Fuel System

GENERAL

DIESEL CONTROL SYSTEM

- ENGINE CONTROL MODULE (ECM)
- ENGINE COOLANT TEMPERATURE SENSOR (ECTS)
- CAMSHAFT POSITION SENSOR (CMPS)
- CRANKSHAFT POSITION SENSOR (CKPS)
- MASS AIR FLOW SENSOR (MAFS)
- RAIL PRESSURE SENSOR (RPS)
- BOOST PRESSURE SENSOR (BPS)
- INTAKE AIR TEMPERATURE SENSOR (IATS)
- ACCELERATOR POSITION SENSOR (APS)
- VGT CONTROL SOLENOID VALVE
- FUEL PRESSURE REGULATOR VALVE
- RAIL PRESSURE REGULATOR VALVE
- EGR SOLENOID VALVE
- THROTTLE CONTROL ACTUATOR
- VARIABLE SWIRL CONTROL ACTUATOR
- FUEL TEMPERATURE SENSOR (FTS)
- LAMBDA SENSOR

FUEL DELIVERY SYSTEM-DIESEL

- INJECTOR
- COMMON RAIL
- HIGH PRESSURE FUEL PUMP
- FUEL FILTER
- FUEL TANK

GENERAL

SPECIFICATION E9B0DD87

FUEL DELIVERY SYSTEM

Items	Specification	
Fuel Tank	Capacity	45lit.
Fuel Retrun System	Type	Return
Fuel Filter	Type	High pressure type (built in engine room)
High Pressure Fuel Pump	Type	Mechanical
	Driven by	Belt
Fuel Pressure	Maximum pressure	1,600 bar (160 Mpa, 23,206 psi)

INPUT SENSORS

Mass Air Flow Sensor (MAFS)
▶ Type: Digital type
▶ Specification

INTAKE AIR TEMPERATURE:20℃(68°F)

Air Quantity(Kg/h)	Frequency(KHz)
8	1.96~1.97
10	2.01~2.02
40	2.50~2.52
105	3.18~3.23
220	4.26~4.35
480	7.59~7.94
560	9.08~9.89

INTAKE AIR TEMPERATURE:80℃(176°F)

Air Quantity(Kg/h)	Frequency(KHz)
10	2.00~2.02
40	2.49~2.53
105	3.16~3.25
480	7.42~8.12

ACCELERATOR POSITION SENSOR (APS)

▶ Type: Potentiometer
▶ Specification

Test Condition	Output Voltage(V)	
	APS 1(V)	APS 2(V)
Idle	0.14 ~ 0.16	0.073~0.077
Fully depressed	0.76 ~ 0.88	0.35~0.47

BOOST PRESSURE SENSOR(BPS)

▶ Type: Piezo-resistive type
▶ Specificiation

Pressure(kpa)	Output Voltage(V)
70	1.02~1.17
140	2.13~2.28
210	3.25~3.40
270	4.20~4.35

HEATED OXYGEN SENSOR(HO2S)

▶ Type: Zirconia sensor
▶ Specificiation

SENSOR

λ Value	Pumping Current(A)
0.65	-2.22
0.70	-1.82
0.80	-1.11
0.90	-0.50
1.01	0.00
1.18	0.33
1.43	0.67
1.70	0.94
2.42	1.38
Air (Atmosphere)	2.54

HEATER

Temperature ℃(˚F)	Sensor Resistance (Ω)
20(68)	9.2
100(212)	10.7
200(392)	13.1
300(572)	14.6
400(752)	17.7
500(932)	19.2
600(1112)	20.7
700(1292)	22.5

INTAKE AIR TEMPERATURE SENSOR (IATS)

▶ Type: Thermistor type (Intergrated with BPS)
▶ Specificiation

IATS1(INTEGRATED IN BOOST PRESSURE SENSOR)

Temperature ℃(˚F)	Sensor Resistance (kΩ)
-20(-4)	12.66~15.12
-10(14)	7.94~9.31
0(32)	5.12~5.89
10(50)	3.38~3.83
20(68)	2.29~2.55
30(86)	1.57~1.75
40(104)	1.10~1.24
50(122)	0.78~0.89
60(140)	0.57~0.65
70(158)	0.42~0.49
80(176)	0.31~0.37
90(194)	0.24~0.29
100(212)	0.18~0.22
110(230)	0.14~0.18
120(248)	0.11~0.14
130(266)	0.11~0.14

IATS2(INTEGRATED IN MASS AIR FLOW SENSOR)

Temperature ℃(˚F)	Sensor Resistance (kΩ)
-20(-4)	12.66~15.12
0(32)	5.2~5.9
20(68)	2.29~2.55
80(176)	0.31~0.37

FUEL TEMPERATURE SENSOR (FTS)

▶ Type: Thermistor type
▶ Specificiation

Temperature ℃(˚F)	Sensor Resistance (kΩ)
-20(-4)	15.67
-10(14)	9.45
0(32)	5.89
20(68)	2.27~2.73
40(104)	1.17
60(140)	0.60
80(176)	0.30~0.32
100(212)	0.176
120(248)	0.112

ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

▶ Type: Thermistor type
▶ Specificiation

BETWEEN PIN 1 AND 3(FOR ECTS)

Temperature ℃(˚F)	Sensor Resistance (kΩ)
-20(-4)	14.13 ~ 16.83
0(32)	5.79
20(68)	2.31 ~ 2.59
40(104)	1.15
60(140)	0.59
80(176)	0.32
100(212)	0.19
110(230)	0.15
120(248)	0.17

BETWEEN PIN 1 AND 2(FOR GUAGE)

Temperature ℃(˚F)	Sensor Resistance (Ω)
60(140)	125
85(185)	42.6~54.2
110(230)	22.1~26.2
125(257)	15.2

VEHICLE SPEED SENSOR (OR WHEEL SPEED SENSOR)

▶ Type: Inductive Type

CAMSHAFT POSITION SENSOR (CMPS)

▶ Type: Hall Effect Sensor
▶ Output Voltage (V): 0~5

CRANKSHAFT POSITION SENSOR (CKPS)

▶ Type: Inductive Type
▶ Output Voltage (V): 0~5
▶ Specificiation

Temperature ℃(℉)	Coil Resistance (Ω)
20 (68)	860 ± 10 %

RAIL PRESSURE SENSOR(RPS)

▶ Type: Piezo-resistive type
▶ Specificiation

Item	Idle	Fully depressed
Rail pressure(bar)	220~320	1800
Output Voltage(V)	Below 1.7	Approx. 4.5

OUTPUT ACTUATORS

INJECTOR

▶ Type: Electromagnetic type
▶ Number: 4
▶ Specificiation

Temperature ℃(℉)	Injector Resistance (Ω)
20~70 (68~158)	0.22~0.30

VARIABLE SWIRL VALVE ACTUATOR

▶ Type: Motor driven(Position sensor installed)
▶ Specificiation

MOTOR

Temperature ℃(℉)	Resistance (Ω)
20 (68)	3.2~4.4

POSITION SENSOR

Temperature ℃(℉)	Resistance (Ω)
20 (68)	3.44~5.16

THROTTLE FLAP CONTROL SOLENOID VALVE

▶ Type: Double coil type
▶ Specificiation

Temperature ℃(℉)	Resistance (Ω)
20 (68)	28.3~31.1

VARIABLE GEOMETRY TURBO CHARGER(VGT) CONTROL SOLENOID VALVE

▶ Type: Double coil type
▶ Specificiation

Temperature ℃(℉)	Resistance (Ω)
20 (68)	14.7 ~ 16.1

ELECTRONIC EMISSION GAS RECIRCULATION(EGR) CONTROL VALVE

▶ Type: Linear solenoid(Electric type)
▶ Duty Cycle: 140Hz
▶ Specificiation

Temperature ℃(℉)	Resistance (Ω)
19~25(66.2~77.0)	7.3 ~ 8.3

FUEL PRESSURE REGULATOR

▶ Control type: Inlet control
▶ Duty Cycle: 185Hz
▶ Specificiation

Temperature ℃(℉)	Resistance (Ω)
20 (68)	2.6~3.15

RAIL PRESSURE REGULATOR

▶ Control type: Outlet control
▶ Duty Cycle: 1000Hz
▶ Specificiation

Temperature ℃(℉)	Resistance (Ω)
20 (68)	3.42~3.78

SERVICE STANDARD EF7D1B7E

Basic Idle rpm (after warm up)	A/C OFF	700±100
	A/C ON	750±100

TIGHTENING TORQUES ED9E96D3

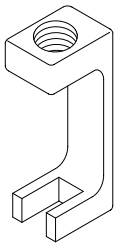
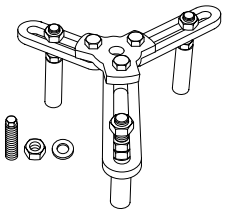
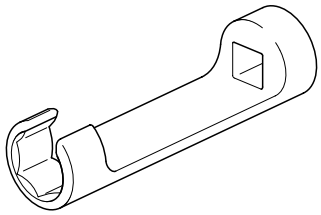
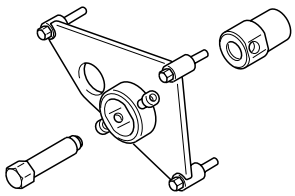
ENGINE CONTROL SYSTEM

Items	N·m	kg·m	lbf·ft
ECM Bracket	7.9~11.8	0.8~1.2	5.8~8.9
Boost Pressure Sensor (BPS)	6.9~10.8	0.7~1.1	5.1~8.0
Crankshaft Position Sensor (CKPS)	5.9~9.8	0.6~1.0	4.3~7.2
Camshaft Position Sensor (CMPS)	6.9~9.8	0.7~1.0	5.1~7.2
Engine Coolant Temperature Sensor (ECTS)	19.6~49.2	2.0~4.0	10.9~14.5
Accelerator Position Sensor (APS)	5.9~7.9	0.6~0.8	4.3~5.8
Vacuum Pump	9.8~11.8	1.0~1.2	7.4~8.9
EGR Pipe to Exhaust System	31.4~37.3	3.2~3.8	23.6~28.0
EGR Pipe to Inlet Manifold System	14.7~19.6	1.5~2.0	10.9~14.5
EGR Valve	21.6~27.5	2.2 ~ 2.8	15.9 ~ 20.3
Variable Swirl Valve Actuator	6.9~10.8	0.7 ~ 1.1	5.1~ 8.0
Heated Oxygen Sensor(HO2S)	40~60	4~6	29.5~44.3

FUEL DELIVERY SYSTEM

Fuel tank band installation bolt	39.2~53.9	4.0 ~ 5.5	28.9 ~ 39.8
Common Rail	14.7~21.6	1.5 ~ 2.2	10.9 ~ 15.9
High Pressure Fuel Pump	15 ~ 19.6	1.5 ~ 2.0	10.9 ~ 14.5
Injector Clamp Bolt	27.5~29.4	2.8 ~ 3.0	20.3 ~ 21.7
High Pressure Fuel Tube(Pump to Rail)	24.5~28.4	2.5 ~ 2.9	18.1~21.0
High Pressure Fuel Tube(Rail to Injectors)	24.5~28.4	2.5 ~ 2.9	18.1~21.0

SPECIAL SERVICE TOOLS E758BEE7

Tool (Number and name)	Illustration	Application
09351-2A100 Injector Remover Adapter	 LCGF062A	Removing the injector
09351-4A200 Injector Remover	 LXGF022A	Removing the injector
09314-27110(14mm) 09314-27120(17mm) Torque Wrench Socket	 AFAF201B	Installing the high pressure pipe
09331-2A000 High Pressure Pump Sprocket Remover	 LXGF021A	Removing the high pressure fuel pump

BASIC TROUBLESHOOTING EFAE5C7F

BASIC TROUBLESHOOTING GUIDE

1	Bring Vehicle to Workshop

2	Analyze Customer's Problem
• Ask the customer about the conditions and environment relative to the issue (Use CUSTOMER PROBLEM ANALYSIS SHEET).	

3	Verify Symptom, and then Check DTC and Freeze Frame Data
• Connect Hi-Scan (Pro) to Diagnostic Link Connector (DLC). • Record the DTC and freeze frame data. ***NOTE*** *To erase DTC and freeze frame data, refer to Step 5.*	

4	Confirm the Inspection Procedure for the System or Part
• Using the SYMPTOM TROUBLESHOOTING GUIDE CHART, choose the correct inspection procedure for the system or part to be checked.	

5	Erase the DTC and Freeze Frame Data
WARNING **NEVER erase DTC and freeze frame data before completing Step 2 MIL/DTC in "CUSTOMER PROBLEM ANALYSIS SHEET".**	

6	Inspect Vehicle Visually
• Go to Step 11, if you recognize the problem.	

7	Recreate (Simulate) Symptoms the DTC
• Try to recreate or simulate the symptoms and conditions of the malfunction as described by customer. • If DTC(s) is/are displayed, simulate the condition according to troubleshooting procedure for the DTC.	

8	Confirm Symptoms of Problem
• If DTC(s) is/are not displayed, go to Step 9. • If DTC(s) is/are displayed, go to Step 11.	

9	Recreate (Simulate) Symptom
• Try to recreate or simulate the condition of the malfunction as described by the customer.	

10	Check the DTC
• If DTC(s) does(do) not occur, refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE. • If DTC(s) occur(s), go to Step 11.	

11	Perform troubleshooting procedure for DTC

12	Adjust or repair the vehicle

13	Confirmation test

14	END

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CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLE INFORMATION

(I) VIN:
(II) Production Date:
(III) Odometer Reading: (mile/㎞)

2. SYMPTOMS

☐ Unable to start	☐ Engine does not turn over ☐ Incomplete combustion ☐ Initial combustion does not occur
☐ Difficult to start	☐ Engine turns over slowly ☐ Other_____
☐ Poor idling	☐ Rough idling ☐ Incorrect idling ☐ Unstable idling (High: _____ rpm, Low: _____rpm) ☐ Other _____
☐ Engine stall	☐ Soon after starting ☐ After accelerator pedal depressed ☐ After accelerator pedal released ☐ During A/C ON ☐ Shifting from N to D-range ☐ Other _____
☐ Others	☐ Poor driving (Surge) ☐ Knocking ☐ Poor fuel economy ☐ Back fire ☐ After fire ☐ Other _____

3. ENVIRONMENT

Problem frequency	☐ Constant ☐ Sometimes (_____) ☐ Once only ☐ Other _____
Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snowy ☐ Other _____
Outdoor temperature	Approx. _____ °C/°F
Place	☐ Highway ☐ Suburbs ☐ Inner City ☐ Uphill ☐ Downhill ☐ Rough road ☐ Other _____
Engine temperature	☐ Cold ☐ Warming up ☐ After warming up ☐ Any temperature
Engine operation	☐ Starting ☐ Just after starting (____ min) ☐ Idling ☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ A/C switch ON/OFF ☐ Other _____

4. MIL/DTC

MIL (Malfunction Indicator Lamp)		☐ Remains ON ☐ Sometimes lights up ☐ Does not light
DTC	Normal Check (Pre-check)	☐ Normal ☐ DTC (_____) ☐ Freeze Frame Data
	Check mode	☐ Normal ☐ DTC (_____) ☐ Freeze Frame Data

BASIC INSPECTION PROCEDURE

MEASURING CONDITION OF ELECTRONIC PARTS' RESISTANCE

The measured resistance at high temperature after vehicle running may be high or low. So all resistance must be measured at ambient temperature (20℃, 68˚F), unless there is any notice.

NOTE

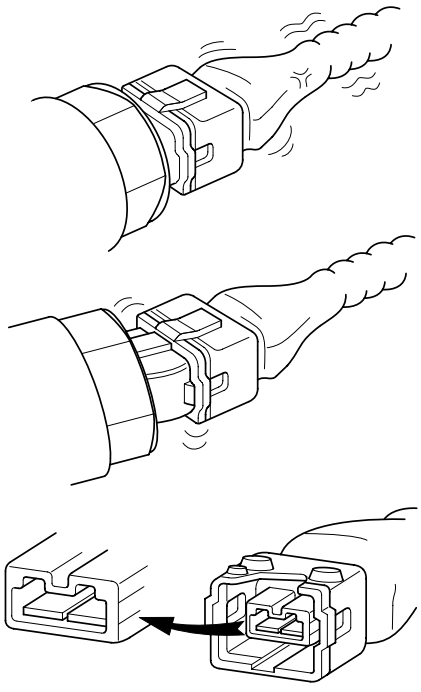
The measured resistance in except for ambient temperature (20℃, 68˚F) is reference value.

INTERMITTENT PROBLEM INSPECTION PROCEDURE

Sometimes the most difficult case in troubleshooting is when a problem symptom occurs but does not occur again during testing. An example would be if a problem appears only when the vehicle is cold but has not appeared when warm. In this case, technician should thoroughly make out a "CUSTOMER PROBLEM ANALYSIS SHEET" and recreate (simulate) the environment and condition which occurred when the vehicle was having the issue.

1. Clear Diagnostic Trouble Code (DTC).

2. Inspect connector connection, and check terminal for poor connections, loose wires, bent, broken or corroded pins, and then verify that the connectors are always securely fastened.



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3. Slightly shake the connector and wiring harness vertically and horizontally.

4. Repair or replace the component that has a problem.

5. Verify that the problem has disappeared with the road test.

● SIMULATING VIBRATION

a. Sensors and Actuators
: Slightly vibrate sensors, actuators or relays with finger.

WARNING

Strong vibration may break sensors, actuators or relays

b. Connectors and Harness
: Lightly shake the connector and wiring harness vertically and then horizontally.

● SIMULATING HEAT

a. Heat components suspected of causing the malfunction with a hair dryer or other heat sourre.

WARNING

- **DO NOT heat components to the point where they may be damaged.**
- **DO NOT heat the ECM directly.**

● SIMULATING WATER SPRINKLING

a. Sprinkle water onto vehicle to simulate a rainy day or a high humidity condition.

WARNING

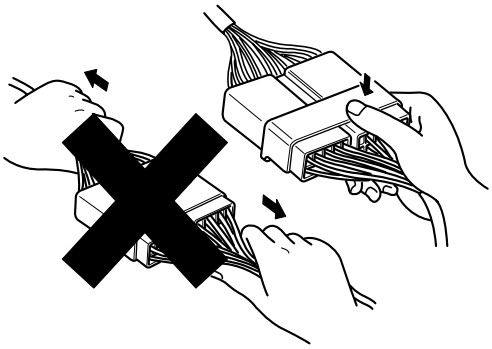
DO NOT sprinkle water directly into the engine compartment or electronic components.

● SIMULATING ELECTRICAL LOAD

a. Turn on all electrical systems to simulate excessive electrical loads (Radios, fans, lights, etc.).

CONNECTOR INSPECTION PROCEDURE

1. Handling of Connector
   a. Never pull on the wiring harness when disconnecting connectors.



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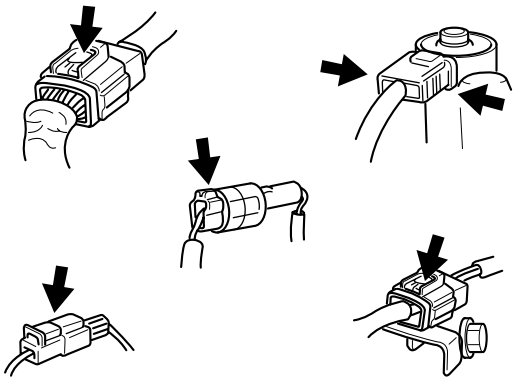
b. When removing the connector with a lock, press or pull locking lever.



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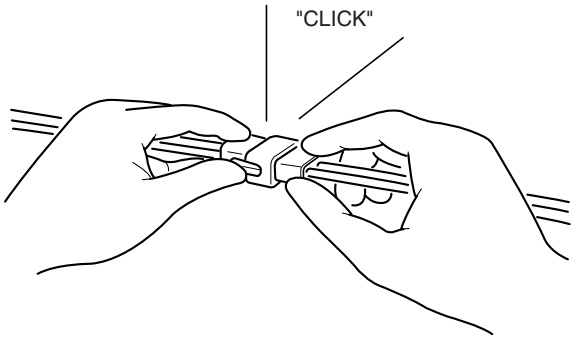
c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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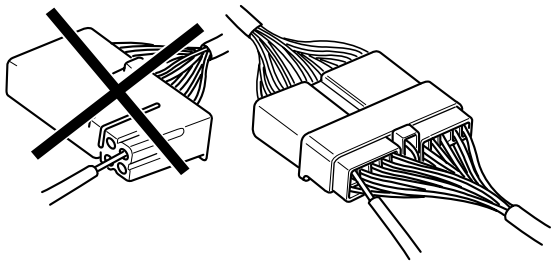
d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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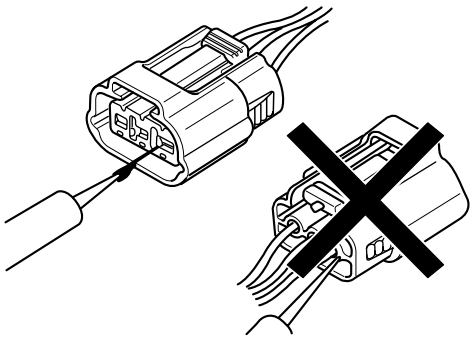
e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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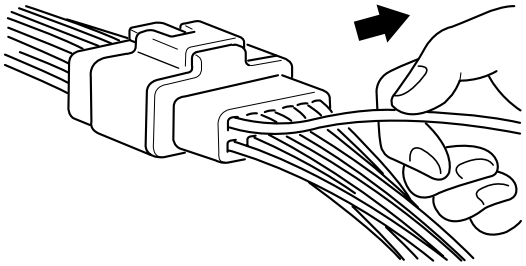
NOTE

- *Use a fine wire to prevent damage to the terminal.*
- *Do not damage the terminal when inserting the tester lead.*

2. Checking Point for Connector
   a. While the connector is connected:
      Hold the connector, check connecting condition and locking efficiency.
   b. When the connector is disconnected:
      Check missed terminal, crimped terminal or broken core wire by slightly pulling the wire harness. Visually check for rust, contamination, deformation and bend.
   c. Check terminal tightening condition:
      Insert a spare male terminal into a female terminal, and then check terminal tightening conditions.

d. Pull lightly on individual wires to ensure that each wire is secured in the terminal.



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3. Repair Method of Connector Terminal
   a. Clean the contact points using air gun and/or shop rag.

   NOTE

   Never use sand paper when polishing the contact points, otherwise the contact point may be damaged.

   b. In case of abnormal contact pressure, replace the female terminal.

WIRE HARNESS INSPECTION PROCEDURE

1. Before removing the wire harness, check the wire harness position and crimping in order to restore it correctly.
2. Check whether the wire harness is twisted, pulled or loosened.
3. Check whether the temperature of the wire harness is abnormally high.
4. Check whether the wire harness is rotating, moving or vibrating against the sharp edge of a part.
5. Check the connection between the wire harness and any installed part.
6. If the covering of wire harness is damaged; secure, repair or replace the harness.

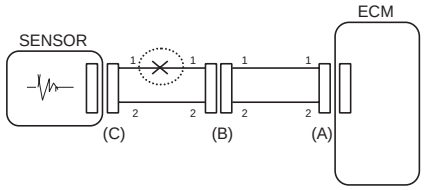
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

● CHECK OPEN CIRCUIT

1. Procedures for Open Circuit
   - Continuity Check
   - Voltage Check

   If an open circuit occurs (as seen in [FIG. 1]), it can be found by performing Step 2 (Continuity Check Method) or Step 3 (Voltage Check Method) as shown below.

FIG 1



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2. Continuity Check Method

   NOTE

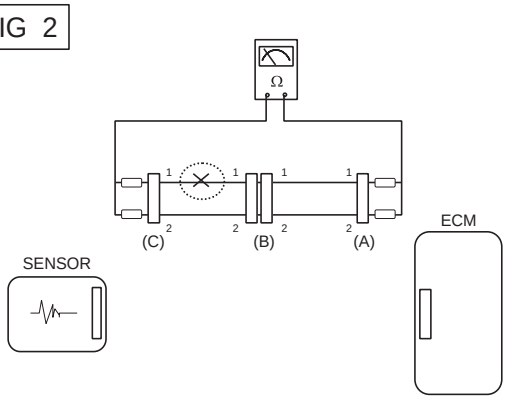
   When measuring for resistance, lightly shake the wire harness above and below or from side to side.

Specification (Resistance)
1Ω or less → Normal Circuit
1 MΩ or Higher → Open Circuit

   a. Disconnect connectors (A), (C) and measure resistance between connector (A) and (C) as shown in [FIG. 2].

      In [FIG.2.] the measured resistance of line 1 and 2 is higher than 1Ω MΩ and below 1 Ω respectively. Specifically the open circuit is line 1 (Line 2 is normal). To find exact break point, check sub line of line 1 as described in next step.

FIG 2



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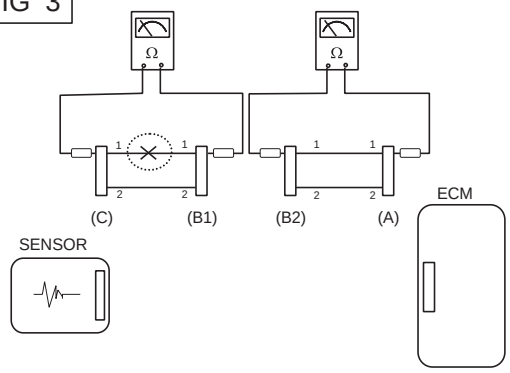
b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

In this case the measured resistance between connector (C) and (B1) is higher than 1MΩ and the open circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).

FIG 3



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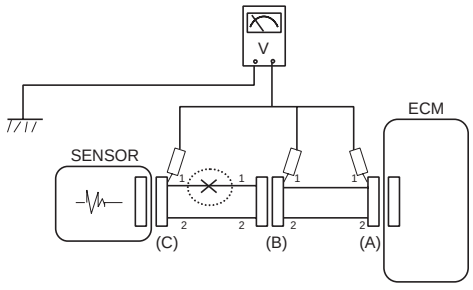
3. Voltage Check Method

a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

The measured voltage of each connector is 5V, 5V and 0V respectively. So the open circuit is between connector (C) and (B).

FIG 4



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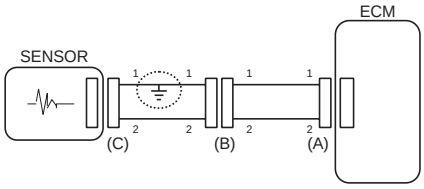
● CHECK SHORT CIRCUIT

1. Test Method for Short to Ground Circuit
   - Continuity Check with Chassis Ground

If short to ground circuit occurs as shown in [FIG. 5], the broken point can be found by performing below Step 2 (Continuity Check Method with Chassis Ground) as shown below.

FIG 5



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2. Continuity Check Method (with Chassis Ground)

NOTE

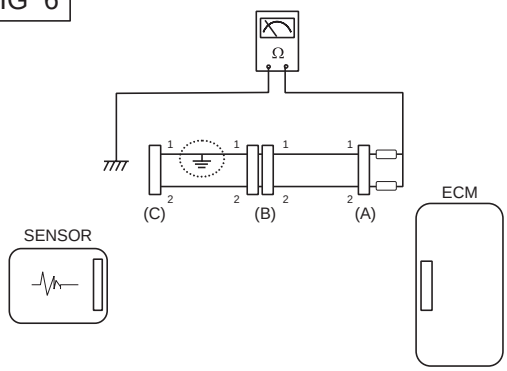
Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

Specification (Resistance)
1Ω or less → Short to Ground Circuit
1MΩ or Higher → Normal Circuit

a. Disconnect connectors (A), (C) and measure for resistance between connector (A) and Chassis Ground as shown in [FIG. 6].

The measured resistance of line 1 and 2 in this example is below 1 Ω and higher than 1MΩ respectively. Specifically the short to ground circuit is line 1 (Line 2 is normal). To find exact broken point, check the sub line of line 1 as described in the folowing step.

FIG 6



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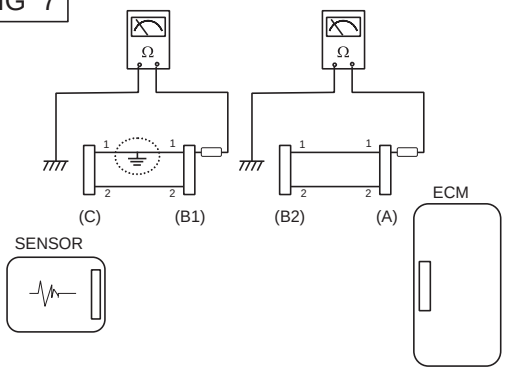
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

The measured resistance between connector (B1) and chassis ground is 1Ω or less. The short to ground circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).

FIG 7



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ACTUATOR TEST

The ACTUATOR TEST mode is to check if the relay, valve, actuator and so on are operated normally.
Before removing parts to inspect or replace them, performing the Actuator test is recommanded.
Perform the ACTUATOR TEST according to the below procedures.

1. Warm up the engine.
2. Turn the ignition switch OFF.
3. Connect the Hi-Scan(or Pro) to the DLC connector.
4. Turn the ignition switch ON.
5. According to the display on tester, select the ACTUATOR TEST mode and perform it.

DISPLAY(HI-SCAN)	TEST METHOD	TEST CONDITION
A/C COMPRESSOR	Control A/C compressor relay ON or OFF.	IG ON, ENG STOP
FAN-LOW SPEED	Control the FAN-LOW SPEED relay ON and operate the fan.	IG ON, ENG STOP
FAN-HIGH SPEED	Control the FAN-HIGH SPEED relay ON and operate the fan.	IG ON, ENG STOP
MIL(ENGINE CHECK)	Turn the lamp ON or OFF.	IG ON, ENG STOP
GLOW IND. LAMP	Turn the lamp ON or OFF.	IG ON, ENG STOP
GLOW RELAY	Control glow relay ON or OFF.	IG ON, ENG STOP
EGR ACTUATOR	Activate the EGR actuator ON or OFF	IG ON, ENG STOP
FUEL PRESSURE REGULATOR VALVE	Activate the valve ON or OFF.	IG ON, ENG STOP
IMMOBILIZER INDICATOR LAMP	Turn the lamp ON or OFF.	IG ON, ENG STOP
CRUISE CONTROL LAMP	Turn the lamp ON or OFF.	IG ON, ENG STOP
VGT ACTUATOR	Activate the VGT actuator ON or OFF	IG ON, ENG STOP
THROTTLE FLAP ACRUATOR	Activate the throttle actuator ON or OFF	IG ON, ENG STOP
VARIABLE SWIRL ACTUATOR	Activate Variable Swirl actuator ON or OFF	IG ON, ENG STOP
RAIL PRESSURE REGULATOR VALVE	Activate the valve ON or OFF	IG ON, ENG STOP
PTC HEATER RELAY	Control PTC heater relay ON or OFF	IG ON, ENG STOP

SYMPTOM TROUBLESHOOTING GUIDE CHART(I)

Problem	Possible cause
Engine does not start	Run out of fuel
	Starter faulty
	Pump hose supply cut
	High pressure leakage
	Fuse out of order
	The compensation of individual injector not adapted
	Drift of the rail pressure sensor not detected
	Cam and Crank signals missing simultaneously
	Battery voltage too low
	Faulty antitheft or immobilizer
	EGR valve blocked open
	Fuel pressure regulator valve contaminated, stuck, jammed
	Rail pressure control valve contaminated, stuck, jammed
	Fuel quality / presence of water
	Inversion of low pressure fuel connections
	Fuel filter not adapted
	Low pressure fuel circuit sealed
	Sealed fuel filter
	Intermittent fault connection
	Air ingress in the low pressure fuel circuit
	Fuel return circuit of the pump sealed
	Engine compression too low
	Leakage at the injector valve
	Low pressure fuel pump faulty
	High pressure fuel pump faulty
	Injector jammed open
	Bug software or hardware fault not detected

Problem	Possible cause
Engine starts with difficulty or starts and stalls	Run out of fuel
	Fuel return hose of nozzle holder cut
	High pressure leakage
	Fuse faulty
	Air filter sealed
	Alternator or voltage regulator faulty
	The compensation of individual injector not adapted
	Drift of the engine coolant temperature sensor not detected
	Drift of the rail pressure sensor not detected
	Battery voltage too low
	EGR valve blocked open
	Fuel pressure regulator valve contaminated, stuck, jammed
	Rail pressure control valve contaminated, stuck, jammed
	Fuel quality / presence of water
	Inversion of low pressure fuel connections
	Low pressure fuel circuit sealed
	Sealed fuel filter
	Oil level too high/too low
	Catalytic converter sealed or damaged
	Intermittent fault connection
	Air ingress in the low pressure fuel circuit
	Fuel return circuit of the pump sealed
	Glow system faulty
	Engine compression too low
	Fuel return hose of nozzle holder sealed
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Petrol in fuel
	Bug software or hardware fault not detected

Problem	Possible cause
Poor starting when hot	The compensation of individual injector not adapted
	Drift of the rail pressure sensor not detected
	EGR valve blocked open
	Fuel pressure regulator valve contaminated, stuck, jammed
	Rail pressure control valve contaminated, stuck, jammed
	Air filter sealed
	Air ingress in the low pressure fuel circuit
	Fuel quality / presence of water
	Fuel return circuit of the pump sealed
	Sealed fuel filter
	Engine compression too low
	Intermittent fault connection
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Petrol in fuel
	Bug software or hardware fault not detected
Unstable idling	Fuel return hose of nozzle holder cut
	The compensation of individual injector not adapted
	Drift of the rail pressure sensor not detected
	Harness resistance increased
	Air ingress in the low pressure fuel circuit
	Fuel quality / presence of water
	Sealed fuel filter
	Air filter sealed
	Fuel return hose of nozzle holder sealed
	High pressure leakage
	Glow system faulty
	Engine compression too low
	Bad flanging of the injector
	High pressure pump out of order
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Injector jammed open
Idle speed too high/too low	Drift of the engine coolant temperature sensor not detected
	Incorrect state of the electrical pack devices
	Alternator or voltage regulator faulty
	Clutch not well set
	Bug software or hardware fault not detected

Problem	Possible cause
Blue, white, black smokes	The compensation of individual injector not adapted
	Drift of the engine coolant temperature sensor not detected
	Drift of the rail pressure sensor not detected
	EGR valve blocked open
	Fuel pressure regulator valve contaminated, stuck, jammed
	Rail pressure control valve contaminated, stuck, jammed
	Oil level too high/too low
	Fuel quality / presence of water
	Catalytic converter sealed or damaged
	Air filter sealed
	Oil suction (engine racing)
	Glow system faulty
	Engine compression too low
	Bad flanging of the injector
	Injector washer not adapted, forgotten, doubled
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Injector jammed open
	Petrol in fuel
Engine rattling, noisy engine	The compensation of individual injector not adapted
	EGR valve blocked closed (noisy engine)
	EGR valve blocked open
	Drift of the engine coolant temperature sensor not detected
	Glow system faulty
	Engine compression too low
	Fuel return hose of nozzle holder sealed
	Drift of the rail pressure sensor not detected
	Injector washer not adapted, forgotten, doubled
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Injector jammed open
Burst noise	The compensation of individual injector not adapted
	Intermittent fault connection
	Exhaust system sealed
	Drift of the rail pressure sensor not detected
	Fuel pressure regulator valve contaminated, stuck, jammed
	Rail pressure control valve contaminated, stuck, jammed
	Bug software or hardware fault not detected

Problem	Possible cause
Untimely acceleration/deceler-ation and engine racing	Accelerator position sensor blocked
	EGR valve blocked open
	Intermittent fault connection
	Oil suction (engine racing)
	Drift of the rail pressure sensor not detected
	Bug software or hardware fault not detected
Gap when accelerating and at re-coupling (response time)	Air inlet circuit open
	Incorrect state of the electrical pack devices
	Accelerator position sensor blocked
	EGR valve blocked open
	Turbo charger damaged
	Sealed fuel filter
	Engine compression too low
	High pressure leakage
	Fuel pressure regulator valve contaminated, stuck, jammed
	Rail pressure control valve contaminated, stuck, jammed
	Needle stuck (injection possible over a certain pressure)
	Bug software or hardware fault not detected
Engine stop/ stalling	Run out of fuel
	Pump hose supply cut
	High pressure leakage
	Fuse faulty
	Fuel quality / presence of water
	Low pressure fuel circuit sealed
	Sealed fuel filter
	Cam and Crank signals missing simultaneously
	EGR valve blocked open
	Fuel pressure regulator valve contaminated, stuck, jammed
	Rail pressure control valve contaminated, stuck, jammed
	Alternator or voltage regulator faulty
	Intermittent fault connection
	Catalytic converter sealed or damaged
	Oil suction (engine racing)
	Low pressure fuel pump faulty
	High pressure pump faulty
	Faulty ignition key
	Petrol in fuel
	Bug software or hardware fault not detected

Problem	Possible cause
Engine judder	Run out of fuel
	Fuel return hose of nozzle holder cut
	Incorrect state of the electrical pack devices
	The compensation of individual injector not adapted
	EGR valve blocked open
	Fuel filter not adapted
	Air ingress in the low pressure fuel circuit
	Fuel quality / presence of water
	Sealed fuel filter
	Intermittent fault connection
	Harness resistance increased
	Glow system faulty
	Engine compression too low
	Fuel return hose of nozzle holder sealed
	Valve clearance
	Low pressure fuel pump faulty
	Injector washer not adapted, forgotten, doubled
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Injector jammed open
	Petrol in fuel
	Bug software or hardware fault not detected
Lack of power	The compensation of individual injector not adapted
	Accelerator position sensor blocked
	Incorrect state of the electrical pack devices
	EGR valve blocked open
	Air inlet circuit open
	Air filter sealed
	Oil level too high/too low
	Catalytic converter sealed or damaged
	Turbo charger damaged
	Sealed fuel filter
	Leakage at the injector valve
	Fuel return circuit of the pump sealed
	Fuel return hose of nozzle holder sealed
	Engine compression too low
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Valve clearance

Problem	Possible cause
Too much power	EGR valve blocked closed (noisy engine)
	The compensation of individual injector not adapted
	Oil suction (engine racing)
	Bug software or hardware fault not detected
Excessive fuel consumption	Fuel return hose of nozzle holder cut
	Leakage at the Fuel pressure regulator valve
	Leakage at fuel temperature sensor
	Leakage at the spacers
	High pressure leakage
	Air inlet circuit open
	Air filter sealed
	The compensation of individual injector not adapted
	EGR valve blocked open
	Incorrect state of the electrical pack devices
	Oil level too high/too low
	Fuel quality / presence of water
	Catalytic converter sealed or damaged
	Turbo charger damaged
	Engine compression too low
	Injector not adapted
	Bug software or hardware fault not detected
Over speed engine when changing the gear box ratio	Accelerator position sensor blocked
	The compensation of individual injector not adapted
	Intermittent fault connection
	Clutch not well set
	Oil suction (engine racing)
	Turbo charger damaged
	Injector not adapted
	Bug software or hardware fault not detected

Problem	Possible cause
Exhaust smells	EGR valve blocked open
	Oil suction (engine racing)
	Turbo charger damaged
	Oil level too high/too low
	The compensation of individual injector not adapted
	Catalytic converter sealed or damaged
	Bad flanging of the injector
	Injector washer not adapted, forgotten, doubled
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Injector jammed open
	Bug software or hardware fault not detected
Smokes (black, white, blue) when accelerating	The compensation of individual injector not adapted
	EGR valve blocked open
	Air filter sealed
	Fuel quality / presence of water
	Oil level too high/too low
	Turbo charger damaged
	Catalytic converter sealed or damaged
	Oil suction (engine racing)
	Air heaters out of order
	Engine compression too low
	High pressure leakage
	Intermittent fault connection
	Bad flanging of the injector
	Injector washer not adapted, forgotten, doubled
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Injector jammed open
	Petrol in fuel
	Bug software or hardware fault not detected
Fuel smells	Pump hose supply cut
	Fuel return hose of nozzle holder cut
	Leakage at the Fuel pressure regulator valve
	Leakage at fuel temperature sensor
	Leakage at the spacers
	High pressure leakage

Problem	Possible cause
The engine collapses at take off	Accelerator position sensor blocked
	Incorrect state of the electrical pack devices
	Air filter sealed
	Inversion of low pressure fuel connections
	Fuel filter not adapted
	Fuel quality/presence of water
	Air ingress in the low pressure fuel circuit
	Sealed fuel filter
	Catalytic converter sealed or damaged
	Clutch not well set
	Intermittent fault connection
	Drift of the rail pressure sensor not detected
	Fuel pressure regulator valve contaminated, stuck, jammed
	Rail pressure control valve contaminated, stuck, jammed
	Petrol in fuel
	Bug software or hardware fault not detected
The engine does not stop	Faulty ignition key
	Oil suction (engine racing)
	Bug software or hardware fault not detected
Different mechanical noises	Buzzer noise (discharge by the injectors)
	Clip broken (vibrations, resonance, noises)
	Incorrect state of the electrical pack devices
	Catalytic converter sealed or damaged
	Air inlet circuit open
	Bad flanging of the injector
	Clutch not well set
	Turbo charger damaged
	Valve clearance

SYMPTOM TROUBLESHOOTING GUIDE CHART (II)

Trouble symtoms / Check items	Engine will not start	Engine shut off and then restart	Engine starts only with difficult	High idle no throttle take-up	Knocking on accel. (warm-up phases)	Vibration at idle	Reduced power	Engine does not run smothly, misfiring, knocking	Bucking
Self-diagnosis	1	1	1	1	1	1	1	1	1
Immobilizer	2								
Vehicle supply voltage	3		2					9	3
Main Relay	4	3	3					11	4
Fuse/plug wiring harness	5	2						8	2
Ignition switch signal	6	4	4					10	5
Crankshaft Position Sensor	7							12	
No fuel	8								
Wrong fuel	9	5	7			2	5	3	
Lack of fuel								2	
Air in fuel system	10	6	8			3		4	
Low-pressure circuit (fuel)	11	7	13			4	6	7	
High-pressure circuit (fuel)	16	8	14			14	19	16	
Fuel filter	12		9			5	7	5	
Electric fuel pump	15		11					6	
Fuel pre-heater	13		10			6	8		
Fuel pressure regulator valve / Rail pressure control valve	18	9	16			13		15	
Incorrect connection of injector	14		17		3	11		13	
Injector	17	10	19		4	10	18	14	
Engine mechanical components (compression, valve clearance...)	19		20				20	19	9
Defective ECM	20								
Camshaft Position sensor			5						
Engine Coolant Temperature Sensor			15		2		16		
Loss of coolant									
Glow-plug system			16						

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Trouble symtoms / Check items	Engine will not start	Engine shut off and then restart	Engine starts only with difficult	High idle no throttle take-up	Knocking on accel. (warm-up phases)	Vibration at idle	Reduced power	Engine does not run smothly, misfiring, knocking	Bucking
Rail Pressure Sensor	21		18			12	17	17	
Accelerator Position Sensor				2			9		
Mechanical fault in accelerator pedal				3			10		
EGR						7	11		
Mass Air Flow Sensor						9	15		
Air filter clogged			12			8	4		
Vacuum system leaking							2		
Turbocharger defective							12		
VGT valve connection							13		
Boost Pressure Sensor							3		
Checking timing belt tension								18	
Clutch switch									6
Brake switch									7
Vehicle speed signal									8
Checking oil level									
Radiator fan									
Radiator defective or clogged									
Ignition switch defective									
A/CON compressor switch									
A/CON switch									
Plug contacts			6						
Leak in connecting surface between turbochager and Intake manifold							14		
High pressure pump	22		21				21		

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Trouble symtoms / Check items	Engine overrun, Accel.	White/Blue smoke	Clouds of black smoke	Engine overheating	Can not shut off with ignition key	Diagnosis lamp not go out or flickers	A/CON cannot be switched on	Radiator fan constantly in operation
Self-diagnosis	1	1	1	1	1	1	1	1
Immobilizer								
Vehicle supply voltage								
Main Relay								
Fuse/plug wiring harness					4	2	2	4
Ignition switch signal					3			
Crankshaft Position Sensor								
No fuel								
Wrong fuel				2				
Lack of fuel								
Air in fuel system		3						
Low-pressure circuit (fuel)		6						
High-pressure circuit (fuel)	7							
Fuel filter		4						
Electric fuel pump								
Fuel pre-heater		5						
Fuel pressure Regulator Valve / Raill pressure control Valve	6							
Incorrect connection of injector								
Injector								
Engine mechanical components (compression, valve clearance...)			8	7				
Defective ECM					5			
Camshaft Position sensor								
Engine Coolant Temperature Sensor	8	2	7	3			5	3
Loss of coolant				6				
Glow-plug system								

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Trouble symtoms / Check items	Engine overrun, Accel.	White/Blue smoke	Clouds of black smoke	Engine overheating	Can not shut off with ignition key	Diagnosis lamp not go out or flickers	A/CON cannot be switched on	Radiator fan constantly in operation
Rail Pressure Sensor								
Accelerator Position Sensor	3						6	
Mechanical fault in accelerator pedal	2							
EGR			3					
Mass Air Flow Sensor			6					
Air filter clogged			2					
Vacuum system leaking			4					
Turbocharger defective	4							
VGT valve connection	5							
Boost Pressure Sensor	9		5					
Checking timing belt tension								
Clutch switch								
Brake switch								
Vehicle speed signal								
Checking oil level		7						
Radiator fan				4				
Radiator defective or clogged				5				
Ignition switch defective					2			
A/CON compressor switch							4	2
A/CON switch							3	
Plug contacts								
Leak in connecting surface between turbochager and Intake manifold								

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FAIL-SAFE CHART

When any of the following codes is recorded, the ECM enters into the fail-safe mode.

DTC	Fail-Safe Operation	Deactivation Condition
P0047	Fuel injection and engine power are restricted.	Normal state is kept for 1.0 sec.
P0048	Fuel injection and engine power are restricted.	Normal state is kept for 1.0 sec.
P0069	Boost pressure sensor output is fixed at 1000hPa.	Normal state is kept for 0.5 sec.
P0097 P0098	Intake air temperature sensor(Integrated in BPS) output is fixed at 28℃.	Normal state is kept for 0.5 sec.
P0101	Fuel injection and engine power are restricted.	Normal state is kept for 1.5 sec.
P0102	Fuel injection and engine power are restricted.	Normal state is kept for 1.0 sec.
P0103	Boost pressure sensor output is fixed at 1000hPa.	Normal state is kept for 1.0 sec.
P0107 P0108	Barometic pressure is fixed at 1000hPa.	Normal state is kept for 0.5 sec.
P0112 P0113	Intake air temperature sensor(Integrated in MAFS) output is fixed at 50℃.	Normal state is kept for 0.5 sec.
P0117 P0118	• If DTC being detected after cranking, ECM senses coolant temperature is 80℃. If DTC being detected in cranking, ECM senses coolant temperature is -10℃. • A/C and auxilary heater operation is inhibited. • Cooling fan keeps being operated.	Normal state is kept for 0.48 sec.
P0182 P0183	Fuel temperature sensor output is fixed at 40℃.	Normal state is kept for 0.5 sec.
P0192 P0193	Rail pressure sensor output is fixed at 330bar.	Normal state is kept for 0.48 sec.
P0237 P0238	Boost pressure sensor output is fixed at 1000hPa.	Normal state is kept for 1.0 sec.
P0532 P0533	A/C pressure is fixed at 4000hPa.	Normal state is kept for 0.6 sec.
P0562 P0563	Battery voltage is fixed at 7.9V.	Normal state is kept for 0.1 sec.
P0642	Engine speed is fixed at 1200 rpm.	Normal state is kept for 0.1 sec.
P0643	Engine speed is fixed at 1200 rpm.	Normal state is kept for 0.1 sec.
P0652 P0653	• Engine speed is fixed at 1200 rpm. • Rail pressure sensor output is fixed at 330bar.	Normal state is kept for 0.1 sec.
P0698 P0699	A/C pressure is fixed at 4000hPa.	Normal state is kept for 0.1 sec.
P2123	Engine speed is fixed at 1200 rpm.	Normal state is kept for 0.1 sec.
P2128	Engine speed is fixed at 1200 rpm.	Normal state is kept for 0.1 sec.
P2138	Engine speed is fixed at 1200 rpm.	Normal state is kept for 0.1 sec.

DTC	Fail-Safe Operation	Deactivation Condition
P2264	Fuel injection and engine power are restricted.	Soon after normal state
P2299	Engine speed is fixed at 1200 rpm.	Normal state is kept for 0.1 sec.

DIESEL CONTROL SYSTEM

DESCRIPTION E28422F5

If the Diesel Engine Control system components (sensors, ECM, injector, etc.) fail, interruption to the fuel supply or failure to supply the proper amount of fuel for various engine operating conditions will result. The following situations may be encountered.

1. Engine is hard to start or does not start at all.
2. Unstable idle.
3. Poor driveability

If any of the above conditions are noted, first perform a routine diagnosis that includes basic engine checks (Ignition system malfunction, incorrect engine adjustment, etc.). Then, inspect the Diesel Engine Control system components with the HI-SCAN (Pro).

NOTE

- *Before removing or installing any part, read the diagnostic trouble codes and then disconnect the battery negative (-) terminal.*
- *Before disconnecting the cable from battery terminal, turn the ignition switch to OFF. Removal or connection of the battery cable during engine operation or while the ignition switch is ON could cause damage to the ECM.*
- *When checking the generator for the charging state, do not disconnect the battery '+' terminal to prevent the ECM from damage due to the voltage.*
- *When charging the battery with the external charger, disconnect the vehicle side battery terminals to prevent damage to the ECM.*

MALFUNCTION INDICATOR LAMP (MIL)

[EOBD]

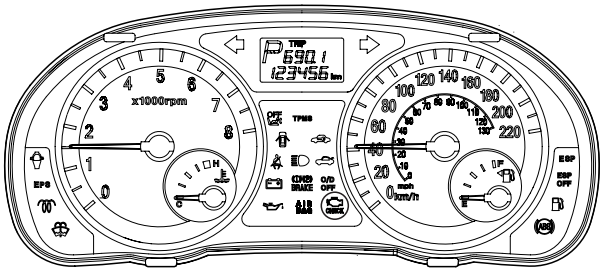
A malfunction indicator lamp illuminates to notify the driver that there is a problem with the vehicle. However, the MIL will go off automatically after 3 subsequent sequential driving cycles without the same malfunction. Immediately after the ignition switch is turned on (ON position - do not start), the MIL will illuminate continuously to indicate that the MIL operates normally.

Faults with the following items will illuminate the MIL.

- Mass Air Flow Sensor (MAFS)
- Vacuum Modulator for EGR

NOTE

Refer to "INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC)" for more information.



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[NON-EOBD]

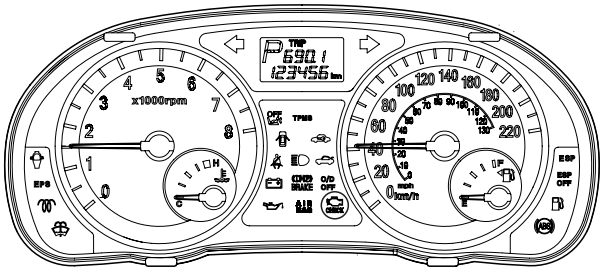
A malfunction indicator lamp illuminates to notify the driver that there is a problem with the vehicle. However, the MIL will go off automatically after 3 subsequent sequential driving cycles without the same malfunction. Immediately after the ignition switch is turned on (ON position - do not start), the MIL will illuminate continuously to indicate that the MIL operates normally.

Faults with the following items will illuminate the MIL

- EGR
- EEEP ROM
- Injector
- Fuel pressure sensor
- Fuel pressure monitoring
- Variable Geometry Turbocharger(VGT)
- Accelerator Position Sensor (APS)
- Mass Air Flow Sensor (MAFS)
- Fuel pressure regulator

NOTE

Refer to "INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC)" for more information.



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[INSPECTION]

1. After turning ON the ignition key, ensure that the light illuminates for about 5 seconds and then goes out.

2. If the light does not illuminate, check for an open circuit in the harness, a blown fuse or a blown bulb.

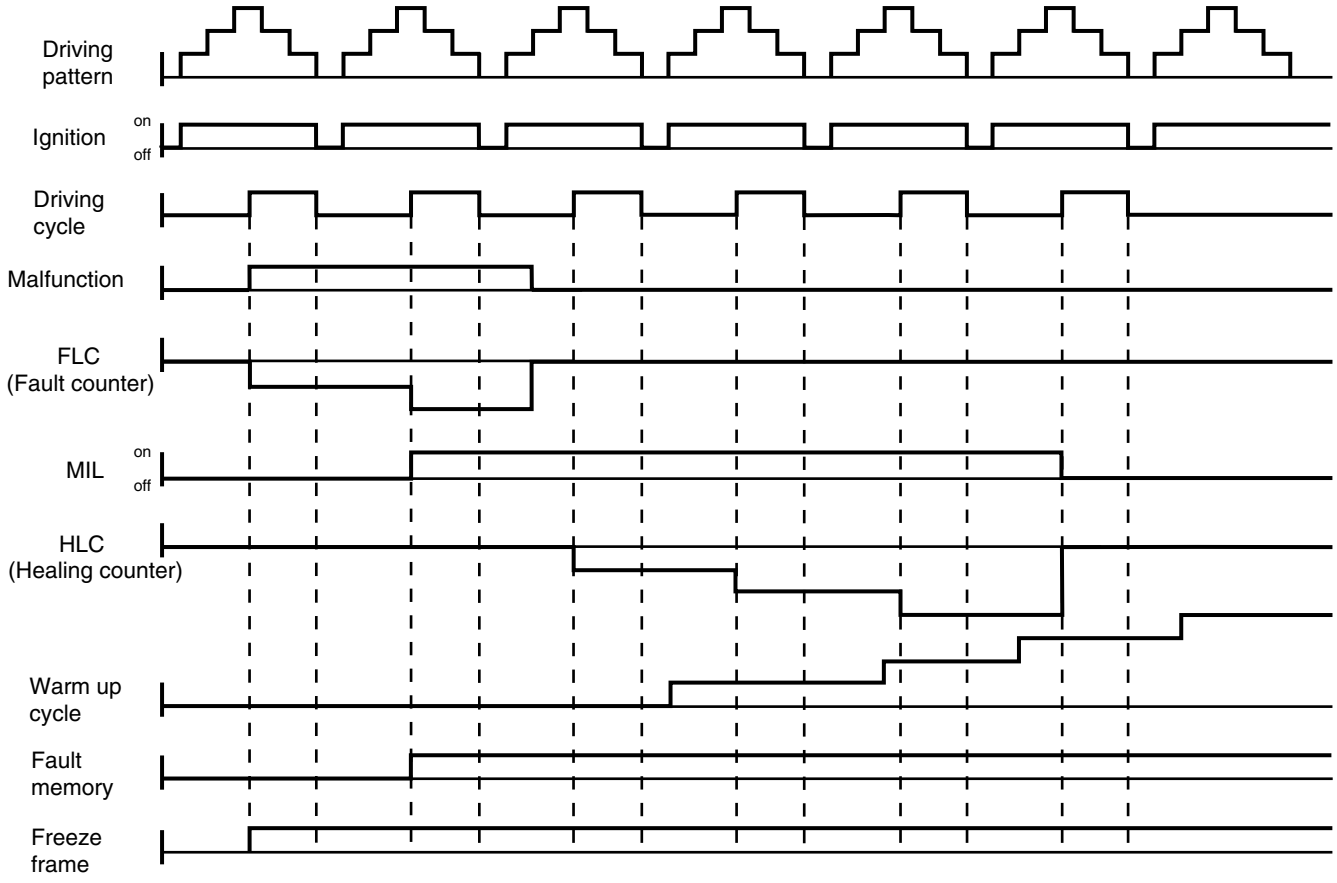
SELF-DIAGNOSIS

The ECM monitors the input/output signals (some signals at all times and the others under specified conditions). When the ECM detects an irregularity, it records the diagnostic trouble code, and outputs the signal to the Data Link connector. The diagnosis results can be read with the MIL or HI-SCAN (Pro). Diagnostic Trouble Codes (DTC) will remain in the ECM as long as battery power is maintained. The diagnostic trouble codes will, however, be erased when the battery terminal or ECM connector is disconnected, or by the HI-SCAN (Pro).

NOTE

If a sensor connector is disconnected with the ignition switch turned on, the diagnostic trouble code (DTC) is recorded. In this case, disconnect the battery negative terminal (-) for 15 seconds or more, and the diagnosis memory will be erased.

THE RELATION BETWEEN DTC AND DRIVING PATTERN IN EOBD SYSTEM



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1. When the same malfunction is detected and maintained during two sequential driving cycles, the MIL will automatically illuminate.

2. The MIL will go off automatically if no fault is detected after 3 sequential driving cycles.

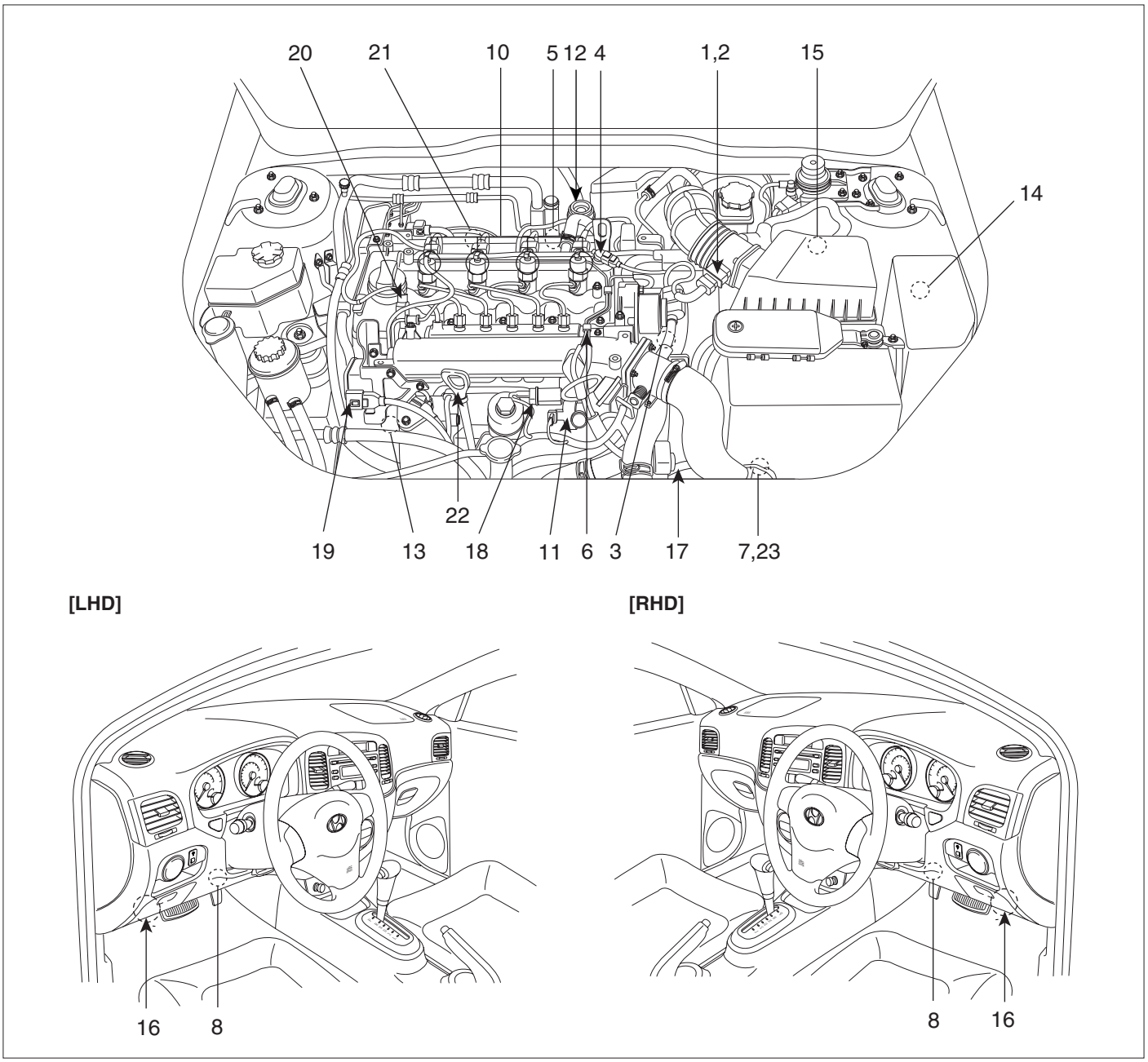
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction is detected after two sequential driving cycles. The MIL will illuminate when the malfunction is detected on the second driving cycle.

4. A Diagnostic Trouble Code(DTC) will automatically erase from ECM memory if the same malfunction is not detected for 40 driving cycles.

NOTE

- *A "warm-up cycle" means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of 160 degress Fahrenheit.*
- *A "driving cycle" consists of engine startup, vehicle operation beyond the beginning of closed loop operation.*

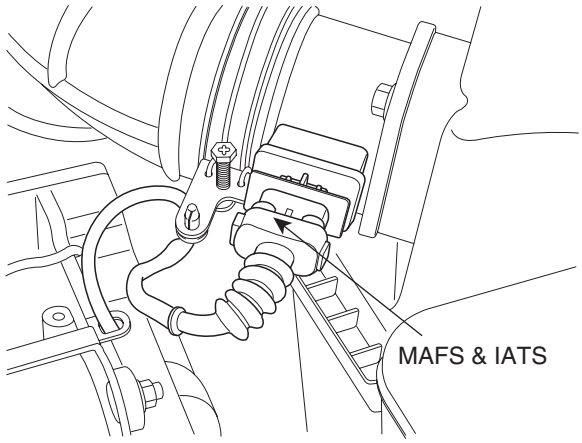
COMPONENTS LOCATION EE4C6B6C



1. Mass Air Flow Sensor (MAFS)
2. Intake Air Temperature Sensor1 (IATS1)
3. Engine Coolant Temperature Sensor (ECTS)
4. Camshaft Position Sensor (CMPS)
5. Crankshaft Position Sensor (CKPS)
6. Rail Pressure Sensor (RPS)
7. Boost Pressure Sensor (BPS)
8. Accelerator Position Sensor (APS)
9. Vehicle Speed Sensor (VSS)
10. Injector
11. VGT solenoid valve
12. EGR Valve
13. Fuel Pressure Regulator Valve
14. Main Relay
15. ECM
16. DLC (Data Link Connector)
17. Multi-purpose Check Connector
18. Throttle Flap Actuator
19. Variable Swirl Valve Actuator
20. Rail Pressure Control Valve
21. Heated Oxygen Sensor (HO2S)
22. Fuel Temperature Sensor
23. Intake Air Temperature Sensor2 (IATS2)

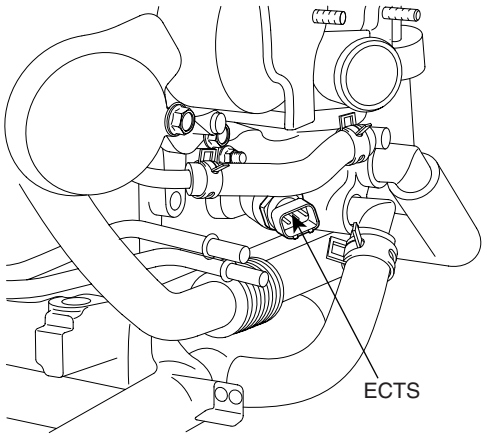
EGNG101A

1. Mass Air Flow Sensor (MAFS)
2. Intake Air Temperature Sensor 1 (IATS1)



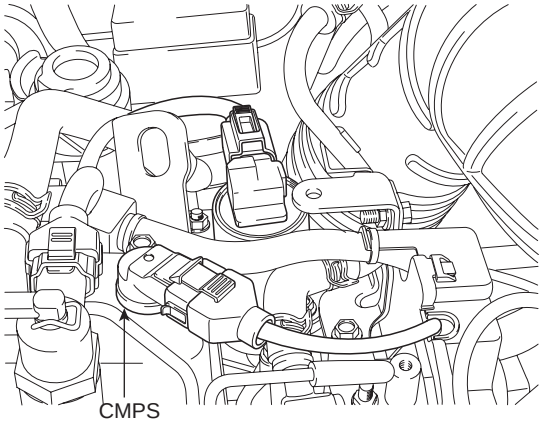
AWJF300F

3. Engine Coolant Temperature Sensor (ECTS)



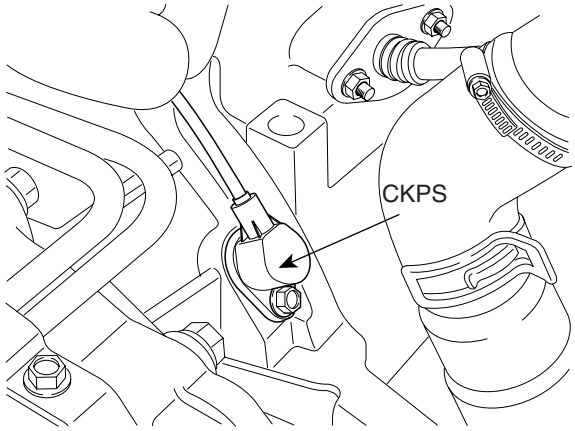
LXGF510A

4. Camshaft Position Sensor (CMPS)



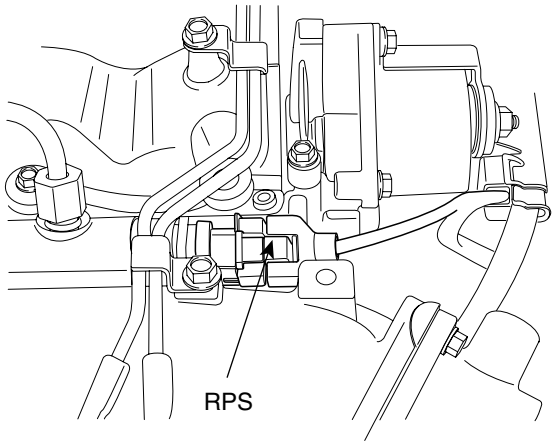
AWJF300G

5. Crankshaft Position Sensor (CKPS)



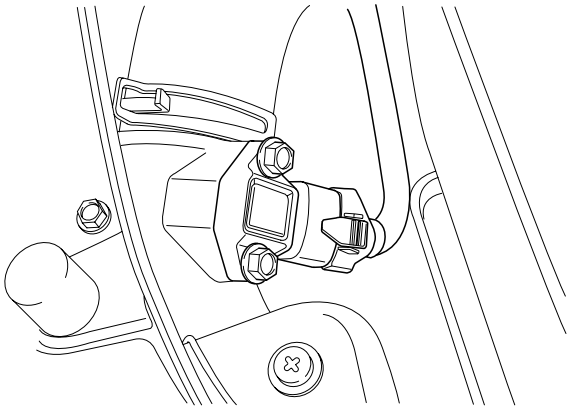
AWJF300H

6. Rail Pressure Sensor (RPS)



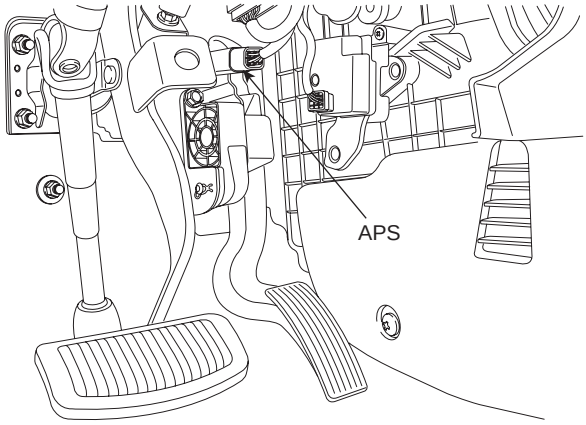
AWJF300I

7. Boost Pressure Sensor (BPS)
23. Intake Air Temperature Sensor2 (IATS2)



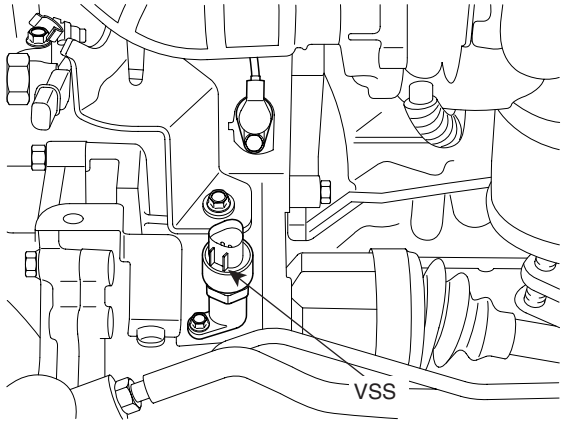
AWJF300J

8. Accelerator Position Sensor (APS)



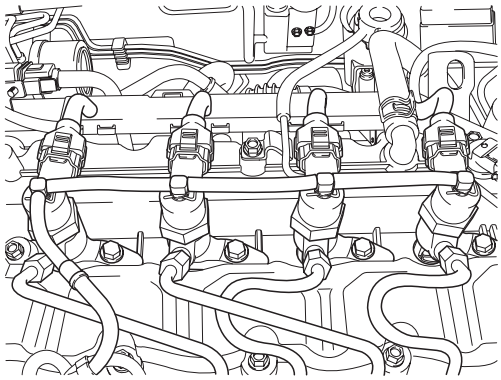
AWJF300K

9. Vehicle Speed Sensor (VSS)



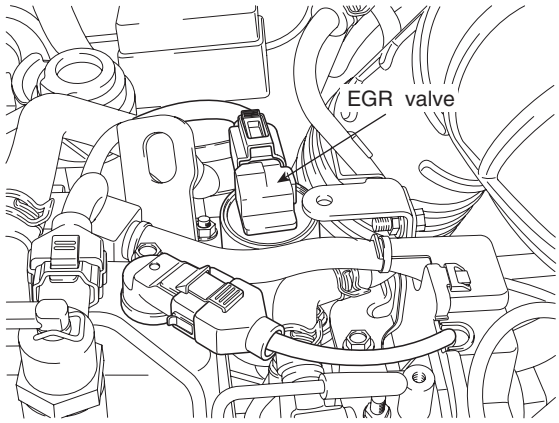
LXGF509A

10. Injector



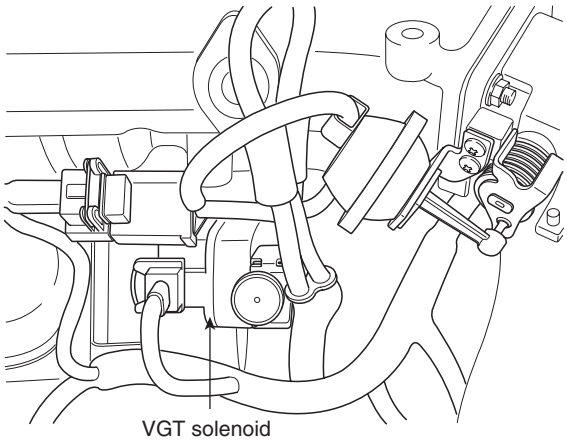
AWJF300M

12. EGR Valve



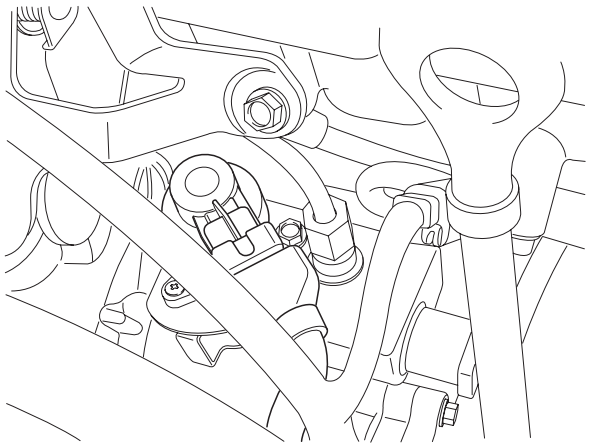
LGJF500E

11. VGT solenoid valve



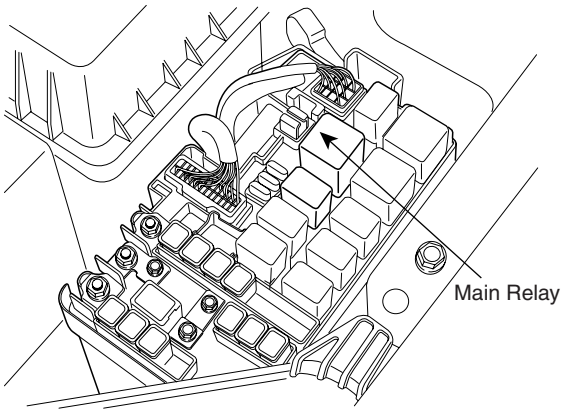
LGJF500F

13. Fuel Pressure Regulator Valve



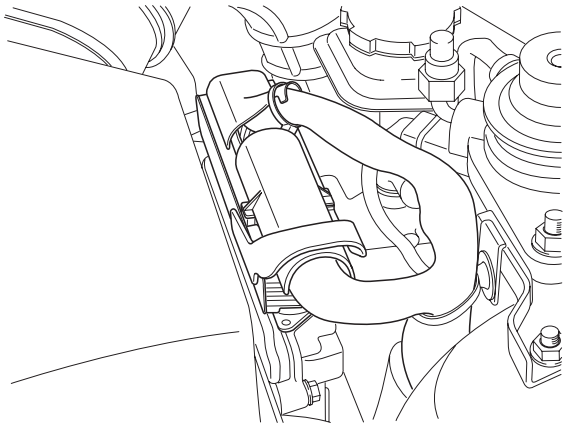
AWJF300P

14. Main relay



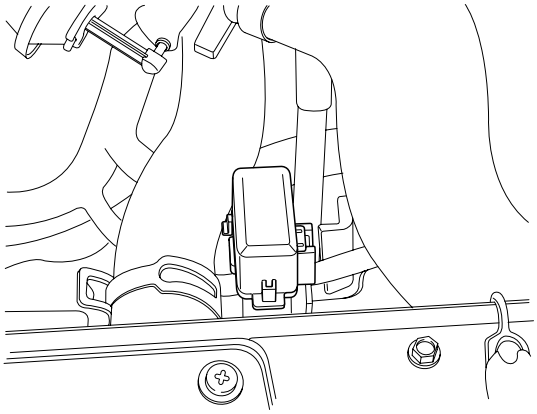
LGJF500G

15. ECM



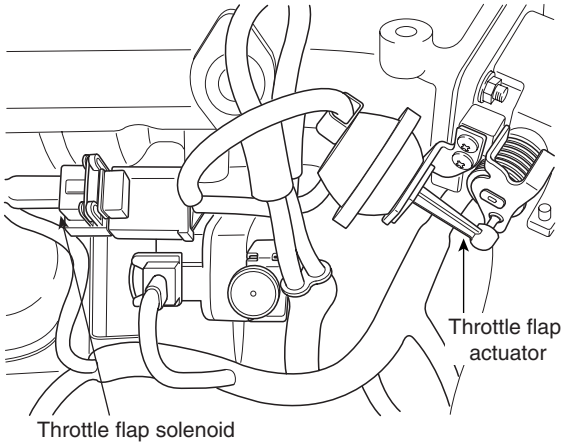
AWJF300R

17. Multi-purpose Check Connector



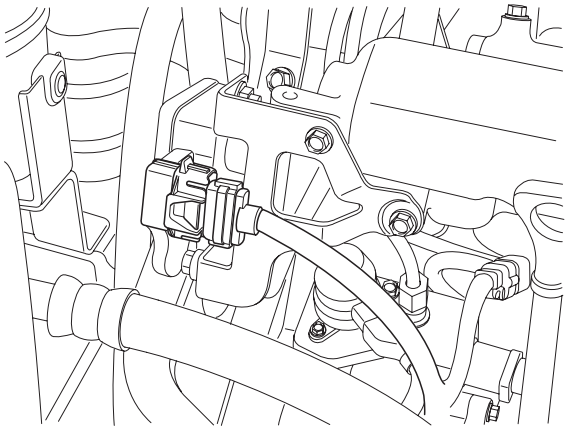
AWJF300S

18. Throttle Flap Actuator



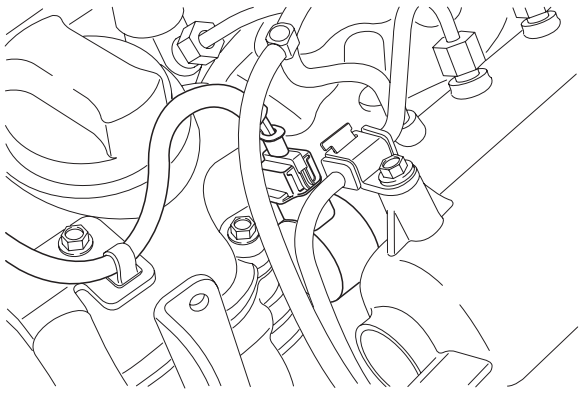
LGJF500H

19. Variable Swirl Valve Actuator

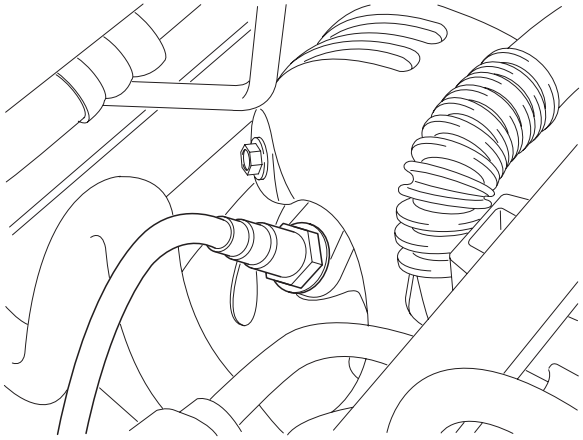
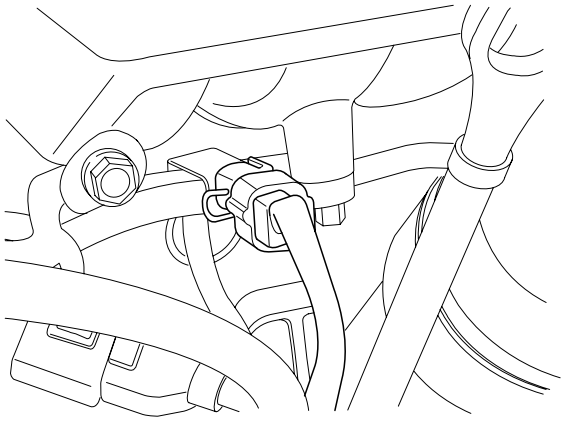


AWJF300W

20. Rail Pressure Regulator Valve



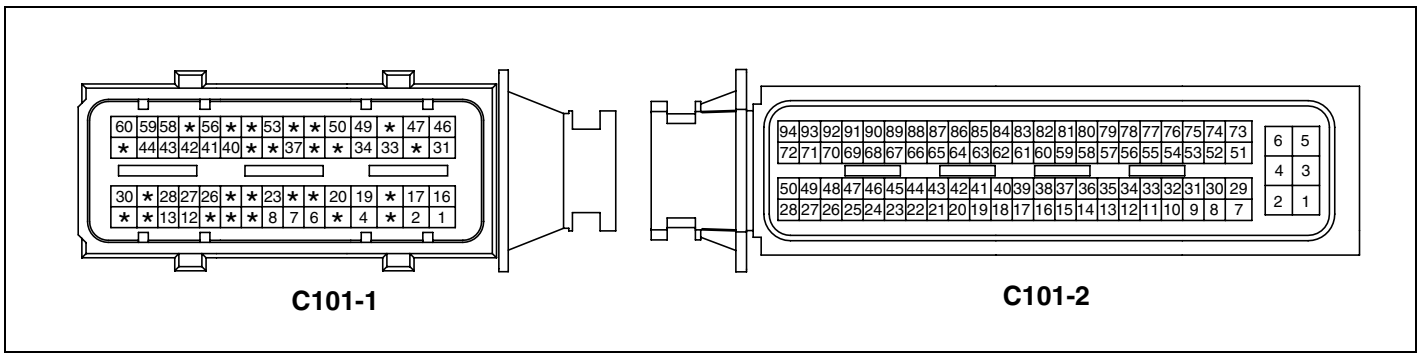
AWJF300V

21. Heated Oxygen Sensor (HO2S)	22. Fuel Temperature Sensor (FTS)
 AWJF300U	 AWJF320A

ENGINE CONTROL MODULE (ECM)

ECM ED5CD9F6

1. ECM HARNESS CONNECTOR



EGNG104A

2. ECM TERMINAL FUNCTION

< **C101-1 CONNECTOR** >

PIN	FUNCTION	CONNECTED TO
1	Injector for Cylinder3(high side)	Injector3
2	Injector for Cylinder2(high side)	Injector2
3	N.A	-
4	Rail pressure control valve supply from BAT+a	Rail pressure control valve
5	N.A	-
6	Variable swirl valve position sendor Ground	Variable swirl valve
7	Crankshaft position sensor shield	Crankshaft position sensor
8	Rail pressure sensor ground	Rail pressure sensor
9	N.A	-
10	N.A	-
11	N.A	-
12	Crankshaft sensor minus signal:AT Crankshaft sensor plus signal:MT	Crankshaft position sensor
13	Boost pressure sensor supply	Boost pressure sensor
14	N.A	-
15	N.A	-
16	Injector for Cylinder1(high side)	Injector1
17	Injector for Cylinder4(high side)	Injector4
18	N.A	-
19	Fuel pressure regulator valve "high side"(MPROP)	Fuel pressure regulator valve
20	Camshaft position sensor ground	Camshaft position sensor
21	N.A	-
22	N.A	-

PIN	FUNCTION	CONNECTED TO
23	Boost pressure sensor ground	Boost pressure sensor
24	N.A	-
25	N.A	-
26	Variable swirl valve position sensor supply	Variable swirl valve
27	Crankshaft sensor minus signal:MT Crankshaft sensor plus signal:AT	Crankshaft position sensor
28	Rail pressure sensor supply	Rail pressure sensor
29	N.A	-
30	Variable swirl valve motor(-)	Variable swirl valve
31	Injector for Cylinder2(low side)	Injector2
32	N.A	-
33	Injector for Cylinder4(low side)	Injector4
34	Rail pressure control valve (low side)	Rail pressure control valve
35	N.A	-
36	N.A	-
37	Mass Air Flow Sensor Reference Frequency	Mass Air Flow Sensor
38	N.A	-
39	N.A	-
40	Boost pressure sensor signal	Boost pressure sensor
41	Engine Coolant temperature sensor ground	Engine Coolant temperature sensor
42	Mass Air Flow sensor signal	Mass Air Flow sensor
43	Rail pressure sensor signal	Rail pressure sensor
44	Mass Air Flow sensor ground	Mass Air Flow sensor
45	N.A	-
46	Injector for Cylinder3(low side)	Injector3
47	Injector for Cylinder1(low side)	Injector1
48	N.A	-
49	Fuel pressure regulator valve "low side"(MPROP)	Fuel pressure regulator valve
50	Camshaft position sensor signal	Camshaft position sensor
51	N.A	-
52	N.A	-
53	Intake Air Temperature Sensor signal(Integrated in BPS)	Boost pressure sensor
54	N.A	-
55	N.A	-
56	Variable swirl valve position sensor signal	Variable swirl valve
57	N.A	-
58	Engine Coolant temperature sensor signal	Engine Coolant temperature sensor
59	Linear EGR control	EGR
60	Variable swirl valve motor(+)	Variable swirl valve

< **C101-2 CONNECTOR** >

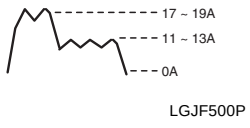
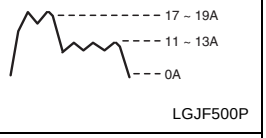
1	Battery plus via Fuse(10A)	Main relay
2	ECM ground	ECM ground
3	Battery plus via Fuse(20A)	Main relay
4	ECM ground	ECM ground
5	Battery plus via Fuse(20A)	Main relay
6	ECM ground	ECM ground
7	Fan High	A/C fan relay
8	Accelerator position sensor 2 ground	Accelerator position sensor
9	Accelerator position sensor 1 signal	Accelerator position sensor
10	Fuel temperature sensor ground	Fuel temperature sensor
11	Fuel temperature sensor signal	Fuel temperature sensor
12	A/C Pressure Transducer ground	A/C Pressure Tranducer
13	A/C Pressure Transducer signal	A/C Pressure Tranducer
14	N.A	-
15	N.A	-
16	Immobilizer SMARTRA ground	Immobilizer
17	N.A	-
18	N.A	-
19	N.A	-
20	N.A	-
21	N.A	-
22	A/C Pressure Transducer supply	A/C Pressure Tranducer
23	N.A	-
24	Cruise Control Supply	Cruise control unit
25	ISO-K interface	Diagnostic link connector
26	N.A	-
27	Fuel consumption signal	Trip computer
28	Terminal 15(switched bat.+)	Ignition key
29	VGT control	VGT solenoid valve
30	Accelerator position sensor 1 ground	Accelerator position sensor
31	Accelerator position sensor 2 signal	Accelerator position sensor
32	N.A	-
33	N.A	-
34	N.A	-
35	N.A	-
36	N.A	-
37	N.A	-
38	Brake main switch signal	Brake switch
39	N.A	-

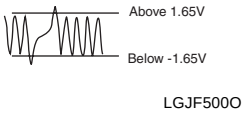
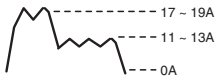
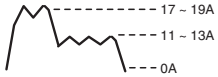
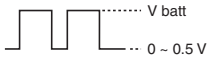
40	Water sensor signal	Water sensor
41	N.A	-
42	Blower switch input signal	Blower switch
43	N.A	-
44	N.A	-
45	Accelerator position sensor 1 supply	Accelerator position sensor
46	Accelerator position sensor 2 supply	Accelerator position sensor
47	Immobilizer imterface	Immobilizer
48	Engine speed output signal	Tachometer
49	Cruise Control Set Lamp	Cluster
50	N.A	-
51	Heated oxygen sensor heater control	Heated oxygen sensor
52	Electronic Load signal input(Power Steering)	EPS control module
53	N.A	-
54	A/C switch ON signal	A/C switch
55	N.A	-
56	A/C compressure switch signal input	A/C compressure switch
57	Neutral recognition switch signal input	Neutral recognition switch
58	N.A	-
59	N.A	-
60	N.A	-
61	N.A	-
62	N.A	-
63	N.A	-
64	Heated oxygen sensor supply	Heated oxygen sensor
65	Heated oxygen sensor current pump	Heated oxygen sensor
66	N.A	-
67	N.A	-
68	Malfunction indication lamp (MIL)	Cluster
69	Glow indication lamp	Cluster
70	A/C compressor relay control	A/C compressor relay
71	Fan Low	Radiator fan relay
72	Main relay control	Main relay
73	N.A	-
74	N.A	-
75	Vehicle speed sensor signal	Vehicle speed sensor
76	N.A	-
77	N.A	-
78	N.A	-
79	Clutch switch signal	Clutch switch

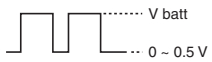
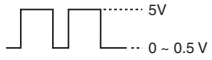
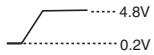
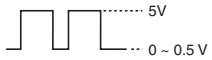
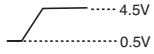
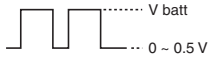
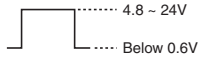
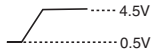
80	Redundant brake switch signal	Brake switch
81	MT/AT Auto Recognition	MT/AT Auto Recognition switch
82	N.A	-
83	CAN LOW	TCM
84	CAN HIGH	TCM
85	N.A	-
86	Heated oxygen sensor ground	Heated oxygen sensor
87	Heated oxygen sensor signal	Heated oxygen sensor
88	N.A	-
89	Intake air temperature sensor signal	Intake air temperature sensor
90	Throttle flap control	Throttle flap solenoid valve
91	Cruise Control on Lamp(Low Side)	Cluster
92	Immobilizer indication lamp	Cluster
93	Glow relay control	Glow relay
94	Auxiliary electric heater control	Auxiliary electric heater

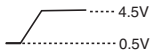
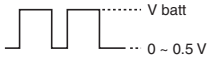
3. ECM TERMINAL INPUT/OTPUT SIGNAL

< **C101-1 CONNECTOR** >

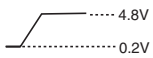
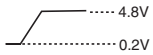
Pin	PinDescription	Vehicle status	Check status	Input/Output signal	
				Type	Level
1	Injector for Cylinder3(high side)	Engine running	Injector operation	Current	
2	Injector for Cylinder2(high side)	Engine running	Injector operation	Current	
3	N.A				
4	Rail pressure control valve supply from BAT+a	Ignition ON	All	DC	Vbatt
5	N.A				
6	Variable swirl valve position sendor Ground	All	All		Ground (0 ~ 0.5 Volt)
7	Crankshaft position sensor shield	All	All		Ground (0 ~ 0.5 Volt)
8	Rail pressure sensor ground	All	All		Ground (0 ~ 0.5 Volt)
9	N.A				
10	N.A				
11	N.A				

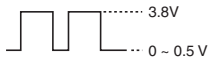
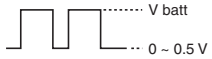
Pin	PinDescription	Vehicle status	Check status	Input/Output signal	
				Type	Level
12	Crankshaft sensor minus signal:AT Crankshaft sensor plus signal:MT	Engine running	All	Sine wave	 LGJF500O
13	Boost pressure sensor supply	Ignition ON	All	DC	4.9 ~ 5.1 Volt
14	N.A				
15	N.A				
16	Injector for Cylinder1(high side)	Engine running	Injector operation	Current	 LGJF500P
17	Injector for Cylinder4(high side)	Engine running	Injector operation	Current	 LGJF500P
18	N.A				
19	Fuel pressure regulator valve "high side"(MPROP)	Engine running	All	PWM 172~185Hz	 LGJF500K
20	Camshaft position sensor ground	All	All		Ground (0 ~ 0.5 Volt)
21	N.A				
22	N.A				
23	Boost pressure sensor ground	All	All		Ground (0 ~ 0.5 Volt)
24	N.A				
25	N.A				
26	Variable swirl valve position sensor supply	Ignition ON	All	DC	4.9 ~ 5.1 Volt
27	Crankshaft position sensor minus signal:MT Crankshaft position sensor plus signal:AT	Engine running	All	Sine wave	
28	Rail pressure sensor supply	Ignition ON	All	DC	4.9 ~ 5.1 Volt
29	N.A				
30	Variable swirl valve motor(-)	Ignition ON	All	PWM 1000Hz	 LGJF500K
31	Injector for Cylinder2(low side)				
32	N.A				
33	Injector for Cylinder4(low side)				

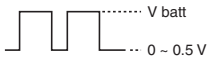
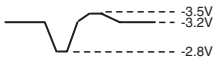
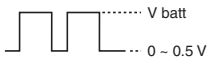
Pin	PinDescription	Vehicle status	Check status	Input/Output signal	
				Type	Level
34	Rail pressure control valve (low side)	Engine running	All	PWM 1kHz	 LGJF500K
35	N.A				
36	N.A				
37	Mass Air Flow Sensor Reference Frequency	Ignition ON	All	PWM 19Hz	 LGJF500L
38	N.A				
39	N.A				
40	Boost pressure sensor signal	Ignition ON	All	Analog	 LGJF500I
41	Engine Coolant temperature sensor ground	All	All		Ground (0 ~ 0.5 Volt)
42	N.A		All	Pulse	 LGJF500L
43	Rail pressure sensor signal	Engine running	All	Analog	 LGJF500J
44	Mass Air Flow sensor ground	All	All		Ground (0 ~ 0.5 Volt)
45	N.A				
46	Injector for Cylinder3(low side)				
47	Injector for Cylinder1(low side)				
48	N.A				
49	Fuel pressure regulator valve "low side"(MPROP)	Engine running	All	PWM 1kHz	 LGJF500K
50	Camshaft position sensor signal	Engine running	All	Analog	 LGJF500N
51	N.A				
52	N.A				
53	Intake Air Temperature Sensor signal(Integrated in BPS)	Ignition ON	All	Analog	 LGJF500J

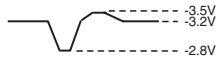
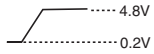
Pin	PinDescription	Vehicle status	Check status	Input/Output signal	
				Type	Level
54	N.A				
55	N.A				
56	Variable swirl valve position sensor signal	Ignition ON	All	Analog	 LGJF500J
57	N.A				
58	Engine Coolant temperature sensor signal	Ignition ON	20deg/80deg	Analog	above3.5V/below1.8V
59	Linear EGR control	Engine running	All	PWM 140Hz	 LGJF500K
60	Variable swirl valve motor(+)	Ignition ON	All	PWM 1000Hz	 LGJF500K

