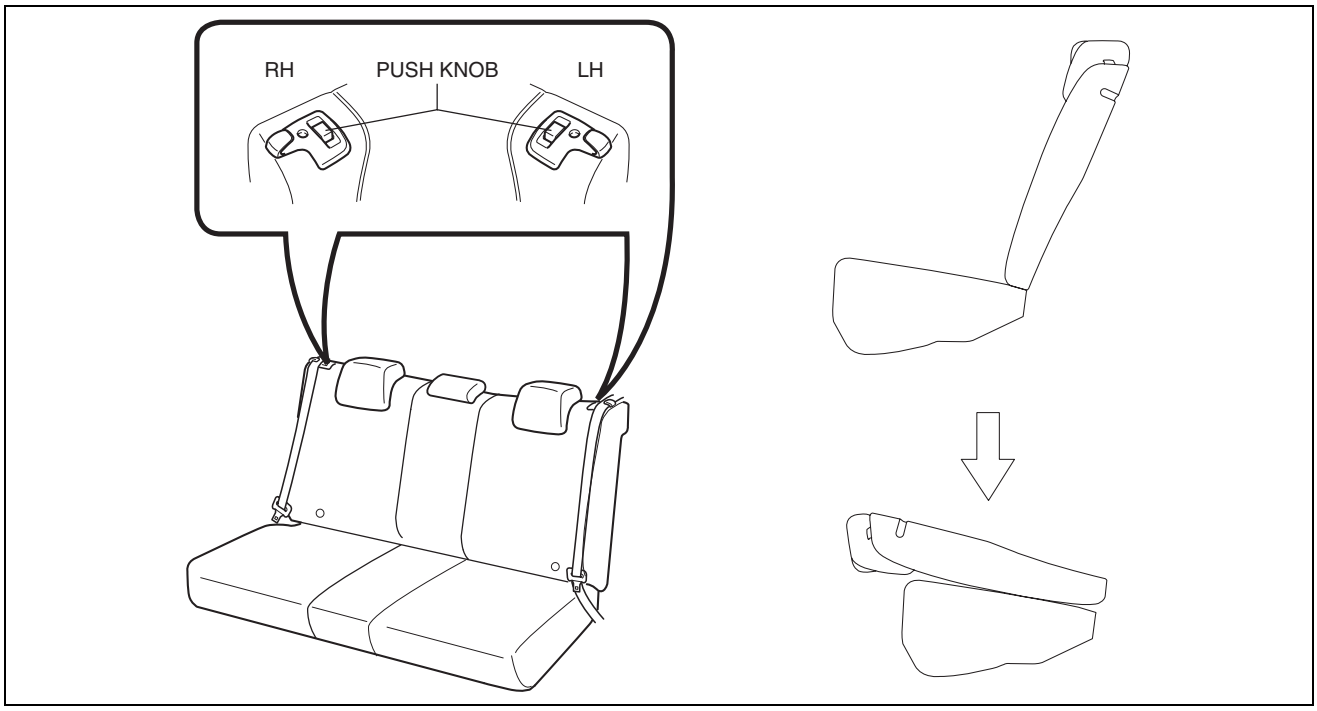
SEATS

- The easy fold-down seats can be folded down by pressing the push knobs to enlarge the cargo space.



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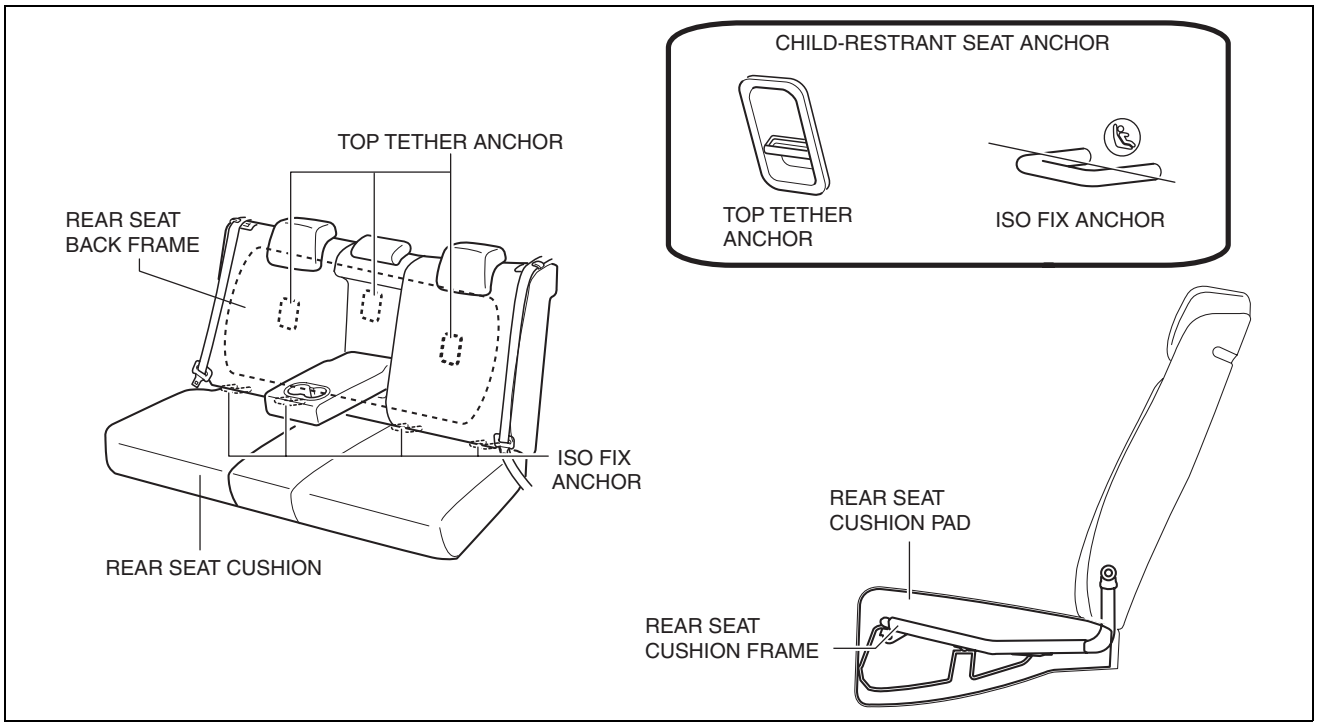
4:2:4 split-type seat

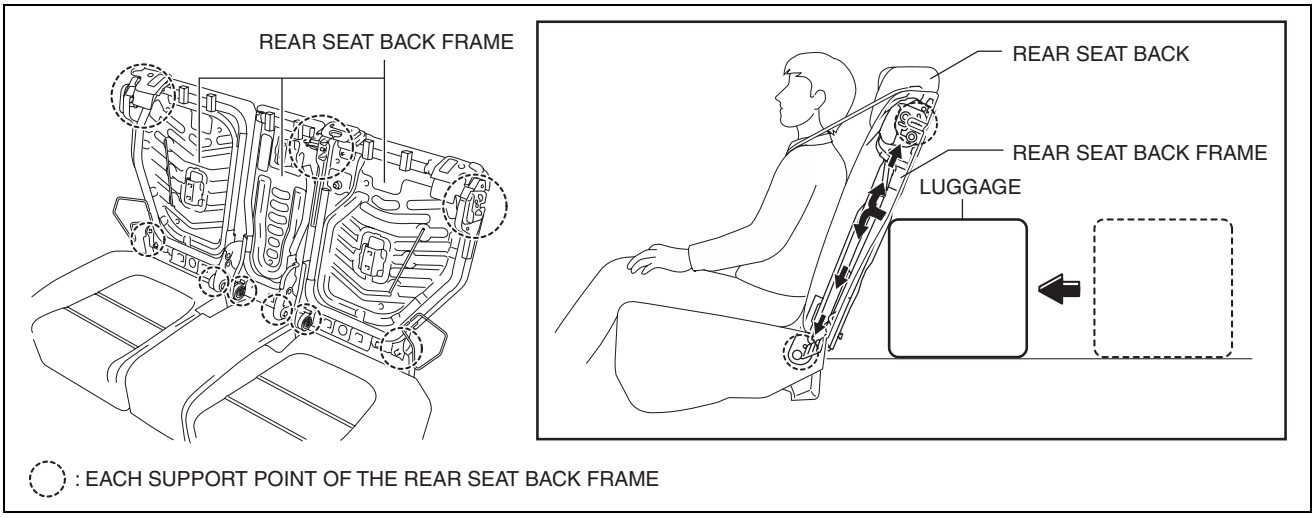
- By titling the front of the rear seat cushion frame upward and indenting the seating surface of the rear seat cushion, the lower body of the occupant is prevented from slipping off during a collision or emergency braking.
- The child-restraint seat anchors include a top tether anchor and ISO FIX anchor to secure the child-restrain seats and prevent them from deviating or falling off the rear seat.



ac5wzn00001891

SEATS

- During a collision, a moving load is stopped by the reinforced rear seat back frame and each support point to prevent the rear seat back from collapsing forward and the luggage intruding into the cabin.



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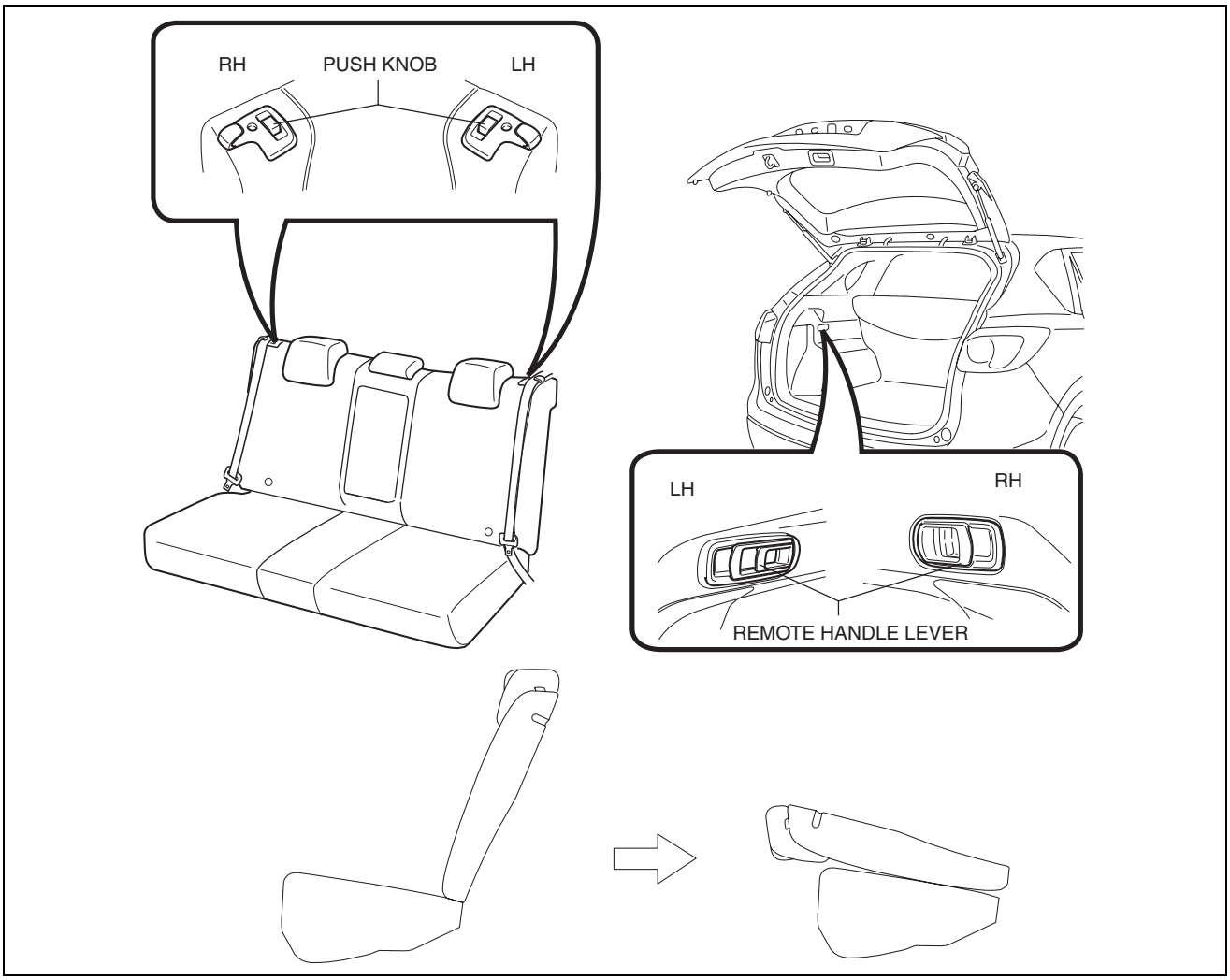
- The easy fold-down seats can be folded down by pressing the push knobs or operating the remote handle lever to enlarge the cargo space.



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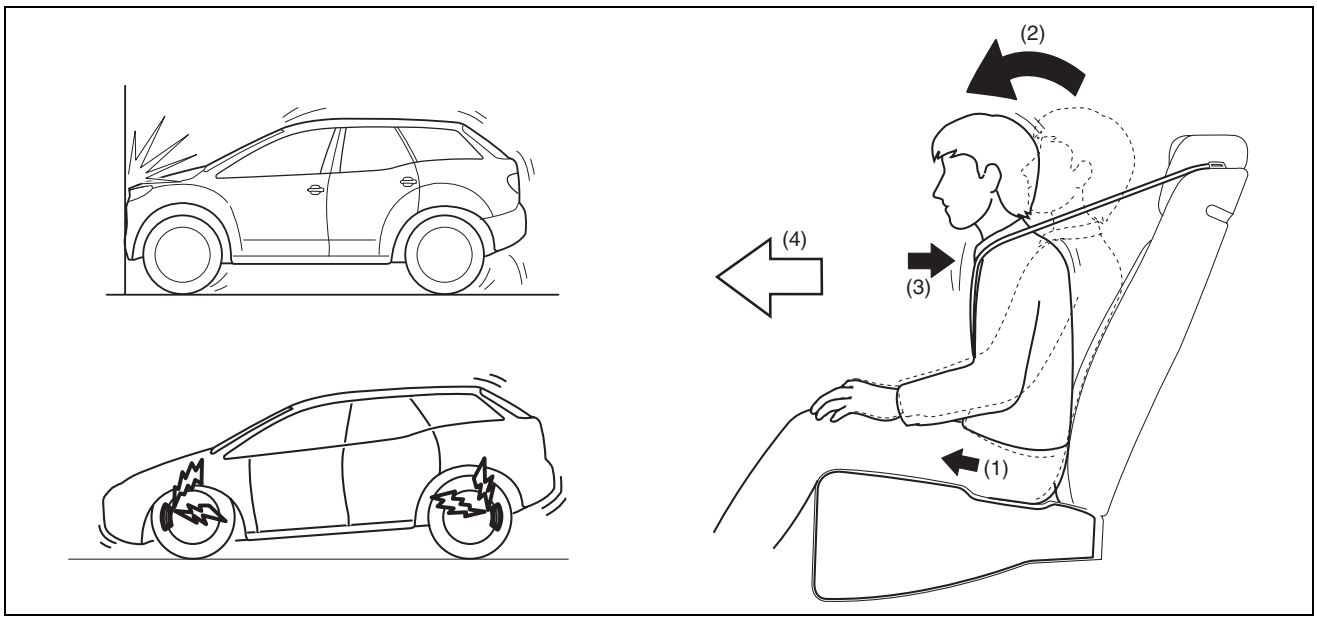
Operation

- When impact force is applied to the occupant during a collision or emergency braking, the force (1) causing the lower body of the occupant to slip is reduced by the dent in the rear seat cushion.

SEATS

- A force that causes the lower body of the occupant to slip and a force (2) that throws the upper body of the occupant occurring at the same time are suppressed (3) by the rear seat belt to prevent the occupant from being thrown (4) to the vehicle front.



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Fail-safe
- Function not equipped.

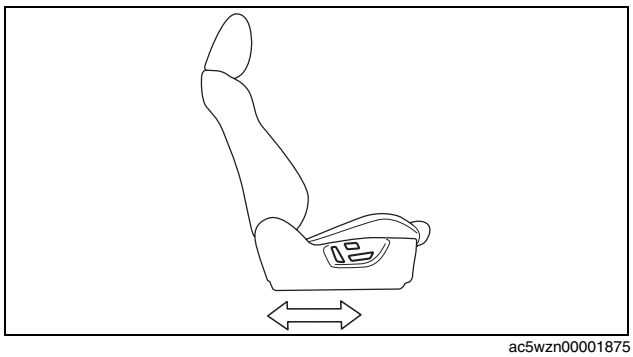
POWER SEAT SYSTEM

id091300262000

Outline
- The power seat system drives the electric motor, operates the front seat safely, and changes the driving posture to suit the occupant by operating the power seat switch.
- 8WAY power seats have been adopted on the driver's seat.

Structural View
- The 8WAY power seats are equipped with the following functions:
  - Slide mechanism
  - Recliner mechanism
  - Lift mechanism
  - Front tilt mechanism
  - Lumbar support mechanism

Slide mechanism
- The sliding function adjusts the front and back positions of the front seat.



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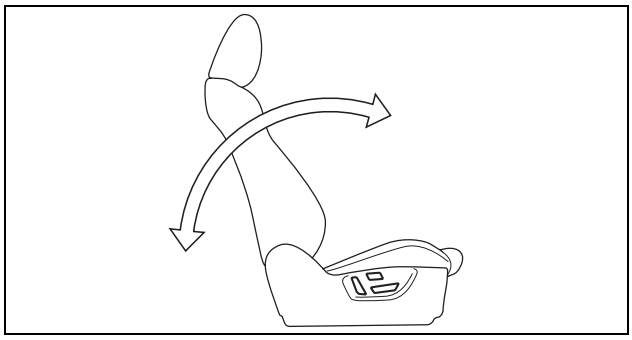
SEATS

Recliner mechanism

- The recliner function adjusts the angle of the front seat back.



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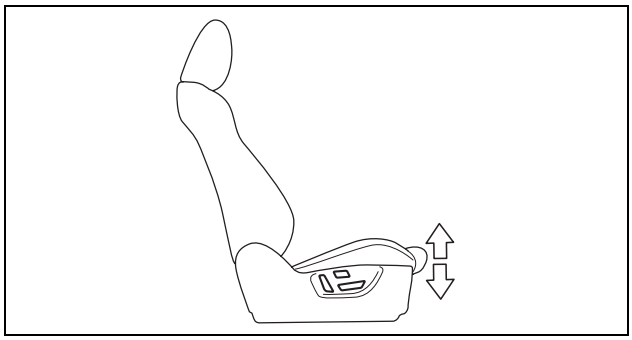
Front tilt mechanism

- The front tilt function adjusts the height of the front part of the front seat cushion.



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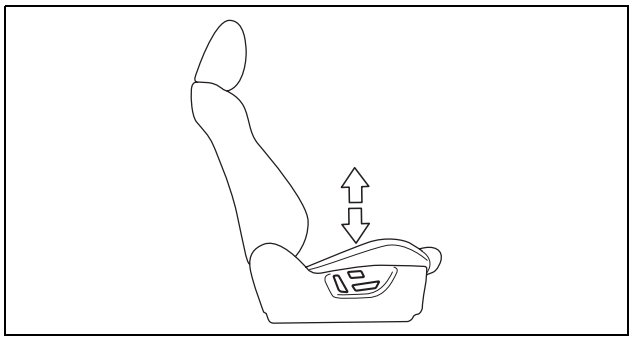
Lift mechanism

- The lift function adjusts the height of the front seat.



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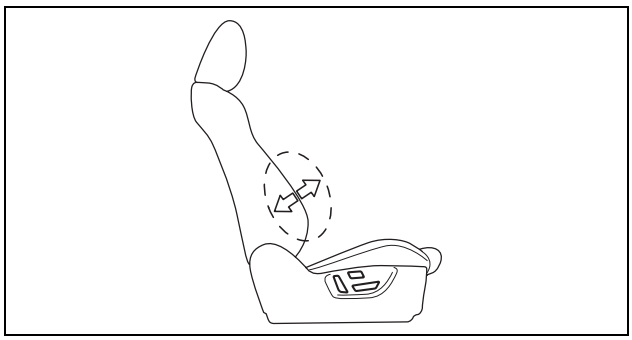
Lumbar support mechanism

- The lumbar support function adjusts the bulge amount of the abdominal area of the front seat back.



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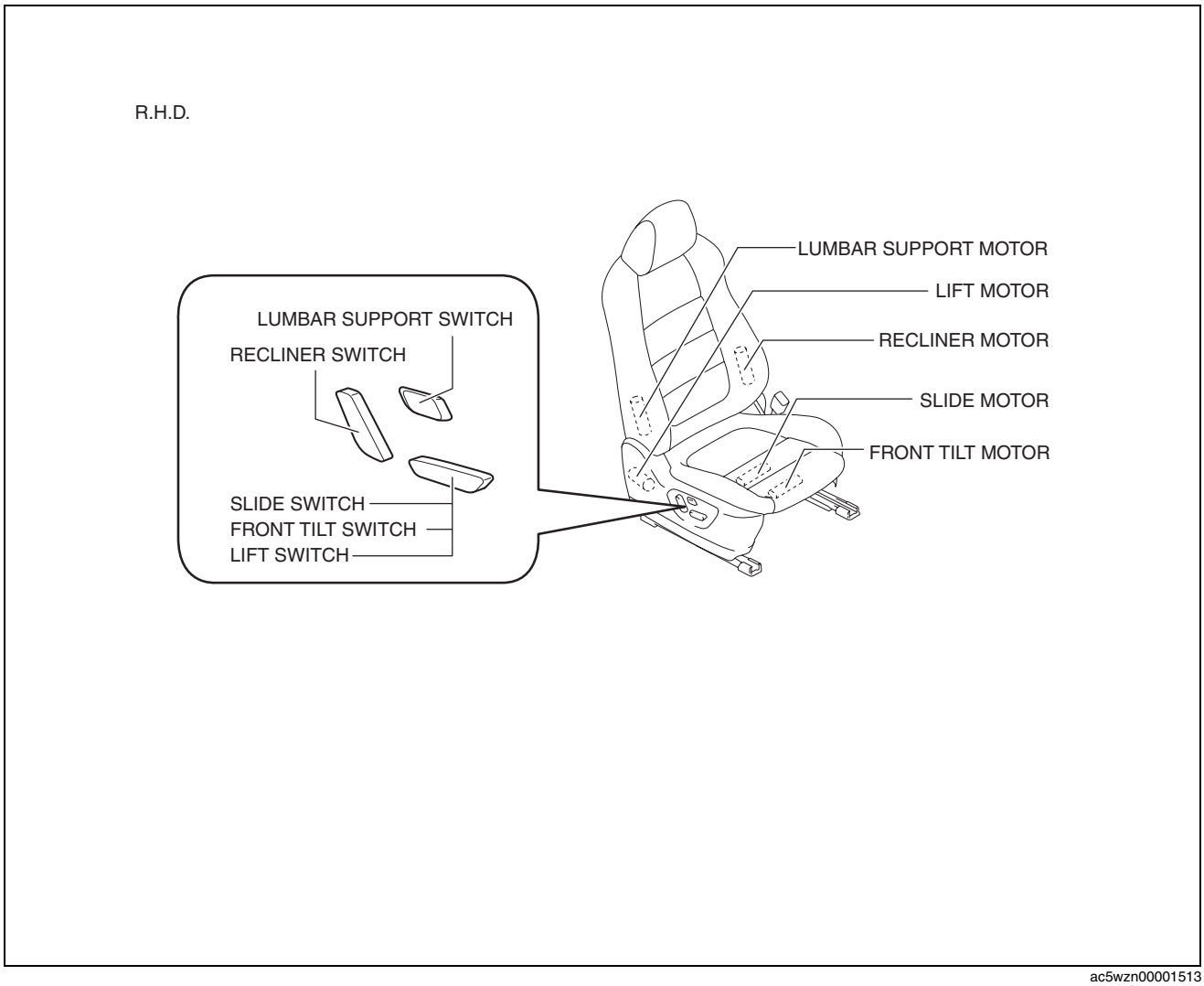
SEATS

Structural view



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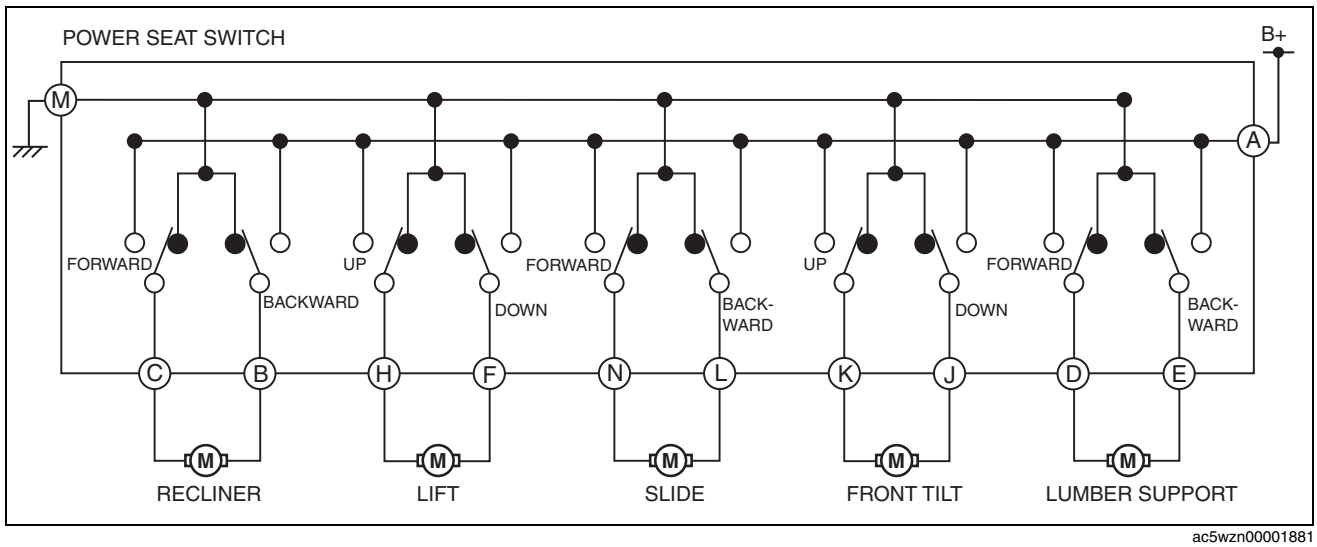
System Diagram

R.H.D.



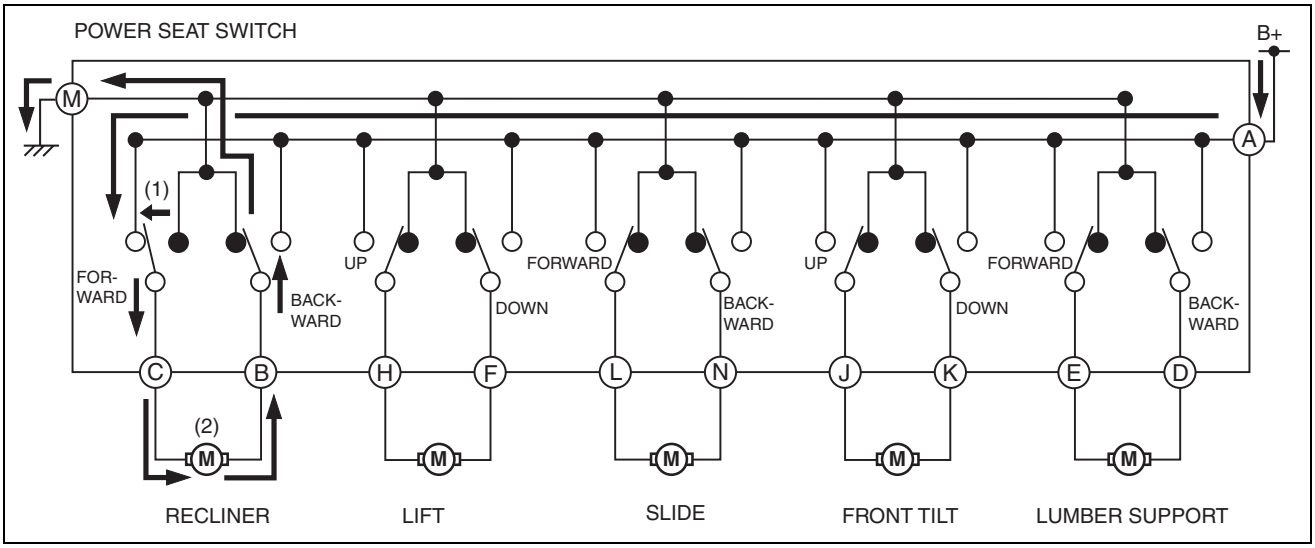
ac5wzn00001881

SEATS

Operation

Recliner operation (example: L.H.D. forward recline operation)

1. When the recliner switch is operated (1) forward, current from the battery flows (2) to the recliner motor.
2. When current flows to the recliner motor for forward motion, the motor drives to tilt the front seat back forward.

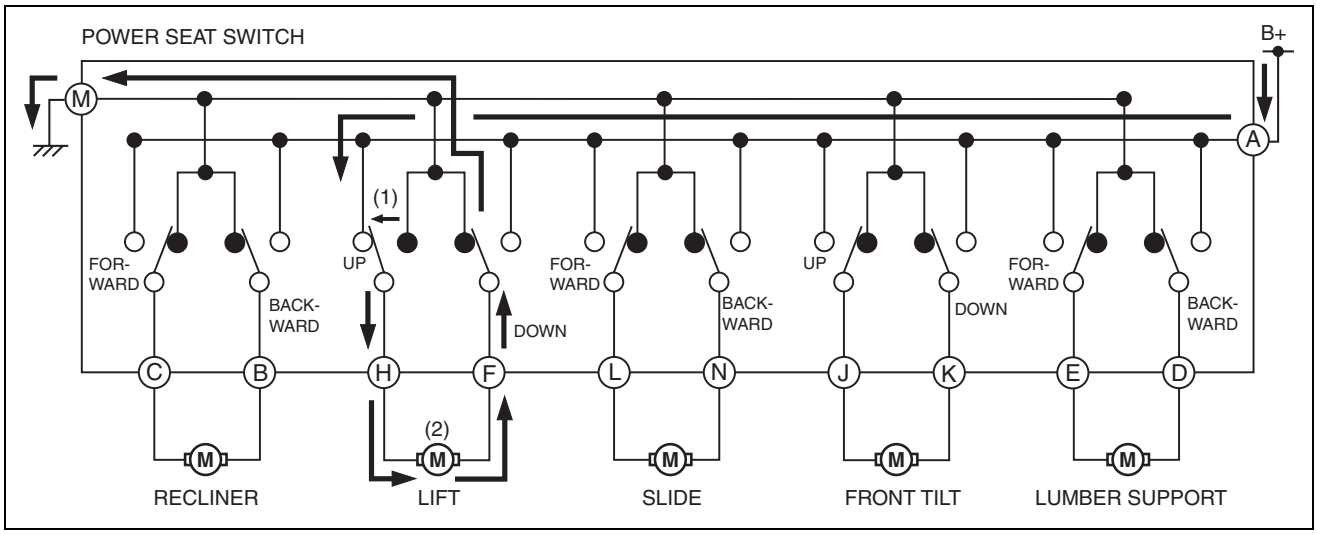


ac5wzn00001882

Lift operation (example: L.H.D. lift up operation)

1. When the lift switch is operated (1) in the lift-up direction, current from the battery flows (2) to the lift motor.
2. When current flows to the lift motor for lift-up motion, the motor drives to set the position of the front seat higher.

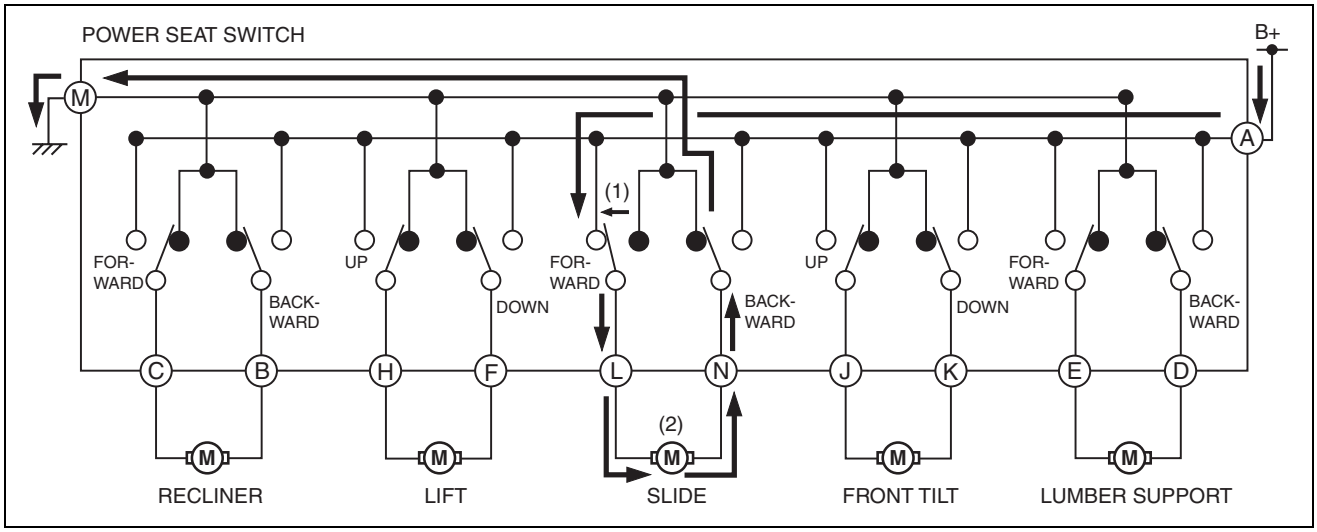
SEATS



ac5wzn00001883

Slide operation (example: L.H.D. forward slide operation)

1. When the sliding switch is operated (1) forward, current from the battery flows (2) to the sliding motor.
2. When current flows to the sliding motor for forward motion, the motor drives to slide the front seat forward.



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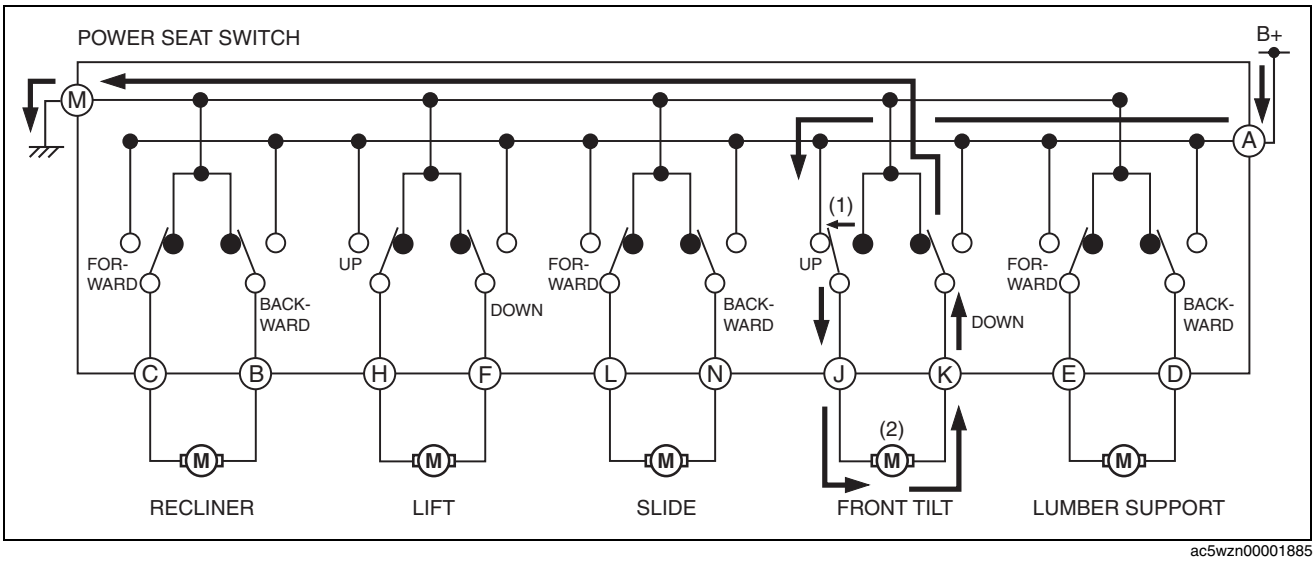
Front tilt operation (example: L.H.D. tilt up operation)

1. When the front tilt switch is operated (1) in the tilt-up direction, current from the battery flows (2) to the front tilt motor.
2. When current flows to the front tilt motor for tilt-up motion, the motor drives to set the position of the front part of the front seat cushion higher.

SEATS



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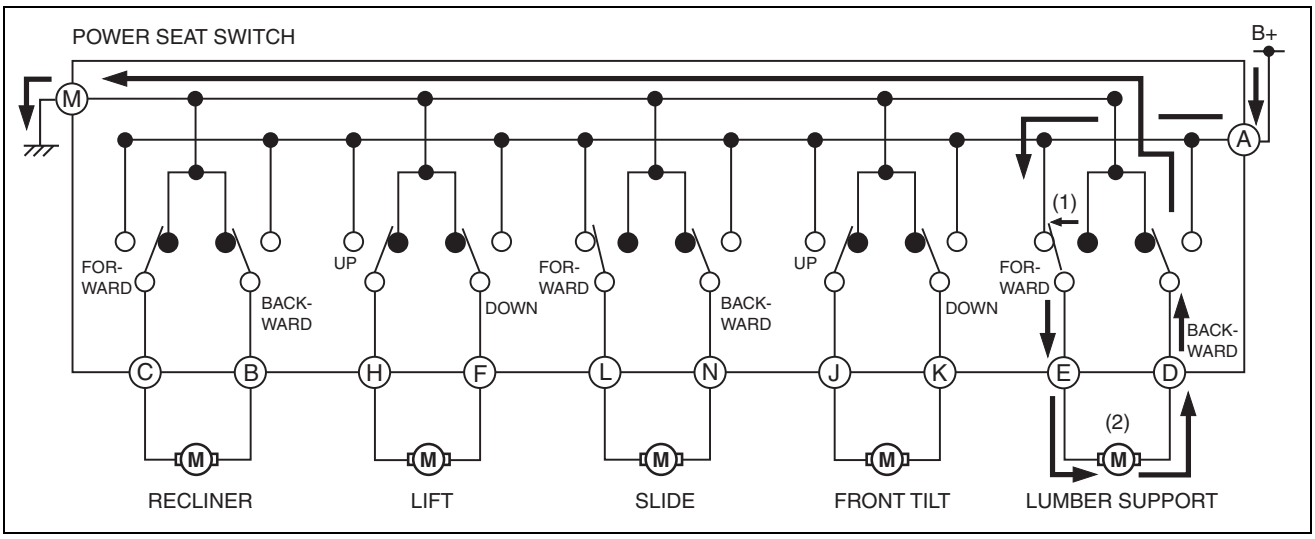
Lumber support operation (example: L.H.D. forward operation)

1. When the lumbar support switch is operated (1) forward, current from the battery flows (2) to the lumbar support motor.
2. When current flows to the lumbar support motor for forward motion, the motor drives to set the bulge amount of the abdominal area of the front seat back.



ac5wzn00001886

Fail-safe

- Function not equipped.

SEAT WARMER SYSTEM

id091300101200

Purpose

- The seat warmer system warms the front seat cushion and front seat back using the seat warmer unit.

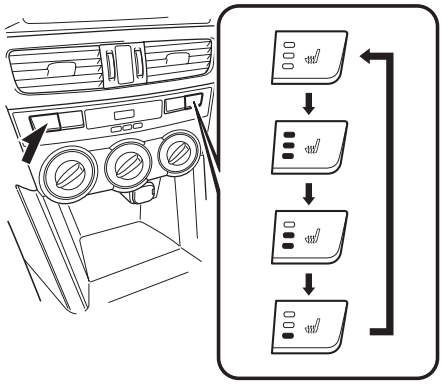
Function

- The seat warmer unit warms the seat cushion and seat back by supplying power to the built-in filaments.
- The seat warmer unit can adjust the temperature between 3 levels.

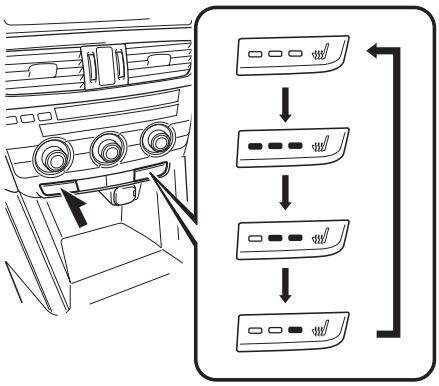
SEATS

- The temperature level of the seat warmer unit changes each time the seat warmer switch is pressed.

WITH MANUAL AIR CONDITIONER SYSTEM



WITH FULL-AUTO AIR CONDITIONER SYSTEM



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- The seat warmer control unit supplies power to the seat warmer unit and increases the temperature around the seat back and seat cushion up to the average temperature which is applied to the temperature level.

Switch display		Temperature level	Average temperature around seat warmer unit	
With manual air conditioner system	With full-auto air conditioner system		Seat cushion side	Seat back side
		0	—	
		1	**Approx. 37°C**	
		2	**Approx. 40°C**	**Approx. 42°C**
		3	**Approx. 42°C**	**Approx. 47°C**

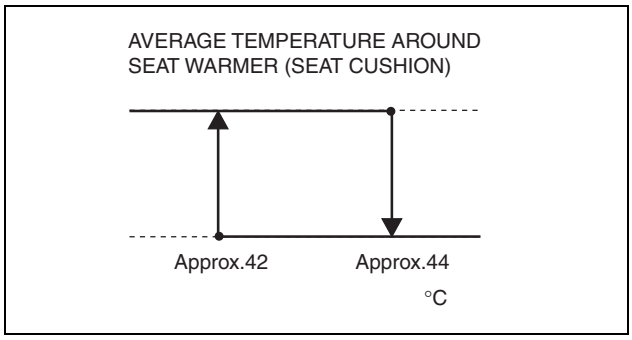
- The seat warmer control unit detects the average temperature around the seat warmer unit (seat cushion side) based on a signal from thermostat (seat cushion side) to prevent overheating, cuts off the power supply to the seat warmer unit when the temperature reaches the specification, and decreases the average temperature below the specified temperature.
- When the seat warmer control unit detects that the average temperature around the seat warmer unit (seat cushion side) decreases below the specified temperature based on a signal from the thermostat, power is supplied to the seat warmer unit again to increase the temperature up to the specified temperature.

Temperature level	Average temperature around seat warmer unit (seat cushion side)			
	Rag type		Leather type	
	Increase start temperature	Decrease start temperature	Increase start temperature	Decrease start temperature
0	—			
1	**Approx.23°C**	**Approx.25°C**	**Approx.23°C**	**Approx.25°C**
2	**Approx.23°C**	**Approx. 34°C**	**Approx.30°C**	**Approx.32°C**
3	**Approx. 42°C**	**Approx.44°C**	**Approx.38°C**	**Approx.40°C**

- The seat warmer control unit maintains a constant average temperature around the seat warmer unit by continuing to supply power to the seat warmer unit.

SEATS

Ex.) Cloth-type temperature level is 3:



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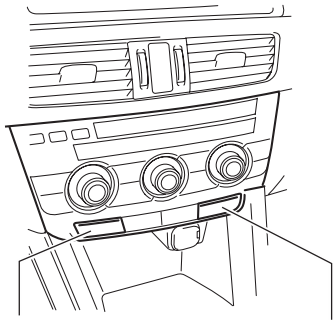
Structural view

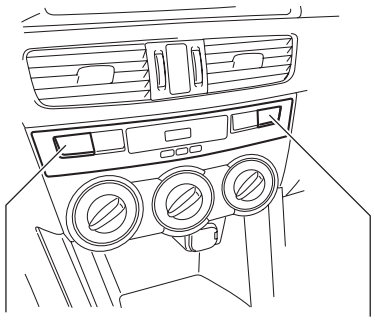
- The seat warmer switch is built into the climate control unit.
- The seat warmer unit is adhered to the front seat cushion and front seat back.
- The seat warmer control unit is located on the bottom of the passenger-side front seat.

WITH FULL-AUTO AIR CONDITIONER SYSTEM

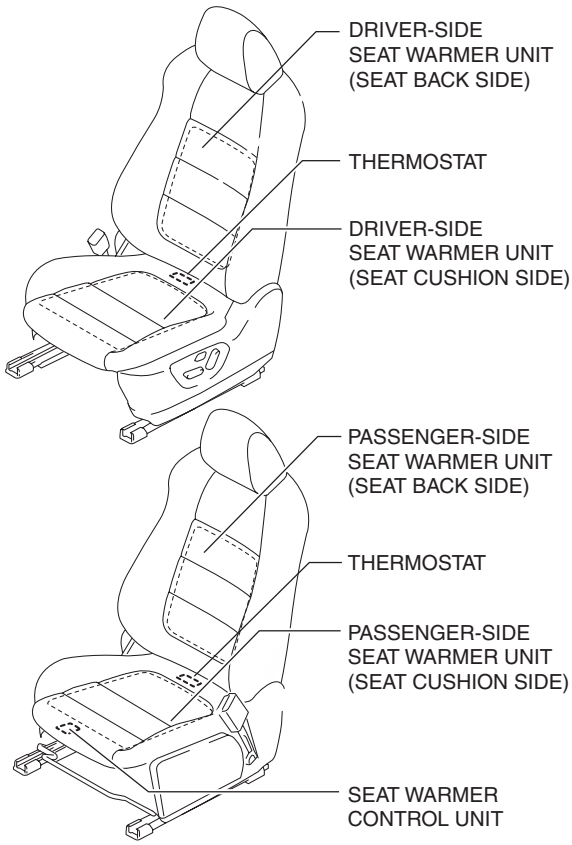


SEAT WARMER SWITCH (LH) SEAT WARMER SWITCH (RH)

WITH MANUAL AIR CONDITIONER SYSTEM



SEAT WARMER SWITCH (LH) SEAT WARMER SWITCH (RH)



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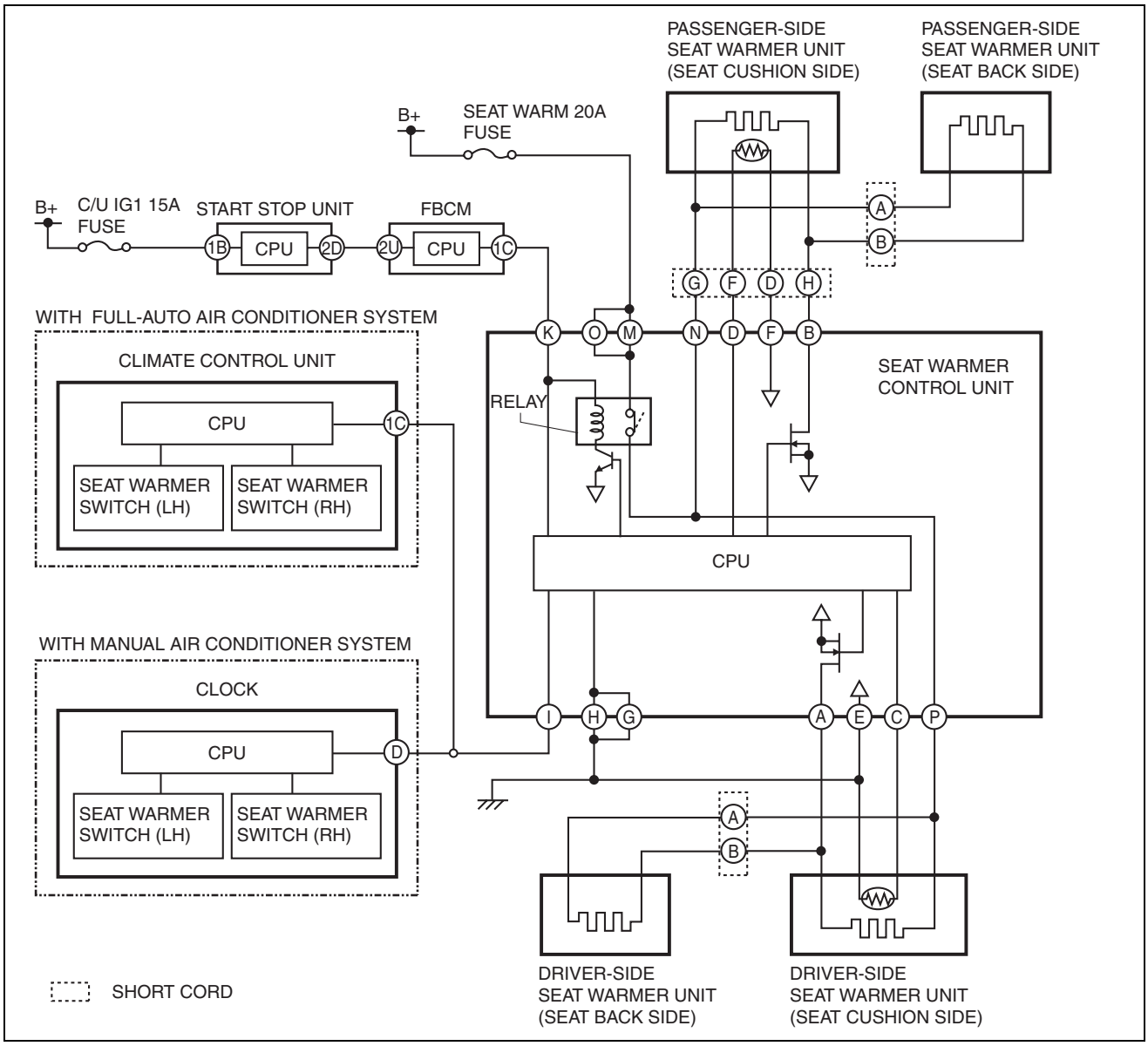
SEATS

System wiring diagram



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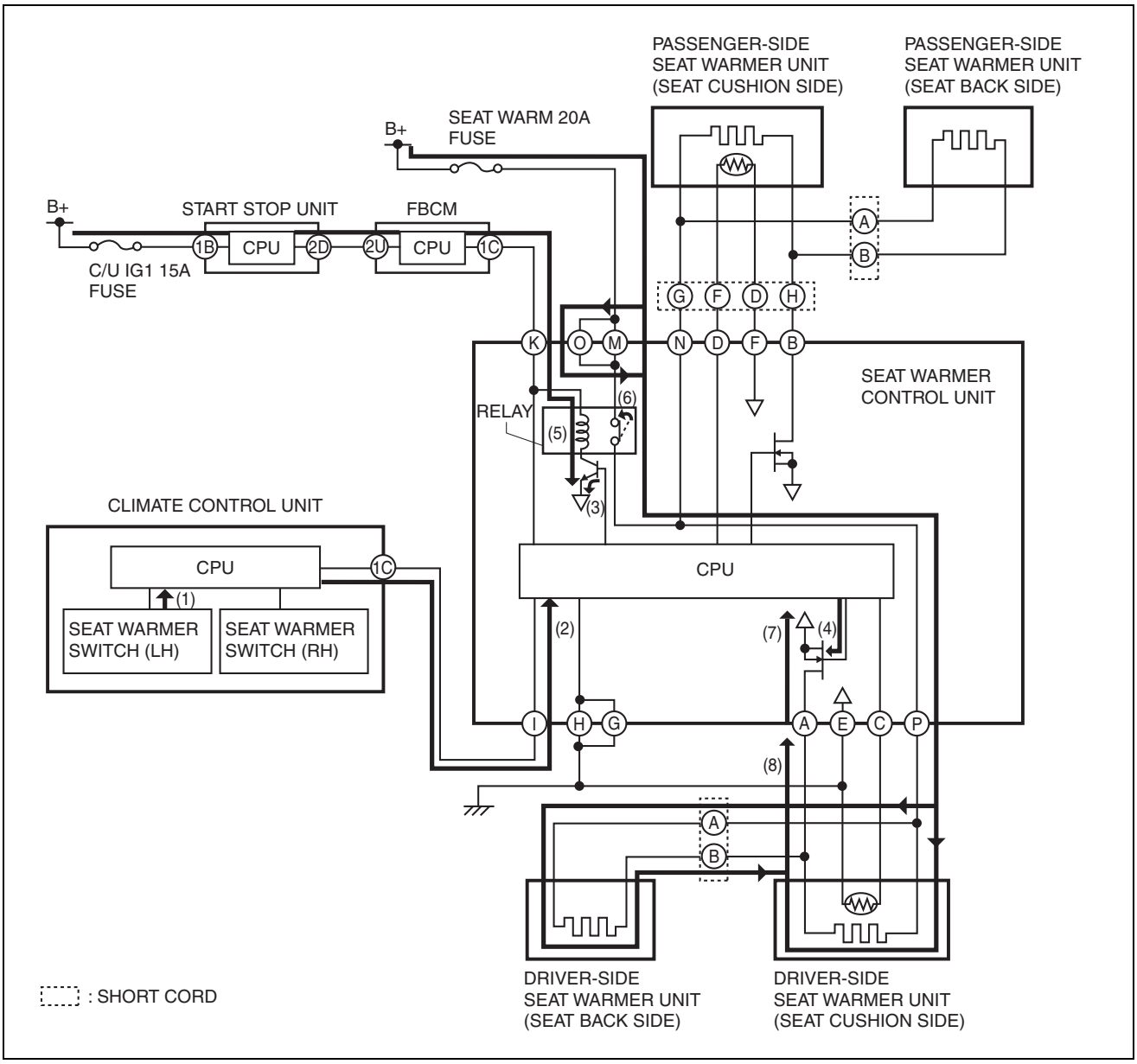
Operation

Ex.) Seat warmer temperature level on cloth-type driver's side is set at 3 (with full-auto air conditioner system):

1. The climate control unit determines (1) the average increase temperature of the seat warmer unit by operating the seat warmer switch (driver-side).
2. The climate control unit sends (2) the temperature level "3" signal for the seat warmer unit to the CPU of the seat warmer control unit.
3. When the CPU of the seat warmer control unit receives the operation level "3" signal from the climate control unit, it supplies the base current to the transistor built into the seat warmer control unit (3), and the gate voltage is applied to the FET simultaneously (4).
4. If the base current is supplied, the transistor supplies collector current to the relay coil (5).
5. If collector current is supplied, the relay coil energizes and turns on the relay switch (6).
6. When the gate voltage is applied, the FET completes the circuit between seat warmer control unit terminal A and ground (7).
7. When the relay switch built into the seat warmer control unit turns on and the FET circuit is completed, the driver-side seat warmer unit circuit is completed (8) and the driver-side front seat cushion and front seat back warm.

- When the climate control unit detects that the temperature around the seat reaches **approx. 44°C**, the power supply is cut off.

SEATS



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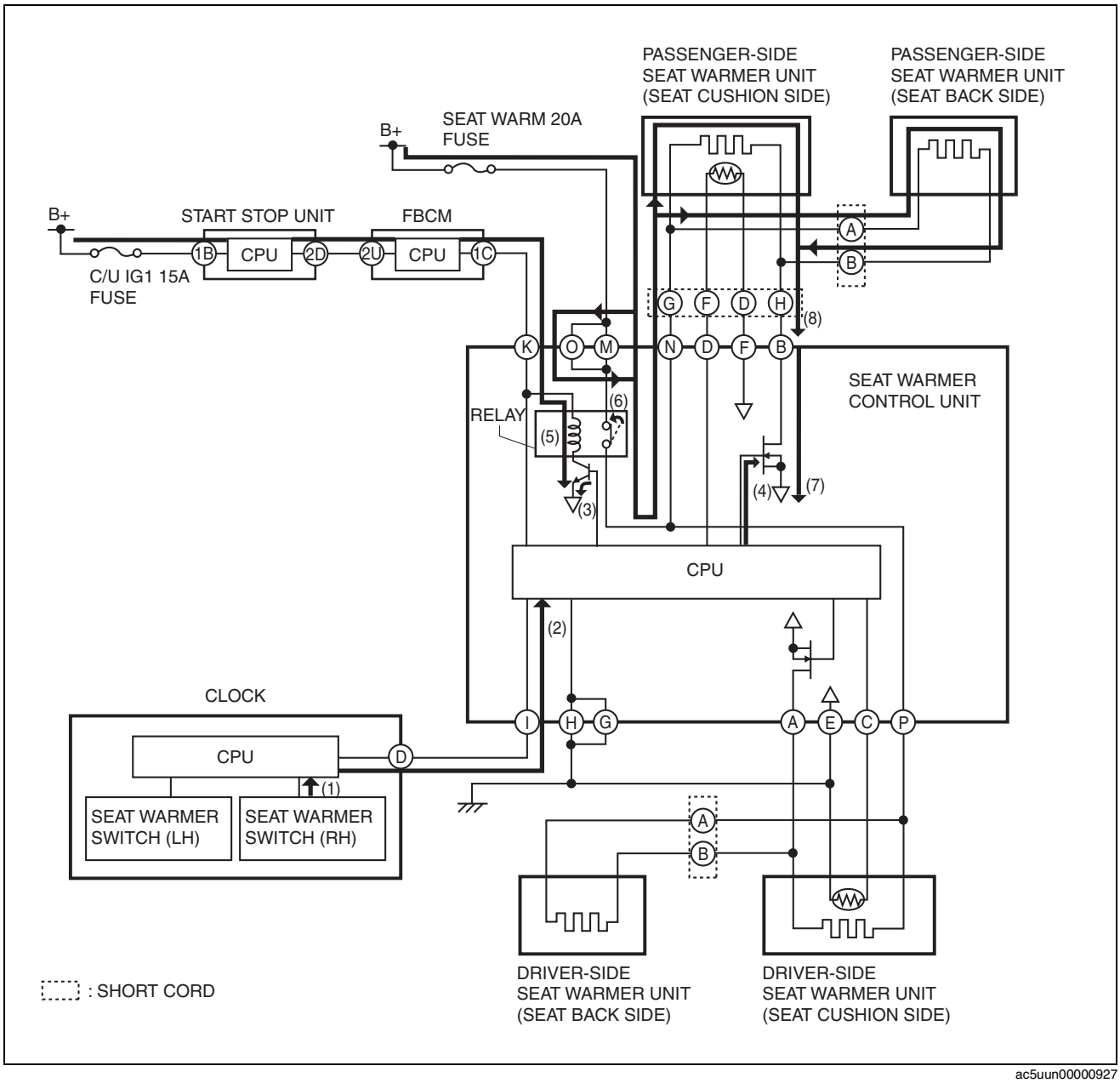
Ex.) Seat warmer temperature level on cloth-type passenger-side is set at 3 (with manual air conditioner system):

1. The climate control unit determines (1) the average increase temperature of the seat warmer unit by operating the seat warmer switch (passenger-side).
2. The climate control unit sends (2) the temperature level "3" signal for the seat warmer unit to the CPU of the seat warmer control unit.
3. When the CPU of the seat warmer control unit receives the operation level "3" signal from the climate control unit, it supplies the base current to the transistor built into the seat warmer control unit (3), and the gate voltage is applied to the FET simultaneously (4).
4. If the base current is supplied, the transistor supplies collector current to the relay coil (5).
5. If collector current is supplied, the relay coil energizes and turns on the relay switch (6).
6. When the gate voltage is applied, the FET completes the circuit between seat warmer control unit terminal B and ground (7).
7. When the relay switch built into the seat warmer control unit turns on and the FET circuit is completed, the driver-side seat warmer unit circuit is completed (8) and the driver-side front seat cushion and front seat back warms.

SEATS



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Fail-safe

- Function not equipped.

09-14 SECURITY AND LOCKS

SECURITY AND LOCKS

SECURITY AND LOCKS

SECURITY AND LOCKS

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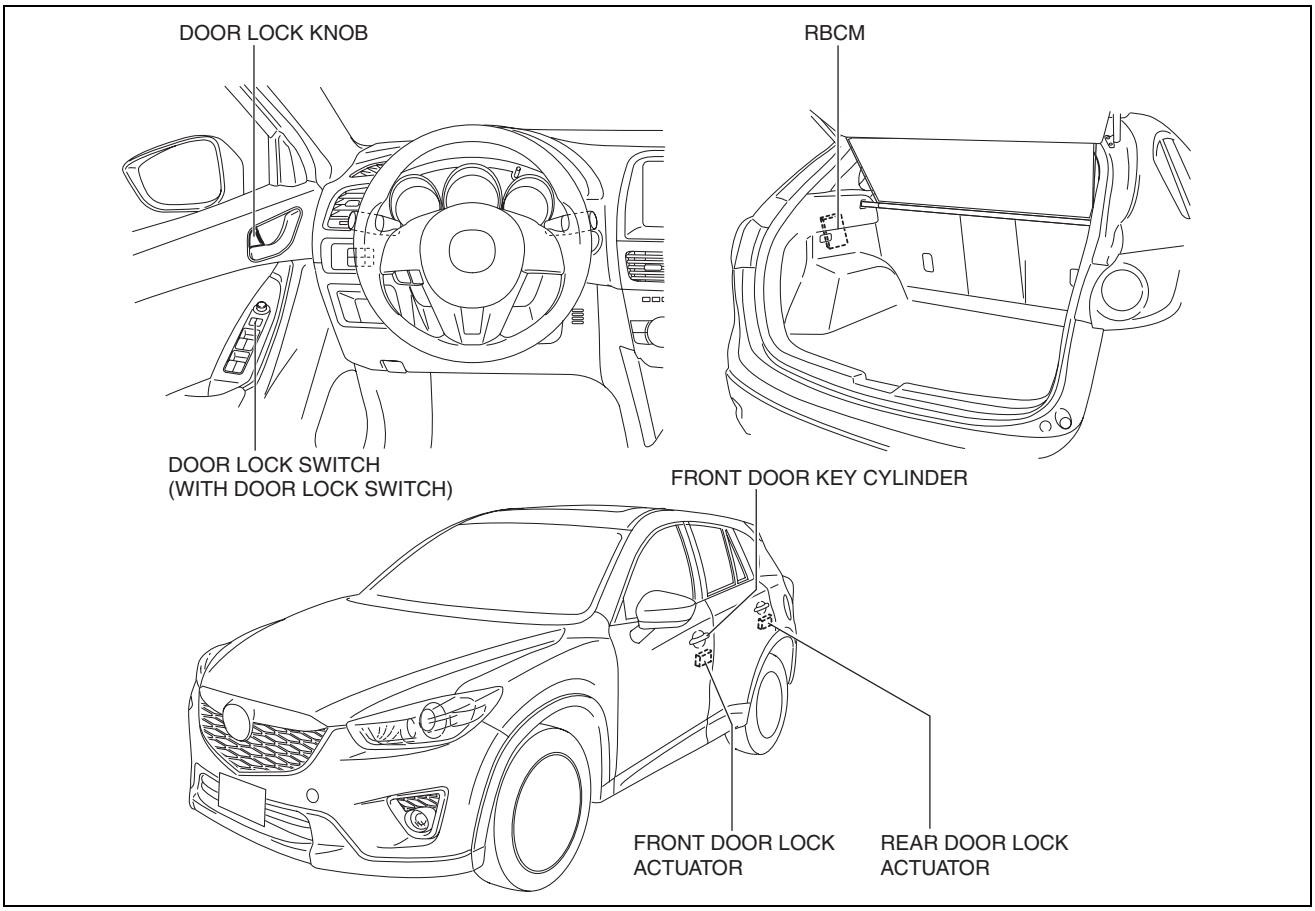
Outline

- Power door lock system adopted
- Liftgate opener system adopted
- Keyless entry system adopted
- Advanced keyless entry system adopted
- Push button start system adopted
- Immobilizer system adopted
- Theft-deterrent system adopted

Structural View

Power door lock system



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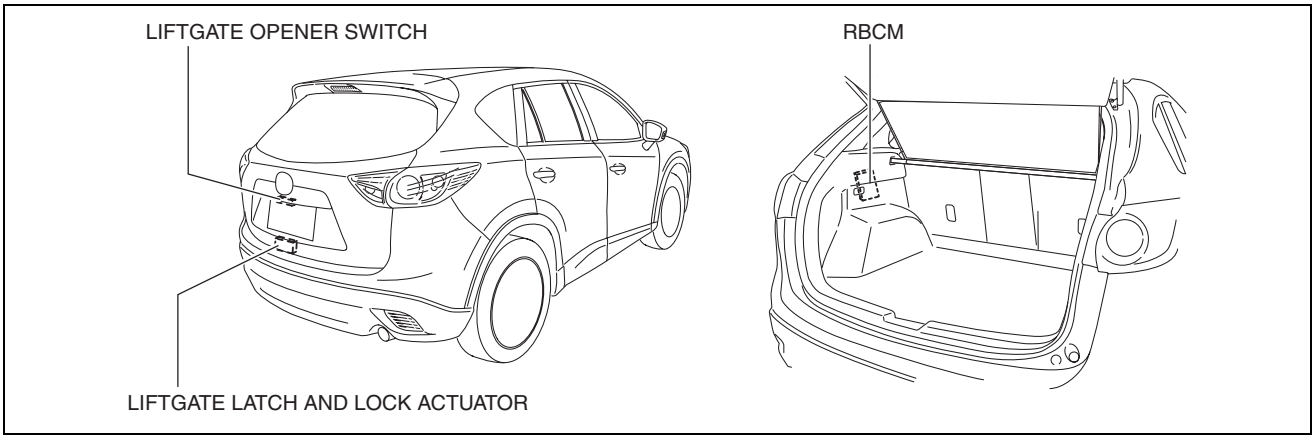
Liftgate opener system



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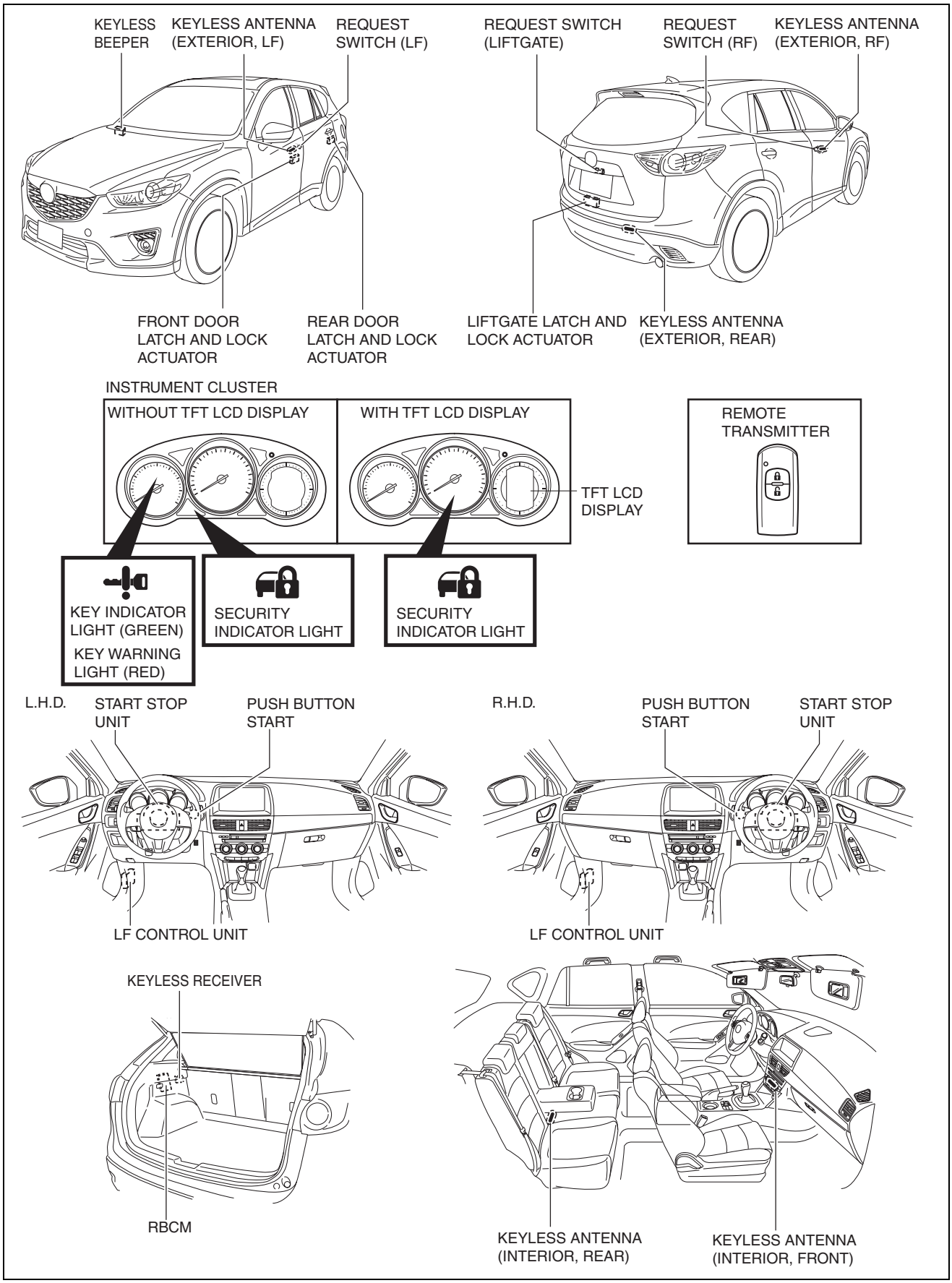
SECURITY AND LOCKS

Advanced keyless entry system / Push button start system / Immobilizer system



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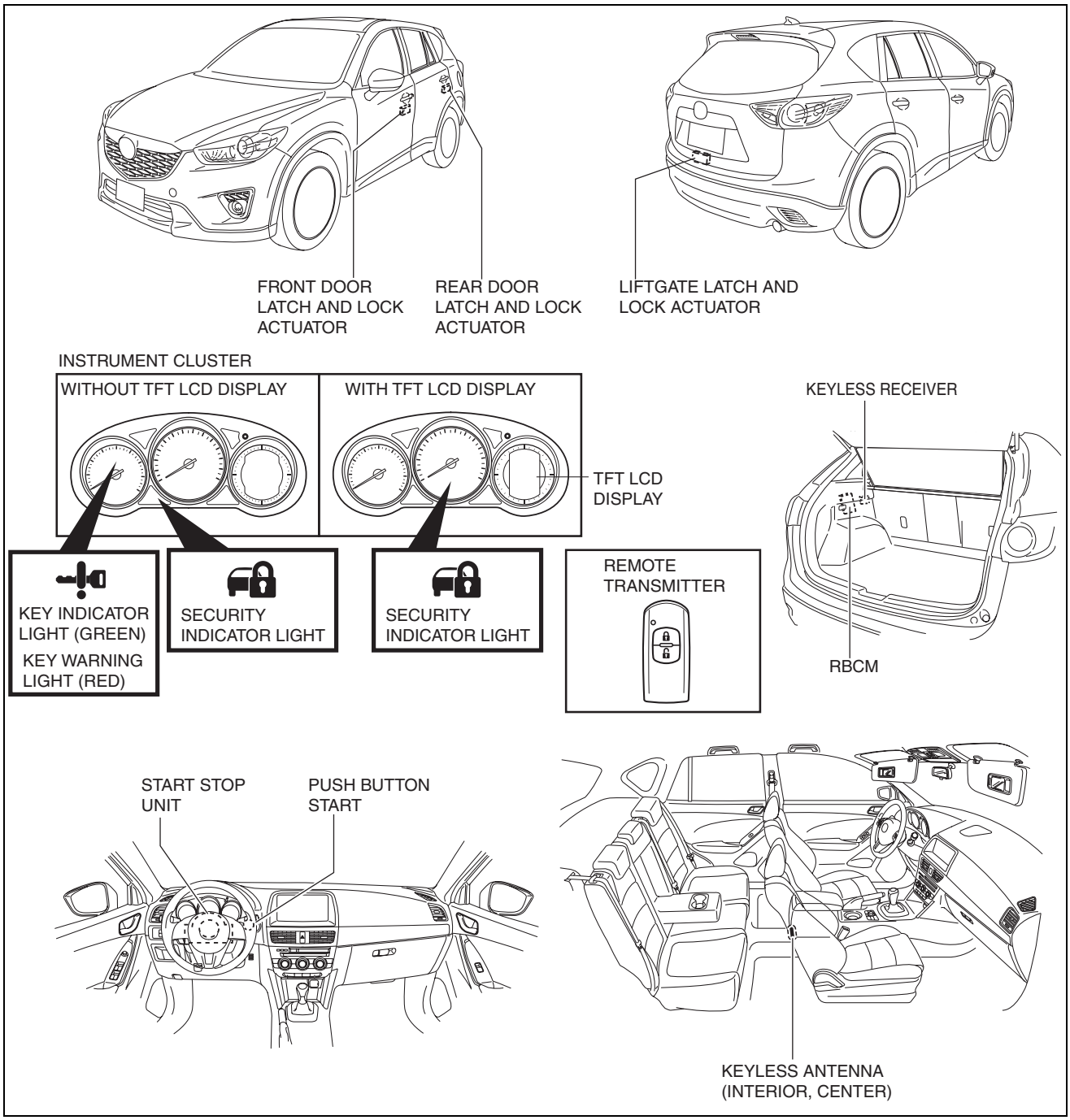
SECURITY AND LOCKS

Keyless entry system / Push button start system / Immobilizer system



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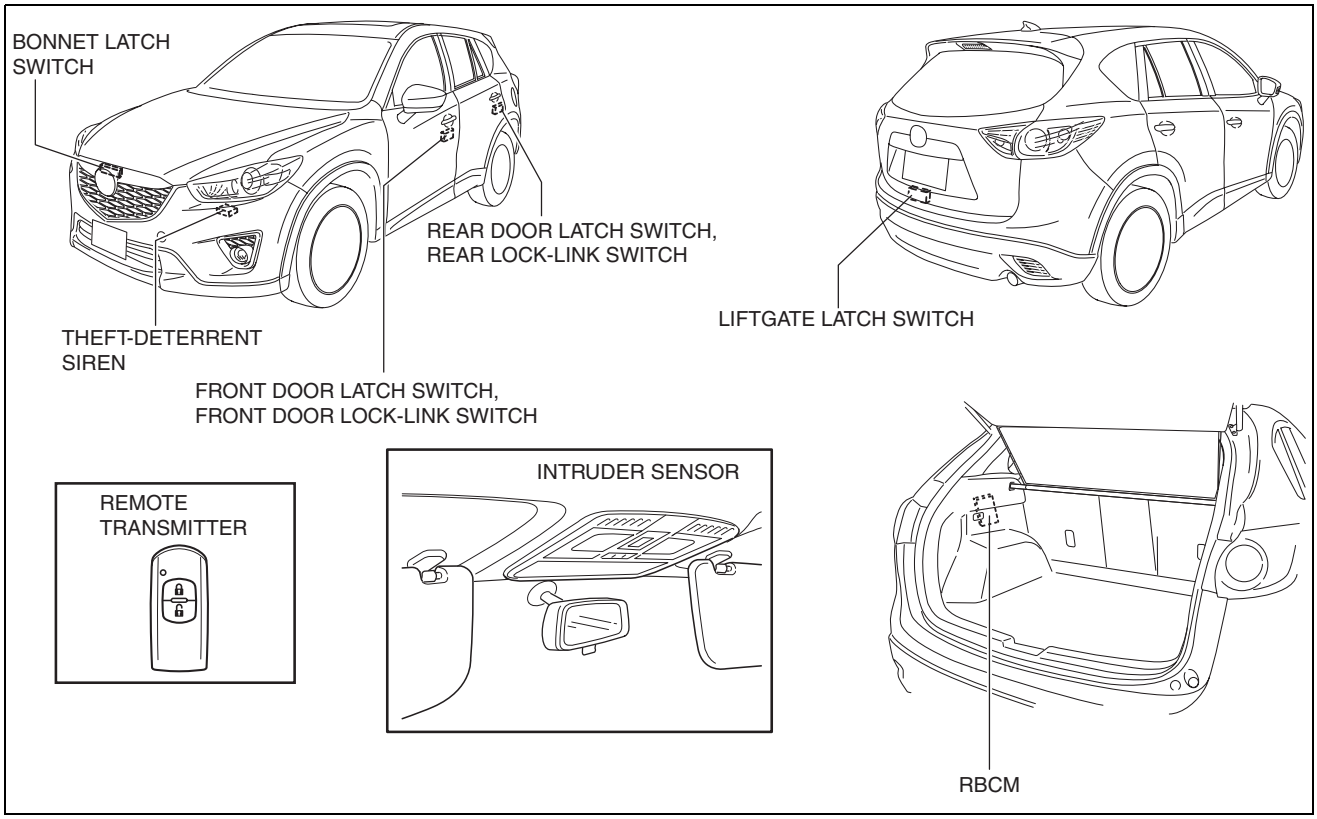
SECURITY AND LOCKS

Theft-deterrent System
With intruder sensor



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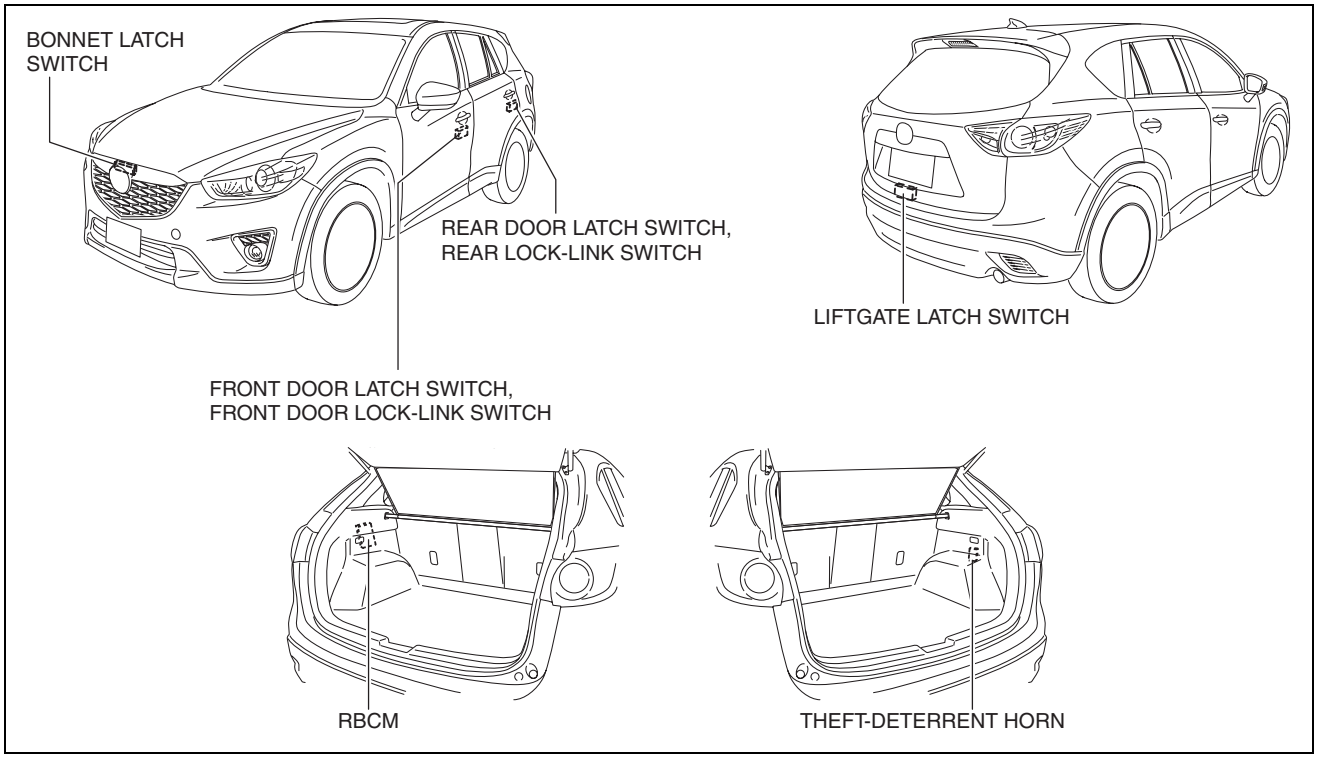
Without intruder sensor



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SECURITY AND LOCKS PERSONALIZATION

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- A personalization features that switches the activation/deactivation of each function has been adopted.
- The setting of the following system functions, and warning and guidance functions can be turned ON/OFF

SECURITY AND LOCKS

optionally.
- Refer to the Workshop Manual for the detailed setting procedure.

Advanced Keyless Entry System
Using Mazda Modular Diagnostic System (M-MDS)

M-MDS display	Function	Initial setting	Setting content	Control unit
Advanced keyless function.*1	The advanced keyless entry system and push button start system functions can be disabled.	Enabled	Enabled. / Disabled.	Start stop unit
Walk Away Lock.	The out-of-area (reception area) type auto lock function can be set.	OFF	Not Adopted. / OFF / ON	Start stop unit
Auto Re-lock Time.	The operation start time of the auto re-lock function can be changed.	30 seconds	Not Adopted. / 30 seconds / 60 seconds / 90 seconds	Start stop unit
Lock Beep Volume.*2	The keyless beeper volume can be adjusted.	Medium	Not Adopted. / Off / Low / Medium / High	Start stop unit

*1 : Because the push button start system function has been disabled, to start the engine press the upper part of the remote transmitter against the center of the push button start.
*2 : Settings can be changed by operation of the remote transmitter button. Refer to the Workshop Manual for the detailed setting procedure.

Using audio unit (with color LCD)

Audio unit display	Function	Initial setting	Setting content	Control unit
Walk Away Lock.	The out-of-area (reception area) type auto lock function can be set.	OFF	OFF / ON	Start stop unit
Auto Re-lock Time.	The operation start time of the auto re-lock function can be changed.	30 seconds	30 seconds / 60 seconds / 90 seconds	Start stop unit
Lock Beep Volume.*1	The keyless beeper volume can be adjusted.	Medium	Off / Low / Medium / High	Start stop unit

*1 : Settings can be changed by operation of the remote transmitter button. Refer to the Workshop Manual for the detailed setting procedure.

Keyless Entry System
Using Mazda Modular Diagnostic System (M-MDS)

M-MDS display	Function	Initial setting	Setting content	Control unit
Advanced keyless function.*1	The keyless entry system and push button start system functions can be disabled.	Enabled	Enabled. / Disabled.	Start stop unit
Auto Re-lock Time.	The operation start time of the auto re-lock function can be changed.	30 seconds	Not Adopted. / 30 seconds / 60 seconds / 90 seconds	Start stop unit

*1 : Because the push button start system function has been disabled, to start the engine press the upper part of the remote transmitter against the center of the push button start.

Using audio unit (with color LCD)

Audio unit display	Function	Initial setting	Setting content	Control unit
Auto Re-lock Time.	The operation start time of the auto re-lock function can be changed.	30 seconds	30 seconds / 60 seconds / 90 seconds	Start stop unit

SECURITY AND LOCKS

Power Door Lock System

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
Auto Door Lock Mode	Auto door lock function can be changed.	Lock: Driving, Unlock: IGN Off	Not Adopted. / OFF / Lock When Driving. / Lock: Driving, Unlock: IGN Off. / Lock When Shifting Out Of P. / Lock: Shift From P, Unlock: In P.	Rear body control module (RBCM)

POWER DOOR LOCK SYSTEM

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Outline

- When the door lock switch or the front door key cylinder is operated to lock/unlock, all the doors lock/unlock.
- The rear body control module (RBCM) performs power door lock system fail-safe. (See 09-40-20 REAR BODY CONTROL MODULE (RBCM).)

Function

Door lock-link switch interlock function (Without 2-step unlocking)

- When the driver's lock knob is locked/unlocked, all the doors lock/unlock.

Door lock switch interlock function (With 2-step unlocking)

- When the door lock switch is operated to lock/unlock, all the doors lock/unlock.

Door key interlock function

- When the front door key cylinder is operated to lock/unlock, all the doors lock/unlock.

Double locking function (With double locking)

- When all the doors and liftgate are closed and locked two times consecutively, the unlock operation for all door lock knobs is disabled.

2-step unlocking function (With 2-step unlocking)

- When an unlock operation is performed using the door key cylinder or the keyless entry remote transmitter, only the door lock on the driver-side door unlocks. In addition, when an unlock operation is performed, the door locks on all the doors unlock.

Collision detection unlock function (With 2-step unlocking)

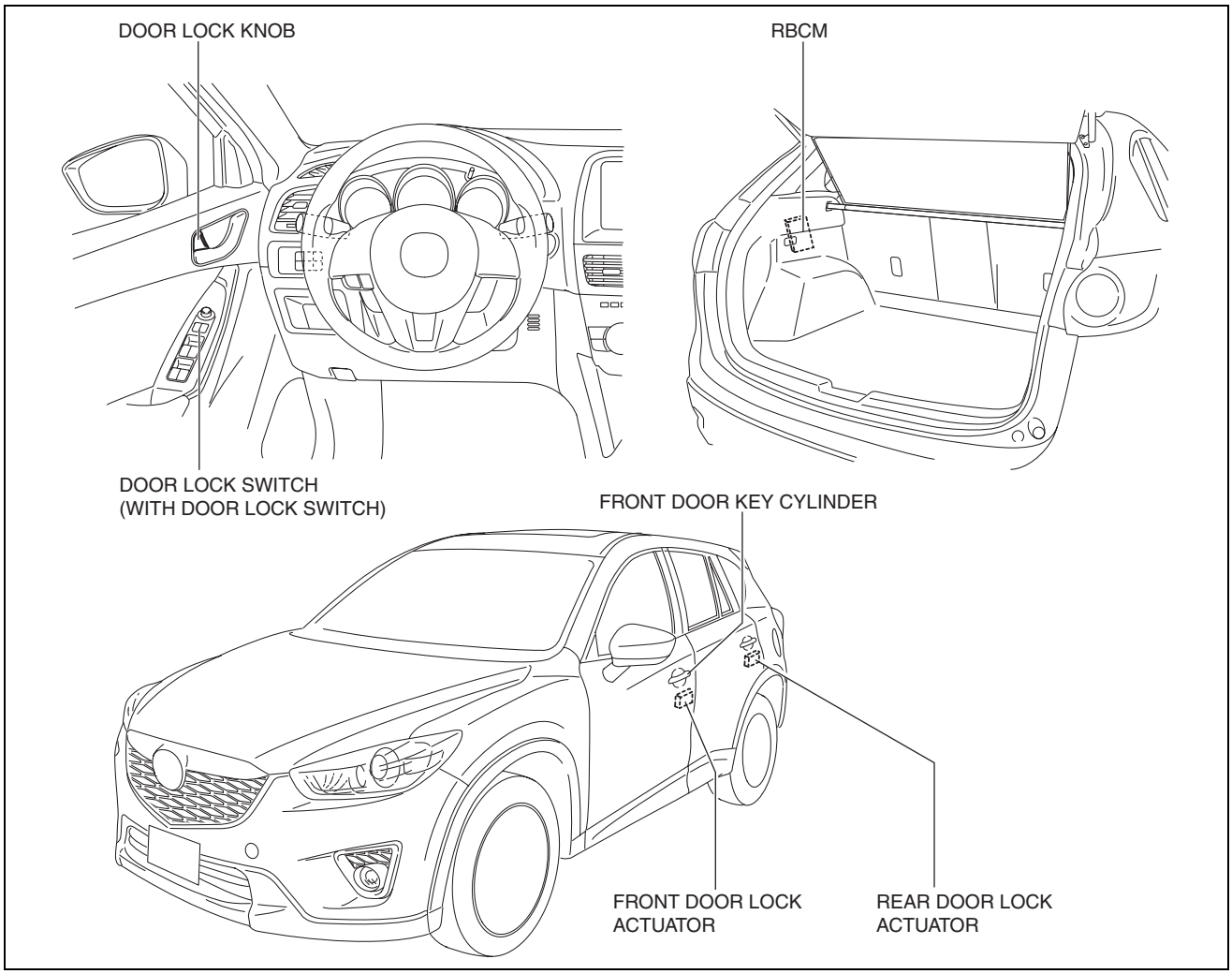
- This function unlocks the doors in case of a collision to enhance rescue operation from outside the vehicle.

Auto door lock function (With 2-step unlocking)

- All doors automatically lock/unlock in conjunction with the vehicle speed and the operation of the selector lever (ATX) and the ignition switch.

SECURITY AND LOCKS

Structural View



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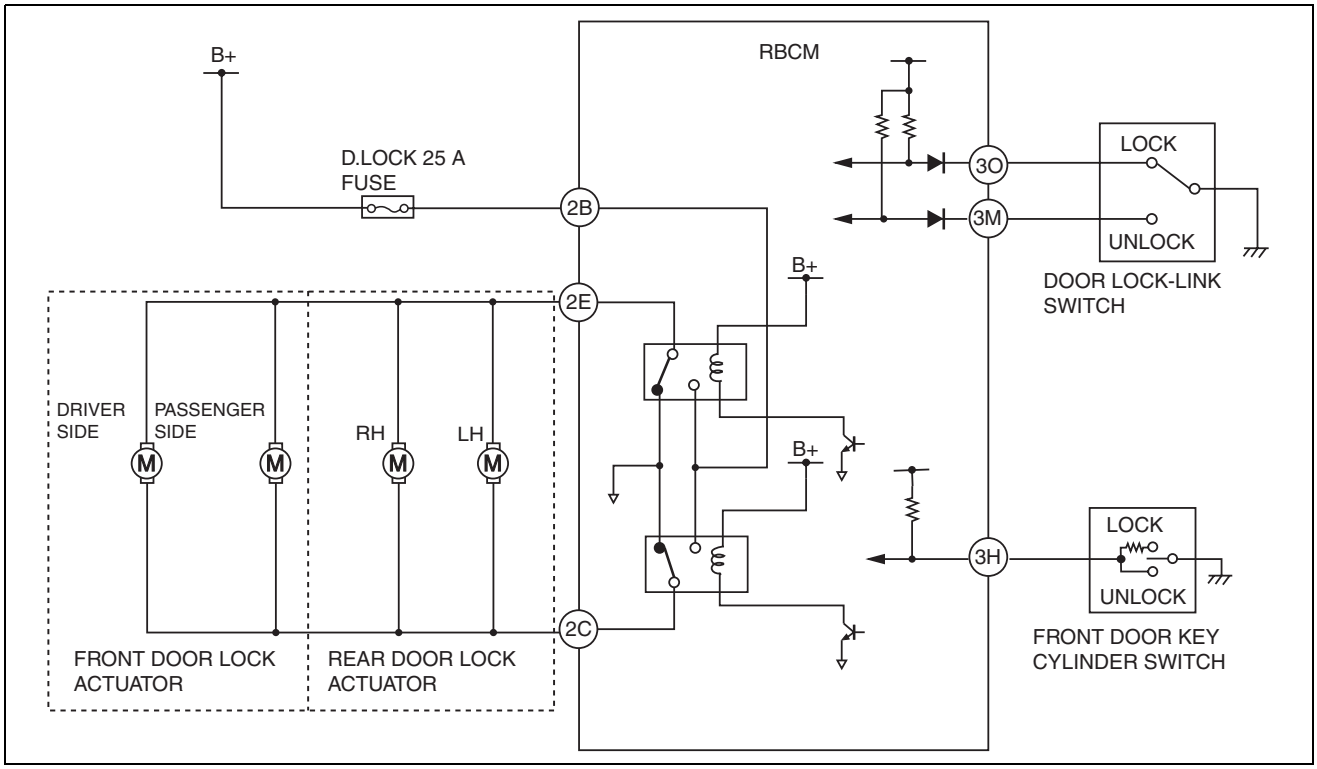
SECURITY AND LOCKS

System Wiring Diagram
Without double locking / 2-step unlocking



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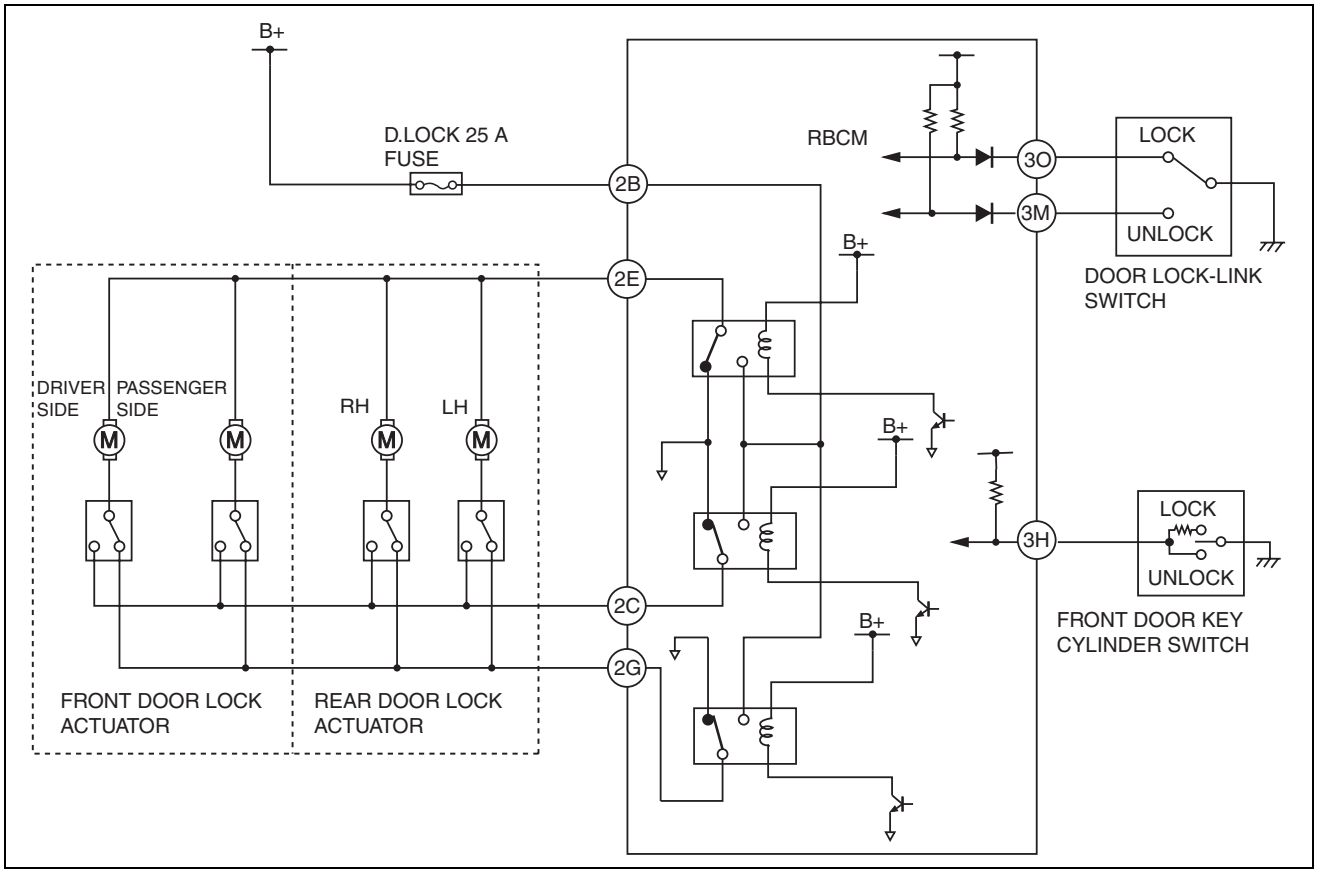
With double locking



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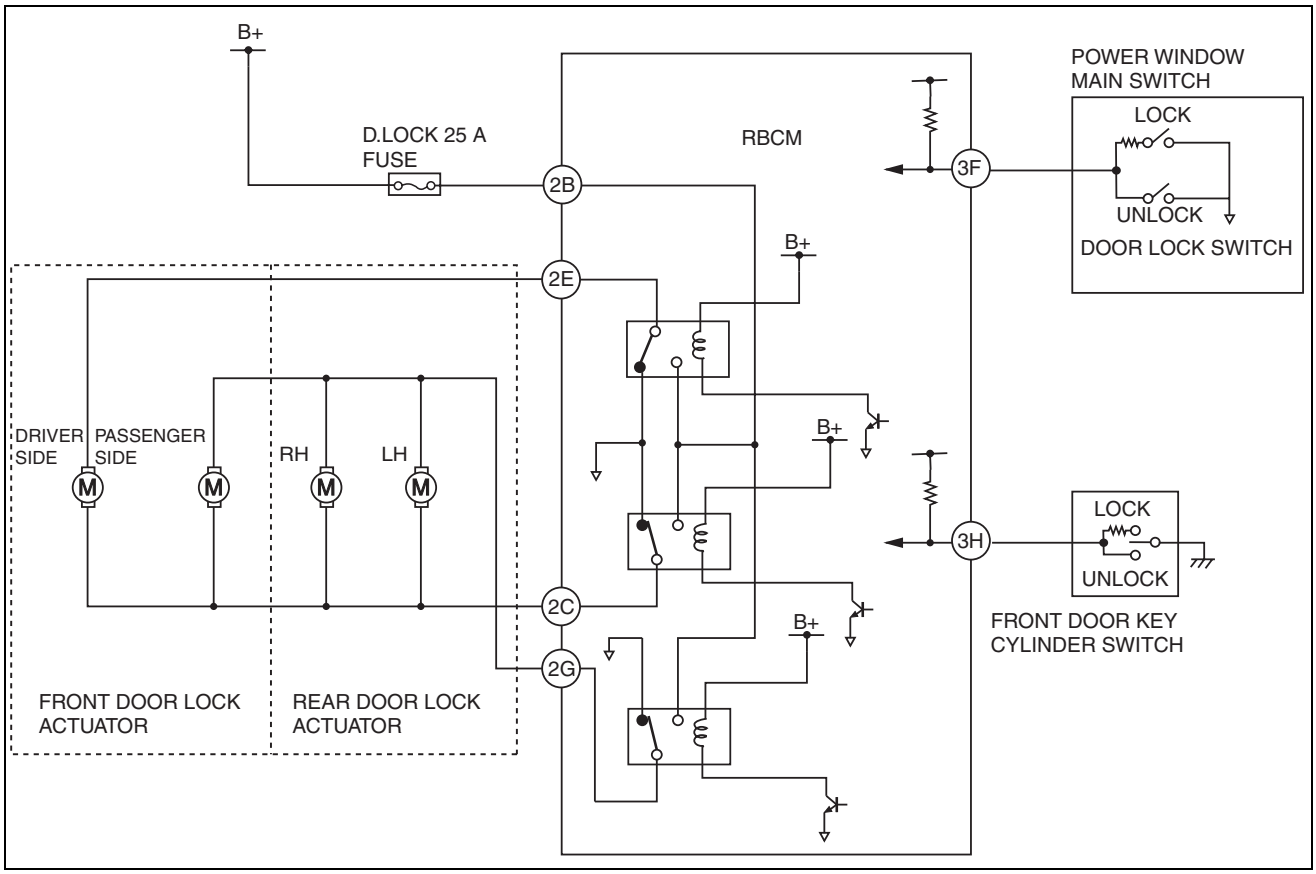
SECURITY AND LOCKS

With 2-step unlocking



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Operation

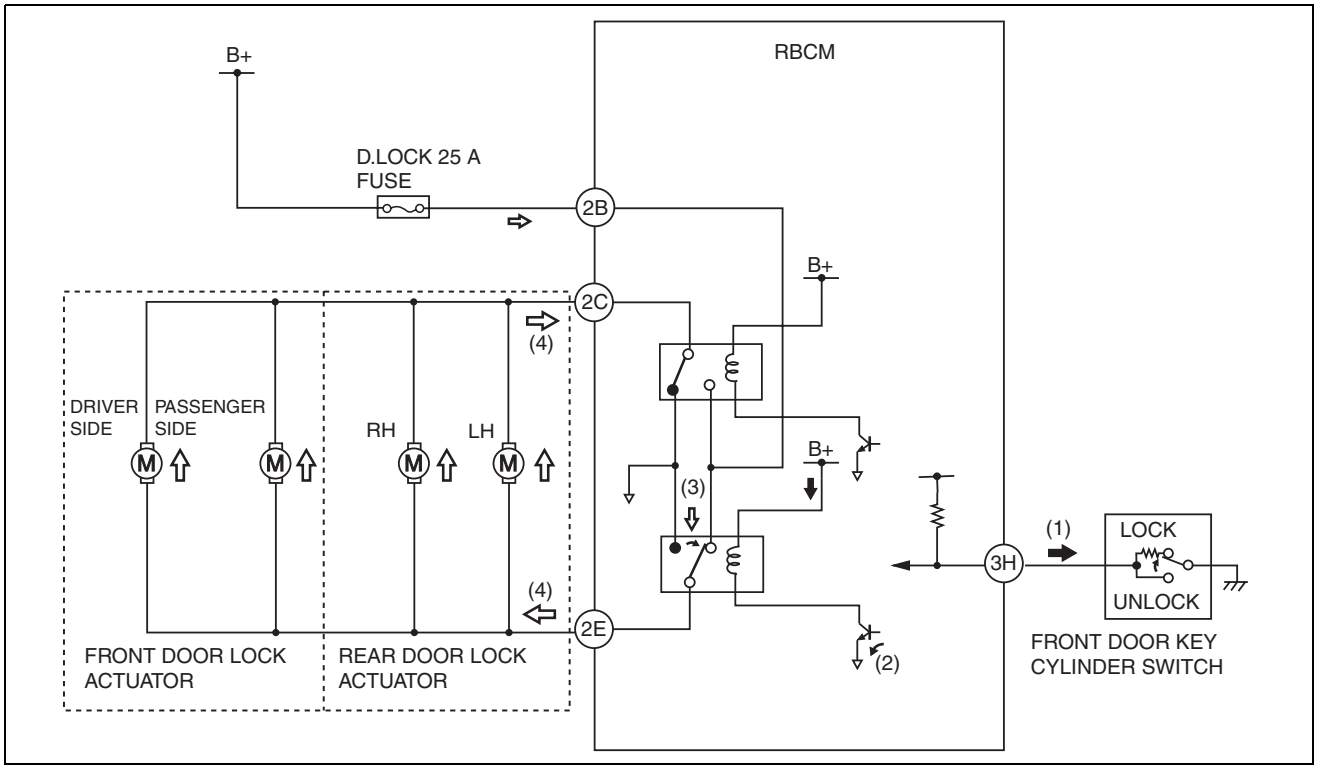
- The power door lock system switches the lock/unlock of all door lock actuators in conjunction with the position of the front door key cylinder switch or door lock-link switch in the driver's door lock actuator.

Lock operation using front door key cylinder

1. When the key is inserted in the front door key cylinder and a lock operation is performed, the front door key cylinder switch switches to the lock side.
2. When the rear body control module (RBCM) detects a front door key cylinder switch lock signal (1), it turns the transistor on (2), and turns the door lock relay (lock side) on.

SECURITY AND LOCKS

3. When the door lock relay (lock side) turns on (3), the front and rear door lock actuator motors perform a lock operation (4), and the front and rear doors lock.



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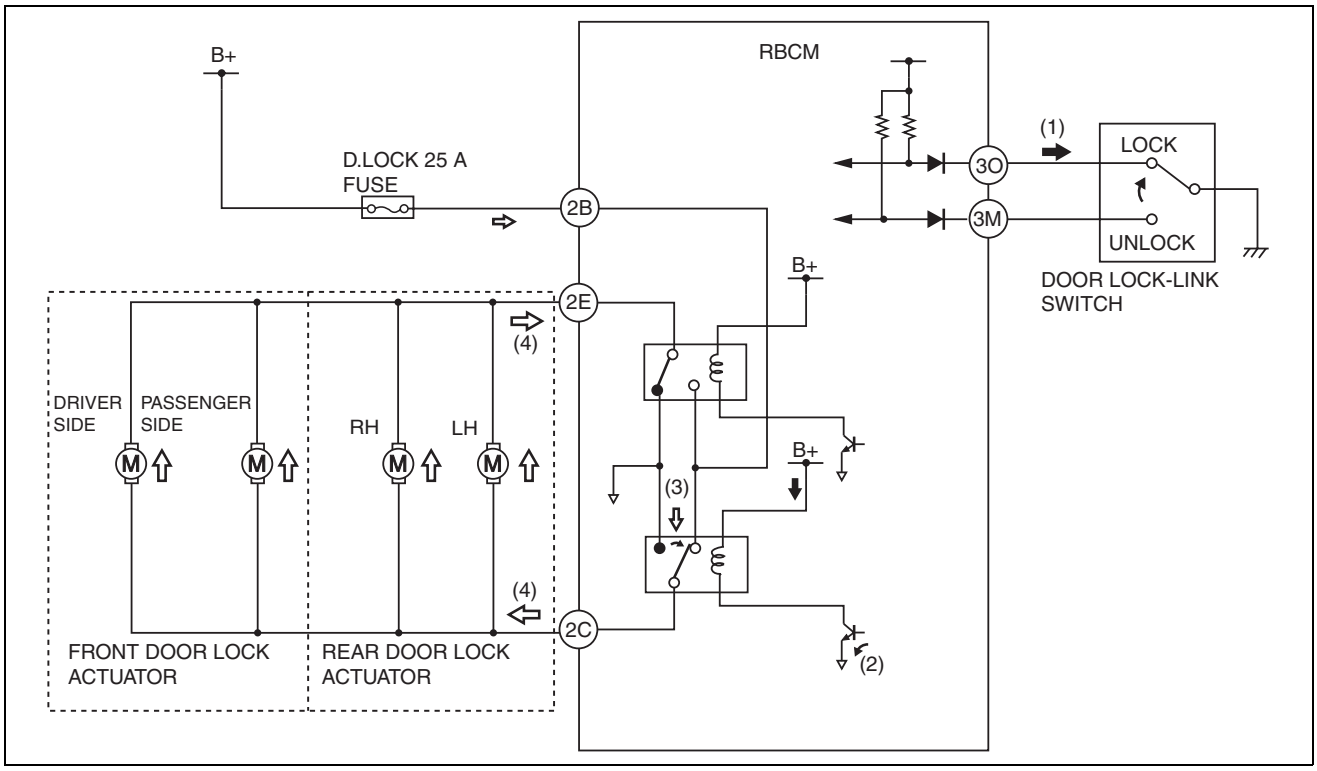
Lock operation using driver's door lock knob (Without 2-step unlocking)

1. When the driver's door lock knob is locked, the door lock-link switch switches to the lock side.
2. When the rear body control module (RBCM) detects a door lock-link switch lock signal (1), it turns on (2) the transistor, and turns on the door lock relay (lock side).
3. When the door lock relay (lock side) turns on (3), the front and rear door lock actuator motors perform a lock operation (4), and the front and rear doors lock.



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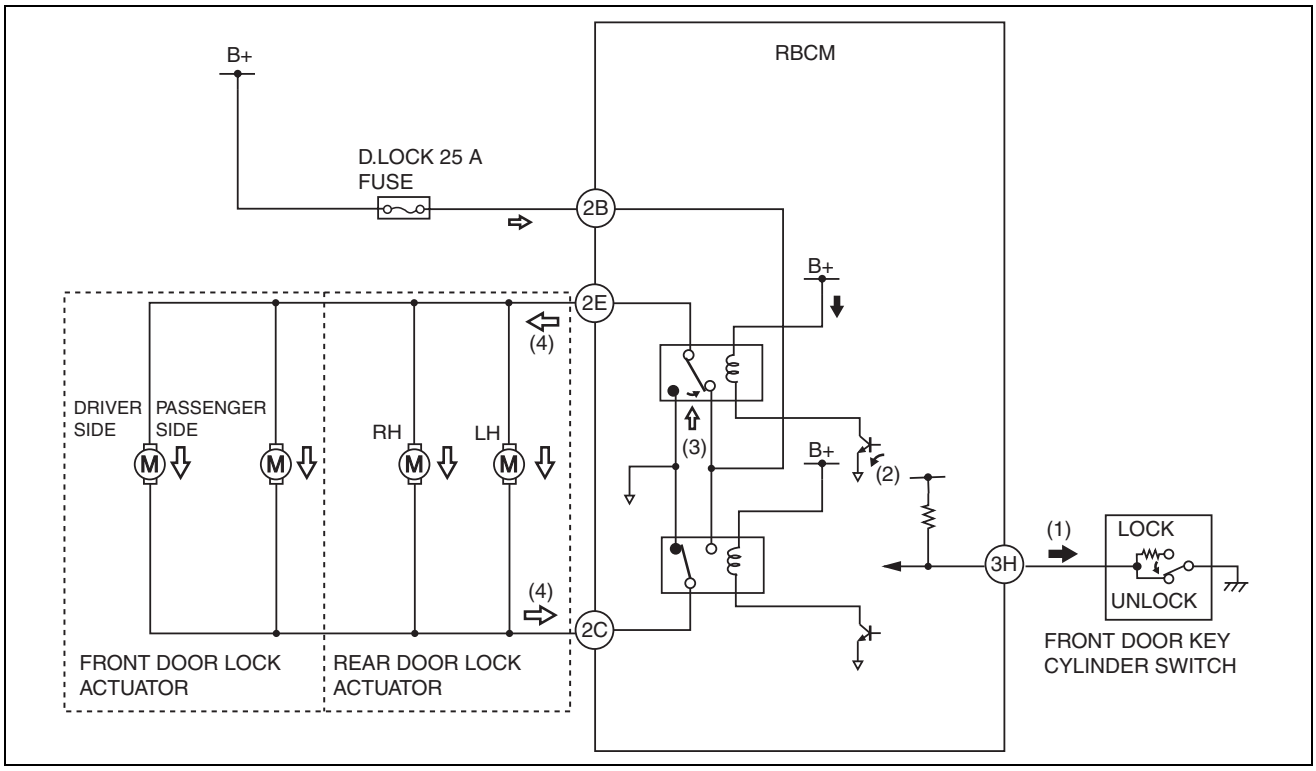
SECURITY AND LOCKS

Unlock operation using front door key cylinder (Without 2-step unlocking)

1. When the key is inserted in the front door key cylinder and an unlock operation is performed, the front door key cylinder switch switches to the unlock side.
2. When the rear body control module (RBCM) detects a front door key cylinder switch unlock signal (1), it turns the transistor on (2), and turns the door lock relay (unlock side) on.
3. When the door lock relay (unlock side) turns on (3), the front and rear door lock actuator motors perform an unlock operation (4), and the front and rear doors unlock.



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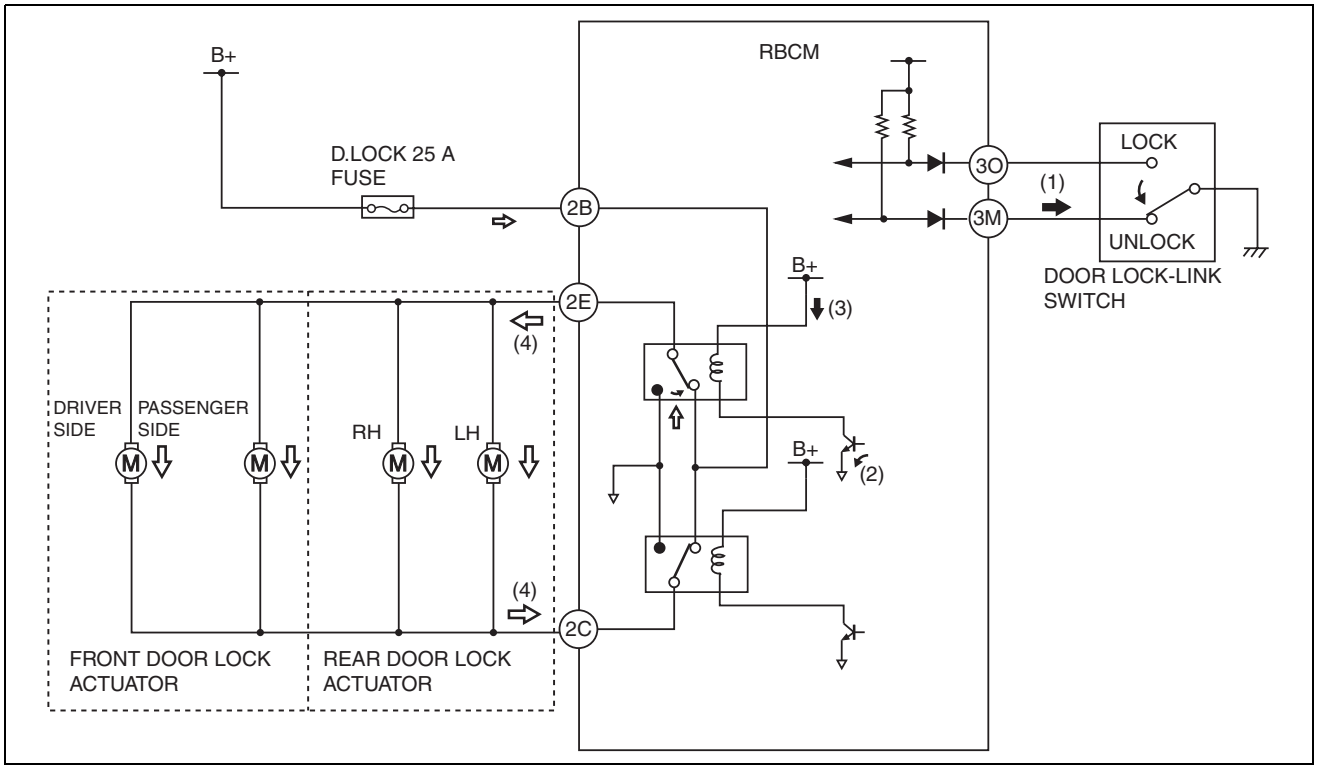
Unlock operation using the driver's door lock knob (Without 2-step unlocking)

1. When the driver's door lock knob is unlocked, the door lock-link switch switches to the unlock side.
2. When the rear body control module (RBCM) detects a door lock-link switch unlock signal (1), it turns on (2) the transistor, and turns on the door lock relay (unlock side).

3. When the door lock relay (unlock side) turns on (3), the front and rear door lock actuator motors perform an unlock operation (4), and the front and rear doors unlock.



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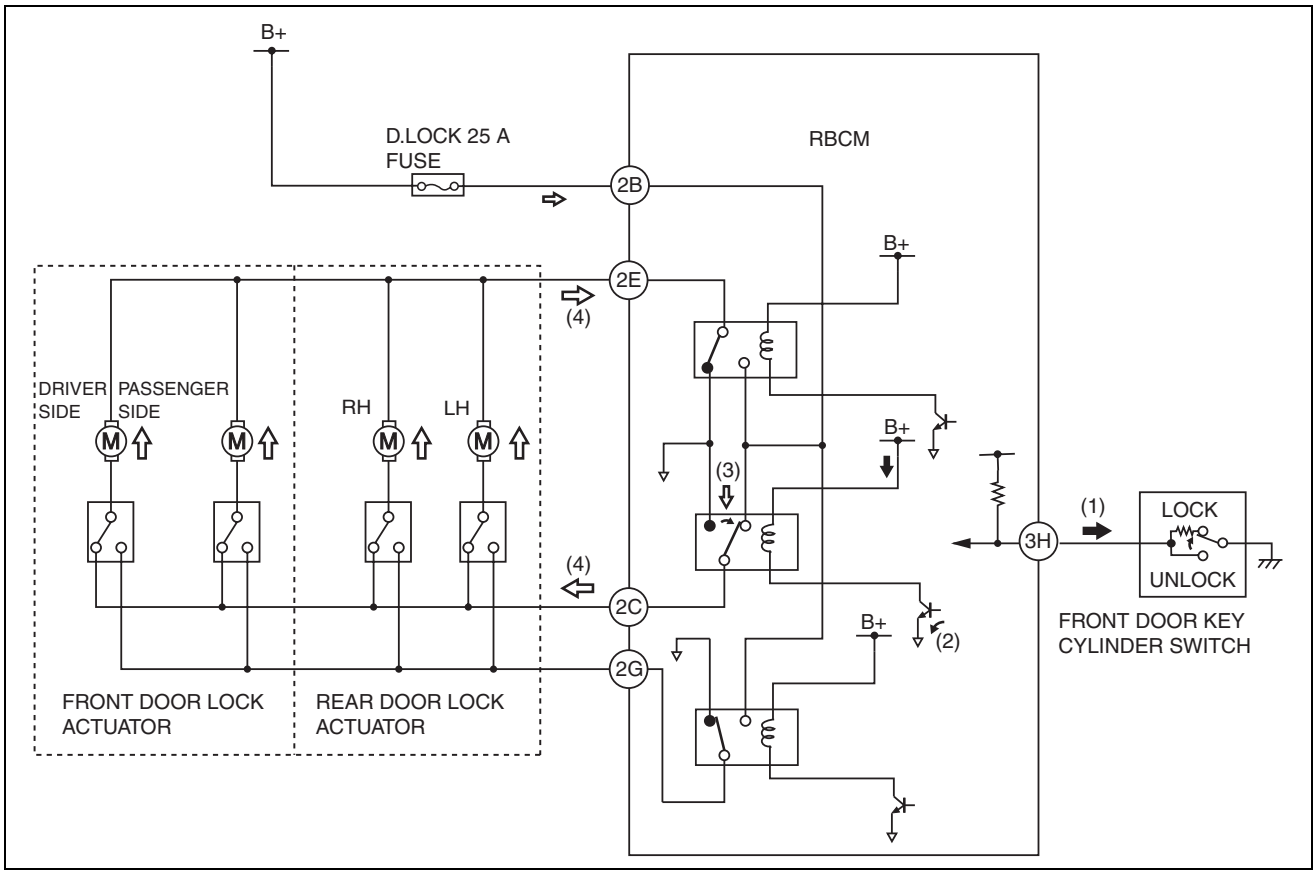
Double locking function (With double locking)

- When all the doors and liftgate are closed and locked two times consecutively, the unlock operation for all door lock knobs is disabled.

1. When the key is inserted in the front door key cylinder and a lock operation is performed, the front door key cylinder switch switches to the lock side.
2. When the rear body control module (RBCM) detects a front door key cylinder switch lock signal (1), it turns the transistor on (2), and turns the door lock relay on.
3. When the door lock relay turns on (3), the front and rear door lock actuator motors perform a lock operation (4), and the front and rear doors lock.

SECURITY AND LOCKS



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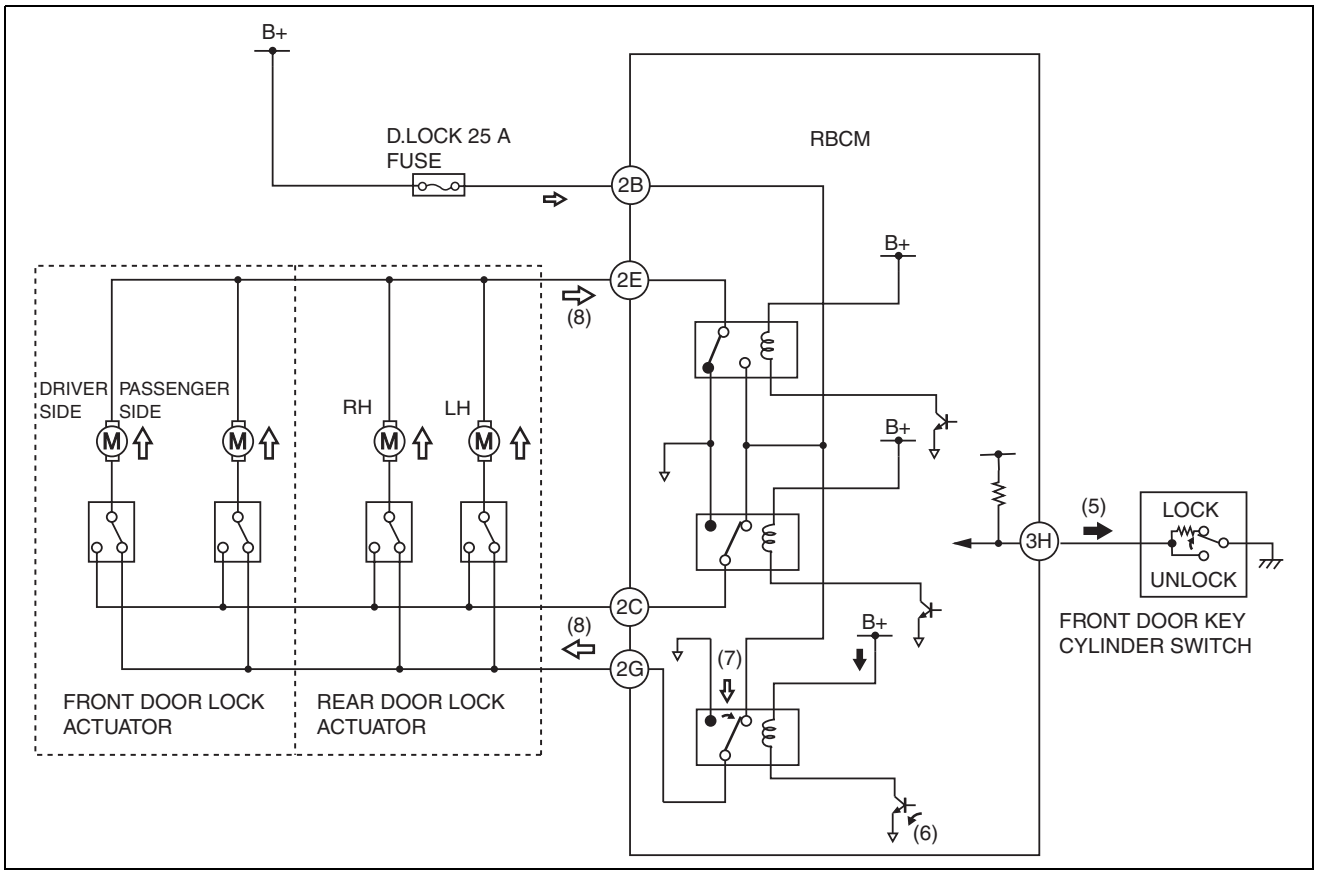
4. When a lock operation is re-performed within **approx. 3 s** after performing it once, the front door key cylinder switch switches to the lock side.
5. When the rear body control module (RBCM) detects a front door key cylinder switch lock signal (5), it turns the transistor on (6), and turns the double locking relay on.
6. When the double locking relay turns on (7), the front and rear door lock actuator motors perform a lock operation (8), and the connection of front and rear door knobs is disconnected. Therefore, the lock/unlock operation cannot be performed using the front and rear door lock knobs.

SECURITY AND LOCKS



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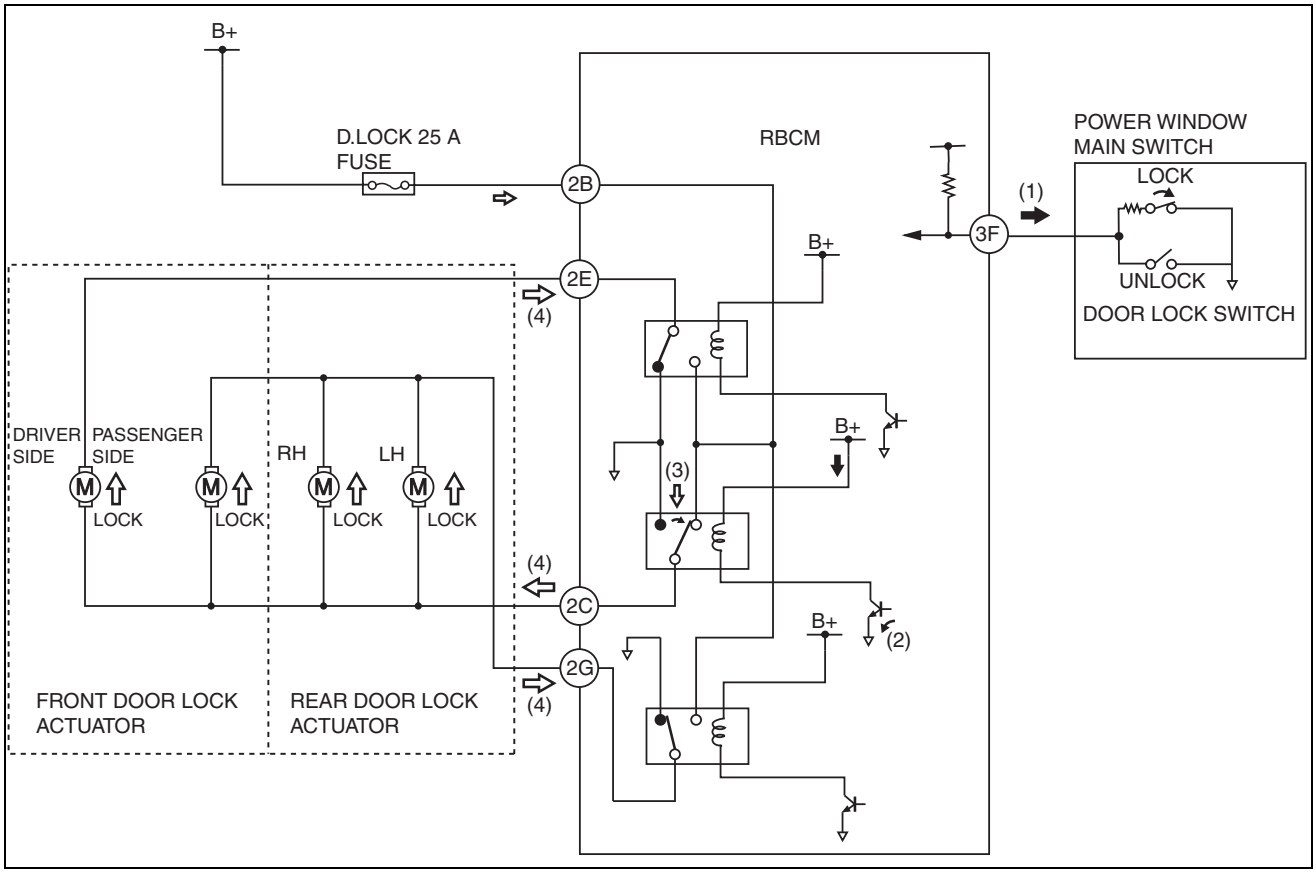
Lock operation using door lock switch (With 2-step unlocking)

1. When the door lock switch is operated to lock, the door lock switch switches to the lock side.
2. When the rear body control module (RBCM) detects a door lock switch lock signal (1), it turns the transistor on (2), and turns the door lock relay (lock side) on.

SECURITY AND LOCKS

3. When the door lock relay (lock side) turns on (3), the front and rear door lock actuator motors perform a lock operation (4), and the front and rear doors lock.



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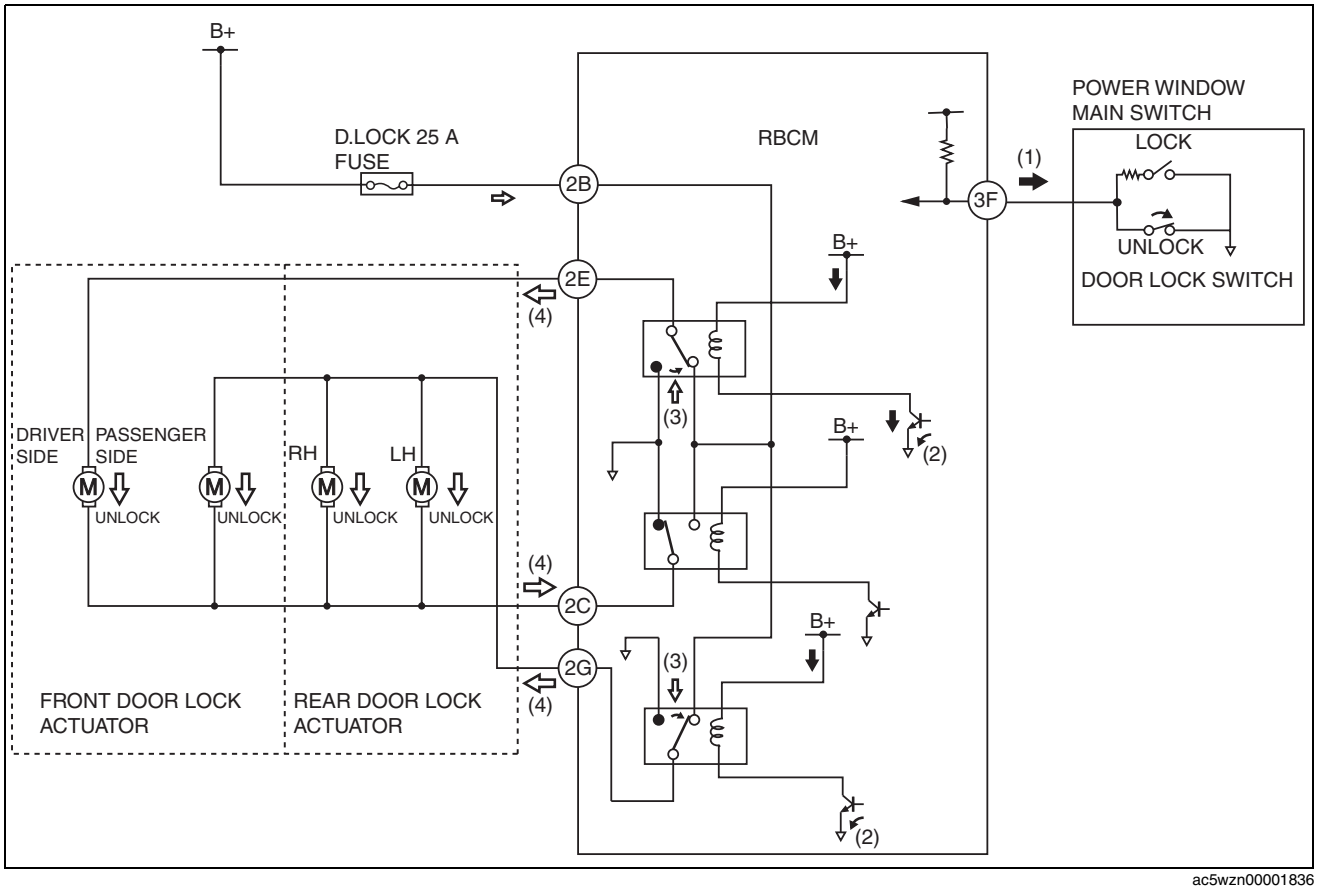
Unlock operation using the door lock switch (With 2-step unlocking)

1. When the door lock switch is operated to unlock, the door lock switch switches to the unlock side.
2. When the rear body control module (RBCM) detects a door lock switch unlock signal (1), it turns the transistor on (2), and turns the door lock relay (unlock side) on.

SECURITY AND LOCKS

3. When the door lock relay (unlock side) turns on (3), the front and rear door lock actuator motors perform an unlock operation (4), and the front and rear doors unlock.



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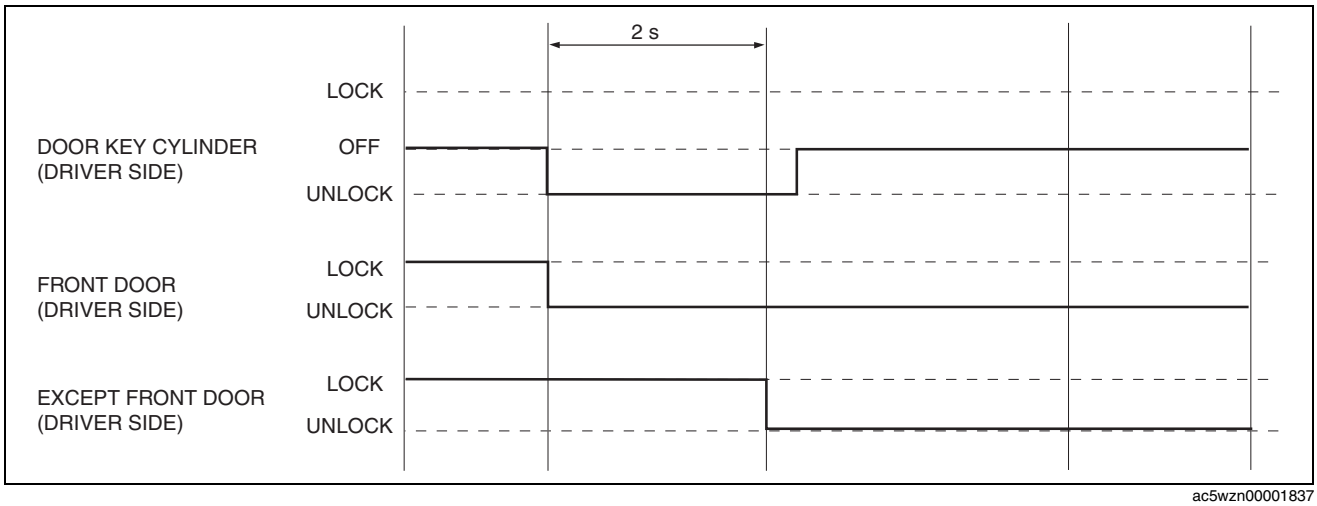
2-step Unlocking Function Operation Using Door Key Cylinder (With 2-step unlocking)
Timing chart of 2-step unlocking function operation using door key cylinder

- If the driver's door key cylinder switch is held in the unlock position for **approx. 2 s** with all the doors locked, the 2-step unlocking function operates.



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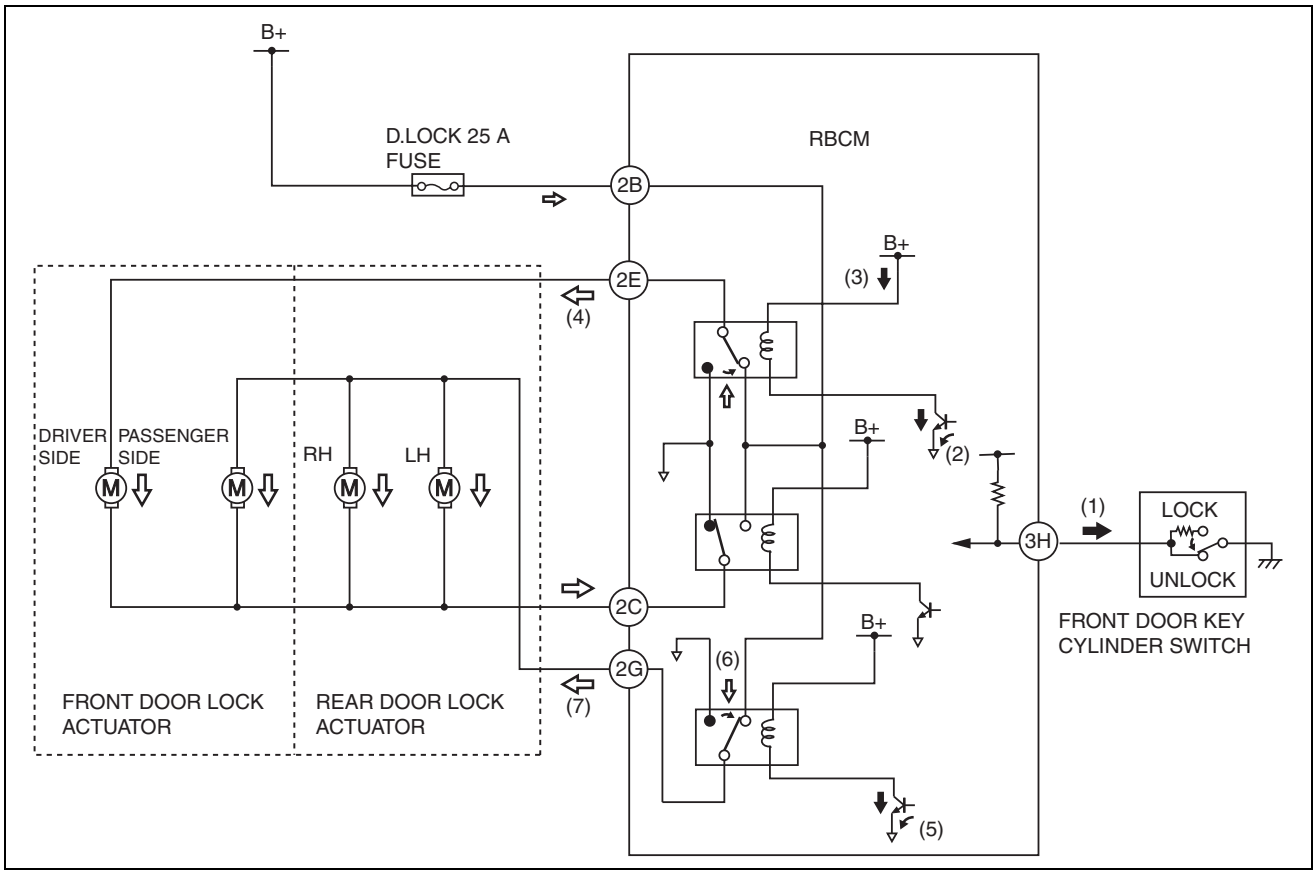
1. When the driver's side key cylinder switch is unlocked (1), the rear body control module (RBCM) turns transistor on (2).
2. When transistor turns on, door lock relay turns on (3), and the driver's side front door unlocks (4).
3. When the rear body control module (RBCM) receives an unlock signal for **approx. 2 s**, it turns transistor on (5).
4. When transistor turns on, 2-step unlocking relay turns on (6), then all doors unlock (7).

SECURITY AND LOCKS



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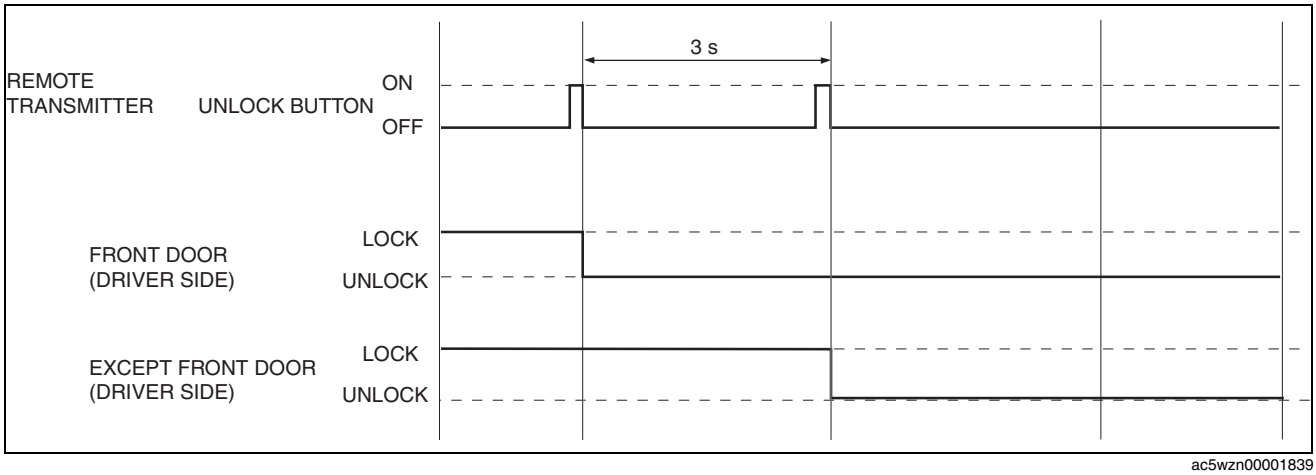
2-step Unlocking Function Operation Using Keyless Entry Remote Transmitter (With 2-step unlocking)
Timing chart of 2-step unlocking function operation using keyless entry remote transmitter

- If the following condition is met with all the doors locked, the 2-step unlocking function operates.
  - — The rear body control module (RBCM) receives an unlock signal, and **within 3 s** it receives another unlock signal.



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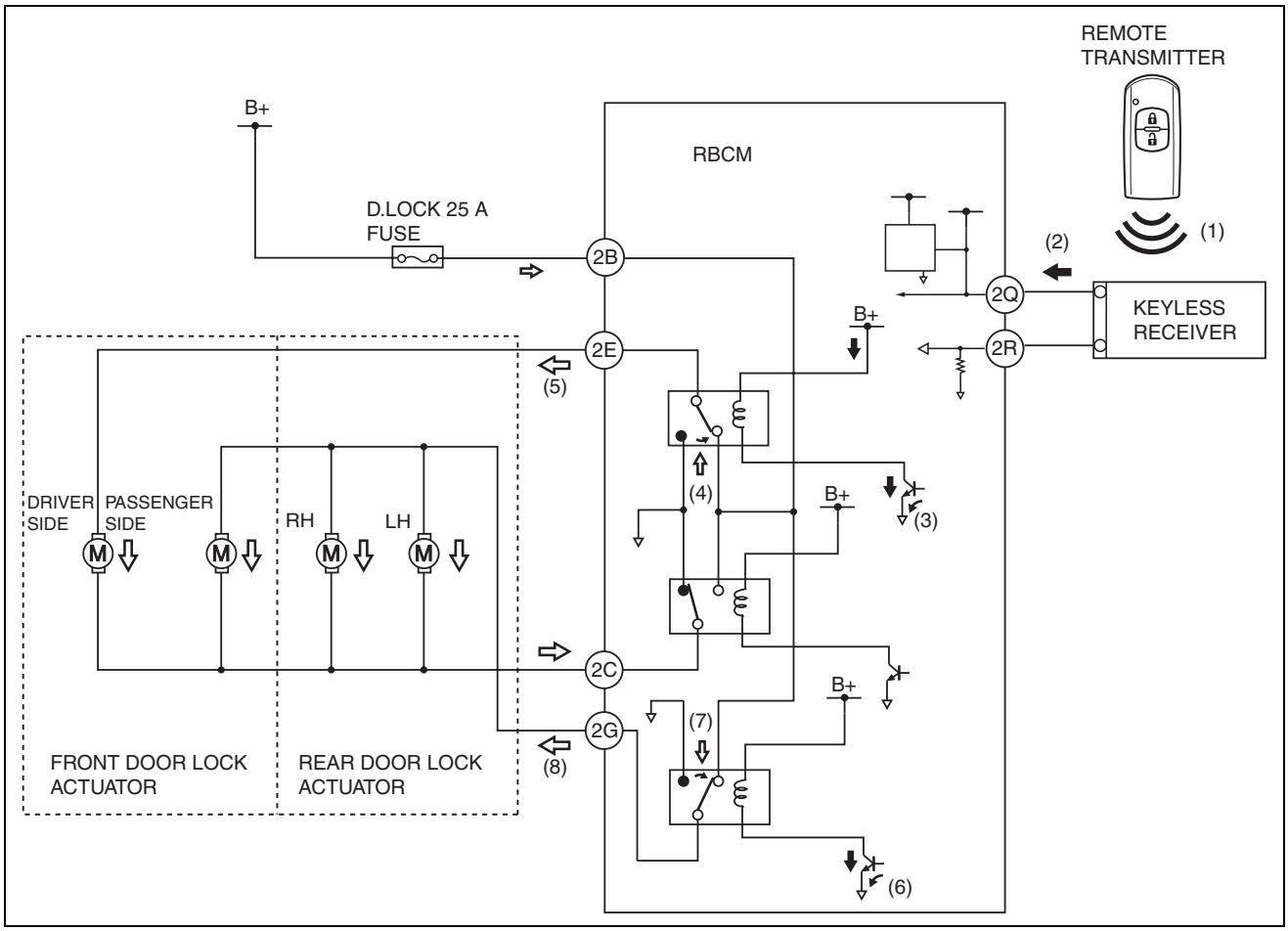
1. When the UNLOCK button on the keyless entry remote transmitter is operated, the keyless entry remote transmitter sends ID data and rolling code to the keyless receiver (1).
2. The keyless receiver sends an unlock signal to the rear body control module (RBCM) (2).
3. When the rear body control module (RBCM) receives the unlock signal, it turns transistor on (3).
4. When transistor turns on, door lock relay turns on (4) and the driver's side front door unlocks (5).
5. If the rear body control module (RBCM) receives another unlock signal **within 5 s after** it received the first unlock signal, it turns transistor on (6).
6. When transistor turns on, 2-step unlocking relay turns on (7), then all doors unlock (8).

SECURITY AND LOCKS



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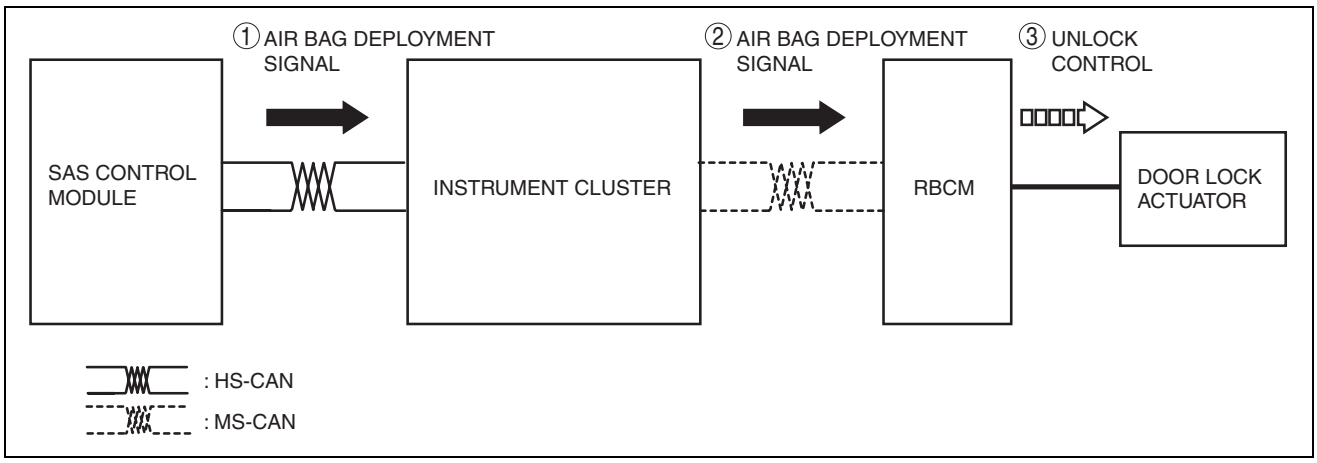
Collision detection unlock function operation (With 2-step unlocking)

1. When an air bag deploys, the SAS control module sends an air bag deployment signal to the instrument cluster as a CAN signal.
2. The instrument cluster sends the air bag deployment signal to the rear body control module (RBCM) as a CAN signal.
3. The rear body control module (RBCM) receives the air bag deployment signal and after approx. 6 s, it operates the front and rear door lock actuator motors, and the front and rear doors unlock.



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Auto Door Lock Operation (With 2-step unlocking)

- The auto door lock system functions to automatically lock and unlock all the doors and the liftgate.
- The auto lock function automatically locks all the doors and the liftgate based on the vehicle speed or the selector lever range operation.

SECURITY AND LOCKS

- The auto unlock function unlocks all the doors and the liftgate based on the selector lever range or the operation of the ignition switch.

Note
- The auto door lock operation setting can be changed using the personalization function. (See 09-14-6 SECURITY AND LOCKS PERSONALIZATION.)

Auto door lock operation based on vehicle speed
- When the vehicle speed reaches approx. 20 km/h {12 mph}, the rear body control module (RBCM) turns on the door lock relay based on the vehicle speed signal from the PCM (CAN signal), and locks all the doors and the liftgate.

Auto door lock operation based on shift position
- When the selector lever is shifted from the park (P) position to any other position, the rear body control module (RBCM) turns on the door lock relay based on the selector lever input signal from the TCM (CAN signal), and locks all the doors and the liftgate.

Auto Door Unlock Operation (With 2-step unlocking)
Auto door unlock operation based on shift position
- When the selector lever is shifted from any position other than the park (P) position to the park (P) position, the rear body control module (RBCM) turns on the driver-side door unlock relay and the door unlock relay based on the selector lever input signal from the TCM (CAN signal), and unlocks all the doors.

Auto door unlock operation based on ignition switch position
- If the engine is being started or the ignition switch is turned from the ON condition to off, the rear body control module (RBCM) turns on the driver-side door unlock relay and the door unlock relay and unlocks all the doors.

FRONT DOOR LOCK ACTUATOR

id091400108300

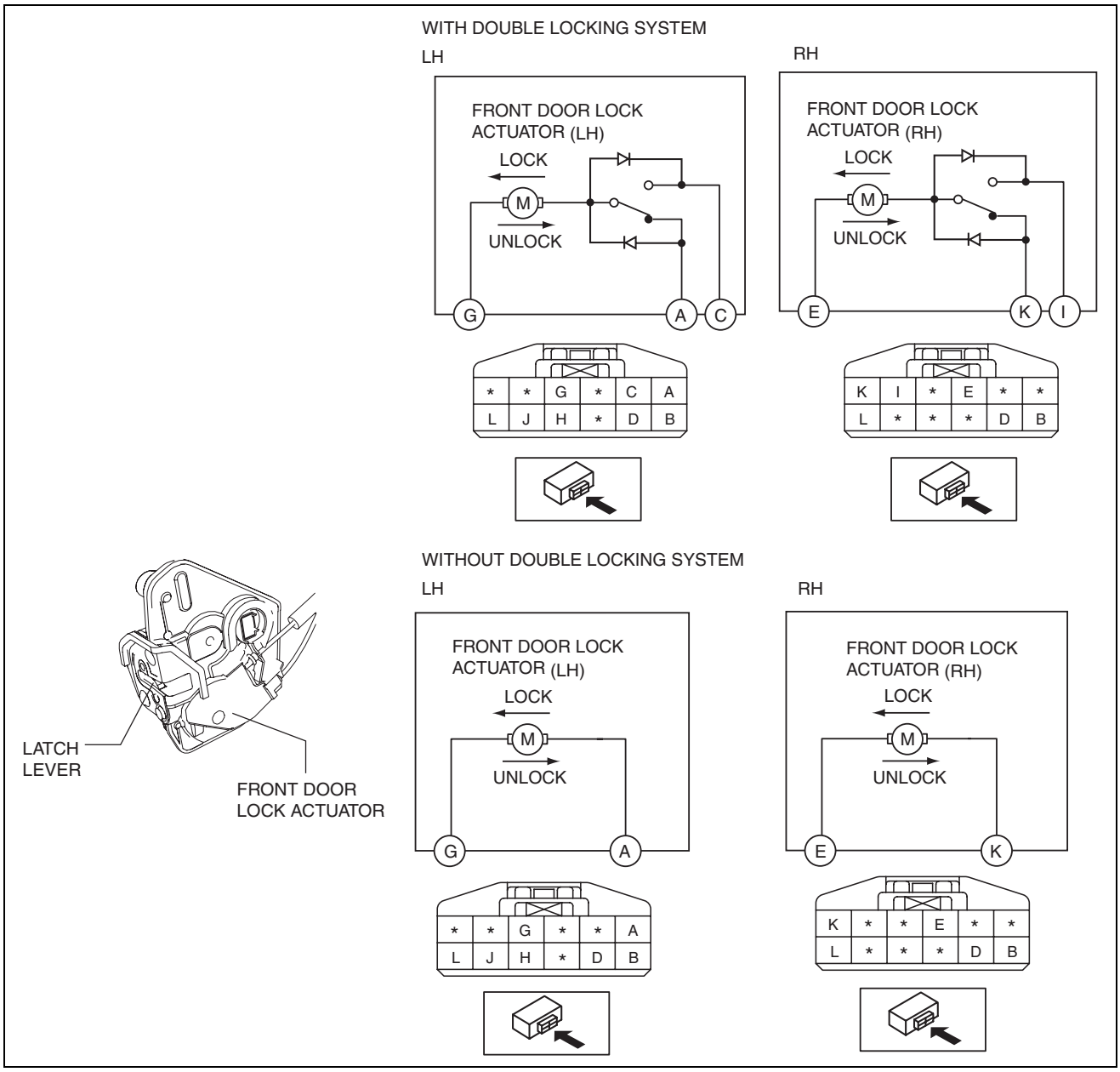
Purpose
- Performs lock/unlock switching of the front doors electrically based on the signal from the rear body control module (RBCM).

Function
Lock function
- The built-in motor is operated in the lock direction, and the latch lever will not release even if an inner/outer handle is operated.

Unlock function
- The built-in motor is operated in the unlock direction and the latch lever releases when an inner/outer handle is operated.

Construction
- The front door lock actuator has a built-in motor, and the link installed to the motor moves in the lock/unlock direction in conjunction with the motor rotation.
- The link for the inner/outer handle and latch lever can be disconnected by the movement of the link installed to the motor.
- When the door lock is unlocked, the link for the inner/outer handle and latch lever release is connected.
- When the door lock is locked, the link for the inner/outer handle and latch lever release is disconnected.

SECURITY AND LOCKS



ac5wzn00000888

Operation

Lock operation

1. The front door lock actuator rotates the built-in motor to the lock side.
2. When the motor rotates to the lock side, the link installed to the motor moves in the lock direction, and the link for the inner/outer handle and latch lever release disconnects.
3. When the link connection is disconnected, the latch lever cannot be released even if an inner/outer handle is operated.

Unlock operation

1. The front door lock actuator rotates the built-in motor to the unlock side.
2. When the motor rotates to the unlock side, the link installed to the motor moves in the unlock direction, and the link for the inner/outer handle and latch lever release connects.
3. When the link connects, the latch lever releases by the inner and outer handle operation.

Double locking operation

1. The front door lock actuator rotates the built-in motor to the double locking side based on the double locking operation signal from the rear body control module (RBCM).
2. When the motor rotates to the double locking side, the connection of the door lock knob and front door lock link is disconnected.

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3. When the link is disconnected, switching between lock/unlock is not possible even if the door lock knob is operated.

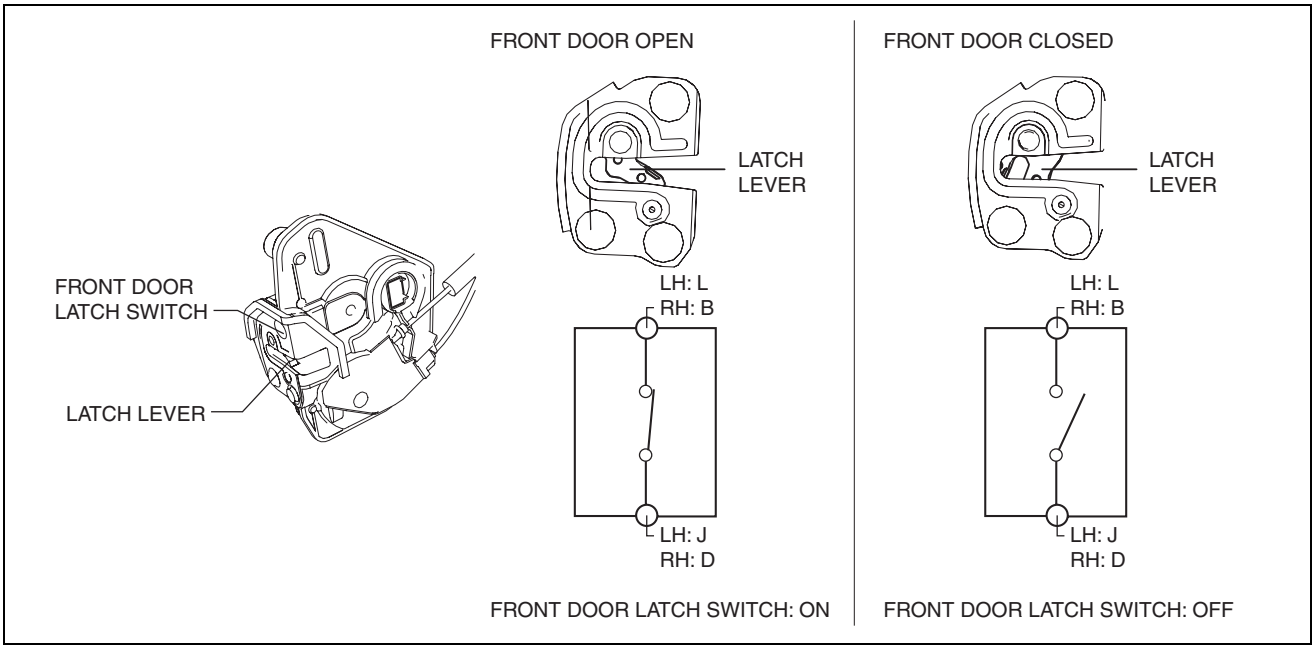
Fail-safe
- Function not equipped.

FRONT DOOR LATCH SWITCH

id091400108400

Purpose, Function
- Switches on/off in conjunction with the latch lever rotation, and detects the front door open/closed condition by the voltage which is changed by the rear body control module (RBCM).

Construction
- The switch is turned on/off by the rotation of the latch lever.
- When the front door is completely opened, the front door latch switch turns on (contact point: Closed).



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Operation
Door open (unlatch) operation
1. When the inner or outer handle is operated, the door opens, the latch lever is in an unlatched condition, and the front door latch switch turns on.

Door closed (latched) operation
1. When a door is closed, the front door lock striker enters the latch lever groove.
2. When the door is further closed, the latch lever is pressed by the front door lock striker and it rotates.
3. When the door is completely closed, the latch lever is in a latched condition, the front door latch switch turns off.

Fail-safe
- Function not equipped.

FRONT DOOR LOCK-LINK SWITCH

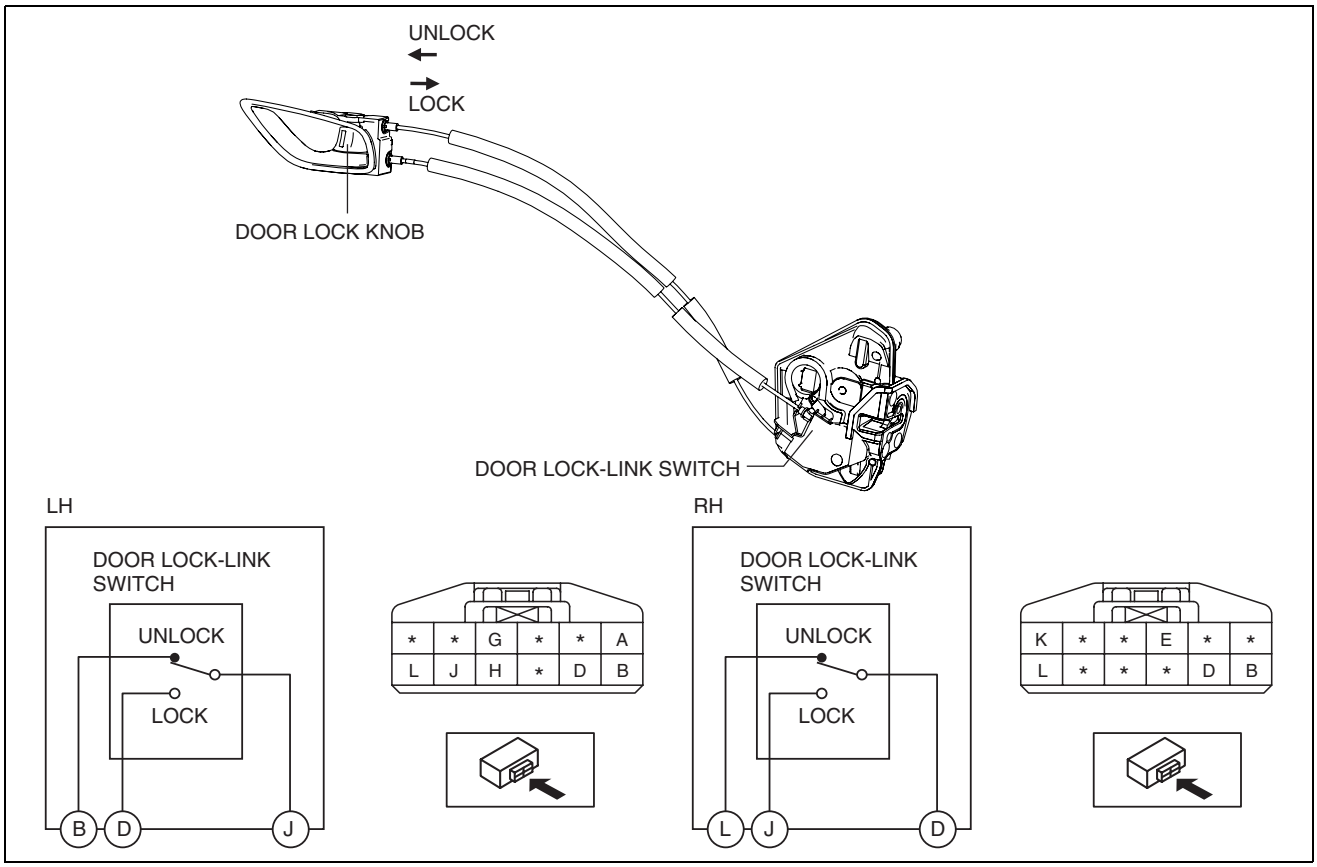
id091400108500

Purpose
- Switches on/off in conjunction with the front door lock knob lock/unlock, and detects the front door lock/unlock condition by the voltage which is changed by the rear body control module (RBCM).

Function
- The door lock-link switch contact point changes in conjunction with the front door lock knob lock/unlock operation.

Construction
- The front door lock knob and door lock-link switch are connected by the door lock-link cable, and are built into the front door latch and lock actuator.

SECURITY AND LOCKS



ac5wzn00001514

Operation

Lock operation

- When the front door lock knob is turned to the lock position, the door lock-link cable is pressed, and the door lock-link switch is switched to the lock side.

Unlock operation

- When the front door lock knob is turned to the unlock position, the door lock-link cable is pulled, and the door lock-link switch is switched to the unlock side.

Fail-safe

- Function not equipped.

KEY CYLINDER SWITCH

id091400108600

Purpose

- The switch turns on/off in conjunction with the front door key cylinder lock/unlock and the rear body control module (RBCM) detects the key cylinder operation condition by the change in the voltage.

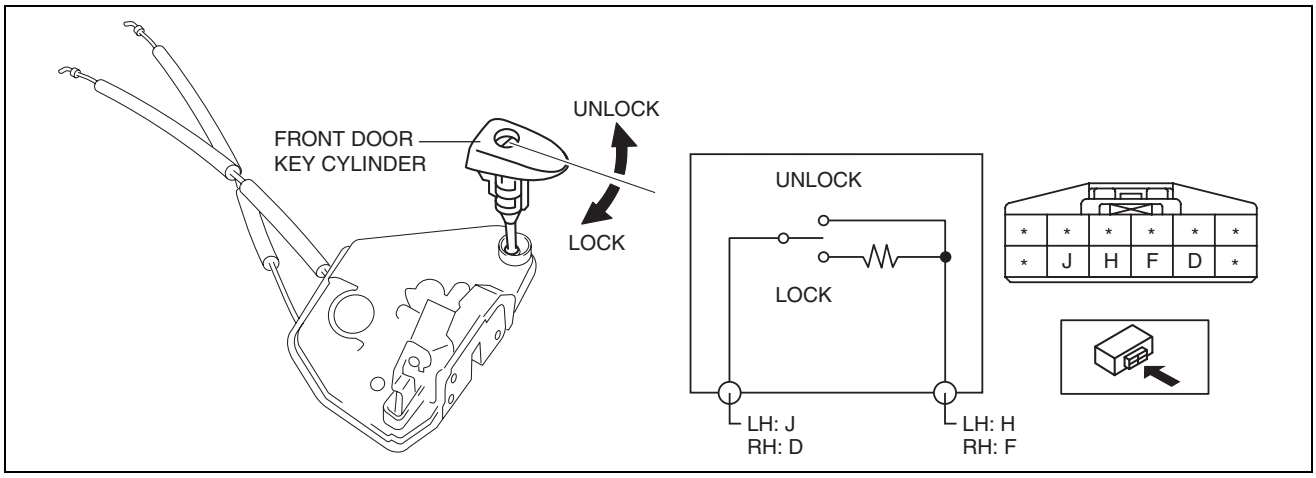
Function

- The key cylinder switch contact point changes in conjunction with the front door key cylinder lock/unlock operation.

Construction

- Built into the driver's side front door latch and lock actuator.
- The front door key cylinder is connected to the front door latch and lock actuator, and the front door key cylinder is rotated to directly switch the key cylinder switch.
- When the front door key cylinder is not operated, the key cylinder switch is off (contact point: Open).

SECURITY AND LOCKS



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Operation
Lock operation
- When the key is inserted in the front door key cylinder and it is rotated in the lock direction, the key cylinder switch switches to the lock side, and the lock-side switch turns on (contact point: Closed).

Unlock operation
- When the key is inserted in the front door key cylinder and it is rotated in the unlock direction, the key cylinder switch switches to the unlock side, and the unlock-side switch turns on (contact point: Closed).

Fail-safe
- Function not equipped.

REAR DOOR LOCK ACTUATOR

id091400111300

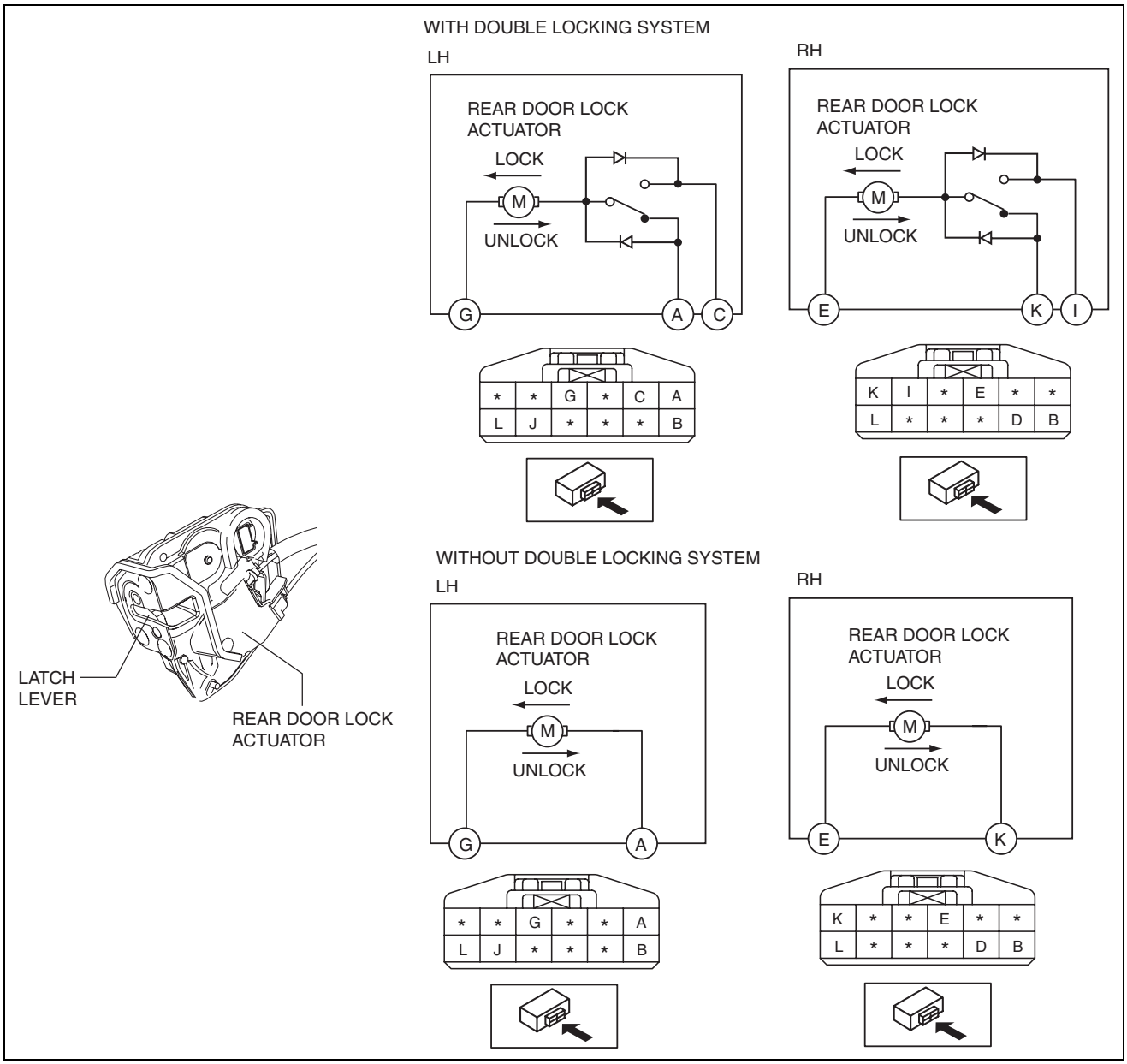
Purpose
- Performs lock/unlock switching of the rear doors electrically based on the signal from the rear body control module (RBCM).

Function
Lock function
- The built-in motor is operated in the lock direction, and the latch lever will not release even if an inner/outer handle is operated.

Unlock function
- The built-in motor is operated in the unlock direction and the latch lever releases when an inner/outer handle is operated.

Construction
- The rear door lock actuator has a built-in motor, and the link installed to the motor moves in the lock/unlock direction in conjunction with the motor rotation.
- The link for the inner/outer handle and latch lever can be disconnected by the movement of the link installed to the motor.
- When the door lock is unlocked, the link for the inner/outer handle and latch lever release is connected.
- When the door lock is locked, the link for the inner/outer handle and latch lever release is disconnected.

SECURITY AND LOCKS



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Operation

Lock operation

1. The rear door lock actuator rotates the built-in motor to the lock side.
2. When the motor rotates to the lock side, the link installed to the motor moves in the lock direction, and the link for the inner/outer handle and latch lever release disconnects.
3. When the link connection is disconnected, the latch lever cannot be released even if an inner/outer handle is operated.

Unlock operation

1. The rear door lock actuator rotates the built-in motor to the unlock side.
2. When the motor rotates to the unlock side, the link installed to the motor moves in the unlock direction, and the link for the inner/outer handle and latch lever release connects.
3. When the link connects, the latch lever releases by the inner and outer handle operation.

Double locking operation

1. The rear door lock actuator rotates the built-in motor to the double locking side based on the double locking operation signal from the rear body control module (RBCM).
2. When the motor rotates to the double locking side, the connection of the door lock knob and rear door lock link is disconnected.

SECURITY AND LOCKS

3. When the link is disconnected, switching between lock/unlock is not possible even if the door lock knob is operated.

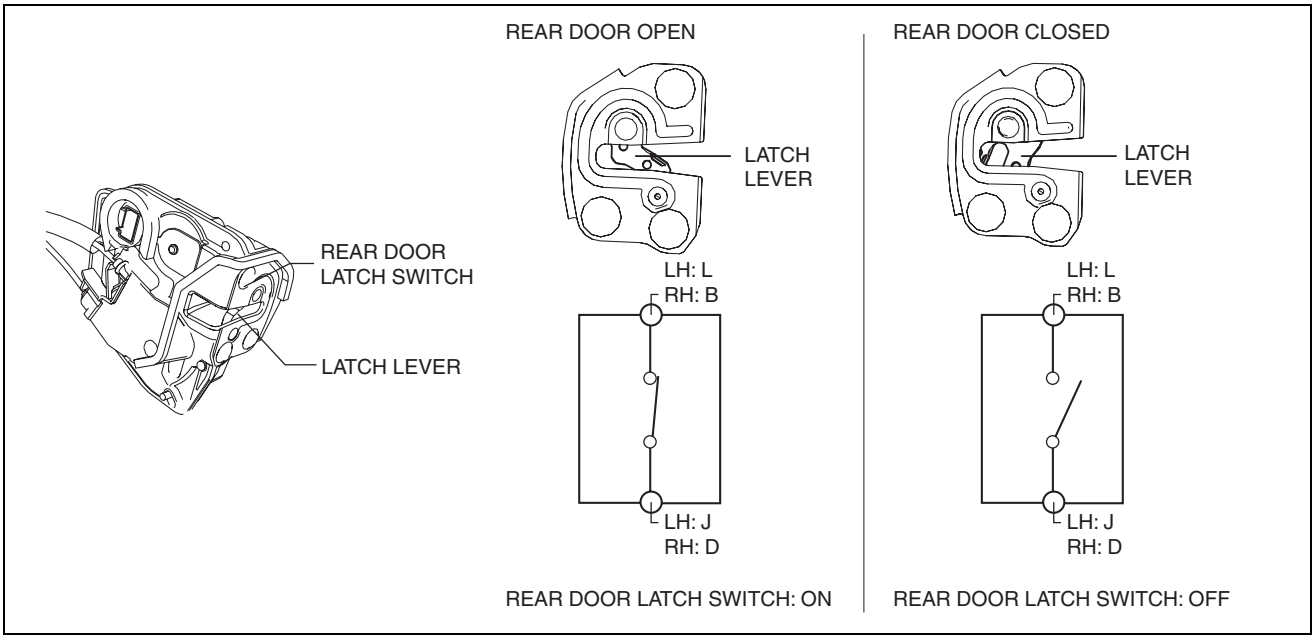
Fail-safe
- Function not equipped.

REAR DOOR LATCH SWITCH

id091400110800

Purpose, Function
- The switch turns on/off in conjunction with the rotation of the latch lever, and it detects the open/closed condition of the rear door by the voltage value which is changed by the rear body control module (RBCM).

Construction
- The switch is turned on/off by the rotation of the latch lever.
- When the rear door is completely opened, the rear door latch switch is on (contact point: Closed).



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Operation
Door open (unlatch) operation
1. When the inner or outer handle is operated, the door opens, the latch lever is in an unlatched condition, and the rear door latch switch turns on.

Door closed (latched) operation
1. When a door is closed, the rear door lock striker enters the latch lever groove.
2. When the door is further closed, the latch lever is pressed by the rear door lock striker and it rotates.
3. When the door is completely closed, the latch lever is in a latched condition, the rear door latch switch turns off.

Fail-safe
- Function not equipped.

REAR DOOR LOCK-LINK SWITCH

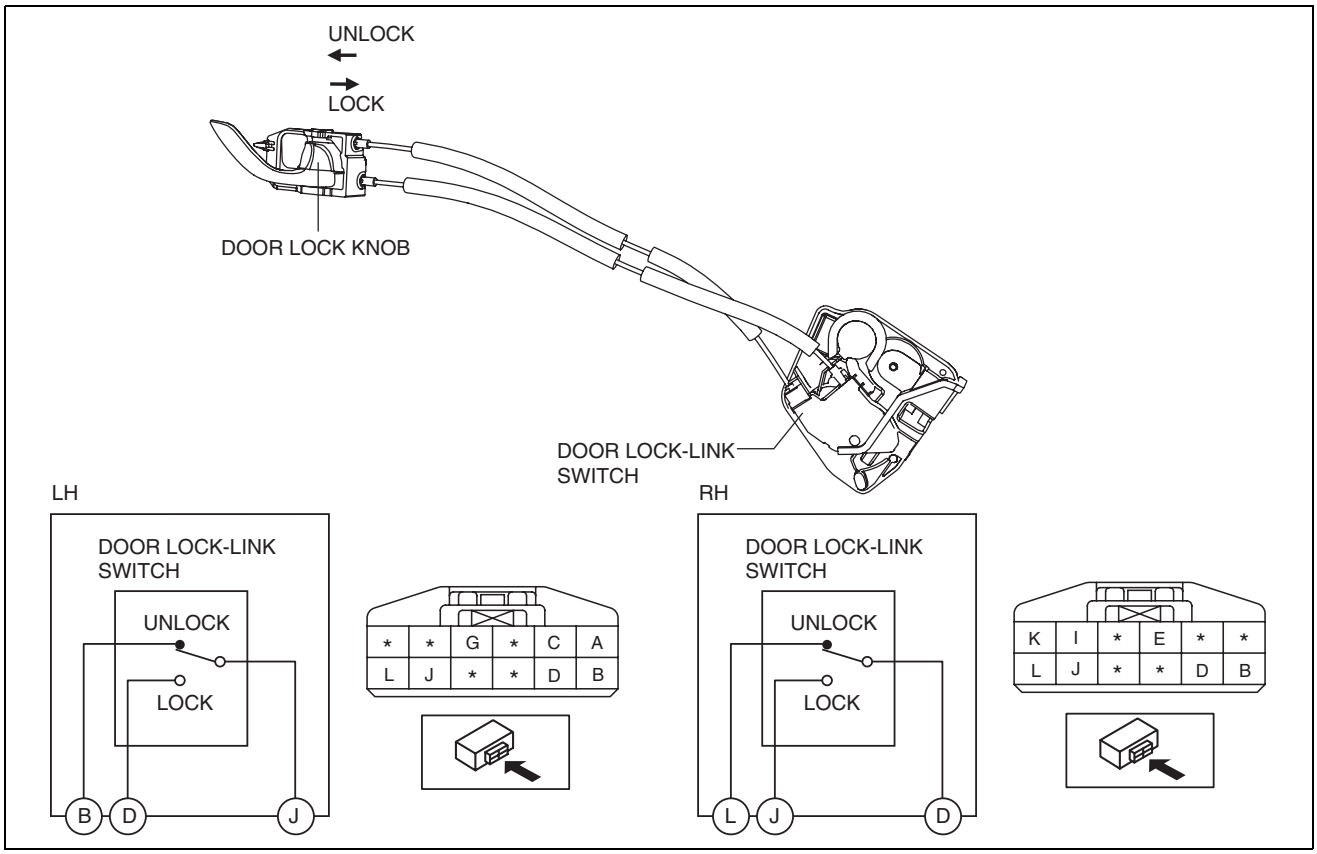
id091400110900

Purpose
- Switches on/off in conjunction with the rear door lock knob lock/unlock, and detects the rear door lock/unlock condition by the voltage which is changed by the rear body control module (RBCM).

Function
- The door lock-link switch contact point changes in conjunction with the rear door lock knob lock/unlock operation.

Construction
- The rear door lock knob and door lock-link switch are connected by the door lock-link cable, and are built into the rear door latch and lock actuator.

SECURITY AND LOCKS



ac5wzn00001484

Operation

Lock operation

- When the rear door lock knob is turned to the lock position, the door lock-link cable is pressed, and the door lock-link switch is switched to the lock side.

Unlock operation

- When the rear door lock knob is turned to the unlock position, the door lock-link cable is pulled, and the door lock-link switch is switched to the unlock side.

Fail-safe

- Function not equipped.

LIFTGATE OPENER SYSTEM

id091400107300

Outline

- A liftgate opener system has been adopted in which the liftgate can be opened just by pressing the liftgate opener switch.
- The rear body control module (RBCM) performs liftgate opener system fail-safe. (See 09-40-20 REAR BODY CONTROL MODULE (RBCM).)

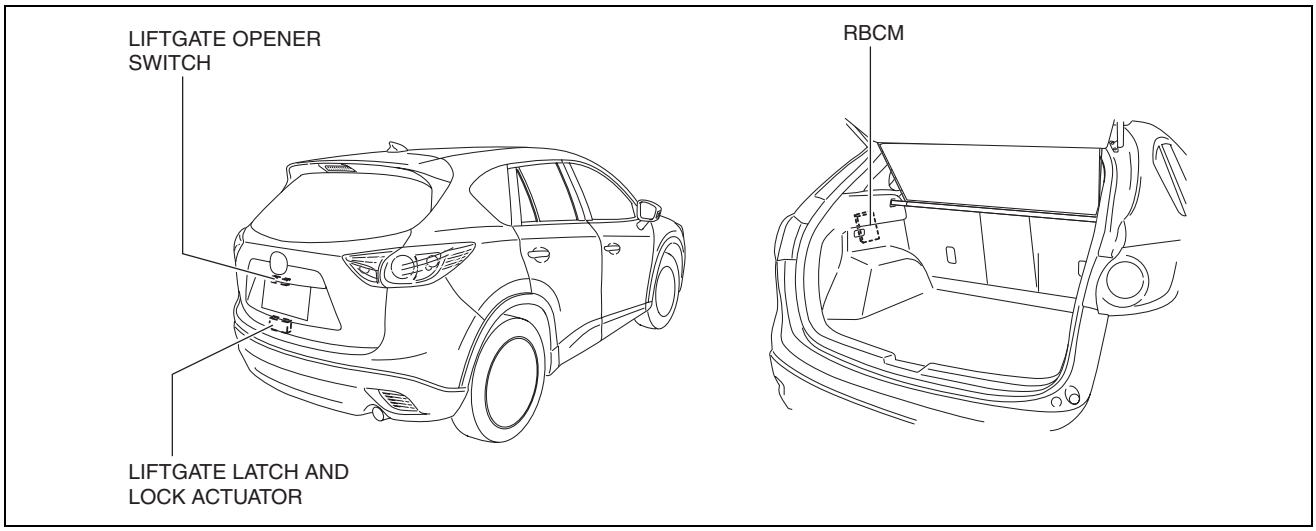
Function

- When the liftgate opener switch is pressed, the liftgate lock actuator operates to open the liftgate.
- The liftgate opener system is controlled based on the following CAN signals:

CAN signal sending module	Signal name
Instrument cluster	Parking brake lever status signal (MTX)
Via instrument cluster from TCM	Selector lever signal (ATX)
Via instrument cluster from PCM	Vehicle speed signal

SECURITY AND LOCKS

Structural view



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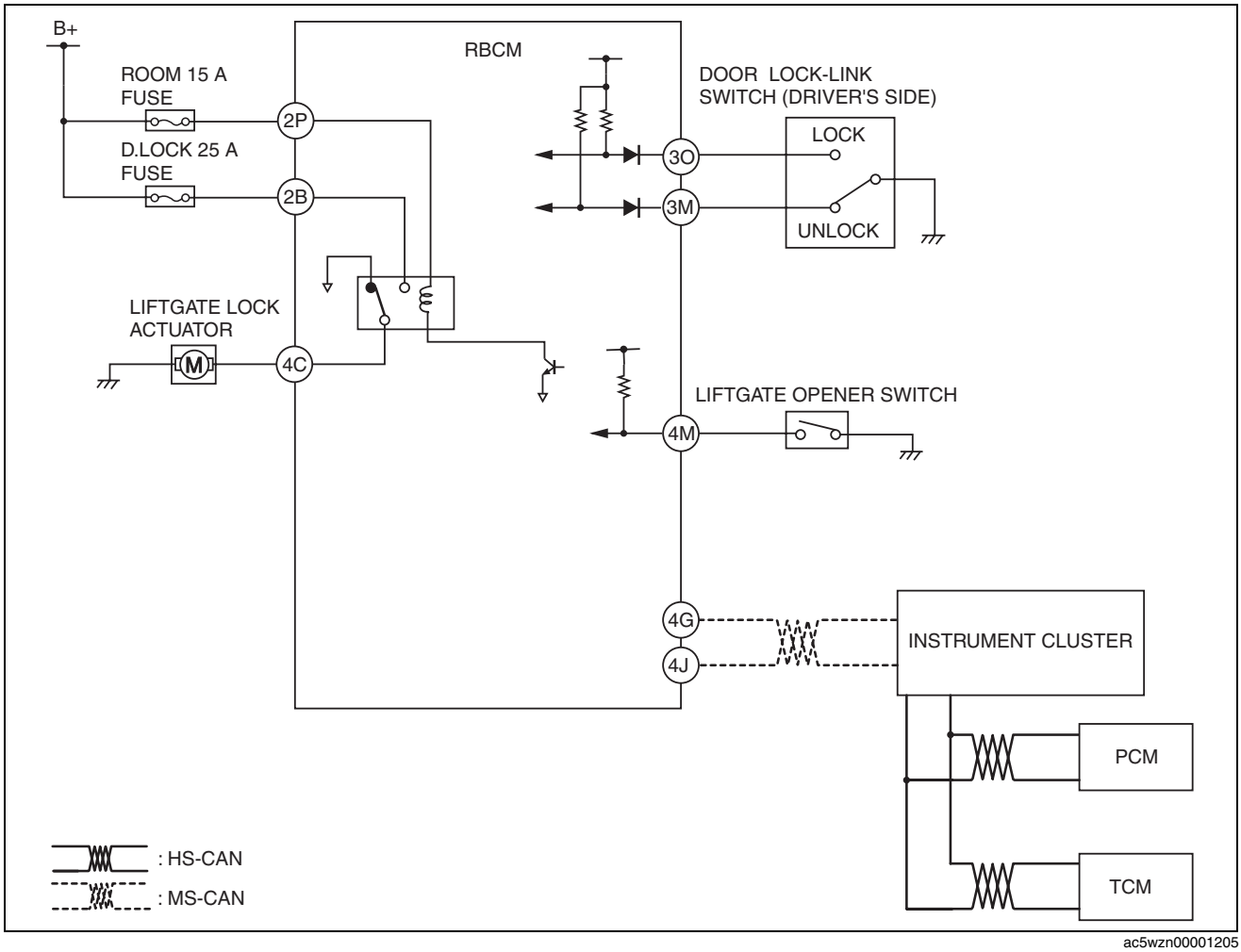
System wiring diagram



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Operation

Operation condition

When all of the following conditions are met, the liftgate opener system operates.

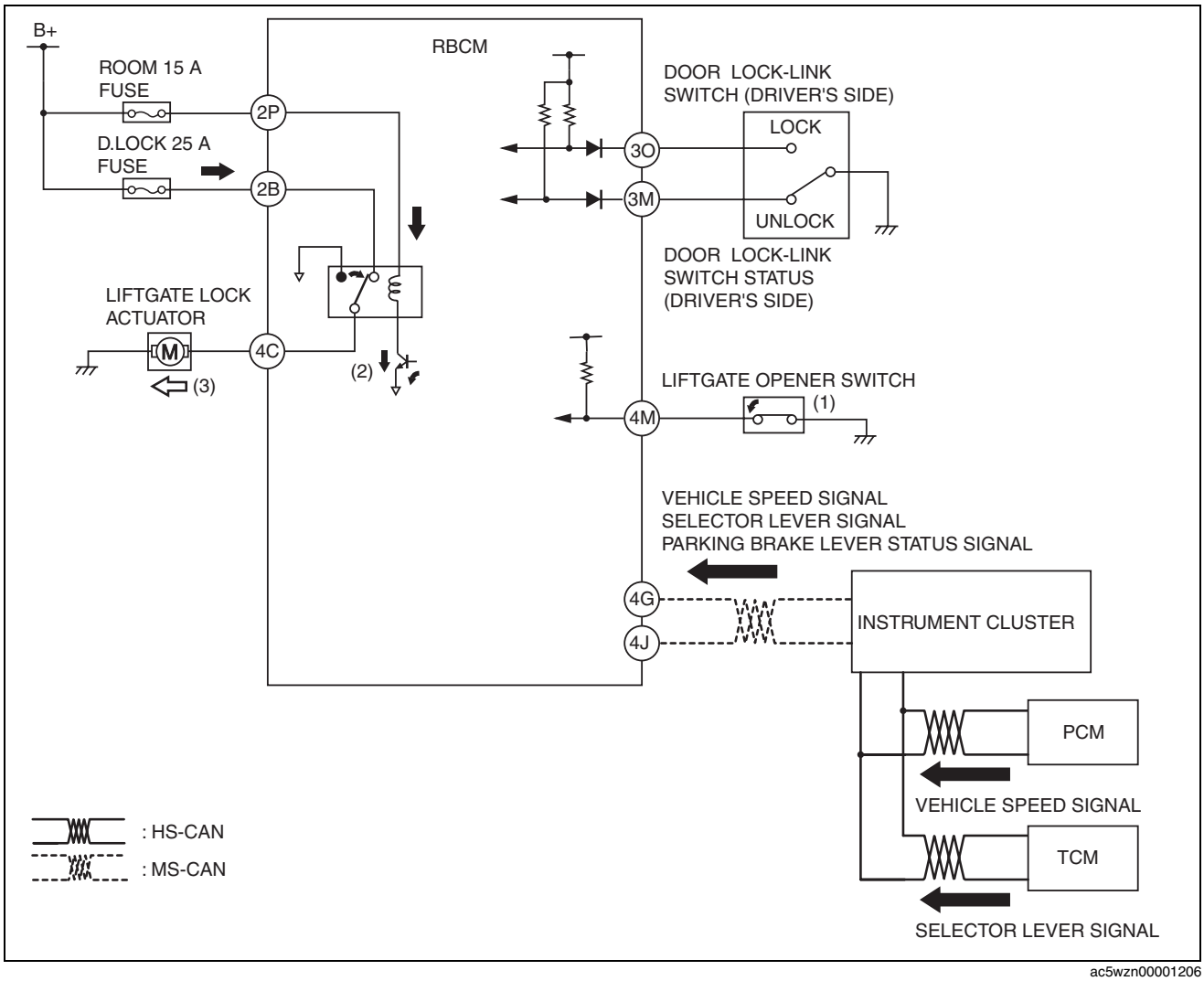
- Ignition is switched ON (engine off or on)
  - — Selector lever is in P position (ATX)
  - — Parking brake lever is pulled (MTX)

SECURITY AND LOCKS

  - — Vehicle speed is **3 km/h {2 mph} or less**
  - — Driver's door is unlocked
- Ignition is switched OFF (LOCK)
  - — Vehicle is stopped (no vehicle speed input)
  - — Driver's door is unlocked

Open operation

1. When the liftgate opener switch is pressed, it turns on (1).
2. When the operation condition of the liftgate opener system is met, the rear body control module (RBCM) turns the transistor on for **approx. 0.7 s** (2) and turns on the liftgate release relay.
3. When the liftgate release relay turns on, the liftgate lock actuator operates (3).
4. When the liftgate lock actuator operates, the latch lever is freed and the liftgate lifts up simultaneously via the spring force of the liftgate weatherstrip and stopper rubber, and opens.



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LIFTGATE LOCK ACTUATOR

id091400109300

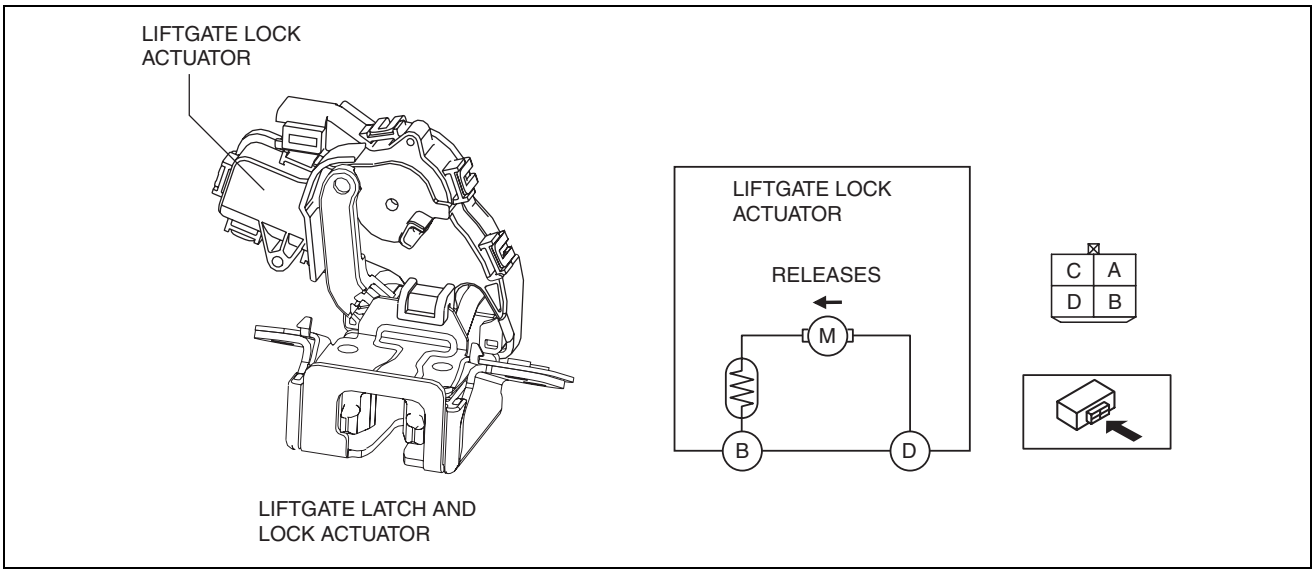
Purpose, Function

- The latch of the liftgate latch lever is released based on the signal from the rear body control module (RBCM).

Construction

- Motor is built-in.
- Installed to the liftgate latch and lock actuator.

SECURITY AND LOCKS



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Operation

1. The liftgate lock actuator rotates the built-in motor based on the liftgate opener system operation signal from the rear body control module (RBCM), and releases the latch of the liftgate latch lever.

Fail-safe

- Function not equipped.

LIFTGATE LATCH SWITCH

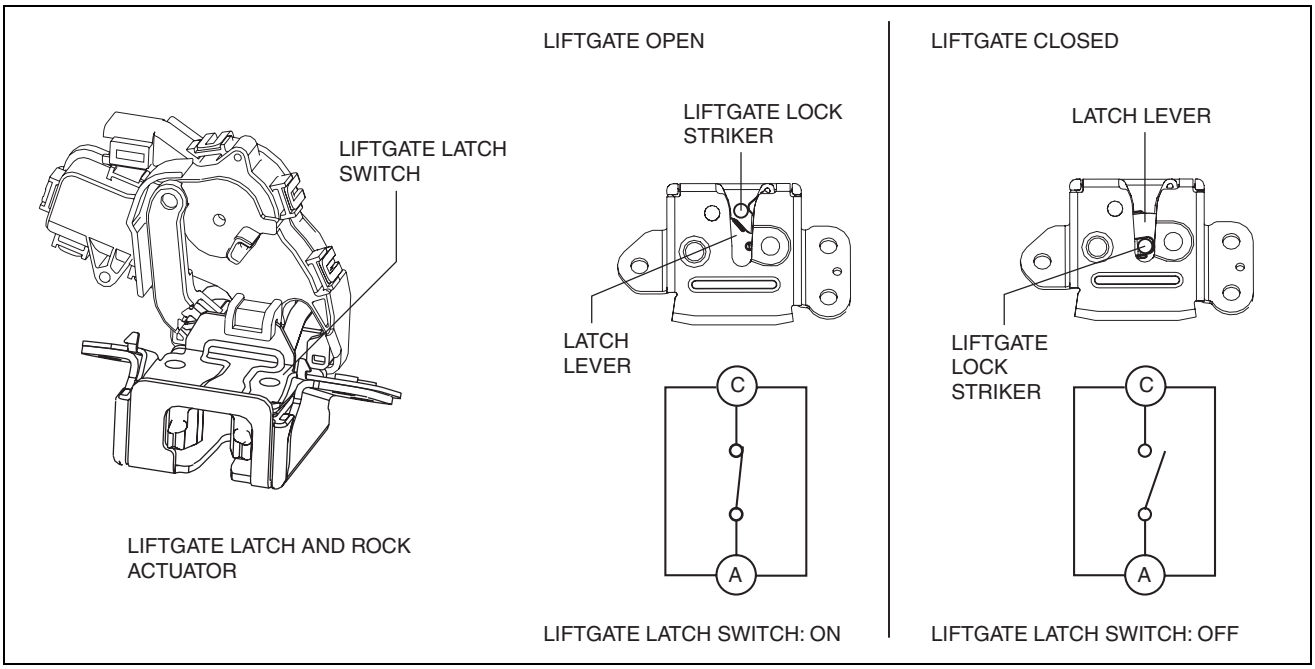
id091400603200

Purpose, Function

- The switch turns on/off in conjunction with the rotation of the latch lever, and it detects the open/closed condition of the liftgate by the voltage value which is changed by the rear body control module (RBCM).

Construction

- The switch is turned on/off by the rotation of the latch lever.
- When the liftgate is completely closed, the switch turns off (contact point: Open)



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SECURITY AND LOCKS

Operation
Liftgate closed (latched) operation
1. When the liftgate is closed, the liftgate lock striker enters the latch lever groove.
2. When the liftgate further closes, the latch lever is pressed by the liftgate lock striker and it rotates.
3. When the liftgate is completely closed, the latch lever is in the latched condition pressing the liftgate latch switch, which turns the switch off.

Liftgate open (unlatch) operation
1. When the liftgate lock actuator operates to open the liftgate, the latch lever is in an unlatched condition, and the liftgate latch switch turns on.

Fail-safe
- Function not equipped.

KEYLESS ENTRY SYSTEM

id091400109400

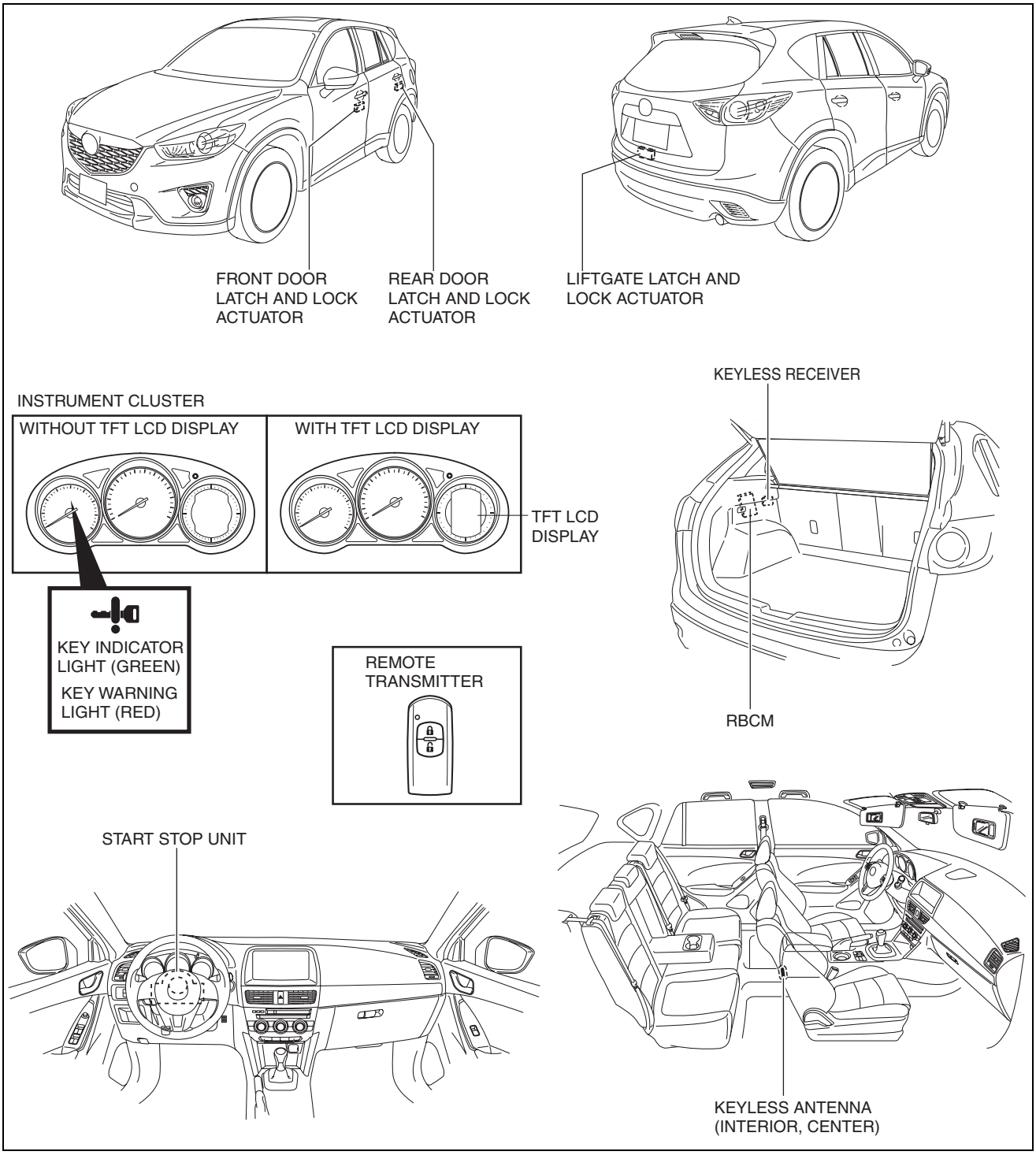
Outline
- A keyless entry system has been adopted in which locking/locking is performed by operation of the remote transmitter button, even from a location away front the vehicle.
- The start stop unit performs keyless entry system fail-safe. (See 09-14-58 START STOP UNIT.)

Function
- When the following operation is performed, the start stop unit verifies the remote transmitter ID data.
  - — Locking/unlocking using a remote transmitter
- The keyless entry system has the following functions in the event that the user operates the system incorrectly or to prevent the user from leaving the vehicle without locking.
  - — Auto re-lock function: After unlocking, if any door or the liftgate is not opened and a period of time according to the customize setting has elapsed, all doors are automatically locked.
  - — Remote transmitter pause function: All the functions of the remote transmitter other than the remote transmitter used for the door lock are paused.
  - — Alert function: If the system is operated incorrectly which results in a possible problem occurring, the system warns the user by using the indicator light, warning light, LCD display, and buzzer in the instrument cluster.

Remote transmitter battery voltage low indication function
- This function notifies the user that the battery voltage of the remote transmitter is low.

SECURITY AND LOCKS

Structural View



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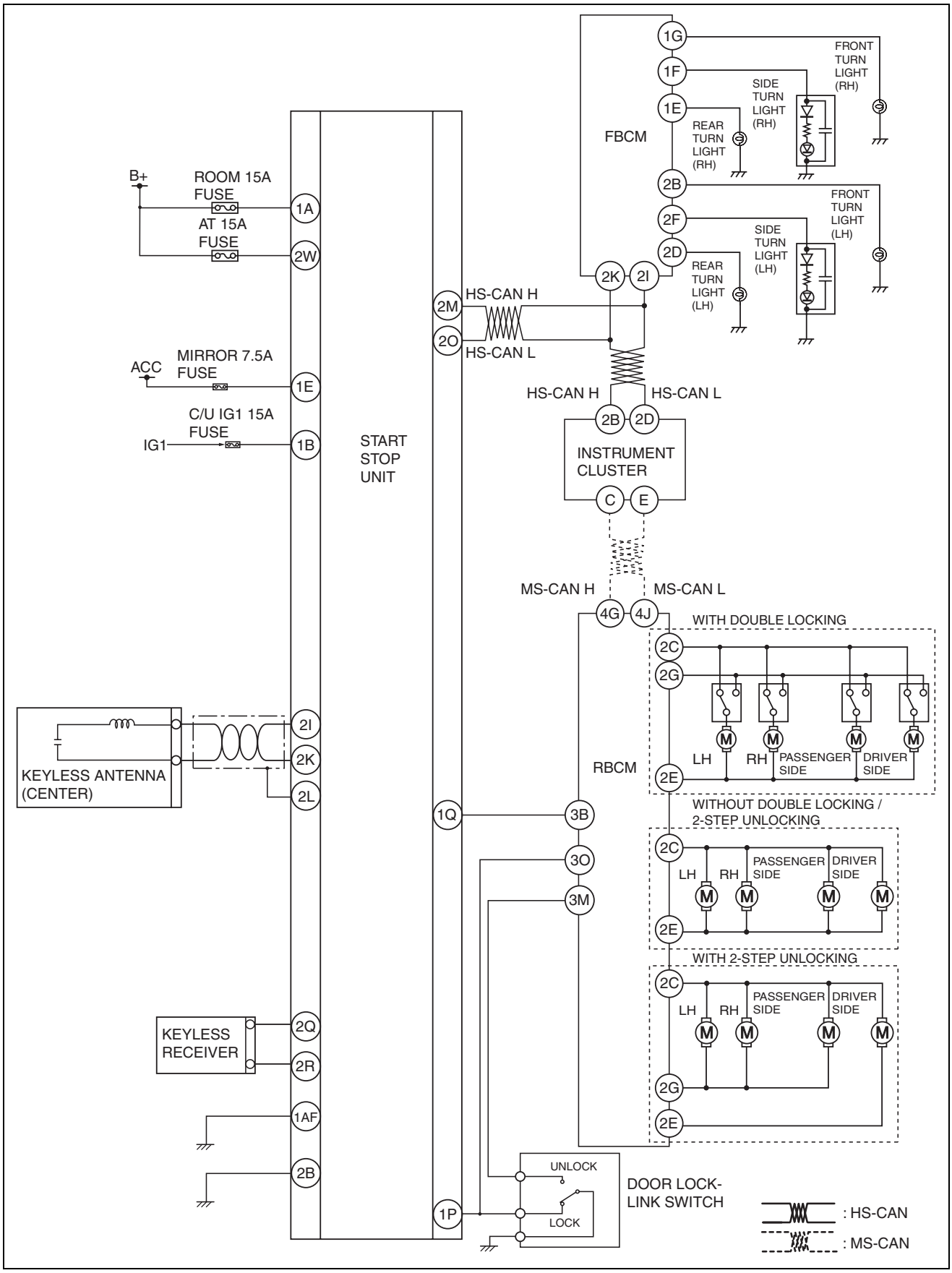
SECURITY AND LOCKS

System Wiring Diagram



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SECURITY AND LOCKS

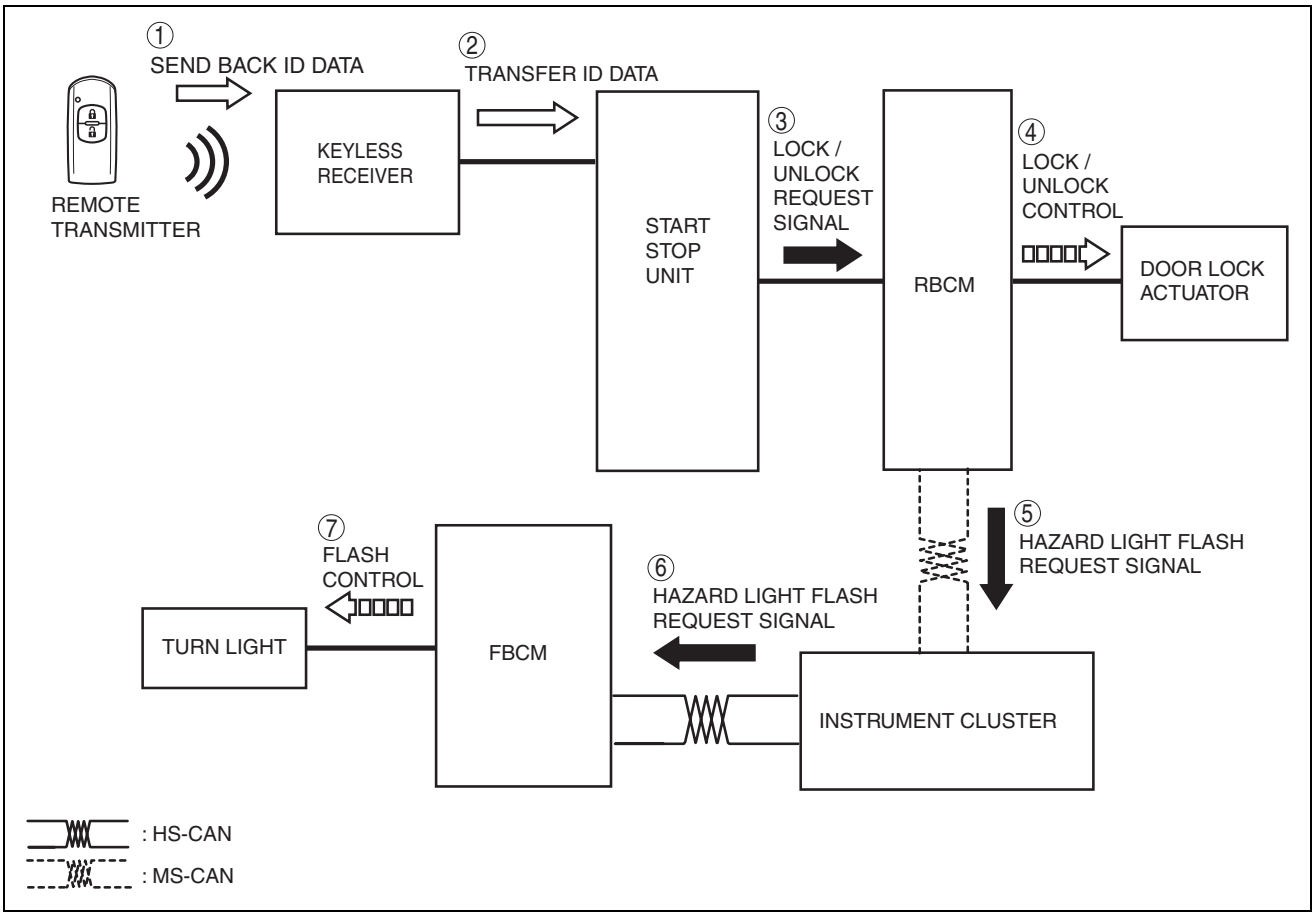
Operation

Lock/unlock operation using remote transmitter

Note

- If the lock button of the remote transmitter is operated when all of the following conditions are met, all the doors and the liftgate are locked.
  - — Ignition is switched off (LOCK)
  - — All doors are closed
- If the unlock button of the remote transmitter is operated when all of the following conditions are met, all the doors and the liftgate are unlocked.
  - — Ignition is switched off (LOCK)

1. When the lock or unlock button of the remote transmitter is pressed, the remote transmitter sends ID data.
2. The keyless receiver receives ID data and transmits the data to the start stop unit.
3. The start stop unit verifies the ID data, and if the ID data matches, it sends a lock/unlock request signal to the rear body control module (RBCM).
4. The rear body control module (RBCM) operates the front/rear door lock actuator motor to lock/unlock the front/rear doors.
5. At the same time as the door lock/unlock operation, it sends a hazard light flash request signal to the instrument cluster as a CAN signal.
6. The instrument cluster sends the hazard light flash request signal to the front body control module (FBCM) as a CAN signal.
7. The front body control module (FBCM) controls the hazard lights to flash for the following number of times to signal that the lock/unlock operation is completed.
   - Lock: Flashed once
   - Unlock: Flashed twice



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Auto re-lock function operation

- After the start stop unit sends an unlock request signal to the rear body control module (RBCM), if any of the following operations is not performed in **30 s** [*1], it sends a lock request signal to the rear body control module (RBCM) to lock the front/rear doors.
  - — A door or the liftgate is opened

SECURITY AND LOCKS

— A lock/unlock operation is performed using the driver's side front door key cylinder.
— A lock/unlock operation is performed using the driver's side front door lock knob.
— A lock/unlock operation is performed using the remote transmitter.
— The ignition is switched to ACC or ON (engine off).

*1 : Customization setting time

Remote transmitter pause function operation
When door locking is performed

- If a door is locked by the remote transmitter operation when all the following conditions are met, all the functions of the remote transmitter other than the remote transmitter used for the door lock operation are paused.
  — All doors and liftgate are closed
  — Ignition is switched off (LOCK)

Remote transmitter pause cancel operation

- The functions of the paused remote transmitter are restored when the following conditions is met:
  — A remote transmitter with which the engine can be started is brought inside the vehicle.
  — The lock/unlock button on the paused remote transmitter is pressed.

Alert function operation

- Under the following conditions, the start stop unit sends a warning request signal to the instrument cluster via CAN communication to illuminate the push button start indicator light (amber).
- When the instrument cluster receives the warning request signal, it displays the warning indicator in the TFT LCD display (with TFT LCD display) or it flashes the KEY warning light (without TFT LCD display).

Condition	Instrument cluster			Push button start
	Keyless warning alarm	KEY warning light (red)	TFT LCD display	Indicator light (amber)
Keyless entry system malfunction	—	On		Flash
Driver's door is opened with ignition in ACC	**European (L.H.D. U.K.) specs.** • Pattern A*1×6 times **Without European (L.H.D. U.K.) specs.** • Pattern A*1×Continuous	—		—
Remote transmitter cannot be detected inside vehicle when all doors are closed with ignition not switched off (LOCK)	Pattern B*1	Flash		—

SECURITY AND LOCKS

*1 : For the keyless warning alarm sound pattern, refer to the keyless warning alarm. (See 09-22-28 KEYLESS WARNING ALARM.)

Remote transmitter battery voltage low indication function operation

- When the ignition is switched from ON (engine off or on) to off (LOCK) under the condition indicated in the table, the start stop unit sends a battery voltage low indication request signal to the instrument cluster as a CAN signal.
- When the instrument cluster receives the battery voltage depletion display request signal, it performs the remote transmitter battery voltage low indication in the TFT LCD display (with TFT LCD display) or it flashes the KEY indicator light (without TFT LCD display).

Condition	Instrument cluster	
	KEY indicator light (green)	Indication on LCD
Start stop unit receives code for low remote transmitter battery voltage	Flash (for approx. 30 s after ignition switched off)	

ADVANCED KEYLESS ENTRY SYSTEM

id091400107400

Outline

- An advanced keyless entry system has been adopted which performs automatic authorization of the remote transmitter that is carried and locking/unlocking of the doors.
- The start stop unit performs advanced keyless entry system fail-safe. (See 09-14-58 START STOP UNIT.)

Function

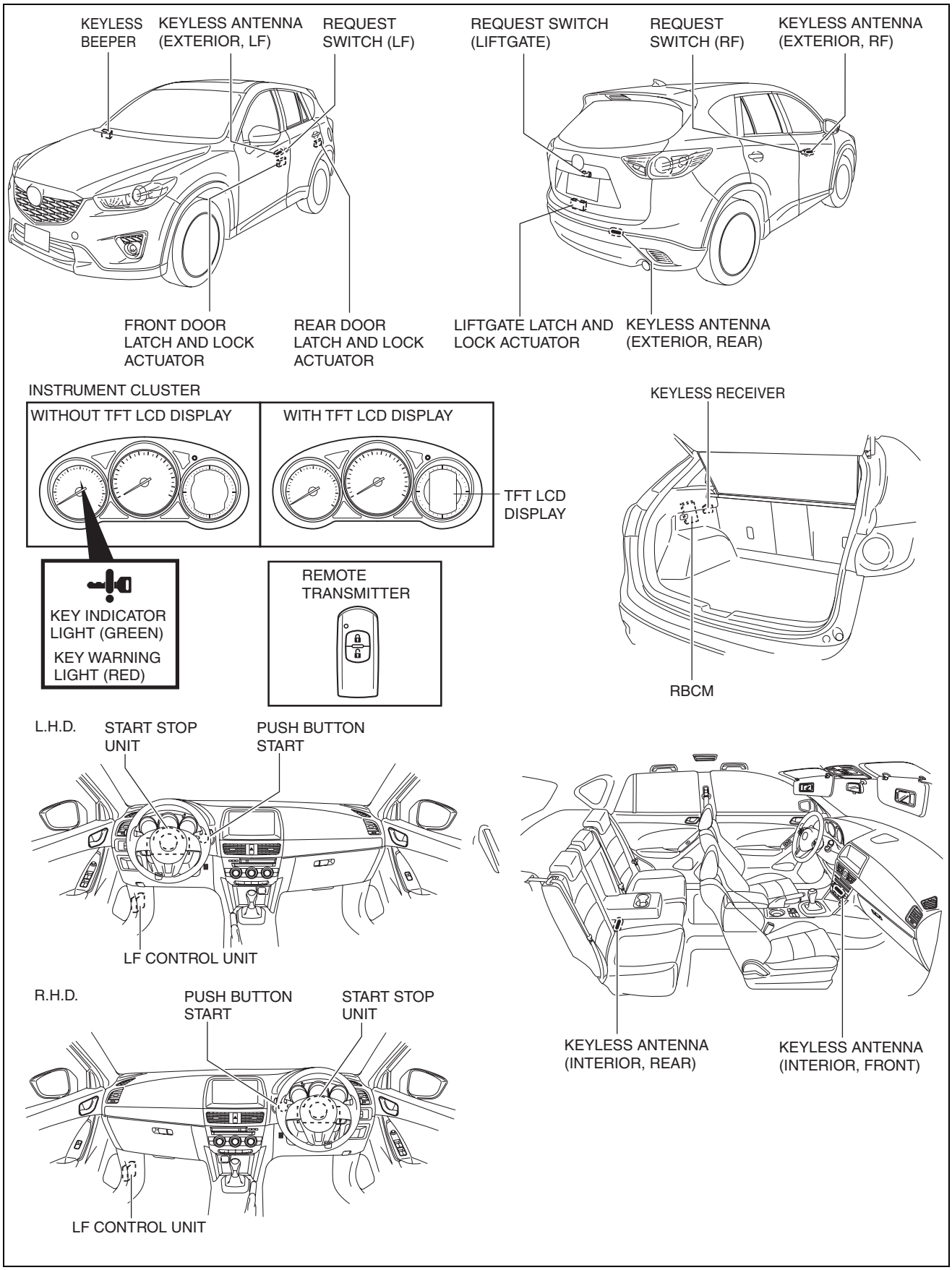
- The advanced keyless entry system performs remote transmitter authorization when any of the following operations is performed.
  - — Locking/unlocking using a request switch on an outer door
  - — Locking using the request switch on the liftgate
  - — Locking/unlocking using a remote transmitter
  - — Opening the liftgate
- The advanced keyless entry system has the following functions in the event that the user operates the system incorrectly or to prevent the user from leaving the vehicle without locking.
  - — Auto re-lock function: After unlocking, if any door or the liftgate is not opened and a period of time according to the personalization setting has elapsed, all doors are automatically locked.
  - — Out-of-area (reception area) type auto lock function: After closing all doors, when the remote transmitter is brought out of the reception area of the keyless antenna, all doors are automatically locked.
  - — Remote transmitter pause function: If all doors are locked with a transmitter left in the vehicle, the functions of the remote transmitter inside the vehicle are paused.
  - — Remote transmitter left-in-vehicle prevention function: If the liftgate is closed with a remote transmitter left in the vehicle, the liftgate can be opened by pressing the liftgate opener switch.
  - — Alert function: If the system is operated incorrectly which results in a possible problem occurring, the system warns the user by using the indicator light, warning light, LCD display, and buzzer in the instrument cluster, or by using the keyless beeper.

Remote transmitter battery voltage low indication function

- This function signals the user that the battery voltage of the remote transmitter is low.

SECURITY AND LOCKS

Structural View



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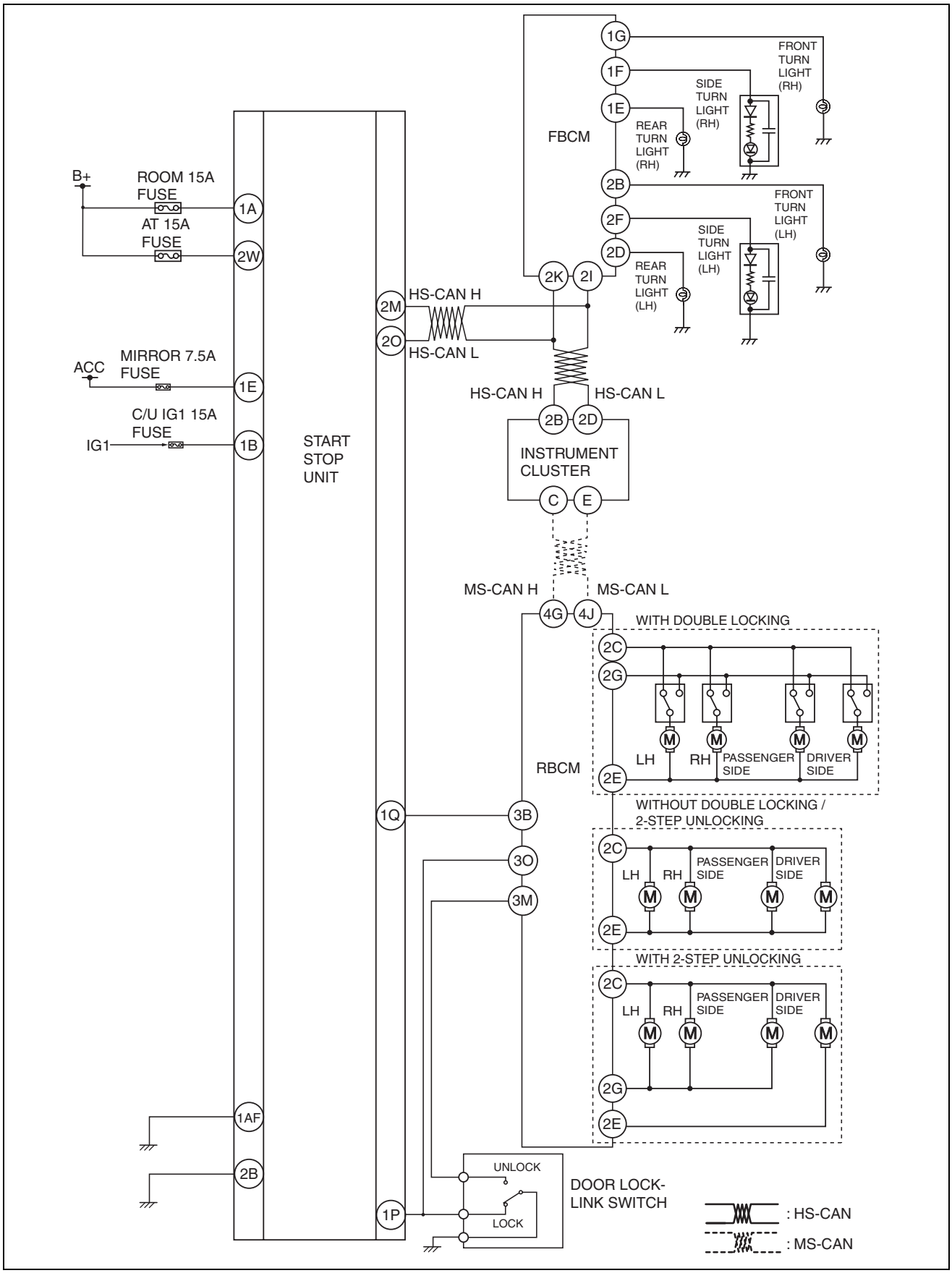
SECURITY AND LOCKS

System Wiring Diagram



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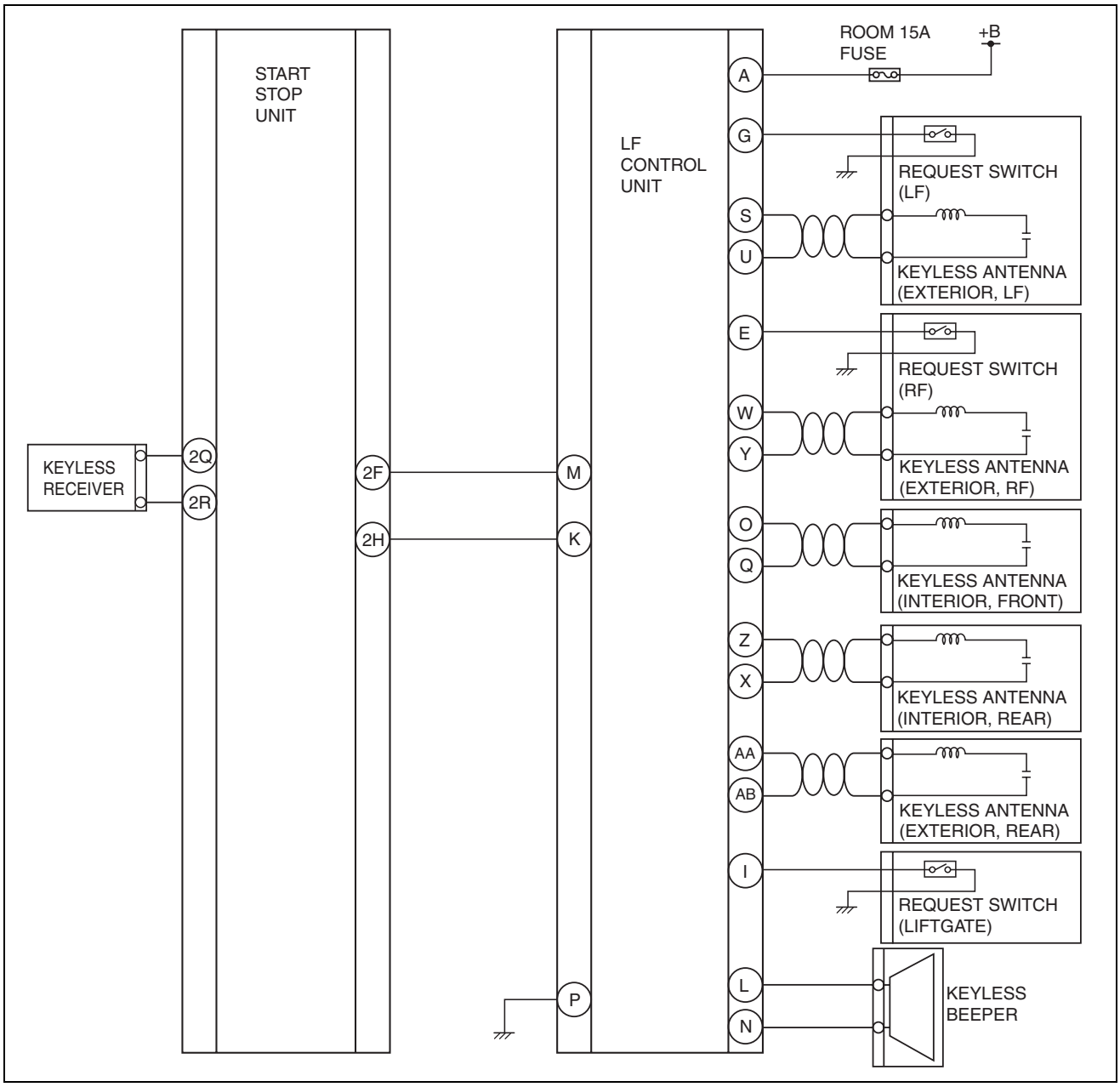
SECURITY AND LOCKS



ac5wzn00001220

Operation
Lock/unlock operation using request switch on outer handle

Note
- Lock/unlock operation is performed when a request switch on an outer handle is pressed with all the following conditions met.
  - — Ignition is switched OFF (LOCK)
  - — All doors are closed
  - — The remote transmitter is within the reception area outside the vehicle.

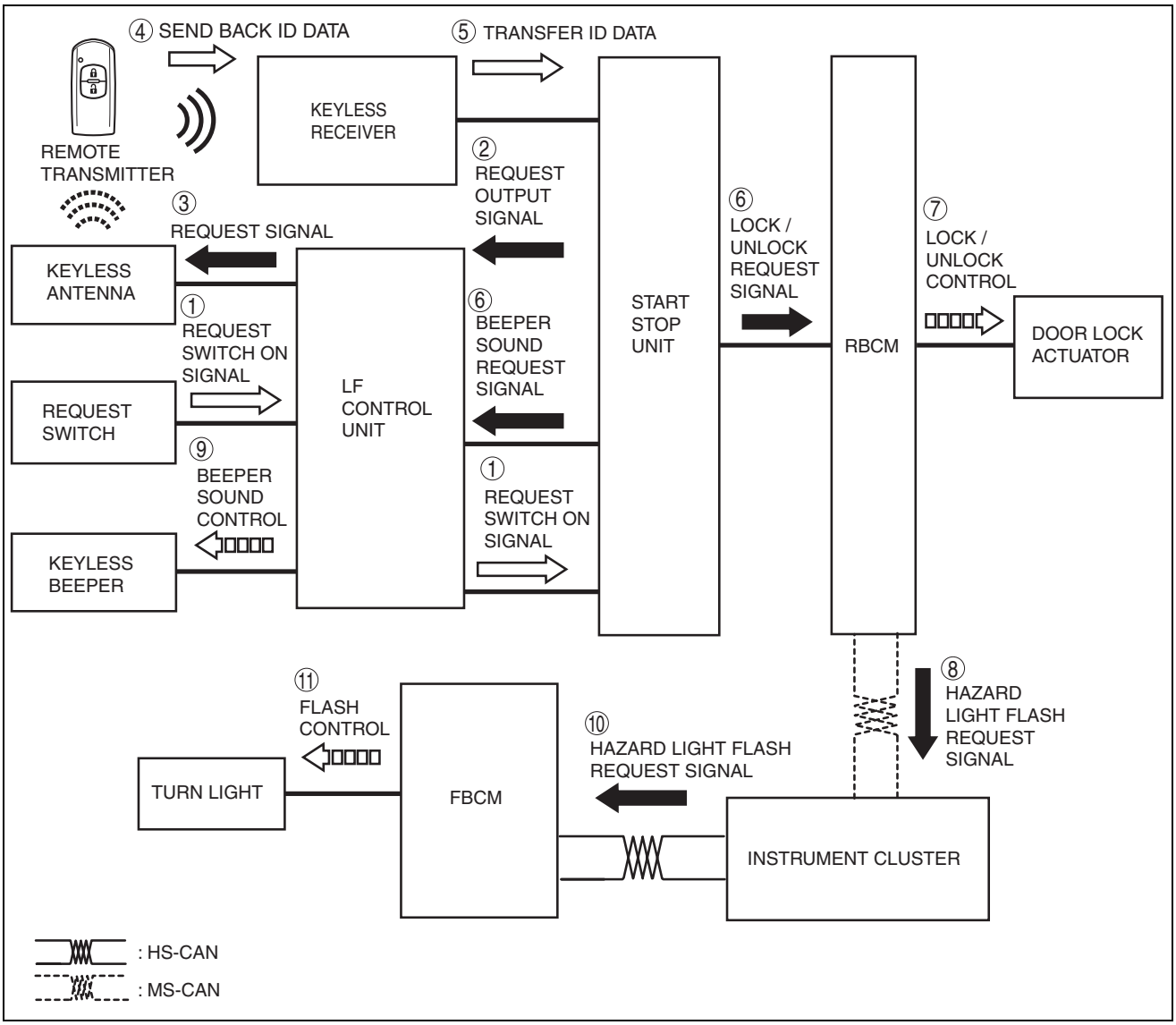
1. When the driver's or the passenger's side request switch is pressed, a request switch on signal is input to the start stop unit via the LF control unit.
2. Based on the request switch on signal, the start stop unit sends a request output signal to the LF control unit to verify that the remote transmitter is inside the reception area.
3. The LF control unit sends a request signal from the keyless antenna of the door in which the request switch was pressed and all keyless antennas for the vehicle interior.
4. The remote transmitter receives the request signal from the outside antenna, and sends ID data to the keyless receiver.

SECURITY AND LOCKS

5. The keyless receiver transmits the received ID data to the start stop unit.
6. The start stop unit verifies the ID data, and if it determines a programmed remote transmitter is outside the vehicle, it sends a lock/unlock signal to the rear body control module (RBCM) and at the same time, it sends a beeper sound request signal to the LF control unit.
7. When the rear body control module (RBCM) receives the lock/unlock signal, it operates the front/rear door lock actuator motor to lock/unlock the front/rear doors.

Note
- It takes **approx. 1—2 s** from when a request switch is pressed until the lock/unlock operation is completed.

8. At the same time as the door lock/unlock operation, it sends a hazard light flash request signal to the instrument cluster as a CAN signal.
9. When the LF control unit receives the beeper sound request signal, it operates the keyless beeper for the following number of times:
   — When locking: Keyless beeper sounds once
   — When unlocking: Keyless beeper sounds twice
10. The instrument cluster sends the hazard light flash request signal to the front body control module (FBCM) as a CAN signal.
11. When the front body control module (FBCM) receives the hazard light flash request signal, it controls the hazard light to flash for the following number of times to signal that the lock/unlock operation is completed.
   — When locking: Hazard light flashes once
   — When unlocking: Hazard light flashes twice



ac5wzn00000828

SECURITY AND LOCKS

Lock operation using request switch on liftgate

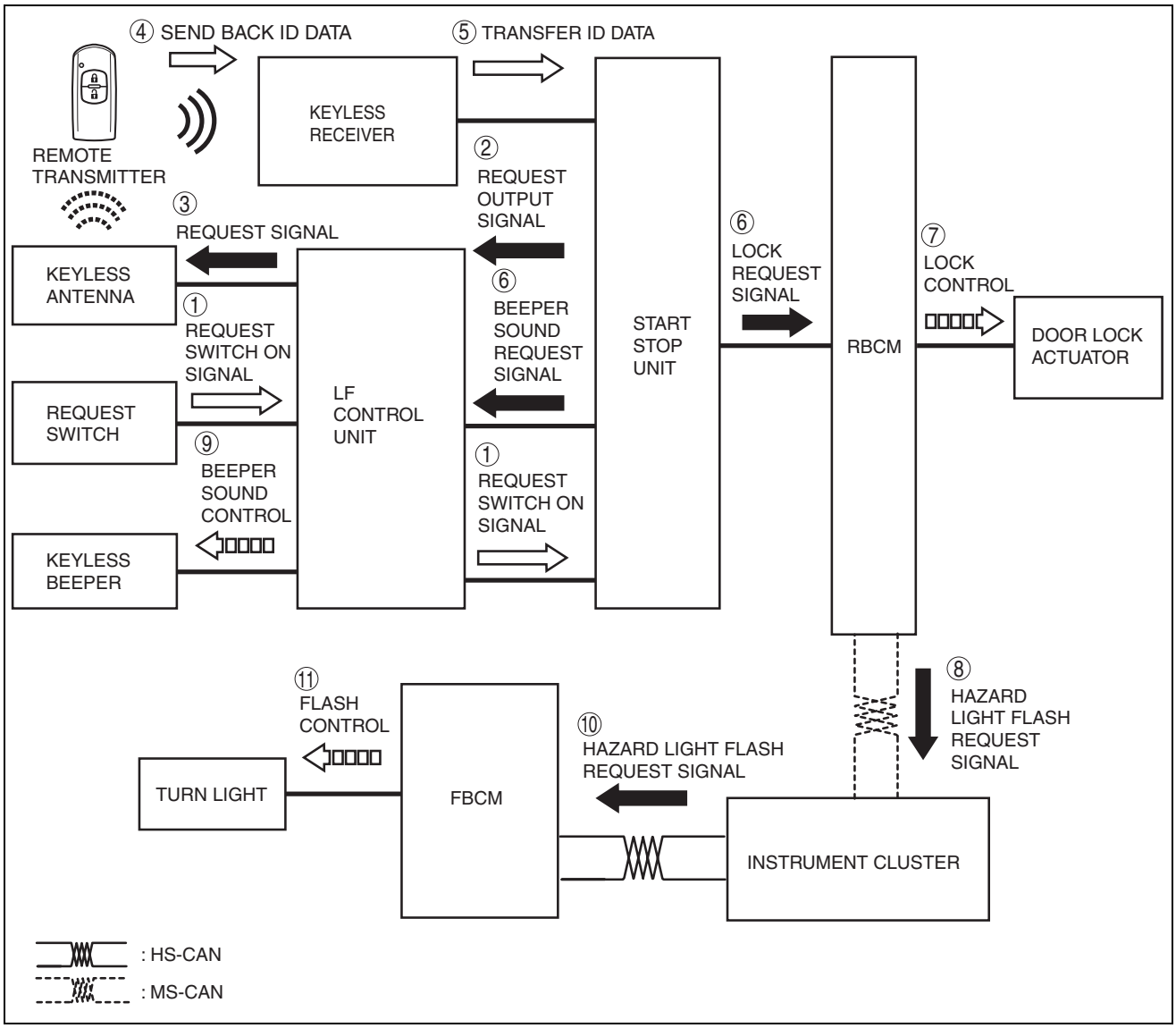
Note
- Lock operation is performed when the request switch on the liftgate is pressed with all the following conditions met.
  - — Ignition is switched OFF (LOCK)
  - — All doors and liftgate are closed
  - — The remote transmitter is within the reception area outside the vehicle.

1. When the request switch is pressed, a request switch on signal is input to the start stop unit via the LF control unit.
2. Based on the request switch on signal, the start stop unit sends a request output signal to the LF control unit to verify that the remote transmitter is inside the reception area.
3. The LF control unit sends a request signal from the outside keyless antenna (rear) and all keyless antennas for the vehicle interior.
4. The remote transmitter receives the request signal from the outside antenna, and sends ID data to the keyless receiver.
5. The keyless receiver transmits the received ID data to the start stop unit.
6. The start stop unit verifies the ID data, and if it determines a programmed remote transmitter is outside the vehicle, it sends a lock signal to the rear body control module (RBCM) and at the same time, it sends a beeper sound request signal to the LF control unit.
7. When the rear body control module (RBCM) receives the lock signal, it operates the front/rear door lock actuator motor to lock the front/rear doors.

Note
- It takes **approx. 1—2 s** from when the request switch is pressed until the lock operation is completed.

8. At the same time as the door lock/unlock operation, it sends a hazard light flash request signal to the instrument cluster as a CAN signal.
9. When the LF control unit receives the beeper sound request signal, it operates the keyless beeper once.
10. The instrument cluster sends the hazard light flash request signal to the front body control module (FBCM) as a CAN signal.
11. When the front body control module (FBCM) receives the hazard light flash request signal, it controls the hazard light to flash once to signal that the lock operation is completed.

SECURITY AND LOCKS



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Lock/unlock operation using remote transmitter

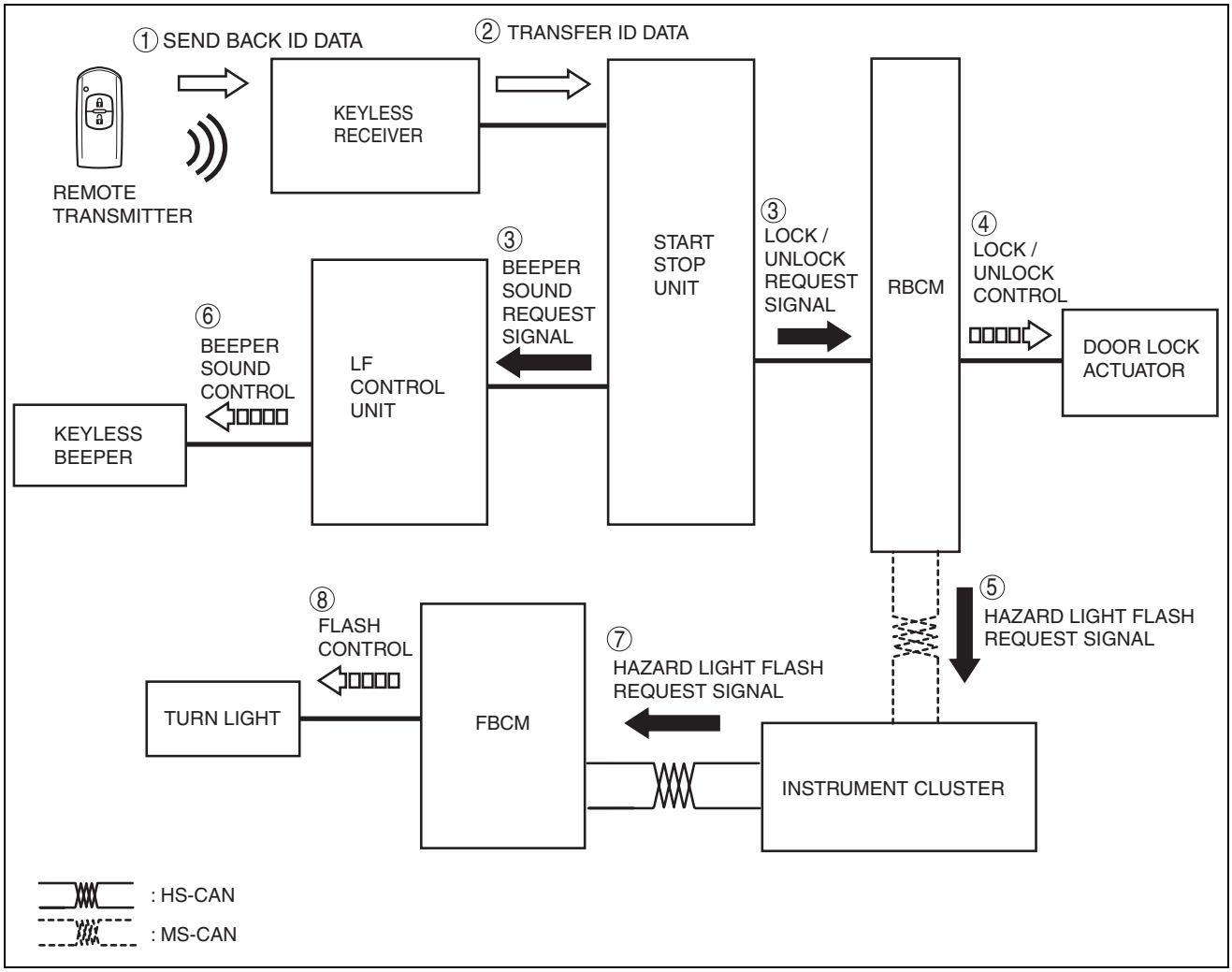
Note

- The lock/unlock operation is performed when the lock button of the remote transmitter is pressed with all the following conditions met.
  - — Ignition is switched OFF (LOCK)
  - — All doors are closed
  - — The remote transmitter is within the operable range

1. When the lock or unlock button of the remote transmitter is pressed, the remote transmitter sends ID data.
2. When the keyless receiver receives ID data, it transmits the data to the start stop unit.
3. The start stop unit verifies the ID data, and if the ID data match, it sends a lock/unlock signal to the rear body control module (RBCM) and at the same time, it sends a beeper sound request signal to the LF control unit.
4. The rear body control module (RBCM) operates the front/rear door lock actuator motor to lock/unlock the front/rear doors.
5. At the same time as the door lock/unlock operation, it sends a hazard light flash request signal to the instrument cluster as a CAN signal.
6. The LF control unit operates the keyless beeper for the following number of times:
   - — When locking: Keyless beeper sounds once
   - — When unlocking: Keyless beeper sounds twice
7. The instrument cluster sends the hazard light flash request signal to the front body control module (FBCM) as a CAN signal.

SECURITY AND LOCKS

8. The front body control module (FBCM) controls the hazard light to flash for the following number of times to signal that the lock/unlock operation is completed.
   — When locking: Hazard light flashes once
   — When unlocking: Hazard light flashes twice



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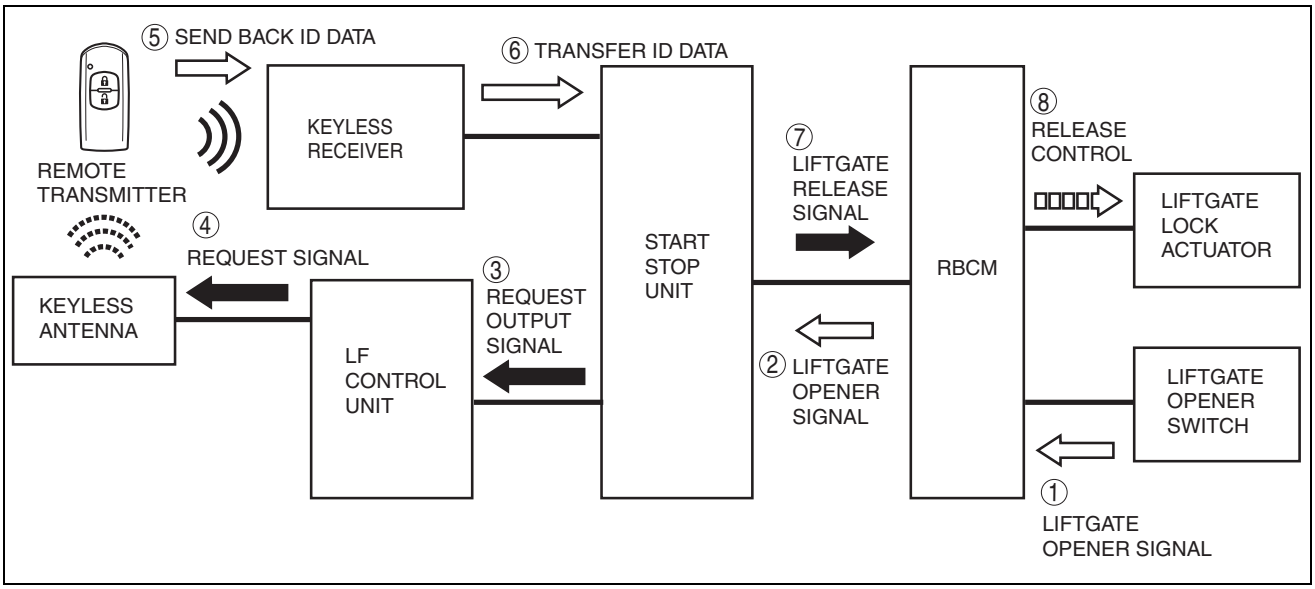
Liftgate open operation

1. When the liftgate opener switch is pressed, a liftgate open signal is input to the rear body control module (RBCM).
2. The rear body control module (RBCM) sends the liftgate open signal to the start stop unit.
3. Based on the liftgate open signal, the start stop unit sends a request output signal to the LF control unit to verify that the remote transmitter is inside the reception area.
4. Based on the request output signal from the start stop unit, the LF control unit outputs a request signal using the keyless antenna inside the rear bumper.
5. The remote transmitter receives the request signal from the antenna (outside, rear), and sends ID data to the keyless receiver.
6. The keyless receiver transmits the received ID data to the start stop unit.
7. The start stop unit verifies the ID data, and if the ID data matches, it sends a liftgate release signal to the rear body control module (RBCM).
8. When the rear body control module (RBCM) receives the liftgate release signal, it operates the liftgate lock actuator motor to release the liftgate.

SECURITY AND LOCKS



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Auto re-lock function operation

- After the start stop unit sends an unlock request signal to the rear body control module (RBCM), if any of the following operations is not performed in **30 s** *1, it sends a lock request signal to the rear body control module (RBCM) to lock the front/rear doors.
  - — A door or the liftgate is opened
  - — A lock/unlock operation is performed using the driver's side front door key cylinder.
  - — A lock/unlock operation is performed using the driver's side front door lock knob.
  - — A lock/unlock operation is performed using the remote transmitter.
  - — The ignition is switched to ACC or ON (engine off).

*1 : Personalization setting time

Out-of-area (reception area) type auto lock function operation

1. When all doors and the liftgate are closed after any door or the liftgate is open, the start stop unit goes on auto lock standby if all the following conditions are met.
   - There is no remote transmitter inside the vehicle.
   - The remote transmitter is within the reception area outside the vehicle.
   - The ignition is switched off (LOCK).
2. After entering the standby status, if the remote transmitter is moved out of the keyless antenna reception area and the ID data cannot be received from the keyless receiver, the start stop unit operates all the lock actuator for a lock operation.

Note

- The keyless beeper sounds once when switching to stand-by and the door is locked.

Remote transmitter pause function operation

When door locking is performed

1. If a lock signal is input with a remote transmitter detected inside the vehicle, the start stop unit outputs a request signal using the outside/inside keyless antennas.
2. When the remote transmitter inside the vehicle sends the ID data to the keyless receiver, the keyless receiver transmits the received ID data to the start stop unit.
3. The start stop unit receives the ID data, and after **approx. 32 s**, it suspends the functions of the transmitter inside the vehicle. It also operates the keyless beeper for 10 s.

When the liftgate is closed

1. When the liftgate is closed with all the following conditions met, the start stop unit outputs a request signal using the inside keyless antennas.
   - — All doors are locked.
   - — The liftgate is open.
   - — The start stop unit identifies a remote transmitter inside the vehicle.
2. When the remote transmitter inside the vehicle sends the ID data to the keyless receiver, the keyless receiver transmits the received ID data to the start stop unit.
3. The start stop unit receives the ID data, and after **approx. 32 s**, it suspends the functions of the transmitter inside the vehicle.

SECURITY AND LOCKS

Remote transmitter pause cancel operation

- The functions of the paused remote transmitter are restored when any one of the following conditions is met:
  - — A remote transmitter with which the engine can be started is brought inside the vehicle.
  - — The lock/unlock button on the paused remote transmitter is pressed.

Remote transmitter left-in-vehicle prevention function operation

1. When the liftgate is closed with all the following conditions met, the start stop unit operates the keyless beeper (See 09-14-46 Alert function operation) and puts the remote transmitter left-in-vehicle prevention function on standby.
   - — The liftgate is open.
   - — All doors are closed and locked.
2. When the liftgate opener switch is pressed while the remote transmitter left-in-vehicle prevention function is on standby, the start stop unit verifies the remote transmitter ID data and if it determines that the transmitter is inside the vehicle, it operates the left-in-vehicle function and sends a latch lever release signal to the rear body control module (RBCM) to release the liftgate latch lever.

- When any of the following conditions is met while the remote transmitter left-in-vehicle prevention function is on standby, the remote transmitter left-in-vehicle prevention function is canceled.
  - — The lock/unlock button of the remote transmitter is pressed.
  - — A request switch is pressed.
  - — Any door is opened.
  - — The vehicle speed exceeds **10 km/h {6.2 mph}**.
  - — The liftgate is opened and closed.

Alert function operation

- Under the conditions indicated in the table, the start stop unit sends an alert request signal to the instrument cluster via CAN communication, and the instrument cluster displays the warning. In addition, it illuminates the push button start indicator (amber) and operates the keyless beeper.

Condition	Keyless beeper	Instrument cluster			Push button start
		Keyless warning alarm	KEY warning light (red)	TFT LCD display	Indicator light (amber)
The advanced keyless entry system has a malfunction.	—	—	On		Flash
The driver's door is opened with the ignition in ACC.	—	**European (L.H.D. U.K.) specs.** • Pattern A[*1]×6 times **Without European (L.H.D. U.K.) specs.** • Pattern A[*1]×Continuous	—		—

SECURITY AND LOCKS

Condition	Keyless beeper	Instrument cluster			Push button start
		Keyless warning alarm	KEY warning light (red)	TFT LCD display	Indicator light (amber)
The remote transmitter cannot be detected inside the vehicle when all doors are closed with the ignition not switched off (LOCK).	Sounds 6 times	Pattern B*1	Flash		—
A door lock operation is performed using a request switch with any door or the liftgate is open.	Sounds 2 times	—	—	—	—
A door lock operation is performed using a request switch with ignition not switched off (LOCK).	Sounds 2 times	—	—	—	—

*1 : For the keyless warning alarm sound pattern, refer to the keyless warning alarm. (See 09-22-28 KEYLESS WARNING ALARM.)

Remote transmitter battery voltage low indication function operation

- When the ignition is switched from ON (engine off or on) to off (LOCK) under the condition indicated in the table, the start stop unit sends a battery voltage low indication request signal to the instrument cluster as a CAN signal, and the instrument cluster performs the remote transmitter battery voltage low indication.

Condition	Instrument cluster	
	KEY indicator light (green)	Indication on LCD
The start stop unit receives a code for remote transmitter battery voltage low.	Flash (for approx. 30 s after ignition switched off)	

PUSH BUTTON START SYSTEM [KEYLESS ENTRY SYSTEM]

id0914001116b3

Outline

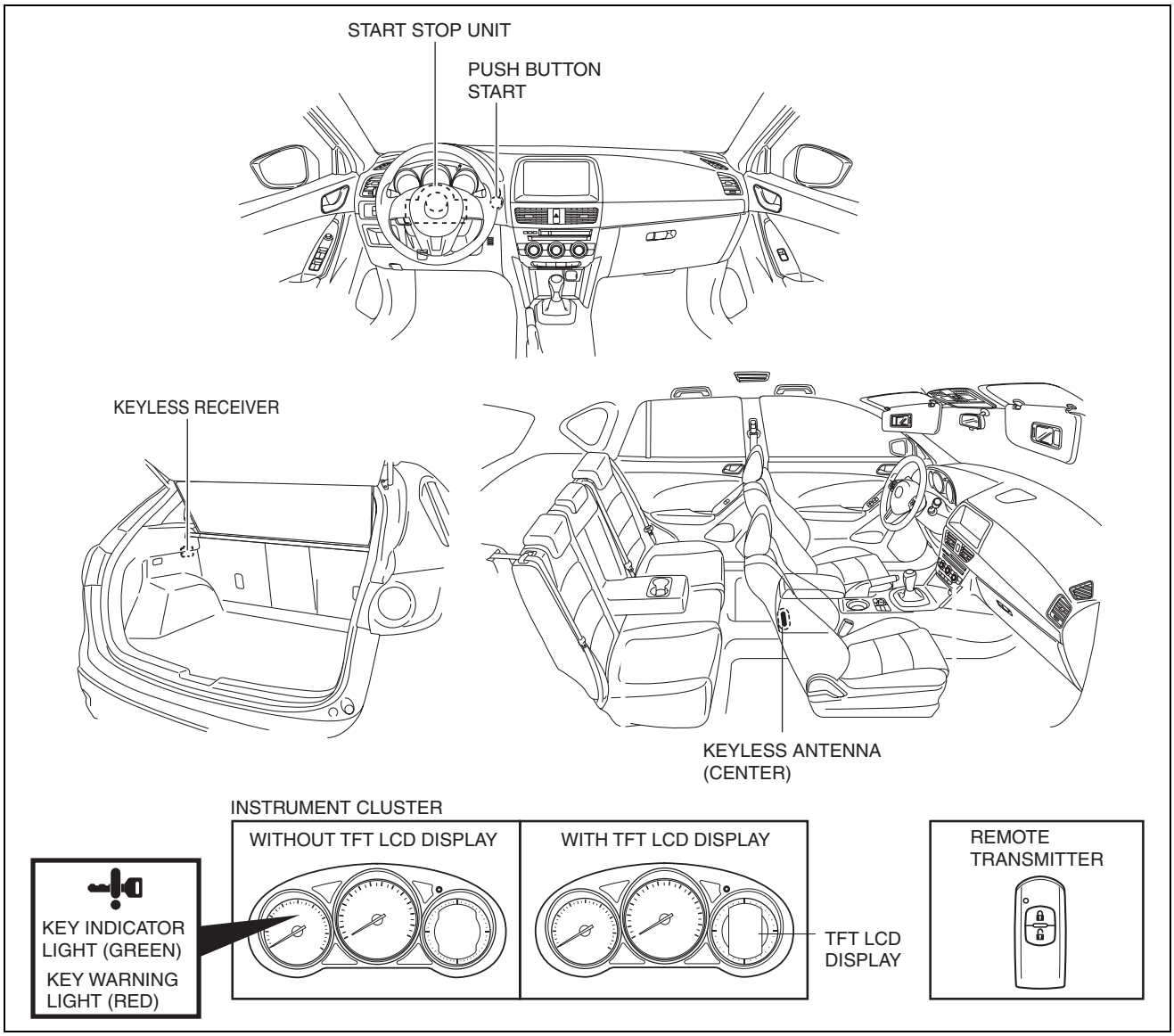
- A push button start system has been adopted that automatically performs authorization of the remote transmitter being brought within the request signal output range of the keyless antennas.
- The start stop unit performs push button start system fail-safe. (See 09-14-58 START STOP UNIT.)

Function

- When the push button start is pressed, the push button start system performs authorization of the remote transmitter that is within the request signal output range of the keyless antennas.
  - — Engine start: When the remote transmitter authorization is performed while the engine starting conditions are met, the engine starts.
  - — Power supply switching: When the remote transmitter authorization is performed, the ignition can be switched between OFF, ACC, and ON (engine on).
- The guidance function displays methods of resolving issues, such as insufficient conditions for starting the engine, or remote transmitter authorization issues or the inability to release the steering lock, in the TFT LCD display (with TFT LCD display).

SECURITY AND LOCKS

Structural View



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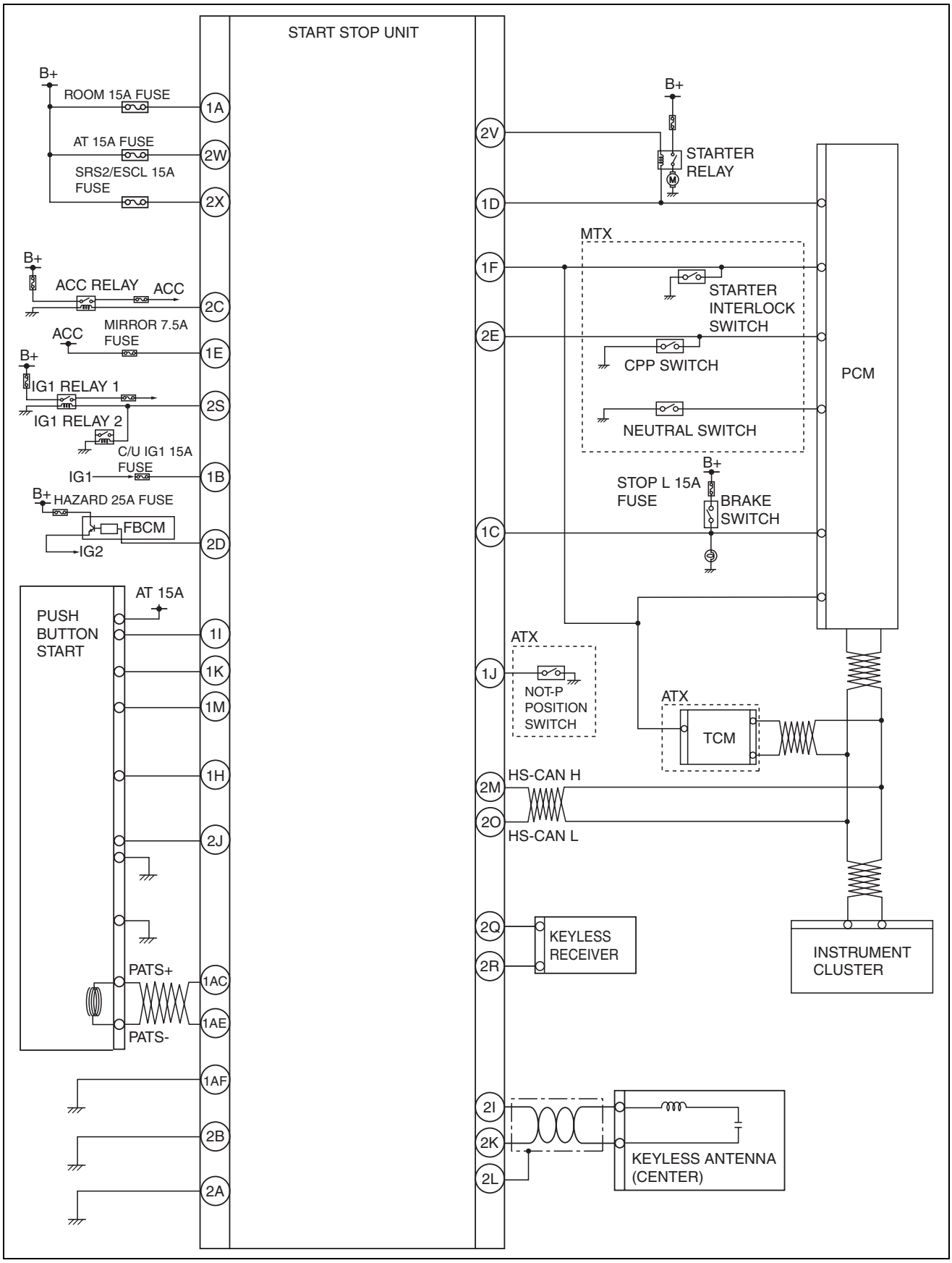
SECURITY AND LOCKS

System Wiring Diagram



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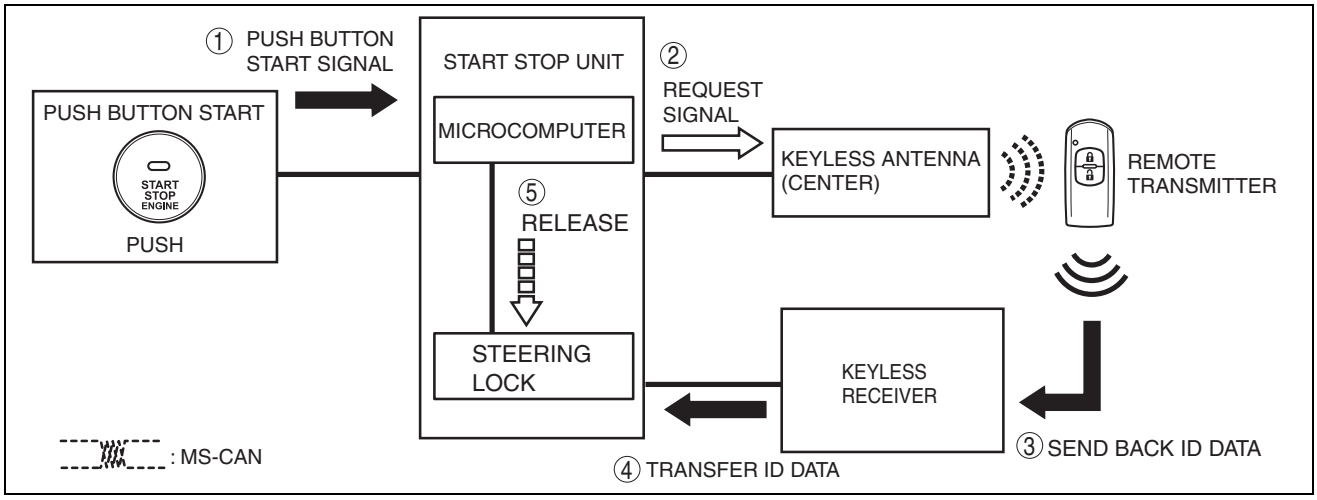
SECURITY AND LOCKS

Operation

Remote transmitter verification

1. When the push button start is pressed, a push button start signal is input to the start stop unit.
2. When the start stop unit detects a push button start signal, it sends a request signal via the keyless antennas.
3. The remote transmitter receives the request signal from the keyless antennas, and transmits ID data to the keyless receiver.
4. The keyless receiver transmits the received ID data to the start stop unit.
5. The start stop unit verifies the ID data and if it matches the steering lock in the module is released and the power supply is switched simultaneously to illuminate the push button start indicator light (amber). For details on the power supply switching, refer to 09-21-7 POWER SUPPLY SWITCHING.



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Engine-start operation

- The remote transmitter authorization is performed and the engine starts by pressing the push button start when all the following conditions are met:
  Engine start conditions
  - — Clutch pedal is depressed (MTX)
  - — Brake pedal is depressed (ATX)
  - — Selector lever is in P or N position (ATX)
  - — Remote transmitter is within request signal output range of keyless antennas in vehicle interior

Back-up mode (MTX) for engine-start

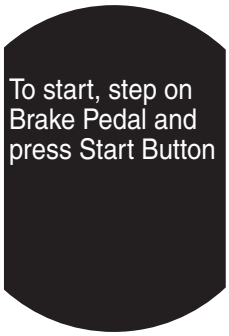
- If the start stop unit determines that either the clutch pedal position switch or clutch cut switch is malfunctioning, the system switches to back-up mode.
- If the push button start is pressed when all the following conditions are met while in the back-up mode, the remote transmitter authorization is performed and the engine starts.
  - — Start stop unit detects that either clutch pedal position switch or clutch cut switch is on
  - — Neutral switch signal is received via CAN communication from PCM
  - — Remote transmitter is within request signal output range of keyless antennas in vehicle interior

Guidance function

Advice display for engine-start

- If all of the engine-start conditions are met, the key indicator light (green) in the instrument cluster and the push button start indicator (green) illuminate.
- Under the following conditions, the start stop unit sends an advice request signal via CAN transmission to the instrument cluster.
- When the instrument cluster receives an advice request signal, it displays the conditions which have not been met in order to start the engine in the TFT LCD display (with TFT LCD display).

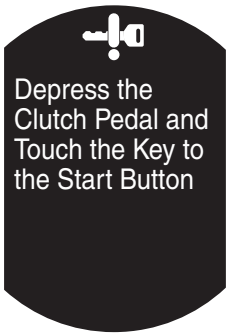
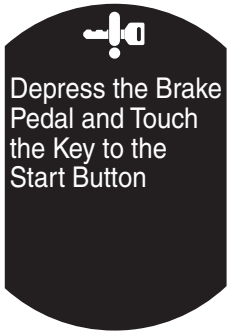
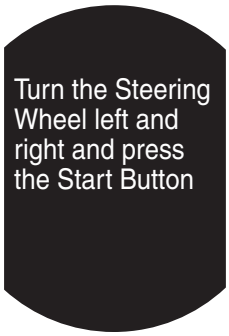
SECURITY AND LOCKS

Condition	TFT LCD display
Ignition is switched ON (engine off) from OFF (LOCK) without depressing clutch pedal (MTX)	
Ignition is switched ON (engine off) from OFF (LOCK) without depressing brake pedal (ATX)	
Ignition is switched ON (engine off) and selector lever is not in P position when pressing push button (ATX)	

Display of methods for resolving issues

- Under the following conditions, the start stop unit sends a warning request signal via CAN transmission to the instrument cluster to flash the push button start indicator (green).
- When the instrument cluster receives the warning request signal, it displays the method for resolving an issue in the TFT LCD display (with TFT LCD display).

SECURITY AND LOCKS

Condition	Instrument cluster			Push button start
	Keyless warning alarm	KEY warning light (red)	TFT LCD display	Indicator light (green)
ID data cannot be verified	—	Flashes	 (MTX)  (ATX)	—
Steering lock cannot be released	Pattern C*1	—		Flashes for 10 s

*1 : For the keyless warning alarm sound pattern, refer to the keyless warning alarm. (See 09-22-28 KEYLESS WARNING ALARM.)

PUSH BUTTON START SYSTEM [ADVANCED KEYLESS ENTRY SYSTEM]

id091400111633

Outline

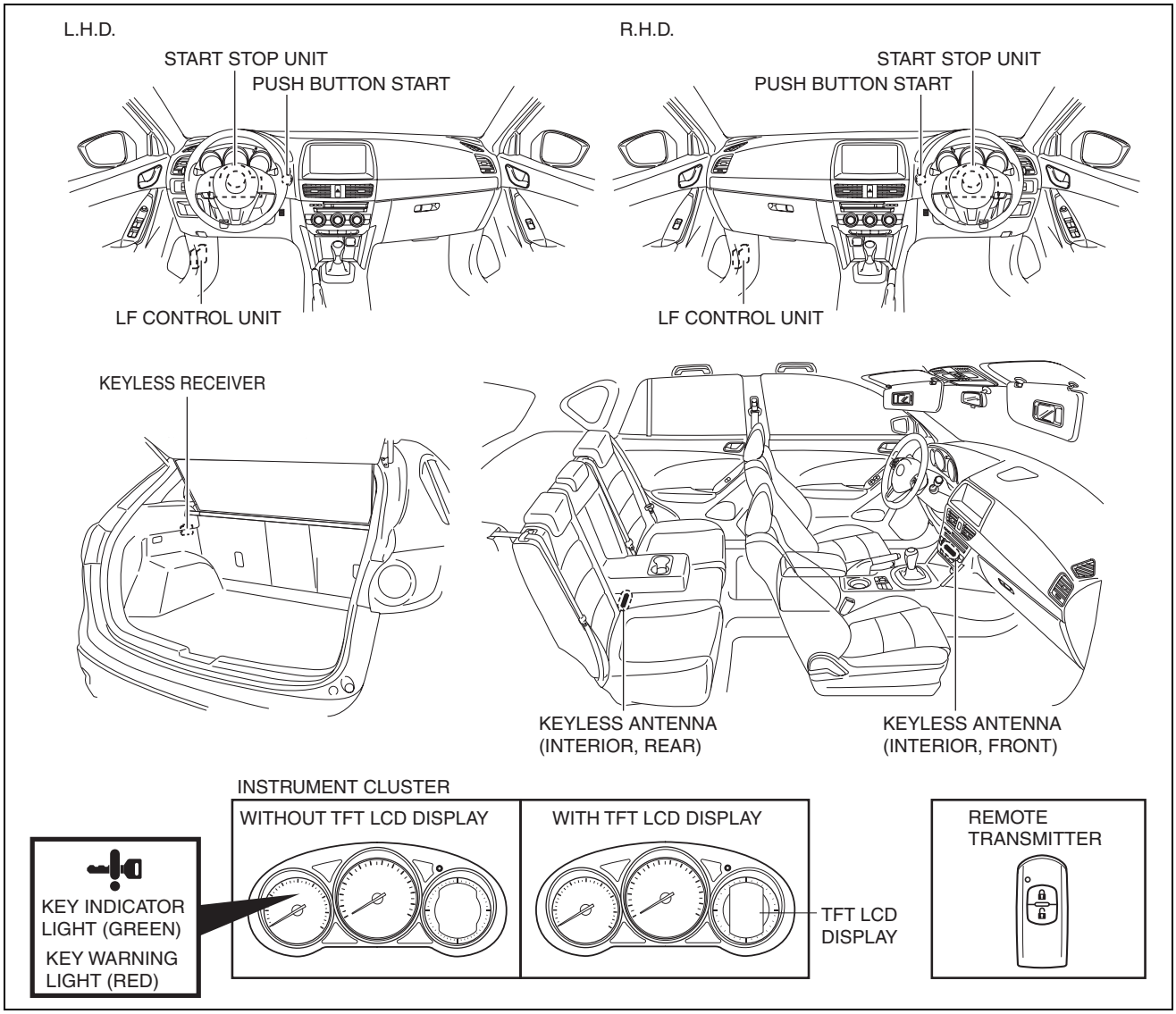
- A push button start system has been adopted that automatically performs authorization of the remote transmitter brought into the vehicle.
- The start stop unit performs push button start system fail-safe. (See 09-14-58 START STOP UNIT.)

Function

- When the push button start is pressed, the push button start system performs authorization of the remote transmitter in the vehicle.
  - — Engine start: When the remote transmitter authorization is performed while the engine starting conditions are met, the engine starts.
  - — Power supply switching: When the remote transmitter authorization is performed, the ignition can be switched between OFF, ACC, and ON (engine on).
- The guidance function displays methods of resolving issues, such as insufficient conditions for starting the engine, or remote transmitter authorization issues or the inability to release the steering lock, in the TFT LCD display (with TFT LCD display).

SECURITY AND LOCKS

Structural View



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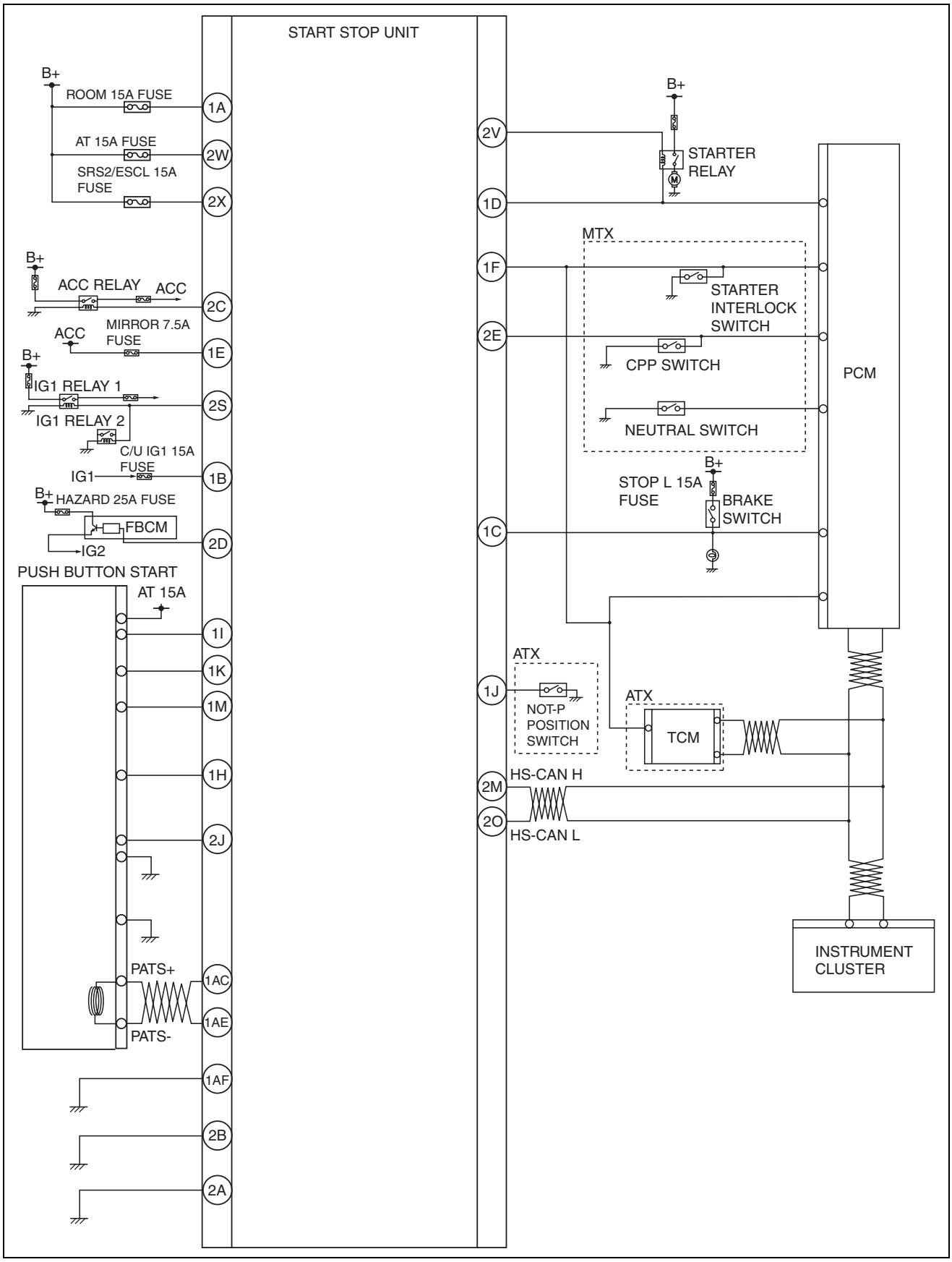
SECURITY AND LOCKS

System Wiring Diagram



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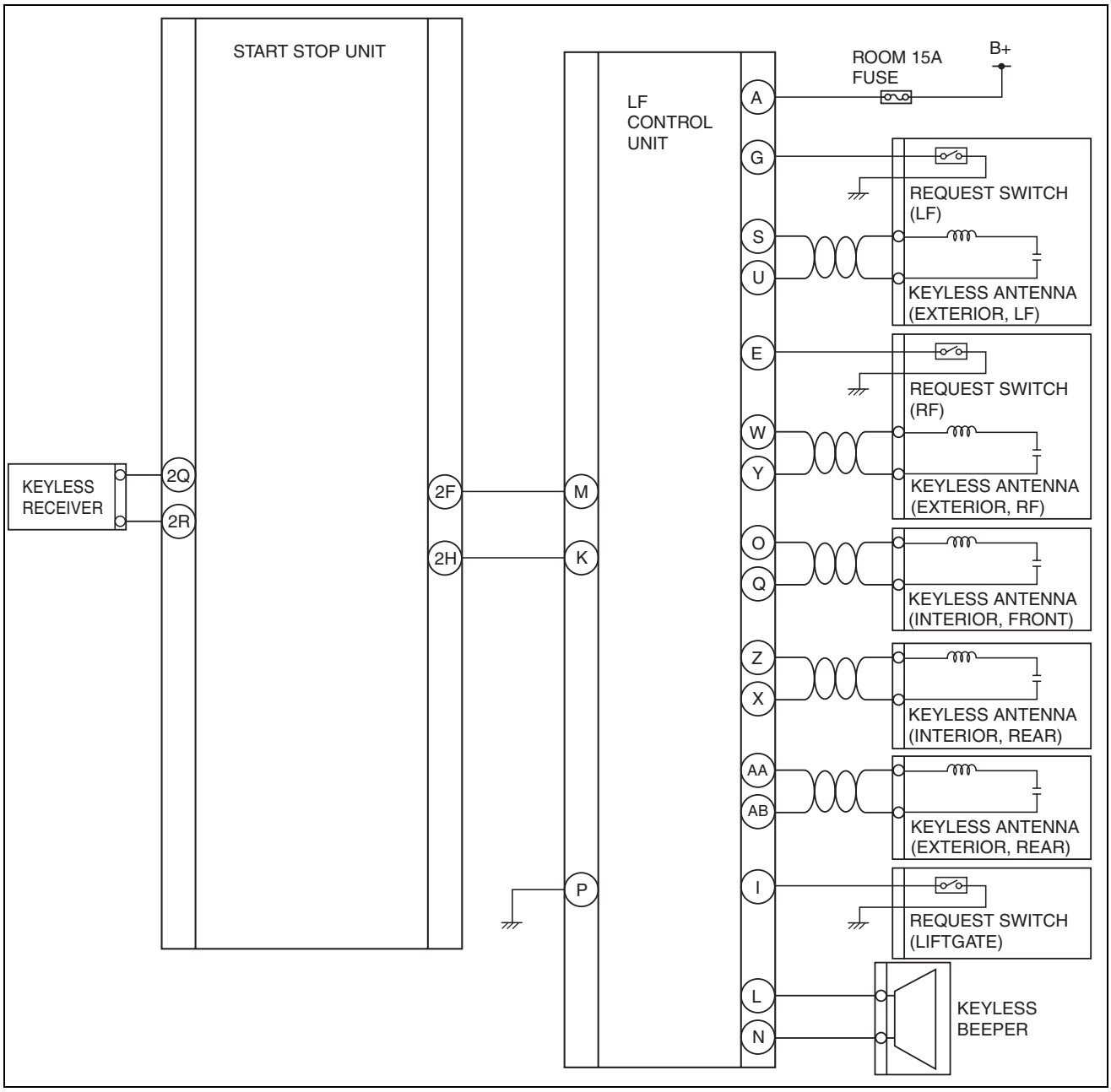
SECURITY AND LOCKS



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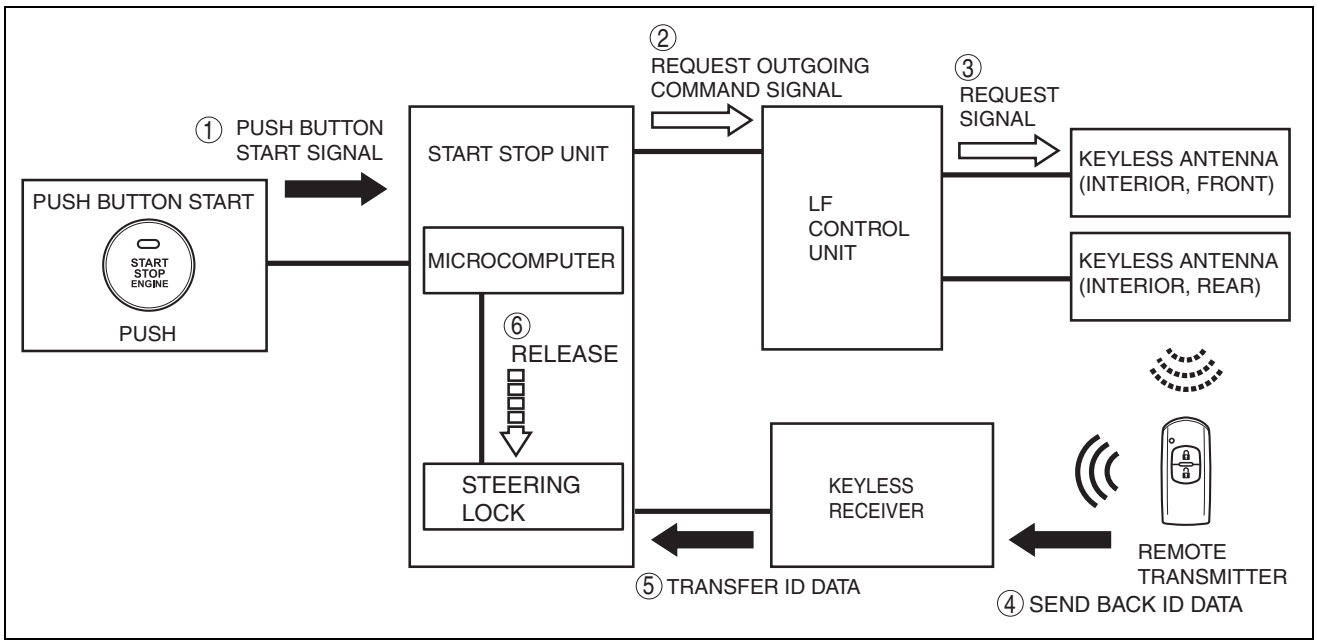
Operation

Remote transmitter verification

1. When the push button start is pressed, a push button start signal is input to the start stop unit.
2. When the start stop unit detects a push button start signal, it sends a request outgoing command signal to the LF control unit.
3. When the LF control unit detects the request outgoing command signal, it sends a request signal using all the keyless antennas in the vehicle interior.
4. The remote transmitter receives the request signal from the interior keyless antennas, and transmits ID data to the keyless receiver.
5. The keyless receiver transmits the received ID data to the start stop unit.

SECURITY AND LOCKS

6. The start stop unit verifies the ID data and if it matches the steering lock in the module is released and the power supply is switched simultaneously to illuminate the push button start indicator light (amber). For details on the power supply switching, refer to 09-21-7 POWER SUPPLY SWITCHING.



ac5wzn00001316

Engine-start operation

- The remote transmitter authorization is performed and the engine starts by pressing the push button start when all the following conditions are met:
  Engine start conditions
  - — Clutch pedal is depressed (MTX)
  - — Brake pedal is depressed (ATX)
  - — Selector lever is in P or N position (ATX)
  - — Remote transmitter is within request output range of keyless antennas in vehicle interior

Back-up mode (MTX) for engine-start

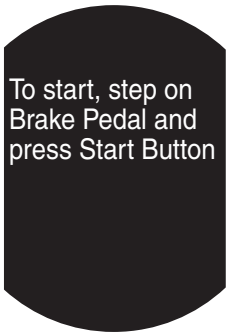
- If the start stop unit determines that either the clutch pedal position switch or clutch cut switch is malfunctioning, the system switches to back-up mode.
- If the push button start is pressed when all the following conditions are met while in the back-up mode, the remote transmitter authorization is performed and the engine starts.
  - — Start stop unit detects that either clutch pedal position switch or clutch cut switch is on
  - — Neutral switch signal is received via CAN communication from PCM
  - — Remote transmitter is within request signal output range of keyless antennas in vehicle interior

Guidance function

Advice display for engine-start

- If all of the engine-start conditions are met, the key indicator light (green) in the instrument cluster and the push button start indicator (green) illuminate.
- Under the following conditions, the start stop unit sends an advice request signal via CAN transmission to the instrument cluster.
- When the instrument cluster receives an advice request signal, it displays the conditions which have not been met in order to start the engine in the TFT LCD display (with TFT LCD display).

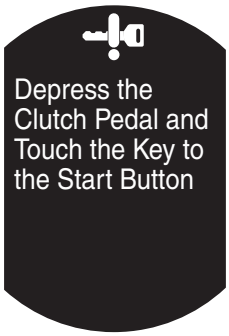
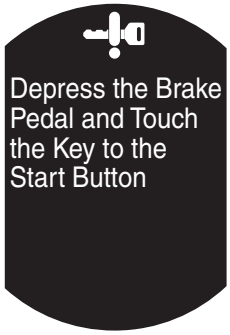
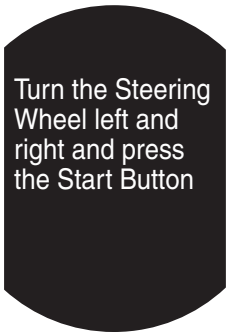
SECURITY AND LOCKS

Condition	TFT LCD display
Ignition is switched ON (engine off) from OFF (LOCK) without depressing clutch pedal (MTX)	
Ignition is switched ON (engine off) from OFF (LOCK) without depressing brake pedal (ATX)	
Ignition is switched ON (engine off) and selector lever is not in P position when pressing push button (ATX)	

Display of methods for resolving issues

- Under the following conditions, the start stop unit sends a warning request signal via CAN transmission to the instrument cluster to flash the push button start indicator (green).
- When the instrument cluster receives the warning request signal, it displays the method for resolving an issue in the TFT LCD display (with TFT LCD display).

SECURITY AND LOCKS

Condition	Instrument cluster			Push button start
	Keyless warning alarm	KEY warning light (red)	TFT LCD display	Indicator light (green)
ID data cannot be verified	—	Flashes	 (MTX)  (ATX)	—
Steering lock cannot be released	Pattern C*1	—		Flashes for 10 s

*1 : For the keyless warning alarm sound pattern, refer to the keyless warning alarm. (See 09-22-28 KEYLESS WARNING ALARM.)

START STOP UNIT

id091400111500

Purpose

- Performs control of several systems based on input/output signals from switches.

Function

- The start stop unit controls systems based on the input/output signals.
- The functions which are controlled are as follows:

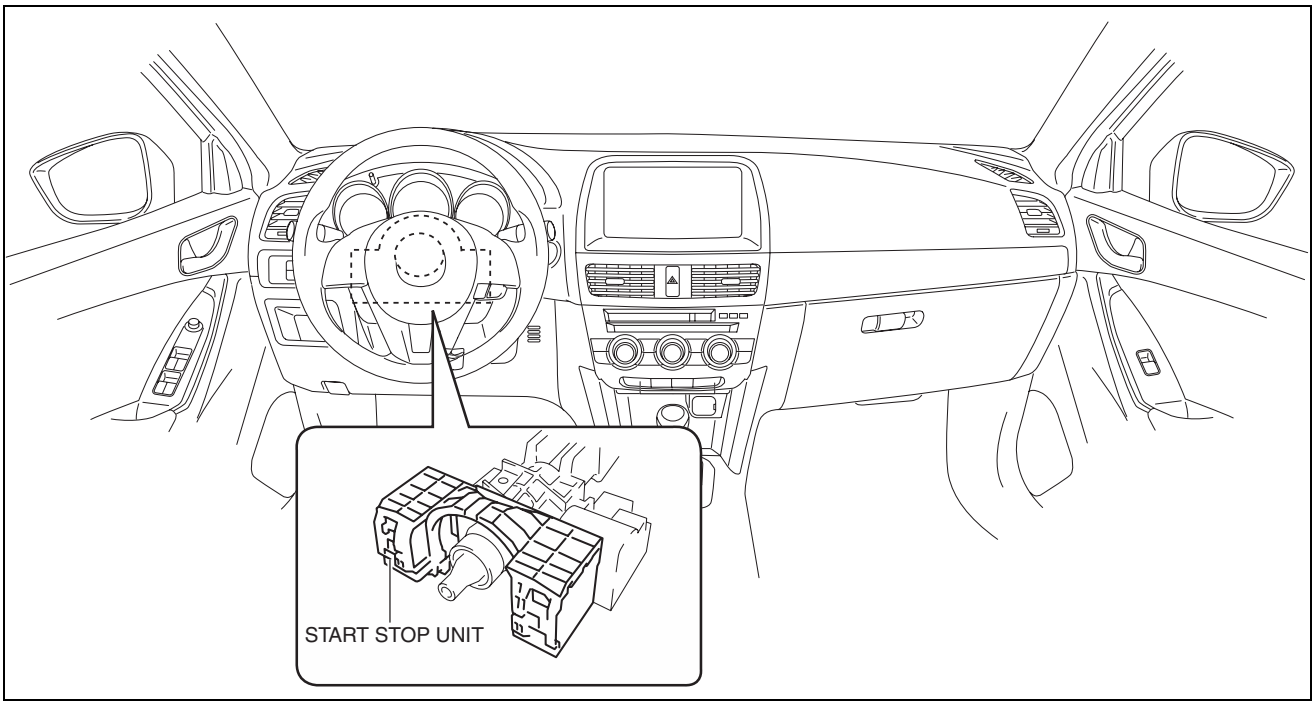
Control Table

Control	Content	Reference
Advanced keyless entry system control	Authorization of the remote transmitter being carried is automatically performed using radio waves, and all the doors lock/unlock according to the switch operation.	(See 09-14-37 ADVANCED KEYLESS ENTRY SYSTEM.)

SECURITY AND LOCKS

Control	Content	Reference
Keyless entry system control	When the lock/unlock buttons on the transmitter are pressed at a distance away from the vehicle (**within approx. 1 m {3 ft}**), all the doors lock/unlock.	(See 09-14-32 KEYLESS ENTRY SYSTEM.)
Push button start system control	When the push button start is pressed, authorization of the remote transmitter brought into the vehicle is automatically performed.	(See 09-14-52 PUSH BUTTON START SYSTEM [ADVANCED KEYLESS ENTRY SYSTEM].) (See 09-14-47 PUSH BUTTON START SYSTEM [KEYLESS ENTRY SYSTEM].)
Immobilizer system control	The immobilizer system is a vehicle theft prevention device that only allows a remote transmitter that has been previously programmed to the vehicle to start the engine.	(See 09-14-68 IMMOBILIZER SYSTEM.)
On-board diagnostic system control	The start stop unit is equipped with an on-board diagnosis function which records DTCs in the event of a malfunction.	(See 09-14-88 ON-BOARD DIAGNOSIS SYSTEM [START STOP UNIT].) (See 09-14-85 ON-BOARD DIAGNOSIS SYSTEM [ADVANCED KEYLESS ENTRY SYSTEM].) (See 09-14-100 ON-BOARD DIAGNOSIS SYSTEM [IMMOBILIZER SYSTEM].)
CAN (Controller Area Network)	Sends and receives signals between CAN system-related modules using CAN system.	(See 10-40-1 CONTROLLER AREA NETWORK (CAN) SYSTEM.)

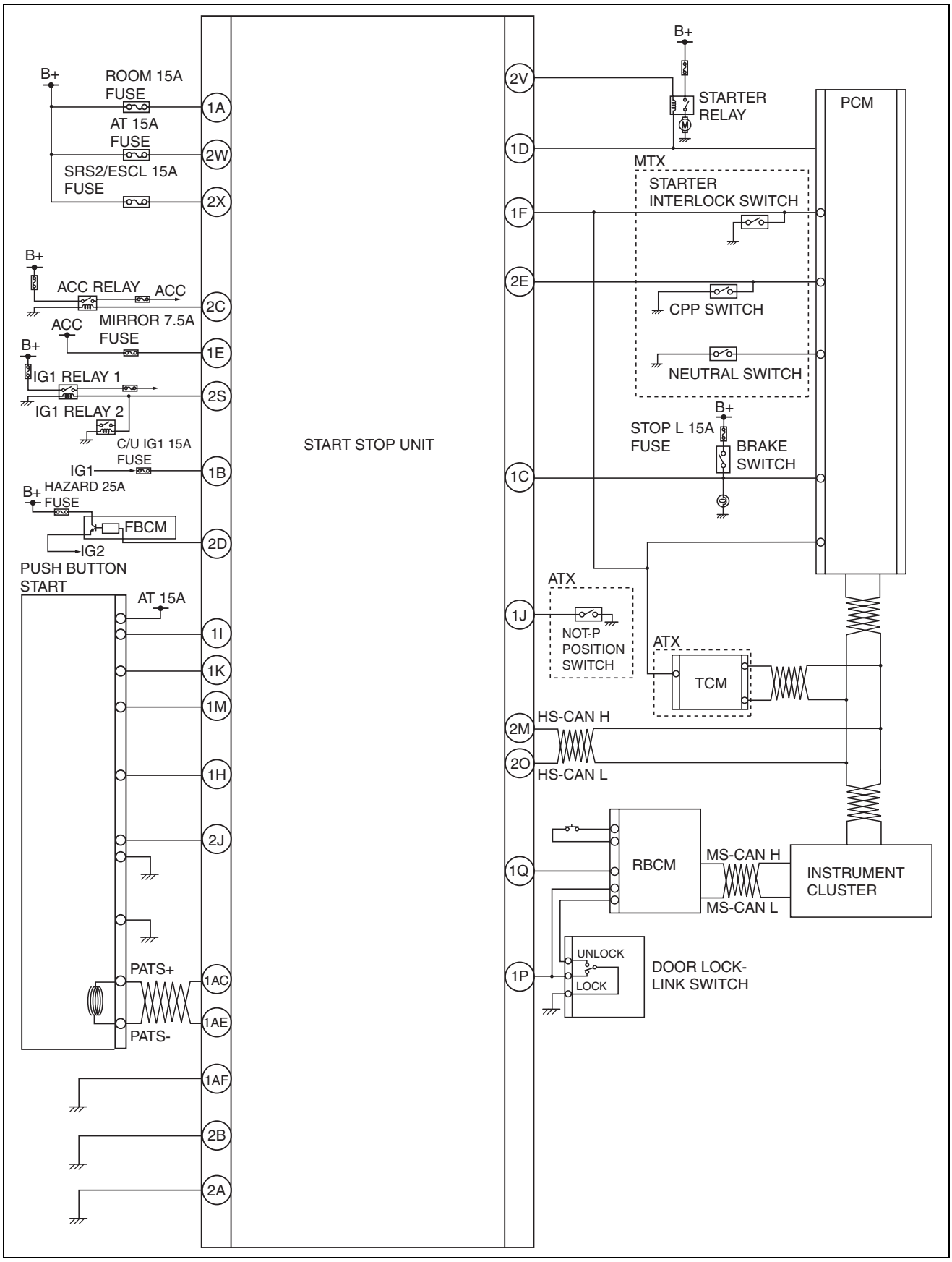
Structural View



ac5wzn00001412

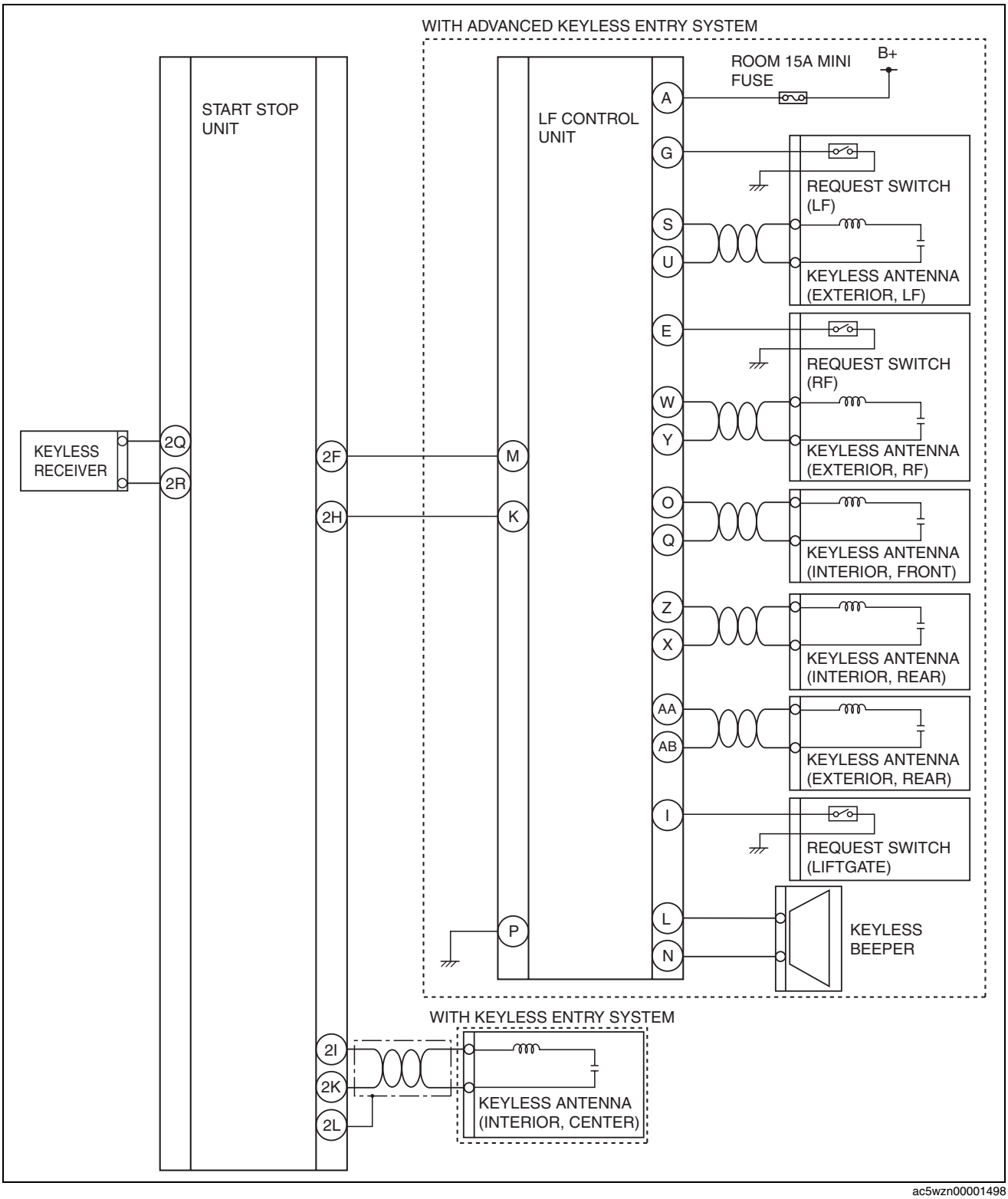
SECURITY AND LOCKS

System Wiring Diagram



ac5wzn00001497

SECURITY AND LOCKS



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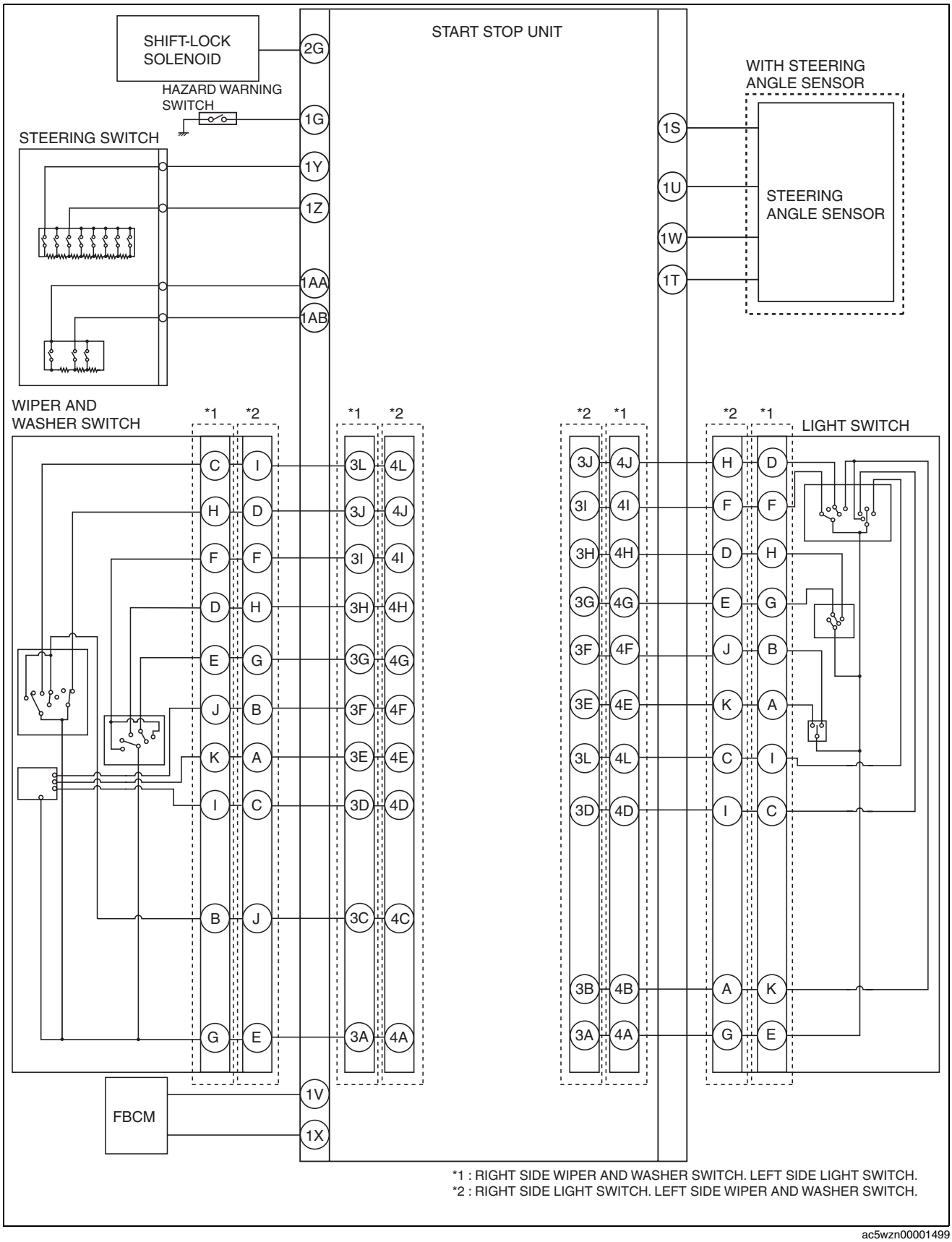
SECURITY AND LOCKS



ac5wzn00001499

Fail-safe
Keyless entry system
- KEY warning light (red) illuminates.

SECURITY AND LOCKS

Advanced keyless entry system
- KEY warning light (red) illuminates.

Push button start system
- If a malfunction is detected in the push button start system, the engine can be started by pressing and holding the press button start.In addition, if the following conditions are met, engine starting is inhibited.
  - — Certain period of time has elapsed since malfunction is detected in push button start
  - — Engine is started a certain number of times by pressing and holding push button start
- Flashes the push button start indicator light (amber).

Immobilizer system
- Flashes the push button start indicator light (amber).

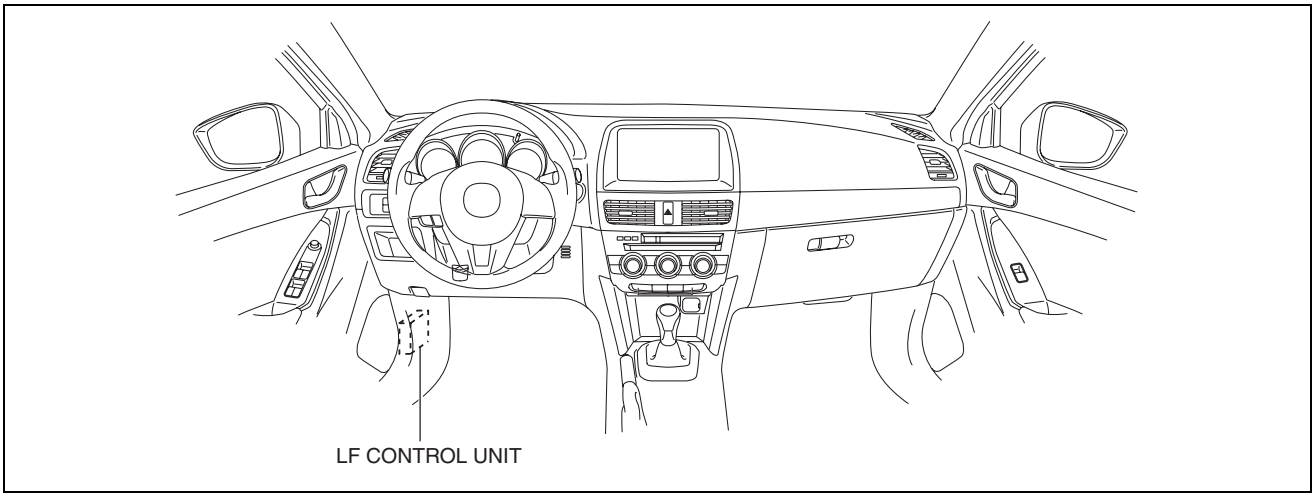
LF CONTROL UNIT

id091400111400

Purpose
- The keyless beeper and keyless antenna are controlled by the input/output signals from the start stop unit.

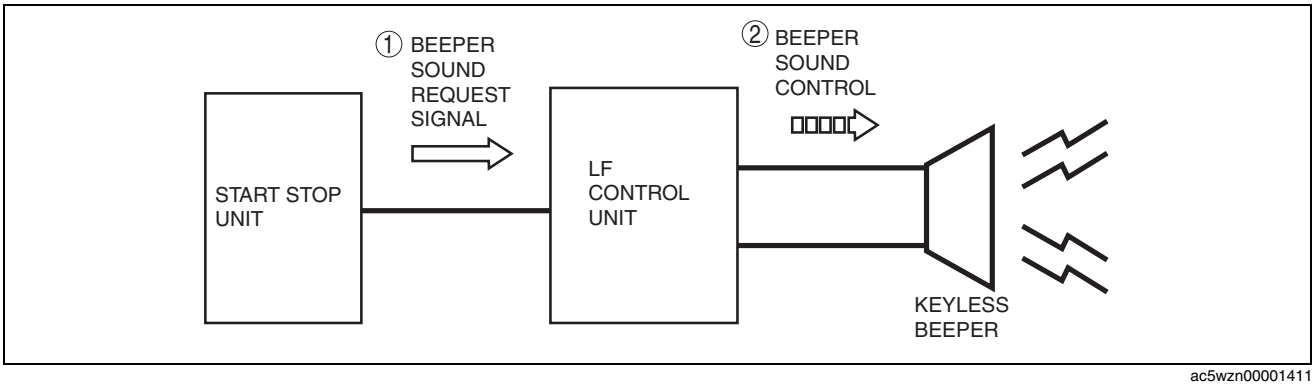
Function
- The LF control unit controls the keyless beeper sound based on the signal from the start stop unit.
- The LF control unit sends the request signal from the keyless antenna based on the signal from the start stop unit.

Construction
- Installed inside the front side trim.



ac5wzn00001413

Operation
Keyless beeper control
1. The LF control unit sends the beeper sound request signal from the start stop unit.
2. The LF control unit sounds the keyless beeper when it receives the beeper sound request signal.

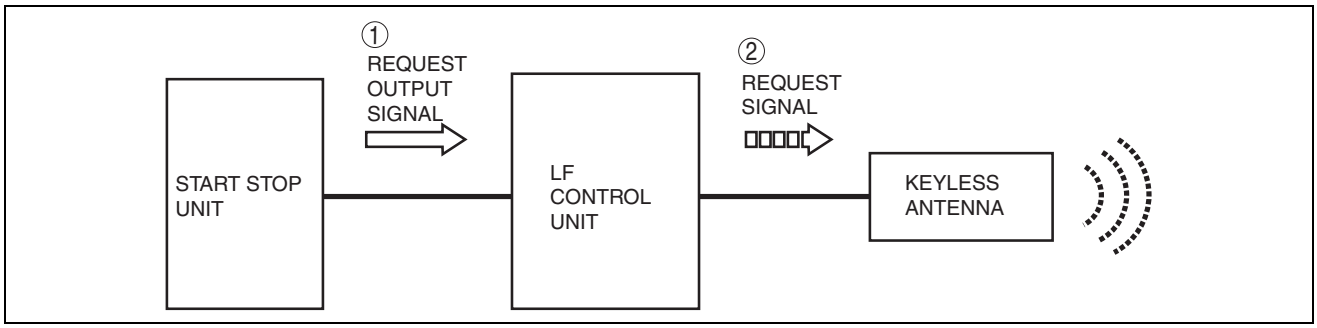


ac5wzn00001411

Keyless antenna control
1. The LF control unit sends the request send signal from the start stop unit.

SECURITY AND LOCKS

2. The LF control unit sends the request signal from the keyless antenna when it receives the request send signal.



ac5wzn00001414

Fail-safe
- Function not equipped.

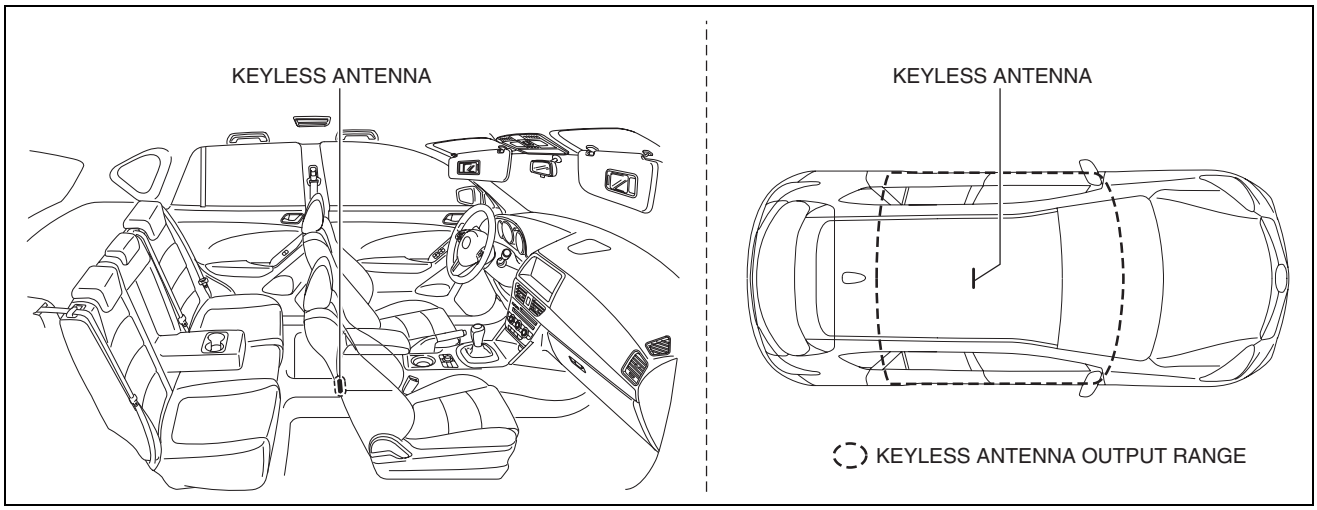
KEYLESS ANTENNA [KEYLESS ENTRY SYSTEM]

id0914001080b3

Purpose
- Outputs a request signal and specifies the remote transmitter location.

Function
- The keyless antennas output request signals based on the signals from the start stop unit.

Construction, Operation
- Request signals are output by the keyless antenna installed in the rear console to produce the keyless antenna output range inside the vehicle.



ac5wzn00000416

Fail-safe
- Function not equipped.

KEYLESS ANTENNA [ADVANCED KEYLESS ENTRY SYSTEM]

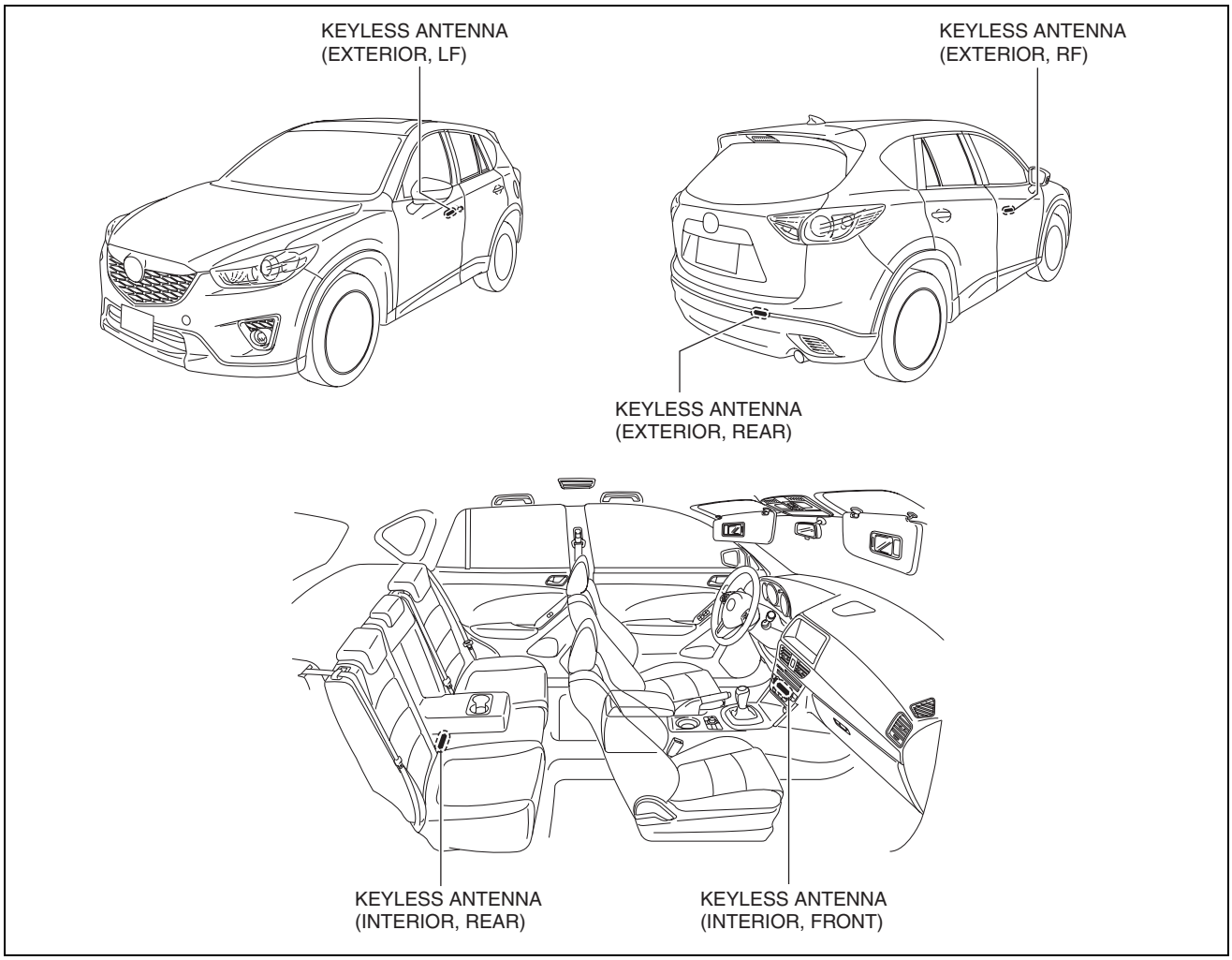
id091400108033

Purpose
- Outputs a request signal and specifies the remote transmitter location.

Function
- The keyless antenna outputs request signals to the inside and outside of the vehicle based on the signals from the LF control unit.

Construction, Operation
- The antennas for request signal output form the request signal output range at 5 locations.

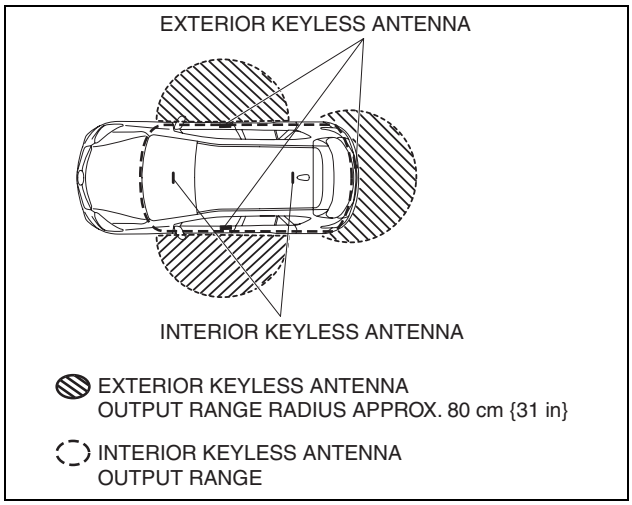
SECURITY AND LOCKS



ac5wzn00000414

Request signal output range

- The keyless antennas for the vehicle exterior (driver-side, passenger-side, rear) form the request signal output area in the range of an **approx. 80 cm {31 in}** radius from each location and communicate with the advanced key.
- The keyless antennas for the vehicle interior (front, rear) form the output range inside the vehicle.



ac5wzn00001410

Fail-safe

- Function not equipped.

SECURITY AND LOCKS

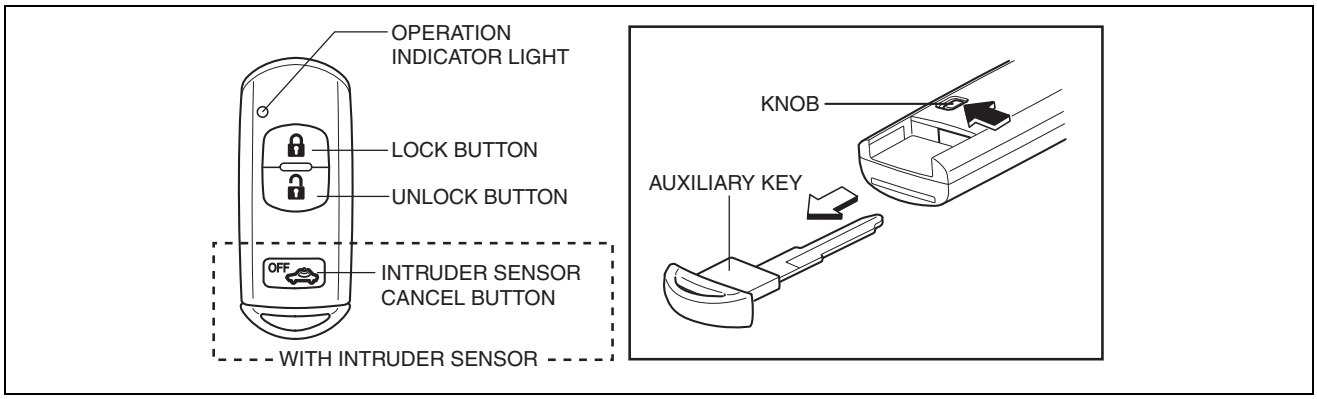
REMOTE TRANSMITTER

id091400111700

Purpose
- When the lock button/unlock button of the remote transmitter is pressed, ID data is sent to the keyless receiver.

Function
- When the remote transmitter sends ID data, the operation indicator light illuminates.

Construction
- The remote transmitter is built into the operation indicator light.
- The remote transmitter secures specific electronic codes (key ID number) built into the electronic communication device (transponder).
- In case the transmitter is inoperable due to battery depletion, the doors can be locked/unlocked using the auxiliary key.



ac5wzn00001093

Operation
- When a remote transmitter button is pressed, ID data at a radio frequency of 433 MHz is sent to the keyless receiver.

Fail-safe
- Function not equipped.

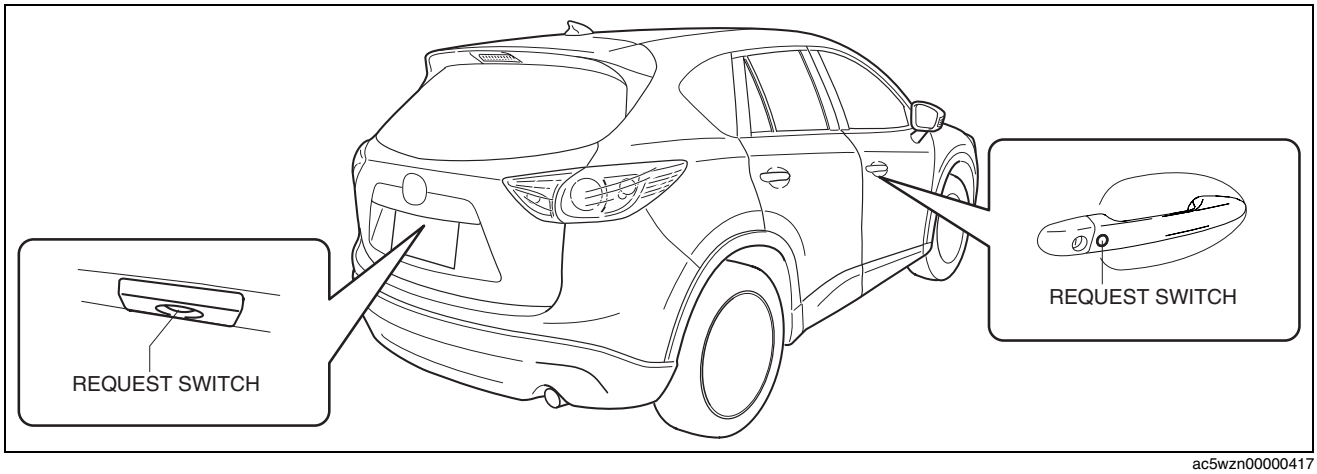
REQUEST SWITCH

id091400109600

Purpose
- Transmits the request switch operation of the user to the LF control unit.

Function
- The request switch ON signal is sent to the LF control unit by operating the request switch.

Construction, Operation
- Installed on the outer handle of the driver-side/passenger side front door and liftgate garnish.
- While the request switch is pressed, the switch turns on (contact point: closed).



ac5wzn00000417

SECURITY AND LOCKS

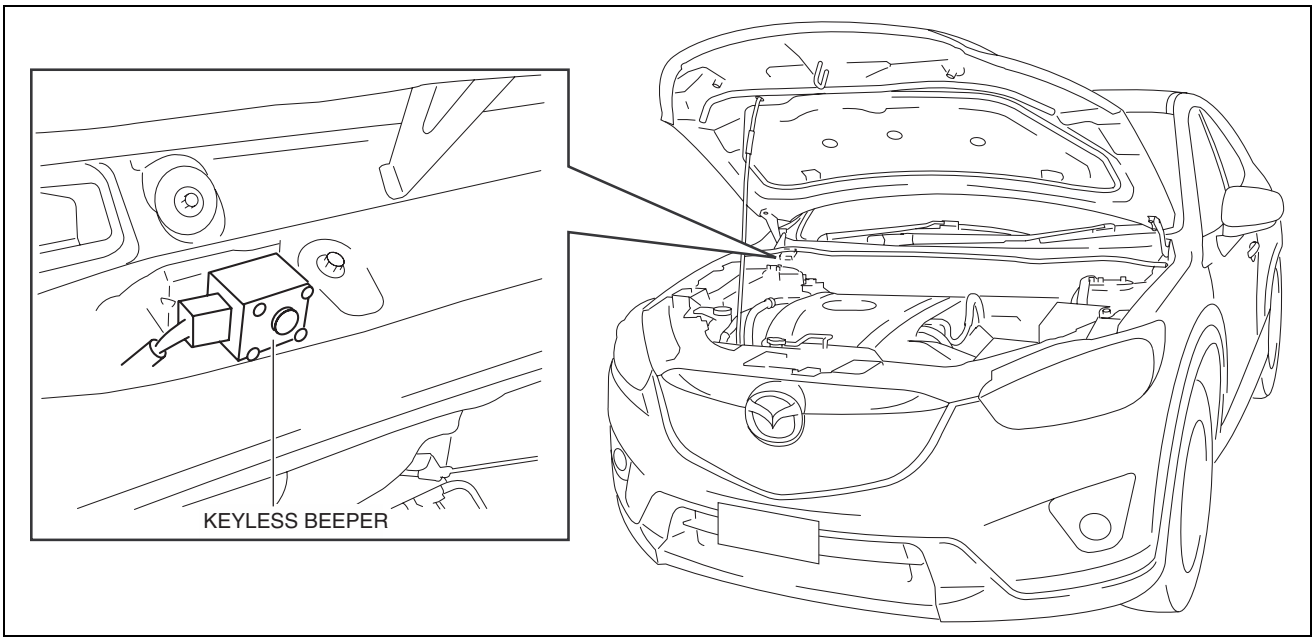
Fail-safe
- Function not equipped.

KEYLESS BEEPER

id091400109700

Purpose, Function
- Notifies the user that the lock/unlock operation of the advanced keyless entry system is completed, and warns if the system is operated incorrectly.

Construction, Operation
- Installed inside the cowl grille.
- The keyless beeper operates based on the LF control unit signals. For the details of the beeper operation, see [ALERT FUNCTION OPERATION] in 09-14-37 ADVANCED KEYLESS ENTRY SYSTEM.



ac5wzn00001554

Fail-safe
- Function not equipped.

KEYLESS RECEIVER

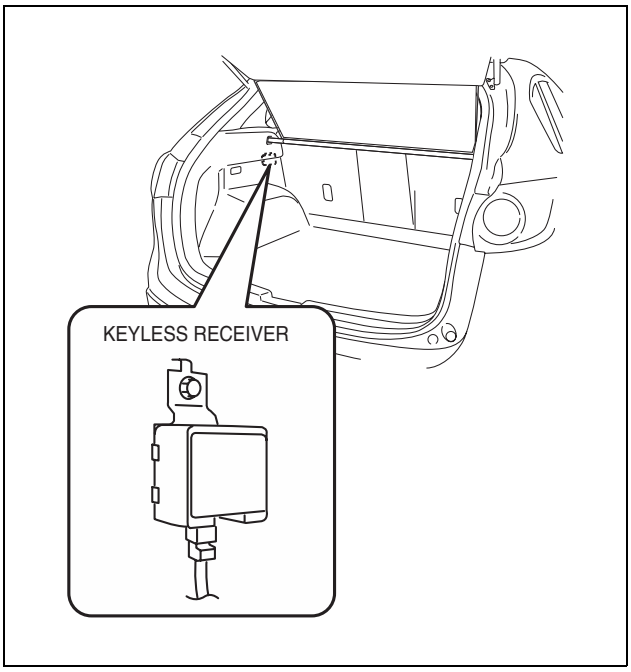
id091400109800

Purpose, Function
- Receives ID data from the remote transmitter and sends the received ID data to the start stop unit.

SECURITY AND LOCKS

Construction

- Installed inside the trunk side trim.



ac5wzn00000551

Operation

1. The ID data sent from the remote transmitter is received by the keyless receiver.
2. The keyless receiver transmits the received ID data to the start stop unit.

Fail-safe

- Function not equipped.

IMMOBILIZER SYSTEM

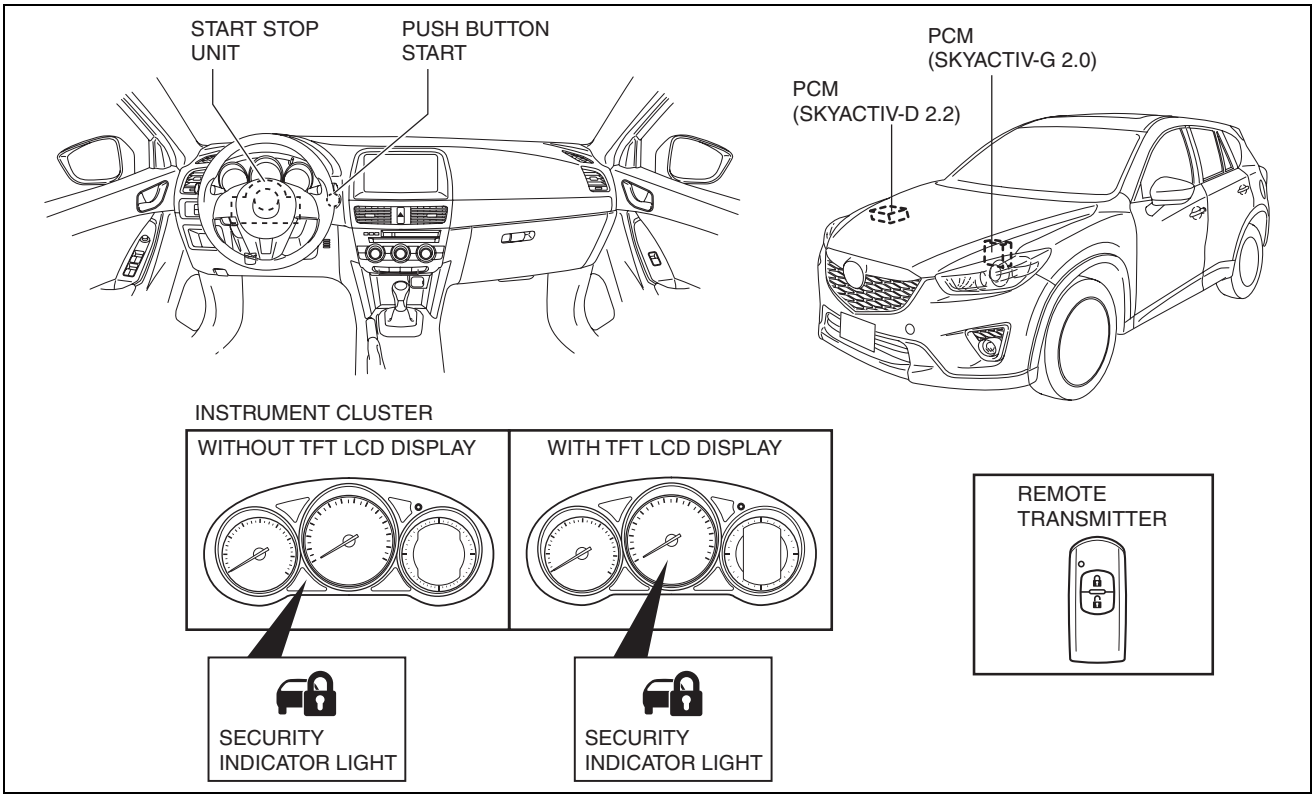
id091400107700

Outline

- The immobilizer system is a vehicle theft prevention device that only allows remote transmitters that have been previously programmed to the vehicle to start the engine.
- The start stop unit performs immobilizer system fail-safe. (See 09-14-58 START STOP UNIT.)

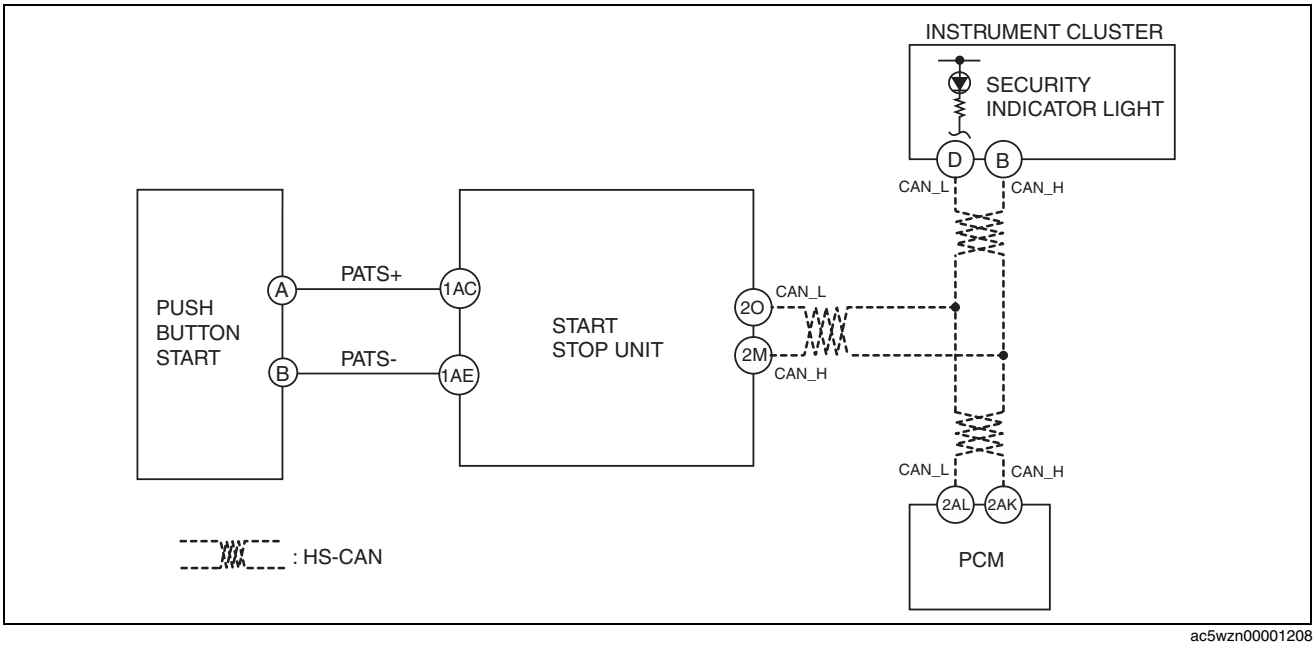
SECURITY AND LOCKS

Structural View



ac5wzn00000962

System Wiring Diagram



ac5wzn00001208

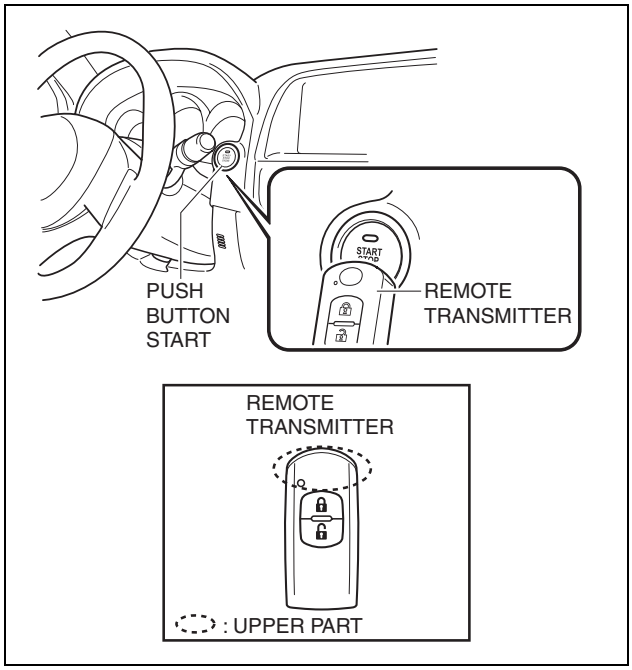
Function

- The immobilizer system-related parts programmed to the immobilizer system have a programmed key ID number, and starting the engine is only permitted when the key ID number matches.
- Immobilizer system-related parts can be programmed using the Mazda Modular Diagnostic System (M-MDS).
- A maximum 6 remote transmitters can be programmed to one vehicle.
- If the following parts are replaced, it is necessary to program them to the immobilizer system.
  - — Remote transmitter (transponder)
  - — PCM
  - — Start stop unit

SECURITY AND LOCKS

Key code read function

- The coil antenna is integrated with the push button start.
- By touching the upper part of the remote transmitter to the push button start, the coil antenna reads the key code from the transponder integrated with the remote transmitter.

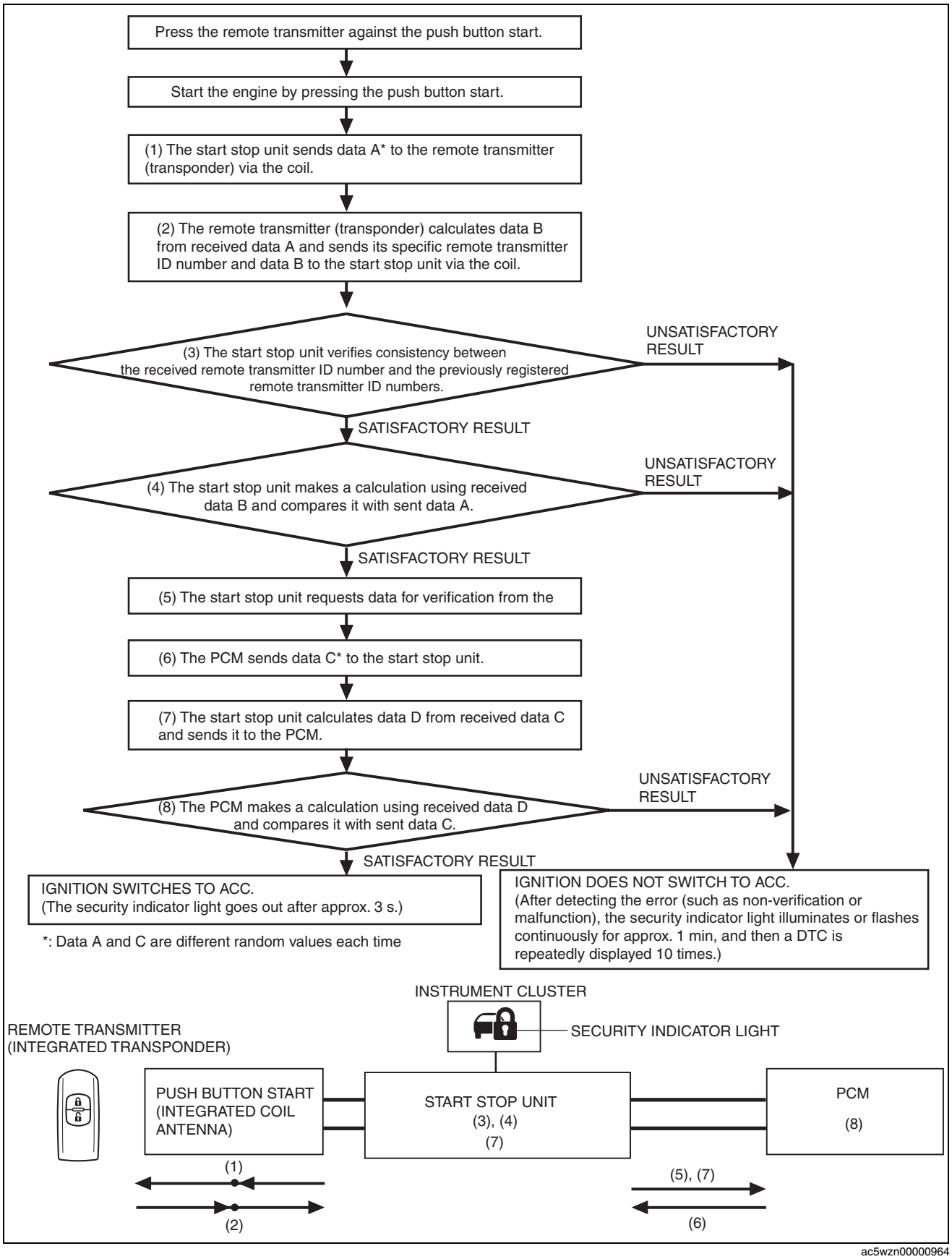


ac5wzn00000966

Operation

- Operate in the following order to allow engine starting.

SECURITY AND LOCKS



ac5wzn00000964

SECURITY AND LOCKS

COIL ANTENNA

id091400109900

Purpose

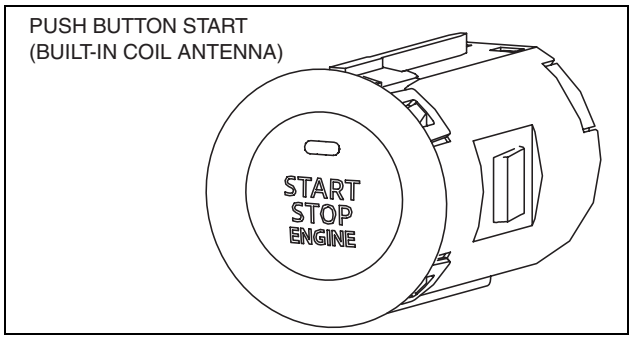
- Sends the ID data programmed to the electronic transmission device (transponder) in the remote transmitter to the start stop unit.

Function

- A magnetic field occurs around the push button start.

Construction, Operation

- The coil antenna built into the push button start sends a signal to the transponder and sends the returned signal to the start stop unit.



ac5wzn00000552

Fail-safe

- Function not equipped.

KEY WARNING LIGHT (RED)/KEY INDICATOR LIGHT (GREEN)

id091400603400

Purpose

KEY warning light (red)

- The KEY warning light (red) notifies the user that the engine cannot be started, the remote transmitter is outside of the vehicle, or that there is a malfunction in the system.

KEY indicator light (green)

- The KEY indicator light (green) notifies the user that the engine starting conditions have been met or that the remote transmitter battery voltage is depleted.

Function

KEY warning indicator light (red)

- When a malfunction is detected in the system, the KEY warning indicator light (red) illuminates. (See 09-14-85 ON-BOARD DIAGNOSIS SYSTEM [ADVANCED KEYLESS ENTRY SYSTEM].)(See 09-14-88 ON-BOARD DIAGNOSIS SYSTEM [START STOP UNIT].)
- The KEY warning indicator light (red) flashes if the engine cannot be started and when the ignition is switched to ACC or ON (engine off or on) and the transmitter is taken outside of the vehicle. (See 09-14-37 ADVANCED KEYLESS ENTRY SYSTEM.)(See 09-14-32 KEYLESS ENTRY SYSTEM.)(See 09-14-52 PUSH BUTTON START SYSTEM [ADVANCED KEYLESS ENTRY SYSTEM].)(See 09-14-47 PUSH BUTTON START SYSTEM [KEYLESS ENTRY SYSTEM].)

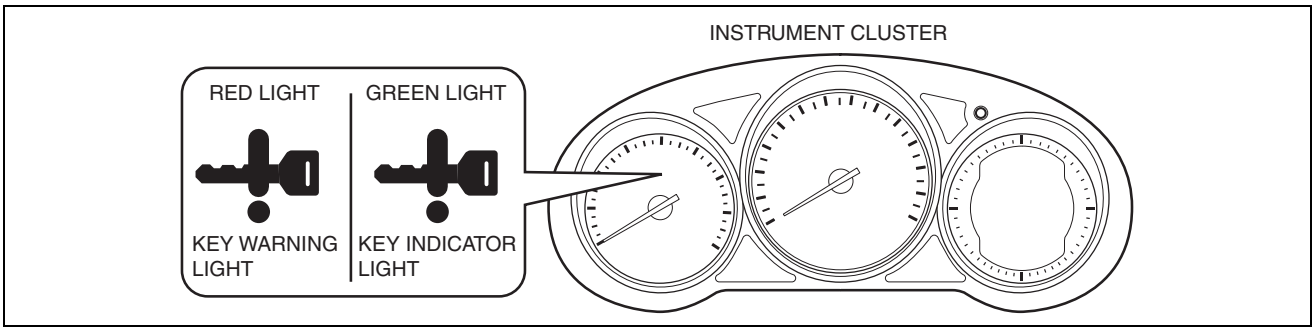
KEY indicator light (green)

- When the engine-starting conditions have been met, the KEY indicator light (green) illuminates. (See 09-14-52 PUSH BUTTON START SYSTEM [ADVANCED KEYLESS ENTRY SYSTEM].)(See 09-14-47 PUSH BUTTON START SYSTEM [KEYLESS ENTRY SYSTEM].)
- If the remote transmitter battery voltage is depleted, the KEY indicator light (green) flashes. (See 09-14-37 ADVANCED KEYLESS ENTRY SYSTEM.)(See 09-14-32 KEYLESS ENTRY SYSTEM.)

Construction

- The KEY warning light (red)/KEY indicator light (green) are built into the instrument cluster.

SECURITY AND LOCKS



ac5wzn00000857

Operation

KEY warning light (red)

- If a malfunction is detected in the system, the engine cannot be started, or the remote transmitter is outside of the vehicle, the start stop unit sends a warning request signal via CAN transmission to the instrument cluster.

KEY indicator light (green)

- If the engine starting conditions have been met, the start stop unit sends a KEY indicator light (green) illumination request signal via CAN transmission to the instrument cluster.
- If the remote transmitter battery voltage has been depleted, the start stop unit sends a battery voltage depletion display request signal via CAN transmission to the instrument cluster.

Fail-safe

- Function not equipped.

SECURITY INDICATOR LIGHT

id091400603300

Purpose

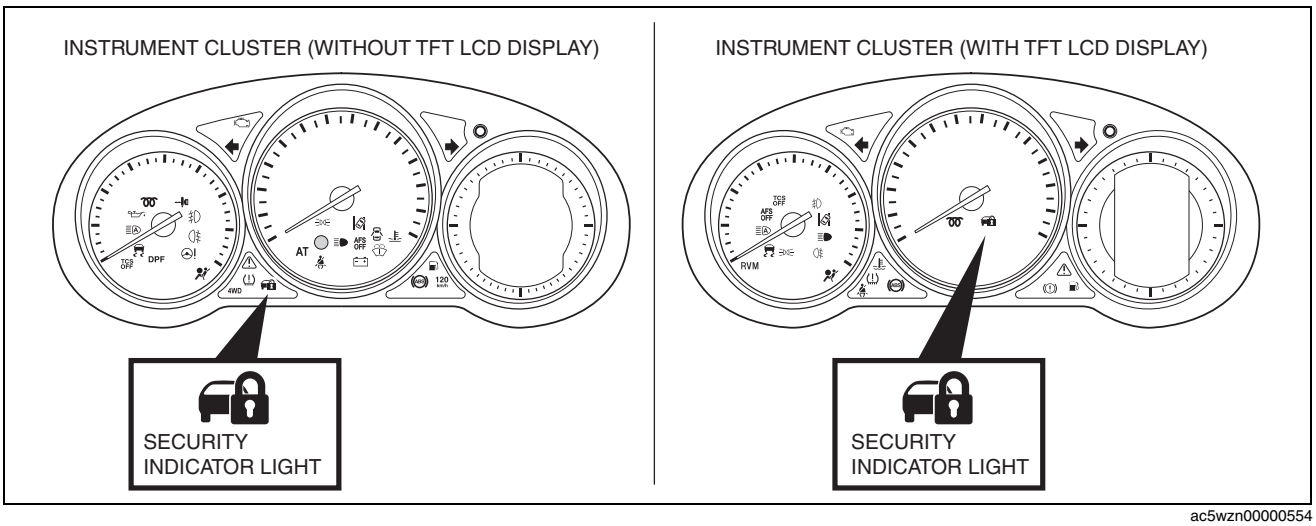
- Notifies the driver that the immobilizer system is operating.

Function

- If a malfunction is detected in the immobilizer system, the DTC can be verified by the flashing pattern of the security indicator light.

Construction

- The security indicator light is built into the instrument cluster.

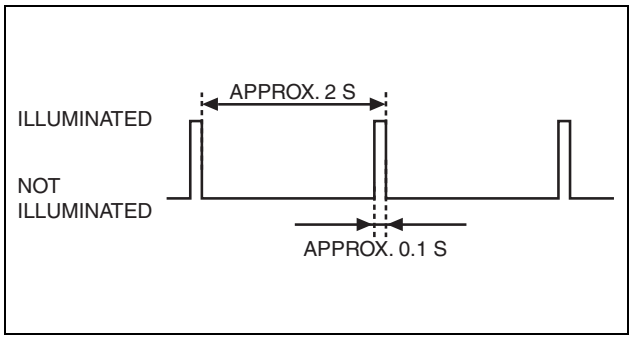


ac5wzn00000554

SECURITY AND LOCKS

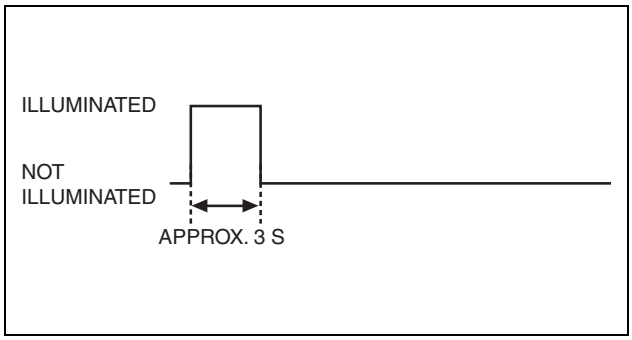
Operation

- When the immobilizer system is operating, it illuminates for **0.1 s every approx. 2 s**.



ac5wzn00000555

- If the immobilizer system is normal, the security indicator light illuminates for **approx. 3 s** and then turns off after the push button start is pressed.



ac5wzn00000556

Fail-safe

- Function not equipped.

THEFT-DETERRENT SYSTEM

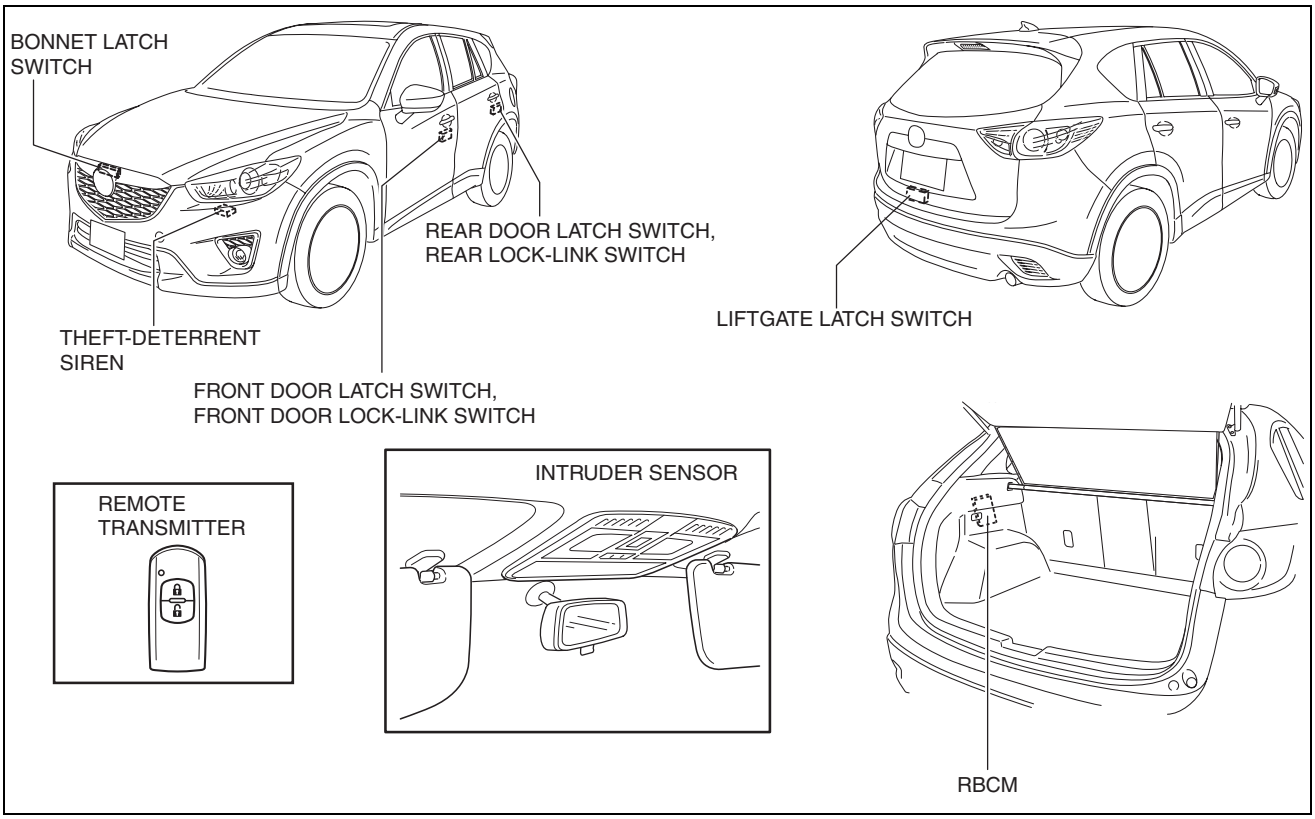
id091400003700

Outline

- The theft-deterrent system operates the theft-deterrent siren or theft-deterrent horn and hazard warning lights if a door, liftgate or the bonnet is improperly opened.
- An answer-back function has been adopted which allows visual verification of the theft-deterrent system operation.
- Signal input/output of the theft-deterrent system is controlled by the rear body control module (RBCM).
- The rear body control module (RBCM) performs theft-deterrent system fail-safe. (See 09-40-20 REAR BODY CONTROL MODULE (RBCM).)

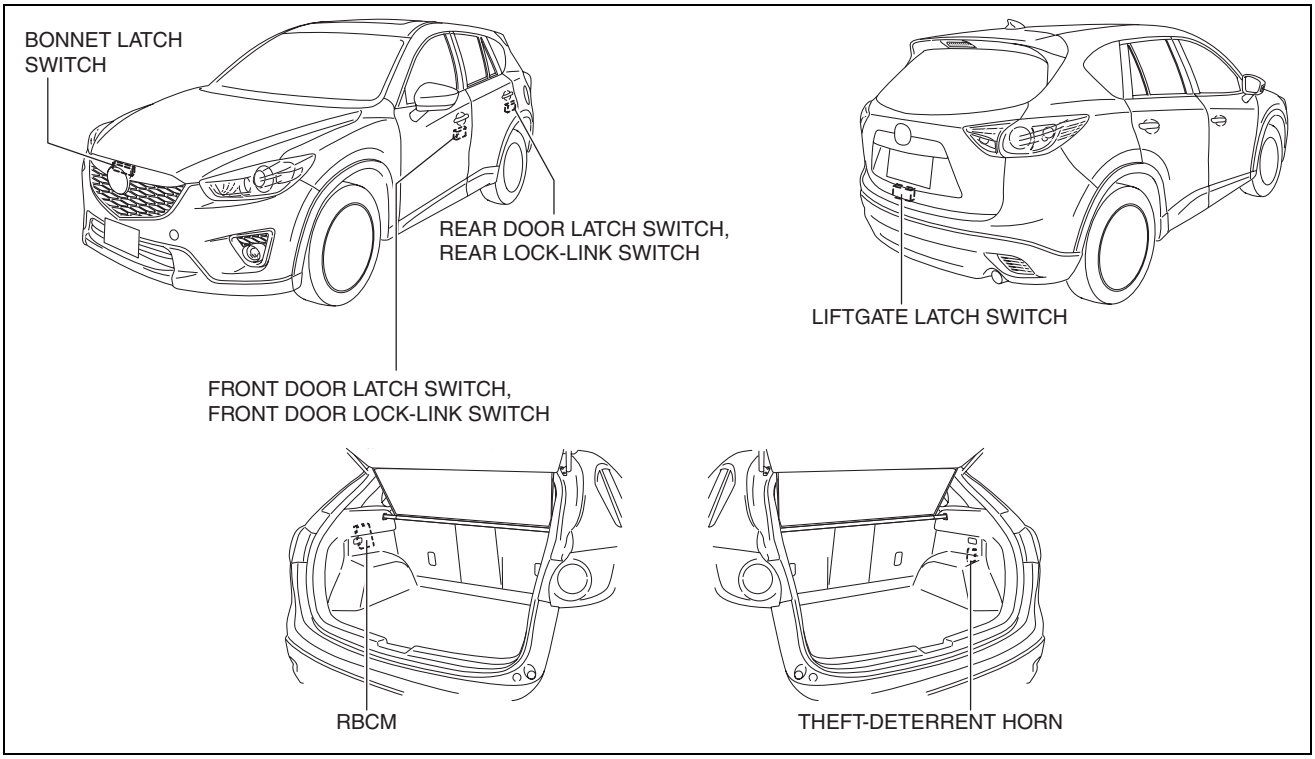
SECURITY AND LOCKS

Structural View
With intruder sensor



ac5wzn00001520

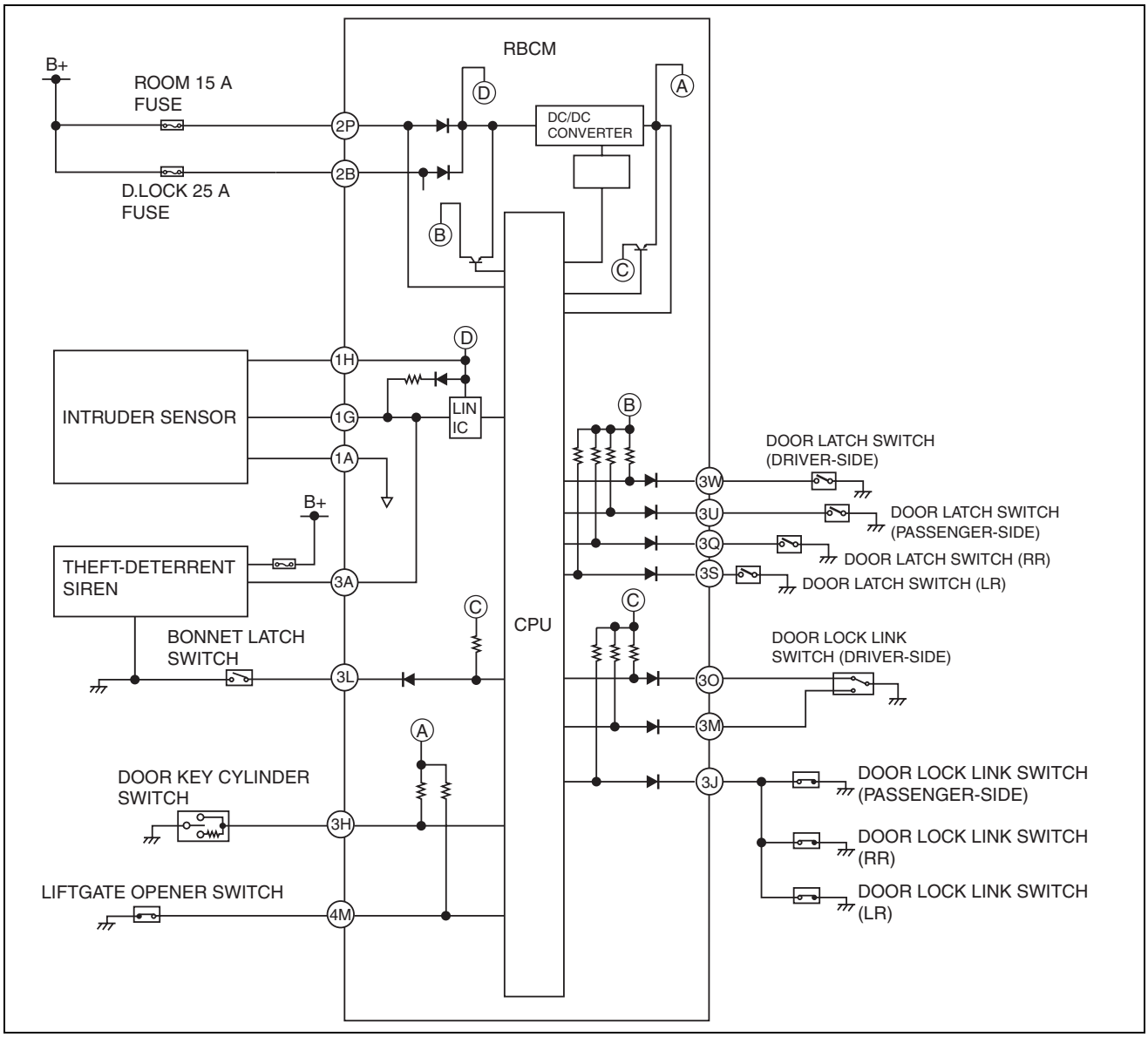
Without intruder sensor



ac5wzn00001521

SECURITY AND LOCKS

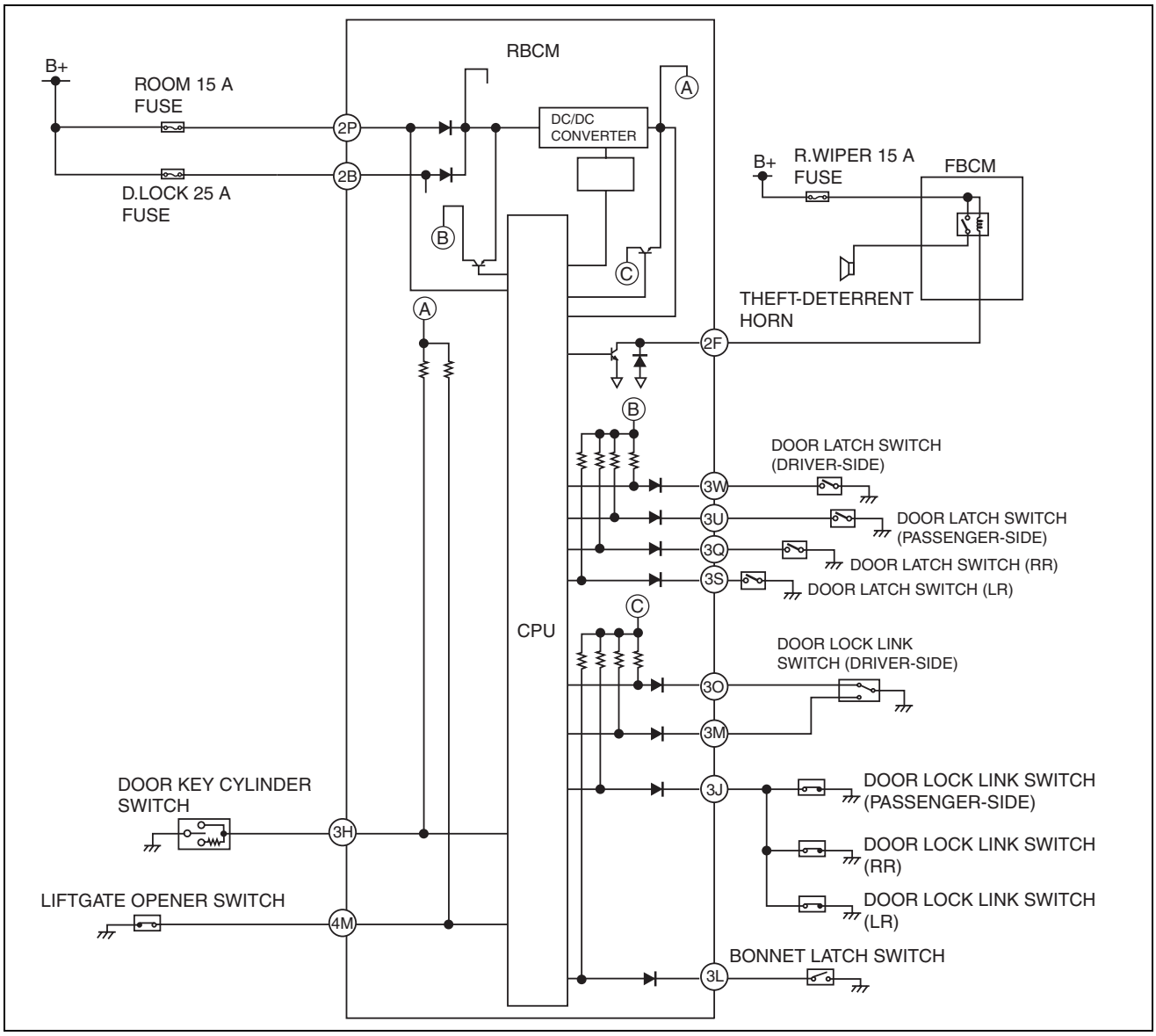
System Wiring Diagram
With intruder sensor



ac5wzn00001204

SECURITY AND LOCKS

Without intruder sensor



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Function

Answer back function

- When a locking operation is performed using the keyless entry remote transmitter is in stand-by preparation mode, stand-by mode, the hazard warning lights flash once.
- When a unlocking operation is performed using the keyless entry remote transmitter is in initial mode, the hazard warning lights flash twice.

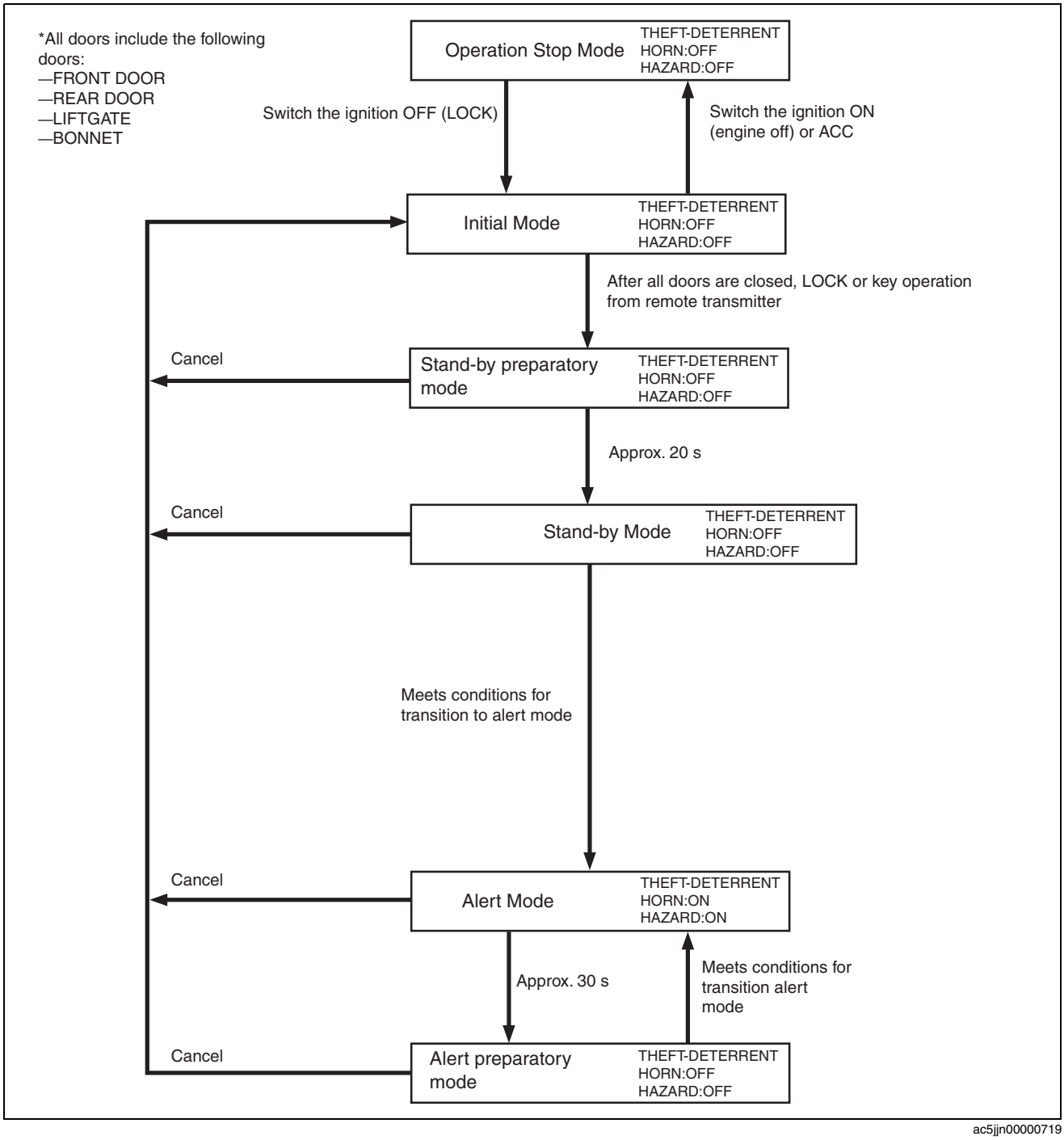
Intruder sensor cancel function

- An intruder sensor cancel button has been installed on the keyless entry remote transmitter. If the intruder sensor cancel button is on while the theft-deterrent system is pre-armed, intruder sensor ultrasonic wave output is cut, and movement detection is stopped.

SECURITY AND LOCKS

Operation (Without Intruder Sensor)
Mode transition

- The rear body control module (RBCM) switches the theft-deterrent system mode based on the ignition switch and door conditions.



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Operation stop mode

- In this mode, all theft-deterrent system operations are stopped.
- The system changes to the operation stop mode when any of the following conditions are met.
  — Switch the ignition to ACC or ON (engine off).

Initial mode

- This mode is the preparatory mode before changing to the stand-by mode. The system does not change directly to the alert mode from this mode.

Transition condition to the initial mode

- The system changes from the operation stop mode to the initial mode if all of the following conditions are met.


SECURITY AND LOCKS

— Switch the ignition OFF (LOCK)
- The system transitions from stand-by preparatory mode, stand-by mode, alert mode, and alert preparatory mode to the initial mode if the cancel conditions in each mode are met.

Transition condition to the stand-by preparatory mode
- The system changes to the stand-by preparatory mode if any of the following conditions are met.
  — A lock operation was performed using the remote transmitter lock button or key with all the doors, liftgate, and bonnet closed.

Stand-by preparatory mode
- This is mode prior to the stand-by mode.
- If the cancel conditions are met, the system changes to the initial mode.

Transition condition to the stand-by mode
- If the stand-by preparatory mode continues for approx. 20 s, the system changes to the stand-by mode.

Cancel conditions
- If any of the following conditions are met, the stand-by preparation mode is canceled and the system changes to the initial mode.
  — Any front door latch switch on (door is open), or any rear door latch switch on (rear door is open), or liftgate latch switch on (liftgate is open), or bonnet latch switch off (bonnet is open)
  — Any door lock-link switch UNLOCK
  — Switch the ignition to ACC or ON (engine off)
  — Unlock operation using remote transmitter
  — The driver-side door key cylinder is unlocked
  — Open the liftgate using the liftgate opener switch (With advanced keyless entry system)

Stand-by mode
- The system starts monitoring approx. 20 s after the doors are locked for unauthorized door opening/closing. If any unauthorized operation is detected, the system changes to the alert mode.
- If the cancel conditions are met, the system changes to the initial mode.

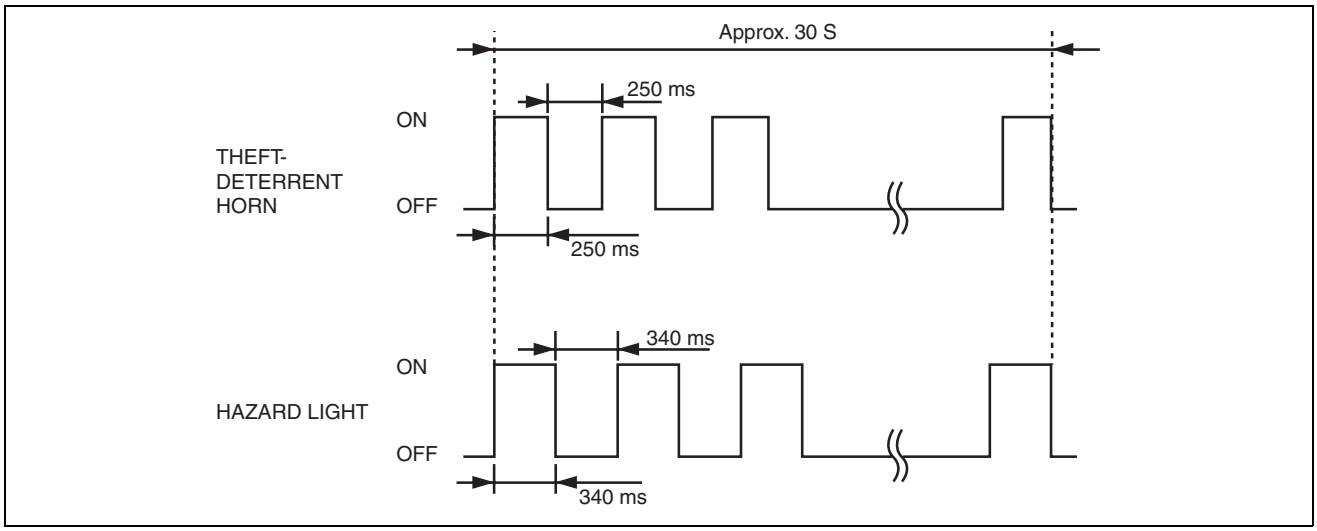
Transition condition to the alert mode
- If any of the following conditions are met, the system changes to the alert mode.
  — Switch the ignition ON (engine off)
  — Door latch switch on (door is open)
  — Liftgate latch switch on (liftgate is open)
  — Bonnet latch switch off (bonnet is open)
  — Door lock-link switch UNLOCK

Cancel condition
- If any of the following conditions are met, the stand-by mode is canceled and the system changes to the initial mode.
  — Unlock operation using remote transmitter
  — Switch the ignition to ACC or ON (engine off).
  — The driver-side door key cylinder is unlocked

Alert mode
- In this mode, the theft-deterrent horn and hazard warning lights are operated to alert the surrounding area.
- When the alarm period (approx. 30 s) has elapsed, the system changes to the alert preparatory mode.


SECURITY AND LOCKS

- If the cancel conditions are met, the system changes to the initial mode.



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Transition condition to the alert preparatory mode

- When the alarm period (approx. 30 s) has elapsed, the system changes to the alert preparatory mode.
- The alarm period is not extended even if a transition condition to alert mode is met again during an alarm period.

Cancel condition

- If any of the following conditions are met, the alert mode is canceled, and the system changes to the initial mode.
  - — Unlock operation using remote transmitter
  - — Switch the ignition ON (engine off), and engine start
  - — The driver-side door key cylinder is unlocked
  - — Open the liftgate using the liftgate opener switch (With advanced keyless entry system)

Alert preparatory mode

- In the alert preparatory mode, the theft-deterrent horn and hazard warning light are not operated, however, the alarm triggers immediately if the condition is changed.
- If the cancel conditions are met, the system changes to the initial mode.

Transition condition to alert mode

- The system changes to the alert mode if any of the following conditions are met.
  - — The ignition is switched from ON to off, or from off to ON
  - — The door latch switch is turned from on (door is open) to off (door is closed), or from off (door is closed) to on (door is open)
  - — The liftgate latch switch is turned from on (liftgate is open) to off (liftgate is closed), or from off (liftgate is closed) to on (liftgate is open)
  - — The bonnet latch switch is turned from off (bonnet is open) to on (bonnet is closed) or from on (bonnet is closed) to off (bonnet is open)
  - — The door lock-link switch is locked from unlock, or unlocked from lock

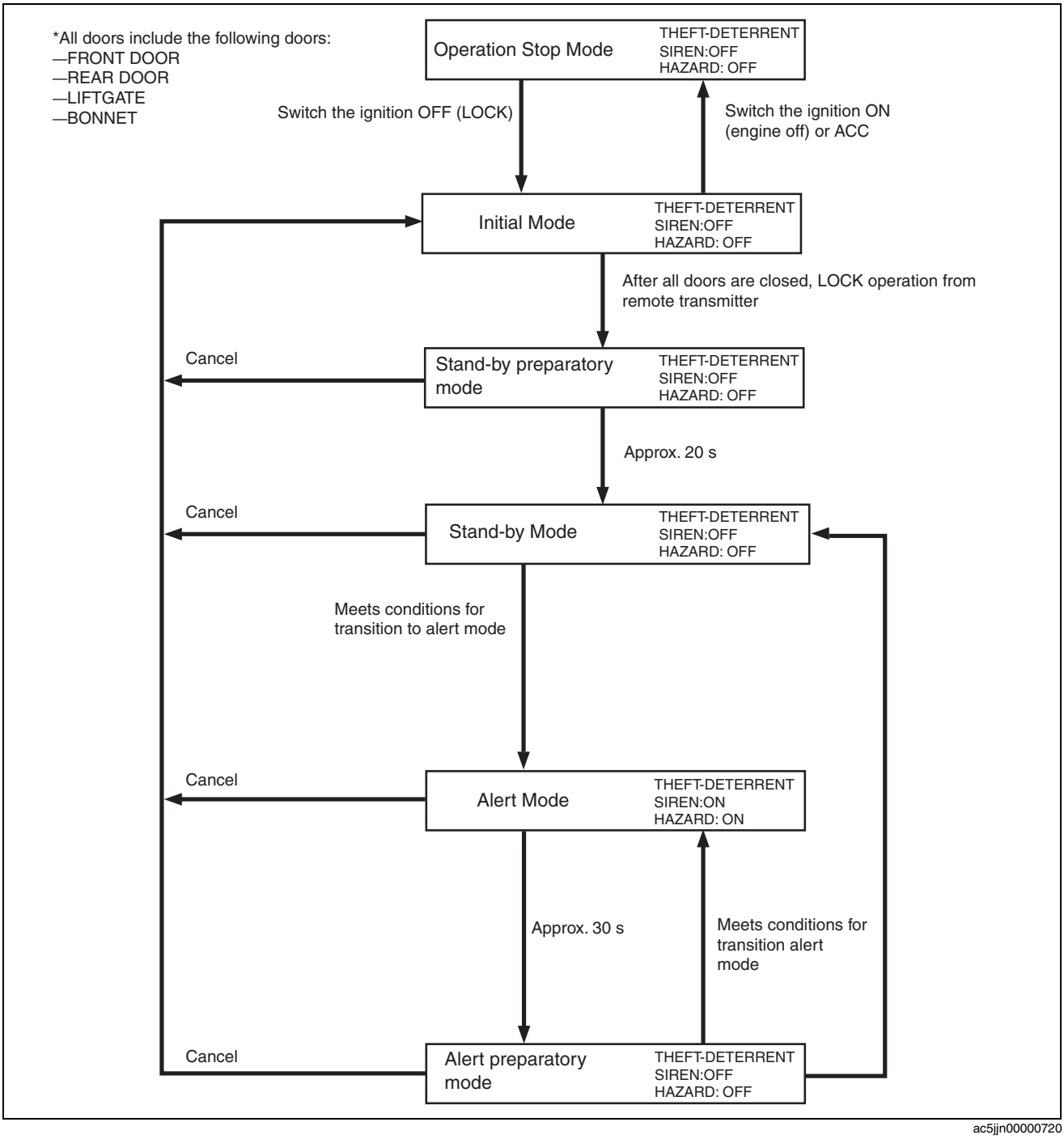
Cancel condition

- If any of the following conditions are met, the alert preparatory mode is canceled and the system changes to the initial mode.
  - — Unlock operation using remote transmitter
  - — Switch the ignition ON, and engine start
  - — Unlock operation using front door key cylinder
  - — Open the liftgate using the liftgate opener switch (With advanced keyless entry system)

SECURITY AND LOCKS

Operation (With Intruder Sensor)
Mode transition

- The rear body control module (RBCM) switches the theft-deterrent system mode based on the ignition switch and door conditions.



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Operation stop mode

- In this mode, all theft-deterrent system operations are stopped.
- The system changes to the operation stop mode when any of the following conditions are met.
  — Switch the ignition to ACC or ON (engine off).

Initial mode

- This mode is the preparatory mode before changing to the stand-by mode. The system does not change directly to the alert mode from this mode.

Transition condition to the initial mode

- The system changes from the operation stop mode to the initial mode if all of the following conditions are met.
  — Switch the ignition OFF (LOCK)

SECURITY AND LOCKS

- The system transitions from stand-by preparatory mode, stand-by mode, alert mode, and alert preparatory mode to the initial mode if the cancel conditions in each mode are met.

Transition condition to the stand-by preparatory mode

- The system changes to the stand-by preparatory mode if any of the following conditions are met.
  - — A lock operation was performed using the remote transmitter lock button with all the doors, liftgate, and bonnet closed.

Stand-by preparatory mode

- This is mode prior to the stand-by mode.
- If the cancel conditions are met, the system changes to the initial mode.

Transition condition to the stand-by mode

- If the stand-by preparatory mode continues for approx. 20 s, the system changes to the stand-by mode.

Cancel conditions

- If any of the following conditions are met, the stand-by preparatory mode is canceled and the system changes to the initial mode.
  - — Any door latch switch on (door is open), or liftgate latch switch on (liftgate is open), or bonnet latch switch off (bonnet is open)
  - — Any door lock-link switch UNLOCK
  - — Switch the ignition to ACC or ON (engine off).
  - — Unlock operation using remote transmitter
  - — Open the liftgate using the liftgate opener switch (With advanced keyless entry system)

Stand-by mode

- The mode monitors for unauthorized door opening/closing approx. 20 s after the doors are locked. If any unauthorized operation is detected, the system changes to alert mode.
- If the cancel conditions are met, the system changes to the initial mode.

Transition condition to the alert mode

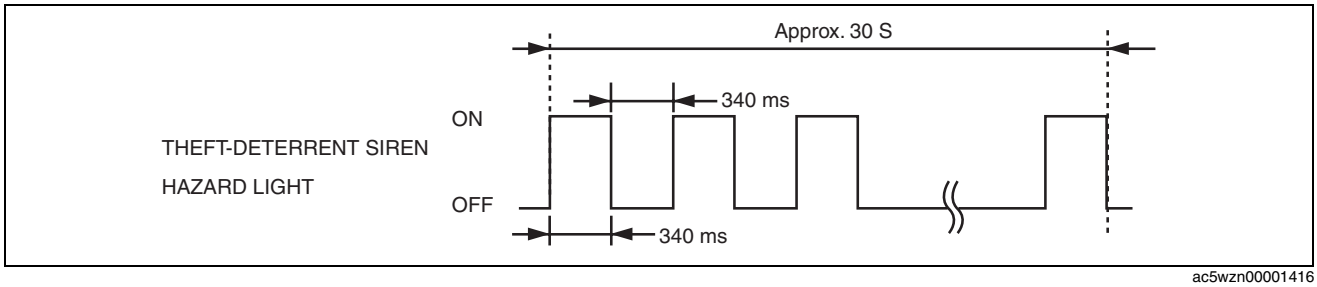
- If any of the following conditions are met, the system changes to the alert mode.
  - — Switch the ignition ON (engine off)
  - — Door latch switch on (door is open)
  - — Liftgate latch switch on (liftgate is open)
  - — Bonnet latch switch off (bonnet is open)
  - — Door lock-link switch UNLOCK
  - — Intrusion into vehicle is detected by intruder sensor

Cancel condition

- If any of the following conditions are met, the stand-by mode is canceled and the system changes to the initial mode.
  - — Unlock operation using remote transmitter
  - — Switch the ignition to ON (engine off), and engine start
  - — Open the liftgate using the liftgate opener switch (With advanced keyless entry system)

Alert mode

- In this mode, the theft-deterrent siren and hazard warning lights are operated to alert the surrounding area.
- When the alarm period (approx. 30 s) has elapsed, the system changes to the alert preparatory mode.
- If the cancel conditions are met, the system changes to the initial mode.



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Transition condition to the alert preparatory mode

- When the alarm period (approx. 30 s) has elapsed, the system changes to the alert preparatory mode.
- The alarm period is not extended even if a transition condition to alert mode is met again during an alarm period.

Cancel condition

- If any of the following conditions are met, the alert mode is canceled, and the system changes to the initial mode.
  - — Unlock operation using remote transmitter
  - — Switch the ignition to ON (engine off), and engine start
  - — Open the liftgate using the liftgate opener switch (With advanced keyless entry system)

SECURITY AND LOCKS

Alert preparatory mode
- In the alert preparatory mode, the theft-deterrent siren and hazard warning light are not operated, however, the alarm triggers immediately if the condition is changed.
- If the cancel conditions are met, the system changes to the initial mode.

Transition condition to alert mode
- The system changes to the alert mode if any of the following conditions are met.
  - — Switch the ignition ON (engine off)
  - — Door latch switch on (door is open)
  - — Liftgate latch switch on (liftgate is open)
  - — Bonnet latch switch off (bonnet is open)
  - — Door lock-link switch UNLOCK
  - — Intrusion into vehicle is detected by intruder sensor

Transition condition to the stand-by mode
- If there is no transition to cancel or alert mode for a period of 5 s after warning stand-by mode is established, the system switches to stand-by mode.

Cancel condition
- If any of the following conditions are met, the alert preparatory mode is canceled and the system changes to the initial mode.
  - — Unlock operation using keyless entry remote transmitter
  - — Switch the ignition ON (engine off), and engine start
  - — Open the liftgate using the liftgate opener switch (With advanced keyless entry system)

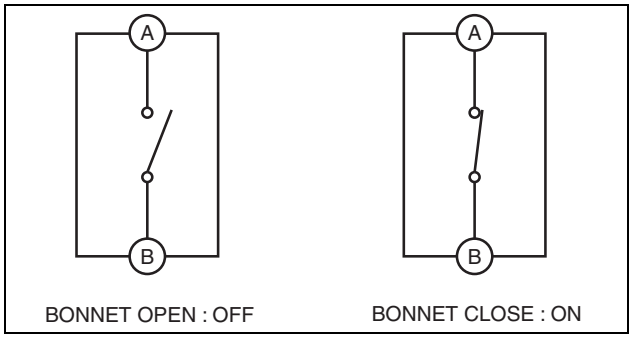
BONNET LATCH SWITCH

id091400597200

Purpose
- Detects the open/closed condition of the bonnet.

Function
- The bonnet latch switch is utilized in the i-stop and theft-deterrent system control.
  - — For the theft-deterrent system, refer to 09-14-74 THEFT-DETERRENT SYSTEM.
  - — For the i-stop control, refer to 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].

Construction
- Built into the bonnet latch.
- Switch turns on and off by the rotation of the latch bar.
- When the bonnet is completely closed, the bonnet latch switch is on (contact point: closed).



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Operation

Bonnet close (latch) operation
1. When the bonnet is closed, the bonnet lock striker enters the latch lever groove.
2. When the bonnet is then further closed, the latch lever is pressed by the bonnet lock striker and rotates.
3. When the bonnet is completely closed, the latch lever is in a latched condition and presses the bonnet latch switch which turns the switch on.

Bonnet open (unlatch) operation
1. When the bonnet release lever is pulled, the bonnet opens and the latch lever is in an unlatched condition, and the bonnet latch switch turns off.

Fail-safe
- Function not equipped.

SECURITY AND LOCKS

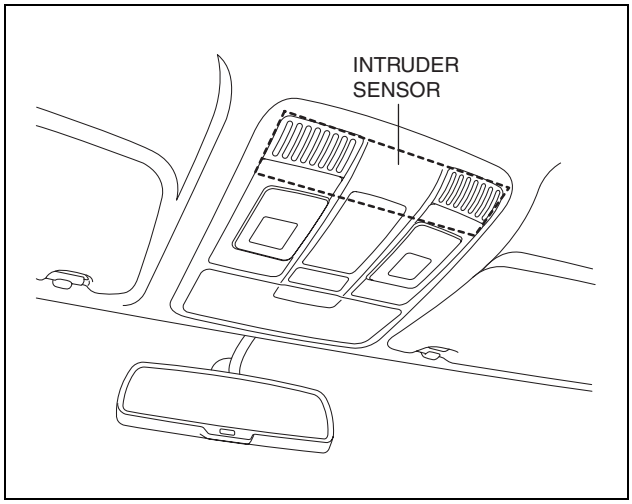
INTRUDER SENSOR

id091400003500

Purpose
- A cabin intrusion is detected.

Function
- The intruder sensor detects movement in the vehicle by ultrasonic waves and sends the detection signal to the rear body control module (RBCM).

Construction
- The intruder sensor is located in center part of the roof the forward part of the roof.



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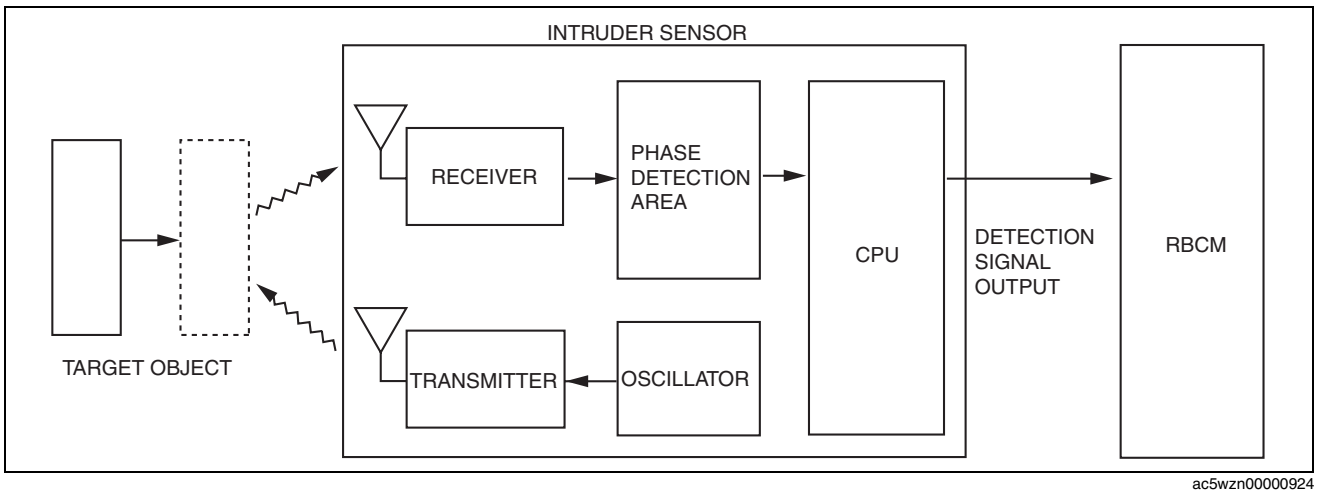
Operation
1. When the theft-deterrent system is armed, the intruder sensor outputs ultrasonic waves in the passenger compartment. The intruder sensor detects differences in the ultrasonic waves (reflected waves) that are output and bounced off a target object.
2. When a difference in reflected waves occurs by movement in the vehicle (intruder), the CPU calculates the level of difference.
3. If the differences meet certain criteria, the intruder sensor sends a detection signal to the rear body control module (RBCM).



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Fail-safe
- Function not equipped.

THEFT-DETERRENT SIREN

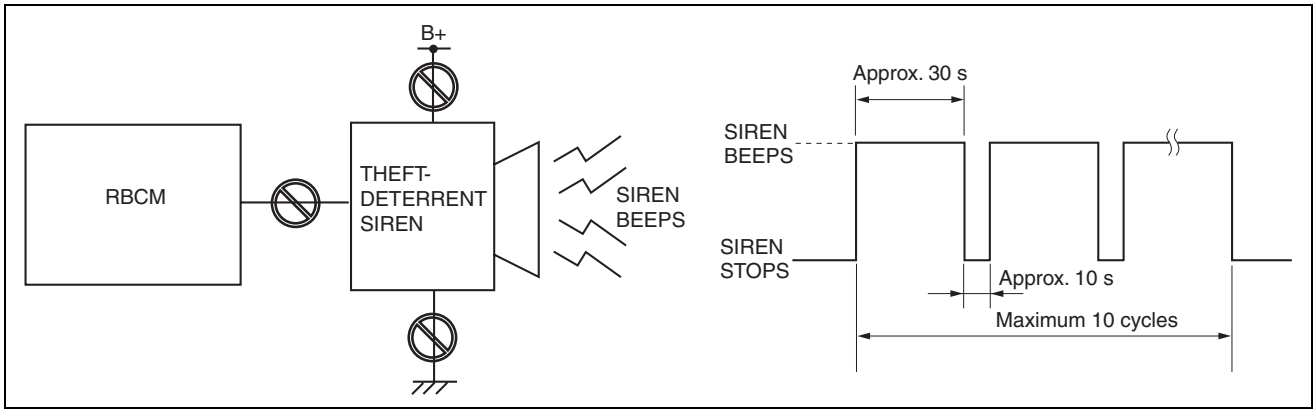
id091400003600

Purpose
- Alerts that a door, liftgate, or the bonnet has been opened improperly.

SECURITY AND LOCKS

Function
- The theft-deterrent system activates if a door, the liftgate, or the bonnet is improperly opened.

Open Circuit Alert Control Function
- If the power or ground lines are cut, the theft-deterrent siren uses the back-up power supply to activate the siren.
- If the transmission lines are cut, the theft-deterrent system uses the vehicle's battery power to activate the siren.
- If any one of the following conditions are met, the siren is stopped:
  — Receives go-to-initial signal from the rear body control module (RBCM).



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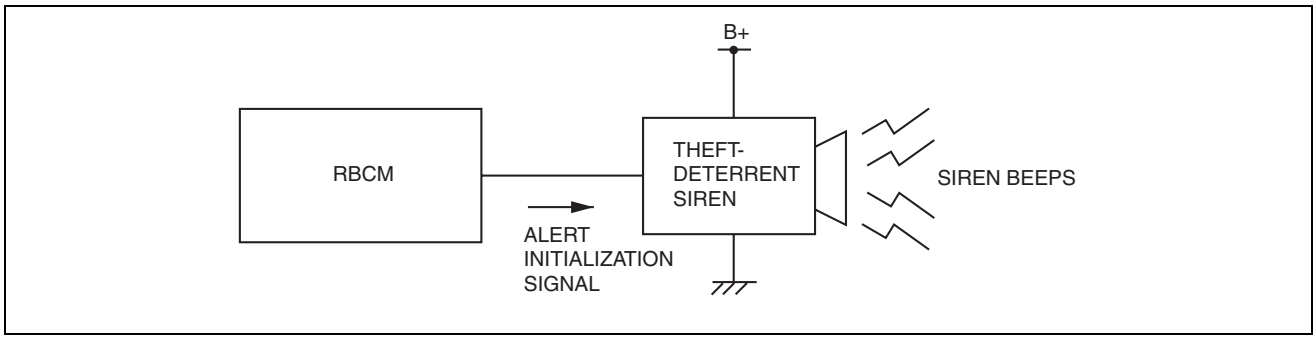
Construction
- The theft-deterrent siren is installed inside the front bumper on the left side.

Operation
- The siren beeps when receiving an alert initialization signal from the rear body control module (RBCM). When a go-to-initial signal is received the siren is stopped.



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Fail-safe
- Function not equipped.

ON-BOARD DIAGNOSIS SYSTEM [ADVANCED KEYLESS ENTRY SYSTEM]

id091400111233

Outline
- The advanced keyless entry system has an on-board diagnostic function to facilitate system diagnosis.

Outline
- The on-board diagnostic function consists of the following functions: A malfunction detection function, which detects overall malfunctions in the advanced keyless entry system-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunction locations and status via DTC output; and a PID/data monitoring function, which reads out specific input/output signals and verifies the input/output condition.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.

Malfunction detection function
- Detects malfunctions in input/output signals.

SECURITY AND LOCKS

- If a malfunction occurs, the start stop unit records the malfunction as a DTC. A recorded DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

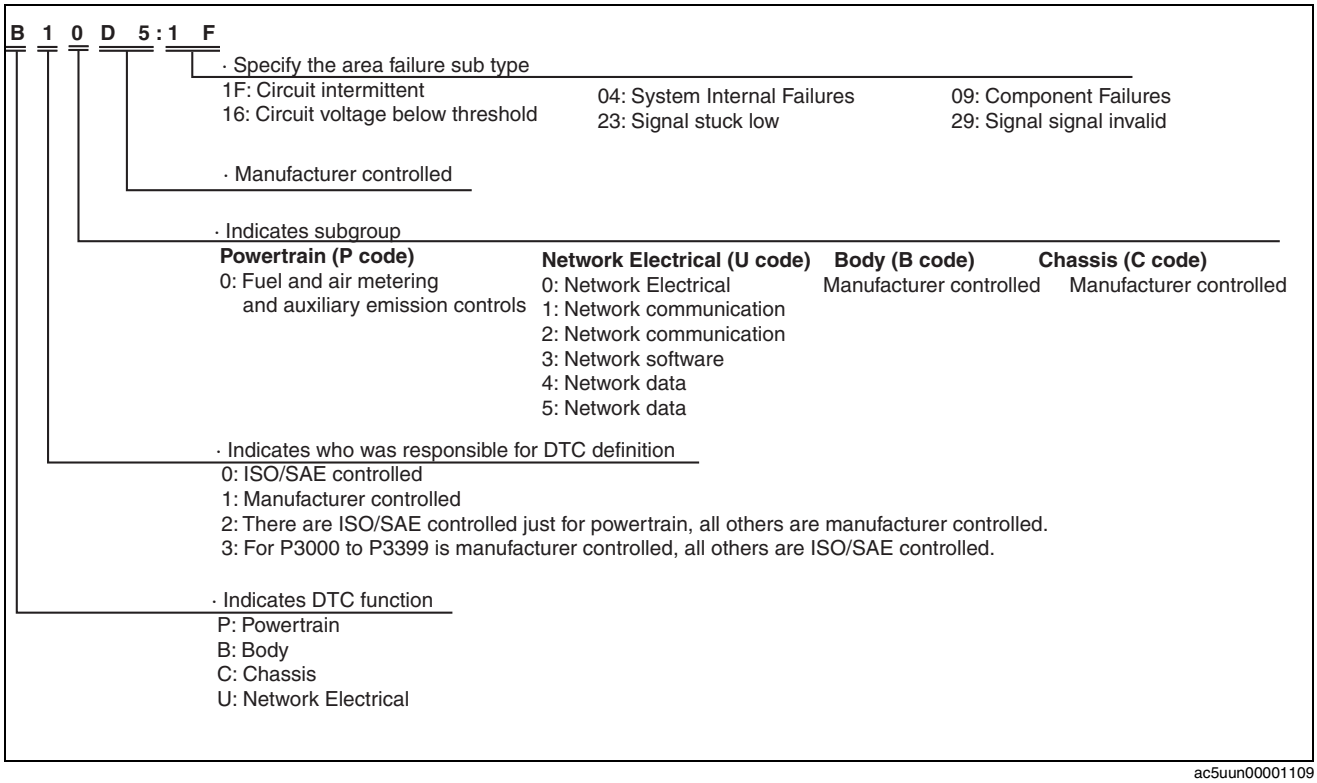
×: Applicable
—: Not applicable

DTC No.	KEY warning light (red)	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B10C6:1F	On	Keyless antenna (exterior, rear) circuit malfunction	×	—	C, D	×
B10C7:1F	On	Keyless antenna (interior, rear) circuit malfunction	×	—	C, D	×
B10C9:1F	On	Keyless antenna (interior, front) circuit malfunction	×	—	C, D	×
B10D1:23	On	Request switch (LF) circuit malfunction	—	—	C	×
B10D3:23	On	Request switch (RF) circuit malfunction	—	—	C	×
B11C4:23	On	Request switch (liftgate) circuit malfunction	—	—	C	×
B11FD:1F	On	Keyless antenna (exterior, LF) circuit malfunction	×	—	C, D	×
B1210:1F	On	Keyless antenna (exterior, RF) circuit malfunction	×	—	C, D	×
B13C3:04	On	LF control unit internal malfunction	×	—	C	×
B13C3:09	On	LF control unit malfunction	×	—	C	×
B13C3:16	On	LF control unit power supply voltage decrease input	×	—	C	×
B13C3:29	On	Communication error with LF control unit	×	—	C	×

*1 : C: CMDTC self test, D:ODDTC self test

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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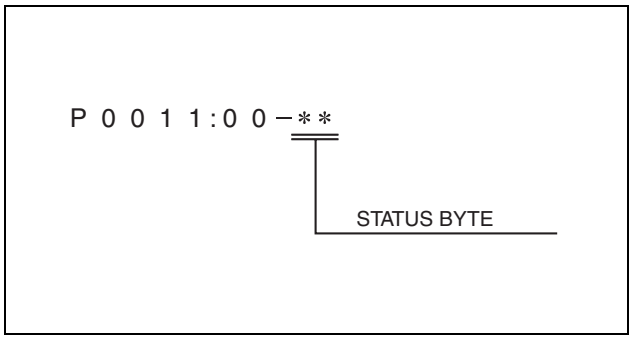
SECURITY AND LOCKS

Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the seven-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the M-MDS when reading the DTC.



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Detection condition for the applicable DTC

DTC	System malfunction location	Detection condition
B10C6:1F	Keyless antenna (exterior, rear) circuit malfunction	The start stop unit detects an open circuit in the keyless antenna (exterior, rear) or a short to ground with the ignition switched off.
B10C7:1F	Keyless antenna (interior, rear) circuit malfunction	The start stop unit detects an open circuit in the keyless antenna (interior, rear) or a short to ground with the ignition switched off.
B10C9:1F	Keyless antenna (interior, front) circuit malfunction	The start stop unit detects an open circuit in the keyless antenna (interior, front) or a short to ground with the ignition switched off.
B10D1:23	Request switch (LF) circuit malfunction	With the ignition switched ON (engine on), the start stop unit detects that the vehicle speed is 5 km/h {3 mph} or more for a continuous 2 min or more and the request switch (LF) is on 7 times or more until the vehicle speed is less than 5 km/h {3 mph}.
B10D3:23	Request switch (RF) circuit malfunction	With the ignition switched ON (engine on), the start stop unit detects that the vehicle speed is 5 km/h {3 mph} or more for a continuous 2 min or more and the request switch (RF) is on 7 times or more until the vehicle speed is less than 5 km/h {3 mph}.
B11C4:23	Request switch (liftgate) circuit malfunction	With the ignition switched ON (engine on), the start stop unit detects that the vehicle speed is 5 km/h {3 mph} or more for a continuous 2 min or more and the request switch (liftgate) is on 7 times or more until the vehicle speed is less than 5 km/h {3 mph}.
B11FD:1F	Keyless antenna (exterior, LF) malfunction	The start stop unit detects an open circuit in the keyless antenna (exterior, LF) or a short to ground with the ignition switched off.
B1210:1F	Keyless antenna (exterior, RF) malfunction	The start stop unit detects an open circuit in the keyless antenna (exterior, RF) or a short to ground with the ignition switched off.
B13C3:04	LF control unit internal malfunction	LF control unit internal malfunction detected
B13C3:09	LF control unit malfunction	• The start stop unit detects that the LF State signal of the LF control unit is low for 5 s or more. • With the communication between the start stop unit and LF control unit being performed normally, there is no response from the LF control unit even though there is a signal transmission request from the start stop unit to the LF control unit, and the LF state signal becomes low.
B13C3:16	LF control unit power supply voltage decrease input	With the ignition switched ON (engine off), start stop unit power supply circuit (+B1) voltage of 8.5 V or more or less than 16.5 V and LF control unit power supply circuit voltage of 5 V or more or less than 8.5 V are detected for 5 s or more.
B13C3:29	Communication error with LF control unit	The start stop unit detects communication error with LF control unit 10 times in a series.

SECURITY AND LOCKS

Data monitor function

- With the PID/data monitor function, input/output signal monitor items set in the start stop unit can be selected and read out in real-time.

PID	Unit/ Operation	Data contents	Inspection item(s)
LG/ T_LK_SW	Off/On	• Off: Request switch (liftgate) is off. • On: Request switch (liftgate) is on.	Request switch (liftgate)
RQ_SW_LF	Off/On	• Off: Request switch (LF) is off. • On: Request switch (LF) is on.	Request switch (LF)
RQ_SW_RF	Off/On	• Off: Request switch (RF) is off. • On: Request switch (RF) is on.	Request switch (RF)

ON-BOARD DIAGNOSIS SYSTEM [START STOP UNIT]

id091400111235

Outline

- The on-board diagnostic function consists of the following functions: A malfunction detection function, which detects overall malfunctions in the start stop unit-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunction locations and status via DTC output; and a PID/data monitoring function, which reads out specific input/output signals and verifies the input/output condition.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.

Malfunction detection function

- Detects malfunctions in input/output signals.
- If a malfunction occurs, the start stop unit records the malfunction as a DTC. A recorded DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

×: Applicable
—: Not applicable

DTC No.	KEY warning indicator light (red)	Push button indicator light (amber)	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B1026:49* 2	—	Flash	Steering lock malfunction	×	—	C	×
B1026:96* 2	—	Flash	Steering lock malfunction	—	—	C	×
B108B:23	—	Flash	Push button start switch No.1 circuit malfunction	×	—	C	×
B108B:24	—	Flash	Push button start switch No.1 circuit malfunction	—	—	C	×
B108C:23	—	Flash	Push button start switch No.2 circuit malfunction	×	—	C	×
B108C:24	—	Flash	Push button start switch No.2 circuit malfunction	—	—	C	×
B10AC:13 *3	—	—	Cruise control switch circuit malfunction	—	—	C	×
B10AC:23 *3	—	—	Cruise control switch circuit malfunction	—	—	C	×
B10C6:1F *4	On	—	Keyless antenna (exterior, rear) circuit malfunction	×	—	C, D	×
B10C7:1F *4	On	—	Keyless antenna (interior, rear) circuit malfunction	×	—	C, D	×
B10C9:1F	On	—	Keyless antenna (interior, center) circuit malfunction (with keyless entry system)	—	—	C, D	×
	On	—	Keyless antenna (interior, front) circuit malfunction (with advanced keyless entry system)	×	—	C, D	×
B10D1:23* 4	On	—	Request switch (LF) circuit malfunction	—	—	C	×

SECURITY AND LOCKS

DTC No.	KEY warning indicator light (red)	Push button indicator light (amber)	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B10D3:23* 4	On	—	Request switch (RF) circuit malfunction	—	—	C	×
B10D9:87	—	Flash	Communication error with coil antenna (built into push button start)	—	—	C	—
B10DA:51	—	—	Communication error with PCM (data send failure)	—	—	C	—
B10DA:62	—	—	Communication error with PCM (data mis-matched)	—	—	C	—
B10E7:11	—	Flash	IG1 relay circuit malfunction	—	—	C	×
B10E7:12	—	Flash	IG1 relay circuit malfunction	—	—	C	×
B10E7:16	—	Flash	IG1 relay circuit malfunction	—	—	C	×
B10E7:17	—	Flash	IG1 relay circuit malfunction	×	—	C	×
B112A:11	—	Flash	IG2 relay circuit malfunction	—	—	C	×
B112A:12	—	Flash	IG2 relay circuit malfunction	—	—	C	×
B1140:29* 5	—	—	i-stop control error signal received	—	—	C	×
B11C4:23* 4	On	—	Request switch (liftgate) circuit malfunction	—	—	C	×
B11FD:1F *4	On	—	Keyless antenna (exterior, LF) malfunction	×	—	C, D	×
B1210:1F* 4	On	—	Keyless antenna (outside vehicle, RF) malfunction	×	—	C, D	×
B124C:56	—	—	Turn switch circuit malfunction	—	—	C	×
B13C3:04* 4	On	—	LF control unit internal malfunction	×	—	C	×
B13C3:09* 4	On	—	LF control unit malfunction	×	—	C	×
B13C3:16* 4	On	—	LF control unit power supply voltage (+B1) low input	×	—	C	×
B13C3:29* 4	On	—	Communication error with LF control unit	×	—	C	×
B13D3:05	—	—	Key ID number program error	—	—	C	—
B13D3:16	On	—	Low remote transmitter battery voltage	—	—	C	×
B13D3:4A	On	—	Remote transmitter assembly malfunction	—	—	C	×
B13D3:51	—	Flash	Key code not programmed	—	—	C	—
B13D3:94	—	—	Communication error with remote transmitter	—	—	C	—
B13D3:97	—	—	Remote transmitter registration work not completed	—	—	C	×
B13D4:00	On	—	Insufficient key code programming number	—	—	C	—
B1C53:13	—	—	Windshield wiper switch circuit malfunction	—	—	C	×
C0040:23* 7	—	Flash	Brake switch (No.1 signal) circuit malfunction	×	—	C	×
C0040:24* 7	—	Flash	Brake switch (No.1 signal) circuit malfunction	×	—	C	×
C0051:95* 6	—	—	Steering angle sensor assembly malfunction	—	—	C	×
C0051:2F* 6	—	—	Steering angle sensor signal error	—	—	C	×
C0052:14* 6	—	—	Steering angle sensor A signal circuit malfunction	—	—	C	×

SECURITY AND LOCKS

DTC No.	KEY warning indicator light (red)	Push button indicator light (amber)	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
C0052:2F* 6	—	—	Steering angle sensor A signal malfunction	—	—	C	×
C0053:14* 6	—	—	Steering angle sensor B signal circuit malfunction	—	—	C	×
C0053:2F* 6	—	—	Steering angle sensor B signal malfunction	—	—	C	×
C2003:13* 6	—	—	Open circuit in steering switch	—	—	C	×
P0560:16* 2	—	Flash	Start stop unit power supply voltage (+B3) low input	—	—	C	×
P0615:11	—	Flash	Starter relay circuit malfunction	—	—	C	×
P0615:12	—	Flash	Starter relay circuit malfunction	×	—	C	×
P0615:13	—	Flash	Starter relay circuit malfunction	—	—	C	×
P0615:16	—	Flash	Starter relay circuit malfunction	—	—	C	×
P0616:23	—	—	Circuit malfunction on downstream side of starter relay	—	—	C	×
P0616:24	—	—	Circuit malfunction on downstream side of starter relay	—	—	C	×
P0616:29	—	—	Starter relay signal malfunction	—	—	C	×
P081C:23* 7	—	Flash	NOT P position switch circuit malfunction	×	—	C	×
P081C:24* 7	—	Flash	NOT P position switch circuit malfunction	×	—	C	×
P081D:29* 8	—	Flash	Neutral switch error signal received	×	—	C	×
P081D:2F *8	—	Flash	Neutral switch signal mismatch	×	—	C	×
P0830:23* 8	—	Flash	CPP switch circuit malfunction	×	—	C	×
P0850:23* 7	—	Flash	TCM circuit malfunction	×	—	C	×
P0850:24* 7	—	Flash	TCM circuit malfunction	×	—	C	×
P0930:71* 7	—	—	Shift-lock solenoid circuit malfunction	×	—	C	×
P1708:24* 8	—	Flash	Starter interlock switch circuit malfunction	×	—	C	×
P1708:29* 8	—	Flash	Starter interlock switch circuit or CPP switch circuit malfunction	×	—	C	×
P1794:16	—	Flash	Start stop unit power supply voltage (+B2) low input	—	—	C	×
U0001:88	On	Flash	Module communication error (HS-CAN)	×	—	C	×
U0028:87	On	—	Communication error with rear body control module (RBCM)	—	—	C	×
U0100:00	On	Flash	Communication error with PCM	×	—	C	×
U0100:87	—	—	Communication error with PCM (no response)	—	—	C	—
U0101:00* 7	—	Flash	Communication error with TCM	×	—	C	×
U0121:00	On	Flash	Communication error with DSC HU/CM	×	—	C	×

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DTC No.	KEY warning indicator light (red)	Push button indicator light (amber)	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
U0121:87	On	Flash	Communication error with DSC HU/CM	×	—	C	×
U0131:00	—	—	Communication error with EPS control module	×	—	C	×
U0140:00	—	—	Communication error with front body control module (FBCM)	×	—	C	×
U0146:00	On	Flash	Communication error with instrument cluster	—	—	C	×
U0151:00	On	Flash	Communication error with SAS control module	×	—	C	×
U0155:00	On	Flash	Communication error with instrument cluster	×	—	C	×
U0447:86	On	Flash	Error signal received from instrument cluster	—	—	C	×
U201F:11	On	—	Keyless receiver circuit malfunction	—	—	C	×
U201F:12	On	—	Keyless receiver circuit malfunction	—	—	C	×
U2100:00	On	—	Start stop unit configuration not completed	×	—	C	×
U2300:00	—	—	Configuration data not received from instrument cluster	×	—	C	×
U3000:01* 6	—	—	Start stop unit internal malfunction	—	—	C	×
U3000:49	On	Flash	Start stop unit internal malfunction	×	—	C	×
U3000:96	On	Flash	Start stop unit malfunction	×	—	C	×
U3003:16	On	—	Start stop unit power supply voltage (+B1) low input	×	—	C	×
U3004:11	—	Flash	ACC relay circuit malfunction	—	—	C	×
U3004:12	—	Flash	ACC relay circuit malfunction	×	—	C	×
U3004:16	—	—	ACC relay circuit malfunction	—	—	C	×
U3004:17	—	—	ACC relay circuit malfunction	×	—	C	×

*1 : C: CMDTC self test, D: ODDTC self test
*2 : With steering lock
*3 : With cruise control system
*4 : With advanced keyless entry system
*5 : With i-stop
*6 : With steering angle sensor
*7 : ATX
*8 : MTX

Snap shot data

- The data for all DTCs currently detected is stored.

Snap shot data table

Snap shot data item	Unit		Data contents	Corresponding data monitor items
AAT	°C	°F	Ambient temperature	—
APP_STATUS	Accelerator Pedal Off/Under20%/ Over20%/FAIL		Accelerator pedal position status	—
CFG_STATUS	Config Complete/Not Configured/ Config Error		Configuration status	—
ECT_STATUS	Under 0 degrees C/0-Under 80 degrees C/Over 80 degrees C/FAIL		Engine coolant temperature status	—
IC_VPWR	V		Instrument cluster power supply voltage	—
IG-ON_TIMER	hh:mm:ss		Elapsed time since ignition switched ON (engine off or on)	—

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Snap shot data item	Unit		Data contents	Corresponding data monitor items
PWR_MODE_KEY	Key Out/Key Recently Out/ Key Approved (Position 0)/ Post Accessory (Position 0)/ Accessory (Position 1)/ Post Ignition (Position 1)/ ignition On (Position 2)/ Running - Starting In Progress (Position 2)/Crank (Position 3)		Push button start power position switching status	—
RPM_STATUS	Engine Stop/Under1500rpm/ Over1500rpm/FAIL		Engine speed status	—
SHIFT_STATUS	P/N/ D/ R/ FAIL		Selector lever position status	—
TOTAL_DIST	Km	miles	Accumulated total traveled distance since vehicle completion	—
TOTAL_TIME	hh:mm:ss		Accumulated total elapsed time since vehicle completion **Note** • When the ROOM fuse is removed, or the ignition is switched off (LOCK), the time is not included in the elapsed time.	—
TRNS_NUM_L	Initial/No.1/No.2/No.3/No.4/No.5/No.6		Order of remote transmitters Programmed to vehicle	—
VPWR	V		Start stop unit power supply malfunction	—
VPWR_B1	V		Start stop unit power supply malfunction	—
VSPD_STATUS	Stop/ 0-10km/h/ Over10km/h/ FAIL		Vehicle speed status	—

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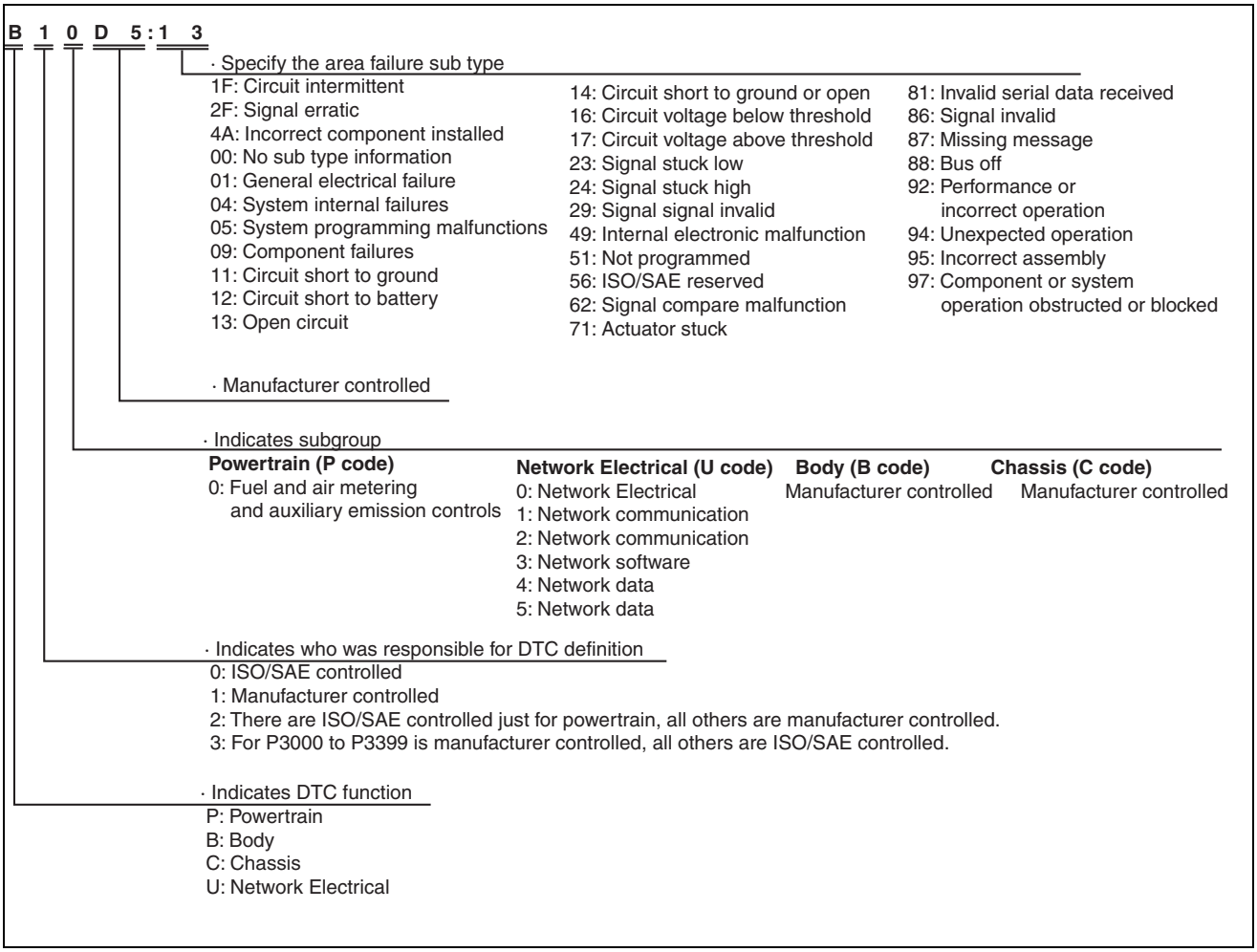
DTC 7-digit code definition

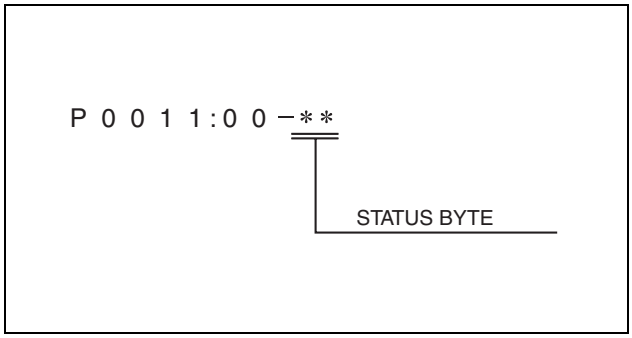
- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



ac5uun00001114

Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the seven-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the M-MDS when reading the DTC.



ac5wzn00002016

Detection condition for the applicable DTC

DTC	System malfunction location	Detection condition
B1026:49* 5	Steering lock malfunction	Start stop unit detects a serious malfunction in the steering lock of the internal start stop unit.
B1026:96* 5	Steering lock malfunction	Start stop unit detects malfunction in the steering lock of the internal start stop unit.
B108B:23	Push button start switch 1 circuit malfunction	Start stop unit detects push button start switch 1 ON stuck for 120 s or more.

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DTC	System malfunction location	Detection condition
B108B:24	Push button start switch 1 circuit malfunction	The start stop unit detects that push button start switch 1 is kept in an off condition 5 times or more even though push button start switch 2 is on.
B108C:23	Push button start switch 2 circuit malfunction	Start stop unit detects push button start switch 2 ON stuck for 120 s or more.
B108C:24	Push button start switch 2 circuit malfunction	The start stop unit detects that push button start switch 2 is kept in an off condition 5 times or more even though push button start switch 1 is on.
B10AC:13* 1	Cruise control switch circuit malfunction	The start stop unit detected an open circuit in the cruise control switch circuit for 5 s or more with the ignition switched ON (engine off or on).
B10AC:23* 1	Cruise control switch circuit malfunction	The start stop unit detects any cruise control switch stuck on for 2 min or more with the ignition switched ON (engine off or on).
B10C9:1F	Keyless antenna (interior, center) circuit malfunction	The start stop unit detects an open circuit in the keyless antenna (interior, center) or a short to ground with the ignition switched off.
B10E7:11	IG1 relay circuit malfunction	The ignition is switched ON (engine off or on) and the starter stop unit detects voltage from IG1 relay output monitor as less than 2.5 V for 0.5 s or more while the engine is not being cranked.
B10E7:12	IG1 relay circuit malfunction	The start stop unit detects IG1 relay output monitor voltage of 2.5 V or more for 0.5 s or more with the ignition switched off or ACC.
B10E7:16	IG1 relay circuit malfunction	The ignition is switched ON (engine off or on) and the starter stop unit detects voltage from IG1 monitor as less than 2.5 V for 1 s or more while the engine is not being cranked.
B10E7:17	IG1 relay circuit malfunction	The start stop unit detects IG1 monitor voltage of 2.5 V or more for 1 s or more with the ignition switched off or ACC.
B112A:11	IG2 relay circuit malfunction	With the ignition switched ON (engine off or on), the start stop unit detects IG2 relay circuit voltage of 2.5 V or less for 0.5 s or more.
B112A:12	IG2 relay circuit malfunction	With the ignition switched off or to ACC, the start stop unit detects IG2 relay circuit voltage of 2.5 V or more for 0.5 s or more.
B1140:29* 6	i-stop control error signal received	The starter ground circuit does not turn on even though the PCM detects an engine restart request while the engine is stopped under i-stop control, or the condition whereby an open circuit is detected for a continuous 12 s or more for a total of five times or more.
B124C:56	Turn switch circuit malfunction	The start stop unit detects that turn switches LH and RH are turned on simultaneously for 5 s or more.
B13D3:16	Low remote transmitter battery voltage	Start stop unit detects low remote transmitter battery voltage in any of the programmed transmitters 3 times continuously.
B13D3:4A	Remote transmitter assembly malfunction	The start stop unit detects a remote transmitter different from the one equipped to the vehicle.
B13D3:97	Remote transmitter registration work not completed	The start stop unit detects that the registration of a remote transmitter has not been completed.
B1C53:13	Windshield wiper switch circuit malfunction	The start stop unit detects an open circuit, short to ground, or short to power supply in the windshield wiper switch circuit for 5 s or more with the ignition switched ON (engine off or on).
C0040:23* 3	Brake switch (No.1 signal) circuit malfunction	With the ignition switched ON (engine off or on), the start stop unit detects that the brake switch No.1 signal is in the off condition for 3 s or more continuously for a continuous 5 times even though brake switch No.2 signal changes.
C0040:24* 3	Brake switch (No.1 signal) circuit malfunction	With the ignition switched ON (engine off or on), the start stop unit detects that the brake switch No.1 signal is in the on condition for 3 s or more continuously for a continuous 5 times even though brake switch No.2 signal changes.
C0051:2F* 2	Steering angle sensor signal error	The start stop unit detects steering angle sensor signal error for 5 s or more with the ignition switched ON (engine off or on).

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DTC	System malfunction location	Detection condition
C0051:95* 2	Steering angle sensor assembly malfunction	• The start stop unit receives the following signals with the ignition switched ON (engine off or on). — Steering angle sensor assembly malfunction from EPS control module for 1 s or more — Improper assembly of steering angle sensor at 360° — Steering wheel angle of 720 or more for 0.048 s or more
C0052:14* 2	Steering angle sensor A signal circuit malfunction	The start stop unit detects an open circuit or a short to ground in steering angle sensor A signal circuit for.
C0052:2F* 2	Steering angle sensor A signal malfunction	• The start stop unit detected sudden change in steering angle sensor A signal. • The start stop unit detected that steering angle sensor A signal is stuck with the ignition switched ON (engine off or on).
C0053:14* 2	Steering angle sensor B signal circuit malfunction	The start stop unit detects an open circuit or a short to ground in steering angle sensor B signal circuit.
C0053:2F* 2	Steering angle sensor B signal malfunction	• The start stop unit detects sudden change in steering angle sensor B signal. • The start stop unit detects that steering angle sensor B signal is stuck with the ignition switched ON (engine off or on).
C2003:13	Open circuit in steering switch	The start stop unit detects an open circuit in the steering switch circuit for 5 s or more with the ignition switched ON (engine off or on).
P0560:16	Start stop unit power supply voltage (+B3) low input	Start stop unit power supply circuit (+B3) voltage of less than 8.5 V is detected for 5 s or more.
P0615:11	Starter relay circuit malfunction	The start stop unit detects starter relay monitor circuit voltage of less than 2.2 V for 1 s or more with the ignition switched off.
P0615:12	Starter relay circuit malfunction	The start stop unit detects starter relay circuit voltage of specification or more for 1 s or more with the ignition switched off.
P0615:13	Starter relay circuit malfunction	The start stop unit detects an open circuit in the starter relay circuit for 1 s or more with the ignition switched off.
P0615:16	Starter relay circuit malfunction	The start stop unit detects starter relay circuit voltage that is less than the specification for 1 s or more during cranking.
P0616:23	Circuit malfunction on downstream side of starter relay	The start stop unit detects a short to ground in the starter relay downstream circuit continuously for 0.5 s or more for a continuous 5 times.
P0616:24	Circuit malfunction on downstream side of starter relay	The start stop unit detects an open circuit in the starter relay downstream circuit continuously for 0.5 s or more for a continuous 5 times.
P0616:29	Starter relay signal malfunction	• If the following CAN signals are unmatched for 0.5 s or more continuously, and this condition is detected for a continuous 5 or more times. — Transaxle range sensor (ATX) or starter interlock switch (MTX) condition — Starter relay downstream circuit condition — PCM control result — CAN signal condition output from PCM
P081C:23* 3	NOT P position switch circuit malfunction	The start stop unit detects NOT P position switch is stuck on for 5 s or more for a continuous 5 times with the ignition switched ON (engine off or on).
P081C:24* 3	NOT P position switch circuit malfunction	The start stop unit detects NOT P position switch is stuck off for 5 s or more for a continuous 5 times with the ignition switched ON (engine off or on).
P081D:29* 4	Neutral switch error signal received	The start stop unit receives neutral switch signal error signal from the PCM for 1 min or more with the ignition switched ON (engine off or on).
P081D:2F* 4	Neutral switch signal mismatch	With the ignition switched ON (engine off or on), the start unit detects that the vehicle speed changes from 0 km/h {0 mph} to 10 km/h {6.2 mph} for a continuous 5 or more times even though the neutral signal from the PCM is being received.

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DTC	System malfunction location	Detection condition
P0830:23* 4	CPP switch circuit malfunction	Start stop unit detects clutch switch is stuck on for 10 s or more.
P0850:23* 3	TCM circuit malfunction	With the ignition switched ON (engine off or on), it is detected that the transaxle range sensor CAN signal is P or N position for 1 s or more continuously for a continuous 5 or more times even though the TCM CAN signal is other than P and N position.
P0850:24* 3	TCM circuit malfunction	With the ignition switched ON (engine off or on), it is detected that the transaxle range sensor CAN signal is other than P and N position for 1 s or more continuously for a continuous 5 or more times even though the TCM CAN signal is other than P or N position.
P0930:71* 3	Shift-lock solenoid circuit malfunction	The start stop unit detects shift-lock solenoid is stuck on for 30 s or more with the ignition switched ON (engine off or on).
P1708:24* 4	Starter interlock switch circuit malfunction	The start stop unit detects an open circuit in the starter interlock switch circuit for 1 s or more for a continuous 5 times with the ignition switched ON (engine off or on).
P1708:29* 4	Starter interlock switch circuit or CPP switch circuit malfunction	The start stop unit detects that the start interlock switch circuit is stuck on for 0.2 s or more, or the CPP switch circuit is stuck off for 0.25 s or more.
P1794:16	Start stop unit power supply voltage (+B2) low input	Start stop unit power supply circuit (+B2) voltage of less than 6.5 V is detected for 5 s or more.
U0001:88	Module communication error (HS-CAN)	The start stop unit detects CAN bus communication line (HS-CAN) malfunction 10 times continuously.
U0028:87	Communication error with rear body control module (RBCM)	Start stop unit detects communication error with rear body control module (RBCM) 10 times continuously.
U0100:00	Communication error with PCM	The start stop unit could not receive CAN signal from the PCM for 1 s or more.
U0101:00* 3	Communication error with TCM	The start stop unit could not receive CAN signal from the TCM for 1 s or more.
U0121:00	Communication error with DSC HU/CM	The start stop unit could not receive CAN signal from the DSC HU/CM for 1 s or more.
U0121:87	Communication error with DSC HU/CM	The start stop unit could not receive CAN signal from the DSC HU/CM for 10 s or more.
U0131:00	Communication error with EPS control module	The start stop unit could not receive CAN signal from the EPS control module for 1.2 s or more.
U0140:00	Communication error with front body control module (FBCM)	The start stop unit could not receive CAN signal from the front body control module (FBCM) for 5 s or more.
U0146:00	Communication error with instrument cluster	The start stop unit cannot receive gateway signals from the instrument cluster for 5 s or more with the ignition switched ON (engine off or on).
U0151:00	SAS control module communication error	The start stop unit could not receive CAN signal from the SAS control module for 1 s or more.
U0155:00	Communication error with instrument cluster	The start stop unit could not receive CAN signal from the instrument cluster for 5 s or more.
U0447:86	Error signal received from instrument cluster	The start stop unit receives error signals from the instrument cluster for 5 s or more with the ignition switched ON (engine off or on).
U201F:11	Keyless receiver circuit malfunction	Start stop unit detects keyless receiver circuit voltage of less than 3.4 V for 0.5 s or more.
U201F:12	Keyless receiver circuit malfunction	Start stop unit detects keyless receiver circuit voltage of 6.2 V or more for 0.5 s or more.
U2100:00	Start stop unit configuration not completed	Start stop unit configuration not completed.
U2300:00	Configuration data not received from instrument cluster	The start stop unit cannot receive configuration data from the instrument cluster for 1 s or more with the ignition switched ON (engine off or on).
U3000:01* 2	Start stop unit internal malfunction	Malfunction inside start stop unit detected.
U3000:49	Start stop unit internal malfunction	Malfunction inside start stop unit detected.
U3000:96	Start stop unit internal malfunction	Malfunction inside start stop unit detected.

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DTC	System malfunction location	Detection condition
U3003:16	Start stop unit power supply voltage (+B1) low input	Start stop unit power supply circuit (+B1) voltage of 5V or more, less than 8.5 V is detected for 5 s or more.
U3004:11	ACC relay circuit malfunction	With the ignition switched to ACC or ON (engine off or on), the start stop unit detects ACC relay output monitor voltage of less than specification for 0.05 s or more.
U3004:12	ACC relay circuit malfunction	The start stop unit detects ACC relay output monitor voltage of 2.5 V or more for 0.5 s or more with the ignition switched off.
U3004:16	ACC relay circuit malfunction	With the ignition switched to ACC or ON (engine off or on), the start stop unit detects ACC monitor voltage of less than 2.5 V for 1 s or more.
U3004:17	ACC relay circuit malfunction	The start stop unit detects ACC monitor voltage of 2.5 V or more for 5 s or more with the ignition switched off.

*1 : With cruise control system
*2 : With steering angle sensor
*3 : ATX
*4 : MTX
*5 : With steering lock
*6 : With i-stop

Data monitor function

- With the PID/data monitor function, input/output signal monitor items set in the start stop unit can be selected and read out in real-time.

PID	Unit/ Operation	Data contents	Inspection item(s)
BRAKE_SW 1*1	Off/On	• Off: Brake switched is off. • On: Brake switch is on.	Brake switch
CLUT_CUT _SW*2	Off/On	• Off: Starter interlock switch is off. • On: Starter interlock switch is on.	Starter interlock switch
CLUTCH_S W*2	Off/On	• Off: CPP switch is off. • On: CPP switch is on.	CPP switch
COMM_ST_ TSP	Off/On	• Off: Remote transmitter is not communicated. • On: Remote transmitter is communicated.	Start stop unit
CRU_CON_ SW*3	Not_Presse d/On/Off/ Cancel/ Resume/ Fault/Set (+)/Set (-)	• Not_Pressed: Each switch of cruise control switch is not pressed. • On: Cruise ON switch is pressed. • Off: Cruise OFF switch is pressed. • Cancel: CANCEL switch is pressed. • Resume: RESUME switch is pressed. • Fault: Cruise control switch has a malfunction. • Set (+): SET (+) switch is pressed . • Set (-): SET (-) switch is pressed.	Cruise control switch
ES_UL_SW	Not_Unlock/ Unlock	• Not_Unlock: Steering lock unlock switch is off. • Unlock: Steering lock unlock switch is on.	Start stop unit
ES_UL_SW _M	Not_Unlock/ Unlock	• Not_Unlock: Memory value of steering lock unlock switch is not unlocked. • Unlock: Memory value of steering lock unlock switch is unlocked.	Start stop unit
ES_ULL_S W	Off/On	• Not_Unlock: Steering lock unlock/lock switch is off. • Unlock: Steering lock unlock/lock switch is on.	Start stop unit
ES_ULL_S W_M	Off/On	• Not_Unlock: Memory value of steering lock unlock/lock switch is not unlocked. • Unlock: Memory value of steering lock unlock/lock switch is unlocked.	Start stop unit
F_FOG_SW	Off/On	• Off: Fog light switch is not in F.FOG position. • On: Fog light switch is in F.FOG position.	Front fog light switch
H/L_SW_HI	Off/On	• Off: Light switch is not in HI position. • On: Light switch is in HI position.	Light switch
H/ L_SW_LOW	Off/On	• Off: Light switch is not in LO position. • On: Light switch is in LO position.	Light switch
H/ L_SW_OFF	Off/On	• Off: Light switch is not in OFF position. • On: Light switch is in OFF position.	Light switch

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PID	Unit/ Operation	Data contents	Inspection item(s)
H/ L_SW_PAS S	Off/On	• Off: Light switch is not in passing position. • On: Light switch is in passing position.	Light switch
H/ L_SW_TNS	Off/On	• Off: Light switch is not in TNS position. • On: Light switch in TNS position.	Light switch
HAZARD_S W	Off/On	• Off: Hazard warning switch is off. • On: Hazard warning switch is on.	Hazard warning switch
IG_POSITI ON	OFF/ACC/ ON/CRANK	• OFF: Ignition is switched off. • ACC: Ignition is switched to ACC. • ON: Ignition is switched ON (engine off or on). • CRANK: During engine cranking	Ignition switch
INFO_SW	Off/ SW1_On/ SW2_On/ SW3_On/ Unknown/ Invalid	• Off: Steering switch UP/DOWN/INFO switch is not pressed. • SW1_On: UP switch is pressed. • SW2_On: DOWN switch is pressed. • SW3_On: INFO switch is pressed. • Unknown: Steering switch UP/DOWN/INFO switch signal is not determined. • Invalid: Steering switch malfunction is received.	Steering switch
INHIBIT_S W*1	Off/On	• Off: Selector lever is not in P and N positions. • On: Selector lever is in P or N position.	Transaxle range sensor
LG/ T_LK_SW*4	Off/On	• Off: Request switch (liftgate) is off. • On: Request switch (liftgate) is on.	Request switch (liftgate)
LG/ T_UNL_SW	Off/On	• Off: Liftgate opener switch is off. • On: Liftgate opener switch is on.	Liftgate opener switch
LL_SW_D_ LK	Off/On	• Off: Front door lock-link switch (driver's side) is in unlock. • On: Front door lock-link switch (driver's side) is in lock.	Front door lock-link switch (driver's door)
NUM_TRNS MIT	—	Displays the number of the remote transmitters programmed to the start stop unit.	Start stop unit
P_RANGE_ SW*1	Off/On	• Off: NOT P position switch is off. • On: NOT P position switch is on.	NOT P position switch
RELAY_AC C	Off/On	• Off: ACC relay drive is off. • On: ACC relay drive is on.	ACC relay
RELAY_IG1	Off/On	• Off: IG1 relay drive is off. • On: IG1 relay drive is on.	IG1 relay
RELAY_IG2	Off/On	• Off: IG2 relay drive is off. • On: IG2 relay drive is on.	Front body control module (FBCM)
RF_RECEP _ST	Initial/ Transmitter/ RF_Respon se	• Initial: Signal from remote transmitter is not received. • Transmitter: Signal is received using remote transmitter button. • RF_Response: Signal is received by remote transmitter radio wave.	Keyless receiver
RQ_SW_LF *4	Off/On	• Off: Request switch (LF) is off. • On: Request switch (LF) is on.	Request switch (LF)
RQ_SW_RF *4	Off/On	• Off: Request switch (RF) is off. • On: Request switch (RF) is on.	Request switch (RF)
SECURITY_ I	Off/On	• Off: Security indicator light is turned off. • On: Security indicator light is illuminated.	Instrument cluster
SFT_LK_S OL*1	Off (Lock)/ On (Unlock)	• Off (Lock): Shift-lock is operated. • On (Unlock): Shift-lock is released.	Selector lever component
SSB_1	Off/On	• Off: Push button start switch 1 is off. • On: Push button start switch 1 is on.	Push button start
SSB_2	Off/On	• Off: Push button start switch 2 is off. • On: Push button start switch 2 is on.	Push button start
SSB_AMBE R	Off/On	• Off: Push button start indicator light (amber) is turned off. • On: Push button start indicator light (amber) is illuminated.	Push button start
SSB_GREE N	Off/On	• Off: Push button start indicator light (green) is turned off. • On: Push button start indicator light (green) is illuminated.	Push button start
SSB_ILLMI	Off/On	• Off: START/STOP/ENGINE indicator light is turned off. • On: START/STOP/ENGINE indicator light is illuminated.	Push button start

SECURITY AND LOCKS

PID	Unit/ Operation	Data contents	Inspection item(s)
START_RLY_1	V	Voltage at start stop unit terminal 2V is displayed.	Starter relay
START_RLY_2	V	Voltage at start stop unit terminal 1D is displayed.	Starter relay
STR_A_ANG_A	° (deg)	Steering angle sensor A signal aiming angle is displayed.	Steering angle sensor
STR_A_ANG_B	° (deg)	Steering angle sensor B signal aiming angle is displayed.	Steering angle sensor
STR_AB_ANG	° (deg)	Steering wheel absolute steering angle is displayed.	Steering angle sensor
STR_ANG_S	Without/ With	• Without: Steering angle sensor is not equipped. • With: Steering angle sensor is equipped.	Steering angle sensor
STR_ANG_S_A	V	Voltage at the steering angle sensor A signal is displayed.	Steering angle sensor
STR_ANG_S_B	V	Voltage at the steering angle sensor B signal is displayed.	Steering angle sensor
STR_ANG_S_V	V	Steering angle sensor power supply voltage is displayed.	Steering angle sensor
TURN_SW_L	Off/On	• Off: Turn switch is in position other than LH. • On: Turn switch is in LH position.	Turn Switch
TURN_SW_R	Off/On	• Off: Turn switch is in position other than RH. • On: Turn switch is in RH position.	Turn Switch
VPWR_ACC	V	Voltage at start stop unit terminal 1E (ACC power supply) is displayed.	• Start stop unit • ACC relay • Battery
VPWR_B1	V	Voltage at start stop unit terminal 1A (+B1 power supply) is displayed.	• Start stop unit • Battery
VPWR_B2	V	Voltage at start stop unit terminal 2W (+B2 power supply) is displayed.	• Start stop unit • Battery
VPWR_B3	V	Voltage at start stop unit terminal 2X (+B3 power supply) is displayed.	• Start stop unit • Battery
VPWR_IG1	V	Voltage at start stop unit terminal 1B (IG1 power supply) is displayed.	• Start stop unit • IG1 relay • Battery
WASHER_F	Off/On	• Off: Windshield washer switch is in OFF position. • On: Windshield washer switch is in ON position.	Windshield washer switch
WASHER_R	Off/On	• Off: Rear washer switch is not in ON position. • On: Rear washer switch is in ON position.	Rear washer switch
WIP_F_INT	Off/On	• Off: Windshield wiper switch is not in INT and AUTO positions. • On: Windshield wiper switch is in INT or AUTO position.	Windshield wiper switch
WIP_F_LOW	Off/On	• Off: Windshield wiper switch is not in LO position. • On: Windshield wiper switch is in LO position.	Windshield wiper switch
WIP_INT_E_A	Low/High	• Low: Windshield wiper switch INT encoder A value is low. • High: Windshield wiper switch INT encoder A value is high.	Windshield wiper and washer switch
WIP_INT_E_B	Low/High	• Low: Windshield wiper switch INT encoder B value is low. • High: Windshield wiper switch INT encoder B value is high.	Windshield wiper and washer switch
WIP_INT_E_C	Low/High	• Low: Windshield wiper switch INT encoder C value is low. • High: Windshield wiper switch INT encoder C value is high.	Windshield wiper and washer switch
WIP_R_INT	Off/On	• Off: Rear wiper switch is not in INT position. • On: Rear wiper switch is in INT position.	Rear wiper switch
WIP_R_ON	Off/On	• Off: Rear wiper switch is not in ON position. • On: Rear wiper switch is in ON position.	Rear wiper switch

*1 : ATX
*2 : MTX
*3 : With cruise control system
*4 : With advanced keyless entry system

SECURITY AND LOCKS

ON-BOARD DIAGNOSIS SYSTEM [IMMOBILIZER SYSTEM]

id0914001112c3

Outline

- The immobilizer system has an on-board diagnostic function to facilitate system diagnosis.

Function

- The on-board diagnostic function consists of the following functions: A malfunction detection function, which detects overall malfunctions in the immobilizer system-related parts; a memory function, which stores detected DTCs; a display function, which indicates system malfunctions via DTC display; and a PID/data monitoring function, which reads out specific input/output signals.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and PID/data monitoring can be performed.

On-board Diagnostic Function

Malfunction detection function

- Detects overall malfunctions in the immobilizer system-related parts.
- Malfunction diagnosis of the immobilizer system is automatically performed every time the engine is switched from OFF/LOCK (ACC) to ON (START).

Memory Function

- Malfunctions detected by the malfunction detection function are all recorded as DTCs in the following modules.
  - — Start stop unit
  - — PCM

Caution

- **Recorded immobilizer system DTCs are cleared when the ignition is switched ON from OFF (LOCK)/ACC.**

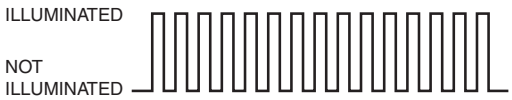
Display Function

- If there is a malfunction in the immobilizer system, the security indicator light in the instrument cluster is illuminated to notify the driver. In addition, DTCs are displayed by the number of times that the security indicator light flashes.

Note

- If two or more malfunctions are detected as a result of malfunction diagnosis, only the DTC with the lowest number of those detected will be indicated by the security indicator light.

- In the approx. 1 min after detecting a malfunction and before indicating the DTC, the security indicator light illuminates or flashes in the following patterns:

Security indicator light flash pattern (before displaying DTC)	DTC
	09, 11, 13, 15, 16
	22, 23

- DTC 21 is displayed when the ignition is switched ON (engine off or on) and the security indicator light illumination turns off after approx. 1 min.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted.

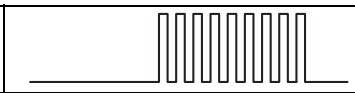
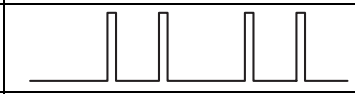
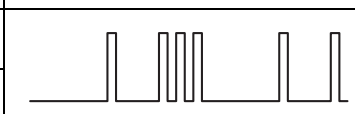
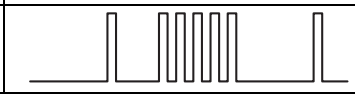
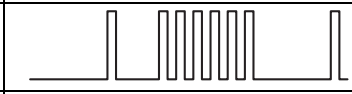
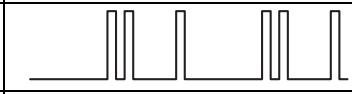
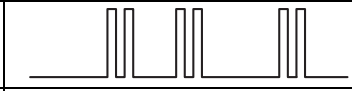
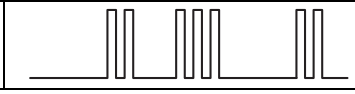
Caution

- **If the security indicator light itself has a malfunction, it is possible that a DTC may not be indicated properly.**

SECURITY AND LOCKS

DTC table

×: Applicable
—: Not applicable

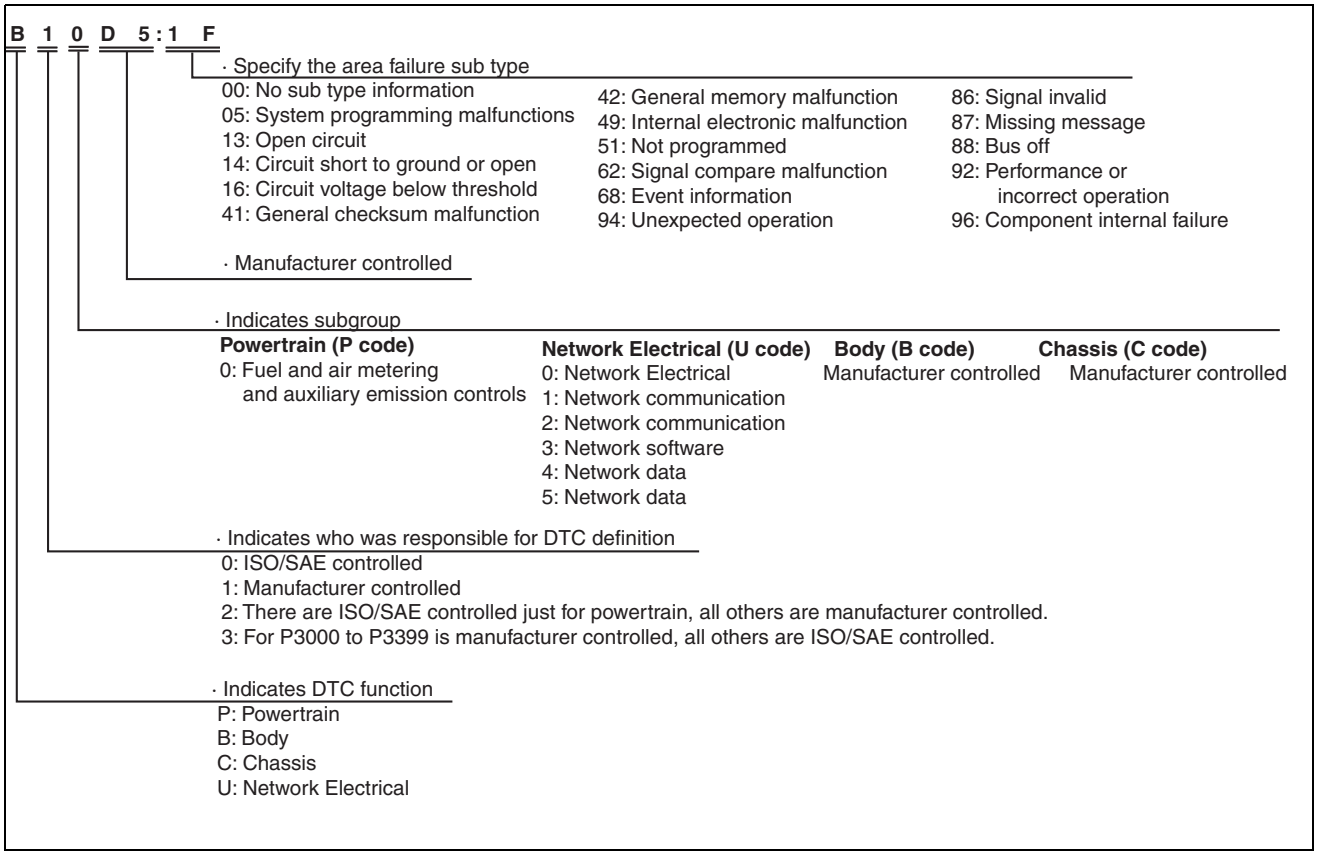
DTC				KEY warning indicator light (red)	Push button indicator light (amber)	Description	Fail-safe function	Drive cycle	Self test type*2	Memory function
M-MDS display*1		Security indicator light flash pattern								
Start stop unit	PCM									
U3000:96	P1260:00	09		On	Flash	Start stop unit malfunction	—	—	C	×
B10D9:87	P1260:00	11		—	Flash	Coil antenna (built into push button start) error	—	—	C	—
B13D3:05	P1260:00	13		—	—	Remote transmitter programming error	—	—	C	—
B13D3:94	P1260:00	13		—	—	Communication error with remote transmitter	—	—	C	—
B13D3:51	P1260:00	15		—	Flash	Unregistered remote transmitter is detected	—	—	C	—
U0100:87	P1260:00	16		—	—	Communication error with PCM (no response or data mis-matched)	—	—	C	—
B13D4:00	P1260:00	21		On	—	Insufficient remote transmitter programming number	—	—	C	—
B10DA:51	P1260:00	22		—	—	Communication error with PCM (data received failure)	—	—	C	—
B10DA:62	P1260:00	23		—	—	Communication error with PCM (code mis-matched)	—	—	C	—

*1 : The letters at the beginning of each DTC are only displayed when using the M-MDS, and refer to the following: B= Body system, P= Powertrain system, U= Network communication system.
*2 : C: CMDTC self test, D: ODDTC self test

SECURITY AND LOCKS

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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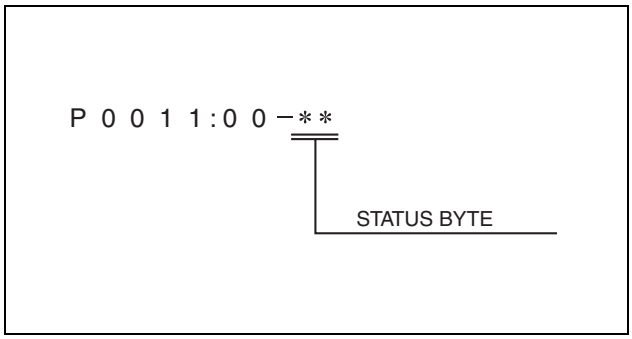
Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the seven-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the M-MDS when reading the DTC.



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Detection condition for the applicable DTC

DTC	System malfunction location	Detection condition
U3000:96	Start stop unit malfunction	Start stop unit malfunction detected.
B10D9:87	Coil antenna (built into push button start) error	The starter stop unit detected a malfunction in the coil antenna, and remote transmitter communication is not possible.
B13D3:05	Remote transmitter program error	The start stop unit detects a remote transmitter program error.
B13D3:94	Communication error with remote transmitter	The starter stop unit could not detect remote transmitter communication or communication error was detected.
B13D3:51	Unregistered remote transmitter is detected	The start stop unit detects that the remote transmitter has not been programmed.

SECURITY AND LOCKS

DTC	System malfunction location	Detection condition
U0100:87	Communication error with PCM (no response or data mis-match)	The starter stop unit detects a communication error (no response or immobilizer system cancel not possible) with the PCM.
B13D4:00	Insufficient remote transmitter programming number	The start stop unit detects that the number of programmed remote transmitters is less than 2.
B10DA:51	Communication error with PCM (data received failure)	The start stop unit detects a communication error (data received failure) with PCM.
B10DA:62	Communication error with PCM (code mis-matched)	The start stop unit detects a communication error (code mis-matched) with PCM.

PID/data Monitor Function

- With the PID/data monitor function, items set in the module can be selected and read out in real-time.

PID/data monitor table

PID	Unit/ Operation	Data contents	Inspection item(s)
NUM_TRNSMIT	—	Displays the number of the remote transmitters programmed to the start stop unit.	Start stop unit

DOOR LOCK SYSTEM OPERATION RECORD

id091400005000

Purpose

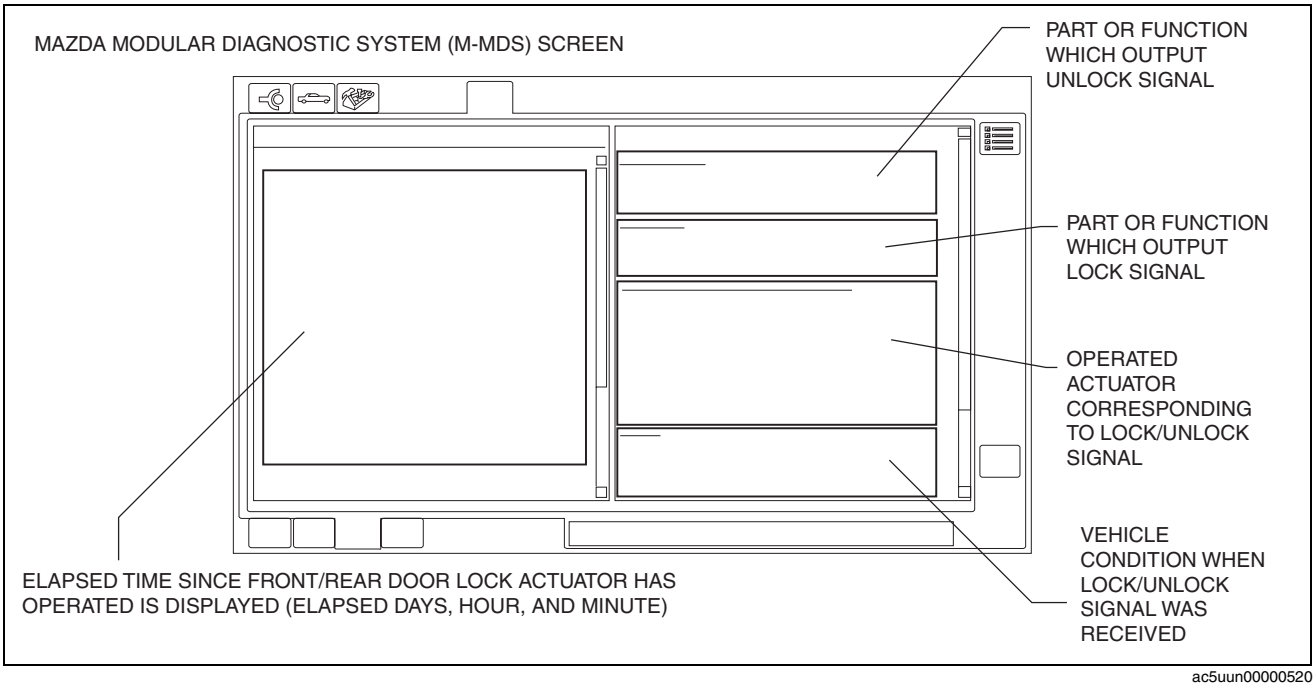
- Stores the record of the user's operation and the door lock system operation corresponding to the user's operation.

Function

- The door lock system operation record is stored by the rear body control module (RBCM) and displayed using the Mazda Modular Diagnostic System (M-MDS).
- The rear body control module (RBCM) stores the followings when the front/rear door lock actuator operates.
  - — Time and date
  - — Part or function which output unlock signal
  - — Part or function which output lock signal
  - — Operated actuator
  - — Vehicle condition

Construction

- Based on the stored record, the rear body control module (RBCM) displays the following operation record on the M-MDS screen.



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SECURITY AND LOCKS

Operation
- Based on the lock/unlock signal, the rear body control module (RBCM) sends an operation signal to the front/rear door lock actuator motor, and stores the operation record at the same time.

Caution
- **Because it takes time from when the front/rear door lock actuator motor operates untill lock/unlock is switched, the operation record may be stored before the lock/unlock switching is completed.**

Fail-safe
- Function not equipped.

THEFT-DETERRENT SYSTEM OPERATION RECORD

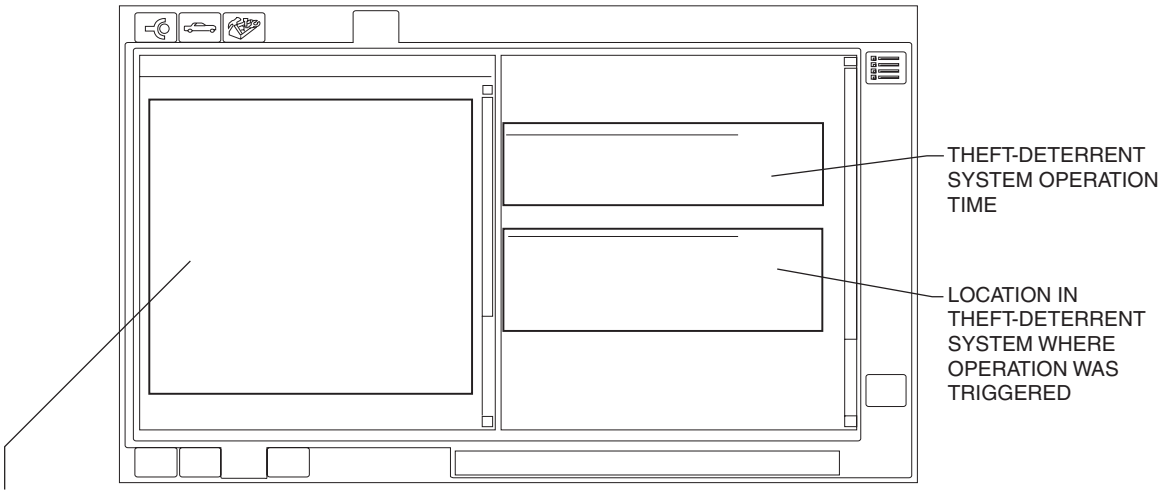
id091400113600

Purpose
- The theft-deterrent system operation history is a record of the theft-deterrent system operation.

Function
- The theft-deterrent system operation record is stored by the rear body control module (RBCM) and displayed using the Mazda Modular Diagnostic System (M-MDS).
- The rear body control module (RBCM) records the following when the theft-deterrent system is operated.
  - — Time and date
  - — Theft-deterrent system operation time
  - — Location in theft-deterrent system where operation was triggered

Construction
- Based on the stored record, the rear body control module (RBCM) displays the following operation record on the M-MDS screen.

MAZDA MODULAR DIAGNOSTIC SYSTEM (M-MDS) SCREEN



Displays the elapsed time from the operation theft-deterrent system (elapsed days, elapsed time, elapsed minutes)

ac5wzn00001074

Operation
- The rear body control module (RBCM) sends an alarm sound signal to the theft-deterrent siren or theft-deterrent horn, and records the operation history simultaneously.

Fail-safe
- Function not equipped.

09-15 SUNROOF

SUNROOF

SUNROOF

id091500101000

Outline

- An electric sunroof with tilt up mechanism has been adopted.
- A deflector has been added to reduce noise.
- A system control using pulse sensors (hall effect switches) has been adopted for system simplification.
- A sunroof motor with an integrated CPU has been adopted.

Specification

Item	Specification
Slide system	Inner slide
Opening measurement (mm {in})	265 × 740 {11.0 × 29.1}
Tilt-up amount (mm {in})	26.4—30.4 {1.04—1.20}
Opening/closing time (s)	Slide: 3.0—6.0, Tilt: 0.5—1.5

Function

Tilt up/open/close

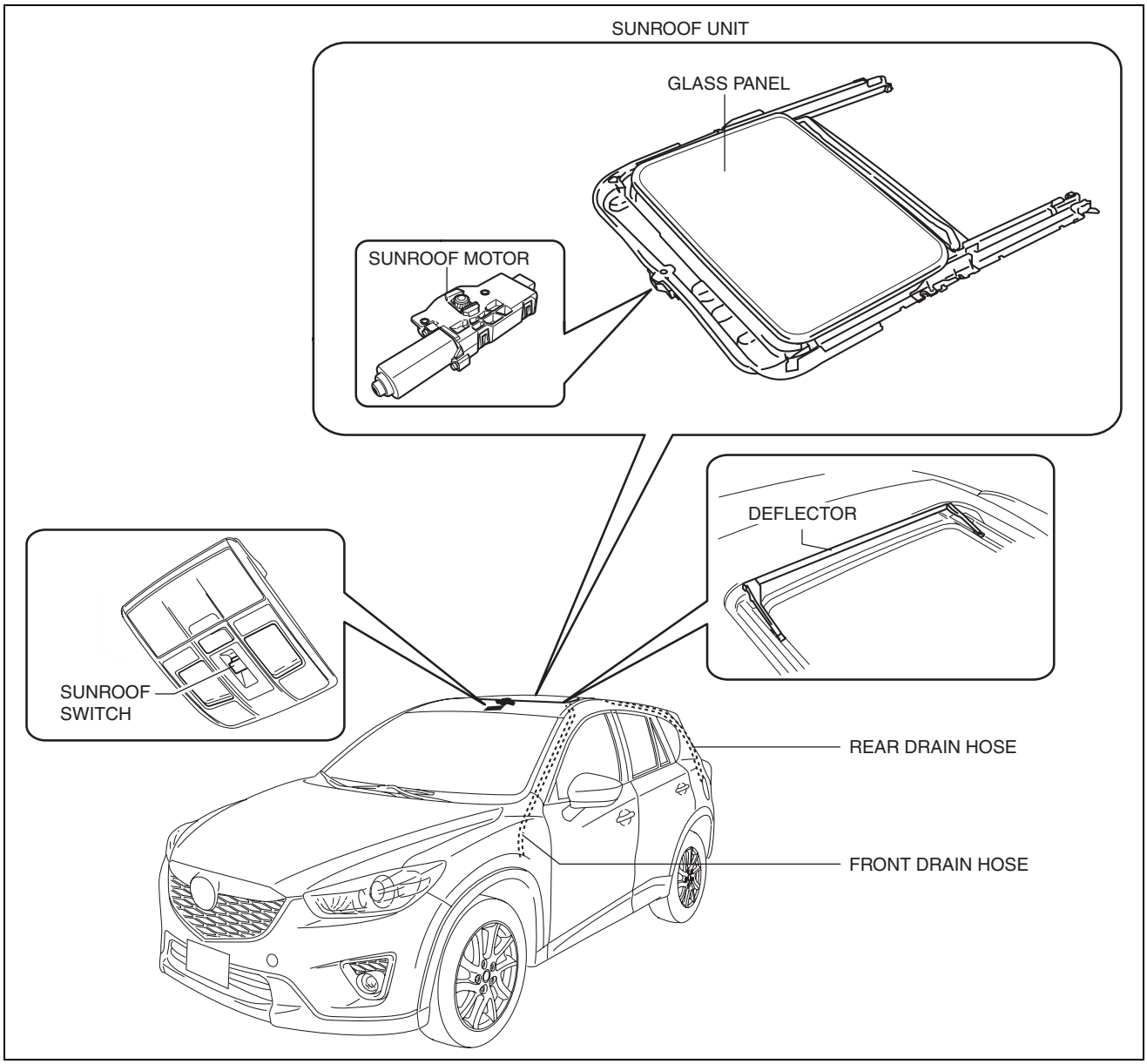
- When the sunroof switch (tilt position) is operated, the sunroof tilt up.
- When the sunroof switch (open position) is operated, the sunroof open.
- When the sunroof switch (close position) is operated, the sunroof slide close and tilt down.

Initial setting

- If the following operations have been performed, initial setting is reset, and except tilt up operation are disabled. Therefore, performing initial setting is necessary.
  - — Negative battery cable is disconnected.
  - — Sunroof system power supply fuse is removed.

SUNROOF

Sunroof System Structural View



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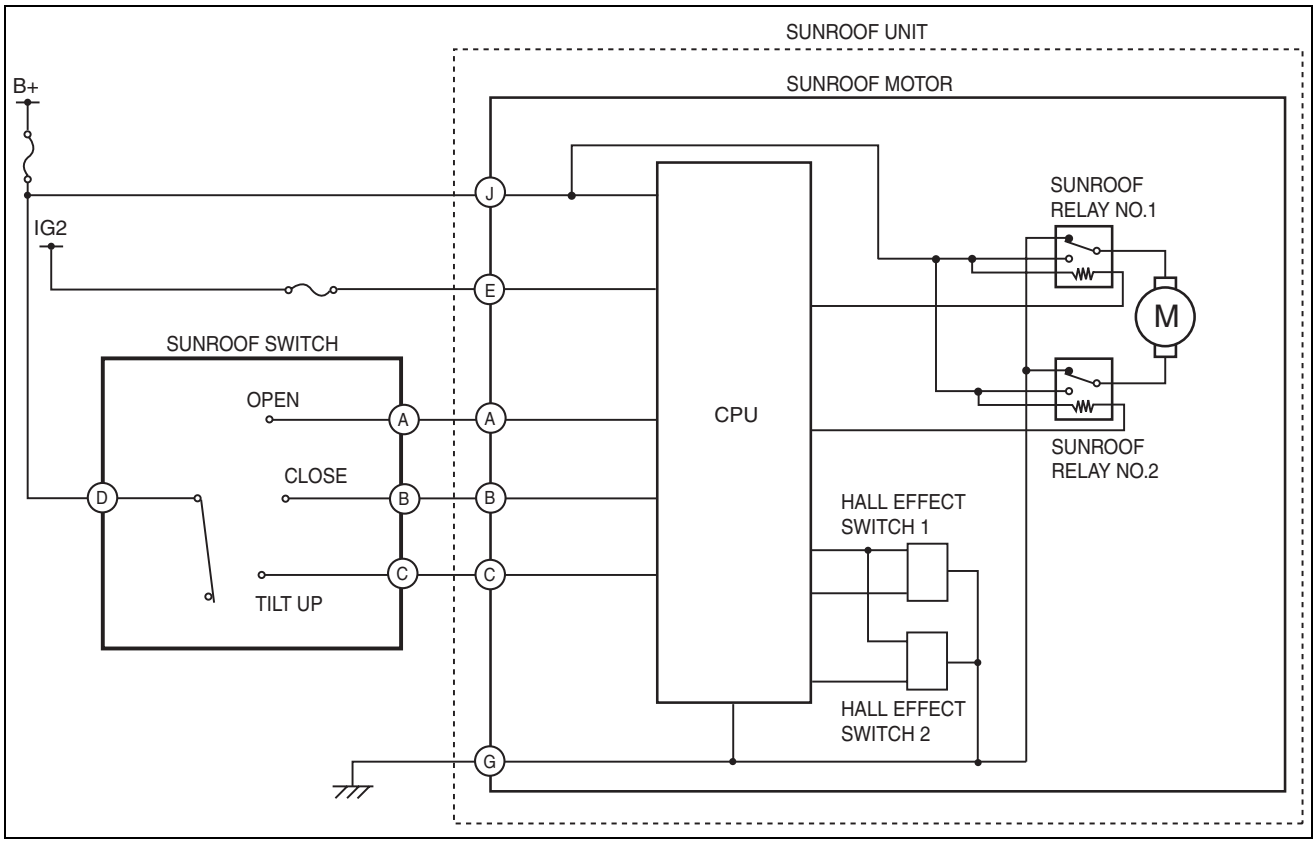
SUNROOF

System Wiring Diagram



ac5wzn00000256

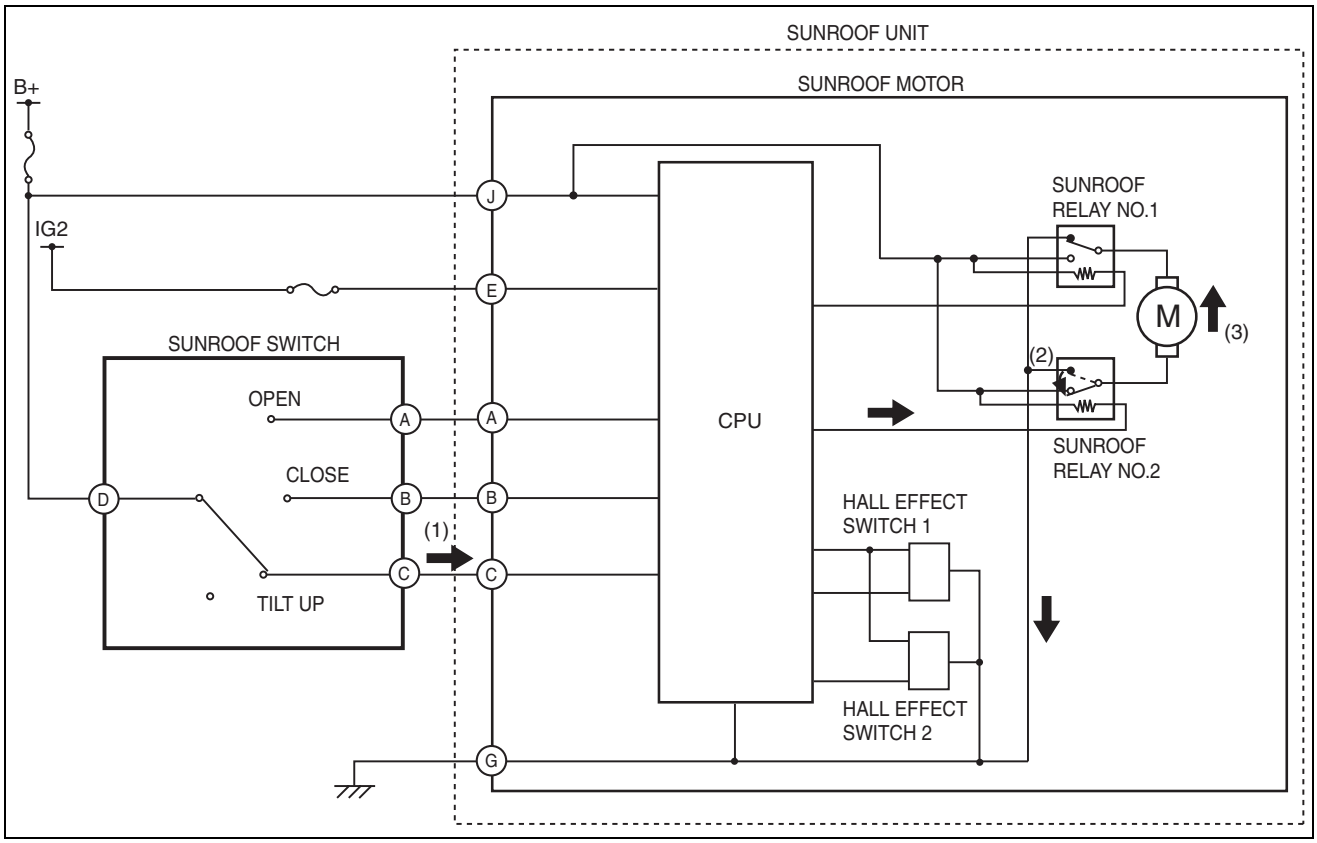
Operation

- The glass panel opens/closes using tilting and sliding operations.
- When the ignition switched ON (engine off or on), the sunroof operates by use of the sunroof switch.
- If the ignition switched OFF or ACC position while the sunroof is operating, it will stop.
- One-touch operation of the tilt up or the slide open switch provides auto-operation.
- If any switch is operated during auto-operation, the sunroof stops.

Tilt up operation

1. When the sunroof switch is operated for tilt up operation, the CPU receives a tilt up signal. (1)
2. When the CPU receives a tilt up signal, it turns on the relay No.2. (2)
3. When the relay No.2 is turned on, the sunroof motor starts tilt up operation.(3)
4. When **approx. 1 s.** has elapsed after the sunroof motor was starts on, the timer control of the CPU turns off the sunroof relay No.1 automatically to stop the tilt up operation.

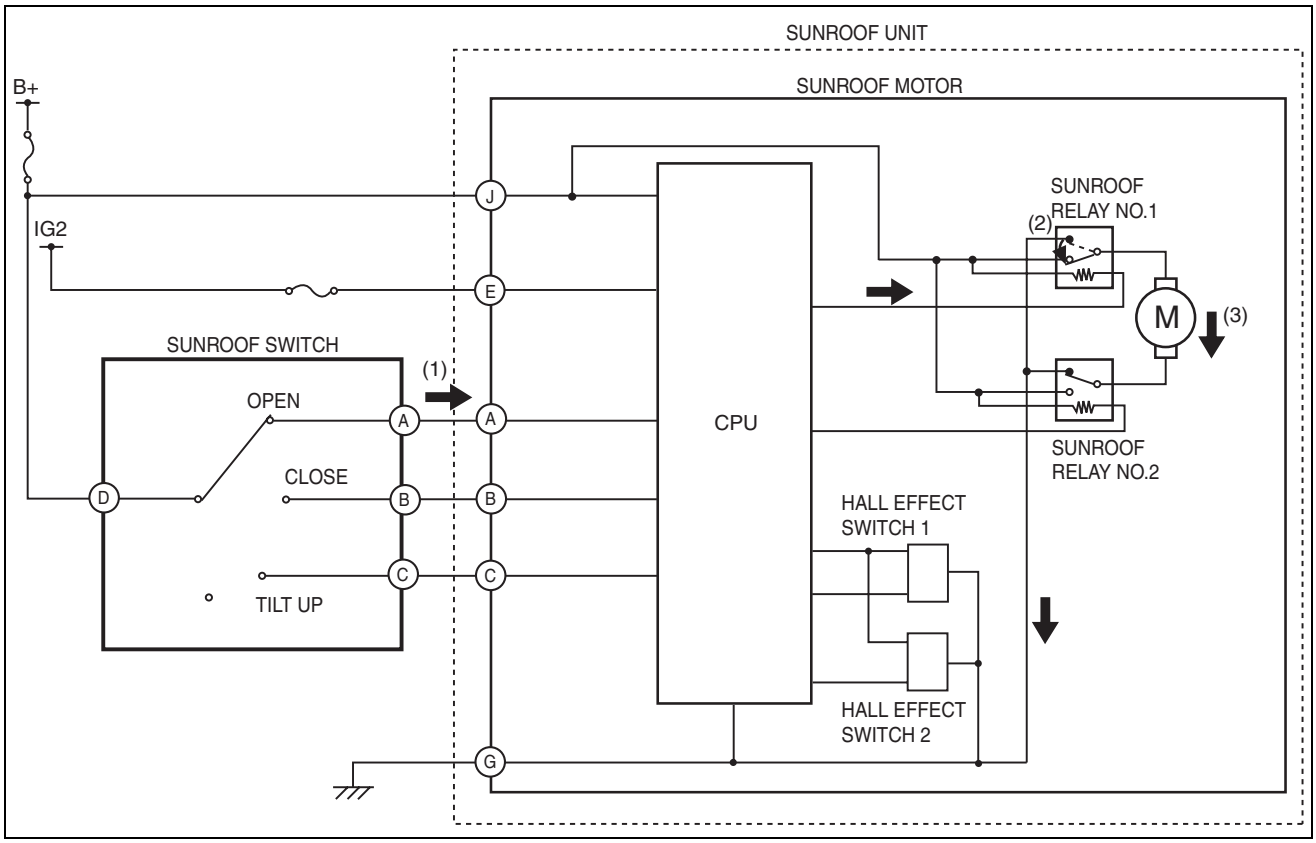
SUNROOF



Open operation

1. When the sunroof switch is operated for open operation, the CPU receives a open signal. (1)
2. When the CPU receives a open signal, it turns on the relay No.1. (2)
3. When the relay No.1 is turned on, the sunroof motor starts open operation.(3)

SUNROOF



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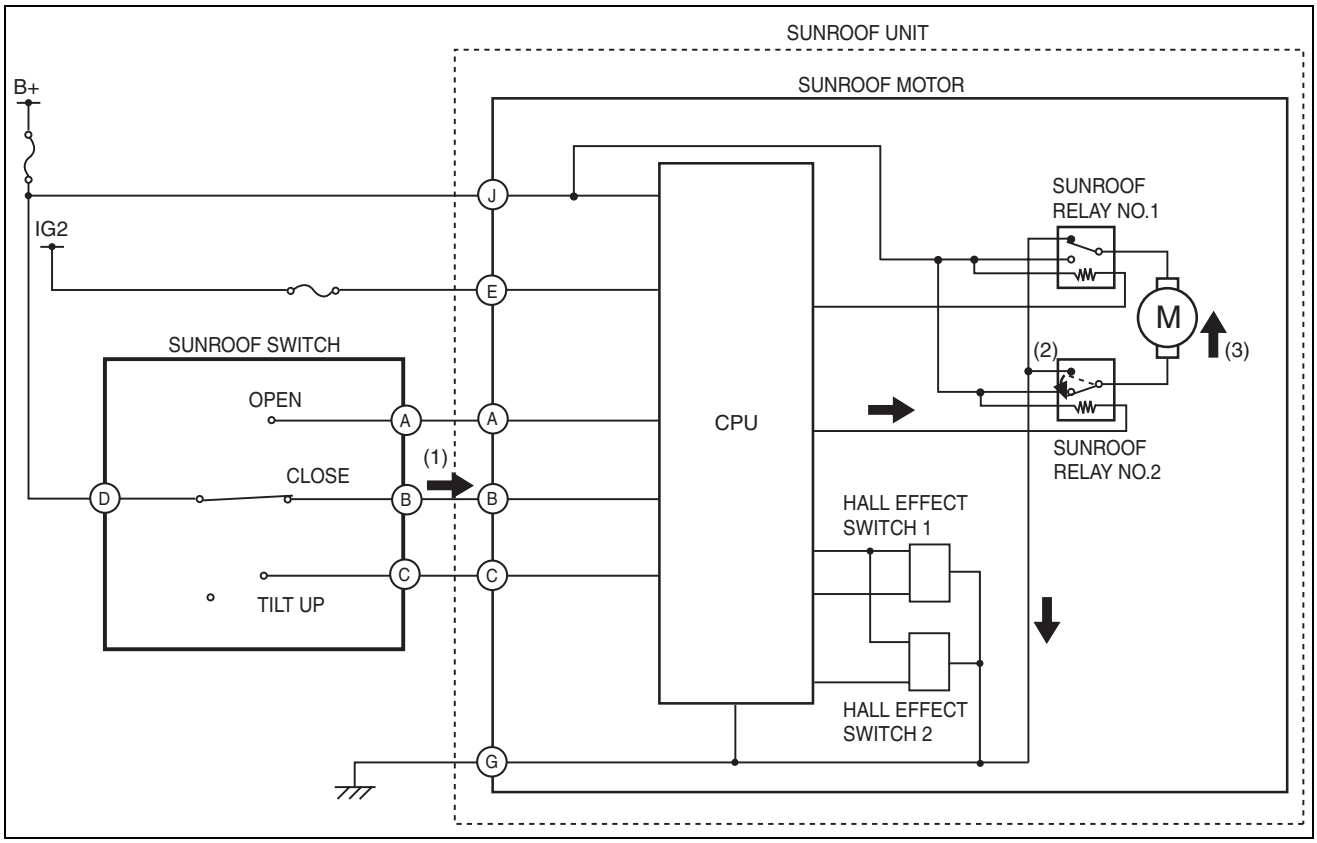
Close operation (at glass panel open)

1. When the sunroof switch is operated for close operation, the CPU receives a close signal. (1)
2. When the CPU receives a close signal, it turns on the relay No.2. (2)
3. When the relay No.2 is turned on, the sunroof motor starts close operation.(3)

SUNROOF



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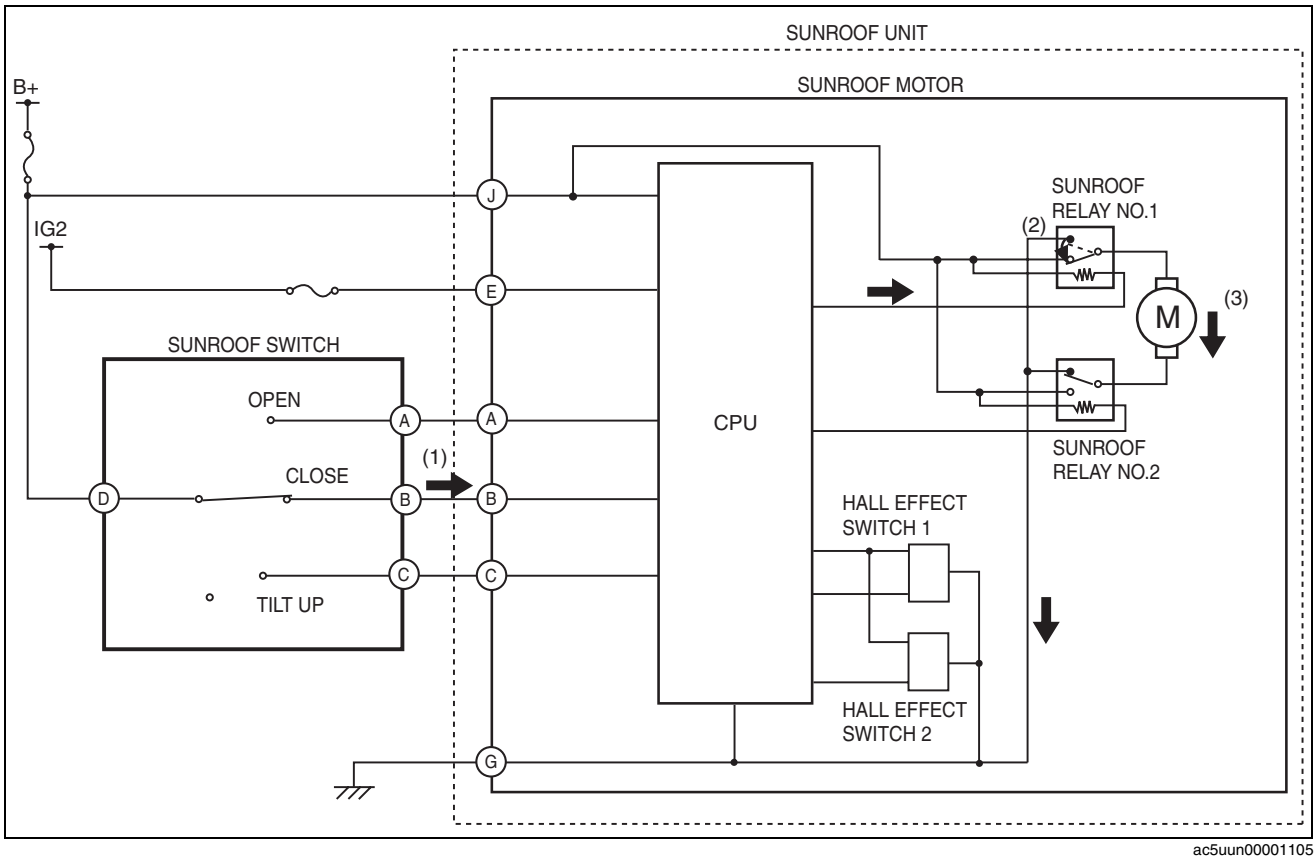
Close operation (at glass panel tilt up)

1. When the sunroof switch is operated for close operation, the CPU receives a close signal. (1)
2. When the CPU receives a close signal, it turns on the relay No.1. (2)
3. When the relay No.1 is turned on, the sunroof motor starts close operation.(3)

SUNROOF



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SUNROOF UNIT

id091500101300

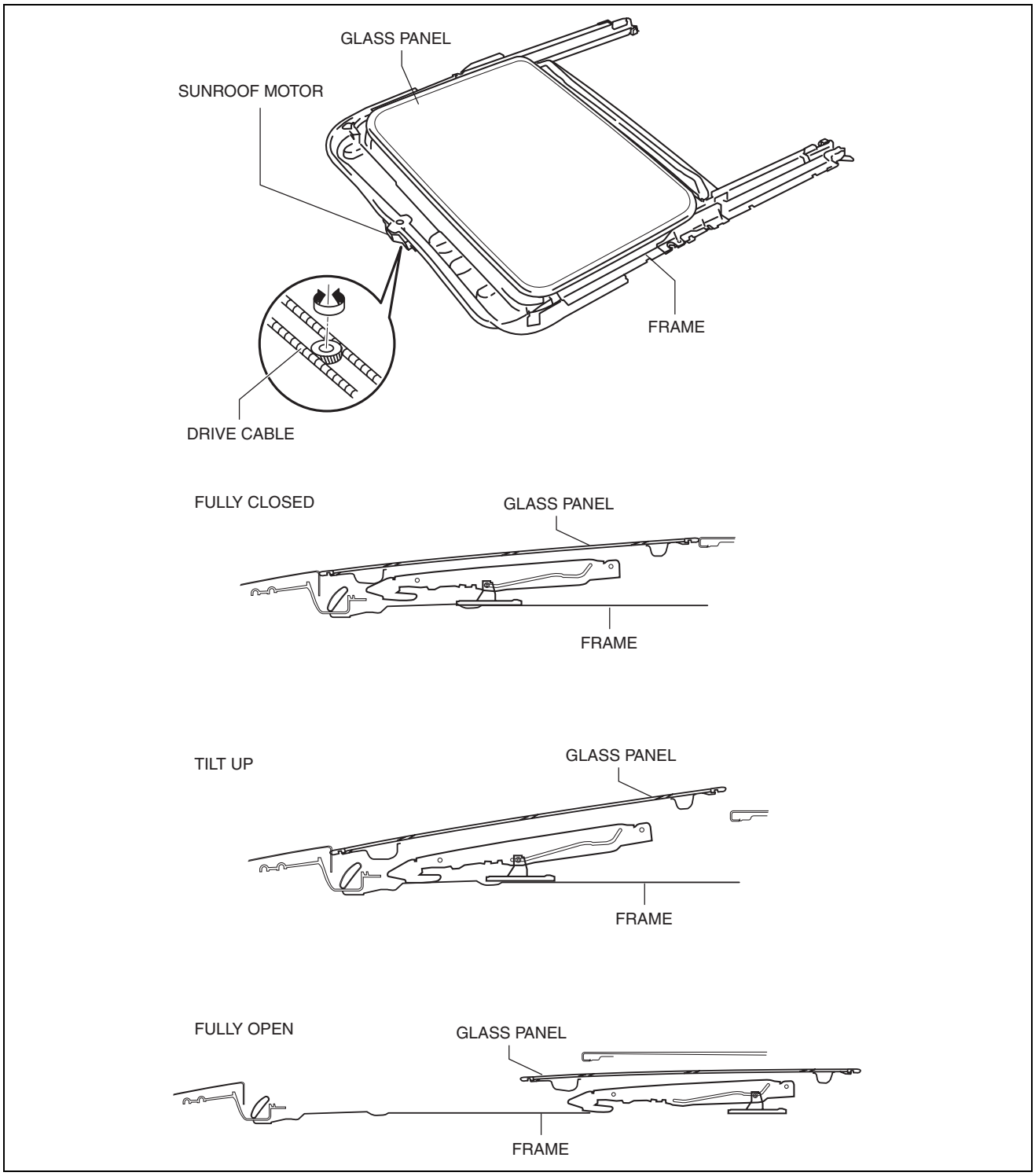
Purpose / Function

- The glass panel tilts up/down or slides open/closed by the operation of the sunroof unit.

Construction/Operation

- The drive cables inside the frame of the sunroof unit are engaged to the sunroof motor drive gear.
- When the sunroof motor rotates normally or in reverse, the drive cables operate in the same direction.
- The glass panel is fixed to the guides so that the panel moves by the drive cables sliding the guides.

SUNROOF



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Fail-safe
- Function not equipped.

SUNROOF MOTOR

id091500101400

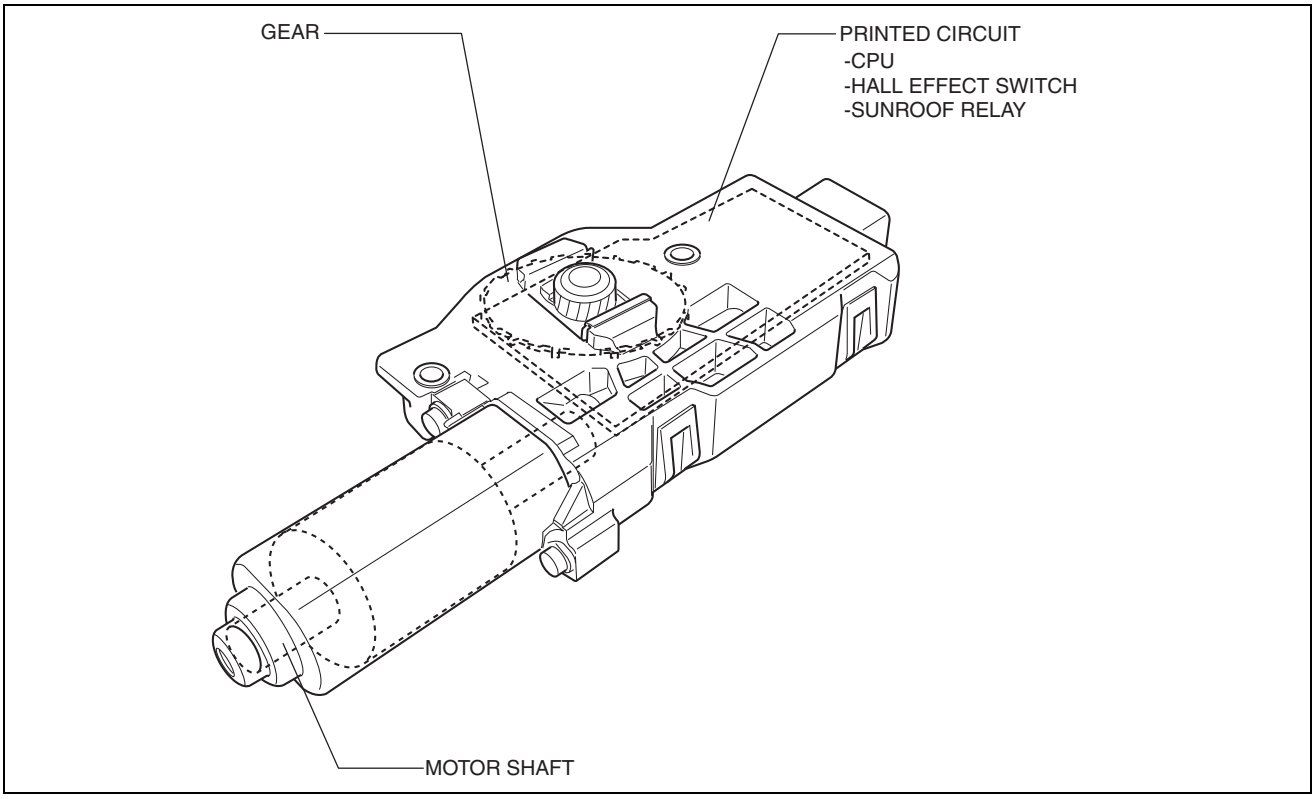
Purpose / Function
- The sunroof motor transmits drive force to the drive cables.
- When the sunroof motor rotates normally or in reverse, the tilt up and open/close of the glass panel operates.

Construction/Operation
- The sunroof motor built-in the following parts:

SUNROOF

— CPU
— Hall effect switch
— Sunroof relay
— Motor shaft
— Gear

- Two hall effect switches are provided in the control part.
- The control module detects the rotation direction, speed and amount based on pulse signals from the two hall effect switches, and controls the position and static load of the glass panel accordingly.



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Fail-safe

- Function not equipped.

09-16 EXTERIOR TRIM

EXTERIOR TRIM

EXTERIOR TRIM

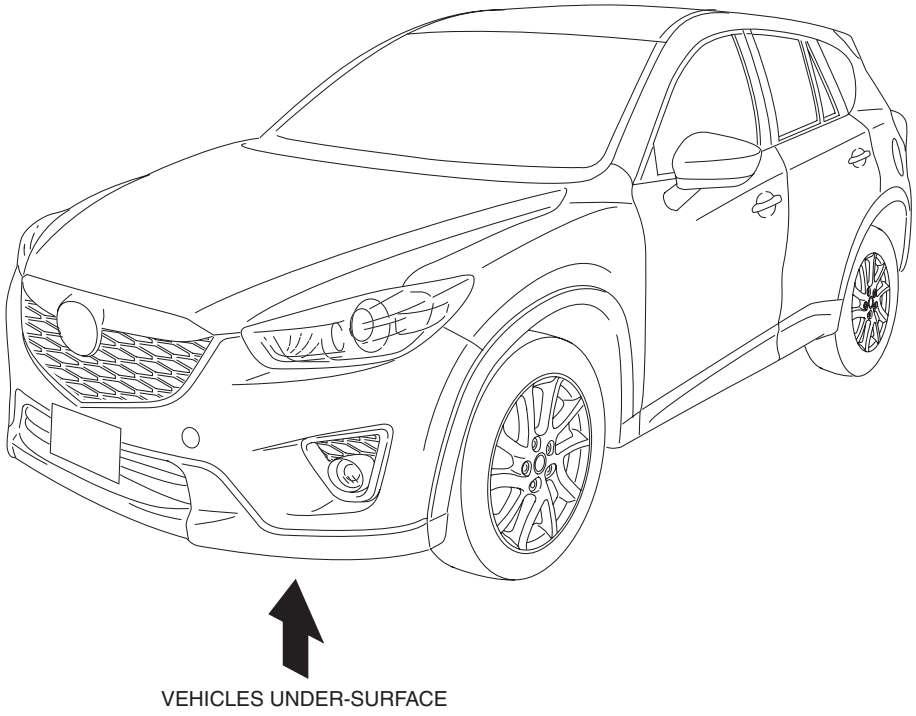
id091600009500

Outline

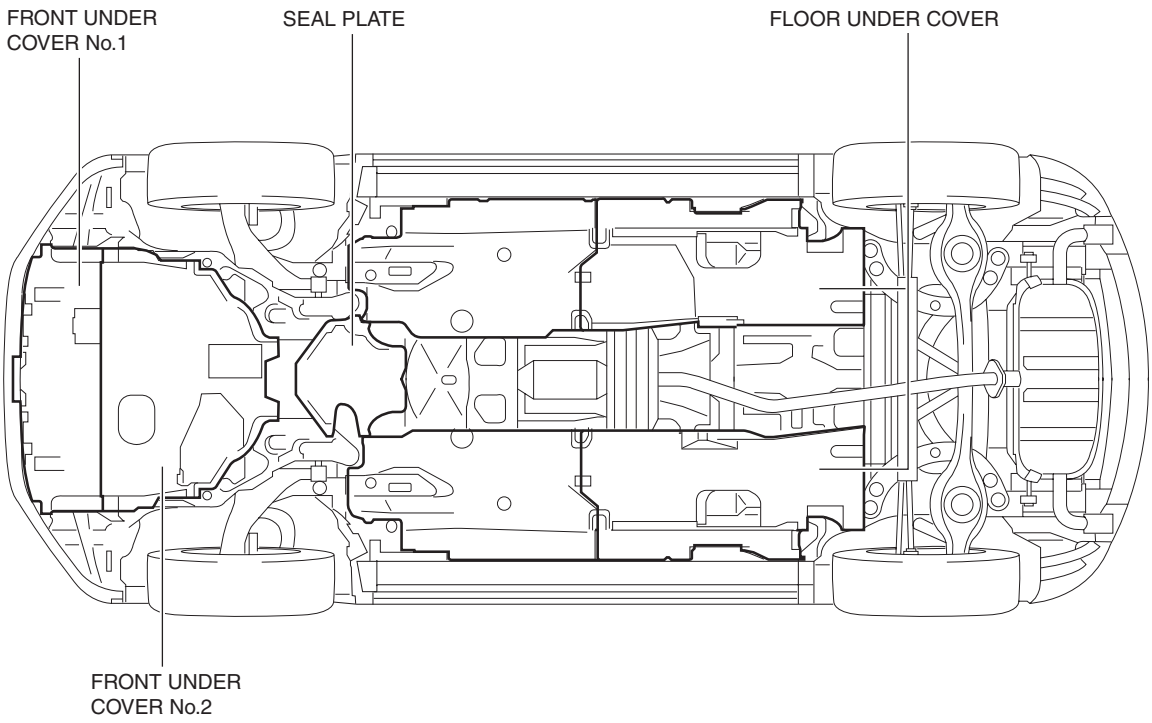
- Exterior is equipped with the under cover on the vehicles under-surface.

EXTERIOR TRIM

Structure View



VEHICLES UNDER-SURFACE



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AERODYNAMIC

id091600010400

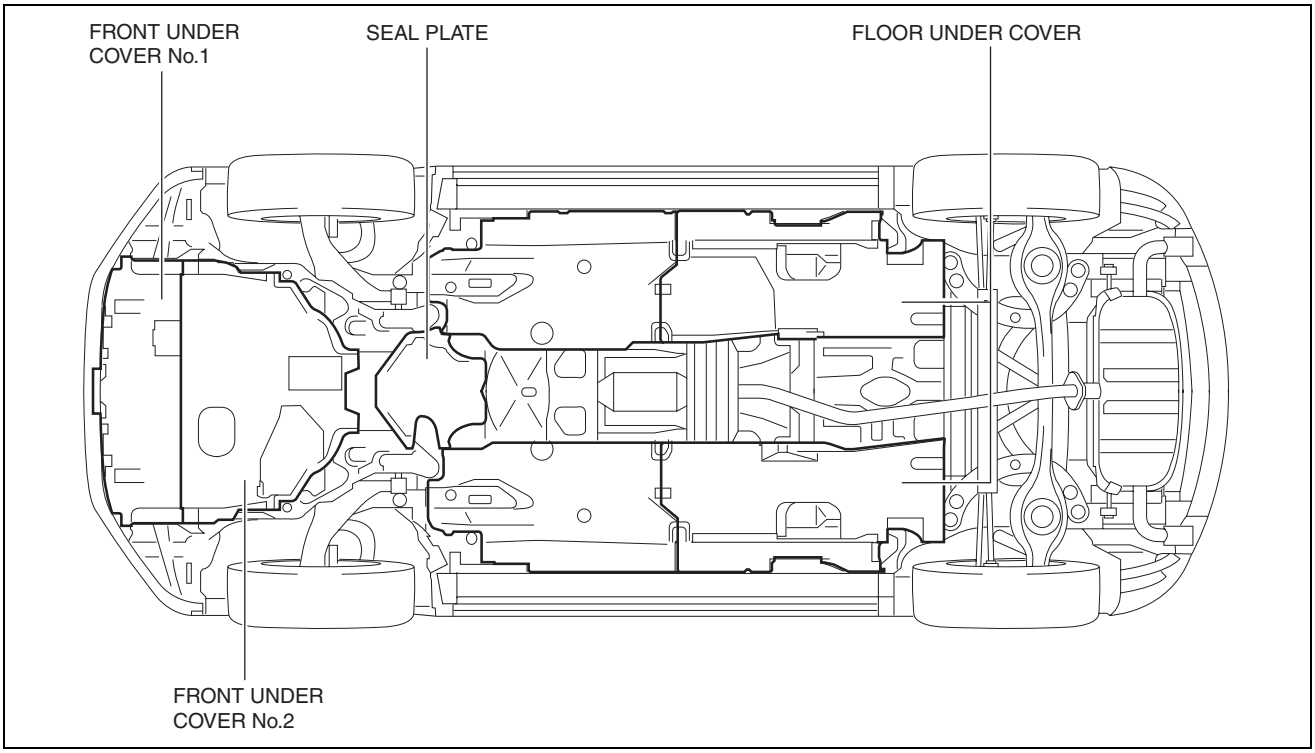
Purpose/Function

- For improved aerodynamics, under covers are installed to the under-surface of the vehicle.

EXTERIOR TRIM

Construction

- The vehicle is equipped with the following four (4) under covers.
  - — Front under cover No.1
  - — Front under cover No.2
  - — Floor under cover
  - — Seal plate



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Fail-safe

- Function not equipped.

09-17 INTERIOR TRIM

INTERIOR TRIM

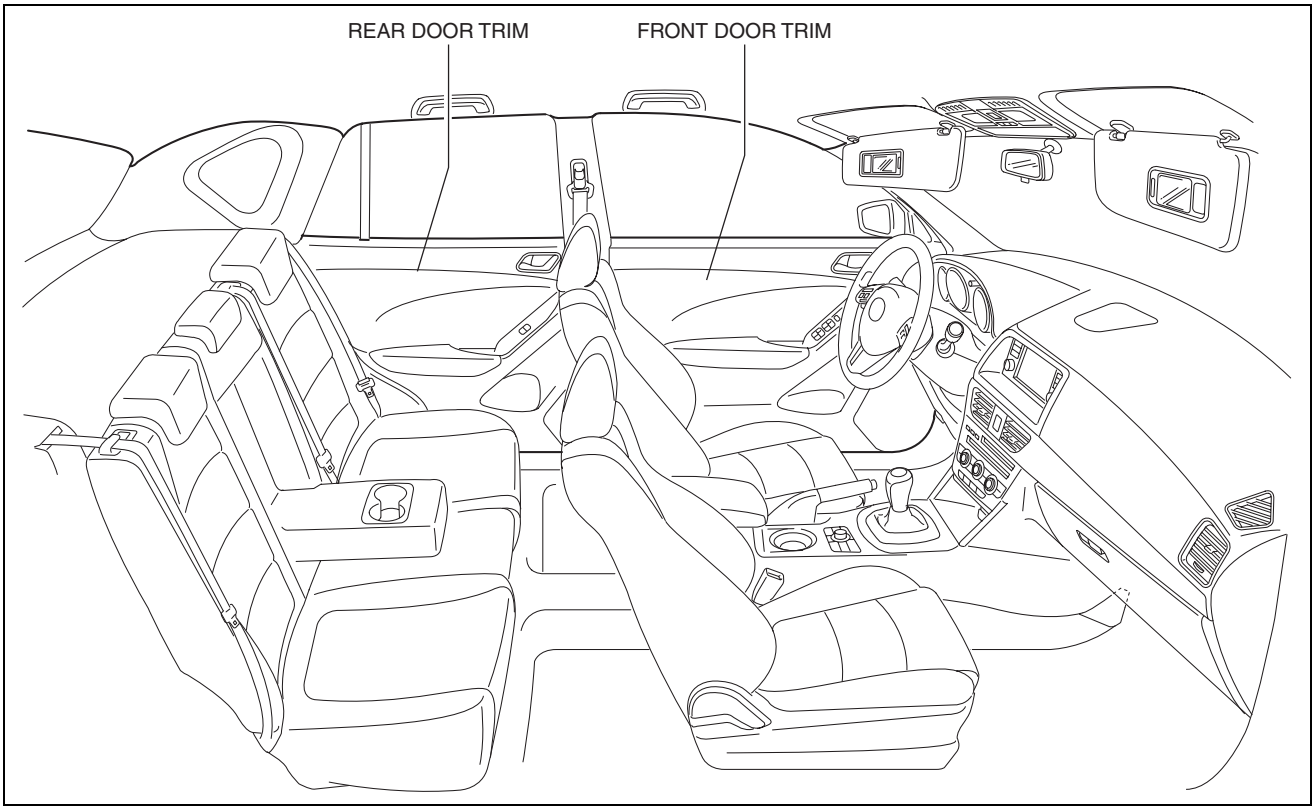
INTERIOR TRIM

id091700009600

Outline

- The front and rear door trims are also equipped with shock absorbing pads.

Construction



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DOOR TRIM

id091700010200

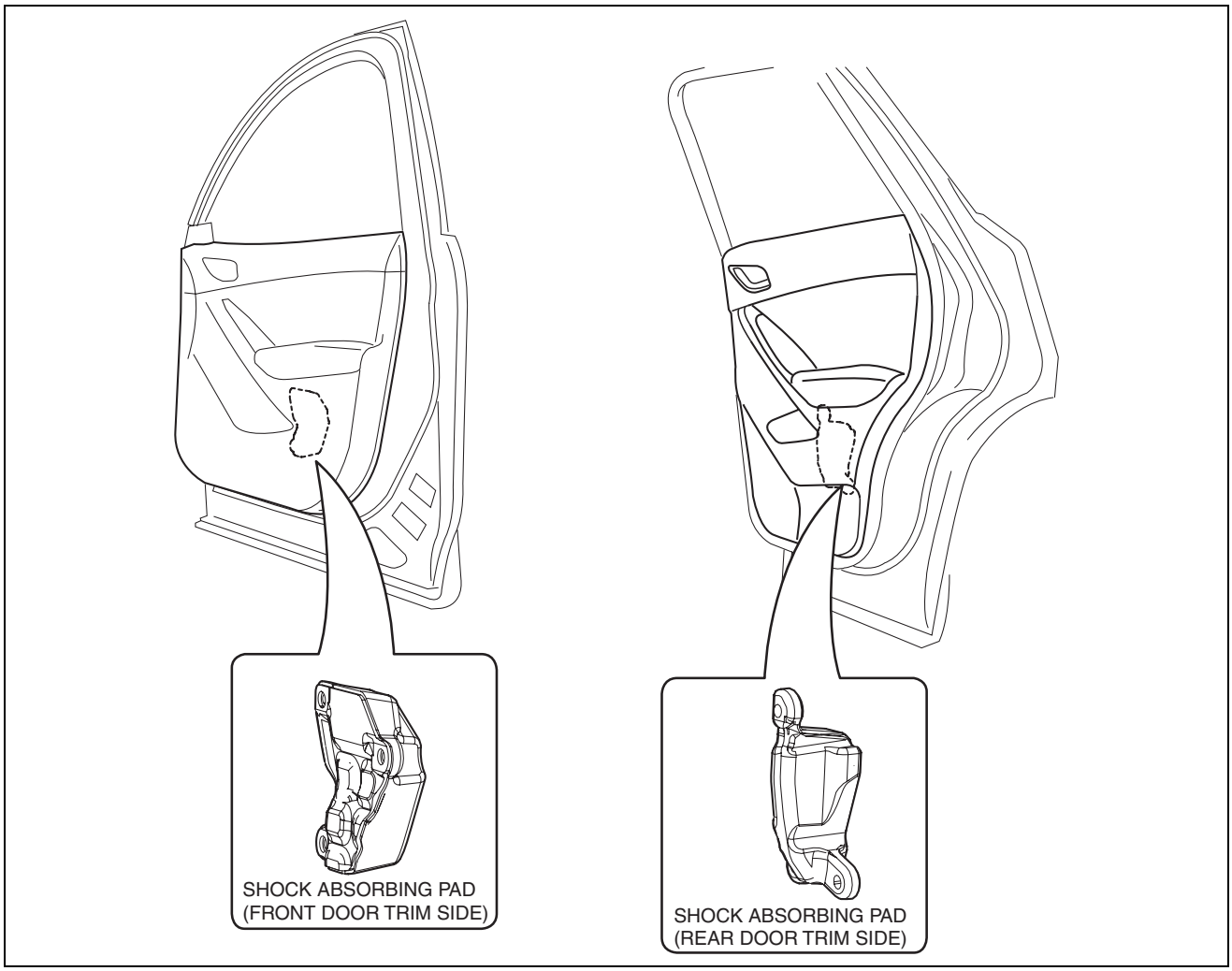
Outline

- The front and rear door trims are equipped with shock absorbing pads for impulse force relief during a collision.

Construction

- Shock absorbing pads are installed inside the front and rear door trims.
- Shock absorbing pads absorb the impulse force during a collision.

INTERIOR TRIM



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Fail-safe

- Function not equipped.

09-18 LIGHTING SYSTEMS

LIGHTING SYSTEMS

LIGHTING SYSTEMS

LIGHTING SYSTEMS

id091800010000

Outline

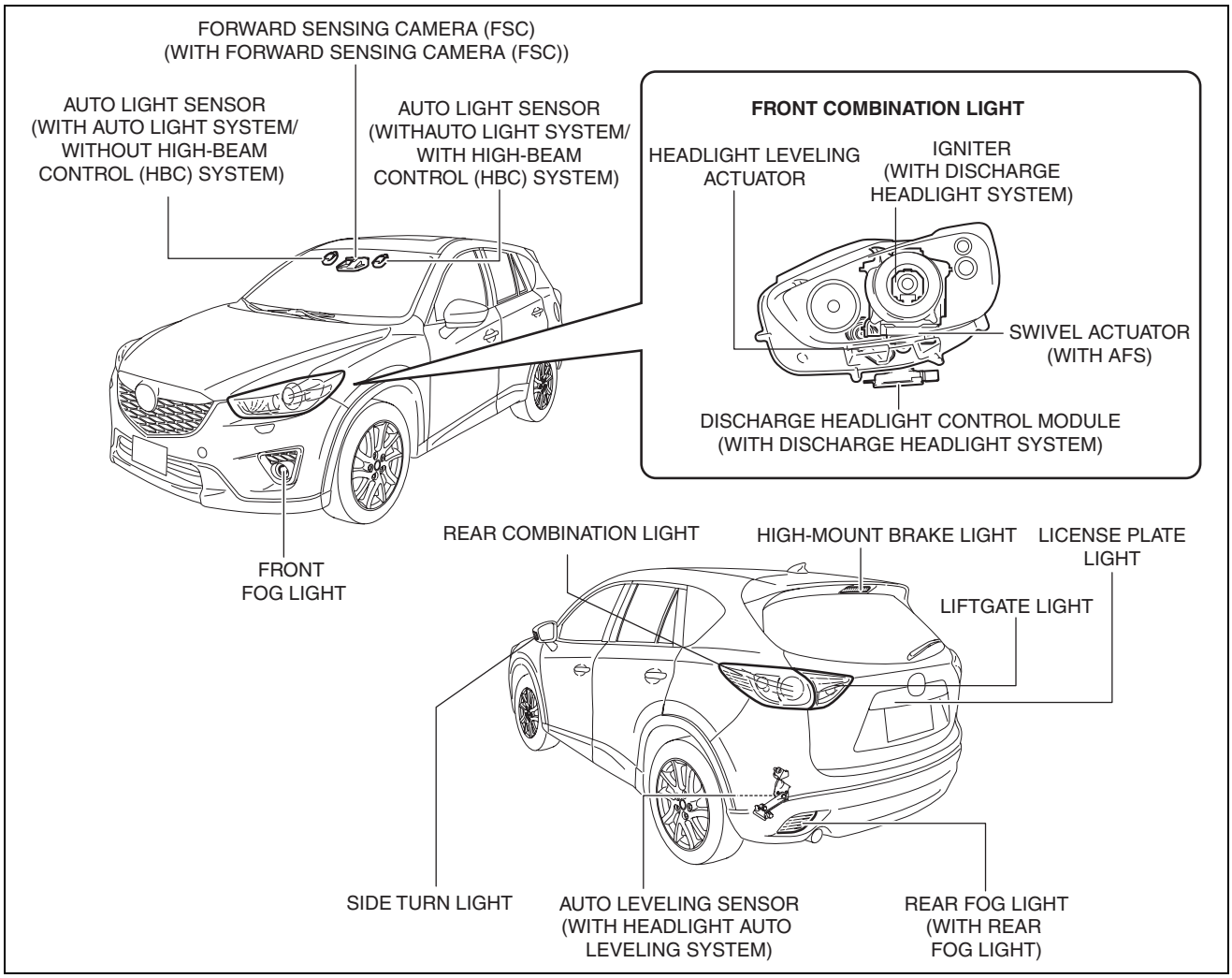
- Front combination lights have been adopted with parts related to the front exterior lights grouped and housed together.
- The following systems have been adopted to the headlights.
  - — Discharge headlight system (with discharge headlight system)
  - — Auto light system (with auto light system)
  - — Adaptive front lighting system (AFS) (with AFS)
  - — High beam control (HBC) system (with HBC)
  - — Headlight auto leveling system (with headlight auto leveling system)
  - — Headlight manual leveling system (with headlight manual leveling system)
- Front fog lights have been adopted. (with front fog lights)
- Emergency signal system (ESS) has been adopted.
- LED type side turn lights have been adopted.
- LED type high-mount brake light has been adopted.
- Rear fog lights have been adopted. (With rear fog lights)
- A room light control system has been adopted in which illumination time and illumination level of the interior lights change.

Specification

Item			Spec (W) × quantity
Exterior	Halogen type	Headlight LO bulb	55 × 2
		Headlight HI bulb (without running light)	60 × 2
		Headlight HI/Running light bulb (with running light)	55 / 15 × 2
	Discharge type	Headlight HI/LO bulb	35 × 2
		Running light bulb	13 × 2
	Parking light bulb		5 × 2
	Front turn light bulb		21 × 2
	Front fog light bulb		55 × 2
	Side turn light (LED)		0.6
	Rear turn light bulb		21 × 2
	Brake/taillight bulb		21 / 5 × 2
	Back-up light bulb		16 × 2
	Taillight bulb (Liftgate light)		5 × 2
	Rear fog light bulb		21 × 1
	High-mount brake light (LED)		2.5
	License plate light bulb		5 × 2
Interior	Front map light bulb		8 × 2
	Rear map light bulb		8 × 2
	Cargo compartment light bulb		5 × 1
	Glove compartment light bulb		1.7× 1
	Vanity mirror illumination bulb		2 × 2

LIGHTING SYSTEMS

Structural view
Exterior



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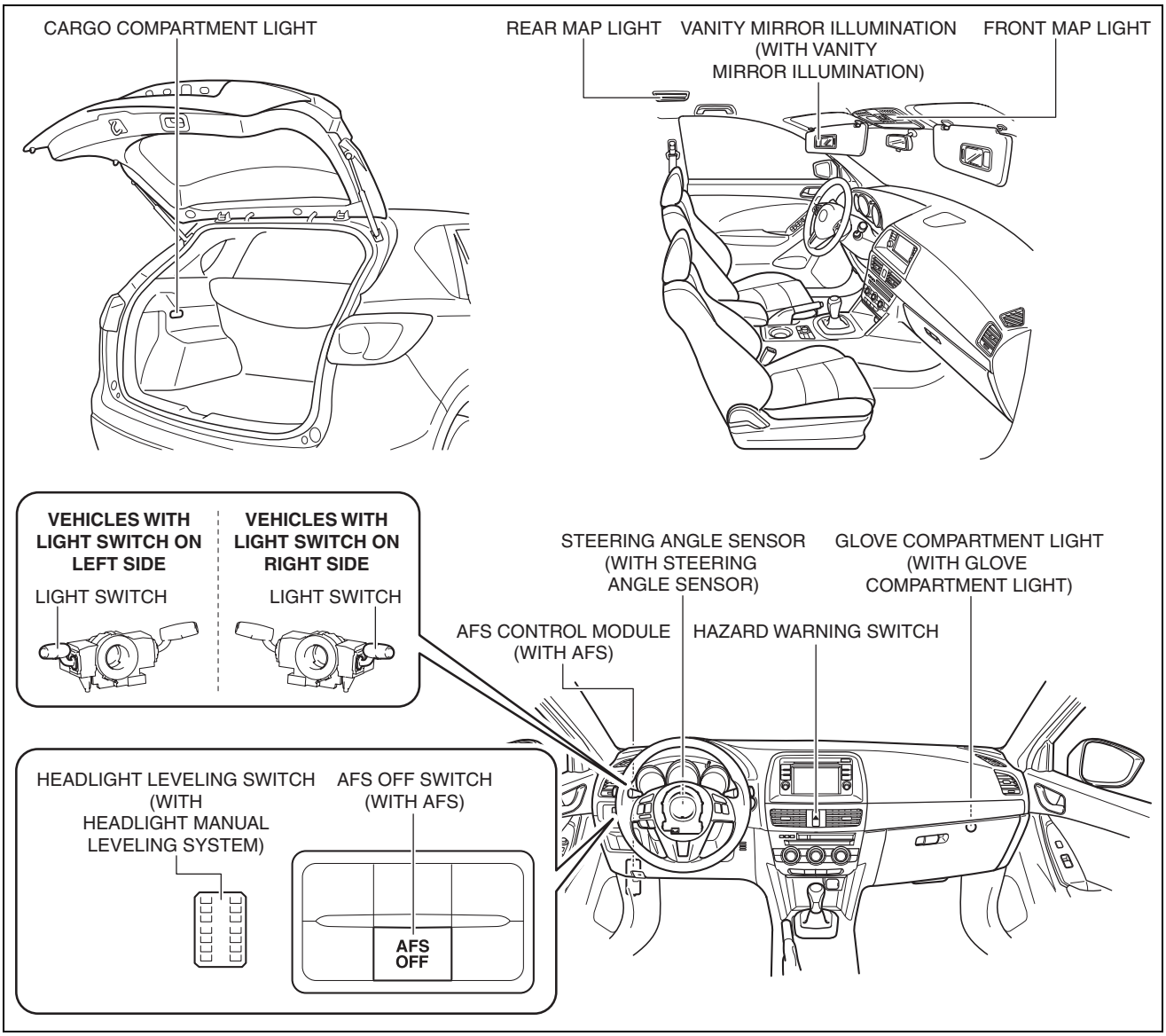
LIGHTING SYSTEMS

Interior



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LIGHTING SYSTEM PERSONALIZATION

id091800013300

- A personalization function has been adopted with which settings for each function can be changed.

Turn Light System
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control module
3-Flash Turn Signal.	The turn light system can be switched between operable and inoperable.	ON	Not Adopted. / OFF / ON	Rear body control module (RBCM)

Using audio unit (with color LCD)

Audio unit display	Function	Initial setting	Setting contents	Control module
3-Flash Turn Signal	The turn light system can be switched between operable and inoperable.	On	On / Off	Rear body control module (RBCM)

LIGHTING SYSTEMS

Auto Light System
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control module
Auto-headlight On.	Auto light sensor sensitivity can be changed.	Medium	Not Adopted. / Dark / Medium Dark / Medium/Medium Light / Light	Rear body control module (RBCM)

Using audio unit (with color LCD)

Audio unit display	Function	Initial setting	Setting contents	Control module
Auto-headlight On	Auto light sensor sensitivity can be changed.	Medium	Light / Medium Light / Medium / Medium Dark / Dark	Rear body control module (RBCM)

- Auto light sensitivity setting illuminates/turns off the headlights (LO) and TNS according to the following illumination level.

Note
- The following illumination level is a reference. It varies depending on conditions in the surrounding area (weather, reflection off buildings).

Setting contents	Illumination operation	Lights off operation
	TNS ON	TNS OFF
	Headlights (LO) ON	Headlights (LO) OFF
Light	4000 lux	8000 lux
Medium Light	3000 lux	6000 lux
Medium	2000 lux	4000 lux
Medium Dark	1000 lux	2000 lux
Dark	500 lux	1000 lux

High Beam Control (HBC) System
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control module
High Beam Control.	The high beam control (HBC) system can be switched between operable and inoperable.	ON	Not Adopted. / OFF / ON	Forward sensing camera (FSC)

Using audio unit (with color LCD)

Audio unit display	Function	Initial setting	Setting contents	Control module
High Beam Control	The high beam control (HBC) system can be switched between operable and inoperable.	On	On / Off	Forward sensing camera (FSC)

Room Light Control System
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control module
Interior Light Timeout-Door Open.	The front/rear map light illumination time after any door is open can be changed.	30 minutes.	Not Adopted. / 30 minutes. / 60 minutes. / 10 minutes.	Rear body control module (RBCM)
Interior Light Timeout-Door Closed.	The front/rear map light illumination time after any door is closed can be changed.	15 seconds.	Not Adopted. / 15 seconds. / 7.5 seconds. / 30 seconds. / 60 seconds.	Rear body control module (RBCM)

LIGHTING SYSTEMS

Using audio unit (with color LCD)

Audio unit display	Function	Initial setting	Setting contents	Control module
Interior Light Timeout - Door Open	The front/rear map light illumination time after any door is open can be changed.	30 minutes	60 minutes / 30 minutes / 10 minutes	Rear body control module (RBCM)
Interior Light Timeout - Door Closed	The front/rear map light illumination time after any door is closed can be changed.	15 seconds	60 seconds / 30 seconds/15 seconds / 7.5 seconds	Rear body control module (RBCM)

EXTERIOR LIGHTING SYSTEMS

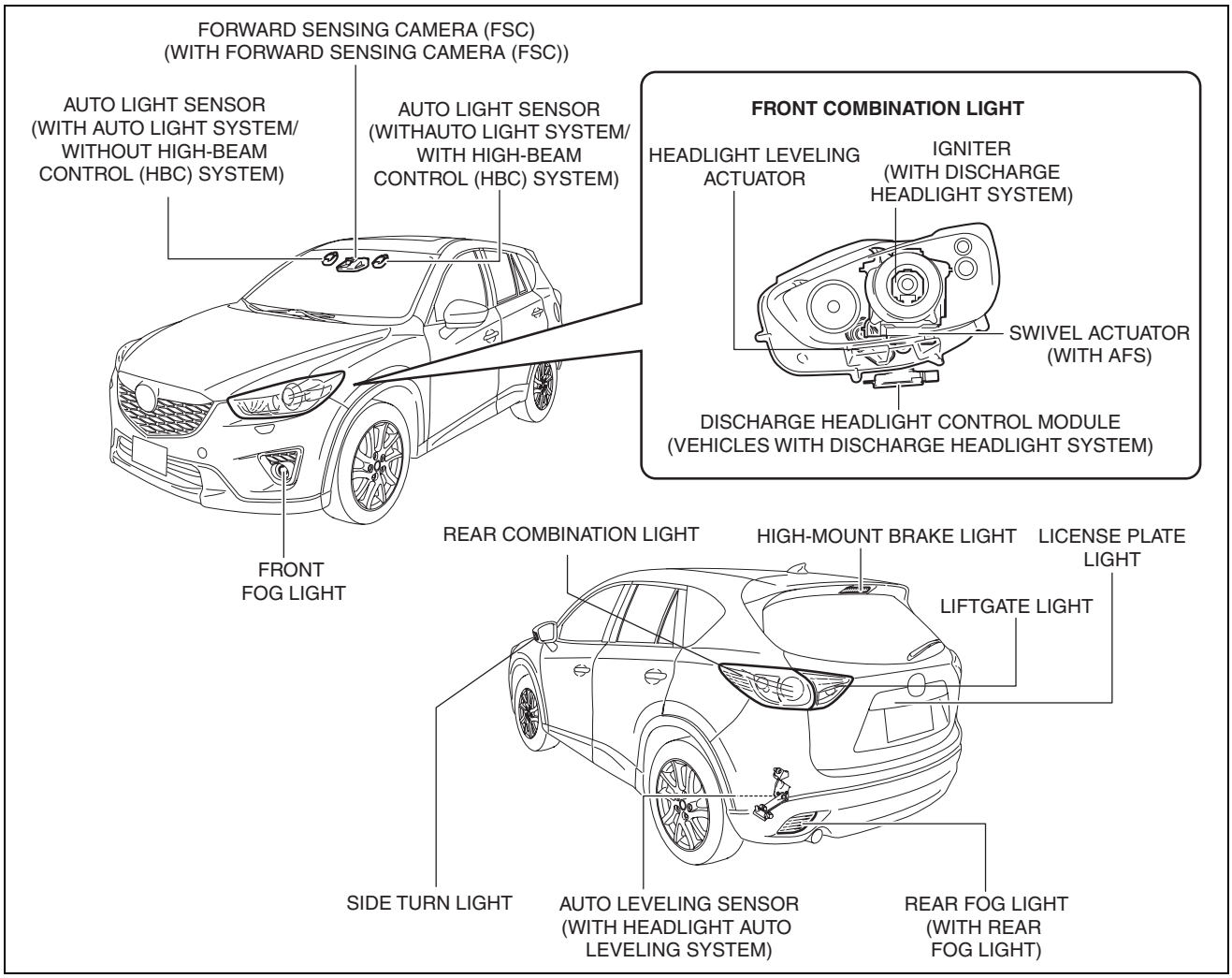
id091800010100

Outline

- Projector type headlights have been adopted to the front combination lights.
- Auto-light system has been adopted in which TNS and headlights automatically and optimally illuminate and turn off. (With auto light system)
- An HBC system has been adopted which automatically changes the headlights to low beams when it recognizes an oncoming vehicle, a vehicle ahead, or travel through city streets. (With HBC)
- An AFS (adaptive front lighting system) has been adopted which changes the optical axis to the direction in which the vehicle is moving according to the amount of steering operation. (With AFS (adaptive front lighting system))
- Discharge headlights that emit light over a wide area have been adopted. (With discharge headlight system)
- A headlight auto leveling system has been adopted which automatically adjusts the headlight optical axis up and down. (With headlight auto leveling system)
- A headlight manual leveling system has been adopted which changes the headlight (LO) optical axis according to the operation of the headlight leveling switch. (With headlight manual leveling system)
- An emergency signal system (ESS) has been adopted which flashes the hazard warning lights if the vehicle suddenly decelerates while traveling at high speed.
- Front fog lights have been adopted in the front bumper. (With front fog lights)
- Rear fog lights have been adopted in the rear bumper. (With rear fog lights)
- Outer mirrors with built-in front side turn lights have been adopted.
- LED type high-mount brake light has been adopted.
- The front body control module (FBCM) performs exterior lighting system fail-safe. (See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)

LIGHTING SYSTEMS

Structural view



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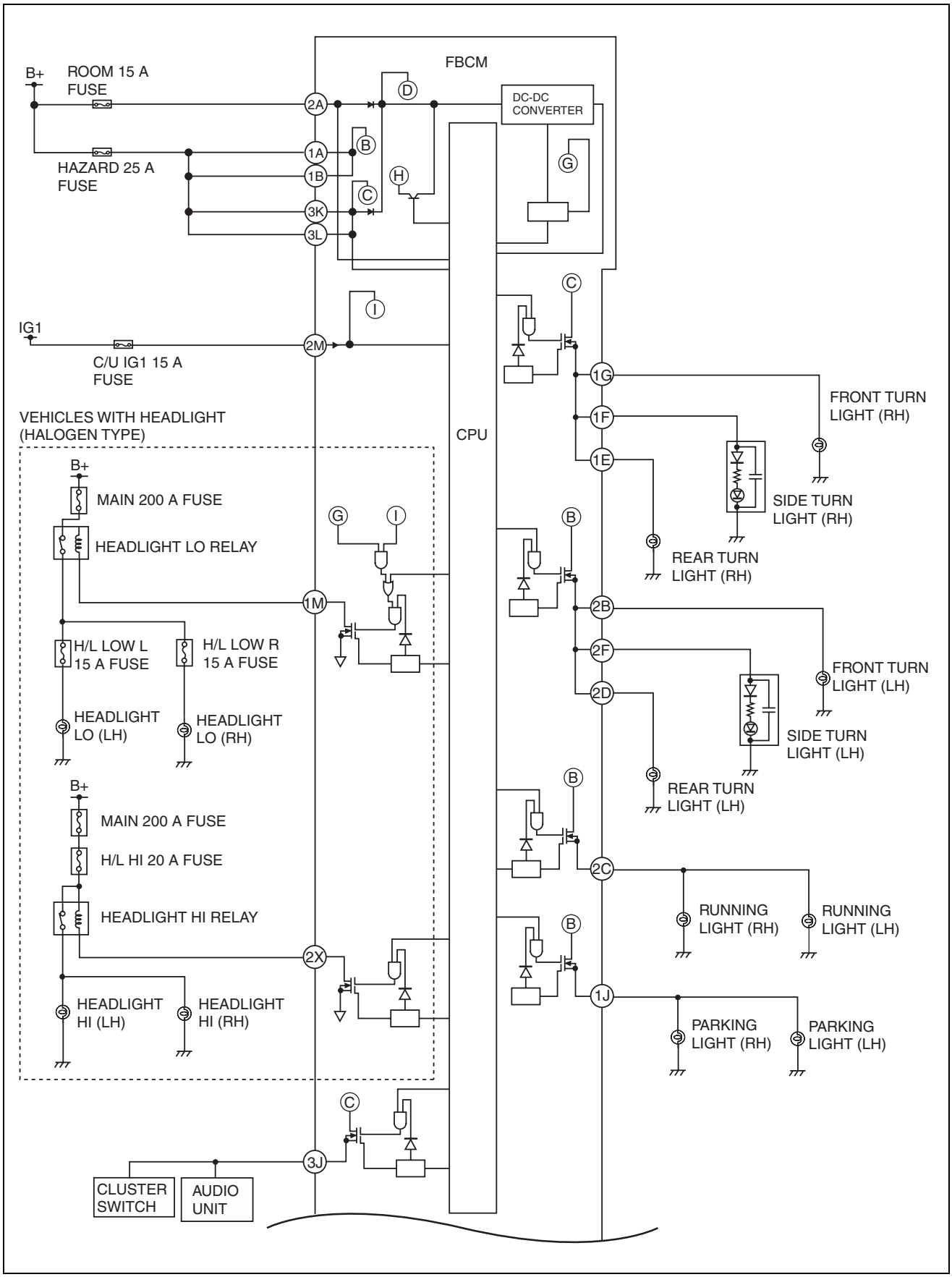
LIGHTING SYSTEMS

System wiring diagram



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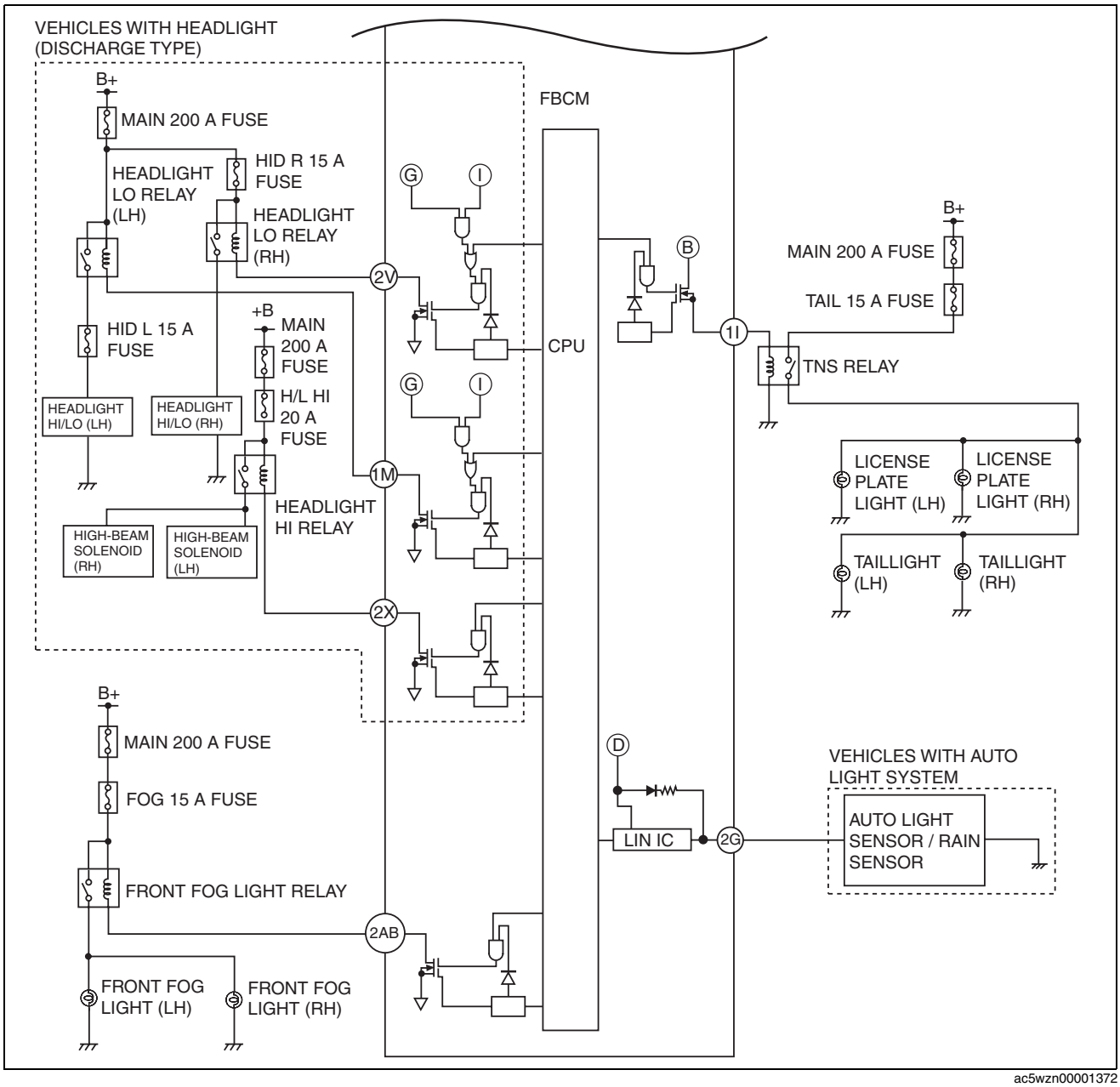
LIGHTING SYSTEMS



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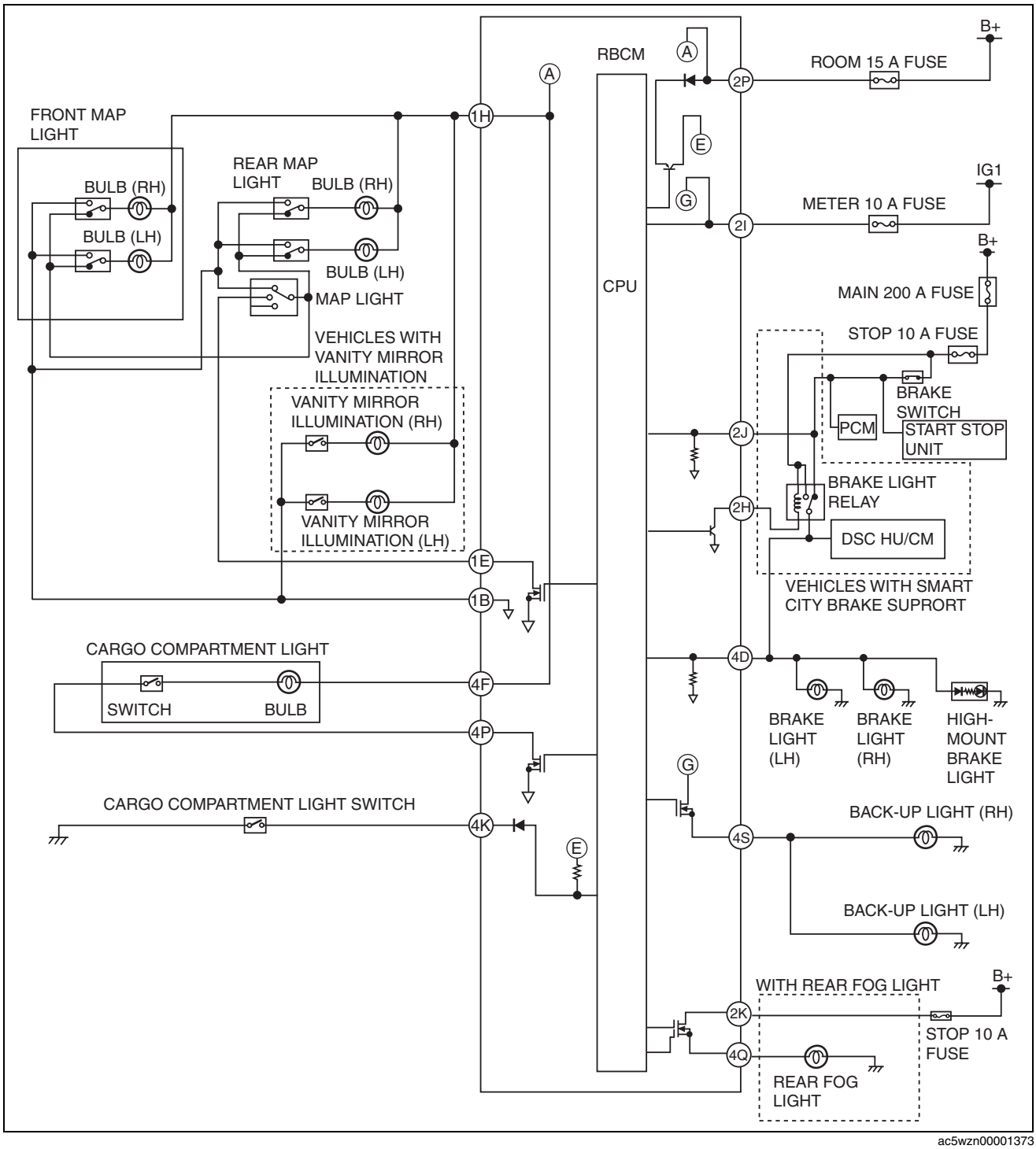
LIGHTING SYSTEMS



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Operation

Headlights LO (halogen type), headlights HI (halogen type), parking lights, front turn lights

- Refer to the front combination lights. (See 09-18-12 FRONT COMBINATION LIGHT.)

Headlight HI/LO (discharge type)

- Refer to the discharge headlight system. (See 09-18-20 DISCHARGE HEADLIGHT SYSTEM.)

Running lights (with running light system)

- Refer to the running light system. (See 09-18-47 RUNNING LIGHT SYSTEM.)

Front fog lights (with front fog lights)

- Refer to the front fog lights. (See 09-18-61 FRONT FOG LIGHT.)

LIGHTING SYSTEMS

Side turn lights
- Refer to the side turn lights. (See 09-18-66 SIDE TURN LIGHT.)

Rear turn lights, brake lights, taillights
- Refer to the rear combination lights. (See 09-18-72 REAR COMBINATION LIGHT.)

Hazard warning lights
- Refer to the front combination lights. (See 09-18-12 FRONT COMBINATION LIGHT.)
- Refer to the side turn lights. (See 09-18-66 SIDE TURN LIGHT.)
- Refer to the rear combination lights. (See 09-18-72 REAR COMBINATION LIGHT.)

Back-up lights, taillights
- Refer to the liftgate lights. (See 09-18-75 LIFTGATE LIGHT.)

Rear fog lights (with rear fog lights)
- Refer to the rear fog lights. (See 09-18-77 REAR FOG LIGHT.)

High-mount brake light
- Refer to the high-mount brake lights. (See 09-18-79 HIGH-MOUNT BRAKE LIGHT.)

License plate lights
- Refer to the license plate lights. (See 09-18-81 LICENSE PLATE LIGHT.)

FRONT COMBINATION LIGHT

id091800010200

Purpose
- Parts related to the front exterior lights are grouped and housed together such as the headlight, parking light, front turn light, headlight leveling actuator, wiring harnesses, and connectors.

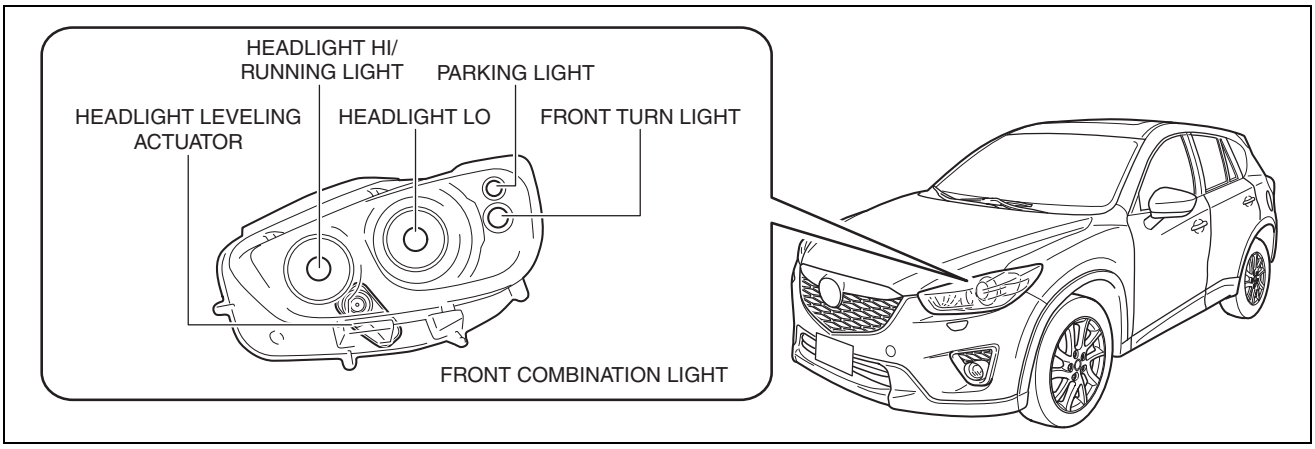
Function
- Each light illuminates or flashes when the light switch, turn switch, or hazard switch is operated.

Construction
- A halogen type or discharge type headlight is available for the front combination light.

Halogen type
- The following parts are an integrated structure.
  - — Headlight LO
  - — Headlight HI/Running light
  - — Parking light
  - — Front turn light
  - — Headlight leveling actuator
- A projector type headlight has been adopted for the headlight LO.
- A clear lens has been adopted for the front combination light.

Note
- Fogging or condensation on the inside of the front combination lights may occur, however, it is a natural phenomenon occurring as a result of a temperature difference between the interior and exterior of the front combination lights and has no effect on the light performance.
- Fogging or condensation occurring as a natural phenomenon will dissipate when the temperature inside the front combination lights rises after the headlights are illuminated and a period of time has elapsed.

LIGHTING SYSTEMS



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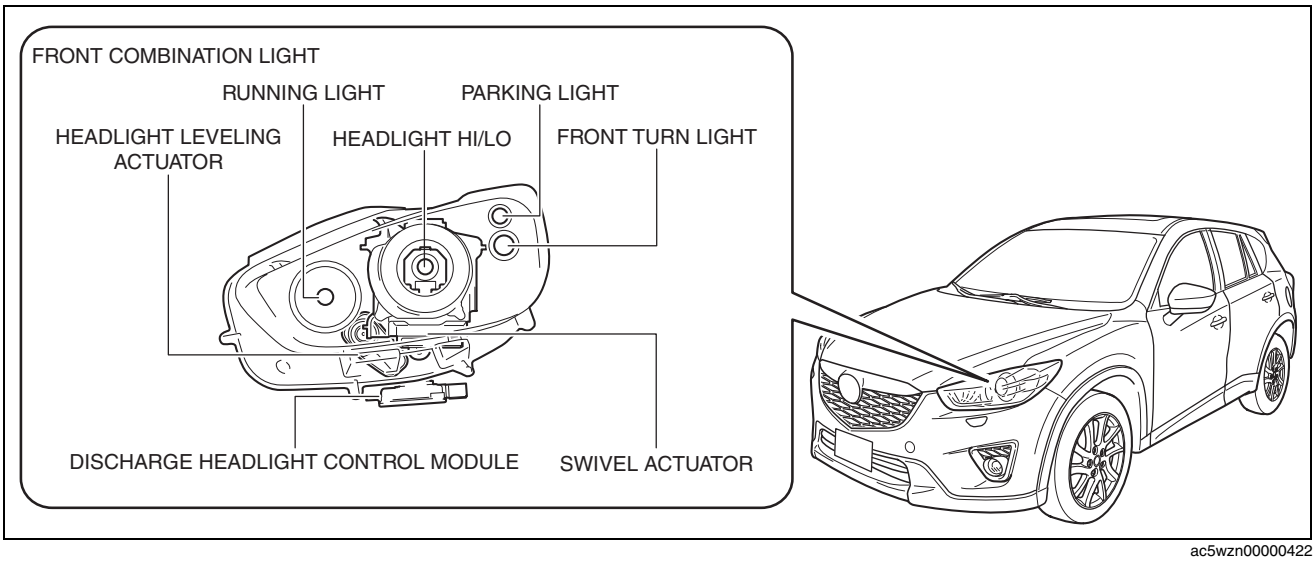
Discharge type

- The following parts are an integrated structure.
  - — Headlight HI/LO
  - — Running light
  - — Parking light
  - — Front turn light
  - — Headlight leveling actuator
  - — Swivel actuator
- A projector type headlight has been adopted for the headlight.
- The discharge headlight control module is assembled to the lower area of the front combination light.
- A clear lens has been adopted for the front combination light.

Note

- Fogging or condensation on the inside of the front combination lights may occur, however, it is a natural phenomenon occurring as a result of a temperature difference between the interior and exterior of the front combination lights and has no effect on the light performance.
- Fogging or condensation occurring as a natural phenomenon will dissipate when the temperature inside the front combination lights rises after the headlights are illuminated and a period of time has elapsed.



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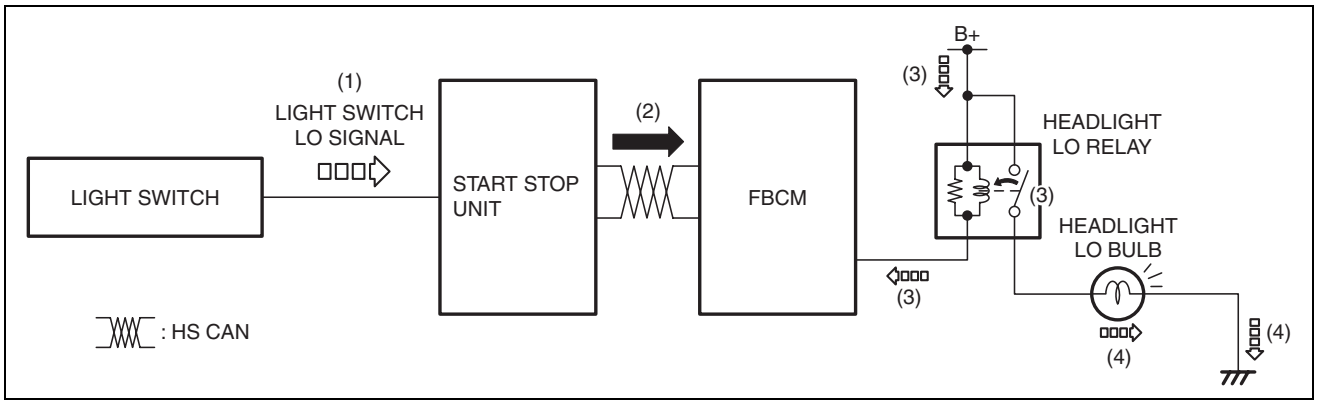
Operation
Headlight LO
Halogen type

1. When the light switch is operated to the HEAD position, a light switch LO signal is input to the start stop unit.
2. The start stop unit sends the light switch LO signal to the front body control module (FBCM) as a CAN signal.
3. When the front body control module (FBCM) receives the light switch LO signal, it turns the headlight LO relay on.

LIGHTING SYSTEMS

4. When the headlight LO relay turns on, the headlight LO bulbs are illuminated.



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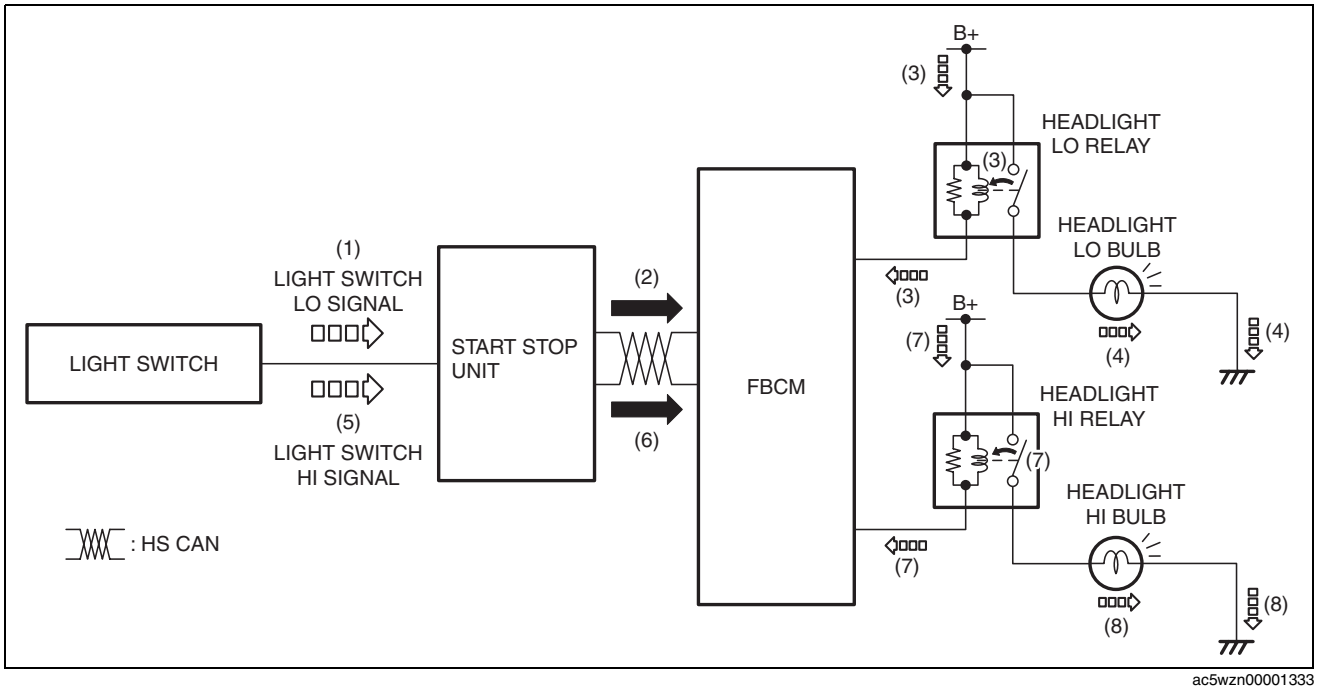
Discharge type

- Refer to the discharge headlight system. (See 09-18-20 DISCHARGE HEADLIGHT SYSTEM.)

Headlight HI
Halogen type

1. When the light switch is operated to the HEAD position, a light switch LO signal is input to the start stop unit.
2. The start stop unit sends the light switch LO signal to the front body control module (FBCM) as a CAN signal.
3. When the front body control module (FBCM) receives the light switch LO signal, it turns the headlight LO relay on.
4. When the headlight LO relay turns on, the headlight LO bulbs are illuminated.
5. When the light switch is operated to the HI position, a light switch HI signal is input to the start stop unit.
6. The start stop unit sends the light switch HI signal to the front body control module (FBCM) as a CAN signal.
7. When the front body control module (FBCM) receives the light switch HI signal, it turns the headlight HI relay on.
8. When the headlight HI relay turns on, the headlight HI bulbs are illuminated.



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Discharge type

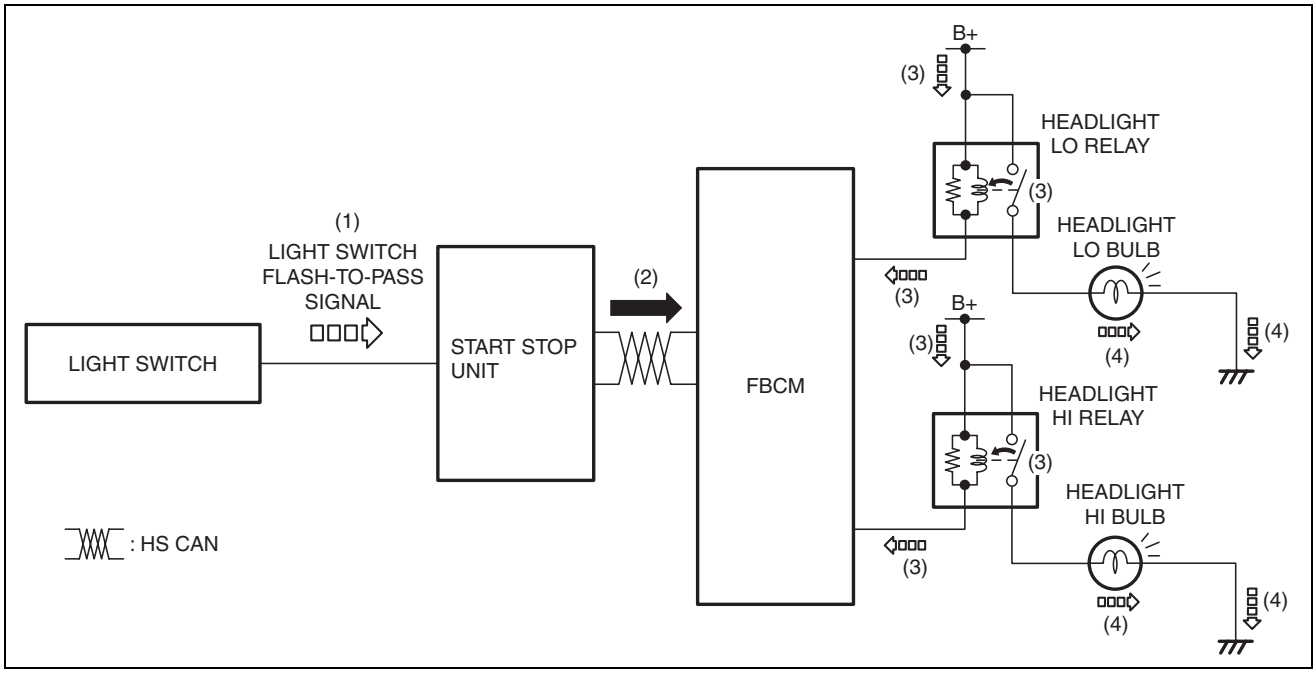
- Refer to the discharge headlight system. (See 09-18-20 DISCHARGE HEADLIGHT SYSTEM.)

Flash-to pass
Halogen type

1. When the light switch is operated to the passing position, a light switch passing signal is input to the start stop unit.
2. The start stop unit sends the light switch passing signal to the front body control module (FBCM) as a CAN signal.

LIGHTING SYSTEMS

3. When the front body control module (FBCM) receives the light switch passing signal, it turns the headlight LO and HI relays on.
4. When the headlight LO and HI relays turn on, the headlight LO and HI bulbs are illuminated.



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Discharge type

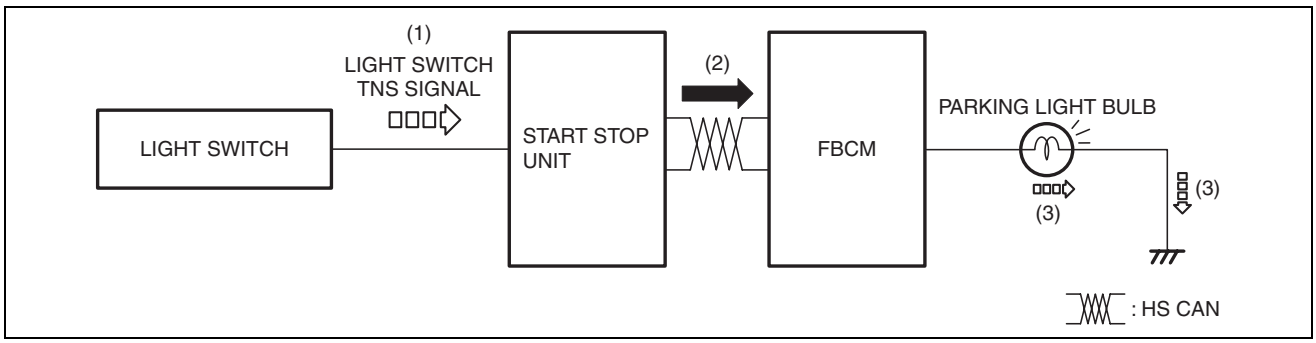
- Refer to the discharge headlight system. (See 09-18-20 DISCHARGE HEADLIGHT SYSTEM.)

Running light

- Refer to the running light system. (See 09-18-47 RUNNING LIGHT SYSTEM.)

Parking light

1. When the light switch is operated to the TNS position, a light switch TNS signal is input to the start stop unit.
2. The start stop unit sends the light switch TNS signal to the front body control module (FBCM) as a CAN signal.
3. When the front body control module (FBCM) receives the light switch TNS signal, the parking light bulbs are illuminated.



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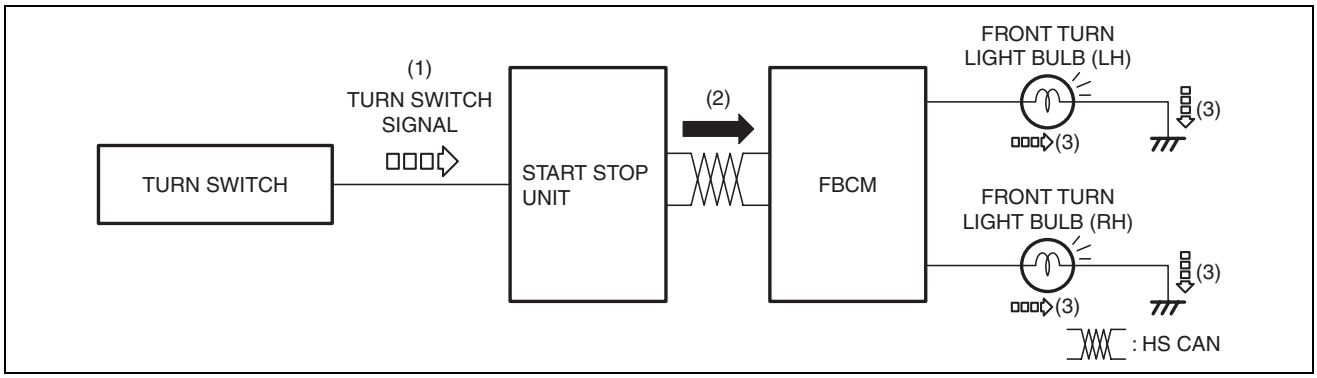
Front turn light

1. When the turn switch is operated to the LH or RH position, a turn switch LH or RH signal is input to the start stop unit.
2. The start stop unit sends the turn switch LH or RH signal to the front body control module (FBCM) as a CAN signal.
3. When the front body control module (FBCM) receives the turn switch LH or RH signal, the front turn light bulb (LH) or (RH) is illuminated.

LIGHTING SYSTEMS



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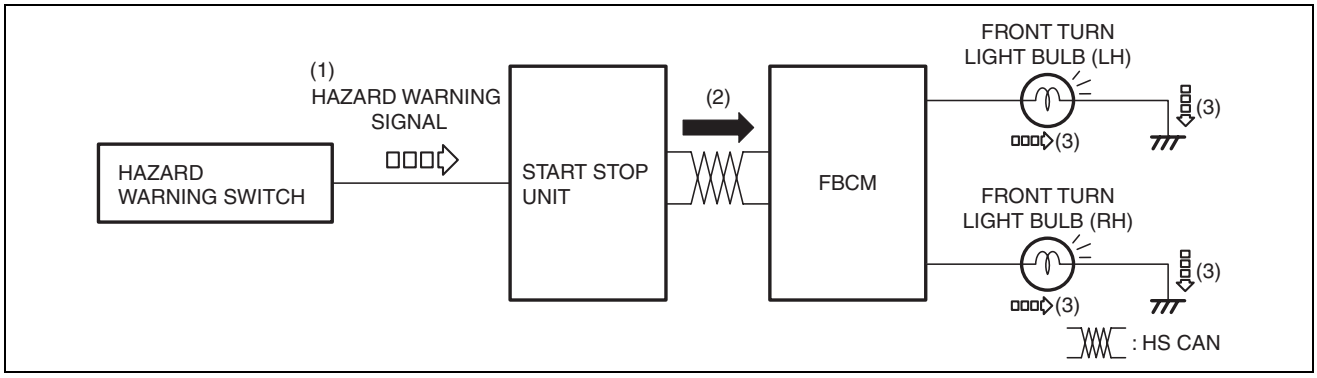
Front turn light (hazard warning)

1. When the hazard warning switch is turned on, a hazard signal is input to the start stop unit.
2. The start stop unit sends a hazard warning signal to the front body control module (FBCM).
3. When the front body control module (FBCM) receives the hazard warning signal, the front turn lights (RH) and (LH) flash.



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Headlight leveling actuator

- Refer to the headlight leveling actuator. (See 09-18-38 HEADLIGHT LEVELING ACTUATOR.)

Swivel actuator (with AFS)

- Refer to the swivel actuator. (See 09-18-40 AFS (ADAPTIVE FRONT LIGHTING SYSTEM).)

Fail-safe

- Function not equipped.

LIGHTS-ON INDICATOR LIGHT

id091800013400

Purpose

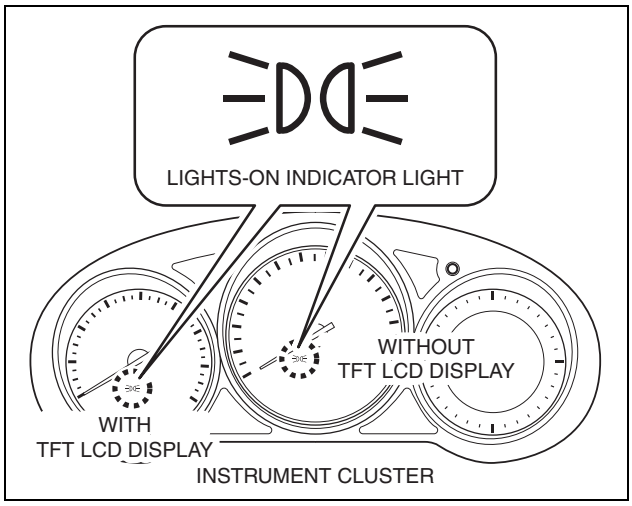
- Notifies the user that the TNS or the headlights (LO) are on.

Function

- Illuminates when the illumination conditions for the TNS, headlights (LO), or parking lights are met.

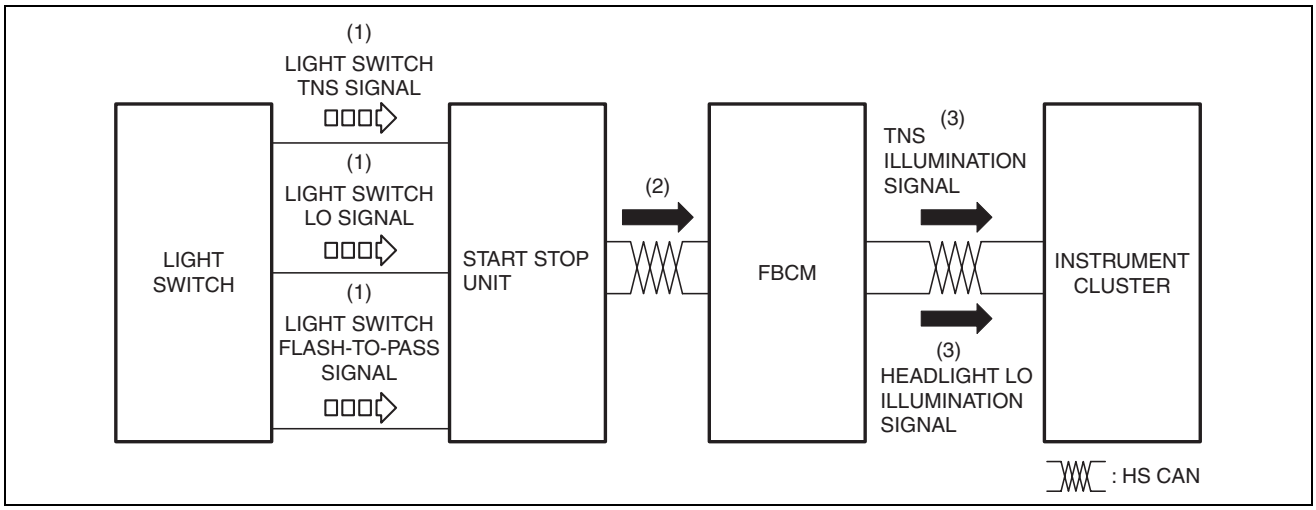
LIGHTING SYSTEMS

Construction
- Displayed in the instrument cluster.



ac5wzn00001508

Operation
1. When the light switch is operated to the TNS, HEAD, or parking position, a light switch TNS, LO, or parking signal is sent to the start stop unit.
2. The start stop unit sends the light switch TNS, LO, or parking signal to the front body control module (FBCM).
3. The front body control module (FBCM) sends the light switch TNS, LO, or parking signal to the instrument cluster as a TNS illumination or headlight LO illumination signal.
4. When the instrument cluster receives the TNS illlumination, or headlight LO illumination signal, it illuminates the lights-on indicator light.



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Fail-safe
- Function not equipped.

HEADLIGHT HIGH-BEAM INDICATOR LIGHT

id091800013600

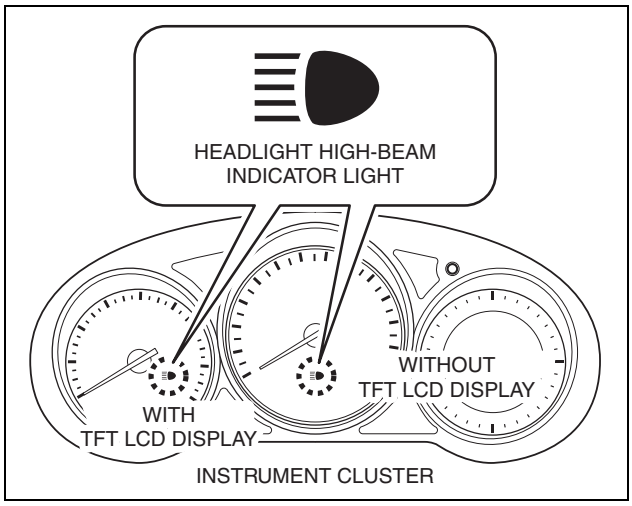
Purpose
- Notifies the user that the headlights (HI) are illuminated.

Function
- Illuminates when the headlight (HI) or parking illumination conditions are met.

LIGHTING SYSTEMS

Construction

- Displayed in the instrument cluster.



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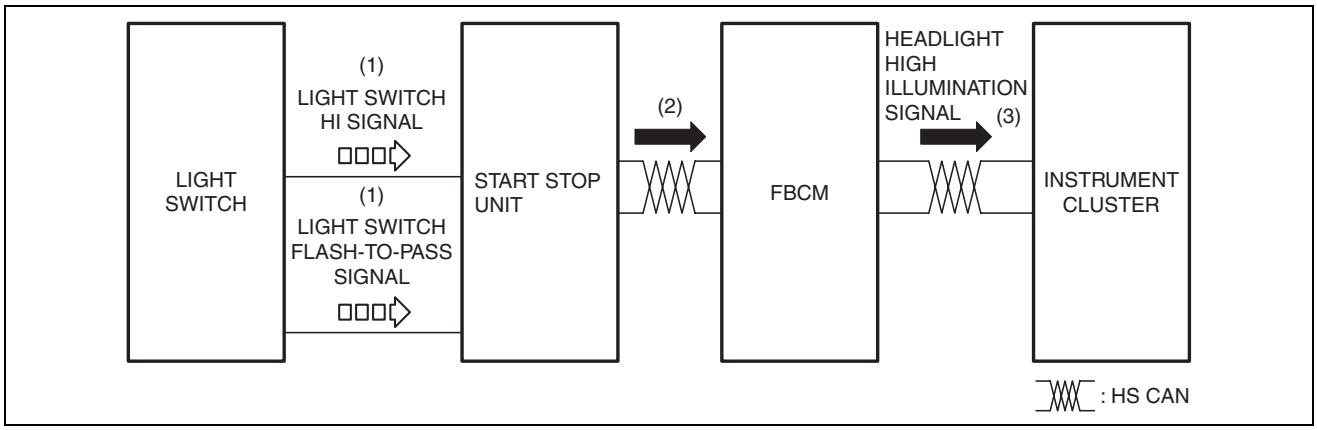
Operation

1. When the light switch is operated to the HI or parking position, a light switch HI or parking signal is input to the start stop unit.
2. The start stop unit sends the light switch HI or parking signal to the front body control module (FBCM).
3. The front body control module (FBCM) sends the light switch HI signal to the instrument cluster as a headlight HI illumination signal.
4. When the instrument cluster receives the headlight HI illumination signal, it illuminates the headlight high-beam indicator light.



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Fail-safe

- Function not equipped.

TURN SIGNAL/HAZARD WARNING INDICATOR LIGHTS

id091800013500

Purpose

- Notifies the driver that a turn light, the hazard warning lights are flashing.

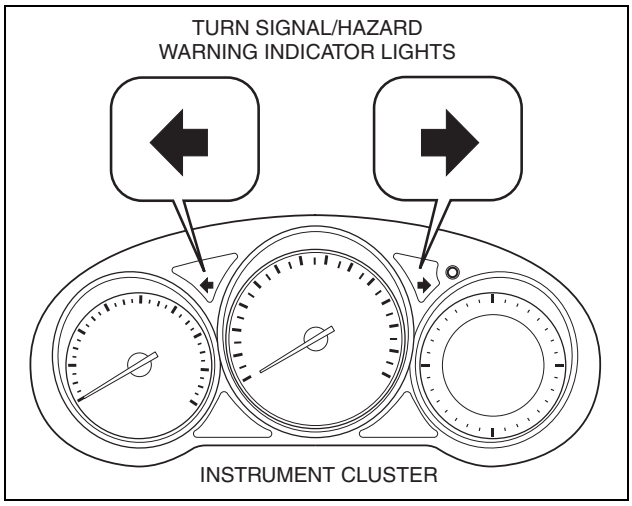
Function

- Flashes according to the turn switch and hazard warning switch operations.

LIGHTING SYSTEMS

Construction

- Displayed in the instrument cluster.

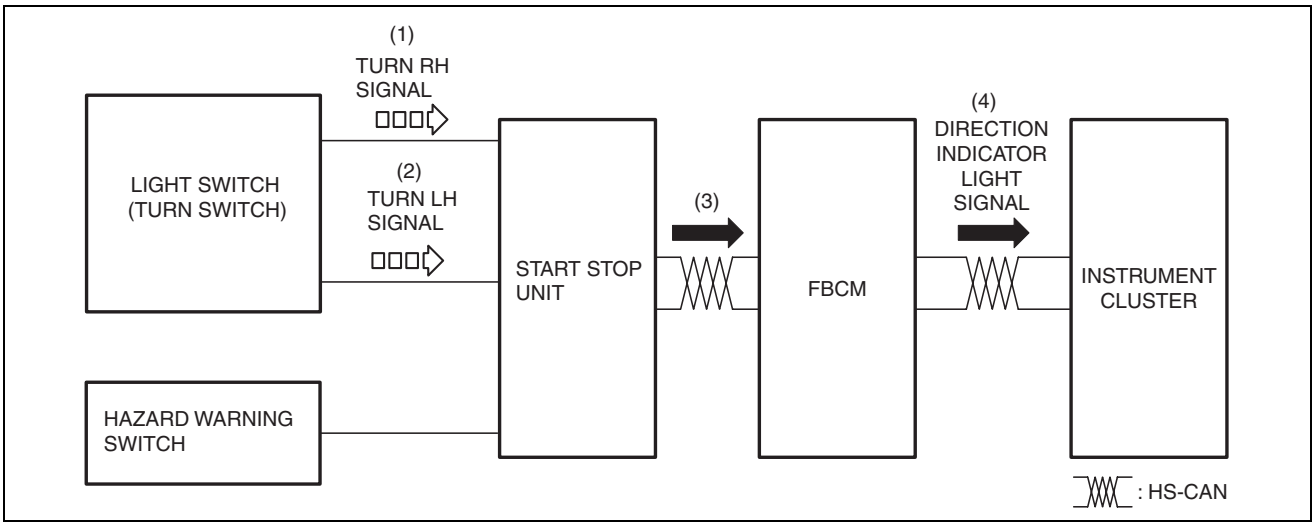


ac5uun00000536

Operation

Turn system

1. When the turn switch is operated to the RH position, a turn RH signal is input to the start stop unit.
2. When the turn switch is operated to the LH position, a turn LH signal is input to the start stop unit.
3. The start stop unit sends the turn RH or LH signal to the front body control module (FBCM).
4. The front body control module (FBCM) sends the turn RH or LH signal to the instrument cluster as a direction indicator light signal.
5. When a direction indicator light signal is received, the instrument cluster flashes the direction indicator light.



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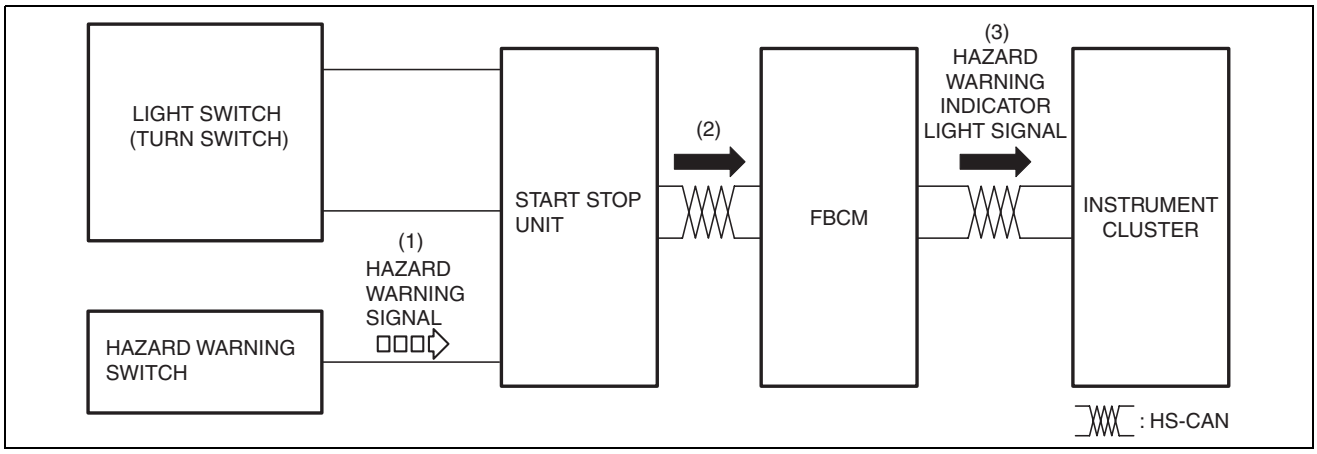
Hazard system

1. When the hazard switch is turned on, a hazard signal is input to the start stop unit.
2. The start stop unit sends a hazard signal to the front body control module (FBCM).
3. The front body control module (FBCM) sends the hazard signal to the instrument cluster as a hazard warning flashing signal.
4. When the hazard warning flash signal is received, the instrument cluster flashes the hazard warning lights.

LIGHTING SYSTEMS



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Fail-safe

- Function not equipped.

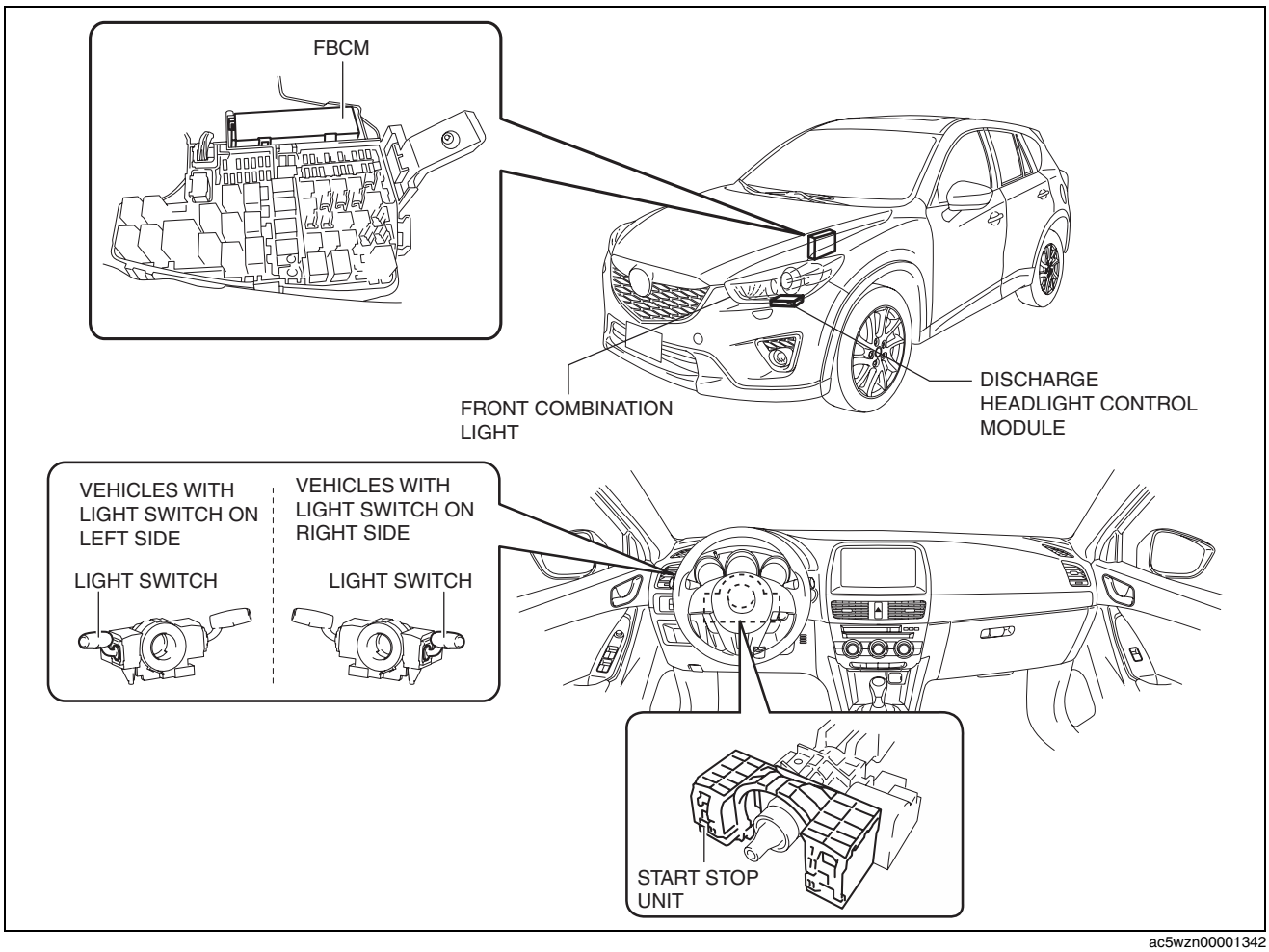
DISCHARGE HEADLIGHT SYSTEM

id091800010300

Outline

- The discharge headlight system utilizes a gas discharge type light to emit a white light resembling sunlight over a wide area. Also, use of the gas discharge type light realizes high efficiency, low power consumption lighting.

Structural view



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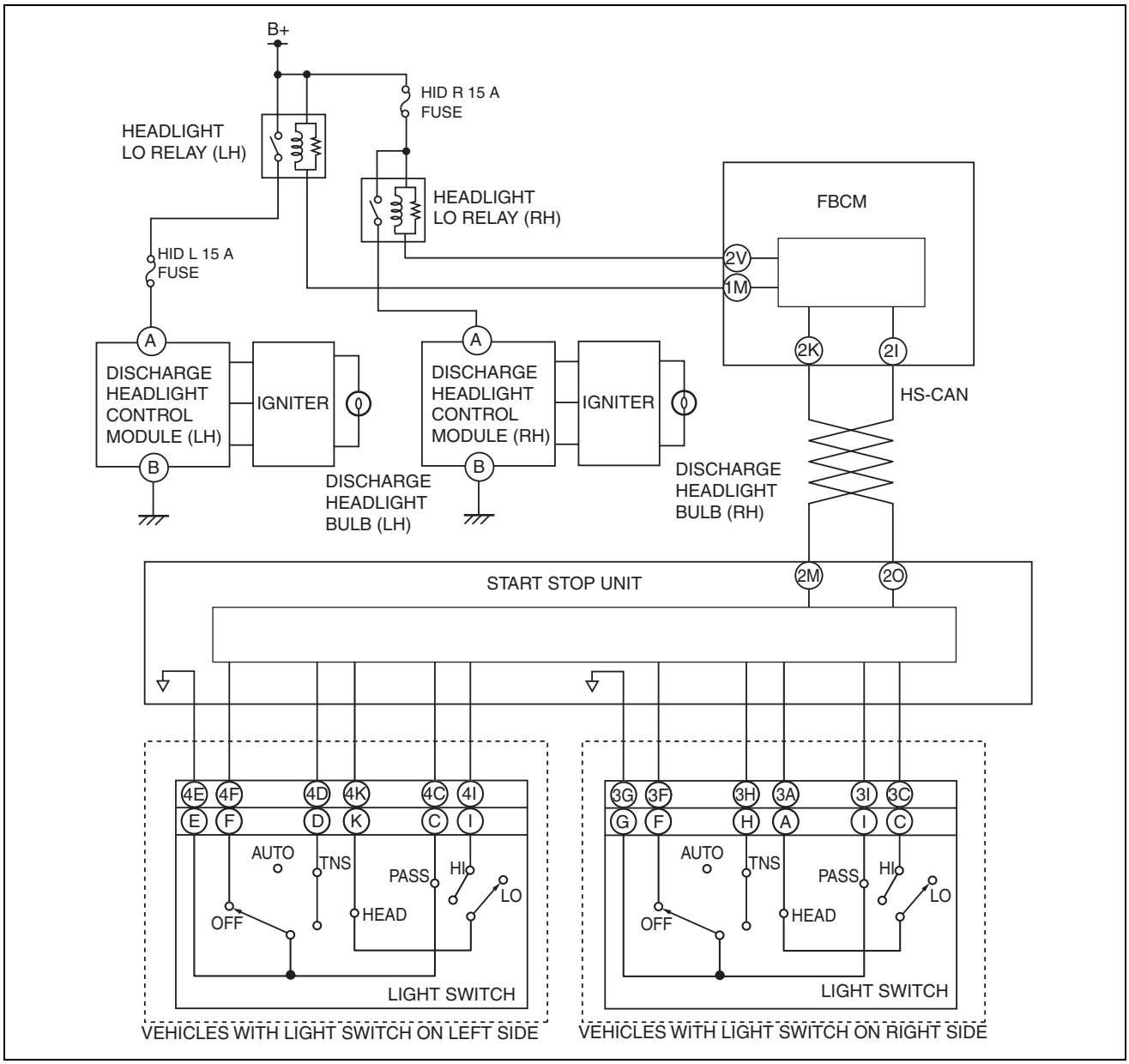
LIGHTING SYSTEMS

System wiring diagram



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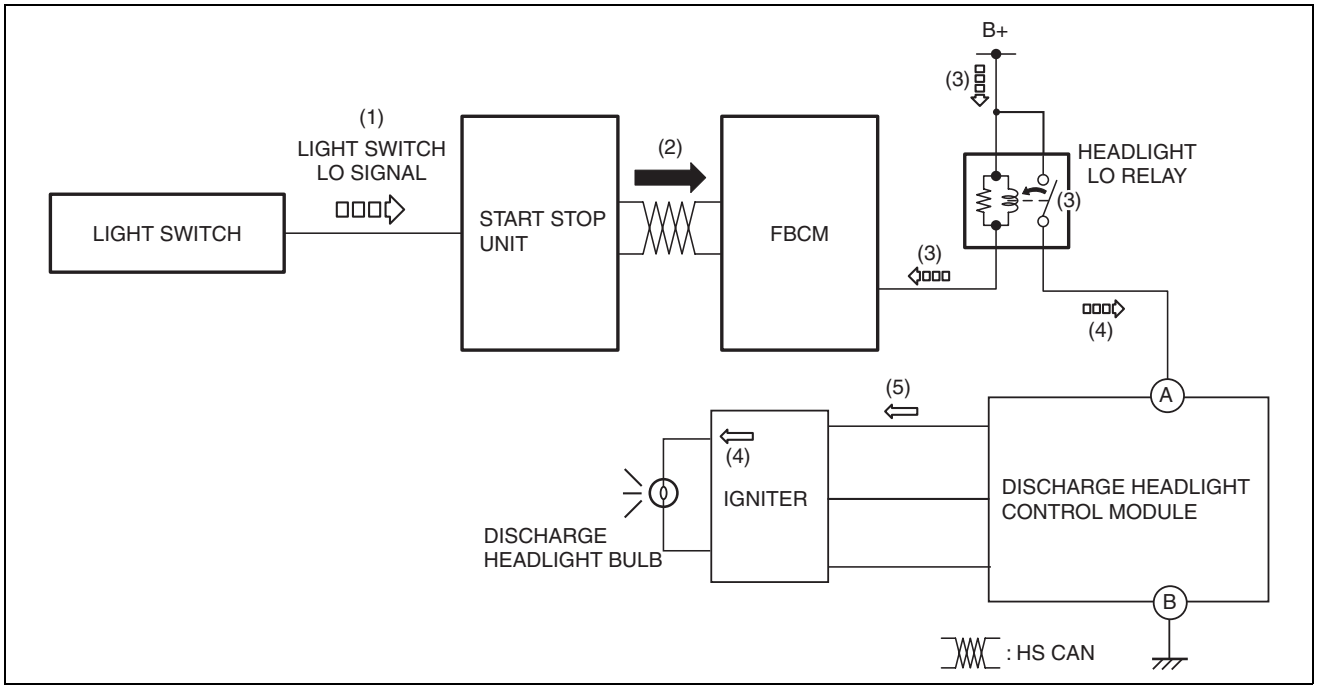
Operation

1. When the light switch is operated to the HEAD position, a light switch LO signal is input to the start stop unit.
2. The start stop unit sends the light switch LO signal to the front body control module (FBCM) as a CAN signal.
3. When the front body control module (FBCM) receives the light switch LO signal, it turns the headlight LO relay on.
4. When the headlight LO relay turns on, the igniter raises the DC voltage from the battery to approx. 25,000 V and outputs it to the discharge headlight bulb so that the xenon gas emits light.

LIGHTING SYSTEMS

5. When the discharge headlight bulb (xenon gas) emits light, the discharge headlight control module converts the DC voltage from the battery to AC voltage (approx. 42 V) and outputs it to the discharge headlight bulb to illuminate the bulb.



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DISCHARGE HEADLIGHT CONTROL MODULE

id091800010400

Purpose

- Converts DC voltage from the battery to AC voltage and outputs the stabilized voltage to the discharge headlight.

Function

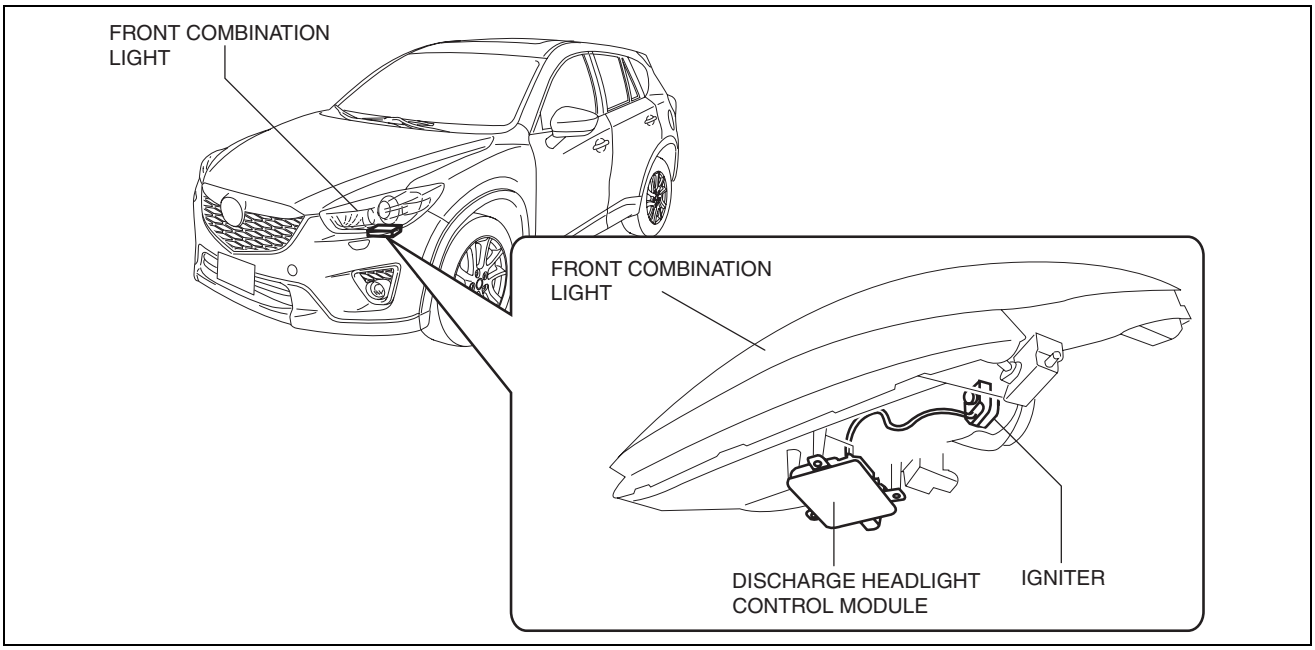
- The discharge headlight control module controls the voltage from the battery to illuminate the discharge headlight.
- The discharge headlight control module has a fail-safe function which turns off the discharge headlight if an input/output voltage malfunction occurs for the prevention of part mis-operation and protection.

Construction

- The discharge headlight control module consists of an igniter which raises the voltage from the battery to approx. 25,000 V, and an inverter which converts the DC voltage from the battery to AC voltage.
- The inverter is integrated with the discharge headlight control module.

LIGHTING SYSTEMS

- The igniter is installed to the discharge headlight bulb.



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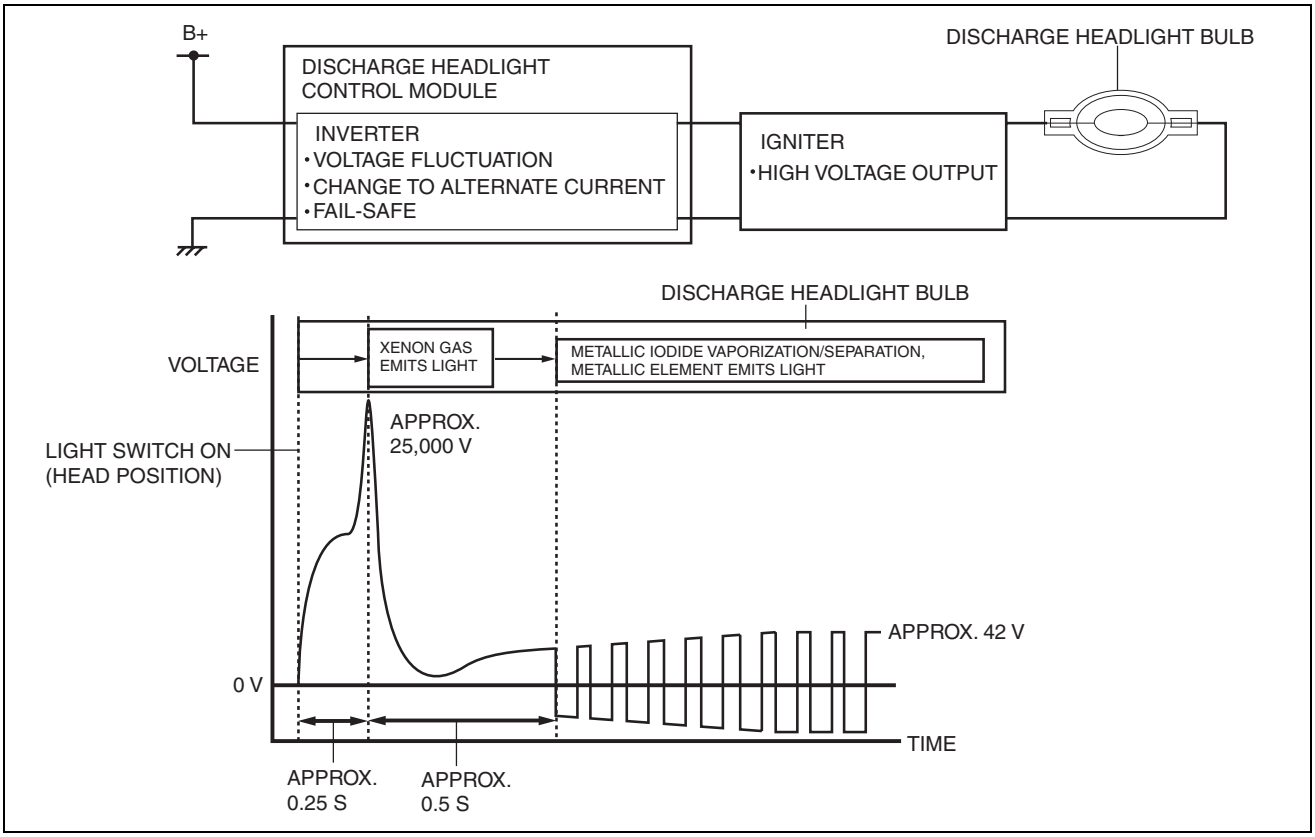
Operation

1. When the headlight relay (LO) turns on, the discharge headlight control module raises the DC voltage from the battery from approx. 12 V to approx. 25,000 V using the igniter, and outputs it to the discharge headlight bulb.
2. After the discharge headlight is illuminated, the discharge headlight control module converts the DC voltage from the battery to AC voltage (approx. 42 V) using the inverter, and outputs it to the discharge headlight bulb.



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Fail-safe

- If the following input/output voltage malfunctions occur, the fail-safe function is activated.

Operation condition	Fail-safe	Recovery condition

LIGHTING SYSTEMS

Input/output voltage from discharge headlight control module is outside of 6—18 V range. (Except for voltage reduction directly after discharge headlight illumination)	Turns off discharge headlights	Normal input voltage detected
Malfunction is detected in output voltage from discharge headlight control module (open circuit or short to ground in wiring harness)	Turns off discharge headlights	Light switch turned to OFF, and then back to ON

DISCHARGE HEADLIGHT BULB

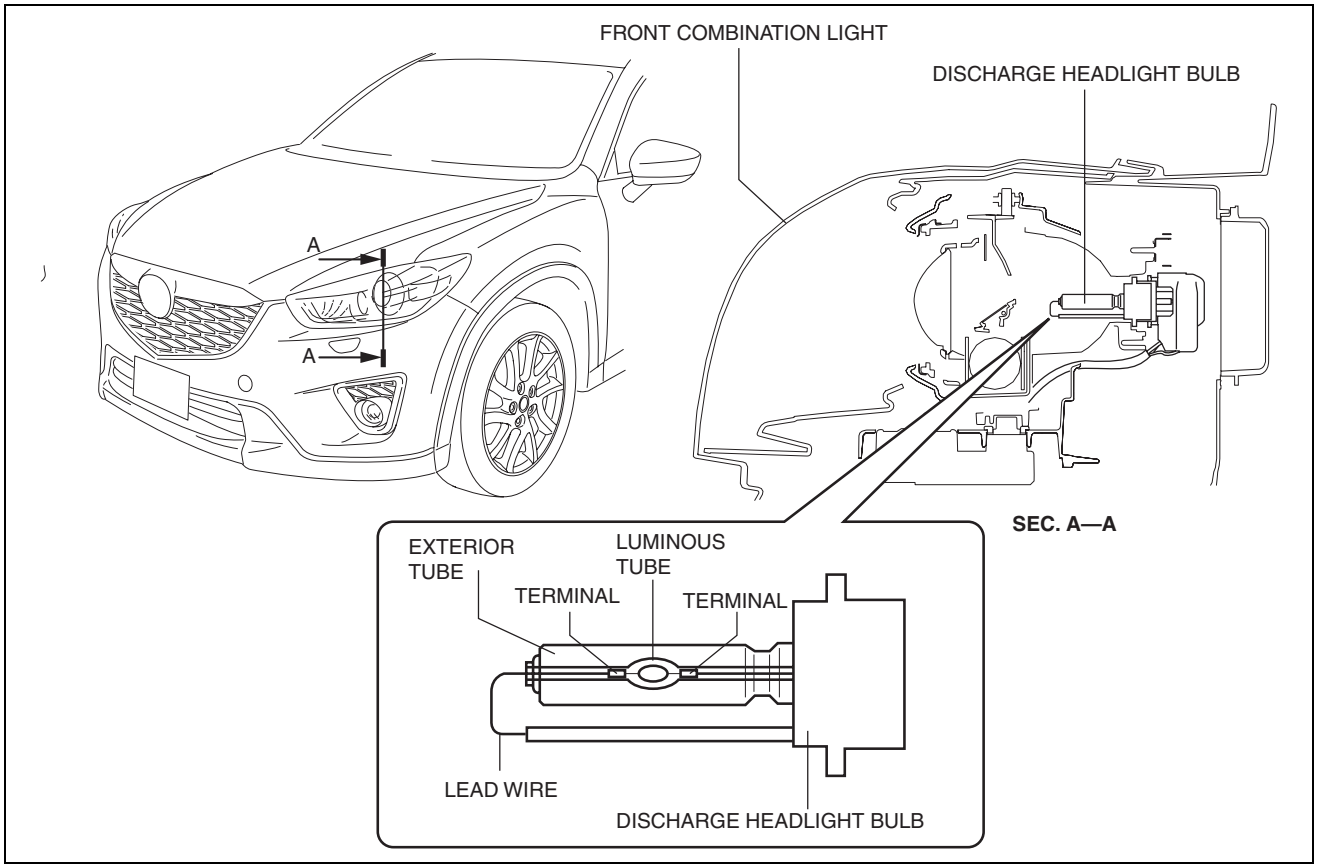
id091800013200

Purpose, Function

- Charges the internal metallic element and emits white light resembling sunlight.

Construction

- A mercury-free bulb has been adopted for the discharge headlight bulb.
- The discharge headlight bulb is assembled to the front combination light.
- The discharge headlight bulb consists of xenon gas, a luminous tube in which metallic iodide is enclosed, a lead wire and electrodes which pass electricity, and an exterior tube.



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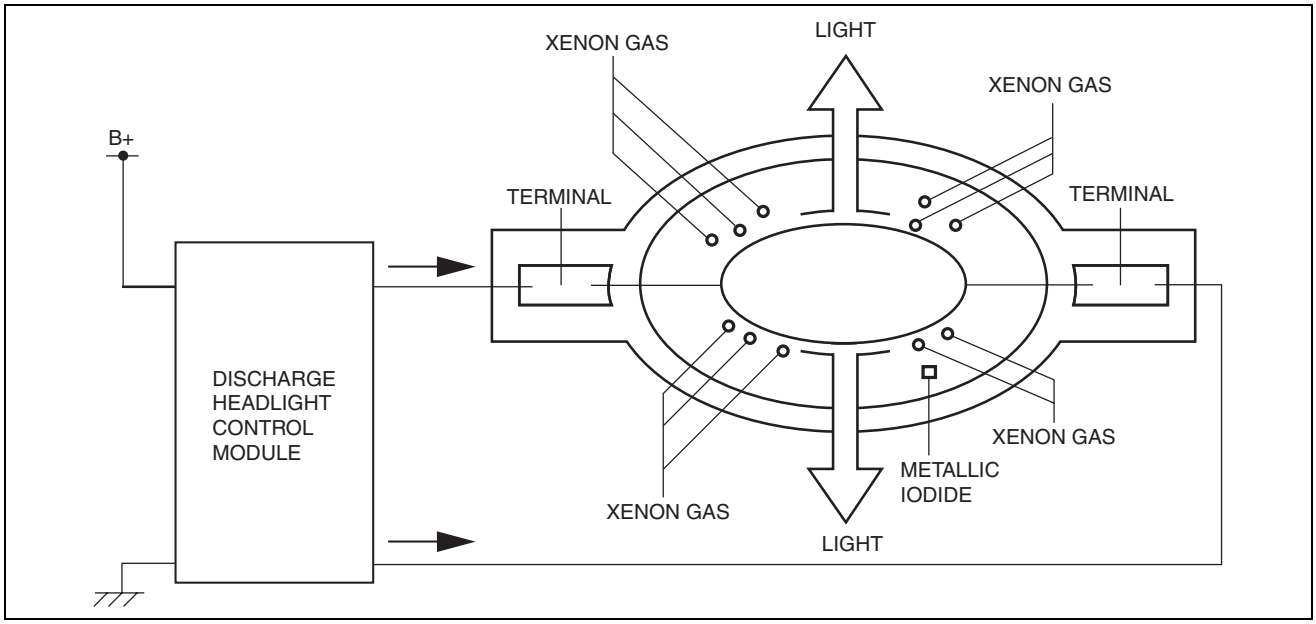
Operation

1. When high DC voltage (approx. 25,000 V) from the discharge headlight control module is input to the electrodes, the insulation between the electrodes is broken down and electrical current flows between the electrodes.
2. When electrical current flows between the electrodes of the discharge headlight bulb, the xenon gas is energized and emits light.

LIGHTING SYSTEMS

3. When the xenon gas emits light, temperature inside the discharge headlight bulb rises, the metallic iodide vaporizes/separates, and the metallic element discharges and emits light.



ac5wzn00001346

Fail-safe

- Function not equipped.

AUTO LIGHT SYSTEM

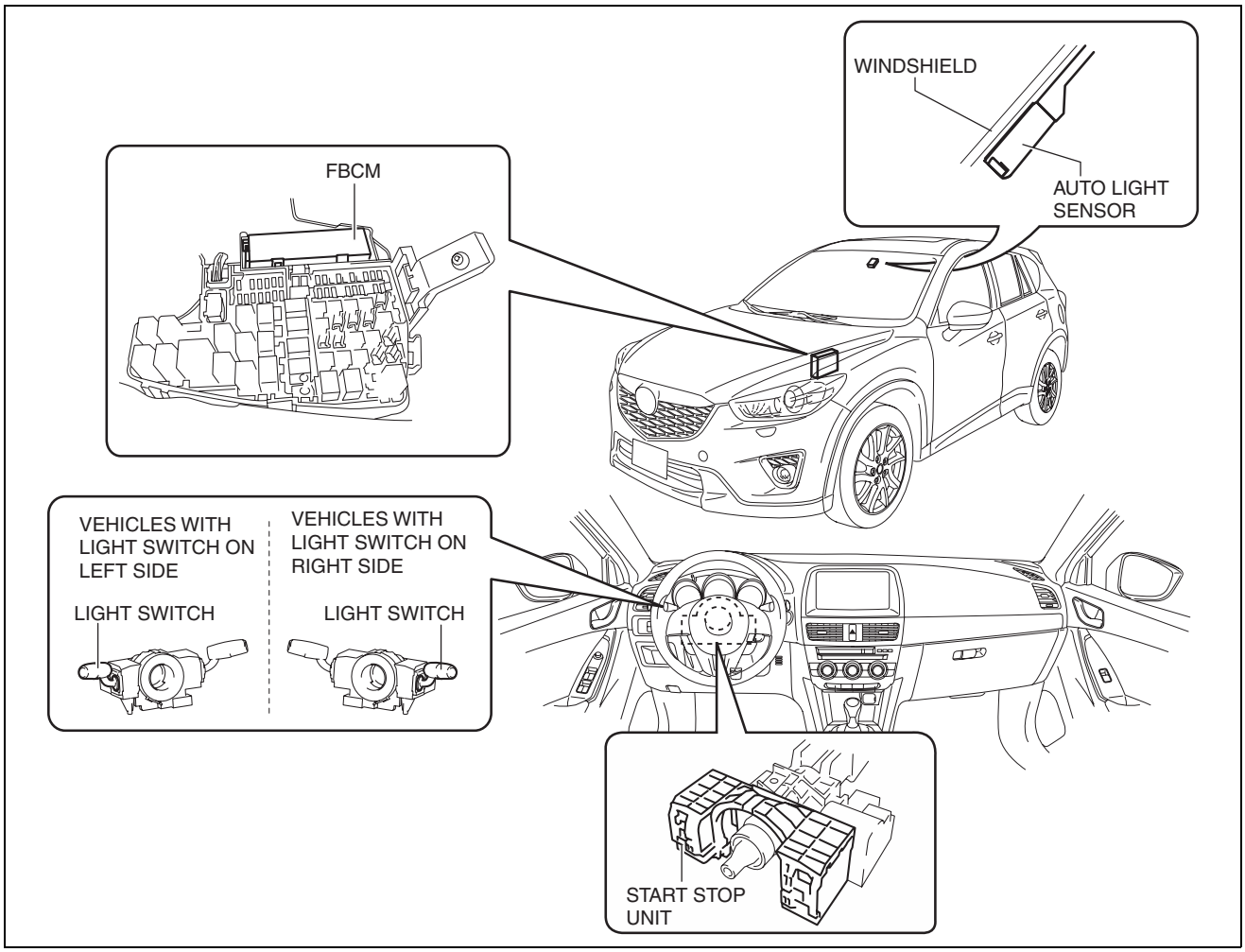
id091800010500

Outline

- The auto light system automatically turns the TNS and headlights on/off according to the illumination level above and in front of the vehicle.
- The auto light system is controlled by the front body control module (FBCM).
- The front body control module (FBCM) performs auto light system fail-safe. (See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)

LIGHTING SYSTEMS

Structural View



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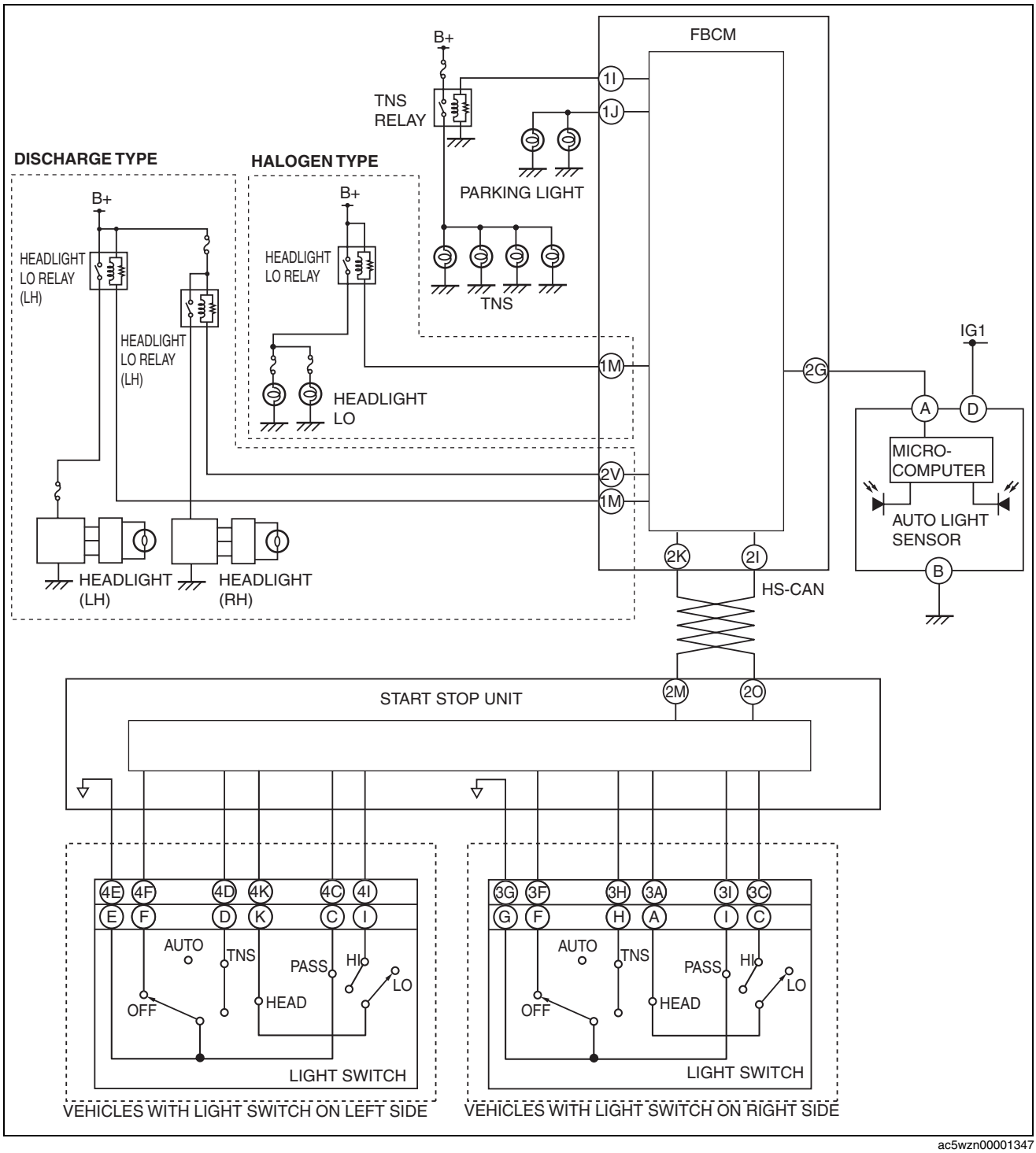
LIGHTING SYSTEMS

System Wiring Diagram



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Function

- The auto light system receives a headlight illumination/off request signal from the auto light sensor and the front body control module (FBCM) turns the headlights on and off.
- If the upward and forward illumination sensors detect the illumination level at which the headlights should be illuminated/turned off, the auto light sensor sends a headlight illumination/off request signal.
- If the auto light sensor detects that the vehicle is being driven at night after sending the headlight illumination request signal, it switches to the night mode and changes the headlight off conditions so that the headlights do not turn off and on repeatedly due to temporary brightness from street lights or store lighting, making it difficult for the headlights to turn off.

LIGHTING SYSTEMS

Night mode

- When the upward and forward illumination level sensors detect an illumination level of approx. 2,000 lux or less for approx. 10 min after sending the headlight illumination request signal, the auto light sensor determines that the vehicle is being driven at night and the auto light system is switched to the night mode.
- The auto light sensor determines the headlight off condition based on the average illumination level for the previous 3 min detected by the upward and forward illumination level sensors while in the night mode.
- If the average illumination level of the calculated past 3 min is approx. 4,000 lux or more, the auto light sensor cancels the night mode and sends a headlight off request signal.
- When a headlight switch OFF signal is input while in the night mode, the auto light sensor cancels the night mode.

Caution

- **If the vehicle is driven a long-distance in a tunnel, the traffic is congested inside a tunnel, or the environment (temperature, buildings, tree shadows) surrounding the vehicle is dark for approx. 10 min, even if the surroundings are bright during daytime, the conditions for driving at night will be met and the auto light sensor may switch to the night mode.**
- **Because turning off of the headlights is determined by the average illumination level for the past 3 min when the mode is switched to the night mode during daytime while the surrounding area is bright, if the vehicle is driven in an environment (temperature, buildings, or tree shadows) surrounding the vehicle which is dark, the average illumination level may be insufficient and the condition for turning off the headlights may not be met, therefore the night mode may not cancel (headlights continue to illuminate).**

Operation

- The auto light system operates when the ignition is switched ON and the light switch is in the AUTO position.

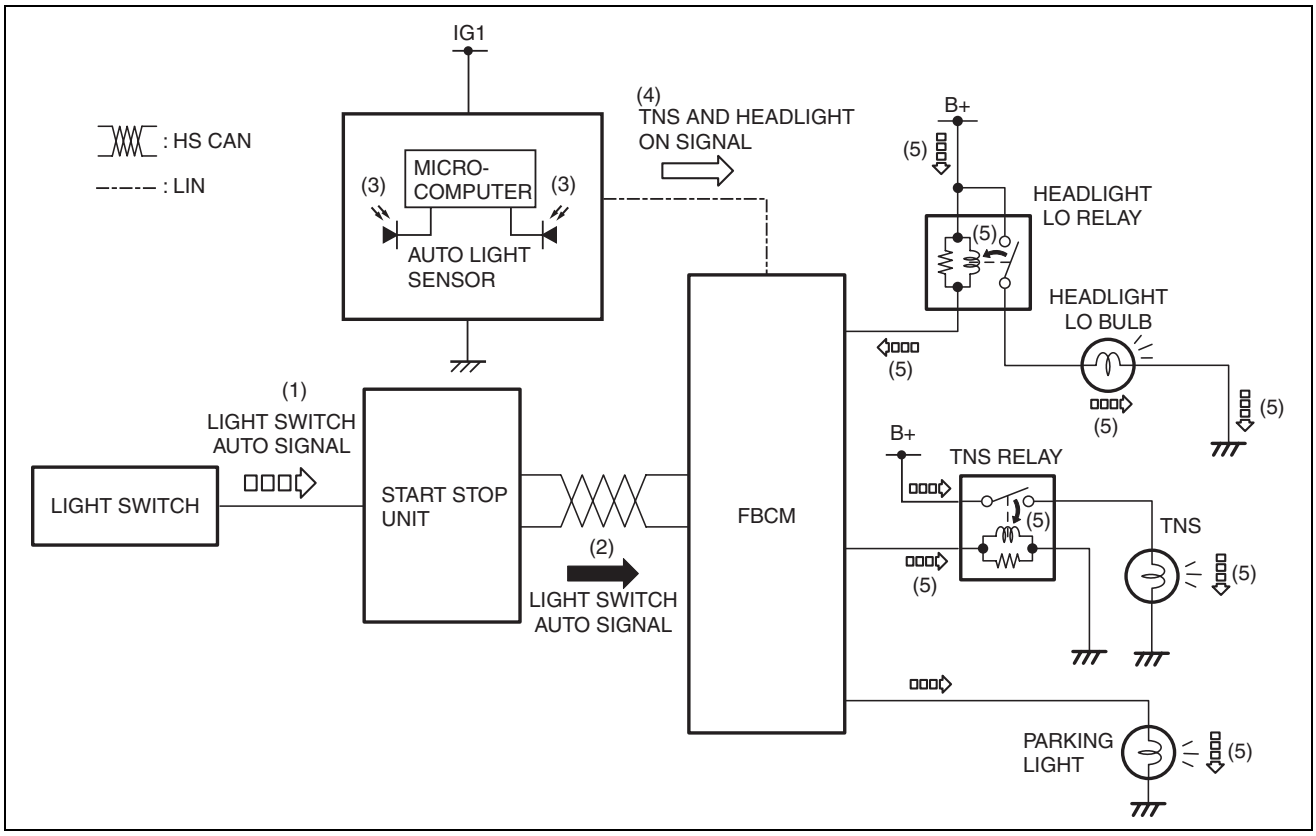
Illumination operation

Note

- The following illumination level is for reference because it varies depending on the surrounding conditions (weather, reflection off buildings).
- The illumination level sensitivity of the auto light sensor can be changed. The illumination level shown below is the standard set value. (See 09-18-5 LIGHTING SYSTEM PERSONALIZATION.)

1. When the light switch is operated to the AUTO position with the ignition switched ON (engine off or on), a light switch AUTO signal is input to the start stop unit.
2. The start stop unit sends the light switch AUTO signal to the front body control module (FBCM) as a CAN signal.
3. The auto-light sensor detects the illumination level above and in front of the vehicle.
4. When the auto light sensor detects an illumination level of approx. 2,000 lux or less, it sends a TNS and headlight on signal to the front body control module (FBCM) as a LIN signal.
5. When the front body control module (FBCM) receives a headlight on signal, it turns the TNS relay and headlight LO relay on and illuminates the TNS, Parking light, and headlights.

LIGHTING SYSTEMS



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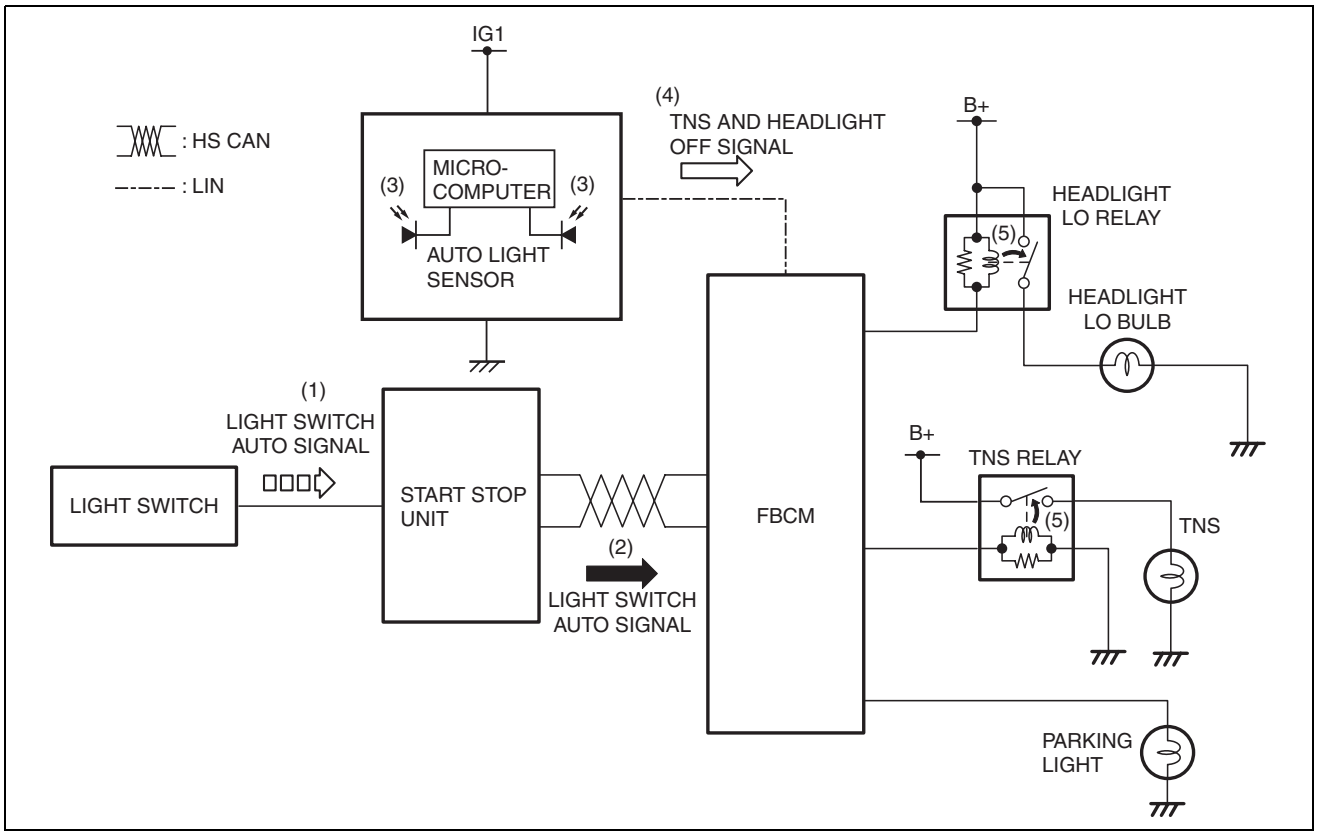
Lights off operation

Note

- The following illumination level is for reference because it varies depending on the surrounding conditions (weather, reflection off buildings).
- The illumination level sensitivity of the auto light sensor can be changed. The illumination level shown below is the standard set value. (See 09-18-5 LIGHTING SYSTEM PERSONALIZATION.)

1. When the light switch is operated to the AUTO position with the ignition switched ON (engine off or on), a light switch AUTO signal is input to the start stop unit.
2. The start stop unit sends the light switch AUTO signal to the front body control module (FBCM) as a CAN signal.
3. The auto-light sensor detects the illumination level above and in front of the vehicle.
4. When the auto light sensor detects an illumination level of approx. 4,000 lux or more for 1.5—2.5 s, it sends a headlight off signal to the front body control module (FBCM) as a LIN signal.
5. When the front body control module (FBCM) receives a headlight off signal, it turns the TNS and headlight LO relay off and turns the TNS, Parking light, and headlights off.

LIGHTING SYSTEMS



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AUTO LIGHT SENSOR

id091800010600

Purpose

- The auto light sensor detects the illumination level above and in front of the vehicle and outputs it to the front body control module (FBCM).

Function

- The auto-light sensor uses the upward illumination level sensor to detect the illumination level above the vehicle, and uses the forward illumination level sensor to detect the illumination level in front of the vehicle.

Illumination level adjustment function

- The illumination level can be switched through 5 levels by using the Mazda Modular Diagnostic System (M-MDS) or the audio unit (with color LCD). (See 09-18-5 LIGHTING SYSTEM PERSONALIZATION.)

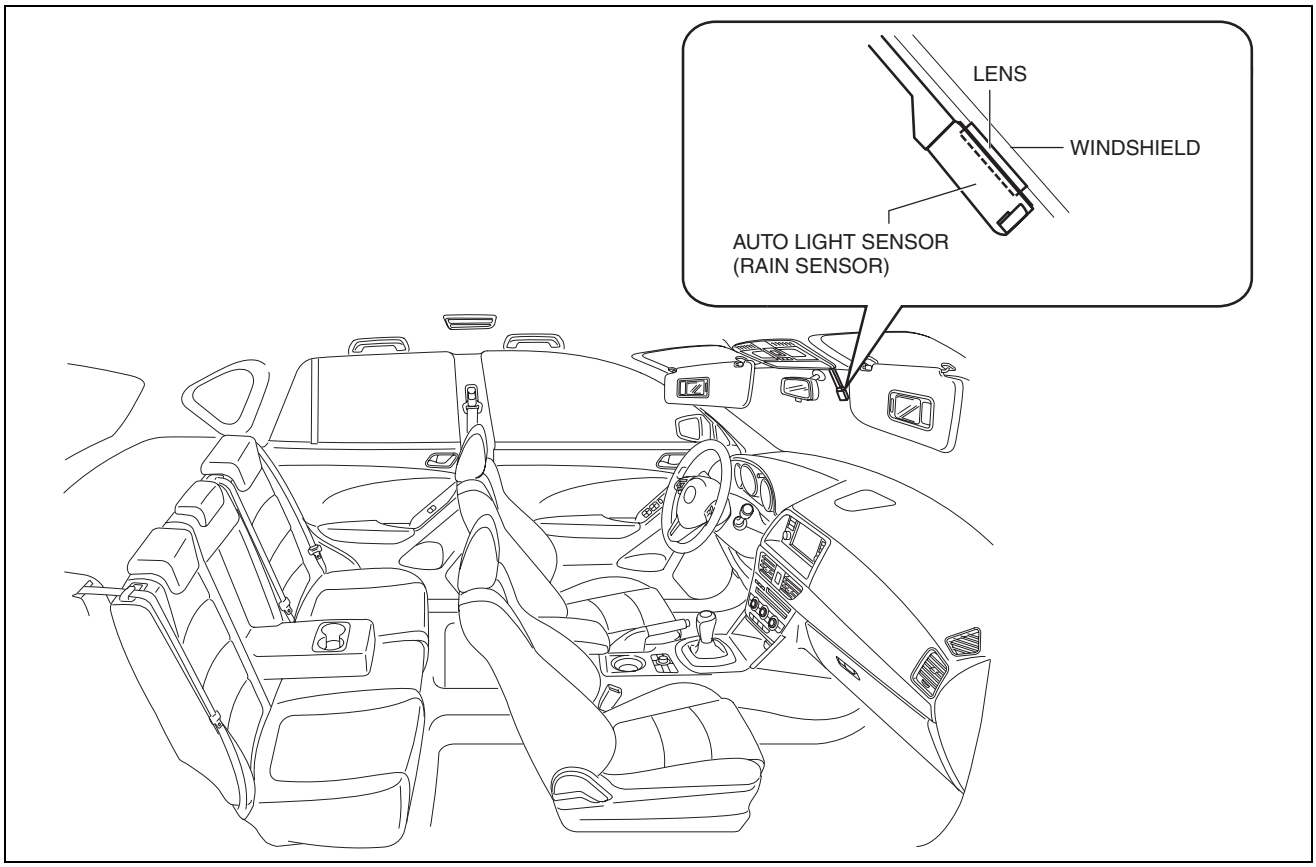
On-board diagnostic function

- If there is a malfunction in the auto light sensor, notifies the front body control module (FBCM) and detects a DTC from the front body control module (FBCM).
- For details on DTCs, refer to the diagnostic system (front body control module (FBCM)), DTC table (front body control module (FBCM)) in the Workshop Manual.

Construction

- The auto-light sensor is integrated with the rain sensor as a single unit.
- The forward and upward illumination level sensors are built into the auto-light sensor.

LIGHTING SYSTEMS



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Operation

Caution
- **Correct illumination level detection is not be possible under the following conditions and could cause the system to operate incorrectly.**
  - **— Stickers or labels are attached to the auto-light sensor area on the windshield.**
  - **— Dirt is adhering to the the auto-light sensor area on the windshield.**

1. The auto light sensor detects the illumination level above and in front of the vehicle when the ignition is switched ON and the light switch is operated to the AUTO position.
2. The auto light sensor outputs a headlight (LO) on signal to the front body control module (FBCM) according to the detected illumination level.

Fail-safe
- Function not equipped.

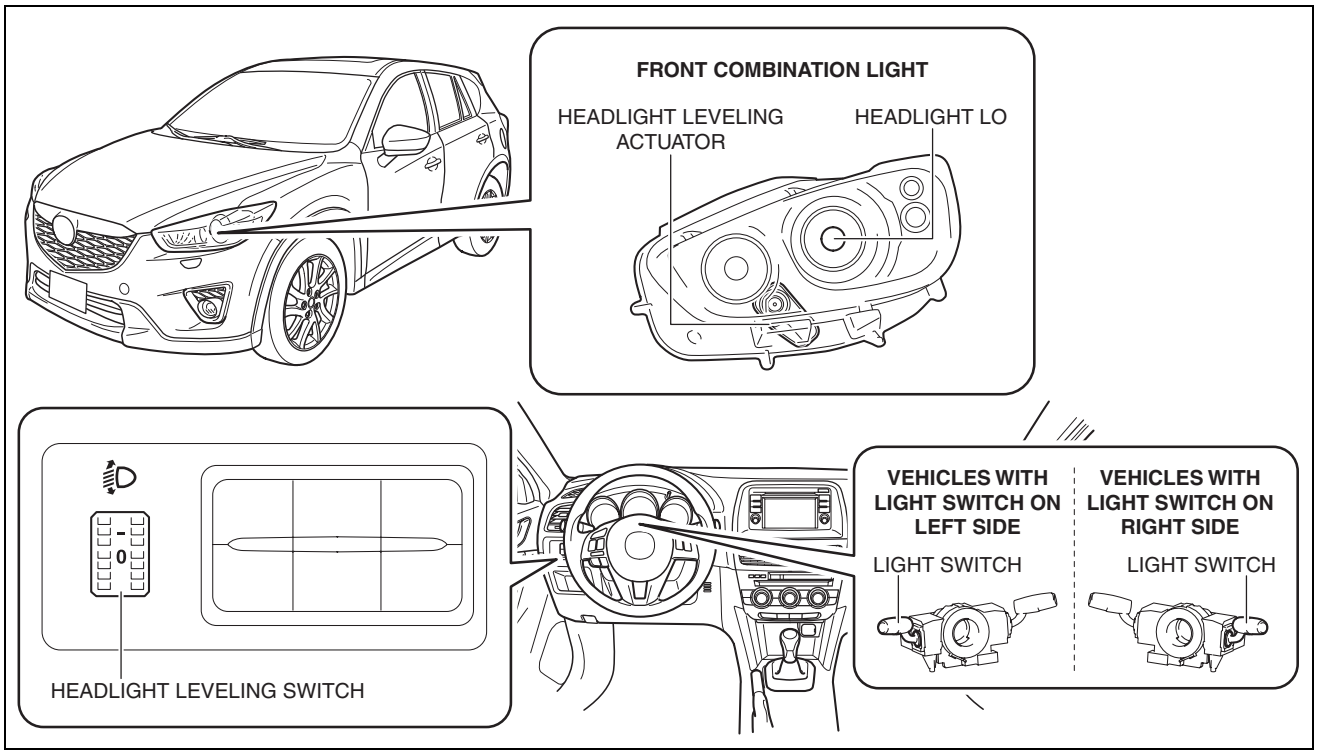
HEADLIGHT LEVELING SYSTEM

id091800010700

Outline
- The headlight manual leveling system changes the headlight (LO) optical axis according to the operation of the headlight leveling switch to prevent driver dazzle in oncoming vehicles from headlight glare and to assure a range of visibility.

LIGHTING SYSTEMS

Structural View



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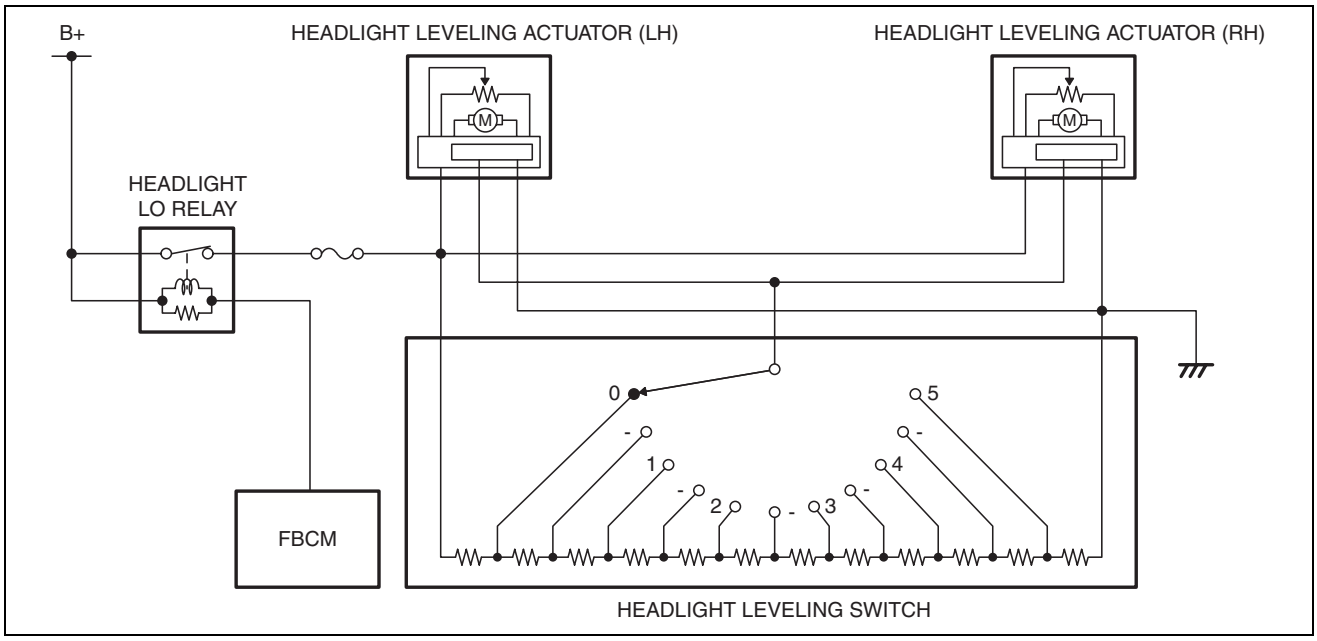
System Wiring Diagram



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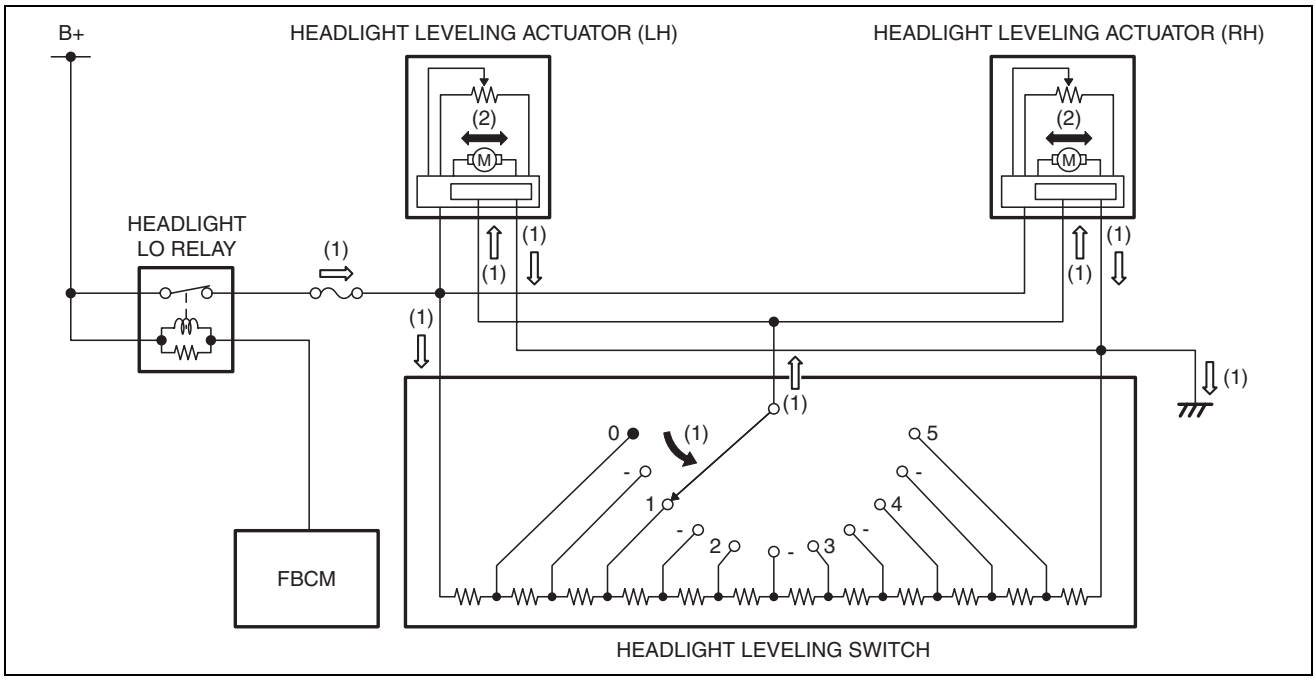
Operation

1. When the headlight leveling switch is operated with the headlights turned on, the resistance value changes according to the changed position, and electric current flows to the headlight leveling actuator.
2. When electric current flows to the headlight leveling actuator, the motor inside the actuator operates and the headlight (LO) optical axis changes.

LIGHTING SYSTEMS



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HEADLIGHT LEVELING SWITCH

id091800010800

Purpose

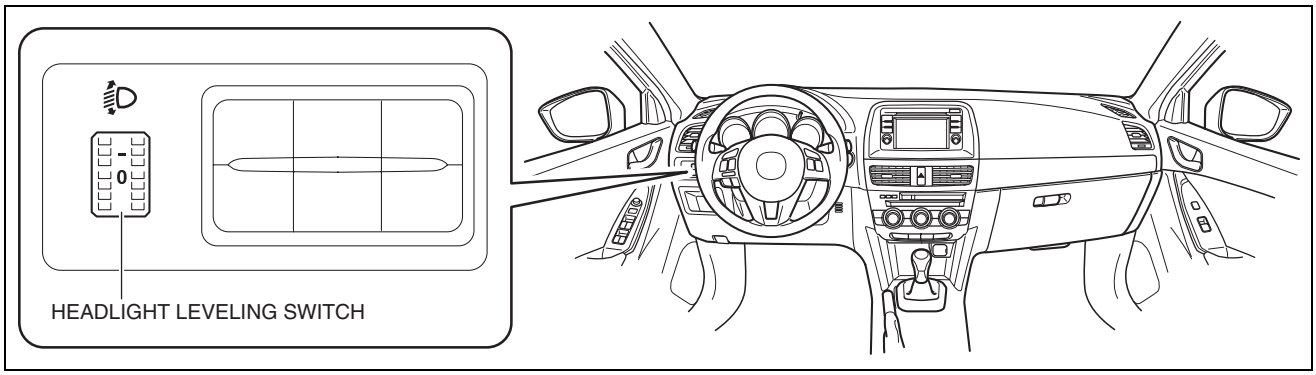
- Changes the resistance value according to the position which the headlight leveling switch has been changed.

Function

- The position of the headlight leveling switch can be switched between 11 levels: 0 to 5.
- When the headlight leveling switch is turned upward, the headlight (LO) optical axis moves upward. When the switch is turned downward, the axis moves downward.

Construction

- Built into the cluster switch.
- Installed to the switch panel.

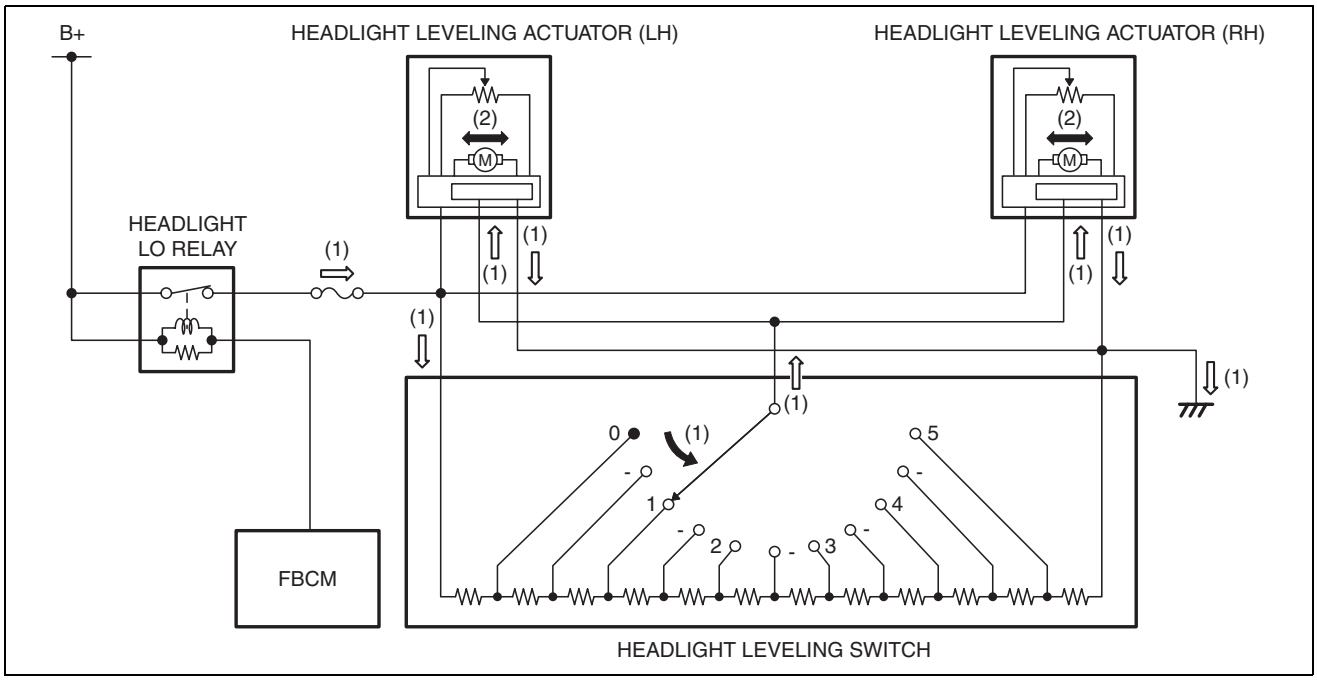


ac5wzn00001401

Operation

1. When the headlight leveling switch is operated with the headlights turned on, the resistance value changes according to the changed position, and electric current flows to the headlight leveling actuator.
2. The headlight leveling actuator operates and the headlight (LO) optical axis changes.

LIGHTING SYSTEMS



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Fail-safe
- Function not equipped.

HEADLIGHT AUTO LEVELING SYSTEM

id091800010900

Outline
- Automatically adjusts the headlight optical axis in response to changes in load and passenger conditions to prevent blinding of oncoming vehicles from headlight glare and to assure a range of visibility.
- The AFS control module performs headlight auto leveling system fail-safe. (See 09-18-44 AFS (ADAPTIVE FRONT LIGHTING SYSTEM) CONTROL MODULE.)

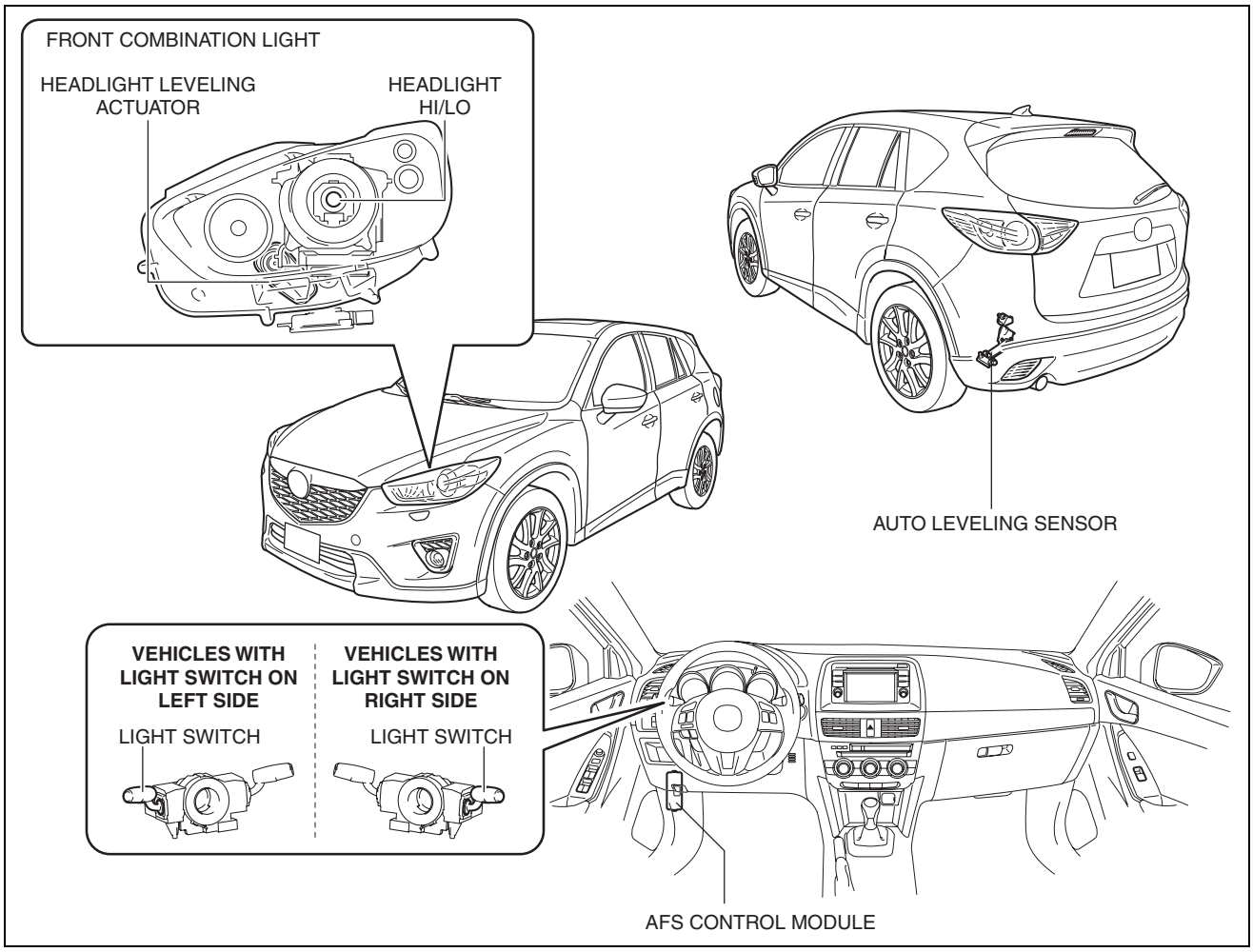
Function
- The headlight auto leveling system is controlled by the AFS control module.
- The AFS control module also controls the AFS which changes the optical axis to the direction in which the vehicle is travelling according to the steering wheel operation and vehicle speed while the headlights are turned on. (See 09-18-40 AFS (ADAPTIVE FRONT LIGHTING SYSTEM).)

Optical axis adjustment function
- If the ignition is switched ON (engine on or off) and there is a vehicle height change when the headlights (LO) are illuminated, the AFS control module automatically adjusts the headlight optical axis.
- The AFS control module controls the optical axis adjustment function based on the following CAN signals.

CAN signal sending module	Signal name
PCM	Vehicle speed signal
Instrument cluster	Ignition switch status signal
Front body control module (FBCM)	Headlight illumination status signal

LIGHTING SYSTEMS

Structural view



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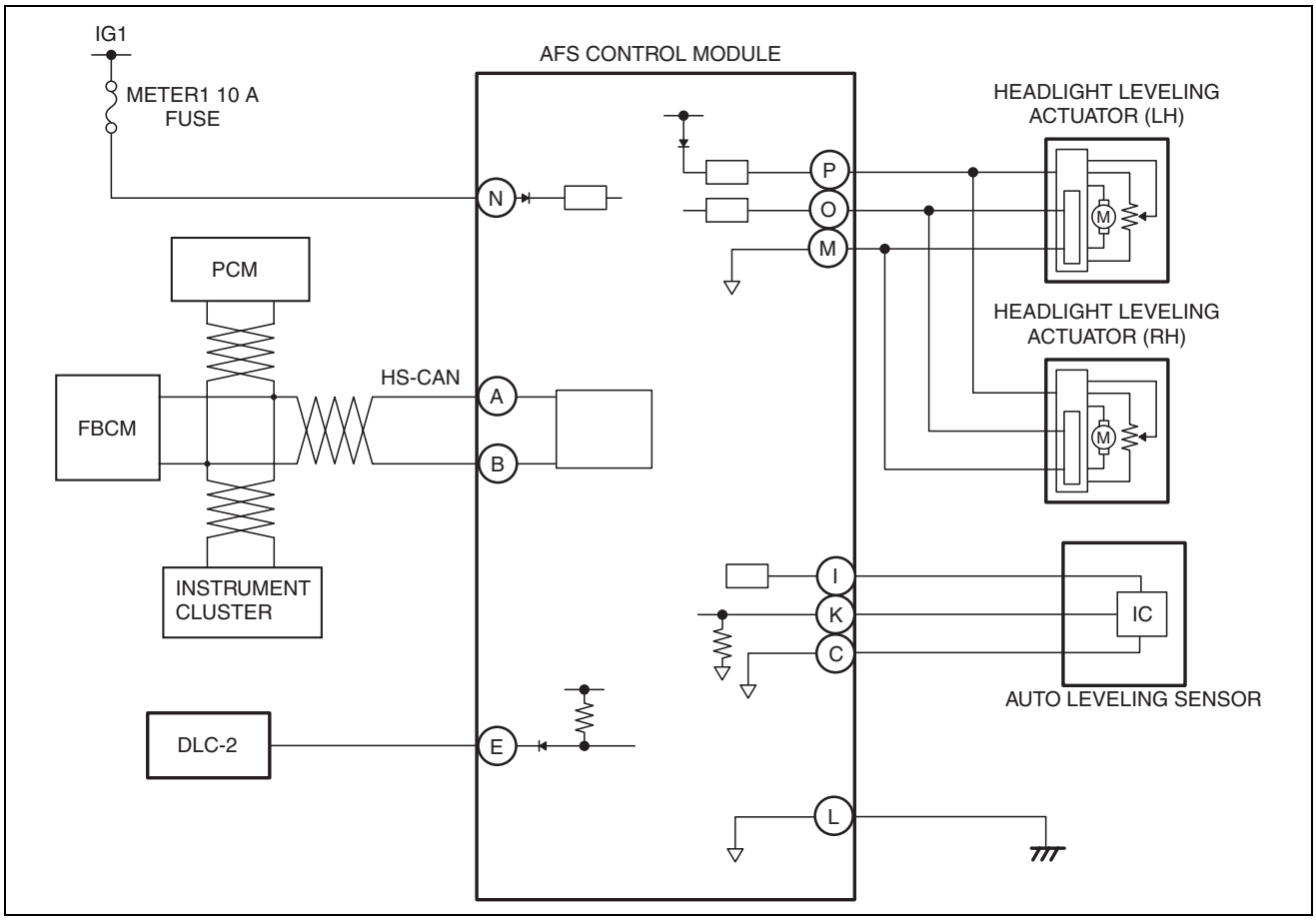
LIGHTING SYSTEMS

System wiring diagram



ac5wzn00001557

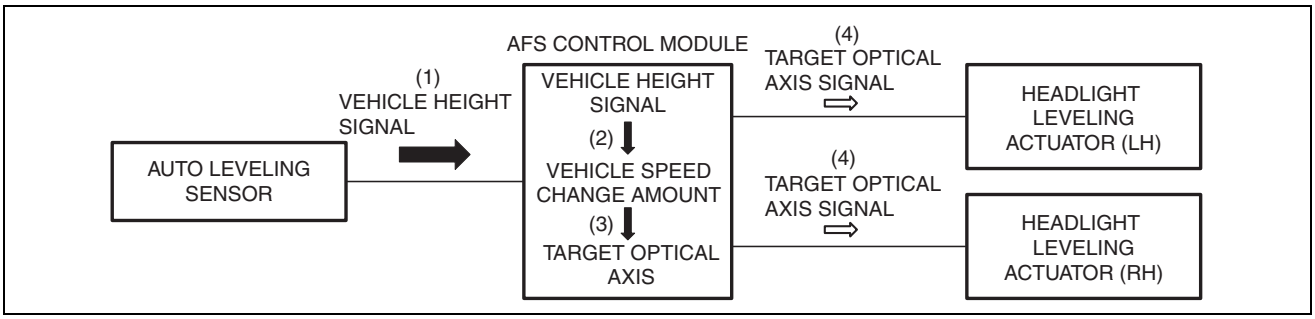
Operation
Optical axis adjustment if vehicle height changes while vehicle is stopped
Operation condition

- Operates when all of the following conditions are met:
  - — Vehicle speed is 0 km/h {0 mph}
  - — Ignition switch ON (engine off or on)
  - — Headlight LO illumination (headlight LO illumination signal reception)
  - — Detects change in vehicle height amount * at specified value or more

Operation

1. When the ignition is switched ON (engine off or on), the auto leveling sensor inputs a vehicle height signal to the AFS control module.
2. When the headlights (LO) turn on, the AFS control module calculates the amount of change in the vehicle height * based on the vehicle height signal.
3. When the amount of change in the vehicle height * is the specified value or more, the AFS control module calculates the target optical axis based on the calculated amount of change in the vehicle height *.
4. The AFS control module outputs the calculated target optical axis signal to the headlight leveling actuator.
5. The headlight leveling actuator drives the motor when the target optical axis signal is input.

LIGHTING SYSTEMS



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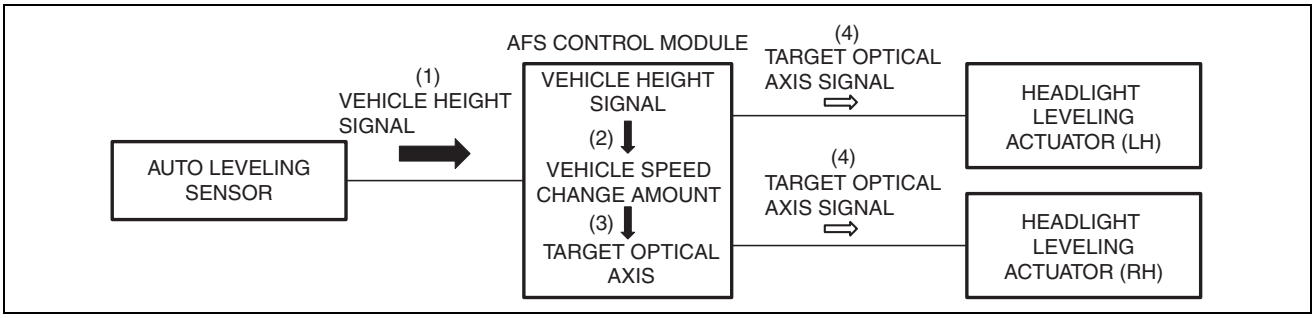
Optical axis adjustment if vehicle height changes while vehicle is moving
Operation condition

- Operates when all of the following conditions are met:
  - — Headlight LO illumination (headlight LO illumination signal reception)
  - — Vehicle speed 30 km/h {19 mph} or more
  - — Detects change in vehicle speed of 3 km/h {2 mph} or less for continuous period of 25 s
  - — Detects change in vehicle height amount * at specified value or more

Operation

1. While the vehicle is travelling, the auto leveling sensor inputs the vehicle height signal to the AFS control module.
2. When the headlights (LO) turn on, the AFS control module calculates the amount of change in the vehicle height * based on the vehicle height signal.
3. When the vehicle speed is 30 km/h {19 mph} or more, the detected change in vehicle speed is 3 km/h {2 mph} or less for a continuous 25 s, and the change in the amount of vehicle height * is the specified value or more, the AFS control module calculates the target optical axis based on the calculated change in the amount of vehicle height *.
4. The AFS control module outputs the calculated target optical axis signal to the headlight leveling actuator.
5. The headlight leveling actuator drives the motor when the target optical axis signal is input.



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* : The change in the amount of vehicle height is the calculated 1 s average value of the vehicle height signal which the AFS control module detects every 0.1 s.

AUTO LEVELING SENSOR

id091800011100

Purpose

- Detects the vehicle height and outputs it to the AFS control module.

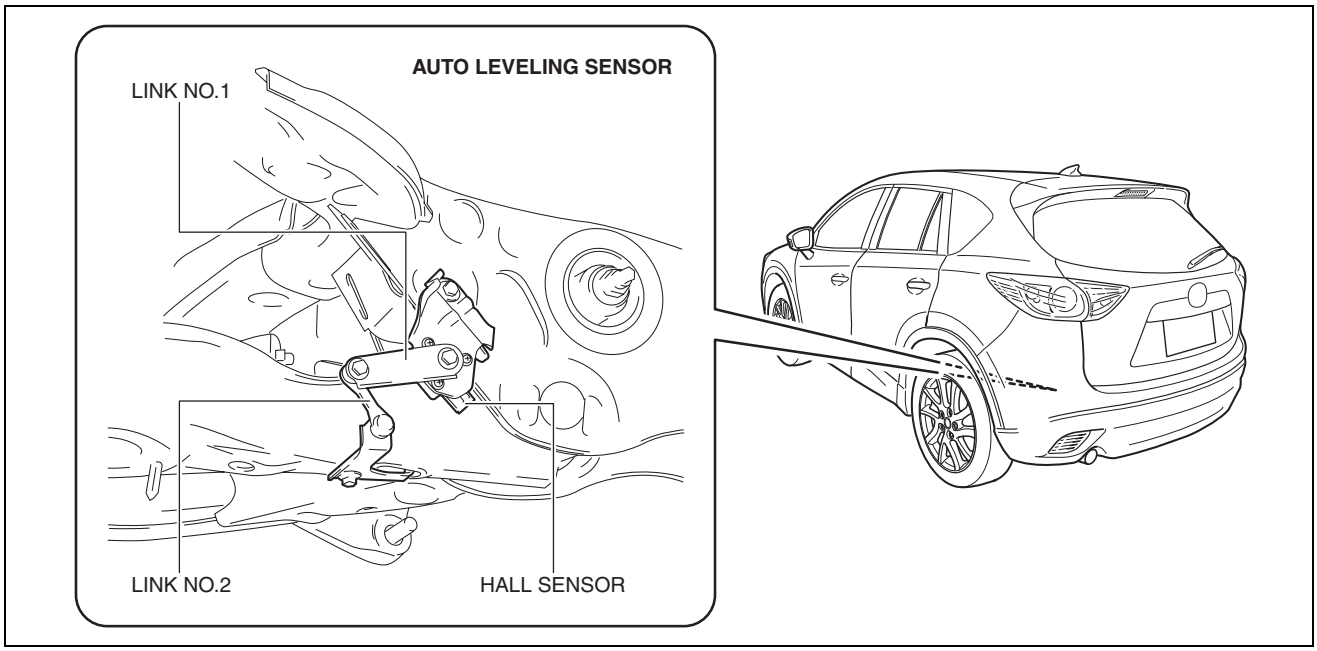
Function

- Changes the detected vehicle height into a voltage value and outputs it to the AFS control module.

Construction

- Installed to the rear cross member.
- Consists of link No. 1, link No.2 and the Hall sensor.

LIGHTING SYSTEMS



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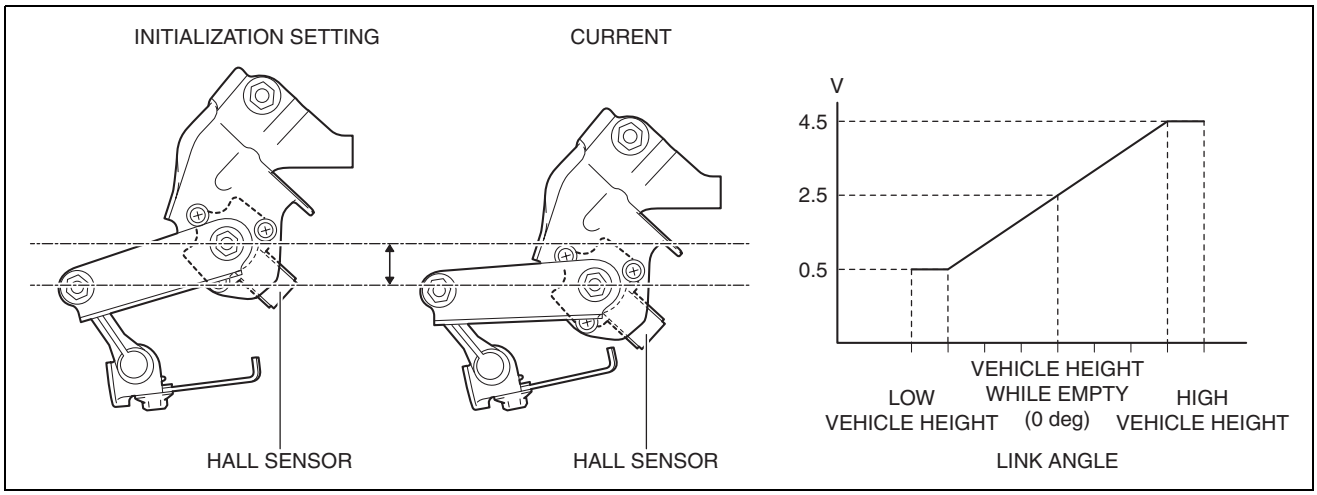
Operation

1. If the rear cross member slumps under a load and passengers, the auto leveling sensor link changes.
2. The auto leveling sensor internal resistance fluctuates in conjunction with the movement of the link.
3. The auto leveling sensor detects the vehicle height based on the voltage value input from the change in internal resistance.
4. The auto leveling sensor compares the detected vehicle height (Hall sensor height under empty vehicle conditions) with the vehicle height at the initial setting.
5. The auto leveling sensor inputs the compared results to the AFS control module as a vehicle height signal.



ac5uun00000689

Fail-safe

- Function not equipped.

HEADLIGHT LEVELING ACTUATOR

id091800011200

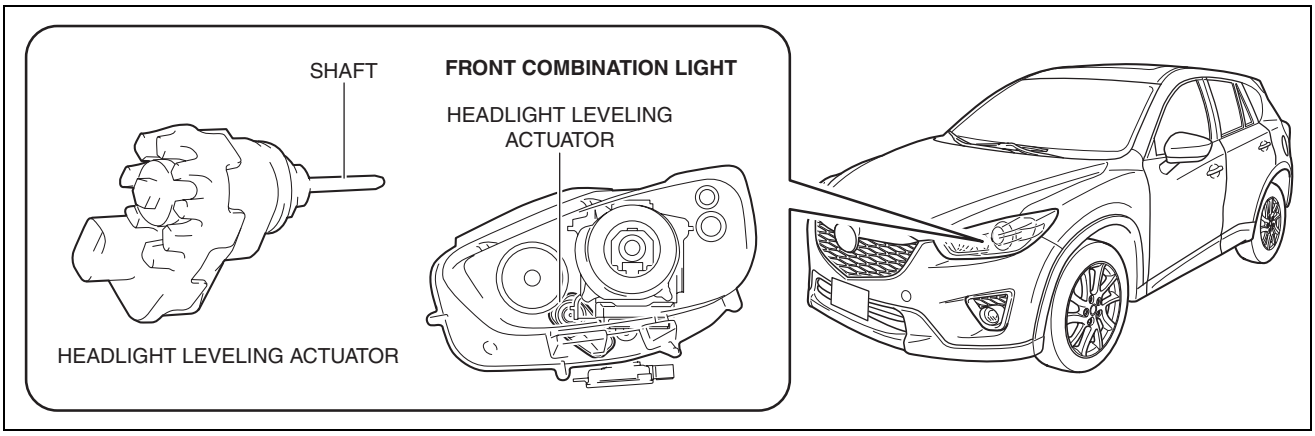
Purpose, Function

- The headlight leveling actuator drives the motor based on the target optical axis voltage, which is input from the AFS control module, to change the optical axis of the headlights.

Construction

- Built into the front combination lights.
- Consists of a motor which expands/retracts the shaft, a shaft, and a microcomputer which calculates the shaft expansion/contraction amount.

LIGHTING SYSTEMS



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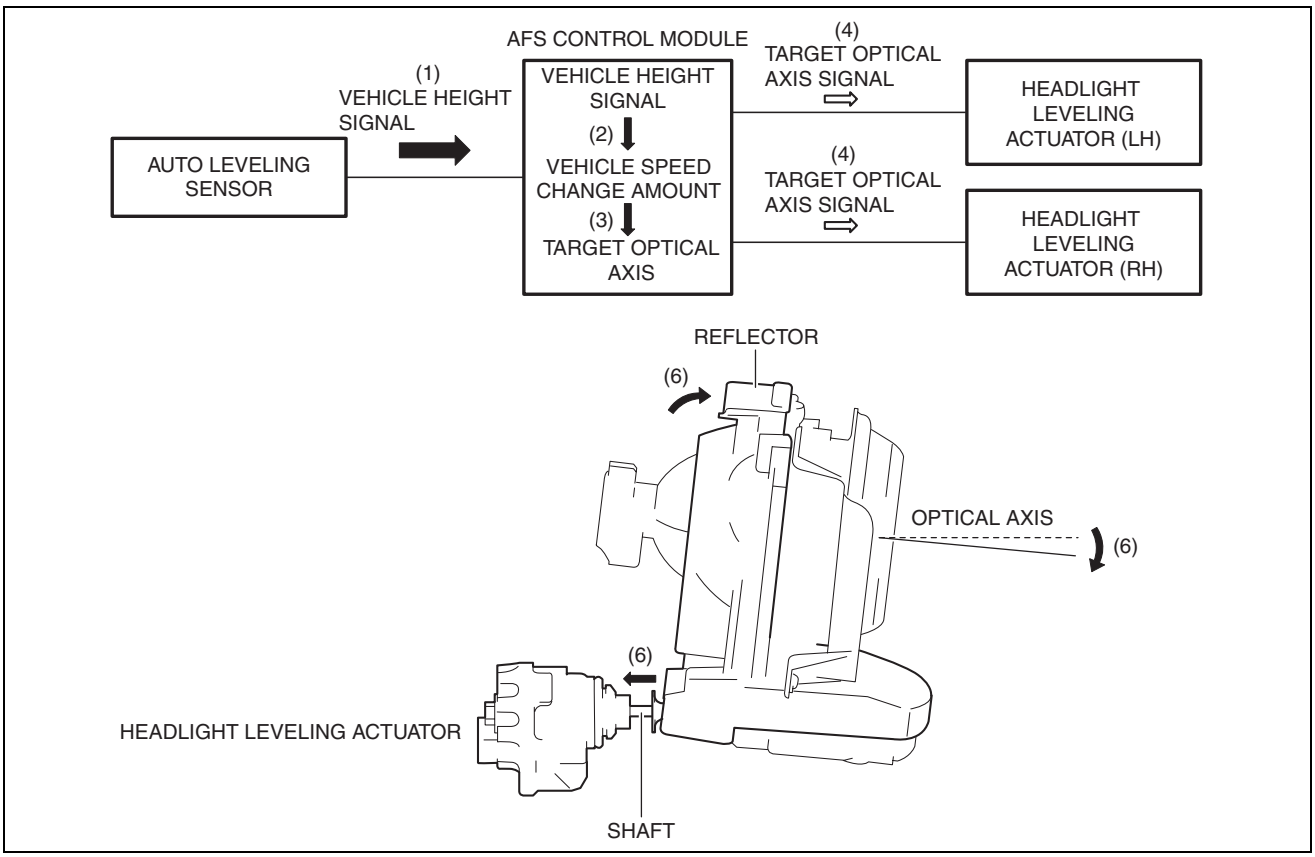
Operation

1. When the ignition is switched on (engine on or off), the auto leveling sensor inputs a vehicle height signal to the AFS control module.
2. When the headlights (LO) turn on, the AFS control module calculates the amount of change in vehicle height * based on the vehicle height signal.
3. If the operation conditions are met, the AFS control module calculates a target optical axis based on the calculated change in vehicle height *. For details on the operation conditions, refer to the headlight auto leveling system. (See 09-18-34 HEADLIGHT AUTO LEVELING SYSTEM.)
4. The AFS control module outputs the calculated target optical axis signal to the headlight leveling actuator.
5. The headlight leveling actuator drives the motor based on the input target optical axis.
6. When the motor is driven, the shaft expands/contracts and the reflector shifts to move the optical axis.



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* : The amount of change in vehicle height is the calculated 1 s average value of the detected vehicle body angle which the AFS control module detects every 0.1 s.

Fail-safe

- Function not equipped.

LIGHTING SYSTEMS

AFS (ADAPTIVE FRONT LIGHTING SYSTEM)

id091800012800

Outline

- The AFS is a system which enhances the range of visibility when the headlights are turned on by pointing the optical axis of the headlights in the direction in which the vehicle is advancing according to the steering operation.

Function

- The AFS is controlled by the AFS control module.
- The AFS control module controls the auto leveling function to adjust the headlight optical axis up or down in response to changes in load and passenger conditions. (See 09-18-34 HEADLIGHT AUTO LEVELING SYSTEM.)

Swivel function

- The AFS control module changes the optical axis to the direction in which the vehicle is travelling according to the steering wheel operation and vehicle speed while the headlights are turned on.
- The AFS control module controls the swivel function based on the following CAN signals.

CAN signal sending module	Signal name
EPS control module	Steering angle signal
PCM	Vehicle speed signal
Instrument cluster	Ignition switch status signal
	Back-up light illumination request signal
	AFS OFF switch status signal
Front body control module (FBCM)	Headlight illumination status signal

Initial position learning function

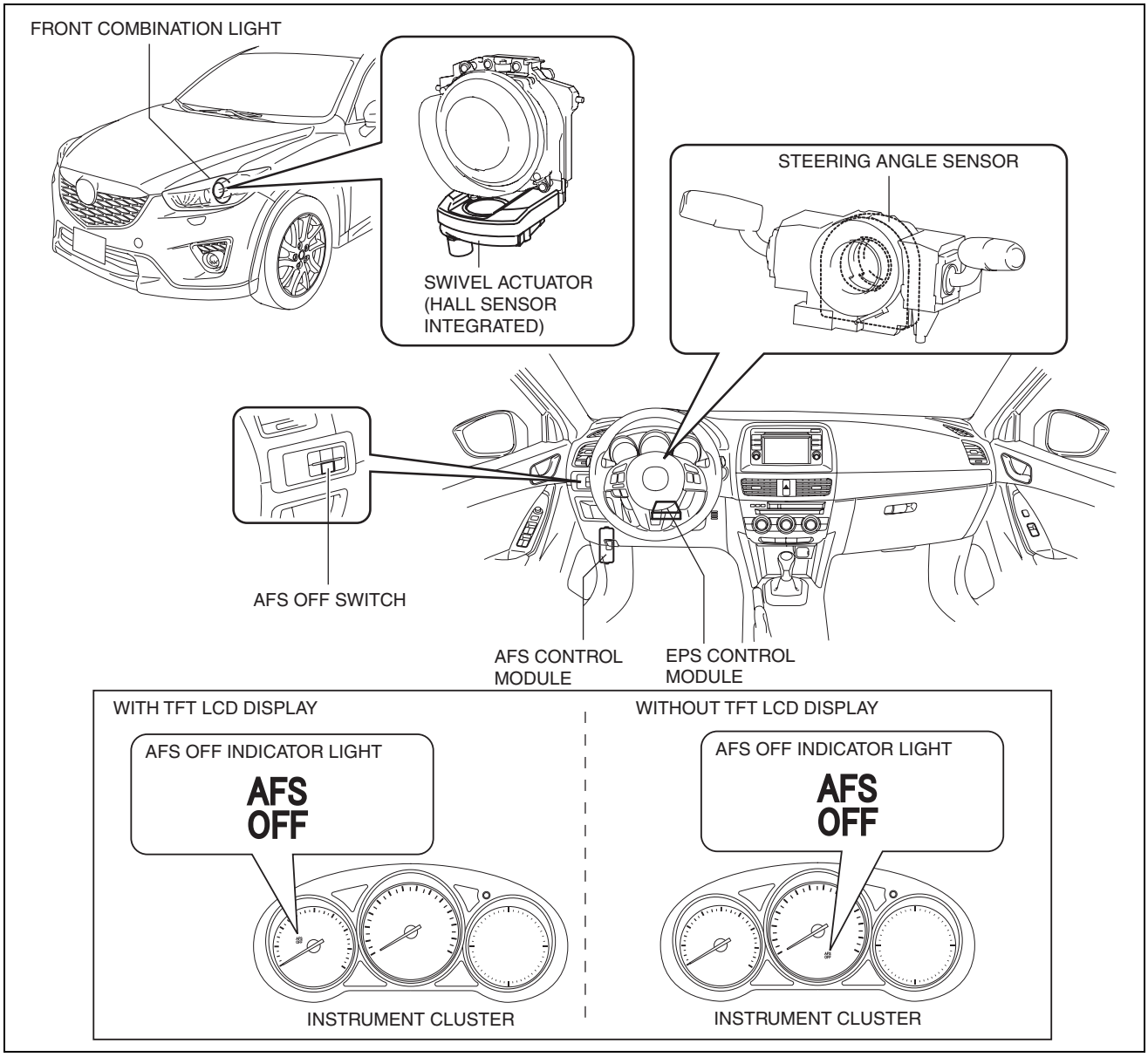
- When the ignition is switched ON (engine on) at a vehicle speed of 0 km/h {0 mph}, the AFS control module calculates the initial position of the swivel actuator for left/right operation, and the headlight optical axis stops at the front position.
- The AFS control module controls the initial position learning function based on the following CAN signals.