< **C101-2 CONNECTOR** >

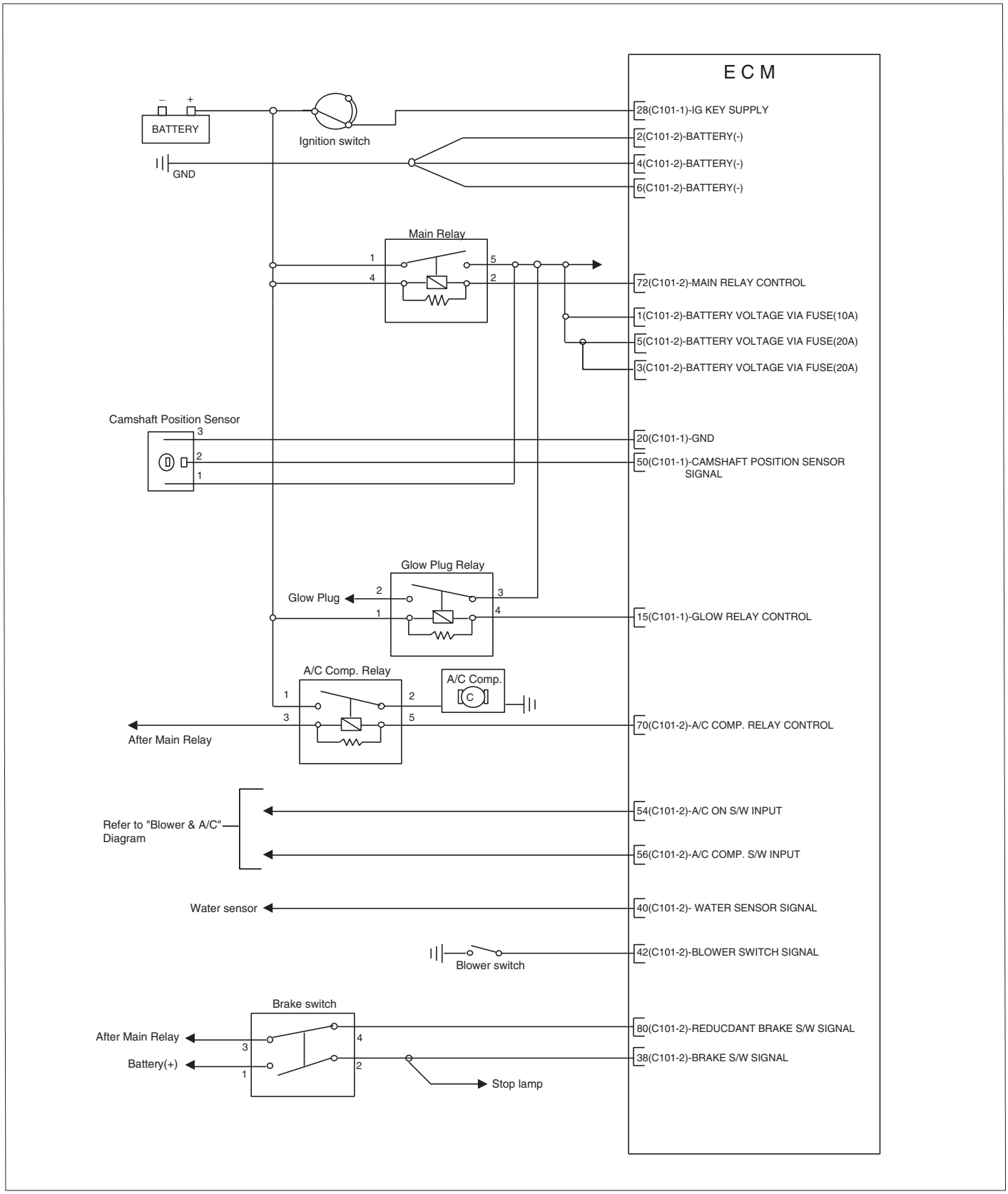
1	Battery plus via Fuse(10A)	Ignition ON	All	DC	V batt
2	ECM ground	All	All		Ground (0 ~ 0.5 Volt)
3	Battery plus via Fuse(20A)	Ignition ON	All	DC	V batt
4	ECM ground	All	All		Ground (0 ~ 0.5 Volt)
5	Battery plus via Fuse(20A)	Ignition ON	All	DC	V batt
6	ECM ground	All	All		Ground (0 ~ 0.5 Volt)
7	Fan High	Engine running	fan on/off	DC	0~0.5V/Vbatt
8	Accelerator position sensor 2 ground	All	All		Ground (0 ~ 0.5 Volt)
9	Accelerator position sensor 1 signal	Ignition ON	IDLE/WOT	Analog	0.6~0.85V/3.5~4.7V
10	Fuel temperature sensor ground	All	All		Ground (0 ~ 0.5 Volt)
11	Fuel temperature sensor signal	Ignition ON	All	Analog	 LGJF500I
12	A/C Pressure Transducer ground	All	All		Ground (0 ~ 0.5 Volt)
13	A/C Pressure Transducer signal	Ignition ON	All	Analog	 LGJF500I
14	N.A				
15	N.A				

16	Immobilizer SMARTRA ground	All	All		Ground (0 ~ 0.5 Volt)
17	N.A				
18	N.A				
19	N.A				
20	N.A				
21	N.A				
22	A/C Pressure Transducer supply	Ignition ON	All	DC	4.9 ~ 5.1 Volt
23	N.A				
24	Cruise Control Supply	Ignition ON	All	DC	V batt
25	ISO-K interface				
26	N.A				
27	Fuel consumption signal	Engine running	All	Pulse	 LGJF500M
28	Terminal 15(switched bat.+)	Ignition ON	All	DC	V batt
29	VGT control	Engine running	All	PWM 300 Hz	 LGJF500K
30	Accelerator position sensor 1 ground	All	All		Ground (0 ~ 0.5 Volt)
31	Accelerator position sensor 2 signal	Ignition ON	IDLE/WOT	Analog	0.25~0.51V/1.6~2.5V
32	N.A				
33	N.A				
34	N.A				
35	N.A				
36	N.A				
37	N.A				
38	Brake main switch signal	Ignition ON	Brake press / release	DC	Vbatt / 0~0.5V
39	N.A				
40	Water sensor signal	Ignition ON	ON / OFF	DC	0~0.5V / Vbatt
41	N.A				
42	Blower switch input signal	Ignition ON	ON / OFF	DC	0~0.5V / Vbatt
43	N.A				
44	N.A				
45	Accelerator position sensor 1 supply	Ignition ON	All	DC	4.9 ~ 5.1 Volt
46	Accelerator position sensor 2 supply	Ignition ON	All	DC	4.9 ~ 5.1 Volt

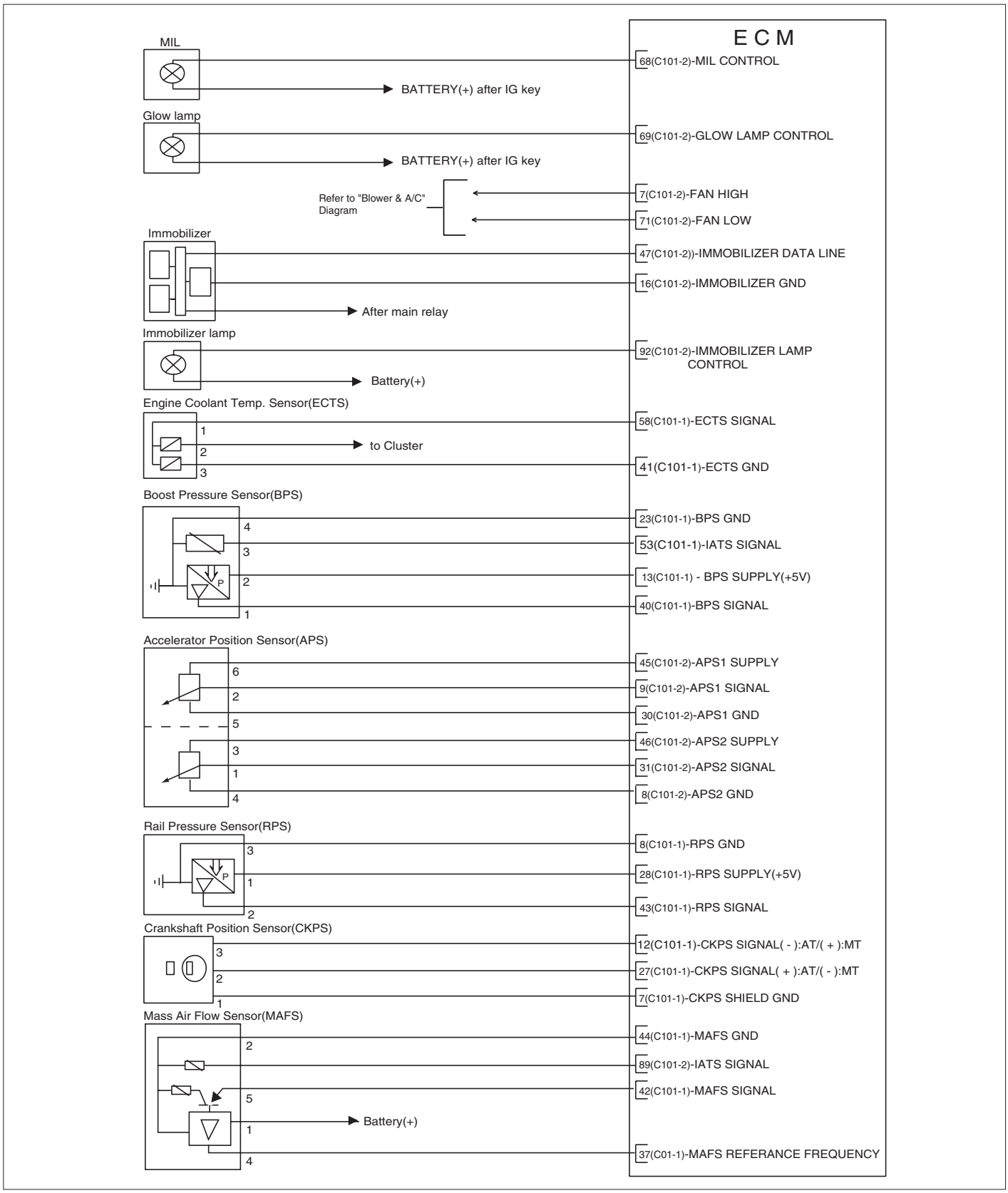
47	Immobilizer imterface				
48	Engine speed output signal	Engine running	All	Pulse	 LGJF500K
49	Cruise Control Set Lamp	Engine running	ON / OFF	DC	0~0.5V / Vbatt
50	N.A				
51	Heated oxygen sensor heater control	Engine running & Hearter ON	All	PWM 100Hz	 LGJF500K
52	-				
53	N.A				
54	A/C switch ON signal	Engine running	Switch ON / OFF	DC	Vbatt / 0~0.5V
55	N.A				
56	A/C compressure switch signal input	Engine running	Switch ON / OFF	DC	Vbatt / 0~0.5V
57	Neutral recognition switch signal input	Ignition ON	Neutral / other gear	DC	0~0.5V / Vbatt
58	N.A				
59	N.A				
60	N.A				
61	N.A				
62	N.A				
63	N.A				
64	Heated oxygen sensor supply	Engine running & Hearter ON	All	DC	~ 3.0 V
65	Heated oxygen sensor current pump	Engine running & Hearter ON	All	DC	 LGJF500Q
66	N.A				
67	N.A				
68	Malfunction indication lamp (MIL)	Ignition ON	ON / OFF	DC	0~0.5V / Vbatt
69	Glow indication lamp	Ignition ON	ON / OFF	DC	0~0.5V / Vbatt
70	A/C compressor relay control	Ignition ON	ON / OFF	DC	0~0.5V / Vbatt
71	Fan Low	Engine running	ON / OFF	DC	0~0.5V/ Vbatt
72	Main relay control	Ignition ON	ON / OFF	DC	0~0.5V / Vbatt
73	N.A				
74	N.A				
75	Vehicle speed sensor signal	Vehicle running	ALL	Pulse	 LGJF500K

76	N.A				
77	N.A				
78	N.A				
79	Clutch switch signal	Ignition ON	Press / Release	DC	0~0.5V / Vbatt
80	Redundant brake switch signal	Ignition ON	Brake press / release	DC	0~0.5V / Vbatt
81	MT/AT Auto Recognition	Ignition ON	MT / AT	DC	Vbatt / 0~0.5V
82	N.A				
83	CAN LOW				
84	CAN HIGH				
85	N.A				
86	Heated oxygen sensor ground	Engine running & Hearter ON	All	DC	~ 2.5 V
87	Heated oxygen sensor signal	Engine running & Hearter ON	All	DC	 LGJF500Q
88	N.A				
89	Intake air temperature sensor signal	Ignition ON	All	Analog	 LGJF500I
90	Throttle flap control	Ignition ON	Ignition OFF	PWM 300Hz	-
91	Cruise Control on Lamp(Low Side)	Vehicle running	ON / OFF	DC	0~0.5V / Vbatt
92	Immobilizer indication lamp	Ignition ON	ON / OFF	DC	0~0.5V / Vbatt
93	Glow relay control	Ignition ON	ON / OFF	DC	0~0.5V / Vbatt
94	Auxiliary electric heater control	Engine running	ON / OFF	DC	0~0.5V / Vbatt

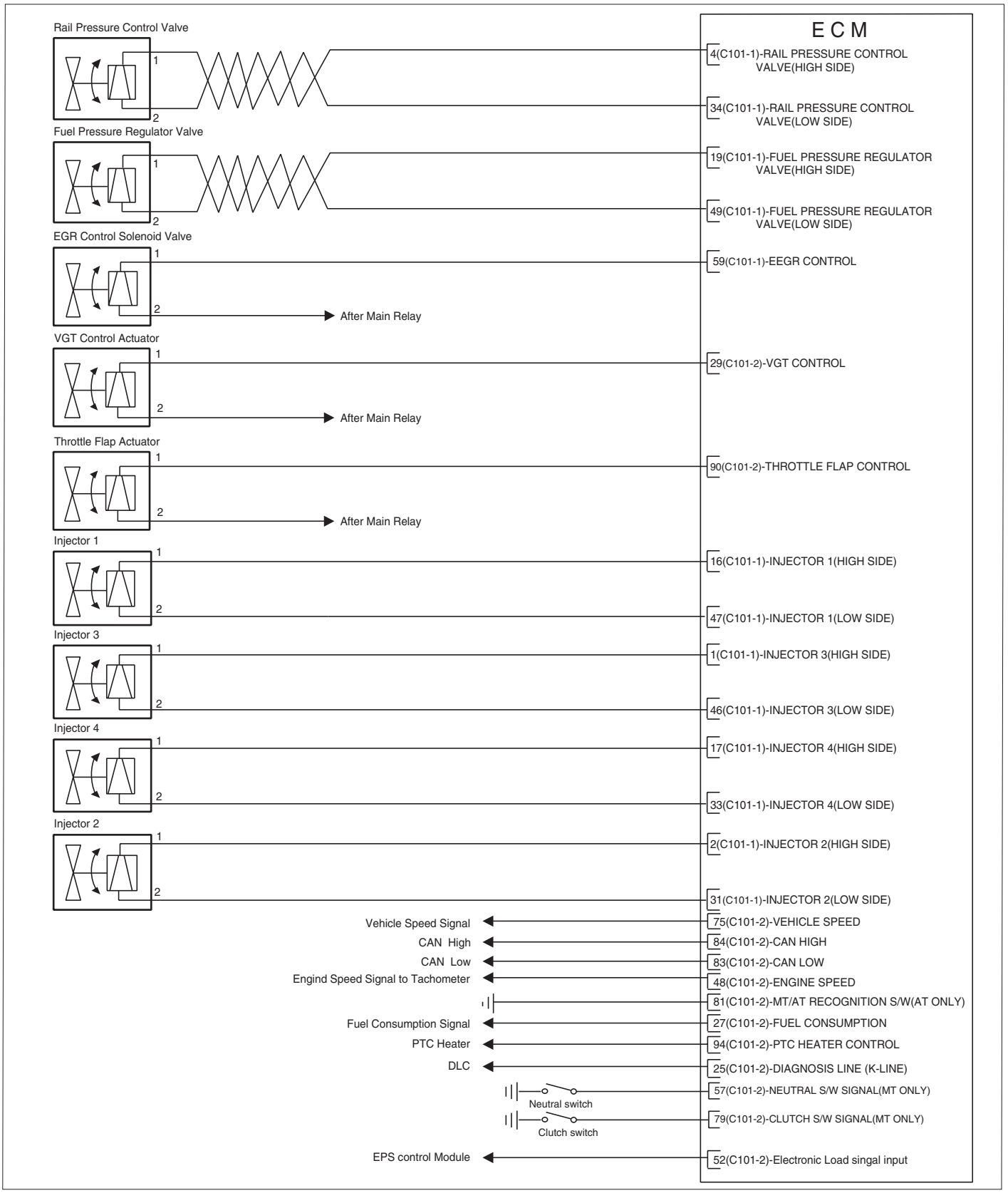
CIRCUIT DIAGRAM ED1A4E6C



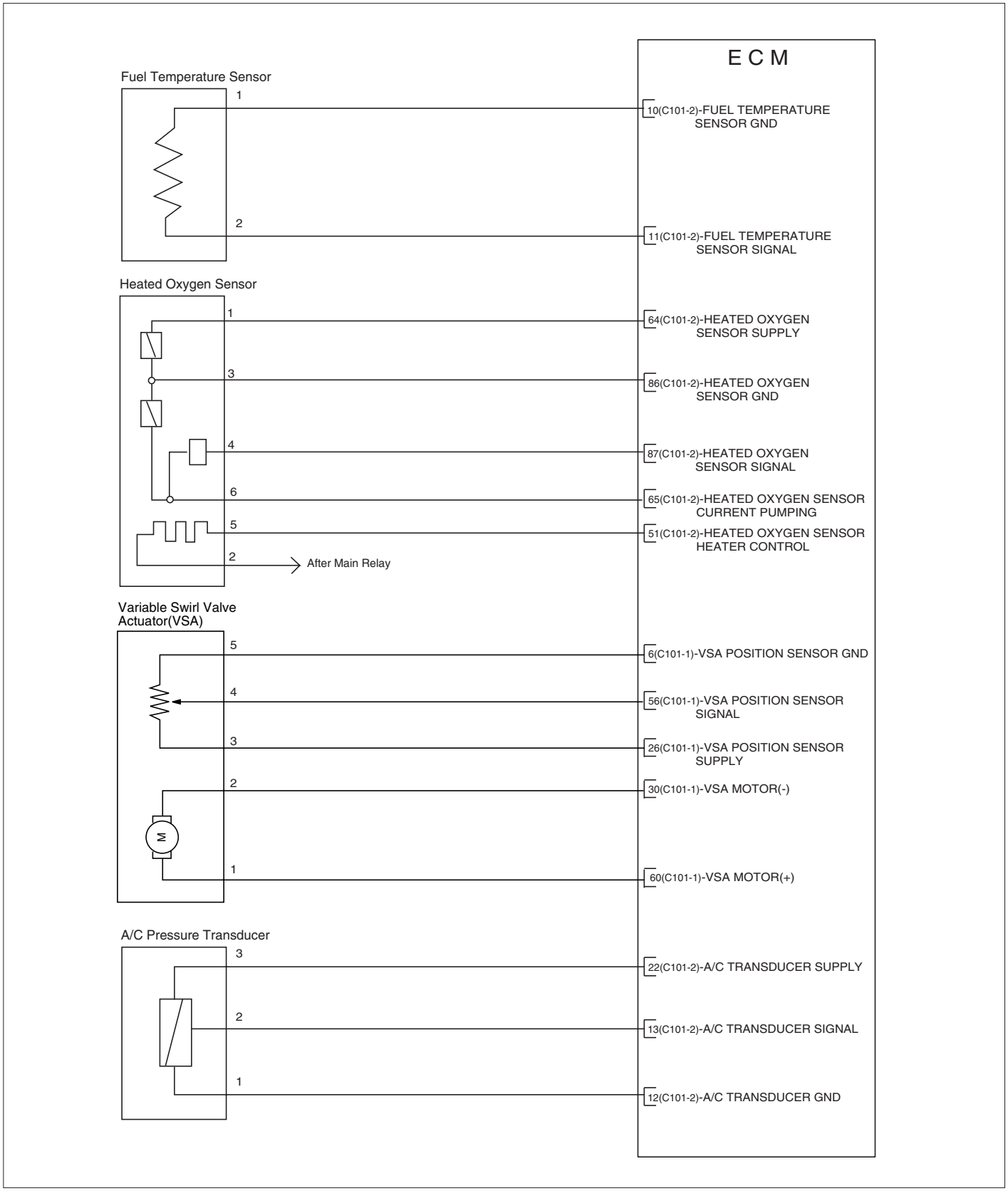
EGNG105A


ECM
MIL
68(C101-2)-MIL CONTROL
BATTERY(+) after IG key
Glow lamp
69(C101-2)-GLOW LAMP CONTROL
BATTERY(+) after IG key
Refer to "Blower & A/C" Diagram
7(C101-2)-FAN HIGH
71(C101-2)-FAN LOW
Immobilizer
47(C101-2))-IMMOBILIZER DATA LINE
16(C101-2)-IMMOBILIZER GND
After main relay
Immobilizer lamp
92(C101-2)-IMMOBILIZER LAMP CONTROL
Battery(+)
Engine Coolant Temp. Sensor(ECTS)
58(C101-1)-ECTS SIGNAL
to Cluster
41(C101-1)-ECTS GND
Boost Pressure Sensor(BPS)
23(C101-1)-BPS GND
53(C101-1)-IATS SIGNAL
13(C101-1) - BPS SUPPLY(+5V)
40(C101-1)-BPS SIGNAL
Accelerator Position Sensor(APS)
45(C101-2)-APS1 SUPPLY
9(C101-2)-APS1 SIGNAL
30(C101-2)-APS1 GND
46(C101-2)-APS2 SUPPLY
31(C101-2)-APS2 SIGNAL
8(C101-2)-APS2 GND
Rail Pressure Sensor(RPS)
8(C101-1)-RPS GND
28(C101-1)-RPS SUPPLY(+5V)
43(C101-1)-RPS SIGNAL
Crankshaft Position Sensor(CKPS)
12(C101-1)-CKPS SIGNAL(-):AT/(+):MT
27(C101-1)-CKPS SIGNAL(+):AT/(-):MT
7(C101-1)-CKPS SHIELD GND
Mass Air Flow Sensor(MAFS)
44(C101-1)-MAFS GND
89(C101-2)-IATS SIGNAL
42(C101-1)-MAFS SIGNAL
Battery(+)
37(C01-1)-MAFS REFERANCE FREQUENCY

EGNG106A


E C M
Rail Pressure Control Valve
1
2
4(C101-1)-RAIL PRESSURE CONTROL VALVE(HIGH SIDE)
34(C101-1)-RAIL PRESSURE CONTROL VALVE(LOW SIDE)
Fuel Pressure Regulator Valve
19(C101-1)-FUEL PRESSURE REGULATOR VALVE(HIGH SIDE)
49(C101-1)-FUEL PRESSURE REGULATOR VALVE(LOW SIDE)
EGR Control Solenoid Valve
59(C101-1)-EEGR CONTROL
After Main Relay
VGT Control Actuator
29(C101-2)-VGT CONTROL
After Main Relay
Throttle Flap Actuator
90(C101-2)-THROTTLE FLAP CONTROL
After Main Relay
Injector 1
16(C101-1)-INJECTOR 1(HIGH SIDE)
47(C101-1)-INJECTOR 1(LOW SIDE)
Injector 3
1(C101-1)-INJECTOR 3(HIGH SIDE)
46(C101-1)-INJECTOR 3(LOW SIDE)
Injector 4
17(C101-1)-INJECTOR 4(HIGH SIDE)
33(C101-1)-INJECTOR 4(LOW SIDE)
Injector 2
2(C101-1)-INJECTOR 2(HIGH SIDE)
31(C101-1)-INJECTOR 2(LOW SIDE)
Vehicle Speed Signal
75(C101-2)-VEHICLE SPEED
CAN High
84(C101-2)-CAN HIGH
CAN Low
83(C101-2)-CAN LOW
Engind Speed Signal to Tachometer
48(C101-2)-ENGINE SPEED
81(C101-2)-MT/AT RECOGNITION S/W(AT ONLY)
Fuel Consumption Signal
27(C101-2)-FUEL CONSUMPTION
PTC Heater
94(C101-2)-PTC HEATER CONTROL
DLC
25(C101-2)-DIAGNOSIS LINE (K-LINE)
57(C101-2)-NEUTRAL S/W SIGNAL(MT ONLY)
Neutral switch
79(C101-2)-CLUTCH S/W SIGNAL(MT ONLY)
Clutch switch
EPS control Module
52(C101-2)-Electronic Load singal input

EGNG107A


E C M
Fuel Temperature Sensor
1
2
10(C101-2)-FUEL TEMPERATURE SENSOR GND
11(C101-2)-FUEL TEMPERATURE SENSOR SIGNAL
Heated Oxygen Sensor
1
3
4
6
5
2
After Main Relay
64(C101-2)-HEATED OXYGEN SENSOR SUPPLY
86(C101-2)-HEATED OXYGEN SENSOR GND
87(C101-2)-HEATED OXYGEN SENSOR SIGNAL
65(C101-2)-HEATED OXYGEN SENSOR CURRENT PUMPING
51(C101-2)-HEATED OXYGEN SENSOR HEATER CONTROL
Variable Swirl Valve Actuator(VSA)
5
4
3
2
1
M
6(C101-1)-VSA POSITION SENSOR GND
56(C101-1)-VSA POSITION SENSOR SIGNAL
26(C101-1)-VSA POSITION SENSOR SUPPLY
30(C101-1)-VSA MOTOR(-)
60(C101-1)-VSA MOTOR(+)
A/C Pressure Transducer
3
2
1
22(C101-2)-A/C TRANSDUCER SUPPLY
13(C101-2)-A/C TRANSDUCER SIGNAL
12(C101-2)-A/C TRANSDUCER GND

EGNG108A

ECM PROBLEM INSPECTION PROCEDURE ED2F36EF

1. TEST ECM GROUND CIRCUIT: Measure resistance between ECM and chassis ground using the backside of ECM harness connector as ECM side check point. If the problem is found, repair it.

Specification (Resistance)
Between terminal 2 of C01-2 connector and chassis ground : 1Ω or less
Between terminal 4 of C01-2 connector and chassis ground : 1Ω or less
Between terminal 6 of C01-2 connector and chassis ground : 1Ω or less

2. TEST ECM CONNECTOR: Disconnect the ECM connector and visually check the ground terminals on ECM side and harness side for bent pins or poor contact contact pressure. If the problem is found, repair it.

3. If problem is not found in Step 1 and 2, the ECM could be faulty. If so, replace the ECM with a new one, and then check the vehicle again. If the vehicle operates normally then the problem was likely with the ECM.

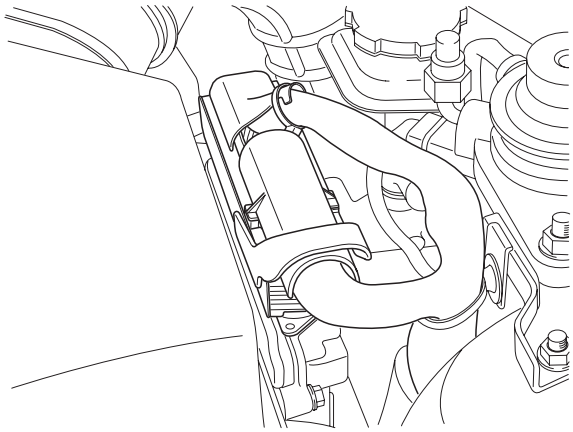
4. RE-TEST THE ORIGINAL ECM : Install the original ECM (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original ECM with a new one. If problem does not occur, this is intermittent problem (Refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE)

REPLACEMENT E7FFA26A

CAUTION

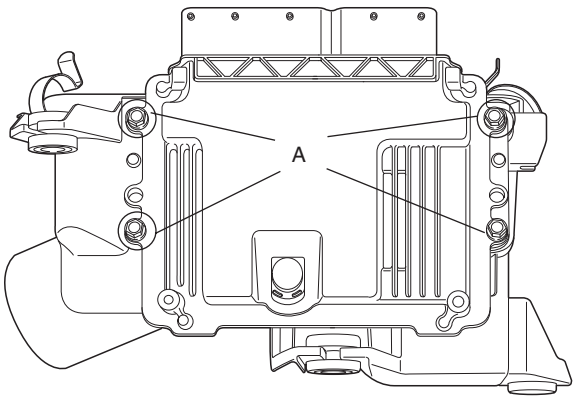
When exchanging ECMS, be sure to input injector data (7 digits) of each cylinder into a new ECM using a Hi-scan(pro).

1. After turning ignition switch off, wait for 30sec..
2. Remove the battery cable(-).
3. Remove the ECM connector.



AWJF301G

4. Unfasten four mounting bolts (A).

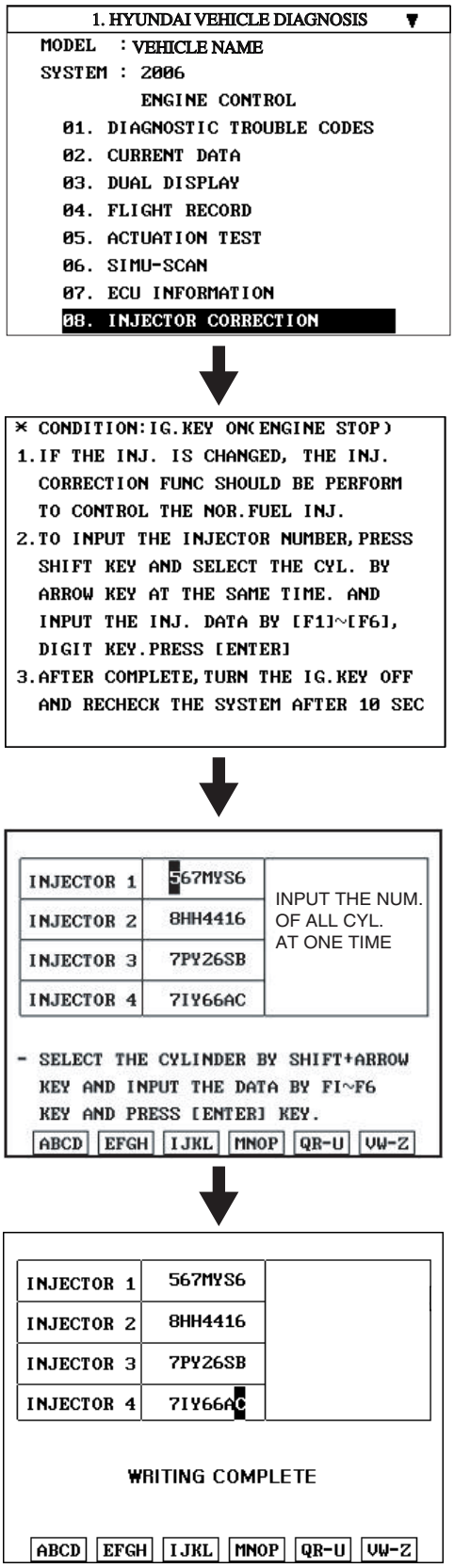


AWJF303A

5. Remove the ECM from the air cleaner assembly.
6. Install a new ECM with air cleaner assembly.
7. Fasten four mounting bolts.

Tightening torque : 0.8 ~ 1.2kgf·m

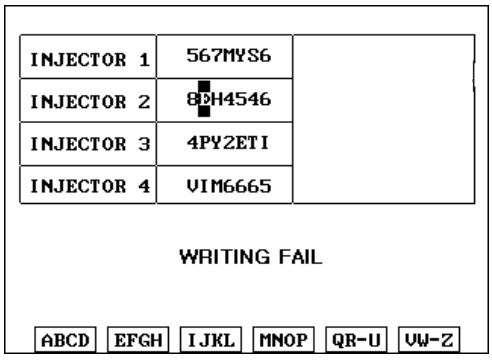
8. Using a Hi-scan(pro), input the injector data (7 digits) into a new ECM as next procedure.



EGNG102A

CAUTION

1. ***When "WRITING FAIL" is displayed ON Hi-scan(Pro), input injector data (7digits) of each cylinder into a new ECM again as prior procedure.***



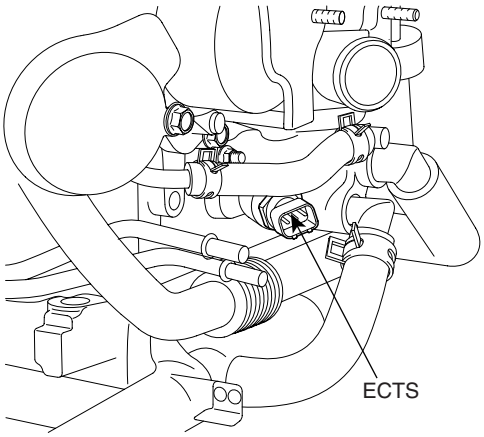
LGJF502A

2. ***If the glow lamp is flashed and DTC P1586 is detected ignition switch ON, take proper steps refering to "P1586 DTC Troubleshooting procedure".***

ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

ENGINE COOLANT TEMPERATURE SENSOR (ECTS) ECD22F3A

The ECTS is located in the engine coolant passage. It detects the coolant temperature and sends to the ECM. It has a thermistor which is sensitive to change according to the coolant temperature. The electric resistance of a thermistor decreases in response to temperature rise.
The ECM uses this information to control the injection quantity and fan operation.



AFGF300F

SPECIFICATION

Between Pin 1 and 3 (For ECTS)

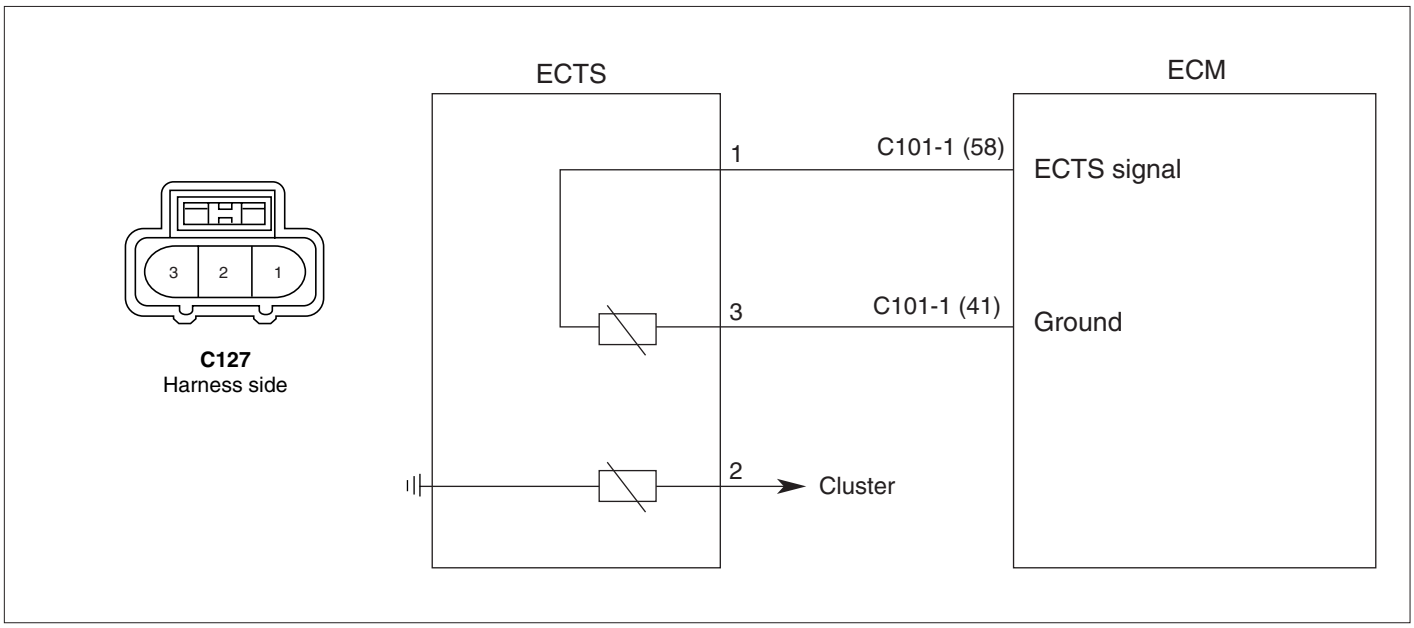
Temperature ℃ (˚F)	Sensor Resistance (kΩ)
-20 (-4)	14.13 ~16.83
0 (32)	5.79
20 (68)	2.31 ~ 2.59
40 (104)	1.15
60 (140)	0.59
80 (176)	0.32
100 (212)	0.19
110 (230)	0.15
120 (248)	0.17

Between Pin 1 and 2 (For Gauge)

Temperature ℃ (˚F)	Sensor Resistance (Ω)
60 (140)	125
85 (185)	42.6 ~ 54.2
110 (230)	22.1 ~ 26.2
125 (257)	15.2

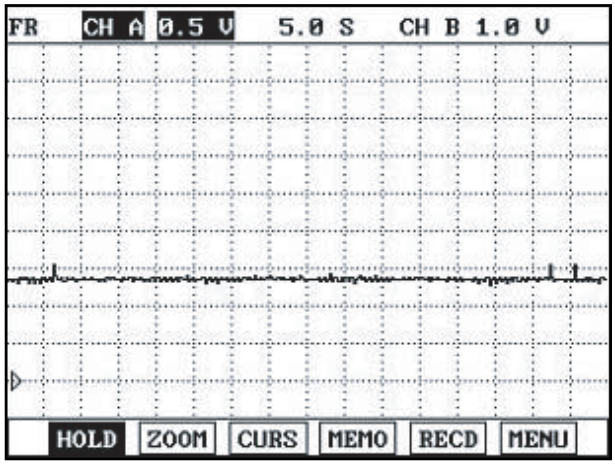
EFNF537A

CIRCUIT DIAGRAM



EGNG109A

SIGNAL WAVEFORM

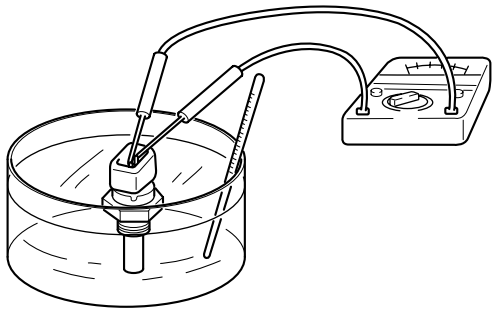


ECTS signal should be smooth and continuous without any sudden changes.
As the engine warms up, ECTS signal will drop.

EFNF539A

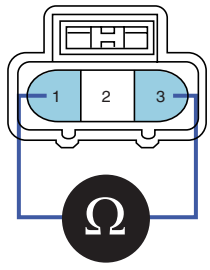
COMPONENT INSPECTION

1. Remove the ECTS from the engine coolant passage.
2. With the temperature sensing portion of the ECTS immersed in hot engine coolant, check the resistance.(Refer to "SPECIFICATION")



EFNF541A

<Sensor connector>



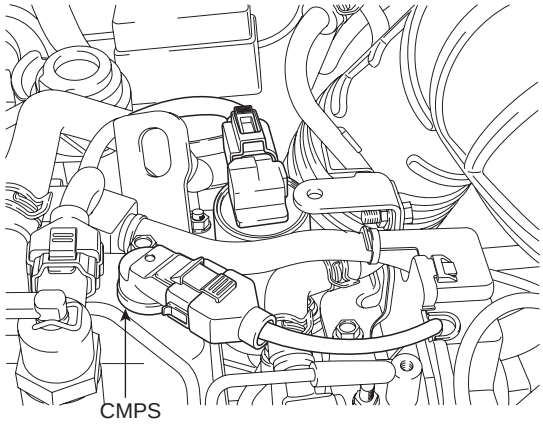
LGJF500W

3. If the resistance deviates from the standard value greatly, replace the sensor.

CAMSHAFT POSITION SENSOR (CMPS)

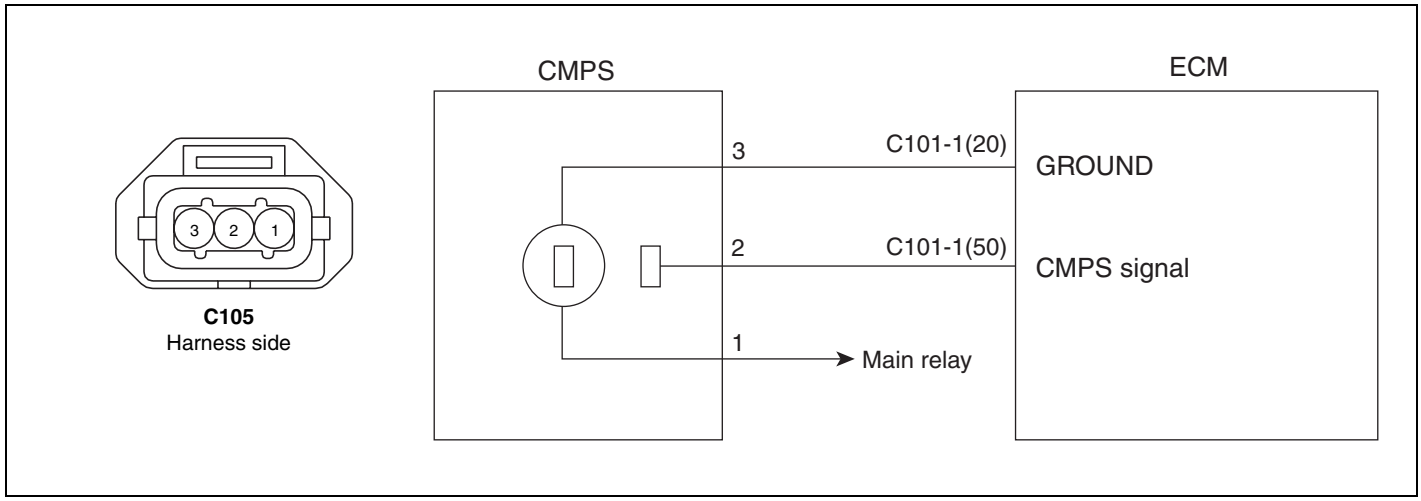
CAMSHAFT POSITION SENSOR (CMPS) E7DC4BAB

CMPS detects the teeth target wheel and provides ECM with the information on the current position of piston and cylinder.
ECM uses this signal to determine the fuel injection timing and ignition timing.



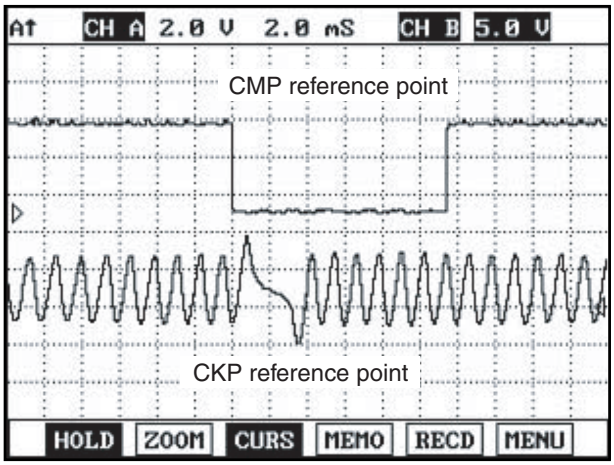
AWJF300G

CIRCUIT DIAGRAM



EGNG110A

SIGNAL WAVWFORM



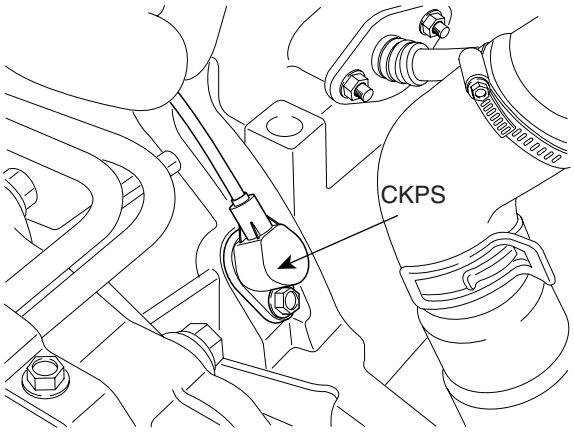
This illustration shows waveform of Crankshaft Position Sensor(CKPS) and Camshaft Position Sensor(CMPS) simultaneously. The middle area indicates reference points of CKPS and CMPS.

LGJF500Y

CRANKSHAFT POSITION SENSOR (CKPS)

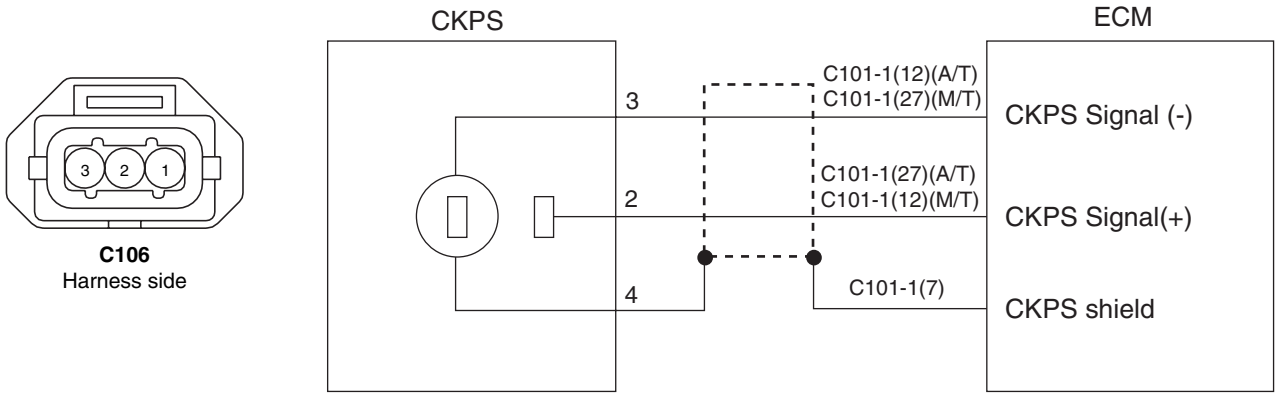
CRANKSHAFT POSITION SENSOR (CKPS) E1852BDD

Piston position on combustion chamber is the substantial to define the starting of injection timing. All engine pistons are connected to crankshaft by connecting rod. Sensor on crankshaft can supply the informations concerning all piston positions, revolution speed is defined by revolution per minute of crankshaft. Prior input variable is determined at ECM by using signal induced from crankshaft position sensor.



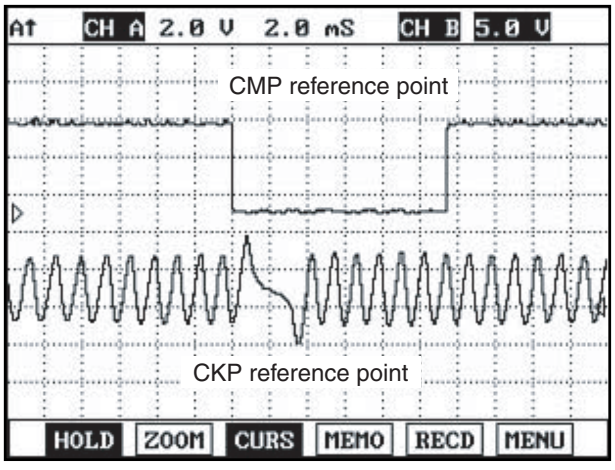
AWJF300H

CIRCUIT DIAGRAM



EGNG111A

SIGNAL WAVEFORM



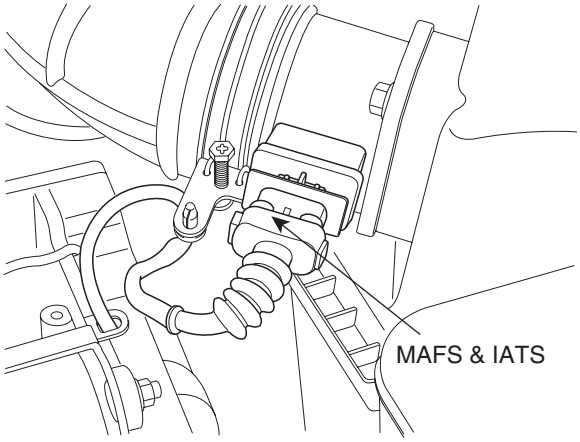
This illustration shows waveform of Crankshaft Position Sensor(CKPS) and Camshaft Position Sensor(CMPS) simultaneously. The middle area indicates reference points of CKPS and CMPS.

LGJF500Y

MASS AIR FLOW SENSOR (MAFS)

MASS AIR FLOW SENSOR (MAFS) ED81669E

MAFS uses a hot-film type sensing element to measure the mass of intake air entering the engine, and send the signal to ECM.
A large amount of intake air represents acceleration or high load conditions while a small amount of intake air represents deceleration or idle.
The ECM uses this information to control the EGR solenoid valve and correct the fuel amount.



AWJF300F

SPECIFICATION

Intake Air Temperature: 20℃

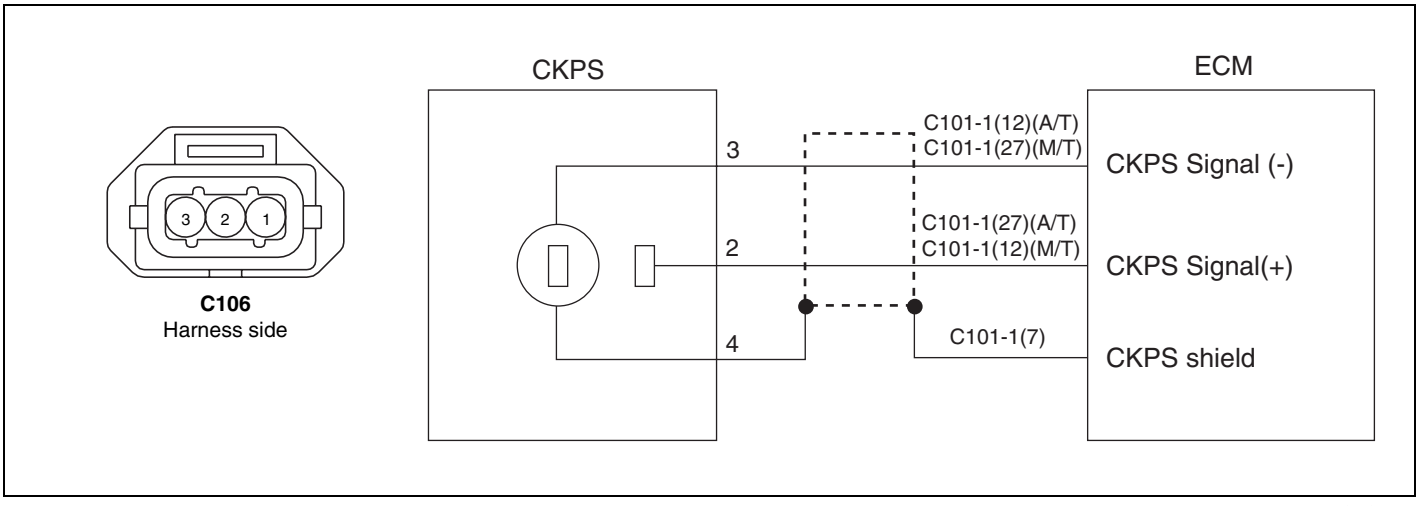
Mass air flow (kg/h)	Frequency (KHz)
8	1.96 ~ 1.97
10	2.01 ~ 2.02
40	2.50 ~ 2.52
105	3.18 ~ 3.23
220	4.26 ~ 4.35
480	7.59 ~ 7.94
560	9.08 ~ 9.89

Intake Air Temperature: 80℃

Mass air flow (kg/h)	Frequency (KHz)
10	2.00 ~ 2.02
40	2.49 ~ 2.53
105	3.16 ~ 3.25
480	7.42 ~ 8.12

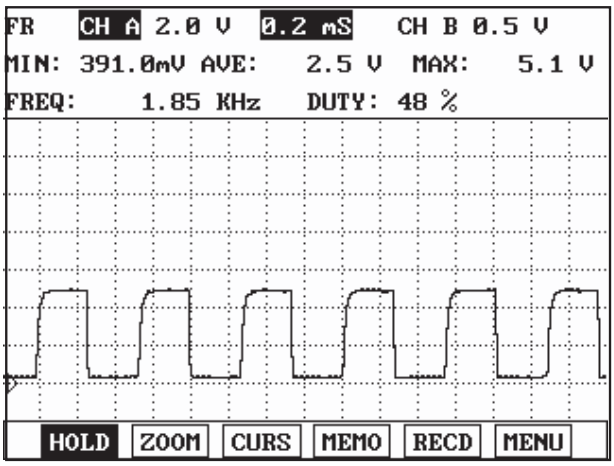
LGJF501B

CIRCUIT DIAGRAM



EGNG111A

SIGNAL EAVEFORM



This illustration shows waveform of MAFS at idle.

LGJF501C

COMPONENT INSPECTION

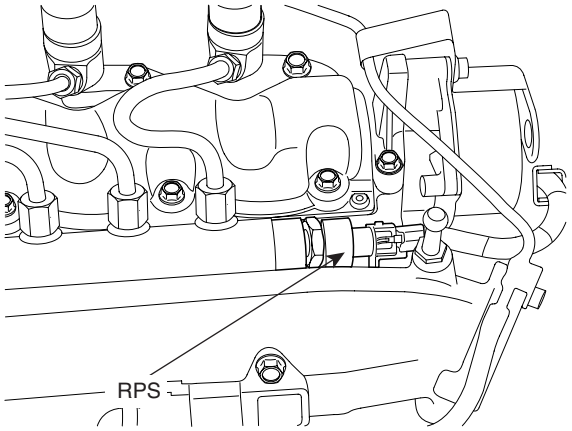
1. Check the MAFS visually.
   - Mounting direction correct.
   - Any contamination, corrosion or damage on connector.
   - Air cleaner's clogging or wet.
   - MAFS cylinder's deforming or blocking by any foreign material.

2. Check any leakage on intake system and intercooler system.

RAIL PRESSURE SENSOR (RPS)

RAIL PRESSURE SENSOR (RPS) EF8EBC2A

In order to output a voltage signal to the ECM which corresponds to the applied pressure, the rail pressure sensor must measure the instantaneous pressure in the rail. The fuel flows to the rail pressure sensor through an opening in the rail, the end of which is sealed off by the sensor diaphragm. Pressurized fuel reaches the sensor's diaphragm through a blind hole. The sensor element (semiconductor device) for converting the pressure to an electric signal is mounted on this diaphrgam. The signal tenerated by the sensor is inputted to an evaluation circuit which amplifies the measuring signal and sends it to the ECM.

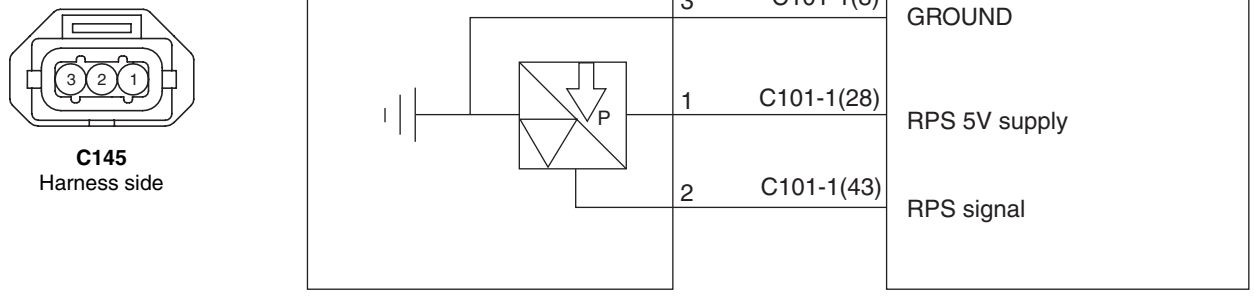


LXGF515A

SPECIFICATION

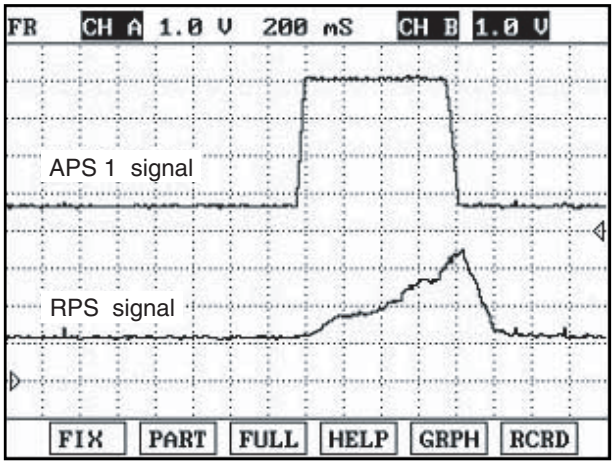
	Engine idle state	Available maximum detecting pressure
Rail Pressure	220 ~ 320 bar (22 ~ 32Mpa)	1500bar (150Mpa)
Signal Voltage	below 1.7V	Approx. 4.5V

CIRCUIT DIAGRAM



EGNG113A

SIGNAL WAVEFORM



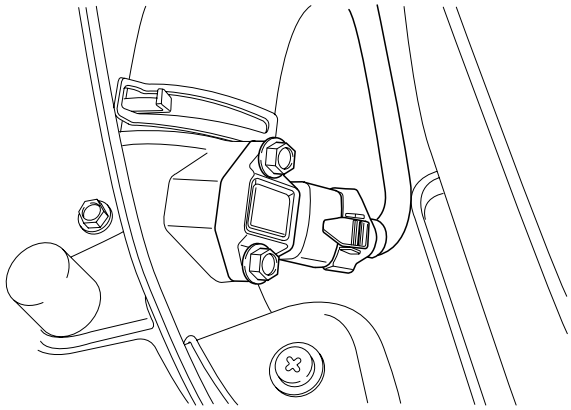
Rail Pressure Sensor (RPS) is to provide to the ECM the voltage signal corresponding to rail pressure.
The change in resistance is preportional to the rail pressure acting upon the diaphragm and rail pressure increases as load increases.

EFNF550A

BOOST PRESSURE SENSOR (BPS)

BOOST PRESSURE SENSOR (BPS) E3D1F62F

Boost pressure sensor (BPS) is installed on surge tank to measure the absolute intake manifold pressure.
BPS input voltage is changed in proportion with absolute pressure in manifold.
This information is used to control Variable Geometery Turbocharger(VGT) by ECM.



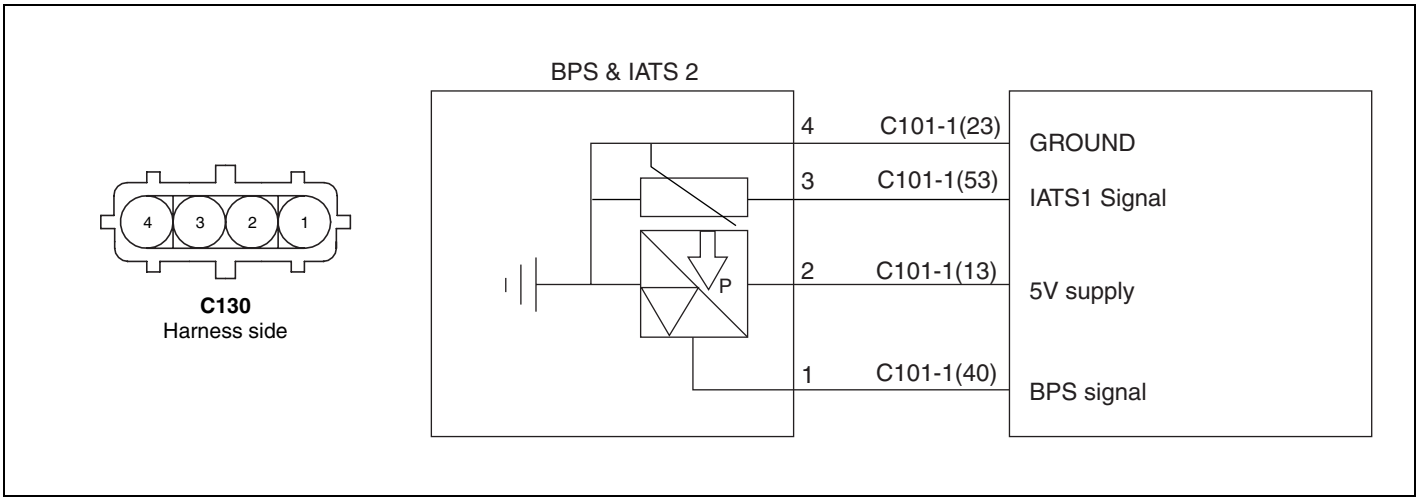
AWJF300J

SPECIFICATION

Pressure (Kpa)	Output Voltage (V)
70	1.02 ~ 1.17
140	2.13 ~ 2.28
210	3.25 ~ 3.40
270	4.20 ~ 4.35

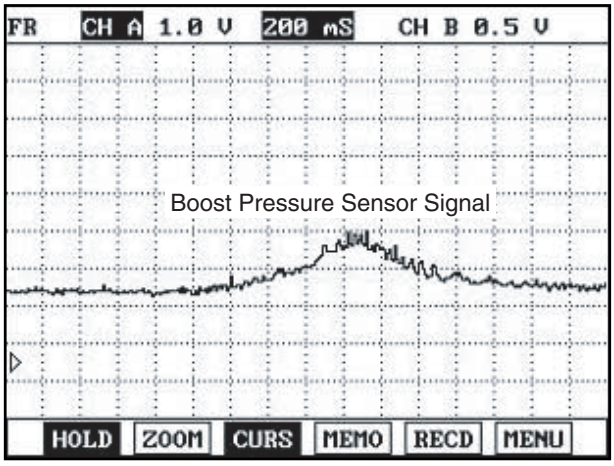
LGJF501E

CIRCUIT DIAGRAM



EGNG114A

SIGNAL WAVEFORM



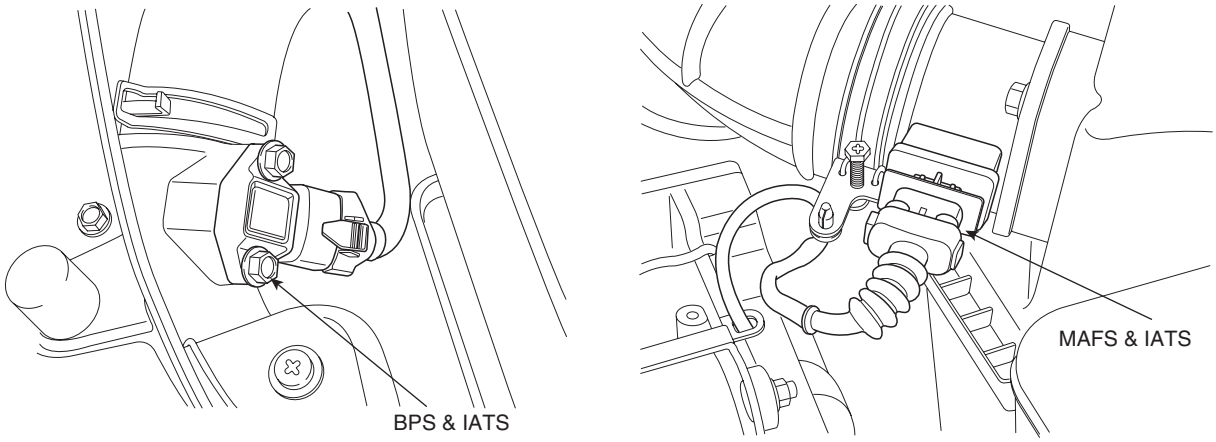
This illustration represents waveform of BPS when accelerating and decelerating.

EFNF553B

INTAKE AIR TEMPERATURE SENSOR (IATS)

INTAKE AIR TEMPERATURE SENSOR (IATS) EF90A524

Intake Air Temperature Sensor (IATS) is Negative Temperature Charcteristics(NTC) thermistor which is installed into both Mass Air Flow Sensor(MAFS) and Boost Pressure Sensor(BPS), It senses intake air temperature which are installed in front of turbocharger (inside of MAFS) and behind it (inside of BPS).
Comparing air temperature from both sensors (one is intake air temperature, the other is air temperature passing through turbo charger), more accurate sensing of intake air temperature is possible.
ECM uses intake air temperature signal to performs EGR control correction and fuel injection quantity correction.



LGJF501G

SPECIFICATION

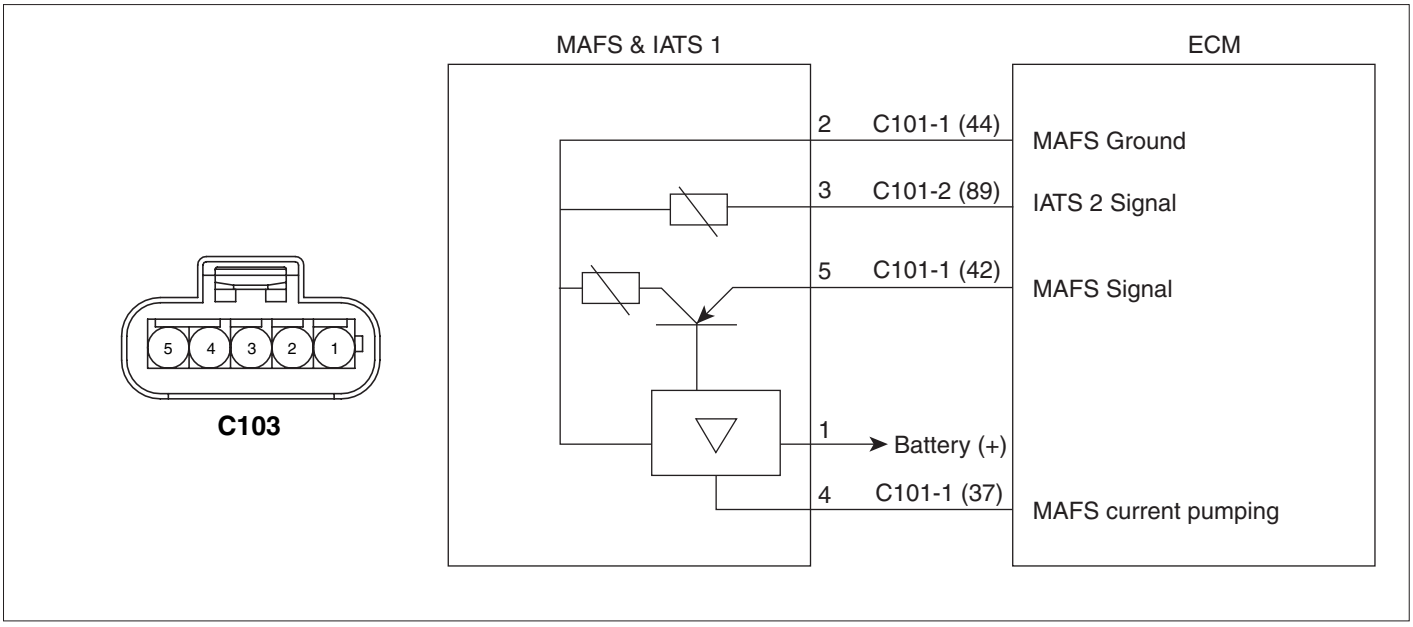
[IATS (INSTALLED INTO BPS)]

Temperature℃(˚F)	Resistance(kΩ)
-20(-4)	13.89 ~ 16.03
-10(14)	8.50 ~ 9.71
0(32)	5.38 ~ 6.09
10(50)	3.48 ~ 3.90
20(68)	2.31 ~ 2.57
30(86)	1.56 ~ 1.74
40(104)	1.08 ~ 1.21
50(122)	0.76 ~ 0.85
60(140)	0.54 ~ 0.62
70(158)	0.40 ~ 0.45
80(176)	0.29 ~ 0.34
90(194)	0.22 ~ 0.26
100(212)	0.17 ~ 0.20
110(230)	0.13 ~ 0.15
120(248)	0.10 ~ 0.12
130(266)	0.08 ~ 0.10

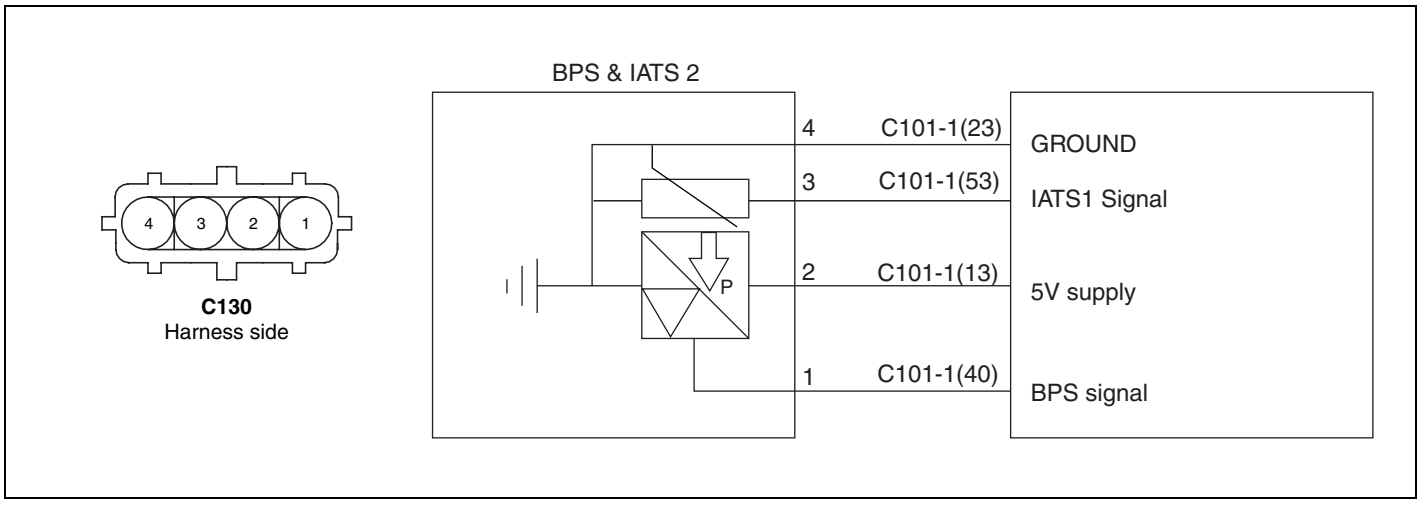
[IATS (INSTALLED INTO MAFS)]

Temperature℃(˚F)	Resistance(kΩ)
-20	12.66 ~ 15.12
0	5.2 ~ 5.9
20	2.29 ~ 2.55
80	0.31 ~ 0.37

CIRCUIT DIAGRAM

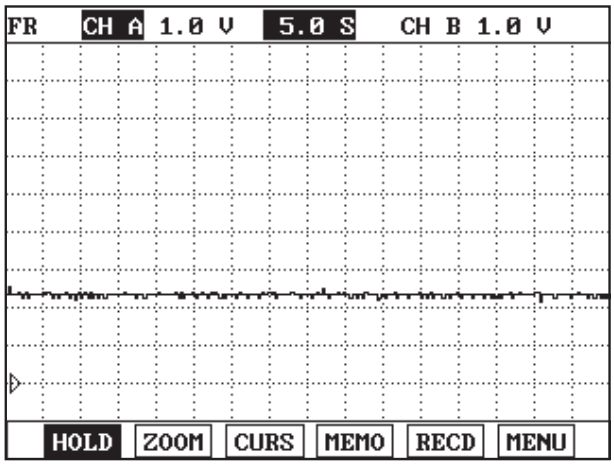


EGNG112A



EGNG114A

SIGNAL WAVEFORM



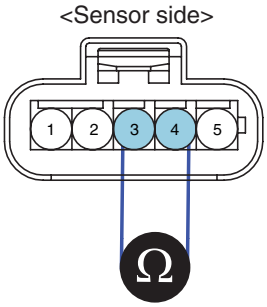
IATS signal should be smooth and continuous without any sudden changes.
After warmed-up, the IATS signal should not change significantly while ECTS signal drops.

LGJF501H

COMPONENT INSPECTION

[IATS 1]

1. Turn the ignition key off.
2. Disconnect Boost Pressure Sensor connector.
3. Measure resistance between the terminals 3 and 4 of MAFS connector.

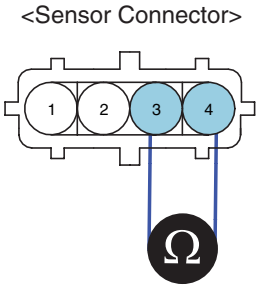


LGJF501J

4. Refering to "SPECIFICATION", check that the resistance is within specification.

[IATS 2]

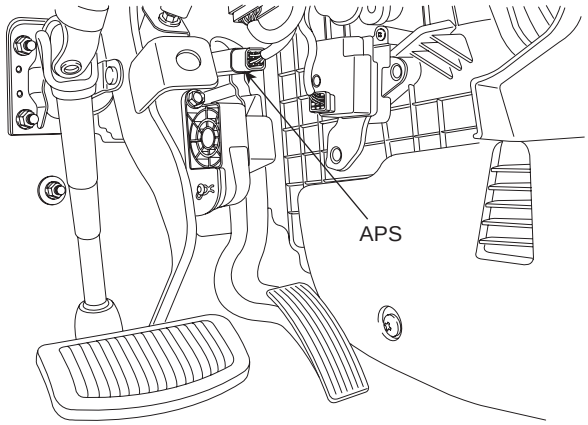
1. Turn the ignition key off.
2. Disconnect Boost Pressure Sensor connector.
3. Measure resistance between the terminals 3 and 2 of BPS connector.



LGJF501I

4. Refering to "SPECIFICATION", check that the resistance is within specification.

ACCELERATOR POSITION SENSOR (APS)



AWJF300K

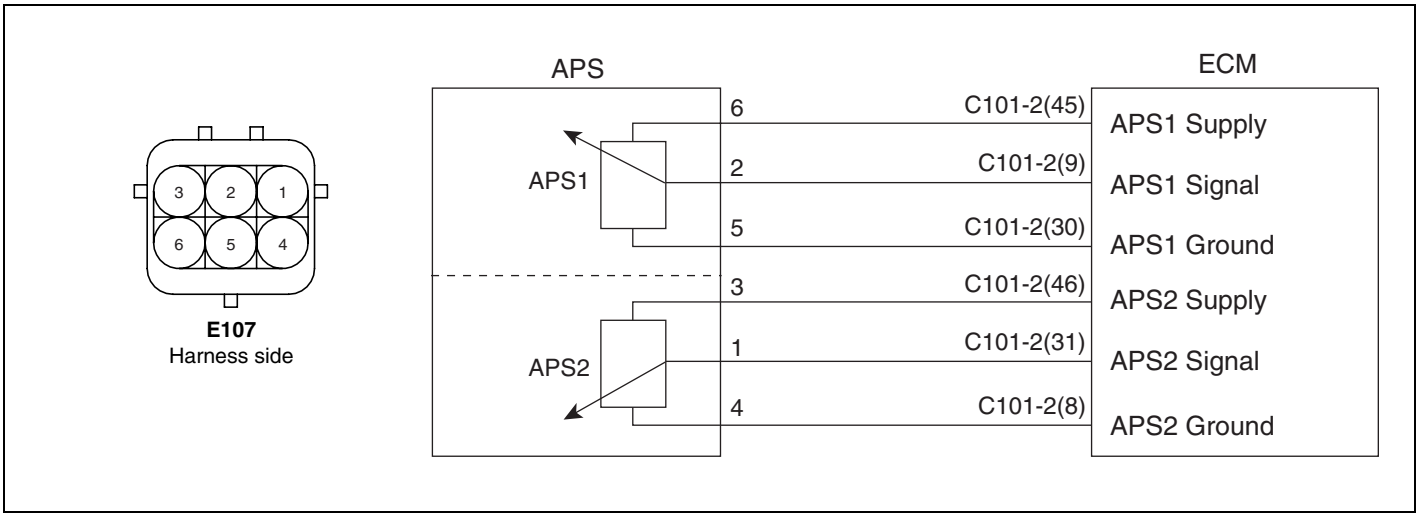
ACCELERATOR POSITION SENSOR (APS) ECAEFC93

On electronic injection systems, there is no longer a load lever that mechanically controls the fuelling. The flow is caculated by the ECM depending on a number of parameters, including pedal position, which is measured using a potentiometer. The pedal sensor has two potentiometers whoses slides are mechanically solid. The two potentiometers are supplied from distinct and different power sources so there is built in redundancy of information giving reliable driver's request information. A voltage is generated across the potentiometer in the acceleration position sensor as a function of the accelerator-pedal setting. Using a peogrammed characteristic curve, the pedal's position is then calculated from this voltage.

SPECIFICATION

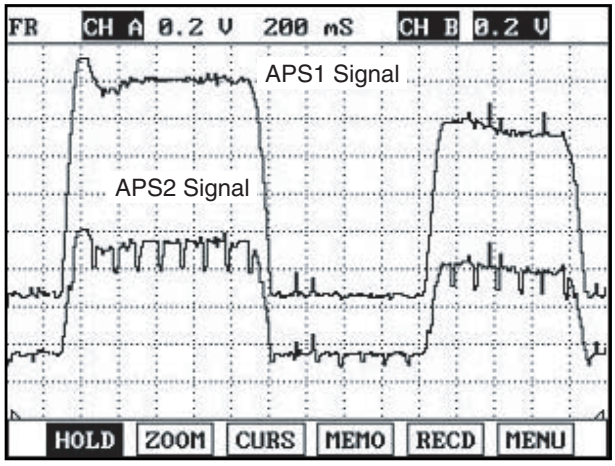
Test Condition	Output Voltage (V)	
	APS1	APS2
Idle	0.14 ~ 0.16	0.073 ~ 0.077
Fully depressed	0.76 ~ 0.88	0.35 ~ 0.47

CIRCUIT DIAGRAM



EGNG115A

SIGNAL WAVEFORM

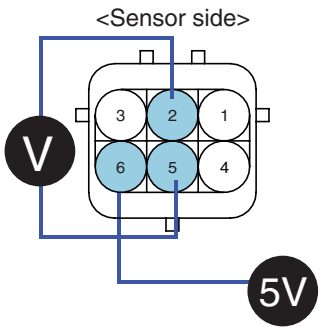


APS2 is a half of APS1 signal.

LGJF501L

COMPONENT INSPECTION

1. Disconnect APS connector and connect the voltimeter to the terminals 2 and 5 of APS connector.
2. Supply the terminal 6 with DC 5V.

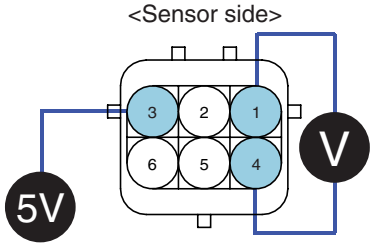


AWJF301S

3. Check the voltage between the terminals 2 and 5 on operating pedal.

Idle: 0.14 ~ 0.16V Fully depressed: 0.76 ~ 0.88V

4. Disconnect the voltimeter and DC 5V.
5. Connect the voltimeter to the terminals 1 and 4 of APS connecotr.
6. Supply the terminal 3 with DC 5V.



AWJF301T

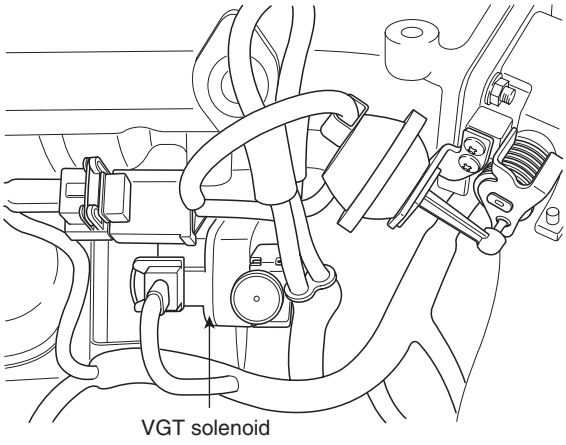
7. Check the voltage between the terminal 1 and 4 on operating pedal.

Idle 0.073 ~ 0.077V Fully depressed: 0.35 ~ 0.47V

VGT CONTROL SOLENOID VALVE

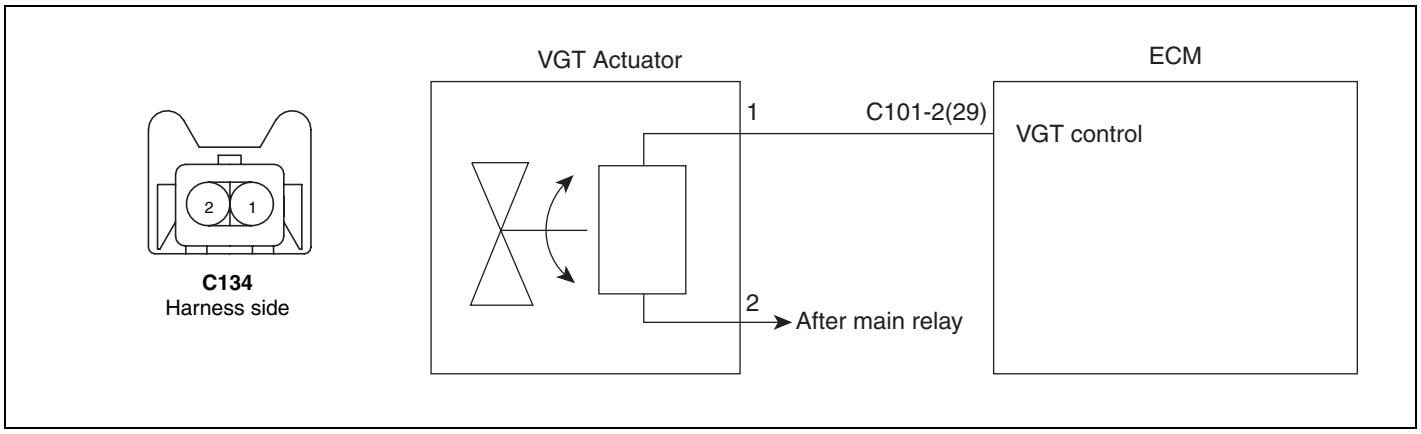
VGT ACTUATOR E79C646F

Variable Geometry Turbocharger (VGT) is used to charge additional air into combustion chamber for improvement of combustion efficiency.
ECM controls the duty of VGT solenoid valve according to engine load.



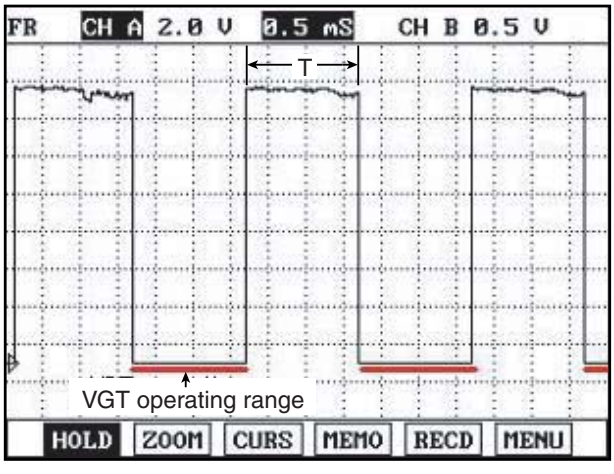
LGJF501M

CIRCUIT DIAGRAM



EGNG116A

SIGNAL WAVEFORM

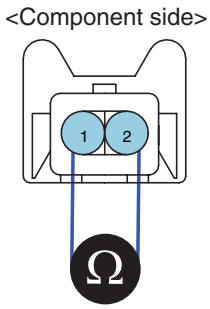


As the VGT actuator is opened increasingly, the time "T" becomes shorter.

EFNF561A

COMPONENT INSPECTION

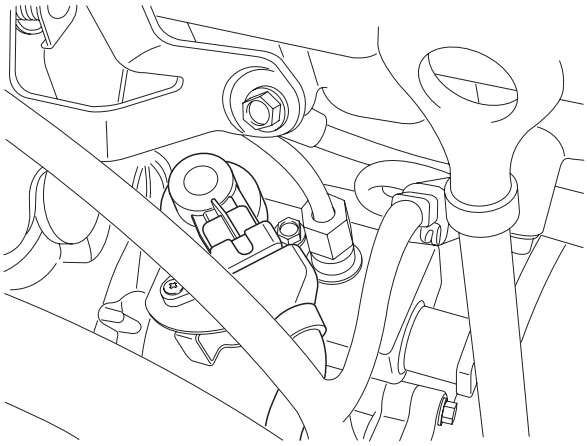
1. Turn the ignition key off.
2. Disconnect the VGT actuator.
3. Measure resistance between the terminals 1 and 2 of the VGT actuator.



LGJF503F

4. Refering to " SPECIFICATION", check that the resistance is within specification.

FUEL PRESSURE REGULATOR VALVE



AWJF300P

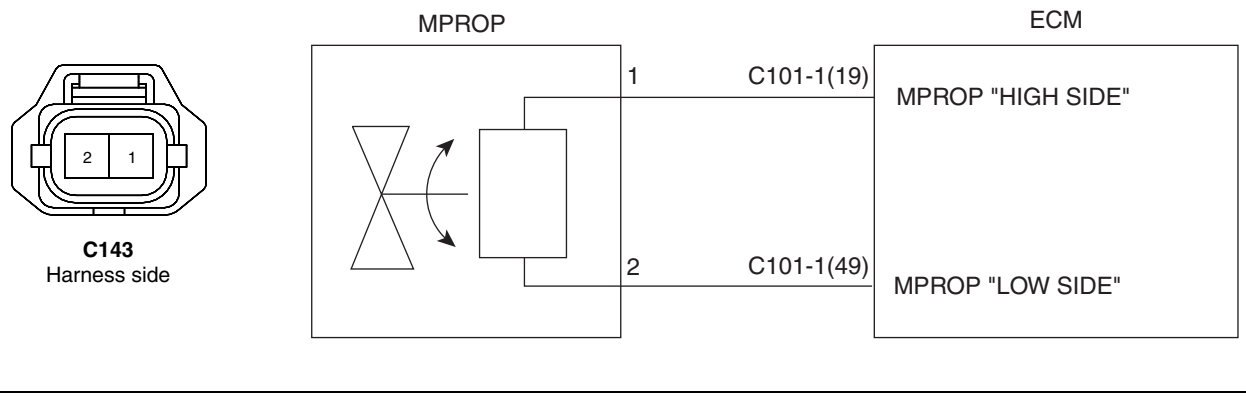
FUEL PRESSURE REGULATOR (MPROP) EA7A92BD

The fuel pressure-control vlave sets the correct pressure in the rail as a function of engine loading, and manitains it at this level. If the rail pressure is excessive, the pressure-control valve opens and a portion of the fuel returns from the rail to the fuel tank via a collector line. If the rail pressure is too low, the pressure-control valve closes and seals off the high-pressure stage from the low-pressure stages. Fuel pressure control valve is integrated in high-pressure pump.

SPECIFICATION

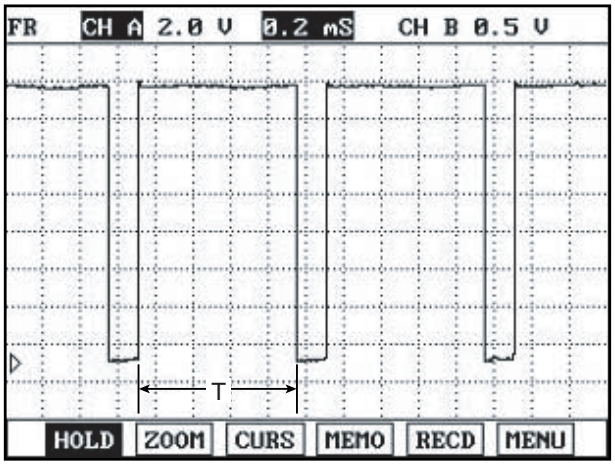
Temperature ℃(˚F)	Resistance (Ω)
20(68)	2.9 ~ 3.15

CIRCUIT DIAGRAM



EGNG117A

SIGNAL WAVEFORM

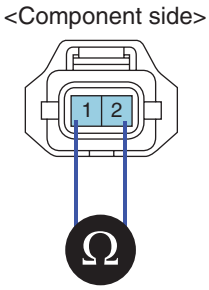


The cycle time "T" becomes shorter while idling and the fuel pressure regulator is opening to allow a large amount of fuel to be returned to the fuel tank.
The cycle time "T" becomes longer when accelerating and the fuel pressure regulator is closing to allow a small amount of fuel to be returned to the fuel tank.

EFNF557A

COMPONENT INSPECTION

1. Turn the ignition key off.
2. Disconnect the fuel pressure regulator connector.
3. Measure resistance between the terminals 1 and 2 of the fuel pressure regulator connector.



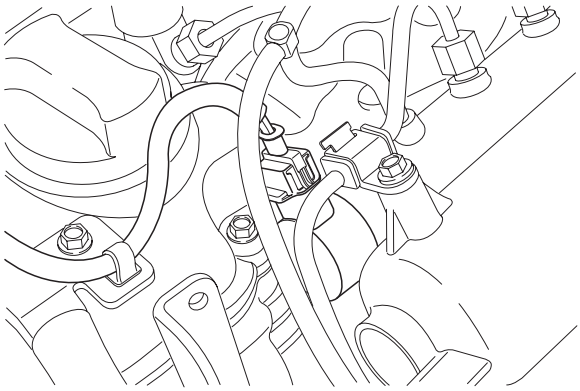
LGJF501Q

4. Refering to "SPECIFICATION", check that the resistance is within specification.

RAIL PRESSURE REGULATOR VALVE

RAIL PRESSURE CONTROL VAVLE E52FBD72

Rail pressure control valve(PCV) is installed in common rail.
If controls common rail pressure fast as regulating returning quantity if fuel which is delivered to common rail when fast rise of rail pressure is required like the moment of turning engine ON or when fast relief of pressure is required like at the point of receleration.

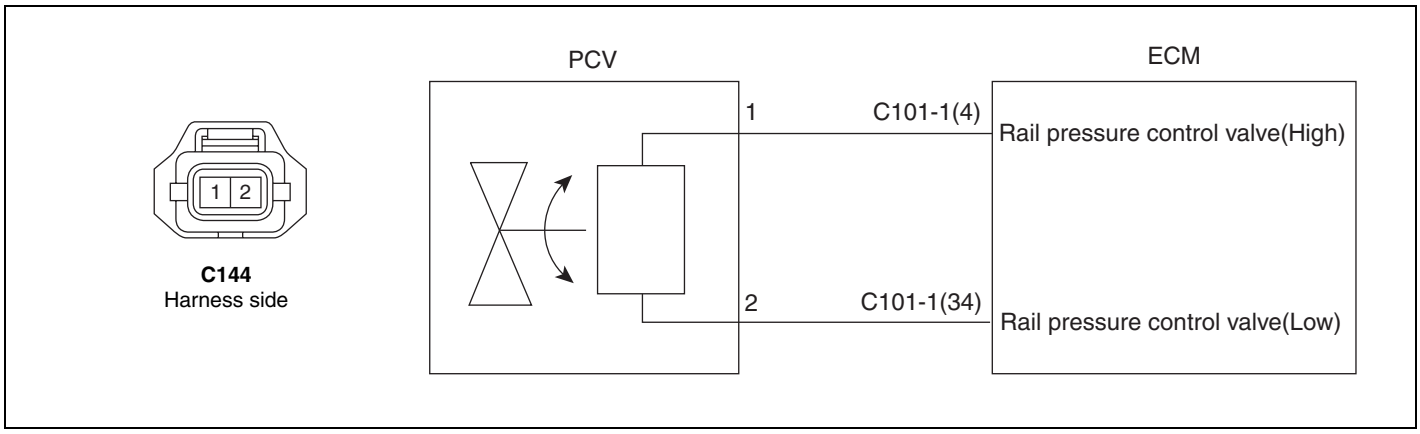


AWJF300V

SPECIFICATION

Temperature ℃(˚F)	Resistance (Ω)
20(68)	3.42 ~ 3.78

CIRCUIT DIAGRAM



EGNG118A

SIGNAL WAVEFORM

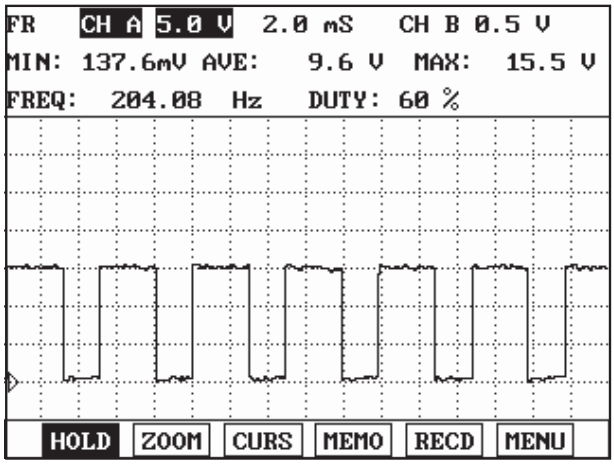


Fig.1

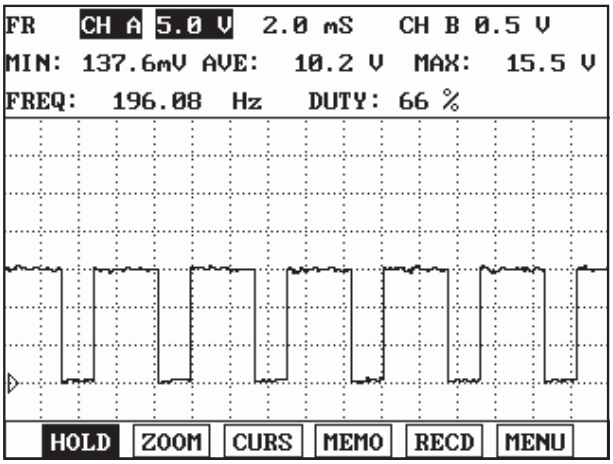


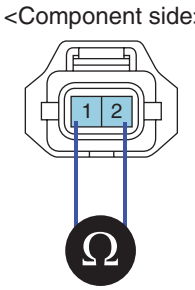
Fig.2

Fig.1) Waveform of rail pressure control valve at idle (20% duty)
Fig.2) Waveform of rail pressure control valve as accelerating (50% duty)

LGJF501S

COMPONENT INSPECTION

1. Turn the ignition key off.
2. Disconnect the rail pressure control valve connector.
3. Measure resistance between the terminals 1 and 2 of the rail pressure control valve connector.



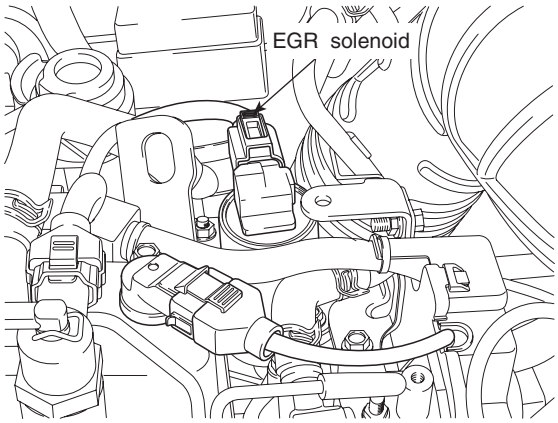
LGJF501Q

4. Refering to "SPECIFICATION", check that the resistance is within specification.

EGR SOLENOID VALVE

EGR CONTROL VALVE EBCC2CAA

The EGR(Exhaust Gas Recirculation) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.
The EGR valve is directly controlled by ECM's control signal directly not by vacuum.
ECM controls the EGR valve with duty.
The duty control of the solenoid valve is determind by ECM depending on engine load and the need of intake air.

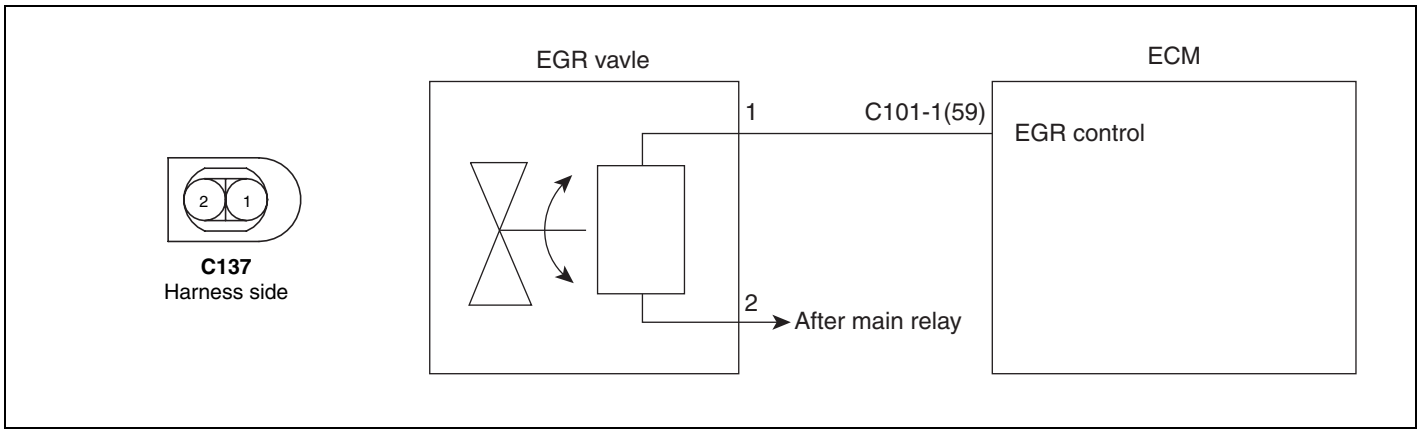


LGJF501T

SPECIFICATION

Temperature℃(˚F)	Resistance(Ω)
19 ~ 25 (66.2 ~ 77)	7.3 ~ 8.3

CIRCUIT DIAGRAM



EGNG119A

SIGNAL WAVEFORM

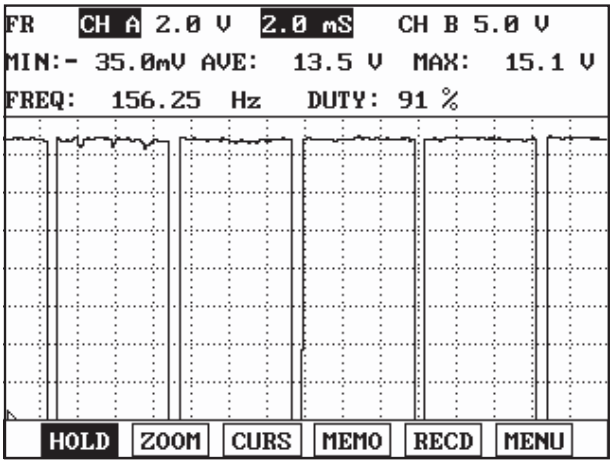


Fig.1

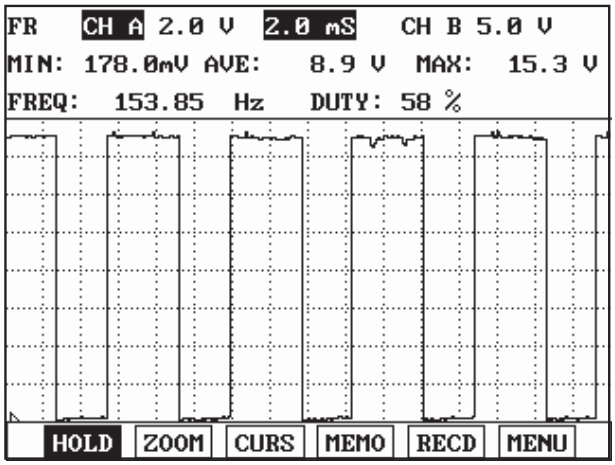


Fig.2

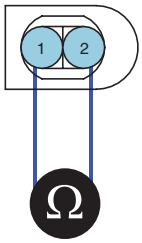
Fig.1) 9.4% duty signal waveform of EGR actuator (EGR valve closed)
Fig.2) 39% duty signal waveform of EGR actuator (EGR valve opened)

LGJF501U

COMPONENT INSPECTION

1. Turn the ignition key off.
2. Disconnect the EGR valve connector.
3. Measure resistance between the terminals 1 and 2 of the EGR valve connector.

<Component side>



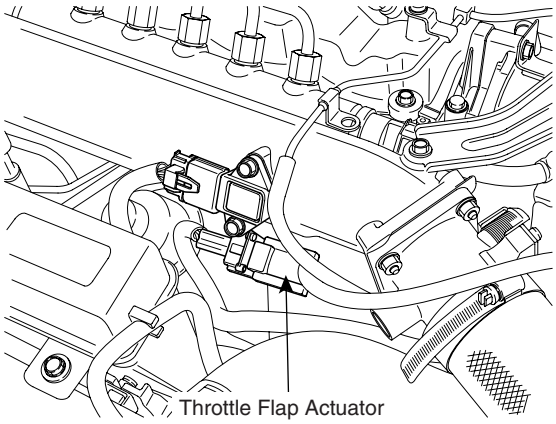
LGJF501W

4. Refering to "SPECIFICATION", check that the resistance is within specification.

THROTTLE CONTROL ACTUATOR

THROTTLE FLAP ACTUATOR E599B5CE

At the moment ignition switch turns off, throttle flap closing movement prevents engine stalling.

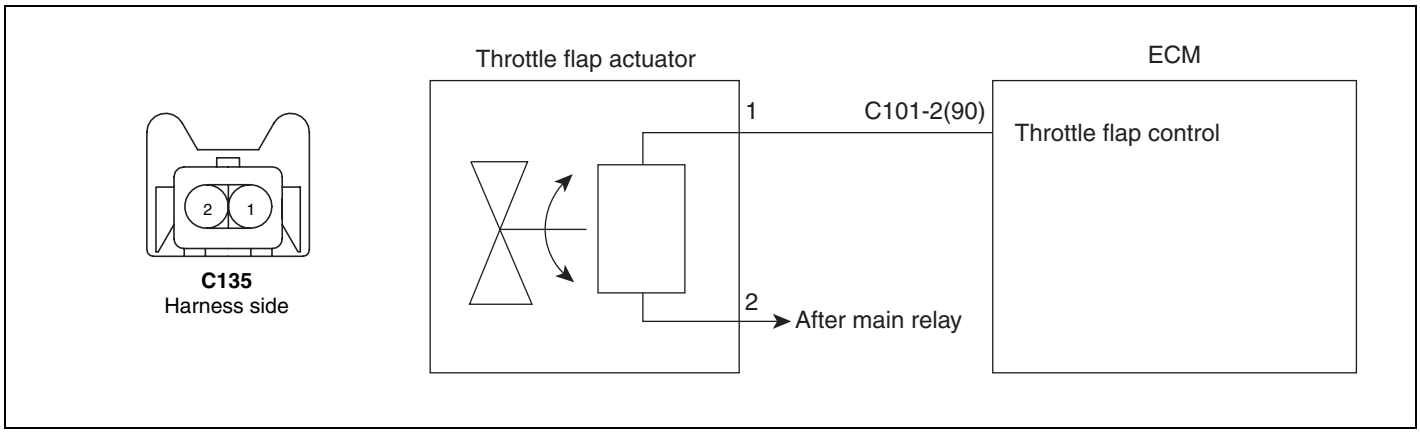


EFNF107A

SPECIFICATION

Temperature ℃(˚F)	Resistance (Ω)
20 (68)	28.3 ~ 31.1

CIRCUIT DIAGRAM



EGNG120A

SIGNAL WAVEFORM

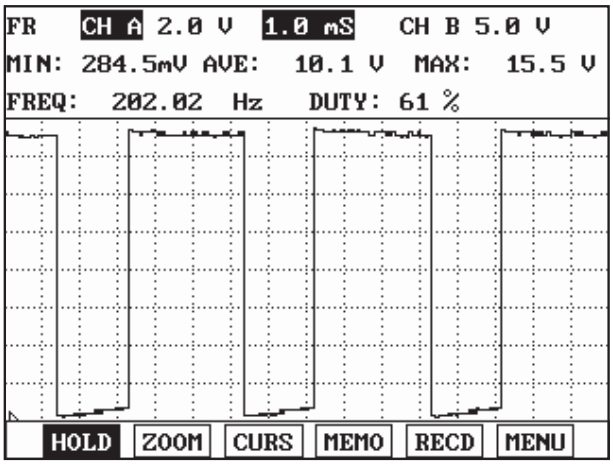


Fig.1

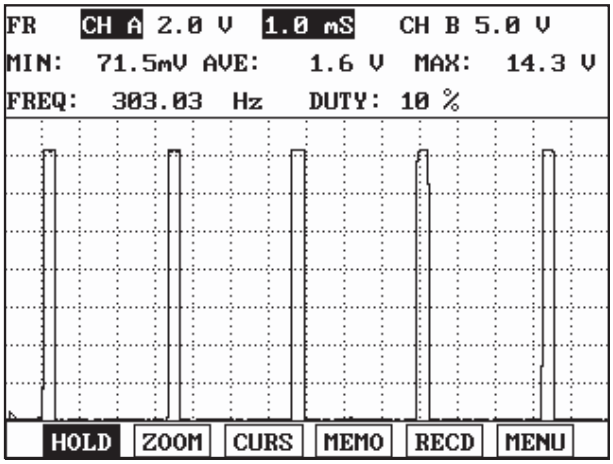


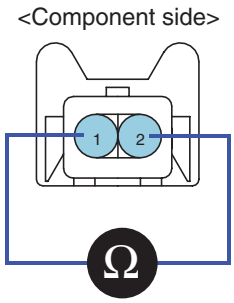
Fig.2

Fig.1) Waveform of throttle flap actuator without throttle flap operation : 38% duty is always outputted at ignition switch "ON" and with engine running.
Fig.2) Waveform of throttle flap actuator without throttle flap operation : 90% duty is outputted for about 1 sec. at ignition switch "OFF".

LGJF501Y

COMPONENT INSPECTION

1. Turn the ignition key off.
2. Disconnect the throttle flap actuator solenoid valve connector.
3. Measure resistance between the terminals 1 and 2 of throttle flap actuator solenoid valve connecotr.



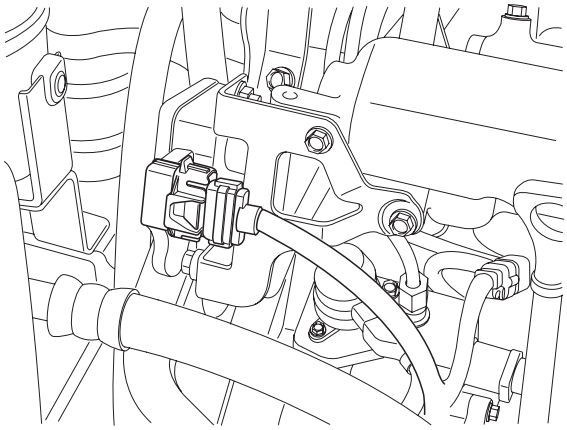
LGJF502B

4. Refering to "SPECIFICATION", check that the resistance is within specification.

VARIABLE SWIRL CONTROL ACTUATOR

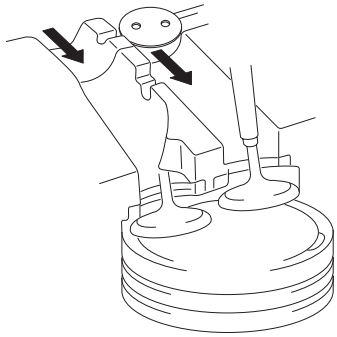
VARIABLE SWIRL ACTUATOR EA6E58C8

Variable swirl actuator consists of DC motor and valve position sensor which detects the position of swirl valve.
At idle and below 3000rpm, swirl valve is closed to take swirl effect. This swirl effect increases air flow rate.



AWJF300W

OPERATION PRINCIPLE

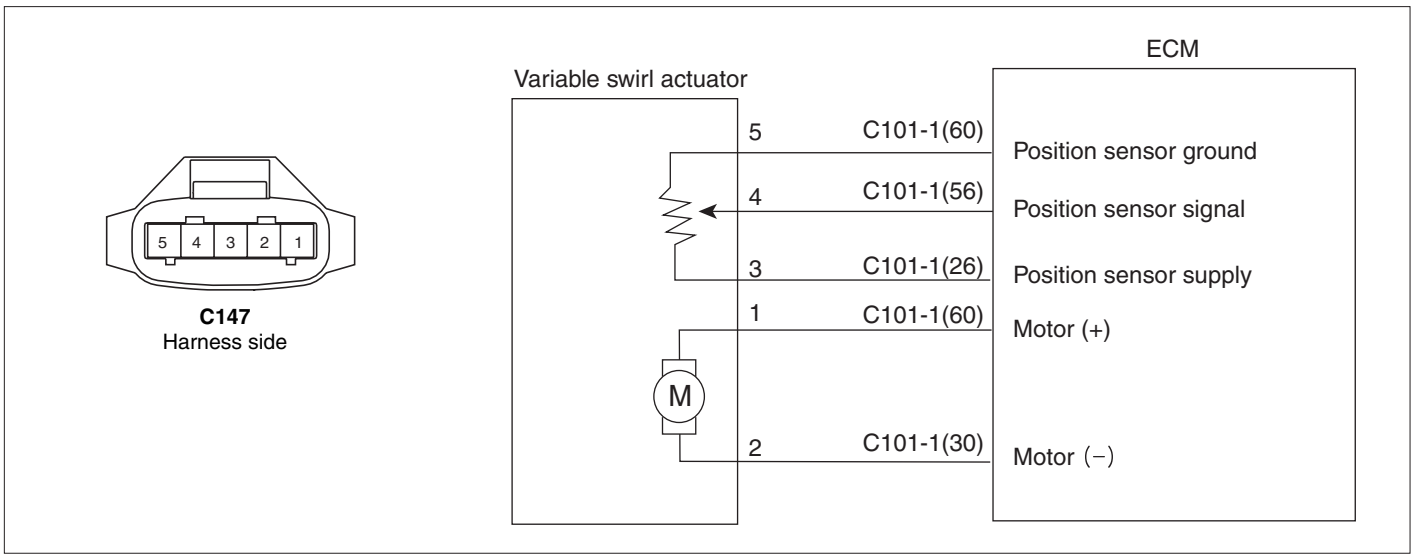
Item	Low and Middle Load	High Load
Engine speed	below 3000rpm	above 3000rpm
Valve operation	close	open
Description illustration	 AWJF302A	 AWJF302B
Fail-safe	Variable Swirl Valve is opened fully	

※ To prevent swirl valve and shaft from being stuck by foreign material and to learn max opening and closing position of swirl valve, it is always fully opened and closed twice at engine stop.

SPECIFICATION

Item	Temperature℃(˚F)	Resistance(Ω)
Motor	20 (68)	3.2 ~ 4.4
Position sensor	20 (68)	3.44 ~ 5.16

CIRCUIT DIAGRAM



EGNG121A

SIGNAL WAVEFORM

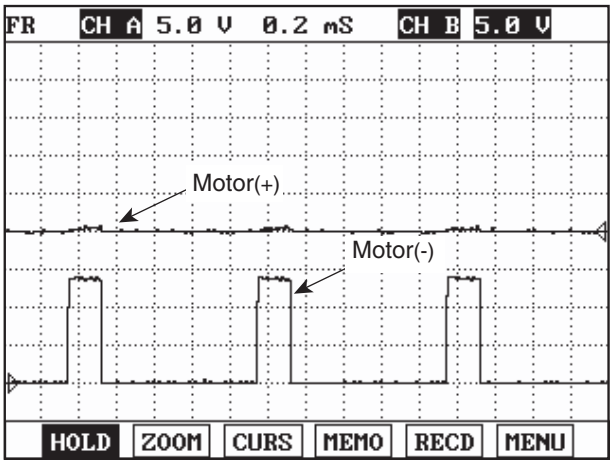


Fig.1

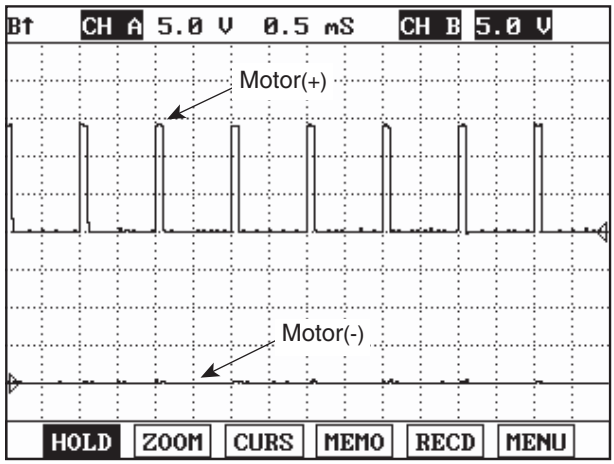


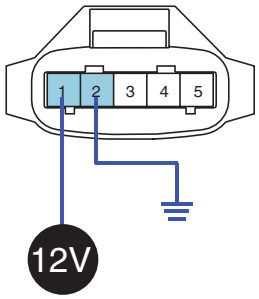
Fig.2

Fig.1) Swirl valve closed (Idle)
Fig.2) Swirl valve opened (Above 3000rpm)

LGJF502D

COMPONENT INSPECTION

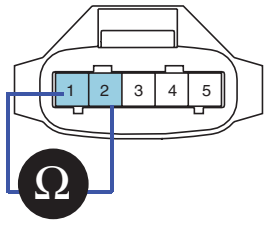
1. Turn ignition switch OFF.
2. Disconnect Variable swirl actuator connector.
3. Check that swirl valve is stuck by foreign material.
4. Supply the terminal 1 of variable swirl actuator connector (component side) with 12V and ground the terminal 2 of it.
5. Check swirl valve operation.



LGJF502E

6. Measure resistance between the terminals 1 and 2 of variable swirl actuator connector (component side).

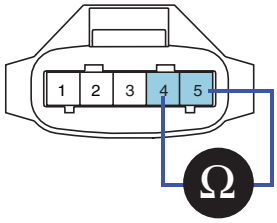
Resistence : 3.2 ~ 4.4Ω (20℃)



LGJF502F

7. Measure resistance between the terminals 4 and 5 of variable swirl actuator connector (component side).

Resistence : 3.44 ~ 5.16Ω (20℃)

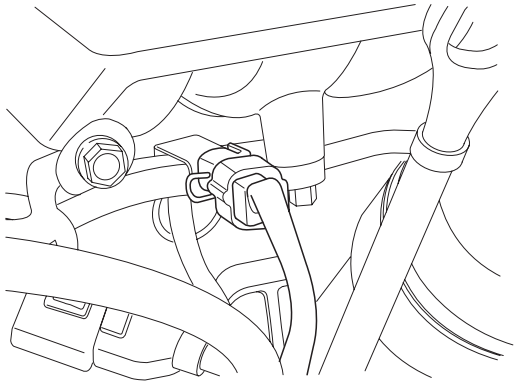


LGJF502G

FUEL TEMPERATURE SENSOR (FTS)

FUEL TEMPERATURE SENSOR E4586FA9

Fuel Temperature Sensor(FTS) is negative temperature characteristic thermistor installed in fuel supplying line. It senses the termperature of fuel supplied to high pressure pump. Fuel temperature is limmited to protect fuel such as high pressure pump and injectors from damages due to rapid deterioration by vapor-lock which can occur at high temperature or destruction of oil membrance.

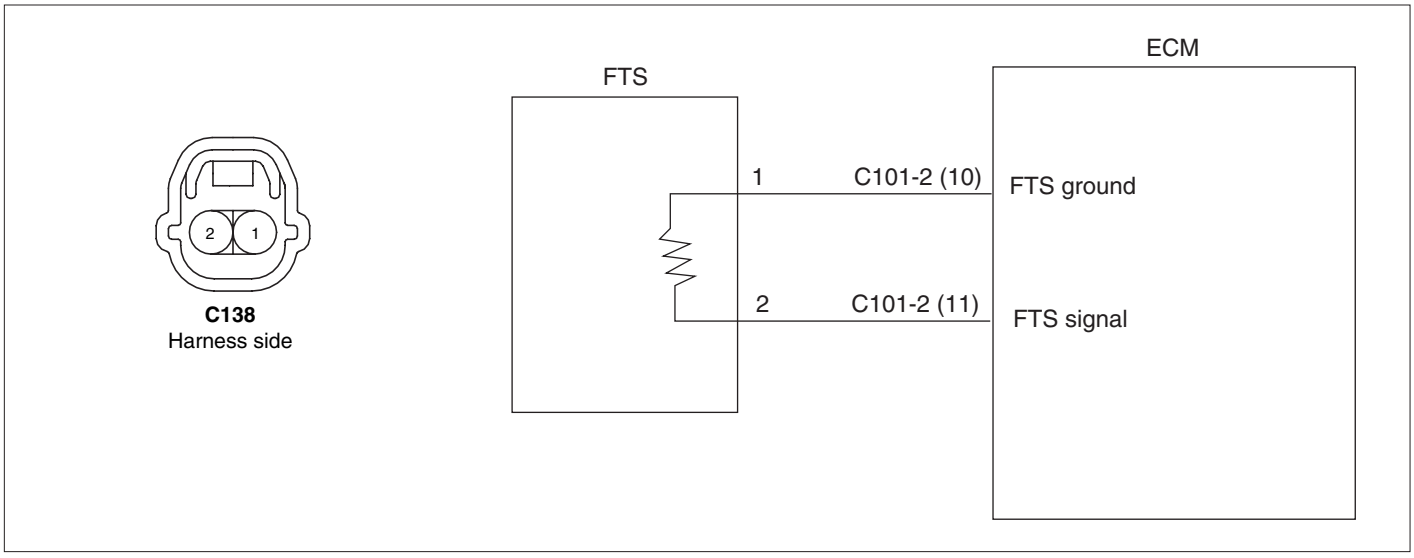


AWJF302K

SPECIFICATION

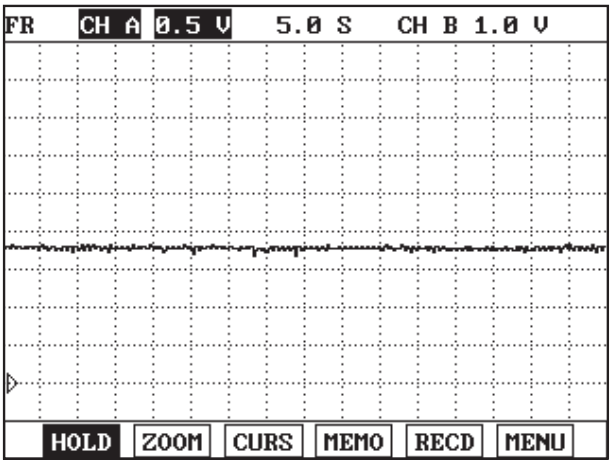
Temperature℃(˚F)	Resistance(kΩ)	Temperature℃(˚F)	Resistance(kΩ)
-30(-22)	27	80(176)	0.30 ~ 0.32
-20(-4)	15.67	85(185)	0.269
-10(14)	9.45	90(194)	0.231
0(32)	5.89	95(203)	0.205
20(68)	2.27 ~ 2.73	100(212)	0.176
40(104)	1.17	105(221)	0.158
50(122)	0.826	110(230)	0.137
60(140)	0.597	120(248)	0.112
70(158)	0.434	130(266)	0.088

CIRCUIT DIAGRAM



EGNG122A

SIGNAL WAVEFORM



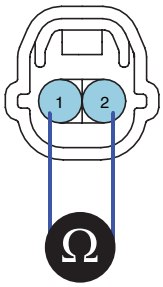
This illustration shows the waveform of fuel temperature sensor at 50℃.
The higher fuel temperature rises, the lower signal voltage becomes.

LGJF502I

COMPONENT INSPECTION

1. Turn the ignition key off.
2. Disconnect Fuel Temperature Sensor connector.
3. Measure resistance between the terminals 1 and 2 of FTS connector.

<Sensor Connector>



LGJF502J

4. Refering to "SPECIFICATION", check that the resistance is within specification.

LAMBDA SENSOR

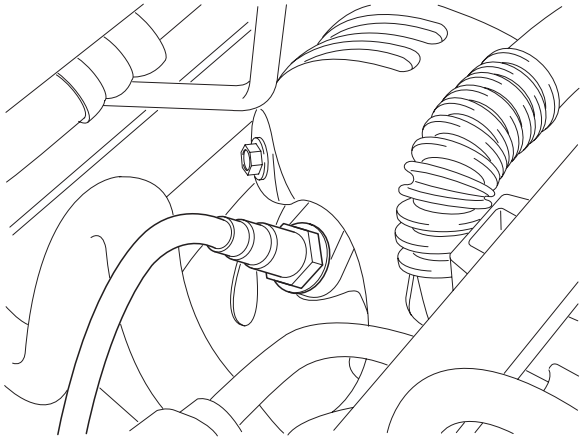
OXYGEN SENSOR E194DFF0

O2 sensor installed at exhaust manifold is linear O2 sensor and it senses O2 density of exhaust gas for accurate EGR control through fuel correction. It also limits smoke which is generated by reach air-fuel mixture at engine maximum loading condition. ECM controls pumping current in order to fit λ -value from linear O2 sensor to 1.0.

Lean air-fuel mixture($1.0 < \lambda < 1.1$) : ECM supplies pumping current to O2 sensor (+pumping current) and activates it for O2 sensor to have the characteristic at λ =1.0 (0.0 pumping current). With the value of pumping current supplied to O2 sensor, ECM detects O2 density of exhaust gas.

Rich air-fuel mixture($0.9 < \lambda < 1.0$) : ECM takes away pumping current from O2 sensor (-pumping current) and deactivates it for O2 sensor to have the characteristic at λ =1.0 (0.0 pumping current). With the value of pumping current taken away from O2 sensor, ECM detects O2 density of exhaust gas.

This performance is the most active and fast at normal operating temp.(450℃~600℃) thus, in order to reach normal operating temp. and last at that temp., heater(heating coil) is integrated with O2 sensor.Heater coil is controlled by ECM as PWM. The resistance of heater coil is low when coil is cold thus, current through it increases while resistance is high when coil is hot thus, current decreases. With this principle, O2 sensor temp. is measured and O2 sensor heater operation varies based on the data.

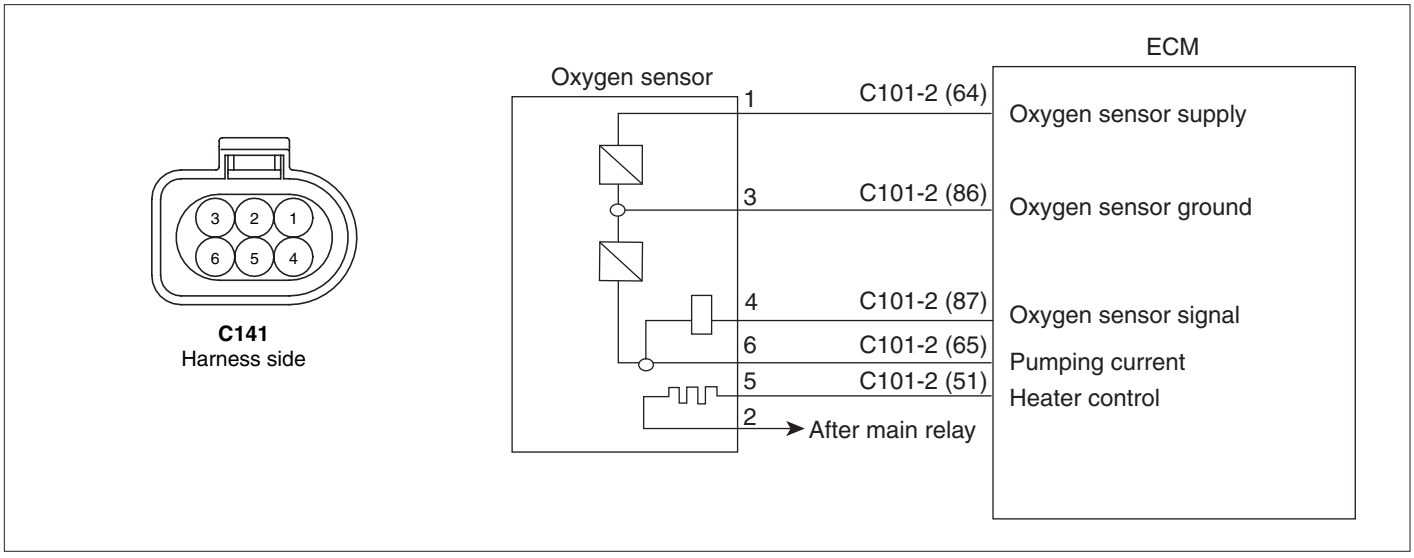


AWJF300U

SPECIFICATION

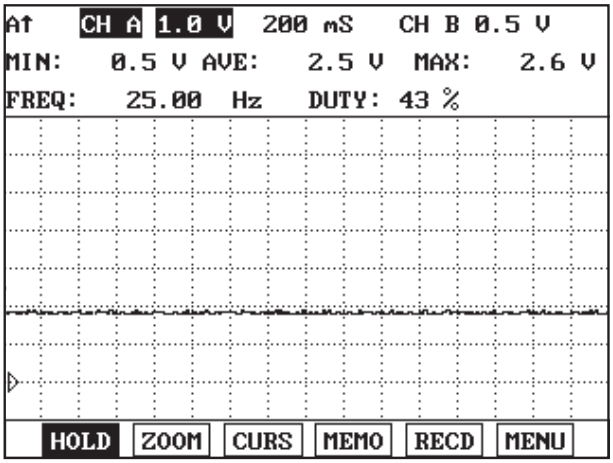
λ -value	0.65	0.70	0.80	0.90	1.01	1.18	1.43	1.70	2.42	Air
Pumping current	-2.22	-1.82	-1.11	-0.50	0.00	0.33	0.67	0.94	1.38	2.54

CIRCUIT DIAGRAM



EGNG123A

SIGNAL WAVEFORM



This illustration represents the waveform of oxygen sensor signal at ignition switch "ON" and engine running.

LGJF502L

DTC TROUBLESHOOTING PROCEDURES E688BCEB

DTC	DESCRIPTION	MIL	PAGE
P0031	Lambda Sensor Heater Circuit low (Bank 1 / Sensor 1)	▲	FLA-92
P0032	Lambda sensor Heater Circuit high (Bank 1 / Sensor 1)	▲	FLA-98
P0047	VGT Vaccum Modulator- Circuit Low	▲	FLA-101
P0048	VGT Vaccum Modulator- Circuit High	▲	FLA-108
P0069	Boost Press. Sensor - Malfunction	▲	FLA-112
P0087	Rail Pressure Monitoring-Minimum Pressure at Engine Speed Too Low	○	FLA-117
P0088	Rail Pressure Monitoring-Maximum Pressure Exceeded	○	FLA-121
P0089	Rail Press. Regulator(PCV) - Circuit Over Current	○	FLA-122
P0091	Rail Press. Regulator(PCV) - Circuit Low	○	FLA-128
P0092	Rail Press. Regulator(PCV) - Circuit High	○	FLA-131
P0097	Intake Air Temperature Sensor - Circuit Low Input	▲	FLA-134
P0098	Intake Air Temperature Sensor - Circuit High Input	▲	FLA-139
P0101	Mass or Volume Air Flow Circuit Range/Performance	○	FLA-143
P0102	Mass or Volume Air Flow Circuit Low Input	○	FLA-150
P0103	Mass or Volume Air Flow Circuit high Input	▲	FLA-154
P0107	Atmospheric Pressure Circuit-Low Input	▲	FLA-158
P0108	Atmospheric Pressure Circuit-High Input	▲	FLA-161
P0112	Intake Air Temperature Sensor1 Circuit Low Input	▲	FLA-163
P0113	Intake Air Temperature Sensor1 Circuit High Input	▲	FLA-169
P0117	Engine Coolant Temperature Circuit Low Input	▲	FLA-173
P0118	Engine Coolant Temperature Circuit High Input	▲	FLA-179
P0182	Fuel Temp Sensor A Circuit Low Input	▲	FLA-183
P0183	Fuel Temp Sensor A Circuit High Input	▲	FLA-188
P0192	Fuel Rail Press. Sensor-Low input	○	FLA-192
P0193	Fuel Rail Press. Sensor-High Input	○	FLA-199
P0201	Injector Circuit/Open-Cylinder 1	○	FLA-204
P0202	Injector Circuit/Open-Cylinder 2	○	FLA-204
P0203	Injector Circuit/Open-Cylinder 3	○	FLA-204
P0204	Injector Circuit/Open-Cylinder 4	○	FLA-204
P0237	Boost Press. Sensor - Circuit Low Input	▲	FLA-211
P0238	Boost Press. Sensor - Circuit High Input	▲	FLA-217

DTC	DESCRIPTION	MIL	PAGE
P0252	Fuel Press. Regulator(MPROP) - Circuit Over Current	○	FLA-222
P0253	Fuel Press. Regulator(MPROP) - Circuit Low	○	FLA-228
P0254	Fuel Press. Regulator(MPROP) - Circuit High	○	FLA-231
P0262	Cylinder 1-Injector Circuit High	○	FLA-235
P0265	Cylinder 2-Injector Circuit High	○	FLA-235
P0268	Cylinder 3-Injector Circuit High	○	FLA-235
P0271	Cylinder 4-Injector Circuit High	○	FLA-235
P0335	Crankshaft Position Sensor A Circuit	○	FLA-242
P0336	Crankshaft Position Sensor A Circuit Range/Performance	○	FLA-250
P0340	Camshaft Position Sensor A Circuit Malfunction (Bank 1 or Single Sensor)	○	FLA-255
P0341	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or Single Sensor)	○	FLA-262
P0381	Glow Indicator Lamp - Circuit Malfunction	▲	FLA-266
P0489	Exhaust Gas Recirculation Control Circuit Low Voltage	○	FLA-271
P0490	Exhaust Gas Recirculation Control Circuit High Voltage	○	FLA-278
P0501	Vehicle Speed Sensor A Range/Performance	▲	FLA-282
P0504	Brake Switch "A"/"B" Correlation	▲	FLA-290
P0532	A/C Refrigerant Pressure Sensor "A" Circuit Low Input	▲	FLA-296
P0533	A/C Refrigerant Pressure Sensor "A" Circuit High Input	▲	FLA-302
P0562	System Voltage Low	▲	FLA-307
P0563	System Voltage High	▲	FLA-313
P0602	EEPROM-Programing Error	▲	FLA-317
P0605	Internal Control Module Read Only Memory(ROM) Error	▲	FLA-319
P0606	ECM/PCM Processor(ECM-SELF TEST Failed)	○	FLA-320
P0611	Injector - Circuit Malfunction (More than two injectors)	○	FLA-322
P062D	Voltage regulator #1 for injector - Malfunction	○	FLA-328
P062E	Voltage regulator #2 for injector - Malfunction	○	FLA-330
P0642	Sensor Reference Voltage "A" Circuit Low	▲	FLA-331
P0643	Sensor Reference Voltage "A" Circuit High	▲	FLA-336
P0646	A/C Clutch Relay Control Circuit Low	▲	FLA-339
P0647	A/C Clutch Relay Control Circuit High	▲	FLA-346
P0650	Malfunction Indicator Lamp(MIL) Control Circuit	▲	FLA-351
P0652	Sensor Reference Voltage "B" Circuit Low	▲	FLA-355
P0653	Sensor Reference Voltage "B" Circuit High	▲	FLA-360

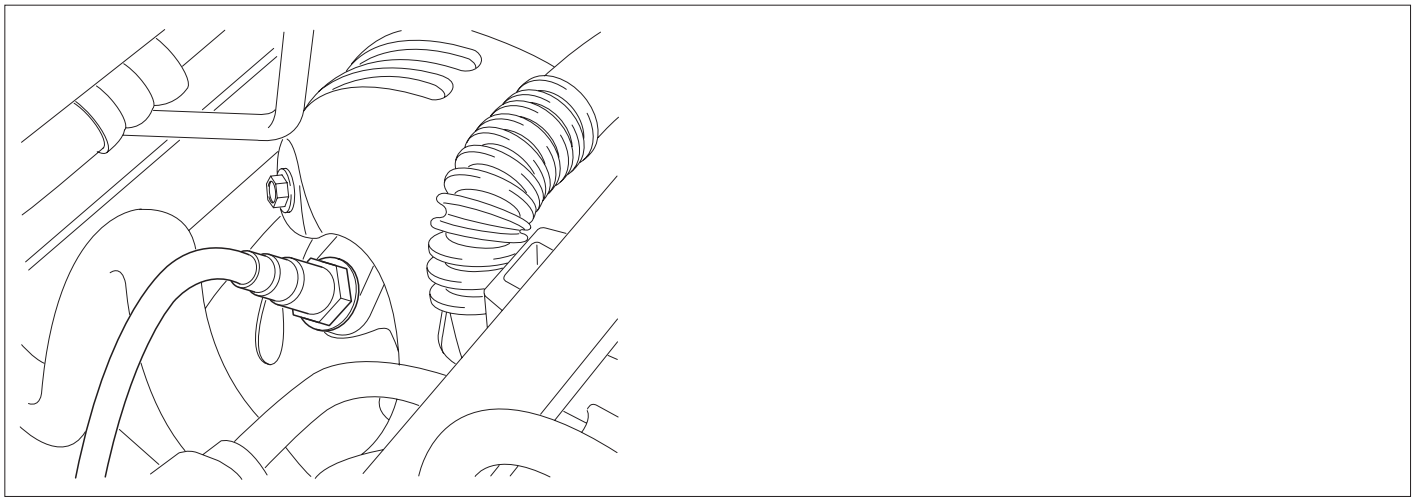
DTC	DESCRIPTION	MIL	PAGE
P0670	Glow Relay - Circuit Malfunction	▲	FLA-363
P0685	ECM/PCM Power Relay Control Circuit /Open	▲	FLA-370
P0698	Sensor Reference Voltage "C" Circuit Low	▲	FLA-377
P0699	Sensor Reference Voltage "C" Circuit High	▲	FLA-382
P0700	TCU Request for MIL On	○	FLA-385
P0701	TCM status Error	▲	FLA-386
P0820	Neutral S/W Malfunction	▲	FLA-387
P0830	Clutch S/W Malfunction	▲	FLA-392
P1145	Overrun monitoring error	▲	FLA-397
P1185	Fuel Pressure Monitoring-Maximum Pressure Exceeded	○	FLA-399
P1186	Fuel Pressure Monitoring-Minimum Pressure at Engine Speed Too Low	○	FLA-403
P1586	MT/AT Encoding	▲	FLA-404
P1587	CAN communication error (MT/AT recognition error)	▲	FLA-407
P1588	Signal Change through MT/AT line (during engine running)	▲	FLA-409
P1634	AUX. Heater Malfunction	▲	FLA-411
P1652	IG S/W Malfunction	▲	FLA-418
P1670	Injector Classification Error	○	FLA-422
P1671	Check-sum error	○	FLA-425
P2009	Intake Manifold Runner Control Circuit Low(Bank 1)	▲	FLA-427
P2010	Intake Manifold Runner Control Circuit High(Bank 1)	▲	FLA-434
P2015	Intake Manifold Runner Position Sensor/Switch Circuit Range/Performance(Bank 1)	▲	FLA-437
P2016	Intake Manifold Runner Position Sensor/Switch Circuit Low(Bank 1)	▲	FLA-444
P2017	Intake Manifold Runner Position Sensor/Switch Circuit High(Bank 1)	▲	FLA-448
P2111	Throttle Control Actuator - Circuit High	▲	FLA-452
P2112	Throttle Control Actuator - Circuit Low	▲	FLA-458
P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input	○	FLA-462
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High Input	○	FLA-469
P2138	Throttle/Pedal Position Sensor/Switch "D" / "E" Voltage Correlation	○	FLA-473
P2238	Lambda Sensor Pumping Current Circuit Low-Bank 1, Sensor 1	▲	FLA-478
P2239	Lambda Sensor Pumping Current Circuit High-Bank 1, Sensor 1	▲	FLA-487
P2251	Lambda Sensor Reference Ground Circuit/Open-Bank 1 Sensor 1	▲	FLA-492
P2264	Detection of Water in fuel	▲	FLA-497
P2299	Brake switch " acc pedal sensor signals input simultaneously at times	▲	FLA-503

DTC	DESCRIPTION	MIL	PAGE
U0001	CAN Communication Malfunction	▲	FLA-511
U0100	CAN-Time Out ECU	▲	FLA-518
U0101	Serial Communication Problem with TCU (Timeout)	▲	FLA-522
U0122	ECM-TCS CAN Error	▲	FLA-526
U0416	Abnormal Torque rise request from TCS	▲	FLA-530

○ : MIL ON & FAULT CODE MEMORY
▲ : MIL OFF & FAULT CODE MEMORY

DTC P0031 LAMBDA SENSOR HEATER CIRCUIT LOW (BANK 1 / SENSOR 1)

COMPONENT LOCATION EE23EB32



EGNG009C

GENERAL DESCRIPTION E4676225

Lambda sensor installed at exhaust manifold is linear Lambda sensor and it senses Lambda density of exhaust gas for accurate EGR control through fuel correction. It also limits smoke which is generated by reach air-fuel mixture at engine maximum loading condition. ECM controls pumping current in order to fit λ -value from linear Lambda sensor to 1.0.

Lean air-fuel mixture($1.0 < \lambda < 1.1$) : ECM supplies pumping current to Lambda sensor (+pumping current) and activates it for Lambda sensor to have the characteristic at λ =1.0 (0.0 pumping current). With the value of pumping current supplied to Lambda sensor, ECM detects Lambda density of exhaust gas.

Rich air-fuel mixture($0.9 < \lambda < 1.0$) : ECM takes away pumping current from Lambda sensor (-pumping current) and deactivates it for Lambda sensor to have the characteristic at λ =1.0 (0.0 pumping current). With the value of pumping current taken away from Lambda sensor, ECM detects Lambda density of exhaust gas.

This performance is the most active and fast at normal operating temp.(450℃~600℃) thus, in order to reach normal operating temp. and last at that temp., heater(heating coil) is integrated with Lambda sensor.Heater coil is controlled by ECM as PWM. the resistance of heater coil is low when coil is cold thus, current through it increases while resistance is high when coil is hot thus, current decreases. With this principle, Lambda sensor temp. is measured and Lambda sensor heater operation varies based on the data.

DTC DESCRIPTION E6119ACF

P0031 is set when open or short to ground in Lambda sensor control circuit is detected for more than 2.0 sec. at Lambda sensor heater control condition. This code is due to 1)open or short to ground in heater control circuit or 2)Lambda sensor heater internal short.

DTC DETECTING CONDITION E0814CFE

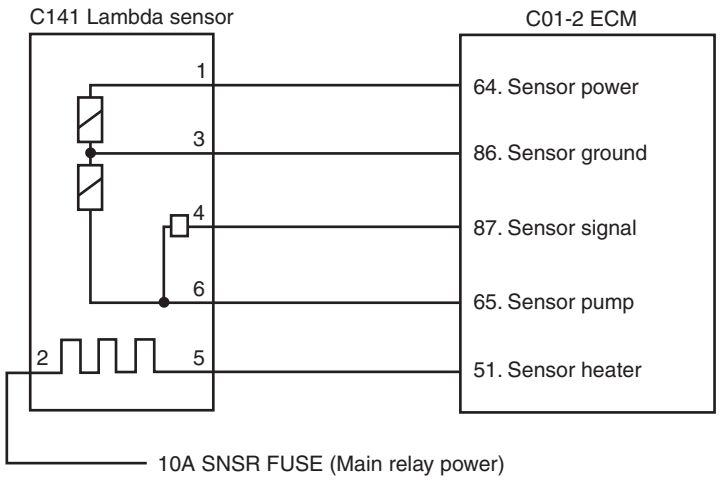
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Lambda sensor heater circuit • Lambda sensor component
Enable Conditions	• Engine running			
ThresholdValue	• Short to GND in Lambda sensor heater control circuit • Open in Lambda sensor heater control circuit			
DiagnosticTime	• 2.0 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION E360B2C8

Temperature (℃)	Lambda sensor heater resistance(Ω)	Temperature (℃)	Lambda sensor heater resistance(Ω)	Lambda sensor heater control Hz
20	9.2	400	17.7	100 Hz
100	10.7	500	19.2	
200	13.1	600	20.7	
300	14.6	700	22.5	

SCHEMATIC DIAGRAM E9509161

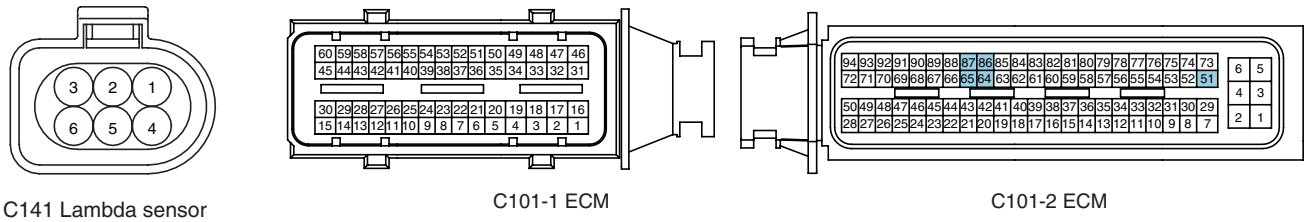
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-2 terminal 64	Sensor power
2	10A SNSR FUSE	Main relay power
3	C101-2 terminal 86	Sensor ground
4	C101-2 terminal 87	Sensor signal
5	C101-2 terminal 51	Sensor heater
6	C101-2 terminal 65	Sensor pump

[HARNESS CONNECTOR]



EGNG009E

SIGNAL WAVEFORM AND DATA E64165B1

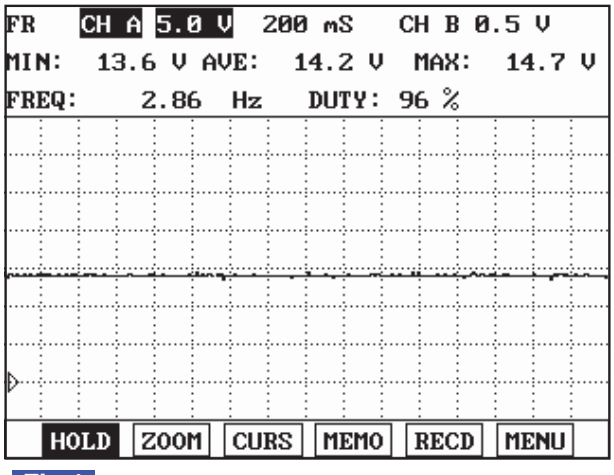


Fig.1

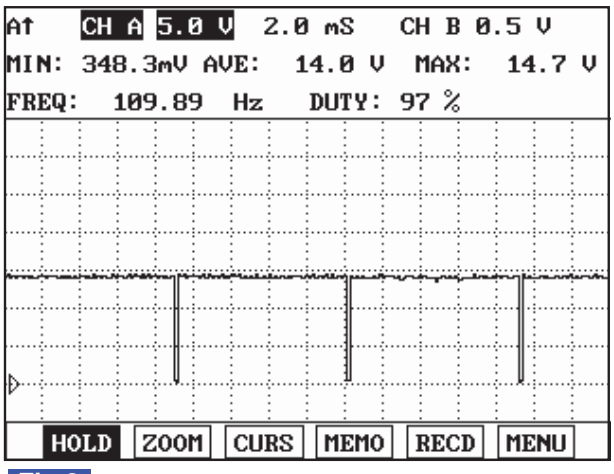


Fig.2

Fig.1) Waveform of Lambda sensor heater power. It is battery voltage.
Fig.2) Waveform of Lambda sensor heater control at idle.

EGNG009O

TERMINAL AND CONNECTOR INSPECTION EF23849D

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)
3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E66CE446

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect Lambda sensor connector.
3. IG KEY "ON".
4. Measure the voltage of Lambda sensor connector terminal 2.

Specification : 11.0V~13.0V (Main relay ON power)

5. Is the measured voltage within the specification?

   YES

   ▶ Go to "Control Circuit Inspection".

   NO

   ▶ Repair open in Main relay power circuit and E/R FUSE & RELAY BOX 10A SNSR fuse and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION ED045D04

1. Check Lambda sensor heater control circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of Lambda sensor connector terminal 5.

Specification : 2.0V~2.5V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ No voltage is detected : Go to "2. Check open in Lambda sensor heater control circuit" as follows.
▶ High voltage is detected : Repair short to battery in control circuit and go to "Verification of Vehicle Repair".

2. Check open in Lambda sensor heater control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between Lambda sensor connector terminal 5 and ECM connector terminal 51.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor heater control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E24EFE60

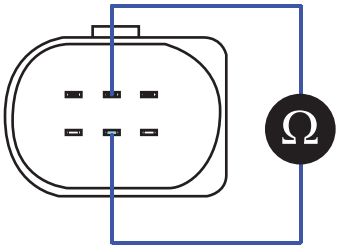
1. Check Lambda sensor component heater coil resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) Check continuity between Lambda sensor component connector 2 and 5.

Specification : Refer to "Specification" of "General Information"



EGNG009S

4) Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace Lambda sensor and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EC603223

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0032 LAMBDA SENSOR HEATER CIRCUIT HIGH (BANK 1 / SENSOR 1)

COMPONENT LOCATION E87987FD

Refer to DTC P0031.

GENERAL DESCRIPTION E01B8283

Refer to DTC P0031.

DTC DESCRIPTION E9697ECF

P0032 is set when short to battery in Lambda sensor control circuit is detected for more than 2.0 sec. at Lambda sensor heater control condition. This code is due to 1)short to battery in heater control circuit or 2)Lambda sensor heater internal open.

DTC DETECTING CONDITION E4348FCF

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Lambda sensor heater circuit • Lambda sensor component
Enable Conditions	• Engine running			
ThresholdValue	• Short to battery in Lambda sensor heater control circuit			
DiagnosticTime	• 2.0 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION ECDB0567

Refer to DTC P0031.

SCHEMATIC DIAGRAM E893E5FC

Refer to DTC P0031.

SIGNAL WAVEFORM AND DATA E588C82C

Refer to DTC P0031.

TERMINAL AND CONNECTOR INSPECTION E7E7A8C7

Refer to DTC P0031.

POWER CIRCUIT INSPECTION E49AC5F5

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect Lambda sensor connector.
3. IG KEY "ON".
4. Measure the voltage of Lambda sensor connector terminal 2.

Specification : 11.0V~13.0V (Main relay ON power)

5. Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair open in Main relay power circuit and E/R FUSE & RELAY BOX 10A SNSR fuse and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E52130AC

1. Check Lambda sensor heater control circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect Lambda sensor connector.
   3) IG KEY "ON".
   4) Measure the voltage of Lambda sensor connector terminal 5.

Specification : 2.0V~2.5V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ No voltage is detected : Go to "2. Check open in Lambda sensor heater control circuit" as follows.
▶ High voltage is detected : Repair short to battery in control circuit and go to "Verification of Vehicle Repair".

2. Check open in Lambda sensor heater control circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect Lambda sensor connector and ECM connector.
   3) Check continuity between Lambda sensor connector terminal 5 and ECM connector terminal 51.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor heater control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EAECF745

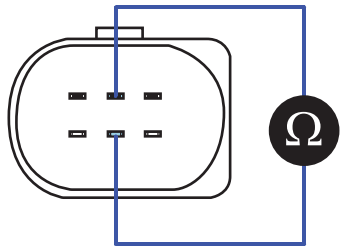
1. Check Lambda sensor component heater coil resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) Check continuity between Lambda sensor component connector 2 and 5.

Specification : Refer to "Specification" of "General Information"



EGNG009S

4) Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

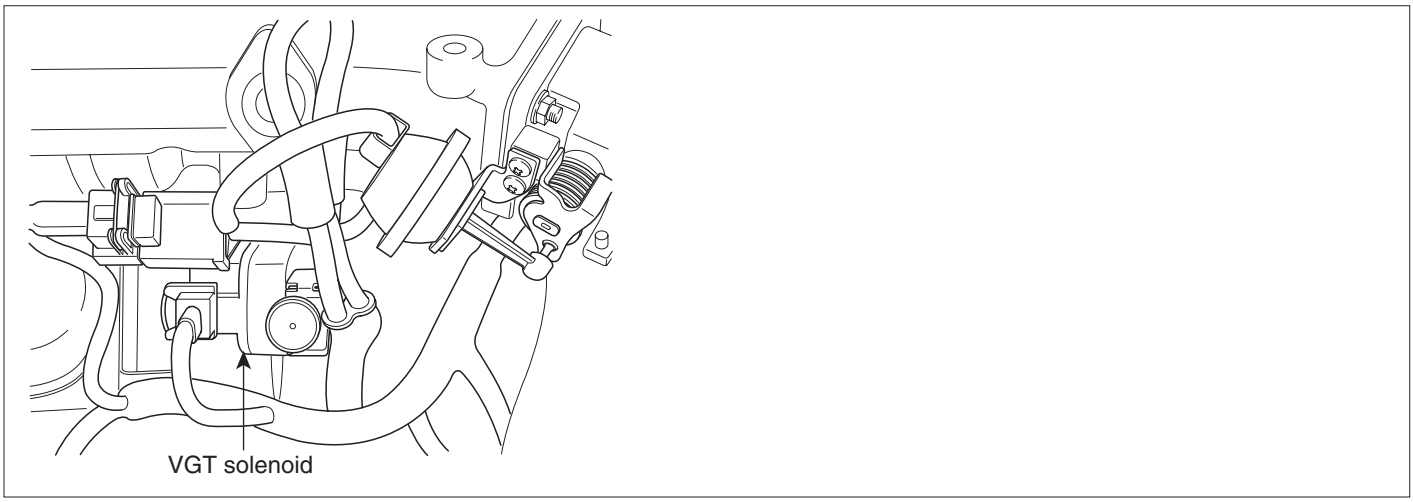
▶ Replace Lambda sensor and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E825264D

Refer to DTC P0031.

DTC P0047 VGT VACCUM MODULATOR CIRCUIT LOW

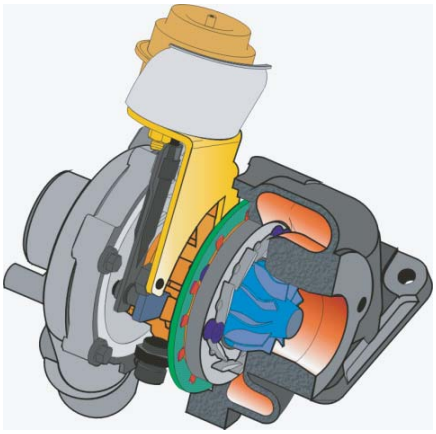
COMPONENT LOCATION EB0B8DDB



EGNG003C

GENERAL DESCRIPTION E98B5BDD

VGT(Variable Geometric Turbocharger) is the device which increases the efficiency of turbocharger at low rpm and lasts optimum turbo efficiency at high rpm as varying the cross sectional area through which exhaust gas passes turbocharger impeller. It relieves turbo lag at low speed and increse engine power genetation.Engine speed, APS signal, MAFS and Boost pressure sensor information is inputted to ECM. ECM actuates vacuum diafragm which controls exhaust gas line as controlling VGT Control solenoid valve duty to maintain optimum state of air compression.



EGNG003D

DTC DESCRIPTION EFD6B18C

P0047 is set when "0"A is detected in VGT Control solenoid valve control circuit for more than 1 sec. This code is due to open or short to ground in VGT Control solenoid valve circuit, or open in VGT Control solenoid valve component.

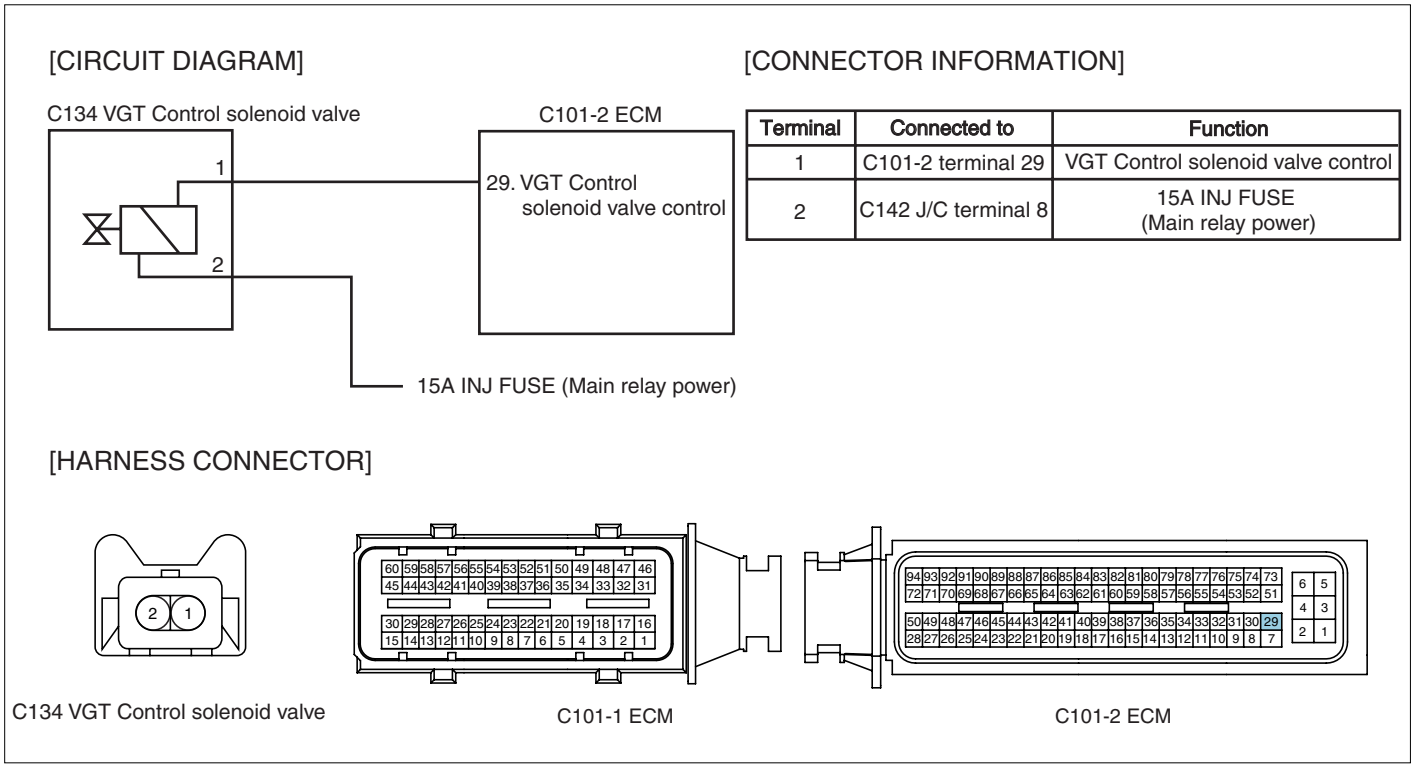
DTC DETECTING CONDITION E7E78DDD

Item	Detecting Condition			Possible Cause
DTC Strategy	• Signal monitoring			• VGT Control solenoid valve circuit • VGT Control solenoid valve component
Enable Conditions	• Engine run			
ThresholdValue	• short to GND, wiring open			
DiagnosticTime	• 1000ms			
Fail Safe	Fuel Cut	NO	• VGT Control solenoid valve duty is fixed at 31.4%.	
	EGR Off	YES		
	Fuel Limit	YES		
	MIL	NO		

SPECIFICATION EFDEF196

VGT Control solenoid valve component resistance	VGT Control solenoid valve operating Hz	VGT Control solenoid valve operating duty
14.7 ~ 16.1Ω (20℃)	300Hz	75% at idle, decreases as accelerating

SCHEMATIC DIAGRAM E147D4C9



EGNG003E

SIGNAL WAVEFORM AND DATA E29FEBAB

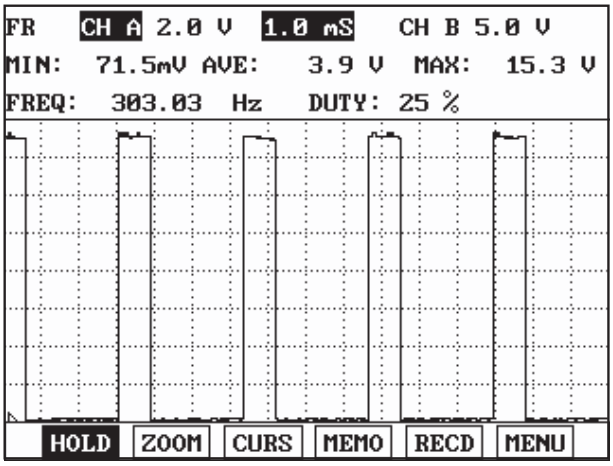


Fig.1

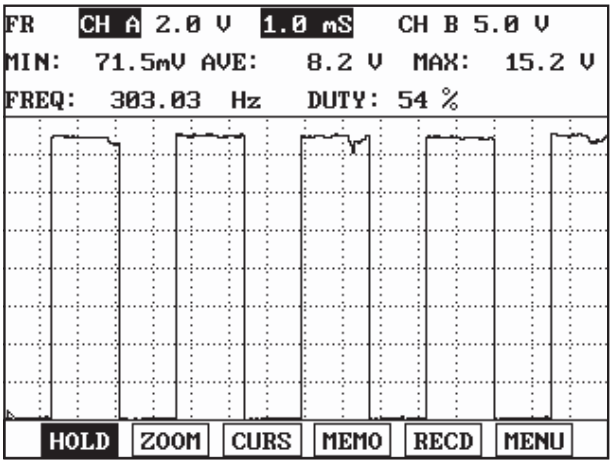


Fig.2

Fig.1) VGT Control solenoid valve output waveform at 75% duty. Duty decreases as boost pressure increases.
Fig.2) VGT Control solenoid valve duty decreased at acceleration.

EGNG003F

MONITOR SCANTOOL DATA E5B7A9E0

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "BOOST PRESS. SENSOR" parameter on the Scantool.

Specification : 1028hpa ± 100hpa(VGT actuator : 75%) at idle

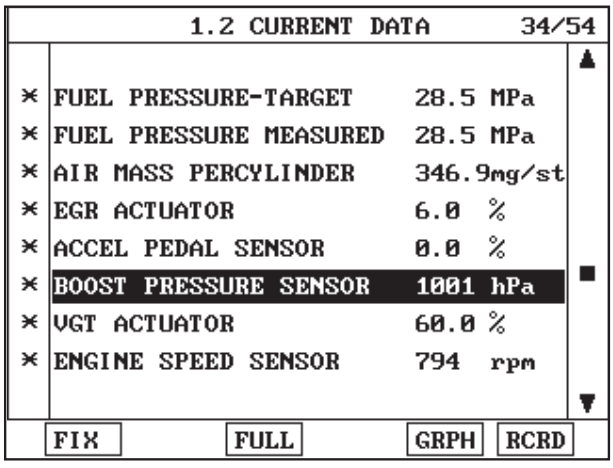


Fig.1

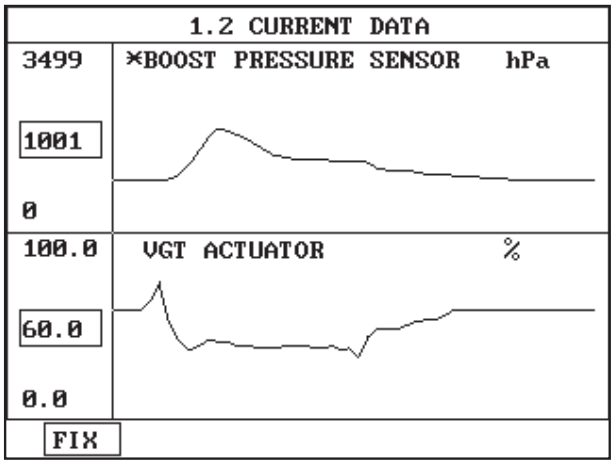


Fig.2

Fig1) Monitor "BOOST PRESSURE SENSOR" parameter on the Scantool at idle after warming engine up. 1000hpa ±100hpa(approx. 1 atm) is correct value.
Fig.2) VGT Control solenoid valve duty decreases and boost pressure increases as accelerating. If boost pressure rises and reaches certain value, VGT Control solenoid valve duty stops to drop and keeps steady. Releasing accelerator pedal at this moment, VGT Control solenoid valve duty drops to 9.8%, then if RPM drops to idle range, duty returns to 75%.

EGNG012Y

TERMINAL AND CONNECTOR INSPECTION E13476E7

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E789B021

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect VGT Control solenoid valve connector.

   3) IG KEY "ON"

   4) Measure the voltage of terminal 2 of VGT Control solenoid valve.

Specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

      YES

      ▶ Go to "Control Circuit Inspection".

      NO

      ▶ Repair E/R FUSE & RELAY BOX 15A INJ fuse and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E42B7EB7

1. Check monitoring voltage in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect VGT Control solenoid valve connector.

3) IG KEY "ON"

4) Measure the voltage of terminal 1 of VGT Control solenoid valve.

Specification : 3.2V~3.7V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect VGT Control solenoid valve connector and ECM connector.

3) Check continuity between VGT Control solenoid valve connector terminal 1 and ECM connector terminal 24.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground and go to "Verification of Vehicle Repair".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E45BF332

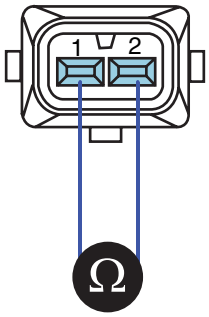
1. Check VGT actuator component resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect VGT Control solenoid valve connector.

3) Measure the resistance between VGT Control solenoid valve component terminal 1 and 2.

Specification : 14.7 ~ 16.1Ω (20℃)



EGNG003J

4) Is VGT actuator component resistance within the specification?

YES

▶ Go to "2.Check VGT Control solenoid valve operation" as follows.

NO

▶ Replace VGT Control solenoid valve and go to "Verification of Vehicle Repair".

2. Check VGT Control solenoid valve operation

1) IG KEY "ON", ENGINE "ON".

2) Check that VGT Control solenoid valve operating duty is 75% after warming engine up.

3) Check if vacuum generates after disconnecting VGT valve vacuum hose.

4) Check if vacuum generates when decelerating after rapid acceleration (VGT Control solenoid valve operating duty 9.8%).

Specification : VGT Control solenoid valve duty 75% : vacuum generates VGT Control solenoid valve duty 9.8% : vacuum does not generate

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace VGT Control solenoid valve and go to "Verification of Vehicle Repair".

※ Repeat this process 2~3 times.

VERIFICATION OF VEHICLE REPAIR E2734D43

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.

2. Clear recorded DTC using Scantool.

3. Drive the vehicle within DTC "Enable conditions" in "General information".

4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0048 VGT VACCUM MODULATOR CIRCUIT HIGH

COMPONENT LOCATION EA3078ED

Refer to DTC P0047.

GENERAL DESCRIPTION EA5EFDE6

Refer to DTC P0047.

DTC DESCRIPTION E3EF75FB

P0048 is set when excessive current is detected in VGT Control solenoid valve control circuit for more than 1 sec.. This code is due to short to battery in control circuit or internal short of VGT Control solenoid valve component.

DTC DETECTING CONDITION E40C3E52

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="6">• VGT Control solenoid valve circuit
• VGT Control solenoid valve component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine run(monitoring only performed at actuator operating condition)</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 1000ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• VGT Control solenoid valve duty is fixed at 31.4%.</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION EF93B537

Refer to DTC P0047.

SCHEMATIC DIAGRAM EEBBC1C9

Refer to DTC P0047.

SIGNAL WAVEFORM AND DATA E00B2D36

Refer to DTC P0047.

MONITOR SCANTOOL DATA E3137F08

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "BOOST PRESS. SENSOR" parameter on the Scantool.

Specification : 1028hpa ± 100hpa(VGT actuator : 75%) at idle

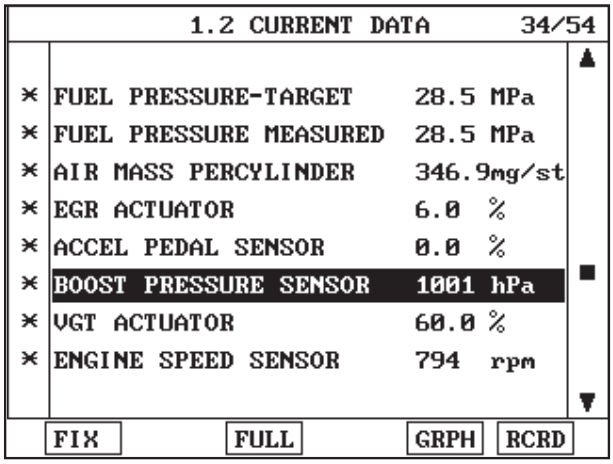


Fig.1

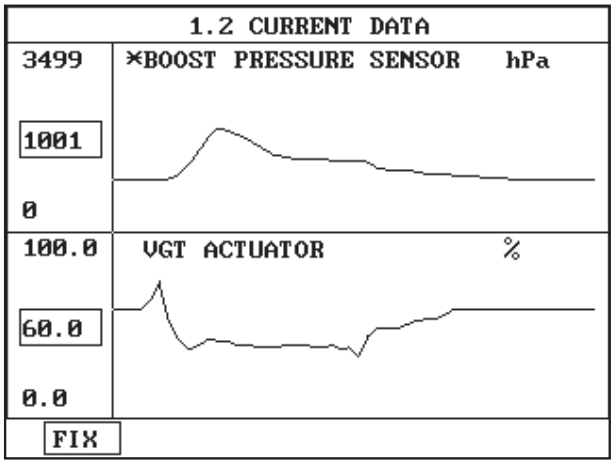


Fig.2

Fig1) Monitor "BOOST PRESSURE SENSOR" parameter on the Scantool at idle after warming engine up. 1000hpa ±100hpa(approx. 1 atm) is correct value.

Fig.2) VGT Control solenoid valve duty decreases and boost pressure increases as accelerating. If boost pressure rises and reaches certain value, VGT Control solenoid valve duty stops to drop and keeps steady. Releasing accelerator pedal at this moment, VGT Control solenoid valve duty drops to 9.8%, then if RPM drops to idle range, duty returns to 75%.

EGNG012Y

TERMINAL AND CONNECTOR INSPECTION E87587D5

Refer to DTC P0047.

POWER CIRCUIT INSPECTION E39426B8

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect VGT Control solenoid valve connector.

   3) IG KEY "ON"

   4) Measure the voltage of terminal 2 of VGT Control solenoid valve.

Specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Control Circuit Inspection".

   NO

   ▶ Repair E/R FUSE & RELAY BOX 15A INJ fuse and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E306EF95

1. Check monitoring voltage in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect VGT Control solenoid valve connector.

3) IG KEY "ON"

4) Measure the voltage of terminal 1 of VGT Control solenoid valve.

Specification : 3.2V~3.7V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect VGT Control solenoid valve connector and ECM connector.

3) Check continuity between VGT Control solenoid valve connector terminal 1 and ECM connector terminal 24.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground and go to "Verification of Vehicle Repair".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E1AC5954

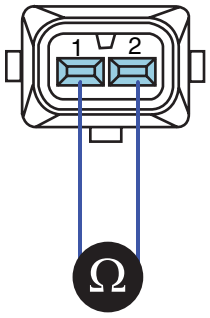
1. Check VGT Control solenoid valve component resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect VGT Control solenoid valve connector.

3) Measure the resistance between VGT Control solenoid valve component terminal 1 and 2.

Specification : 14.7 ~ 16.1Ω (20℃)



EGNG003J

4) Is VGT actuator component resistance within the specification?

YES

▶ Go to "2.Check VGT Control solenoid valve operation" as follows.

NO

▶ Replace VGT Control solenoid valve and go to "Verification of Vehicle Repair".

2. Check VGT Control solenoid valve operation

1) IG KEY "ON", ENGINE "ON".

2) Check that VGT Control solenoid valve operating duty is 75% after warming engine up.

3) Check if vacuum generates after disconnecting VGT valve vacuum hose.

4) Check if vacuum generates when decelerating after rapid acceleration (VGT Control solenoid valve operating duty 9.8%).

Specification : VGT Control solenoid valve duty 75% : vacuum generates
VGT Control solenoid valve duty 9.8% : vacuum does not generate

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace VGT Control solenoid valve and go to "Verification of Vehicle Repair".

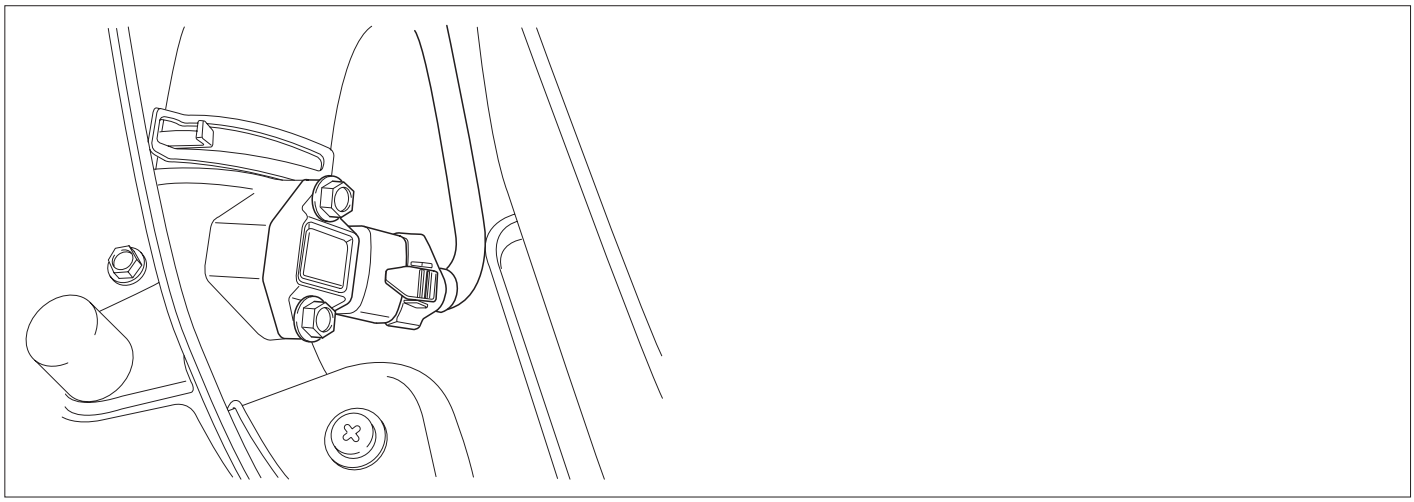
※ Repeat this process 2~3 times.

VERIFICATION OF VEHICLE REPAIR EC6FFCEF

Refer to DTC P0047.

DTC P0069 BOOST PRESSURE SENSOR CIRCUIT MALFUNCTION

COMPONENT LOCATION E167B17D



EGNG012V

GENERAL DESCRIPTION E2144507

Boost Pressure Sensor(BPS) is installed in intake manifold and senses the pressure of air inside of intake manifold which is compressed by turbo charager.Measuring mass air flow accurately with the information of intake mainfold pressure, mass air flow and intake air temperature, ECM performs actuating correction of EGR and VGT.When excessive intake manifold pressure is detected, engine power generation is limited to protect engine because too highly compressed pressure due to turbo charger may harm engine.

DTC DESCRIPTION E5179665

P0069 is set when the difference between BPS output voltage and atmospheric pressure sensor output voltage is above 300hpa at below 100RPM(in other word, IG KEY ON condition) for more than 2.0 sec. This code is due to abnormal output characteristic of BPS component.

DTC DETECTING CONDITION ED0FEF64

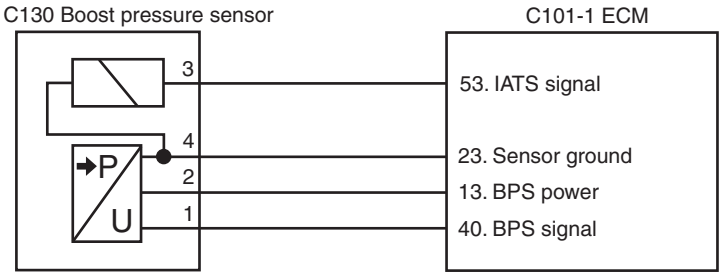
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• BPS circuit
• BPS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON" (below 100RPM)</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• |Boost pressure - Barometric pressure| is above 300hpa.</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Boost pressure is fixed at 1000 hpa.</td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E7C05E2E

Pressure [Kpa]	20	100	190	250
Outpur voltage [V]	0.4±0.077	1.878±0.063	3.541±0.063	4.650±0.077

SCHEMATIC DIAGRAM EC83A170

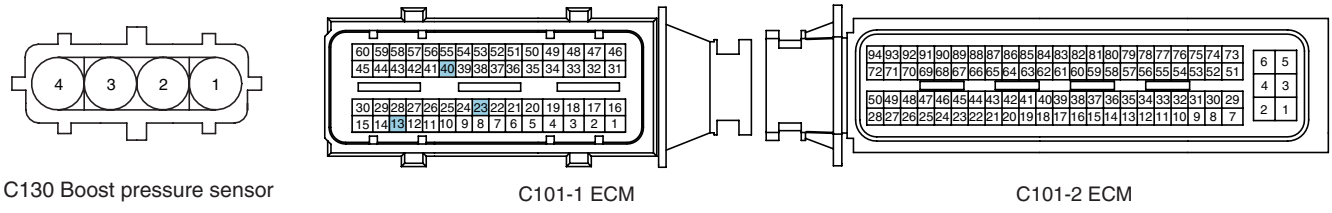
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-1 terminal 40	BPS signal
2	C101-1 terminal 13	BPS power
3	C101-1 terminal 53	IATS signal
4	C101-1 terminal 23	Sensor ground

[HARNESS CONNECTOR]



EGNG012W

SIGNAL WAVEFORM AND DATA E9C5CBE5

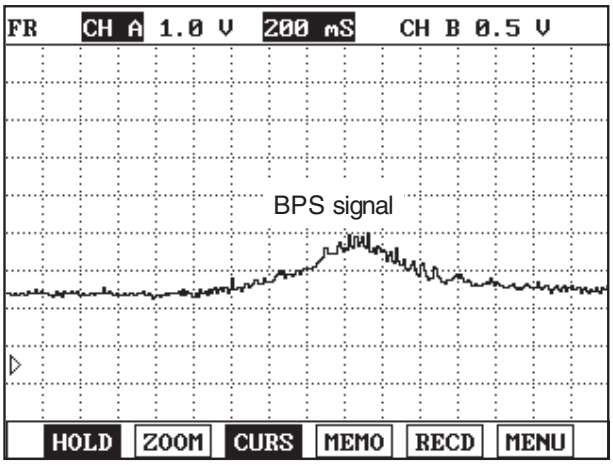


Fig.1

Fig1) This is the waveform of BPS as accelerating from idle state. Signal voltage rises as accelerating.

EGNG012X

MONITOR SCANTOOL DATA EF76325C

1. Connect Scantool to Data Link Connector (DLC).

2. Warm engine up to normal operating temperature.

3. Turn "OFF" electrical devices and A/C.

4. Monitor "BOOST PRESS. SENSOR" parameter on the Scantool.

Specification : 1028hpa ± 100hpa(VGT actuator : 75%) at idle

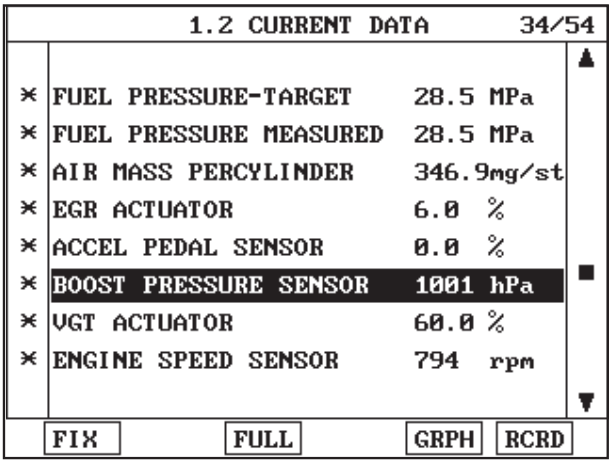


Fig.1

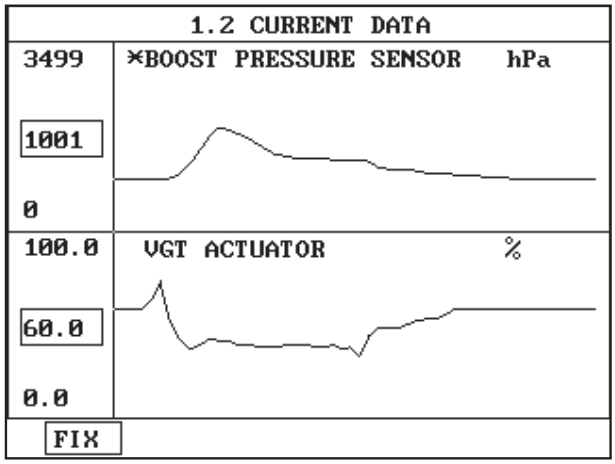


Fig.2

Fig1) Monitor "BOOST PRESSURE SENSOR" parameter on the Scantool at idle after warming engine up. 1000hpa ± 100hpa(approx. 1 atm) is correct value.

Fig.2) VGT actuator duty decreases and boost pressure increases as accelerating. If boost pressure rises and reaches certain value, VGT actuator duty stops to drop and keeps steady. Releasing accelerator pedal at this moment, VGT actuator duty drops to 9.8%, then if RPM drops to idle range, duty returns to 75%.

EGNG014P

TERMINAL AND CONNECTOR INSPECTION E38E902B

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Component Inspection ".

COMPONENT INSPECTION E0F5B8D0

1. BPS visual iInspection

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect BPS connector.

   3) Check if corrosion and damage in BPS terminal is detected.

   4) Check BPS mounting state, leakage at O'ring, clogged carbon at pressure detecting hall.

   5) Are the problems relevant to BPS found?

      YES

      ▶ Replace BPS if necessary and go to "Verification of Vehicle Repair".

      NO

      ▶ Go to "2. Check BPS output voltage at IG KEY ON" as follows.

2. Check BPS output voltage at IG KEY ON

   1) IG KEY "OFF", ENGINE "OFF".

   2) Connect Scantool to Data Link Connector (DLC).

   3) IG KEY "ON"

   4) Monitor "ATMOSPHERIC PRESSURE" and "BOOST PRESSURE SENSOR" parameters on scantool.

   5) Check if both "ATMOSPHERIC PRESSURE" and "BOOST PRESSURE SENSOR" indicates similar value at IG KEY "ON".

Specification : Refer to "Monitor Scantool Data" of Scantool diagnostics parameters.

   6) Is any BPS related problem is detedcted?

      YES

      ▶ Go to "Verification of Vehicle Repair".

      NO

      ▶ Replace BPS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EAC0D29D

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

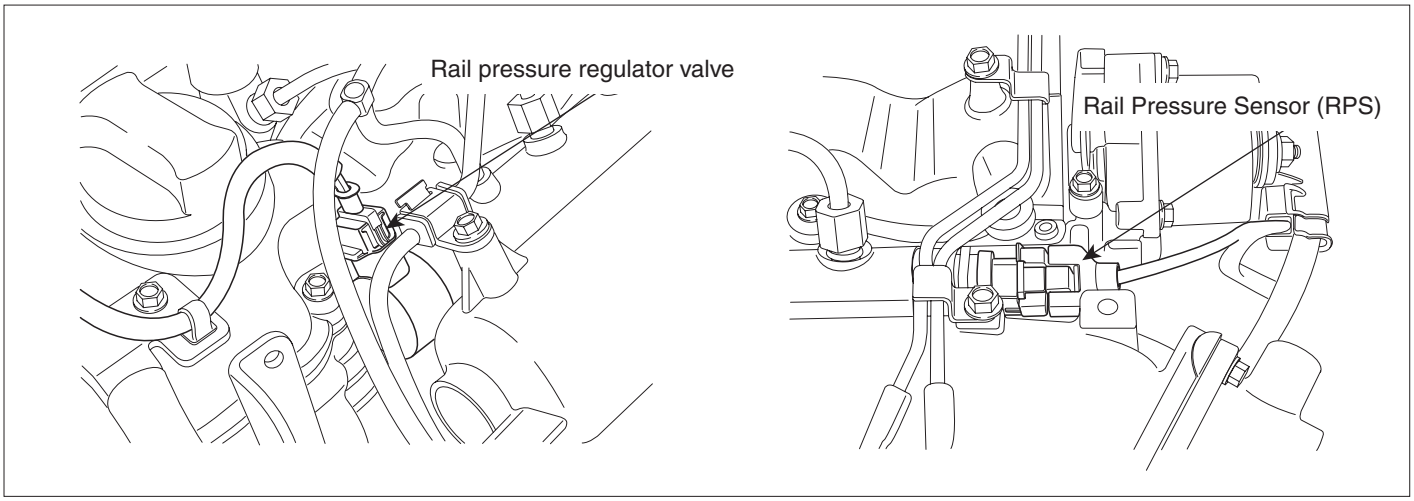
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0087 RAIL PRESSURE MONITORING-MINIMUM PRESSURE AT ENGINE SPEED TOO LOW

COMPONENT LOCATION E6F44697



EGNG010U

GENERAL DESCRIPTION E904649C

As inputted rail pressure sensor signal, ECM of Commom rail diesel engine controls Fuel pressure regulator valve(intergrated with high press. pump) and rail pressure regulator valve(ntegrated with common rail) in order to maintain optimum rail pressure according to current engine rpm and load. However when the problem that leads rail pressure to out of target value intended by ECM occurs due to mechanical or electronical reason, ECM shuts engine down and sets DTC by limiting fuel (stops injector operation) in order to prevent engine from being controlled abnormally. "rail pressure monitoring error" is the DTC which diagnose 1).supplying state of low pressure fuel and 2).mechanical operating conditions of high pressure pump and 3). rail pressure regulator valve indirectly based on RPS output voltage and RPS duty. thus, repair relavant to this DTC requires mechanics the total understand of fuel system.

DTC DESCRIPTION E96AACAC

P0087 is set when rail pressure is lower than target rail pressure by more than 250bar for more than 1.0 sec. in condition that rail press. is controlled by Rail pressure regulator valve or rail pressure is below the minimum limiting value(200bar). This code is due to 1)fuel less than target value supplied to common rail or 2)excessive return of fuel supplied to common rail or 3)short to low voltage line in fuel press. sensor.

DTC DETECTING CONDITION E051A128

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• fuel metering unit (close stuck) • rail pressure regulator valve (open stuck) • Rail pressure sensor (Output fixed at low voltage line)
Enable Conditions	• Engine running			
ThresholdValue	• Rail pressure is below target rail pressure by more than 250bar at rail pressure regulator valve operating condition. • Rail pressure is below minimum limiting value(200bar) at rail pressure regulator valve operating condition.			
DiagnosticTime	• 1.0 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	YES		
	MIL	YES		

MONITOR SCANTOOL DATA EA7F227F

1. Monitoring rail pressure data

   1) Connect Scantool to Data Link Connector (DLC).

   2) Warm engine up to normal operating temperature.

   3) Turn "OFF" electrical devices and A/C.

   4) Monitor "FUEL PRESSURE MEASURED", "FUEL PRESSURE-TARGET", "RAIL PRESS. REGULATOR1", "INJ. PUMP REGULATOR" parameter on the Scantool.

Specification :
FUEL PRESSURE MEASURED : similar to "FUEL PRESSURE-TARGET"
FUEL PRESSURE-TARGET : 28 ± 5 Mpa
RAIL PRESS. REGULATOR1 : 20 ± 5%
INJ. PUMP REGULATOR : 40 ± 5%

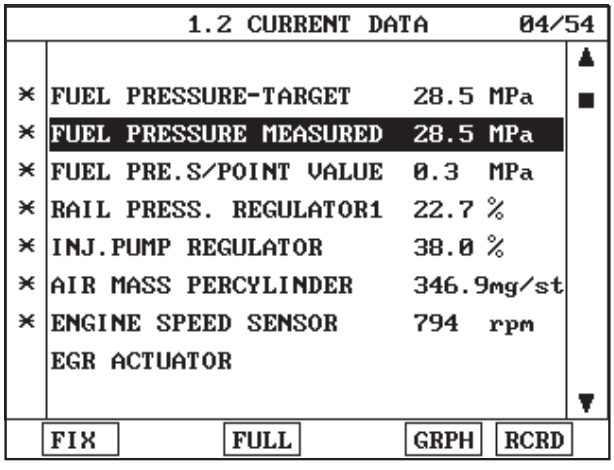


Fig.1

Fig.1) Monitor "FUEL PRESSURE MEASURED" at idle after warming engine up.

Check if "FUEL PRESSURE MEASURED"data is similar to "FUEL PRESSURE-TARGET". Not only former two data but also "RAIL PRESS. REGULATOR1" and "INJ. PUMP REGULATOR"should be monitored carefully. Although "FUEL PRESSURE MEASURED" is similar to "FUEL PRESSURE-TARGET", if "RAIL PRESS. REGULATOR1" and "INJ. PUMP REGULATOR" is out of specification, it means wear, leakage, stuck of fuel system.

2. Monitoring rail pressure data at acceleration(loading condition).

   1) Connect Scantool to Data Link Connector (DLC).

   2) Warm engine up to normal operating temperature.

   3) Turn "OFF" electrical devices and A/C.

   4) Monitor "FUEL PRESSURE MEASURED", "RAIL PRESS. REGULATOR1", "INJ. PUMP REGULATOR" parameter on the Scantool.

SPECIFICATION :

	Idle(without load)	Accelerating(stall test)	Diagnosis
INJ. PUMP REGULATOR	38 ± 5%	32 ± 5%	duty decreases
FUEL PRESSURE MEASURED	28.5 ± 5 Mpa	145 ± 10 Mpa	press. increases
RAIL PRESS. REGULATOR1	19 ± 5%	48 ± 5%	duty increases

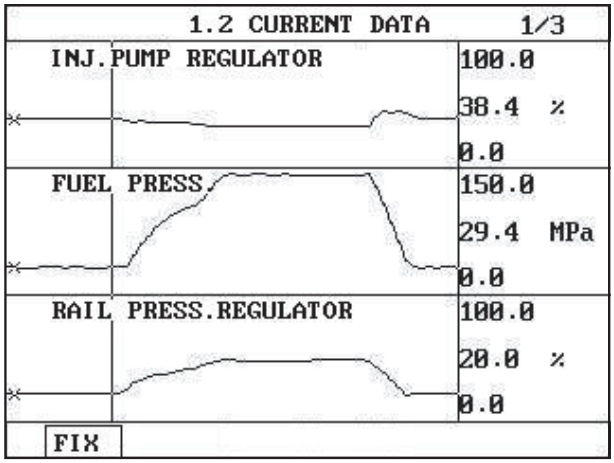


Fig.1

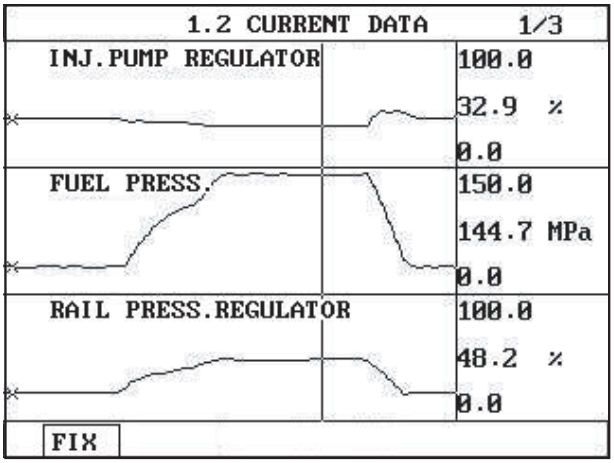


Fig.2

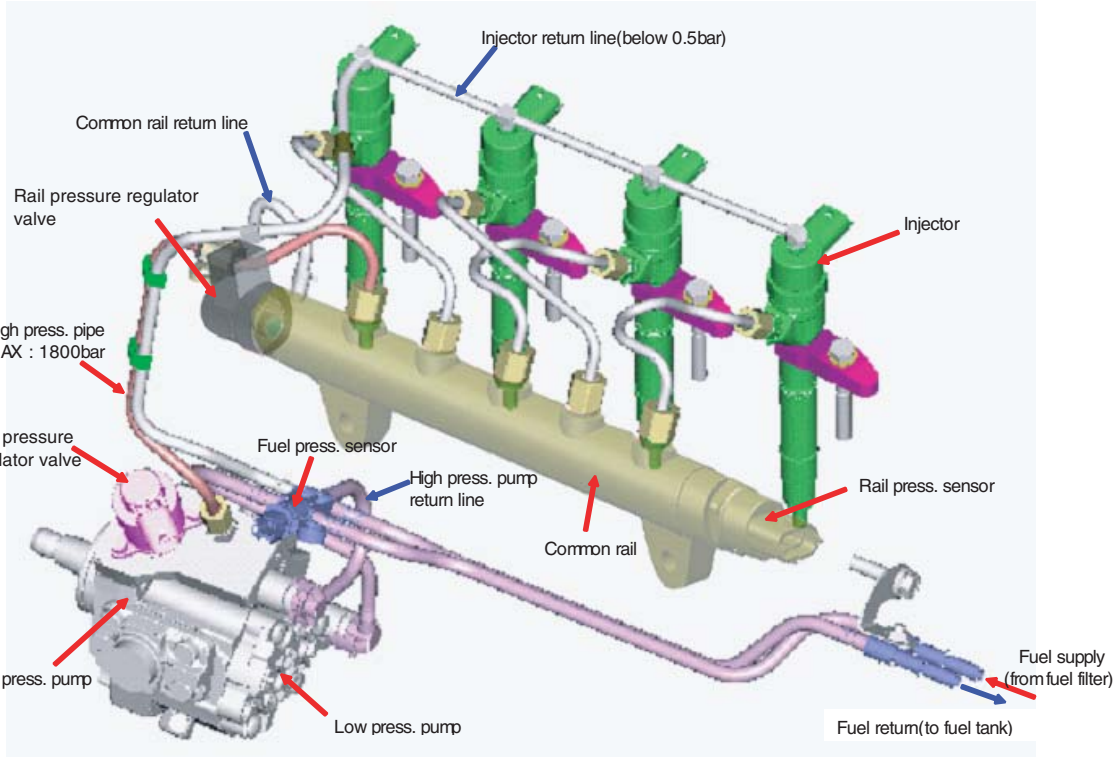
Fig.1) The position of curser on the graph represents idle data.
Fig.2) Data during acceleration(stall test).