CAN signal sending module	Signal name
PCM	Vehicle speed signal
Instrument cluster	Ignition switch status signal

LIGHTING SYSTEMS

Structural view

- The AFS consists of the following parts:



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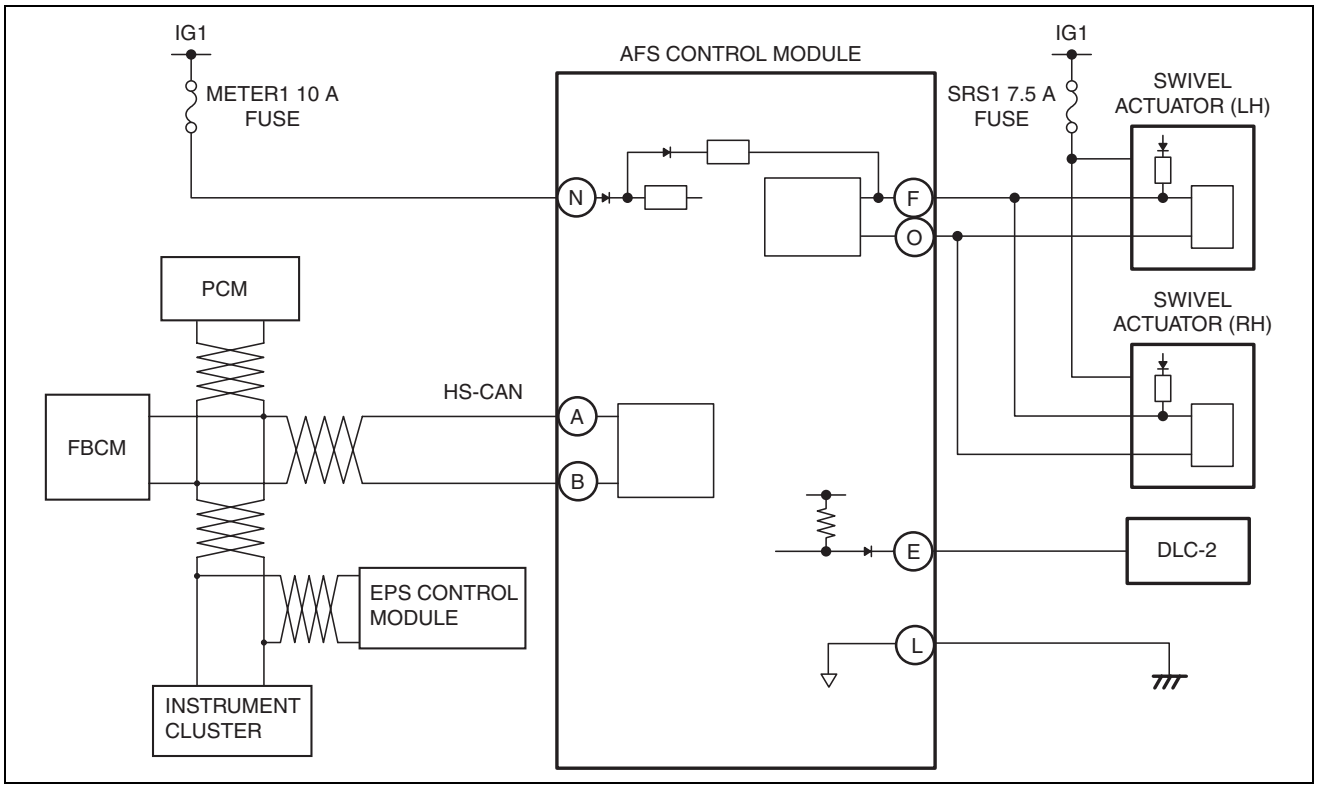
LIGHTING SYSTEMS

System wiring diagram

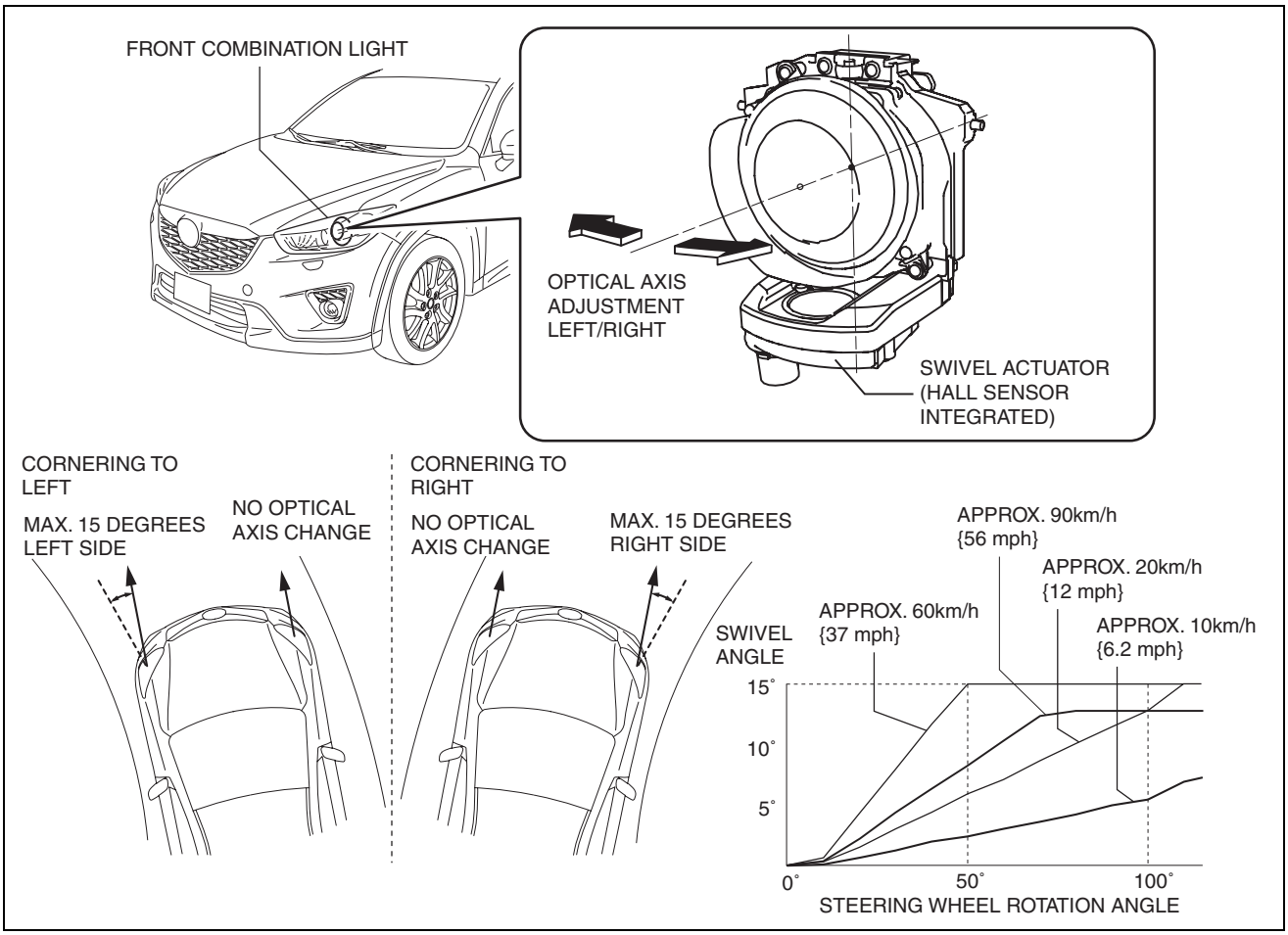


ac5uun00001103

Construction

- The swivel actuator for adjusting the optical axis is built into the front combination light, and it is an integrated construction with the headlights.
- The swivel actuator has an internal Hall sensor and inputs the current position of the headlight to the AFS control module.
- The variation (swivel angle) of the optical axis of the headlights is 15 degrees for the right and left.
- Changes in the headlight optical axis (swivel angle) are controlled freely (non-step) based on the vehicle speed and the steering angle, and the swivel angle differs for each of the conditions.
- The steering wheel angle amount changes according to the vehicle speed until reaching the maximum value of the swivel angle (15 degrees).

LIGHTING SYSTEMS



ac5wzn00000904

Operation

Swivel function

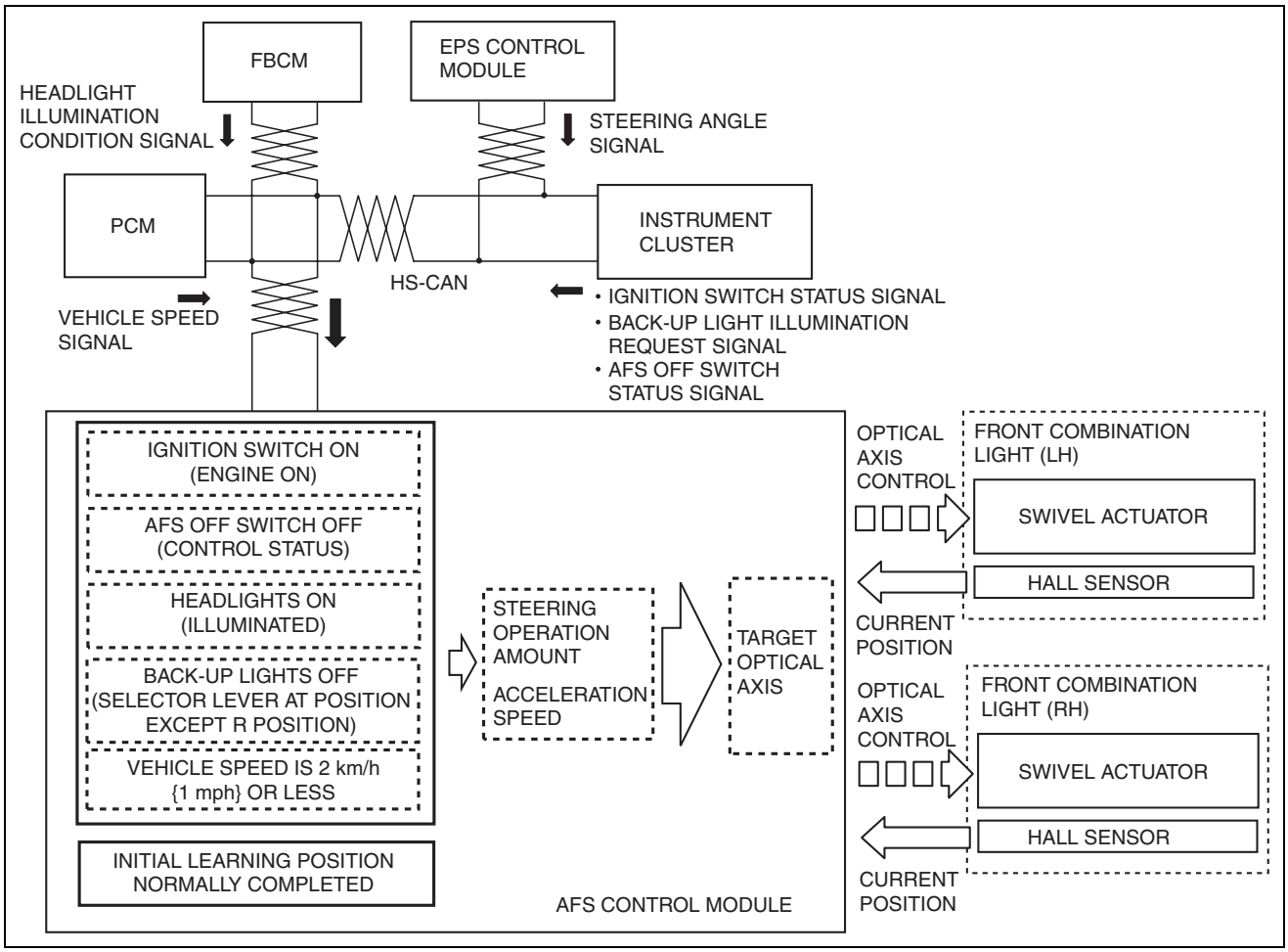
- When the ignition is switched ON (engine off or on), the AFS control module constantly calculates the swivel actuator control amount based on the steering angle signal and vehicle speed signal.
- If the following operation conditions are met, the AFS control module controls the swivel actuator based on the calculated amount of control, and adjusts the headlight optical axis.

Operation condition

Item	Condition
Initial position learning	After normal completion
Headlight	ON (illumination)
AFS OFF switch	OFF (control status)
Gear position signal	Except reverse position
Vehicle speed	Control start: 2 km/h {1 mph} or more

- The swivel actuator drives the motor based on the signal from the AFS control module.
- Changes in the swivel angle of the headlights are detected by the Hall sensor and input to the AFS control module.

LIGHTING SYSTEMS



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AFS (ADAPTIVE FRONT LIGHTING SYSTEM) CONTROL MODULE

id091800012900

Purpose

- The AFS control module calculates the target optical axis based on the vehicle height signal and outputs the target optical axis signal to the headlight leveling actuator.

Function

- The AFS control module performs control of the AFS and headlight auto leveling.

Automatic configuration function

- When the ignition is switched ON (engine off or on) after the AFS control module is replaced, the AFS control module reads the vehicle specification information sent via CAN communication from the instrument cluster, and stores the vehicle specification information.

On-board diagnostic function

- The AFS control module is equipped with an on-board diagnosis function which records DTCs in the event of a malfunction.

Malfunction detection function

- Detects malfunctions of the AFS and the headlight auto leveling related parts.

Display Function

- If any malfunction is detected, the AFS OFF indicator light in the instrument cluster flashes to notify the driver of a system malfunction.

Operation

- For the AFS control module operation, refer to 09-18-34 HEADLIGHT AUTO LEVELING SYSTEM and 09-18-40 AFS (ADAPTIVE FRONT LIGHTING SYSTEM).

LIGHTING SYSTEMS

Fail-safe

DTC No.	Fail-safe function
B1041:14	• The swivel actuator is moved to the center. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
B1041:54	• The swivel actuator is moved to the center. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
B1044:01	• The swivel actuator is moved to the center. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
B10A3:86	• The swivel actuator (LH) is stopped at the position when the malfunction is determined. • The swivel actuator (RH) is moved to the center. • Control of the headlight auto leveling system is continued with the headlight leveling actuator positioned -0.6° from where the malfunction is determined.
B10A3:87	• The swivel actuator (LH) is stopped at the position when the malfunction is determined. • The swivel actuator (LH) is moved to the center, or the swivel actuators (LH) and (RH) are moved to the center. • Control of the headlight auto leveling system is continued with the headlight leveling actuator positioned -0.6° from where the malfunction is determined.
B10A4:86	• The swivel actuator (RH) is stopped at the position when the malfunction is determined. • The swivel actuator (LH) is moved to the center. • Control of the headlight auto leveling system is continued with the headlight leveling actuator positioned -0.6° from where the malfunction is determined.
B10A4:87	• The swivel actuator (RH) is stopped at the position when the malfunction is determined. • The swivel actuator (RH) is moved to the center, or the swivel actuators (LH) and (RH) are moved to the center. • Control of the headlight auto leveling system is continued with the headlight leveling actuator positioned -0.6° from where the malfunction is determined.
C0051:86	• The swivel actuator is moved to the center. • Control of the headlight auto leveling system is continued.
U0001:88	• The swivel actuator is moved to the center. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
U0100:00	• The swivel actuator is moved to the center. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
U0131:00	• The swivel actuator is moved to the center. • Control of the headlight auto leveling system is continued.
U0140:00	• The swivel actuator is moved to the center. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
U0155:00	• The swivel actuator is moved to the center. • Control of the headlight auto leveling system is continued.
U0320:09	• The swivel actuator is moved to the center. • Control of the headlight auto leveling system is continued.
U0420:68	• The swivel actuator is moved to the center. • Control of the headlight auto leveling system is continued.
U0423:68	• AFS OFF switch error signal — Control of the swivel actuator is continued with the AFS OFF switch fixed in the condition when the malfunction is detected. — Control of the headlight auto leveling system is continued. • Ignition switch error signal — Control of the AFS is continued with the ignition switched ON (engine on). — Control of the headlight auto leveling system is continued. • Selector lever position (R position) (ATX)/Reverse (MTX) signal error — The swivel actuator is moved to the center. — Control of the headlight auto leveling system is continued. • Selector lever position (R position) (ATX)/Reverse (MTX) signal not determined — Control of the swivel actuator is continued with the transaxle range sensor (ATX)/back-up light switch (MTX) fixed in the condition when the malfunction is determined. — Control of the headlight auto leveling system is continued.
U2005:86	• The swivel actuator is moved to the center. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
U2300:54	• Control of the AFS is continued. • Control of the headlight auto leveling system is continued.
U2300:55	• The swivel actuator is moved to the center. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
U2300:56	• Control of the AFS is continued. • Control of the headlight auto leveling system is continued.

LIGHTING SYSTEMS

DTC No.	Fail-safe function
U3000:42	• The swivel actuator is moved to the center. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
U3000:49	• RAM/ROM malfunction — The swivel actuator is moved to the center. — The headlight leveling actuator is stopped at the position when the malfunction is determined. • AFS function malfunction — Not applicable • CAN hardware malfunction — The swivel actuator is moved to the center. — The headlight leveling actuator is stopped at the position when the malfunction is determined.
U3003:16	• The swivel actuator is stopped at the position when the malfunction is determined. • The headlight leveling actuator is stopped at the position when the malfunction is determined.
U3003:17	• The swivel actuator is stopped at the position when the malfunction is determined. • The headlight leveling actuator is stopped at the position when the malfunction is determined.

AFS OFF INDICATOR LIGHT

id091800014000

Purpose
- The AFS OFF indicator light notifies the user that the AFS is stopped or a malfunction occurs in the AFS.

Function
- The AFS OFF indicator light illuminates when the AFS is stopped and flashes when a malfunction occurs in the AFS.

Construction
- When the microcomputer in the instrument cluster receives a AFS OFF indicator light illumination request, it controls the illumination and flashing of the AFS OFF indicator light based on the received illumination request.

Operation

Note
- When the ignition is switched ON, the AFS control module illuminates the AFS OFF indicator light for 3 s to check the light bulb and notifies that the AFS OFF indicator light bulb is normal.

1. The AFS control module sends a AFS OFF indicator light illumination/flash request signal to the instrument cluster when a malfunction occurs in the AFS or the AFS is stopped.
2. The instrument cluster illuminates/flashes the AFS OFF indicator light based on the AFS OFF indicator light illumination/flash request signal.

Fail-safe
- Function not equipped.

STEERING ANGLE SENSOR

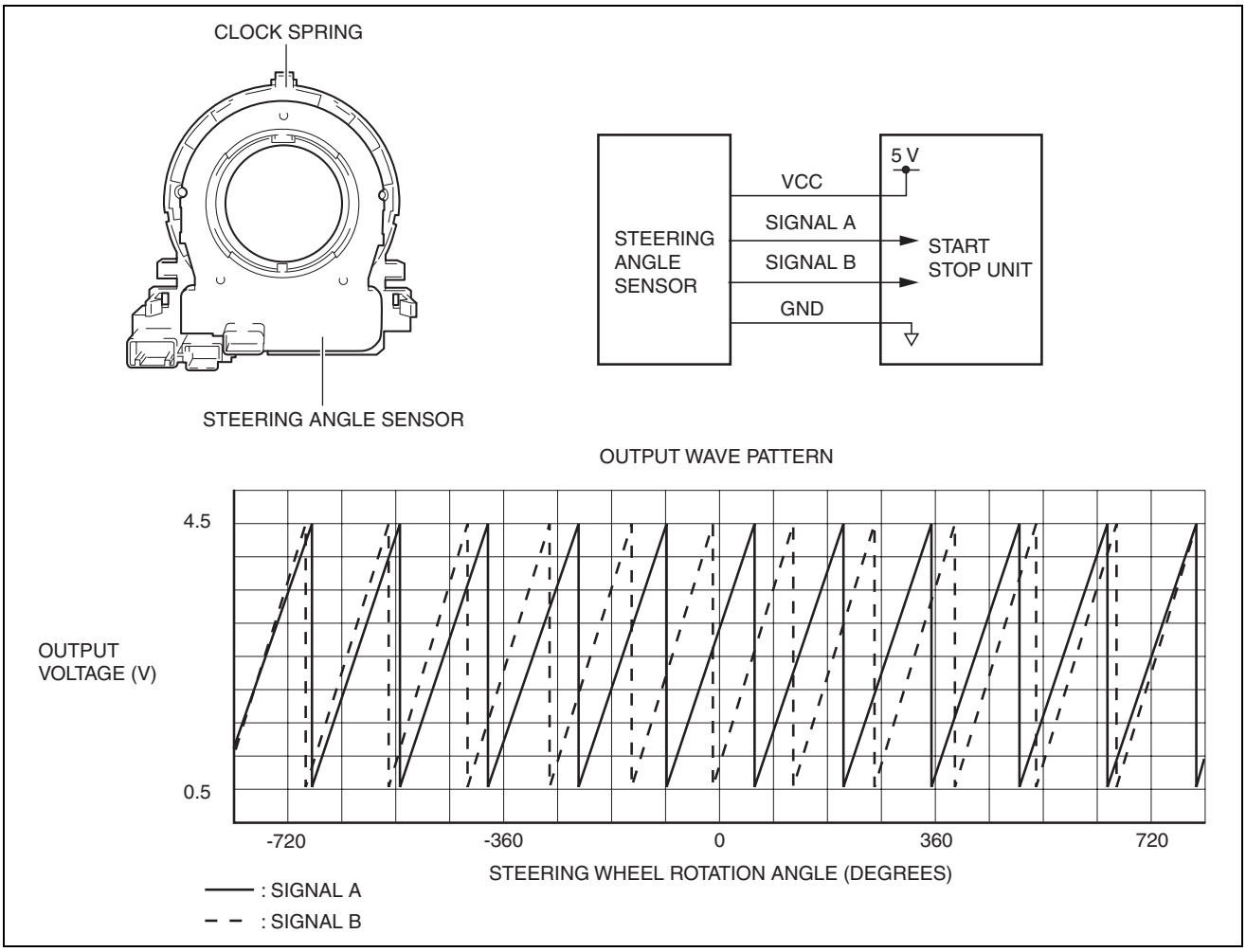
id091800112000

Purpose, Function
- The steering angle sensor outputs the steering angle and steering angle reference point during the period which the EPS control module performs initial learning (approx. 1 min period).

Construction
- The steering angle sensor is installed to the clock spring.

LIGHTING SYSTEMS

- Consists of the gear which rotates together with the steering (magnet) and the magnetic sensor.



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Operation

1. By the rotation of the gear (magnet) corresponding to the steering operation, the magnetic sensor output value changes.
2. The steering angle sensor outputs the magnetic sensor output to the start stop unit.

Fail-safe

- Function not equipped.

RUNNING LIGHT SYSTEM

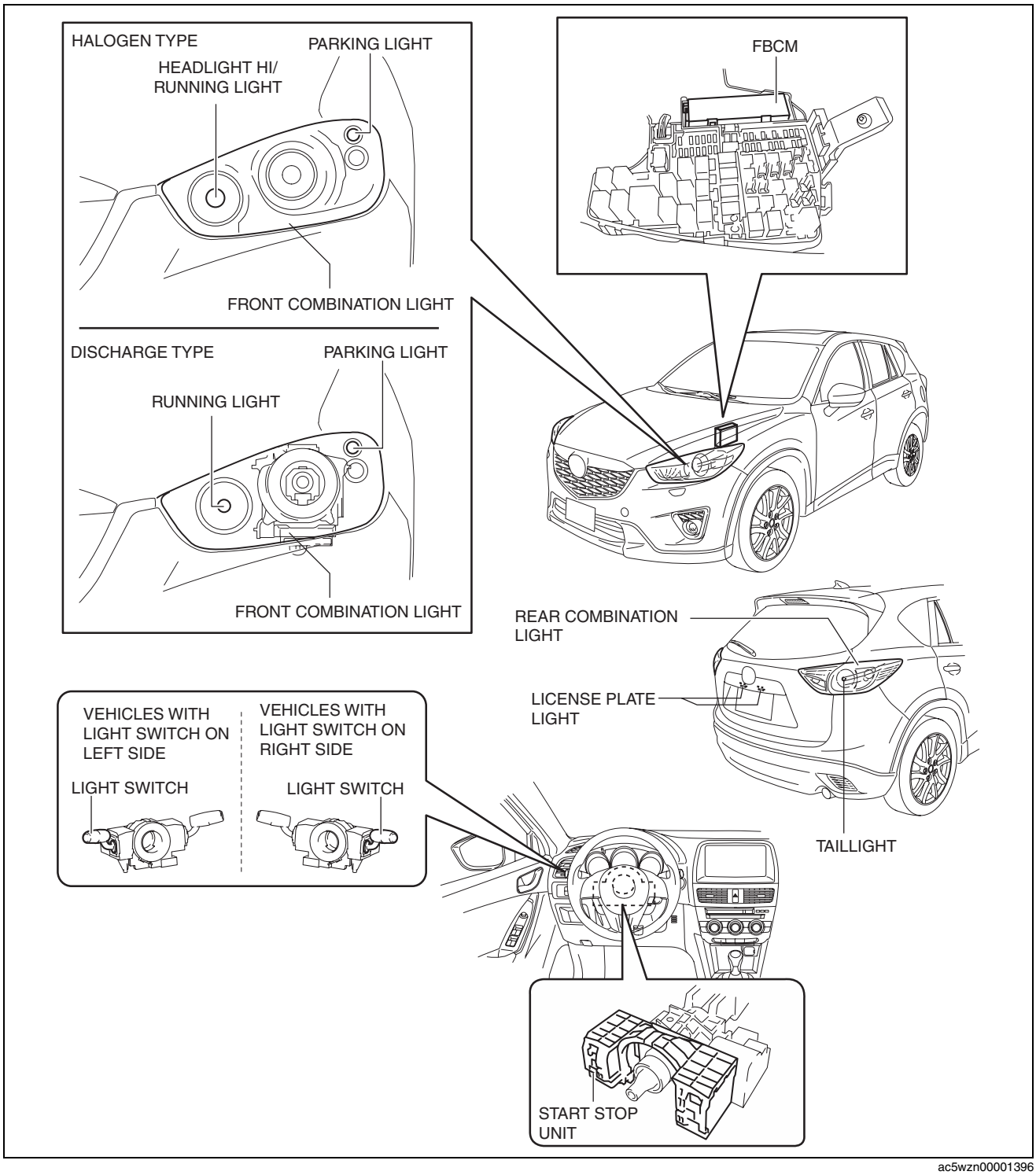
id091800011700

Outline

- When the ignition is switched ON, the running light system automatically illuminates the running lights, parking lights, taillights and license plates lights.

LIGHTING SYSTEMS

Structural View



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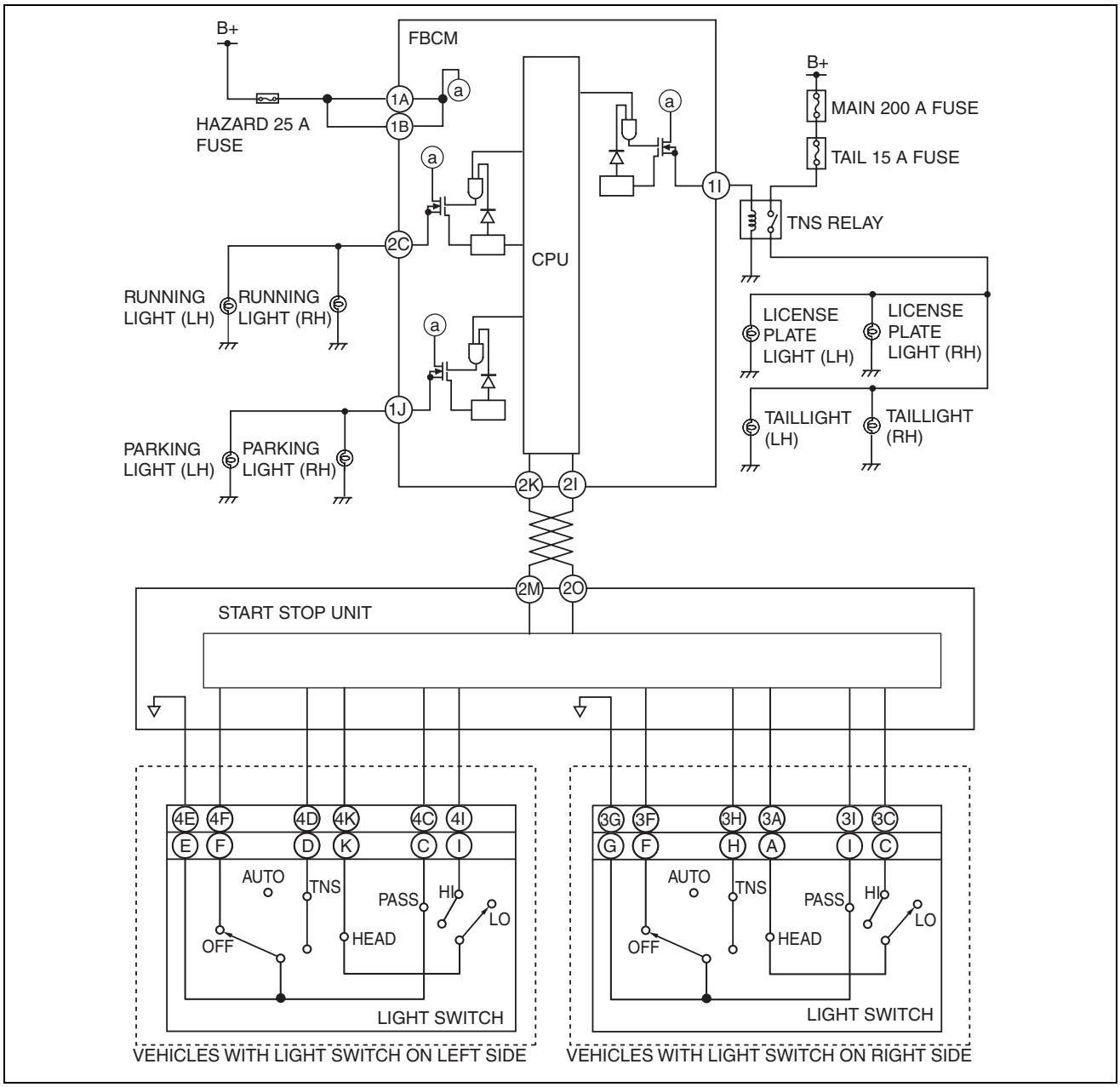
LIGHTING SYSTEMS

System Wiring Diagram



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Operation

- The front body control module (FBCM) turns on the running light mode when the following conditions are met, and turns on the running lights and exterior lights.

LIGHTING SYSTEMS

Operation condition

ENGINE SWITCH	LIGHT SWITCH		DIMMER SWITCH	RUNNING LIGHT BULB	EXTERIOR LIGHT	ILLUMINATION LIGHT	RUNNING LIGHT MODE
	TNS	HEAD					
OFF	OFF	OFF	LO	OFF	OFF	OFF	OFF
			PASS	ON	OFF	OFF	
			HI	OFF	OFF	OFF	
	ON	OFF	LO	OFF	ON	ON	
			PASS	ON	ON	ON	
			HI	OFF	ON	ON	
		ON	LO	ON	ON	ON	
			PASS	ON	ON	ON	
			HI	ON	ON	ON	
ON	OFF	OFF	LO	ON	ON	OFF	ON
			PASS	ON	ON	OFF	
			HI	ON	ON	OFF	
	ON	OFF	LO	OFF	ON	ON	OFF
			PASS	ON	ON	ON	
			HI	OFF	ON	ON	
		ON	LO	ON	ON	ON	
			PASS	ON	ON	ON	
			HI	ON	ON	ON	

HIGH BEAM CONTROL (HBC) SYSTEM

id091800005000

Outline

- The high beam control (HBC) system performs automatic switching to low beams only when the forward sensing camera (FSC) installed to the windshield recognizes an on-coming vehicle, a vehicle that is ahead or when traveling through towns and cities to prevent blinding of other vehicles from headlight glare and to assure visibility of drivers.

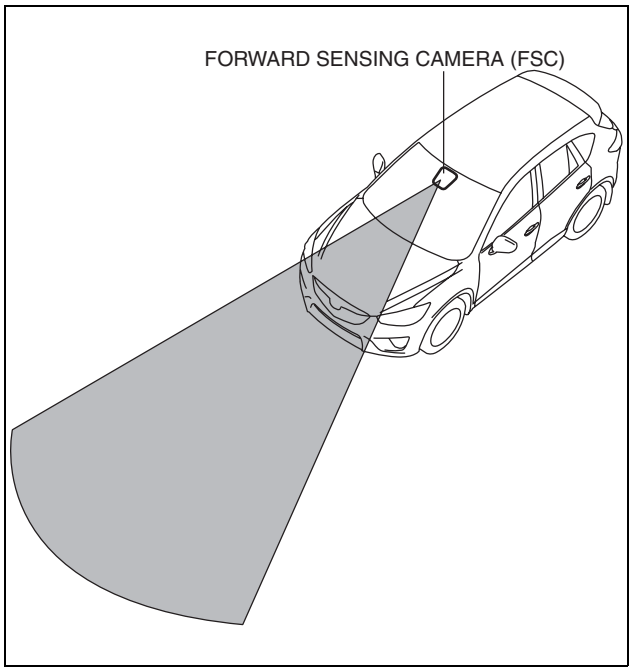
Caution

- **Under the following conditions the ability of the FSC to detect light-emitting objects decreases, which could result in the system not operating normally and the inability to detect on-coming vehicles or vehicles ahead. Do not rely solely on the HBC system, and perform the appropriate switching operation based on a visual determination of the conditions.**
  - **— Brightness of moonlight in surrounding area**
  - **— Poor visibility due to rain and fog**
  - **— Scratches or soiling on the camera lens or windshield glass**

LIGHTING SYSTEMS

Function

- With the light switch in the AUTO and HI position and when the headlights are turned on, the FSC automatically switches to low beams when it recognizes a light-emitting object (on-coming vehicle, vehicle ahead, town and city streets). Refer to 09-22-113 FORWARD SENSING CAMERA (FSC)for details on the FSC.



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Setting function for control order of precedence

- If several light-emitting objects are recognized (on-coming vehicles, vehicles ahead, town/city streets), control is conducted according to the following order of precedence.
  1. Closest on-coming vehicle
  2. Closest vehicle ahead (no on-coming vehicles)
  3. Traveling through towns and cities

System conditions display function

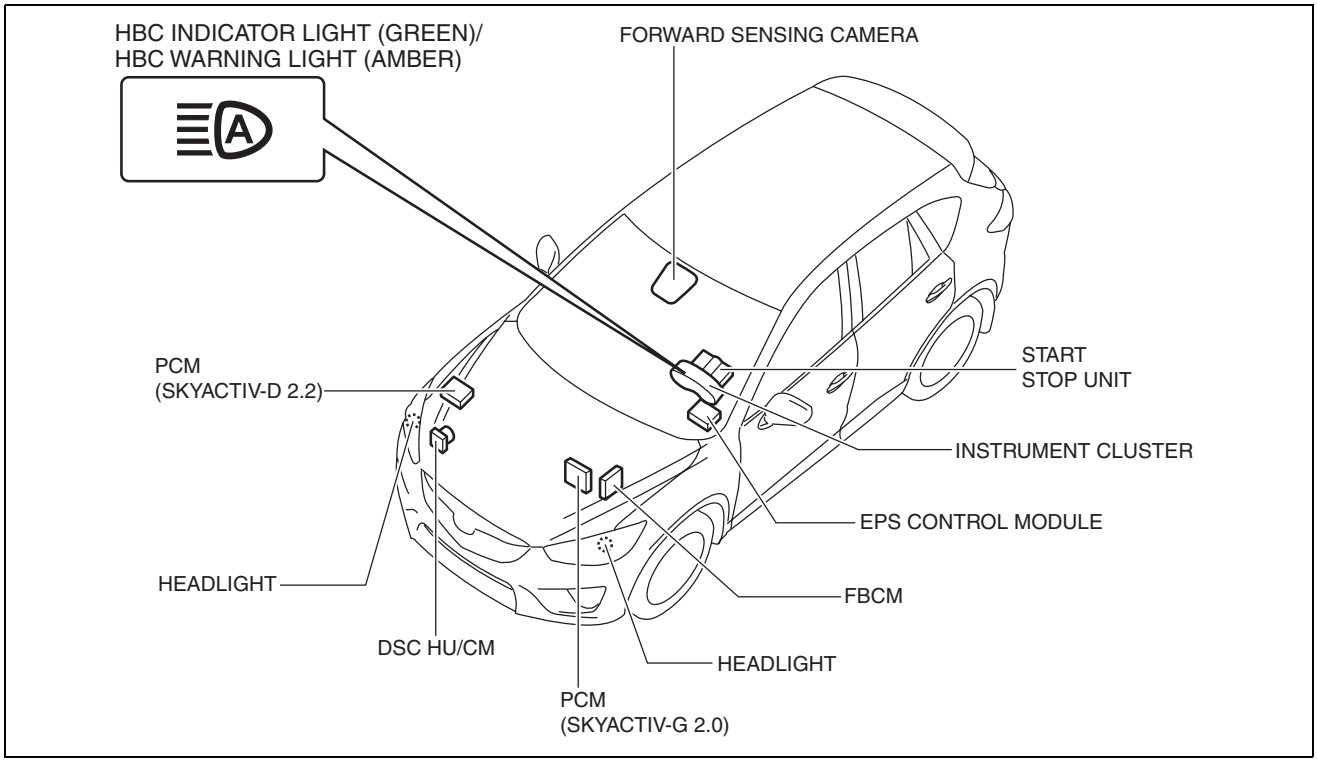
- The FSC displays system conditions using the HBC indicator light (green), HBC warning light (amber), and TFT LCD display (with TFT LCD display) in the instrument cluster.

Condition	HBC indicator light (green)	HBC warning light (amber)	TFT LCD display
Light switch is in position other than AUTO and high position	Illumination off	Illumination off	No display
Headlights off			
While vehicle is stopped			
System set to off by personalization			
Light switch is in AUTO and high position and headlights turned on	Illumination on	Illumination off	No display

LIGHTING SYSTEMS

Condition	HBC indicator light (green)	HBC warning light (amber)	TFT LCD display
FSC detects camera fogging	Illumination off	Illumination on	
FSC detects camera soiling			
Malfunction in HBC occurs		Flashes	
Malfunction in FSC occurs			

Structural view



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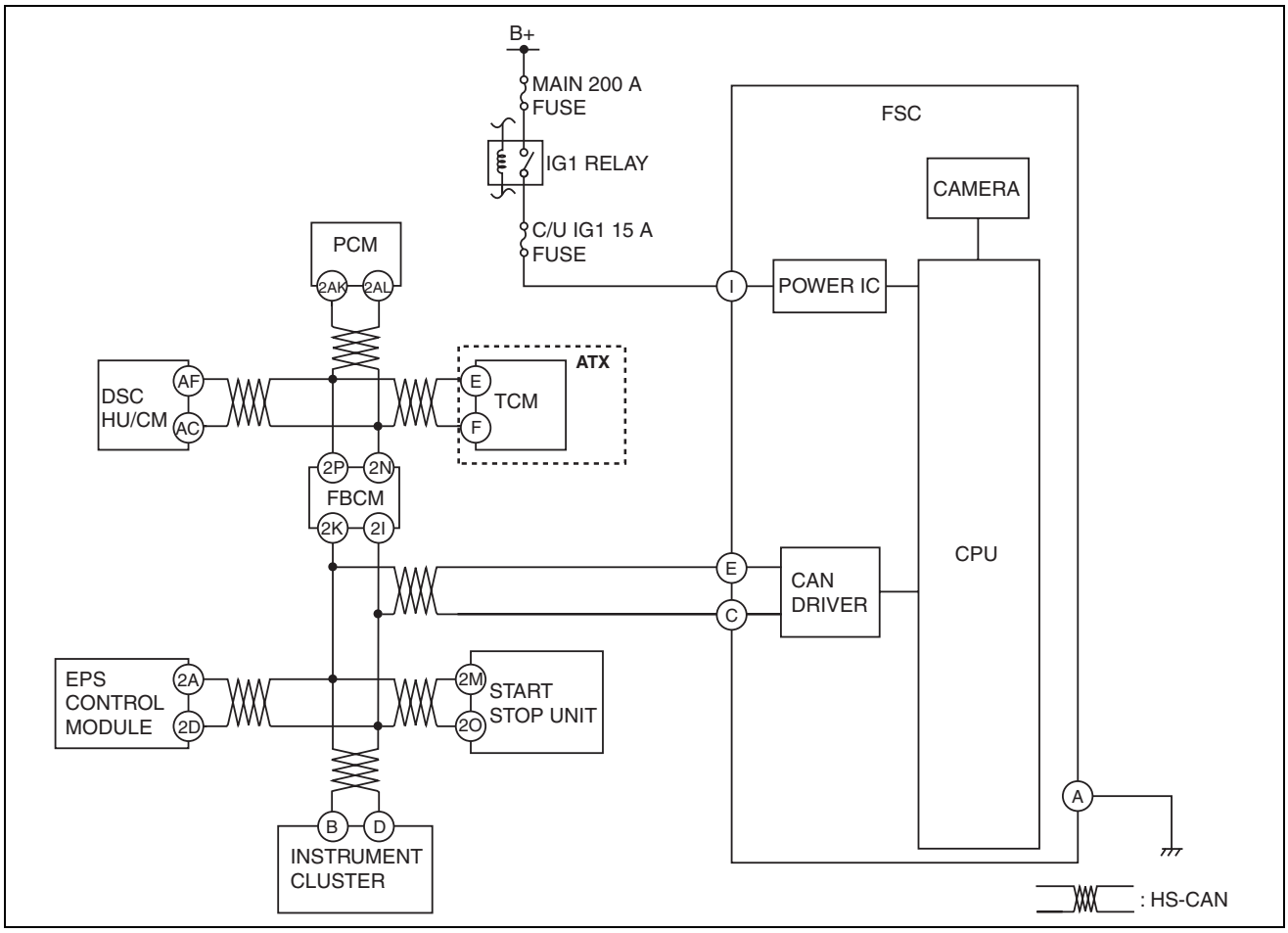
LIGHTING SYSTEMS

System wiring diagram



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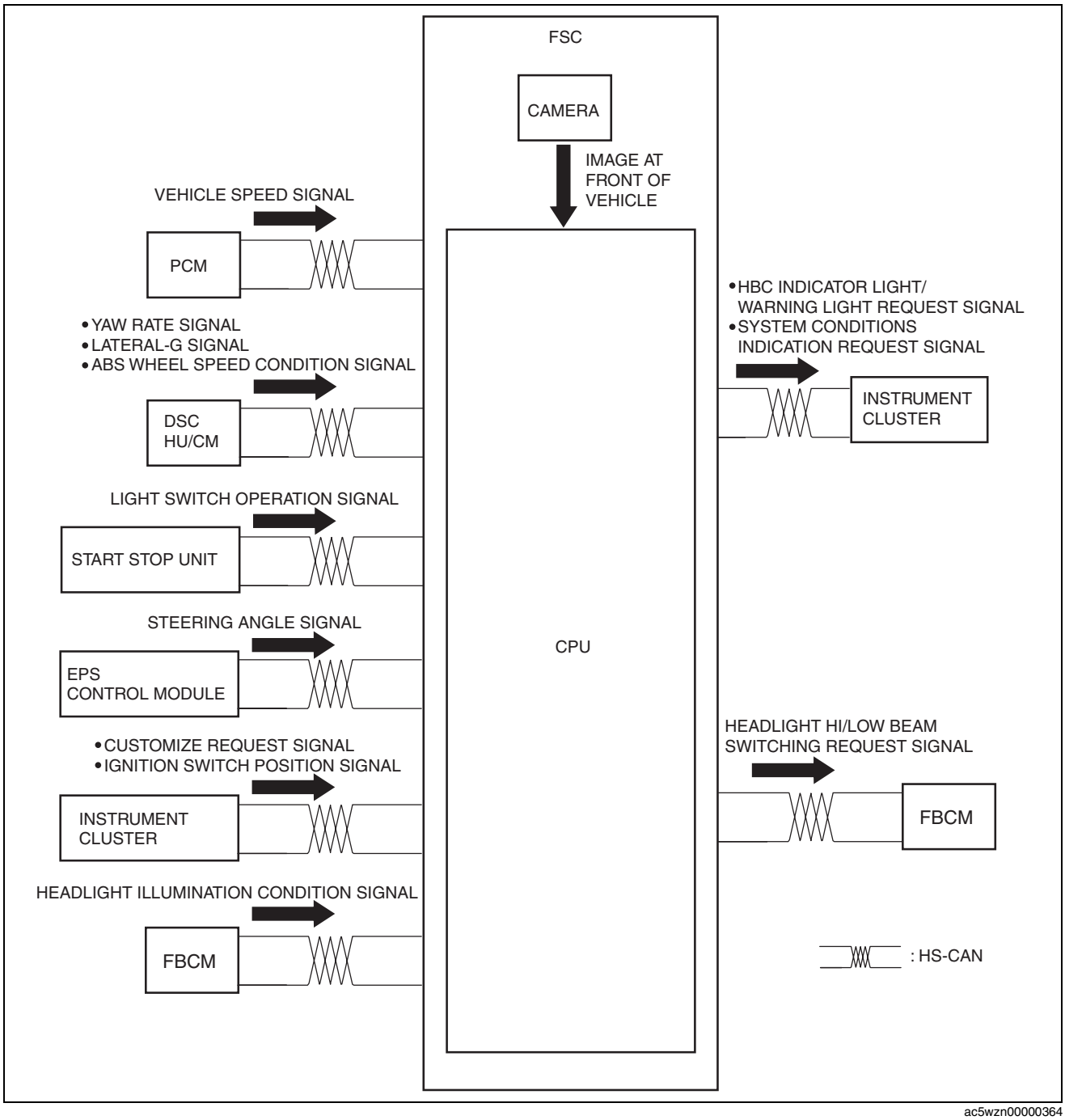
LIGHTING SYSTEMS

Block diagram



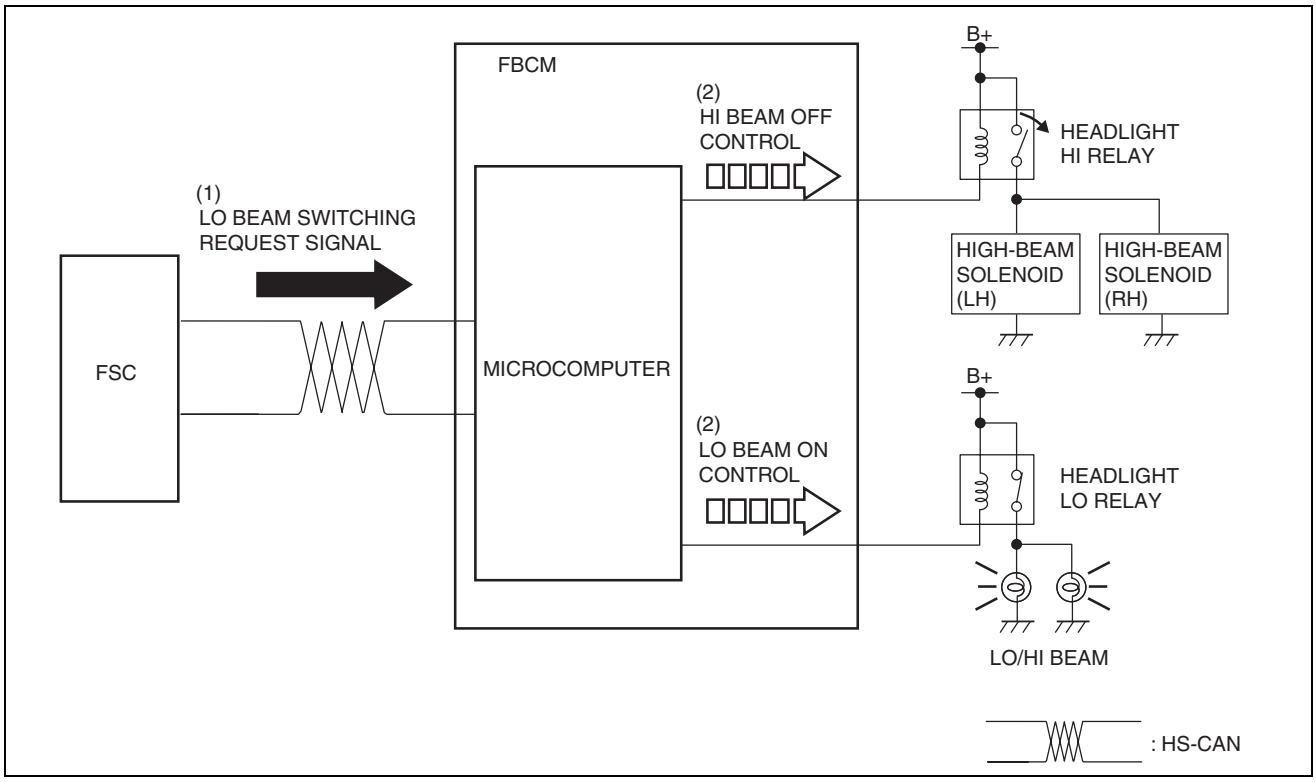
ac5wzn00000364

Operation
Low beam switching operation
Operation condition

- With the light switch in the AUTO and HI position and when the headlights are turned on, the headlights are switched to low beams when any of the following conditions are met:
  — On-coming vehicles, vehicles ahead, town/city streets are recognized.
  — Vehicle speed is 20 km/h {12 mph} or less

1. When the FSC recognizes a light-emitting object (on-coming vehicles, vehicles ahead, town/city streets) or detects a vehicle speed of 20 km/h {12 mph}, it sends a low beam switching request signal to the front body control module (FBCM).
2. When the front body control module (FBCM) receives the low beam switching request signal from the FSC, it turns off the headlight HI relay.

LIGHTING SYSTEMS



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HI beam return operation

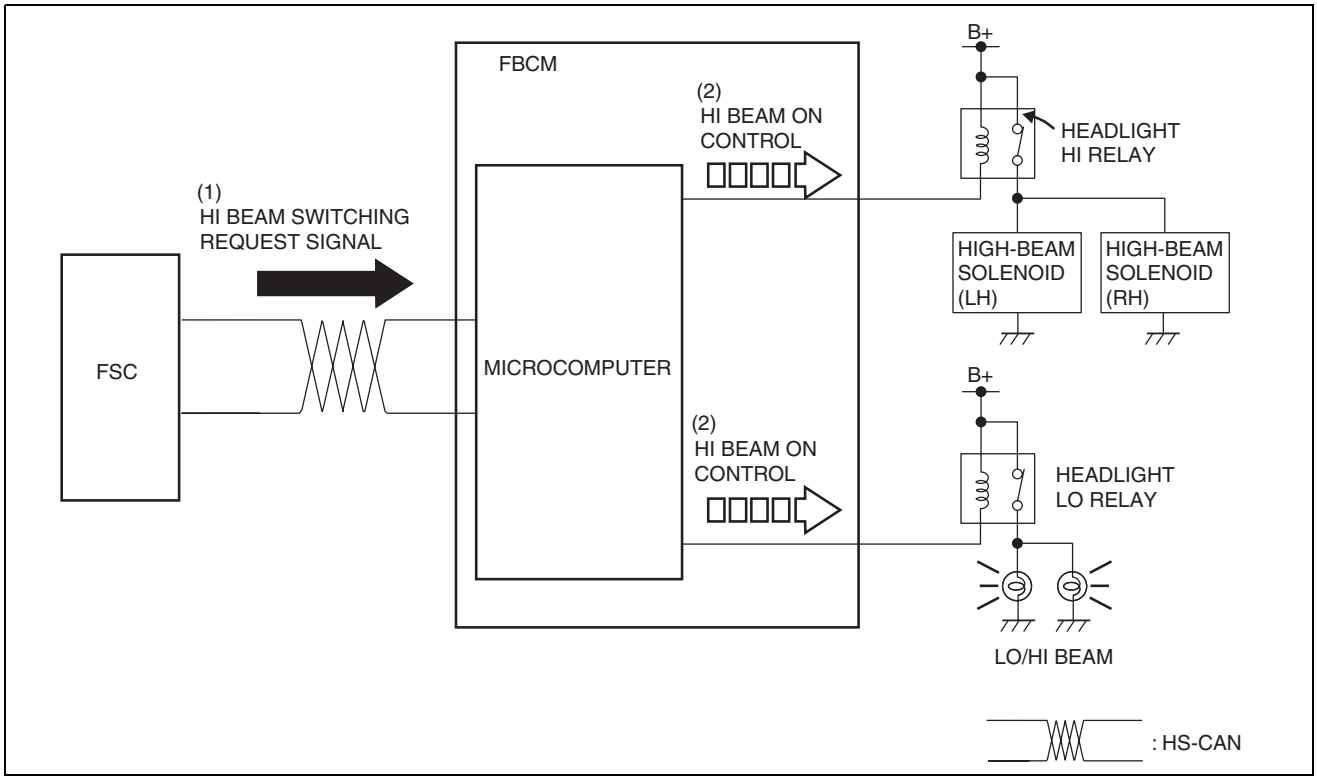
Operation condition

- If the following conditions are met, the headlights are switched to HI beams.
  - — If vehicle speed is 30 km/h {19 mph} and on-coming vehicles, vehicles ahead or street lights are not recognized

On-coming vehicles

1. If a recognized on-coming vehicle moves away from the camera range, the FSC sends a HI beam switching request signal to the front body control module (FBCM).

2. When the front body control module (FBCM) receives the HI beam switching request signal from the FSC, it turns on the headlight HI relay to turn on the HI beams.



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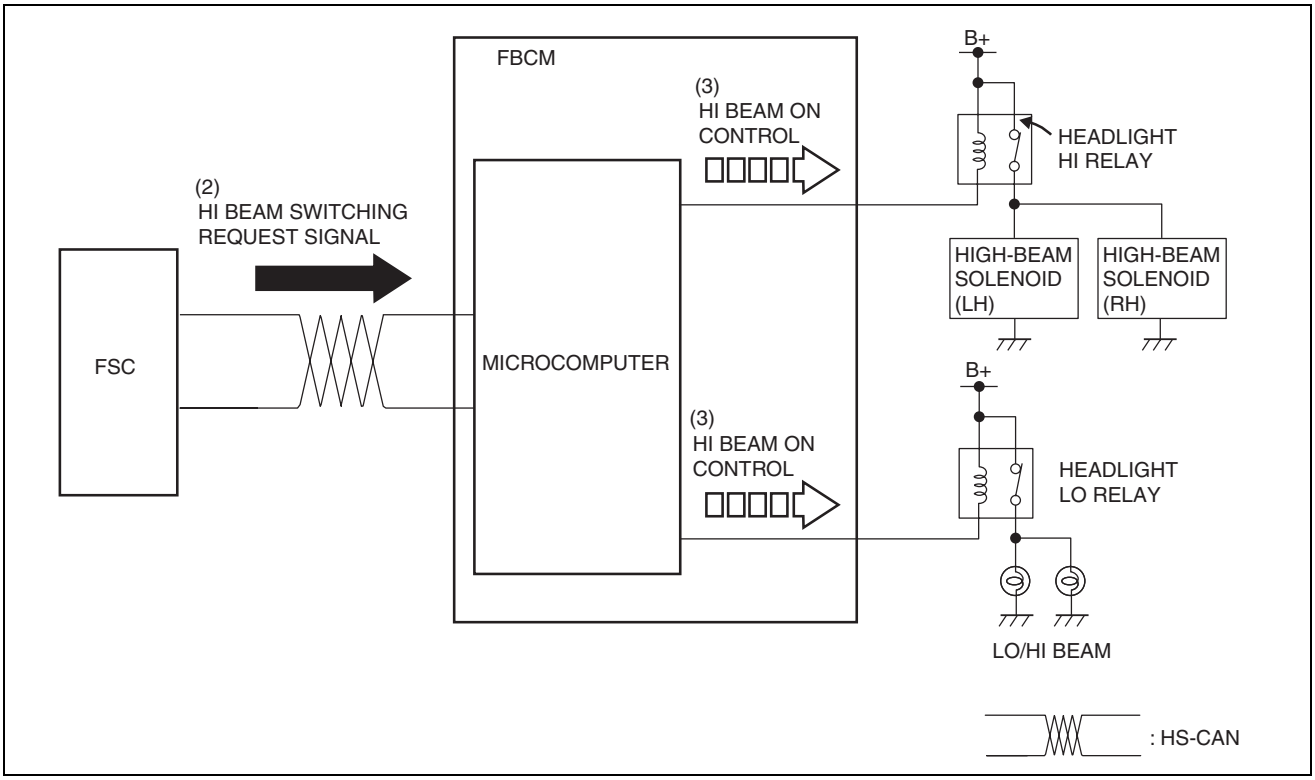
Vehicle ahead or town/city streets (street lights)

1. If a recognized vehicle ahead moves away from the camera range, or town/city streets (street lights) are no longer detected in the camera range, the low beams are maintained for a certain period of time.
2. If a vehicle ahead or town/city streets (street lights) are not detected for a certain period of time, the FSC sends a HI beam switching request signal to the front body control module (FBCM).

LIGHTING SYSTEMS

3. When the front body control module (FBCM) receives the HI beam switching request signal from the FSC, it turns on the headlight HI relay to turn on the HI beams.



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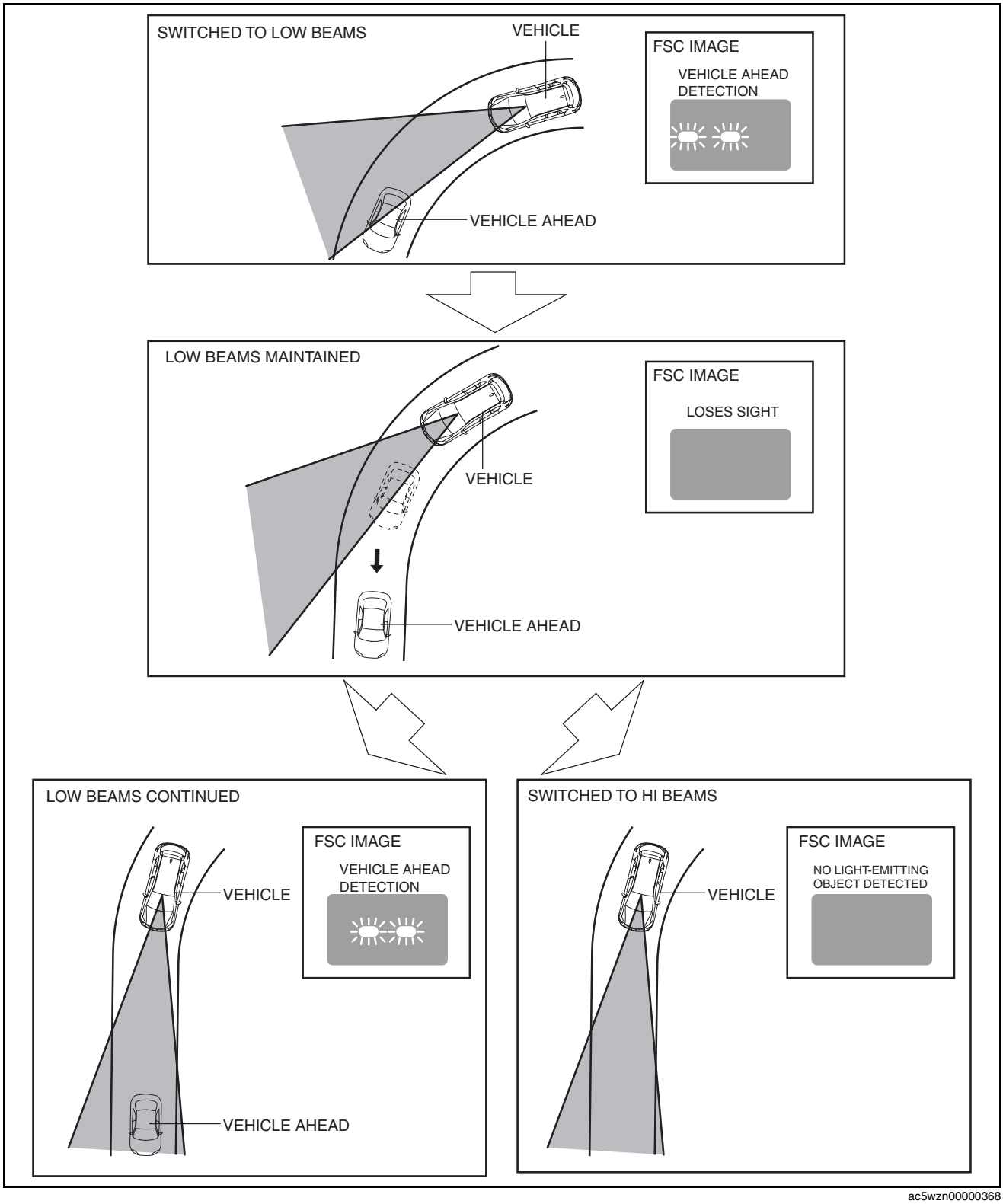
LIGHTING SYSTEMS

FSC loses sight of vehicle ahead which is cornering

- If the FSC loses sight of a recognized vehicle which is cornering, the FSC maintains the low beams until reaching the locus at which the FSC lost sight of it. If the vehicle ahead is not detected at the locus at which the FSC had lost sight of it, the headlights are switched to high beams. If the vehicle ahead is detected, the low beams are maintained.



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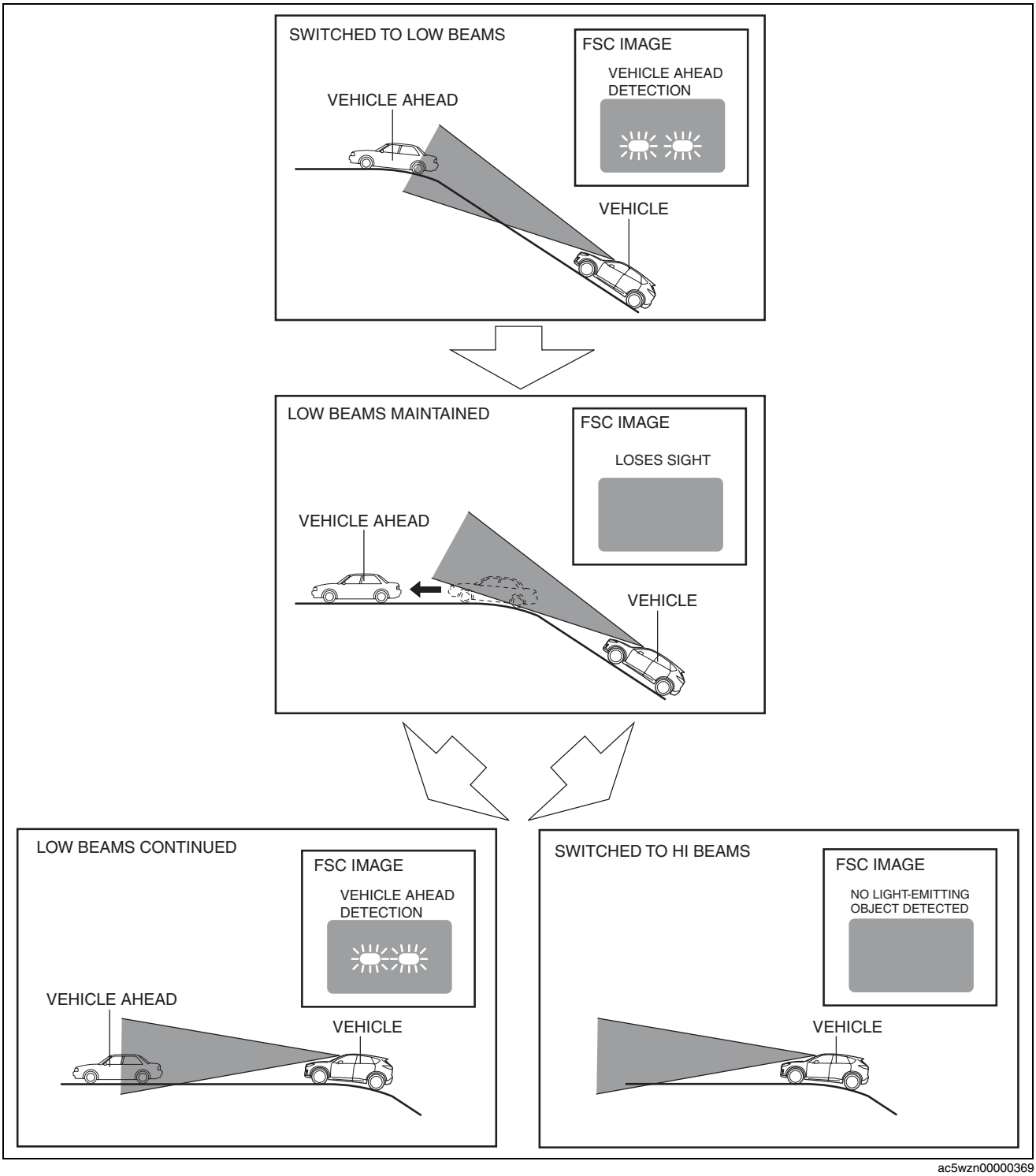
LIGHTING SYSTEMS

FSC suddenly loses sight of light-emitting object (on-coming vehicles, vehicles ahead, town/city streets (street lights))

- If the FSC suddenly loses sight of a recognized light-emitting object in the camera range, the low beams are maintained for a certain period of time. Depending on whether a light-emitting object is detected or not after the certain period of time has elapsed, the headlights are switched to high beams or the system determines that the low beams are to be maintained.



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Fail-safe

- If a malfunction is detected in the system, control is inhibited and the headlights are switched to HI beams.

LIGHTING SYSTEMS

HBC INDICATOR LIGHT (GREEN)/HBC WARNING LIGHT (AMBER)

id091800005200

Purpose

HBC indicator light (green)

- The HBC indicator light (green) notifies the driver that the High Beam Control (HBC) system is operating.

HBC warning light (amber)

- The HBC warning light (amber) warns the driver that a malfunction is occurring in the HBC system.

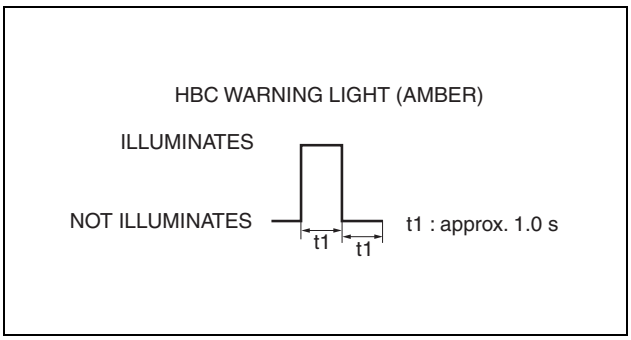
Function

HBC indicator light (green)

- The instrument cluster illuminates the HBC indicator light (green) based on the system conditions display request signal sent via a CAN signal from the FSC.

HBC warning light (amber)

- The instrument cluster illuminates the HBC warning light (amber) based on the system conditions display request signal sent via a CAN signal from the FSC.
- The instrument cluster flashes the HBC warning light (amber) based on the system malfunction display request signal sent via a CAN signal from the FSC.
- The flash pattern of the HBC warning light (amber) is as shown in the table.



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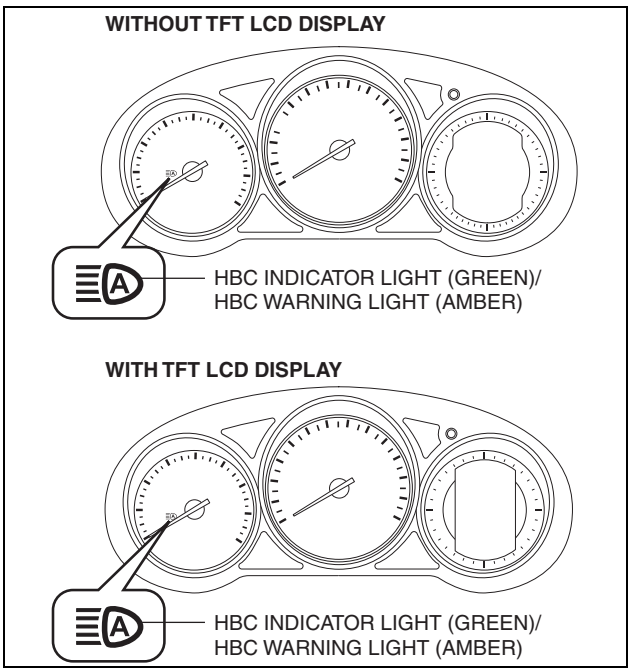
Construction

- The HBC indicator light (green) and HBC warning light (amber) are equipped in the instrument cluster.



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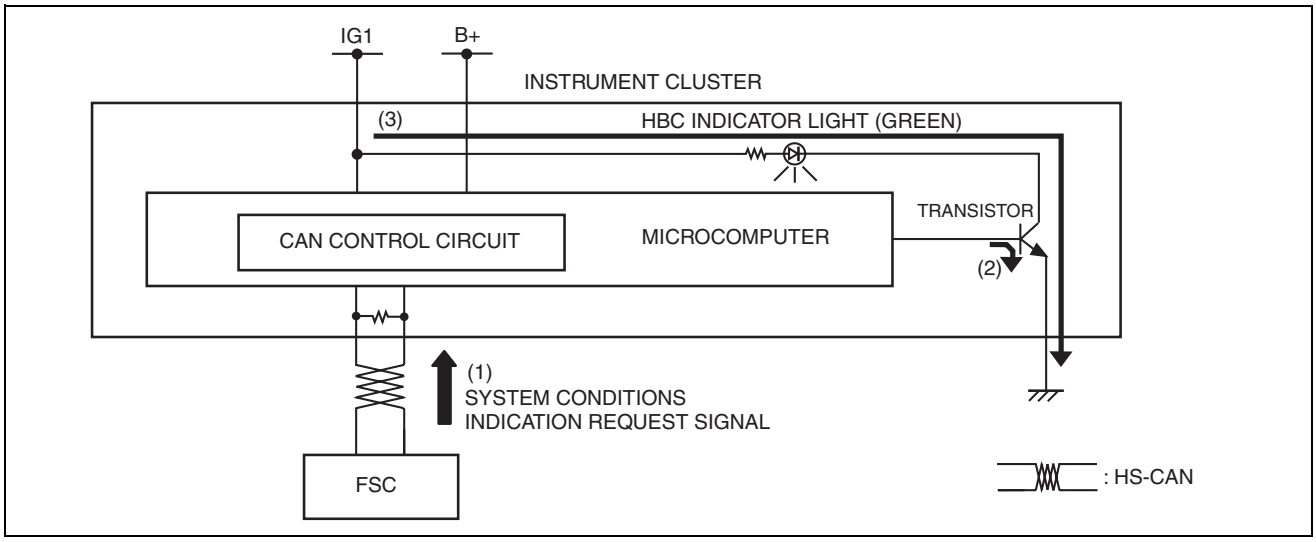
Operation

HBC indicator light (green)

1. The instrument cluster receives (1) the system conditions display request signal from the FSC via the CAN signal.
2. The instrument cluster turns the transistor on (2) based on the system conditions display request signal.

LIGHTING SYSTEMS

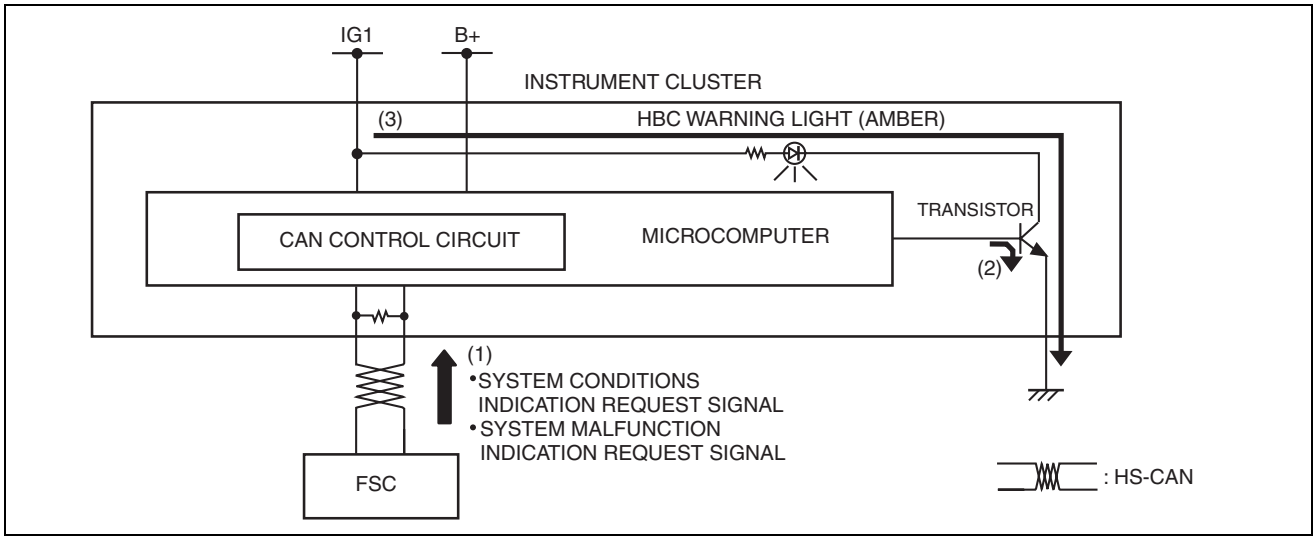
3. When the transistor turns on, a ground circuit with the HBC indicator light (green) is established, and the HBC indicator light (green) illuminates (3).



ac5wzn00000372

HBC warning light (amber)

1. The instrument cluster receives (1) the system conditions display request signal from the FSC or a system malfunction display request signal via a CAN signal.
2. The instrument cluster turns the transistor (2) on intermittently for a system malfunction display request signal, and continuously for a system conditions display request signal.
3. When the transistor is turned on intermittently, the HBC warning light (amber) flashes (3), and when it is turned on continuously, the HBC indicator light (green) illuminates (3).



ac5wzn00000373

Fail-safe

- Function not equipped.

FRONT FOG LIGHT

id091800011300

Purpose

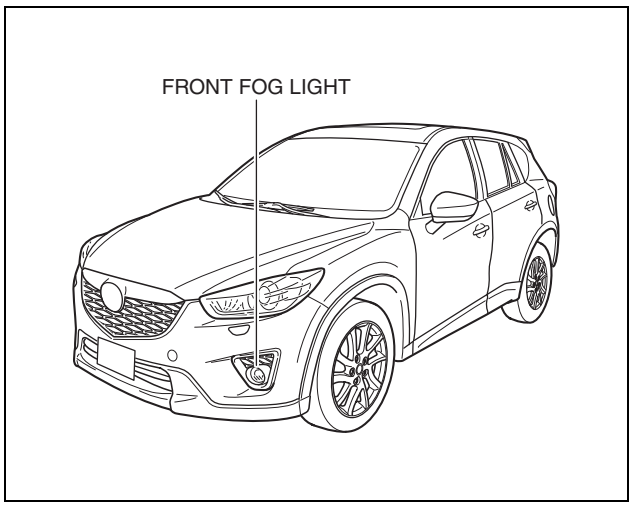
- By shining light in a wider area in front of the vehicle than the light from the headlights, visibility during poor weather conditions, such as rain and fog, has been improved. In addition, the visibility of the vehicle from on-coming vehicles, pedestrians, and other people has been improved.

Function

- Illuminates according to the light switch and front fog light switch operation.

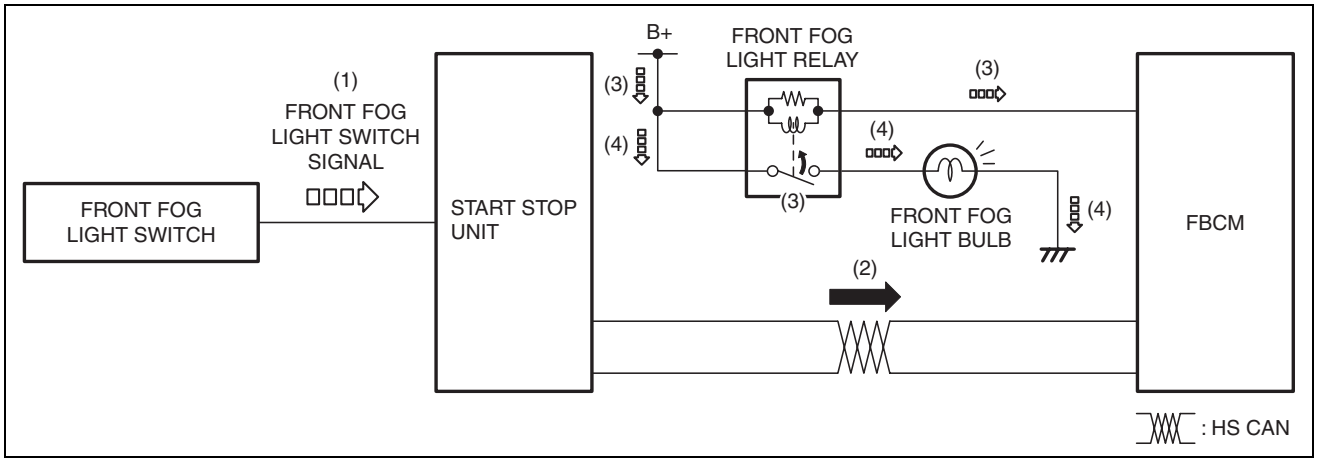
LIGHTING SYSTEMS

Construction
- Round-type fog lights are installed to the front bumper.
- Clear lenses have been adopted to the front fog lights.



ac5wzn00001351

Operation
1. With the light switch in the TNS, HEAD, or HI position, a front fog light switch signal is sent to the start stop unit when the fog light switch is operated to the F. FOG position.
2. The start stop unit sends the front fog light switch signal to the front body control module (FBCM).
3. When the front body control module (FBCM) receives the fog light switch signal, it turns the front fog light relay on.
4. When the front fog light relay turns on, the front fog light bulb illuminates.



ac5wzn00001352

Fail-safe
- Function not equipped.

FRONT FOG LIGHTS INDICATOR LIGHT

id091800013700

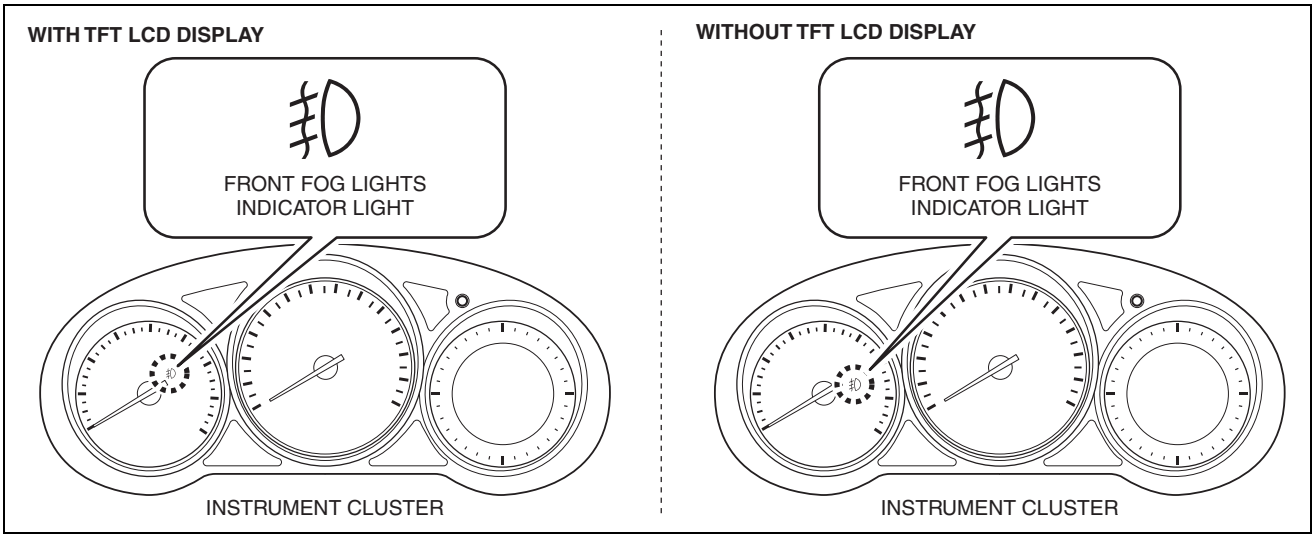
Purpose
- Notifies the user that the front fog lights are illuminated.

Function
- Illuminates when the front fog light illumination conditions are met.

LIGHTING SYSTEMS

Construction

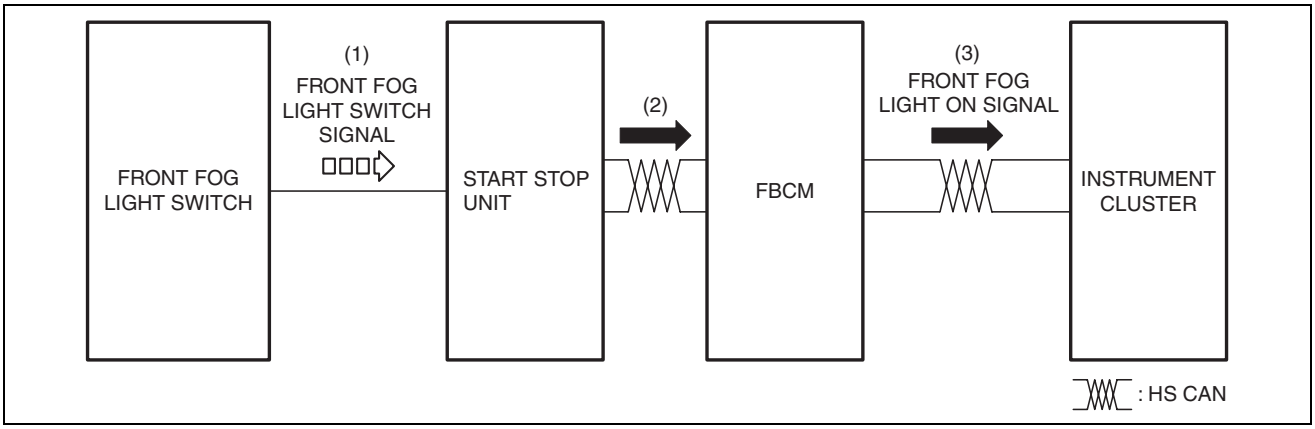
- Displayed in the instrument cluster.



ac5wzn00001509

Operation

1. With the light switch in the TNS or HEAD position, a front fog light switch signal is input to the start stop unit when the front fog light switch is operated to the on position.
2. The start stop unit sends the front fog light switch signal to the front body control module (FBCM).
3. The front body control module (FBCM) sends the front fog light switch signal to the instrument cluster as a front fog light illumination signal.
4. The instrument cluster illuminates the front fog light indicator light when it receives the front fog light illumination signal.



ac5wzn00001366

Fail-safe

- Function not equipped.

TURN LIGHT SYSTEM

id091800111900

Purpose

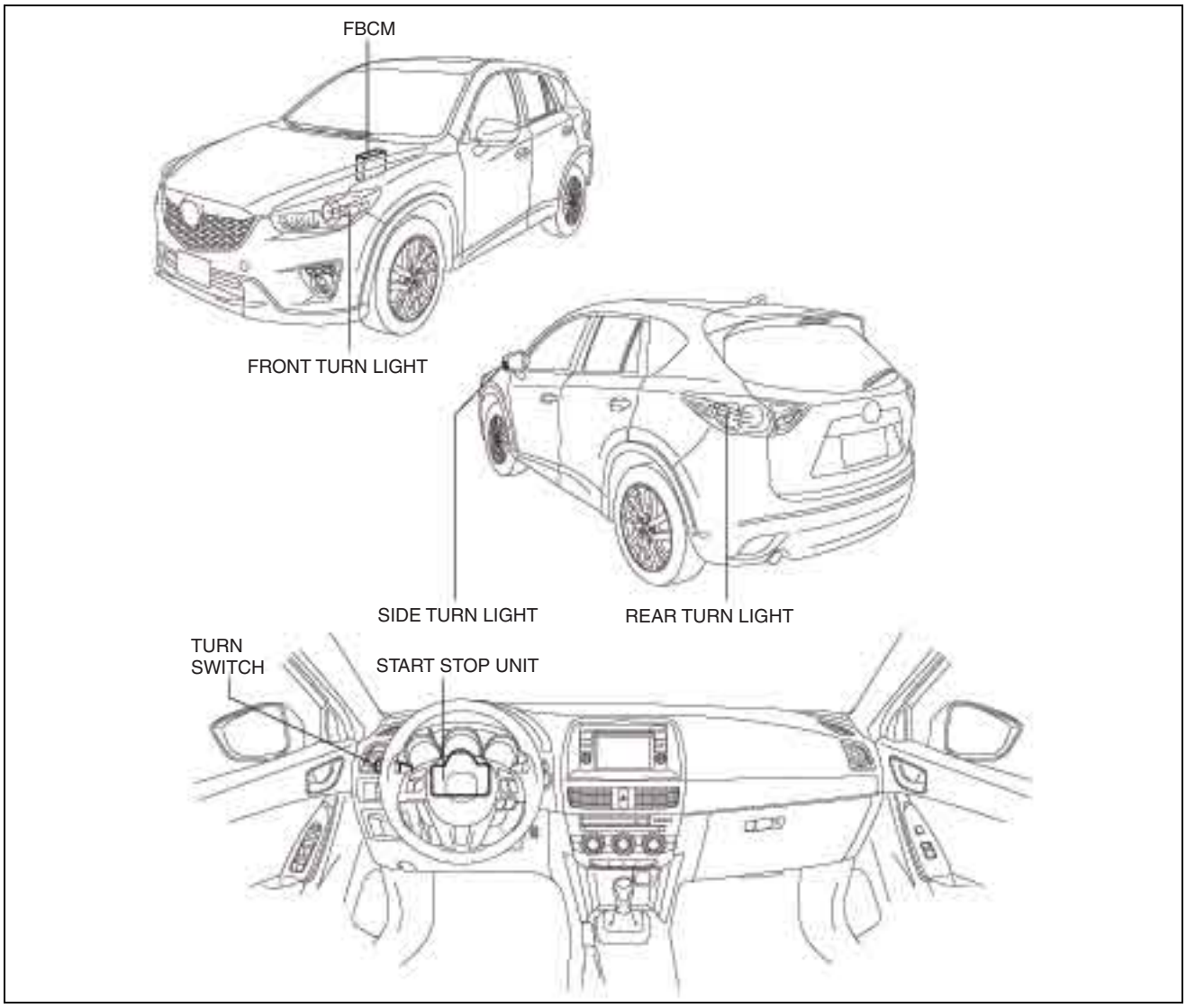
- The turn light system flashes the turn light three times automatically according to the turn switch operation.
- The front body control module (FBCM) performs turn light system fail-safe. (See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)

Function

- The front body control module (FBCM) performs control based on the turn switch (RH or LH) signal sent from the start stop unit via the CAN signal as follows:
  - — On-signal receive time of turn switch is less than 0.7 s: Operates the turn light system.
  - — On-signal receive time of turn switch is 0.7 s or more: Flashes the turn light according to the receive time.

LIGHTING SYSTEMS

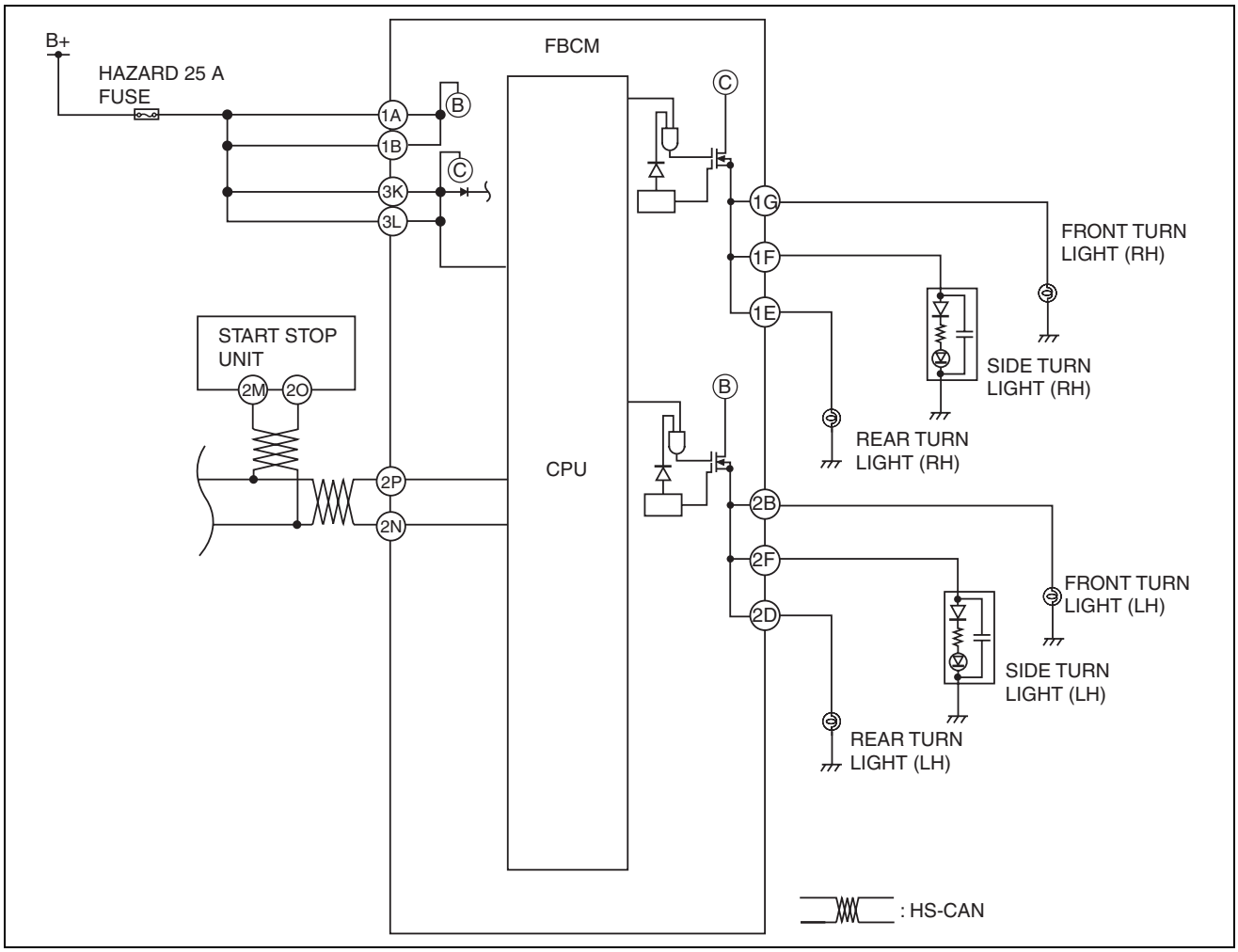
Structural view



ac5wzn00001367

LIGHTING SYSTEMS

System wiring diagram

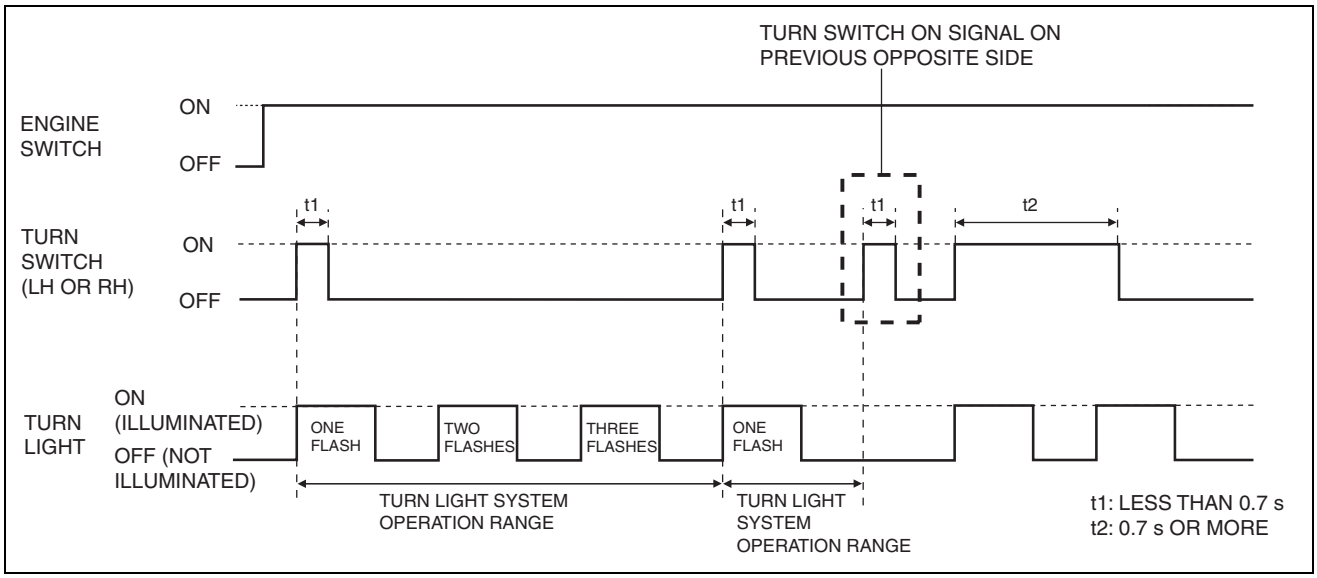


ac5wzn00001368

Operation

- If the front body control module (FBCM) receives the turn switch on signal from the start stop unit for less than 0.7 s when the ignition is switched ON (engine off or on), it flashes the turn light three times.
- If the front body control module (FBCM) receives the turn switch on signal from the previous opposite side during the turn light system operation, it stop the turn light system operation. In addition, if the turn switch on signal on the opposite side is less than 0.7 s, the turn light system does not operate.

LIGHTING SYSTEMS



ac5uun00000640

SIDE TURN LIGHT

id091800011400

Purpose

- The side turn lights are used to signal vehicles/people at the side of the vehicle that the vehicle is going to make a right or left turn.

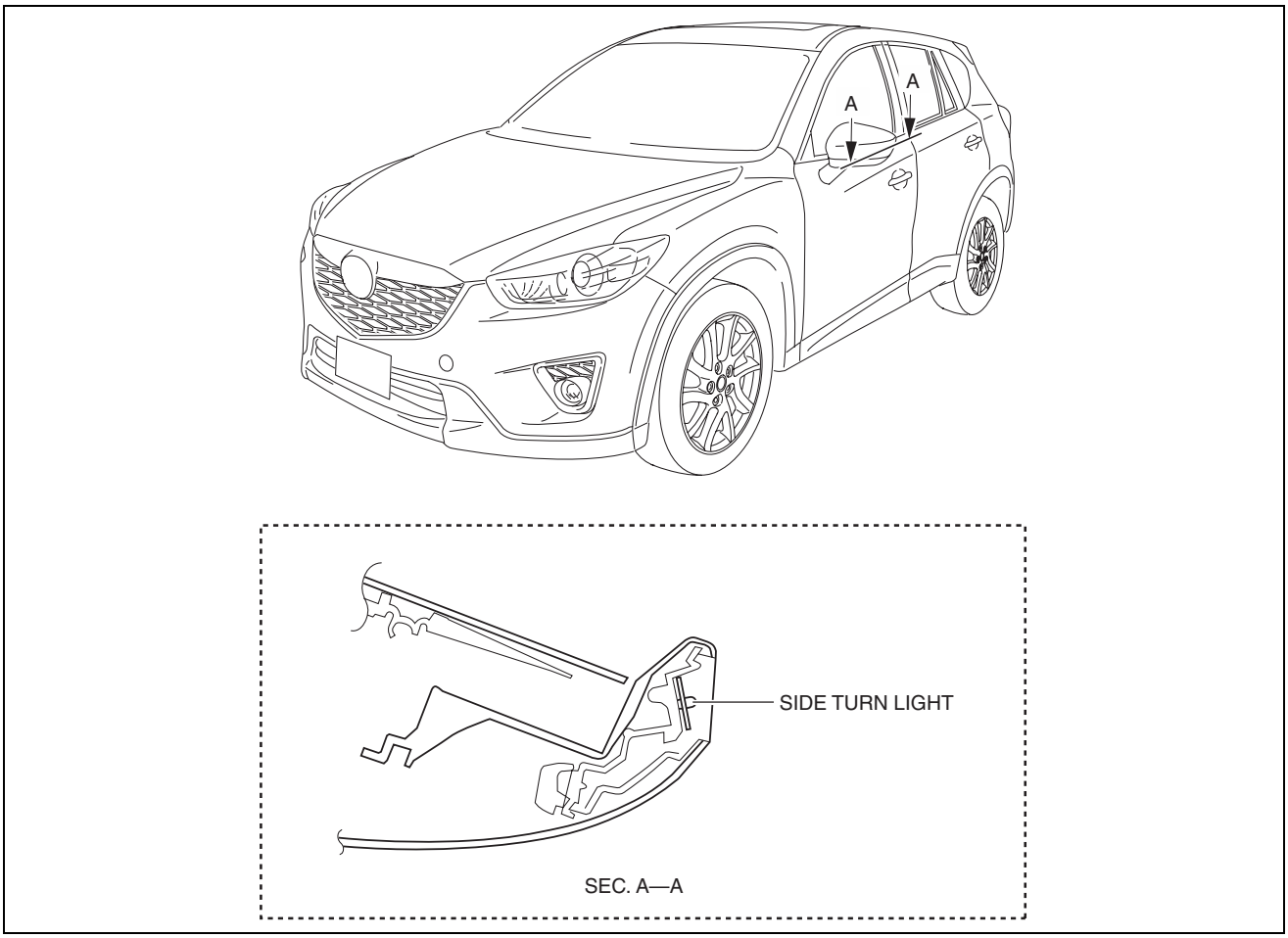
Function

- The side turn lights flash according to the operation of the turn or the hazard switch.

Construction

- Side turn lights built into the outer mirrors have been adopted.
- LED type side turn lights have been adopted.

LIGHTING SYSTEMS

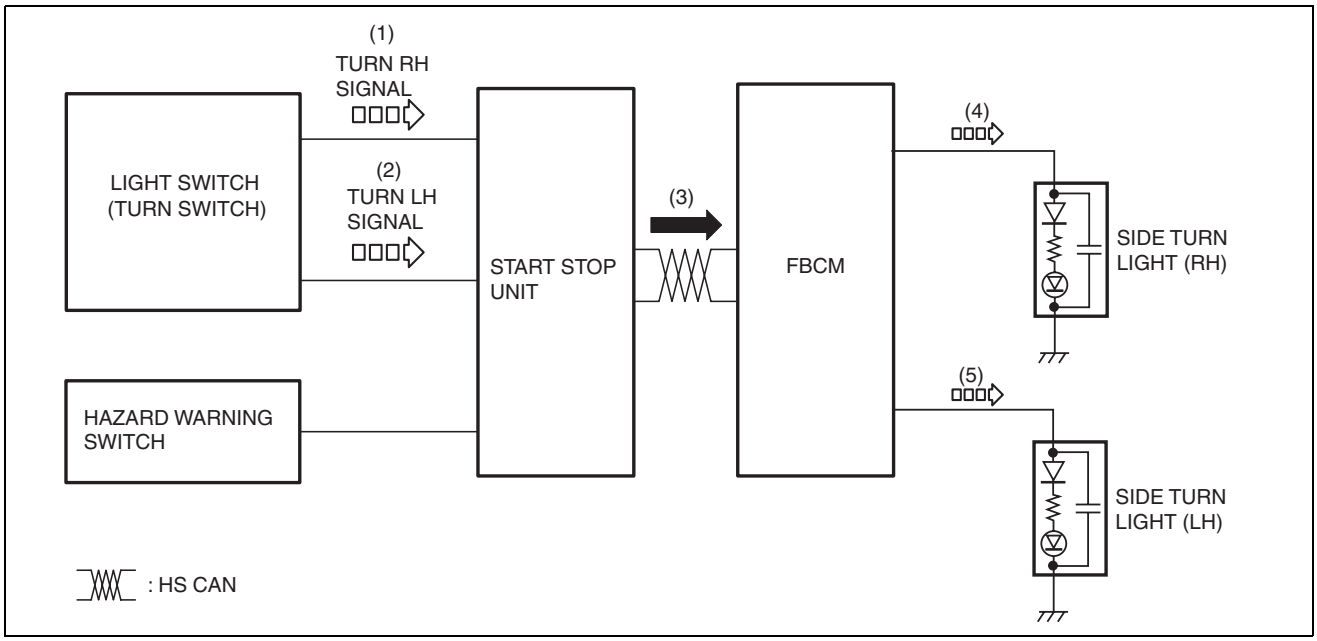


ac5wzn00001426

Operation
Turn system

1. When the turn switch is operated to the RH position, a turn RH signal is input to the start stop unit.
2. When the turn switch is operated to the LH position, a turn LH signal is input to the start stop unit.
3. The start stop unit sends the turn RH or LH signal to the front body control module (FBCM).
4. When the front body control module (FBCM) receives the turn RH signal, the side turn light (RH) flashes.
5. When the front body control module (FBCM) receives the turn LH signal, the side turn light (LH) flashes.

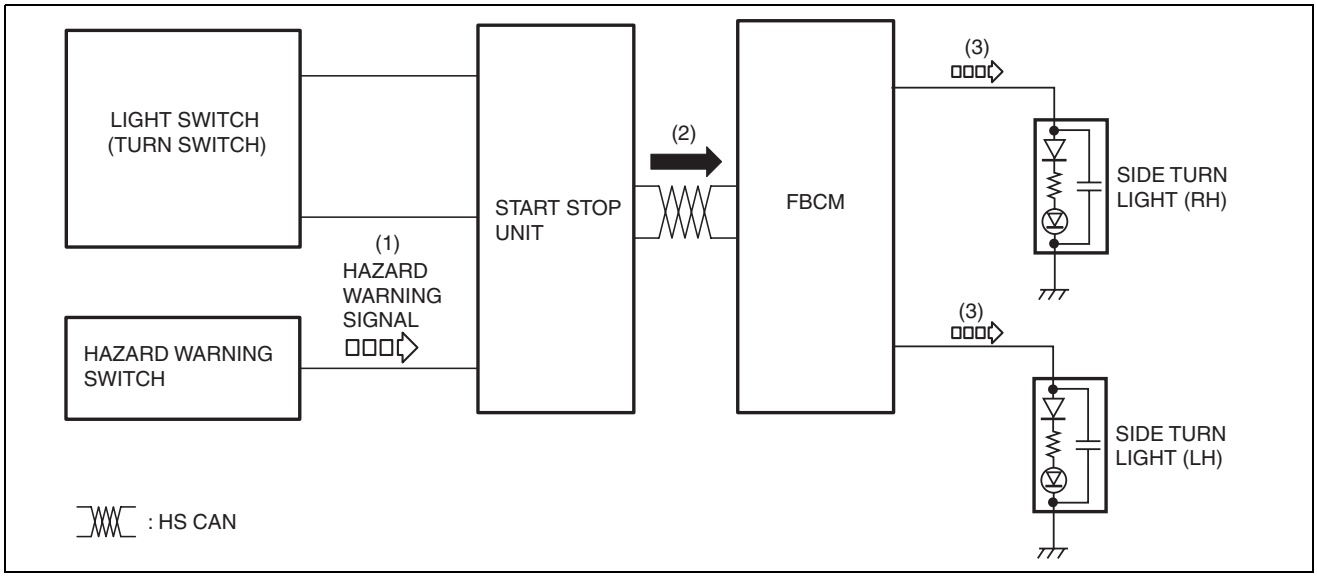
LIGHTING SYSTEMS



ac5wzn00001353

Hazard system

1. When the hazard switch is turned on, a hazard signal is input to the start stop unit.
2. The start stop unit sends a hazard signal to the front body control module (FBCM).
3. When the front body control module (FBCM) receives the hazard signal, the side turn lights (RH) and (LH) flash.



ac5wzn00001354

Fail-safe

- Function not equipped.

EMERGENCY STOP SIGNAL SYSTEM (ESS)

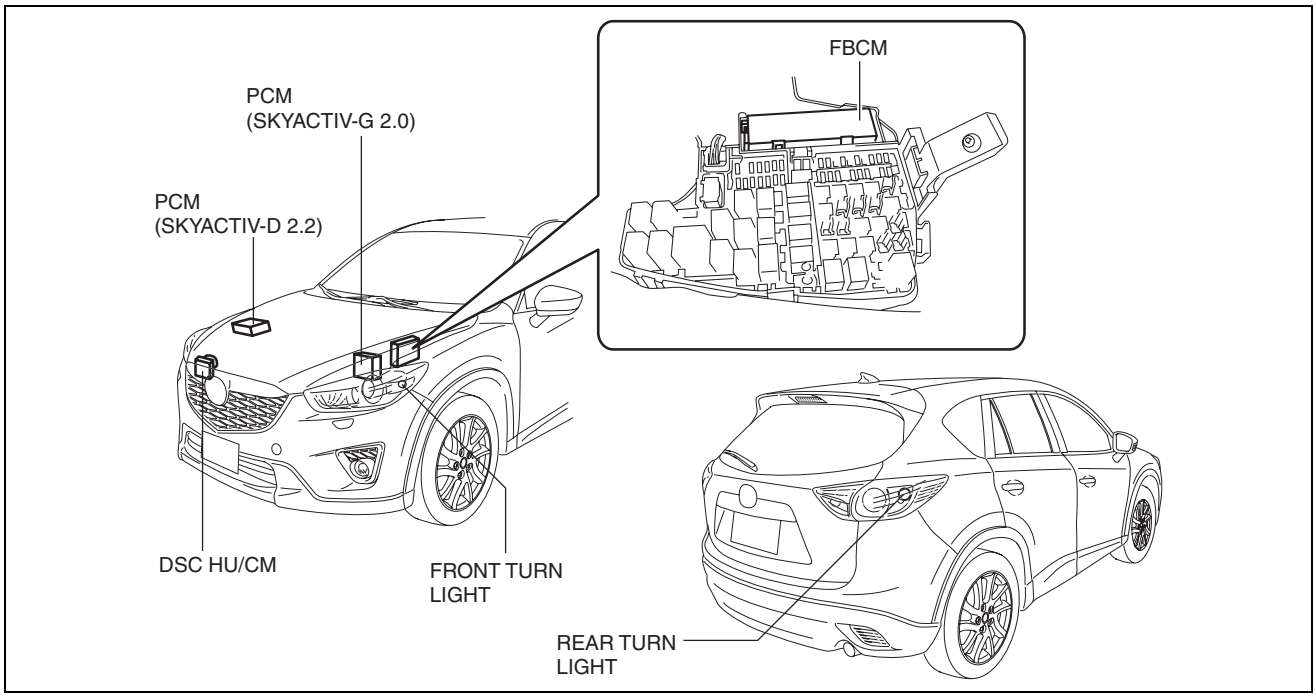
id091800014600

Outline

- The emergency stop signal system (ESS) is designed to caution the driver of a vehicle following behind of an emergency braking situation by automatically and rapidly flashing the hazard warning lights when the vehicle decelerates suddenly.
- The front body control module (FBCM) performs ESS fail-safe. (See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)

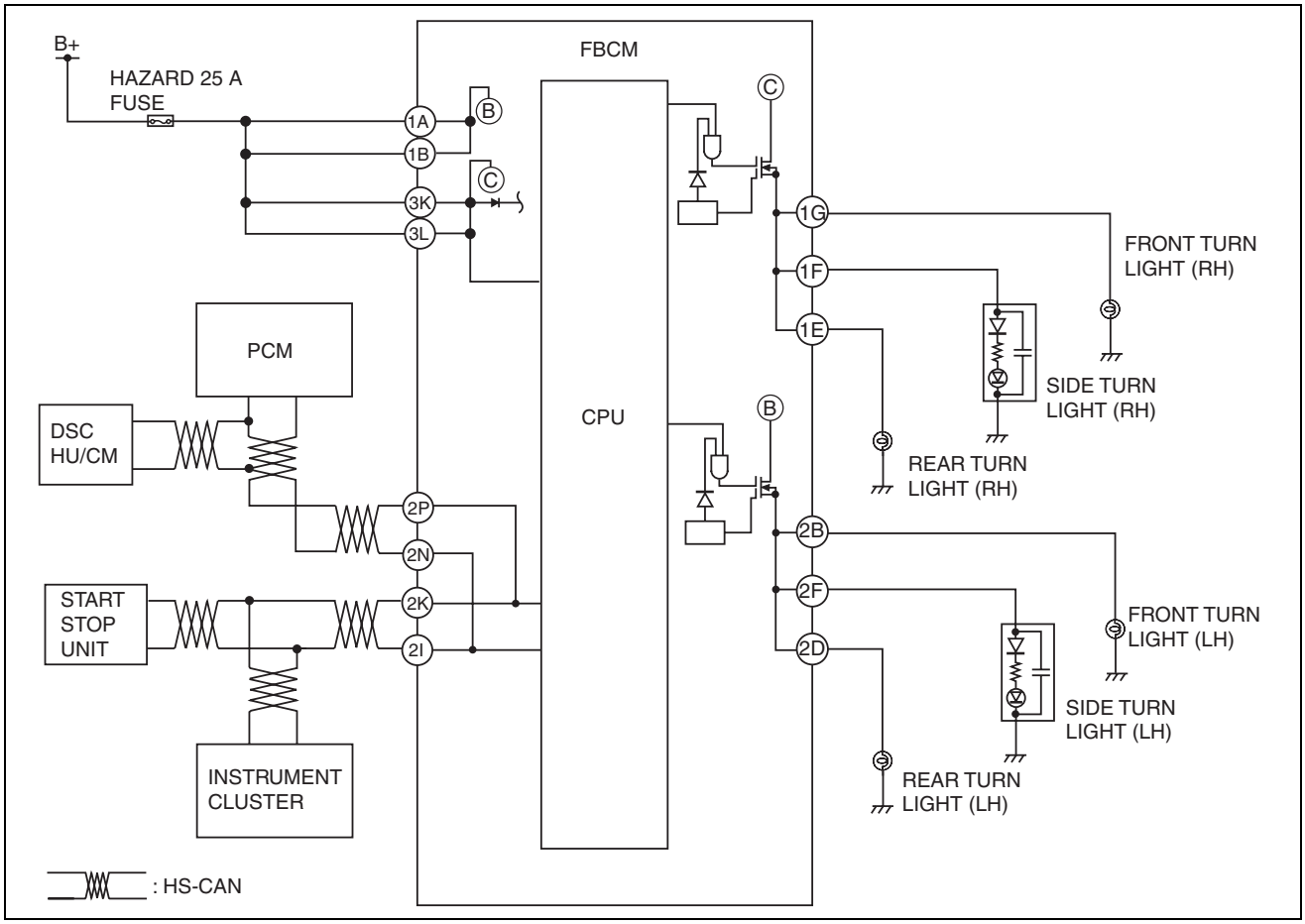
LIGHTING SYSTEMS

Structural View



ac5wzn00001241

System Wiring Diagram



ac5wzn00001242

LIGHTING SYSTEMS

Function

- The front body control module (FBCM) gives priority to the emergency signal system (ESS) operation even if the turn switch is turned on during the emergency signal system (ESS) operation.
- When the hazard warning switch is turned on during the emergency signal system (ESS) operation, the front body control module (FBCM) stops the emergency signal system (ESS) operation and gives priority to the hazard warning light flashing operation.
- The front body control module (FBCM) controls the emergency signal system (ESS) based on the following CAN signals:

CAN signal sending module	Signal name
PCM	Brake switch status
	Vehicle speed signal
DSC HU/CM	Wheel speed (LF, RF, LR, RR)
	ABS operation condition
	Vehicle acceleration speed

- The emergency signal system (ESS) has two warning modes; the sudden deceleration hazard warning mode in which the hazard warning lights flash rapidly, and the emergency stop hazard warning mode in which the hazard warning lights flash normally.

Sudden deceleration hazard warning mode

- The sudden deceleration hazard warning mode operates when the brake pedal is depressed while driving at a vehicle speed of 50 km/h {31 mph} or more and emergency braking is determined based on the vehicle's deceleration.
- When the sudden deceleration hazard warning mode operates the hazard warning lights flash at 2.5—4.5 Hz.

Emergency stop hazard warning mode

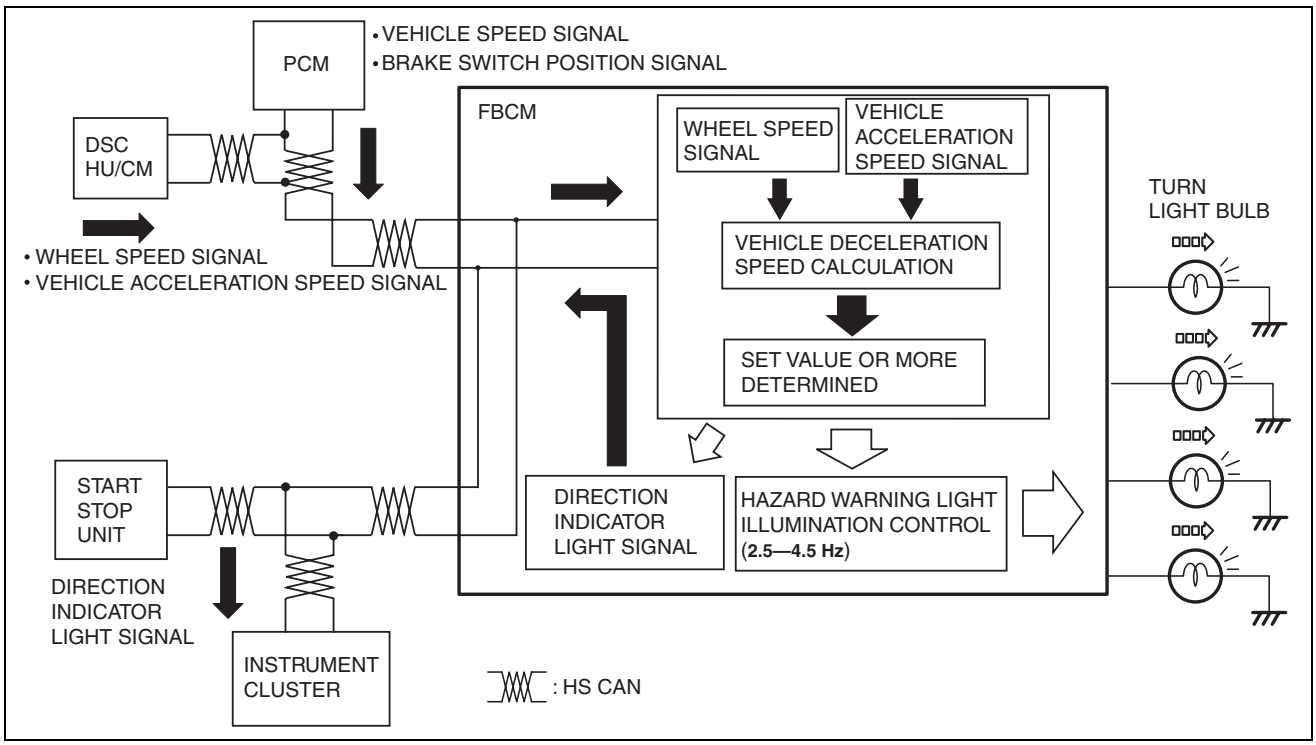
- The mode switches from the sudden deceleration hazard warning mode to the emergency stop hazard warning mode after certain conditions are met.
- The emergency stop hazard warning mode operates when the vehicle speed is 10 km/h {6.2 mph} or less and the brake pedal is depressed after the sudden deceleration hazard warning mode is cancelled.

Operation

1. If the brake pedal is depressed and the vehicle is decelerated while the vehicle speed is 50 km/h {31 mph} or more, the front body control module (FBCM) calculates the vehicle deceleration speed based on the wheel speed signal and vehicle acceleration speed signal.

LIGHTING SYSTEMS

2. If the calculated deceleration speed is the set value or more for the sudden deceleration hazard warning mode, the front body control module (FBCM) controls the flashing of the hazard warning lights at 2.5—4.5 Hz and sends a direction indicator light signal to the instrument cluster simultaneously.



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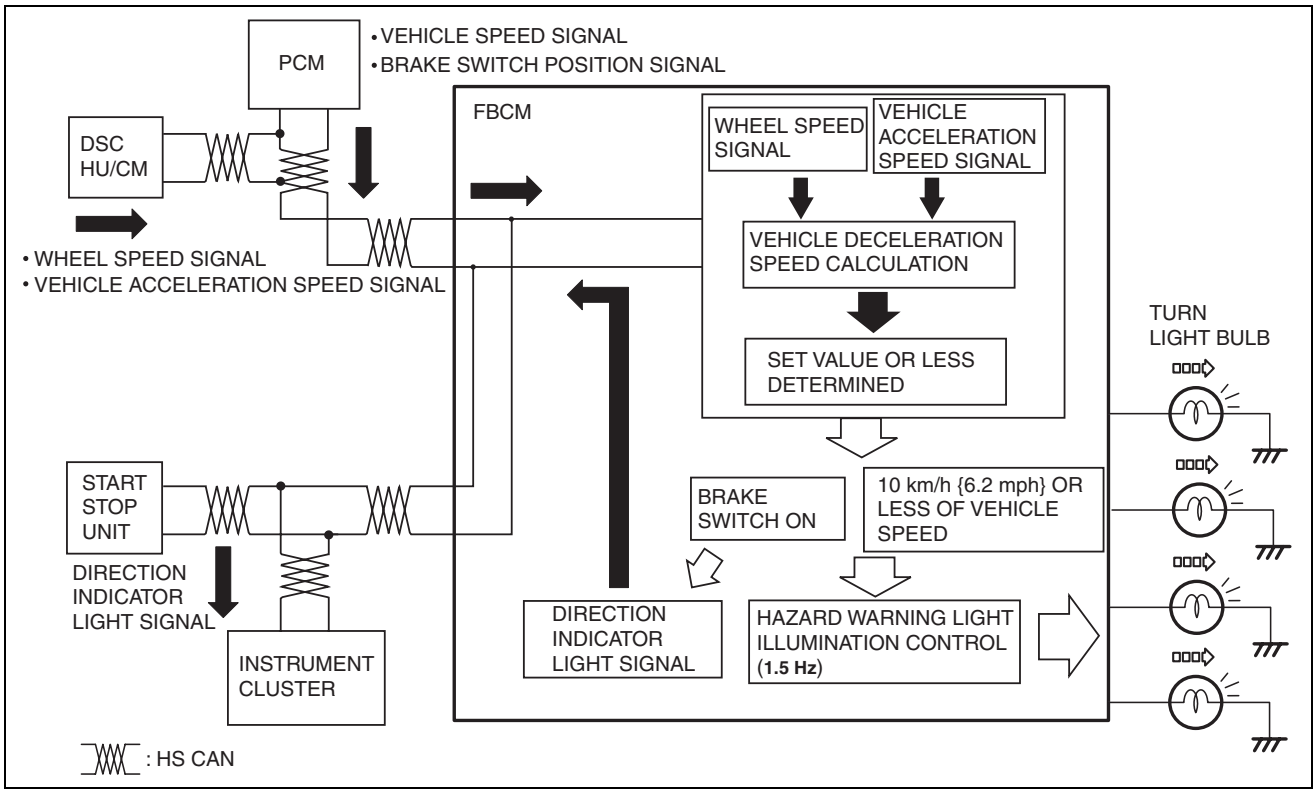
3. If the calculated deceleration speed is the set value or less for the sudden deceleration hazard warning mode, the front body control module (FBCM) stops the operation of the sudden deceleration warning mode.
4. If the vehicle speed is 10 km/h {6.2 mph} or less and the brake switch ON (brake pedal depressed) signal is sent after the sudden deceleration hazard warning mode operates, the front body control module (FBCM) controls the flashing of the hazard warning lights at 1.5 Hz (same as normal flashing).



ac5wzn00001244

LIGHTING SYSTEMS

5. If the brake switch OFF (brake pedal not depressed) signal is sent, the front body control module (FBCM) stops the operation of the emergency stop hazard warning mode and turns off the hazard warning lights.

REAR COMBINATION LIGHT

id091800011800

Purpose

- The rear combination lights are used to signal the following conditions to vehicles/people at the rear.
  - — Rear turn lights: Signals a left or right turn of the vehicle.
  - — Brake lights: Signals a vehicle stop.
  - — Taillights: Signals the presence of the vehicle to vehicles/people at the rear during nighttime.

Function

- The related light turns on or flashes according to the operation of each switch.

Operation switch	Related light	Operation condition
Light switch (TNS)	Taillight	Turns on
Brake switch	Brake light	Turns on
Turn switch	Rear turn light	Flashes
Hazard warning switch		

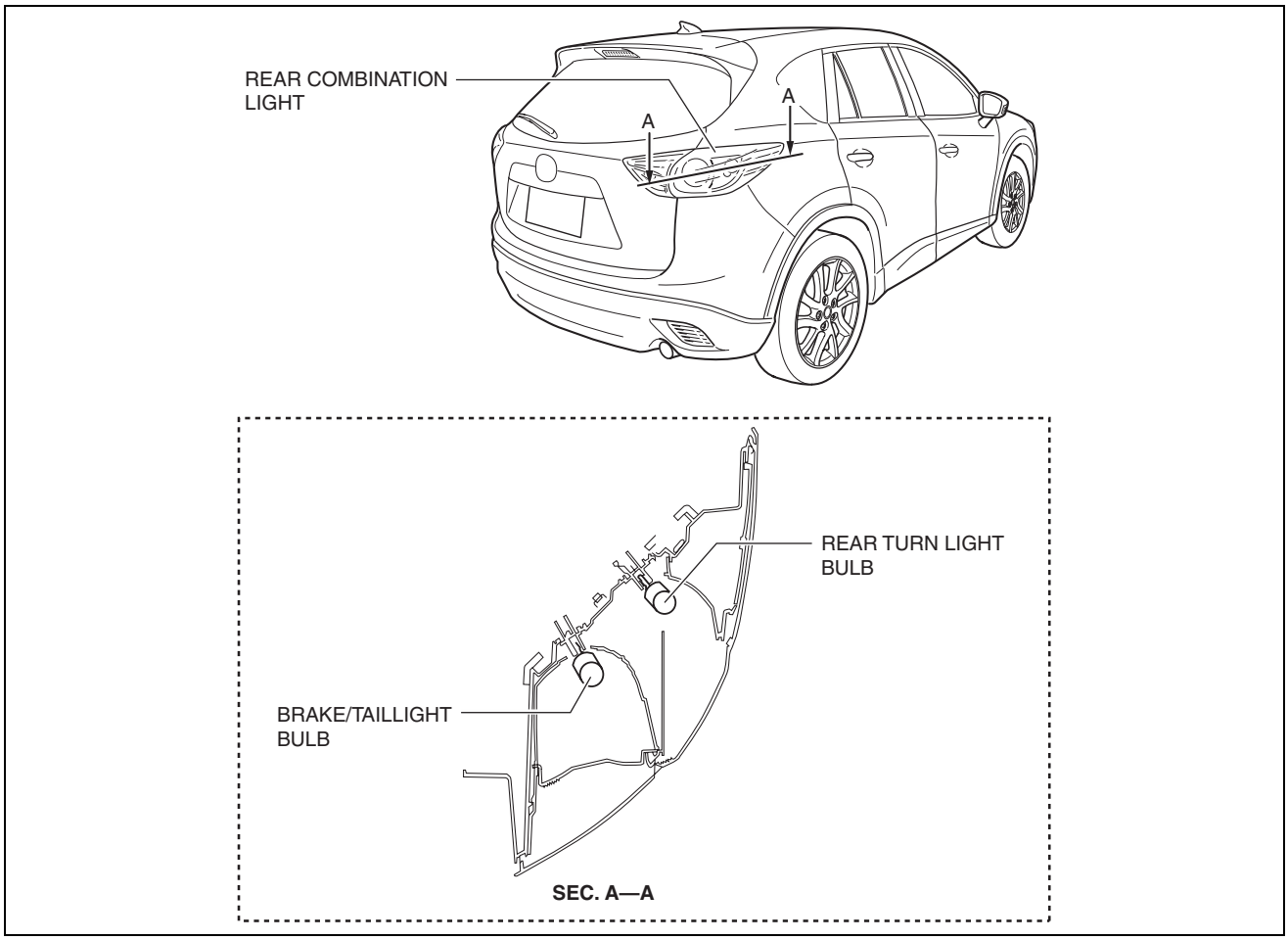
Construction

- The following parts are an integrated structure.
  - — Rear turn light
  - — Brake/taillight
- A clear lens has been adopted for the rear combination light.

Note

- Fogging or condensation on the inside of the rear combination lights may occur, however, it is a natural phenomenon occurring as a result of a temperature difference between the interior and exterior of the combination lights and has no effect on the light performance. Fogging or condensation will dissipate when the temperature inside the rear combination lights rises after the brake/taillight bulbs are illuminated and a period of time has elapsed.

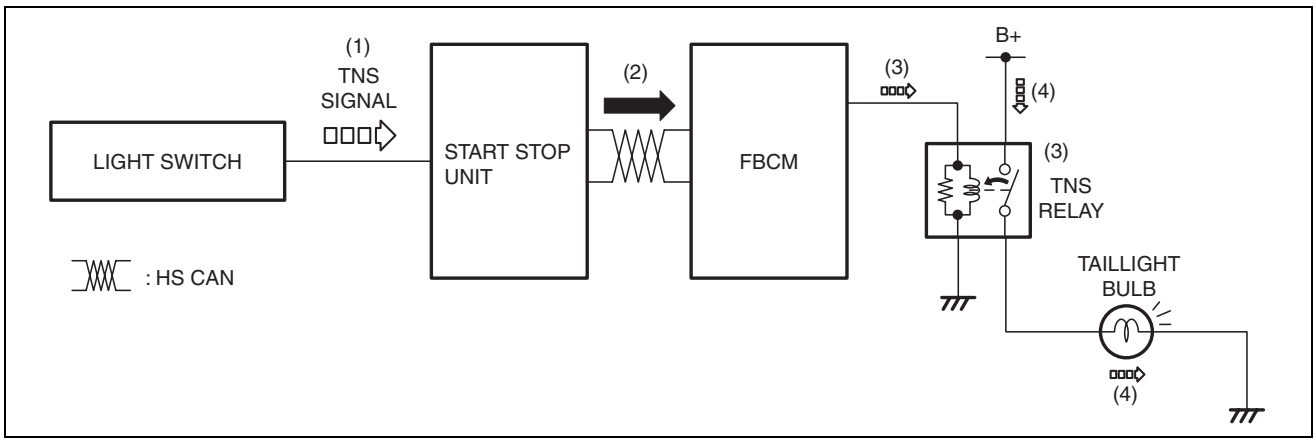
LIGHTING SYSTEMS



ac5wzn00000518

Operation
Taillights

1. When the light switch is operated to the TNS position, a TNS signal is input to the start stop unit.
2. The start stop unit sends the TNS signal to the front body control module (FBCM).
3. When the front body control module (FBCM) receives the TNS signal. it turns the TNS relay on.
4. When the TNS relay turns on, the taillight bulbs are illuminated.

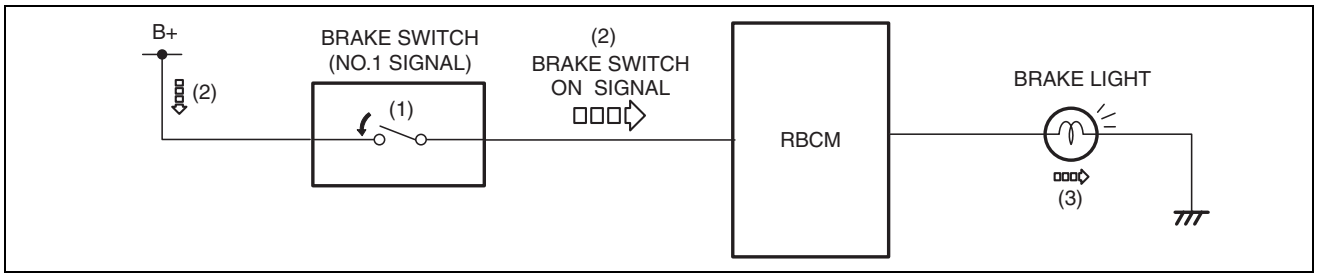


ac5wzn00001355

Brake lights (with smart city brake support)

1. When the brake pedal is depressed, the brake light switch turns on.
2. When the brake light switch turns on, a brake light switch on signal is input to the rear body control module (RBCM).
3. When the rear body control module (RBCM) receives the brake light switch on signal, it illuminates the brake lights.

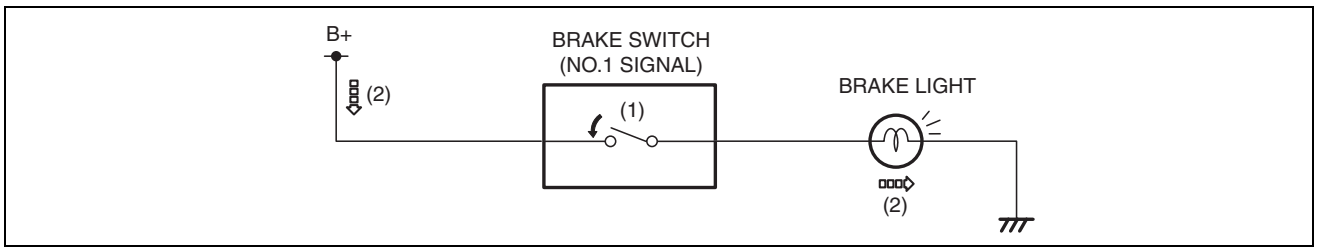
LIGHTING SYSTEMS



ac5wzn00001356

Brake lights (without smart city brake support)

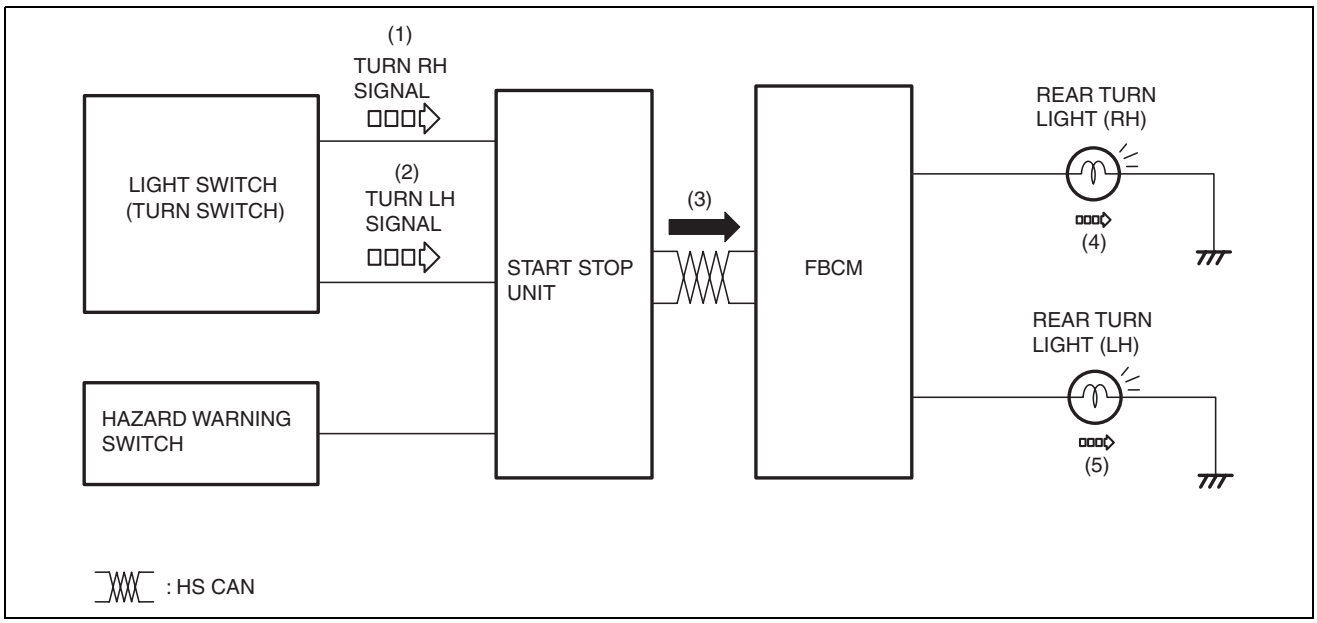
1. When the brake pedal is depressed, the brake light switch turns on.
2. When the brake light switch turns on, the brake lights are illuminated.



ac5wzn00001357

Rear turn lights (turn)

1. When the turn switch is operated to the RH position, a turn RH signal is input to the start stop unit.
2. When the turn switch is operated to the LH position, a turn LH signal is input to the start stop unit.
3. The start stop unit sends the turn RH or LH signal to the front body control module (FBCM).
4. When the front body control module (FBCM) receives the turn RH signal, the rear turn light (RH) flashes.
5. When the front body control module (FBCM) receives the turn LH signal, the rear turn light (LH) flashes.

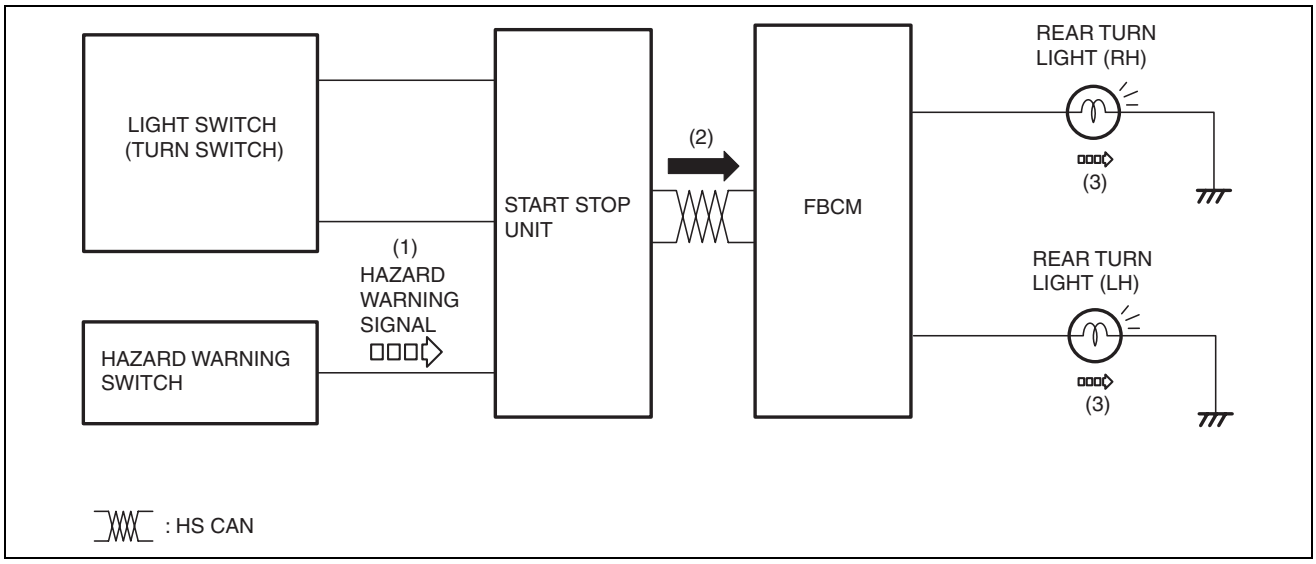


ac5wzn00001358

Rear turn lights (hazard)

1. When the hazard switch is turned on, a hazard signal is input to the start stop unit.
2. The start stop unit sends a hazard signal to the front body control module (FBCM).
3. When the front body control module (FBCM) receives the hazard signal, the rear turn lights (RH) and (LH) flash.

LIGHTING SYSTEMS



ac5wzn00001359

Fail-safe
- Function not equipped.

LIFTGATE LIGHT

id091800011900

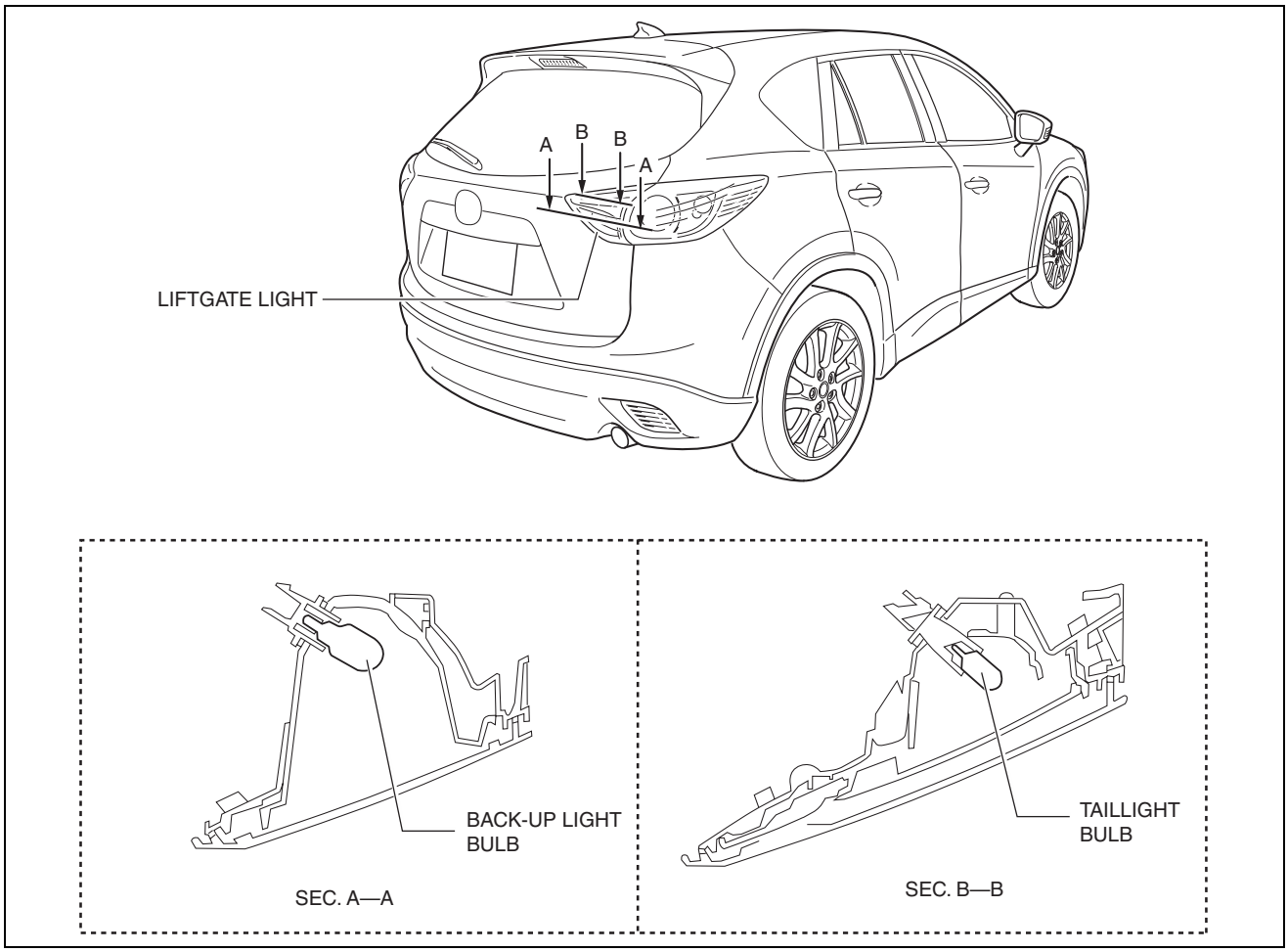
Purpose
- The liftgate lights are used to signal the following conditions to vehicles/people at the rear.
  - — Back-up lights: Signals that the vehicle is backing up.
  - — Taillights: Signals the presence of the vehicle during nighttime.

Function
- The back-up lights are illuminated in conjunction with the shift operation.
- The taillights are illuminated in conjunction with the light switch operation (TNS).

Construction
- The following parts are an integrated structure.
  - — Back-up light
  - — Taillight
- A clear lens has been adopted for the liftgate light.

Note
- Fogging or condensation may occur inside the liftgate lights, however, it is a natural phenomenon occurring as a result of a temperature difference between the interior and exterior of the liftgate lights and has no effect on the light performance. Fogging or condensation will dissipate when the temperature inside the liftgate lights rises after the back-up light bulb is illuminated and a period of time has elapsed.

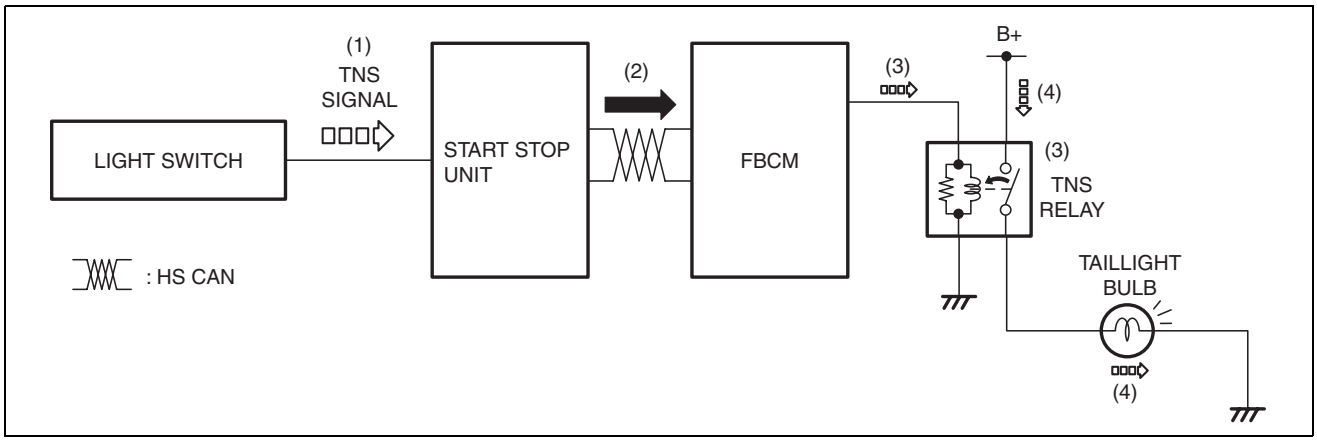
LIGHTING SYSTEMS



ac5wzn00000533

Operation
Taillights

1. When the light switch is operated to the TNS position, a TNS signal is input to the start stop unit.
2. The start stop unit sends the TNS signal to the front body control module (FBCM).
3. When the front body control module (FBCM) receives the TNS signal, it turns the TNS relay on.
4. When the TNS relay turns on, the taillight bulbs are illuminated.



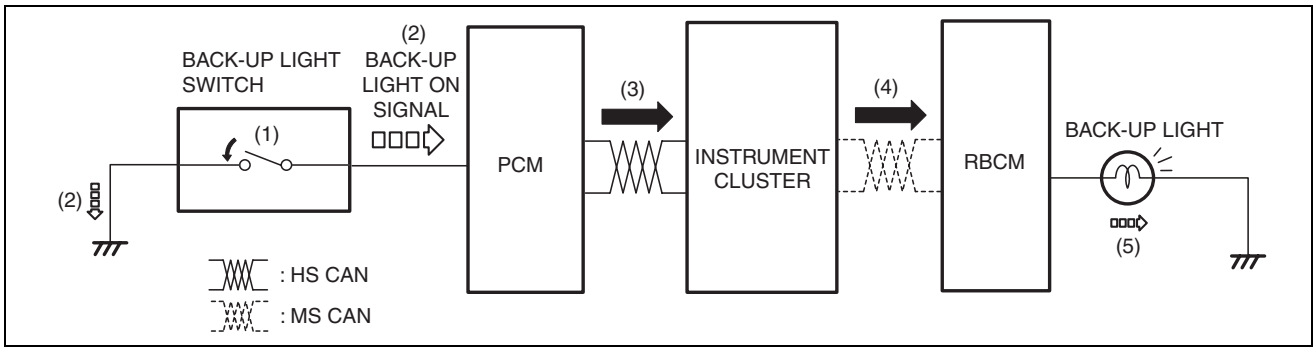
ac5wzn00001360

Buck-up lights (MTX)

1. When the shift lever is operated to the R position, the back-up light switch is turned on.
2. When the back-up light switch is turned on, a back-up light on signal is input to the PCM.
3. The PCM sends the back-up light switch on signal to the instrument cluster.
4. The instrument cluster sends the back-up light switch on signal to the rear body control module (RBCM).

LIGHTING SYSTEMS

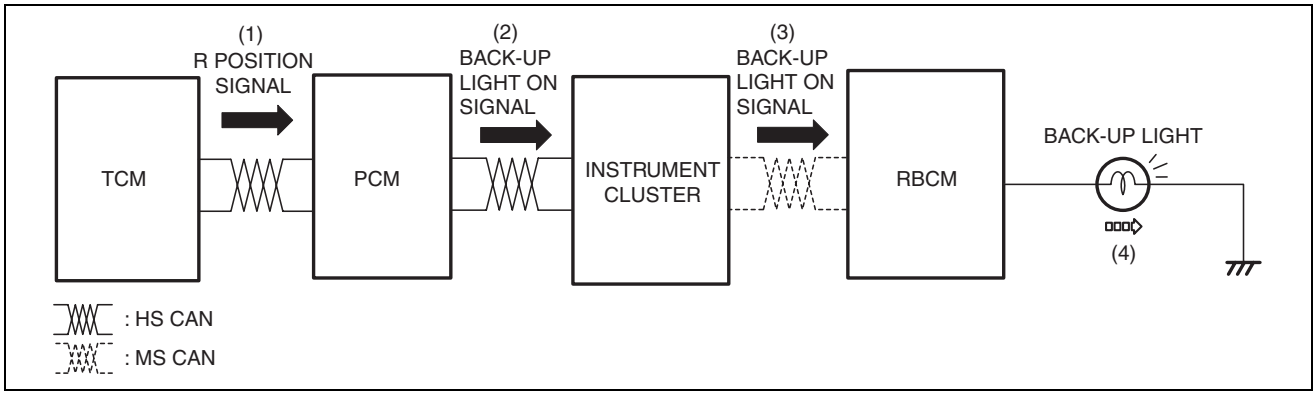
5. When the rear body control module (RBCM) receives the back-up light switch on signal, the back-up lights are illuminated.



ac5wzn00001361

Buck-up lights (ATX)

1. When the selector lever is operated to the R position, the TCM sends an R position signal to the PCM.
2. When the PCM receives the R position signal, it sends a back-up light on signal to the instrument cluster.
3. The instrument cluster sends the back-up light switch on signal to the rear body control module (RBCM).
4. When the rear body control module (RBCM) receives the back-up light on signal, the back-up lights are illuminated.



ac5wzn00001415

Fail-safe

- Function not equipped.

REAR FOG LIGHT

id091800014100

Purpose

- The vehicle's presence is signaled to vehicles at the rear by the illumination of the rear fog light during poor weather conditions such as dense fog.

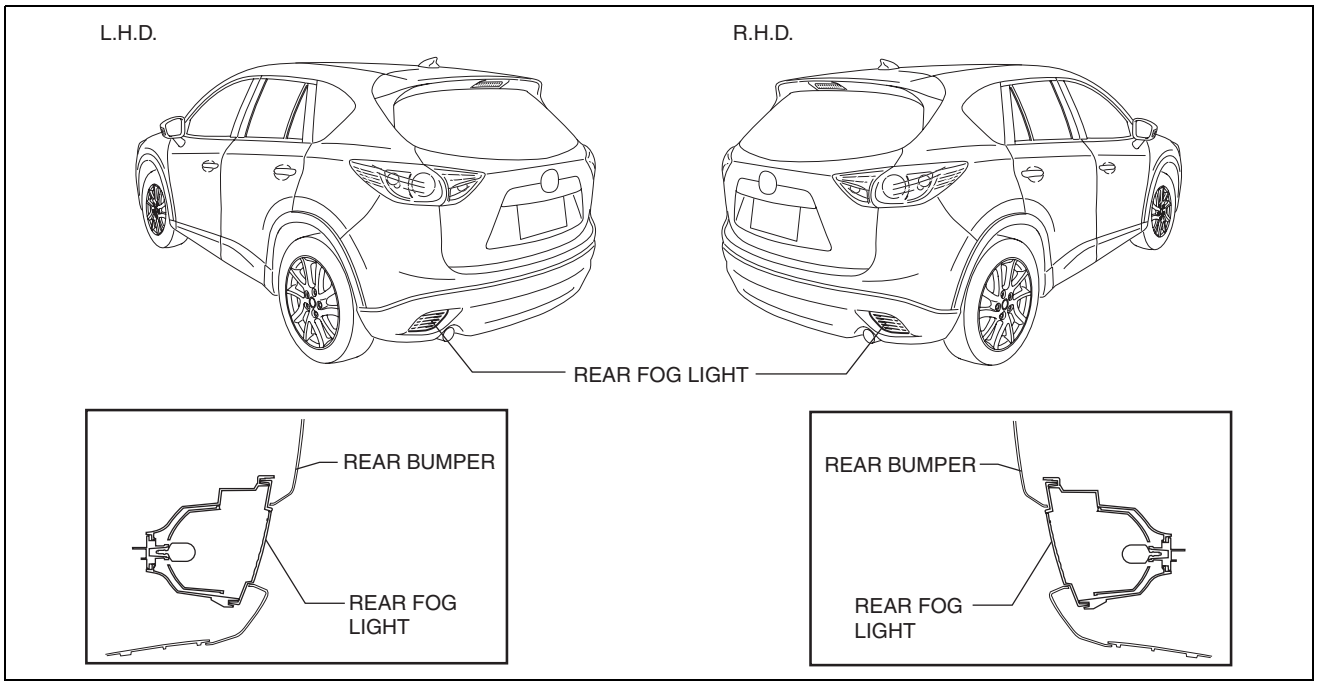
Function

- The rear fog light illuminates when all of the following conditions are met:
  - — TNS illuminated
  - — Rear fog light switch ON

Construction

- The rear fog light is built into the rear bumper.
- The front body control module (FBCM) controls the rear fog light.

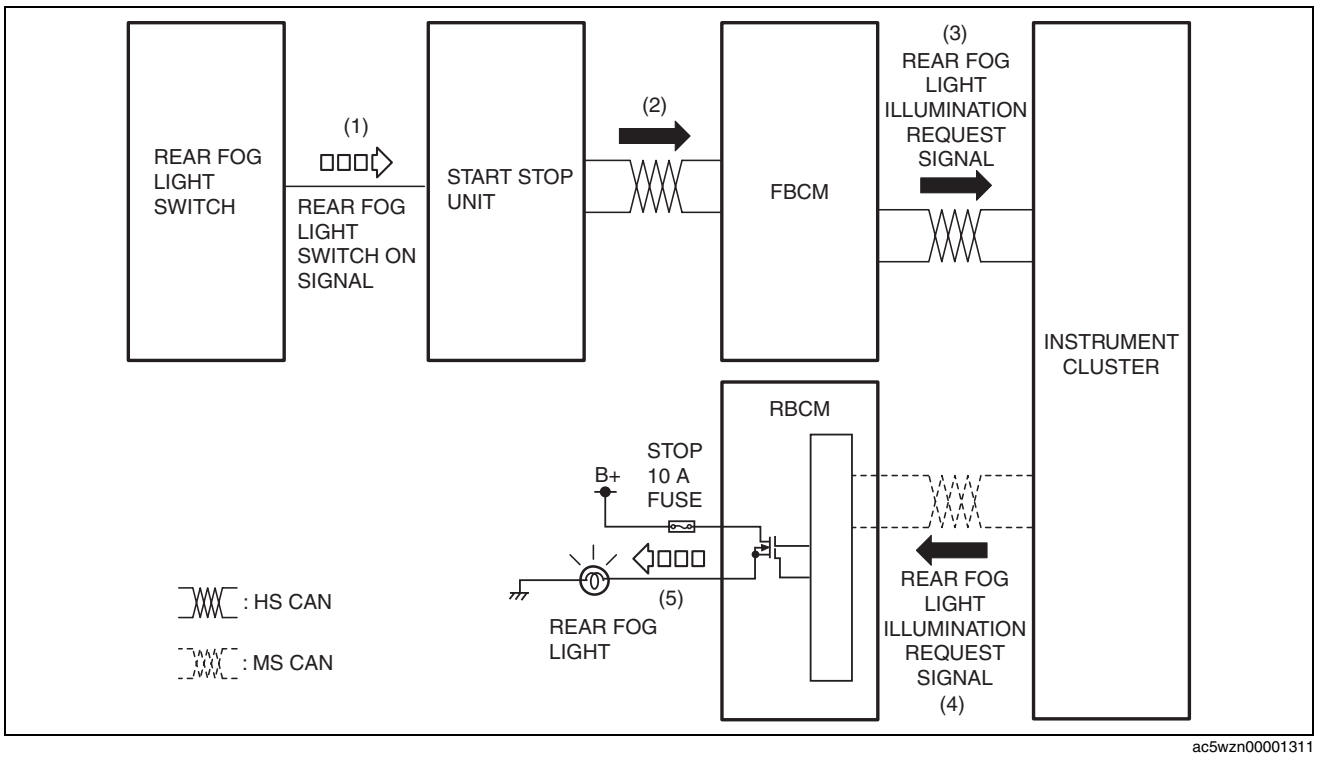
LIGHTING SYSTEMS



ac5wzn00001281

Operation

1. When the rear fog light switch turns on, a rear fog light switch ON signal is sent to the start stop unit.
2. The start stop unit sends the rear fog light switch condition (rear fog light switch ON) signal to the front body control module (FBCM) via the CAN signal.
3. When the front body control module (FBCM) receives the rear fog light switch condition (rear fog light switch ON) signal while the TNS are illuminated, it sends the rear fog light illumination request signal to the instrument cluster via the CAN signal.
4. The instrument cluster sends the rear fog light illumination request signal to the rear body control module (RBCM).
5. When the rear body control module (RBCM) receives the rear fog light illumination request signal, it illuminates the rear fog light.



ac5wzn00001311

LIGHTING SYSTEMS

Fail-safe
- Function not equipped.

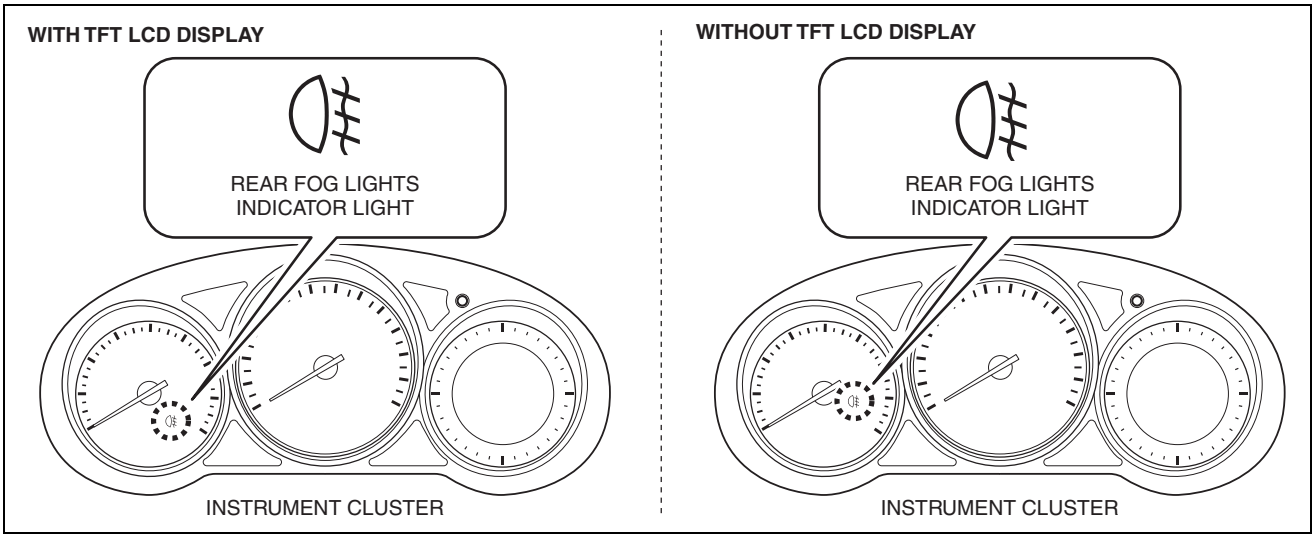
REAR FOG LIGHT INDICATOR LIGHT

id091800013900

Purpose
- Notifies the user that the rear fog lights are illuminated.

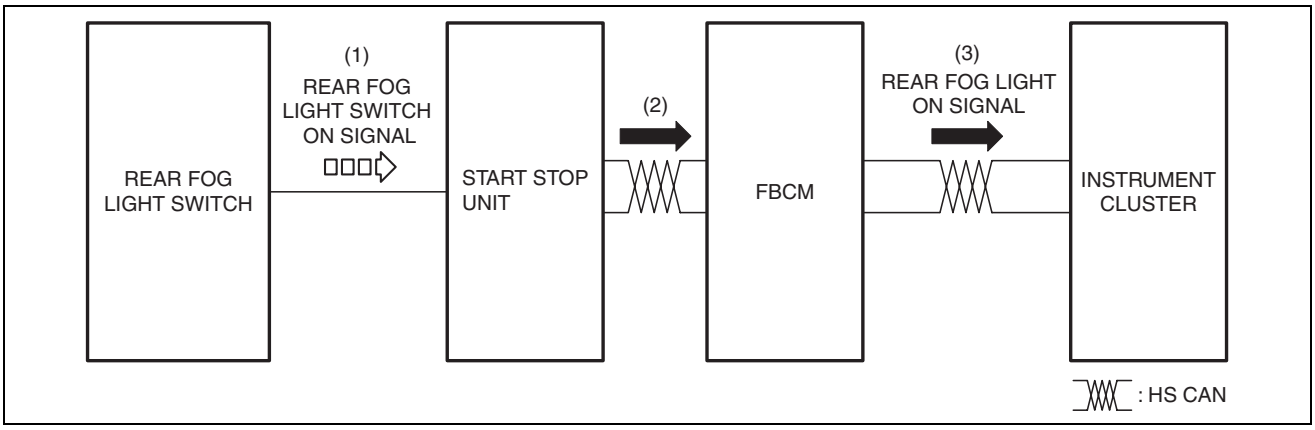
Function
- Illuminates when the rear fog light illumination conditions are met.

Construction
- Displayed in the instrument cluster.



ac5wzn00001312

Operation
1. With the light switch in the TNS or HEAD position, a rear fog light switch signal is input to the start stop unit when the rear fog light switch is operated to the on position.
2. The start stop unit sends the rear fog light switch signal to the front body control module (FBCM).
3. The front body control module (FBCM) sends the rear fog light switch signal to the instrument cluster as a rear fog light illumination signal.
4. The instrument cluster illuminates the rear fog light indicator light when it receives the rear fog light illumination signal.



ac5wzn00001313

Fail-safe
- Function not equipped.

HIGH-MOUNT BRAKE LIGHT

id091800012000

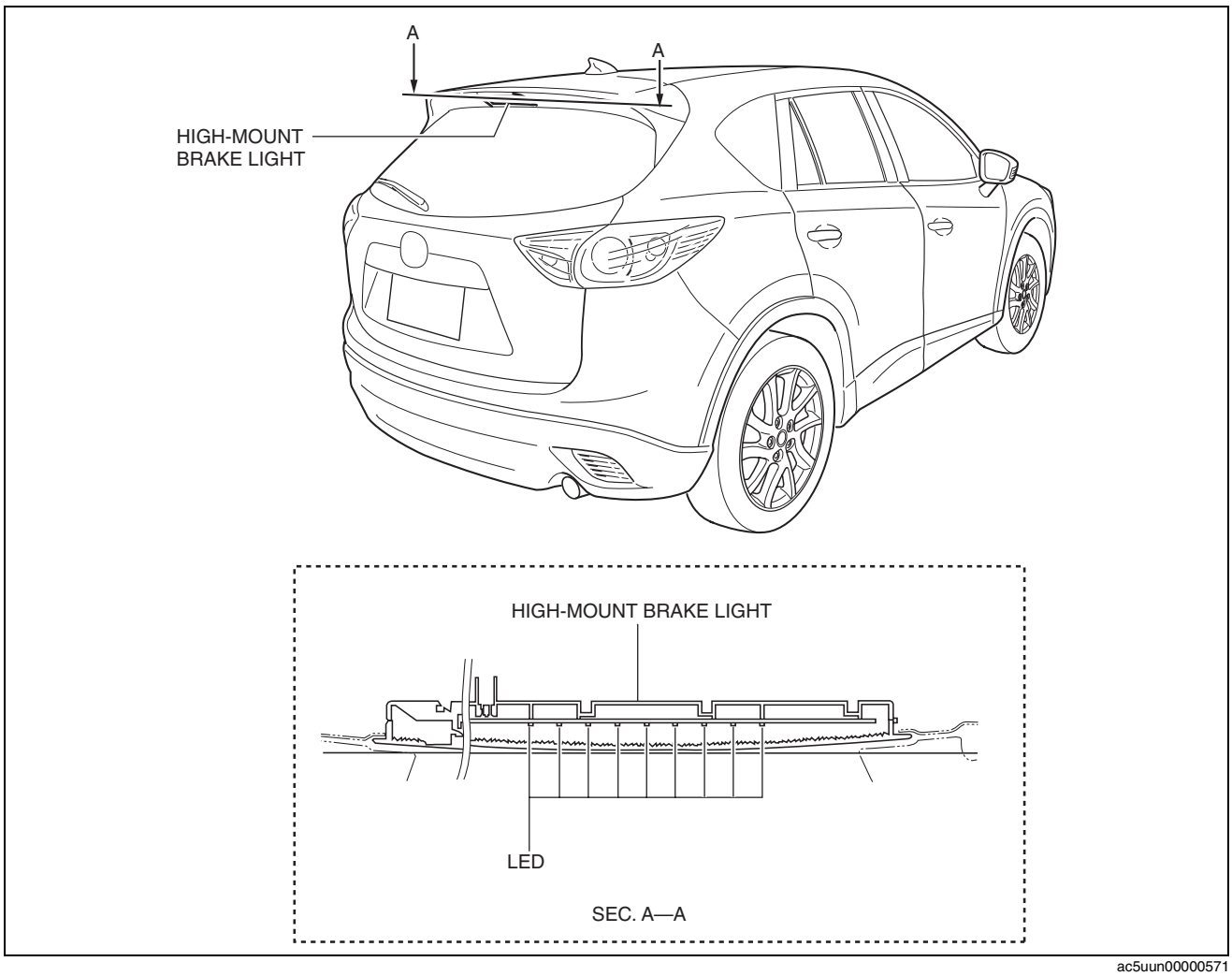
Purpose
- The high-mount brake light signals vehicles to the rear that the vehicle is stopped.

LIGHTING SYSTEMS

Function
- The high-mount brake light illuminates in conjunction with the operation of the brake light switch.

Construction
- The high-mount brake light is positioned on the roof.
- The high-mount brake light has adopted an LED.

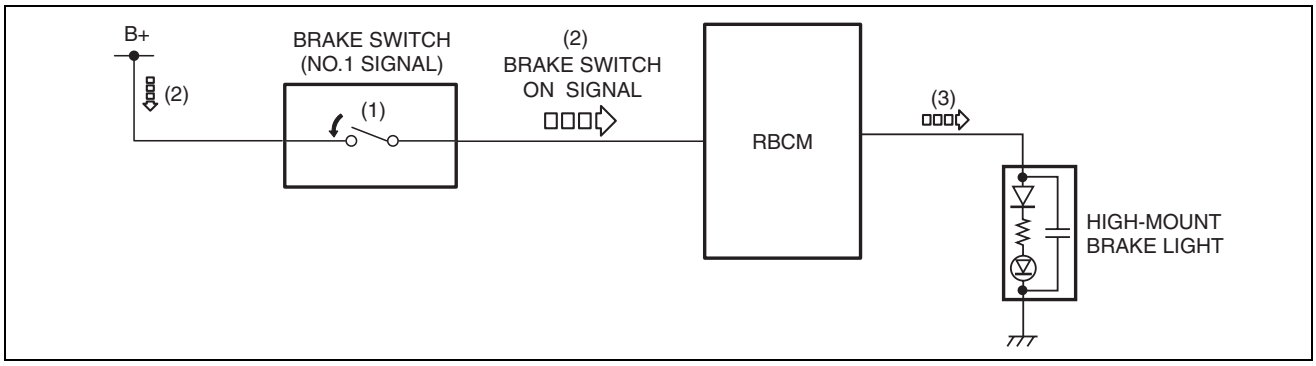
Note
- Fogging or condensation on the inside of the high-mount brake light may occur, however, it is a natural phenomenon occurring as a result of a temperature difference between the interior and exterior of the high-mount brake light and has no effect on the light performance. Fogging or condensation will dissipate when the temperature inside the high-mount brake light rises after the high-mount brake light is illuminated and a period of time has elapsed.



ac5uun00000571

Operation
Brake lights (with smart city brake support)
1. When the brake pedal is depressed, the brake light switch turns on.
2. When the brake light switch turns on, a brake light switch on signal is input to the rear body control module (RBCM).
3. When the rear body control module (RBCM) receives the high-mount brake light switch on signal, it illuminates the brake lights.

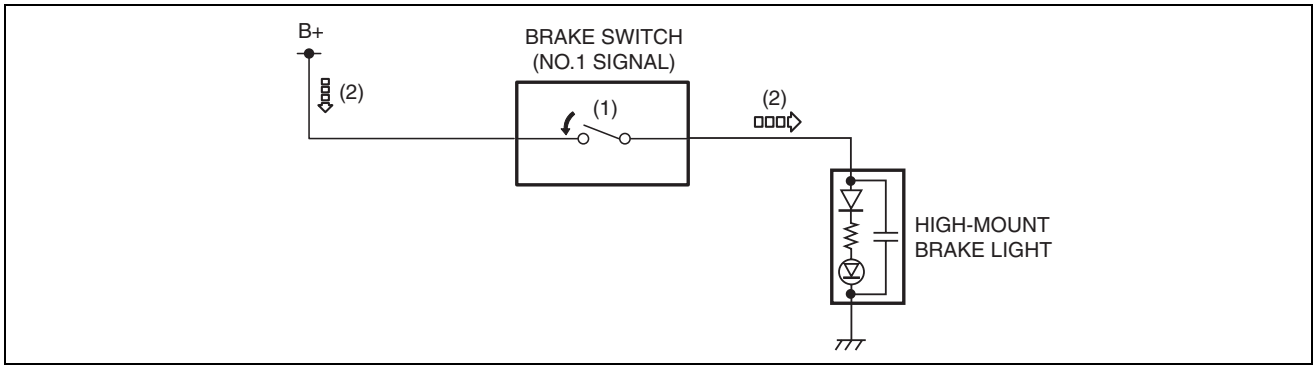
LIGHTING SYSTEMS



ac5wzn00001362

Brake lights (without smart city brake support)

1. When the brake pedal is depressed, the brake light switch turns on.
2. When the brake light switch turns on, the high-mount brake light illuminates.



ac5wzn00001363

Fail-safe

- Function not equipped.

LICENSE PLATE LIGHT

id091800012100

Purpose

- The license plate lights shine light on the license plate during nighttime driving.

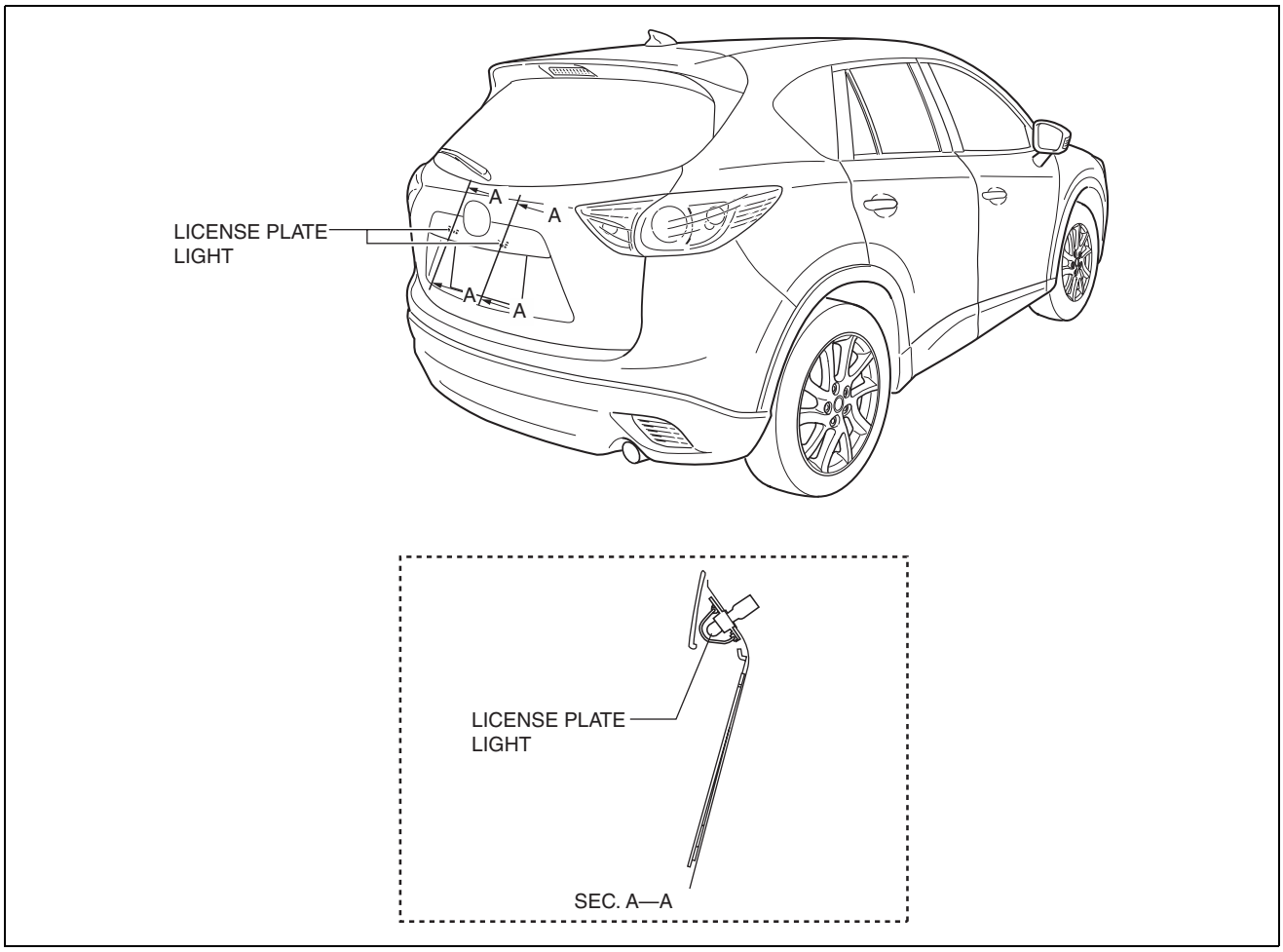
Function

- The license plate lights illuminate in conjunction with the operation of the light switch.

Construction

- The license plate lights are installed to the liftgate.

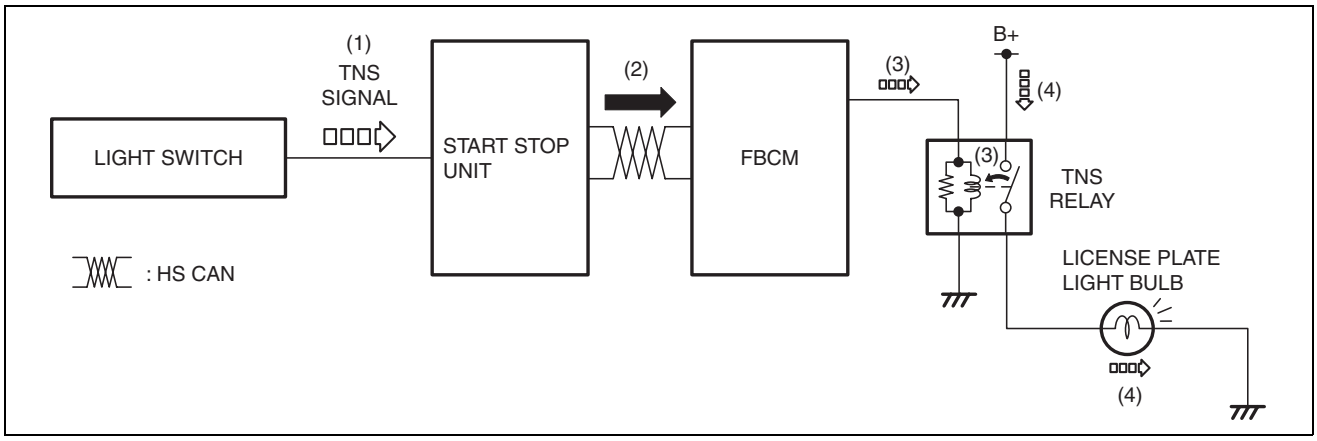
LIGHTING SYSTEMS



ac5uun00000572

Operation

1. When the light switch is operated to the TNS position, a TNS signal is input to the start stop unit.
2. The start stop unit sends the TNS signal to the front body control module (FBCM).
3. When the front body control module (FBCM) receives the TNS signal, it turns the TNS relay on.
4. When the TNS relay turns on, the license plate bulbs are illuminated.



ac5wzn00001364

Fail-safe

- Function not equipped.

LIGHTING SYSTEMS

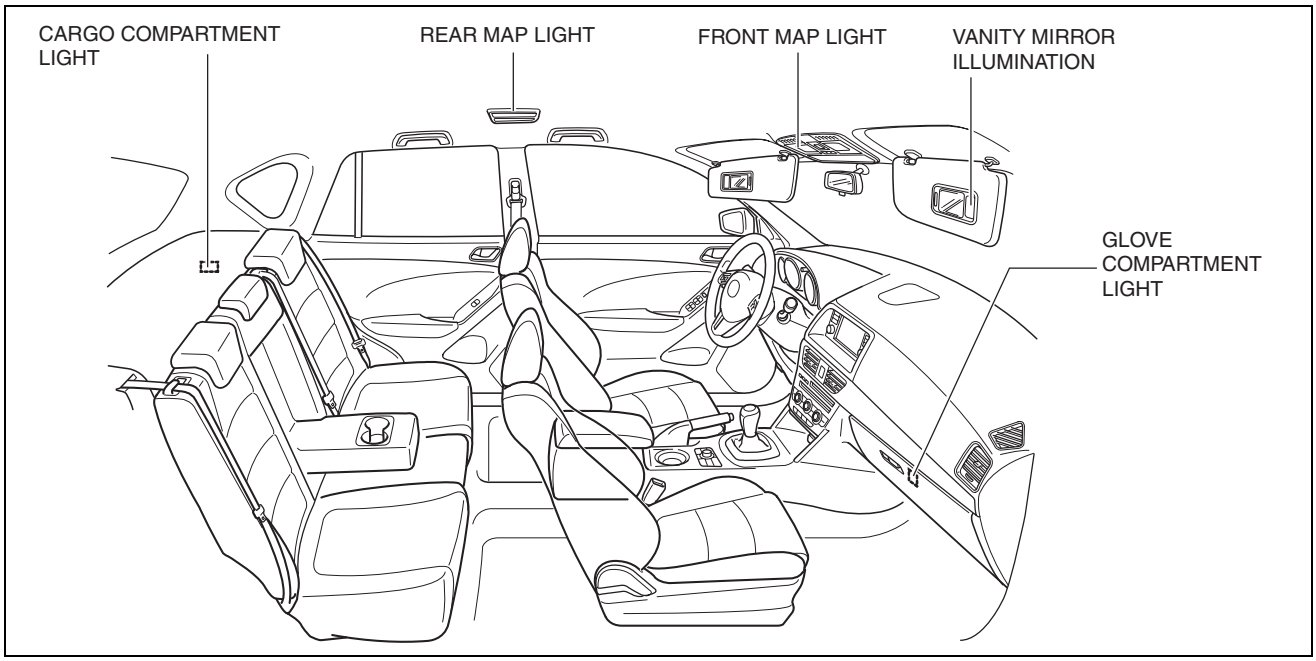
INTERIOR LIGHTING SYSTEM

id091800012200

Outline

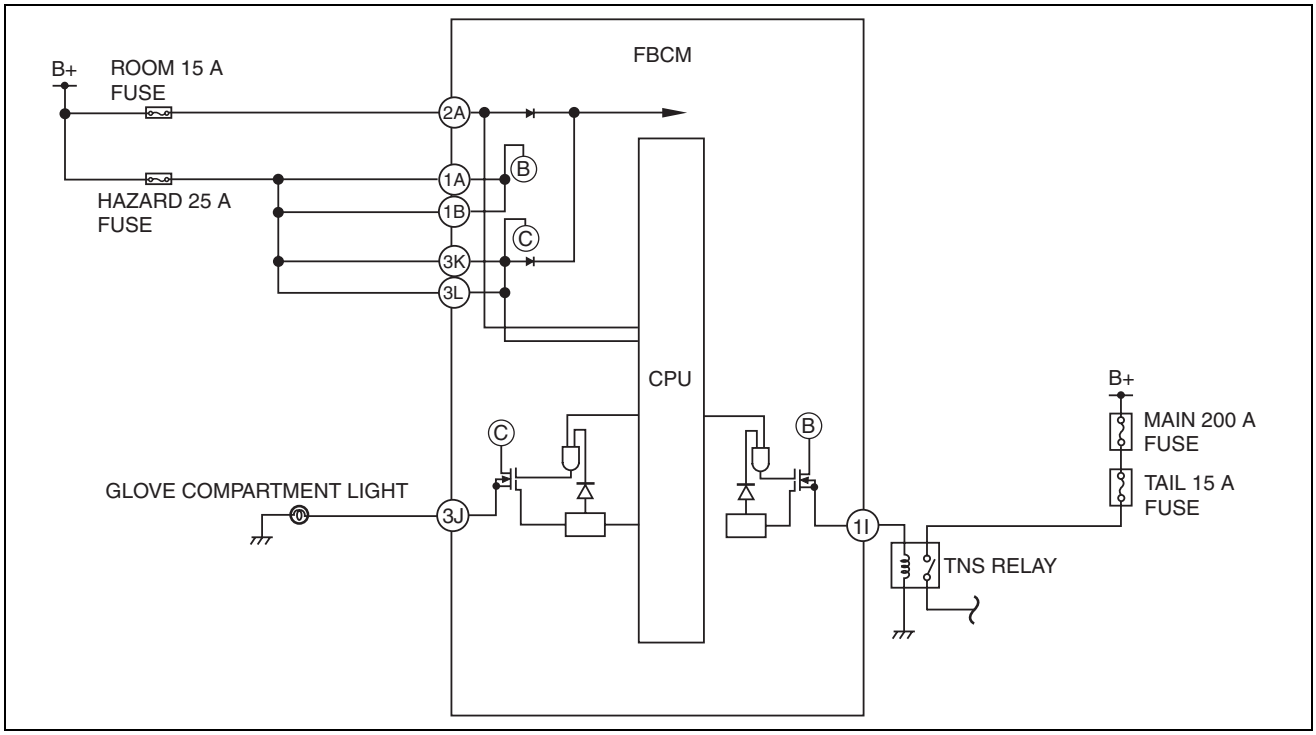
- A room light control system has been adopted in which illumination time and illumination level of the interior lights change.
- The rear body control module (RBCM) performs room light control system fail-safe. (See 09-40-20 REAR BODY CONTROL MODULE (RBCM).)

Structural View



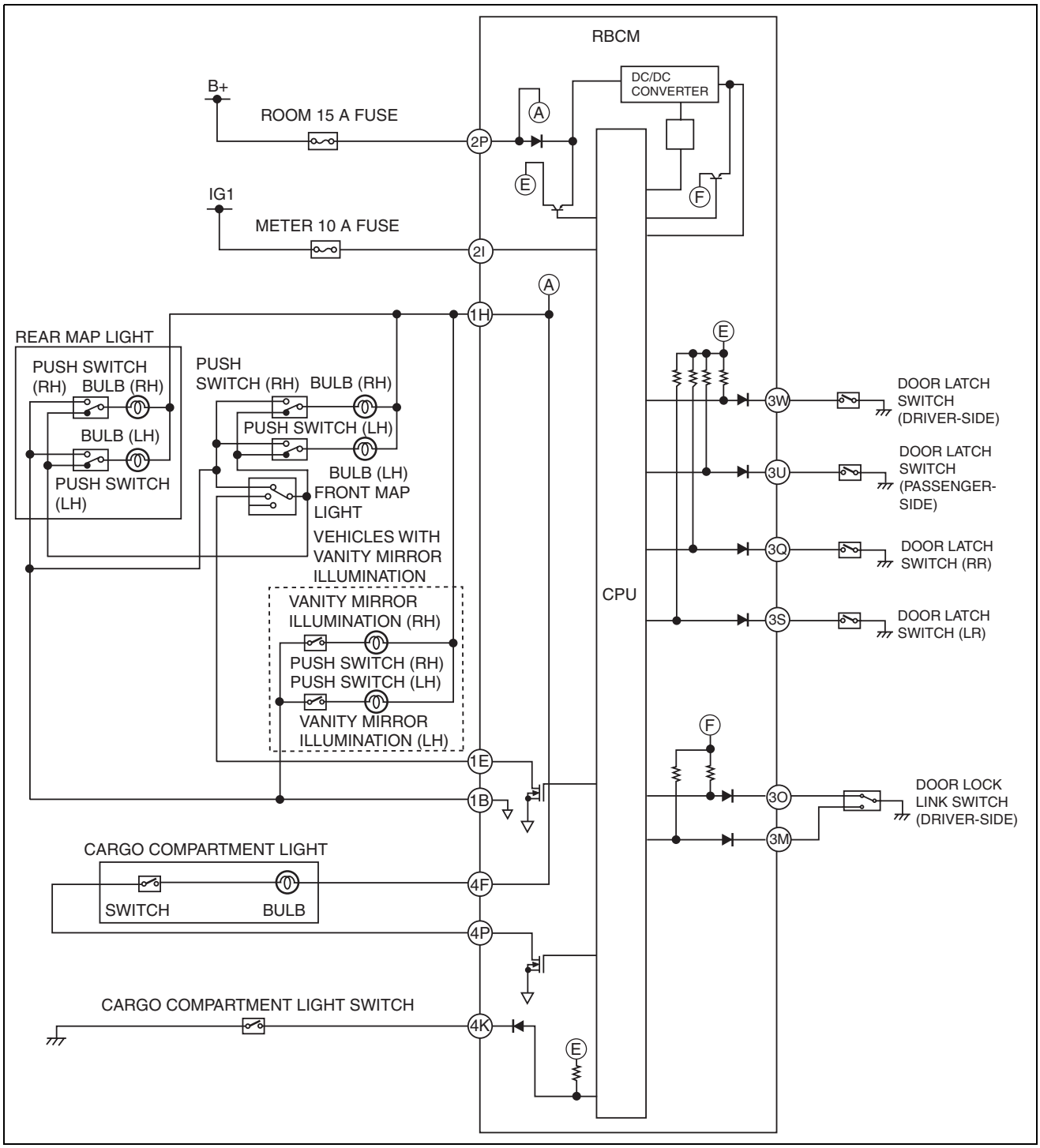
ac5wzn00000585

System Wiring Diagram



ac5wzn00000587

LIGHTING SYSTEMS



ac5wzn00001407

ROOM LIGHT CONTROL SYSTEM

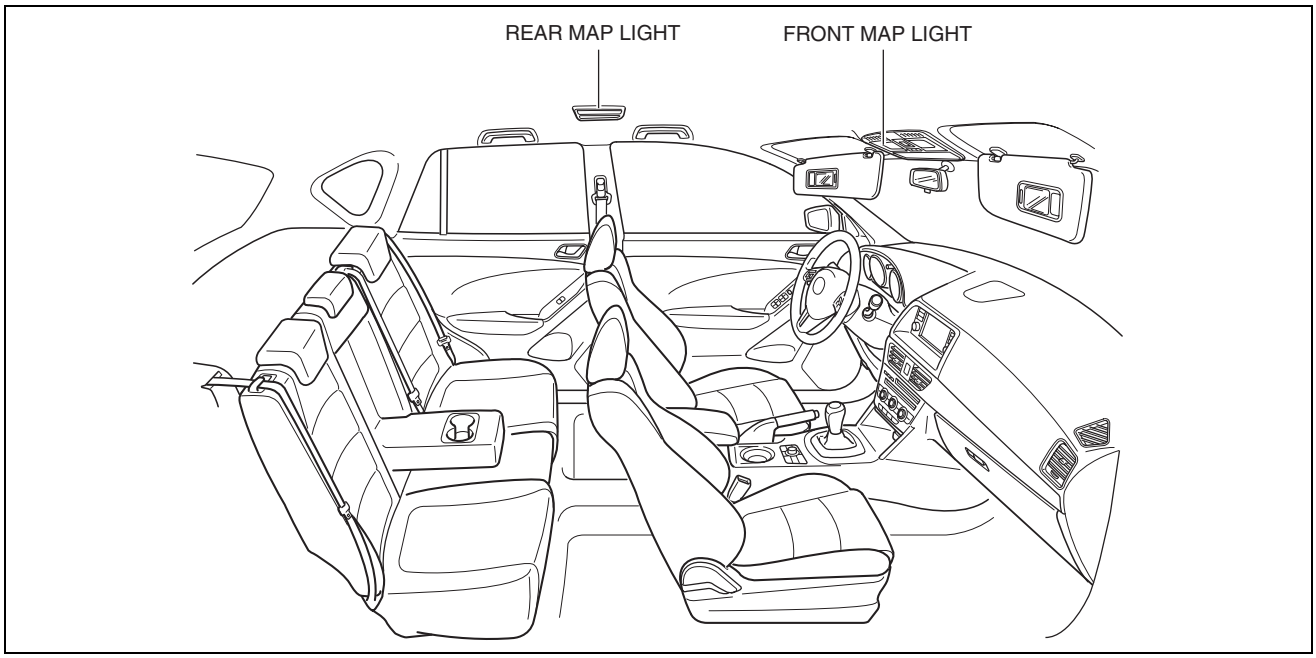
id091800012300

Outline

- The room light control system changes the illumination condition and illumination level of the interior lights (door position) according to whether the doors are opened/closed and locked/unlocked.
- The room light control system is controlled by the rear body control module (RBCM).
- The rear body control module (RBCM) performs room light control system fail-safe. (See 09-40-20 REAR BODY CONTROL MODULE (RBCM).)

LIGHTING SYSTEMS

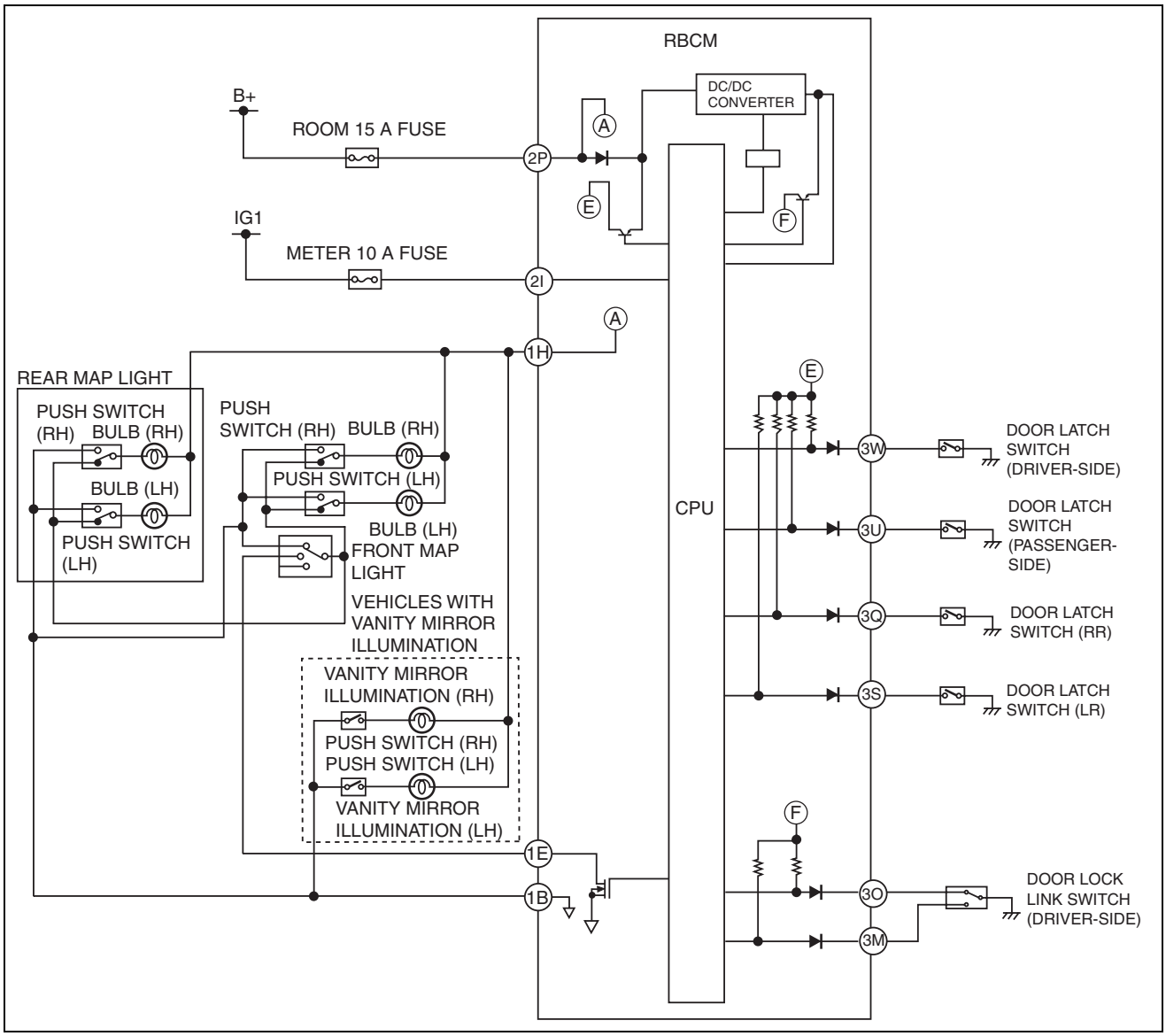
Structural View



ac5wzn00001478

LIGHTING SYSTEMS

System Wiring Diagram



ac5wzn00001408

Operation

Operation condition	Interior light		Lights off condition (Any of the following conditions is met)
	Illumination period	Brightness level	
• Condition detected in which any door is opened (any door latch switch is on) from condition in which ignition is switched OFF (LOCK) or in ACC position, and all doors are closed (all door latch switches and door switches are off).	Approx. 30 min	100 %	• All doors closed except for liftgate (All door latch switches and door switches are off) • After illumination time elapses *1
• All doors are closed (all door latch switches and door switches are off), and driver's door lock knob is unlocked from lock	Approx. 30 s	100 %	• Ignition is switched ON • Lock driver's door lock knob (Door lock link switch is in lock position) • After illumination time elapses
• Condition detected in which ignition is switched off (LOCK) with ignition switched ON (engine off or on)	Approx. 30 s	100 %	• Ignition is switched ON • After illumination time elapses

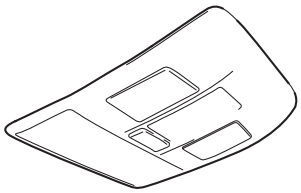
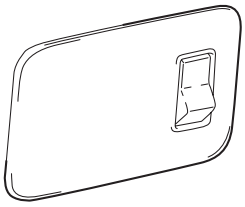
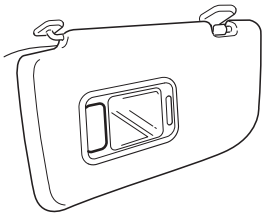
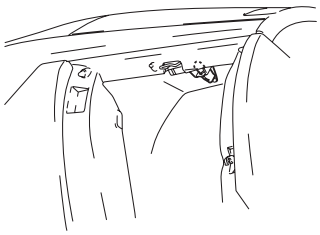
LIGHTING SYSTEMS

Operation condition	Interior light		Lights off condition (Any of the following conditions is met)
	Illumination period	Brightness level	
• Condition detected in which all doors are closed (all door latch switches and door switches are off) from a condition in which the ignition is switched OFF (LOCK) or in ACC position and any door is opened.	Approx. 15 s	60 %	• Ignition is switched ON • Lock driver's door lock knob (Door lock link switch is in lock position) • After illumination time elapses

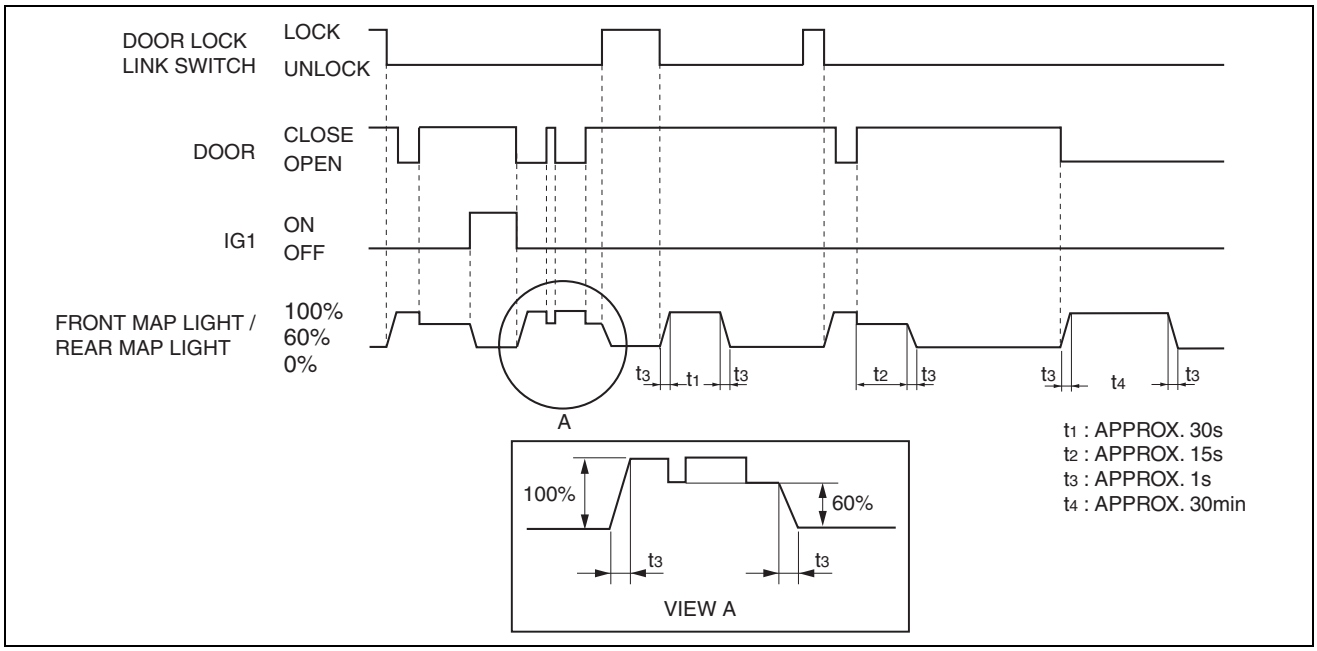
*1 : After the interior light is turned off according to the cancel conditions, it turns on again if any one of the following conditions is met.

— After all doors are closed, any door is re-opened (after all door latch switches and door switches are off, any door latch switch and door switch is on)
— Ignition is switched ON

x:With room light control system
-: No airflow

Type		Installation position	Room light control system
Front map light		Front	x
Rear map light		Center area of roof	x
Cargo compartment light		Cargo compartment	-
Vanity mirror illumination		Sunvisor	-
Glove compartment light		Passenger's side floor panel	-

LIGHTING SYSTEMS



ac5wzn00001409

FRONT MAP LIGHT

id091800112600

Purpose

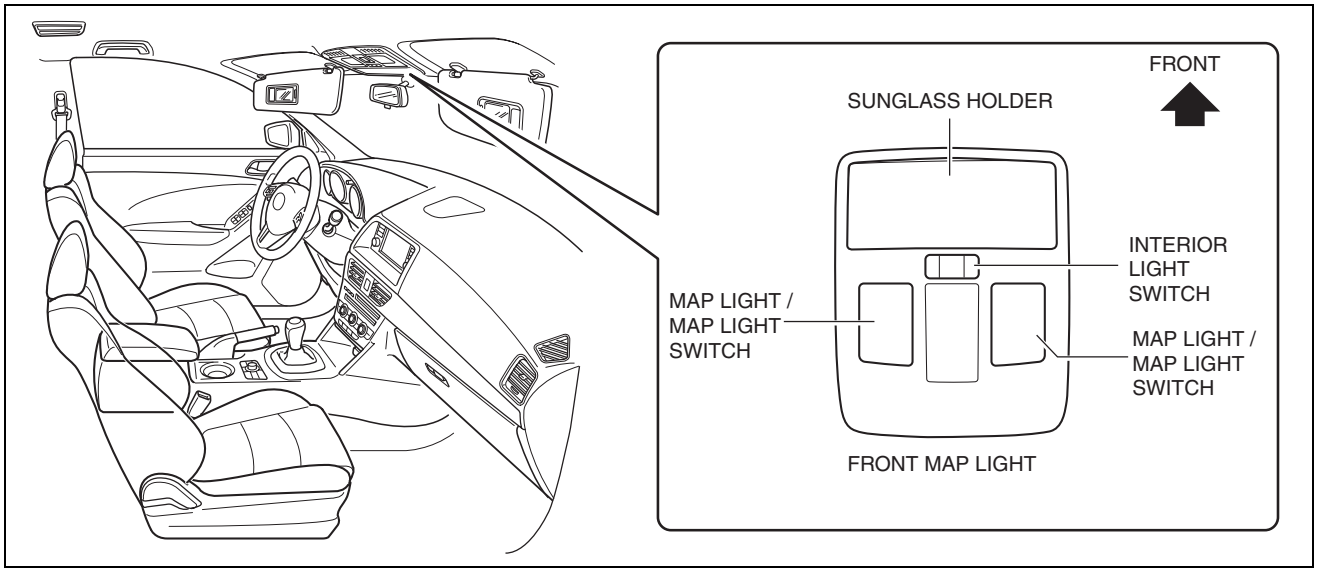
- The front map lights shine light at the front of the vehicle interior.

Function

- The front map lights illuminate when the map light switch is turned on.
- Illuminates according to the lock condition of the driver's door and open/close conditions of the doors under the rear body control module (RBCM) control when the interior light switch is in the DOOR position.

Construction

- Map lights which are integrated with the sunglass holder have been adopted.



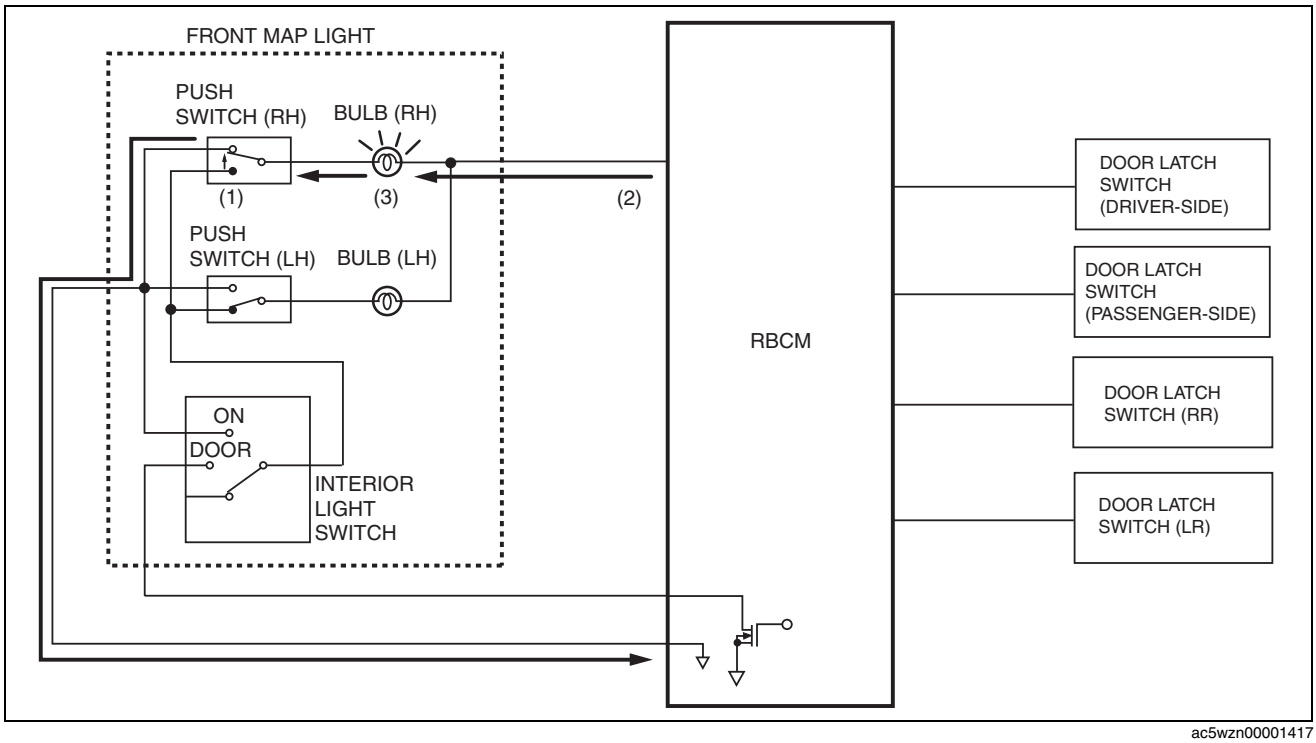
ac5wzn00000630

Operation

Map light switch operation

1. Turn the map light switch on.
2. The battery current flows to the map light bulb from the rear body control module (RBCM).
3. The map light illuminates.

LIGHTING SYSTEMS



ac5wzn00001417

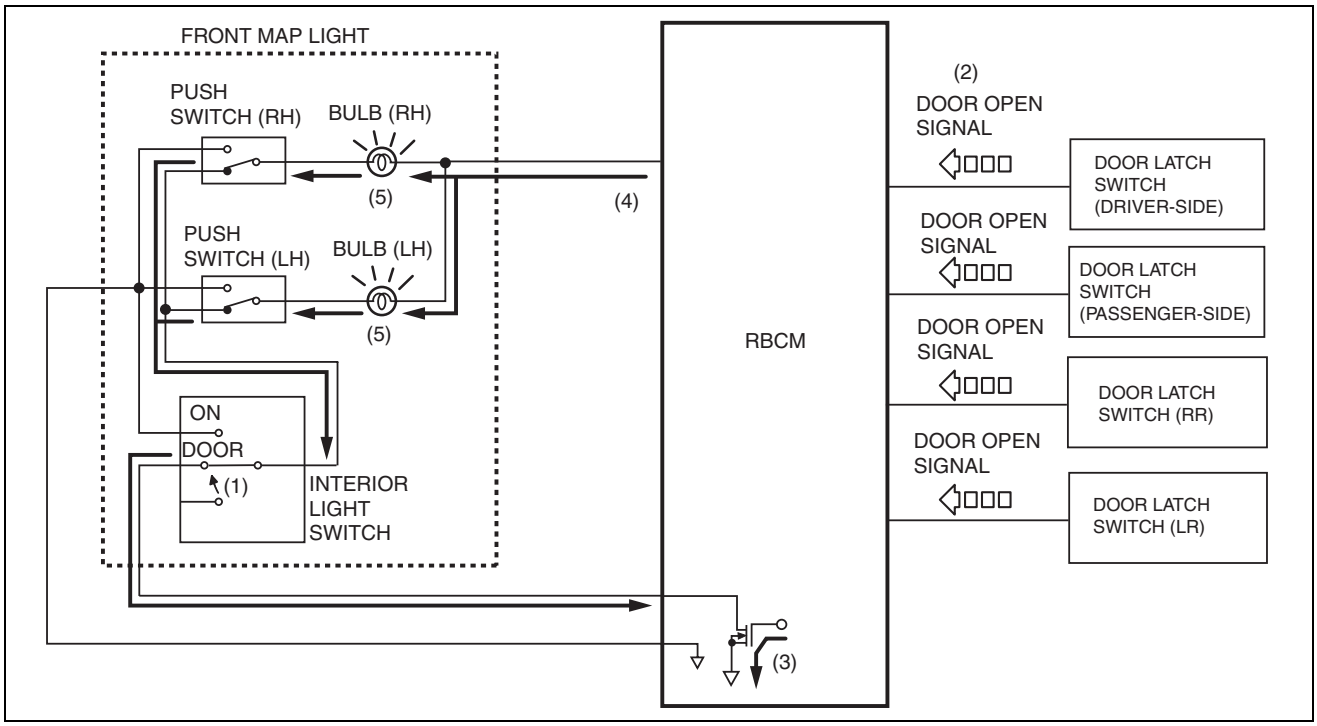
Interior light switch operation

1. Interior light switch is in DOOR position.
2. When any door is opened, the door open signal is input to the rear body control module (RBCM).
3. When the rear body control module (RBCM) receives the door-open signal, it turns on the transistor.
4. When the transistor turns on, the battery current flows to the map light bulb from the rear body control module (RBCM).
5. The map light illuminates.

Note

- When the interior light switch is in the DOOR position, the map light illumination on/off timing is controlled by the interior light control system. For details, refer to the room light control system. (See 09-18-84 ROOM LIGHT CONTROL SYSTEM.)

LIGHTING SYSTEMS



ac5wzn00001369

Fail-safe
- Function not equipped.

REAR MAP LIGHT

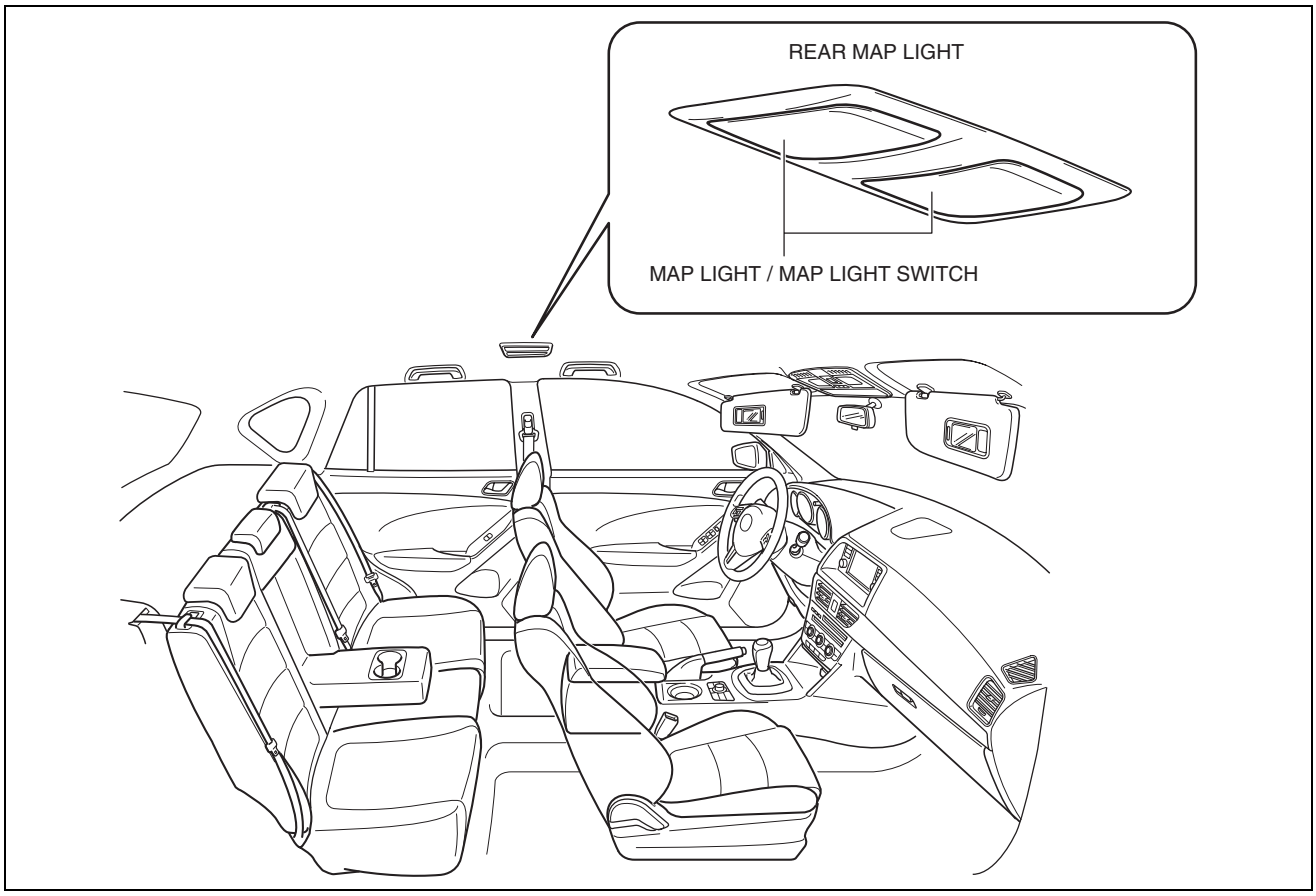
id091800112700

Purpose
- The rear map lights shine light at the center of the vehicle interior.

Function
- The rear map lights illuminate when the interior light switch is in the ON position or the map light switch is turned on.
- The rear map lights illuminate according to the lock condition of the driver's door and open/close conditions of the doors under the rear body control module (RBCM) control when the interior light switch for front map lights is in the DOOR position.

Construction
- The rear map lights are assembled to the headliner.

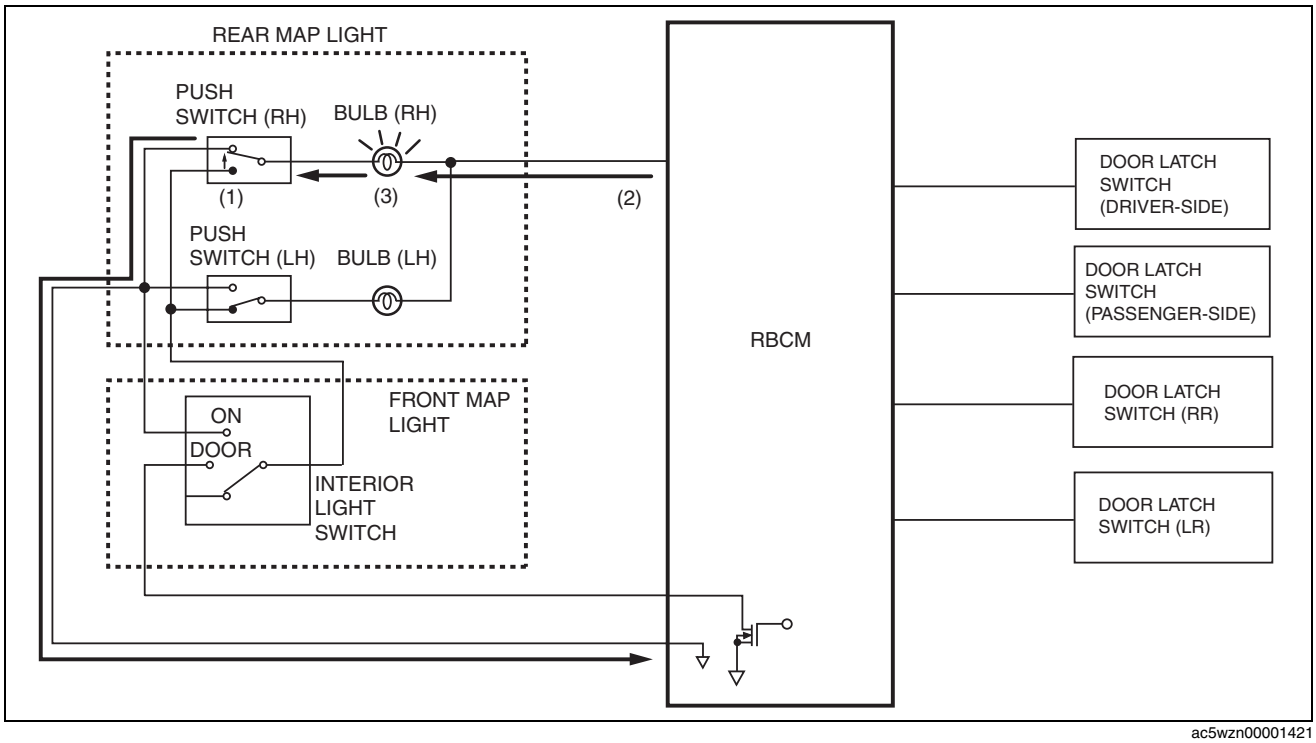
LIGHTING SYSTEMS



ac5wzn00000610

Operation
Map light switch operation

1. The map light switch is on.
2. The battery current flows to the map light bulb from the rear body control module (RBCM).
3. The map light illuminates.



ac5wzn00001421

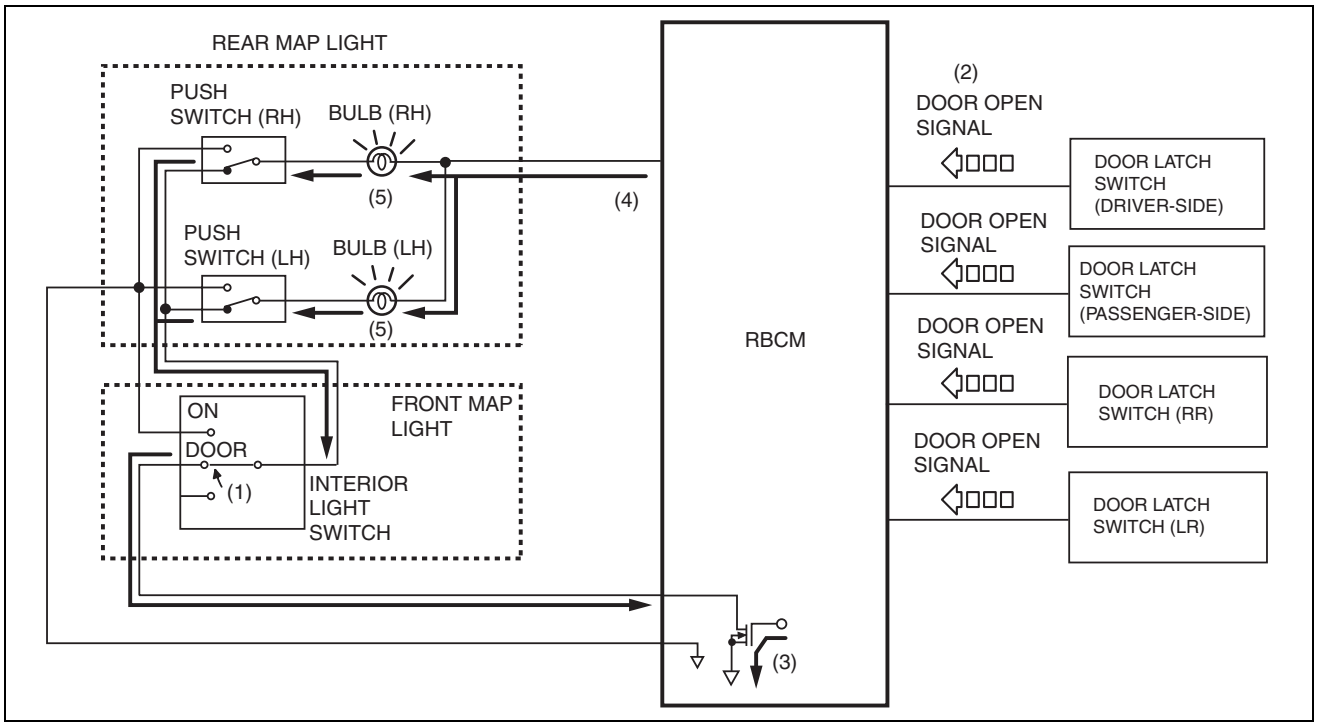
LIGHTING SYSTEMS

Interior light switch for front map lights operation

1. Interior light switch for the front map lights is in the DOOR position.
2. When any door is opened, the door open signal is input to the rear body control module (RBCM).
3. When the rear body control module (RBCM) receives the door-open signal, it turns on the transistor.
4. When the transistor turns on, the battery current flows to the map light bulb from the rear body control module (RBCM).
5. The map light illuminates.

Note

- When the interior light switch is in the DOOR position, the map light illumination on/off timing is controlled by the interior light control system. For details, refer to the interior light control system. (See 09-18-84 ROOM LIGHT CONTROL SYSTEM.)



ac5wzn00001370

Fail-safe

- Function not equipped.

CARGO COMPARTMENT LIGHT

id091800012600

Purpose

- The cargo compartment light illuminates the cargo room interior when the liftgate is opened.

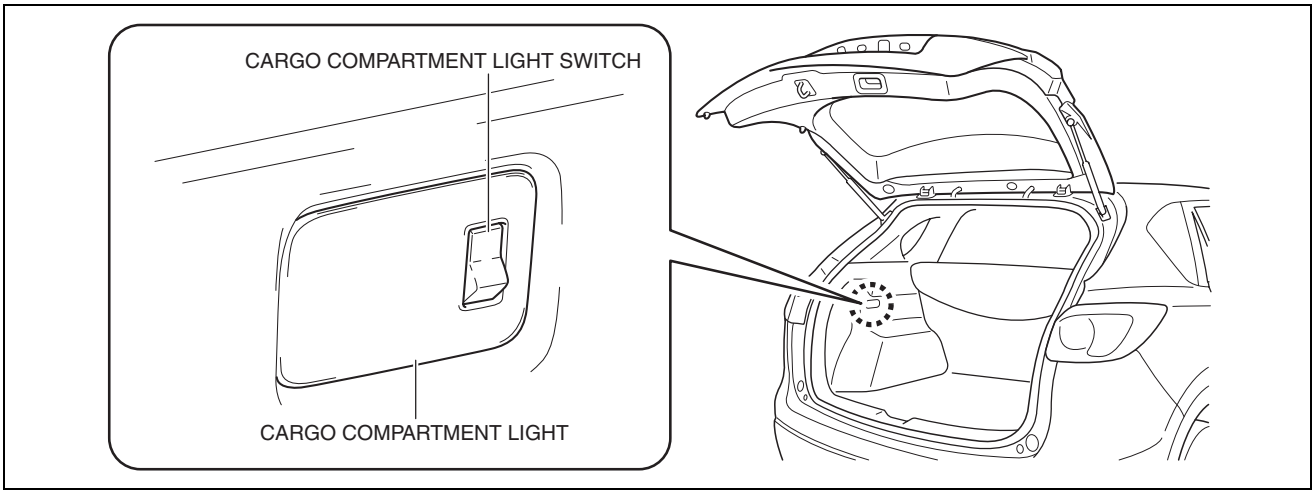
Function

- When the liftgate is opened, illuminates by the cargo room light switch turning on.

LIGHTING SYSTEMS

Construction

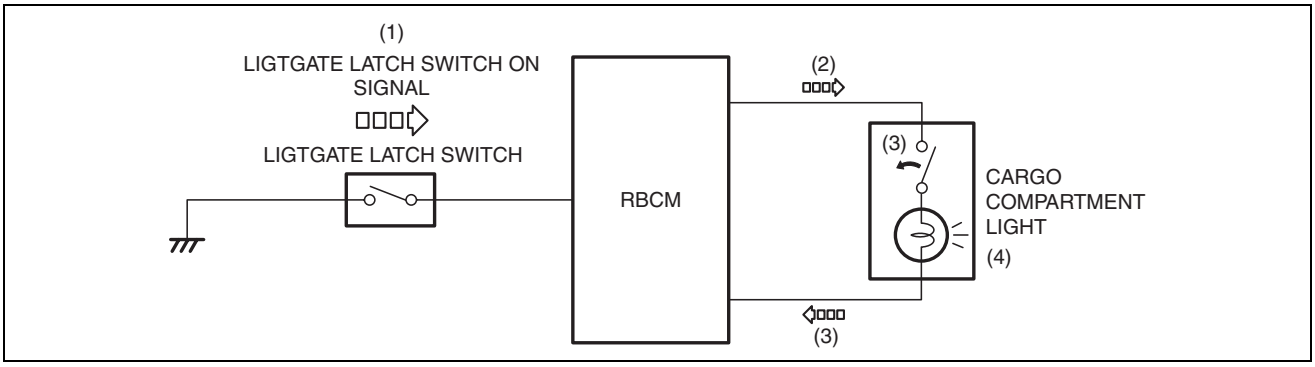
- The cargo room light is installed to the trunk side trim.



ac5wzn00000445

Operation

1. When the liftgate opens, the liftgate latch switch turns on and a liftgate light switch on signal is input to the rear body control module (RBCM).
2. When the rear body control module (RBCM) inputs the liftgate latch switch, electric current flows to the cargo room light.
3. When the cargo room light switch turns on, electric current flows to the cargo light bulb.
4. When electric current flows to the cargo room light bulb, the cargo room light bulb illuminates.



ac5wzn00001365

Fail-safe

- Function not equipped.

ON-BOARD DIAGNOSTIC [ADAPTIVE FRONT LIGHTING SYSTEM (AFS)]

id091800693100

Outline

- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the AFS control module-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunction locations and status via DTC output; and a PID/data monitoring function, which reads out specific input/output signals and verifies the input/output condition.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.

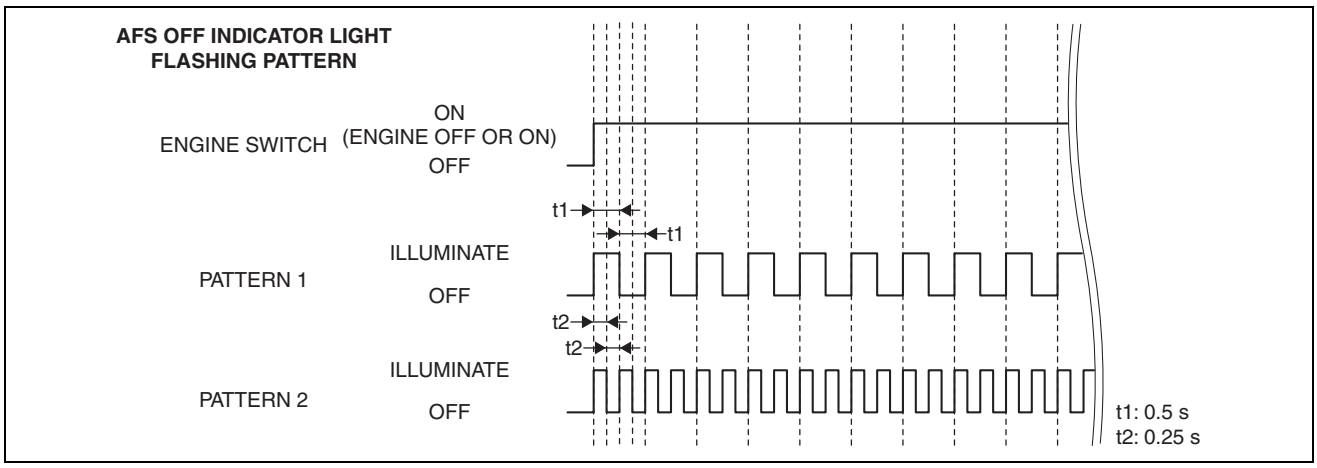
Malfunction detection function

- Detects malfunctions in input/output signals.
- If a malfunction occurs, the AFS control module records the malfunction as a DTC. A recorded DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

LIGHTING SYSTEMS

Note

- The AFS control module flashes the AFS OFF light as follows if there is a malfunction in the system.



ac5wzn00001406

DTC table

×: Applicable
—: Not applicable

DTC No.	AFS OFF indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B1041:14	Flash (Pattern 1)	Headlight leveling actuator circuit malfunction	×	—	D	×
B1041:54	Flash (Pattern 2)	Headlight auto leveling system initial setting error	×	—	D	×
B1044:01	Flash (Pattern 1)	Auto leveling sensor circuit malfunction	×	—	D	×
B10A3:86	Flash (Pattern 1)	Communication error with swivel actuator (LH)	×	—	D	×
B10A3:87	Flash (Pattern 1)	Communication error with swivel actuator (LH)	×	—	D	×
B10A4:86	Flash (Pattern 1)	Communication error with swivel actuator (RH)	×	—	D	×
B10A4:87	Flash (Pattern 1)	Communication error with swivel actuator (RH)	×	—	D	×
C0051:86	Flash (Pattern 1)	Error steering angle signal received from EPS control module	×	—	C, D	×
U0001:88	Flash (Pattern 1)	Unit communication error (HS-CAN)	×	—	C, D	×
U0100:00	Flash (Pattern 1)	Communication error with PCM	×	—	C, D	×
U0131:00	Flash (Pattern 1)	Communication error with EPS control module	×	—	C, D	×
U0140:00	Flash (Pattern 1)	Communication error with front body control module (FBCM)	×	—	C, D	×
U0155:00	Flash (Pattern 1)	Communication error with instrument cluster	×	—	C, D	×
U0320:09	Flash (Pattern 1)	EPS control module malfunction	×	—	C, D	×
U0420:68	Flash (Pattern 1)	Error signal received from EPS control module	×	—	C, D	×

LIGHTING SYSTEMS

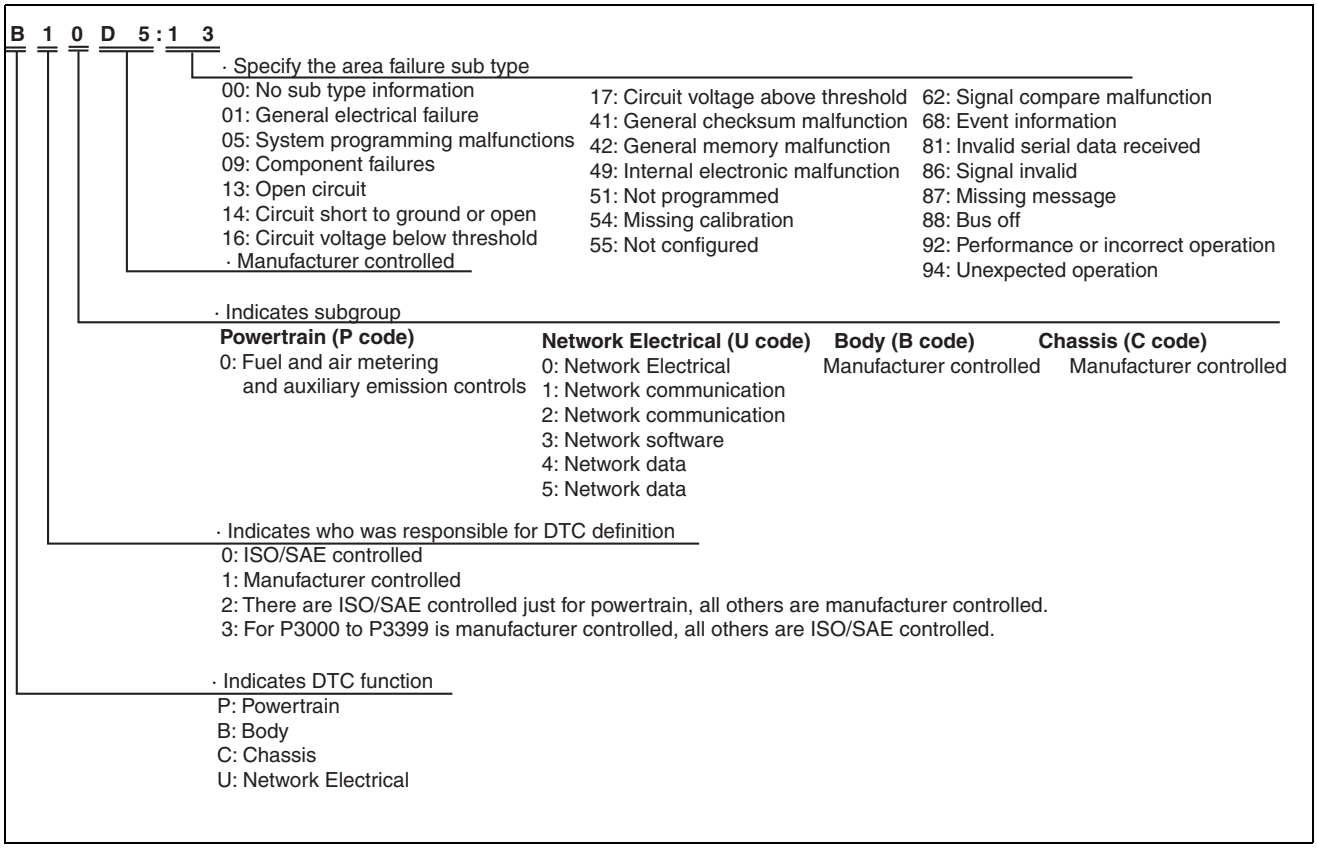
DTC No.	AFS OFF indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
U0423:68	—	Error signal received from instrument cluster • AFS OFF switch error signal	×	—	C, D	—
	—	Error signal received from instrument cluster • Ignition switch error signal	×	—	C, D	—
	Flash (Pattern 1)	Error signal received from instrument cluster • Selector lever position (R position) (ATX)/Reverse (MTX) signal error	×	—	C, D	×
	—	Error signal received from instrument cluster • Selector lever position (R position) (ATX)/Reverse (MTX) signal not determined	×	—	C, D	—
U2005:86	Flash (Pattern 1)	Error signal received from PCM	×	—	C, D	×
U2300:54	Flash (Pattern 1)	Error configuration data received from instrument cluster	×	—	C, D	×
U2300:55	—	Instrument cluster configuration not implemented	×	—	C, D	×
U2300:56	Flash (Pattern 1)	Configuration data unmatched with instrument cluster	×	—	C, D	×
U3000:42	Flash (Pattern 1)	AFS control module internal malfunction	×	—	C, D	×
U3000:49	—	AFS control module internal malfunction • RAM/ROM malfunction	×	—	C, D	×
	—	AFS control module internal malfunction • AFS function malfunction	—	—	C, D	—
	—	AFS control module internal malfunction • CAN hardware malfunction	×	—	C, D	×
U3003:16	—	AFS control module low power supply voltage input	×	—	C, D	—
U3003:17	—	AFS control module high power supply voltage input	×	—	C, D	—

*1 : C: CMDTC self test, D: ODDTC self test

LIGHTING SYSTEMS

DTC 7-digit code definition

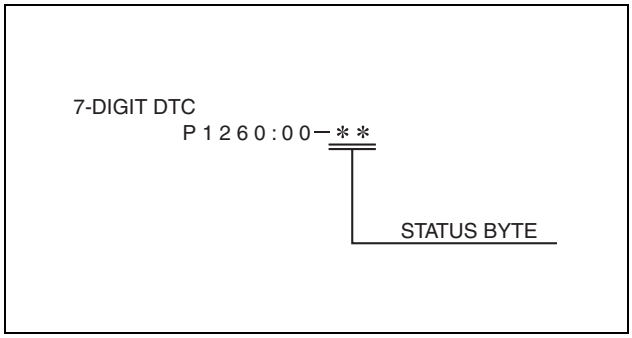
- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



ac5uun00001106

Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



ac5wzn00002013

Detection condition for the applicable DTC

DTC No.	System malfunction location	Detection condition
B1041:14	Headlight leveling actuator circuit malfunction	Headlight leveling actuator circuit voltage of 3.2 V or less is detected for 5 s or more with the ignition switched ON (engine off or on).
B1041:54	Headlight auto leveling system initialization error	Ignition is switched ON (engine off or on) and headlight auto leveling system initialization is not performed.
B1044:01	Auto leveling sensor circuit malfunction	Auto leveling sensor circuit voltage of 0.25 V or less or 4.75 V or more is detected by AFS control module for 10 s or more with the ignition switched ON (engine off or on).

LIGHTING SYSTEMS

DTC No.	System malfunction location	Detection condition
B10A3:86	Communication error with swivel actuator (LH)	• The AFS control module received error signals from the swivel actuator (LH) three times continuously with the ignition switched ON (engine off or on). • The AFS control module could not receive the signal from the swivel actuator (LH) for 5 s or more with the ignition switched ON (engine off or on).
B10A3:87	Communication error with swivel actuator (LH)	The AFS control module detected communication error with the swivel actuator (LH) for 5 s or more with the ignition switched ON (engine off or on).
B10A4:86	Communication error with swivel actuator (RH)	• The AFS control module received error signals from the swivel actuator (RH) three times continuously with the ignition switched ON (engine off or on). • The AFS control module could not receive the signal from the swivel actuator (RH) for 5 s or more with the ignition switched ON (engine off or on).
B10A4:87	Communication error with swivel actuator (RH)	The AFS control module detected communication error with the swivel actuator (RH) for 5 s or more with the ignition switched ON (engine off or on).
C0051:86	Error steering angle signal received from EPS control module	Either a condition in which the steering angle sensor has a malfunction and the EPS control module has not performed steering angle neutral position auto learning, or a condition in which the EPS control module has a malfunction is detected for 5 s or more.
U0001:88	Unit communication error (HS-CAN)	The AFS control module detected CAN bus communication line (HS-CAN) malfunction ten times continuously.
U0100:00	Communication error with PCM	The AFS control module could not receive CAN signal from the PCM for 5 s or more.
U0131:00	Communication error with EPS control module	The AFS control module could not receive CAN signal from the EPS control module for 5 s or more.
U0140:00	Communication error with front body control module (FBCM)	The AFS control module could not receive CAN signal from the front body control module (FBCM) for 5 s or more.
U0155:00	Communication error with instrument cluster	The AFS control module could not receive CAN signal from the instrument cluster for 5 s or more.
U0320:09	EPS control module malfunction	The AFS control module received CAN error signal from the EPS control module for 5 s or more with the ignition switched ON (engine off or on).
U0420:68	Error signal received from EPS control module	The AFS control module received error signal from the EPS control module for 5 s or more with the ignition switched ON (engine off or on).
U0423:68	AFS OFF switch error signal	The AFS control module received AFS OFF switch error signal for 5 s or more with the ignition switched ON (engine off or on).
	Ignition switch error signal	The AFS control module received ignition switch error signal for 5 s or more with the ignition switched ON (engine off or on).
	Selector lever position (R position) (ATX)/Reverse (MTX) signal error	The AFS control module received selector lever position (R position) (ATX)/Reverse (MTX) signal error for 5 s or more with the ignition switched ON (engine off or on).
	Selector lever position (R position) (ATX)/Reverse (MTX) signal not determined	The AFS control module detected undetermined selector lever position (R position) (ATX)/Reverse (MTX) signal.
U2005:86	Error signal received from PCM	The AFS control module received vehicle speed signal error from the PCM for 5 s or more with the ignition switched ON (engine off or on).
U2300:54	Error configuration data received from instrument cluster	The AFS control module received error configuration data from the instrument cluster for 30 s or more with the ignition switched ON (engine off or on).
U2300:55	Instrument cluster configuration not implemented	The AFS control module received a signal which indicates the instrument cluster configuration is not performed.
U2300:56	Configuration data unmatched with instrument cluster	Configuration data of the AFS control module and instrument cluster are not matched.
U3000:42	AFS control module internal malfunction	Malfunction in the AFS control module internal EEPROM is detected.

DTC No.	System malfunction location	Detection condition
U3000:49	RAM/ROM malfunction	The AFS control module detected a malfunction in the internal RAM/ ROM.
	AFS function malfunction	The AFS control module detected AFS function malfunction three times.
	CAN hardware malfunction	The AFS control module detected CAN hardware malfunction three times.
U3003:16	AFS control module low power supply voltage input	AFS control module power supply circuit voltage of 9 V or less is detected for 5 s or more with the ignition switched ON (engine off or on).
U3003:17	AFS control module high power supply voltage input	AFS control module power supply circuit voltage of 18.1 V or more is detected for 5 s or more with the ignition switched ON (engine off or on).

Snapshot data

- The data for all DTCs currently detected is stored.

Snapshot data table

—: Not applicable

Snap shot data item	Unit	Unit	Data contents	Corresponding data monitor items
AAT	°C	°F	Ambient temperature	—
APP_STATUS	Accelerator Pedal Off/Under20%/Over20%/FAIL		Accelerator pedal position status	—
CFG_STATUS	Config Complete/Not Configured/Config Error		Configuration status	—
ECT_STATUS	Under 0 degrees C/0-Under 80 degrees C/Over 80 degrees C/FAIL		Engine coolant temperature status	—
IC_VPWR	V		Instrument cluster power supply voltage	—
IG-ON_TIMER	hh:mm:ss		Elapsed time since ignition switched ON (engine off or on)	—
PWR_MODE_KEY	Key Out/Key Recently Out/ Key Approved (Position 0)/ Post Accessory (Position 0)/ Accessory (Position 1)/ Post Ignition (Position 1)/ ignition On (Position 2)/ Running - Starting In Progress (Position 2)/Crank (Position 3)		Push button start power position switching status	—
RPM_STATUS	Engine Stop/Under1500rpm/Over1500rpm/FAIL		Engine speed status	—
SHIFT_STATUS	P/N/ D/ R/ FAIL		Selector lever position status	—
TOTAL_DIST	Km	miles	Accumulated total traveled distance since vehicle completion	—
TOTAL_TIME	hh:mm:ss		Accumulated total elapsed time since vehicle completion **Note** • When the ROOM fuse is removed, or the ignition is switched off (LOCK), the time is not included in the elapsed time.	—
VPWR	V		AFS control module power supply malfunction	VPWR_IG
VSPD_STATUS	Stop/ 0-10km/h/ Over10km/h/ FAIL		Vehicle speed status	VSPD

LIGHTING SYSTEMS

Data Monitor Function

- With the PID/data monitor function, input/output signal monitor items set in the AFS control module can be selected and read out in real-time.

PID/data monitor table

PID	Unit/ Operation	Data contents	Inspection item(s)
AFS_ST	Off/On	• Off: AFS is not operated • On: AFS is operated	• AFS OFF switch • AFS control module
H/L_CS	OFF/DRL/ TNS/H/ L_LOW/H/ L_HI	• OFF: Light switch at OFF position • DRL: Light switch at AUTO position and auto light sensor sends turn-off signal • TNS: Light switch at TNS position • H/L_LOW: Light switch at LO position • H/L_HI: Light switch at HI position	Light switch
R_HGT_S	V	Voltage at auto leveling sensor is displayed.	Auto leveling sensor
R_HGT_S_I NI	V	Voltage at headlight auto leveling system initial setting is displayed.	Auto leveling sensor
R_LMP_CS	Off/On/ Unknown/ Fault	ATX: • Off: Selector lever position signal (R position) is not received • On: Selector lever position signal (R position) is received • Unknown: Selector lever position signal (R position) is not determined • Fault: Selector lever position signal (R position) error is received MTX: • Off: Reverse signal is not received • On: Reverse signal is received • Unknown: Reverse signal is not determined • Fault: Reverse signal error is received	ATX: • Transaxle range sensor (TCM) MTX: • Back-up light switch
STR_AB_A NG	° (deg)	Steering angle is displayed.	Steering angle sensor
VPWR_IG	V	AFS control module power supply voltage is displayed.	• AFS control module • IG1 relay • Battery
VSPD	KPH, MPH	Vehicle speed is displayed.	—

09-19 WIPER/WASHER SYSTEM

WIPER/WASHER SYSTEM

WIPER/WASHER SYSTEM

id091900000600

Outline

- The following wiper/washer system has been adopted.
  - — Windshield wiper system
  - — Rear wiper system (with rear wiper system)
  - — Auto wiper system (with auto wiper system)
  - — Washer fluid-level sensor (with washer fluid-level sensor)
  - — Headlight cleaner system (with headlight cleaner system)

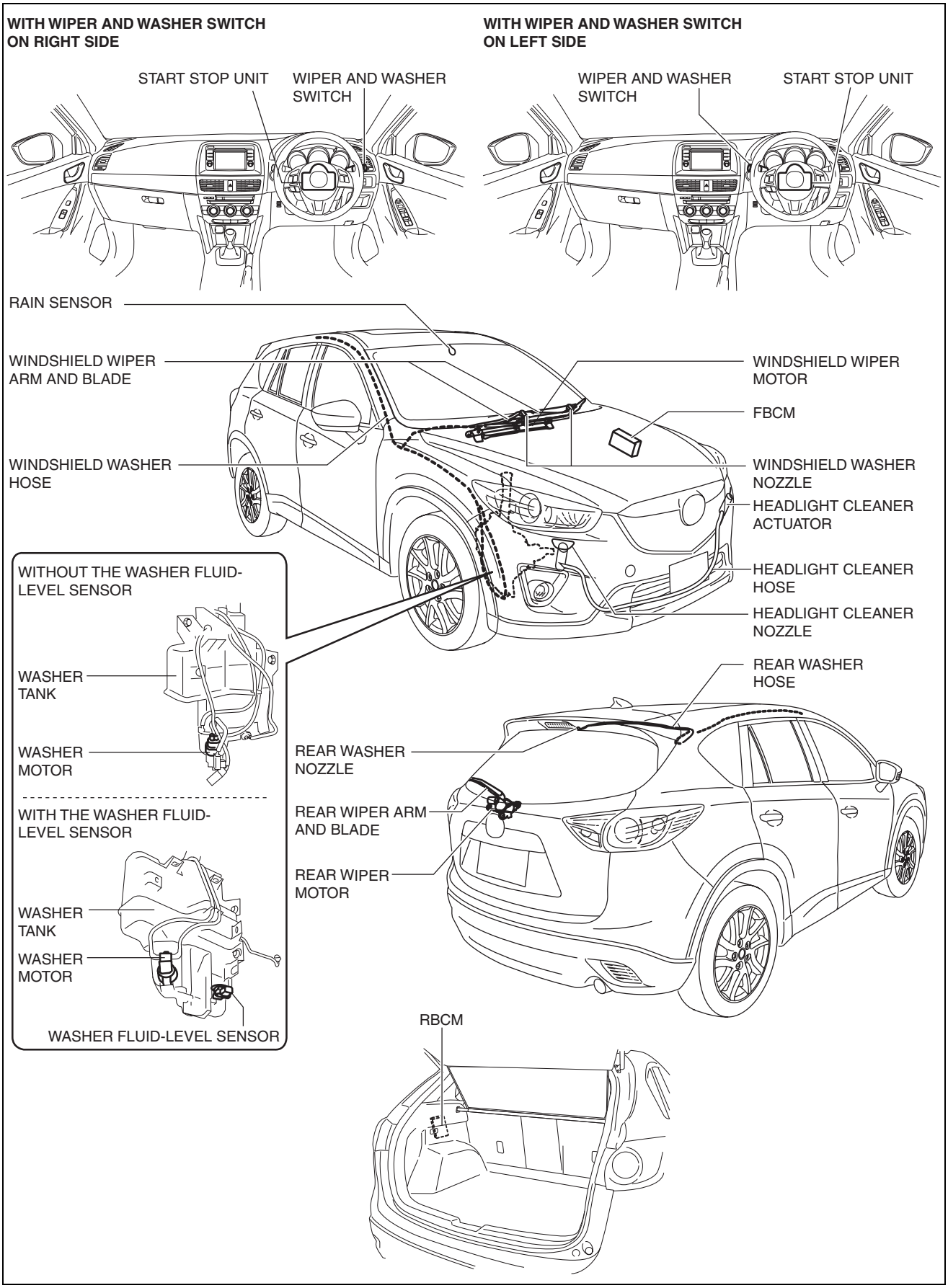
Specification

- Windshield wiper system with continuous (low/high), auto-stop, one-touch wiper, intermittent wiper, and synchronized washer and wiper operation adopted.
  - — CAN communication has been adopted for the windshield wiper system.
  - — Windshield washer nozzles have been adopted in which the area where the washer fluid is sprayed can be adjusted.
- Rear wiper system with continuous, auto-stop, intermittent wiper, and synchronized washer and wiper operation adopted.
  - — CAN communication has been adopted for the rear wiper system.
  - — Rear washer nozzle have been adopted in which the area where the washer fluid is sprayed can be adjusted.
- An auto wiper system adopted which enables fully automatic windshield wiper operation.
  - — CAN communication has been adopted for the auto wiper system.
  - — A rain sensor integrated with the lens has been adopted which aggregates infrared light to detect the amount of rainfall.
  - — Auto wiper system personalization features has been adopted.
- A washer fluid-level sensor is installed in the washer tank.
- A pop-up type headlight cleaner has been adopted.
- Washer tank capacity
  - — With the washer fluid-level sensor: **4.5 L {4.8 US qt, 4.0 Imp qt}**
  - — Without the washer fluid-level sensor: **2.2 L {2.3 US qt, 1.9 Imp qt}**

WIPER/WASHER SYSTEM

System Structural View

R.H.D.



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WIPER/WASHER SYSTEM

WIPER/WASHER SYSTEM PERSONALIZATION

id091900103200

- A customize function has been adopted which switches the auto wiper system between operable/inoperable.

Using Mazda Modular Diagnostic System (M-MDS)

- The auto wiper function can be enabled or disabled using the Mazda Modular Diagnostic System (M-MDS). Refer to the Workshop Manual for the customize function setting procedure.

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control module
Rain Sensing Wipers	Auto wiper system can be set to operable or inoperable.	On	Not Adopted / Off (Intermittent) / On (Rain Sensing)	Rear body control module (RBCM)

Using audio unit (with color LCD)

- The user can enable or disable the auto wiper function by operating the audio unit display. Refer to the Workshop Manual for the detailed customize function setting procedure.

Audio unit display	Function	Initial setting	Setting contents	Control module
Wipers	Auto wiper system can be set to operable or inoperable.	On (Rain Sensing)	On (Rain Sensing) / Off (Intermittent)	Rear body control module (RBCM)

WINDSHIELD WIPER SYSTEM

id091900000700

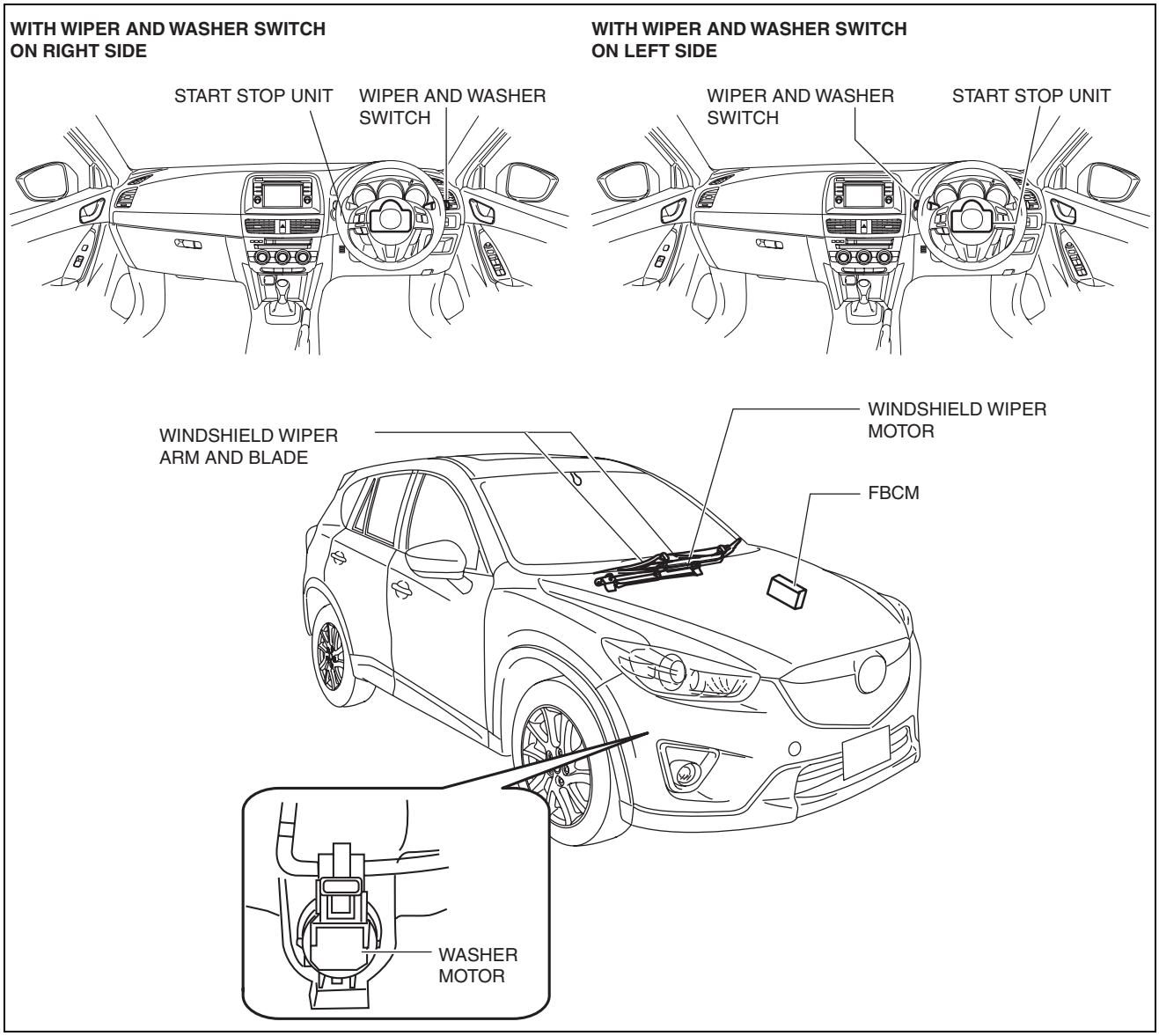
Outline

- Equipped with continuous (low/high), auto-stop, one-touch wiper, intermittent wiper (without auto wiper system), auto wiper (with auto wiper system), and synchronized washer and wiper operation.
- The front body control module (FBCM) performs windshield wiper and washer system fail-safe. (See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)

WIPER/WASHER SYSTEM

Structural View

R.H.D.



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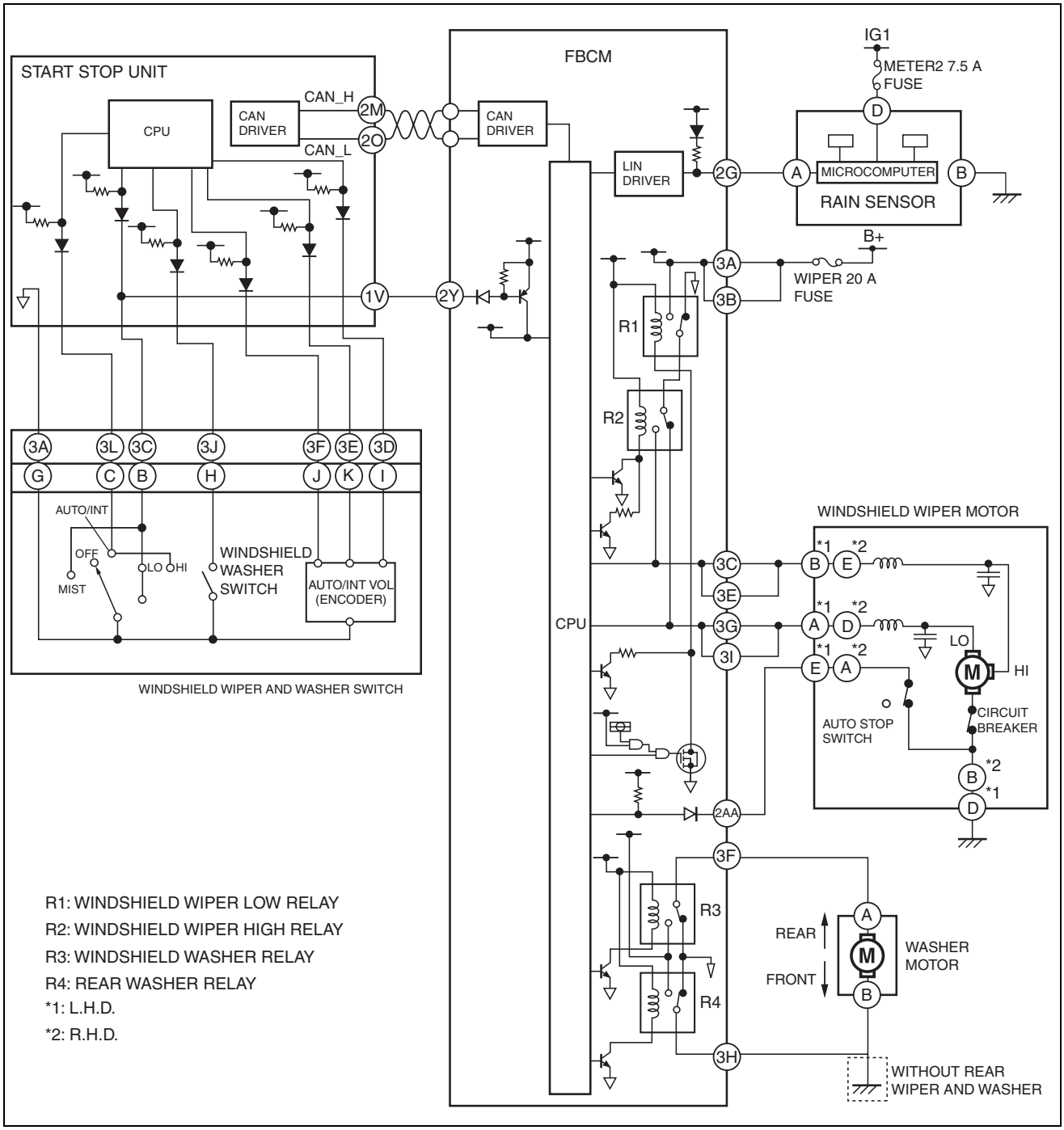
WIPER/WASHER SYSTEM

System Wiring Diagram
With wiper and washer switch on right side

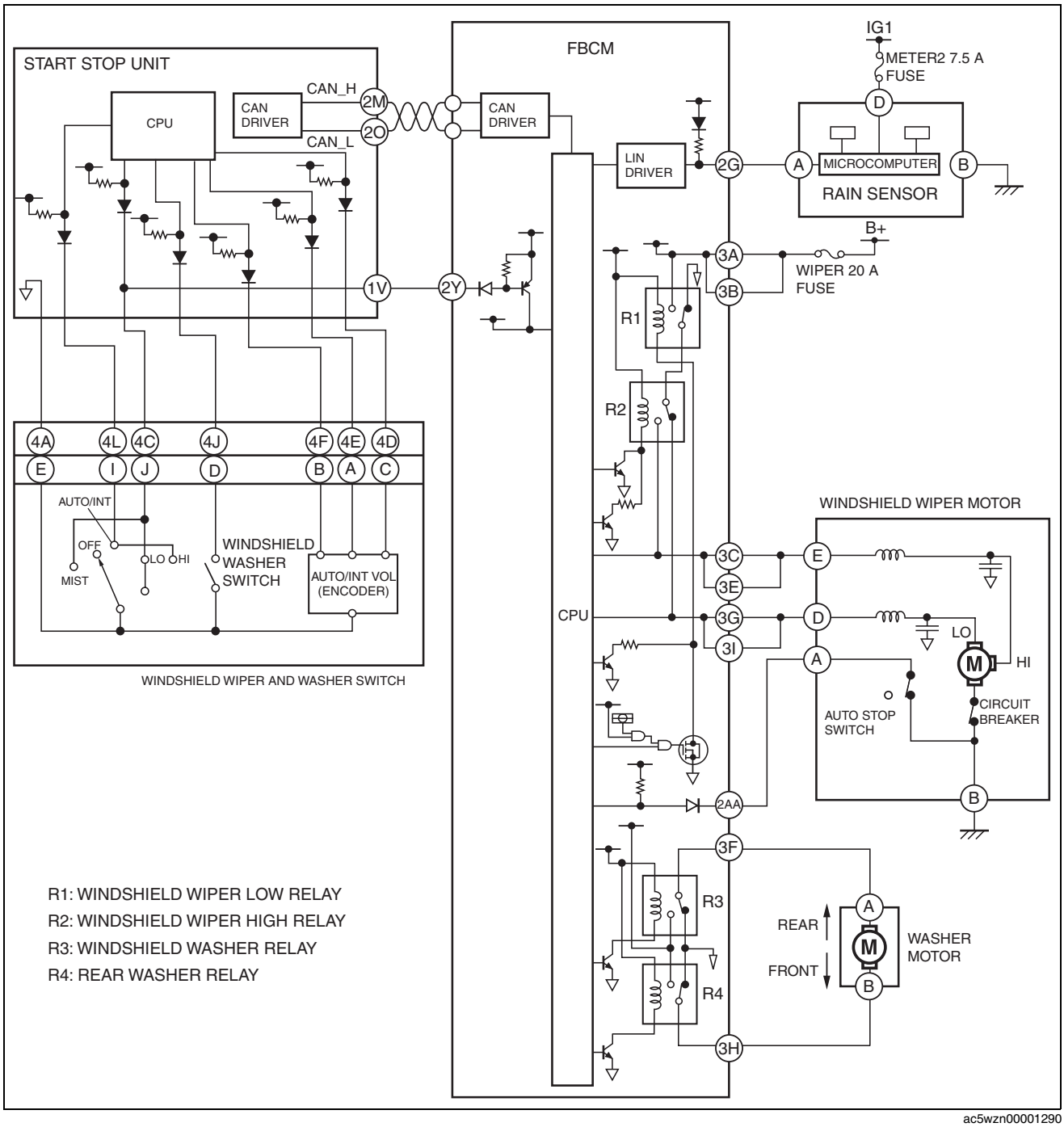


R1: WINDSHIELD WIPER LOW RELAY
R2: WINDSHIELD WIPER HIGH RELAY
R3: WINDSHIELD WASHER RELAY
R4: REAR WASHER RELAY
*1: L.H.D.
*2: R.H.D.

ac5wzn00001256

WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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Operation

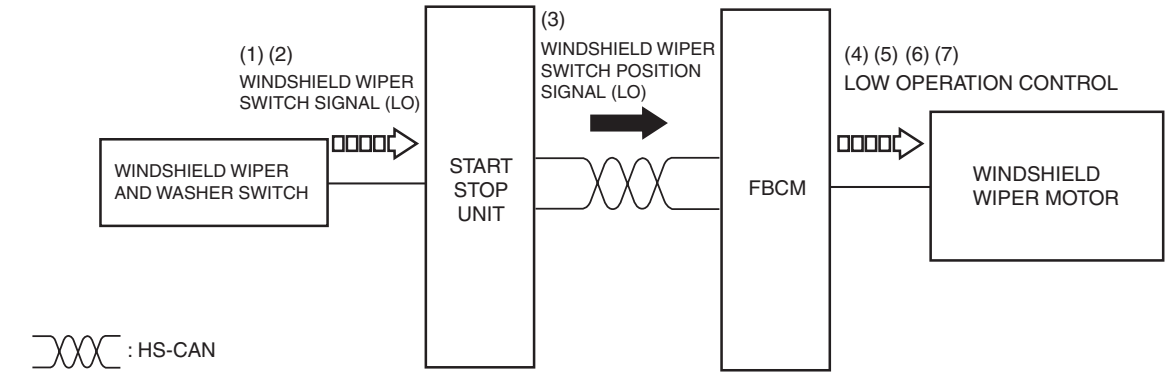
Continuous low operation

1. When the wiper and washer switch is moved to the LO position with the ignition switched ON (engine off or on) (1), the start stop unit detects a windshield wiper switch signal (LO).(2)
2. When the start stop unit detects the windshield wiper switch signal (LO), it send a windshield wiper switch position signal (LO) to the front body control module (FBCM) as a CAN signal.(3)
3. When the front body control module (FBCM) receives the windshield wiper switch position signal (LO), it supplies the base current from the internal CPU to transistor A (4), and collector current flows from the internal power supply (5), turning the windshield wiper low relay on. (6)
4. When the windshield wiper low relay is turned on, current flows from the battery to the windshield wiper motor and the windshield wipers operate continuously at low speed.(7)

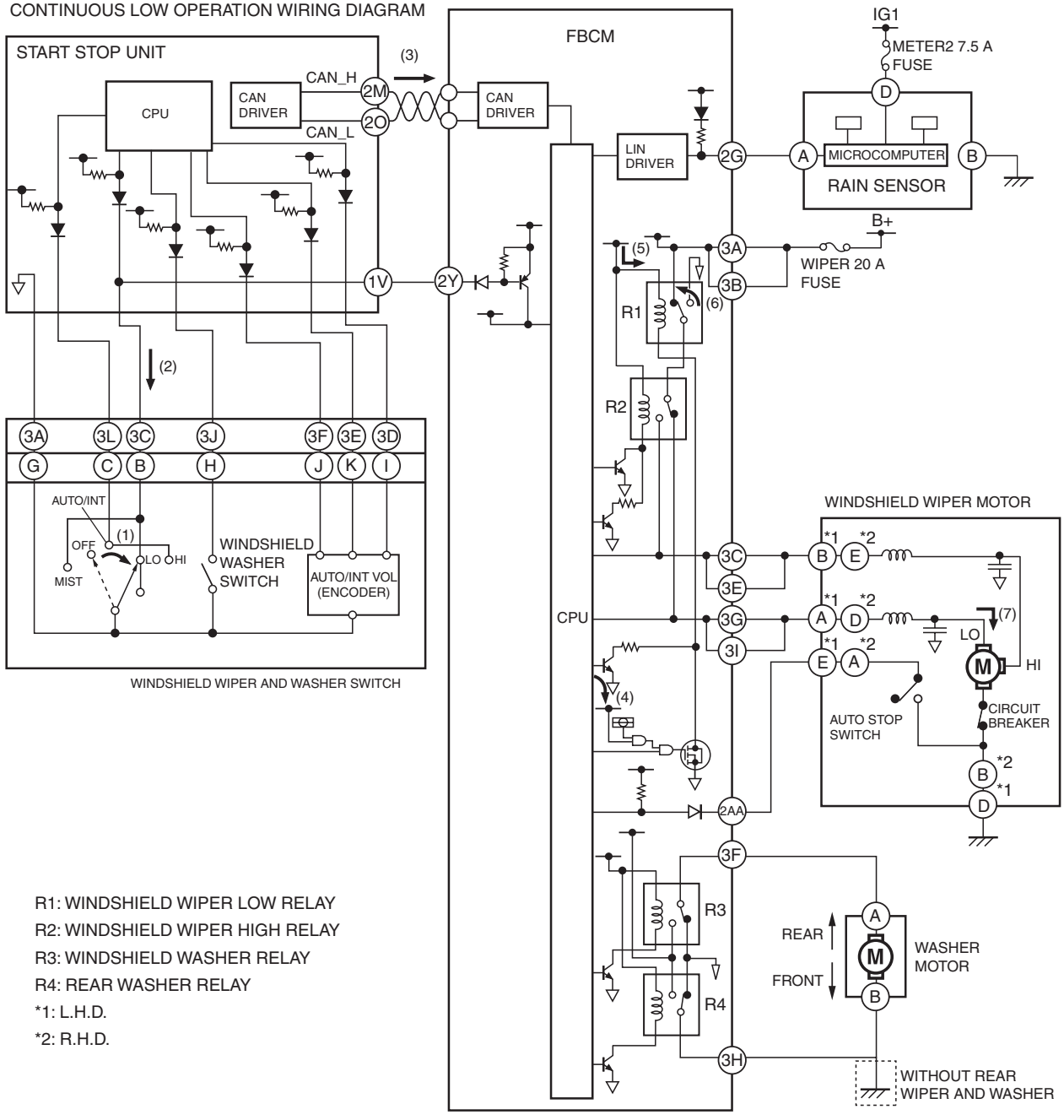
WIPER/WASHER SYSTEM

With wiper and washer switch on right side

CONTINUOUS LOW OPERATION BLOCK DIAGRAM



CONTINUOUS LOW OPERATION WIRING DIAGRAM



R1: WINDSHIELD WIPER LOW RELAY
R2: WINDSHIELD WIPER HIGH RELAY
R3: WINDSHIELD WASHER RELAY
R4: REAR WASHER RELAY
*1: L.H.D.
*2: R.H.D.

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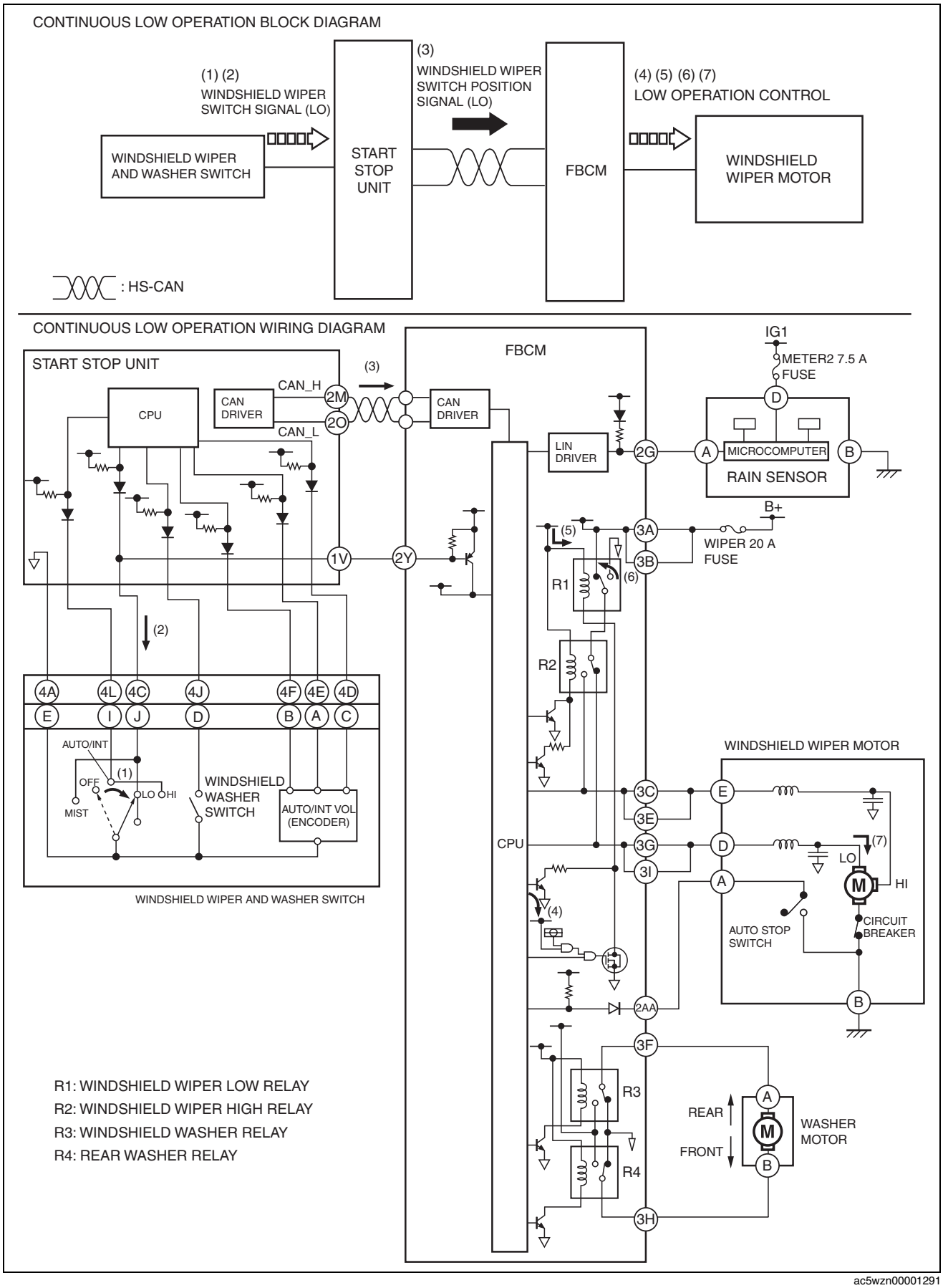
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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WIPER/WASHER SYSTEM

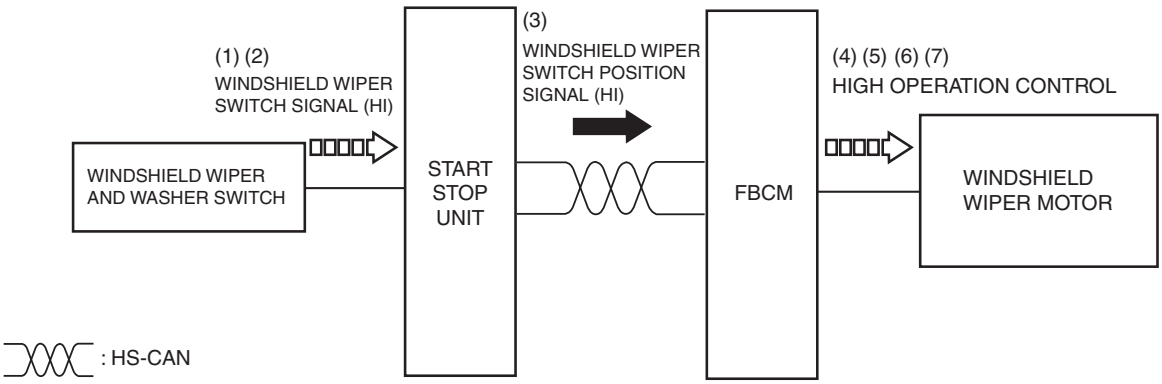
Continuous high operation

1. When the wiper and washer switch is moved to the HI position with the ignition switched ON (engine off or on) (1), the start stop unit detects a windshield wiper switch signal (HI).(2)
2. When the start stop unit detects a windshield wiper switch signal (HI), it send a windshield wiper switch position signal (HI) to the front body control module (FBCM) as a CAN signal.(3)
3. When the front body control module (FBCM) receives the windshield wiper switch position signal (HI), it supplies the base current from the internal CPU to transistors A and B (4), and collector current flows from the internal power supply (5), turning the windshield wiper low relay and windshield wiper high relay on.(6)
4. When the windshield wiper low relay and windshield wiper high relay are turned on, current flows from the battery to the windshield wiper motor and the windshield wipers operate continuously at high speed.(7)

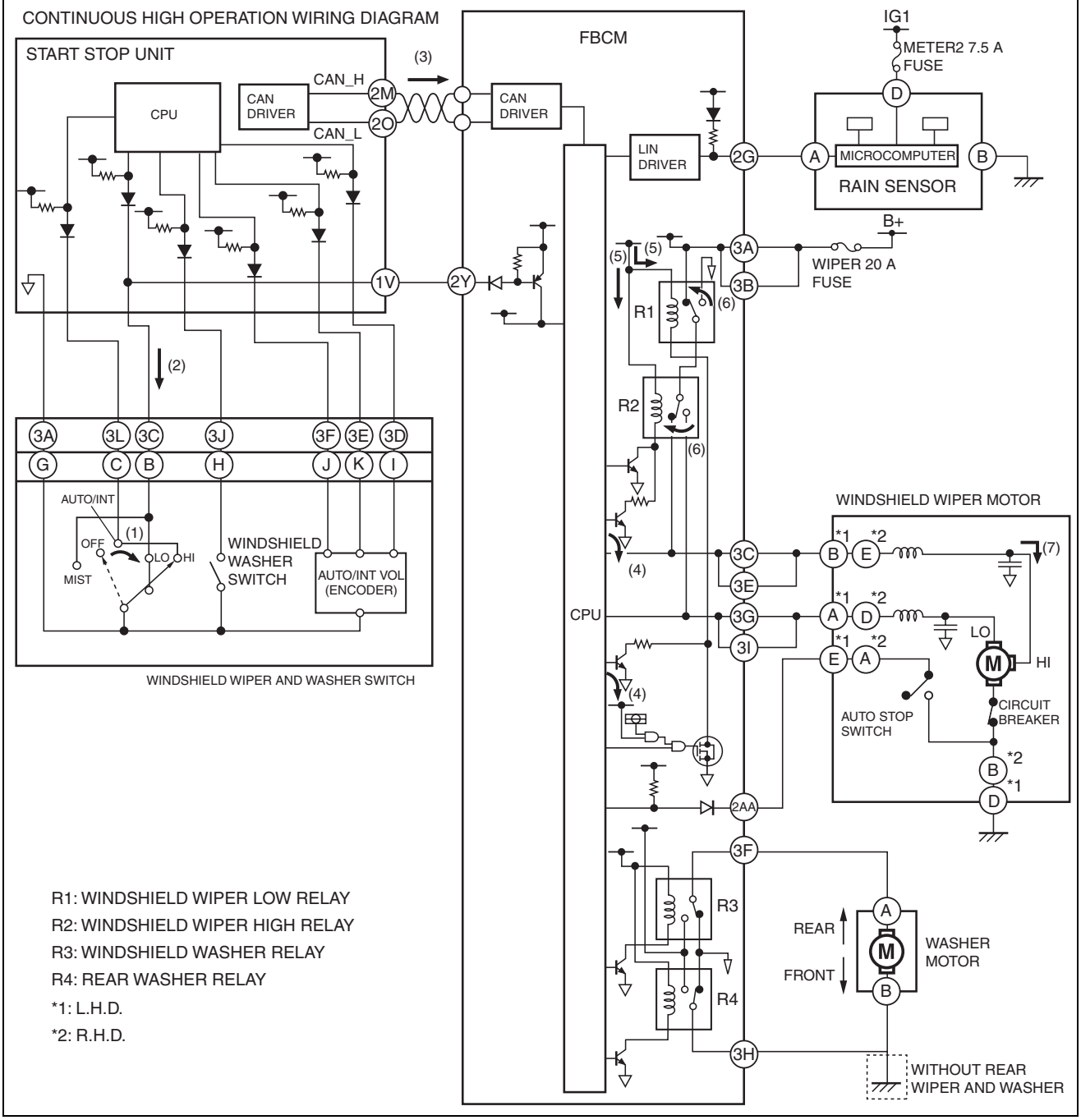
WIPER/WASHER SYSTEM

With wiper and washer switch on right side

CONTINUOUS HIGH OPERATION BLOCK DIAGRAM



CONTINUOUS HIGH OPERATION WIRING DIAGRAM



R1: WINDSHIELD WIPER LOW RELAY
R2: WINDSHIELD WIPER HIGH RELAY
R3: WINDSHIELD WASHER RELAY
R4: REAR WASHER RELAY
*1: L.H.D.
*2: R.H.D.

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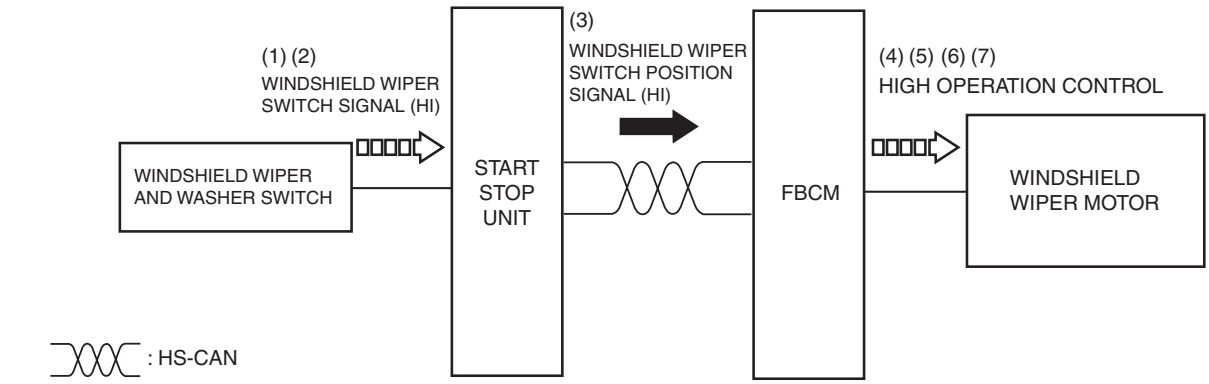
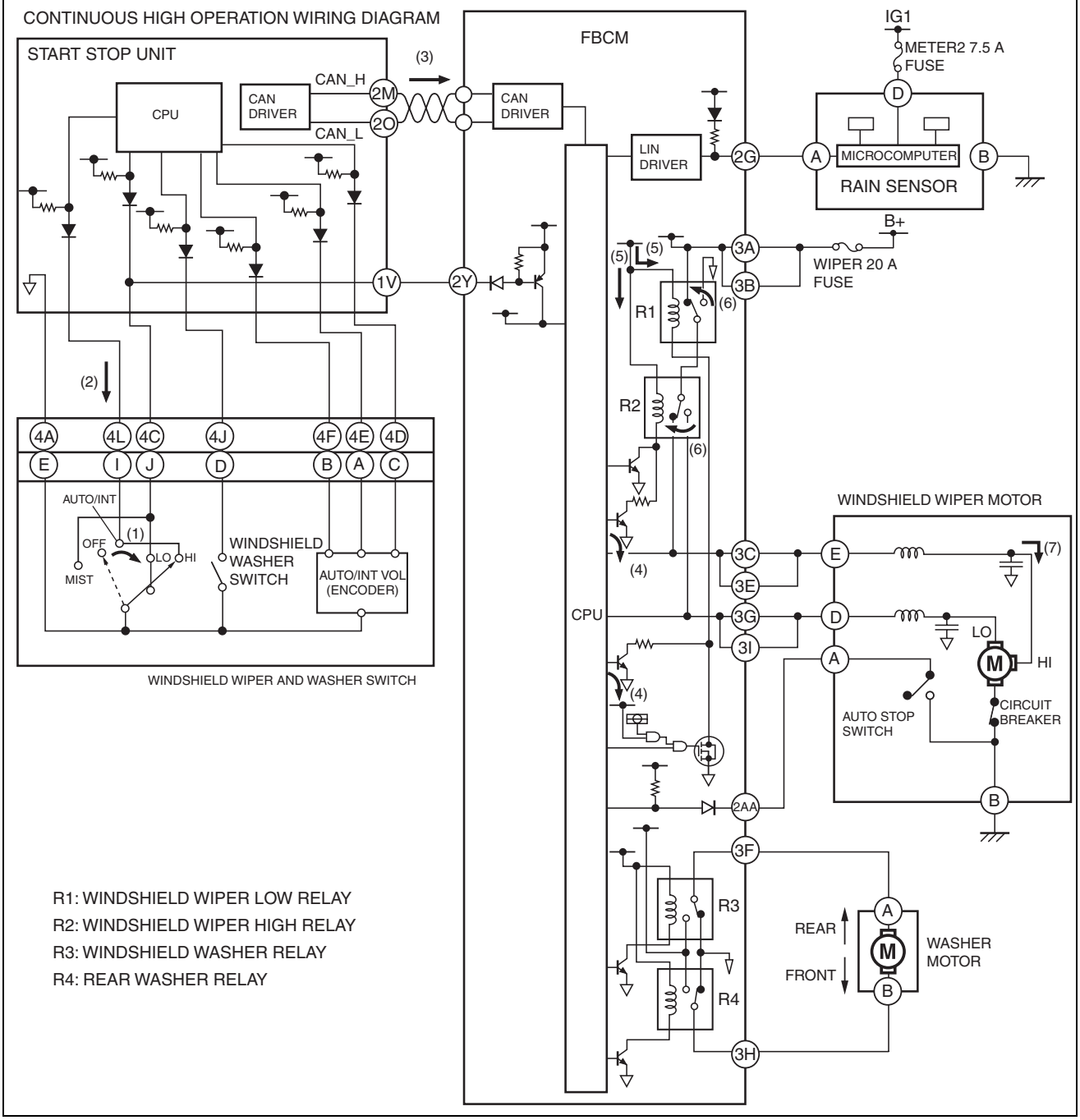
WIPER/WASHER SYSTEM

With wiper and washer switch on left side

CONTINUOUS HIGH OPERATION BLOCK DIAGRAM



CONTINUOUS HIGH OPERATION WIRING DIAGRAM



R1: WINDSHIELD WIPER LOW RELAY
R2: WINDSHIELD WIPER HIGH RELAY
R3: WINDSHIELD WASHER RELAY
R4: REAR WASHER RELAY

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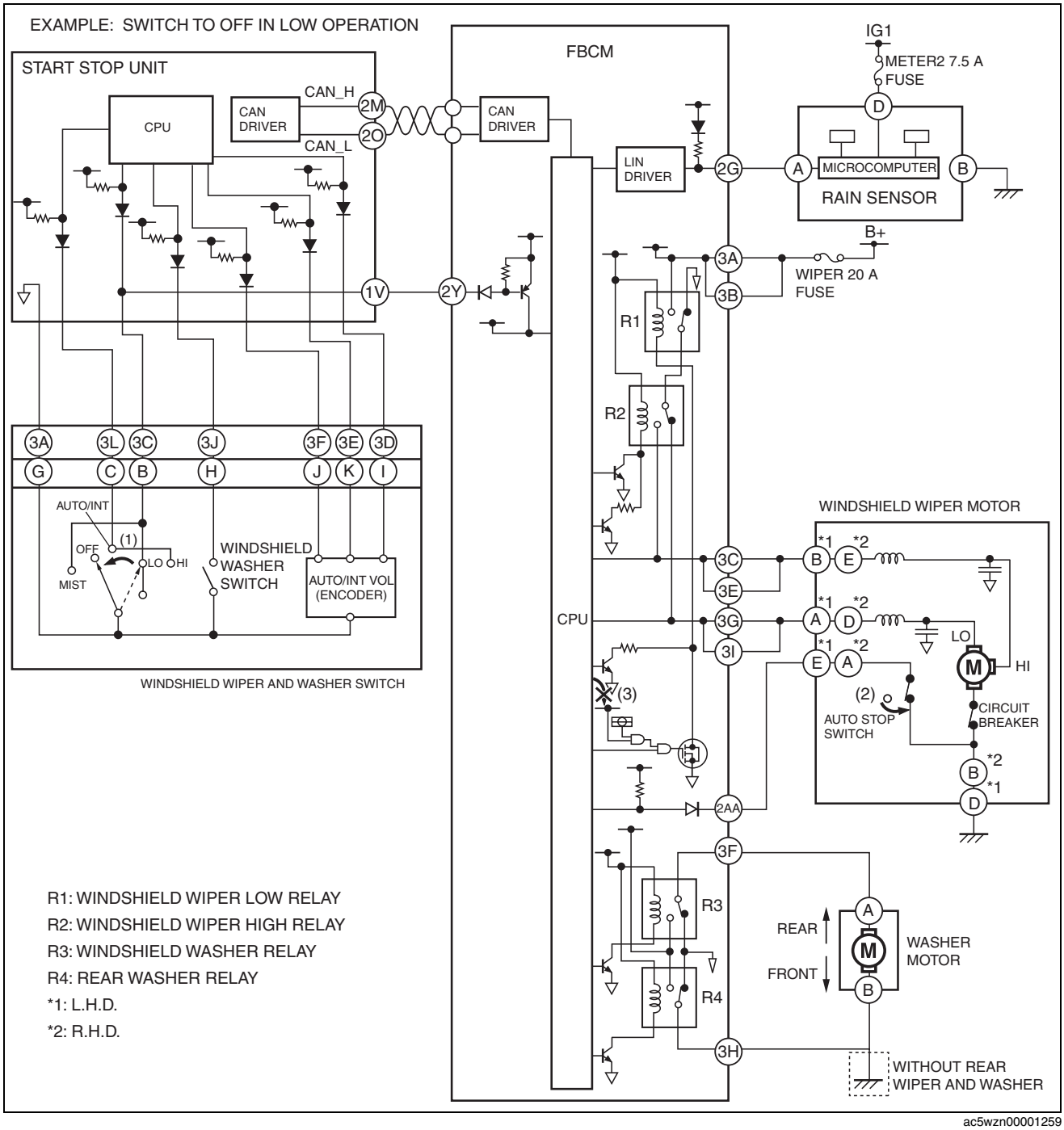
WIPER/WASHER SYSTEM

Auto-stop operation

1. The auto stop switch inside the windshield wiper motor operates as follows according to the operation position of the windshield wipers.
   - Windshield wipers stopped in park position: On
   - Windshield wipers stopped in position other than park: Off
2. When the wiper and washer switch is in the OFF position (1) during windshield wiper operation, the windshield wipers operate continuously because the auto stop switch is off.
3. The auto stop switch turns on when the windshield wipers move to the park position.(2)
4. When the front body control module (FBCM) detects that the auto stop switch is on, it stops the base current to the transistor (3) and turns off the windshield wiper low relay, and the windshield wipers stop at the park position.

With wiper and washer switch on right side



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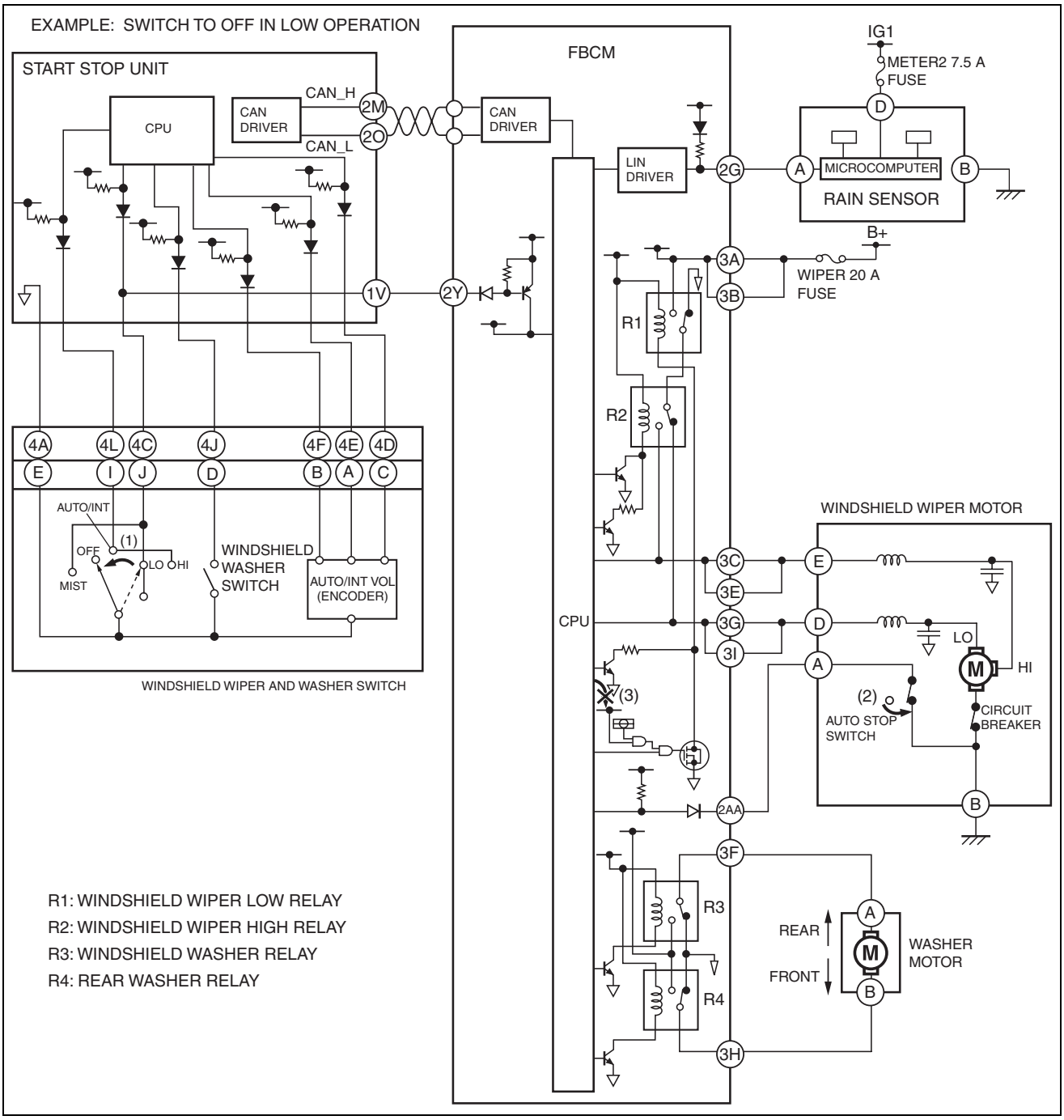
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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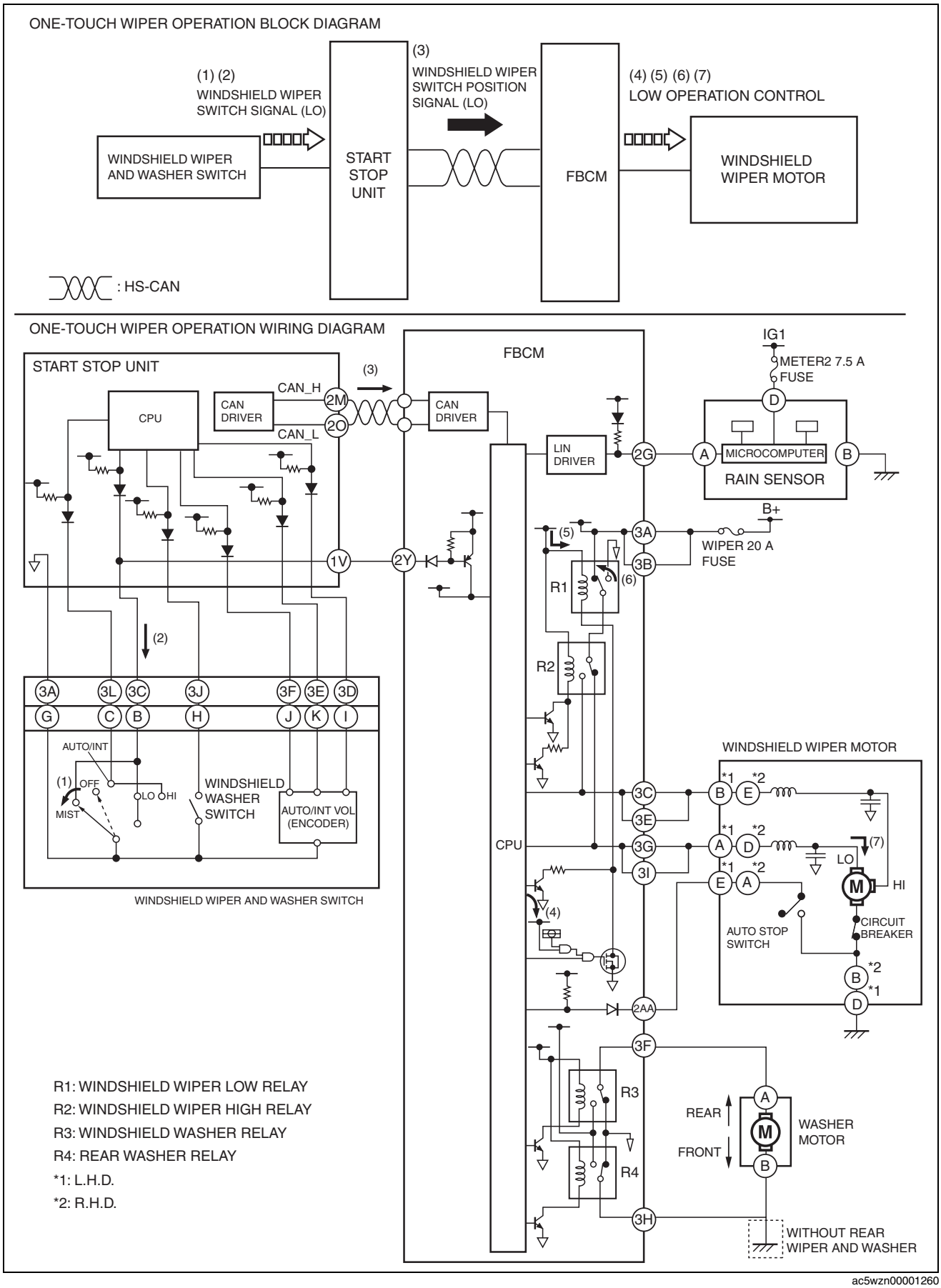
One-touch wiper operation

1. When the wiper and washer switch is moved up with the ignition switched ON (engine off or on) (1), the start stop unit detects a windshield wiper switch signal (LO).(2)
2. When the start stop unit detects a windshield wiper switch signal (LO), it send a windshield wiper switch position signal (LO) to the front body control module (FBCM) as a CAN signal.(3)
3. When the front body control module (FBCM) receives the windshield wiper switch position signal (LO), it supplies the base current from the internal CPU to transistor A (4), and collector current flows from the internal power supply (5), turning the windshield wiper low relay on.(6)
4. When the windshield wiper low relay is turned on, current flows from the battery to the windshield wiper motor and the windshield wipers operate at low speed.(7)

WIPER/WASHER SYSTEM

With wiper and washer switch on right side



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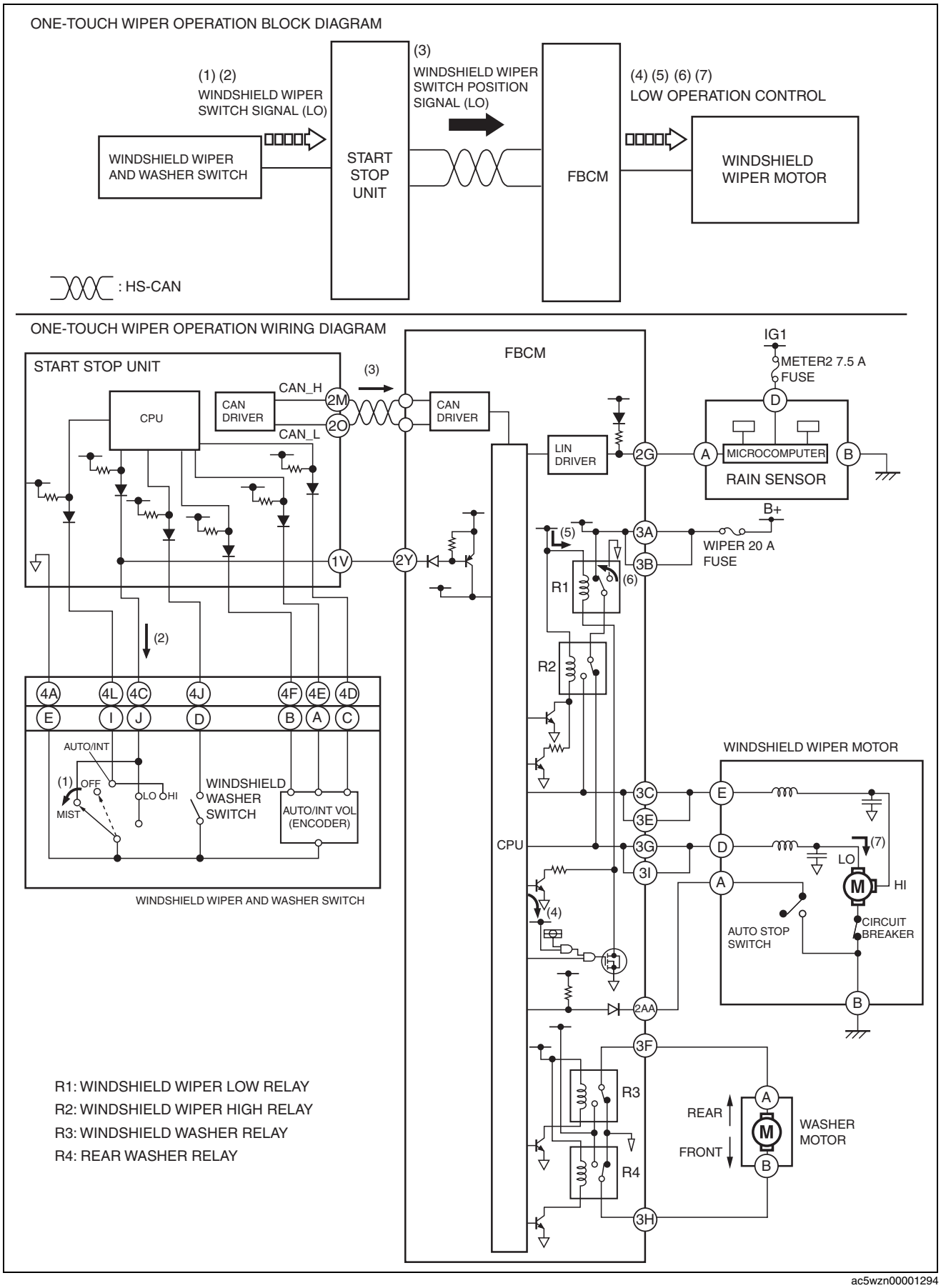
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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WIPER/WASHER SYSTEM

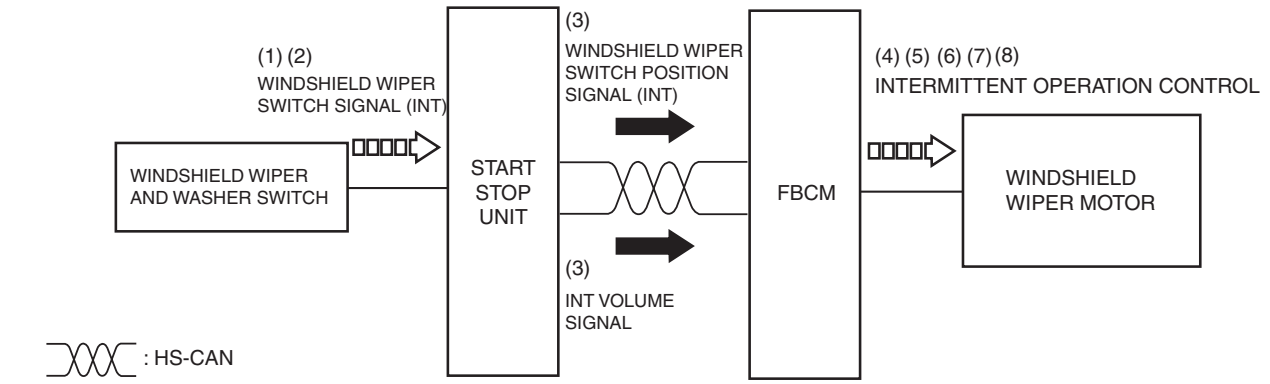
Intermittent wiper operation (without auto wiper system)

1. When the wiper and washer switch is moved to the INT position with the ignition switched ON (engine off or on) (1), the start stop unit detects a windshield wiper switch signal (INT).(2)
2. When the start stop unit detects a windshield wiper switch signal (INT), it send a windshield wiper switch position signal (INT) and an INT volume signal to the front body control module (FBCM) as CAN signals.(3)
3. When the front body control module (FBCM) receives the windshield wiper switch position signal (INT), it supplies the base current from the internal CPU to transistor A (4), and collector current flows from the internal power supply (5), turning the windshield wiper low relay on.(6)
4. When the windshield wiper low relay is turned on, current flows from the battery to the windshield wiper motor and the windshield wipers operate continuously at low speed.(7)
5. The windshield wipers stop at the park position due to the auto stop operation, and after a certain period of time has elapsed, which was calculated based on the INT volume signal, the front body control module (FBCM) operates the windshield wipers at a low speed. By repeating this, the windshield wipers operate intermittently.(8)

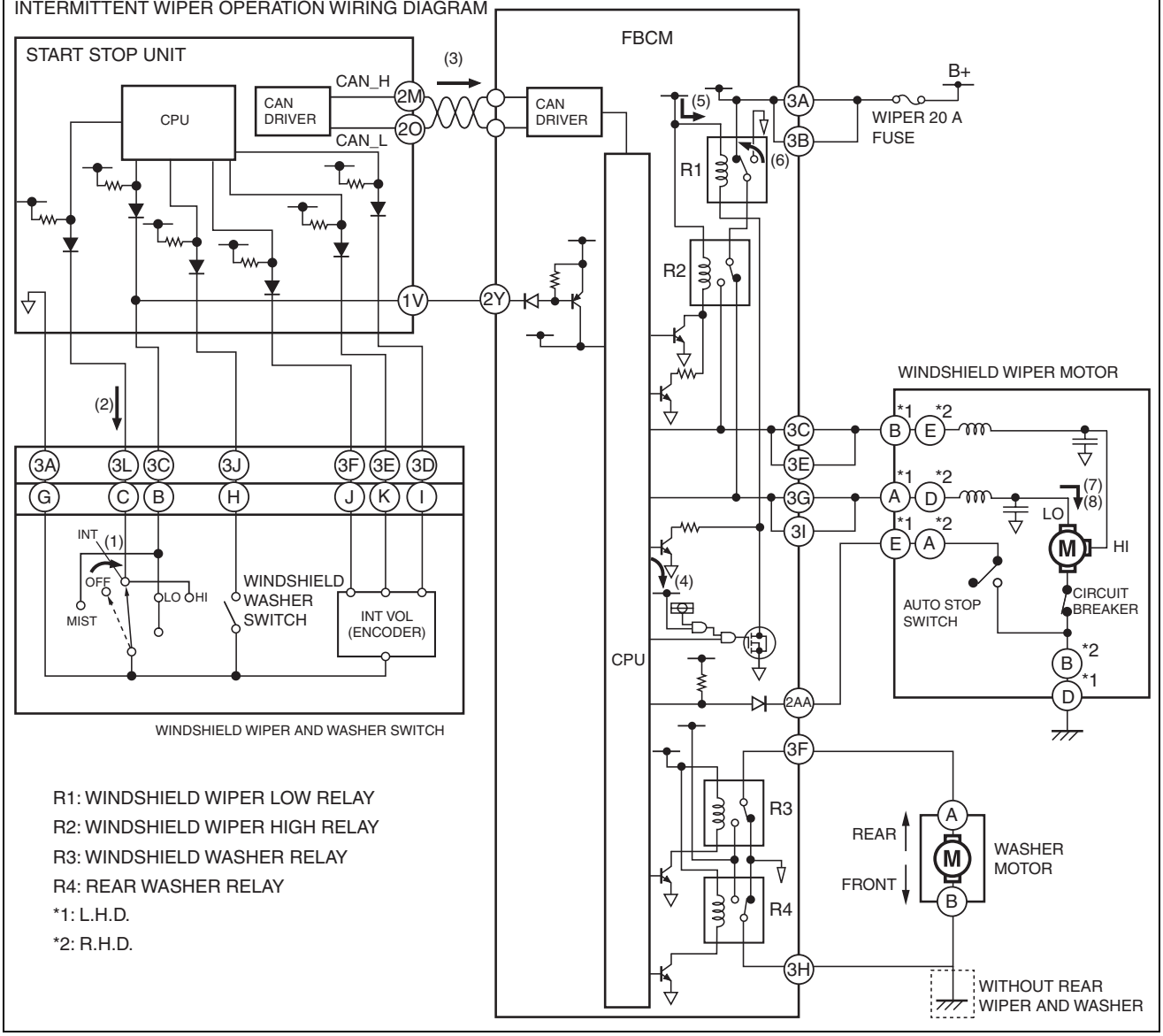
WIPER/WASHER SYSTEM

With wiper and washer switch on right side

INTERMITTENT WIPER OPERATION BLOCK DIAGRAM



INTERMITTENT WIPER OPERATION WIRING DIAGRAM

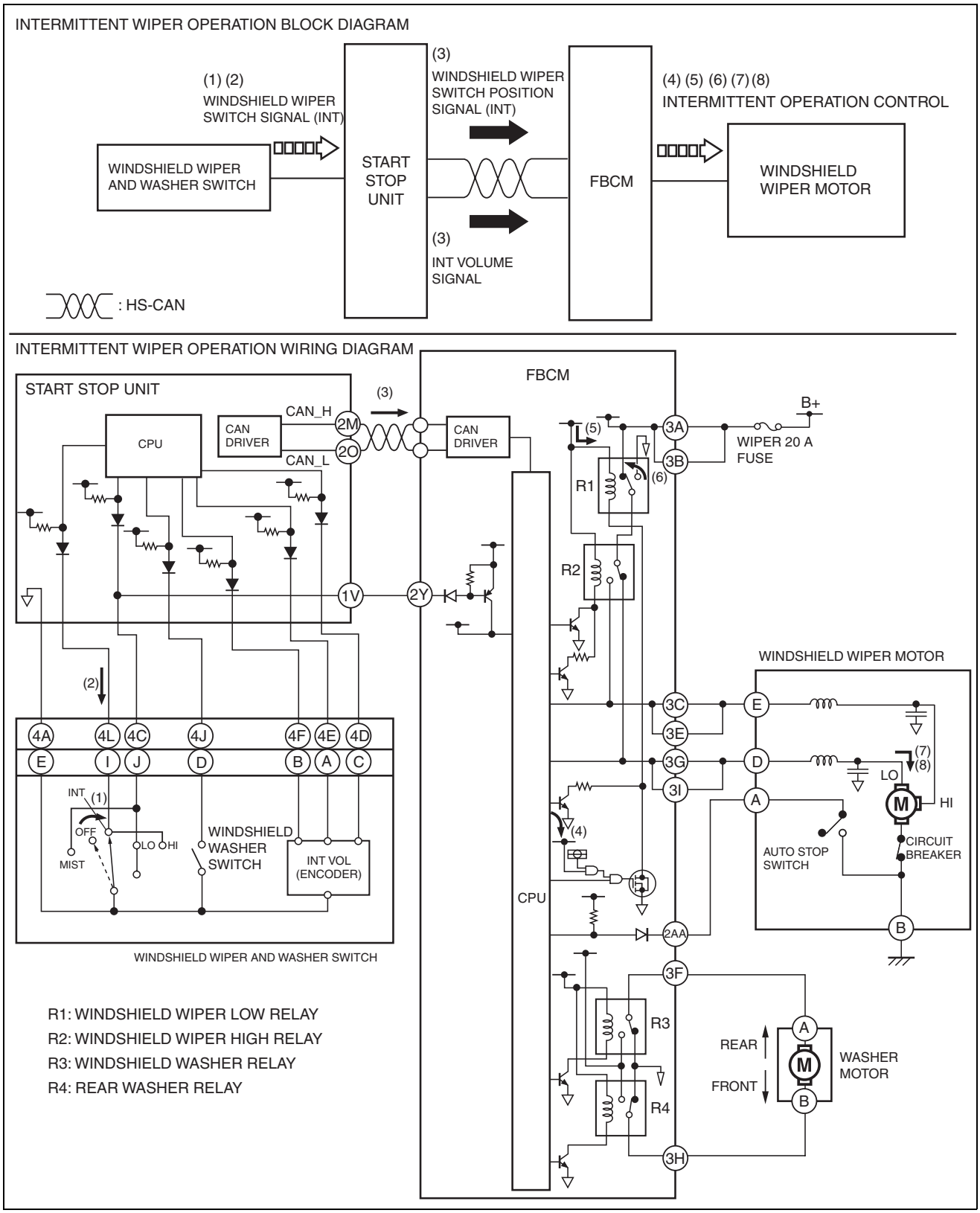


R1: WINDSHIELD WIPER LOW RELAY
R2: WINDSHIELD WIPER HIGH RELAY
R3: WINDSHIELD WASHER RELAY
R4: REAR WASHER RELAY
*1: L.H.D.
*2: R.H.D.

ac5wzn00001261

WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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Auto wiper operation (with auto wiper system)

- Refer to AUTO WIPER SYSTEM for a detailed explanation of the auto wiper operation. (See 09-19-42 AUTO WIPER SYSTEM.)

WIPER/WASHER SYSTEM

Synchronized washer and wiper operation

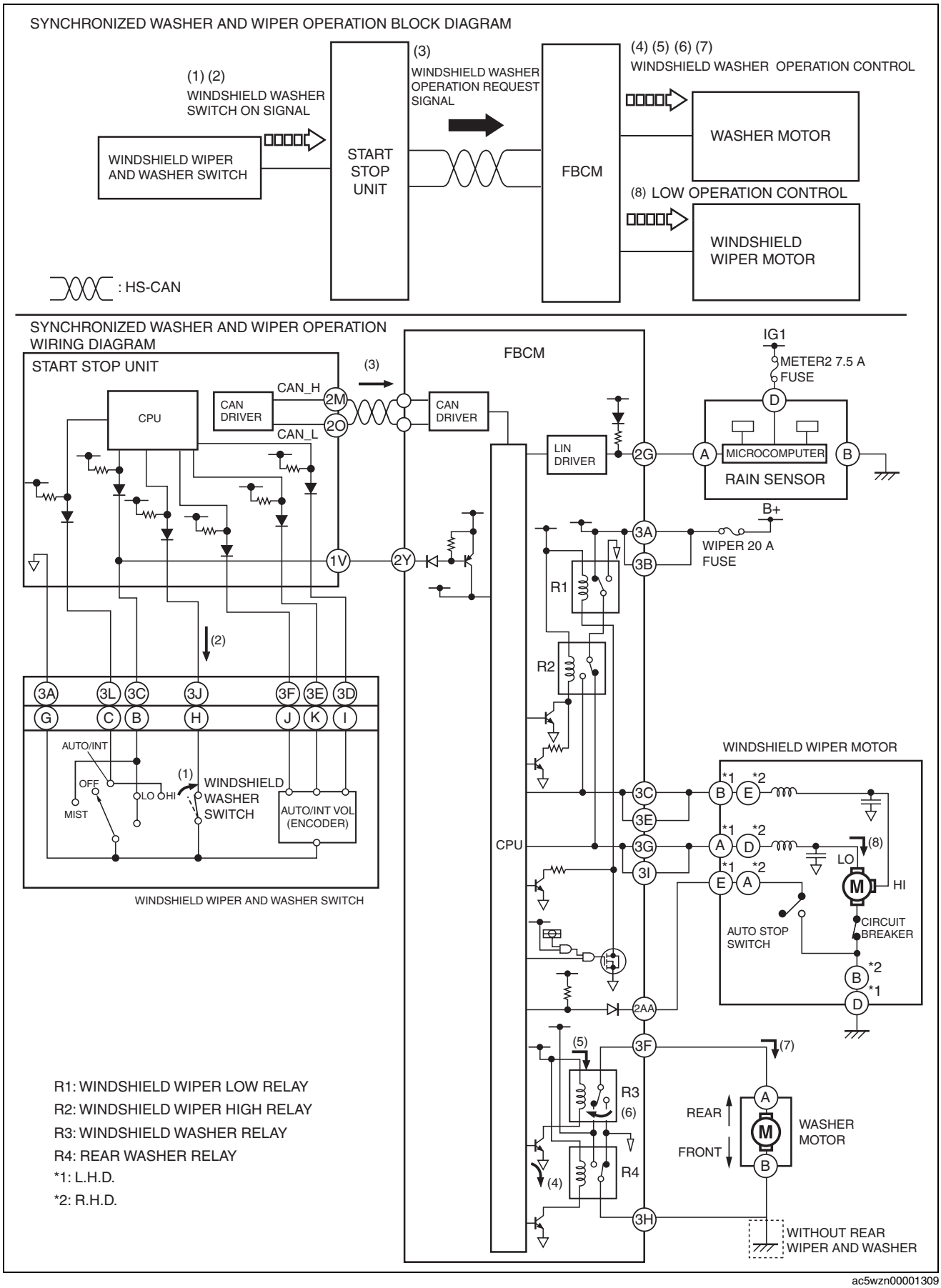
1. When the windshield washer switch is turned on with the ignition switched ON (engine off or on) and the windshield wipers not operated (1), the start stop unit detects a windshield washer switch ON signal.(2)
2. When the start stop unit detects a windshield washer switch ON signal, it send a windshield washer operation request signal to the front body control module (FBCM) as a CAN signal.(3)
3. When the front body control module (FBCM) receives the windshield washer operation request signal, it supplies the base current from the internal CPU to transistor C (4), and collector current flows from the internal power supply (5), turning the windshield washer relay on.(6)
4. When the windshield washer relay is turned on, current flows from the power supply inside the front body control module (FBCM) to the washer motor and the washer motor operates, and washer fluid is sprayed from the front washer nozzles.(7)
5. When the front body control module (FBCM) receives the windshield washer operation request signal for a certain period of time, it operates the windshield wipers at low speed.(8)
6. When the windshield washer switch is turned off, the operation stops after the windshield wipers operate two times.

Note

- If the headlight cleaner operates automatically while the windshield washer is operating, the operation stops after the windshield wipers operate four times.
- If the windshield washer switch is turned on while the windshield wipers are operating, windshield wiper operation is continued and the windshield washer operation, from (3) to (7), is performed.

WIPER/WASHER SYSTEM

With wiper and washer switch on right side



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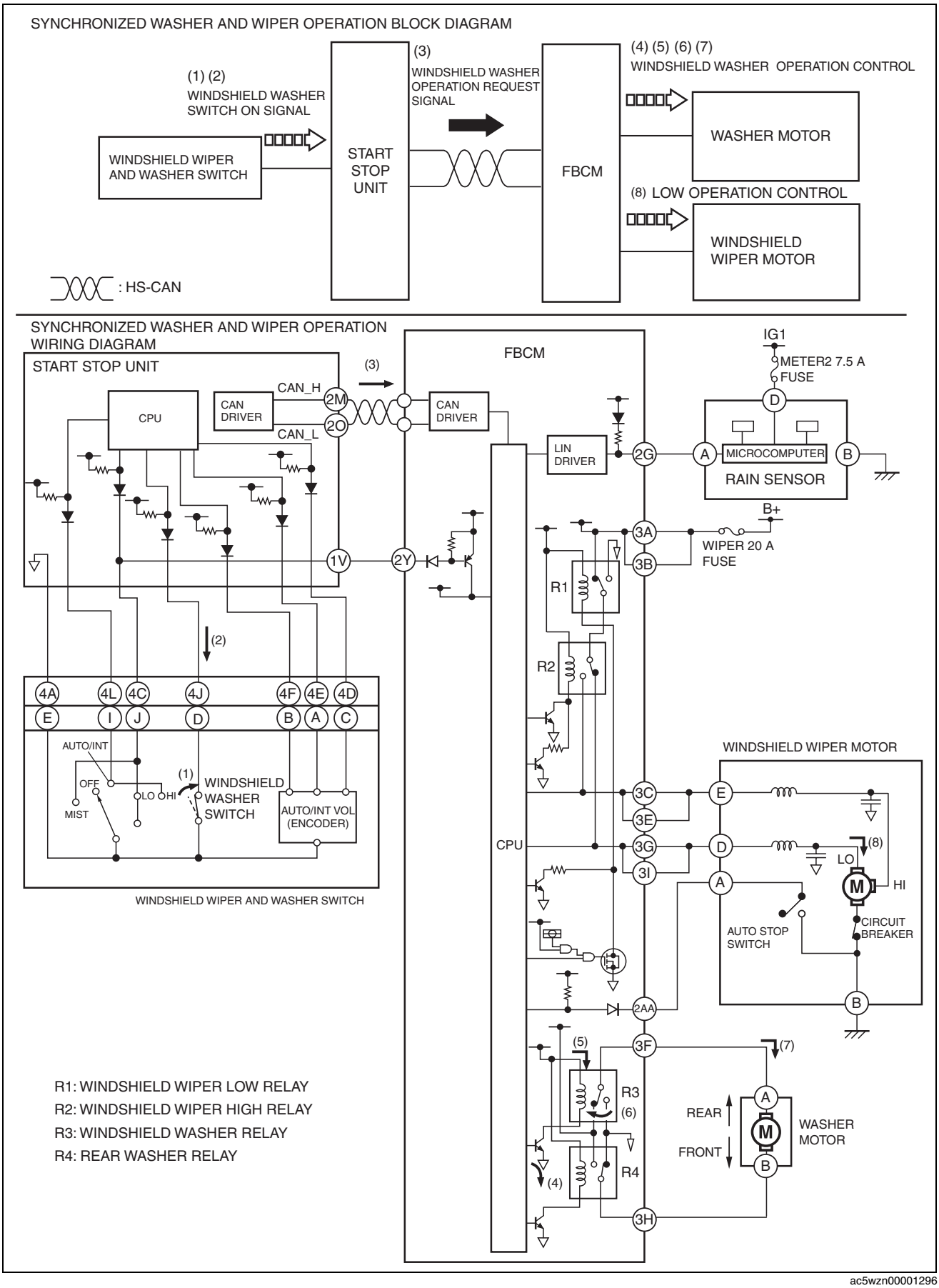
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



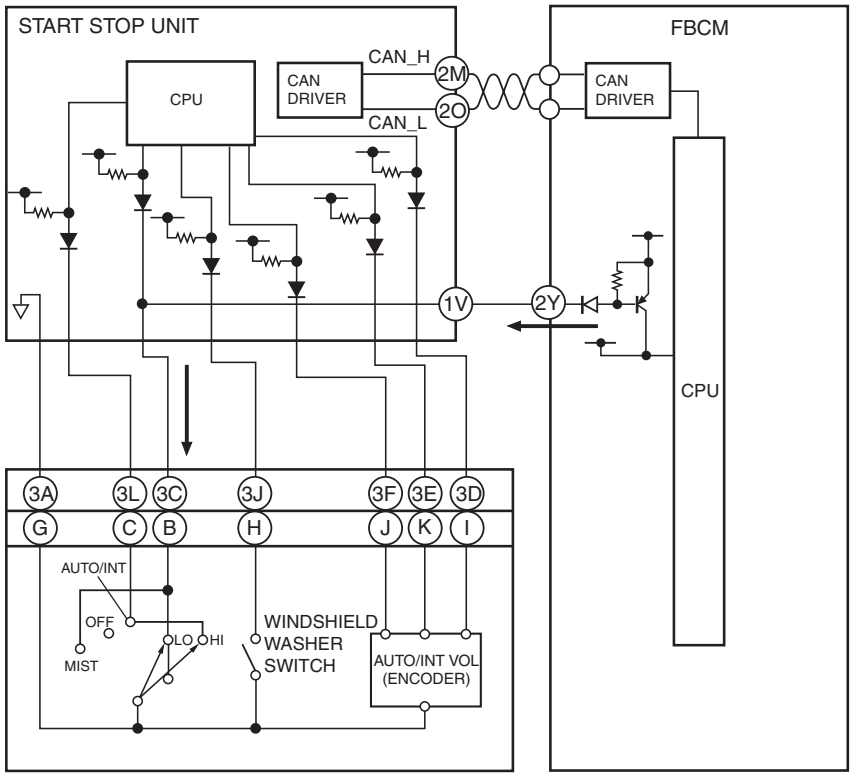
ac5wzn00001296

WIPER/WASHER SYSTEM

LO/HI detection function

- The LO/HI detection function is used in the fail-safe function during a system malfunction.
  - — The front body control module (FBCM) detects that the wiper and washer switch is in the LO or HI position and monitors it.

With wiper and washer switch on right side

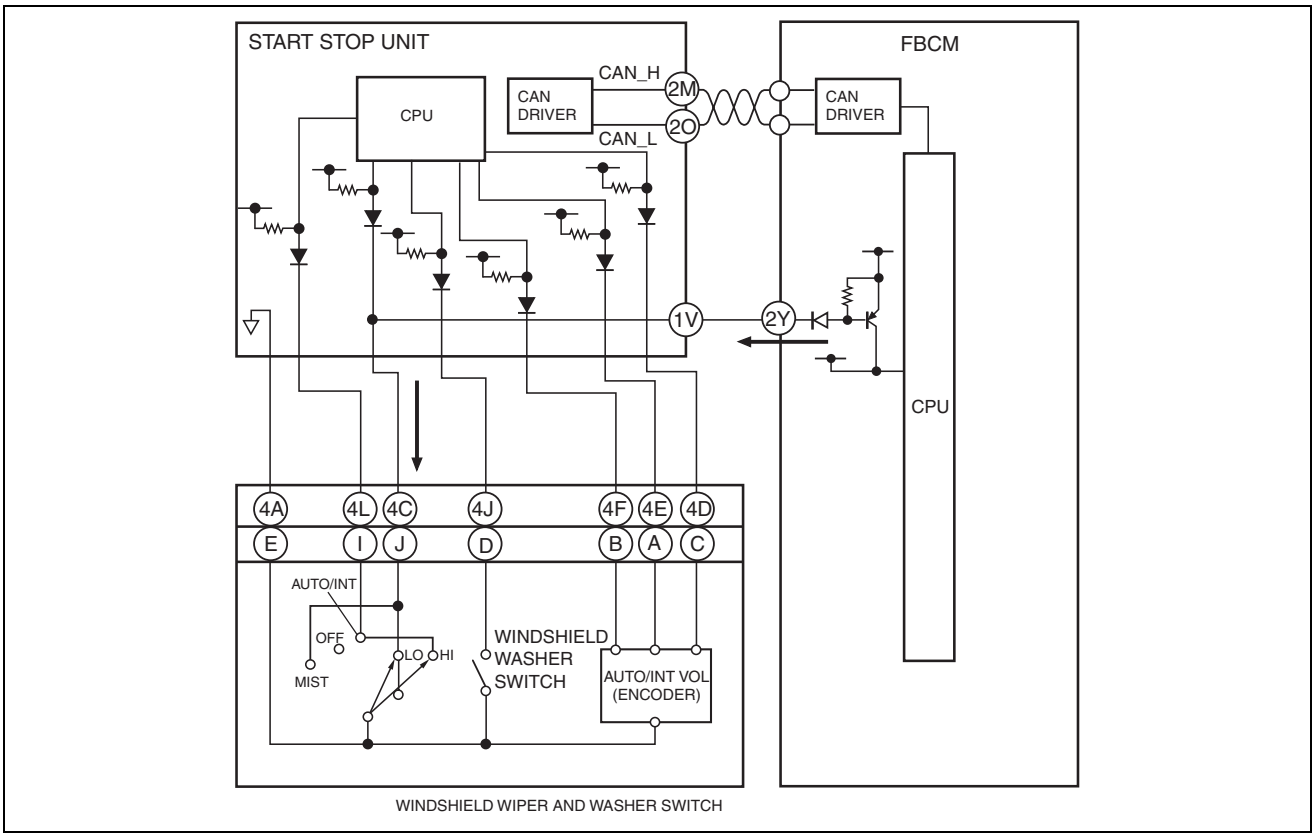


WINDSHIELD WIPER AND WASHER SWITCH

ac5wzn00001310

WIPER/WASHER SYSTEM

With wiper and washer switch on left side



WINDSHIELD WIPER AND WASHER SWITCH

ac5wzn00001263

WINDSHIELD WIPER MOTOR

id091900015000

Purpose

- The windshield wiper motor transmits rotation force to the windshield wiper link to operate the windshield wiper arms and blades.

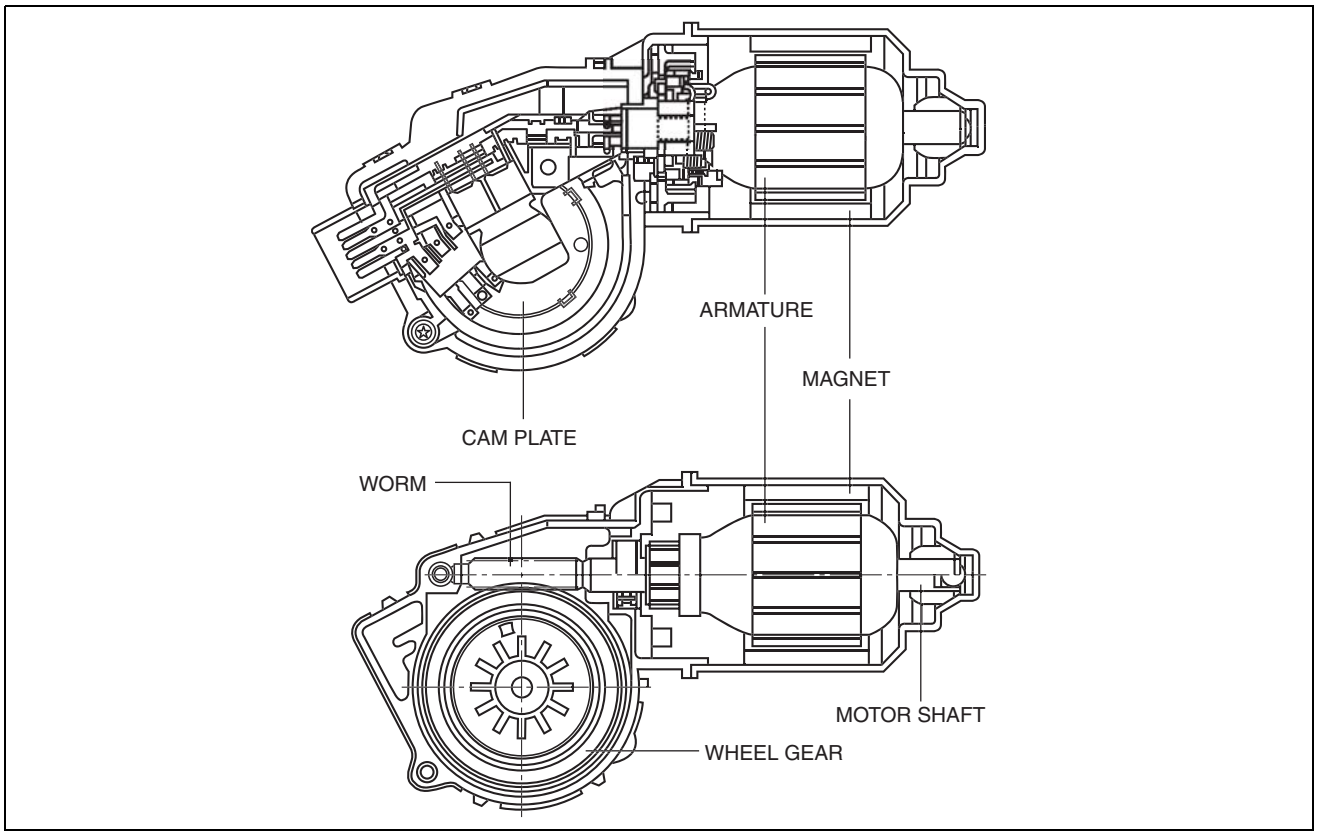
Function

- The windshield wiper motor operates using the current from the front body control module (FBCM) which is input according to the wiper and washer switch operation, and generates rotation force for the low/high 2 system.

Construction

- The windshield wiper motor consists of the following parts:

WIPER/WASHER SYSTEM



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Operation

1. The current flowing from the front body control module (FBCM) is input to the magnet and the motor shaft connected to the armature is rotated.
2. The rotation force of the motor shaft is transmitted to the wheel gear via the worm connected to the motor shaft to drive the windshield wiper link.
3. The windshield wiper link converts the rotation force of the windshield wiper motor to a horizontal reciprocating movement to drive the windshield wiper arms and blades.
4. If the windshield wiper arms and blades are operated to the park position, the auto stop switch turns on by contacting the contact point of the cam plate to stop windshield wiper arms and blades at the park position.

Fail-safe

- Function not equipped.

REAR WIPER SYSTEM

id091900000800

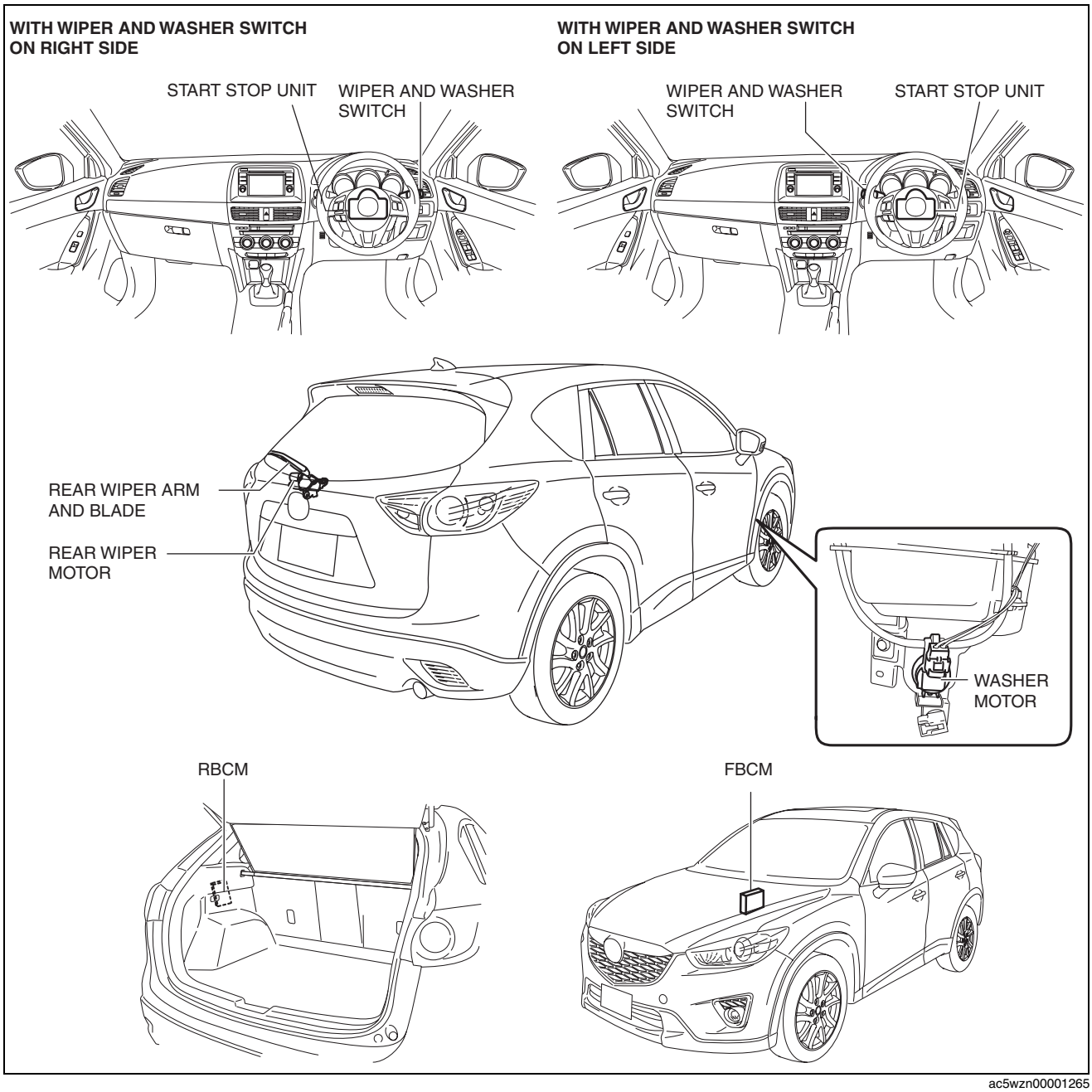
Outline

- Equipped with continuous, auto-stop, intermittent wiper, and synchronized washer and wiper operation.
- The front body control module (FBCM) performs rear wiper and washer system fail-safe. (See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)

WIPER/WASHER SYSTEM

Structural View

R.H.D.