EGNG010S

NOTE

The waveform of fuel pressure regulator valve installed at high pressure pump(fuel detecting MPROP) shows 38% duty at idle, duty drops to approx. 32% at acceleration to raise rail pressure. Duty drop means the decrease of current.
→ Fuel delivered to common rail increases as current drops.

The waveform of rail pressure regulator valve installed at common rail shows 19% duty at idle, duty rises to approx. 48% at acceleration to raise rail pressure. Duty rise means the increase of current.
→ If current rises, the returning quantity of fuel deliverd to common rail decreases and common rail pressure rises.



EGNG014Q

VERIFICATION OF VEHICLE REPAIR E4756FB9

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0088 RAIL PRESSURE MONITORING-MAXIMUM PRESSURE EXCEEDED

COMPONENT LOCATION EED2DEF0

Refer to DTC P0087.

GENERAL DESCRIPTION E15BA53D

Refer to DTC P0087.

DTC DESCRIPTION EEAF7D4A

P0088 is set if measured rail pressure is higher than target rail pressure by more than 200bar when rail pressure is regulated by Rail pressure regulator valve or rail pressure is above the max limiting value. This code is due to 1)fuel more than target value supplied to common rail or 2)poor return of fuel supplied to common rail or 3)short to high voltage line in fuel press. sensor.

DTC DETECTING CONDITION E8D4FCA4

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="8">• fuel metering unit (open stuck)
• Rail pressure regulator valve (close stuck)
• Rail pressure sensor (Output fixed at high voltage line)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Rail pressure is above target rail pressure by more than 200bar at rail pressure regulator valve operating condition.- 400ms
• Rail pressure is above maximum limiting value(1750bar) at rail pressure regulator valve operating condition. - 120 ms</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Refer to threshold Value.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

MONITOR SCANTOOL DATA E994545F

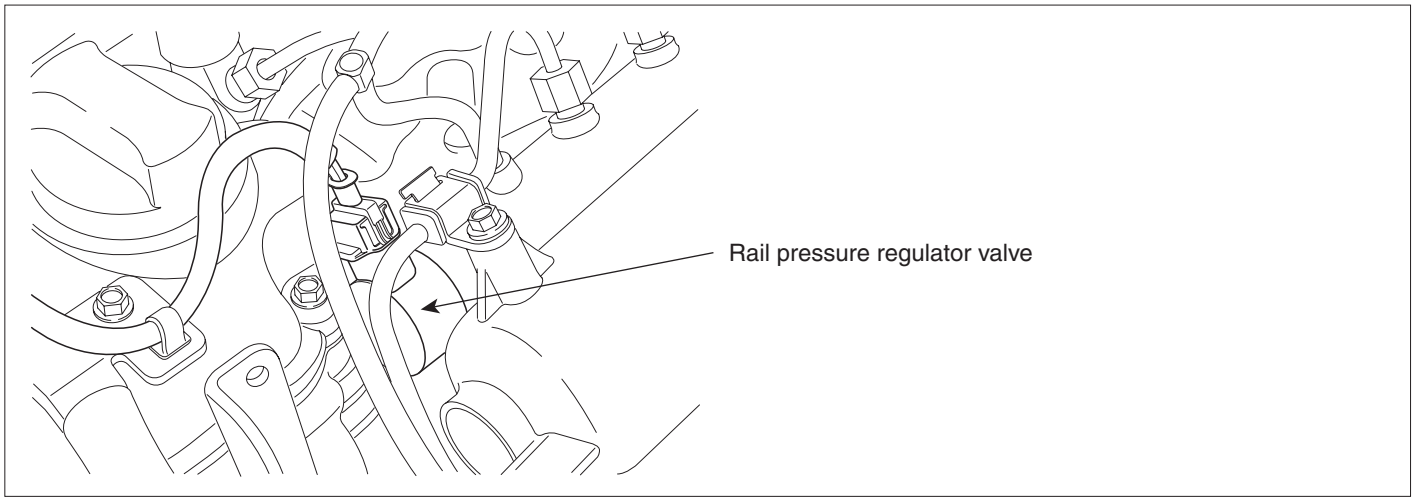
Refer to DTC P0087.

VERIFICATION OF VEHICLE REPAIR E1E79242

Refer to DTC P0087.

DTC P0089 RAIL PRESSURE REGULATOR VALVE CIRCUIT OVER CURRENT

COMPONENT LOCATION E1D88520



EGNG013Z

GENERAL DESCRIPTION E7E0702D

Rail pressure regulator valve is installed in common rail and controls common rail pressure fast as regulating returning quantity of fuel which is delivered to common rail when fast rise of rail pressure is required like the moment of turning engine ON or when fast relief of pressure is required like at the point of deceleration.The lower Rail pressure regulator valve current is, the more fuel is supplied to common rail. Thus it leads rail pressure to be high. On the contrary, the higher Rail pressure regulator valve current is, the less fuel is supplied to common rail.

DTC DESCRIPTION EF15534C

P0089 is set when excessive current in control circuit of Rail pressure regulator valve(integrated with high common rail) is detected for more than 0.22 sec.. This code is due to short to battery in control circuit orRail pressure regulator valve internal short.

DTC DETECTING CONDITION EC1B676E

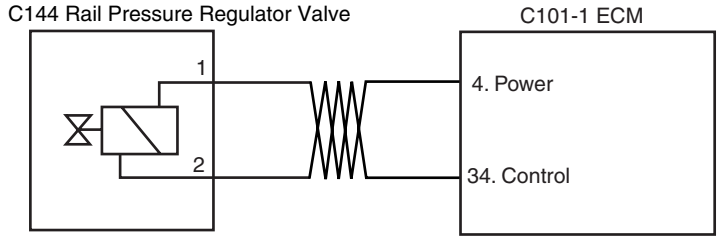
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="8">• Rail pressure regulator valve circuit
• Rail pressure regulator valve component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery (control circuit of Rail pressure regulator valve)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 220ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION E0C77CD9

rail pressure regulator valve resistance	Operating frequancy
3.42 ~ 3.78Ω (20℃)	1000Hz(1KHz)

SCHEMATIC DIAGRAM ECA3B2C8

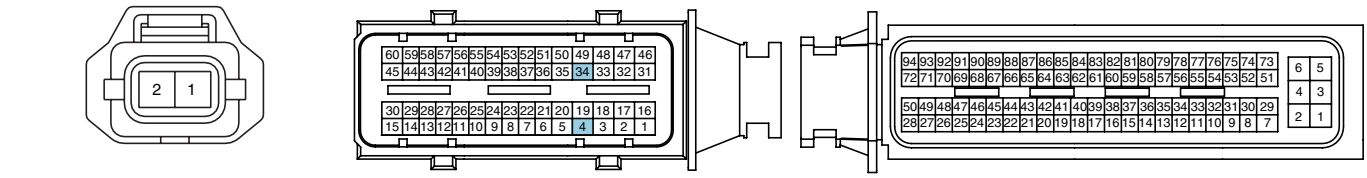
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-1 terminal 4	Rail Pressure Control Valve Power
2	C101-1 terminal 34	Rail Pressure Control Valve Control

[HARNESS CONNECTOR]



C144 Rail Pressure Regulator Valve | C101-1 ECM | C101-2 ECM

EGNG014A

SIGNAL WAVEFORM AND DATA E8270A95

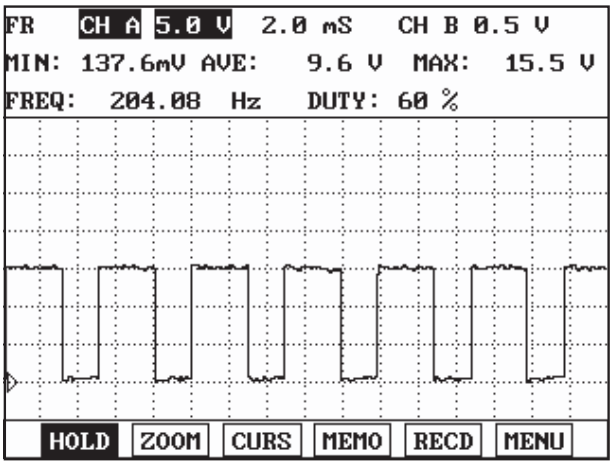


Fig.1

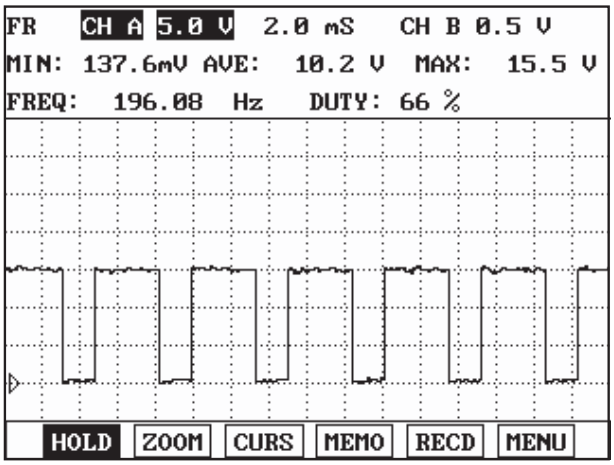


Fig.2

Fig.1) Waveform of rail pressure regulator valve at idle. It shows approx. 20% duty.
Fig.2) Waveform of rail pressure regulator valve as accelerating. Approx. 50% duty is outputted as engine load increases.
(When rail pressure increases as accelerating, rail pressure regulator valve duty(current) rises.)

EGNG014B

MONITOR SCANTOOL DATA E604792E

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "FUEL PRESSURE MEASURED", "RAIL PRESS. REGULATOR1", "INJ. PUMP REGULATOR" parameter on the Scantool.

SPECIFICATION :

	Idle(without load)	Accelerating(stall test)	Diagnosis
INJ. PUMP REGULATOR	38 ± 5%	32 ± 5%	duty decreases
FUEL PRESSURE MEASURED	28.5 ± 5 Mpa	145 ± 10 Mpa	press. increases
RAIL PRESS. REGULATOR1	19 ± 5%	48 ± 5%	duty increases

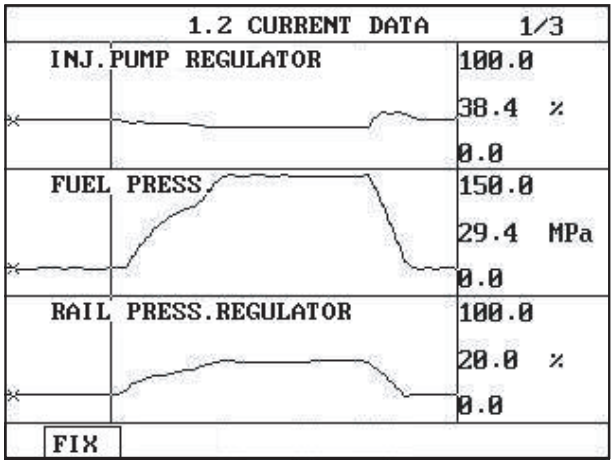


Fig.1

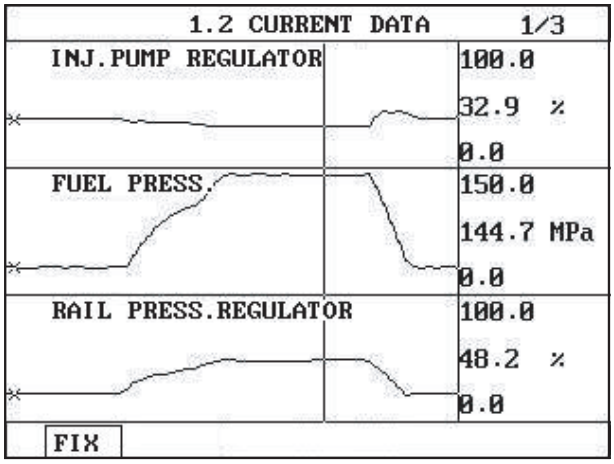


Fig.2

Fig.1) The position of curser on the graph represents idle data.
Fig.2) Data during acceleration(stall test).

EGNG013U

NOTE

The waveform of fuel pressure regulator valve installed at high pressure pump(fuel detecting MPROP) shows 38% duty at idle, duty drops to approx. 32% at acceleration to raise rail pressure. Duty drop means the decrease of current.
→ Fuel delivered to common rail increases as current drops.

The waveform of rail pressure regulator valve installed at common rail shows 19% duty at idle, duty rises to approx. 48% at acceleration to raise rail pressure. Duty rise means the increase of current.
→ If current rises, the returning quantity of fuel deliverd to common rail decreases and common rail pressure rises.

TERMINAL AND CONNECTOR INSPECTION EDED0FB5

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.
2. Perform checking procedure as follows.

1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION EB278DCC

1. Check power circuit voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Rail pressure regulator valve connector.

3) IG KEY "ON".

4) Measure the voltage of Rail pressure regulator valve connector terminal 1.

specification : 11.5V~13.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair open between rail pressure control valve connector terminal 1 and ECM connector terminal 4 and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION EDEB4672

1. Check monitoring voltage in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Rail pressure regulator valve connector.

3) IG KEY "ON".

4) Measure the voltage of Rail pressure regulator valve connector terminal 2.

specification : 3.2V~3.7V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection"

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Rail pressure regulator valve connector and ECM connector.

3) Check continuity between Rail pressure regulator valve connector terminal 2 and ECM connector terminal 34.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Rail pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Rail pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E15DCA64

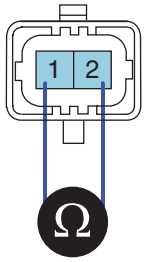
1. Check Rail pressure regulator valve component resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Rail pressure regulator valve connector.

3) Check Rail pressure regulator valve component resistance.

Specification : 3.42 ~ 3.78Ω (20℃)



EGNG014F

4) Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace common rail assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E246BA16

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0091 RAIL PRESSURE REGULATOR VALVE CIRCUIT LOW

COMPONENT LOCATION E195BDC4

Refer to DTC P0089.

GENERAL DESCRIPTION EBB17DBE

Refer to DTC P0089.

DTC DESCRIPTION E83785E1

P0091 is set when "0"A in control circuit of Rail pressure regulator valve(integrated with common rail) is detected for more than 0.11 sec.. This code is due to open of short to ground in control circuit or Rail pressure regulator valve internal open.

DTC DETECTING CONDITION E2EACD66

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Rail pressure regulator valve circuit
• Rail pressure regulator valve component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to GND, Wiring open</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 110ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION E8F3A3C2

Refer to DTC P0089.

SCHEMATIC DIAGRAM EFAEC57C

Refer to DTC P0089.

SIGNAL WAVEFORM AND DATA EF8B5851

Refer to DTC P0089.

MONITOR SCANTOOL DATA EB79B159

Refer to DTC P0089.

TERMINAL AND CONNECTOR INSPECTION EBB737A9

Refer to DTC P0089.

POWER CIRCUIT INSPECTION ECB3397A

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Rail pressure regulator connector.

   3) IG KEY "ON".

   4) Measure the voltage of Rail pressure regulator connector terminal 1.

specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Control Circuit Inspection".

   NO

   ▶ Repair open between rail pressure control valve connector terminal 1 and ECM connector terminal 4 and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E052155F

1. Check monitoring voltage in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect RRail pressure regulator connector.

   3) IG KEY "ON".

   4) Measure the voltage of Rail pressure regulator connector terminal 2.

specification : 3.2V~3.7V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Component Inspection"

   NO

   ▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
   ▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Rail pressure regulator connector and ECM connector.

   3) Check continuity between Rail pressure regulator connector terminal 2 and ECM connector terminal 34.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Rail pressure regulator control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Rail pressure regulator control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION ECAB6893

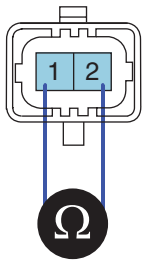
1. Check Rail pressure regulator component resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Rail pressure regulator connector.

3) Check Rail pressure regulator component resistance.

Specification : 3.42 ~ 3.78Ω (20℃)



EGNG014F

4) Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace common rail assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E2FC03D6

Refer to DTC P0089.

DTC P0092 RAIL PRESSURE REGULATOR VALVE CIRCUIT HIGH

COMPONENT LOCATION EE571EDE

Refer to DTC P0089.

GENERAL DESCRIPTION E93567AB

Refer to DTC P0089.

DTC DESCRIPTION E5BE67B9

P0092 is set when excessive current in power circuit of Fuel Pressure control valve(integrated with common rail) is detected for more than 0.14 sec.. This code is due to short to battery in power circuit or Rail pressure regulator valve internal short.

DTC DETECTING CONDITION E4806A09

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="8">• Rail pressure regulator valve circuit
• Rail pressure regulator valve component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery (power circuit in rail pressure regulator valve)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 140ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION E772CBC8

Refer to DTC P0089.

SCHEMATIC DIAGRAM EB358AA9

Refer to DTC P0089.

SIGNAL WAVEFORM AND DATA EC9F46CE

Refer to DTC P0089.

MONITOR SCANTOOL DATA EF78DCD5

Refer to DTC P0089.

TERMINAL AND CONNECTOR INSPECTION EE534BFA

Refer to DTC P0089.

POWER CIRCUIT INSPECTION E6C40344

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Rail pressure regulator valve connector.

   3) IG KEY "ON".

   4) Measure the voltage of Rail pressure regulator valve connector terminal 1.

specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Control Circuit Inspection".

   NO

   ▶ Repair open between rail pressure regulator valve connector terminal 1 and ECM connector terminal 4 and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E58BB727

1. Check monitoring voltage in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Rail pressure regulator valve connector.

   3) IG KEY "ON".

   4) Measure the voltage of Rail pressure regulator valve connector terminal 2.

specification : 3.2V~3.7V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Component Inspection"

   NO

   ▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
   ▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Rail pressure regulator valve connector and ECM connector.

   3) Check continuity between Rail pressure regulator valve connector terminal 2 and ECM connector terminal 34.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Rail pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Rail pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E984D474

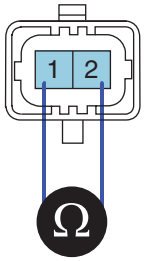
1. Check Rail pressure regulator component resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Rail pressure regulator valve connector.

3) Check Rail pressure regulator valve component resistance.

Specification : 3.42 ~ 3.78Ω (20℃)



EGNG014F

4) Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

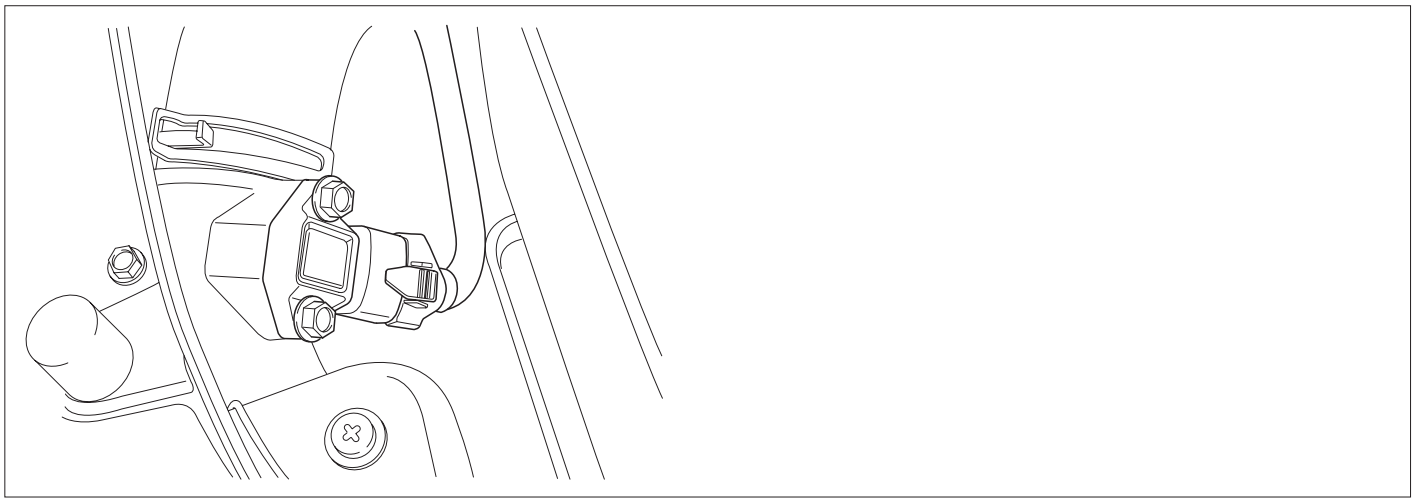
▶ Replace common rail assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E4A5FEAF

Refer to DTC P0089.

DTC P0097 INTAKE AIR TEMPERATURE SENSOR 2 CIRCUIT LOW INPUT

COMPONENT LOCATION E705CB82



EGNG012V

GENERAL DESCRIPTION E5C99627

Intake Air Temperature Sensor(IATS) is NTC thermistor. Installed inside of both MAFS and BPS, it senses intake air temperature. In case of EURO-4 diesel engine, IATS is installed in front of turbocharger(inside of MAFS) and behind it(inside of BPS). Comparing air temperature from both sensors(one is intake air temperature, the other is air temperature passing through turbo charger), more accurate sensing of intake air temperature is possible.With intake air temperature signal, ECM performs EGR control correction and fuel injection quantity correction.(MAFS is needed for EGR FEED BACK control in electronically controlled diesel engine. The calculation of air density at certain temperture is required to perform EGR FEED BACK control correctly.)

DTC DESCRIPTION EC3845AD

P0097 is set when the voltage below 73mV(0.11V) - minimum output voltage of IATS(integrated with BPS) - is detected for more than 2.0 sec. This code is due to short to ground in IATS signal circuit.

DTC DETECTING CONDITION E5BF9CB7

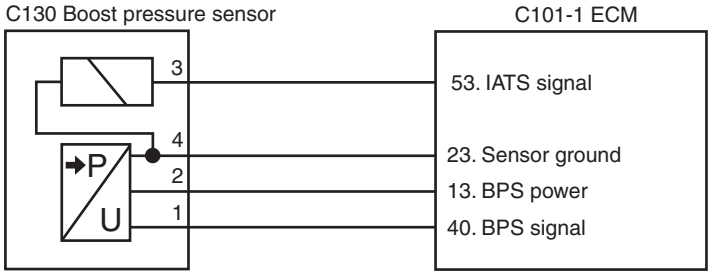
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• IATS circuit • IATS component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• Output signal below minimum value(below 73mV)			
DiagnosticTime	• 2.0 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION EF3FB478

Temp.	-40℃	-20℃	0℃	20℃	40℃	60℃	80℃
Resistance	35.14 ~43.76KΩ	12.66 ~15.12KΩ	5.12 ~5.89KΩ	2.29 ~2.55KΩ	1.10 ~1.24KΩ	0.57 ~0.65KΩ	0.31 ~0.37KΩ

SCHEMATIC DIAGRAM E7A12C98

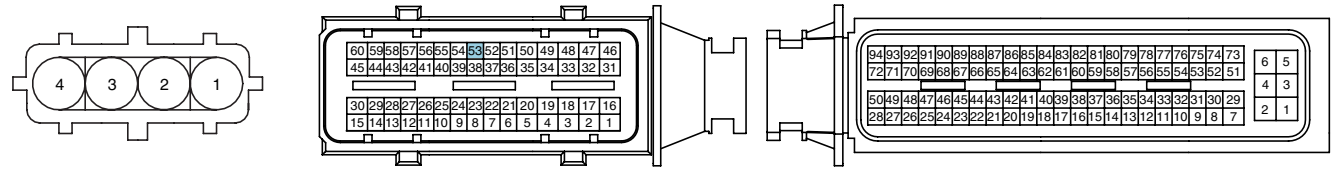
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-1 terminal 40	BPS signal
2	C101-1 terminal 13	BPS power
3	C101-1 terminal 53	IATS signal
4	C101-1 terminal 23	Sensor ground

[HARNESS CONNECTOR]



EGNG007Y

SIGNAL WAVEFORM AND DATA E25FE16F

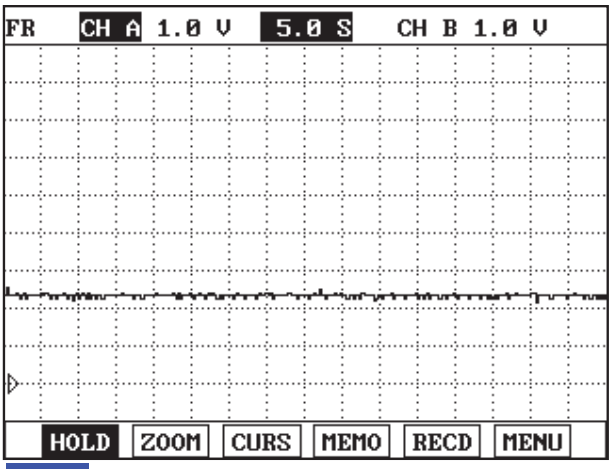


Fig.1

Fig.1) IATS output waveform at 25℃. The higher temperature is, the lower voltage becomes.

EGNG007Z

MONITOR SCANTOOL DATA EF601EB3

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "AIR TEMPERATURE SENSOR" parameter on the Scantool.

specification : current intake air temperture is displayed.

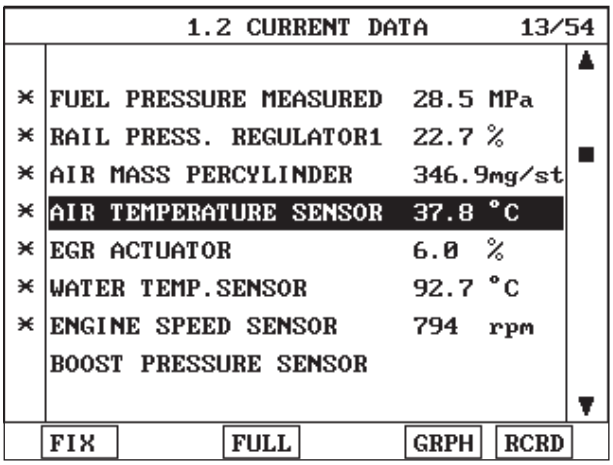


Fig.1

Fig.1) Check if current temperature is same as the value displayed on the Scantool.

EGNG008A

TERMINAL AND CONNECTOR INSPECTION ED67C5AA

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Signal Circuit Inspection".

SIGNAL CIRCUIT INSPECTION E2694094

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect BPS connector.

   3) IG KEY "ON"

   4) Check the voltage of BPS connector terminal 3.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specificaiton?

   YES

   ▶ Go to "Component Inspection".

   NO

   ▶ Repair "2. Check short to ground in signal circuit" as follows.

2. Check short to ground in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect BPS connector and ECM connector.

   3) Check continuity between BPS connector terminal 3 and chassis ground.

Specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

   YES

   ▶ Go to"Component Inspection".

   NO

   ▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

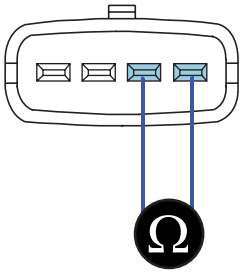
COMPONENT INSPECTION EC004A7F

1. IG KEY "OFF", ENGINE "OFF".

2. Disconnect BPS connector.

3. Measure resistance between IATS component terminal 3 and 4, referring to resistance characteristic table of specification of General information.

Specification : Refer to Specification of General Information



EGNG008B

4. Is the measured resistance at certain temperature within the specified resisance range at the temperature?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace BPS assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E03162E4

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0098 INTAKE AIR TEMPERATURE SENSOR 2 CIRCUIT HIGH INPUT

COMPONENT LOCATION E2314274

Refer to DTC P0097.

GENERAL DESCRIPTION E647739B

Refer to DTC P0097.

DTC DESCRIPTION E91B78A4

P0098 is set when the voltage above 4965mV - maximum output voltage of IATS(integrated with BPS) - is detected for more than 2.0 sec.. This code is due to 1) open or 2) short to ground or 3) short to battery in IATS signal circuit.

DTC DETECTING CONDITION E2CDDBEB

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• IATS circuit
• IATS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Output signal above maximum value(above 4965mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E9856A34

Refer to DTC P0097.

SCHEMATIC DIAGRAM EA3DB456

Refer to DTC P0097.

SIGNAL WAVEFORM AND DATA E3D96A76

Refer to DTC P0097.

MONITOR SCANTOOL DATA EC505B2F

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "AIR TEMPERATURE SENSOR" parameter on the Scantool.

specification : current intake air temperture is displayed.

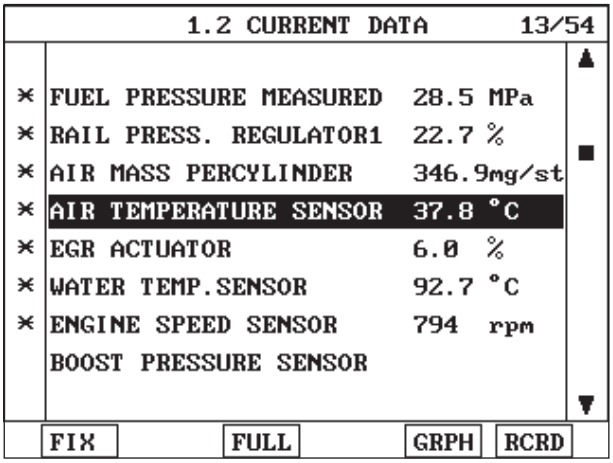


Fig.1

Fig.1) Check if current temperature is same as the value displayed on the Scantool.

EGNG008A

TERMINAL AND CONNECTOR INSPECTION E4DC10AC

Refer to DTC P0097.

SIGNAL CIRCUIT INSPECTION E10FE190

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect BPS connector.

   3) IG KEY "ON"

   4) Check the voltage of BPS connector terminal 3.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specificaiton?

   YES

   ▶ Go to "Ground Circuit Inspection".

   NO

   ▶ Go to "2.Check open in signal circuit" as follows.

2. Check open in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect BPS connector and ECM connector.

   3) Check continuity between BPS connector terminal 3 and ECM connector terminal 53.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "3. Check short to battery in signal circuit" as follows.

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect BPS connector and ECM connector.

3) IG KEY "ON"

4) Check the voltage of BPS connector terminal 3.

Specification : 0.0V~0.1V

5) Is the measured voltage within the specification?(with both connector disconnected)

YES

▶ Repair short to battery in signal circuit and go to "Verification of Vehicle Repair".

NO

▶ Go to "Ground Circuit Inspection".

GROUND CIRCUIT INSPECTION E75B427C

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect BPS connector.
3. IG KEY "ON".
4. Measure the voltage of BPS connector terminal 3. [TEST "A"]
5. Measure the voltage between BPS connector terminal 3 and 4. [TEST "B"]
   (terminal 3 : Check + prove , terminal 4 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

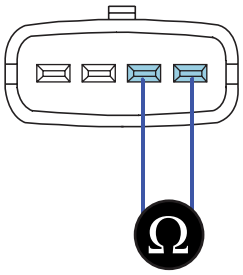
NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION ECFAA528

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect BPS connector.
3. Measure resistance between IATS component terminal 3 and 4, referring to resistance characteristic table of specification of General information.

Specification : Refer to Specification of General Information



EGNG008B

4. Is the measured resistance at certain temperature within the specified resisance range at the temperature?

YES

▶ Go to "Verification of Vehicle Repair".

NO

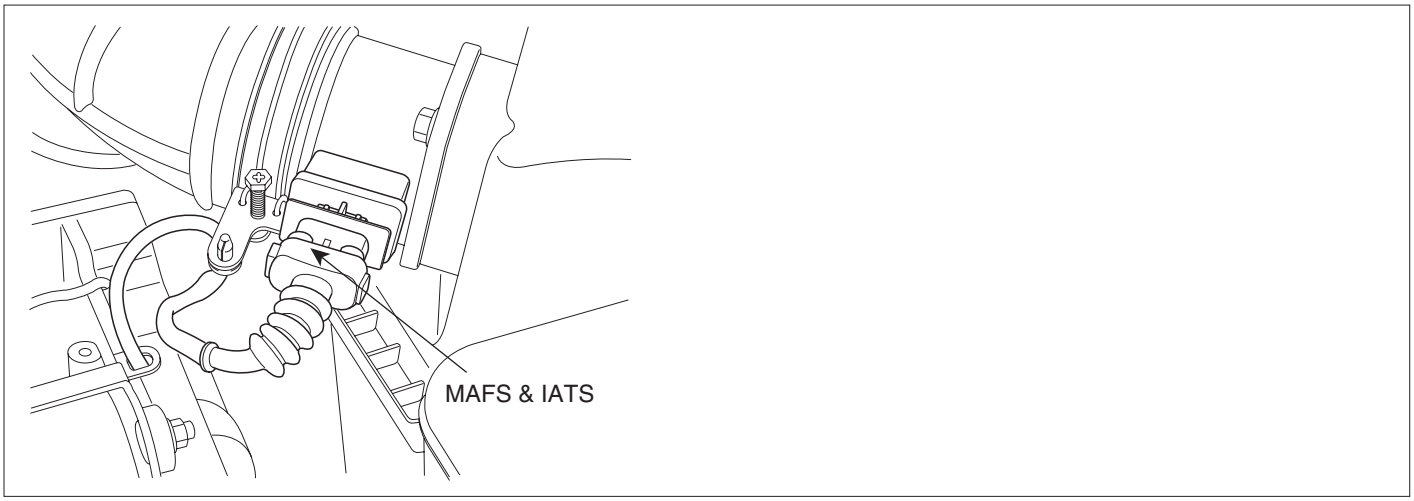
▶ Replace BPS assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E421AC33

Refer to DTC P0097.

DTC P0101 MASS OR VOLUME AIR FLOW CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION E5E2D324



EGNG012O

GENERAL DESCRIPTION E5B08F12

Air Flow Sensor(MAFS) is digital sensor. Measuring mass of air flow, signal is outputted as frequency(Hz). ECM performs EGR system feed back control with the information of measured mass air flow. (The role of MAFS in diesel engine is different from gasoline engine. Fuel injection quantity is decided by MAFS signal in gasoline engine.)When EGR gas(contains no oxygen) flowing into combustion chamber increases, the air passing through AFS(contains oxygen) decreases. Thus, with the output signal change of MAFS accompanied by EGR actuator actuation, ECM determines the amount of recirculated EGR gas quantity.

NOTE

NOx is produced from the reaction of nitrogen and oxygen.
If least intake air required for complete combustion flows into combustion chamber by controlling EGR gas(contains no oxygen) which is recirculated to combustion chamber, NOx decreases because there is no supplementary oxygen to react with nitrogen.

DTC DESCRIPTION EC30F227

P0101 is set when MAFS output voltage above 4.8V is detected for more than 1.0 sec.. This code is due to short to battery in signal circuit or open in ground circuit.

DTC DETECTING CONDITION E39F91F1

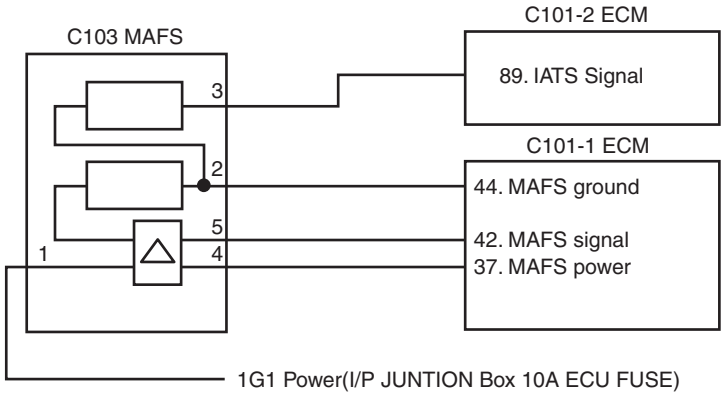
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• MAFS circuit • MAFS component
Enable Conditions	• Engine running			
ThresholdValue	• Shrot to battery in MAFS circuit			
DiagnosticTime	• 1.0 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	YES		
	Fuel Limit	YES		
	MIL	YES		

SPECIFICATION ED0AFB75

Intake air quantity (Kg/h)	Output frequency (KHz)		deviation [%]
	20℃	**80**℃	
8	1.97		±3
10	2.01	2.01	±2
40	2.50	2.50	±2
105	3.20	3.20	±2
220	4.30		±2
480	7.80	7.80	±2
560	9.50		±3

SCHEMATIC DIAGRAM EA634E1B

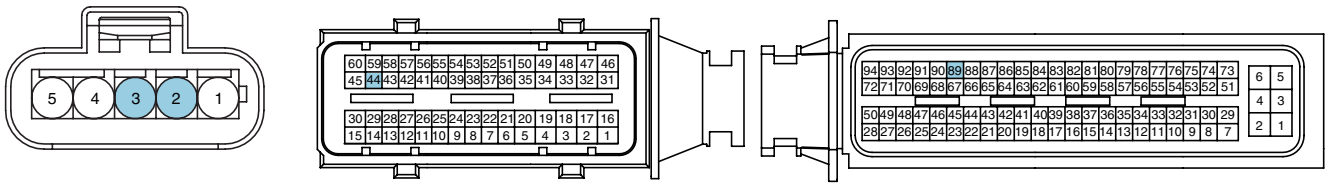
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C142 J/C terminal 5	1G1 Power
2	C101-1 terminal 44	Sensor ground
3	C101-2 terminal 89	IATS Signal
4	C101-1 terminal 37	Sensor power
5	C101-1 terminal 42	MAFS signal

[HARNESS CONNECTOR]



EGNG012P

SIGNAL WAVEFORM AND DATA E366EE4D

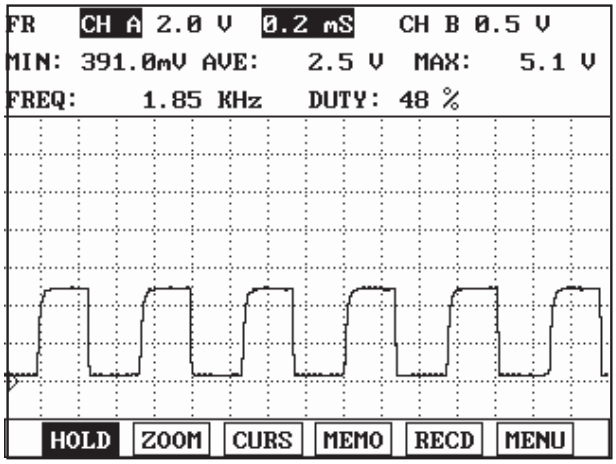


Fig.1

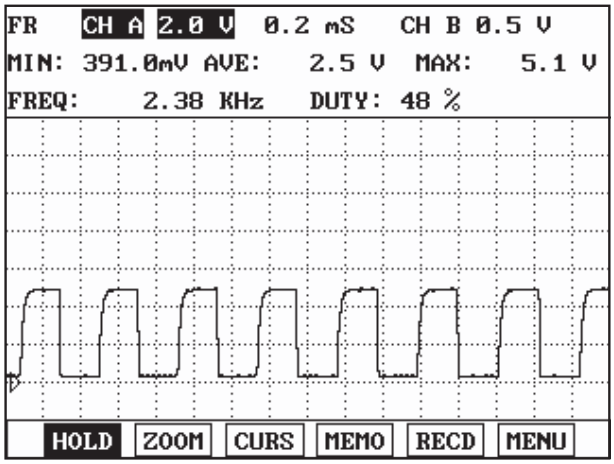


Fig.2

Fig.1) MAFS signal waveform at IG KEY "ON". It shows digital signal of 50% duty, 1.8KHz.
Fig.2) MAFS signal waveform at idle(830RPM, Electric EGR control valae duty 9.4%, air flow for each cylinder 340mg/st). It shows digital signal of 50% duty, 2.0~2.5KHz.

EGNG012Q

NOTE

Signal frequency increases as RPM rises.

MONITOR SCANTOOL DATA EDE98702

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "AIR MASS PERCYLINDER" parameter on the Scantool.

Specification : When EElectric EGR control valve does not operate 6% duty) at idle : 340mg/st ± 50 mg/st
When EElectric EGR control valve operates(Approx. 50% duty) at idle : 200ms/st ± 50 mg/st

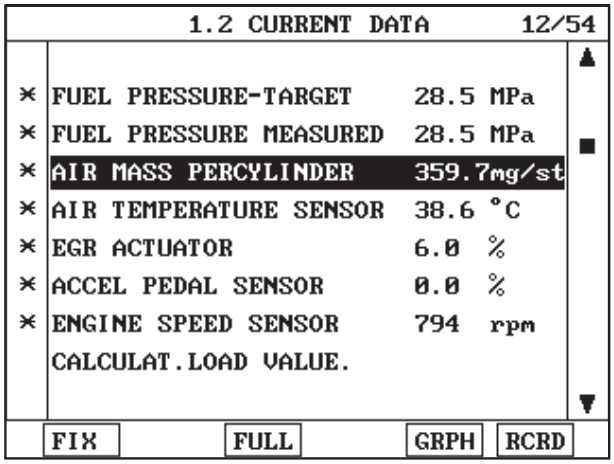


Fig.1

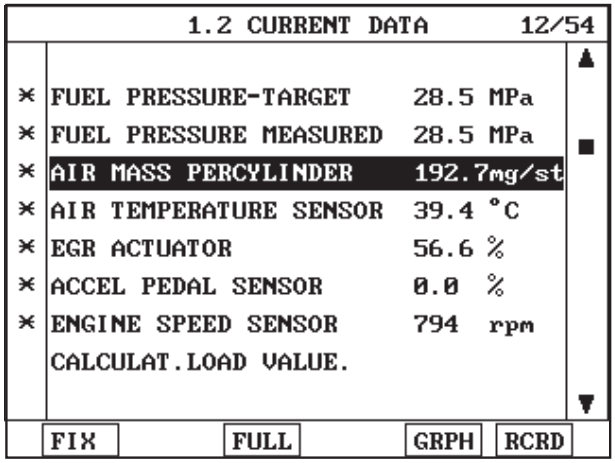


Fig.2

Fig.1) Check if "AIR MASS PERCYLINDER"I is 340mg/st ± 50mg/st without EEGR operation at warm idle (Electric EGR control valve 6% duty)
Fig.2) Check if "AIR MASS PERCYLINDER"I is 200mg/st ± 50mg/st with EEGR operation at warm idle (Electric EGR control valve approx. 50% duty)

※Electric EGR control valae operates as decelerating after rapid acceleration when idle EEGR does not operate, Electric EGR control valve operating duty decreases as time goes by. This controlling process lasts for about 3 min. and Electric EGR control valve turns "OFF" (duty 6%) after 3 min..

EGNG012R

TERMINAL AND CONNECTOR INSPECTION EC0FFFB0

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION EAFA70E3

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect MAFS connector.

   3) IG KEY "ON".

   4) Measure the voltage of MAFS connector terminal 1 and 4.

Specification : Terminal 4 : 4.8V~5.1V (Sensor power)
Terminal 1 : 11.5V~13.0V (IG Power)

   5) Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ When output voltage is not detected at terminal 1 :
☞ Repair open in In-pannel junction box 10A ECU fuse and related circuit and go to "Verification of Vehicle Repair".
▶ When output voltage is not detected at terminal 4 :
☞ Repair open between MAFS connector terminal 4 and ECM connector 37, and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E5053C88

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect MAFS connector and ECM connector.

   3) IG KEY "ON".

   4) Measure the voltage of MAFS connector terminal 5.

Specification : 4.8~5.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair short to battery in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E72AFE74

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect MAFS connector.
3. IG KEY "ON".
4. Measure the voltage of MAFS connector terminal 4. [TEST "A"]
5. Measure the voltage between MAFS connector terminal 4 and 2. [TEST "B"]
   (terminal 4 : Check + prove , terminal 2 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EE0D6D18

1. IG KEY "OFF", ENGINE "OFF".
2. Check that MAFS is installed in correctly according to the direction of arrow on AFS assy'.
3. Check contamination of air cleaner filter.
4. IG KEY "ON", ENGINE "ON".
5. Let IDLE RPM last after warming engine up.
6. Check the leakage of intake system(the leakage or damage of intercooler).
7. Check that VGT operates correctly.(Check if vacuum operating state of VGT Control solenoid valve is appropriate, if VGT diaphragm and unison ring are stuck.)
8. Check that Electric EGR control valve does not operate.
   (Electric EGR control valve turns "OFF" and 6% duty is outputted 3 min after rapid acceleration. Disconnect Electric EGR control valve connector if needed.)
9. Monitor signal voltage of MAFS when engine speed lasts at approx. 800RPM using Scantool.
10. Check MAFS output signal at idle after rapid acceleration.(Electric EGR control valve duty 50%)

Specification : When Electric EGR control valve does not operate (6%) at idle : 340mg/st ± 50 mg/st
EEGR When Electric EGR control valve operates(50%) at idle : 200ms/st ± 50 mg/st

11. Is output signal within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace MAFS assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EC146149

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0102 MASS OR VOLUME AIR FLOW CIRCUIT LOW INPUT

COMPONENT LOCATION E070478C

Refer to DTC P0101.

GENERAL DESCRIPTION E2FF040F

Refer to DTC P0101.

DTC DESCRIPTION E282609F

P0102 is set when MAFS output voltage below 0.2V(below 1200Hz) is detected for more than 1.0 sec. This code is due to 1)open in power circuit 2) open or short to ground in signal circuit.

DTC DETECTING CONDITION E0148924

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• MAFS circuit
• MAFS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Shrot to battery in MAFS circuit</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 1.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION E5C5B0E5

Refer to DTC P0101.

SCHEMATIC DIAGRAM E4AEF152

Refer to DTC P0101.

SIGNAL WAVEFORM AND DATA EB36829A

Refer to DTC P0101.

MONITOR SCANTOOL DATA E7E3979C

Refer to DTC P0101.

TERMINAL AND CONNECTOR INSPECTION E92527D5

Refer to DTC P0101.

POWER CIRCUIT INSPECTION E7C8EA54

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect MAFS connector.

   3) IG KEY "ON".

   4) Measure the voltage of MAFS connector terminal 1 and 4.

Specification : Terminal 4 : 4.8V~5.1V (Sensor power)
Terminal 1 : 11.5V~13.0V (IG Power)

   5) Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ When output voltage is not detected at terminal 1 :
☞ Repair open in In-pannel junction box 10A ECU fuse and related circuit and go to "Verification of Vehicle Repair".
▶ When output voltage is not detected at terminal 4 :
☞ Repair open between MAFS connector terminal 4 and ECM connector 37, and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E792AA3E

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect MAFS connector and ECM connector.

   3) IG KEY "ON".

   4) Measure the voltage of MAFS connector terminal 5.

Specification : 4.8~5.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Go to "2. Check open in signal circuit" as follows.

2. Check short to ground in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect MAFS sensor connector and ECM connector.

3) Check continuity between MAFS connector terminal 5 and ECM connector terminal 42.

Specification : Discontinuity (Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "3. Check short to ground in signal circuit" as follows.

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

3. Check short to ground in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect MAFS sensor connector and ECM connector.

3) Check continuity between MAFS connector terminal 5 and chassis ground.

Specification : Discontinuity(Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E5A6CC02

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect MAFS connector.
3. IG KEY "ON".
4. Measure the voltage of MAFS connector terminal 4. [TEST "A"]
5. Measure the voltage between MAFS connector terminal 4 and 2. [TEST "B"]
   (terminal 4 : Check + prove , terminal 2 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E7DD1C4E

1. IG KEY "OFF", ENGINE "OFF".
2. Check that MAFS is installed in correctly according to the direction of arrow on AFS assy'.
3. Check contamination of air cleaner filter.
4. IG KEY "ON", ENGINE "ON".
5. Let IDLE RPM last after warming engine up.
6. Check the leakage of intake system(the leakage or damage of intercooler).
7. Check that VGT operates correctly.(Check if vacuum operating state of VGT Control solenoid valve is appropriate, if VGT diaphragm and unison ring are stuck.)
8. Check that Electric EGR control valve does not operate.
   (Electric EGR control valve turns "OFF" and 6% duty is outputted 3 min after rapid acceleration. Disconnect Electric EGR control valve connector if needed.)
9. Monitor signal voltage of MAFS when engine speed lasts at approx. 800RPM using Scantool.
10. Check MAFS output signal at idle after rapid acceleration.(Electric EGR control valve duty 50%)

Specification : When Electric EGR control valve does not operate (6%) at idle : 340mg/st ± 50 mg/st EEGR When Electric EGR control valve operates(50%) at idle : 200ms/st ± 50 mg/st

11. Is output signal within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace MAFS assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E042F809

Refer to DTC P0101.

DTC P0103 MASS OR VOLUME AIR FLOW CIRCUIT HIGH INPUT

COMPONENT LOCATION E47611F5

Refer to DTC P0101.

GENERAL DESCRIPTION E4CB5C2A

Refer to DTC P0101.

DTC DESCRIPTION EC47A9D0

P0103 is set when MAFS output voltage above 14100Hz is detected for more than 1.0 sec. This code is due to excessive output voltage from sensor component or poor connection in sensor circuit.

DTC DETECTING CONDITION E6B842D7

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• MAFS circuit
• MAFS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Abnormal maximum output signal(above 14100Hz)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 1.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION EFE35CDD

Refer to DTC P0101.

SCHEMATIC DIAGRAM E2001216

Refer to DTC P0101.

SIGNAL WAVEFORM AND DATA EE33FB29

Refer to DTC P0101.

MONITOR SCANTOOL DATA E7522645

Refer to DTC P0101.

TERMINAL AND CONNECTOR INSPECTION E283F939

Refer to DTC P0101.

POWER CIRCUIT INSPECTION E5FEDA89

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect MAFS connector.

   3) IG KEY "ON".

   4) Measure the voltage of MAFS connector terminal 1 and 4.

Specification : Terminal 4 : 4.8V~5.1V (Sensor power)
Terminal 1 : 11.5V~13.0V (IG Power)

   5) Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ When output voltage is not detected at terminal 1 :
☞ Repair open in In-pannel junction box 10A ECU fuse and related circuit and go to "Verification of Vehicle Repair".
▶ When output voltage is not detected at terminal 4 :
☞ Repair open between MAFS connector terminal 4 and ECM connector 37, and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E96AB215

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect MAFS connector and ECM connector.

   3) IG KEY "ON".

   4) Measure the voltage of MAFS connector terminal 5.

Specification : 4.8~5.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Go to "2. Check open in signal circuit" as follows.

2. Check short to ground in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect MAFS sensor connector and ECM connector.

3) Check continuity between MAFS connector terminal 5 and ECM connector terminal 42.

Specification : Discontinuity (Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "3. Check short to ground in signal circuit" as follows.

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

3. Check short to ground in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect MAFS sensor connector and ECM connector.

3) Check continuity between MAFS connector terminal 5 and chassis ground.

Specification : Discontinuity(Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION EAFCDB06

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect MAFS connector.
3. IG KEY "ON".
4. Measure the voltage of MAFS connector terminal 4. [TEST "A"]
5. Measure the voltage between AFS connector terminal 4 and 2. [TEST "B"]
   (terminal 4 : Check + prove , terminal 2 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E5C4F86B

1. IG KEY "OFF", ENGINE "OFF".
2. Check that MAFS is installed in correctly according to the direction of arrow on AFS assy'.
3. Check contamination of air cleaner filter.
4. IG KEY "ON", ENGINE "ON".
5. Let IDLE RPM last after warming engine up.
6. Check the leakage of intake system(the leakage or damage of intercooler).
7. Check that VGT operates correctly.(Check if vacuum operating state of VGT Control solenoid valve is appropriate, if VGT diaphragm and unison ring are stuck.)
8. Check that Electric EGR control valve does not operate.
   (Electric EGR control valve turns "OFF" and 6% duty is outputted 3 min after rapid acceleration. Disconnect Electric EGR control valve connector if needed.)
9. Monitor signal voltage of MAFS when engine speed lasts at approx. 800RPM using Scantool.
10. Check MAFS output signal at idle after rapid acceleration.(Electric EGR control valve duty 50%)

Specification : When Electric EGR control valve does not operate (6%) at idle : 340mg/st ± 50 mg/st EEGR When Electric EGR control valve operates(50%) at idle : 200ms/st ± 50 mg/st

11. Is output signal within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

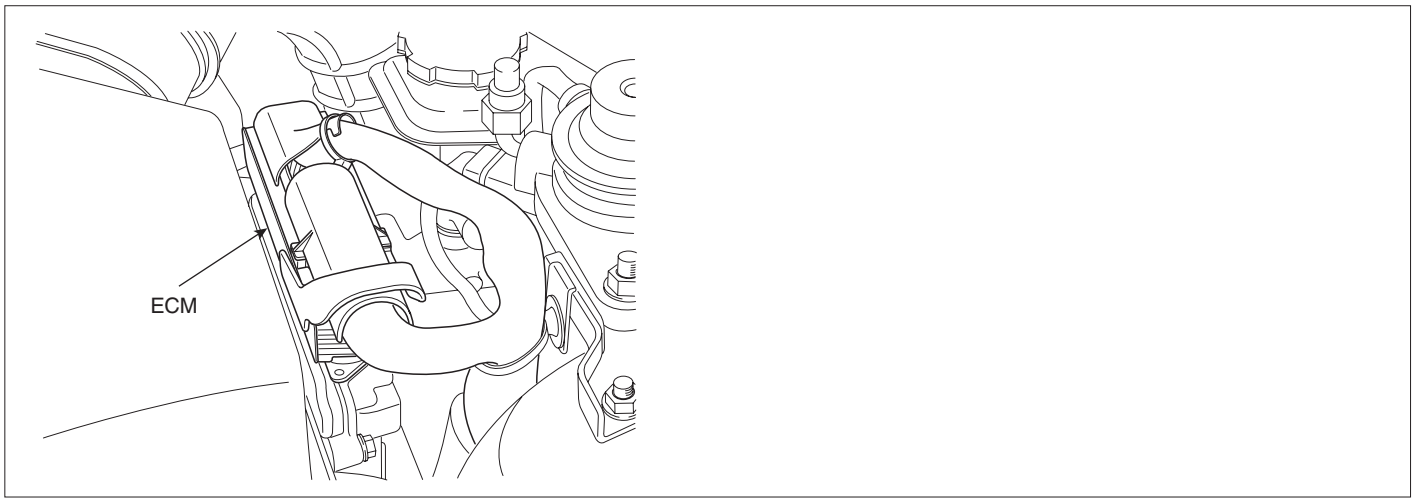
▶ Replace MAFS assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E2F112B5

Refer to DTC P0101.

DTC P0107 ATMOSPHERIC PRESSURE CIRCUIT LOW INPUT

COMPONENT LOCATION E75BA5CE



EGNG007T

GENERAL DESCRIPTION E9CD0AB4

Atmospheric sensor is installed in ECM and senses atmospheric pressure where the vehicle is.Based on singal of atmospheric sensor, air density is calculated. And atmospheric sensor is used to detect mass air flow with MAFS, IATS. This sensor is required to perform 1) fuel injection quantity correction in high altitude and 2) EGR control. Atmospheric pressure is fixed at 900hpa when atmospheric sensor fails.

DTC DESCRIPTION E5223337

P0107 is set when the voltage below 250mV - minimum output voltage of Atmospheric pressure sensor - is detected for more than 0.4 sec. This code is due to fhe failure of the sensor inside of ECM.

DTC DETECTING CONDITION E57A4CBE

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="7">• Atmospheric pressure sensor (ECM component)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• When output voltage is below the minimum value.(below 152mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Atmospheric pressure is fixed at 1000hpa.</td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION EBF7483D

1ATM IS SAME AS

hpa (hecto pascal)	mb	mmHg
1013	1013	760

MONITOR SCANTOOL DATA E78F5B38

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "ATMOSPHERIC PRESS. SNSR" parameter on the scantool.

Specification : Approx. 1 atm is displayed

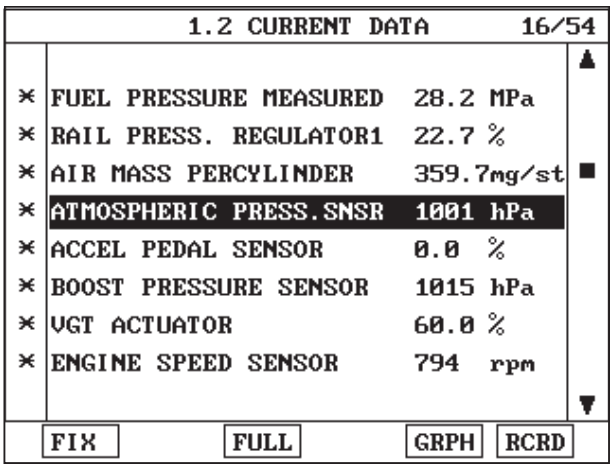


Fig.1

Fig.1) The atmospheric pressure where the vehicle is displayed. atmospheric pressure decreases as vehicle going up to higher altitude. The pressure at average level of sea surface is regarded as 1atm and, check if the pressure different from 1 atm is displayed. (1 atm is correct pressure)

EGNG003B

COMPONENT INSPECTION EAAC0D94

1. ECM Component Inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect ECM.
   3) Replace ECM, check if abnormal operations disappear.
   4) If problems are corrected, replace ECM.

VERIFICATION OF VEHICLE REPAIR E5134CBF

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.

2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0108 ATMOSPHERIC PRESSURE CIRCUIT HIGH INPUT

COMPONENT LOCATION E5427083

Refer to DTC P0107.

GENERAL DESCRIPTION E71F32EE

Refer to DTC P0107.

DTC DESCRIPTION E1469A98

P0108 is set when the voltage above 4.85V - maximum output voltage of Atmospheric pressure sensor - is detected for more than 0.4 sec.. This code is due to fhe failure of the sensor inside of ECM.

DTC DETECTING CONDITION E72A4CA4

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Atmospheric pressure sensor (ECM component)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• When output voltage is above the maximum value. (above 4.85V)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Atmospheric pressure is fixed at 1000hpa.</td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E6934E71

Refer to DTC P0107.

MONITOR SCANTOOL DATA EDE8D891

Refer to DTC P0107.

COMPONENT INSPECTION E44AF3D4

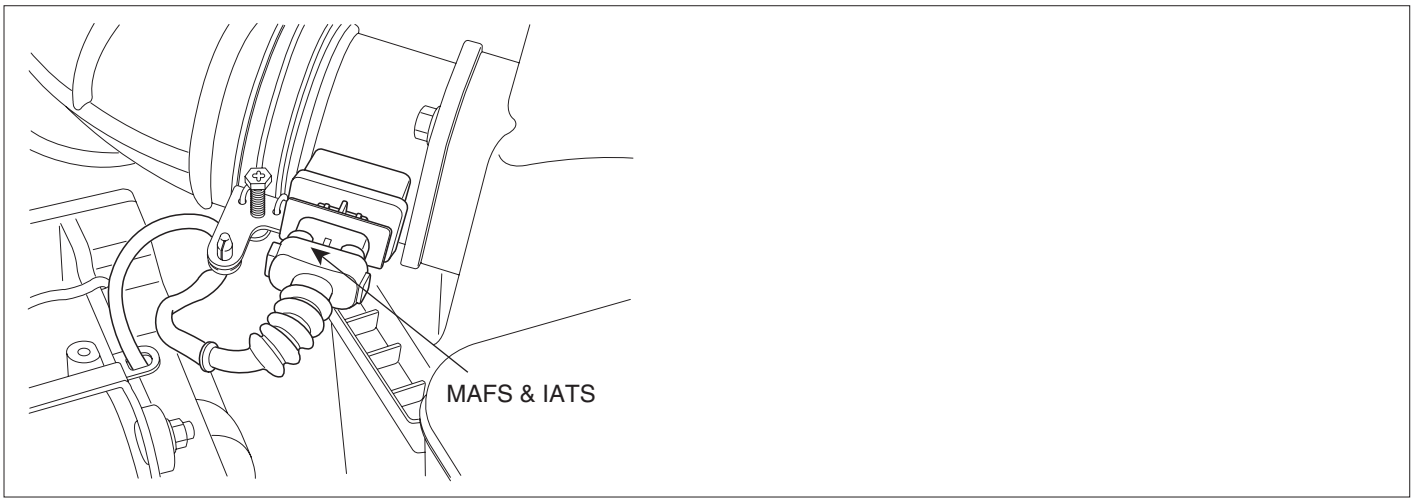
1. ECM Component Inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect ECM.
   3) Replace ECM, check if abnormal operations disappear.
   4) If problems are corrected, replace ECM.

VERIFICATION OF VEHICLE REPAIR E8B258F2

Refer to DTC P0107.

DTC P0112 INTAKE AIR TEMPERATURE SENSOR 1 CIRCUIT LOW INPUT

COMPONENT LOCATION EE29DAA6



EGNG004N

GENERAL DESCRIPTION E918D7A8

Intake Air Temperature Sensor(IATS) is NTC thermistor. Installed inside of both MAFS and BPS, it senses intake air temperature. In case of EURO-4 diesel engine, IATS is installed in front of turbocharger(inside of MAFS) and behind it(inside of BPS). Comparing air temperature from both sensors(one is intake air temperature, the other is air temperature passing through turbo charger), more accurate sensing of intake air temperature is possible.With intake air temperature signal, ECM performs EGR control correction and fuel injection quantity correction.(MAFS is needed for EGR FEED BACK control in electronically controlled diesel engine. The calculation of air density at certain temperture is required to perform EGR FEED BACK control correctly.)

DTC DESCRIPTION E13FDC5B

P0112 is set when the voltage below 73mV - minimum output voltage of IATS(inside of AFS) - is detected for more than 2.0 sec. This code is due to short to ground in IATS signal circuit.

DTC DETECTING CONDITION E7FDFE30

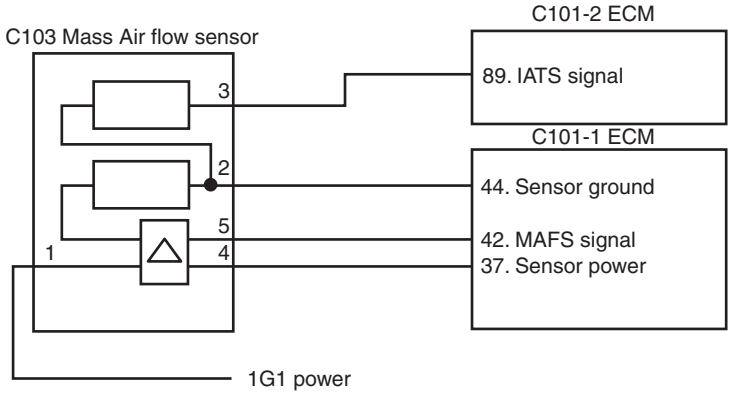
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage Monitoring</td><td rowspan="8">• IATS circuit
• IATS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• When output signal is below the minimum value (below 73mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Intake air temperature is regarded as 50℃</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION EDF5A538

Tempera-ture	-40℃	-20℃	0℃	20℃	40℃	60℃	80℃
Resistance	35.14 ~43.76KΩ	12.66 ~15.12KΩ	5.12 ~5.89KΩ	2.29 ~2.55KΩ	1.10 ~1.24KΩ	0.57 ~0.65KΩ	0.31 ~0.37KΩ

SCHEMATIC DIAGRAM E2356DAC

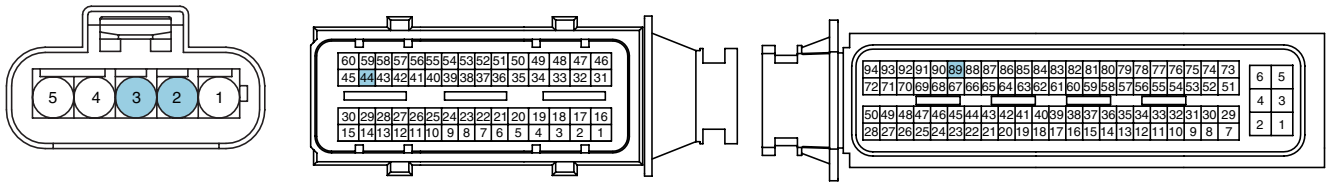
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C142 J/C terminal 5	1G1 power
2	C101-1 terminal 44	Sensor ground
3	C101-2 terminal 89	IATS signal
4	C101-1 terminal 37	Sensor power
5	C101-1 terminal 42	MAFS signal

[HARNESS CONNECTOR]



EGNG004O

SIGNAL WAVEFORM AND DATA E6BC2AA8

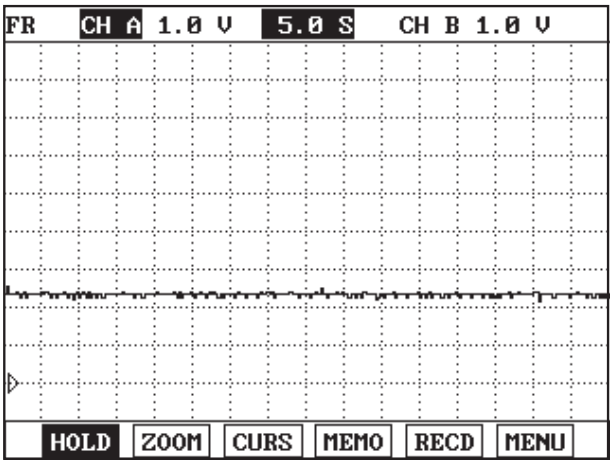


Fig.1

Fig.1) IATS output signal at 25℃.The higher temperature rises, the lower signal voltage becomes.

EGNG004P

MONITOR SCANTOOL DATA E077D6EA

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "AIR TEMPERATURE SENSOR" parameter on the scantool.

Specification : Intake air temperature is displayed

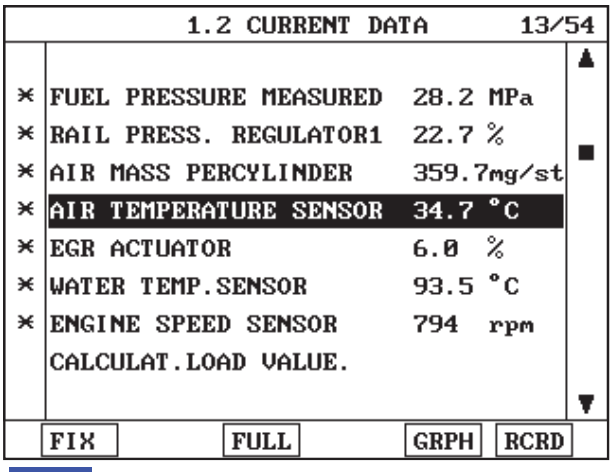


Fig.1

Fig.1) "AIR TEMPERATURE SENSOR" value should not change according to engine state.

EGNG004Q

TERMINAL AND CONNECTOR INSPECTION E0AF83E2

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Signal Circuit Inspection".

SIGNAL CIRCUIT INSPECTION E18E9BA2

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect IATS connector

   3) IG KEY "ON"

   4) Measure the voltage of terminal 3 of MAFS connector.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

      YES

      ▶ Go to "Component Inspection".

      NO

      ▶ Go to "2.Check short to ground in signal circuit" as follows.

2. Check short to ground in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect MAFS connector and ECM connector

   3) Check continuity between MAFS connector terminal 3 and chassis ground.

Specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

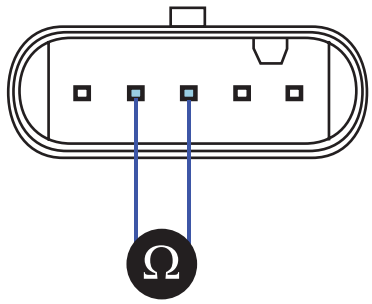
NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E428B692

1. Ignition "OFF", Turn Engine "OFF".
2. Disconnect MAFS connector.
3. Measure resistance of IATS component terminal 3 and 2, referring to resistance characteristic table of specification of General information.

Specification : Refer to Specification of General Information.



EGNG004S

4. Is the measured resistance at certain temperature within the specified resisance range at the temperature?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace MAFS ASSY' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EA50D73E

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0113 INTAKE AIR TEMPERATURE SENSOR 1 CIRCUIT HIGH INPUT

COMPONENT LOCATION E4A627CA

Refer to DTC P0112.

GENERAL DESCRIPTION E472BDF9

Refer to DTC P0112.

DTC DESCRIPTION ED6C8A71

P0113 is set when the voltage above 4886mV - maximum output voltage of IATS - is detected for more than 2.0 sec. This code is due to 1) open or 2) short to ground or 3) short to battery in IATS signal circuit.

DTC DETECTING CONDITION E7BE8492

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage Monitoring</td><td rowspan="6">• IATS circuit
• IATS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• When output signal is above the maximum value (above 4.886mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Intake air temperature is regarded as 50℃</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION EF060A26

Refer to DTC P0112.

SCHEMATIC DIAGRAM E7F7D236

Refer to DTC P0112.

SIGNAL WAVEFORM AND DATA E30871A7

Refer to DTC P0112.

MONITOR SCANTOOL DATA E82AE35E

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "AIR TEMPERATURE SENSOR" parameter on the scantool.

Specification : Intake air temperature is displayed

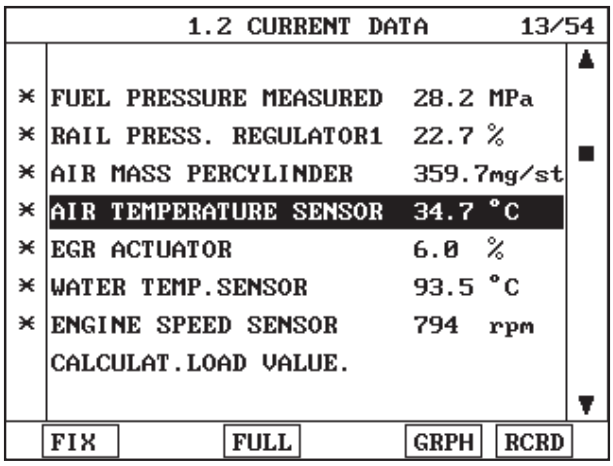


Fig.1

Fig.1) "AIR TEMPERATURE SENSOR" value should not change according to engine state.

EGNG004Q

TERMINAL AND CONNECTOR INSPECTION E58294E2

Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION E7DA0844

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect MAFS connector

   3) IG KEY "ON"

   4) Measure the voltage of terminal 3 of MAFS connector.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Component Inspection"

   NO

   ▶ Go to "2.Check open in signal circuit" as follows.

2. Check open in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect MAFS connector and ECM connector

   3) Check continuity between MAFS connector terminal 3 and ECM connector terminal 89.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "3.Check short to battery in signal circuit " as follows

NO

▶ Repair open spots in signal circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect MAFS connector and ECM connector

3) IG KEY "ON"

4) Measure the voltage of terminal 3 of MAFS connector.

Specification : 0.0V~0.1V

5) Is abnormal voltage detected in the circuit with both connector disconnected?

YES

▶ Repair short to battery and go to "Verification of Vehicle Repair".

NO

▶ Go to "Ground Circuit Inspection".

GROUND CIRCUIT INSPECTION EB5A491E

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect MAFS connector and ECM connector
3. IG KEY "ON"
4. Measure the voltage of terminal 3 of MAFS connector. [TEST "A"]
5. Measure the voltage of MAFS terminal 3 and terminal 2. [TEST "B"]
   (terminal 3 : Check + prove , terminal 2 : Check - prove)

Specification : the voltage difference between TEST "A" and TEST "B" is within 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

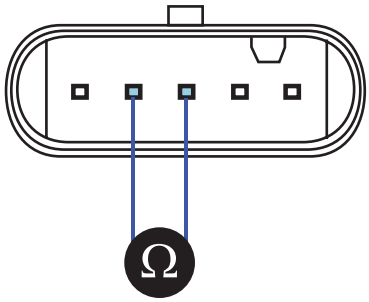
NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EAE176F7

1. Ignition "OFF", Turn Engine "OFF".
2. Disconnect MAFS connector.
3. Measure resistance of IATS component terminal 3 and 2, referring to resistance characteristic table of specification of General information.

Specification : Refer to Specification of General Information.



EGNG004S

4. Is the measured resistance at certain temperature within the specified resisance range at the temperature?

YES

▶ Go to "Verification of Vehicle Repair".

NO

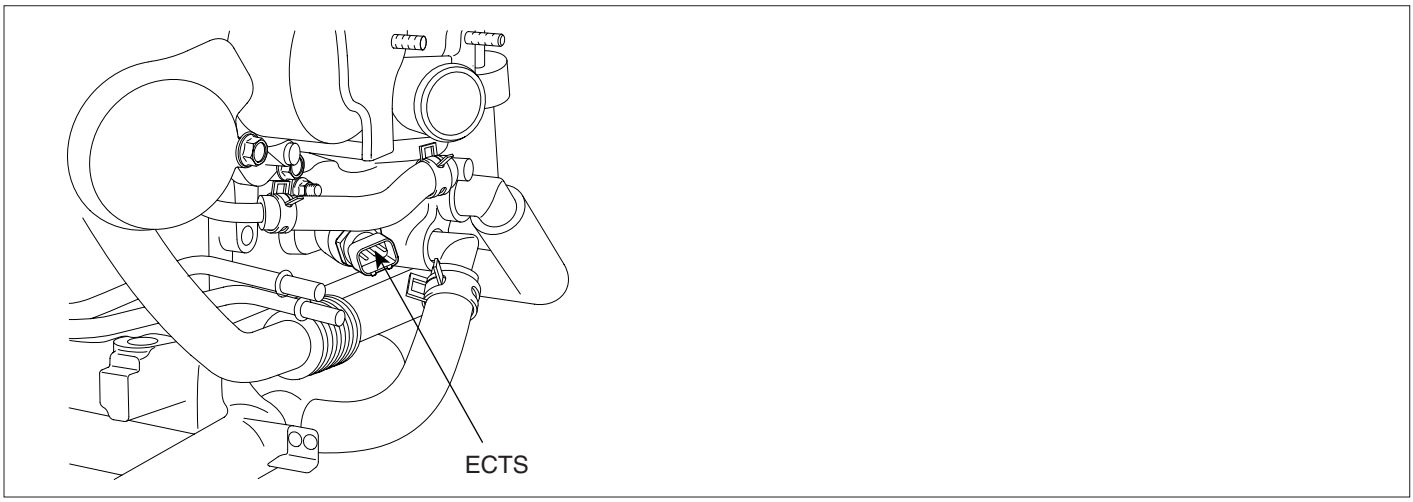
▶ Replace AFS ASSY' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E16AFF01

Refer to DTC P0112.

DTC P0117 ENGINE COOLANT TEMPERATURE CIRCUIT LOW INPUT

COMPONENT LOCATION ED6BF22E



EGNG012E

GENERAL DESCRIPTION E0EEA0F0

Engine Coolant Temperature Sensor(ECTS), installed in coolant line, senses engine coolant temperature.With the information about engine coolant temperature, ECM performs fuel injection quantity correction, cooling fan control and glow relay operating duration control.Especially, because ECTS signal is main variable of fuel injection quantity correction when engine is cold, sensor trouble makes starting engine difficult when engine is cold.If engine is running when ECTS is out of order, ECM regards engine coolant temperature as 80℃. And during cranking, ECM considers engine coolant temperature as -10℃. Besides, cooling fan, which is controlled based on ECTS signal, operates at HIGH-MODE to prevent engine overheat and supplementary heater is deactivated.

DTC DESCRIPTION EAC91BF0

P0117 is set when the voltage below 225mV - minimum output voltage of ECTS - is detected for more than 2.0 sec. This code is due to short to ground in signal circuit.

DTC DETECTING CONDITION EC96666B

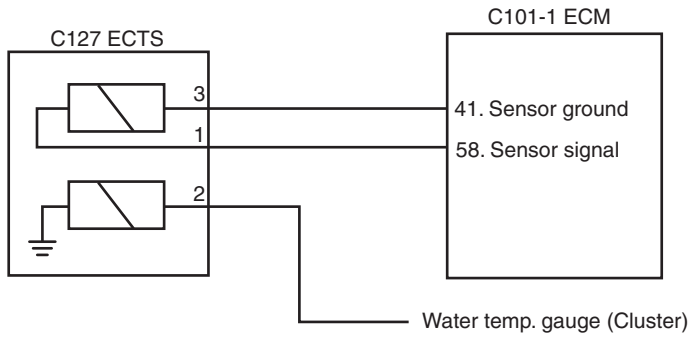
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="8">• ECTS circuit
• ECTS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Output signal below the minimum value.(below 225mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• A/C condensor fan control operation based on engine coolant temperature inhibited.
• PTC heater inhibited.
• Cooling fan is fixed at HIGH-MODE.
• during engine operation : temperature is fixed at 80℃
at cranking : temperature is fixed at -10℃</td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E09C851C

Temperature	**-40**℃	**-20**℃	**0**℃	**20**℃	**40**℃
Resistance	48.14㏀	15.48±1.35㏀	5.790㏀	2.45±0.14㏀	1.148㏀
Temperature	**60**℃	**80**℃	**100**℃	**110**℃	**120**℃
Resistance	0.586㏀	0.322㏀	0.188㏀	0.147±0.002㏀	0.116㏀

SCHEMATIC DIAGRAM E1E39678

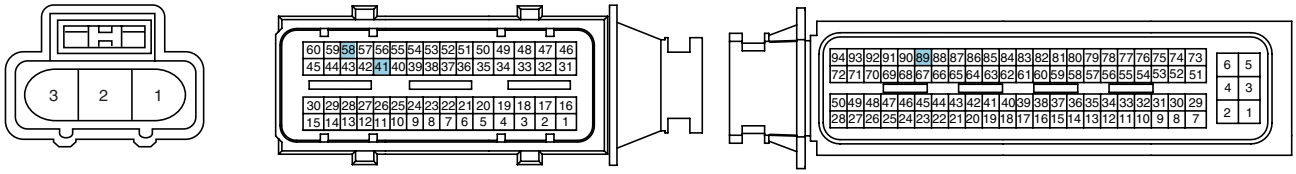
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-1 terminal 58	Sensor signal
2	M09-3 terminal 2	Water temp. gauge (Cluster)
3	C101-1 terminal 41	Sensor ground

[HARNESS CONNECTOR]



EGNG012F

SIGNAL WAVEFORM AND DATA E71310F8

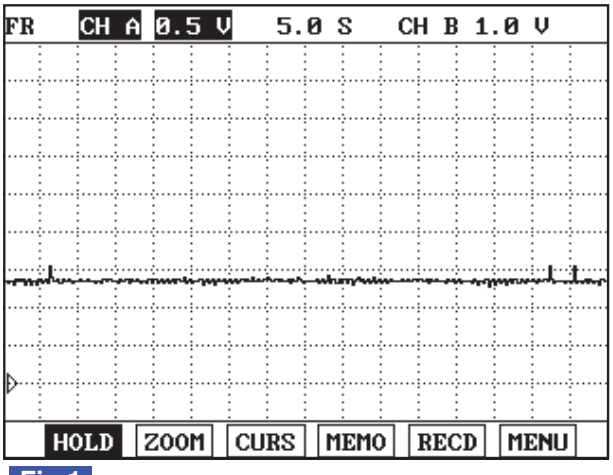


Fig.1

Fig.1) ECTS output signal at 80℃.The higher temperature rises, the lower signal voltage becomes.

EGNG012G

MONITOR SCANTOOL DATA E7F78564

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "ECTS" parameter on the Scantool.

Specification : Current enigne coolant temperature is displayed.

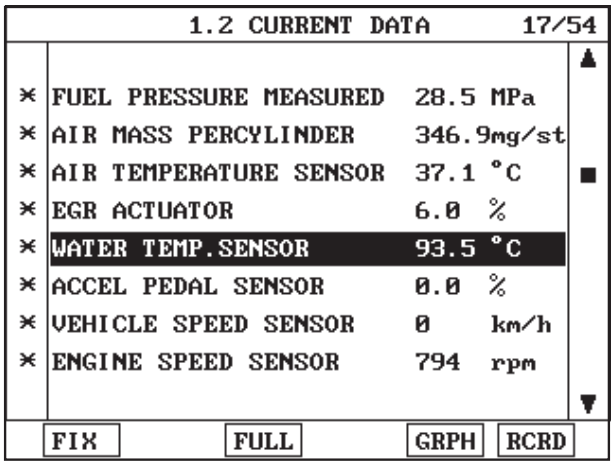


Fig.1

Fig.1) Check if 1) incorrect value is displayed 2) coolant temperature is fixed at 80℃ suddenly during driving 3)coolant temperature is fixed at -10℃ when turning IG KEY "ON". That coolant temperature is fixed at -10℃or 80℃ means failure of ECTS. To prevent overheat of engine due to ECTS , if ECTS fails, cooling fan operates continuously.

EGNG012H

TERMINAL AND CONNECTOR INSPECTION E2FFBEAC

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Signal Circuit Inspection ".

SIGNAL CIRCUIT INSPECTION E4F37CE1

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect ECTS connector.

3) IG KEY "ON".

4) Measure the voltage of ECTS connector terminal 1.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2.Check short to ground in signal circuit" as follows.

2. Check short to ground in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECTS connector and ECM connector.

3) Check continuity between ECTS connector terminal 1 and chassis ground.

Specification : Discontinuity (Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

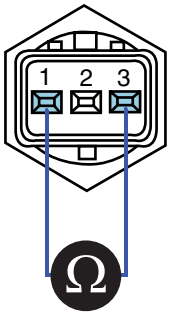
NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION ECBD402D

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect ECTS connector.
3. Measure resistance between ECTS terminal 1 and 3, referring to resistance characteristic table of specification of General information.

Specification : Refer to Specification of General Information



EGNG012I

4. Is the measured resistance at certain temperature within the specified resisance range at the temperature?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace ECTS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E92C8D5A

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0118 ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT

COMPONENT LOCATION E9B50B9C

Refer to DTC P0117.

GENERAL DESCRIPTION E34FBD94

Refer to DTC P0117.

DTC DESCRIPTION EF455BA1

P0118 is set when the voltage above 4965mV - maximum output voltage of ECTS - is detected for more than 2.0 sec. This code is due to open or short to battery in signal circuit or open in ground circuit.

DTC DETECTING CONDITION E6EF25F1

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• ECTS circuit
• ECTS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Output signal above the maximum value(above 4965mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• A/C condensor fan control operation based on engine coolant temperature inhibited.
• PTC heater inhibited.
• Cooling fan is fixed at HIGH-MODE.
• during engine operation : temperature is fixed at 80℃
at cranking : temperature is fixed at -10℃</td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E3560CE8

Refer to DTC P0117.

SCHEMATIC DIAGRAM EC432000

Refer to DTC P0117.

SIGNAL WAVEFORM AND DATA EE65EBE5

Refer to DTC P0117.

MONITOR SCANTOOL DATA EAC9797A

1. Connect Scantool to Data Link Connector (DLC).

2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "ECTS" parameter on the Scantool.

Specification : Current enigne coolant temperature is displayed.

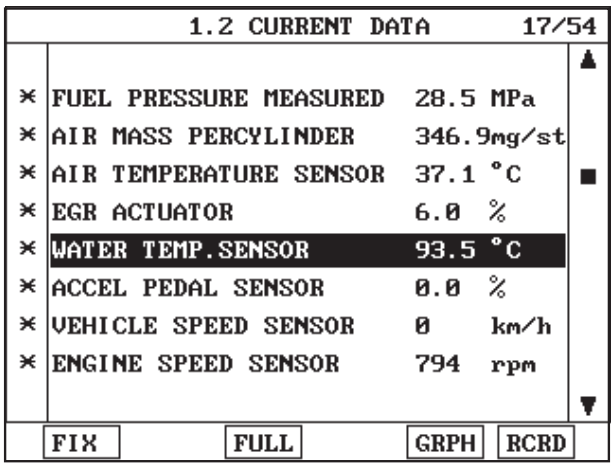


Fig.1

Fig.1) Check if 1) incorrect value is displayed 2) coolant temperature is fixed at 80℃ suddenly during driving 3)coolant temperature is fixed at -10℃ when turning IG KEY "ON". That coolant temperature is fixed at -10℃or 80℃ means failure of ECTS. To prevent overheat of engine due to ECTS , if ECTS fails, cooling fan operates continuously.

EGNG012H

TERMINAL AND CONNECTOR INSPECTION E5C5D906

Refer to DTC P0117.

SIGNAL CIRCUIT INSPECTION E8380F8A

1. Check signal circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect ECTS connector.
   3) IG KEY "ON".
   4) Measure the voltage of ECTS connector terminal 1.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2.Check open in signal circuit" as follows.

2. Check open in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECTS connector and ECM connector.

3) Check continuity between ECTS connector terminal 1 and ECM connector terminal 58.

Specification : continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "3.Check short to battery in signal circuit" as follows.

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECTS connector and ECM connector.

3) IG KEY "ON".

4) Measure the voltage of ECTS connector terminal 1.

Specification : 0.0V~0.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair short to battery in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E8180801

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect ECTS connector.
3. IG KEY "ON".
4. Measure the voltage of ECTS connector terminal 1. [TEST "A"]
5. Measure the voltage between ECTS connector terminal 1 and 3. [TEST "B"]
   (terminal 1 : Check + prove , terminal 3 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

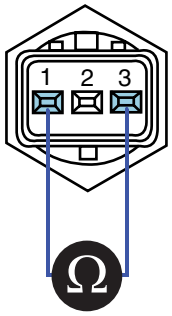
NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E6688785

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect ECTS connector.
3. Measure resistance between ECTS terminal 1 and 3, referring to resistance characteristic table of specification of General information.

Specification : Refer to Specification of General Information



EGNG012I

4. Is the measured resistance at certain temperature within the specified resisance range at the temperature?

YES

▶ Go to "Verification of Vehicle Repair".

NO

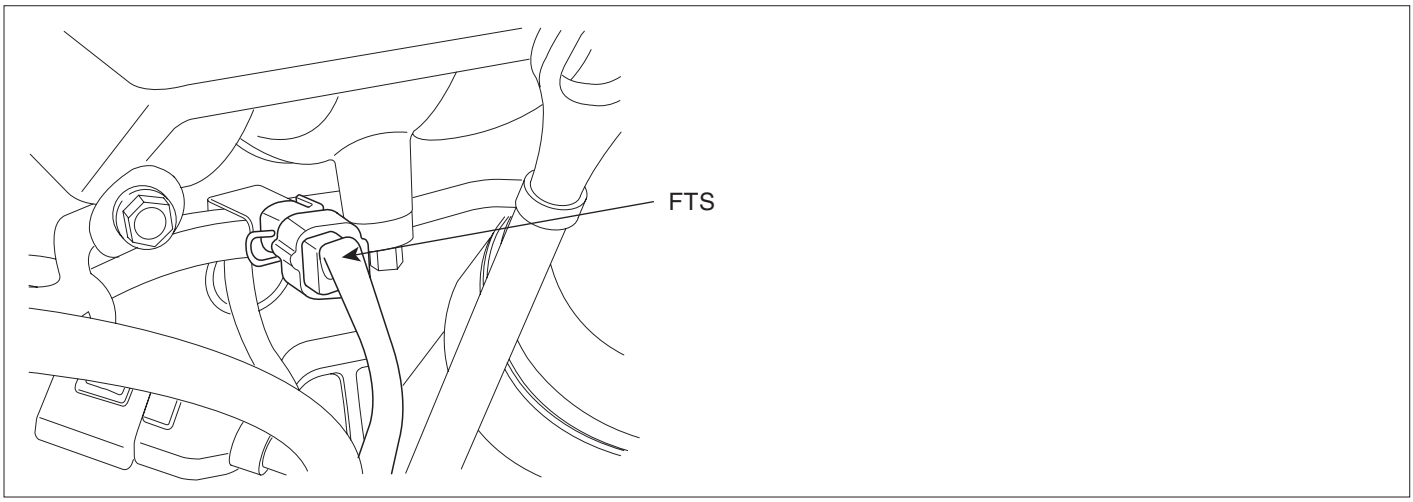
▶ Replace ECTS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EF4F4BEC

Refer to DTC P0117.

DTC P0182 FUEL TEMPERATURE SENSOR A CIRCUIT LOW INPUT

COMPONENT LOCATION EEDAE31D



EGNG006H

GENERAL DESCRIPTION E710D5AF

Fuel Temperature Sensor is NTC thermistor installed in fuel supplying line. It senses the temperature of fuel supplied to high pressure pump.Fuel temperature is limited (engine power is limited) to keep fuel temperature from reaching at 120℃.This limit is to protect fuel line such as high pressure pump and injectors from damages due to rapid deterioration by vapor-lock phenomenon which can occur at high temperature or destruction of oil membrane.

DTC DESCRIPTION E490E388

P0183 is set when the voltage below 53mV(0.053V) - minimum voltage of FTS output - is detected for more than 2.0 sec.. This code is due to short to ground in FTS signal circuit.

DTC DETECTING CONDITION EC3013F3

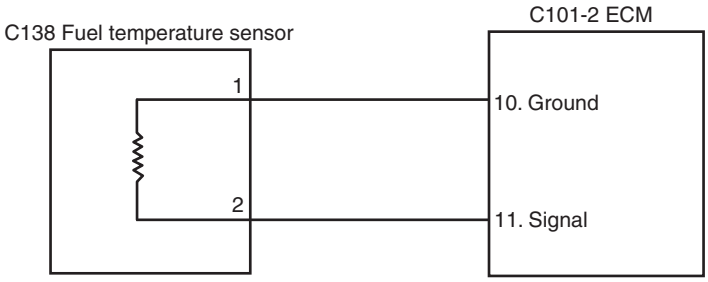
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage Monitoring			• FTS circuit • FTS component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• When output signal is below the minimum value.(below 53mV)			
DiagnosticTime	• 2.0sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION EE9A5359

Temperature	-30℃	-20℃	-10℃	0℃	20℃
Resistance	22.22~31.78㏀	13.24~18.10㏀	8.16~10.74㏀	5.18~6.60㏀	2.27~2.73㏀
Temperature	40℃	50℃	60℃	70℃	
Resistance	1.059~1.281㏀	0.748~0.904㏀	0.538~0.650㏀	0.392~0.476㏀	

SCHEMATIC DIAGRAM EDECB04E

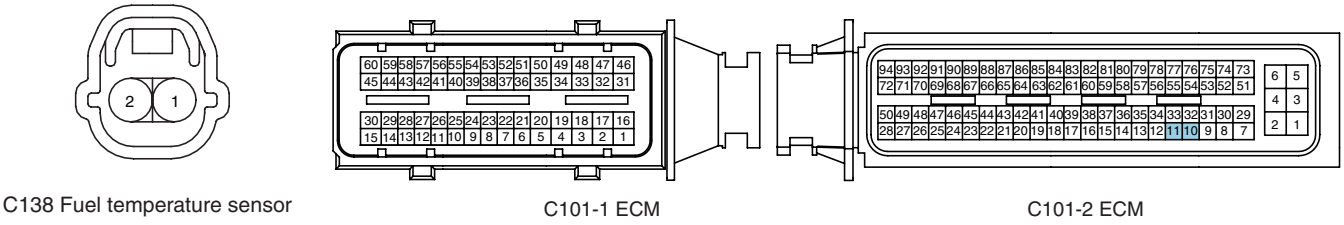
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-2 terminal 10	Ground
2	C101-2 terminal 11	Signal

[HARNESS CONNECTOR]



EGNG006I

SIGNAL WAVEFORM AND DATA E7970DC0

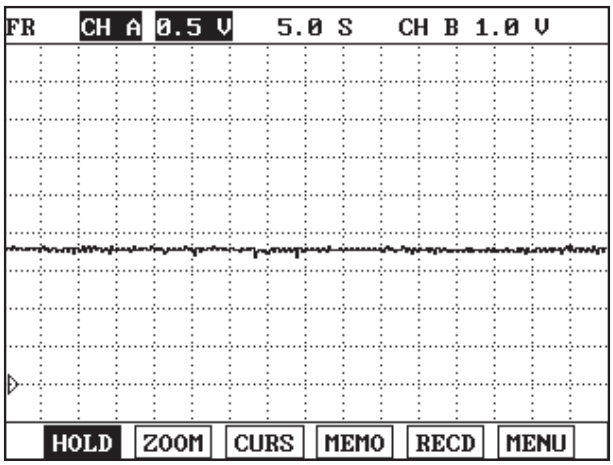


Fig.1

Fig.1) FTS output signal at 50℃.The higher temperature rises, the lower signal voltage becomes.

EGNG006J

MONITOR SCANTOOL DATA E41BFF19

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "FUEL TEMPERATURE" parameter on the scantool.

Specification :Fuel temperature is displayed

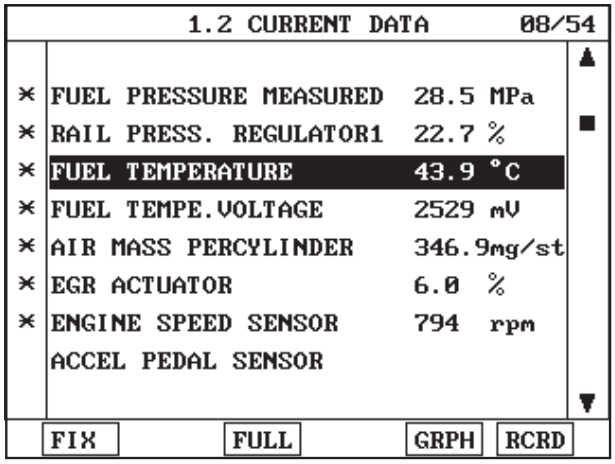


Fig.1

Fig.1) Check if too high or low temperature is displayed.(too high or low temperature is abnormal value.)

EGNG006K

TERMINAL AND CONNECTOR INSPECTION EA1C5C1A

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Signal Circuit Inspection ".

SIGNAL CIRCUIT INSPECTION E668148B

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect FTS connector.

   3) IG KEY "ON".

   4) Measure the voltage of terminal 2 of FTS connector.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Component Inspection".

   NO

   ▶ Go to "2.Check short to ground in signal circuit" as follows.

2. Check short to ground in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect FTS connector and ECM connector.

   3) Check continuity between FTS connector terminal 2 and chassis ground.

Specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

   YES

   ▶ Go to "Component Inspection".

   NO

   ▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

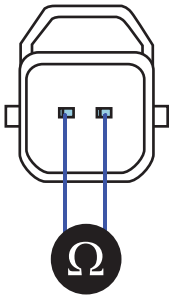
COMPONENT INSPECTION EFD4A86B

1. IG KEY "OFF", ENGINE "OFF".

2. Disconnect FTS connector.

3. Measure resistance of FTS component terminal 1 and 2, referring to resistance characteristic table of specification of General information.

Specification : Refer to Specification of General Information.



EGNG006L

4. Is the measured resistance at certain temperature within the specified resisance range at the temperature?

YES

▶ Go to "Verification of Vehicle Rapair".

NO

▶ Replace FTS and go to "Verification of Vehicle Rapair".

VERIFICATION OF VEHICLE REPAIR EDABB9FE

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0183 FUEL TEMPERATURE SENSOR A CIRCUIT HIGH INPUT

COMPONENT LOCATION ECB19CA7

Refer to DTC P0182.

GENERAL DESCRIPTION E22B11A1

Refer to DTC P0182.

DTC DESCRIPTION ED6570C4

P0183 is set when the voltage above 4912mV - maximum voltage of FTS output - is detected for more than 2.0 sec.. This code is due to 1)open or short to battery in FTS signal circuit or 2)open in ground circuit.

DTC DETECTING CONDITION E53739DE

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage Monitoring			• FTS circuit • FTS component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• When output signal is above the maximum value.(above 4912mV)			
DiagnosticTime	• 2.0sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION E373CFFF

Refer to DTC P0182.

SCHEMATIC DIAGRAM E81C2805

Refer to DTC P0182.

SIGNAL WAVEFORM AND DATA E7531801

Refer to DTC P0182.

MONITOR SCANTOOL DATA E060B685

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "FUEL TEMPERATURE" parameter on the scantool.

Specification :Fuel temperature is displayed

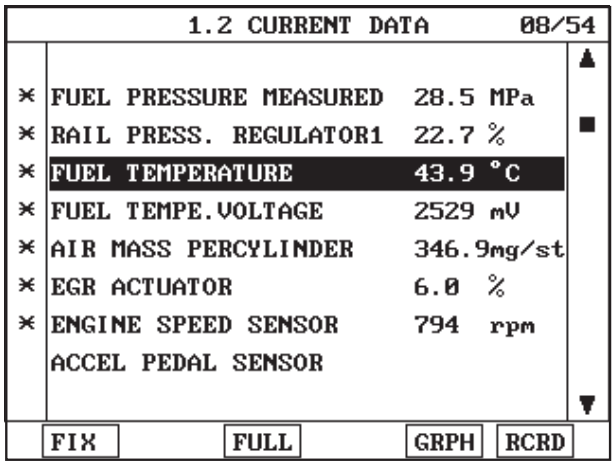


Fig.1

Fig.1) Check if too high or low temperature is displayed.(too high or low temperature is abnormal value.)

EGNG006K

TERMINAL AND CONNECTOR INSPECTION E9E796AC

Refer to DTC P0182.

SIGNAL CIRCUIT INSPECTION EADED853

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect FTS connector.

   3) IG KEY "ON".

   4) Measure the voltage of terminal 2 of FTS connector.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Ground Circuit Inspection".

   NO

   ▶ Go to "2.Check open in signal circuit" as follows.

2. Check open in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect FTS connector and ECM connector.

   3) Check continuity between FTS connector terminal 2 and ECM connector terminal 11.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "3. Check short to battery in signal circuit" as follows.

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect FTS connector and ECM connector.

3) IG KEY "ON".

4) Measure the voltage of FTS connector terminal 2.

Specification : 0.0V~0.1V

5) Is abnormal voltage detected in the circuit with both connector disconnected?

YES

▶ Repair short to battery and go to "Verification of Vehicle Repair".

NO

▶ Go to "Ground Circuit Inspection".

GROUND CIRCUIT INSPECTION E4B4EA4C

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect FTS connector and ECM connector.
3. IG KEY "ON".
4. Measure the voltage of terminal 2 of FTS connector.[TEST "A"]
5. Measure the voltage between FTS connector terminal 2 and 1. [TEST "B"]
   (terminal 2 : Check + prove , terminal 1 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

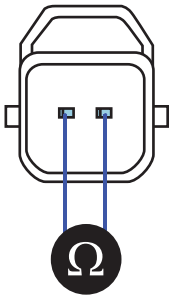
NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EB8FF81A

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect FTS connector.
3. Measure resistance of FTS component terminal 1 and 2, referring to resistance characteristic table of specification of General information.

Specification : Refer to Specification of General Information.



EGNG006L

4. Is the measured resistance at certain temperature within the specified resisance range at the temperature?

YES

▶ Go to "Verification of Vehicle Rapair".

NO

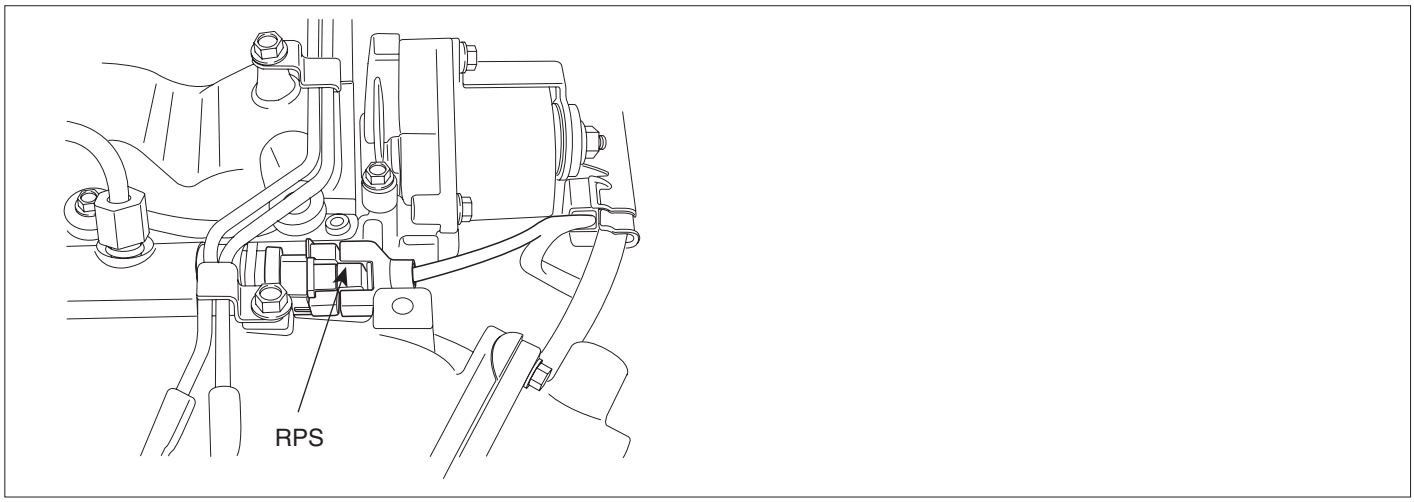
▶ Replace FTS and go to "Verification of Vehicle Rapair".

VERIFICATION OF VEHICLE REPAIR E3F2FEAA

Refer to DTC P0182.

DTC P0192 FUEL RAIL PRESSURE SENSOR LOW INPUT

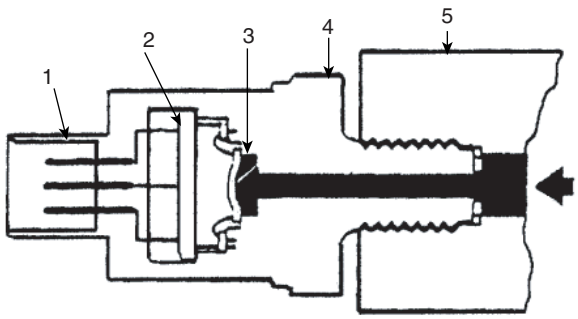
COMPONENT LOCATION E04FFD89



EGNG010M

GENERAL DESCRIPTION EBF30C12

RPS(Rail Pressure Sensor), consists of piezzo electric element, measures rail pressure inside of common rail.ECM determines optimum fuel injection quantity at specific engine condition based on RPS signal. RPS signal is also used as rail pressure regualtor feed back signal in order to achieve optimum rail pressure at certain engine condition.



1. Connector
2. Sensor circuit
3. Sensor element (diaphragm)
4. RPS assy'
5. Commom rail

EGNG010N

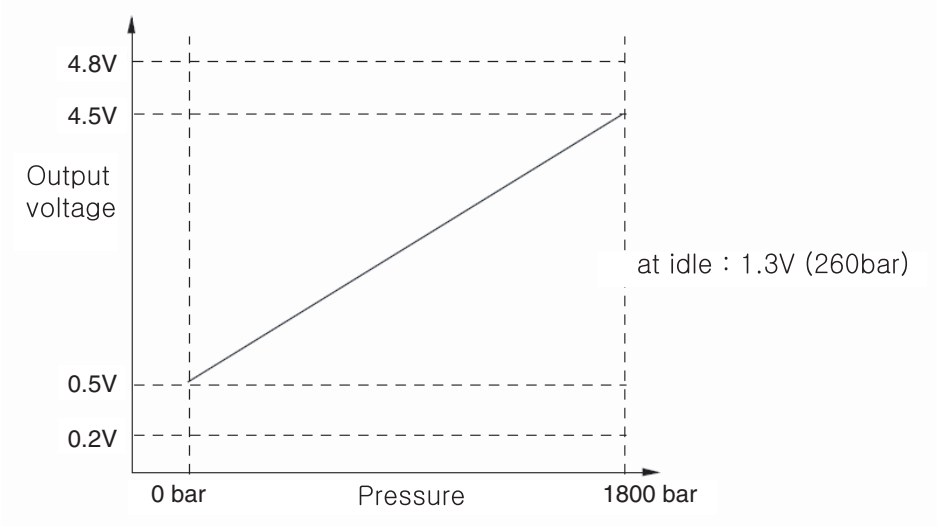
DTC DESCRIPTION ED31E36B

P0192 is set when RPS output voltage is below the minimum value of 254mV for more than 0.2 sec.. This code is due to the open in power circuit or the short to ground in signal circuit.

DTC DETECTING CONDITION E2CD89EB

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• RPS circuit
• RPS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Output sinal below minimum value (below 254mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 200ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Rail press. Sensor value fixed at 330bar</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

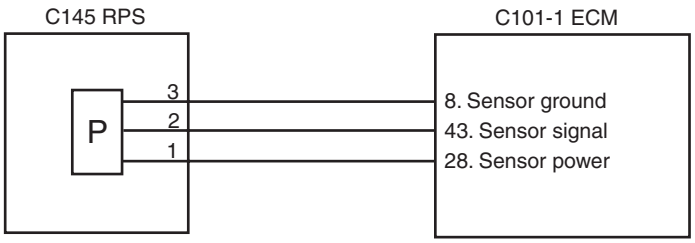
SPECIFICATION EDEA7CDF



EGNG010O

SCHEMATIC DIAGRAM E144B0E3

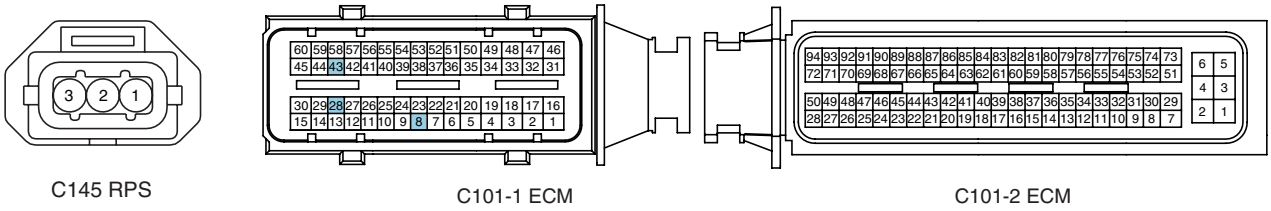
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-1 terminal 28	Sensor power
2	C101-1 terminal 43	Sensor signal
3	C101-1 terminal 8	Sensor ground

[HARNESS CONNECTOR]



EGNG010P

SIGNAL WAVEFORM AND DATA EC602D03

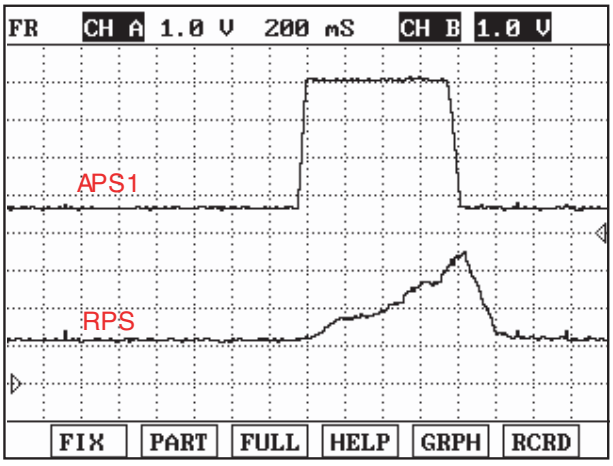


Fig.1

Fig.1) APS 1 and RPS signals are measured simultaneously.
This waveform shows the rise of RPS output voltage at rapid acceleration.

EGNG010Q

MONITOR SCANTOOL DATA EF9558C7

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.

4. Monitor "FUEL PRESSURE MEASURED", "RAIL PRESS. REGULATOR1", "INJ. PUMP REGULATOR" parameter on the Scantool.

SPECIFICATION :

	Idle(without load)	Accelerating(stall test)	Diagnosis
INJ. PUMP REGULATOR	38 ± 5%	32 ± 5%	duty decreases
FUEL PRESSURE MEASURED	28.5 ± 5 Mpa	145 ± 10 Mpa	press. increases
RAIL PRESS. REGULATOR1	19 ± 5%	48 ± 5%	duty increases

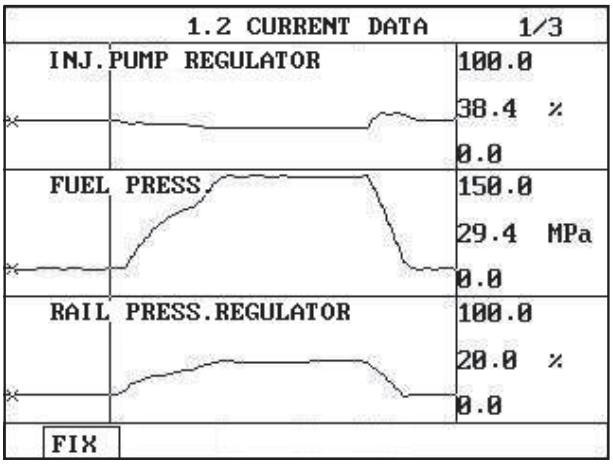


Fig.1

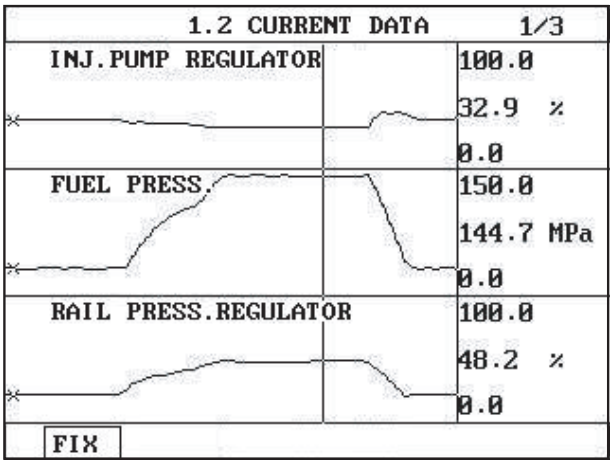


Fig.2

Fig.1) The position of curser on the graph represents idle data.
Fig.2) Data during acceleration(stall test).

EGNG013U

NOTE

The waveform of fuel pressure regulator valve installed at high pressure pump(fuel detecting MPROP) shows 38% duty at idle, duty drops to approx. 32% at acceleration to raise rail pressure. Duty drop means the decrease of current.
→ Fuel delivered to common rail increases as current drops.

The waveform of rail pressure regulator valve installed at common rail shows 19% duty at idle, duty rises to approx. 48% at acceleration to raise rail pressure. Duty rise means the increase of current.
→ If current rises, the returning quantity of fuel deliverd to common rail decreases and common rail pressure rises.

TERMINAL AND CONNECTOR INSPECTION E6661C32

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E8569595

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect RPS connector.
3. IG KEY "ON".
4. Measure the voltage of RPS connector terminal "1".

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in RPS power circuit and go to "Verification of Vehicle Repair".
[Check between RPS connector terminal 1 and ECM connector terminal28.]

SIGNAL CIRCUIT INSPECTION EE1A1AA9

1. Check signal circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect RPS connector.
   3) IG KEY "ON".
   4) Measure the voltage of RPS connector terminal 2.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION ED51384B

1. Visual Inspection of RPS
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect RPS connector.
   3) Check if corrosion and damage in RPS terminal is detected.
   4) Check RPS mounting torque and oil leakage.
   5) Are the problems relevant to RPS found?

      YES

      ▶ Replace RPS if necessary and go to "Verification of Vehicle Repair".

      NO

      ▶ Go to "RPS waveform Inspection".
2. RPS Waveform Inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Connect RPS connector.
   3) Connect an Oscilloscope to RPS connector terminal 2.
   4) After turning engine "ON", Check waveform at idle and during acceleration.

Specification : Refer to "Signal Waveform & Data" of "General Information".

   5) Does RPS waveform look similar to standard "Signal Waveform & Data"?

      YES

      ▶ go to "Verification of Vehicle Repair".

      NO

      ▶ Replace RPS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E1F86919

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".

4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0193 FUEL RAIL PRESSURE SENSOR HIGH INPUT

COMPONENT LOCATION EFC85C40

Refer to DTC P0192.

GENERAL DESCRIPTION E9C3BB9E

Refer to DTC P0192.

DTC DESCRIPTION E8A95337

P0193 is set when RPS output voltage is above the maximum value of 4830mV(4.8V) for more than 0.2 sec.. This code is due to the open or short in 1) RPS signal circuit 2) RPS ground circuit.

DTC DETECTING CONDITION E921D710

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• RPS circuit
• RPS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Output signal above the maximum value(above 4750mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 200ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Rail press. Sensor value fixed at 330bar</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION E76E7C9D

Refer to DTC P0192.

SCHEMATIC DIAGRAM E3E385AE

Refer to DTC P0192.

SIGNAL WAVEFORM AND DATA E216313A

Refer to DTC P0192.

MONITOR SCANTOOL DATA E2113B27

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "FUEL PRESSURE MEASURED", "RAIL PRESS. REGULATOR1", "INJ. PUMP REGULATOR" parameter on the Scantool.

SPECIFICATION :

	Idle(without load)	Accelerating(stall test)	Diagnosis
INJ. PUMP REGULATOR	38 ± 5%	32 ± 5%	duty decreases
FUEL PRESSURE MEASURED	28.5 ± 5 Mpa	145 ± 10 Mpa	press. increases
RAIL PRESS. REGULATOR1	19 ± 5%	48 ± 5%	duty increases

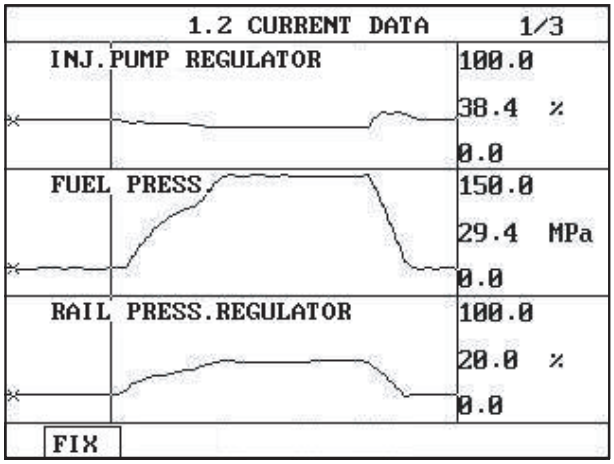


Fig.1

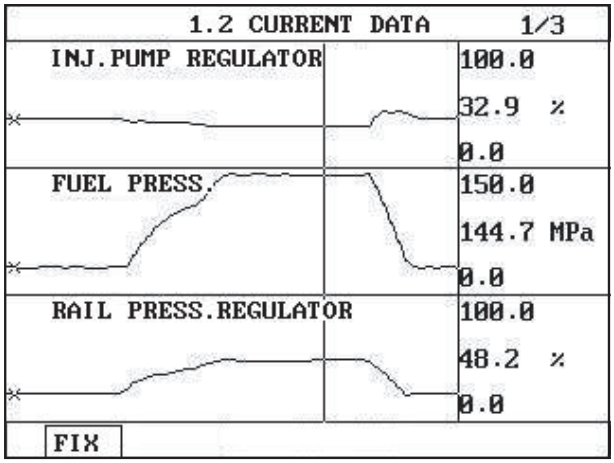


Fig.2

Fig.1) The position of curser on the graph represents idle data.
Fig.2) Data during acceleration(stall test).

EGNG013U

NOTE

The waveform of fuel pressure regulator valve installed at high pressure pump(fuel detecting MPROP) shows 38% duty at idle, duty drops to approx. 32% at acceleration to raise rail pressure. Duty drop means the decrease of current.
→ Fuel delivered to common rail increases as current drops.

The waveform of rail pressure regulator valve installed at common rail shows 19% duty at idle, duty rises to approx. 48% at acceleration to raise rail pressure. Duty rise means the increase of current.
→ If current rises, the returning quantity of fuel deliverd to common rail decreases and common rail pressure rises.

TERMINAL AND CONNECTOR INSPECTION ECA83094

Refer to DTC P0192.

POWER CIRCUIT INSPECTION E60CA8AA

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect RPS connector.
3. IG KEY "ON".
4. Measure the voltage of RPS connector terminal "1".

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in RPS power circuit and go to "Verification of Vehicle Repair".
[Check between RPS connector terminal 1 and ECM connector terminal28.]

SIGNAL CIRCUIT INSPECTION EBEE3020

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect RPS connector.

   3) IG KEY "ON".

   4) Measure the voltage of RPS connector terminal 2.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2. Check open in signal circuit" as follows.

2. Check open in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect RPS connector and ECM connector.

   3) Check continuity between RPS connector terminal 2 and ECM connector terminal 43.

Specification : continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "3. Check short to battery in signal circuit" as follows.

NO

▶ Repair open in RPS signal circuit and go to "Verification of Vehicle Repair".
[Check the circuit between Rail Pressure sensor terminal 2 and ECM connector terminal 43.]

3. Check short to battery in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect RPS connector and ECM connector.

3) IG KEY "ON".

4) Measure the voltage of RPS connector terminal 2.

Specification : 0.0V~0.1V

5) Is abnormal voltage measured in signal circuit(with both connectors disconnected)?

YES

▶ Repair short to battery in signal circuit and go to "Verification of Vehicle Repair".

NO

▶ Go to "Component Inspection".

GROUND CIRCUIT INSPECTION E27F5BAD

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect RPS connector.
3. IG KEY "ON".
4. Measure the voltage of RPS connector terminal 2. [TEST "A"]
5. Measure the voltage between RPS connector terminal 2 and 3. [TEST "B"]
   (terminal 2 : Check + prove , terminal 3 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION ECF6CCD1

1. Visual Inspection of RPS

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect RPS connector.

   3) Check if corrosion and damage in RPS terminal is detected.

   4) Check RPS mounting torque and oil leakage.

5) Are the problems relevant to RPS found?

YES

▶ Replace RPS if necessary and go to "Verification of Vehicle Repair".

NO

▶ Go to "RPS waveform Inspection".

2. RPS Waveform Inspection

1) IG KEY "OFF", ENGINE "OFF".

2) Connect RPS connector.

3) Connect an Oscilloscope to RPS connector terminal 2.

4) After turning engine "ON", Check waveform at idle and during acceleration.

Specification : Refer to "Signal Waveform & Data" of "General Information".

5) Does RPS waveform look similar to standard "Signal Waveform & Data"?

YES

▶ Go to "Verification of Vehicle Repair".

NO

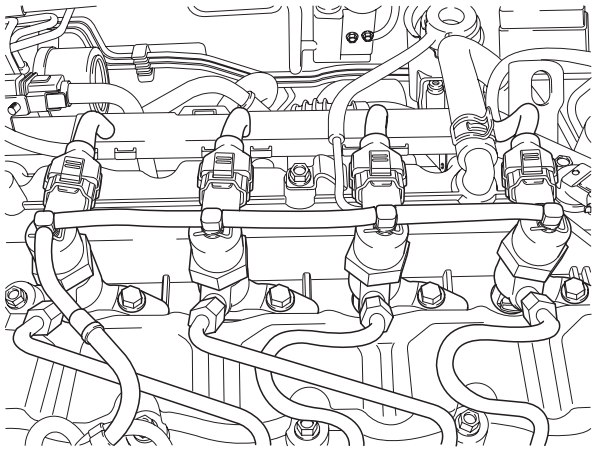
▶ Replace RPS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EB9C8E01

Refer to DTC P0192.

DTC P0201 CYLINDER 1-INJECTOR CIRCUIT/OPEN
DTC P0202 CYLINDER 2-INJECTOR CIRCUIT/OPEN
DTC P0203 CYLINDER 3-INJECTOR CIRCUIT/OPEN
DTC P0204 CYLINDER 4-INJECTOR CIRCUIT/OPEN

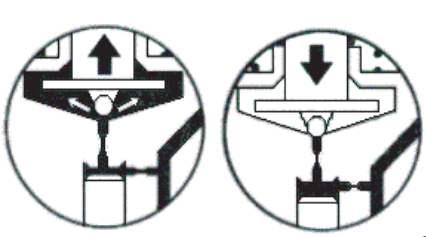
COMPONENT LOCATION E8EF3F9E



EGNG008C

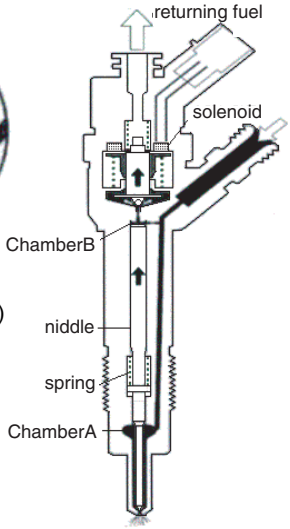
GENERAL DESCRIPTION EE11035A

Injectors spray fuel in the highly compressed combustion chamber, and power generates through combustion process.Fuel pressure is raised to 1600bar in common rail diesel engine for the purpose of making fuel into minute particles. And fuel devided into minute particles leads smoke reduction, high power generation, and improved fuel efficiency. To control pressure of 1600bar with solenoid, oil pressure surbo is applied. And injector solenoids is actuated by solenoid operating voltage raised to 80V with the method of current control. Niddle valve inside of injector is located between A and B chamber. If applied pressure to B chamber is relived by injector solenoid, niddle valve is raised by the pressure of A chamber then, fuel is injected. If same pressure is applied to A and B chamber, niddle valve closes by the elasticity then, fuel injection stops.As electronically controlled injector is applied instead of mechanical injector, pilot and post injection, injeciton duration and quantity control are achieved. And engine performance is improved by these control.



B chamber press. Released (injection performed)

B chamber press. loaded (injection disabled)



EGNG008D

DTC DESCRIPTION EF12DD9C

P0201 is set when no current is detected in injector power and control circuit at injector #1 operating condition. This code is due to open in injector circuit or open in injector component coil.

DTC DETECTING CONDITION E6B8289E

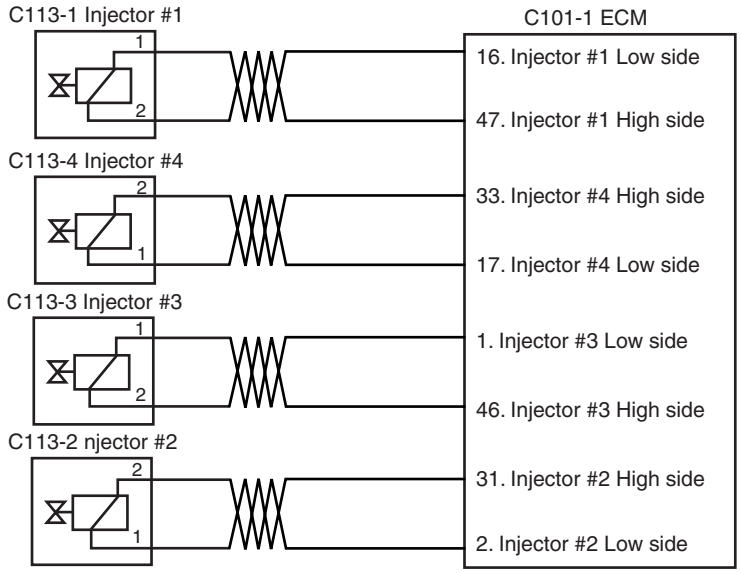
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Current monitoring</td><td rowspan="6">• Open in injector circuit
• Injector component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Open in injector circuit</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION ED33C1AC

Injector Component Resistance	Injector Operating Voltage	Injector Operating Current	Injector Control Type
0.255Ω ±0.04 (20℃).	80V	Peak current : 18±1A Hold in current : 12±1A Recharging current : 7A	Current control

SCHEMATIC DIAGRAM EB6BF894

[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

[C113-1 Injector #1]

Terminal	Connected to	Function
1	C101-1 terminal 16	Injector #1 Low side
2	C101-1 terminal 47	Injector #1 High side

[C113-2 Injector #2]

Terminal	Connected to	Function
1	C101-1 terminal 2	Injector #2 Low side
2	C101-1 terminal 31	Injector #2 High side

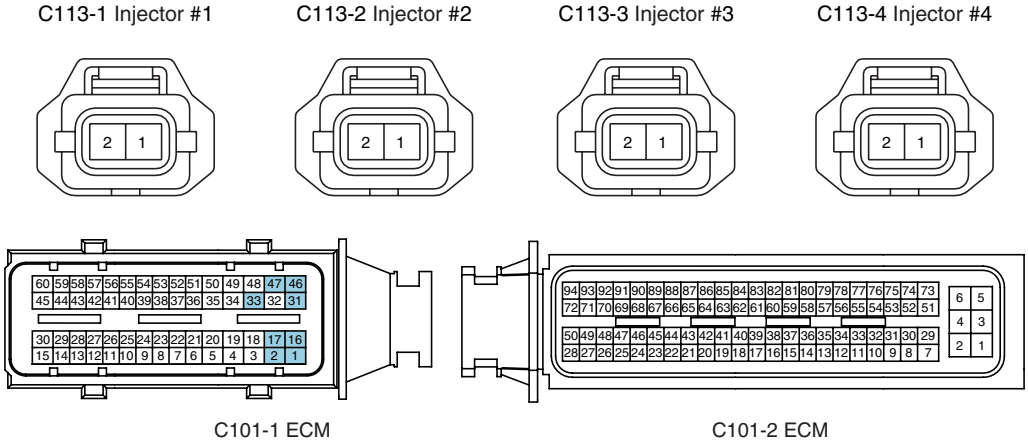
[C113-3 Injector #3]

Terminal	Connected to	Function
1	C101-1 terminal 1	Injector #3 Low side
2	C101-1 terminal 46	Injector #3 High side

[C113-4 Injector #4]

Terminal	Connected to	Function
1	C101-1 terminal 17	Injector #4 Low side
2	C101-1 terminal 33	Injector #4 High side

[HARNESS CONNECTOR]



EGNG008E

SIGNAL WAVEFORM AND DATA E2C0B675

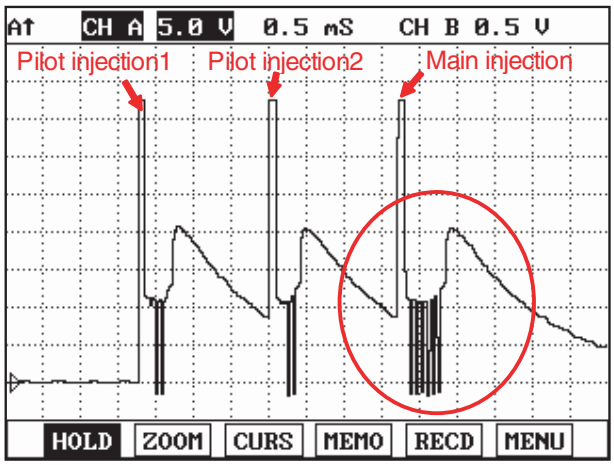


Fig.1

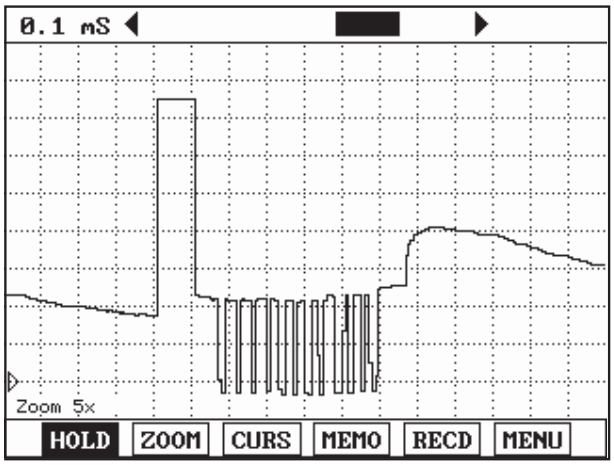


Fig.2

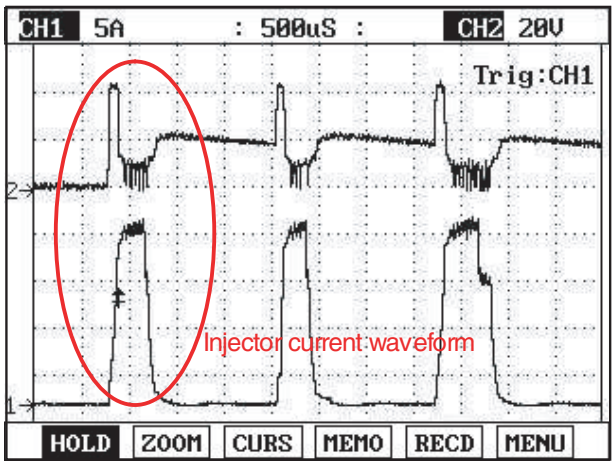


Fig.3

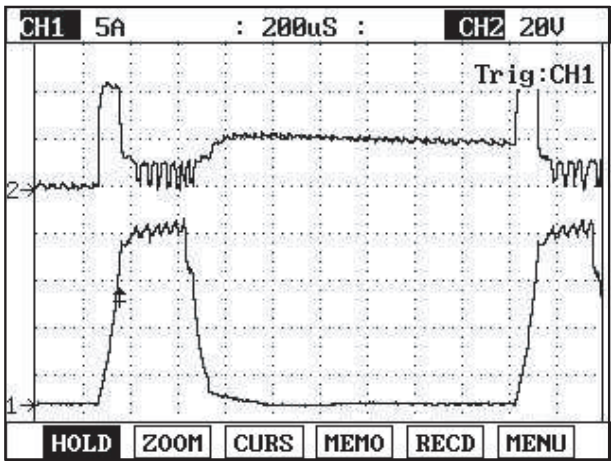


Fig.4

Fig.1) Injector operating waveform at Low side, It shows 2 pilot and 1 main injection.
Fig.2) Magnified waveform of main injection at Fig.1)
Fig.3) Injector voltage and current waveforms are measured at the same time using current prove of scope meter.
Fig.4) Magnified waveform of pilot injection at Fig.3)

EGNG008F

TERMINAL AND CONNECTOR INSPECTION E8C159AA

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION ED0E36E1

1. Check open in power circuit(High side)

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect injector #1 connector and ECM connector.

   3) [P0201] Check continuity between injector #1 connector terminal 2 and ECM connector terminal 47.
   [P0202] Check continuity between injector #2 connector terminal 2 and ECM connector terminal 31.
   [P0203] Check continuity between injector #3 connector terminal 2 and ECM connector terminal 46.
   [P0204] Check continuity between injector #4 connector terminal 2 and ECM connector terminal 33.

Specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair open in injector #1 power circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION EF6EDA56

1. Check open in control circuit(Low side)

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect injector #1 connector and ECM connector.

   3) [P0201] Check continuity between injector #1 connector terminal 1 and ECM connector terminal 16.
   [P0202] Check continuity between injector #2 connector terminal 1 and ECM connector terminal 2.
   [P0203] Check continuity between injector #3 connector terminal 1 and ECM connector terminal 1.
   [P0204] Check continuity between injector #4 connector terminal 1 and ECM connector terminal 17.

Specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open in injector #1 control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EED82859

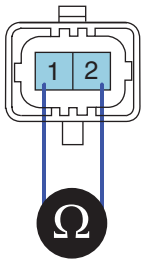
1. Check injector component resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect injector connector.

   3) Measure the resistance between injector component terminal 1 and 2.

Specification : 0.255Ω ±0.04 (20℃).



EGNG008I

   4) Is the measured resistance(of injector solenoid) within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace injector and go to "Verification of Vehicle Repair".

NOTE

Replacing injectors, peculiar IQA code of each injector should be inputted to ECM
Perform this process using "Injector data input" function on scantool, Refer to P1670, P1671 for more detailed information.

VERIFICATION OF VEHICLE REPAIR E7885D4C

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

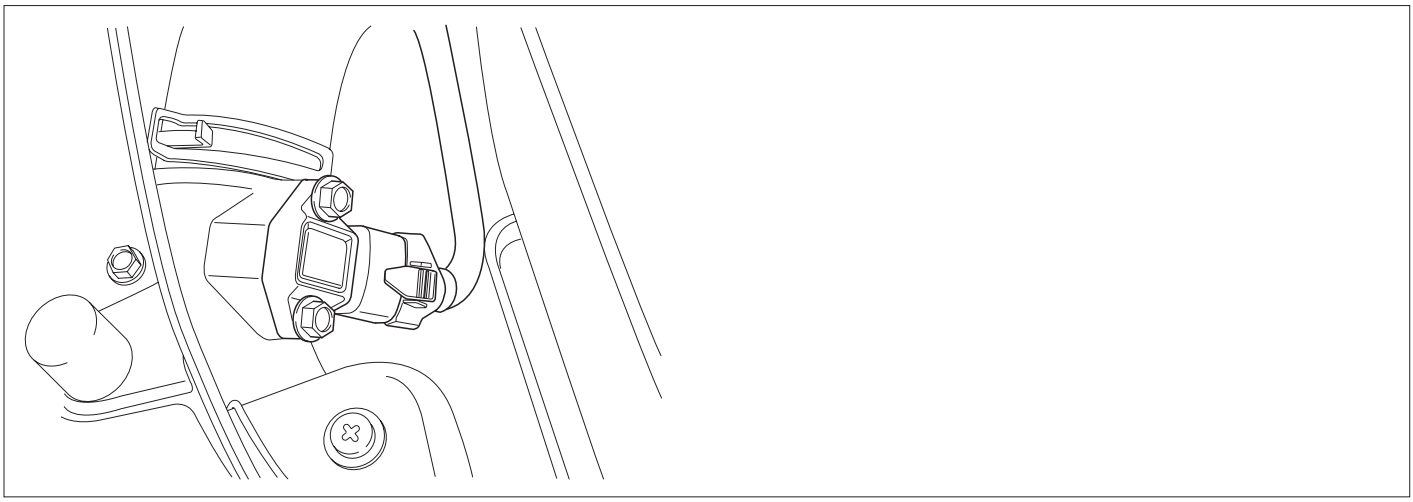
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0237 BOOST PRESSURE SENSOR CIRCUIT LOW INPUT

COMPONENT LOCATION EB7D69B2



EGNG012V

GENERAL DESCRIPTION E5D63902

Boost Pressure Sensor(BPS) is installed in intake manifold and senses the pressure of air inside of intake manifold which is compressed by turbo charager.Measuring mass air flow accurately with the information of intake mainfold pressure, mass air flow and intake air temperature, ECM performs actuating correction of EGR and VGT.When excessive intake manifold pressure is detected, engine power generation is limited to protect engine because too highly compressed pressure due to turbo charger may harm engine.

DTC DESCRIPTION EF19EB84

P0237 is set when the voltage below 200mV - mimimum output voltage of BPS - is detected for more than 2.0 sec.. This code is due to short to ground in signal circuit.

DTC DETECTING CONDITION E92DF05F

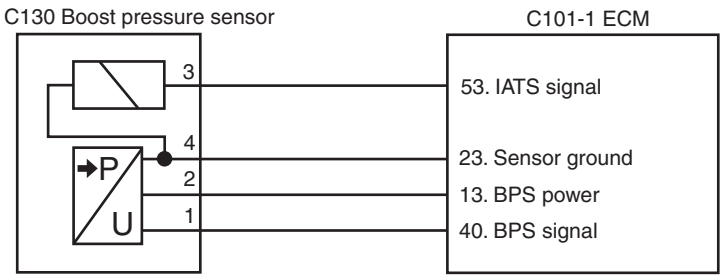
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• BPS circuit
• BPS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Output signal below minimum value(below 200mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Boost pressure is fixed at 1000 hpa.</td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E4C6DB8C

Pressure [Kpa]	20	100	190	250
Outpur voltage [V]	0.4±0.077	1.878±0.063	3.541±0.063	4.650±0.077

SCHEMATIC DIAGRAM E8018BDC

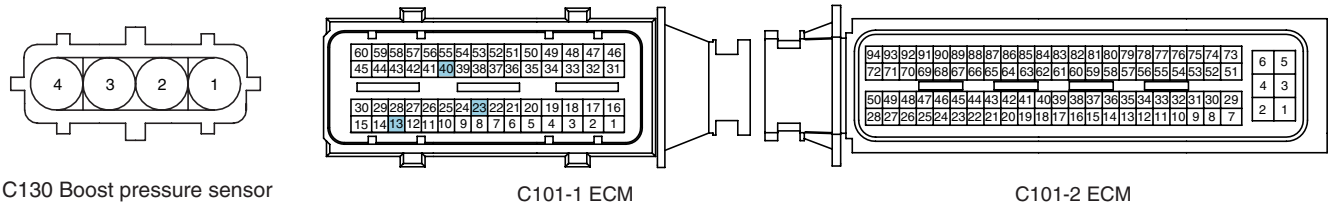
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-1 terminal 40	BPS signal
2	C101-1 terminal 13	BPS power
3	C101-1 terminal 53	IATS signal
4	C101-1 terminal 23	Sensor ground

[HARNESS CONNECTOR]



EGNG012W

SIGNAL WAVEFORM AND DATA ED7CB996

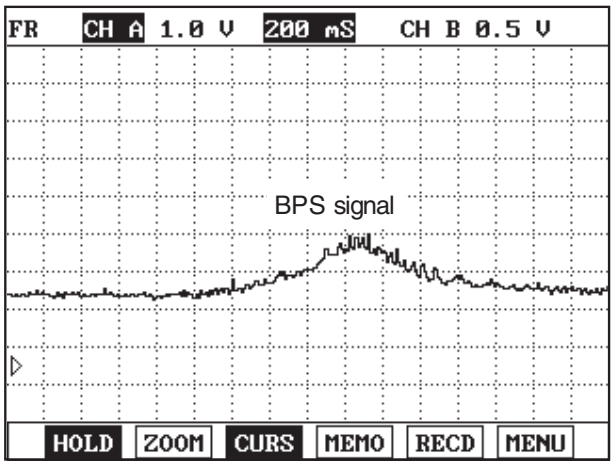


Fig.1

Fig1) This is the waveform of BPS as accelerating from idle state. Signal voltage rises as accelerating.

EGNG012X

MONITOR SCANTOOL DATA EB07CF25

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "BOOST PRESSURE SENSOR" parameter on the Scantool.

Specification : 1000hpa ± 100hpa(VGT actuator : 75%) at idle

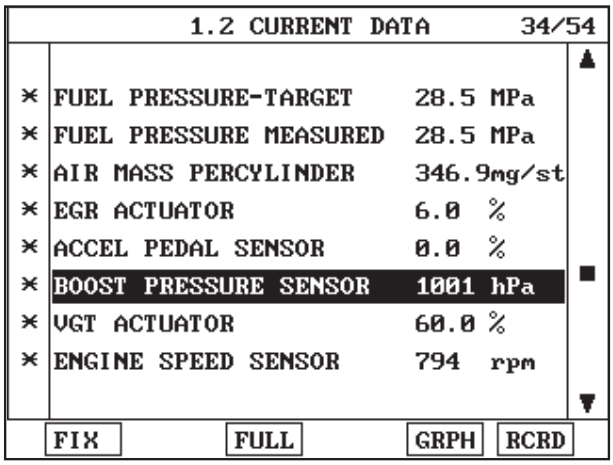


Fig.1

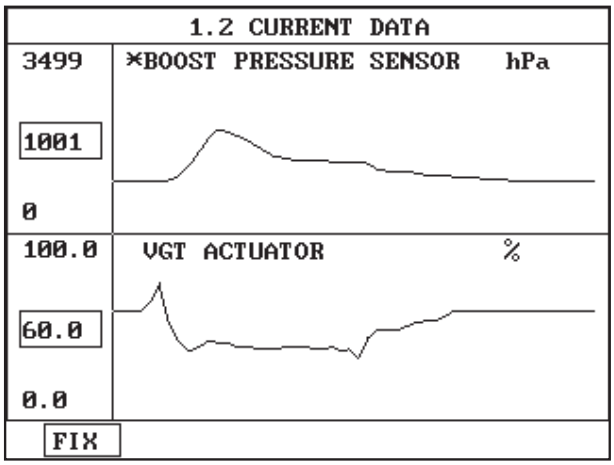


Fig.2

Fig1) Monitor "BOOST PRESSURE SENSOR" parameter on the Scantool at idle after warming engine up. 1000hpa ±100hpa(approx. 1 atm) is correct value.

Fig.2) VGT Control solenoid valve duty decreases and boost pressure increases as accelerating. If boost pressure rises and reaches certain value, VGT Control solenoid valve duty stops to drop and keeps steady. Releasing accelerator pedal at this moment, VGT Control solenoid valve duty drops to 9.8%, then if RPM drops to idle range, duty returns to 75%.

EGNG012Y

TERMINAL AND CONNECTOR INSPECTION E4E6BDAE

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E58C9FD5

1. IG KEY "OFF", ENGINE "OFF".

2. Disconnect BPS connector.

3. IG KEY "ON".
4. Measure the voltage of BPS connector terminal 2.

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in power circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION EE9D8BD5

1. Check open in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect BPS connector and ECM connector.
   3) Check continuity between BPS connector terminal 1 and ECM connector terminal 40.

Specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check short to ground in signal circuit" as follows.

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

2. Check short to ground in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect BPS connector and ECM connector.
   3) Check continutity between BPS connector terminal 1 and chassis ground.

Specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E9B2F8CF

1. BPS visual inspection

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect BPS connector.

   3) Check if corrosion and damage in BPS terminal is detected.

   4) Check BPS mounting state, leakage at O'ring, clogged carbon at pressure detecting hall.

   5) Are the problems relevant to BPS found?

      YES

      ▶ Replace BPS if necessary and go to "Verification of Vehicle Repair".

      NO

      ▶ Go to "2. Check VGT Turbo charger and leakage in intake system".

2. Check VGT turbo charger and leakage in intake system

   1) IG KEY "OFF", ENGINE "OFF".

   2) Check if VGT actuating rod which is connected to diaphragm of VGT turbo charger assy' is at the bottom position.

   3) IG KEY "ON"., ENGINE "ON".

   4) Check if VGT actuating rod is pulled upward Approx. 10mm when engine is about to start.

   5) As accelerating and decelerating, Check if VGT actuating rod moves upward and downward.

   6) Check if intake air leak is detected at intake hose at acceleration.
      (Check if intake hose inflates properly.)

   7) Are the problems relevant to VGT turbo charger and intake hose found?

      YES

      ▶ VGT actuating rod does not work.
      ☞ If any problem is not detected after checking connecting condition of VGT Control solenoid valve vacuum hose and VGT Control solenoid valve operating states(refer to "Component Inspection" of P0048), VGT Control solenoid valve variable controlling part is considered as stuck, Replace VGT turbo charger in this case.

      ▶ Intake air leak is detected.
      ☞ Checking intake hose is not damaged and band clamp is fastened well, repair trouble causing parts.

      If trouble causing parts are repaired, go to "Verification of Vehicle Repair".

      NO

      ▶ Go to "3. BPS Waveform inspection".

3. BPS Waveform inspection

   1) IG KEY "ON", ENGINE "OFF".

   2) Connect BPS.

3) Connect Oscilloscope to BPS connector terminal 1.

4) Monitor the waveform at idle and acceleration after ENGINE "ON".

Specification : Refer to "Signal Waveform & Data" of "General Information".

5) Is BPS waveform displayed correctly?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace BPS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E4AEFF07

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0238 BOOST PRESSURE SENSOR CIRCUIT HIGH INPUT

COMPONENT LOCATION EB0AF68D

Refer to DTC P0237.

GENERAL DESCRIPTION E85777A6

Refer to DTC P0237.

DTC DESCRIPTION E391DD20

P0238 is set when the voltage above 4900mV - maximum output voltage of BPS - is detected for more than 2.0 sec.. This code is due to short to battery in BPS signal circuit or open in ground circuit.

DTC DETECTING CONDITION E073F040

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• BPS circuit
• BPS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Output signal above maximum value(above 4900mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Boost pressure is fixed at 1000 hpa.</td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E2234476

Refer to DTC P0237.

SCHEMATIC DIAGRAM E80E84AF

Refer to DTC P0237.

SIGNAL WAVEFORM AND DATA EF572B9D

Refer to DTC P0237.

MONITOR SCANTOOL DATA E3AA41EC

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "BOOST PRESSURE SENSOR" parameter on the Scantool.

Specification : 1000hpa ± 100hpa(VGT actuator : 75%) at idle

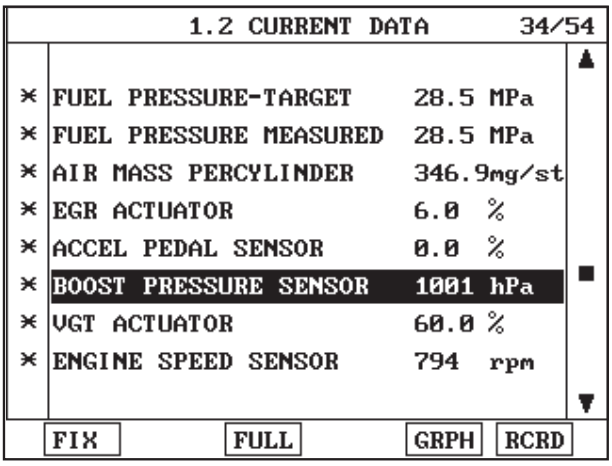


Fig.1

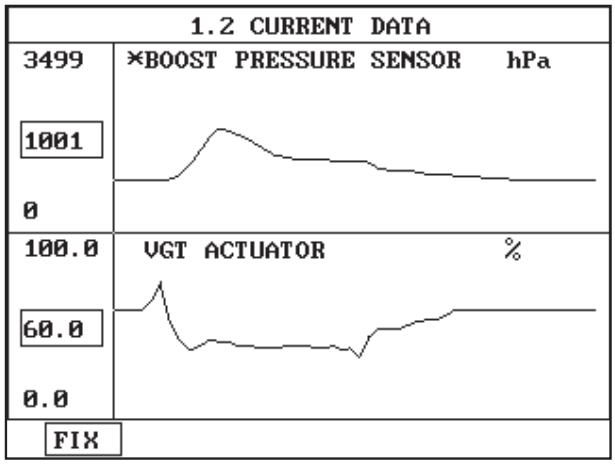


Fig.2

Fig1) Monitor "BOOST PRESSURE SENSOR" parameter on the Scantool at idle after warming engine up. 1000hpa ±100hpa(approx. 1 atm) is correct value.

Fig.2) VGT Control solenoid valve duty decreases and boost pressure increases as accelerating. If boost pressure rises and reaches certain value, VGT Control solenoid valve duty stops to drop and keeps steady. Releasing accelerator pedal at this moment, VGT Control solenoid valve duty drops to 9.8%, then if RPM drops to idle range, duty returns to 75%.

EGNG012Y

TERMINAL AND CONNECTOR INSPECTION E9AF58E8

Refer to DTC P0237.

POWER CIRCUIT INSPECTION E00120D0

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect BPS connector.
3. IG KEY "ON".
4. Measure the voltage of BPS connector terminal 2.

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Sensor power too high : Refer to circuit inspection of P0653.

SIGNAL CIRCUIT INSPECTION EFC180B4

1. Check signal circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect BPS connector.

3) IG KEY "ON".

4) Measure the voltage of BPS connector terminal 1.

Specification : below 0.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair short to battery in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E50E9938

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect BPS connector.
3. IG KEY "ON".
4. Measure the voltage of BPS connector terminal 2. [TEST "A"]
5. Measure the voltage between BPS connector terminal 2 and 4. [TEST "B"]
   (terminal 2 : Check + prove , terminal 4 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E14F4361

1. BPS visual inspection

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect BPS connector.

   3) Check if corrosion and damage in BPS terminal is detected.

   4) Check BPS mounting state, leakage at O’ring, clogged carbon at pressure detecting hall.

   5) Are the problems relevant to BPS found?

YES

▶ Replace BPS if necessary and go to "Verification of Vehicle Repair".

NO

▶ Go to "2. Check VGT Turbo charger and leakage in intake system".

2. Check VGT turbo charger and leakage in intake system

1) IG KEY "OFF", ENGINE "OFF".

2) Check if VGT actuating rod which is connected to diaphragm of VGT turbo charger assy' is at the bottom position.

3) IG KEY "ON"., ENGINE "ON".

4) Check if VGT actuating rod is pulled upward Approx. 10mm when engine is about to start.

5) As accelerating and decelerating, Check if VGT actuating rod moves upward and downward.

6) Check if intake air leak is detected at intake hose at acceleration.
(Check if intake hose inflates properly.)

7) Are the problems relevant to VGT turbo charger and intake hose found?

YES

▶ VGT actuating rod does not work.
☞ If any problem is not detected after checking connecting condition of VGT Control solenoid valve vacuum hose and VGT Control solenoid valve operating states(refer to "Component Inspection" of P0048), VGT Control solenoid valve variable controlling part is considered as stuck, Replace VGT turbo charger in this case.

▶ Intake air leak is detected.
☞ Checking intake hose is not damaged and band clamp is fastened well, repair trouble causing parts.

If trouble causing parts are repaired, go to "Verification of Vehicle Repair".

NO

▶ Go to "3. BPS Waveform inspection".

3. BPS Waveform inspection

1) IG KEY "ON", ENGINE "OFF".

2) Connect BPS.

3) Connect Oscilloscope to BPS connector terminal 1.

4) Monitor the waveform at idle and acceleration after ENGINE "ON".

Specification : Refer to "Signal Waveform & Data" of "General Information".

5) Is BPS waveform displayed correctly?

YES

▶ Go to "Verification of Vehicle Repair".

NO

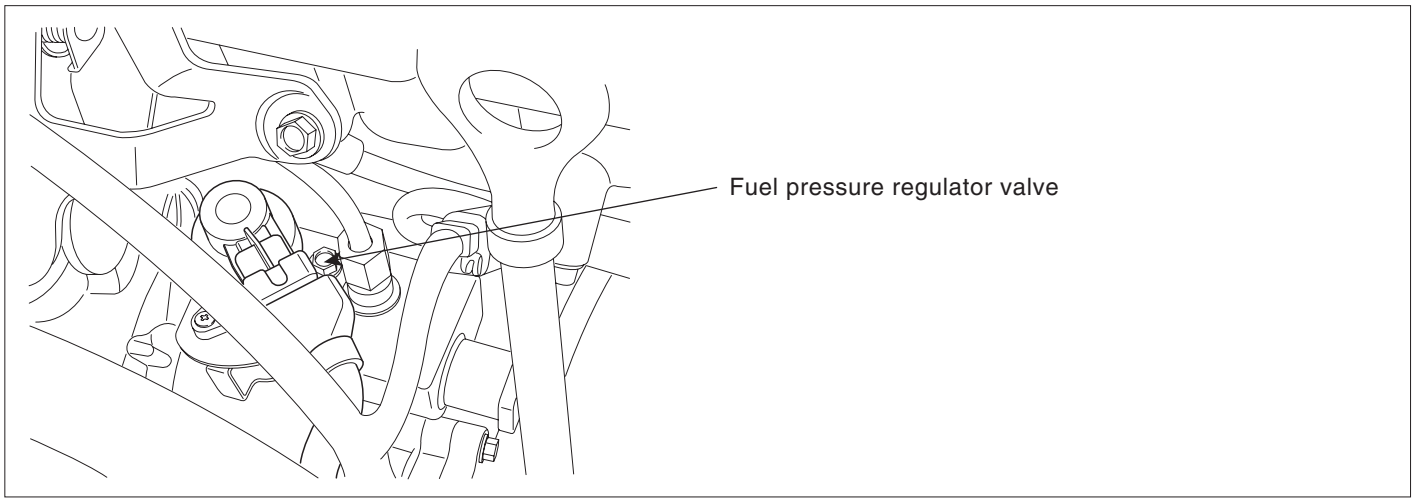
▶ Replace BPS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EFBC1CA2

Refer to DTC P0237.

DTC P0252 FUEL PRESSURE REGULATOR VALVE CIRCUIT OVER CURRENT

COMPONENT LOCATION E71686E8



EGNG013R

GENERAL DESCRIPTION EBBAABF0

Fuel pressure regulator valve is integrated with high pressure pump and controls common rail pressure as regulating the quantity of fuel which is delivered to common rail. In order to control rail pressure to be optimum to current driving condition, ECM controls fuel pressure regulator operating current(with the method of duty-control) using Rail pressure regulator valve signal, RPM and APS signal.The lower Fuel pressure regulator valve current is, the more fuel is supplied to common rail. Thus it leads rail pressure to be high. On the contrary, the higher Fuel pressure regulator valve current is, the less fuel is supplied to common rail. Thus it leads rail pressure to be low. Therefore, when Fuel pressure regulator valve current becomes "0", as if there is open spot in Fuel pressure regulator valve circuit or connector is disconnected, maximum fuel quantity is supplied to common rail, so the pressure of common rail rise to maximum value.

DTC DESCRIPTION EA1DB386

P0252 is set when excessive current in control circuit of Fuel pressure regulator valve(integrated with high pressure pump) is detected for more than 0.22 sec.. This code is due to short to battery in control circuit or Fuel pressure regulator valve internal short.

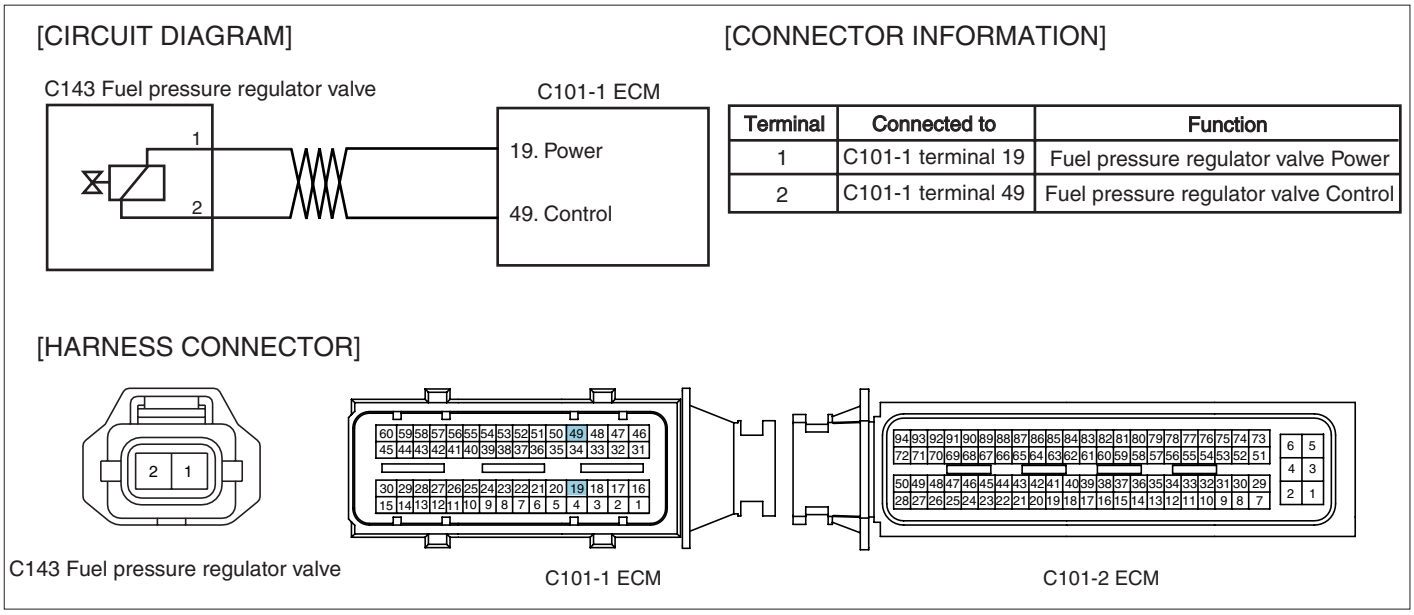
DTC DETECTING CONDITION E8AA723F

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="8">• Fuel pressure regulator valve circuit
• Fuel pressure regulator valve component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery (control circuit in Fuel pressure regulator valve)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 220ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION E66F63DB

Fuel pressure regulator valve resistance	Operating frequancy
2.9 ~ 3.15Ω (20℃)	185 Hz

SCHEMATIC DIAGRAM E99AB4F2



EGNG013S

SIGNAL WAVEFORM AND DATA E8BC91E6

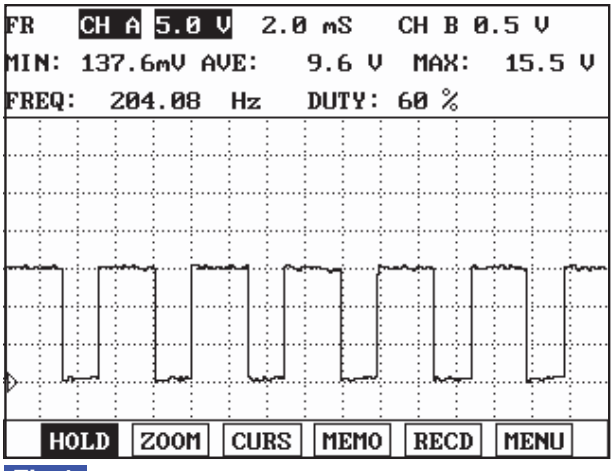


Fig.1

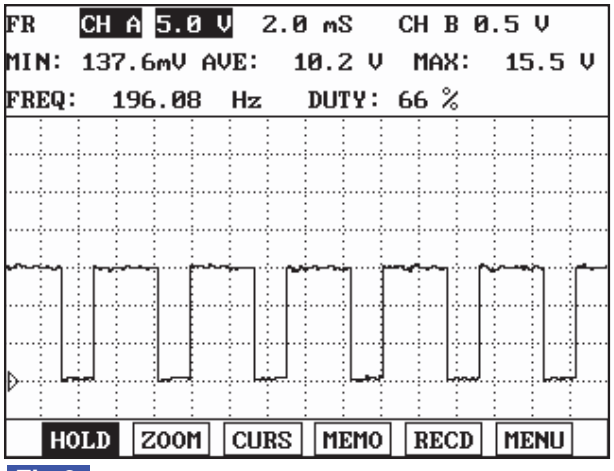


Fig.2

Fig.1) Waveform of fuel pressure regulator valve at idle. It shows approx. 38% duty.
Fig.2) Waveform of fuel pressure regulator valve as accelerating. Approx. 32% duty is outputted as engine load increases.
(When rail pressure increases as accelerating, rail pressure regulator valve duty(current) drops.)

EGNG013T

MONITOR SCANTOOL DATA E6146CBB

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.

3. Turn "OFF" electrical devices and A/C.

4. Monitor "FUEL PRESSURE MEASURED", "RAIL PRESS. REGULATOR1", "INJ. PUMP REGULATOR" parameter on the Scantool.

SPECIFICATION :

	Idle(without load)	Accelerating(stall test)	Diagnosis
INJ. PUMP REGULATOR	38 ± 5%	32 ± 5%	duty decreases
FUEL PRESSURE MEASURED	28.5 ± 5 Mpa	145 ± 10 Mpa	press. increases
RAIL PRESS. REGULATOR1	19 ± 5%	48 ± 5%	duty increases

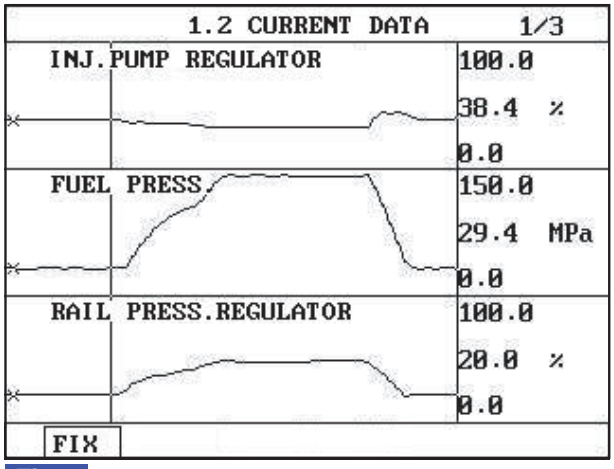


Fig.1

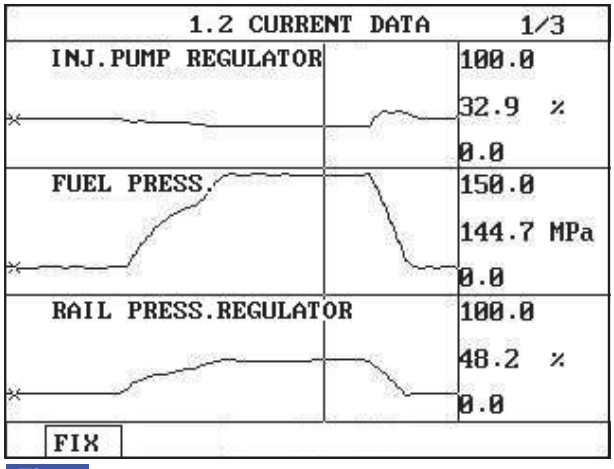


Fig.2

Fig.1) The position of curser on the graph represents idle data.
Fig.2) Data during acceleration(stall test).

EGNG013U

NOTE

The waveform of Fuel pressure regulator valve installed at high pressure pump(fuel detecting MPROP) shows 38% duty at idle, duty drops to approx. 32% at acceleration to raise rail pressure. Duty drop means the decrease of current.
→ Fuel delivered to common rail increases as current drops.

The waveform of rail pressure regulator valve installed at common rail shows 19% duty at idle, duty rises to approx. 48% at acceleration to raise rail pressure. Duty rise means the increase of current.
→ If current rises, the returning quantity of fuel deliverd to common rail decreases and common rail pressure rises.

TERMINAL AND CONNECTOR INSPECTION E9375A00

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION EE8674C3

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Fuel pressure regulator valve connector.

   3) IG KEY "ON".

   4) Measure the voltage of Fuel pressure regulator valve connector terminal 1.

specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair open between Fuel pressure regulator valve connector terminal 1 and ECM connector terminal 19 and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E62139D6

1. Check monitoring voltage in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Fuel pressure regulator valve connector.

   3) IG KEY "ON".

   4) Measure the voltage of Fuel pressure regulator valve connector terminal 2.

specification : 3.2V~3.7V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection"

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Fuel pressure regulator valve and ECM connector.

3) Check continuity between Fuel pressure regulator valve connector terminal 2 and ECM connector terminal 49.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Fuel pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Fuel pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E2D189AA

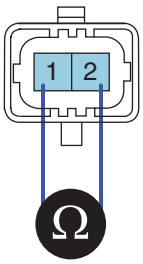
1. Check Fuel pressure regulator valve component resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect rail pressure control valve connector.

3) Check Fuel pressure regulator valve component resistance.

Specification : 2.9 ~ 3.15Ω (20℃)



EGNG013Y

4) Is Fuel pressure regulator valve component resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace High pressure pump ass'y and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EC6018E5

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0253 FUEL PRESSURE REGULATOR VALVE CIRCUIT LOW

COMPONENT LOCATION E8C9EE43

Refer to DTC P0252.

GENERAL DESCRIPTION E101515A

Refer to DTC P0252.

DTC DESCRIPTION ED3E52C5

P0253 is set when "0"A in control circuit of Fuel pressure regulator valve(integrated with high pressure pump) is detected for more than 0.22 sec.. This code is due to open of short to ground in control circuit or Fuel pressure regulator valve internal open.

DTC DETECTING CONDITION E4B4A5B8

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Fuel pressure regulator valve circuit • Fuel pressure regulator valve component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• Short to GND, Wiring open			
DiagnosticTime	• 220ms			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	YES		
	MIL	YES		

SPECIFICATION E12452BC

Refer to DTC P0252.

SCHEMATIC DIAGRAM EC86826B

Refer to DTC P0252.

SIGNAL WAVEFORM AND DATA EBF2787A

Refer to DTC P0252.

MONITOR SCANTOOL DATA ECB79822

Refer to DTC P0252.

TERMINAL AND CONNECTOR INSPECTION E7033B2F

Refer to DTC P0252.

POWER CIRCUIT INSPECTION ECC6E38D

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Fuel pressure regulator valve connector.

   3) IG KEY "ON".

   4) Measure the voltage of Fuel pressure regulator valve connector terminal 1.

specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Control Circuit Inspection".

   NO

   ▶ Repair open between Fuel pressure regulator valve connector terminal 1 and ECM connector terminal 19 and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E2692483

1. Check monitoring voltage in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Fuel pressure regulator valve connector.

   3) IG KEY "ON".

   4) Measure the voltage of Fuel pressure regulator valve connector terminal 2.

specification : 3.2V~3.7V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Component Inspection"

   NO

   ▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
   ▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Fuel pressure regulator valve and ECM connector.

   3) Check continuity between Fuel pressure regulator valve connector terminal 2 and ECM connector terminal 49.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Fuel pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Fuel pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E8CAA46A

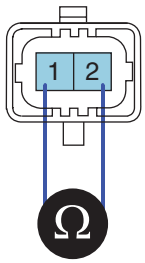
1. Check Fuel pressure regulator valve component resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect rail pressure control valve connector.

3) Check Fuel pressure regulator valve component resistance.

Specification : 2.9 ~ 3.15Ω (20℃)



EGNG013Y

4) Is Fuel pressure regulator valve component resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace High pressure pump ass'y and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EA3BBF69

Refer to DTC P0252.

DTC P0254 FUEL PRESSURE REGULATOR VALVE CIRCUIT HIGH

COMPONENT LOCATION E514E39F

Refer to DTC P0252.

GENERAL DESCRIPTION E9179347

Refer to DTC P0252.

DTC DESCRIPTION ECFD7E12

P0254 is set when excessive current in power circuit of Fuel pressure regulator valve(integrated with high pressure pump) is detected for more than 0.22 sec.. This code is due to short to battery in power circuit or Fuel pressure regulator valve internal short.

DTC DETECTING CONDITION E7470325

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Fuel pressure regulator valve circuit
• Fuel pressure regulator valve component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery (power circuit in Fuel pressure regulator valve)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 220ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION EF956A86

Refer to DTC P0252.

SCHEMATIC DIAGRAM E131FD63

Refer to DTC P0252.

SIGNAL WAVEFORM AND DATA EB2702BE

Refer to DTC P0252.

MONITOR SCANTOOL DATA E45F7EEA

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.

4. Monitor "FUEL PRESSURE MEASURED", "RAIL PRESS. REGULATOR1", "INJ. PUMP REGULATOR" parameter on the Scantool.

SPECIFICATION :

	Idle(without load)	Accelerating(stall test)	Diagnosis
INJ. PUMP REGULATOR	38 ± 5%	32 ± 5%	duty decreases
FUEL PRESSURE MEASURED	28.5 ± 5 Mpa	145 ± 10 Mpa	press. increases
RAIL PRESS. REGULATOR1	19 ± 5%	48 ± 5%	duty increases

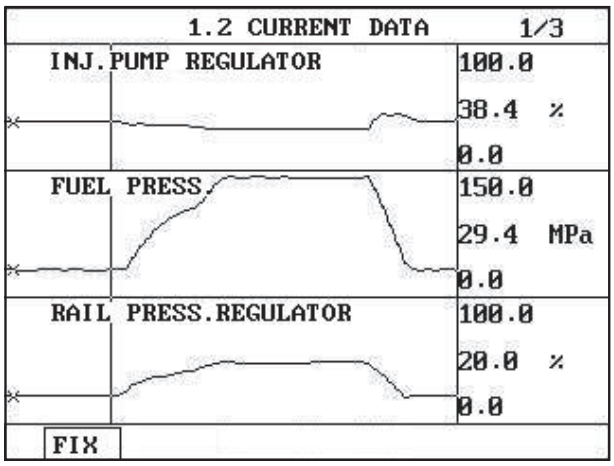


Fig.1

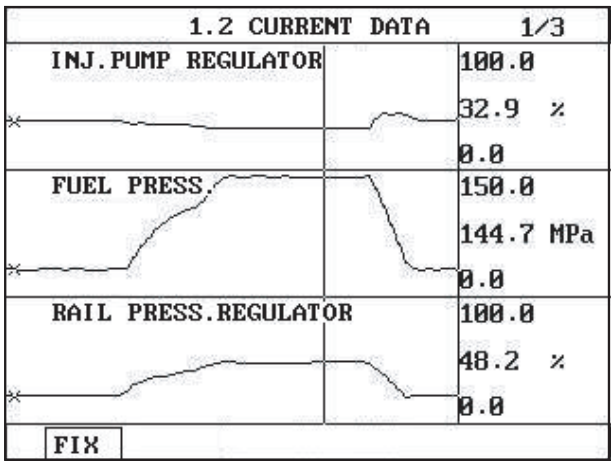


Fig.2

Fig.1) The position of curser on the graph represents idle data.
Fig.2) Data during acceleration(stall test).

EGNG013U

NOTE

The waveform of fuel pressure regulator valve installed at high pressure pump(fuel detecting MPROP) shows 38% duty at idle, duty drops to approx. 32% at acceleration to raise rail pressure. Duty drop means the decrease of current.
→ Fuel delivered to common rail increases as current drops.

The waveform of rail pressure regulator valve installed at common rail shows 19% duty at idle, duty rises to approx. 48% at acceleration to raise rail pressure. Duty rise means the increase of current.
→ If current rises, the returning quantity of fuel deliverd to common rail decreases and common rail pressure rises.

TERMINAL AND CONNECTOR INSPECTION EFB0849C

Refer to DTC P0252.

POWER CIRCUIT INSPECTION EAF55516

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Fuel pressure regulator valve connector.

   3) IG KEY "ON".

4) Measure the voltage of Fuel pressure regulator valve connector terminal 1.

specification : 11.5V~13.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair open between Fuel pressure regulator valve connector terminal 1 and ECM connector terminal 19 and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E3F38FE3

1. Check monitoring voltage in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Fuel pressure regulator valve connector.

3) IG KEY "ON".

4) Measure the voltage of Fuel pressure regulator valve connector terminal 2.

specification : 3.2V~3.7V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Fuel pressure regulator valve and ECM connector.

3) Check continuity between Fuel pressure regulator valve connector terminal 2 and ECM connector terminal 49.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Fuel pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Fuel pressure regulator valve control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E20A6E45

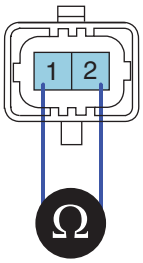
1. Check Fuel pressure regulator valve component resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect rail pressure control valve connector.

   3) Check Fuel pressure regulator valve component resistance.

Specification : 2.9 ~ 3.15Ω (20℃)



EGNG013Y

   4) Is Fuel pressure regulator valve component resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

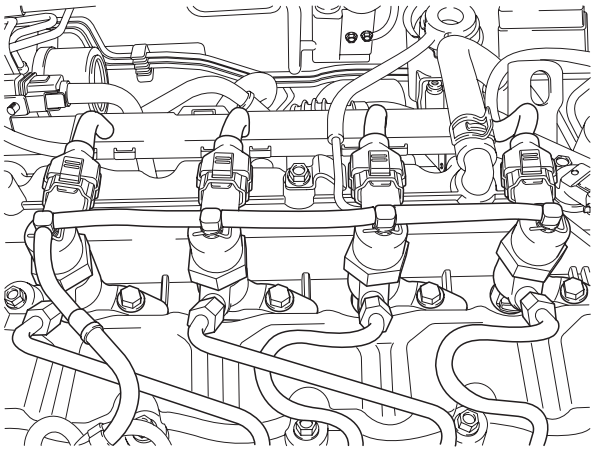
▶ Replace High pressure pump ass'y and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E55496D1

Refer to DTC P0252.

DTC P0262 CYLINDER 1-INJECTOR CIRCUIT HIGH
DTC P0265 CYLINDER 2-INJECTOR CIRCUIT HIGH
DTC P0268 CYLINDER 3-INJECTOR CIRCUIT HIGH
DTC P0271 CYLINDER 4-INJECTOR CIRCUIT HIGH

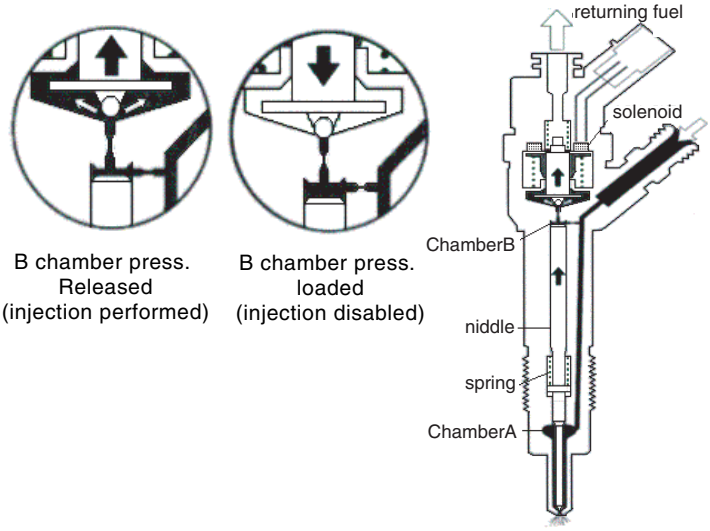
COMPONENT LOCATION E44F9928



EGNG008C

GENERAL DESCRIPTION E8B438C7

Injectors spray fuel in the highly compressed combustion chamber, and power generates through combustion process.Fuel pressure is raised to 1600bar in common rail diesel engine for the purpose of making fuel into minute particles. And fuel devided into minute particles leads smoke reduction, high power generation, and improved fuel efficiency. To control pressure of 1600bar with solenoid, oil pressure surbo is applied. And injector solenoids is actuated by solenoid operating voltage raised to 80V with the method of current control. Niddle valve inside of injector is located between A and B chamber. If applied pressure to B chamber is relived by injector solenoid, niddle valve is raised by the pressure of A chamber then, fuel is injected. If same pressure is applied to A and B chamber, niddle valve closes by the elasticity then, fuel injection stops.As electronically controlled injector is applied instead of mechanical injector, pilot and post injection, injeciton duration and quantity control are achieved. And engine performance is improved by these control.



EGNG008D

DTC DESCRIPTION EEE36708

P0262 is set when short between injector power circuit(High side) and control circuit(Low side), short to battery in control circuit. This code is due to 1)the detection of over current from opened injector circuit or 2)short of coil inside of injector.

DTC DETECTING CONDITION E60A3BBC

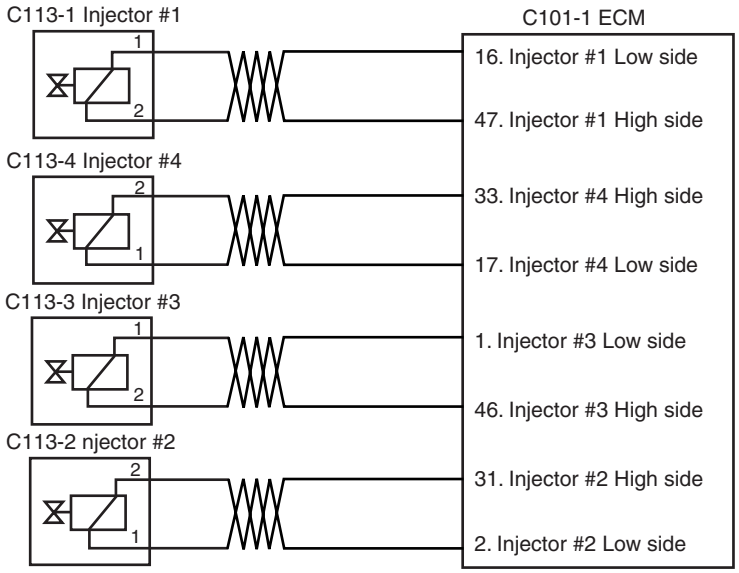
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Current monitoring</td><td rowspan="6">• Short in injector circuit
• Injector component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short in injector circuit</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>YES</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION E6D4B7EA

Injector Component Resistance	Injector Operating Voltage	Injector Operating Current	Injector Control Type
0.255Ω ±0.04 (20℃).	80V	Peak current : 18±1A Hold in current : 12±1A Recharging current : 7A	Current control

SCHEMATIC DIAGRAM E01A823E

[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

[C113-1 Injector #1]

Terminal	Connected to	Function
1	C101-1 terminal 16	Injector #1 Low side
2	C101-1 terminal 47	Injector #1 High side

[C113-2 Injector #2]

Terminal	Connected to	Function
1	C101-1 terminal 2	Injector #2 Low side
2	C101-1 terminal 31	Injector #2 High side

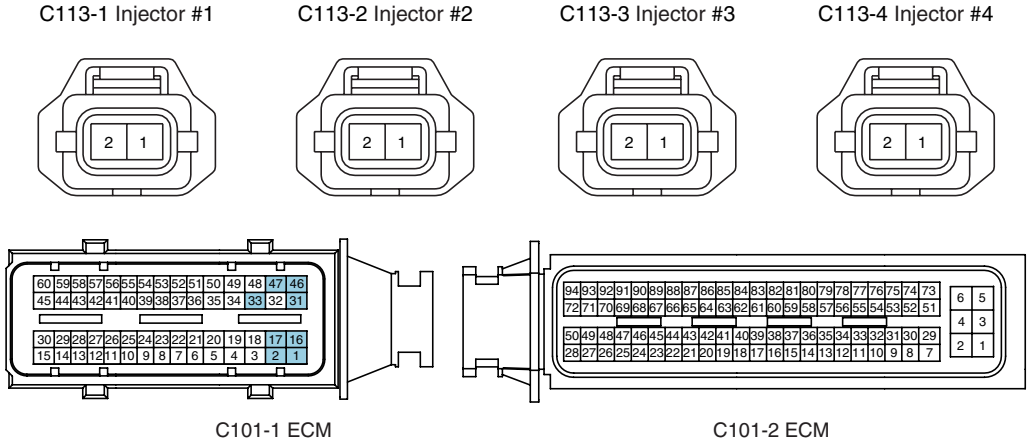
[C113-3 Injector #3]

Terminal	Connected to	Function
1	C101-1 terminal 1	Injector #3 Low side
2	C101-1 terminal 46	Injector #3 High side

[C113-4 Injector #4]

Terminal	Connected to	Function
1	C101-1 terminal 17	Injector #4 Low side
2	C101-1 terminal 33	Injector #4 High side

[HARNESS CONNECTOR]



EGNG008E

SIGNAL WAVEFORM AND DATA E46BDD7E

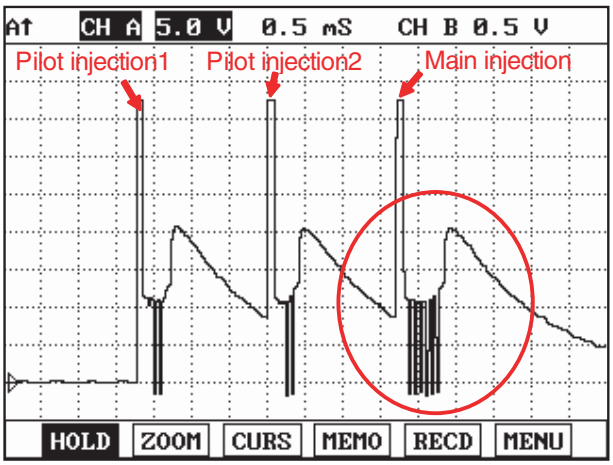


Fig.1

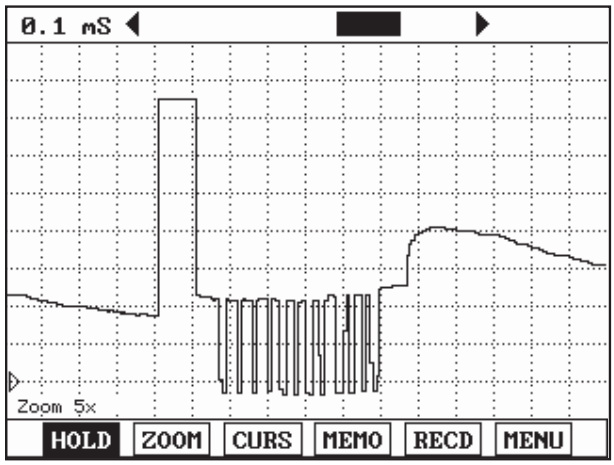


Fig.2

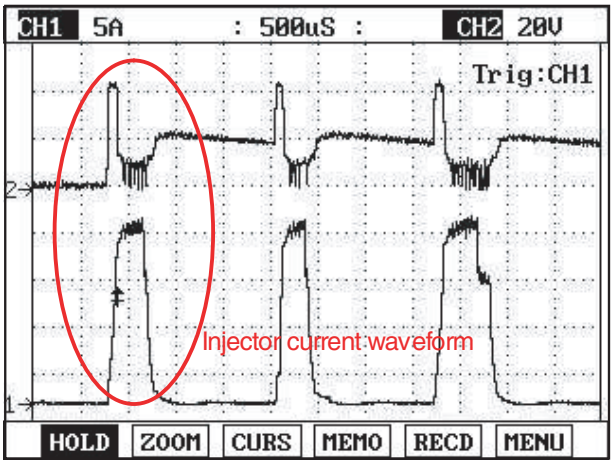


Fig.3

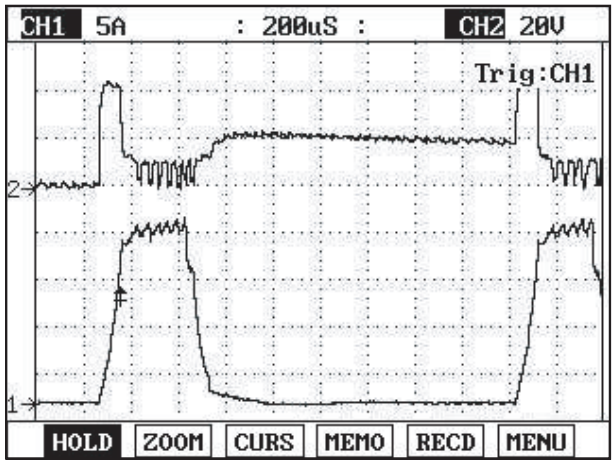


Fig.4

Fig.1) Injector operating waveform at Low side, It shows 2 pilot and 1 main injection.
Fig.2) Magnified waveform of main injection at Fig.1)
Fig.3) Injector voltage and current waveforms are measured at the same time using current prove of scope meter.
Fig.4) Magnified waveform of pilot injection at Fig.3)

EGNG008F

TERMINAL AND CONNECTOR INSPECTION EAC80A3D

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E7F7023C

1. Check short to ground in power circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect injector #1 connector.

   3) IG KEY "ON"

   4) [P0262] Check the voltage of injector #1 connector terminal 2.
      [P0265] Check the voltage of injector #2 connector terminal 2.
      [P0268] Check the voltage of injector #3 connector terminal 2.
      [P0271] Check the voltage of injector #4 connector terminal 2.

Specification : 2.0V~2.5V

   5) Is the measured voltage within the specification?

      YES

      ▶ Go to "2. Check short between power circuit and control circuit".

      NO

      ▶ Repair short to ground in injector #1 power circuit and go to "Verification of Vehicle Repair".

2. Check short between power circuit and control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) [P0262] Disconnect injector #1 connector and ECM connector.
      [P0265] Disconnect injector #2 connector and ECM connector.
      [P0268] Disconnect injector #3 connector and ECM connector.
      [P0271] Disconnect injector #4 connector and ECM connector.

   3) [P0262] Check continuity between injector #1 connector terminal 1 and 2.
      [P0265] Check continuity between injector #2 connector terminal 1 and 2.
      [P0268] Check continuity between injector #3 connector terminal 1 and 2.
      [P0271] Check continuity between injector #4 connector terminal 1 and 2.

Specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

      YES

      ▶ Go to "Control Circuit Inspection".

NO

▶ Repair short between injector power circuit and control circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION EB9EBCA4

1. Check short to battery in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect injector #1 connector.

   3) IG KEY "ON"

   4) [P0262] Check the voltage of injector #1 connector terminal 1.
      [P0265] Check the voltage of injector #2 connector terminal 1.
      [P0268] Check the voltage of injector #3 connector terminal 1.
      [P0271] Check the voltage of injector #4 connector terminal 1.

Specification : 0.4V~0.5V

   5) Is the measured resistance within the specificaiton?

YES

▶ Go to "Component Inspection".

NO

▶ Repair short to battery in injector #1 control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION ED680B65

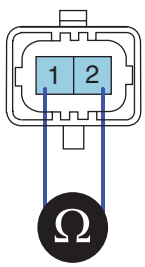
1. Check injector component resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect injector connector.

   3) Measure the resistance between injector component terminal 1 and 2.

Specification : 0.255Ω ±0.04 (20℃).



EGNG008I

   4) Is the measured resistance(of injector solenoid) within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace injector and go to "Verification of Vehicle Repair".

NOTE

Replacing injectors, peculiar IQA code of each injector should be inputted to ECM
Perform this process using "Injector data input" function on scantool, Refer to P1670, P1671 for more detailed information.

VERIFICATION OF VEHICLE REPAIR E8631528

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

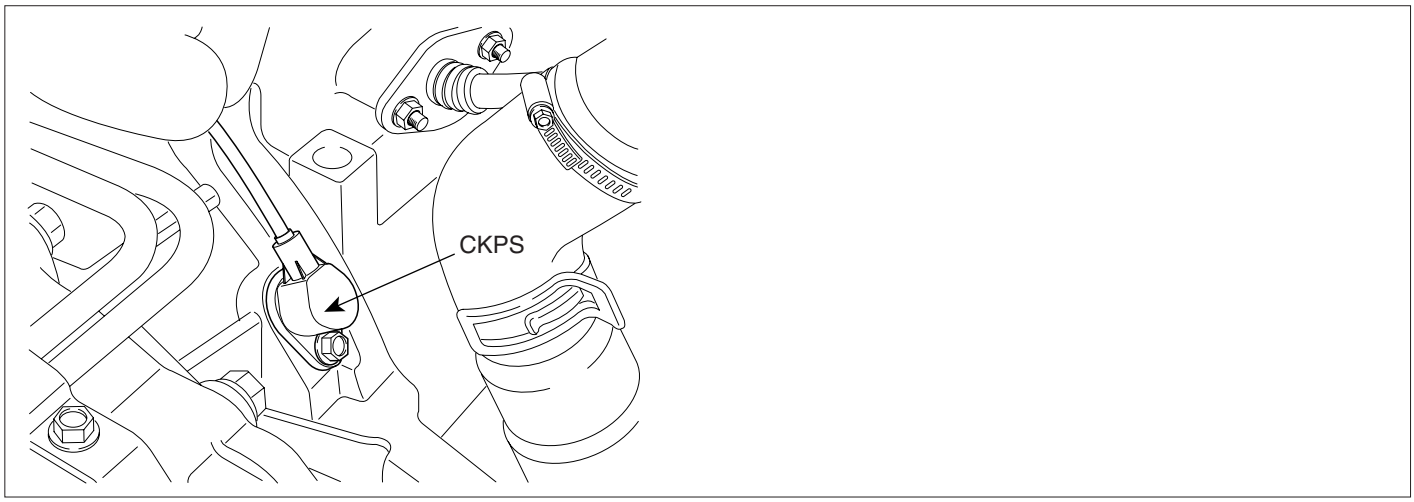
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0335 CRANKSHAFT POSITION SENSOR A CIRCUIT

COMPONENT LOCATION E6A5A4B7



EGNG005S

GENERAL DESCRIPTION E0692982

Crank Shaft Position Sensor(CKPS) is magnetic inductive type. Mounted on transaxle hausing, it senses tone wheel position of fly wheel.As tone wheel is devided with 58 teeth and 2 missing teeth (referrence point), 1 tooth corresponds to 6 degree.CKPS which calculates RPM and crank angle is important to determine fuel injection quantity and injection timing with APS.crank shaft position is closely related to engine starting.

DTC DESCRIPTION E8C2E126

P0335 is set when CMPS signal is outputted while CKPS signal does not generate for more than 0.7 sec.. This code is due to CKPS circuit or component failure. If CKPS signal is not inputted during driving, RPM is calculated based on CMPS signal.