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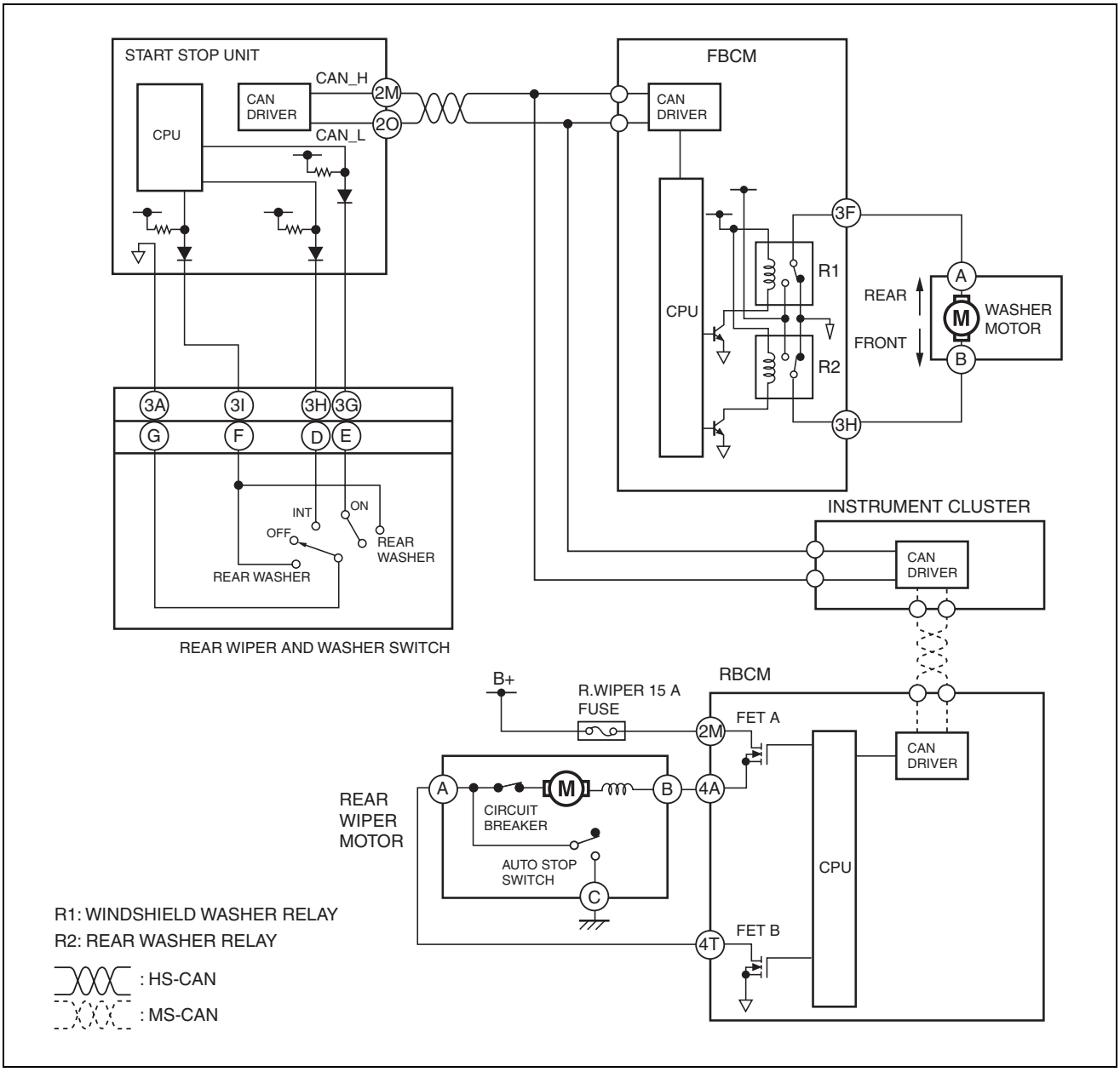
WIPER/WASHER SYSTEM

System Wiring Diagram
With wiper and washer switch on right side



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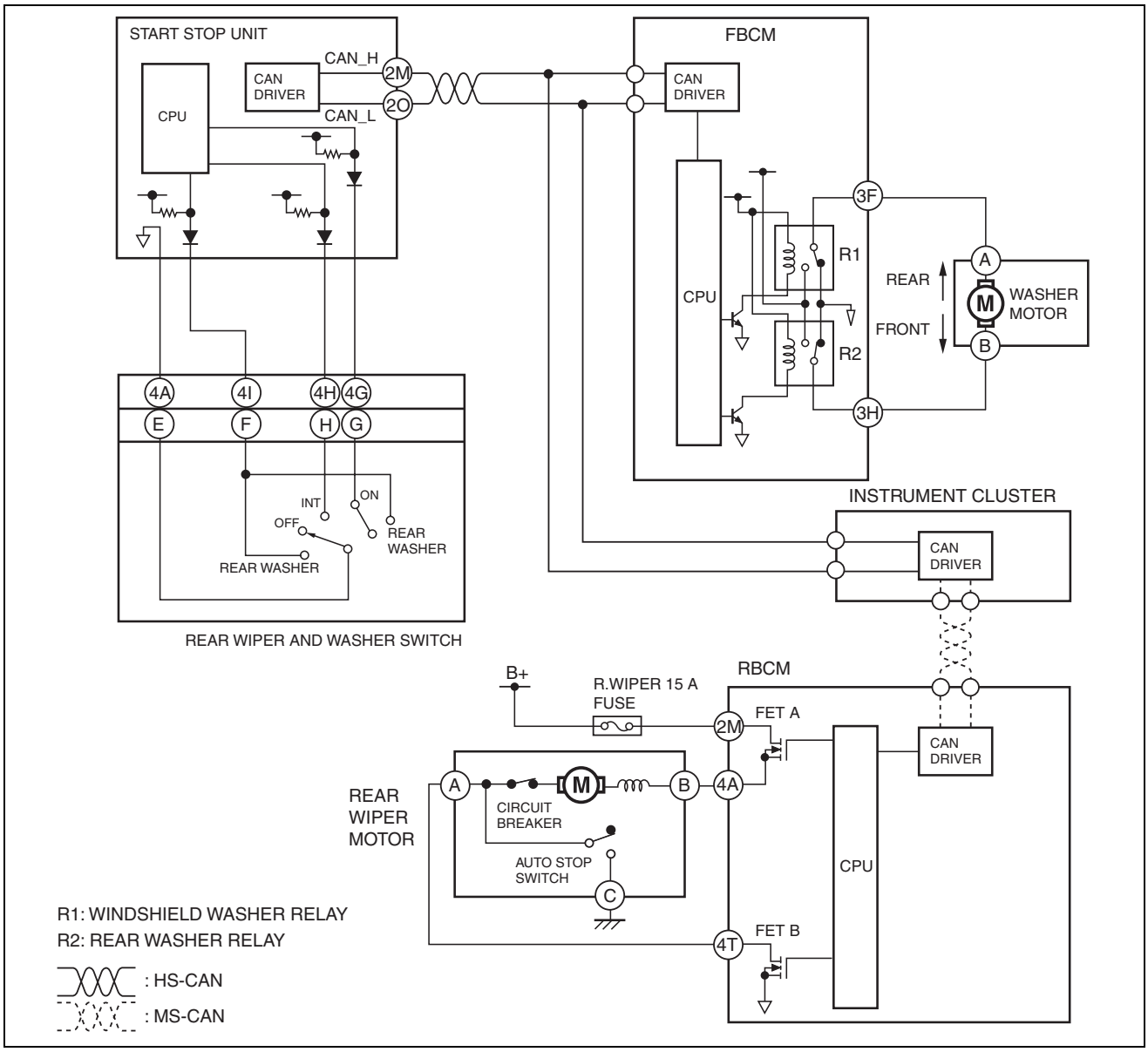
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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Operation

Continuous operation

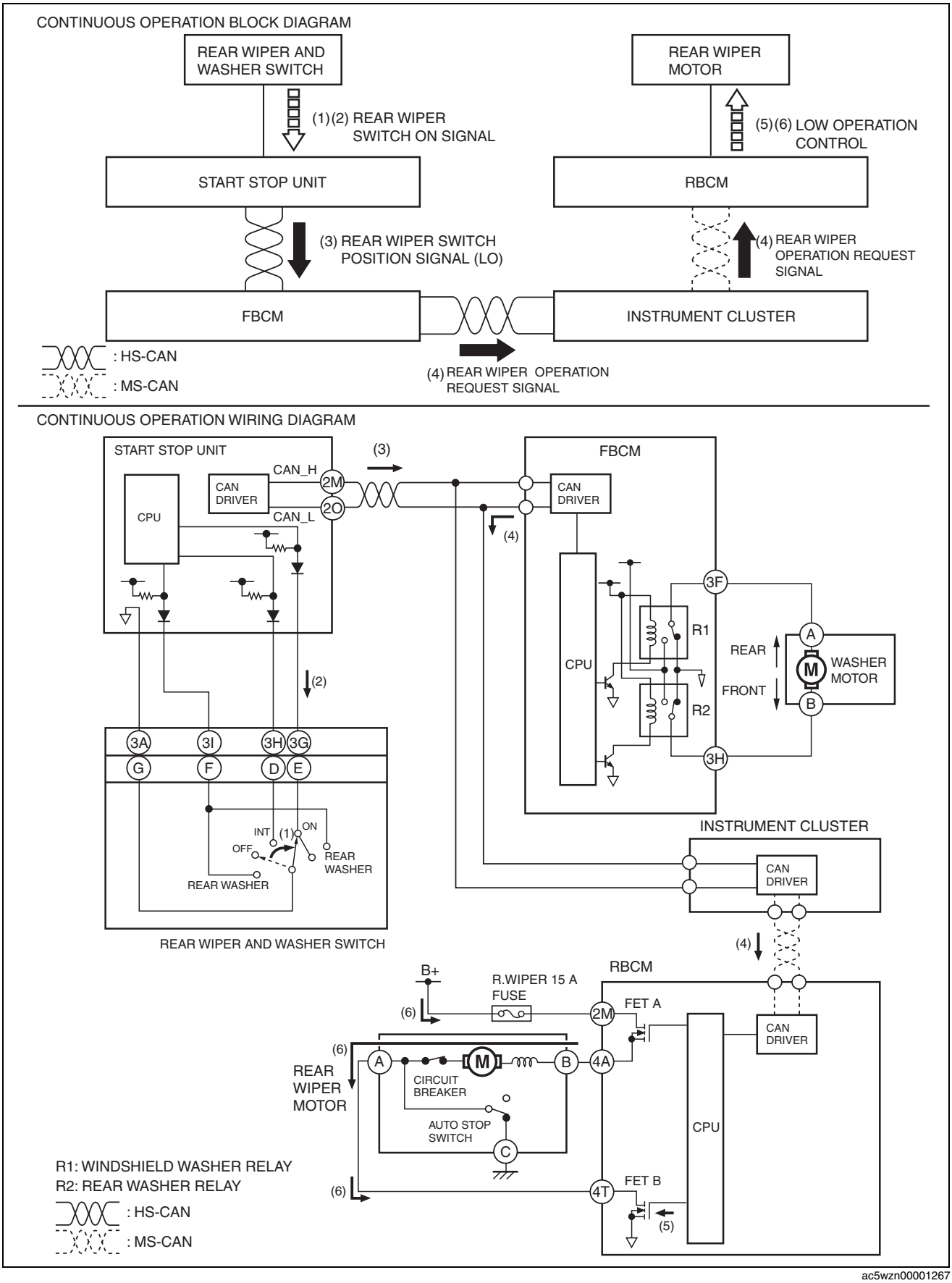
1. When the rear wiper and washer switch is turned to the ON position with the ignition switched ON (engine off or on) (1), the start stop unit detects a rear wiper switch ON signal.(2)
2. When the start stop unit detects a rear wiper switch ON signal, it send a rear wiper switch position signal (LO) to the front body control module (FBCM) as a CAN signal.(3)
3. When the front body control module (FBCM) receives the rear wiper switch position signal (LO), it sends a rear wiper operation request signal to the rear body control module (RBCM) via the instrument cluster as a CAN signal.(4)
4. When the rear body control module (RBCM) receives the rear wiper operation request signal, it supplies the gate current from the internal CPU to FET B (5), and current flows from the battery to the rear wiper motor and the rear wiper operates continuously.(6)

Note

- When the ignition is switched ON (engine on or off), the rear body control module (RBCM) turns the FET A on.

WIPER/WASHER SYSTEM

With wiper and washer switch on right side



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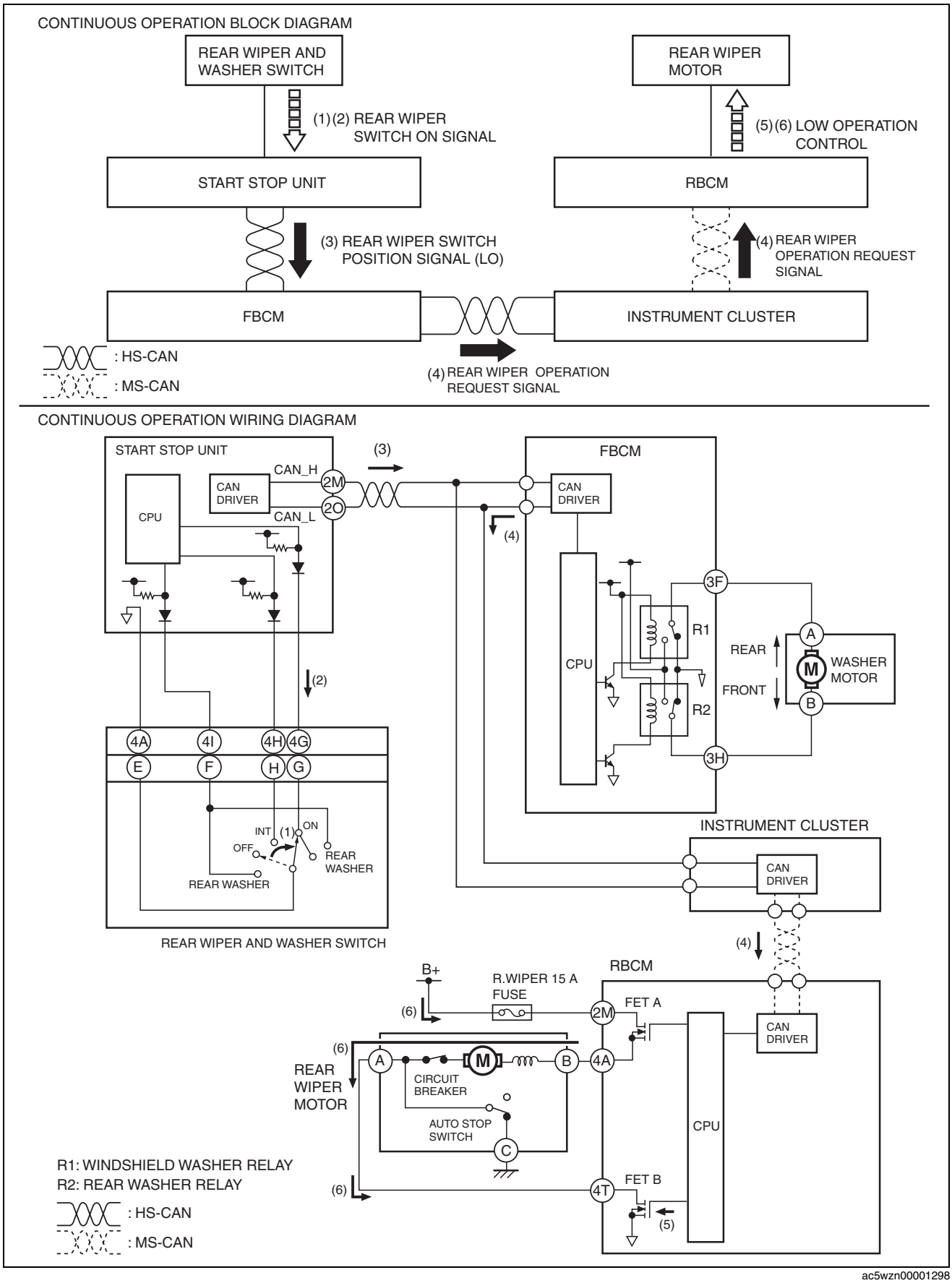
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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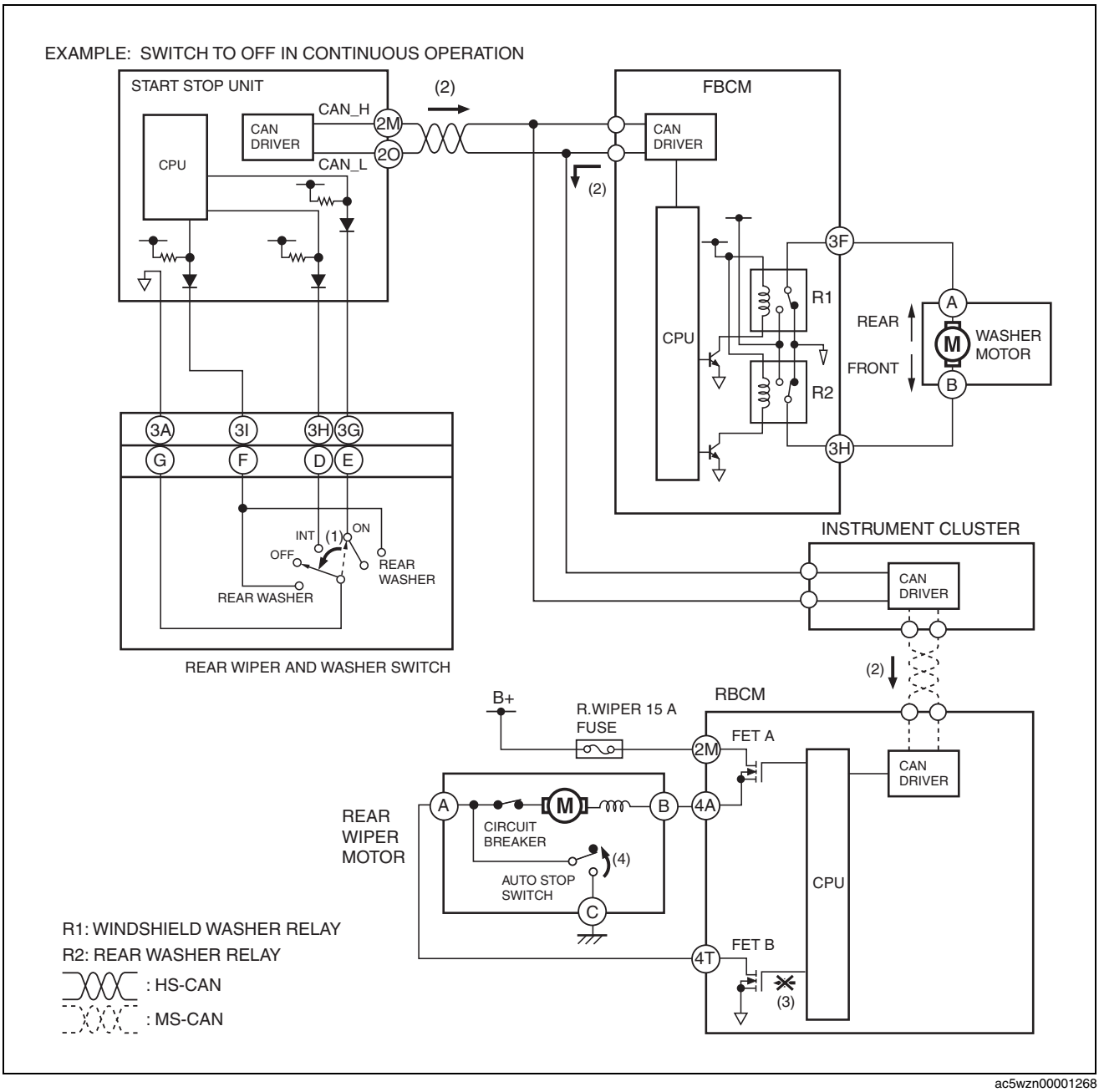
WIPER/WASHER SYSTEM

Auto-stop operation

1. The auto stop switch inside the rear wiper motor operates as follows according to the operation position of the rear wipers.
   - Rear wipers stopped in park position: Off
   - Rear wipers stopped in position other than park: On
2. When the rear wiper and washer switch is in the OFF position (1) during rear wiper operation, the rear wiper operation request signal sent to the rear body control module (RBCM) via the instrument cluster from the front body control module (FBCM) turns off. (2)
3. When the rear wiper operation request signal turns off, the rear body control module (RBCM) turns the FET B off. (3)
4. The rear wiper operates continuously because the auto stop switch is on.
5. The autostop switch in the rear wiper motor turns off if the rear wiper stops at the correct position, and the rear wiper stops based on this.(4)

With wiper and washer switch on right side



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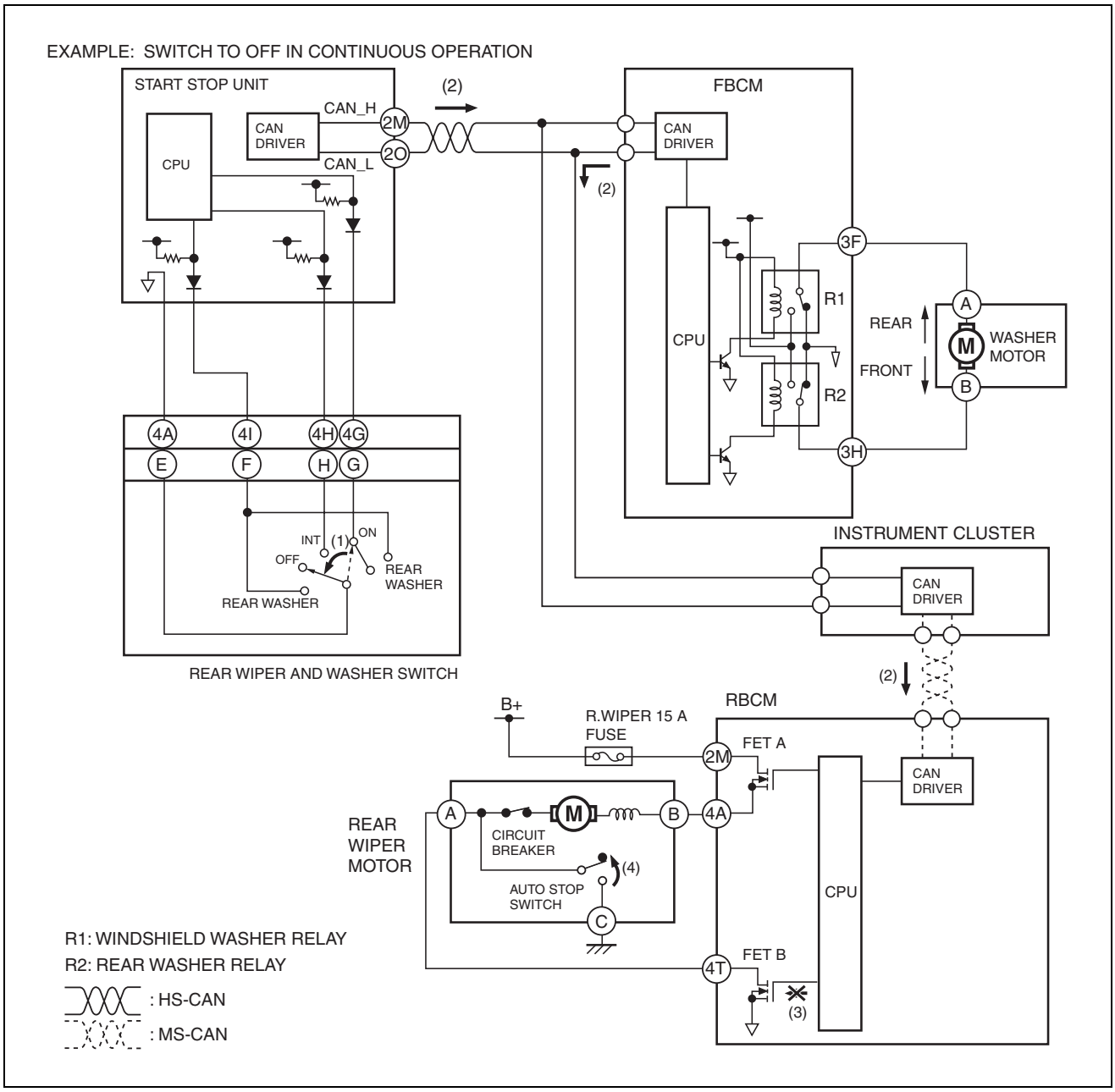
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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Intermittent wiper operation

1. When the rear wiper and washer switch is moved to the INT position with the ignition switched ON (engine off or on) (1), the start stop unit detects a rear wiper switch signal (INT).(2)
2. When the start stop unit detects a rear wiper switch signal (INT), it send a rear wiper switch position signal (INT) to the front body control module (FBCM) as a CAN signal.(3)
3. When the front body control module (FBCM) receives the rear wiper switch position signal (INT), it sends a rear wiper operation request signal to the rear body control module (RBCM) via the instrument cluster as a CAN signal.(4)
4. When the rear body control module (RBCM) receives the rear wiper operation request signal, it supplies the gate current from the internal CPU to FET B (5), and current flows from the battery to the rear wiper motor and the rear wiper operates.(6)

Note

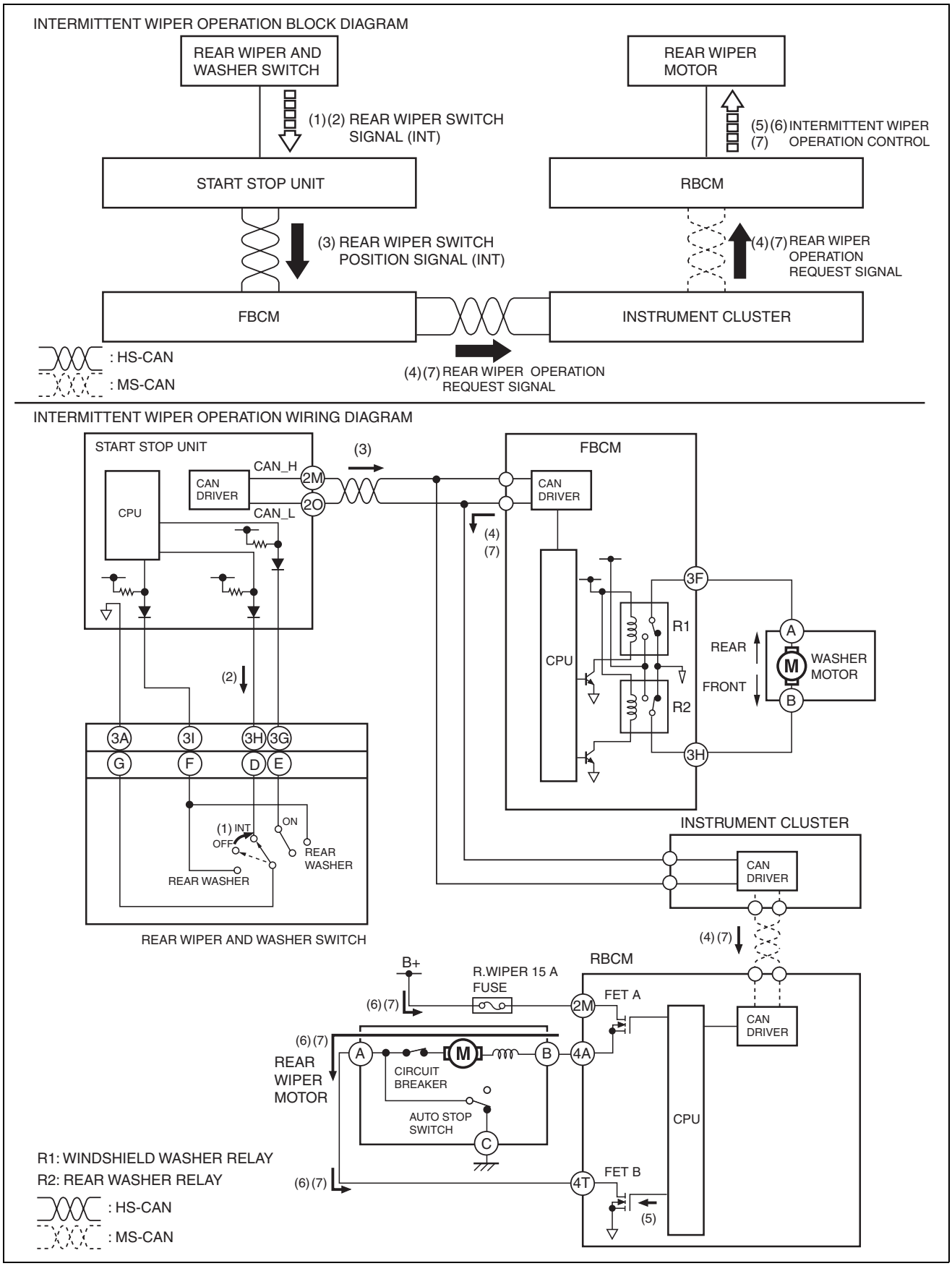
- When the ignition is switched ON (engine on or off), the rear body control module (RBCM) turns the FET A on.


WIPER/WASHER SYSTEM

5. The front body control module (FBCM) sends a rear wiper operation request signal to the rear body control module (RBCM) via the instrument cluster at regular intervals. Due to this, the rear wiper operates intermittently.(7)


WIPER/WASHER SYSTEM

With wiper and washer switch on right side



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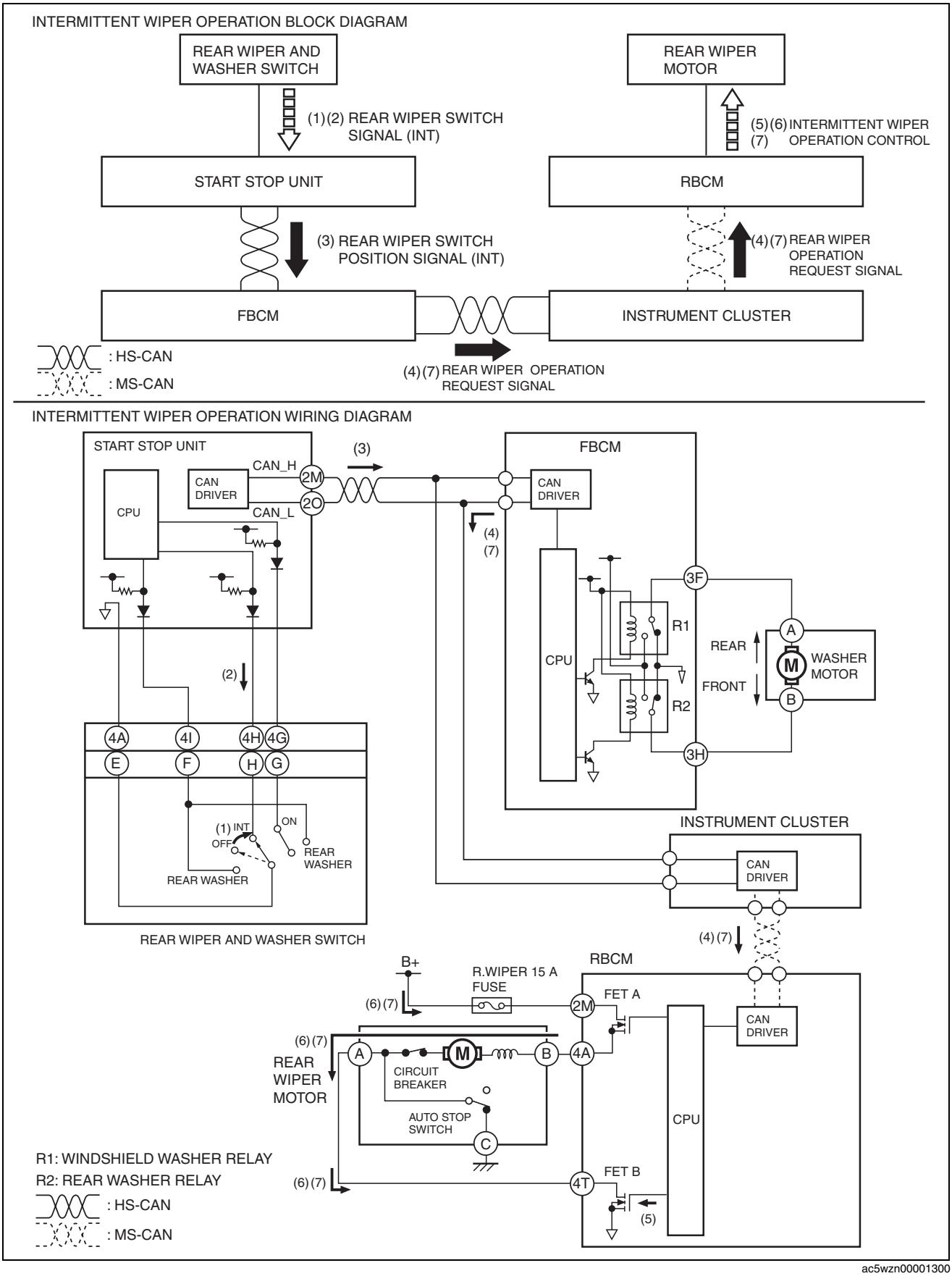
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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WIPER/WASHER SYSTEM

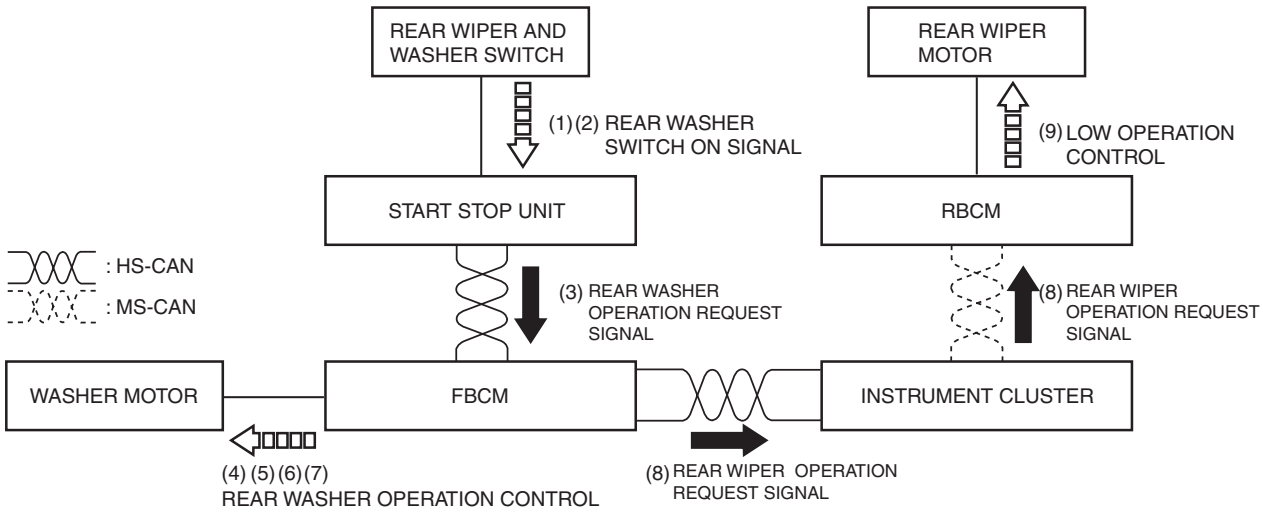
Synchronized washer and wiper operation

1. When the rear wiper and washer switch is turned to the rear washer position with the ignition switched ON (engine off or on) (1), the start stop unit detects a rear washer switch ON signal.(2)
2. When the start stop unit detects a rear washer switch ON signal, it send a rear washer operation request signal to the front body control module (FBCM) as a CAN signal.(3)
3. When the front body control module (FBCM) receives the rear washer operation request signal, it supplies the base current from the internal CPU to transistor (4), and collector current flows from the internal power supply (5), turning the rear washer relay on.(6)
4. When the rear washer relay is turned on, current flows to the washer motor and the washer motor operates, and washer fluid is sprayed from the rear washer nozzle.(7)
5. When the front body control module (FBCM) receives the rear washer operation request signal for a certain period of time, it sends a rear wiper operation request signal to the rear body control module (RBCM) via the instrument cluster as a CAN signal.(8)
6. When the rear body control module (RBCM) receives the rear wiper operation request signal, it operates the rear wiper.(9)
7. When the rear washer switch is turned off, the rear wiper stops after it operates for **approx. 2.6 s**.

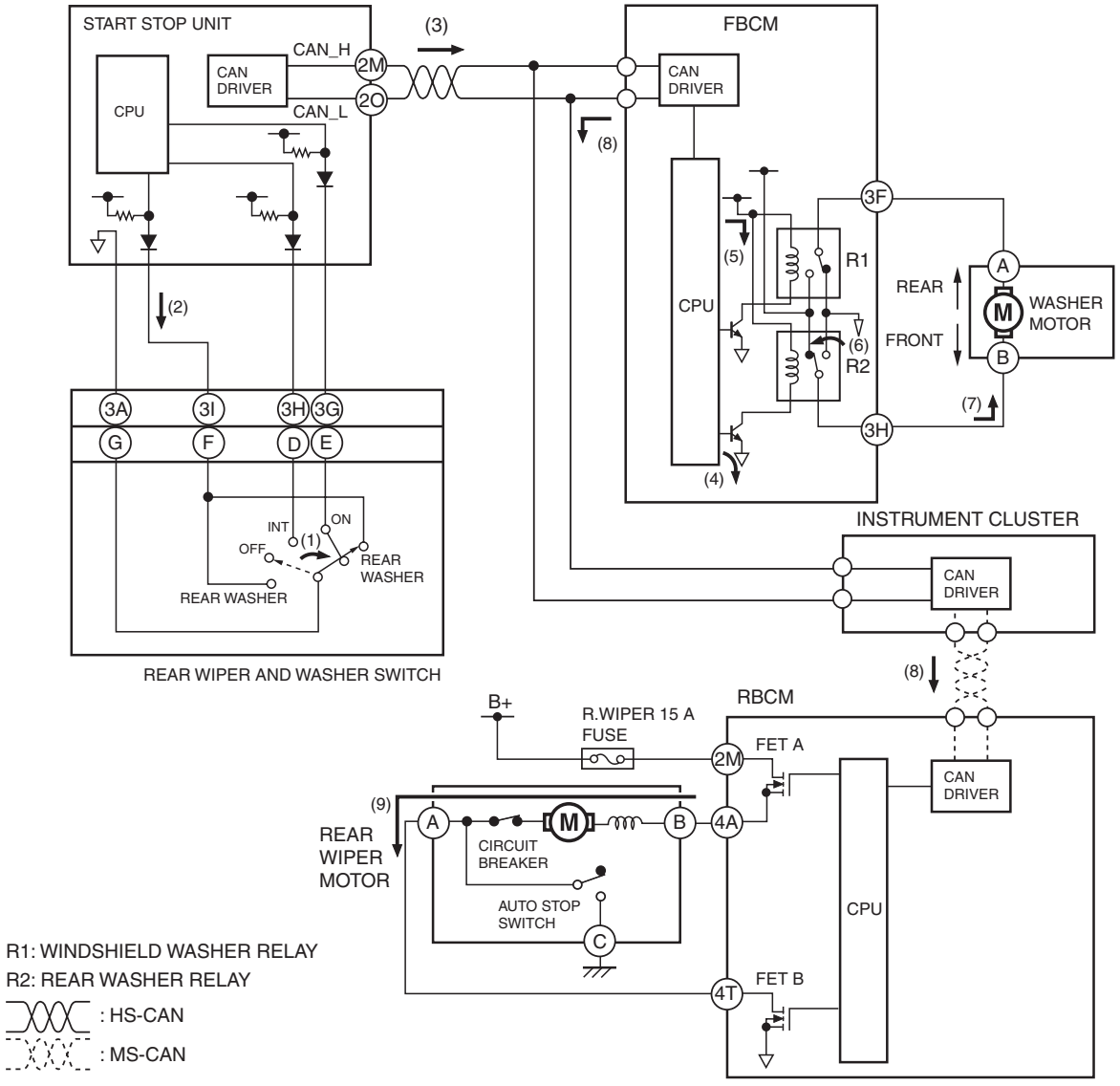
WIPER/WASHER SYSTEM

With wiper and washer switch on right side

SYNCHRONIZED WASHER AND WIPER OPERATION BLOCK DIAGRAM



SYNCHRONIZED WASHER AND WIPER OPERATION WIRING DIAGRAM



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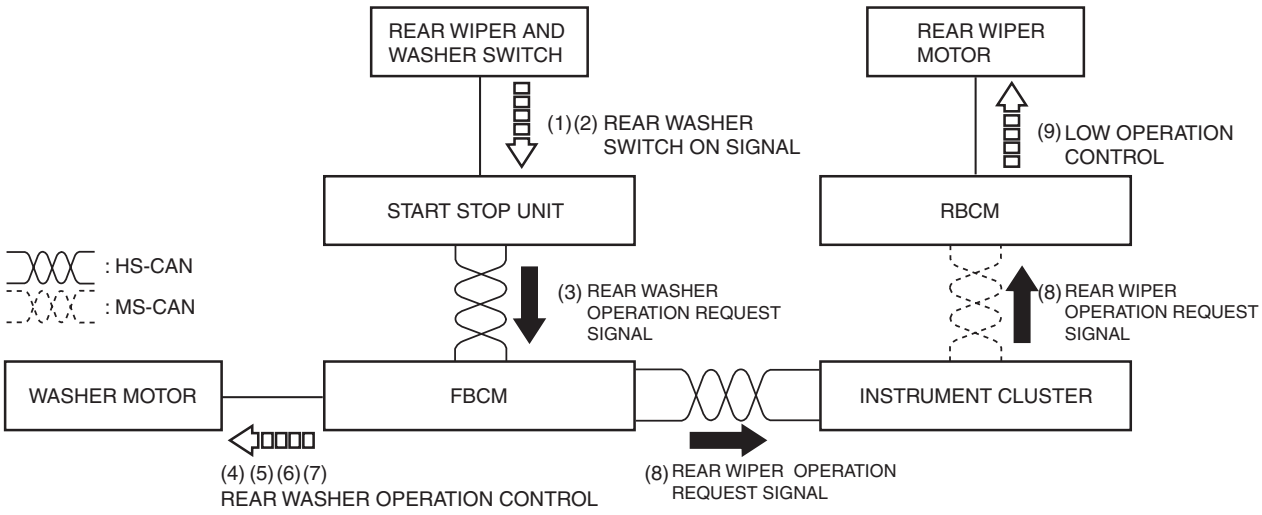
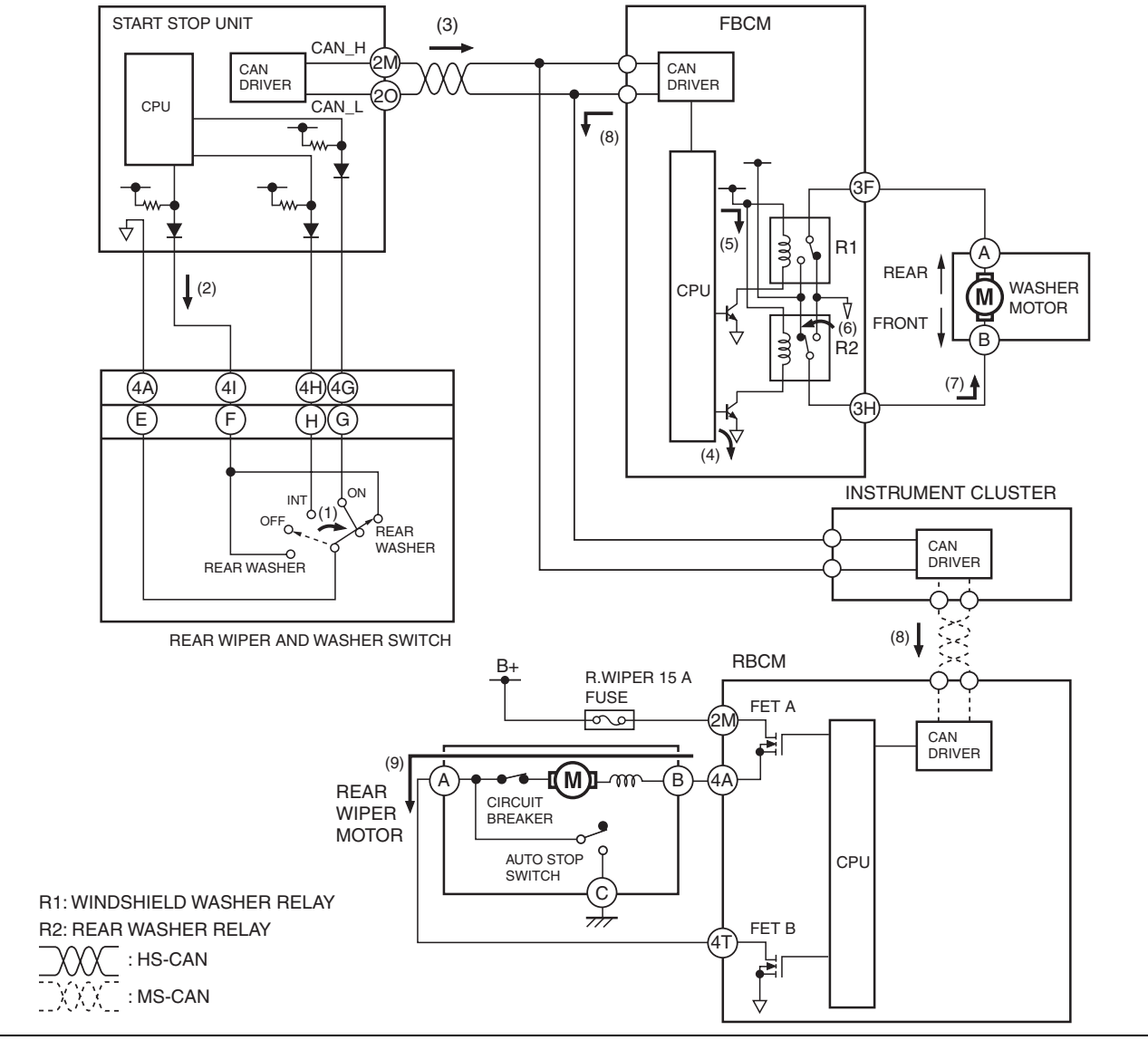
WIPER/WASHER SYSTEM

With wiper and washer switch on left side

SYNCHRONIZED WASHER AND WIPER OPERATION BLOCK DIAGRAM



SYNCHRONIZED WASHER AND WIPER OPERATION WIRING DIAGRAM



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WIPER/WASHER SYSTEM

WASHER NOZZLE

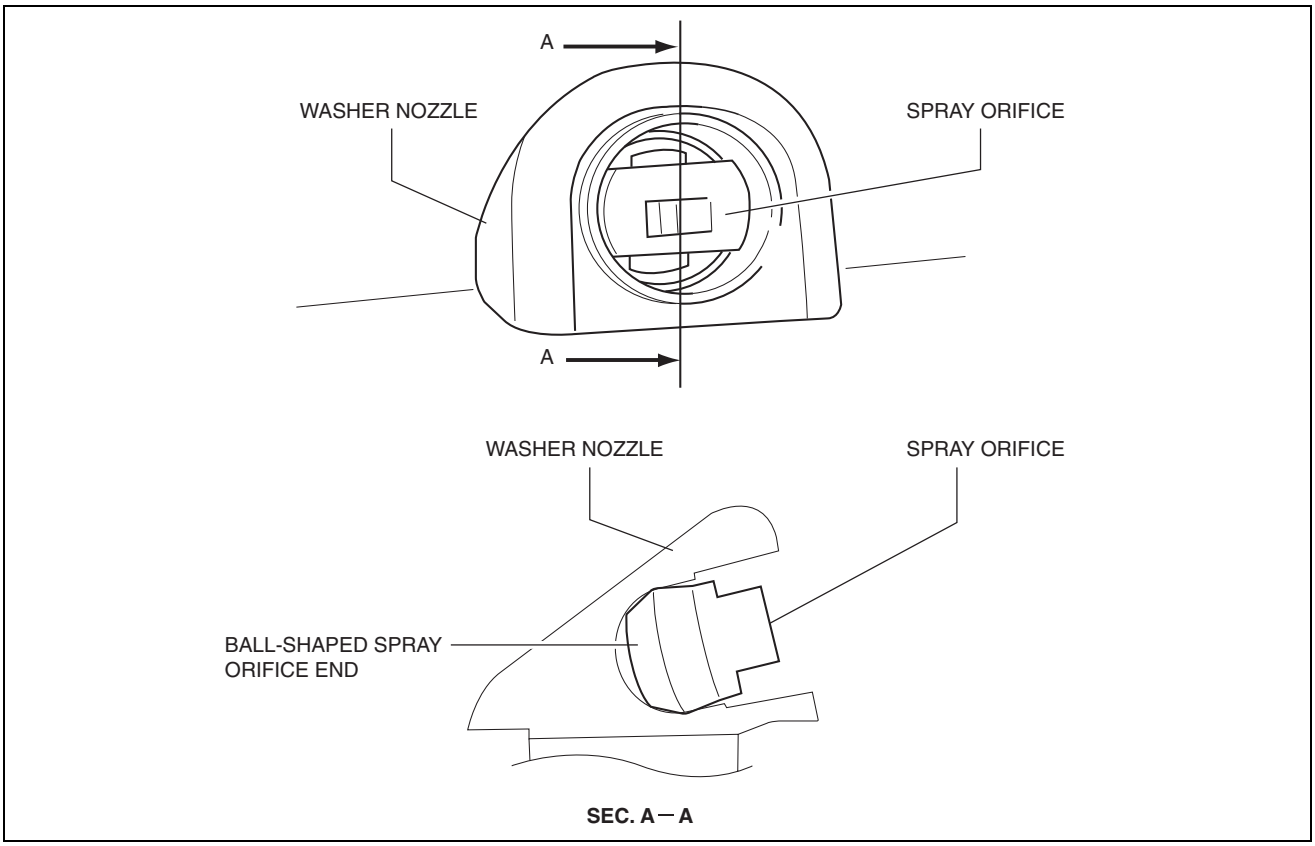
id091900202000

Purpose

- The washer nozzle sprays the washer fluid sent from the washer motor to the optimum positions on the windshield.

Construction

- A ball-shaped spray orifice is set inside the washer nozzle which can be adjusted up or down.



SEC. A—A

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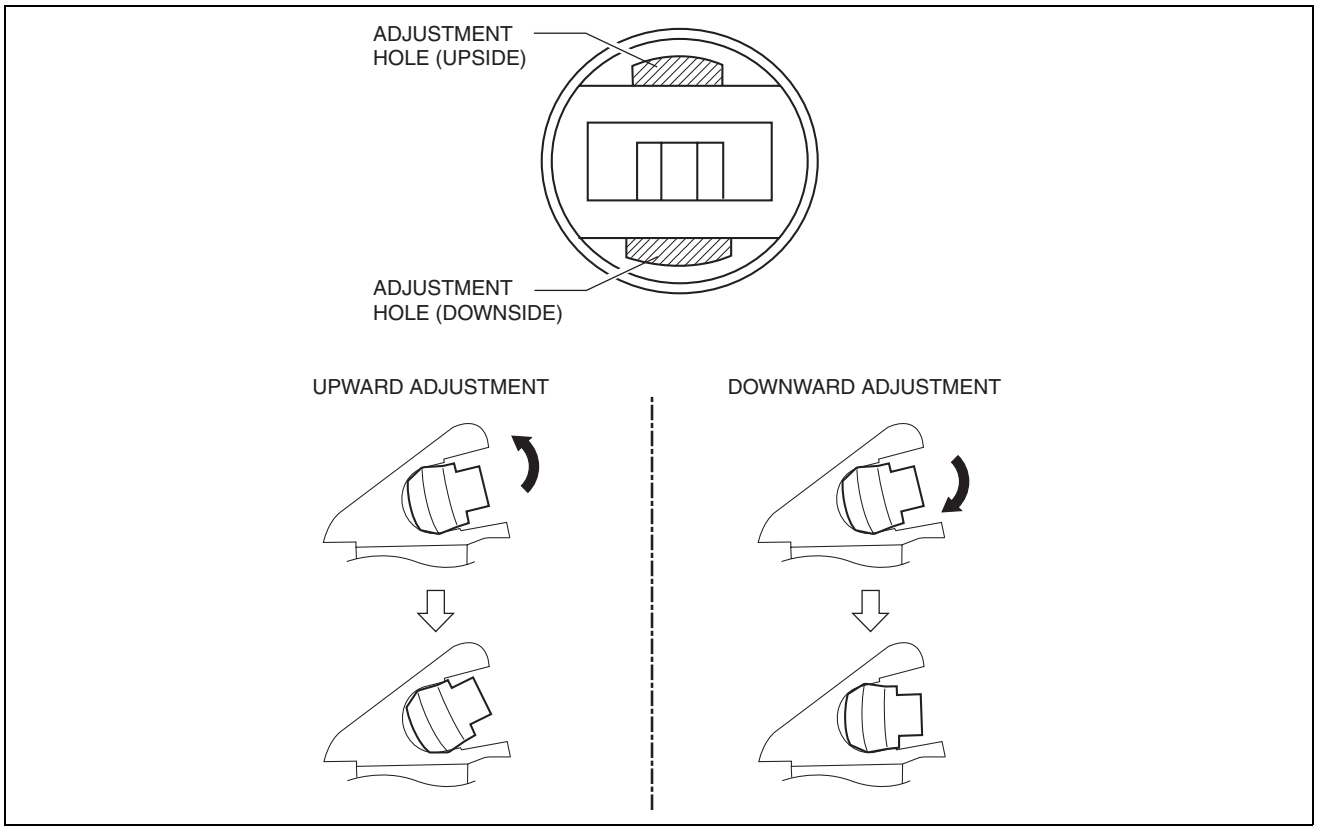
- The washer nozzle is moved up and down using the adjustment holes.



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Fail-safe
- Function not equipped.

AUTO WIPER SYSTEM

id091900000900

Outline
- The auto wiper system performs windshield wiper operation and stopping according to the rainfall amount on the windshield glass.
- Equipped with intermittent, and continuous low and high operation.
- The front body control module (FBCM) performs auto wiper system fail-safe. (See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)

Function
- The front body control module (FBCM) control the windshield wipers based on the windshield wiper operation signal from the rain sensor.
  - — Intermittent operation control
    - When the rain sensor detects an amount of rainfall, the windshield wipers are operated once at low speed.
    - The intermittent operation of the windshield wipers is switched at 5 levels according to the amount of rainfall detected by the rain sensor.
  - — Continuous low speed operation control
    - When the rain sensor detects an amount of rainfall greater than the amount required for intermittent operation control, the windshield wipers are operated continuously at low speed.
  - — High speed operation control
    - When the vehicle speed is **4 km/h {2 mph} or more** and the rain sensor detects an amount of rainfall greater than the amount required for continuous low speed operation control, the windshield wipers are operated twice at high speed.
    - Afterwards, if the rain sensor detects the necessary amount of rainfall for high speed operation, the windshield wipers are operated continuously at high speed.
    - When the vehicle speed is **4 km/h {2 mph} or less** and the rain sensor detects an amount of rainfall greater than the amount required for continuous low speed operation, the windshield wipers are operated continuously at low speed.
  - — Sensitivity adjustment function

WIPER/WASHER SYSTEM

- The sensitivity adjustment function can adjust the rain sensor rain detection sensitivity by operation of the wiper and washer switch sensitivity adjustment volume.
- When the windshield wipers are stopped during an interval and the sensitivity adjustment volume is operated in the direction of high sensitivity, the windshield wipers operate one time to notify the driver that the rain detection sensitivity has been changed.

Customize function

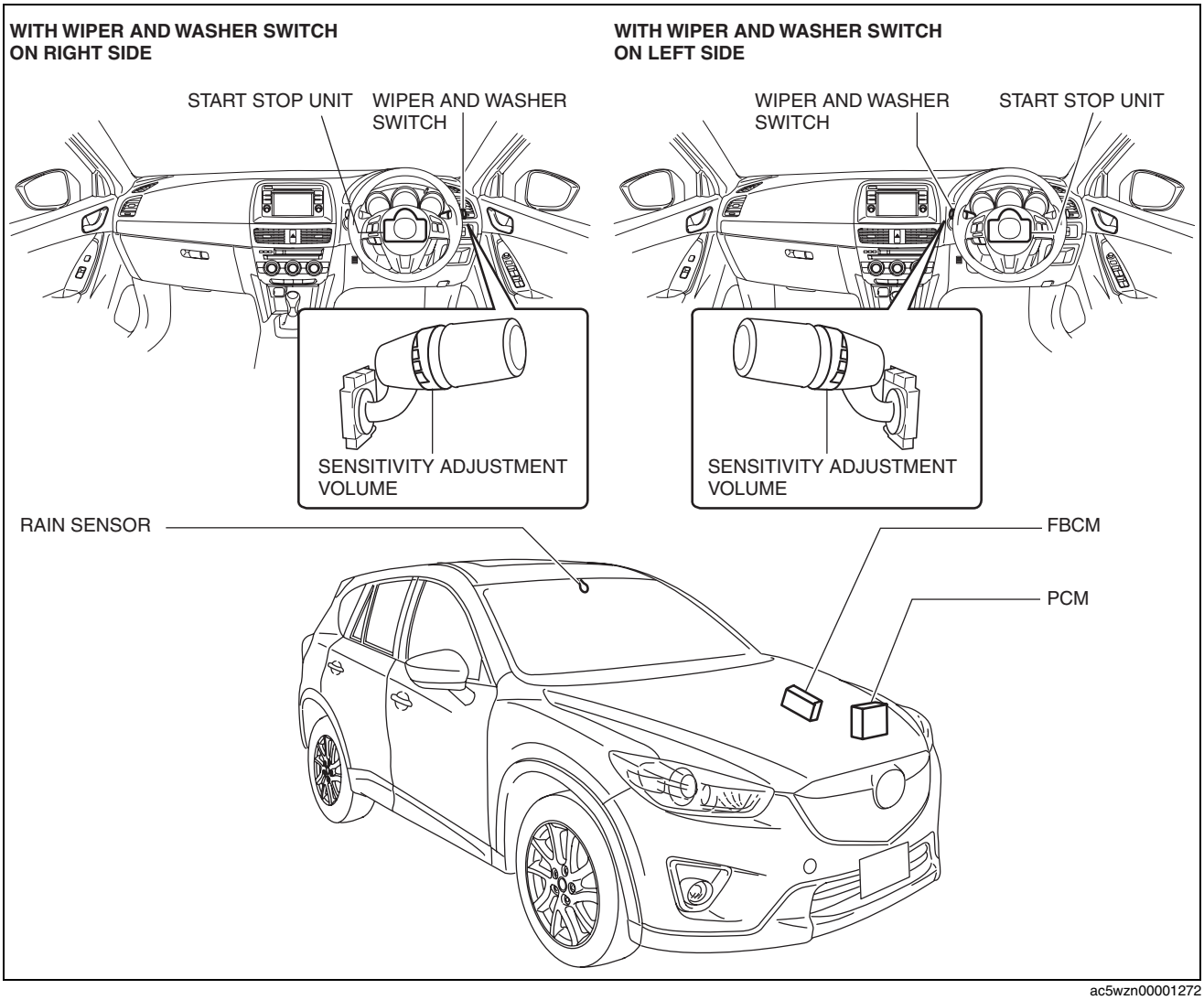
- The auto wiper system customize function uses the rear body control module (RBCM) control to enable or disable the auto wiper functions.
- If the auto wiper system is set to disabled, intermittent operation is performed.
- Refer to WIPER AND WASHER SYSTEM CUSTOMIZATION for the detailed customization function.

On-board diagnostic function

- If a malfunction occurs in the auto wiper control-related switch, sensor, and circuit, the front body control module (FBCM) detects DTCs. For details, refer to the diagnostic system (FBCM), DTC table (FBCM) in the workshop manual.

Structural view

R.H.D.



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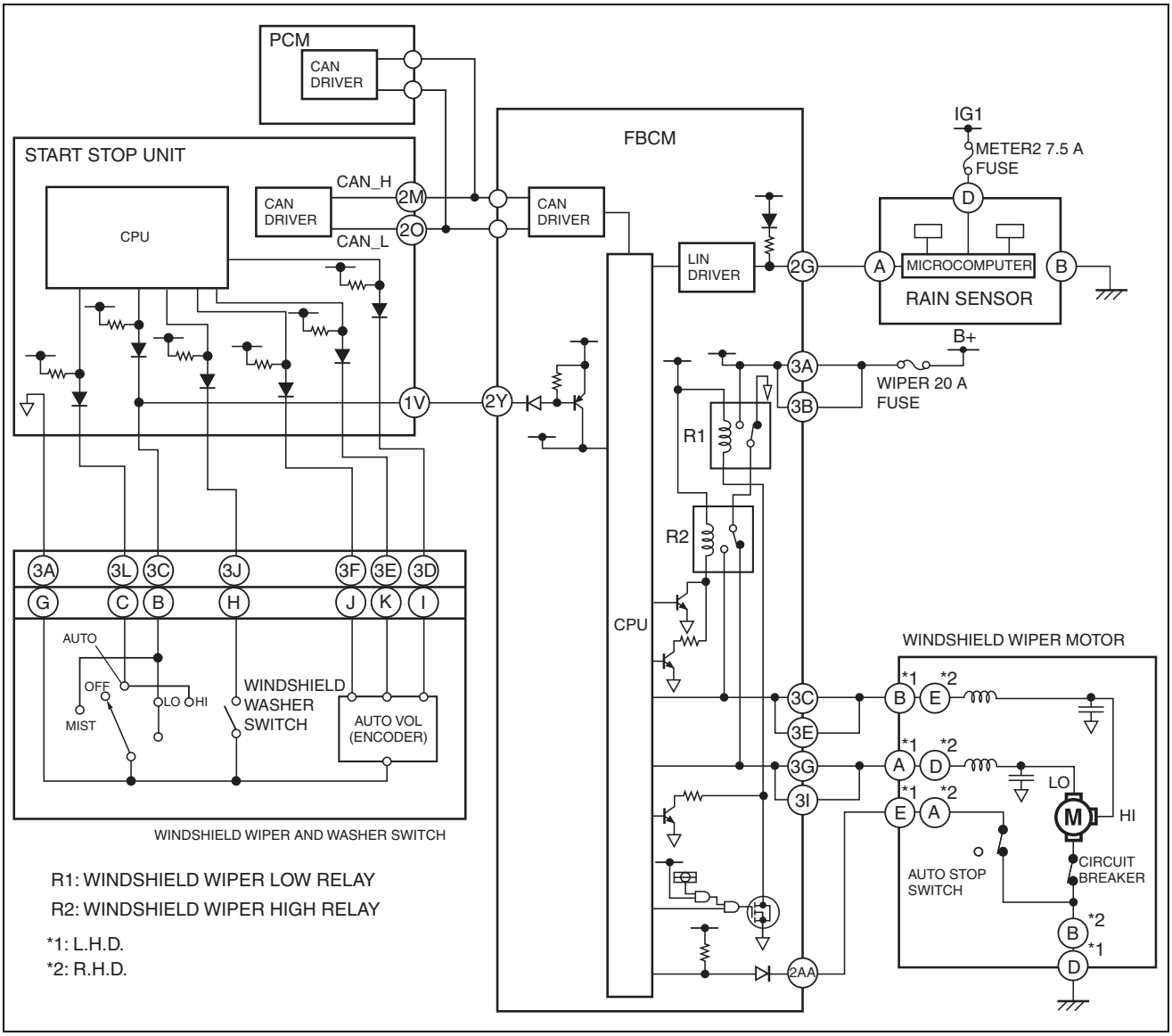
WIPER/WASHER SYSTEM

System wiring diagram
With wiper and washer switch on right side



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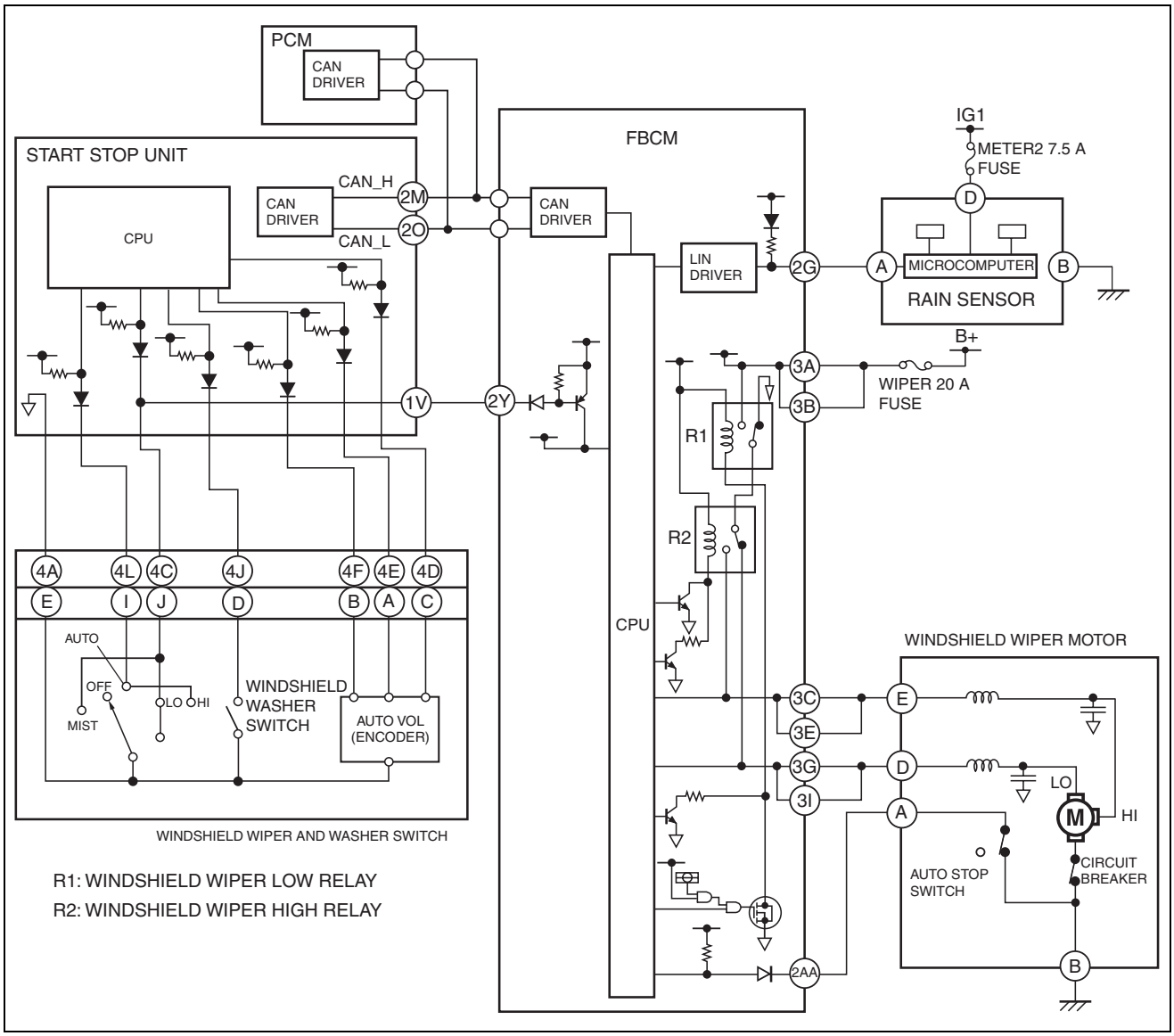
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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Operation

Warning

- **If servicing such as vehicle washing is performed with the ignition switched ON (engine off or on) and the wiper and washer switch in the AUTO position, the windshield wipers may operate automatically and your finger or hand is pinched, leading to an injury or wiper system malfunction. Always switch the ignition OFF (LOCK) or turn the wiper and washer switch to the OFF position before servicing.**

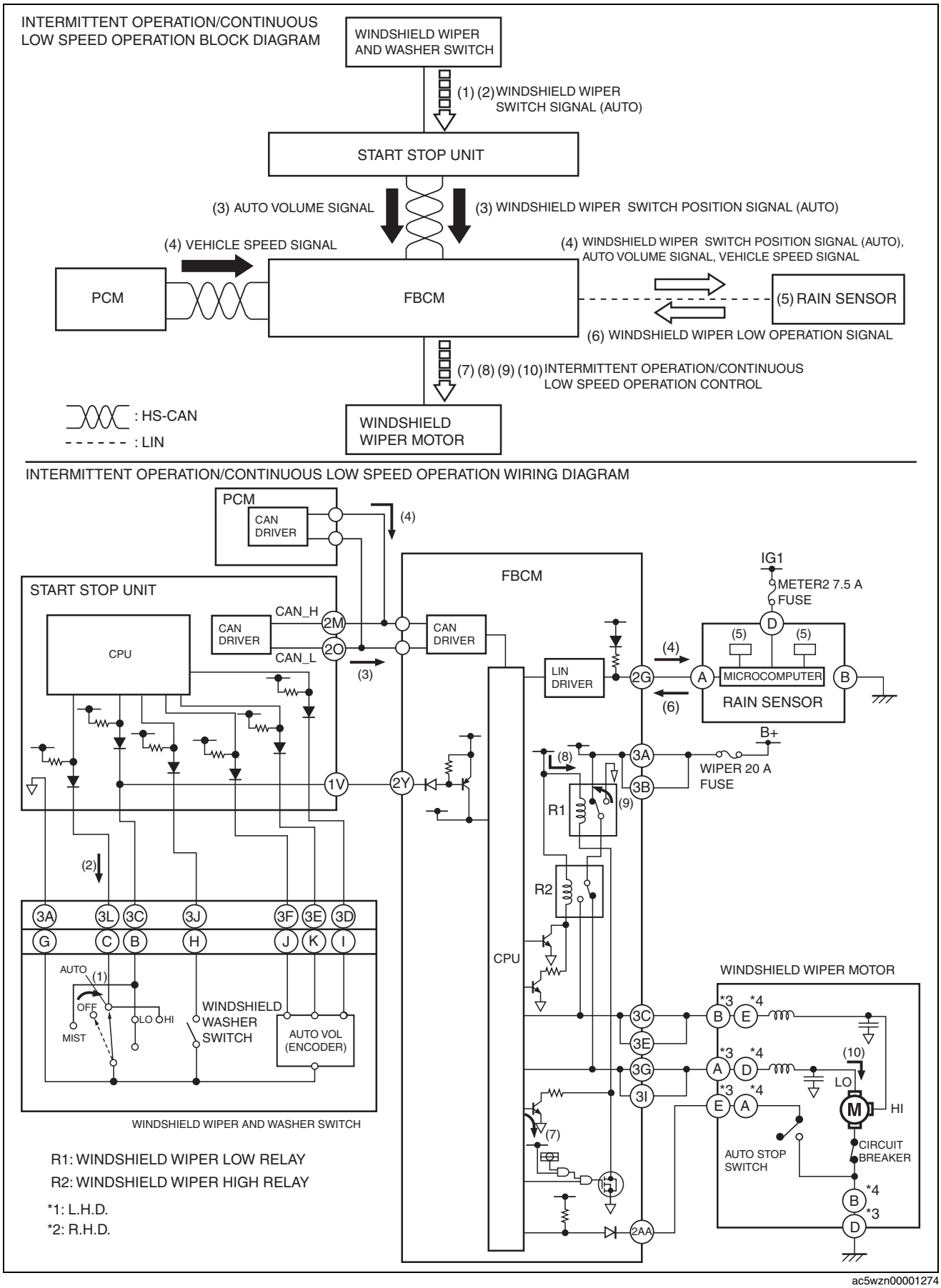
Intermittent Operation/Continuous Low Speed Operation

1. When the wiper and washer switch is moved to the AUTO position with the ignition switched ON (engine off or on) (1), the start stop unit detects a windshield wiper switch signal (AUTO).(2)
2. When the start stop unit detects a windshield wiper switch signal (AUTO), it sends a windshield wiper switch position signal (AUTO) and an AUTO volume signal to the front body control module (FBCM) as CAN signals.(3)
3. When the front body control module (FBCM) receives the windshield wiper switch position signal (AUTO), it sends the windshield wiper switch position signal (AUTO) and the AUTO volume signal to the rain sensor as LIN signals. At the same time, it sends a vehicle speed signal from the PCM to the rain sensor as a LIN signal.(4)
4. When the rain sensor receives the windshield wiper switch position signal (AUTO), it detects amount of rainfall and illumination level.(5)

5. The rain sensor determines the operation interval of the windshield wipers based on the detected rainfall amount and illumination level, and sends a windshield wiper low speed operation signal to the front body control module (FBCM).(6)
6. When the front body control module (FBCM) receives the windshield wiper low speed operation signal, it supplies the base current from the internal CPU to transistor A (7), and collector current flows from the internal power supply (8), turning the windshield wiper low relay on.(9)
7. When the windshield wiper low relay is turned on, current flows from the battery to the windshield wiper motor and the windshield wipers operate intermittently or continuously at low speed.(10)

WIPER/WASHER SYSTEM

With wiper and washer switch on right side



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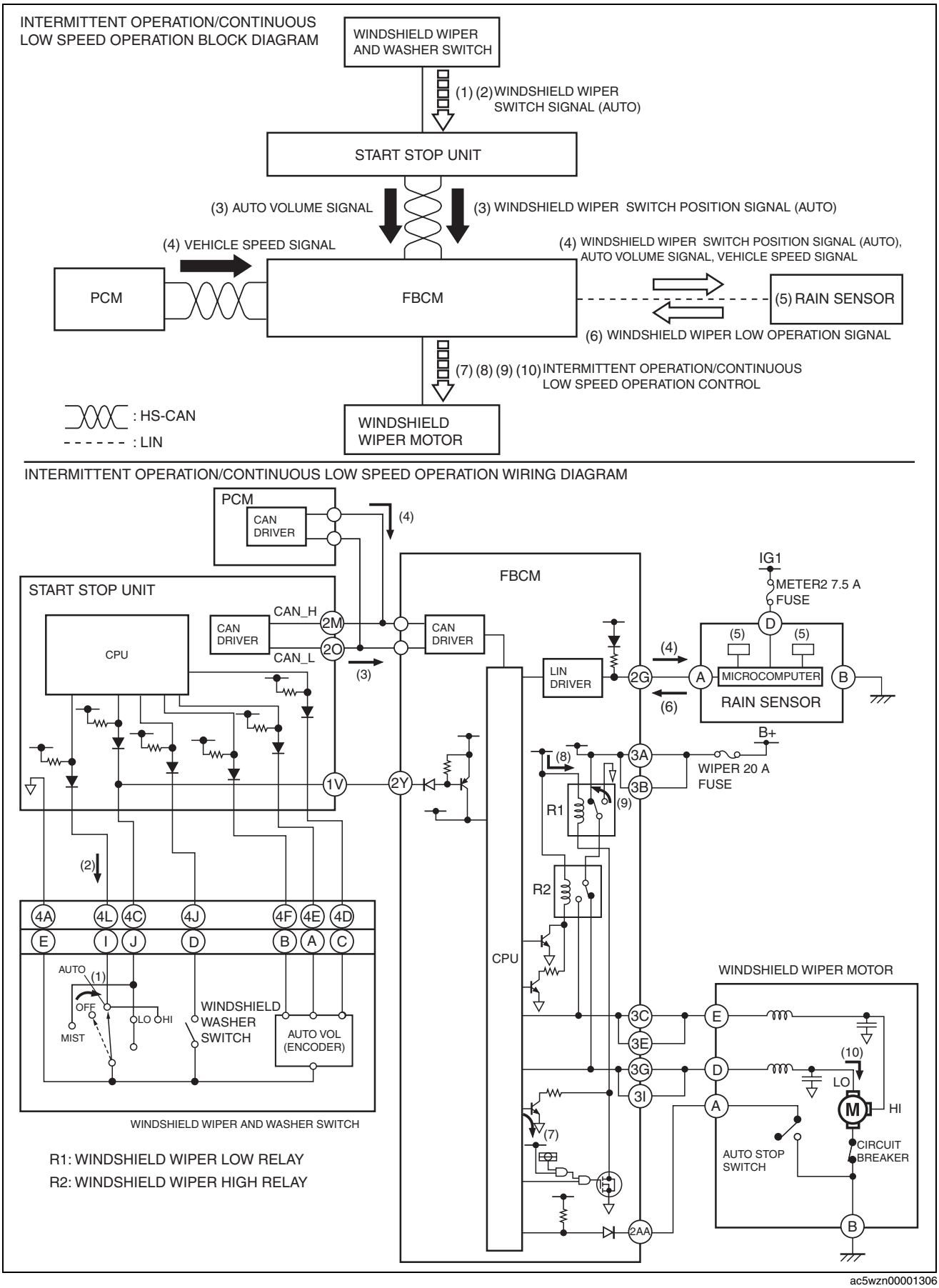
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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WIPER/WASHER SYSTEM

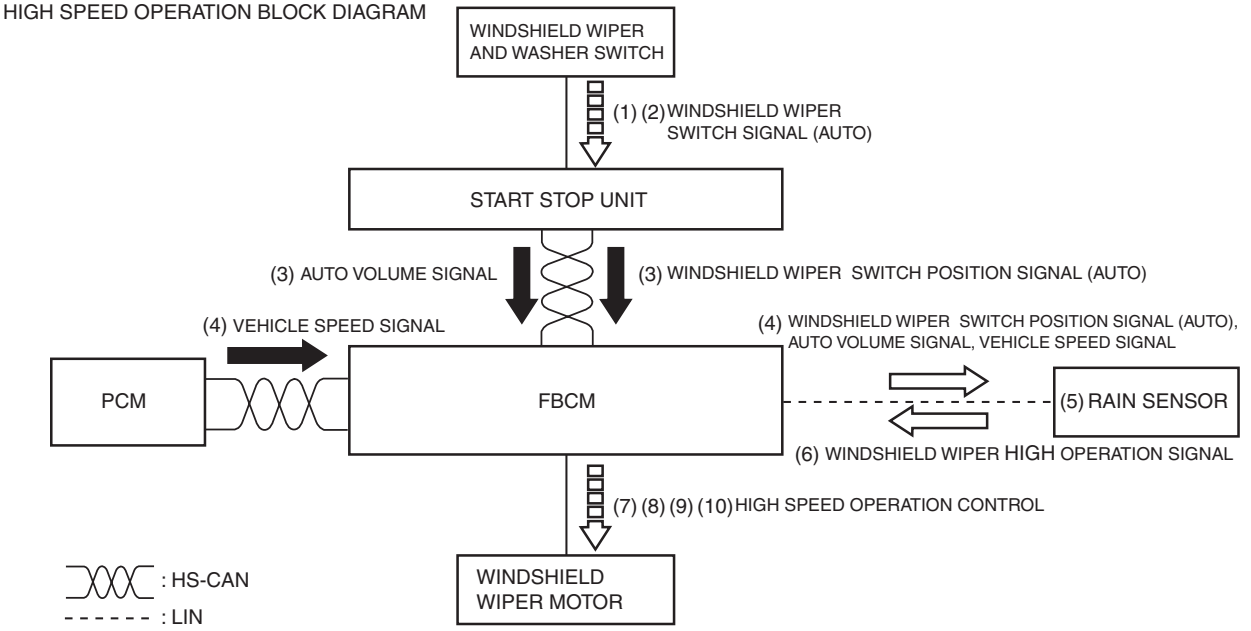
High Speed Operation

1. When the wiper and washer switch is moved to the AUTO position with the ignition switched ON (engine off or on) (1), the start stop unit detects a windshield wiper switch signal (AUTO).(2)
2. When the start stop unit detects the windshield wiper switch signal (AUTO), it sends the windshield wiper switch position signal (AUTO) and an AUTO volume signal to the front body control module (FBCM) as CAN signals.(3)
3. When the front body control module (FBCM) receives the windshield wiper switch position signal (AUTO), it sends the windshield wiper switch position signal (AUTO) and the AUTO volume signal to the rain sensor as LIN signals. At the same time, it sends a vehicle speed signal from the PCM to the rain sensor as a LIN signal.(4)
4. When the rain sensor receives the windshield wiper switch position signal (AUTO), it detects the amount of rainfall and illumination level.(5)
5. Based on the detected rainfall amount and illumination level, the rain sensor sends a windshield wiper high speed operation signal to the front body control module (FBCM).(6)
6. When the front body control module (FBCM) receives the windshield wiper high speed operation signal, it supplies the base current from the internal CPU to transistors A and B (7), and collector current flows from the internal power supply (8), turning the windshield wiper high relay on.(9)
7. When the windshield wiper high relay is turned on, current flows from the battery to the windshield wiper motor and the windshield wipers operate at high speed.(10)

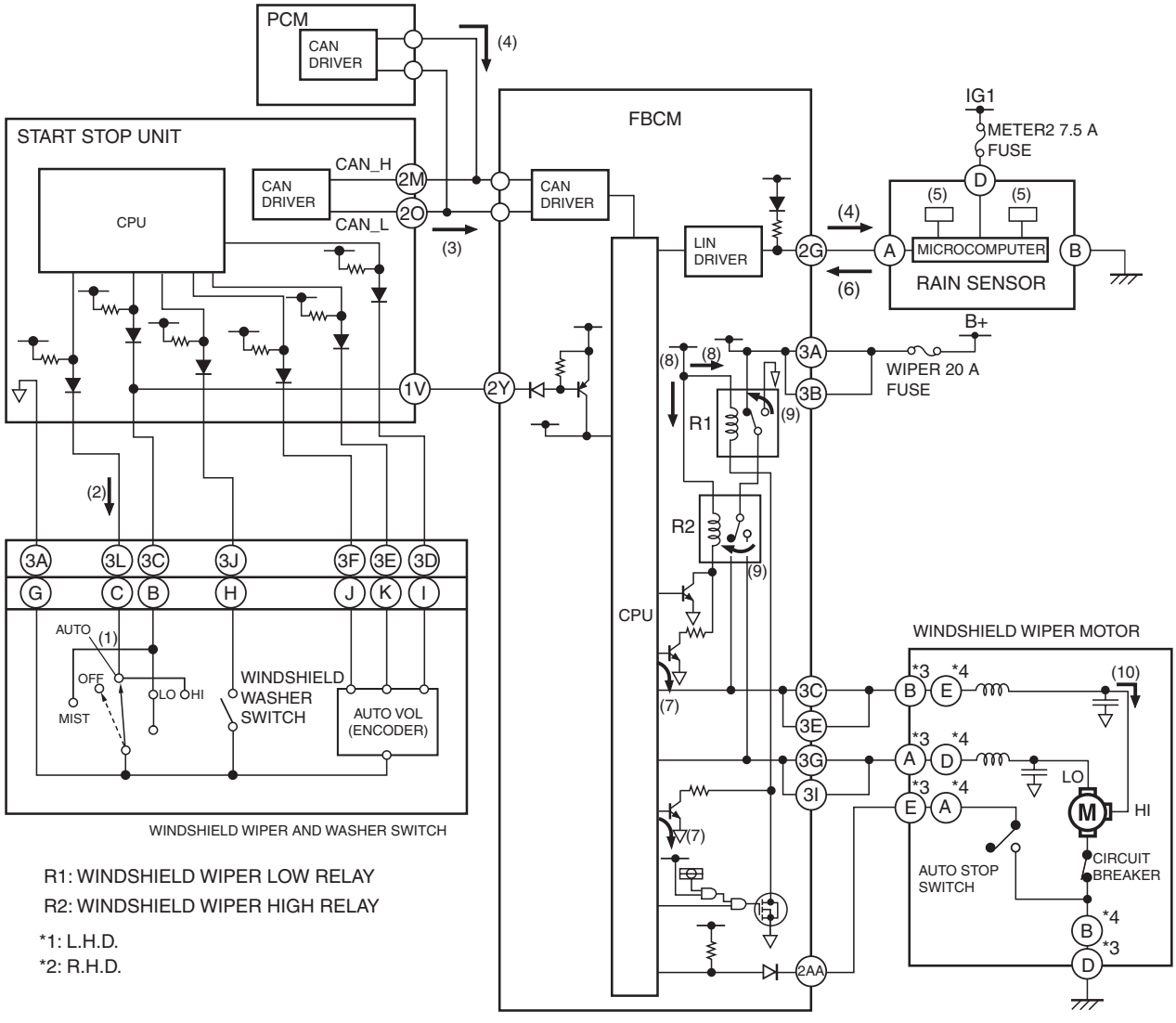
WIPER/WASHER SYSTEM

With wiper and washer switch on right side

HIGH SPEED OPERATION BLOCK DIAGRAM



HIGH SPEED OPERATION WIRING DIAGRAM



R1: WINDSHIELD WIPER LOW RELAY

R2: WINDSHIELD WIPER HIGH RELAY

*1: L.H.D.

*2: R.H.D.

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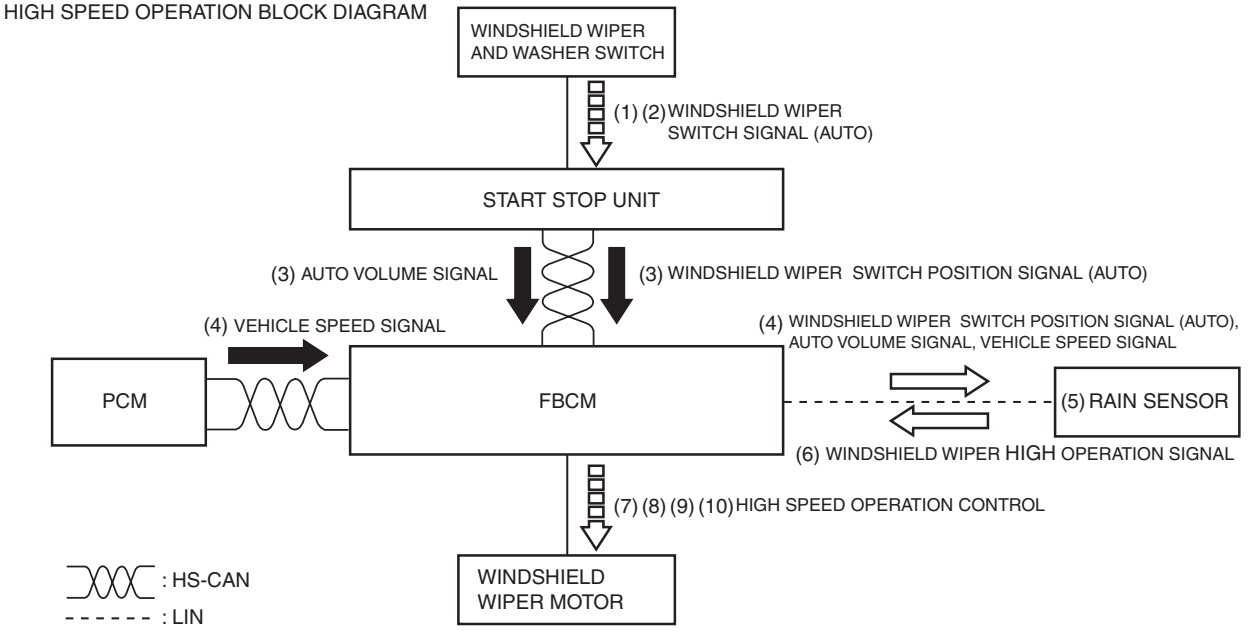
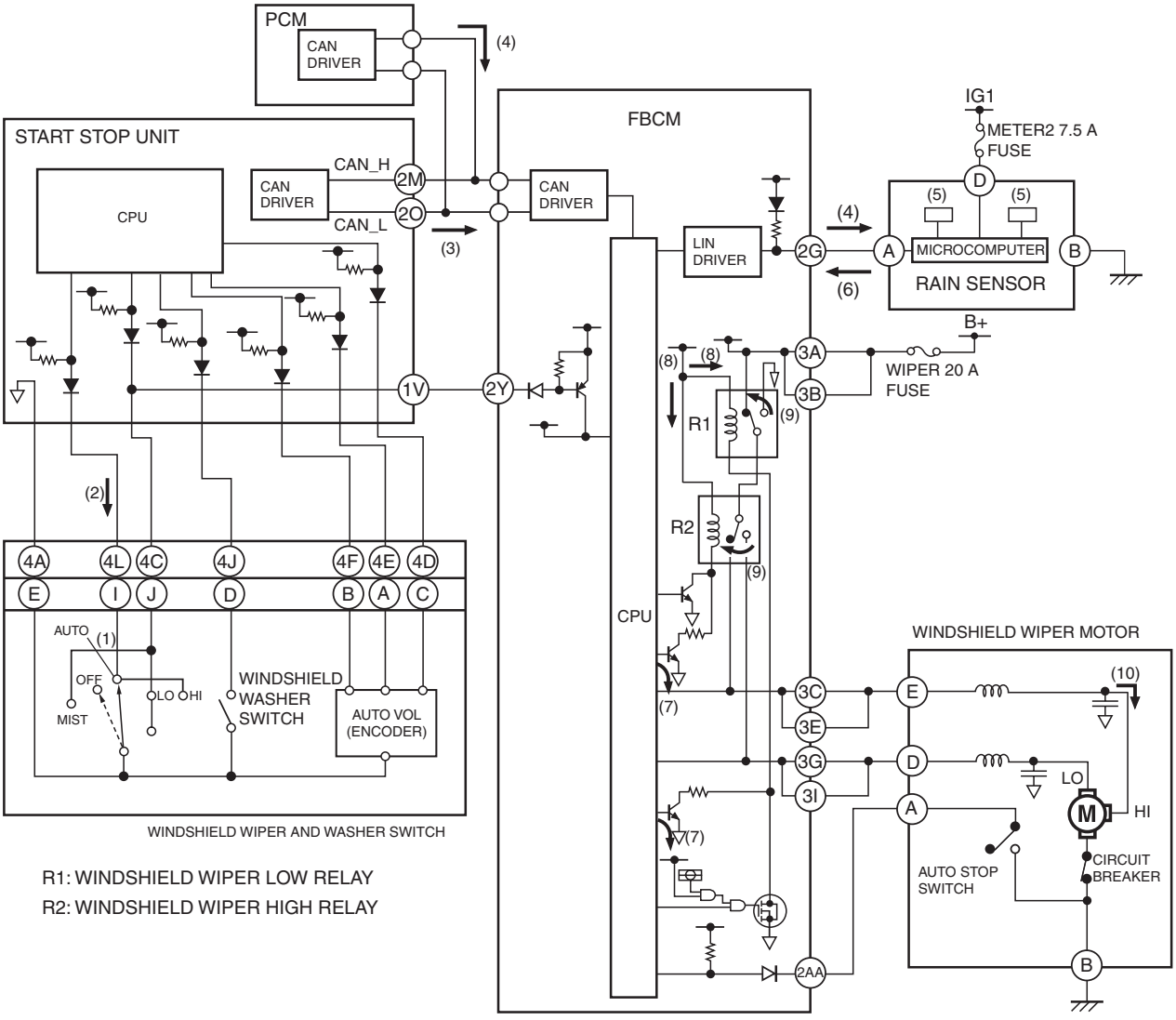
WIPER/WASHER SYSTEM

With wiper and washer switch on left side

HIGH SPEED OPERATION BLOCK DIAGRAM



HIGH SPEED OPERATION WIRING DIAGRAM



R1: WINDSHIELD WIPER LOW RELAY
R2: WINDSHIELD WIPER HIGH RELAY

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WIPER/WASHER SYSTEM

RAIN SENSOR

id091900001000

Outline

- The rain sensor detects the amount of rainfall on the windshield and calculates the windshield wiper operation speed based on the detected amount of rainfall.
- The rain sensor outputs the calculated windshield wiper operation signal to the front body control module (FBCM).
- The front body control module (FBCM) performs rain sensor fail-safe. (See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)

Function

Rainfall Amount Detection Function

Caution

- **If the windshield is under any of the following conditions, the rain sensor cannot detect the amount of rainfall correctly and the windshield wipers operate incorrectly.**
  - **— Stickers or labels are adhered to the rain sensor detection area in the upper part of the windshield.**
  - **— The rain sensor detection area in the upper part of the windshield is dirty.**

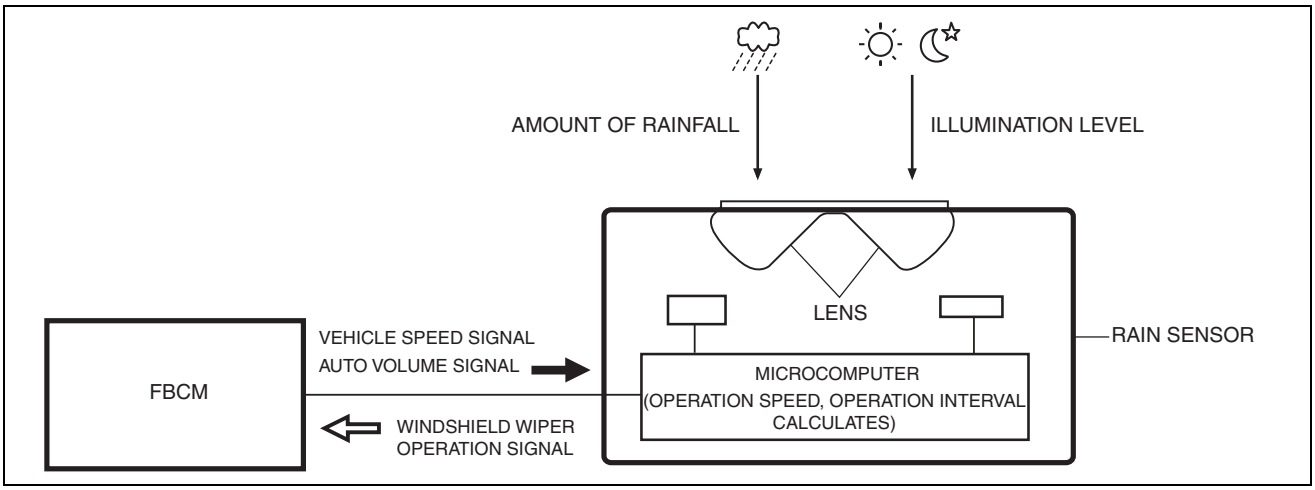
- The rain sensor detects the amount of rainfall by the rate of reflected infrared light emitted from the built-in LED.
- The windshield wiper operation signal is calculated based on the detected amount of rainfall.

Initial Setting Function

- When the ignition is switched ON (engine off or on), the rain sensor detects and records the transparency of the windshield surface, which varies depending on wear and accumulation of dust.
- As a result, the rain sensor determines the optimal speed (LO/HI) for the windshield wipers and sends the windshield wiper operation signal to the front body control module (FBCM).
- The initial setting is performed everytime the ignition is switched ON (engine off or on).

Sensitivity Adjustment Function

- While the auto wiper is operating, sensitivity of the rain sensor can be optionally adjusted by operating the sensitivity adjustment volume on the wiper and washer switch which changes the volume signal input to the front body control module (FBCM).
  - — Sensitivity of the rain sensor can be adjusted between 1 (low sensitivity) and 5 (high sensitivity) by operating the sensitivity adjustment volume according to the conditions such as rain intensity.
- While the auto wiper is operating, the sensitivity of the rain sensor is adjusted automatically according to the vehicle signal sent from the PCM via the front body control module (FBCM).
- While the auto wiper is operating, the rain sensor (auto light sensor) detects the illumination level above and in front of the vehicle.
- When the rain sensor detects an illumination level higher than a level required for turning on the TNS, the sensitivity of the rain sensor increases.



ac5wzn00000479

On-board diagnostic function

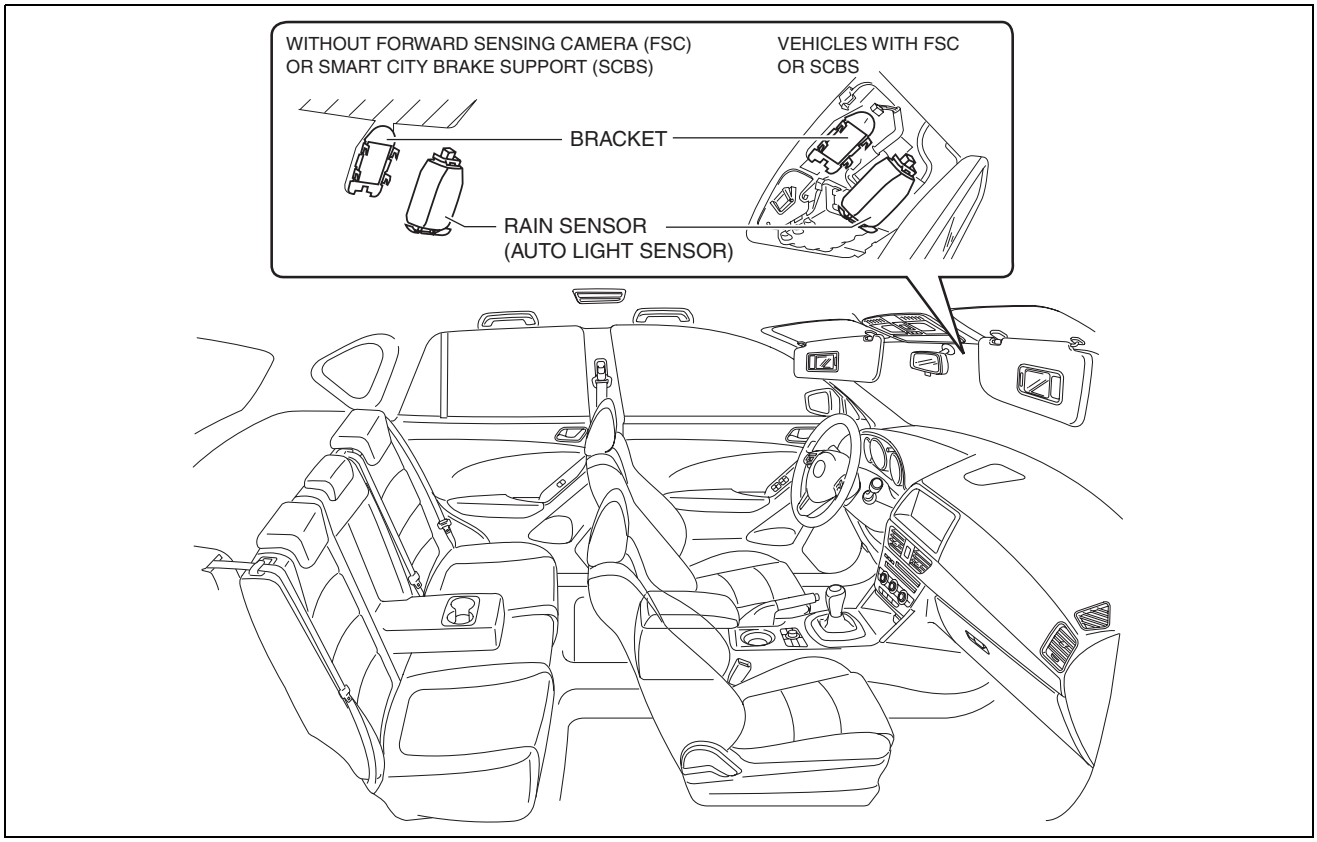
- The rain sensor performs on-board diagnostics when the ignition is switched ON (engine off or on).
- If a malfunction is detected in the rain sensor, an error signal is sent to the front body control module (FBCM).
- The front body control module (FBCM) outputs DTCs based on error signals from the rain sensor.

WIPER/WASHER SYSTEM

- For details on DTCs, refer to the diagnostic system (FBCM), DTC table (FBCM) in the Workshop Manual.

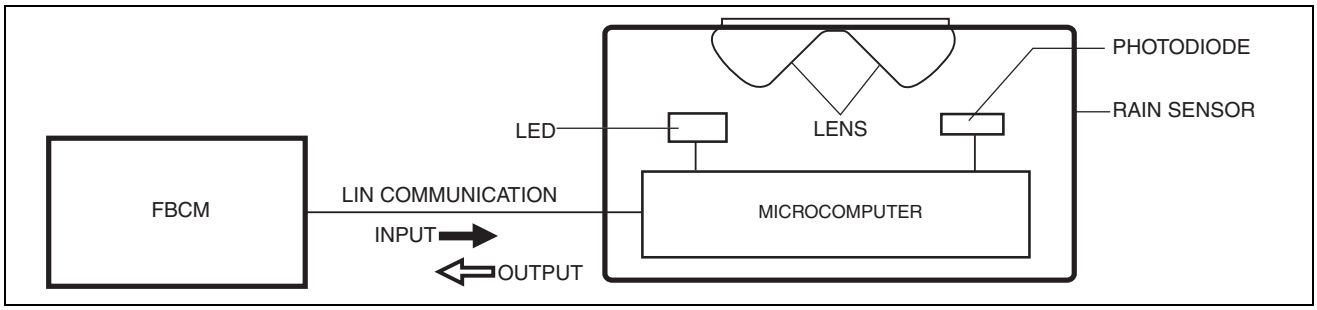
Construction

- The rain sensor is installed to the bracket in the upper center part of the windshield.



ac5wzn00000480

- The rain sensor is integrated with the auto light sensor.
- The rain sensor consists of the lens, LED, photodiode, and microcomputer, and sends/receives signals between the front body control module (FBCM) using LIN communication.



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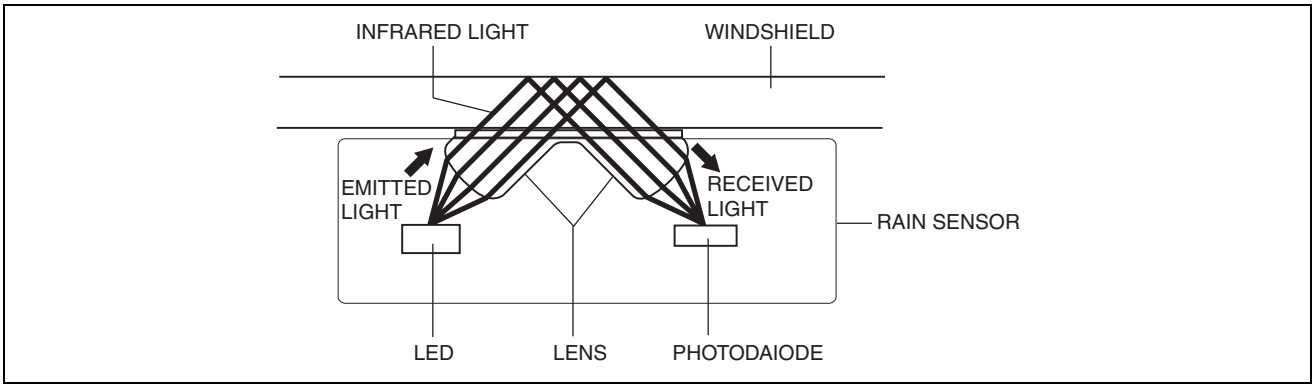
Operation

Operation With No Rainfall Contacting Windshield

1. Infrared light is emitted from the LED in the rain sensor towards the windshield.
2. The emitted infrared light reflects off the windshield.
3. The infrared light reflected off the windshield is received by the photodiode in the rain sensor.

WIPER/WASHER SYSTEM

4. When the photodiode receives the light, the microcomputer in the rain sensor calculates the rainfall amount from the reflection rate, and sends a windshield wiper control signal to the front body control module (FBCM).



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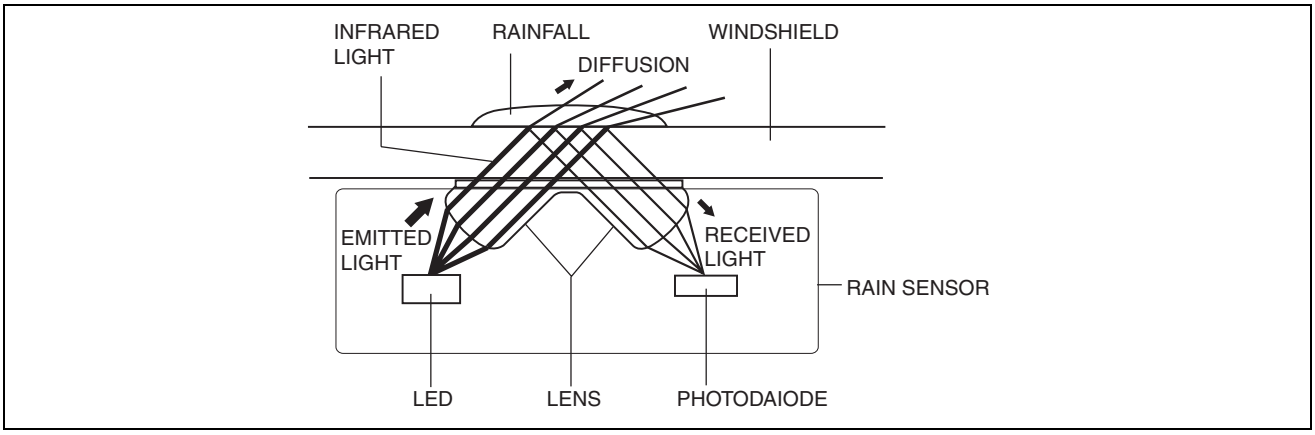
Operation with Rainfall Contacting Windshield

1. Infrared light is emitted from the LED in the rain sensor towards the windshield.
2. Emitted infrared light goes through the windshield and penetrates the rain drops on the windshield.
3. The infrared light which cannot penetrate is reflected off the windshield and is received by the photodiode in the rain sensor.
4. When the photodiode receives the light, the microcomputer in the rain sensor calculates the rainfall amount from the reflection rate, converts this to an electrical signal and sends a windshield wiper control signal to the front body control module (FBCM).



am5ezn0000090

Fail-safe

- Function not equipped.

WASHER FLUID-LEVEL SENSOR

id091900103300

Purpose

- The washer fluid-level sensor illuminates the low washer fluid level warning light when the washer fluid level is lowered.

Function

- The washer fluid-level sensor detects the decrease in the washer fluid level.

Construction

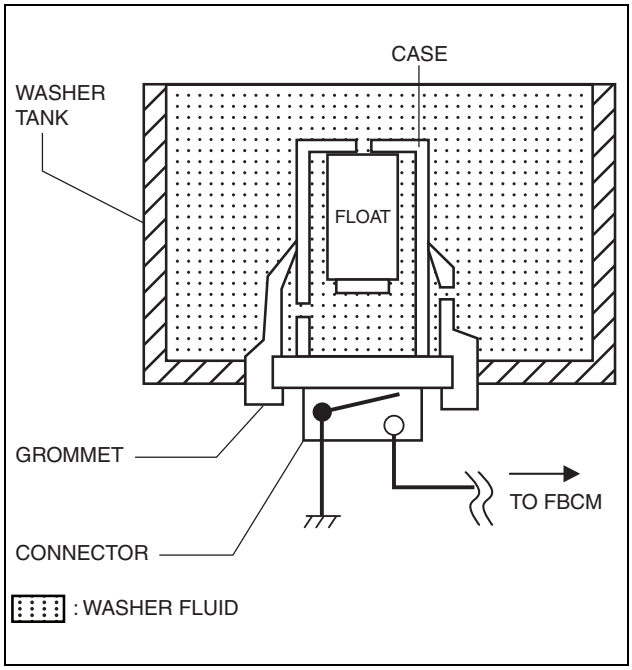
- The washer fluid-level sensor consists of the following parts:
  - — Connector (switch)
  - — Float
  - — Grommet
  - — Case
- The float has an integrated magnet which creates a magnetic field.

WIPER/WASHER SYSTEM

Operation

When washer fluid is added

1. Washer fluid enters the case of the washer fluid-level sensor, the float rises, and the connector switch turns off.



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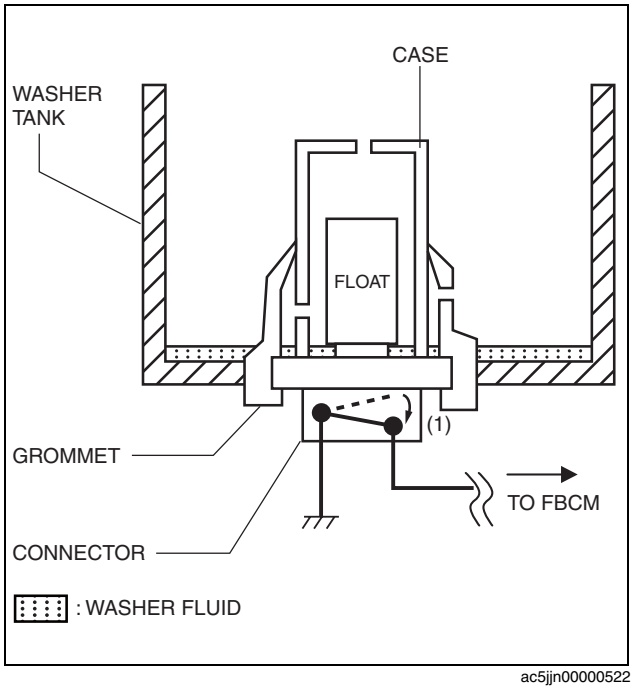
When washer fluid is decreased

1. When washer fluid inside the case of the washer fluid-level sensor decreases, the float comes close to the connector switch.
2. When the float approaches the switch, the magnetic field inside the float acts on the switch and the switch turns on. (1)
3. When the switch is turned on, the front body control module (FBCM) detects that the washer fluid level is lowered (2) and sends a low washer fluid level warning light illumination request signal to the instrument cluster as a CAN signal. (3)



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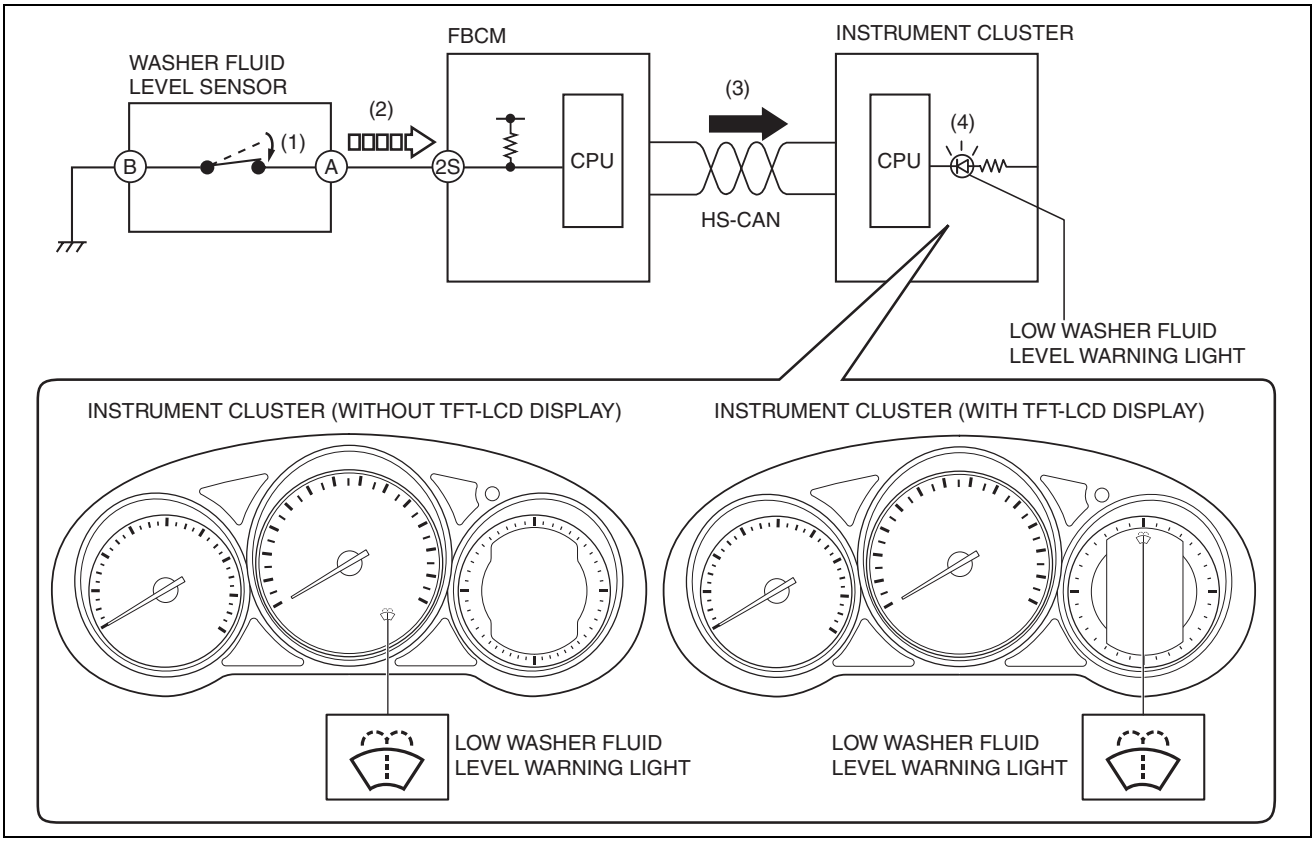
WIPER/WASHER SYSTEM

4. When the instrument cluster receives the low washer fluid level warning light illumination request signal, it illuminates the low washer fluid level warning light. (4)



ac5wzn00000872

Fail-safe

- Function not equipped.

HEADLIGHT CLEANER SYSTEM

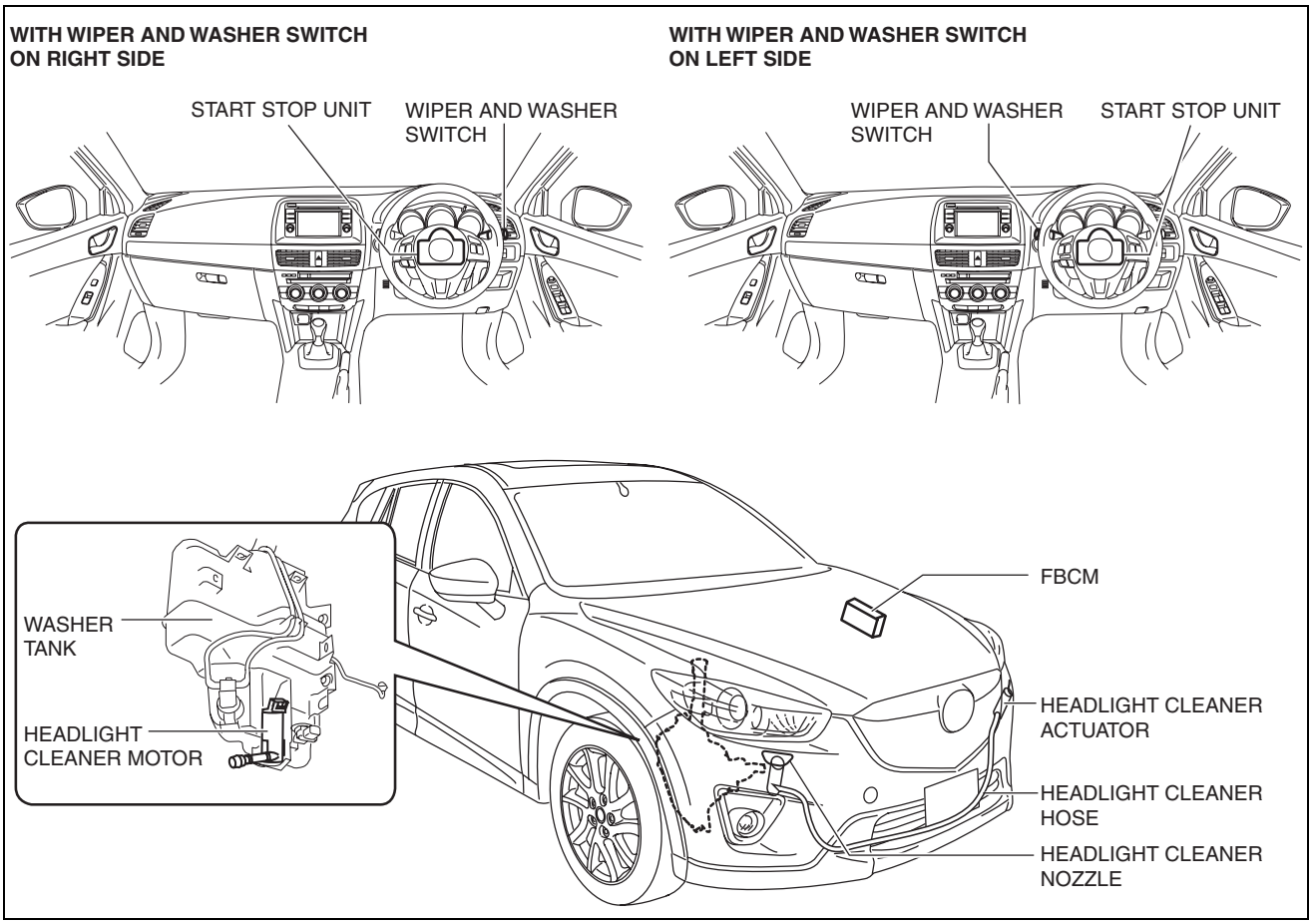
id091900103400

Outline

- The headlight cleaner system removes dirt from the headlights by spraying washer fluid from the headlight cleaner nozzles installed to the front bumper.
- A pop-up type headlight cleaner has been adopted.
- The front body control module (FBCM) performs headlight cleaner system fail-safe. (See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)

WIPER/WASHER SYSTEM

Structural View
R.H.D.



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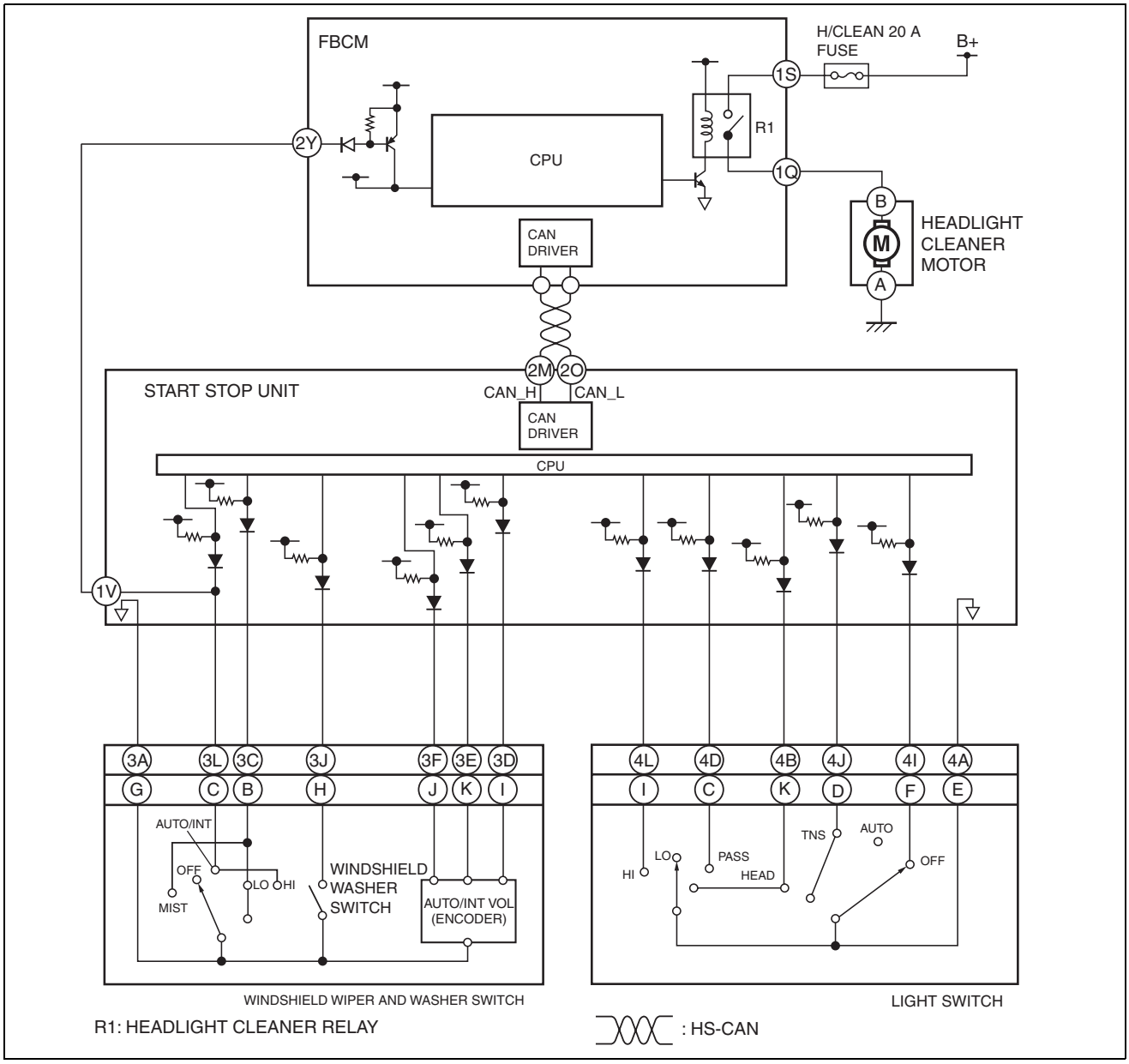
WIPER/WASHER SYSTEM

System Wiring Diagram
With wiper and washer switch on right side



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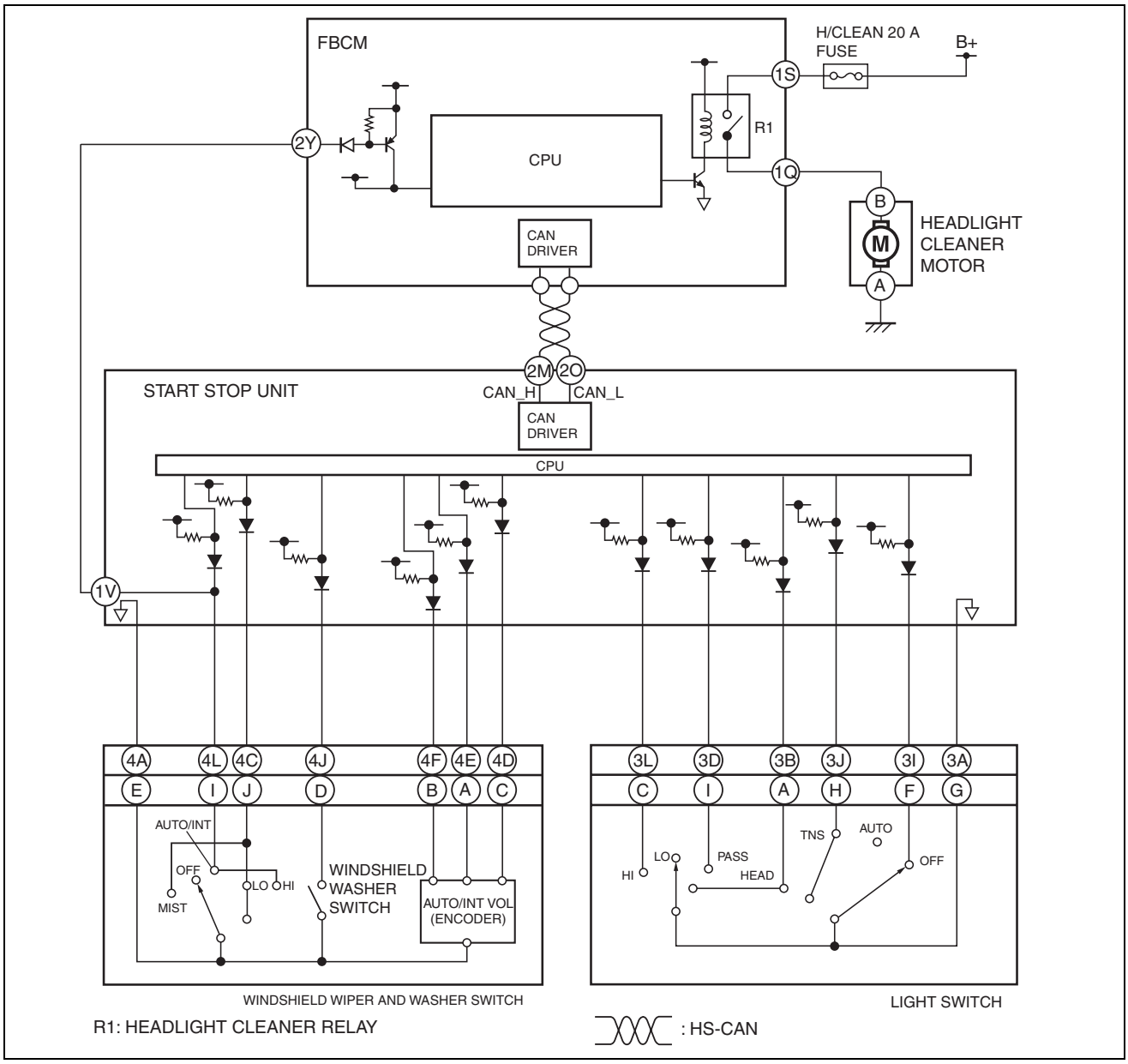
WIPER/WASHER SYSTEM

With wiper and washer switch on left side



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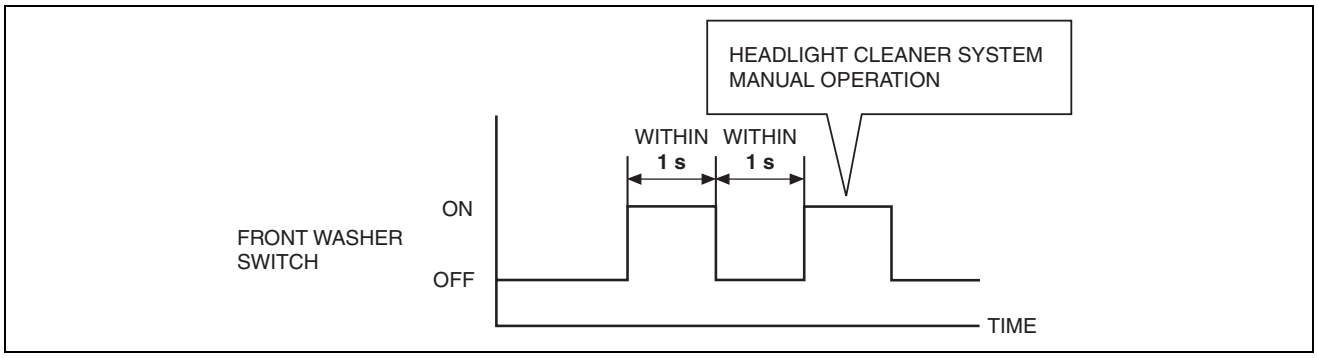
Function

- The headlight cleaner motor operates when the windshield washer switch is operated with the ignition switched ON (engine off or on) and headlights turned on.
- When the headlight cleaner motor operates, the headlight cleaner actuator is operated by the hydraulic pressure of the washer fluid pumped from the headlight cleaner motor, and washer fluid is sprayed from the headlight cleaner nozzles.
  - — Auto-operation Control
    - When the windshield washer switch is turned on the first time after the headlights are turned on, the headlight cleaner system operates automatically.
    - Afterwards, the headlight cleaner system operates automatically every 5th times the windshield washer switch is turned on.
  - — Manual operation Control
    - The headlight cleaner system operates when the windshield washer switch is turned on twice quickly.

- The windshield washer switch operation needs to be done within the period of time shown in the figure.



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Operation
Auto-operation

1. When the windshield washer switch is turned on with the ignition switched ON (engine off or on) and the headlights turned on (1), the start stop unit sends a windshield washer operation request signal to the front body control module (FBCM) as a CAN signal.(2)
2. When the front body control module (FBCM) receives the windshield washer operation request signal the first time after the headlights are turned on, it supplies the base current from the internal CPU to the transistor (3), and collector current flows from the internal power supply (4), turning the headlight cleaner relay on.(5)

   Note
   - The front body control module (FBCM) monitors the headlight on/off condition by receiving CAN signals from the start stop unit.

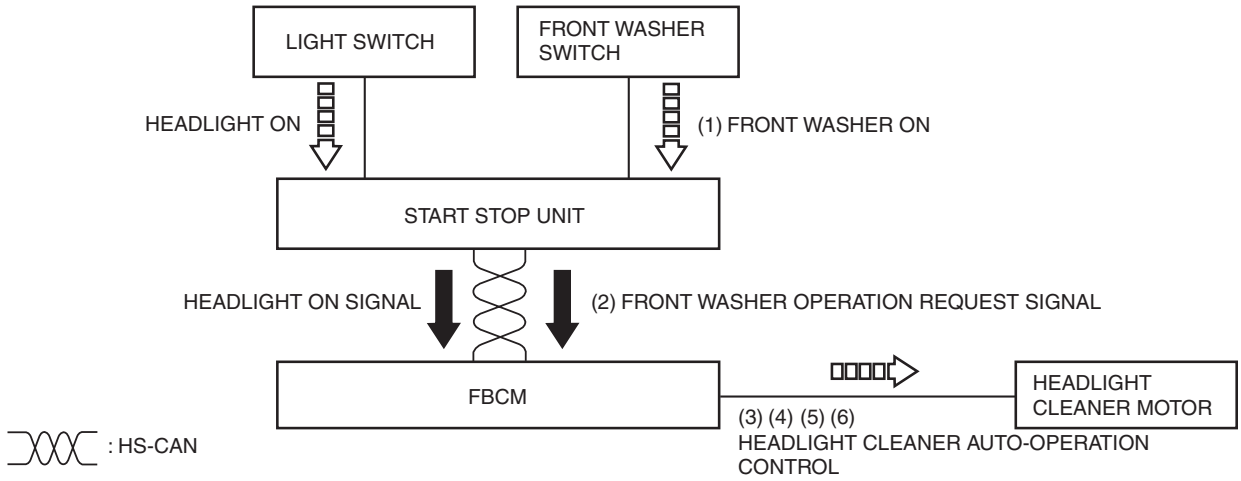
3. When the headlight cleaner relay is turned on, current flows from the power supply inside the front body control module (FBCM) to the headlight cleaner motor and the headlight cleaner motor operates, and washer fluid is sprayed from the headlight washer nozzles.(6)
4. The front body control module (FBCM) counts the number of times it receives a windshield washer operation signal from the start stop unit, and it operates the headlight cleaner each time the counted number of times reaches five.

   Note
   - The counted number of windshield washer operation request signals is reset to zero in the following cases:
     — When the counted number of windshield washer operation request signal reaches five.
     — When the headlights are turned off.

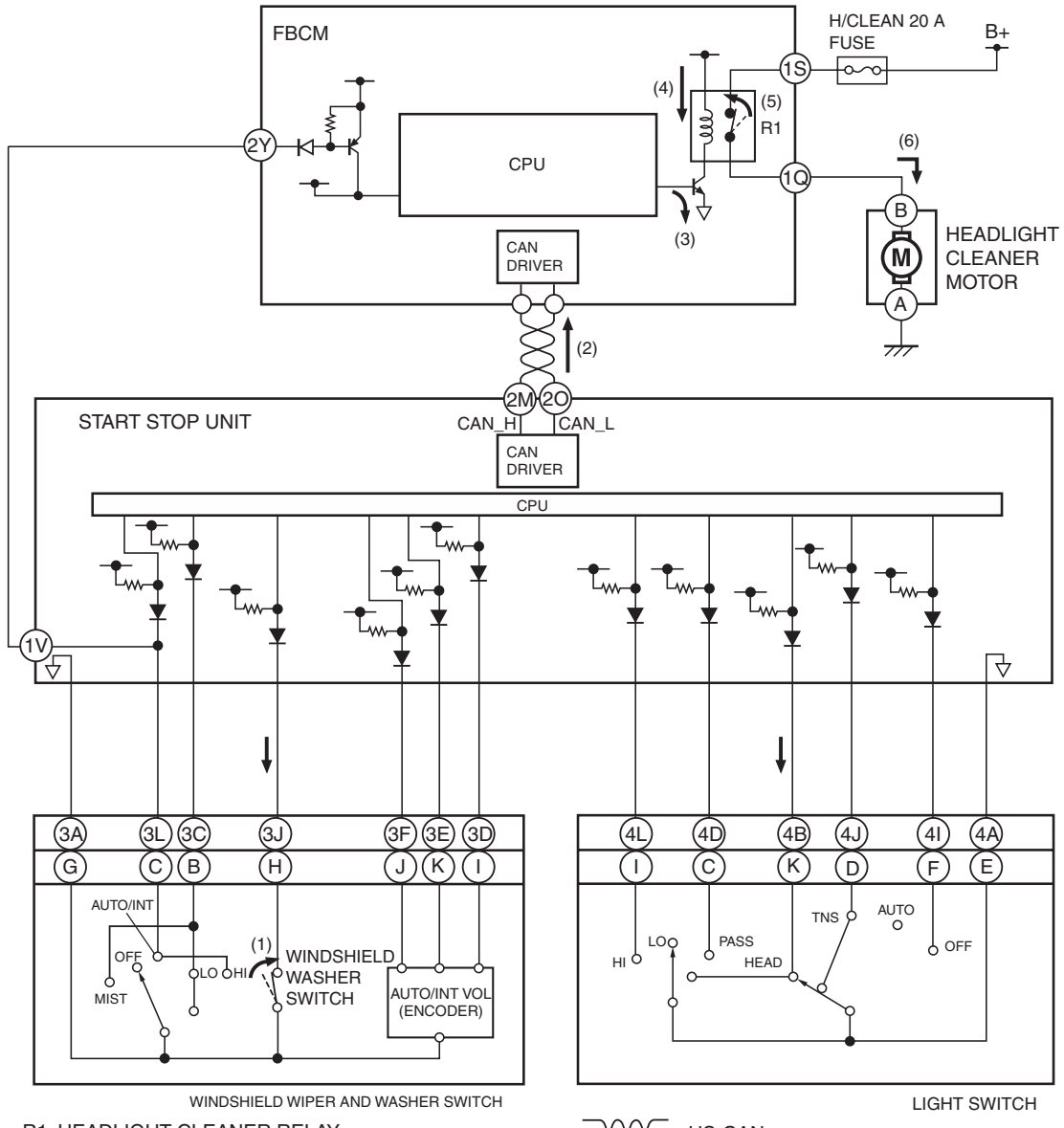
WIPER/WASHER SYSTEM

With wiper and washer switch on right side

HEADLIGHT CLEANER AUTO-OPERATION CONTROL BLOCK DIAGRAM



HEADLIGHT CLEANER AUTO-OPERATION CONTROL WIRING DIAGRAM



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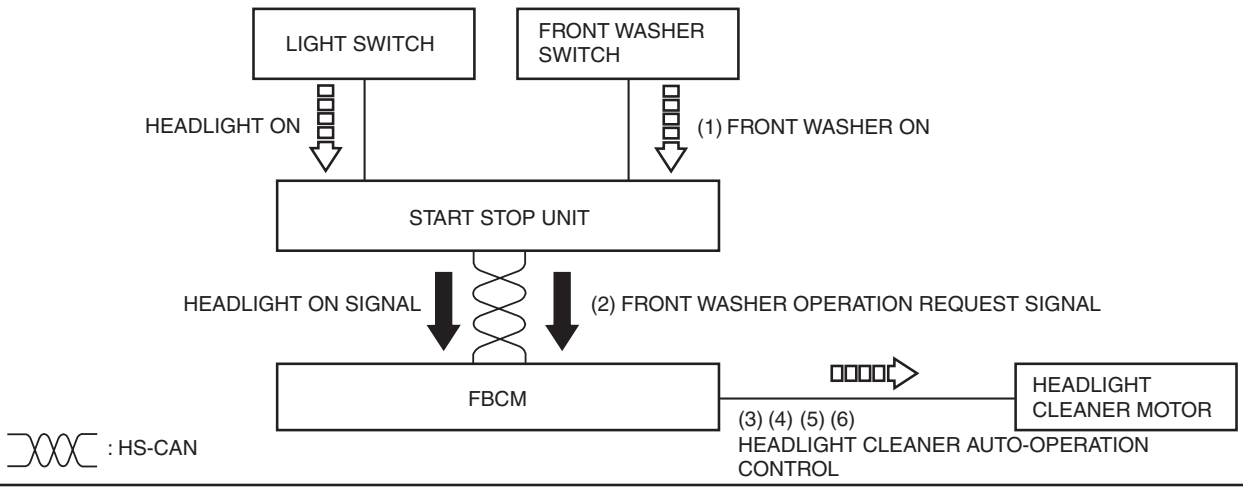
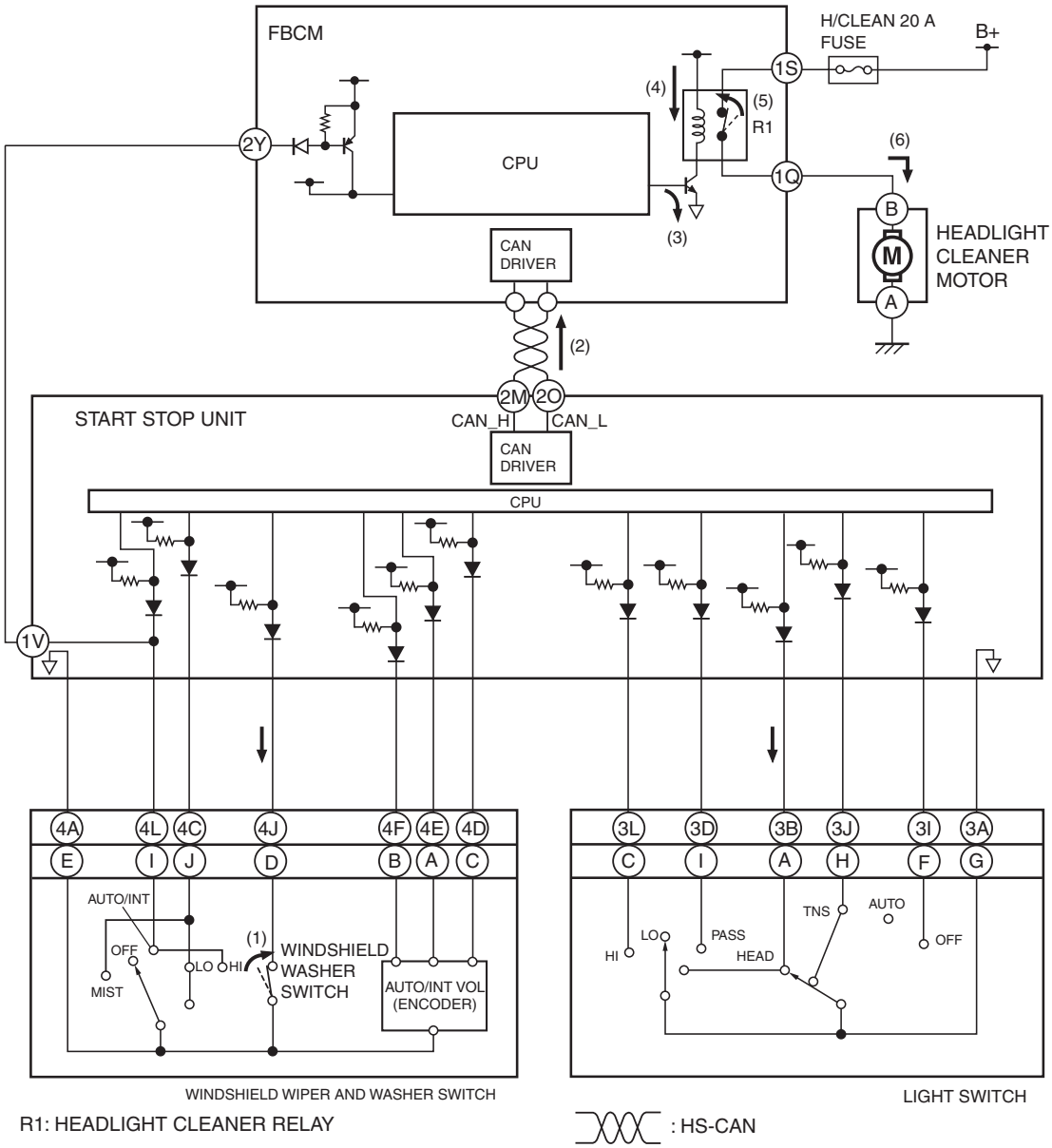
WIPER/WASHER SYSTEM

With wiper and washer switch on left side

HEADLIGHT CLEANER AUTO-OPERATION CONTROL BLOCK DIAGRAM



HEADLIGHT CLEANER AUTO-OPERATION CONTROL WIRING DIAGRAM



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WIPER/WASHER SYSTEM

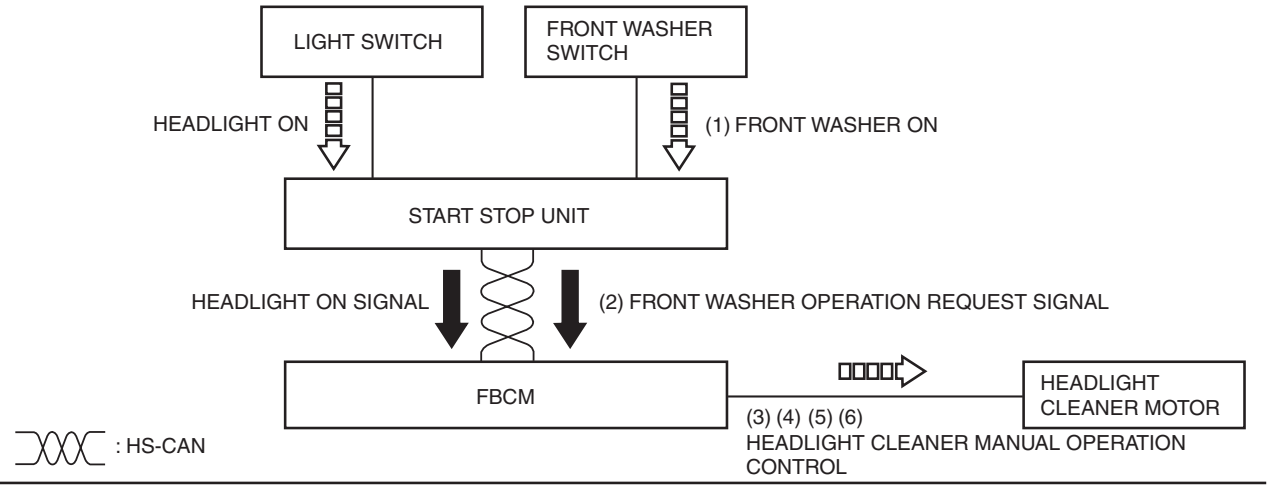
Manual operation

1. When the windshield washer switch is turned on twice quickly with the ignition switched ON (engine off or on) and the headlights turned on (1), the start stop unit sends a windshield washer operation request signal to the front body control module (FBCM) as a CAN signal.(2)
2. When the front body control module (FBCM) receives the windshield washer operation request signal twice within a certain period of time, it supplies the base current from the internal CPU to the transistor (3), and collector current flows from the internal power supply (4), turning the headlight cleaner relay on.(5)
3. When the headlight cleaner relay is turned on, current flows from the power supply inside the front body control module (FBCM) to the headlight cleaner motor and the headlight cleaner motor operates, and washer fluid is sprayed from the headlight cleaner nozzles.(6)

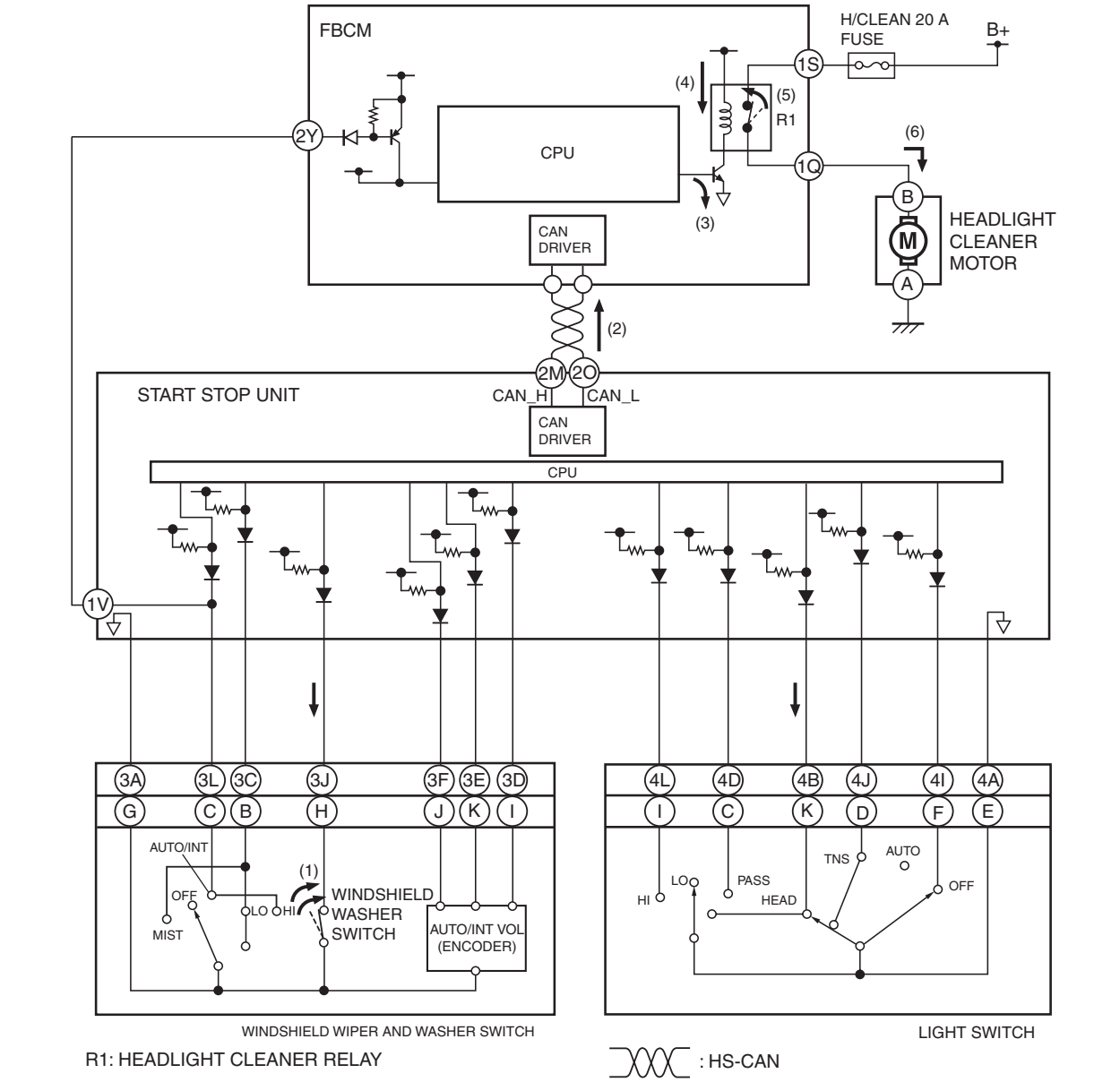
WIPER/WASHER SYSTEM

With wiper and washer switch on right side

HEADLIGHT CLEANER MANUAL OPERATION CONTROL BLOCK DIAGRAM



HEADLIGHT CLEANER MANUAL OPERATION CONTROL WIRING DIAGRAM



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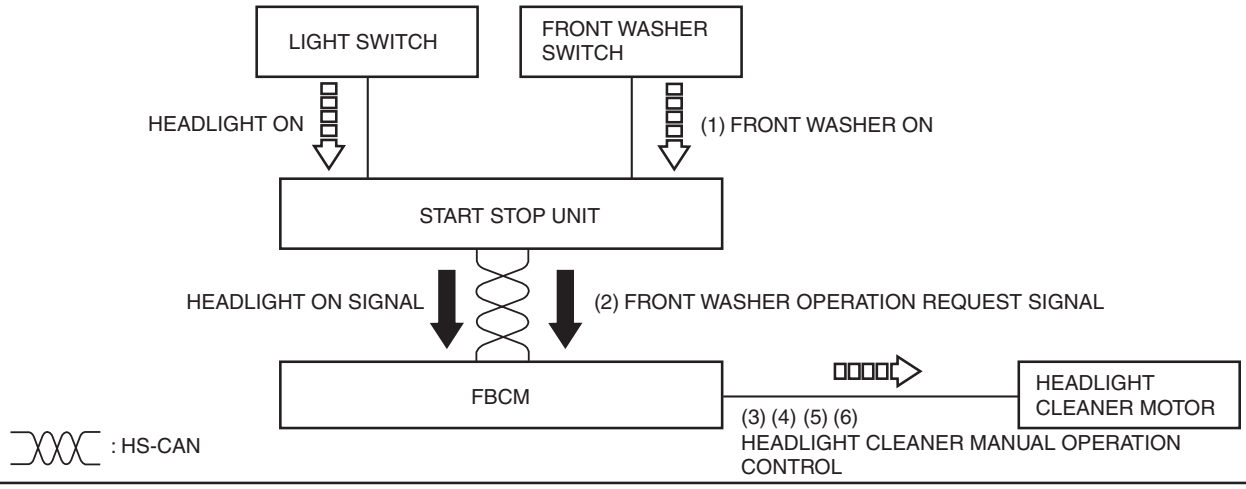
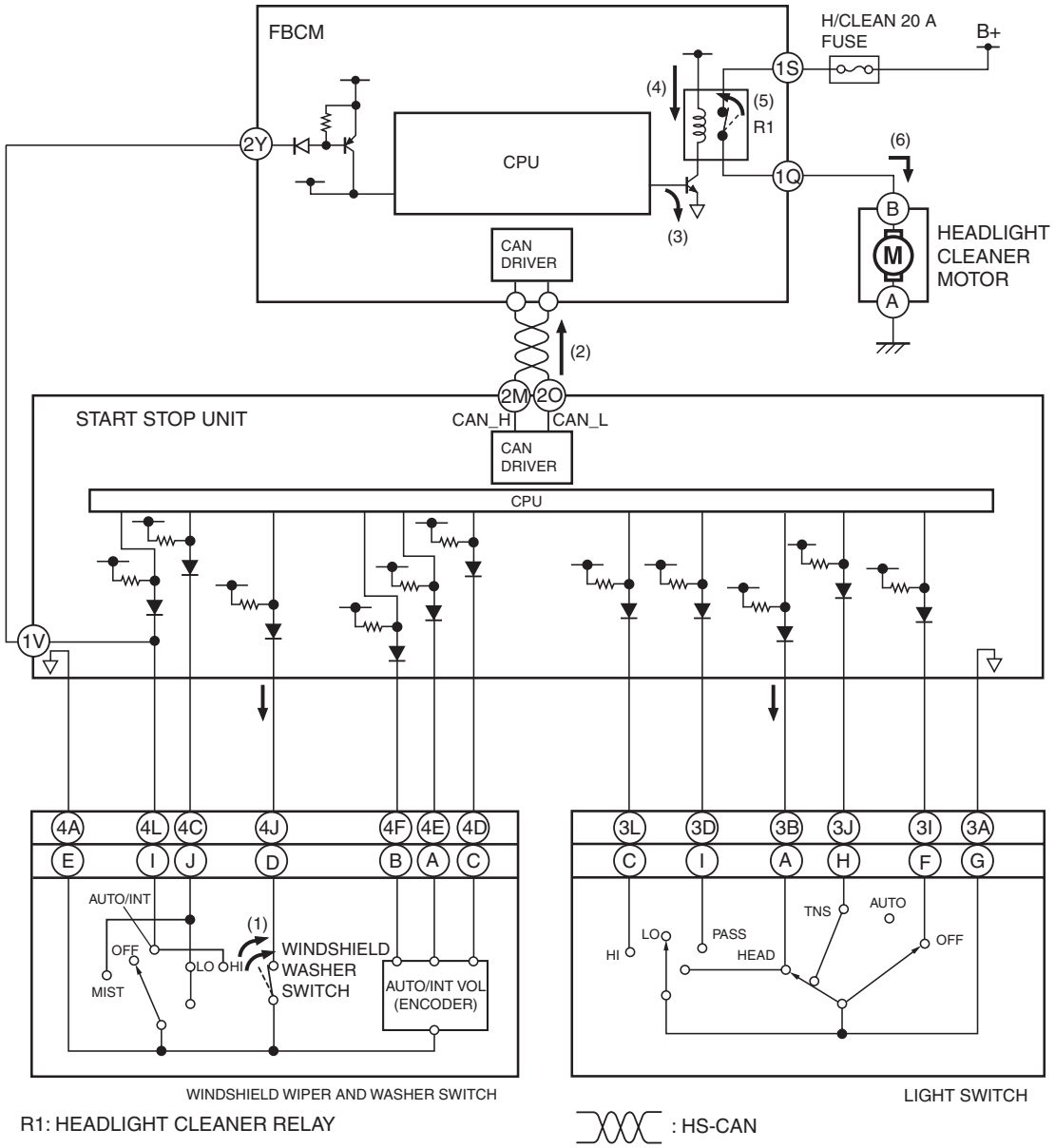
WIPER/WASHER SYSTEM

With wiper and washer switch on left side

HEADLIGHT CLEANER MANUAL OPERATION CONTROL BLOCK DIAGRAM



HEADLIGHT CLEANER MANUAL OPERATION CONTROL WIRING DIAGRAM



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WIPER/WASHER SYSTEM

HEADLIGHT CLEANER ACTUATOR

id091900103500

Purpose

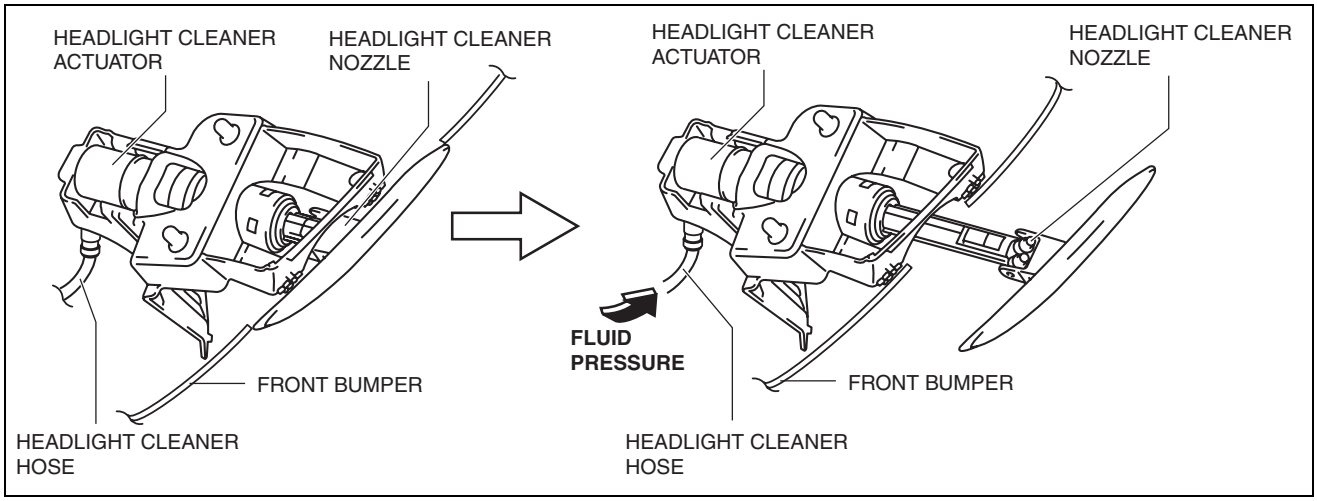
- The headlight cleaner actuator pushes the headlight cleaner nozzle outward from the front bumper.

Function

- The headlight cleaner actuator pushes the headlight cleaner nozzle outward from the front bumper using the washer pressure from the headlight cleaner hose.

Construction / Operation

- The headlight cleaner nozzle is held retracted by a spring within the headlight cleaner actuator.
- When fluid pressure rises due to the operation of the headlight cleaner motor, the piston in the headlight cleaner actuator is pushed, causing the nozzle to pop out of the front bumper and spray washer fluid.



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Fail-safe

- Function not equipped.

09-20 ENTERTAINMENT

ENTERTAINMENT

ENTERTAINMENT

ENTERTAINMENT SYSTEM

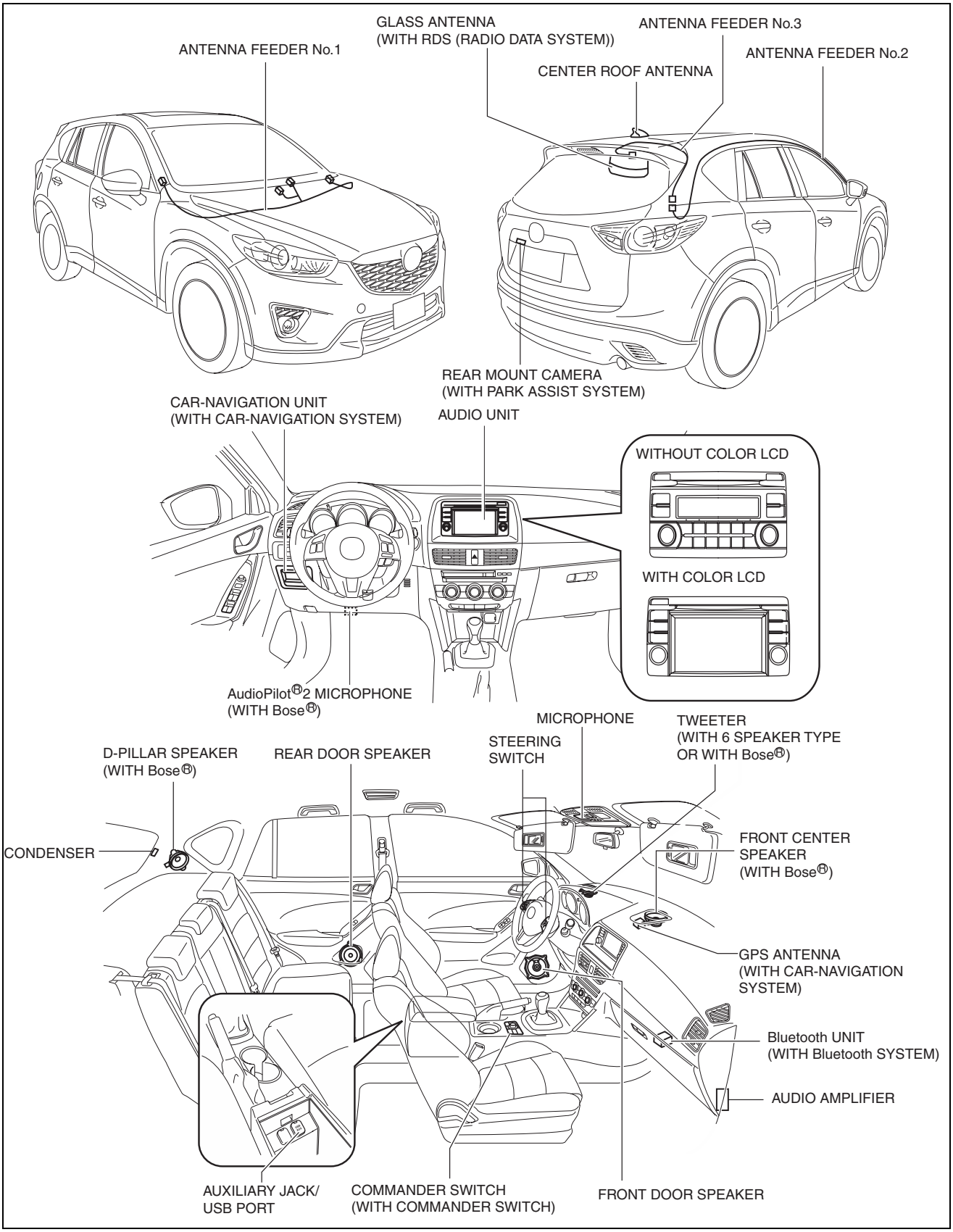
id092000010000

Outline

- The following entertainment system has been adopted.
  - — Audio system (with audio system)
  - — Car-navigation system (with car-navigation system)
  - — Park assist system (with park assist system)
  - — Bluetooth system (with Bluetooth system)
- Two types of audio units are available as follows:
  - — An audio unit with integrated AM/FM tuner/MP3/WMA (Windows Media Audio)/AAC (Advanced Audio Coding) applicable CD player in the audio panel. (Without color LCD)
  - — An audio unit with integrated AM/FM tuner/MP3/WMA (Windows Media Audio) applicable CD player in the audio panel. (With color LCD)
- Steering switch has been adopted.
- Commander switch has been adopted. (With commander switch)
- Auxiliary jack/USB port has been adopted.
- A center roof antenna has been adopted.
- A glass antenna has been adopted. (with RDS (radio data system))
- A rear mount camera has been adopted.

ENTERTAINMENT

Structural view



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ENTERTAINMENT

AUDIO SYSTEM

id092000010100

Note
- "iPod" is a registered trademark of Apple Inc. in the United States and other countries.

Outline
- Two types of audio units are available as follows:
  - An audio unit with integrated AM/FM tuner/MP3/WMA (Windows Media Audio)/AAC (Advanced Audio Coding) applicable CD player in the audio panel. (Without color LCD)
  - An audio unit with integrated AM/FM tuner/MP3/WMA (Windows Media Audio) applicable CD player in the audio panel. (With color LCD)
- ALC (auto level control) function has been adopted. (With Bose ®)
- A road noise correction system (AudioPilot®2)* has been adopted. (With Bose ®)
- RDS (radio data system) has been adopted. (WIth RDS (radio data system))
- Three types of speakers have been provided as follows:

  4 speaker type (without Bose ®)
  - Front door speaker
  - Rear door speaker

  6 speaker type (without Bose ®)
  - Front door speaker
  - Rear door speaker
  - Tweeter

  9 speaker type (with Bose ®)
  - Front door speaker
  - Rear door speaker
  - Front center speaker
  - D-pillar speaker
  - Tweeter
- The steering switch enables the driver to operate a part of the audio system functions and change the trip computer display without changing the driving posture.
- By operating the commander switch, the audio system can be operated without the driver having to change posture. (with commander switch)
- A rear mount camera has been adopted which monitors the conditions at the rear of the vehicle when reversing, and outputs a video signal to the audio unit.
- An Auxiliary jack/USB port unit has been adopted which can connect to commercially-available portable audio/USB devices/iPod, and output sound from the speakers via the audio unit.
- A condenser has been adopted to the D-pillar for noise reduction.

* : "AudioPilot®2" is a registered trademark of Bose ®.

Function
- The audio system has the following functions:

ALC (auto level control) function (without Bose ®)
- Compensates for the passengers' sense of a lack of audio volume which occurs as a result of external noise while driving.

Road noise correction system (AudioPilot®2) (with Bose ®)
- The volume of the music constituent covered by noise is corrected by the audio amplifier based on the cabin noise measured by the two AudioPilot®2 microphones and the vehicle speed signal sent from the instrument cluster.

Operation sound function
- When the audio panel, climate control unit, steering switch, and clock unit buttons and switches are operated, an operation sound is output.

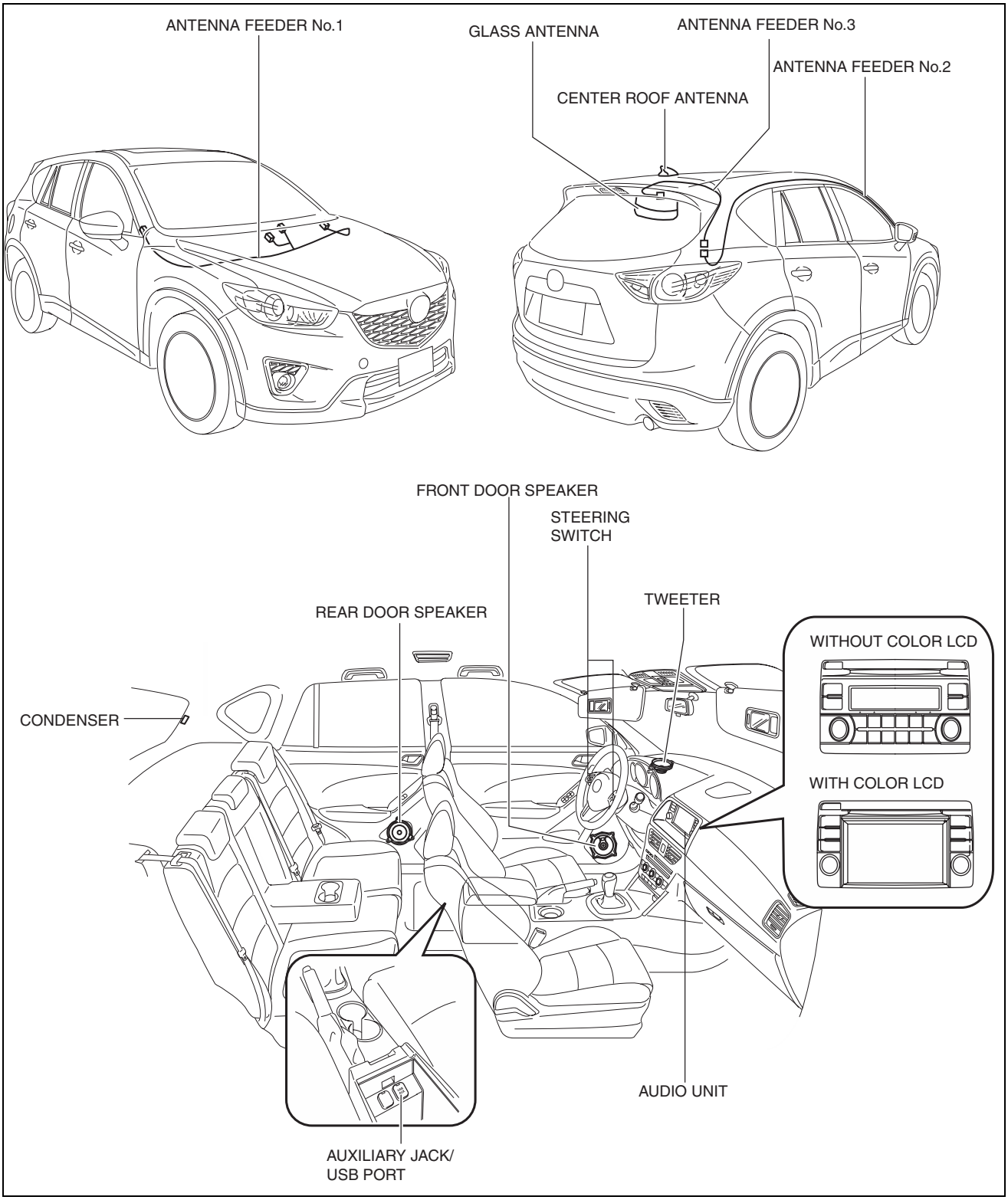
On-board diagnostic function
- Performs on-board diagnosis to detect the location of a malfunction.
- For details on the on-board diagnostic function, refer to the 09-20-63 ON-BOARD DIAGNOSTIC [AUDIO SYSTEM].

Diagnostic Assist Function
- Can verify specifications, connection status and operation status of audio system related parts.

ENTERTAINMENT

- For details on the diagnostic assist function, refer to the 09-20-63 ON-BOARD DIAGNOSTIC [AUDIO SYSTEM].

Structural view
Without Bose®



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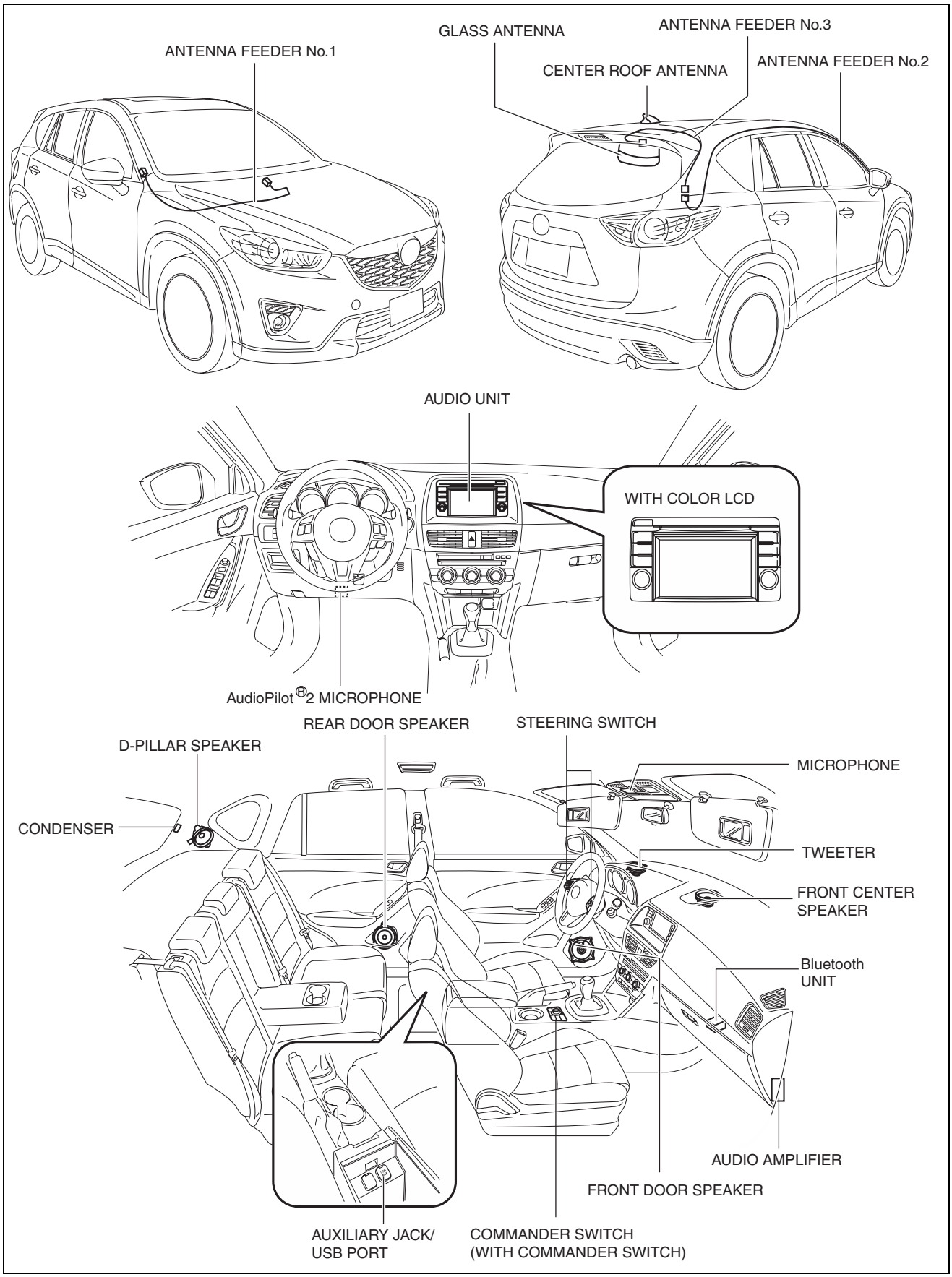
ENTERTAINMENT

With Bose®



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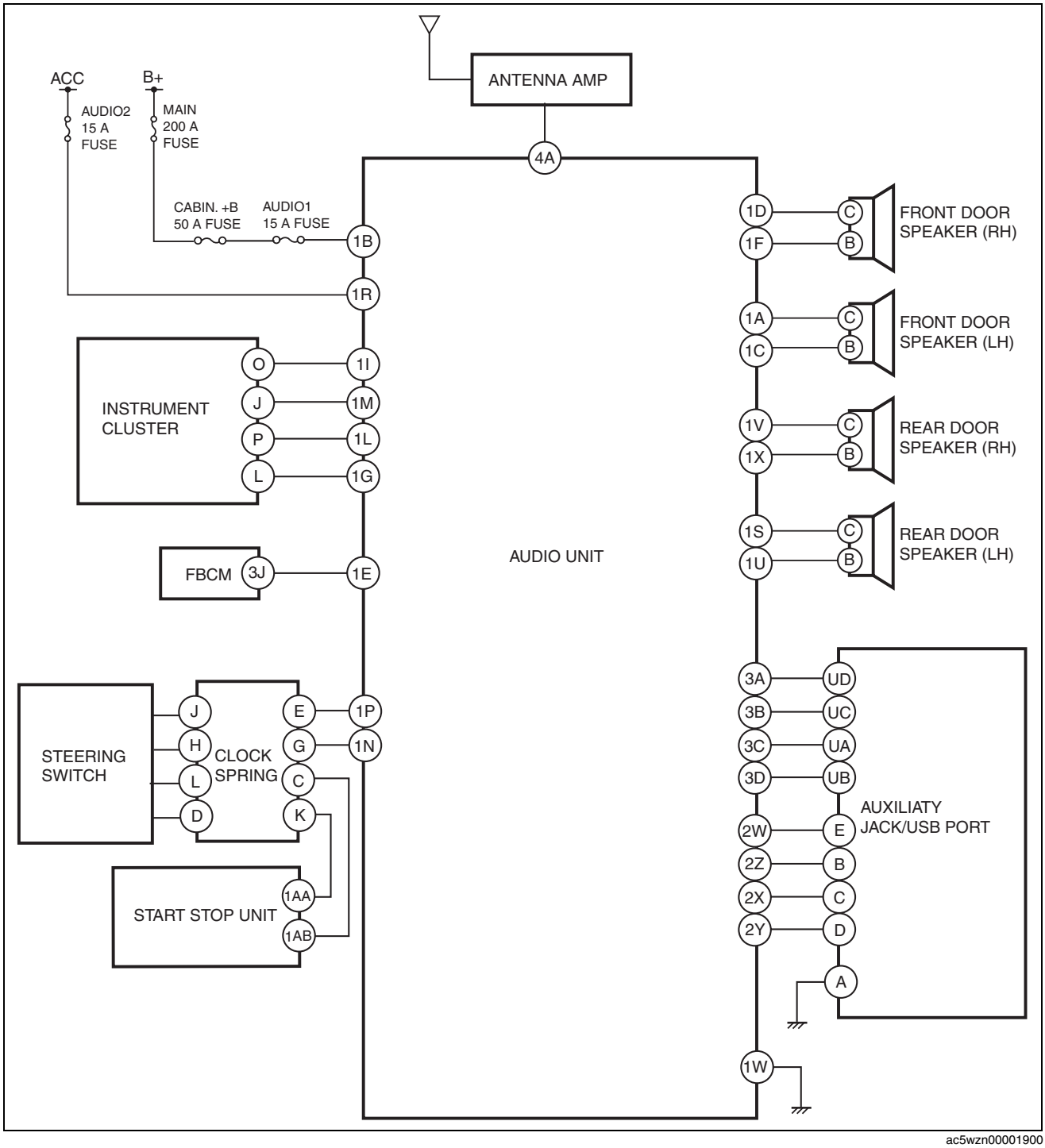
ENTERTAINMENT

Block diagram
Without color LCD
Without i-stop system



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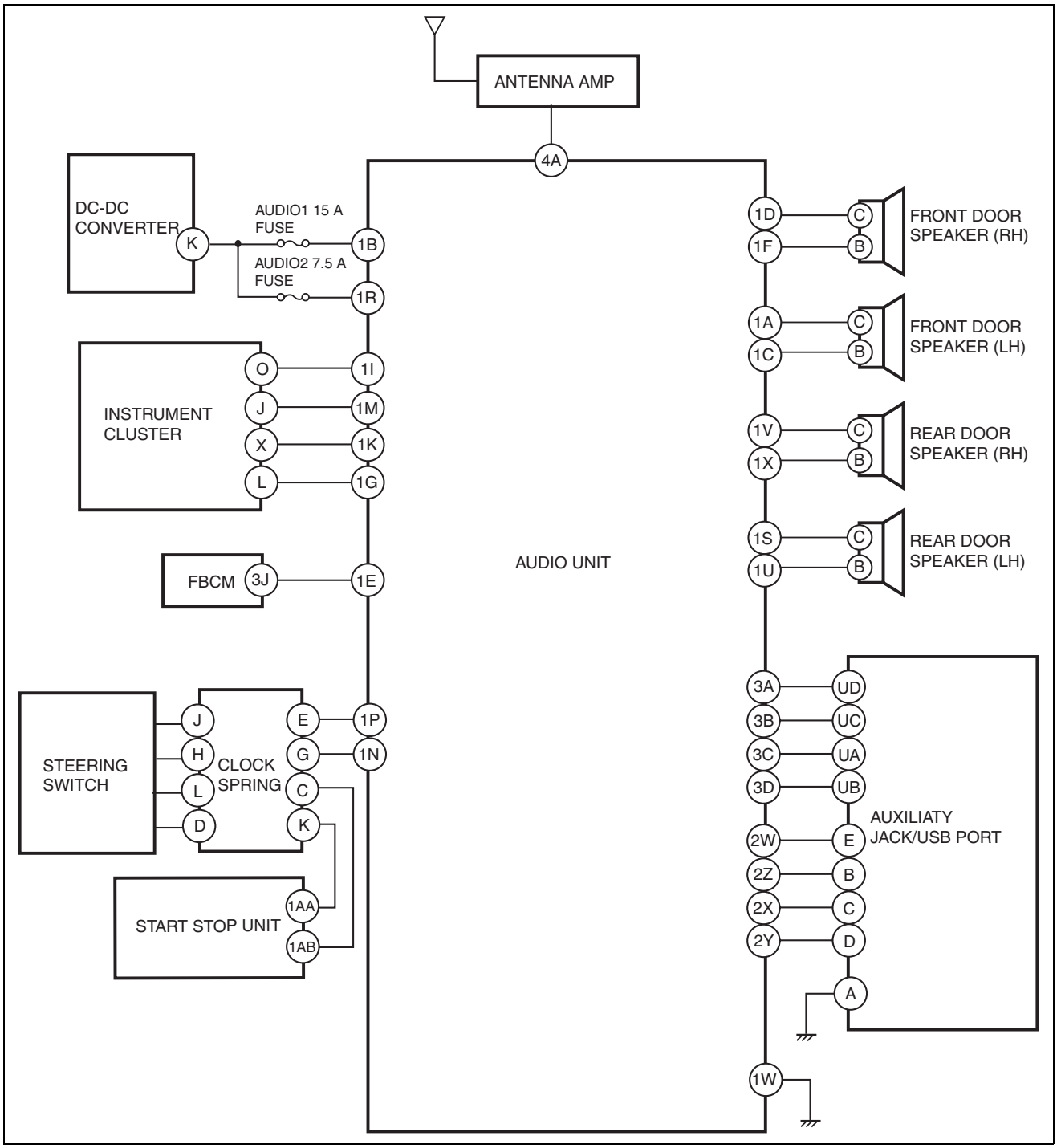
ENTERTAINMENT

With i-stop system



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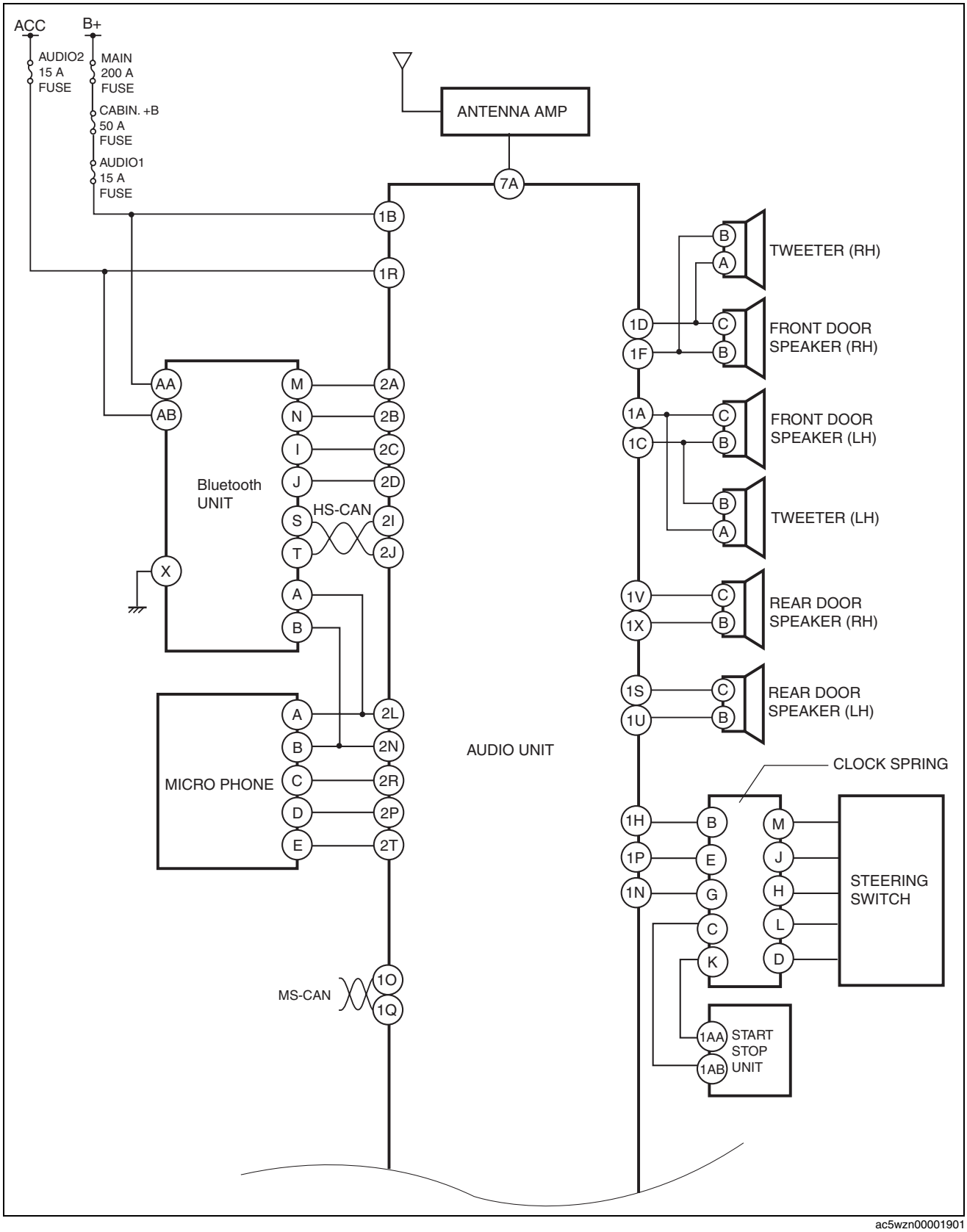
ENTERTAINMENT

With color LCD (Without Bose ®)
Without i-stop system



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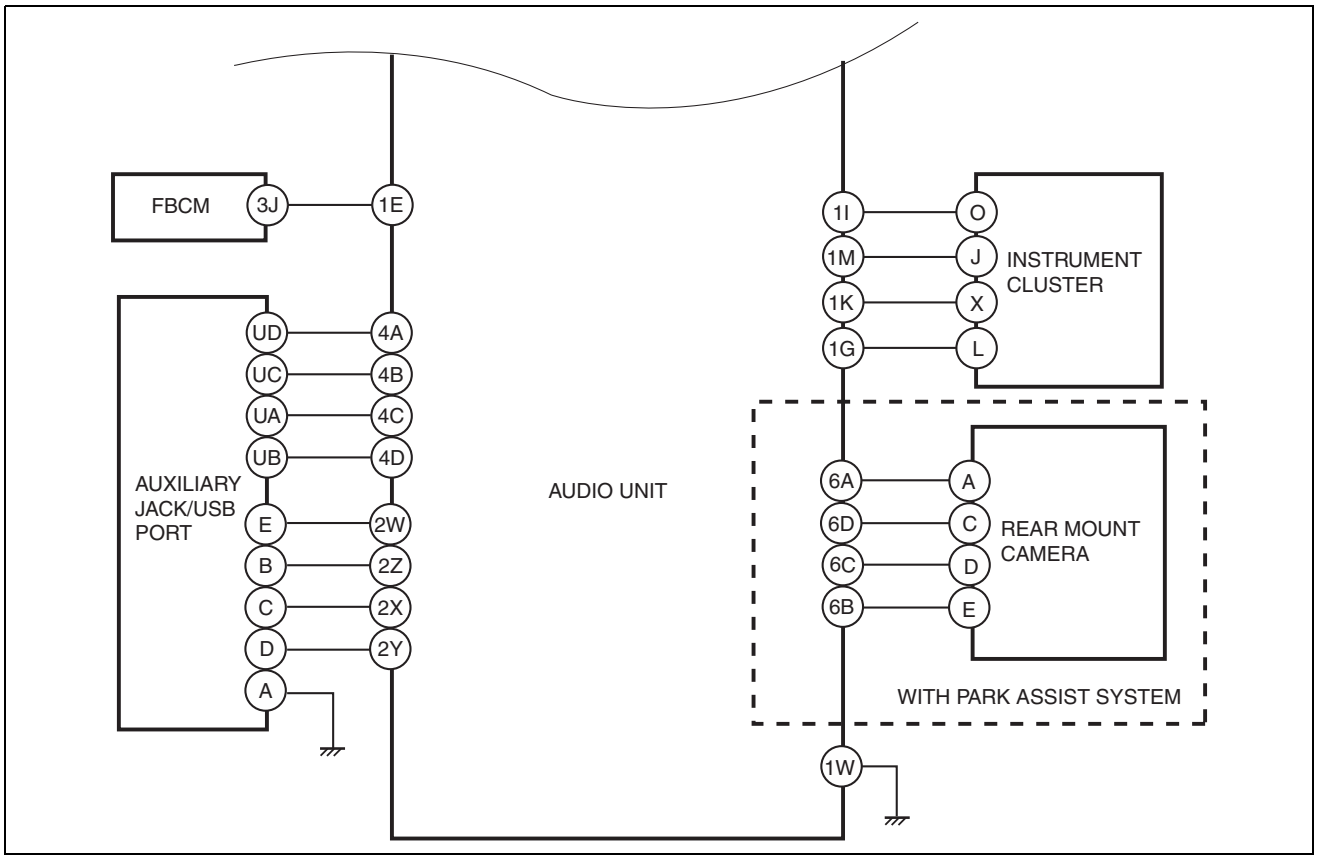
ENTERTAINMENT



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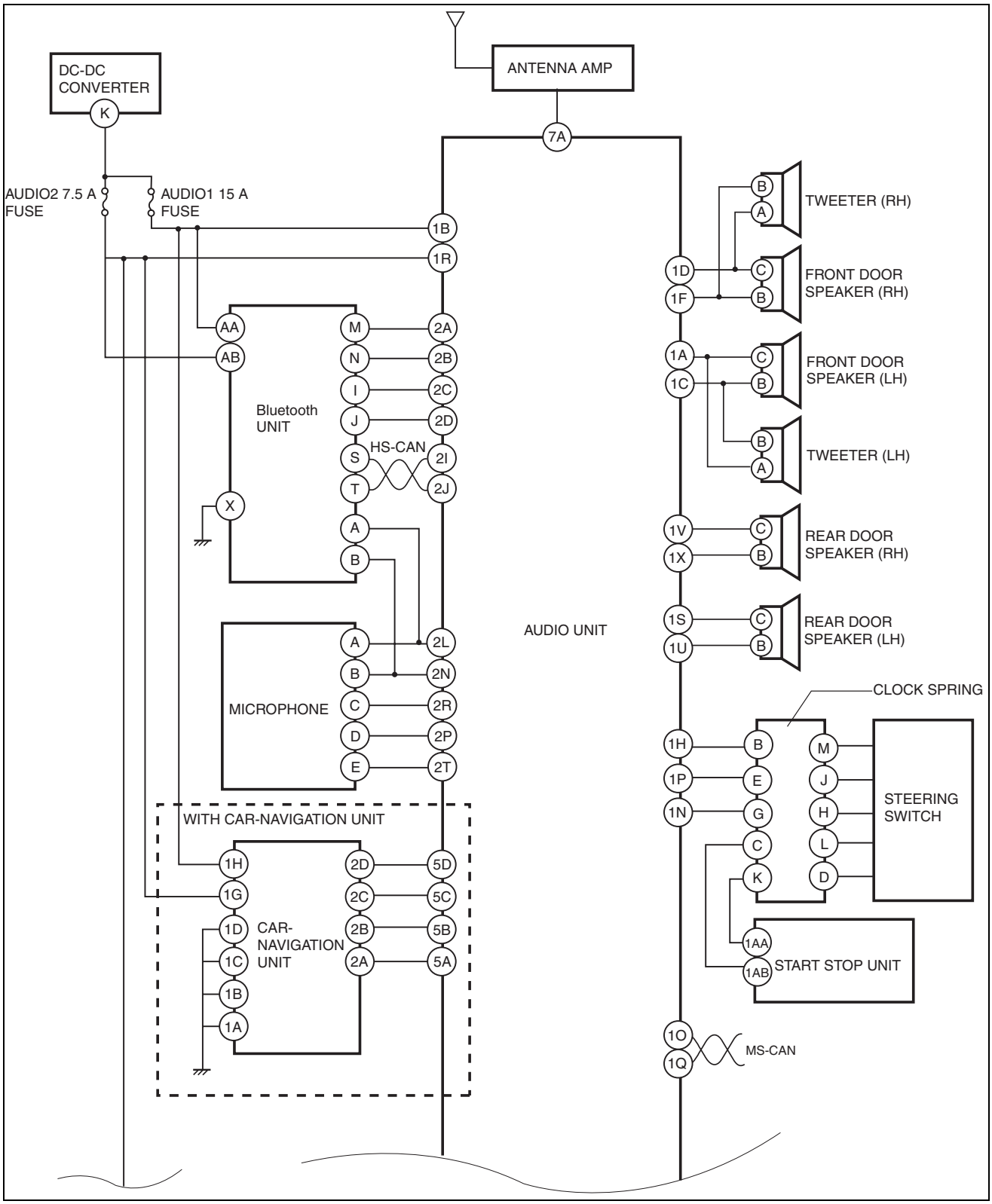
ENTERTAINMENT

With i-stop system



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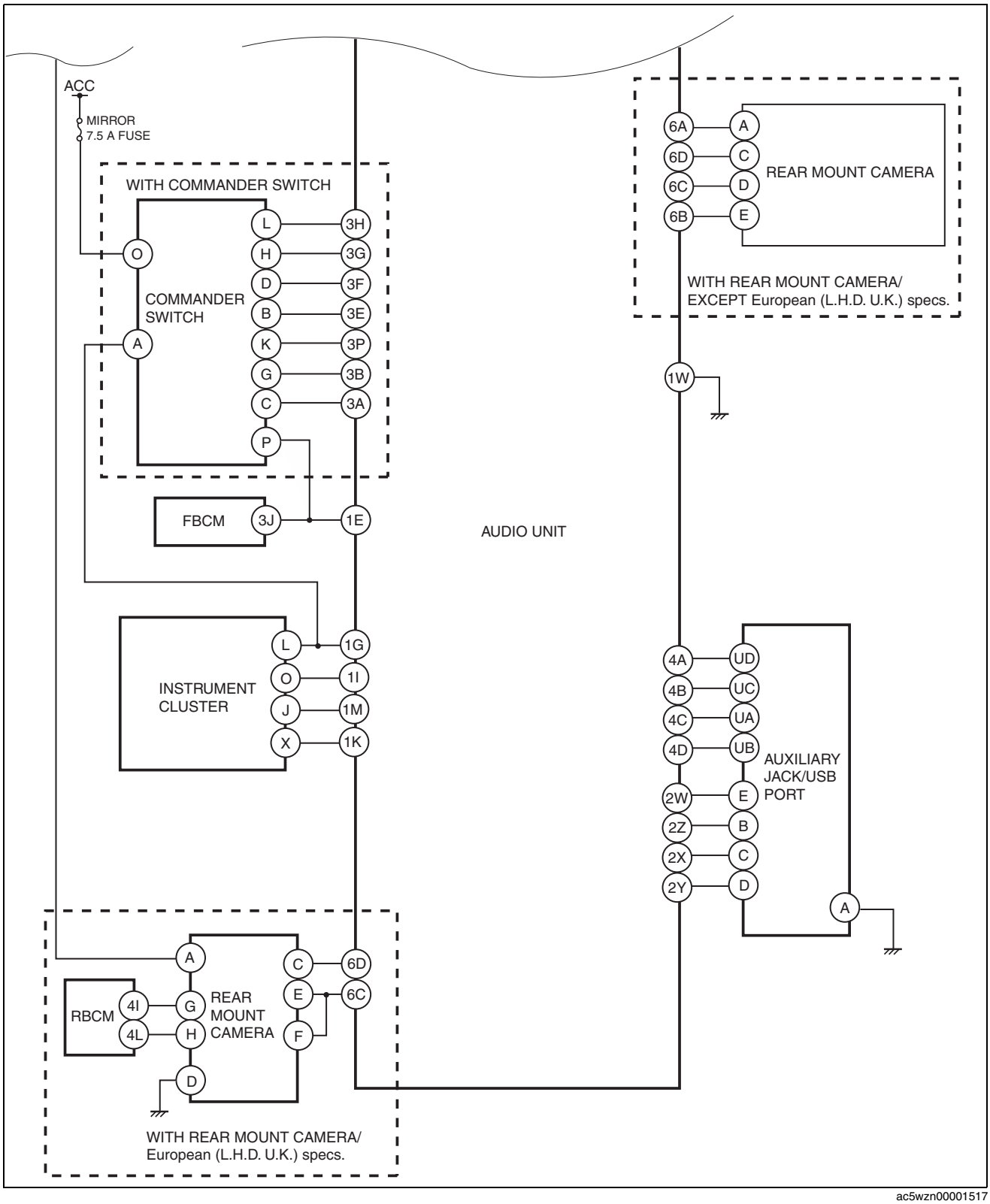
ENTERTAINMENT



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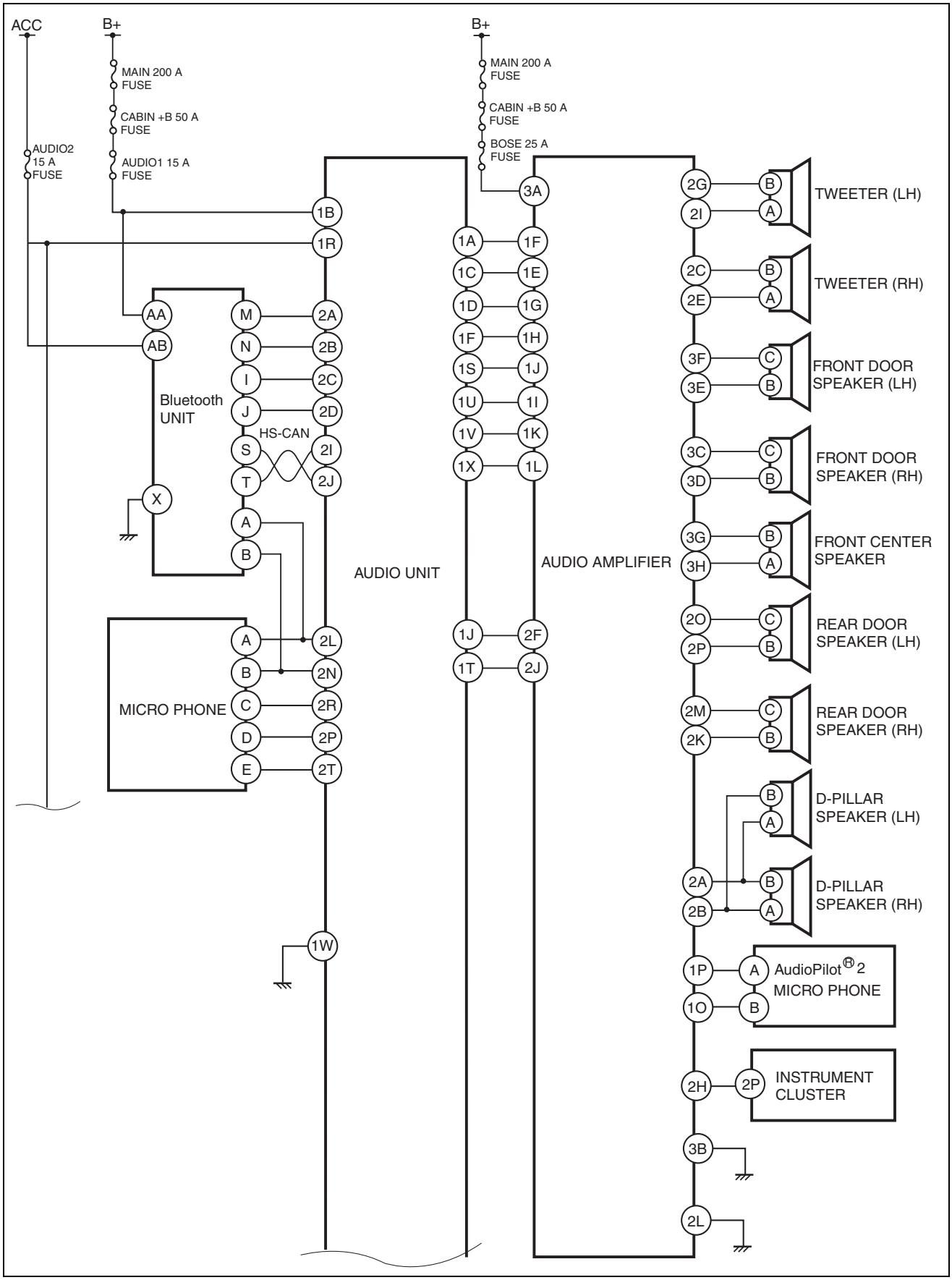
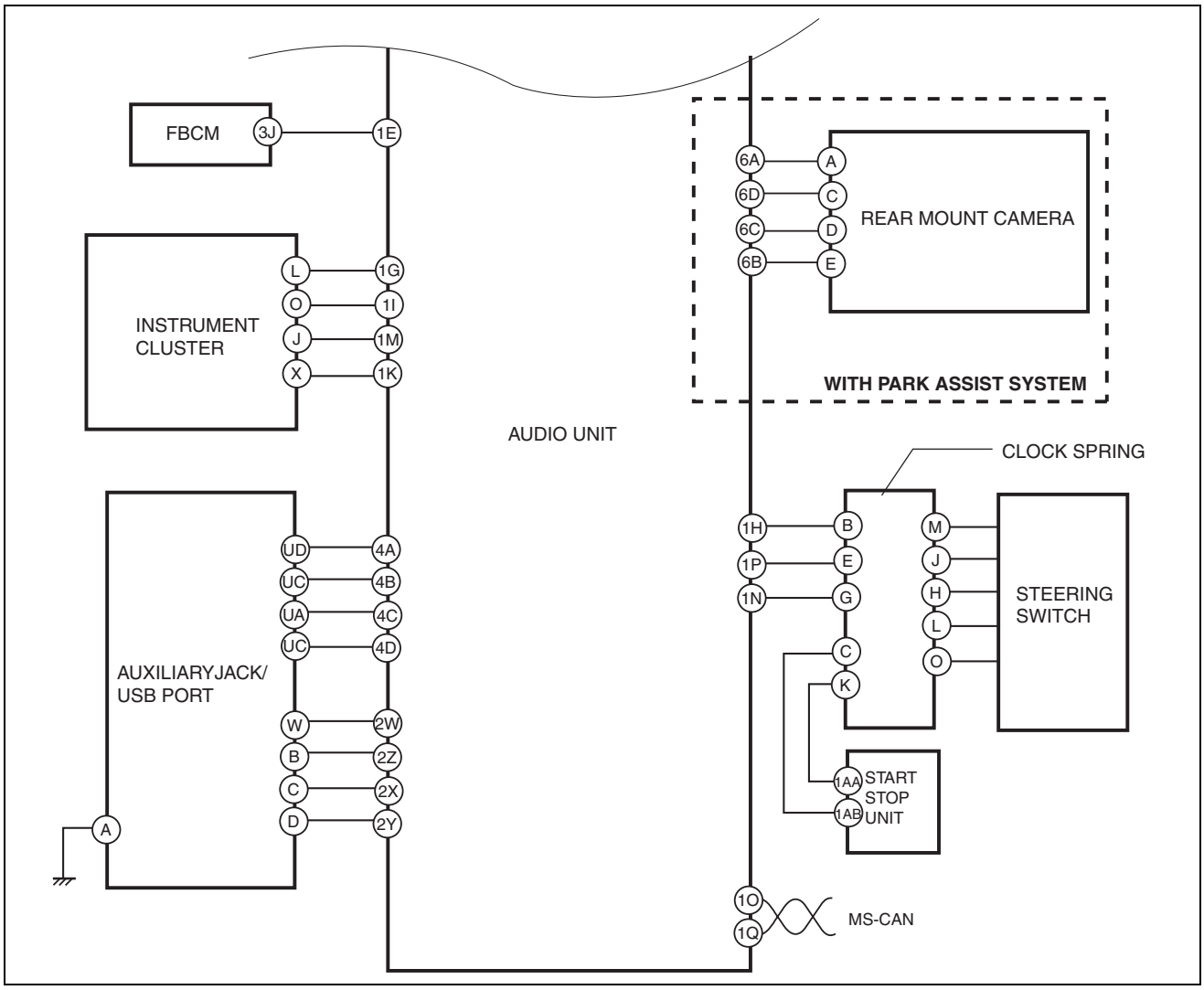
ENTERTAINMENT

With color LCD (With Bose ®)
Without i-stop system



ac5wzn00001911

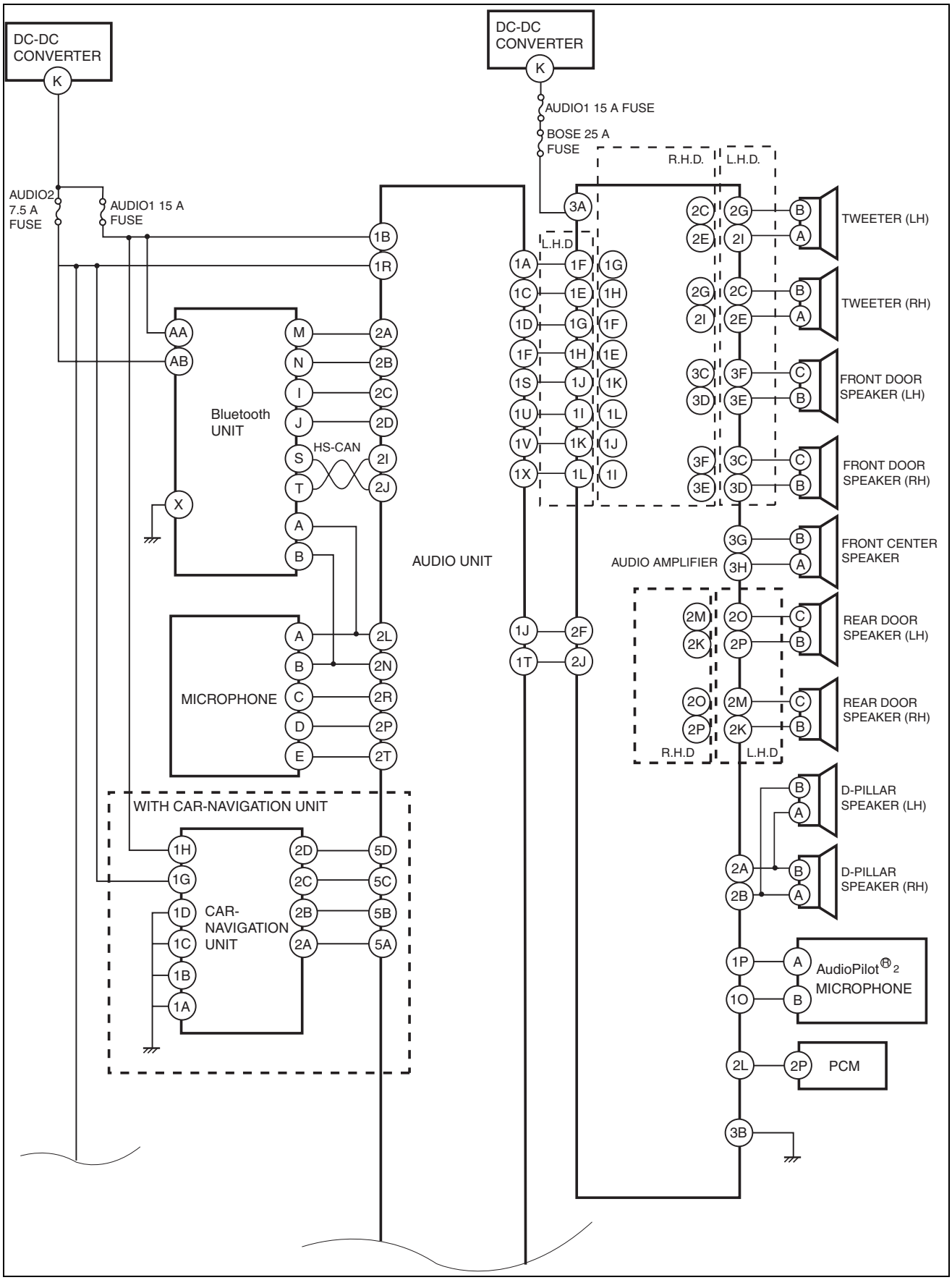
ENTERTAINMENT



ac5wzn00001902

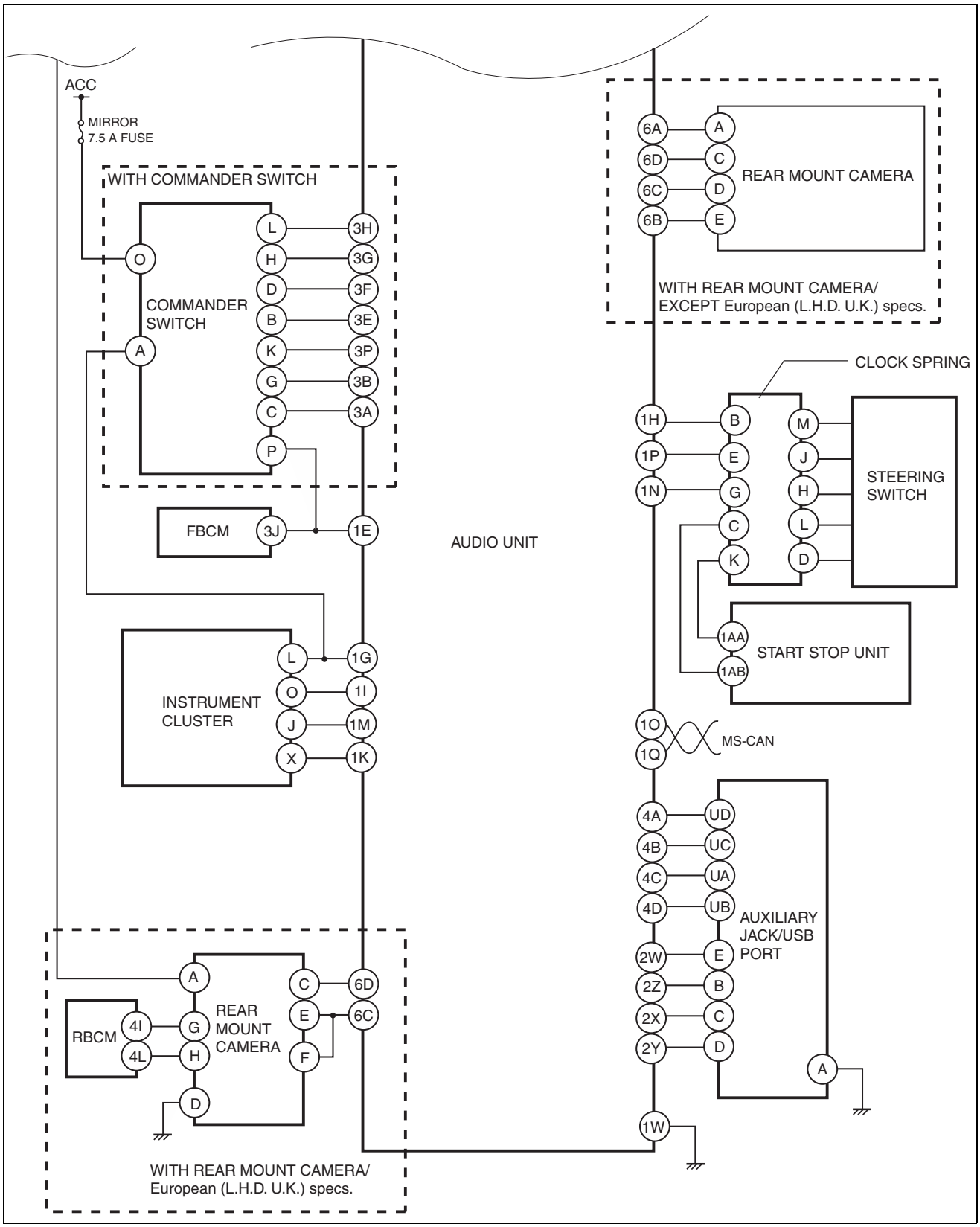
ENTERTAINMENT

With i-stop system



ac5wzn00001146

ENTERTAINMENT



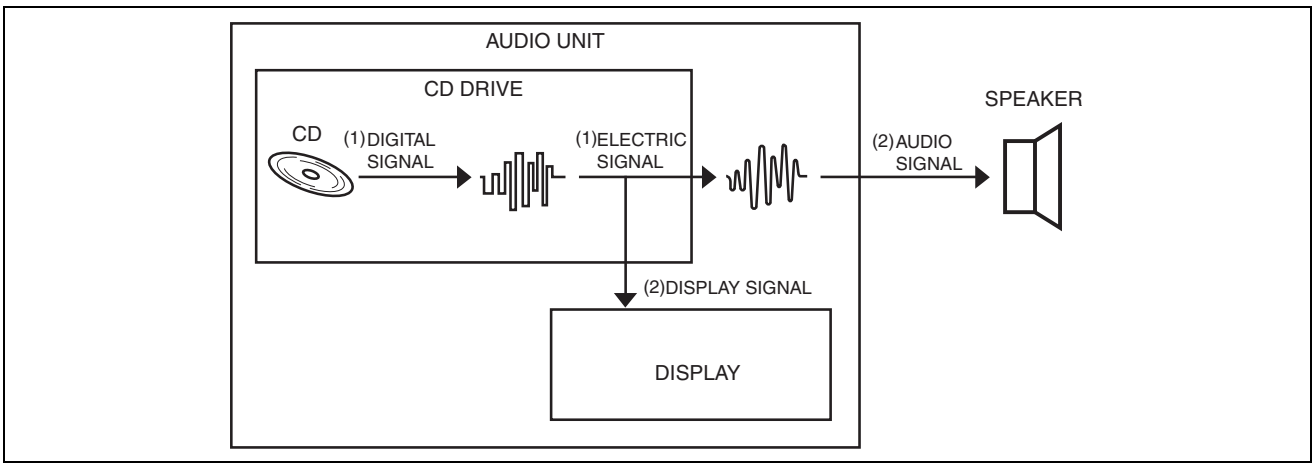
ac5wzn00001518

Operation
CD operation

ENTERTAINMENT

Without Bose®

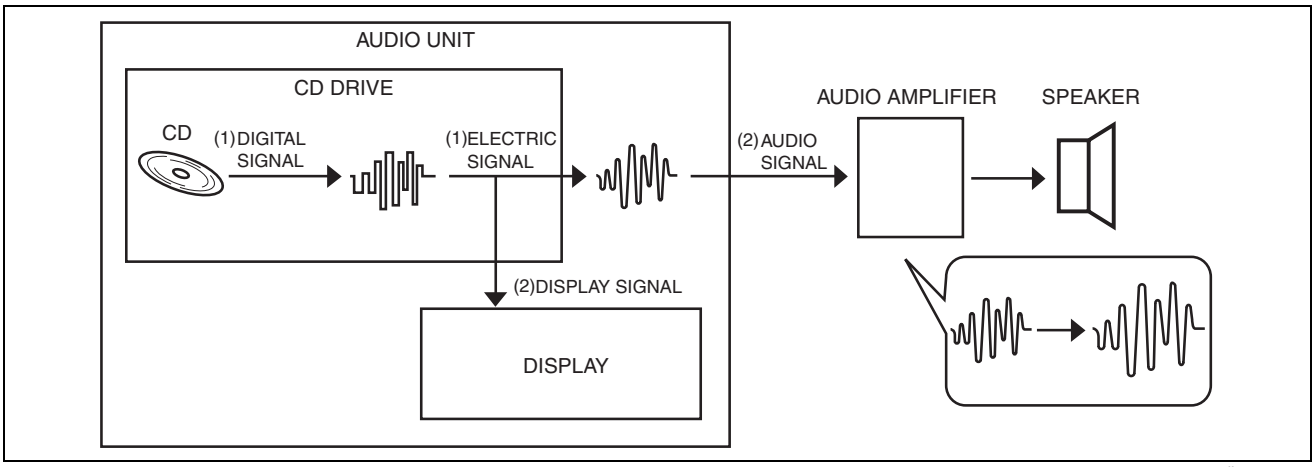
1. When a CD is inserted into the audio unit, laser light is emitted to the CD by the CD drive in the audio unit. The reflected light is detected by the light sensor and the data recorded in the CD is converted from a digital signal to an electric signal.
2. The audio unit converts the electric signal to an audio signal and video signal using the electrical circuit in the audio unit. The audio signal is sent to the speakers and the video signal is sent to the audio display.
3. The speakers generate audio based on the audio signal sent from the audio unit. The audio unit displays CD information based on the video signal.



ac5jjn00000758

With Bose®

1. When a CD is inserted into the audio unit, laser light is emitted to the CD by the CD drive in the audio unit. The reflected light is detected by the light sensor and the data recorded in the CD is converted from a digital signal to an electric signal.
2. The audio unit converts the electric signal to an audio signal and video signal using the electrical circuit in the audio unit. The audio signal is sent to the speakers and the video signal is sent to the audio display.
3. The audio amplifier amplifies the audio signal sent from the audio unit and sends it to the speakers.
4. The speakers generate audio based on the audio signal sent from the audio unit. The audio display displays CD information based on the video signal.



ac5jjn00001059

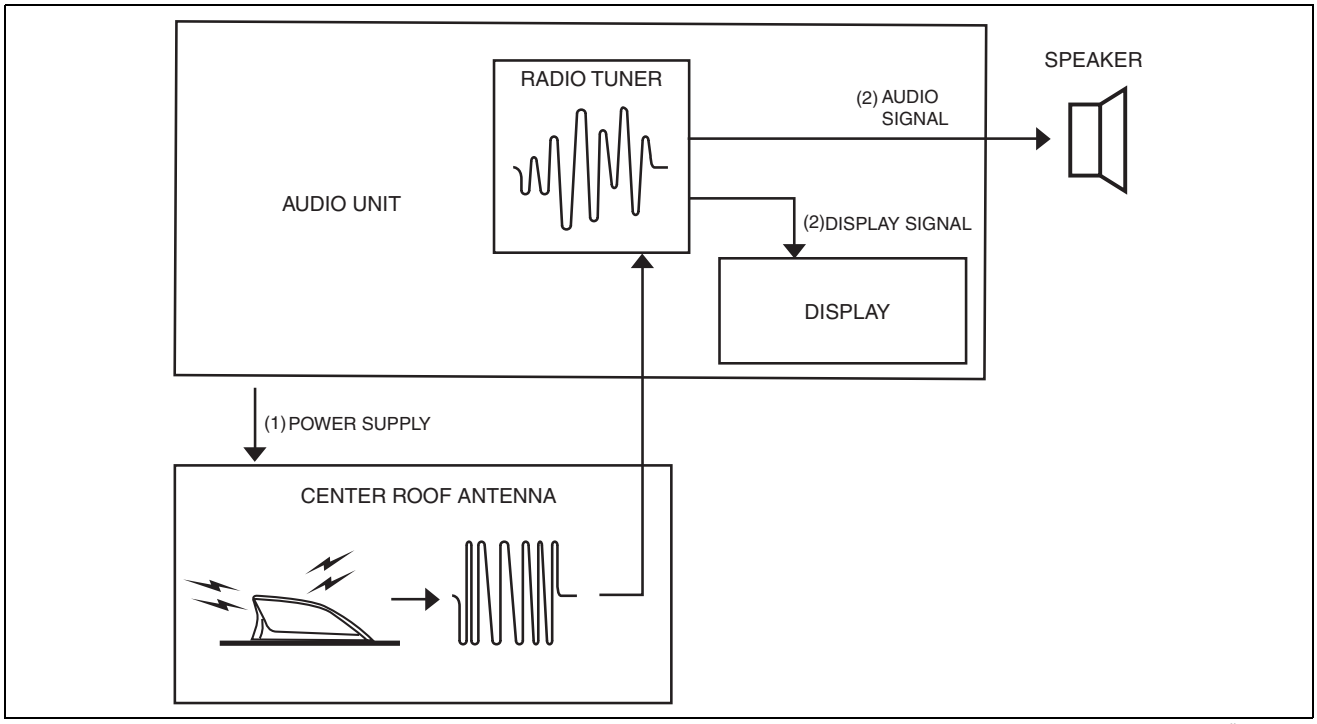
Radio operation

Without Bose®

1. When the ignition is switched to ACC or ON (engine off or on), the audio unit supplies power to the amplifier in the center roof antenna.
2. The audio unit detects the radio broadcast selected by the user using the radio tuner in the audio unit based on the electrical signal sent from the center roof antenna. The audio signal from the detected radio broadcast is then sent to the speakers. In addition, the video signal of the detected radio broadcast is sent to the display of the audio unit.

ENTERTAINMENT

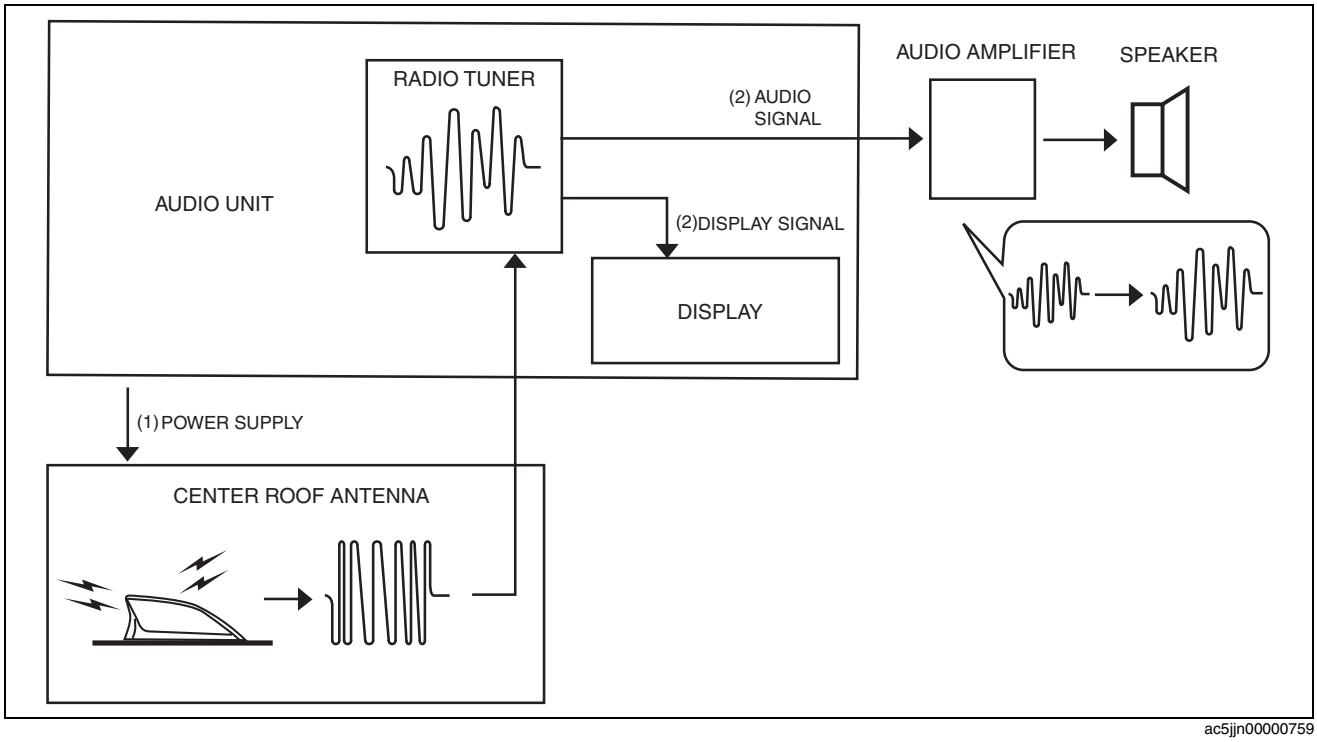
3. The speakers generate audio based on the audio signal sent from the audio unit. The audio display displays radio information based on the video signal.



ac5jjn00001060

With Bose®

1. When the ignition is switched to ACC or ON (engine off or on), the audio unit supplies power to the amplifier in the center roof antenna.
2. The audio unit detects the radio broadcast selected by the user using the radio tuner in the audio unit based on the electrical signal sent from the center roof antenna. The audio signal from the detected radio broadcast is then sent to the audio amplifier. In addition, the video signal of the detected radio broadcast is sent to the display of the audio unit.
3. The audio amplifier amplifies the audio signal sent from the audio unit and sends it to the speakers.
4. The speakers produce audio based on the audio signal sent from the audio unit. The audio display displays radio information based on the video signal.

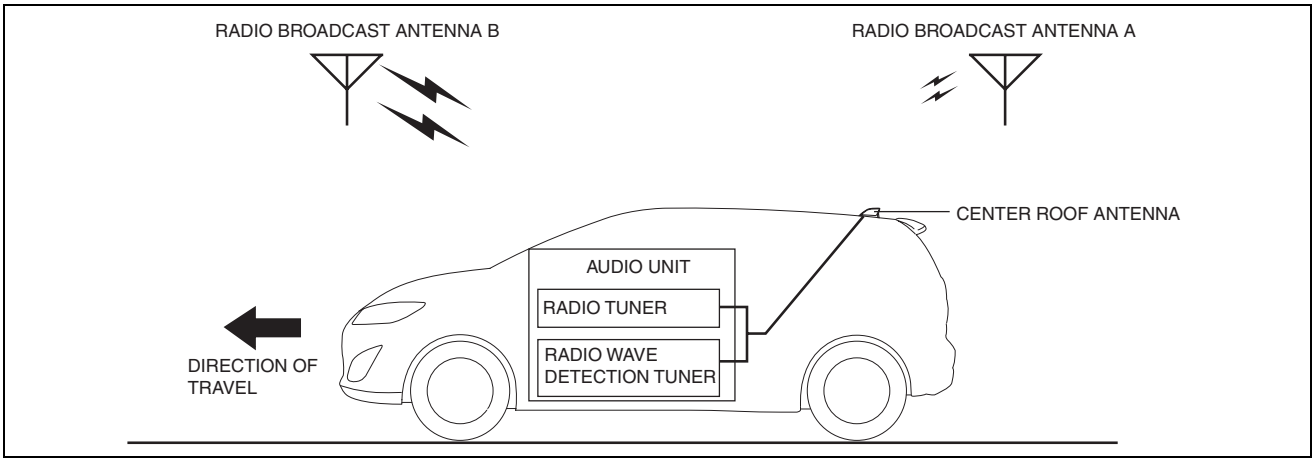


ac5jjn00000759

ENTERTAINMENT

RDS (radio data system) operation

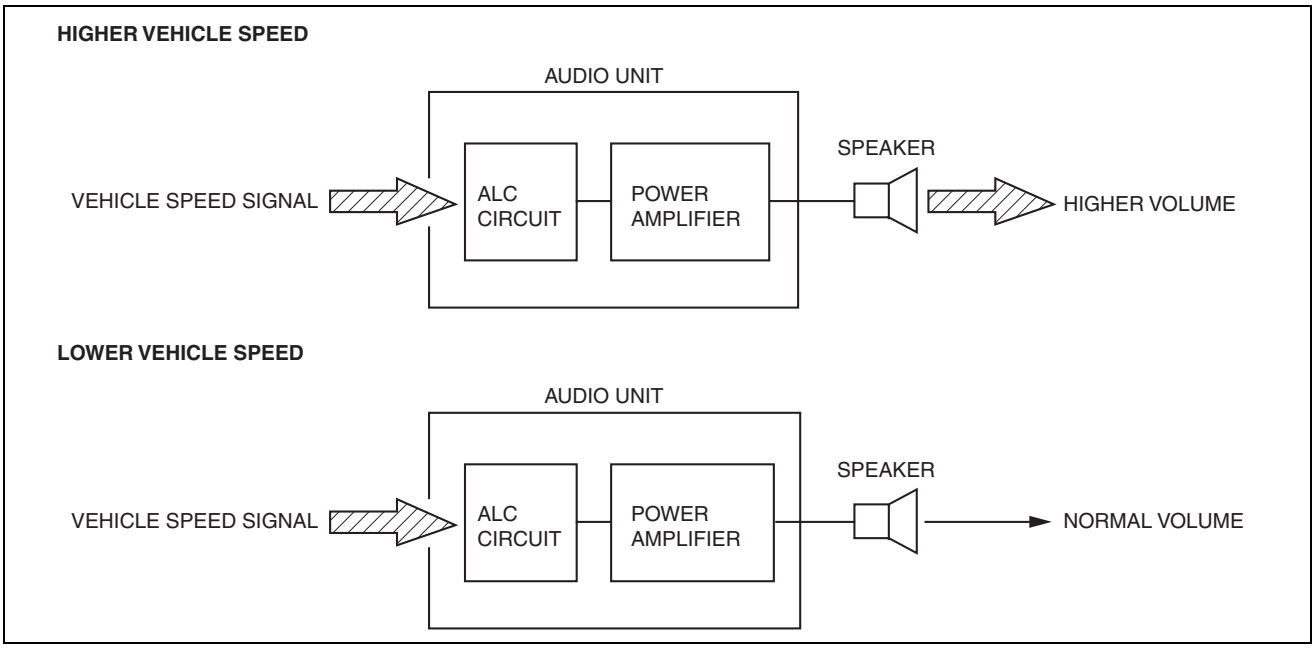
- The radio wave detection tuner (different type of radio reception tuner) detects the reception conditions of radio broadcasts and detects radio broadcasts which are broadcasting the same content as the radio broadcast currently being received.
- If the radio reception tuner reception conditions are less than the specified value, the radio detection tuner switches to the same radio broadcast being detected which has more stable reception conditions.



ac5wzn00001519

ALC (auto level control) operation (with Bose ®)

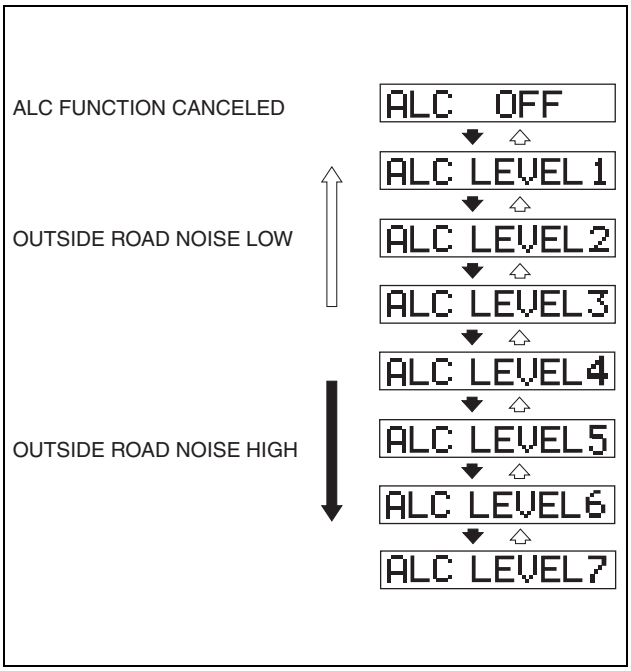
- The audio unit automatically changes the volume and audio quality based on the vehicle speed signal sent from the instrument cluster.



am3uun0000104

ENTERTAINMENT

- The ALC function is divided into 7 levels. When the level is in the high range, the volume correction range and correction amount is large. The maximum correction amount is 14dB. The ALC function can be stopped by selecting ALC OFF.



am5ezn0000205

Volume correction amount table

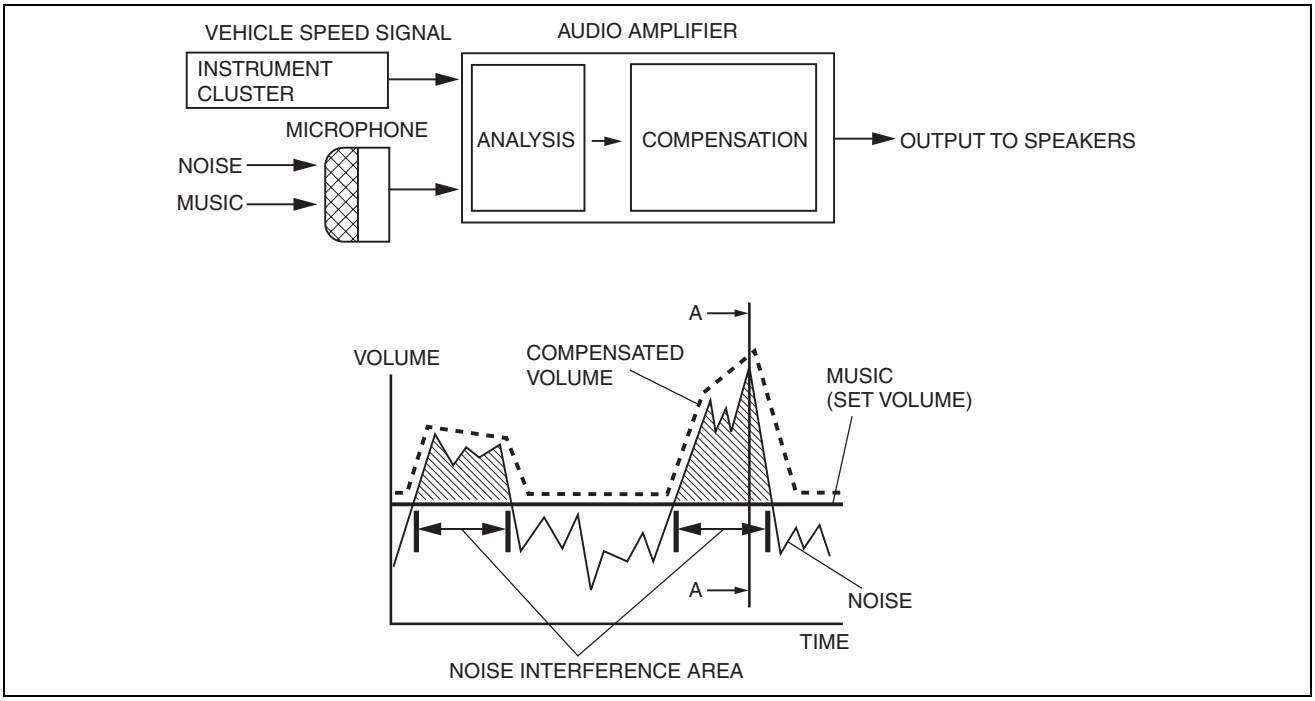
Vehicle speed (km/h {mph})	ALC LEVEL 1 (dB)	ALC LEVEL 2 (dB)	ALC LEVEL 3 (dB)	ALC LEVEL 4 (dB)	ALC LEVEL 5 (dB)	ALC LEVEL 6 (dB)	ALC LEVEL 7 (dB)
0—15 {0—9.3}	0	0	0	0	0	0	0
20 {12}	0	0	0	0	0	0	1
25 {16}	0	0	1	1	1	1	1
30 {19}	0	1	1	1	1	1	2
35 {22}	1	1	1	1	2	2	2
40 {25}	1	1	1	2	2	2	3
45 {28}	1	1	2	2	2	3	3
50 {31}	1	1	2	2	3	3	4
55 {34}	1	2	2	3	3	4	4
60 {37}	1	2	2	3	4	4	5
65 {40}	1	2	3	3	4	5	5
70 {43}	1	2	3	4	4	5	6
75 {47}	2	2	3	4	5	6	7
80 {50}	2	3	3	4	5	6	7
85 {53}	2	3	4	5	6	7	8
90 {56}	2	3	4	5	6	7	8
95 {59}	2	3	4	5	7	8	9
100 {62.1}	2	3	5	6	7	8	9
105 {65.2}	2	4	5	6	7	9	10
110 {68.4}	2	4	5	6	8	9	10
115 {71.5}	3	4	5	7	8	10	11
120 {74.6}	3	4	6	7	9	10	11
125 {77.7}	3	4	6	7	9	10	12
130 {80.8}	3	5	6	8	9	11	13
135 {83.9}	3	5	6	8	10	11	13
140 {87}	3	5	7	8	10	12	14
145 {90.1}	3	5	7	9	11	12	14
150 {93.2}	3	5	7	9	11	13	14
155 {96.3}	4	6	7	9	11	13	14
160 {99.4}	4	6	8	10	12	14	14
165 {103}	4	6	8	10	12	14	14

ENTERTAINMENT

Vehicle speed (km/h {mph})	ALC LEVEL 1 (dB)	ALC LEVEL 2 (dB)	ALC LEVEL 3 (dB)	ALC LEVEL 4 (dB)	ALC LEVEL 5 (dB)	ALC LEVEL 6 (dB)	ALC LEVEL 7 (dB)
170 {106}	4	6	8	10	13	14	14
175 {109}	4	6	9	11	13	14	14
180 {112}	4	7	9	11	13	14	14
185 {115}	4	7	9	11	14	14	14
190 {118}	4	7	9	12	14	14	14
195 {121}	5	7	10	12	14	14	14
200 {124}	5	7	10	12	14	14	14
205 {127}	5	7	10	13	14	14	14
210 {130}	5	8	10	13	14	14	14
215 {134}	5	8	11	13	14	14	14
220 {137}	5	8	11	14	14	14	14
225 {140}	5	8	11	14	14	14	14
230 {143}	5	8	11	14	14	14	14
235 {146}	6	9	12	14	14	14	14
240 {149}	6	9	12	14	14	14	14
245 {152}	6	9	12	14	14	14	14
250 {155}	6	9	13	14	14	14	14

Road noise correction system (AudioPilot®2) (with Bose ®)

- The audio amplifier differentiates each of the noise and music frequencies and compares the noise and music level based on the cabin sound measured by the two microphones used with the AudioPilot®2 and by the vehicle speed signal sent from the instrument cluster. As a result, sound correction is performed if it is determined that the frequency band from the noise makes it difficult to hear the music.



amxzzn00000636

Operation sounds

- The audio unit outputs operation sound when it detects an operation signal from the operation of an audio panel and steering switch.
- The operation sound is output from the front door speakers.
- The operation sound can be set to activated/deactivated. If the operation sound is deactivated, operation sound is not output.
- The operation sound is output as follows.

ENTERTAINMENT

Without color LCD

Signal		Operation sound setting ON	Operation sound setting OFF	Sound frequency
Audio panel switch/switch operation signal Steering switch operation signal	Short-press	 0.1 s	—	3 kHz
	Long-press	 0.5 s	 AUDIO PANEL SWITCH 0.5 s STEERING SWITCH 0.1 s	3 kHz

With color LCD

Signal		Operation sound setting ON	Operation sound setting OFF	Sound frequency
Audio panel switch/switch operation signal Steering switch operation signal	Short-press	 0.1 s	—	3 kHz
	Long-press	 0.5 s	—	3 kHz
	SIRIUS seek alert	 0.5 s	—	1.5 kHz

AUDIO UNIT (WITHOUT COLOR LCD)

id092000110200

Note
- "iPod" is a registered trademark of Apple Inc. in the United States and other countries.

Outline
- The audio unit controls the CD, radio, exterior input devices (AUX/USB/iPod) and the display.

Function
- The display integrated into the audio unit displays audio information such as CD and radio related information.
- Records the following items which the user has set.

Item		Specification
Preset memory	AM	6
	FM1	6
	FM2	6

USB/iPod applicable
- A USB device such as USB memory or an iPod connected to the auxiliary jack/USB port can be controlled by the audio unit.

Latin character display
- Information such as CD and radio related information can be displayed in the audio unit display in Latin characters.

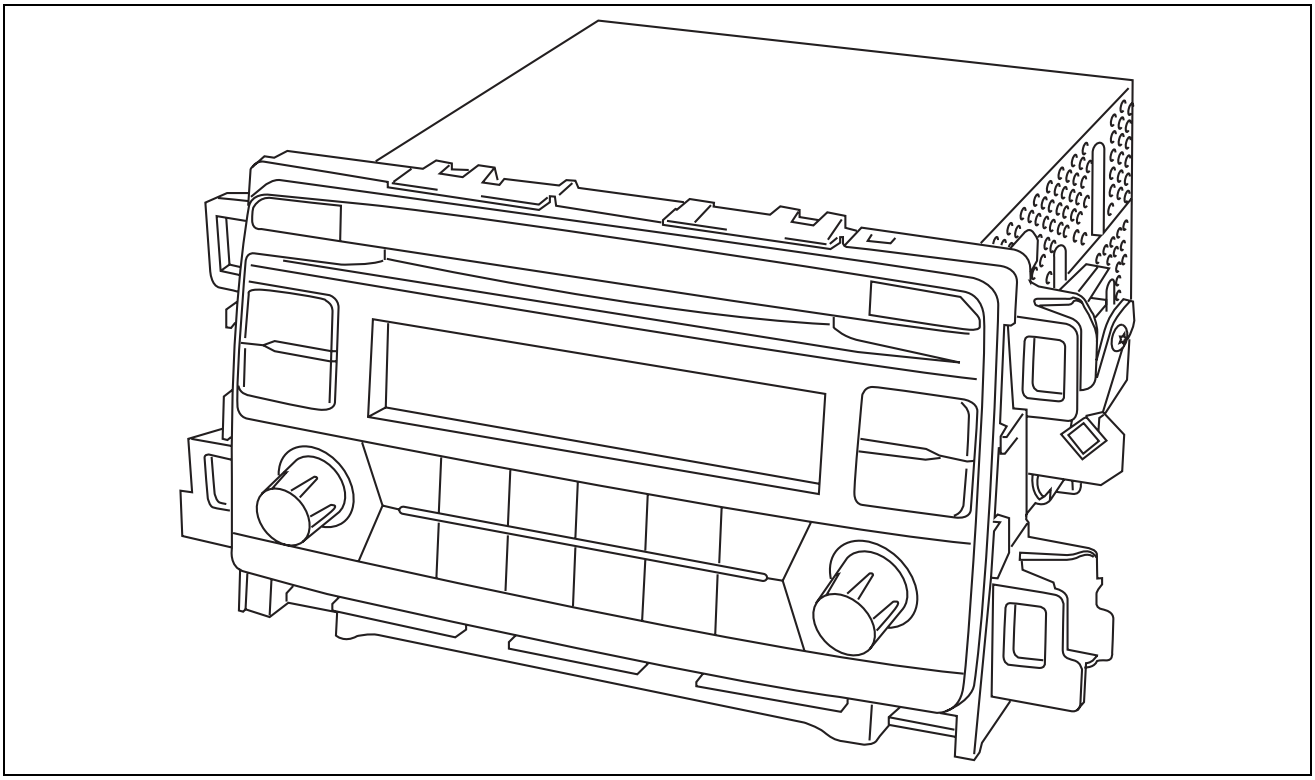
Specification

Item			Specification
Rated voltage		(V)	12
Frequency range	AM	(kHz)	531—1602 (European (L.H.D. U.K.) specs.) 530—1620 (With AM frequency pitch: 5KHz pitch) 522—1629 (With AM frequency pitch: 9KHz pitch)
	FM	(MHz)	87.5—108
	LW	(kHz)	153—279
Amplifier maximum output		(W)	25×4
Output impedance		(ohm)	4

ENTERTAINMENT

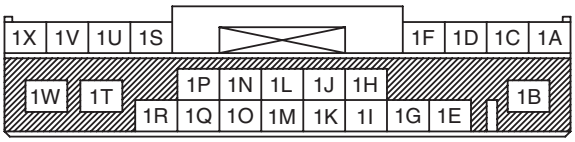
Construction

- An audio unit with integrated AM/FM tuner/MP3/WMA (Windows Media Audio)/AAC (Advanced Audio Coding) applicable CD player is assembled to the audio panel.

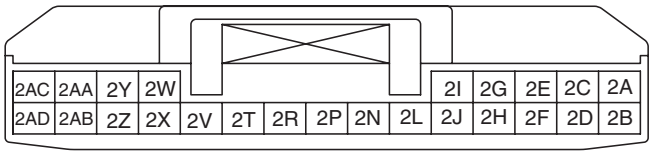
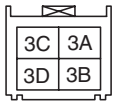


ac5jjn00000375

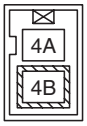
Terminal layout and signal
Audio unit

Terminal		Signal
	1A	Front door speaker LH (+)
	1B	B+
	1C	Front door speaker LH (-)
	1D	Front door speaker RH (+)
	1E	TNS (+)
	1F	Front door speaker RH (-)
	1G	TNS (–)
	1H	—
	1I	Vehicle speed signal
	1J	—
	1K	—
	1L	—
	1M	—
	1N	Steering switch 1
	1O	—
	1P	Steering switch 2
	1Q	—
	1R	ACC
	1S	Rear door speaker LH (+)
	1T	—
	1U	Rear door speaker LH (-)
	1V	Rear door speaker RH (+)
	1W	Power ground
	1X	Rear door speaker RH (-)

ENTERTAINMENT

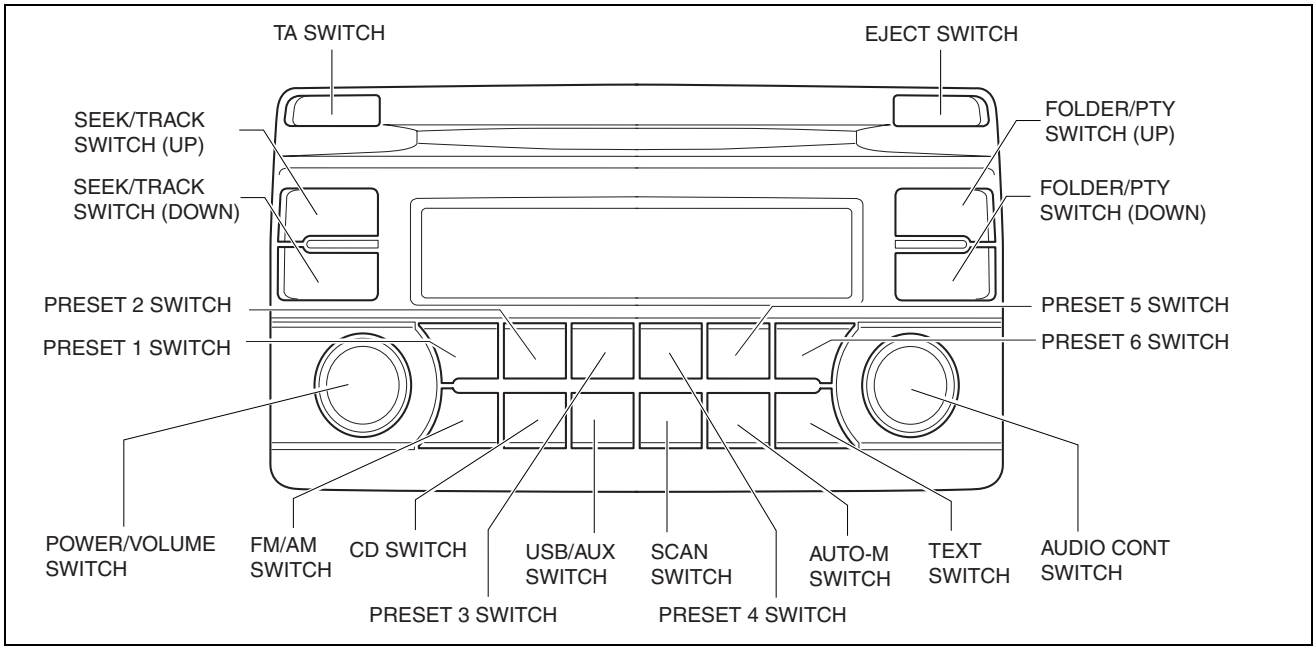
Terminal		Signal
	2A	Power ground
	2B	—
	2C	—
	2D	—
	2E	—
	2F	—
	2G	—
	2H	—
	2I	—
	2J	—
	2L	—
	2N	—
	2P	—
	2R	—
	2T	—
	2V	—
	2W	AUX control
	2X	AUX LH, RH (+)
	2Y	AUX signal RH (-)
	2Z	AUX signal LH (-)
	2AA	—
	2AB	—
	2AC	—
	2AD	—
	3A	USB GND
	3B	USB data (+)
	3C	USB +B
	3D	USB data (-)

Antenna feeder connector

Terminal		Signal
	4A	ANT CONT
	4B	Antenna

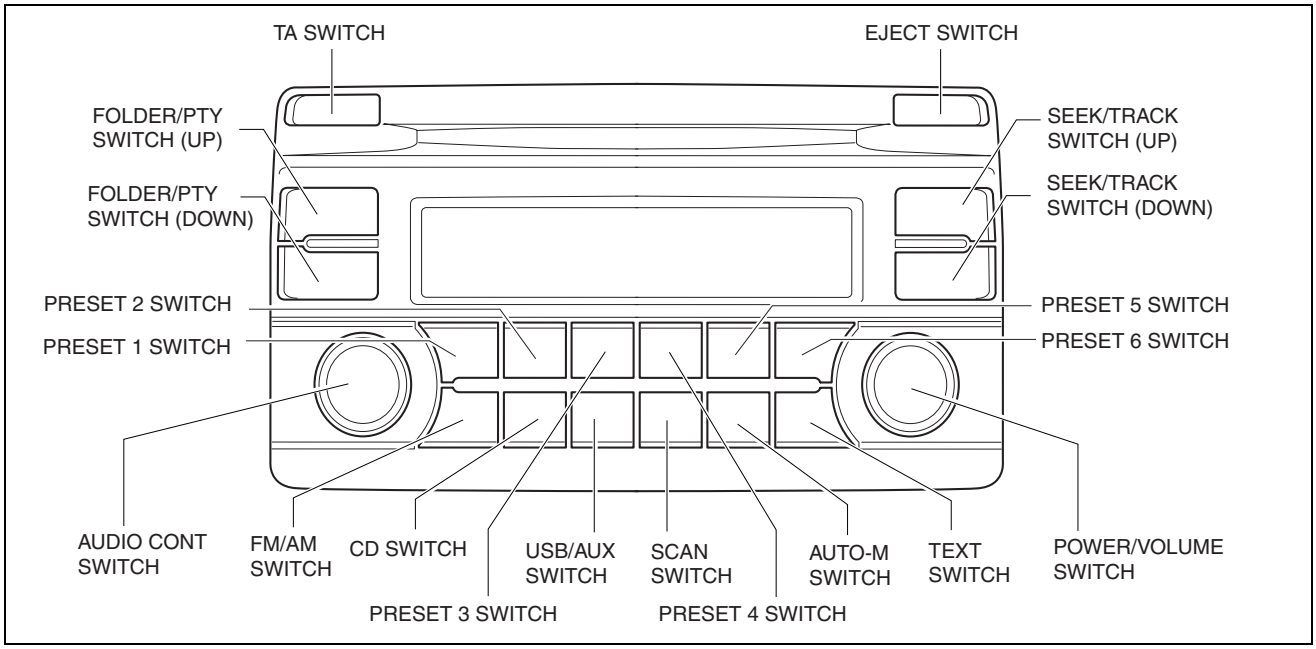
ENTERTAINMENT

Switch Location
With POWER/VOLUME switch on right side



ac5wzn00001485

With POWER/VOLUME switch on left side



ac5wzn00000584

Operation
- Refer to 09-20-4 AUDIO SYSTEM.

Fail-safe
- Function not equipped.

AUDIO UNIT (WITH COLOR LCD)

id092000110300

Note
- “iPod” is a registered trademark of Apple Inc. in the United States and other countries.

Purpose
- The audio unit controls the CD, radio, exterior input devices (AUX/USB/iPod) and the display.

ENTERTAINMENT

Function
- Records the following items which the user has set.

Item		Specification
Preset memory	AM	6
	LW/AM	6
	FM1	6
	FM2	6

- The imbedded touch panel type display in the audio unit displays music information for CD and radio, and it also displays back camera images and the navigation screen.
- The audio unit has the following functions:

USB/iPod applicable
- A USB device such as USB memory or an iPod connected to the auxiliary jack/USB port can be controlled by the audio unit.

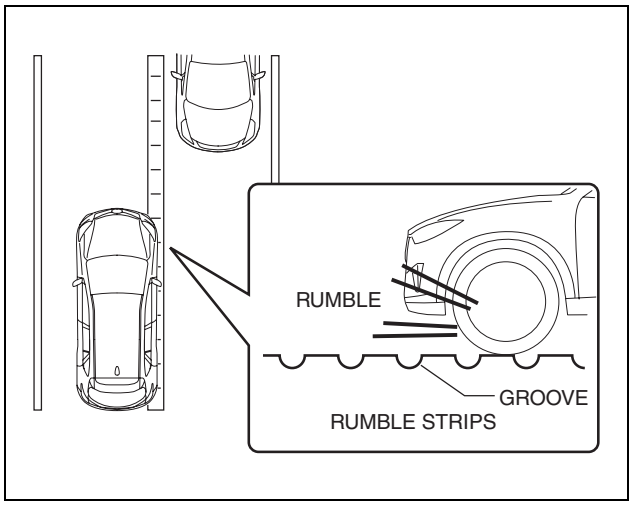
User personalization
- By operating the display of the audio unit, the following personalization features can be set.
- Door Locks Systems
  - — Advanced keyless entry system
    - Auto Re-lock Time
    - Lock Beep Volume
    - Walk Away Lock
  - — Keyless entry system
    - Auto Re-lock Time
  - — Power door lock system
    - Unlock Mode (Without Touch Sensor)
    - Auto Door Lock Mode
- Lighting Systems
  - — Turn light system
    - 3-Flash Turn Signal
  - — Auto light system
    - Auto-headlight On
  - — Auto Light OFF System
    - Headlight Off Timer
  - — Room Light Control System
    - Interior Light Timeout - Door Open
    - Interior Light Timeout - Door Closed
- Wiper/Washer System
  - Rain Sensing Wipers

Note
- For details on each personalization feature, refer to personalization items for each system. (See 09-14-6 SECURITY AND LOCKS PERSONALIZATION.) (See 09-18-5 LIGHTING SYSTEM PERSONALIZATION.) (See 09-19-4 WIPER/WASHER SYSTEM PERSONALIZATION.)

Lane departure warning system (LDWS) warning function
- The audio unit contains a rumble strip *1 recording. When a warning sound request signal from the FSC is received, the recorded rumble strip sound is output. Refer to 09-22-106 LANE DEPARTURE WARNING SYSTEM (LDWS) for details on the LDWS.

*1 : A rumble strip is a series of grooves in the road pavement surface positioned at specific intervals, and when the vehicle passes over it a rumble sound is produced and an uncomfortable vibration can be felt which alerts the driver that the vehicle is departing from the lane lines. The rumble strip sound is a reproduction of the sound which occurs when a vehicle passes over a rumble strip.

ENTERTAINMENT



ac5wzn00001084

Specification

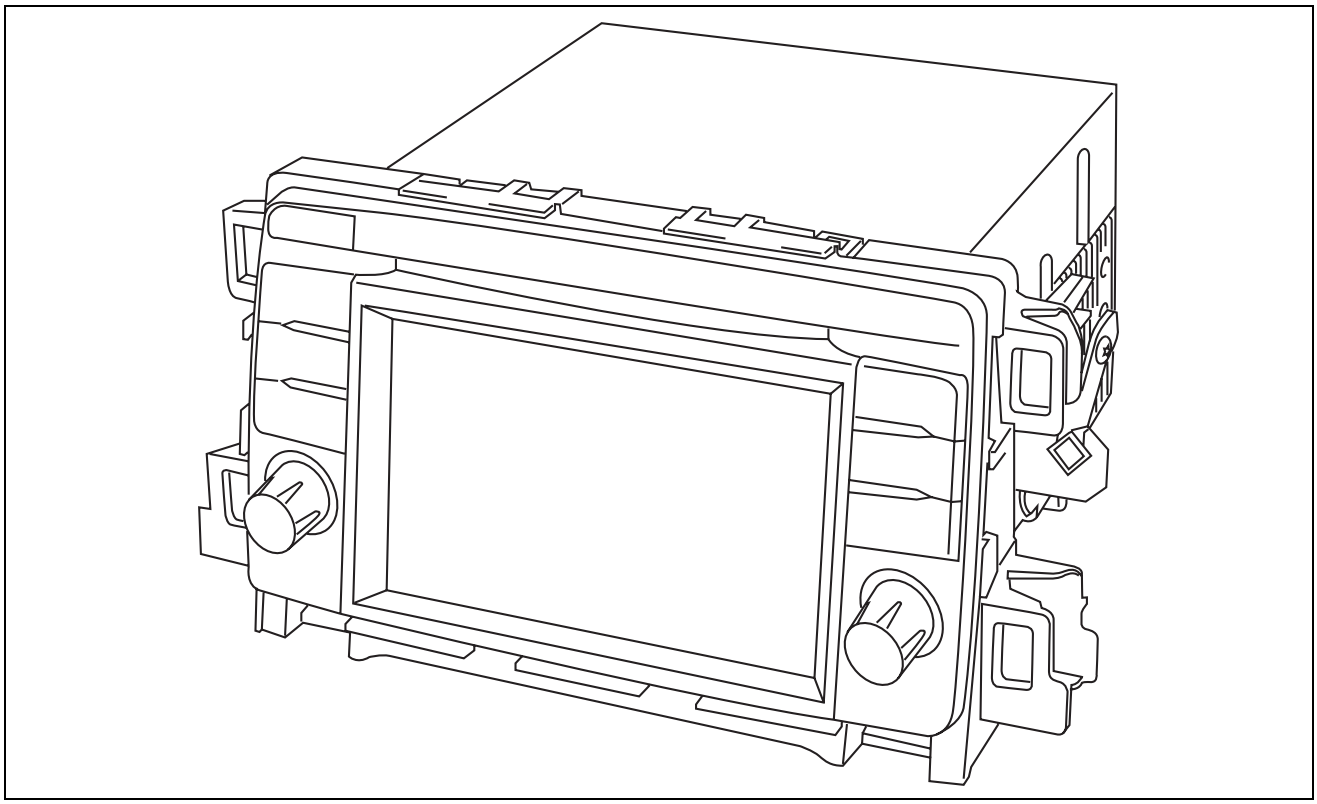
Item			Specification
Rated voltage		(V)	12
Frequency range	AM	(kHz)	531—1602 (European (L.H.D. U.K.) specs., General (L.H.D. R.H.D.)) 530—1620 (With AM frequency pitch: 5KHz pitch) 522—1629 (With AM frequency pitch: 9KHz pitch)
	FM	(MHz)	87.5—108
Amplifier maximum output		(W)	With Bose ®: 264 (external audio amplifier) Without Bose®: 25×4
Output impedance		(ohm)	4
Display	Size	(inches)	480×272 (5.8)
	Type		TFT *(Thin Film Transistor): Full-color

* : Short for Thin Film Transistor Used a lot with color LCDs.

Construction

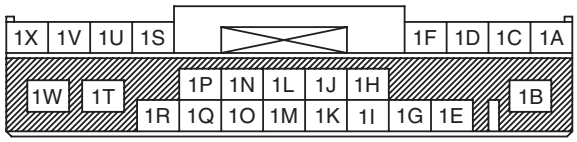
- An audio unit with AM/FM tuner/MP3/WMA (Windows Media Audio) applicable CD player (type B) is assembled in the audio panel.

ENTERTAINMENT

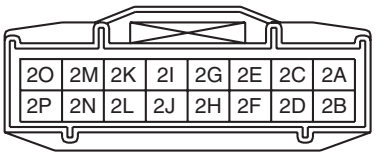
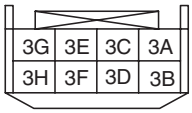
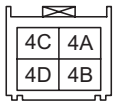
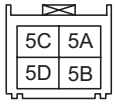
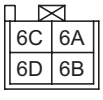


ac5jjn00000376

Terminal layout and signal
Audio unit

Terminal		Signal
	1A	Front door speaker LH (+)
	1B	B+
	1C	Front door speaker LH (-)
	1D	Front door speaker RH (+)
	1E	TNS (+)
	1F	Front door speaker RH (-)
	1G	TNS (–)
	1H	Steering switch3
	1I	Vehicle speed signal
	1J	Amplifier control *1
	1K	Parking brake signal
	1L	—
	1M	R position signal
	1N	Steering switch1
	1O	CAN_H
	1P	Steering switch2
	1Q	CAN_L
	1R	ACC
	1S	Rear door speaker LH (+)
	1T	AudioPilot®2 control *1
	1U	Rear door speaker LH (-)
	1V	Rear door speaker RH (+)
	1W	Power ground
	1X	Rear door speaker RH (-)

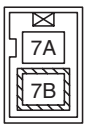
ENTERTAINMENT

Terminal		Signal
	2A	Bluetooth voice input RH (+)
	2B	Bluetooth voice input RH (-)
	2C	Bluetooth voice input LH (+)
	2D	Bluetooth voice input LH (-)
	2E	AUDIO voice input RH (+)
	2F	AUDIO voice input RH (-)
	2G	AUDIO voice input LH (+)
	2H	AUDIO voice input LH (-)
	2I	HS-CAN (+)
	2J	HS-CAN (-)
	2L	Microphone voice input (+)
	2N	Microphone voice input (-)
	2P	Microphone ground
	2R	Microphone power
	2T	Microphone connection detection
	2V	—
	2W	AUX connection detection
	2X	AUX signal LH RH (-)
	2Y	AUX signal RH (+)
	2Z	AUX signal LH (+)
	2AA	—
	2AB	—
	2AC	—
	2AD	—
	3A	CM-SW GND*2
	3B	CM-SW1*2
	3C	—
	3D	CM-SW3*2
	3E	Commander connection detection *2
	3F	CM-PH GND*2
	3G	CM-PH2*2
	3H	CM-PH2*2
	4A	USB GND
	4B	USB data communication (+)
	4C	USB power supply
	4D	USB data communication (-)
	5A	USB power supply
	5B	USB data communication (+)
	5C	USB GND
	5D	USB data communication (-)
	6A	Back camera power supply *3
	6B	Back camera power supply ground*3
	6C	Back camera image ground*3
	6D	Back camera power signal input *3

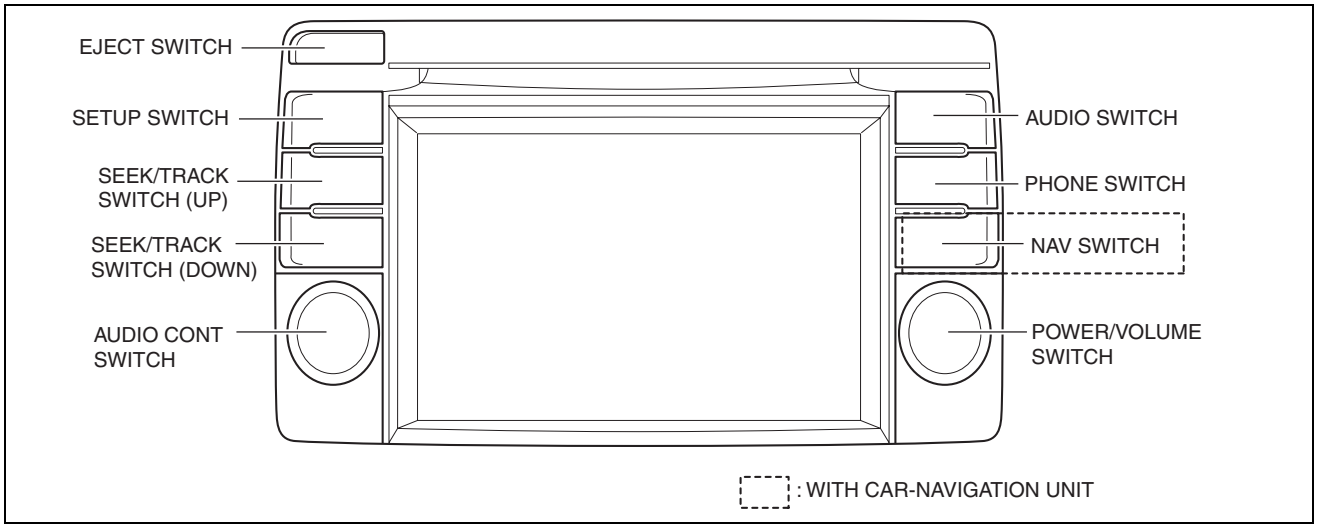
*1 : With Bose®
*2 : With commander switch
*3 : With rear mount camera

ENTERTAINMENT

Antenna feeder connector

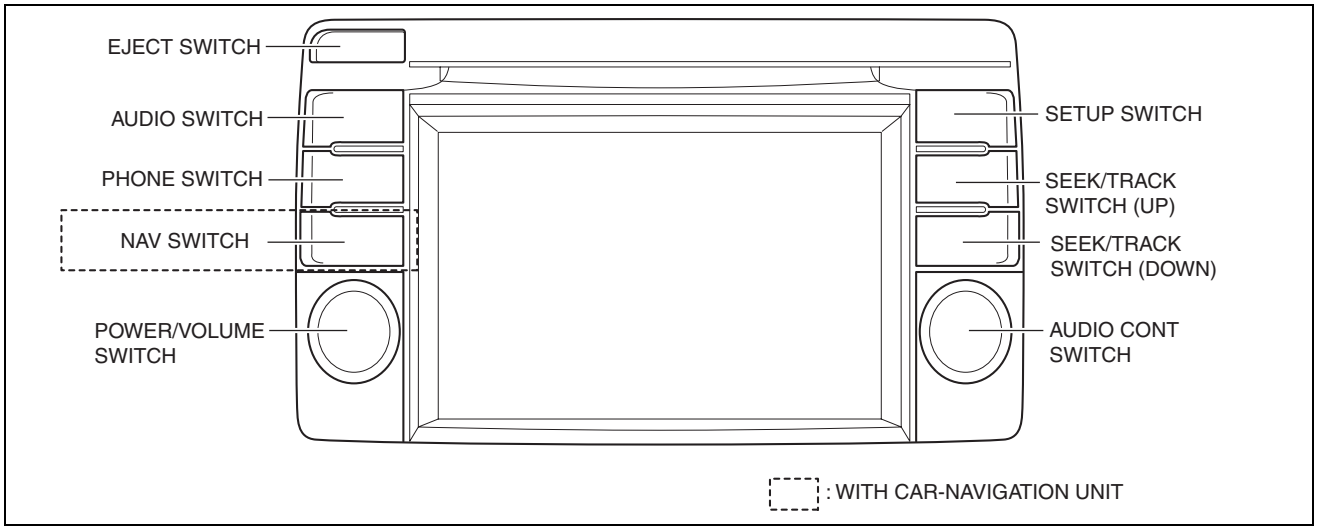
Terminal		Signal
	7A	Antenna control
	7B	Antenna

Switch location
With POWER/VOLUME switch on right side



ac5jjn00000621

With POWER/VOLUME switch on left side



ac5wzn00001479

Operation

- For the audio unit operation, refer to the 09-20-4 AUDIO SYSTEM.

User personalization

1. When a panel switch on the audio unit or the SETUP switch on the commander switch is pressed, the system switches to SETUP mode.
2. When the vehicle button on the SETUP mode screen displayed in the audio unit display is pressed, the system names which can be set are displayed in the audio unit display.
3. The audio unit sends the personalization feature change information set by the user to the each control system (Start stop unit, rear body control module (RBCM), FSC) via CAN communication.
4. When each control system (Start stop unit, rear body control module (RBCM), FSC) receive the personalization feature change information, each personalization feature setting is changed according to the change information.

ENTERTAINMENT

Note
- Refer to the Personalization Features for details on the method for setting the personalization features.

Fail-safe
- Function not equipped.

SPEAKER [WITHOUT Bose®]

id092000110400

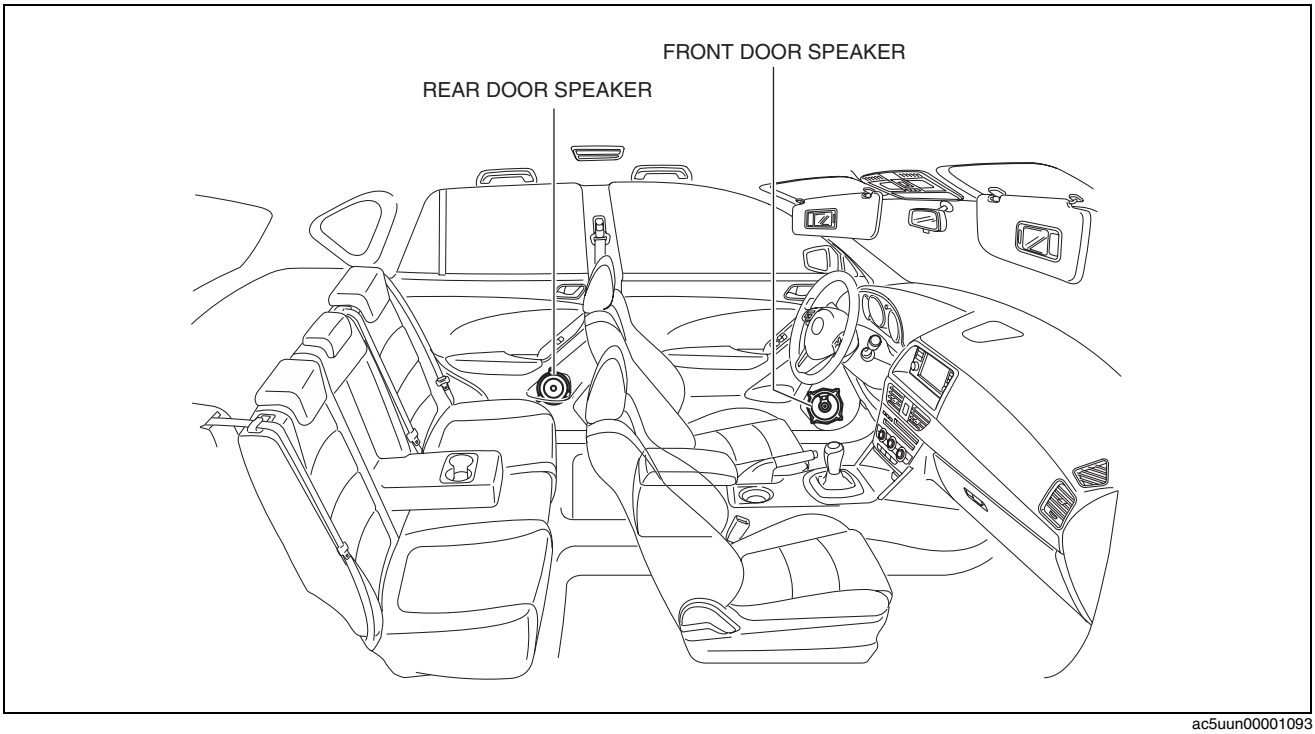
Purpose
- Converts the audio signal from the audio unit to sound.

Function
- Full-range speakers, which can output wide-range sound from low to high frequency, have been adopted.

Specification

Item		Front door speaker	Rear speaker	Tweeter
Rated input	(W)	10	10	10
Max. input	(W)	25	25	25
Rated impedance	(ohm)	3.4 — 4.6	3.4 — 4.6	3.4 — 4.6
Size	(mm {in})	165 {6.5} (229 {9})	165 {6.5}	30 {1}

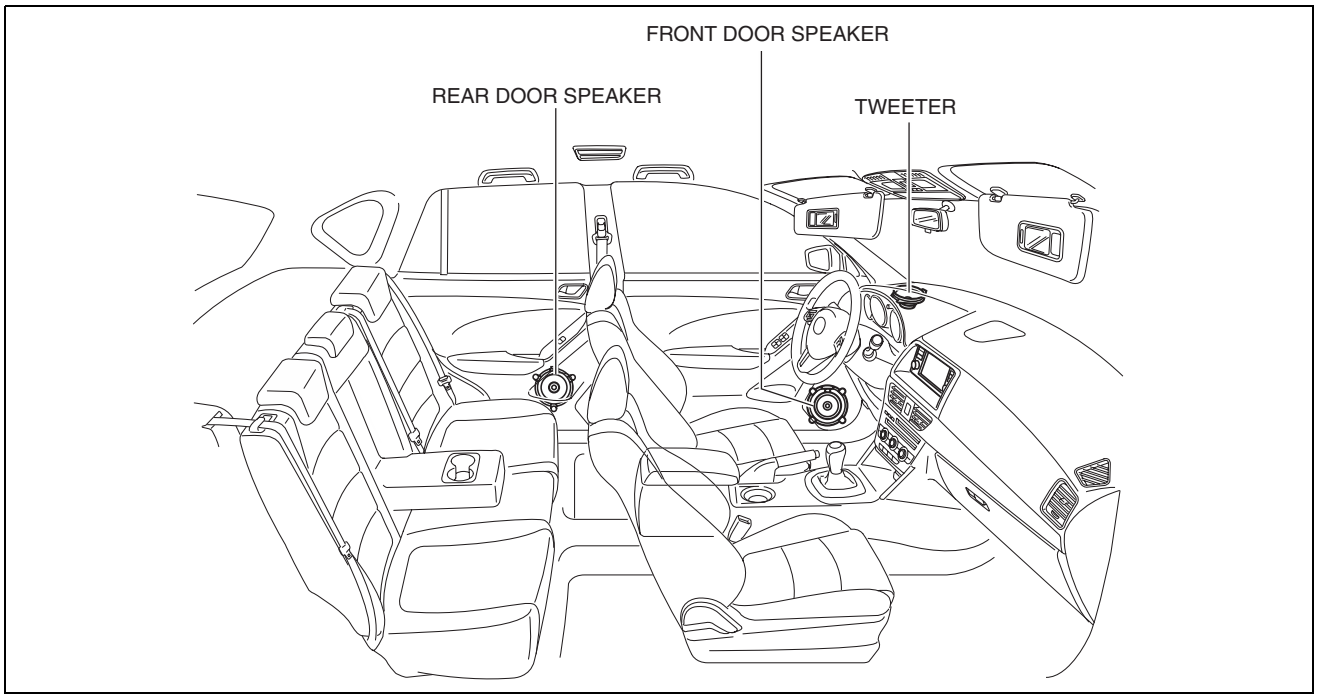
Construction
4 speaker type
- A cone-shaped dynamic speaker has been adopted for each speaker.
- Pulp for the cone material and a neodymium magnet have been adopted.



ac5uun00001093

6 speaker type
- A cone-shaped dynamic speaker has been adopted for each speaker.

ENTERTAINMENT

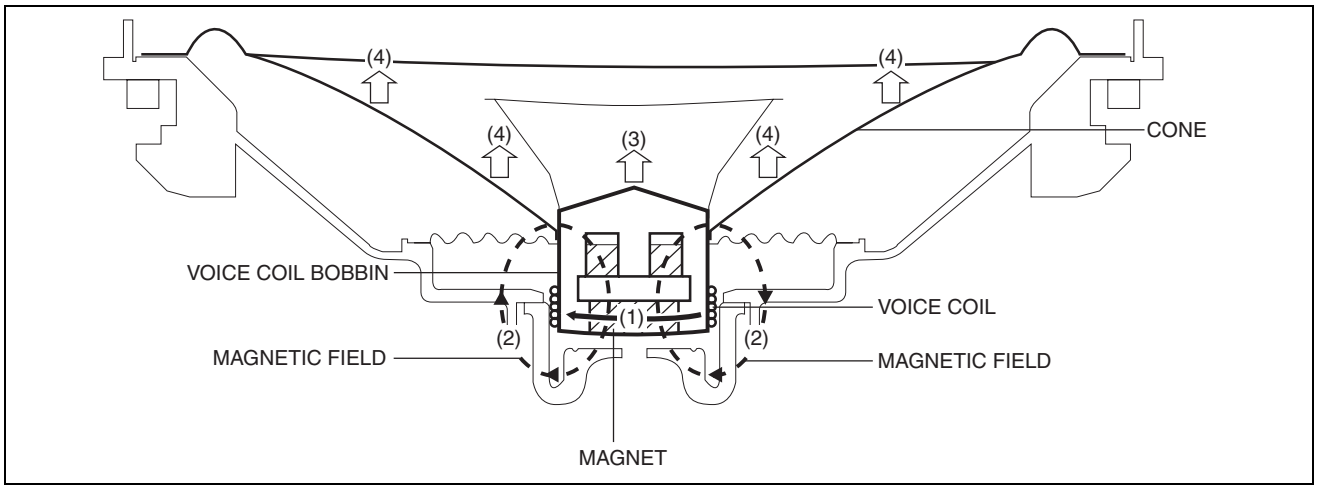


ac5uun00001094

- Front door speaker/rear door speaker
  — Pulp for the cone material and a neodymium magnet have been adopted.
- Tweeter
  — Polyethylene naphthalene for the cone material and a strontium ferrite magnet have been adopted.

Operation

1. The speaker sends the audio signal (current) from the audio unit to the voice coil.
2. When the audio signal (current) is sent to the voice coil, the coil becomes magnetized and a magnetic field occurs. Because the voice coil and the magnet pull and repel each other in the magnetic field, the voice coil vibrates.
3. Because the voice coil is wrapped around the voice coil bobbin, the voice coil bobbin vibrates when the voice coil vibrates.
4. When the voice coil bobbin vibrates, the cone (diaphragm) installed to the voice coil bobbin vibrates and generates sound.



am5ezn0000129

Fail-safe

- Function not equipped.

ENTERTAINMENT

SPEAKER [WITH Bose®]

id092000110500

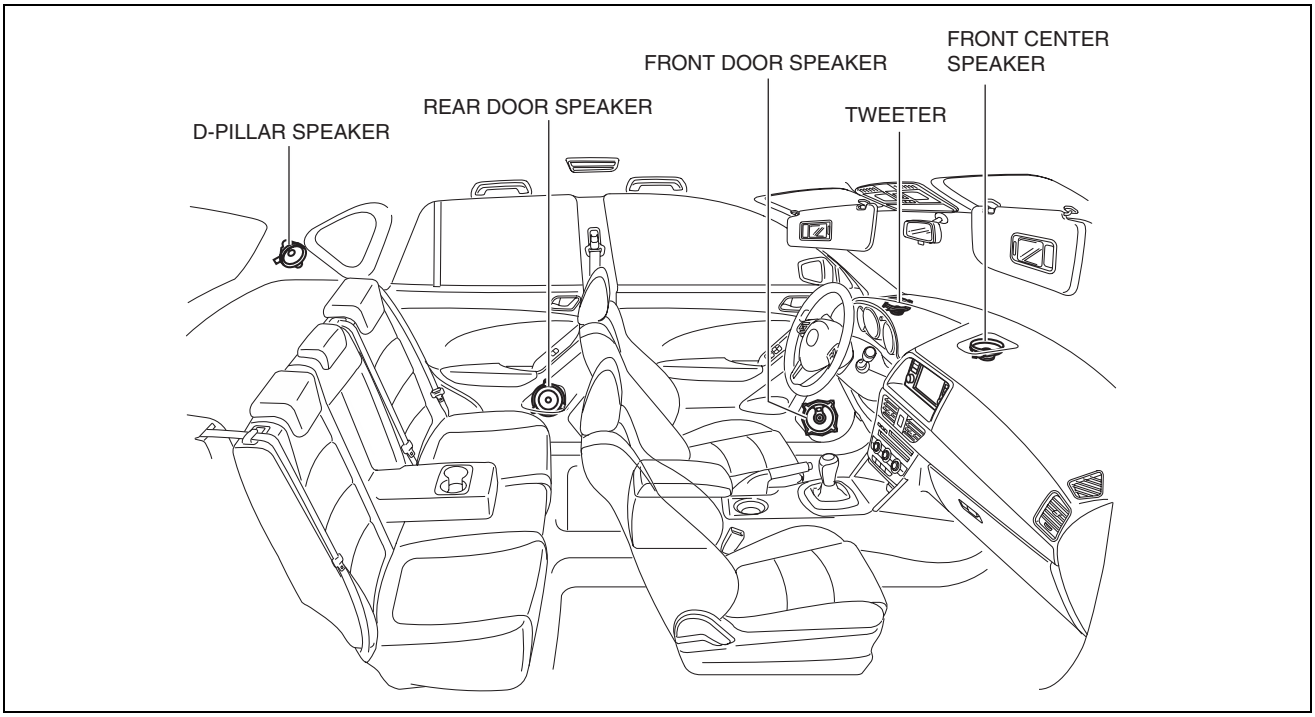
Purpose
- Converts the audio signal from the audio unit to sound.
- High quality sound is provided for the driver and passengers.

Function
- Full-range speakers, which can output wide-range sound from low to high frequency, have been adopted.
- A better sound effect and clear sound have been realized by using tweeters (speaker for upper register sound range) which differ the range of the output sound and woofer (speaker for lower register sound range).

Specification

Item		Front door speaker	Rear speaker	Tweeter	Front center speaker	D-pillar speaker
Rated impedance	(ohm)	1.25	3.7	3.24 — 3.96	3.24 — 3.96	3.24 — 3.96
Size	(cm {in})	22.5 {8.86}	13.3 {5.25}	8 {3}	8 {3}	8 {3}

Construction
- A cone-shaped dynamic speaker has been adopted for each speaker.
- Pulp for the cone material and a neodymium magnet have been adopted.



ac5uun00000898

- A better sound effect is achieved by the use of speakers which differ the range of the output sound.
  - — Front door speaker (speaker for deep bass sound range)
  - — Rear door speaker (speaker for all sound ranges)
  - — Tweeter (speaker for medium-to-high-sound range)
  - — Front center speaker (speaker for medium-to-high-sound range)
  - — D-pillar speaker (speaker for medium-to-high-sound range)

Operation
- For the speaker operation, refer to the 09-20-31 SPEAKER [WITHOUT Bose®].

Fail-safe
- Function not equipped.

AUDIO AMPLIFIER

id092000011200

Purpose, Function
- The audio signal (analog voltage waveform) output from the unit equipped on the vehicle is converted into a digital pulse. The converted digital pulse signal is amplified and sent to the speakers.

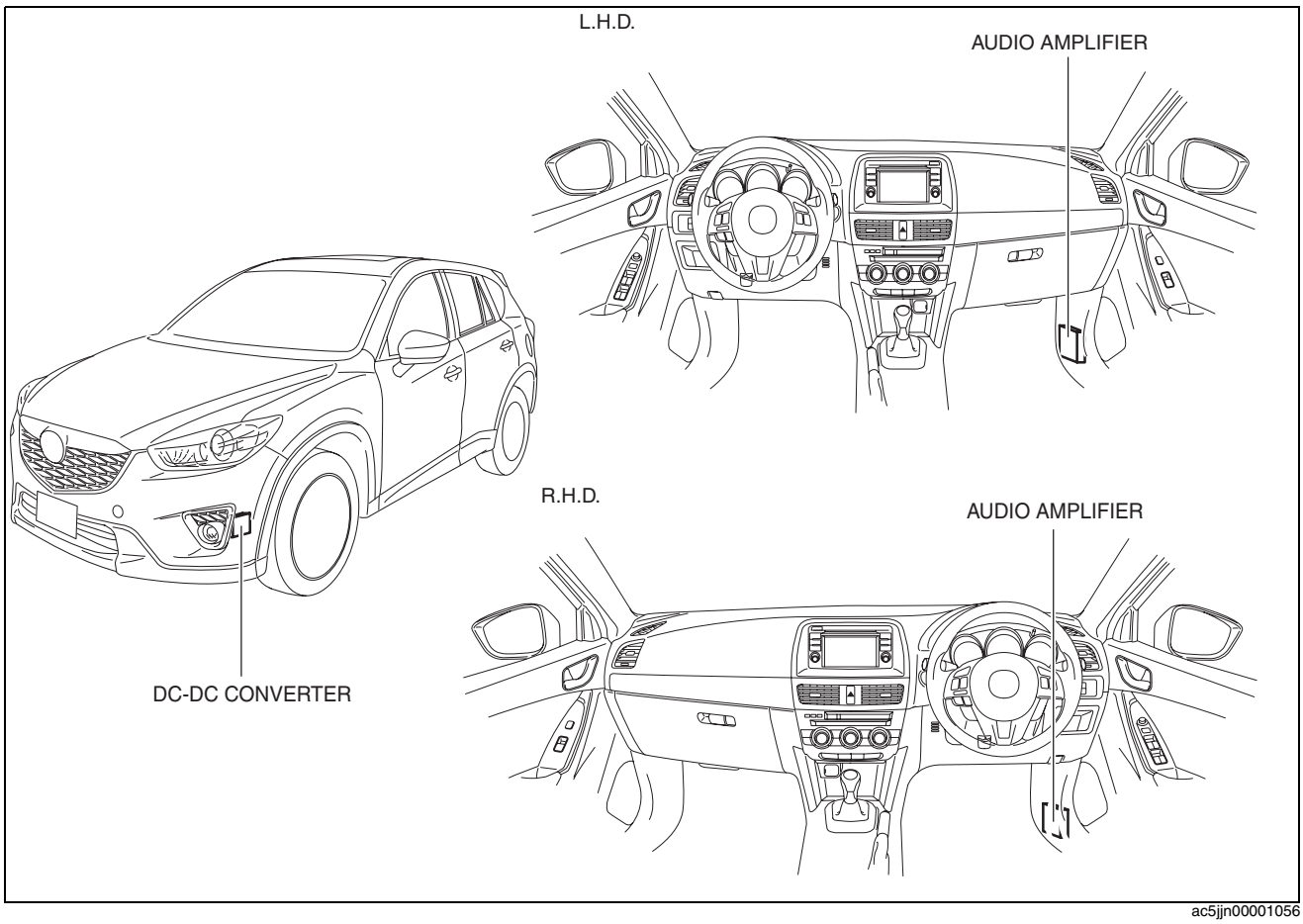
ENTERTAINMENT

Function

- When the audio amplifier receives a voltage increase request signal from the PCM, output current to the speakers is controlled at 10 A or less to assure input voltage to the DC-DC converter when the engine is re-started by the i-stop control. (With i-stop system)

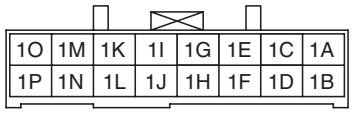
Construction

- The audio amplifier is placed in the front side trim (RH).

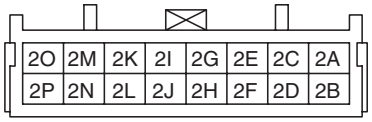
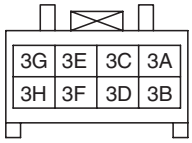


ac5jjn00001056

Terminal Layout and Signal
L.H.D.

Terminal		Signal
	1A	—
	1B	—
	1C	—
	1D	—
	1E	Front door speaker input LH (-)
	1F	Front door speaker input LH (+)
	1G	Front door speaker input RH (-)
	1H	Front door speaker input RH (+)
	1I	Rear door speaker input LH (-)
	1J	Rear door speaker input LH (+)
	1K	Rear door speaker input RH (-)
	1L	Rear door speaker input RH (+)
	1M	—
	1N	—
	1O	AudioPilot ®2 microphone (+)
	1P	AudioPilot ®2 microphone (-)

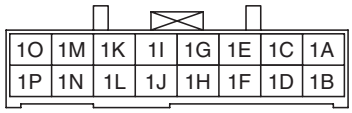
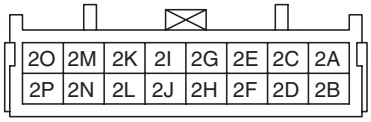
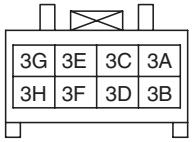
ENTERTAINMENT

Terminal		Signal
	2A	D-pillar speaker (+)
	2B	D-pillar speaker (-)
	2C	Tweeter input RH (+)
	2D	Body select
	2E	Tweeter input RH(-)
	2F	AMP control (SW B+)
	2G	Tweeter input LH (-)
	2H	Vehicle speed signal
	2I	Tweeter input LH (+)
	2J	AudioPilot ®2
	2K	Rear door speaker output RH (-)
	2L	i-stop control*
	2M	Rear door speaker output RH (+)
	2N	—
	2O	Rear door speaker output LH (+)
	2P	Rear door speaker output LH (-)
	3A	B+
	3B	Ground
	3C	Front door speaker output RH (+)
	3D	Front door speaker output RH (-)
	3E	Front door speaker output LH (-)
	3F	Front door speaker output LH (-)
	3G	Front door speaker (+)
	3H	Front door speaker (-)

* : With i-stop system

ENTERTAINMENT

R.H.D.

Terminal		Signal
	1A	—
	1B	—
	1C	—
	1D	—
	1E	Front door speaker input RH (-)
	1F	Front door speaker input RH (+)
	1G	Front door speaker input LH (-)
	1H	Front door speaker input LH (+)
	1I	Rear door speaker input RH (-)
	1J	Rear door speaker input RH (+)
	1K	Rear door speaker input LH (-)
	1L	Rear door speaker input LH (+)
	1M	—
	1N	—
	1O	AudioPilot ®2 microphone (+)
	1P	AudioPilot ®2 microphone (-)
	2A	D-pillar speaker (+)
	2B	D-pillar speaker (-)
	2C	Tweeter input LH (+)
	2D	Body select
	2E	Tweeter input LH(-)
	2F	AMP control (SW B+)
	2G	Tweeter input RH (-)
	2H	Vehicle speed signal
	2I	Tweeter input RH (+)
	2J	AudioPilot ®2
	2K	Rear door speaker output LH (-)
	2L	i-stop control
	2M	Rear door speaker output LH (+)
	2N	—
	2O	Rear door speaker output RH (+)
	2P	Rear door speakeroutput RH (-)
	3A	B+
	3B	Ground
	3C	Front door speaker output LH (+)
	3D	Front door speaker output LH (-)
	3E	Front door speaker output RH (-)
	3F	Front door speaker output RH (-)
	3G	Front door speaker (+)
	3H	Front door speaker (-)

Operation

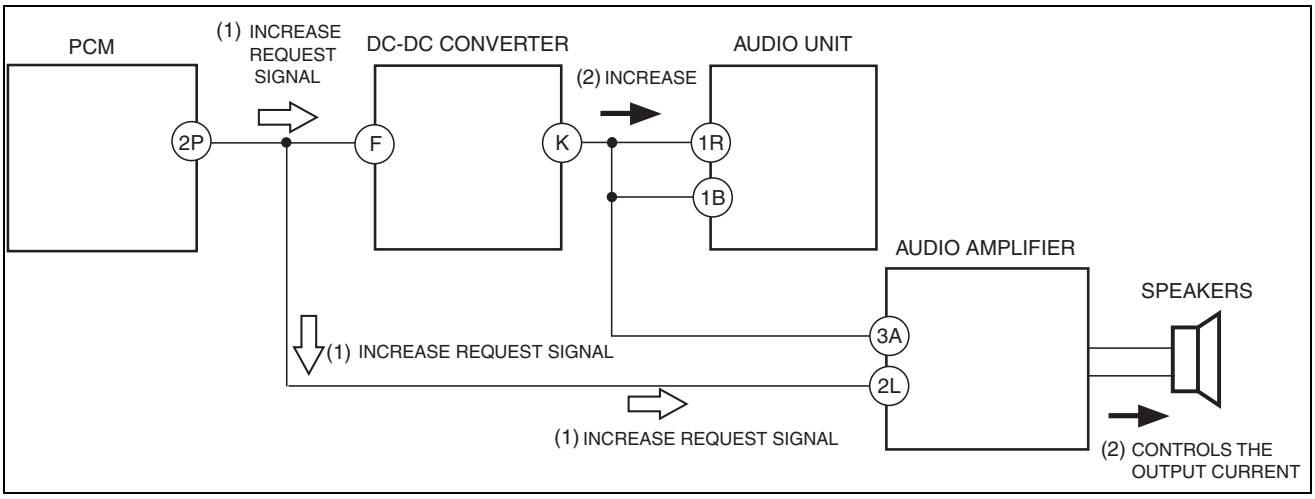
Note
- For the audio amplifier operation, refer to the 09-20-4 AUDIO SYSTEM.

Engine restart by i-stop (With i-stop system)

1. The PCM sends a boost request signal to the DC-DC converter and audio amplifier when the engine is restarted by the i-stop control.
2. The DC-DC converter increases the electric current voltage to the audio unit, and when the audio amplifier receives the increase request signal, it controls the output current to the speakers at 10 A or less.

Note
- If the audio amplifier performs current control when the audio volume is 50 or more, the audio volume may decrease for approx. 0.3 s.

ENTERTAINMENT



ac5wzn00000989

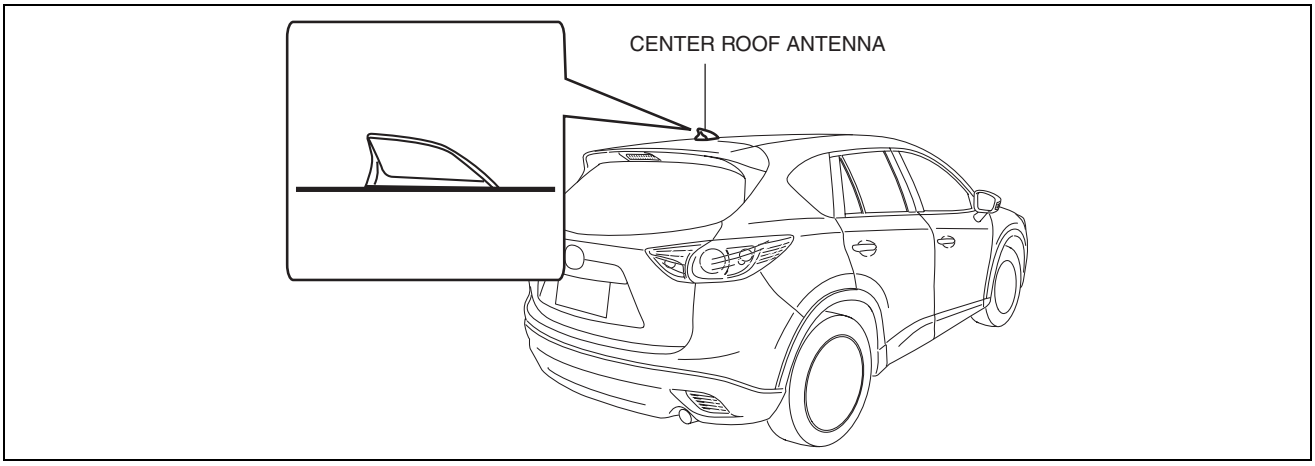
Fail-safe
- Function not equipped.

CENTER ROOF ANTENNA

id092000012000

Purpose, Function
- Converts radio broadcast waves to electric signals and sends the signals to the audio unit.

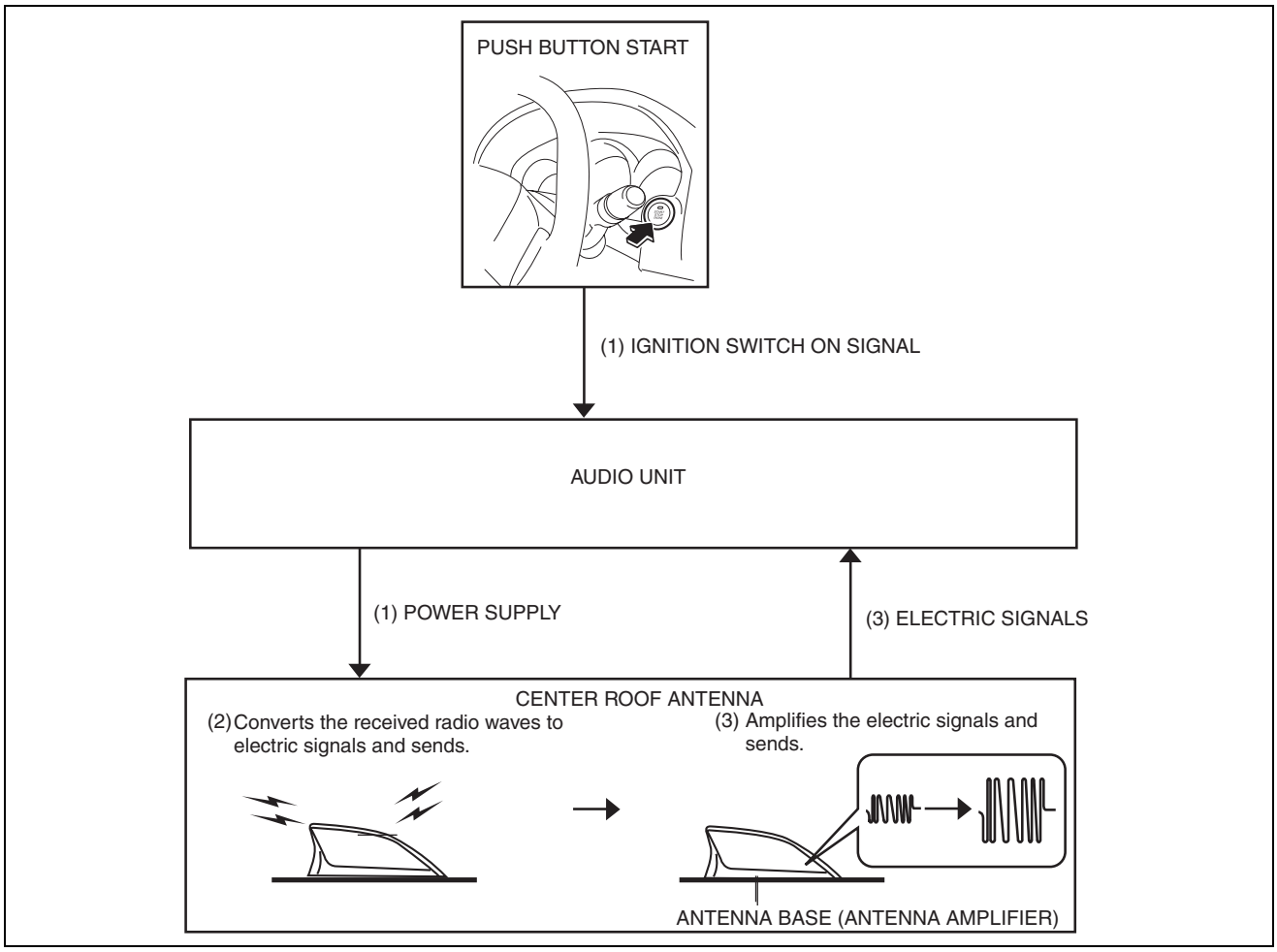
Construction
- A center roof antenna has been adopted which does not require retraction or removal before going through an automatic car wash machine.
- The center antenna has an integrated antenna amplifier which amplifies the electric signal.



ac5wzn00000581

Operation
1. When the ignition is switched to ACC or ON (engine off or on), power is supplied from the audio unit to the antenna amplifier inside the center roof antenna.
2. The center roof antenna converts the received radio waves of a radio broadcast to an electric signal.
3. The center roof antenna amplifies the converted electric signal using the antenna amplifier and sends the signal to the audio unit.

ENTERTAINMENT



ac5wzn00000582

Fail-safe
- Function not equipped.

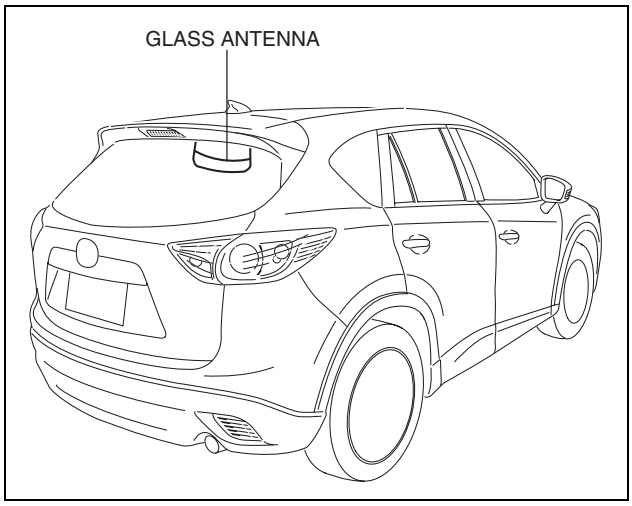
GLASS ANTENNA

id092000012100

Purpose, Function
- The RDS (Radio Data System) converts radio broadcast waves to electric signals and sends the signals to the audio unit.

Construction
- An antenna with excellent noise resistance has been adopted to the rear window glass.

ENTERTAINMENT



ac5wzn00000908

Fail-safe
- Function not equipped.

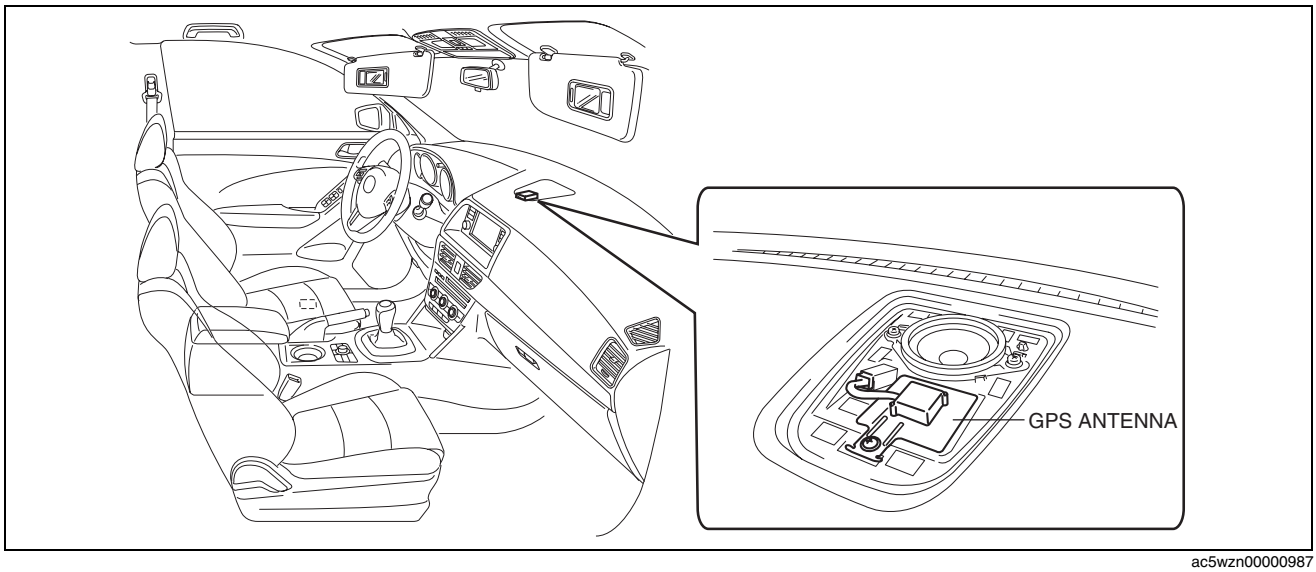
GLOBAL POSITIONING SYSTEM (GPS) ANTENNA

id092000012500

Purpose, Function
- The GPS antenna receives signals sent from GPS satellites and sends them to the car navigation unit.

Note
- GPS (Global Positioning System) was developed by the Pentagon (U.S.A.) as an object locating system using satellites. The GPS antenna receives signals from several of the satellites orbiting at an altitude of approx. 21, 000 {13,049 mile} km to detect the current position of the vehicle.

Construction
- The GPS antenna is installed inside the center part of the instrument panel.



ac5wzn00000987

Fail-safe
- Function not equipped

STEERING SWITCH

id092000010500

Purpose, Function
- Operation of the audio system and change of the trip computer system display are possible without a change in driving posture.

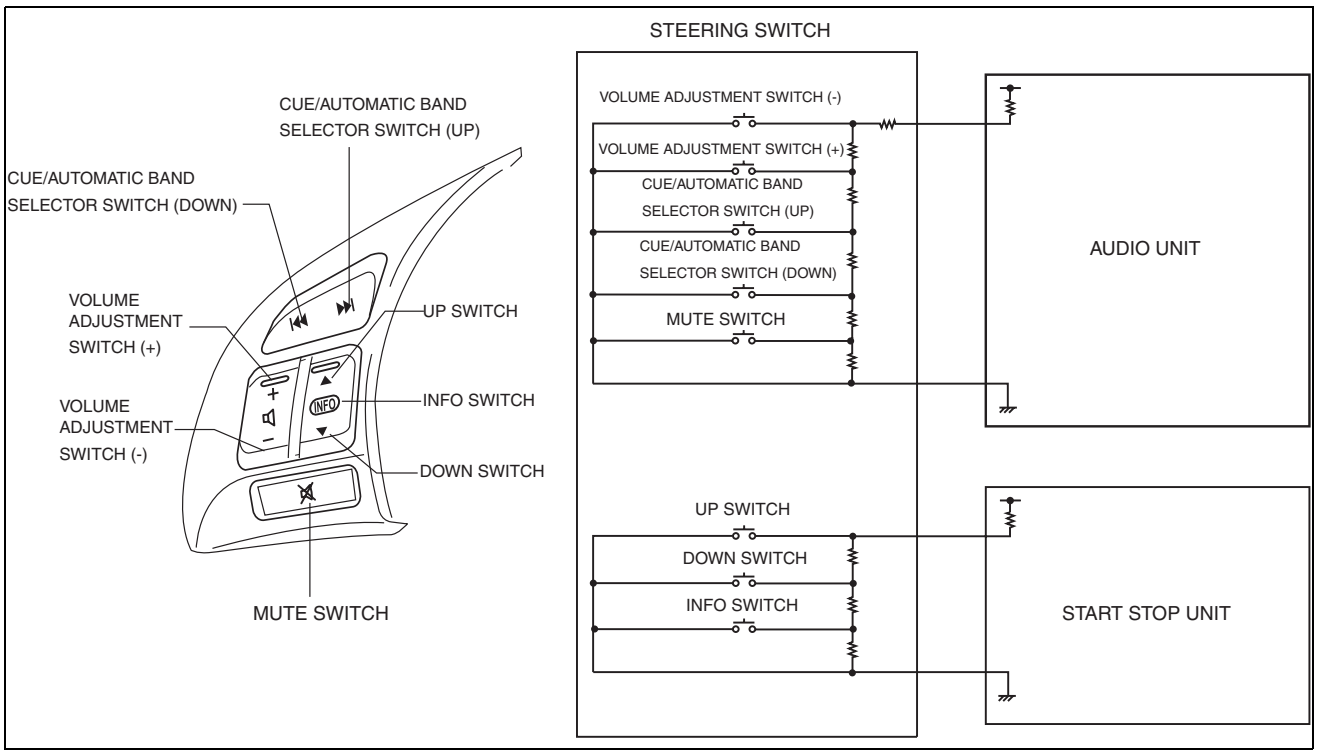
ENTERTAINMENT

Construction

- The steering switch is located on the spoke of the steering wheel.
- The resistance is built into each switch.

Without Bluetooth system

- The steering switch consists of a volume adjustment (+) or (-) switch, cue/automatic band selector (up) or (down) switch, INFO switch, up switch, down switch, and mute switch.

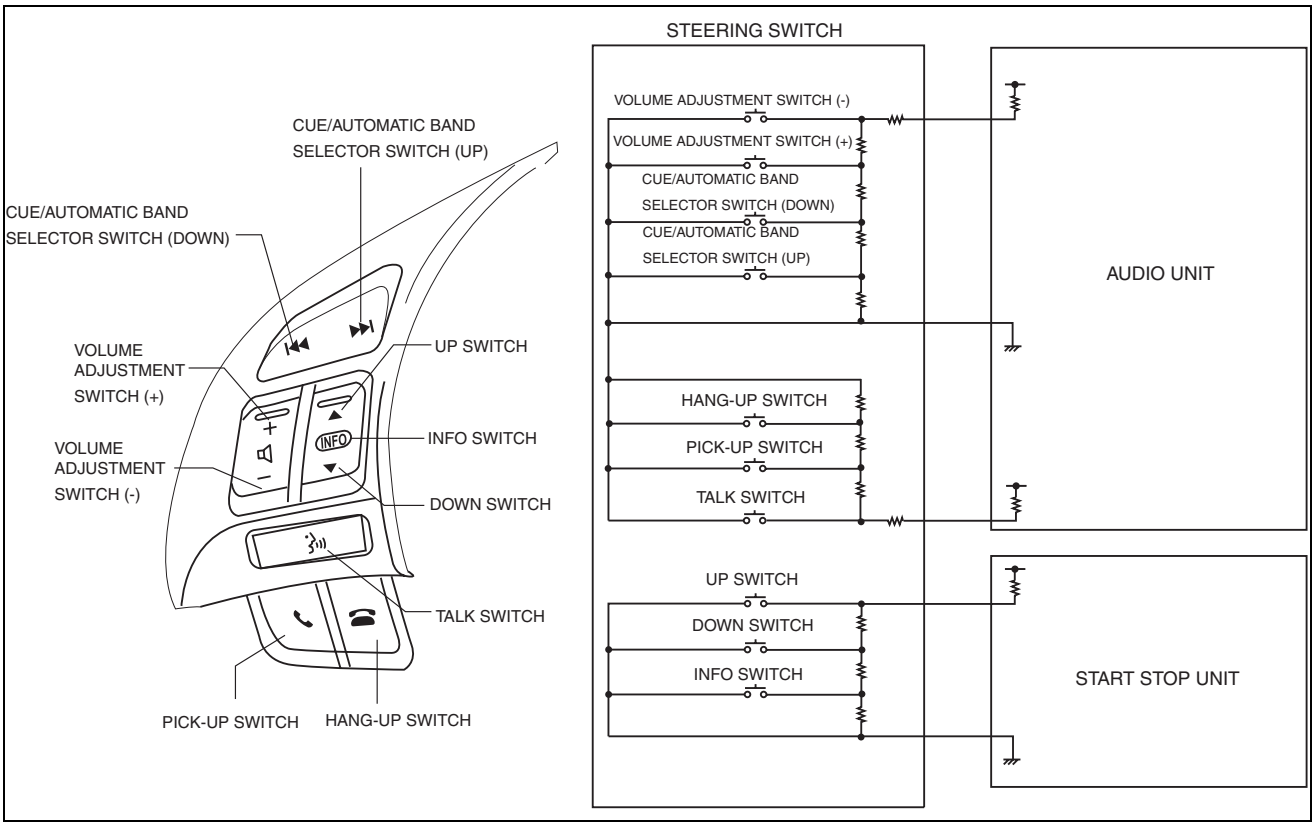


ac5wzn00001912

With Bluetooth system

- The steering switch consists of a volume adjustment (+) or (-) switch, cue/automatic band selector (up) or (down) switch, INFO switch, up switch, down switch, TALK switch, PICK-UP switch, and HANG-UP switch.

ENTERTAINMENT



ac5wzn00001913

Operation

Switch name	Operation
Volume adjustment switch	Audio volume can be adjusted.
Cue/Automatic band selector switch	Cue of CD tracks and selection of radio band are possible.
Mute switch (Without Bluetooth system)	Audio volume can be muted. Pressing again after muting returns to previous volume level.
INFO switch	Trip computer information system display can be changed. Refer to 09-22-56 TRIP COMPUTER INFORMATION SYSTEM for display content.
Up/down switch	Trip computer information system display can be changed. Refer to 09-22-56 TRIP COMPUTER INFORMATION SYSTEM for display content.
TALK switch (With Bluetooth system)	Launches the Bluetooth system.
Pick-up switch (With Bluetooth system)	Receives a phone call.
Hang-up switch (With Bluetooth system)	Hangs up a phone call.

Fail-safe

- Function not equipped.

COMMANDER SWITCH

id092000012300

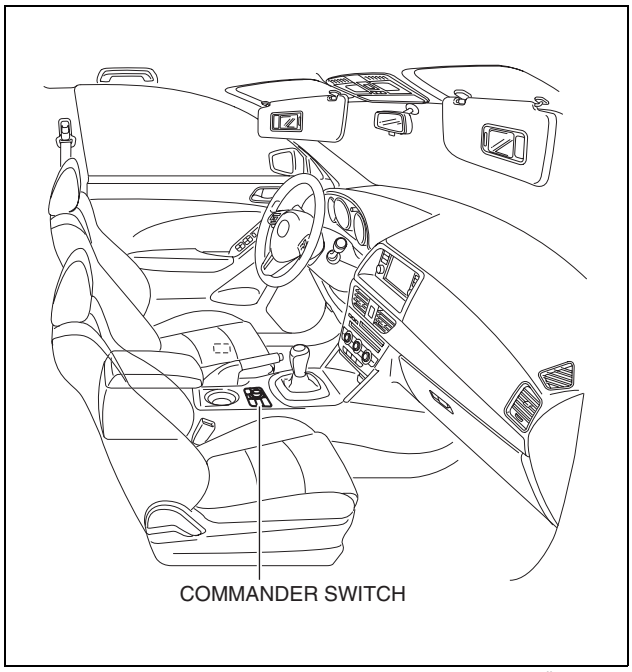
Purpose, Function

- The audio unit can be operated without having to change the driving posture.

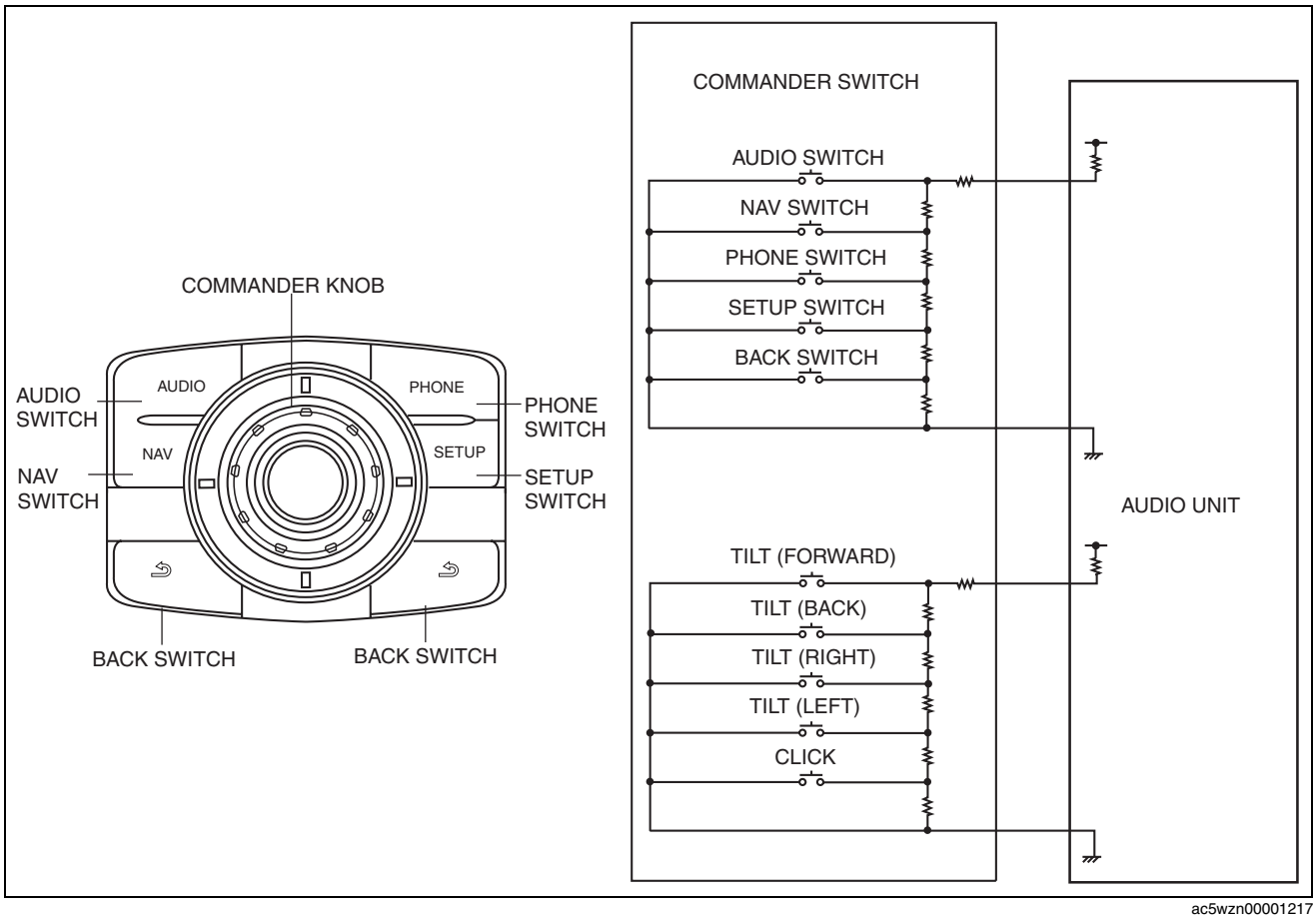
ENTERTAINMENT

Structure

- Installed to the center of the rear console.
- The commander switch consists of the AUDIO switch, NAV switch, PHONE switch, SETUP switch, BACK switch, and the commander knob.



ac5jjn00000654



ac5wzn00001217

Operation

Switch name	Operation
AUDIO switch	Switches to the audio screen. After changing to the audio screen, the display content does not change even if the switch is pressed down again.

ENTERTAINMENT

Switch name	Operation
NAV switch	Switches to the car navigation screen. After changing to the car navigation screen, the display content does not change even if the switch is pressed down again.
PHONE switch	Switches to the dial screen. After changing to the dial screen, the display content does not change even if the switch is pressed down again.
SETUP switch	Switches to the display screen. After changing to the display screen, the display content does not change even if the switch is pressed down again.
BACK switch	**When BACK switch icon is displayed on screen** • When “BACK” is displayed beside the icon, switches the screen to one-level upper tier. When “Now Playing” or “Listening” is displayed beside the icon, switches to the main screen. **When BACK switch icon is not displayed on screen** • Switches the screen to one-level upper tier. If at the top tier, the display content does not change even if the BACK switch is pressed down again.
Commander knob (tilt*1)	Moves the focus (selection area) of the buttons on the screen. Tilting the knob moves the focus between the areas. Tilt in lateral direction for left/right transit; tilt in longitudinal direction for forward/back transit.
Commander knob (rotation)	Moves the focus (selection area) of the buttons on the screen. Rotating the knob moves the focus within an area.
Commander knob (click*2)	Selects the button on the screen which the focus is on.

*1 : Moving of the commander knob forward/back, left/right.
*2 : Pressing down of the commander knob.

Fail-safe
- Function not equipped.

CAR-NAVIGATION SYSTEM

id092000011400

Outline
- The car navigation system displays point-of-origin and road guidance maps via the audio unit display and provides guidance and information to the desired point of destination.

  Note
  - For the car navigation system operation, refer to the owner's manual.

- A TomTom car navigation unit has been adopted.

Function
Navigation function
- Calculates route to destination, and provides guidance using the settings made by the user.
- The navigation system is a hybrid-type system which combines independent navigation and satellite navigation to provide highly accurate detection of the current position based on specialized map matching which identifies the current position by comparing the map information data read from the navigation map data on the SD card with the current position measured by the independent navigation and satellite navigation systems.

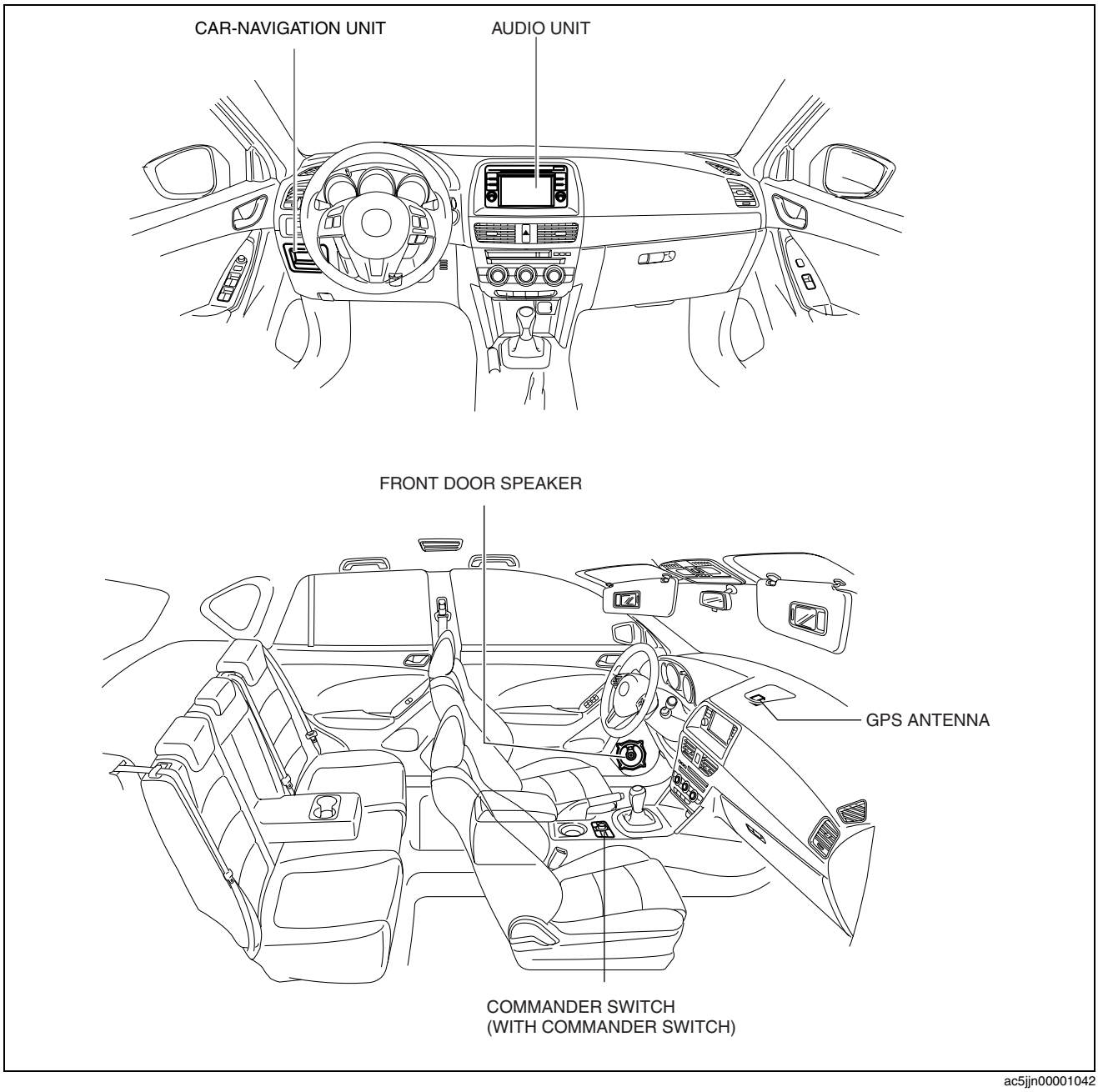
Map matching
- Map matching compares the road configurations of the map information data stored in the SD based on the current position information measured from independent navigation and satellite navigation, and corrects the current position to the most suitable map information data on the route.

Guidance
Display guidance
- The remaining distance to destination, branch points, and road names are indicated on the display.

Voice guidance
- Voice guidance is provided for destination, distance to branch point and heading. The voice guidance is output from the speakers equipped on the vehicle.

Structural view
- The car navigation system consists of the car navigation unit, audio unit, command switch, GPS antenna, voice recognition microphone, and speakers.

ENTERTAINMENT



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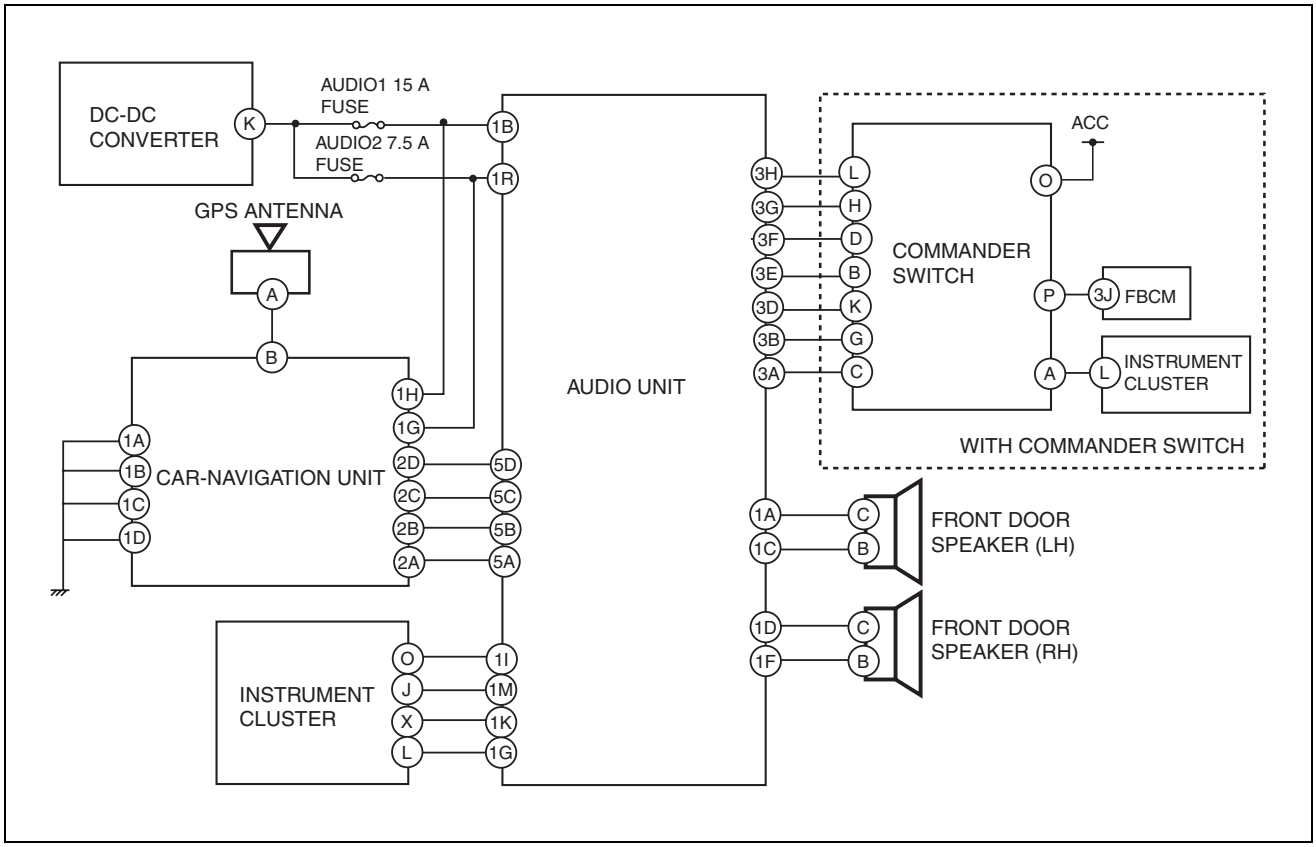
ENTERTAINMENT

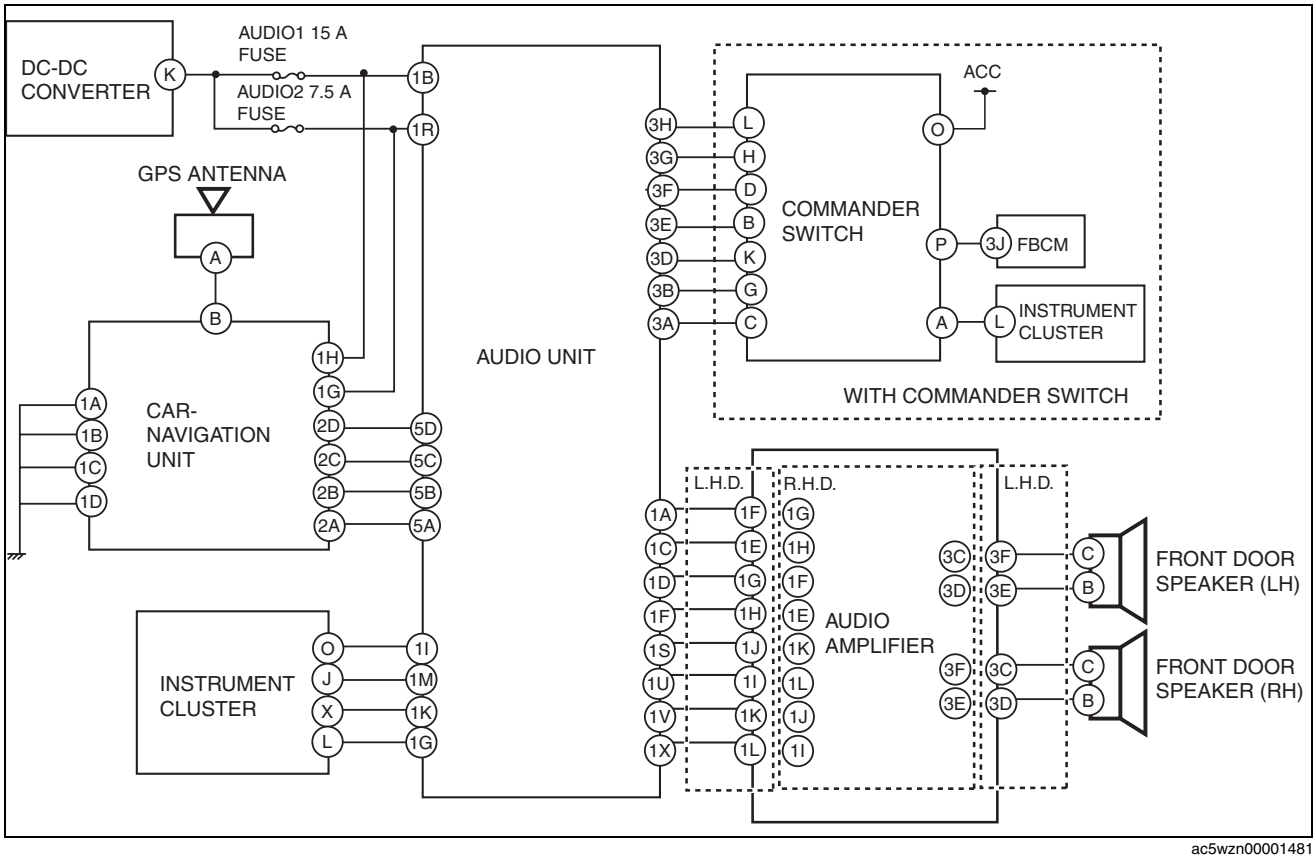
Block diagram

Without Bose®



ac5wzn00001480

With Bose®



ac5wzn00001481

ENTERTAINMENT

Operation

1. Reads the SD card map data inserted into the car-navigation unit and sends the read data to the audio unit.
2. When the audio unit NAV switch or the NAV switch on the commander switch is pressed, the system switches to NAVI mode and the navigation screen is displayed in the audio unit display.
3. The car navigation unit is a hybrid-type system which combines independent navigation with satellite navigation, calculates position information and route and arrival time to the destination, and displays it in the audio unit display.

Note

- For details on the car navigation system, refer to the owner's manual.

CAR-NAVIGATION UNIT

id092000011500

Purpose

- Reads the SD card data inserted into the car-navigation unit and sends the read data to the audio unit.

Function

- The car-navigation unit has the following functions:

TomTom Home

- By connecting the SD card to your computer at home, the map data or software can be updated by the user.

LIVE Service

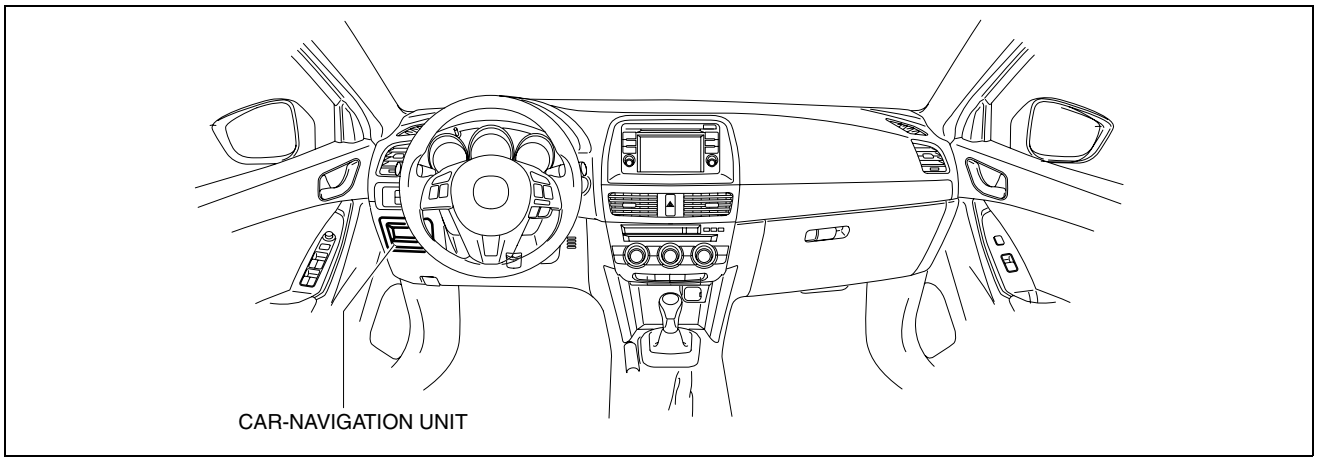
Note

- Can be used when the TomTom Live servise is contracted.

- HD traffic™
- Safety alerts
- Local search
- Weather forecast

Construction

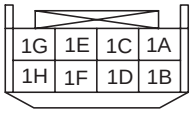
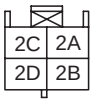
- The car-navigation unit is installed to the driver-side lower panel.
- The panel is integrated with the unit.



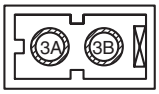
ac5jjn00001038

ENTERTAINMENT

Terminal layout and signal
Antenna feeder connector

Terminal		Signal
	1A	Ground
	1B	Ground
	1C	Ground
	1D	Ground
	1E	—
	1F	—
	1G	ACC
	1H	B+
	2A	USB power
	2B	USB data (+)
	2C	USB GND
	2D	USB data (+)

GPS/RDS-TMC antenna
Antenna feeder connector

Terminal		Signal
	3A	RDS-TMC
	3B	GPS

Operation
- For the car-navigation unit operation, refer to the 09-20-43 CAR-NAVIGATION SYSTEM

Fail-safe
- Function not equipped.

PARK ASSIST SYSTEM

id092000011000

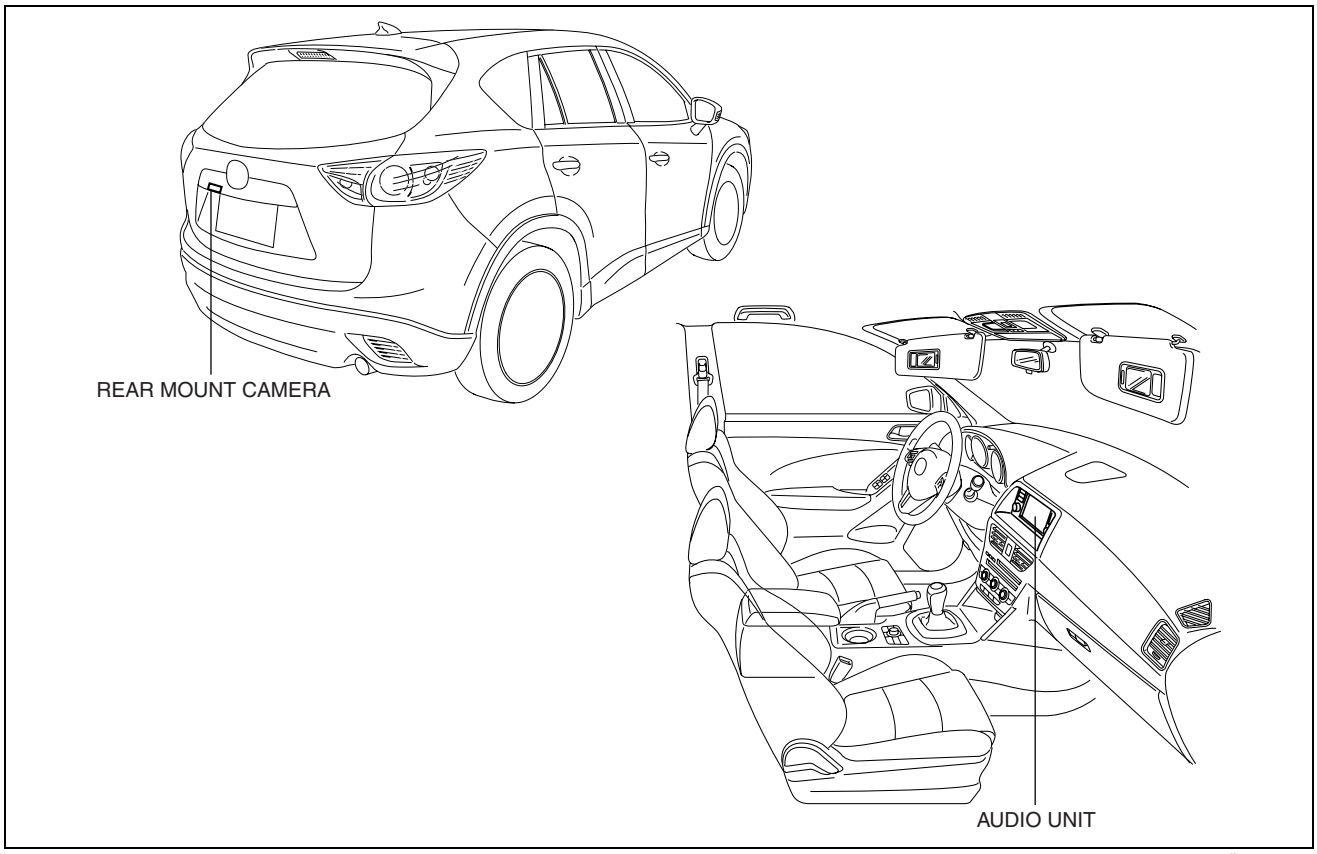
Outline
- When the vehicle is reversing, the rear view monitor camera installed to the liftgate displays the images at the rear of the vehicle in the audio unit display for verification of the presence of pedestrians and obstructions at the rear of the vehicle.

Function
Guide line display
- The images at the rear of the vehicle taken by rear view monitor camera and the guidelines are displayed in the audio unit display.

Predicted vehicle track display (European (L.H.D. U.K.) specs.)
- Displays the predicted vehicle track relative to the movement of the steering wheel and the images at the rear of the vehicle taken by rear view monitor camera.

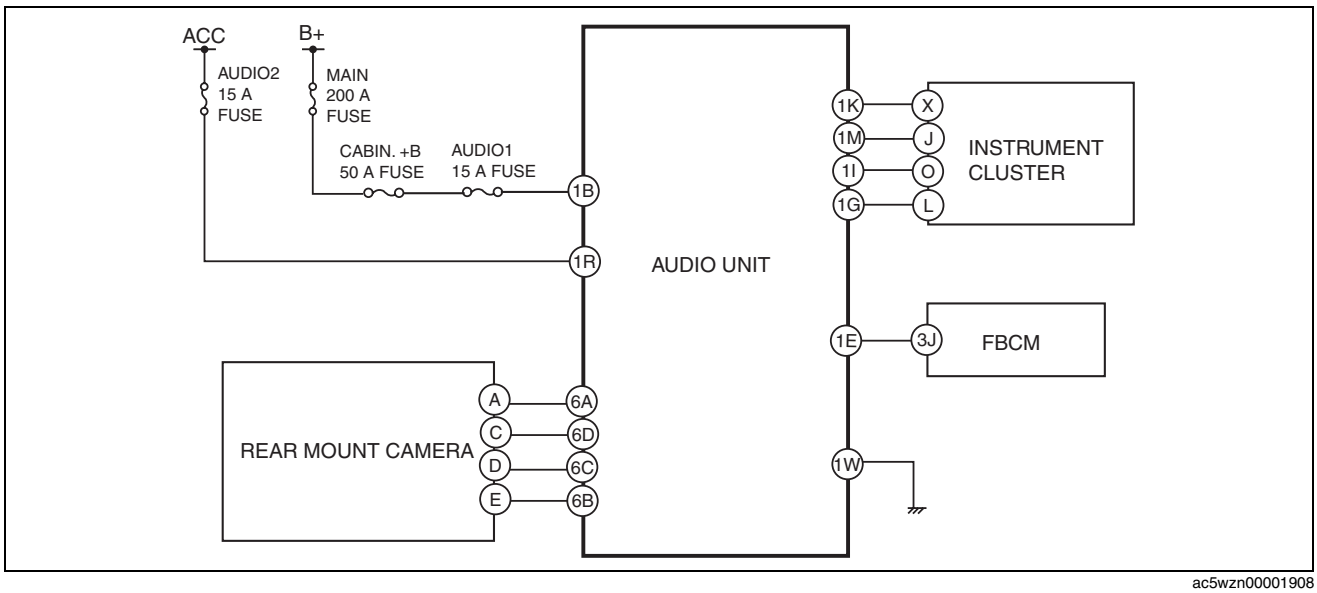
ENTERTAINMENT

Structural view



ac5jjn00001043

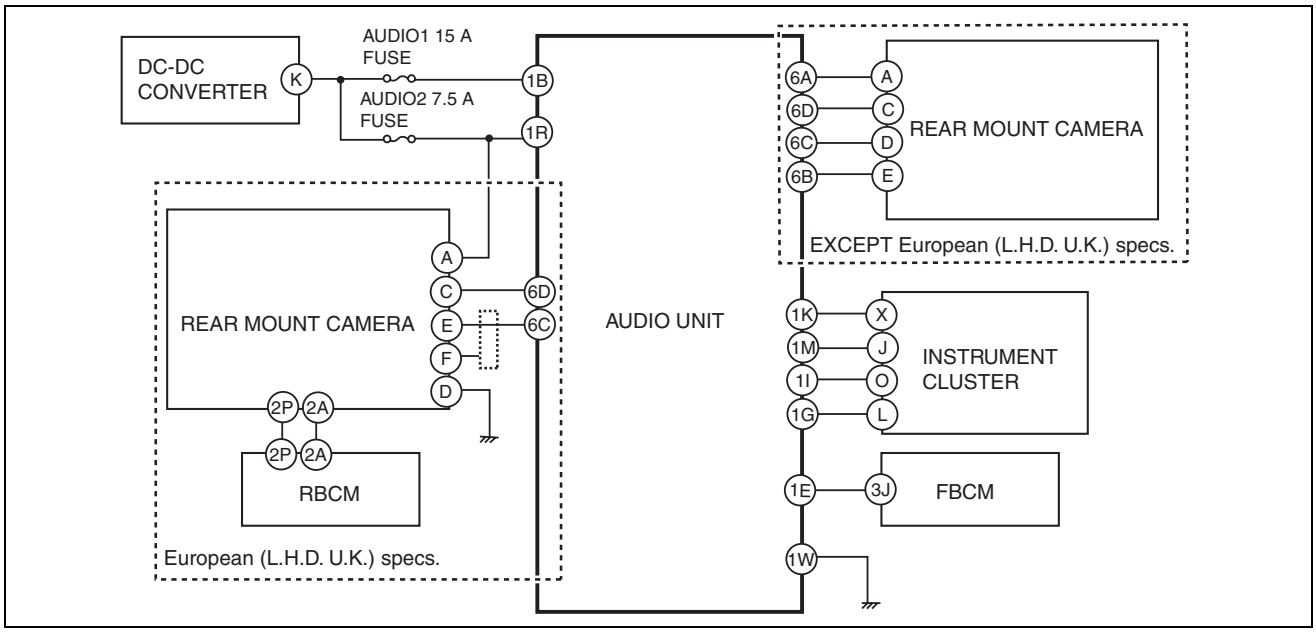
Block diagram
Without i-stop system



ac5wzn00001908

ENTERTAINMENT

With i-stop system

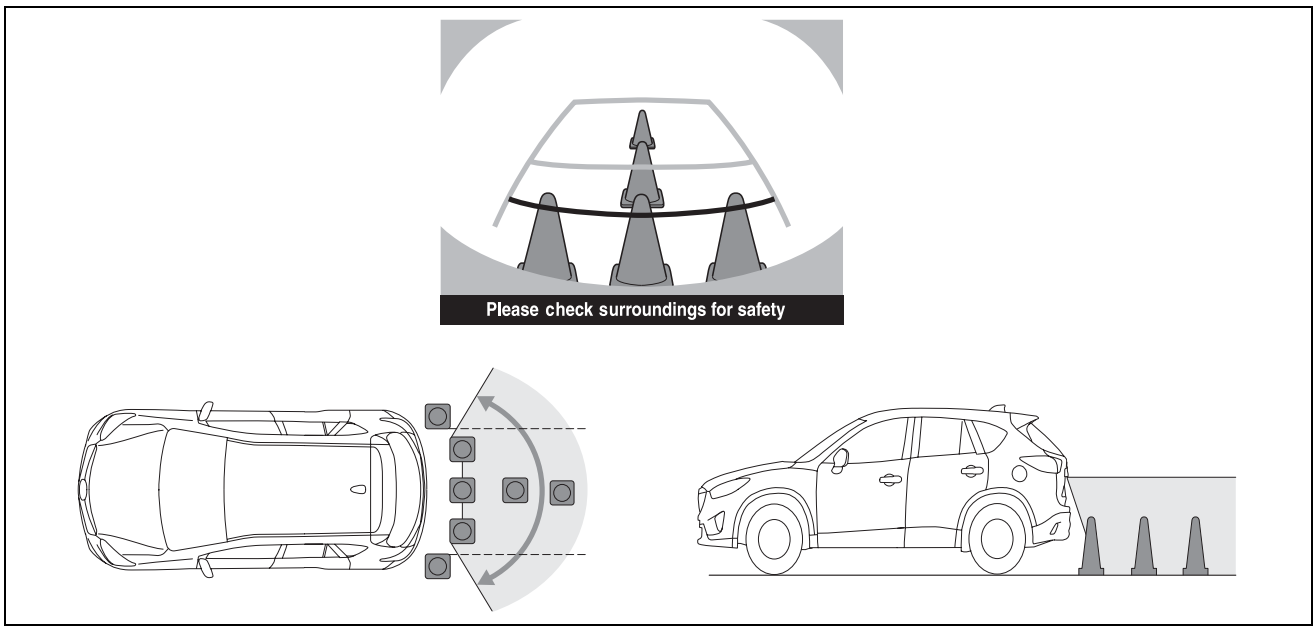


ac5wzn00001075

Image range

Note

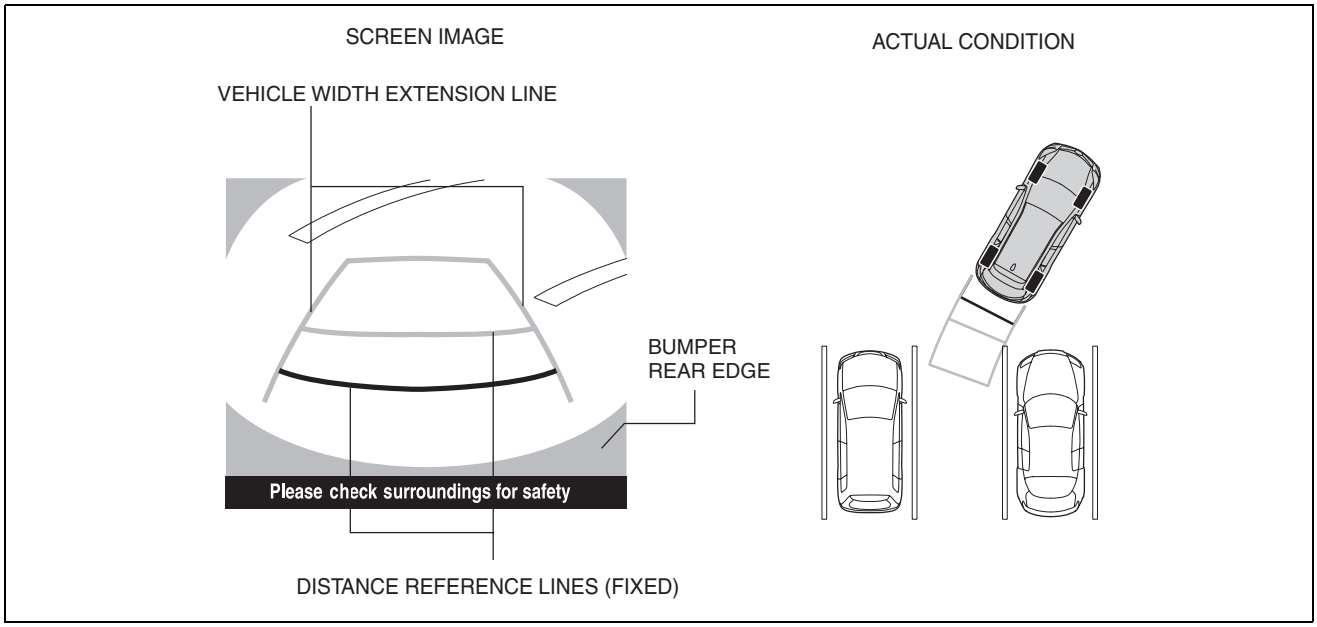
- The image range may differ depending on the road surface conditions and the vehicle conditions. In addition, images near both sides of the rear bumper and below the rear bumper cannot be obtained.



ac5jjn00000328

ENTERTAINMENT

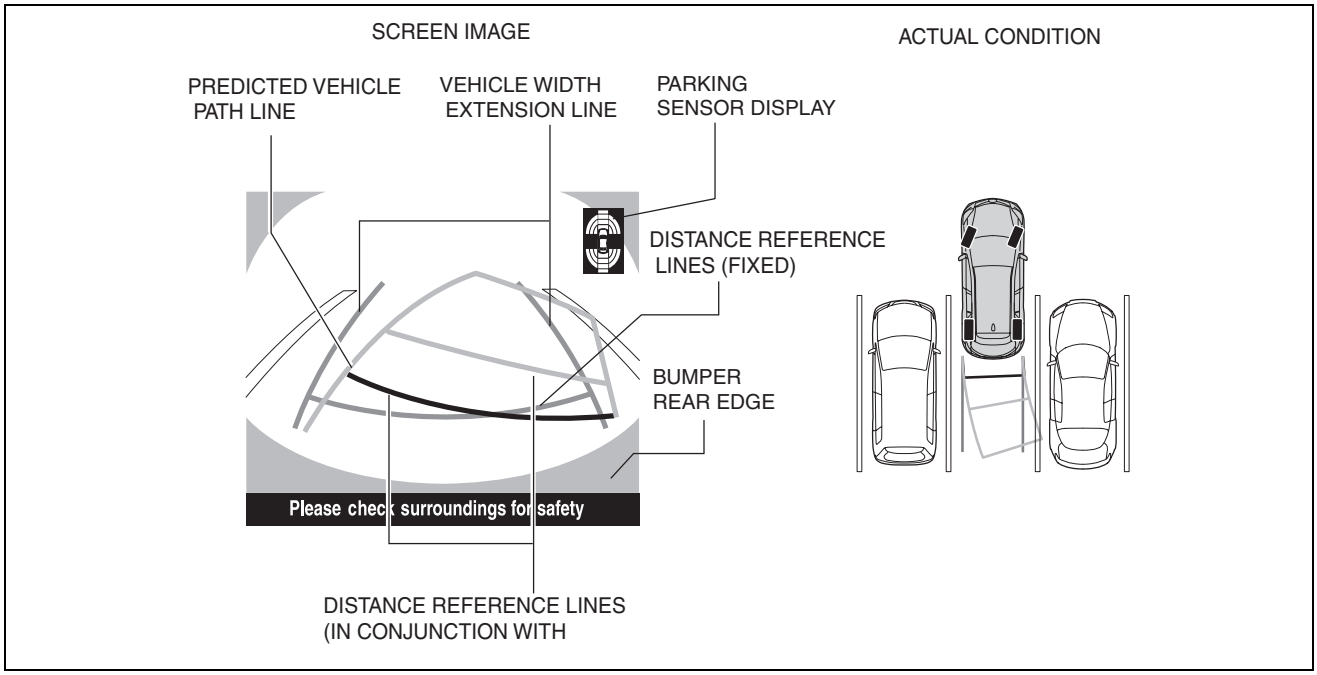
Rear view monitor screen
Except European (L.H.D. U.K.) specs.



ac5wzn00001076

Display item	Display line color	Function
Distance reference lines (fixed)	Red	• Shows distance reference line 0.5 m from the rear of the rear bumper. • Not in conjunction with steering operation.
	Yellow	• Shows distance reference line 1.0 m from the rear of the rear bumper. • Not in conjunction with steering operation.
	Yellow	• Shows distance reference line 0.5 m from the rear of the rear bumper. • Not in conjunction with steering operation.
Vehicle width extension line	Yellow	• Vehicle width extension line. (Length: 2.7 m, width: vehicle width)

European (L.H.D. U.K.) specs.



ac5wzn00001083

ENTERTAINMENT

Display item	Display line color	Function
Parking sensor display	—	• Displays the location of the obstruction detected by the parking sensor.
Distance reference line (in conjunction with steering)	Red	• Shows distance reference line 0.5 m from the rear of the rear bumper. • Display changes in conjunction with the steering operation.
	Yellow	• Shows distance reference line 1.0 m from the rear of the rear bumper. • Display changes in conjunction with the steering operation.
	Yellow	• Shows distance reference line 2.7 m from the rear of the rear bumper. • Display changes in conjunction with the steering operation.
Distance reference lines (fixed)	Blue	• Shows distance reference line 0.5 m from the rear of the rear bumper. • Not in conjunction with steering operation.
Vehicle width extension line	Blue	• Vehicle width extension line. (Length: 2.7 m, width: vehicle width)
Predicted vehicle path line	Yellow	• Calculated vehicle path based on steering angle signal. (Length: 2.7 m, width: vehicle width) • Predicted vehicle path which expresses the vehicle outermost circumference in conjunction with the steering operation.

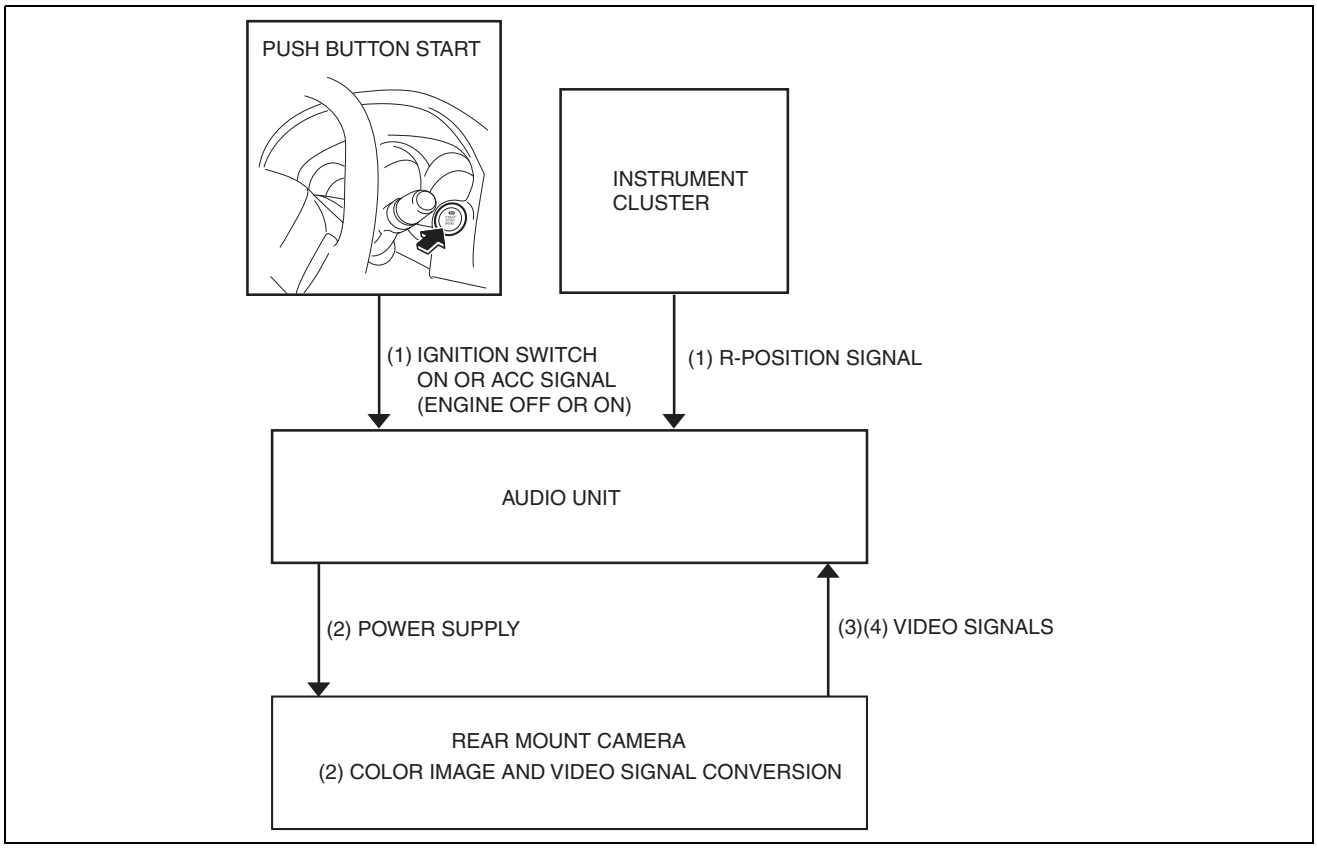
Operation

Caution

- **The images shot by the rear view monitor camera differ depending on the actual conditions resulting from road surface conditions, the number of passengers, and cargo load, and even though it may appear that the vehicle will not come into contact with an object as seen in the image, it may actually come into contact with it. When reversing the vehicle, always verify the surroundings visually.**

1. When the ignition is switched to ACC or ON (engine off or on) and the shift lever is shifted to the R position, power is supplied to the rear view monitor camera from the audio unit.
2. The rear view monitor camera produces color images of the conditions at the rear of the vehicle when power is supplied, and converts them to an image signal.
3. The rear view monitor camera combines the fixed lines with the video signal and outputs it to the audio unit. (Except European (L.H.D. U.K.) specs.)
4. The rear view monitor camera receives the steering angle signal via CAN communication. Performs calculations based on the received steering angle signal, combines the predicted vehicle track, and outputs the result to the audio unit. (European (L.H.D. U.K.) specs.)

ENTERTAINMENT



ac5wzn00000991

Note

- It may be difficult to see the display under the following conditions; however, it does not indicate a malfunction:
  - — When the temperature around the lens is high/low.
  - — When the camera is wet such as on a rainy day or during period of high humidity.
  - — When foreign material such as mud is stuck around the camera.
  - — When the camera lens reflects sunlight or headlight beams.

BACK CAMERA

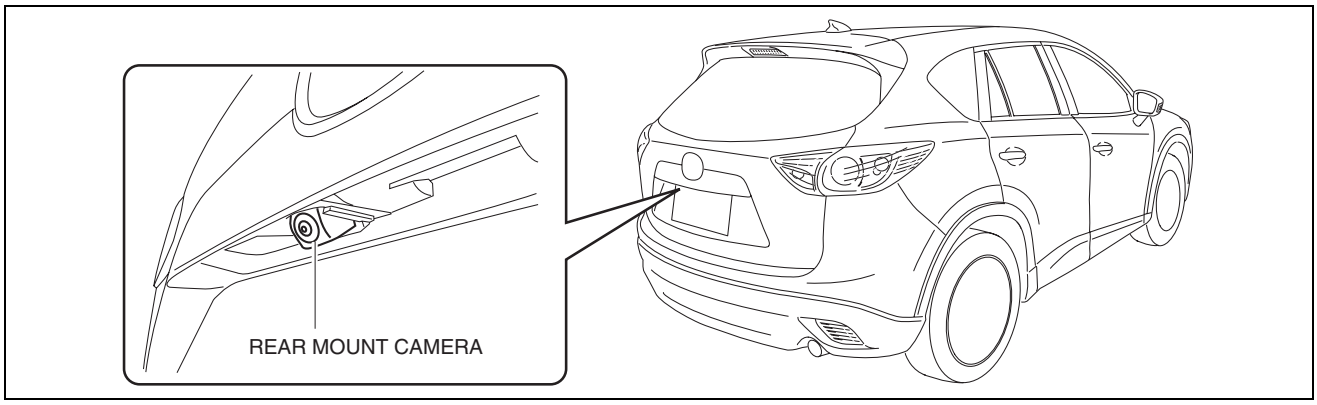
id092000010600

Purpose, Function

- The back camera shoots the conditions at the rear of the vehicle in color, and after converting the video signal, it outputs the signal to the audio unit.

Construction

- The back camera is installed to the liftgate.



ac5wzn00000988

ENTERTAINMENT

- A super-wide angle lens which can shoot images in a wide parameter is assembled to the compact (1/3.6 in), color CMOS camera which has a high precision CMOS *1 imaging element.

*1 : Complementary Metal-Oxide Semiconductor

Operation
- For the back camera operation, refer to the 09-20-47 PARK ASSIST SYSTEM.

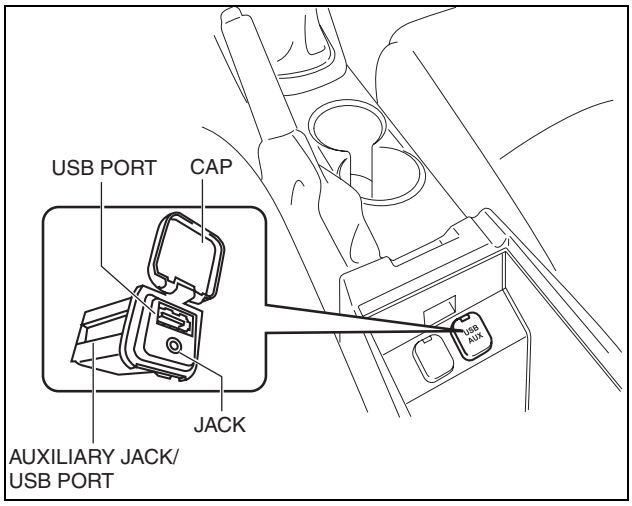
Fail-safe
- Function not equipped

AUXILIARY JACK/USB PORT

id092000012600

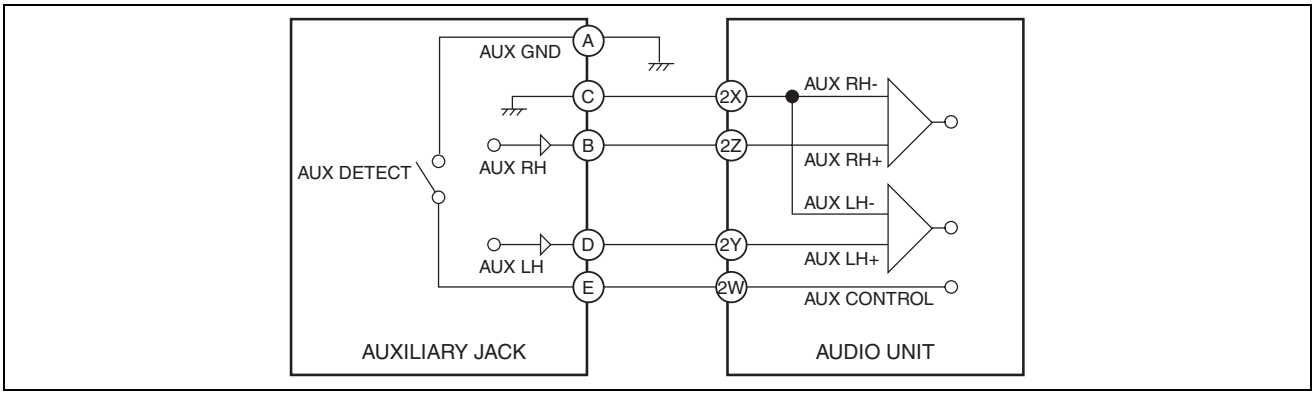
Purpose, Function
- The Auxiliary jack/USB port outputs the audio signals of commercially-available portable audio, a USB device, or an iPod connected to the Auxiliary jack/USB port to the audio unit.

Construction
- Auxiliary jack/USB port is installed inside the rear console.
- An auxiliary jack and USB port are equipped.



ac5wzn00000911

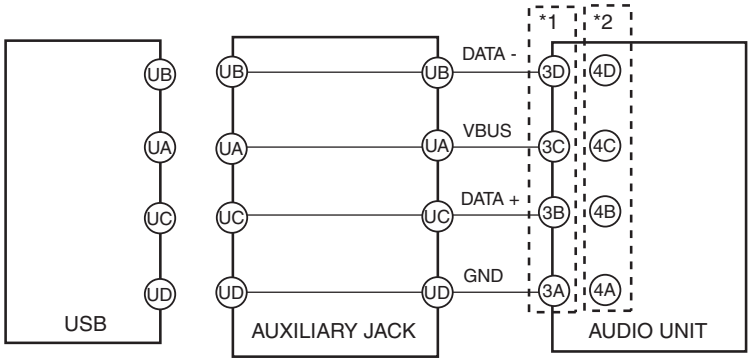
Operation
Auxiliary jack
1. When the plug of a portable audio unit is connected to the Auxiliary jack/USB port, the Auxiliary jack/USB port sends the audio signal from the portable audio device to the audio unit.
2. When the audio unit is switched to AUX mode using the AUX switch for the audio panel switch (without color LCD)/display (with color LCD) or the commander switch, the audio unit outputs the audio signal sent from the auxiliary jack/USB port to the speakers.



ac5uun00000905

USB port
1. When the USB device/iPod is connected to the USB port for the auxiliary jack/USB port, the auxiliary jack/USB port sends the audio signal of the USB device/iPod to the audio unit.

2. When the audio unit is switched to the USB mode using the USB switch of the audio panel switch (without color LCD)/display (without color LCD) or the commander switch, the audio unit outputs the audio signal sent from the auxiliary jack/USB port to the speakers.



ac5uun00000906

Fail-safe
- Function not equipped.

Bluetooth SYSTEM

id092000011700

Outline
- The Bluetooth system can be used for wireless audio from Bluetooth-enabled mobile/portable audio devices having a common profile with the Bluetooth unit.

Note
- The profile indicates the wireless communication standard. If the profile of Bluetooth-enabled devices differs from the Bluetooth unit, wireless communication is not possible.

Function
- The communication between the Bluetooth unit and the audio unit is sent and received via CAN signals.
- The communication between the Bluetooth unit and Bluetooth-enabled mobile phones is performed by radio waves in the frequency range of 2.4 GHz. In addition, the range in which communication is possible is approx. 10 m (33 ft).
- The Bluetooth system has the following functions:

Bluetooth audio function
- Music files programmed to Bluetooth-enabled devices can be sent to the Bluetooth unit by radio wave and output via the audio unit. In addition, Bluetooth-enabled devices can be operated using the audio panel and commander switch. Corresponding functions differ according to the profile.

Hands-free telephone (HF/TEL) function
- Operations such as making and receiving calls can be done without directly operating the mobile phone. Corresponding functions differ according to the profile.

Voice recognition function
- The Bluetooth unit is preset with voice commands, and voice produced by facing the microphone for the voice recognition is matched to the preset voice commands which activates the mode set to the voice command.
- The voice commands and functions are as follows.

Note
- For details, refer to the owner's manual.

Voice command	Operation
Phonebook	Imports phonebook data programmed in the mobile phone to the Bluetooth unit.(Registers, edits, lists or deletes a voice tag)
Dial	Operates the dial-up connection mode.

ENTERTAINMENT

Voice command	Operation
Mute	Mutes the microphone during a call.
Setup	Operates each set-up mode of the Bluetooth system.
Emergency	Connects to emergency services.

TTG (Text to Grammer) function

- This function matches the voice of the user to the phone book text data. Calls can be made just by downloading a Bluetooth-enabled mobile phone book without having to re-register using the voice recognition mode.

Speed dial function (Favorites registration function)

- The speed dial function can used to register frequently called contacts to the speed dial enabling phone calls to be made with little operation. Phone numbers and names registered beforehand are displayed on the speed dial screen to enable immediate phone calling. A maximum of 8 phone numbers can be registered.

Note

- For the phone number registration method, refer to the owner's manual.

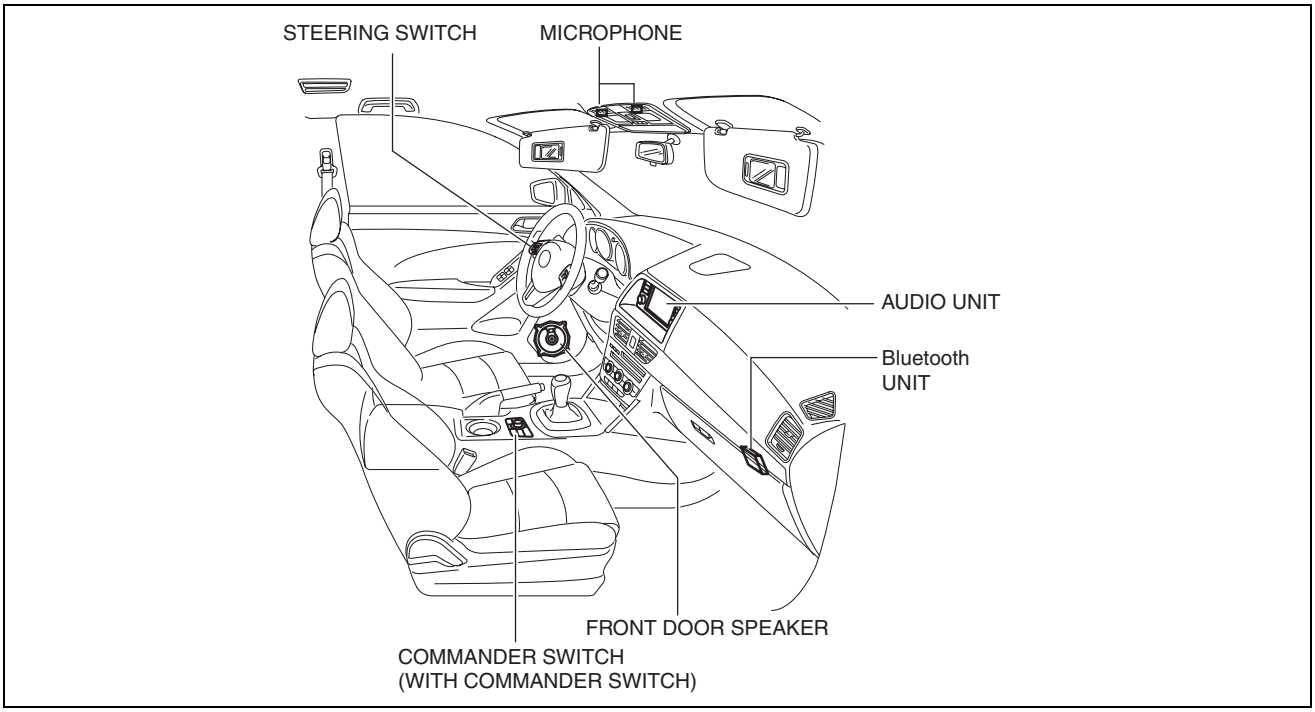
On-board diagnostic function

- This function performs on-board diagnostics to detect malfunction locations.
- For details on the on-board diagnostic function, refer to the Diagnostic System [Bluetooth System].

Diagnostic Assist Function

- Using the audio unit, this function can verify the Bluetooth unit connection status and 7-digit software version using the audio unit display.
- For details on the diagnostic assist function, refer to the Diagnostic Assist System [Audio System].

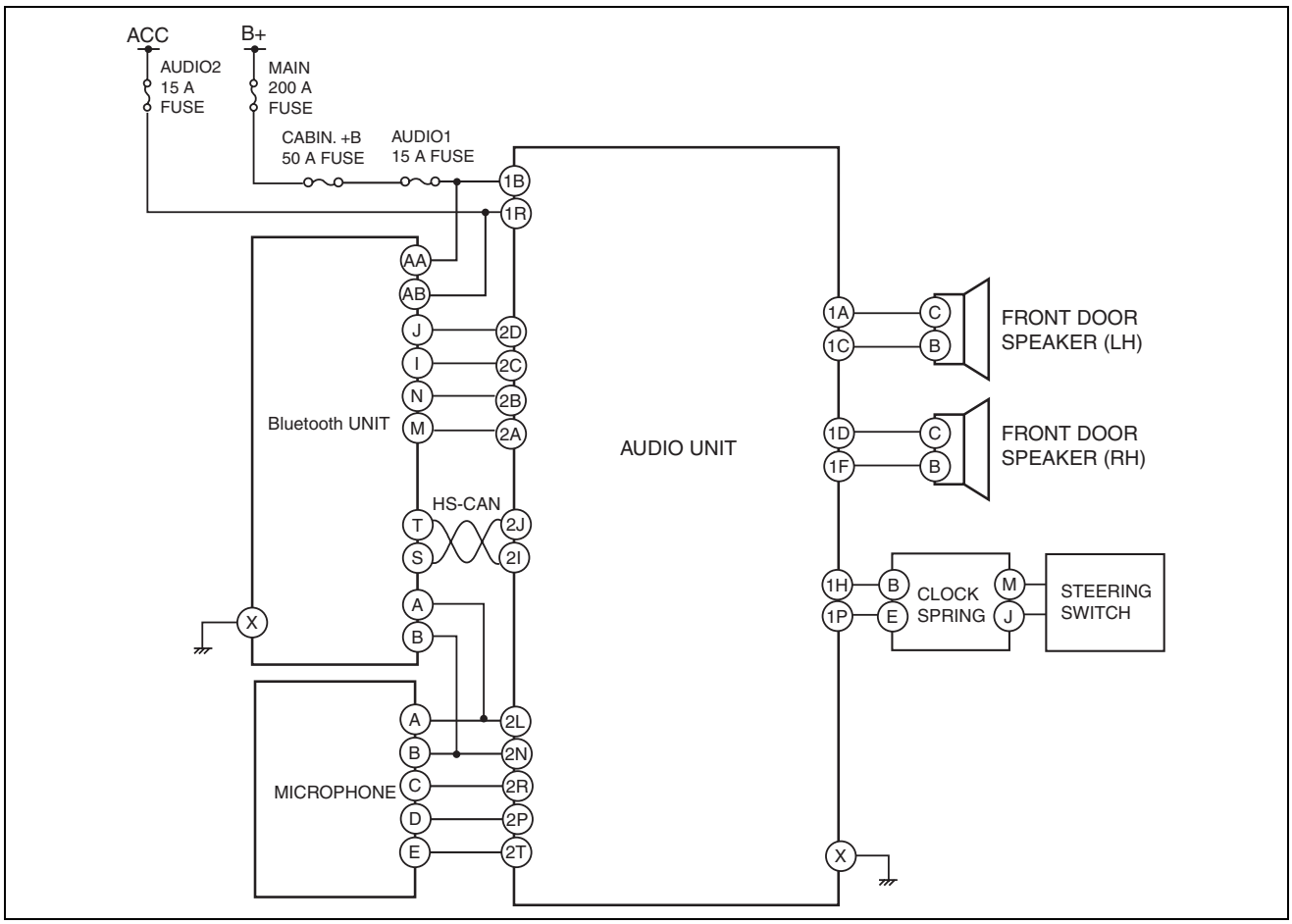
Structural View



ac5wzn00001329

ENTERTAINMENT

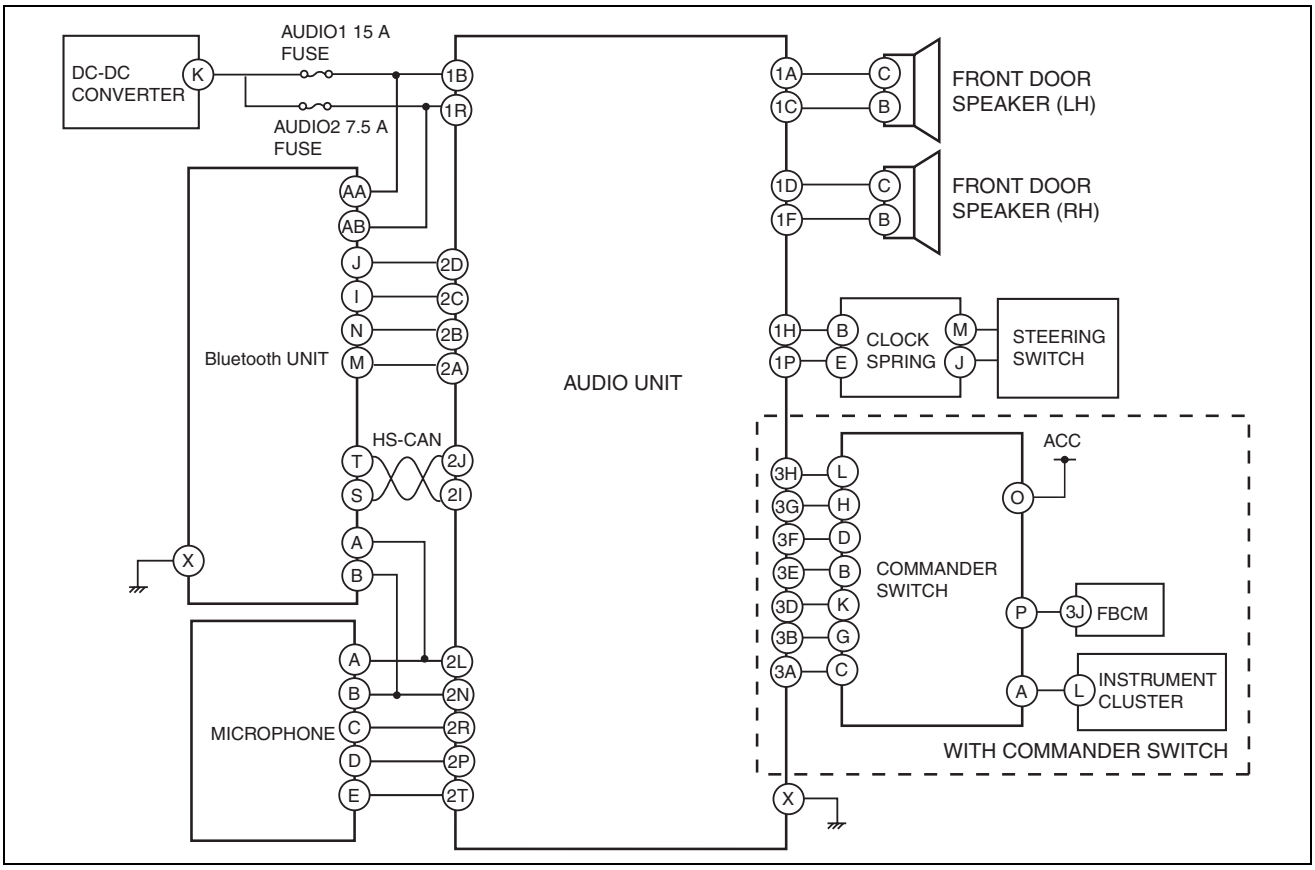
Block Diagram
Without Bose®
Without i-stop system



ac5wzn00001909

ENTERTAINMENT

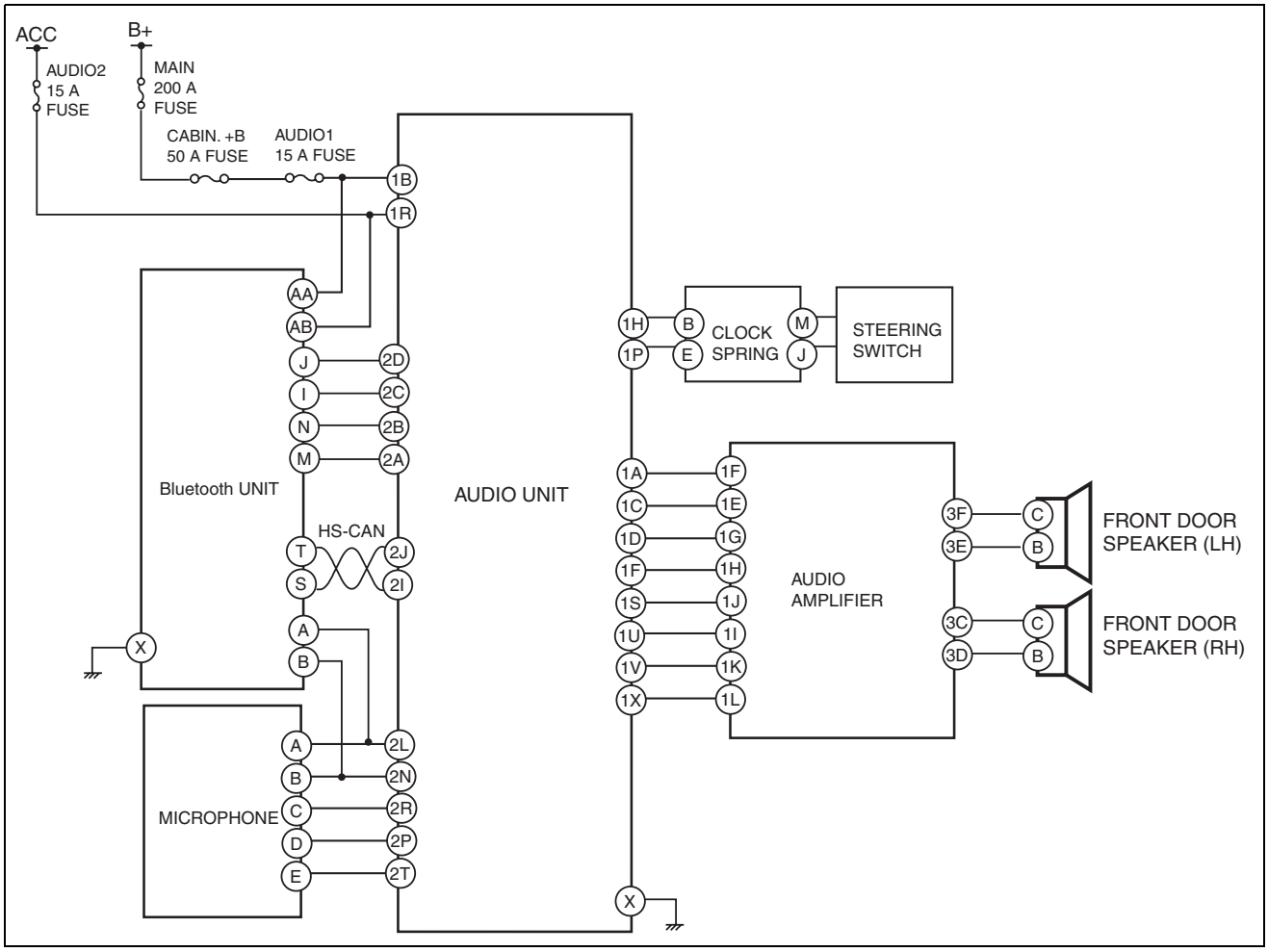
Without i-stop system



ac5wzn00001330

ENTERTAINMENT

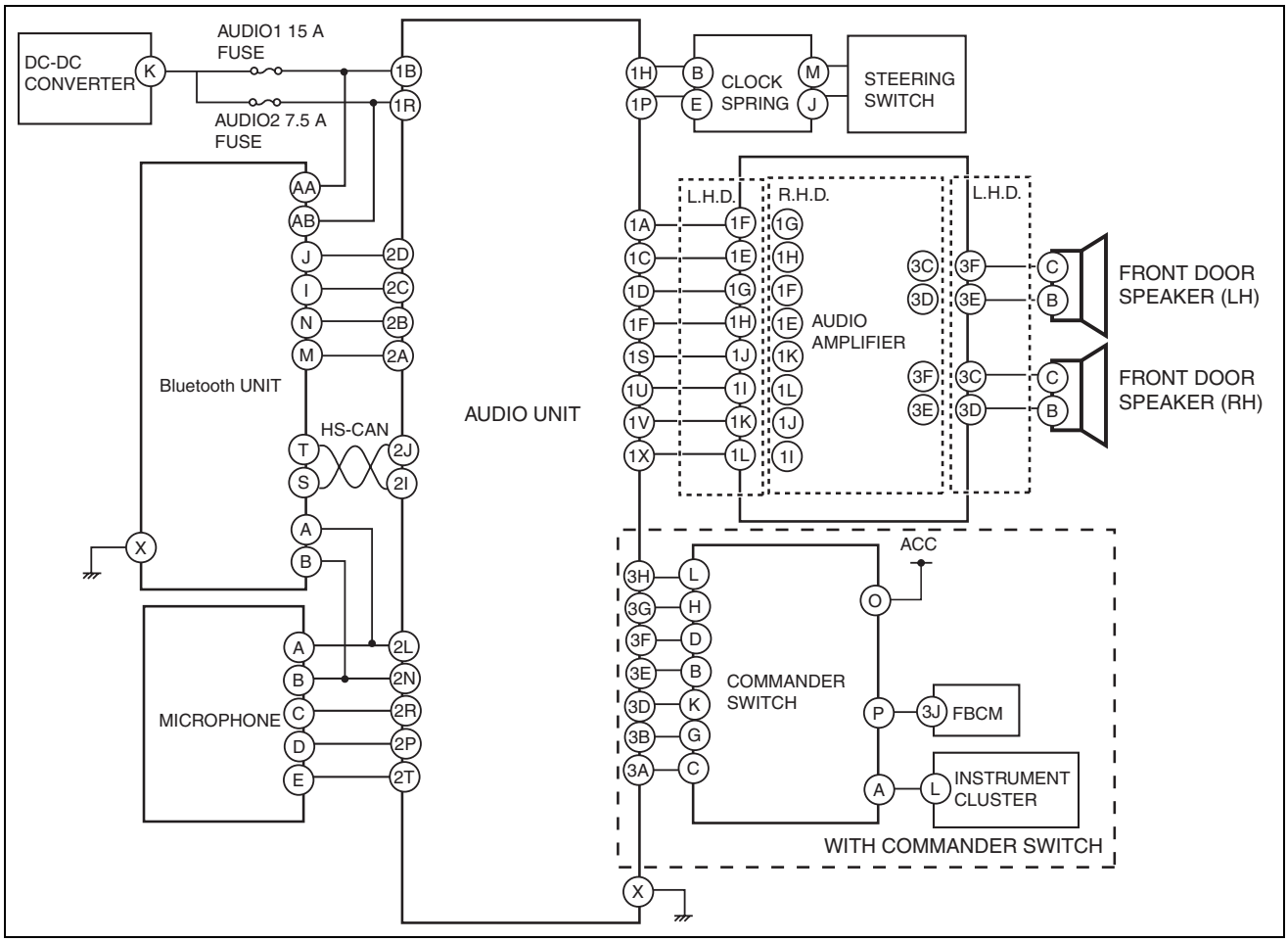
With Bose®
Without i-stop system



ac5wzn00001910

ENTERTAINMENT

With i-stop system



ac5wzn00001374

Operation

- When the ignition is switched to ACC or ON (engine off or on), the Bluetooth unit begins communication with a Bluetooth-enabled mobile phone/portable audio device.

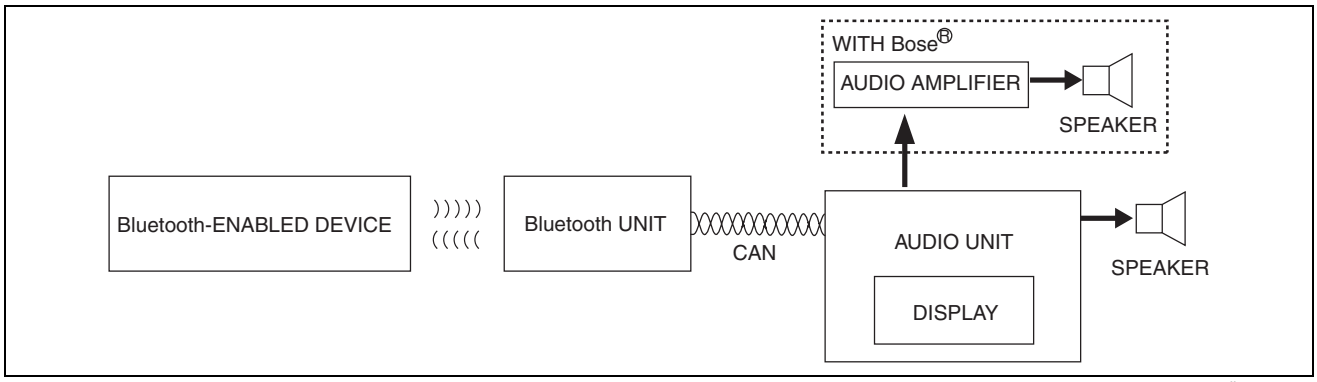
  Note
  - It is necessary to register a Bluetooth-enabled device to the Bluetooth unit. For the registration method, refer to the owner's manual.

- When the audio unit, commander switch, or steering switch is operated, the Bluetooth unit sends Bluetooth-enabled mobile phone/portable audio device information to the audio unit.

Bluetooth audio operation

1. The Bluetooth unit sends information received from the Bluetooth-enabled device to the audio unit.
2. The audio unit outputs music data to the speakers (with Bose®)/audio amplifier (with Bose®) and displays video information in the audio unit display.
3. When the audio panel and commander switch is operated, the audio unit sends the operation information to the Bluetooth unit.
4. The Bluetooth unit sends the operation information to the Bluetooth-enabled device.

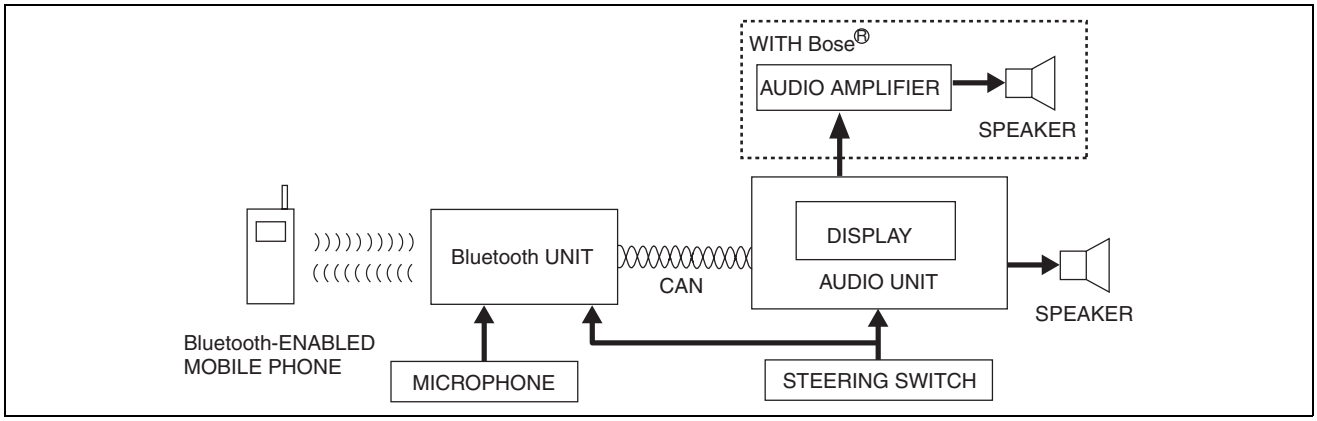
ENTERTAINMENT



ac5jjn00000321

Hands-free telephone (HF/TEL) operation

1. When a call is received by a registered and connected cell phone, the Bluetooth unit sends incoming call information to the audio unit.
2. When the steering switch Pick up button is pressed, the line is opened.
3. The audio received by the mobile phone is output from the speakers.
4. Voice spoken into the voice recognition microphone is sent to the Bluetooth-enabled mobile phone by the Bluetooth unit.



ac5jjn00000637

Voice recognition operation

1. When the Talk switch is operated, the voice recognition function operates. The user's voice spoken into the microphone for the voice recognition activates the voice command mode if it matches a Bluetooth unit voice command.

Bluetooth UNIT

id092000011800

Purpose, Function

- The Bluetooth unit communicates information between the Bluetooth-enabled mobile phone and portable audio via radio waves.

Function

- Communicates information between the Bluetooth unit and audio unit via the CAN signal.

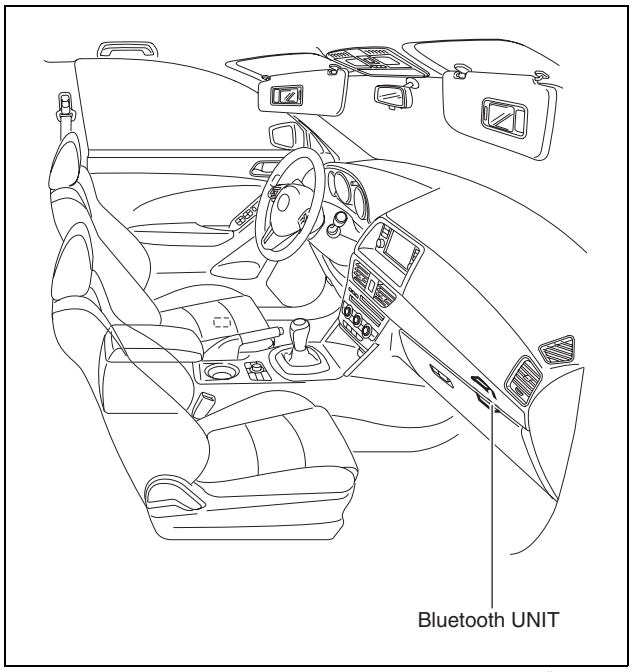
Specification

Item		Function
Profiles	A2DP 1.0/1.2 (Advanced audio distribution profile)	Sends/receives music or audio data.
	AVRCP 1.0/1.3/1.4 (Audio/video remote control profile)	Sends/receives operation information.
	HFP 1.0/1.5 (Hands-free profile)	Enables a call using a hands-free phone.
	OPP 1.1 (Object push profile)	Phone book can be downloaded.
	PBAP 1.0 (Phone book access profile)	Sends/receives phone book data.
Maximum number of devices can be registered		7
Devices can be used simultaneously		2

ENTERTAINMENT

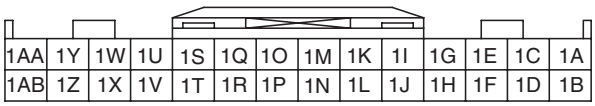
Construction

- The Bluetooth unit is installed inside the glove compartment.



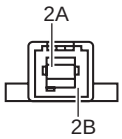
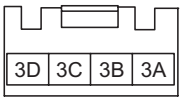
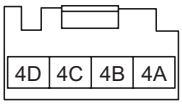
ac5jjn00000652

Terminal layout and signal



Terminal	Signal
1A	Mic input (+)
1B	Mic input (-)
1C	—
1D	—
1E	—
1F	Steering switch
1G	—
1H	—
1I	—
1J	—
1K	—
1L	Audio out shield
1M	Audio output RH (+)
1N	Audio output RH (-)
1O	—
1P	—
1Q	—
1R	—
1S	CAN_H
1T	CAN_L
1U	—
1V	—
1W	—
1X	Ground
1Y	—
1Z	—
1AA	B+
1AB	ACC

ENTERTAINMENT

Terminal		Signal
	2A	GPS
	2B	Ground
	3A	Ground
	3B	DATA (+)
	3C	DATA (-)
	3D	V_BUS
	4A	Ground
	4B	DATA (+)
	4C	DATA (-)
	4D	V_BUS

Operation
- For the Bluetooth unit operation, refer to the 09-20-54 Bluetooth SYSTEM

Fail-safe
- Function not equipped.

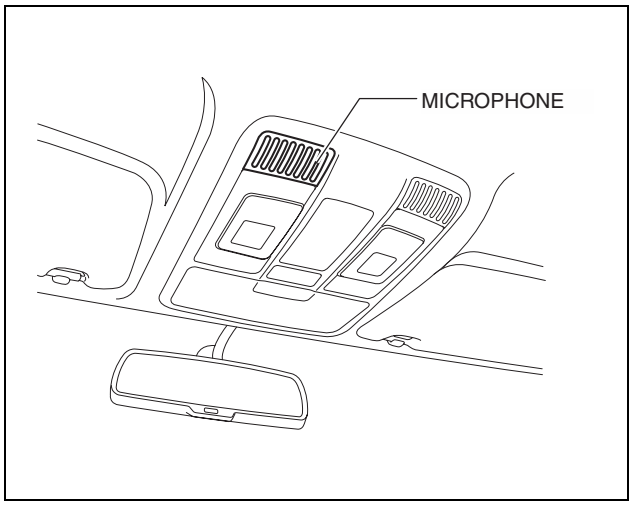
MICROPHONE

id092000011600

Purpose, Function
- Converts the user's voice command to an electrical signal and sends it to the audio unit or Bluetooth unit.

Construction
- Noise due to the vehicle being driving or air blown by the air conditioner has been reduced by locating the voice recognition microphone next to the map light.

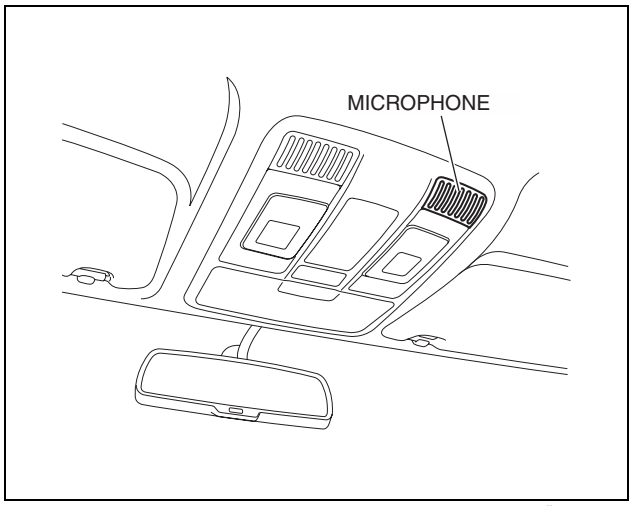
L.H.D.



ac5jjn00000667

ENTERTAINMENT

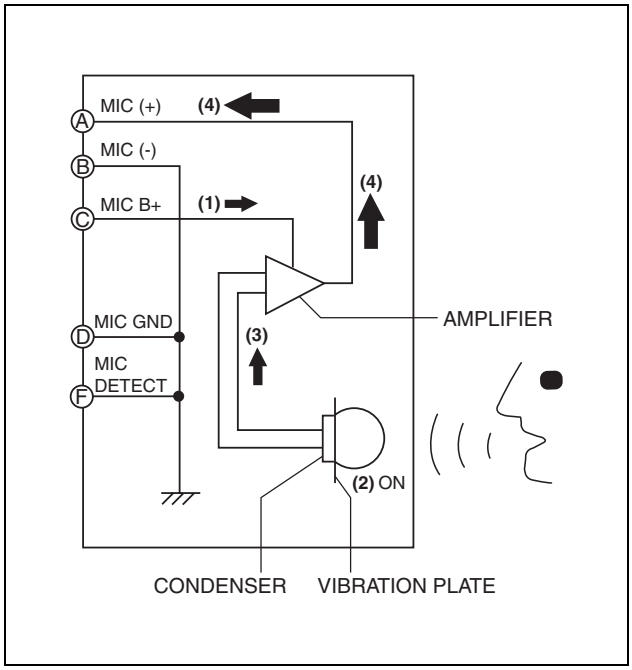
R.H.D.



ac5jjn00000668

Operation

1. When the ignition is switched to ACC or ON (engine off or on), power is supplied from the audio unit to the voice recognition microphone.
2. If the TALK switch in the steering switch is pressed, the voice recognition function operates.
3. The air which is vibrated by the user's voice is converted to an electrical signal by the vibration plate and condenser in the voice recognition microphone.
4. The converted electrical signal is amplified by the amplifier for the voice recognition microphone and output to the audio unit or Bluetooth unit.



ac5wzn00001549

Fail-safe

- Function not equipped.

ON-BOARD DIAGNOSTIC [AUDIO SYSTEM]

id0920001101a1

Outline

- The audio system has an on-board diagnostic function and diagnostic assist function to facilitate audio system diagnosis.

ENTERTAINMENT

Function

- The on-board diagnostic function consists of the following functions: A malfunction detection function, which detects overall malfunctions in the audio system-related parts; a memory function, which stores detected DTCs; and a display function, which indicates system malfunctions via a DTC display.
- There are two methods for DTC output and clearing; one using the Mazda Modular Diagnostic System (M-MDS) and one which does not use it. Because the DTCs differ depending on whether the M-MDS is used or not, use both methods. (with color LCD)
- The diagnostic assist function is a function for forcibly operating audio system related parts to verify their connection condition and operation status. In addition, the specifications for the audio system related parts are displayed in the audio display to enable their verification.

On-board diagnostic function
Malfunction detection function

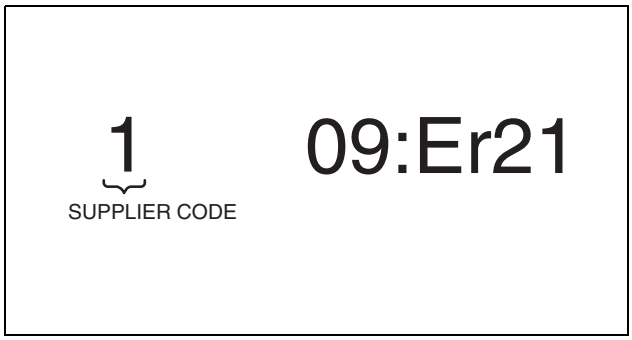
- Detects malfunctions in the audio system.

Memory function

- If the audio unit detects a malfunction in the audio system, a maximum of 3 DTCs are recorded in the audio unit. If the audio unit has already stored 3 DTCs (without color LCD)/20 DTCs (with color LCD) and detects another malfunction, it clears the oldest DTC and stores the new DTC.
- DTCs stored in the audio unit are cleared if the negative battery cable is disconnected (if backup power is interrupted).

Display Function
Mazda Modular Diagnostic System (M-MDS) not used

- To display DTCs in the audio unit display that have been recorded in the memory function, activate the on-board diagnostic function by operating the audio unit. Refer to the Workshop Manual for the activation procedure of the on-board diagnostic function.
  The DTCs consist of the following:
  — Supplier code (supplier name)
  — Device code (malfunction location)
  — Error code (malfunction contents)



ac5wzw0000073

Supplier code	Supplier name
01	SANYO Automedia
02	Panasonic
03	CLARION
04	PIONEER
05	VISTEON

Device code	Device name
09	Audio unit
10	• AM/FM tuner/MP3/WMA (Windows Media Audio)/AAC (Advanced Audio Coding) applicable CD player (Without color LCD) • AM/FM tuner/MP3/WMA (Windows Media Audio) applicable CD player (With color LCD)
16	CAN system
26	Bluetooth unit
28	Auxiliary jack/USB port
29	iPod

Error code	Malfunction contents
01	Mechanical malfunction
02	Servo malfunction
07	Poor data read-outs
10	BUS line (communication line) error
11	CAN line (communication line) error
12	CAN line (communication line) error
20	Insufficient power supply
21	Amplifier related circuit

ENTERTAINMENT

Error code	Malfunction contents
22	Tuner error

With Using Mazda Modular Diagnostic System (M-MDS)

- When a DTC inspection is performed using the Mazda Modular Diagnostic System (M-MDS), the malfunction diagnostics for the audio system and Bluetooth system (hands-free telephone (HF/TEL) system) is initiated. A maximum of 20 DTCs detected by the malfunction diagnostics are displayed. Refer the Workshop Manual for the DTC inspection procedure.

× : Applicable
— : Not applicable

DTC table

With color LCD

DTC No.		Security indicator light	Description	Fail-safe	Drive cycle	Self-test type*1	Memory function
Mazda Modular Diagnostic System (M-MDS) display	Information display (On-board diagnostic test mode)						
B116A:12	26:Er82	—	Microphone circuit malfunction	—	—	D	—
B1188:64	10:Er07	—	Audio unit internal malfunction	—	—	C	×
B1D19:71	10:Er02	—	Audio unit internal malfunction	—	—	C	×
B1D19:79	10:Er01	—	Audio unit internal malfunction	—	—	C	×
B1D19:96	10:Er10	—	Audio unit internal malfunction	—	—	C	×
U0010:88	16:Er12	—	CAN system communication error	—	—	C	×
U0155:00	—*2	—	Instrument cluster communication error	—	—	C, D	×
U0197:00	—*2	—	Communication error with Bluetooth unit	—	—	D	—
U3000:04	09:Er22	—	Audio unit internal malfunction	×	—	D	×
U3000:09	09:Er21	—	Audio unit internal malfunction	×	—	C	×
U3003:16	09:Er20	—	Voltage decrease input from battery	—	—	C	×
—	28:Er01	—	Poor connection with exterior input unit, or read error	—	—	—	×
—	29:Er01	—	Audio unit internal malfunction, or iPod malfunction	—	—	—	×
—	—	—	DTCs not stored	—	—	—	—

*1 : C: CMDTC self test, D: ODDTC self test
*2 : It is not displayed in the audio display because the on-board diagnostic test mode is not available.

Without color LCD

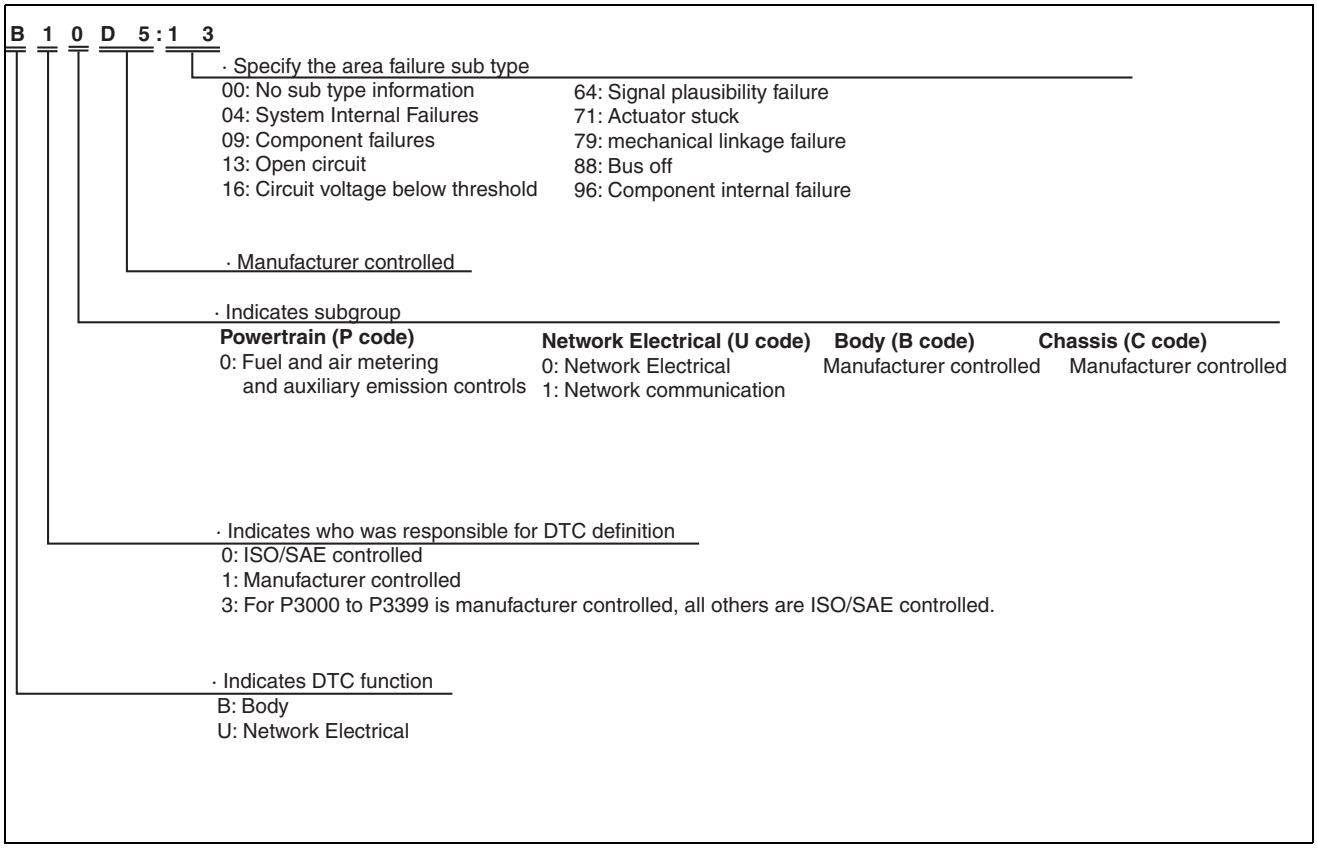
DTC	Security indicator light	Description	Fail-safe	Drive cycle	Self-test type*1	Memory function
09:Er20	—	Voltage decrease input from battery	—	—	C	×
09:Er21	—	Audio unit internal malfunction	—	—	C	×
09:Er22	—	Audio unit internal malfunction	—	—	C	×
10:Er01	—	Audio unit internal malfunction	—	—	C	×
10:Er02	—	Audio unit internal malfunction	—	—	C	×
10:Er07	—	Audio unit internal malfunction	—	—	C	×
10:Er10	—	Audio unit internal malfunction	—	—	C	×
28:Er01	—	Poor connection with exterior input unit, or read error	—	—	—	×
29:Er01	—	Audio unit internal malfunction, or iPod malfunction	—	—	—	×
No Err	—	DTCs not stored	—	—	—	—

*1 : C: CMDTC self test,

ENTERTAINMENT

DTC 7-digit code definition

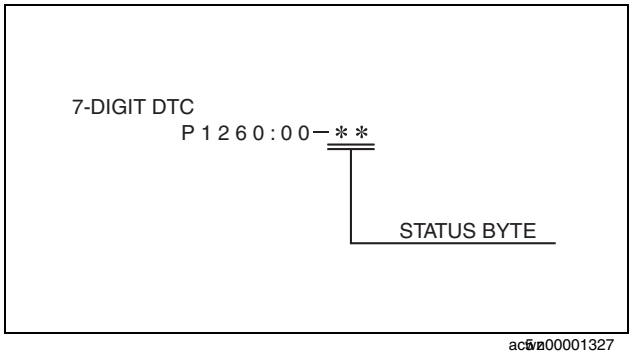
- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



acsun00001121

Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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Diagnostic Assist Function

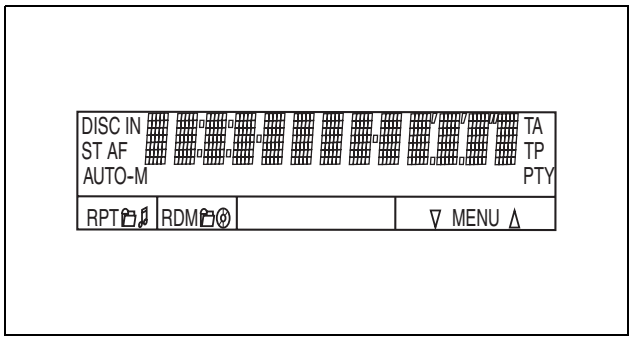
- The audio system related parts are forcibly operated to enable verification of the connection condition and operation status of the audio system related parts.In addition, the specifications for the audio system related parts are displayed in the information display to enable their verification. Refer to the Workshop Manual for the diagnostic assist function activation procedure.

Display inspection

- All characters are displayed in the audio unit display to enable examination of the display. (Without color LCD)

ENTERTAINMENT

- By touching the audio unit display, the display color can be changed for color verification and display examination. (with color LCD)



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Button Inspection

- Activates a buzzer sound when a switch is operated and examines each of the switches.

Speaker Inspection

- Verifies that the speakers output sound in the following order and examines each speaker or the wiring harness between the audio unit and each speaker.

  Without Bose®

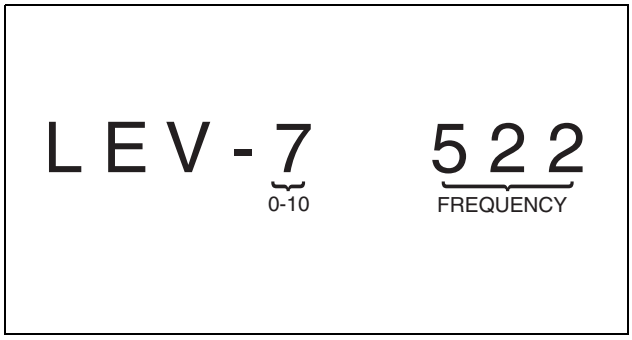
  1. Front door speaker (LH) and tweeter (LH) (6 speaker type)
  2. Front door speaker (RH) and tweeter (RH) (6 speaker type)
  3. Rear door speaker (RH)
  4. Rear door speaker (LH)

  With Bose®

  1. Front door speaker (LH), tweeter (LH) and front center speaker (LH)
  2. Front door speaker (RH), tweeter (RH) and front center speaker (RH)
  3. Rear door speaker (RH) and D-pillar speaker (RH)
  4. Rear door speaker (LH) and D-pillar speaker (LH)

Radio Reception Condition Inspection

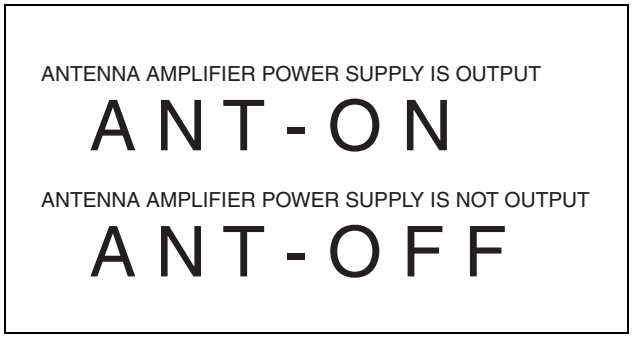
- Displays the radio reception status on the audio unit display and examines the center roof antenna, antenna feeder, and audio unit (tuner). (Display example when receiving AM 522kHz)



am5ezn0000177

Antenna control inspection

- Displays the power supply output status to the center roof antenna to the audio unit display for examination of the center roof antenna, audio unit and wiring harness (between audio unit and center roof antenna).



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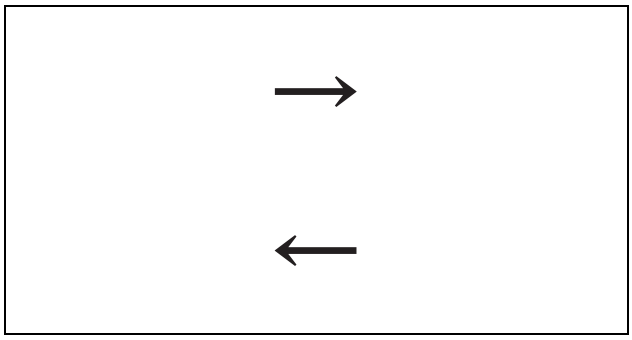
ENTERTAINMENT

Dial inspection

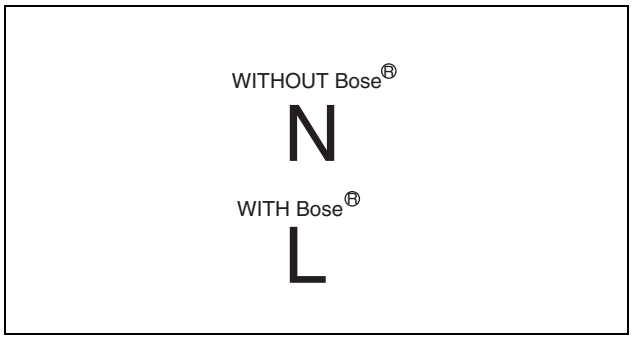
- Displays the rotation direction of the operated dial switch in the audio unit display for examination of each switch.



am3uun0000095

Audio amplifier specification verification.

- Displays the audio amplifier specifications on the audio unit display to verify the specifications.



ac5wzn00002018

AUTO-M inspection (without color LCD only)

- Activates AUTO-M and displays the radio reception conditions in the audio unit display for examination of the radio unit.

CD inspection (without color LCD only)

- Displays inspection results in the audio unit and verifies whether a malfunction is audio unit or CD related.

Vehicle/NAVI signal verification (with color LCD only)

- Displays the following signal conditions, the vehicle speed, and connection conditions on the audio unit display and verifies the vehicle and NAVI signals.
  - TNS signal
  - Reverse signal
  - Parking brake signal
  - Vehicle speed
  - Steering switch connection condition
  - Commander switch connection condition
  - Connection condition of voice recognition-use microphone
  - Car navigation unit connection condition
  - GPS antenna connection condition

Exterior device connection information clearing (with color LCD only)

- The car navigation unit, Bluetooth unit, SIRIUS satellite radio unit, and back camera connection information stored in the audio unit can be cleared.

Gateway signal verification (with color LCD only)

- Displays the information directed at the vehicle HS-CAN in the audio unit display, and verifies if the vehicle information in the audio unit arrives correctly.

ON-BOARD DIAGNOSTIC [Bluetooth SYSTEM]

id0920001101z6

Outline

- To facilitate malfunction diagnosis in the audio system, the Bluetooth system (Hands-Free telephone (HF/TEL)) is equipped with an on-board diagnostic function and diagnostic assist function.

ENTERTAINMENT

Function

- The on-board diagnostic function has a malfunction detection function which detects overall malfunctions in the audio system-related parts, and a display function which indicates a system malfunction via DTC display.
- There are two methods for DTC output and clearing; one using the Mazda Modular Diagnostic System (M-MDS) and one which does not use it. Because the DTCs differ depending on whether the M-MDS is used or not, use both methods.
- The diagnostic assist function displays Bluetooth unit connection conditions and specifications in the audio unit display, and verifies the Bluetooth system connection conditions and specifications.

On-board diagnostic function

Malfunction detection function

- The malfunction detection function detects malfunctions occurring in the Bluetooth system (hands-free telephone (HF/TEL) system).

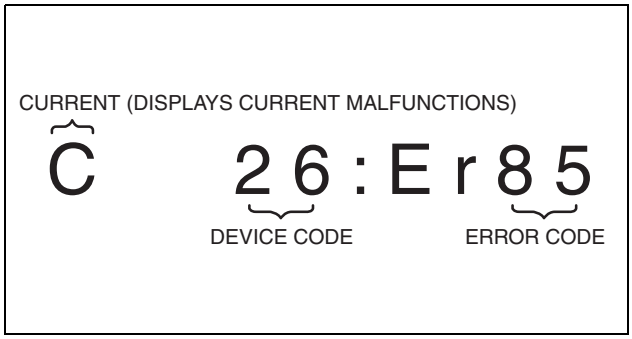
Display Function

Mazda Modular Diagnostic System (M-MDS) not used

- Activates the on-board diagnostic function by operating the audio unit and displays DTCs in the audio unit display. Refer to the Workshop Manual for the activation procedure of the on-board diagnostic function.
- The DTC consists of the following codes and numbers:
  - — Supplier code (supplier name)
  - — Device code (malfunction location)
  - — Error code (malfunction contents)

With using Mazda Modular Diagnostic System (M-MDS)

- When a DTC inspection is performed using the Mazda Modular Diagnostic System (M-MDS), the malfunction diagnostics for the audio system and Bluetooth system (hands-free telephone (HF/TEL) system) is initiated.Refer the Workshop Manual for the DTC inspection procedure.



am5ezn0000177

× : Applicable
— : Not applicable

DTC table

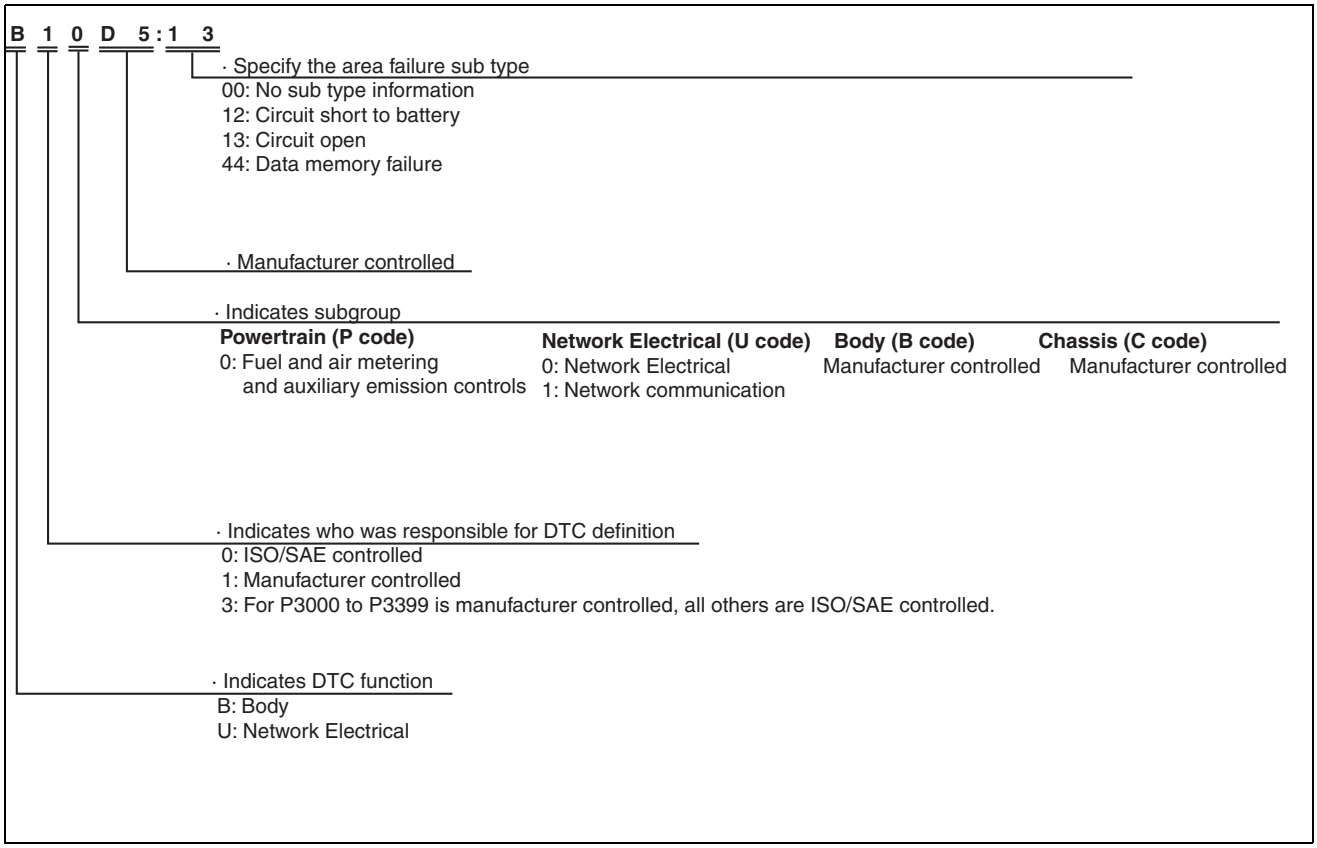
DTC No.		Security indicator light	Description	Fail-safe	Drive cycle	Self-test type*1	Memory function
Mazda Modular Diagnostic System (M-MDS) display	Information display (On-board diagnostic test mode)						
B116A:12	26:Er82	—	Microphone circuit malfunction	—	—	D	—
B116A:13	—*2	—	Microphone circuit malfunction	—	—	D	—
B116A:44	26:Er86	—	Bluetooth unit internal malfunction	—	—	D	—
—	26:Er81	—	CAN system communication error	—	—	—	—
U0197:00	—*2	—	CAN system communication error	—	—	D	—
—	—	—	DTC is not recorded.	—	—	—	—

*1 : D: ODDTC self test
*2 : It is not displayed in the audio display because the on-board diagnostic test mode is not available.

ENTERTAINMENT

DTC 7-digit code definition

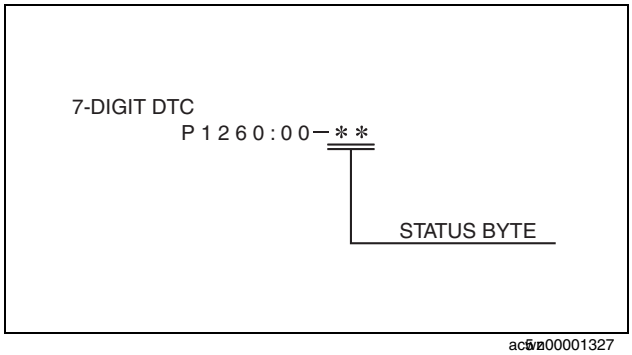
- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



acsun00001122

Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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Diagnostic Assist Function

- Displays the Bluetooth system connection conditions and specifications in the audio unit display, and verifies the Bluetooth system connection conditions and specifications. Refer to the workshop manual for the diagnostic assist function activation procedure.

HF unit connection information

- Displays the connection conditions in the audio unit display and verifies the Bluetooth unit connection conditions.

HF unit software version

- Displays the Bluetooth unit software version in the audio unit, and verifies the Bluetooth unit specifications.

09-21 POWER SYSTEMS

POWER SYSTEMS

POWER SYSTEMS

id092100960000

Outline

- System in which electric current from the battery supplies power to each electrical part.
- There are mainly three types of electric power supply as follows, which are divided into system-supplied power and power used by parts.
  - — Supply of direct power from battery
  - — Supply of power by switching ignition ON (engine off)
  - — Supply of power by switching ignition ON (engine on)

Specification

SYKACTIV-G 2.0

Component parts	Specification	
Relay and fuse block	Wiring harness-integrated type	
Fuse block	Wiring harness-integrated type	
Relay box	Wiring harness-integrated type	
Main fuse	DCDC fuse rating	50 A
	EPS fuse rating	60 A
	MAIN fuse rating	200 A
	STARTER fuse rating	250 A
Push button start	Durable number of times	200,000 time
	Type	ON/OFF switch
Accessory socket	Rated voltage	DC 12 V
	Rated load	10 A

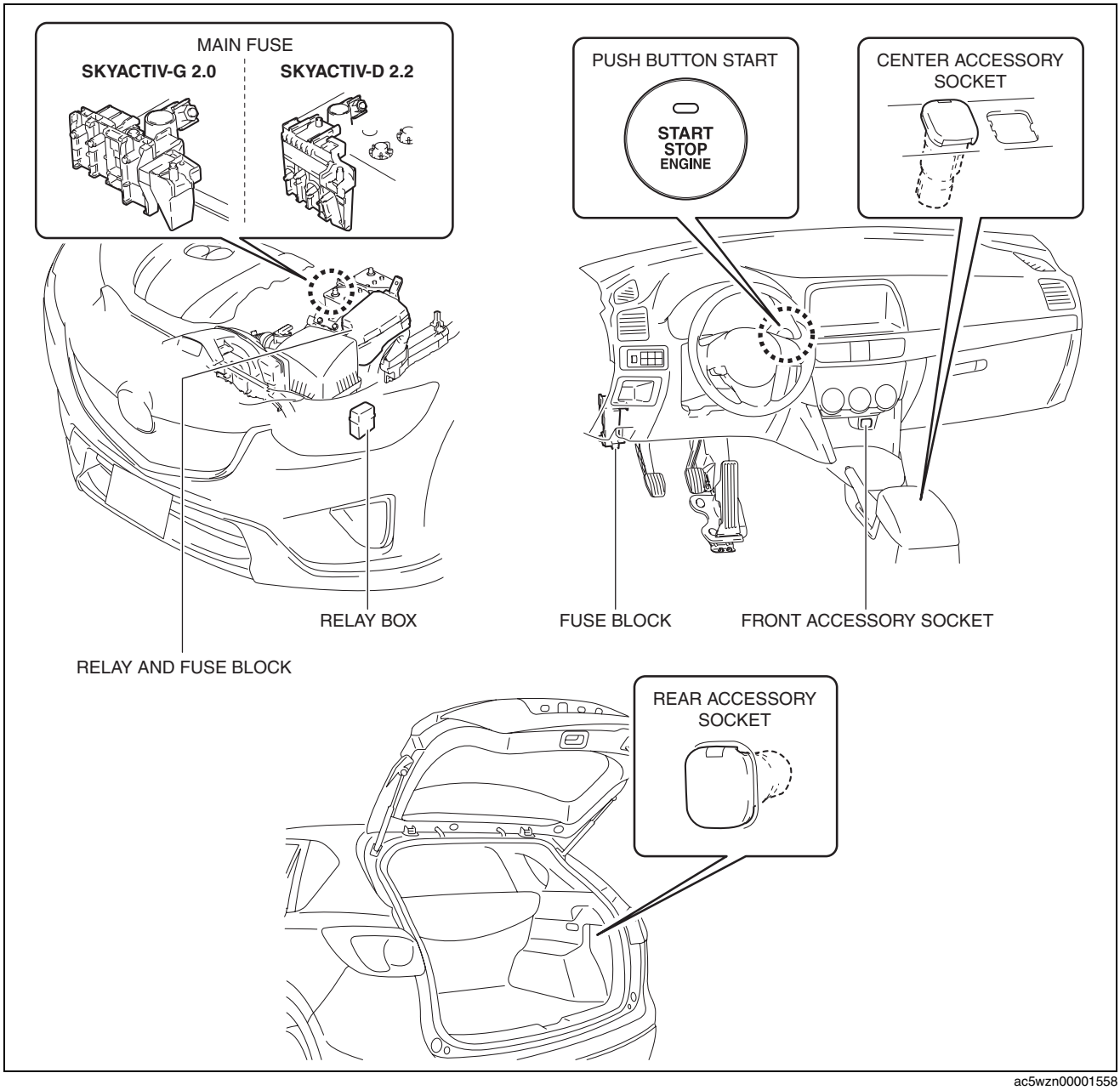
SKYACTIV-D 2.2

Component parts	Specification
Relay and fuse block	Wiring harness-integrated type
Fuse block	Wiring harness-integrated type
Relay box	Wiring harness-integrated type

POWER SYSTEMS

Component parts	Specification	
Main fuse	GLOW fuse rating	80 A
	EPS fuse rating	60 A
	PTC fuse rating	100 A
	MAIN fuse rating	200 A
	STARTER fuse rating	450 A
Push button start	Durable number of times	200,000 time
	Type	ON/OFF switch
Accessory socket	Rated voltage	DC 12 V
	Rated load	10 A

Structural view



ac5wzn00001558

RELAY AND FUSE BLOCK

id092100960100

Purpose

- Relays and fuses used by each system are grouped and housed together for smooth inspection and replacement servicing.

POWER SYSTEMS

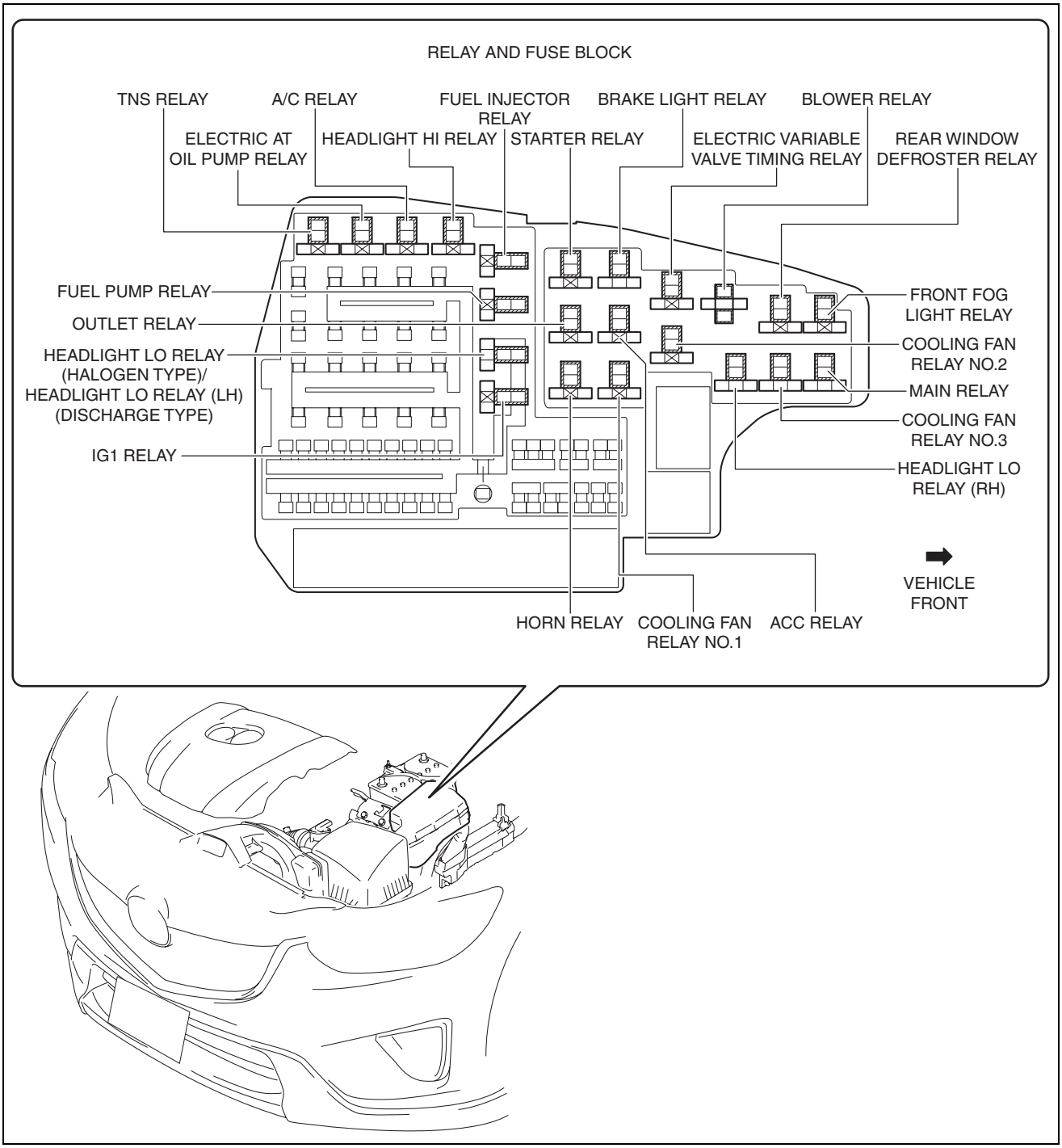
Function

- Relays and fuses used by each system are grouped and housed together.

Construction

- Installed in the engine compartment.

SKYACTIV-G 2.0



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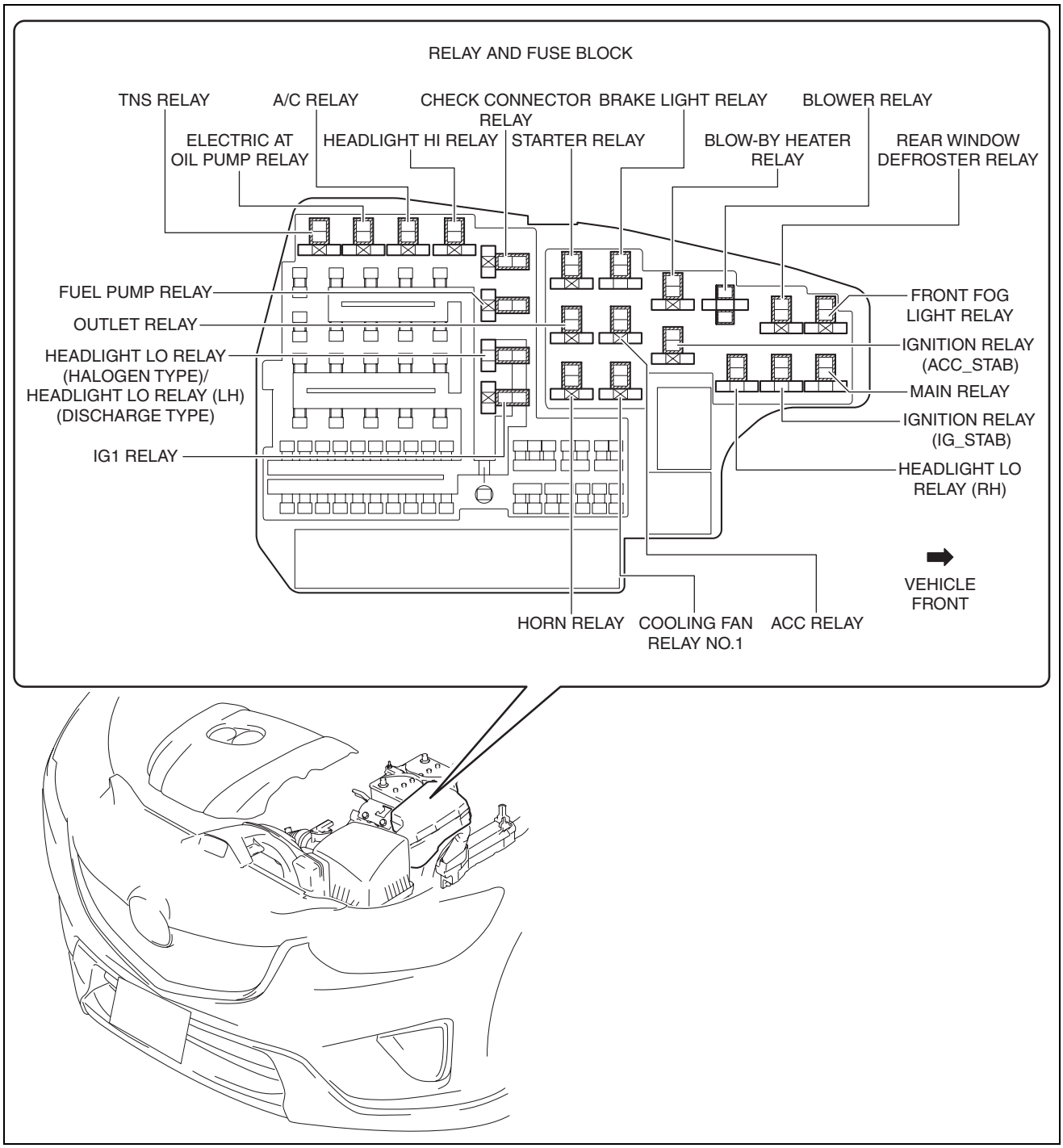
POWER SYSTEMS

SKYACTIV-D 2.2

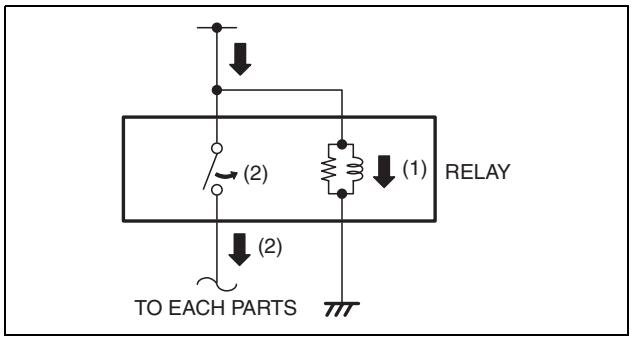


ac5wzn00001865

Operation
Relay operation

1. When electric current flows to the coil, electromagnetic power is generated.
2. The switch is attracted by the generated electromagnetic power and it switches on.
3. Electric current flows to each part that is downstream of the switch.

POWER SYSTEMS



ac5wzn00000289

Fuse operation
1. If electric current to each fuse is the specified value or more, the fuse melts due to heat generation.
2. Interrupts electric current flow downstream of the fuse.

Fail-safe
- Function not equipped.

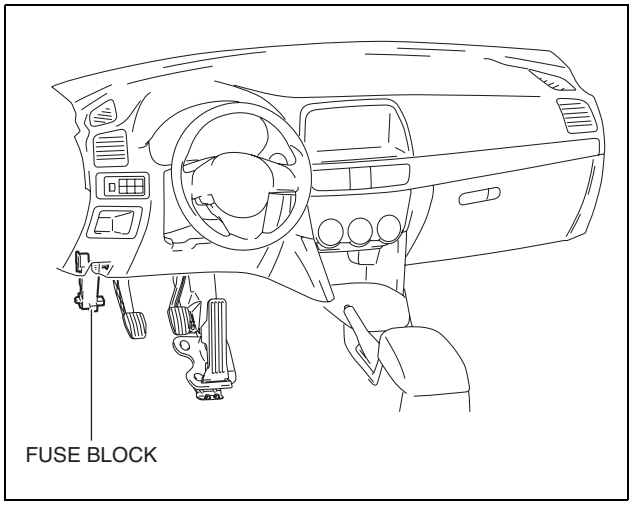
FUSE BLOCK

id092100528800

Purpose
- Fuses used by each system are grouped and housed together for smooth inspection and replacement servicing.

Function
- Fuses used by each system are grouped and housed together.

Construction
- Installed inside the front side trim (LH).



ac5wzn00000281

Operation
Fuse operation
1. If electric current to each fuse is the specified value or more, the fuse melts due to heat generation.
2. Interrupts electric current flow downstream of the fuse.

Fail-safe
- Function not equipped.

RELAY BOX

id092100900300

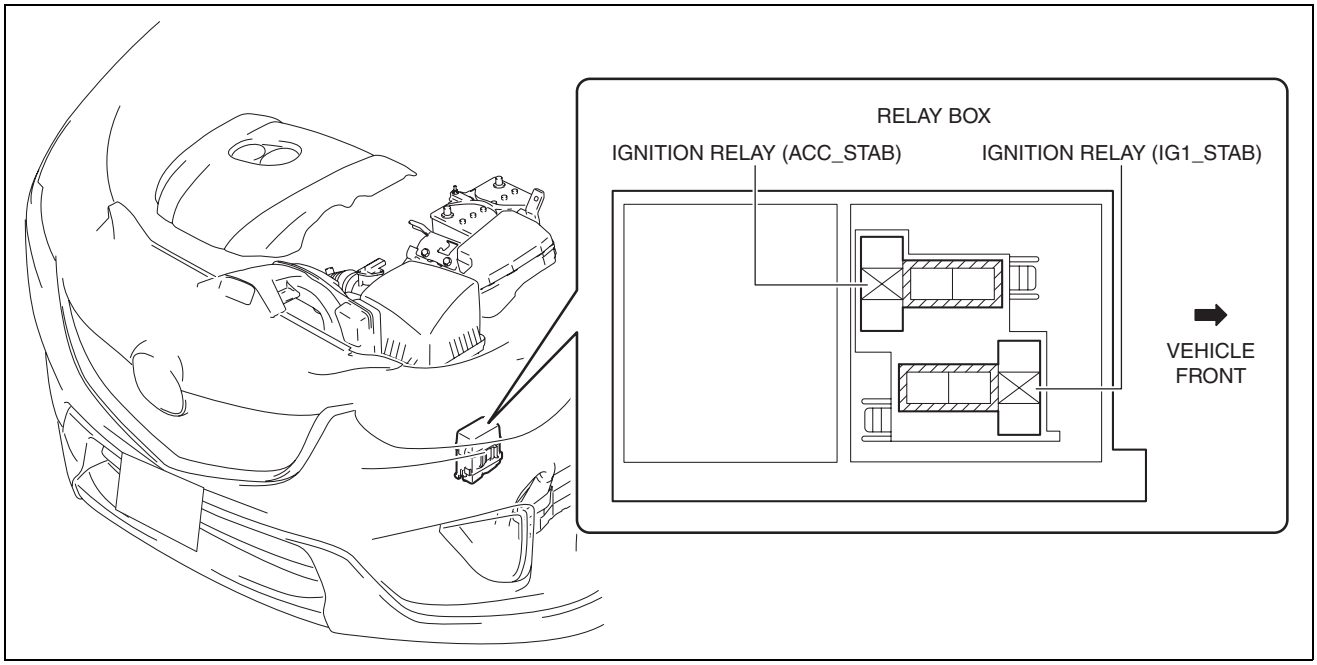
Purpose
- Relays used by each system are grouped and housed together for smooth inspection and replacement servicing.

POWER SYSTEMS

Function
- Relays used by each system are grouped and housed together.

Construction
- Installed the inside front bumper.

SKYACTIV-G 2.0



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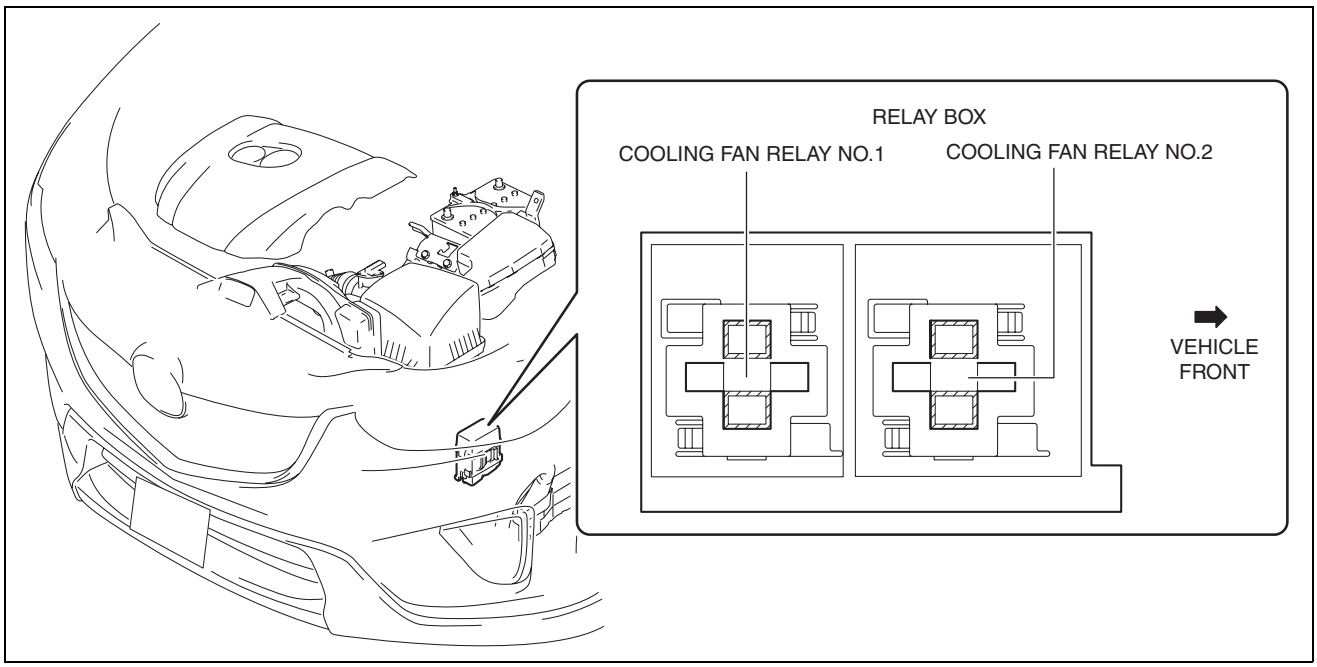
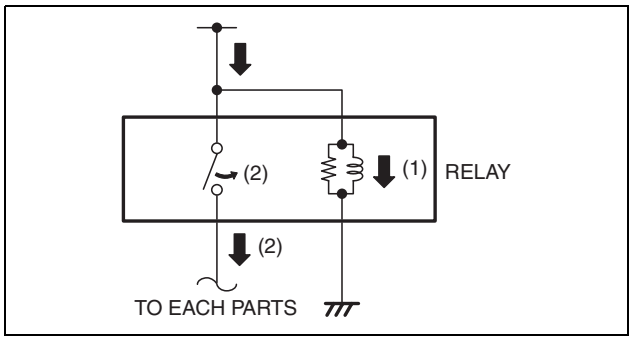
SKYACTIV-D 2.2



ac5wzn00001871

Operation
Relay operation
1. When electric current flows to the coil, electromagnetic power is generated.
2. The switch is attracted by the generated electromagnetic power and switches on.
3. Electric current flows to each part downstream of the fuse.

POWER SYSTEMS



ac5wzn00000285

Fail-safe
- Function not equipped.

POWER SUPPLY SWITCHING

id092100205000

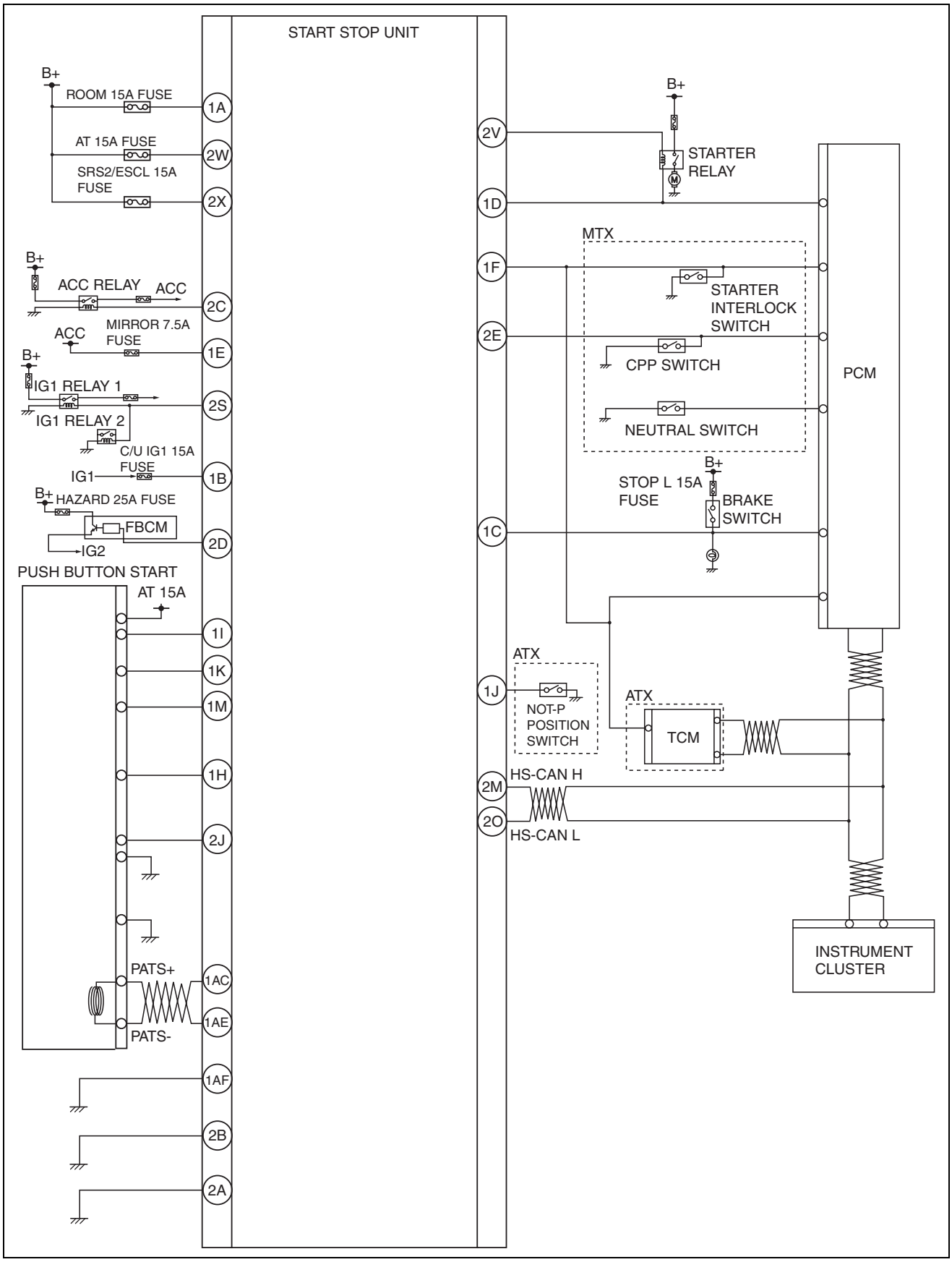
Outline
- By pressing the push button start, switching of the power supply is performed.

Function
- The start stop unit switches the power supply according to the vehicle conditions such as the selector lever (ATX)/shift lever (MTX) position and the pedal depression/release when the push button start is pressed.

Push button start indicator light
- Illuminates the push button start indicator light to notify the driver of the power supply status.

POWER SYSTEMS

System wiring diagram



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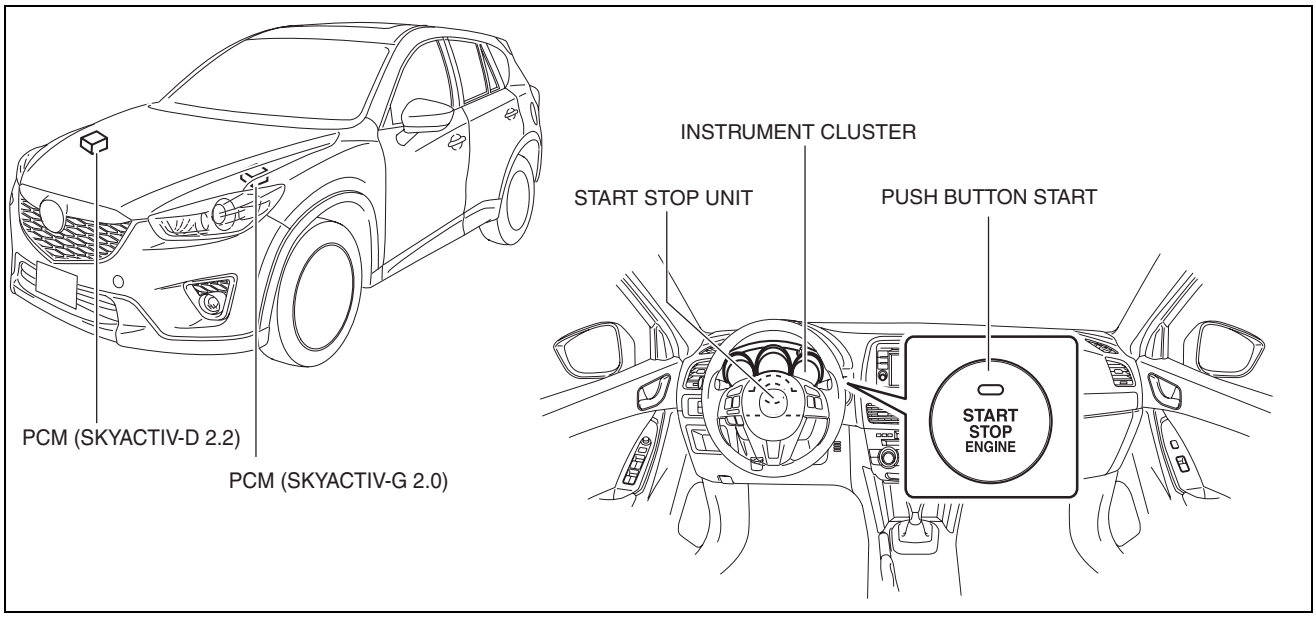
POWER SYSTEMS

Structural view



ac5wzn00001522

Operation

Switches between ignition switch ON (engine on)/ON (engine off)/ACC/ OFF (LOCK).

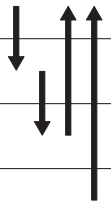
1. When the push button start is pressed, a push button start switch signal is input to the start stop unit.
2. The power supply switches according to the vehicle conditions such as the selector lever (ATX)/shift lever (MTX) position and the pedal depression/release.

Note

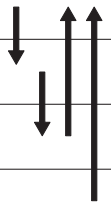
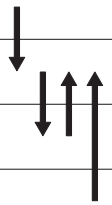
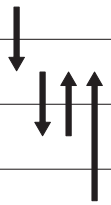
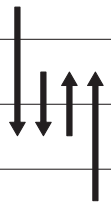
- Refer to the Push Button Start System Engine Start Permit Function regarding the engine starting conditions.

POWER SYSTEMS

MTX

IGNITION	SHIFT LEVER POSITION	
	ALL	
	CLUTCH PEDAL RELEASED	CLUTCH PEDAL DEPRESSED
OFF (LOCK)*		
ACC		
ON (ENGINE OFF)		
ON (ENGINE ON)		

ATX

IGNITION	SELECTOR LEVER POSITION					
	P		N		OTHER THAN P AND N	
	BRAKE PEDAL RELEASED	BRAKE PEDAL DEPRESSED	BRAKE PEDAL RELEASED	BRAKE PEDAL DEPRESSED	BRAKE PEDAL RELEASED	BRAKE PEDAL DEPRESSED
OFF (LOCK)*						
ACC						
ON (ENGINE OFF)						
ON (ENGINE ON)						

ac5wzn00000290

* : To switch the ignition to ACC or off (LOCK) from ON (engine on), a vehicle speed of 5 km/h {3 mph} or less is required.

Automatic ignition switch off
- If the ignition has been switched ON (engine off) or switched to ACC for 60 min or more, the start stop unit automatically switches the ignition off (LOCK).

Engine Emergency Stop
- If an ignition switch ON signal is input for 3 s or more (ignition switch held pressed), or a push button start ON signal is input 3 times within 1.5 s, the start stop unit switches the ignition to ACC or off (LOCK).

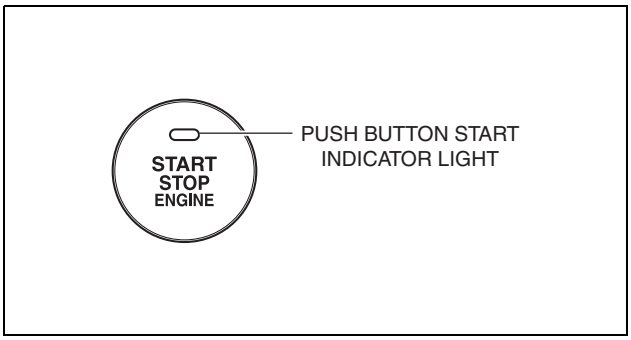
Push button start indicator light
Green illumination
- Illuminates if the conditions necessary for engine-start are met.

Green flashing
- Flashes when the steering lock cannot be released.

Amber illumination
- Illuminates when the steering lock has been released or there is a malfunction in the system.

Amber flashing
- Flashes when a malfunction is detected.

POWER SYSTEMS



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Fail-safe
- Function not equipped.

MAIN FUSE

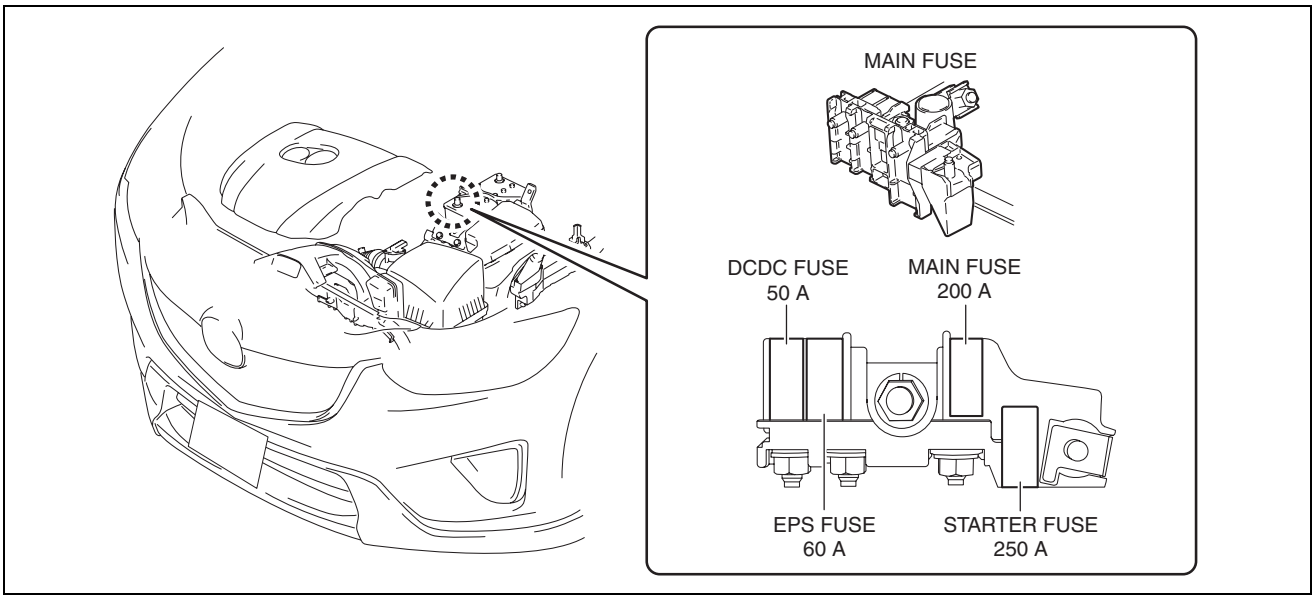
id092100800000

Purpose
- If electric current of the specified value or more flows to each fuse, the fuse melts due to heat generation to protect the systems and parts downstream of the fuse.

Function
- If electric current to each fuse is the specified value or more, the fuse melts due to heat generation.

Construction
- Installed to the battery terminal (+).

SKYACTIV-G 2.0



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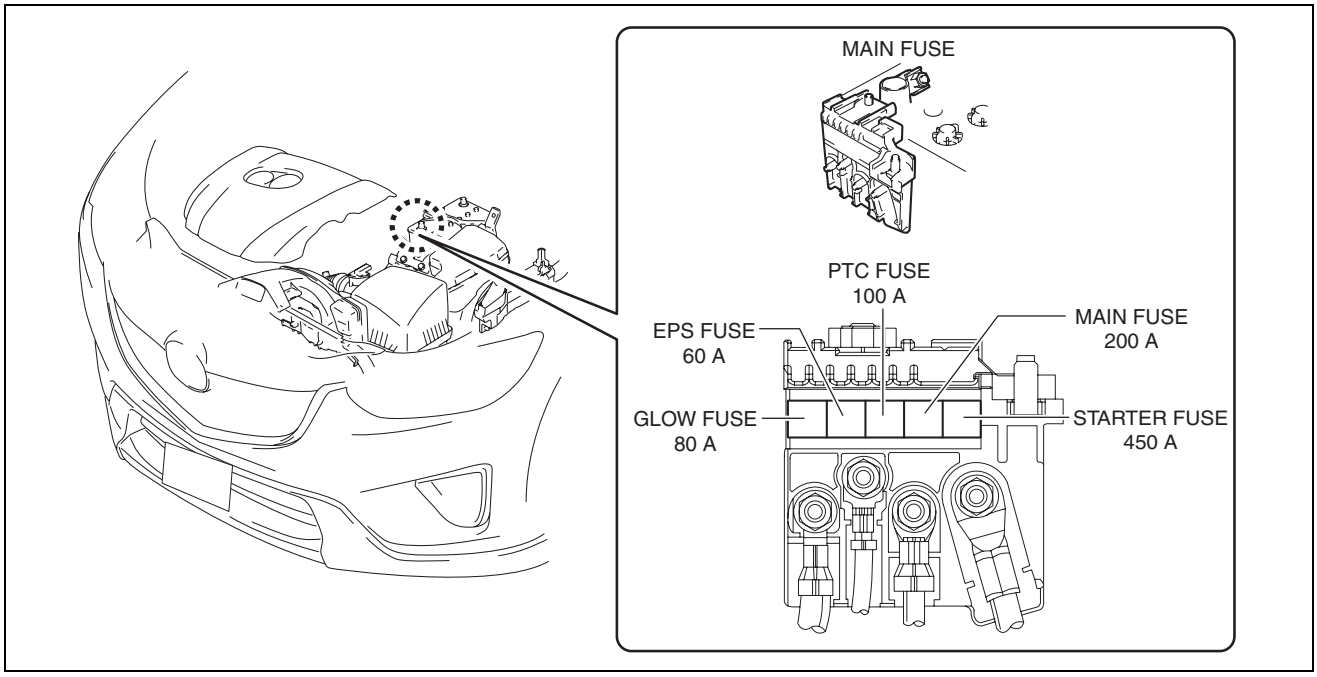
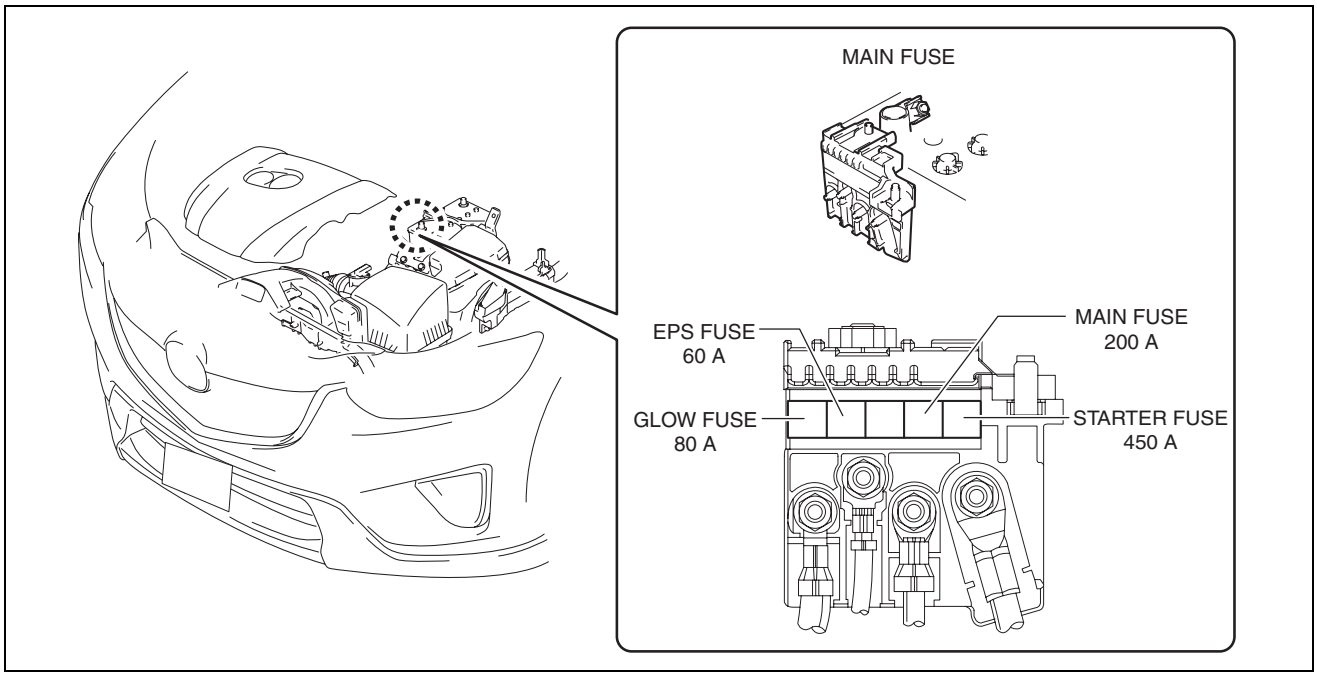
POWER SYSTEMS

SKYACTIV-D 2.2
European (L.H.D.) specs., General (L.H.D.) specs., China specs.



ac5wzn00001873

Except European (L.H.D.) specs., General (L.H.D.) specs., China specs.



ac5wzn00001872

Operation
1. If electric current to each fuse is the specified value or more, the fuse melts due to heat generation.
2. Interrupts electric current flow downstream of the fuse.

Fail-safe
- Function not equipped.

PUSH BUTTON START

id092100900200

Purpose
- By pressing the switch ON/OFF, the push button start notifies the start stop unit of the user power supply switching operation.

POWER SYSTEMS

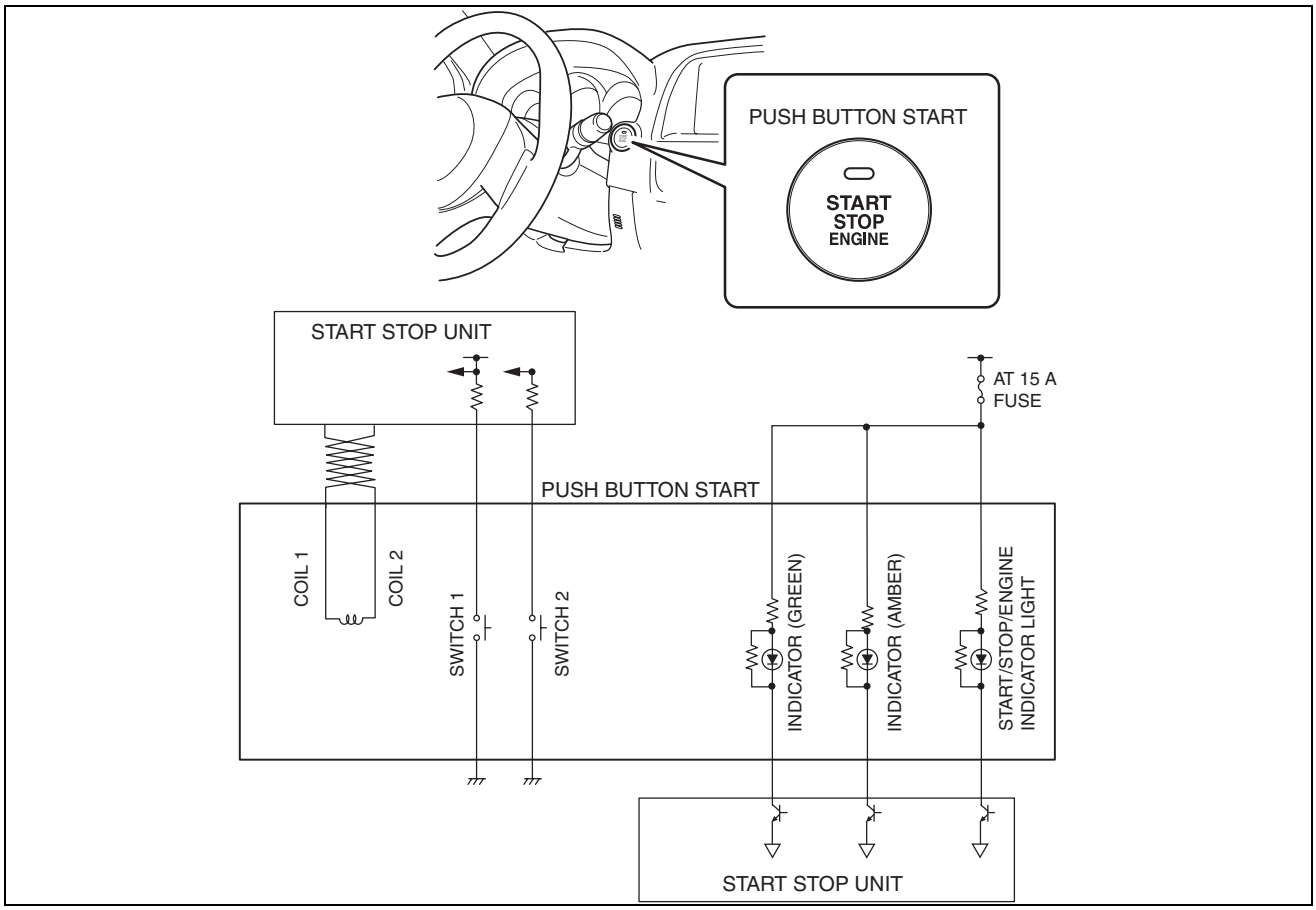
Function

START/STOP/ENGINE indicator light

- The characters in the push button start illuminate to notify the user of the button position.

Construction

- The push button start is installed in the meter hood.
- Two types of switches are integrated in the push button start.
- The push button start has the following integrated indicators. For the indicator inspection conditions, refer to the.
  - — ACC indicator
  - — ON indicator
  - — Indicator (green)
  - — Indicator (amber)
- The push button start has an integrated coil antenna for the immobilizer system. (See 09-14-72 COIL ANTENNA.)



ac5wzn00001523

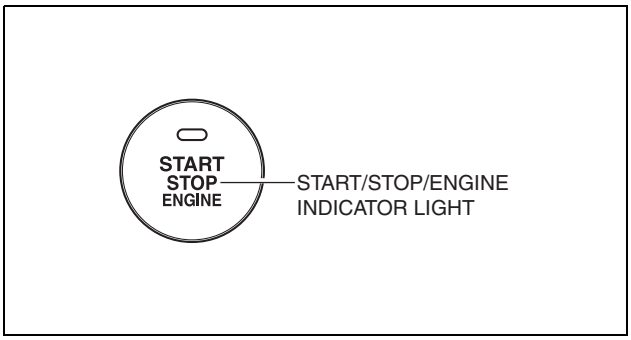
Operation

- When the push button start is pressed, switches 1 and 2 turn on (contact point: closed), and when released, it turns off (contact point: open).

START/STOP/ENGINE indicator light

- When a door is open/closed, the START/STOP/ENGINE indicator light illuminates when the headlights are turned on.

POWER SYSTEMS



ac5wzn00001087

Fail-safe
- Function not equipped.

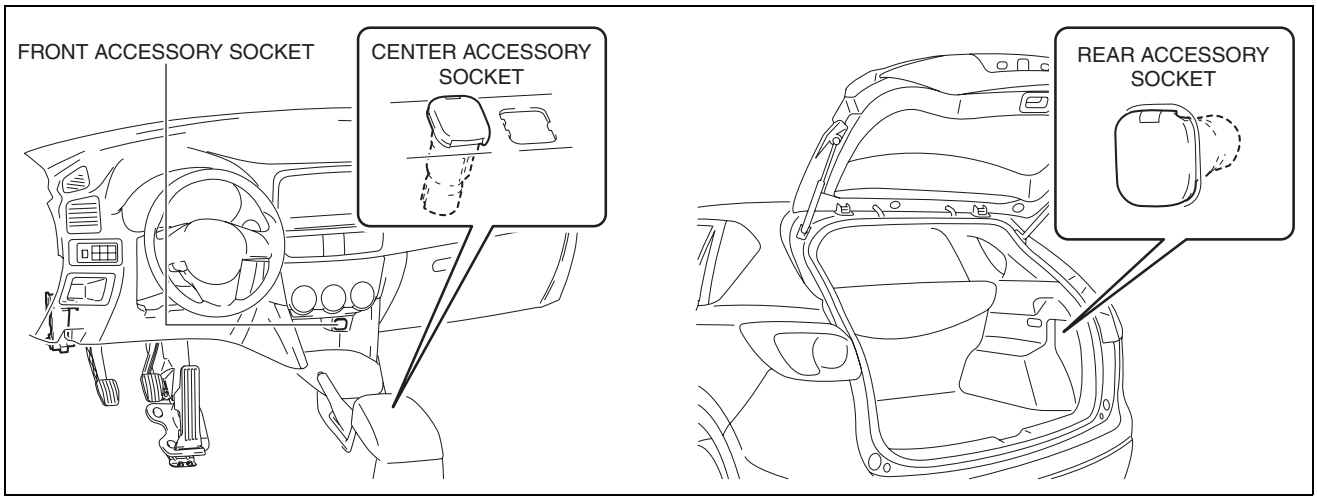
ACCESSORY SOCKET

id092100900400

Purpose
- By inserting the plug of an electrical device, 12 V (maximum 120 W) of power is supplied enabling use of the electrical device in the vehicle.

Function
- When the ignition is switched to ACC or ON (engine off or on), 12 V (maximum 120 W) of power is supplied.

Construction
- A cap is installed to prevent penetration of foreign matter in the socket such as dust.
- A front accessory socket is installed to the front console.
- A center accessory socket is installed inside the rear console.
- A rear accessory socket is installed to the trunk side trim (RH).



ac5wzn00000286

Operation
1. When the ignition is switched to ACC or ON (engine on or off), power is supplied constantly.

Fail-safe
- Function not equipped.

09-22 INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

id092200018200

Outline

- An LCD has been adopted to the instrument cluster which displays the ambient temperature, trip computer, and odometer/tripmeter. (Without TFT LCD)
- A TFT LCD has been adopted to the instrument cluster which displays the door-ajar warning light, trip computer, and warning messages. (With TFT LCD)
- A rear vehicle monitoring (RVM) system has been adopted which notifies the driver of vehicles approaching from behind and warns the driver if the driver tries to change lanes to the side of the approaching vehicle. (With rear vehicle monitoring (RVM) system)
- A blind spot monitoring (BSM) system has been adopted which notifies the driver of vehicles approaching from behind on the left or right adjacent lanes in the driver's blind spot, and warns the driver if the driver tries to change lanes to the side of the approaching vehicle. (With blind spot monitoring (BSM) system)
- A parking assist system has been adopted which detects obstructions in the blind spot (vehicle front/rear/corners) to a wide extent using ultrasonic sensors and notifies the driver of the obstructions. (With parking sensor system)
- A lane departure warning system (LDWS) has been adopted which recognizes vehicle lane lines on the road using the forward sensing camera (FSC) installed to the windshield and notifies the driver if the vehicle may depart from its lane unbeknownst to the driver. (With lane departure warning system (LDWS))
- A clock has been adopted to the LCD which displays the current time, passenger/rear seat belt warning light, and front passenger air bag deactivation indicator light. (With manual A/C)

INSTRUMENTATION/DRIVER INFO.

Specification

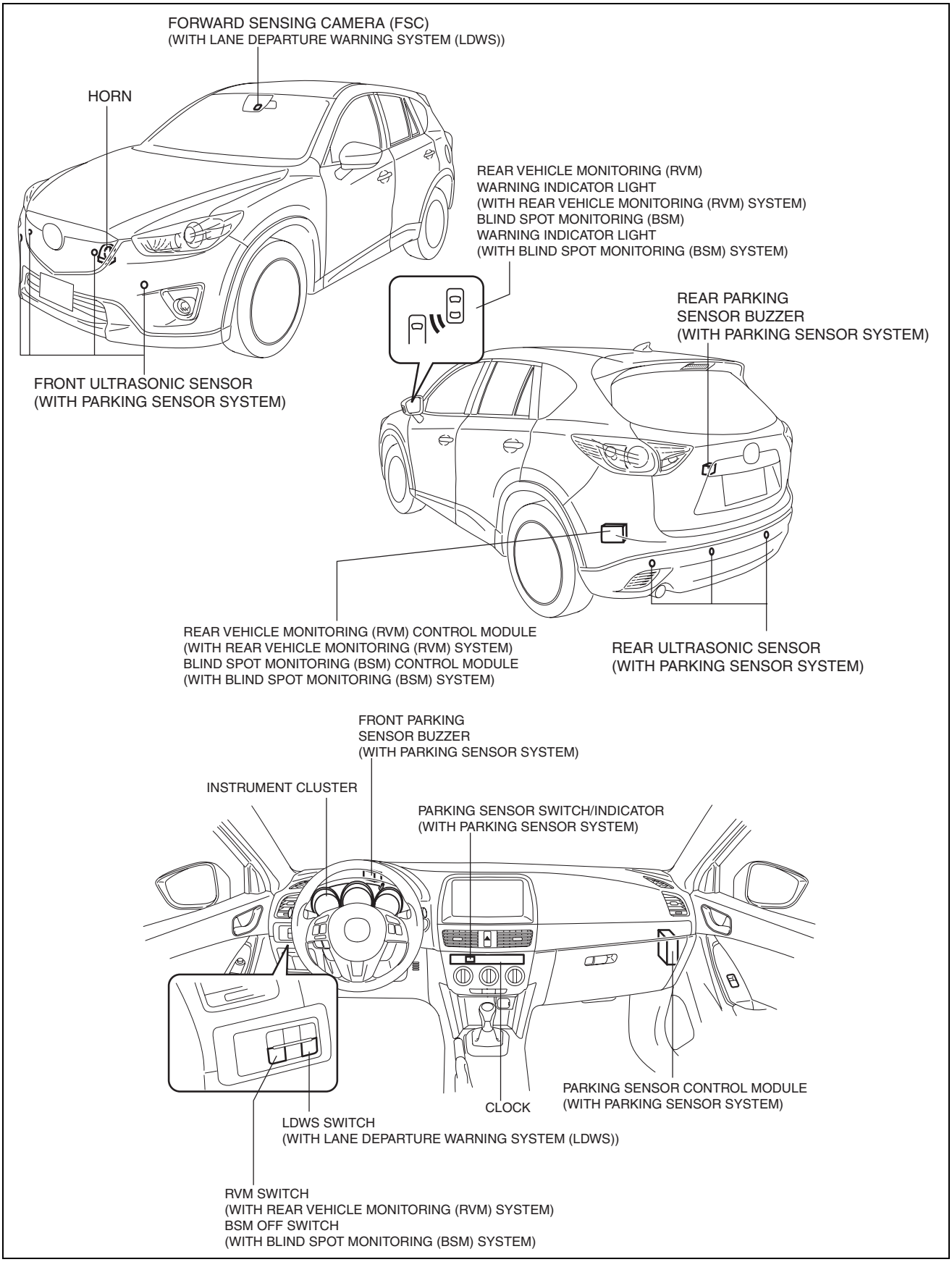
Item			Specification
Instrument cluster	Warning lights	Brightness level (cd/m^2)	200—300
		Light source	LED
	Indicator lights	Brightness level (cd/m^2)	85—135
		Light source	LED
	Warning beep	Oscillation frequency (Hz)	1,000—2,200
		Output sound pressure (dB)	46.0—72.5
	Display sound	Oscillation frequency (Hz)	1,700—1,800
		Output sound pressure (dB)	50.0—60.0
	Speedometer	System	Stepping motor type
		Display	Analog needle
		Input signal communication system	CAN system
	Tachometer	System	Stepping motor type
		Display	Analog needle
		Input signal communication system	CAN system
	Low engine coolant temperature indicator light/High engine coolant temperature warning light	Operation	(See 09-22-37 LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED).)
		Input signal communication system	CAN system

INSTRUMENTATION/DRIVER INFO.

Instrument cluster	Fuel gauge	System		LCD															
		Input signal source		Fuel gauge sender unit															
		Remaining fuel quantity (L {US gal, Imp gal}) in fuel tank	Segment indication number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			2WD	6—8 {1.6 — 2.1, 1.4— 1.7}	8— 10 {3.0 — 2.6, 2.0 — 2.1}	10 — 12 {2.7 — 3.1, 2.2 — 2.6}	12 — 14 {3.2 — 3.6, 2.7 — 3.0}	14 — 16 {3.7 — 4.2, 3.1 — 3.5}	16 — 18 {4.3 — 4.7, 3.6 — 3.9}	18 — 22 {4. 8— 5.8, 4.0 — 4.8 }	22 — 25 {5. 9— 6.6, 4.9 — 5.4 }	25 — 29 {6. 7— 7.6, 5.5 — 6.3 }	29 — 33 {7. 7— 8.7, 6.4 — 7.2 }	33 — 37 {8. 8— 9.7, 7.3 — 8.1 }	37 — 40 {9. 8— 10. 0, 8.2 — 8.7 }	40 — 44 {10 .6 — 11. 6, 8.8 — 9.6 }	44 — 48 {11 .7 — 12. 6, 9.7 — 10. 0}	48 — 56 {13 — 14, 11 — 12}
			4WD	6—8 {1.6 — 2.1, 1.4— 1.7}	8— 10 {3.0 — 2.6, 2.0 — 2.1}	10 — 12 {2.7 — 3.1, 2.2 — 2.6}	12 — 14 {3.2 — 3.6, 2.7 — 3.0}	14 — 16 {3.7 — 4.2, 3.1 — 3.5}	16 — 18 {4.3 — 4.7, 3.6 — 3.9}	18 — 22 {4. 8— 5.8, 4.0 — 4.8 }	22 — 26 {5. 9— 6.8, 4.9 — 5.7 }	26 — 30 {6. 9— 7.9, 5.8 — 6.5 }	30 — 34 {8. 0— 8.9, 6.6 — 7.4 }	34 — 38 {9. 0— 10. 0, 7.5 — 8.3 }	38 — 42 {10 .1 — 11, 8.4 — 9.2 }	42 — 46 {11 .1 — 12. 1, 9.3 — 10. 0}	46 — 50 {12 .2 — 13. 2, 10. 2— 10. 9}	50 — 58 {14 — 15, 11 — 12}
		Remaining fuel level (L {US gal, Imp gal}) when fuel tank level warning light illuminates	2WD	Approx. 10 {2.6, 2.2}														
			4WD															
		Invalid remaining fuel level. (L {US gal, Imp gal})	2WD	Approx. 1.36 {0.359, 0.299}														
			4WD	Approx. 0.45 {0.12, 0.099}														
	Odometer	System		LCD														
		Display area		0—999,999														
		Minimum display unit (km {mile})		1 {0.6}														
		Input signal communication system		CAN system														
	Tripmeter	System		LCD														
		Display area		Returns to 0.0 from 999.9, calculation continues														
		Minimum display unit (km {mile})		0.1 {0.06}														
		Input signal communication system		CAN system														
Horn	Type A	Oscillation frequency (Hz)		390—440														
		Waveform		Spiral														
	Type B	Oscillation frequency (Hz)		385—425														
		Waveform		Spiral														

INSTRUMENTATION/DRIVER INFO.

Structural view



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INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO. PERSONALIZATION

id092200018400

- A personalization function has been adopted with which settings for each function can be changed.

Instrument Cluster
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
Lights-on Reminder Volume.	The volume for the lights-on reminder warning alarm can be changed.	Large	Not Adopted. / OFF / Low / High	Instrument cluster
Turn Signal Volume.	The volume of the turn and hazard indicator alarm can be changed.	Large	Not Adopted. / Low / High	Instrument cluster

Using instrument cluster (with TFT LCD display)

TFT LCD display	Function	Initial setting	Setting contents	Control unit
Turn Signal	The volume of the turn and hazard indicator alarm can be changed.	High	High / Low	Instrument cluster
Light-on	The volume for the lights-on reminder warning alarm can be changed.	High	High / Low / OFF	Instrument cluster

Rear Vehicle Monitoring (RVM) System
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
RVM Volume.	The volume of the rear vehicle monitoring (RVM) warning alarm can be changed.	High	Not Adopted. / OFF / Low / High	Instrument cluster

Using instrument cluster (with TFT LCD display)

TFT LCD display	Function	Initial setting	Setting contents	Control unit
Volume	The volume of the rear vehicle monitoring (RVM) warning alarm can be changed.	High	High / Low / OFF	Instrument cluster

Blind Spot Monitoring (BSM) System

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
BSM Volume.	The volume of the blind spot monitoring (BSM) warning alarm can be changed.	High	Not Adopted. / OFF / Low / High	Instrument cluster

Lane Departure Warning System (LDWS)
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
LDWS Timing.	The warning operation timing of the lane departure warning system (LDWS) can be changed.	Adaptive	Not Adopted / Adaptive / Early / Medium / Late	Forward sensing camera (FSC)
LDWS Warning.	The warning operation sensitivity of the lane departure warning system (LDWS) can be changed.	Medium	Not Adopted. / Often / Medium / Rare	Forward sensing camera (FSC)

INSTRUMENTATION/DRIVER INFO.

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
LDWS Volume.	The volume of the LDWS warning alarm can be changed.	Volume 3	Not Adopted. / Volume 1 / Volume 2 / Volume 3	Instrument cluster
LDWS Sound.	The type of the LDWS warning alarm can be changed.	Rumble	Beep / Rumble	Instrument cluster

Using instrument cluster (with TFT LCD display)

TFT LCD display	Function	Initial setting	Setting contents	Control unit
Timing	The warning operation timing of the lane departure warning system (LDWS) can be changed.	Adaptive	Early / Medium / Late / Adaptive	Instrument cluster
Warning	The warning operation sensitivity of the lane departure warning system (LDWS) can be changed.	Medium	Often / Medium / Rare	Instrument cluster
Sound	The type of LDWS warning alarm can be changed.	Rumble	Rumble / Beep	Instrument cluster
Volume	The volume of the LDWS warning alarm can be changed.	Low	High / Medium / Low	Instrument cluster
Volume	The high and low range of the LDWS warning alarm can be changed.	Low	High / Low	Instrument cluster

INSTRUMENT CLUSTER

id092200018500

Outline

- The instrument cluster centrally controls the speedometer, tachometer, odometer/tachometer, fuel gauge, warning/indicator lights, TFT LCD (with TFT LCD), trip computer, warning sounds and panel lights.

Function

- The instrument cluster displays the following information to notify the user of the vehicle conditions.
  - — Vehicle speed (speedometer)
  - — Engine speed (tachometer)
  - — Remaining fuel quantity (fuel gauge)
  - — Traveled distance (odometer/tripmeter)
  - — Indicator/warning lights
  - — Indicator/warning messages (with TFT LCD)
  - — Average fuel economy, average vehicle speed, instantaneous fuel economy, remaining distance to empty (trip computer)

Speedometer display function

- The instrument cluster controls the needle based on the vehicle speed signal sent via CAN transmission from the PCM, and displays the current vehicle speed. For details on the speedometer, refer to 09-22-48 SPEEDOMETER.

Tachometer display function

- The instrument cluster controls the needle based on the engine speed signal sent via CAN transmission from the PCM, and displays the current engine speed. For details on the tachometer, refer to 09-22-49 TACHOMETER.

Fuel gauge display function

- The instrument cluster displays the remaining fuel quantity based on the fuel gauge resistance signal sent via CAN transmission from the RBCM, and the fuel injection amount signal sent via CAN transmission from the PCM. For details on the fuel gauge, refer to 09-22-50 FUEL GAUGE.

INSTRUMENTATION/DRIVER INFO.

Odometer/tripmeter display function

- The instrument cluster displays the total traveled distance/traveled distance over a specific interval based on the travel distance signal sent via CAN transmission from the PCM. For details on the odometer/speedometer, refer to 09-22-52 ODOMETER/TRIPMETER.

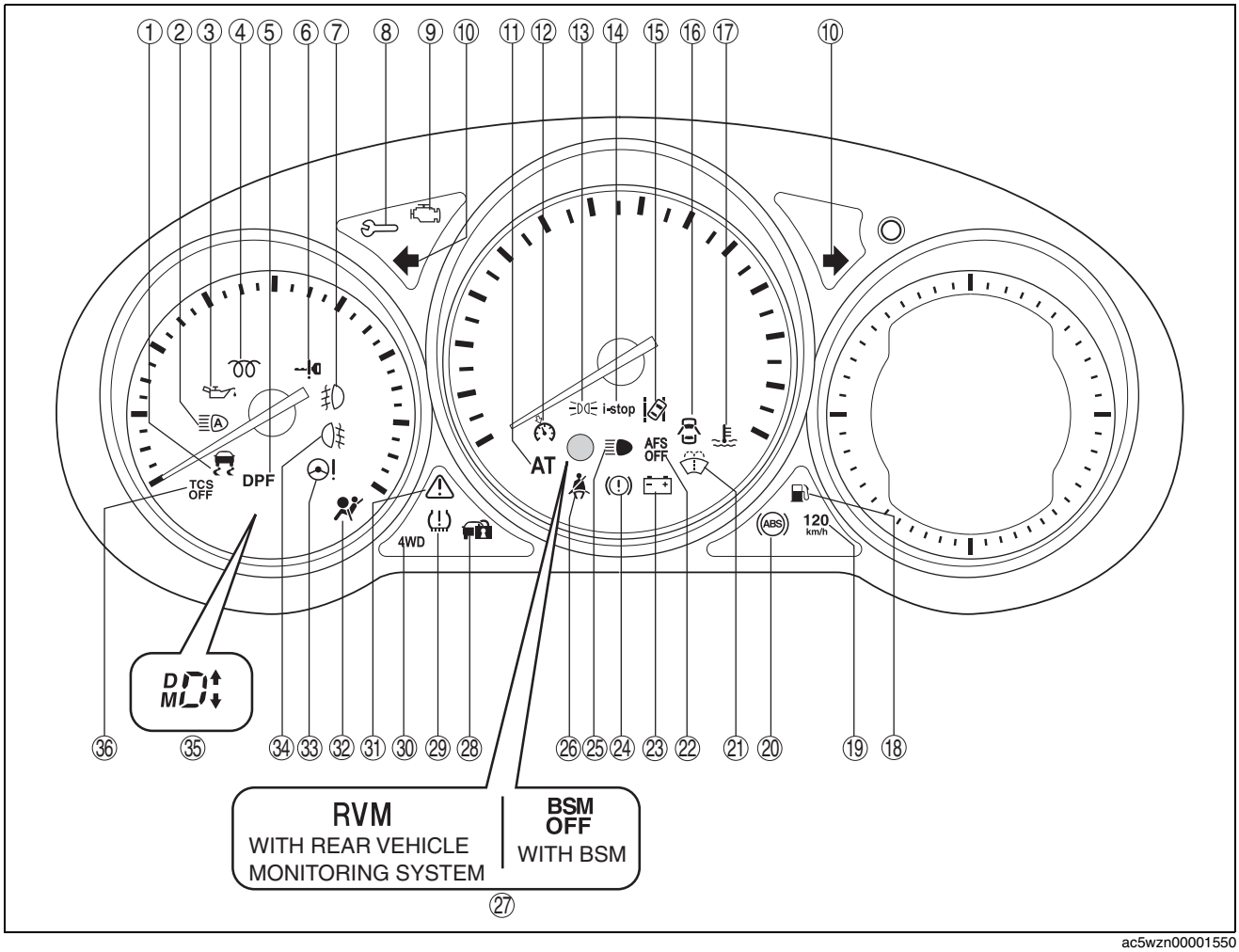
Trip computer calculation function

- The instrument cluster calculates the average fuel economy, average vehicle speed, instantaneous fuel economy, and the remaining distance to empty, and displays it on the LCD in the instrument cluster. For details on the trip computer, refer to 09-22-56 TRIP COMPUTER INFORMATION SYSTEM.

Warning/Indicator lights

- The instrument cluster illuminates/flashes the indicator/warning lights to notify the user of the vehicle system conditions.
- The types of indicator/warning lights are as follows: Refer to reference for details on each indicator/warning light.

Without TFT LCD display



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×: Applicable
—: Not applicable

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
1		TCS/DSC indicator light	—	×	(See 04-15-43 TCS/DSC INDICATOR LIGHT.)

INSTRUMENTATION/DRIVER INFO.

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
2		High beam control (HBC) system indicator light (green)/high beam control system (hbc) warning light (amber)	With High beam control (HBC) system	×	(See 09-18-60 HBC INDICATOR LIGHT (GREEN)/ HBC WARNING LIGHT (AMBER).)
3		Engine oil warning light	—	×	(See 09-22-41 ENGINE OIL WARNING LIGHT.)
4		Glow indicator light	SKYACTIV-D 2.2	×	
5	DPF	Diesel particulate filter indicator light	SKYACTIV-D 2.2	×	
6		KEY warning light (red)/indicator light (green)	—	—	(See 09-14-72 KEY WARNING LIGHT (RED)/KEY INDICATOR LIGHT (GREEN).)
7		Front fog light indicator light	With front fog light	—	(See 09-18-62 FRONT FOG LIGHTS INDICATOR LIGHT.)
8		Wrench indicator light	SKYACTIV-D 2.2	×	
9		Check engine light	—	×	(See 01-02-29 CHECK ENGINE LIGHT [SKYACTIV-G 2.0].)
10		Turn signal/hazard warning indicator lights	—	—	(See 09-18-18 TURN SIGNAL/ HAZARD WARNING INDICATOR LIGHTS.)
11	AT	Automatic transaxle warning light	ATX	×	(See 05-17A-66 AUTOMATIC TRANSAXLE WARNING LIGHT [FW6A-EL, FW6AX-EL].)
12		Cruise main indicator light (amber)/cruise set indicator light (green)	With cruise control system	×	(See 01-20A-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-G 2.0].) (See 01-20A-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].) (See 01-20B-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-D 2.2].) (See 01-20B-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-D 2.2].)

INSTRUMENTATION/DRIVER INFO.

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
13		Lights-on indicator light	—	—	(See 09-18-16 LIGHTS-ON INDICATOR LIGHT.)
14	i-stop	i-stop warning light (amber)/indicator light (green)	With i-stop system	×	(See 01-40-59 i-stop INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].) (See 01-40-65 i-stop WARNING LIGHT (AMBER) [SKYACTIV-G 2.0].)
15		Lane departure warning system (LDWS) indicator light (green)/lane departure warning system (LDWS) warning light (amber)	With LDWS	×	(See 09-22-122 LDWS INDICATOR LIGHT (GREEN)/ LDWS WARNING LIGHT (AMBER).)
16		Door-ajar warning light	—	—	(See 09-22-40 DOOR-AJAR WARNING LIGHT.)
17		Low engine coolant temperature indicator light (blue)/high engine coolant temperature warning light (red)	—	×	(See 09-22-37 LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED).)
18		Low fuel warning light	—	—	(See 09-22-45 LOW FUEL WARNING LIGHT.)
19	120 km/h	120 km/h warning light	With 120 km/h warning light	×	(See 09-22-47 120 km/h WARNING LIGHT.)
20		ABS warning light	—	×	(See 04-15-42 BRAKE SYSTEM/ ABS WARNING LIGHT.)
21		Low washer fluid level warning light	—	—	(See 09-19-55 WASHER FLUID-LEVEL SENSOR.)
22	AFS OFF	AFS OFF indicator light	With AFS	×	(See 09-18-46 AFS OFF INDICATOR LIGHT.)
23		Charging system warning light	—	×	(See 01-17A-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-G 2.0].) (See 01-17B-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-D 2.2].)

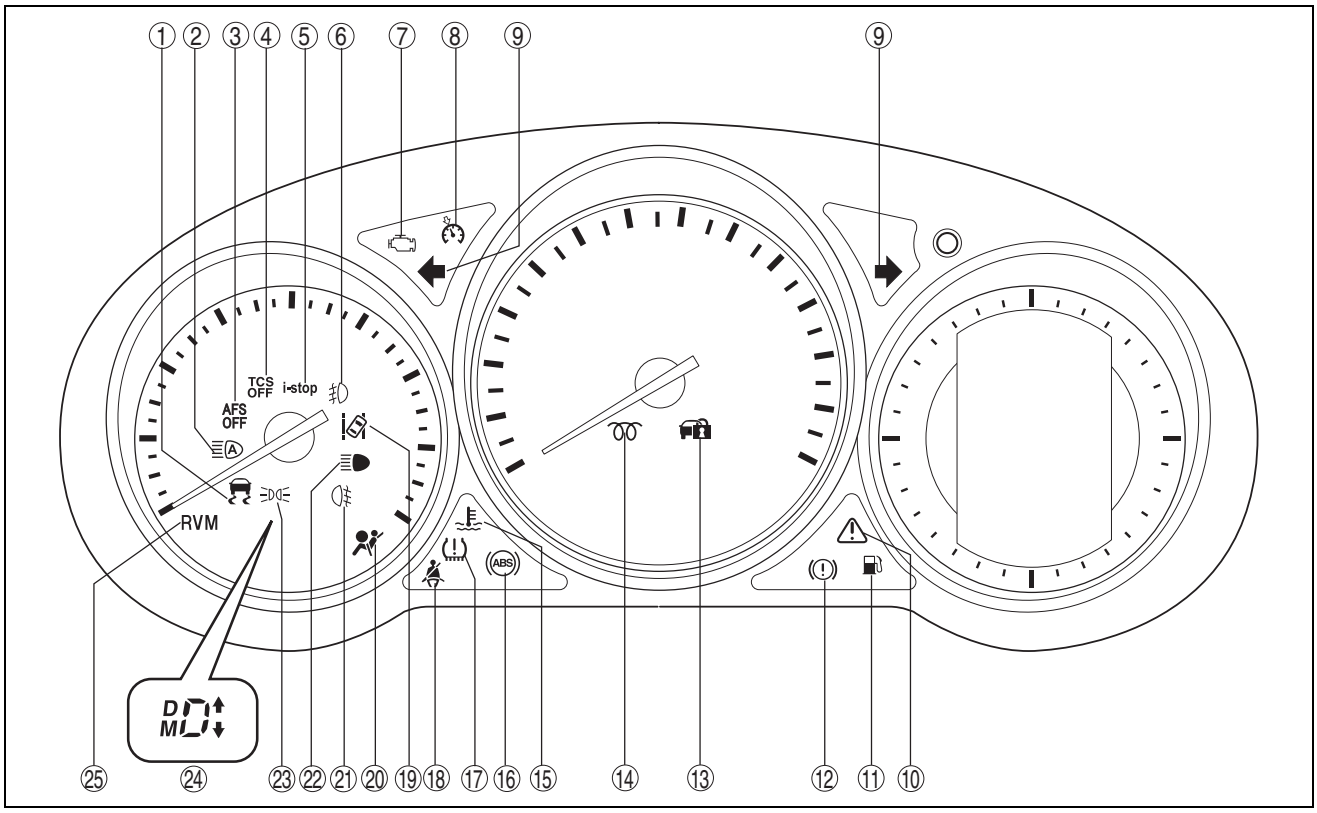
INSTRUMENTATION/DRIVER INFO.

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
24		Brake system warning light	—	×	(See 04-15-42 BRAKE SYSTEM/ ABS WARNING LIGHT.)
25		Headlight high-beam indicator light	—	—	(See 09-18-17 HEADLIGHT HIGH-BEAM INDICATOR LIGHT.)
26		Seat belt warning light	—	—	(See 09-22-42 SEAT BELT WARNING LIGHT.)
27	RVM	Rear vehicle monitoring (RVM) system warning light (amber)/indicator light (green)	With Rear Vehicle Monitoring (RVM) System	×	(See 09-22-82 REAR VEHICLE MONITORING (RVM) SYSTEM WARNING LIGHT (AMBER)/ INDICATOR LIGHT (GREEN).)
	BSM OFF	BSM OFF indicator light	With BSM	×	(See 09-22-91 BLIND SPOT MONITORING (BSM) OFF INDICATOR LIGHT.)
28		Security indicator light	With immobilizer system	×	(See 09-14-73 SECURITY INDICATOR LIGHT.)
29		Tire pressure monitoring system warning light	With TPMS	×	(See 02-12-7 TIRE PRESSURE MONITORING SYSTEM WARNING LIGHT.)
30	4WD	4WD warning light	With 4WD	×	(See 03-18-9 4WD WARNING LIGHT.)
31		Master warning light	—	×	(See 09-22-46 MASTER WARNING LIGHT.)
32		Air bag/front seat belt pretensioner system warning light	—	×	(See 08-10-7 AIR BAG SYSTEM WARNING LIGHT.)
33		Power steering malfunction indicator light	—	×	(See 06-13-16 POWER STEERING MALFUNCTION INDICATOR LIGHT.)
34		Rear fog light indicator light	With rear fog light	—	(See 09-18-79 REAR FOG LIGHT INDICATOR LIGHT.)

INSTRUMENTATION/DRIVER INFO.

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
35	D M	Shift position indicator/gear position indicator	ATX	—	(See 05-17A-65 SHIFT POSITION INDICATOR LIGHT [FW6A-EL, FW6AX-EL].) (See 05-17A-65 GEAR POSITION INDICATOR [FW6A-EL, FW6AX-EL].)
		Gear shift indicator	MTX (with gear shift indicator)	—	(See 01-40-66 GEAR SHIFT INDICATOR [SKYACTIV-G 2.0].)
36	TCS OFF	TCS OFF indicator light	—	×	(See 04-15-44 TCS OFF SWITCH, TCS OFF INDICATOR LIGHT.)

With TFT LCD display



ac5wzn00000947

×: Applicable

INSTRUMENTATION/DRIVER INFO.

—: Not applicable

No	Warning/ Indicator lights	Name	Messages*1	Master warning light simultaneous illumination	Comment	Warning/ indicator lights which illuminate during initial check	Reference
1		TCS/DSC indicator light	—	—	—	×	(See 04-15-43 TCS/DSC INDICATOR LIGHT.)
2		High beam control system (HBC) indicator light (green)/high beam control system (HBC) warning light (amber)	• HBC Inspection Required	×	With HBC System	×	(See 09-18-60 HBC INDICATOR LIGHT (GREEN)/ HBC WARNING LIGHT (AMBER).)
3	AFS OFF	AFS OFF indicator light	—	—	With AFS	×	(See 09-18-46 AFS OFF INDICATOR LIGHT.)
4	TCS OFF	TCS OFF indicator light	—	—	—	×	(See 04-15-44 TCS OFF SWITCH, TCS OFF INDICATOR LIGHT.)
5	i-stop	i-stop warning light (amber)/indicator light (green)	• Ready Apply more Brake Pressure • Can't be activated Turn Steering Wheel to Neutral • Can't be activatedAir Conditioninghas Priority • Can't be activated. •Steering wheel •Brake •Air Conditioning • Please Restart Engine	—	With i-stop system	×	(See 01-40-59 i-stop INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].) (See 01-40-65 i-stop WARNING LIGHT (AMBER) [SKYACTIV-G 2.0].)
6		Front Fog Light Indicator Light	—	—	With front fog light	—	(See 09-18-62 FRONT FOG LIGHTS INDICATOR LIGHT.)
7		Check engine light	• Engine Inspection Required	×	—	×	(See 01-02-29 CHECK ENGINE LIGHT [SKYACTIV-G 2.0].)

INSTRUMENTATION/DRIVER INFO.

No	Warning/ Indicator lights	Name	Messages*1	Master warning light simultaneous illumination	Comment	Warning/ indicator lights which illuminate during initial check	Reference
8		Cruise main indicator light (amber)/cruise set indicatorlight (green)	—	—	With cruise control system	×	(See 01-20A-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-G 2.0].) (See 01-20A-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].) (See 01-20B-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-D 2.2].) (See 01-20B-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-D 2.2].)
9		Turn signal/hazard warning indicator lights	—	—	—	—	(See 09-18-18 TURN SIGNAL/ HAZARD WARNING INDICATOR LIGHTS.)
10		Master warning light	• Battery Management System Inspection Required • Brake Override System Inspection Required • Vehicle System Inspection Required • FSC Inspection Required • SCBS Inspection Required	—	—	×	(See 09-22-46 MASTER WARNING LIGHT.)
11		Low fuel warning light	• Refill Fuel Tank	×	—	—	(See 09-22-45 LOW FUEL WARNING LIGHT.)
12		Brake system warning light	• Brake Fluid Level Low • Release Parking Brake • Brake Inspection Required	×	—	×	(See 04-15-42 BRAKE SYSTEM/ABS WARNING LIGHT.)

INSTRUMENTATION/DRIVER INFO.

No	Warning/ Indicator lights	Name	Messages*1	Master warning light simultaneous illumination	Comment	Warning/ indicator lights which illuminate during initial check	Reference
13		Security indicator light	—	—	—	×	(See 09-14-73 SECURITY INDICATOR LIGHT.)
14		Glow indicator light	—	—	SKYACTIV-D 2.2	×	
15		Low engine coolant temperature indicator light (blue)/high engine coolant temperature warning light (red)	• Engine Coolant Temperature High • Stop Vehicleat safe area	×	—	×	(See 09-22-37 LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED).)
16		ABS warning light	—	—	—	×	(See 04-15-42 BRAKE SYSTEM/ABS WARNING LIGHT.)
17		Tire pressure monitoring system warning light	• Check Tyre Pressure • TPMS Inspection Required • Tyre Pressure Monitor Initialized	×	With TPMS	×	(See 02-12-7 TIRE PRESSURE MONITORING SYSTEM WARNING LIGHT.)
18		Seat belt warning light	—	—	—	—	(See 09-22-42 SEAT BELT WARNING LIGHT.)
19		Lane departure warning system (LDWS) indicator light (green)/warning light (amber)	• LDWS Inspection Required	×	With LDWS	×	(See 09-22-122 LDWS INDICATOR LIGHT (GREEN)/ LDWS WARNING LIGHT (AMBER).)
20		Air bag/front seat belt pretensioner system warning light	—	—	—	×	(See 08-10-7 AIR BAG SYSTEM WARNING LIGHT.)
21		Rear fog light indicator light	—	—	With rear fog light	—	(See 09-18-79 REAR FOG LIGHT INDICATOR LIGHT.)
22		Headlight high-beam indicator light	—	—	—	—	(See 09-18-17 HEADLIGHT HIGH-BEAM INDICATOR LIGHT.)

INSTRUMENTATION/DRIVER INFO.

No	Warning/ Indicator lights	Name	Messages*1	Master warning light simultaneous illumination	Comment	Warning/ indicator lights which illuminate during initial check	Reference
23		Lights-on indicator light	• Headlights On	×	—	—	(See 09-18-16 LIGHTS-ON INDICATOR LIGHT.)
24		Shift position indicator/ gear position indicator	—	—	ATX	—	(See 05-17A-65 SHIFT POSITION INDICATOR LIGHT [FW6A-EL, FW6AX-EL].) (See 05-17A-65 GEAR POSITION INDICATOR [FW6A-EL, FW6AX-EL].)
		Gear shift indicator	—	—	MTX (with gear shift indicator)	—	(See 01-40-66 GEAR SHIFT INDICATOR [SKYACTIV-G 2.0].)
25	RVM	Rear vehicle monitoring (RVM) system warning light (amber)/indicator light (green)	—	—	With rear vehicle monitoring (RVM) system	×	(See 09-22-82 REAR VEHICLE MONITORING (RVM) SYSTEM WARNING LIGHT (AMBER)/ INDICATOR LIGHT (GREEN).)

*1 : For the system without the warning light/indicator light, refer to the message in the 09-22-61 LIQUID CRYSTAL DISPLAY (LCD).

Alarm operation function

- The instrument cluster sounds the alarm using the buzzer built into the instrument cluster to notify the user of the vehicle conditions.
- The alarm types are as follows: Refer to reference for details on each alarm.

Name	Reference
Lights-on reminder warning alarm	(See 09-22-24 LIGHTS-ON REMINDER WARNING ALARM.)
Seat belt warning alarm	(See 09-22-25 SEAT BELT WARNING ALARM.)
Air bag system warning alarm	(See 09-22-27 AIR BAG SYSTEM WARNING ALARM.)
Keyless warning alarm	(See 09-22-28 KEYLESS WARNING ALARM.)
Tire pressure warning alarm (with TPMS)	(See 09-22-30 TIRE PRESSURE WARNING ALARM.)
Ambient temperature warning alarm	(See 09-22-31 AMBIENT TEMPERATURE WARNING ALARM.)
Panel light control indicator alarm	(See 09-22-34 PANEL LIGHT CONTROL INDICATOR ALARM.)
Turn and hazard indicator alarm	(See 09-22-35 TURN AND HAZARD INDICATOR ALARM.)
Vehicle speed alarm (with vehicle speed alarm)	(See 09-22-56 TRIP COMPUTER INFORMATION SYSTEM.)
Panel light control indicator alarm	(See 09-22-34 PANEL LIGHT CONTROL INDICATOR ALARM.)

INSTRUMENTATION/DRIVER INFO.

Name	Reference
Turn and hazard indicator alarm	(See 09-22-35 TURN AND HAZARD INDICATOR ALARM.)
Rear vehicle monitoring (RVM) warning alarm (with rear vehicle monitoring (RVM) system)	(See 09-22-84 RVM WARNING ALARM.)
Blind spot monitoring (BSM) warning alarm (with BSM system)	(See 09-22-93 BLIND SPOT MONITORING (BSM) WARNING ALARM.)
i-stop warning alarm (with i-stop system)	(See 09-22-33 i-stop WARNING ALARM.)
LDWS warning alarm (with lane departure warning system (LDWS))	(See 09-22-121 LDWS WARNING ALARM.)
120 km/h warning alarm (with 120 km/h warning alarm)	(See 09-22-36 120 km/h WARNING ALARM.)

- If several alarm request signals are received simultaneously, the alarms sound according to the order of precedence in the following table.

Ignition is switched OFF (LOCK)

Order or precedence	Name
1	Keyless warning alarm (pattern A)
2	Lights-on reminder warning alarm
3	Keyless warning alarm (pattern B, C)
4	Turn and hazard indicator alarm
5	Panel light control indicator alarm

Ignition switch ON (engine off or on)

Order or precedence	Name
1	120 km/h warning alarm (with 120 km/h warning alarm)
2	i-stop warning alarm (with i-stop system)
3	Seat belt warning alarm (Driver/passenger)
4	Seat belt warning alarm (Rear) (with rear seat belt warning alarm)
5	Tire pressure warning alarm (Tire pressure monitoring system initialization) (with TPMS)
6	Tire pressure warning alarm (Tire pressure monitoring system operating) (with TPMS)
7	Rear vehicle monitoring (RVM) warning alarm (with rear vehicle monitoring (RVM) system)
	Blind spot monitoring (BSM) warning alarm (with BSM system)
8	LDWS warning alarm (with lane departure warning system (LDWS))
9	Keyless warning alarm
10	Air bag system warning alarm
11	Ambient temperature warning alarm
12	Vehicle speed alarm (with vehicle speed alarm)
13	Turn and hazard indicator alarm
14	Panel light control indicator alarm

Panel light control function

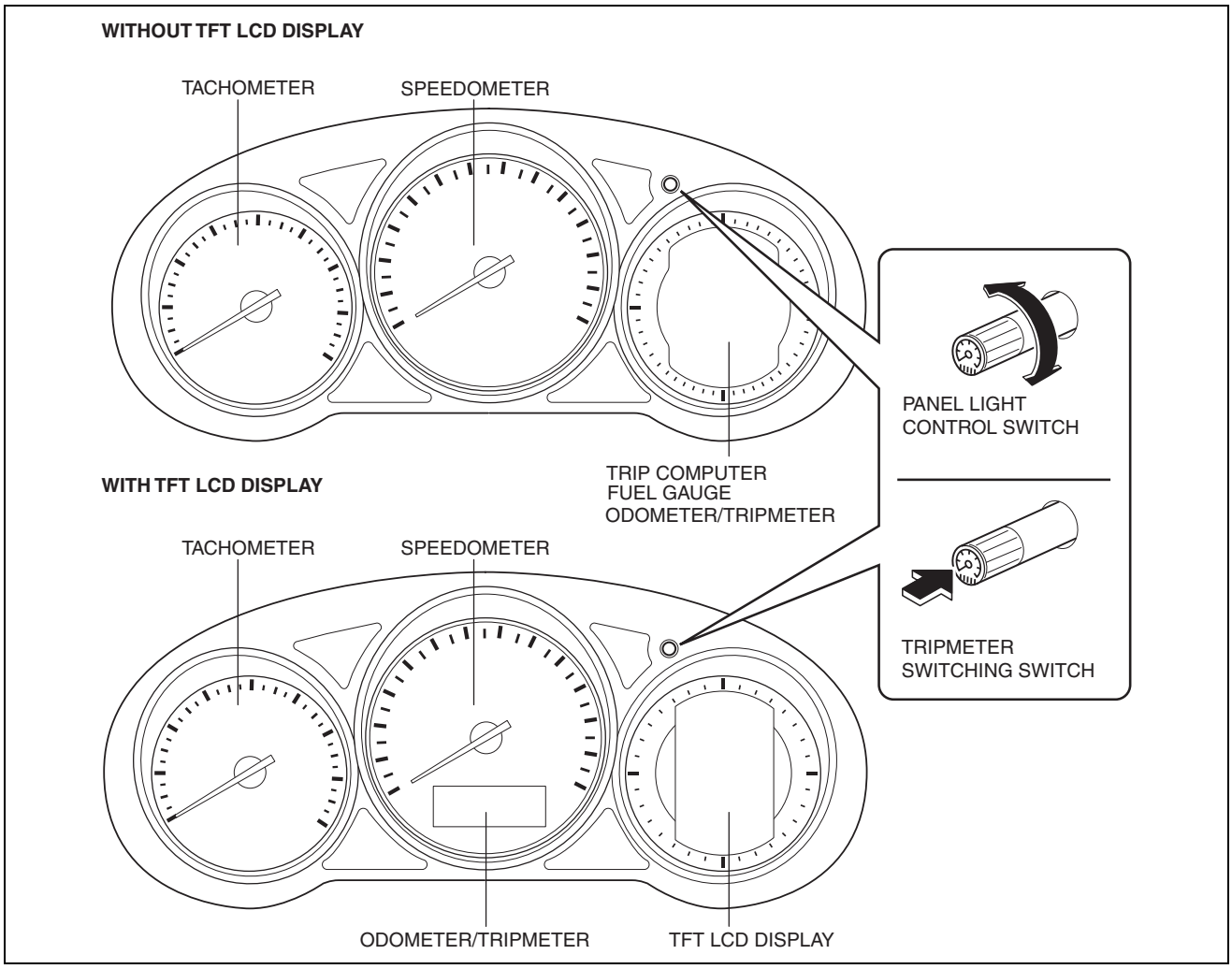
- The instrument cluster changes the panel light brightness according to the ignition switch being turned ON (engine off or on) or the TNS being illuminated. For details on the panel light, refer to 09-22-53 PANEL LIGHT.

Vehicle specification information transmission function

- The instrument cluster sends vehicle specification information stored during configuration to the following modules via CAN transmission. The following modules perform configuration automatically by reading the vehicle specification information from the instrument cluster.
  - — DSC HU/CU
  - — EPS control module
  - — AFS control module (with AFS)
  - — LASER SENSOR (with smart city brake support (SCBS))

INSTRUMENTATION/DRIVER INFO.

Structural View



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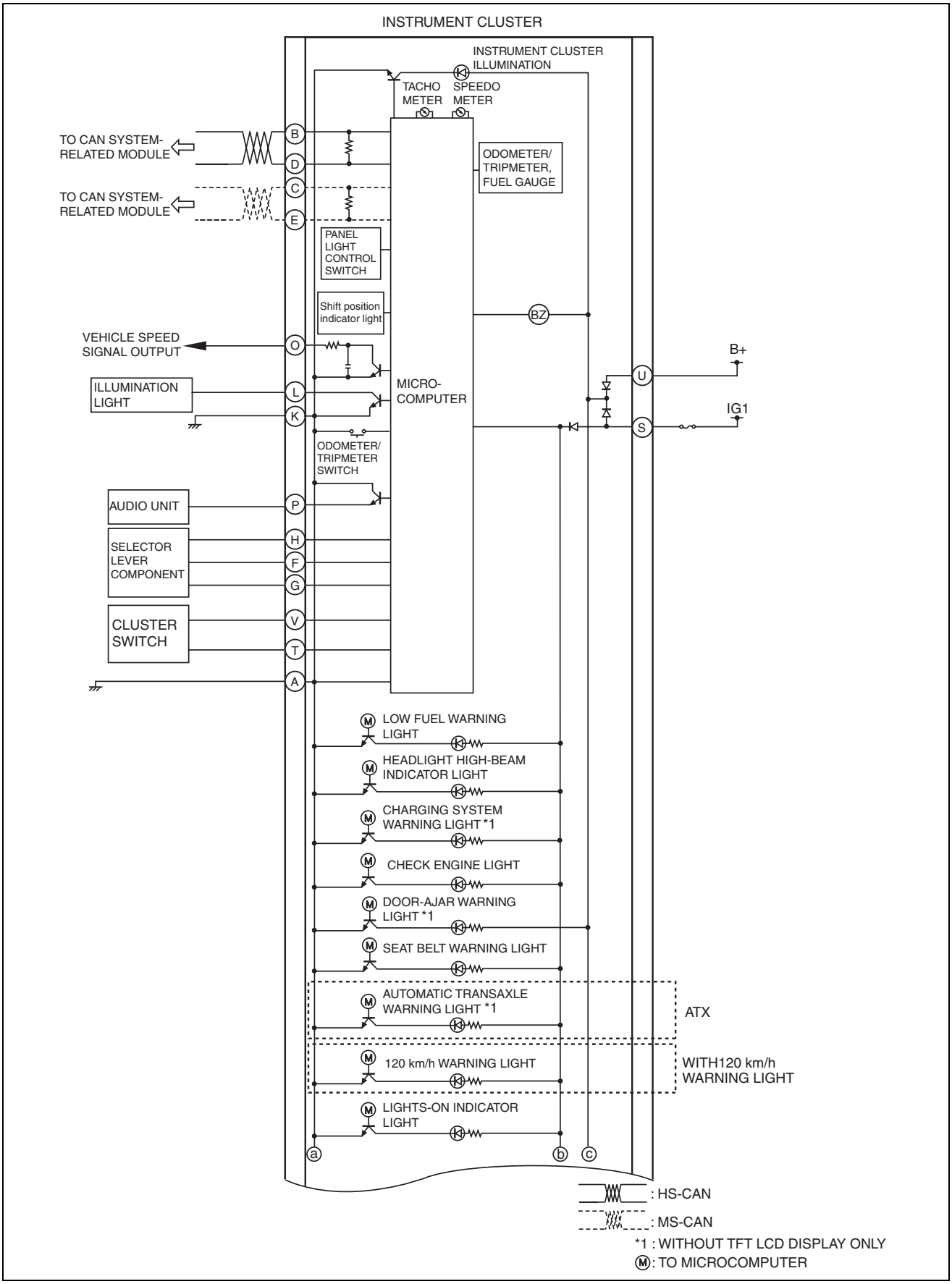
INSTRUMENTATION/DRIVER INFO.

System Wiring Diagram



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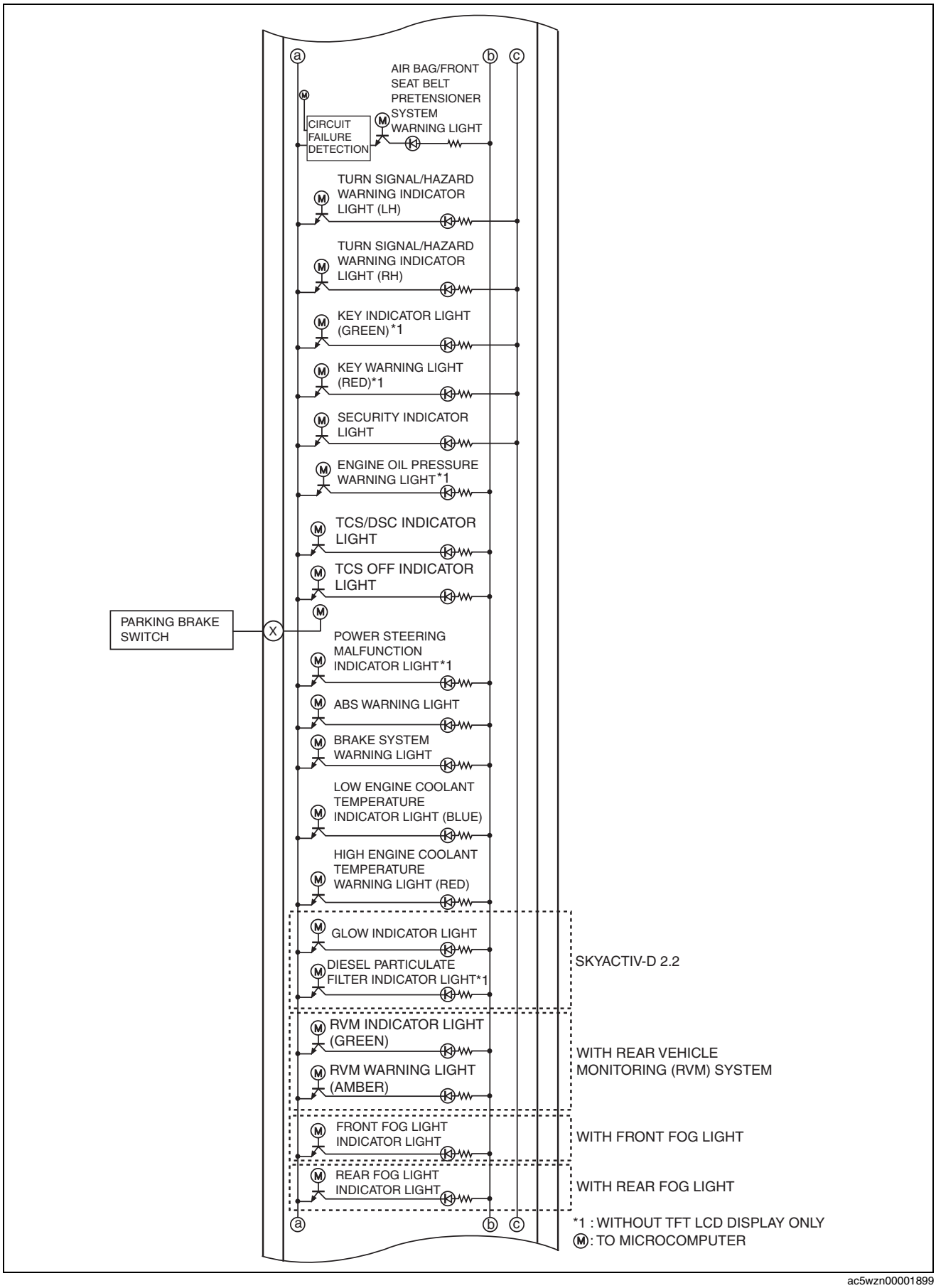
INSTRUMENTATION/DRIVER INFO.



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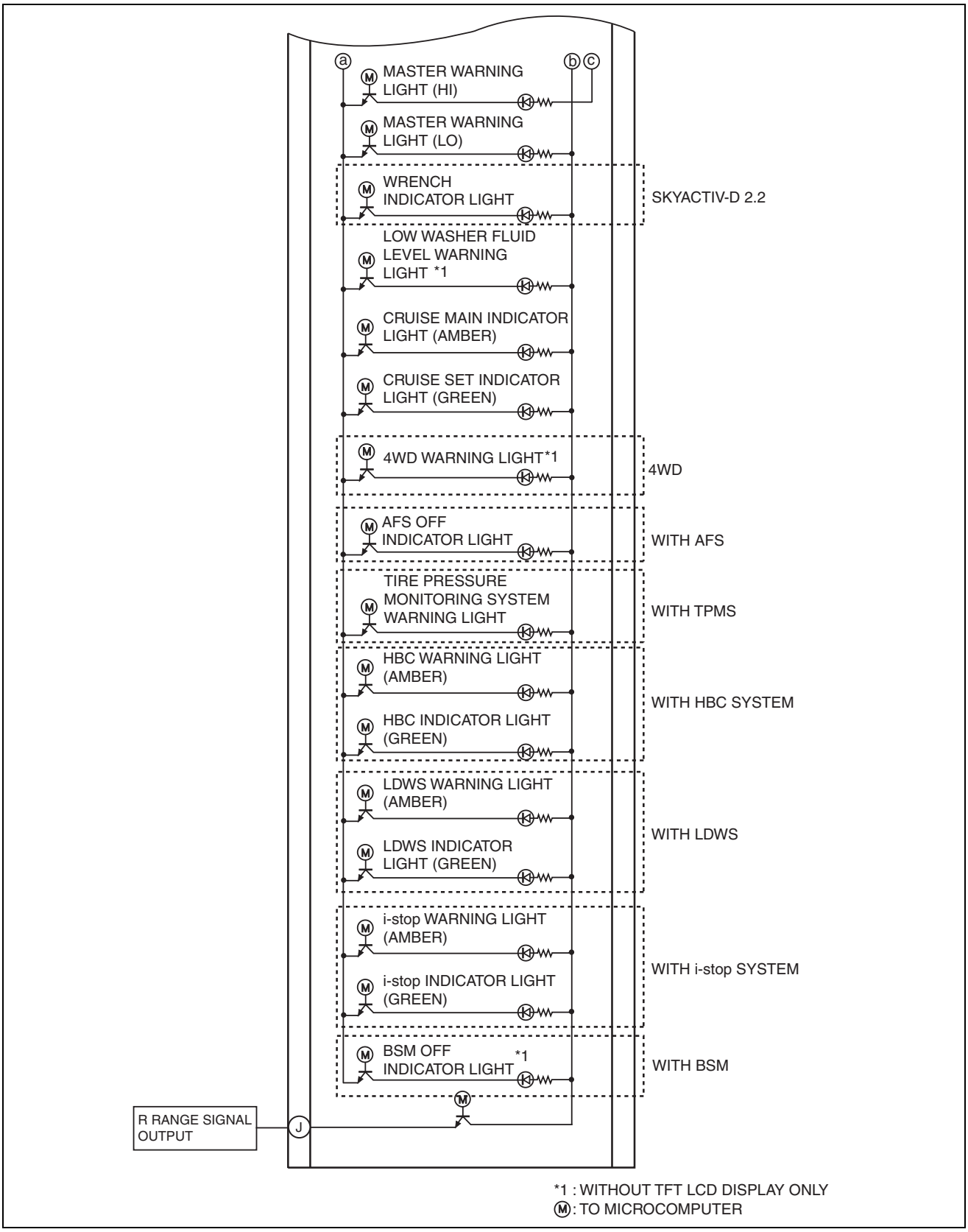

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Fail-safe
Speedometer

- If the CAN signal cannot be received normally, the instrument cluster displays the 0 mark.

INSTRUMENTATION/DRIVER INFO.

Tachometer
- If the CAN signal cannot be received normally, the instrument cluster displays the 0 mark.

Fuel gauge
- If the CAN signal cannot be received normally, the instrument cluster turns off one segment at regular time intervals since the segments calculated based on the signal last received are displayed.

Odometer/tripmeter
- Function not equipped.

Warning lights
- If the CAN signal cannot be received normally, the instrument cluster turns the warning light on.

Indicator lights
- If the CAN signal cannot be received normally, the instrument cluster turns the indicator light off.

Alarm
- If the CAN signal cannot be received normally, the instrument cluster stops the alarm.

Panel light
- If the CAN signal cannot be received normally, the instrument cluster turns the panel light on.

Trip computer information system
- If the CAN signal cannot be received normally, the instrument cluster displays the "— —".

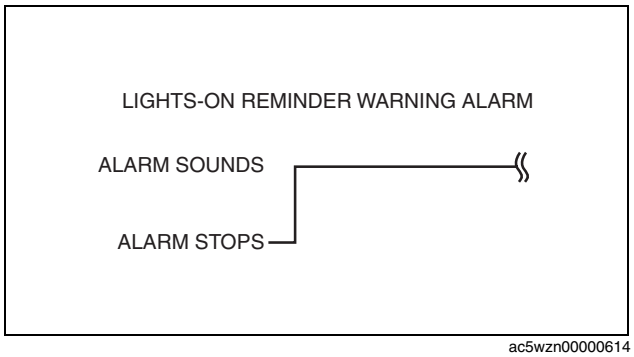
Ambient temperature display
- If the CAN signal cannot be received normally, the instrument cluster displays the "— —" and does not display the ice mark.

LIGHTS-ON REMINDER WARNING ALARM

id092200019200

Purpose
- The lights-on reminder warning alarm notifies the driver that the TNS and headlights are not turned off.

Function
- The instrument cluster receives the following vehicle condition signals via the CAN signal from the start stop unit and rear body control module (RBCM).
  - — TNS switch ON signal from start stop unit (TNS and headlights illuminate)
  - — Driver's front door latch switch ON signal from rear body control module (RBCM)
- If the ignition is switched to OFF or ACC when all the above vehicle condition signals are received, the instrument cluster operates the lights-on reminder alarm.
- The lights-on reminder warning alarm sound pattern is as shown in the figure.

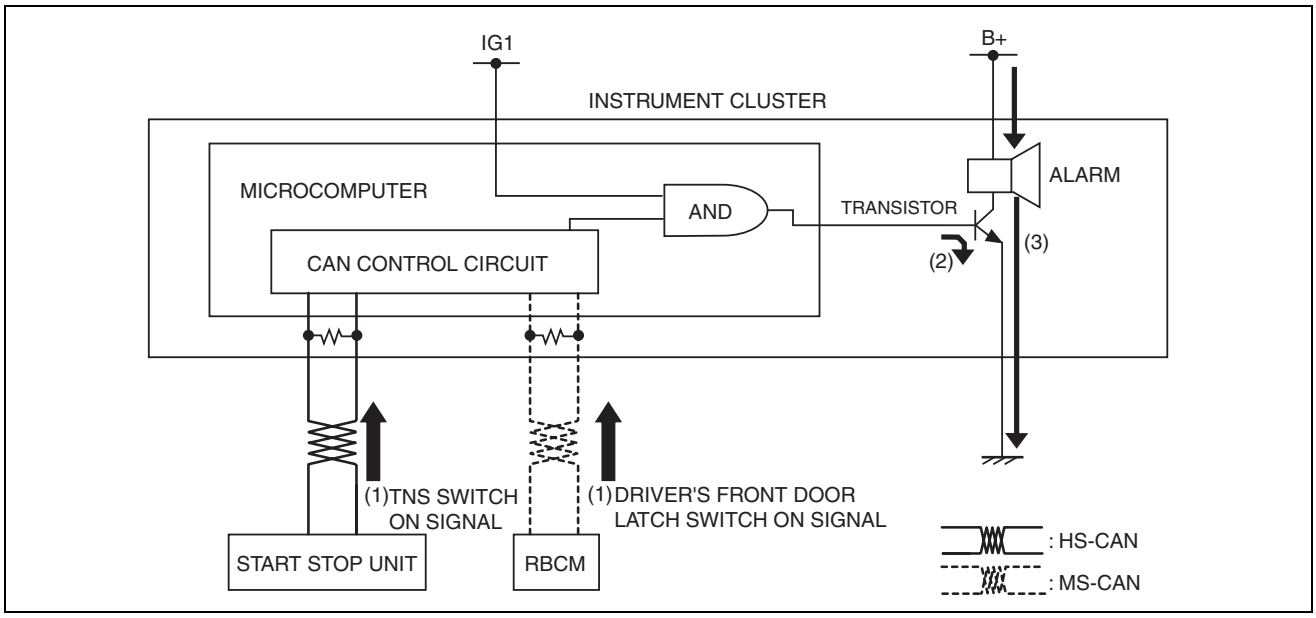


ac5wzn00000614

Construction
- The lights-on reminder warning alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the TNS switch ON signal from the start stop unit and driver's front door latch switch ON signal from the rear body control module (RBCM).
2. When the ignition is switched to OFF or ACC while each signal is received, the instrument cluster turns on (2) the transistor.
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5uun00000887

Fail-safe
- Function not equipped.

SEAT BELT WARNING ALARM

id092200019600

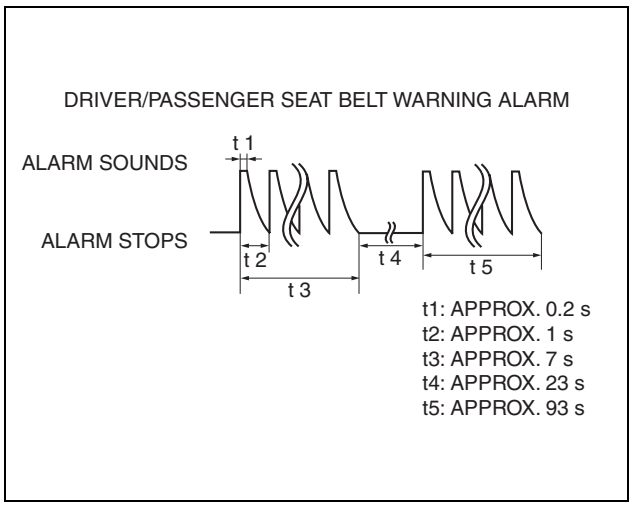
Purpose
- The seat belt warning alarm warns occupants that a seat belt is not fastened.

Function
- The instrument cluster sounds the seat belt warning alarm based on the following CAN signals:
  - — Vehicle speed signal sent from PCM
  - — Driver/passenger buckle switch signal, occupancy sensor signal sent from SAS control module
  - — Rear seat buckle switch signal sent from rear body control module (RBCM)

Driver/Passenger seat belt warning alarm sound function
- The driver/passenger seat belt warning alarm has an initial warning and subsequent warning.

Initial warning
- When all of the following conditions are met, the alarm sounds.
  - — Vehicle speed is approx. 20 km/h {12 mph} or more
  - — Driver/passenger buckle switch on signal (seat belt unfastened) is detected
  - — Occupancy sensor on signal (occupant in passenger seat) is detected (passenger seat belt warning light only)
- The driver/passenger seat belt warning alarm sound pattern is as shown in the figure.

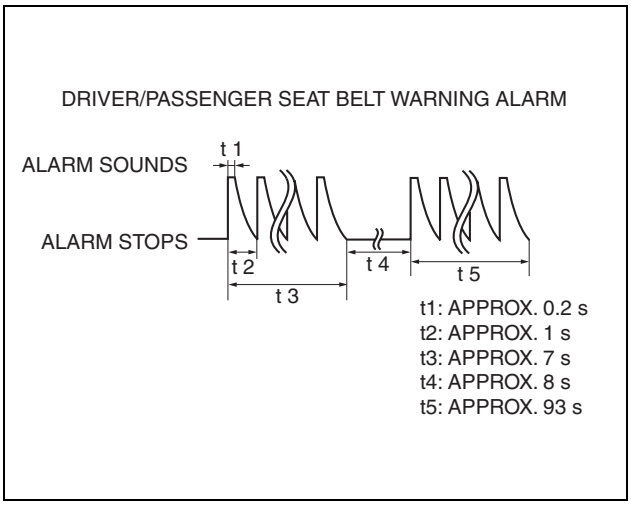
Subsequent warning
- When all of the following conditions are met, the alarm sounds.
  - — Vehicle speed is approx. 20 km/h {12 mph} or more
  - — Occupancy sensor on signal (occupant in passenger seat) detected (passenger seat belt warning light only)
  - — After initial warning, buckle switch off signal (seat belt fastened) to on signal (seat belt unfastened) is detected



ac5wzn00000932

INSTRUMENTATION/DRIVER INFO.

- The driver/passenger seat belt warning alarm sound pattern is as shown in the figure.



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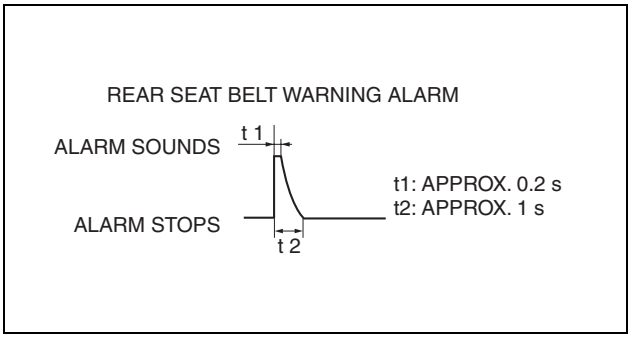
Rear seat belt warning alarm sound function (with rear seat belt warning alarm)

- When all of the following conditions are met, the alarm sounds.
  - — Ignition switch ON (engine off or on)
  - — Rear seat buckle switch off signal (seat belt fastened) to on signal (seat belt unfastened) is detected
- The rear seat belt warning alarm sound pattern is as shown in the figure.



ac5wzn00000934

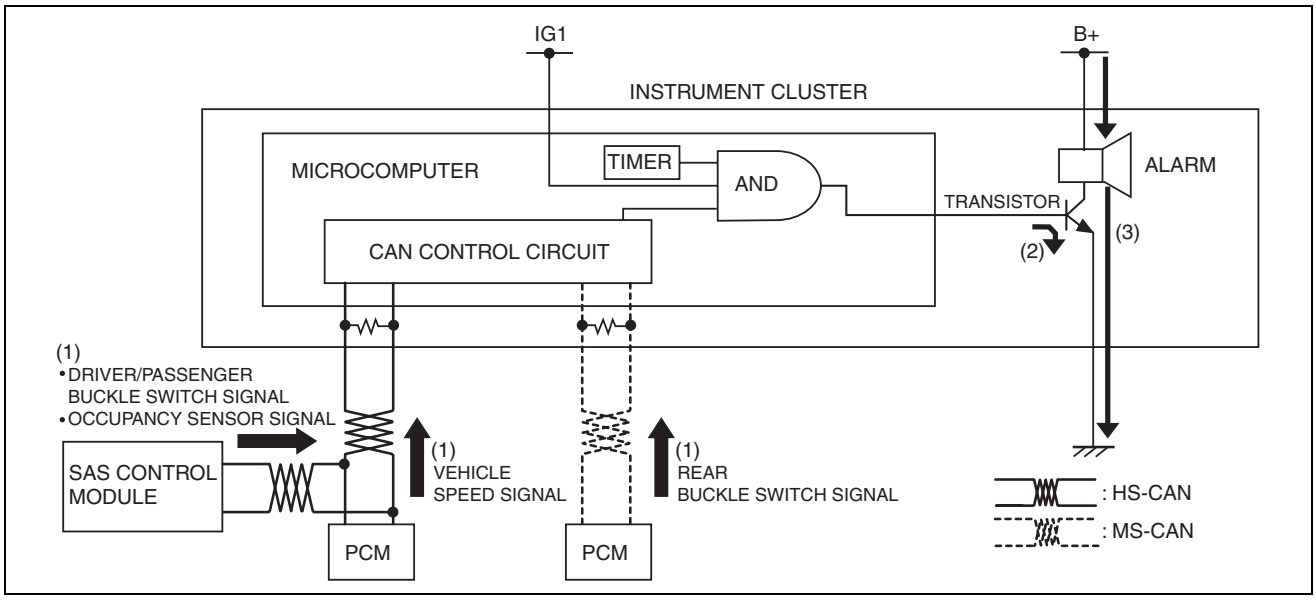
Construction

- The seat belt warning alarm sounds using the buzzer built into the instrument cluster.

Operation

1. The instrument cluster receives (1) the vehicle speed signal from the PCM, the driver/passenger buckle switch signal and occupancy sensor signal from the SAS control module, and the rear seat buckle switch signal from the rear body control module (RBCM) when the ignition is switched ON (engine off or on).
2. The instrument cluster microcomputer turns the transistor on (2) based on each signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000935

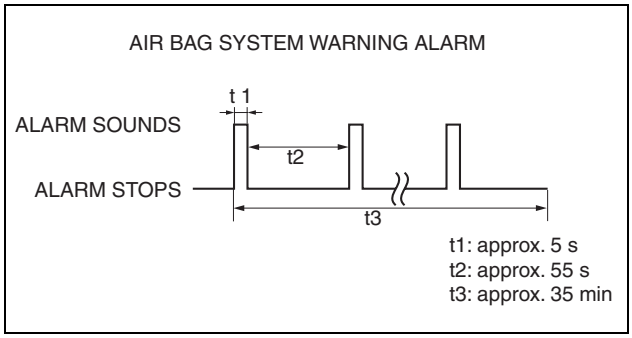
Fail-safe
- Function not equipped.

AIR BAG SYSTEM WARNING ALARM

id092200019800

Purpose
- The air bag system warning alarm notifies the driver of an air bag system malfunction.

Function
- When the instrument cluster receives the air bag system warning alarm request signal sent from the SAS control module via the CAN signal, the air bag system warning alarm sounds.
- The air bag system warning alarm sound pattern is as shown in the figure.

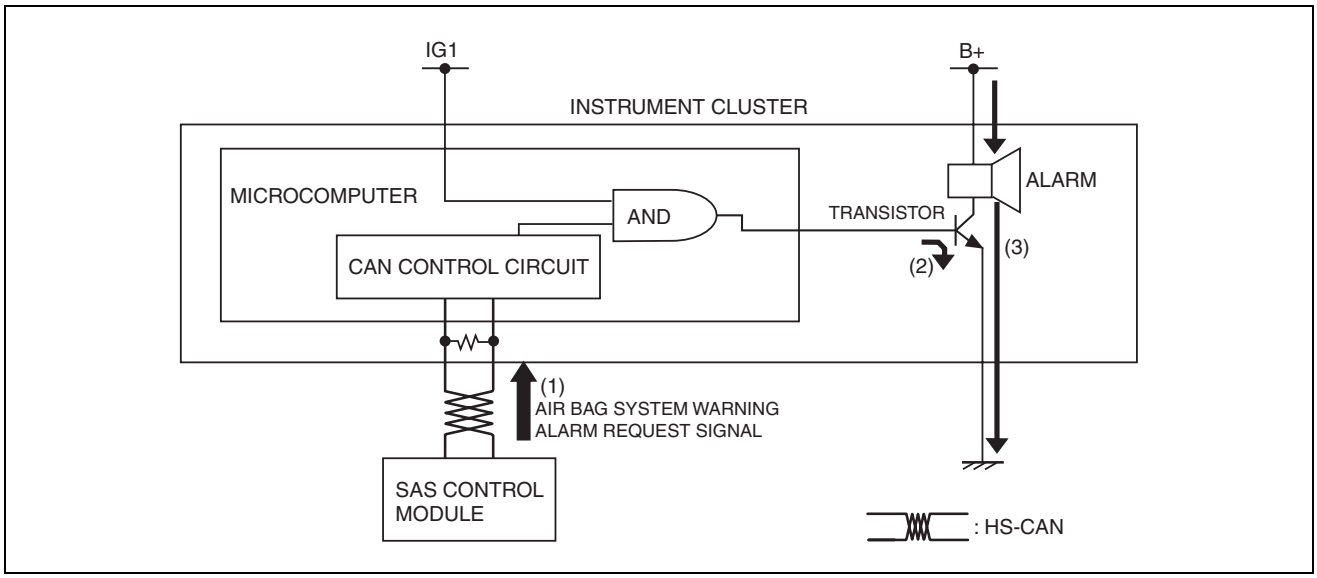


ac5wzn00000618

Construction
- The air bag system warning alarm sounds using the buzzer built into the instrument cluster.

Operation
1. When the ignition is switched ON (while engine is stopped or running), the instrument cluster receives (1) the air bag system warning alarm request signal from the SAS control module.
2. The instrument cluster microcomputer turns the transistor on (2) based on the air bag system warning alarm request signal.
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000619

Fail-safe
- Function not equipped.

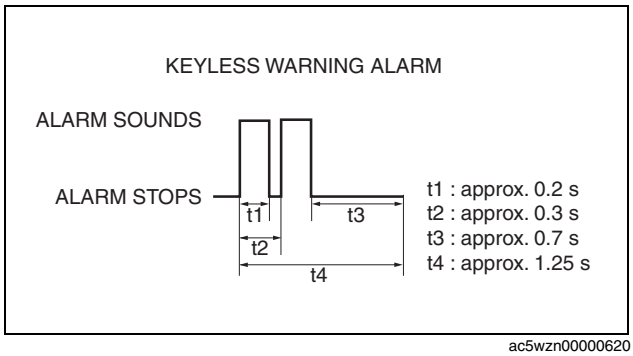
KEYLESS WARNING ALARM

id092200031400

Purpose
- The keyless warning alarm notifies the driver that the remote transmitter cannot be verified or the steering lock cannot be released.

Function
- When the instrument cluster receives the keyless warning alarm request signal sent from the start stop unit via the CAN signal, the keyless warning alarm sounds.
- The keyless warning alarm sound pattern is as follows: For the conditions that the alarm for each pattern sounds, refer to 09-14-32 KEYLESS ENTRY SYSTEM (without advanced keyless entry system)/09-14-37 ADVANCED KEYLESS ENTRY SYSTEM (with advanced keyless entry system).

Pattern A



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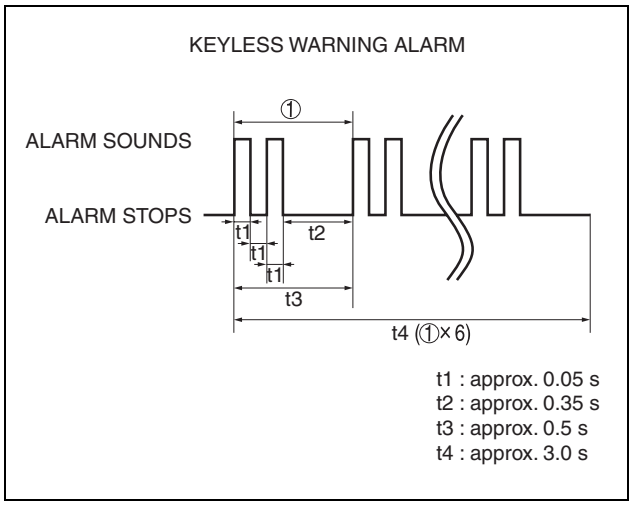
INSTRUMENTATION/DRIVER INFO.

Pattern B



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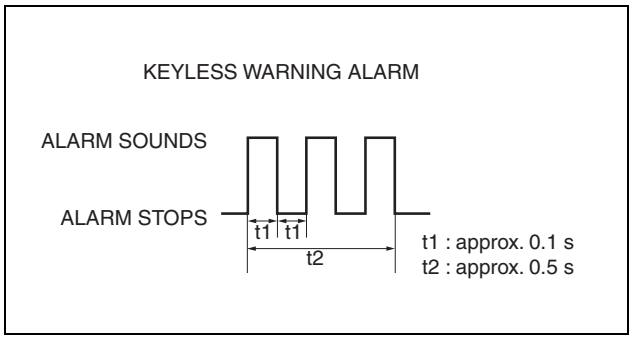
Pattern C



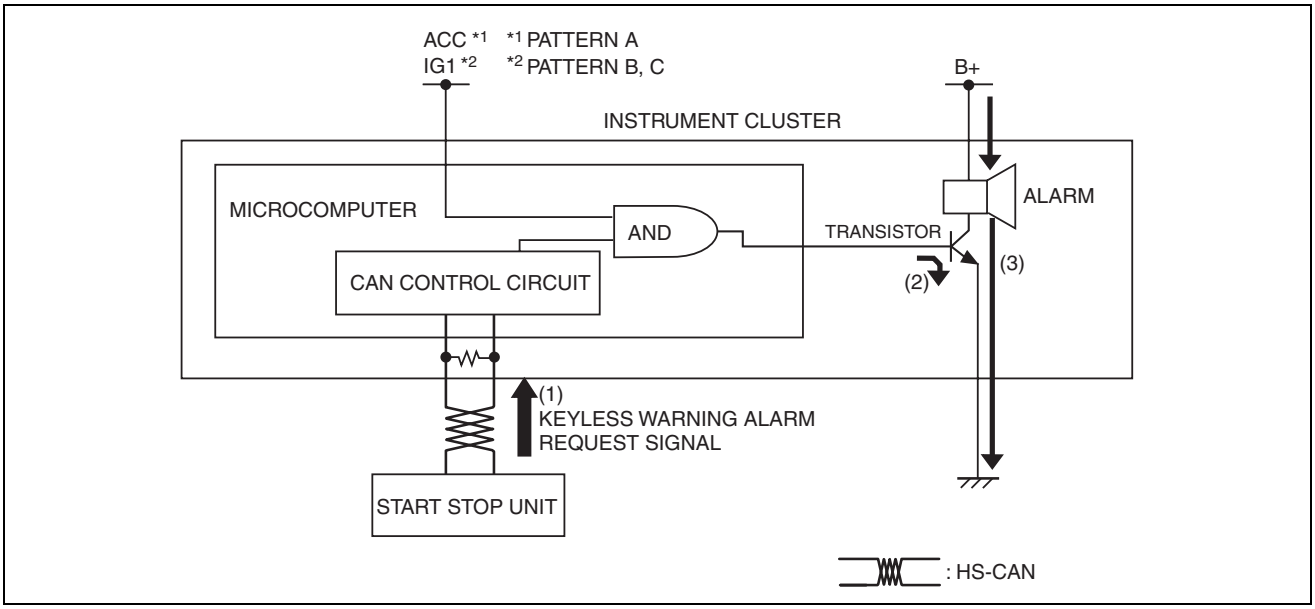
ac5wzn00000622

Construction

- The keyless warning alarm sounds using the buzzer built into the instrument cluster.

Operation

1. The instrument cluster receives (1) the keyless warning alarm request signal from the start stop unit.
2. The instrument cluster microcomputer turns the transistor on (2) based on the keyless warning alarm request signal.
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).



ac5wzn00000623

INSTRUMENTATION/DRIVER INFO.

Fail-safe
- Function not equipped.

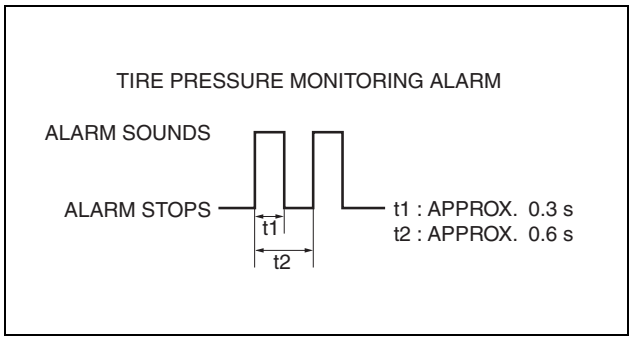
TIRE PRESSURE WARNING ALARM

id092200033500

Purpose
- The tire pressure monitoring alarm warns the user that a tire pressure has decreased or notifies the user that the tire pressure monitoring alarm has been reset.

Function
- If the instrument cluster receives a tire pressure monitoring alarm request signal sent from the DSC HU/CM via the CAN signal, the tire pressure monitoring alarm is sounded.
- The tire pressure monitoring alarm sound pattern is as follows: For the conditions in which each alarm pattern sounds, refer to 02-12-3 TIRE PRESSURE MONITORING SYSTEM (TPMS).

Tire pressure monitoring system operating



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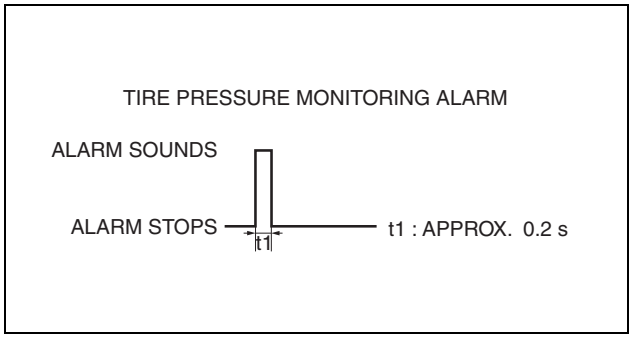
Tire pressure monitoring system initialization

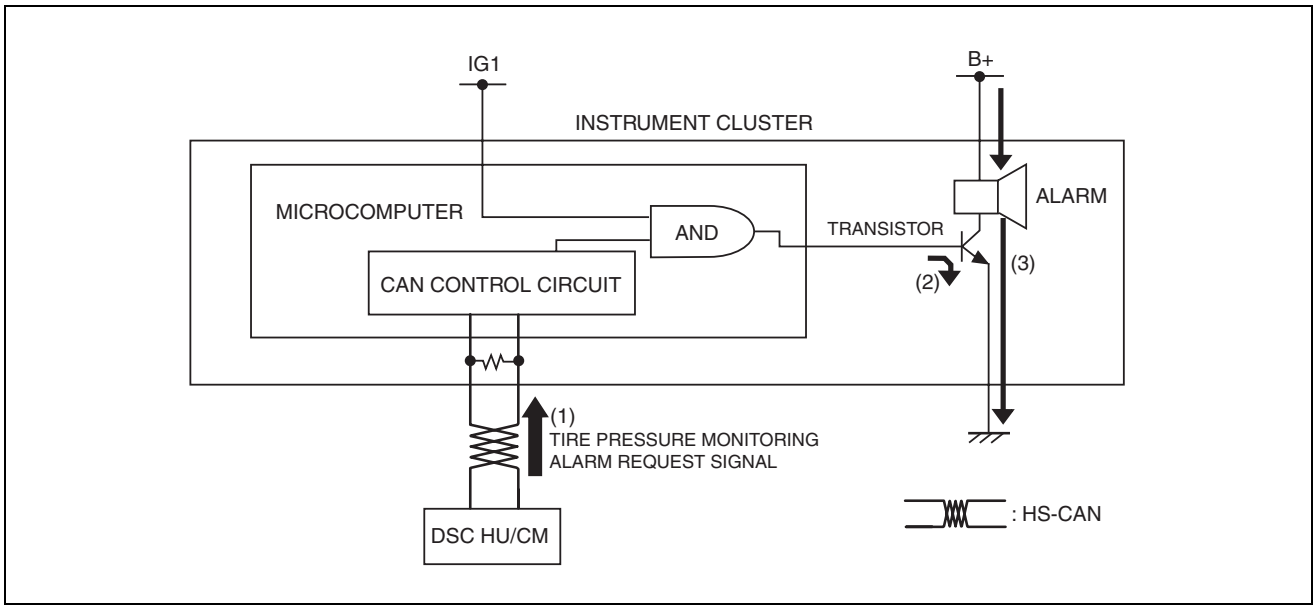


ac5uun00000750

Construction
- The tire pressure monitoring alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the tire pressure monitoring alarm request signal from the DSC HU/CM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the tire pressure monitoring alarm request signal.
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5uun00000751

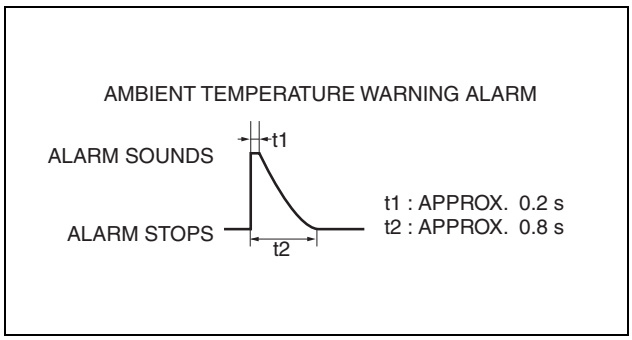
Fail-safe
- Function not equipped.

AMBIENT TEMPERATURE WARNING ALARM

id092200020600

Purpose
- The ambient temperature warning alarm warns the user when the ambient temperature is 4°C {39°F} or less and the road surface may be frozen.

Function
- When the instrument cluster receives an ambient temperature signal of -19—4°C {-2.2—39°F}, which is sent from the PCM as a CAN signal, it operates the ambient temperature warning alarm.
- After the instrument cluster operates the ambient temperature warning alarm, it does not operate the alarm until it receives an ambient temperature signal of 6°C {43°F} or more.
- The ambient temperature alarm sound pattern is as shown in the figure.

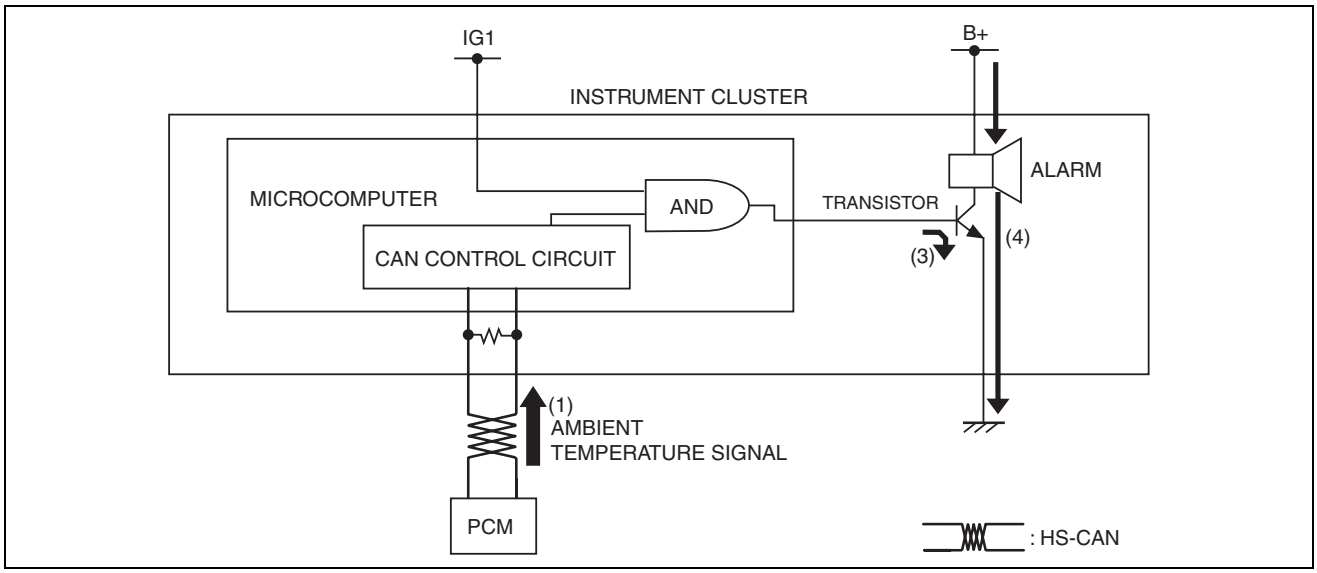


ac5wzn00000936

Construction
- The ambient temperature warning alarm sounds using the buzzer built into the instrument cluster.

Operation
1. When the ignition is switched ON, the instrument cluster receives an ambient temperature signal from the PCM (1).
2. When the instrument cluster receives an ambient temperature signal of -19—4°C {-2.2—39°F}, it turns the transistor on (2).
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000937

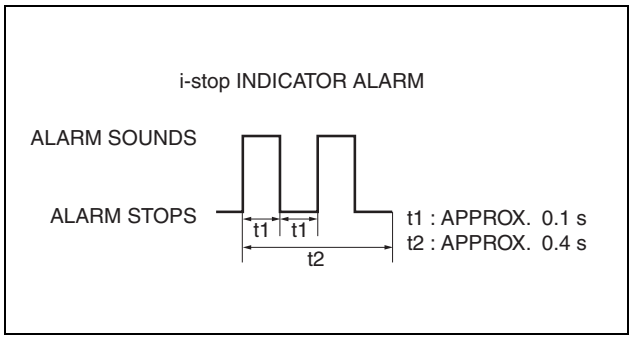
Fail-safe
- Function not equipped.

i-stop INDICATOR ALARM

id092200023100

Purpose
- The i-stop indicator alarm alerts the user that the i-stop OFF switch is pressed.

Function
- When the i-stop OFF switch signal is received from the PCM, the instrument cluster sounds the i-stop indicator alarm.
- The i-stop indicator alarm sound pattern is as follows:

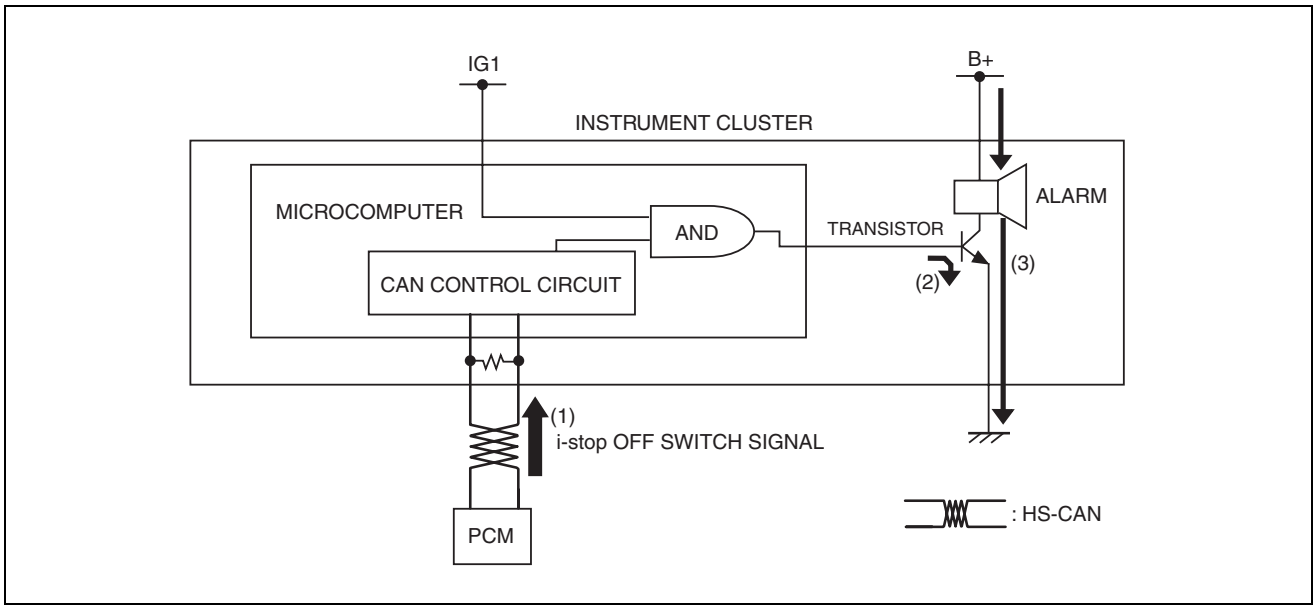


ac5wzn00001424

Construction
- The i-stop indicator alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the i-stop OFF switch signal from the PCM.
2. The instrument cluster microcomputer turns on (2) the transistor based on the i-stop OFF switch signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00001425

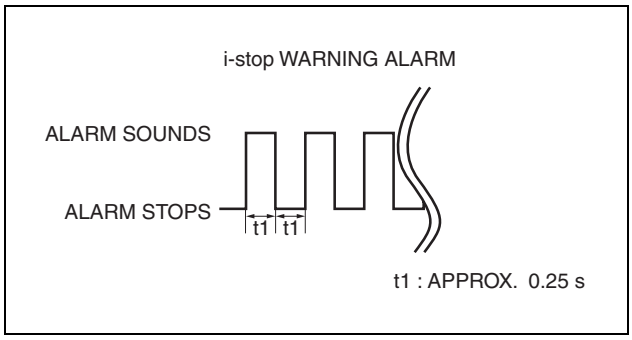
Fail-safe
- Function not equipped.

i-stop WARNING ALARM

id092200022200

Purpose
- The i-stop warning alarm alerts the driver that the driver-side door is open or the engine stalls while the engine is stopped by i-stop control.

Function
- When the instrument cluster receives the i-stop warning alarm request signal sent from the PCM via the CAN signal, the i-stop warning alarm sounds.
- The i-stop warning alarm sound pattern is as indicated in the figure.

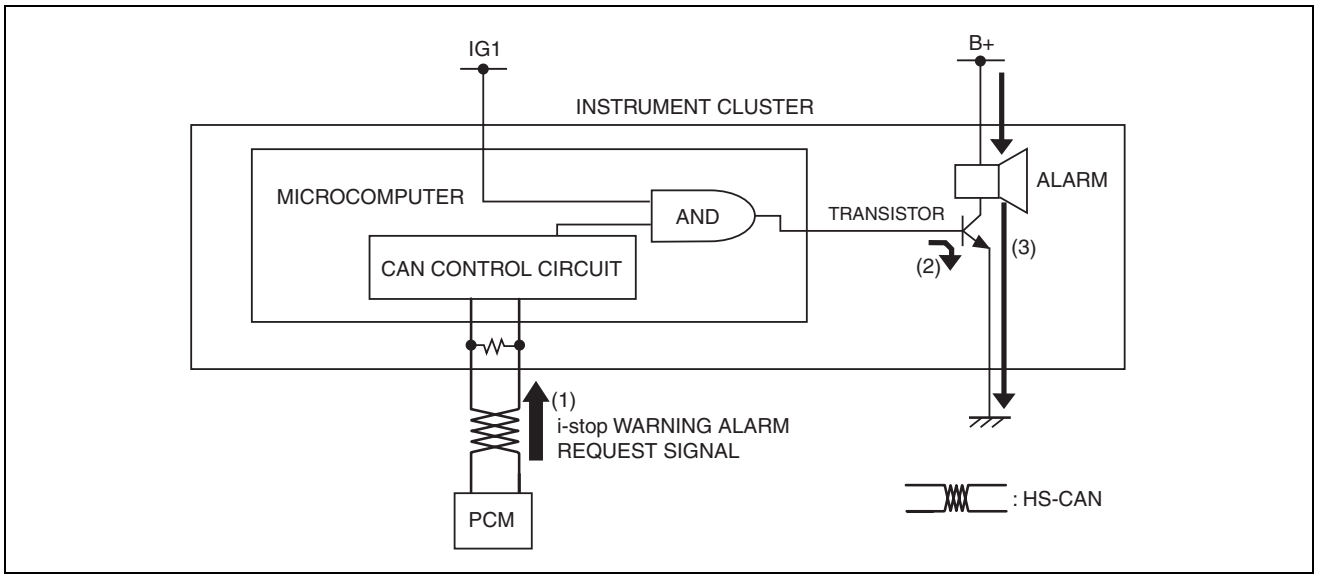


ac5wzn00001422

Construction
- The i-stop warning alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the i-stop warning alarm request signal from the PCM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the i-stop warning alarm request signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00001423

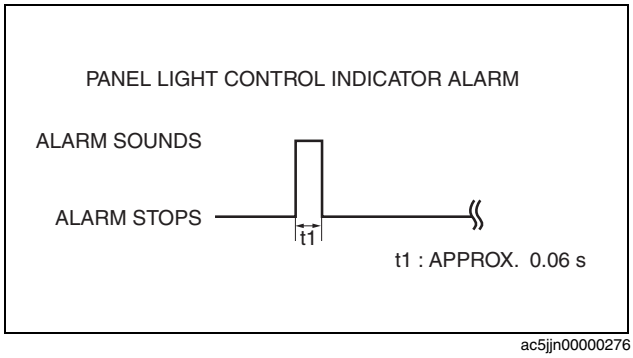
Fail-safe
- Function not equipped.

PANEL LIGHT CONTROL INDICATOR ALARM

id092200020700

Purpose
- The panel light control indicator alarm notifies the driver that the panel light brightness is either at maximum or minimum.

Function
- If the panel light control switch is in the maximum rotation position right or left when the TNS switch ON signal (TNS and headlights illuminate) sent from the start stop unit via the CAN signal is received, the instrument cluster sounds the panel light control indicator alarm.
- The panel light control indicator alarm sound pattern is as shown in the figure.

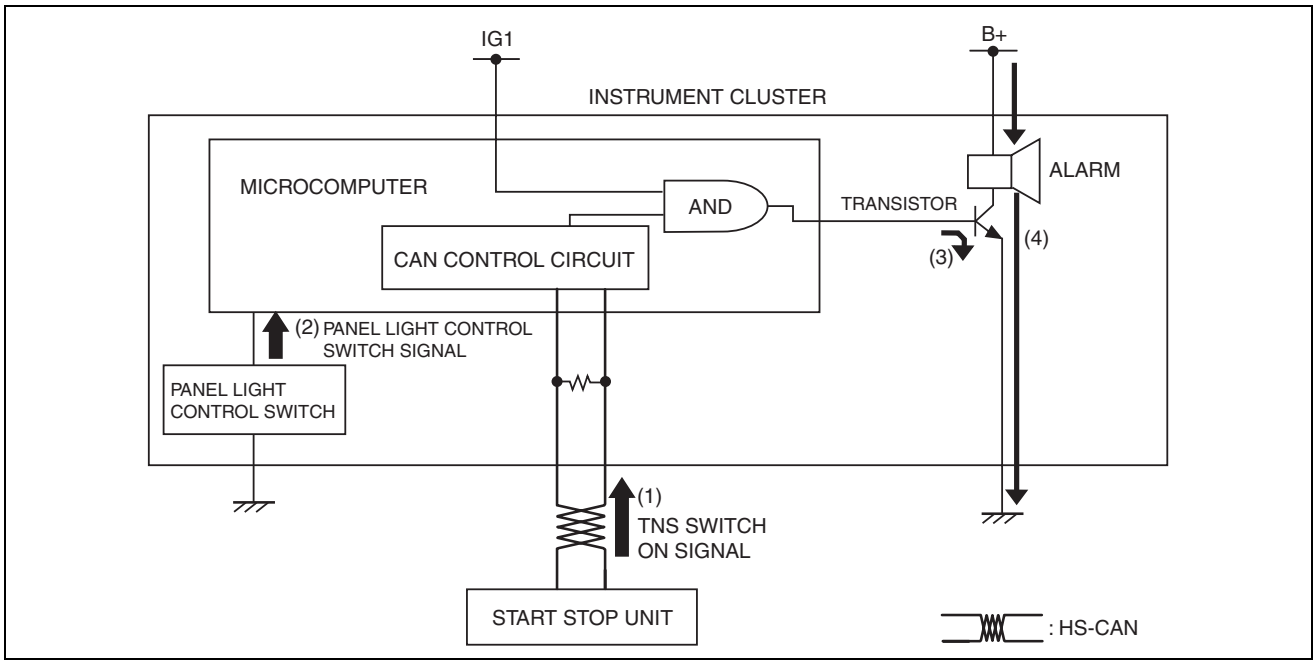


ac5jjn00000276

Construction
- The panel light control indicator alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the TNS switch ON signal from the start stop unit.
2. If the maximum rotation position of the panel light control switch is detected (2) when the TNS switch ON signal is received, the instrument cluster microcomputer turns on (3) the transistor.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (4).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000615

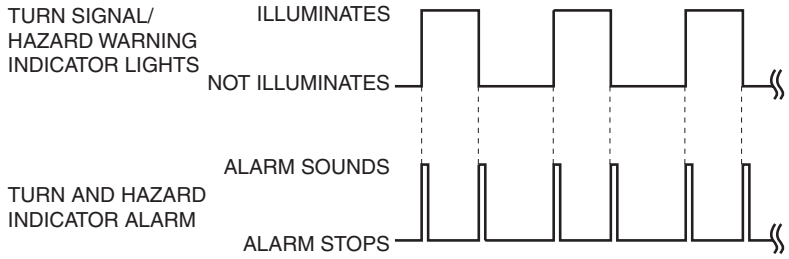
Fail-safe
- Function not equipped.

TURN AND HAZARD INDICATOR ALARM

id092200020800

Purpose
- The turn and hazard indicator alarm notifies the driver that a turn light or the hazard warning lights are flashing.

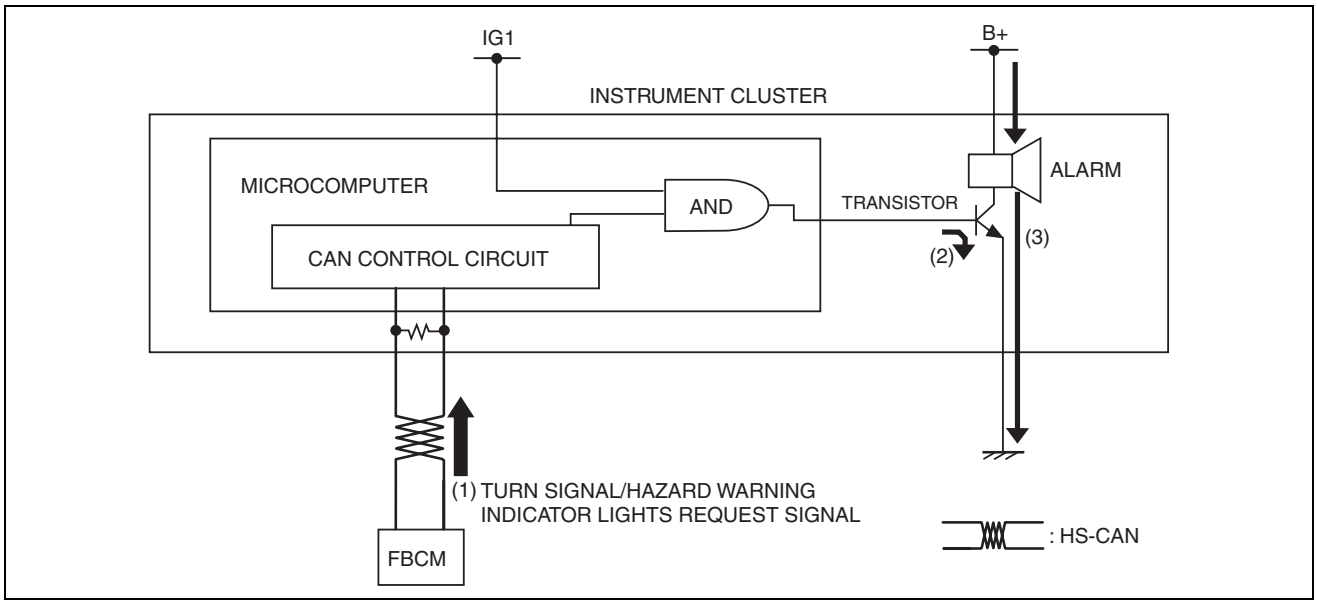
Function
- When the instrument cluster receives the turn signal/hazard warning indicator light illumination request signal sent from the front body control module (FBCM) via the CAN signal, the turn and hazard indicator alarm sounds simultaneously with illumination on/off of the direction/hazard warning indicator lights.
- The turn and hazard indicator alarm sound pattern is as follows:

Sound frequency (Hz)	Alarm when turn signal/hazard warning indicator lights illumination off → on: 1,400 Alarm when turn signal/hazard warning indicator lights illumination on → off: 1,300
Sound frequency	Continuously
Wave pattern	

Construction
- The turn and hazard indicator alarm sounds using the buzzer built into the instrument cluster.

Construction, Operation
1. The instrument cluster receives (1) the turn signal/hazard warning indicator light request signal from the front body control module (FBCM).
2. The instrument cluster microcomputer turns the transistor on (2) based on the turn signal/hazard warning indicator light request signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000617

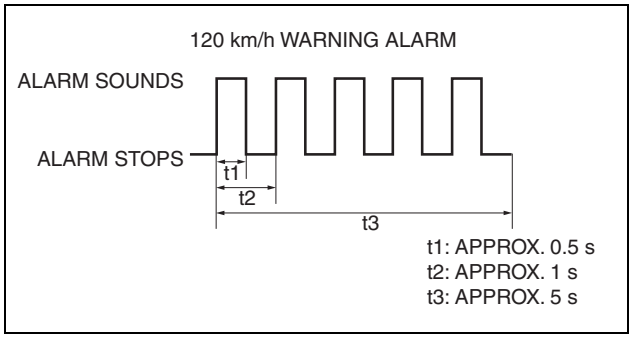
Fail-safe
- Function not equipped.

120 km/h WARNING ALARM

id092200033900

Purpose
- The 120 km/h warning alarm alerts the driver that the current vehicle speed exceeds 120 km/h {74.6 mph}.

Function
- When the instrument cluster receives a 120 km/h {74.6 mph} vehicle speed signal sent from the PCM via the CAN signal, it sounds the 120 km/h warning alarm.
- The 120 km/h warning alarm sound pattern is as follows:

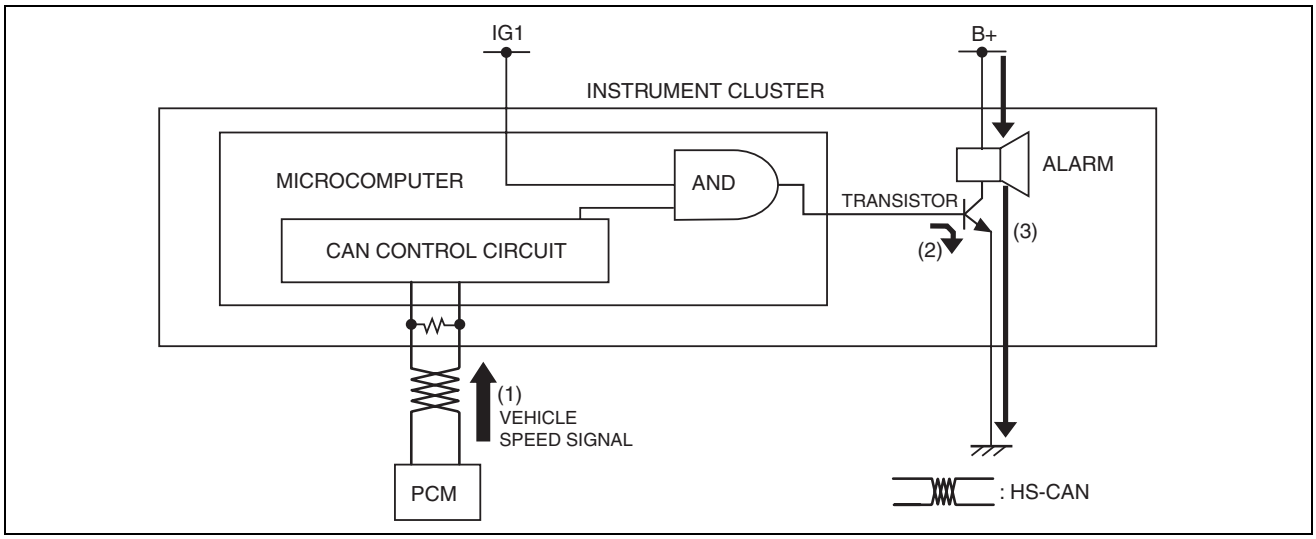


ac5wzn00001403

Construction
- The 120 km/h warning alarm sounds the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the vehicle speed signal from the PCM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the 120 km/h {74.6 mph} vehicle speed signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5jjn00001528

Fail-safe
- Function not equipped.

LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED)

id092200018300

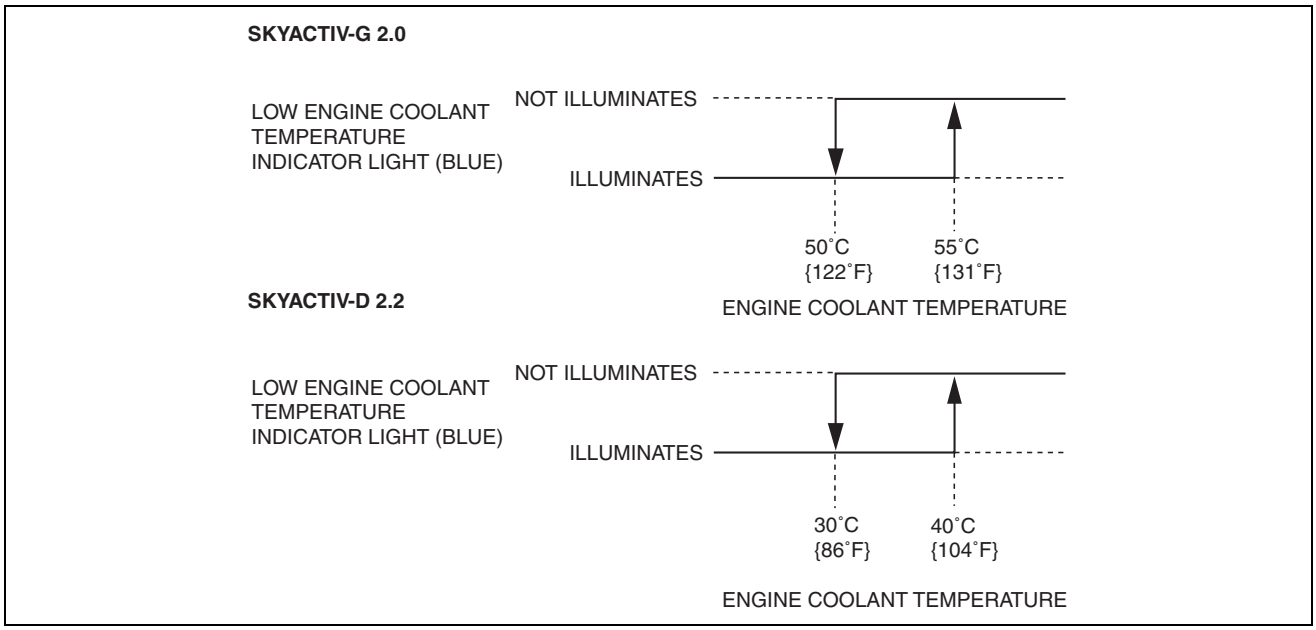
Purpose

Low engine coolant temperature indicator light (blue)
- The low engine coolant temperature indicator light (blue) notifies the driver that the engine coolant temperature is low and vaporization of the fuel is difficult.

High engine coolant temperature warning light (red)
- The high engine coolant temperature warning light (red) notifies the driver that the engine coolant temperature is high and that there is the danger of overheating.

Function

Low engine coolant temperature indicator light (blue)
- The low engine coolant temperature indicator light (blue) illuminates when the engine coolant temperature is low.
- The illumination condition of the low engine coolant temperature indicator light (blue) is as shown in the figure.

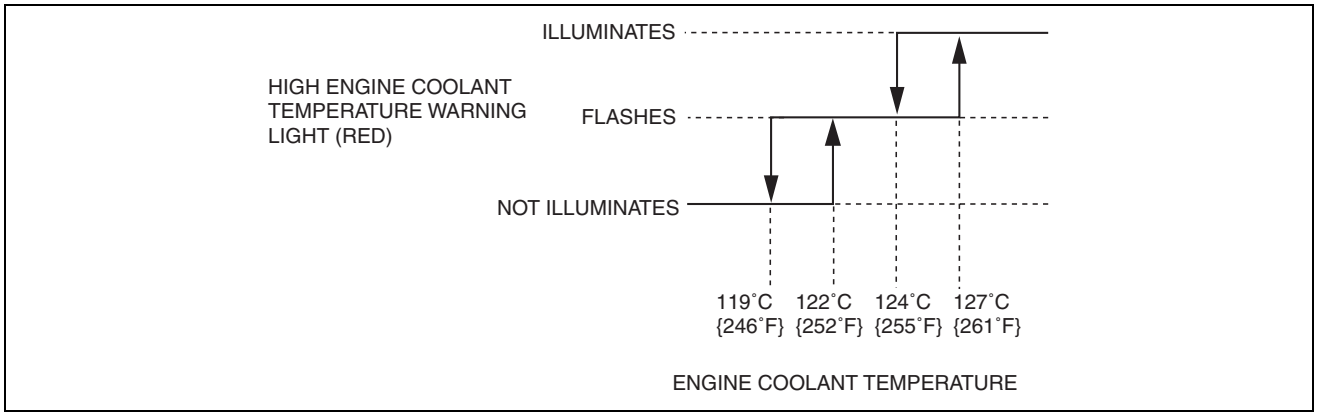


ac5wzn00000624

INSTRUMENTATION/DRIVER INFO.

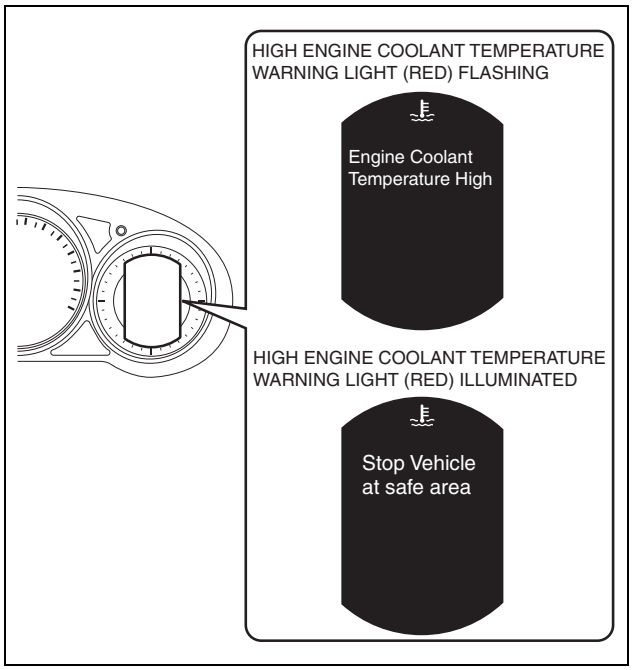
High engine coolant temperature warning light (red)

- The high engine coolant temperature warning light flashes at 0.5 s intervals when the engine coolant temperature exceeds the set value, and illuminates if the temperature increases further.
- The flashing/illumination condition of the high engine coolant temperature warning light (red) is as shown in the figure.



ac5wzn00000625

- The instrument cluster equipped with the TFT LCD displays a warning message in the TFT LCD display simultaneously when the high engine coolant temperature warning light (red) flashes or illuminates.



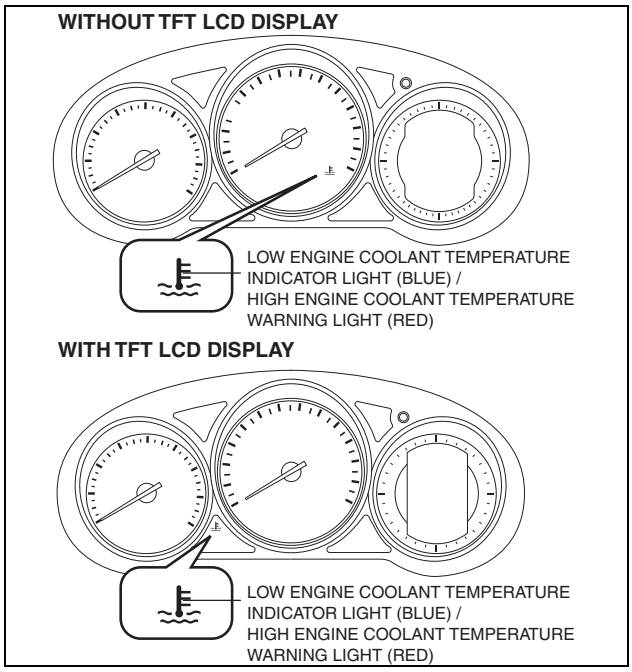
ac5wzn00001870

Construction

- Illumination, flashing, or turning off of the low engine coolant temperature indicator light (blue)/high engine coolant temperature warning light (red) is controlled by the instrument cluster microcomputer based on the engine coolant temperature signal from the PCM.

INSTRUMENTATION/DRIVER INFO.

- The low engine coolant temperature indicator light (blue)/high engine coolant temperature warning light (red) is set in the instrument cluster.

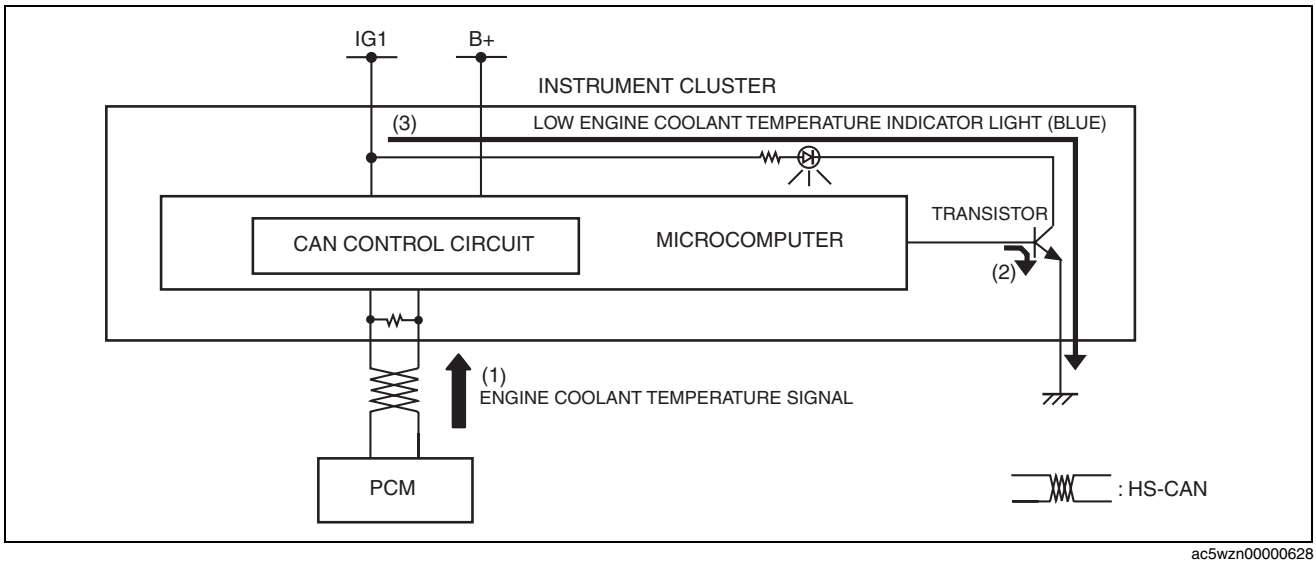


ac5wzn00001381

Operation

Low engine coolant temperature indicator light (blue)

1. When the ignition is switched ON (while engine is running), the instrument cluster receives (1) the engine coolant temperature signal from the PCM via the CAN signal.
2. The instrument cluster turns the transistor on (2) based on the engine coolant temperature signal.
3. When the transistor turns on, the ground circuit of the low engine coolant temperature indicator light (blue) is established and the low engine coolant temperature indicator light (blue) illuminates (3).



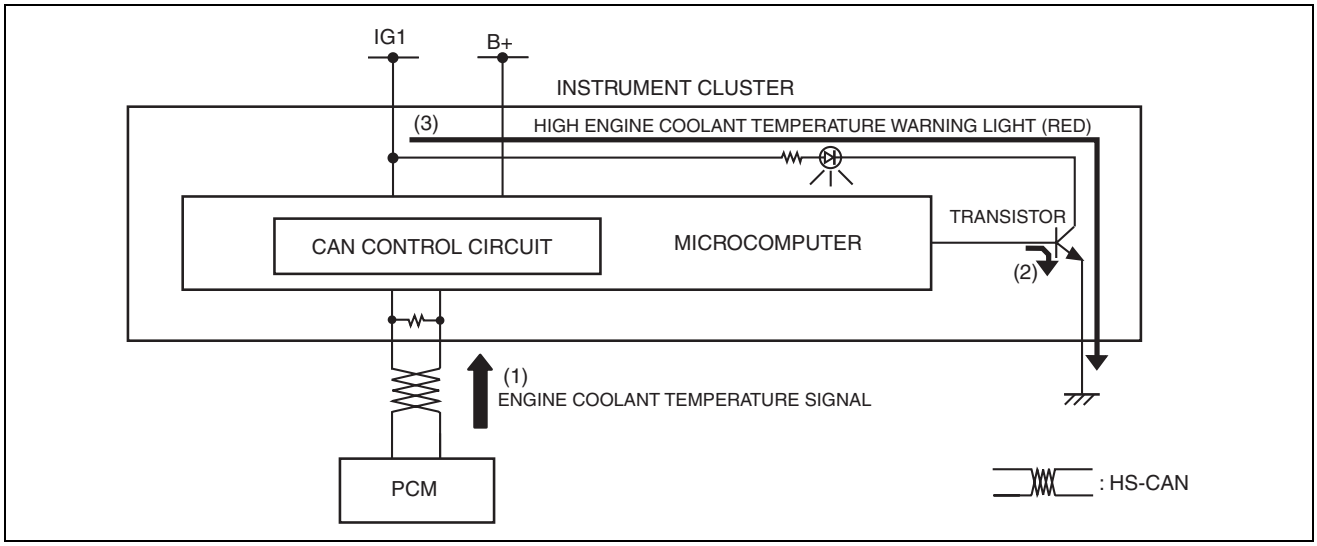
ac5wzn00000628

High engine coolant temperature warning light (red)

1. When the ignition is switched ON (while engine is running), the instrument cluster receives (1) the engine coolant temperature signal from the PCM via the CAN signal.
2. The instrument cluster turns the transistor on (2) intermittently for flashing and continuously for illumination based on the engine coolant temperature signal.

INSTRUMENTATION/DRIVER INFO.

3. The high engine coolant temperature warning light (red) flashes (3) when the transistor is turned on intermittently, and it illuminates (3) when the transistor is turned on continuously.



ac5wzn00000629

Fail-safe
- Function not equipped.

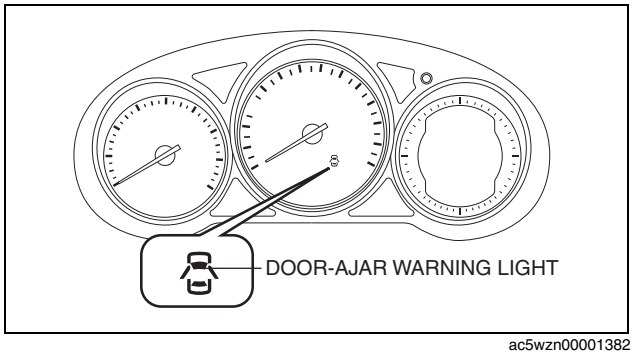
DOOR-AJAR WARNING LIGHT

id092200018700

Purpose
- The door-ajar warning light notifies the driver that any door or the liftgate is open.

Function
- When the instrument cluster receives any of the following signals sent from the rear body control module (RBCM) via the CAN signal, the door-ajar warning light illuminates.
  - — Door latch switch ON signal (door open)
  - — Liftgate latch switch ON signal (liftgate open)

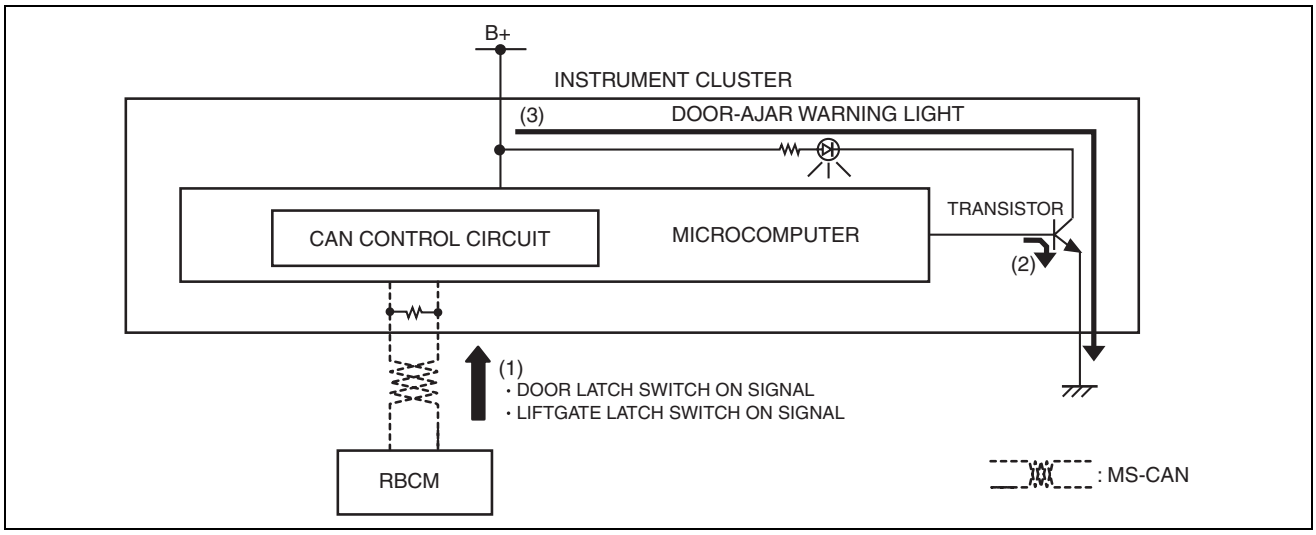
Construction
- The instrument cluster controls illumination on/off of the door-ajar warning light using the instrument cluster microcomputer based on the door latch or liftgate latch position signal from the rear body control module (RBCM).
- The door-ajar warning light is set in the instrument cluster.
- The door-ajar warning light in the instrument cluster for vehicles with a TFT LCD is displayed in the TFT LCD display. Refer to the 09-22-72 DOOR AJAR WARNING DISPLAY for the display content.



ac5wzn00001382

Operation
1. The instrument cluster receives (1) the door latch switch ON signal or liftgate latch switch ON signal from the rear body control module (RBCM).
2. The instrument cluster microcomputer turns the transistor on (2) based on each signal.
3. When the transistor turns on, a ground circuit with the door-ajar warning light is established and the door-ajar warning light illuminates (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000627

Fail-safe
- Function not equipped.

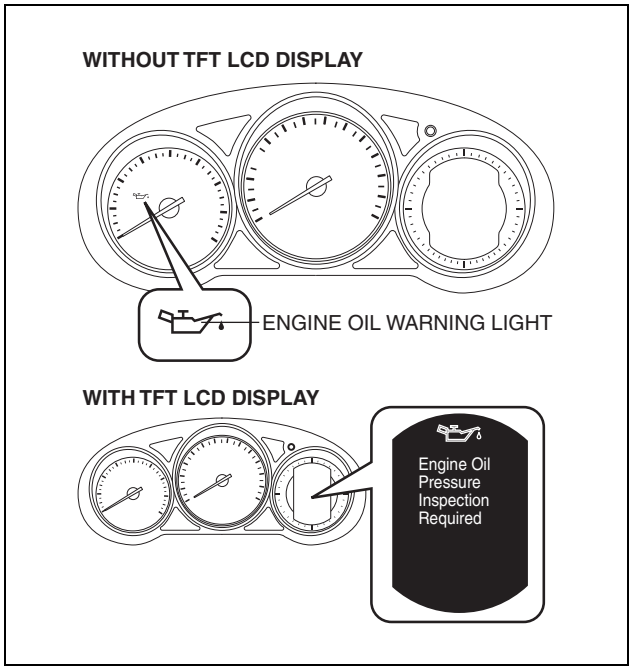
ENGINE OIL WARNING LIGHT

id092200034300

Purpose
- The engine oil warning light warns the driver that the engine oil level is insufficient.

Function
- When the instrument cluster receives the engine oil warning light request signal sent from the PCM via the CAN signal, it illuminates the engine oil warning light.

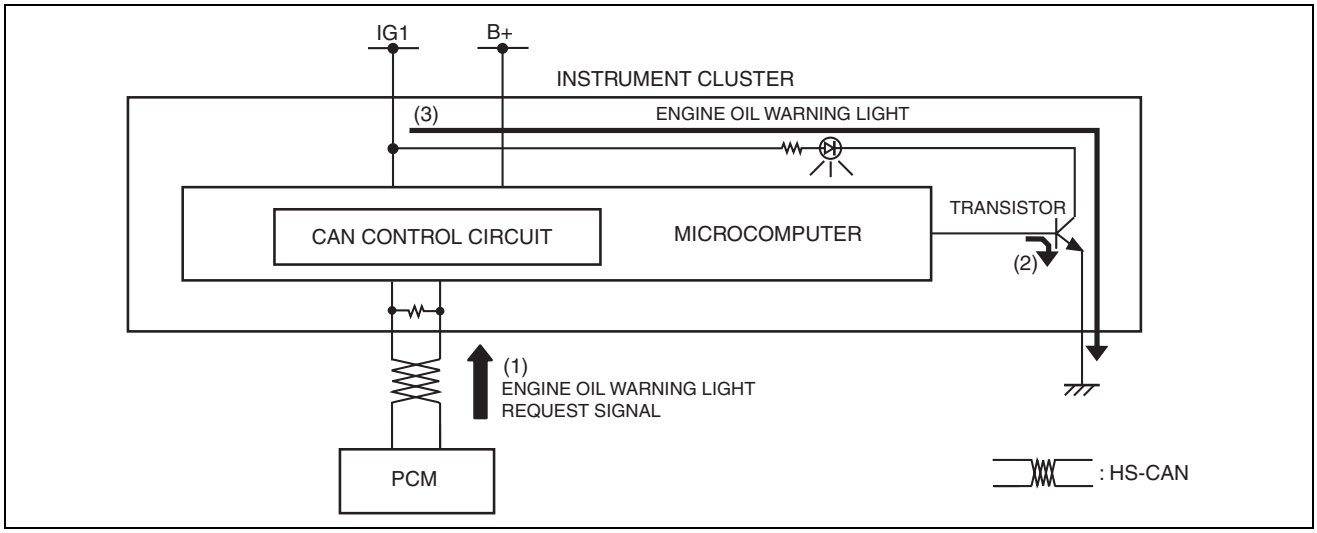
Construction
- The instrument cluster controls illumination on/off of the engine oil warning light using the instrument cluster microcomputer based on the engine oil warning light request signal from the PCM.
- The engine oil warning light is set in the instrument cluster.



ac5wzn00001385

Operation
Without TFT LCD display
1. The instrument cluster receives (1) the engine oil warning light request signal from the PCM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the engine oil warning light request

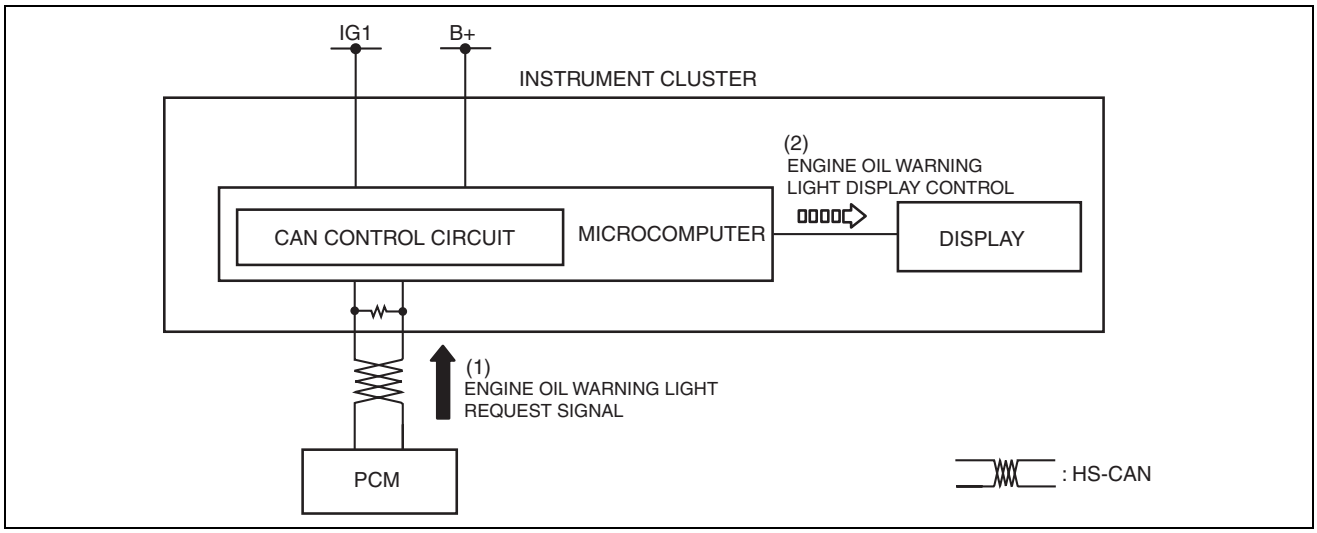
signal.
3. When the transistor turns on, a ground circuit with the engine oil warning light is established and the engine oil warning light illuminates (3).



ac5wzn00001511

With TFT LCD display

1. The instrument cluster receives (1) the engine oil warning light request signal from the PCM.
2. The instrument cluster microcomputer displays (2) the engine oil warning light in the TFT LCD display screen.



ac5wzn00001512

Fail-safe

- Function not equipped.

SEAT BELT WARNING LIGHT

id092200022900

Purpose

- The seat belt warning light warns the driver that a seat belt is not fastened.

Function

- The instrument cluster flashes/illuminates the seat belt warning light based on the following CAN signals:
  - — Vehicle speed signal sent from PCM
  - — Driver/passenger buckle switch signal, occupancy detection sensor signal sent from SAS control module
  - — Rear seat buckle switch signal sent from rear body control module (RBCM)

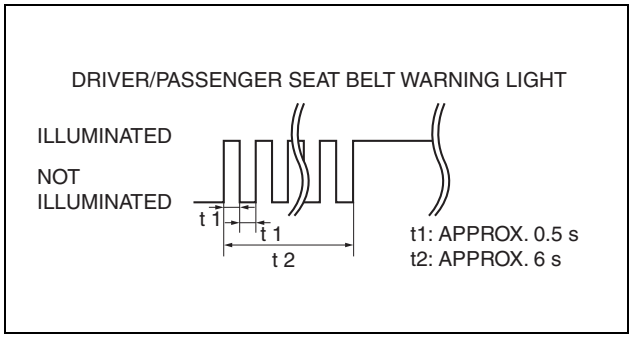
Driver/passenger seat belt warning light display function

- The driver/passenger seat belt warning light has a warning for when the vehicle is stopped, while the vehicle is being driven, and subsequent warnings while the vehicle is being driven.

INSTRUMENTATION/DRIVER INFO.

Warning when vehicle is stopped

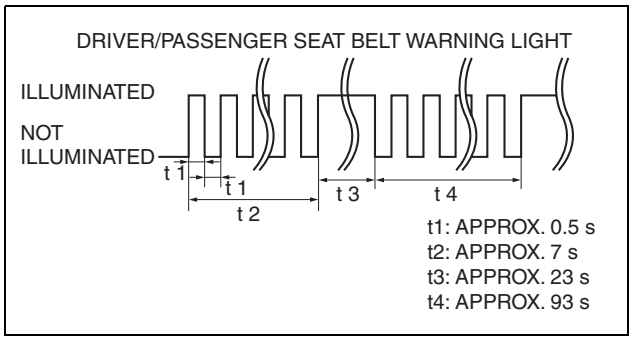
- When all of the following conditions are met, it illuminates
  - — Ignition switch ON (engine off or on)
  - — Driver/passenger buckle switch on signal (seat belt unfastened) is detected
  - — Occupancy sensor on signal (occupant in passenger seat) is detected (passenger seat belt warning light only)
- The driver/passenger seat belt warning flash/illumination pattern is as shown in the figure.



ac5wzn00001376

Warning while vehicle is driven

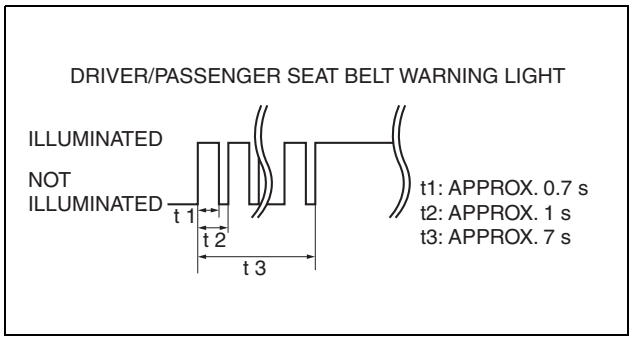
- When all of the following conditions are met, it flashes/illuminates
  - — Vehicle speed is approx. 20 km/h {12 mph} or more
  - — Driver/passenger buckle switch on signal (seat belt unfastened) is detected
  - — Occupancy sensor on signal (occupant in passenger seat) is detected (passenger seat belt warning light only)
- The driver/passenger seat belt warning flash/illumination pattern is as shown in the figure.



ac5wzn00001377

Subsequent warning while vehicle is driven

- When all of the following conditions are met, it flashes/illuminates
  - — Vehicle speed is approx. 20 km/h {12 mph} or more
  - — Occupancy sensor on signal (occupant in passenger seat) is detected (passenger seat belt warning light only)
  - — After warning while vehicle is being driven operates, buckle switch off signal (seat belt fastened) to on signal (seat belt unfastened) is detected
- The driver/passenger seat belt warning flash/illumination pattern is as shown in the figure.



ac5wzn00001378

Rear seat belt warning light display function

- The rear seat belt warning light illuminates in green to indicate seat belts are fastened, and it illuminates in red to indicate a seat belt is not fastened.
- The rear seat belt warning light has an initial warning and a subsequent warnings.

Initial warning

- When the ignition is switched ON (engine off or on), it illuminates for approx. 33 s.

Subsequent warning

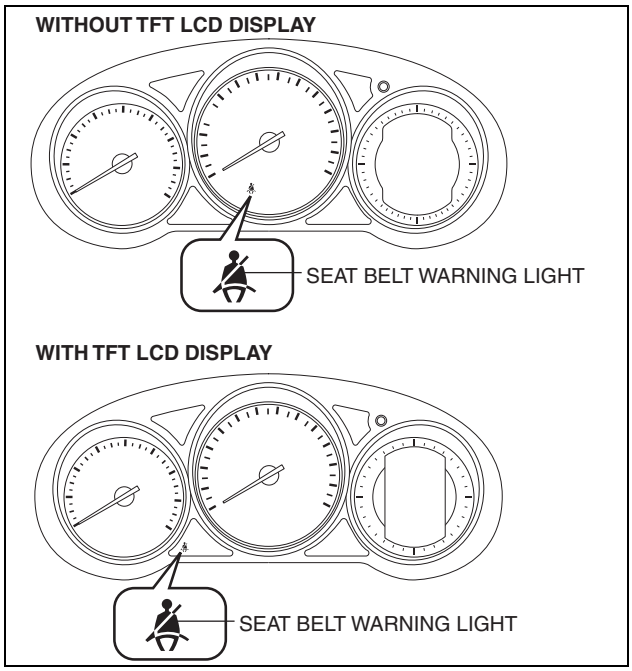
- After the initial warning operates, if a buckle switch signal change (on to off, or off to on), illuminates for approx. 33 s.

Construction

- The microcomputer in the instrument cluster controls the illumination/flashing/turning off of the seat belt warning light based on the driver/passenger buckle switch signal and occupancy sensor signal from the SAS control module, the rear seat buckle switch signal from the rear body control module (RBCM), and the vehicle speed signal from the PCM.

INSTRUMENTATION/DRIVER INFO.

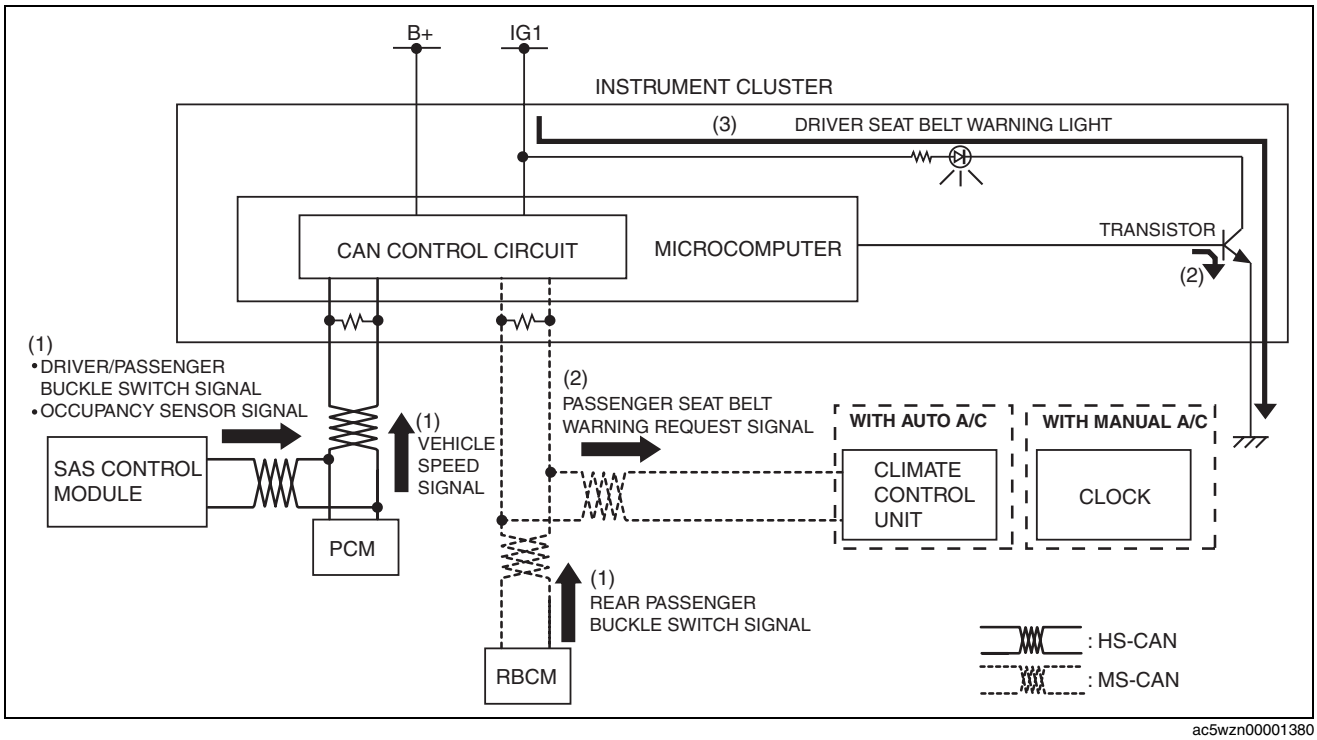
- The driver seat belt warning light is set in the instrument cluster.
- The passenger seat belt warning light and rear seat belt warning light are set in the clock (with manual A/C)/climate control unit (with auto A/C). For details on the passenger seat belt warning light and rear seat belt warning light, refer to 07-40A-21 CLIMATE CONTROL UNIT [FULL-AUTO AIR CONDITIONER] (with auto A/C)/09-22-124 CLOCK (with manual A/C).



ac5wzn00001555

Operation

1. The instrument cluster receives (1) a vehicle speed signal from the PCM, a driver/passenger seat buckle switch signal and occupancy sensor signal from the SAS control module, and a rear passenger buckle switch signal from the rear body control module (RBCM).
2. The instrument cluster microcomputer turns the transistor on (2) intermittently for flashing and continuously for illumination based on the each signal. In addition, it sends a driver/passenger seat belt warning request signal to the clock (with manual A/C)/climate control unit (with auto A/C).
3. When the transistor turns on intermittently, the driver seat belt warning light flashes (3), when it turns on continuously, the driver seat belt warning light illuminates (3).



ac5wzn00001380

Fail-safe

- Function not equipped.

INSTRUMENTATION/DRIVER INFO.

LOW FUEL WARNING LIGHT

id092200023000

Purpose

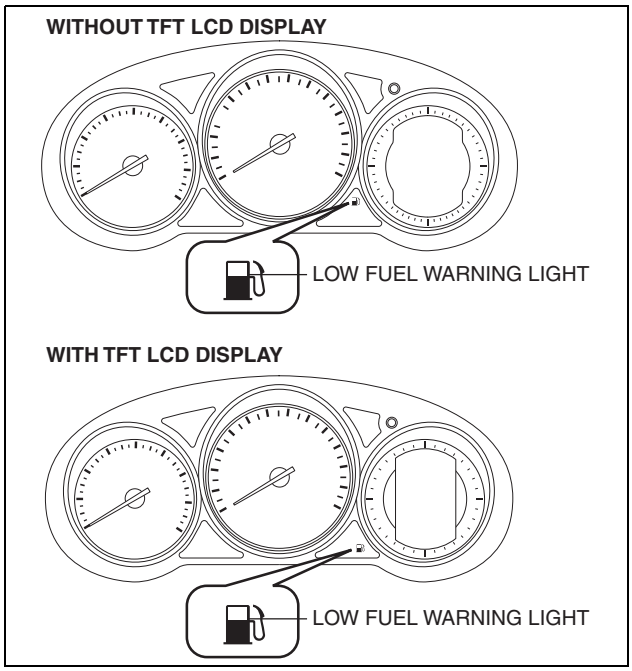
- The low fuel warning light warns the driver that the remaining fuel level is low.

Function

- The instrument cluster calculates the fuel quantity based on the following CAN signals, and if a remaining fuel amount of approx. 10 L {2.6 US gal, 2.2 Imp gal} (fuel gauge displays remaining two segments) is detected, the low fuel warning light illuminates.
  - — Fuel gauge sender unit voltage signal sent from rear body control module (RBCM)
  - — Fuel injection amount signal, vehicle speed signal sent from PCM

Construction

- The instrument cluster microcomputer controls the low fuel warning light illumination on/off based on the remaining fuel amount calculation that is calculated by the instrument cluster.
- The low fuel warning light is set in the instrument cluster.
- The instrument cluster with the TFT LCD displays a warning message in the TFT LCD display simultaneously when the fuel tank level warning light illuminates. For details on the message, refer to the 09-22-70 FUEL TANK LEVEL WARNING DISPLAY.

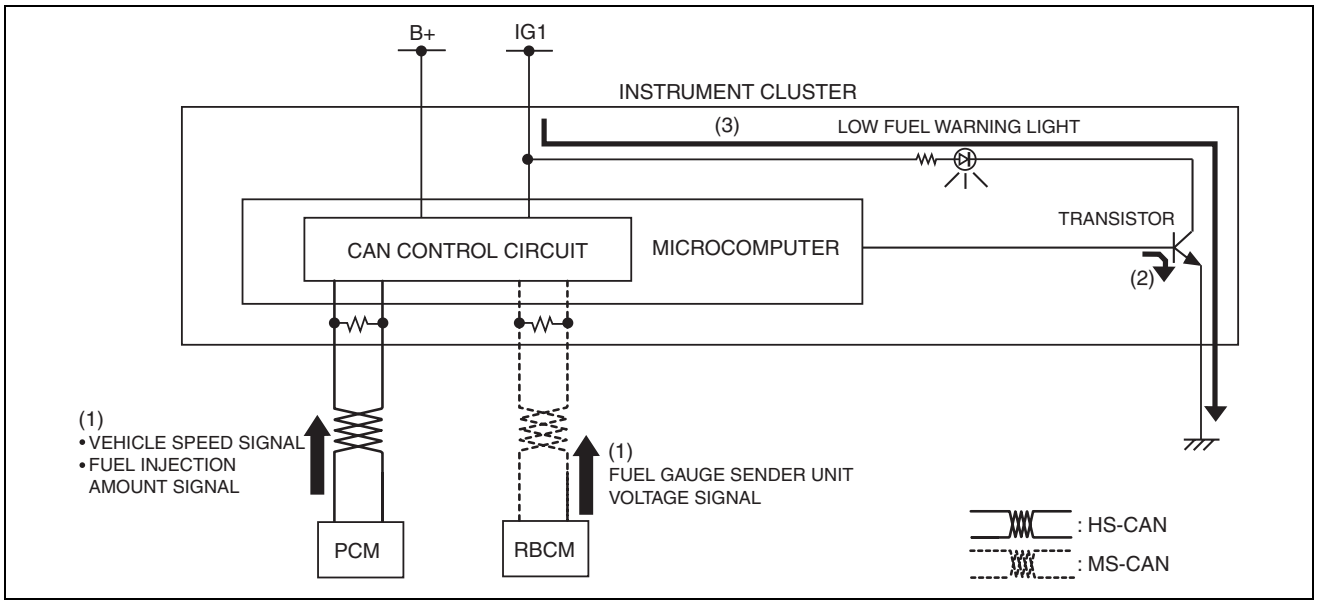


ac5wzn00001383

Operation

1. When the ignition is switched ON (engine off or on) the instrument cluster receives (1) the fuel gauge sender unit voltage signal from the rear body control module (RBCM), and the fuel injection amount signal from the PCM.
2. The instrument cluster turns the transistor on (2) if the calculated remaining fuel amount based on each signal is approx. 10 L {2.6 US gal, 2.2 Imp gal}.
3. When the transistor turns on, a ground circuit with the low fuel warning light is established and the low fuel warning light illuminates (3).

INSTRUMENTATION/DRIVER INFO.



ac5jjn00000706

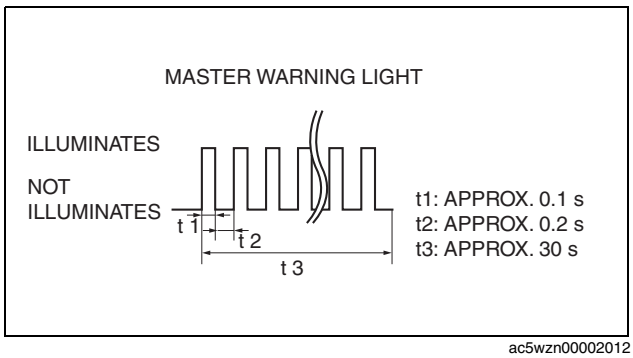
Fail-safe
- Function not equipped.

MASTER WARNING LIGHT

id092200032400

Purpose
- The master warning light warns the driver that any of the following malfunctions is occurring.
  - — Brake switch malfunction
  - — Engine oil solenoid valve malfunction
  - — Power supply system malfunction
  - — Current sensor malfunction
- When the instrument cluster equipped with the TFT LCD receives a TFT LCD warning message display request signal from the related system, the master warning light illuminates simultaneously to notify the user that a malfunction is occurring in the vehicle. For the warning messages which display simultaneously when the master warning light illuminates, refer to the 09-22-61 LIQUID CRYSTAL DISPLAY (LCD).

Function
- The instrument cluster illuminates the master warning light based on the following CAN signals:
  - — Brake switch No.1 error signal, brake switch No.2 error signal, engine oil solenoid valve error signal, current sensor error signal, and power supply system error signal sent from the PCM
- The instrument cluster flashes the master warning light based on the master warning light flash request signal sent from the PCM as a CAN signal.
- The master warning light flashing pattern is as indicated in the figure.

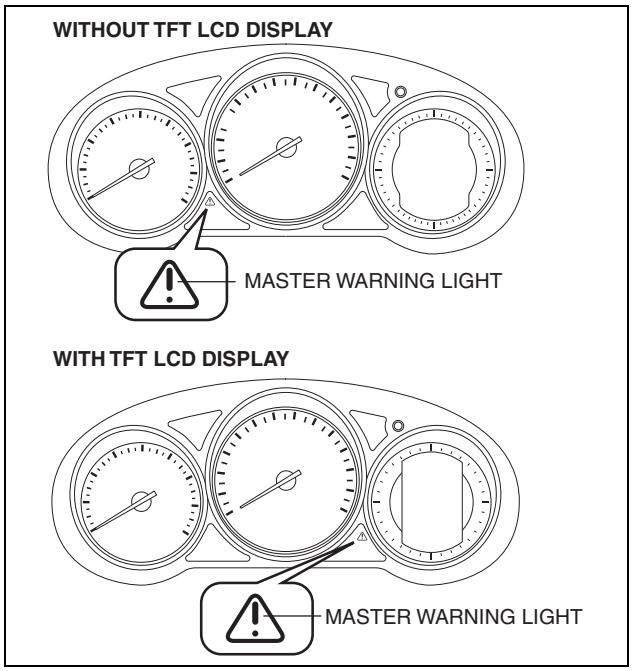


ac5wzn00002012

Construction
- The instrument cluster microcomputer controls the illumination/flashing/turning off of the master warning light based on each error signal sent from the PCM.

INSTRUMENTATION/DRIVER INFO.

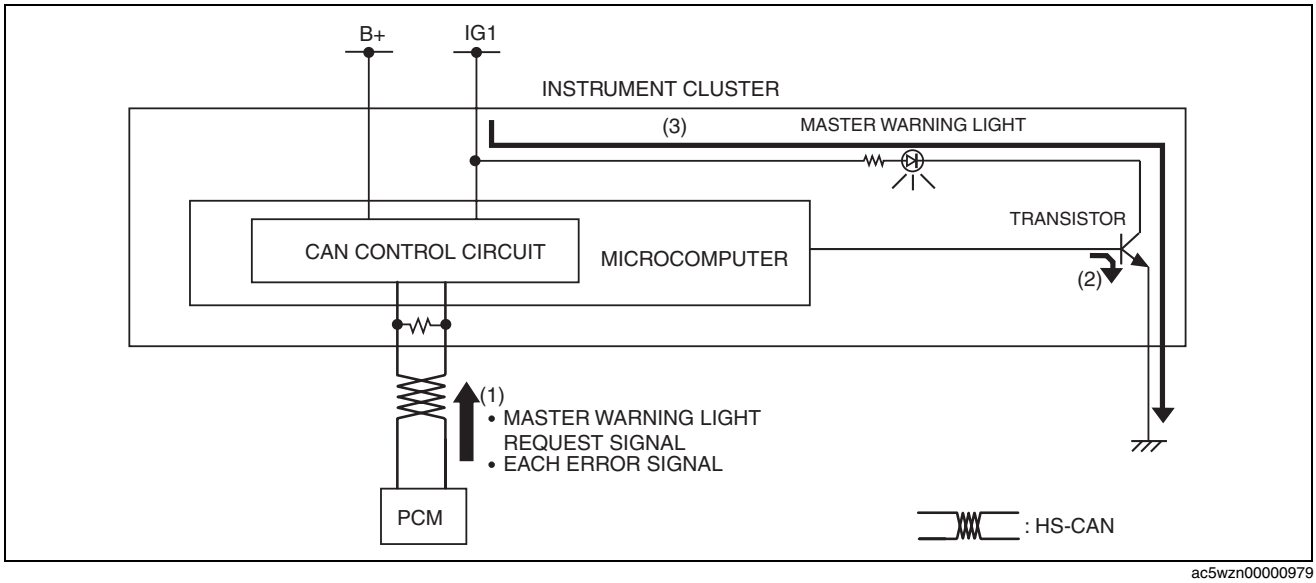
- The master warning light is set in the instrument cluster.



ac5wzn00001384

Operation

1. When the ignition is switched ON (engine off or on), the instrument cluster receives (1) each error signal or a master warning light request signal from the PCM.
2. The instrument cluster turns the transistor on (2) intermittently for flashing and continuously for illumination based on each signal.
3. The master warning light flashes (3) when the transistor is turned on intermittently, and it illuminates (3) when the transistor is turned on continuously.



ac5wzn00000979

Fail-safe

- Function not equipped.

120 km/h WARNING LIGHT

id092200034000

Purpose

- The 120 km/h warning light notifies the driver that the current vehicle speed exceeds 120 km/h {74.6 mph}.

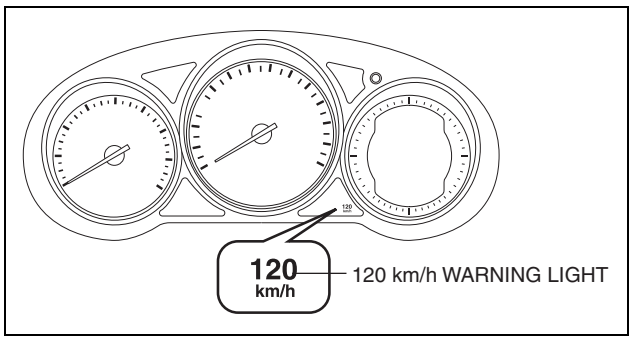
Function

- When the instrument cluster receives a 120 km/h {74.6 mph} vehicle speed signal sent from the PCM via the CAN signal, it illuminates the 120 km/h warning light.

INSTRUMENTATION/DRIVER INFO.

Construction

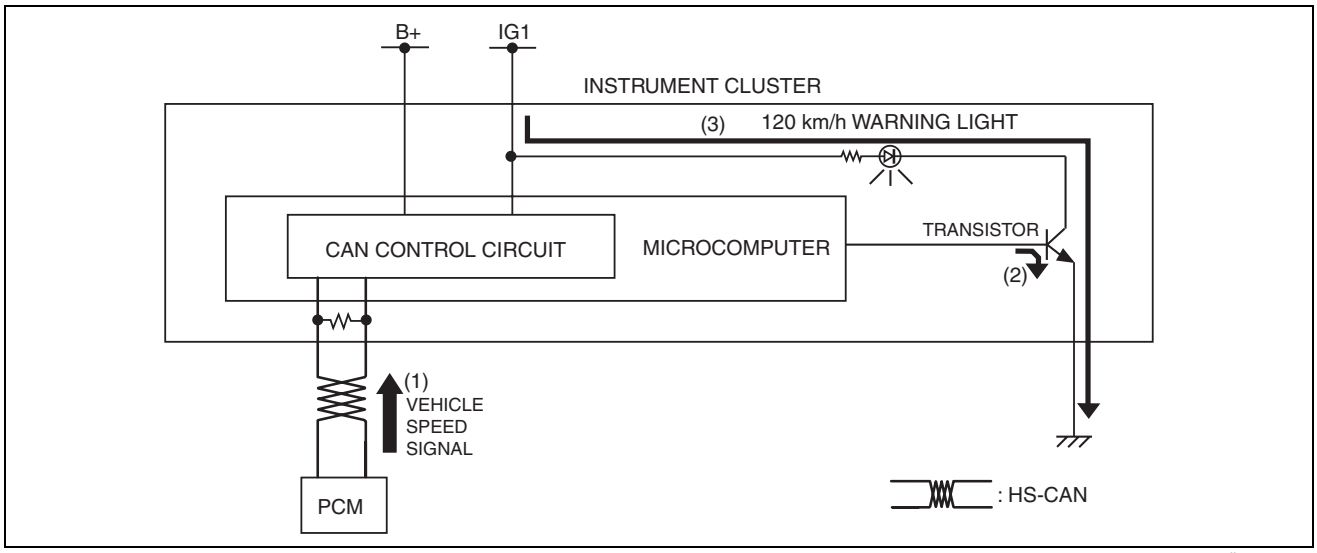
- The instrument cluster microcomputer controls the illumination on/off of the 120 km/h warning light based on the 120 km/h {74.6 mph} vehicle speed signal from the PCM.
- The 120 km/h warning light is set in the instrument cluster.



ac5wzn00001404

Operation

1. The instrument cluster receives (1) the vehicle speed signal from the PCM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the 120 km/h {74.6 mph} vehicle speed signal.
3. When the transistor turns on, a ground circuit with the 120 km/h warning light is established and the 120 km/h warning light illuminates (3).



ac5jjn00001530

Fail-safe

- Function not equipped.

SPEEDOMETER

id092200032500

Purpose

- The speedometer notifies the driver of the speed at which the vehicle is traveling.

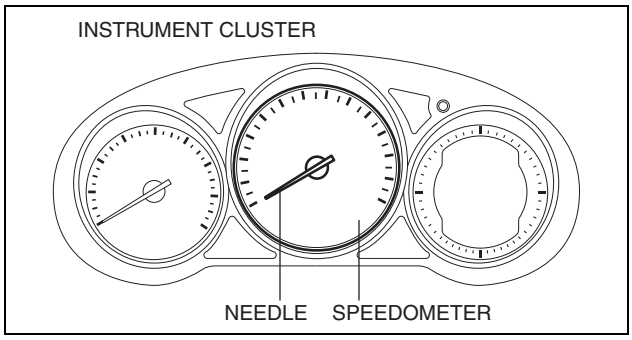
Function

- The instrument cluster controls the speedometer needle based on the vehicle speed signal from the PCM and displays the current vehicle speed.

INSTRUMENTATION/DRIVER INFO.

Construction

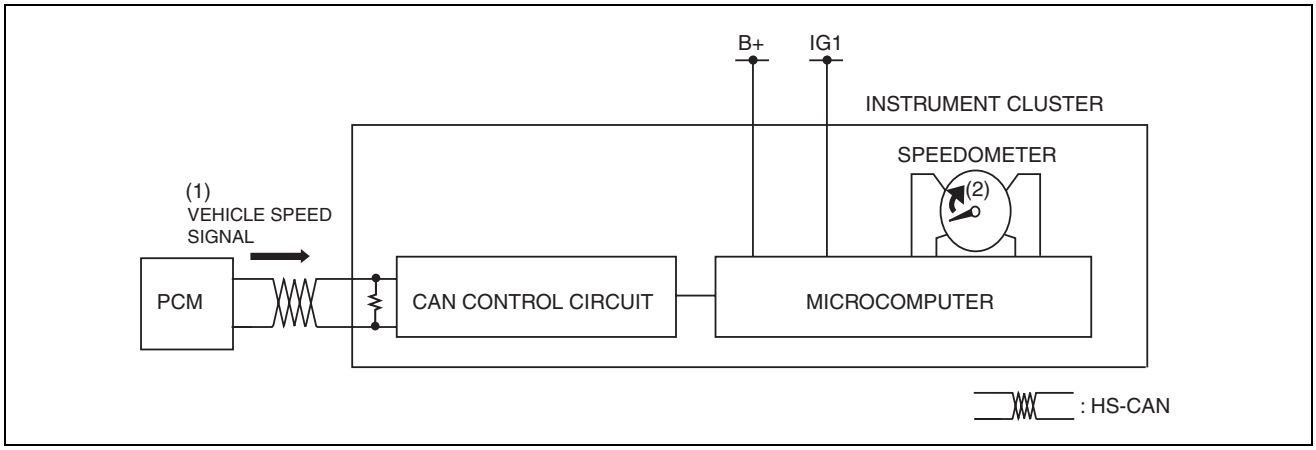
- An analog needle display speedometer with a stepping motor mechanism has been adopted.



ac5wzn00000881

Operation

- The instrument cluster receives (1) the vehicle speed signal from the PCM when the ignition is switched ON (engine on).
- The instrument cluster moves the needle based on the vehicle speed signal and displays (2) the current vehicle speed.



ac5wzn00000882

Fail-safe

- Function not equipped.

TACHOMETER

id092200032600

Purpose

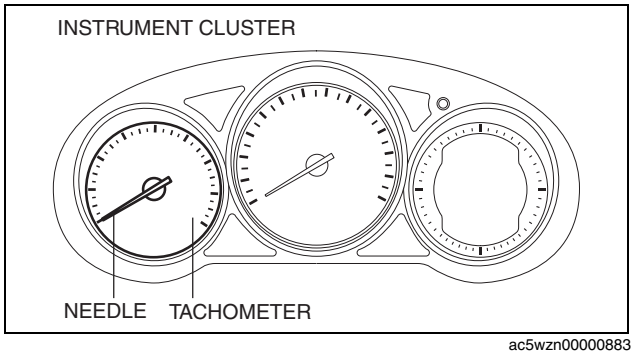
- The tachometer notifies the driver of the engine speed.

Function

- The instrument cluster controls the tachometer needle based on the engine speed signal from the PCM and displays the engine speed per minute.

Construction

- An analog needle display tachometer with a stepping motor mechanism has been adopted.

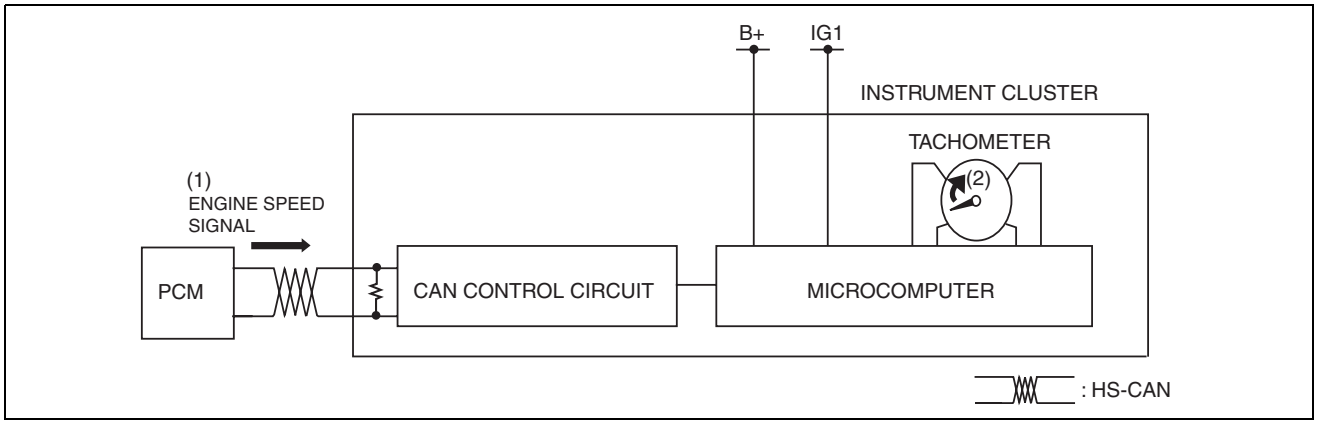


ac5wzn00000883

INSTRUMENTATION/DRIVER INFO.

Operation

- The instrument cluster receives (1) the engine speed signal from the PCM when the ignition is switched ON (engine on).
- The instrument cluster moves the needle based on the engine speed signal and displays (2) the current engine speed.



ac5wzn00000884

Fail-safe

- Function not equipped.

FUEL GAUGE

id092200032700

Purpose

- The fuel gauge notifies the user of the amount of remaining fuel.

Function

- The instrument cluster calculates the amount of fuel in the fuel tank based on the following CAN signals and displays the fuel gauge segments.
  - — Fuel gauge sender unit voltage signal sent from rear body control module (RBCM)
  - — Fuel injection amount signal, vehicle speed signal sent from PCM

Fuel gauge flicker prevention function

- When the instrument cluster determines that the vehicle is being driven, it retards the response with which the calculated amount of fuel is reflected to the fuel gauge. As a result, fuel gauge flicker caused by the variation of fuel surface during driving is prevented.

Refuel determination function

- If the amount of fuel is changed by 5 L {1 US gal, 1 Imp gal}/2 L {0.5 US gal, 0.4 Imp gal}*1 or more while the vehicle is stopped, the instrument cluster determines that the vehicle is refueled and displays the fuel gauge segments based on the fuel gauge sender unit voltage signal from the rear body control module (RBCM).

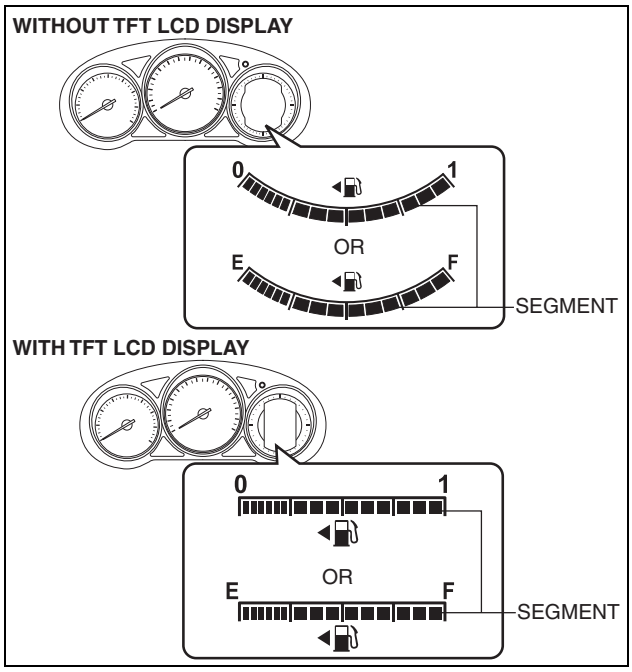
*1 : 5 L {1 US gal, 1 Imp gal} when the number of fuel gauge segments is 10 or less/2 L {0.5 US gal, 0.4 Imp gal} when the number of fuel gauge segments is 11 or more

Construction

- The fuel gauge is displayed in the LCD of the instrument cluster.

INSTRUMENTATION/DRIVER INFO.

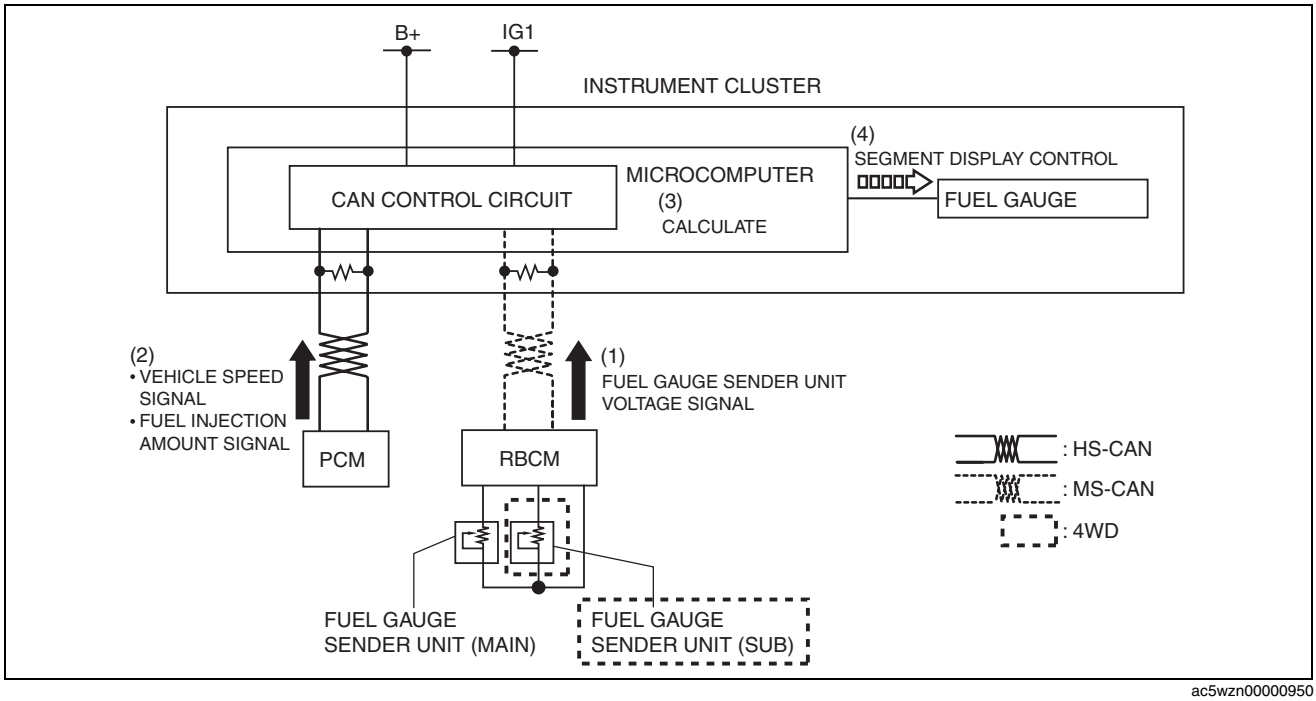
- The fuel gauge is consists of 15 segments.



ac5wzn00000949

Operation

1. When the ignition is switched ON (engine off or on), the rear body control module (RBCM) converts the resistance from the fuel gauge sender unit to voltage and sends it to the instrument cluster as a fuel gauge sender unit voltage signal (1).
2. The instrument cluster receives the fuel gauge sender unit voltage signal from the rear body control module (RBCM), and it also receives the fuel injection amount control signal and vehicle speed signal from the PCM (2).
3. The instrument cluster calculates the amount of fuel in the fuel tank based on the signals (3).
4. The instrument cluster displays/turns off the fuel gauge segments according to the calculation result (4).



ac5wzn00000950

Fail-safe

- Function not equipped.

INSTRUMENTATION/DRIVER INFO.

ODOMETER/TRIPMETER

id092200032900

Purpose

- The odometer/tripmeter notifies the user of the total travel distance or the traveled distance over a specific interval.

Function

- The instrument cluster calculates the traveled distance based on the traveled distance signal from the PCM and displays it.
- The instrument cluster stores the calculated travel distance in the microcomputer of the instrument cluster.

Odometer calculation function

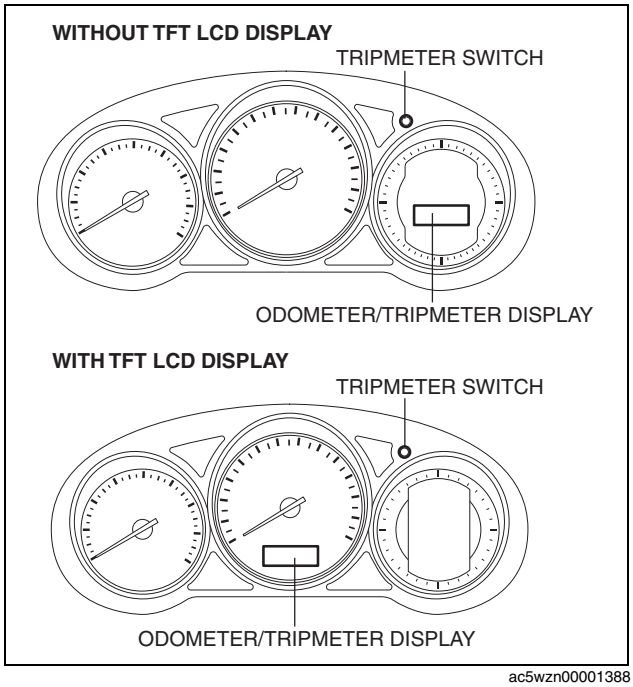
- The instrument cluster calculates the total traveled distance based on the traveled distance signal from the PCM and the stored traveled distance, and displays it.
- The total traveled distance which can be displayed is from 0 to 999,999.

Tripmeter A/B calculation function

- The instrument cluster calculates the traveled distance based on the traveled distance signal from the PCM and the traveled distance from when the tripmeter is reset, and displays it.
- There are A and B tripmeters and the display for each can be switched with each press of the tripmeter switch.
- If the tripmeter switch is continuously pressed for **approx. 1 s or more**, the tripmeter traveled distance is reset (0.0)
- The traveled distance which can be displayed is from 0.0 to 999.9. After 999.9, it returns to 0.

Construction

- The odometer/tripmeter is displayed in the LCD of the instrument cluster.
- The tripmeter switch is installed to the instrument cluster.
- The calculation for the odometer/tripmeter display and the traveled distance is performed by the instrument cluster microcomputer.



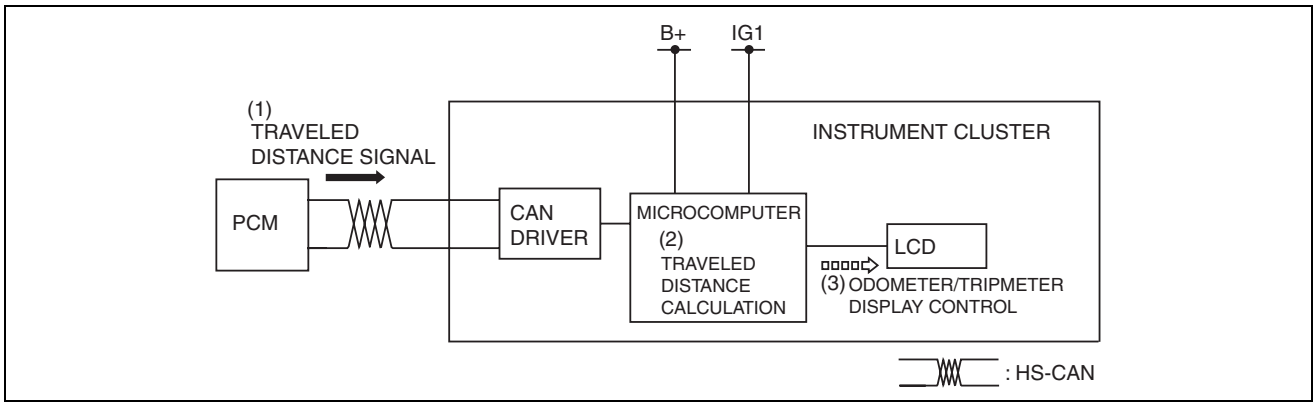
ac5wzn00001388

Operation

1. The instrument cluster receives (1) the traveled distance signal from the PCM when the ignition is switched ON (engine on).
2. The instrument cluster calculates the traveled distance (2) in the recorded total traveled distance (odometer) data and the traveled distance over a specific interval (tripmeter) based on the received traveled distance signal.

INSTRUMENTATION/DRIVER INFO.

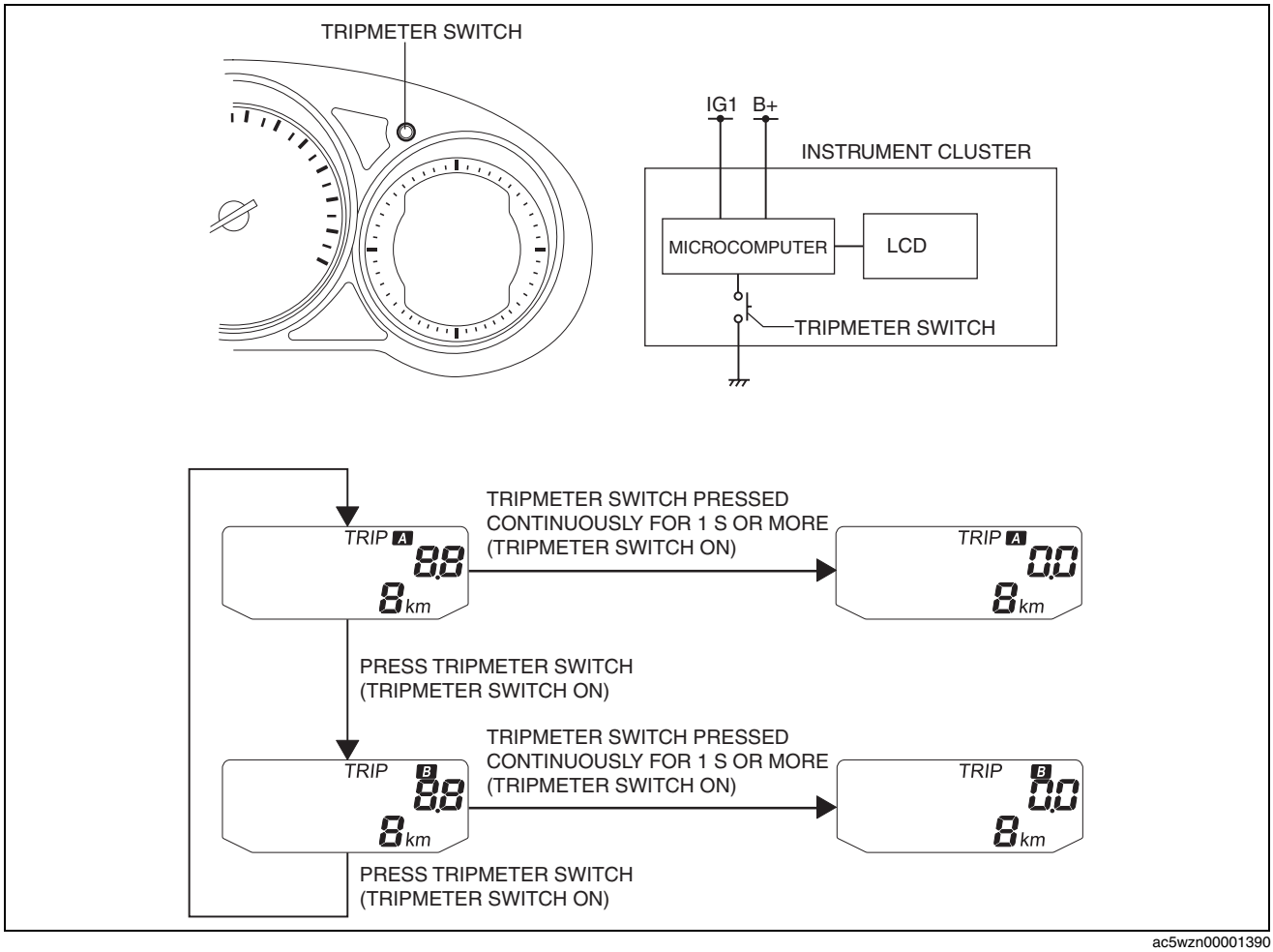
3. The instrument cluster displays (3) the calculated travel distance in the LCD.



ac5wzn00001389

Odometer/tripmeter switching operation

- The instrument cluster switches the odometer/tripmeter display when a tripmeter switch ON is detected.
- The instrument cluster returns the traveled distance display to 0.0 when a tripmeter switch ON is detected for 1 s or more while tripmeter A or B is displayed.



ac5wzn00001390

Fail-safe

- Function not equipped.

PANEL LIGHT

id092200033000

Purpose

- The panel light adjusts the instrument cluster and steering switch illumination brightness.

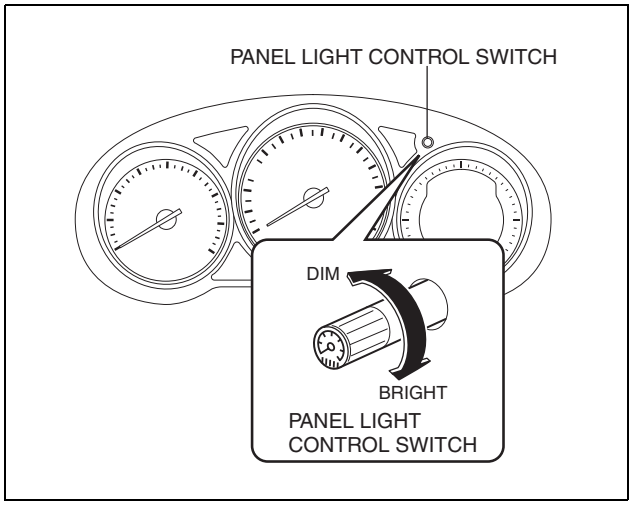
INSTRUMENTATION/DRIVER INFO.

Function

- The instrument cluster adjusts the brightness of the following illumination lights when a TNS illumination signal sent via CAN transmission from the front body control module (FBCM) is received.
  - — Instrument cluster
  - — Climate control unit
  - — Steering switch
  - — Cluster switch
  - — Hazard warning switch
  - — Selector illumination
  - — Audio unit
  - — Commander switch
  - — Clock (with manual A/C)
- The instrument cluster changes the brightness of the illumination lights according to the rotation signal of the panel light control switch.

Construction

- The panel light control switch is set in the instrument cluster.



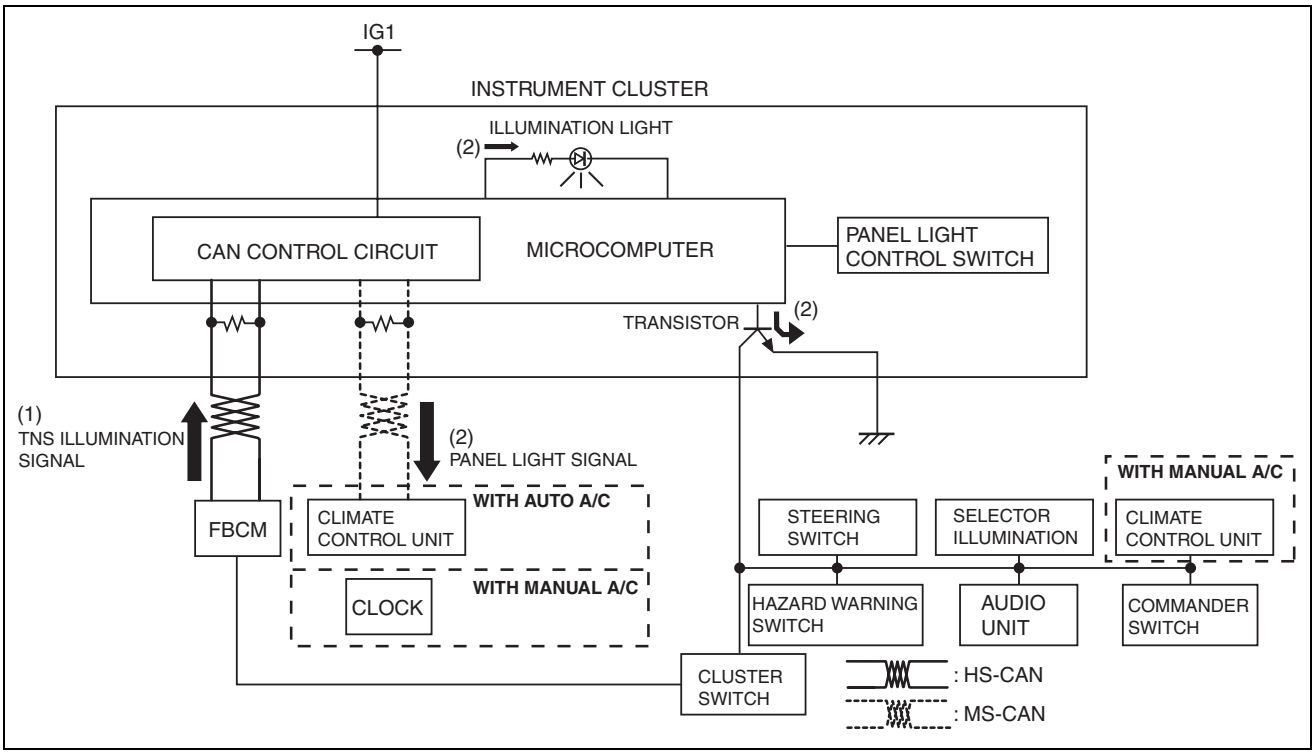
ac5wzn00000885

Operation

1. When the ignition is switched ON (engine off or on), the instrument cluster receives (1) the TNS illumination signal from the front body control module (FBCM).
2. The instrument cluster performs the following controls when it receives the TNS illumination signal.
   - — Changes the brightness of the instrument panel illumination.
   - — Outputs a panel light signal via CAN signal to the climate control unit (with auto A/C)/clock (with manual A/C).
   - — Turns on the panel light circuit transistor.

INSTRUMENTATION/DRIVER INFO.

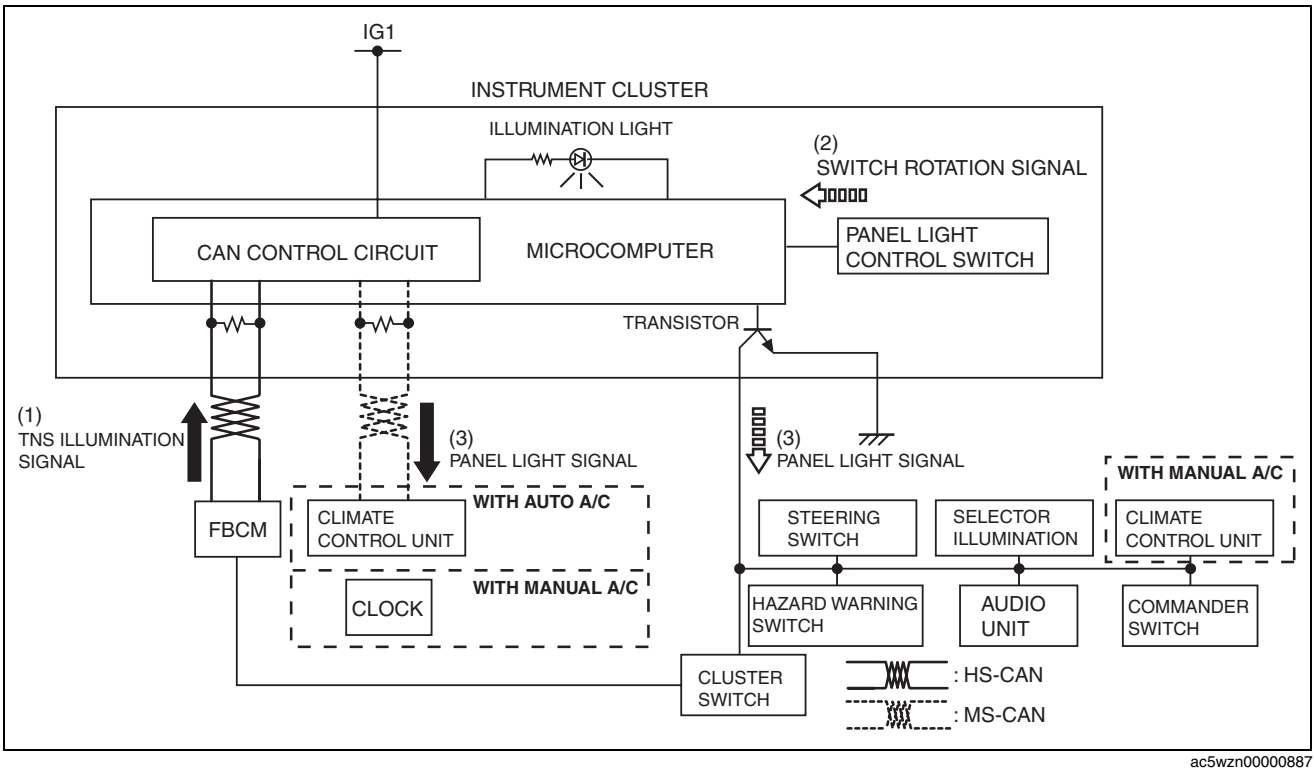
3. When the transistor turns on, a ground circuit with the panel light is established and the panel light illuminates.



ac5wzn00000886

Panel light control switch operation

1. When the ignition is switched ON (engine off or on), the instrument cluster receives (1) the TNS illumination signal from the front body control module (FBCM).
2. The instrument cluster changes the brightness of the panel light according to the rotation angle when it receives a panel light control switch rotation signal while receiving the TNS illumination signal.
3. The instrument cluster outputs a panel light signal to related units.



ac5wzn00000887

INSTRUMENTATION/DRIVER INFO.

Fail-safe
- Function not equipped.

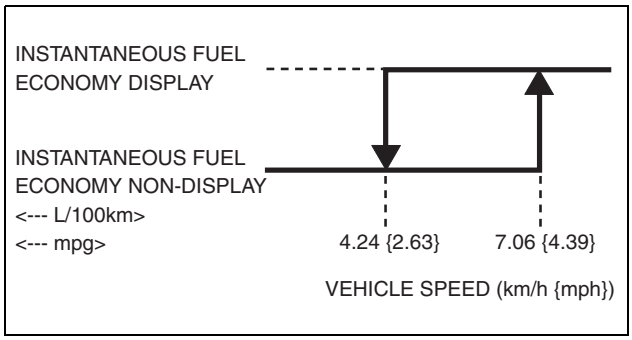
TRIP COMPUTER INFORMATION SYSTEM

id092200018000

Outline
- The trip computer system displays the instantaneous fuel economy, average fuel economy, remaining distance to empty, average vehicle speed and the vehicle speed alarm.
- The instrument cluster performs trip computer system fail-safe. (See 09-22-9 INSTRUMENT CLUSTER.)

Function
- The instrument cluster controls the trip computer system based on the following CAN signals.
  - — Vehicle speed signal, fuel injection amount signal, traveled distance signal sent from PCM
  - — Fuel gauge sender unit voltage signal sent from rear body control module (RBCM)
  - — Steering switch operation signal sent from start stop unit

Instantaneous fuel economy calculation function
- The instrument cluster calculates the instantaneous fuel economy based on the fuel consumption and traveled distance over the past 2 s when the vehicle speed is at the set value or more. In addition, the calculation results are updated every 2 s.
  Instantaneous fuel economy formula
  - — A type or B type and with TFT LCD display: Instantaneous fuel economy (L/100 km) = Fuel consumption (L) over past 2 s ×100 / Traveled distance (km) over past 2 s
  - — C type: Instantaneous fuel economy (mpg) = Traveled distance (mile) over past 2 s / Fuel consumption (gallon) over past 2 s
- When there is no fuel consumption, such as during engine braking, <0.0 L/100 km> or <99.9 mpg> is displayed.
- The instantaneous fuel economy is displayed when the vehicle speed is 7.06 km/h {4.39 mph} or more, and <--- L/100 km> or <--- mpg> is displayed when the vehicle speed is 4.24 km/h {2.63 mph} or less.



ac5wzn00000873

Average fuel economy calculation function
- The instrument cluster calculates the average fuel economy based on the traveled distance and fuel consumption from connecting the battery or resetting the average fuel economy. In addition, the calculation results are updated every minute.
  Average fuel economy formula
  - — A type or B type and with TFT LCD display: Average fuel economy (L/100 km) = Cumulative fuel consumption *1 (L) × 100 / Cumulative traveled distance *2 (km)
  - — C type: Average fuel economy (mpg) = Cumulative traveled distance *1 (mile) / Cumulative fuel consumption *2 (gallon)
- If the cumulative traveled distance is 0 km, <99.9 L/100 km> or <0.0 mpg> is displayed.
- If the INFO switch is pressed for approx. 1.5 s or more while the average fuel economy is displayed, the cumulative fuel economy and cumulative traveled distance data are reset.
- If tripmeter A is reset, the average fuel economy is also reset.
- During the 1 min period after the data has been reset, <--- L/100 km> or <--- mpg> is displayed.

*1 : Sum of fuel economy of vehicle to present
*2 : Sum of traveled distance of vehicle to present

Remaining travel distance calculation function
- The instrument cluster calculates the remaining travel distance based on the instantaneous fuel economy, cumulative fuel economy *1 and the fuel tank level. In addition, the calculation results are updated every second.

Remaining travel distance formula

— A type or B type and with TFT LCD display: Remaining travel distance (km) = Fuel tank level (L) / cumulative fuel economy (L/km) × (1500-1)/1500 + instantaneous fuel economy (L/km) in past 0.1 km interval / 1500

— C type: Remaining travel distance (miles) = Fuel tank level (L) / cumulative fuel economy (L/mile) × (1500-1)/1500 + instantaneous fuel economy (L/mile) in past 0.06 mile interval / 1500

*1 : Sum of fuel economy every 0.1 km

Average vehicle speed calculation function

- The instrument cluster calculates the average vehicle speed based on the cumulative traveled distance and cumulative traveled time from connecting the battery or resetting the average vehicle speed. In addition, the calculation results are updated every 10 s.

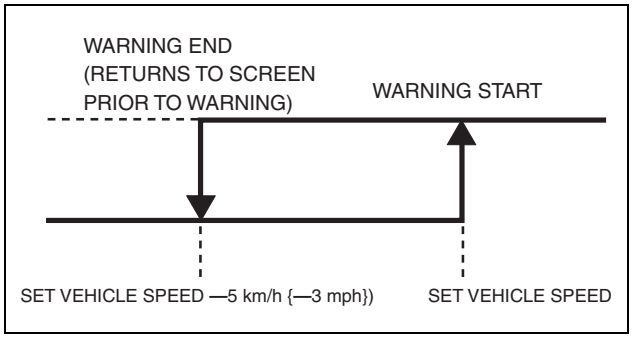
  Average vehicle speed formula

  — A type or B type and with TFT LCD display: Average vehicle speed (km/h) = Cumulative traveled distance (km) / cumulative traveled time (h)

  — C type: Average vehicle speed (mph) = Cumulative traveled distance (mile) / cumulative traveled time (h)
- If the INFO switch is pressed for approx.1.5 s or more while the average vehicle speed is displayed, the average vehicle speed (cumulative traveled distance and cumulative traveled time data) is reset.
- During the 1 min period after the data has been reset, <--- km/h> or <--- mph> is displayed.

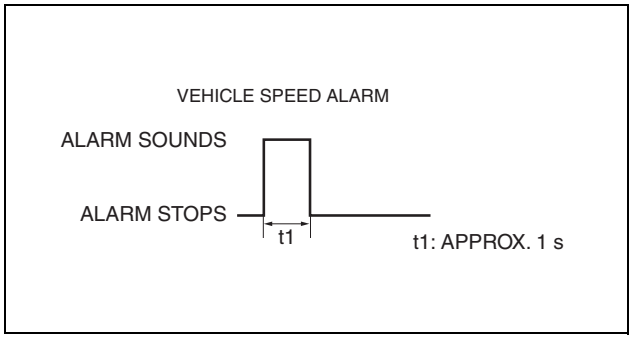
Vehicle speed alarm function

- The instrument cluster compares the current vehicle speed with the speed set by the user and if the current vehicle speed exceeds the set vehicle speed, the alarm is triggered.
- The set vehicle speed can be set in 10 km/h {10 mph} increments between 30 km/h—250 km/h {20 mph—150 mph}.
- If the vehicle speed alarm is not set, <--- km/h> or <--- mph> is displayed.
- The instrument cluster outputs a warning display and warning sound when the current vehicle speed is the same as the set vehicle speed.
- The instrument cluster switches the warning display back to the screen prior to the warning display when the current vehicle speed is -5 km/h {-3 mph} or less than the set vehicle speed.



ac5wzn00000874

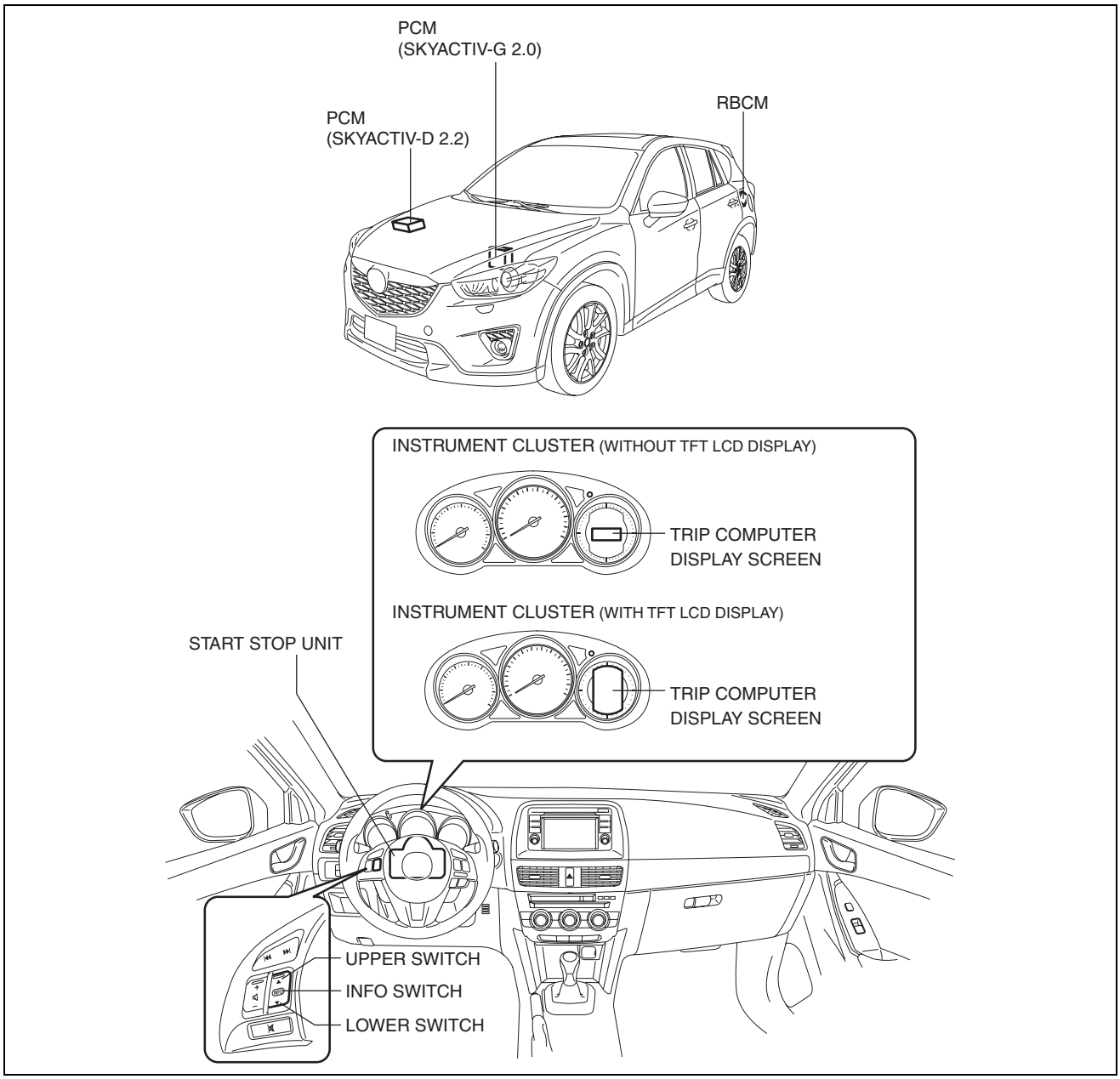
- The alarm sound pattern is as follows:



ac5wzn00000875

INSTRUMENTATION/DRIVER INFO.

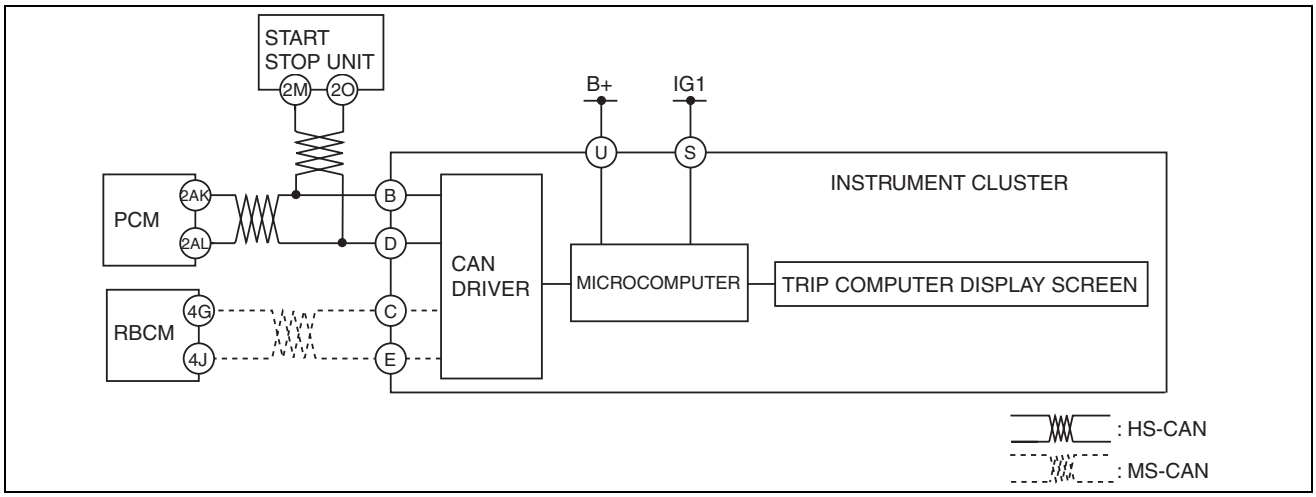
Structural view



ac5wzn00000876

INSTRUMENTATION/DRIVER INFO.

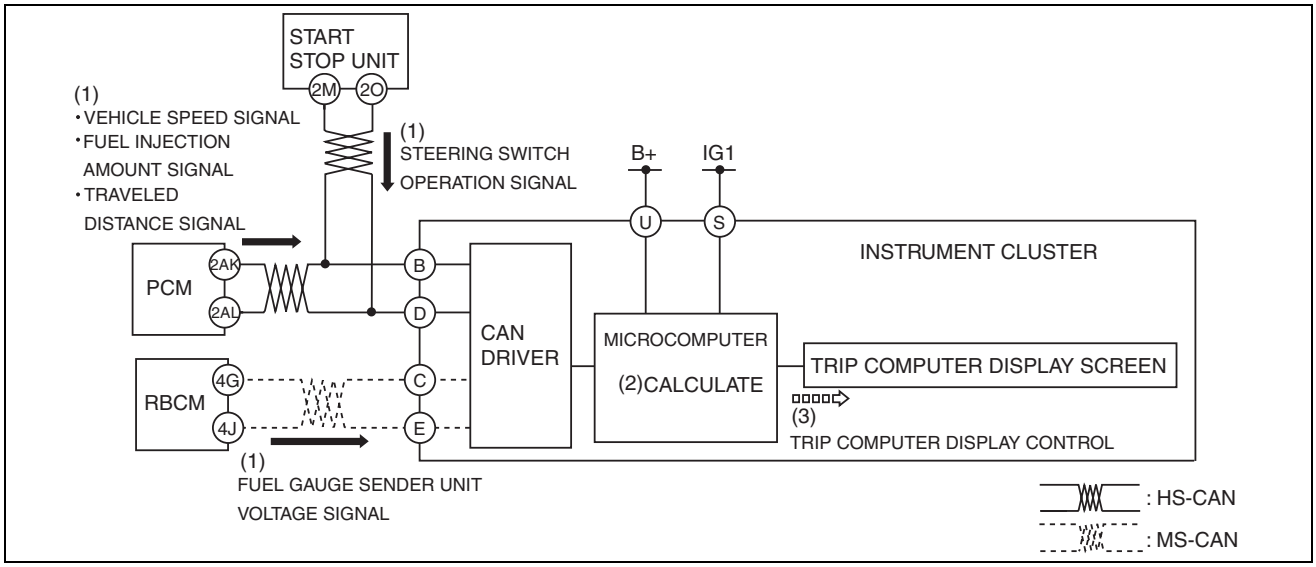
System wiring diagram



ac5wzn00000877

Operation

1. When the ignition is switched ON (engine on), the instrument cluster receives (1) the vehicle speed signal, fuel injection amount signal, traveled distance signal from the PCM, the fuel gauge sender unit voltage signal from the rear body control module (RBCM), and the steering switch operation signal from the start stop unit.
2. The instrument cluster microcomputer calculates (2) the instantaneous fuel economy and average fuel economy based on the received data.
3. The instrument cluster microcomputer displays (3) the calculated results in the trip computer display screen.