DTC DETECTING CONDITION E5CFAD10

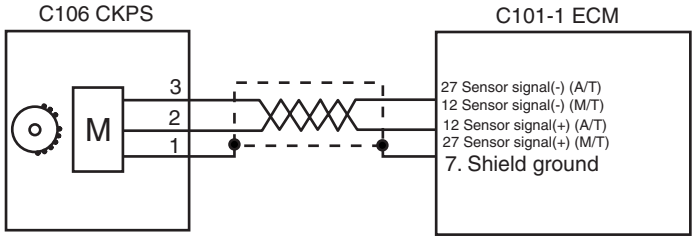
Item	Detecting Condition			Possible Cause
DTC Strategy	• Signal monitoring			• CKPS circuit • CKPS component • Abnormal deformation of Crank Shaft tone wheel
Enable Conditions	• Engine running			
ThresholdValue	• CMPS signal is outputted while CKPS signal does not generate.			
DiagnosticTime	• 700ms			
Fail Safe	Fuel Cut	YES		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	YES		

SPECIFICATION EEE6F4B2

Sensor Type	Output Signal Characteristic	Air Gab	Low RPM Minimum Detecting Voltage	High RPM Minimum Detecting Voltage
Magnetic inductive	A/C waveform	1.8mm	230mV	2769 mV

SCHEMATIC DIAGRAM E2C69115

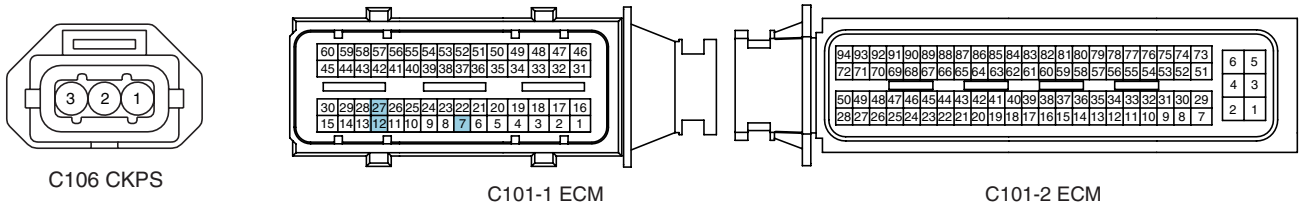
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-1 terminal 7	Shield ground
2	C101-1 terminal 12(A/T) C101-1 terminal 27(M/T)	Sensor signal
3	C101-1 terminal 27(A/T) C101-1 terminal 12(M/T)	Sensor signal

[HARNESS CONNECTOR]



EGNG005T

SIGNAL WAVEFORM AND DATA E645DF76

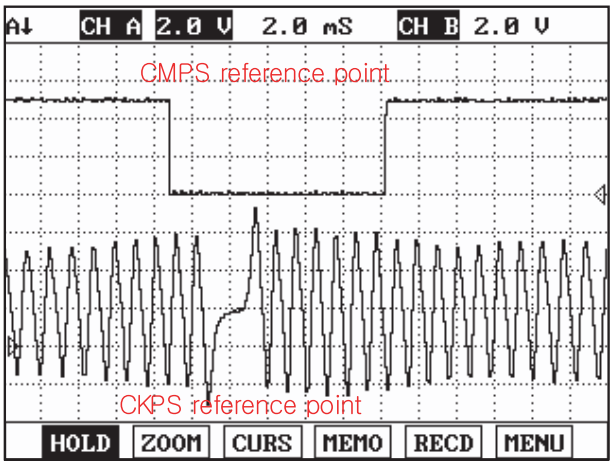


Fig.1

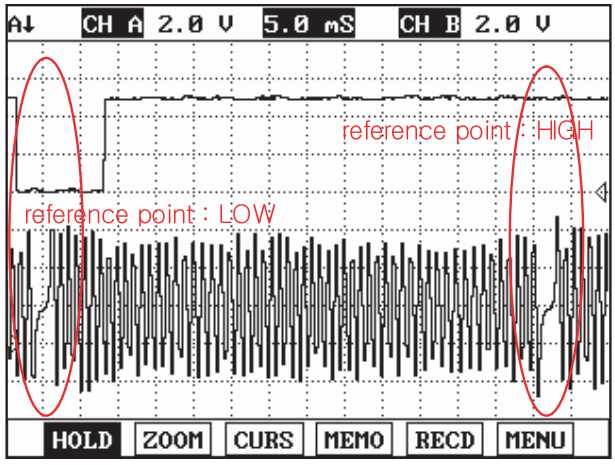


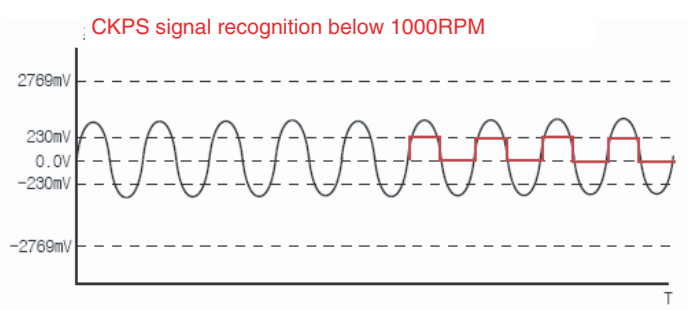
Fig.2

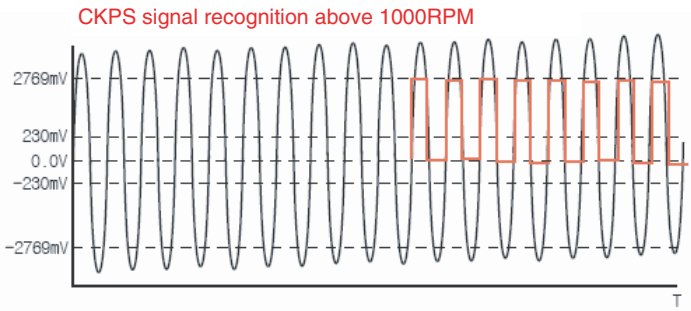
Fig.1) This shows waveform of Crank Shaft Position Sensor and Cam Shaft Position Sensor simulatneously.
The middle area indicates reference points of Crank Shaft Position Sensor and Cam Shaft Position Sensor.

Fig.2) Crank Shaft Position Sensor and Cam Shaft Position Sensor signal are measured simultaneously.
Cam Shaft Position Sensor signal is outputted once when Crank Shaft Position sensor signal is outputted twice.
LOW and HIGH output of Cam Shaft Position sensor reference point is detected at Crank Shaft Position sensor reference point.
(Injection sequence is determined based on LOW and HIGH signal of Cam Shaft Position Sensor reference point as detecting cylinder position.)

EGNG005U

※ SIGNAL ANALYSIS





EGNG005V

1. The output voltage of CKPS signal varies according to rpm(the speed of tone wheel passing by sensor)
(low voltage is inducted for low speed and high voltage is inducted for high speed.)

2. CKPS should detect from low rpm at cranking to above 5000rpm. If minimum detecting voltage is set low for the ease of signal detection at low rpm, 1) the abnormal signal at high rpm from which high voltage generates or 2) electrical NOise through circuit can be recognized as Crank signal. Thus minimum detecting voltages at low rpm and high rpm are set differently.

3. ECM convert analog signal like the waveform illustrated above into digital signal with A/D converter.The voltage above minimum detecting voltage of crank signal and "-"voltage below 0.0V is meaningless at converting process. RPM is detected as Hz.(signal detecting period)

MONITOR SCANTOOL DATA E716DA8B

1. Connect Scantool to Data Link Connector (DLC).

2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "ENGINE SPEED SENSOR" parameter on the Scantool.

Specification : 800±50RPM at idle

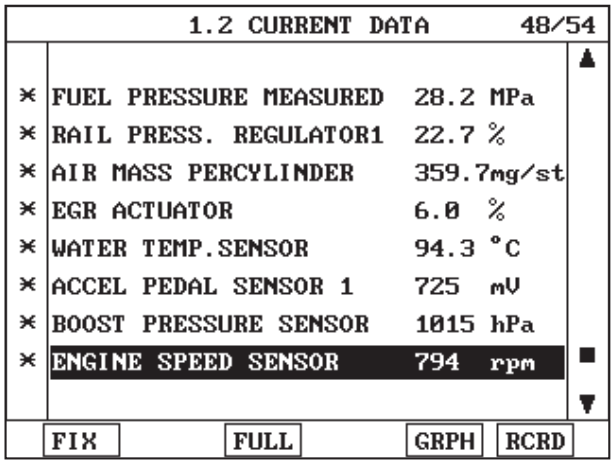


Fig.1

Fig.1) Check "ENGINE SPEED SENSOR" parameter carefully after warming engine up, also check engine stall and rpm instability or engine shut down.

EGNG005M

TERMINAL AND CONNECTOR INSPECTION EBF78CF9

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)
3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Signal Circuit Inspection ".

SIGNAL CIRCUIT INSPECTION E93F7435

1. Check signal circuit voltage

1) IG KEY "OFF", ENGINE "OFF".
2) Disconnect CKPS connector.
3) IG KEY "ON".
4) Measure the voltage of CKPS connector terminal 2 and 3.

Specification : 2.4V~2.6V

5) Is the measured voltage within the specification?

YES

▶ Go to "3.Check short between signal circuits."

NO

▶ Go to "2.Check open in signal circuit" as follows.

2. Check open in signal circuit

1) IG KEY "OFF", ENGINE "OFF".
2) Disconnect CKPS connector and ECM connector.
3) Check continuity between CKPS connector terminal 2 and ECM connector terminal 12(A/T),27(M/T).
4) Check continuity between CKPS connector terminal 3 and ECM connector terminal 27(A/T),12(M/T).

Specification : continuity (below 1.0Ω)

5) Is the measured resistance within the specification?

YES

▶ Go to "3. Check short between signal circuits".

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

3. Check short between signal circuits

1) IG KEY "OFF", ENGINE "OFF".
2) Disconnect CKPS connector and ECM connector.
3) Check continuity between CKPS connector terminal 2 and 3.

Specification : Discontinuity (Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "4. Check short to ground in signal circuit" as follows.

NO

▶ Repair short between signal circuits and go to "Verification of Vehicle Repair".

4. Check short to ground in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect CKPS connector and ECM connector.

   3) Check continuity between CKPS connector terminal 1(shield ground) and 2,3(crank signal)

Specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair the short between signal circuit and shield ground and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION EBB94C34

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect CKPS connector.
3. Check continuity between CKPS connector terminal 1(shield ground) and chassis ground.

Specification : continuity (below 1.0Ω)

4. Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open or poor connection in ground circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EA6F7829

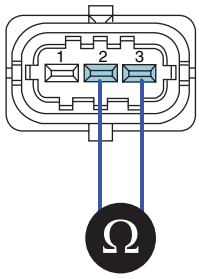
1. Check Resistance of CKPS component

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect CKPS connector.

   3) Check resistance between CKPS connector terminal 2 and 3 at component side.

Specification : 860Ω ±10% (20℃)



EGNG006B

4) Is the measured resistance within the specification?

YES

▶ Go to "Check short to ground in CKPS component" as follows.

NO

▶ Replace CKPS and go to "Verification of Vehicle Repair".

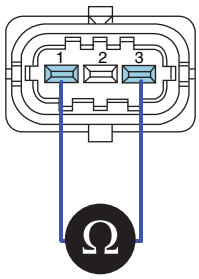
2. Check short to ground in CKPS component

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect CKPS connector.

3) Check resistance between CKPS connector terminal 1 and 3 at component side.

Specification : Discontinuity (Infinite Ω)



EGNG006C

4) Is the measured resistance within the specification? (Is the inside of component insulated correctly?)

YES

▶ Go to "Check CKPS waveform".

NO

▶ Replace CKPS and go to "Verification of Vehicle Repair".

3. Check CKPS waveform

1) IG KEY "OFF", ENGINE "OFF".

2) Connect CKPS connector.

3) Connect Oscilloscope to CKPS connector terminal 2.

4) Check if CKPS waveform is outputted correctly as cranking or turning engine on.

Specification : Refer to "Signal waveform & data" of "General Information".

5) Is CKPS waveform outputted correctly?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace CKPS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR ED4AB5B6

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0336 CRANKSHAFT POSITION SENSOR A CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION E533A1E1

Refer to DTC P0335.

GENERAL DESCRIPTION E75D00E8

Refer to DTC P0335.

DTC DESCRIPTION ECA32BD8

P0336 is set when 1). engine speed detected by CKPS is above 6000RPM, or 2). CKPS signal pulse is abnormal. For repair, check temporary poor connection in CKPS circuit, component failure or deformation of tone wheel.

DTC DETECTING CONDITION EAFA6628

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="6">• CKPS circuit
• CKPS component
• Abnormal deformation of Crank Shaft tone wheel</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Engine speed sensed at CKPS above 6000RPM
• Abnormal crank signal pulse</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>YES</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION EAC777E3

Refer to DTC P0335.

SCHEMATIC DIAGRAM E074B4A6

Refer to DTC P0335.

SIGNAL WAVEFORM AND DATA EBA92BFA

Refer to DTC P0335.

MONITOR SCANTOOL DATA E616CC4D

Refer to DTC P0335.

TERMINAL AND CONNECTOR INSPECTION E5A8D1BE

Refer to DTC P0335.

SIGNAL CIRCUIT INSPECTION EE186438

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect CKPS connector.

   3) IG KEY "ON".

   4) Measure the voltage of CKPS connector terminal 2 and 3.

Specification : 2.4V~2.6V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "3.Check short between signal circuits."

   NO

   ▶ Go to "2.Check open in signal circuit" as follows.

2. Check open in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect CKPS connector and ECM connector.

   3) Check continuity between CKPS connector terminal 2 and ECM connector terminal 12(A/T),27(M/T).

   4) Check continuity between CKPS connector terminal 3 and ECM connector terminal 27(A/T),12(M/T).

Specification : continuity (below 1.0Ω)

   5) Is the measured resistance within the specification?

   YES

   ▶ Go to "3. Check short between signal circuits".

   NO

   ▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

3. Check short between signal circuits

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect CKPS connector and ECM connector.

   3) Check continuity between CKPS connector terminal 2 and 3.

Specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "4. Check short to ground in signal circuit" as follows.

NO

▶ Repair short between signal circuits and go to "Verification of Vehicle Repair".

4. Check short to ground in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect CKPS connector and ECM connector.

   3) Check continuity between CKPS connector terminal 1(shield ground) and 2,3(crank signal)

Specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair the short between signal circuit and shield ground and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E91966FC

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect CKPS connector.
3. Check continuity between CKPS connector terminal 1(shield ground) and chassis ground.

Specification : continuity (below 1.0Ω)

4. Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open or poor connection in ground circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E5F58310

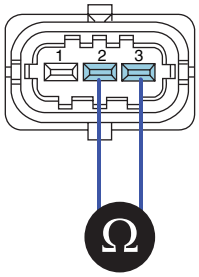
1. Check Resistance of CKPS component

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect CKPS connector.

   3) Check resistance between CKPS connector terminal 2 and 3 at component side.

Specification : 860Ω ±10% (20℃)



EGNG006B

4) Is the measured resistance within the specification?

YES

▶ Go to "Check short to ground in CKPS component" as follows.

NO

▶ Replace CKPS and go to "Verification of Vehicle Repair".

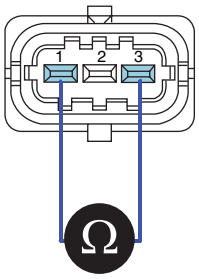
2. Check short to ground in CKPS component

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect CKPS connector.

3) Check resistance between CKPS connector terminal 1 and 3 at component side.

Specification : Discontinuity (Infinite Ω)



EGNG006C

4) Is the measured resistance within the specification? (Is the inside of component insulated correctly?)

YES

▶ Go to "Check CKPS waveform".

NO

▶ Replace CKPS and go to "Verification of Vehicle Repair".

3. Check CKPS waveform

1) IG KEY "OFF", ENGINE "OFF".

2) Connect CKPS connector.

3) Connect Oscilloscope to CKPS connector terminal 2.

4) Check if CKPS waveform is outputted correctly as cranking or turning engine on.

Specification : Refer to "Signal waveform & data" of "General Information".

5) Is CKPS waveform outputted correctly?

YES

▶ Go to "Verification of Vehicle Repair".

NO

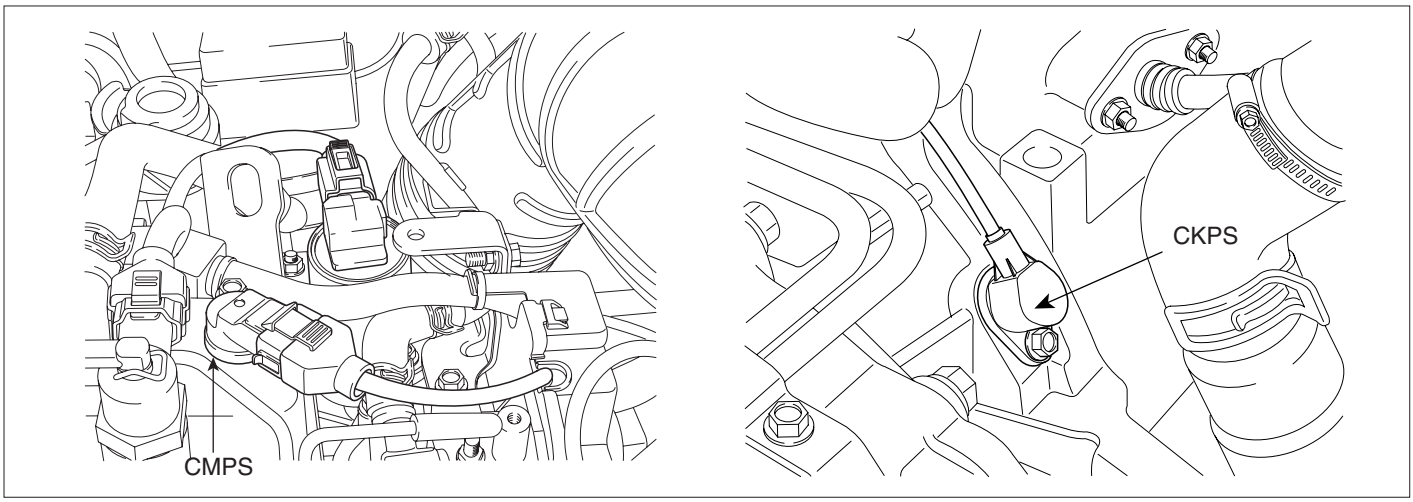
▶ Replace CKPS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E94E67A2

Refer to DTC P0335.

DTC P0340 CAMSHAFT POSITION SENSOR A CIRCUIT MALFUNCTION (BANK 1 OR SINGLE SENSOR)

COMPONENT LOCATION E617D2D3



EGNG005I

GENERAL DESCRIPTION EE657C80

Cam Shaft Position Sensor(CMPS) is hall sensor type. Sensing the teeth attatch at the end of exhaust cam shaft, CMPS detects rotation of Cam shaft (1 signal per 1 lotation)As Cam shaft rotates once while Crank shaft does twice, CMPS referrence point generates once while CKPS' do twice.As this signal inputted to ECM, it distinguishes crank angle and the cylinder which requires fuel injection in order to determine injection sequence and duration.

DTC DESCRIPTION E41B283B

P0340 is set when CKPS signal is outputted while CMPS signal does not generate for more than 0.7 sec.. This code is due to the failure relevant to CMPS related circuit and sensor component.

DTC DETECTING CONDITION E7865094

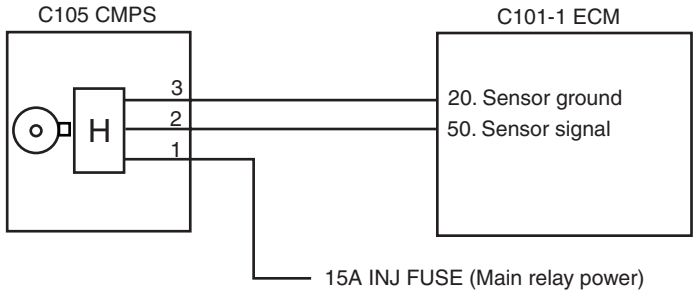
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="6">• CMPS circuit
• CMPS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running(during accelerating)</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• CKPS signal is outputted while CMPS signal does not generate.</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 700ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">Engine does not turn "ON" at starting.</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION ECCF378D

Sensor Type	Output Signal Characteristic	Air Gab	LOW Signal Detecting Voltage	HIGH Signal Detecting Voltage
Hall effect type	0V~5V Digital signal output	1.25mm	below 2.0V	above 3.8V

SCHEMATIC DIAGRAM E2482EDE

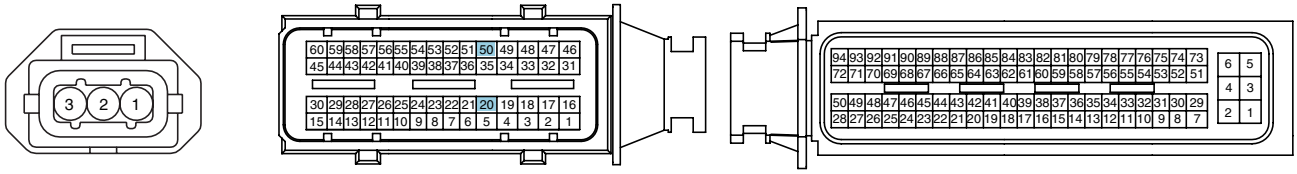
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C142 J/C terminal 9	Sensor power
2	C101-1 terminal 50	Sensor signal
3	C101-1 terminal 20	Sensor ground

[HARNESS CONNECTOR]



C105 CMPS C101-1 ECM C101-2 ECM

EGNG005J

SIGNAL WAVEFORM AND DATA E8E228EE

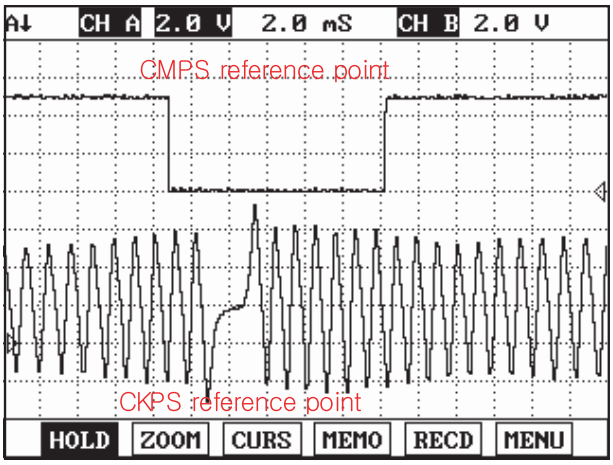


Fig.1

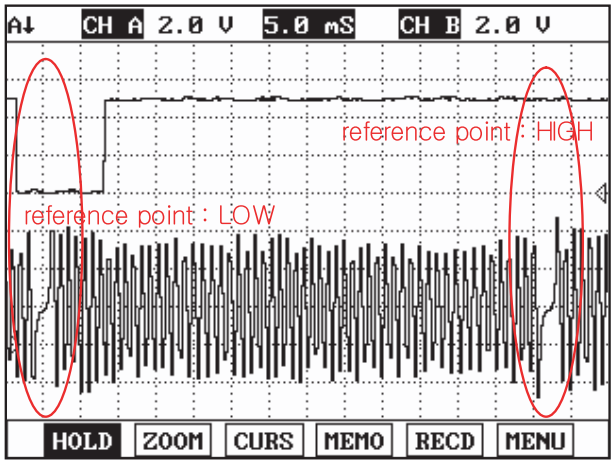


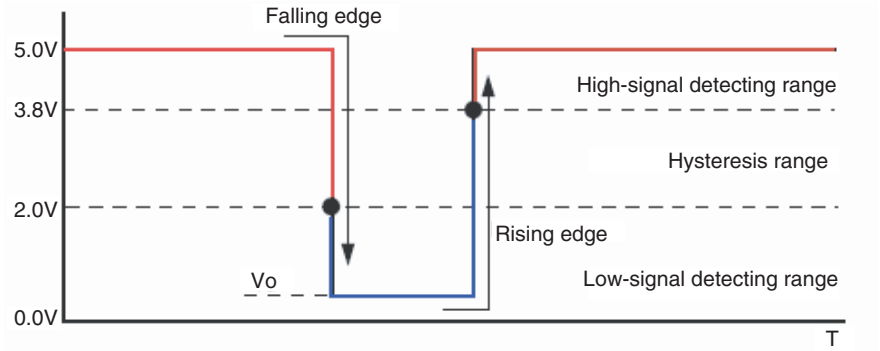
Fig.2

Fig.1) This shows waveform of Crank Shaft Position Sensor and Cam Shaft Position Sensor simulatneously.
The middle area indicates reference points of Crank Shaft Position Sensor and Cam Shaft Position Sensor.

Fig.2) Crank Shaft Position Sensor and Cam Shaft Position Sensor signal are measured simultaneously.
Cam Shaft Position Sensor signal is outputted once when Crank Shaft Position sensor signal is outputted twice.
LOW and HIGH output of Cam Shaft Position sensor reference point is detected at Crank Shaft Position sensor reference point.
(Injection sequence is determined based on LOW and HIGH signal of Cam Shaft Position Sensor reference point as detecting cylinder position.)

EGNG005K

※ SIGNAL ANALYSIS



EGNG005L

1. ECM recognizes HIGH signal as LOW signal when CMPS signal drops below 2.0V and LOW signal as HIGH signal when CMPS signal rises above 3.8V.

2. V0 - the Minimum voltage of LOW signal does not drop below 0.0V due to the hall sensor inside resistance. When the Minimum voltage of LOW signal is above 0.6V during signal waveform inspection, check excessive resistance inside of CMPS component or in ground circuit.

MONITOR SCANTOOL DATA E72206B9

1. Connect Scantool to Data Link Connector (DLC).

2. Warm engine up to normal operating temperature.

3. Turn "OFF" electrical devices and A/C.

4. Monitor "ENGINE SPEED SENSOR" parameter on the Scantool.

Specification : 800±50RPM at idle

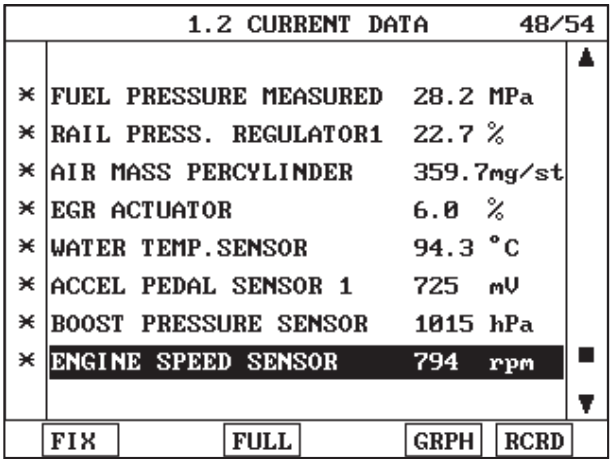


Fig.1

Fig.1) Check "ENGINE SPEED SENSOR" parameter carefully after warming engine up, also check engine stall and rpm instability or engine shut down.

EGNG005M

TERMINAL AND CONNECTOR INSPECTION EC09A43F

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E0635D22

1. IG KEY "OFF", ENGINE "OFF".

2. Disconnect CMPS connector.

3. IG KEY "ON".

4. Measure the voltage of CMPS connector terminal 1.

Specification : 11.0V~13.0V (Main relay "ON" power)

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in Main relay power circuit and fuse, and go to "Verification of Vehicle Repair".
[Check open in Engine room junction box 15A INJ and related circuit.]
※ If the fuse is damaged again after replacing the damaged fuse, repair short to ground in Main relay power circuit.

SIGNAL CIRCUIT INSPECTION E018BFC3

1. Check CMPS signal voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect CMPS connector.
   3) IG KEY "ON".
   4) Measure the voltage of CMPS connector terminal 2.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Go to "Check open in signal circuit" as follows.

2. Check open in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect CMPS connector and ECM connector.
   3) Check continuity between CMPS connector terminal 2 and ECM connector terminal 50.

Specification : continuity (below 1.0Ω)

   4) Is the measured resistance within the specification? (Is continuity confirmed?)

YES

▶ Go to "Check short to ground in signal circuit" as follows.

NO

▶ Repair open in the circuit between CMPS connector terminal 2 and ECM connector terminal 50 and go to "Verification of Vehicle Repair".

3. Check short to ground in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect CMPS connector and ECM connector.

   3) Check continuity between CMPS connector terminal 2 and chassis ground.

Specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION EF903797

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect CMPS connector.
3. IG KEY "ON".
4. Check the voltage of CMPS connetor terminal 2. [TEST "A"]
5. Check the voltage between CMPS connetor terminal 2 and 3. [TEST "B"]
   (terminal 2 : Check + prove , terminal 3 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EEE062DD

1. Cam shaft detecting teeth inspection

   1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect CMPS connector.

3) Disconnect CMPS.

4) Check the condition of Cam shaft detecting teeth through CMPS mounting hall.

5) Is abnormal deformation of Cam shaft detecting teeth found?

YES

▶ Replace Cam shaft assy' or Cylinder head assy' and go to "Verification of Vehicle Repair".

NO

▶ Go to "CMPS waveform Inspection" as follows.

2. CMPS waveform inspection

1) IG KEY "OFF", ENGINE "OFF".

2) Connect CMPS connector.

3) Connect Oscilloscope to CMPS connector terminal 2.

4) Monitor if CMPS waveform is outputted normally as cranking or turning engine "ON".

Specification : Refer to "Signal waveform & Data" of "General Information".

5) Is CMPS waveform displayed correctly?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace CMPS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E9B90C35

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0341 CAMSHAFT POSITION SENSOR A CIRCUIT RANGE/PERFORMANCE (BANK 1 OR SINGLE SENSOR)

COMPONENT LOCATION E06E4E62

Refer to DTC P0340.

GENERAL DESCRIPTION EA69EB4F

Refer to DTC P0340.

DTC DESCRIPTION E8A635AF

P0341 is set when CMPS reference point is detected more or less than twice while CKPS reference point is recognized 4 times. This code is due to temporary poor connection or short to ground in CMPS circuit. CMPS component failure.

DTC DETECTING CONDITION E1316A1A

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="6">• CMPS circuit
• CMPS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running(during accelerating)</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• When RPM from CMPS correlates with RPM from CKPS abnormally.</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Crank Shaft 4 rotation</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>YES</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E02B850F

Refer to DTC P0340.

SCHEMATIC DIAGRAM E26728C7

Refer to DTC P0340.

SIGNAL WAVEFORM AND DATA EB68CDD2

Refer to DTC P0340.

MONITOR SCANTOOL DATA E36F02FD

Refer to DTC P0340.

TERMINAL AND CONNECTOR INSPECTION E95038A7

Refer to DTC P0340.

POWER CIRCUIT INSPECTION E4FB0C7D

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect CMPS connector.
3. IG KEY "ON".
4. Measure the voltage of CMPS connector terminal 1.

Specification : 11.0V~13.0V (Main relay "ON" power)

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in Main relay power circuit and fuse, and go to "Verification of Vehicle Repair".
[Check open in Engine room junction box 15A INJ and related circuit.]
※ If the fuse is damaged again after replacing the damaged fuse, repair short to ground in Main relay power circuit.

SIGNAL CIRCUIT INSPECTION E237EA9A

1. Check CMPS signal voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect CMPS connector.
   3) IG KEY "ON".
   4) Measure the voltage of CMPS connector terminal 2.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Go to "Check open in signal circuit" as follows.

2. Check open in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect CMPS connector and ECM connector.
   3) Check continuity between CMPS connector terminal 2 and ECM connector terminal 50.

Specification : continuity (below 1.0Ω)

4) Is the measured resistance within the specification? (Is continuity confirmed?)

YES

▶ Go to "Check short to ground in signal circuit" as follows.

NO

▶ Repair open in the circuit between CMPS connector terminal 2 and ECM connector terminal 50 and go to "Verification of Vehicle Repair".

3. Check short to ground in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect CMPS connector and ECM connector.

3) Check continuity between CMPS connector terminal 2 and chassis ground.

Specification : Discontinuity (Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E211B617

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect CMPS connector.
3. IG KEY "ON".
4. Check the voltage of CMPS connetor terminal 2. [TEST "A"]
5. Check the voltage between CMPS connetor terminal 2 and 3. [TEST "B"]
(terminal 2 : Check + prove , terminal 3 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E5CF54A4

1. Cam shaft detecting teeth inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect CMPS connector.
   3) Disconnect CMPS.
   4) Check the condition of Cam shaft detecting teeth through CMPS mounting hall.
   5) Is abnormal deformation of Cam shaft detecting teeth found?

      YES

      ▶ Replace Cam shaft assy' or Cylinder head assy' and go to "Verification of Vehicle Repair".

      NO

      ▶ Go to "CMPS waveform Inspection" as follows.
2. CMPS waveform inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Connect CMPS connector.
   3) Connect Oscilloscope to CMPS connector terminal 2.
   4) Monitor if CMPS waveform is outputted normally as cranking or turning engine "ON".

Specification : Refer to "Signal waveform & Data" of "General Information".

   5) Is CMPS waveform displayed correctly?

      YES

      ▶ Go to "Verification of Vehicle Repair".

      NO

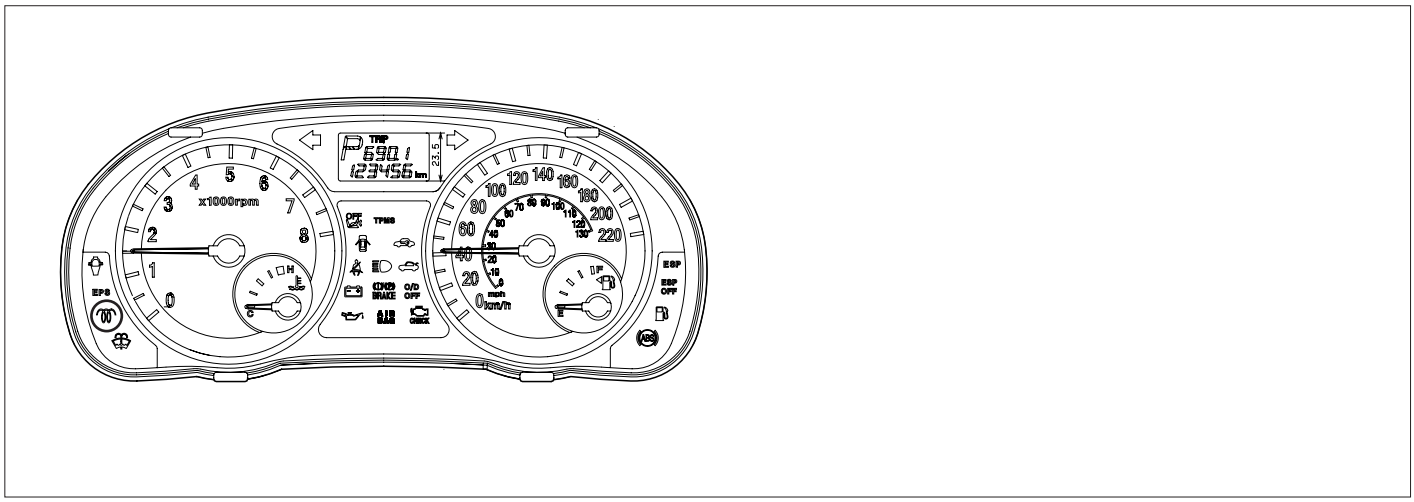
      ▶ Replace CMPS and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E7E6B529

Refer to DTC P0340.

DTC P0381 GLOW INDICATOR LAMP - CIRCUIT MALFUNCTION

COMPONENT LOCATION EA1E3CAC



EGNG007O

GENERAL DESCRIPTION E3DDCBAA

Heating combustion chamber, glow plug increases fuel ignitibility and makes fuel foggy state easily when engine is cold. Thus, glow plug makes engine starting easily and decreases exhaust gas produced just after turning engine on when engine is cold.ECM controls operation and operating duration of glow plug relay which supplies power to glow plug with ECTS signal, battery voltage and IG KEY ON signal.Through glow lamp in cluster, ECM let drivers know if glow plug is ON.

DTC DESCRIPTION E9342D33

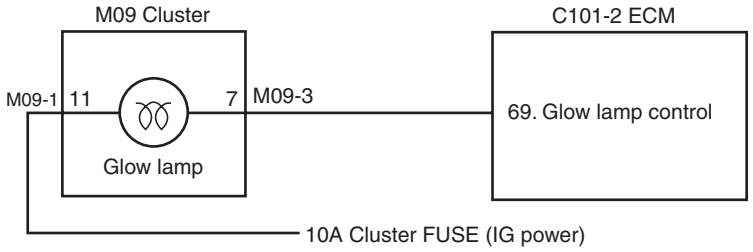
P0381 is set when 1)excessive voltage is detected or 2)no current is detected like open or short to ground in glow lamp control circuit for more than 1 sec. at glow lamp ON condition. This code is due to open in glow lamp control circuit or internal open in filament of glow lamp component.

DTC DETECTING CONDITION E747BC4E

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in glow lamp • Glow lamp circuit
Enable Conditions	• IG KEY "ON" (monitoring only performed within lamp operating condition)			
ThresholdValue	• short to battery • Short to GND, Wiring open			
DiagnosticTime	• 1.0 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SCHEMATIC DIAGRAM EFB675FD

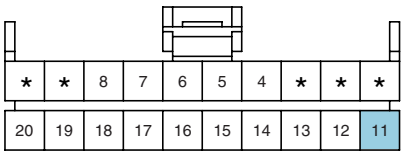
[CIRCUIT DIAGRAM]



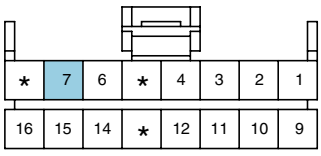
[CONNECTOR INFORMATION]

Terminal	Connected to	Function
M09-1 terminal 11	10A Cluster FUSE	IG power
M09-3 terminal 7	C101-2 terminal 69	Glow lamp control

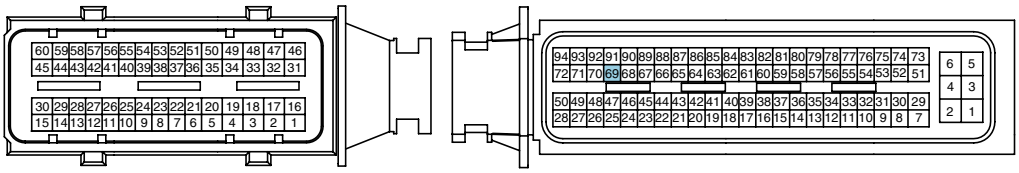
[HARNESS CONNECTOR]



M09-1



M09-3



C101-1 ECM C101-2 ECM

EGNG007P

MONITOR SCANTOOL DATA E18DB7A2

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Select "ACTUATION TEST" parameter on the scantool.

specification : Lamp turns ON at ACTUATION TEST of Glow lamp.

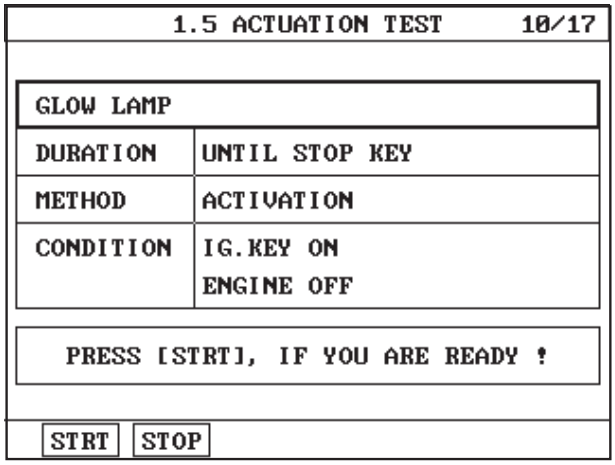


Fig.1

Fig.1) Diagnosing problem is convenient through ACTUATION TEST of glow lamp.

EGNG007Q

TERMINAL AND CONNECTOR INSPECTION E93A6444

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Control Circuit Inspection".

CONTROL CIRCUIT INSPECTION E6211F58

1. Check voltage in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect ECM connector.

   3) IG KEY "ON".

   4) Measure the voltage of terminal 69 of ECM connector.

Specification : 10.8V~13.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "2. Grounding test of glow lamp control circuit".

NO

▶ Check filament of glow lamp. (Refer to Component Inspection)

2. Grounding test of glow lamp control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM connector.

3) IG KEY "ON".

4) Ground ECM connector terminal 69 to chassis ground.

specification : Glow lamp turns ON.

5) Does glow lamp turn ON?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Repair short to battery in glow lamp control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E090ECDF

1. IG KEY "OFF", ENGINE "OFF".
2. Dismount cluster and disconnect glow lamp.
3. Check filament of glow lamp.
4. supply 12V to glow lamp to turn lamp ON.

specification : Lamp turns ON when 12V is supplied.

5. Does glow lamp turn ON?

1)

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace glow lamp and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EBE01516

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

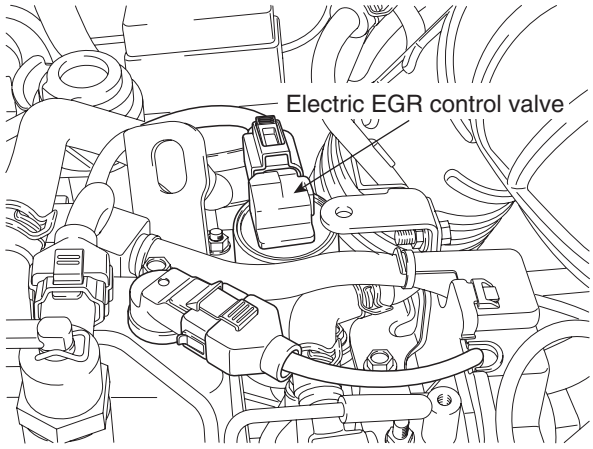
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0489 EXHAUST GAS RECIRCULATION CONTROL CIRCUIT LOW VOLTAGE

COMPONENT LOCATION E5327A73



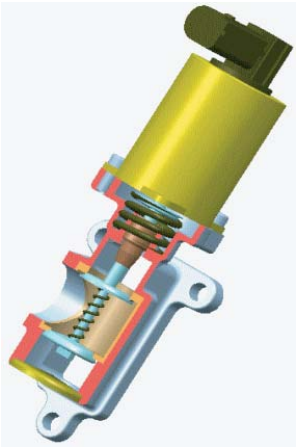
EGNG004V

GENERAL DESCRIPTION EED8163E

Receiving ECM signal, linear solenoid type electronic EGR actuator operates Electric EGR control valve directly.ECM performs EGR system feed back control with the information of measured mass air flow (The role of MAFS in diesel engine is different from gasoline engine. Fuel injection quantity is decided by MAFS signal in gasoline engine.)When EGR gas(contains no oxygen) flowing into combustion chamber increases, the air passing through MAFS(contains oxygen) decreases. Thus, with the output signal change of MAFS accompanied by Electric EGR control valve actuation, ECM determine the amount of recirculated EGR gas quantity.

NOTE

NOx is produced from the reaction of nitrogen and oxygen. Controlling EGR gas(contains no oxyger) which is recirculated to combustion chamber, if least intake air required for complete combustion flows into combustion chamber, NOx decreases because there is no supplementary oxygen to react with nitrogen.



EGNG004W

DTC DESCRIPTION E1F52904

P0489 is set when '0'A is detected in Electric EGR control valve circuit for more than 0.5 sec.. This code is due to open or short to ground in Electric EGR control valve circuit or internal open in Electric EGR control valve component.

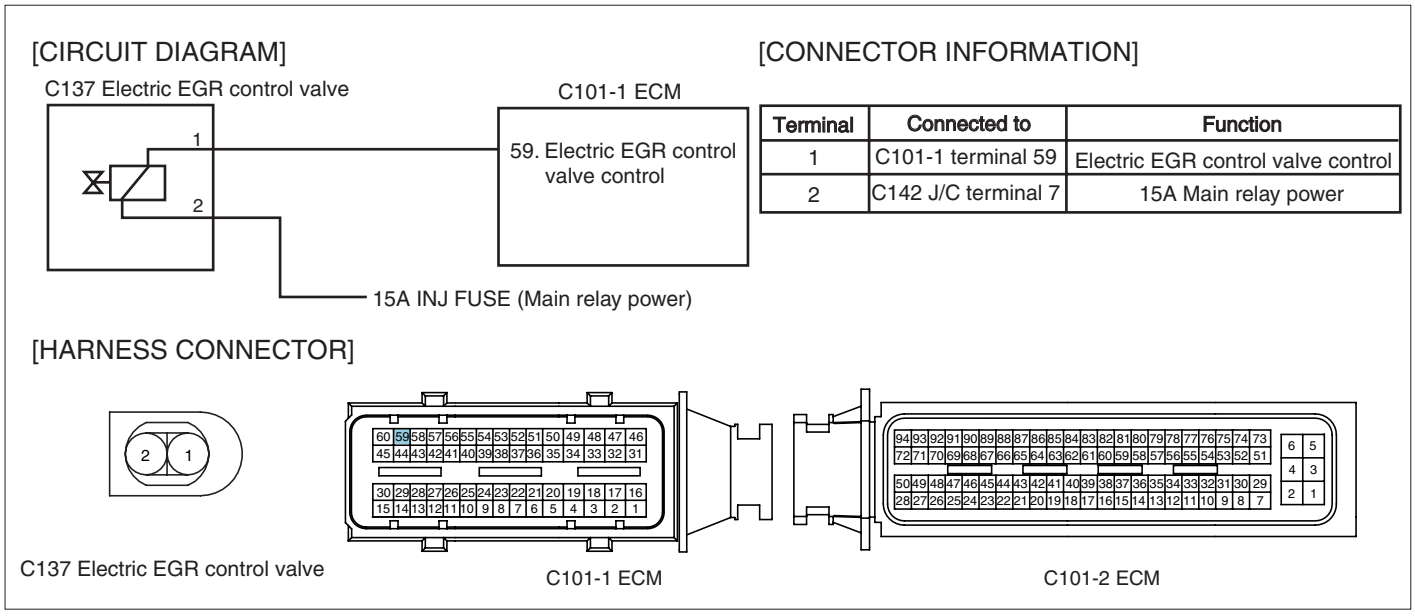
DTC DETECTING CONDITION E295D65E

Item	Detecting Condition			Possible Cause
DTC Strategy	• Signal monitoring			• Electric EGR control valve circuit • Electric EGR control valve component
Enable Conditions	• Engine run			
ThresholdValue	• short to GND, wiring open			
DiagnosticTime	• 500ms			
Fail Safe	Fuel Cut	NO		
	EGR Off	YES		
	Fuel Limit	NO		
	MIL	YES		

SPECIFICATION E1119B59

Electric EGR control vavle component resistance	Electric EGR control vavle operating Hz	Electric EGR control vavle operating duty
14.7 ~ 16.1Ω (20℃)	142Hz	5%(closed)~39%(opened)

SCHEMATIC DIAGRAM EDA5ED22



EGNG004X

SIGNAL WAVEFORM AND DATA E620352D

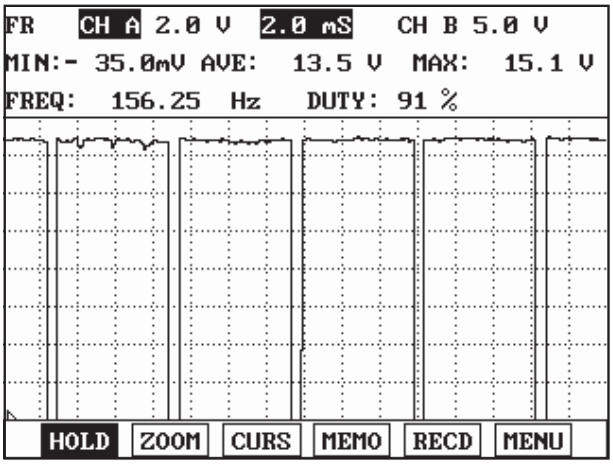


Fig.1

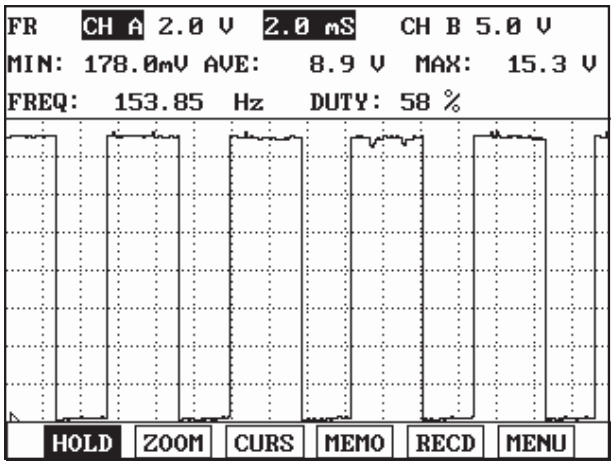


Fig.2

Fig.1) Approx. 6% duty signal waveform of Electric EGR control valve (with EEGR valve closed)
Fig.2) Approx. 40% duty signal waveform of Electric EGR control valve(with EEGR valve opened)

EGNG004Y

NOTE

The output of approx. 6% duty is mainly for the diagnosis of Electric EGR control valve circuit than actuating EEGR.

MONITOR SCANTOOL DATA E22F4AD7

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "AIR MASS PERCYLINDER" parameter on the Scantool.

Specification : When Electric EGR control valve does not operate 6% duty) at idle : 340mg/st ± 50 mg/st
When Electric EGR control valve operates(Approx. 50% duty) at idle : 200ms/st ± 50 mg/st

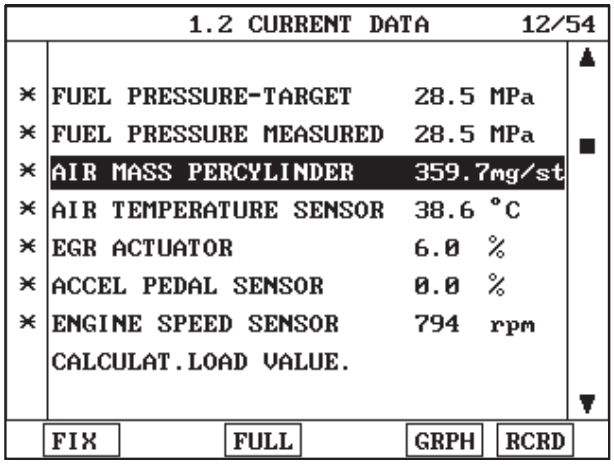


Fig.1

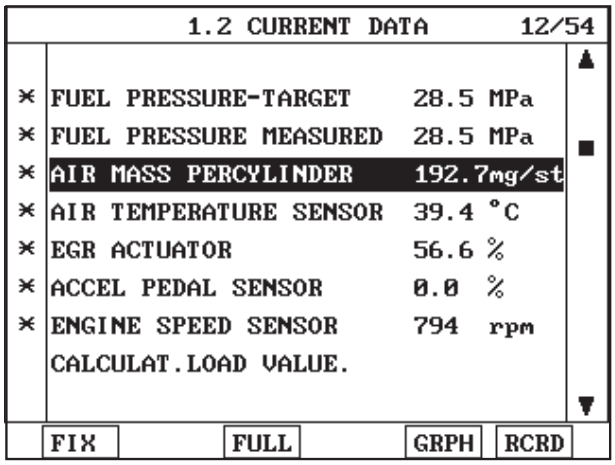


Fig.2

Fig.1) Check if "AIR MASS PERCYLINDER"I is 340mg/st ± 50mg/st without EEGR operation at warm idle (Electric EGR control valve 6% duty)
Fig.2) Check if "AIR MASS PERCYLINDER"I is 200mg/st ± 50mg/st with EEGR operation at warm idle (Electric EGR control valve approx. 50% duty)

※Electric EGR control valae operates as decelerating after rapid acceleration when idle EEGR does not operate, Electric EGR control valve operating duty decreases as time goes by. This controlling process lasts for about 3 min. and Electric EGR control valve turns "OFF" (duty 6%) after 3 min..

EGNG012R

TERMINAL AND CONNECTOR INSPECTION E7AA7A35

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E244A549

1. Check power circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Electric EGR control valve connector

3) IG KEY "ON"

4) Measure the voltage of terminal 2 of Electric EGR control valve connector

Specification : 11.5V~13.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair E/R FUSE & RELAY BOX 15A INJ fuse and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E8316459

1. Check control circuit monitoring voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Electric EGR control valve connector.

3) IG KEY "ON".

4) Measure the voltage of terminal 1 of Electric EGR control valve connector.

Specification : 3.2V~3.7V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Electric EGR control valve connector and ECM connector.

3) Check continuity between Electric EGR control valve terminal 1 and ECM connector terminal 59.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground and go to "Verification of Vehicle Repair".

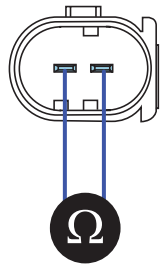
NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E0144D65

1. Check Electric EGR control valve component resistance
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect Electric EGR control valve.
   3) Measure the resistance between Electric EGR control valve component terminal 1 and 2.

Specification : 14.7 ~ 16.1Ω (20℃)



EGNG005C

   4) Is Electric EGR control valve component resistance within the specification?

YES

▶ go to "Verification of Vehicle Repair".

NO

▶ Replace Electric EGR control valve and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EA7D5B93

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0490 EXHAUST GAS RECIRCULATION CONTROL CIRCUIT HIGH VOLTAGE

COMPONENT LOCATION E7FBFA48

Refer to DTC P0489.

GENERAL DESCRIPTION E1437C1E

Refer to DTC P0489.

DTC DESCRIPTION E5303428

P0490 is set when excessive current is detected in Electric EGR control valve circuit for more than 0.5 sec.. This code is due to short to battery in Electric EGR control valve control circuit or internal short in Electric EGR control valve component.

DTC DETECTING CONDITION EA9AD4BE

Item	Detecting Condition			Possible Cause
DTC Strategy	• Signal monitoring			• Electric EGR control valve circuit • Electric EGR control valve component
Enable Conditions	• Engine run			
ThresholdValue	• Short to battery			
DiagnosticTime	• 500ms			
Fail Safe	Fuel Cut	NO		
	EGR Off	YES		
	Fuel Limit	NO		
	MIL	YES		

SPECIFICATION E3794001

Refer to DTC P0489.

SCHEMATIC DIAGRAM E4D9993D

Refer to DTC P0489.

SIGNAL WAVEFORM AND DATA E20528E0

Refer to DTC P0489.

MONITOR SCANTOOL DATA EB20F87C

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "AIR MASS PERCYLINDER" parameter on the Scantool.

Specification : When Electric EGR control valve does not operate 6% duty) at idle : 340mg/st ± 50 mg/st
When Electric EGR control valve operates(Approx. 50% duty) at idle : 200ms/st ± 50 mg/st

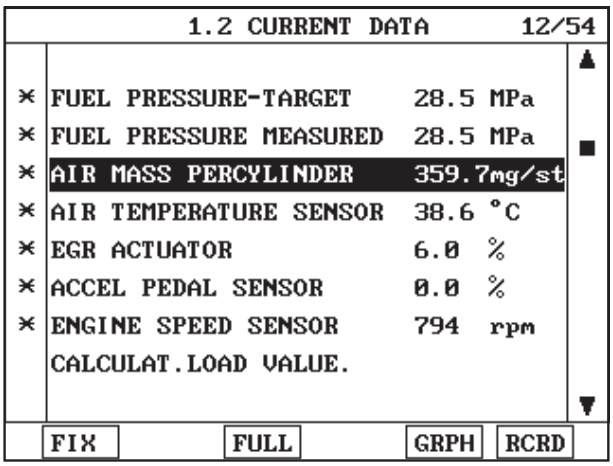


Fig.1

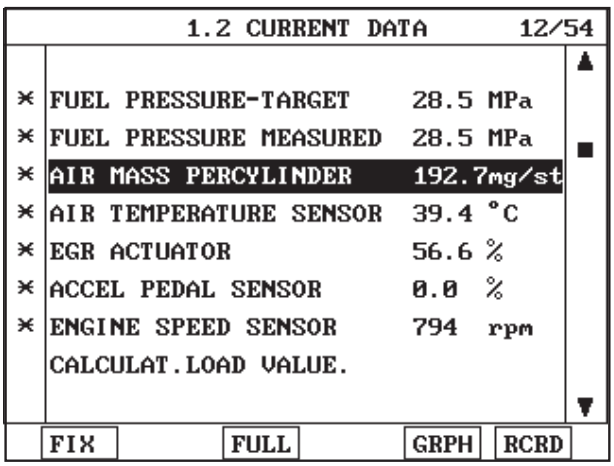


Fig.2

Fig.1) Check if "AIR MASS PERCYLINDER"l is 340mg/st ± 50mg/st without EEGR operation at warm idle
(Electric EGR control valve 6% duty)
Fig.2) Check if "AIR MASS PERCYLINDER"l is 200mg/st ± 50mg/st with EEGR operation at warm idle
(Electric EGR control valve approx. 50% duty)

※Electric EGR control valae operates as decelerating after rapid acceleration when idle EEGR does not operate, Electric EGR control valve operating duty decreases as time goes by. This controlling process lasts for about 3 min. and Electric EGR control valve turns "OFF" (duty 6%) after 3 min..

EGNG012R

TERMINAL AND CONNECTOR INSPECTION E24B9677

Refer to DTC P0489.

POWER CIRCUIT INSPECTION EF73F372

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Electric EGR control valve connector

   3) IG KEY "ON"

   4) Measure the voltage of terminal 2 of Electric EGR control valve connector

Specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair E/R FUSE & RELAY BOX 15A INJ fuse and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION EF85A419

1. Check control circuit monitoring voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Electric EGR control valve connector.

   3) IG KEY "ON".

   4) Measure the voltage of terminal 1 of Electric EGR control valve connector.

Specification : 3.2V~3.7V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Electric EGR control valve connector and ECM connector.

   3) Check continuity between Electric EGR control valve terminal 1 and ECM connector terminal 59.

specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Repair short to ground and go to "Verification of Vehicle Repair".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EC8125C7

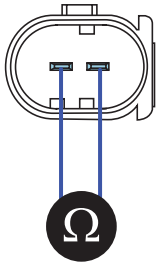
1. Check Electric EGR control valve component resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Electric EGR control valve.

   3) Measure the resistance between EGR actuator component terminal 1 and 2.

Specification : 14.7 ~ 16.1Ω (20℃)



EGNG005C

4) Is Electric EGR control valve component resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

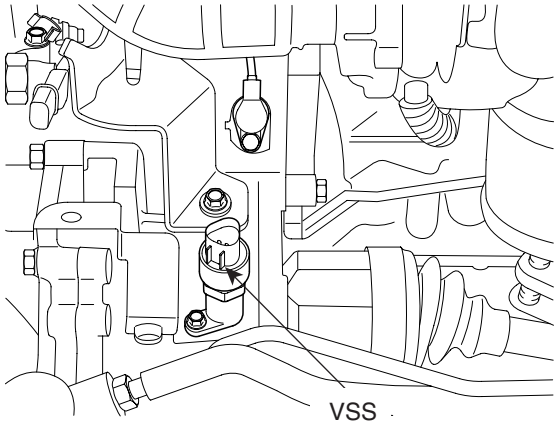
▶ Replace Electric EGR control valve and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E79C0411

Refer to DTC P0489.

DTC P0501 VEHICLE SPEED SENSOR A RANGE/PERFORMANCE

COMPONENT LOCATION E307EA1F



EGNG011R

GENERAL DESCRIPTION E4220010

< M/T >
Vehicle Speed Sensor(VSS) is hall sensor type and senses the rotating speed of differential gear mounted on transaxle.Comparing engine speed with vehicle speed calculated based on vehicle speed sensor signal, ECM recognizes engaged gear. And based on the information about engaged gear, ECM performs optimum fuel injection quantity correction. VSS signal is also used in speed meter of cluster, aircon control module, BCM, etc.

< A/T >
Any seperate vehicle speed sensor is not installed in auto transaxle vehicle. Therefore, instead of using sensor signal, A/T vehicle calculates vehicle speed through the signals from "INPUT SPEED SENSOR" and "OUTPUT SPEED SENSOR" which are installed in auto transaxle.Through E152 connector terminal 53, vehicle speed which is calculated in TCM is used at ECM, cluster, Aircon control module, BCM, etc.

DTC DESCRIPTION E2EECC05

P0501 is set when 1)vehicle speed below 13.8Km/h is detected for more than 1 sec. at above 4000RPM and above 38.5 cc of fuel injection quantity or 2)above 240Kph is detected for more than 0.5 sec.

DTC DETECTING CONDITION E7840B6E

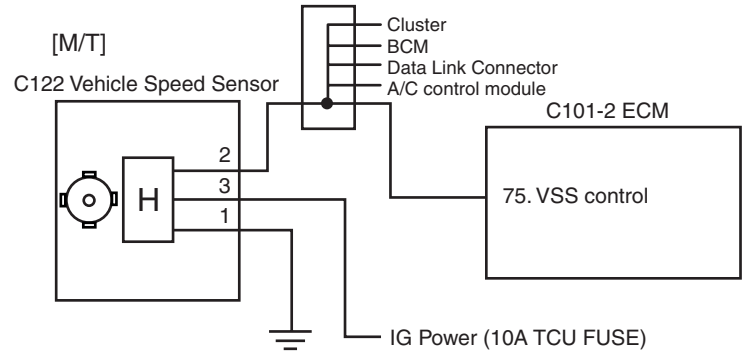
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="6">• Vehicle speed sensor circuit
• Vehicle speed sensor component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• During driving</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Vehicle speed calculated by ECM is above 240Kph for more than 0.5 sec.
• When vehicle speed below 13.8Km/h is detected for more than 1.0 sec. at above 4000RPM and above 38.5mcc of fuel injection quantity.</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Refer to threshold Value</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Clutch error monitoring inhibited
• Cruise control deactivated (for Cruise control option applied vehicle)
• Idle correction deactivated at low battery voltage</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

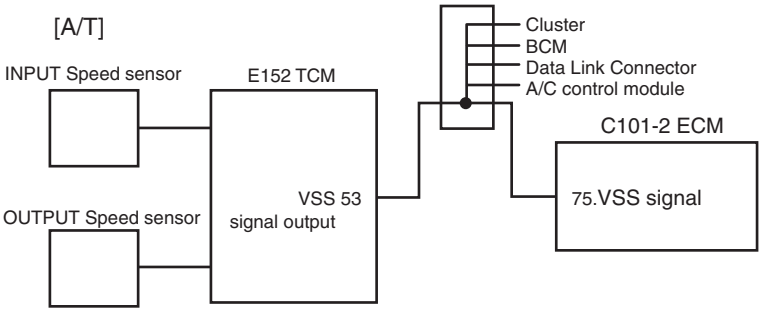
SPECIFICATION EF343697

Sensing Type	LOW Signal Voltage	HIGH Signal Voltage	Signal Duty
M/T : Hall sensor typeA/T : driven by TCM	below 1.5V	above 3.5V	50±5%

SCHEMATIC DIAGRAM EFE1C228

[CIRCUIT DIAGRAM]





[CONNECTOR INFORMATION]

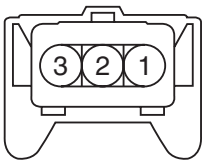
C122 Vehicle Speed Sensor

Terminal	Connected to	Function
1	G102 ground point	Chassis Ground
2	I/P-E terminal 4	IG Power
3	C101-2 terminal 75	VSS signal

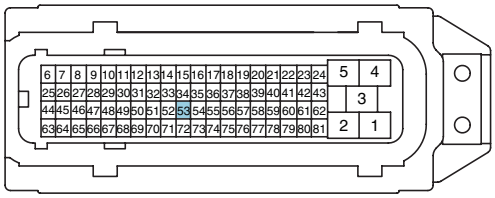
E152 TCM

Terminal	Connected to	Function
49	EC103 terminal 75	VSS signal

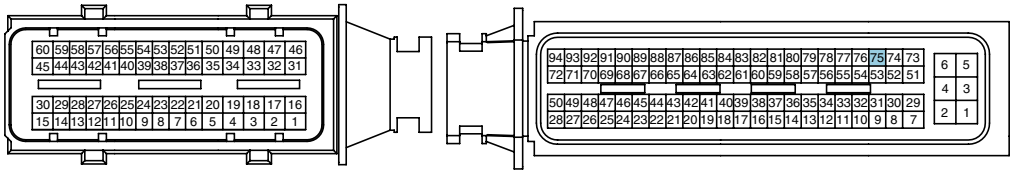
[HARNESS CONNECTOR]



C122 Vehicle Speed Sensor



E152 TCM



C101-1 ECM C101-2 ECM

EGNG011S

SIGNAL WAVEFORM AND DATA EC8E8045

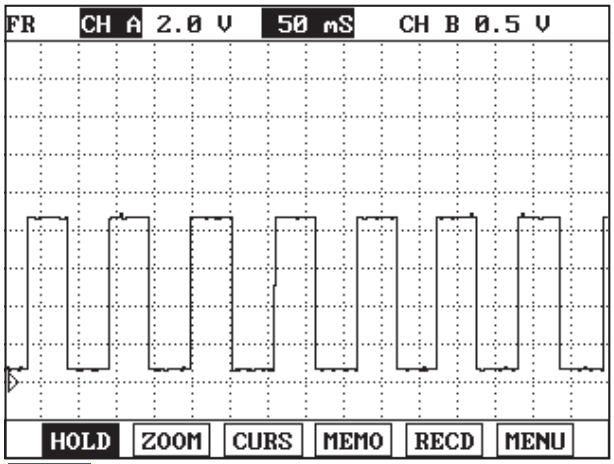


Fig.1

Fig.1) This is the signal waveform of vehicle speed sensor. Digital waveform, LOW 0.8V, HIGH : 10V with 50% duty is outputted. ECM detects vehicle speed, sensing this ON-OFF period (Hz).

EGNG011T

MONITOR SCANTOOL DATA E2170DF0

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "VEHICLE SPEED SENSOR " parameter on the Scantool.

specification : current vehicle speed is displayed.

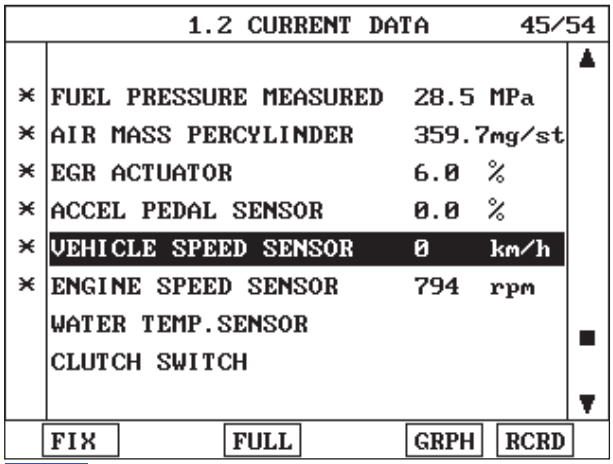


Fig.1

Fig.1) Check if current vehicle speed is same as vehicle speed displayed on the Scantool.

EGNG011U

TERMINAL AND CONNECTOR INSPECTION E049174F

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ with M/T : Go to "Power Circuit Inspection".
   ▶ with A/T : Go to "Signal Circuit Inspection".

POWER CIRCUIT INSPECTION ECFEEB93

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Vehicle Speed Sensor connector.

   3) IG KEY "ON".

   4) Measure the voltage of VSS connector terminal 2.

Specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

      YES

      ▶ Go to "Signal Circuit Inspection".

      NO

      ▶ Repair In-pannel junction box 10A ECU fuse and related circuit, and related circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E87344B4

[WITH M/T]

1. Check signal circuit voltage at sensor side

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect VSS connector.

   3) IG KEY "ON".

4) Measure the voltage of VSS connector termianl 3.

Specification : 8.0V~11.5V

5) Is the measured voltage within the specification?

YES

▶ Go to "2.Check open in signal circuit at ECM side".

NO

▶ Repair poor connection or open in joint connector EC103 terminal 12 related circuit and go to "Verification of Vehicle Repair".

[WITH A/T]

2. Check signal circuit voltage at TCM side

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect TCM connector.

3) IG KEY "ON".

4) Measure the voltage of VSS connector terminal 53.

Specification : 8.0V~11.5V

5) Is the measured voltage within the specification?

YES

▶ Go to "2.Check open in signal circuit at ECM side".

NO

▶ Repair poor connection or open in joint connector EC103 terminal 12 related circuit and go to "Verification of Vehicle Repair".

3. Check open in signal circuit at ECM side

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect VSS connector and ECM connector.

3) IG KEY "ON".

4) Measure the voltage of ECM connector terminal 75.

Specification : 8.0V~11.5V

5) Is the measured voltage within the specification?

YES

▶ with M/T : → Go to "Ground Circuit Inspection".

▶ with A/T : → Identity the trouble causing part, referring DTC guide for the vehicle with A/T, such as "P0722 Output Speed Sensor Circuit - No Signal ", "P0717 Input Speed Sensor Circuit - No Signal" , "P0716 INPUT SPEED SENSOR RANGE/PERFORMANCE".

NO

▶ Repair poor connection or open in joint connector EC103 terminal 12 related circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E29C9A10

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect VSS connector.
3. IG KEY "ON".
4. Measure the voltage of VSS connector terminal 3. [TEST "A"]
5. Measure the voltage between VSS connector terminal 3 and 1. [TEST "B"]
   (terminal 3 : Check + prove , terminal 1 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION ECD442E9

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect VSS connector.
3. Disconnect VSS and Driven gear assy'.
4. Check rotating state of VSS driven gear.
5. Connect VSS connector and IG KEY "ON".
6. Rotate Driven gear with hand.

Specification : Vehicle Speed Signal generates.

7. Does vehicle speed signal generate?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace vehicle speed sensor and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR ED195077

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

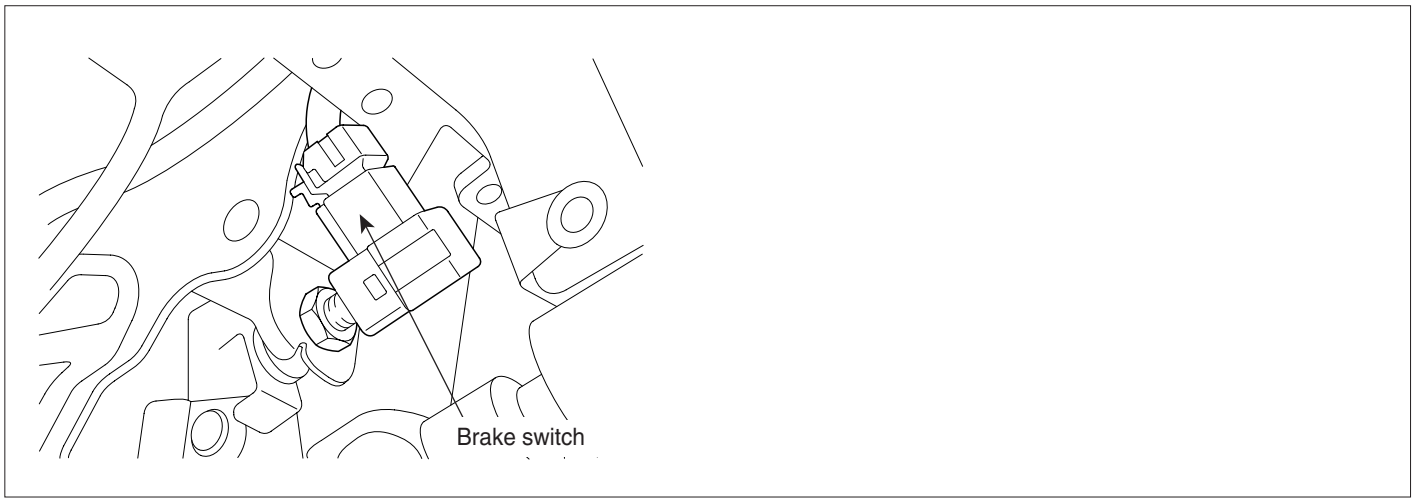
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0504 BRAKE PEDAL POSITION A/B CORREALTION

COMPONENT LOCATION E041476D



EGNG003T

GENERAL DESCRIPTION E4142DB3

Brake switch is connected to brake pedal and transmits brake operating state to ECM.When the output signal of APS is higher than what driver intended during driving (e.g. short to high voltage line in APS circuit, false signal), driver depresses brake pedal.Like this, if driver's decelerating intension is transmitted to ECM (break pedal depressed)when APS output voltage is high, ECM recognizes APS trouble and Limp Home mode is activated.At Limp Home mode, engine speed is fixed at 1200RPM and engine power generation is limitted.Even at Limp home mode, if correct APS signal is detected, Limp Home mode is deactivated. Brake switch, which monitors proper operation of APS, is devided 1 and 2 for the fidelity of brake switch.

DTC DESCRIPTION E96A18CB

When brake switch operates correctly, switch 1 is OFF and switch 2 is ON when releasing brake pedal, while switch 1 is ON and switch 2 is OFF when depressing brake pedal. thus when the signal from a switch is different from the other's, brake switch is in good condition. When the signal from a switch is same as the other's, brake switch is fault.

DTC DETECTING CONDITION E5A11F33

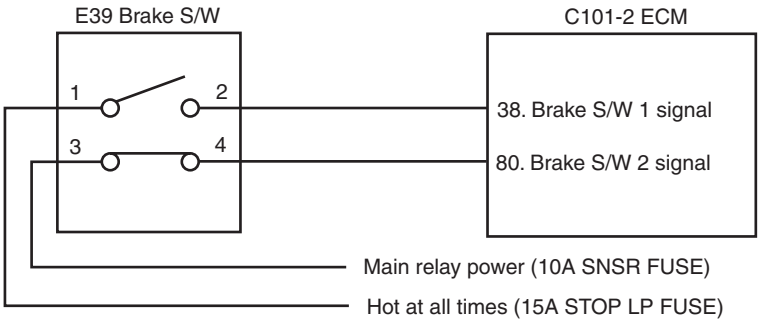
Item	Detecting Condition			Possible Cause
DTC Strategy	• Signal monitoring			• Brake switch component • Abnormal brake pedal height • Brake switch circuit
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• Wiring open			
DiagnosticTime	• 30 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION E6AAC055

Condition	Brake Pedal Released		Brake Pedal Depressed	
switch activated	Switch 1	Switch 2	Switch 1	Switch 2
	OFF	ON	ON	OFF

SCHEMATIC DIAGRAM EE8EC4C4

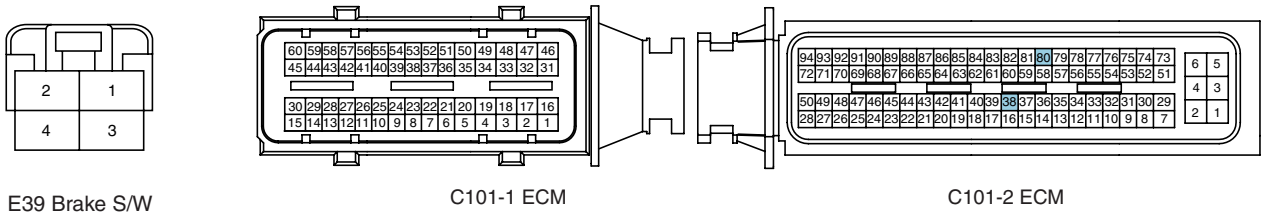
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	15A STOP LP FUSE	Hot at all times
2	C101-2 terminal 38	Brake S/W 1 signal
3	10A SNSR FUSE	Main relay power
4	C101-2 terminal 80	Brake S/W 2 signal

[HARNESS CONNECTOR]



EGNG003U

SIGNAL WAVEFORM AND DATA ECB44D7B

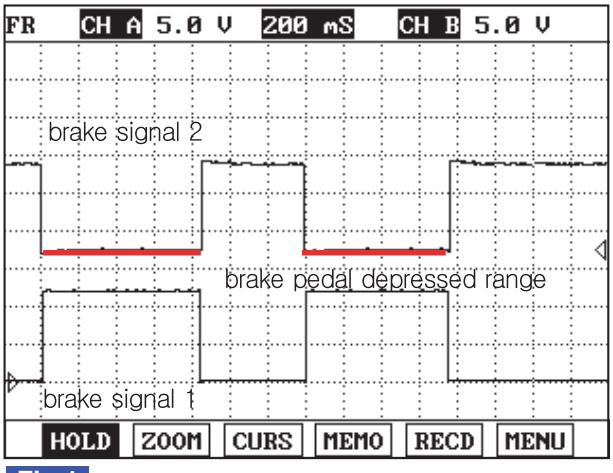


Fig.1

Fig.1) The waveform of brake signal 1 and 2 are measured simultaneously. Both waveforms are symmetrical.

EGNG003V

MONITOR SCANTOOL DATA EB81DE4D

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "BRAKE SWITCH" and "REDUNDANT BRAKE SWITCH" parameter on the Scantool.

specification : When brake pedal is released : "BRAKE SWITCH" and "REDUNDANT BRAKE SWITCH" : OFF
When brake pedal is depressed : "BRAKE SWITCH" and "REDUNDANT BRAKE SWITCH" : ON

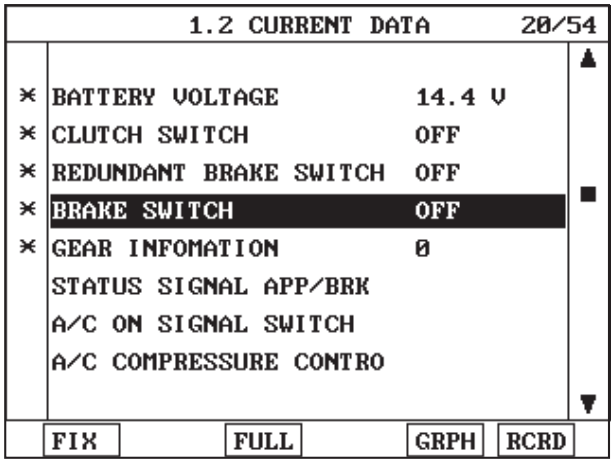


Fig.1

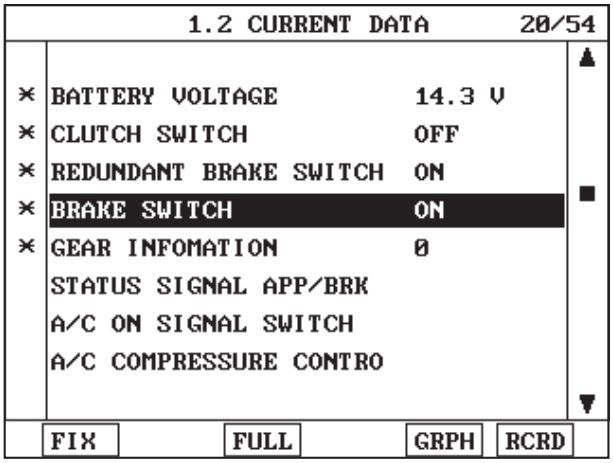


Fig.2

Fig.1) Data when brake switch(brake pedal) is deactivated(released) :
"BRAKE SWITCH" and "REDUNDANT BRAKE SWITCH" : OFF
Fig.2) Data when brake switch(brake pedal) is activated(depressed) :
"BRAKE SWITCH" and "REDUNDANT BRAKE SWITCH" : ON

EGNG003W

TERMINAL AND CONNECTOR INSPECTION EE4A7775

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION EFDA8FE4

1. Check brake switch 1 "HOT AT ALL TIMES"

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect brake switch connector.

   3) Measure the voltage of terminal 2 of brake switch connector.

Specification : 11.5V~13.0V

   4) Is the measured voltage within the specification?

   YES

   ▶ Go to "2.Check brake switch 2 main relay power" as follows.

   NO

   ▶ Repair E/R FUSE & RELAY BOX 15A STOP FUSE and related circuit and go to "Verification of Vehicle Repair".

2. Check brake switch 2 main relay power

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect brake switch connector.

   3) IG KEY "ON".

   4) Measure the voltage of brake switch connector terminal 4.

Specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Signal Circuit Inspection".

   NO

   ▶ Repair E/R FUSE & RELAY BOX 15A INJ FUSE and related circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E01EF76A

1. Check brake switch signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect ECM connector with brake switch connector connected.

   3) Disconnect Engine room junction box main relay, connect main relay terminal 1 and 5 using jump wire.

4) Measure the voltage of ECM connector terminal 38 and 80 as depressing brake pedal.

SPECIFICATION :

	Brake Pedal Released	Brake Pedal Depressed
Brake switch 1 (terminal 59)	0.0V~0.1V	11.5V~13.0V
Brake switch 2 (terminal 54)	11.5V~13.0V	0.0V~0.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ If component has no problem after performing "Component Inspection" and go to "2. Check open in signal circuit".

2. Check open in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect brake switch connector and ECM connector.

3) Check continuity between brake switch connector terminal 1 and ECM connector terminal 38. (brake switch 1 circuit)

4) Check continuity between brake switch connector terminal 3 and ECM connector terminal 80. (brake switch 2 circuit)

specification : Continuity (below 1.0Ω)

5) Is the measured resistance within the specification?

YES

▶ Repair short in signal circuit and go to "Verification of Vehicle Repair".

NO

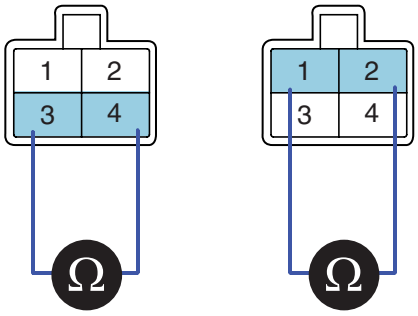
▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E8E805D3

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect brake switch connector.
3. Check continuity between brake switch component terminal 1and 2 as depressing brake pedal. (brake switch 1)
4. Check continuity between brake switch component terminal 3and 4 as depressing brake pedal. (brake switch 2)

SPECIFICATION :

Brake Pedal Released		Brake Pedal Depressed	
Switch 1	Switch 2	Switch 1	Switch 2
Discontinuity	Continuity	Continuity	Discontinuity



EGNG004B

5. Does brake switch operate correctly?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Unless any problem is detected after checking height of brake pedal, replace brake switch component and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EF1AB3C2

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

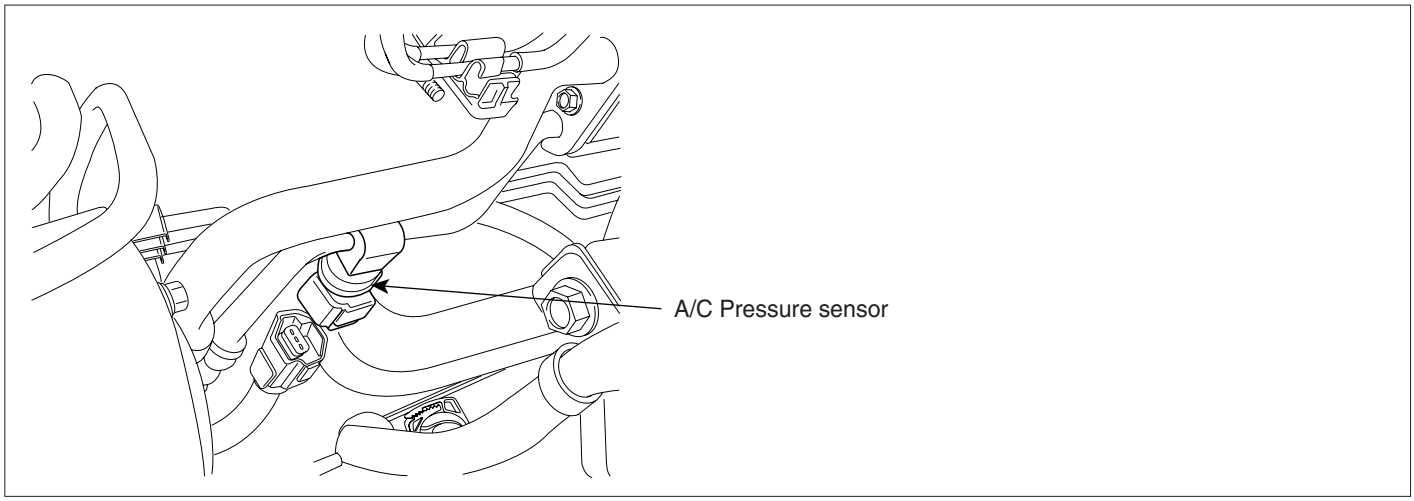
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0532 A/C REFRIGERANT PRESSURE SENSOR "A" CIRCUIT LOW INPUT

COMPONENT LOCATION EBC60CBF



EGNG014T

GENERAL DESCRIPTION E45AB0FB

A/C pressure transducer consists of piezoelectric element and it detects aircon refrigerant pressure. Piezoeletric type is more advantageous to obtain linear data of pressure than existing switch type. Thus, optimum control of aircon compressor and fan is realized and improved fuel efficiency follows with it.

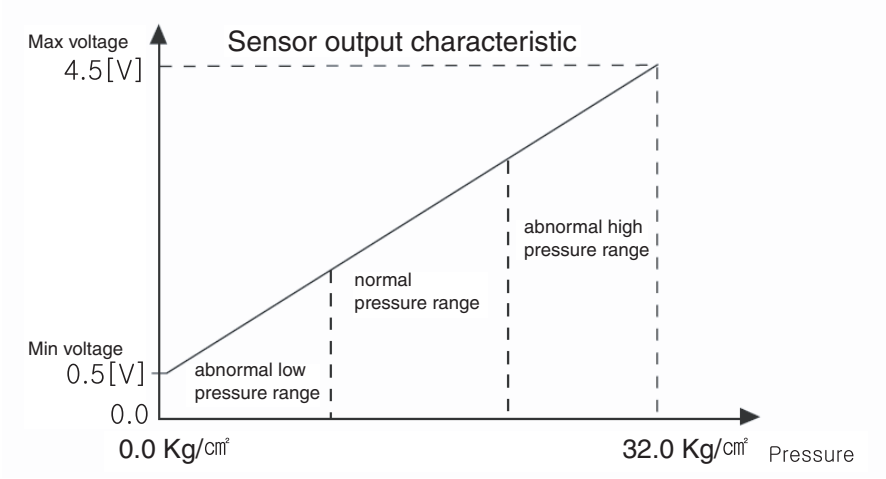
DTC DESCRIPTION EB007F4D

P0532 is set when the voltage below 0.3V - minimum voltage of A/C pressure transducer signal - is detected for more than 0.6 sec.. This code is due to open in power circuit or short to ground in signal circuit of A/C pressure transducer.

DTC DETECTING CONDITION EB7F93DB

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• A/C pressure transducer circuit • A/C pressure transducer component
Enable Conditions	• Engine run			
ThresholdValue	• When output voltage is below the minimum value (below 300mV)			
DiagnosticTime	• 600ms			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

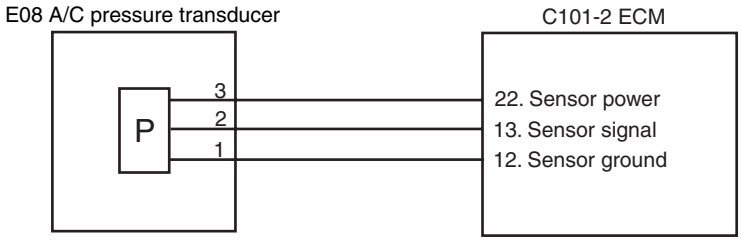
SPECIFICATION E3F71BFD



EGNG001Q

SCHEMATIC DIAGRAM E00BBD4F

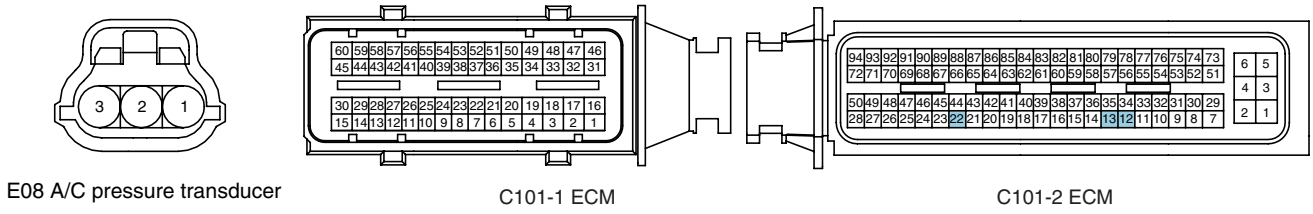
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-2 terminal 12	Sensor ground
2	C101-2 terminal 13	Sensor signal
3	C101-2 terminal 22	Sensor power

[HARNESS CONNECTOR]



EGNG001R

SIGNAL WAVEFORM AND DATA E21FF245

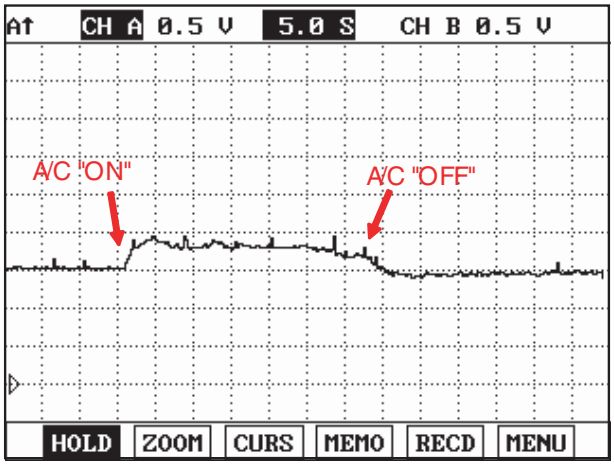


Fig.1

Fig.1) Waveform of A/C pressure transducer in accordance with aircon operation.(aircon compressor operation)

EGNG001S

NOTE

Output signal(voltage) changes in accordance with the amount of refrigerant and the change of weather. Check if normal pressure change occurs in accordance with aircon compressor operation at normal pressure range shown in "Specification".

MONITOR SCANTOOL DATA E52EBD84

1. Connect scantool to Data Link Cable (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "A/C PRESSURE SENSOR" parameter on the scantool.

Specification : A/C "OFF" : 1200mV~1500mV
A/C " ON" : 1500mV~ 2400mV

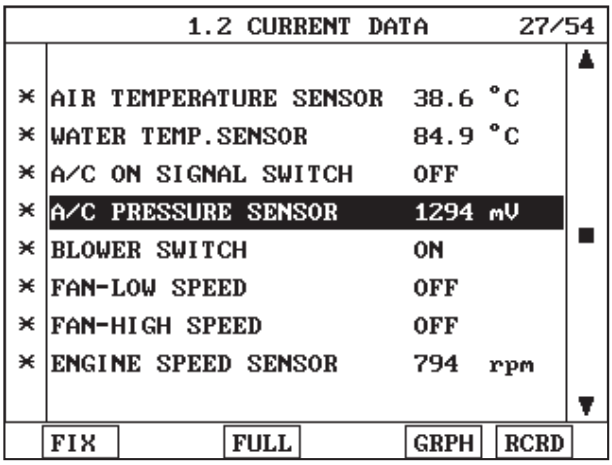


Fig.1

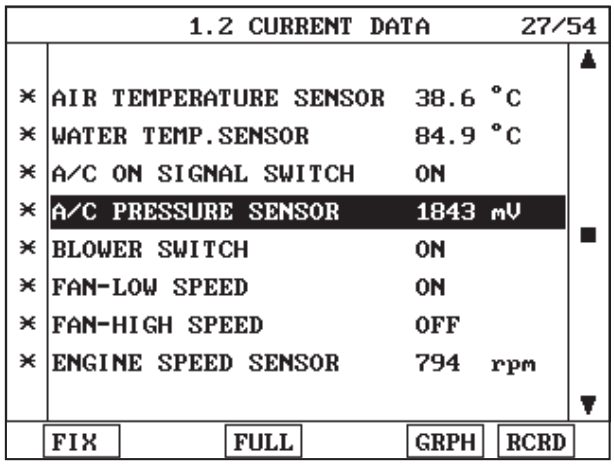


Fig.2

Fig.1) Data at idle and aircon "OFF", Aircon pressure sensor output voltage is 1300mV.
Fig.2) Data at idle and aircon "ON". Aircon pressure sensor output voltage increases as aircon compressor operates.

EGNG001T

TERMINAL AND CONNECTOR INSPECTION E22C863B

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damage of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at mail connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION EACACD4F

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect A/C pressure transducer connector.
3. IG KEY "ON".
4. Measure the voltage of A/C pressure transducer terminal 3.

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification ?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in power circuit of A/C pressure transducer and go to "Verification of Vehicle Repair".
[Check open between aircon pressure sensor connector terminal 3 and ECM connector terminal 22.]

SIGNAL CIRCUIT INSPECTION E9663565

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect A/C pressure transducer connector.

   3) IG KEY "ON".

   4) Measure the voltage of A/C pressure transducer terminal 2.

Specification : 4.8V~5.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E7207EB8

1. Aircon pressure sensor visual inspection

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect A/C pressure transducer connector.

   3) Check if corrosion and contamination at aircon pressure sensor terminal is detected.

   4) Check aircon pressure sensor connecting torque and aircon refrigerant leakage.

   5) Does any problem is detected at aircon pressure sensor?

YES

▶ Replace aircon pressure sensor and go to "Verification of Vehicle Repair".

NO

▶ Go to "2. Check A/C pressure transducer waveform " as follows.

2. Check A/C pressure transducer waveform

1) IG KEY "OFF", ENGINE "OFF".
2) Connect A/C pressure transducer connector.
3) Connect oscilloscope to A/C pressure transducer connector terminal 2.
4) Monitor aircon pressure sensor waveform at idle as turning Aircon "ON".

Specification : Refer to "Siganl waveform & data"

5) Is A/C pressure transducer waveform outputted correctly?

YES

▶ Go to "Verification of Vehicle Rapair".

NO

▶ Replace A/C pressure transducer and go to "Verification of Vehicle Rapair".

VERIFICATION OF VEHICLE REPAIR E0A6CA65

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0533 A/C REFRIGERANT PRESSURE SENSOR "A" CIRCUIT HIGH INPUT

COMPONENT LOCATION ECEBFCE3

Refer to DTC P0532.

GENERAL DESCRIPTION EF918BDD

Refer to DTC P0532.

DTC DESCRIPTION EDBC0DDF

P0533 is set when the voltage above 4800mV - maximum voltage of A/C pressure transducer signal - is detected for more than 0.6 sec.. This code is due to open or short in signal or ground circuit of A/C pressure transducer.

DTC DETECTING CONDITION E4B3BCB7

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• A/C pressure transducer circuit • A/C pressure transducer component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• When output signal is above the maximum value (above 4800mV)			
DiagnosticTime	• 600ms			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION EBC0F624

Refer to DTC P0532.

SCHEMATIC DIAGRAM EFBE7BB1

Refer to DTC P0532.

SIGNAL WAVEFORM AND DATA E6554D86

Refer to DTC P0532.

MONITOR SCANTOOL DATA E54D9902

1. Connect scantool to Data Link Cable (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "A/C PRESSURE SENSOR" parameter on the scantool.