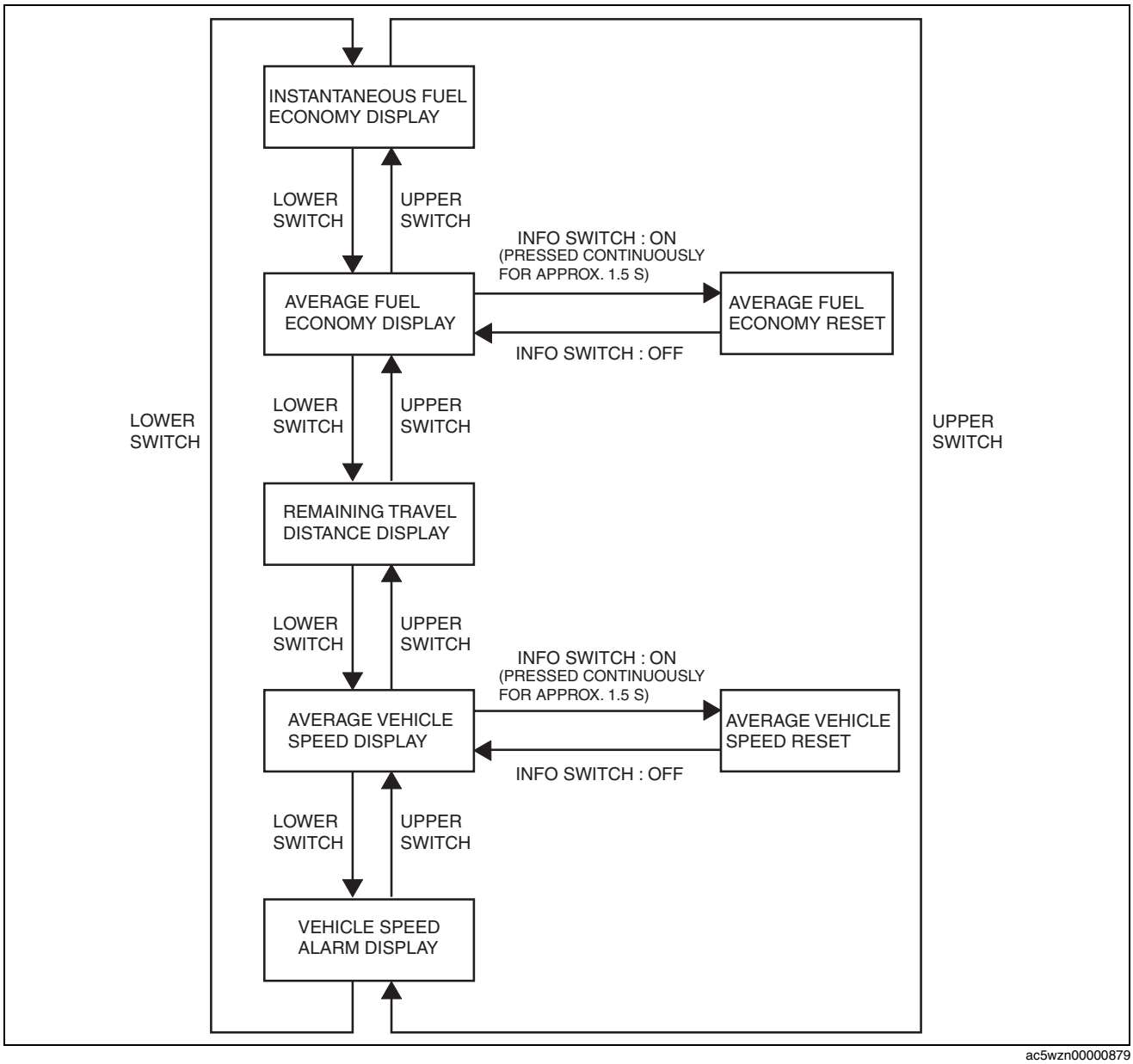


ac5wzn00000878

Trip computer display switching operation

- The instrument cluster switches the trip computer display content as follows based on the steering switch operation signal from the start stop unit.

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000879

INSTRUMENTATION/DRIVER INFO.

Display screen table

WITHOUT TFT LCD DISPLAY

	INSTANTANEOUS FUEL ECONOMY	AVERAGE FUEL ECONOMY	REMAINING TRAVEL DISTANCE	AVERAGE VEHICLE SPEED	VEHICLE SPEED ALARM
A TYPE	10.5 L/100km	Ø 10.5 L/100km	160 km	Ø 40 km/h	100 km/h
B TYPE	CURRENT 10.5 L/100km	AVG 10.5 L/100km	RANGE 100 km	AVG 40 L/100km	—
C TYPE	22.4 mpg	Ø 22.4 mpg	160 miles	Ø 25 mph	80 mph

WITH TFT LCD DISPLAY

INSTANTANEOUS FUEL ECONOMY	AVERAGE FUEL ECONOMY	REMAINING TRAVEL DISTANCE	AVERAGE VEHICLE SPEED	VEHICLE SPEED ALARM
Consumption 10.5 L/100km	Consumption Ø 10.5 L/100km	Range 160 km	Speed Ø 40 km/h	Speed Warning 100 km/h

ac5wzn00000880

LIQUID CRYSTAL DISPLAY (LCD)

id092200103500

Outline

- The LCD displays vehicle information in the instrument cluster.

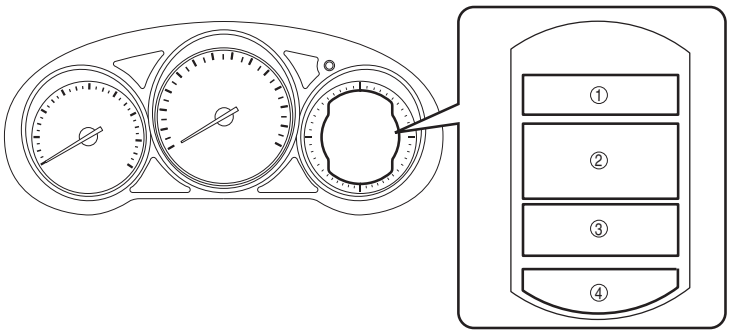
Function/Construction

- The instrument cluster configures the indication of the LCD based on the CAN signals sent from the related modules and displays it.
- Two types of LCDs, LCD and TFT LCD, are available.

LCD indication table

Without TFT LCD display

- Information displayed on the LCD and the display areas are as follows: Refer to the referenced section for details of the displayed information.



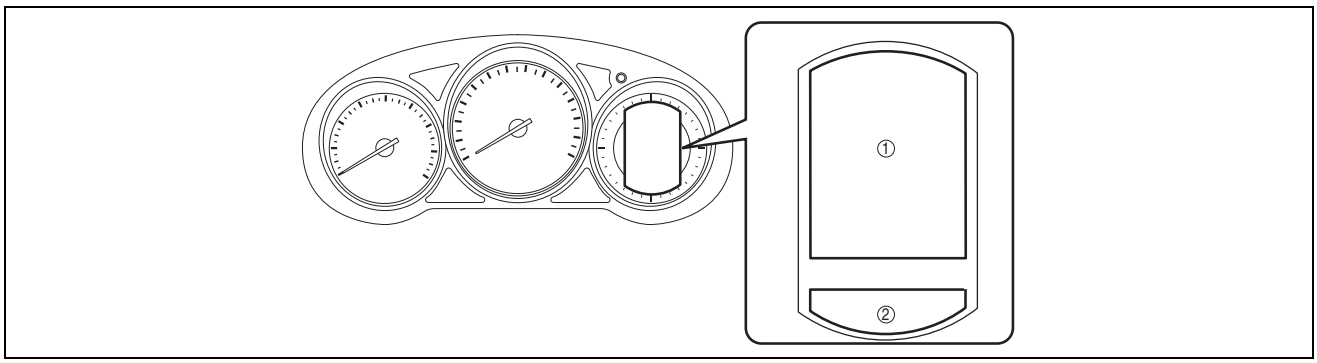
ac5jjn00000160

Display area	Display information	Reference
1	Ambient temperature is displayed.	(See 09-22-66 AMBIENT TEMPERATURE DISPLAY.)
2	Trip computer is displayed.	(See 09-22-56 TRIP COMPUTER INFORMATION SYSTEM.)
3	Odometer/tripmeter is displayed.	(See 09-22-52 ODOMETER/TRIPMETER.)
4	Amount of remaining fuel is displayed.	(See 09-22-50 FUEL GAUGE.)

INSTRUMENTATION/DRIVER INFO.

Wit TFT LCD display

- Information displayed on the LCD and the display areas are as follows: Refer to the referenced section for details of the displayed information.



ac5jjn00000126

Display area	Display information	Function
1	Trip computer is displayed.	(See 09-22-56 TRIP COMPUTER INFORMATION SYSTEM.)
1	Ambient temperature is displayed.	(See 09-22-66 AMBIENT TEMPERATURE DISPLAY.)
1	Door-ajar warning is displayed.	(See 09-22-72 DOOR AJAR WARNING DISPLAY.)
1	Screen for personalization settings is displayed.	(See 09-22-8 INSTRUMENTATION/DRIVER INFO. PERSONALIZATION.)
1	Displays a maintenance setting and maintenance-related messages.	• When the maintenance period which recorded in the instrument cluster based on the maintenance setting approaches, the following messages are displayed. — Scheduled Maintenance Due* — Tyre Rotation Due* — Oil Change Due* — Tyre Pressure Increase Pressure*
1	Messages for the following systems are displayed. **Note** • If message requests are received from multiple modules, the messages are displayed at certain intervals.	
1	**Engine system** — Engine Inspection Required* — Engine Oil Pressure Inspection Required* — Engine Coolant Temperature High* — Stop Vehicle at safe area* — Vehicle System Inspection Required* — Soot Accumulation in DPF too high* — DPF Inspection Required* — Drain Water from Fuel Filter* — Brake Override System Inspection Required*	(See 01-02-29 CHECK ENGINE LIGHT [SKYACTIV-G 2.0].) (See 09-22-41 ENGINE OIL WARNING LIGHT.) (See 09-22-37 LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED).) (See 01-40-16 DRIVE-BY-WIRE CONTROL [SKYACTIV-G 2.0].)
1	**Battery system** — Charging System Inspection Required* — Battery Management System Inspection Required*	(See 01-17A-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-G 2.0].) (See 01-17B-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-D 2.2].) (See 01-40-41 GENERATOR CONTROL [SKYACTIV-G 2.0].)
1	**EPS system** — Power Steering System Inspection Required*	(See 06-13-1 ELECTRIC POWER STEERING SYSTEM.)
1	**Tire pressure monitoring system (With TPMS)** — Check Tyre Pressure* — TPMS Inspection Required* — Tyre Pressure Monitor Initialized	(See 02-12-3 TIRE PRESSURE MONITORING SYSTEM (TPMS).)

INSTRUMENTATION/DRIVER INFO.

Display area	Display information	Function
1	**Brake system** — Brake Fluid Level Low* — Brake Inspection Required* — Release Parking Brake*	(See 04-15-42 BRAKE SYSTEM/ABS WARNING LIGHT.) (See 09-22-71 PARKING BRAKE WARNING DISPLAY.)
1	**Smart city brake support (With SCBS)** — SCBS Automatic Brake — SCBS Inspection Required* — SCBS Clear windshield completely*	(See 04-15-28 SMART CITY BRAKE SUPPORT (SCBS).)
1	**Automatic transaxle (ATX)** — Auto trans System Inspection Required*	(See 05-17A-66 AUTOMATIC TRANSAXLE WARNING LIGHT [FW6A-EL, FW6AX-EL].) (See 05-17B-67 AUTOMATIC TRANSAXLE WARNING LIGHT [GW6A-EL, GW6AX-EL].)
1	**4WD system (4WD)** — 4WD System Inspection Required* — Stop Vehicle at safe area*	(See 03-18-9 4WD WARNING LIGHT.)
1	**i-stop system** — Ready Apply more Brake Pressure — Can't be activated Turn Steering Wheel to Neutral — Can't be activated Air Conditioning has Priority — Can't be activated. Steering wheel Brake Air Conditioning — Please Restart Engine	(See 09-22-67 i-stop GUIDANCE DISPLAY.) (See 09-22-69 i-stop EFFECT DISPLAY.)
1	**Advanced keyless entry system (With advanced keyless entry system)/Keyless entry system (without advanced keyless entry system)/Push button start system** — Keyless System Inspection Required* — Set Power to OFF* — Key not found* — Depress the Brake Pedal and Touch the Key to the Start Button — Depress the Clutch Pedal and Touch the Key to the Start Button — Key Battery is low — Set Shift Lever to “P“ — To start, step on Brake Pedal and press Start Button — To start, step on Clutch Pedal and press Start Button — Turn the Steering Wheel left and right and press the Start Button	(See 09-14-37 ADVANCED KEYLESS ENTRY SYSTEM.) (See 09-14-32 KEYLESS ENTRY SYSTEM.) (See 09-14-47 PUSH BUTTON START SYSTEM [KEYLESS ENTRY SYSTEM].) (See 09-14-52 PUSH BUTTON START SYSTEM [ADVANCED KEYLESS ENTRY SYSTEM].)
1	**High beam control (HBC) system (with HBC)** — HBC Inspection Required* — FSC Inspection Required* — HBC, LDWS Defog windshield completely — HBC, LDWS Clear windshield completely	(See 09-18-50 HIGH BEAM CONTROL (HBC) SYSTEM.)
1	**Washer system** — Refill w/screen washer *	(See 09-19-55 WASHER FLUID-LEVEL SENSOR.)

INSTRUMENTATION/DRIVER INFO.

Display area	Display information	Function
1	**Lane departure warning system (LDWS) (with LDWS)** — LDWS Inspection Required* — FSC Inspection Required* — HBC, LDWS Defog windshield completely — HBC, LDWS Clear windshield completely	(See 09-22-106 LANE DEPARTURE WARNING SYSTEM (LDWS).)
2	Amount of remaining fuel is displayed.	(See 09-22-50 FUEL GAUGE.) (See 09-22-70 FUEL TANK LEVEL WARNING DISPLAY.)

* : The master warning light illuminates simultaneously.

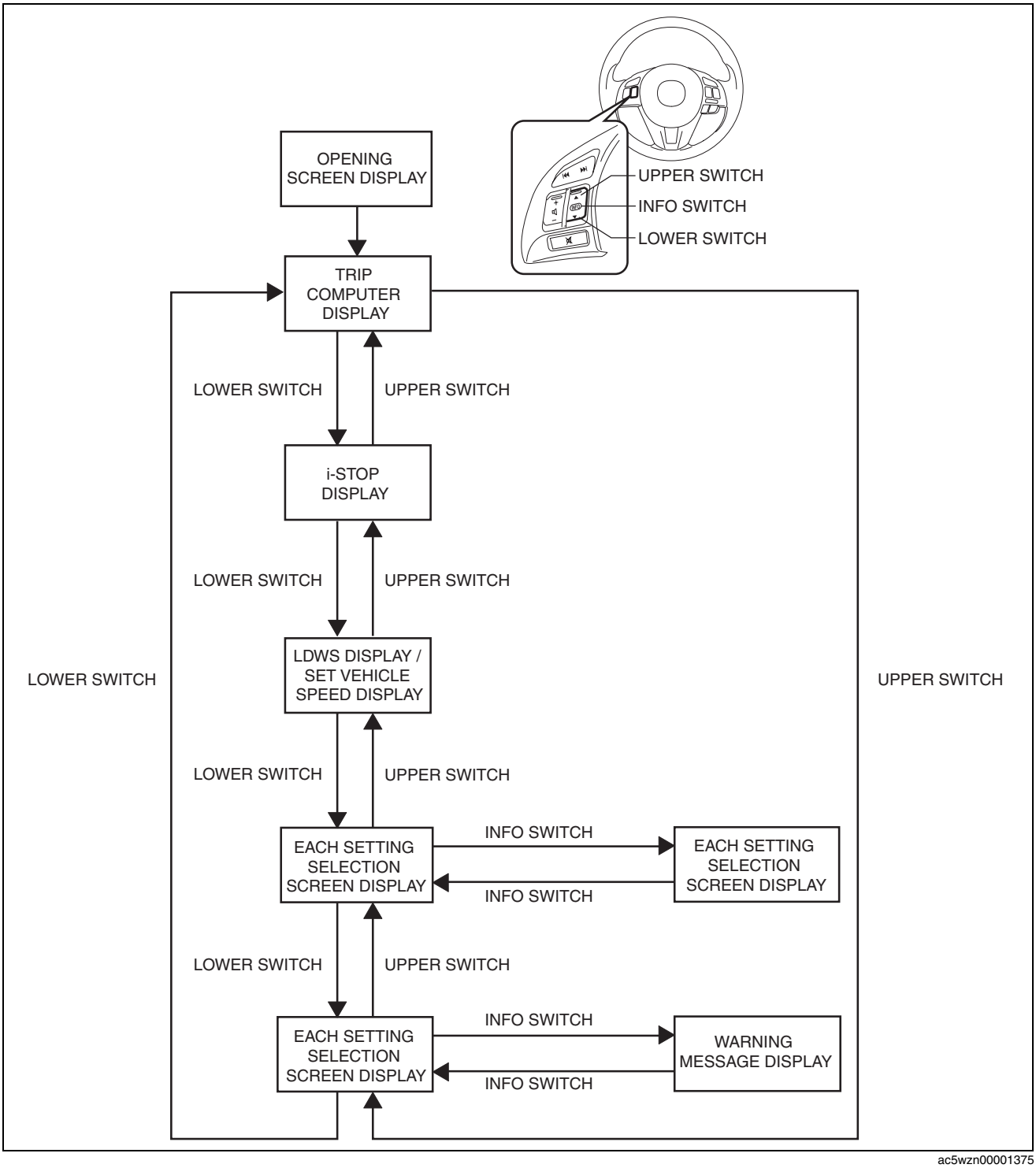
LCD display switch

- The instrument cluster switches the LCD display content as follows based on the steering switch operation signal from the start stop unit.
  Without TFT LCD display
  — Trip computer display is switched. Refer to 09-22-56 TRIP COMPUTER INFORMATION SYSTEM for details.

INSTRUMENTATION/DRIVER INFO.

With TFT LCD

— Display is changed as follows:



ac5wzn00001375

TFT LCD display content data reset

Caution

- **The reset data cannot be recovered. When resetting data, explain the reset items to the customer and reset data after obtaining their consensus.**

- The following information displayed on the TFT LCD can be reset all at once. Refer to the Workshop Manual for the detailed resetting procedure.
  i-stop-related information
  — i-stop total time

— i-stop time

Trip computer-related information

— Average fuel economy
— Average vehicle speed
— TRIP value

AMBIENT TEMPERATURE DISPLAY

id092200021500

Purpose

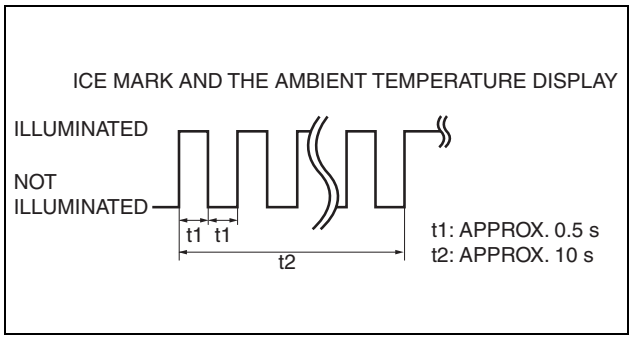
- The ambient temperature display notifies the user of the ambient temperature.

Function

- The instrument cluster displays the ambient temperature based on the ambient temperature signal sent from the PCM as a CAN signal.
- The ambient temperature is displayed between -40—70°C {-40—160°F} If the ambient temperature is -40°C {-40°F} or less, -40°C {-40°F} is displayed, and 70°C {160°F} is displayed if the temperature is 70°C {160°F} or more.

Road ice warning function

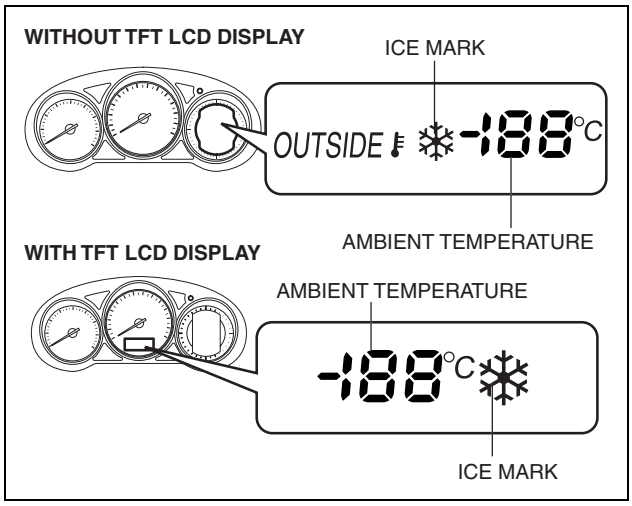
- When the instrument cluster receives an ambient temperature signal of 4°C {39°F} or less from the PCM, it displays the ice mark. After receiving the ambient temperature signal of 4°C {39°F} or more, it flashes the ice mark and the ambient temperature display for about 10 s to warn the user that the road surface may be icy.
- Once the instrument cluster performs the road ice warning, it will not perform it again until it receives an ambient temperature of 6°C {43°F} or more.
- The ice mark and ambient temperature flashing pattern is as indicated in the figure.



ac5wzn00001391

Construction

- The ambient temperature is displayed on the LCD in the instrument cluster.

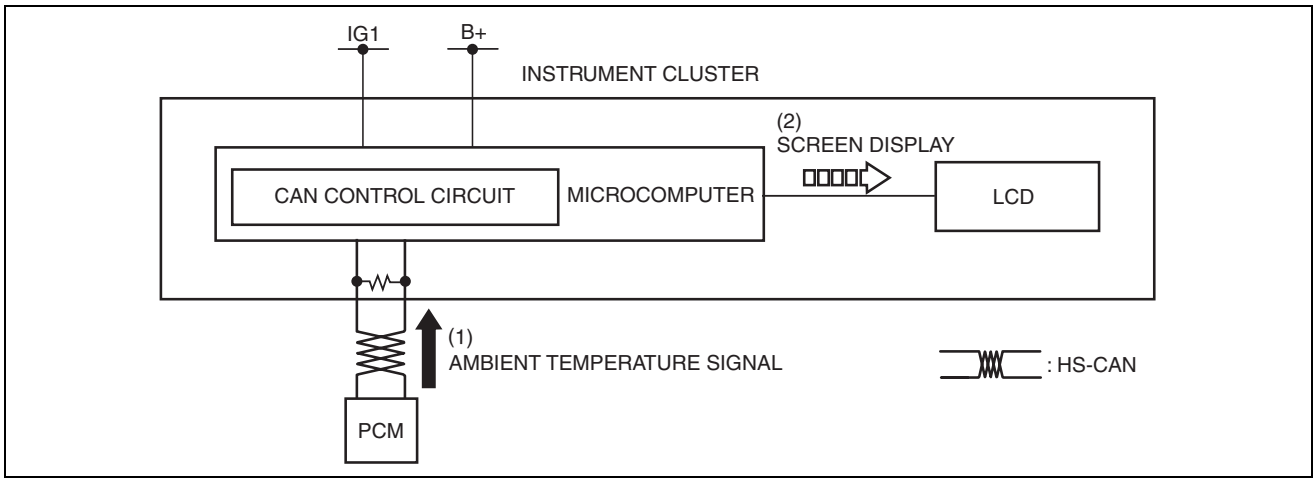


ac5wzn00001392

Operation

1. When the ignition is switched ON, the instrument cluster receives an ambient temperature signal from the PCM (1).
2. Based on the ambient temperature signal, the instrument cluster displays the ambient temperature and ice mark on the LCD.

INSTRUMENTATION/DRIVER INFO.



ac5wzn00001393

Fail-safe
- Function not equipped.

i-stop GUIDANCE DISPLAY

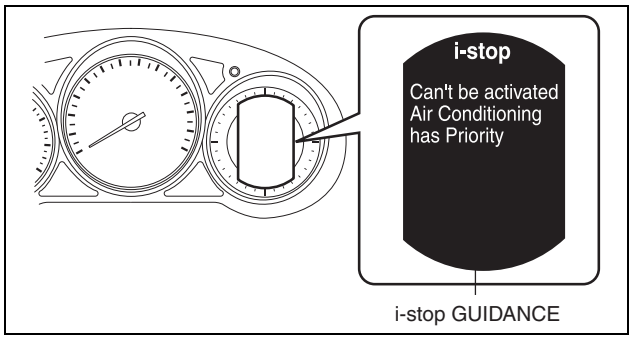
id092200025700

Purpose
- The i-stop guidance display informs the driver of the reason for not operating the i-stop (engine stop control) while the vehicle is being driven or is stopped.

Function
- The i-stop guidance displays the reason for not operating the i-stop engine stop control on the LCD based on the following CAN signals sent from the PCM or climate control unit while the i-stop effect screen is displayed.

CAN signal sending module	Signal name
PCM	• i-stop related information signal • Engine coolant temperature signal • Vehicle speed signal
Climate control unit	i-stop request (i-stop (engine stop control) inhibit command) signal

Construction
- The i-stop guidance is displayed in the LCD of the instrument cluster.
- The i-stop guidance display is performed by the instrument cluster microcomputer.
- The i-stop guidance which displays in the LCD is as follows:



ac5wzn00001461

INSTRUMENTATION/DRIVER INFO.

i-stop guidance display table

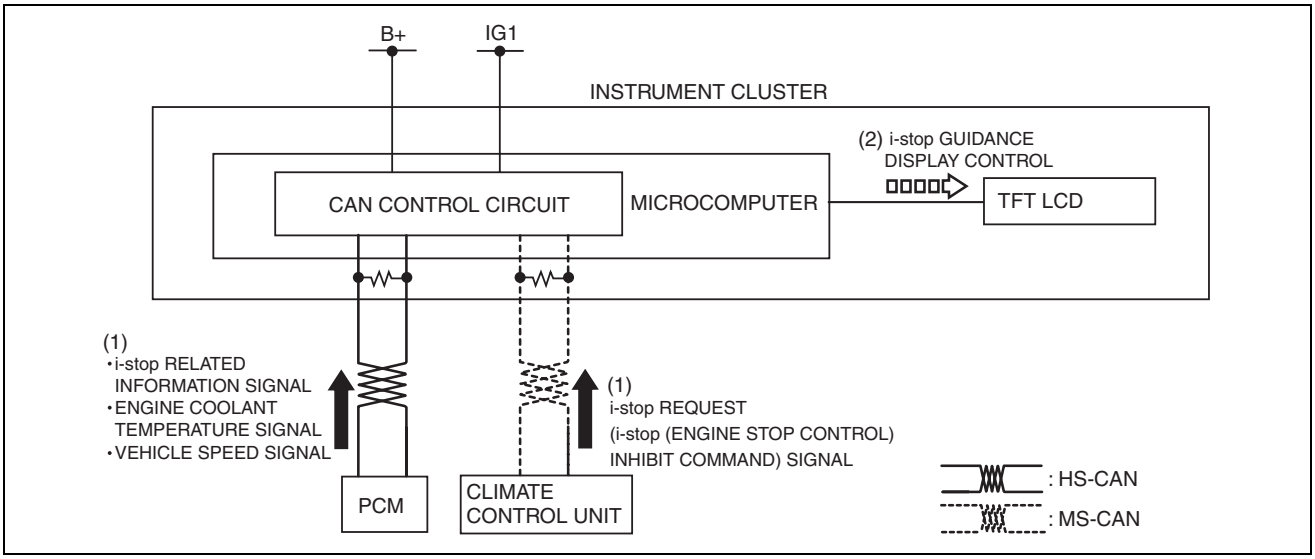
Indication on LCD	Content	Reference
	If an engine-stop by the i-stop control is attempted, the guidance indicates that the i-stop (engine stop control) inhibit conditions for the air conditioner system are met.	(See 07-40A-40 AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER].) (See 07-40B-18 AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER].)
	If an engine-stop by the i-stop control is attempted, the guidance indicates that the steering angle is not within the specification of the i-stop (engine stop control) control conditions.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)
	If an engine-stop by the i-stop control is attempted, the guidance indicates that the brake fluid pressure is not the specification or more for the i-stop (engine stop control) control conditions.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)
	Displays if several i-stop (engine stop control) control conditions for the steering angle, brake fluid pressure, and air conditioner system are not met.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].) (See 07-40A-40 AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER].) (See 07-40B-18 AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER].)
	Displays if several i-stop (engine stop control) control conditions for the brake fluid pressure and air conditioner system are not met.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].) (See 07-40A-40 AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER].) (See 07-40B-18 AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER].)
	Displays if several i-stop (engine stop control) control conditions for the steering angle and brake fluid pressure are not met.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)
	Displays if several i-stop (engine stop control) control conditions for the steering angle and air conditioner system are not met.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].) (See 07-40A-40 AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER].) (See 07-40B-18 AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER].)

INSTRUMENTATION/DRIVER INFO.

Please Restart Engine	Displays when the engine stalls, not the i-stop function operates.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)

Operation

1. The instrument cluster receives the CAN signal sent from the PCM or climate control unit.
2. The instrument cluster displays the i-stop guidance information in the LCD based on the received CAN signal.



ac5wzn00001470

Fail-safe

- Function not equipped.

i-stop EFFECT DISPLAY

id092200026100

Purpose

- The i-stop effect display informs the driver of i-stop effect information.

Function

- i-stop effect displays the i-stop total time, i-stop time, and current i-stop time based on the i-stop related information signal from the PCM.

i-stop total time

- i-stop total time is displayed as the total time at which the i-stop has operated.
- The range of i-stop total time is from 0 h 00 min to 1999 h 59 min.

i-stop time

- i-stop time is displayed as the total i-stop operation time from engine start (ignition switch: ON) to engine stop (ignition switch: OFF).
- The range of i-stop time is from 0 h 00 min 00 s to 99 h 59 min 59 s.

Current i-stop time

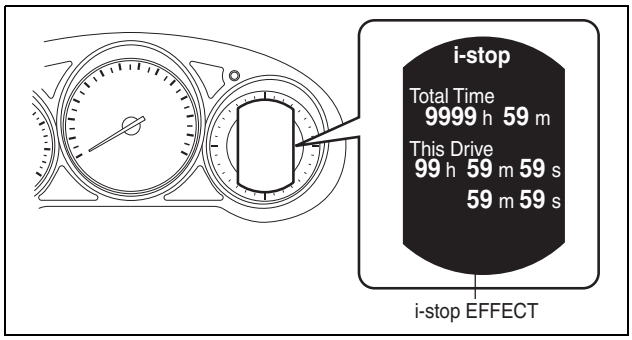
- Current i-stop time is displayed i-stop time at which the i-stop is operating.
- The range of the current i-stop time is from 0 min 00 s to 59 min 59 s.

Construction

- i-stop effect is displayed in the TFT LCD of the instrument cluster.
- i-stop effect display and time at i-stop calculations are performed by the instrument cluster microcomputer.

INSTRUMENTATION/DRIVER INFO.

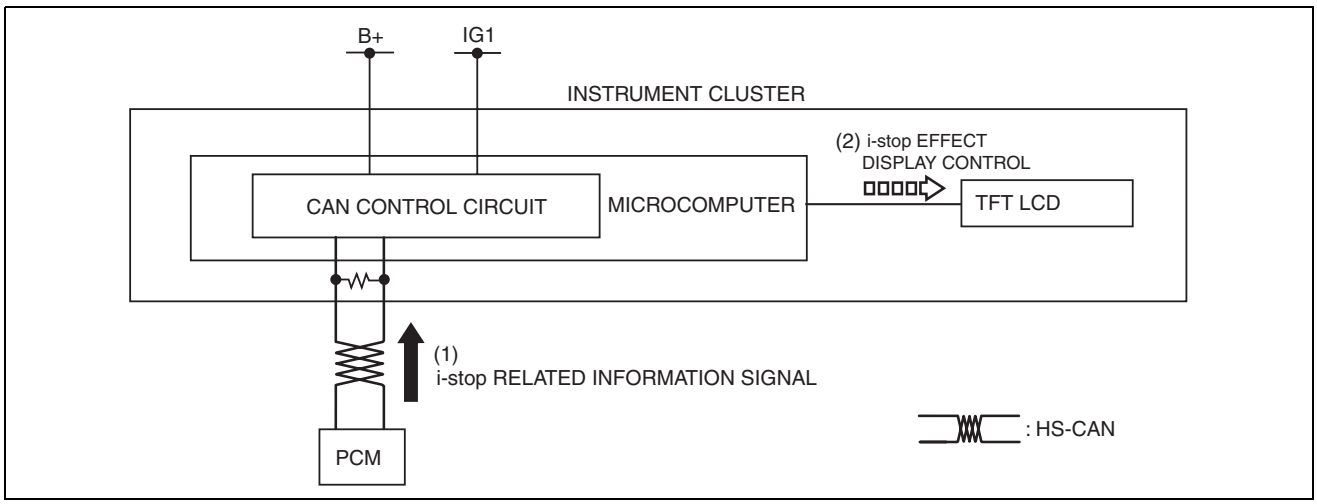
- When the ignition is switched ON (engine on), the i-stop time and total are displayed in the i-stop effect display.



ac5wzn00001476

Operation

1. The instrument cluster receives (1) the i-stop related information signal from the PCM via the CAN signal.
2. The instrument cluster calculates (2) the i-stop time based on the received i-stop related information signal.
3. The instrument cluster displays (3) the calculated i-stop effect information in the TFT LCD.



ac5wzn00001477

Fail-safe

- Function not equipped.

FUEL TANK LEVEL WARNING DISPLAY

id092200027100

Purpose

- The fuel tank level warning display notifies the driver that the remaining fuel level is low.

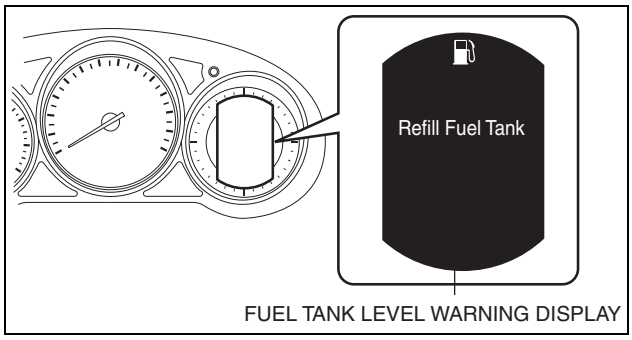
Function

- The instrument cluster calculates the fuel quantity based on the following CAN signals, and if a remaining fuel amount of approx. 10 L {11 US qt, 8.8 imp qt} (fuel gauge displays remaining two segments) is detected, the low fuel warning light illuminates.
  - — Fuel gauge sender unit voltage signal sent from rear body control module (RBCM)
  - — Fuel injection amount signal, vehicle speed signal sent from PCM

INSTRUMENTATION/DRIVER INFO.

Construction

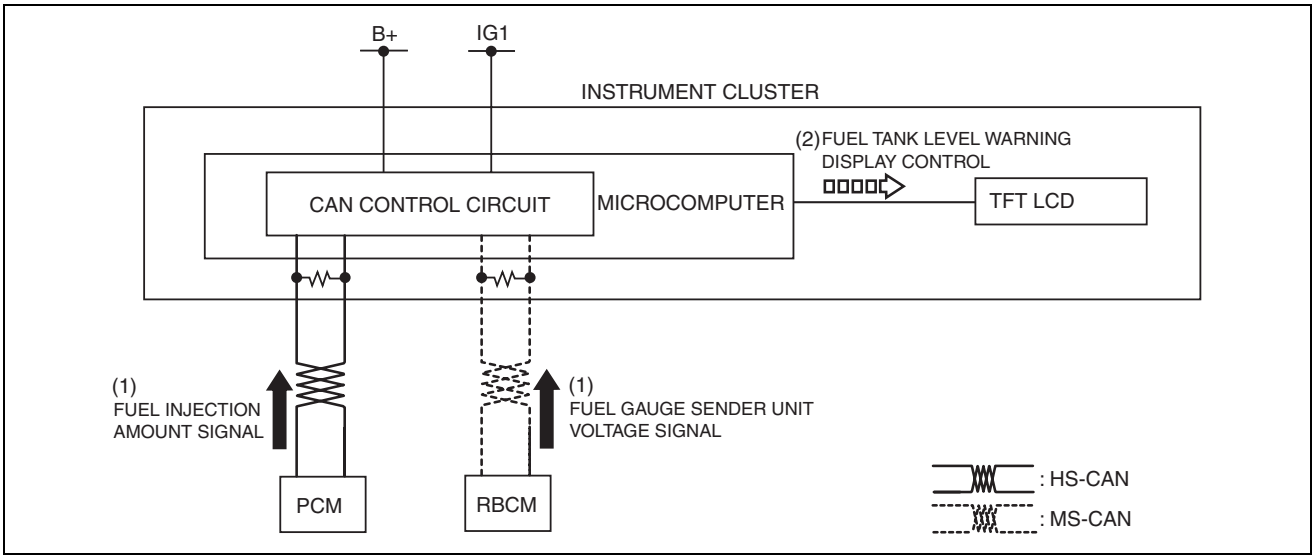
- The fuel tank level warning display is displayed in the TFT LCD of the instrument cluster.
- The fuel tank level warning display and value calculation are performed by the instrument cluster microcomputer.



ac5wzn00001427

Operation

1. When the ignition is switched ON (engine off or on) the instrument cluster receives (1) the fuel gauge sender unit voltage signal from the rear body control module (RBCM), and the fuel injection amount signal from the PCM.
2. The fuel tank level warning display is displayed in the TFT LCD (3) if the calculated remaining fuel amount based on each signal is approx. 10 L {11 US qt, 8.8 imp qt}.



ac5wzn00001428

Fail-safe

- Function not equipped.

PARKING BRAKE WARNING DISPLAY

id092200034600

Purpose

- The parking brake warning display warns the user that the parking brake is not released.

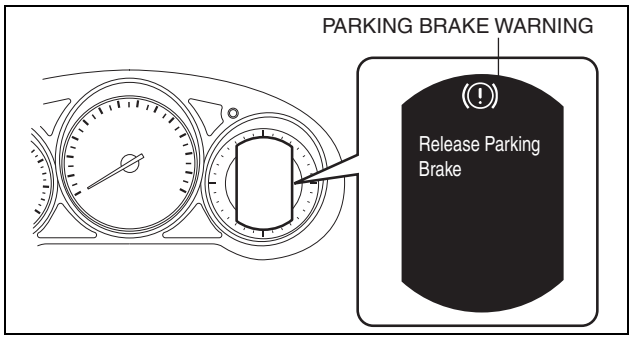
Function

- The instrument cluster displays the parking brake warning based on the following signals.
  - — Vehicle speed signal sent via CAN communication from PCM
  - — Parking brake switch ON signal (parking brake lever pulled)

INSTRUMENTATION/DRIVER INFO.

Construction

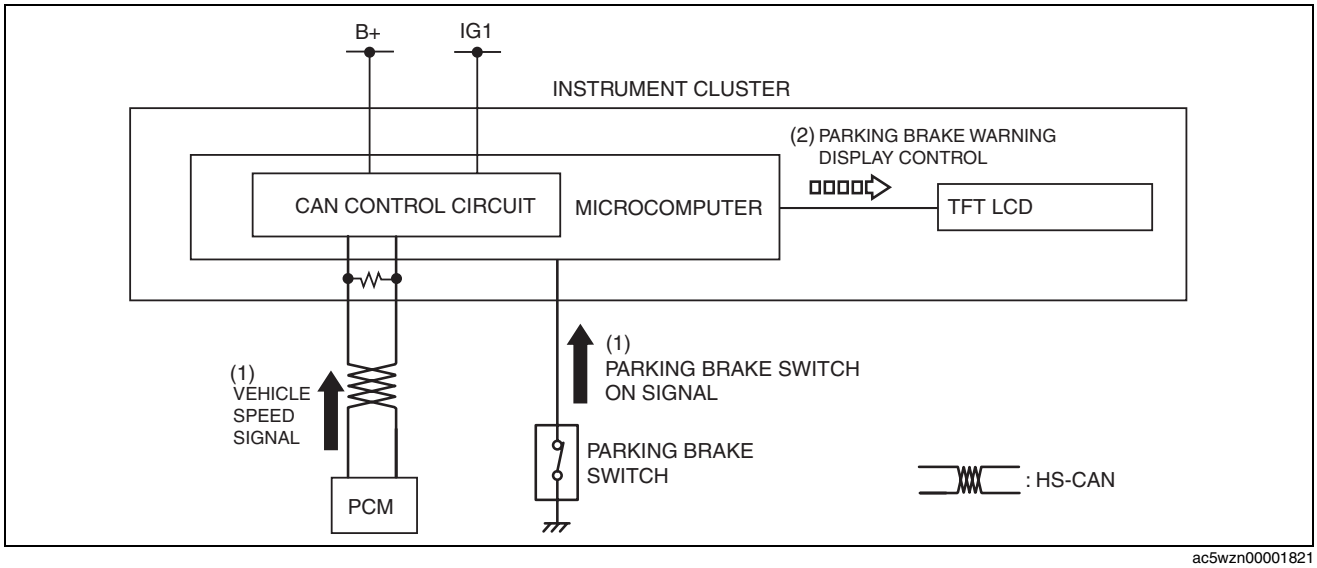
- The parking brake warning is displayed in the TFT LCD of the instrument cluster.



ac5wzn00001820

Operation

1. The instrument cluster receives (1) the vehicle speed signal from the PCM when the ignition is switched ON (engine on) and detects (1) the parking brake switch.
2. The microcomputer in the instrument cluster displays (2) the parking brake warning in the TFT LCD when it receives a vehicle speed signal of 5 km/h {3 mph} or more while a parking brake switch on condition is detected.



ac5wzn00001821

Fail-safe

- Function not equipped.

DOOR AJAR WARNING DISPLAY

id092200026300

Purpose

- The door-ajar warning light notifies the driver that any door or the liftgate is open.

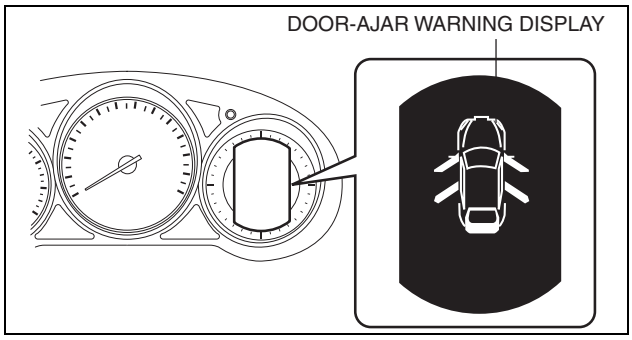
Function

- When the instrument cluster receives any of the following signals sent from the rear body control module (RBCM) via the CAN signal, the door-ajar warning light illuminates.
  - — Door latch switch ON signal (door open)
  - — Liftgate latch switch ON signal (liftgate open)

INSTRUMENTATION/DRIVER INFO.

Construction

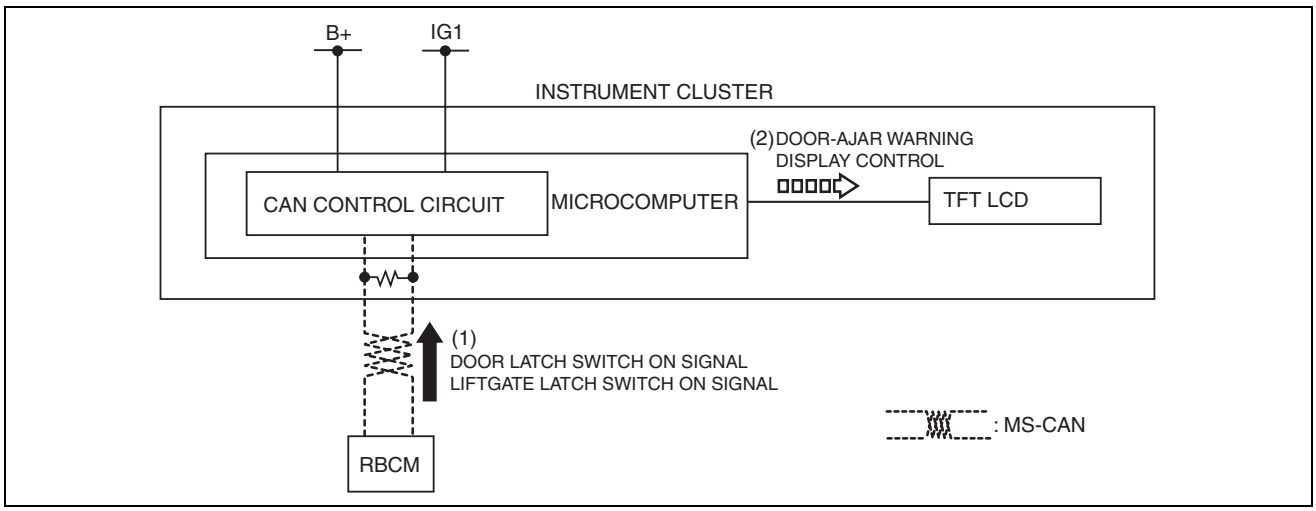
- The door-ajar warning is displayed in the TFT LCD of the instrument cluster.



ac5wzn00001429

Operation

1. The instrument cluster receives (1) the door latch switch ON signal or liftgate latch switch ON signal from the rear body control module (RBCM).
2. When any received signal indicates that door is open, the instrument cluster displays (2) the door-ajar warning in the TFT LCD.



ac5wzn00001430

Fail-safe

- Function not equipped.

REAR VEHICLE MONITORING SYSTEM

id092200029800

Outline

- The rear vehicle monitoring system detects vehicles approaching from behind and notifies the driver using a warning indication and warning sound if the driver tries to change lanes to the side of the approaching vehicle.
- The rear vehicle monitoring control module performs rear vehicle monitoring system fail-safe. (See 09-22-78 REAR VEHICLE MONITORING CONTROL MODULE.)

Warning

- **The rear vehicle monitoring system is not a substitute for the driver in confirming safety. The driver is responsible for assuring the safety of lane changes and other maneuvers. Do not rely completely on the rear vehicle monitoring system, and always confirm the safety around the vehicle visually before changing lanes.**
- **Due to various restrictions in the operation of the rear vehicle monitoring system, the RVM warning indicator light might not illuminate or it may be delayed even if there is a vehicle traveling in the adjacent lane.**
- **If there is mud, water, or snow adhering to the areas near the rear vehicle monitoring control modules, obstruction of the radar could result in the system not appropriately detecting a target vehicle, or complete non-detection of the target vehicle. Always pay attention to the direction of vehicle travel and the area around the vehicle.**

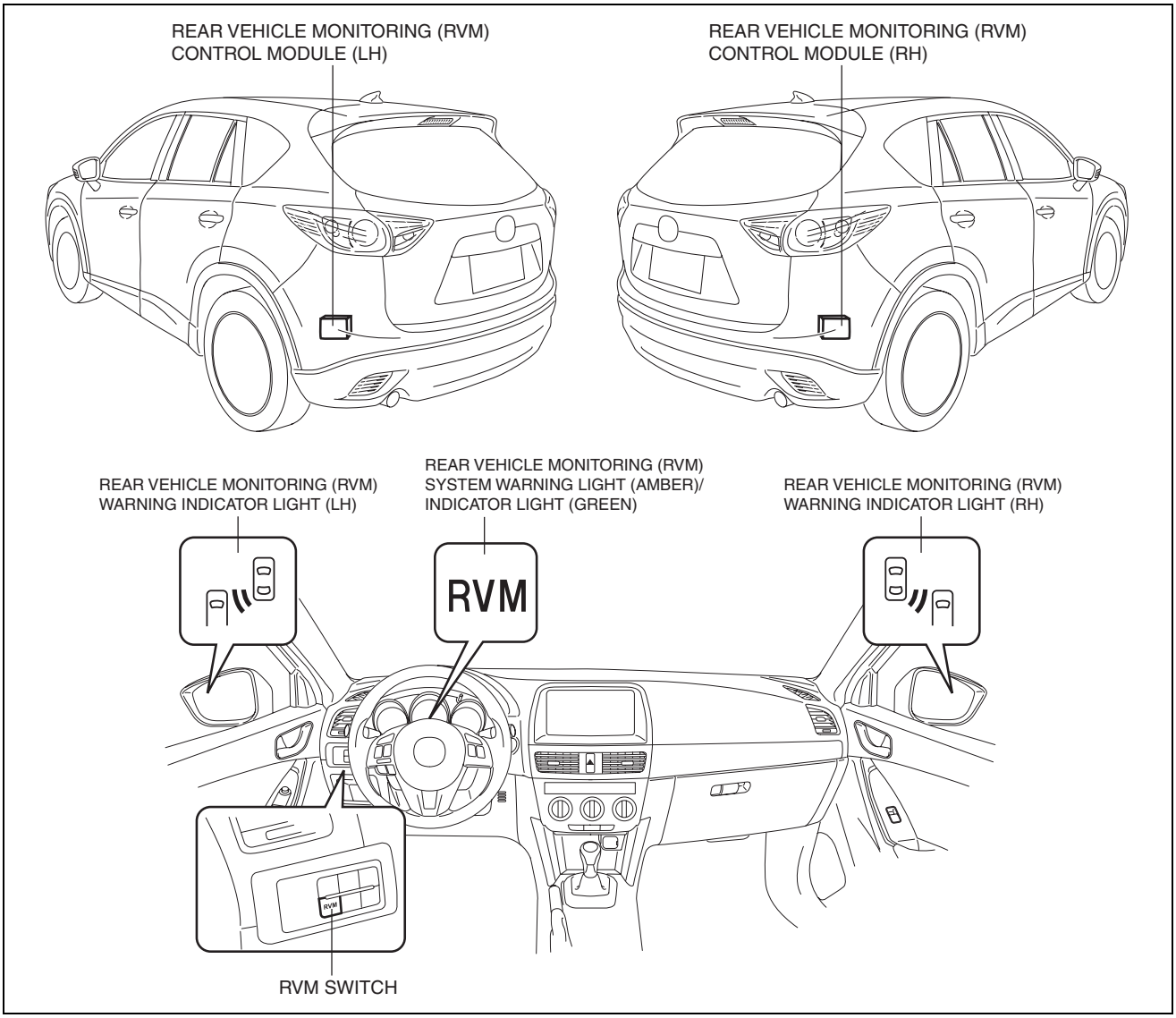
- Do not block the area around the rear vehicle monitoring control modules on the rear bumper with foreign material (such as bumper stickers) so as not to affect the rear vehicle monitoring system functions.
- Perform radar aiming for the rear vehicle monitoring control modules if the rear bumper has received an impact.
- The rear vehicle monitoring system may not operate normally under the following conditions:
  - — Dirt, ice or snow is adhering to rear bumper surface
  - — Vehicle is driven in heavy rain or snowfall, or under conditions where water on road is sprayed by vehicle
  - — Vehicle is towing trailer
  - — Vehicle accelerates from standing-start with target vehicle alongside
  - — Target vehicle moves laterally from lane two lanes over to adjacent lane
  - — Difference in vehicle speed between vehicle and target vehicle is higher with target vehicle passing through detection area in very short period
  - — On steep incline, or if there is difference in height between lanes
- The system may detect guardrails or vehicles on a road shoulder and activate the warning light/beep.
- The rear vehicle monitoring control modules may not detect all types of vehicles. In particular, detection of the following types of vehicles may not occur:
  - — A vehicle driving at a low speed
  - — Small vehicles such as motorcycles
  - — Vehicles with body shapes that may not reflect radar such as unloaded trailers
  - — Vehicles with low vehicle height
  - — The difference in vehicle speed between the vehicle and a target vehicle is extremely high.
  - — A target vehicle accelerates suddenly from the rear of the vehicle and changes to the adjacent lane.
  - — Target vehicles which are traveling in the vehicle's blind spot at nearly the same speed for long periods
- The RVM warning indicator light may be difficult to view under the following conditions:
  - — Sunlight at sunrise and sunset is reflected in and around the RVM warning indicator light
  - — A lighting device with strong illumination is used in the vehicle
- On a road with a narrower lane width, the system could detect vehicles on a lane next to the adjacent lane and cause the warning light/beep to operate. Conversely, on a road with a wider lane width, the system may not detect vehicles on the adjacent lane and may not operate the warning light/beep.

Caution

- If the rear bumper installation position is changed or individual differences (coating film/thickness) occur, the radar angle will deviate and the rear vehicle monitoring system may not operate properly. Perform the radar aiming using the SSTs (Service Special Tools) and Mazda Modular Diagnostic System (M-MDS) when any of the following items have been performed.
  - — Rear vehicle monitoring control modules are replaced
  - — Rear vehicle monitoring brackets are replaced
  - — Rear bumper is repaired or replaced
  - — Vehicle’s rear area is repaired due to collision
- Refer to the Workshop Manual for the radar aiming procedure.

INSTRUMENTATION/DRIVER INFO.

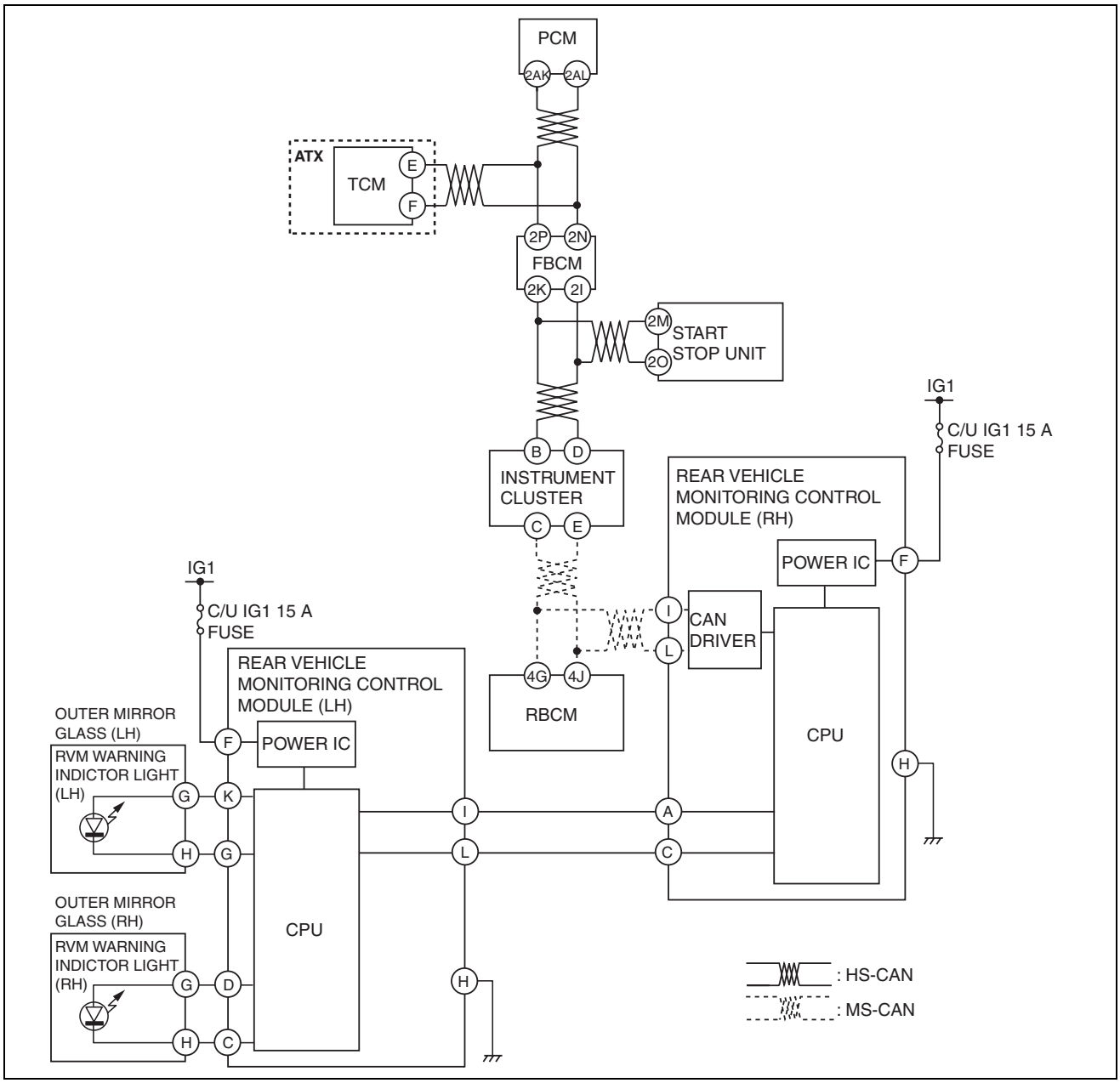
Structural view



ac5wzn00001434

INSTRUMENTATION/DRIVER INFO.

System wiring diagram



ac5wzn00001435

Operation

Operation condition

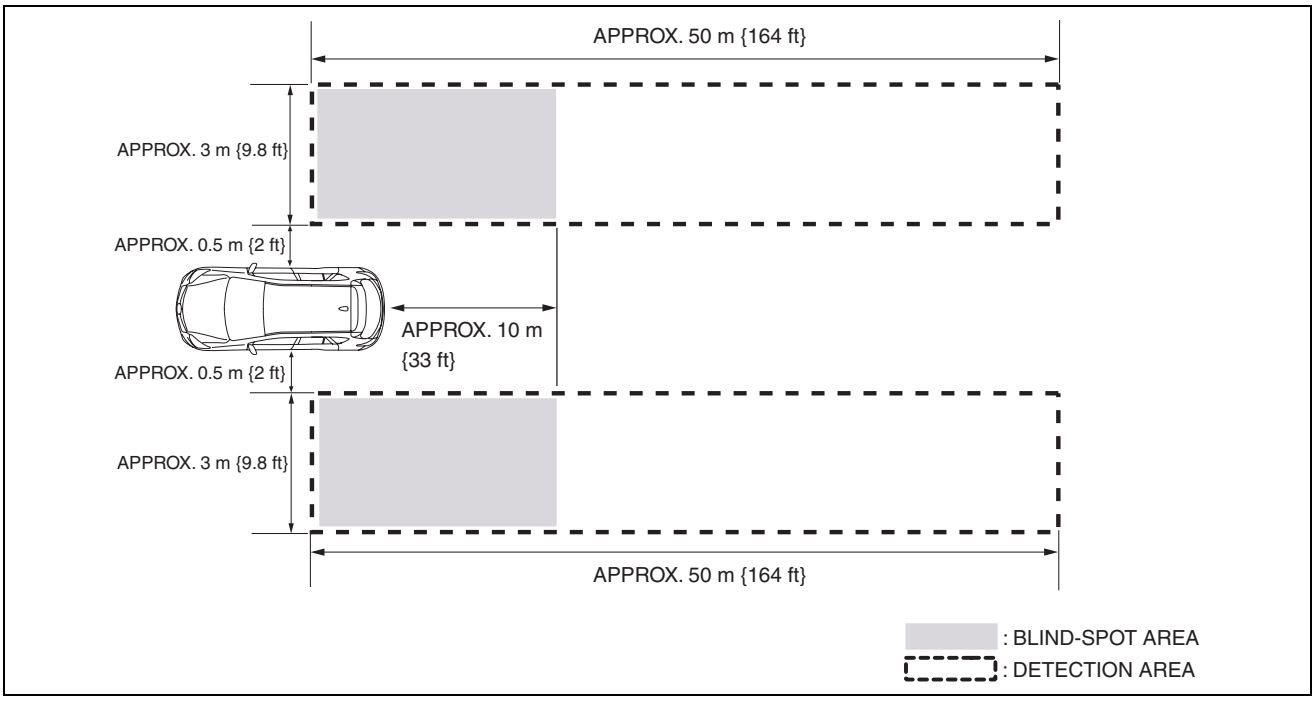
- When all of the following conditions are met, the system operates and the RVM indicator light (green) illuminates.
  - — RVM switch is on (system on)
  - — Vehicle speed is **approx. 30 km/h {19 mph} or more**
- When the vehicle speed is **approx. 30 km/h {19 mph} or less**, the vehicle detection is cancelled and the RVM indicator light (green) remains illuminated.

Cancel conditions

- When the following condition is met, the system is cancelled and the RVM indicator light (green) turns off.
  - — RVM switch is off (system off)

Monitor operation

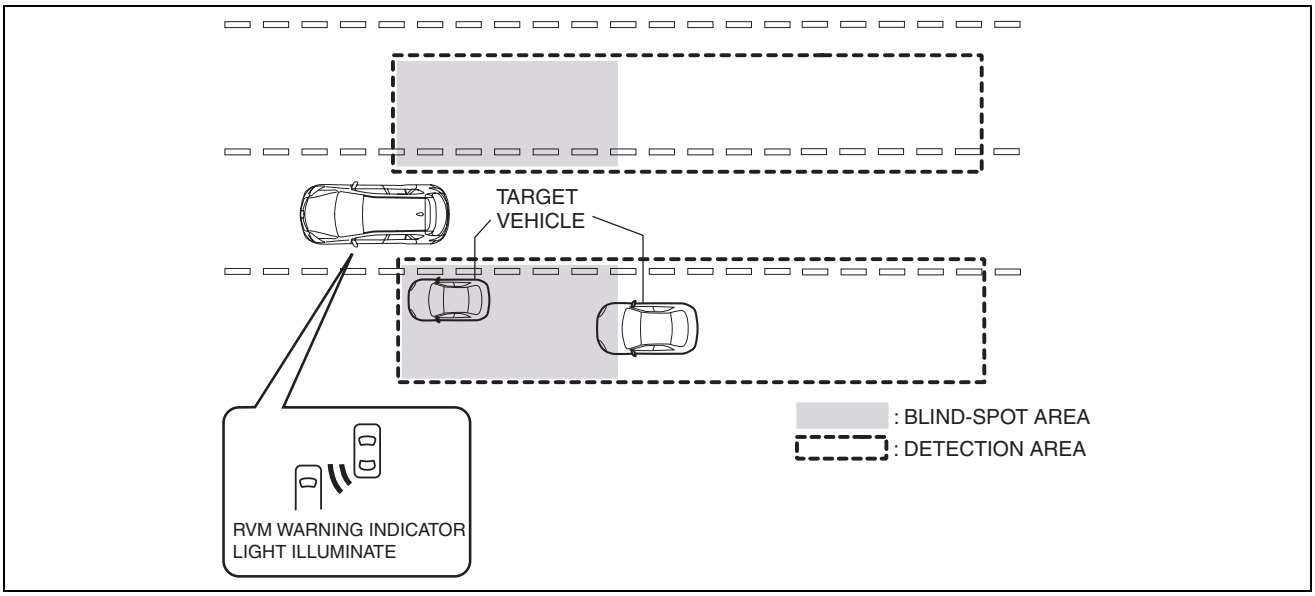
- The monitored areas are called the detection area and the blind-spot area, and the rear vehicle monitoring system control modules monitor the following ranges:
  - — Detection area: From B-pillar towards vehicle rear at area to a distance of **approx. 50 m {164 ft}**
  - — Blind-spot area: Area to a distance of **approx. 10 m {33 ft}** from vehicle rear



ac5wzn00001436

Vehicle detection operation

- If the following vehicles are detected, the rear vehicle monitoring control module illuminates the RVM warning indicator light.
  - — When a vehicle is detected in the blind-spot area (**approx. 10 m {33 ft}** from vehicle rear), the RVM warning indicator light is illuminated on side where the vehicle is detected.



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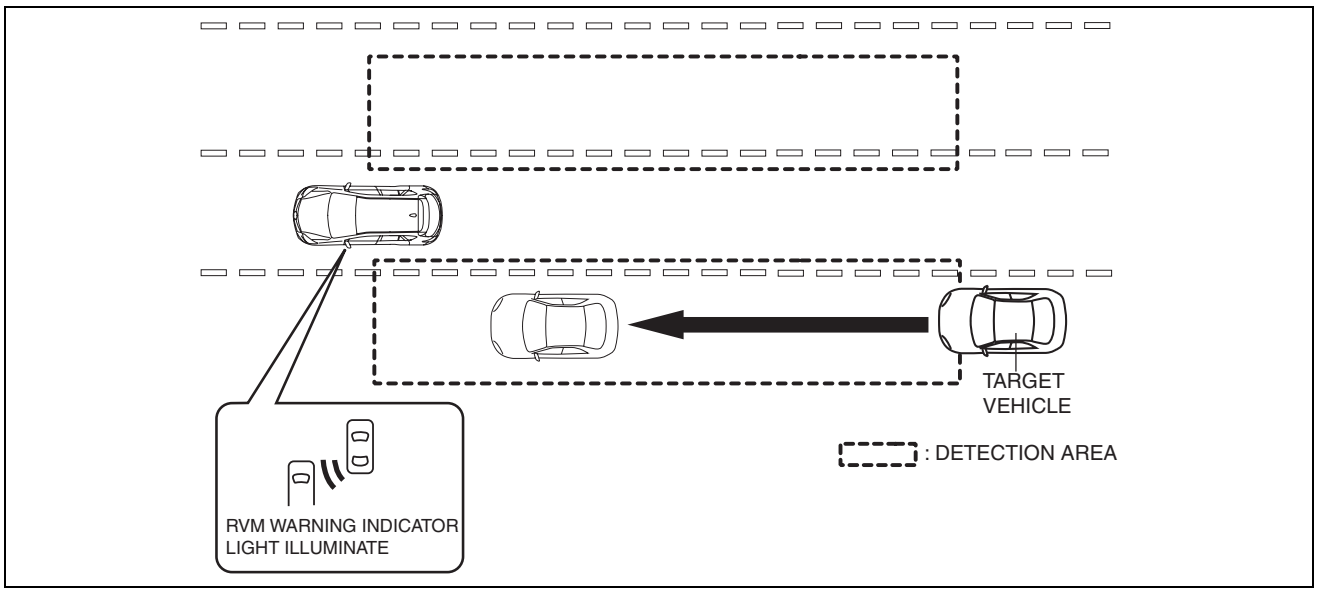
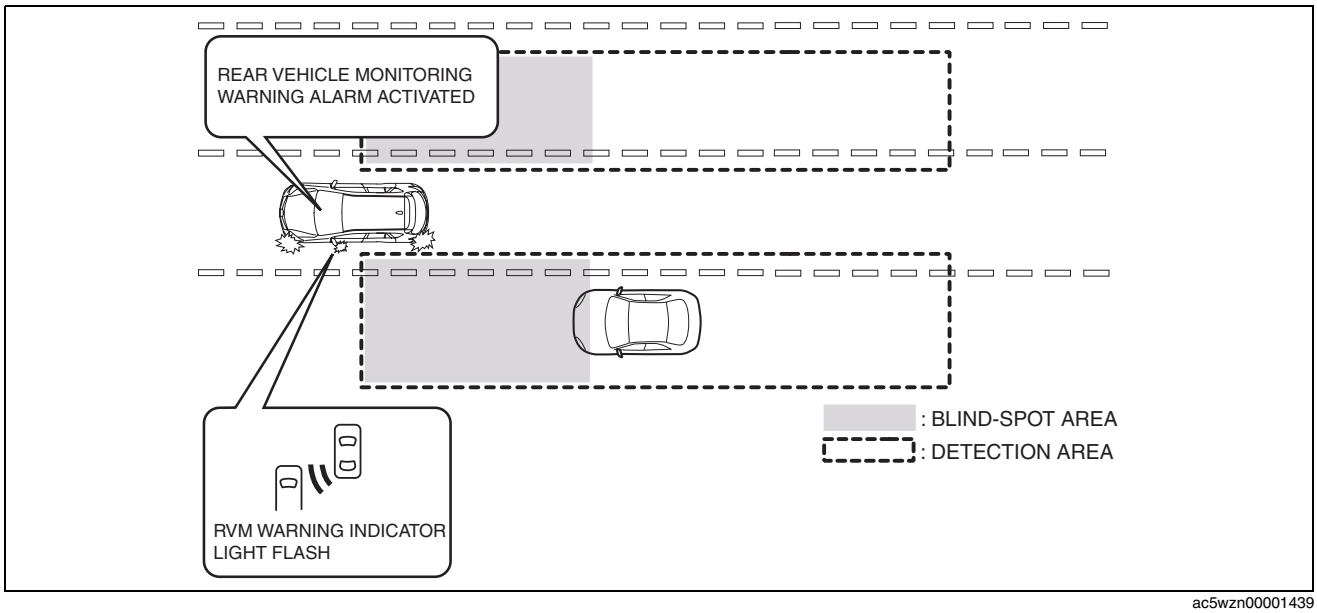
— When a vehicle is detected in the detection area (**approx. 50 m {164 ft}** from vehicle rear) and the vehicle which can enter the blind-spot area within approx. 5 s from when it enters the detection area, the RVM warning indicator light is illuminated on side where the vehicle is detected.



ac5wzn00001438

Warning operation

- When a turn switch ON signal is received on the side where the vehicle is detected during the vehicle detection operation, the rear vehicle monitoring control module warns as follows:
  — Flashes RVM warning indicator light
  — Sounds rear vehicle monitoring warning alarm



ac5wzn00001439

REAR VEHICLE MONITORING CONTROL MODULE

id092200029900

Purpose

- The rear vehicle monitoring control module detects vehicles approaching from behind and controls the rear vehicle monitoring system.

Function

- The rear vehicle monitoring control module emits microwaves from the radar integrated with the rear vehicle monitoring control module to detect an oncoming vehicle's position and speed via the reflected microwaves.
- The rear vehicle monitoring control module controls the rear vehicle monitoring system based on the information from the detected approaching vehicle and following CAN signals:

INSTRUMENTATION/DRIVER INFO.

CAN signal sending module	Signal name
DSC HU/CM	Yaw rate signal
Start stop unit	Turn switch signal
Instrument cluster	• RVM switch operation signal • Panel light signal
TCM (ATX)	Shift lever position signal
PCM	• Vehicle speed signal • Gear position signal (MTX)

RVM warning indicator light brightness level change function

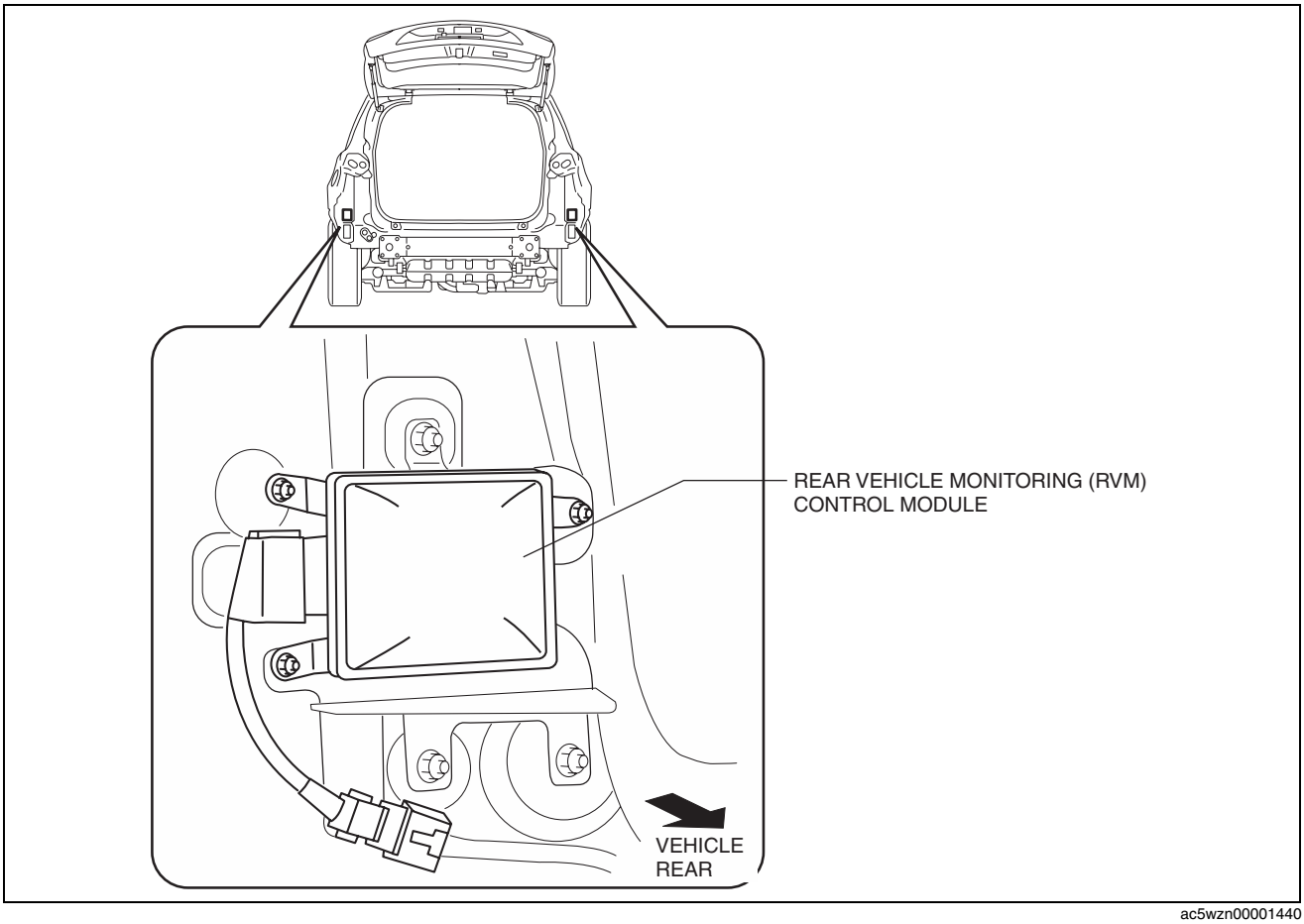
- When the rear vehicle monitoring control module receives the panel light signal from the instrument cluster, it determines that the vehicle is being driven at night or in a dark place and changes the brightness of the RVM warning indicator light.

On-board diagnostic function

- The rear vehicle monitoring control module detects a system communication error and control module internal malfunction and outputs DTCs. For DTC details, refer to On-board Diagnostic System [rear vehicle monitoring system].

Construction

- The control module is integrated with the radar which emits microwaves and receives the reflected waves.
- Two control modules are positioned on the left and right sides of the body inside the rear bumper.



ac5wzn00001440

Operation

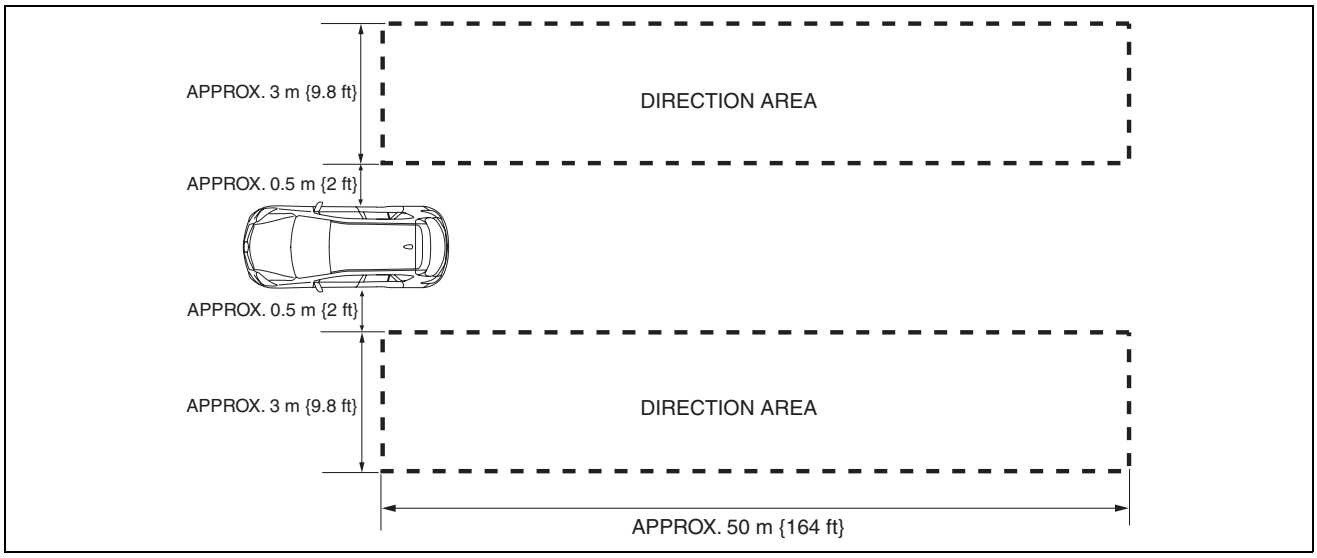
- When the ignition is switched ON (engine on) and vehicle speed is 30 km/h or more, the rear vehicle monitoring control module emits microwaves from the radar and starts detection of approaching vehicles.

Detection area

- Forward and rear directions: From B-pillar towards vehicle rear at distance of **approx. 50 m {164 ft}**

INSTRUMENTATION/DRIVER INFO.

- Lateral direction: **Approx. 3 m {9.8 ft}** for vehicle side surface



ac5wzn00001441

Fail-safe

DTC No.	Rear vehicle monitoring (RVM) system warning light (amber)
B11CB:11	Inhibits the rear vehicle monitoring system.
B11CB:15	Inhibits the rear vehicle monitoring system.
B11D3:11	Inhibits the rear vehicle monitoring system.
B11D3:15	Inhibits the rear vehicle monitoring system.
B11F2:23	Inhibits the rear vehicle monitoring system.
U0001:88	Inhibits the rear vehicle monitoring system.
U0028:87	Inhibits the rear vehicle monitoring system.
U0100:00	Inhibits the rear vehicle monitoring system.
U0121:00	Inhibits the rear vehicle monitoring system.
U0155:00	Inhibits the rear vehicle monitoring system.
U0214:00	Inhibits the rear vehicle monitoring system.
U0401:68	Inhibits the rear vehicle monitoring system.
U0415:68	Inhibits the rear vehicle monitoring system.
U0423:68	Inhibits the rear vehicle monitoring system.
U0515:68	Inhibits the rear vehicle monitoring system.
U1A4B:16	Inhibits the rear vehicle monitoring system.
U1A4B:17	Inhibits the rear vehicle monitoring system.
U1A4B:43	Inhibits the rear vehicle monitoring system.
U1A4B:44	Inhibits the rear vehicle monitoring system.
U1A4B:45	Inhibits the rear vehicle monitoring system.
U1A4B:46	Inhibits the rear vehicle monitoring system.
U1A4B:47	Inhibits the rear vehicle monitoring system.
U1A4B:48	Inhibits the rear vehicle monitoring system.
U1A4B:49	Inhibits the rear vehicle monitoring system.
U1A4B:54	Inhibits the rear vehicle monitoring system.
U1A4B:96	Inhibits the rear vehicle monitoring system.
U2100:00	Inhibits the rear vehicle monitoring system.
U3000:43	Inhibits the rear vehicle monitoring system.
U3000:44	Inhibits the rear vehicle monitoring system.
U3000:45	Inhibits the rear vehicle monitoring system.
U3000:46	Inhibits the rear vehicle monitoring system.
U3000:47	Inhibits the rear vehicle monitoring system.
U3000:48	Inhibits the rear vehicle monitoring system.
U3000:49	Inhibits the rear vehicle monitoring system.

INSTRUMENTATION/DRIVER INFO.

DTC No.	Rear vehicle monitoring (RVM) system warning light (amber)
U3000:4B	Inhibits the rear vehicle monitoring system.
U3000:54	Inhibits the rear vehicle monitoring system.
U3000:96	Inhibits the rear vehicle monitoring system.
U3000:97	Inhibits the rear vehicle monitoring system.
U3003:16	Inhibits the rear vehicle monitoring system.
U3003:17	Inhibits the rear vehicle monitoring system.

RVM SWITCH

id092200030000

Purpose

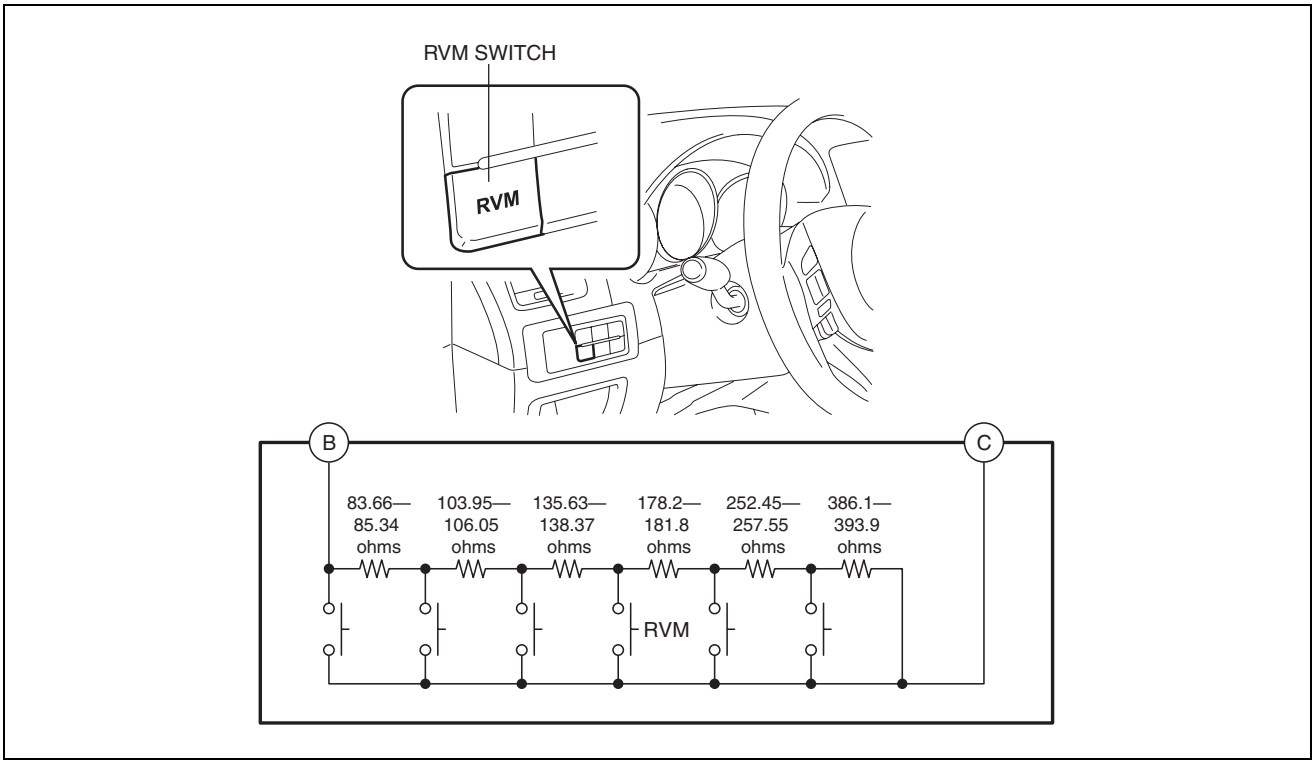
- The rear vehicle monitoring system can be optionally switched between operable and inoperable.

Function

- The switch operation signal is sent to the instrument cluster.

Construction

- The RVM switch is built into the cluster switch.
- The resistance is built into each switch.



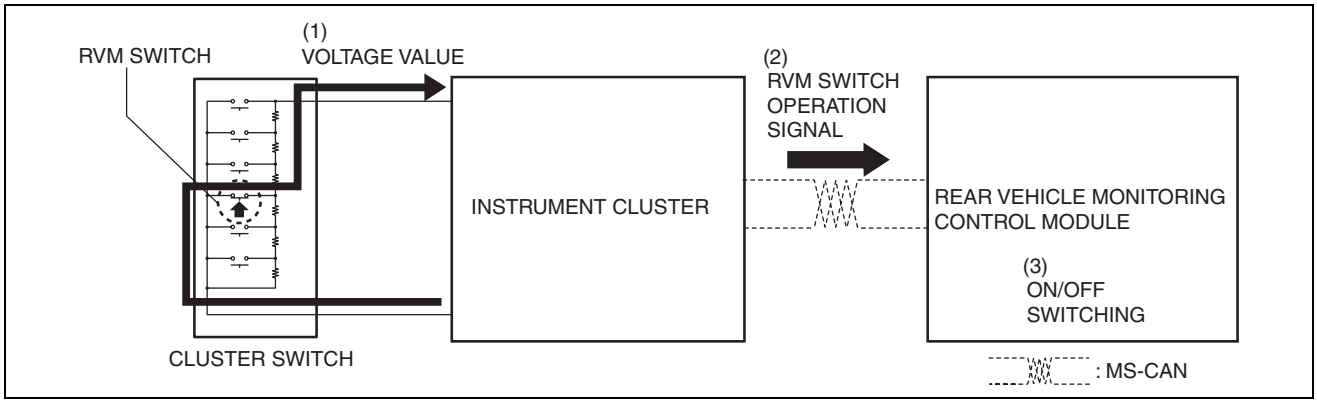
ac5wzn00001442

Operation

1. When the RVM switch operates, the switch operation signal is sent to the instrument cluster.
2. The instrument cluster sends a RVM switch operation signal to the rear vehicle monitoring control module based on the received voltage value (switch operation signal).

INSTRUMENTATION/DRIVER INFO.

3. When the rear vehicle monitoring control module receives the RVM switch operation signal from the instrument cluster, it switches the rear vehicle monitoring system on/off.



ac5wzn00001443

Fail-safe
- Function not equipped.

REAR VEHICLE MONITORING (RVM) SYSTEM WARNING LIGHT (AMBER)/INDICATOR LIGHT (GREEN)

id092200034100

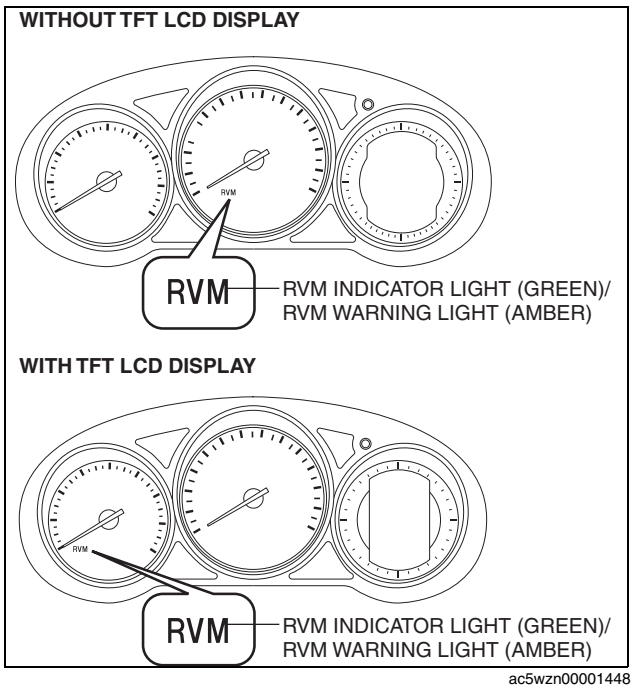
Purpose
RVM indicator light (green)
- The RVM indicator light (green) notifies the driver that the rear vehicle monitoring system is operating.

RVM warning light (amber)
- The RVM warning light (amber) notifies the driver that a malfunction is occurring in the rear vehicle monitoring system.

Function
RVM indicator light (green)
- The instrument cluster illuminates the RVM indicator light (green) based on the system condition display request signal sent via a CAN signal from the rear vehicle monitoring control module (RH).

RVM warning light (amber)
- The instrument cluster illuminates the RVM warning indicator light (amber) based on the system malfunction indication request signal sent via a CAN signal from the rear vehicle monitoring control module (RH).

Construction
- The RVM indicator light (green) and RVM warning indicator light (amber) are equipped in the instrument cluster.



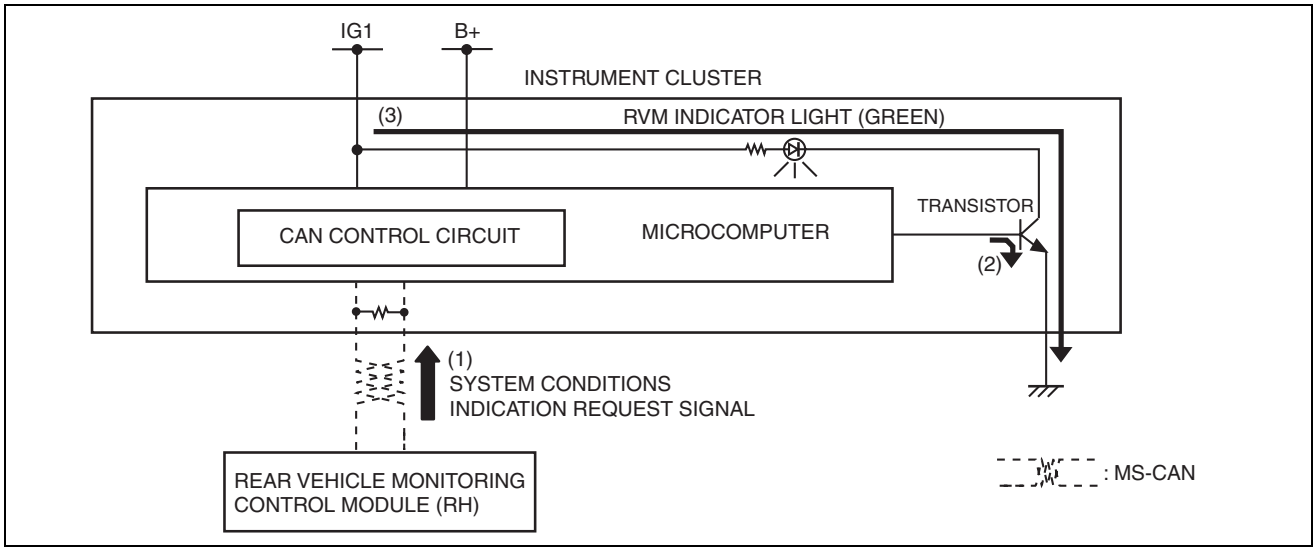
ac5wzn00001448

INSTRUMENTATION/DRIVER INFO.

Operation

RVM indicator light (green)

1. The instrument cluster receives (1) the system conditions indication request signal from the rear vehicle monitoring control module (RH) via the CAN signal.
2. When the instrument cluster receives the system conditions indication request signal, it turns the transistor on (2).
3. When the transistor turns on, a ground circuit with the RVM indicator light (green) is established, and the RVM indicator light (green) illuminates (3).



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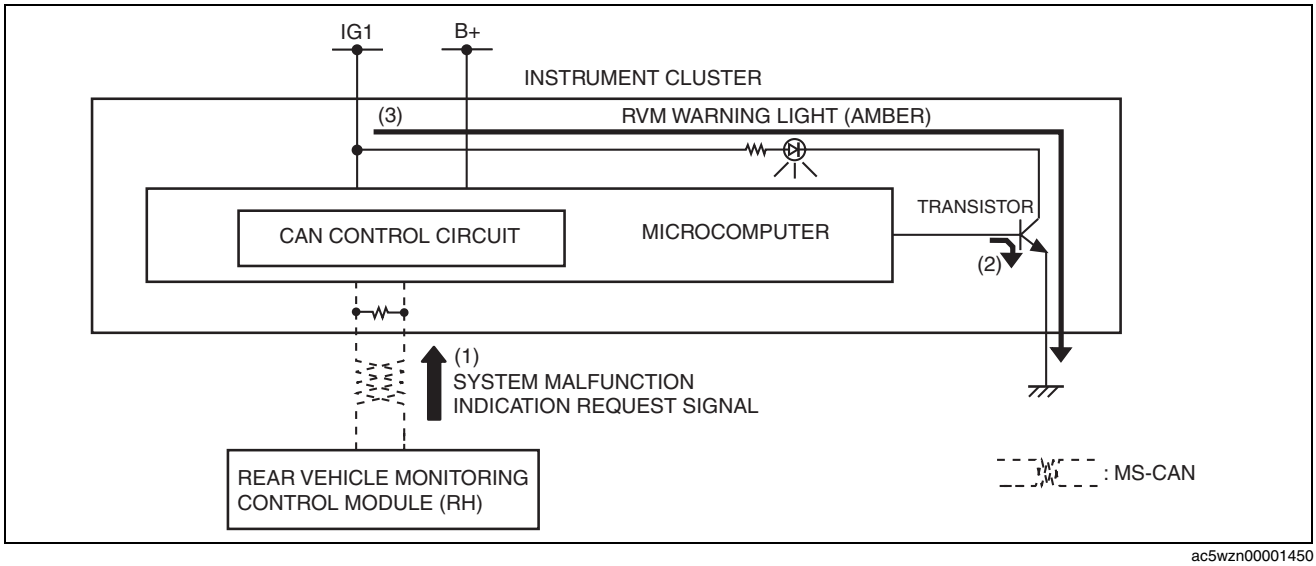
RVM warning light (amber)

1. The instrument cluster receives (1) the system malfunction indication request signal from the rear vehicle monitoring control module (RH) via the CAN signal.
2. When the instrument cluster receives the system conditions display request signal, it turns the transistor on (2).
3. When the transistor turns on, a ground circuit with the RVM warning light (amber) is established, and the RVM warning light (amber) illuminates (3).



ac5wzn00001450

Fail-safe

- Function not equipped.

RVM WARNING INDICATOR LIGHT

id092200030100

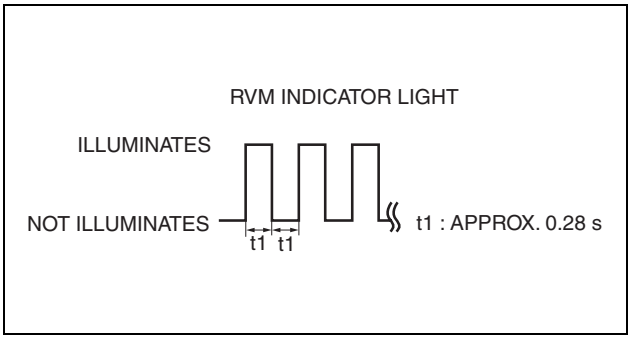
Purpose

- The RVM warning indicator light notifies the driver that vehicles are approaching from the rear.

INSTRUMENTATION/DRIVER INFO.

Function

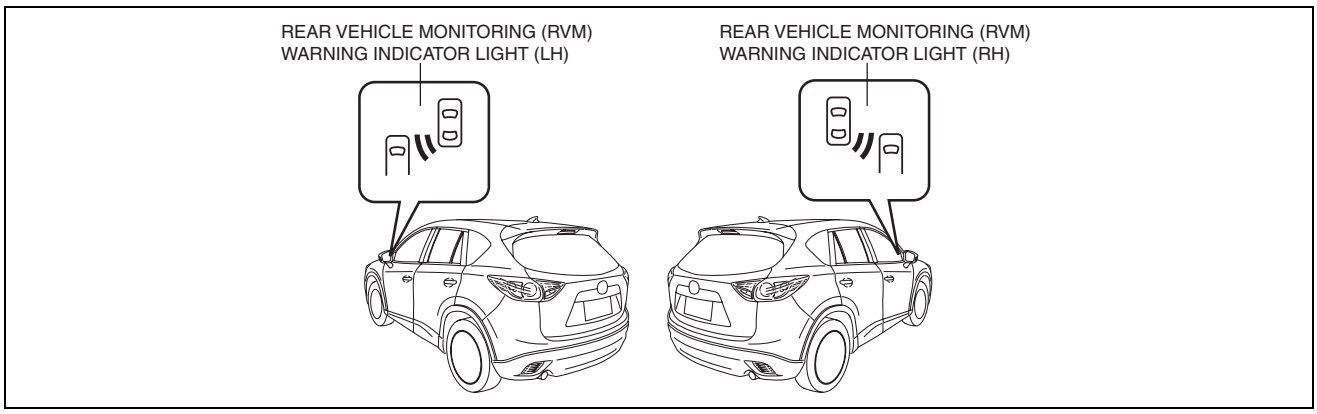
- If there is an approaching vehicle in the detection area of the rear vehicle monitoring control module, the RVM warning indicator light illuminates. If the driver tries to change lanes to the side of the approaching vehicle, the indicator light flashes.
- The RVM warning light flashing pattern is as indicated in the figure.



ac5wzn00001444

Construction

- The RVM warning indicator lights are equipped in the left and right heater outer mirrors.
- LEDs with low-power consumption and high durability have been adopted for the RVM warning indicator light.



ac5wzn00001445

- For details on the RVM warning indicator light illumination/flashing/off conditions, refer to 09-22-73 REAR VEHICLE MONITORING SYSTEM.

Operation

- For the RVM warning indicator light operation, refer to the 09-22-73 REAR VEHICLE MONITORING SYSTEM.

Fail-safe

- Function not equipped.

RVM WARNING ALARM

id092200031300

Purpose

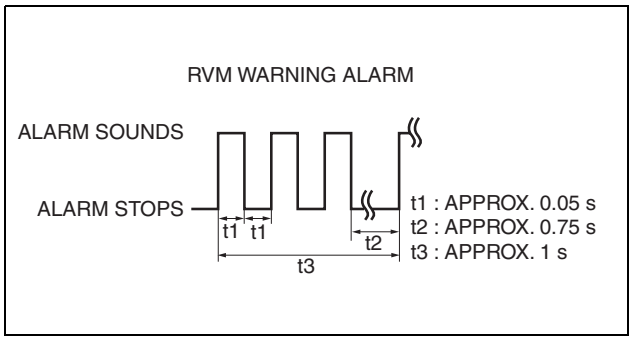
- The rear vehicle monitoring warning alarm alerts the driver that there is a vehicle approaching in the lane which the driver is attempting to enter.

Function

- If the instrument cluster receives a warning sound request signal from the rear vehicle monitoring control module (RH), is sounds the rear vehicle monitoring warning alarm using the buzzer in the instrument cluster.

INSTRUMENTATION/DRIVER INFO.

- The rear vehicle monitoring warning alarm sound pattern is as follows:



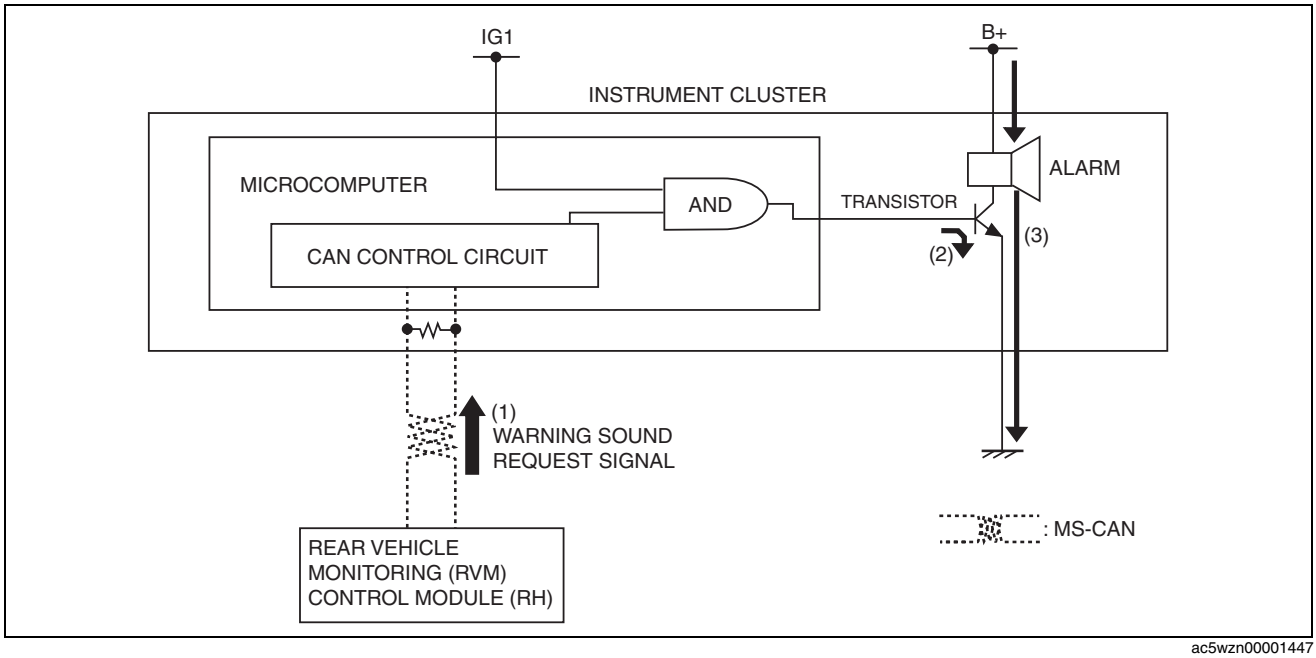
ac5wzn00001446

Construction

- The rear vehicle monitoring warning alarm sounds using the buzzer built into the instrument cluster.

Operation

1. The instrument cluster receives (1) the warning sound request signal from the rear vehicle monitoring control module (RH).
2. The instrument cluster turns the transistor on (2) based on the warning sound request signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).



ac5wzn00001447

Fail-safe

- Function not equipped.

BLIND SPOT MONITORING (BSM) SYSTEM

id092200027200

Outline

- The blind spot monitoring (BSM) system detects vehicles approaching from the rear blind spots, and illuminates the BSM indicator light on the outer mirror glass. When the BSM indicator light is illuminated and the turn light switch is turned on to the side in which the indicator light is illuminated, the indicator light flashes and a warning alarm is activated to alert the driver.
- The BSM system operates while the vehicle is traveling at **approx. 32 km/h {20 mph} or more**.
- The BSM system has an on-board diagnostic function for improved serviceability.
- The BSM control module performs BSM system fail-safe. (See 09-22-89 BLIND SPOT MONITORING (BSM) CONTROL MODULE.)

Warning

- **The BSM system is not a substitute for the driver in confirming safety. The driver is responsible for assuring the safety of lane changes and other maneuvers. Do not rely completely on the BSM system and always confirm the safety around the vehicle visually before changing lanes.**

INSTRUMENTATION/DRIVER INFO.

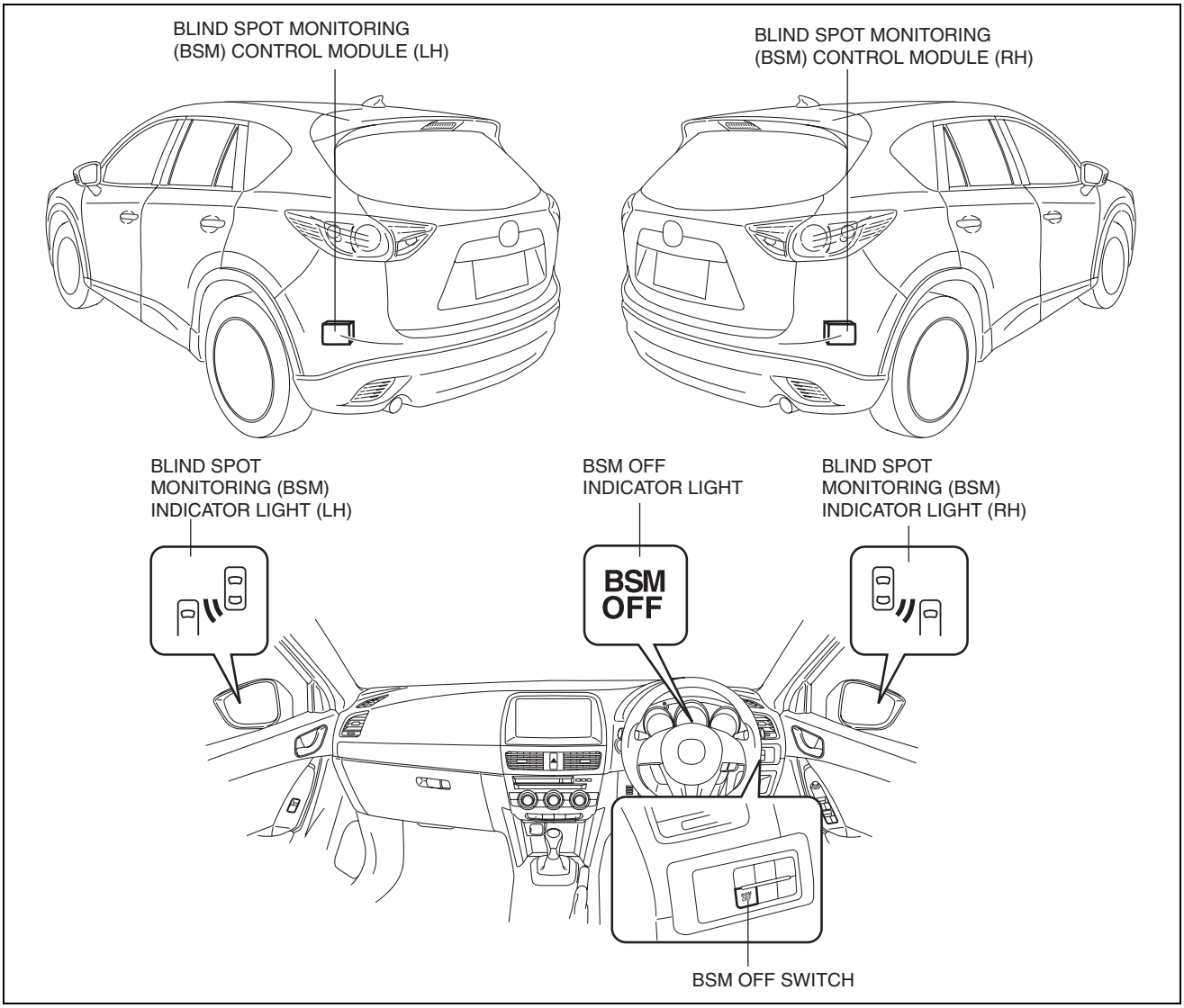
- Because the BSM system has various restrictions in the operation, the BSM indicator light might not illuminate or it may be delayed even if there is a vehicle traveling in the adjacent lane.
- If there is mud, water, or snow adhering to the areas near the BSM control module, obstruction of the radar could result in the system not appropriately detecting a target vehicle, or complete non-detection of the target vehicle. Always pay attention to the direction of vehicle travel and the area around the vehicle.
- Do not block the area around the BSM control module on the rear bumper with foreign material (such as bumper stickers) so as not to affect the BSM system functions.
- Perform radar aiming for the BSM control module if the rear bumper has received an impact.
- The BSM system may not operate normally under the following conditions:
  - — Dirt, ice or snow is adhering to the rear bumper surface.
  - — The vehicle is driven in heavy rain or snowfall, or under conditions where water on the road is sprayed by the vehicle.
  - — The vehicle is towing a trailer.
  - — The vehicle accelerates from a standing-start with a target vehicle alongside.
  - — A target vehicle moves laterally from a lane two lanes over to the adjacent lane.
  - — The difference in vehicle speed between the vehicle and a target vehicle is higher with the target vehicle passing through the detection area in a very short period.
  - — On a steep incline, or if there is a difference in height between lanes.
- The BSM system may detect guardrails or parked vehicles on a road shoulder and activate the warning light/beep.
- The BSM control module may not detect all types of vehicles. In particular, detection of the following types of vehicles may not occur:
  - — A vehicle driving at a low speed
  - — Small vehicles such as motorcycles
  - — Vehicles with body shapes that may not reflect radar such as unloaded trailers
  - — Vehicles with low vehicle height
  - — The difference in vehicle speed between the vehicle and a target vehicle is extremely high.
  - — A target vehicle accelerates suddenly from the rear of the vehicle and changes to the adjacent lane.
  - — A target vehicle which is traveling in the vehicle's blind spot at nearly the same speed for long periods
- The BSM indicator light may be difficult to view under the following conditions:
  - — Sunlight at sunrise and sunset is reflected in and around the BSM indicator light
  - — A lighting device with strong illumination is used in the vehicle
- On a road with a narrower lane width, the system could detect vehicles on a lane next to the adjacent lane and cause the warning light/beep to operate. Conversely, on a road with a wider lane width, the system may not detect vehicles on the adjacent lane and may not operate the warning light/beep.

Caution

- If the rear bumper installation position is changed or individual differences (coating film/ thickness) occur, the radar angle will deviate and the BSM system may not operate properly. Perform the radar aiming using the SSTs (Service Special Tools) and Mazda Modular Diagnostic System (M-MDS) when any of the following items have been performed.
  - — BSM control module is replaced
  - — BSM bracket is replaced
  - — Rear bumper is repaired or replaced
  - — Vehicle’s rear area is repaired due to collision
- Refer to the Workshop Manual for the radar aiming procedure.

INSTRUMENTATION/DRIVER INFO.

Structural view



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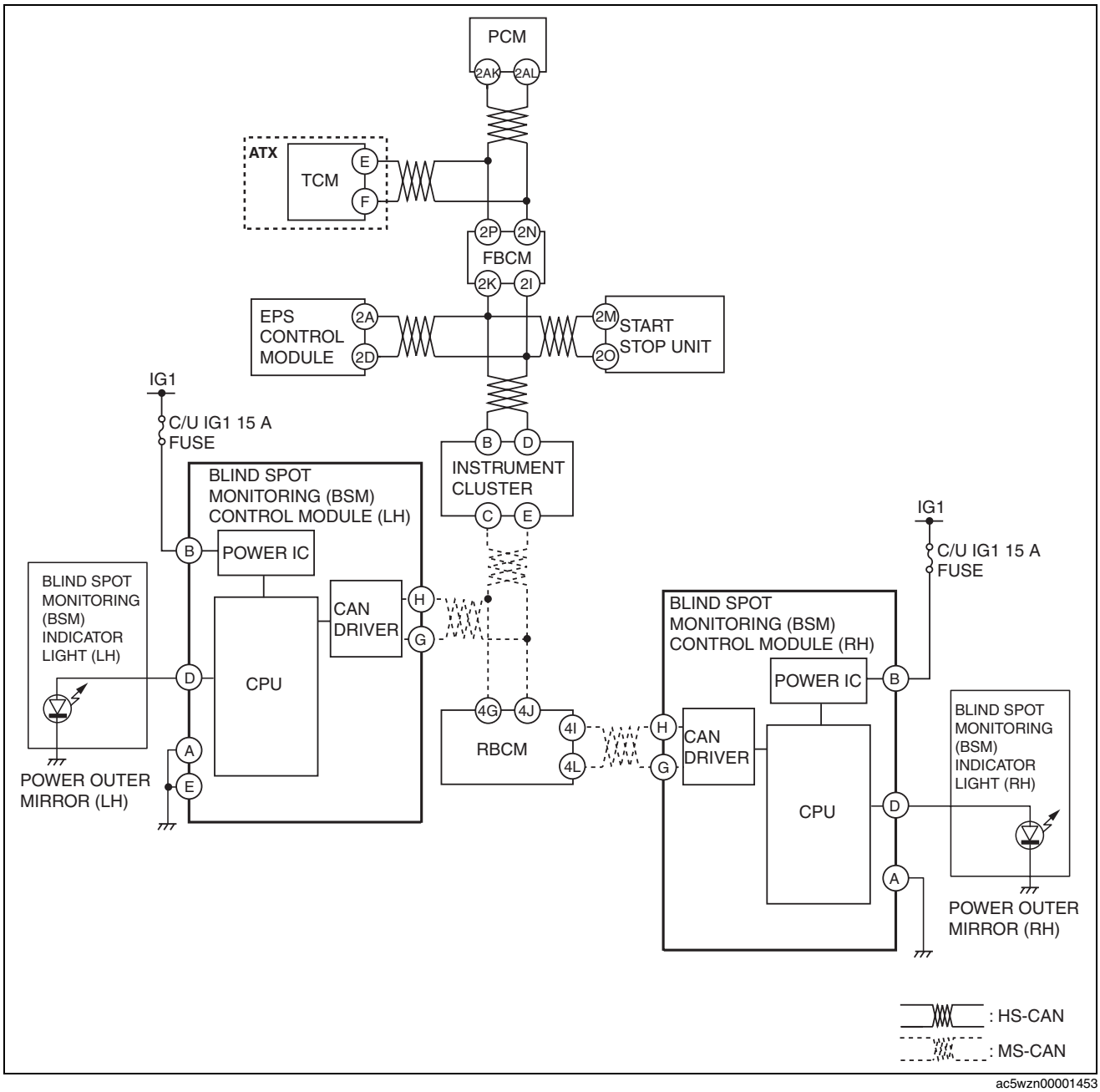
INSTRUMENTATION/DRIVER INFO.

System wiring diagram



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Operation

- When the vehicle is driven at approx. 32 km/h {20 mph} or more and a vehicle enters the radar-monitored area at the rear, the BSM indicator light illuminates. If the turn signal lever is operated to the side the BSM indicator light illuminated, the BSM indicator light starts flashing and the warning alarm operates.
- The BSM system has operation, operation-stop, warning, and alert modes.

System operation conditions

- The BSM can operate when the following conditions are met with the ignition switched ON.
  - — Vehicle speed is **approx. 32 km/h {20 mph} or more**
  - — Shift lever is not in reverse (MTX) (The BSM system is automatically turned off when the shift lever is in reverse.)
  - — Selector lever is not in R position (ATX) (The BSM system is automatically turned off when the selector lever is in the R position.)

System turn-off procedure

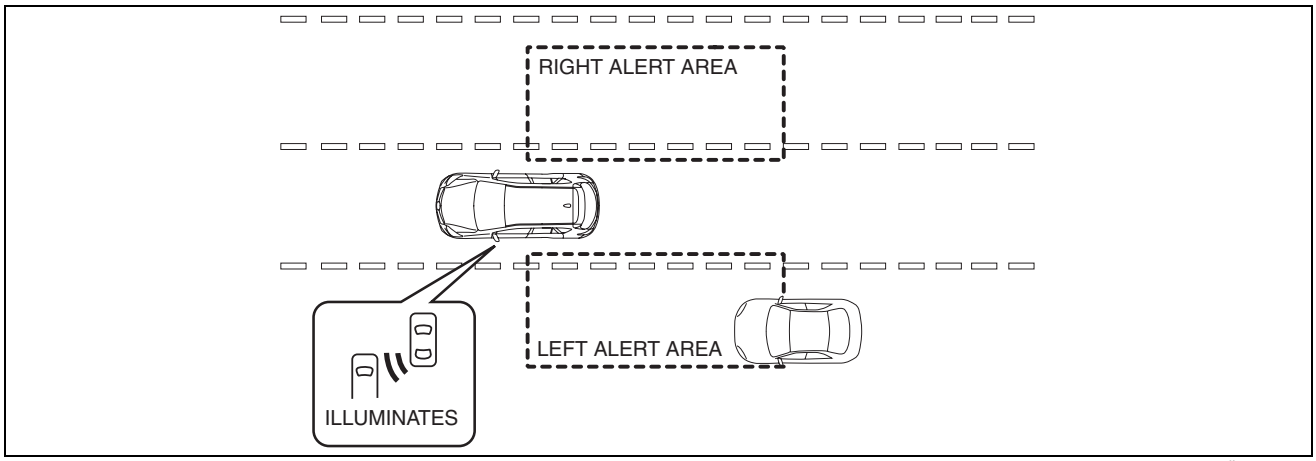
- The BSM can be turned off by pressing the BSM OFF switch with the ignition switched ON. (At this time, the BSM OFF indicator light in the instrument cluster illuminates.)

INSTRUMENTATION/DRIVER INFO.

- When the BSM OFF switch is pressed again with the system turned off, the system becomes operable and the BSM OFF indicator light in the instrument cluster turns off.
- The BSM-OFF condition is cancelled when the ignition is switched off (LOCK or ACC), and the BSM system becomes operable automatically when the ignition is switched ON the next time.

Alert Mode

- If a vehicle enters the alert area when passing or being passed, the system alerts the driver that a vehicle is in the alert area as follows:
  - — If a vehicle enters the alert area on the left, the BSM indicator light (LH) in the left outer mirror illuminates.
  - — If a vehicle enters the alert area on the right, the BSM indicator light (RH) in the right outer mirror illuminates.



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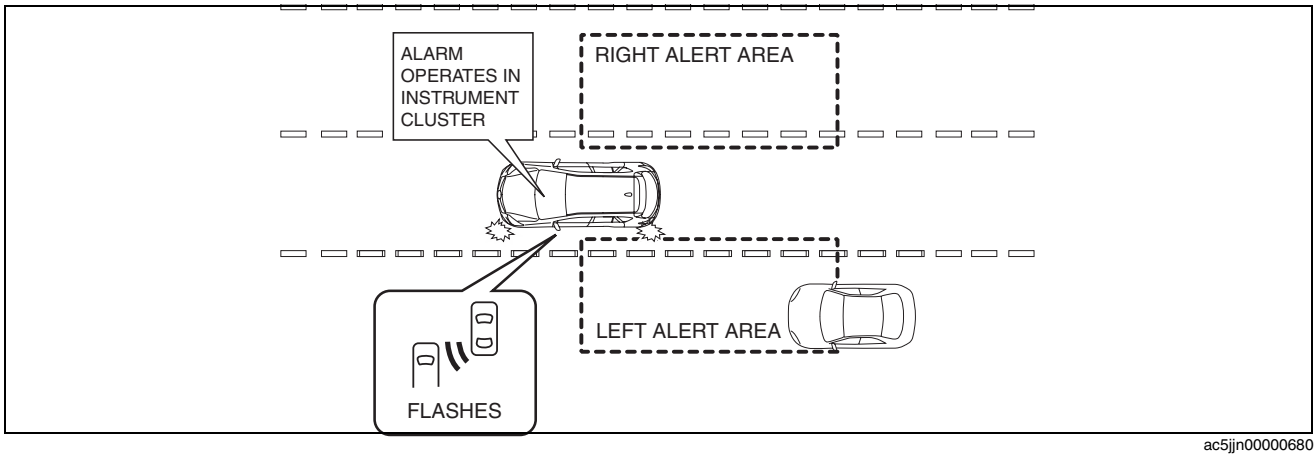
Warning Mode

- While in the alert mode, if the turn signal lever is operated to the side the target vehicle is detected, the system warns the driver of the possibility of an accident as follows:
  - — BSM indicator light in the outer mirror flashes
  - — Warning alarm in instrument cluster operates



ac5jjn00000680

BLIND SPOT MONITORING (BSM) CONTROL MODULE

id092200027400

Purpose

- Controls the blind spot monitoring (BSM) system.

Function

- The BSM control module emits microwaves to detect an oncoming vehicle's position and speed information via the reflected microwaves.
- The BSM system is controlled based on the detected vehicle position and speed information.
- A self-diagnostic function has been adopted.

Construction

- The BSM control module and radar have been integrated.
- Microwaves are emitted from the radar.

INSTRUMENTATION/DRIVER INFO.

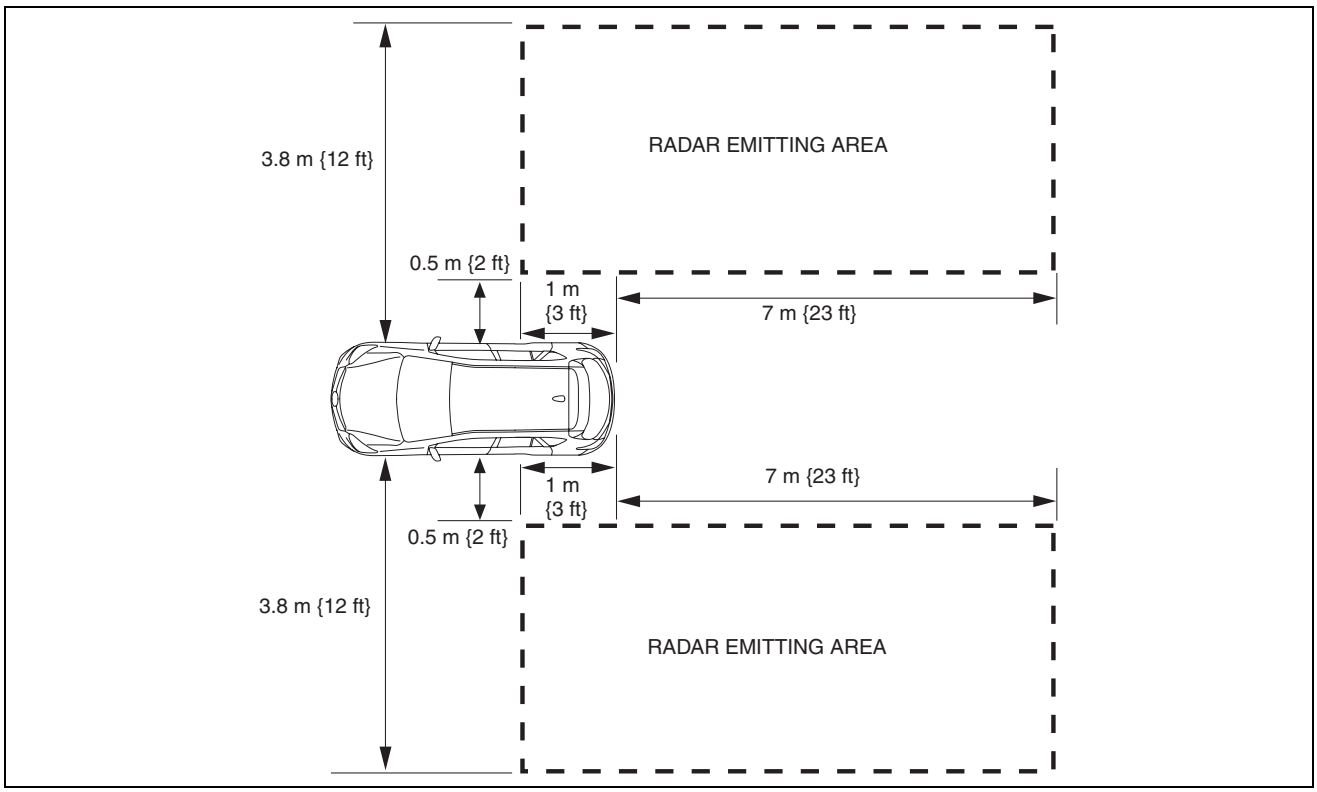
- Two control modules are positioned on the left and right sides of the body inside the rear bumper.

Operation

- The BSM control module emits microwaves to the vehicle rear to detect the obstruction via the reflected microwaves.

Radar Emitting Area

- Cross-directional: **1 m {3 ft}** toward the front of the vehicle, and **7 m {23 ft}** toward the rear of the vehicle from the rear end of the vehicle (total, **8 m {26 ft}**).
- Lateral direction: **0.5—3.8 m {2—12 ft}** from the side of the vehicle (total, **3.3 m {11 ft}**).



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- When the vehicle is cornering, such as turning into an intersection, the shape of the warning area on the inner side changes.
  - — Cross-directional: Length of the vehicle rear changes depending on the steering angle.
  - — Lateral direction: Angle of the warning area changes along the vehicle's turning orbit.

Fail-safe

DTC No.	Fail-safe function
B118C:11	BSM is stopped.
B118C:15	BSM is stopped.
B118D:11	BSM is stopped.
B118D:15	BSM is stopped.
U0001:88	BSM is stopped.
U0100:00	BSM is stopped.
U0131:00	BSM is stopped.
U0155:00	BSM is stopped.
U0214:00	BSM is stopped.
U0232:00	BSM is stopped.
U0233:00	BSM is stopped.
U0401:68	BSM is stopped.
U0420:68	BSM is stopped.
U0423:68	BSM is stopped.
U0515:68	BSM is stopped.
U0533:68	BSM is stopped.

INSTRUMENTATION/DRIVER INFO.

DTC No.	Fail-safe function
U0534:68	BSM is stopped.
U3000:01	BSM is stopped.
U3000:09	BSM is stopped.
U3000:4A	Not equipped.
U3000:97	Not equipped.
U3003:16	BSM is stopped.
U3003:17	BSM is stopped.

BLIND SPOT MONITORING (BSM) OFF INDICATOR LIGHT

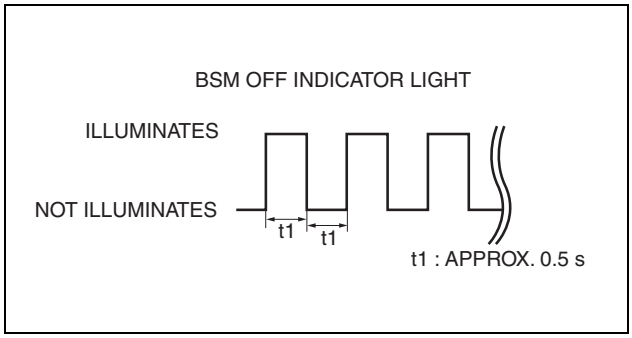
id092200027500

Purpose

- The BSM OFF indicator light informs the driver that the Blind Spot Monitoring (BSM) system is turned off or there is a malfunction in the system.

Function

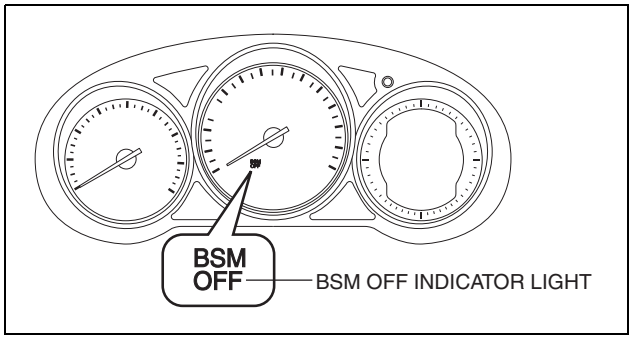
- The instrument cluster illuminates the BSM OFF indicator light based on the BSM system off signal sent via a CAN signal from the BSM control module (RH).
- The instrument cluster flashes the BSM OFF indicator light based on the malfunction indication request signal sent via a CAN signal from the BSM control module (RH).
- The flash pattern of the BSM OFF indicator light is as indicated in the table.



ac5wzn00001432

Construction

- The BSM OFF indicator light are equipped in the instrument cluster.



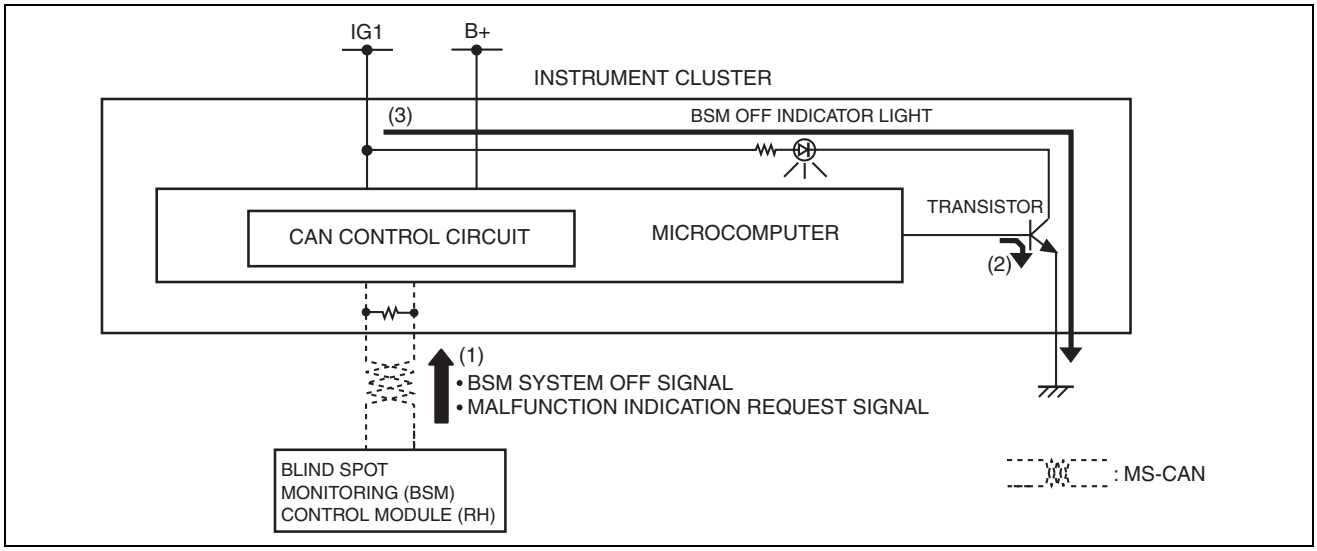
ac5jjn00000803

Operation

1. The instrument cluster receives (1) the BSM system off signal or malfunction indication request signal from the BSM control module (RH) via the CAN signal.
2. The instrument cluster turns the transistor on (2) intermittently for a malfunction indication request signal and continuously for a BSM system off signal.

INSTRUMENTATION/DRIVER INFO.

3. When the transistor turns on intermittently, the BSM OFF indicator light flashes (3) and when it turns on continuously, the BSM OFF indicator light illuminates (3).



ac5jjn00000804

Fail-safe
- Function not equipped.

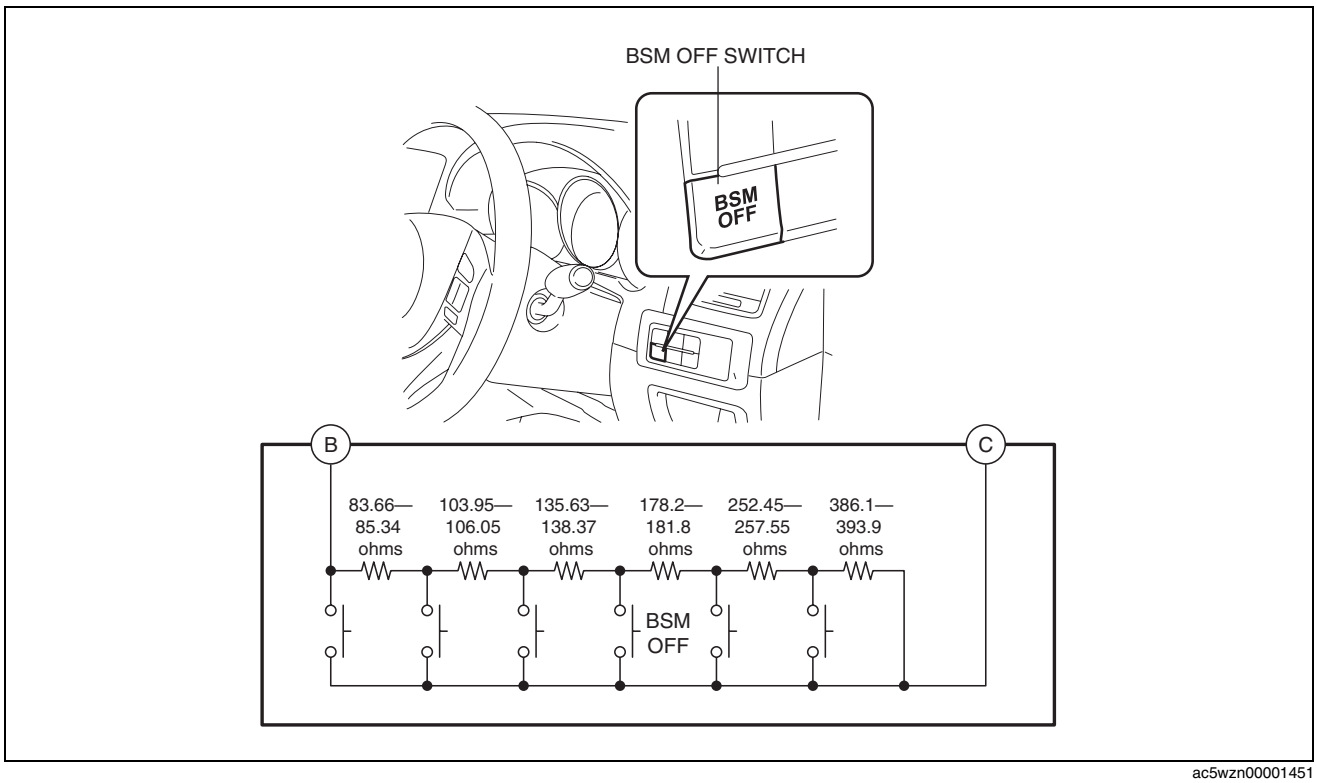
BLIND SPOT MONITORING (BSM) OFF SWITCH

id092200027600

Purpose
- The blind spot monitoring (BSM) system can be turned on or off optionally by the driver.

Function
- The switch operation signal is sent to the instrument cluster.

Construction
- The BSM OFF switch is built into the cluster switch.
- The resistance is built into each switch.

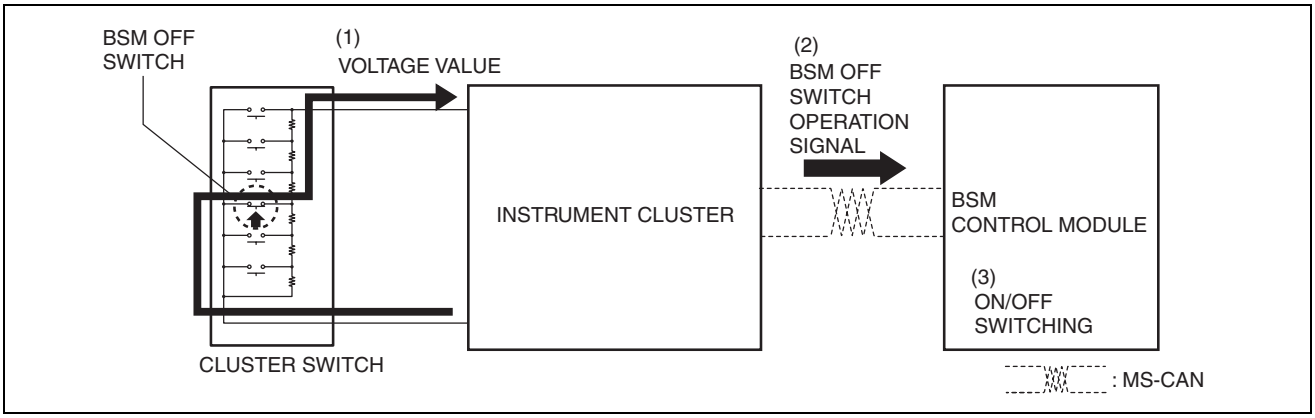


ac5wzn00001451

INSTRUMENTATION/DRIVER INFO.

Operation

1. When the BSM OFF switch operates, the switch operation signal is sent to the instrument cluster.
2. The instrument cluster sends a BSM OFF switch operation signal to the BSM control module based on the received voltage value (switch operation signal).
3. The BSM control module switches the BSM system on/off when it receives the BSM OFF switch operation signal from the instrument cluster.



ac5wzn00000890

Fail-safe

- Function not equipped.

BLIND SPOT MONITORING (BSM) WARNING ALARM

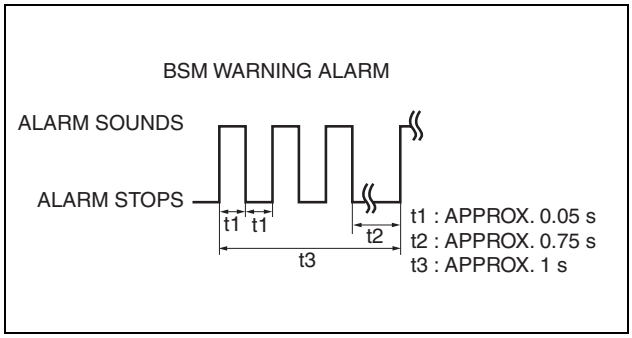
id092200028100

Purpose

- The Blind Spot Monitoring (BSM) warning alarm warns the driver of a possible accident.

Function

- If the instrument cluster receives a warning sound request signal from the BSM control module (RH), it sounds the BSM warning alarm using the buzzer in the instrument cluster.
- The BSM warning alarm sound pattern is as follows:



ac5wzn00001433

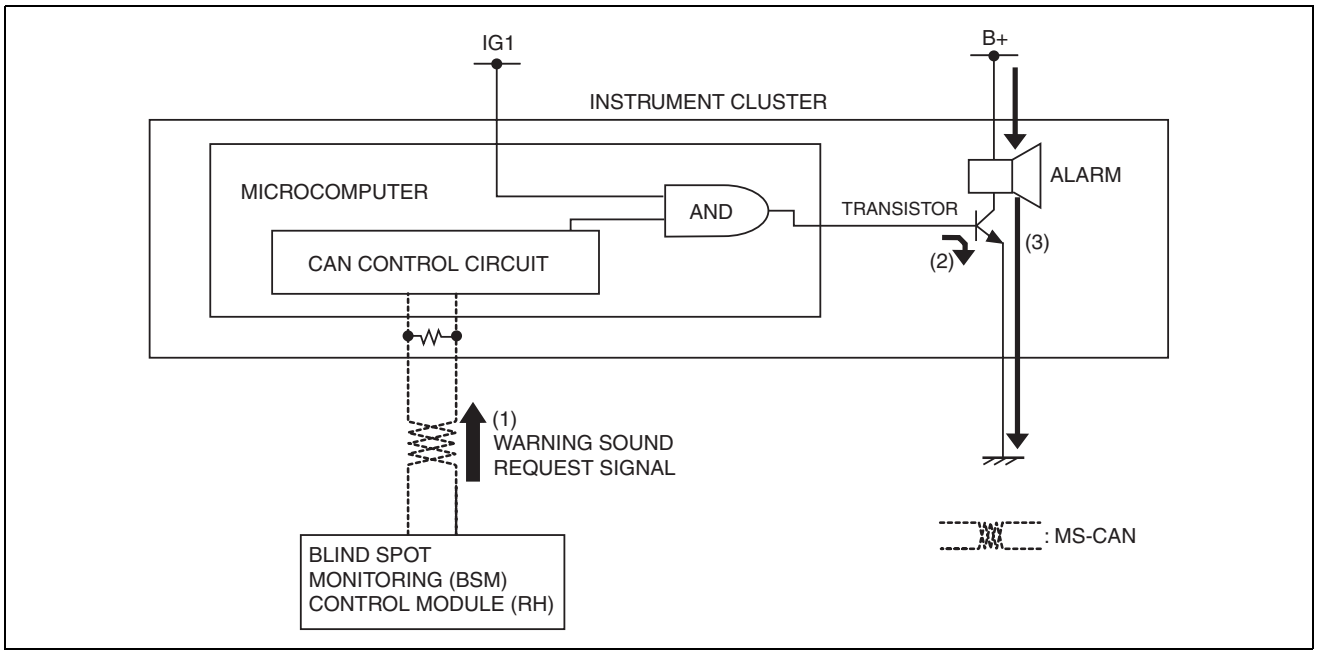
Construction

- The BSM warning alarm sounds using the buzzer built into the instrument cluster.

Operation

1. The instrument cluster receives (1) the warning sound request signal from the BSM control module (RH).
2. The instrument cluster turns the transistor on (2) based on the warning sound request signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5jjn00000806

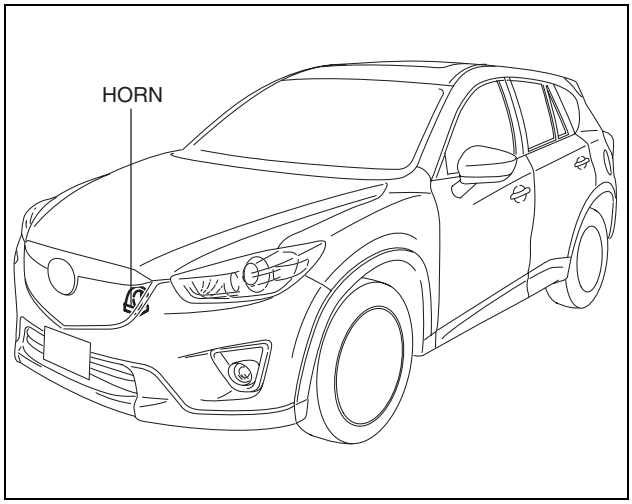
Fail-safe
- Function not equipped.

HORN

id092200021700

Purpose, Function
- The horn sounds according to the horn switch operation.

Construction
- Installed to the inside of the front grille.
- The diaphragm is vibrated to apply vibration to the air and produce sound.



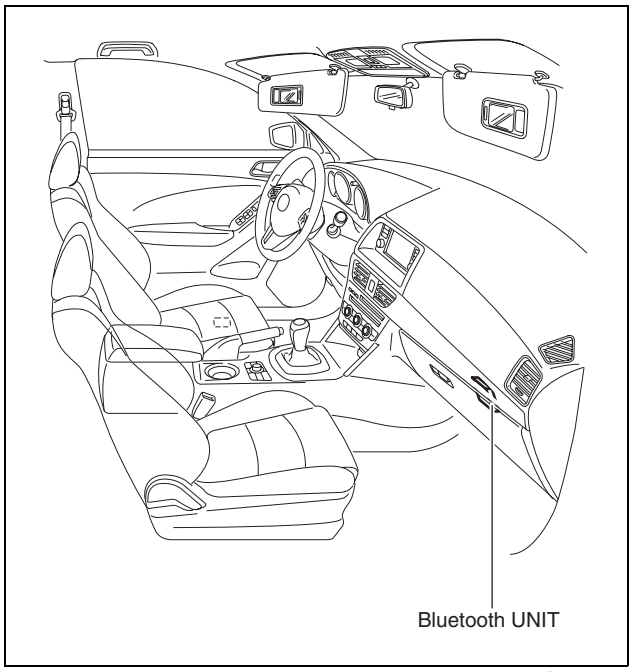
ac5wzn00001431

Operation
1. When the horn switch turns on (1), the horn relay turns on (2).
2. When the horn relay turns on, the horn sounds.

ENTERTAINMENT

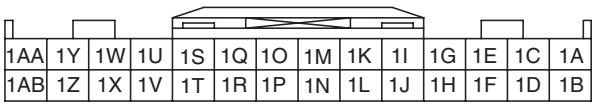
Construction

- The Bluetooth unit is installed inside the glove compartment.



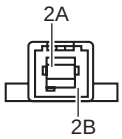
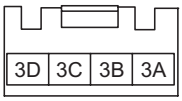
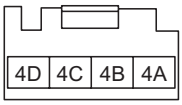
ac5jjn00000652

Terminal layout and signal



Terminal	Signal
1A	Mic input (+)
1B	Mic input (-)
1C	—
1D	—
1E	—
1F	Steering switch
1G	—
1H	—
1I	—
1J	—
1K	—
1L	Audio out shield
1M	Audio output RH (+)
1N	Audio output RH (-)
1O	—
1P	—
1Q	—
1R	—
1S	CAN_H
1T	CAN_L
1U	—
1V	—
1W	—
1X	Ground
1Y	—
1Z	—
1AA	B+
1AB	ACC

ENTERTAINMENT

Terminal		Signal
	2A	GPS
	2B	Ground
	3A	Ground
	3B	DATA (+)
	3C	DATA (-)
	3D	V_BUS
	4A	Ground
	4B	DATA (+)
	4C	DATA (-)
	4D	V_BUS

Operation
- For the Bluetooth unit operation, refer to the 09-20-54 Bluetooth SYSTEM

Fail-safe
- Function not equipped.

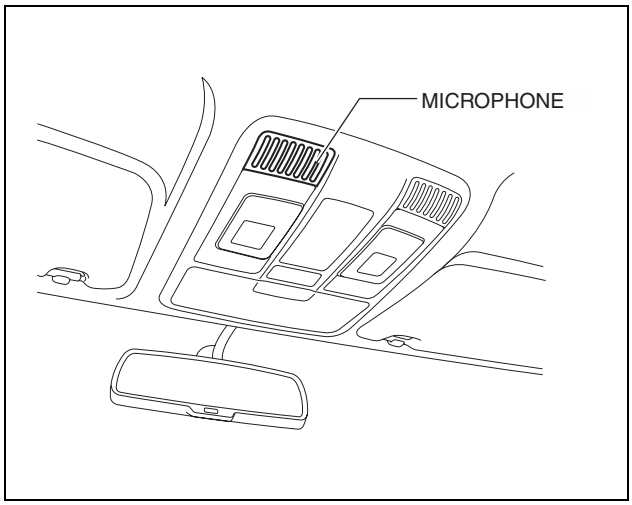
MICROPHONE

id092000011600

Purpose, Function
- Converts the user's voice command to an electrical signal and sends it to the audio unit or Bluetooth unit.

Construction
- Noise due to the vehicle being driving or air blown by the air conditioner has been reduced by locating the voice recognition microphone next to the map light.

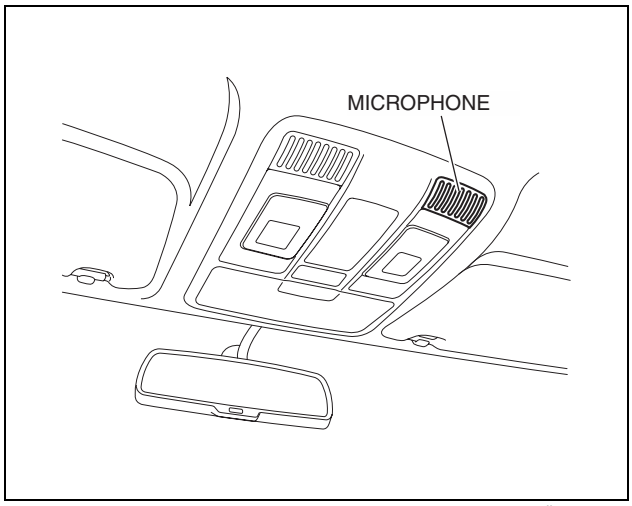
L.H.D.



ac5jjn00000667

ENTERTAINMENT

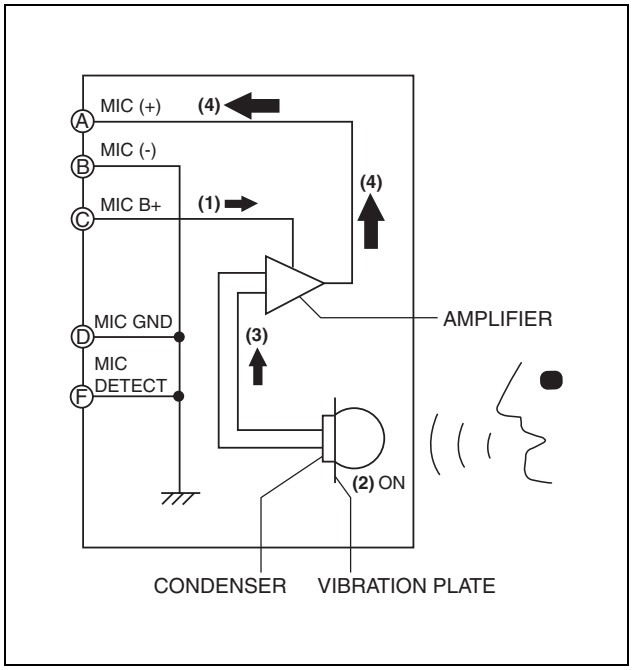
R.H.D.



ac5jjn00000668

Operation

1. When the ignition is switched to ACC or ON (engine off or on), power is supplied from the audio unit to the voice recognition microphone.
2. If the TALK switch in the steering switch is pressed, the voice recognition function operates.
3. The air which is vibrated by the user's voice is converted to an electrical signal by the vibration plate and condenser in the voice recognition microphone.
4. The converted electrical signal is amplified by the amplifier for the voice recognition microphone and output to the audio unit or Bluetooth unit.



ac5wzn00001549

Fail-safe

- Function not equipped.

ON-BOARD DIAGNOSTIC [AUDIO SYSTEM]

id0920001101a1

Outline

- The audio system has an on-board diagnostic function and diagnostic assist function to facilitate audio system diagnosis.

ENTERTAINMENT

Function

- The on-board diagnostic function consists of the following functions: A malfunction detection function, which detects overall malfunctions in the audio system-related parts; a memory function, which stores detected DTCs; and a display function, which indicates system malfunctions via a DTC display.
- There are two methods for DTC output and clearing; one using the Mazda Modular Diagnostic System (M-MDS) and one which does not use it. Because the DTCs differ depending on whether the M-MDS is used or not, use both methods. (with color LCD)
- The diagnostic assist function is a function for forcibly operating audio system related parts to verify their connection condition and operation status. In addition, the specifications for the audio system related parts are displayed in the audio display to enable their verification.

On-board diagnostic function
Malfunction detection function

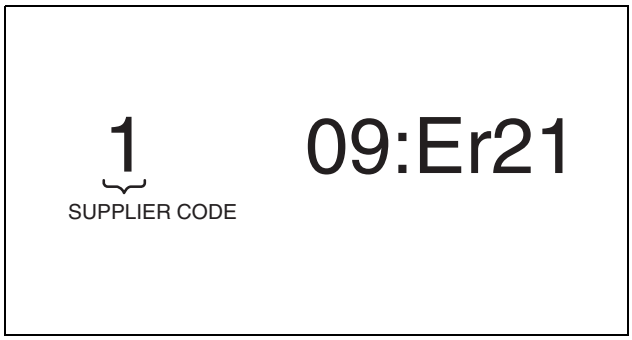
- Detects malfunctions in the audio system.

Memory function

- If the audio unit detects a malfunction in the audio system, a maximum of 3 DTCs are recorded in the audio unit. If the audio unit has already stored 3 DTCs (without color LCD)/20 DTCs (with color LCD) and detects another malfunction, it clears the oldest DTC and stores the new DTC.
- DTCs stored in the audio unit are cleared if the negative battery cable is disconnected (if backup power is interrupted).

Display Function
Mazda Modular Diagnostic System (M-MDS) not used

- To display DTCs in the audio unit display that have been recorded in the memory function, activate the on-board diagnostic function by operating the audio unit. Refer to the Workshop Manual for the activation procedure of the on-board diagnostic function.
  The DTCs consist of the following:
  — Supplier code (supplier name)
  — Device code (malfunction location)
  — Error code (malfunction contents)



ac5wzw0000073

Supplier code	Supplier name
01	SANYO Automedia
02	Panasonic
03	CLARION
04	PIONEER
05	VISTEON

Device code	Device name
09	Audio unit
10	• AM/FM tuner/MP3/WMA (Windows Media Audio)/AAC (Advanced Audio Coding) applicable CD player (Without color LCD) • AM/FM tuner/MP3/WMA (Windows Media Audio) applicable CD player (With color LCD)
16	CAN system
26	Bluetooth unit
28	Auxiliary jack/USB port
29	iPod

Error code	Malfunction contents
01	Mechanical malfunction
02	Servo malfunction
07	Poor data read-outs
10	BUS line (communication line) error
11	CAN line (communication line) error
12	CAN line (communication line) error
20	Insufficient power supply
21	Amplifier related circuit

ENTERTAINMENT

Error code	Malfunction contents
22	Tuner error

With Using Mazda Modular Diagnostic System (M-MDS)

- When a DTC inspection is performed using the Mazda Modular Diagnostic System (M-MDS), the malfunction diagnostics for the audio system and Bluetooth system (hands-free telephone (HF/TEL) system) is initiated. A maximum of 20 DTCs detected by the malfunction diagnostics are displayed. Refer the Workshop Manual for the DTC inspection procedure.

× : Applicable
— : Not applicable

DTC table

With color LCD

DTC No.		Security indicator light	Description	Fail-safe	Drive cycle	Self-test type*1	Memory function
Mazda Modular Diagnostic System (M-MDS) display	Information display (On-board diagnostic test mode)						
B116A:12	26:Er82	—	Microphone circuit malfunction	—	—	D	—
B1188:64	10:Er07	—	Audio unit internal malfunction	—	—	C	×
B1D19:71	10:Er02	—	Audio unit internal malfunction	—	—	C	×
B1D19:79	10:Er01	—	Audio unit internal malfunction	—	—	C	×
B1D19:96	10:Er10	—	Audio unit internal malfunction	—	—	C	×
U0010:88	16:Er12	—	CAN system communication error	—	—	C	×
U0155:00	—*2	—	Instrument cluster communication error	—	—	C, D	×
U0197:00	—*2	—	Communication error with Bluetooth unit	—	—	D	—
U3000:04	09:Er22	—	Audio unit internal malfunction	×	—	D	×
U3000:09	09:Er21	—	Audio unit internal malfunction	×	—	C	×
U3003:16	09:Er20	—	Voltage decrease input from battery	—	—	C	×
—	28:Er01	—	Poor connection with exterior input unit, or read error	—	—	—	×
—	29:Er01	—	Audio unit internal malfunction, or iPod malfunction	—	—	—	×
—	—	—	DTCs not stored	—	—	—	—

*1 : C: CMDTC self test, D: ODDTC self test
*2 : It is not displayed in the audio display because the on-board diagnostic test mode is not available.

Without color LCD

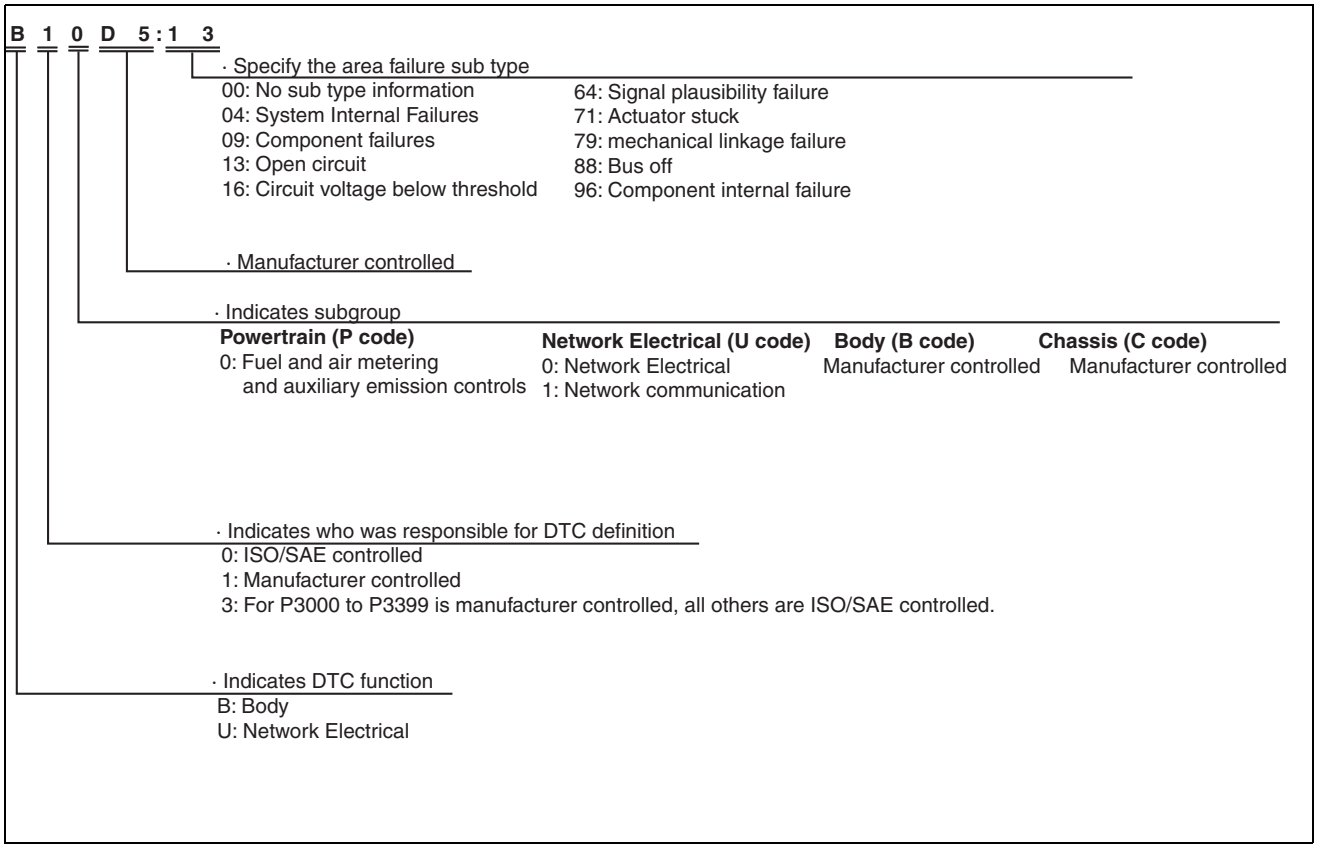
DTC	Security indicator light	Description	Fail-safe	Drive cycle	Self-test type*1	Memory function
09:Er20	—	Voltage decrease input from battery	—	—	C	×
09:Er21	—	Audio unit internal malfunction	—	—	C	×
09:Er22	—	Audio unit internal malfunction	—	—	C	×
10:Er01	—	Audio unit internal malfunction	—	—	C	×
10:Er02	—	Audio unit internal malfunction	—	—	C	×
10:Er07	—	Audio unit internal malfunction	—	—	C	×
10:Er10	—	Audio unit internal malfunction	—	—	C	×
28:Er01	—	Poor connection with exterior input unit, or read error	—	—	—	×
29:Er01	—	Audio unit internal malfunction, or iPod malfunction	—	—	—	×
No Err	—	DTCs not stored	—	—	—	—

*1 : C: CMDTC self test,

ENTERTAINMENT

DTC 7-digit code definition

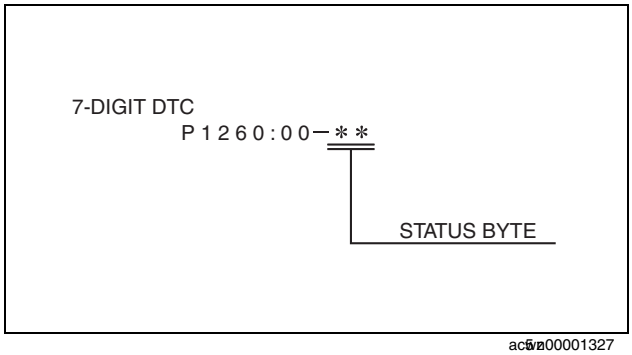
- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



acsun00001121

Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



acsun00001327

Diagnostic Assist Function

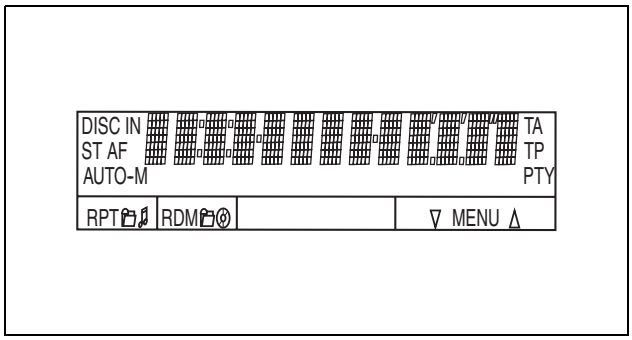
- The audio system related parts are forcibly operated to enable verification of the connection condition and operation status of the audio system related parts.In addition, the specifications for the audio system related parts are displayed in the information display to enable their verification. Refer to the Workshop Manual for the diagnostic assist function activation procedure.

Display inspection

- All characters are displayed in the audio unit display to enable examination of the display. (Without color LCD)

ENTERTAINMENT

- By touching the audio unit display, the display color can be changed for color verification and display examination. (with color LCD)



ac5jjn00001051

Button Inspection

- Activates a buzzer sound when a switch is operated and examines each of the switches.

Speaker Inspection

- Verifies that the speakers output sound in the following order and examines each speaker or the wiring harness between the audio unit and each speaker.

  Without Bose®

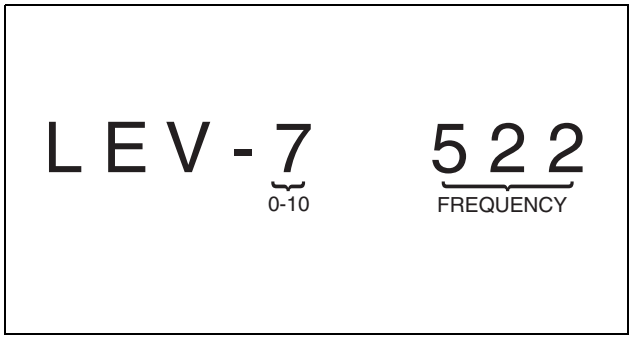
  1. Front door speaker (LH) and tweeter (LH) (6 speaker type)
  2. Front door speaker (RH) and tweeter (RH) (6 speaker type)
  3. Rear door speaker (RH)
  4. Rear door speaker (LH)

  With Bose®

  1. Front door speaker (LH), tweeter (LH) and front center speaker (LH)
  2. Front door speaker (RH), tweeter (RH) and front center speaker (RH)
  3. Rear door speaker (RH) and D-pillar speaker (RH)
  4. Rear door speaker (LH) and D-pillar speaker (LH)

Radio Reception Condition Inspection

- Displays the radio reception status on the audio unit display and examines the center roof antenna, antenna feeder, and audio unit (tuner). (Display example when receiving AM 522kHz)



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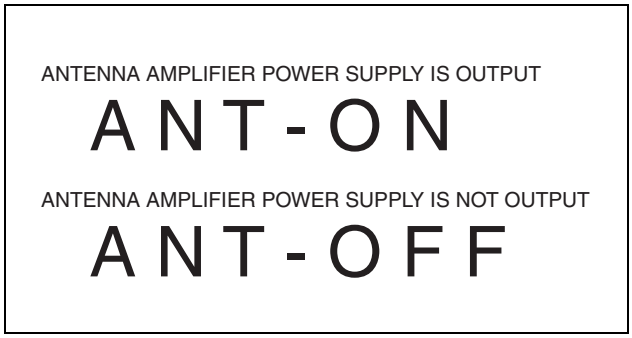
Antenna control inspection

- Displays the power supply output status to the center roof antenna to the audio unit display for examination of the center roof antenna, audio unit and wiring harness (between audio unit and center roof antenna).



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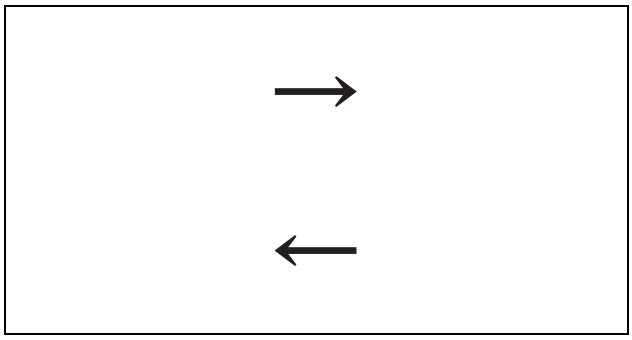
ENTERTAINMENT

Dial inspection

- Displays the rotation direction of the operated dial switch in the audio unit display for examination of each switch.



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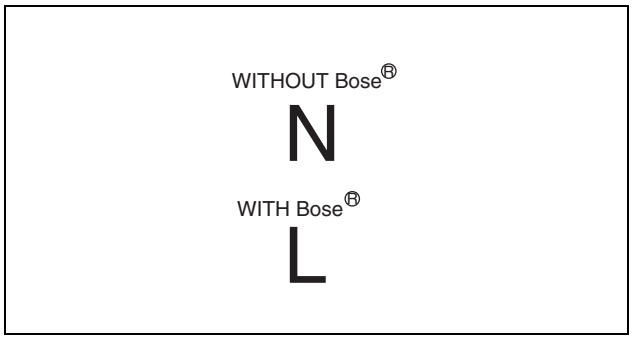
Audio amplifier specification verification.

- Displays the audio amplifier specifications on the audio unit display to verify the specifications.



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AUTO-M inspection (without color LCD only)

- Activates AUTO-M and displays the radio reception conditions in the audio unit display for examination of the radio unit.

CD inspection (without color LCD only)

- Displays inspection results in the audio unit and verifies whether a malfunction is audio unit or CD related.

Vehicle/NAVI signal verification (with color LCD only)

- Displays the following signal conditions, the vehicle speed, and connection conditions on the audio unit display and verifies the vehicle and NAVI signals.
  - TNS signal
  - Reverse signal
  - Parking brake signal
  - Vehicle speed
  - Steering switch connection condition
  - Commander switch connection condition
  - Connection condition of voice recognition-use microphone
  - Car navigation unit connection condition
  - GPS antenna connection condition

Exterior device connection information clearing (with color LCD only)

- The car navigation unit, Bluetooth unit, SIRIUS satellite radio unit, and back camera connection information stored in the audio unit can be cleared.

Gateway signal verification (with color LCD only)

- Displays the information directed at the vehicle HS-CAN in the audio unit display, and verifies if the vehicle information in the audio unit arrives correctly.

ON-BOARD DIAGNOSTIC [Bluetooth SYSTEM]

id0920001101z6

Outline

- To facilitate malfunction diagnosis in the audio system, the Bluetooth system (Hands-Free telephone (HF/TEL)) is equipped with an on-board diagnostic function and diagnostic assist function.

ENTERTAINMENT

Function

- The on-board diagnostic function has a malfunction detection function which detects overall malfunctions in the audio system-related parts, and a display function which indicates a system malfunction via DTC display.
- There are two methods for DTC output and clearing; one using the Mazda Modular Diagnostic System (M-MDS) and one which does not use it. Because the DTCs differ depending on whether the M-MDS is used or not, use both methods.
- The diagnostic assist function displays Bluetooth unit connection conditions and specifications in the audio unit display, and verifies the Bluetooth system connection conditions and specifications.

On-board diagnostic function

Malfunction detection function

- The malfunction detection function detects malfunctions occurring in the Bluetooth system (hands-free telephone (HF/TEL) system).

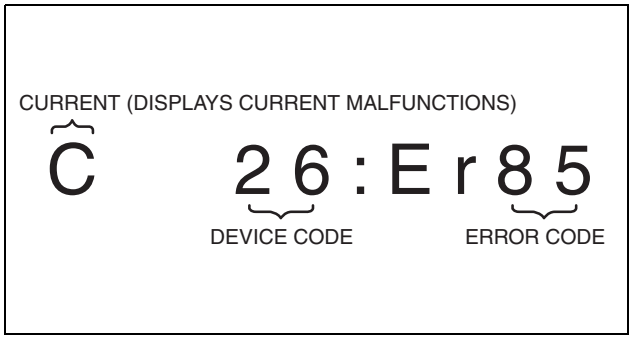
Display Function

Mazda Modular Diagnostic System (M-MDS) not used

- Activates the on-board diagnostic function by operating the audio unit and displays DTCs in the audio unit display. Refer to the Workshop Manual for the activation procedure of the on-board diagnostic function.
- The DTC consists of the following codes and numbers:
  - — Supplier code (supplier name)
  - — Device code (malfunction location)
  - — Error code (malfunction contents)

With using Mazda Modular Diagnostic System (M-MDS)

- When a DTC inspection is performed using the Mazda Modular Diagnostic System (M-MDS), the malfunction diagnostics for the audio system and Bluetooth system (hands-free telephone (HF/TEL) system) is initiated.Refer the Workshop Manual for the DTC inspection procedure.



am5ezn0000177

× : Applicable
— : Not applicable

DTC table

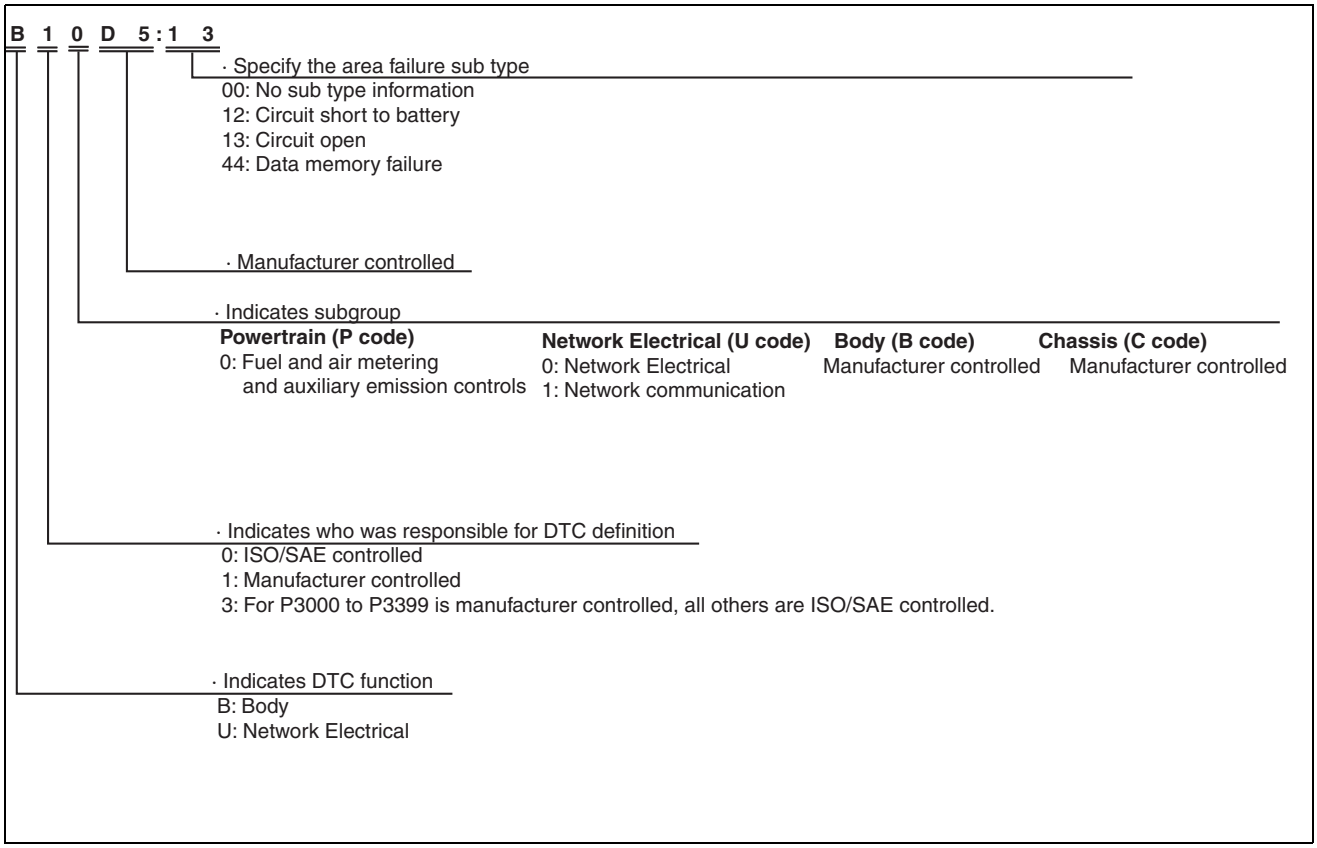
DTC No.		Security indicator light	Description	Fail-safe	Drive cycle	Self-test type*1	Memory function
Mazda Modular Diagnostic System (M-MDS) display	Information display (On-board diagnostic test mode)						
B116A:12	26:Er82	—	Microphone circuit malfunction	—	—	D	—
B116A:13	—*2	—	Microphone circuit malfunction	—	—	D	—
B116A:44	26:Er86	—	Bluetooth unit internal malfunction	—	—	D	—
—	26:Er81	—	CAN system communication error	—	—	—	—
U0197:00	—*2	—	CAN system communication error	—	—	D	—
—	—	—	DTC is not recorded.	—	—	—	—

*1 : D: ODDTC self test
*2 : It is not displayed in the audio display because the on-board diagnostic test mode is not available.

ENTERTAINMENT

DTC 7-digit code definition

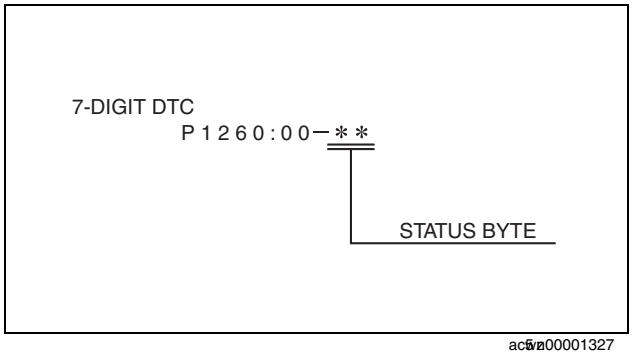
- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



acsun00001122

Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



acsun00001327

Diagnostic Assist Function

- Displays the Bluetooth system connection conditions and specifications in the audio unit display, and verifies the Bluetooth system connection conditions and specifications. Refer to the workshop manual for the diagnostic assist function activation procedure.

HF unit connection information

- Displays the connection conditions in the audio unit display and verifies the Bluetooth unit connection conditions.

HF unit software version

- Displays the Bluetooth unit software version in the audio unit, and verifies the Bluetooth unit specifications.

09-21 POWER SYSTEMS

POWER SYSTEMS

POWER SYSTEMS

id092100960000

Outline

- System in which electric current from the battery supplies power to each electrical part.
- There are mainly three types of electric power supply as follows, which are divided into system-supplied power and power used by parts.
  - — Supply of direct power from battery
  - — Supply of power by switching ignition ON (engine off)
  - — Supply of power by switching ignition ON (engine on)

Specification

SYKACTIV-G 2.0

Component parts	Specification	
Relay and fuse block	Wiring harness-integrated type	
Fuse block	Wiring harness-integrated type	
Relay box	Wiring harness-integrated type	
Main fuse	DCDC fuse rating	50 A
	EPS fuse rating	60 A
	MAIN fuse rating	200 A
	STARTER fuse rating	250 A
Push button start	Durable number of times	200,000 time
	Type	ON/OFF switch
Accessory socket	Rated voltage	DC 12 V
	Rated load	10 A

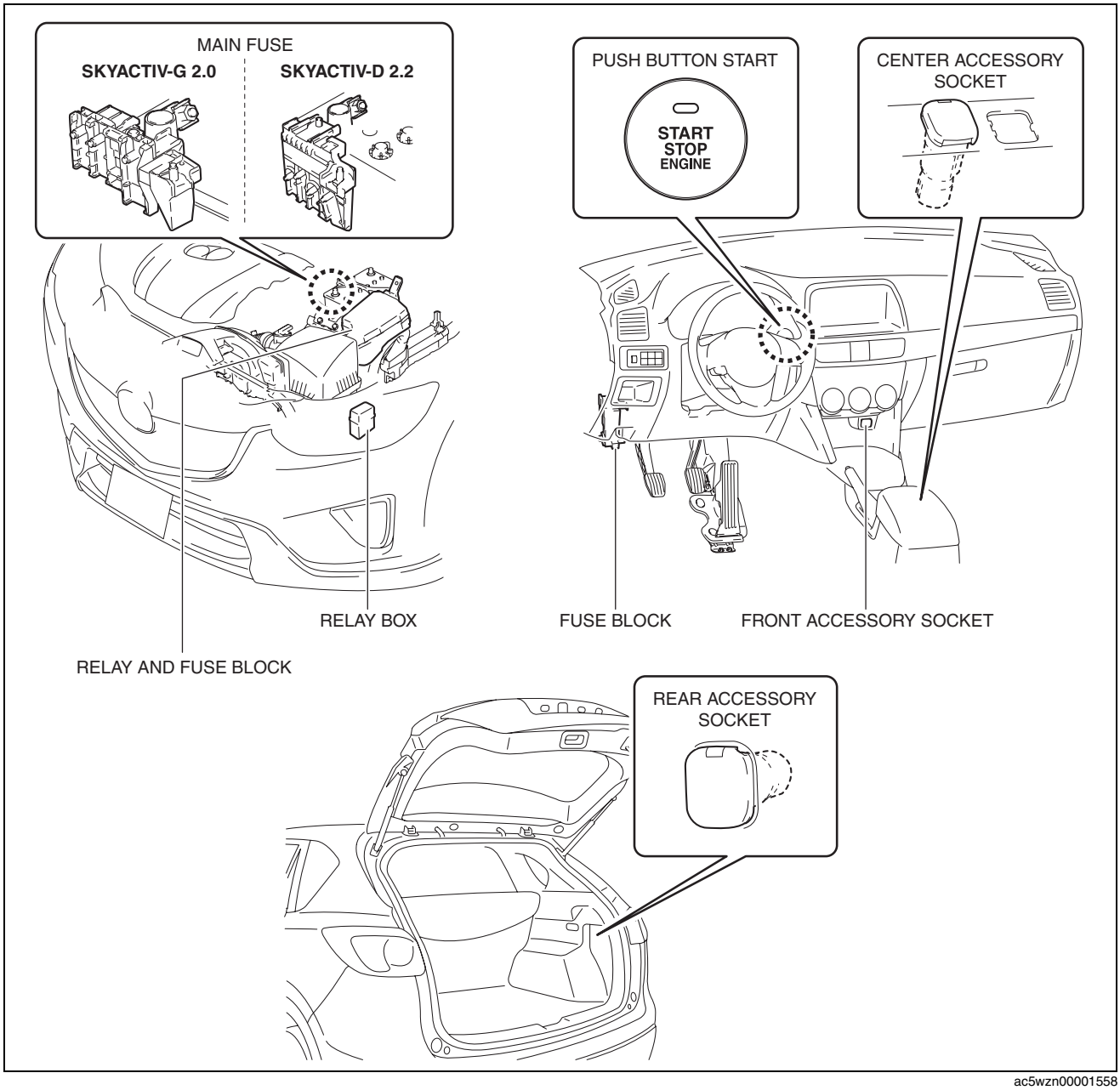
SKYACTIV-D 2.2

Component parts	Specification
Relay and fuse block	Wiring harness-integrated type
Fuse block	Wiring harness-integrated type
Relay box	Wiring harness-integrated type

POWER SYSTEMS

Component parts	Specification	
Main fuse	GLOW fuse rating	80 A
	EPS fuse rating	60 A
	PTC fuse rating	100 A
	MAIN fuse rating	200 A
	STARTER fuse rating	450 A
Push button start	Durable number of times	200,000 time
	Type	ON/OFF switch
Accessory socket	Rated voltage	DC 12 V
	Rated load	10 A

Structural view



ac5wzn00001558

RELAY AND FUSE BLOCK

id092100960100

Purpose

- Relays and fuses used by each system are grouped and housed together for smooth inspection and replacement servicing.

POWER SYSTEMS

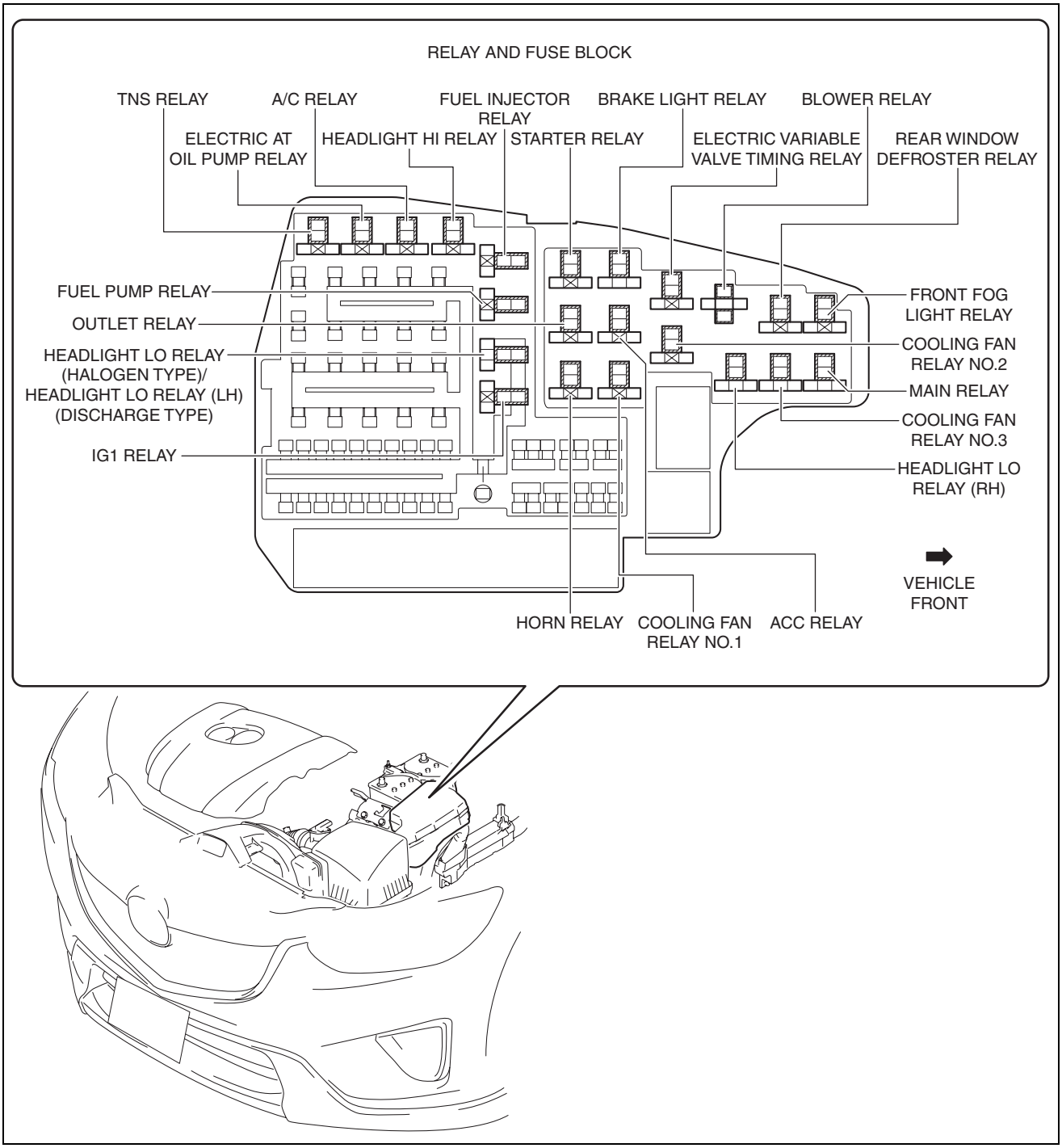
Function

- Relays and fuses used by each system are grouped and housed together.

Construction

- Installed in the engine compartment.

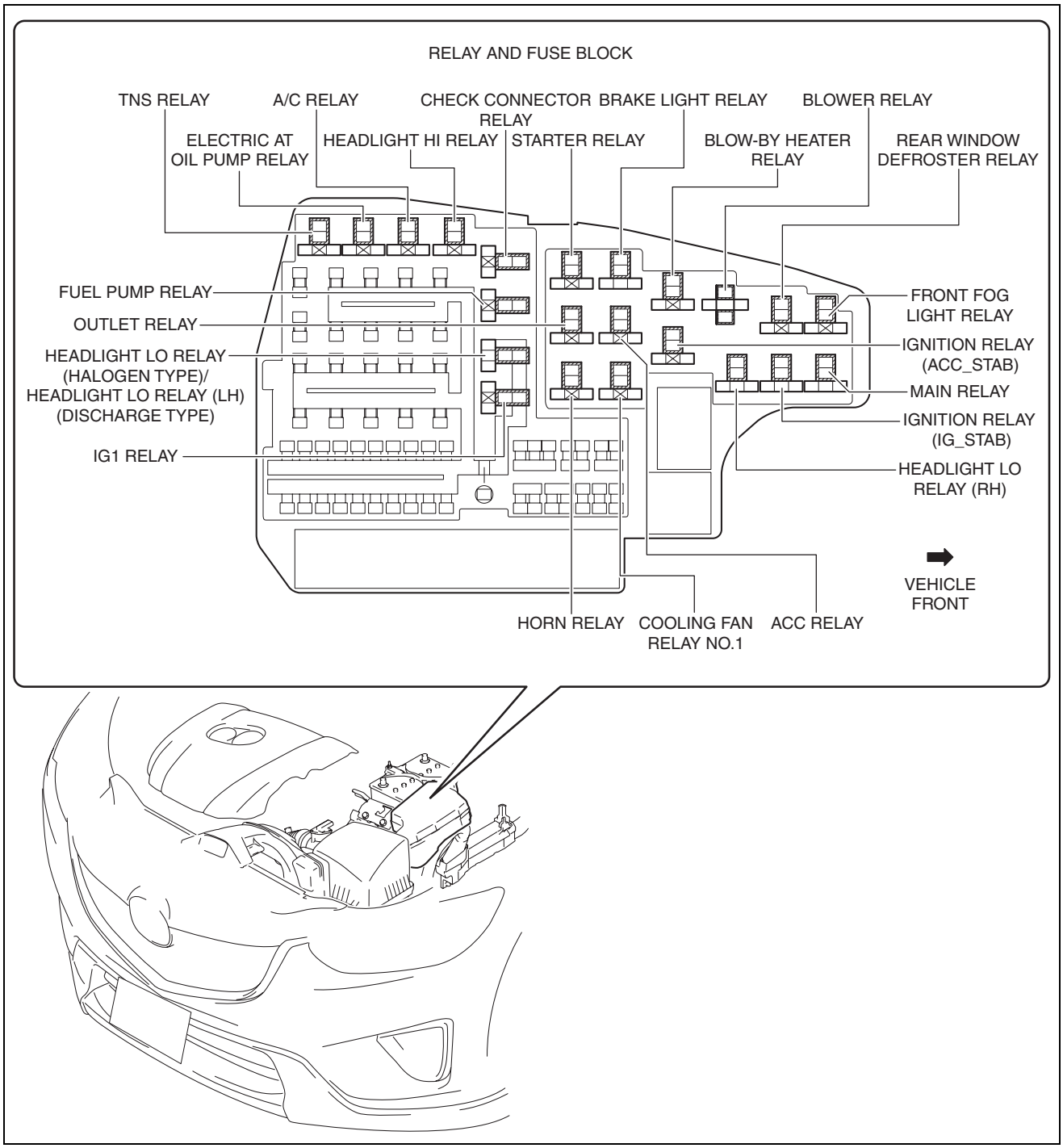
SKYACTIV-G 2.0



ac5wzn00001559

POWER SYSTEMS

SKYACTIV-D 2.2

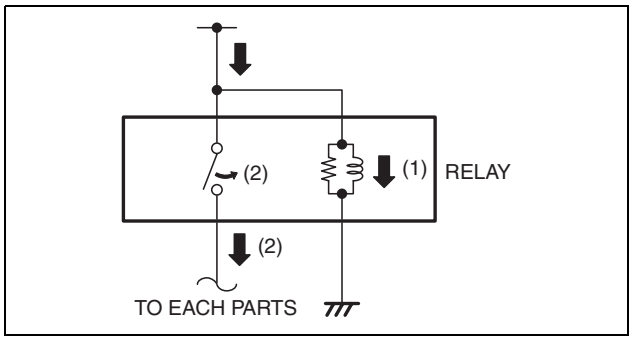


ac5wzn00001865

Operation
Relay operation

1. When electric current flows to the coil, electromagnetic power is generated.
2. The switch is attracted by the generated electromagnetic power and it switches on.
3. Electric current flows to each part that is downstream of the switch.

POWER SYSTEMS



ac5wzn00000289

Fuse operation
1. If electric current to each fuse is the specified value or more, the fuse melts due to heat generation.
2. Interrupts electric current flow downstream of the fuse.

Fail-safe
- Function not equipped.

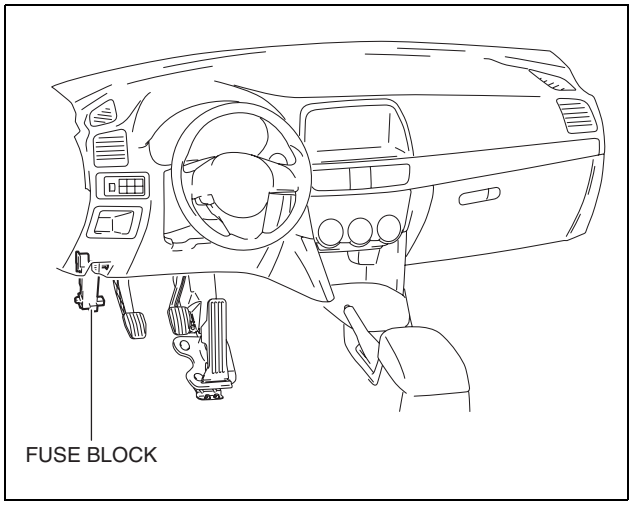
FUSE BLOCK

id092100528800

Purpose
- Fuses used by each system are grouped and housed together for smooth inspection and replacement servicing.

Function
- Fuses used by each system are grouped and housed together.

Construction
- Installed inside the front side trim (LH).



ac5wzn00000281

Operation
Fuse operation
1. If electric current to each fuse is the specified value or more, the fuse melts due to heat generation.
2. Interrupts electric current flow downstream of the fuse.

Fail-safe
- Function not equipped.

RELAY BOX

id092100900300

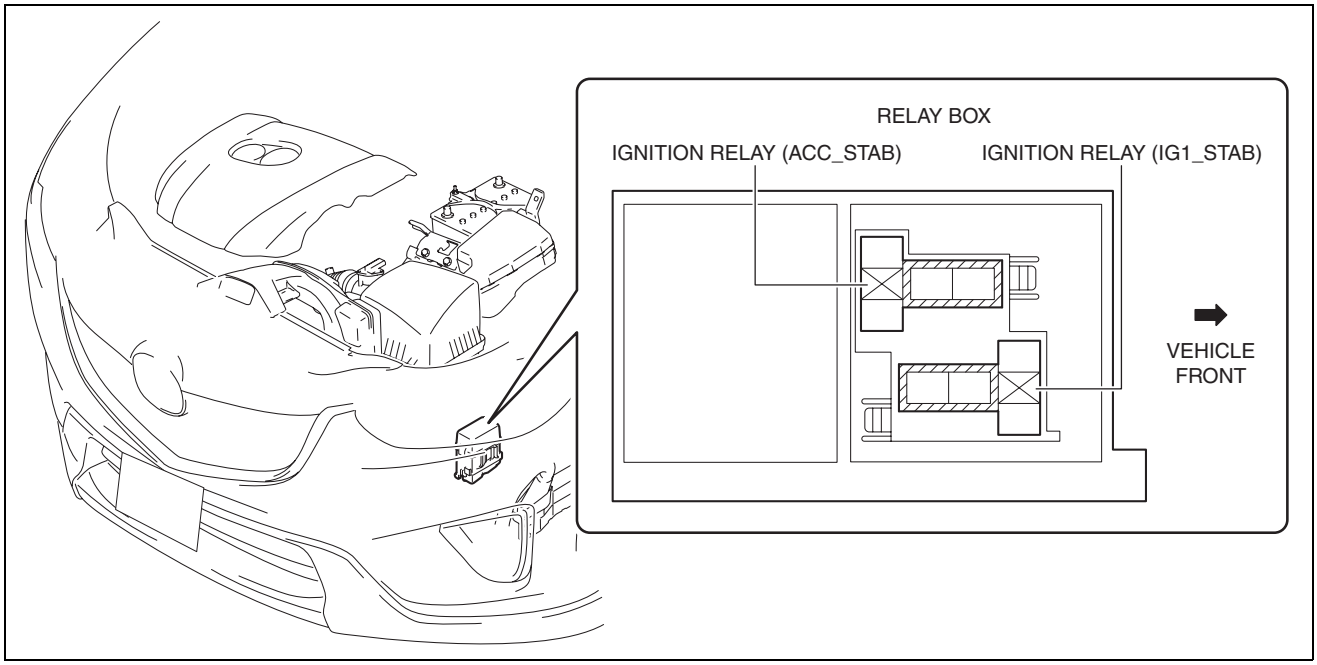
Purpose
- Relays used by each system are grouped and housed together for smooth inspection and replacement servicing.

POWER SYSTEMS

Function
- Relays used by each system are grouped and housed together.

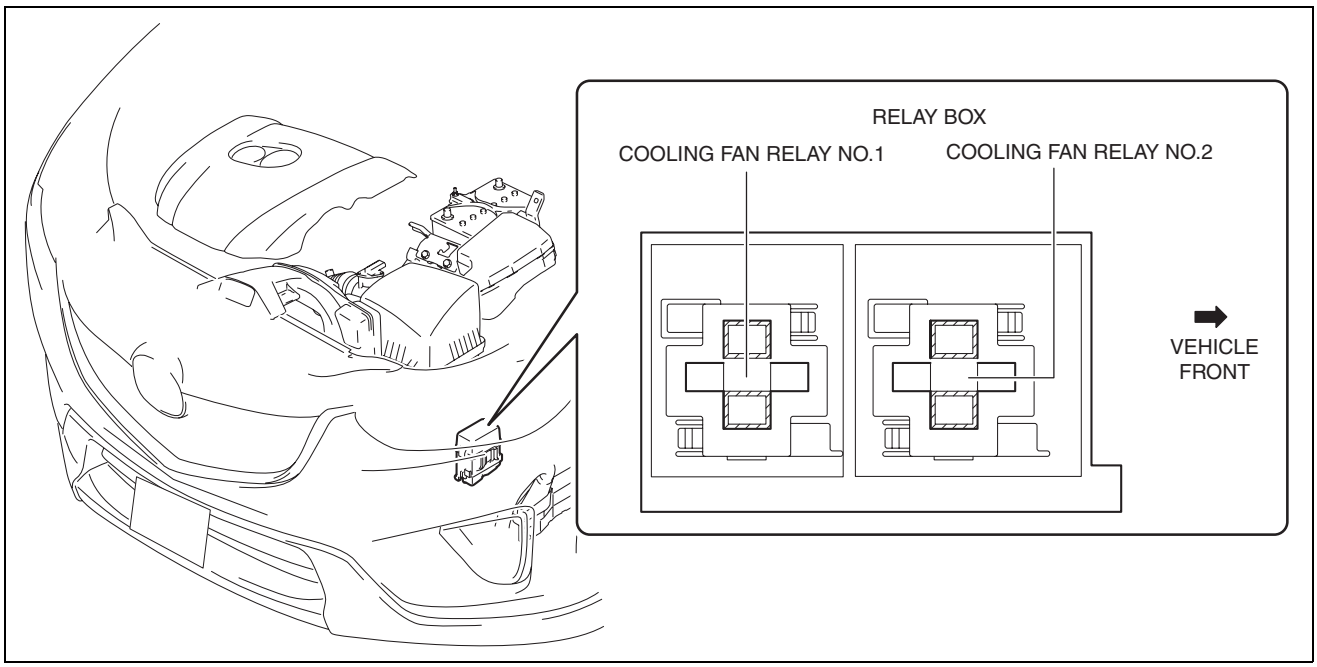
Construction
- Installed the inside front bumper.

SKYACTIV-G 2.0



ac5wzn00001560

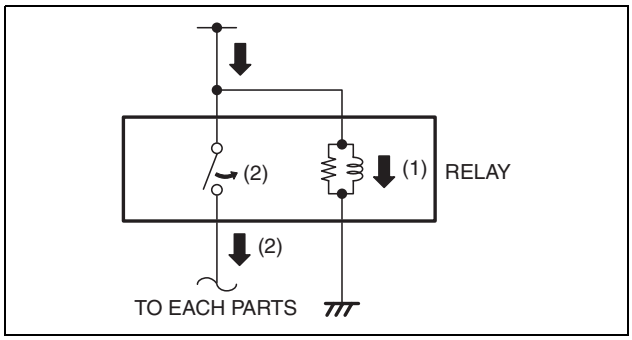
SKYACTIV-D 2.2



ac5wzn00001871

Operation
Relay operation
1. When electric current flows to the coil, electromagnetic power is generated.
2. The switch is attracted by the generated electromagnetic power and switches on.
3. Electric current flows to each part downstream of the fuse.

POWER SYSTEMS



ac5wzn00000285

Fail-safe
- Function not equipped.

POWER SUPPLY SWITCHING

id092100205000

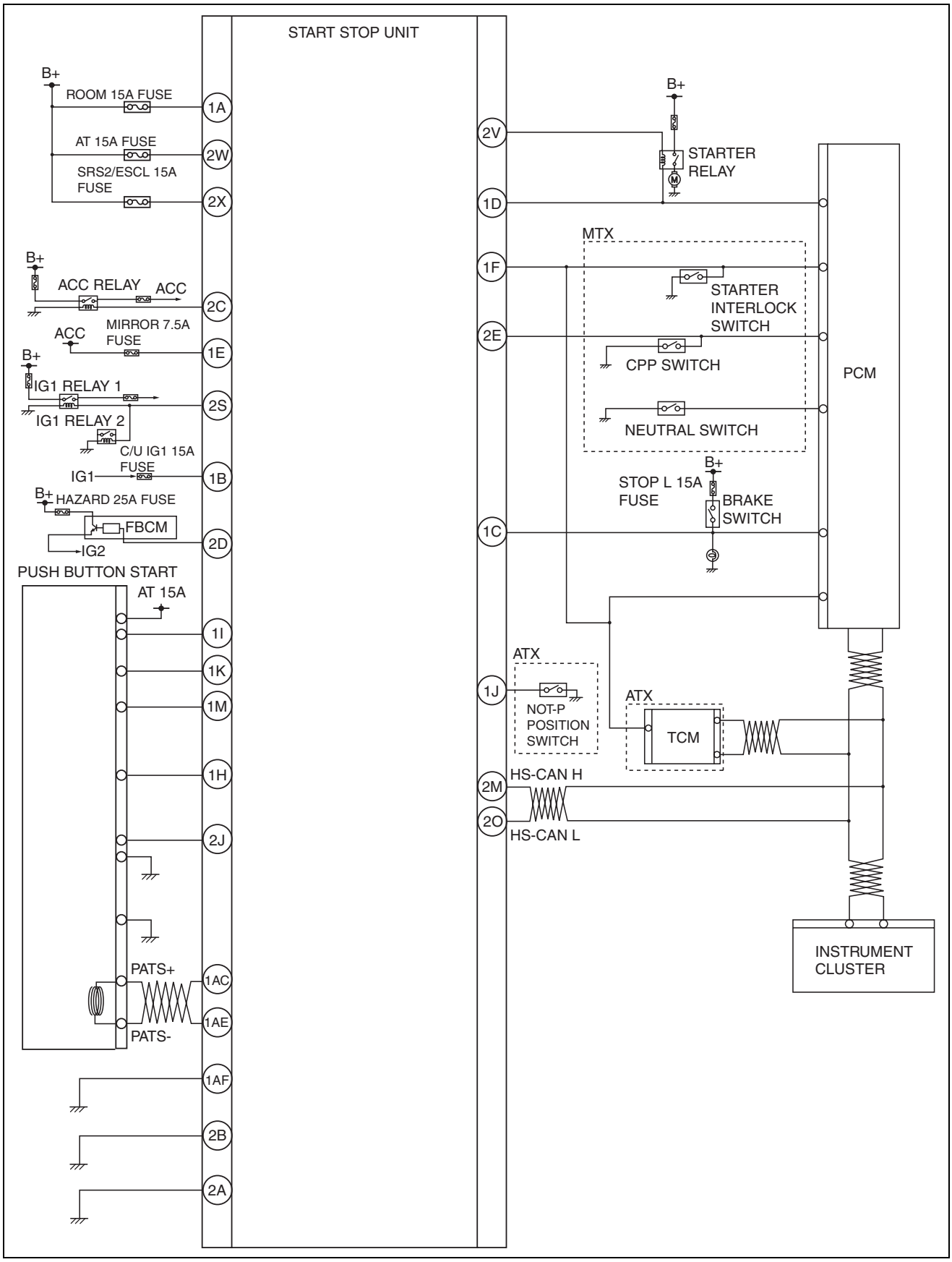
Outline
- By pressing the push button start, switching of the power supply is performed.

Function
- The start stop unit switches the power supply according to the vehicle conditions such as the selector lever (ATX)/shift lever (MTX) position and the pedal depression/release when the push button start is pressed.

Push button start indicator light
- Illuminates the push button start indicator light to notify the driver of the power supply status.

POWER SYSTEMS

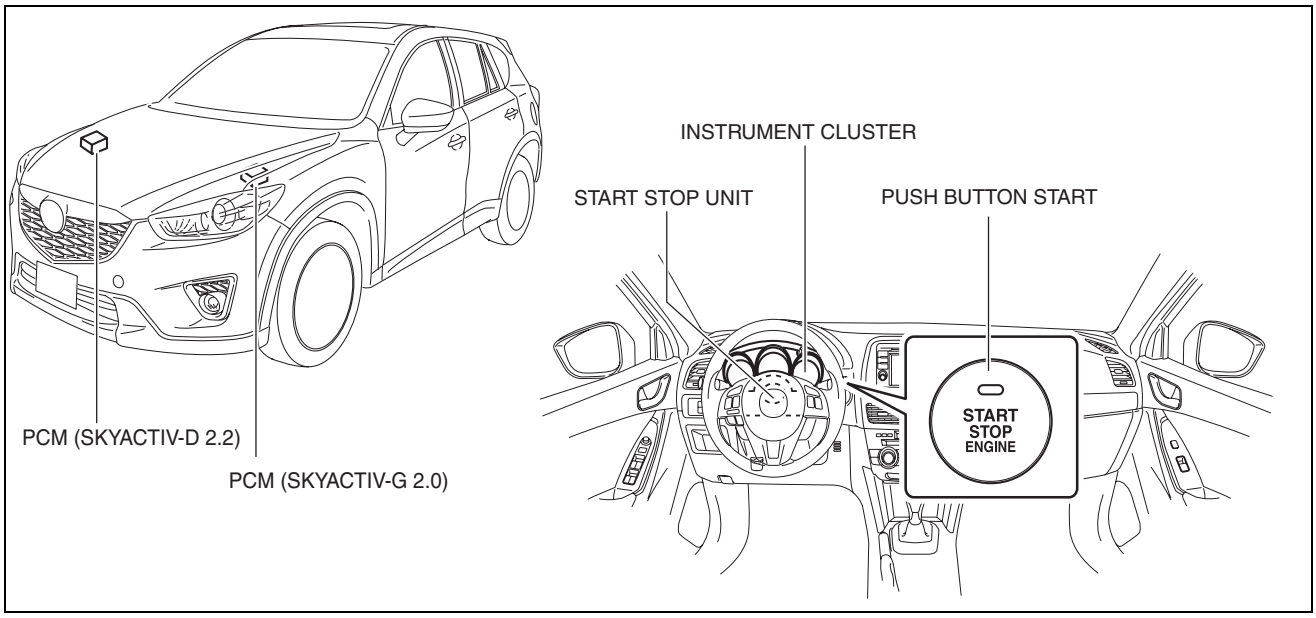
System wiring diagram



ac5wzn00001318

POWER SYSTEMS

Structural view



ac5wzn00001522

Operation

Switches between ignition switch ON (engine on)/ON (engine off)/ACC/ OFF (LOCK).

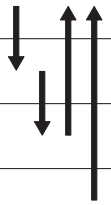
1. When the push button start is pressed, a push button start switch signal is input to the start stop unit.
2. The power supply switches according to the vehicle conditions such as the selector lever (ATX)/shift lever (MTX) position and the pedal depression/release.

Note

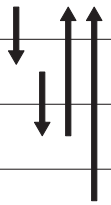
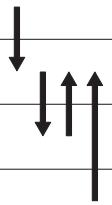
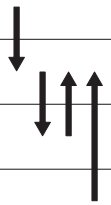
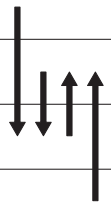
- Refer to the Push Button Start System Engine Start Permit Function regarding the engine starting conditions.

POWER SYSTEMS

MTX

IGNITION	SHIFT LEVER POSITION	
	ALL	
	CLUTCH PEDAL RELEASED	CLUTCH PEDAL DEPRESSED
OFF (LOCK)*		
ACC		
ON (ENGINE OFF)		
ON (ENGINE ON)		

ATX

IGNITION	SELECTOR LEVER POSITION					
	P		N		OTHER THAN P AND N	
	BRAKE PEDAL RELEASED	BRAKE PEDAL DEPRESSED	BRAKE PEDAL RELEASED	BRAKE PEDAL DEPRESSED	BRAKE PEDAL RELEASED	BRAKE PEDAL DEPRESSED
OFF (LOCK)*						
ACC						
ON (ENGINE OFF)						
ON (ENGINE ON)						

ac5wzn00000290

* : To switch the ignition to ACC or off (LOCK) from ON (engine on), a vehicle speed of 5 km/h {3 mph} or less is required.

Automatic ignition switch off
- If the ignition has been switched ON (engine off) or switched to ACC for 60 min or more, the start stop unit automatically switches the ignition off (LOCK).

Engine Emergency Stop
- If an ignition switch ON signal is input for 3 s or more (ignition switch held pressed), or a push button start ON signal is input 3 times within 1.5 s, the start stop unit switches the ignition to ACC or off (LOCK).

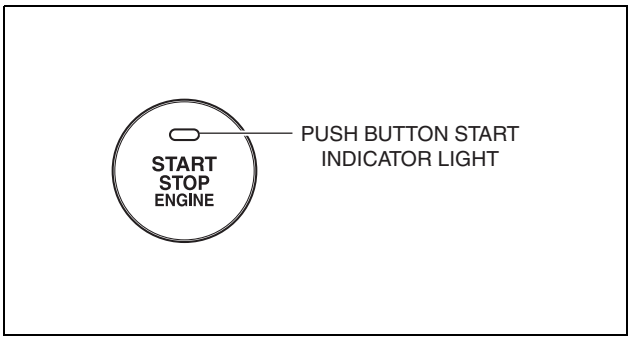
Push button start indicator light
Green illumination
- Illuminates if the conditions necessary for engine-start are met.

Green flashing
- Flashes when the steering lock cannot be released.

Amber illumination
- Illuminates when the steering lock has been released or there is a malfunction in the system.

Amber flashing
- Flashes when a malfunction is detected.

POWER SYSTEMS



ac5wzn00001237

Fail-safe
- Function not equipped.

MAIN FUSE

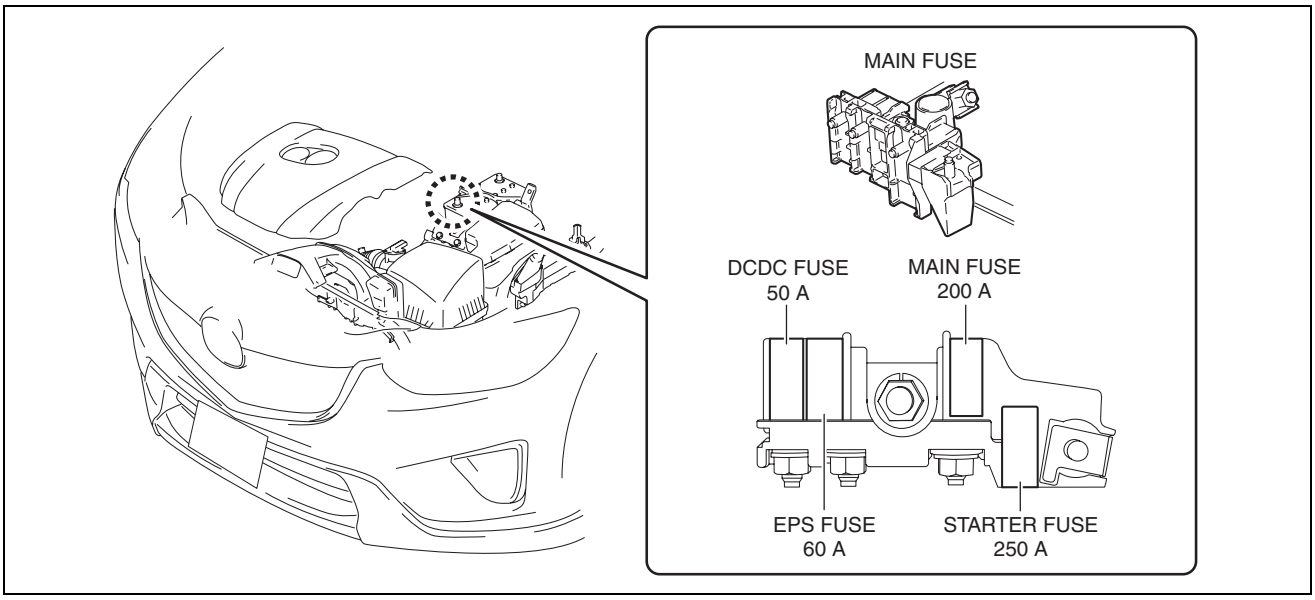
id092100800000

Purpose
- If electric current of the specified value or more flows to each fuse, the fuse melts due to heat generation to protect the systems and parts downstream of the fuse.

Function
- If electric current to each fuse is the specified value or more, the fuse melts due to heat generation.

Construction
- Installed to the battery terminal (+).

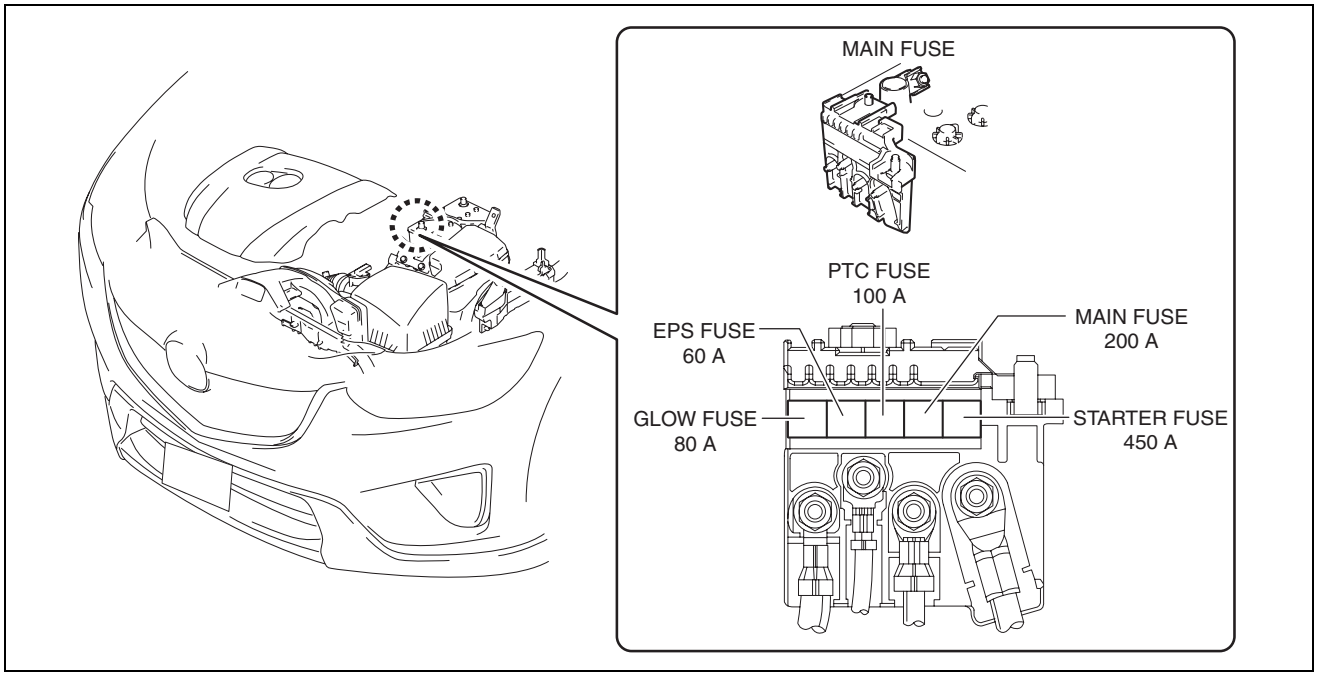
SKYACTIV-G 2.0



ac5wzn00001561

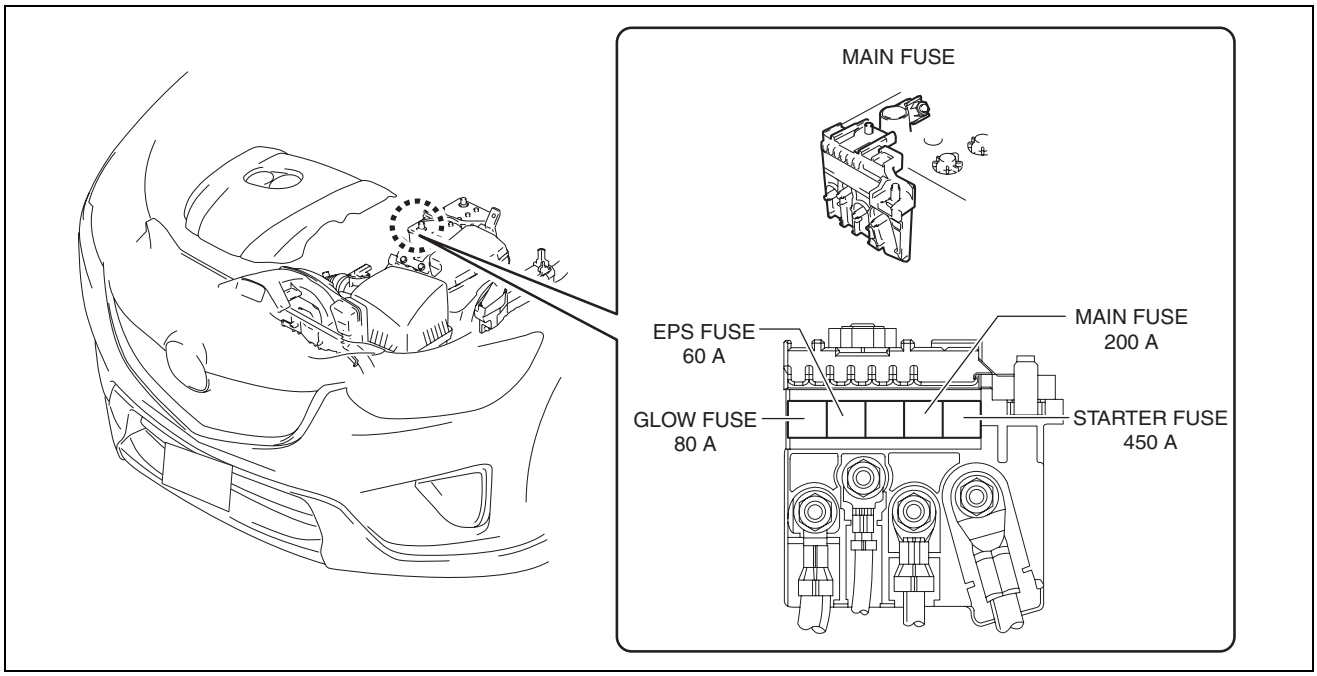
POWER SYSTEMS

SKYACTIV-D 2.2
European (L.H.D.) specs., General (L.H.D.) specs., China specs.



ac5wzn00001873

Except European (L.H.D.) specs., General (L.H.D.) specs., China specs.



ac5wzn00001872

Operation
1. If electric current to each fuse is the specified value or more, the fuse melts due to heat generation.
2. Interrupts electric current flow downstream of the fuse.

Fail-safe
- Function not equipped.

PUSH BUTTON START

id092100900200

Purpose
- By pressing the switch ON/OFF, the push button start notifies the start stop unit of the user power supply switching operation.

POWER SYSTEMS

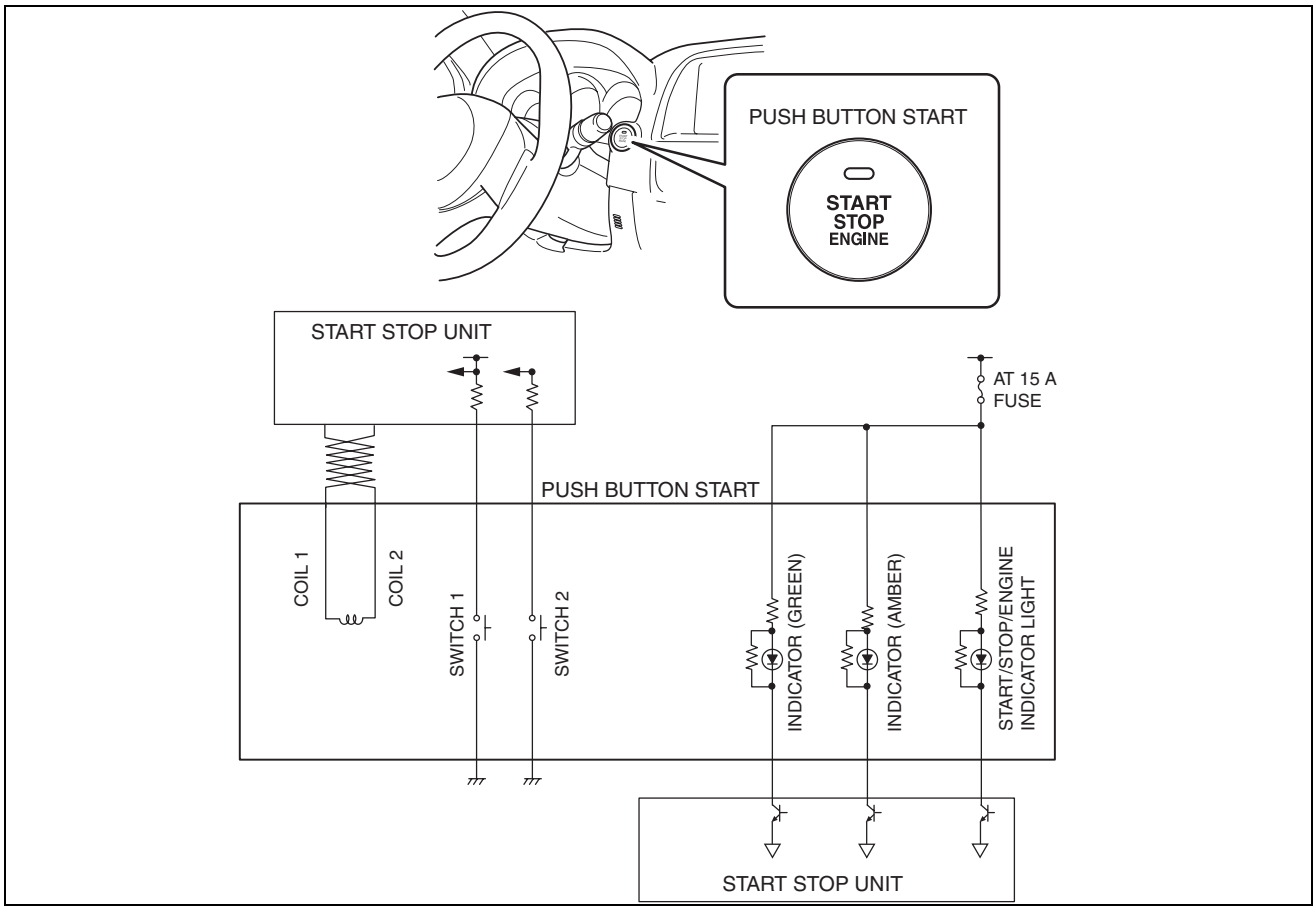
Function

START/STOP/ENGINE indicator light

- The characters in the push button start illuminate to notify the user of the button position.

Construction

- The push button start is installed in the meter hood.
- Two types of switches are integrated in the push button start.
- The push button start has the following integrated indicators. For the indicator inspection conditions, refer to the.
  - — ACC indicator
  - — ON indicator
  - — Indicator (green)
  - — Indicator (amber)
- The push button start has an integrated coil antenna for the immobilizer system. (See 09-14-72 COIL ANTENNA.)



ac5wzn00001523

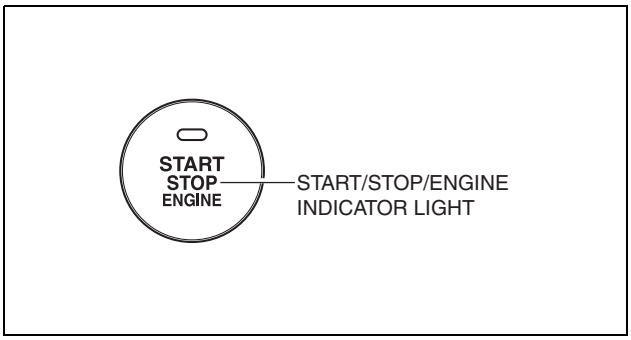
Operation

- When the push button start is pressed, switches 1 and 2 turn on (contact point: closed), and when released, it turns off (contact point: open).

START/STOP/ENGINE indicator light

- When a door is open/closed, the START/STOP/ENGINE indicator light illuminates when the headlights are turned on.

POWER SYSTEMS



ac5wzn00001087

Fail-safe
- Function not equipped.

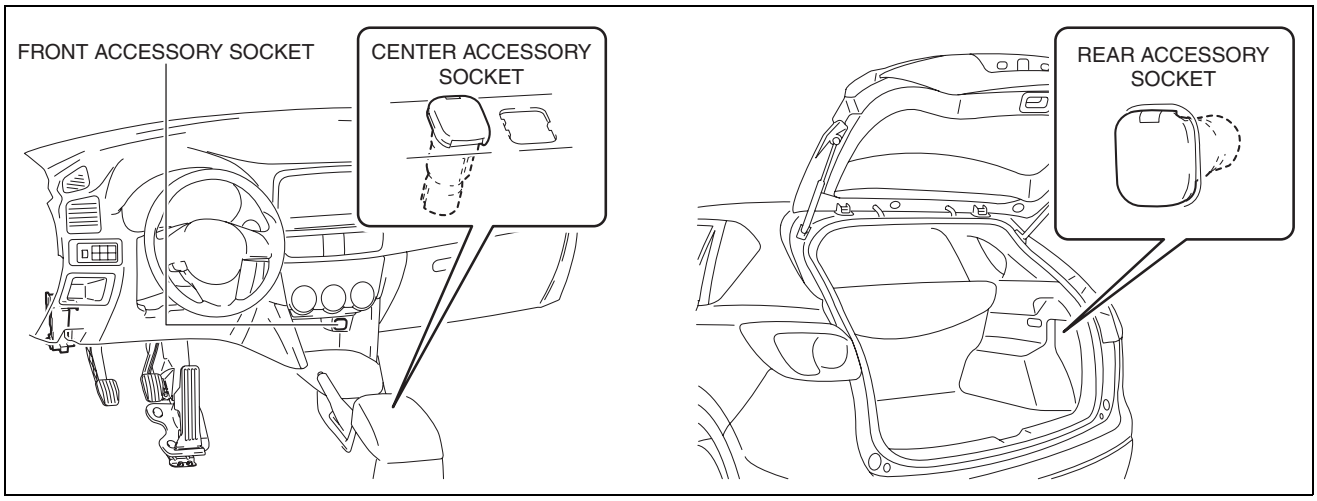
ACCESSORY SOCKET

id092100900400

Purpose
- By inserting the plug of an electrical device, 12 V (maximum 120 W) of power is supplied enabling use of the electrical device in the vehicle.

Function
- When the ignition is switched to ACC or ON (engine off or on), 12 V (maximum 120 W) of power is supplied.

Construction
- A cap is installed to prevent penetration of foreign matter in the socket such as dust.
- A front accessory socket is installed to the front console.
- A center accessory socket is installed inside the rear console.
- A rear accessory socket is installed to the trunk side trim (RH).



ac5wzn00000286

Operation
1. When the ignition is switched to ACC or ON (engine on or off), power is supplied constantly.

Fail-safe
- Function not equipped.

09-22 INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO.

id092200018200

Outline

- An LCD has been adopted to the instrument cluster which displays the ambient temperature, trip computer, and odometer/tripmeter. (Without TFT LCD)
- A TFT LCD has been adopted to the instrument cluster which displays the door-ajar warning light, trip computer, and warning messages. (With TFT LCD)
- A rear vehicle monitoring (RVM) system has been adopted which notifies the driver of vehicles approaching from behind and warns the driver if the driver tries to change lanes to the side of the approaching vehicle. (With rear vehicle monitoring (RVM) system)
- A blind spot monitoring (BSM) system has been adopted which notifies the driver of vehicles approaching from behind on the left or right adjacent lanes in the driver's blind spot, and warns the driver if the driver tries to change lanes to the side of the approaching vehicle. (With blind spot monitoring (BSM) system)
- A parking assist system has been adopted which detects obstructions in the blind spot (vehicle front/rear/corners) to a wide extent using ultrasonic sensors and notifies the driver of the obstructions. (With parking sensor system)
- A lane departure warning system (LDWS) has been adopted which recognizes vehicle lane lines on the road using the forward sensing camera (FSC) installed to the windshield and notifies the driver if the vehicle may depart from its lane unbeknownst to the driver. (With lane departure warning system (LDWS))
- A clock has been adopted to the LCD which displays the current time, passenger/rear seat belt warning light, and front passenger air bag deactivation indicator light. (With manual A/C)

INSTRUMENTATION/DRIVER INFO.

Specification

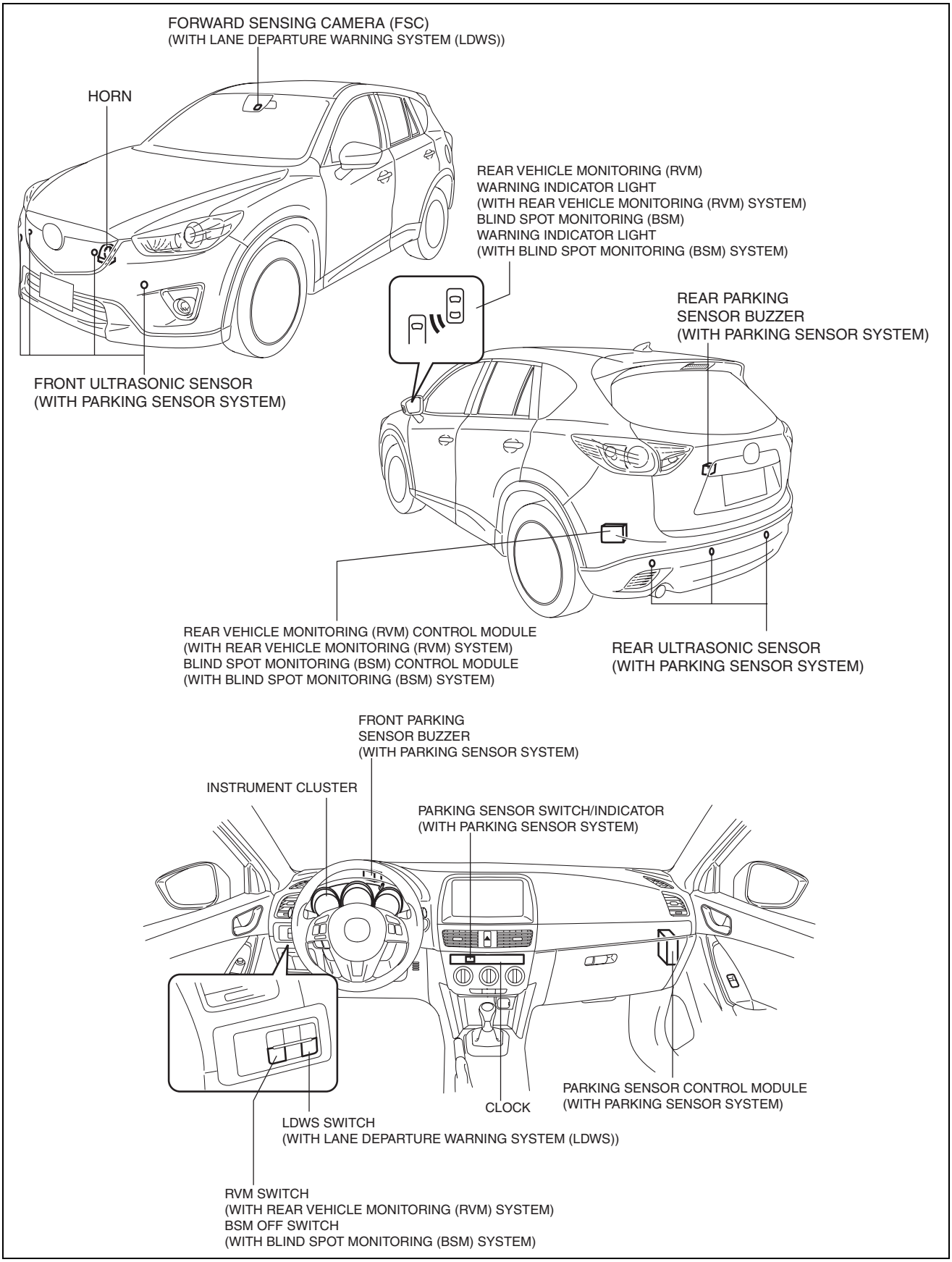
Item			Specification
Instrument cluster	Warning lights	Brightness level (cd/m^2)	200—300
		Light source	LED
	Indicator lights	Brightness level (cd/m^2)	85—135
		Light source	LED
	Warning beep	Oscillation frequency (Hz)	1,000—2,200
		Output sound pressure (dB)	46.0—72.5
	Display sound	Oscillation frequency (Hz)	1,700—1,800
		Output sound pressure (dB)	50.0—60.0
	Speedometer	System	Stepping motor type
		Display	Analog needle
		Input signal communication system	CAN system
	Tachometer	System	Stepping motor type
		Display	Analog needle
		Input signal communication system	CAN system
	Low engine coolant temperature indicator light/High engine coolant temperature warning light	Operation	(See 09-22-37 LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED).)
		Input signal communication system	CAN system

INSTRUMENTATION/DRIVER INFO.

Instrument cluster	Fuel gauge	System		LCD															
		Input signal source		Fuel gauge sender unit															
		Remaining fuel quantity (L {US gal, Imp gal}) in fuel tank	Segment indication number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			2WD	6—8 {1.6 — 2.1, 1.4— 1.7}	8— 10 {3.0 — 2.6, 2.0 — 2.1}	10 — 12 {2.7 — 3.1, 2.2 — 2.6}	12 — 14 {3.2 — 3.6, 2.7 — 3.0}	14 — 16 {3.7 — 4.2, 3.1 — 3.5}	16 — 18 {4.3 — 4.7, 3.6 — 3.9}	18 — 22 {4. 8— 5.8, 4.0 — 4.8 }	22 — 25 {5. 9— 6.6, 4.9 — 5.4 }	25 — 29 {6. 7— 7.6, 5.5 — 6.3 }	29 — 33 {7. 7— 8.7, 6.4 — 7.2 }	33 — 37 {8. 8— 9.7, 7.3 — 8.1 }	37 — 40 {9. 8— 10. 0, 8.2 — 8.7 }	40 — 44 {10 .6 — 11. 6, 8.8 — 9.6 }	44 — 48 {11 .7 — 12. 6, 9.7 — 10. 0}	48 — 56 {13 — 14, 11 — 12}
			4WD	6—8 {1.6 — 2.1, 1.4— 1.7}	8— 10 {3.0 — 2.6, 2.0 — 2.1}	10 — 12 {2.7 — 3.1, 2.2 — 2.6}	12 — 14 {3.2 — 3.6, 2.7 — 3.0}	14 — 16 {3.7 — 4.2, 3.1 — 3.5}	16 — 18 {4.3 — 4.7, 3.6 — 3.9}	18 — 22 {4. 8— 5.8, 4.0 — 4.8 }	22 — 26 {5. 9— 6.8, 4.9 — 5.7 }	26 — 30 {6. 9— 7.9, 5.8 — 6.5 }	30 — 34 {8. 0— 8.9, 6.6 — 7.4 }	34 — 38 {9. 0— 10. 0, 7.5 — 8.3 }	38 — 42 {10 .1 — 11, 8.4 — 9.2 }	42 — 46 {11 .1 — 12. 1, 9.3 — 10. 0}	46 — 50 {12 .2 — 13. 2, 10. 2— 10. 9}	50 — 58 {14 — 15, 11 — 12}
		Remaining fuel level (L {US gal, Imp gal}) when fuel tank level warning light illuminates	2WD	Approx. 10 {2.6, 2.2}														
			4WD															
		Invalid remaining fuel level. (L {US gal, Imp gal})	2WD	Approx. 1.36 {0.359, 0.299}														
			4WD	Approx. 0.45 {0.12, 0.099}														
	Odometer	System		LCD														
		Display area		0—999,999														
		Minimum display unit (km {mile})		1 {0.6}														
		Input signal communication system		CAN system														
	Tripmeter	System		LCD														
		Display area		Returns to 0.0 from 999.9, calculation continues														
		Minimum display unit (km {mile})		0.1 {0.06}														
		Input signal communication system		CAN system														
Horn	Type A	Oscillation frequency (Hz)		390—440														
		Waveform		Spiral														
	Type B	Oscillation frequency (Hz)		385—425														
		Waveform		Spiral														

INSTRUMENTATION/DRIVER INFO.

Structural view



ac5jjn00001055

INSTRUMENTATION/DRIVER INFO.

INSTRUMENTATION/DRIVER INFO. PERSONALIZATION

id092200018400

- A personalization function has been adopted with which settings for each function can be changed.

Instrument Cluster
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
Lights-on Reminder Volume.	The volume for the lights-on reminder warning alarm can be changed.	Large	Not Adopted. / OFF / Low / High	Instrument cluster
Turn Signal Volume.	The volume of the turn and hazard indicator alarm can be changed.	Large	Not Adopted. / Low / High	Instrument cluster

Using instrument cluster (with TFT LCD display)

TFT LCD display	Function	Initial setting	Setting contents	Control unit
Turn Signal	The volume of the turn and hazard indicator alarm can be changed.	High	High / Low	Instrument cluster
Light-on	The volume for the lights-on reminder warning alarm can be changed.	High	High / Low / OFF	Instrument cluster

Rear Vehicle Monitoring (RVM) System
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
RVM Volume.	The volume of the rear vehicle monitoring (RVM) warning alarm can be changed.	High	Not Adopted. / OFF / Low / High	Instrument cluster

Using instrument cluster (with TFT LCD display)

TFT LCD display	Function	Initial setting	Setting contents	Control unit
Volume	The volume of the rear vehicle monitoring (RVM) warning alarm can be changed.	High	High / Low / OFF	Instrument cluster

Blind Spot Monitoring (BSM) System

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
BSM Volume.	The volume of the blind spot monitoring (BSM) warning alarm can be changed.	High	Not Adopted. / OFF / Low / High	Instrument cluster

Lane Departure Warning System (LDWS)
Using Mazda Modular Diagnostic System (M-MDS)

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
LDWS Timing.	The warning operation timing of the lane departure warning system (LDWS) can be changed.	Adaptive	Not Adopted / Adaptive / Early / Medium / Late	Forward sensing camera (FSC)
LDWS Warning.	The warning operation sensitivity of the lane departure warning system (LDWS) can be changed.	Medium	Not Adopted. / Often / Medium / Rare	Forward sensing camera (FSC)

INSTRUMENTATION/DRIVER INFO.

Mazda Modular Diagnostic System (M-MDS) display	Function	Initial setting	Setting contents	Control unit
LDWS Volume.	The volume of the LDWS warning alarm can be changed.	Volume 3	Not Adopted. / Volume 1 / Volume 2 / Volume 3	Instrument cluster
LDWS Sound.	The type of the LDWS warning alarm can be changed.	Rumble	Beep / Rumble	Instrument cluster

Using instrument cluster (with TFT LCD display)

TFT LCD display	Function	Initial setting	Setting contents	Control unit
Timing	The warning operation timing of the lane departure warning system (LDWS) can be changed.	Adaptive	Early / Medium / Late / Adaptive	Instrument cluster
Warning	The warning operation sensitivity of the lane departure warning system (LDWS) can be changed.	Medium	Often / Medium / Rare	Instrument cluster
Sound	The type of LDWS warning alarm can be changed.	Rumble	Rumble / Beep	Instrument cluster
Volume	The volume of the LDWS warning alarm can be changed.	Low	High / Medium / Low	Instrument cluster
Volume	The high and low range of the LDWS warning alarm can be changed.	Low	High / Low	Instrument cluster

INSTRUMENT CLUSTER

id092200018500

Outline

- The instrument cluster centrally controls the speedometer, tachometer, odometer/tachometer, fuel gauge, warning/indicator lights, TFT LCD (with TFT LCD), trip computer, warning sounds and panel lights.

Function

- The instrument cluster displays the following information to notify the user of the vehicle conditions.
  - — Vehicle speed (speedometer)
  - — Engine speed (tachometer)
  - — Remaining fuel quantity (fuel gauge)
  - — Traveled distance (odometer/tripmeter)
  - — Indicator/warning lights
  - — Indicator/warning messages (with TFT LCD)
  - — Average fuel economy, average vehicle speed, instantaneous fuel economy, remaining distance to empty (trip computer)

Speedometer display function

- The instrument cluster controls the needle based on the vehicle speed signal sent via CAN transmission from the PCM, and displays the current vehicle speed. For details on the speedometer, refer to 09-22-48 SPEEDOMETER.

Tachometer display function

- The instrument cluster controls the needle based on the engine speed signal sent via CAN transmission from the PCM, and displays the current engine speed. For details on the tachometer, refer to 09-22-49 TACHOMETER.

Fuel gauge display function

- The instrument cluster displays the remaining fuel quantity based on the fuel gauge resistance signal sent via CAN transmission from the RBCM, and the fuel injection amount signal sent via CAN transmission from the PCM. For details on the fuel gauge, refer to 09-22-50 FUEL GAUGE.

INSTRUMENTATION/DRIVER INFO.

Odometer/tripmeter display function

- The instrument cluster displays the total traveled distance/traveled distance over a specific interval based on the travel distance signal sent via CAN transmission from the PCM. For details on the odometer/speedometer, refer to 09-22-52 ODOMETER/TRIPMETER.

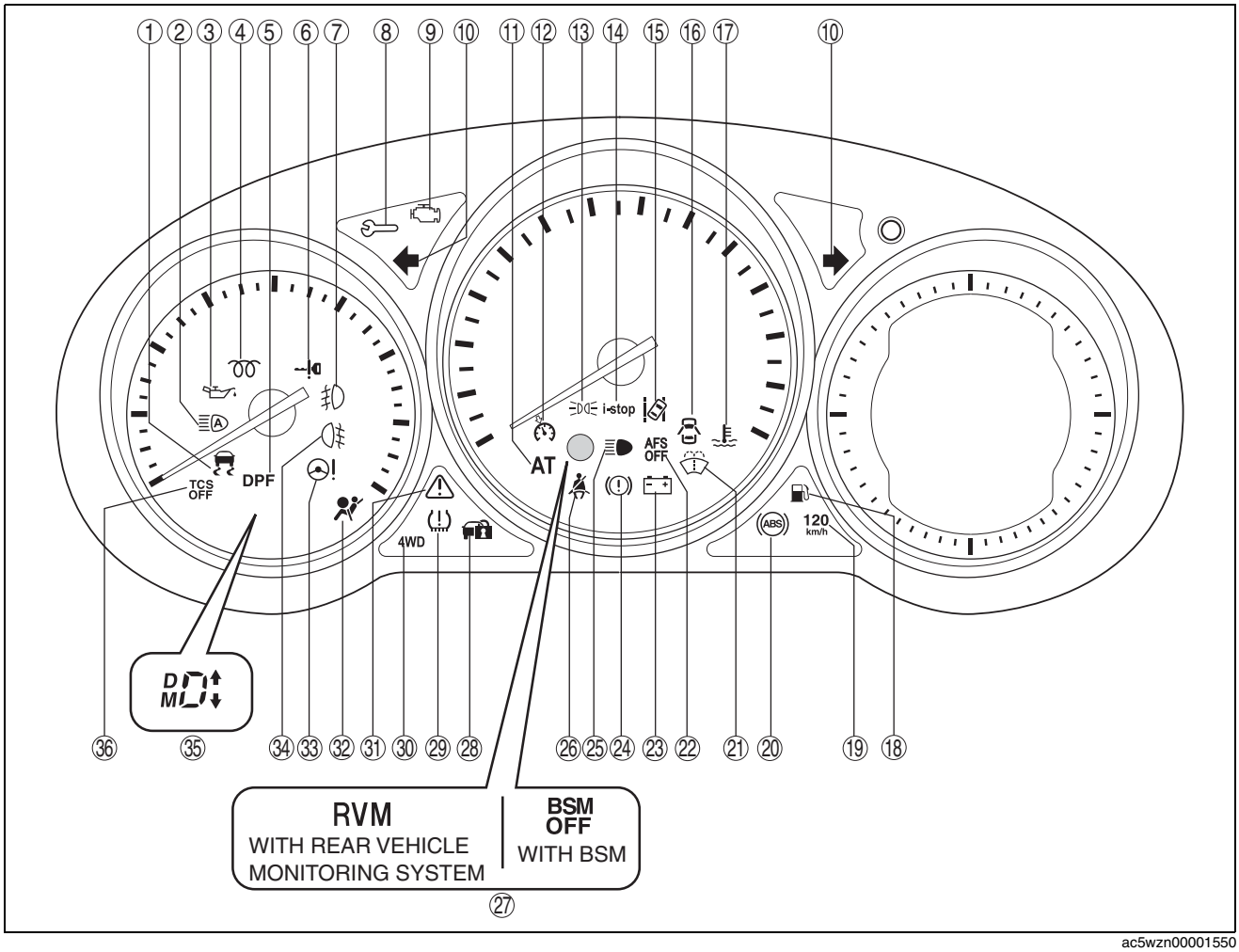
Trip computer calculation function

- The instrument cluster calculates the average fuel economy, average vehicle speed, instantaneous fuel economy, and the remaining distance to empty, and displays it on the LCD in the instrument cluster. For details on the trip computer, refer to 09-22-56 TRIP COMPUTER INFORMATION SYSTEM.

Warning/Indicator lights

- The instrument cluster illuminates/flashes the indicator/warning lights to notify the user of the vehicle system conditions.
- The types of indicator/warning lights are as follows: Refer to reference for details on each indicator/warning light.

Without TFT LCD display



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×: Applicable
—: Not applicable

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
1		TCS/DSC indicator light	—	×	(See 04-15-43 TCS/DSC INDICATOR LIGHT.)

INSTRUMENTATION/DRIVER INFO.

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
2		High beam control (HBC) system indicator light (green)/high beam control system (hbc) warning light (amber)	With High beam control (HBC) system	×	(See 09-18-60 HBC INDICATOR LIGHT (GREEN)/ HBC WARNING LIGHT (AMBER).)
3		Engine oil warning light	—	×	(See 09-22-41 ENGINE OIL WARNING LIGHT.)
4		Glow indicator light	SKYACTIV-D 2.2	×	
5	DPF	Diesel particulate filter indicator light	SKYACTIV-D 2.2	×	
6		KEY warning light (red)/indicator light (green)	—	—	(See 09-14-72 KEY WARNING LIGHT (RED)/KEY INDICATOR LIGHT (GREEN).)
7		Front fog light indicator light	With front fog light	—	(See 09-18-62 FRONT FOG LIGHTS INDICATOR LIGHT.)
8		Wrench indicator light	SKYACTIV-D 2.2	×	
9		Check engine light	—	×	(See 01-02-29 CHECK ENGINE LIGHT [SKYACTIV-G 2.0].)
10		Turn signal/hazard warning indicator lights	—	—	(See 09-18-18 TURN SIGNAL/ HAZARD WARNING INDICATOR LIGHTS.)
11	AT	Automatic transaxle warning light	ATX	×	(See 05-17A-66 AUTOMATIC TRANSAXLE WARNING LIGHT [FW6A-EL, FW6AX-EL].)
12		Cruise main indicator light (amber)/cruise set indicator light (green)	With cruise control system	×	(See 01-20A-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-G 2.0].) (See 01-20A-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].) (See 01-20B-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-D 2.2].) (See 01-20B-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-D 2.2].)

INSTRUMENTATION/DRIVER INFO.

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
13		Lights-on indicator light	—	—	(See 09-18-16 LIGHTS-ON INDICATOR LIGHT.)
14	i-stop	i-stop warning light (amber)/indicator light (green)	With i-stop system	×	(See 01-40-59 i-stop INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].) (See 01-40-65 i-stop WARNING LIGHT (AMBER) [SKYACTIV-G 2.0].)
15		Lane departure warning system (LDWS) indicator light (green)/lane departure warning system (LDWS) warning light (amber)	With LDWS	×	(See 09-22-122 LDWS INDICATOR LIGHT (GREEN)/ LDWS WARNING LIGHT (AMBER).)
16		Door-ajar warning light	—	—	(See 09-22-40 DOOR-AJAR WARNING LIGHT.)
17		Low engine coolant temperature indicator light (blue)/high engine coolant temperature warning light (red)	—	×	(See 09-22-37 LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED).)
18		Low fuel warning light	—	—	(See 09-22-45 LOW FUEL WARNING LIGHT.)
19	120 km/h	120 km/h warning light	With 120 km/h warning light	×	(See 09-22-47 120 km/h WARNING LIGHT.)
20		ABS warning light	—	×	(See 04-15-42 BRAKE SYSTEM/ ABS WARNING LIGHT.)
21		Low washer fluid level warning light	—	—	(See 09-19-55 WASHER FLUID-LEVEL SENSOR.)
22	AFS OFF	AFS OFF indicator light	With AFS	×	(See 09-18-46 AFS OFF INDICATOR LIGHT.)
23		Charging system warning light	—	×	(See 01-17A-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-G 2.0].) (See 01-17B-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-D 2.2].)

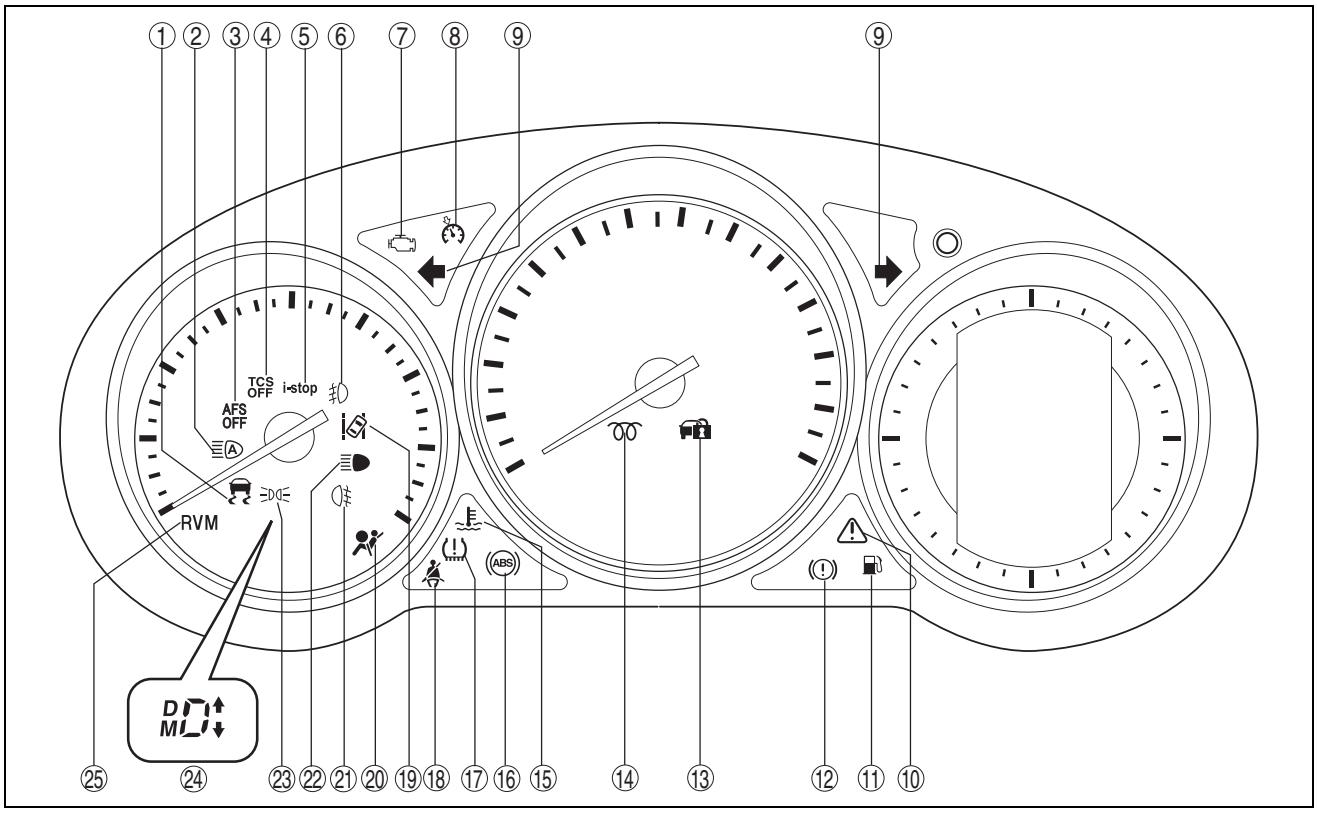
INSTRUMENTATION/DRIVER INFO.

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
24		Brake system warning light	—	×	(See 04-15-42 BRAKE SYSTEM/ ABS WARNING LIGHT.)
25		Headlight high-beam indicator light	—	—	(See 09-18-17 HEADLIGHT HIGH-BEAM INDICATOR LIGHT.)
26		Seat belt warning light	—	—	(See 09-22-42 SEAT BELT WARNING LIGHT.)
27	RVM	Rear vehicle monitoring (RVM) system warning light (amber)/indicator light (green)	With Rear Vehicle Monitoring (RVM) System	×	(See 09-22-82 REAR VEHICLE MONITORING (RVM) SYSTEM WARNING LIGHT (AMBER)/ INDICATOR LIGHT (GREEN).)
	BSM OFF	BSM OFF indicator light	With BSM	×	(See 09-22-91 BLIND SPOT MONITORING (BSM) OFF INDICATOR LIGHT.)
28		Security indicator light	With immobilizer system	×	(See 09-14-73 SECURITY INDICATOR LIGHT.)
29		Tire pressure monitoring system warning light	With TPMS	×	(See 02-12-7 TIRE PRESSURE MONITORING SYSTEM WARNING LIGHT.)
30	4WD	4WD warning light	With 4WD	×	(See 03-18-9 4WD WARNING LIGHT.)
31		Master warning light	—	×	(See 09-22-46 MASTER WARNING LIGHT.)
32		Air bag/front seat belt pretensioner system warning light	—	×	(See 08-10-7 AIR BAG SYSTEM WARNING LIGHT.)
33		Power steering malfunction indicator light	—	×	(See 06-13-16 POWER STEERING MALFUNCTION INDICATOR LIGHT.)
34		Rear fog light indicator light	With rear fog light	—	(See 09-18-79 REAR FOG LIGHT INDICATOR LIGHT.)

INSTRUMENTATION/DRIVER INFO.

No.	Warning/ Indicator lights	Name	Comment	Warning/indicator lights which illuminate during initial check	Reference
35	D M	Shift position indicator/gear position indicator	ATX	—	(See 05-17A-65 SHIFT POSITION INDICATOR LIGHT [FW6A-EL, FW6AX-EL].) (See 05-17A-65 GEAR POSITION INDICATOR [FW6A-EL, FW6AX-EL].)
		Gear shift indicator	MTX (with gear shift indicator)	—	(See 01-40-66 GEAR SHIFT INDICATOR [SKYACTIV-G 2.0].)
36	TCS OFF	TCS OFF indicator light	—	×	(See 04-15-44 TCS OFF SWITCH, TCS OFF INDICATOR LIGHT.)

With TFT LCD display



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×: Applicable

INSTRUMENTATION/DRIVER INFO.

—: Not applicable

No	Warning/ Indicator lights	Name	Messages*1	Master warning light simultaneous illumination	Comment	Warning/ indicator lights which illuminate during initial check	Reference
1		TCS/DSC indicator light	—	—	—	×	(See 04-15-43 TCS/DSC INDICATOR LIGHT.)
2		High beam control system (HBC) indicator light (green)/high beam control system (HBC) warning light (amber)	• HBC Inspection Required	×	With HBC System	×	(See 09-18-60 HBC INDICATOR LIGHT (GREEN)/ HBC WARNING LIGHT (AMBER).)
3	AFS OFF	AFS OFF indicator light	—	—	With AFS	×	(See 09-18-46 AFS OFF INDICATOR LIGHT.)
4	TCS OFF	TCS OFF indicator light	—	—	—	×	(See 04-15-44 TCS OFF SWITCH, TCS OFF INDICATOR LIGHT.)
5	i-stop	i-stop warning light (amber)/indicator light (green)	• Ready Apply more Brake Pressure • Can't be activated Turn Steering Wheel to Neutral • Can't be activatedAir Conditioninghas Priority • Can't be activated. •Steering wheel •Brake •Air Conditioning • Please Restart Engine	—	With i-stop system	×	(See 01-40-59 i-stop INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].) (See 01-40-65 i-stop WARNING LIGHT (AMBER) [SKYACTIV-G 2.0].)
6		Front Fog Light Indicator Light	—	—	With front fog light	—	(See 09-18-62 FRONT FOG LIGHTS INDICATOR LIGHT.)
7		Check engine light	• Engine Inspection Required	×	—	×	(See 01-02-29 CHECK ENGINE LIGHT [SKYACTIV-G 2.0].)

INSTRUMENTATION/DRIVER INFO.

No	Warning/ Indicator lights	Name	Messages*1	Master warning light simultaneous illumination	Comment	Warning/ indicator lights which illuminate during initial check	Reference
8		Cruise main indicator light (amber)/cruise set indicatorlight (green)	—	—	With cruise control system	×	(See 01-20A-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-G 2.0].) (See 01-20A-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].) (See 01-20B-4 CRUISE MAIN INDICATOR LIGHT (AMBER) [SKYACTIV-D 2.2].) (See 01-20B-4 CRUISE SET INDICATOR LIGHT (GREEN) [SKYACTIV-D 2.2].)
9		Turn signal/hazard warning indicator lights	—	—	—	—	(See 09-18-18 TURN SIGNAL/ HAZARD WARNING INDICATOR LIGHTS.)
10		Master warning light	• Battery Management System Inspection Required • Brake Override System Inspection Required • Vehicle System Inspection Required • FSC Inspection Required • SCBS Inspection Required	—	—	×	(See 09-22-46 MASTER WARNING LIGHT.)
11		Low fuel warning light	• Refill Fuel Tank	×	—	—	(See 09-22-45 LOW FUEL WARNING LIGHT.)
12		Brake system warning light	• Brake Fluid Level Low • Release Parking Brake • Brake Inspection Required	×	—	×	(See 04-15-42 BRAKE SYSTEM/ABS WARNING LIGHT.)

INSTRUMENTATION/DRIVER INFO.

No	Warning/ Indicator lights	Name	Messages*1	Master warning light simultaneous illumination	Comment	Warning/ indicator lights which illuminate during initial check	Reference
13		Security indicator light	—	—	—	×	(See 09-14-73 SECURITY INDICATOR LIGHT.)
14		Glow indicator light	—	—	SKYACTIV-D 2.2	×	
15		Low engine coolant temperature indicator light (blue)/high engine coolant temperature warning light (red)	• Engine Coolant Temperature High • Stop Vehicleat safe area	×	—	×	(See 09-22-37 LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED).)
16		ABS warning light	—	—	—	×	(See 04-15-42 BRAKE SYSTEM/ABS WARNING LIGHT.)
17		Tire pressure monitoring system warning light	• Check Tyre Pressure • TPMS Inspection Required • Tyre Pressure Monitor Initialized	×	With TPMS	×	(See 02-12-7 TIRE PRESSURE MONITORING SYSTEM WARNING LIGHT.)
18		Seat belt warning light	—	—	—	—	(See 09-22-42 SEAT BELT WARNING LIGHT.)
19		Lane departure warning system (LDWS) indicator light (green)/warning light (amber)	• LDWS Inspection Required	×	With LDWS	×	(See 09-22-122 LDWS INDICATOR LIGHT (GREEN)/ LDWS WARNING LIGHT (AMBER).)
20		Air bag/front seat belt pretensioner system warning light	—	—	—	×	(See 08-10-7 AIR BAG SYSTEM WARNING LIGHT.)
21		Rear fog light indicator light	—	—	With rear fog light	—	(See 09-18-79 REAR FOG LIGHT INDICATOR LIGHT.)
22		Headlight high-beam indicator light	—	—	—	—	(See 09-18-17 HEADLIGHT HIGH-BEAM INDICATOR LIGHT.)

INSTRUMENTATION/DRIVER INFO.

No	Warning/ Indicator lights	Name	Messages*1	Master warning light simultaneous illumination	Comment	Warning/ indicator lights which illuminate during initial check	Reference
23		Lights-on indicator light	• Headlights On	×	—	—	(See 09-18-16 LIGHTS-ON INDICATOR LIGHT.)
24		Shift position indicator/ gear position indicator	—	—	ATX	—	(See 05-17A-65 SHIFT POSITION INDICATOR LIGHT [FW6A-EL, FW6AX-EL].) (See 05-17A-65 GEAR POSITION INDICATOR [FW6A-EL, FW6AX-EL].)
		Gear shift indicator	—	—	MTX (with gear shift indicator)	—	(See 01-40-66 GEAR SHIFT INDICATOR [SKYACTIV-G 2.0].)
25	RVM	Rear vehicle monitoring (RVM) system warning light (amber)/indicator light (green)	—	—	With rear vehicle monitoring (RVM) system	×	(See 09-22-82 REAR VEHICLE MONITORING (RVM) SYSTEM WARNING LIGHT (AMBER)/ INDICATOR LIGHT (GREEN).)

*1 : For the system without the warning light/indicator light, refer to the message in the 09-22-61 LIQUID CRYSTAL DISPLAY (LCD).

Alarm operation function

- The instrument cluster sounds the alarm using the buzzer built into the instrument cluster to notify the user of the vehicle conditions.
- The alarm types are as follows: Refer to reference for details on each alarm.

Name	Reference
Lights-on reminder warning alarm	(See 09-22-24 LIGHTS-ON REMINDER WARNING ALARM.)
Seat belt warning alarm	(See 09-22-25 SEAT BELT WARNING ALARM.)
Air bag system warning alarm	(See 09-22-27 AIR BAG SYSTEM WARNING ALARM.)
Keyless warning alarm	(See 09-22-28 KEYLESS WARNING ALARM.)
Tire pressure warning alarm (with TPMS)	(See 09-22-30 TIRE PRESSURE WARNING ALARM.)
Ambient temperature warning alarm	(See 09-22-31 AMBIENT TEMPERATURE WARNING ALARM.)
Panel light control indicator alarm	(See 09-22-34 PANEL LIGHT CONTROL INDICATOR ALARM.)
Turn and hazard indicator alarm	(See 09-22-35 TURN AND HAZARD INDICATOR ALARM.)
Vehicle speed alarm (with vehicle speed alarm)	(See 09-22-56 TRIP COMPUTER INFORMATION SYSTEM.)
Panel light control indicator alarm	(See 09-22-34 PANEL LIGHT CONTROL INDICATOR ALARM.)

INSTRUMENTATION/DRIVER INFO.

Name	Reference
Turn and hazard indicator alarm	(See 09-22-35 TURN AND HAZARD INDICATOR ALARM.)
Rear vehicle monitoring (RVM) warning alarm (with rear vehicle monitoring (RVM) system)	(See 09-22-84 RVM WARNING ALARM.)
Blind spot monitoring (BSM) warning alarm (with BSM system)	(See 09-22-93 BLIND SPOT MONITORING (BSM) WARNING ALARM.)
i-stop warning alarm (with i-stop system)	(See 09-22-33 i-stop WARNING ALARM.)
LDWS warning alarm (with lane departure warning system (LDWS))	(See 09-22-121 LDWS WARNING ALARM.)
120 km/h warning alarm (with 120 km/h warning alarm)	(See 09-22-36 120 km/h WARNING ALARM.)

- If several alarm request signals are received simultaneously, the alarms sound according to the order of precedence in the following table.

Ignition is switched OFF (LOCK)

Order or precedence	Name
1	Keyless warning alarm (pattern A)
2	Lights-on reminder warning alarm
3	Keyless warning alarm (pattern B, C)
4	Turn and hazard indicator alarm
5	Panel light control indicator alarm

Ignition switch ON (engine off or on)

Order or precedence	Name
1	120 km/h warning alarm (with 120 km/h warning alarm)
2	i-stop warning alarm (with i-stop system)
3	Seat belt warning alarm (Driver/passenger)
4	Seat belt warning alarm (Rear) (with rear seat belt warning alarm)
5	Tire pressure warning alarm (Tire pressure monitoring system initialization) (with TPMS)
6	Tire pressure warning alarm (Tire pressure monitoring system operating) (with TPMS)
7	Rear vehicle monitoring (RVM) warning alarm (with rear vehicle monitoring (RVM) system)
	Blind spot monitoring (BSM) warning alarm (with BSM system)
8	LDWS warning alarm (with lane departure warning system (LDWS))
9	Keyless warning alarm
10	Air bag system warning alarm
11	Ambient temperature warning alarm
12	Vehicle speed alarm (with vehicle speed alarm)
13	Turn and hazard indicator alarm
14	Panel light control indicator alarm

Panel light control function

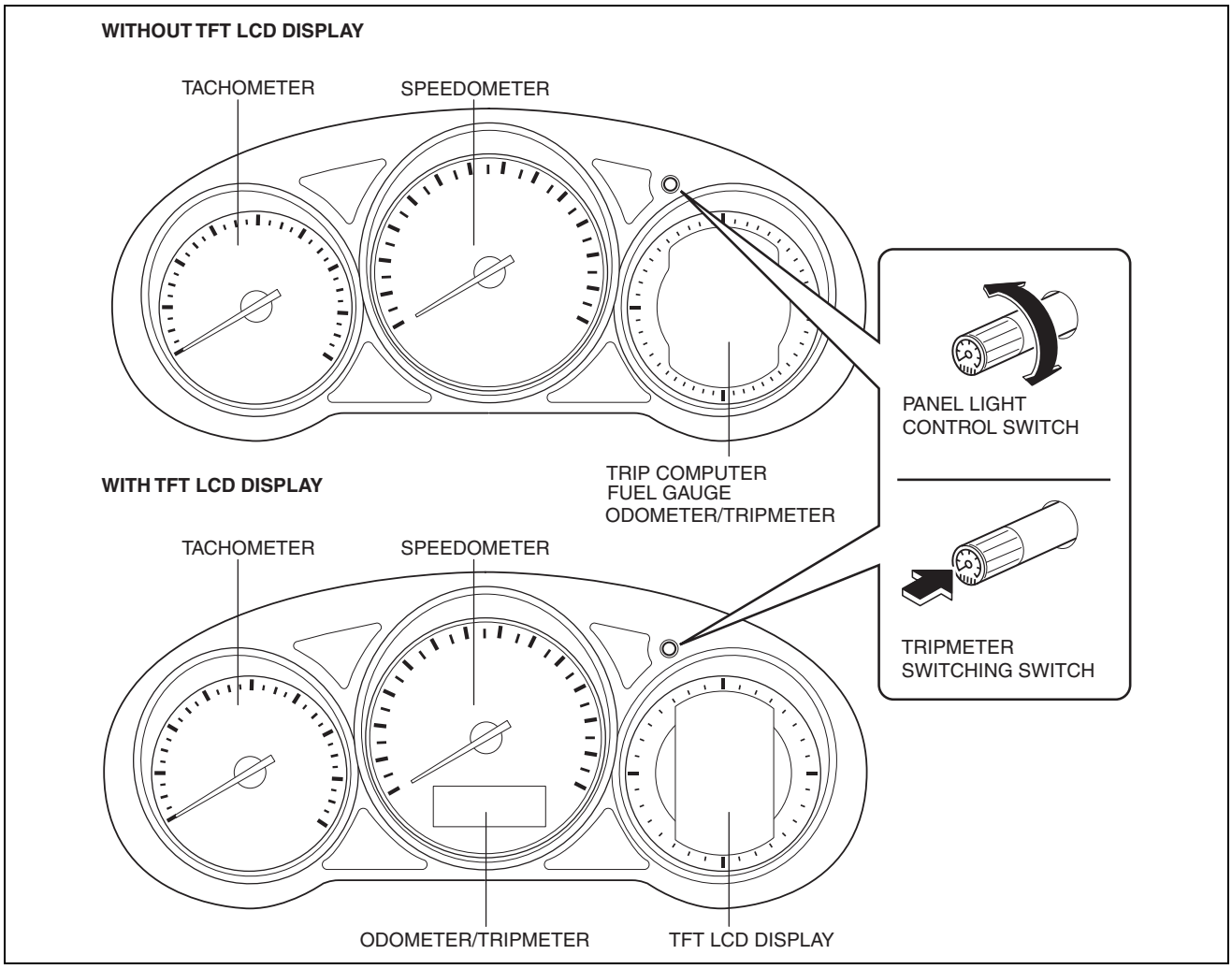
- The instrument cluster changes the panel light brightness according to the ignition switch being turned ON (engine off or on) or the TNS being illuminated. For details on the panel light, refer to 09-22-53 PANEL LIGHT.

Vehicle specification information transmission function

- The instrument cluster sends vehicle specification information stored during configuration to the following modules via CAN transmission. The following modules perform configuration automatically by reading the vehicle specification information from the instrument cluster.
  - — DSC HU/CU
  - — EPS control module
  - — AFS control module (with AFS)
  - — LASER SENSOR (with smart city brake support (SCBS))

INSTRUMENTATION/DRIVER INFO.

Structural View



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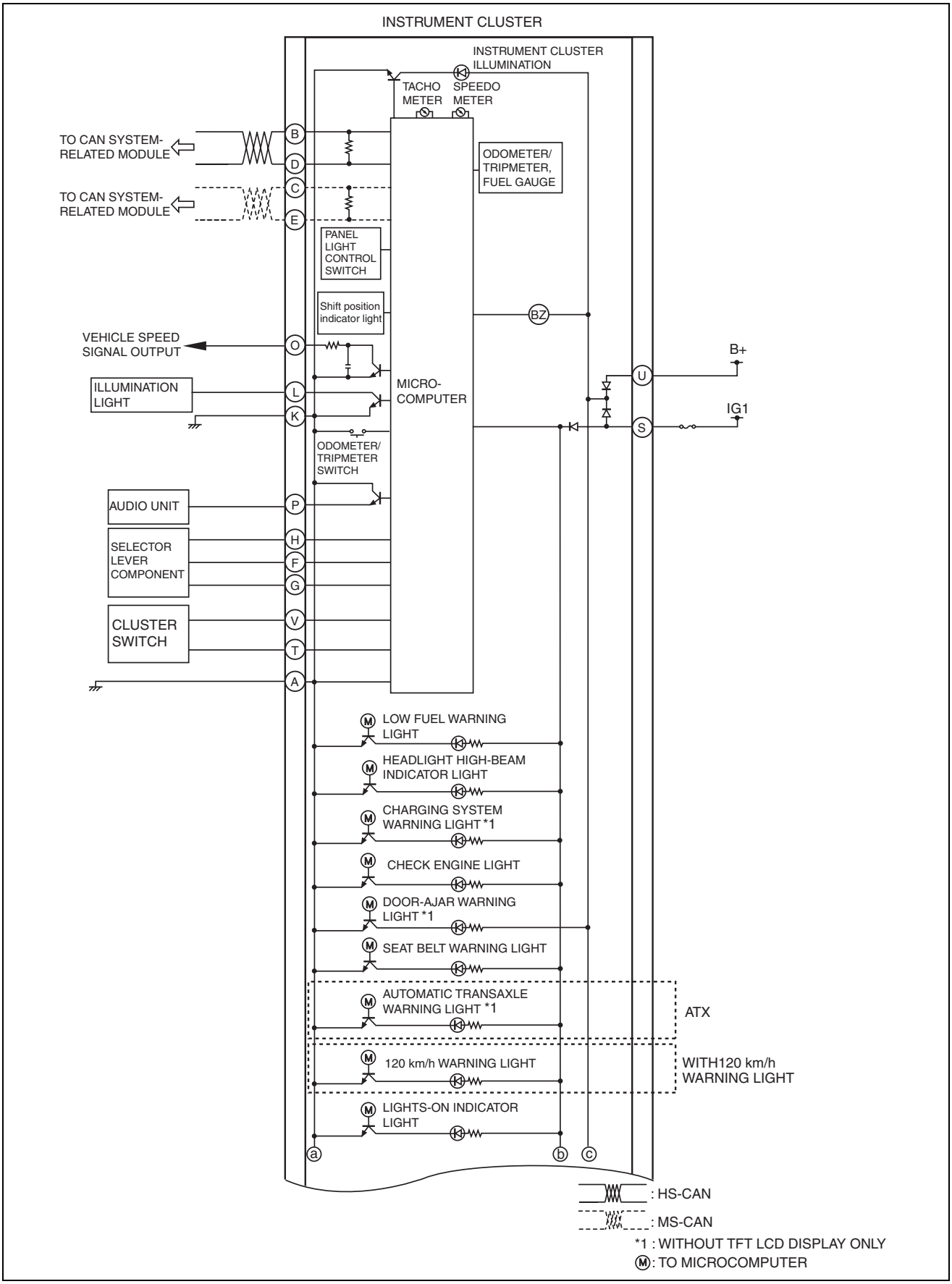
INSTRUMENTATION/DRIVER INFO.

System Wiring Diagram



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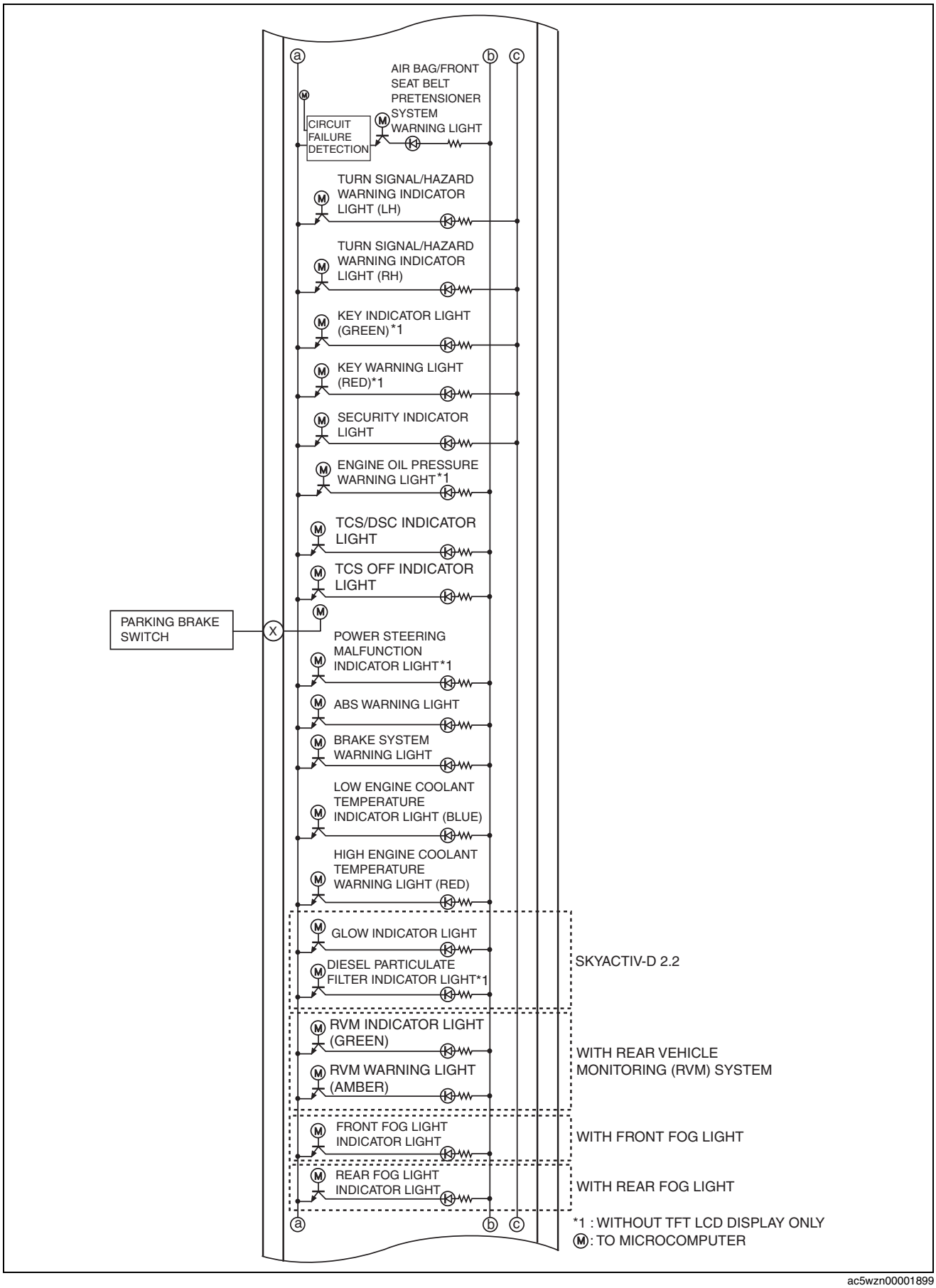
INSTRUMENTATION/DRIVER INFO.



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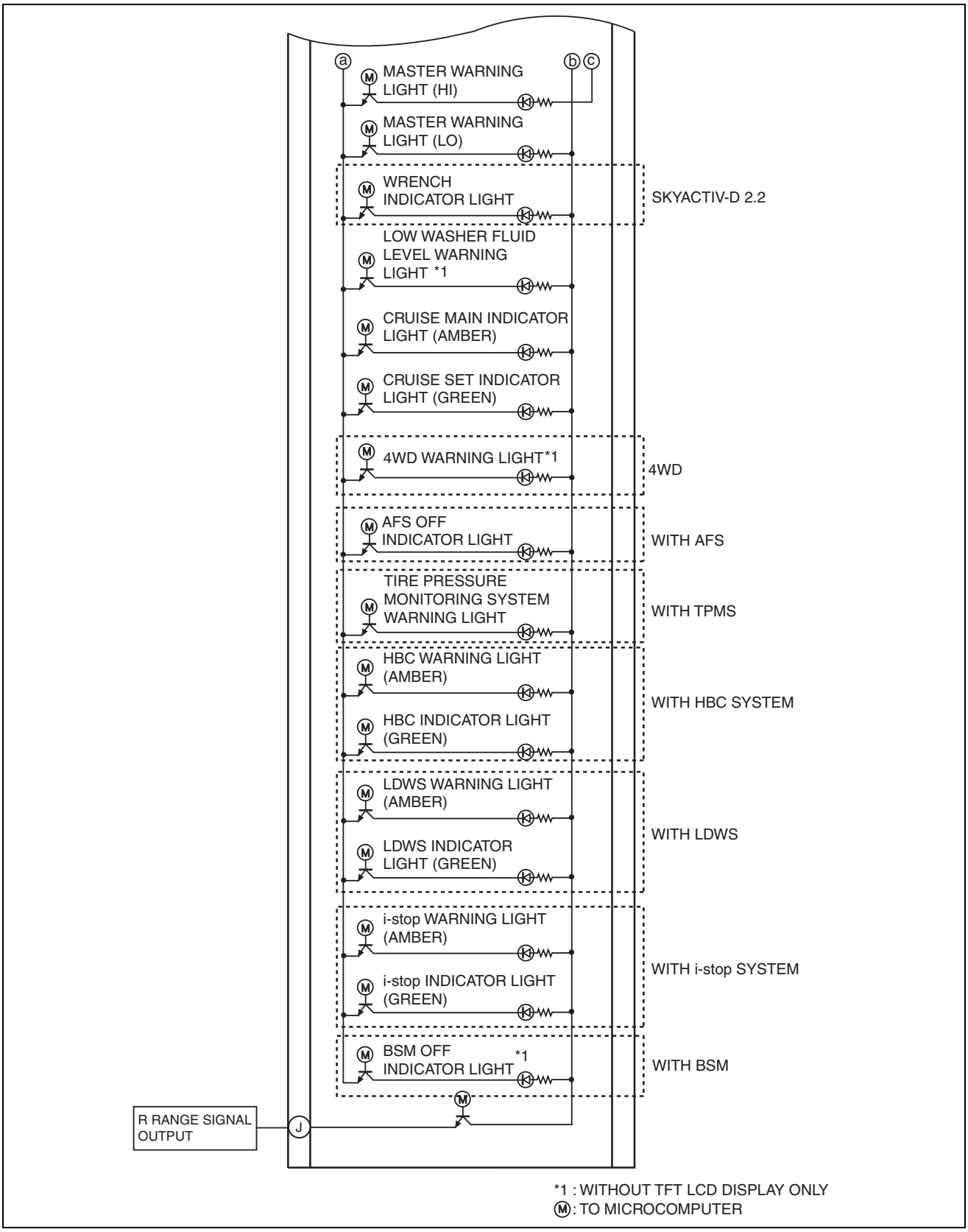

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Fail-safe
Speedometer

- If the CAN signal cannot be received normally, the instrument cluster displays the 0 mark.

INSTRUMENTATION/DRIVER INFO.

Tachometer
- If the CAN signal cannot be received normally, the instrument cluster displays the 0 mark.

Fuel gauge
- If the CAN signal cannot be received normally, the instrument cluster turns off one segment at regular time intervals since the segments calculated based on the signal last received are displayed.

Odometer/tripmeter
- Function not equipped.

Warning lights
- If the CAN signal cannot be received normally, the instrument cluster turns the warning light on.

Indicator lights
- If the CAN signal cannot be received normally, the instrument cluster turns the indicator light off.

Alarm
- If the CAN signal cannot be received normally, the instrument cluster stops the alarm.

Panel light
- If the CAN signal cannot be received normally, the instrument cluster turns the panel light on.

Trip computer information system
- If the CAN signal cannot be received normally, the instrument cluster displays the "— —".

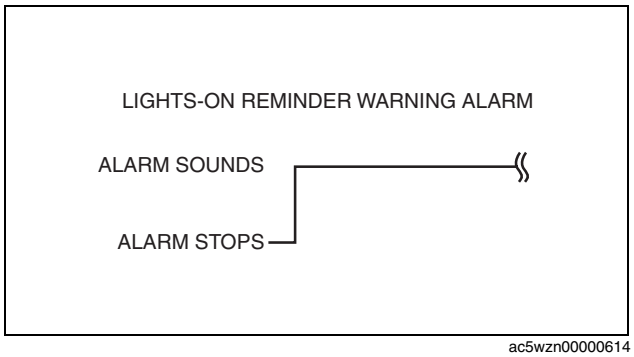
Ambient temperature display
- If the CAN signal cannot be received normally, the instrument cluster displays the "— —" and does not display the ice mark.

LIGHTS-ON REMINDER WARNING ALARM

id092200019200

Purpose
- The lights-on reminder warning alarm notifies the driver that the TNS and headlights are not turned off.

Function
- The instrument cluster receives the following vehicle condition signals via the CAN signal from the start stop unit and rear body control module (RBCM).
  - — TNS switch ON signal from start stop unit (TNS and headlights illuminate)
  - — Driver's front door latch switch ON signal from rear body control module (RBCM)
- If the ignition is switched to OFF or ACC when all the above vehicle condition signals are received, the instrument cluster operates the lights-on reminder alarm.
- The lights-on reminder warning alarm sound pattern is as shown in the figure.



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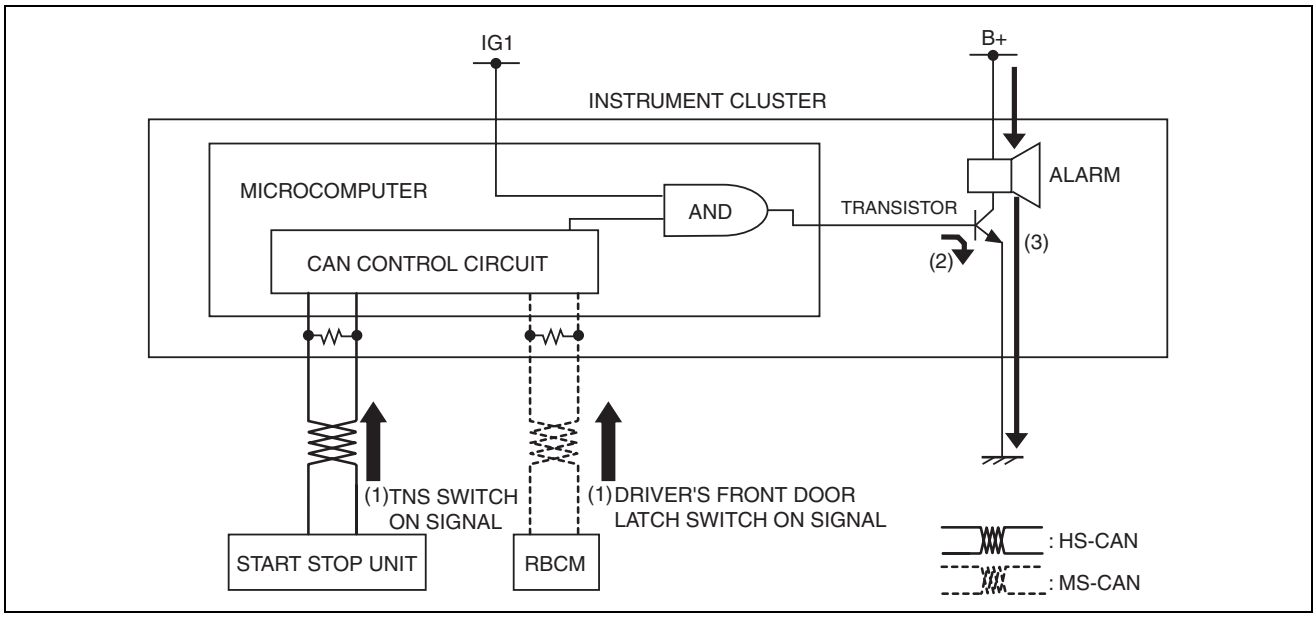
Construction
- The lights-on reminder warning alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the TNS switch ON signal from the start stop unit and driver's front door latch switch ON signal from the rear body control module (RBCM).
2. When the ignition is switched to OFF or ACC while each signal is received, the instrument cluster turns on (2) the transistor.
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



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Fail-safe
- Function not equipped.

SEAT BELT WARNING ALARM

id092200019600

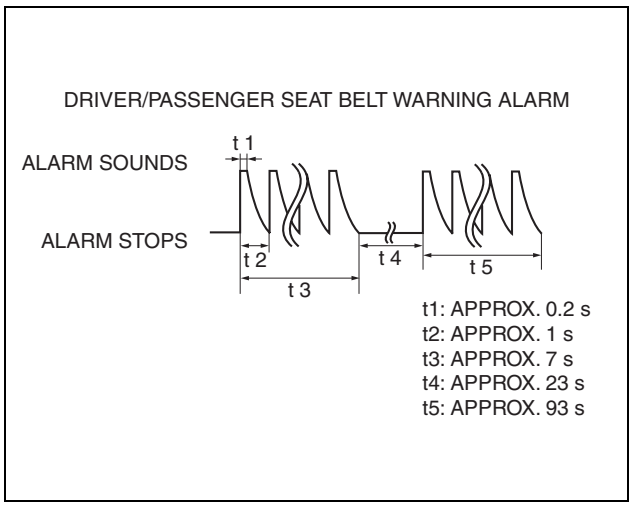
Purpose
- The seat belt warning alarm warns occupants that a seat belt is not fastened.

Function
- The instrument cluster sounds the seat belt warning alarm based on the following CAN signals:
  - — Vehicle speed signal sent from PCM
  - — Driver/passenger buckle switch signal, occupancy sensor signal sent from SAS control module
  - — Rear seat buckle switch signal sent from rear body control module (RBCM)

Driver/Passenger seat belt warning alarm sound function
- The driver/passenger seat belt warning alarm has an initial warning and subsequent warning.

Initial warning
- When all of the following conditions are met, the alarm sounds.
  - — Vehicle speed is approx. 20 km/h {12 mph} or more
  - — Driver/passenger buckle switch on signal (seat belt unfastened) is detected
  - — Occupancy sensor on signal (occupant in passenger seat) is detected (passenger seat belt warning light only)
- The driver/passenger seat belt warning alarm sound pattern is as shown in the figure.

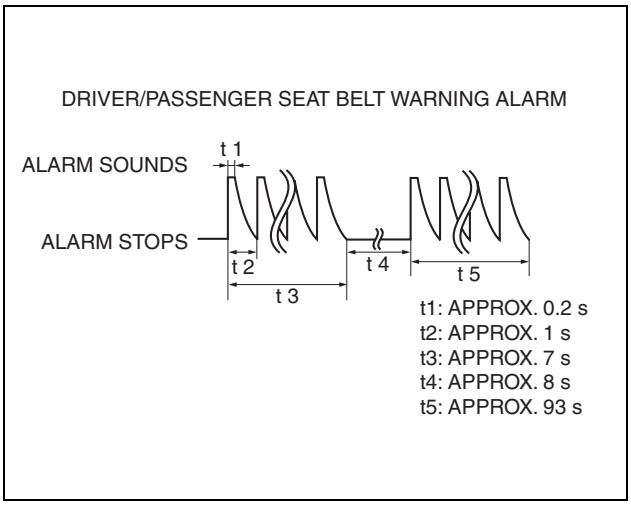
Subsequent warning
- When all of the following conditions are met, the alarm sounds.
  - — Vehicle speed is approx. 20 km/h {12 mph} or more
  - — Occupancy sensor on signal (occupant in passenger seat) detected (passenger seat belt warning light only)
  - — After initial warning, buckle switch off signal (seat belt fastened) to on signal (seat belt unfastened) is detected



ac5wzn00000932

INSTRUMENTATION/DRIVER INFO.

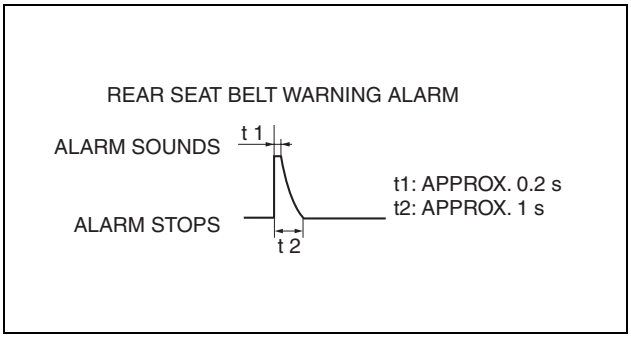
- The driver/passenger seat belt warning alarm sound pattern is as shown in the figure.



ac5wzn00000933

Rear seat belt warning alarm sound function (with rear seat belt warning alarm)

- When all of the following conditions are met, the alarm sounds.
  - — Ignition switch ON (engine off or on)
  - — Rear seat buckle switch off signal (seat belt fastened) to on signal (seat belt unfastened) is detected
- The rear seat belt warning alarm sound pattern is as shown in the figure.



ac5wzn00000934

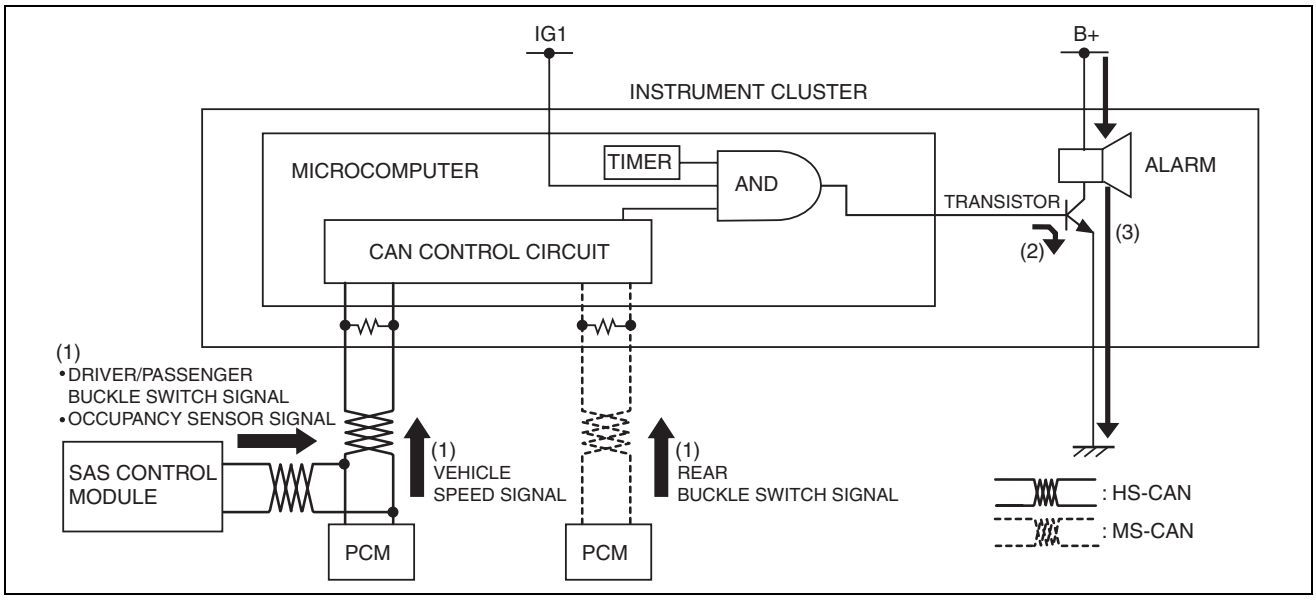
Construction

- The seat belt warning alarm sounds using the buzzer built into the instrument cluster.

Operation

1. The instrument cluster receives (1) the vehicle speed signal from the PCM, the driver/passenger buckle switch signal and occupancy sensor signal from the SAS control module, and the rear seat buckle switch signal from the rear body control module (RBCM) when the ignition is switched ON (engine off or on).
2. The instrument cluster microcomputer turns the transistor on (2) based on each signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000935

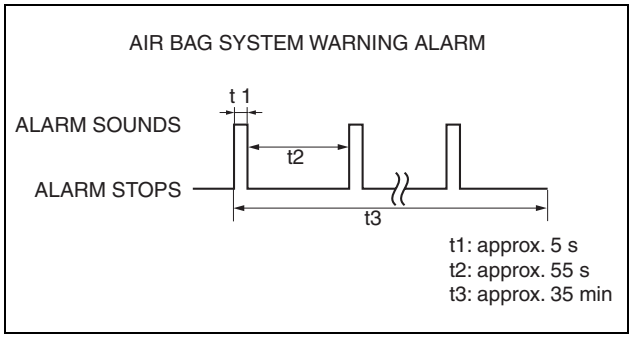
Fail-safe
- Function not equipped.

AIR BAG SYSTEM WARNING ALARM

id092200019800

Purpose
- The air bag system warning alarm notifies the driver of an air bag system malfunction.

Function
- When the instrument cluster receives the air bag system warning alarm request signal sent from the SAS control module via the CAN signal, the air bag system warning alarm sounds.
- The air bag system warning alarm sound pattern is as shown in the figure.

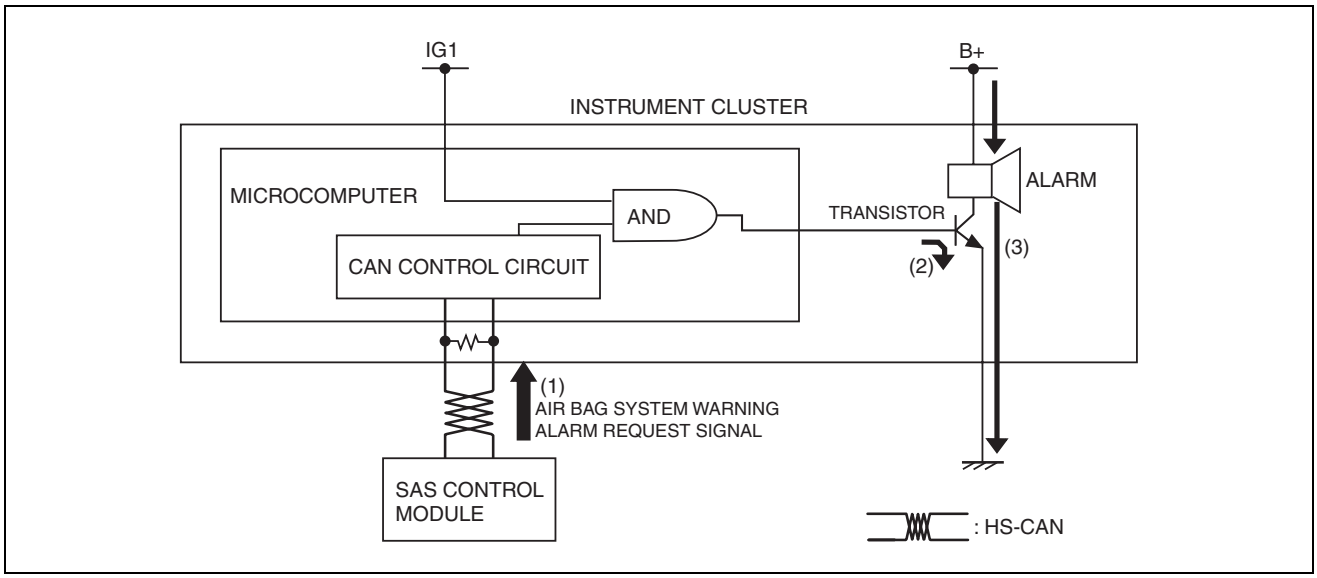


ac5wzn00000618

Construction
- The air bag system warning alarm sounds using the buzzer built into the instrument cluster.

Operation
1. When the ignition is switched ON (while engine is stopped or running), the instrument cluster receives (1) the air bag system warning alarm request signal from the SAS control module.
2. The instrument cluster microcomputer turns the transistor on (2) based on the air bag system warning alarm request signal.
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000619

Fail-safe
- Function not equipped.

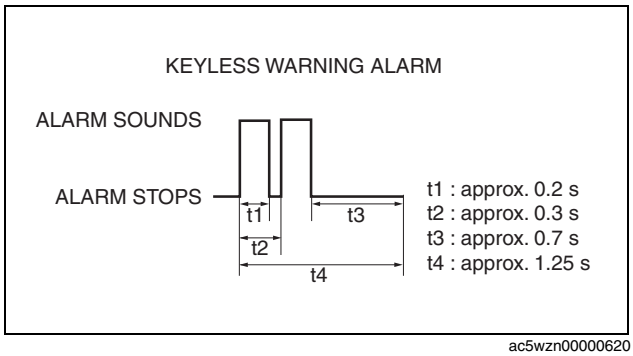
KEYLESS WARNING ALARM

id092200031400

Purpose
- The keyless warning alarm notifies the driver that the remote transmitter cannot be verified or the steering lock cannot be released.

Function
- When the instrument cluster receives the keyless warning alarm request signal sent from the start stop unit via the CAN signal, the keyless warning alarm sounds.
- The keyless warning alarm sound pattern is as follows: For the conditions that the alarm for each pattern sounds, refer to 09-14-32 KEYLESS ENTRY SYSTEM (without advanced keyless entry system)/09-14-37 ADVANCED KEYLESS ENTRY SYSTEM (with advanced keyless entry system).

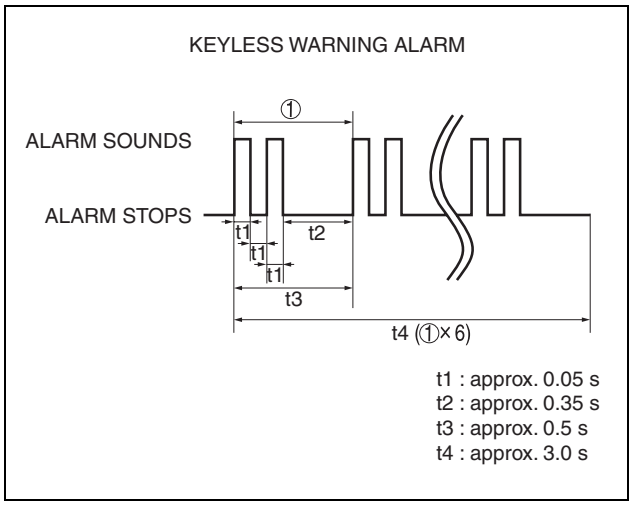
Pattern A



ac5wzn00000620

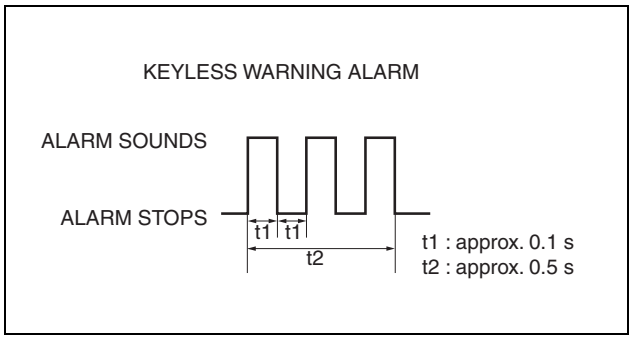
INSTRUMENTATION/DRIVER INFO.

Pattern B



ac5wzn00000621

Pattern C



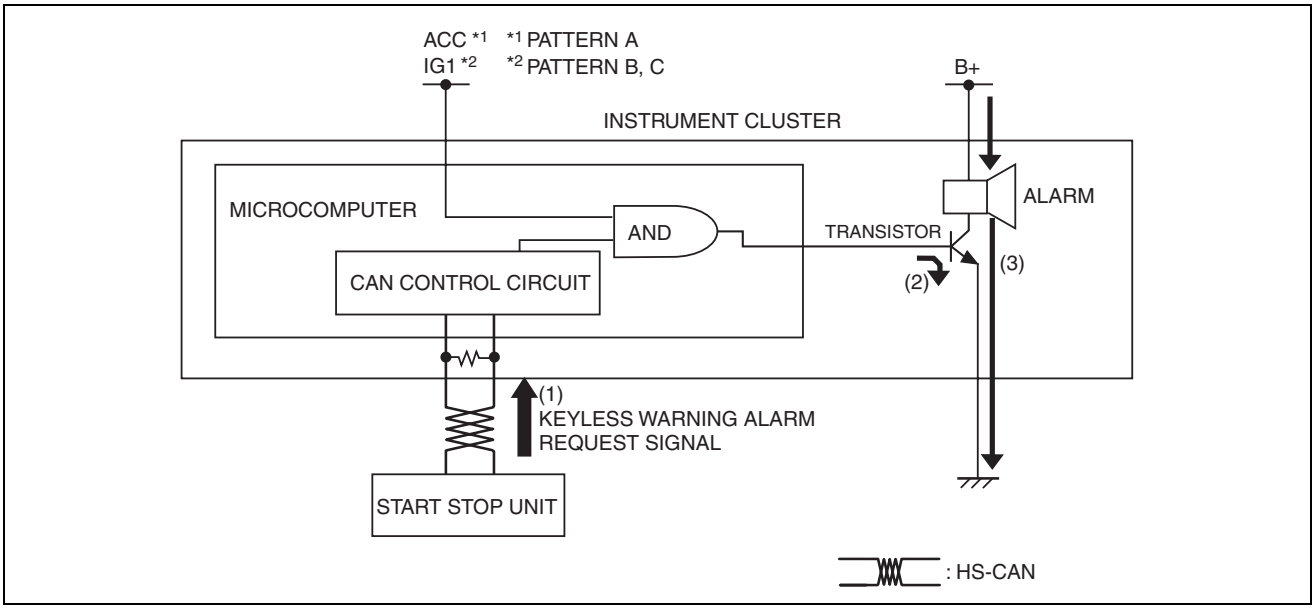
ac5wzn00000622

Construction

- The keyless warning alarm sounds using the buzzer built into the instrument cluster.

Operation

1. The instrument cluster receives (1) the keyless warning alarm request signal from the start stop unit.
2. The instrument cluster microcomputer turns the transistor on (2) based on the keyless warning alarm request signal.
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).



ac5wzn00000623

INSTRUMENTATION/DRIVER INFO.

Fail-safe
- Function not equipped.

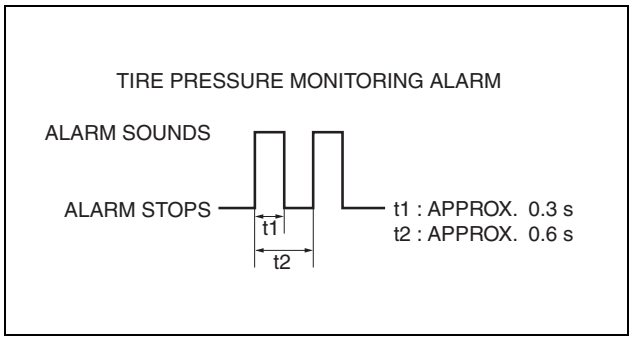
TIRE PRESSURE WARNING ALARM

id092200033500

Purpose
- The tire pressure monitoring alarm warns the user that a tire pressure has decreased or notifies the user that the tire pressure monitoring alarm has been reset.

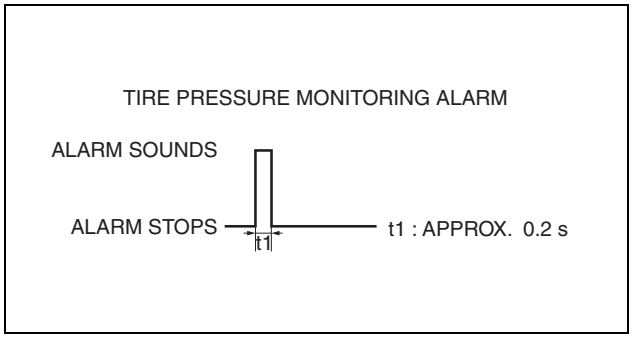
Function
- If the instrument cluster receives a tire pressure monitoring alarm request signal sent from the DSC HU/CM via the CAN signal, the tire pressure monitoring alarm is sounded.
- The tire pressure monitoring alarm sound pattern is as follows: For the conditions in which each alarm pattern sounds, refer to 02-12-3 TIRE PRESSURE MONITORING SYSTEM (TPMS).

Tire pressure monitoring system operating



ac5uun00000749

Tire pressure monitoring system initialization

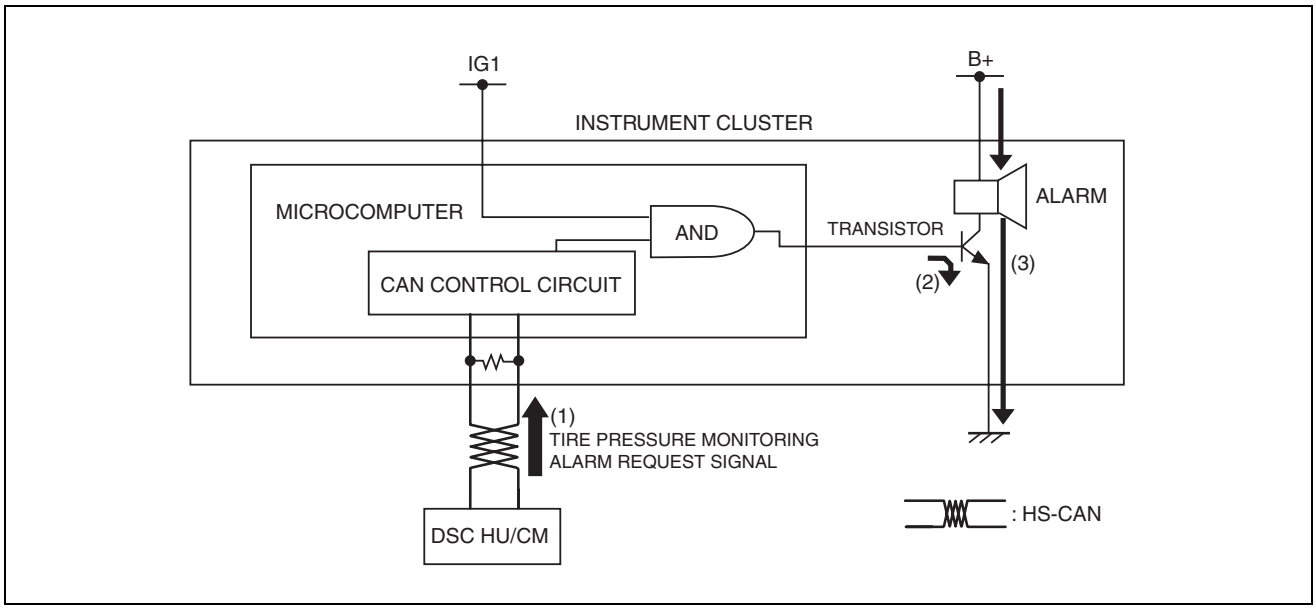


ac5uun00000750

Construction
- The tire pressure monitoring alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the tire pressure monitoring alarm request signal from the DSC HU/CM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the tire pressure monitoring alarm request signal.
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5uun00000751

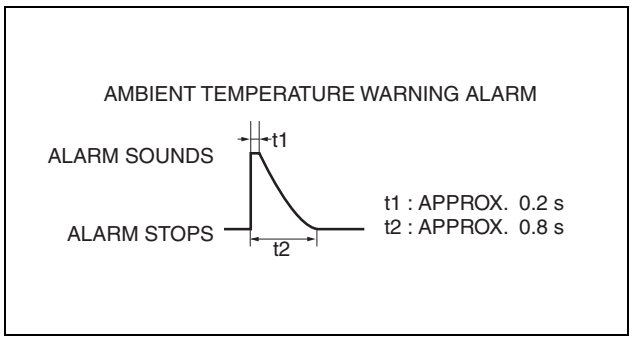
Fail-safe
- Function not equipped.

AMBIENT TEMPERATURE WARNING ALARM

id092200020600

Purpose
- The ambient temperature warning alarm warns the user when the ambient temperature is 4°C {39°F} or less and the road surface may be frozen.

Function
- When the instrument cluster receives an ambient temperature signal of -19—4°C {-2.2—39°F}, which is sent from the PCM as a CAN signal, it operates the ambient temperature warning alarm.
- After the instrument cluster operates the ambient temperature warning alarm, it does not operate the alarm until it receives an ambient temperature signal of 6°C {43°F} or more.
- The ambient temperature alarm sound pattern is as shown in the figure.

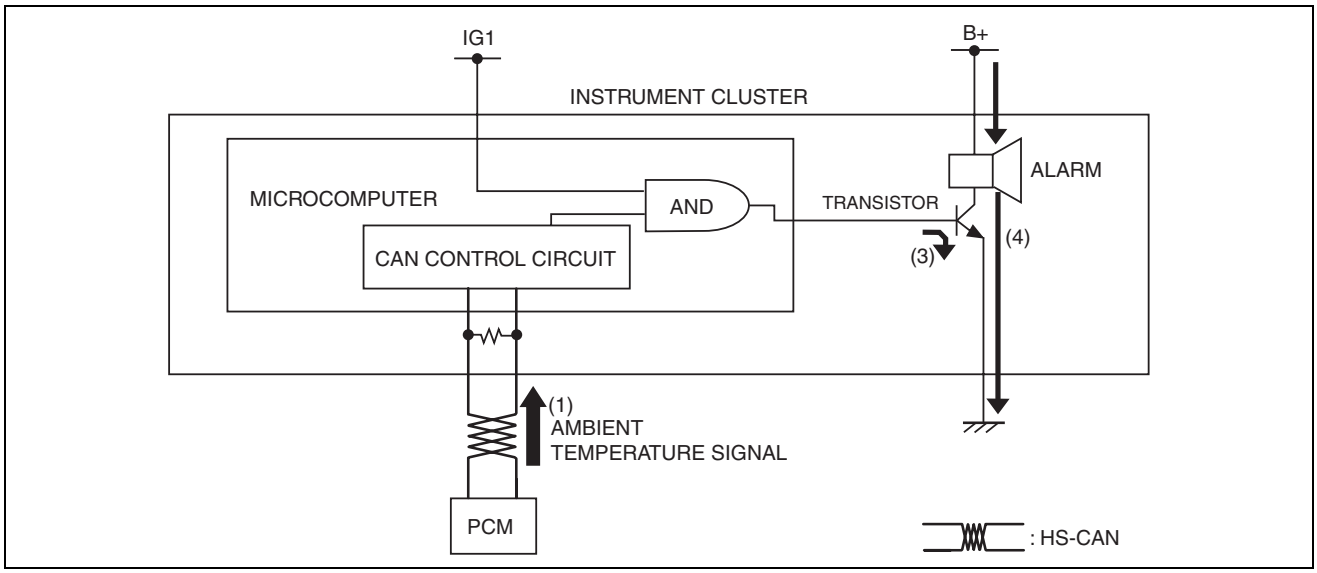


ac5wzn00000936

Construction
- The ambient temperature warning alarm sounds using the buzzer built into the instrument cluster.

Operation
1. When the ignition is switched ON, the instrument cluster receives an ambient temperature signal from the PCM (1).
2. When the instrument cluster receives an ambient temperature signal of -19—4°C {-2.2—39°F}, it turns the transistor on (2).
3. When the transistor turns on, the ground circuit of the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000937

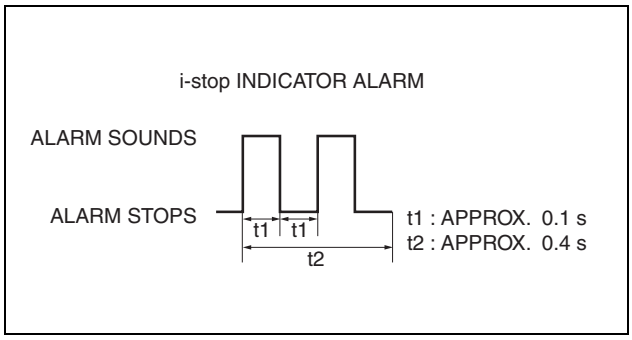
Fail-safe
- Function not equipped.

i-stop INDICATOR ALARM

id092200023100

Purpose
- The i-stop indicator alarm alerts the user that the i-stop OFF switch is pressed.

Function
- When the i-stop OFF switch signal is received from the PCM, the instrument cluster sounds the i-stop indicator alarm.
- The i-stop indicator alarm sound pattern is as follows:

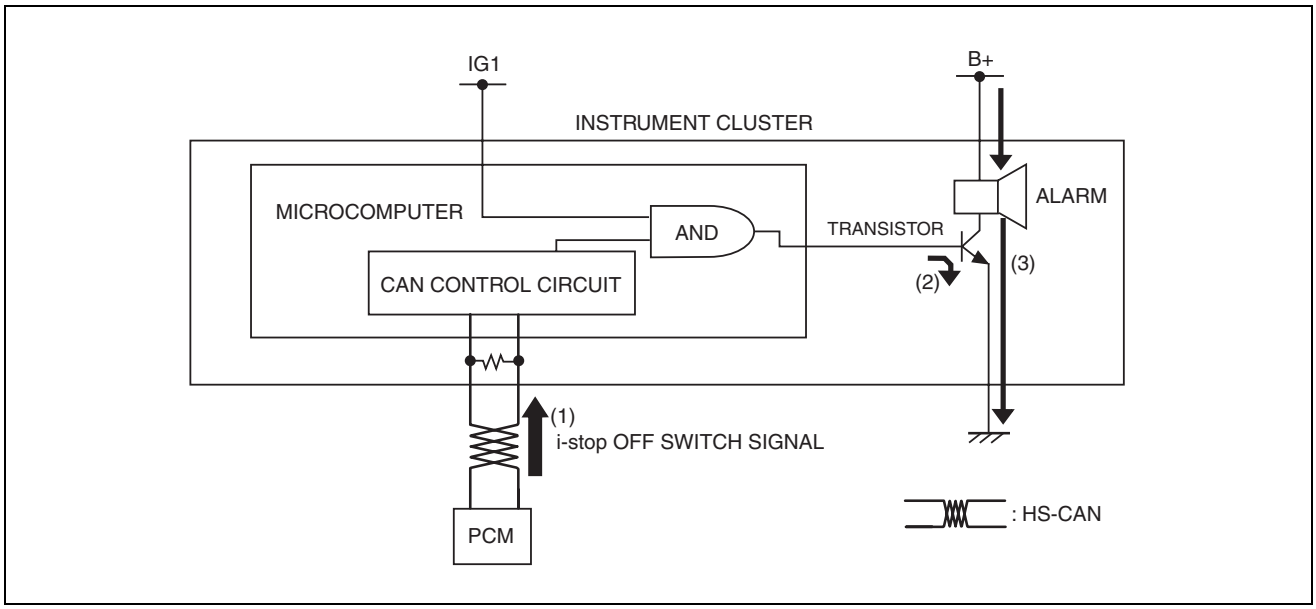


ac5wzn00001424

Construction
- The i-stop indicator alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the i-stop OFF switch signal from the PCM.
2. The instrument cluster microcomputer turns on (2) the transistor based on the i-stop OFF switch signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00001425

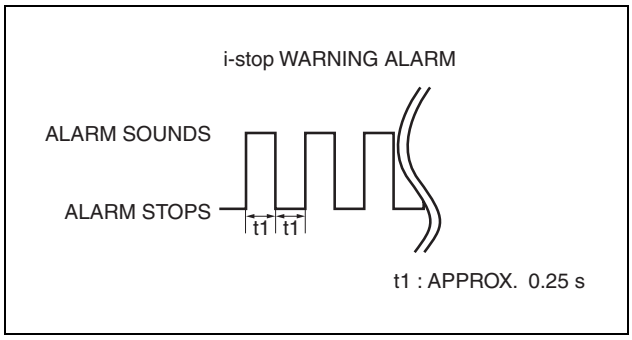
Fail-safe
- Function not equipped.

i-stop WARNING ALARM

id092200022200

Purpose
- The i-stop warning alarm alerts the driver that the driver-side door is open or the engine stalls while the engine is stopped by i-stop control.

Function
- When the instrument cluster receives the i-stop warning alarm request signal sent from the PCM via the CAN signal, the i-stop warning alarm sounds.
- The i-stop warning alarm sound pattern is as indicated in the figure.

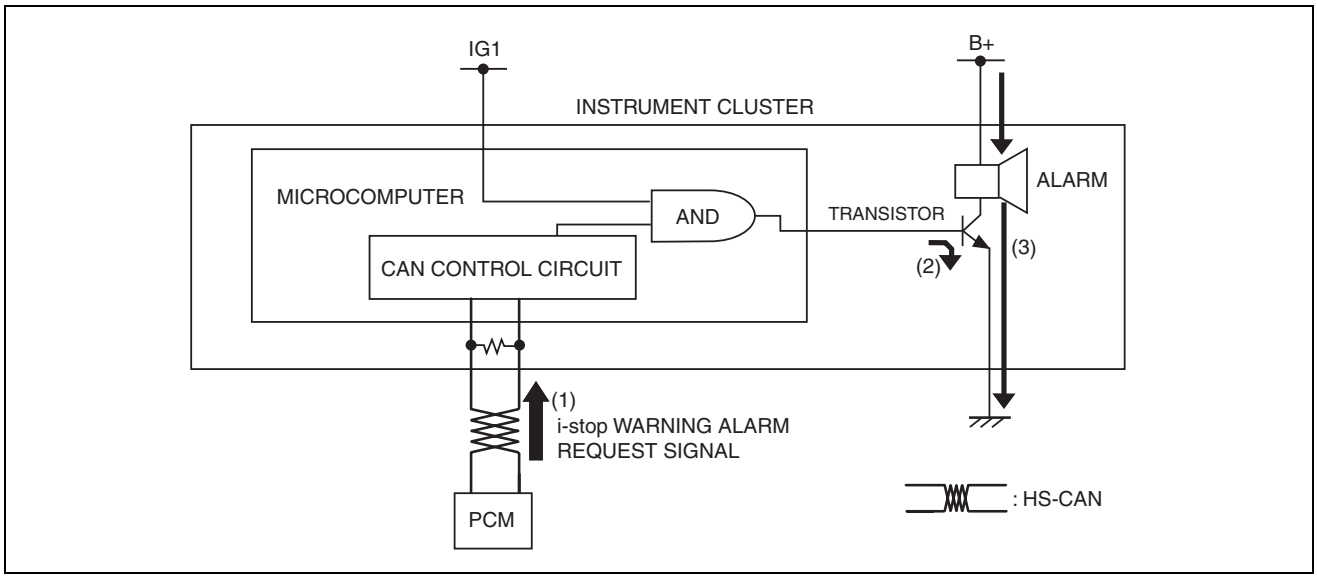


ac5wzn00001422

Construction
- The i-stop warning alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the i-stop warning alarm request signal from the PCM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the i-stop warning alarm request signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00001423

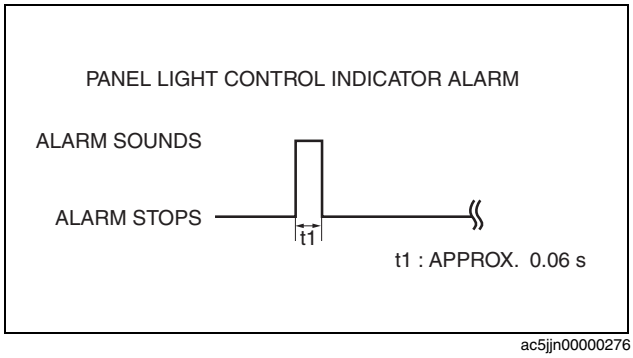
Fail-safe
- Function not equipped.

PANEL LIGHT CONTROL INDICATOR ALARM

id092200020700

Purpose
- The panel light control indicator alarm notifies the driver that the panel light brightness is either at maximum or minimum.

Function
- If the panel light control switch is in the maximum rotation position right or left when the TNS switch ON signal (TNS and headlights illuminate) sent from the start stop unit via the CAN signal is received, the instrument cluster sounds the panel light control indicator alarm.
- The panel light control indicator alarm sound pattern is as shown in the figure.

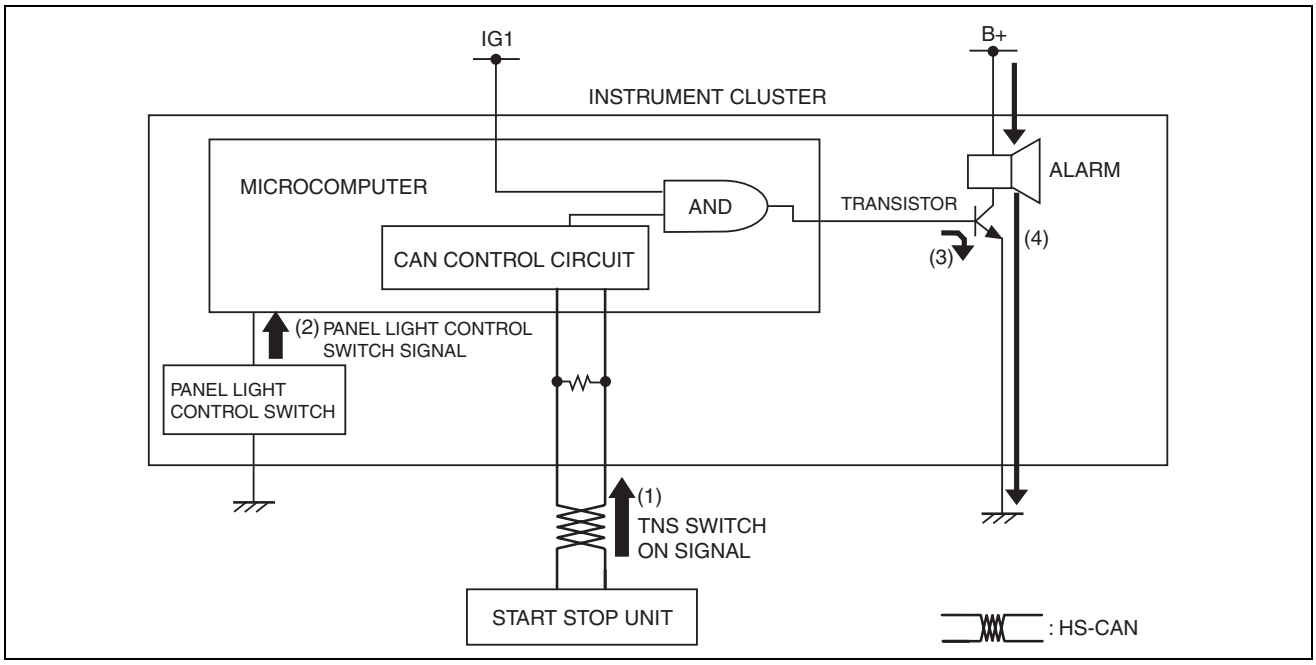


ac5jjn00000276

Construction
- The panel light control indicator alarm sounds using the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the TNS switch ON signal from the start stop unit.
2. If the maximum rotation position of the panel light control switch is detected (2) when the TNS switch ON signal is received, the instrument cluster microcomputer turns on (3) the transistor.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (4).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000615

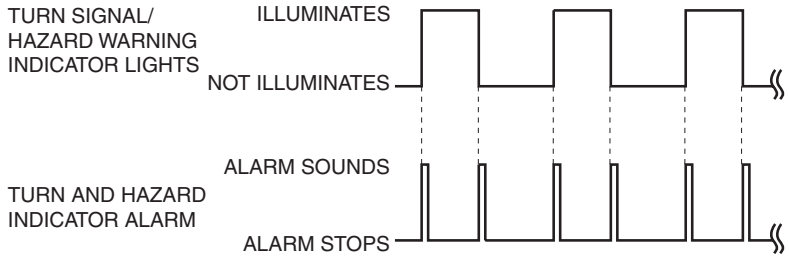
Fail-safe
- Function not equipped.

TURN AND HAZARD INDICATOR ALARM

id092200020800

Purpose
- The turn and hazard indicator alarm notifies the driver that a turn light or the hazard warning lights are flashing.

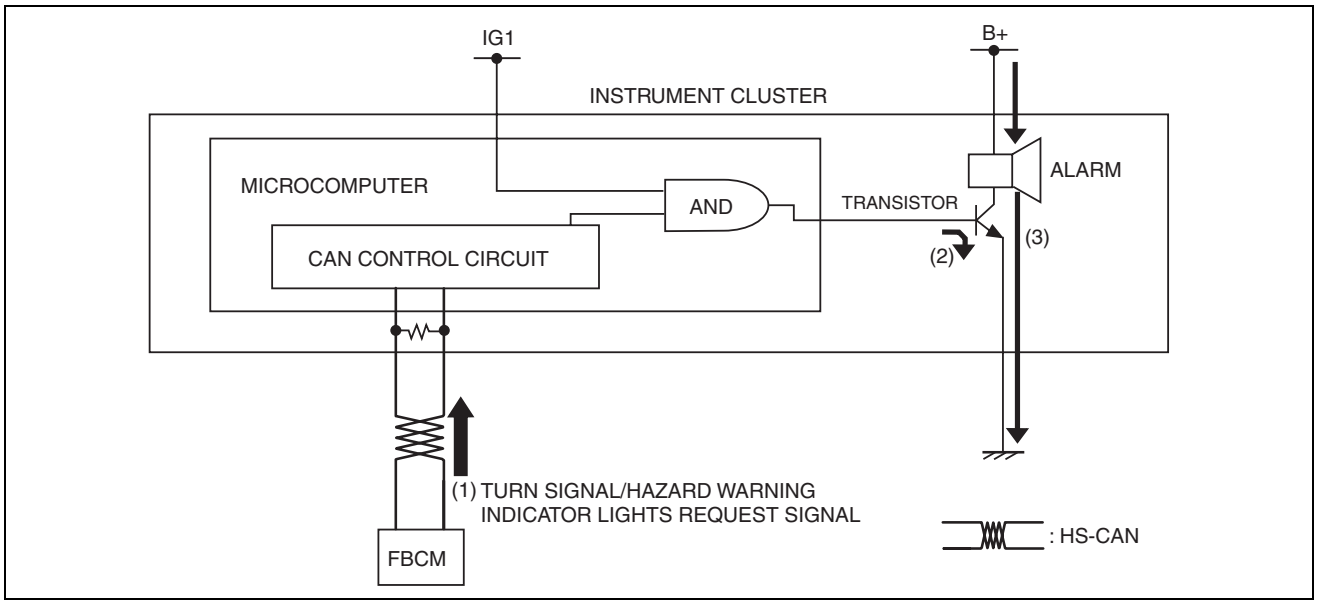
Function
- When the instrument cluster receives the turn signal/hazard warning indicator light illumination request signal sent from the front body control module (FBCM) via the CAN signal, the turn and hazard indicator alarm sounds simultaneously with illumination on/off of the direction/hazard warning indicator lights.
- The turn and hazard indicator alarm sound pattern is as follows:

Sound frequency (Hz)	Alarm when turn signal/hazard warning indicator lights illumination off → on: 1,400 Alarm when turn signal/hazard warning indicator lights illumination on → off: 1,300
Sound frequency	Continuously
Wave pattern	

Construction
- The turn and hazard indicator alarm sounds using the buzzer built into the instrument cluster.

Construction, Operation
1. The instrument cluster receives (1) the turn signal/hazard warning indicator light request signal from the front body control module (FBCM).
2. The instrument cluster microcomputer turns the transistor on (2) based on the turn signal/hazard warning indicator light request signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000617

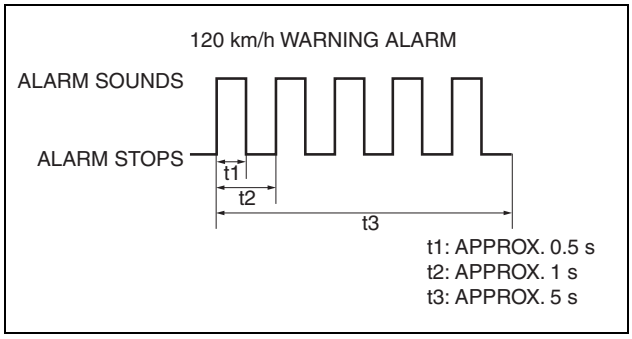
Fail-safe
- Function not equipped.

120 km/h WARNING ALARM

id092200033900

Purpose
- The 120 km/h warning alarm alerts the driver that the current vehicle speed exceeds 120 km/h {74.6 mph}.

Function
- When the instrument cluster receives a 120 km/h {74.6 mph} vehicle speed signal sent from the PCM via the CAN signal, it sounds the 120 km/h warning alarm.
- The 120 km/h warning alarm sound pattern is as follows:

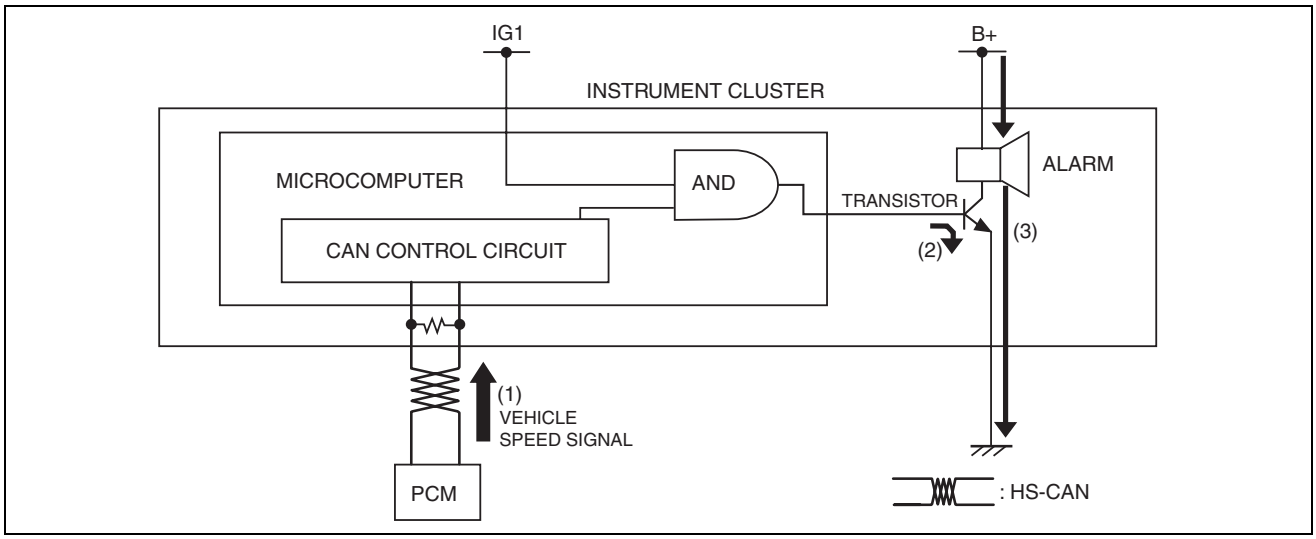


ac5wzn00001403

Construction
- The 120 km/h warning alarm sounds the buzzer built into the instrument cluster.

Operation
1. The instrument cluster receives (1) the vehicle speed signal from the PCM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the 120 km/h {74.6 mph} vehicle speed signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5jjn00001528

Fail-safe
- Function not equipped.

LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED)

id092200018300

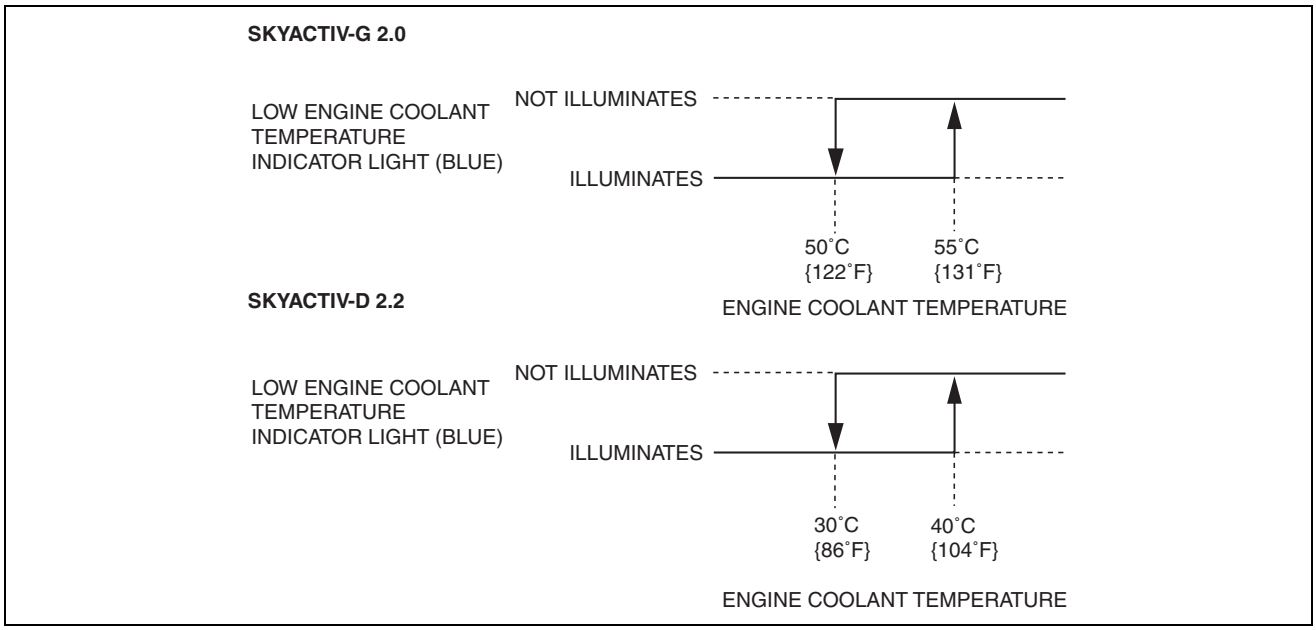
Purpose

Low engine coolant temperature indicator light (blue)
- The low engine coolant temperature indicator light (blue) notifies the driver that the engine coolant temperature is low and vaporization of the fuel is difficult.

High engine coolant temperature warning light (red)
- The high engine coolant temperature warning light (red) notifies the driver that the engine coolant temperature is high and that there is the danger of overheating.

Function

Low engine coolant temperature indicator light (blue)
- The low engine coolant temperature indicator light (blue) illuminates when the engine coolant temperature is low.
- The illumination condition of the low engine coolant temperature indicator light (blue) is as shown in the figure.

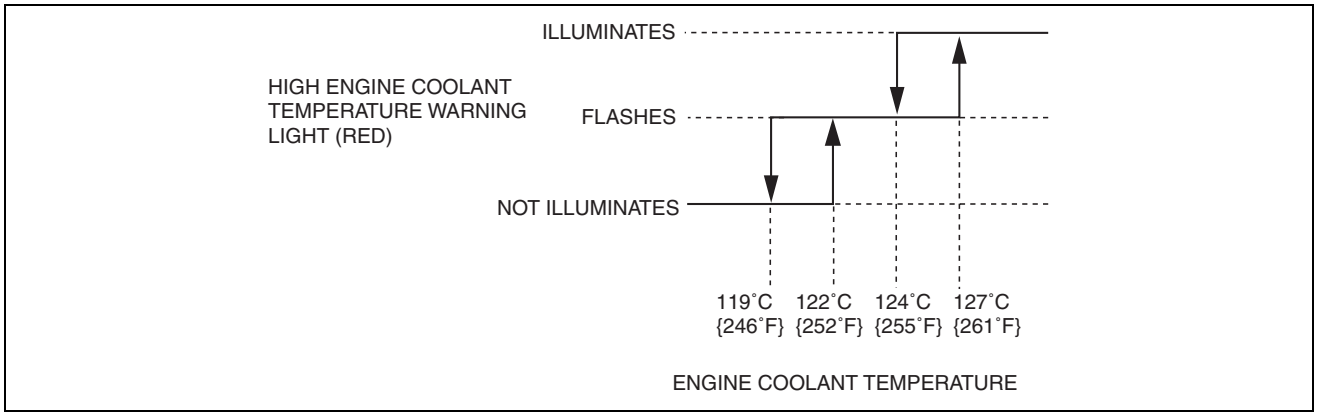


ac5wzn00000624

INSTRUMENTATION/DRIVER INFO.

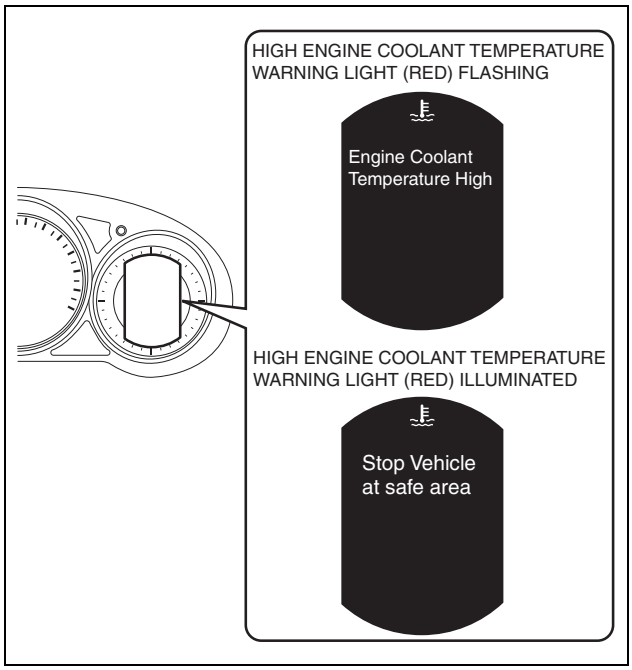
High engine coolant temperature warning light (red)

- The high engine coolant temperature warning light flashes at 0.5 s intervals when the engine coolant temperature exceeds the set value, and illuminates if the temperature increases further.
- The flashing/illumination condition of the high engine coolant temperature warning light (red) is as shown in the figure.



ac5wzn00000625

- The instrument cluster equipped with the TFT LCD displays a warning message in the TFT LCD display simultaneously when the high engine coolant temperature warning light (red) flashes or illuminates.