Specification : A/C "OFF" : 1200mV~1500mV
A/C " ON" : 1500mV~ 2400mV

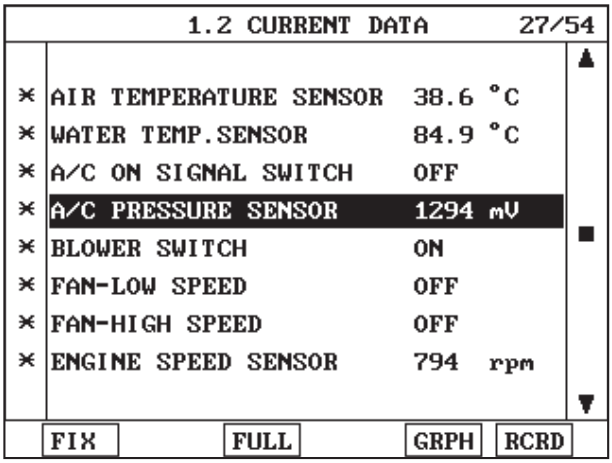


Fig.1

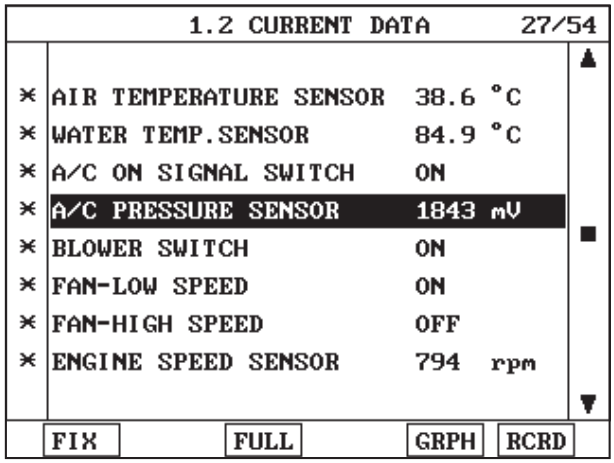


Fig.2

Fig.1) Data at idle and aircon "OFF", Aircon pressure sensor output voltage is 1300mV.
Fig.2) Data at idle and aircon "ON". Aircon pressure sensor output voltage increases as aircon compressor operates.

EGNG001T

TERMINAL AND CONNECTOR INSPECTION EF4CD920

Refer to DTC P0532.

POWER CIRCUIT INSPECTION E7C53071

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect A/C pressure transducer connector.
3. IG KEY "ON".
4. Measure the voltage of A/C pressure transducer terminal 3.

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification ?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in power circuit of A/C pressure transducer and go to "Verification of Vehicle Repair".
[Check open between aircon pressure sensor connector terminal 3 and ECM connector terminal 22.]

SIGNAL CIRCUIT INSPECTION E94955BA

1. Check signal circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C pressure transducer connector.

3) IG KEY "ON".

4) Measure the voltage of A/C pressure transducer terminal 2.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Go to "2.Check open in signal circuit" as follows.

2. Check open in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C pressure transducer connector and ECM connector.

3) Check continuity between A/C pressure transducer connector terminal 2 and ECM connector terminal 13.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "3.Check short to battery in signal circuit " as follows.

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C pressure transducer connector and ECM connector.

3) IG KEY "ON".

4) Measure the voltage of A/C pressure transducer terminal 2.

Specification : 0.0V~0.1V

5) Is abnormal voltage detected in the circuit with both connector disconnected?

YES

▶ Repair short to battery and go to "Verification of Vehicle Repair".

NO

▶ Go to "Component Inspection".

GROUND CIRCUIT INSPECTION EDF0A090

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect A/C pressure transducer connector.
3. IG KEY "ON".
4. Measure the voltage of A/C pressure transducer terminal 3. [TEST "A"]
5. Measure the voltage of A/C pressure transducer terminal 3 and terminal 1. [TEST "B"]
   (terminal 3: Check + prove , terminal 1 : Check - prove)

Specification : the voltage difference between TEST "A" and TEST "B" is within 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E28F69F9

1. Aircon pressure sensor visual inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect A/C pressure transducer connector.
   3) Check if corrosion and contamination at aircon pressure sensor terminal is detected.
   4) Check aircon pressure sensor connecting torque and aircon refrigerant leakage.
   5) Does any problem is detected at aircon pressure sensor?

YES

▶ Replace aircon pressure sensor and go to "Verification of Vehicle Repair".

NO

▶ Go to "2. Check A/C pressure transducer waveform " as follows.

2. Check A/C pressure transducer waveform
   1) IG KEY "OFF", ENGINE "OFF".
   2) Connect A/C pressure transducer connector.

3) Connect oscilloscope to A/C pressure transducer connector terminal 2.

4) Monitor aircon pressure sensor waveform at idle as turning Aircon "ON".

Specification : Refer to "Siganl waveform & data"

5) Is A/C pressure transducer waveform outputted correctly?

YES

▶ Go to "Verification of Vehicle Rapair".

NO

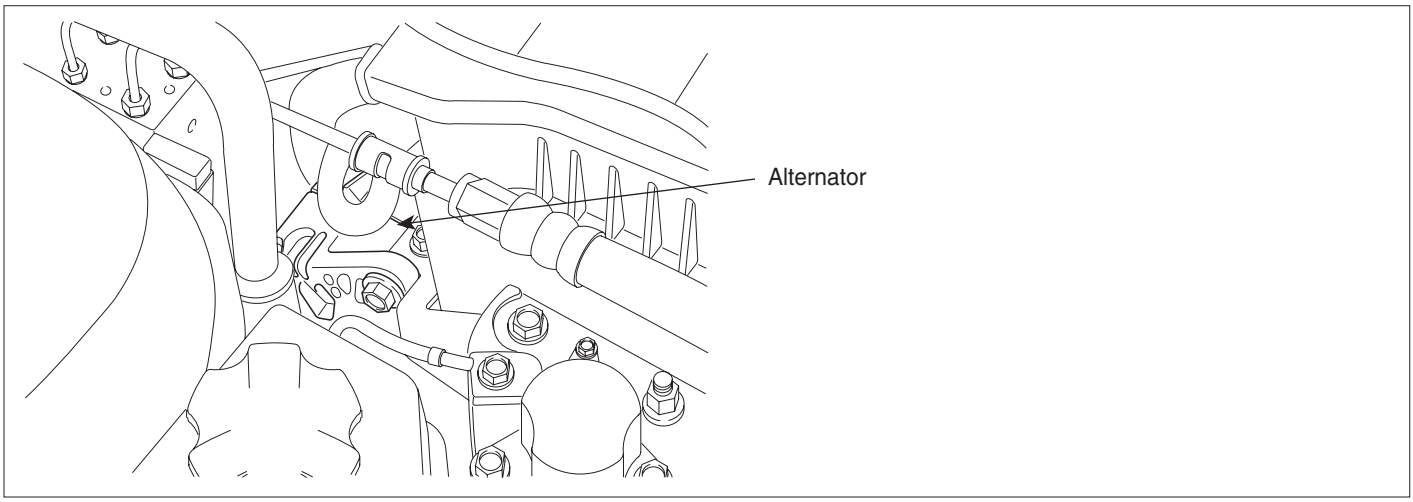
▶ Replace A/C pressure transducer and go to "Verification of Vehicle Rapair".

VERIFICATION OF VEHICLE REPAIR EFB38236

Refer to DTC P0532.

DTC P0562 SYSTEM VOLTAGE LOW

COMPONENT LOCATION ED191A4D



EGNG003M

GENERAL DESCRIPTION E97DDA44

Normally, battery voltage fluctuates from 11.5V to 14.5V. Especially at cranking, voltage can drop to 9.8V. Therefore, actuators which require 12V power supply meet fluctuation of power by 5V.A little change of voltage supply can shift controlling characteristic of actuators, such as injectors, Rail pressure regulator valve and EGR actuator, which should be controlled delicately. To correct controlling characteristic change arrised from voltage fluctuation, ECM performs actuator operating correction according to voltage change as detecting battery voltage change.

DTC DESCRIPTION E513ABDB

P0562 is set when battery voltage below 6V is detected for more than 5 sec. Check charging system.(charging circuit, alternator component)

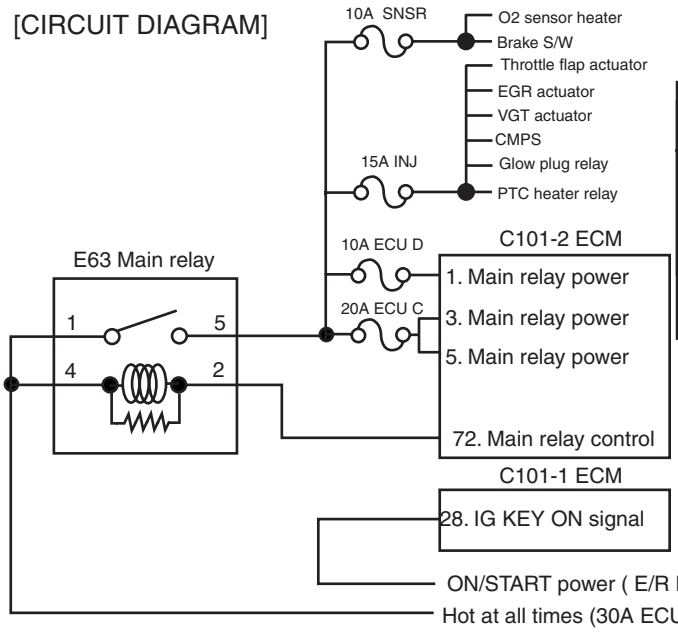
▶ ECM senses battery voltage as monitoring the voltages in ECM(C101-2) connector terminal 1,3,5 which are transmitted from main relay.

DTC DETECTING CONDITION E1936633

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Charging circuit • Alternator component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• when battery voltage is below 6V			
DiagnosticTime	• 5 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

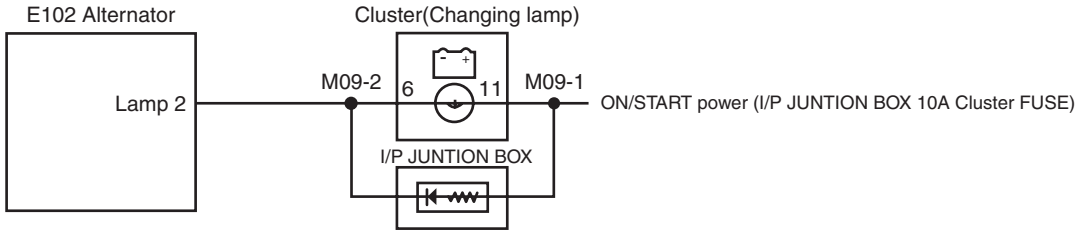
SCHEMATIC DIAGRAM E9C22A8B

[CIRCUIT DIAGRAM]

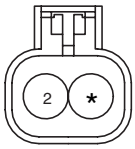


[CONNECTOR INFORMATION]

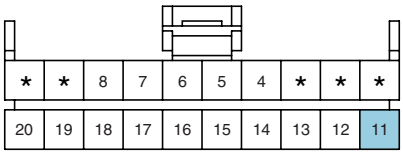
Terminal	Connected to	Function
1	30A ECU A FUSIBLE LINK	Hot at all times
2	C101-2 terminal 72	Main relay control
3	*	*
4	30A ECU A FUSIBLE LINK	Main relay coil power
5	C101-2 terminal 1,3,5 etc.	Power supply to ECM, Sensor, Actuator



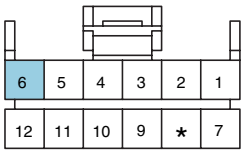
[HARNESS CONNECTOR]



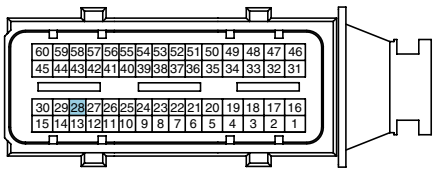
E102 Iternator



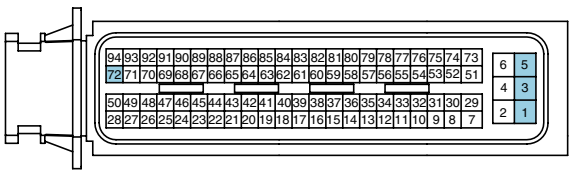
M09-1 Cluster



M09-2 Cluster



C101-1 ECM



C101-2 ECM

EGNG003N

SIGNAL WAVEFORM AND DATA E33B9B53

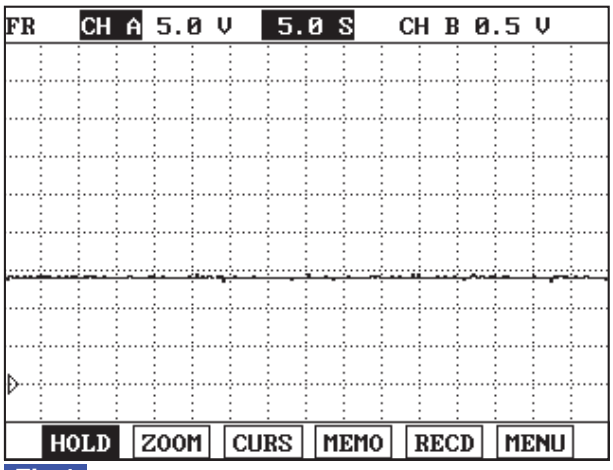


Fig.1

Fig.1) This is alternator charging waveform during engine running. Check if battery voltage drops dramatically as turning on the electrical device such as head lamp, defogger and A/C.

EGNG003O

MONITOR SCANTOOL DATA E5CB078B

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "BATTERY VOLTAGE" parameter on the Scantool.

specification :12.5V~14.5V at idle without any load(800RPM)

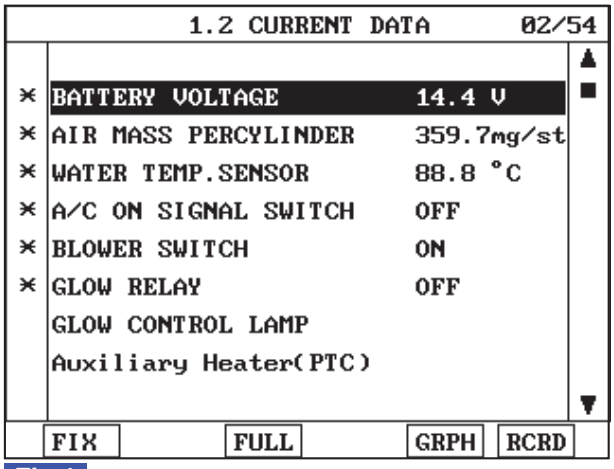


Fig.1

Fig 1) "BATTERY VOLTAGE" data at idle after warming engine up.
Check if the symptoms listed below occur as checking if battery voltage drops dramatically when turning on the electrical devices.

EGNG003P

※ The vehicles with the alternator of poor charging efficiency
1. Lamps are dim at idle, while lamps are bright at acceleration.
2. Intermitently RPM drops excessively or engine shut down at low RPM close to idle state at times.

3. Smooth cranking happens rarely. (Warning lamps in cluster turn dimmer excessively at cranking and poor cranking happen.)
4. Charging lamp turns on during driving.

TERMINAL AND CONNECTOR INSPECTION EB2E7390

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E58BB543

1. Check power supply in alternator connector

   1) IG KEY "ON", Turn engine "OFF".

   2) Disconnect alternator connector.

   3) Measure the voltage of terminal 2 of alternator connector.

Specification : 10.5V~12.0V

   4) Is the measured voltage within the specification?

      YES

      ▶ Go to "2. Check charging lamp operation".

      NO

      ▶ When no voltage is detected at terminal 2.
      Check charging lamp on cluster and charging lamp resistor and repair the open in related circuit and go to "Verification of Vehicle Repair".

2. Check charging lamp operation

   1) IG KEY "ON", ENGINE "OFF".

2) Disconnect alternator connector.

3) Ground alternator connector terminal 2 to chassis ground using jump wire.

specification : charging lamp "ON" when grounded to chassis ground.

4) Does charging lamp turn ON?

YES

▶ Go to "3.Check voltage drop of aternator B+ cable".

NO

▶ Replace lamp and go to "Verification of Vehicle Repair".

3. Check voltage drop of aternator B+ cable

1) IG KEY "ON", Turn engine "ON".

2) Measure the voltage difference between alternator B+ terminal and battery + terminal.
(connect + terminal of multimeter to alternator B+ and connect - terminal of multimeter to battery +terminal.)

specification : below 0.2V (below 200mV)

3) Is the measured voltage within the specification? (Is the voltage drop in alternator B+ cable normal?)

YES

▶ Go to "Component Inspection".

NO

▶ After checking corrosion and deformation of alternator B+ cable and replace it if needed and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E73B3458

1. IG KEY "OFF", ENGINE "OFF".
2. Check belt tension which operates alternator .
3. Check battery terminal and fusible link, poor connection or corrosion of alternator B+ terminal.
4. Turn Engien "ON".
5. Operate the electrical device such as head lamp,defroster and blower motor.
6. Check battery voltage at above 2000 RPM.

Specification : 12.5V~14.5V

7. Is the measured voltage within the specification?

YES

▶ Alternator is performing within the specification.

NO

▶ Replace alternator and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E20C89E0

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0563 SYSTEM VOLTAGE HIGH

COMPONENT LOCATION E744AB4F

Refer to DTC P0562.

GENERAL DESCRIPTION E6D406DF

Refer to DTC P0562.

DTC DESCRIPTION E3D5BD64

P0563 is set when battery voltage above 17.5V is detected for more than 5 sec.. Check alternator component. (over-charging of alternator)
▶ ECM senses battery voltage as monitoring the voltages in ECM(C101-2)connector terminal 1,3,5 which are transmitted from main relay.

DTC DETECTING CONDITION E801EB03

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Charging circuit
• Alternator component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• when battery voltage is above 17.5V</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 5 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SCHEMATIC DIAGRAM E65A25BF

Refer to DTC P0562.

SIGNAL WAVEFORM AND DATA EAFD7CBE

Refer to DTC P0562.

MONITOR SCANTOOL DATA E1091A5E

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "BATTERY VOLTAGE" parameter on the Scantool.

specification :12.5V~14.5V at idle without any load(800RPM)

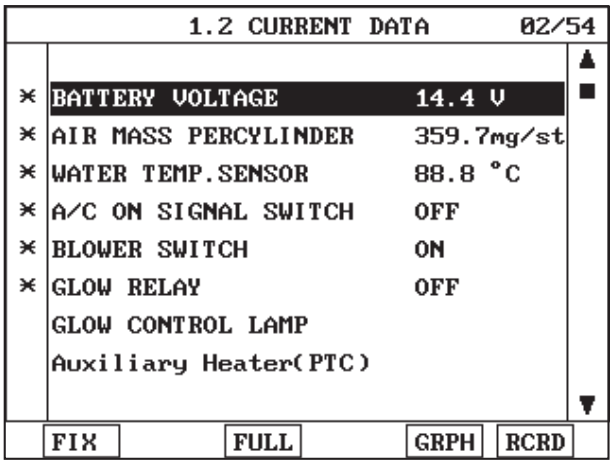


Fig.1

Fig 1) "BATTERY VOLTAGE" data at idle after warming engine up.
Check if the symptoms listed below occur as checking if battery voltage rises dramatically when turning on the electrical devices.

EGNG003L

※ The vehicles with the alternator of over charging efficiency
1. Electrolyte inside battery overflows, check corrosion of battery and around of it.
2. Check if the smell of hydrogen gas which is produced at charging process during engine running state generates excessively.
3. Lamps on cluster, tail lamp and head lamp turn brighter intermittently .

TERMINAL AND CONNECTOR INSPECTION E3F1C178

Refer to DTC P0562.

POWER CIRCUIT INSPECTION EFE685D1

1. Check power supply in alternator connector

   1) IG KEY "ON", Turn engine "OFF".

   2) Disconnect alternator connector.

   3) Measure the voltage of terminal 2 of alternator connector.

Specification : 10.5V~12.0V

   4) Is the measured voltage within the specification?

   YES

   ▶ Go to "2. Check charging lamp operation".

   NO

   ▶ When no voltage is detected at terminal 2.
   Check charging lamp on cluster and charging lamp resistor and repair the open in related circuit and go to "Verification of Vehicle Repair".

2. Check charging lamp operation

   1) IG KEY "ON", ENGINE "OFF".

2) Disconnect alternator connector.

3) Ground alternator connector terminal 2 to chassis ground using jump wire.

specification : charging lamp "ON" when grounded to chassis ground.

4) Does charging lamp turn ON?

YES

▶ Go to "3.Check voltage drop of aternator B+ cable".

NO

▶ Replace lamp and go to "Verification of Vehicle Repair".

3. Check voltage drop of aternator B+ cable

1) IG KEY "ON", Turn engine "ON".

2) Measure the voltage difference between alternator B+ terminal and battery + terminal.
(connect + terminal of multimeter to alternator B+ and connect - terminal of multimeter to battery +terminal.)

specification : below 0.2V (below 200mV)

3) Is the measured voltage within the specification? (Is the voltage drop in alternator B+ cable normal?)

YES

▶ Go to "Component Inspection".

NO

▶ After checking corrosion and deformation of alternator B+ cable and replace it if needed and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E69573DB

1. IG KEY "OFF", ENGINE "OFF".
2. Check belt tension which operates alternator .
3. Check battery terminal and fusible link, poor connection or corrosion of alternator B+ terminal.
4. Turn Engien "ON".
5. Operate the electrical device such as head lamp,defroster and blower motor.
6. Check battery voltage at above 2000 RPM.

Specification : 12.5V~14.5V

7. Is the measured voltage within the specification?

YES

▶ Alternator is performing within the specification.

NO

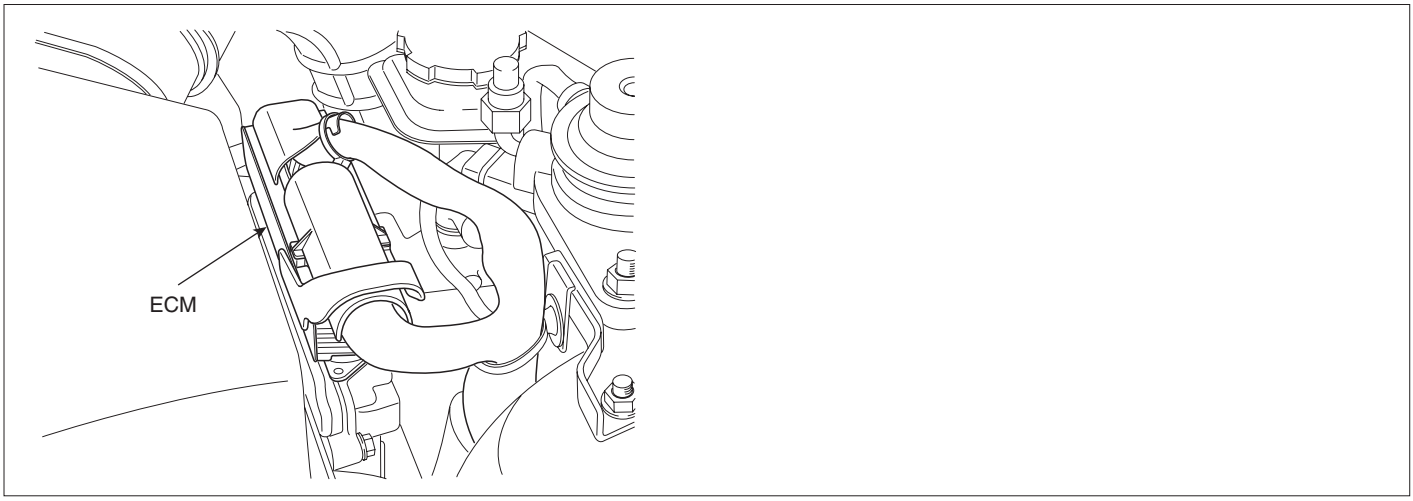
▶ Replace alternator and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E18D01A7

Refer to DTC P0562.

DTC P0602 EEPROM-PROGRAMING ERROR

COMPONENT LOCATION EC226664



EGNG007T

GENERAL DESCRIPTION EFB33A83

ECM is activated by power supply. Signals from several sensors, such as CKPS and APS, is inputted to ECM. Comparing inputted siganals with control LOGIC saved at micro controller and EEPROM, ECM controlls engine as actuating injectors, solenoids and relays. To guarantee accurate control, ECM performs SELF TEST, DIAGNOSIS of several sensors and actuators. And if serious trouble which affects vehicle performance occurrs, ECM sets DTCs.At certain cases, ECM shuts down whole systems in order to prevent dangerous situation due to incorrect control.

DTC DESCRIPTION E054F451

P0602 is set when data writing on EEPROM inside of ECM is impossible.This code is due to the failure of ECM(ECM hardware failure).

DTC DETECTING CONDITION EFC2B6DF

Item	Detecting Condition			Possible Cause
DTC Strategy	• EEPROM monitorting			• ECM component failure
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• when data writing on EEPROM inside of ECM is impossible			
DiagnosticTime	• Immediately			
Fail Safe	Fuel Cut	YES		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

COMPONENT INSPECTION EFDDD122

1. ECM Component Inspection

1) IG KEY "OFF", ENGINE "OFF".
2) Disconnect ECM.
3) Replace ECM, check if abnormal operations disappear.
4) If problems are corrected, replace ECM.

VERIFICATION OF VEHICLE REPAIR E8334536

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0605 INTERNAL CONTROL MODULE READ ONLY MEMORY(ROM) ERROR

COMPONENT LOCATION E3CA5F91

Refer to DTC P0602.

GENERAL DESCRIPTION EAF8FFDC

Refer to DTC P0602.

DTC DESCRIPTION E7F18B44

P0605 is set when 1)communication error between micro controller inside of ECM and EEP ROM is detected or 2)a different vesion of ECM is installed.

DTC DETECTING CONDITION ED8A09D3

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• EEPROM monitorting</td><td rowspan="7">• Version difference between ECM and ECMcommunication module
• ECM component failure</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• (EEPROM communication error): communication failure between micro controller inside of ECM and EEPROM
• Each data range is activated abnormally.
• self test about optional devices(A/C, immobilizer, cruise control)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>YES</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

COMPONENT INSPECTION EF2DEFF3

1. ECM Component Inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect ECM.
   3) Replace ECM, check if abnormal operations disappear.
   4) If problems are corrected, replace ECM.

VERIFICATION OF VEHICLE REPAIR E0D33456

Refer to DTC P0602.

DTC P0606 ECM/PCM PROCESSOR(ECM-SELF TEST FAILED)

COMPONENT LOCATION E556A464

Refer to DTC P0602.

GENERAL DESCRIPTION EA98F57C

Refer to DTC P0602.

DTC DESCRIPTION E0AEAC1F

P0606 is set when 1) writing/reading error inside of ECM occur. 2) error of APS 2 ground checking which is repeated every 0.2 sec. or 3) the voltage of sensor power supply 1 and 2 (the standard voltage of A/D converter) are below 4.7V or above 5.1V. This code is due to ECM internal failure.

DTC DETECTING CONDITION E09FAEE2

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="7">• ECM component failure</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• writing/reading error inside of ECM - 100ms
• APS 2 ground checking error - 500ms
• APS 2 ground checking error - 100ms</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Refer to the data above this cell</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SIGNAL WAVEFORM AND DATA E0AA3EBC

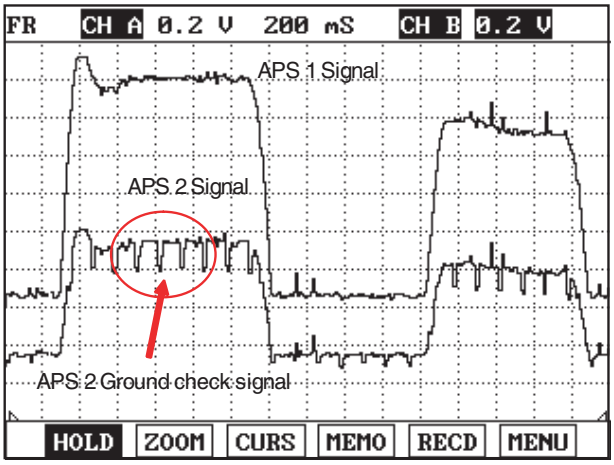


Fig.1

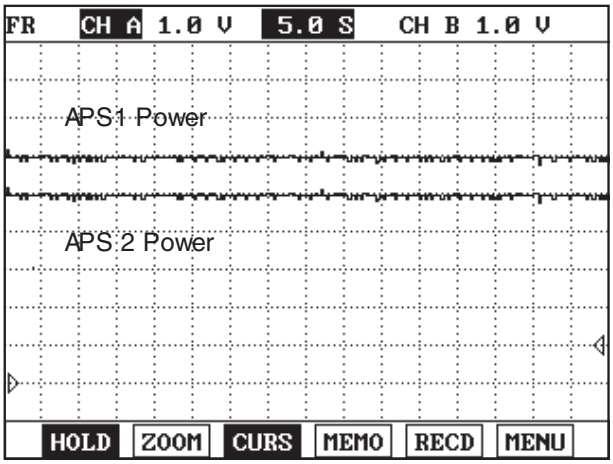


Fig.2

Fig.1) Ground checking signal of APS 2 signal is for ECM to monitor APS 2. This signal drops APS 2 output voltage to below 200.39mV every 200msec. If APS 2 output voltage does not drop to below 200.39mV, ECM sets DTC as recognizing ground circuit error of APS 2 .

※ The waveform below 200.39mV is not detectable in ground checking signal waveform of APS 2 signal. Instead, the waveform which drops a little is detected. If APS 2 data of "SERVICE DATA" on the Scantool varies from 350mV to 0mV periodically, it means it works normally.

Fig.2) APS 1 and APS 2 signals are measured simultaneously, Check if 5V sensor voltage(the standard voltage of A/D converter inside of ECM) is from 4.8V to 5.16V.

EGNG001Y

COMPONENT INSPECTION E43AE240

1. ECM Component Inspection

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect ECM.

   3) Replace ECM, check if abnormal operations disappear.

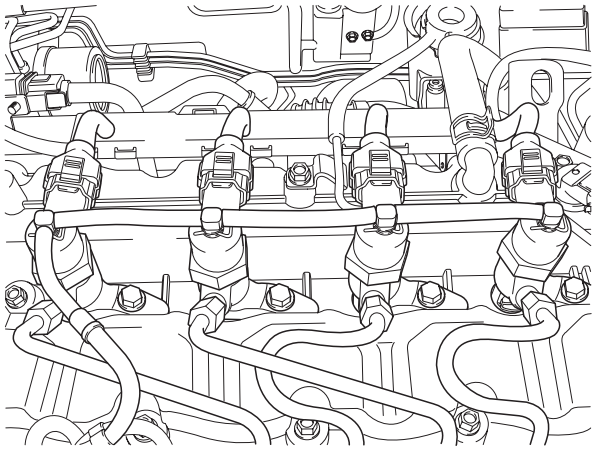
   4) If problems are corrected, replace ECM.

VERIFICATION OF VEHICLE REPAIR E1AE96AD

Refer to DTC P0602.

DTC P0611 INJECTOR CIRCUIT MALFUNCTION (MORE THAN TWO INJECTORS)

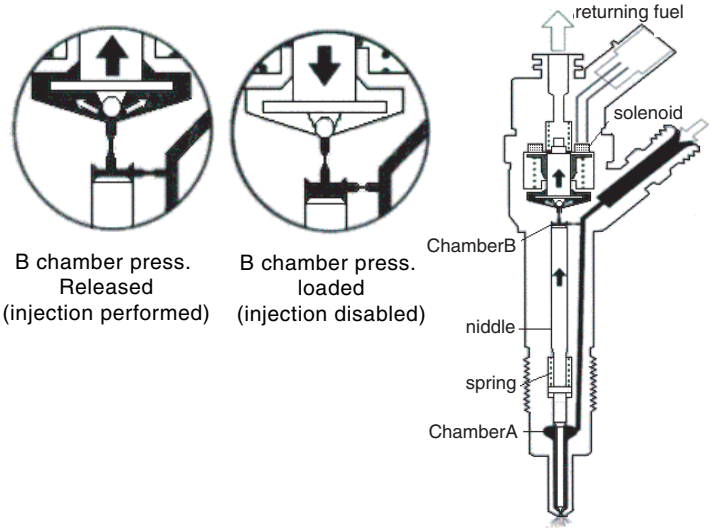
COMPONENT LOCATION E2C338B1



EGNG008C

GENERAL DESCRIPTION E8583E16

Injectors spray fuel in the highly compressed combustion chamber, and power generates through combustion process.Fuel pressure is raised to 1600bar in common rail diesel engine for the purpose of making fuel into minute particles. And fuel devided into minute particles leads smoke reduction, high power generation, and improved fuel efficiency. To control pressure of 1600bar with solenoid, oil pressure surbo is applied. And injector solenoids is actuated by solenoid operating voltage raised to 80V with the method of current control. Niddle valve inside of injector is located between A and B chamber. If applied pressure to B chamber is relived by injector solenoid, niddle valve is raised by the pressure of A chamber then, fuel is injected. If same pressure is applied to A and B chamber, niddle valve closes by the elasticity then, fuel injection stops.As electronically controlled injector is applied instead of mechanical injector, pilot and post injection, injeciton duration and quantity control are achieved. And engine performance is improved by these control.



B chamber press. Released (injection performed)

B chamber press. loaded (injection disabled)

EGNG008D

DTC DESCRIPTION E2A1B928

P0611 is set when the problems of more than 2 injector circuits are detected thus, it is difficult to find abnormal injector. Check "Circuit Inspection" of all injectors

DTC DETECTING CONDITION EB903688

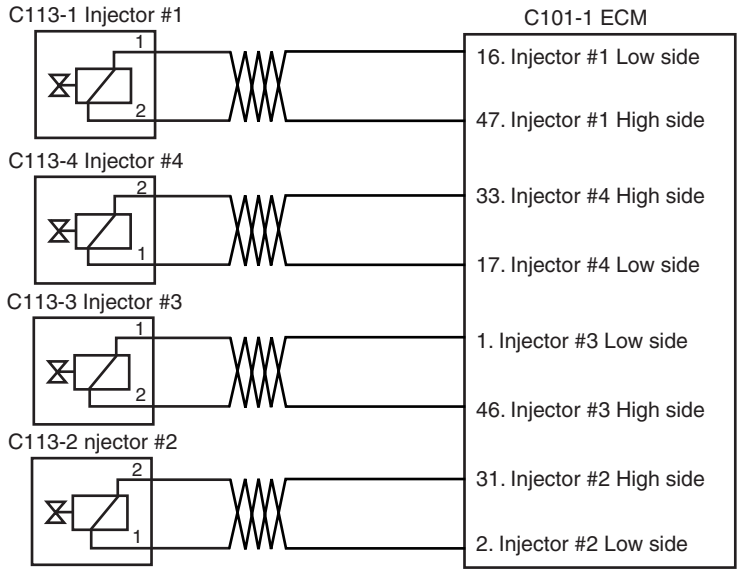
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Current monitoring</td><td rowspan="6">• Short in Injector circuit
• Injector component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Cylinder recognition is impossible due to the failure more than 2 injectors.</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>YES</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION E43C5A79

Injector Component Resistance	Injector Operating Voltage	Injector Operating Current	Injector Control Type
0.255Ω ±0.04 (20℃).	80V	Peak current : 18±1A Hold in current : 12±1A Recharging current : 7A	Current control

SCHEMATIC DIAGRAM EA35C959

[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

[C113-1 Injector #1]

Terminal	Connected to	Function
1	C101-1 terminal 16	Injector #1 Low side
2	C101-1 terminal 47	Injector #1 High side

[C113-2 Injector #2]

Terminal	Connected to	Function
1	C101-1 terminal 2	Injector #2 Low side
2	C101-1 terminal 31	Injector #2 High side

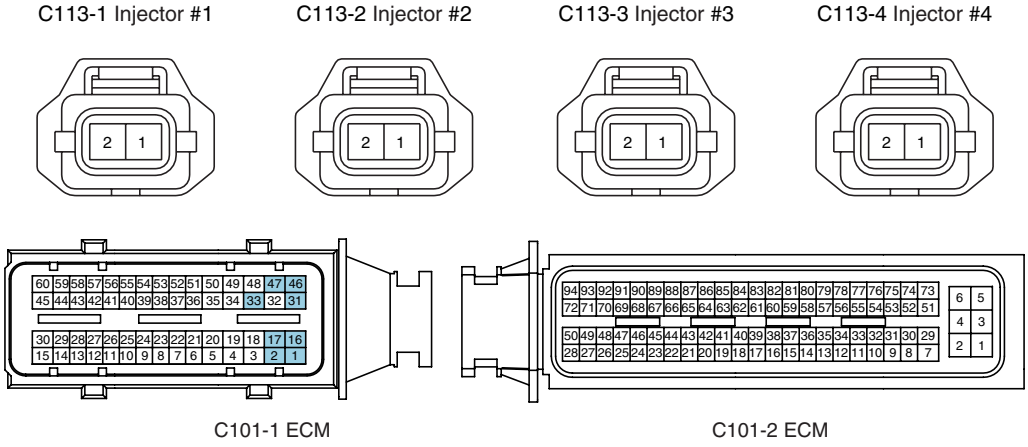
[C113-3 Injector #3]

Terminal	Connected to	Function
1	C101-1 terminal 1	Injector #3 Low side
2	C101-1 terminal 46	Injector #3 High side

[C113-4 Injector #4]

Terminal	Connected to	Function
1	C101-1 terminal 17	Injector #4 Low side
2	C101-1 terminal 33	Injector #4 High side

[HARNESS CONNECTOR]



EGNG008E

SIGNAL WAVEFORM AND DATA EA9DD9FB

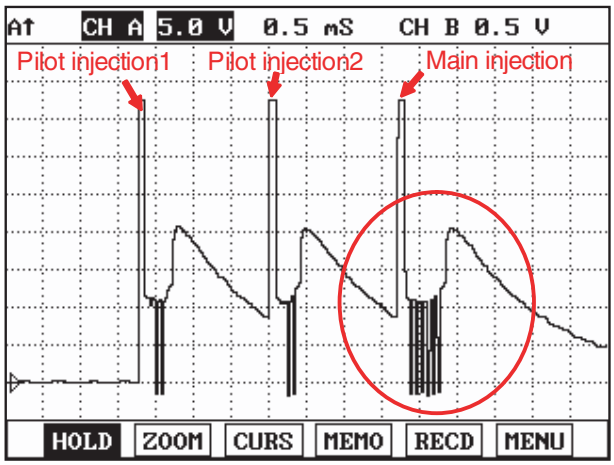


Fig.1

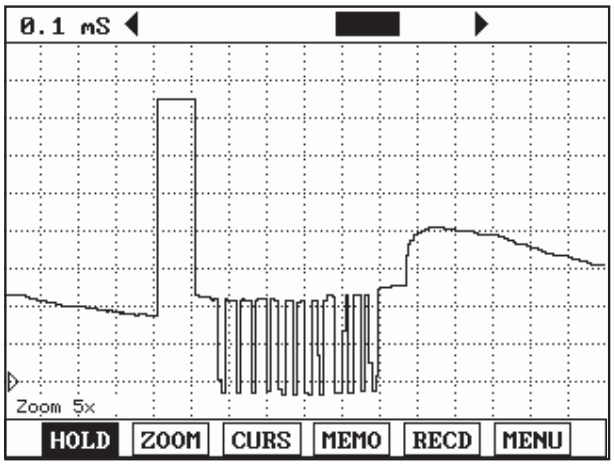


Fig.2

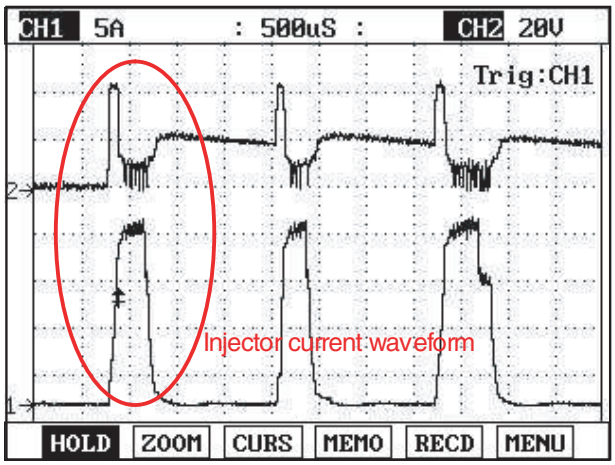


Fig.3

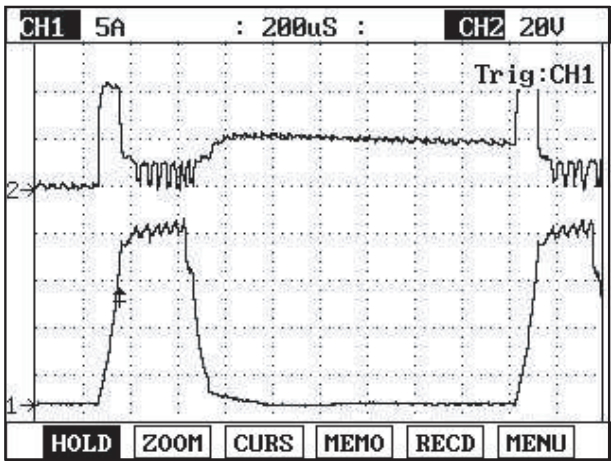


Fig.4

Fig.1) Injector operating waveform at Low side, It shows 2 pilot and 1 main injection.
Fig.2) Magnified waveform of main injection at Fig.1)
Fig.3) Injector voltage and current waveforms are measured at the same time using current prove of scope meter.
Fig.4) Magnified waveform of pilot injection at Fig.3)

EGNG008F

TERMINAL AND CONNECTOR INSPECTION E46C5F40

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION EC1BE6C5

1. Check injector connector terminal voltage (failed injector analysis)

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect all injectors.

   3) IG KEY "ON".

   4) Check the voltage of all injector connector terminal 1 and 2.

Specification : Terminal 1 : 0.4V~0.5V Terminal 2 : 2.0V~2.5V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Refer to "DTC" guide corresponding to each problem occurred injector.

Injector #1 related problem :
Refer to P0201for open in injector circuit.
Refer to P0262 for short in injectoer circuit.

Injector #2 related problem :
Refer to P0202 for open in injector circuit.
Refer to P0265 for short in injectoer circuit.

Injector #3 related problem :
Refer to P0203 for open in injector circuit.
Refer to P0268 for short in injectoer circuit.

Injector #4 related problem :
Refer to P0204 for open in injector circuit.
Refer to P0271 for short in injectoer circuit.

COMPONENT INSPECTION E2473CCF

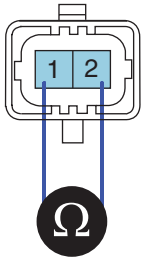
1. Check injector component resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect injector connector.

3) Measure the resistance between injector component terminal 1 and 2.

Specification : 0.255Ω ±0.04 (20℃).



EGNG008I

4) Is the measured resistance(of injector solenoid) within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace injector and go to "Verification of Vehicle Repair".

NOTE

Replacing injectors, peculiar IQA code of each injector should be inputted to ECM
Perform this process using "Injector data input" function on scantool, Refer to P1670, P1671 for more detailed information.

VERIFICATION OF VEHICLE REPAIR E8BBEE17

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

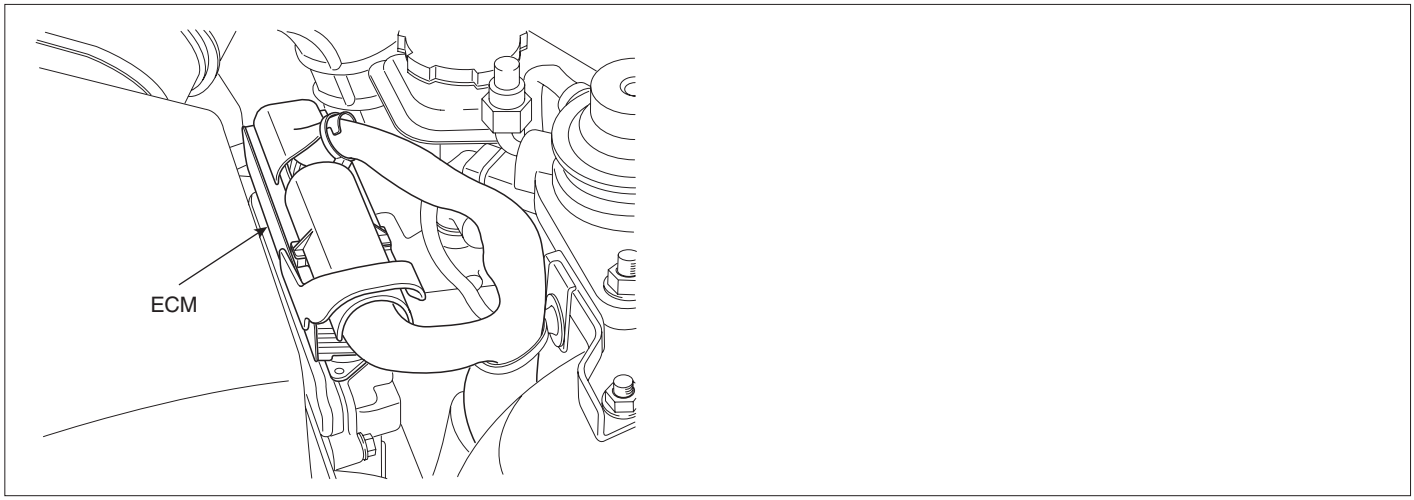
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P062D VOLTAGE REGULATOR #1 FOR INJECTOR MALFUNCTION

COMPONENT LOCATION EE17A438



EGNG007T

GENERAL DESCRIPTION EE9AD80E

There are two transformer for injector operation in side of ECM. 1 pilot and 1 main injection are operated by ECM in EURO 3 diesel engine therefore one transformer device is sufficient to control injector however, 2 pilot and if CPF is applied, 2 post injection are performed additionally by ECM in EURO 4 diesel engine thus, two transformer is required.

DTC DESCRIPTION E9BBFC95

P062D is set when the problem of transforming system 1 for injector contol occurs. This code is due to the failure of transforming system inside of ECM.
※If battery voltage is low, this code can be set. Therefore, beforehand, check DTC code relevant to battery voltage and charging system.

DTC DETECTING CONDITION EA16EF32

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• ECM internal error
Enable Conditions	• Engine running			
ThresholdValue	• Power stage error for injector voltage control, CPU circuit failure			
DiagnosticTime	• Immediately			
Fail Safe	Fuel Cut	YES		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	YES		

COMPONENT INSPECTION E0E819A3

1. ECM Component Inspection

1) IG KEY "OFF", ENGINE "OFF".
2) Disconnect ECM.
3) Replace ECM, check if abnormal operations disappear.
4) If problems are corrected, replace ECM.

VERIFICATION OF VEHICLE REPAIR EEBC51A3

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P062E VOLTAGE REGULATOR #2 FOR INJECTOR MALFUNCTION

COMPONENT LOCATION EE0377C2

Refer to DTC P062D.

GENERAL DESCRIPTION EA2DD0CD

Refer to DTC P062D.

DTC DESCRIPTION E5C63267

P062E is set when the problem of transforming system 2 for injector contol occurs. This code is due to the failure of transforming system inside of ECM.
※If battery voltage is low, this code can be set. Therefore, beforehand, check DTC code relevant to battery voltage and charging system.

DTC DETECTING CONDITION E20E65B1

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• ECM internal error
Enable Conditions	• Engine running			
ThresholdValue	• Power stage error for injectoer voltage control, CPU circuit failure			
DiagnosticTime	• Immediately			
Fail Safe	Fuel Cut	YES		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	YES		

COMPONENT INSPECTION EDE2A480

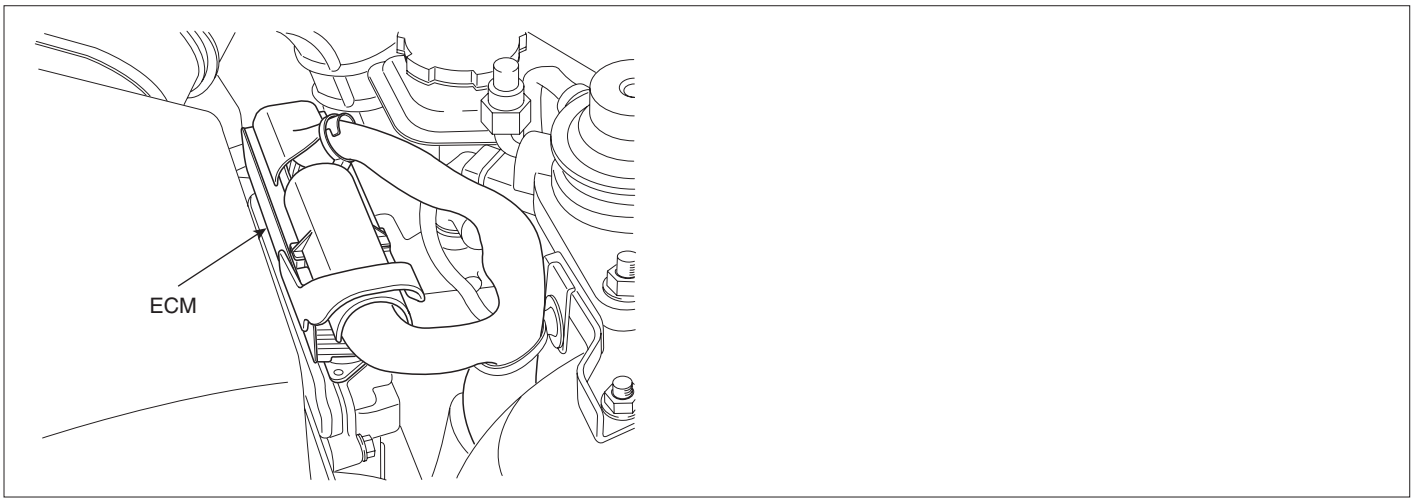
1. ECM Component Inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect ECM.
   3) Replace ECM, check if abnormal operations disappear.
   4) If problems are corrected, replace ECM.

VERIFICATION OF VEHICLE REPAIR EB89084F

Refer to DTC P062D.

DTC P0642 SENSOR REFERENCE VOLTAGE "A" CIRCUIT LOW

COMPONENT LOCATION E81EF00E



EGNG007T

GENERAL DESCRIPTION EB034AA4

ECM is activated by power supply. Signals from several sensors, such as CKPS and APS, is inputted to ECM. Comparing inputted siganals with control LOGIC saved at micro controller and EEPROM, ECM controlls engine as actuating injectors, solenoids and relays. To guarantee accurate control, ECM performs SELF TEST, DIAGNOSIS of several sensors and actuators. And if serious trouble which affects vehicle performance occurrs, ECM sets DTCs.At certain cases, ECM shuts down whole systems in order to prevent dangerous situation due to incorrect control.

DTC DESCRIPTION E914BDC8

P0642 is set when the voltage below 4700mV - minimum voltage of sensor power supply 1 generates from ECM - is detected for more than 0.1 sec.. This code is due to the short to ground in sensor power circuit or the voltage problem inside of ECM.

DTC DETECTING CONDITION E106D213

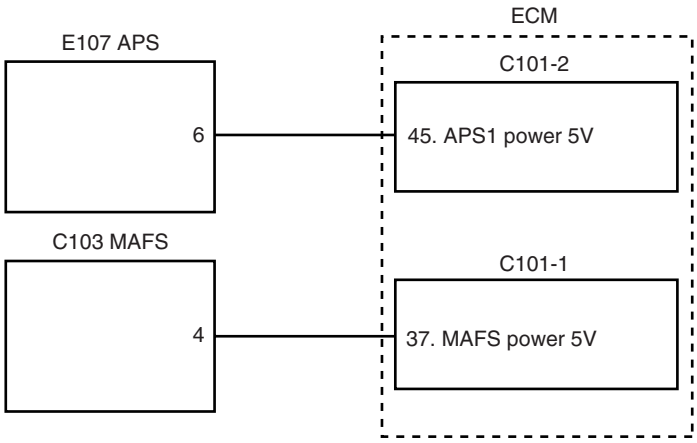
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="7">• MAFS power supply circuit
• APS 1 power supply circuit
• ECM component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• when the voltage is below the minimum voltage of sensor power supply.
(below 4700mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 100ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Limp home mode is activated. (engine speed is fixed at 1200RPM.)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E71F821D

Sensor power 1	Sensor power 2	Sensor power 3
MAFS, APS 1 4830mV~5158mV	RPS, APS 2,BPS 4830mV~5158mV	A/C pressure transducer, VSA position Sensor 4830mV~5158mV

SCHEMATIC DIAGRAM EAB458DF

[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

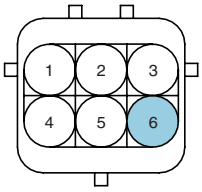
[E107 APS]

Terminal	Connected to	Function
1	C101-2 terminal 31	APS 2 Sensor signal
2	C101-2 terminal 9	APS 1 Sensor signal
3	C101-2 terminal 46	APS 2 Sensor power
4	C101-2 terminal 8	APS 2 Sensor ground
5	C101-2 terminal 30	APS 1 Sensor ground
6	C101-2 terminal 45	APS 1 Sensor power

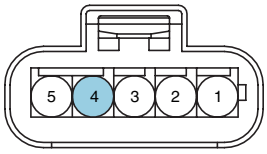
[C103 MAFS]

Terminal	Connected to	Function
1	C142 J/C terminal 5	IG 1 Power
2	C101-1 terminal 44	Sensor ground
3	C101-1 terminal 89	IATS Signal
4	C101-1 terminal 37	Sensor power
5	C101-1 terminal 42	MAFS signal

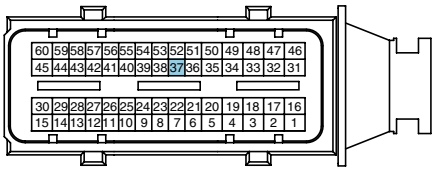
[HARNESS CONNECTOR]



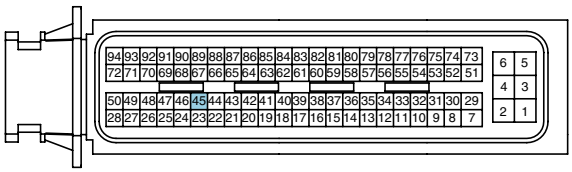
E107 APS



C103 MAFS



C101-1 ECM



C101-2 ECM

EGNG002R

SIGNAL WAVEFORM AND DATA E24DEB71

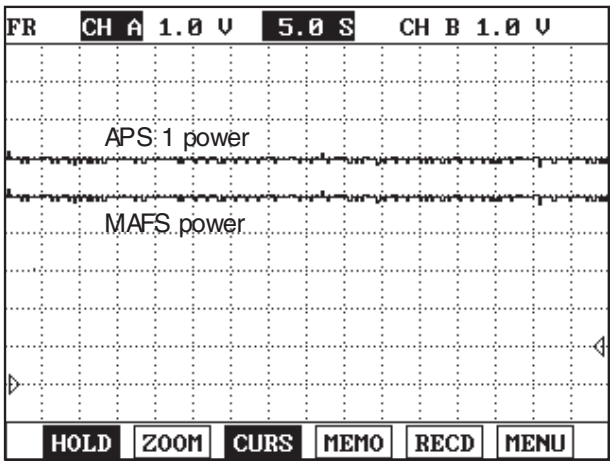


Fig.1

Fig.1) APS 1 and MAFS power supply is measured simultaneously , check if this waveform is within the specification (4.8~5.1V) when turning ignition "ON".

EGNG002S

TERMINAL AND CONNECTOR INSPECTION EF54AD43

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damage of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at mail connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position)
3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E32E7F9F

1. Check power circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnector MAFS connector and APS connector.
   3) IG KEY "ON".

4) Measure the voltage between MAFS connector terminal 4 or APS connector terminal 6 and chassis ground.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2. Check short to ground in power circuit" as follows.

2. Check short to ground in power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect MAFS connector, APS connector, ECM connectors.

3) Check continuity between MAFS connector terminal 4 or APS connector terminal 6 and chassis ground.

specification : Discontinuity (Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ If the circuit is insulated well and the sensor power supply from ECM is low, replace ECM and "Verification of Vehicle Repair".

NO

▶ Repair short to ground and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E51B96AA

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect MAFS connector(C252) and APS connector(M41).
3. Check that sensor connector power supply is within the specification after turning IG KEY "ON".
4. Connect MAFS connector and APS connector in turn.

Specification : sensor power supply should not change as connecting MAFS connector and APS connector.
(If the change of sensor power supply occur as connecting sensor connector, this means the occurrence of short inside of sensor.)

5. Does change of sensor power supply occur as connecting sensor connector?

YES

▶ Replace MAFS or APS.

NO

▶ Go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EF8725B3

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0643 SENSOR REFERENCE VOLTAGE "A" CIRCUIT HIGH

COMPONENT LOCATION E22922EB

Refer to DTC P0642.

GENERAL DESCRIPTION ED5BD757

Refer to DTC P0642.

DTC DESCRIPTION E0E7AAB8

P0643 is set when the voltage above 5158mV - maximum voltage of sensor power supply 1 generates from ECM - is detected for more than 0.1 sec.. This code is due to the short to battery in sensor power circuit or the voltage problem inside of ECM.

DTC DETECTING CONDITION E2C5D0E8

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• MAFS power supply circuit
• APS 1 power supply circuit
• ECM component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• when the voltage is above the maximum voltage of sensor power supply.
(above 5158mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 100ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Limp home mode is activated.(engine speed is fixed at 1200RPM)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION EAB90E28

Refer to DTC P0642.

SCHEMATIC DIAGRAM EF7AE1CE

Refer to DTC P0642.

SIGNAL WAVEFORM AND DATA E1CEFC84

Refer to DTC P0642.

TERMINAL AND CONNECTOR INSPECTION E9D072D7

Refer to DTC P0642.

POWER CIRCUIT INSPECTION EE2B8FB7

1. Check power circuit voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnector MAFS connector and APS connector.

3) IG KEY "ON".

4) Measure the voltage between MAFS connector terminal 4 or APS connector terminal 6 and chassis ground.

specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2. Check short to battery in power circuit" as follows.

2. Check short to battery in power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnector MAFS connector and APS connector.

3) IG KEY "ON".

4) Measure the voltage between MAFS connector terminal 2 or APS connector terminal 6 and chassis ground.

Specification : 0.0V~0.1V

5) Is abnormal voltate measured in this test?

YES

▶ Repair short to battery and go to "Verification of Vehicle Repair".

YES

▶ If the circuit is insulated well and the sensor power supply from ECM is high, replace ECM and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E07D4E8A

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect MAFS connector(C252) and APS connector(M41).
3. Check that sensor connector power supply is within the specification after turning IG KEY "ON".
4. Connect MAFS connector and APS connector in turn.

Specification : sensor power supply should not change as connecting MAFS connector and APS connector.
(If the change of sensor power supply occur as connecting sensor connector, this means the occurrence of short inside of sensor.)

5. Does change of sensor power supply occur as connecting sensor connector?

YES

▶ Replace MAFS or APS.

NO

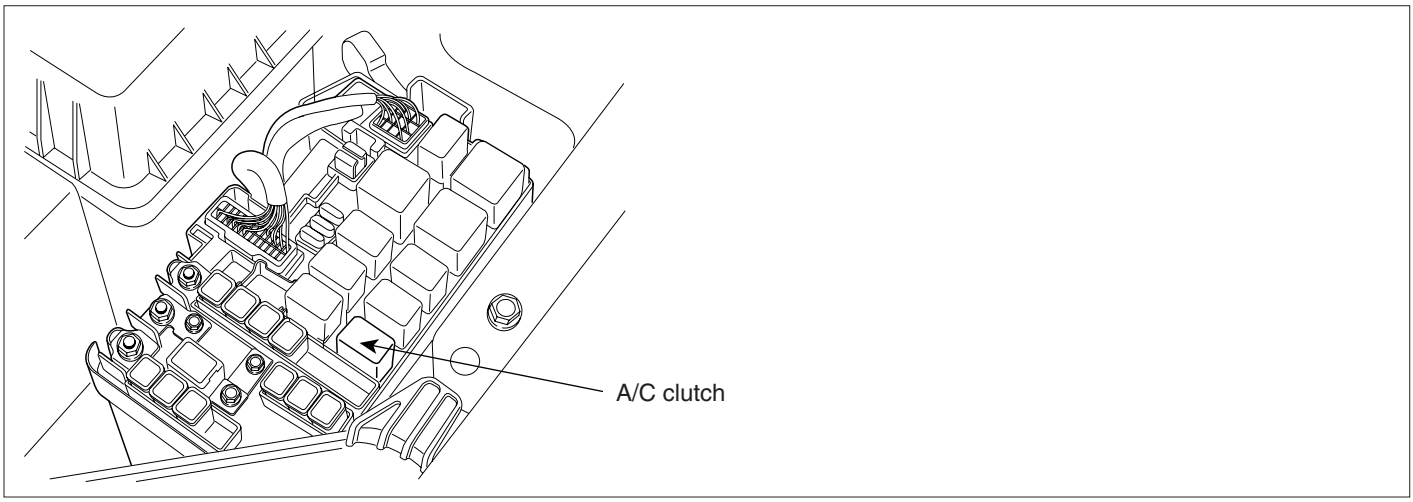
▶ Go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EE51A8BE

Refer to DTC P0642.

DTC P0646 A/C CLUTCH RELAY CONTROL CIRCUIT LOW

COMPONENT LOCATION EEA5390B



EGNG014U

GENERAL DESCRIPTION E631C372

Aircon Relay which is controled by ECM supplies and cut electrical power to Aircon compressor. ECM activates or deactivates Aircon Relay based on inputted signal such as aircon switch siganl and Aircon switch signal.As controlling Aircon Relay, ECM 1)turns OFF aircon compressor at rapid acceleration to retain suffiecient capacity for acceleration, 2)actively performs idle-up function to cope with the change of engine load which happens at aircom compressor operation.

DTC DESCRIPTION E0C754B5

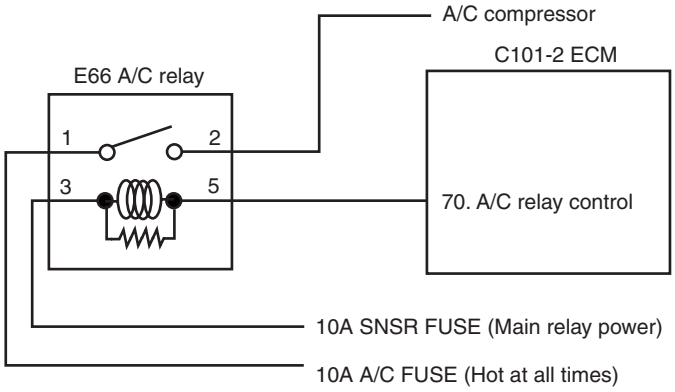
P0646 is set when '0A' is detected in Aircon relay control circuit for more than 1 sec.. This code is due to open or short to ground in Aircon relay control circuit or internal open in relay component.

DTC DETECTING CONDITION EFF203A7

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• A/C relay circuit • A/C relay component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• Short to GND, Wiring open			
DiagnosticTime	• 1.0 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SCHEMATIC DIAGRAM E4B2E0FC

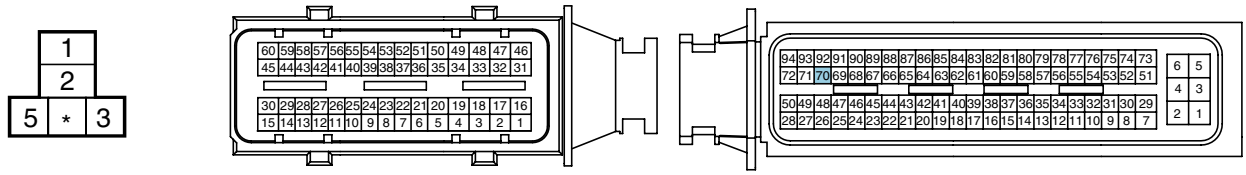
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	10A A/C FUSE (Hot at all times)	Relay power(INPUT)
2	A/C compressor	Relay power(OUTPUT)
3	10A SNSR FUSE (Main relay power)	Relay coil power
4	*	*
5	C101-2 terminal 70	Relay control

[HARNESS CONNECTOR]



E66 A/C relay C101-1 ECM C101-2 ECM

EGNG001B

MONITOR SCANTOOL DATA E4E33BE7

1. Connect scantool to Data Link Cable (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "A/C COMPRESSOR CONTROL" parameter on the scantool.

specification : A/C switch "ON" : A/C RELAY "ON" (Aircon compressor turns ON and OFF periodically by Aircon pressure S/W.)
A/C switch "OFF" : A/C RELAY "OFF"

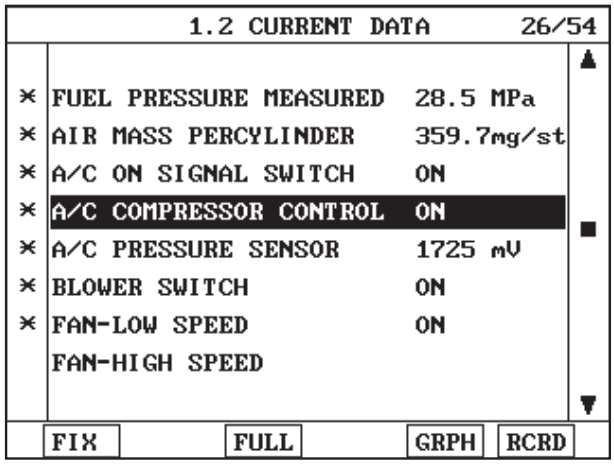


Fig.1

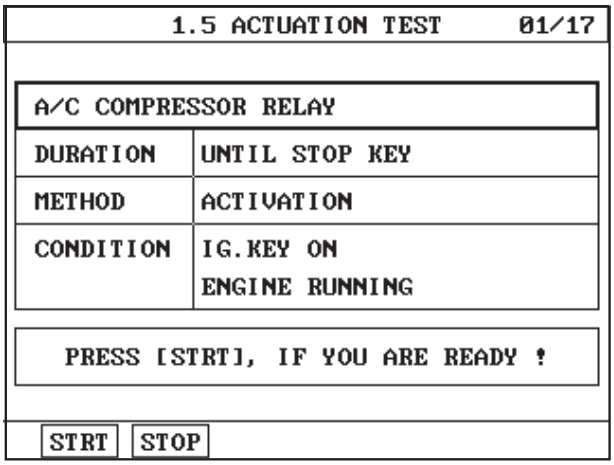


Fig.2

Fig.1) The operating condition of aircon relay is shown. Check if aircon compressor works properly when aircon switch is turning ON.
Fig.2) Diagnosing problem of "A/C RELAY" and "AIRCON COMPRESSOR" is convenient through ACTUATION TEST on the Scantool.

EGNG001C

TERMINAL AND CONNECTOR INSPECTION E1F82ED2

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damage of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at mail connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E3E7297E

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect A/C relay.

   3) Measure the voltage of A/C relay terminal 1.

specification : 11.5V~13.0V

4) Is the measured voltage within the specification?

YES

▶ Go to "2. Check IG KEY "ON" power circuit".

NO

▶ Repair problems of 10A FUSE in engineroom junction box and related circuit and go to "Verification of Vehicle Repair".

2. Check IG KEY "ON" power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C relay (E66).

3) IG KEY "ON".

4) Measure the voltage of glow relay terminal 3.

specification : 11.5V~13.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair problems of E/R FUSE & RELAY BOX 10A FUSE in engineroom junction box and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E311F1D2

1. Check monitoring voltage in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C relay (E66).

3) IG KEY "ON".

4) Measure the voltage of glow relay terminal 5.

specification : 3.2V~3.7V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C relay and ECM connector.

3) Check continuity between glow relay terminal 5 and ECM connector terminal 70.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground and go to "Verification of Vehicle Repair".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E791613B

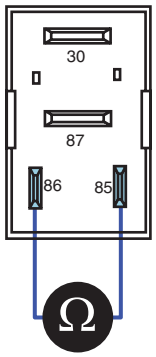
1. Check A/C relay component resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C relay.

3) Measure the coil resistance of A/C relay.

specification : 85±5 Ω (20℃)



EGNG001H

4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check A/C relay component operation" as follows.

NO

▶ Replace A/C relay and go to "Verification of Vehicle Repair".

2. Check A/C relay component operation

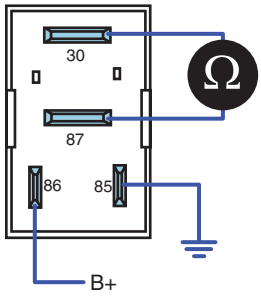
   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect A/C relay

   3) Supplies random B+ and ground to coil sides of A/C relay (terminal 85, terminal 86)

   4) Check continuity between A/C relay terminal 30 and terminal 87.

specification : When power is supplied : Continuity (below 1.0Ω)
When power is not supplied : Discontinuity (Infinite Ω)



EGNG001I

   5) Is the continuity test within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace A/C relay and go to "Verification of Vehicle Repair".

※ Repeat this process 2~3 times.

VERIFICATION OF VEHICLE REPAIR E398F248

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0647 A/C CLUTCH RELAY CONTROL CIRCUIT HIGH

COMPONENT LOCATION E3EE5FD9

Refer to DTC P0646.

GENERAL DESCRIPTION E0149D6E

Refer to DTC P0646.

DTC DESCRIPTION E2F37569

P0647 is set when excessive current is detected in Aircon relay control circuit for more than 1 sec.. This code is due to short to battery in Aircon relay control circuit or internal short in relay component.

DTC DETECTING CONDITION EAE75FD0

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• A/C relay circuit
• A/C relay component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 1.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SCHEMATIC DIAGRAM ECB373DD

Refer to DTC P0646.

MONITOR SCANTOOL DATA EDA365F5

1. Connect scantool to Data Link Cable (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "A/C COMPRESSOR CONTROL" parameter on the scantool.

specification : A/C switch "ON" : A/C RELAY "ON" (Aircon compressor turns ON and OFF periodically by Aircon pressure S/W.)
A/C switch "OFF" : A/C RELAY "OFF"

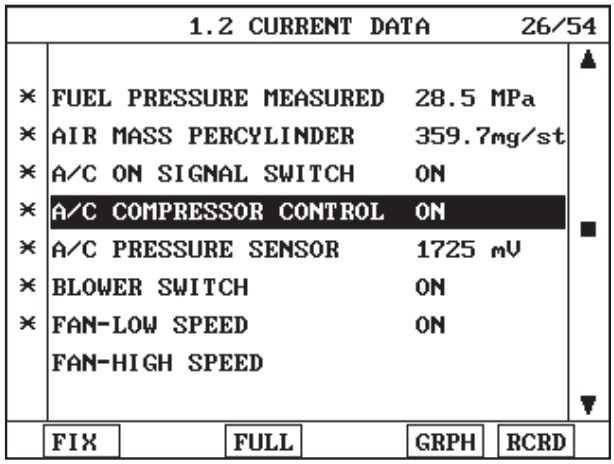


Fig.1

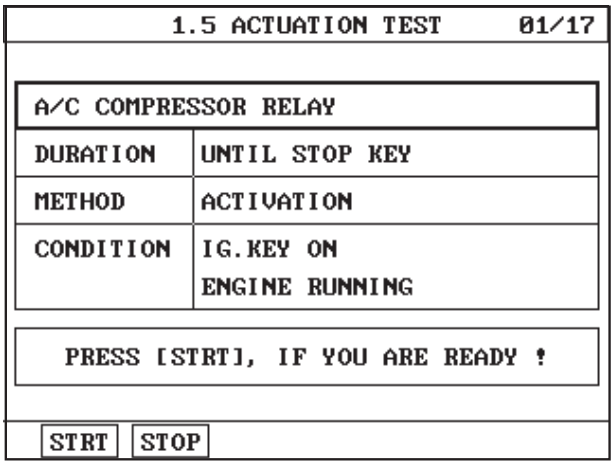


Fig.2

Fig.1) The operating condition of aircon relay is shown. Check if aircon compressor works properly when aircon switch is turning ON.
Fig.2) Diagnosing problem of "A/C RELAY" and "AIRCON COMPRESSOR" is convenient through ACTUATION TEST on the Scantool.

EGNG001C

TERMINAL AND CONNECTOR INSPECTION E5424A6D

Refer to DTC P0646.

POWER CIRCUIT INSPECTION E961180A

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect A/C relay.

   3) Measure the voltage of A/C relay terminal 1.

specification : 11.5V~13.0V

   4) Is the measured voltage within the specification?

   YES

   ▶ Go to "2. Check IG KEY "ON" power circuit".

   NO

   ▶ Repair problems of 10A FUSE in engineroom junction box and related circuit and go to "Verification of Vehicle Repair".

2. Check IG KEY "ON" power circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect A/C relay (E66).

   3) IG KEY "ON".

   4) Measure the voltage of glow relay terminal 3.

specification : 11.5V~13.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair problems of E/R FUSE & RELAY BOX 10A FUSE and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E54456DB

1. Check monitoring voltage in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C relay (E66).

3) IG KEY "ON".

4) Measure the voltage of glow relay terminal 5.

specification : 3.2V~3.7V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C relay and ECM connector.

3) Check continuity between glow relay terminal 5 and ECM connector terminal 70.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground and go to "Verification of Vehicle Repair".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E068E6E5

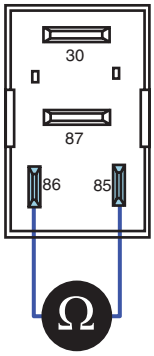
1. Check A/C relay component resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect A/C relay.

   3) Measure the coil resistance of A/C relay.

specification : 85±5 Ω (20℃)



EGNG001H

   4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check A/C relay component operation" as follows.

NO

▶ Replace A/C relay and go to "Verification of Vehicle Repair".

2. Check A/C relay component operation

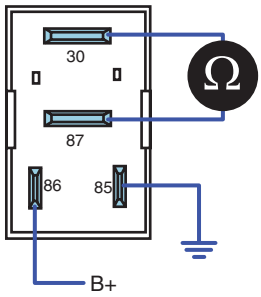
   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect A/C relay

   3) Supplies random B+ and ground to coil sides of A/C relay (terminal 85, terminal 86)

   4) Check continuity between A/C relay terminal 30 and terminal 87.

specification : When power is supplied : Continuity (below 1.0Ω)
When power is not supplied : Discontinuity (Infinite Ω)



EGNG001I

5) Is the continuity test within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace A/C relay and go to "Verification of Vehicle Repair".

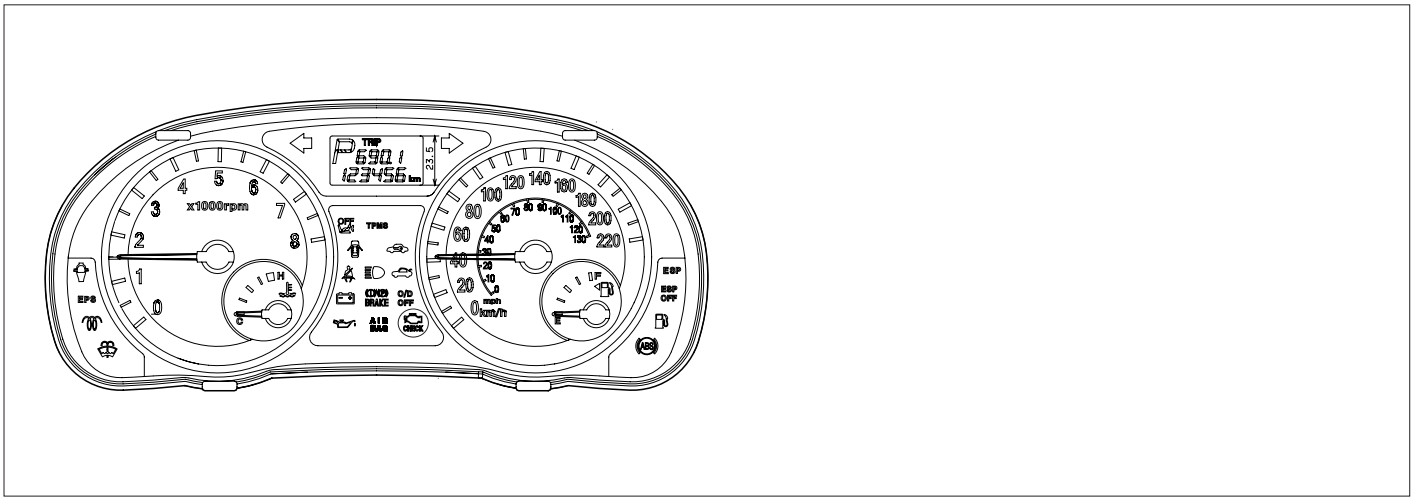
※ Repeat this process 2~3 times.

VERIFICATION OF VEHICLE REPAIR E597F4C2

Refer to DTC P0646.

DTC P0650 MALFUNCTION INDICATOR LAMP(MIL) CONTROL CIRCUIT

COMPONENT LOCATION E807E36B



EGNG009T

GENERAL DESCRIPTION EB81D50C

As monitoring the errors of several sensors and actuator circuit, TCM related problem and ECM error, if any problem occurs, ECM turns Engine Check Lamp ON at cluster to notify driver the occurence of a problem.Generally, Engine Check Lamp turns ON at Ignition ON and turns OFF within couple of seconds after turning engine ON. If engine check lamp turns on during driving, perform diagnosis of engine system and auto-transaxle system.

DTC DESCRIPTION E7F64B1A

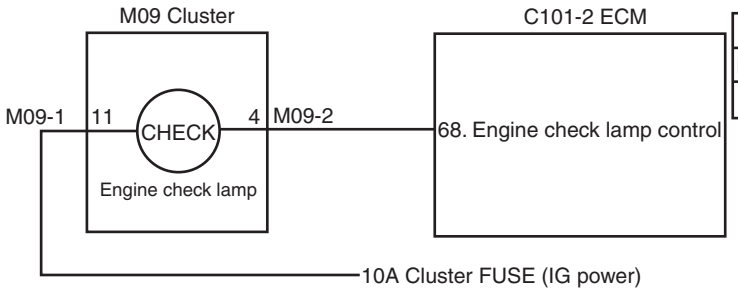
P0650 is set when 1)excessive current is detected in engine check lamp control circuit for more than 1.0 sec. at engine check lamp ON condition or 2)like open or short to ground, no current is detected. This code is due to open in control circuit or opened filament of lamp component.

DTC DETECTING CONDITION EDC9D9D3

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in engine check lamp • Engine check lamp circuit.
Enable Conditions	• IG KEY "ON" (Monitoring only performed within lamp operating condition)			
ThresholdValue	• Short to battery • Short to GND, Wiring open			
DiagnosticTime	• 1.0 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SCHEMATIC DIAGRAM E04BABA8

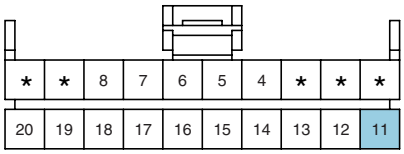
[CIRCUIT DIAGRAM]



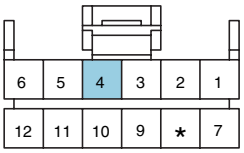
[CONNECTOR INFORMATION]

Terminal	Connected to	Function
M09-1 terminal 11	10A Cluster FUSE	IG power
M09-2 terminal 4	C101-2 terminal 68	Engine check lamp control

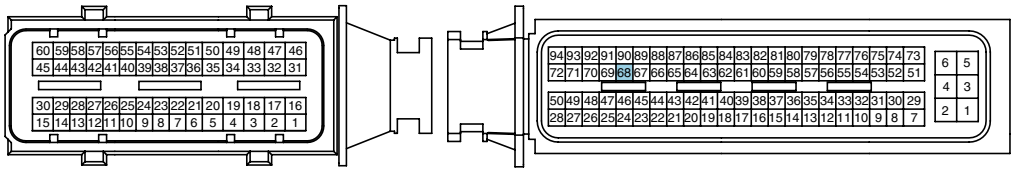
[HARNESS CONNECTOR]



M09-1 Cluster



M09-2 Cluster



C101-1 ECM C101-2 ECM

EGNG009U

TERMINAL AND CONNECTOR INSPECTION E51FEF4B

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Control Circuit Inspection".

CONTROL CIRCUIT INSPECTION E6040292

1. Check control circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect ECM connector.

   3) IG KEY "ON".

   4) Measure the voltage of terminal 68 of ECM connector.

Specification : 10.8V~13.0V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "2. Grounding test of check lamp control circuit" as follows.

   NO

   ▶ Check open in filament of check lamp. (Refer to Component Inspection)
   ▶ Repair open between cluster connector(M09-2) terminal 4 and ECM connector(C101-2) terminal 68 and go to "Verification of Vehicle Repair",

2. Grounding test of check lamp control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect ECM connector.

   3) IG KEY "ON".

   4) Ground ECM connector terminal 68 to chassis ground.

specification : check lamp turns ON.

   5) Does check lamp turn ON?

   YES

   ▶ Go to "Verification of Vehicle Repair".

   NO

   ▶ Repair short to battery in check lamp control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E8DF547C

1. IG KEY "OFF", ENGINE "OFF".

2. Dismount cluster and disconnect check lamp.

3. Check filament of check lamp.
4. supply 12V to "check lamp" to turn lamp ON

specification : lamp turns ON when 12V is supplied.

5. Does check lamp turn ON?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace check lamp and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E92CF181

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

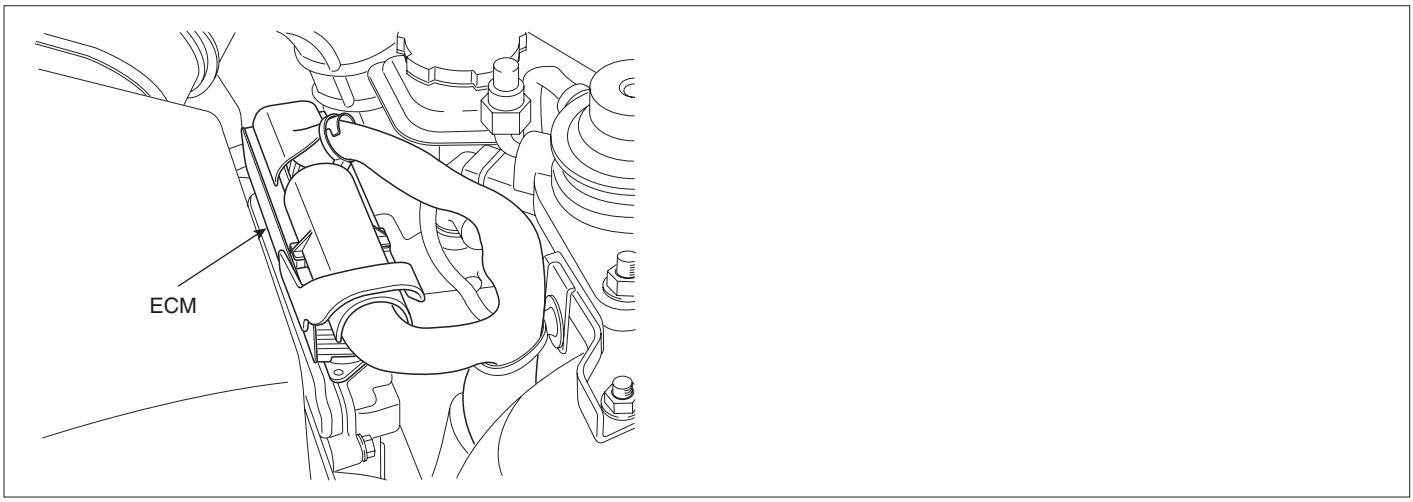
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0652 SENSOR REFERENCE VOLTAGE "B" CIRCUIT LOW

COMPONENT LOCATION E16D9BAE



EGNG007T

GENERAL DESCRIPTION E25EB118

ECM is activated by power supply. Signals from several sensors, such as CKPS and APS, is inputted to ECM. Comparing inputted siganals with control LOGIC saved at micro controller and EEPROM, ECM controlls engine as actuating injectors, solenoids and relays. To guarantee accurate control, ECM performs SELF TEST, DIAGNOSIS of several sensors and actuators. And if serious trouble which affects vehicle performance occurrs, ECM sets DTCs.At certain cases, ECM shuts down whole systems in order to prevent dangerous situation due to incorrect control.

DTC DESCRIPTION E1236E04

P0652 is set when the voltage below 4700mV - minimum voltage of sensor power supply 2 generates from ECM - is detected for more than 0.1 sec.. This code is due to the short to ground in sensor power circuit or the voltage problem inside of ECM.

DTC DETECTING CONDITION E8F69838

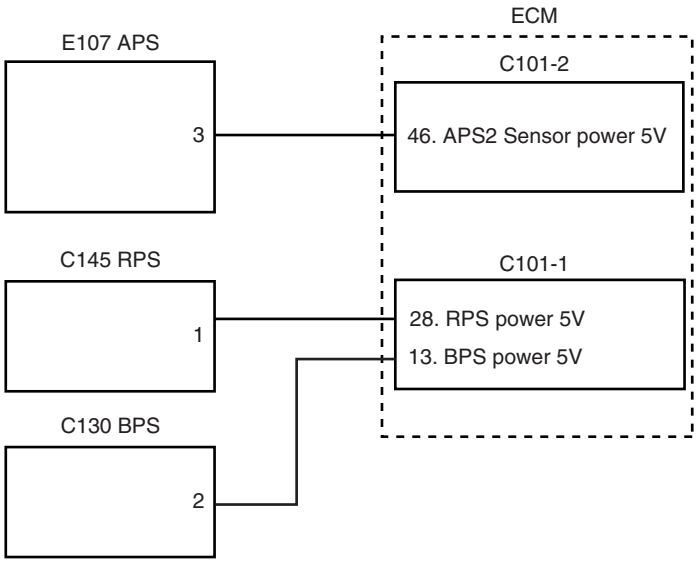
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="8">• RPS power supply circuit
• APS 2 power supply circuit
• BPS power supply circuit
• ECM component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• when the voltage is below the minimum voltage of sensor power supply (below 4700mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 100ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Limp home mode is activated.(engine speed is fixed at 1200RPM.)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E959E4B4

Sensor power 1	Sensor power 2	Sensor power 3
MAFS, APS 1 4830mV~5158mV	RPS, APS 2,BPS 4830mV~5158mV	A/C pressure transducer, VSA position Sensor 4830mV~5158mV

SCHEMATIC DIAGRAM E406FB8F

[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

[E107 APS]

Terminal	Connected to	Function
1	C101-2 terminal 31	APS 2 Sensor signal
2	C101-2 terminal 9	APS 1 Sensor signal
3	C101-2 terminal 46	APS 2 Sensor power
4	C101-2 terminal 8	APS 2 Sensor ground
5	C101-2 terminal 30	APS 1 Sensor ground
6	C101-2 terminal 45	APS 1 Sensor power

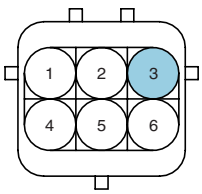
[C145 RPS]

Terminal	Connected to	Function
1	C101-1 terminal 28	Sensor power
2	C101-1 terminal 43	Sensor signal
3	C101-1 terminal 8	Sensor ground

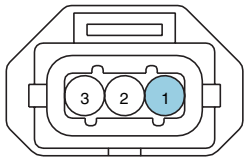
[C130 BPS]

Terminal	Connected to	Function
1	C101-1 terminal 40	BPS signal
2	C101-1 terminal 13	BPS power
3	C101-1 terminal 53	IATS signal
4	C101-1 terminal 23	Sensor ground

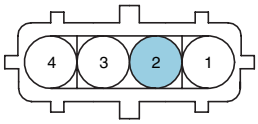
[HARNESS CONNECTOR]



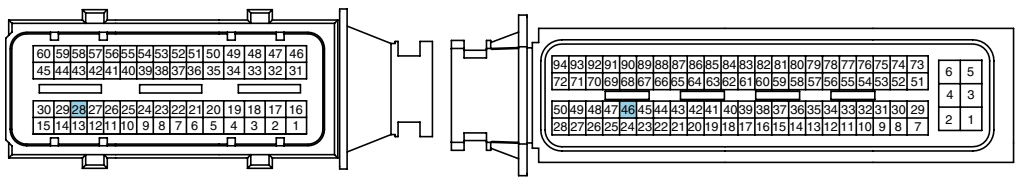
E107 APS



C145 RPS



C130 BPS



C101-1 ECM C101-2 ECM

EGNG002Z

SIGNAL WAVEFORM AND DATA E4EA9926

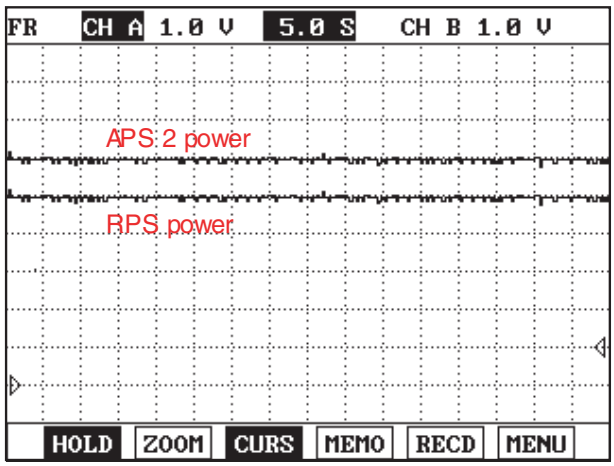


Fig.1

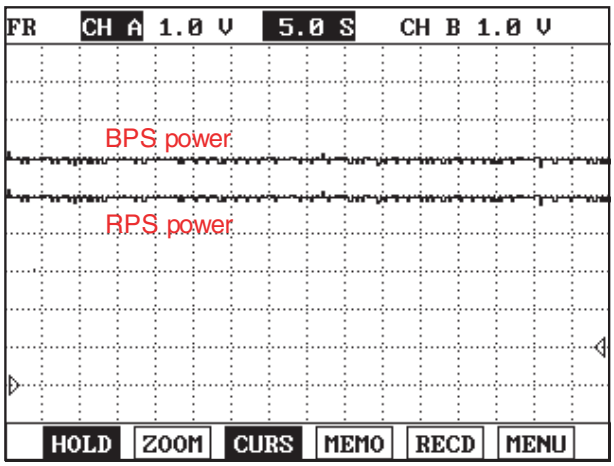


Fig.2

Fig.1) APS2 and RPS power supply signals are measured simultaneously. Check if the voltages are within the specification (4.8~5.1V) at IG KEY "ON".
Fig.2) BPS and RPS power supply signals are measured simultaneously. Check if the voltages are within the specification (4.8~5.1V) at IG KEY "ON".

EGNG003A

TERMINAL AND CONNECTOR INSPECTION EDEC0E04

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damage of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at mail connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION ED369E8C

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnector RPS connector, APS connector and BPS connector.

3) IG KEY "ON".

4) Measure the voltage of RPS connector terminal 1, APS connector terminal 3 and BPS terminal 2.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2. Check short to ground in power circuit" as follows.

2. Check short to ground in power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect RPS connector, APS connector, BPS connector, ECM connectors.

3) Check continuity between RPS connector terminal 1(APS connector terminal 3, BPS connector terminal 2) and chassis ground.

specification : Discontinuity (Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ If the circuit is insulated well and the sensor power supply from ECM is low, replace ECM and "Verification of Vehicle Repair".

NO

▶ Repair short to ground and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EB27DEB8

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect RPS connector, APS connector, BPS connector.
3. Check that sensor connector power supply is within the specification after turning IG KEY "ON".
4. Connect RPS connector and APS connector in turn.

Specification : sensor power supply should not change as connecting RPS connector, APS connector, BPS connector.
(If the change of sensor power supply occur as connecting sensor connector, this means
the occurrence of short inside of sensor.)

5. Does change of sensor power supply occur as connecting sensor connector?

YES

▶ Replace related sensors.(rail pressure sensor, accel pedal sensor, boost pressure sensor)

NO

▶ Go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E105CA30

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0653 SENSOR REFERENCE VOLTAGE "B" CIRCUIT HIGH

COMPONENT LOCATION E7497065

Refer to DTC P0652.

GENERAL DESCRIPTION E6EDA9F7

Refer to DTC P0652.

DTC DESCRIPTION E0847204

P0653 is set when the voltage above 5158mV - maximum voltage of sensor power supply 2 generates from ECM - is detected for more than 0.1 sec.. This code is due to the short to battery in sensor power circuit or the voltage problem inside of ECM.

DTC DETECTING CONDITION E425BDA7

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• RPS power supply circuit
• APS 2 power supply circuit
• BPS power supply circuit
• ECM component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• when the voltage is above the maximum voltage of sensor power supply.(above 5158mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 100ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Limp home mode is activated.(engine speed is fixed at 1200RPM.)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E49AA653

Refer to DTC P0652.

SCHEMATIC DIAGRAM E822ABAB

Refer to DTC P0652.

SIGNAL WAVEFORM AND DATA EE1B61BA

Refer to DTC P0652.

TERMINAL AND CONNECTOR INSPECTION E0D97F85

Refer to DTC P0652.

POWER CIRCUIT INSPECTION EAC32F19

1. Check power circuit voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnector RPS connector, APS connector and BPS connector.

3) IG KEY "ON".

4) Measure the voltage of RPS connector terminal 1, APS connector terminal 3 and BPS terminal 2.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2. Check short to battery in power circuit" as follows.

2. Check short to battery in power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect RPS connector, APS connector, BPS connector, ECM connectors.

3) IG KEY "ON"

4) Measure the voltage of RPS connector terminal 1 or APS connector terminal 3 and BPS connector terminal 2.

Specification : 0.0V~0.1V

5) Is abnormal voltate measured in this test?

YES

▶ Repair short to battery and go to "Verification of Vehicle Repair".

NO

▶ If the circuit is insulated well and the sensor power supply from ECM is high, replace ECM and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E87F7475

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect RPS connector, APS connector, BPS connector.
3. Check that sensor connector power supply is within the specification after turning IG KEY "ON".
4. Connect RPS connector and APS connector in turn.

Specification : sensor power supply should not change as connecting RPS connector, APS connector, BPS connector.
(If the change of sensor power supply occur as connecting sensor connector, this means the occurrence of short inside of sensor.)

5. Does change of sensor power supply occur as connecting sensor connector?

YES

▶ Replace related sensors.(rail pressure sensor, accel pedal sensor, boost pressure sensor)

NO

▶ Go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E8F3012F

Refer to DTC P0652.

DTC P0670 GLOW RELAY CIRCUIT MALFUNCTION

GENERAL DESCRIPTION ECC9C57C

Heating combustion chamber, glow plug increases fuel ignitibility and makes fuel in the foggy state easily when engine is cold. Thus, glow plug makes engine starting easily and decreases exhaust gas produced just after turning engine on when engine is cold.ECM controls operation and operating duration of glow plug relay which supplies power to glow plug with ECTS signal, battery voltage and IG KEY ON signal.Through glow lamp in cluster, ECM let drivers know if glow plug is ON.