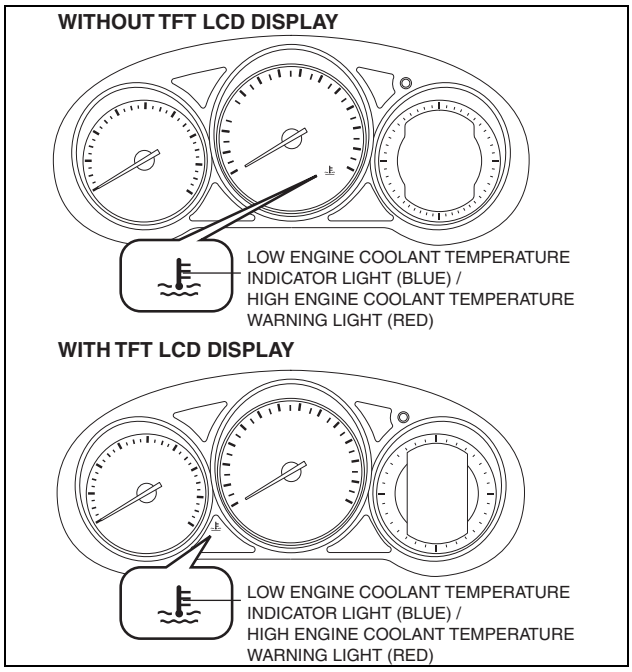
ac5wzn00001870

Construction

- Illumination, flashing, or turning off of the low engine coolant temperature indicator light (blue)/high engine coolant temperature warning light (red) is controlled by the instrument cluster microcomputer based on the engine coolant temperature signal from the PCM.

INSTRUMENTATION/DRIVER INFO.

- The low engine coolant temperature indicator light (blue)/high engine coolant temperature warning light (red) is set in the instrument cluster.

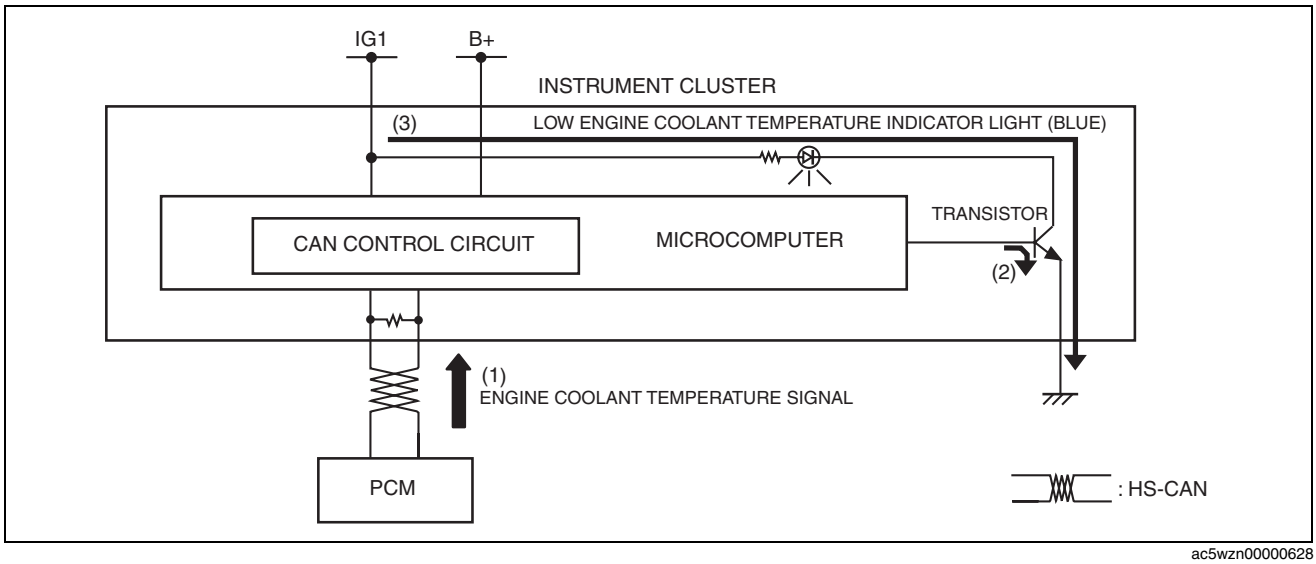


ac5wzn00001381

Operation

Low engine coolant temperature indicator light (blue)

1. When the ignition is switched ON (while engine is running), the instrument cluster receives (1) the engine coolant temperature signal from the PCM via the CAN signal.
2. The instrument cluster turns the transistor on (2) based on the engine coolant temperature signal.
3. When the transistor turns on, the ground circuit of the low engine coolant temperature indicator light (blue) is established and the low engine coolant temperature indicator light (blue) illuminates (3).



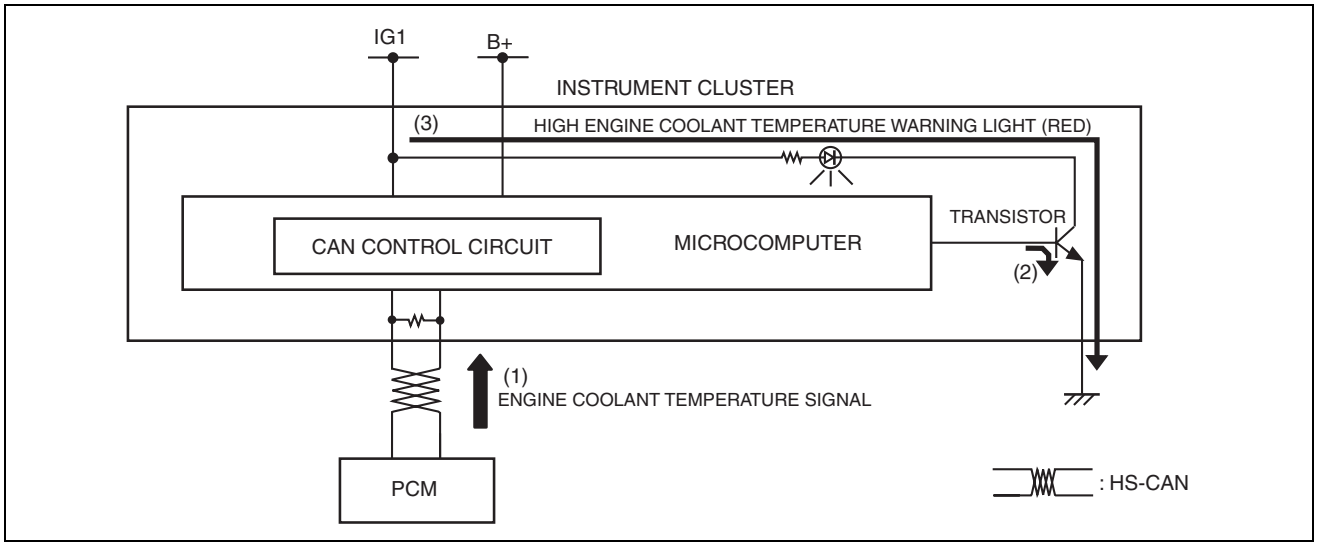
ac5wzn00000628

High engine coolant temperature warning light (red)

1. When the ignition is switched ON (while engine is running), the instrument cluster receives (1) the engine coolant temperature signal from the PCM via the CAN signal.
2. The instrument cluster turns the transistor on (2) intermittently for flashing and continuously for illumination based on the engine coolant temperature signal.

INSTRUMENTATION/DRIVER INFO.

3. The high engine coolant temperature warning light (red) flashes (3) when the transistor is turned on intermittently, and it illuminates (3) when the transistor is turned on continuously.



ac5wzn00000629

Fail-safe
- Function not equipped.

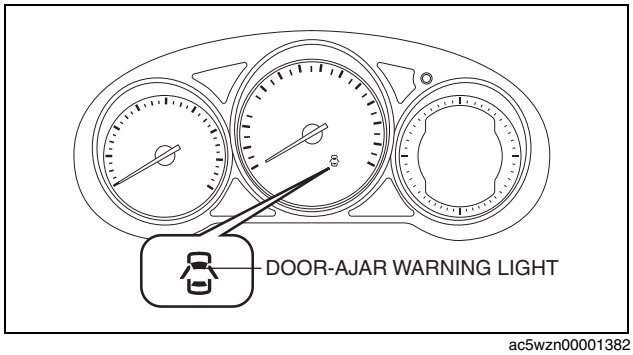
DOOR-AJAR WARNING LIGHT

id092200018700

Purpose
- The door-ajar warning light notifies the driver that any door or the liftgate is open.

Function
- When the instrument cluster receives any of the following signals sent from the rear body control module (RBCM) via the CAN signal, the door-ajar warning light illuminates.
  - — Door latch switch ON signal (door open)
  - — Liftgate latch switch ON signal (liftgate open)

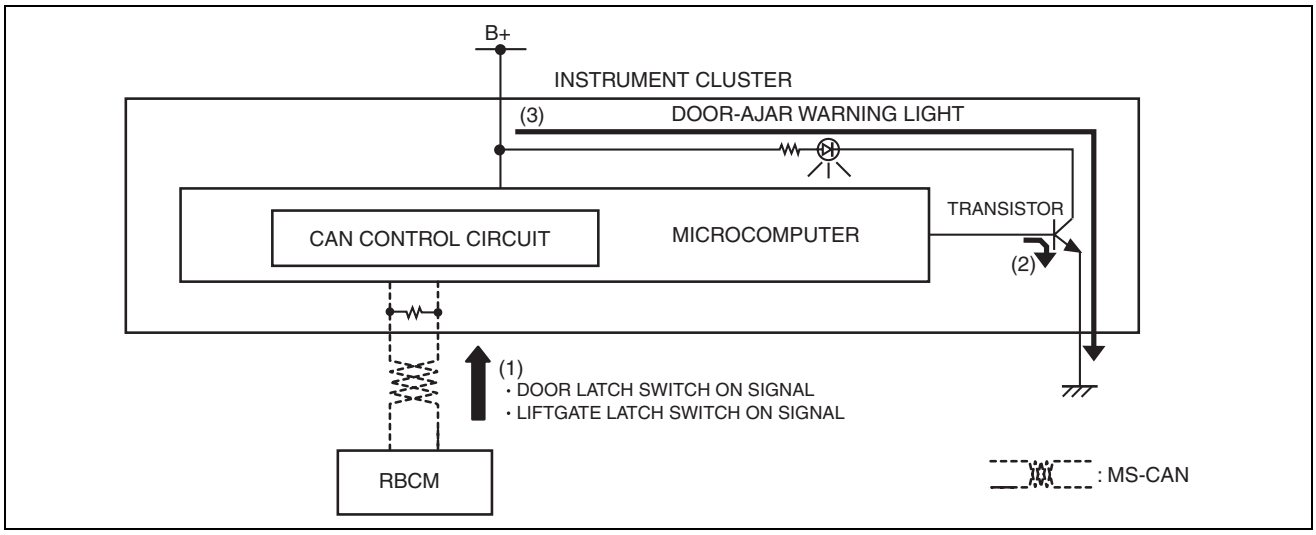
Construction
- The instrument cluster controls illumination on/off of the door-ajar warning light using the instrument cluster microcomputer based on the door latch or liftgate latch position signal from the rear body control module (RBCM).
- The door-ajar warning light is set in the instrument cluster.
- The door-ajar warning light in the instrument cluster for vehicles with a TFT LCD is displayed in the TFT LCD display. Refer to the 09-22-72 DOOR AJAR WARNING DISPLAY for the display content.



ac5wzn00001382

Operation
1. The instrument cluster receives (1) the door latch switch ON signal or liftgate latch switch ON signal from the rear body control module (RBCM).
2. The instrument cluster microcomputer turns the transistor on (2) based on each signal.
3. When the transistor turns on, a ground circuit with the door-ajar warning light is established and the door-ajar warning light illuminates (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00000627

Fail-safe
- Function not equipped.

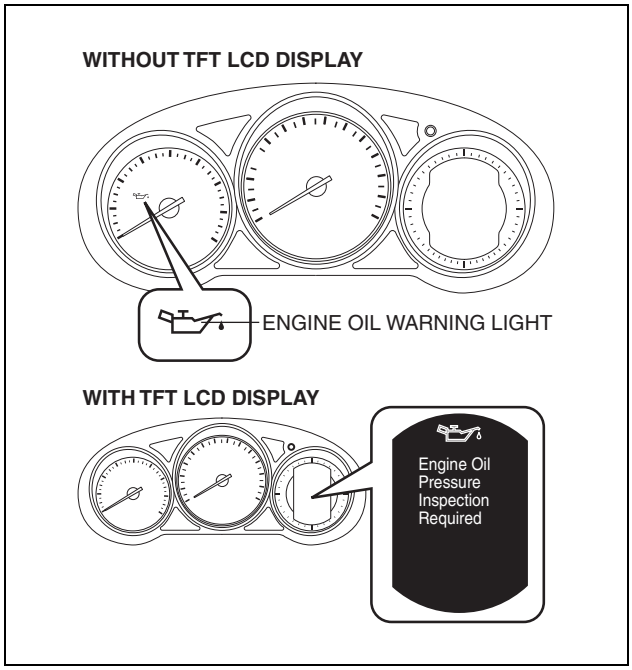
ENGINE OIL WARNING LIGHT

id092200034300

Purpose
- The engine oil warning light warns the driver that the engine oil level is insufficient.

Function
- When the instrument cluster receives the engine oil warning light request signal sent from the PCM via the CAN signal, it illuminates the engine oil warning light.

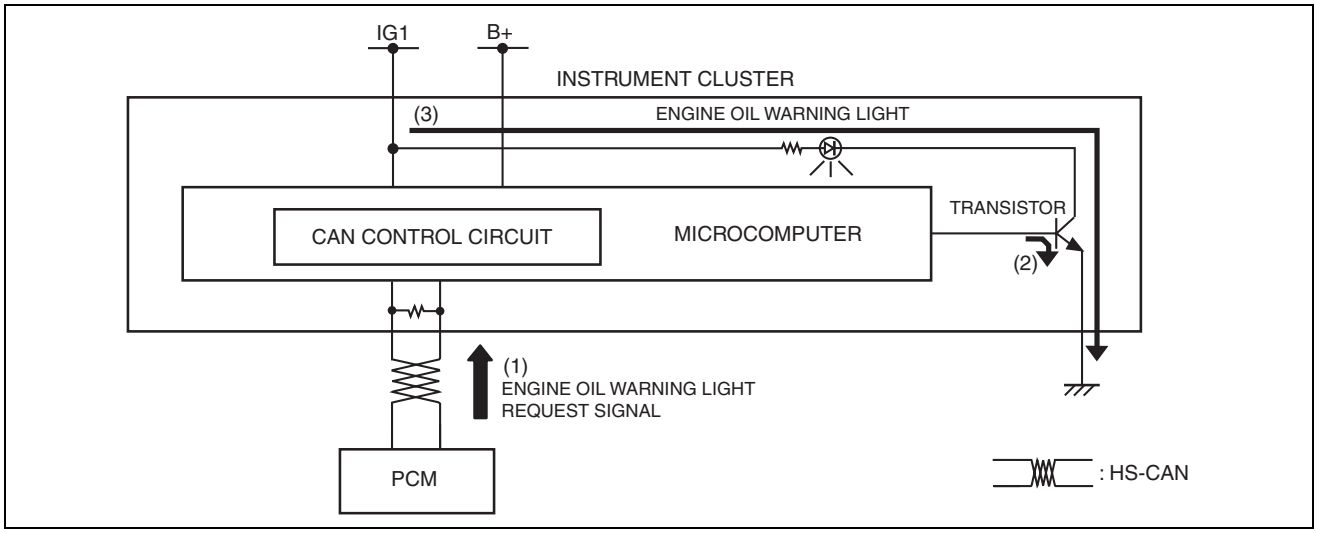
Construction
- The instrument cluster controls illumination on/off of the engine oil warning light using the instrument cluster microcomputer based on the engine oil warning light request signal from the PCM.
- The engine oil warning light is set in the instrument cluster.



ac5wzn00001385

Operation
Without TFT LCD display
1. The instrument cluster receives (1) the engine oil warning light request signal from the PCM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the engine oil warning light request

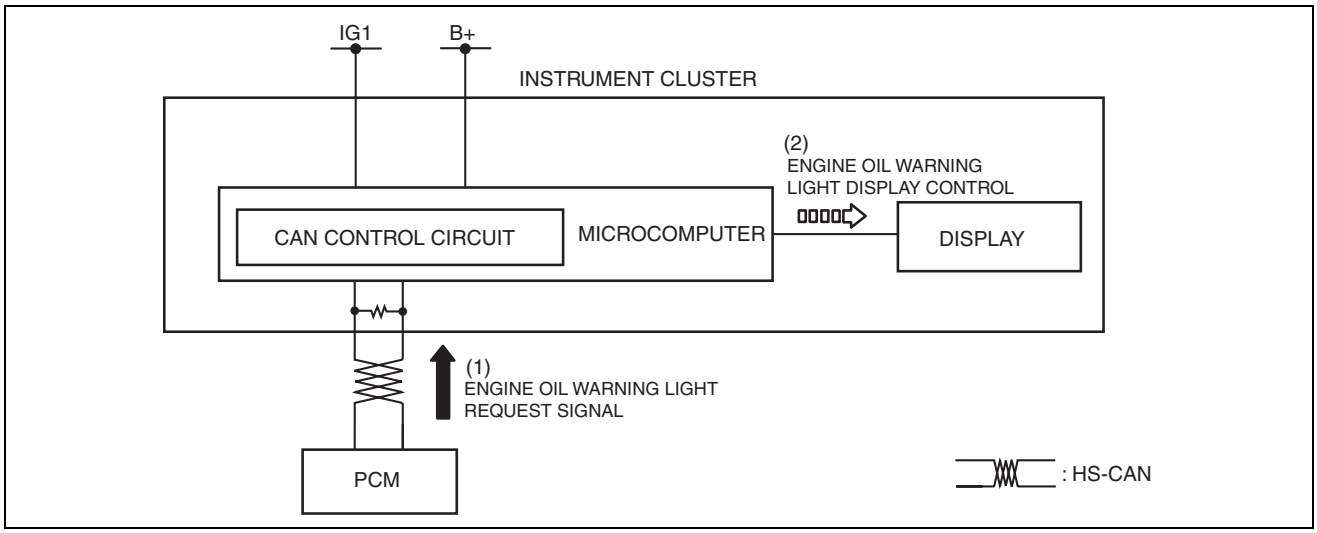
signal.
3. When the transistor turns on, a ground circuit with the engine oil warning light is established and the engine oil warning light illuminates (3).



ac5wzn00001511

With TFT LCD display

1. The instrument cluster receives (1) the engine oil warning light request signal from the PCM.
2. The instrument cluster microcomputer displays (2) the engine oil warning light in the TFT LCD display screen.



ac5wzn00001512

Fail-safe

- Function not equipped.

SEAT BELT WARNING LIGHT

id092200022900

Purpose

- The seat belt warning light warns the driver that a seat belt is not fastened.

Function

- The instrument cluster flashes/illuminates the seat belt warning light based on the following CAN signals:
  - — Vehicle speed signal sent from PCM
  - — Driver/passenger buckle switch signal, occupancy detection sensor signal sent from SAS control module
  - — Rear seat buckle switch signal sent from rear body control module (RBCM)

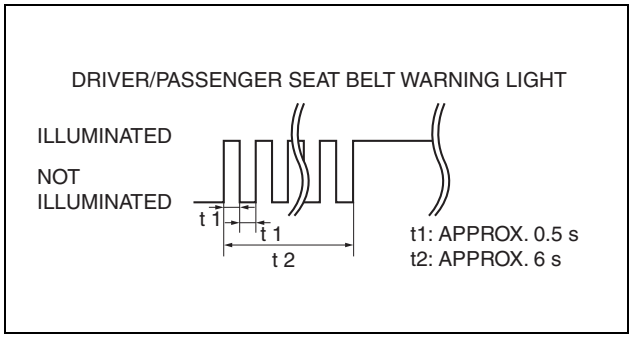
Driver/passenger seat belt warning light display function

- The driver/passenger seat belt warning light has a warning for when the vehicle is stopped, while the vehicle is being driven, and subsequent warnings while the vehicle is being driven.

INSTRUMENTATION/DRIVER INFO.

Warning when vehicle is stopped

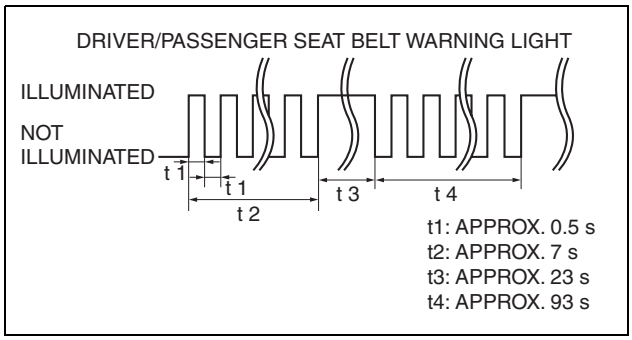
- When all of the following conditions are met, it illuminates
  - — Ignition switch ON (engine off or on)
  - — Driver/passenger buckle switch on signal (seat belt unfastened) is detected
  - — Occupancy sensor on signal (occupant in passenger seat) is detected (passenger seat belt warning light only)
- The driver/passenger seat belt warning flash/illumination pattern is as shown in the figure.



ac5wzn00001376

Warning while vehicle is driven

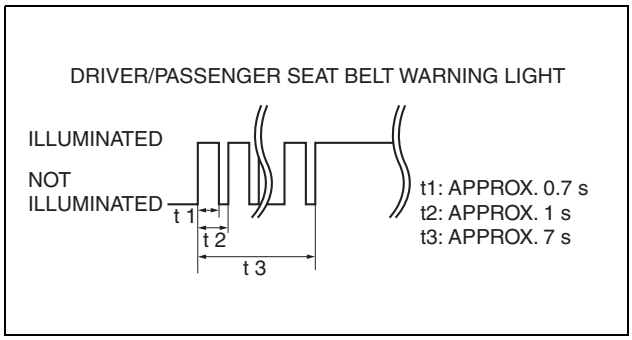
- When all of the following conditions are met, it flashes/illuminates
  - — Vehicle speed is approx. 20 km/h {12 mph} or more
  - — Driver/passenger buckle switch on signal (seat belt unfastened) is detected
  - — Occupancy sensor on signal (occupant in passenger seat) is detected (passenger seat belt warning light only)
- The driver/passenger seat belt warning flash/illumination pattern is as shown in the figure.



ac5wzn00001377

Subsequent warning while vehicle is driven

- When all of the following conditions are met, it flashes/illuminates
  - — Vehicle speed is approx. 20 km/h {12 mph} or more
  - — Occupancy sensor on signal (occupant in passenger seat) is detected (passenger seat belt warning light only)
  - — After warning while vehicle is being driven operates, buckle switch off signal (seat belt fastened) to on signal (seat belt unfastened) is detected
- The driver/passenger seat belt warning flash/illumination pattern is as shown in the figure.



ac5wzn00001378

Rear seat belt warning light display function

- The rear seat belt warning light illuminates in green to indicate seat belts are fastened, and it illuminates in red to indicate a seat belt is not fastened.
- The rear seat belt warning light has an initial warning and a subsequent warnings.

Initial warning

- When the ignition is switched ON (engine off or on), it illuminates for approx. 33 s.

Subsequent warning

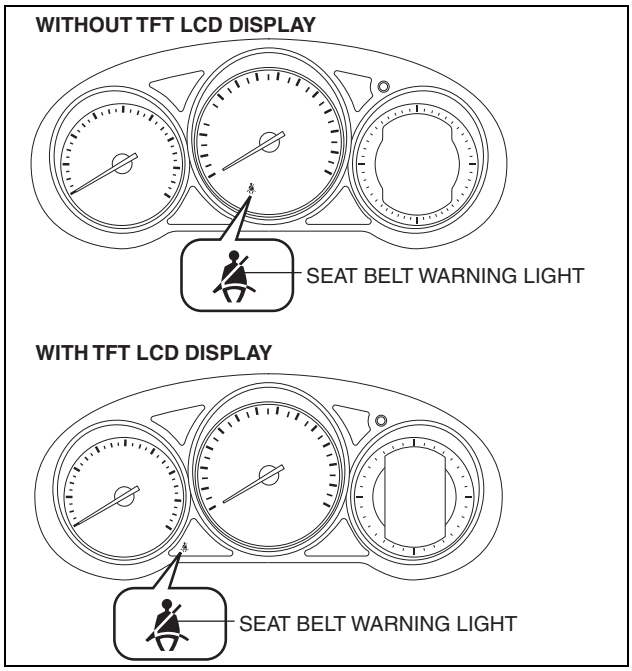
- After the initial warning operates, if a buckle switch signal change (on to off, or off to on), illuminates for approx. 33 s.

Construction

- The microcomputer in the instrument cluster controls the illumination/flashing/turning off of the seat belt warning light based on the driver/passenger buckle switch signal and occupancy sensor signal from the SAS control module, the rear seat buckle switch signal from the rear body control module (RBCM), and the vehicle speed signal from the PCM.

INSTRUMENTATION/DRIVER INFO.

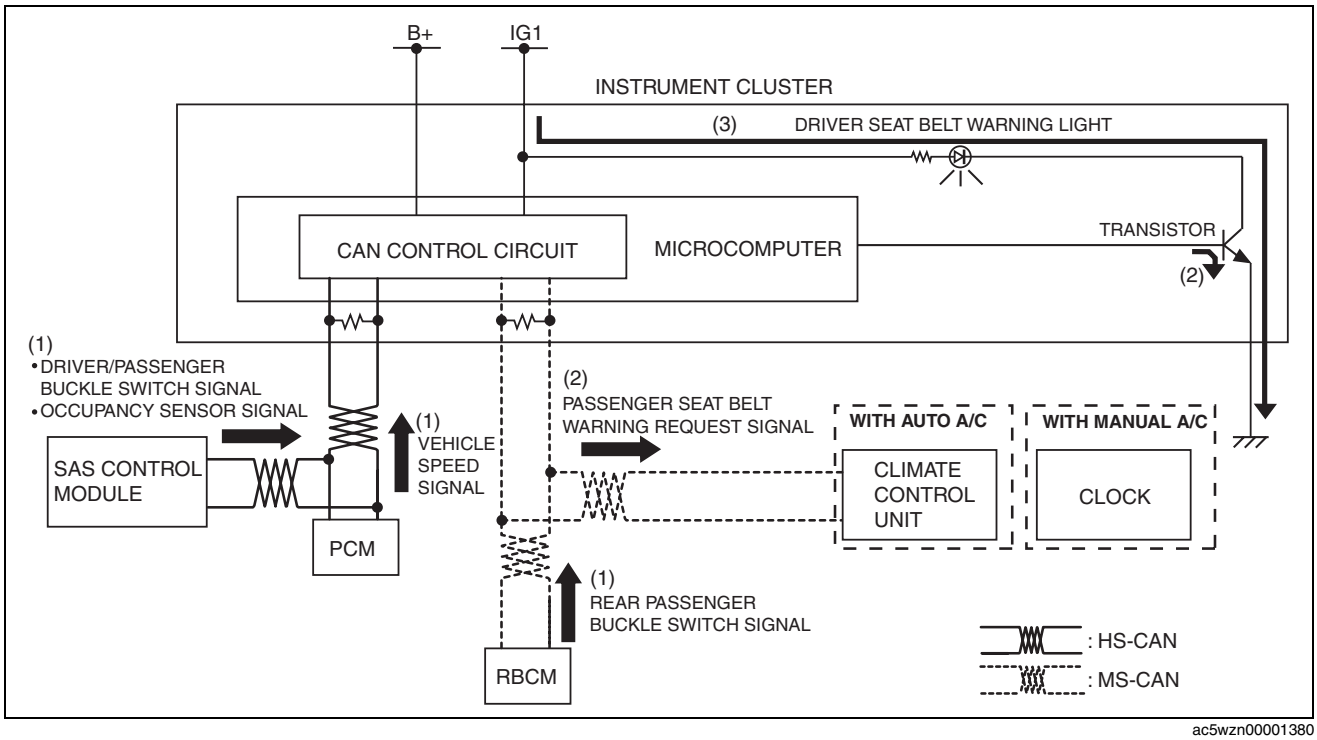
- The driver seat belt warning light is set in the instrument cluster.
- The passenger seat belt warning light and rear seat belt warning light are set in the clock (with manual A/C)/climate control unit (with auto A/C). For details on the passenger seat belt warning light and rear seat belt warning light, refer to 07-40A-21 CLIMATE CONTROL UNIT [FULL-AUTO AIR CONDITIONER] (with auto A/C)/09-22-124 CLOCK (with manual A/C).



ac5wzn00001555

Operation

1. The instrument cluster receives (1) a vehicle speed signal from the PCM, a driver/passenger seat buckle switch signal and occupancy sensor signal from the SAS control module, and a rear passenger buckle switch signal from the rear body control module (RBCM).
2. The instrument cluster microcomputer turns the transistor on (2) intermittently for flashing and continuously for illumination based on the each signal. In addition, it sends a driver/passenger seat belt warning request signal to the clock (with manual A/C)/climate control unit (with auto A/C).
3. When the transistor turns on intermittently, the driver seat belt warning light flashes (3), when it turns on continuously, the driver seat belt warning light illuminates (3).



ac5wzn00001380

Fail-safe

- Function not equipped.

INSTRUMENTATION/DRIVER INFO.

LOW FUEL WARNING LIGHT

id092200023000

Purpose

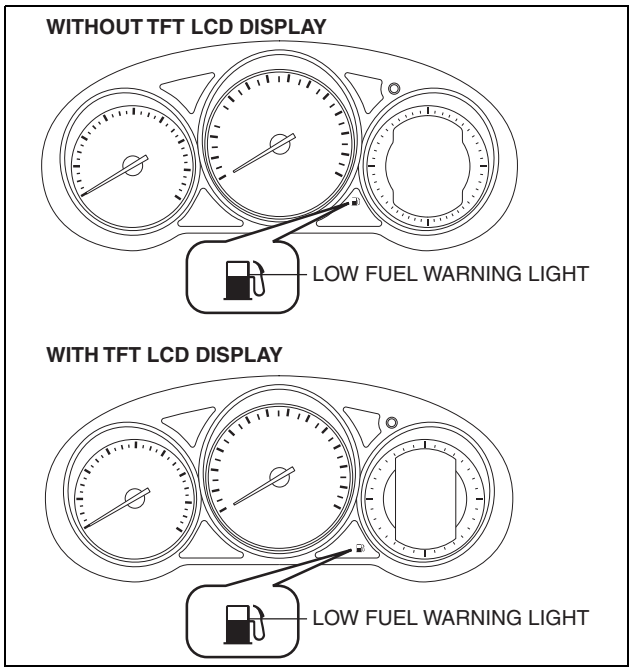
- The low fuel warning light warns the driver that the remaining fuel level is low.

Function

- The instrument cluster calculates the fuel quantity based on the following CAN signals, and if a remaining fuel amount of approx. 10 L {2.6 US gal, 2.2 Imp gal} (fuel gauge displays remaining two segments) is detected, the low fuel warning light illuminates.
  - — Fuel gauge sender unit voltage signal sent from rear body control module (RBCM)
  - — Fuel injection amount signal, vehicle speed signal sent from PCM

Construction

- The instrument cluster microcomputer controls the low fuel warning light illumination on/off based on the remaining fuel amount calculation that is calculated by the instrument cluster.
- The low fuel warning light is set in the instrument cluster.
- The instrument cluster with the TFT LCD displays a warning message in the TFT LCD display simultaneously when the fuel tank level warning light illuminates. For details on the message, refer to the 09-22-70 FUEL TANK LEVEL WARNING DISPLAY.

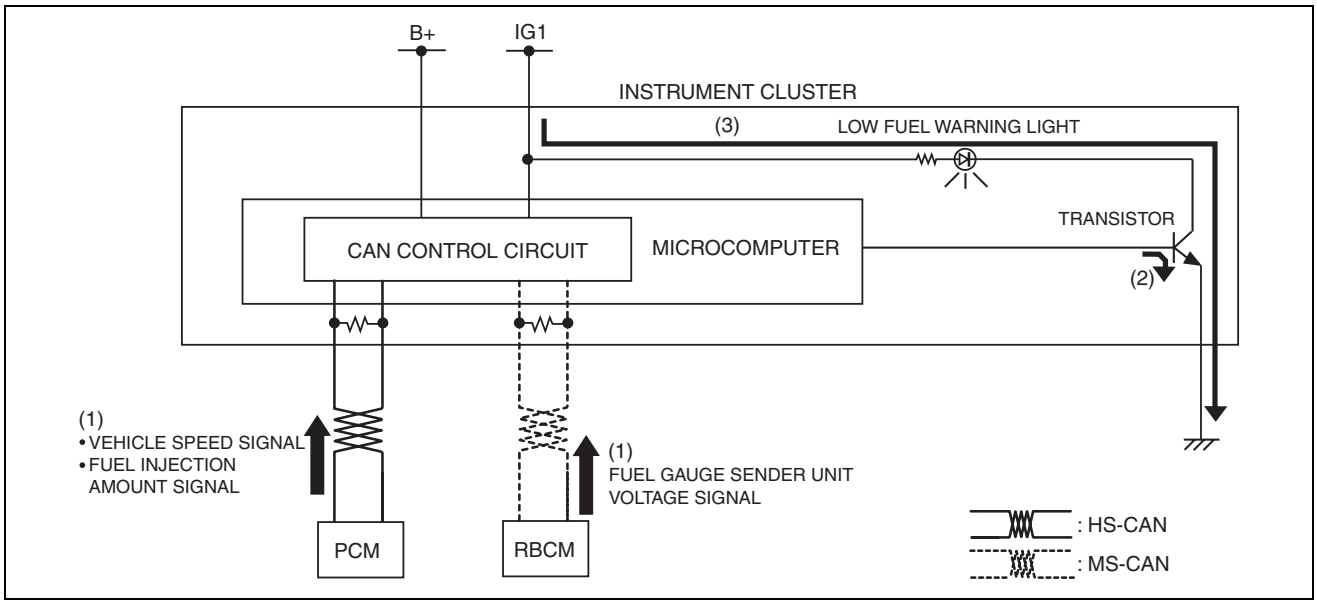


ac5wzn00001383

Operation

1. When the ignition is switched ON (engine off or on) the instrument cluster receives (1) the fuel gauge sender unit voltage signal from the rear body control module (RBCM), and the fuel injection amount signal from the PCM.
2. The instrument cluster turns the transistor on (2) if the calculated remaining fuel amount based on each signal is approx. 10 L {2.6 US gal, 2.2 Imp gal}.
3. When the transistor turns on, a ground circuit with the low fuel warning light is established and the low fuel warning light illuminates (3).

INSTRUMENTATION/DRIVER INFO.



ac5jjn00000706

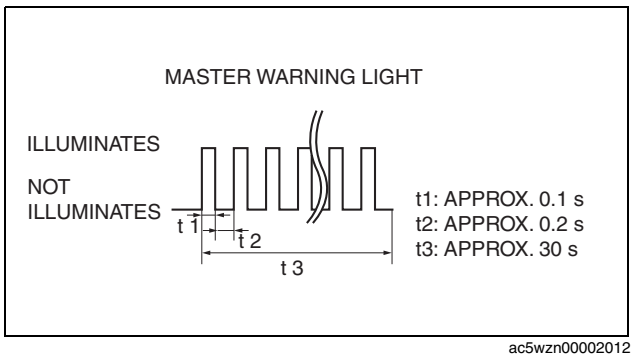
Fail-safe
- Function not equipped.

MASTER WARNING LIGHT

id092200032400

Purpose
- The master warning light warns the driver that any of the following malfunctions is occurring.
  - — Brake switch malfunction
  - — Engine oil solenoid valve malfunction
  - — Power supply system malfunction
  - — Current sensor malfunction
- When the instrument cluster equipped with the TFT LCD receives a TFT LCD warning message display request signal from the related system, the master warning light illuminates simultaneously to notify the user that a malfunction is occurring in the vehicle. For the warning messages which display simultaneously when the master warning light illuminates, refer to the 09-22-61 LIQUID CRYSTAL DISPLAY (LCD).

Function
- The instrument cluster illuminates the master warning light based on the following CAN signals:
  - — Brake switch No.1 error signal, brake switch No.2 error signal, engine oil solenoid valve error signal, current sensor error signal, and power supply system error signal sent from the PCM
- The instrument cluster flashes the master warning light based on the master warning light flash request signal sent from the PCM as a CAN signal.
- The master warning light flashing pattern is as indicated in the figure.

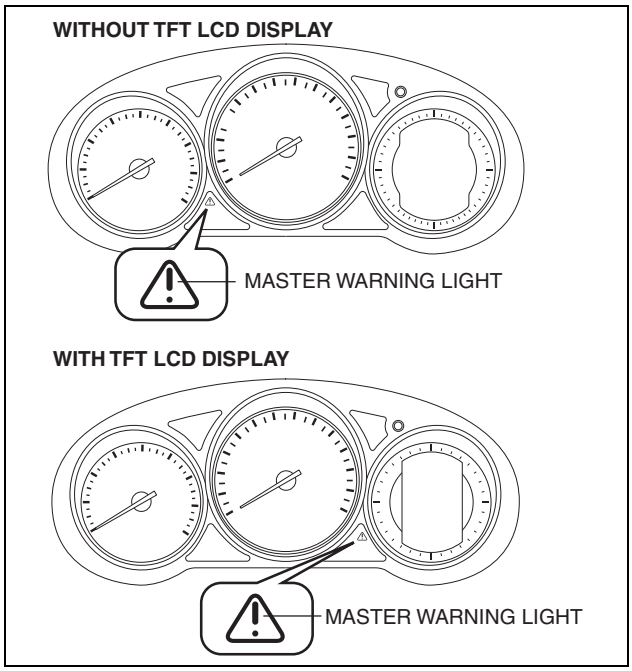


ac5wzn00002012

Construction
- The instrument cluster microcomputer controls the illumination/flashing/turning off of the master warning light based on each error signal sent from the PCM.

INSTRUMENTATION/DRIVER INFO.

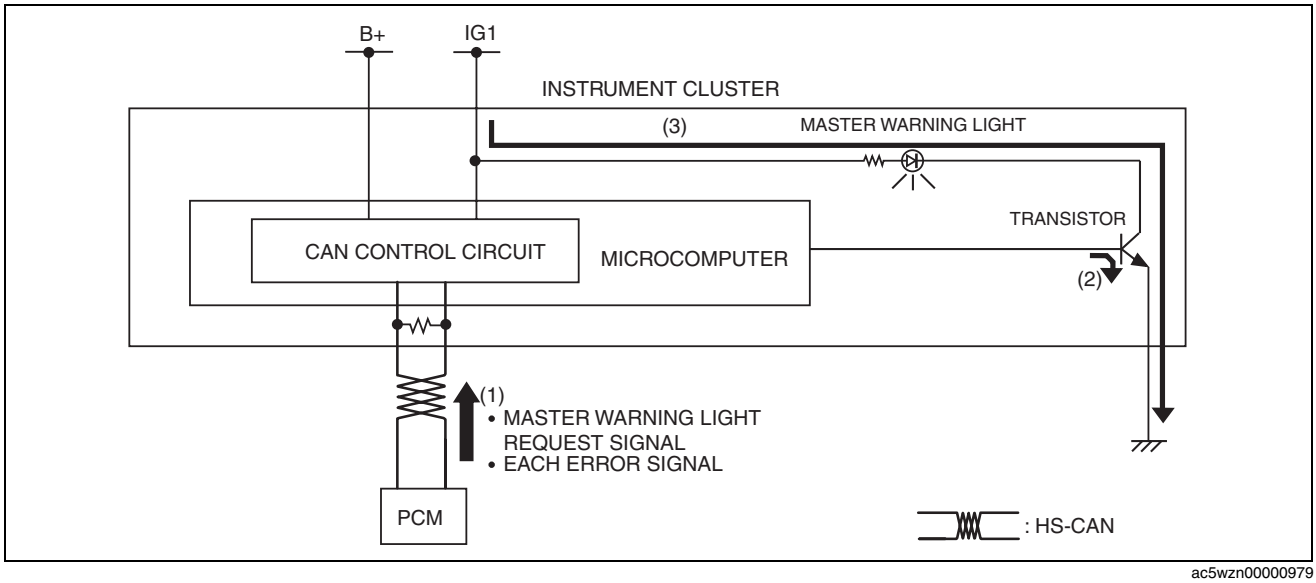
- The master warning light is set in the instrument cluster.



ac5wzn00001384

Operation

1. When the ignition is switched ON (engine off or on), the instrument cluster receives (1) each error signal or a master warning light request signal from the PCM.
2. The instrument cluster turns the transistor on (2) intermittently for flashing and continuously for illumination based on each signal.
3. The master warning light flashes (3) when the transistor is turned on intermittently, and it illuminates (3) when the transistor is turned on continuously.



ac5wzn00000979

Fail-safe

- Function not equipped.

120 km/h WARNING LIGHT

id092200034000

Purpose

- The 120 km/h warning light notifies the driver that the current vehicle speed exceeds 120 km/h {74.6 mph}.

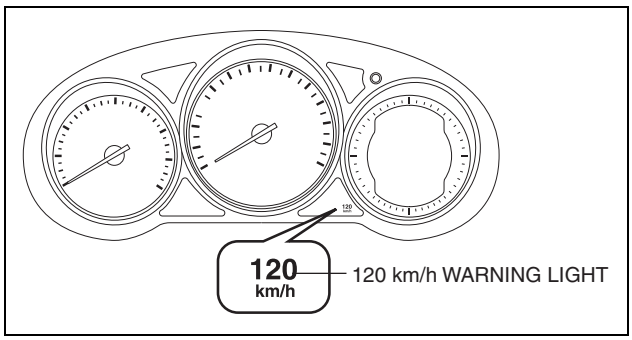
Function

- When the instrument cluster receives a 120 km/h {74.6 mph} vehicle speed signal sent from the PCM via the CAN signal, it illuminates the 120 km/h warning light.

INSTRUMENTATION/DRIVER INFO.

Construction

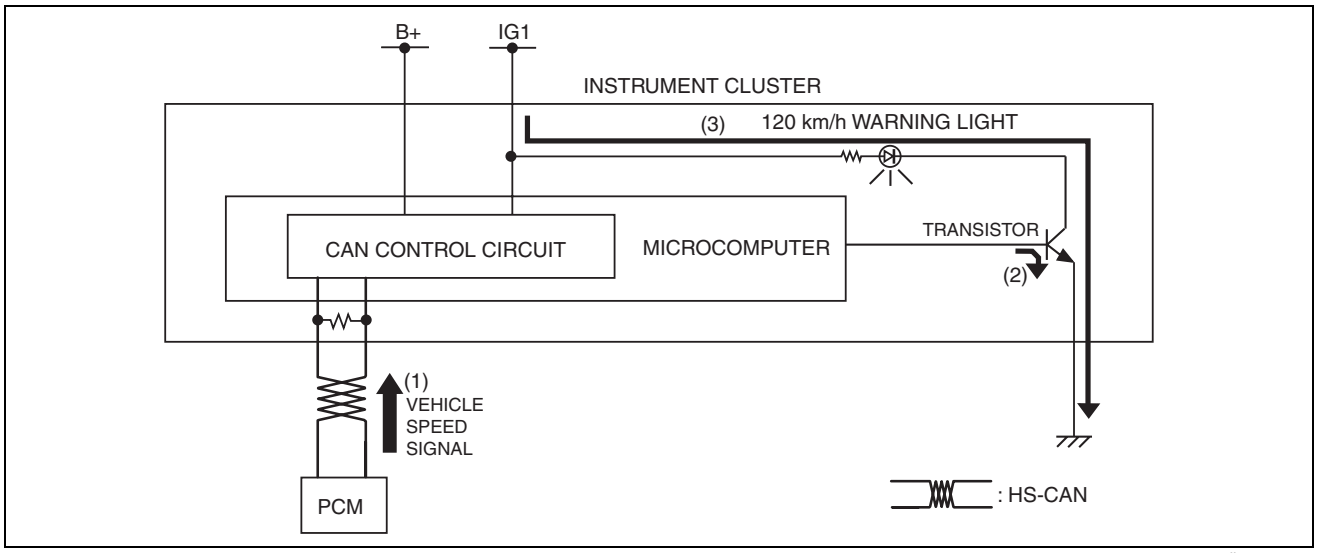
- The instrument cluster microcomputer controls the illumination on/off of the 120 km/h warning light based on the 120 km/h {74.6 mph} vehicle speed signal from the PCM.
- The 120 km/h warning light is set in the instrument cluster.



ac5wzn00001404

Operation

1. The instrument cluster receives (1) the vehicle speed signal from the PCM.
2. The instrument cluster microcomputer turns the transistor on (2) based on the 120 km/h {74.6 mph} vehicle speed signal.
3. When the transistor turns on, a ground circuit with the 120 km/h warning light is established and the 120 km/h warning light illuminates (3).



ac5jjn00001530

Fail-safe

- Function not equipped.

SPEEDOMETER

id092200032500

Purpose

- The speedometer notifies the driver of the speed at which the vehicle is traveling.

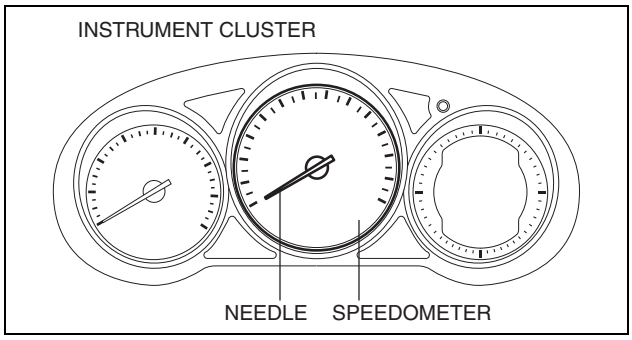
Function

- The instrument cluster controls the speedometer needle based on the vehicle speed signal from the PCM and displays the current vehicle speed.

INSTRUMENTATION/DRIVER INFO.

Construction

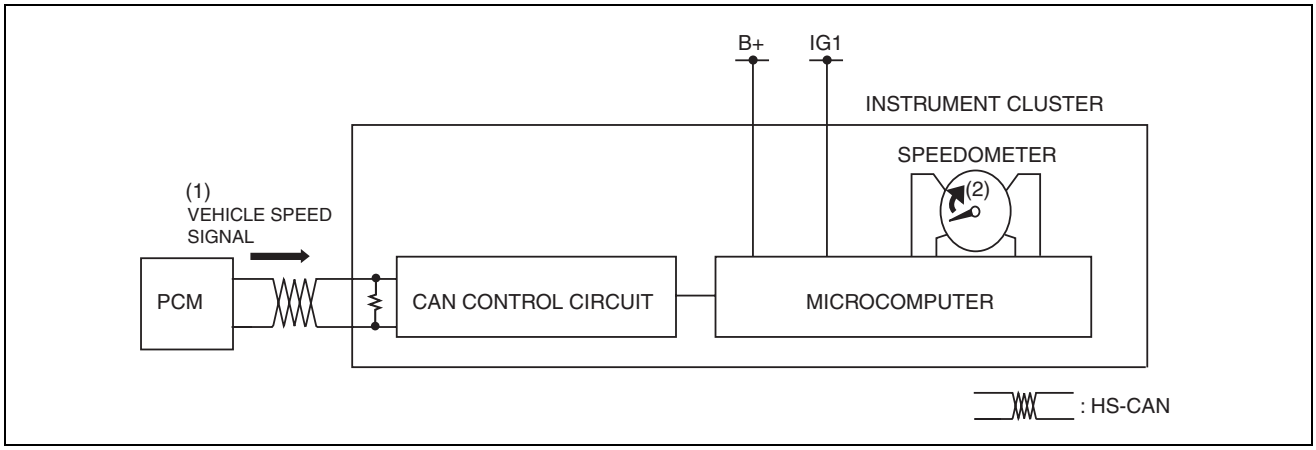
- An analog needle display speedometer with a stepping motor mechanism has been adopted.



ac5wzn00000881

Operation

- The instrument cluster receives (1) the vehicle speed signal from the PCM when the ignition is switched ON (engine on).
- The instrument cluster moves the needle based on the vehicle speed signal and displays (2) the current vehicle speed.



ac5wzn00000882

Fail-safe

- Function not equipped.

TACHOMETER

id092200032600

Purpose

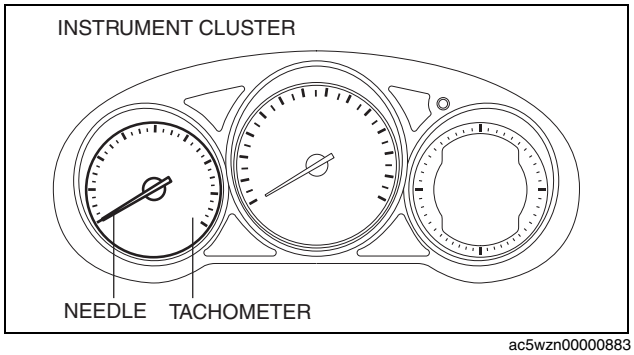
- The tachometer notifies the driver of the engine speed.

Function

- The instrument cluster controls the tachometer needle based on the engine speed signal from the PCM and displays the engine speed per minute.

Construction

- An analog needle display tachometer with a stepping motor mechanism has been adopted.

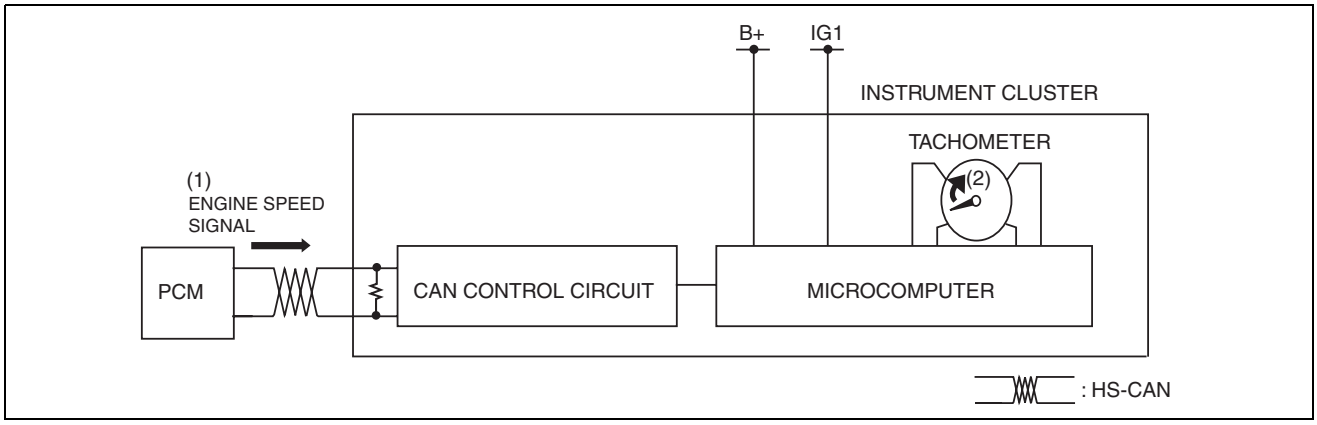


ac5wzn00000883

INSTRUMENTATION/DRIVER INFO.

Operation

- The instrument cluster receives (1) the engine speed signal from the PCM when the ignition is switched ON (engine on).
- The instrument cluster moves the needle based on the engine speed signal and displays (2) the current engine speed.



ac5wzn00000884

Fail-safe

- Function not equipped.

FUEL GAUGE

id092200032700

Purpose

- The fuel gauge notifies the user of the amount of remaining fuel.

Function

- The instrument cluster calculates the amount of fuel in the fuel tank based on the following CAN signals and displays the fuel gauge segments.
  - — Fuel gauge sender unit voltage signal sent from rear body control module (RBCM)
  - — Fuel injection amount signal, vehicle speed signal sent from PCM

Fuel gauge flicker prevention function

- When the instrument cluster determines that the vehicle is being driven, it retards the response with which the calculated amount of fuel is reflected to the fuel gauge. As a result, fuel gauge flicker caused by the variation of fuel surface during driving is prevented.

Refuel determination function

- If the amount of fuel is changed by 5 L {1 US gal, 1 Imp gal}/2 L {0.5 US gal, 0.4 Imp gal}*1 or more while the vehicle is stopped, the instrument cluster determines that the vehicle is refueled and displays the fuel gauge segments based on the fuel gauge sender unit voltage signal from the rear body control module (RBCM).

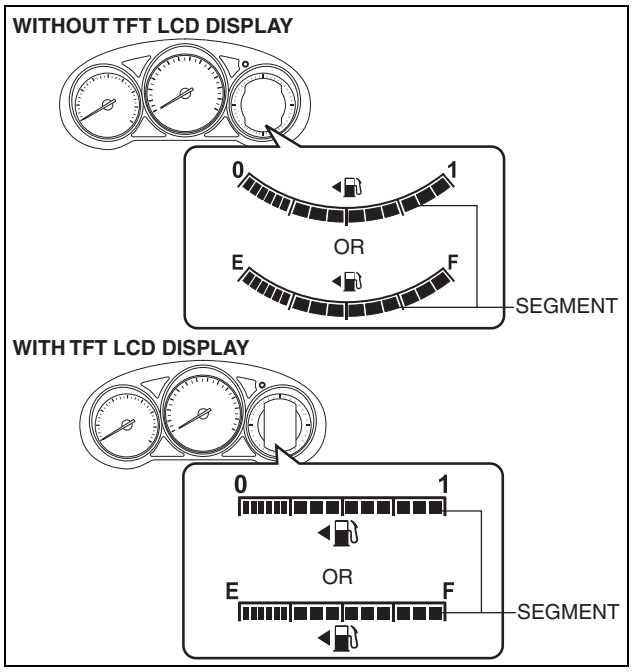
*1 : 5 L {1 US gal, 1 Imp gal} when the number of fuel gauge segments is 10 or less/2 L {0.5 US gal, 0.4 Imp gal} when the number of fuel gauge segments is 11 or more

Construction

- The fuel gauge is displayed in the LCD of the instrument cluster.

INSTRUMENTATION/DRIVER INFO.

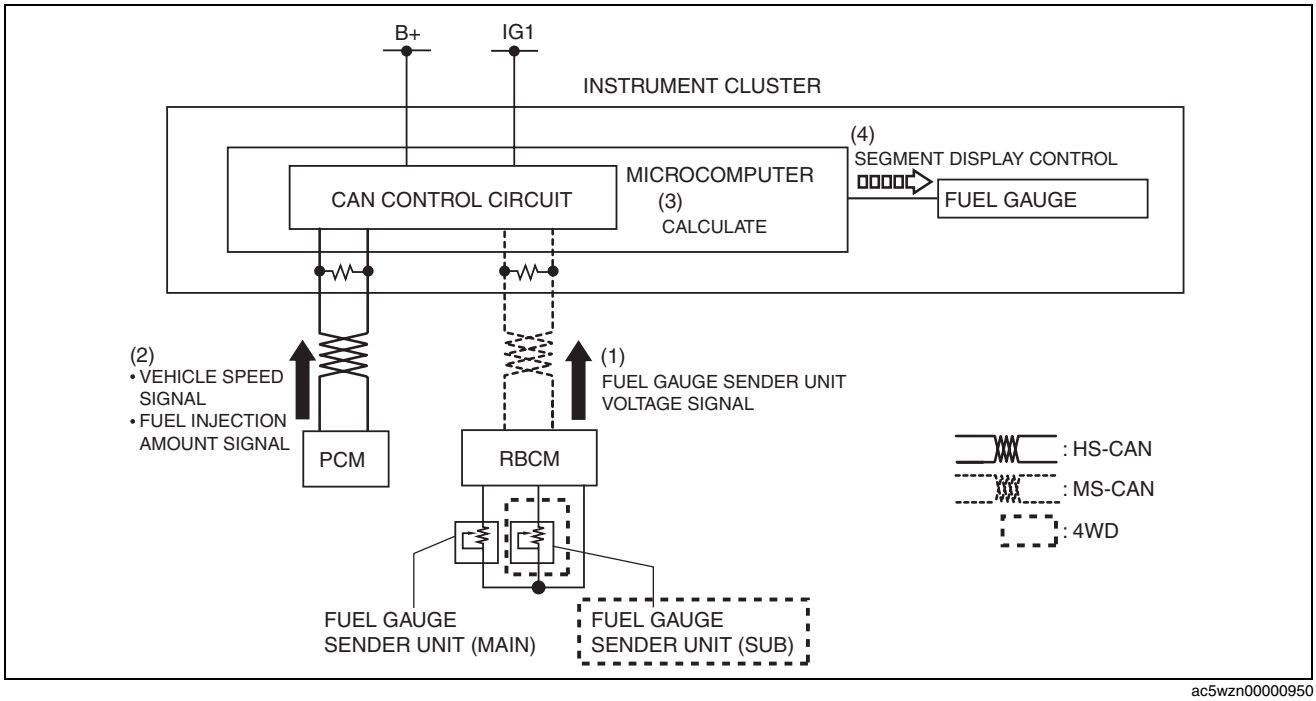
- The fuel gauge is consists of 15 segments.



ac5wzn00000949

Operation

1. When the ignition is switched ON (engine off or on), the rear body control module (RBCM) converts the resistance from the fuel gauge sender unit to voltage and sends it to the instrument cluster as a fuel gauge sender unit voltage signal (1).
2. The instrument cluster receives the fuel gauge sender unit voltage signal from the rear body control module (RBCM), and it also receives the fuel injection amount control signal and vehicle speed signal from the PCM (2).
3. The instrument cluster calculates the amount of fuel in the fuel tank based on the signals (3).
4. The instrument cluster displays/turns off the fuel gauge segments according to the calculation result (4).



ac5wzn00000950

Fail-safe

- Function not equipped.

INSTRUMENTATION/DRIVER INFO.

ODOMETER/TRIPMETER

id092200032900

Purpose

- The odometer/tripmeter notifies the user of the total travel distance or the traveled distance over a specific interval.

Function

- The instrument cluster calculates the traveled distance based on the traveled distance signal from the PCM and displays it.
- The instrument cluster stores the calculated travel distance in the microcomputer of the instrument cluster.

Odometer calculation function

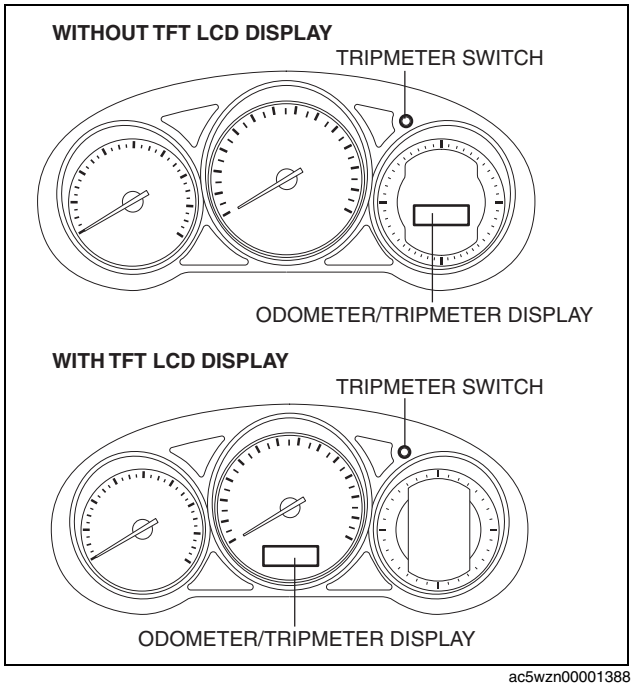
- The instrument cluster calculates the total traveled distance based on the traveled distance signal from the PCM and the stored traveled distance, and displays it.
- The total traveled distance which can be displayed is from 0 to 999,999.

Tripmeter A/B calculation function

- The instrument cluster calculates the traveled distance based on the traveled distance signal from the PCM and the traveled distance from when the tripmeter is reset, and displays it.
- There are A and B tripmeters and the display for each can be switched with each press of the tripmeter switch.
- If the tripmeter switch is continuously pressed for **approx. 1 s or more**, the tripmeter traveled distance is reset (0.0)
- The traveled distance which can be displayed is from 0.0 to 999.9. After 999.9, it returns to 0.

Construction

- The odometer/tripmeter is displayed in the LCD of the instrument cluster.
- The tripmeter switch is installed to the instrument cluster.
- The calculation for the odometer/tripmeter display and the traveled distance is performed by the instrument cluster microcomputer.



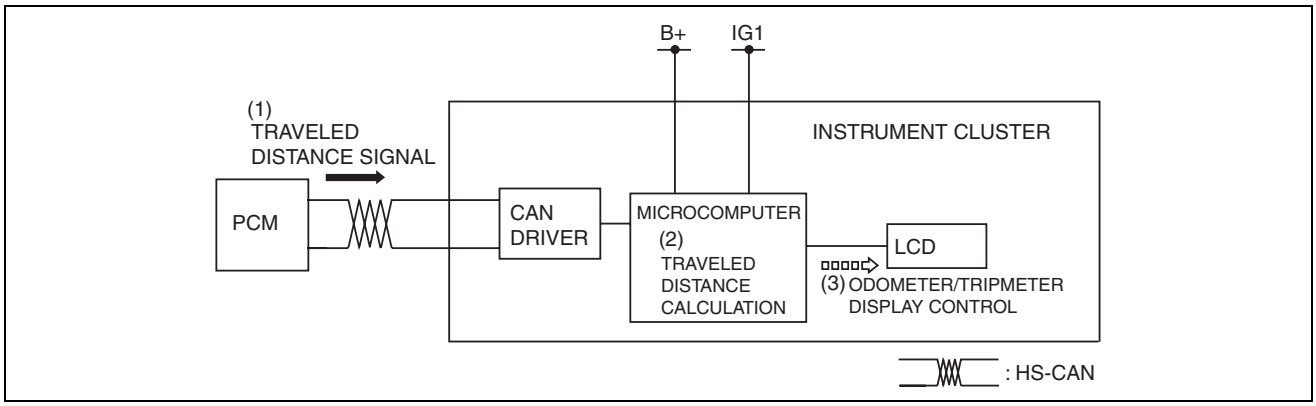
ac5wzn00001388

Operation

1. The instrument cluster receives (1) the traveled distance signal from the PCM when the ignition is switched ON (engine on).
2. The instrument cluster calculates the traveled distance (2) in the recorded total traveled distance (odometer) data and the traveled distance over a specific interval (tripmeter) based on the received traveled distance signal.

INSTRUMENTATION/DRIVER INFO.

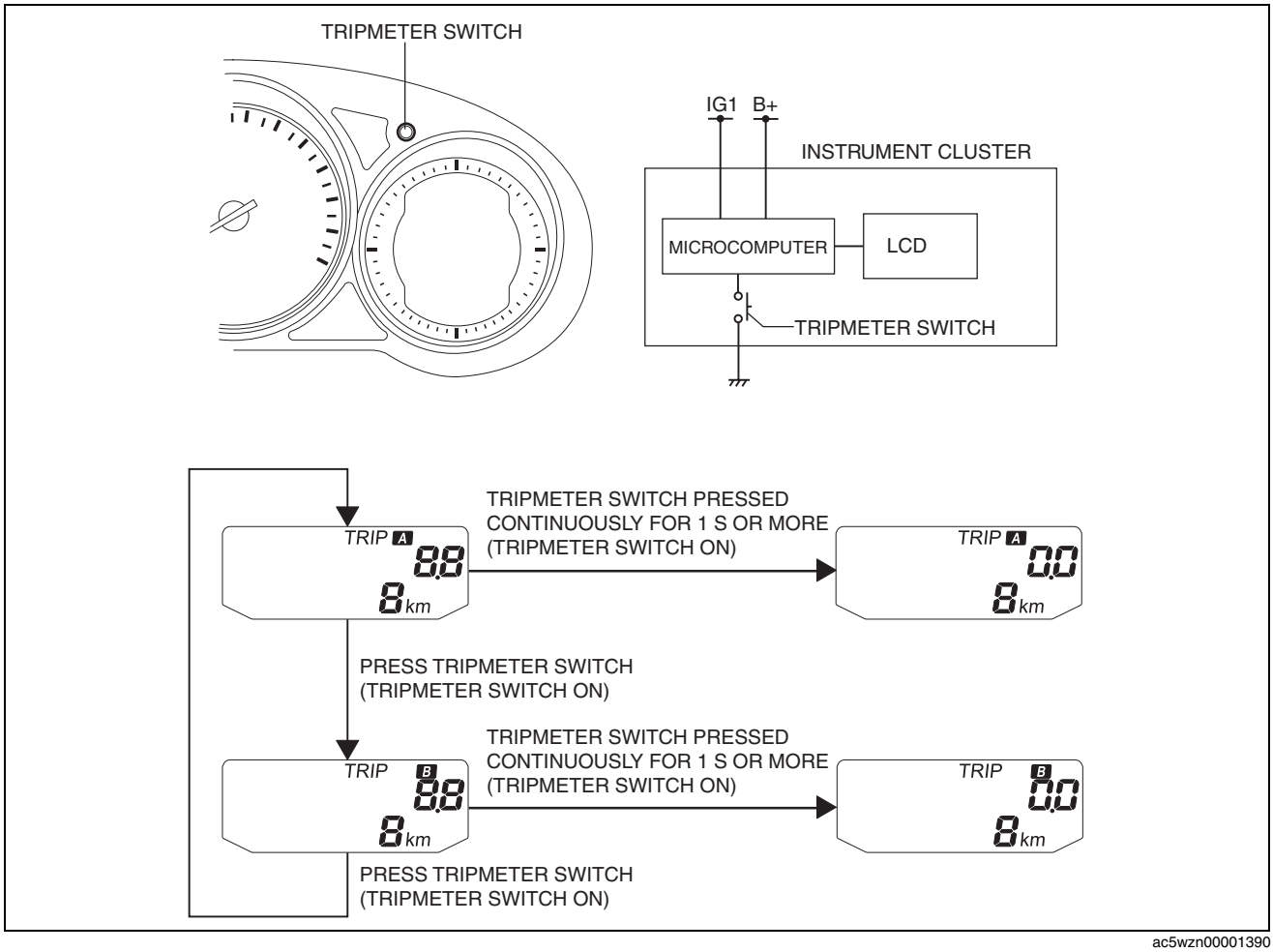
3. The instrument cluster displays (3) the calculated travel distance in the LCD.



ac5wzn00001389

Odometer/tripmeter switching operation

- The instrument cluster switches the odometer/tripmeter display when a tripmeter switch ON is detected.
- The instrument cluster returns the traveled distance display to 0.0 when a tripmeter switch ON is detected for 1 s or more while tripmeter A or B is displayed.



ac5wzn00001390

Fail-safe

- Function not equipped.

PANEL LIGHT

id092200033000

Purpose

- The panel light adjusts the instrument cluster and steering switch illumination brightness.

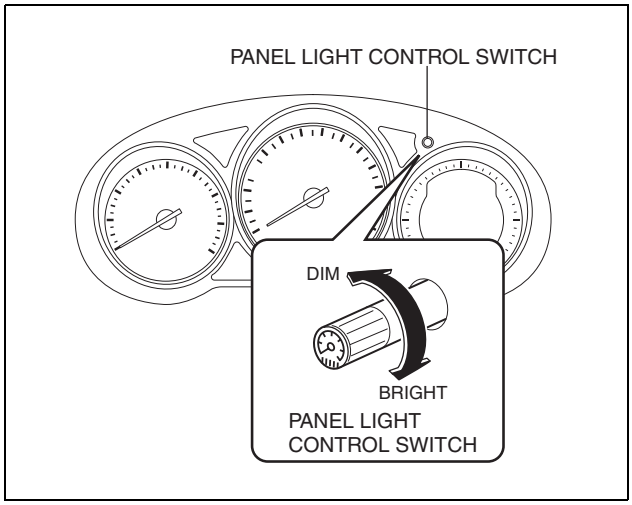
INSTRUMENTATION/DRIVER INFO.

Function

- The instrument cluster adjusts the brightness of the following illumination lights when a TNS illumination signal sent via CAN transmission from the front body control module (FBCM) is received.
  - — Instrument cluster
  - — Climate control unit
  - — Steering switch
  - — Cluster switch
  - — Hazard warning switch
  - — Selector illumination
  - — Audio unit
  - — Commander switch
  - — Clock (with manual A/C)
- The instrument cluster changes the brightness of the illumination lights according to the rotation signal of the panel light control switch.

Construction

- The panel light control switch is set in the instrument cluster.



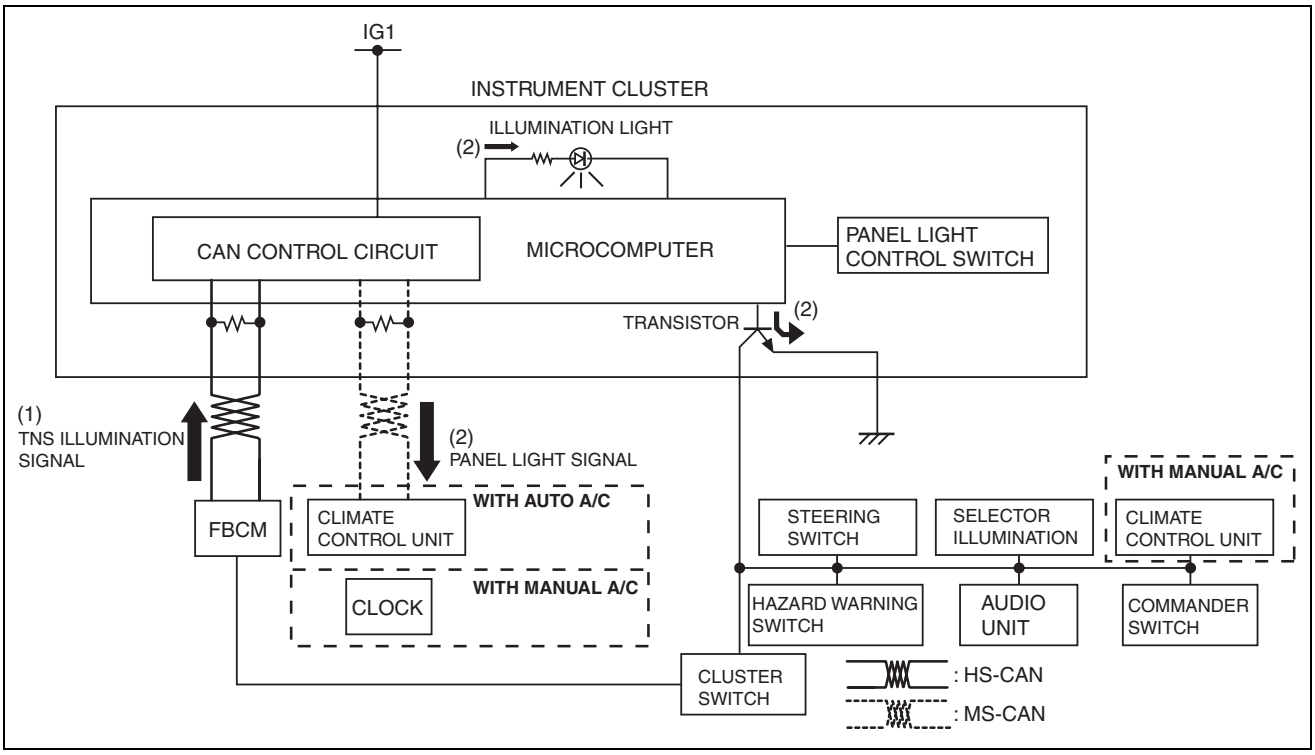
ac5wzn00000885

Operation

1. When the ignition is switched ON (engine off or on), the instrument cluster receives (1) the TNS illumination signal from the front body control module (FBCM).
2. The instrument cluster performs the following controls when it receives the TNS illumination signal.
   - — Changes the brightness of the instrument panel illumination.
   - — Outputs a panel light signal via CAN signal to the climate control unit (with auto A/C)/clock (with manual A/C).
   - — Turns on the panel light circuit transistor.

INSTRUMENTATION/DRIVER INFO.

3. When the transistor turns on, a ground circuit with the panel light is established and the panel light illuminates.



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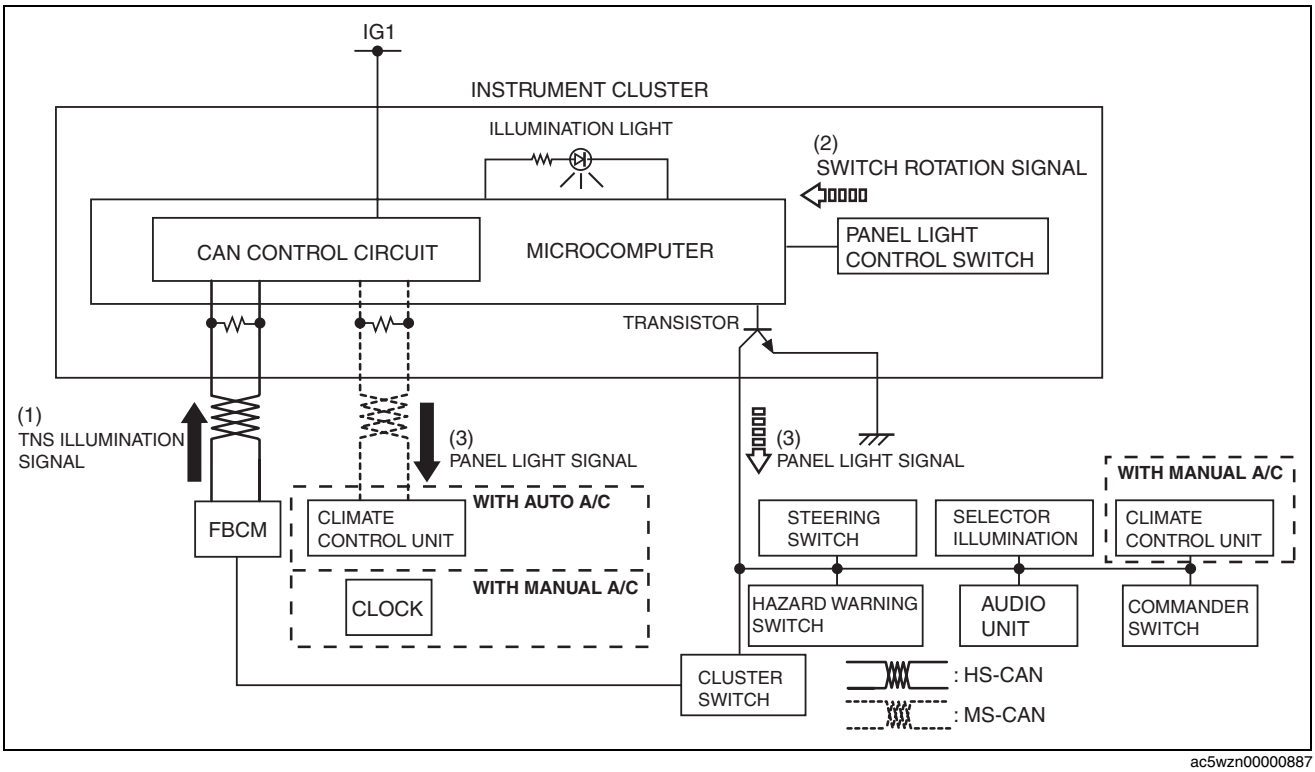
Panel light control switch operation

1. When the ignition is switched ON (engine off or on), the instrument cluster receives (1) the TNS illumination signal from the front body control module (FBCM).
2. The instrument cluster changes the brightness of the panel light according to the rotation angle when it receives a panel light control switch rotation signal while receiving the TNS illumination signal.
3. The instrument cluster outputs a panel light signal to related units.



ac5wzn00000887

INSTRUMENTATION/DRIVER INFO.

Fail-safe
- Function not equipped.

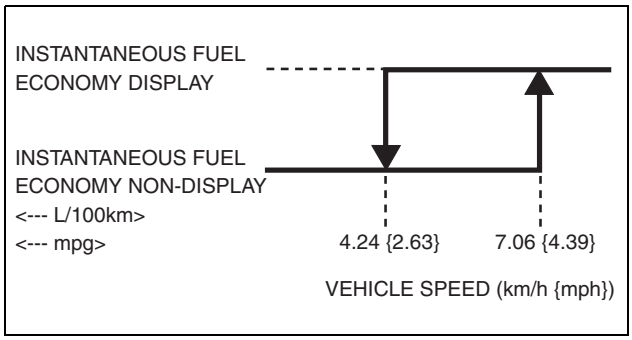
TRIP COMPUTER INFORMATION SYSTEM

id092200018000

Outline
- The trip computer system displays the instantaneous fuel economy, average fuel economy, remaining distance to empty, average vehicle speed and the vehicle speed alarm.
- The instrument cluster performs trip computer system fail-safe. (See 09-22-9 INSTRUMENT CLUSTER.)

Function
- The instrument cluster controls the trip computer system based on the following CAN signals.
  - — Vehicle speed signal, fuel injection amount signal, traveled distance signal sent from PCM
  - — Fuel gauge sender unit voltage signal sent from rear body control module (RBCM)
  - — Steering switch operation signal sent from start stop unit

Instantaneous fuel economy calculation function
- The instrument cluster calculates the instantaneous fuel economy based on the fuel consumption and traveled distance over the past 2 s when the vehicle speed is at the set value or more. In addition, the calculation results are updated every 2 s.
  Instantaneous fuel economy formula
  - — A type or B type and with TFT LCD display: Instantaneous fuel economy (L/100 km) = Fuel consumption (L) over past 2 s ×100 / Traveled distance (km) over past 2 s
  - — C type: Instantaneous fuel economy (mpg) = Traveled distance (mile) over past 2 s / Fuel consumption (gallon) over past 2 s
- When there is no fuel consumption, such as during engine braking, <0.0 L/100 km> or <99.9 mpg> is displayed.
- The instantaneous fuel economy is displayed when the vehicle speed is 7.06 km/h {4.39 mph} or more, and <--- L/100 km> or <--- mpg> is displayed when the vehicle speed is 4.24 km/h {2.63 mph} or less.



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Average fuel economy calculation function
- The instrument cluster calculates the average fuel economy based on the traveled distance and fuel consumption from connecting the battery or resetting the average fuel economy. In addition, the calculation results are updated every minute.
  Average fuel economy formula
  - — A type or B type and with TFT LCD display: Average fuel economy (L/100 km) = Cumulative fuel consumption *1 (L) × 100 / Cumulative traveled distance *2 (km)
  - — C type: Average fuel economy (mpg) = Cumulative traveled distance *1 (mile) / Cumulative fuel consumption *2 (gallon)
- If the cumulative traveled distance is 0 km, <99.9 L/100 km> or <0.0 mpg> is displayed.
- If the INFO switch is pressed for approx. 1.5 s or more while the average fuel economy is displayed, the cumulative fuel economy and cumulative traveled distance data are reset.
- If tripmeter A is reset, the average fuel economy is also reset.
- During the 1 min period after the data has been reset, <--- L/100 km> or <--- mpg> is displayed.

*1 : Sum of fuel economy of vehicle to present
*2 : Sum of traveled distance of vehicle to present

Remaining travel distance calculation function
- The instrument cluster calculates the remaining travel distance based on the instantaneous fuel economy, cumulative fuel economy *1 and the fuel tank level. In addition, the calculation results are updated every second.

Remaining travel distance formula

— A type or B type and with TFT LCD display: Remaining travel distance (km) = Fuel tank level (L) / cumulative fuel economy (L/km) × (1500-1)/1500 + instantaneous fuel economy (L/km) in past 0.1 km interval / 1500

— C type: Remaining travel distance (miles) = Fuel tank level (L) / cumulative fuel economy (L/mile) × (1500-1)/1500 + instantaneous fuel economy (L/mile) in past 0.06 mile interval / 1500

*1 : Sum of fuel economy every 0.1 km

Average vehicle speed calculation function

- The instrument cluster calculates the average vehicle speed based on the cumulative traveled distance and cumulative traveled time from connecting the battery or resetting the average vehicle speed. In addition, the calculation results are updated every 10 s.

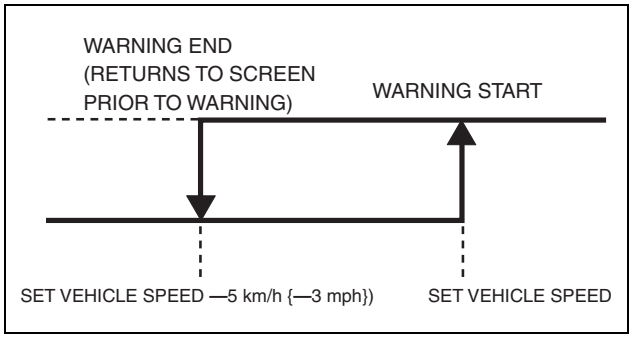
  Average vehicle speed formula

  — A type or B type and with TFT LCD display: Average vehicle speed (km/h) = Cumulative traveled distance (km) / cumulative traveled time (h)

  — C type: Average vehicle speed (mph) = Cumulative traveled distance (mile) / cumulative traveled time (h)
- If the INFO switch is pressed for approx.1.5 s or more while the average vehicle speed is displayed, the average vehicle speed (cumulative traveled distance and cumulative traveled time data) is reset.
- During the 1 min period after the data has been reset, <--- km/h> or <--- mph> is displayed.

Vehicle speed alarm function

- The instrument cluster compares the current vehicle speed with the speed set by the user and if the current vehicle speed exceeds the set vehicle speed, the alarm is triggered.
- The set vehicle speed can be set in 10 km/h {10 mph} increments between 30 km/h—250 km/h {20 mph—150 mph}.
- If the vehicle speed alarm is not set, <--- km/h> or <--- mph> is displayed.
- The instrument cluster outputs a warning display and warning sound when the current vehicle speed is the same as the set vehicle speed.
- The instrument cluster switches the warning display back to the screen prior to the warning display when the current vehicle speed is -5 km/h {-3 mph} or less than the set vehicle speed.



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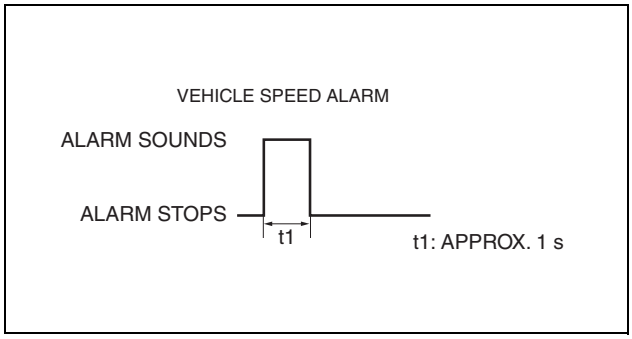
- The alarm sound pattern is as follows:



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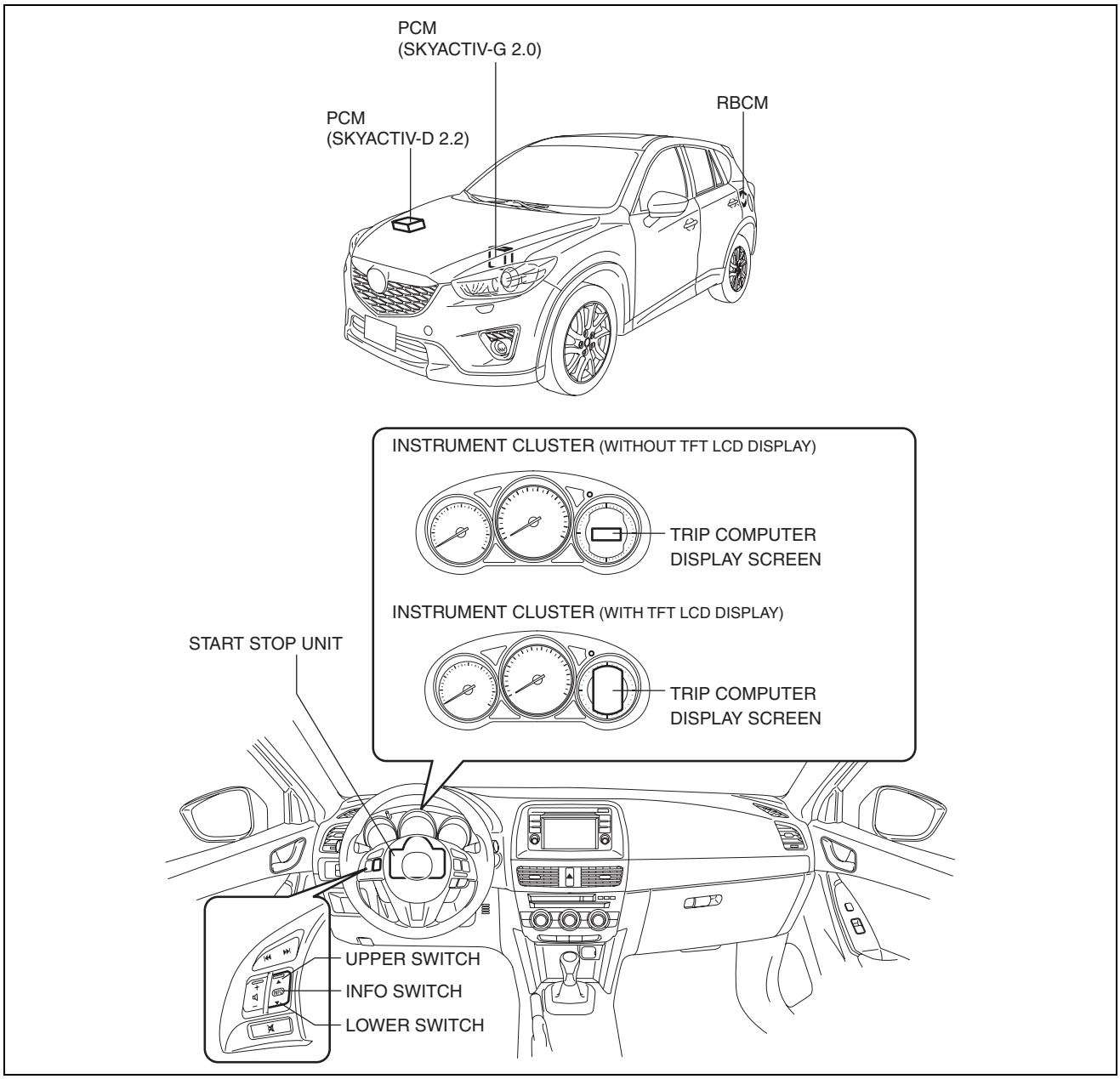
INSTRUMENTATION/DRIVER INFO.

Structural view



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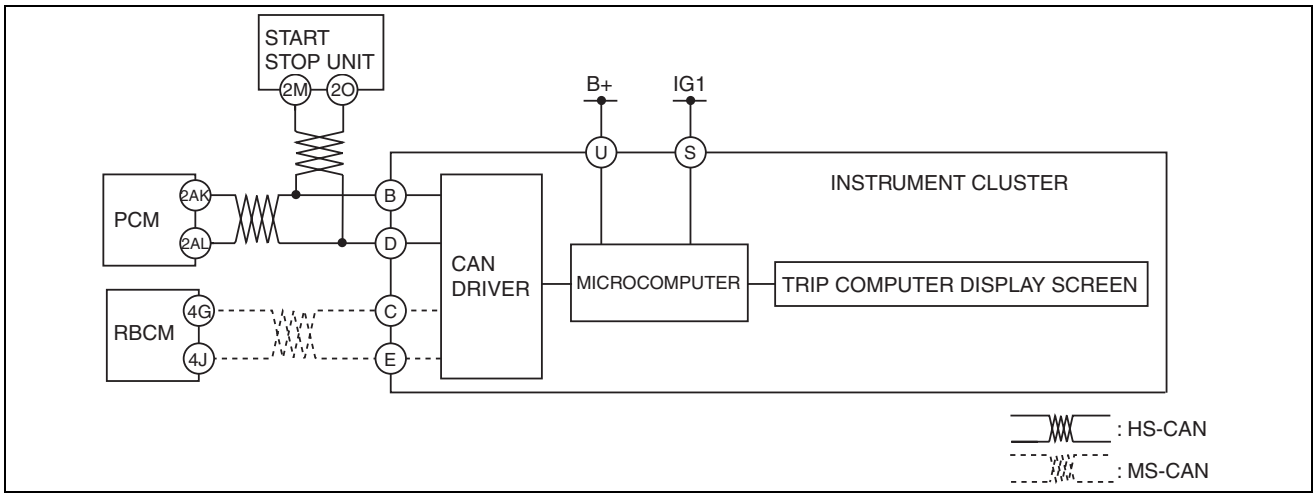
INSTRUMENTATION/DRIVER INFO.

System wiring diagram



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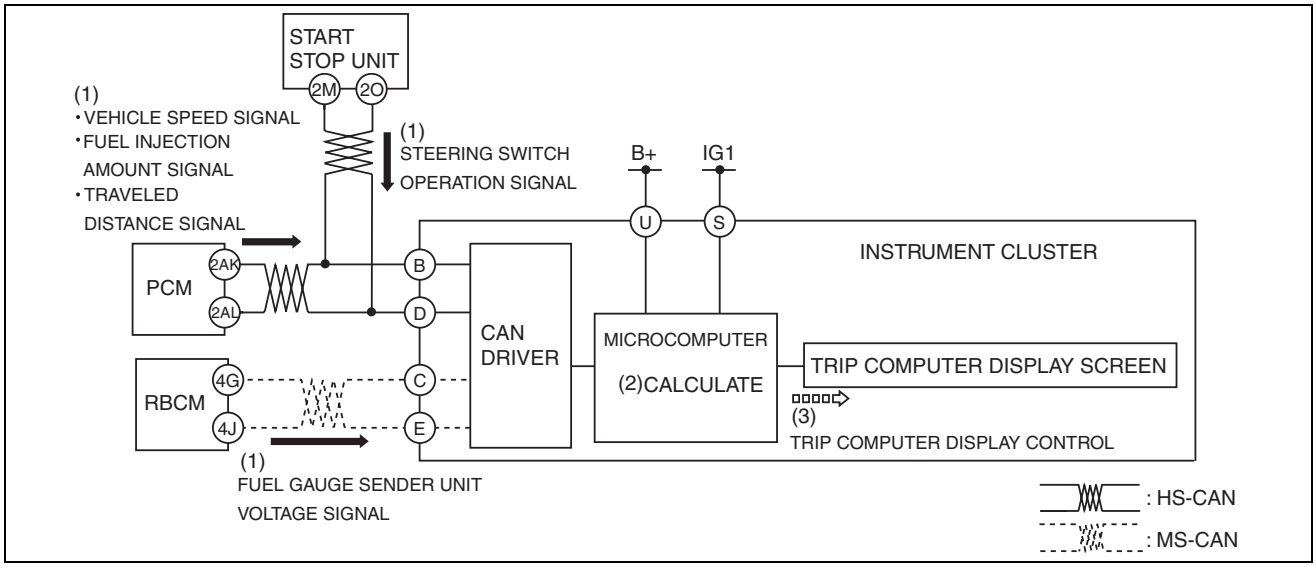
Operation

1. When the ignition is switched ON (engine on), the instrument cluster receives (1) the vehicle speed signal, fuel injection amount signal, traveled distance signal from the PCM, the fuel gauge sender unit voltage signal from the rear body control module (RBCM), and the steering switch operation signal from the start stop unit.
2. The instrument cluster microcomputer calculates (2) the instantaneous fuel economy and average fuel economy based on the received data.
3. The instrument cluster microcomputer displays (3) the calculated results in the trip computer display screen.



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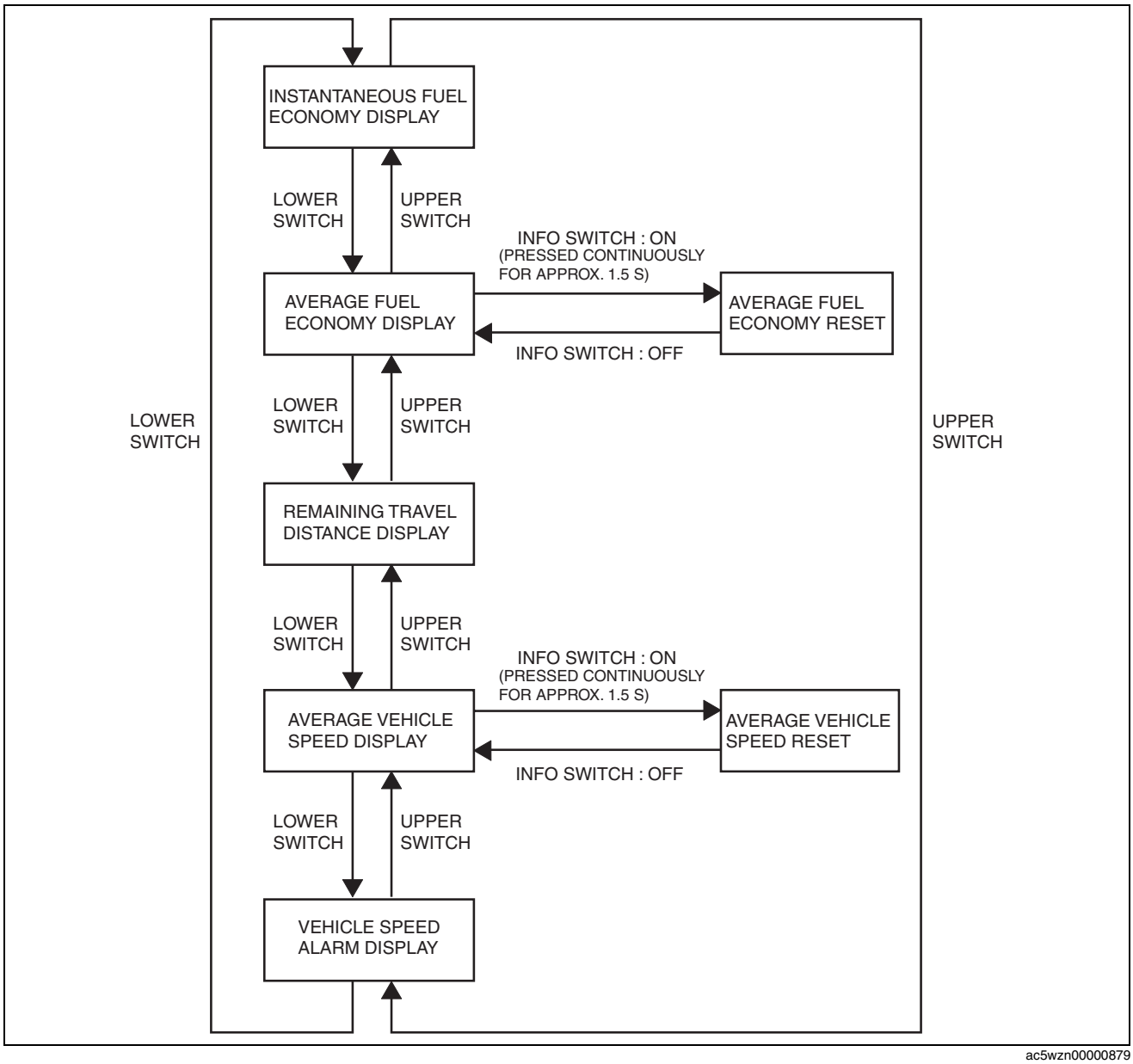
Trip computer display switching operation

- The instrument cluster switches the trip computer display content as follows based on the steering switch operation signal from the start stop unit.

INSTRUMENTATION/DRIVER INFO.



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INSTRUMENTATION/DRIVER INFO.

Display screen table

WITHOUT TFT LCD DISPLAY

	INSTANTANEOUS FUEL ECONOMY	AVERAGE FUEL ECONOMY	REMAINING TRAVEL DISTANCE	AVERAGE VEHICLE SPEED	VEHICLE SPEED ALARM
A TYPE	10.5 L/100km	Ø 10.5 L/100km	160 km	Ø 40 km/h	100 km/h
B TYPE	CURRENT 10.5 L/100km	AVG 10.5 L/100km	RANGE 100 km	AVG 40 L/100km	—
C TYPE	22.4 mpg	Ø 22.4 mpg	160 miles	Ø 25 mph	80 mph

WITH TFT LCD DISPLAY

INSTANTANEOUS FUEL ECONOMY	AVERAGE FUEL ECONOMY	REMAINING TRAVEL DISTANCE	AVERAGE VEHICLE SPEED	VEHICLE SPEED ALARM
Consumption 10.5 L/100km	Consumption Ø 10.5 L/100km	Range 160 km	Speed Ø 40 km/h	Speed Warning 100 km/h

ac5wzn00000880

LIQUID CRYSTAL DISPLAY (LCD)

id092200103500

Outline

- The LCD displays vehicle information in the instrument cluster.

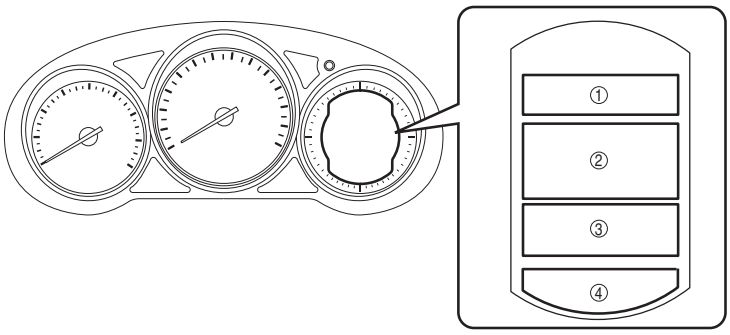
Function/Construction

- The instrument cluster configures the indication of the LCD based on the CAN signals sent from the related modules and displays it.
- Two types of LCDs, LCD and TFT LCD, are available.

LCD indication table

Without TFT LCD display

- Information displayed on the LCD and the display areas are as follows: Refer to the referenced section for details of the displayed information.



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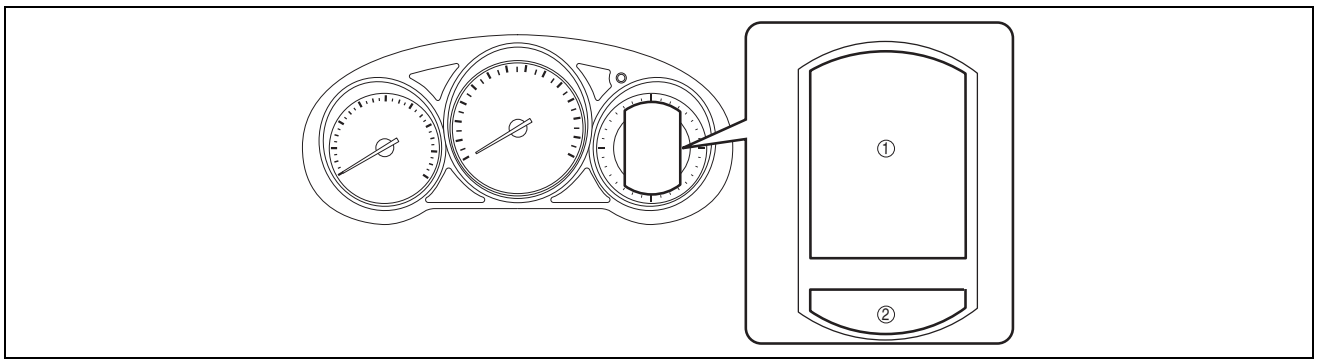
Display area	Display information	Reference
1	Ambient temperature is displayed.	(See 09-22-66 AMBIENT TEMPERATURE DISPLAY.)
2	Trip computer is displayed.	(See 09-22-56 TRIP COMPUTER INFORMATION SYSTEM.)
3	Odometer/tripmeter is displayed.	(See 09-22-52 ODOMETER/TRIPMETER.)
4	Amount of remaining fuel is displayed.	(See 09-22-50 FUEL GAUGE.)

INSTRUMENTATION/DRIVER INFO.

Wit TFT LCD display

- Information displayed on the LCD and the display areas are as follows: Refer to the referenced section for details of the displayed information.



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Display area	Display information	Function
1	Trip computer is displayed.	(See 09-22-56 TRIP COMPUTER INFORMATION SYSTEM.)
1	Ambient temperature is displayed.	(See 09-22-66 AMBIENT TEMPERATURE DISPLAY.)
1	Door-ajar warning is displayed.	(See 09-22-72 DOOR AJAR WARNING DISPLAY.)
1	Screen for personalization settings is displayed.	(See 09-22-8 INSTRUMENTATION/DRIVER INFO. PERSONALIZATION.)
1	Displays a maintenance setting and maintenance-related messages.	• When the maintenance period which recorded in the instrument cluster based on the maintenance setting approaches, the following messages are displayed. — Scheduled Maintenance Due* — Tyre Rotation Due* — Oil Change Due* — Tyre Pressure Increase Pressure*
1	Messages for the following systems are displayed. **Note** • If message requests are received from multiple modules, the messages are displayed at certain intervals.	
1	**Engine system** — Engine Inspection Required* — Engine Oil Pressure Inspection Required* — Engine Coolant Temperature High* — Stop Vehicle at safe area* — Vehicle System Inspection Required* — Soot Accumulation in DPF too high* — DPF Inspection Required* — Drain Water from Fuel Filter* — Brake Override System Inspection Required*	(See 01-02-29 CHECK ENGINE LIGHT [SKYACTIV-G 2.0].) (See 09-22-41 ENGINE OIL WARNING LIGHT.) (See 09-22-37 LOW ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (BLUE)/HIGH ENGINE COOLANT TEMPERATURE WARNING LIGHT (RED).) (See 01-40-16 DRIVE-BY-WIRE CONTROL [SKYACTIV-G 2.0].)
1	**Battery system** — Charging System Inspection Required* — Battery Management System Inspection Required*	(See 01-17A-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-G 2.0].) (See 01-17B-5 CHARGING SYSTEM WARNING LIGHT [SKYACTIV-D 2.2].) (See 01-40-41 GENERATOR CONTROL [SKYACTIV-G 2.0].)
1	**EPS system** — Power Steering System Inspection Required*	(See 06-13-1 ELECTRIC POWER STEERING SYSTEM.)
1	**Tire pressure monitoring system (With TPMS)** — Check Tyre Pressure* — TPMS Inspection Required* — Tyre Pressure Monitor Initialized	(See 02-12-3 TIRE PRESSURE MONITORING SYSTEM (TPMS).)

INSTRUMENTATION/DRIVER INFO.

Display area	Display information	Function
1	**Brake system** — Brake Fluid Level Low* — Brake Inspection Required* — Release Parking Brake*	(See 04-15-42 BRAKE SYSTEM/ABS WARNING LIGHT.) (See 09-22-71 PARKING BRAKE WARNING DISPLAY.)
1	**Smart city brake support (With SCBS)** — SCBS Automatic Brake — SCBS Inspection Required* — SCBS Clear windshield completely*	(See 04-15-28 SMART CITY BRAKE SUPPORT (SCBS).)
1	**Automatic transaxle (ATX)** — Auto trans System Inspection Required*	(See 05-17A-66 AUTOMATIC TRANSAXLE WARNING LIGHT [FW6A-EL, FW6AX-EL].) (See 05-17B-67 AUTOMATIC TRANSAXLE WARNING LIGHT [GW6A-EL, GW6AX-EL].)
1	**4WD system (4WD)** — 4WD System Inspection Required* — Stop Vehicle at safe area*	(See 03-18-9 4WD WARNING LIGHT.)
1	**i-stop system** — Ready Apply more Brake Pressure — Can't be activated Turn Steering Wheel to Neutral — Can't be activated Air Conditioning has Priority — Can't be activated. Steering wheel Brake Air Conditioning — Please Restart Engine	(See 09-22-67 i-stop GUIDANCE DISPLAY.) (See 09-22-69 i-stop EFFECT DISPLAY.)
1	**Advanced keyless entry system (With advanced keyless entry system)/Keyless entry system (without advanced keyless entry system)/Push button start system** — Keyless System Inspection Required* — Set Power to OFF* — Key not found* — Depress the Brake Pedal and Touch the Key to the Start Button — Depress the Clutch Pedal and Touch the Key to the Start Button — Key Battery is low — Set Shift Lever to “P“ — To start, step on Brake Pedal and press Start Button — To start, step on Clutch Pedal and press Start Button — Turn the Steering Wheel left and right and press the Start Button	(See 09-14-37 ADVANCED KEYLESS ENTRY SYSTEM.) (See 09-14-32 KEYLESS ENTRY SYSTEM.) (See 09-14-47 PUSH BUTTON START SYSTEM [KEYLESS ENTRY SYSTEM].) (See 09-14-52 PUSH BUTTON START SYSTEM [ADVANCED KEYLESS ENTRY SYSTEM].)
1	**High beam control (HBC) system (with HBC)** — HBC Inspection Required* — FSC Inspection Required* — HBC, LDWS Defog windshield completely — HBC, LDWS Clear windshield completely	(See 09-18-50 HIGH BEAM CONTROL (HBC) SYSTEM.)
1	**Washer system** — Refill w/screen washer *	(See 09-19-55 WASHER FLUID-LEVEL SENSOR.)

INSTRUMENTATION/DRIVER INFO.

Display area	Display information	Function
1	**Lane departure warning system (LDWS) (with LDWS)** — LDWS Inspection Required* — FSC Inspection Required* — HBC, LDWS Defog windshield completely — HBC, LDWS Clear windshield completely	(See 09-22-106 LANE DEPARTURE WARNING SYSTEM (LDWS).)
2	Amount of remaining fuel is displayed.	(See 09-22-50 FUEL GAUGE.) (See 09-22-70 FUEL TANK LEVEL WARNING DISPLAY.)

* : The master warning light illuminates simultaneously.

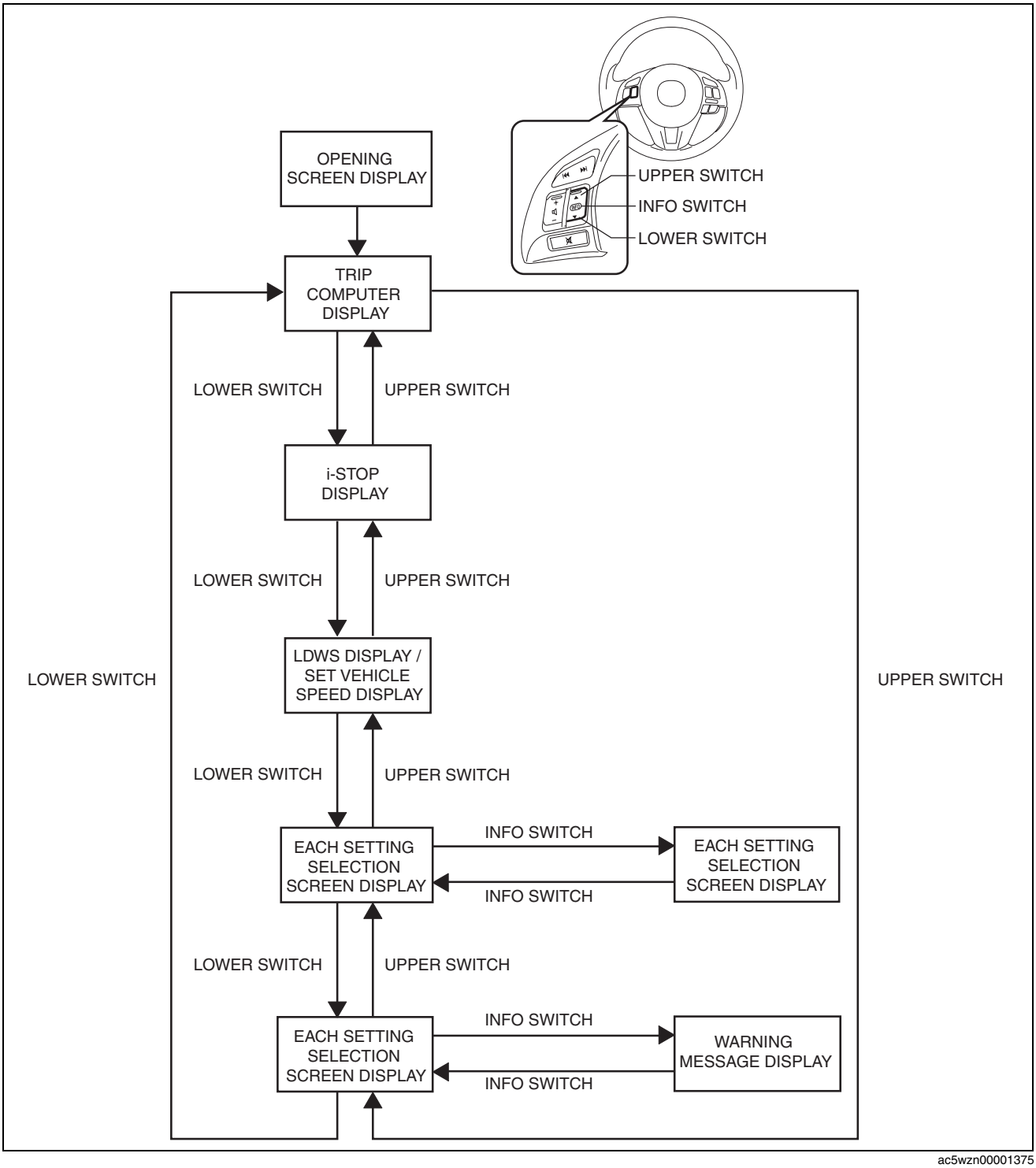
LCD display switch

- The instrument cluster switches the LCD display content as follows based on the steering switch operation signal from the start stop unit.
  Without TFT LCD display
  — Trip computer display is switched. Refer to 09-22-56 TRIP COMPUTER INFORMATION SYSTEM for details.

INSTRUMENTATION/DRIVER INFO.

With TFT LCD

— Display is changed as follows:



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TFT LCD display content data reset

Caution

- **The reset data cannot be recovered. When resetting data, explain the reset items to the customer and reset data after obtaining their consensus.**

- The following information displayed on the TFT LCD can be reset all at once. Refer to the Workshop Manual for the detailed resetting procedure.
  i-stop-related information
  — i-stop total time

— i-stop time

Trip computer-related information

— Average fuel economy
— Average vehicle speed
— TRIP value

AMBIENT TEMPERATURE DISPLAY

id092200021500

Purpose

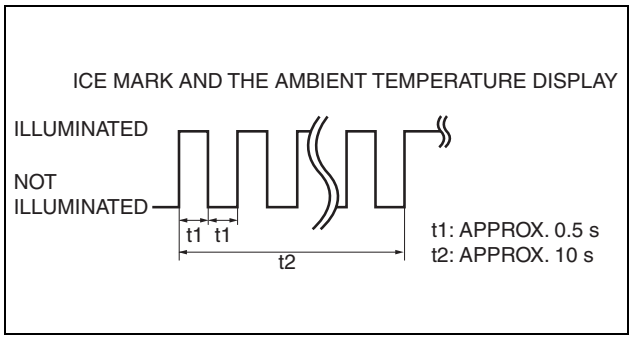
- The ambient temperature display notifies the user of the ambient temperature.

Function

- The instrument cluster displays the ambient temperature based on the ambient temperature signal sent from the PCM as a CAN signal.
- The ambient temperature is displayed between -40—70°C {-40—160°F} If the ambient temperature is -40°C {-40°F} or less, -40°C {-40°F} is displayed, and 70°C {160°F} is displayed if the temperature is 70°C {160°F} or more.

Road ice warning function

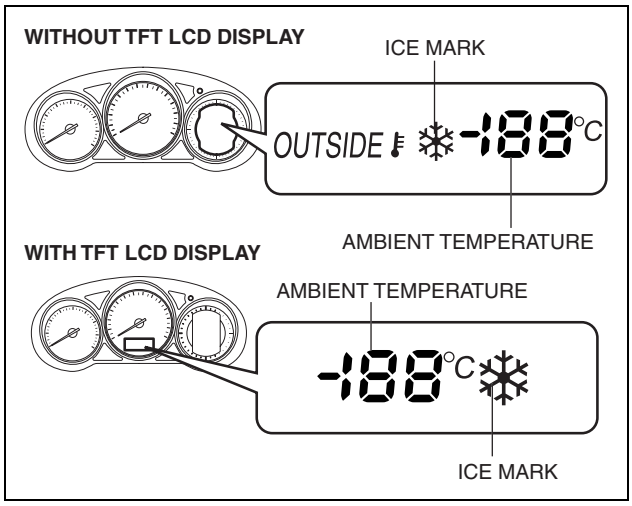
- When the instrument cluster receives an ambient temperature signal of 4°C {39°F} or less from the PCM, it displays the ice mark. After receiving the ambient temperature signal of 4°C {39°F} or more, it flashes the ice mark and the ambient temperature display for about 10 s to warn the user that the road surface may be icy.
- Once the instrument cluster performs the road ice warning, it will not perform it again until it receives an ambient temperature of 6°C {43°F} or more.
- The ice mark and ambient temperature flashing pattern is as indicated in the figure.



ac5wzn00001391

Construction

- The ambient temperature is displayed on the LCD in the instrument cluster.

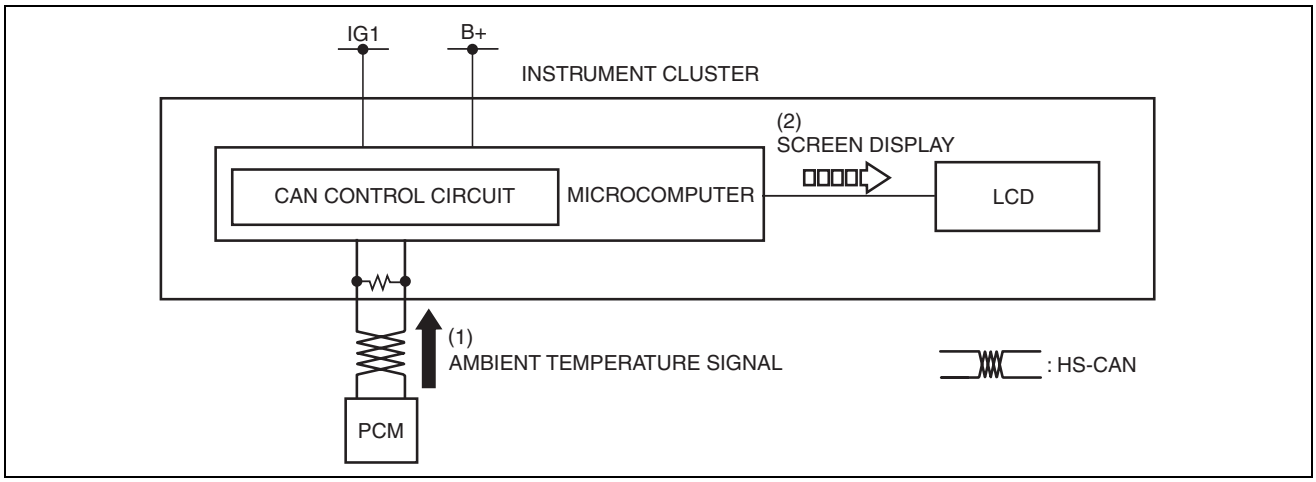


ac5wzn00001392

Operation

1. When the ignition is switched ON, the instrument cluster receives an ambient temperature signal from the PCM (1).
2. Based on the ambient temperature signal, the instrument cluster displays the ambient temperature and ice mark on the LCD.

INSTRUMENTATION/DRIVER INFO.



ac5wzn00001393

Fail-safe
- Function not equipped.

i-stop GUIDANCE DISPLAY

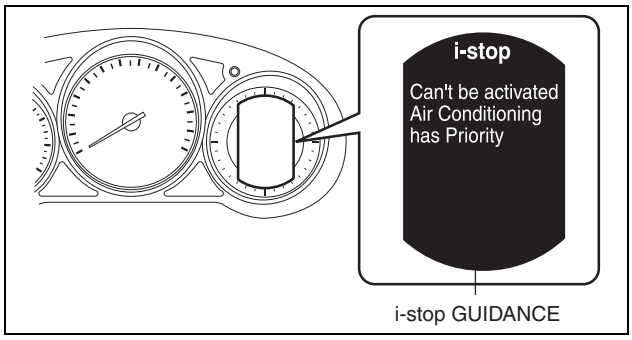
id092200025700

Purpose
- The i-stop guidance display informs the driver of the reason for not operating the i-stop (engine stop control) while the vehicle is being driven or is stopped.

Function
- The i-stop guidance displays the reason for not operating the i-stop engine stop control on the LCD based on the following CAN signals sent from the PCM or climate control unit while the i-stop effect screen is displayed.

CAN signal sending module	Signal name
PCM	• i-stop related information signal • Engine coolant temperature signal • Vehicle speed signal
Climate control unit	i-stop request (i-stop (engine stop control) inhibit command) signal

Construction
- The i-stop guidance is displayed in the LCD of the instrument cluster.
- The i-stop guidance display is performed by the instrument cluster microcomputer.
- The i-stop guidance which displays in the LCD is as follows:



ac5wzn00001461

INSTRUMENTATION/DRIVER INFO.

i-stop guidance display table

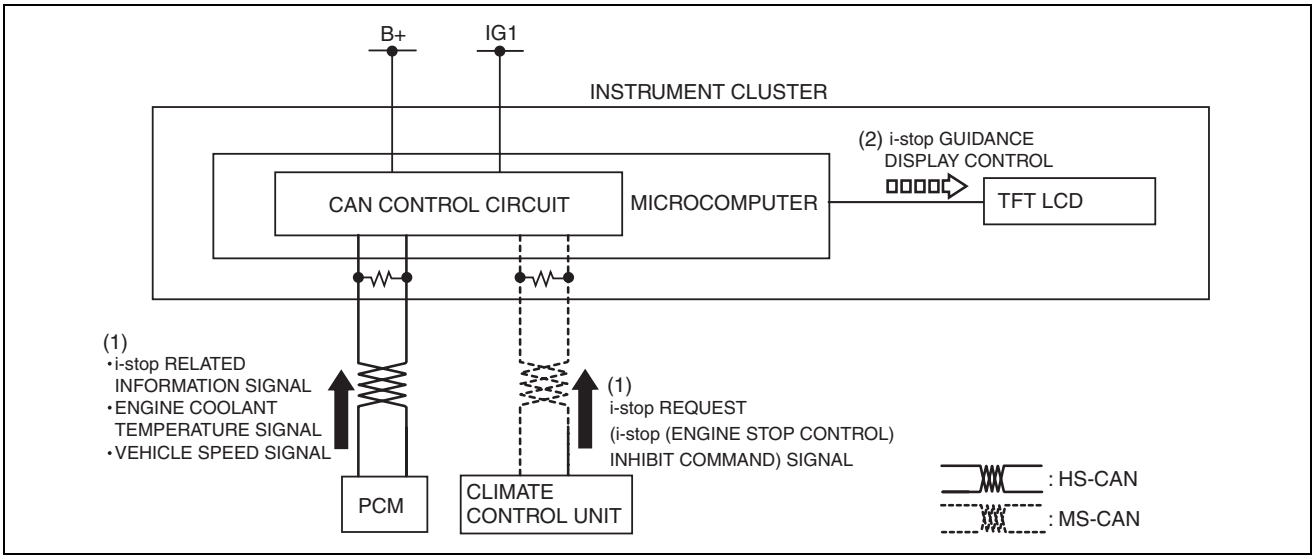
Indication on LCD	Content	Reference
	If an engine-stop by the i-stop control is attempted, the guidance indicates that the i-stop (engine stop control) inhibit conditions for the air conditioner system are met.	(See 07-40A-40 AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER].) (See 07-40B-18 AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER].)
	If an engine-stop by the i-stop control is attempted, the guidance indicates that the steering angle is not within the specification of the i-stop (engine stop control) control conditions.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)
	If an engine-stop by the i-stop control is attempted, the guidance indicates that the brake fluid pressure is not the specification or more for the i-stop (engine stop control) control conditions.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)
	Displays if several i-stop (engine stop control) control conditions for the steering angle, brake fluid pressure, and air conditioner system are not met.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].) (See 07-40A-40 AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER].) (See 07-40B-18 AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER].)
	Displays if several i-stop (engine stop control) control conditions for the brake fluid pressure and air conditioner system are not met.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].) (See 07-40A-40 AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER].) (See 07-40B-18 AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER].)
	Displays if several i-stop (engine stop control) control conditions for the steering angle and brake fluid pressure are not met.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)
	Displays if several i-stop (engine stop control) control conditions for the steering angle and air conditioner system are not met.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].) (See 07-40A-40 AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER].) (See 07-40B-18 AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER].)

INSTRUMENTATION/DRIVER INFO.

Please Restart Engine	Displays when the engine stalls, not the i-stop function operates.	(See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].)

Operation

1. The instrument cluster receives the CAN signal sent from the PCM or climate control unit.
2. The instrument cluster displays the i-stop guidance information in the LCD based on the received CAN signal.



ac5wzn00001470

Fail-safe

- Function not equipped.

i-stop EFFECT DISPLAY

id092200026100

Purpose

- The i-stop effect display informs the driver of i-stop effect information.

Function

- i-stop effect displays the i-stop total time, i-stop time, and current i-stop time based on the i-stop related information signal from the PCM.

i-stop total time

- i-stop total time is displayed as the total time at which the i-stop has operated.
- The range of i-stop total time is from 0 h 00 min to 1999 h 59 min.

i-stop time

- i-stop time is displayed as the total i-stop operation time from engine start (ignition switch: ON) to engine stop (ignition switch: OFF).
- The range of i-stop time is from 0 h 00 min 00 s to 99 h 59 min 59 s.

Current i-stop time

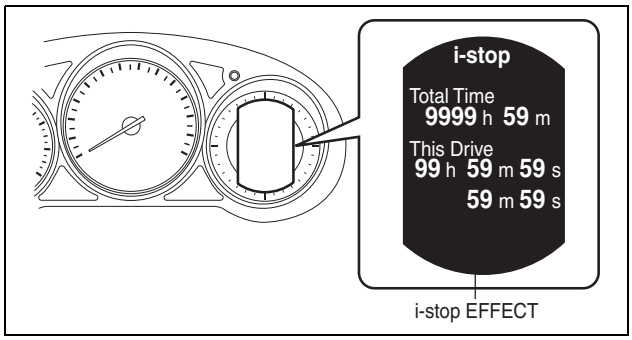
- Current i-stop time is displayed i-stop time at which the i-stop is operating.
- The range of the current i-stop time is from 0 min 00 s to 59 min 59 s.

Construction

- i-stop effect is displayed in the TFT LCD of the instrument cluster.
- i-stop effect display and time at i-stop calculations are performed by the instrument cluster microcomputer.

INSTRUMENTATION/DRIVER INFO.

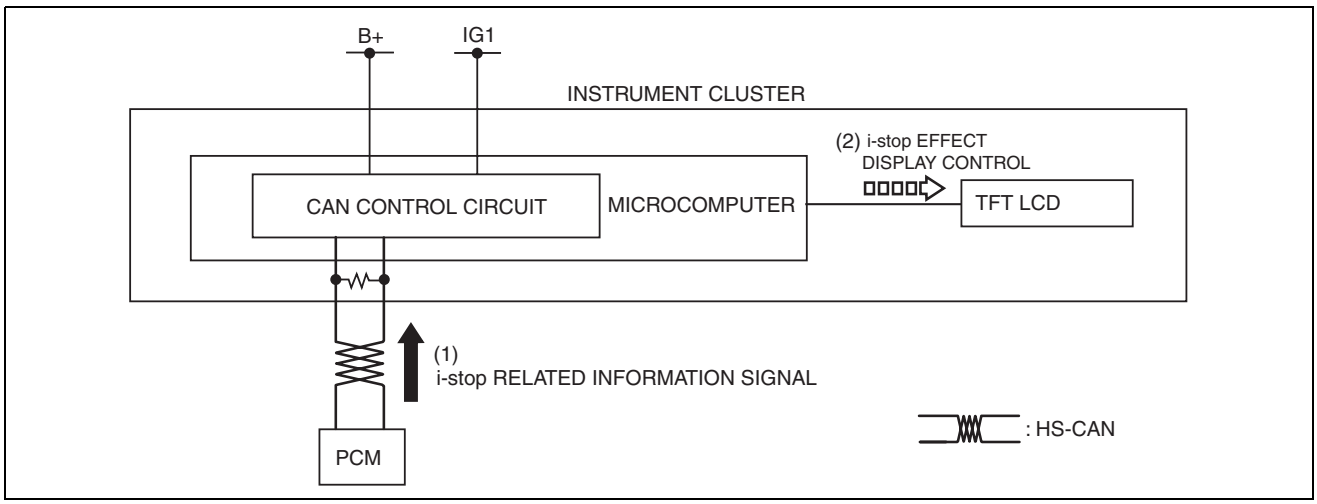
- When the ignition is switched ON (engine on), the i-stop time and total are displayed in the i-stop effect display.



ac5wzn00001476

Operation

1. The instrument cluster receives (1) the i-stop related information signal from the PCM via the CAN signal.
2. The instrument cluster calculates (2) the i-stop time based on the received i-stop related information signal.
3. The instrument cluster displays (3) the calculated i-stop effect information in the TFT LCD.



ac5wzn00001477

Fail-safe

- Function not equipped.

FUEL TANK LEVEL WARNING DISPLAY

id092200027100

Purpose

- The fuel tank level warning display notifies the driver that the remaining fuel level is low.

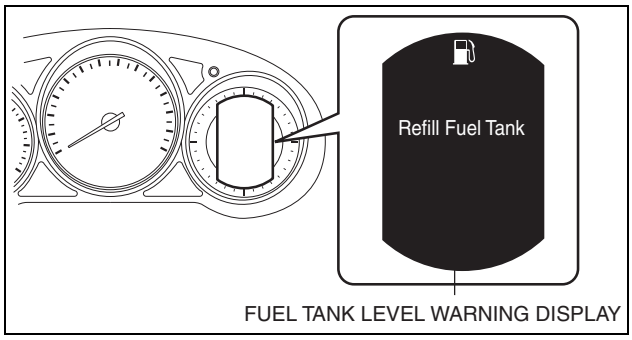
Function

- The instrument cluster calculates the fuel quantity based on the following CAN signals, and if a remaining fuel amount of approx. 10 L {11 US qt, 8.8 imp qt} (fuel gauge displays remaining two segments) is detected, the low fuel warning light illuminates.
  - — Fuel gauge sender unit voltage signal sent from rear body control module (RBCM)
  - — Fuel injection amount signal, vehicle speed signal sent from PCM

INSTRUMENTATION/DRIVER INFO.

Construction

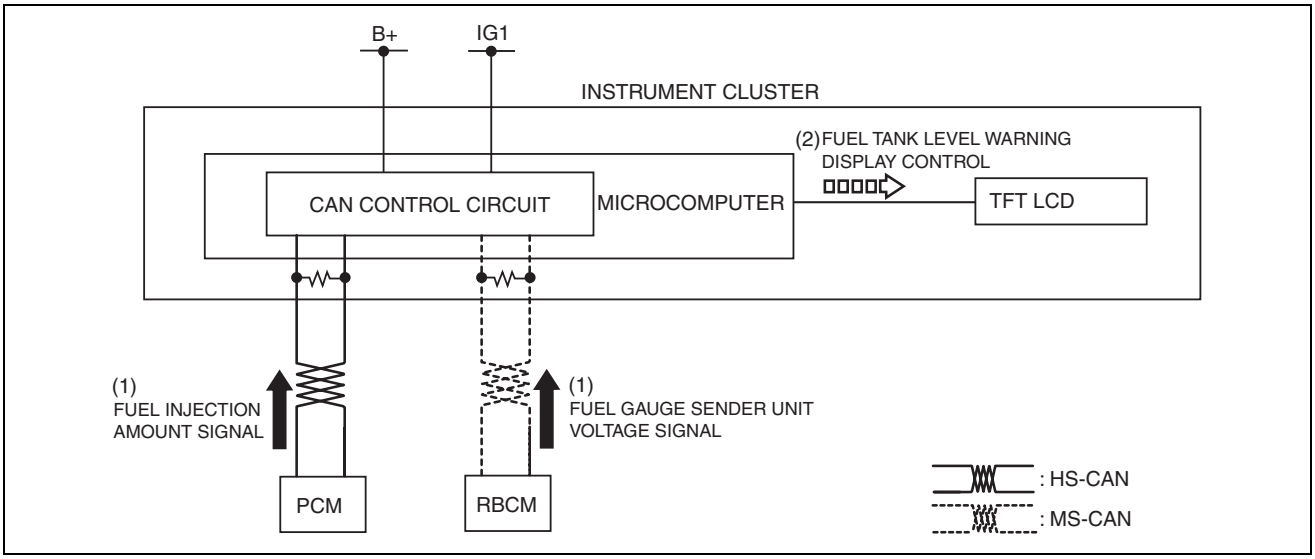
- The fuel tank level warning display is displayed in the TFT LCD of the instrument cluster.
- The fuel tank level warning display and value calculation are performed by the instrument cluster microcomputer.



ac5wzn00001427

Operation

1. When the ignition is switched ON (engine off or on) the instrument cluster receives (1) the fuel gauge sender unit voltage signal from the rear body control module (RBCM), and the fuel injection amount signal from the PCM.
2. The fuel tank level warning display is displayed in the TFT LCD (3) if the calculated remaining fuel amount based on each signal is approx. 10 L {11 US qt, 8.8 imp qt}.



ac5wzn00001428

Fail-safe

- Function not equipped.

PARKING BRAKE WARNING DISPLAY

id092200034600

Purpose

- The parking brake warning display warns the user that the parking brake is not released.

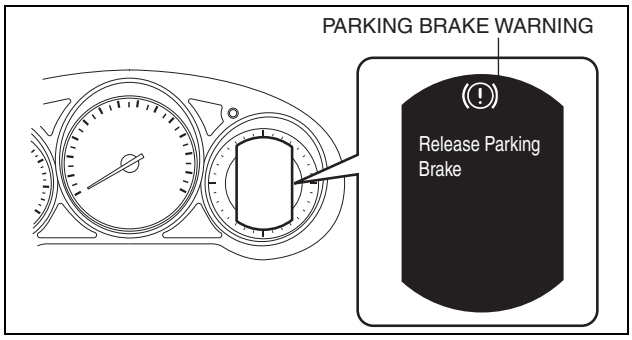
Function

- The instrument cluster displays the parking brake warning based on the following signals.
  - — Vehicle speed signal sent via CAN communication from PCM
  - — Parking brake switch ON signal (parking brake lever pulled)

INSTRUMENTATION/DRIVER INFO.

Construction

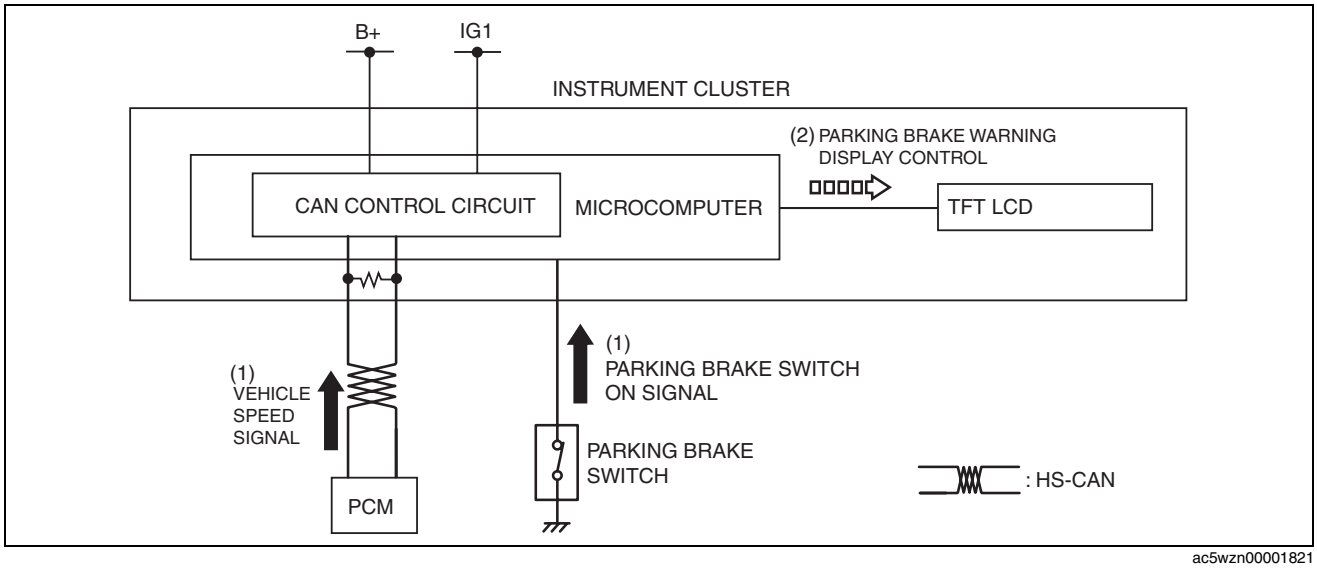
- The parking brake warning is displayed in the TFT LCD of the instrument cluster.



ac5wzn00001820

Operation

1. The instrument cluster receives (1) the vehicle speed signal from the PCM when the ignition is switched ON (engine on) and detects (1) the parking brake switch.
2. The microcomputer in the instrument cluster displays (2) the parking brake warning in the TFT LCD when it receives a vehicle speed signal of 5 km/h {3 mph} or more while a parking brake switch on condition is detected.



ac5wzn00001821

Fail-safe

- Function not equipped.

DOOR AJAR WARNING DISPLAY

id092200026300

Purpose

- The door-ajar warning light notifies the driver that any door or the liftgate is open.

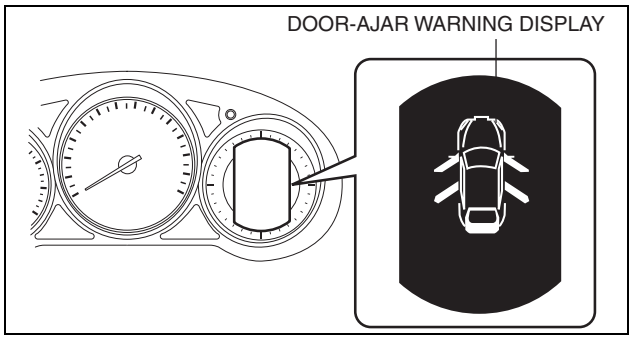
Function

- When the instrument cluster receives any of the following signals sent from the rear body control module (RBCM) via the CAN signal, the door-ajar warning light illuminates.
  - — Door latch switch ON signal (door open)
  - — Liftgate latch switch ON signal (liftgate open)

INSTRUMENTATION/DRIVER INFO.

Construction

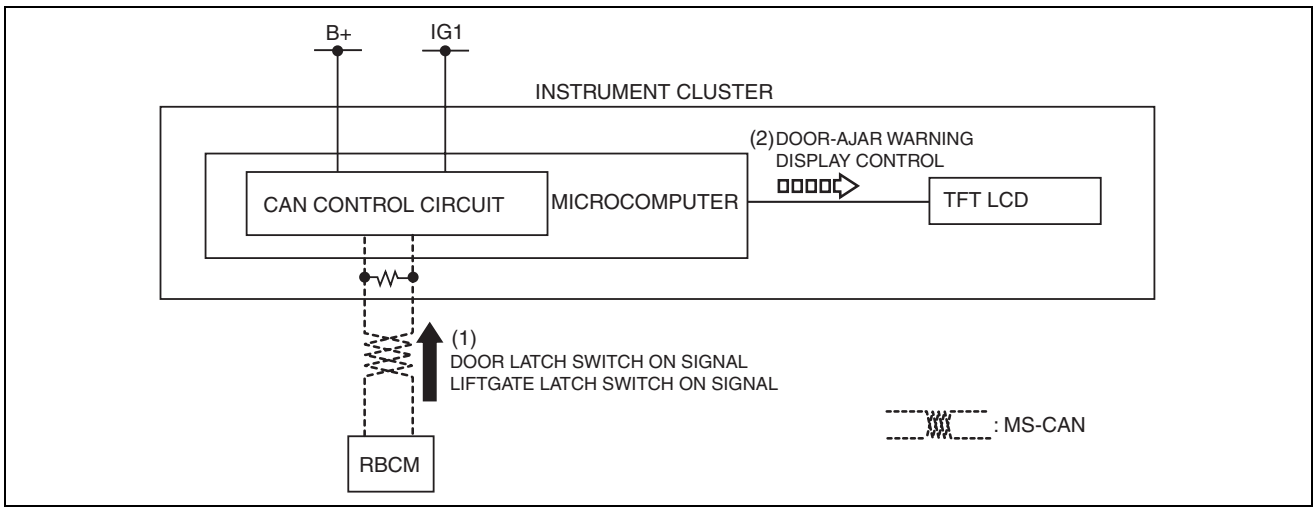
- The door-ajar warning is displayed in the TFT LCD of the instrument cluster.



ac5wzn00001429

Operation

1. The instrument cluster receives (1) the door latch switch ON signal or liftgate latch switch ON signal from the rear body control module (RBCM).
2. When any received signal indicates that door is open, the instrument cluster displays (2) the door-ajar warning in the TFT LCD.



ac5wzn00001430

Fail-safe

- Function not equipped.

REAR VEHICLE MONITORING SYSTEM

id092200029800

Outline

- The rear vehicle monitoring system detects vehicles approaching from behind and notifies the driver using a warning indication and warning sound if the driver tries to change lanes to the side of the approaching vehicle.
- The rear vehicle monitoring control module performs rear vehicle monitoring system fail-safe. (See 09-22-78 REAR VEHICLE MONITORING CONTROL MODULE.)

Warning

- **The rear vehicle monitoring system is not a substitute for the driver in confirming safety. The driver is responsible for assuring the safety of lane changes and other maneuvers. Do not rely completely on the rear vehicle monitoring system, and always confirm the safety around the vehicle visually before changing lanes.**
- **Due to various restrictions in the operation of the rear vehicle monitoring system, the RVM warning indicator light might not illuminate or it may be delayed even if there is a vehicle traveling in the adjacent lane.**
- **If there is mud, water, or snow adhering to the areas near the rear vehicle monitoring control modules, obstruction of the radar could result in the system not appropriately detecting a target vehicle, or complete non-detection of the target vehicle. Always pay attention to the direction of vehicle travel and the area around the vehicle.**

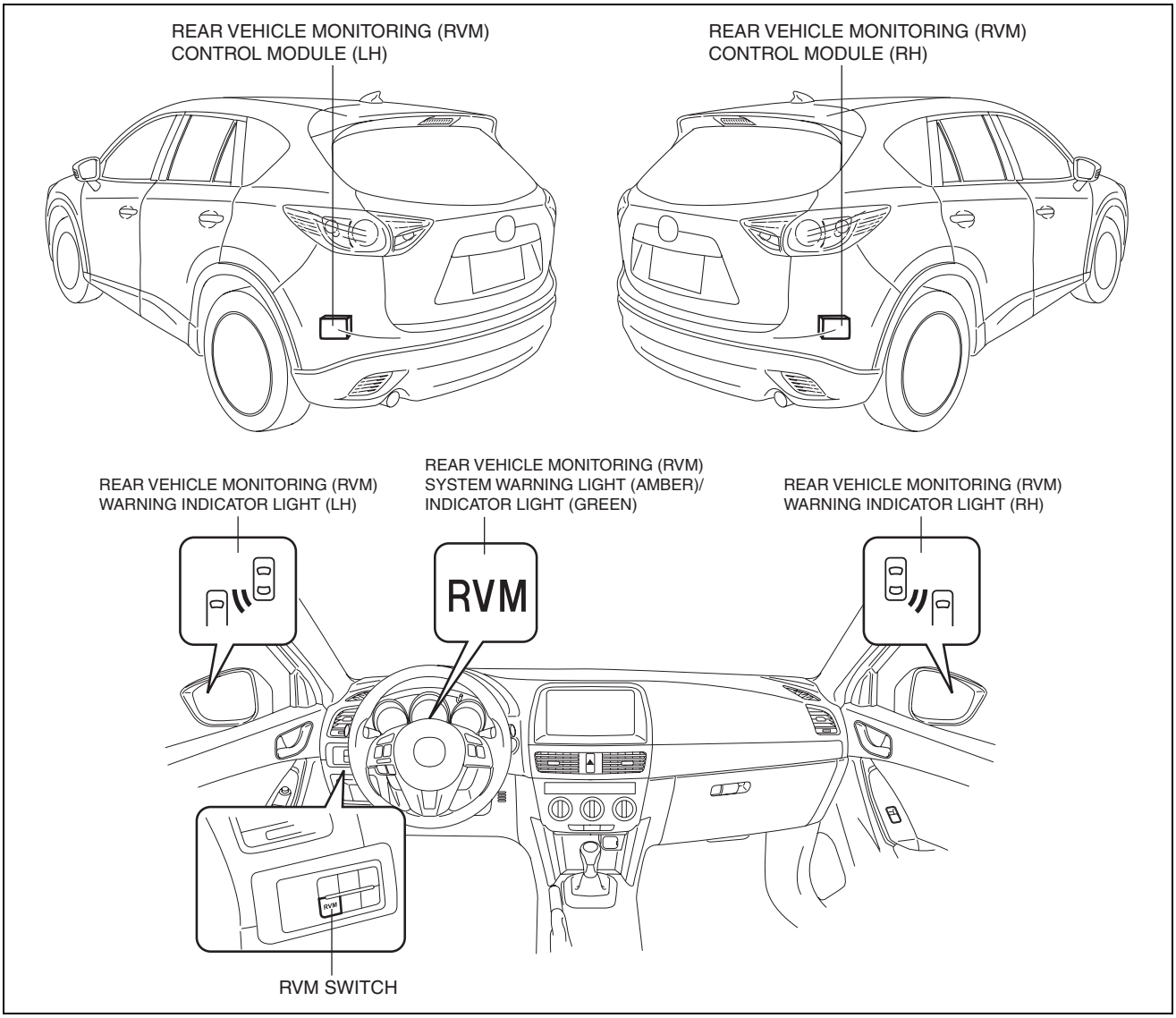
- Do not block the area around the rear vehicle monitoring control modules on the rear bumper with foreign material (such as bumper stickers) so as not to affect the rear vehicle monitoring system functions.
- Perform radar aiming for the rear vehicle monitoring control modules if the rear bumper has received an impact.
- The rear vehicle monitoring system may not operate normally under the following conditions:
  - — Dirt, ice or snow is adhering to rear bumper surface
  - — Vehicle is driven in heavy rain or snowfall, or under conditions where water on road is sprayed by vehicle
  - — Vehicle is towing trailer
  - — Vehicle accelerates from standing-start with target vehicle alongside
  - — Target vehicle moves laterally from lane two lanes over to adjacent lane
  - — Difference in vehicle speed between vehicle and target vehicle is higher with target vehicle passing through detection area in very short period
  - — On steep incline, or if there is difference in height between lanes
- The system may detect guardrails or vehicles on a road shoulder and activate the warning light/beep.
- The rear vehicle monitoring control modules may not detect all types of vehicles. In particular, detection of the following types of vehicles may not occur:
  - — A vehicle driving at a low speed
  - — Small vehicles such as motorcycles
  - — Vehicles with body shapes that may not reflect radar such as unloaded trailers
  - — Vehicles with low vehicle height
  - — The difference in vehicle speed between the vehicle and a target vehicle is extremely high.
  - — A target vehicle accelerates suddenly from the rear of the vehicle and changes to the adjacent lane.
  - — Target vehicles which are traveling in the vehicle's blind spot at nearly the same speed for long periods
- The RVM warning indicator light may be difficult to view under the following conditions:
  - — Sunlight at sunrise and sunset is reflected in and around the RVM warning indicator light
  - — A lighting device with strong illumination is used in the vehicle
- On a road with a narrower lane width, the system could detect vehicles on a lane next to the adjacent lane and cause the warning light/beep to operate. Conversely, on a road with a wider lane width, the system may not detect vehicles on the adjacent lane and may not operate the warning light/beep.

Caution

- If the rear bumper installation position is changed or individual differences (coating film/thickness) occur, the radar angle will deviate and the rear vehicle monitoring system may not operate properly. Perform the radar aiming using the SSTs (Service Special Tools) and Mazda Modular Diagnostic System (M-MDS) when any of the following items have been performed.
  - — Rear vehicle monitoring control modules are replaced
  - — Rear vehicle monitoring brackets are replaced
  - — Rear bumper is repaired or replaced
  - — Vehicle’s rear area is repaired due to collision
- Refer to the Workshop Manual for the radar aiming procedure.

INSTRUMENTATION/DRIVER INFO.

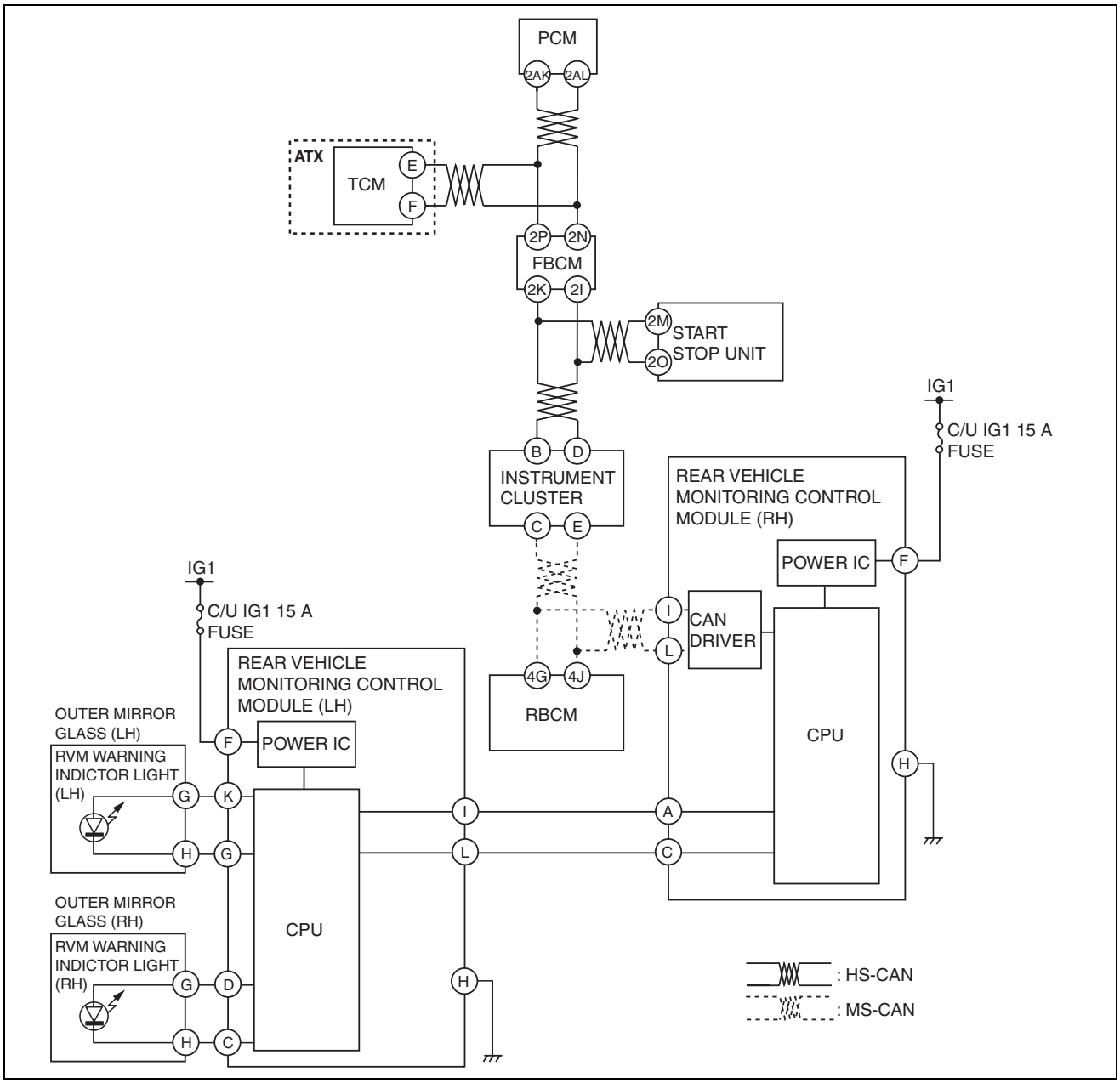
Structural view



ac5wzn00001434

INSTRUMENTATION/DRIVER INFO.

System wiring diagram



ac5wzn00001435

Operation

Operation condition

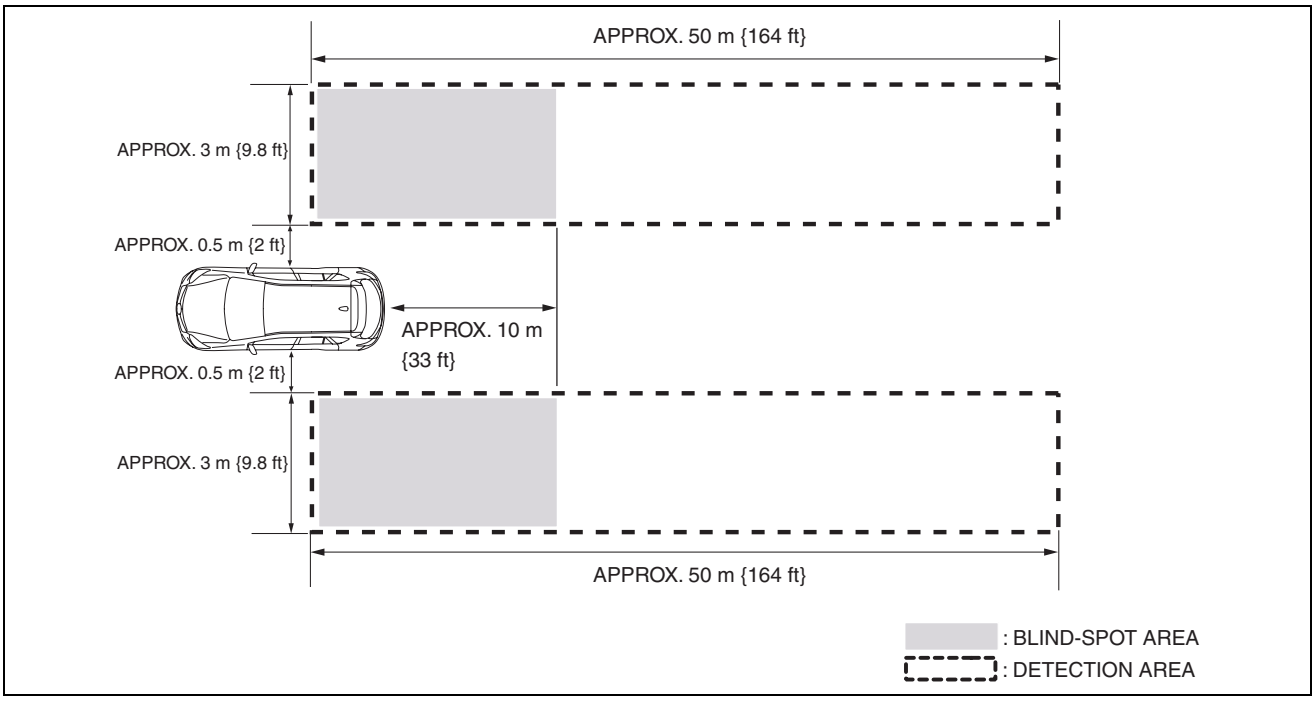
- When all of the following conditions are met, the system operates and the RVM indicator light (green) illuminates.
  - — RVM switch is on (system on)
  - — Vehicle speed is **approx. 30 km/h {19 mph} or more**
- When the vehicle speed is **approx. 30 km/h {19 mph} or less**, the vehicle detection is cancelled and the RVM indicator light (green) remains illuminated.

Cancel conditions

- When the following condition is met, the system is cancelled and the RVM indicator light (green) turns off.
  - — RVM switch is off (system off)

Monitor operation

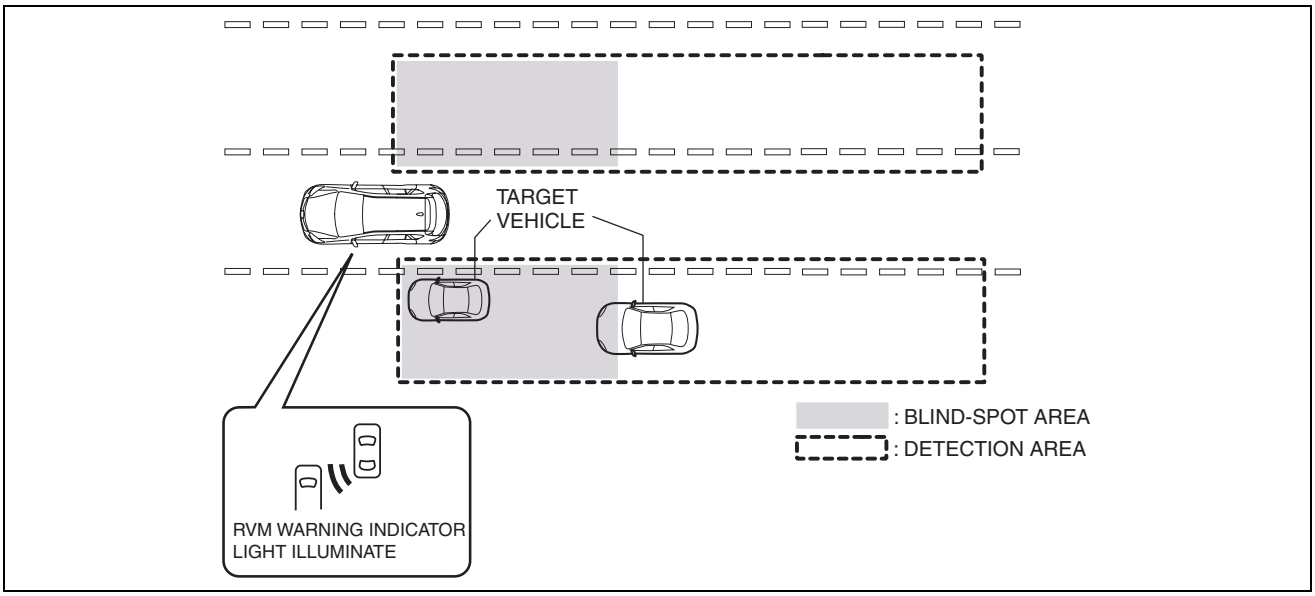
- The monitored areas are called the detection area and the blind-spot area, and the rear vehicle monitoring system control modules monitor the following ranges:
  - — Detection area: From B-pillar towards vehicle rear at area to a distance of **approx. 50 m {164 ft}**
  - — Blind-spot area: Area to a distance of **approx. 10 m {33 ft}** from vehicle rear



ac5wzn00001436

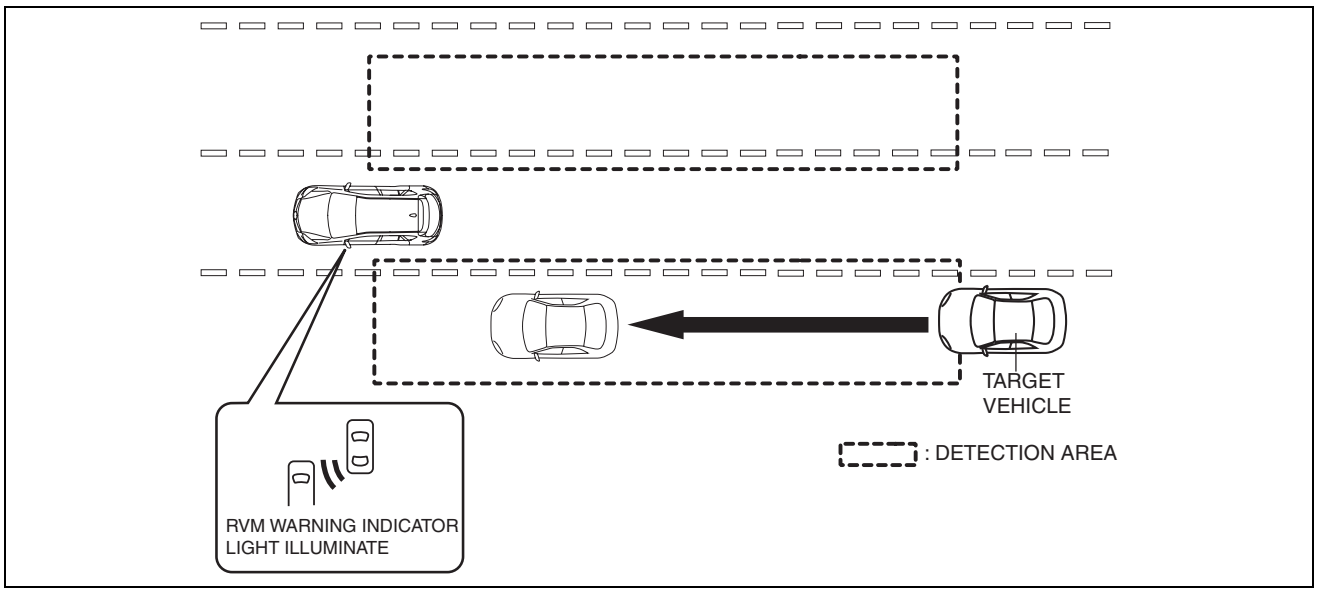
Vehicle detection operation

- If the following vehicles are detected, the rear vehicle monitoring control module illuminates the RVM warning indicator light.
  - — When a vehicle is detected in the blind-spot area (**approx. 10 m {33 ft}** from vehicle rear), the RVM warning indicator light is illuminated on side where the vehicle is detected.



ac5wzn00001437

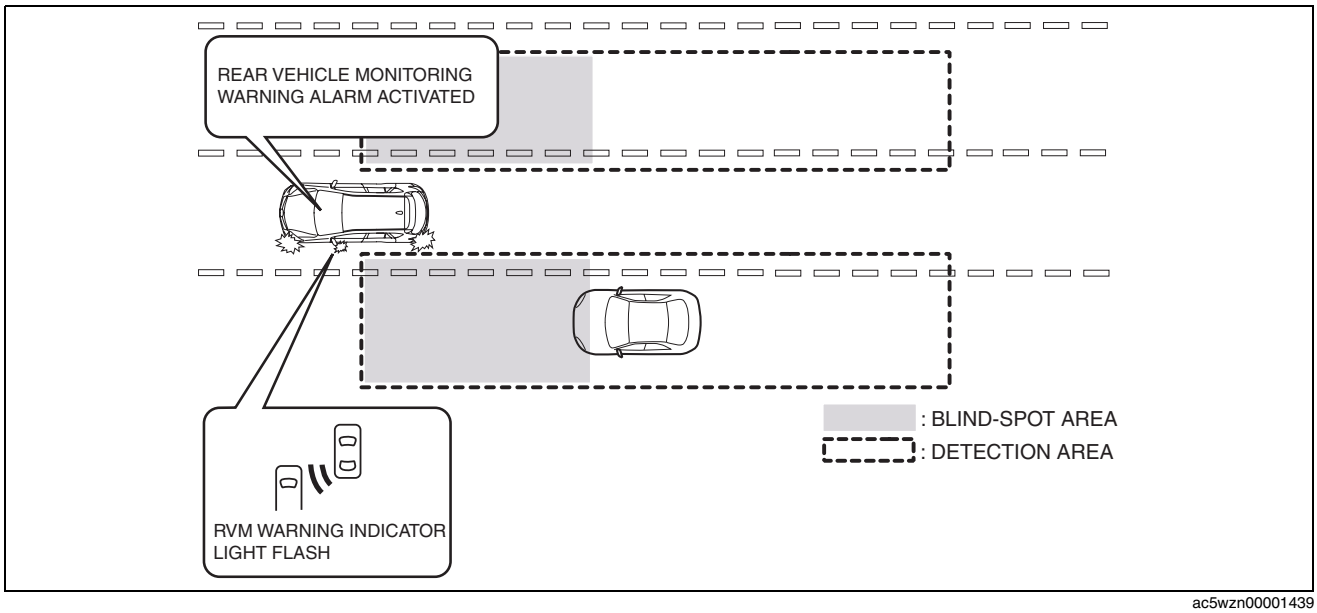
— When a vehicle is detected in the detection area (**approx. 50 m {164 ft}** from vehicle rear) and the vehicle which can enter the blind-spot area within approx. 5 s from when it enters the detection area, the RVM warning indicator light is illuminated on side where the vehicle is detected.



ac5wzn00001438

Warning operation

- When a turn switch ON signal is received on the side where the vehicle is detected during the vehicle detection operation, the rear vehicle monitoring control module warns as follows:
  — Flashes RVM warning indicator light
  — Sounds rear vehicle monitoring warning alarm



ac5wzn00001439

REAR VEHICLE MONITORING CONTROL MODULE

id092200029900

Purpose

- The rear vehicle monitoring control module detects vehicles approaching from behind and controls the rear vehicle monitoring system.

Function

- The rear vehicle monitoring control module emits microwaves from the radar integrated with the rear vehicle monitoring control module to detect an oncoming vehicle's position and speed via the reflected microwaves.
- The rear vehicle monitoring control module controls the rear vehicle monitoring system based on the information from the detected approaching vehicle and following CAN signals:

INSTRUMENTATION/DRIVER INFO.

CAN signal sending module	Signal name
DSC HU/CM	Yaw rate signal
Start stop unit	Turn switch signal
Instrument cluster	• RVM switch operation signal • Panel light signal
TCM (ATX)	Shift lever position signal
PCM	• Vehicle speed signal • Gear position signal (MTX)

RVM warning indicator light brightness level change function

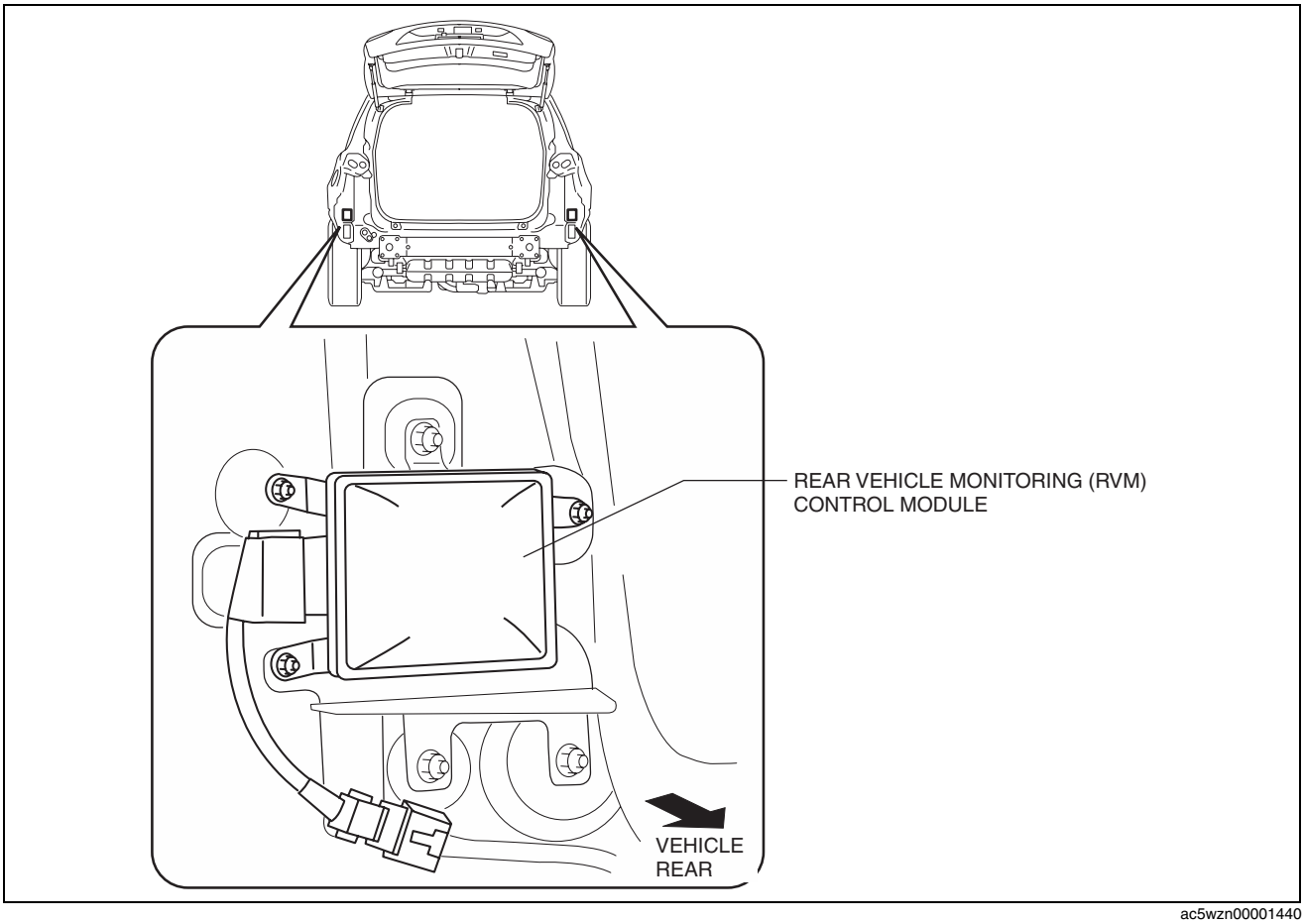
- When the rear vehicle monitoring control module receives the panel light signal from the instrument cluster, it determines that the vehicle is being driven at night or in a dark place and changes the brightness of the RVM warning indicator light.

On-board diagnostic function

- The rear vehicle monitoring control module detects a system communication error and control module internal malfunction and outputs DTCs. For DTC details, refer to On-board Diagnostic System [rear vehicle monitoring system].

Construction

- The control module is integrated with the radar which emits microwaves and receives the reflected waves.
- Two control modules are positioned on the left and right sides of the body inside the rear bumper.



ac5wzn00001440

Operation

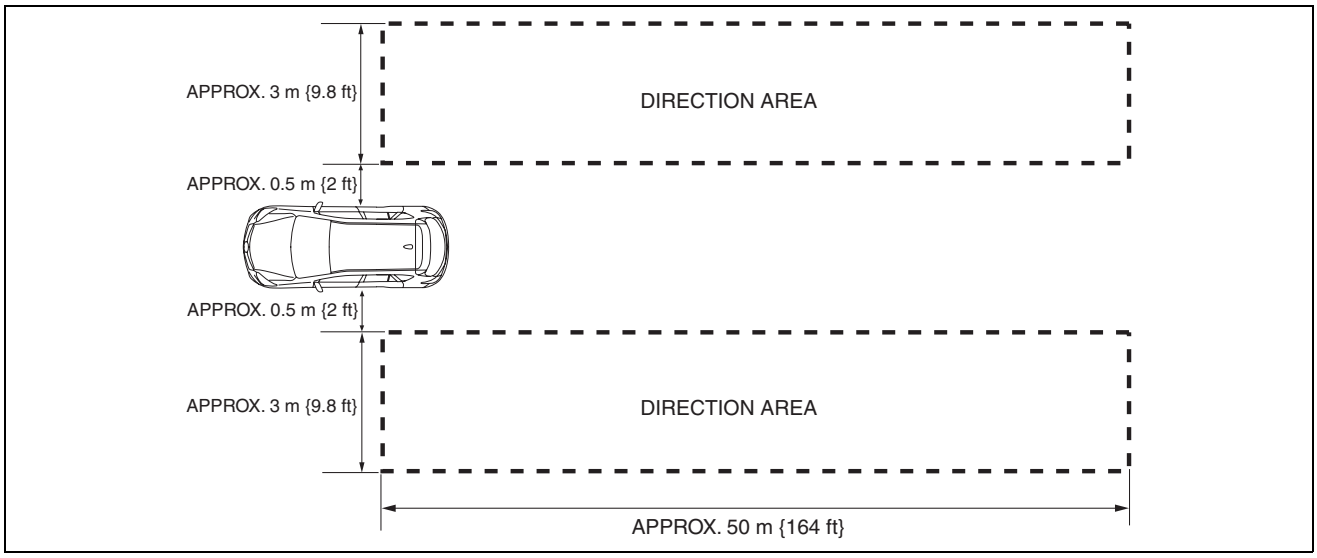
- When the ignition is switched ON (engine on) and vehicle speed is 30 km/h or more, the rear vehicle monitoring control module emits microwaves from the radar and starts detection of approaching vehicles.

Detection area

- Forward and rear directions: From B-pillar towards vehicle rear at distance of **approx. 50 m {164 ft}**

INSTRUMENTATION/DRIVER INFO.

- Lateral direction: **Approx. 3 m {9.8 ft}** for vehicle side surface



ac5wzn00001441

Fail-safe

DTC No.	Rear vehicle monitoring (RVM) system warning light (amber)
B11CB:11	Inhibits the rear vehicle monitoring system.
B11CB:15	Inhibits the rear vehicle monitoring system.
B11D3:11	Inhibits the rear vehicle monitoring system.
B11D3:15	Inhibits the rear vehicle monitoring system.
B11F2:23	Inhibits the rear vehicle monitoring system.
U0001:88	Inhibits the rear vehicle monitoring system.
U0028:87	Inhibits the rear vehicle monitoring system.
U0100:00	Inhibits the rear vehicle monitoring system.
U0121:00	Inhibits the rear vehicle monitoring system.
U0155:00	Inhibits the rear vehicle monitoring system.
U0214:00	Inhibits the rear vehicle monitoring system.
U0401:68	Inhibits the rear vehicle monitoring system.
U0415:68	Inhibits the rear vehicle monitoring system.
U0423:68	Inhibits the rear vehicle monitoring system.
U0515:68	Inhibits the rear vehicle monitoring system.
U1A4B:16	Inhibits the rear vehicle monitoring system.
U1A4B:17	Inhibits the rear vehicle monitoring system.
U1A4B:43	Inhibits the rear vehicle monitoring system.
U1A4B:44	Inhibits the rear vehicle monitoring system.
U1A4B:45	Inhibits the rear vehicle monitoring system.
U1A4B:46	Inhibits the rear vehicle monitoring system.
U1A4B:47	Inhibits the rear vehicle monitoring system.
U1A4B:48	Inhibits the rear vehicle monitoring system.
U1A4B:49	Inhibits the rear vehicle monitoring system.
U1A4B:54	Inhibits the rear vehicle monitoring system.
U1A4B:96	Inhibits the rear vehicle monitoring system.
U2100:00	Inhibits the rear vehicle monitoring system.
U3000:43	Inhibits the rear vehicle monitoring system.
U3000:44	Inhibits the rear vehicle monitoring system.
U3000:45	Inhibits the rear vehicle monitoring system.
U3000:46	Inhibits the rear vehicle monitoring system.
U3000:47	Inhibits the rear vehicle monitoring system.
U3000:48	Inhibits the rear vehicle monitoring system.
U3000:49	Inhibits the rear vehicle monitoring system.

INSTRUMENTATION/DRIVER INFO.

DTC No.	Rear vehicle monitoring (RVM) system warning light (amber)
U3000:4B	Inhibits the rear vehicle monitoring system.
U3000:54	Inhibits the rear vehicle monitoring system.
U3000:96	Inhibits the rear vehicle monitoring system.
U3000:97	Inhibits the rear vehicle monitoring system.
U3003:16	Inhibits the rear vehicle monitoring system.
U3003:17	Inhibits the rear vehicle monitoring system.

RVM SWITCH

id092200030000

Purpose

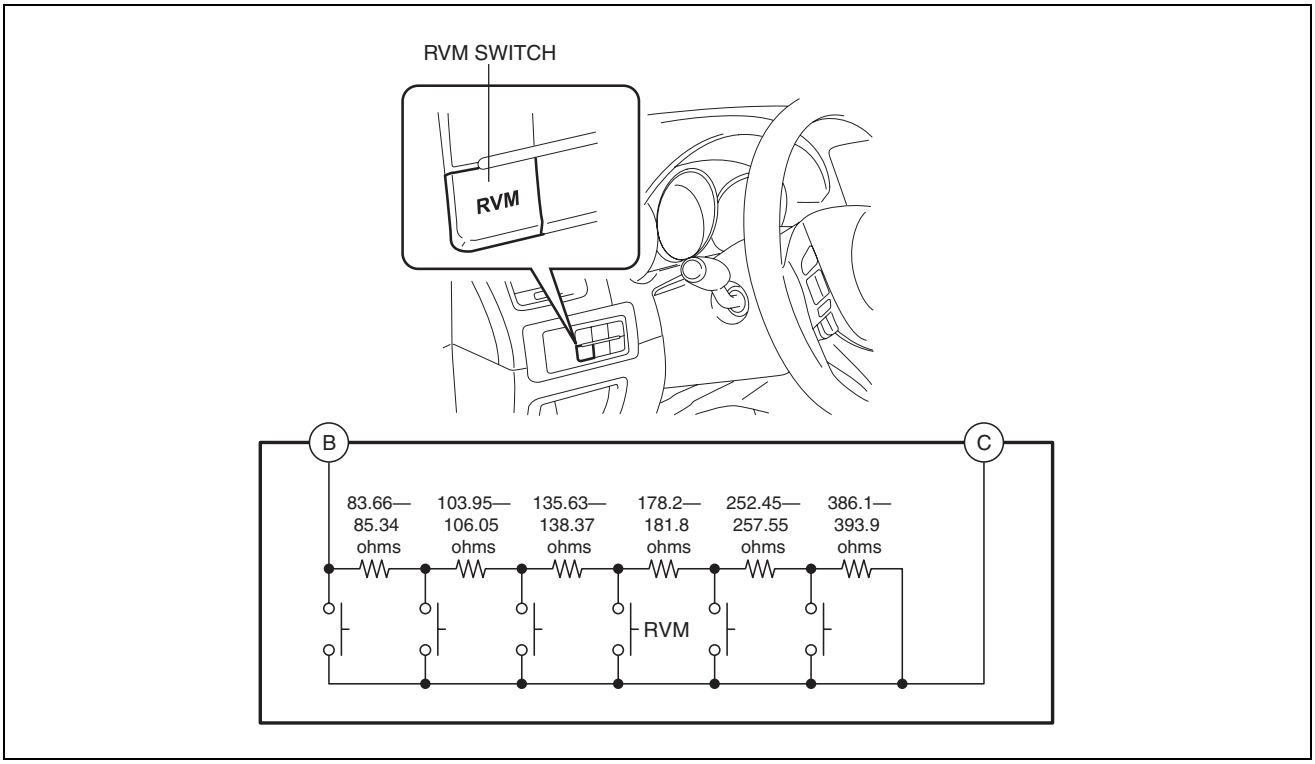
- The rear vehicle monitoring system can be optionally switched between operable and inoperable.

Function

- The switch operation signal is sent to the instrument cluster.

Construction

- The RVM switch is built into the cluster switch.
- The resistance is built into each switch.



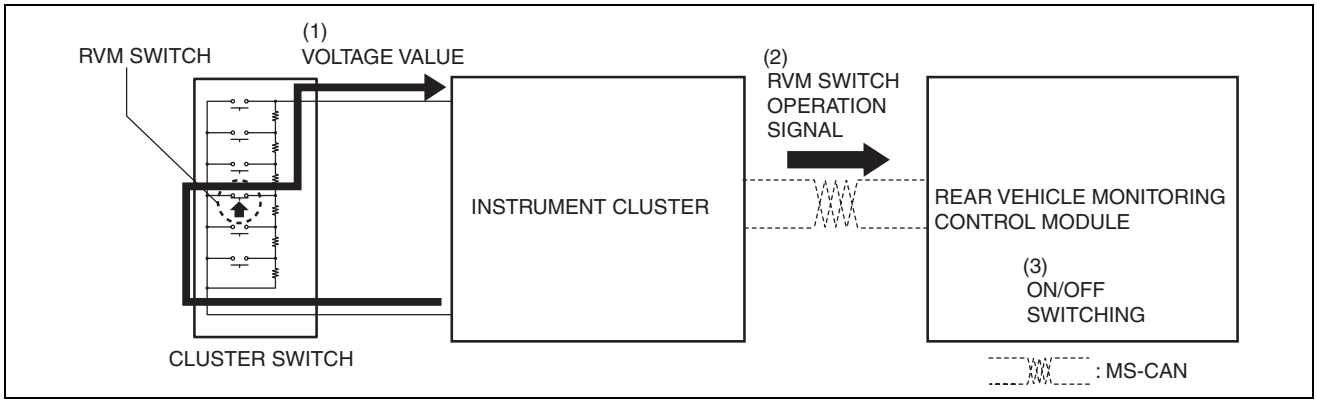
ac5wzn00001442

Operation

1. When the RVM switch operates, the switch operation signal is sent to the instrument cluster.
2. The instrument cluster sends a RVM switch operation signal to the rear vehicle monitoring control module based on the received voltage value (switch operation signal).

INSTRUMENTATION/DRIVER INFO.

3. When the rear vehicle monitoring control module receives the RVM switch operation signal from the instrument cluster, it switches the rear vehicle monitoring system on/off.



ac5wzn00001443

Fail-safe
- Function not equipped.

REAR VEHICLE MONITORING (RVM) SYSTEM WARNING LIGHT (AMBER)/INDICATOR LIGHT (GREEN)

id092200034100

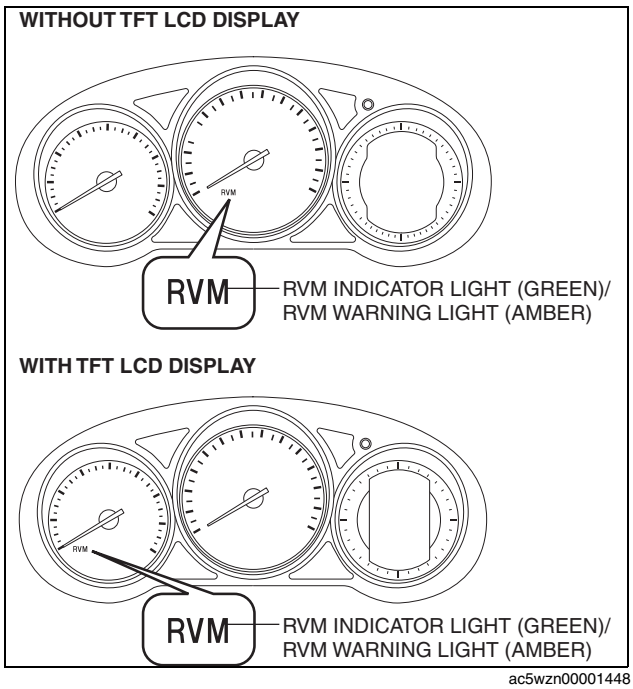
Purpose
RVM indicator light (green)
- The RVM indicator light (green) notifies the driver that the rear vehicle monitoring system is operating.

RVM warning light (amber)
- The RVM warning light (amber) notifies the driver that a malfunction is occurring in the rear vehicle monitoring system.

Function
RVM indicator light (green)
- The instrument cluster illuminates the RVM indicator light (green) based on the system condition display request signal sent via a CAN signal from the rear vehicle monitoring control module (RH).

RVM warning light (amber)
- The instrument cluster illuminates the RVM warning indicator light (amber) based on the system malfunction indication request signal sent via a CAN signal from the rear vehicle monitoring control module (RH).

Construction
- The RVM indicator light (green) and RVM warning indicator light (amber) are equipped in the instrument cluster.



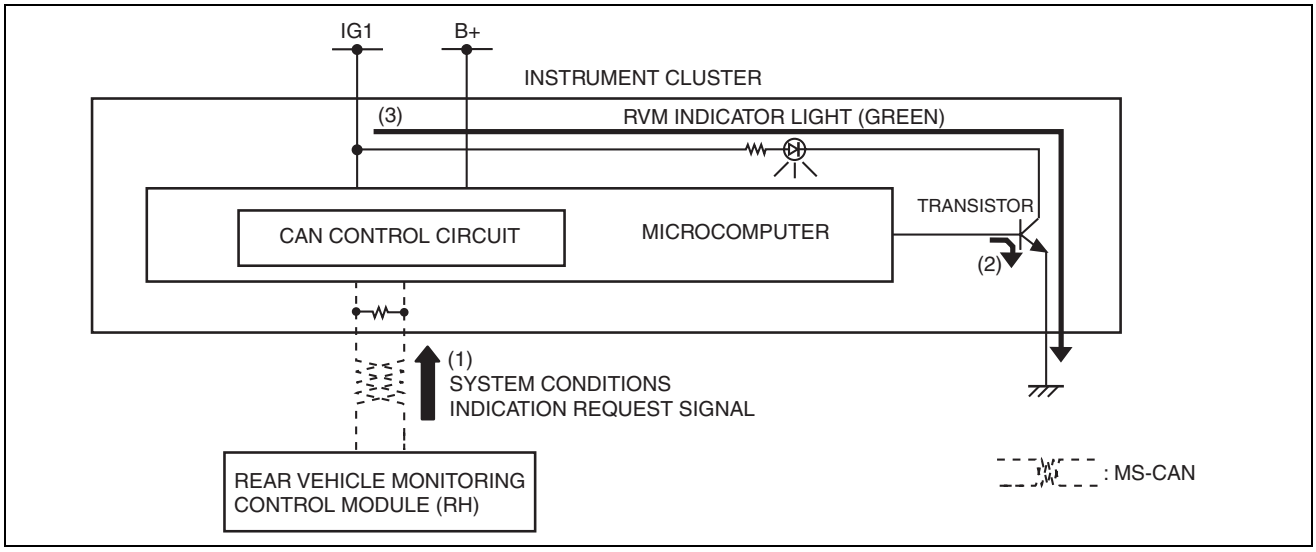
ac5wzn00001448

INSTRUMENTATION/DRIVER INFO.

Operation

RVM indicator light (green)

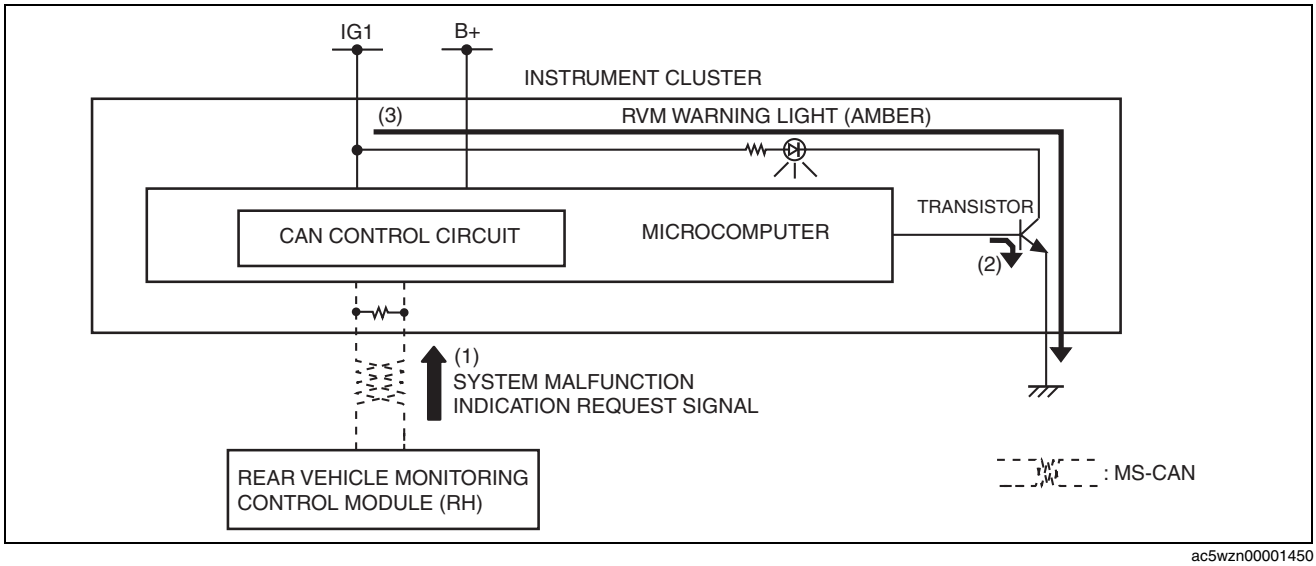
1. The instrument cluster receives (1) the system conditions indication request signal from the rear vehicle monitoring control module (RH) via the CAN signal.
2. When the instrument cluster receives the system conditions indication request signal, it turns the transistor on (2).
3. When the transistor turns on, a ground circuit with the RVM indicator light (green) is established, and the RVM indicator light (green) illuminates (3).



ac5wzn00001449

RVM warning light (amber)

1. The instrument cluster receives (1) the system malfunction indication request signal from the rear vehicle monitoring control module (RH) via the CAN signal.
2. When the instrument cluster receives the system conditions display request signal, it turns the transistor on (2).
3. When the transistor turns on, a ground circuit with the RVM warning light (amber) is established, and the RVM warning light (amber) illuminates (3).



ac5wzn00001450

Fail-safe

- Function not equipped.

RVM WARNING INDICATOR LIGHT

id092200030100

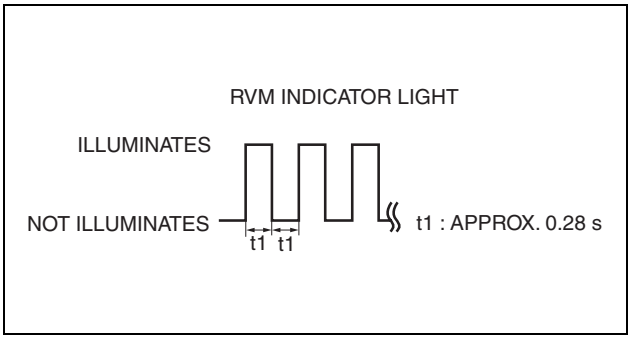
Purpose

- The RVM warning indicator light notifies the driver that vehicles are approaching from the rear.

INSTRUMENTATION/DRIVER INFO.

Function

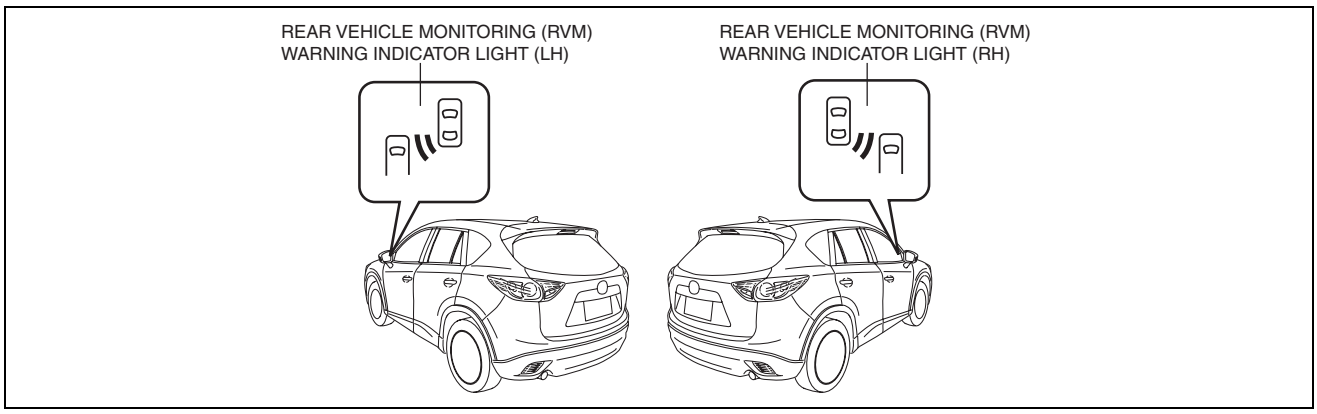
- If there is an approaching vehicle in the detection area of the rear vehicle monitoring control module, the RVM warning indicator light illuminates. If the driver tries to change lanes to the side of the approaching vehicle, the indicator light flashes.
- The RVM warning light flashing pattern is as indicated in the figure.



ac5wzn00001444

Construction

- The RVM warning indicator lights are equipped in the left and right heater outer mirrors.
- LEDs with low-power consumption and high durability have been adopted for the RVM warning indicator light.



ac5wzn00001445

- For details on the RVM warning indicator light illumination/flashing/off conditions, refer to 09-22-73 REAR VEHICLE MONITORING SYSTEM.

Operation

- For the RVM warning indicator light operation, refer to the 09-22-73 REAR VEHICLE MONITORING SYSTEM.

Fail-safe

- Function not equipped.

RVM WARNING ALARM

id092200031300

Purpose

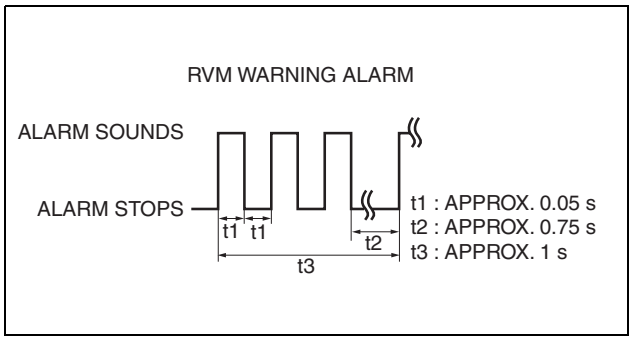
- The rear vehicle monitoring warning alarm alerts the driver that there is a vehicle approaching in the lane which the driver is attempting to enter.

Function

- If the instrument cluster receives a warning sound request signal from the rear vehicle monitoring control module (RH), is sounds the rear vehicle monitoring warning alarm using the buzzer in the instrument cluster.

INSTRUMENTATION/DRIVER INFO.

- The rear vehicle monitoring warning alarm sound pattern is as follows:



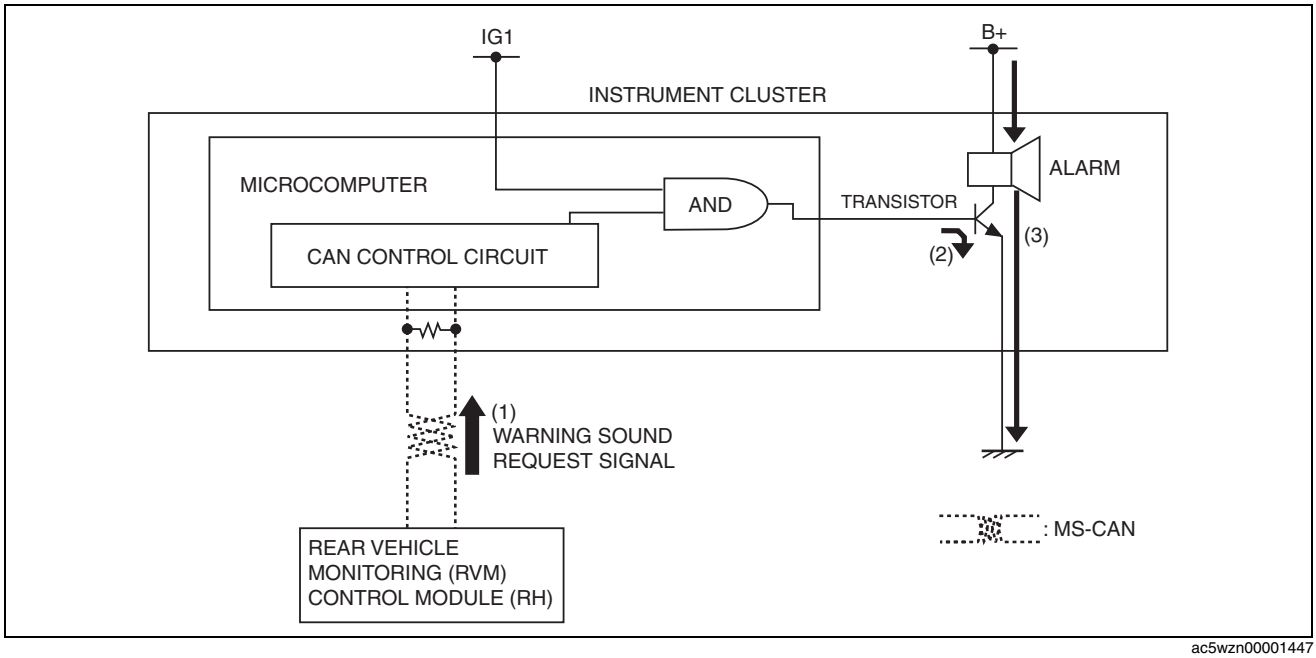
ac5wzn00001446

Construction

- The rear vehicle monitoring warning alarm sounds using the buzzer built into the instrument cluster.

Operation

1. The instrument cluster receives (1) the warning sound request signal from the rear vehicle monitoring control module (RH).
2. The instrument cluster turns the transistor on (2) based on the warning sound request signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).



ac5wzn00001447

Fail-safe

- Function not equipped.

BLIND SPOT MONITORING (BSM) SYSTEM

id092200027200

Outline

- The blind spot monitoring (BSM) system detects vehicles approaching from the rear blind spots, and illuminates the BSM indicator light on the outer mirror glass. When the BSM indicator light is illuminated and the turn light switch is turned on to the side in which the indicator light is illuminated, the indicator light flashes and a warning alarm is activated to alert the driver.
- The BSM system operates while the vehicle is traveling at **approx. 32 km/h {20 mph} or more**.
- The BSM system has an on-board diagnostic function for improved serviceability.
- The BSM control module performs BSM system fail-safe. (See 09-22-89 BLIND SPOT MONITORING (BSM) CONTROL MODULE.)

Warning

- **The BSM system is not a substitute for the driver in confirming safety. The driver is responsible for assuring the safety of lane changes and other maneuvers. Do not rely completely on the BSM system and always confirm the safety around the vehicle visually before changing lanes.**

INSTRUMENTATION/DRIVER INFO.

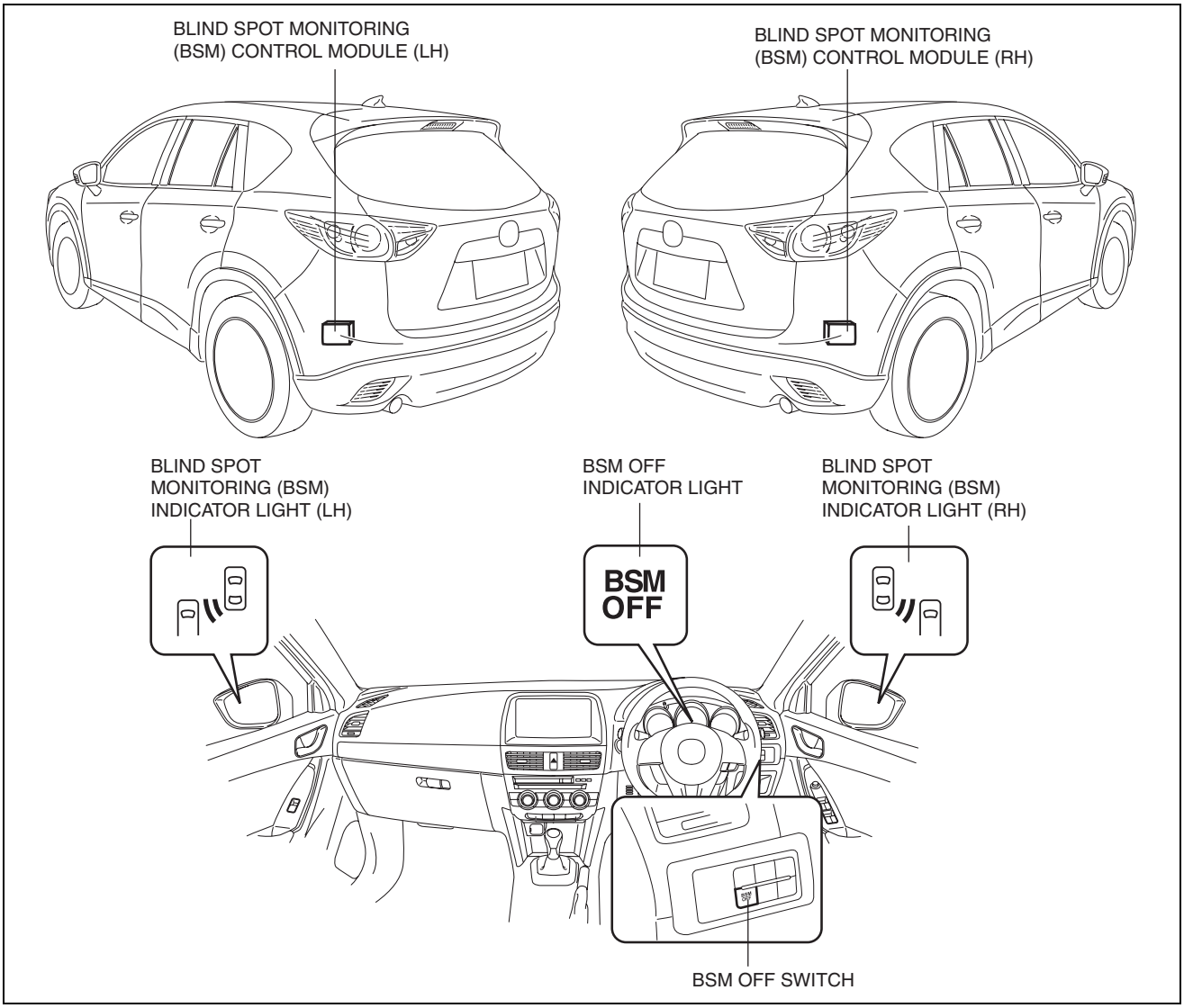
- Because the BSM system has various restrictions in the operation, the BSM indicator light might not illuminate or it may be delayed even if there is a vehicle traveling in the adjacent lane.
- If there is mud, water, or snow adhering to the areas near the BSM control module, obstruction of the radar could result in the system not appropriately detecting a target vehicle, or complete non-detection of the target vehicle. Always pay attention to the direction of vehicle travel and the area around the vehicle.
- Do not block the area around the BSM control module on the rear bumper with foreign material (such as bumper stickers) so as not to affect the BSM system functions.
- Perform radar aiming for the BSM control module if the rear bumper has received an impact.
- The BSM system may not operate normally under the following conditions:
  - — Dirt, ice or snow is adhering to the rear bumper surface.
  - — The vehicle is driven in heavy rain or snowfall, or under conditions where water on the road is sprayed by the vehicle.
  - — The vehicle is towing a trailer.
  - — The vehicle accelerates from a standing-start with a target vehicle alongside.
  - — A target vehicle moves laterally from a lane two lanes over to the adjacent lane.
  - — The difference in vehicle speed between the vehicle and a target vehicle is higher with the target vehicle passing through the detection area in a very short period.
  - — On a steep incline, or if there is a difference in height between lanes.
- The BSM system may detect guardrails or parked vehicles on a road shoulder and activate the warning light/beep.
- The BSM control module may not detect all types of vehicles. In particular, detection of the following types of vehicles may not occur:
  - — A vehicle driving at a low speed
  - — Small vehicles such as motorcycles
  - — Vehicles with body shapes that may not reflect radar such as unloaded trailers
  - — Vehicles with low vehicle height
  - — The difference in vehicle speed between the vehicle and a target vehicle is extremely high.
  - — A target vehicle accelerates suddenly from the rear of the vehicle and changes to the adjacent lane.
  - — A target vehicle which is traveling in the vehicle's blind spot at nearly the same speed for long periods
- The BSM indicator light may be difficult to view under the following conditions:
  - — Sunlight at sunrise and sunset is reflected in and around the BSM indicator light
  - — A lighting device with strong illumination is used in the vehicle
- On a road with a narrower lane width, the system could detect vehicles on a lane next to the adjacent lane and cause the warning light/beep to operate. Conversely, on a road with a wider lane width, the system may not detect vehicles on the adjacent lane and may not operate the warning light/beep.

Caution

- If the rear bumper installation position is changed or individual differences (coating film/ thickness) occur, the radar angle will deviate and the BSM system may not operate properly. Perform the radar aiming using the SSTs (Service Special Tools) and Mazda Modular Diagnostic System (M-MDS) when any of the following items have been performed.
  - — BSM control module is replaced
  - — BSM bracket is replaced
  - — Rear bumper is repaired or replaced
  - — Vehicle’s rear area is repaired due to collision
- Refer to the Workshop Manual for the radar aiming procedure.

INSTRUMENTATION/DRIVER INFO.

Structural view



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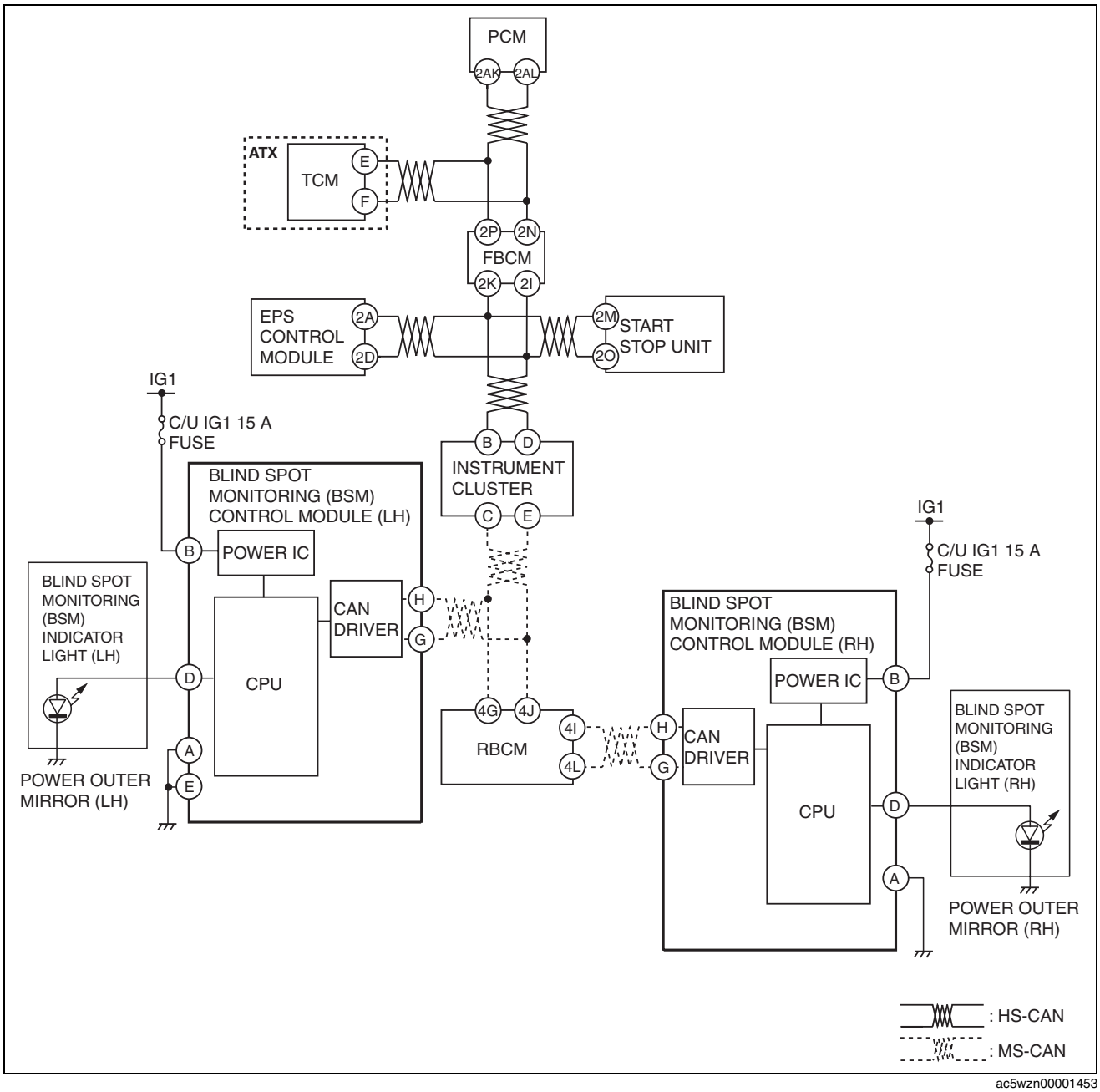
INSTRUMENTATION/DRIVER INFO.

System wiring diagram



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Operation

- When the vehicle is driven at approx. 32 km/h {20 mph} or more and a vehicle enters the radar-monitored area at the rear, the BSM indicator light illuminates. If the turn signal lever is operated to the side the BSM indicator light illuminated, the BSM indicator light starts flashing and the warning alarm operates.
- The BSM system has operation, operation-stop, warning, and alert modes.

System operation conditions

- The BSM can operate when the following conditions are met with the ignition switched ON.
  - — Vehicle speed is **approx. 32 km/h {20 mph} or more**
  - — Shift lever is not in reverse (MTX) (The BSM system is automatically turned off when the shift lever is in reverse.)
  - — Selector lever is not in R position (ATX) (The BSM system is automatically turned off when the selector lever is in the R position.)

System turn-off procedure

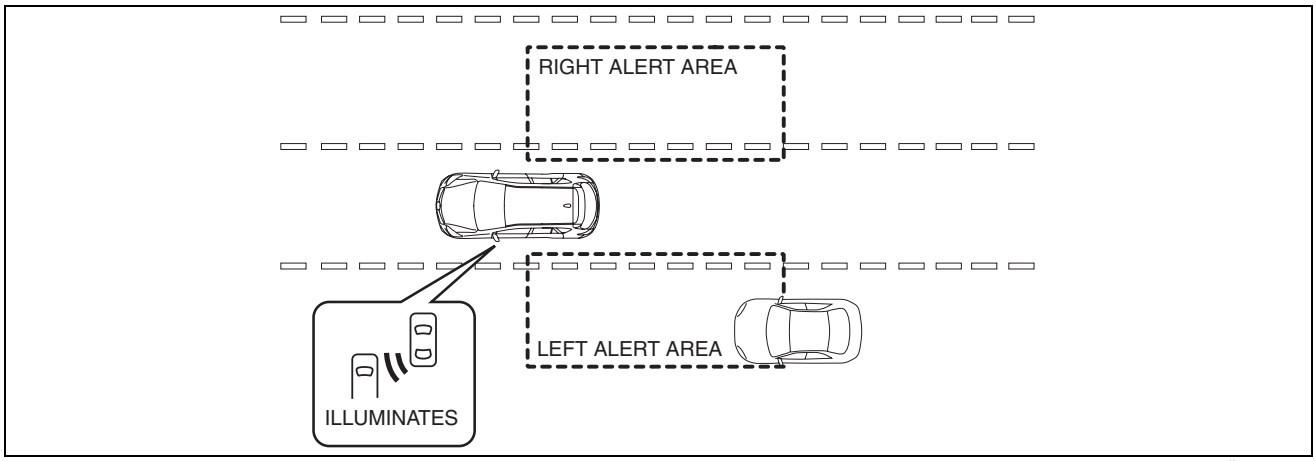
- The BSM can be turned off by pressing the BSM OFF switch with the ignition switched ON. (At this time, the BSM OFF indicator light in the instrument cluster illuminates.)

INSTRUMENTATION/DRIVER INFO.

- When the BSM OFF switch is pressed again with the system turned off, the system becomes operable and the BSM OFF indicator light in the instrument cluster turns off.
- The BSM-OFF condition is cancelled when the ignition is switched off (LOCK or ACC), and the BSM system becomes operable automatically when the ignition is switched ON the next time.

Alert Mode

- If a vehicle enters the alert area when passing or being passed, the system alerts the driver that a vehicle is in the alert area as follows:
  - — If a vehicle enters the alert area on the left, the BSM indicator light (LH) in the left outer mirror illuminates.
  - — If a vehicle enters the alert area on the right, the BSM indicator light (RH) in the right outer mirror illuminates.



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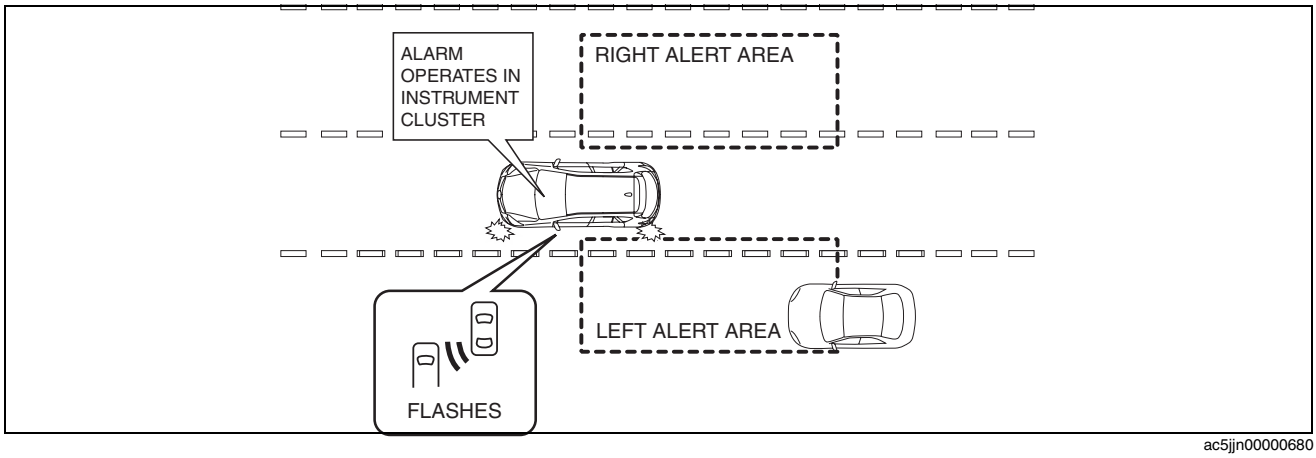
Warning Mode

- While in the alert mode, if the turn signal lever is operated to the side the target vehicle is detected, the system warns the driver of the possibility of an accident as follows:
  - — BSM indicator light in the outer mirror flashes
  - — Warning alarm in instrument cluster operates



ac5jjn00000680

BLIND SPOT MONITORING (BSM) CONTROL MODULE

id092200027400

Purpose

- Controls the blind spot monitoring (BSM) system.

Function

- The BSM control module emits microwaves to detect an oncoming vehicle's position and speed information via the reflected microwaves.
- The BSM system is controlled based on the detected vehicle position and speed information.
- A self-diagnostic function has been adopted.

Construction

- The BSM control module and radar have been integrated.
- Microwaves are emitted from the radar.

INSTRUMENTATION/DRIVER INFO.

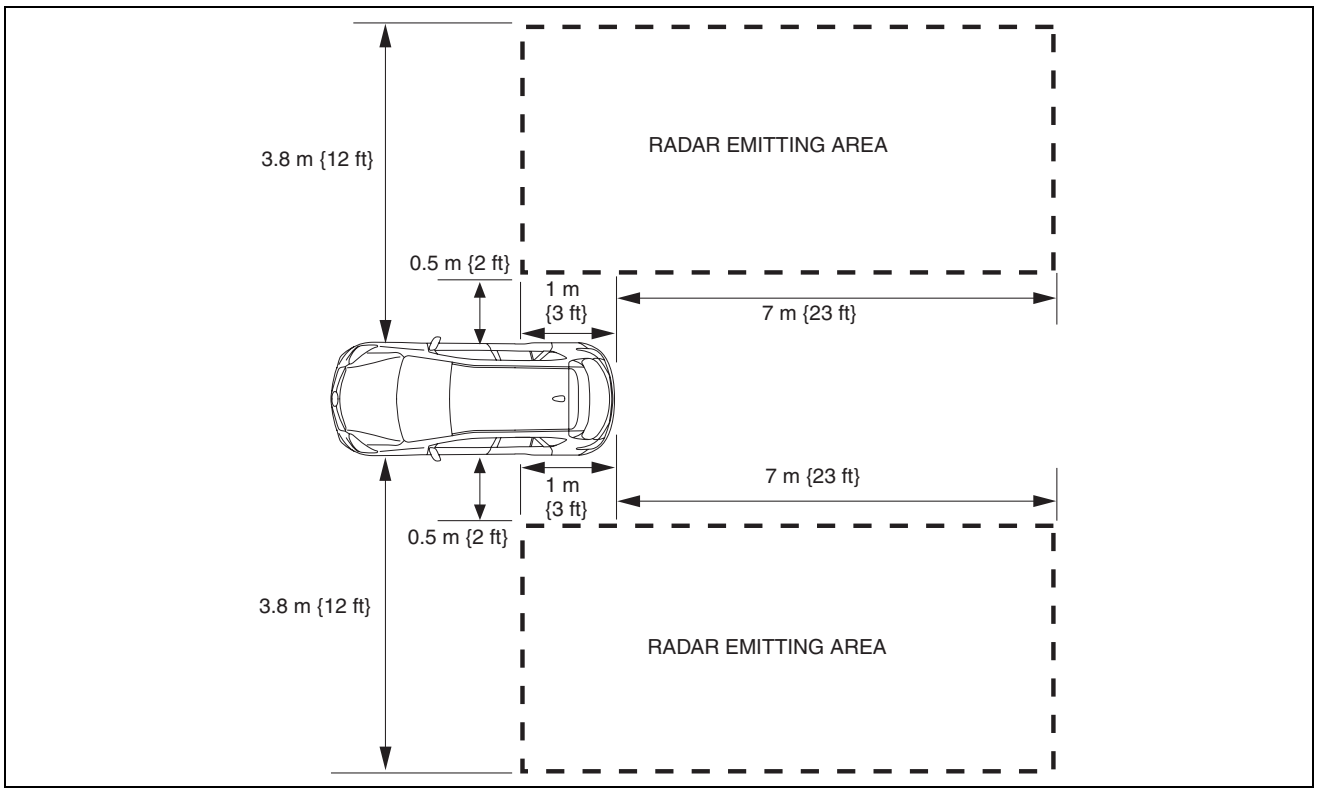
- Two control modules are positioned on the left and right sides of the body inside the rear bumper.

Operation

- The BSM control module emits microwaves to the vehicle rear to detect the obstruction via the reflected microwaves.

Radar Emitting Area

- Cross-directional: **1 m {3 ft}** toward the front of the vehicle, and **7 m {23 ft}** toward the rear of the vehicle from the rear end of the vehicle (total, **8 m {26 ft}**).
- Lateral direction: **0.5—3.8 m {2—12 ft}** from the side of the vehicle (total, **3.3 m {11 ft}**).



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- When the vehicle is cornering, such as turning into an intersection, the shape of the warning area on the inner side changes.
  - — Cross-directional: Length of the vehicle rear changes depending on the steering angle.
  - — Lateral direction: Angle of the warning area changes along the vehicle's turning orbit.

Fail-safe

DTC No.	Fail-safe function
B118C:11	BSM is stopped.
B118C:15	BSM is stopped.
B118D:11	BSM is stopped.
B118D:15	BSM is stopped.
U0001:88	BSM is stopped.
U0100:00	BSM is stopped.
U0131:00	BSM is stopped.
U0155:00	BSM is stopped.
U0214:00	BSM is stopped.
U0232:00	BSM is stopped.
U0233:00	BSM is stopped.
U0401:68	BSM is stopped.
U0420:68	BSM is stopped.
U0423:68	BSM is stopped.
U0515:68	BSM is stopped.
U0533:68	BSM is stopped.

INSTRUMENTATION/DRIVER INFO.

DTC No.	Fail-safe function
U0534:68	BSM is stopped.
U3000:01	BSM is stopped.
U3000:09	BSM is stopped.
U3000:4A	Not equipped.
U3000:97	Not equipped.
U3003:16	BSM is stopped.
U3003:17	BSM is stopped.

BLIND SPOT MONITORING (BSM) OFF INDICATOR LIGHT

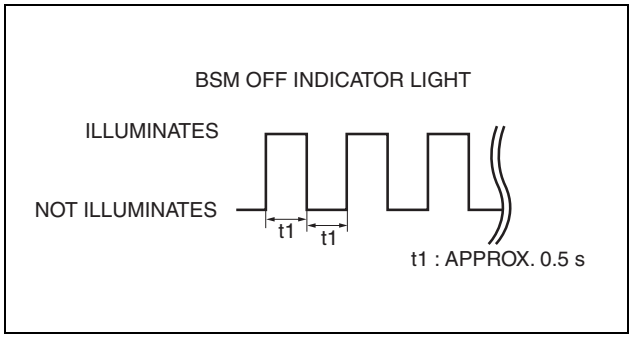
id092200027500

Purpose

- The BSM OFF indicator light informs the driver that the Blind Spot Monitoring (BSM) system is turned off or there is a malfunction in the system.

Function

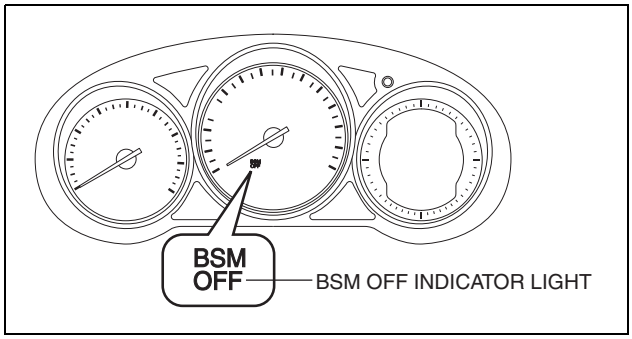
- The instrument cluster illuminates the BSM OFF indicator light based on the BSM system off signal sent via a CAN signal from the BSM control module (RH).
- The instrument cluster flashes the BSM OFF indicator light based on the malfunction indication request signal sent via a CAN signal from the BSM control module (RH).
- The flash pattern of the BSM OFF indicator light is as indicated in the table.



ac5wzn00001432

Construction

- The BSM OFF indicator light are equipped in the instrument cluster.



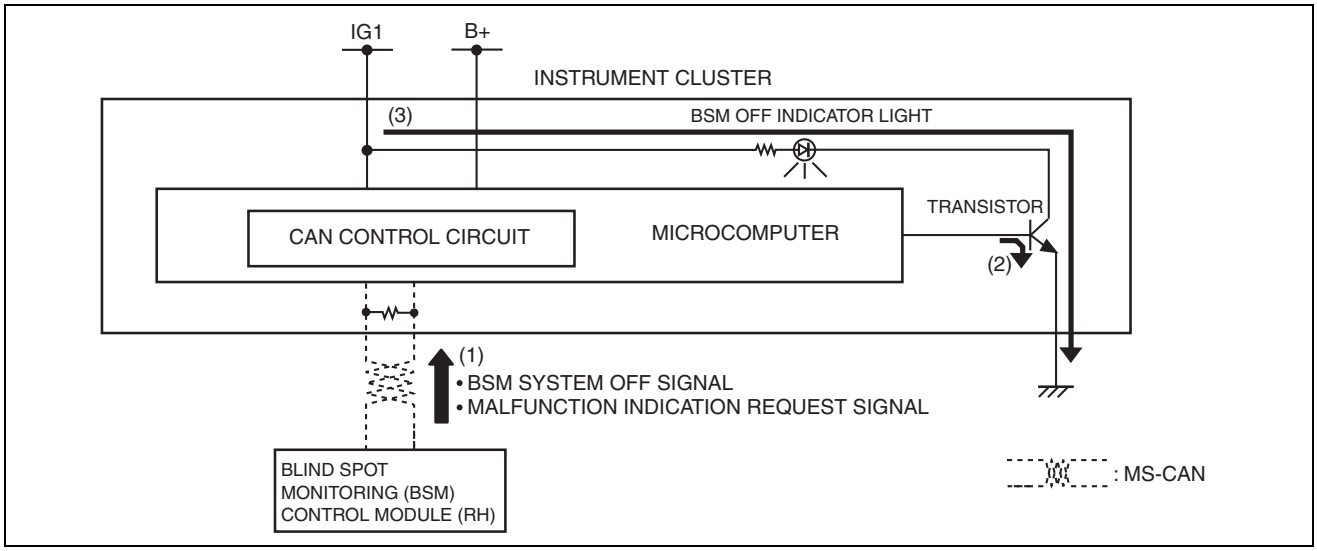
ac5jjn00000803

Operation

1. The instrument cluster receives (1) the BSM system off signal or malfunction indication request signal from the BSM control module (RH) via the CAN signal.
2. The instrument cluster turns the transistor on (2) intermittently for a malfunction indication request signal and continuously for a BSM system off signal.

INSTRUMENTATION/DRIVER INFO.

3. When the transistor turns on intermittently, the BSM OFF indicator light flashes (3) and when it turns on continuously, the BSM OFF indicator light illuminates (3).



ac5jjn00000804

Fail-safe
- Function not equipped.

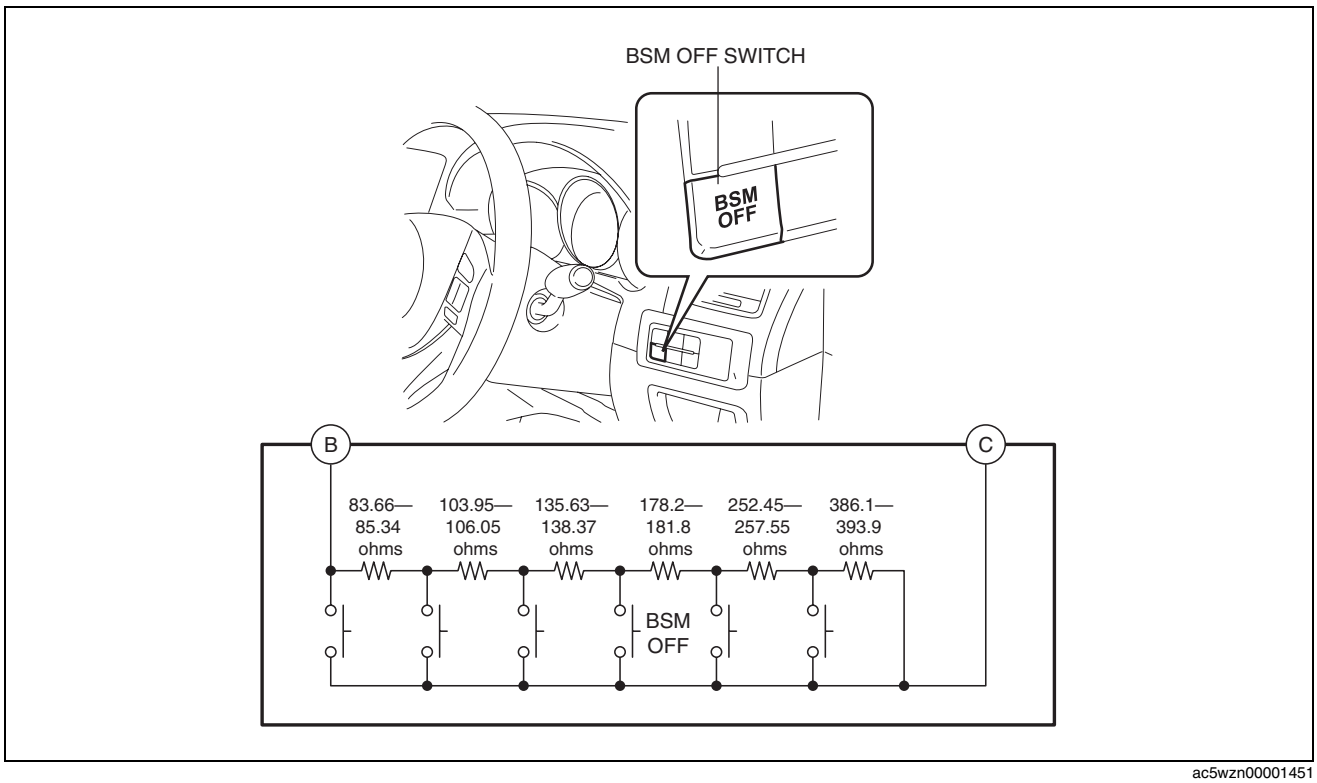
BLIND SPOT MONITORING (BSM) OFF SWITCH

id092200027600

Purpose
- The blind spot monitoring (BSM) system can be turned on or off optionally by the driver.

Function
- The switch operation signal is sent to the instrument cluster.

Construction
- The BSM OFF switch is built into the cluster switch.
- The resistance is built into each switch.

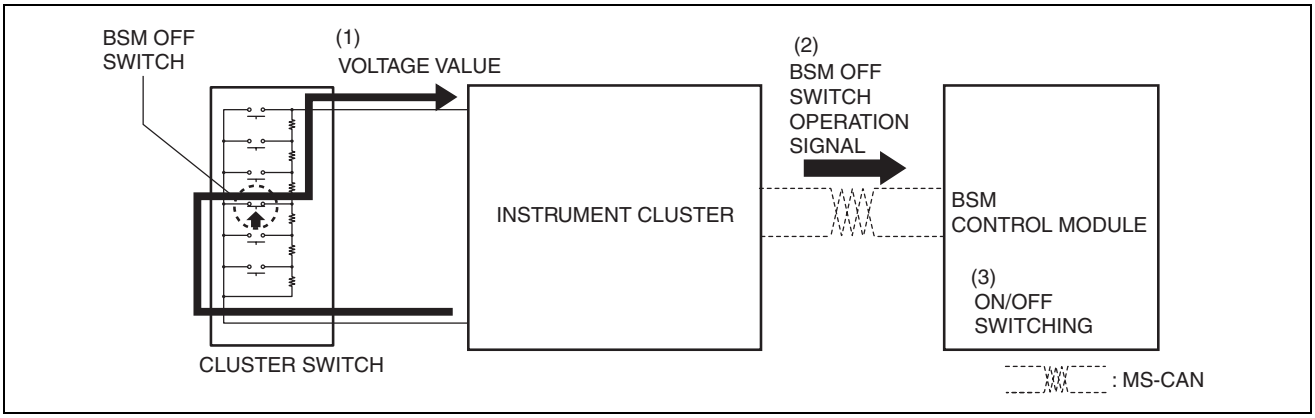


ac5wzn00001451

INSTRUMENTATION/DRIVER INFO.

Operation

1. When the BSM OFF switch operates, the switch operation signal is sent to the instrument cluster.
2. The instrument cluster sends a BSM OFF switch operation signal to the BSM control module based on the received voltage value (switch operation signal).
3. The BSM control module switches the BSM system on/off when it receives the BSM OFF switch operation signal from the instrument cluster.



ac5wzn00000890

Fail-safe

- Function not equipped.

BLIND SPOT MONITORING (BSM) WARNING ALARM

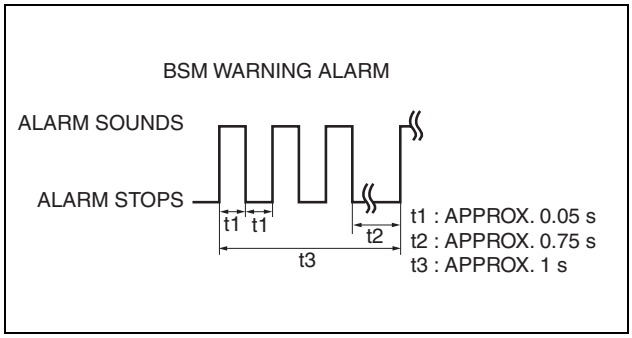
id092200028100

Purpose

- The Blind Spot Monitoring (BSM) warning alarm warns the driver of a possible accident.

Function

- If the instrument cluster receives a warning sound request signal from the BSM control module (RH), it sounds the BSM warning alarm using the buzzer in the instrument cluster.
- The BSM warning alarm sound pattern is as follows:



ac5wzn00001433

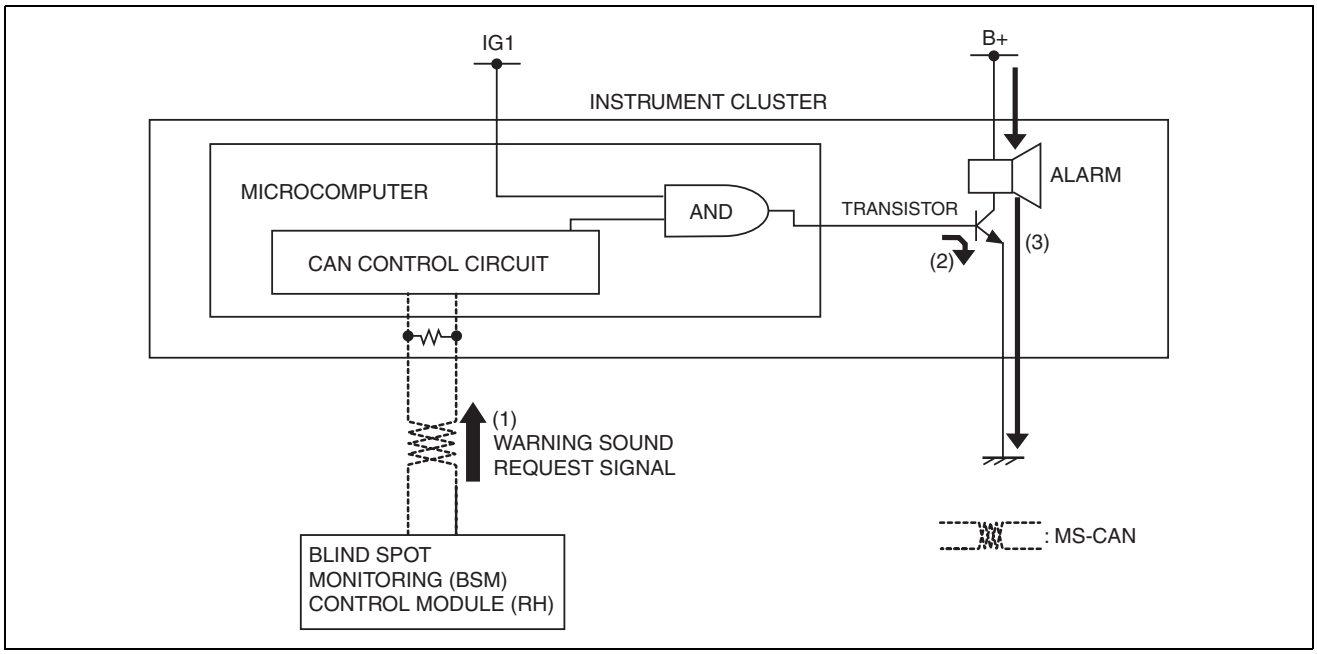
Construction

- The BSM warning alarm sounds using the buzzer built into the instrument cluster.

Operation

1. The instrument cluster receives (1) the warning sound request signal from the BSM control module (RH).
2. The instrument cluster turns the transistor on (2) based on the warning sound request signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).

INSTRUMENTATION/DRIVER INFO.



ac5jjn00000806

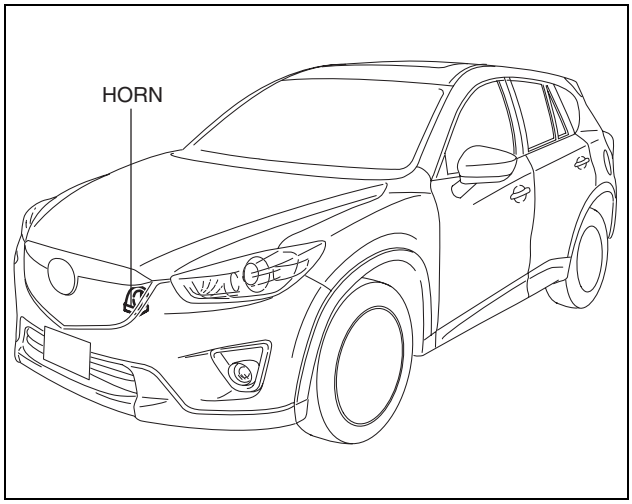
Fail-safe
- Function not equipped.

HORN

id092200021700

Purpose, Function
- The horn sounds according to the horn switch operation.

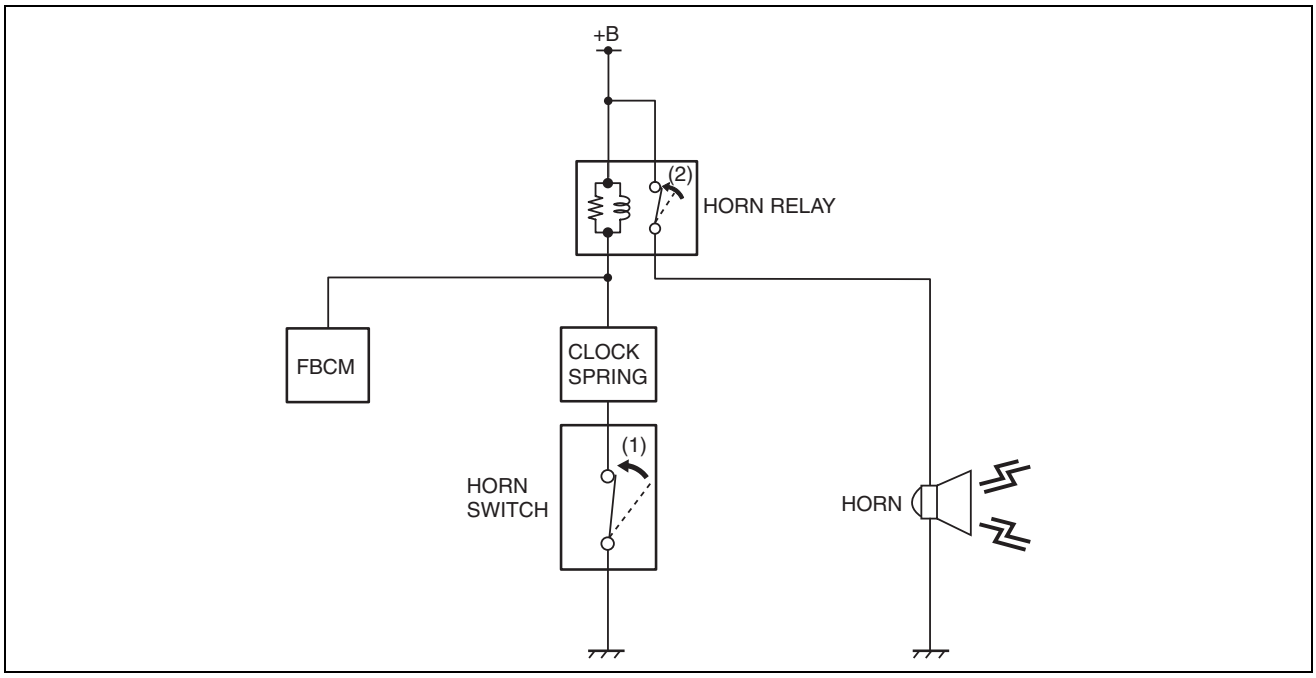
Construction
- Installed to the inside of the front grille.
- The diaphragm is vibrated to apply vibration to the air and produce sound.



ac5wzn00001431

Operation
1. When the horn switch turns on (1), the horn relay turns on (2).
2. When the horn relay turns on, the horn sounds.

INSTRUMENTATION/DRIVER INFO.



ac5wzn00001552

Fail-safe
- Function not equipped.

PARKING SENSOR SYSTEM

id092200024200

Outline
- The parking sensor system detects obstructions in the blind spot (vehicle front/rear/corners) to a wide extent using ultrasonic sensors and notifies the driver of the obstructions using the indicator and buzzer.

  Warning
  - **The parking sensor is a device to assist the driver in confirming safety. It is not a substitute for the driver and cannot guarantee 100% safety. Do not rely completely on the parking sensor and drive while confirming the safety of the surrounding area visually.**

- The following circumstances may obstruct the ultrasonic sensor resulting in an accident:
  — Ice, snow, or dirt is adhering to the ultrasonic sensor.
  — The ultrasonic sensor is covered by foreign material (such as bumper stickers).
  — A shock is applied to the bumper in an accident and the ultrasonic sensor installation angle is deviated.
  — The ultrasonic sensor is exposed to heavy rain or water-spray from the road.
  — There is another device emitting ultrasonic waves (such as a parking assist system of another vehicle) near the ultrasonic sensor.
- The parking sensor may not operate correctly under the following conditions:
  — Ice, snow, or dirt is adhering to the ultrasonic sensor surface.
  — The ultrasonic sensor is frozen.
  — The vehicle is in a tilted position.
  — The vehicle is parked on a steep incline or there is a difference in height between lines.
  — Obstructions have approached too close to the sensor.
- The parking sensor may not detect the following items:
  — Thin objects such as wire or rope
  — Items which absorb ultrasonic waves easily, such as cotton or snow
  — Angular-shaped objects
  — Tall objects with protruding at the top
  — Short objects
  — Objects located immediately below the bumper, such as wheel stoppers
- The warning alert may activate while driving near parked vehicles/guardrails/walls on a narrow road, or while driving on a slope, gravel road, or grass field. This is a normal effect caused by the system's response to ultrasonic waves, and does not indicate a malfunction.

INSTRUMENTATION/DRIVER INFO.

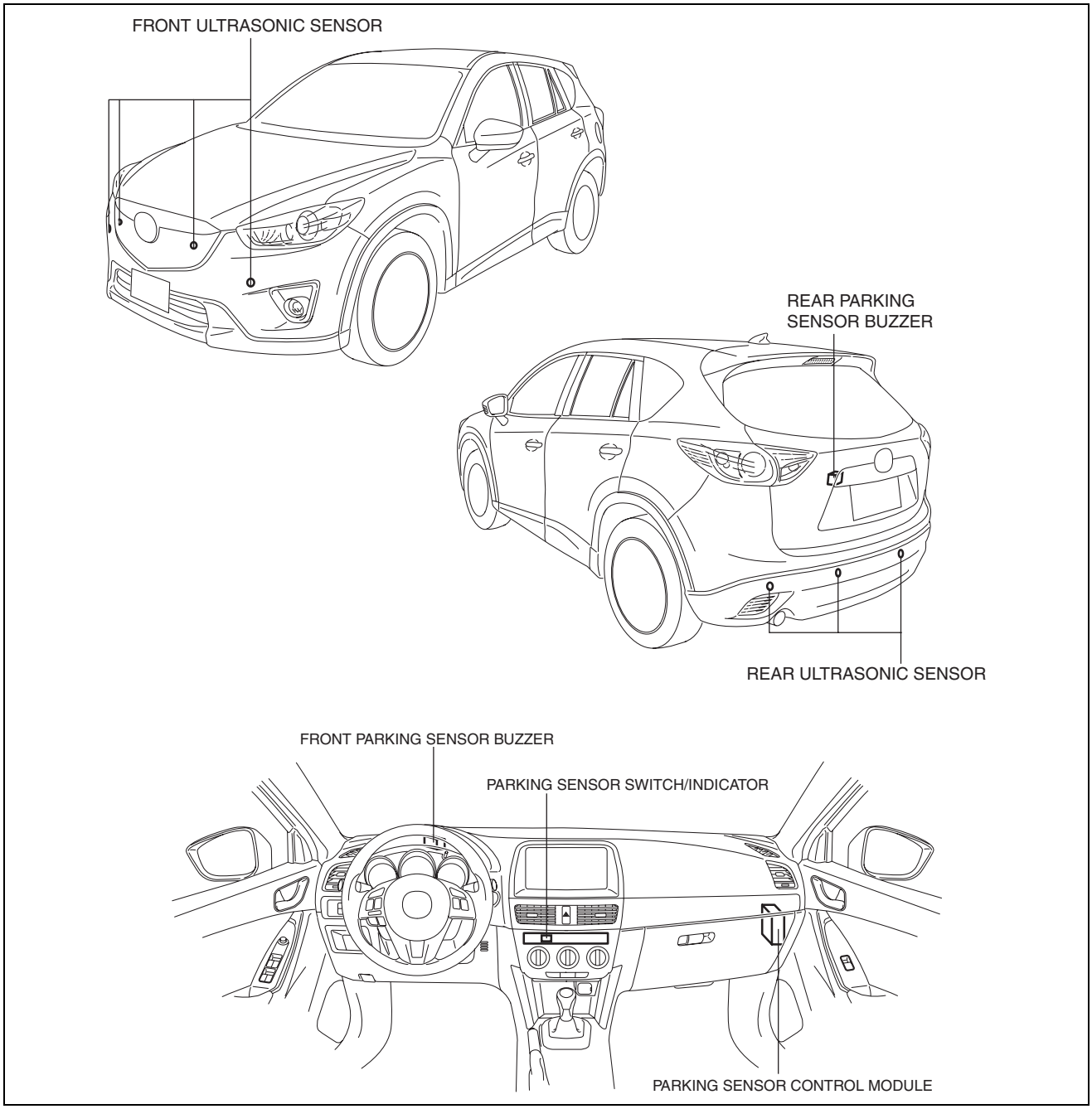
Function

- The ultrasonic sensor assembled to the bumper detects an obstruction and the parking sensor control module notifies the driver of the area and the distance between the vehicle and the obstruction using the parking sensor buzzer, parking sensor indicator, and parking sensor screen (with color LCD and audio unit only).

Volume adjustment function

- The volume of the parking sensor buzzer can be adjusted. Refer to the Workshop Manual for the adjustment procedure.

Structural view



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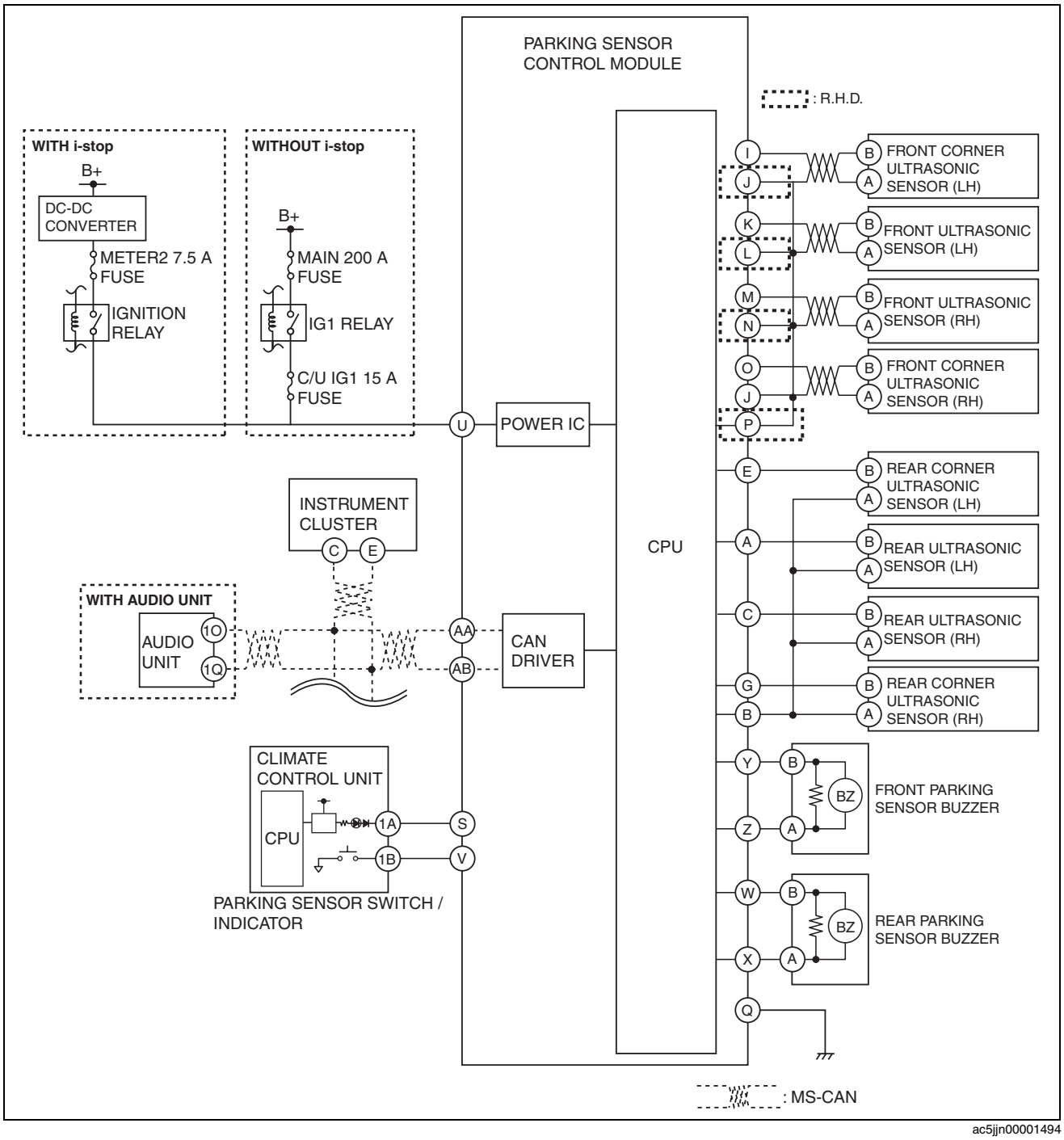
System wiring diagram

- Twisted pair wiring harnesses are used between the front ultrasonic sensors and the parking sensor control module because many of the electrical components on the front ultrasonic sensor may be affected by noise.

INSTRUMENTATION/DRIVER INFO.



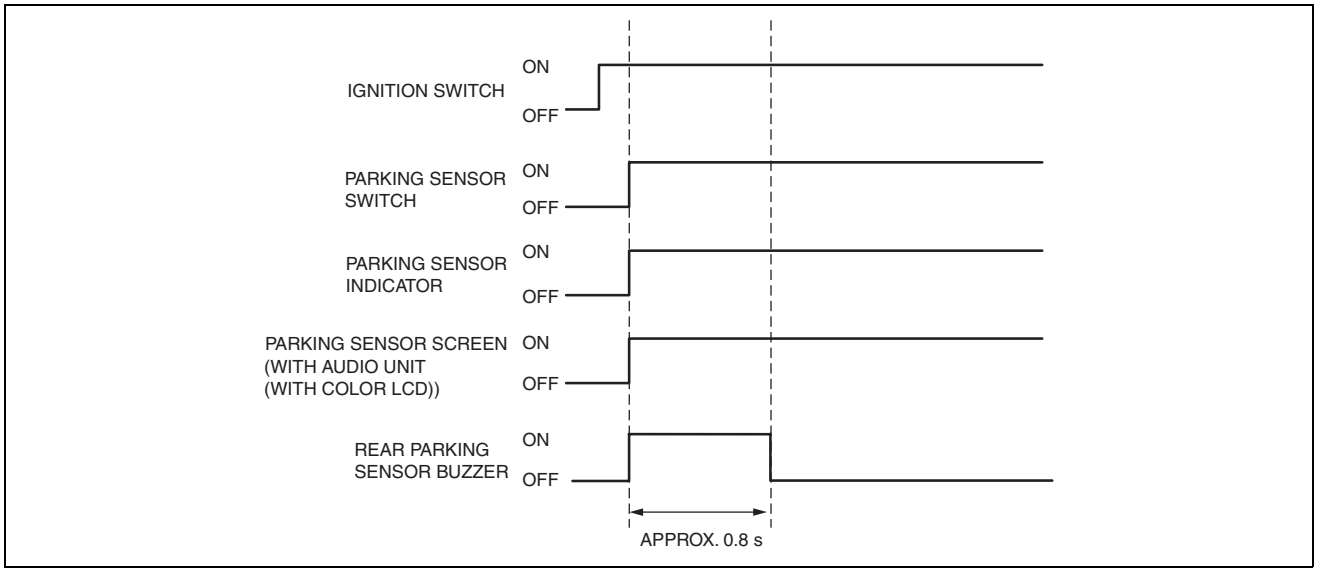
ac5jjn00001494

Operation
Operation condition

- If any one of the following conditions is met, the parking sensor system operates.
  - — Parking sensor switch turned on (system on) with ignition switched ON (engine on) and vehicle speed of less than 10 km/h {6.2 mph}
  - — Selector lever shifted to R position (ATX)/reverse gear (MTX) with ignition switched ON (engine on) and vehicle speed of less than 10 km/h {6.2 mph}

INSTRUMENTATION/DRIVER INFO.

- If the operation condition is met, the rear parking sensor buzzer sounds for approx. 0.8 s and the parking sensor indicator illuminates. In addition, the parking sensor screen is displayed on the audio unit (with color LCD) screen.



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- If the system activates, the ultrasonic sensor starts to detect obstructions. For the ultrasonic sensor which is operating, refer to the following table.

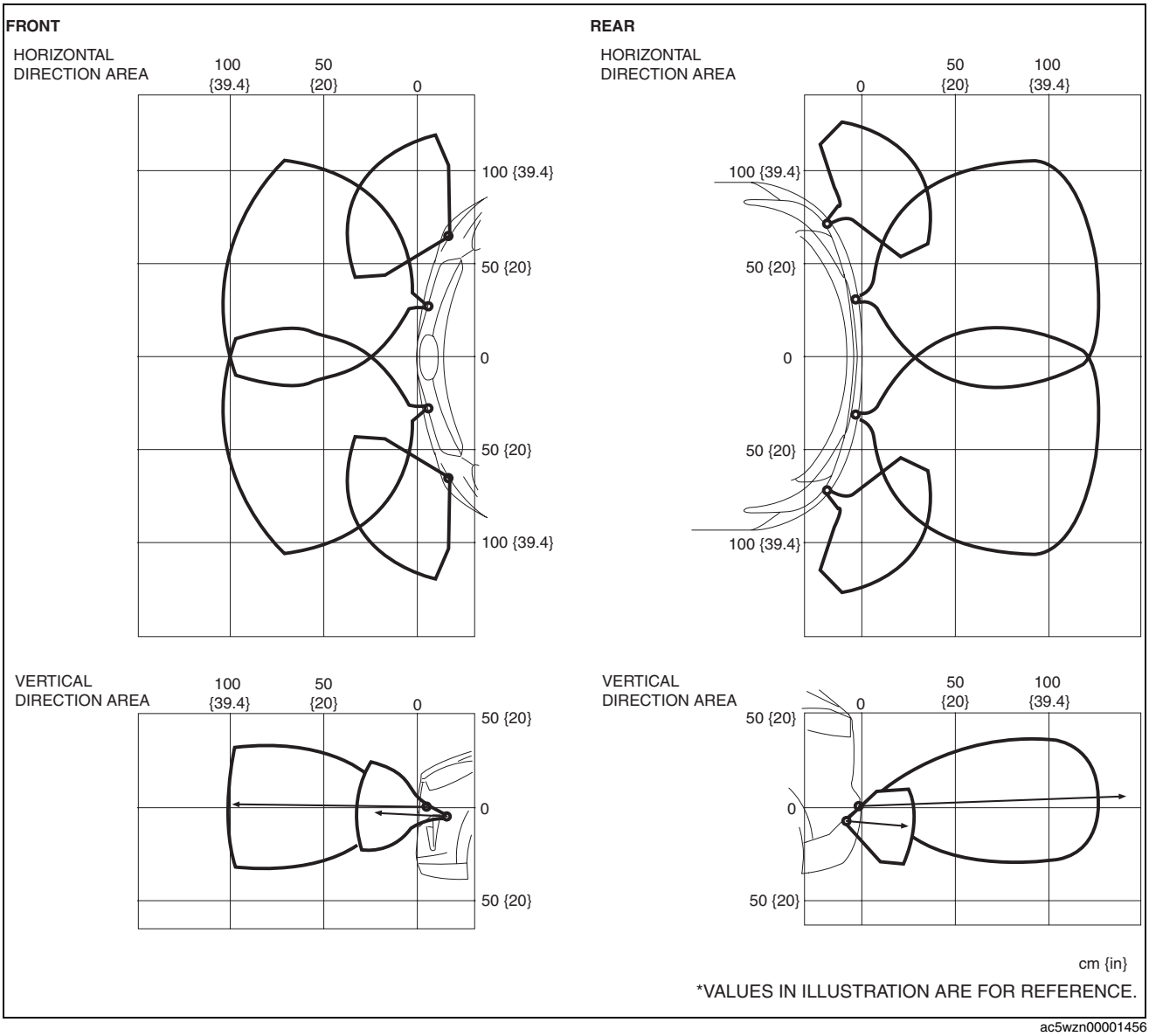
×: Indicator illumination/flashing —: Not operating

Vehicle condition		Parking sensor indicator	Ultrasonic sensor			
			Front		Rear	
Shift lever	Vehicle speed		Corner	Center	Corner	Center
Except R position (ATX)/ reverse gear (MTX)	Less than approx. 10 km/h {6.2 mph}	On	×	×	—	—
	Approx. 10 km/h {6.2 mph} or more	Off	—	—	—	—
R position (ATX)/reverse gear (MTX)	Less than approx. 10 km/h {6.2 mph}	On	×	—	×	×
	Approx. 10 km/h {6.2 mph} or more	On	—	—	—	×

INSTRUMENTATION/DRIVER INFO.

Obstruction Detection Area

- Each ultrasonic sensor detects obstructions in the following areas.



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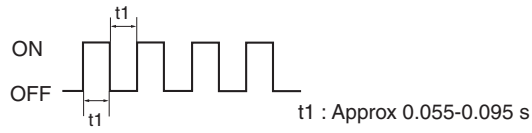
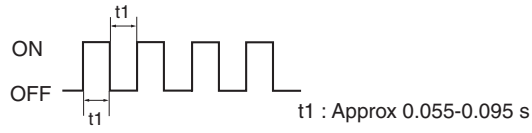
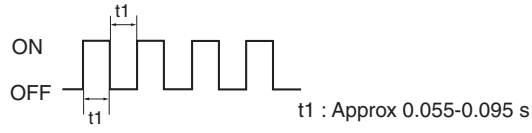
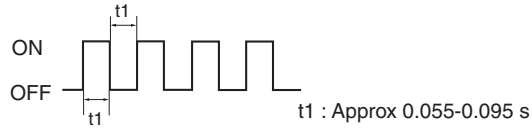
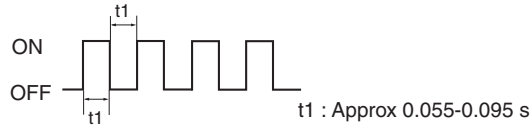
Illumination/flashing of parking sensor indicator, buzzer sound pattern

Obstructions detected

- Change in the illumination/flashing of the parking sensor indicator and the amount of time the buzzer sounds are as follows:
- The parking sensor indicator and buzzer are non-synchronized.

Ultrasonic sensor	Zone	Distance from obstruction	Parking sensor buzzer sound pattern

INSTRUMENTATION/DRIVER INFO.

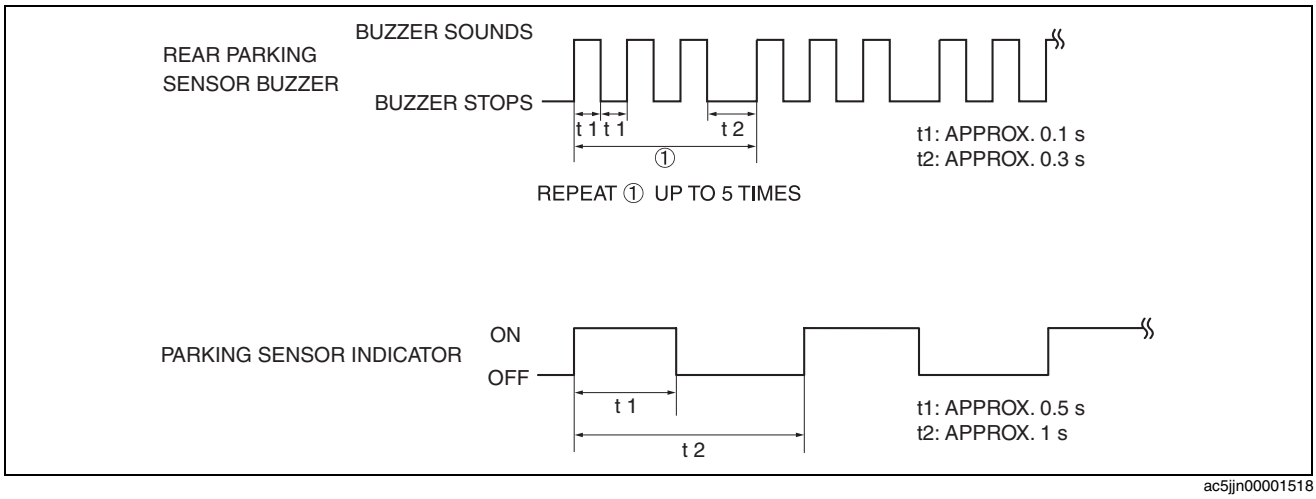
Front/rear corner sensor	Short distance	Approx. 0—25 cm {9.8 in}	CONTINUOUS ON OFF
	Intermediate distance	Approx. 25—38 cm {9.9—14.0 in}	
	Long distance	Approx. 38—55 cm {15—21 in}	
Front sensor	Short distance	Approx. 0—40 cm {15 in}	CONTINUOUS ON OFF
	Intermediate distance	Approx. 40—50 cm {16—19 in}	
	Long distance	Approx. 50—65 cm {20—25 in}	
	Maximum long distance	Approx. 65—110 cm {26—43.3 in}	
Rear sensor	Short distance	Approx. 0—35 cm {13 in}	CONTINUOUS ON OFF
	Intermediate distance	Approx. 35—45 cm {14—17 in}	
	Long distance	Approx. 45—60 cm {18—23 in}	
	Maximum long distance	Approx. 60—150 cm {24.0—59.0 in}	

Ultrasonic sensor malfunction is detected

- If the parking sensor control module detects that there is a malfunction in the ultrasonic sensor circuit, it sounds the buzzer in the following pattern and flashes the parking sensor indicator.

Note

- If there is a malfunction in the front ultrasonic sensor circuit, the front parking sensor buzzer sounds. If there is a malfunction in the rear ultrasonic sensor circuit, the rear parking sensor buzzer sounds.



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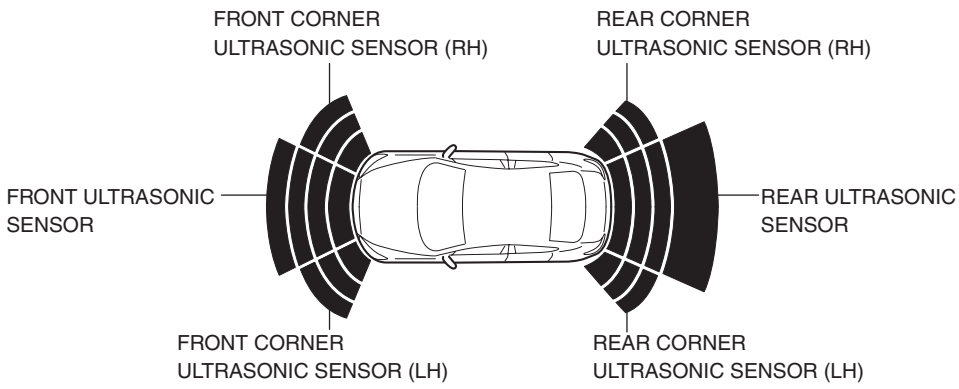
- Flashes the indicator for the sensor location that is malfunctioning on the parking sensor screen.

PARKING SENSOR SCREEN



ac5wzn00001460

ULTRASONIC SENSOR

id092200024300

Purpose

- Detects obstructions.

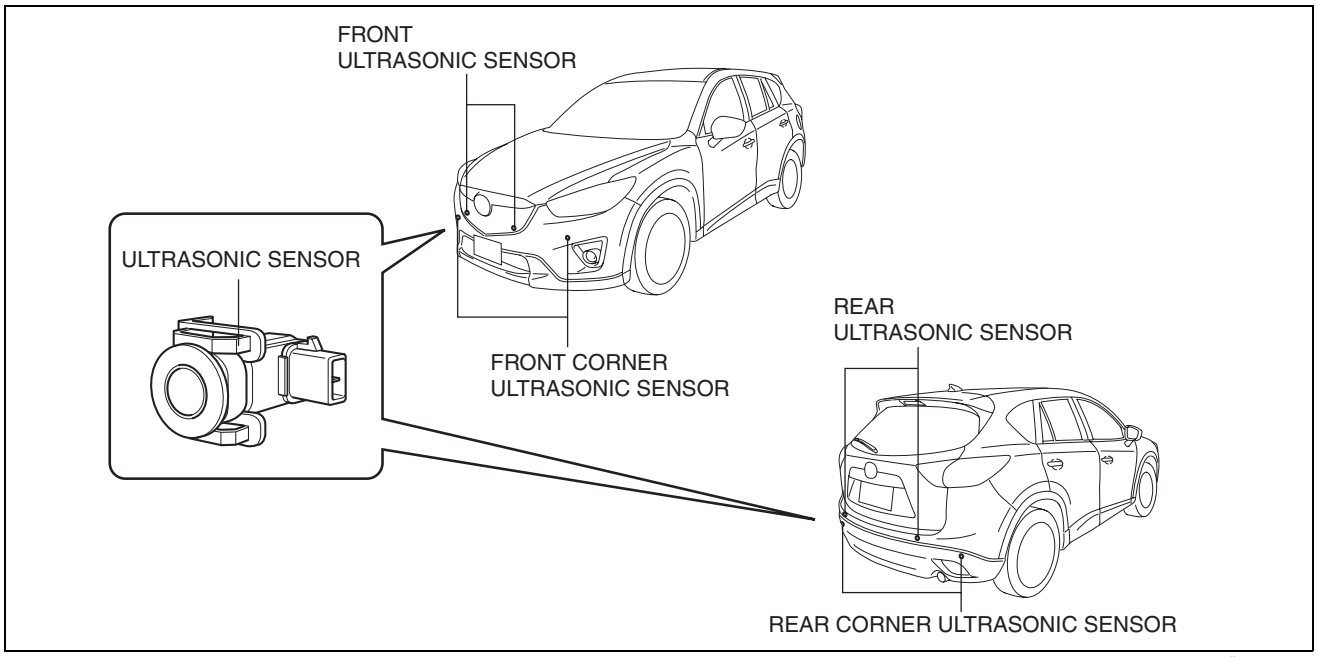
Function

- The ultrasonic sensor emits ultrasonic waves from its head and receives the waves reflected off an obstruction.

Construction

- Consist of a total of eight ultrasonic sensors; four on the front bumper and four on the rear bumper.

- A flat-type ultrasonic sensor of the same color as the body with no concavity has been adopted.



ac5jjn00001520

Operation

- For details on the ultrasonic sensor operation, refer to 09-22-95 PARKING SENSOR SYSTEM.

Fail-safe

- Function not equipped.

PARKING SENSOR CONTROL MODULE

id092200024400

Purpose

- An obstruction is detected by the ultrasonic sensor to control the parking sensor indicator, parking sensor buzzer, and parking sensor screen.

Function

- The parking sensor control module controls the parking sensor system based on the following CAN signals.

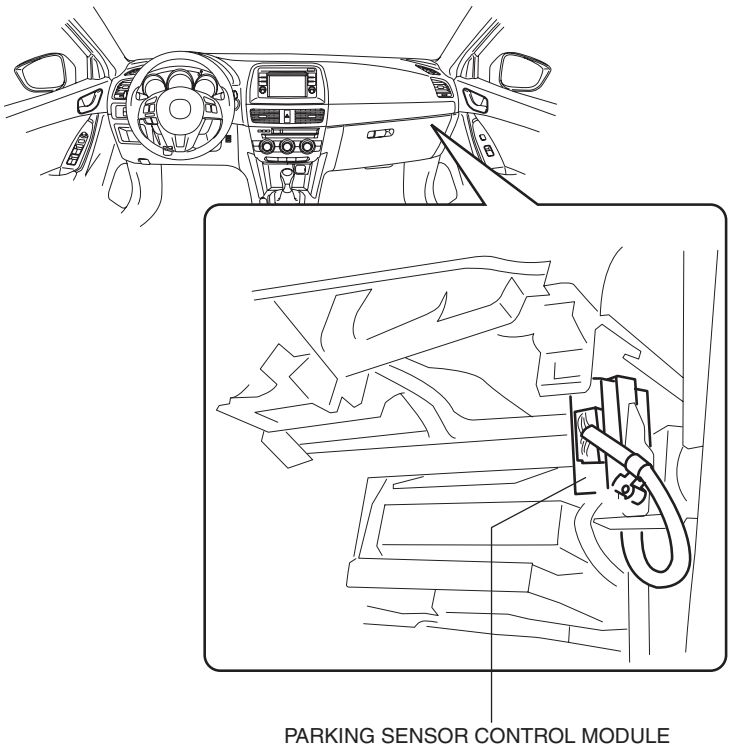
CAN signal sending module	Signal name
PCM	• Vehicle speed signal • Reverse gear signal (MTX)
TCM (ATX)	R position signal
EPS control module	Steering angle signal
Front body control module (FBCM)	Headlight illumination status signal
Instrument cluster	• Parking brake signal • Ignition switch status signal

- The system turns on/off according to the signal from the parking sensor switch.

INSTRUMENTATION/DRIVER INFO.

Construction

- The parking sensor control module is installed to the interior of the glove compartment.



ac5jjn00001521

Operation

- The parking sensor system is activated/turned off, the parking sensor indicator light is turned off/illuminated/flashed, and the buzzer is operated based on the signals from the ultrasonic sensors and the parking sensor switch. For details on the parking control module operation, refer to 09-22-95 PARKING SENSOR SYSTEM.

PARKING SENSOR BUZZER

id092200024700

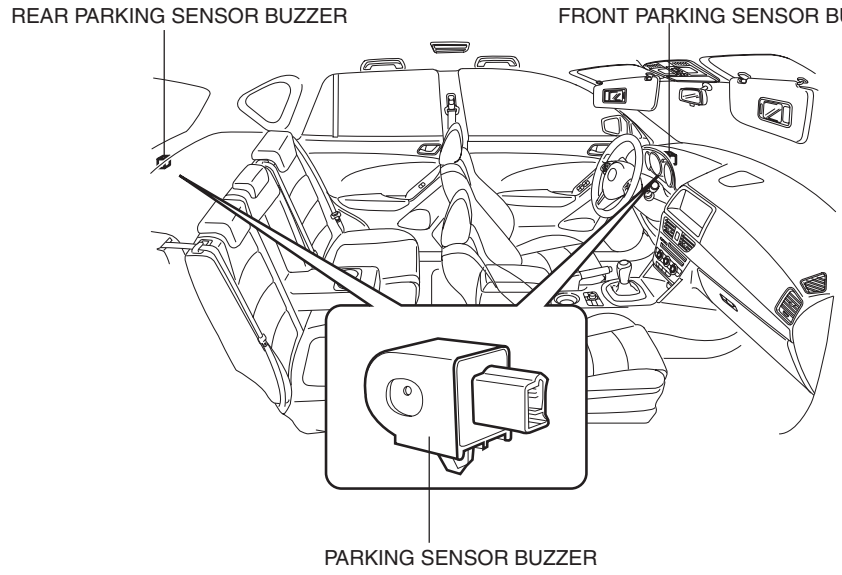
Purpose, Function

- Sound is generated based on the signal from the parking sensor control module.

Construction

- The parking sensor buzzers are provided for the front and rear.
- The front parking sensor buzzer is installed inside the instrument cluster.

- The rear parking sensor buzzer is installed inside the liftgate lower trim.



ac5jjn00001522

Operation

- If the front ultrasonic sensor detects an obstruction, the front parking sensor buzzer sounds. If the rear ultrasonic sensor detects an obstruction, the rear parking sensor buzzer sounds. For details on the parking buzzer operation, refer to 09-22-95 PARKING SENSOR SYSTEM.

Fail-safe

- Function not equipped.

PARKING SENSOR SWITCH

id092200024600

Purpose

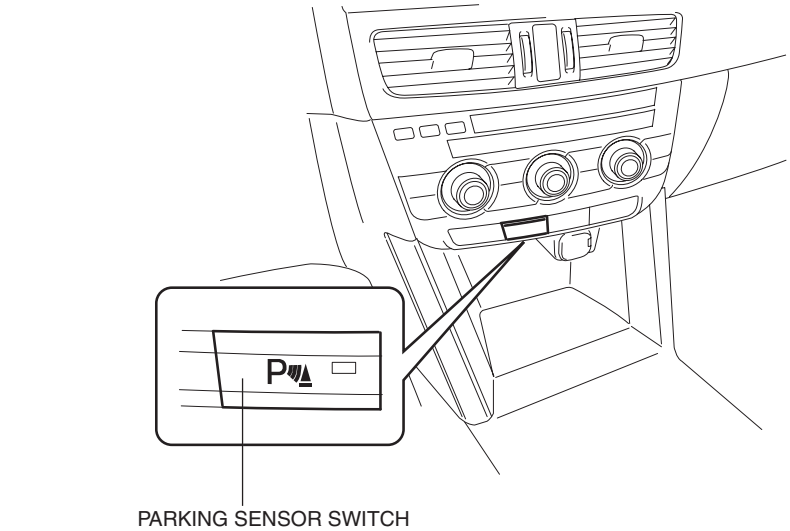
- The parking sensor system can be optionally switched between operable and inoperable.

Function

- The switch operation signal is sent to the parking sensor control module.

Construction

- The parking sensor switch is built into the climate control unit.

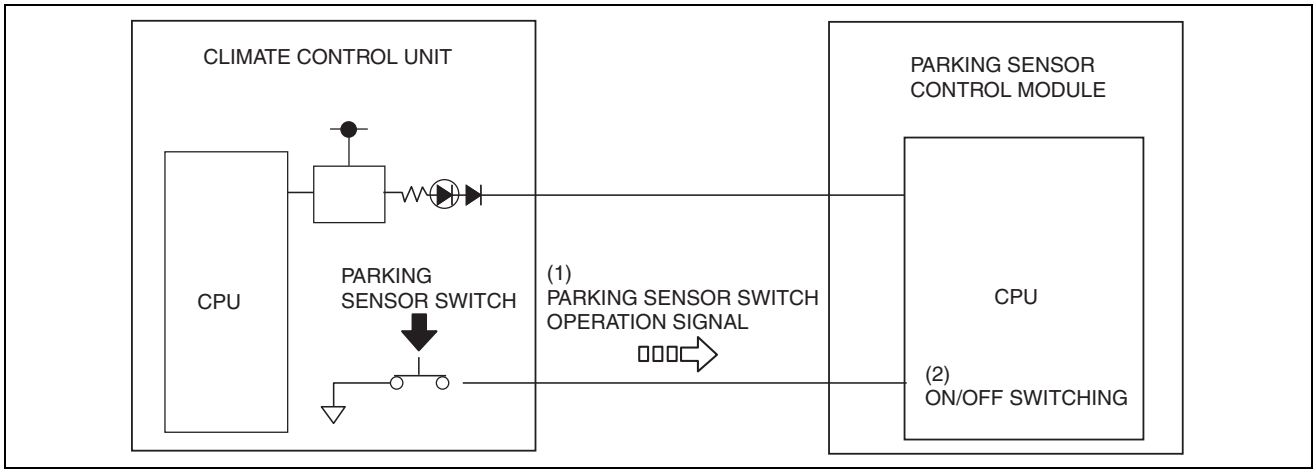


ac5jjn00001523

INSTRUMENTATION/DRIVER INFO.

Operation

1. When the parking sensor switch operates, the switch operation signal is sent to the parking sensor control module.
2. When the parking sensor control module receives the parking sensor switch operation signal, it switches the parking sensor system on/off.



ac5jjn00001524

Fail-safe

- Function not equipped.

PARKING SENSOR INDICATOR LIGHT

id092200024500

Purpose

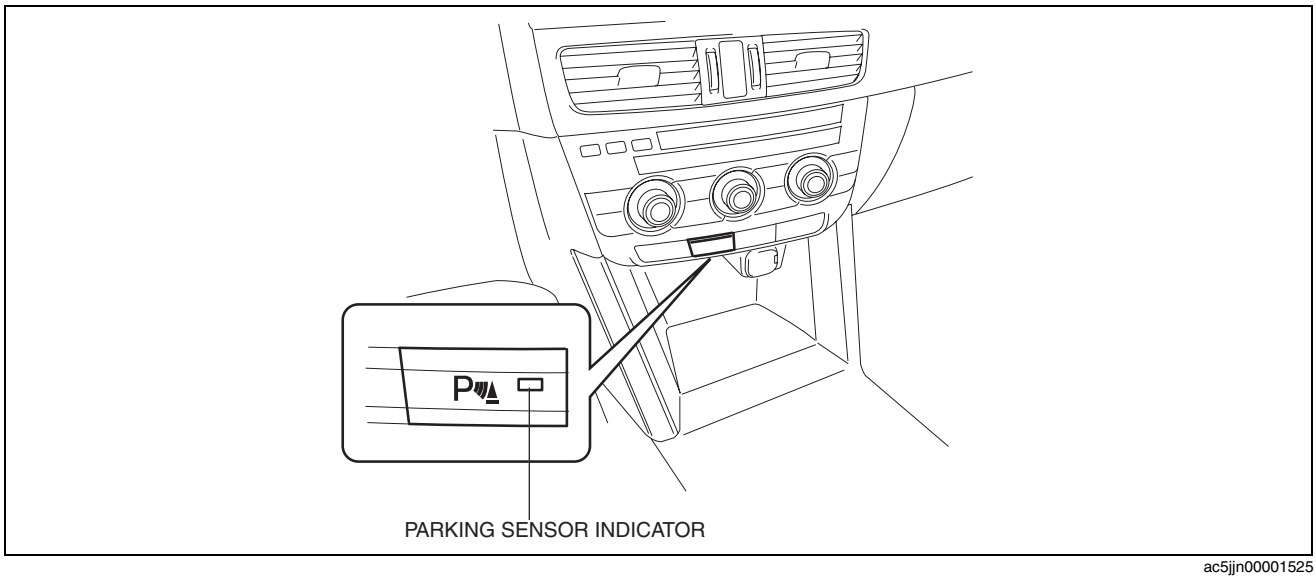
- Illuminates/flashes based on the signal from the parking sensor control module.

Function

- Illuminates when the parking sensor system is operating, and flashes if there is a malfunction in the ultrasonic sensor circuit.

Construction

- The parking sensor indicator is built into the parking sensor switch.



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Operation

- For details on the parking sensor indicator operation/flashing, refer to 09-22-95 PARKING SENSOR SYSTEM.

Fail-safe

- Function not equipped.

INSTRUMENTATION/DRIVER INFO.

LANE DEPARTURE WARNING SYSTEM (LDWS)

id092200029200

Outline

- The Lane Departure Warning System (LDWS) recognizes vehicle lane lines on a road using the forward sensing camera (FSC) installed to the windshield, and if the vehicle departs from its lane unbeknownst to the driver, the system alerts the driver of the lane departure using warning indication and warning sound.

Warning

- **LDWS is only a supplementary system for the prevention of a lane departure, however the LDWS functions have limitations. Relying solely on the LDWS and neglecting prudent steering wheel operation could cause an unexpected accident resulting in death or serious injury. Do not rely solely on the LDWS. Always make lane corrections using the steering wheel and drive safely.**
- **The LDWS may not operate normally under the following conditions:**
  - **— Poor vehicle lane line visibility due to adverse weather (rain, snow, fog)**
  - **— Poor vehicle lane line visibility due to backlight, snow on the road, water puddles, road ruts**
  - **— Poor vehicle lane line visibility due to cracks and fissures in the vehicle lane**
  - **— Vehicle lane lines intersect with complexity due to additions or reductions of travel lanes**
  - **— Vehicle lane marking is not completely erased after road maintenance, two or more lane lines next to each other**
  - **— Vehicle lane lines not recognized due to vehicle ahead**

Function

- The FSC sets warning-trigger lines based on the vehicle lane lines recognized by the camera, and if the vehicle contacts one of these warning-trigger lines it activates the warning indicator and warning sound. Refer to 09-22-113 FORWARD SENSING CAMERA (FSC) for FSC and warning-trigger line details.

Warning-trigger line auto-adjust function*1

- When the vehicle is driven for a certain period of time or more during 1 drive-cycle *2, the FSC adjusts the warning-trigger lines according to the reduction in travel lane width and the driver's driving characteristics (such as staying to the left) to control unnecessary warnings.

*1 : The warning-trigger auto-adjust function operates when the warning-trigger timing is set to adaptive mode. Refer to 09-22-8 INSTRUMENTATION/DRIVER INFO. PERSONALIZATION for changing the warning-trigger timing.

*2 : One drive cycle means the period from when the ignition is switched ON (engine on) to when the ignition is switched off (engine off).

Driver operation determination function

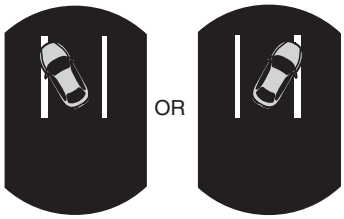
- The FSC determines the driver's intentions according to the following driving operations, and controls the warning-trigger operation.
  - — After the turn switch is operated and the vehicle lane is changed within 6 s.
  - — The steering wheel is turned at a certain angle or more, and the vehicle lane is changed.
  - — The accelerator pedal is depressed a certain amount or more, and the vehicle lane is changed.

System conditions display function

- The FSC displays the system conditions using the LDWS indicator light (green), LDWS warning light (amber), and the TFT LCD display (with TFT LCD display) in the instrument cluster.

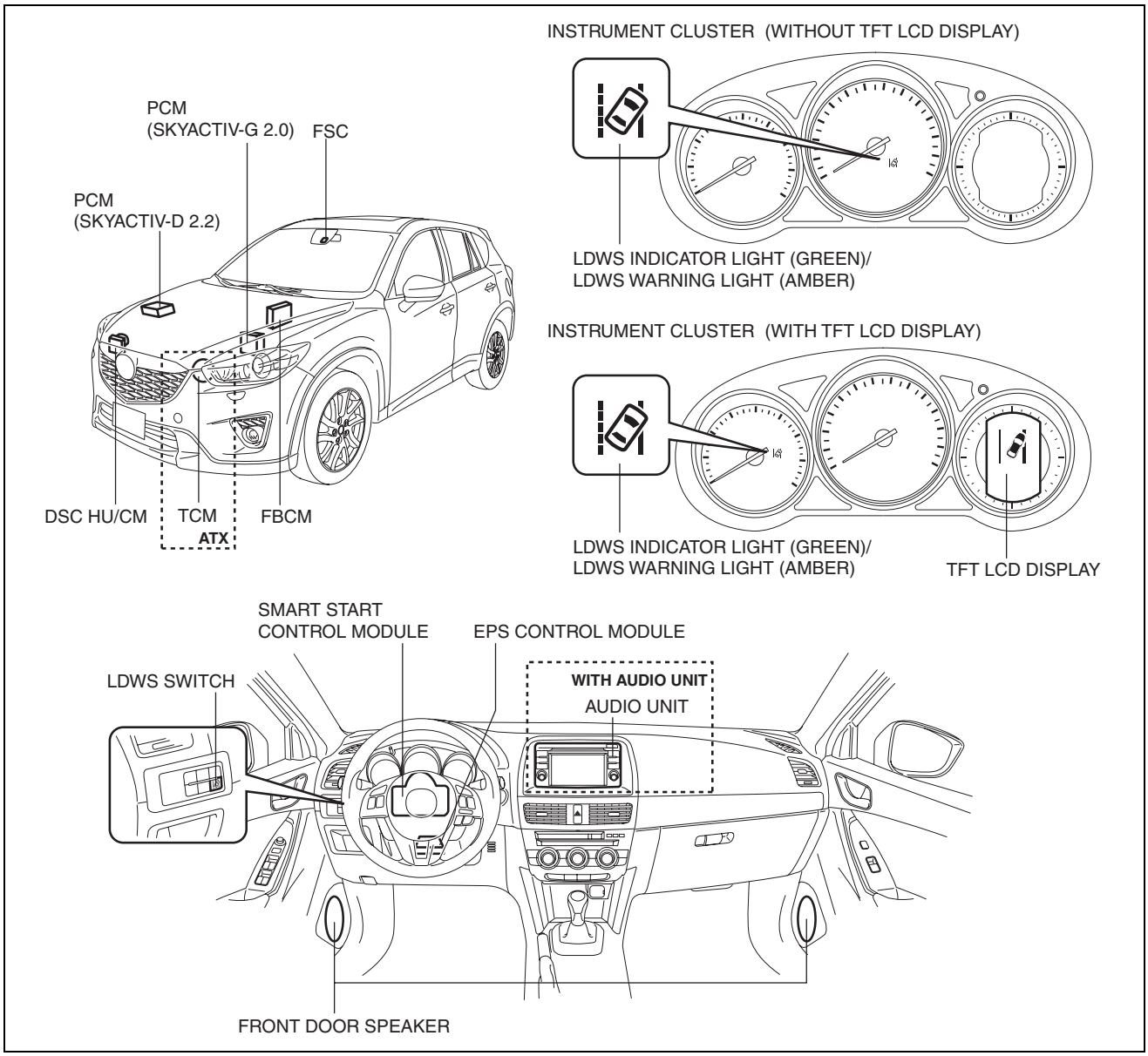
LDWS Switch	Condition	LDWS indicator light (green)	LDWS warning light (amber)	TFT LCD display
OFF	System is off	Illumination off	Illumination off	No display

INSTRUMENTATION/DRIVER INFO.

LDWS Switch	Condition	LDWS indicator light (green)	LDWS warning light (amber)	TFT LCD display
ON	Vehicle lane lines recognized at vehicle speed of 65 km/h {40 mph} or more	Illumination on	Illumination off	
	While warning is triggered	Flashes	Illumination off	
	Vehicle speed 60 km/h {37 mph} or less	Illumination off	Illumination on	
	Vehicle lanes not recognized			
	FSC detects camera fogging			
	FSC detects camera soiling			
	Malfunction in LDWS occurs		Flashes	
	Malfunction in FSC occurs			

INSTRUMENTATION/DRIVER INFO.

Structural view



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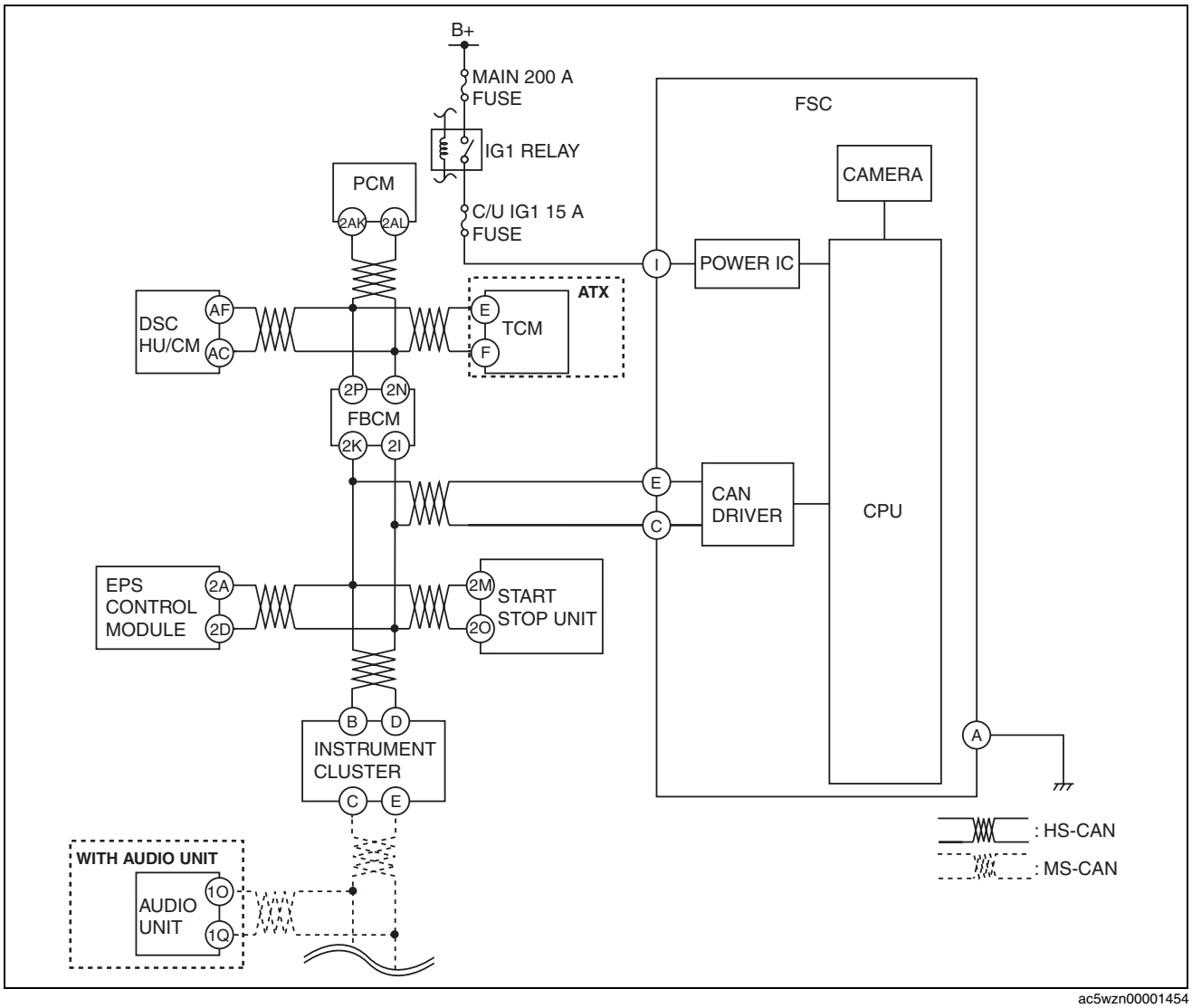
INSTRUMENTATION/DRIVER INFO.

System wiring diagram



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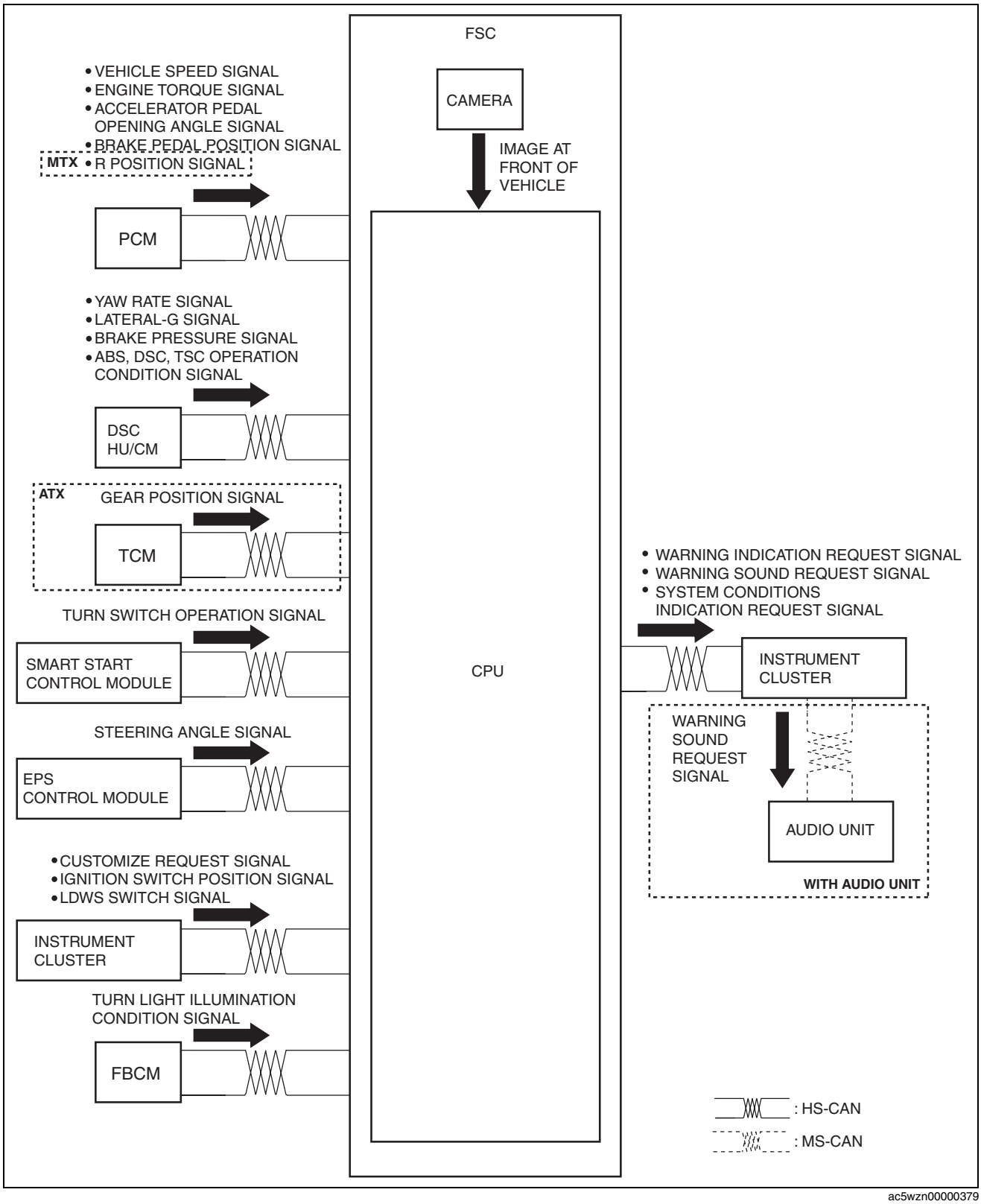
INSTRUMENTATION/DRIVER INFO.

Block diagram



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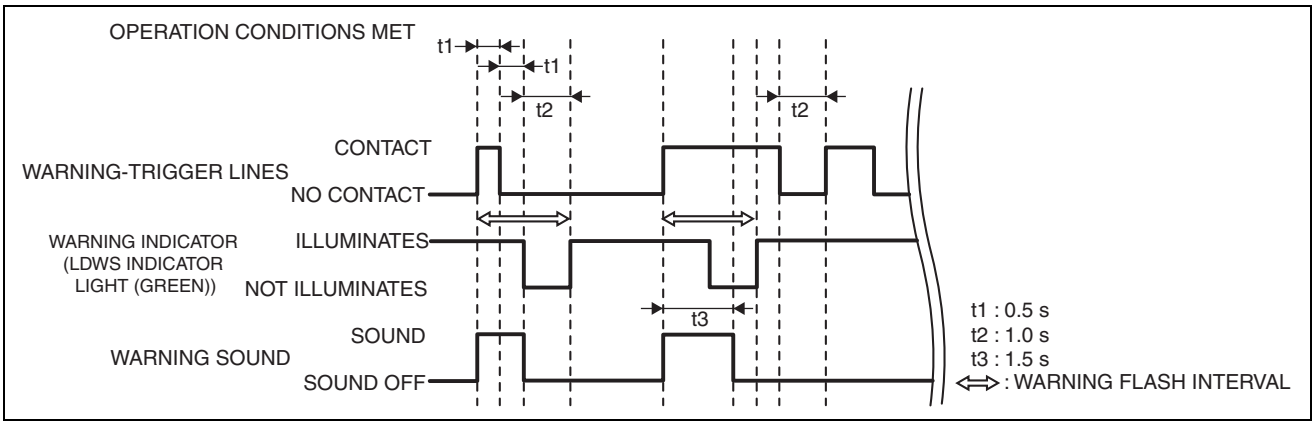
Operation
Operation condition

- The warning is triggered when all of the following conditions are met:
  - — LDWS switch is on (system on)
  - — Vehicle speed is 65 km/h {40 mph} or more
  - — Vehicle contacts warning-trigger line unbeknownst to driver

INSTRUMENTATION/DRIVER INFO.

Operation

- The period of time in which the warning is triggered differs by the period of time in which the vehicle is contacting the warning-trigger line.
  - — Vehicle contacts warning-trigger line for less than 1 s: Warning triggers for 1 s
  - — Vehicle contacts warning-trigger line for 1 s or more: Warning triggers for 1.5 s
- If the warning is triggered one time, the warning will not trigger again if the vehicle travels within the warning-trigger lines for a period of 2 s.



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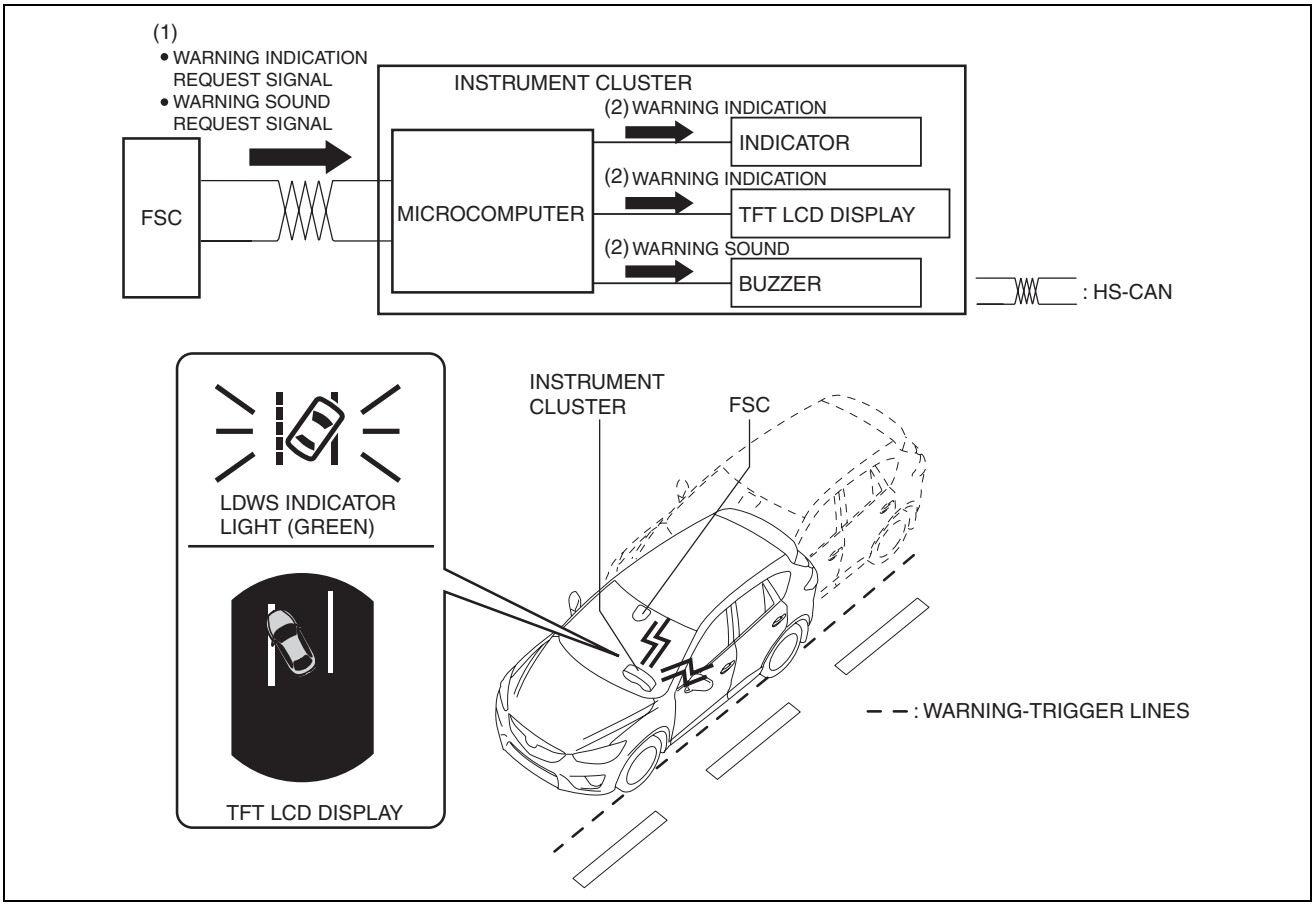
- If the vehicle is not equipped with an audio unit, the warning activation sound is output from the instrument cluster, for vehicles with an audio unit, the sound is output through the audio unit.

Without audio unit

1. If the FSC determines that the vehicle has contacted an warning-trigger line, it sends warning sound request signal and an warning indication signal to the instrument cluster.
2. When the instrument cluster receives the warning sound request signal and the warning indication request signal from the FSC, it flashes the LDWS indicator light (green) and displays the warning screen in the TFT LCD display (with TFT LCD display). In addition, the warning is sounded using the buzzer in the instrument cluster.



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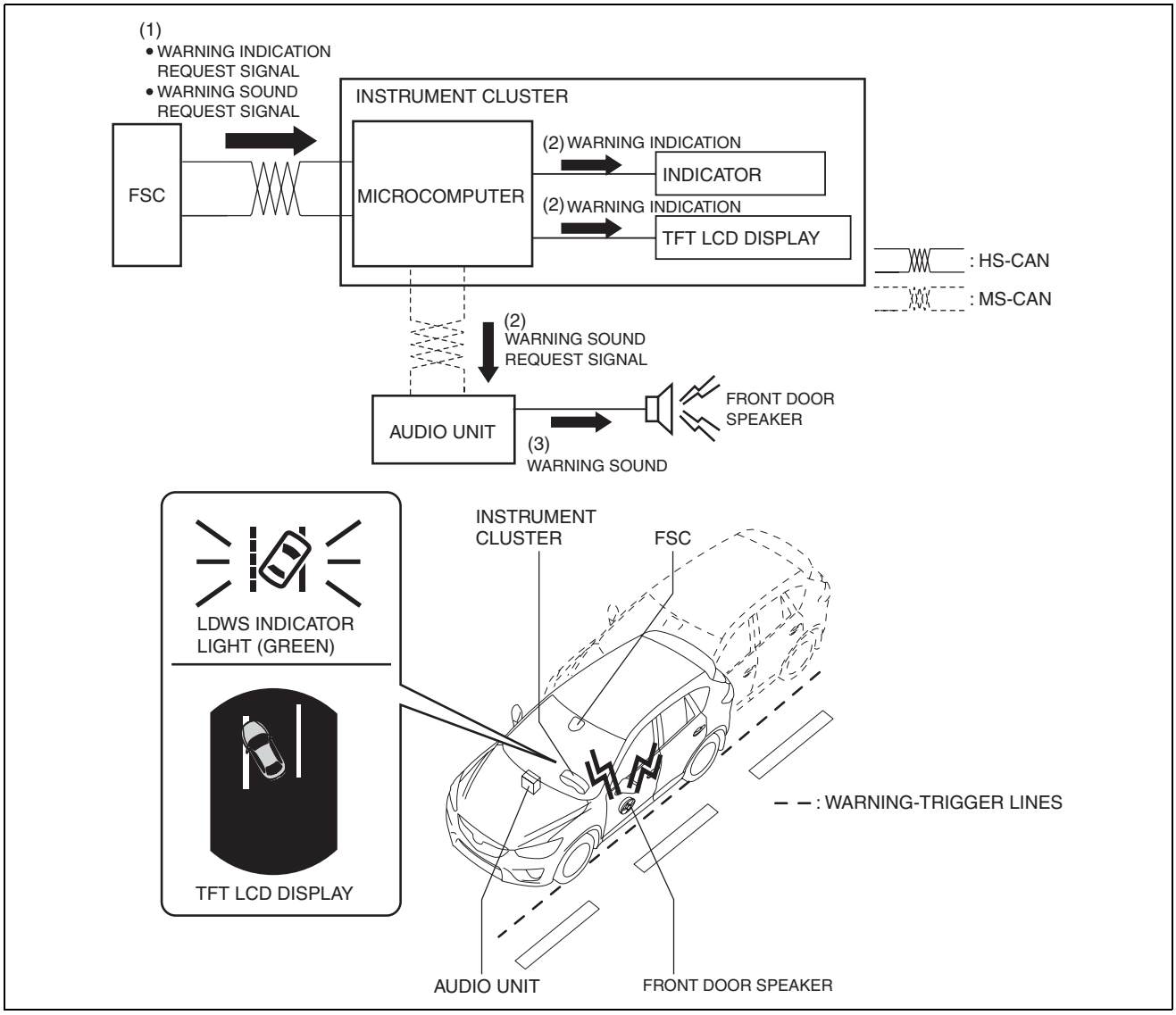
INSTRUMENTATION/DRIVER INFO.

With audio unit

1. If the FSC determines that the vehicle has contacted a warning-trigger line, it sends an warning sound request signal and an warning indication request signal to the instrument cluster.
2. When the instrument cluster receives the warning sound request signal and the warning indication request signal from the FSC, it flashes the LDWS indicator light (green) and displays the warning screen in the TFT LCD display (with TFT LCD display). In addition, the warning sound request signal is sent to the audio unit.
3. When the audio unit receives the warning sound request signal from the instrument cluster, it stops sound output from either the front left or right door speaker according to the request signal and outputs a rumble strip sound *1.

Note

- If the user is conversing using the HF/TEL, or the voice recognition function is outputting voice, the rumble strip sound is not output.



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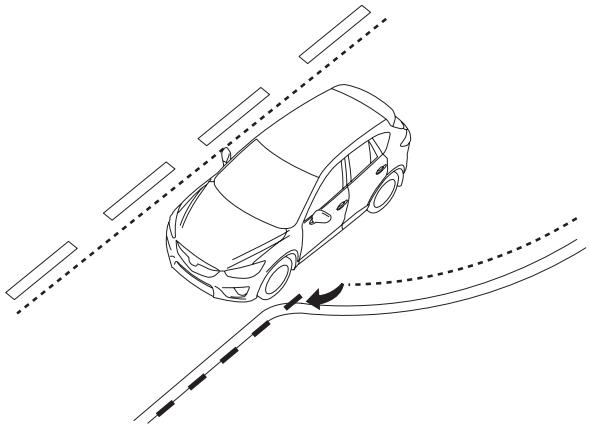
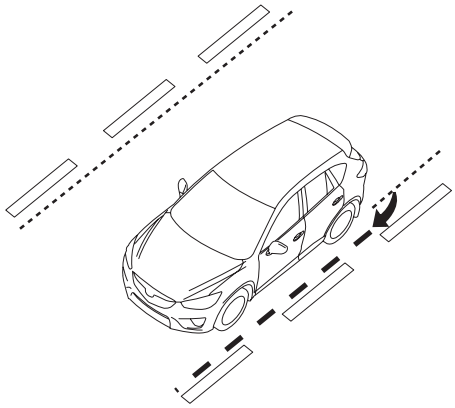
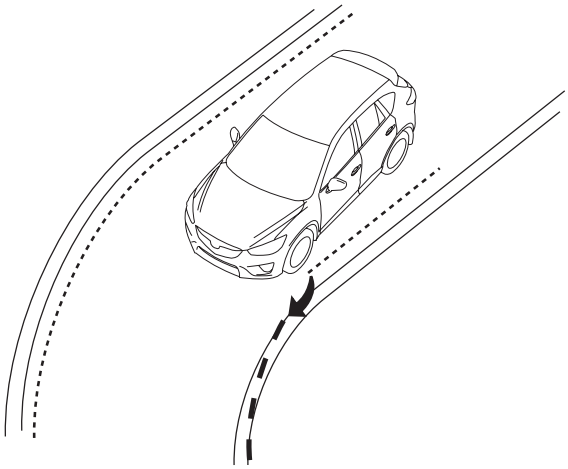
*1 : Refer to 09-20-25 AUDIO UNIT (WITH COLOR LCD) for rumble strip sound details.

Warning-trigger line auto-adjust operation

- The FSC adjusts the warning-trigger lines in the following cases:

INSTRUMENTATION/DRIVER INFO.

Detection state	Adjustment
Recognized travel lane width decreases to certain width or less	 : WARNING-TRIGGER LINES BEFORE ADJUSTMENT : WARNING-TRIGGER LINES AFTER ADJUSTMENT
Distance of vehicle to recognized vehicle lane line detected (such as staying to left) continuously as closer than specified value for certain period of time.	SUCH AS STAYING TO LEFT  : WARNING-TRIGGER LINES BEFORE ADJUSTMENT : WARNING-TRIGGER LINES AFTER ADJUSTMENT
Recognized vehicle lane line curves for certain period of time or more and system determines that vehicle is cornering (out-in-out travel)	 : WARNING-TRIGGER LINES BEFORE ADJUSTMENT : WARNING-TRIGGER LINES AFTER ADJUSTMENT

- The warning-trigger lines which the FSC stores during 1 drive-cycle are cleared when the ignition is switched off (engine off).

FORWARD SENSING CAMERA (FSC)

id092200029300

Purpose

- The camera recognizes light-emitting objects and vehicle lane lines based on the images picked up at the front of the vehicle, and controls the high beam control (HBC) system and lane departure warning system (LDWS).

INSTRUMENTATION/DRIVER INFO.

Function

Light-emitting object (on-coming vehicle, vehicle ahead, street lights) recognition function

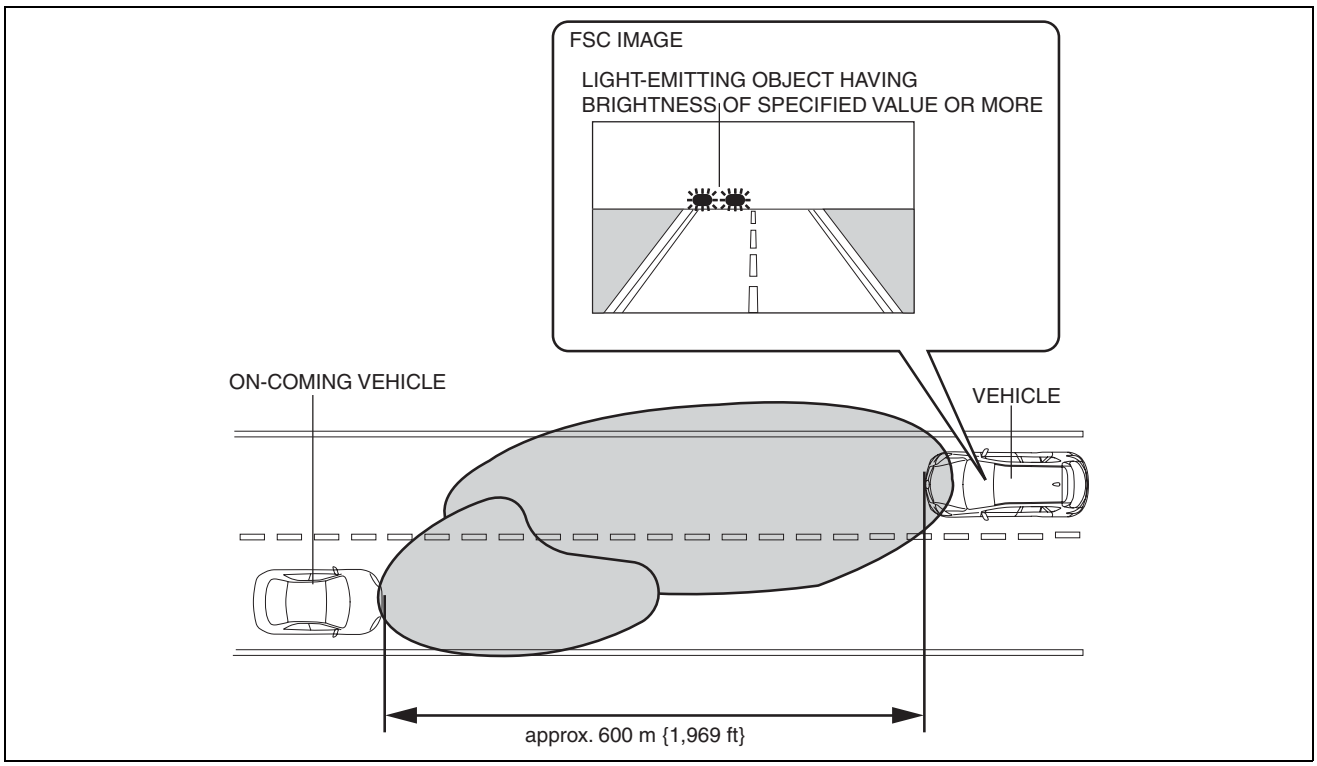
- The camera analyzes the light-emitting object is picks up and recognizes it as an on-coming vehicle, vehicle ahead, or street lights (traveling on town/city streets).

On-coming vehicle recognition function

- The FSC recognizes a light-emitting object that is at least approx. 600 m {1,969 ft} from the detecting vehicle as an on-coming vehicle when any of the following conditions are met:
  - — Light-emitting object approaches having brightness of specified value or more
  - — Light-emitting object approaches having white color and certain level of brightness or more (if it approaches and brightness changes, determination made at point of image capture)

Note

- If the on-coming vehicle and the surrounding conditions are as follows, the FSC may require time until it recognizes an on-coming vehicle.
  - — Poor visibility due to rain and fog
  - — On-coming vehicle is travelling with only TNS or fog lights
  - — Brightness of light source, such as vehicle, lowers



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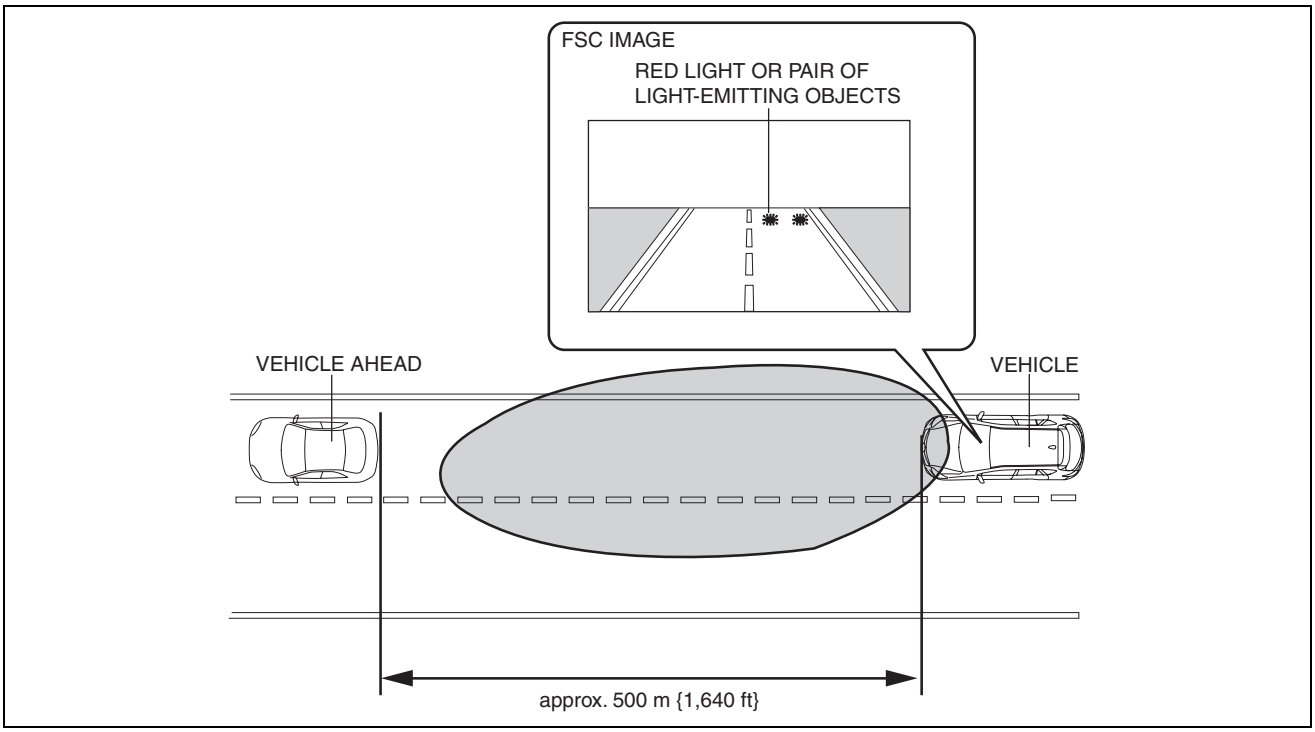
Vehicle ahead recognition function

- The FSC recognizes a light-emitting object that is at least approx. 500 m {1,640 ft} of the detecting vehicle as a vehicle ahead, and when any of the following conditions is met:
  - — Red light emitted from light-emitting object is detected
  - — Determines that there is a pair of light-emitting objects

Note

- To make prevention of dazzling other vehicles a priority, the system could recognize reflecting objects on the road surface or a guard rail as a vehicle ahead (switches to low beams).
- If visibility is poor due to rain or fog, a vehicle ahead may not be recognized even though one may exist (maintains high beams).

INSTRUMENTATION/DRIVER INFO.



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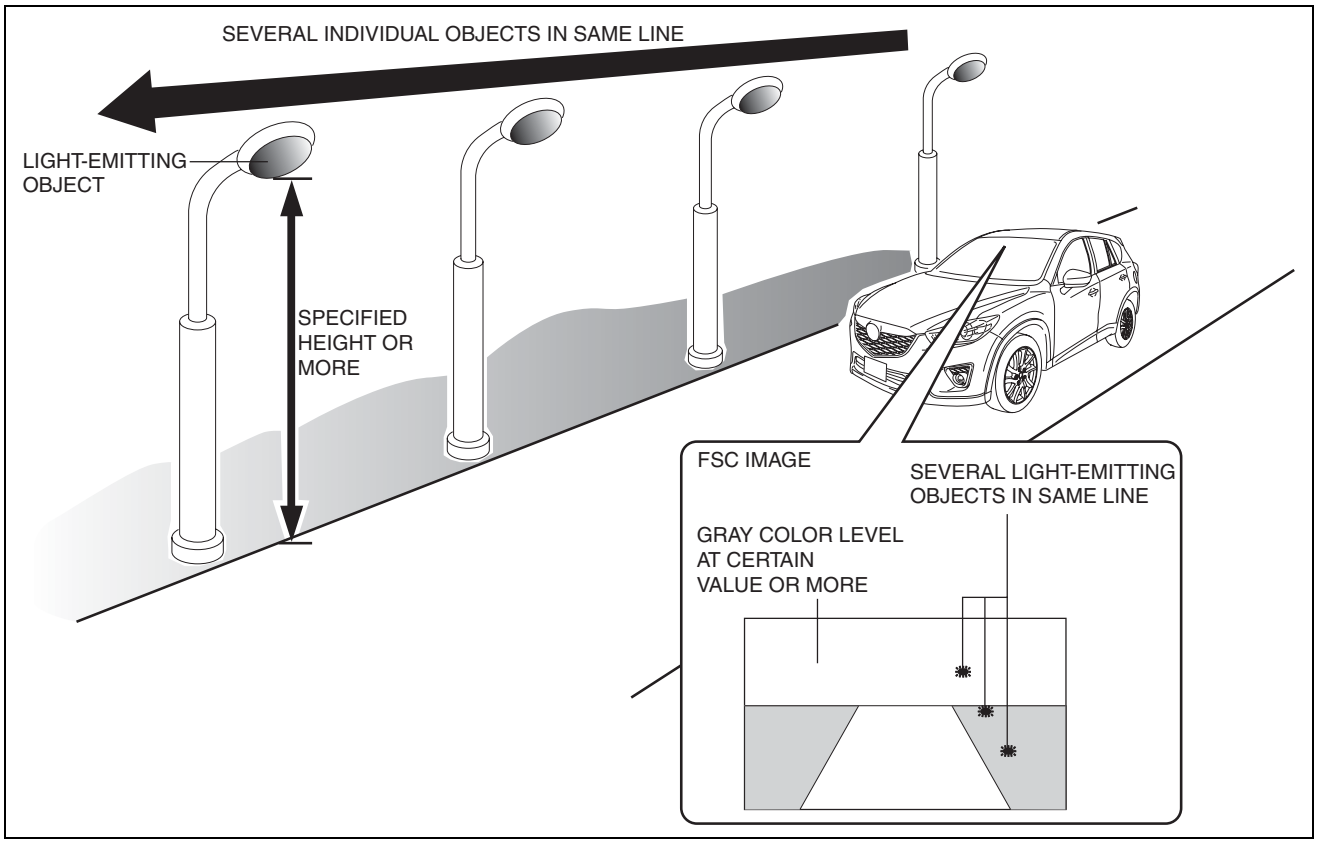
Town/city streets recognition function

- Travel on town/city streets is recognized in the following cases:
  - — Several light-emitting objects of certain height or more from road surface along same line are detected
  - — Camera image gray color is certain level or more

Note

- Even during travel other than at night or on town/city streets, if the road surface is bright from moonlight, the system may recognize that the vehicle is traveling on town/city streets (switches to low beams).

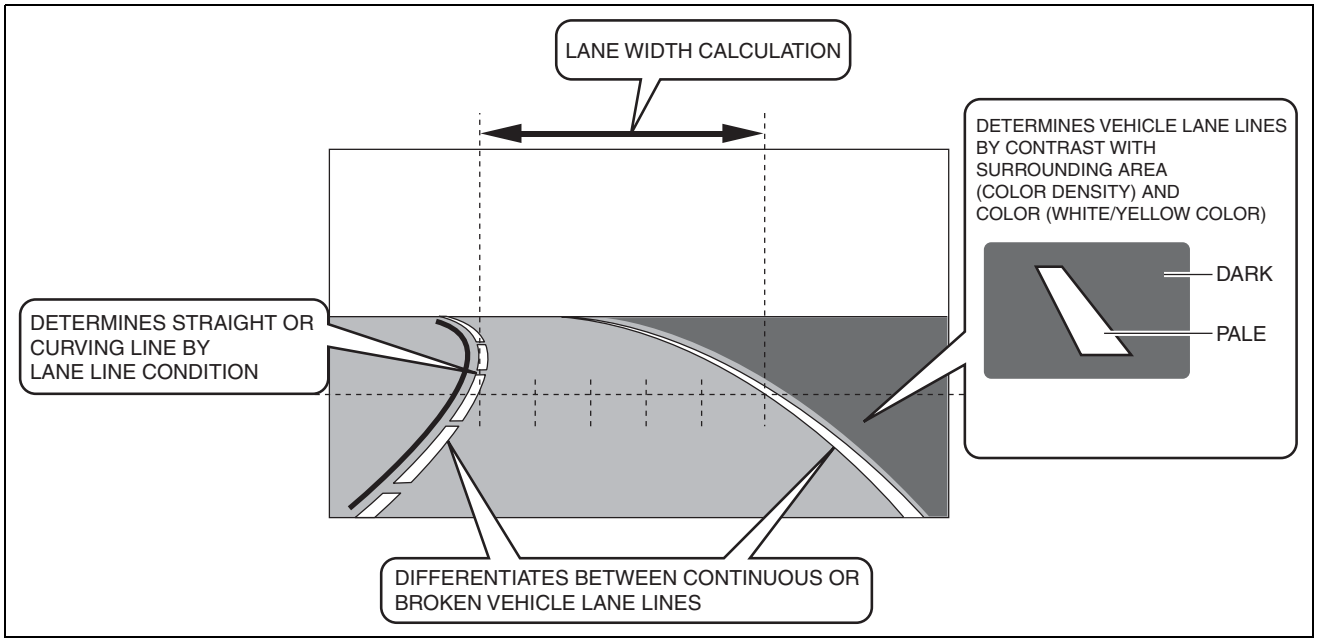
INSTRUMENTATION/DRIVER INFO.



ac5wzn00000388

Vehicle lane lines and travel lane recognition function

- The FSC recognizes line shapes which are paler than the surrounding color, and white/yellow lines as vehicle lane lines from the contrast (color density) of the camera image.
- If the vehicle lane lines are continuous they are recognized as actual lines, if discontinuous they are recognized as broken lines.
- The travel lanes recognized from the vehicle lane lines on the left and right of the vehicle are used to calculate the width.
- Traveling in a straight line or cornering is determined by the status of the vehicle lane lines.



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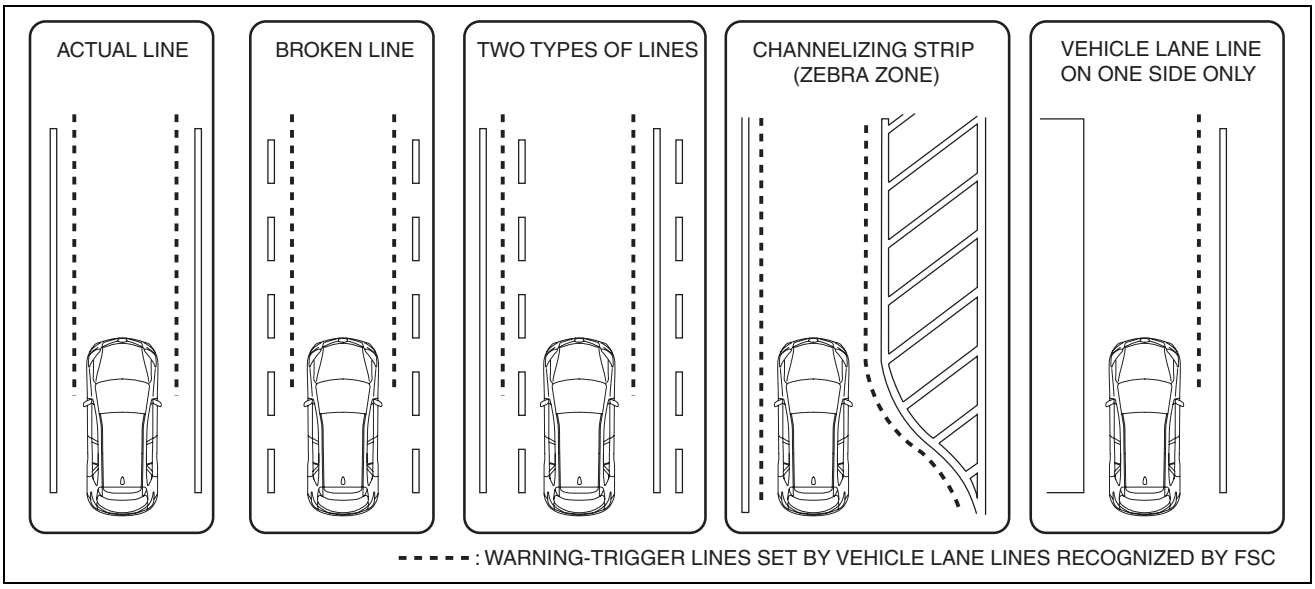
INSTRUMENTATION/DRIVER INFO.

Warning-trigger line setting function

- The FSC sets the warning-trigger lines *1 at approx. 5 cm {2 in} inside of the recognized vehicle lane lines, and if the vehicle contacts a warning-trigger line, the warning is triggered.
- If there is only one vehicle lane line or only one vehicle lane line can be recognized, the warning-trigger line is set to only the recognized vehicle lane line.
- If the FSC recognizes both broken vehicle lane lines and actual vehicle lane lines, the warning-trigger line is set to the actual vehicle lane line.



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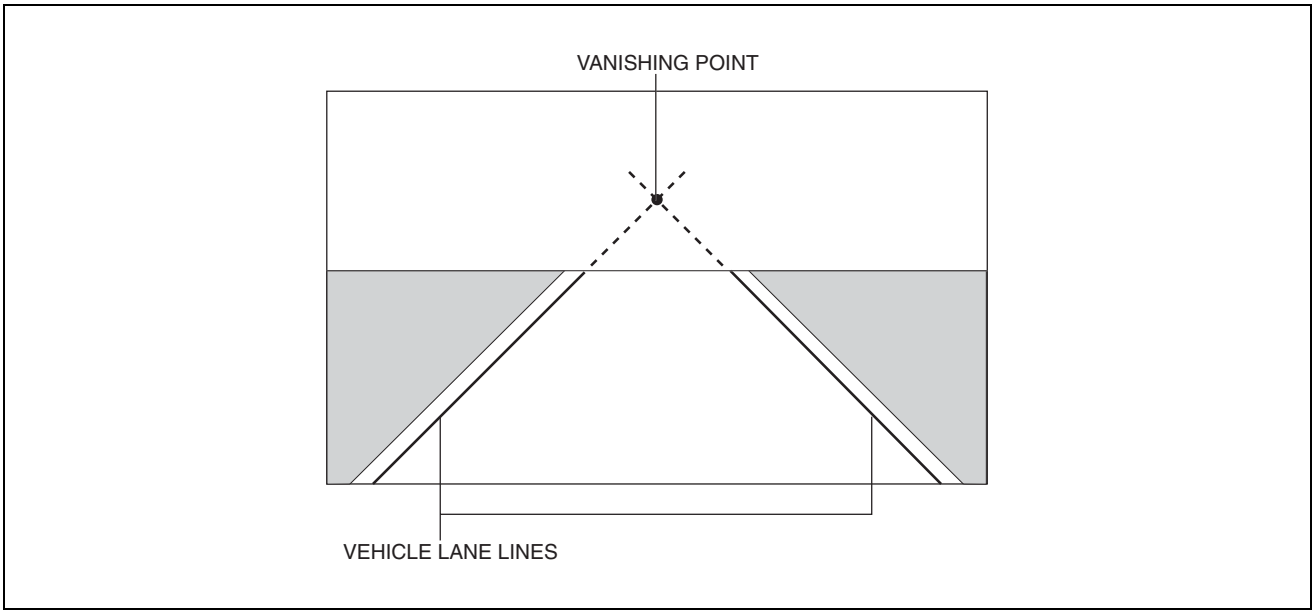
*1 : The distance from the vehicle lane lines to the warning-trigger lines can be changed using the customization. Refer to 09-22-8 INSTRUMENTATION/DRIVER INFO. PERSONALIZATION for details.

Aiming correction function

- The FSC adjusts the camera shot angle by aiming, and stores the vanishing point *1. The stored vanishing point and the current vanishing point are compared and if there is a deviation of a certain value or more in the vanishing point, the current vanishing point is stored as the new vanishing point.

*1 : The vehicle lane lines on the road surface are parallel and do not intersect, however, when viewed by the camera image, the lines converge in the distance and eventually cross. The point at which the lines cross is called the vanishing point.



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INSTRUMENTATION/DRIVER INFO.

HBC indicator light (green)/HBC warning light (amber) and LDWS indicator light (green)/LDWS warning light (amber) blown fuse check function

- When the ignition is switched ON, the FSC illuminates the HBC indicator light (green)/LDWS warning light (amber) for approx. 3 s and performs a blown fuse check of each indicator light/warning light.

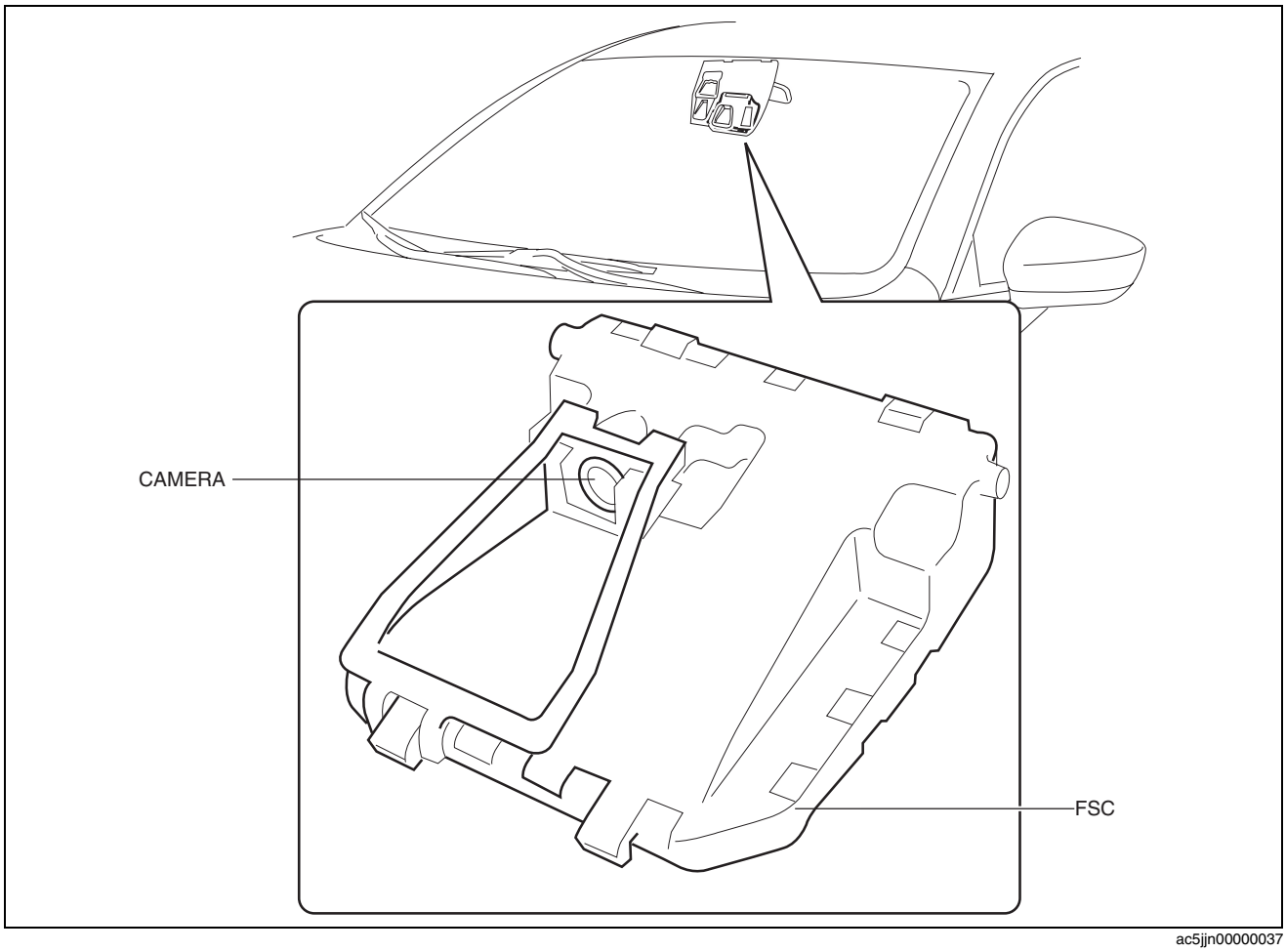
On-board diagnostic function

- The FSC detects soiling and fogging of the camera lens and windshield glass, FSC transmission errors, FSC internal malfunctions, and outputs DTCs. For DTC details, refer to 09-22-144 ON-BOARD DIAGNOSTIC [FORWARD SENSING CAMERA (FSC)].

Construction

- Installed to the windshield.
- By integrating a small, color CMOS camera *1 with the control module, lightness and size reduction have been achieved.
- The FSC transmits between other modules using CAN.

*1 : Camera with high sensitivity CMOS (Complementary Metal-Oxide Semiconductor) picture element



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Operation

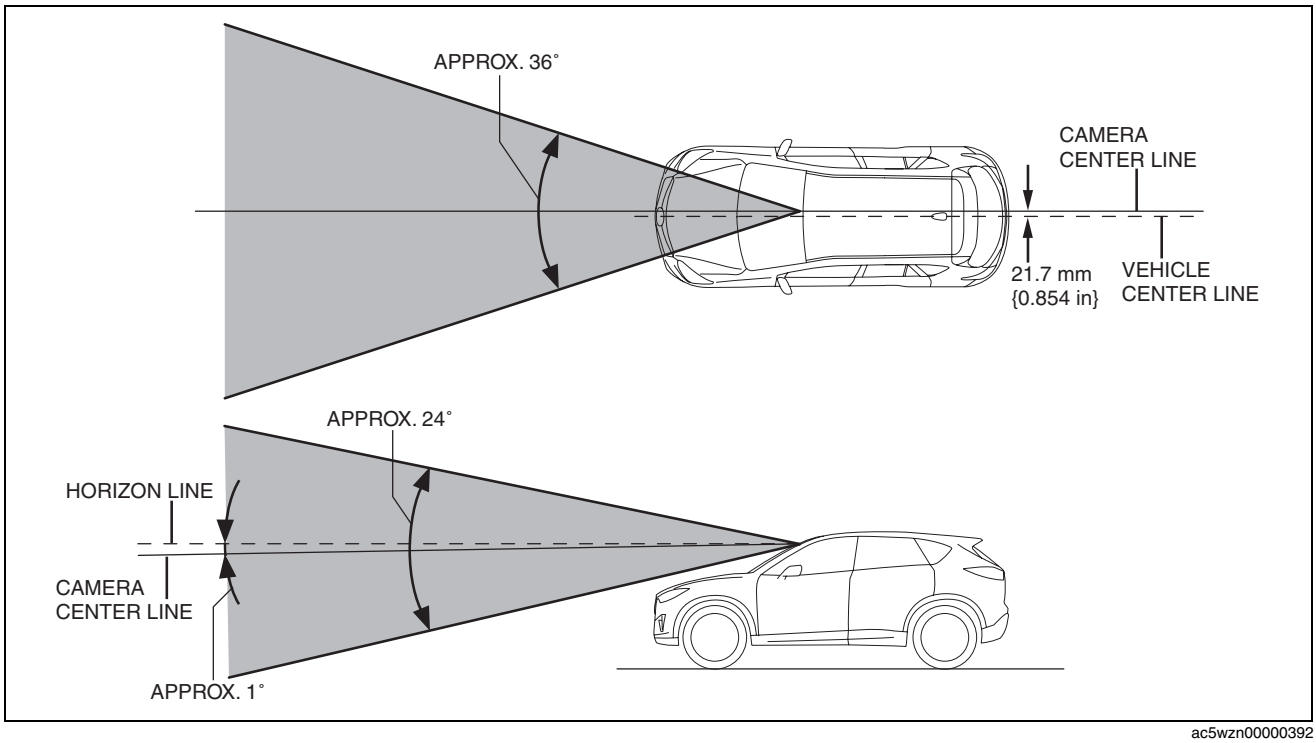
Camera range

- The FSC camera shoots in the following range.

Note

- Direction, depending on the surrounding conditions (ascending roads, winding roads, walls), the camera may be unable to pickup an object within the camera range in front of the vehicle, and not recognize it as a controlled target object.

INSTRUMENTATION/DRIVER INFO.



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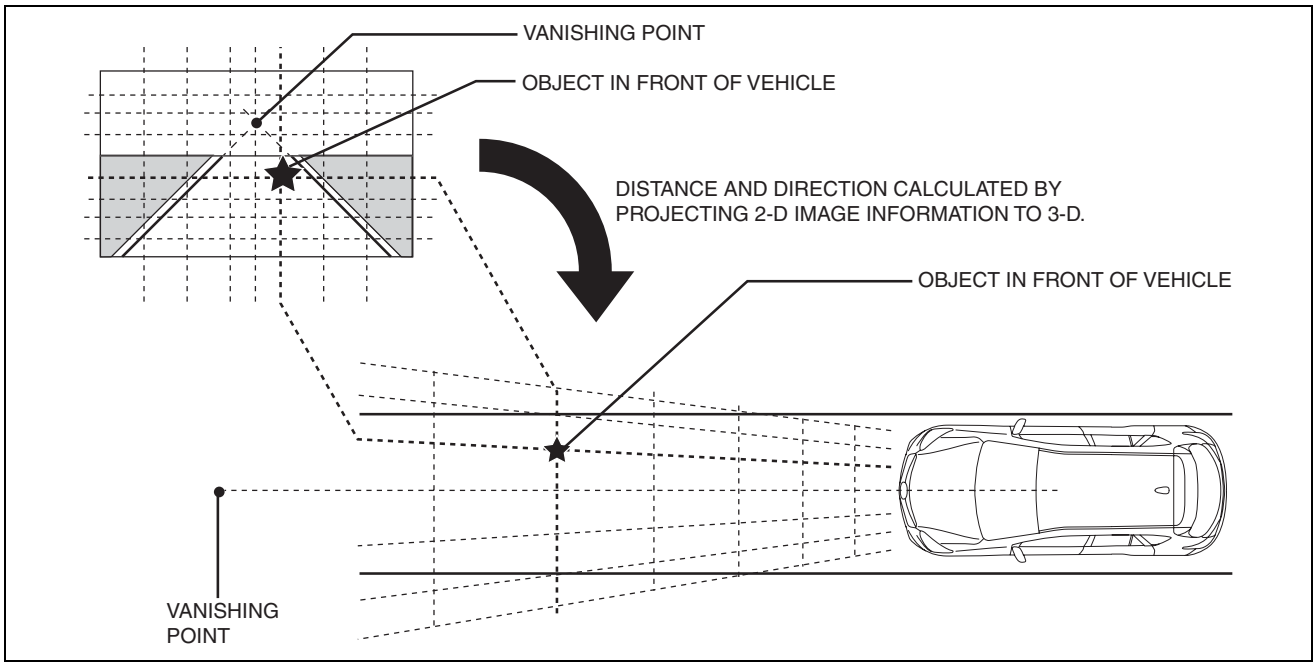
Position calculation

- When an object appears on the screen, the FSC determines the position coordinates, and from the coordinates it calculates the distance of the vehicle to the object and the direction.



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Fail-safe

DTC No.	Fail-safe function
B115E:54	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
B13A6:11	• Inhibits the lane departure warning system (LDWS).
C1001:92	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).

INSTRUMENTATION/DRIVER INFO.

DTC No.	Fail-safe function
C1001:97	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U0001:88	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U0100:00	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U0121:00	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U0131:00	• Inhibits the lane departure warning system (LDWS).
U0140:00	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U0155:00	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U0214:00	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U0401:68	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U0415:68	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U0420:68	• Inhibits the lane departure warning system (LDWS).
U0423:68	• Inhibits the lane departure warning system (LDWS).
U0515:68	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U2005:86	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U2100:00	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U2101:00	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U3000:04	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U3000:09	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U3000:42	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U3000:49	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U3003:16	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).
U3003:17	• Inhibits the lane departure warning system (LDWS). • Inhibits the high beam control system (HBC).

LDWS SWITCH

id092200029500

Purpose

- The lane departure warning system (LDWS) can be turned on or off optionally by the driver.

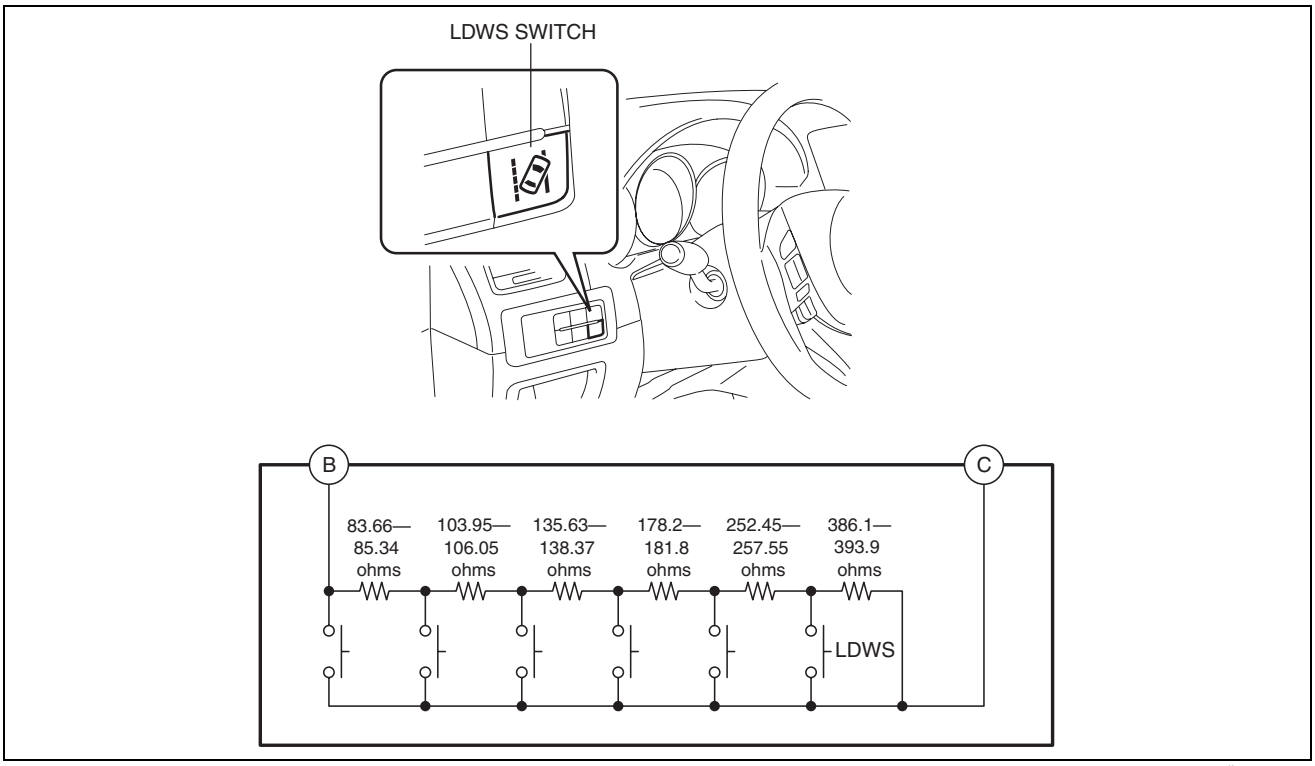
Function

- The switch operation signal is sent to the instrument cluster.

Construction

- The LDWS switch is built into the cluster switch.
- The resistance is built into each switch.

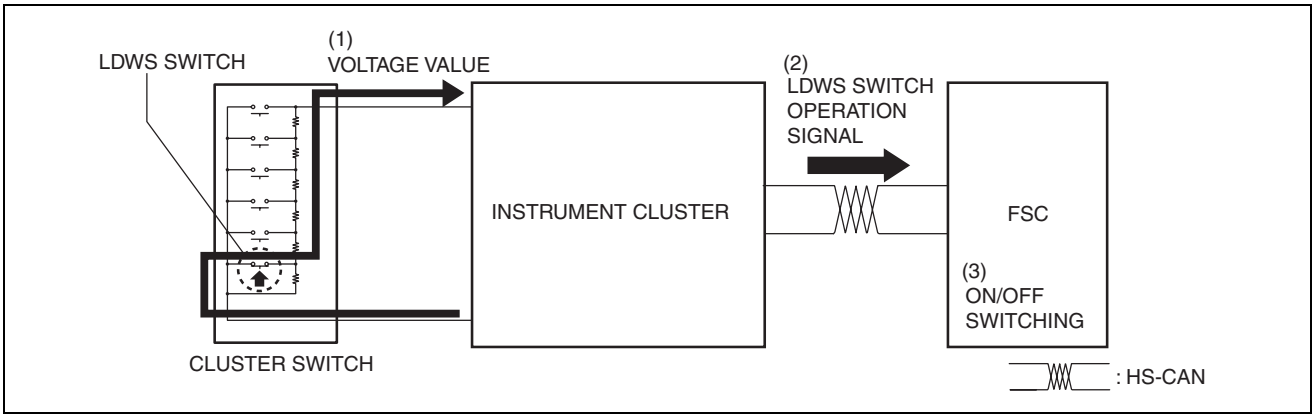
INSTRUMENTATION/DRIVER INFO.



ac5jjn00000045

Operation

1. When the LDWS switch operates, the switch operation signal is sent to the instrument cluster.
2. The instrument cluster determines that the switch has been operated based on the received voltage value (switch operation signal), and the LDWS switch operation signal is sent to the FSC.
3. When the FSC receives the LDWS switch operation signal from the instrument cluster, it switches the LDWS on/off.



ac5wzn00000395

Fail-safe

- Function not equipped.

LDWS WARNING ALARM

id092200029600

Purpose

- The LDWS warning alarm warns the user of a possible lane departure.

Function

Without audio unit

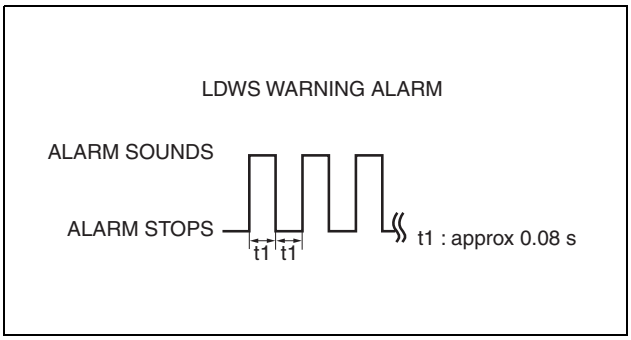
- If the instrument cluster receives a warning sound request signal from the FSC, is sounds the LDWS warning alarm using the buzzer in the instrument cluster.

INSTRUMENTATION/DRIVER INFO.

- The LDWS warning alarm patterns are as indicated in the following table:

With audio unit

- For the LDWS warning alarm on vehicles with an audio unit, refer to 09-22-106 LANE DEPARTURE WARNING SYSTEM (LDWS).



ac5wzn00000396

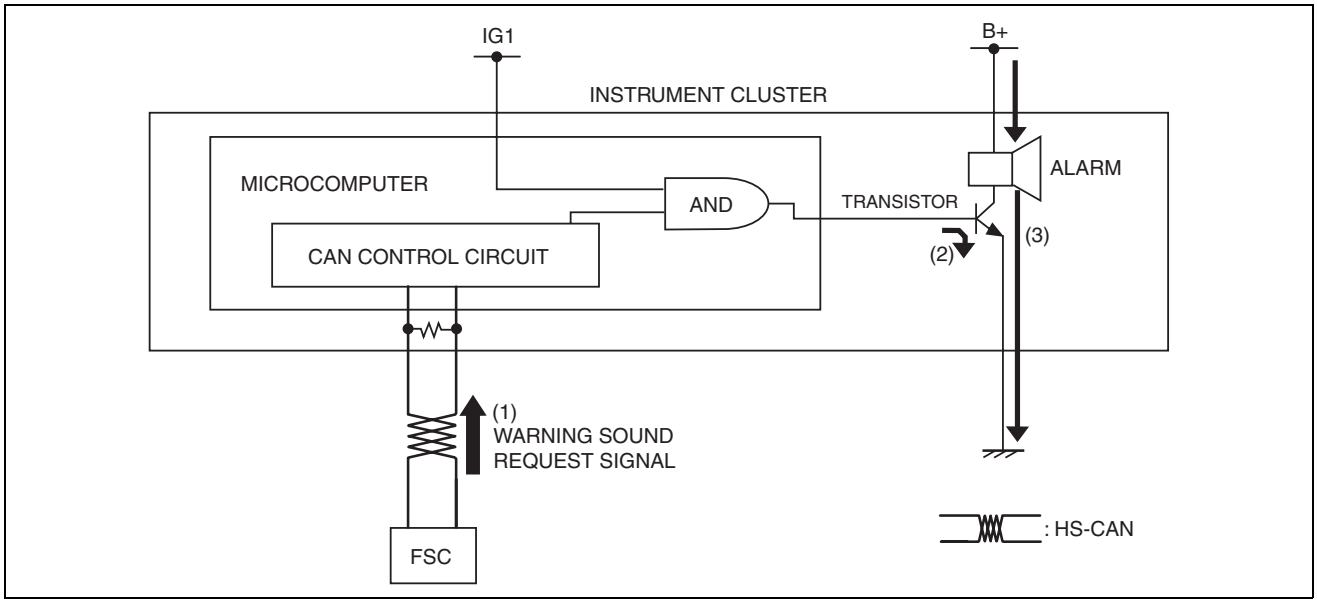
Construction

- The LDWS warning alarm sounds using the buzzer built into the instrument cluster.

Operation

With audio unit

1. The instrument cluster receives (1) the warning sound request signal from the FSC.
2. The instrument cluster turns the transistor on (2) based on the warning sound request signal.
3. When the transistor turns on, a ground circuit with the alarm is established and the alarm sounds (3).



ac5wzn00000397

With audio unit

- For operation with vehicles having an audio unit, refer to 09-22-106 LANE DEPARTURE WARNING SYSTEM (LDWS).

Fail-safe

- If a CAN transmission error occurs with the audio unit, it determines that the audio unit is malfunctioning. If the instrument cluster receives a warning sound request signal based on the determination that the audio unit is malfunctioning, the LDWS warning alarm is sounded using the buzzer built into the instrument cluster.

LDWS INDICATOR LIGHT (GREEN)/LDWS WARNING LIGHT (AMBER)

id092200029700

Purpose

LDWS indicator light (green)

- The LDWS indicator light (green) notifies the driver of the vehicle lane lines being recognized or that the vehicle may be departing from its lane.

LDWS warning light (amber)

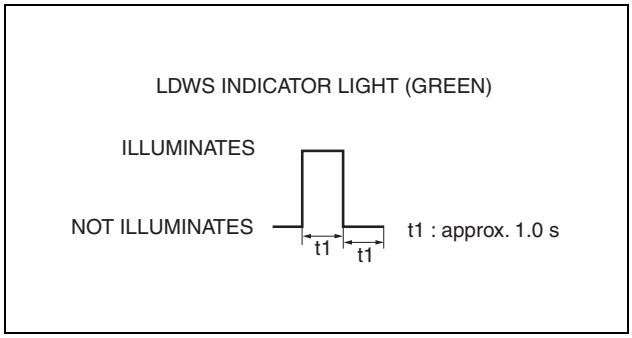
- The LDWS warning light (amber) warns the driver that a malfunction is occurring in the Lane Departure Warning System (LDWS).

INSTRUMENTATION/DRIVER INFO.

Function

LDWS indicator light (green)

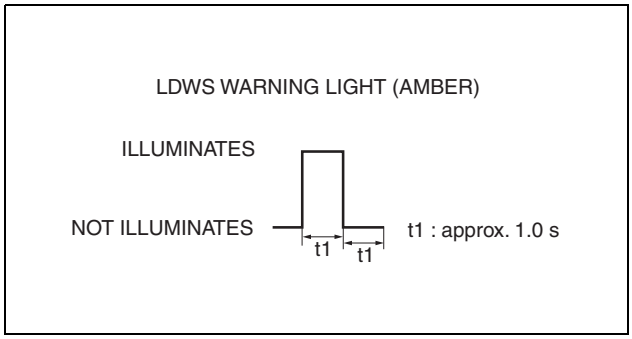
- The instrument cluster illuminates the LDWS indicator light (green) based on the system condition display request signal sent via a CAN signal from the FSC.
- The instrument cluster flashes the LDWS indicator light (green) based on the warning indication request signal sent via a CAN signal from the FSC.
- The flash pattern of the LDWS indicator light (green) is as indicated in the table.



ac5wzn00000374

LDWS warning light (amber)

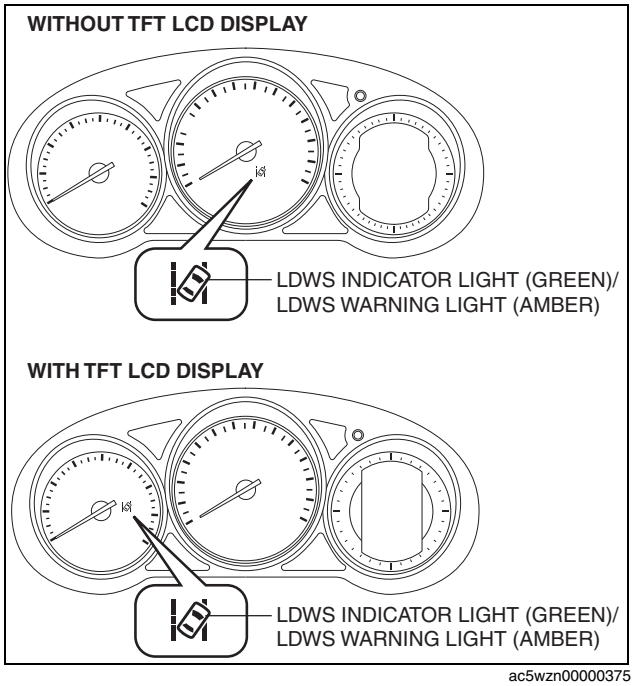
- The instrument cluster illuminates the LDWS warning light (amber) based on the system condition display request signal sent via a CAN signal from the FSC.
- The instrument cluster flashes the LDWS warning light (amber) based on the malfunction indication request signal sent via a CAN signal from the FSC.
- The flash pattern of the LDWS warning light (amber) is as indicated in the table.



ac5wzn00000824

Construction

- The LDWS indicator light (green) and LDWS warning light (amber) are equipped in the instrument cluster.



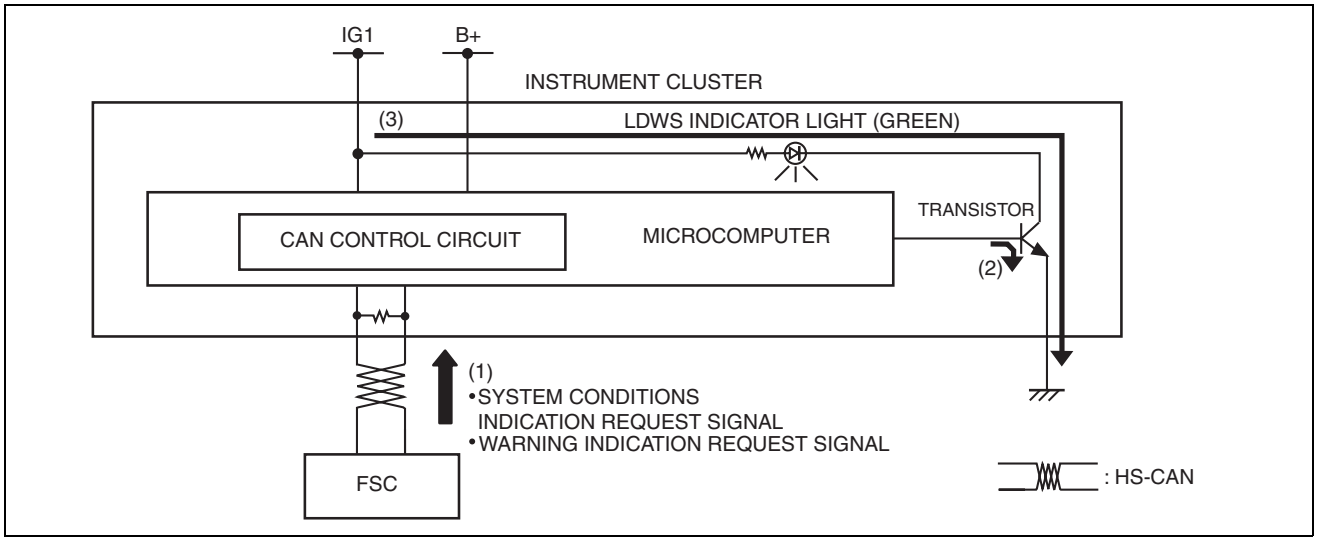
ac5wzn00000375

INSTRUMENTATION/DRIVER INFO.

Operation

LDWS indicator light (green)

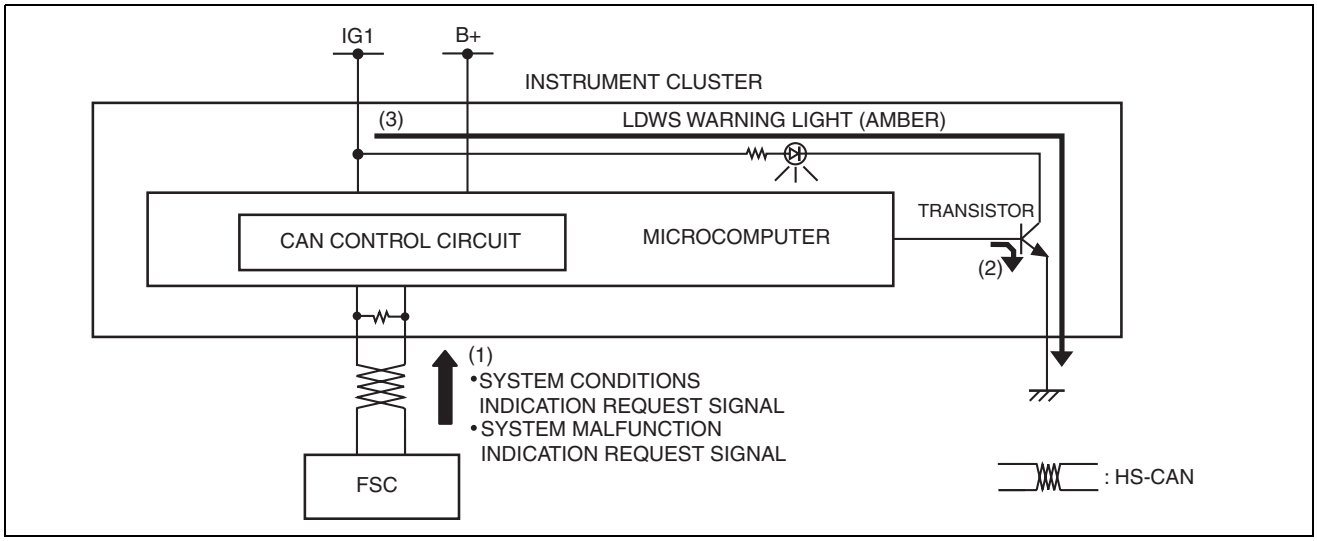
1. The instrument cluster receives (1) the system conditions indication request signal or warning indication request signal from the FSC via the CAN signal.
2. The instrument cluster turns the transistor on (2) intermittently for a warning indication request signal and continuously for a system conditions indication request signal.
3. When the transistor turns on intermittently, the LDWS indicator light (green) flashes (3) and when it turns on continuously, the LDWS indicator light (green) illuminates (3).



ac5wzn00000376

LDWS warning light (amber)

1. The instrument cluster receives (1) the system conditions display request signal from the FSC or the system malfunction indication request signal via the CAN signal.
2. The instrument cluster turns the transistor on (2) intermittently for a system malfunction indication request signal and continuously for a system conditions indication request signal.
3. When the transistor turns on intermittently, the LDWS warning light (amber) flashes (3), and the when it turns on continuously, the LDWS warning light (amber) illuminates (3).



ac5wzn00000377

Fail-safe

- Function not equipped.

CLOCK

id092200029400

Purpose

- The clock displays the current time, the passenger and rear seat belt status, the passenger air bag deactivation (PAD) switch status, and the seat warmer operation status to notify the user.

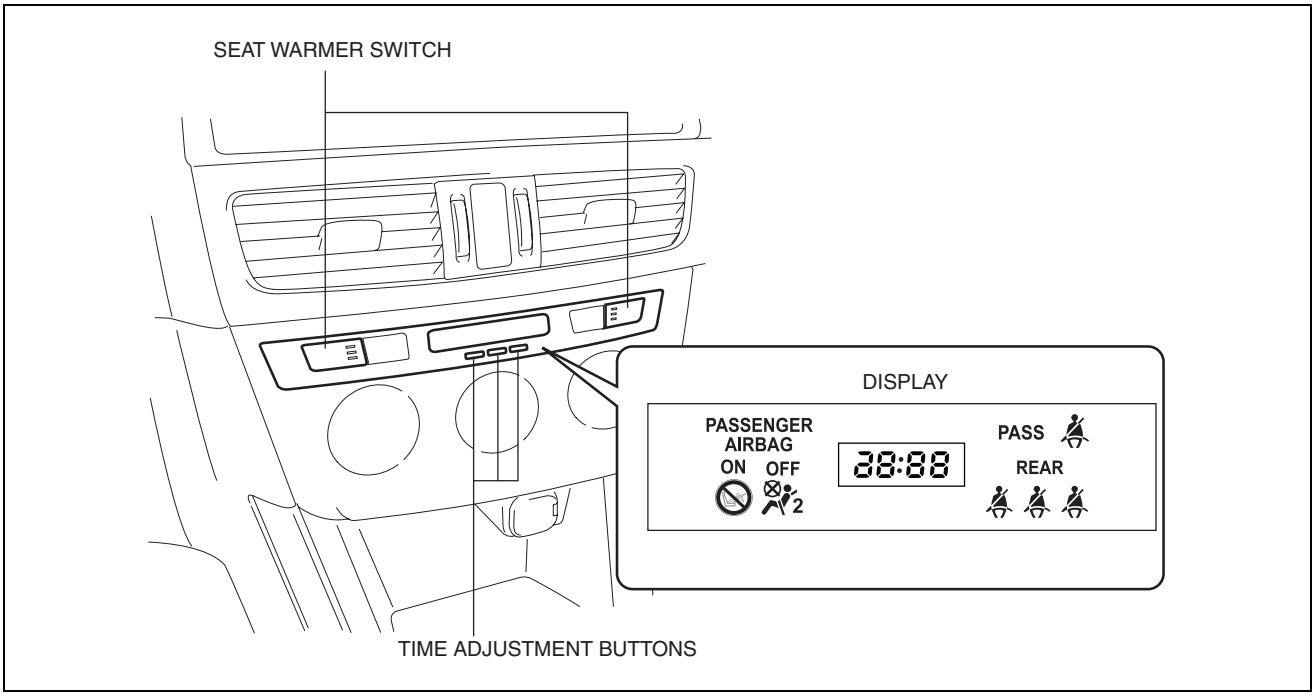
INSTRUMENTATION/DRIVER INFO.

Function
- Stores the time set by the user and displays the current time.

Seat belt warning light function
- When the clock receives a seat belt warning light request signal sent via CAN transmission from the instrument cluster, it illuminates the seat belt warning light.

Front passenger air bag deactivation indicator light function
- When the clock receives a front passenger air bag deactivation indicator light request signal sent via a CAN signal from the instrument cluster, it illuminates the front passenger air bag deactivation indicator light.

Construction
- Consists of the display which displays the current time and indicator/warning lights, the time adjustment button, and the seat warmer switch (with seat warmer).
- Assembled to the climate control unit.

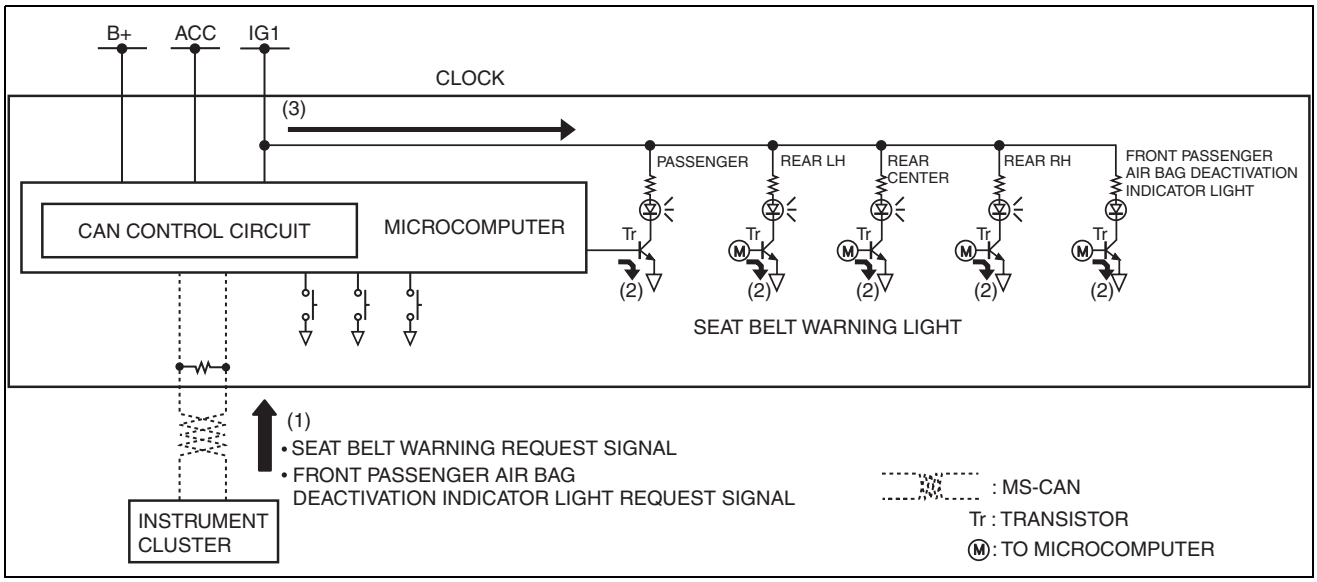


ac5wzn00001386

Operation
- The clock displays the current time when the ignition is switched to ACC or ON (engine off or on).

Warning/indicator light operation
1. The clock receives (1) a seat belt warning request signal and front passenger air bag deactivation indicator light request signal from the instrument cluster.
2. The clock microcomputer turns the transistor on (2) based on each signal.
3. When the transistor turns on, a ground circuit with each warning/indicator light is established, and the warning/indicator light illuminates (3).

INSTRUMENTATION/DRIVER INFO.



ac5wzn00001387

Seat warmer switch

- For details on the seat warmer switch operation, refer to 09-13-13 SEAT WARMER SYSTEM.

Fail-safe

- Function not equipped.

ON-BOARD DIAGNOSTIC [INSTRUMENT CLUSTER]

id092200021843

Outline

- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the instrument cluster-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunction locations and status via DTC output; and a PID/data monitoring function, which reads out specific input/output signals and verifies the input/output condition.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.

Malfunction detection function

- Detects malfunctions in input/output signals.
- If a malfunction occurs, the instrument cluster records the malfunction as a DTC. A recorded DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

×: Applicable
—: Not applicable

DTC No.	Warning/ indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B11D4:53*2	—	Laser sensor malfunction	×	—	C, D	×
U0001:88	—	Unit communication error (HS-CAN)	—	—	C, D	×
U0010:88	—	Unit communication error (MS-CAN)	—	—	C, D	×
U0100:00	—	Communication error with PCM	—	—	C, D	×
U0101:00*3	—	Communication error with TCM	—	—	C, D	×
U0114:00*4	—	4WD control module communication error	—	—	C, D	×
U0121:00	—	Communication error with DSC HU/CM	—	—	C, D	×
U0131:00	—	Communication error with EPS control module	—	—	C, D	×
U0140:00	—	Communication error with front body control module (FBCM)	—	—	C, D	×
U0142:00	—	Communication error with rear body control module (RBCM)	—	—	C, D	×
U0151:00	—	Communication error with SAS control module	—	—	C, D	×

INSTRUMENTATION/DRIVER INFO.

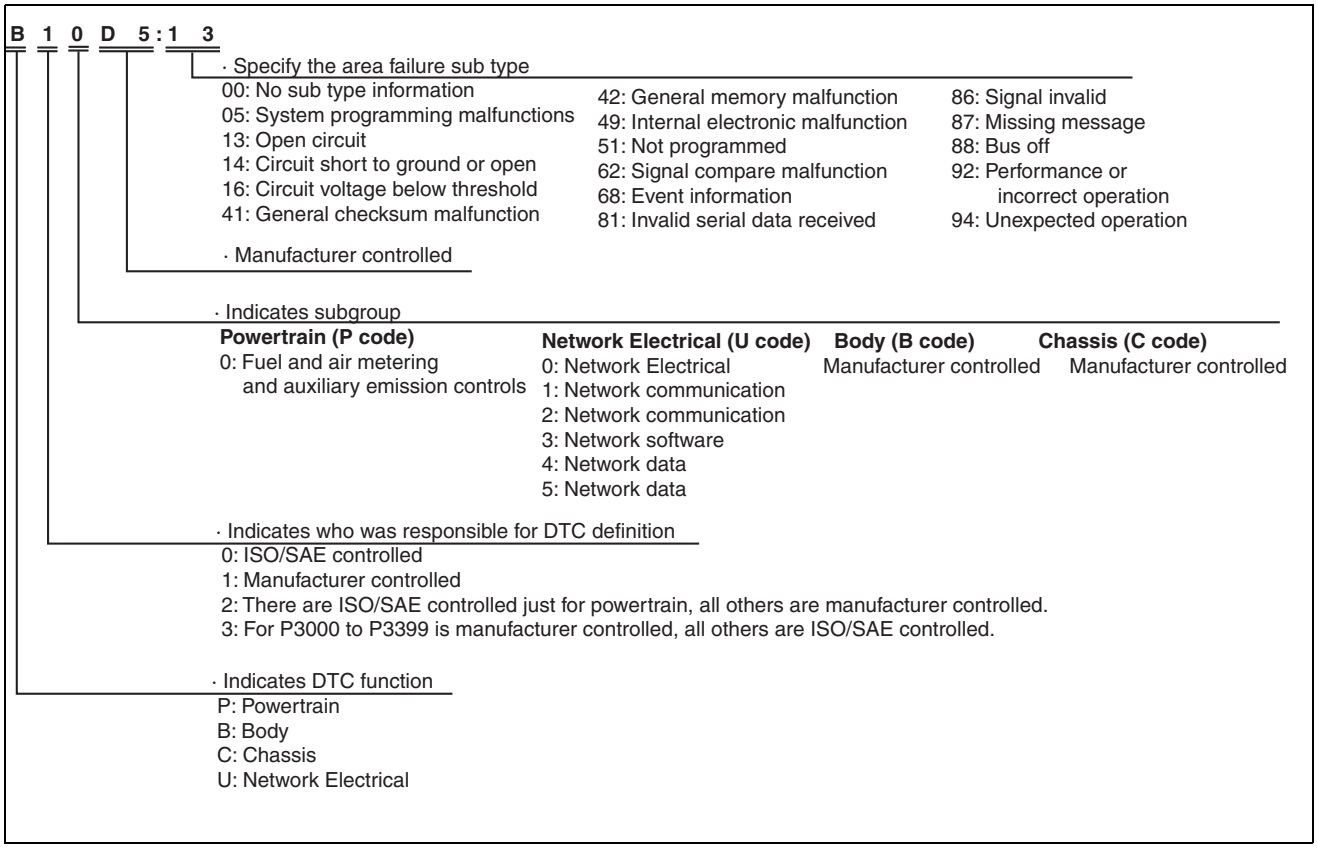
DTC No.	Warning/ indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
U0182:00*5	—	Communication error with AFS control module	—	—	C, D	×
U0214:00	—	Communication error with start stop unit	—	—	C, D	×
U0232:00*6	—	Communication error with rear vehicle monitoring control module (RH)	—	—	C, D	×
U0233:00*7	—	Communication error with BSM control module (RH)	—	—	C, D	×
U0235:00*2	—	Communication error with laser sensor	—	—	C, D	×
U023A:00*8	—	Communication error with forward sensing camera (FSC)	—	—	C, D	×
U0300:00	—	Instrument cluster configuration error	—	—	C, D	×
U0401:68	—	Error signal received from PCM	—	—	C, D	×
U0402:68*3	—	Error signal received from transmission/ transaxle	—	—	C, D	×
U0422:68	—	Error signal received from front body control module (FBCM)	—	—	C, D	×
U0433:00*2	—	Error signal received from laser sensor	×	—	C, D	×
U0433:68*2	—	Error signal received from laser sensor	×	—	C, D	×
U0515:68	—	Error signal received from start stop unit	—	—	C, D	×
U053B:00*8	—	Error signal received from forward sensing camera (FSC)	—	—	C, D	×
U2005:86	—	Error signal received from PCM	—	—	C, D	×
U2013:13	—	Cluster switch circuit malfunction	—	—	C, D	×
U2100:00	—	Instrument cluster configuration error	—	—	C, D	×
U2300:41	—	Instrument cluster configuration error	—	—	C, D	×
U2300:51	—	Instrument cluster configuration error	—	—	C, D	×
U2300:56	—	Instrument cluster configuration error	—	—	C, D	×
U2300:57	—	Instrument cluster configuration error	—	—	C, D	×
U3000:41	—	Malfunction inside instrument cluster	—	—	C, D	×
U3003:16	—	Low power supply voltage input to instrument cluster	—	—	C, D	×

*1 : C: CMDTC self test, D: ODDTC self test
*2 : With smart city brake support
*3 : ATX
*4 : 4WD
*5 : With AFS
*6 : With rear vehicle monitoring system
*7 : With BSM
*8 : With forward sensing camera (FSC)

INSTRUMENTATION/DRIVER INFO.

DTC 7-digit code definition

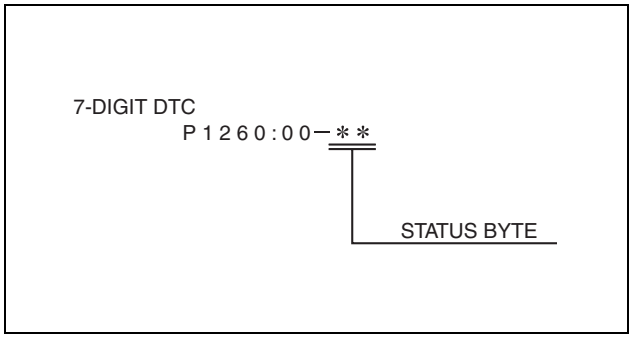
- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



am6xun0000078

Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



ac5wzn00002008

Detection condition for the applicable DTC

DTC No.	System malfunction location	Detection condition
B11D4:53*1	Laser sensor malfunction	• Instrument cluster detects the following malfunctions — Laser sensor malfunction — Malfunction in smart city brake support related system (laser sensor, DSC HU/CM, PCM)
U0001:88	Module communication error (HS-CAN)	The instrument cluster detects a CAN bus communication line (HS-CAN) malfunction.
U0010:88	Unit communication error (MS-CAN)	The instrument cluster detects a CAN bus communication line (MS-CAN) malfunction.
U0100:00	Communication error with PCM	The instrument cluster cannot receive CAN signal from the PCM.
U0101:00*2	Communication error with TCM	The instrument cluster cannot receive CAN signal from the TCM for 1 s or more.

INSTRUMENTATION/DRIVER INFO.

DTC No.	System malfunction location	Detection condition
U0114:00*3	4WD control module communication error	The instrument cluster cannot receive CAN signal from the 4WD control module for 1 s or more.
U0121:00	Communication error with DSC HU/CM	The instrument cluster cannot receive CAN signal from the DSC HU/CM for 1 s or more.
U0131:00	Communication error with EPS control module	The instrument cluster could not receive CAN signal from the EPS control module for 1 s or more.
U0140:00	Communication error with front body control module (FBCM)	The instrument cluster cannot receive CAN signal from the front body control module (FBCM) for 5 s or more.
U0142:00	Communication error with rear body control module (RBCM)	The instrument cluster cannot receive CAN signal from the rear body control module (RBCM) for 5 s or more.
U0151:00	Communication error with SAS control module	The instrument cluster cannot receive CAN signal from the SAS control module for 2 s or more.
U0182:00*4	Communication error with AFS control module	The instrument cluster cannot receive CAN signal from the AFS control module for 5 s or more.
U0214:00	Communication error with start stop unit	The instrument cluster could not receive CAN signal from the start stop unit.
U0232:00*5	Communication error with rear vehicle monitoring control module (RH)	The instrument cluster cannot receive CAN signal from the rear vehicle monitoring control module (RH) for 5 s or more.
U0233:00*6	Communication error with BSM control module (RH)	The instrument cluster cannot receive CAN signal from the BSM control module (RH) for 1.5 s or more.
U0235:00*1	Communication error with laser sensor	The instrument cluster cannot receive CAN signal from the laser sensor for 1 s or more.
U023A:00*7	Communication error with forward sensing camera (FSC)	The instrument cluster cannot receive CAN signal from the forward sensing camera (FSC) for 1 s or more.
U0300:00	Instrument cluster configuration error	Instrument cluster configuration error (incorrect value write) detected.
U0401:68	Error signal received from PCM	The instrument cluster receives error signals from the PCM with the ignition switched ON (engine off or on).
U0402:68*2	Error signal received from transmission/transaxle	The instrument cluster received error signals from the transmission/ transaxle for 1 s or more with the ignition switched ON (engine off or on).
U0422:68	Error signal received from front body control module (FBCM)	The instrument cluster receives error signals from the front body control module (FBCM) for 5 s or more with the ignition switched ON (engine off or on).
U0433:00*1	Error signal received from laser sensor	• Instrument cluster detects the following conditions: — The smart city brake support operated normally in the past. — Malfunction of laser sensor or smart city brake support related system (laser sensor, DSC HU/CM, PCM) — Laser sensor control is temporarily inhibited.
U0433:68*1	Error signal received from laser sensor	Instrument cluster detects a malfunction in the laser sensor.
U0515:68	Error signal received from start stop unit	The instrument cluster receives error signals from the start stop unit with the ignition switched ON (engine off or on).
U053B:00*7	Error signal received from forward sensing camera (FSC)	The instrument cluster receives error signals from the forward sensing camera (FSC) for 1 s or more with the ignition switched ON (engine off or on).
U2005:86	Error signal received from PCM	The instrument cluster receives vehicle speed signal error from the PCM for 1 s or more with the ignition switched ON (engine off or on).
U2013:13	Cluster switch circuit malfunction	The instrument cluster detects an open circuit in the cluster switch circuit for 5 s or more with the ignition switched ON (engine off or on).
U2100:00	Instrument cluster configuration error	• Instrument cluster configuration error detected as follows: — No configuration of instrument cluster — Instrument cluster configuration has not been correctly performed.
U2300:41	Instrument cluster configuration error	Instrument cluster configuration error (data error) detected.
U2300:51	Instrument cluster configuration error	Instrument cluster configuration error (no configuration) detected.
U2300:56	Instrument cluster configuration error	Instrument cluster configuration error (incorrect value write) detected.

INSTRUMENTATION/DRIVER INFO.

DTC No.	System malfunction location	Detection condition
U2300:57	Instrument cluster configuration error	Instrument cluster configuration error (data size error) detected.
U3000:41	Malfunction inside instrument cluster	Malfunction inside instrument cluster detected.
U3003:16	Low power supply voltage input to instrument cluster	Instrument cluster power supply circuit voltage of 10 V or less is detected with the ignition switched ON (engine off or on).

*1 : With smart city brake support
*2 : ATX
*3 : 4WD
*4 : With AFS
*5 : With rear vehicle monitoring system
*6 : With BSM
*7 : With forward sensing camera (FSC)

Snapshot Data
- The data for all DTCs currently detected is stored.

Snapshot data table

—: Not applicable

Snapshot data item	Unit		Data contents	Corresponding data monitor items
AAT	°C	°F	Ambient temperature	—
APP_STATUS	Accelerator Pedal Off/Under20%/Over20%/FAIL		Accelerator pedal position status	—
CFG_STATUS	Config Complete/Not Configured/Config Error		Configuration status	—
ECT_STATUS	Under 0 degrees C/0-Under 80 degrees C/Over 80 degrees C/FAIL		Engine coolant temperature status	—
IC_VPWR	V		Instrument cluster power supply voltage	—
IG-ON_TIMER	hh:mm:ss		Elapsed time since ignition switched ON (engine off or on)	—
PWR_MODE_KEY	Key Out/Key Recently Out/ Key Approved (Position 0)/ Post Accessory (Position 0)/ Accessory (Position 1)/ Post Ignition (Position 1)/ ignition On (Position 2)/ Running - Starting In Progress (Position 2)/ Crank (Position 3)		Push button start power position switching status	—
RPM_STATUS	Engine Stop/Under1500rpm/Over1500rpm/FAIL		Engine speed status	—
SHIFT_STATUS	P/N/ D/ R/ FAIL		Selector lever position status	—
TOTAL_DIST	Km	miles	Accumulated total traveled distance since vehicle completion	—
TOTAL_TIME	hh:mm:ss		Accumulated total elapsed time since vehicle completion **Note** • When the ROOM fuse is removed, or the ignition is switched off (LOCK), the time is not included in the elapsed time.	TOTAL_TIME
VPWR	V		Instrument cluster power supply voltage	VPWR

INSTRUMENTATION/DRIVER INFO.

Snapshot data item	Unit	Data contents	Corresponding data monitor items
VSPD_STATUS	Stop/ 0-10km/h/ Over10km/h/ FAIL	Vehicle speed status	—
VSS	KPH, MPH	Vehicle speed	—

Data Monitor Function

- The PID/data monitor function performs reading in real time of optionally selected input/output signal monitor items that are set in the instrument cluster.

PID/data monitor table

PID	Unit/ Operation	Data contents	Inspection item(s)
AFS_OFF_SW*1	Off/On	• Off: AFS OFF switch is off. • On: AFS off switch is on.	AFS OFF switch
AFS_ST*1	Off/On	• Off: AFS not operated • On: AFS operated	• AFS OFF switch • AFS control module
AT_MAN_M_SW*2	Off/On/ Reserved/ Unknown	• Off: M range switch is off. • On: M range switch is on. • Unknown: M range switch signal is not determined.	M position switch
AT_S_DWN_SW*2	Off/On/ Reserved/ Unknown	• Off: Down switch switch is off. • On: Down switch is on. • Unknown: Down switch is not determined.	Down switch
AT_S_UP_SW*2	Off/On/ Reserved/ Unknown	• Off: Up switch is off. • On: Up switch is on. • Unknown: Up switch is not determined.	Up switch
BSM/ RVM_SW*3	Off/On	• Off: Off: BSM OFF switch is off. • On: BSM OFF switch is on.	BSM OFF switch
BSM/ RVM_SW*4	Off/On	• Off: RVM OFF switch is off. • On: RVM switch is on.	RVM switch
DSC_OFF_SW	Off/On	• Off: TCS OFF switch is off. • On: TCS off switch is on.	TCS OFF switch
FUEL_GAUGE	L	Fuel gauge is displayed.	Fuel gauge (instrument cluster)
FUEL_SEN_M	ohm	Fuel gauge sender unit resistance is displayed.	• Fuel gauge sender unit • Rear body control module (RBCM)
FUEL_SEN_S*5	ohm	Displays the fuel gauge sender unit (sub) resistance value.	• Fuel gauge sender unit (sub) • Rear body control module (RBCM)
I_ILLUMI_M	Off (Day)/On (Night)	• Off (Day): TNS switch is off. • On (Night): TNS switch is on.	• Instrument cluster • Front body control module (FBCM)
I-ST_OFF_SW*6	Off/On	• Off: i-stop OFF switch is off. • On: i-stop OFF switch is on.	i-stop OFF switch
LDWS_ON_SW*7	Off/On	• Off: LDWS switch is off. • On: LDWS switch is on.	LDWS switch
MULTI_SW_ST	O.K./FAULT	• O.K.: Cluster switch is normal. • FAULT: Cluster switch is malfunctioning.	Cluster switch
ODO_CNT	km, ft, mi	Displays the rolling count of the odometer.	Odometer (instrument cluster)
P_BRAKE_SW	Off/On	• Off: Parking brake not applied • On: Parking brake applied	Parking brake switch
R_GEAR_SW	Off/On	ATX: • Off: Selector lever is in R position. • On: Selector lever is in R position. MTX: • Off: Back-up light switch is off. • On: Back-up light switch is on.	ATX: • Transaxle range sensor (TCM) • TCM MTX: • Back-up light switch • PCM

INSTRUMENTATION/DRIVER INFO.

PID	Unit/ Operation	Data contents	Inspection item(s)
R_LMP	Off/On/ Unknown/ Fault	• Off: Back-up light is turned off. • On: Back-up light is turned on. • Unknown: Back-up light signal is not determined. • Fault: Back-up light malfunction	ATX: • Transaxle range sensor (TCM) • TCM • Instrument cluster MTX: • Back-up light switch • PCM • Instrument cluster
SPEEDOMTR	KPH, MPH	Vehicle speed is displayed. (100 % = 300 km/h {186 mph})	Speedometer (instrument cluster)
TACHOMTR	RPM	Displays the engine speed. (100 % = 10,000 rpm)	Tachometer (instrument cluster)
TOTAL_TIME	hh:mm:ss	Cumulative elapsed time since vehicle completion is displayed.	Instrument cluster
TPMS_CAL_SW	Off/On	• Off: Tire pressure monitoring system set switch is off. • On: Tire pressure monitoring system set switch is on.	Tire pressure monitoring system set switch
VPWR	V	Displays the power supply voltage.	• Instrument cluster • IG1 relay • Battery

*1 : With AFS
*2 : ATX
*3 : With BSM
*4 : With rear vehicle monitoring system
*5 : 4WD
*6 : With i-stop
*7 : With LDWS

Active Command Modes Function

- The active command modes are shown below.

Simulation item	Unit/ Operation	Data contents	Output part name
ALARM	On/Off	• On: Warning alarm sounds. • Off: Warning alarm does not sound.	Warning alarm (instrument cluster)
LCD_SEG	Off/On	Vehicles without TFT LCD display: • Off: Turns off the LCD. • On: Fully displays LCD. Vehicles with TFT LCD display: • Off: Turns off the LCD. • On: Illuminates the LCD.	Vehicles without TFT LCD display: • LCD (instrument cluster) Vehicles with TFT LCD display: • TFT LCD display (instrument cluster)
SPEEDOMTR	Off/60 Km/h/ 120 Km/h	European (L.H.D./U.K.), General (L.H.D./R.H.D.) specs., Australian specs.: • Off: Moves speedometer needle to the bottom-most position. • 60 Km/h: Moves speedometer needle to **61—66 km/h {38—41 mph}**. • 120 Km/h: Moves speedometer needle to **122—129 km/h {75.9—80.1 mph}**. General (L.H.D./R.H.D.) specs.: • Off: Moves speedometer needle to the bottom-most position. • 60 Km/h: Moves speedometer needle to **58—62 km/h {36—39 mph}**. • 120 Km/h: Moves speedometer needle to **117—123 km/h {72.8—76.4 mph}**.	Speedometer (instrument cluster)
TACHOMTR	Off/3000 RPM/6000 RPM	• Off: Moves tachometer needle to the bottom-most position. • 3000 RPM: Moves tachometer needle to **approx. 3,050 rpm**. • 6000 RPM: Moves tachometer needle to **approx. 6,100 rpm**.	Tachometer (instrument cluster)
WL+IL	Off/On	• Off: Turns off all warning lights, indicator lights. • On: Illuminates all warning lights, indicator lights.	Warning lights, indicator lights (instrument cluster)

INSTRUMENTATION/DRIVER INFO.

ON-BOARD DIAGNOSTIC [REAR VEHICLE MONITORING (RVM) SYSTEM]

id092200021851

Outline

- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the rear vehicle monitoring control module-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunction locations and status via DTC output; and a PID/data monitoring function, which reads out specific input/output signals and verifies the input/output condition.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.

Malfunction Detection Function

- Detects malfunctions in input/output signals.
- If a malfunction occurs, the rear vehicle monitoring control module records the malfunction as a DTC. A recorded DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

×: Applicable
—: Not applicable

DTC No.	Rear vehicle monitoring (RVM) system warning light (amber)	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B11CB:11	On	RVM warning indicator light (RH) circuit malfunction	×	—	C, D	×
B11CB:15	On	RVM warning indicator light (RH) circuit malfunction	×	—	C, D	×
B11D3:11	On	RVM warning indicator light (LH) circuit malfunction	×	—	C, D	×
B11D3:15	On	RVM warning indicator light (LH) circuit malfunction	×	—	C, D	×
B11F2:23	On	RVM switch circuit malfunction	×	—	C	×
U0001:88	On	Unit communication error (MS-CAN)	×	—	C	×
U0028:87	On	Rear vehicle monitoring control module (LH) and (RH) communication error	×	—	C	×
U0100:00	On	Communication error with PCM	×	—	C	×
U0121:00	On	Communication error with DSC HU/CM	×	—	C	×
U0155:00	On	Communication error with instrument cluster	×	—	C	×
U0214:00	On	Communication error with start stop unit	×	—	C	×
U0401:68	On	Error signal received from PCM	×	—	C	×
U0415:68	On	Error signal received from DSC HU/CM	×	—	C	×
U0423:68	On	Error signal received from instrument cluster	×	—	C	×
U0515:68	On	Error signal received from start stop unit	×	—	C	×
U1A4B:16	On	Rear vehicle monitoring control module (LH) low power supply input	×	—	C	×
U1A4B:17	On	Rear vehicle monitoring control module (LH) high power supply input	×	—	C	×
U1A4B:43	On	Rear vehicle monitoring control module (LH) malfunction	×	—	C	×
U1A4B:44	On	Rear vehicle monitoring control module (LH) malfunction	×	—	C	×
U1A4B:45	On	Rear vehicle monitoring control module (LH) malfunction	×	—	C	×
U1A4B:46	On	Rear vehicle monitoring control module (LH) malfunction	×	—	C	×
U1A4B:47	On	Rear vehicle monitoring control module (LH) malfunction	×	—	C	×
U1A4B:48	On	Rear vehicle monitoring control module (LH) malfunction	×	—	C	×

INSTRUMENTATION/DRIVER INFO.

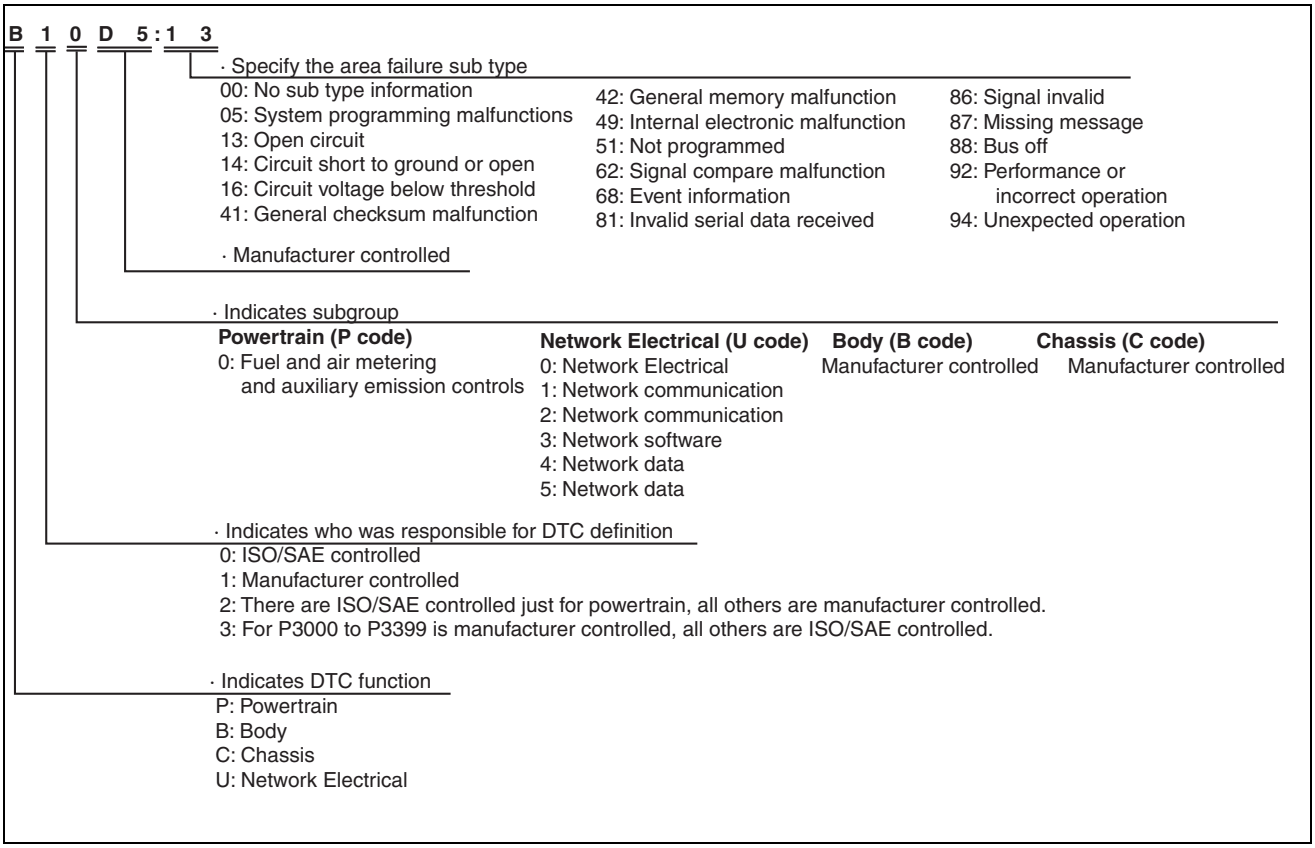
DTC No.	Rear vehicle monitoring (RVM) system warning light (amber)	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
U1A4B:49	On	Rear vehicle monitoring control module (LH) malfunction	×	—	C	×
U1A4B:54	On	Radar aiming is not performed or radar sensor axis is deviated (rear vehicle monitoring control module (LH))	×	—	C	×
U1A4B:96	On	Rear vehicle monitoring control module (LH) malfunction	×	—	C	×
U2100:00	On	Rear vehicle monitoring control module (RH) configuration error	×	—	C, D	×
U3000:43	On	Rear vehicle monitoring control module (RH) malfunction	×	—	C	×
U3000:44	On	Rear vehicle monitoring control module (RH) malfunction	×	—	C	×
U3000:45	On	Rear vehicle monitoring control module (RH) malfunction	×	—	C	×
U3000:46	On	Rear vehicle monitoring control module (RH) malfunction	×	—	C	×
U3000:47	On	Rear vehicle monitoring control module (RH) malfunction	×	—	C	×
U3000:48	On	Rear vehicle monitoring control module (RH) malfunction	×	—	C	×
U3000:49	On	Rear vehicle monitoring control module (RH) malfunction	×	—	C	×
U3000:4B	On	Temperature temporarily increases depending on various external and environmental factors (rear vehicle monitoring control module (LH) or (RH))	×	—	C	×
U3000:54	On	Radar aiming is not performed or radar sensor axis is deviated (rear vehicle monitoring control module (RH))	×	—	C, D	×
U3000:96	On	Rear vehicle monitoring control module (RH) malfunction	×	—	C	×
U3000:97	On	Radar sensor sensitivity temporarily decreases depending on various external and environmental factors (rear vehicle monitoring control module (LH) or (RH))	×	—	C	×
U3003:16	On	Rear vehicle monitoring control module (RH) low power supply input	×	—	C, D	×
U3003:17	On	Rear vehicle monitoring control module (RH) high power supply voltage input	×	—	C, D	×

*1 : C: CMDTC self test, D: ODDTC self test

INSTRUMENTATION/DRIVER INFO.

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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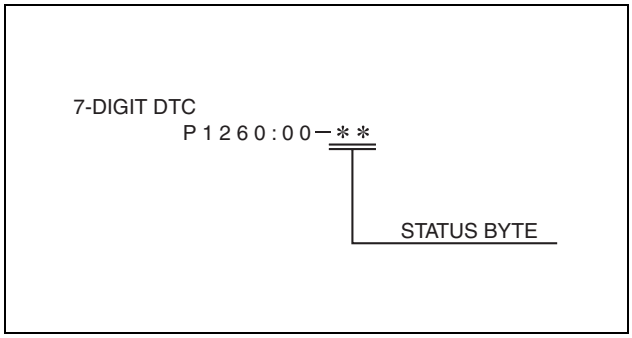
Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the M-MDS when reading the DTC.



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INSTRUMENTATION/DRIVER INFO.

Detection condition for the applicable DTC

DTC No.	System malfunction location	Detection condition
B11CB:11	RVM warning indicator light (RH) circuit malfunction	Rear vehicle monitoring control module (LH) detects short to ground in RVM warning indicator light (RH).
B11CB:15	RVM warning indicator light (RH) circuit malfunction	Rear vehicle monitoring control module (LH) detects an open or short circuit to ground in RVM warning indicator light (RH) power supply circuit.
B11D3:11	RVM warning indicator light (LH) circuit malfunction	Rear vehicle monitoring control module (LH) detects short to ground in RVM warning indicator light (LH).
B11D3:15	RVM warning indicator light (LH) circuit malfunction	Rear vehicle monitoring control module (LH) detects an open or short circuit to ground in RVM warning indicator light (LH) power supply circuit.
B11F2:23	RVM switch circuit malfunction	The rear vehicle monitoring control module (RH) receives RVM switch ON signal from the instrument cluster for 2 min or more.
U0001:88	Unit communication error (MS-CAN)	The rear vehicle monitoring control module (RH) detects a CAN bus communication line (MS-CAN) malfunction.
U0028:87	Rear vehicle monitoring control module (LH) and (RH) communication error	No communication between rear vehicle monitoring control modules (LH) and (RH) for 1 s or more.
U0100:00	Communication error with PCM	The rear vehicle monitoring control module (RH) cannot receive CAN signal from the PCM for 2 s or more.
U0121:00	Communication error with DSC HU/CM	Rear vehicle monitoring control module (RH) cannot receive CAN signal from the DSC HU/CM for 2 s or more.
U0155:00	Communication error with instrument cluster	The rear vehicle monitoring control module (RH) cannot receive CAN signal from the instrument cluster for 2 s or more.
U0214:00	Communication error with start stop unit	The rear vehicle monitoring control module (RH) cannot receive CAN signal from the start stop unit for 2 s or more.
U0401:68	Error signal received from PCM	The rear vehicle monitoring control module (RH) receives malfunction signal from the PCM for 2 s or more.
U0415:68	Error signal received from DSC HU/CM	The rear vehicle monitoring control module (RH) receives malfunction signal from the DSC HU/CM for 2 s or more.
U0423:68	Error signal received from instrument cluster	The rear vehicle monitoring control module (RH) receives malfunction signal from the instrument cluster for 2 s or more.
U0515:68	Error signal received from start stop unit	The rear vehicle monitoring control module (RH) receives malfunction signal from the start stop unit for 2 s or more.
U1A4B:16	Rear vehicle monitoring control module (LH) low power supply voltage input	Rear vehicle monitoring control module (LH) low power supply voltage input
U1A4B:17	Rear vehicle monitoring control module (LH) high power supply voltage input	Power supply circuit voltage of 16 V or more is detected in rear vehicle monitoring control module (LH) for 1 s or more.
U1A4B:43	Rear vehicle monitoring control module (LH) malfunction	Rear vehicle monitoring control module (LH) external RAM malfunction detected.
U1A4B:44	Rear vehicle monitoring control module (LH) malfunction	Rear vehicle monitoring control module (LH) internal RAM malfunction detected.
U1A4B:45	Rear vehicle monitoring control module (LH) malfunction	Rear vehicle monitoring control module (LH) ROM malfunction detected.
U1A4B:46	Rear vehicle monitoring control module (LH) malfunction	Rear vehicle monitoring control module (LH) EEPROM malfunction detected.
U1A4B:47	Rear vehicle monitoring control module (LH) malfunction	Rear vehicle monitoring control module (LH) monitoring system malfunction detected.
U1A4B:48	Rear vehicle monitoring control module (LH) malfunction	Rear vehicle monitoring control module (LH) communication circuit malfunction detected.
U1A4B:49	Rear vehicle monitoring control module (LH) malfunction	Rear vehicle monitoring control module (LH) voltage control circuit malfunction detected.
U1A4B:54	Radar aiming is not performed or radar sensor axis is deviated (rear vehicle monitoring control module (LH))	Malfunction in radar aiming of rear vehicle monitoring control module (LH) detected for 1 s or more.
U1A4B:96	Rear vehicle monitoring control module (LH) malfunction	Rear vehicle monitoring control module (LH) internal circuit malfunction detected.
U2100:00	Rear vehicle monitoring control module (RH) configuration error	Rear vehicle monitoring control module (RH) configuration error detected.

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DTC No.	System malfunction location	Detection condition
U3000:43	Rear vehicle monitoring control module (RH) malfunction	Rear vehicle monitoring control module (RH) malfunction
U3000:44	Rear vehicle monitoring control module (RH) malfunction	Rear vehicle monitoring control module (RH) internal RAM malfunction detected.
U3000:45	Rear vehicle monitoring control module (RH) malfunction	Rear vehicle monitoring control module (RH) ROM malfunction detected.
U3000:46	Rear vehicle monitoring control module (RH) malfunction	Rear vehicle monitoring control module (RH) EEPROM malfunction detected.
U3000:47	Rear vehicle monitoring control module (RH) malfunction	Rear vehicle monitoring control module (RH) monitoring system malfunction detected.
U3000:48	Rear vehicle monitoring control module (RH) malfunction	Rear vehicle monitoring control module (RH) communication circuit malfunction detected.
U3000:49	Rear vehicle monitoring control module (RH) malfunction	Rear vehicle monitoring control module (RH) voltage control circuit malfunction detected.
U3000:4B	Temperature temporarily increases depending on various external and environmental factors (rear vehicle monitoring control module (LH) or (RH))	Rear vehicle monitoring control module internal temperature of 85°C {185°F} or more detected for 10 s or more.
U3000:54	Radar aiming is not performed or radar sensor axis is deviated (rear vehicle monitoring control module (RH))	Malfunction in radar aiming of rear vehicle monitoring control module (RH) detected for 1 s or more.
U3000:96	Rear vehicle monitoring control module (RH) malfunction	Inhibits the rear vehicle monitoring system.
U3000:97	Radar sensor sensitivity temporarily decreases depending on various external and environmental factors (rear vehicle monitoring control module (LH) or (RH))	Radar sensor sensitivity in rear vehicle monitoring control module (LH) or (RH) temporarily decreases
U3003:16	Rear vehicle monitoring control module (RH) low power supply voltage input	Power supply circuit voltage of 9 V or less is detected in rear vehicle monitoring control module (RH) for 1 s or more.
U3003:17	Rear vehicle monitoring control module (RH) high power supply voltage input	Power supply circuit voltage of 16 V or more is detected in rear vehicle monitoring control module (RH) for 1 s or more.

Data Monitor Function

- The PID/data monitor function performs reading in real time of optionally selected input/output signal monitor items that are set in the rear vehicle monitoring control module.

PID/data monitor table

PID name	Unit/Status	Data contents	Inspection item(s)
AIM_ANGL_L	° (deg)	Displays rear vehicle monitoring control module (LH) radar aiming angle.	Rear vehicle monitoring control module (LH)
AIM_ANGL_R	° (deg)	Displays rear vehicle monitoring control module (RH) radar aiming angle.	Rear vehicle monitoring control module (RH)
Buzzer	Off/On	• Off: Rear vehicle monitoring warning alarm does not sound. • On: Rear vehicle warning alarm sounds.	Instrument cluster
INTNL_TMP_L	°C,°F	Displays rear vehicle monitoring control module (LH) internal temperature.	Rear vehicle monitoring control module (LH)
INTNL_TMP_R	°C,°F	Displays rear vehicle monitoring control module (RH) internal temperature.	Rear vehicle monitoring control module (RH)
MAIN_SW	Off/On	• Off: RVM switch not pressed • On: RVM switch pressed	RVM switch
OP_BRT_L	—	Displays the RVM warning indicator light (LH) output brightness.	RVM warning indicator light (LH)
OP_BRT_R	—	Displays the RVM warning indicator light (RH) output brightness.	RVM warning indicator light (RH)
RVM_SYS_ST	Off/ Passive_On/ Active_On/ Failure	• Off: Rear vehicle monitoring system does not operate. • Passive_On: Rear vehicle monitoring system is on standby. • Active_On: Rear vehicle monitoring system operates. • Failure: Rear vehicle monitoring system malfunction	Rear vehicle monitoring control module
TURN_SW_L	Off/On	• Off: Turn switch is in position other than LH. • On: Turn switch is in LH position.	Turn Switch

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PID name	Unit/Status	Data contents	Inspection item(s)
TURN_SW_R	Off/On	• Off: Turn switch is in position other than RH. • On: Turn switch is in RH position.	Turn Switch
VPWR_L	V	Displays rear vehicle monitoring control module (LH) power supply voltage.	Rear vehicle monitoring control module (LH)
VPWR_R	V	Displays rear vehicle monitoring control module (RH) power supply voltage.	Rear vehicle monitoring control module (RH)
VSPD	KPH, MPH	Vehicle speed is displayed.	—
YAW_RATE	°/s	• —: Vehicle is stopped or while moving straight ahead. • Exceeds 0°/s: Vehicle tilted left. • Less than 0°/s: Vehicle tilted right.	SAS control module

Active Command Modes Function

- The active command modes are shown below.

Command name	Unit/ Operation	Data contents	Output part name
Buzzer	Off/On	• Off: Rear vehicle monitoring warning alarm does not sound. • On: Rear vehicle monitoring warning alarm sounds.	Rear vehicle monitoring warning alarm (instrument cluster)
WRN_IND_L	Off/On	• Off: Turns off the RVM warning indicator light (LH). • On: Illuminates the RVM warning indicator light (LH).	RVM warning indicator light (LH)
WRN_IND_R	Off/On	• Off: Turns off the RVM warning indicator light (RH). • On: Illuminates the RVM warning indicator light (RH).	RVM warning indicator light (RH)

ON-BOARD DIAGNOSTIC [BLIND SPOT MONITORING (BSM) SYSTEM]

id092200021846

Outline

- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the BSM control module-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunction locations and status via DTC output; and a PID/data monitoring function, which reads out specific input/output signals and verifies the input/output condition.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.

Malfunction Detection Function

- Detects malfunctions in input/output signals.
- If a malfunction occurs, the BSM control module (RH) records the malfunction as a DTC. A recorded DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

DTC table
BSM control module (LH)

×: Applicable
—: Not applicable

DTC No.	BSM OFF indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B118C:11	Flash	BSM indicator light (LH) circuit malfunction	×	—	C, D	×
B118C:15	Flash	BSM indicator light (LH) circuit malfunction	×	—	C, D	×
U0001:88	Flash	Module communication error (HS-CAN)	×	—	C	×
U0100:00	Flash	Communication error with PCM	×	—	C	×
U0131:00	Flash	Communication error with EPS control module	×	—	C	×
U0155:00	Flash	Communication error with instrument cluster	×	—	C	×
U0214:00	Flash	Communication error with start stop unit	×	—	C	×
U0233:00	Flash	Communication error with BSM control module (RH)	×	—	C	×
U0401:68	Flash	Error signal received from PCM	×	—	C	×
U0420:68	Flash	Error signal received from EPS control module	×	—	C	×

INSTRUMENTATION/DRIVER INFO.

DTC No.	BSM OFF indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
U0423:68	Flash	Error signal received from instrument cluster	×	—	C	×
U0515:68	Flash	Error signal received from start stop unit	×	—	C	×
U0534:68	Flash	Error signal received from BSM control module (RH)	×	—	C	×
U3000:01	Flash	Electrical malfunction inside BSM control module	×	—	C, D	×
U3000:09	Flash	BSM control module internal malfunction	×	—	C, D	×
U3000:4A	—	BSM control module (LH) assembly malfunction	—	—	C	×
U3000:97	—	Radar performance malfunction	—	—	C	×
U3003:16	Flash	BSM control module (LH) low power supply voltage input	×	—	C, D	×
U3003:17	Flash	BSM control module (LH) high power supply voltage input	×	—	C, D	×

*1 : C: CMDTC self test, D:ODDTC self test

BSM Control Module (RH)

×: Applicable
—: Not applicable

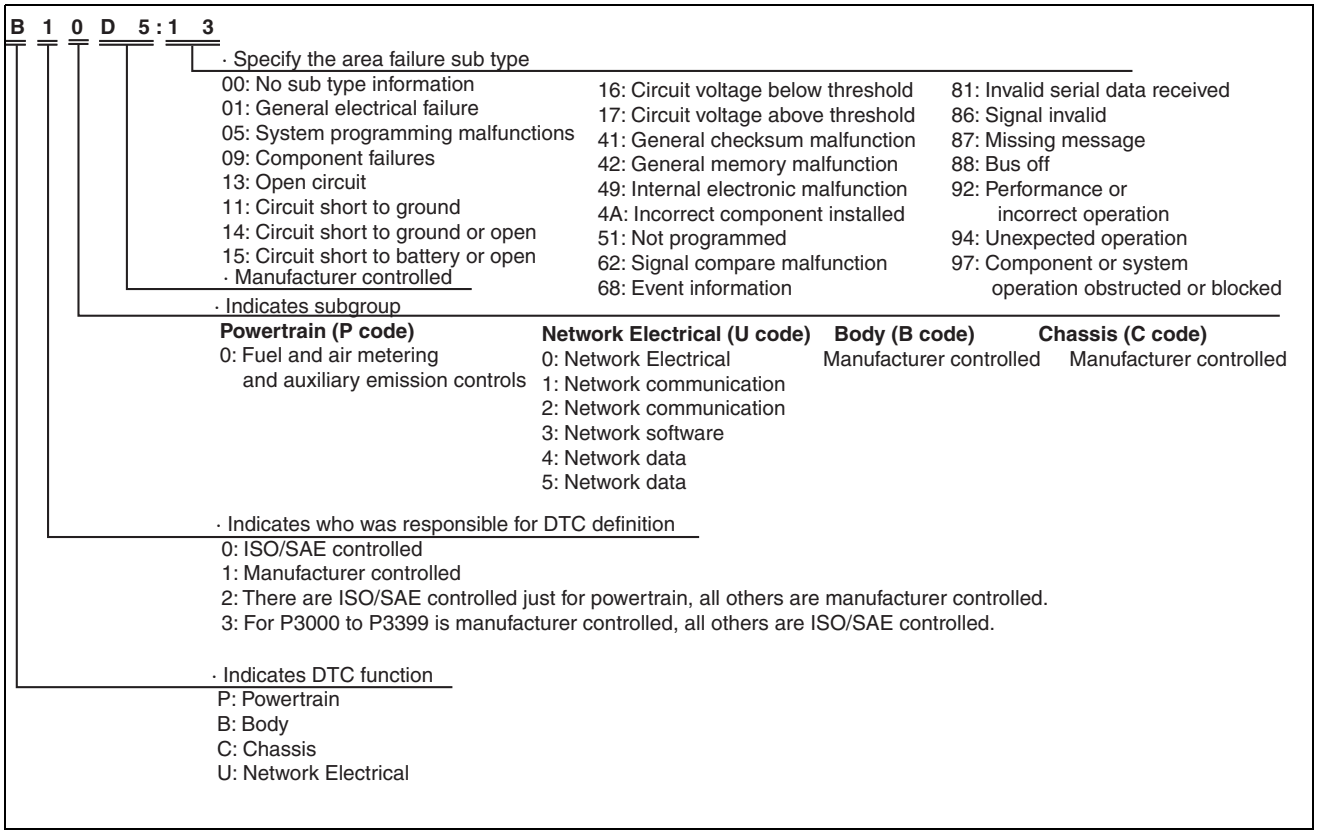
DTC No.	BSM OFF indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B118D:11	Flash	BSM indicator light (RH) circuit malfunction	×	—	C, D	×
B118D:15	Flash	BSM indicator light (RH) circuit malfunction	×	—	C, D	×
U0001:88	Flash	Module communication error (HS-CAN)	×	—	C	×
U0100:00	Flash	Communication error with PCM	×	—	C	×
U0131:00	Flash	Communication error with EPS control module	×	—	C	×
U0155:00	Flash	Communication error with instrument cluster	×	—	C	×
U0214:00	Flash	Communication error with start stop unit	×	—	C	×
U0232:00	Flash	Communication error with BSM control module (LH)	×	—	C	×
U0401:68	Flash	Error signal received from PCM	×	—	C	×
U0420:68	Flash	Error signal received from EPS control module	×	—	C	×
U0423:68	Flash	Error signal received from instrument cluster	×	—	C	×
U0515:68	Flash	Error signal received from start stop unit	×	—	C	×
U0533:68	Flash	Error signal received from BSM control module (LH)	×	—	C	×
U3000:01	Flash	Electrical problem inside BSM control module	×	—	C, D	×
U3000:09	Flash	BSM control module internal malfunction	×	—	C, D	×
U3000:4A	—	BSM control module (RH) assembly malfunction	—	—	C	×
U3000:97	—	Radar performance malfunction	—	—	C	×
U3003:16	Flash	BSM control module (RH) low power supply voltage input	×	—	C, D	×
U3003:17	Flash	BSM control module (RH) high power supply voltage input	×	—	C, D	×

*1 : C: CMDTC self test, D:ODDTC self test

INSTRUMENTATION/DRIVER INFO.

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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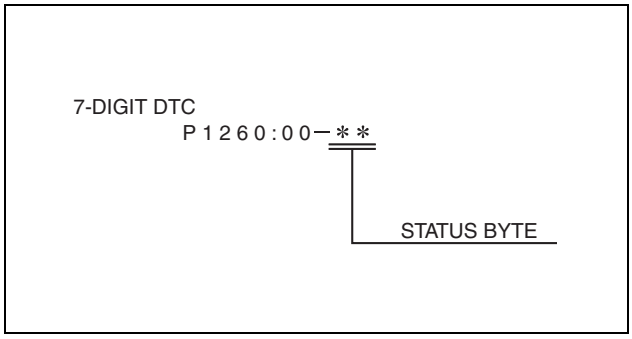
Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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Detection condition for the applicable DTC
BSM control module (LH)

DTC No.	System malfunction location	Detection condition
B118C:11	BSM indicator light (LH) circuit malfunction	While the BSM indicator light (LH) is operated, the BSM control module (LH) monitors the BSM indicator light (LH) load voltage. Increase in the monitored BSM indicator light (LH) load voltage is the specified value or more, and the BSM control module (LH) determined that there is a short to ground in the BSM indicator light (LH) circuit.
B118C:15	BSM indicator light (LH) circuit malfunction	While the BSM indicator light (LH) is operated, the BSM control module (LH) monitors the BSM indicator light (LH) load voltage. Decrease in the BSM indicator light (LH) load voltage is the specified value or less, and the BSM control module (LH) determined that there is a short to power supply or an open circuit in the BSM indicator light (LH) circuit.

INSTRUMENTATION/DRIVER INFO.

DTC No.	System malfunction location	Detection condition
U0001:88	Module communication error (HS-CAN)	The BSM control module detected a CAN bus communication line (HS-CAN) malfunction.
U0100:00	Communication error with PCM	The BSM control module could not receive a CAN signal from the PCM.
U0131:00	Communication error with EPS control module	The BSM control module could not receive a CAN signal from the EPS control module.
U0155:00	Communication error with instrument cluster	The BSM control module could not receive a CAN signal from the instrument cluster.
U0214:00	Communication error with start stop unit	The BSM control module could not receive a CAN signal from the start stop unit.
U0233:00	Communication error with BSM control module (RH)	The BSM control module (LH) could not receive a CAN signal from the BSM control module (RH).
U0401:68	Error signal received from PCM	The BSM control module received an error signal from the PCM.
U0420:68	Error signal received from EPS control module	The BSM control module received an error signal from the EPS control module.
U0423:68	Error signal received from instrument cluster	The BSM control module received an error signal from the instrument cluster.
U0515:68	Error signal received from start stop unit	The BSM control module received an error signal from the start stop unit.
U0534:68	Error signal received from BSM control module (RH)	The BSM control module (LH) received an error signal from the BSM control module (RH).
U3000:01	Electrical malfunction inside BSM control module	An electrical malfunction inside BSM control module is detected.
U3000:09	BSM control module internal malfunction	The BSM control module detected a malfunction inside the voltage control oscillator.
U3000:4A	BSM control module assembly malfunction	The left and right BSM control modules are installed in reverse, or an open circuit is detected in the BSM control module circuit.
U3000:97	Radar performance malfunction	• BSM control module internal radar sensor sensitivity is decreased. • BSM control module internal radar sensor axis is deviated.
U3003:16	BSM control module low power supply voltage input (less than 9 V)	BSM control module power supply voltage of less than 9 V is detected for 10 s or more.
U3003:17	BSM control module high power supply voltage input (16 V or more)	BSM control module power supply voltage of 16 V or more is detected for 10 s or more.

BSM Control Module (RH)

DTC No.	System malfunction location	Detection condition
B118D:11	BSM indicator light (RH) circuit malfunction	While the BSM indicator light (RH) is operated, the BSM control module (RH) monitors the BSM indicator light (RH) load voltage. Increase in the monitored BSM indicator light (RH) load voltage is the specified value or more, and the BSM control module (RH) determined that there is a short to ground in the BSM indicator light (RH) circuit.
B118D:15	BSM indicator light (RH) circuit malfunction	While the BSM indicator light (RH) is operated, the BSM control module (RH) monitors the BSM indicator light (RH) load voltage. Decrease in the BSM indicator light (RH) load voltage is the specified value or less, and the BSM control module (RH) determined that there is a short to power supply or an open circuit in the BSM indicator light (RH) circuit.
U0001:88	Module communication error (HS-CAN)	The BSM control module detected a CAN bus communication line (HS-CAN) malfunction.
U0100:00	Communication error with PCM	The BSM control module could not receive a CAN signal from the PCM.
U0131:00	Communication error with EPS control module	The BSM control module could not receive a CAN signal from the EPS control module.
U0155:00	Communication error with instrument cluster	The BSM control module could not receive a CAN signal from the instrument cluster.
U0214:00	Communication error with start stop unit	The BSM control module could not receive a CAN signal from the start stop unit.
U0232:00	Communication error with BSM control module (LH)	The BSM control module (RH) could not receive a CAN signal from the BSM control module (LH).
U0401:68	Error signal received from PCM	The BSM control module received an error signal from the PCM.
U0420:68	Error signal received from EPS control module	The BSM control module received an error signal from the EPS control module.
U0423:68	Error signal received from instrument cluster	The BSM control module received an error signal from the instrument cluster.
U0515:68	Error signal received from start stop unit	The BSM control module received an error signal from the start stop unit.
U0533:68	Error signal received from BSM control module (LH)	The BSM control module (RH) received an error signal from the BSM control module (LH).
U3000:01	Electrical malfunction inside BSM control module	An electrical malfunction inside BSM control module is detected.
U3000:09	BSM control module internal malfunction	The BSM control module detected a malfunction inside the voltage control oscillator.
U3000:4A	BSM control module assembly malfunction	The left and right BSM control modules are installed in reverse, or an open circuit is detected in the BSM control module circuit.
U3000:97	Radar performance malfunction	• BSM control module internal radar sensor sensitivity is decreased. • BSM control module internal radar sensor axis is deviated.
U3003:16	BSM control module low power supply voltage input (less than 9 V)	BSM control module power supply voltage of less than 9 V is detected for 10 s or more.
U3003:17	BSM control module high power supply voltage input (16 V or more)	BSM control module power supply voltage of 16 V or more is detected for 10 s or more.

Data Monitor Function

- With the PID/data monitor function, input/output signal monitor items set in the BSM control module can be selected and read out in real-time.

INSTRUMENTATION/DRIVER INFO.

PID/data monitor table
BSM control module (LH)

—: Not applicable

PID name	Unit/Status	Data contents	Inspection item(s)
BSM_ST	On/Off	• On: BSM is operated • Off: BSM is not operated	BSM control module (LH)
DTC_CNT	—	Number of DTCs stored in the BSM control module (LH) is displayed.	BSM control module (LH)
SHIFT_R	Not_R/R	ATX: • Not_R: Selector lever is in position other than R • R: Selector lever is in R position MTX: • Not_R: Shift lever is in position other than reverse • R: Shift lever is in reverse position	ATX: • Selector lever MTX: • Shift lever
SWA_POS	° (deg)	Steering angle is displayed.	Steering angle sensor
TURN_SW_L	On/Off	• On: Turn switch is in LH position • Off: Turn switch is in position other than LH	Turn switch
TURN_SW_R	On/Off	• On: Turn switch is in RH position • Off: Turn switch is in position other than RH	Turn switch
VPWR_IG1	V	BSM control module (LH) power supply voltage is displayed.	• BSM control module (LH) • IG1 relay • Battery
VSPD	KPH, MPH	Vehicle speed is displayed.	—
WRN_IND_L	Off/On	• Off: BSM indicator light (LH) is not illuminated • On: BSM indicator light (LH) is illuminated	BSM indicator light (LH)

BSM control module (RH)

—: Not applicable

PID name	Unit/Status	Data contents	Inspection item(s)
BSM_OFF_IL	On/Off	• On: BSM OFF indicator light is illuminated • Off: BSM OFF indicator light is not illuminated	• BSM OFF switch • Instrument cluster
BSM_ST	On/Off	• On: BSM is operated • Off: BSM is not operated	BSM control module (RH)
Buzzer	On/Off	• On: BSM buzzer is operated • Off: BSM buzzer is not operated	• BSM control module • Instrument cluster
DTC_CNT	—	Number of DTCs stored in the BSM control module (RH) is displayed.	BSM control module (RH)
SHIFT_R	Not_R/R	ATX: • Not_R: Selector lever is in position other than R • R: Selector lever is in R position MTX: • Not_R: Shift lever is in position other than reverse • R: Shift lever is in reverse position	ATX: • Selector lever MTX: • Shift lever
SWA_POS	° (deg)	Steering angle is displayed.	Steering angle sensor
TURN_SW_L	On/Off	• On: Turn switch is in LH position • Off: Turn switch is in position other than LH	Turn switch
TURN_SW_R	On/Off	• On: Turn switch is in RH position • Off: Turn switch is in position other than RH	Turn switch
VPWR_IG1	V	BSM control module (RH) power supply voltage is displayed.	• BSM control module (RH) • IG1 relay • Battery
VSPD	KPH, MPH	Vehicle speed is displayed.	—
WRN_IND_L	Off/On	• Off: BSM indicator light (RH) is not illuminated • On: BSM indicator light (RH) is illuminated	BSM indicator light (RH)

Active Command Modes Function

- The active command modes are shown below.

BSM control module (LH)

Command name	Unit/ Operation	Data contents	Output part name
VSPD	OFF/ON	• OFF: Does not input vehicle speed. • ON: Inputs vehicle speed of 34 km/h {21 mph}.	BSM control module (LH)

INSTRUMENTATION/DRIVER INFO.

Command name	Unit/ Operation	Data contents	Output part name
WRN_IND_L	Off/On	• Off: Turns off BSM indicator light (LH). • On: Illuminates BSM indicator light (LH).	BSM indicator light (LH)

BSM control module (RH)

Command name	Unit/ Operation	Data contents	Output part name
BSM_OFF_IL	On/Off	• On: Illuminates BSM OFF indicator light. • On: Turns off BSM OFF indicator light.	BSM OFF indicator light (instrument cluster)
Buzzer	On/Off	• On: Operates BSM buzzer. • Off: Stops BSM buzzer.	BSM buzzer (instrument cluster)
VSPD	OFF/ON	• OFF: Does not input vehicle speed. • ON: Inputs vehicle speed of 34 km/h {21 mph}.	BSM control module (RH)
WRN_IND_L	Off/On	• Off: Turns off BSM indicator light (RH). • On: Illuminates BSM indicator light (RH).	BSM indicator light (RH)

ON-BOARD DIAGNOSTIC [FORWARD SENSING CAMERA (FSC)]

id092200021852

Outline

- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the forward sensing camera (FSC)-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunction locations and status via DTC output; and a PID/data monitoring function, which reads out specific input/output signals and verifies the input/output condition.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.

Malfunction detection function

- Detects malfunctions in input/output signals.
- If a malfunction occurs, the FSC records the malfunction as a DTC. A recorded DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

×: Applicable
—: Not applicable

DTC No.	High beam control system (HBC) warning light (amber)/ Lane departure warning system (LDWS) warning light (amber)	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B115E:54	Flash	Forward sensing camera (FSC) aiming not completed	×	—	C, D	×
B13A6:11	Flash	LDWS switch circuit malfunction	×	—	C, D	×
C1001:92	Illuminate	Poor functioning of forward sensing camera (FSC)	×	—	C, D	×
C1001:97	Illuminate	Forward sensing camera (FSC) poor visibility	×	—	C, D	×
U0001:88	Flash	Module communication error (HS-CAN)	×	—	C, D	×
U0100:00	Flash	Communication error with PCM	×	—	C, D	×
U0121:00	Flash	Communication error with DSC HU/CM	×	—	C, D	×
U0131:00	Flash	Communication error with EPS control module	×	—	C, D	×
U0140:00	Flash	Communication error with front body control module (FBCM)	×	—	C, D	×

INSTRUMENTATION/DRIVER INFO.

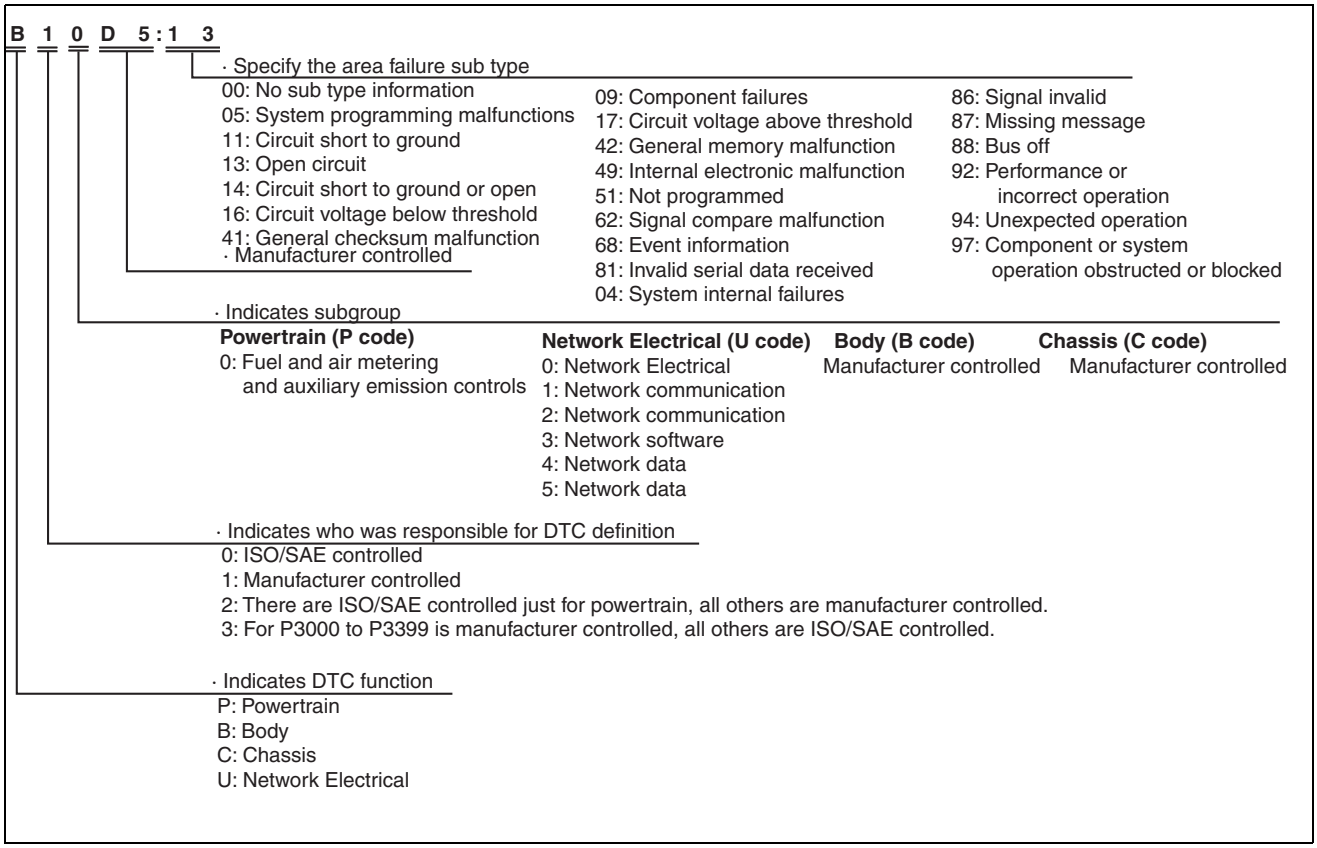
DTC No.	High beam control system (HBC) warning light (amber)/ Lane departure warning system (LDWS) warning light (amber)	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
U0155:00	Flash	Communication error with instrument cluster	×	—	C, D	×
U0214:00	Flash	Communication error with start stop unit	×	—	C, D	×
U0401:68	Flash	Error signal received from PCM	×	—	C, D	×
U0415:68	Flash	Error signal received from DSC HU/CM	×	—	C, D	×
U0420:68	Flash	Error signal received from EPS control module	×	—	C, D	×
U0423:68	Flash	Error signal received from instrument cluster	×	—	C, D	×
U0515:68	Flash	Error signal received from start stop unit	×	—	C, D	×
U2005:86	Flash	Error signal received from PCM	×	—	C, D	×
U2100:00	Illuminate	Forward sensing camera (FSC) configuration error	×	—	C, D	×
U2101:00	Illuminate	Forward sensing camera (FSC) configuration error	×	—	C, D	×
U3000:04	Flash	Forward sensing camera (FSC) internal malfunction	×	—	C, D	×
U3000:09	Flash	Forward sensing camera (FSC) internal malfunction	×	—	C, D	×
U3000:42	Flash	Forward sensing camera (FSC) internal malfunction	×	—	C, D	×
U3000:49	Flash	Forward sensing camera (FSC) internal malfunction	×	—	C, D	×
U3003:16	Flash	Forward sensing camera (FSC) low power supply voltage input	×	—	C, D	×
U3003:17	Flash	Forward sensing camera (FSC) high power supply voltage input	×	—	C, D	×

*1 : C: CMDTC self test, D: ODDTC self test

INSTRUMENTATION/DRIVER INFO.

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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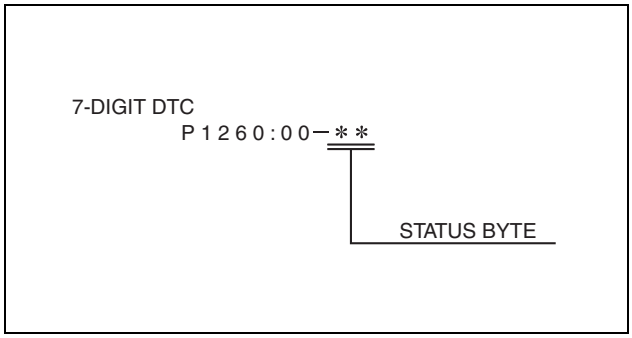
Status byte for DTC

- The status byte is the two digits (two digits after hyphen (-)) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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Detection condition for the applicable DTC

DTC No.	System malfunction location	Detection condition
B115E:54	Forward sensing camera (FSC) aiming not completed	Forward sensing camera (FSC) aiming not completed is detected.
B13A6:11	LDWS switch circuit malfunction	Forward sensing camera (FSC) detects that LDWS switch is held pressed for 10 s or more.
C1001:92	Poor functioning of forward sensing camera (FSC)	With the LDWS switch on or the high beam control (HBC) system operating, it is detected that the area around the forward sensing camera (FSC) is excessively bright, and the system is inoperable for 10 min.
C1001:97	Forward sensing camera (FSC) poor visibility	With the LDWS switch on or the high beam control (HBC) system operating, it is detected that the forward sensing camera (FSC) field of view is obstructed for 10 min.

INSTRUMENTATION/DRIVER INFO.

DTC No.	System malfunction location	Detection condition
U0001:88	Module communication error (HS-CAN)	Forward sensing camera (FSC) detects CAN bus communication line (HS-CAN) malfunction 10 times continuously.
U0100:00	Communication error with PCM	Forward sensing camera (FSC) cannot receive CAN signal from the PCM for 1 s or more.
U0121:00	Communication error with DSC HU/CM	Forward sensing camera (FSC) cannot receive CAN signal from the DSC HU/CM for 1 s or more.
U0131:00	Communication error with EPS control module	Forward sensing camera (FSC) cannot receive CAN signal from the EPS control module for 1 s or more.
U0140:00	Communication error with front body control module (FBCM)	Forward sensing camera (FSC) cannot receive CAN signal from front body control module (FBCM) for 5 s or more.
U0155:00	Communication error with instrument cluster	Forward sensing camera (FSC) cannot receive CAN signal from instrument cluster for 5 s or more.
U0214:00	Communication error with start stop unit	Forward sensing camera (FSC) cannot receive CAN signal from the start stop unit for 1 s or more.
U0401:68	Error signal received from PCM	Forward sensing camera (FSC) receives error signal from the PCM for 1 s or more.
U0415:68	Error signal received from DSC HU/CM	Forward sensing camera (FSC) receives error signal from the DSC HU/CM for 1 s or more.
U0420:68	Error signal received from EPS control module	Forward sensing camera (FSC) receives error signal from the EPS control module for 1 s or more.
U0423:68	Error signal received from instrument cluster	Forward sensing camera (FSC) receives error signal from the instrument cluster for 5 s or more.
U0515:68	Error signal received from start stop unit	Forward sensing camera (FSC) receives error signal from the start stop unit for 1 s or more.
U2005:86	Error signal received from PCM	Forward sensing camera (FSC) receives vehicle speed signal error from the PCM for 1 s or more.
U2100:00	Forward sensing camera (FSC) configuration error	Forward sensing camera (FSC) configuration not completed is detected.
U2101:00	Forward sensing camera (FSC) configuration error	Detects that forward sensing camera (FSC) has unsupported configuration data.
U3000:04	Forward sensing camera (FSC) internal malfunction	The front body control module (FBCM) detects an error in the image-related circuit in the forward sensing camera (FSC) with the ignition switched ON (engine off or on).
U3000:09	Forward sensing camera (FSC) internal malfunction	The front body control module (FBCM) detects an internal temperature sensor malfunction in the forward sensing camera (FSC) with the ignition switched ON (engine off or on).
U3000:42	Forward sensing camera (FSC) internal malfunction	The front body control module (FBCM) detects a NVRAM error in the forward sensing camera (FSC) with the ignition switched ON (engine off or on).
U3000:49	Forward sensing camera (FSC) internal malfunction	The front body control module (FBCM) detects a malfunction in the forward sensing camera (FSC) with the ignition switched ON (engine off or on).
U3003:16	Forward sensing camera (FSC) low power supply voltage input	Forward sensing camera (FSC) power supply circuit voltage of 8.2 V or less is detected for 5 s or more with the ignition switched ON (engine off or on).
U3003:17	Forward sensing camera (FSC) high power supply input	Forward sensing camera (FSC) power supply circuit voltage of 16.8 V or more is detected for 5 s or more with the ignition switched ON (engine off or on).

Snap shot data

- The data for all DTCs currently detected is stored.

INSTRUMENTATION/DRIVER INFO.

—: Not applicable

Snapshot data item	Unit		Data contents	Corresponding data monitor items
IG-ON_TIMER	hh:mm:ss		Elapsed time since ignition switched ON (engine off or on)	—
OPE_MODE	Normal/CALIBRATION/ EMERGENCY		Operation Mode	—
ECU_IN_TMP	°C	°F	ECU Internal Temperature	—
VSPD	KPH	MPH	Vehicle speed status	VSPD

Data Monitor Function

- The PID/data monitor function performs reading in real time of optionally selected input/output signal monitor items that are set in the FSC.

PID/data monitor table

—: Not applicable

PID	Unit/ Operation	Data contents	Inspection item(s)
A_ANG_PITCH	° (deg)	Displays forward sensing camera (FSC) aiming angle (pitch).	Forward sensing camera (FSC)
A_ANG_ROLL	° (deg)	Displays forward sensing camera (FSC) aiming angle (roll).	Forward sensing camera (FSC)
A_ANG_YAW	° (deg)	Displays forward sensing camera (FSC) aiming angle (yaw).	Forward sensing camera (FSC)
BRAKE_SW	Off/On	• Off: Brake switch (No. 2) is off. (Brake pedal is depressed.) • On: Brake switch (No. 2) is on. (Brake pedal is not depressed.)	Brake switch
DSP_LANE_ST	Off/ Dash_Lane/ Solid_Lane	• Off: Vehicle lanes not displayed in TFT LCD display • DashLane: Displays broken lines in TFT LCD display. • Lane: Displays actual lanes in TFT LCD display.	TFT LCD display (instrument cluster)
DSP_WRN_ST	Off/ LDWS_Left/ LDWS_Right/ LDWS_Fail/ HBC_Fail/ Camera_BLK/FSC_Fail/ Camera_DRDT	• Off: Warning not displayed in TFT LCD display • LDWS_Left: Warning related to lane departure on vehicle left side is displayed in TFT LCD display. • LDWS_Right: Warning related to lane departure on vehicle right side is displayed in TFT LCD display. • LDWS_Fail: Warning related to malfunction in lane departure warning system (LDWS) is displayed in TFT LCD display. • LDWS_Fail: Warning related to malfunction in high beam control (HBC) system is displayed in TFT LCD display. • Camera_BLK: Warning related to soiling of the forward sensing camera (FSC) is displayed in the TFT LCD display. • FSC_Fail: Warning related to malfunction in forward sensing camera (FSC) is displayed in the TFT LCD display. • Camera_DRDT: Warning related to soiling of the forward sensing camera (FSC) is displayed in the TFT LCD display.	TFT LCD display (instrument cluster)
HBC_H/L_CS	Hi_Request/ Low_Request/Invalid	• HiRequest: HI beam switch signal received • Low_Request: LO beam switch signal received • Invalid: Error in HI/LO beam switch request signal	Forward sensing camera (FSC)
IL_ST_HBC	Off/ Green_On/ Green_Flash/ Amber_On/ Amber_Flash	• On: HBC indicator light illuminated • Green_On: HBC indicator light (green) is illuminated. • Green_Flash: HBC indicator light (green) is flashing. • Amber_On: HBC indicator light (amber) is illuminated. • Amber_Flash: HBC indicator light (amber) is flashing.	HBC indicator light (instrument cluster)
IL_ST_LDWS	Off/ Green_On/ Green_Flash/ Amber_On/ Amber_Flash	• On: LDWS indicator light illuminated • Green_On: LDWS indicator light (green) illuminated • Green_Flash: LDWS indicator light (green) is flashing. • Amber_On: LDWS indicator light (amber) is illuminated. • Amber_Flash: LDWS indicator light (amber) is flashing.	LDWS indicator light (instrument cluster)

INSTRUMENTATION/DRIVER INFO.

PID	Unit/ Operation	Data contents	Inspection item(s)
LDWS_BUZZER	Off/On	• Off: LDWS warning alarm does not sound. • On: LDWS warning alarms sounds.	LDWS warning alarm (instrument cluster)
LDWS_SW	Off/On	• Off: LDWS switch is off. • On: LDWS switch is on.	LDWS switch
RS_SOUND_CS	Off/Left/ Right	• Off: Rumble strip sound is not heard. • Left: Left side rumble strip sound heard • Right: Right side rumble strip sound heard	Audio unit
VPWR_IG1	V	Displays forward sensing camera (FSC) power supply voltage.	Forward sensing camera (FSC)
VSPD	KPH, MPH	Vehicle speed is displayed.	—

INSTRUMENT CLUSTER OPERATION RECORD

id092200033100

Purpose

- The instrument cluster operation record stores the record of the illumination or flashing of the warning light.

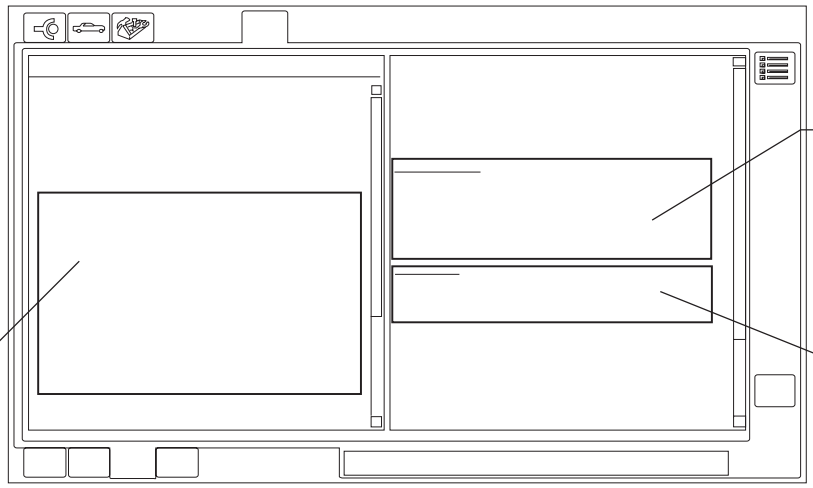
Function

- The operation record is stored by the instrument cluster and displayed using the Mazda Modular Diagnostic System (M-MDS).
- The instrument cluster stores the following when any of the warning lights illuminates or flashes.
  - — Time and date
  - — Control module which sent warning light illumination/flash request
  - — Battery voltage

Construction

- Based on the stored record, the instrument cluster displays the following operation record on the M-MDS screen.

MAZDA MODULAR DIAGNOSTIC SYSTEM (M-MDS) SCREEN



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Operation

- When the instrument cluster receives a CAN signal or a warning light illumination/flash request signal sent from each switch, it controls the warning light to illuminate/flash and stores the operation record at the same time.

Fail-safe

- Function not equipped.

09-40 CONTROL SYSTEM

CONTROL SYSTEM

CONTROL SYSTEM

id094000001100

Outline

- A front body control module (FBCM) has been adopted for the vehicle front which controls systems such as the headlights, windshield wipers, and turn lights.
- A rear body control module (RBCM) has been adopted for the vehicle rear which controls systems such as the power door lock, rear wiper, and interior light.

FRONT BODY CONTROL MODULE (FBCM)

id094000002500

Outline

- Located at the front of the vehicle, the front body control module (FBCM) performs numerous system controls for functions at the front of the vehicle.

Function

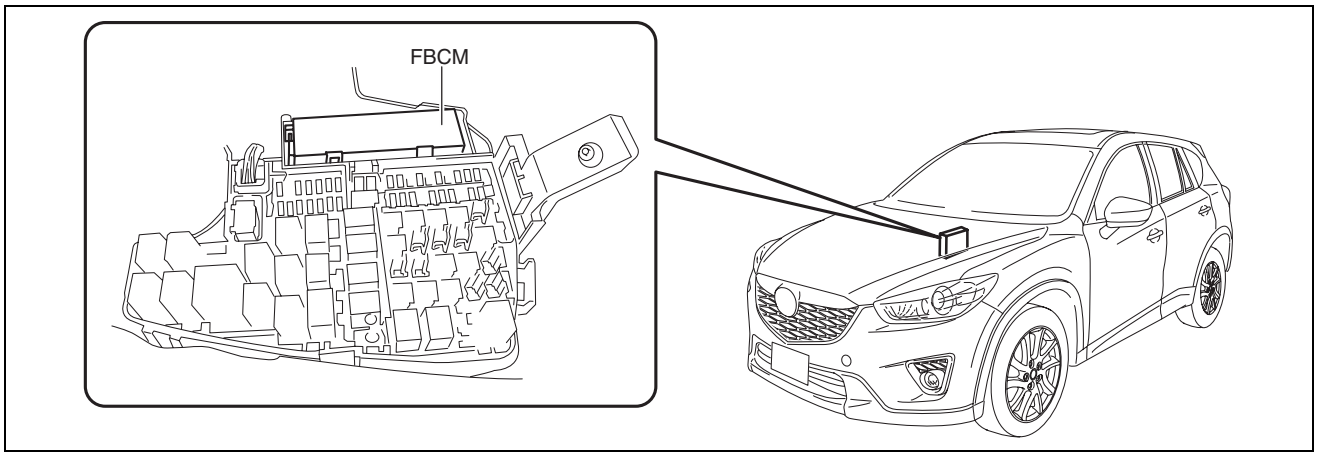
- The front body control module (FBCM) controls the system based on the input/output signals.
- The functions which are controlled are as follows:

Control table

Control	Content	Reference
Front combination light control	Each light illuminates or flashes in conjunction with the operation of the light switch, turn switch and hazard warning switch.	(See 09-18-12 FRONT COMBINATION LIGHT.)
Horn control	Sound is harmonized between high and low pitch.	(See 09-22-94 HORN.)
Rear defroster system control	Warms the rear window glass and the outer mirror glass using heat filaments to defog the glass surface.	(See 09-12-3 REAR WINDOW DEFROSTER/OUTER MIRROR HEATER.)
Headlight cleaner control	The headlight cleaner system removes dirt from the headlights by spraying washer fluid from the headlight cleaner nozzles installed to the front bumper.	(See 09-19-57 HEADLIGHT CLEANER SYSTEM.)
Front fog light control	By shining light in a wider area in front of the vehicle than the light from the headlights, visibility during poor weather conditions, such as rain and fog, has been improved. In addition, the visibility of the vehicle from on-coming vehicles, pedestrians, has been improved.	(See 09-18-61 FRONT FOG LIGHT.)
Front wiper system control	Equipped with continuous (low/high), auto-stop, one-touch wiper, intermittent wiper, and synchronized washer and wiper operation.	(See 09-19-4 WINDSHIELD WIPER SYSTEM.)
CAN (Controller Area Network)	Sends and receives signals between CAN system-related modules using CAN system.	(See 10-40-1 CONTROLLER AREA NETWORK (CAN) SYSTEM.)
ON-BOARD DIAGNOSTIC SYSTEM	The front body control module (FBCM) is equipped with an on-board diagnosis function which records DTCs in the event of a malfunction.	(See 09-40-9 ON-BOARD DIAGNOSTIC SYSTEM [FRONT BODY CONTROL MODULE (FBCM)].)

CONTROL SYSTEM

Structural view



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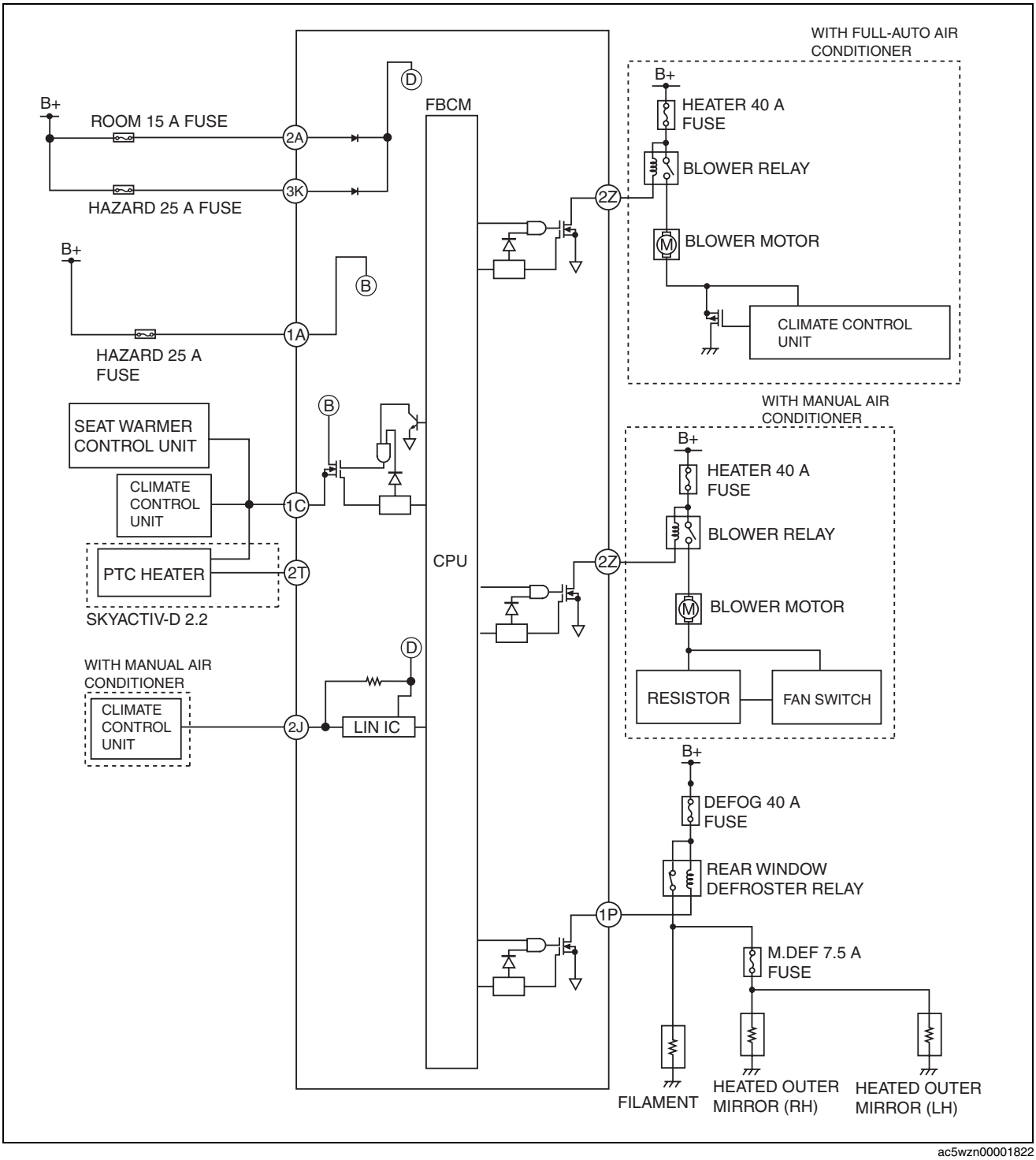
CONTROL SYSTEM

System wiring diagram
Rear defroster, blower motor



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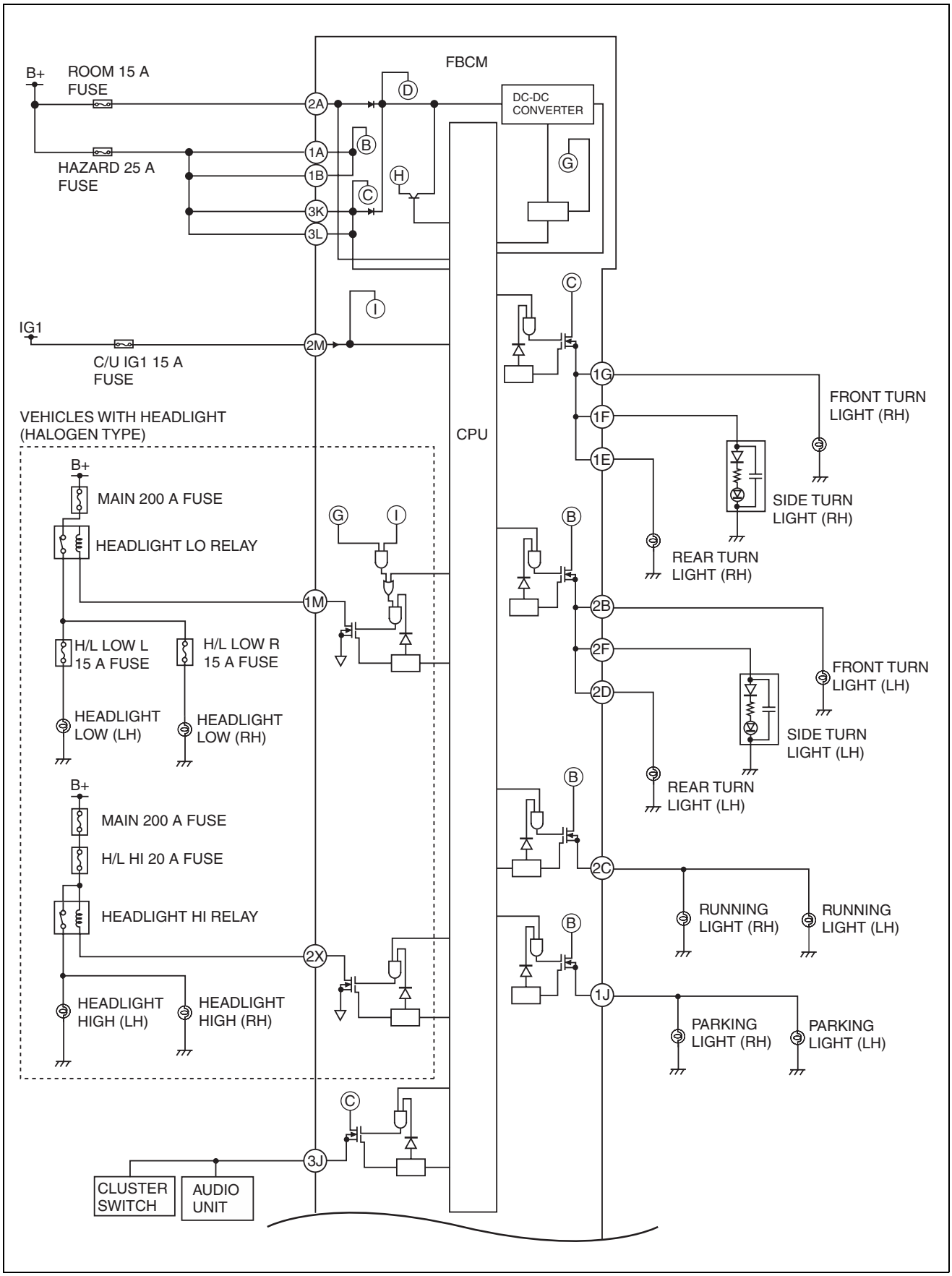
CONTROL SYSTEM

Headlights, turn lights, front fog lights



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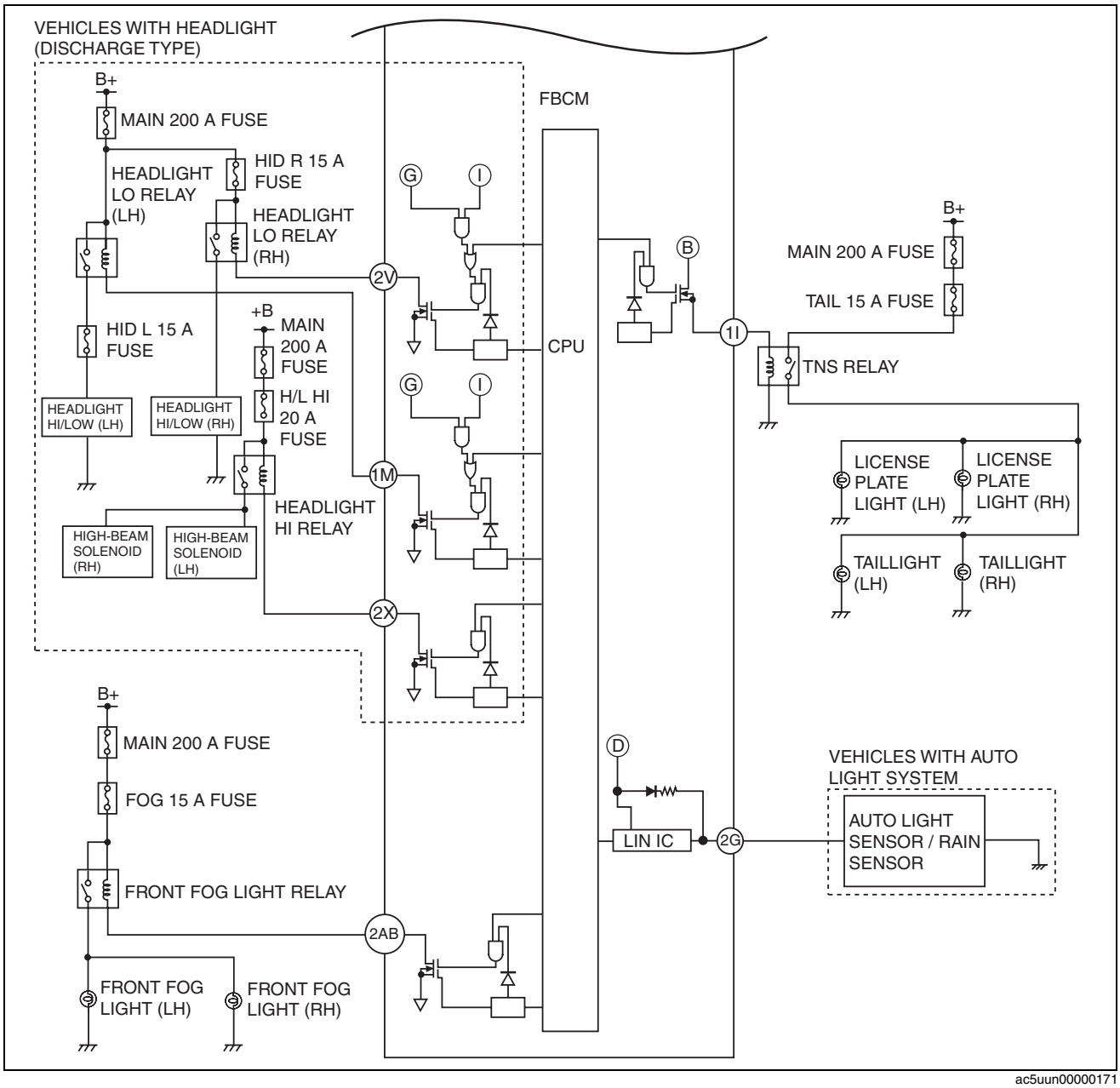
CONTROL SYSTEM



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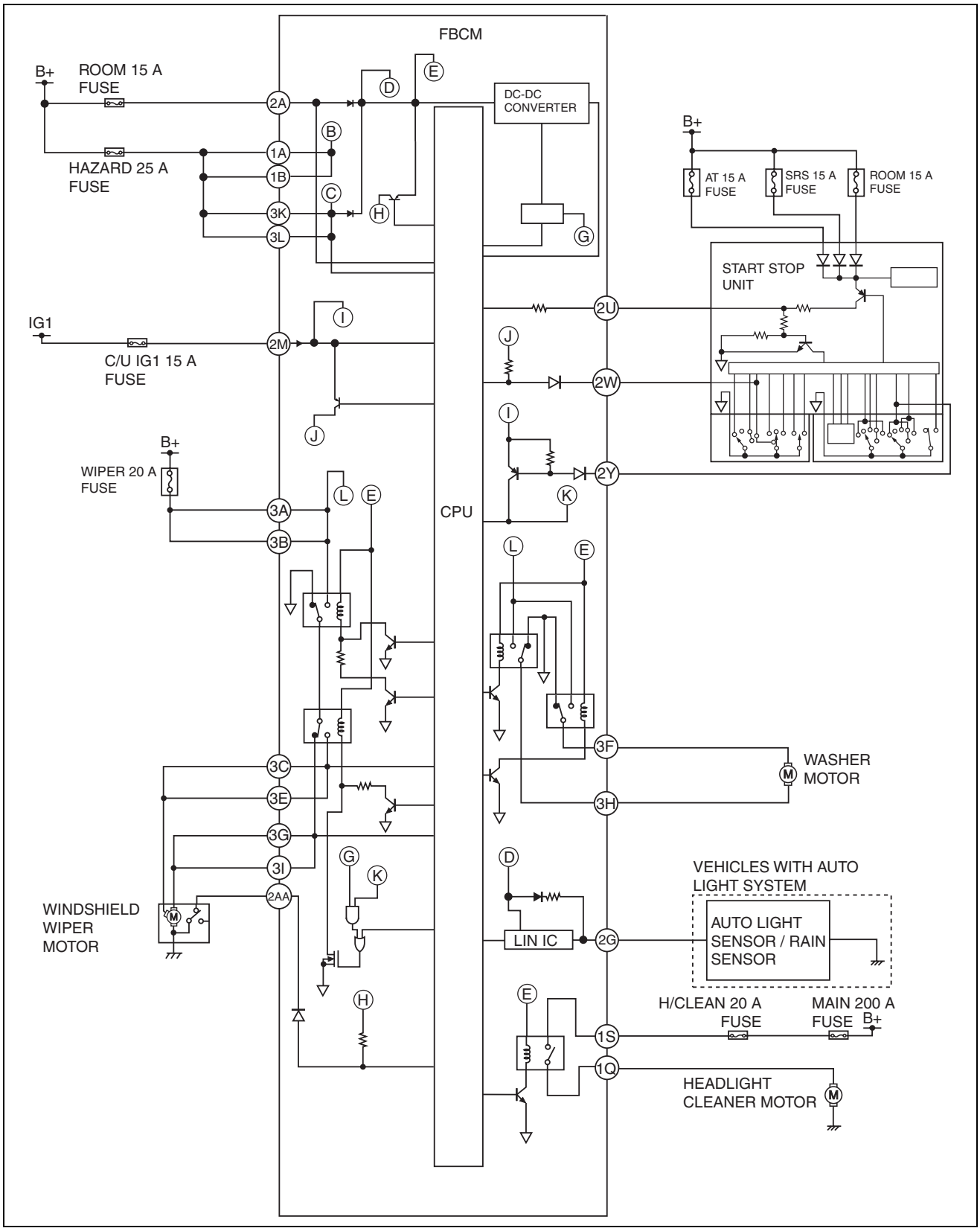
CONTROL SYSTEM

Windshield wipers, front/rear washers



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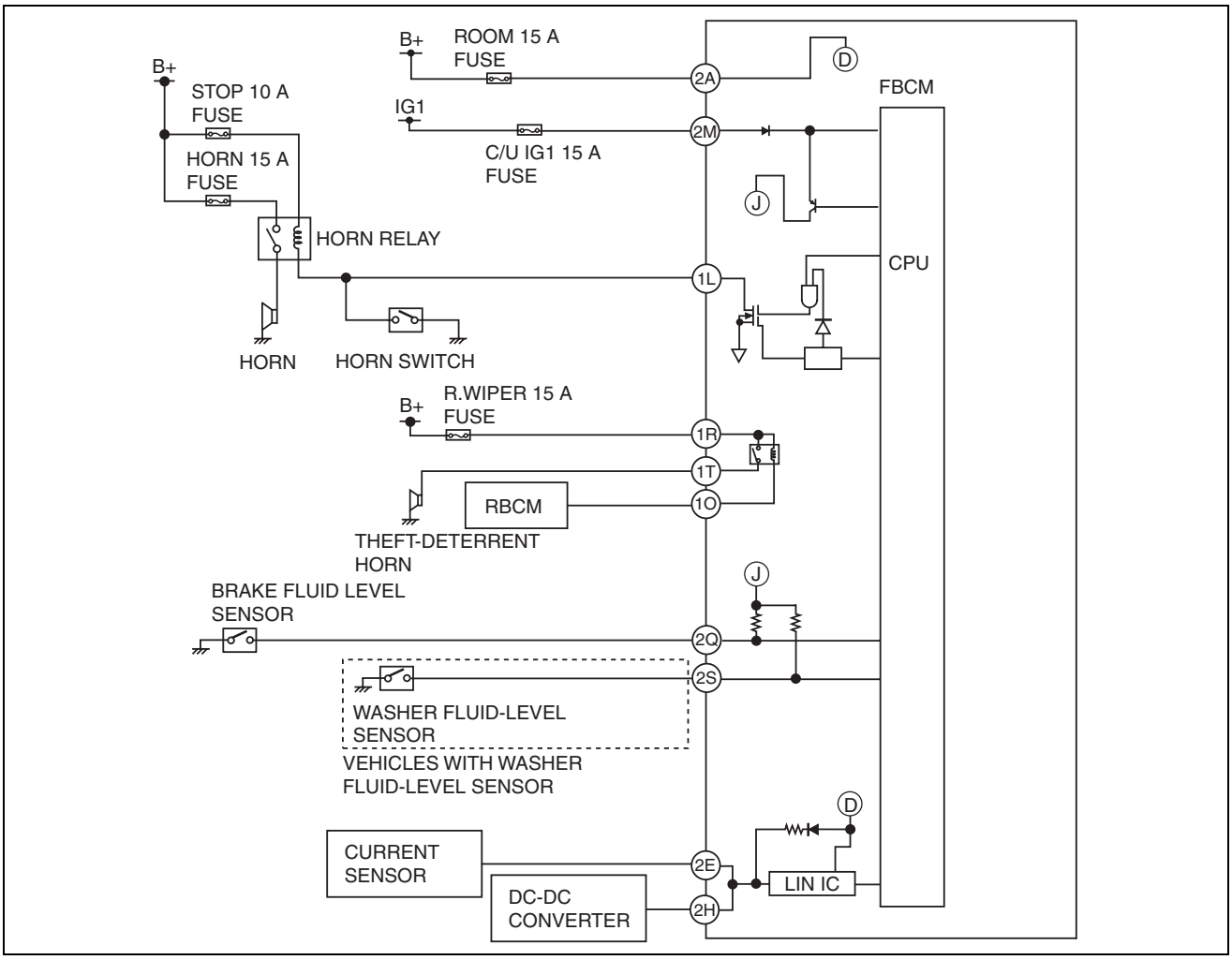
CONTROL SYSTEM

Theft-deterrent system, horn, sensors



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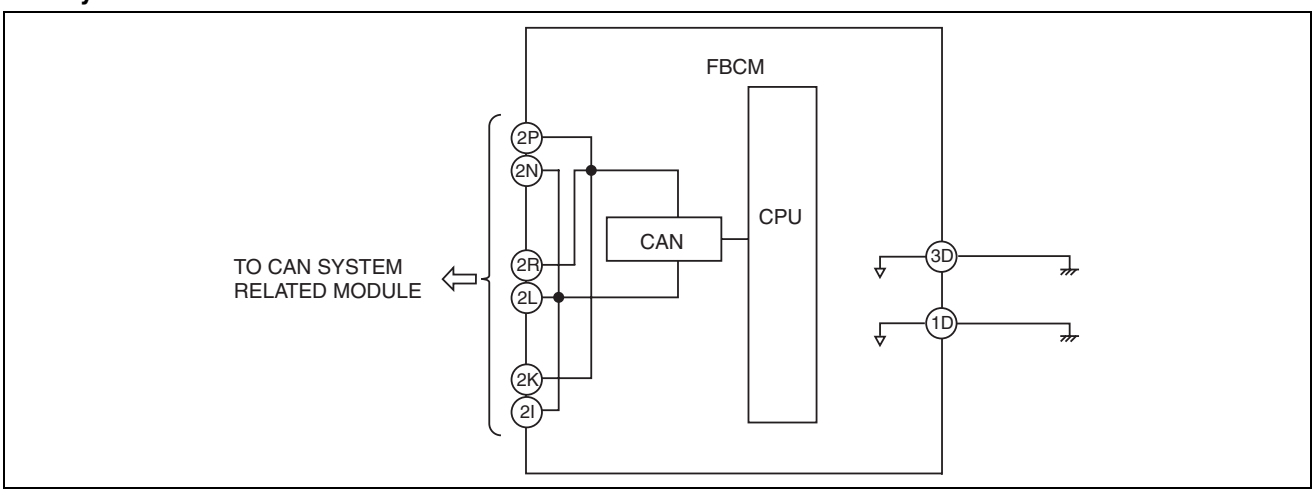
CAN system



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Fail-safe
Exterior lighting system

- If the CAN signal cannot be received normally, the front body control module (FBCM) performs the following controls:
  - — Light is illuminated: Continues to illuminate until the ignition is switched OFF (LOCK).
  - — Light is turned off: Turns on/off according to the light switch operation. If the light switch is off, the TNS is forced on. When the ignition is switched OFF (LOCK), the light turns off.

CONTROL SYSTEM

Auto light system
- If there is a communication error in the rain sensor while the light is illuminated, the front body control module (FBCM) continues to illuminate the light until the ignition is switched OFF (LOCK) or the light switch is operated to the position other than AUTO.

Running light system
- Function not equipped.

Emergency stop signal system (ESS)
- If the CAN signal cannot be received normally, the front body control module (FBCM) controls the ESS based on the signal last received. If the CAN signal cannot be received normally for 5 s or more, the front body control module (FBCM) stops the turn light system control.

Turn light system
- If the CAN signal cannot be received normally, the front body control module (FBCM) controls the turn light system based on the signal last received. If the CAN signal cannot be received normally for 5 s or more, the front body control module (FBCM) stops the turn light system control.

Rear defroster system control
- Function not equipped.

Horn control
- Function not equipped.

Windshield wiper and washer system
- If the front body control module (FBCM) detects a malfunction in the internal CPU, it controls as follows:
  - — When the wiper and washer switch is in the LO or HI position: LO operation control is performed.
  - — When the wiper and washer switch is in the OFF position: Windshield wiper operation is stopped.
- If the front body control module (FBCM) cannot receive a windshield wiper switch position signal because of a malfunction in the start stop unit or a CAN communication error between the start stop unit, or if it detects an error in the windshield wiper switch position signal, it continues the control before detecting the malfunction. However, if the driver operates the wiper and washer switch, it controls as follows:
  - — When the front body control module (FBCM) detects LO/HI ON using the LO/HI detection function: The windshield wipers are operated at low speed.
  - — When the front body control module (FBCM) detects LO/HI OFF using the LO/HI detection function: The windshield wipers are stopped at the park position.
- If the windshield wiper switch position which is monitored by the LO/HI detection function of the front body control module (FBCM) does not match the one which is sent from the start stop unit as a CAN signal, the windshield wipers are controlled according to the CAN signal for a certain period of time. After a certain period of time has elapsed, they are controlled as follows:
  - — When the front body control module (FBCM) detects LO/HI ON using the LO/HI detection function: The windshield wipers are operated at low speed.
  - — When the front body control module (FBCM) detects LO/HI OFF using the LO/HI detection function: The windshield wipers are stopped at the park position.
- If the front body control module (FBCM) detects a malfunction in the auto stop switch circuit while the windshield wipers are operating, it allows the windshield wipers to operate for a certain period of time and then stops the operation. However, if the driver operates the wiper and washer switch, or if the ignition is switched OFF (LOCK) and switched ON (engine off or on) again, it operates the windshield wipers again.
- If the front body control module (FBCM) cannot receive an INT volume signal because of a CAN communication error between the start stop unit or a malfunction in the start stop unit, it continues the operation at a certain intermittent timing.
- If the front body control module (FBCM) detects an error in the INT volume signal from the start stop unit, it continues the operation according to the INT volume signal before detecting the malfunction.
- If the front body control module (FBCM) cannot receive a windshield washer operation request signal because of a CAN communication error between the start stop unit or a malfunction in the start stop unit, it controls as follows:
  - — When the windshield washer is operated: The washer operation is continued for a certain period of time and then stopped.
  - — When the windshield washer is not operated: The washer is not operated.
- If the windshield washer is continuously operated for a long period (**approx. 1 min. or more**), the operation is stopped temporarily to prevent the windshield washer relay from overheating.

Auto wiper system
- If the front body control module (FBCM) cannot receive a CAN signal (vehicle speed signal) from the PCM normally, it continues the control using the vehicle speed signal before detecting the malfunction.

- If there is a malfunction in the rain sensor or a communication error between the rain sensor and front body control module (FBCM), and if the front body control module (FBCM) detects a signal error ten times in a series, the operation before the malfunction was detected is continued.
- If the rain sensor detects rainfall and then detects no change in the detected amount after the wipers have been operated approx. two times, the windshield is determined to be dirty and windshield wiper operation is stopped.
  - — If the windshield is dirty, set the wiper and washer switch to LO or HI position to operate the windshield wiper. Or, remove the dirt from the windshield, then operate the auto wiper.
- If the temperature sensor in the rain sensor detects **approx. -10 °C {14 °F}** or less when the ignition is switched ON (engine off or on), the windshield wipers do not operate even though it may be snowing.

Rear wiper and washer system

- If the front body control module (FBCM) cannot receive a rear wiper switch position signal because of a malfunction in the start stop unit or a CAN communication error between the start stop unit, it controls as follows:
  - — When the rear wiper is operated: The rear wiper operation is continued for a certain period of time and then stopped.
  - — When the rear wiper is not operated: The rear wiper is not operated.
- If the front body control module (FBCM) detects an error in the signal from the start stop unit, it controls the rear wiper and washer according to the signal before detecting the malfunction.
- If the front body control module (FBCM) cannot receive a rear washer operation request signal from the start stop unit because of a malfunction in the start stop unit or a CAN communication error between the start stop unit, it controls as follows:
  - — When the rear washer is operated: The rear washer operation is continued for a certain period of time and then stopped.
  - — When the rear washer is not operated: The rear washer is not operated.
- If the rear washer is continuously operated for a long period (**approx. 1 min. or more**), the operation is stopped temporarily to prevent the rear washer relay from overheating.

ON-BOARD DIAGNOSTIC SYSTEM [FRONT BODY CONTROL MODULE (FBCM)]

id094000002700

Outline

- The on-board diagnostic function consists of the following functions: A malfunction detection function, which detects overall malfunctions in the front body control module (FBCM)-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunction locations and status via DTC output; and a PID/data monitoring function, which reads out specific input/output signals and verifies the input/output condition.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.

Malfunction detection function

- Detects malfunctions in input/output signals.
- If a malfunction occurs, the front body control module (FBCM) records the malfunction as a DTC. A recorded DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

DTC table

×: Applicable
—: Not applicable

DTC No.	Warning/ indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B1008:02	—	Windshield wiper control signal mismatch	—	—	C, D	×
B1008:62	—	Windshield wiper (LO) switch signal mismatch	—	—	C, D	×
B1048:7B	—	Brake fluid level sensor circuit malfunction	—	—	C, D	×
B1087:88	—	LIN communication error	—	—	C, D	×
B1088:88	—	LIN communication error	—	—	C, D	×
B1095:72	—	Autostop switch circuit malfunction	—	—	C, D	×
B1095:73	—	Autostop switch circuit malfunction	—	—	C, D	×
B109A:12	—	Headlight (HI) relay circuit malfunction	—	—	C, D	×
B109A:14	—	Headlight (HI) relay circuit malfunction	—	—	C, D	×
B10A6:64	—	Light switch error signal received	—	—	C, D	×
B10A8:12*2	—	Headlight (LO) relay circuit malfunction	—	—	C, D	×

CONTROL SYSTEM

DTC No.	Warning/ indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B10AD:86*3	—	Error signal received from auto-light sensor/rain sensor	—	—	C, D	×
B10AF:12	—	Blower relay circuit malfunction	—	—	C, D	×
B1142:13	—	Front body control module (FBCM) power supply voltage (+IG1 power supply) input circuit malfunction	—	—	C, D	×
B1143:13	—	IG2 power supply control circuit malfunction	—	—	C, D	×
B11DB:86	—	Error signal received from current sensor	—	—	C, D	×
B1314:11	—	Illumination output circuit malfunction	—	—	C, D	×
B134D:02	—	Headlight control signal malfunction	—	—	C, D	×
B13AF:62	—	Headlight LO signal mismatch	—	—	C, D	×
B13CF:19	—	IG2 power supply output circuit malfunction	—	—	C, D	×
B13D0:11	—	TNS circuit malfunction	—	—	C, D	×
B13D2:12*4	—	Front fog light relay circuit malfunction	—	—	C, D	×
B13FE:12*5	—	Headlight (LO) relay (LH) circuit malfunction	—	—	C, D	×
B13FE:14*5	—	Headlight (LO) relay (RH) circuit malfunction	—	—	C, D	×
B141E:12*5	—	Headlight (LO) relay (RH) circuit malfunction	—	—	C, D	×
B1C79:97	—	Washer motor switch circuit malfunction	—	—	C, D	×
B1C82:97*6	—	Headlight cleaner motor switch circuit malfunction	—	—	C, D	×
B1C84:12	—	Rear window defroster circuit malfunction	—	—	C, D	×
B1C84:14	—	Rear window defroster circuit malfunction	—	—	C, D	×
B1D06:11	—	Turn light (LH) circuit malfunction	—	—	C, D	×
B1D06:13	—	Turn light (LH) circuit malfunction	—	—	C, D	×
B1D07:11	—	Turn light (RH) circuit malfunction	—	—	C, D	×
B1D07:13	—	Turn light (RH) circuit malfunction	—	—	C, D	×
C1126:11	—	Parking light (LH/RH) circuit malfunction	—	—	C, D	×
C1126:13	—	Parking light (LH/RH) circuit malfunction	—	—	C, D	×
U0001:88	—	Module communication error (HS-CAN)	—	—	C, D	×
U0100:00	—	Communication error with PCM	—	—	C, D	×
U0101:00*7	—	Communication error with TCM	—	—	C, D	×
U0121:00	—	Communication error with DSC HU/CM	—	—	C, D	×
U0155:00	—	Communication error with instrument cluster	—	—	C, D	×
U0164:68*8	—	Communication error between climate control unit	—	—	C, D	×
U0214:00	—	Communication error with start stop unit	—	—	C, D	×
U0231:68*3	—	Communication error with auto-light sensor/rain sensor	—	—	C, D	×
U023A:00*9	—	Communication error with forward sensing camera (FSC)	—	—	C, D	×
U0298:68	—	Communication error with DC-DC converter	—	—	C, D	×
U0338:09	—	Error signal received from start stop unit	—	—	C, D	×
U0401:68	—	Error signal received from PCM	—	—	C, D	×
U0415:68*10	—	Error signal received from DSC HU/CM	—	—	C, D	×
U0515:00	—	SAS control module communication error	—	—	C, D	×
U053B:68*9	—	Error signal received from forward sensing camera (FSC)	—	—	C, D	×
U0599:68	—	Error signal received from DC-DC converter	—	—	C, D	×

CONTROL SYSTEM

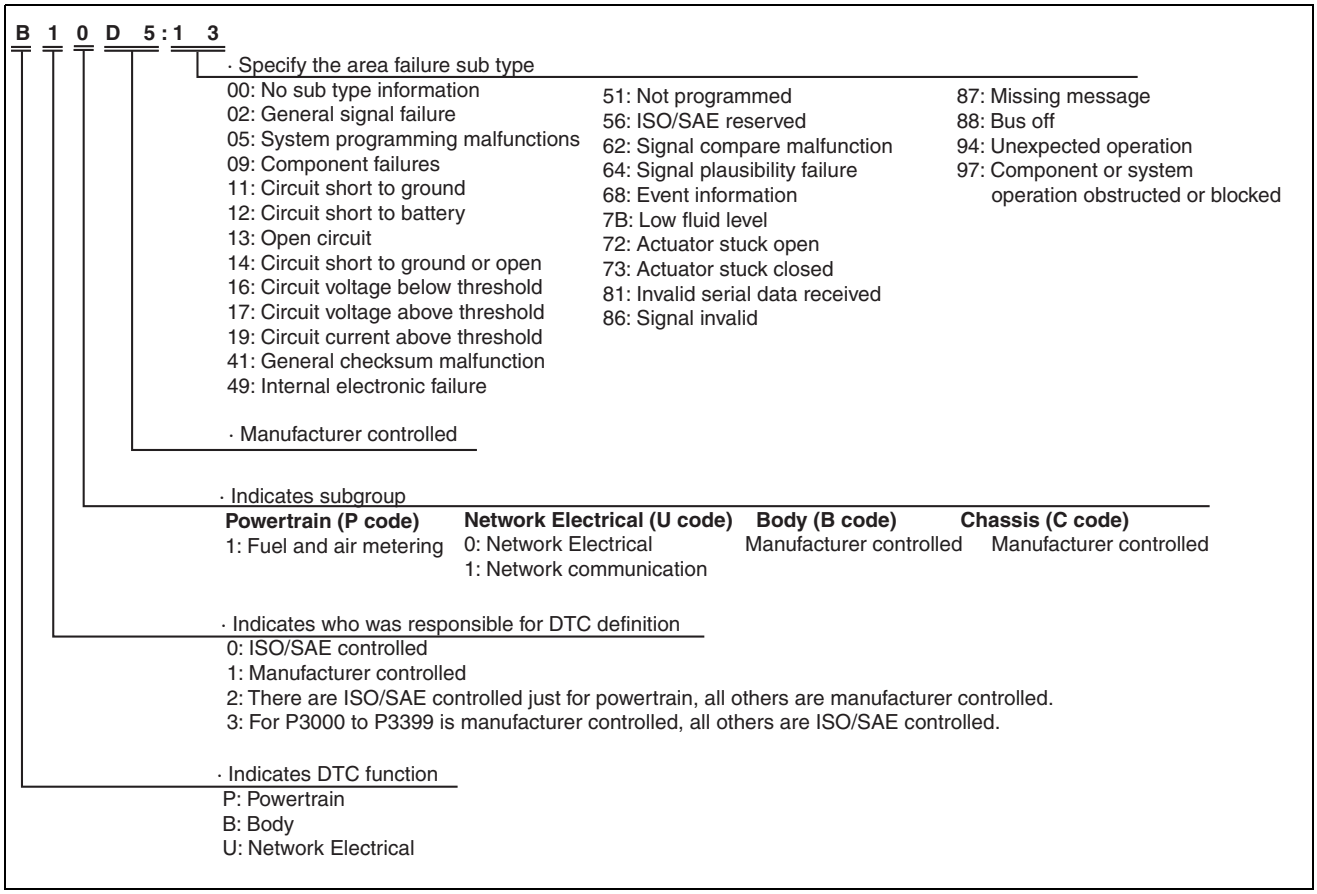
DTC No.	Warning/ indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
U1007:68	—	Communication error with current sensor	—	—	C, D	×
U2005:68	—	Error signal received from PCM	—	—	C, D	×
U2100:00	—	Front body control module (FBCM) configuration error	—	—	C, D	×
U2101:00	—	Front body control module configuration error	—	—	C, D	×
U3000:49	—	Front body control module internal malfunction	—	—	C, D	×
U3000:56	—	Front body control module configuration error	—	—	C, D	×
U3003:16	—	Front body control module power supply voltage (+B power supply) low input	—	—	C, D	×
U3003:17	—	Front body control module power supply voltage (+B power supply) high input	—	—	C, D	×
U3006:62	—	Front body control module power supply voltage mismatch	—	—	C, D	×

*1 : C: CMDTC self test, D:ODDTC self test
*2 : With headlights (halogen type)
*3 : With auto-light sensor
*4 : With front fog lights
*5 : With headlights (discharge type)
*6 : With headlight cleaner
*7 : ATX
*8 : With manual A/C
*9 : With forward sensing camera (FSC)
*10 : With emergency stop signal system (ESS)

CONTROL SYSTEM

DTC 7-digit code definition

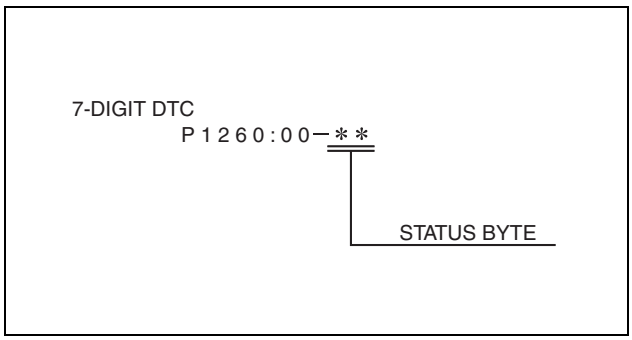
- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



ac5wzn00001566

Status byte for DTC

- The status byte is the two digits (after hyphen) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



ac5wzn00001327

Detection condition for the applicable DTC

DTC	System malfunction location	Detection condition
B1008:02	Windshield wiper control signal mismatch	The front body control module (FBCM) receives error signals from the start stop unit with the ignition switched ON (engine off or on).
B1008:62	Windshield wiper (LO) switch signal mismatch	The front body control module (FBCM) and start stop unit signals are compared and it is detected that the signals do not match for 5 s or more with the ignition switched ON (engine off or on).
B1048:7B	Brake fluid level sensor circuit malfunction	The front body control module (FBCM) detected that the brake fluid level is less than MIN with the ignition switched ON (engine off or on).

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DTC	System malfunction location	Detection condition
B1087:88	LIN communication error	LIN bus communication line malfunction detected for 1 s or more
B1088:88	LIN communication error	LIN bus communication line malfunction detected for 1 s or more
B1095:72	Autostop switch circuit malfunction	The front body control module (FBCM) detects that the autostop switch is stuck closed with the ignition switched ON (engine off or on).
B1095:73	Autostop switch circuit malfunction	The front body control module (FBCM) detects that the autostop switch is stuck open with the ignition switched ON (engine off or on).
B109A:12	Headlight (HI) relay circuit malfunction	The front body control module (FBCM) detects a short to power supply in the headlight HI relay circuit with the ignition switched ON (engine off or on).
B109A:14	Headlight (HI) relay circuit malfunction	The front body control module (FBCM) detects an open or short to ground in the headlight HI relay circuit with the ignition switched ON (engine off or on).
B10A6:64	Light switch error signal received	The front body control module (FBCM) receives error signals from the start stop unit for 5 s or more with the ignition switched ON (engine off or on).
B10A8:12*1	Headlight (LO) relay circuit malfunction	The front body control module (FBCM) detects a short to power supply in the headlight LO relay circuit with the ignition switched ON (engine off or on).
B10AD:86*2	Error signal received from auto-light sensor/ rain sensor	The front body control module (FBCM) receives error signals from the auto-light sensor/rain sensor 10 times continuously with the ignition switched ON (engine off or on).
B10AF:12	Blower relay circuit malfunction	The front body control module (FBCM) detects a short to power supply in the blower relay circuit with the ignition switched ON (engine off or on).
B1142:13	Front body control module (FBCM) power supply voltage (+IG1 power supply) input circuit malfunction	The front body control module (FBCM) detects an open circuit in the IG1 relay circuit for 2 s or more with the ignition switched ON (engine off or on).
B1143:13	IG2 power supply control circuit malfunction	The front body control module (FBCM) detects an open circuit in the start stop unit circuit for 2 s or more with the ignition switched ON (engine off or on).
B11DB:86	Error signal received from current sensor	The front body control module (FBCM) receives error signals from the current sensor for 5 s or more with the ignition switched ON (engine off or on).
B1314:11	Illumination output circuit malfunction	The front body control module (FBCM) detects a short to ground in the illumination output circuit with the ignition switched ON (engine off or on).
B134D:02	Headlight control signal malfunction	The condition in which the front body control module (FBCM) and start stop unit signals are compared and no match is detected between the signals for 5 s or more with the ignition switched ON (engine off or on).
B13AF:62	Headlight LO signal mismatch	The condition in which the CAN and module signals are compared and no match is detected between the signals for 5 s or more with the ignition switched ON (engine off or on).
B13CF:19	IG2 power supply output circuit malfunction	The front body control module (FBCM) detects over-current in IG2 power supply output circuit with the ignition switched ON (engine off or on).
B13D0:11	TNS relay circuit malfunction	The front body control module (FBCM) detects a short to ground in the TNS relay circuit with the ignition switched ON (engine off or on).
B13D2:12*3	Front fog light relay circuit malfunction	The front body control module (FBCM) detects a short to power supply in the front fog light relay circuit with the ignition switched ON (engine off or on).
B13FE:12*4	Headlight (LO) relay (RH) circuit malfunction	The front body control module (FBCM) detects a short to power supply in the headlight LO relay (RH) circuit with the ignition switched ON (engine off or on).
B13FE:14*4	Headlight (LO) relay (RH) circuit malfunction	The front body control module (FBCM) detects an open or short circuit to ground in the headlight LO relay (RH) circuit with the ignition switched ON (engine off or on).

CONTROL SYSTEM

DTC	System malfunction location	Detection condition
B141E:12*4	Headlight (LO) relay (LH) circuit malfunction	The front body control module (FBCM) detects a short to power supply in the headlight LO relay (LH) circuit with the ignition switched ON (engine off or on).
B1C79:97	Washer motor switch circuit malfunction	The front body control module (FBCM) detects a malfunction in the washer motor circuit for 2 min or more with the ignition switched ON (engine off or on).
B1C82:97*5	Headlight cleaner motor switch circuit malfunction	The front body control module (FBCM) detects a malfunction in headlight cleaner motor circuit for 2 min or more with the ignition switched ON (engine off or on).
B1C84:12	Rear window defroster circuit malfunction	The front body control module (FBCM) detects a short to power supply in the rear window defroster relay circuit with the ignition switched ON (engine off or on).
B1C84:14	Rear window defroster circuit malfunction	The front body control module (FBCM) detects an open or short to ground in the rear window defroster relay circuit with the ignition switched ON (engine off or on).
B1D06:11	Turn light (LH) circuit malfunction	The front body control module (FBCM) detects a short to ground in the turn light (LH) circuit with the ignition switched ON (engine off or on).
B1D06:13	Turn light (LH) circuit malfunction	The front body control module (FBCM) detects an open or short to power supply in the turn light (LH) circuit with the ignition switched ON (engine off or on).
B1D07:11	Turn light (RH) circuit malfunction	The front body control module (FBCM) detects a short to ground in the turn light (RH) circuit with the ignition switched ON (engine off or on).
B1D07:13	Turn light (RH) circuit malfunction	The front body control module (FBCM) detects an open or short to power supply in the turn light (RH) circuit with the ignition switched ON (engine off or on).
C1126:11	Parking light (LH/RH) circuit malfunction	The front body control module (FBCM) detects a short to ground in the parking light (LH/RH) circuit with the ignition switched ON (engine off or on).
C1126:13	Parking light (LH/RH) circuit malfunction	The front body control module (FBCM) detects an open or short to power supply in the parking light (LH/RH) circuit with the ignition switched ON (engine off or on).
U0001:88	Module communication error (HS-CAN)	The front body control module (FBCM) detects CAN bus communication line (HS-CAN) malfunction 10 times continuously.
U0100:00	Communication error with PCM	The front body control module (FBCM) could not receive CAN signal from the PCM for 5 s or more.
U0101:00*6	Communication error with TCM	The front body control module (FBCM) could not receive CAN signal from the TCM for 5 s or more.
U0121:00	Communication error with DSC HU/CM	The front body control module (FBCM) could not receive CAN signal from the DSC HU/CM for 5 s or more.
U0515:00	SAS control module communication error	The front body control module (FBCM) could not receive CAN signal from the SAS control module for 5 s or more.
U0155:00	Communication error with instrument cluster	The front body control module (FBCM) could not receive CAN signal from the instrument cluster for 5 s or more.
U0164:68*7	Communication error between climate control unit	The front body control module (FBCM) receives error signals from the climate control unit for 5 s or more with the ignition switched ON (engine off or on).
U0214:00	Communication error with start stop unit	The front body control module (FBCM) could not receive CAN signal from the start stop unit for 5 s or more.
U0231:68*2	Communication error with auto-light sensor/ rain sensor	The front body control module (FBCM) receives error signals from the auto-light sensor/rain sensor for 5 s or more with the ignition switched ON (engine off or on).
U023A:00*8	Communication error with forward sensing camera (FSC)	The front body control module (FBCM) could not receive CAN signal from the forward sensing camera (FSC) for 5 s or more.
U0298:68	Communication error with DC-DC converter	The front body control module (FBCM) detects a communication error with the DC-DC converter.
U0338:09	Error signal received from start stop unit	The front body control module (FBCM) receives CAN error signals from the start stop unit 3 times with the ignition switched ON (engine off or on).

CONTROL SYSTEM

DTC	System malfunction location	Detection condition
U0401:68	Error signal received from PCM	The front body control module (FBCM) receives error signals from the PCM for 5 s or more with the ignition switched ON (engine off or on).
U0415:68*9	Error signal received from DSC HU/CM	The front body control module (FBCM) receives error signals from the DSC HU/CM for 5 s or more with the ignition switched ON (engine off or on).
U053B:68*8	Error signal received from forward sensing camera (FSC)	The front body control module (FBCM) receives error signals from the forward sensing camera (FSC) for 5 s or more with the ignition switched ON (engine off or on).
U0599:68	Error signal received from DC-DC converter	The front body control module (FBCM) receives error signals from the DC-DC converter for 5 s or more with the ignition switched ON (engine off or on).
U1007:68	Communication error with current sensor	The front body control module (FBCM) detects communication error with the current sensor for 5 s.
U2005:68	Error signal received from PCM	The front body control module (FBCM) receives vehicle speed signal error from the PCM for 5 s or more with the ignition switched ON (engine off or on).
U2100:00	Front body control module (FBCM) configuration error	Front body control module (FBCM) configuration error detected.
U2101:00	Front body control module (FBCM) configuration error	Front body control module (FBCM) configuration error detected.
U3000:49	Front body control module (FBCM) internal malfunction	Malfunction inside front body control module (FBCM) detected.
U3000:56	Front body control module (FBCM) configuration error	Front body control module (FBCM) configuration error detected.
U3003:16	Front body control module (FBCM) power supply voltage (+B power supply) low input	Front body control module (FBCM) power supply circuit voltage of 9 V or less is detected for 10 s or more with the ignition switched ON (engine off or on).
U3003:17	Front body control module (FBCM) power supply voltage (+B power supply) high input	Front body control module (FBCM) power supply circuit voltage of 14.2 V or more is detected for 10 s or more with the ignition switched ON (engine off or on).
U3006:62	Front body control module (FBCM) power supply voltage mismatch	Any voltage detected at front body control module (FBCM) terminals 2A, 1A, 1B, 3K, and 3L is 3V or less for 5 s or more with the ignition switched ON (engine off or on).

*1 : With headlights (halogen type)
*2 : With auto-light sensor
*3 : With front fog lights
*4 : With headlights (discharge type)
*5 : With headlight cleaner
*6 : ATX
*7 : With manual A/C
*8 : With forward sensing camera (FSC)
*9 : With emergency stop signal system (ESS)

Snapshot data

- The data for all DTCs currently detected is stored.

Snapshot data table

Snapshot data item	Unit		Data contents	Corresponding data monitor items
AAT	°C	°F	Ambient temperature	-
APP_STATUS	Accelerator Pedal Off/Under20%/ Over20%/FAIL		Accelerator pedal position status	-
CFG_STATUS	Config Complete/Not Configured/Config Error		Configuration status	-
ECT_STATUS	Under 0 degrees C/ 0-Under 80 degrees C/ Over 80 degrees C/FAIL		Engine coolant temperature status	-
IC_VPWR	V		Instrument cluster power supply voltage	-
IG-ON_TIMER	hh:mm:ss		Elapsed time since ignition switched ON (engine off or on)	-

CONTROL SYSTEM

Snapshot data item	Unit		Data contents	Corresponding data monitor items
PWR_MODE_KEY	Key Out/Key Recently Out/ Key Approved (Position 0)/ Post Accessory (Position 0)/ Accessory (Position 1)/ Post Ignition (Position 1)/ ignition On (Position 2)/ Running (Position 2)/ Running - Starting In Progress (Position 2)/Crank (Position 3)		Push button start power position switching status	-
RPM_STATUS	Engine Stop/Under1500rpm/ Over1500rpm/FAIL		Engine speed status	-
SHIFT_STATUS	P/N/D/R/FAIL		Selector lever position status	-
TOTAL_DIST	Km	miles	Accumulated total traveled distance since vehicle completion	-
TOTAL_TIME	hh:mm:ss		Accumulated total elapsed time since vehicle completion **Note** • When the ROOM fuse is removed, or the ignition is switched off (LOCK), the time is not included in the elapsed time.	-
VPWR	V		Front body control module (FBCM) power supply malfunction	VPWR_IG
VSPD_STATUS	Stop/ 0-10km/h/ Over10km/h/ FAIL		Vehicle speed status	VSPD

Data monitor function

- With the PID/data monitor function, input/output signal monitor items set in the front body control module (FBCM) can be selected and read out in real-time.

PID/data monitor table

PID	Unit/ Operation	Data contents	Inspection item(s)
ABK_CS_BG	Off/On	• Off: Theft-deterrent system answer-back signal is not received • On: Theft-deterrent system answer-back signal is received	Front body control module (FBCM)
ABK_CS_KEY*1	Off/On	• Off: Advanced keyless entry system answer-back signal is not received • On: Advanced keyless entry system answer-back signal is received	Front body control module (FBCM)
ABK_HN_KEY*1	Off/On	• Off: Keyless beeper answer-back signal is not received • On: Keyless beeper answer-back signal is received	Front body control module (FBCM)
BAT_SOC	%	Battery charge condition is displayed.	Battery
BAT_TMP	°C, °F	Battery temperature is displayed.	Battery
BG_ALARM_CS*2	Off/On	• Off: Theft-deterrent system alarm signal is not received • On: Theft-deterrent system alarm signal is received	Front body control module (FBCM)
BLWR_MT_RY	Off/On	• Off: Blower relay is off • On: Blower relay is on	Blower relay
BRAKE_SW	Off/On	• Off: Brake switch (No. 2) is off (brake pedal is depressed) • On: Brake switch (No. 2) is on (brake pedal is not depressed)	Brake switch
BRK_F_L_SW	Normal/Low/ Reserved/ Unknown	• Normal: Brake fluid level is between MAX and MIN • Low: Brake fluid level is lower than MIN • Reserved: - • Unknown: Brake fluid level is not determined	Brake fluid level sensor
C_IG_OFF	A	Back-up current when ignition is switched off (LOCK) previously is displayed.	Front body control module (FBCM)

CONTROL SYSTEM

PID	Unit/ Operation	Data contents	Inspection item(s)
C_T_IG_OFF	—	Cumulative back-up current (unit: Ah) when ignition is switched off (LOCK) previously is displayed.	Front body control module (FBCM)
C_T_IG_ON	—	Cumulative charging/discharging current (unit: Ah) when ignition is switched ON (engine off or on) is displayed.	Front body control module (FBCM)
DCDC_CVT_ST	Wake_Up/ Bypass/ Boost_1/ Boost_2/ Boost_3/ Error/Default	DC-DC converter status	DC-DC converter
DCDC_VLT_I	V	DC-DC converter input voltage is displayed.	DC-DC converter
DCDC_VLT_O	V	DC-DC converter output voltage is displayed.	DC-DC converter
DEFOG_R_CS	Off/On	• Off: Rear window defroster control signal is not received • On: Rear window defroster control signal is received	Front body control module (FBCM)
ENG_C_TMP	°C, °F	Engine coolant temperature is displayed.	ECT sensor
ESS_ST	Off/On	• Off: ESS is not operated • On: ESS is operated	Front body control module (FBCM)
F_FOG_LMP*3	Off/On	• Off: Front fog light is turned off • On: Front fog light is turned on	Front fog light
F_FOG_SW*3	Off/On	• Off: Front fog light switch is not in F.FOG position • On: Front fog light switch is in F.FOG position	Front fog light switch
H/L	OFF/DRL/ TNS/H/ L_LOW/H/ L_HI	• OFF: Headlight is turned off • DRL: Running light is turned on • TNS: TNS is turned on • H/L_LOW: Headlight (LO) is turned on • H/L_HI: Headlight (HI) is turned on	Headlight
H/L_CLN_RY*4	Off/On	• Off: Headlight cleaner relay is off • On: Headlight cleaner relay is on	Front body control module (FBCM)
H/L_CS_RLS	Off/ TNS_On/ TNS+H/ L_On	• Off: TNS and headlight on request signal is not received from auto-light sensor • TNS_On: TNS on signal is received from auto-light sensor • TNS+H/L_On: TNS and headlight LO on signal is received from auto-light sensor	Auto-light sensor
H/L_HI	Off/On	• Off: Headlight HI is turned off • On: Headlight HI is turned on	Headlight HI
H/L_SW_HI	Off/On	• Off: Light switch is not in HI position • On: Light switch is in HI position	Light switch
H/L_SW_LOW1	Off/On	• Off: Light switch is not in LO position • On: Light switch is in LO position	Light switch
H/L_SW_LOW2	Off/On	• Off: Light switch is not in LO position • On: Light switch is in LO position	Light switch
H/L_SW_OFF	Off/On	• Off: Light switch is not in OFF position • On: Light switch is in OFF position	Light switch
H/L_SW_PASS	Off/On	• Off: Light switch is not in passing position • On: Light switch is in passing position	Light switch
H/L_SW_TNS	Off/On	• Off: Light switch is not in TNS position • On: Light switch in TNS position	Light switch
H/L_TNS	Off/On	• Off: TNS is turned off • On: TNS is turned on	• Parking light • Taillight • License plate light
HAZARD_LMP	Off/On	• Off: Hazard light is turned off • On: Hazard light is flashing	• Front turn light • Side turn lights • Rear turn light

CONTROL SYSTEM

PID	Unit/ Operation	Data contents	Inspection item(s)
HAZARD_SW	Off/On/ Unknown	• Off: Hazard warning switch is not pressed • Off: Hazard warning switch is pressed • Unknown: Hazard warning switch on/off is not determined	Hazard warning switch
HBC_CS*6	Off/On/ Invalid	• Off: High beam control (HBC) system signal is not received • On: High beam control (HBC) system signal is received • Invalid: High beam control (HBC) system signal has error	Forward sensing camera (FSC)
HBC_ST*6	Off/On	• Off: High beam control (HBC) system is not operated • On: High beam control (HBC) system is operated	Forward sensing camera (FSC)
IG_ST	Off/On	• Off: IG1 relay is off • On: IG1 relay is on	IG1 relay
L_OFF_AUTO	Off/On	• Off: TNS or headlight off control by auto-light off system is not operated • On: TNS or headlight off control by auto-light off system is operated	Front body control module (FBCM)
L_OFF_BS	Off/On	• Off: TNS or headlight off control by front combination light fail-safe function is not operated • On: TNS or headlight off control by front combination light fail-safe function is operated	Front body control module (FBCM)
OIL_P_SW	Off(Normal)/ On(Low)	• Off: Hydraulic pressure is normal • On: Hydraulic pressure is low	Oil pressure switch
OUT_CAR_TMP	°C, °F	Ambient temperature is displayed.	Ambient temperature sensor
P_BRAKE_SW	Off/On	• Off: Parking brake switch is off (parking brake lever is not pulled) • On: Parking brake switch is on (parking brake lever is pulled)	Parking brake switch
PNC_CS	Off/On	• Off: Panic control signal is not received • On: Panic control signal is received	Front body control module (FBCM)
R_FOG_LMP*7	Off/On	• Off: Rear fog light is turned off • On: Rear fog light is turned on	Rear fog light
R_FOG_SW*7	Off/On	• Off: Rear fog light switch is not in R.FOG position • On: Rear fog light switch is in R.FOG position	Rear fog light switch
RLS_FLT*5	O.K./FAULT	• OK: Rain sensor is normal • FAULT: Rain sensor has a malfunction	Rain sensor
S_HT_CUT*8	No_Request /Cut	• No_Request: Except below • Cut: Seat warmer is turned off or lowered	Seat warmer control unit
SHIFT_L_POS*9	Between/P/ R/N/D/S(2)// L(1)	• Between: Selector lever is between two positions • P: Selector lever is in P position • R: Selector lever is in R position • N: Selector lever is in N position • D: Selector lever is in D position • S (2): Selector lever is in D position 2nd gear • L (1): Selector lever is in D position 1st gear	TCM
TURN_L_L	Off/On	• Off: Turn light (LH) is turned off • On: Turn light (LH) is turned on	• Front turn light • Side turn lights • Rear turn light
TURN_L_R	Off/On	• Off: Turn light (RH) is turned off • On: Turn light (RH) is turned on	• Front turn light • Side turn lights • Rear turn light
TURN_SW	Off/ Turn_R_On/ Turn_L_On/ Unknown	• Off: Turn switch is in OFF position • Turn_R_On: Turn switch is in RH position • Turn_L_On: Turn switch is in LH position • Unknown: Turn switch position is not determined	Turn Switch
VPWR_B	V	Front body control module (FBCM) power supply voltage is displayed.	Front body control module (FBCM)
VSPD	KPH, MPH	Displays the vehicle speed.	—
WAS_FLUID_L*10	Normal/Low/ Reserved/ Unknown	• Normal: Washer fluid level is normal • Low: Washer fluid level is low • Reserved: - • Unknown: Washer fluid level is not determined	Washer fluid-level sensor

CONTROL SYSTEM

PID	Unit/ Operation	Data contents	Inspection item(s)
WAS_MT_RY_F	Off/On	• Off: Front washer motor relay is off • On: Front washer motor relay is on	Front body control module (FBCM)
WAS_MT_RY_R	Off/On	• Off: Rear washer motor relay is off • On: Rear washer motor relay is on	Front body control module (FBCM)
WASHER_F	Off/On	• Off: Front washer switch is off • On: Front washer switch is on	Windshield washer switch
WASHER_R	Off/On	• Off: Rear wiper and washer switch is not in rear washer position • On: Rear wiper and washer switch is in rear washer position	Rear wiper and washer switch
WIP_CS_RLS*5	Off/ Single_Wipe / F_Wiper_LOW/ F_Wiper_HI/ Failure	• Off: Wiper operation signal is not received from rain sensor • Single_Wipe: Signal to operate wiper once is received from rain sensor • F_Wiper_LOW: Signal to operate wiper at low speed is received from rain sensor • F_Wiper_HI: Signal to operate wiper at high speed is received from rain sensor • Failure: Communication with rain sensor is failed	Rain sensor
WIP_F	OFF/LOW/ HI/INT / AUTO	• OFF: Windshield wiper switch is in OFF position • LOW: Windshield wiper switch is in LO position • HI: Windshield wiper switch is in HI position • INT / AUTO: Windshield wiper switch is in INT or AUTO position	Windshield wiper switch
WIP_F_INT_L	%	Windshield wiper INT level is displayed.	Windshield wiper switch
WIP_F_LOW	Off/On	• Off: Windshield wiper switch is not in LO position • On: Windshield wiper switch is in LO position	Windshield wiper switch
WIP_F_MST	Stop/Move	• Stop: Autostop switch is on • Move: Autostop switch is off	Windshield wiper motor
WIP_F_RY_HI	Off/On	• Off: Windshield wiper high relay is off • On: Windshield wiper high relay is on	Front body control module (FBCM)
WIP_F_RY_LO	Off/On	• Off: Windshield wiper low relay is off • On: Windshield wiper low relay is on	Front body control module (FBCM)
WIP_R	OFF/LOW/ INT	• OFF: Rear wiper switch is in OFF position • LOW: Rear wiper switch is in ON position • INT: Rear wiper switch is in INT position	Rear wiper switch
WIP_R_RY	Off/On	• Off: Rear wiper motor is not operated • On: Rear wiper motor is operated	Rear wiper motor

*1 : With advanced keyless entry system
*2 : With theft-deterrent system
*3 : With front fog lights
*4 : With headlight cleaner
*5 : With auto-light sensor
*6 : With high beam control (HBC) system
*7 : With rear fog light
*8 : With seat warmer
*9 : ATX
*10 : With washer fluid-level sensor

Active Command Modes Function

- The active command modes are shown below.

Simulation item	Unit/ Operation	Data contents	Output part name
DEFOG_R_ST	Off/On	• Off: Stops rear window defroster. • On: Operates rear window defroster.	Front body control module (FBCM)
ESS_ST	Off/On	• Off: Stops ESS. • On: Operates ESS.	Front body control module (FBCM)
F_FOG_LMP*1	Off/On	• Off: Turns off front fog light. • On: Illuminates front fog light.	Front fog light

CONTROL SYSTEM

Simulation item	Unit/ Operation	Data contents	Output part name
H/L	OFF/DRL/ TNS/H/ L_LOW/H/ L_HI	• Off: Turns off headlights. • DRL: Illuminates running light. • TNS: Illuminates TNS. • H/L_LOW: Illuminates headlights LO. • H/L_HI: Illuminates headlights HI.	Headlight
H/ L_CLN_RY*2	Off/On	• Off: Turns headlight cleaner relay off. • On: Turns headlight cleaner relay on.	Front body control module (FBCM)
HAZARD_L MP	Off/On	• Off: Turns off hazard warning light. • On: Flashes hazard warning light.	• Front turn light • Side turn lights • Rear turn light
WAS_MT_R Y_F	Off/On	• Off: Turns front washer motor relay off. • On: Turns front washer motor relay on.	Front body control module (FBCM)
WAS_MT_R Y_R	Off/On	• Off: Turns rear washer motor relay off. • On: Turns rear washer motor relay on.	Front body control module (FBCM)

*1 : With front fog lights
*2 : With headlight cleaner

REAR BODY CONTROL MODULE (RBCM)

id094000002600

Outline

- Positioned at the rear of the vehicle, the rear body control module (RBCM) performs numerous system controls for functions at the vehicle rear.

Function

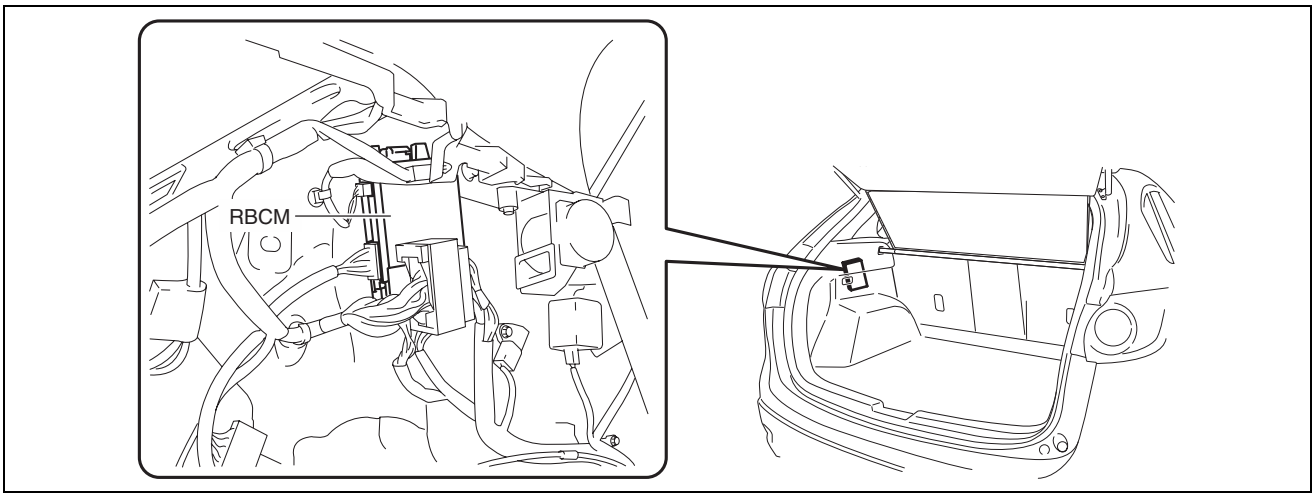
- The rear body control module (RBCM) controls the system based on the input/output signals.
- The functions which are controlled are as follows:

Control table

Control	Content	Reference
Interior light control system control	The rear body control module (RBCM) changes the illumination condition and illumination level of the interior light (door position) according to whether the doors are opened/closed.	(See 09-18-83 INTERIOR LIGHTING SYSTEM.)
Back-up light control	The back-up light illuminates in conjunction with the shift operation.	(See 09-18-72 REAR COMBINATION LIGHT.)
Power door lock system control	A power door lock system has been adopted in which all doors and the liftgate are locked/unlocked when the driver's door is locked/unlocked using the driver's door lock knob, or the door key cylinder is operated.	(See 09-14-8 POWER DOOR LOCK SYSTEM.)
Rear wiper system control	Equipped with continuous, auto-stop, intermittent wiper, and synchronized washer and wiper operation.	(See 09-19-26 REAR WIPER SYSTEM.)
Rear fog light system control	The rear fog light illuminates in conjunction with the operating light switch and the rear fog light switch.	(See 09-18-77 REAR FOG LIGHT.)
Liftgate opener system control	A liftgate opener system has been adopted in which the liftgate can be opened just by pressing the liftgate opener switch.	(See 09-14-28 LIFTGATE OPENER SYSTEM.)
CAN (Controller Area Network)	Sends and receives signals between CAN system-related modules using the CAN system.	(See 10-40-1 CONTROLLER AREA NETWORK (CAN) SYSTEM.)
ON-BOARD DIAGNOSTIC SYSTEM	The rear body control module (RBCM) is equipped with an on-board diagnosis function which records DTCs in the event of a malfunction.	(See 09-40-25 ON-BOARD DIAGNOSTIC SYSTEM [REAR BODY CONTROL MODULE (RBCM)].)

CONTROL SYSTEM

Structural view



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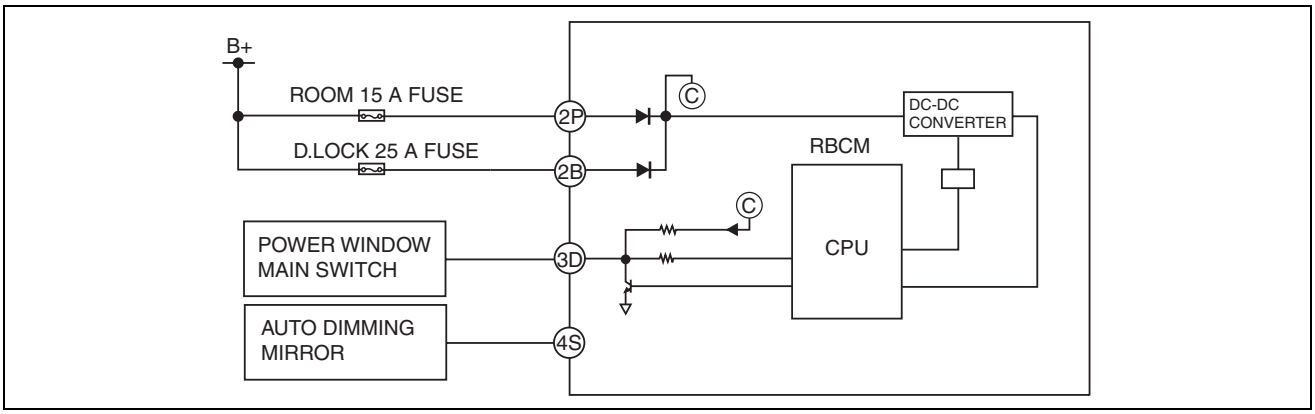
System wiring diagram
Power window system, Auto dimming mirror



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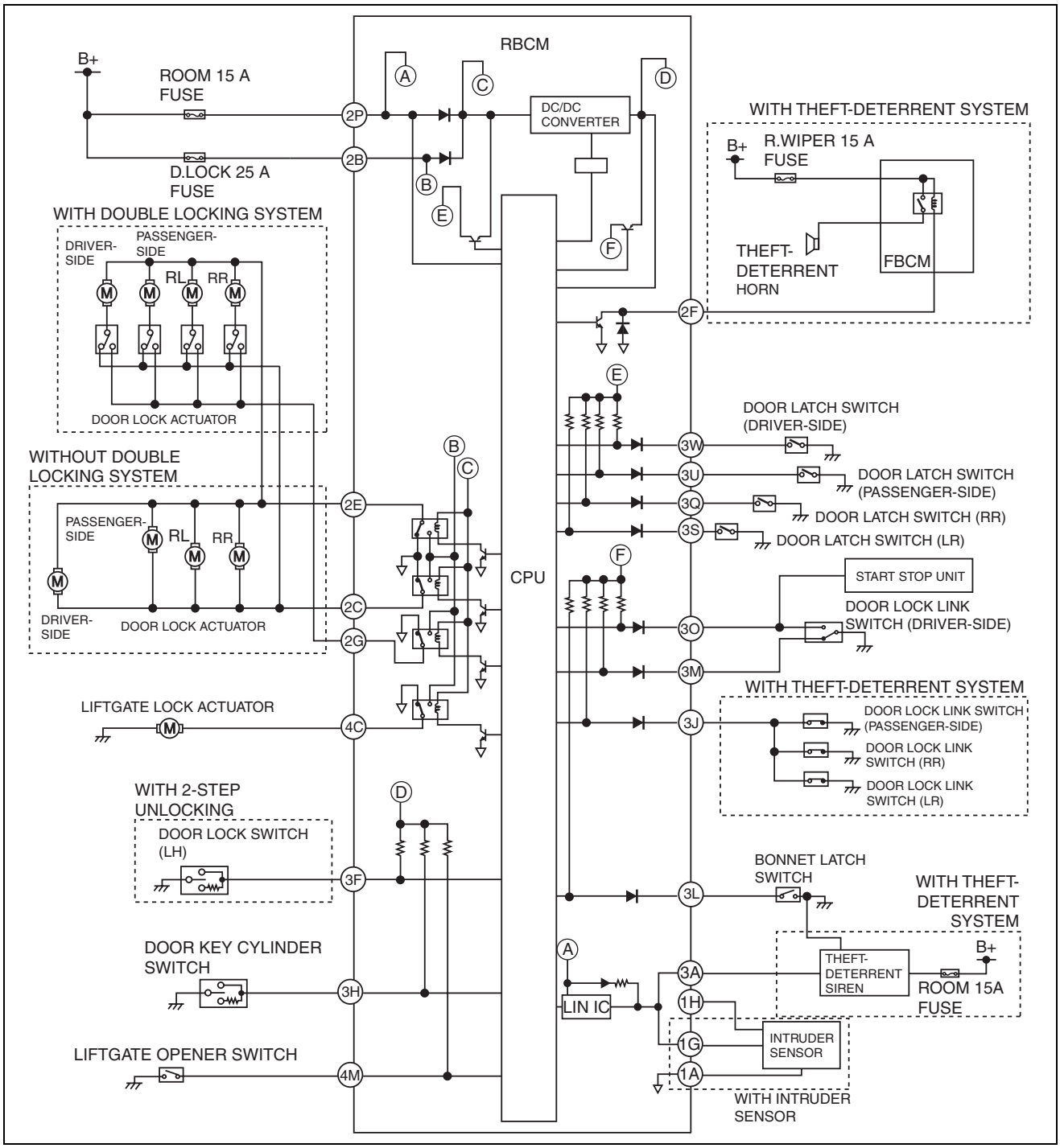
CONTROL SYSTEM

Power door lock system, theft-deterrent system



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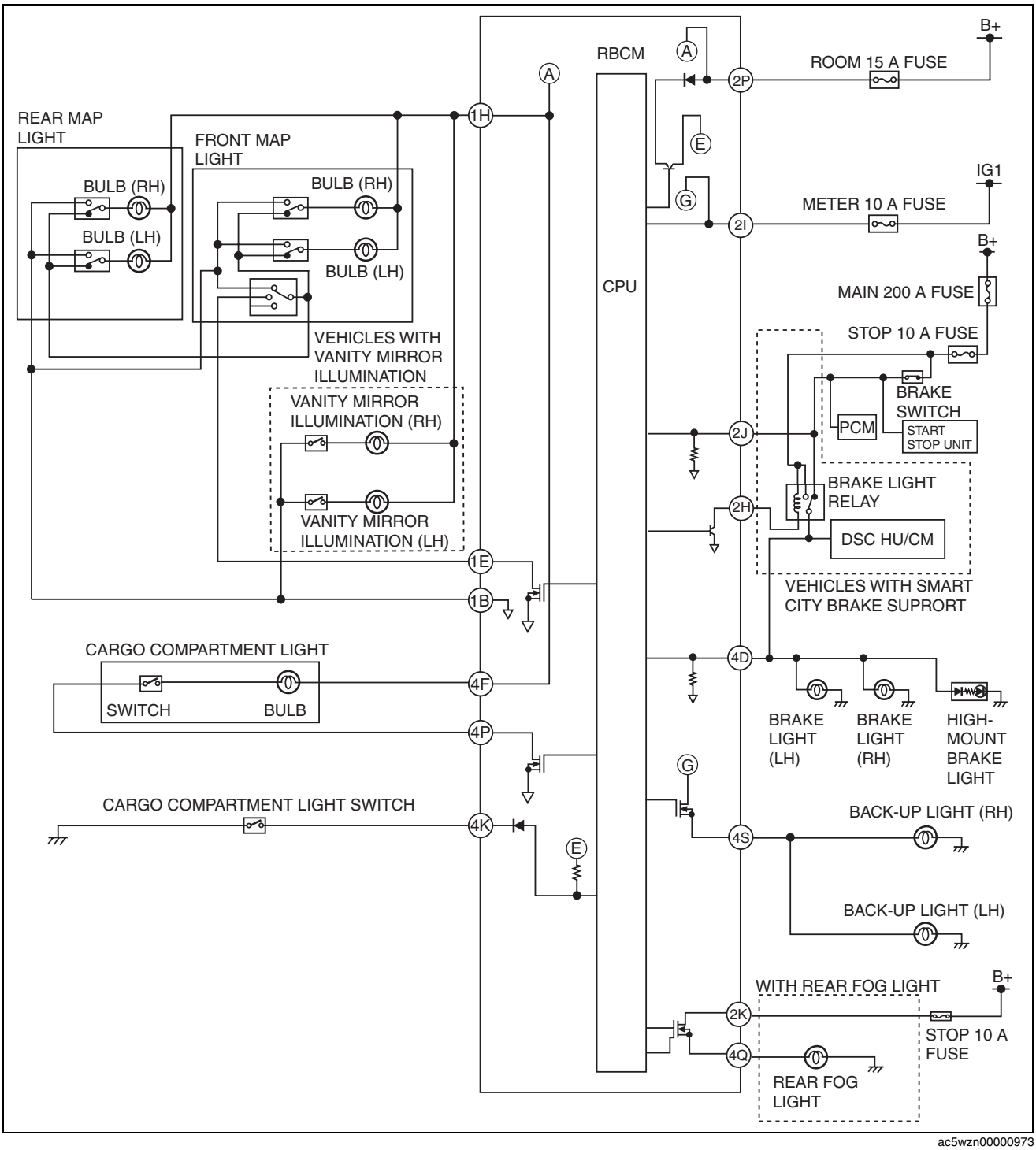
CONTROL SYSTEM

Room lights, brake light, rear fog light system



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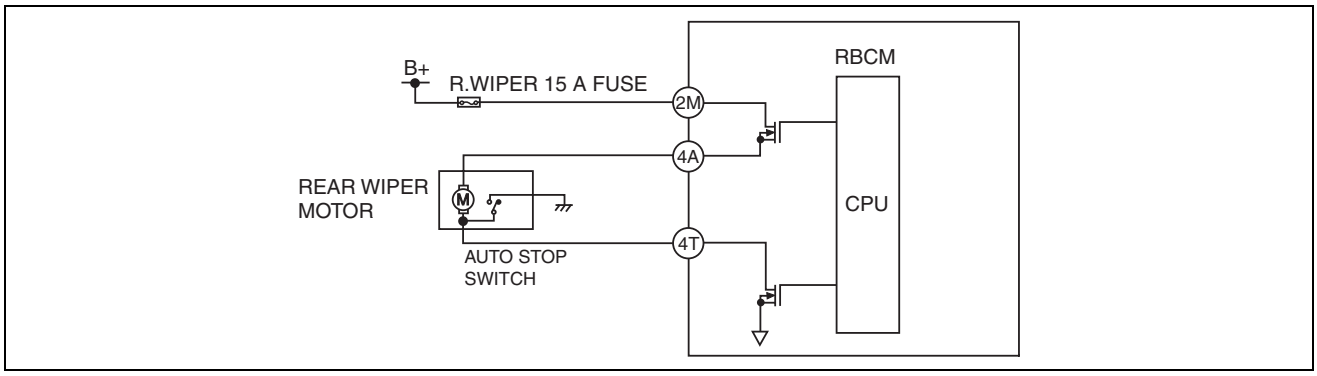
CONTROL SYSTEM

Rear wiper system



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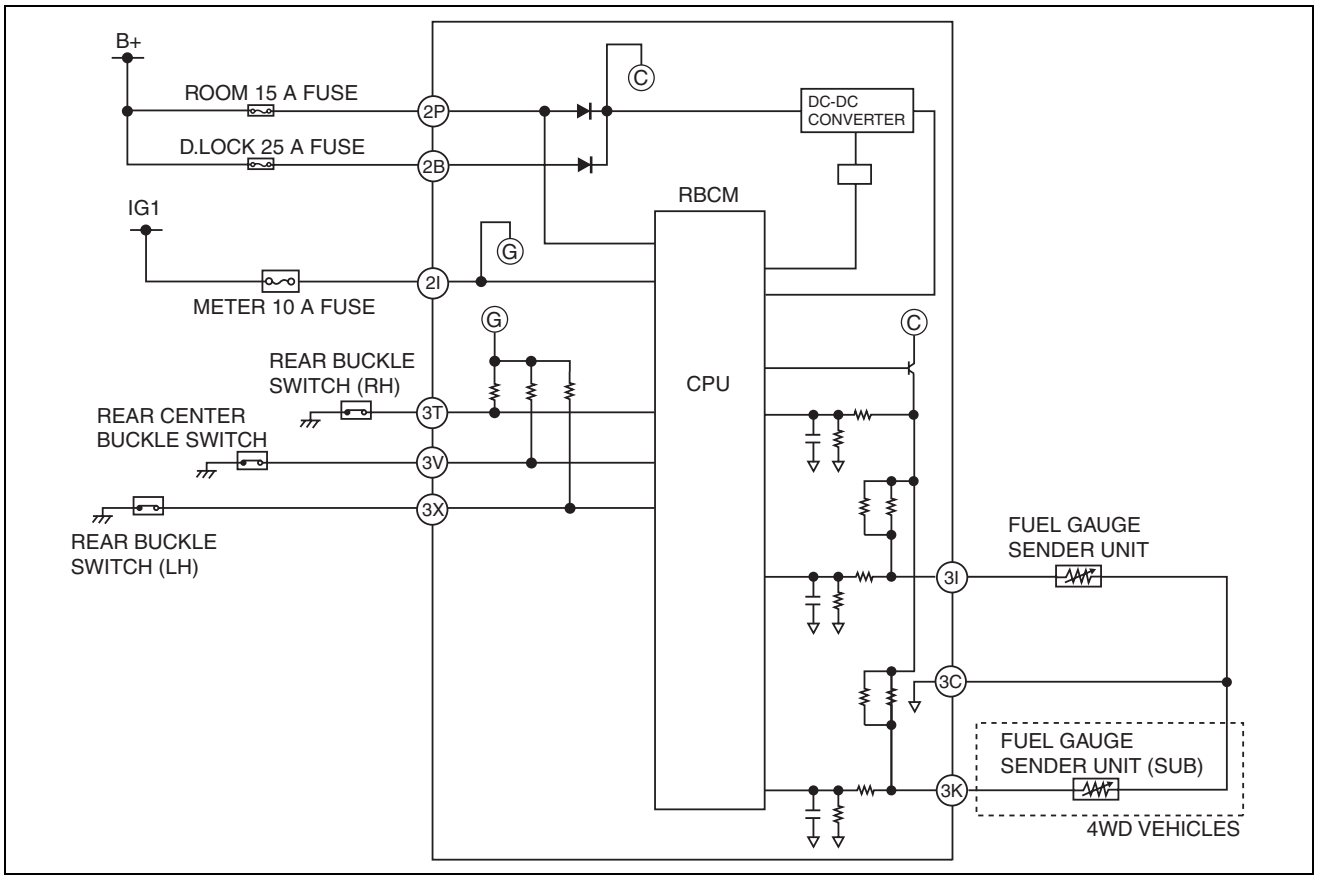
Fuel-level sensor, rear seat belt reminder system



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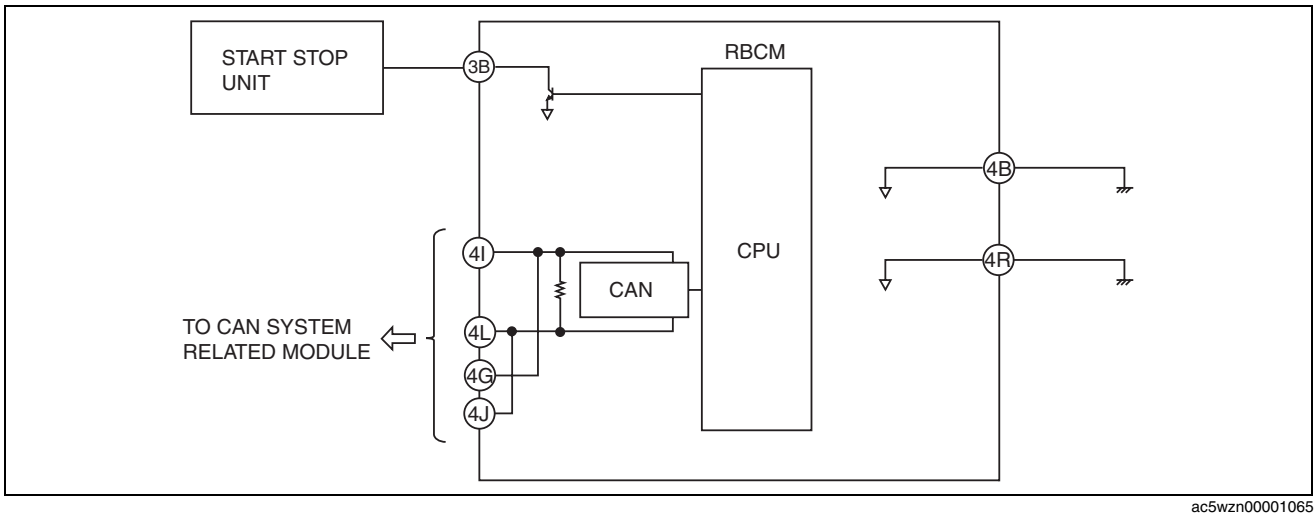
CONTROL SYSTEM

CAN system



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Fail-safe

Room light control system

- If an error is detected in a combination of the door lock-link switch signals, the rear body control module (RBCM) controls the interior light based on the signal before the error occurred.
- If the CAN signal cannot be received normally, the rear body control module (RBCM) controls the interior light based on the signal last received. If the CAN signal cannot be received normally for 5 s or more, the rear body control module (RBCM) stops the interior light control.

Back-up light

- Function not equipped.

Power door lock system

- Function not equipped.

Rear wiper system

- If the CAN signal cannot be received normally, the rear body control module (RBCM) controls the rear wiper based on the signal last received. If the CAN signal cannot be received normally for 5 s or more, the rear body control module (RBCM) stops the rear wiper control.

Liftgate opener system

- If the CAN signal cannot be received normally, the liftgate open operation is inhibited.

Theft-deterrent system

- Function not equipped.

Rear fog light system

- Function not equipped.

ON-BOARD DIAGNOSTIC SYSTEM [REAR BODY CONTROL MODULE (RBCM)]

id094000002800

Outline

- The on-board diagnostic function consists of the following functions: A malfunction detection function, which detects overall malfunctions in the rear body control module (RBCM)-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunction locations and status via DTC output; and a PID/data monitoring function, which reads out specific input/output signals and verifies the input/output condition.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.

CONTROL SYSTEM

Malfunction detection function

- Detects malfunctions in input/output signals.
- If a malfunction occurs, the rear body control module (RBCM) records the malfunction as a DTC. A recorded DTC can be read by the Mazda Modular Diagnostic System (M-MDS).

×: Applicable
—: Not applicable

DTC No.	Warning/ indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
B1079:13	—	Bonnet switch circuit malfunction	—	—	D	—
B108F:16	—	Door lock switch circuit malfunction	—	—	D	—
B109E:87	—	Communication error with start stop unit	—	—	C, D	×
B109F:49*2	—	Intruder sensor internal malfunction	—	—	C, D	×
B109F:86*2	—	Error signal received from intruder sensor	—	—	C, D	×
B109F:87*2	—	Communication error with intruder sensor	—	—	C, D	×
B10A5:49*2	—	Theft-deterrent siren internal malfunction	—	—	C, D	×
B10A5:86*2	—	Error signal received from theft-deterrent siren	—	—	C, D	×
B10A5:87*2	—	Communication error with theft-deterrent siren	—	—	C, D	×
B113E:11	—	Liftgate opener switch circuit malfunction	—	—	D	—
B1172:11	—	Front door lock-link switch (driver's side) unlock circuit malfunction	—	—	D	—
B1172:13	—	Front door lock-link switch (driver's side) unlock circuit malfunction	—	—	D	—
B1174:11*3	—	Front door lock-link switch (passenger's side)/Rear door lock-link switch (LH)/(RH) unlock circuit malfunction	—	—	D	—
B1174:13*3	—	Front door lock-link switch (passenger's side)/Rear door lock-link switch (LH)/(RH) unlock circuit malfunction	—	—	D	—
B1175:11	—	Front door latch switch (driver's side) circuit malfunction	—	—	D	—
B1176:11	—	Front door latch switch (passenger's side) circuit malfunction	—	—	D	—
B1178:11	—	Liftgate latch switch circuit malfunction	—	—	D	—
B11DA:16	—	Front door key cylinder switch circuit malfunction	—	—	D	—
B11E9:11	—	Rear door latch switch (LH) circuit malfunction	—	—	D	—
B11EA:11	—	Rear door latch switch (RH) circuit malfunction	—	—	D	—
B126A:11	—	Front door lock-link switch (driver's side) lock circuit malfunction	—	—	D	—
B126A:13	—	Front door lock-link switch (driver's side) lock circuit malfunction	—	—	D	—
B1A79:13*3	—	Rear fog light circuit malfunction	—	—	C, D	×
C0023:14*4	—	Rear body control module (RBCM) internal malfunction (brake light drive circuit)	—	—	C, D	×
U0010:88	—	Unit communication error (MS-CAN)	—	—	C, D	×
U0155:00	—	Communication error with instrument cluster	—	—	C, D	×
U0447:86*3	—	Communication error between front body control module (FBCM) and instrument cluster	—	—	C, D	×
U2100:00	—	Rear body control module (RBCM) configuration error	—	—	C, D	×
U3000:49	—	Rear body control module (RBCM) internal malfunction	—	—	C, D	×

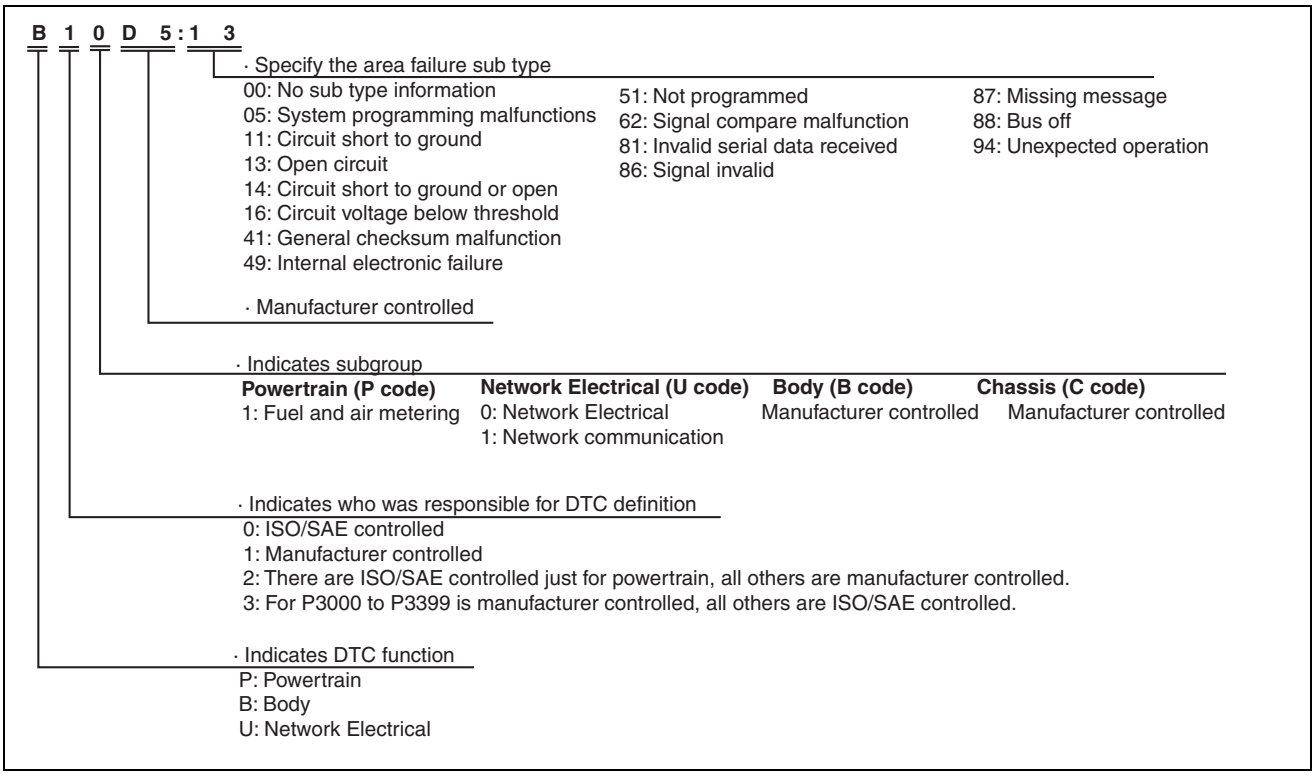
CONTROL SYSTEM

DTC No.	Warning/ indicator light	Description	Fail-safe function	Drive cycle	Self test type*1	Memory function
U3003:16	—	Rear body control module (RBCM) power supply voltage low input	—	—	C, D	×

*1 : C: CMDTC self test, D:ODDTC self test
*2 : With theft-deterrent system
*3 : With rear fog light
*4 : With smart city brake support

DTC 7-digit code definition

- When related systems or components have failed, the CM stores the DTC of the malfunctioning part in the CM memory, and allows for the retrieval of the store data using scanning tool when necessary. The DTCs are indicated using seven digits. Each digit indicates the following.



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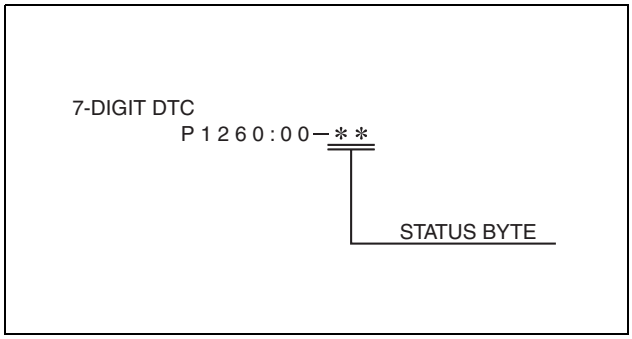
Status byte for DTC

- The status byte is the two digits (after hyphen) after the 7-digit DTC.
- The status byte is a code which indicates the pending code, current/past malfunction status, or warning illumination status.
- The status byte can be read by performing a CMDTC self-test using the Mazda Modular Diagnostic System (M-MDS).
- For details on the status byte, refer to the explanation on the Mazda Modular Diagnostic System (M-MDS) when reading the DTC.



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CONTROL SYSTEM

Detection condition for the applicable DTC

×: Applicable
—: Not applicable

DTC	System malfunction location	Detection condition
B1079:13	Bonnet switch circuit malfunction	Rear body control module (RBCM) detects open circuit in bonnet latch switch circuit.
B108F:16	Door lock switch circuit malfunction	With the door lock switch off, the rear body control module (RBCM) detects door lock switch circuit voltage of 4 V or less.
B109E:87	Communication error with start stop unit	Rear body control module (RBCM) detects communication error with start stop unit for 10 times continuously.
B109F:49*1	Intruder sensor internal malfunction	Rear body control module (RBCM) detects intruder sensor internal malfunction.
B109F:86*1	Error signal received from intruder sensor	Rear body control module (RBCM) receives error signal from intruder sensor for 1.5 s or more.
B109F:87*1	Communication error with intruder sensor	Rear body control module (RBCM) cannot receive signal from intruder sensor for 1.5 s or more.
B10A5:49*1	Theft-deterrent siren internal malfunction	Rear body control module (RBCM) detects theft-deterrent siren internal malfunction.
B10A5:86*1	Error signal received from theft-deterrent siren	Rear body control module (RBCM) receives error signal from theft-deterrent siren for 1.5 s or more.
B10A5:87*1	Communication error with theft-deterrent siren	Rear body control module (RBCM) cannot receive signal from theft-deterrent siren for 1.5 s or more.
B113E:11	Liftgate opener switch circuit malfunction	Rear body control module (RBCM) detects short to ground in liftgate opener switch circuit
B1172:11	Front door lock-link switch (driver's side) unlock circuit malfunction	With the front door lock-link switch (driver's side) locked, the rear body control module (RBCM) detects a short to ground in the front door lock-link switch (driver's side) unlock circuit.
B1172:13	Front door lock-link switch (driver's side) unlock circuit malfunction	Rear body control module (RBCM) detects open circuit in front door lock-link switch (driver's side) unlock side circuit with front door lock-link switch (driver's side) unlocked
B1174:11*1	Front door lock-link switch (passenger's side)/Rear door lock-link switch (LH)/(RH) unlock circuit malfunction	With the front door lock-link switch (passenger's side)/rear door lock link switch (LH)/(RH) locked, the rear body control module (RBCM) detects a short to ground in the door lock-link switch unlock circuit.
B1174:13*1	Front door lock-link switch (passenger's side)/Rear door lock-link switch (LH)/(RH) unlock circuit malfunction	With the front door lock-link switch (passenger's side)/rear door lock link switch (LH)/(RH) unlocked, the rear body control module (RBCM) detects an open circuit in the door lock-link switch unlock circuit.
B1175:11	Front door latch switch (driver's side) circuit malfunction	With the front door (driver's side) closed (front door latch switch (driver's side) off, the rear body control module (RBCM) detects a short to ground in the front door latch switch (driver's side) circuit.
B1176:11	Front door latch switch (passenger's side) circuit malfunction	With the front door (passenger's side) closed (front door latch switch (passenger's side) off, the rear body control module (RBCM) detects a short to ground in the front door latch switch (passenger's side) circuit.
B1178:11	Liftgate latch switch circuit malfunction	With the liftgate closed (liftgate latch switch off), rear body control module (RBCM) detects short to ground in liftgate latch switch circuit.
B11DA:16	Front door key cylinder switch circuit malfunction	With the front door key cylinder switch (driver's side) off, the rear body control module (RBCM) detects front door key cylinder switch (driver's side) voltage of 4 V or less.
B11E9:11	Rear door latch switch (LH) circuit malfunction	With the rear door (LH) closed (rear door latch switch (LH) off), the rear body control module (RBCM) detects a short to ground in the rear door latch switch (LH) cylinder.
B11EA:11	Rear door latch switch (RH) circuit malfunction	With the rear door (RH) closed (rear door latch switch (RH) off), the rear body control module (RBCM) detects a short to ground in the rear door latch switch (RH) cylinder.
B126A:11	Front door lock-link switch (driver's side) lock circuit malfunction	With the front door lock-link switch (driver's side) unlocked, the rear body control module (RBCM) detects a short to ground in the front door lock-link switch (driver's side) lock circuit.
B126A:13	Front door lock-link switch (driver's side) lock circuit malfunction	Rear body control module (RBCM) detects open circuit in front door lock-link switch (driver's side) lock side circuit with front door lock-link switch (driver's side) locked.

CONTROL SYSTEM

DTC	System malfunction location	Detection condition
B1A79:13*2	Rear fog light circuit malfunction	Rear body control module (RBCM) detects open circuit in rear fog light circuit.
C0023:14*3	Rear body control module (RBCM) internal malfunction (brake light drive circuit)	Rear body control module (RBCM) detects open circuit in brake light circuit.
U0010:88	Unit communication error (MS-CAN)	Rear body control module (RBCM) detects open circuit in brake light circuit.
U0155:00	Communication error with instrument cluster	The Rear body control module (RBCM) cannot receive CAN signals from the instrument cluster for 5 s or more with the ignition switched ON (engine off or on).
U0447:86*2	Communication error between front body control module (FBCM) and instrument cluster	The rear body control module (RBCM) receives error signals from the instrument cluster for 10 s or more continuously with the ignition switched ON (engine off or on).
U2100:00	Rear body control module (RBCM) configuration error	Rear body control module (RBCM) configuration error detected.
U3000:49	Rear body control module (RBCM) internal malfunction	Malfunction inside rear body control module (RBCM) detected.
U3003:16	Rear body control module (RBCM) power supply voltage low input	Rear body control module (RBCM) power supply circuit voltage of 5 V or more, less than 9 V is detected for 10 s or more.

*1 : With theft-deterrent system
*2 : With rear fog light
*3 : With smart city brake support

Snapshot data

- The data for all DTCs currently detected is stored.

Snapshot data table

Snapshot data item	Unit		Data contents	Corresponding data monitor items
AAT	°C	°F	Ambient temperature	-
APP_STATUS	Accelerator Pedal Off/Under20%/ Over20%/FAIL		Accelerator pedal position status	-
CFG_STATUS	Config Complete/Not Configured/Config Error		Configuration status	-
ECT_STATUS	Under 0 degrees C/ 0-Under 80 degrees C/ Over 80 degrees C/FAIL		Engine coolant temperature status	-
IC_VPWR	V		Instrument cluster power supply voltage	-
IG-ON_TIMER	hh:mm:ss		Elapsed time since ignition switched ON (engine off or on)	-
PWR_MODE_KEY	Key Out/Key Recently Out/ Key Approved (Position 0)/ Post Accessory (Position 0)/ Accessory (Position 1)/ Post Ignition (Position 1)/ ignition On (Position 2)/ Running (Position 2)/ Running - Starting In Progress (Position 2)/Crank (Position 3)		Push button start power position switching status	-
RPM_STATUS	Engine Stop/Under1500rpm/ Over1500rpm/FAIL		Engine speed status	-
SHIFT_STATUS	P/N/D/R/FAIL		Selector lever position status	-
TOTAL_DIST	Km	miles	Accumulated total traveled distance since vehicle completion	-
TOTAL_TIME	hh:mm:ss		Accumulated total elapsed time since vehicle completion **Note** • When the ROOM fuse is removed, or the ignition is switched off (LOCK), the time is not included in the elapsed time.	-
VPWR	V		Rear body control module (RBCM) power supply malfunction	VPWR_IG

CONTROL SYSTEM

Snapshot data item	Unit	Data contents	Corresponding data monitor items
VSPD_STATUS	Stop/ 0-10km/h/ Over10km/h/ FAIL	Vehicle speed status	VSPD

Data monitor function

- With the PID/data monitor function, input/output signal monitor items set in the rear body control module (RBCM) can be selected and read out in real-time.

PID/data monitor table

—: Not applicable

PID	Unit/ Operation	Data contents	Inspection item(s)
AT_DL_IG	Off/On	• Off: Door lock actuator does not operate to unlock in conjunction with ignition off • On: Door lock actuator operates to unlock in conjunction with ignition off	Door lock actuator
AT_DL_SHIFT	Off/On	• Off: Door lock actuator does not operate to unlock in conjunction with shifting • On: Door lock actuator operates to unlock in conjunction with shifting	Door lock actuator
AT_DL_VSPD	Off/On	• Off: Door lock actuator does not operate to unlock in conjunction with vehicle speed • On: Door lock actuator operates to unlock in conjunction with vehicle speed	Rear body control module (RBCM)
BG_HORN_RLY*1	Off/On	• Off: Theft-deterrent horn relay is off • On: Theft-deterrent horn relay is on	Theft-deterrent horn relay
BRAKE_SW*4	Off/On	• Off: Brake switch (No. 1 signal) is off (brake pedal is not depressed) • On: Brake switch (No. 1 signal) is on (brake pedal is depressed)	Brake switch
C_DL_SW_LK*5	Off/On	• Off: Door lock switch is not in lock • On: Door lock switch is in lock	Door lock switch
C_DL_SW_UNL*5	Off/On	• Off: Door lock switch is not in unlock • On: Door lock switch is in unlock	Door lock switch
CNT_S_COMM	—	Count number of serial communication signal received from start stop unit is displayed. **Note** • Display returns to 0 if the number of times exceeds 15.	start stop unit
DL_MT_A_LK	Off/On	• Off: All door lock actuators are not operated to lock • On: All door lock actuators are operated to lock	Door lock actuator
DL_MT_A_UNL	Off/On	• Off: All door lock actuators are not operated to unlock • On: All door lock actuators are operated to unlock	Door lock actuator
DL_MT_S-LK	Off/On	• Off: Double locking system is not operated • On: Double locking system is operated	Door lock actuator
DOOR_ALL	Close/ OPEN	• Close: All doors are closed • OPEN: Any door is open	Door latch switch
DOOR_D	Close/ OPEN	• Close: Driver's door is closed • OPEN: Driver's door is open	Front door latch switch (driver's door)
ELAT_MT_RLY	Off/On	• Off: E latch motor relay is off • On: E latch motor relay is on	Liftgate Latch And Lock Actuator
ELAT_UNL	Off/On	• Off: Liftgate latch is not operated to unlock • Off: Liftgate latch is operated to unlock	Liftgate Latch And Lock Actuator
FUEL_SEN_M*8	V	Fuel gauge sender unit input voltage is displayed.	Fuel gauge sender unit
FUEL_SEN_S	V	Fuel gauge sender unit (SUB) input voltage is displayed.	Fuel gauge sender unit (SUB)

CONTROL SYSTEM

PID	Unit/ Operation	Data contents	Inspection item(s)
FUEL_SEN _SV	V	Fuel gauge sender unit power supply voltage is displayed.	• Fuel gauge sender unit • Fuel gauge sender unit (SUB)
HOOD*6	Close/ OPEN	• Close: Bonnet is closed • OPEN: Bonnet is open	Bonnet switch
IG1_SW	Off/On	• Off: IG1 relay is off • On: IG1 relay is on	IG1 relay
KC_SW_D_ LK	Off/On	• Off: Front door key cylinder switch is not in lock • On: Front door key cylinder switch is in lock	Front door key cylinder switch
KC_SW_D_ UNL	Off/On	• Off: Front door key cylinder switch is not in unlock • On: Front door key cylinder switch is in unlock	Front door key cylinder switch
LL_P/R*2	Unlock/ Other	• Unlock: Front door lock-link switch (passenger's side), rear door lock-link switch (LH), rear door lock-link switch (RH) are in unlock • Other: Front door lock-link switch (passenger's side), rear door lock-link switch (LH), rear door lock-link switch (RH) are other than unlock.	• Front door lock-link switch (passenger's door) • Rear door lock-link switch (LH) • Rear door lock-link switch (RH)
LL_SW_D_ LK	Off/On	• Off: Front door lock-link switch (driver's side) is in unlock • On: Front door lock-link switch (driver's side) is in lock	Front door lock-link switch (driver's door)
LL_SW_D_ UNL	Off/On	• Off: Front door lock-link switch (driver's side) is in lock • On: Front door lock-link switch (driver's side) is in unlock	Front door lock-link switch (driver's door)
R_FOG_L_ CS*3	Off/On	• Off: Rear fog light on signal is not received • On: Rear fog light on signal is received	Front body control module (FBCM)
R_FOG_LM P*3	Off/On	• Off: Rear fog light is turned off • On: Rear fog light is turned on	Rear fog light
R_LMP	Off/On	• Off: Back-up light is turned off • On: Back-up light is turned on	Back-up light
R_LMP_CS	Off/On/ Unknown/ Fault	• Off: Back-up light off signal is received • On: Back-up light on signal is received • Unknown: Back-up light off signal not determined • Fault: Communication with instrument cluster is failed	• Instrument cluster • Back-up light
R_WIP_MT _LO	Off/On	• Off: Rear wiper motor is not operated • On: Rear wiper motor is operated	Rear wiper motor
ROOM_LM P	Off/On	• Off: Map light is turned off • On: Map light is turned on	• Front map light • Rear map light
SEAT_B_2C *7	Unbuckled/ Buckled	• Unbuckled: Second-row center seat belt is not fastened • Buckled: Second-row center seat belt is fastened	Rear center buckle switch
SEAT_B_2L *7	Unbuckled/ Buckled	• Unbuckled: Second-row left-side seat belt is not fastened • Buckled: Second-row left-side seat belt is fastened	Rear buckle switch (LH)
SEAT_B_2R *7	Unbuckled/ Buckled	• Unbuckled: Second-row right-side seat belt is not fastened • Buckled: Second-row right-side seat belt is fastened	Rear buckle switch (RH)
STOP_LMP* 4	Off/On	• Off: Brake light is turned off • On: Brake light is turned on	Brake light
STOP_LMP _CS*4	Off/On	• Off: Brake light off signal is received • On: Brake light on signal is received	• Instrument cluster • Brake light
T_ROOM_L MP	Off/On	• Off: Cargo compartment light is turned off • On: Cargo compartment light is turned on	Cargo compartment light
T_UNL_SW	Off/On	• Off: Liftgate opener switch is not pressed • On: Liftgate opener switch is pressed	Liftgate opener switch
TRUNK	Close/ OPEN	• Close: Liftgate is closed • OPEN: Liftgate is open	Liftgate latch switch
VPWR_B_R	V	Voltage at rear body control module (RBCM) terminal 2P (+B power supply) is displayed.	Battery
VPWR_IG1	V	Voltage at rear body control module (RBCM) terminal 2I (IG1 power supply) is displayed.	• IG1 relay • Battery

*1 : With theft-deterrent system
*2 : With double locking system
*3 : With rear fog light
*4 : With smart city brake support

CONTROL SYSTEM

*5 : With door lock switch
*6 : With bonnet switch
*7 : With rear seat belt buckle switch
*8 : With 4WD vehicles

Active Command Modes Function

- The active command modes are shown below.

Simulation item	Unit/ Operation	Data contents	Output part name
BG_HORN_RLY*1	Off/On	• Off: Stops theft-deterrent horn. • On: Sounds the theft-deterrent horn.	Rear body control module (RBCM)
DL_MT_A	Lock/Unlock	• Lock: Locks all of the doors. • Unlock: Unlocks all of the doors.	Door lock actuater
ELAT_MT_RLY	Off/On	• Off: Stops the liftgate latch release operation. • On: Releases the liftgate latch.	Liftgate Latch And Lock Actuator
ELAT_UNL	Off/On	• Off: Stops the liftgate latch release operation. • On: Releases the liftgate latch.	Liftgate Latch And Lock Actuator
R_FOG_LMP*2	Off/On	• Off: Turns off rear fog light. • On: Illuminates rear fog light.	Rear fog light
R_LMP	Off/On	• Off: Turns off back-up light. • On: Illuminates back-up light.	Back-up light
R_WIP_MT_LO	Off/On	• Off: Stops rear wiper motor. • On: Operates rear wiper motor.	Rear wiper motor
STOP_LMP_CS*3	Off/On	• Off: Turns off brake light. • On: Illuminates brake light.	Brake light

*1 : With theft-deterrent horn
*2 : With rear fog light
*3 : With smart city brake support

MULTIPLEX COMMUNICATION SYSTEM

10
SECTION

10-00 OUTLINE

OUTLINE

MULTIPLEX COMMUNICATION SYSTEM

id100000001400

- A controller area network (CAN) system has been adopted in which multiplex communication is performed using a single communication path.
- A high-speed controller area network (HS-CAN) has been adopted for the communication between the following modules:
  - PCM
  - DSC HU/CM
  - TCM (ATX vehicles)
  - AFS control module (with AFS system)
  - Front body control module (FBCM)
  - 4WD control module (4WD vehicles)
  - Laser sensor (with smart city brake support system)
  - Forward sensing camera (with hi-beam control (HBC) system)
  - Start stop unit
  - EPS control module
  - SAS control module
  - Instrument cluster
- A mid-speed controller area network (MS-CAN) has been adopted for the communication between the following modules:
  - Rear body control module (RBCM)
  - Rear mount camera (with rear mount camera)
  - BSM control module (LH) (with BSM system)
  - Rear vehicle monitoring control module (RH) (with rear vehicle monitoring system)
  - BSM control module (RH) (with BSM system)
  - Parking sensor control module (with parking sensor system)
  - Climate control unit (with full-auto air conditioner)
  - Clock (with manual air conditioner)
  - Audio unit (with audio unit (color LCD))
  - Instrument cluster

10-02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC

id100200001500

Features

- The CAN system-related modules have an on-board diagnostic function. The on-board diagnostic function consists of the following functions: A malfunction detection function, which detects malfunctions in the CAN system-related parts; a memory function, which stores detected DTCs; a display function, which indicates malfunctioning areas and status via DTC display.

On-board diagnostic function

Malfunction detection function

- Detects errors in the input and output signals.
- If a malfunction is detected, a DTC is output to the DLC-2 through the malfunction indication function. At the same time, malfunction detection results are sent to the memory function.

Memory function

- The memory function stores malfunctions in input/output signal systems. With this function, malfunction data is not cleared after the ignition is switched off (LOCK), even if the malfunctioning signal system has returned to normal.
- The stored malfunction information can be cleared by connecting the Mazda Modular Diagnostic System (M-MDS) to the DLC-2 following the Workshop Manual procedure for clearing codes.

Display Function

- This function is for outputting present or past malfunctions via the DLC-2 as DTCs.
- To read DTCs output to the DLC-2, use the Mazda Modular Diagnostic System (M-MDS).

DTC table (HS-CAN)

DTC output module (Mazda Modular Diagnostic System (M-MDS) display)	DTC	Malfunction location
PCM*1 (PCM)	U0073:00	Unit communication error
	U0101:00	Communication error with TCM
	U0121:00	Communication error with DSC HU/CM
	U0131:00	Communication error with EPS control module
	U0140:00	Communication error with front body control module (FBCM)
	U0151:00	Communication error with SAS control module
	U0155:00	Communication error with instrument cluster
	U0214:00	Communication error with start stop unit
	U0235:00	Communication error with laser sensor
PCM*2 (PCM)	U0073:00	Unit communication error
	U0101:00	Communication error with TCM
	U0120:00	Communication error with start stop unit
	U0121:00	Communication error with DSC HU/CM
	U0131:00	Communication error with EPS control module
	U0140:00	Communication error with front body control module (FBCM)
	U0151:00	Communication error with SAS control module
	U0155:00	Communication error with instrument cluster
	U0235:00	Communication error with laser sensor

ON-BOARD DIAGNOSTIC

DTC output module (Mazda Modular Diagnostic System (M-MDS) display)	DTC	Malfunction location
DSC HU/CM (ABS)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0101:00	Communication error with TCM
	U0114:00	Communication error with 4WD control module
	U0131:00	• Communication error with EPS control module[*8] • Communication error with start stop unit[*9]
	U0154:00	Communication error with SAS control module
	U0155:00	Communication error with instrument cluster
	U0235:00	Communication error with laser sensor
TCM[*3] (TCM)	U0073:00	Unit communication error
	U0100:00	Communication error with PCM
	U0121:00	Communication error with DSC HU/CM
	U0141:00	Communication error with front body control module (FBCM)
	U0155:00	Communication error with instrument cluster
AFS control module[*4] (AFS)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0131:00	Communication error with EPS control module
	U0140:00	Communication error with front body control module (FBCM)
	U0155:00	Communication error with instrument cluster
Front body control module (FBCM) (F_BCM)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0101:00	Communication error with TCM
	U0121:00	Communication error with DSC HU/CM
	U0155:00	Communication error with instrument cluster
	U0214:00	Communication error with start stop unit
	U0515:00	Communication error with SAS control module
4WD control module[*5] (4×4)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0101:00	Communication error with TCM
	U0121:00	Communication error with DSC HU/CM
Laser sensor[*6] (SCBS)	U0001:00	Unit communication error
	U0100:00	Communication error with PCM
	U0121:00	Communication error with DSC HU/CM
	U0131:00	Communication error with EPS control module
	U0155:00	Communication error with instrument cluster
Forward sensing camera[*7] (FSC)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0121:00	Communication error with DSC HU/CM
	U0131:00	Communication error with EPS control module
	U0140:00	Communication error with front body control module (FBCM)
	U0155:00	Communication error with instrument cluster
	U0214:00	Communication error with start stop unit
Start stop unit (SSU)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0101:00	Communication error with TCM
	U0121:00	Communication error with DSC HU/CM
	U0121:87	Communication error with DSC HU/CM
	U0131:00	Communication error with EPS control module
	U0140:00	Communication error with front body control module (FBCM)
	U0146:00	Communication error with instrument cluster
	U0151:00	Communication error with SAS control module
	U0155:00	Communication error with instrument cluster

ON-BOARD DIAGNOSTIC

DTC output module (Mazda Modular Diagnostic System (M-MDS) display)	DTC	Malfunction location
EPS control module (EPS)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0121:00	Communication error with DSC HU/CM
	U0155:00	Communication error with instrument cluster
SAS control module (RCM)	U0001:88	Unit communication error
	U0155:00	Communication error with instrument cluster
Instrument cluster (IC)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0101:00	Communication error with TCM
	U0114:00	Communication error with 4WD control module
	U0121:00	Communication error with DSC HU/CM
	U0131:00	Communication error with EPS control module
	U0140:00	Communication error with front body control module (FBCM)
	U0151:00	Communication error with SAS control module
	U0182:00	Communication error with AFS control module
	U0214:00	Communication error with start stop unit
	U0235:00	Communication error with laser sensor
	U023A:00	Communication error with forward sensing camera

*1 : SKYACTIV-G 2.0
*2 : SKYACTIV-D 2.2
*3 : ATX vehicles
*4 : With AFS system
*5 : 4WD vehicles
*6 : With smart city brake support
*7 : With hi-beam control (HBC) system
*8 : Without smart city brake support or steering angle sensor
*9 : With smart city brake support or steering angle sensor

DTC table (MS-CAN)

DTC output module (M-MDS display)	DTC	Malfunction location
Rear body control module (RBCM) (R_BCM)	U0010:88	Unit communication error
	U0155:00	Communication error with instrument cluster
BSM control module (LH)*1 (BSML)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0131:00	Communication error with EPS control module
	U0155:00	Communication error with instrument cluster
	U0214:00	Communication error with start stop unit
	U0233:00	Communication error with BSM control module (RH)
BSM control module (RH)*1 (BSMR)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0131:00	Communication error with EPS control module
	U0155:00	Communication error with instrument cluster
	U0214:00	Communication error with start stop unit
	U0232:00	Communication error with BSM control module (LH)
Rear vehicle monitoring control module (RH)*2 (RVM)	U0001:88	Unit communication error
	U0100:00	Communication error with PCM
	U0121:00	Communication error with DSC HU/CM
	U0155:00	Communication error with instrument cluster
	U0214:00	Communication error with start stop unit
Climate control unit*3 (EATC)	U0010:88	Unit communication error
	U0155:00	Communication error with instrument cluster

ON-BOARD DIAGNOSTIC

DTC output module (M-MDS display)	DTC	Malfunction location
Audio unit*4 (ACU)	U0010:88 (16:Er12)	Unit communication error
	U0155:00	Communication error with instrument cluster
Instrument cluster (IC)	U0010:88	Unit communication error
	U0142:00	Communication error with rear body control module (RBCM)
	U0232:00	Communication error with rear vehicle monitoring control module (RH)
	U0233:00	Communication error with BSM control module (RH)

*1 : With BSM system
*2 : With rear vehicle monitoring system
*3 : With full-auto air conditioner
*4 : With audio unit

Malfunction diagnosis procedure

- After the vehicle is brought in, verify the repair order form and the malfunctioning symptom, and if a CAN malfunction is considered to be the cause, perform CAN malfunction diagnosis to determine if the malfunction is in the CAN system or not.
- For CAN malfunction diagnosis, the voltage at the CAN connection terminal on the DLC-2 is measured, and based on the measured value, the CAN circuit can be examined or the malfunction symptom can be determined.
- If the malfunction symptom is not an open circuit, inspect the voltage or continuity at the CAN circuit and determine the malfunctioning part.
- If the malfunction symptom is an open circuit, determine the area of the open circuit by using the displayed communication error DTC and the module in which communication has failed.

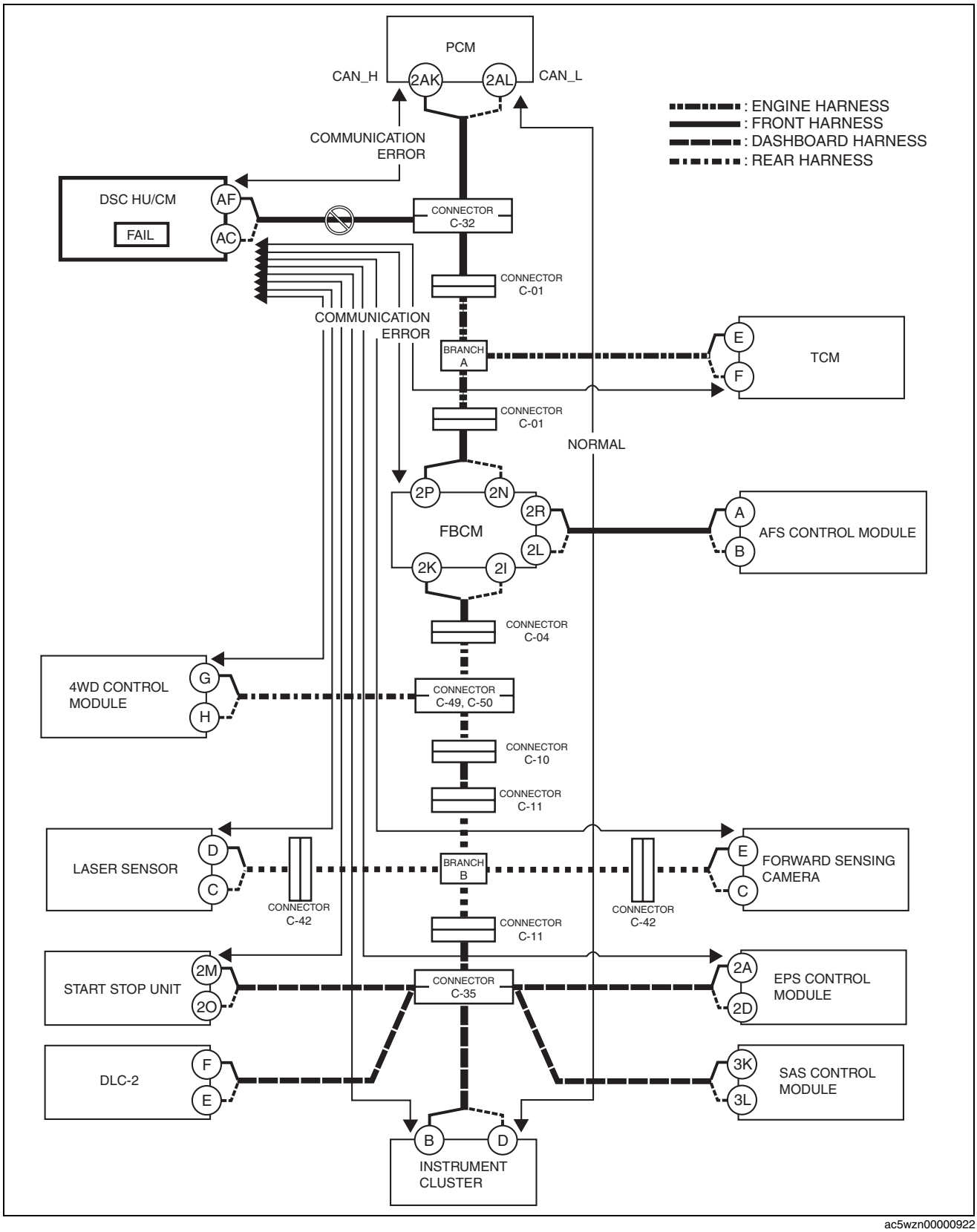
Example: determining open circuit location

1. Verify the CAN system-related module DTCs and the failed module using the Mazda Modular Diagnostic System (M-MDS).

DTC output module	Mazda Modular Diagnostic System (M-MDS) display	Displayed DTC	System malfunction location
PCM	PCM	U0121:00	Communication error with DSC HU/CM
TCM	TCM	U0121:00	Communication error with DSC HU/CM
Front body control module (FBCM)	F_BCM	U0121:00	Communication error with DSC HU/CM
4WD control module	4×4	U0121:00	Communication error with DSC HU/CM
Laser sensor	SCBS	U0121:00	Communication error with DSC HU/CM
Forward sensing camera	FSC	U0121:00	Communication error with DSC HU/CM
Start stop unit	SSU	U0121:00	Communication error with DSC HU/CM
EPS control module	EPS	U0121:00	Communication error with DSC HU/CM
Instrument cluster	IC	U0121:00	Communication error with DSC HU/CM

Module	Fail
DSC HU/CM	×

ON-BOARD DIAGNOSTIC



ac5wzn00000922

2. Despite normal communication between the PCM and instrument cluster, a communication error DTC is displayed for the signal between the DSC HU/CM and PCM / TCM / front body control module (FBCM) / 4WD control module / laser sensor / forward sensing camera / start stop unit / EPS control module / instrument cluster. In addition, the wiring harness between the DSC HU/CM and connector C-32 is considered to be malfunctioning because “Fail” is displayed for the DSC HU/CM.

10-40 CONTROL SYSTEM

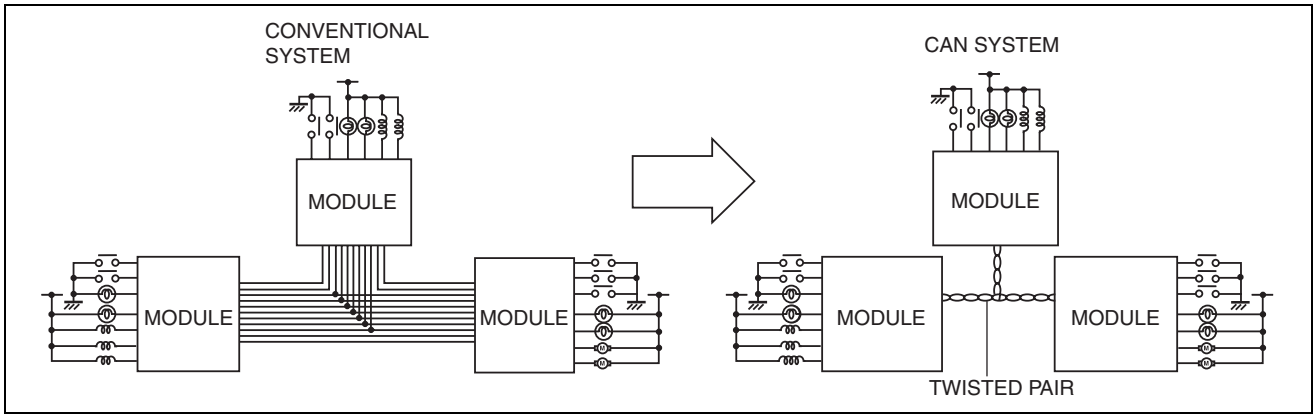
CONTROL SYSTEM

CONTROLLER AREA NETWORK (CAN) SYSTEM

id104000001300

Outline

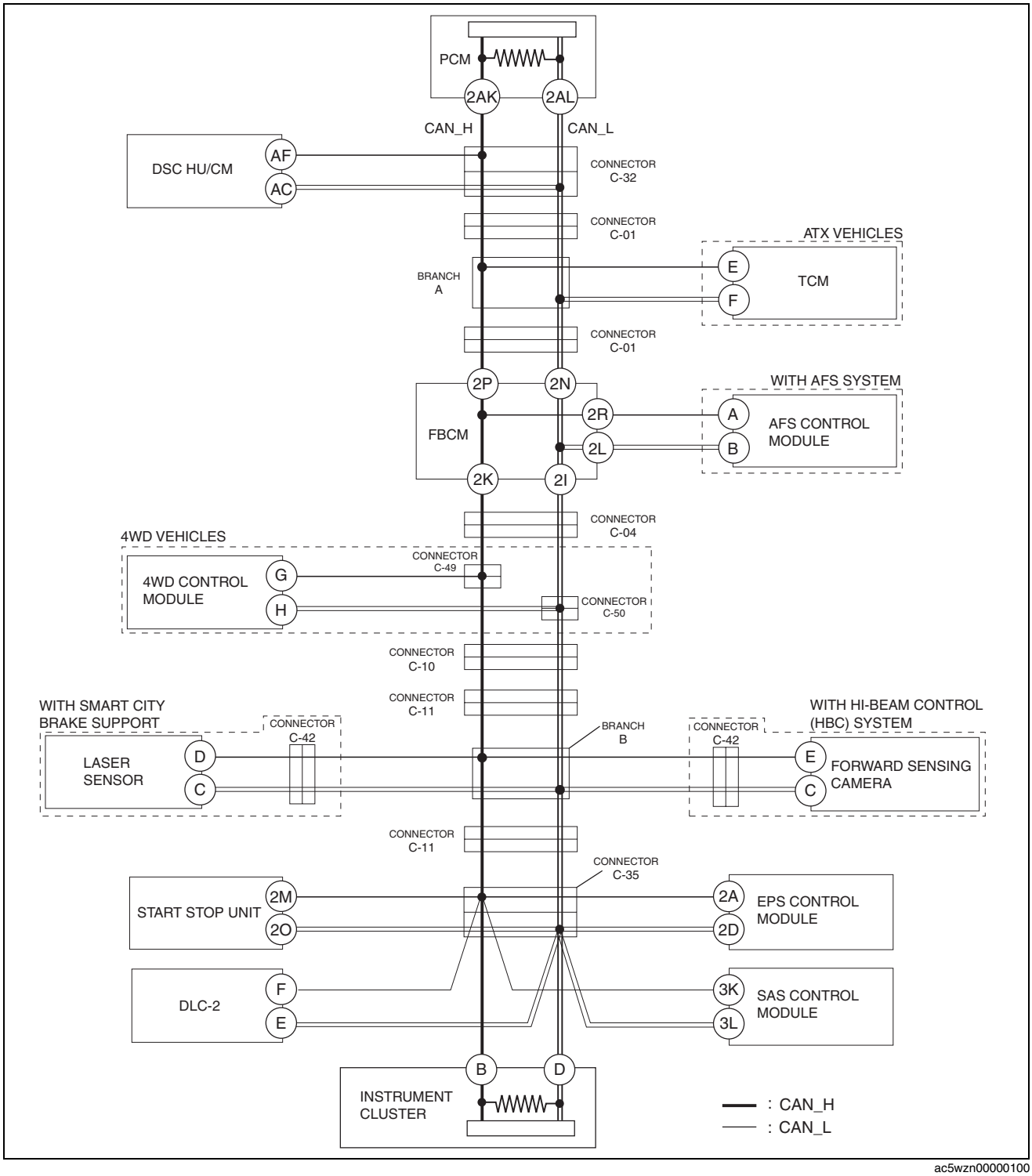
- A CAN system has been adopted which can send and receive multiple signals over a single communication path from related modules.



ac5wzn00000292

CONTROL SYSTEM

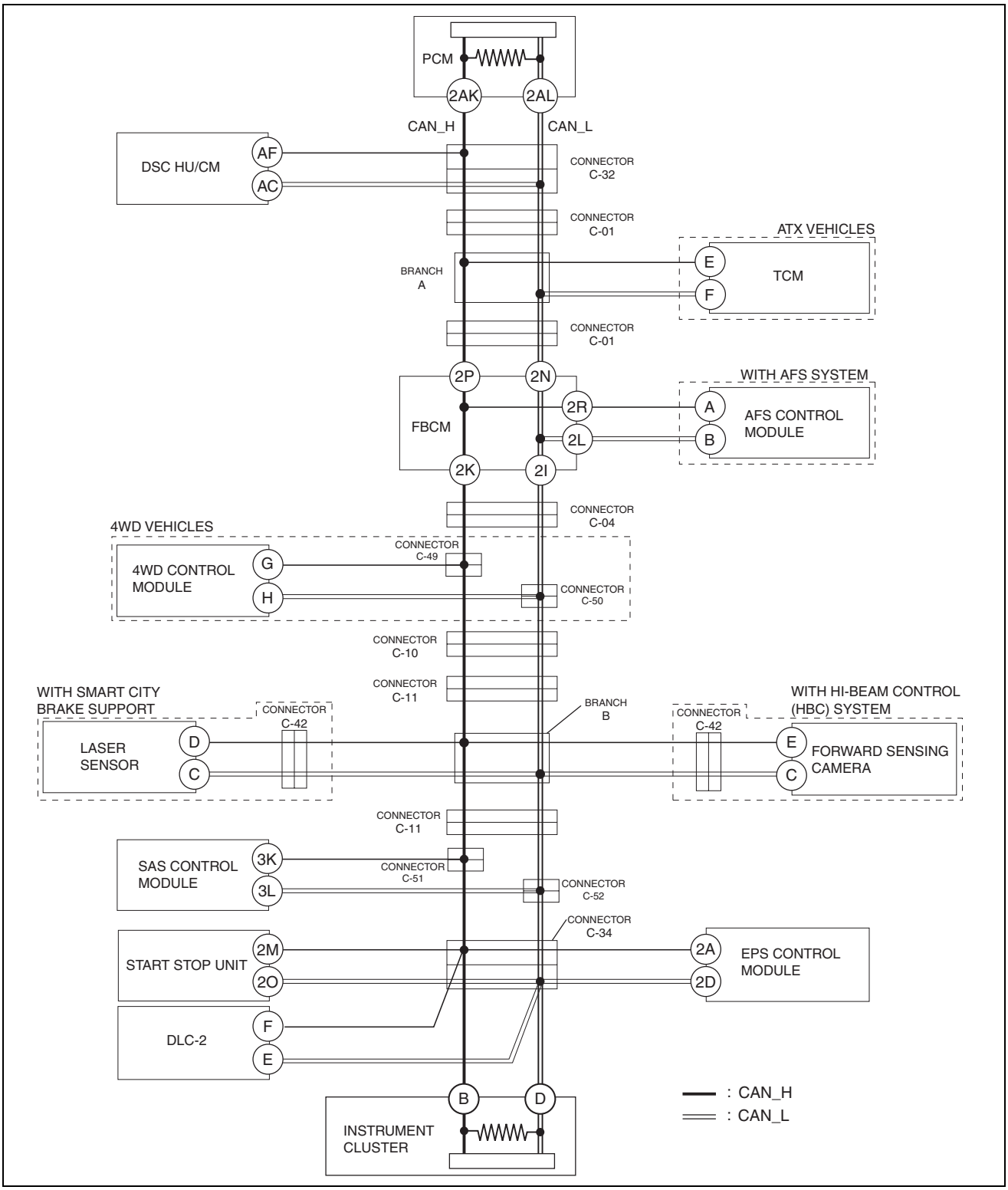
System wiring diagram
HS-CAN (SKYACTIV-G 2.0 (L.H.D.))



ac5wzn00000100

CONTROL SYSTEM

HS-CAN (SKYACTIV-G 2.0 (R.H.D.))



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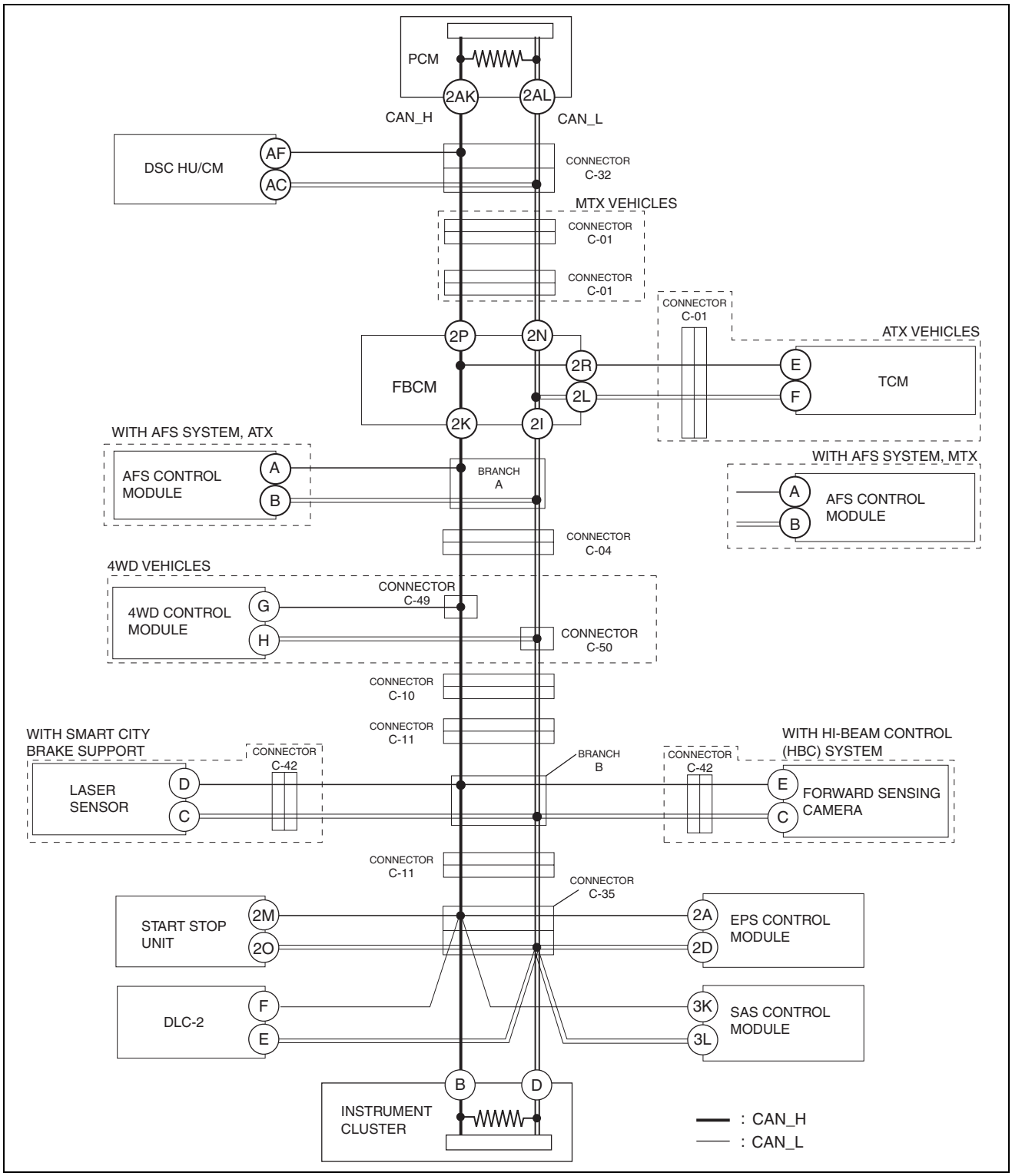
CONTROL SYSTEM

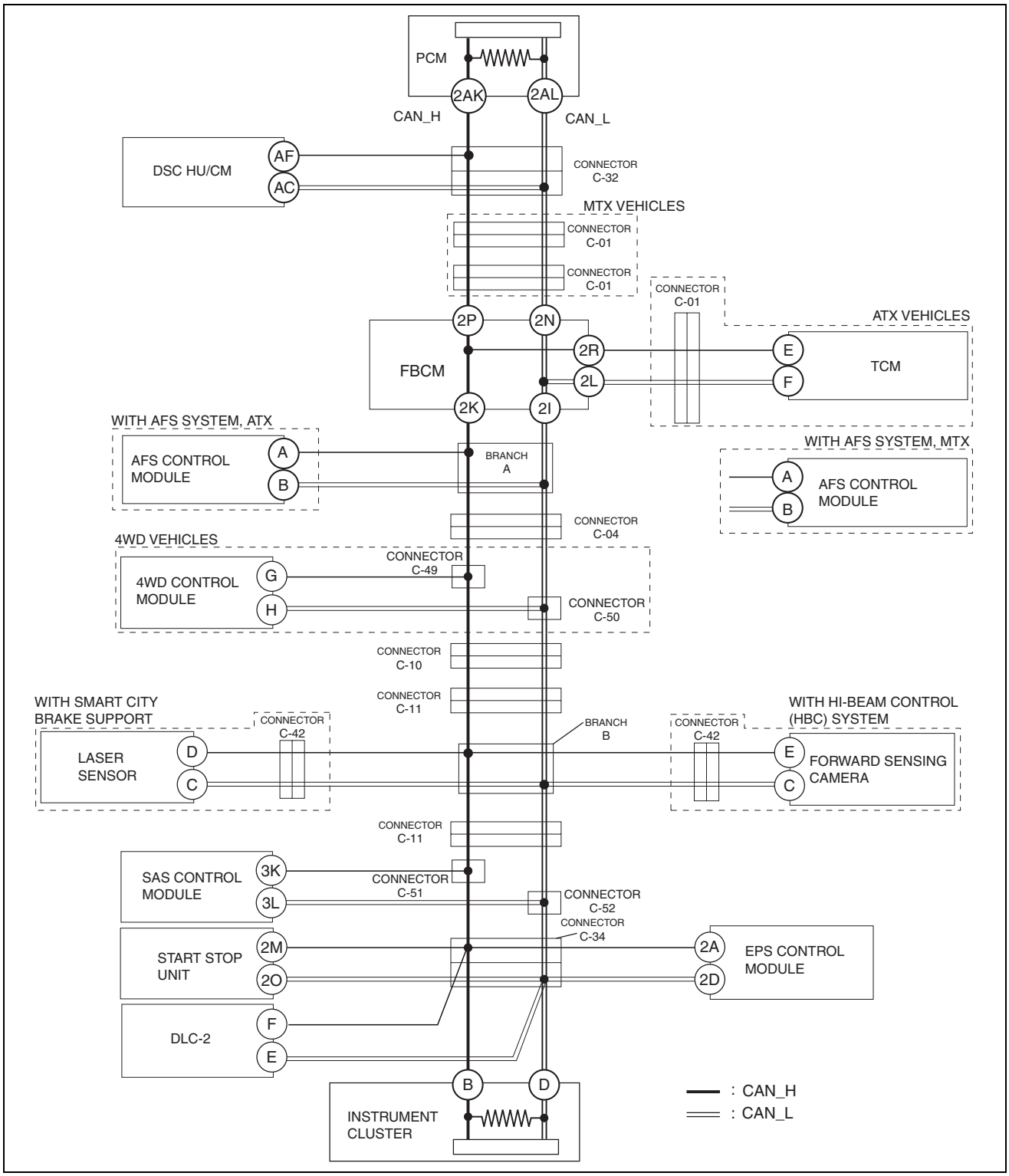
HS-CAN (SKYACTIV-D 2.2 (L.H.D.))



ac5wzn00001679

CONTROL SYSTEM

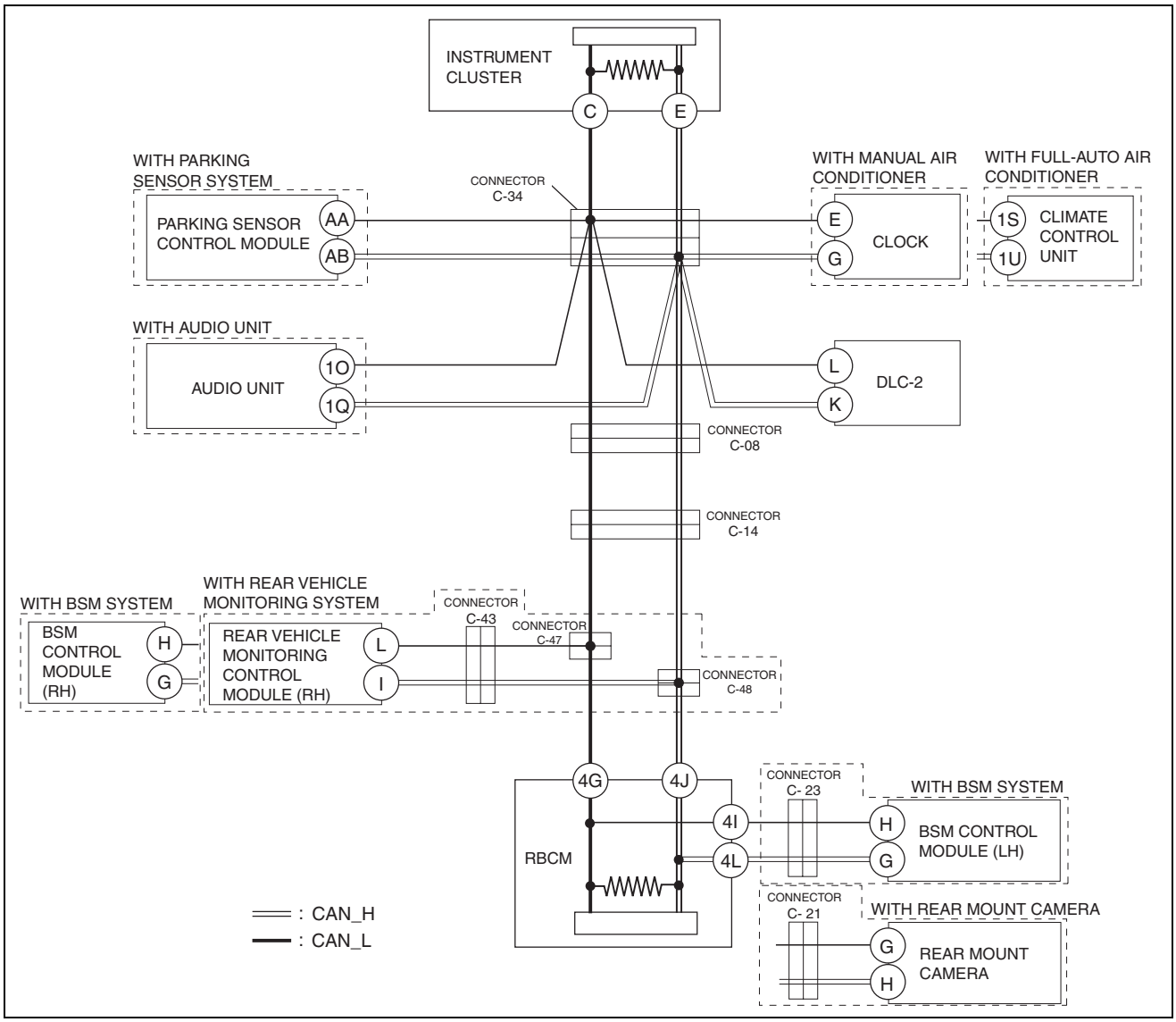
HS-CAN (SKYACTIV-D 2.2 (R.H.D.))



ac5wzn00001680

CONTROL SYSTEM

MS-CAN



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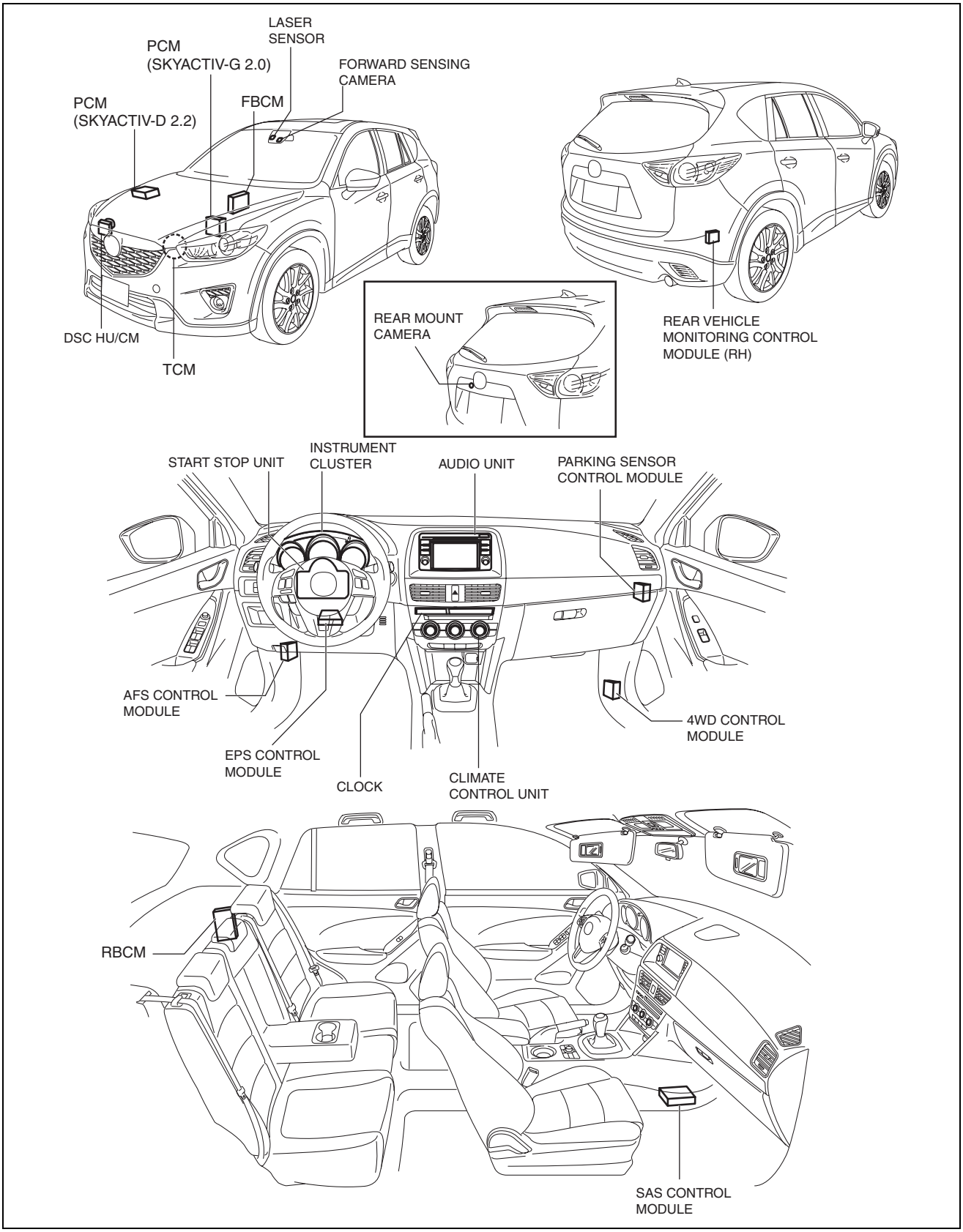
Structure

- The CAN system consists of CAN system-related modules built into the CPU and wiring harnesses connecting related modules.

CONTROL SYSTEM

L.H.D.



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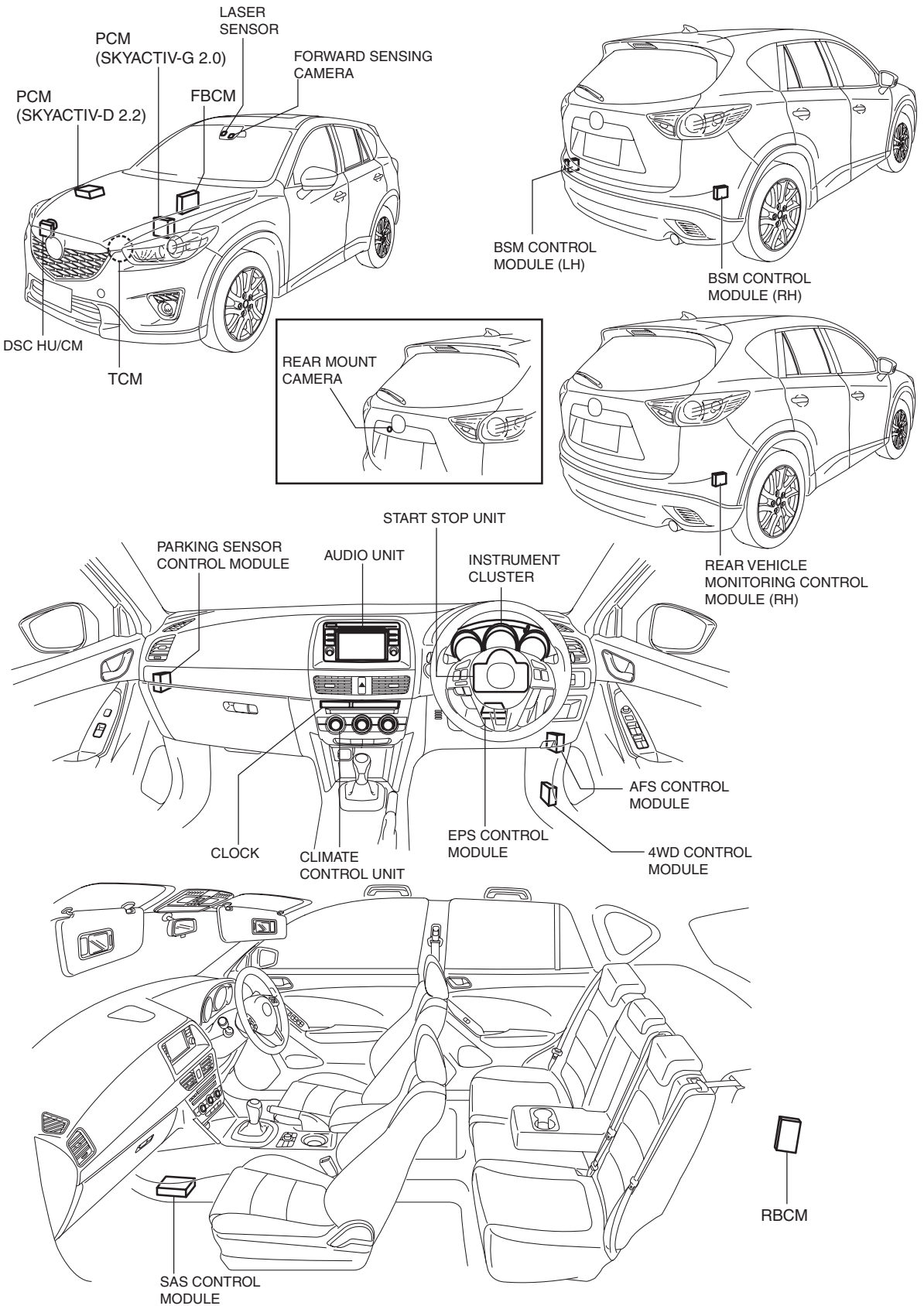
R.H.D.

CONTROL SYSTEM



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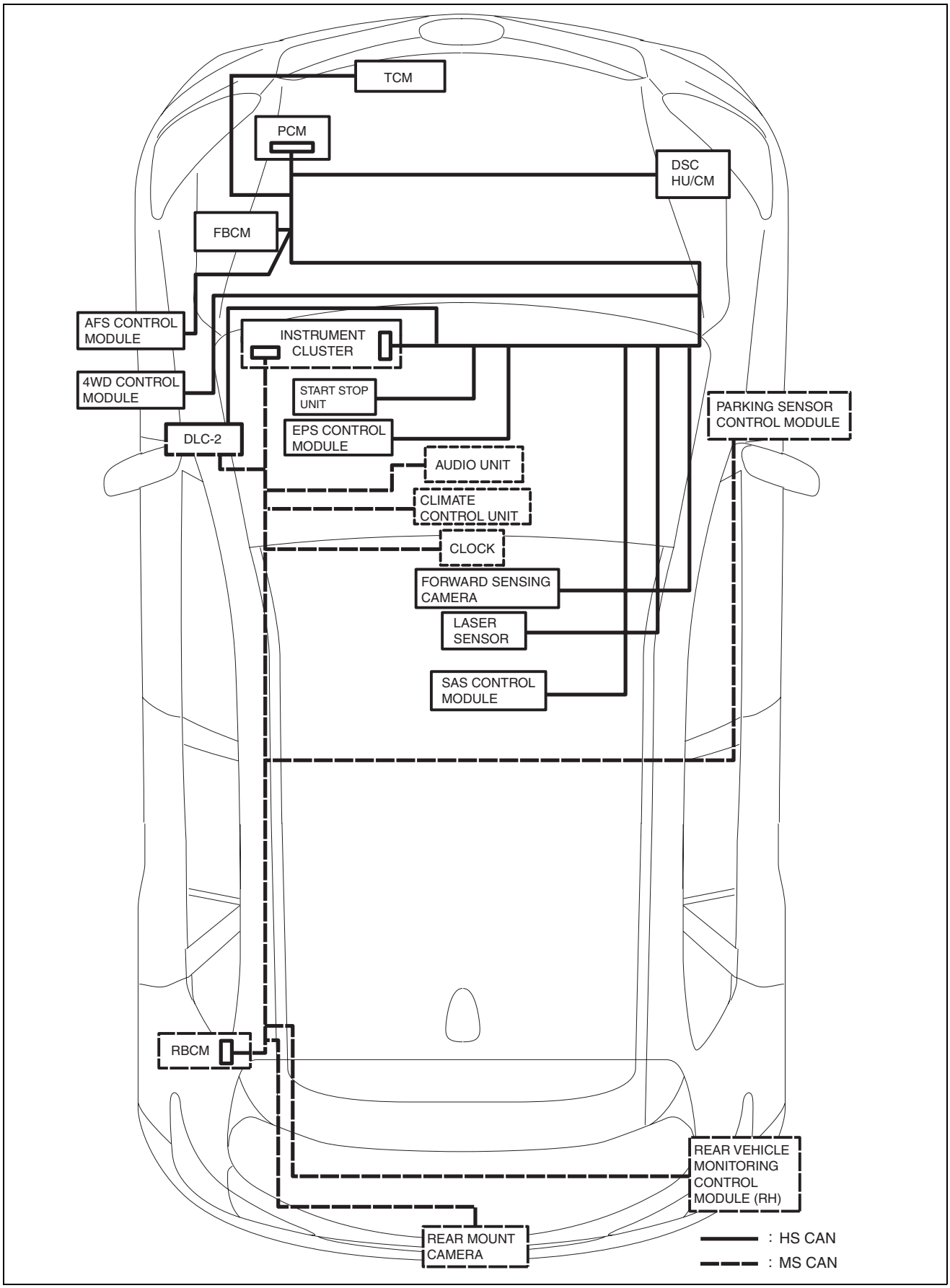
CONTROL SYSTEM

Function

- Terminator resistors are built into the PCM and instrument cluster which form the HS-CAN between the PCM and instrument cluster.
- Terminator resistors are built into the rear body control module (RBCM) and instrument cluster which form the MS-CAN between the rear body control module (RBCM) and instrument cluster.
- The instrument cluster is connected to the HS-CAN and MS-CAN which communicate with each other via the instrument cluster.

CONTROL SYSTEM

L.H.D.



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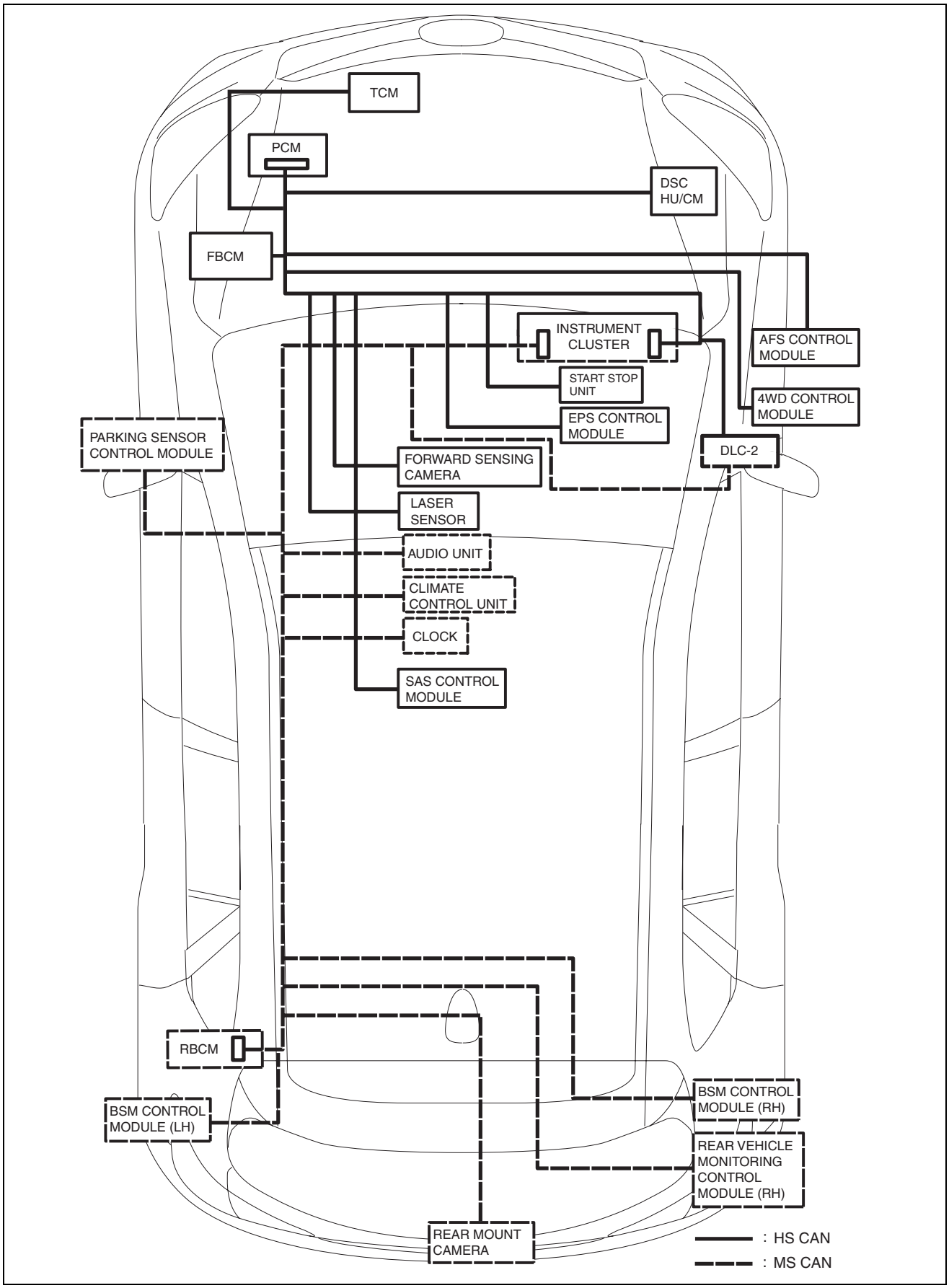
CONTROL SYSTEM

R.H.D.



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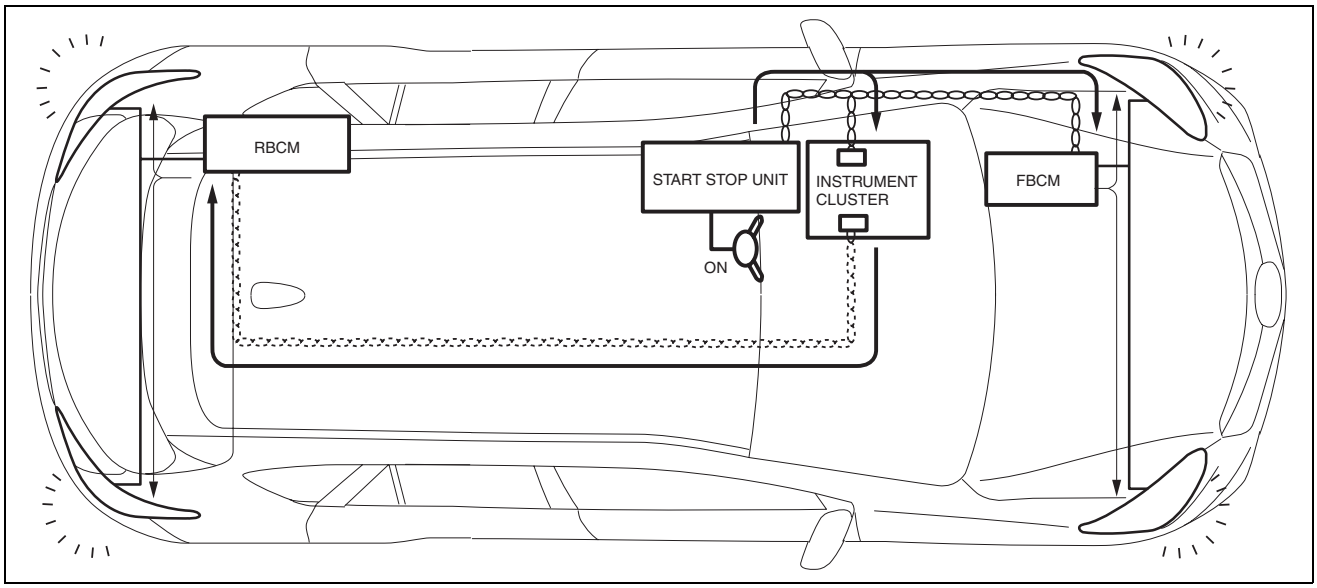
CONTROL SYSTEM

Body communication function

- The front body control module (FBCM) is located at the vehicle front, the start stop unit is located in the dashboard, the rear body control module (RBCM) is located at the rear, and lighting parts, wiper parts, each type of switch, and door lock parts in each location are each connected to three CMs, creating a three-system communication network.
- The front body control module (FBCM) and start stop unit are connected to the HS-CAN and the rear body control module (RBCM) is connected to the MS-CAN which communicate with each other via the instrument cluster.
- For example, when the switch connected to the start stop unit is turned ON, the start stop unit sends an operation request signal to the front body control module (FBCM) and rear body control module (RBCM), which operate the parts on the front or rear.



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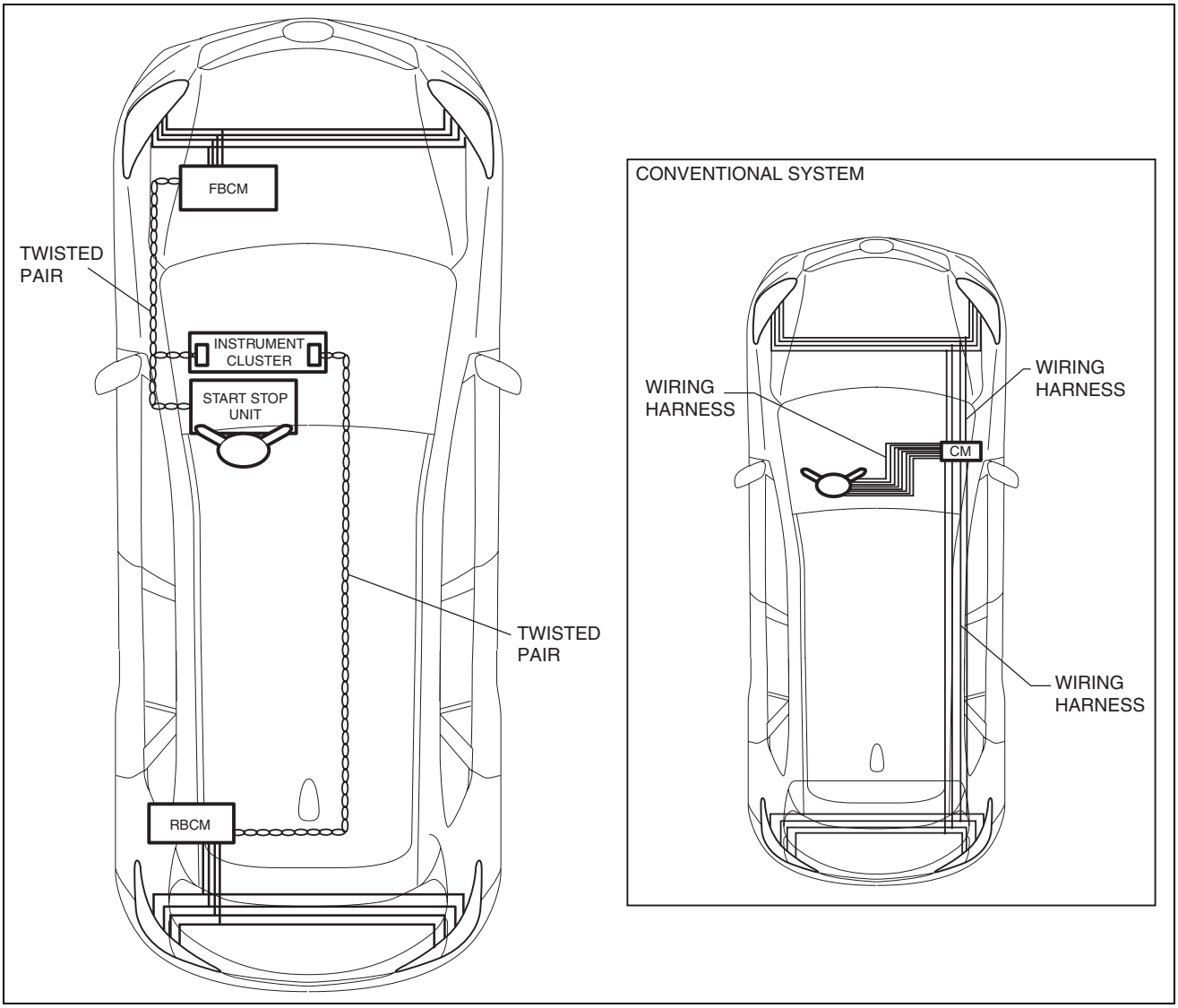
CONTROL SYSTEM

- By connecting the front body control module (FBCM), start stop unit, and rear body control module (RBCM) via the CAN, the number of wiring harness used compared to the conventional number used has decreased.



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CAN signal table

- Signals transmitted using the CAN system are as follows:

HS-CAN communication table

OUT: Output (sends signal)
IN: Input (receives signal)

Signal	CAN system related module											
	PCM	TCM*1	AFS control module*2	4WD control module*3	Laser sensor*4	DSC HU/ CM	EPS control module	Front body control module (FBCM)	Forward sensing camera*5	Instrument cluster	Start stop unit	SAS control module
Accelerator pedal opening angle	OUT	–	–	IN	–	IN	–	–	IN	IN	–	IN
AFS OFF switch status	–	–	IN	–	–	–	–	–	–	OUT	–	–

CONTROL SYSTEM

Signal	CAN system related module											
	PCM	TCM*1	AFS control module*2	4WD control module*3	Laser sensor*4	DSC HU/ CM	EPS control module	Front body control module (FBCM)	Forward sensing camera*5	Instrument cluster	Start stop unit	SAS control module
AFS system configuration information	–	–	OUT	–	–	–	–	–	–	IN	–	–
AFS system warning light status	–	–	OUT	–	–	–	–	–	–	IN	–	–
Air bag system warning buzzer status	–	–	–	–	–	–	–	–	–	IN	–	OUT
Air bag system warning light on request	–	–	–	–	–	–	–	–	–	IN	–	OUT
Air bag system-related information	–	–	–	–	–	–	–	–	–	IN	–	OUT
Ambient temperature	IN	IN	IN	IN	IN	IN	IN	IN	–	OUT	–	IN
	OUT	–	–	–	–	IN	–	–	–	–	–	–
Answer-back-related information	–	–	–	–	–	–	–	IN	–	OUT	–	–
AT shift position	IN	OUT	–	–	–	–	–	–	–	–	–	–
Back-up light on request	–	–	IN	–	IN	IN	–	–	–	OUT	–	–
Back-up light switch	OUT	–	–	–	–	IN	–	–	IN	IN	–	–
Battery management system malfunction determination	OUT	–	–	–	–	–	–	–	–	IN	–	–
Battery regeneration status	OUT	–	–	–	–	–	–	–	–	IN	–	–
Blower motor relay status	–	–	–	–	–	–	–	OUT	–	IN	–	–
Bonnet status (with i-stop)	IN	–	–	–	–	–	–	–	–	OUT	IN	–
Brake fluid level	–	–	–	–	–	–	–	OUT	–	IN	–	–
Brake light status	–	–	–	–	–	IN	–	–	–	OUT	–	–
Brake override system cancel execution signal	OUT	–	–	–	–	–	–	IN	–	IN	–	–
Brake pedal depressed status	OUT	–	–	–	IN	–	–	–	–	–	–	–
Brake switch (No.1 signal)	OUT	IN	–	–	–	IN	–	IN	IN	IN	–	–
Brake switch (No.2 signal)	OUT	IN	–	–	–	–	–	–	IN	IN	IN	IN
Brake switch malfunction determination	OUT	–	–	–	–	–	–	–	–	IN	–	–
Check engine light on request	OUT	–	–	–	–	–	–	–	–	IN	–	–
Cluster switch status	–	–	IN	–	–	–	–	–	IN	OUT	–	–
Clutch pedal stroke sensor	OUT	–	–	IN	–	IN	–	–	–	–	–	–
Collision detection (front, side, roll over)	IN	–	–	–	–	IN	–	IN	–	–	–	OUT

CONTROL SYSTEM

Signal	CAN system related module											
	PCM	TCM*1	AFS control module*2	4WD control module*3	Laser sensor*4	DSC HU/ CM	EPS control module	Front body control module (FBCM)	Forward sensing camera*5	Instrument cluster	Start stop unit	SAS control module
Collision detection (rear)	IN	–	–	–	–	IN	–	IN	–	–	–	OUT
Cranking start	IN	–	–	–	–	–	–	IN	–	IN	OUT	–
Cranking time	OUT	–	–	–	–	–	–	–	–	–	IN	–
Cruise control control status	OUT	–	–	–	–	IN	–	–	–	–	–	–
Cruise control set speed	OUT	–	–	–	–	IN	–	–	–	–	–	–
Cruise control switch	OUT	–	–	–	–	IN	–	–	–	–	–	–
Cruise control switch signal	IN	–	–	–	–	–	–	–	–	–	OUT	–
	IN	–	–	–	–	IN	–	–	–	–	OUT	–
Cruise control system-related information	IN	–	–	–	–	OUT	–	–	–	–	–	–
	OUT	–	–	–	–	IN	–	–	–	–	–	–
	–	–	–	–	OUT	–	–	–	–	IN	–	–
	–	–	–	–	OUT	IN	–	–	–	IN	–	–
Dimmer cancel	–	–	–	–	–	–	–	–	–	OUT	IN	–
Driver-side buckle switch status	–	–	–	–	–	–	–	–	–	IN	IN	OUT
TCS OFF switch status	–	–	–	–	–	IN	–	–	–	OUT	–	–
DSC system-related information	–	–	–	–	–	OUT	–	–	–	IN	–	–
	–	IN	–	–	–	OUT	–	–	–	IN	–	–
	–	–	–	–	–	OUT	–	IN	–	–	–	–
	–	–	–	–	IN	OUT	–	–	–	–	–	–
	–	–	–	–	IN	OUT	–	–	–	IN	–	–
DPF warning light on request*6	OUT	–	–	–	–	–	–	–	–	IN	–	–
Electric AT oil pump-related signal (i-stop)	IN	OUT	–	–	–	–	–	–	–	–	–	–
Engine coolant temperature	OUT	–	–	–	–	–	–	IN	–	IN	–	–
Engine displacement	OUT	–	–	IN	–	IN	–	–	–	IN	–	–
	OUT	IN	–	IN	–	IN	IN	IN	–	IN	–	–
Engine status	OUT	–	–	–	–	–	–	–	–	IN	–	–
Engine status at idle	OUT	–	–	–	–	–	–	–	–	IN	–	–
Engine torque	OUT	–	–	–	–	–	–	IN	–	–	–	–
	OUT	–	–	IN	–	–	–	–	–	–	–	–
	OUT	–	–	IN	–	IN	–	–	–	–	–	–
Engine-off time	IN	–	–	–	–	–	–	–	–	–	OUT	–
EPS status	IN	–	–	IN	–	–	OUT	–	–	–	–	–
	IN	–	–	–	–	–	OUT	–	–	–	–	–
	–	–	–	–	–	–	OUT	–	–	IN	–	–
Forward sensing camera customize request	–	–	–	–	–	–	–	–	OUT	IN	–	–
	–	–	–	–	–	–	–	–	IN	OUT	–	–
Front combination light on request	–	–	–	–	–	–	–	IN	OUT	–	–	–

CONTROL SYSTEM

Signal	CAN system related module											
	PCM	TCM*1	AFS control module*2	4WD control module*3	Laser sensor*4	DSC HU/ CM	EPS control module	Front body control module (FBCM)	Forward sensing camera*5	Instrument cluster	Start stop unit	SAS control module
Front fog light information	–	–	–	–	–	–	–	OUT	IN	IN	–	–
Fuel cap status	OUT	–	–	–	–	–	–	–	–	IN	–	–
Fuel cut request	IN	–	–	–	–	–	–	IN	–	IN	–	OUT
	IN	–	–	–	–	IN	–	–	–	–	–	OUT
Fuel injection amount	OUT	–	–	–	–	–	–	–	–	IN	–	–
Generator warning light on request	OUT	–	–	–	–	–	–	IN	–	IN	–	–
Glow indicator light on request*6	OUT	–	–	–	–	–	–	–	–	IN	–	–
Hazard warning switch information	–	–	–	–	–	–	–	IN	IN	IN	OUT	–
Headlight information	IN	–	IN	–	–	–	–	OUT	IN	IN	–	–
Headlight status	–	–	–	–	–	–	–	OUT	IN	–	–	–
High-beam indicator	–	–	–	–	–	–	–	OUT	IN	IN	–	–
Ignition off timer	IN	IN	IN	IN	IN	IN	IN	IN	–	OUT	IN	IN
Ignition switch status	–	–	IN	IN	–	–	IN	IN	IN	OUT	–	–
Immobilizer system related information	OUT	–	–	–	–	–	–	–	–	–	IN	–
	IN	–	–	–	–	–	–	–	–	–	OUT	–
i-stop OFF switch status	IN	–	–	–	–	–	–	–	–	OUT	–	–
i-stop status	OUT	–	–	–	IN	–	–	–	–	–	–	–
i-stop-related information (with i-stop)	IN	–	–	–	–	–	–	–	–	–	OUT	–
	OUT	–	–	–	–	–	–	–	–	IN	–	–
	OUT	IN	–	–	–	–	–	–	–	IN	–	–
	OUT	IN	–	–	–	–	–	–	–	IN	IN	–
	OUT	–	–	–	–	IN	–	–	–	–	–	–
	OUT	–	–	–	–	–	–	–	–	–	IN	–
	OUT	–	–	–	–	–	–	IN	–	–	–	–
	OUT	IN	–	–	–	IN	IN	IN	–	IN	IN	–
Key status	OUT	–	–	–	–	–	–	–	–	–	IN	–
Keyless indicator light on request	–	–	–	–	–	–	–	–	–	IN	OUT	–
Keyless warning buzzer operation request	–	–	–	–	–	–	–	–	–	IN	OUT	–
Keyless warning light on request	–	–	–	–	–	–	–	–	–	IN	OUT	–
Laser sensor-related information	IN	–	–	–	OUT	–	–	–	–	–	–	–
Manual air conditioner operation request	IN	–	–	–	–	–	–	OUT	–	IN	–	–
Manual shift control	–	IN	–	–	–	–	–	–	–	OUT	–	–
	IN	–	–	–	–	–	–	–	–	OUT	–	–
Neutral switch	OUT	–	–	IN	–	–	–	–	–	IN	IN	–

CONTROL SYSTEM

Signal	CAN system related module											
	PCM	TCM*1	AFS control module*2	4WD control module*3	Laser sensor*4	DSC HU/CM	EPS control module	Front body control module (FBCM)	Forward sensing camera*5	Instrument cluster	Start stop unit	SAS control module
Oil pressure warning light on request	OUT	–	–	–	–	–	–	–	–	IN	–	–
PAD indicator on request	–	–	–	–	–	–	–	–	–	IN	–	OUT
Parking brake status	IN	–	–	IN	–	IN	–	IN	–	OUT	–	–
Passenger-side buckle switch status	–	–	–	–	–	–	–	–	–	IN	–	OUT
Power supply status	IN	–	–	–	–	–	–	IN	–	IN	OUT	–
	IN	–	–	–	–	–	–	IN	–	–	OUT	–
Priority recirculate request	OUT	–	–	–	–	–	–	IN	–	IN	–	–
Push button system-related information	–	–	–	–	–	–	–	–	–	IN	OUT	–
Rear body control module (RBCM) customize request	–	–	–	–	–	–	–	–	IN	OUT	–	–
Rear fog indicator light information	–	–	–	–	–	–	–	IN	–	OUT	–	–
Rear fog light information	–	–	–	–	–	–	–	OUT	IN	IN	–	–
Rear washer switch information	–	–	–	–	–	–	–	IN	–	–	OUT	–
Rear window defroster information	IN	–	–	–	–	–	–	OUT	–	IN	–	–
Rear wiper information	–	–	–	–	–	–	–	OUT	IN	IN	–	–
Rear wiper status	–	–	–	IN	–	–	–	IN	–	–	OUT	–
ROOM fuse status	–	IN	–	IN	–	–	IN	–	IN	OUT	–	–
Seat warmer cut status	–	–	–	–	–	–	–	OUT	–	IN	–	–
Security indicator buzzer sound request	–	–	–	–	–	–	–	–	–	IN	OUT	–
Security indicator on request	–	–	–	–	–	–	–	–	–	IN	OUT	–
Selector lever position	IN	OUT	–	IN	–	IN	–	IN	IN	IN	IN	–
	–	OUT	–	–	–	–	–	–	–	IN	–	–
	IN	OUT	–	–	–	IN	–	–	–	–	–	–
	–	OUT	–	–	–	IN	–	–	–	IN	–	–
Shift indicator light	OUT	–	–	–	–	–	–	–	–	IN	–	–
Shift range position	OUT	–	–	IN	–	–	–	–	–	IN	–	–
Start stop unit customize request	–	–	–	–	–	–	–	–	–	IN	OUT	–
	–	–	–	–	–	–	–	–	–	OUT	IN	–
Starter relay status	OUT	–	–	–	–	–	–	–	–	–	IN	–

CONTROL SYSTEM

Signal	CAN system related module											
	PCM	TCM*1	AFS control module*2	4WD control module*3	Laser sensor*4	DSC HU/ CM	EPS control module	Front body control module (FBCM)	Forward sensing camera*5	Instrument cluster	Start stop unit	SAS control module
Steering angle/ steering angle sensor status	–	–	–	–	–	–	IN	–	–	–	OUT	–
	–	–	–	–	–	IN	OUT	–	IN	IN	–	–
	IN	IN	IN	IN	IN	–	OUT	–	IN	IN	IN	–
	IN	IN	IN	IN	–	–	OUT	–	IN	IN	IN	–
	IN	IN	IN	–	IN	–	OUT	–	IN	IN	IN	–
	IN	IN	IN	–	–	–	OUT	–	–	–	–	–
	–	–	–	–	–	–	OUT	–	–	–	IN	–
	–	–	IN	–	IN	–	OUT	–	–	–	–	–
	IN	–	–	–	–	–	OUT	–	–	–	–	–
	–	–	–	IN	–	–	OUT	–	–	–	–	–
	–	–	–	–	IN	–	OUT	–	–	–	–	–
Steering lock system-related information	–	–	–	–	–	–	–	–	–	IN	OUT	–
Steering shift switch	–	IN	–	–	–	–	–	–	–	–	OUT	–
Steering switch information	–	–	–	–	–	–	–	IN	IN	IN	OUT	–
	–	–	–	–	–	–	–	IN	IN	–	OUT	–
	–	–	–	–	–	–	–	IN	–	–	OUT	–
Target gear position	IN	OUT	–	IN	–	–	–	–	–	IN	–	–
Theft-deterrent system alarm-related information	–	–	–	–	–	–	–	IN	–	OUT	–	–
Theft-deterrent system status	–	–	–	–	–	–	–	–	–	OUT	IN	–
Tire size	IN	IN	–	–	–	IN	–	–	–	OUT	–	–
TNS status	–	–	–	–	–	–	–	OUT	–	IN	IN	–
TPMS OFF switch status	–	–	–	–	–	IN	–	–	–	OUT	–	–
Traveled distance	IN	IN	IN	IN	IN	IN	IN	IN	–	OUT	IN	IN
Turn indicator light on request	–	–	–	–	–	–	–	OUT	IN	IN	–	–
Vehicle speed	IN	–	–	–	IN	OUT	IN	–	IN	IN	–	–
	IN	–	–	–	–	OUT	IN	–	IN	–	–	–
	IN	–	–	–	IN	OUT	–	–	IN	IN	–	–
	IN	–	–	–	–	OUT	–	–	IN	–	–	–
	OUT	–	IN	–	–	IN	IN	IN	IN	IN	IN	IN
Washer level sensor status	–	–	–	–	–	–	–	OUT	–	IN	–	–
Wheel speed (LF, RF, LR, RR)	IN	IN	–	IN	–	OUT	IN	IN	IN	IN	IN	–
Windshield washer switch information	–	–	–	–	IN	–	–	IN	–	IN	OUT	–
Windshield wiper (INT) status	–	–	–	–	–	–	–	IN	–	–	OUT	–
Windshield wiper operation status	IN	–	–	–	–	–	–	OUT	IN	IN	–	–
Windshield wiper status	–	–	–	–	–	–	–	OUT	IN	–	–	–
	–	–	–	IN	–	–	–	IN	–	–	OUT	–
Windshield wiper switch information	–	–	–	IN	IN	–	–	IN	–	–	OUT	–

CONTROL SYSTEM

Signal	CAN system related module											
	PCM	TCM*1	AFS control module*2	4WD control module*3	Laser sensor*4	DSC HU/CM	EPS control module	Front body control module (FBCM)	Forward sensing camera*5	Instrument cluster	Start stop unit	SAS control module
Yaw rate	IN	IN	–	–	IN	OUT	IN	–	IN	–	–	–
	IN	IN	–	–	–	OUT	–	–	IN	–	–	–
4WD system status	–	–	–	OUT	–	IN	–	–	–	–	–	–
	–	–	–	OUT	–	–	–	–	–	IN	–	–

*1 : ATX vehicles
*2 : With AFS system
*3 : 4WD vehicles
*4 : With smart city brake support
*5 : With hi-beam control (HBC) system
*6 : With SKYACTIV-D 2.2

MS-CAN communication table

OUT: Output (sends signal)
IN: Input (receives signal)

Signal	CAN system related module									
	Rear body control module (RBCM)	BSM control module (LH)*1	BSM control module (RH)*1	Climate control unit*2	Clock*3	Audio	Instrument cluster	Rear vehicle monitoring control module*4	Rear mount camera*5	Parking sensor control module*6
A/C	–	–	–	OUT	–	–	IN	–	–	–
Alarm status	OUT	–	–	–	–	–	IN	–	–	–
Answer-back-related information	OUT	–	–	–	–	–	IN	–	–	–
Audio configuration information	–	–	–	–	–	IN	OUT	–	–	–
Back-up light on request signal	IN	IN	IN	–	–	–	OUT	IN	IN	IN
Blower speed	–	–	–	OUT	–	–	IN	–	–	–
Brake light status	IN	–	–	–	–	–	OUT	–	–	–
BSM control module (LH) status	–	OUT	IN	–	–	–	–	–	–	–
BSM control module (RH) status	–	IN	OUT	–	–	–	–	–	–	–
BSM control module configuration information	–	IN	IN	–	–	–	OUT	–	–	–
BSM system (LH) buzzer on request	–	OUT	IN	–	–	–	–	–	–	–
BSM system (LH) indicator off request	–	OUT	IN	–	–	–	–	–	–	–
BSM system (RH) buzzer on request	–	IN	OUT	–	–	–	–	–	–	–
BSM system (RH) indicator off request	–	IN	OUT	–	–	–	–	–	–	–
BSM system buzzer on request	–	IN	OUT	–	–	–	IN	–	–	–
BSM system customize-related information	–	IN	IN	–	–	–	OUT	IN	–	–
	–	–	OUT	–	–	–	IN	–	–	–

CONTROL SYSTEM

Signal	CAN system related module									
	Rear body control module (RBCM)	BSM control module (LH)*1	BSM control module (RH)*1	Climate control unit*2	Clock*3	Audio	Instrument cluster	Rear vehicle monitoring control module*4	Rear mount camera*5	Parking sensor control module*6
BSM system indicator off request	–	IN	OUT	–	–	–	IN	–	–	–
BSM system main switch status	–	IN	OUT	–	–	–	–	–	–	–
Climate control unit configuration information	–	–	–	IN	–	–	OUT	–	–	–
Cranking start status	–	–	–	IN	–	–	OUT	–	–	–
Customize information	–	–	–	–	–	OUT	IN	–	–	–
	–	–	–	–	–	IN	OUT	–	–	–
Defroster	–	–	–	OUT	–	–	IN	–	–	–
Dimmer cancel	–	–	–	IN	IN	IN	OUT	IN	–	–
Driver's seat belt status	IN	–	–	–	–	–	OUT	–	–	–
Engine status (with i-stop)	–	–	–	IN	–	–	OUT	–	–	–
Engine stop request	–	–	–	OUT	–	–	IN	–	–	–
Engine-off time	IN	–	–	IN	–	–	OUT	IN	–	–
Fuel cut request	IN	–	–	–	–	IN	OUT	–	–	–
Fuel-level sensor-related information	OUT	–	–	–	–	–	IN	–	–	–
Gear position	IN	–	–	–	–	–	OUT	IN	–	IN
	–	–	–	–	–	–	OUT	IN	–	–
Gear position/selector lever position	–	–	–	–	–	OUT	IN	–	IN	–
Hazard warning switch status	IN	–	–	–	–	–	OUT	–	–	–
Headlight status	–	–	–	–	–	–	OUT	–	IN	IN
High beam control system customize information	–	–	–	–	–	OUT	IN	–	–	–
	–	–	–	–	–	IN	OUT	–	–	–
Ignition key status	IN	–	–	IN	–	–	OUT	–	–	–
Ignition switch status	–	–	–	–	–	IN	OUT	–	–	–
	IN	–	–	–	–	–	OUT	–	–	–
	IN	IN	IN	IN	–	IN	OUT	–	IN	–
Light switch status	–	IN	IN	–	–	–	OUT	–	–	–
Neutral switch status	–	–	–	–	–	–	OUT	–	–	IN
PAD indicator on status	–	–	–	OUT	OUT	–	IN	–	–	–
Panel light level	–	–	–	IN	IN	–	OUT	–	–	–
Parking assist control signal	–	–	–	–	–	IN	–	–	OUT	–
Parking brake status	IN	–	–	–	–	–	OUT	–	IN	IN
Parking sensor system status	–	–	–	–	–	IN	–	–	IN	OUT
Passing switch status	–	–	–	–	–	–	OUT	–	IN	–
PTC heater operation request	–	–	–	OUT	–	–	IN	–	–	–
Rear body control module (RBCM) customize-related information	IN	–	–	–	–	OUT	–	–	–	–
	OUT	–	–	–	–	IN	–	–	–	–
	OUT	–	–	–	–	IN	IN	–	–	–
	OUT	–	–	–	–	–	IN	–	–	–
Rear fog indicator light on request	OUT	–	–	–	–	–	IN	–	–	–

CONTROL SYSTEM

Signal	CAN system related module									
	Rear body control module (RBCM)	BSM control module (LH)*1	BSM control module (RH)*1	Climate control unit*2	Clock*3	Audio	Instrument cluster	Rear vehicle monitoring control module*4	Rear mount camera*5	Parking sensor control module*6
Rear fog light status	IN	–	–	–	–	–	OUT	–	–	–
Rear vehicle monitoring control module configuration information	–	–	–	–	–	–	OUT	IN	–	–
Rear vehicle monitoring status	–	–	–	–	–	–	IN	OUT	–	–
Rear vehicle monitoring system buzzer on request	–	–	–	–	–	–	IN	OUT	–	–
Rear window defroster operation request	–	–	–	OUT	–	–	IN	–	–	–
Rear window defroster status	–	–	–	IN	–	–	OUT	–	–	–
Rear wiper low speed status	IN	–	–	–	–	–	OUT	–	–	–
ROOM fuse status	–	–	–	IN	–	–	OUT	–	IN	–
	OUT	–	–	–	–	IN	IN	–	–	–
Seat belt status	OUT	–	–	–	–	–	IN	–	–	–
Seat belt warning status (passenger's seat, rear)	–	–	–	IN	IN	–	OUT	–	–	–
Seat warmer cut status	–	–	–	IN	IN	–	OUT	–	–	–
Security indicator light on request	OUT	–	–	–	–	–	IN	–	–	–
Steering angle/ steering angle sensor condition	–	–	–	–	–	–	OUT	–	IN	–
	–	IN	IN	–	–	–	OUT	–	IN	–
Temperature control dial status	–	–	–	OUT	–	–	IN	–	–	–
Theft-deterrent system alarm-related information	OUT	–	–	–	–	–	IN	–	–	–
Theft-deterrent system status	OUT	–	–	–	–	–	IN	–	–	–
Traveled distance	IN	–	–	IN	–	–	OUT	–	–	–
Turn switch status	–	IN	IN	–	–	–	OUT	IN	IN	–
Warning buzzer request signal	–	–	–	–	–	IN	OUT	–	–	–
Wheel speed	–	–	–	–	–	–	OUT	–	IN	–
Windshield washer switch status	–	–	–	–	–	–	OUT	–	–	IN
Windshield wiper operation status	–	–	–	IN	–	–	OUT	–	–	–

*1 : With BSM system
*2 : With full-auto air conditioner
*3 : With manual air conditioner
*4 : With rear vehicle monitoring system
*5 : With rear mount camera
*6 : With parking sensor system

Construction

- The HS-CAN has terminator resistors built into the following units which form the CAN lines.
  — Between PCM terminal 2AK (CAN_H)—2AL terminal (CAN_L), resistance value: **124 ohms**

— Between instrument cluster terminal B (CAN_H)—Terminal D (CAN_L), resistance value:**120 ohms**

- The MS-CAN has terminal resistors built into the following units which form the CAN lines.
  — Rear body control module (RBCM) terminal 4G (CAN_H)—Terminal 4J (CAN_L), resistance value: **120 ohms**
  — instrument cluster terminal C (CAN_H)—Terminal E (CAN_L), resistance value: **120 ohms**

i-stop

11
SECTION

11-11 OUTLINE

OUTLINE

i-stop CONTROL

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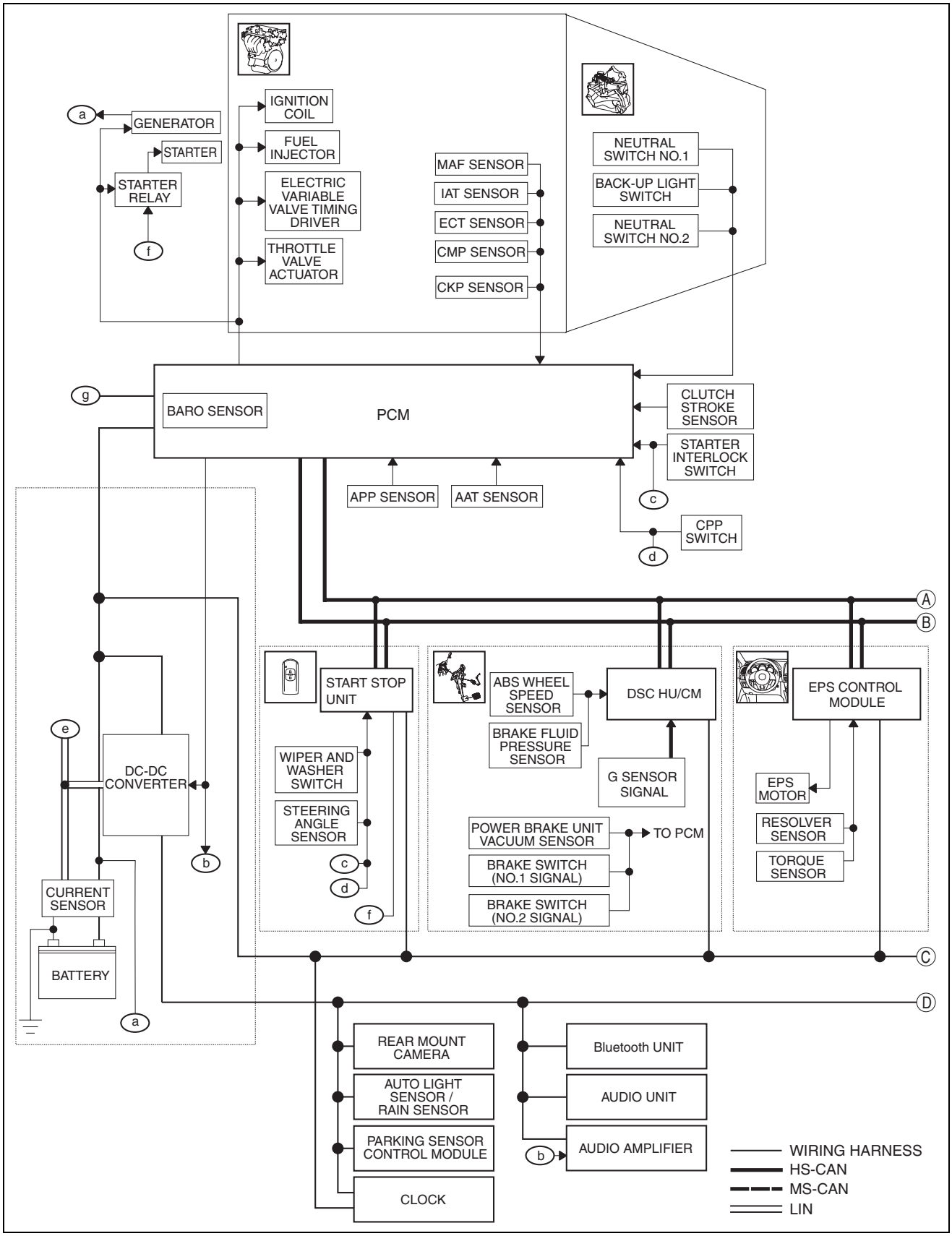
i-stop Control Outline
SKYACTIV-G 2.0 (MTX)



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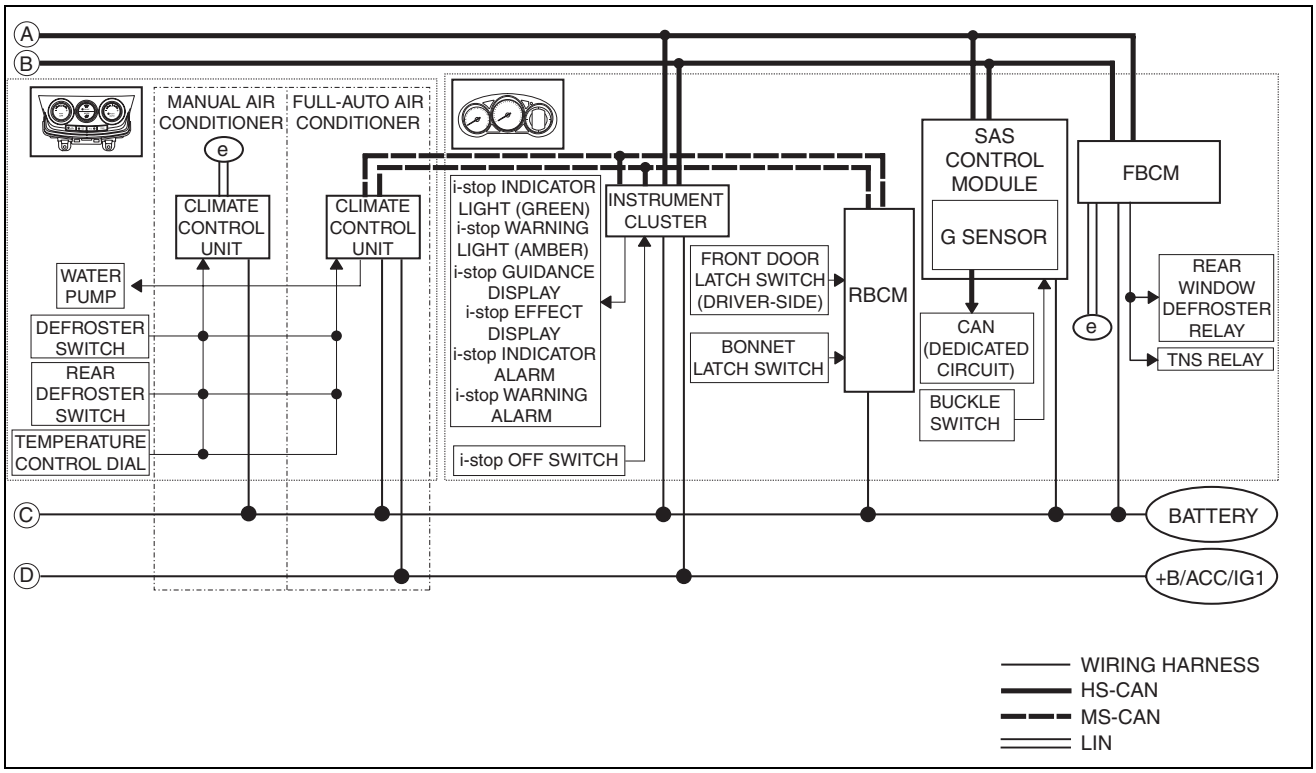
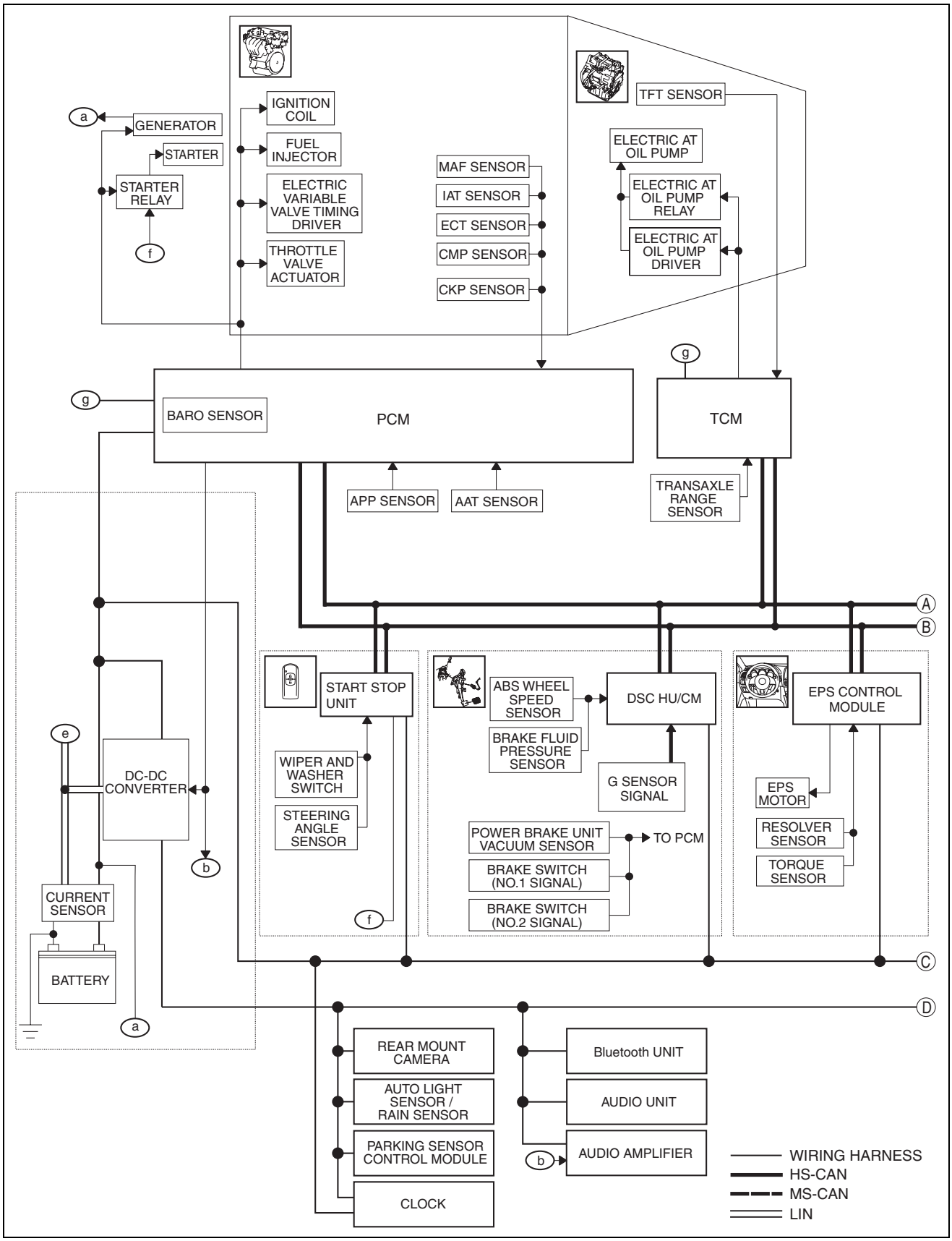

A
B
MANUAL AIR CONDITIONER
FULL-AUTO AIR CONDITIONER
e
CLIMATE CONTROL UNIT
CLIMATE CONTROL UNIT
WATER PUMP
DEFROSTER SWITCH
REAR DEFROSTER SWITCH
TEMPERATURE CONTROL DIAL
i-stop INDICATOR LIGHT (GREEN)
i-stop WARNING LIGHT (AMBER)
i-stop GUIDANCE DISPLAY
i-stop EFFECT DISPLAY
i-stop INDICATOR ALARM
i-stop WARNING ALARM
INSTRUMENT CLUSTER
i-stop OFF SWITCH
FRONT DOOR LATCH SWITCH (DRIVER-SIDE)
BONNET LATCH SWITCH
RBCM
SAS CONTROL MODULE
G SENSOR
CAN (DEDICATED CIRCUIT)
BUCKLE SWITCH
FBCM
e
REAR WINDOW DEFROSTER RELAY
TNS RELAY
C
D
BATTERY
+B/ACC/IG1
WIRING HARNESS
HS-CAN
MS-CAN
LIN

OUTLINE

SKYACTIV-G 2.0 (ATX)



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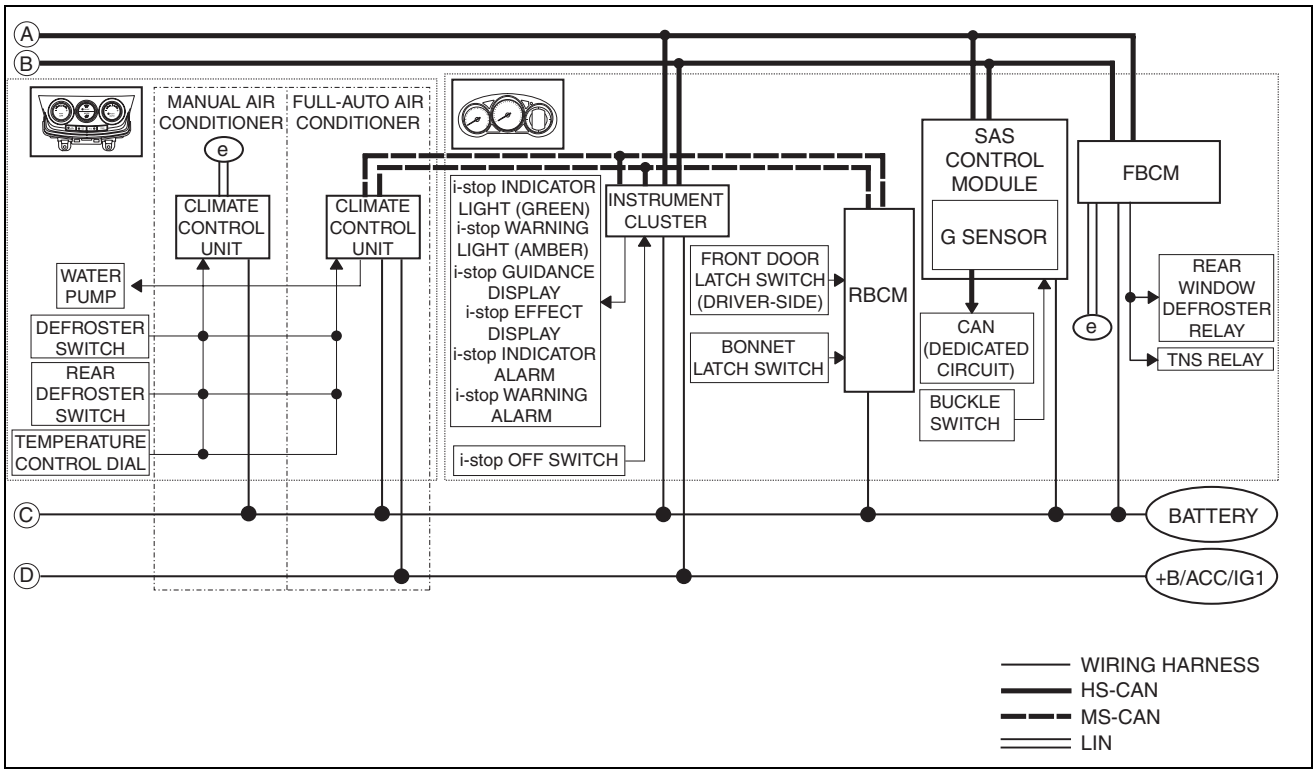
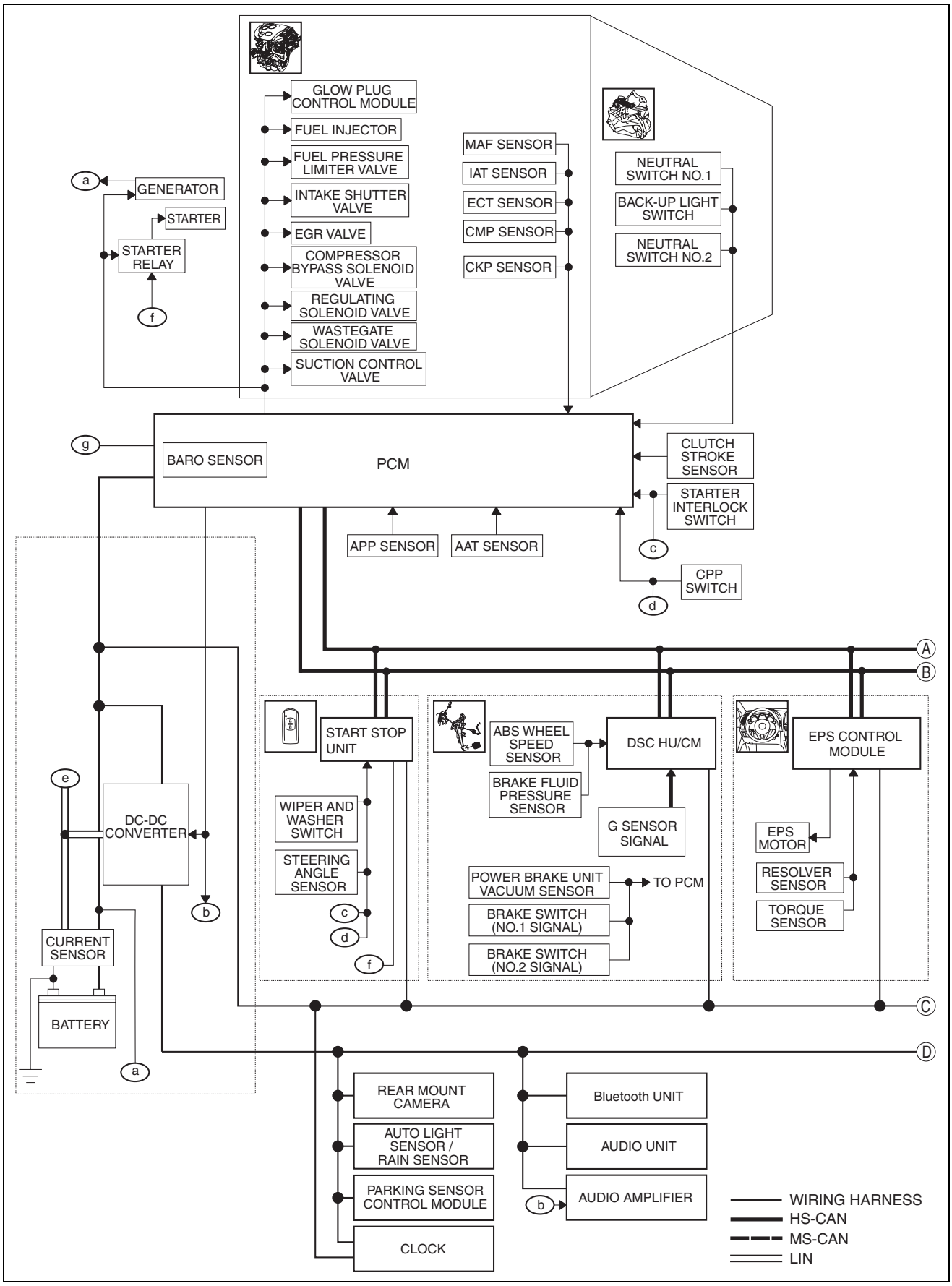

A
B
MANUAL AIR CONDITIONER
FULL-AUTO AIR CONDITIONER
e
CLIMATE CONTROL UNIT
CLIMATE CONTROL UNIT
WATER PUMP
DEFROSTER SWITCH
REAR DEFROSTER SWITCH
TEMPERATURE CONTROL DIAL
i-stop INDICATOR LIGHT (GREEN)
i-stop WARNING LIGHT (AMBER)
i-stop GUIDANCE DISPLAY
i-stop EFFECT DISPLAY
i-stop INDICATOR ALARM
i-stop WARNING ALARM
INSTRUMENT CLUSTER
i-stop OFF SWITCH
FRONT DOOR LATCH SWITCH (DRIVER-SIDE)
BONNET LATCH SWITCH
RBCM
SAS CONTROL MODULE
G SENSOR
CAN (DEDICATED CIRCUIT)
BUCKLE SWITCH
FBCM
e
REAR WINDOW DEFROSTER RELAY
TNS RELAY
C
D
BATTERY
+B/ACC/IG1
WIRING HARNESS
HS-CAN
MS-CAN
LIN

OUTLINE

SKYACTIV-D 2.2 (MTX)



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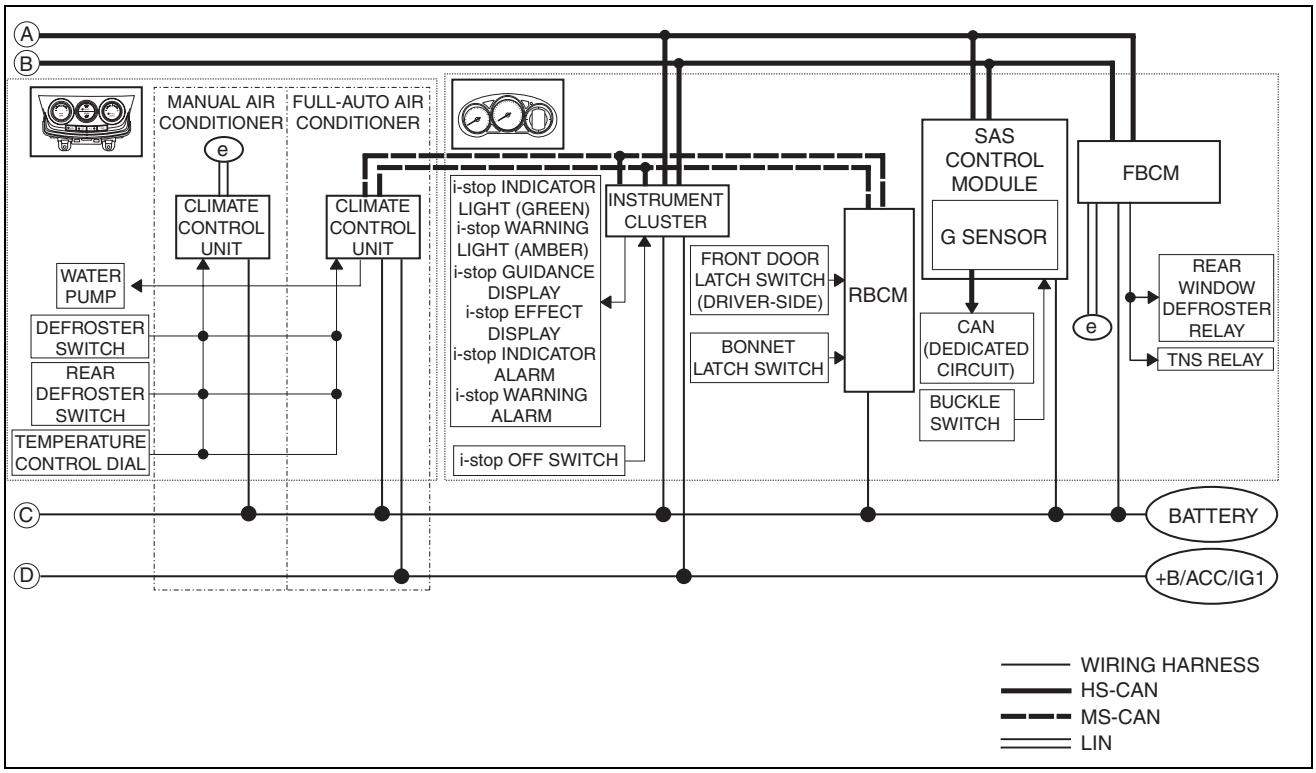
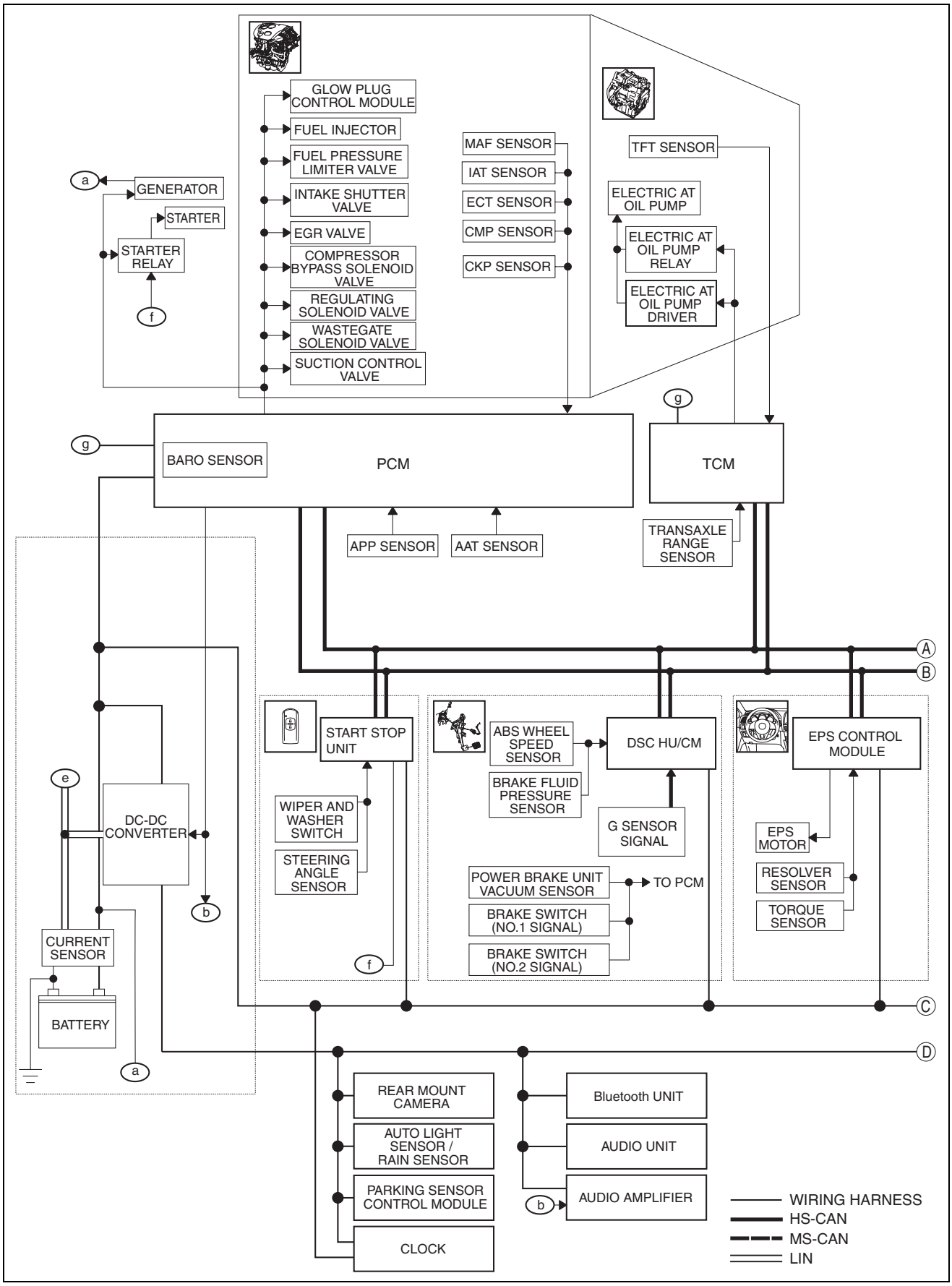

A
B
MANUAL AIR CONDITIONER
FULL-AUTO AIR CONDITIONER
e
CLIMATE CONTROL UNIT
CLIMATE CONTROL UNIT
WATER PUMP
DEFROSTER SWITCH
REAR DEFROSTER SWITCH
TEMPERATURE CONTROL DIAL
i-stop INDICATOR LIGHT (GREEN)
i-stop WARNING LIGHT (AMBER)
i-stop GUIDANCE DISPLAY
i-stop EFFECT DISPLAY
i-stop INDICATOR ALARM
i-stop WARNING ALARM
INSTRUMENT CLUSTER
i-stop OFF SWITCH
FRONT DOOR LATCH SWITCH (DRIVER-SIDE)
BONNET LATCH SWITCH
RBCM
SAS CONTROL MODULE
G SENSOR
CAN (DEDICATED CIRCUIT)
BUCKLE SWITCH
FBCM
e
REAR WINDOW DEFROSTER RELAY
TNS RELAY
C
D
BATTERY
+B/ACC/IG1
WIRING HARNESS
HS-CAN
MS-CAN
LIN

OUTLINE

SKYACTIV-D 2.2 (ATX)



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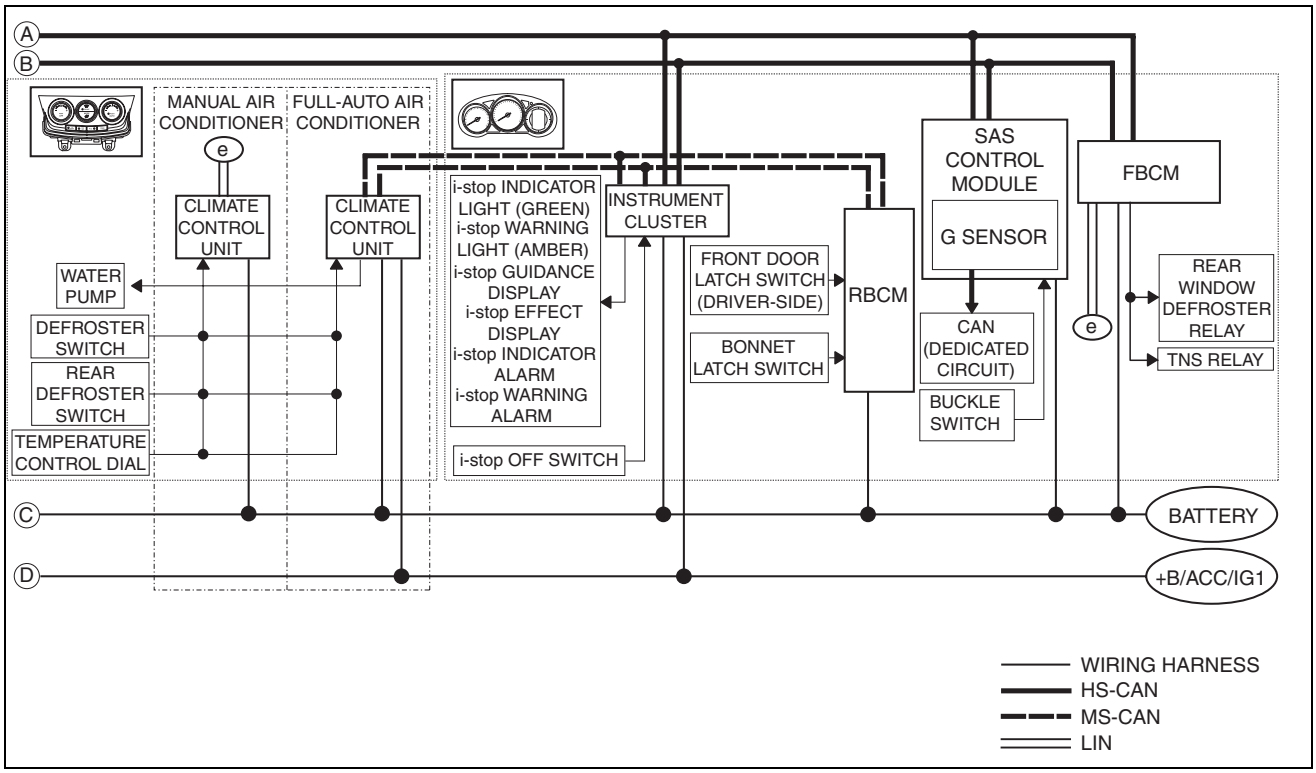

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i-stop Control modules

- i-stop is controlled by the following modules. For details on each of the controls, refer to the control content for each module.

Module name	Reference
PCM	**SKYACTIV-G 2.0** (See 01-40-42 i-stop CONTROL [SKYACTIV-G 2.0].) (See 01-40-54 DC-DC CONVERTER CONTROL [SKYACTIV-G 2.0].) (See 01-40-59 i-stop INDICATOR LIGHT (GREEN) [SKYACTIV-G 2.0].) (See 01-40-65 i-stop WARNING LIGHT (AMBER) [SKYACTIV-G 2.0].)
	SKYACTIV-D 2.2
DSC HU/CM	(See 04-15-24 HILL LAUNCH ASSIST (HLA).)
TCM (ATX)	(See 05-17A-49 ELECTRIC AT OIL PUMP [FW6A-EL, FW6AX-EL].)
START STOP UNIT	(See 09-14-58 START STOP UNIT.)
EPS CONTROL MODULE	(See 06-13-9 ELECTRIC POWER STEERING (EPS) CONTROL MODULE.)
CLIMATE CONTROL UNIT	(See 07-40A-40 AIR CONDITIONER i-stop CONTROL [FULL-AUTO AIR CONDITIONER].) (See 07-40B-18 AIR CONDITIONER i-stop CONTROL [MANUAL AIR CONDITIONER].)
SAS CONTROL MODULE	(See 08-10-3 SAS CONTROL MODULE.)
INSUTRMENT CLUSTER	(See 09-22-32 i-stop INDICATOR ALARM.) (See 09-22-33 i-stop WARNING ALARM.) (See 09-22-67 i-stop GUIDANCE DISPLAY.) (See 09-22-69 i-stop EFFECT DISPLAY.)
FRONT BODY CONTROL MODULE (FBCM)	(See 09-40-1 FRONT BODY CONTROL MODULE (FBCM).)
REAR BODY CONTROL MODULE (RBCM)	(See 09-40-20 REAR BODY CONTROL MODULE (RBCM).)