DTC DESCRIPTION E1A4A81F

P0670 is set when 1)excessive voltage is detected or 2)no current is detected like open or short to ground in glow relay control circuit for more than 1 sec. at glow relay ON condition. This code is due to open in glow relay control circuit or internal open in glow relay component.

DTC DETECTING CONDITION E2902D10

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Glow relay control circuit
• Glow relay component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON" (monitoring only performed within relay operating condition)</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• short to battery
• Short to GND, Wiring open</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 1.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

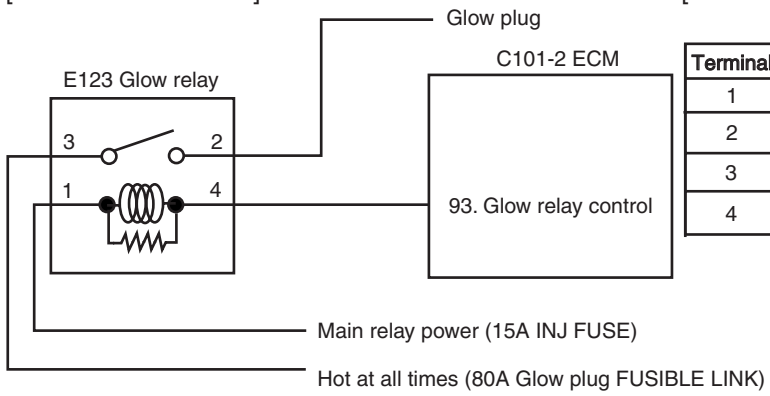
SPECIFICATION E8B3C8BF

※ RELAY OPERATING TIME

	-20℃	**-10**℃	**10**℃	**50**℃
10V	16sec	10sec	4sec	2.0sec
14.9V	16sec	10sec	4sec	2.0sec

SCHEMATIC DIAGRAM EAAD3717

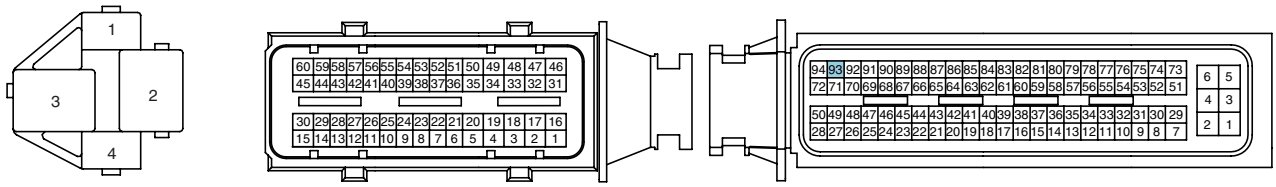
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	EC102 terminal 15	Glow relay coil power
2	E172 terminal 1	Glow plug power(OUTPUT)
3	80A Glow plug FUSIBLE LINK	Glow plug power(INPUT)
4	C101-2 terminal 93	Glow relay control

[HARNESS CONNECTOR]



E123 Glow relay C101-1 ECM C101-2 ECM

EGNG007G

MONITOR SCANTOOL DATA E4354334

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "GLOW RELAY" parameter on the Scantool.

specification : After operating according to engine coolant temperature and battery voltage, Glow relay turns "OFF". at IG KEY "ON". (Refer to Specification)

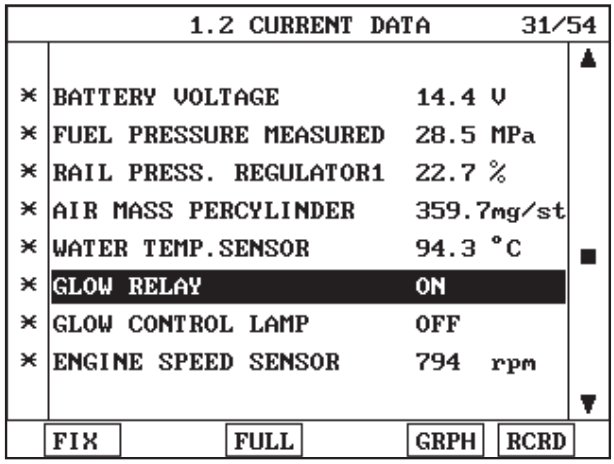


Fig.1

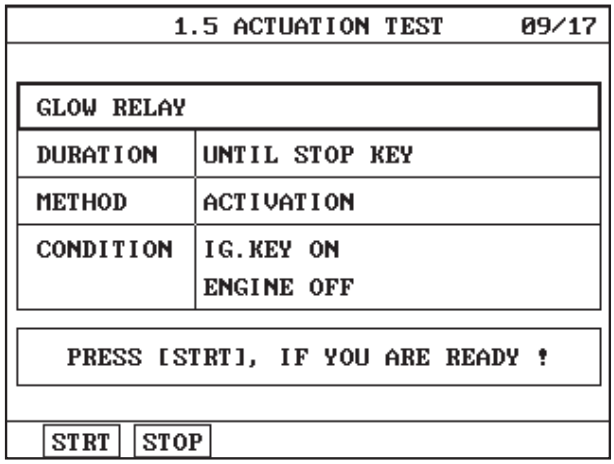


Fig.2

Fig 1) Operating state of Glow relay is shown. However, it is difficult to check operating state because Glow relay turns OFF 2~3 sec. after operation at normal temp.
Fig.2) Checking glow relay operation and power supply to glow plug using "ACTUATION TEST" on Scantool is convenient.

EGNG007H

TERMINAL AND CONNECTOR INSPECTION EE30EC88

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E94FD416

1. Check HOT AT ALL TIMES power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect glow relay.

   3) Measure the voltage of glow relay connector terminal 3.

Specification : 11.5V~13.0V

4) Is the measured voltage within the specification?

YES

▶ Go to "2. Check IG KEY "ON" power circuit voltage" as follows.

NO

▶ Repair Diesel box 60A glow plug fuse and related circuit and go to "Verification of Vehicle Repair".

2. Check IG KEY "ON" power circuit voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect glow relay.

3) IG KEY "ON".

4) Measure the voltage of glow relay connector terminal 1.

Specification : 11.5V~13.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair E/R FUSE & RELAY BOX 15A INJ fuse and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION EC464767

1. Check control circuit monitoring voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect glow relay.

3) IG KEY "ON".

4) Measure the voltage of glow relay connector terminal 4.

Specification : 3.2V~3.7V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When no value is detected : Go to "2. Check open in control circuit".

▶ When high voltage is detected : Repair short to battery in signal circuit and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect glow relay and ECM connector.

3) Check continuity between glow relay connector terminal 4 and ECM connector terminal 93.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground and go to "Verification of Vehicle Repair".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EA4EC585

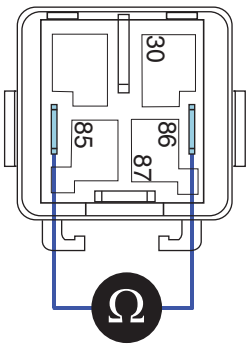
1. Check golw relay component coil resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect glow relay.

3) Measure the resistance of glow relay component coil.

Specification : 55±5 Ω (20℃)



EGNG007M

4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check glow relay component operation" as follows.

NO

▶ Replace glow relay and go to "Verification of Vehicle Repair".

2. Check glow relay component operation

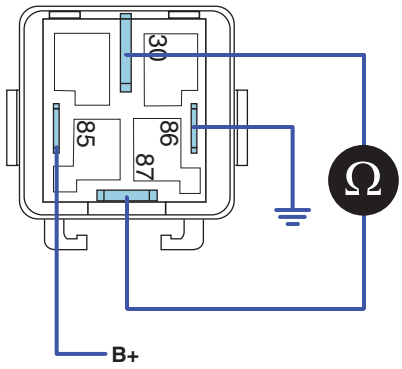
   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect glow relay.

   3) Supplies random B+ and ground to coil sides of glow relay (terminal 85, terminal 86).

   4) Check continuity between glow relay terminal 30 and terminal 87.

specification : When power is supplied : Continuity (below 1.0Ω)
When power is not supplied : Discontinuity (Infinite Ω)



EGNG007N

   5) Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace glow relay and go to "Verification of Vehicle Repair".

※ Repeat this process 2~3 times.

VERIFICATION OF VEHICLE REPAIR EB8676F6

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

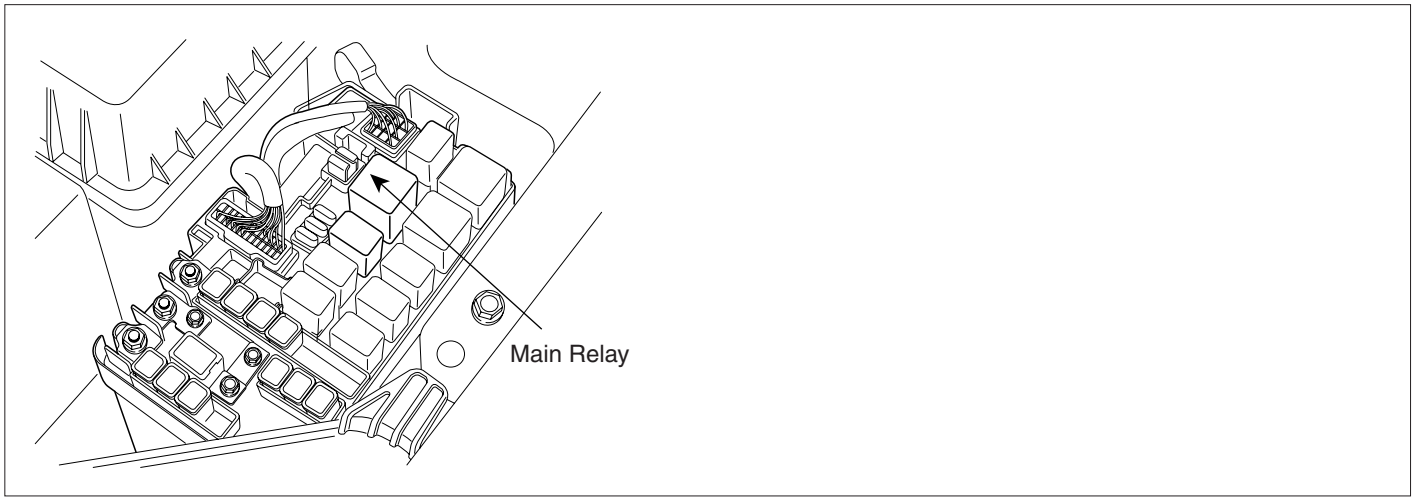
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0685 ECM/PCM POWER RELAY CONTROL CIRCUIT /OPEN

COMPONENT LOCATION E5E5EDF6



EGNG009X

GENERAL DESCRIPTION E1972588

Main relay operates when Ignition ON signal is inputted to terminal 28 of ECM C101-1 connector and it supplies power to ECM, fuel pump relay, CMP, EGR actuator, throttle flap actuator, PTC heater relay and brake switch, etc. Especially, the power supplied to ECM is used as a main power of injectors, rail pressure control valve and ECM operation.When IG KEY ON signal is shut off during turning engine OFF, ECM stops injector operation then engine turns OFF. Approx. after 5 sec., ECM shuts OFF main relay and system turns OFF. Main relay is very important for engine operation, so careful inspection is strongly required.

DTC DESCRIPTION ED694DE5

When IG KEY OFF signal is imputted to ECM. ECM stops injector operation andn engine turns OFF. Then, After-run(turning off process of ECM intermal system) is performed in order to shut system down. During this process, if main relay power supply is cut too late or power supply is cut too early before After-run process completes, ECM detect main relay error and P0685 is set.

DTC DETECTING CONDITION E531545D

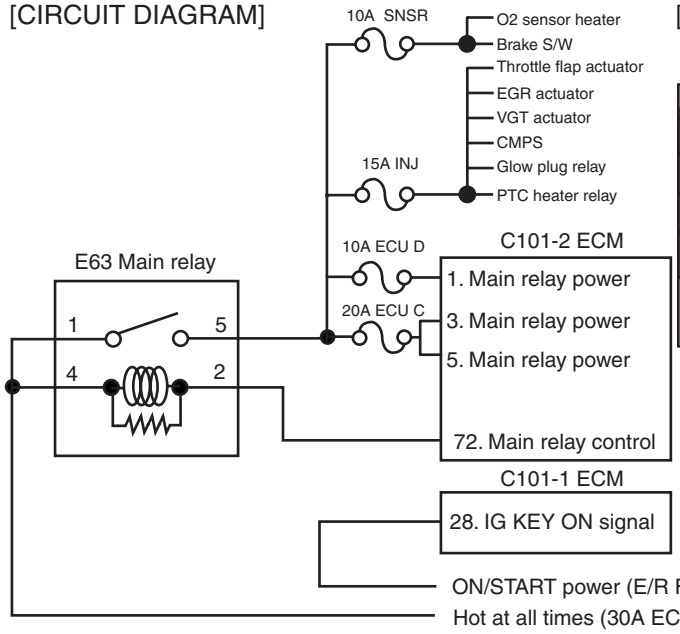
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Main relay circuit • Main relay component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• When main relay respond to IG KEY - ON/OFF signal too fast or slow (After-run finished and it requires more than 2 sec. for Main relay to be deactivated. Main relay deactivated before After-run finished more than 3 times.)			
DiagnosticTime	• Immediately			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION E86CAC25

Main Relay Coil Resistance	73±10 Ω (20℃)

SCHEMATIC DIAGRAM E02BF241

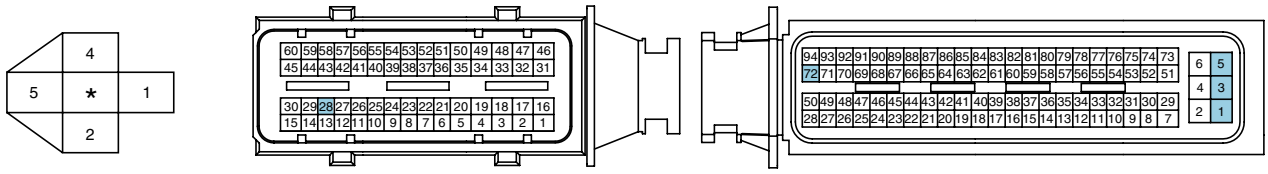
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	30A ECU A FUSIBLE LINK	Hot at all times
2	C101-2 terminal 72	Main relay control
3	*	*
4	30A ECU A FUSIBLE LINK	Main relay coil power
5	C101-2 terminal 1,3,5 etc.	Power supply to ECM, Sensor, Actuator

[HARNESS CONNECTOR]



EGNG009Y

SIGNAL WAVEFORM AND DATA E477A48B

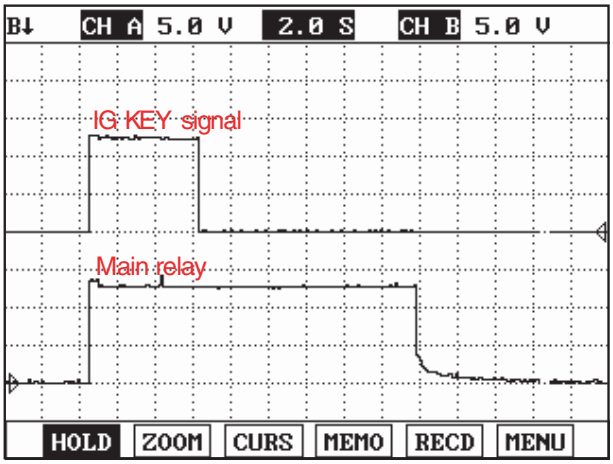


Fig.1

Fig.1) Main relay operates when IG KEY "ON" (C101-1 terminal 28 ON signal), it turns "OFF" in 12 sec. after IG KEY "OFF".

EGNG009Z

TERMINAL AND CONNECTOR INSPECTION EC6DCDAB

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION EDA7503B

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect main relay.

   3) Measure the voltage of main relay terminal 1 and 4.

Specification : 11.5V~13.0V

4) Is the measured voltage within the specification?

YES

▶ Go to "Check power supply line(relay→actuator)" as follows.

NO

▶ Repair E/R FUSE & RELAY BOX 30A ECU A fusible link and related circuit and go to "Verification of Vehicle Repair".

2. Check power supply line(relay→actuator)

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect main relay and ECM connector.

3) Connect main relay terminal 1 and 5 using jump wire.

4) Measure the voltage of ECM connector terminal 1,3,5.

specification : 11.5V~13.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "Control Circuit Inspection".

NO

▶ Repair open in E/R FUSE & RELAY BOX ECU C, ECU D fusible link and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E2DDFFE8

1. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect main relay and ECM connector.

3) Check continuity between main relay terminal 2 and ECM connector 72.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check short to ground in control circuit" as follows.

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

2. Check short to ground in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect main relay and ECM connector.

   3) Check continuity between main relay terminal 2 and chassis ground.

specification : Discontinuity (Infinite Ω)

   4) Is the measured resistance within the specification?

   YES

   ▶ Go to "3.Check short to battery in control circuit" as follows.

   NO

   ▶ Repair short to ground in control circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect main relay and ECM connector.

   3) IG KEY "ON".

   4) Measure the voltage of main relay connector terminal 2.

specification : 0.0V~0.1V

   5) Is abnormal voltage detected in the circuit with both connectors disconnected?

   YES

   ▶ Repair short to battery in signal circuit and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Component Inspection".

COMPONENT INSPECTION EBB5625F

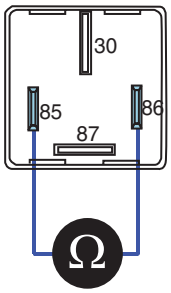
1. Check main relay component resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect main relay.

   3) Measure the resistance between main relay coil component terminal 85 and 86.

Specification : 73±10 Ω (20℃)



EGNG010F

4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check main relay component operation" as follows.

NO

▶ Replace main relay and go to "Verification of Vehicle Repair".

2. Check main relay component operation

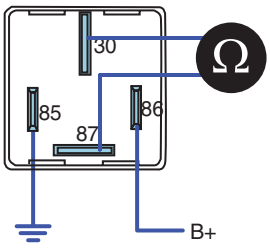
1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect main relay.

3) Supplies random B+ and ground to coil sides of main relay. (terminal 85, terminal 86)

4) Check continuity between main relay component terminal 30 and 87.

specification : When power is supplied : Continuity (below 1.0Ω)
When power is not supplied : Discontinuity (Infinite Ω)



EGNG010G

5) Is the continuity test within the specification?

YES

▶ go to "Verification of Vehicle Repair".

NO

▶ Replace main relay and go to "Verification of Vehicle Repair".

※ Repeat this process 2~3 times.

VERIFICATION OF VEHICLE REPAIR EB016D4C

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

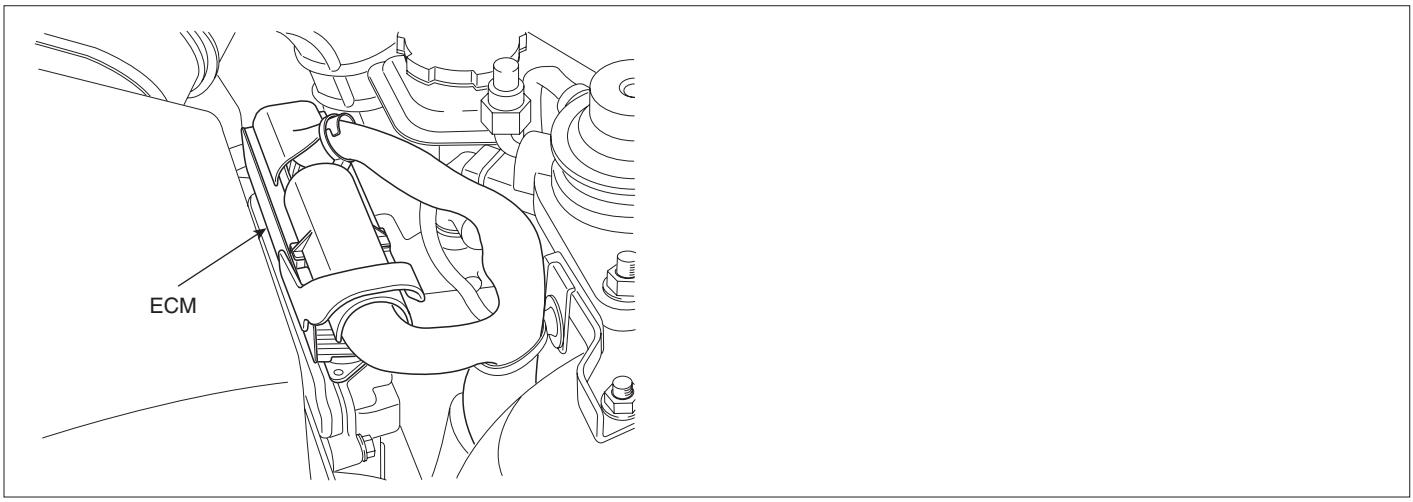
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0698 SENSOR REFERENCE VOLTAGE "C" CIRCUIT LOW

COMPONENT LOCATION E14C1C71



EGNG007T

GENERAL DESCRIPTION EAE27187

ECM is activated by power supply. Signals from several sensors, such as CKPS and APS, is inputted to ECM. Comparing inputted siganals with control LOGIC saved at micro controller and EEPROM, ECM controlls engine as actuating injectors, solenoids and relays. To guarantee accurate control, ECM performs SELF TEST, DIAGNOSIS of several sensors and actuators. And if serious trouble which affects vehicle performance occurrs, ECM sets DTCs.At certain cases, ECM shuts down whole systems in order to prevent dangerous situation due to incorrect control.

DTC DESCRIPTION E48A79CD

P0698 is set when the voltage below 4700mV - minimum voltage of sensor power supply 3 generates from ECM - is detected for more than 0.1 sec.. This code is due to the short to ground in sensor power circuit or the voltage problem inside of ECM.

DTC DETECTING CONDITION E4D0E123

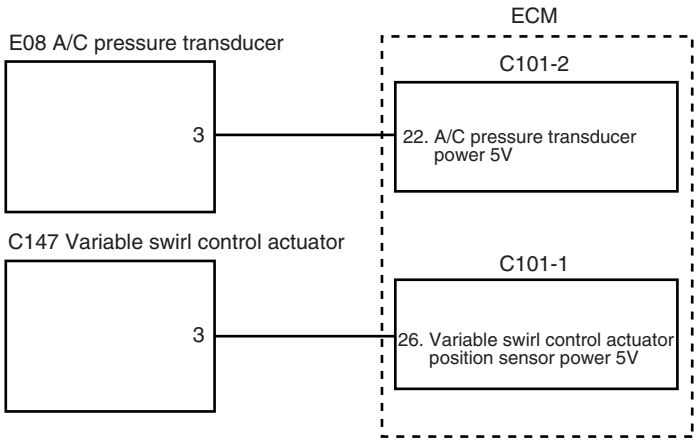
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="7">• A/C pressure transducer power supply circuit
• variable swirl control actuator power supply circuit
• ECM component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• when the voltage is below the minimum voltage of sensor power supply.
(below 4700mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 100ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Limp home mode is activated. (engine speed is fixed at 1200RPM.)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E3C24ADA

Sensor power 1	Sensor power 2	Sensor power 3
MAFS, APS 1 4830mV~5158mV	RPS, APS 2,BPS 4830mV~5158mV	A/C pressure transducer, VSA position Sensor 4830mV~5158mV

SCHEMATIC DIAGRAM E77CE18F

[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

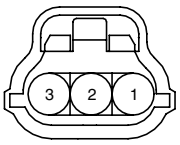
[E08 A/C Refrigerant Pressure Sensor]

Terminal	Connected to	Function
1	C101-2 terminal 12	Sensor ground
2	C101-2 terminal 13	Sensor signal
3	C101-2 terminal 22	Sensor power

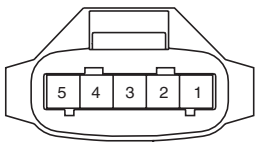
[C147 Variable swirl control actuator]

Terminal	Connected to	Function
1	C101-1 terminal 60	MTR (+)
2	C101-1 terminal 30	MTR (-)
3	C101-1 terminal 26	Sensor power
4	C101-1 terminal 56	Sensor signal
5	C101-1 terminal 6	Sensor ground

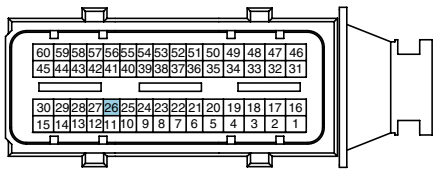
[HARNESS CONNECTOR]



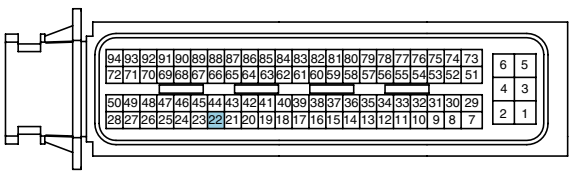
E08 A/C pressure transducer



C147 Variable swirl control actuator



C101-1 ECM



C101-2 ECM

EGNG001W

SIGNAL WAVEFORM AND DATA E2095350

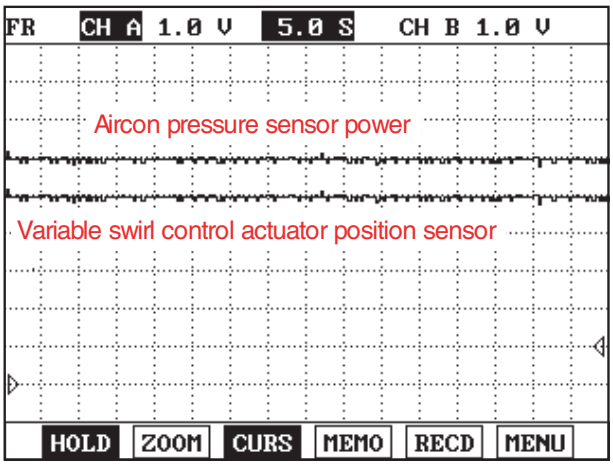


Fig.1

Fig.1) A/C pressure transducer and VSA position Sensor power supply signals are measured simultaneously.
Check if the voltages are within the specification (4.8~5.1V) at IG KEY "ON"

EGNG001X

TERMINAL AND CONNECTOR INSPECTION E1683981

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damage of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at mail connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position)
3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION ED6933C6

1. Check power circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect A/C pressure transducer connector and variable swirl control actuator connector.
   3) IG KEY "ON".

4) Measure the voltage between A/C pressure transducer connector terminal 3 or variable swirl control actuator connector terminal 6 and chassis ground.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2. Check short to ground in power circuit" as follows.

2. Check short to ground in power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C pressure transducer connector, variable swirl control actuator connector, ECM connectors.

3) Check continuity between A/C pressure transducer connector terminal 3 or variable swirl control actuator connector terminal 3 and chassis ground.

specification : Discontinuity (Infinite Ω)

4) Is the measured resistance within the specification?

YES

▶ If the circuit is insulated well and the sensor power supply from ECM is low, replace ECM and go to "Verification of Vehicle Repair".

NO

▶ Repair short to ground and go to go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E83F85BD

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect A/C pressure transducer connector and variable swirl control actuator connector.
3. Check that sensor connector power supply is within the specification after turning IG KEY "ON".
4. Connect A/C pressure transducer connector and variable swirl control actuator connector in turn.

Specification : sensor power supply should not change as connecting A/C pressure transducer connector and variable swirl control actuator connector.
(If the change of sensor power supply occur as connecting sensor connector, this means the occurrence of short inside of sensor.)

5. Does change of sensor power supply occur as connecting sensor connector?

YES

▶ Replace A/C pressure transducer or variable swirl control actuator.

NO

▶ Go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EE7F414B

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0699 SENSOR REFERENCE VOLTAGE "C" CIRCUIT HIGH

COMPONENT LOCATION EE29F25E

Refer to DTC P0698.

GENERAL DESCRIPTION E6F59335

Refer to DTC P0698.

DTC DESCRIPTION E45DB6B9

P0699 is set when the voltage above 5158mV - maximum voltage of sensor power supply 3 generates from ECM - is detected for more than 0.1 sec.. This code is due to the short to battery in sensor power circuit or the voltage problem inside of ECM.

DTC DETECTING CONDITION E8B00FE5

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• A/C pressure transducer power supply circuit
• variable swirl control actuator power supply circuit
• ECM component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• when the voltage is above the maximum voltage of sensor power supply (above 5158mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 100ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Limp home mode is activated. (engine speed is fixed at 1200RPM.)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E9CCE773

Refer to DTC P0698.

SCHEMATIC DIAGRAM E89C60C9

Refer to DTC P0698.

SIGNAL WAVEFORM AND DATA E2EF5784

Refer to DTC P0698.

TERMINAL AND CONNECTOR INSPECTION E1983FCD

Refer to DTC P0698.

POWER CIRCUIT INSPECTION E3D9E035

1. Check power circuit voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C pressure transducer connector and variable swirl control actuator connector.

3) IG KEY "ON".

4) Measure the voltage between A/C pressure transducer connector terminal 3 or variable swirl control actuator connector terminal 6 and chassis ground.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2. Check short to ground in power circuit" as follows.

2. Check short to ground in power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect A/C pressure transducer connector, variable swirl control actuator connector, ECM connectors.

3) IG KEY "ON".

4) Measure the voltage between A/C pressure transducer connector terminal 3 or variable swirl control actuator connector terminal 6 and chassis ground.

specification : 0.0V~0.1V

5) Is abnormal voltate measured in this test?

YES

▶ Repair short to battery and go to "Verification of Vehicle Repair".

NO

▶ If the circuit is insulated well and the sensor power supply from ECM is high, replace ECM and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EC8A090D

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect A/C pressure transducer connector and variable swirl control actuator connector.
3. Check that sensor connector power supply is within the specification after turning IG KEY "ON".
4. Connect A/C pressure transducer connector and variable swirl control actuator connector in turn.

Specification : sensor power supply should not change as connecting A/C pressure transducer connector and variable swirl control actuator connector.
(If the change of sensor power supply occur as connecting sensor connector, this means the occurrence of short inside of sensor.)

5. Does change of sensor power supply occur as connecting sensor connector?

YES

▶ Replace A/C pressure transducer or variable swirl control actuator.

NO

▶ Go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E4B5604C

Refer to DTC P0698.

DTC P0700 TCU REQUEST FOR MIL ON

GENERAL DESCRIPTION EB4CD621

ECM and TCM give and take various data through CAN communication each other. When the problem of TCM related sensor(input speed sensor, output speed sensor, inhibiter switch, etc.) and actuators(transaxle solenoid valve, etc.) occurs, gear is fixed at 3rd gear position. However, alam device which notifies drivers of the occurrence of TCM related problem directly like "TCM warning lamp". Instead of TCM lamp, including TCM, if power train related problem happens, Engine check lamp turns ON to let drivers recognize the occurrence of power train system(A/T system) related problem.

DTC DESCRIPTION E9B1A2A3

P0700 is the code which notifies drivers of the occurrence of TCM related problem indirectly as illuminating engine check lamp. If this code is recorded, Do not check engine but auto transaxle.

DTC DETECTING CONDITION E1111772

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="6">• Problem of TCM system</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Engine check lamp ON requirement from TCM</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

VERIFICATION OF VEHICLE REPAIR ECA7191F

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0701 TCM STATUS ERROR

GENERAL DESCRIPTION E411CD38

ECM and TCM give and take various data through CAN communication each other. When the problem of TCM related sensor(input speed sensor, output speed sensor, inhibiter switch, etc.) and actuators(transaxle solenoid valve, etc.) occurs, gear is fixed at 3rd gear position. However, alam device which notifies drivers of the occurrence of TCM related problem directly like "TCM warning lamp". Instead of TCM lamp, including TCM, if power train related problem happens, Engine check lamp turns ON to let drivers recognize the occurrence of power train system(A/T system) related problem.

DTC DESCRIPTION E40D2EB3

P0701 is set when ECM detects TCM problem through CAN communication. Check whether TCM operatures or not.

DTC DETECTING CONDITION E0645AE6

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="6">• TCM failure</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• TCM failure</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

VERIFICATION OF VEHICLE REPAIR ED062B9A

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0820 NEUTRAL S/W MALFUNCTION

GENERAL DESCRIPTION ED98BF36

Neutral Gear Switch is installed in M/T vehicle and senses driver's intension to shift gear(driver's intension to drive).ECM recognizes engaged gear based on vehicle speed sensor signal and engine RPM in M/T vehicle. And Black Smoke limiting fuel quantity value varies according to engaged gear.(As higher gear shift is engaged, maximum possible fuel injection quantity increases to raise power generation.)The recognition of engaged gear is available when vehicle speed reachs to 2Km/h - the minimum speed for ECM to detect. When vehicle starts to move after standing for a while and vehicle speed does not reach to 2Km/h, fuel quantity mapping value at neutral gear is adopted to vehicle. Moreover, this phenomenon is more serious when vehicle requires high power generation such as the situation when vehicle is on the slope. To cope with this problem, neutral gear switch which senses driver's intension of starting to move is applied. And fuel injection quantity mapping value suitable for 1st gear is adopted immediately.

NOTE

To reduce black smoke produced during rapid acceleration when no load is applied, fuel injection quantity at none load condition is 70% of that at 1st gear.

DTC DESCRIPTION EC0AEE18

P0820 is set when 1)gear is engaged at non-neutral positon at engine ON, but clutch signal is not detected. or 2)only neutral signal is detected at above 600RPM or above 80Km/h. for more than 3 sec.. This code is due to open, short to battery or ground in neutral gear switch circuit.

DTC DETECTING CONDITION EB0CC802

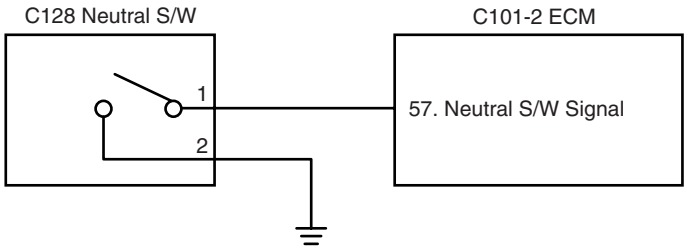
Item	Detecting Condition			Possible Cause
DTC Strategy	• Signal monitoring			• Nertral gear switch component • Nertral gear switch circuit
Enable Conditions	• During driving			
ThresholdValue	• Short to Battery • short to GND, wiring open			
DiagnosticTime	• 3.0sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION EB912244

Signal Voltage	Neutral Position	Except Neutral Position
11.0V~13.5V	0.0V~0.2V(LOW)	11.0V~13.5V(HIGH)

SCHEMATIC DIAGRAM E1BAD68A

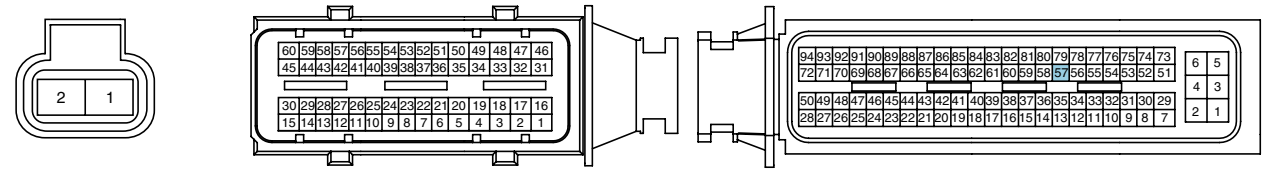
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-2 terminal 57	Neutral S/W Signal
2	G102 Ground Point	Chassis Ground

[HARNESS CONNECTOR]



EGNG006U

SIGNAL WAVEFORM AND DATA E94282F8

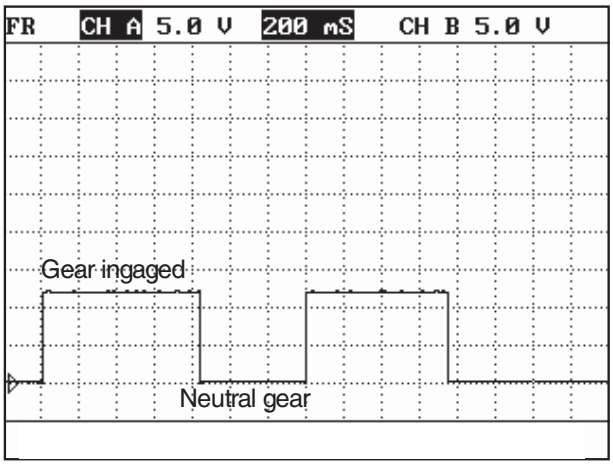


Fig.1

Fig 1) 0V at neutral gear position, 12V at any gear position except neutral position.

EGNG006V

TERMINAL AND CONNECTOR INSPECTION EFDACE94

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Signal Circuit Inspection".

SIGNAL CIRCUIT INSPECTION E417C715

1. Neutral gear switch Voltage Inspection

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect neutral gear switch connector.

   3) Check the voltage of neutral gear switch connector terminal 1.

Specification : 11.5V~13.0V

   4) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Go to "2. Check open in neutral gear switch signal cicuit" as follows.

2. Check open in neutral gear switch signal cicuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect neutral gear switch connector and ECM connector.

   3) Check Continuity between neutral gear switch connector terminal 1 and ECM connector terminal 57.

specifications : Approx. below 1Ω

   4) Is the measured resistance within the specifications ?

YES

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E5D07186

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect neutral gear switch connector and ECM connector.
3. IG KEY "ON".
4. Measure the voltage of neutral gear switch connector terminal 1. [TEST "A"]
5. Measure the voltage between neutral gear switch connector terminal 1 and terminal 2. [TEST "B"]
   (Terminal 1 : Check + prove , terminal 2 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

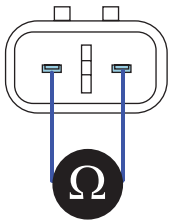
NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E063FAFF

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect neutral gear switch connector and ECM connector.
3. Check the contituity between neutral gear switch component terminal 1 and 2 as shifting gear lever.

specifications : at neutral position : Continuity (below 1.0) at any gear position except neutral position : Discontinuity (Iinfinite Ω)



EGNG007A

4. Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace neutral gear switch and go to Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E8A43040

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P0830 CLUTCH PEDAL SWITCH "A" CIRCUIT

GENERAL DESCRIPTION E4EF4AAC

Clutch switch is connected to clutch pedal and transmits clutch operating state to ECM.When clutch pedal is depressed during driving, engine load changes from loaded to none loaded condition. However, ECM regards vehicle to be loaded becuase VSS signal is still inputted to it. therefore, ECM controls none loaded engine with the condition suitable for loaded engine.Accordingly, optimum fuel injection control is not performed then, RPM becomes unstable and smoke is produced. Clutch operation is detected through clutch switch signal. This signal enables ECM to cope with instant change of load condition. Besides, clutch switch signal is used to detect engaged gear with vehicle speed and engine speed.

DTC DESCRIPTION E66D9532

P0830 is set when no clutch switch signal change is detected 1). within 2 sec. after shifting gear during driving. 2). while gear shifts 4 times at above 10Km/h and 1000rpm. This code is due to 1) clutch switch component failure or 2) open or short in circuit 3) improper height of clutch pedal.
※ECM recognize ingaged gear with rpm and vehicle speed sensor signal.

DTC DETECTING CONDITION E144A414

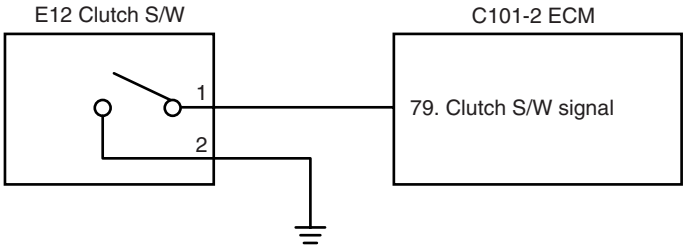
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="7">• Clutch S/W circuit
• Clutch S/W component
• Clutch S/W pedal hight</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine run</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• No clutch switch signal change is detected within 2 sec. after shifting gear during driving
• No clutch switch signal change is detected until gear shifted 4 times at above 10Km/h and 1000rpm</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E48888BA

Condition	Clutch Pedal Depressed	Clutch Pedal Released
Switch Operation	Switch ON	Switch OFF

SCHEMATIC DIAGRAM EEF9790E

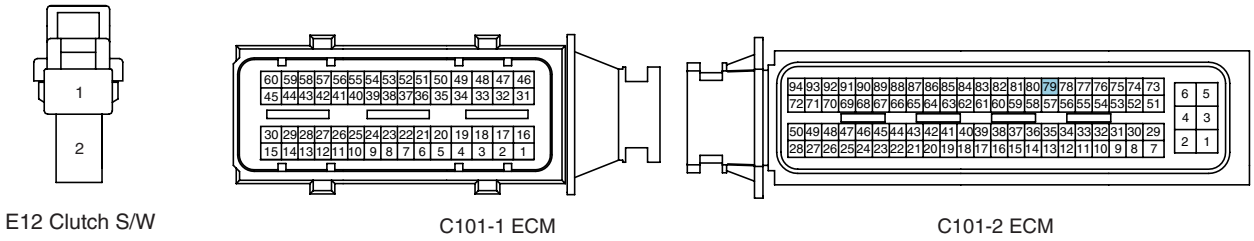
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-2 terminal 79	Clutch S/W signal
2	G13 ground point	Chassis ground

[HARNESS CONNECTOR]



EGNG004C

SIGNAL WAVEFORM AND DATA E6693B91

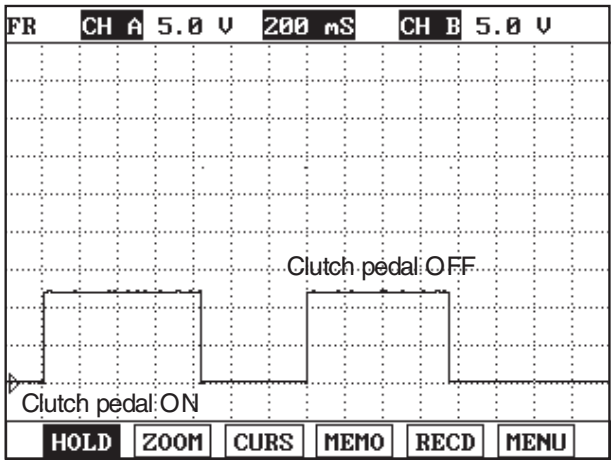


Fig.1

Fig.1) The waveform of clutch switch when clutch pedal is depressed. The output voltage of clutch pedal is 0V when clutch pedal is depressed and 12V when released.

EGNG004D

MONITOR SCANTOOL DATA EDD53229

1. Connect scantool to Data Link Cable. (DLC)
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Select "CLUTCH SWITCH" parameter on the Scantool.

Specification : When clutch switch released : CLUTCH SWITCH : OFF
When clutch switch depressed : CLUTCH SWITCH : ON

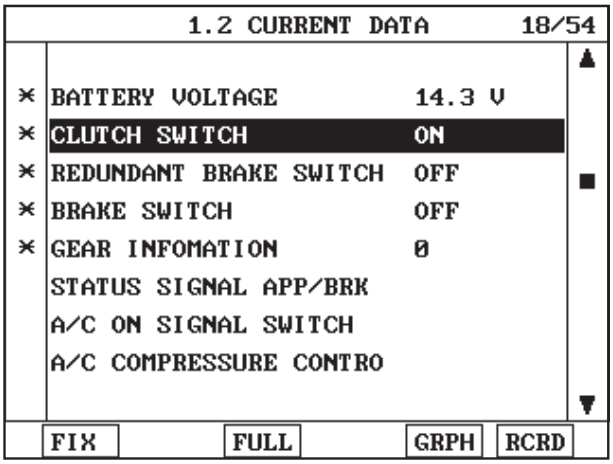


Fig.1

Fig. 1) Check if "CLUTCH SWITCH" parameter changes correctly from "ON" to "OFF" and vice versa as activating clutch pedal.

EGNG004E

TERMINAL AND CONNECTOR INSPECTION E84FF789

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Signal Circuit Inspection".

SIGNAL CIRCUIT INSPECTION EAD89C37

1. Check clutch switch pull-up voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect clutch switch connector.
   3) IG KEY "ON".

4) Measure the voltage of terminal 1 of clutch switch connector.

Specification : 11.5V~13.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Go to "2.Check open in clutch switch signal circuit" as follows.

2. Check open in clutch switch signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect clutch switch connector and ECM connector.

3) Check continuity between clutch switch connector terminal 1 and ECM connector terminal 79.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION EEC2D6F2

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect clutch switch connector.
3. Check continuity between clutch switch connector terminal 2 and chassis ground.

specification : Continuity (below 1.0Ω)

4. Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

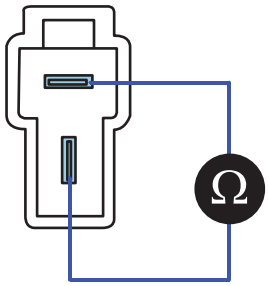
NO

▶ Repair open or poor connection in ground circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E1ECD2B6

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect clutch switch connector.
3. Check continuity between clutch switch component terminal 1 and 2 as depressing clutch pedal.

Specification : Clutch pedal depressed : Continuity (below 1.0Ω)
Clutch pedal released : Discontinuity (Infinite Ω)



EGNG004I

4. Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ After checking height of clutch pedal, if therer is no problem, replace clutch switch and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E23CFA77

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

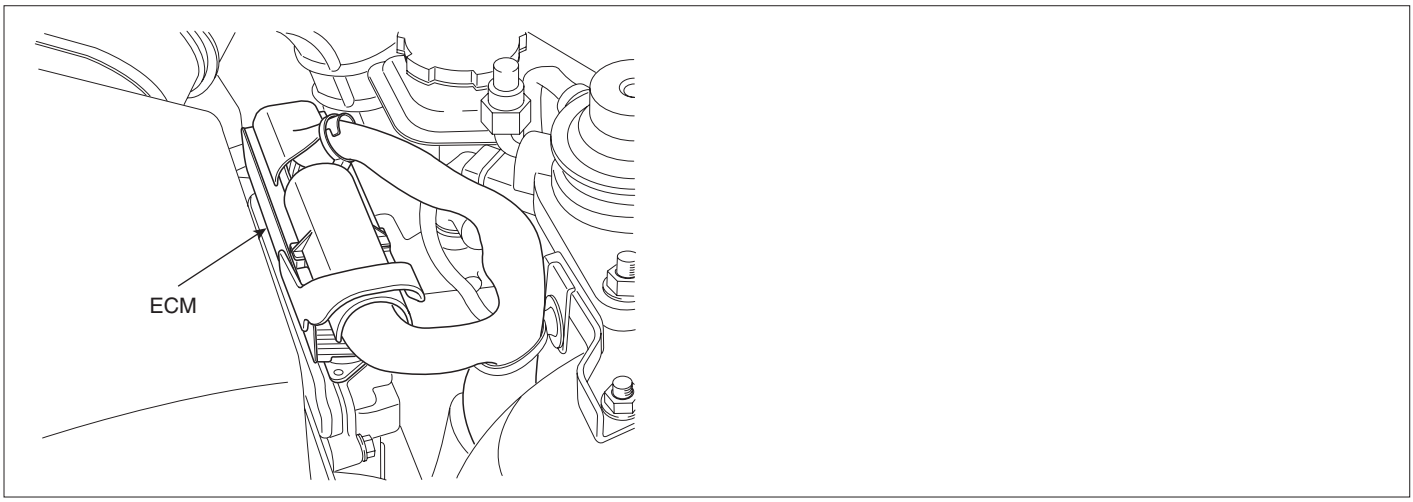
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P1145 OVERRUN MONITORING ERROR

COMPONENT LOCATION EC4165E7



EGNG007T

GENERAL DESCRIPTION E98FA67D

ECM is activated by power supply. Signals from several sensors, such as CKPS and APS, is inputted to ECM. Comparing inputted siganals with control LOGIC saved at micro controller and EEPROM, ECM controlls engine as actuating injectors, solenoids and relays. To guarantee accurate control, ECM performs SELF TEST, DIAGNOSIS of several sensors and actuators. And if serious trouble which affects vehicle performance occurrs, ECM sets DTCs.At certain cases, ECM shuts down whole systems in order to prevent dangerous situation due to incorrect control.

DTC DESCRIPTION E2957009

P1145 is set if fuel to injector is not limited(fuel cut disabled) and injector operates when accelerator pedal is released after acceleraton(when vehicle coasts). This code is due to the case that ECM fails to cut power of injector operating system inside of ECM.

DTC DETECTING CONDITION EA5381E9

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Software monitoring</td><td rowspan="7">• ECM internal error</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• During driving</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Overrun lasts for seconds.
(fuel injection performed regardless with driver’s intension)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>YES</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

COMPONENT INSPECTION ED1E4362

1. ECM Component Inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect ECM.
   3) Replace ECM, check if abnormal operations disappear.
   4) If problems are corrected, replace ECM.

VERIFICATION OF VEHICLE REPAIR EB8D98F7

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

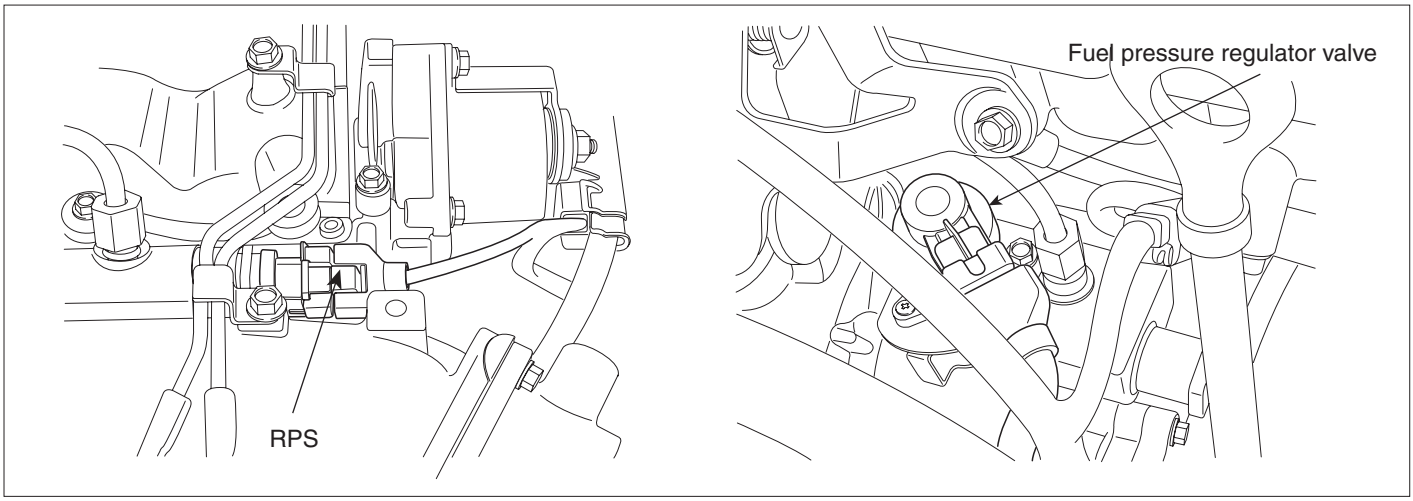
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P1185 FUEL PRESSURE MONITORING-MAXIMUM PRESSURE EXCEEDED

COMPONENT LOCATION E19BC45C



EGNG010K

GENERAL DESCRIPTION E84FA83C

As inputted rail pressure sensor signal, ECM of Commom rail diesel engine controls Fuel pressure regulator valve(intergrated with high press. pump) and rail pressure regulator valve(ntegrated with common rail) in order to maintain optimum rail pressure according to current engine rpm and load. However when the problem that leads rail pressure to out of target value intended by ECM occurs due to mechanical or electronical reason, ECM shuts engine down and sets DTC by limiting fuel (stops injector operation) in order to prevent engine from being controlled abnormally. "rail pressure monitoring error" is the DTC which diagnose 1).supplying state of low pressure fuel and 2).mechanical operating conditions of high pressure pump and 3). rail pressure regulator valve indirectly based on RPS output voltage and RPS duty. thus, repair relavant to this DTC requires mechanics the total understand of fuel system.

DTC DESCRIPTION EF4A2B47

P1185 is set when 1)rail press. is higher than target rail press. by 200bar in condition that rail press. is controlled by Fuel pressure regulator valve or 2)rail press. exceeds maximum limiting value. This code is due to 1)more than intended fuel supply to common rail or 2)poor return of fuel supplied to common rail or 3)short to high voltage line in fuel press. sensor.

DTC DETECTING CONDITION E96C514C

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Fuel pressure regulator valve (open stuck) • Rail pressure regulator valve (close stuck) • Rail pressure sensor (Output fixed at high voltage line)
Enable Conditions	• Engine running			
ThresholdValue	• Rail pressure is above target rail pressure by more than 200bar at Fuel pressure regulator valve operating condition.- 400ms • Rail pressure is above maximum limiting value(1750bar) at Fuel pressure regulator valve operating condition. - 120 ms			
DiagnosticTime	• Refer to threshold Value			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	YES		
	MIL	YES		

MONITOR SCANTOOL DATA EB340AF3

1. Monitoring rail pressure data

   1) Connect Scantool to Data Link Connector (DLC).

   2) Warm engine up to normal operating temperature.

   3) Turn "OFF" electrical devices and A/C.

   4) Monitor "FUEL PRESSURE MEASURED", "FUEL PRESSURE-TARGET", "RAIL PRESS. REGULATOR1", "INJ. PUMP REGULATOR" parameter on the Scantool.

Specification : Rail pressure at idle :
FUEL PRESSURE MEASURED : similar to "FUEL PRESSURE-TARGET"
FUEL PRESSURE-TARGET : 28 ± 5 Mpa
RAIL PRESS. REGULATOR1 : 20 ± 5%
INJ. PUMP REGULATOR : 40 ± 5%

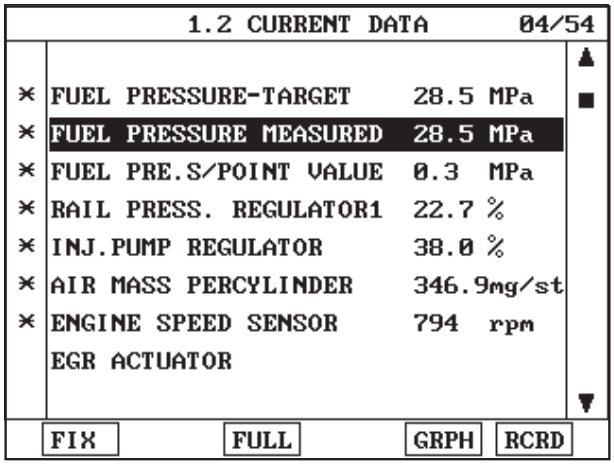


Fig.1

Fig.1) Monitor "FUEL PRESSURE MEASURED" at idle after warming engine up.

Check if "FUEL PRESSURE MEASURED"data is similar to "FUEL PRESSURE-TARGET". Not only former two data but also "RAIL PRESS. REGULATOR1" and "INJ. PUMP REGULATOR"should be monitored carefully. Although "FUEL PRESSURE MEASURED" is similar to "FUEL PRESSURE-TARGET", if "RAIL PRESS. REGULATOR1" and "INJ. PUMP REGULATOR" is out of specification, it means wear, leakage, stuck of fuel system.

2. Monitoring rail pressure data at acceleration(loading condition).

   1) Connect Scantool to Data Link Connector (DLC).

   2) Warm engine up to normal operating temperature.

   3) Turn "OFF" electrical devices and A/C.

   4) Monitor "FUEL PRESSURE MEASURED", "RAIL PRESS. REGULATOR1", "INJ. PUMP REGULATOR" parameter on the Scantool.

SPECIFICATION :

	Idle(without load)	Accelerating(stall test)	Diagnosis
INJ. PUMP REGULATOR	38 ± 5%	32 ± 5%	duty decreases
FUEL PRESSURE MEASURED	28.5 ± 5 Mpa	145 ± 10 Mpa	press. increases
RAIL PRESS. REGULATOR1	19 ± 5%	48 ± 5%	duty increases

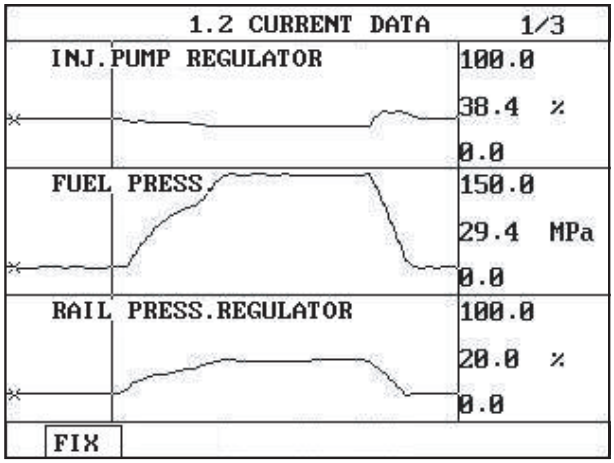


Fig.1

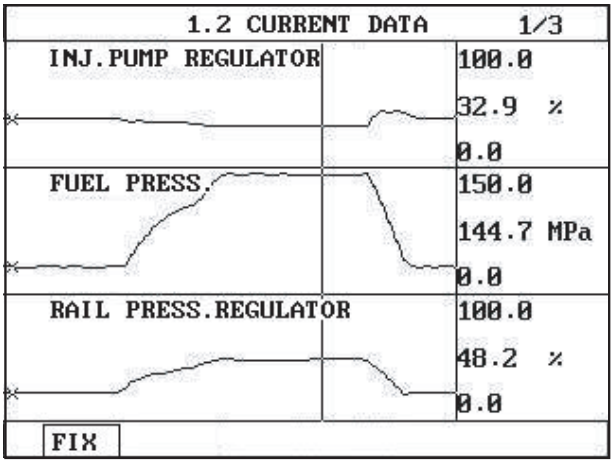


Fig.2

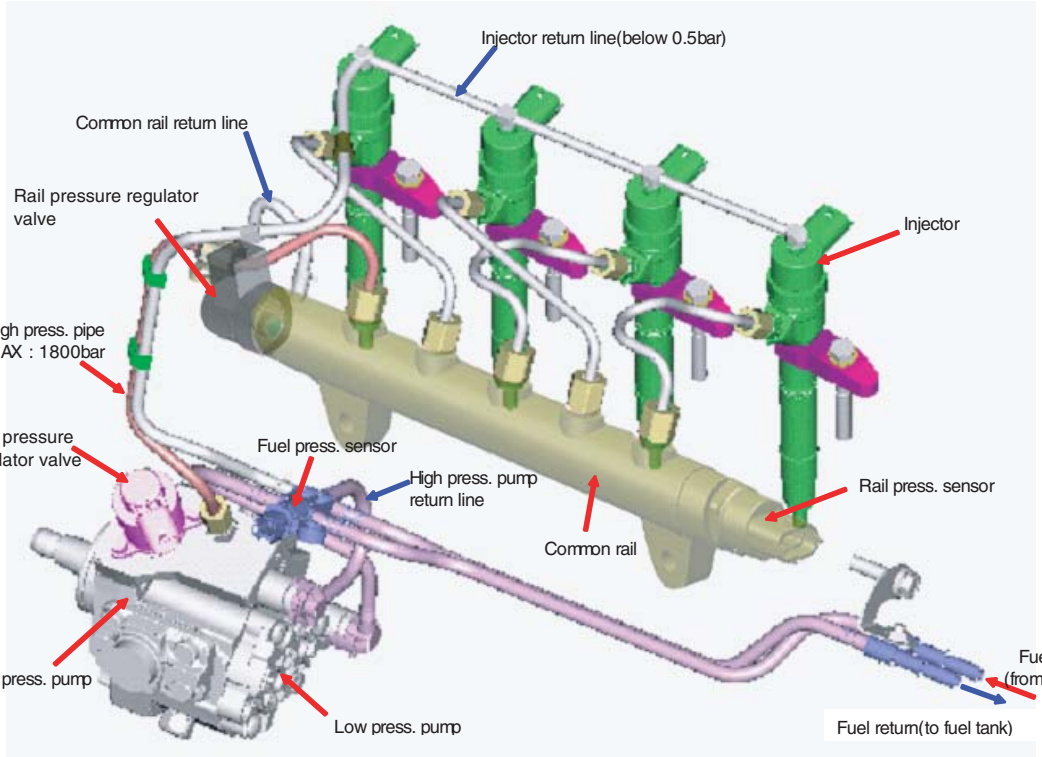
Fig.1) The position of curser on the graph represents idle data.
Fig.2) Data during acceleration(stall test).

EGNG010S

NOTE

The waveform of fuel pressure regulator valve installed at high pressure pump(fuel detecting MPROP) shows 38% duty at idle, duty drops to approx. 32% at acceleration to raise rail pressure. Duty drop means the decrease of current.
→ Fuel delivered to common rail increases as current drops.

The waveform of rail pressure regulator valve installed at common rail shows 19% duty at idle, duty rises to approx. 48% at acceleration to raise rail pressure. Duty rise means the increase of current.
→ If current rises, the returning quantity of fuel deliverd to common rail decreases and common rail pressure rises.



EGNG014Q

VERIFICATION OF VEHICLE REPAIR EC4B9224

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P1186 FUEL PRESSURE MONITORING-MINIMUM PRESSURE AT ENGINE SPEED TOO LOW

COMPONENT LOCATION E80B2033

Refer to DTC P1186.

GENERAL DESCRIPTION E4141CE3

Refer to DTC P1186.

DTC DESCRIPTION E20321AE

P1185 is set when rail press. is lower than target rail press. by 200bar for more than 1.0 sec. in condition that rail press. is controlled by Fuel pressure regulator valve. This code is due to 1)less than intended fuel supply to common rail or 2)excessive return of fuel supplied to common rail or 3)short to low voltage line in fuel press. sensor.

DTC DETECTING CONDITION E2AF3A3C

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="7">• Fuel pressure regulator valve (close stuck)
• rail pressure regulator valve (open stuck)
• Rail pressure sensor (Output fixed at low voltage line)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Rail pressure is below target rail pressure by more than 200bar at Fuel pressure regulator valve operating condition.</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 1.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

MONITOR SCANTOOL DATA E4105D91

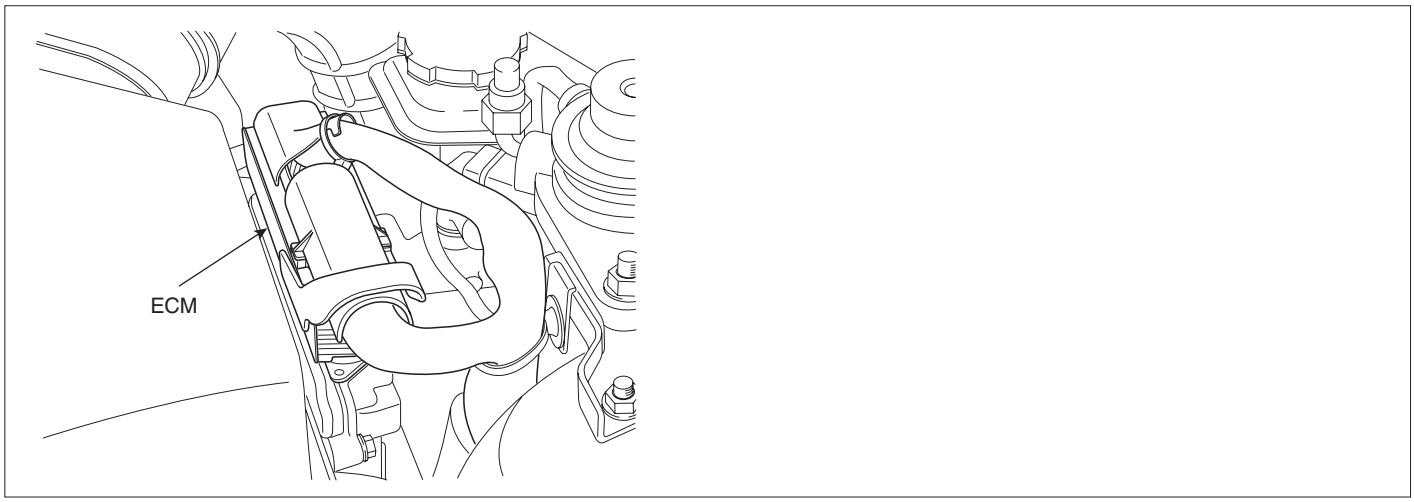
Refer to DTC P1186.

VERIFICATION OF VEHICLE REPAIR E3D90CCA

Refer to DTC P1186.

DTC P1586 MT/AT ENCODING

COMPONENT LOCATION EAC9DC78



EGNG007T

GENERAL DESCRIPTION EC5C7E36

Because both A/T and M/T fuel control map is inputted in one type of ECM and selecting option is possible, one type is applied to both A/T and M/T option.When ECM is installed to vehicle, A/T and M/T recognition is performed by ECM automatically as checking whether ground line(ECM connector C101-2 terminal 81) is grounded or opened.(A/T and M/T recognition is performed every IG KEY ON process.) If A/T, M/T recognition is not fulfilled well or any error occurs during the process, engine power generation is not sufficient and glow lamp on cluster blinks.

A/T : ECM connector C101-2 terminal 81 is grounded
M/T : ECM connector C101-2 terminal 81 is opened(no wiring exists)

DTC DESCRIPTION E4417233

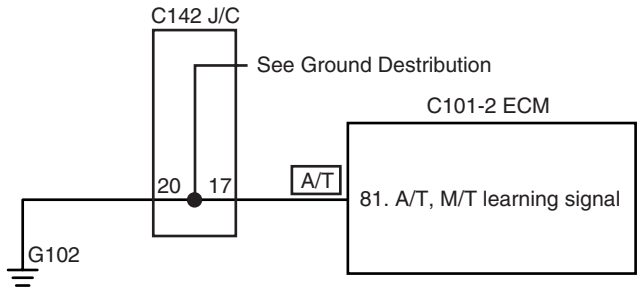
P1586 is set when recognized A/T, M/T data based on ECM C101-2 terminal 81 state(grounded or opened) is not readable or writable at EEP ROM. This code is due to ECM failure.

DTC DETECTING CONDITION EA51D2D3

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• software monitoring</td><td rowspan="6">• ECM component failure</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• A/T, M/T learning error
(when data writing on EEPROM inside of ECM is impossible)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 4.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Glow Lamp blinks.</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SCHEMATIC DIAGRAM E84DDF02

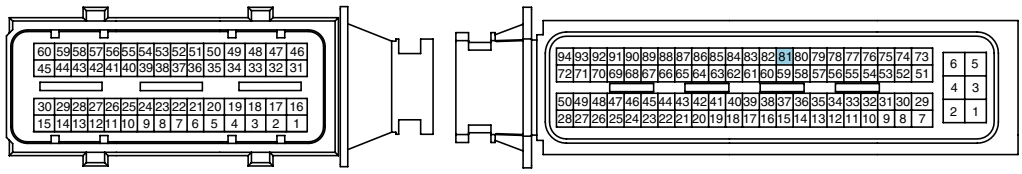
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
81	G102 ground point	A/T, M/T learning

[HARNESS CONNECTOR]



EGNG007B

COMPONENT INSPECTION E847B115

1. ECM Component Inspection
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect ECM.
   3) Replace ECM, check if abnormal operations disappear.
   4) If problems are corrected, replace ECM.

VERIFICATION OF VEHICLE REPAIR E7295853

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P1587 CAN COMMUNICATION ERROR (MT/AT RECOGNITION ERROR)

COMPONENT LOCATION EB68EEA9

Refer to DTC P1586.

GENERAL DESCRIPTION E3BE21DD

Refer to DTC P1586.

DTC DESCRIPTION EB5354F4

P1587 is set when ECM is recognized as 1)A/T but CAN communication signal is not transmitted from TCM 2)M/T but CAN communication signal is transmitted from TCM. After checking if A/T, M/T auto recognition terminal is normal for each vehicle option, if no problem is detected, check poor connection in CAN communication circuit or CAN communication problem of TCM.

DTC DETECTING CONDITION E37AF4D9

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="8">• A/T, M/T recognition terminal circuit
• CAN communication linecircuit
• TCM component failure
• ECM component failure</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine run</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• When TCM signal(through CAN communication) opposite to recognized data(A/T or M/T) at ECM is detected.</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 1.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Glow Lamp blinks.</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SCHEMATIC DIAGRAM E143D900

Refer to DTC P1586.

TERMINAL AND CONNECTOR INSPECTION EF57055A

Refer to DTC P1586.

POWER CIRCUIT INSPECTION E6005DE2

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect ECM.
3. Check continuity between ECM connector(C101-2) terminal 3 and chassis ground.

specification : Discontinuity (Infinite Ω)

4. Is A/T, M/T auto recognition terminal grounded well?

YES

▶ Go to "Check CAN communication line".
Refer to "U0101" DTC guide for checking CAN communication line.

NO

▶ Repair poor connection or open in C142 joint connector 17 termianl 20 and G102 ground point related circuit and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E4554621

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P1588 SIGNAL CHANGE THROUGH MT/AT LINE (DURING ENGINE RUNNING)

COMPONENT LOCATION EA850174

Refer to DTC P1586.

GENERAL DESCRIPTION E50FAA4B

Refer to DTC P1586.

DTC DESCRIPTION E4B03891

P1588 is set when the signal from A/T, M/T auto recognition terminal(ECM C101-2 terminal 81) changes during engine run. This code is due to open in terminal for A/T option, grounded condition for M/T option. This code is normally arises from A/T option vehicle. Check the grounding condition of A/T, M/T auto recognition terminal.

DTC DETECTING CONDITION E35D24C3

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• A/T, M/T recognition terminal circuit
• ECM component failure</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine run</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• A/T, M/T auto recognition signal changes at engine ON.</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 1.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Glow Lamp blinks.</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SCHEMATIC DIAGRAM E7E69571

Refer to DTC P1586.

TERMINAL AND CONNECTOR INSPECTION ECB11D8E

Refer to DTC P1586.

GROUND CIRCUIT INSPECTION E53E21FB

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect ECM.
3. Check continuity between ECM connector(C101-2) terminal 3 and chassis ground.

specification : Discontinuity (Infinite Ω)

4. Is A/T, M/T auto recognition terminal grounded well?

YES

▶ Go to "Component Inspection".

NO

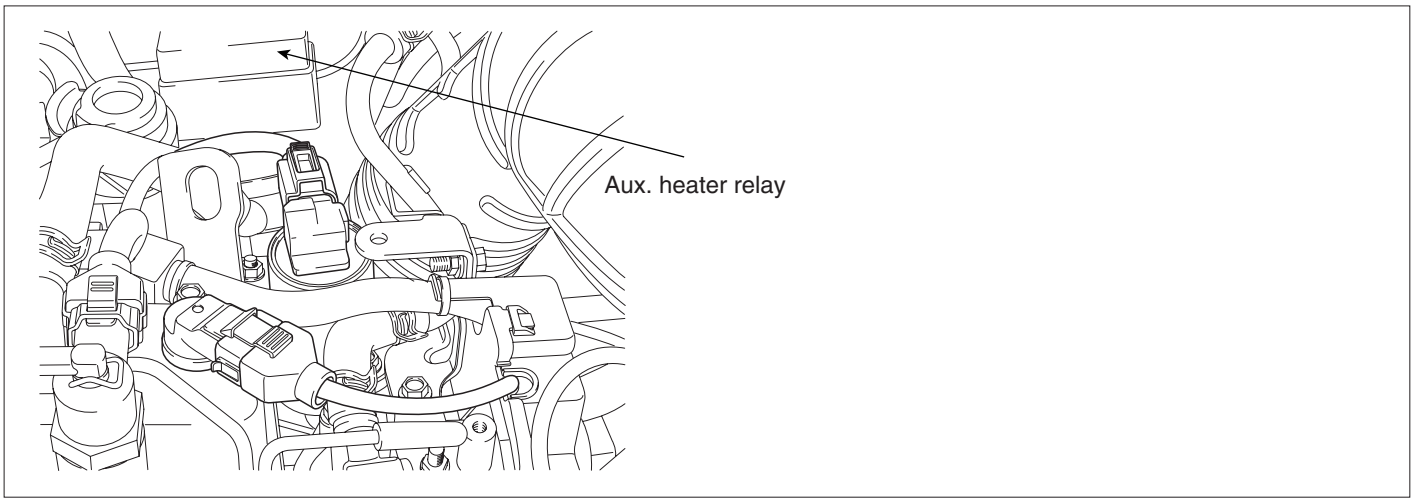
▶ Repair poor connection or open in C142 joint connector 17 termianl 20 and G102 ground point related circuit and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EDE64E36

Refer to DTC P1586.

DTC P1634 AUXILIARY HEATER MALFUNCTION

COMPONENT LOCATION E56FA5A1



EGNG013I

GENERAL DESCRIPTION E9A6BA6F

Because thermal efficiency of electronically controlled diesel engine is higher than that of gasoline engine, heat loss to cylinder wall is lower. This enables electronically controlled diesel engine to generate high power and have high fuel efficiency. However in other point of view, due to low engine coolant temperature, heating efficiency lowered then, driver is unsatisfied with the heating. To cope with this situation, PTC heater is installed in coolant line and it raises heating efficiency and raise coolant temperature.ECM activates heater relay 1 and 2 when engine coolant temperature is below 70℃ and engine speed is above 700RPM.

※ Heater relay operation inhibited condition : engine coolant temperature above 70℃, engine speed below 700RPM(to prevent battery discharge)

DTC DESCRIPTION E152D41E

P1634 is set when excessive current or "0"A is detected in heater relay control circuit for more than 1.0 sec. at heater relay operating condition. This code is due to 1)open or 2)short to battery or ground in heater relay control circuit or 3)component problem.

DTC DETECTING CONDITION EAFFDBB9

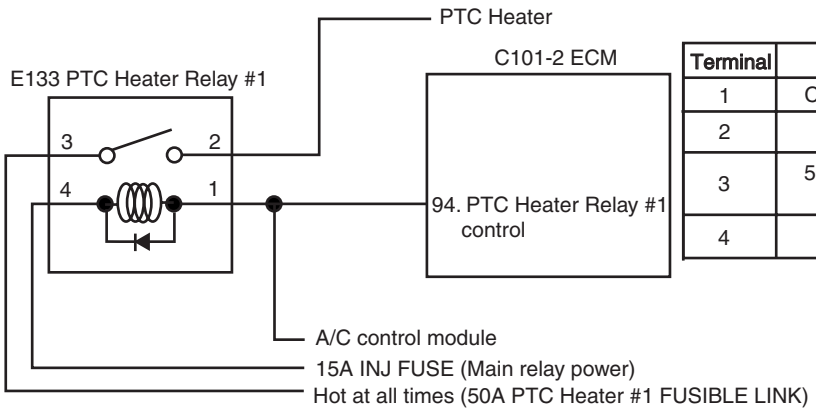
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• PTC heater relay #1control circuit
• Heater relay component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON" (monitoring only performed at relay operating condition)</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 1.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E5D616C1

Heater relay coil resistance	PTC heater operating temperature	PTC heater operating condition
52±5Ω (20℃)	Coolant temp. beolw 70℃ (Intake air temp.below 5℃)	Engine speed above 700RPM (Battery voltage above 8.9V)

SCHEMATIC DIAGRAM E0145EE6

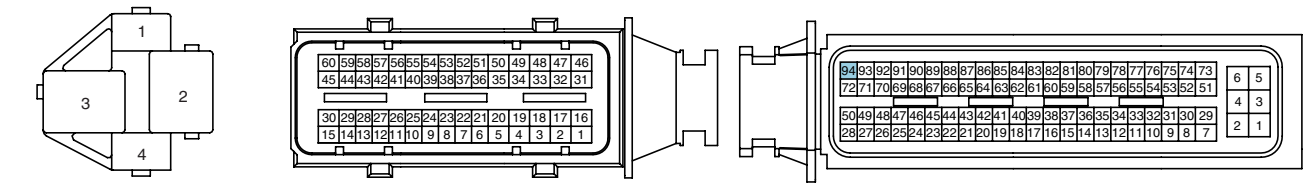
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C102-1 terminal 94	PTC Heater Relay #1 control
2	E132 terminal 3	PTC Heater Relay power(OUTPUT)
3	50A PTC Heater #1 Fusible Link	PTC Heater Relay power(INPUT)
4	15A INJ FUSE	PTC Heater Relay #1 coil power

[HARNESS CONNECTOR]



E133 PTC Heater Relay #1 C101-1 ECM C101-2 ECM

EGNG013J

MONITOR SCANTOOL DATA ED0CB6C7

1. Connect Scantool to Data Link Connector (DLC).
2. ENGINE "ON".(Engine coolant temp. below 70℃,Intake air temp. below 5℃)
3. Blower switch "ON".
4. Monitor "Auxiliary Heater(PTC)" parameter on the Scantool.
   (As soon as turning engine ON "Auxiliary Heater(PTC)" parameter turns "ON". Check if the parameter turns "OFF" after engine is warmed up.)

specification : Engine coolant temp. below 70℃(Intake air temp. below 5℃) : "Auxiliary Heater(PTC)" "ON"
Engine coolant temp. above 70℃ : "Auxiliary Heater(PTC)" "OFF"

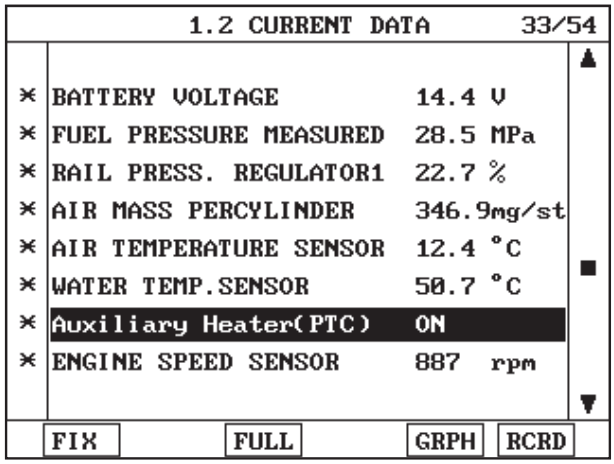


Fig.1

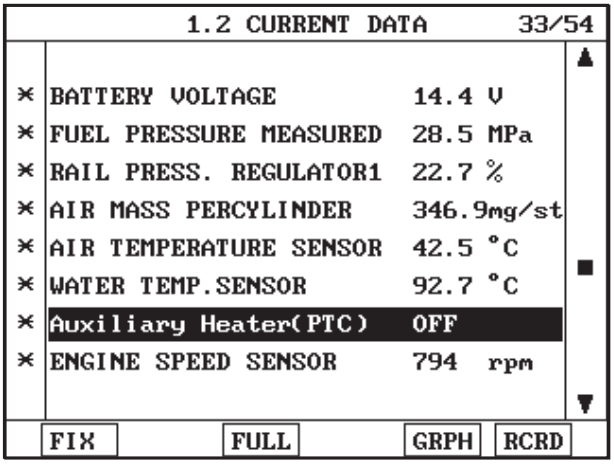


Fig.2

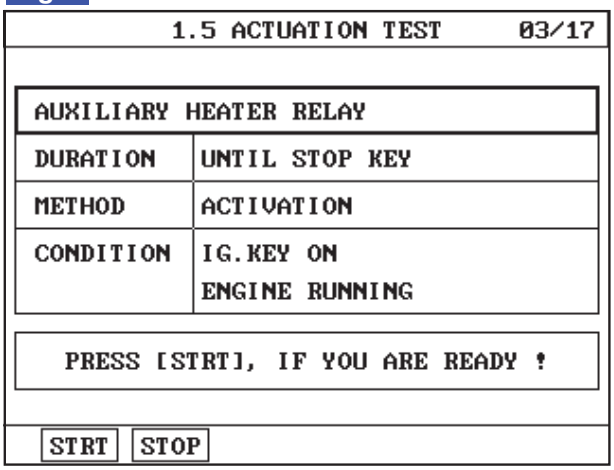


Fig.3

Fig.1) "Auxiliary Heater(PTC)" operates only when Intake air temp. is below 5℃ and Engine coolant temp. is below 70℃.
"ON" state of "Auxiliary Heater(PTC)" lasts till Engine coolant temp. reaches 70℃.
Fig.2) "Auxiliary Heater(PTC)" turns "OFF" as soon as engine coolant temp. reaches 70℃.
Fig.3) If it is difficult to cool engine when current condition does not meat "Auxiliary Heater(PTC)" operating condition, check relay operation using "Auxiliary Heater(PTC)" on the Scantool.

EGNG013K

TERMINAL AND CONNECTOR INSPECTION E9F4606C

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION ED04CB4F

1. Check HOT AT ALL TIMES power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect PTC heater relay #1.

   3) Measure the voltage of PTC heater relay #1 connector terminal 3.

Specification : 11.5V~13.0V

   4) Is the measured voltage within the specification?

   YES

   ▶ Go to "2. Check IG KEY "ON" power circuit voltage" as follows.

   NO

   ▶ Repair Fusible link box 50A PTC heater#1 fusible link and related circuit and go to "Verification of Vehicle Repair".

2. Check IG KEY "ON" power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect PTC heater relay #1.

   3) IG KEY "ON".

   4) Measure the voltage of PTC heater relay #1 connector terminal 4.

Specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Control Circuit Inspection".

   NO

   ▶ Repair E/R FUSE & RELAY BOX 15A INJ fuse and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E4839F72

1. Check control circuit monitoring voltage

1) IG KEY "ON", ENGINE "OFF".

2) Disconnect PTC heater relay #1.

3) IG KEY "ON".

4) Measure the voltage of PTC heater relay #1connector terminal 1.

Specification : 8.0V~10.0V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When no value is detected : Go to "2. Check open in control circuit".
▶ When high voltage is detected : Repair short to battery in control circuit and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect PTC heater relay #1 and ECM connector.

3) Check continuity between PTC heater relay #1 connector terminal 1 and ECM connector terminal 94.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground and go to "Verification of Vehicle Repair".

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EDF97812

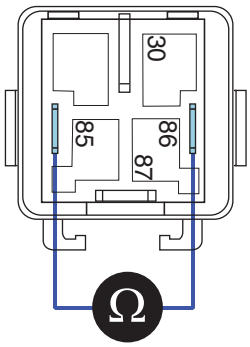
1. Check PTC heater relay #1 component coil resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect PTC heater relay #1.

3) Measure the resistance of PTC heater relay #1 component coil.

Specification : 52±5 Ω (20℃)



EGNG013P

4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check PTC heater relay #1 component operation" as follows.

NO

▶ Replace PTC heater relay #1 and go to "Verification of Vehicle Repair".

2. Check PTC heater relay #1 component operation

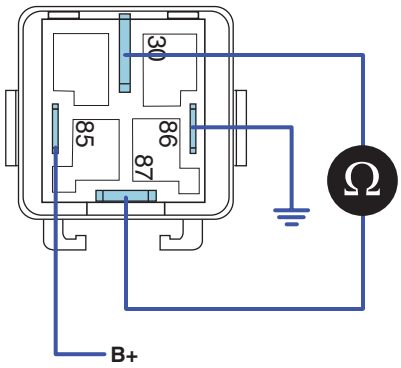
1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect PTC heater relay #1.

3) Supplies random B+ and ground to coil sides of PTC heater relay #1. (terminal 85, 86)

4) Check continuity between PTC heater relay #1 terminal 30 and terminal 87.

specification : When power is supplied : Continuity (below 1.0Ω)
When power is not supplied : Discontinuity (Infinite Ω)



EGNG013Q

5) Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace PTC heater relay #1 and go to "Verification of Vehicle Repair".

※ Repeat this process 2~3 times.

VERIFICATION OF VEHICLE REPAIR E73CF251

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

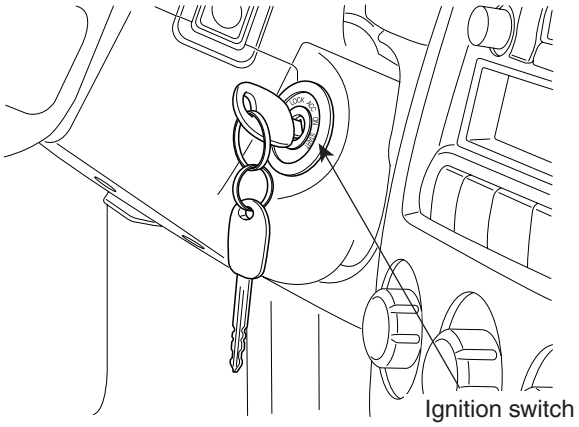
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P1652 IGNITION SWITCH CIRCUIT MALFUNCTION

COMPONENT LOCATION E262B147



EGNG013D

GENERAL DESCRIPTION E4165984

When a driver turns on IG KEY, IG KEY ON signal is inputted to ECM C101-1 connector terminal 28 through IG KEY switch. This signal initializes(boots) ECM accordingly, main relay operates. Main relay supplies powers for ECM, sensors and actuators in order to enable engine to start.When IG KEY ON signal is shut off during turning engine OFF, ECM stops injector operation then engine turns OFF. Approx. after 12 sec., ECM shuts OFF main relay and system turns OFF.

DTC DESCRIPTION E45C4579

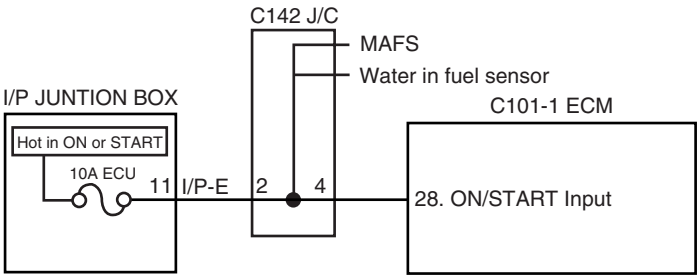
When the condition that IG KEY ON signal turns OFF while ECM, to which IG signal inputted, is initialized (booting, Approx. 25ms is required), IG KEY switch error is recognized and P1652 is set (monitored only once every IG KEY ON initialization process). This code is due to poor connection in IG KEY ON signal circuit.

DTC DETECTING CONDITION EE76111D

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• IG KEY "ON"signal circuit
• IG KEY switch</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• No signal through IG line after IG KEY "ON"</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SCHEMATIC DIAGRAM E3124AAD

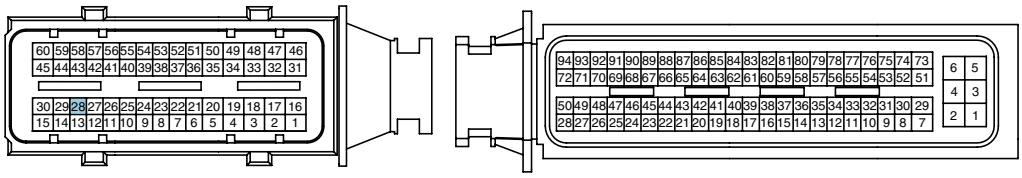
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
28	G142 terminal 4	ON/START Input

[HARNESS CONNECTOR]



C101-1 ECM C101-2 ECM

EGNG013E

SIGNAL WAVEFORM AND DATA E713C46C

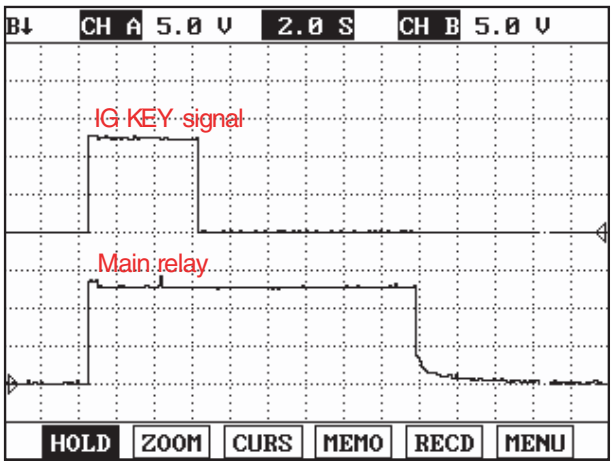


Fig.1

Fig.1) The waveforms of IG KEY "ON" signal and main relay operation are measured simultaneously. Check poor connection at the point of IG KEY "ON".

EGNG013F

TERMINAL AND CONNECTOR INSPECTION EF17371E

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Signal Circuit Inspection".

SIGNAL CIRCUIT INSPECTION E29AAC29

1. IG KEY "OFF", ENGINE "OFF".
2. Connect Oscilloscope to ECM connector terminal 28 with ECM connector being connected.
3. Check IG KEY "ON" signal waveform at IG KEY "ON".

specification : The signals indicate poor connection should not exist at IG KEY "ON" range.

4. Does abnormal waveform generate at IG KEY "ON" range?

YES

▶ Repair IG KEY S/W and poor connection of In-pannel junction box 10A ECU fuse, C142 joint connector terminal 2, 4 and related circuit and go to "Verification of Vehicle Repair".

NO

▶ Go to "Verification of Vehicle Repair".

※ Repeat this process 2~3 times.

VERIFICATION OF VEHICLE REPAIR E1B6548E

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

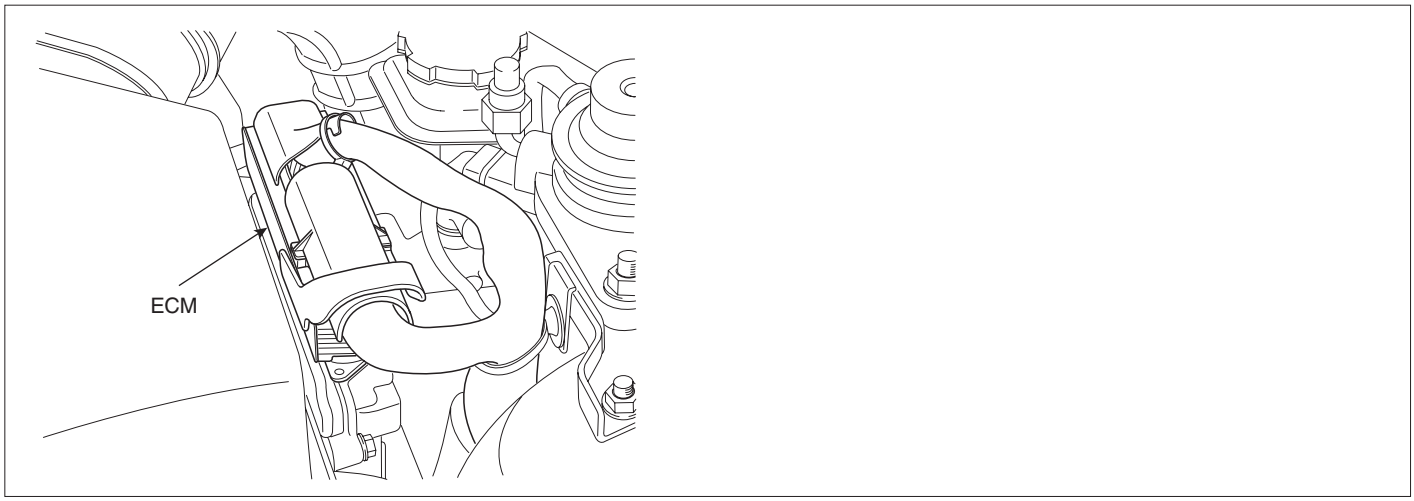
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P1670 INJECTOR CLASSIFICATION ERROR (DIESEL 1) / INJECTOR SPECIFIC DATA ERROR (DIESEL 2)

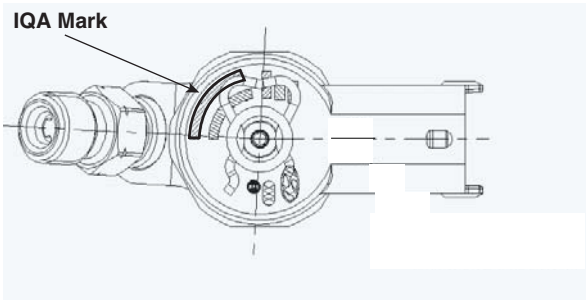
COMPONENT LOCATION E7699087



EGNG007T

GENERAL DESCRIPTION E85F3145

IQA (Injector Quantity Adjustment) means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic as recognizing specific fuel injection map which is different for each serial number.



EGNG004T

DTC DESCRIPTION EAA786C4

P1670 is set when 'IQA input error' or 'saving error' occurs in EEP ROM where IQA data is saved. This code is due to ECM internal error.

DTC DETECTING CONDITION E0120227

Item	Detecting Condition			Possible Cause
DTC Strategy	• EEPROM monitorting			• ECM internal error
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• Input error, saving error occurs at injector IQA code inputting.			
DiagnosticTime	• Immediately			
Fail Safe	Fuel Cut	NO	• Engine Check Lamp blinks.	
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	YES		

COMPONENT INSPECTION EB11F154

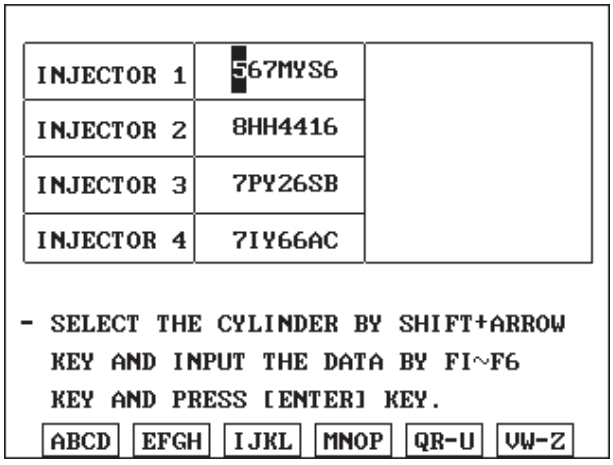
1. Check injector class input state

   1) IG KEY "OFF", ENGINE "OFF".

   2) Using Scantool, select "ENGINE CONTROL" - "INJECTOR CORRECTION".

   3) Check currently inputted "injector class input state".

Specification : IQA data inputted to ECM should be identical with IQA data of injector.



EGNG004U

   4) Are both data identical?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ If error is not corrected after reperforming "INJECTOR CORRECTION" procedure, replace ECM.

NOTE

Input iQA data of injector mounted at cylinder at replacing ECM using scantool.

If this process is not performed, engine check lamp on cluster blinks and normal engine power generation is impossible.

VERIFICATION OF VEHICLE REPAIR EC503282

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P1671 CHECK-SUM ERROR

COMPONENT LOCATION EE7CE20A

Refer to DTC P1670.

GENERAL DESCRIPTION E9C3D9CB

Refer to DTC P1670.

DTC DESCRIPTION E5C3E816

P1671 is set when IQA data is not inputted to ECM during initialization of ECM.

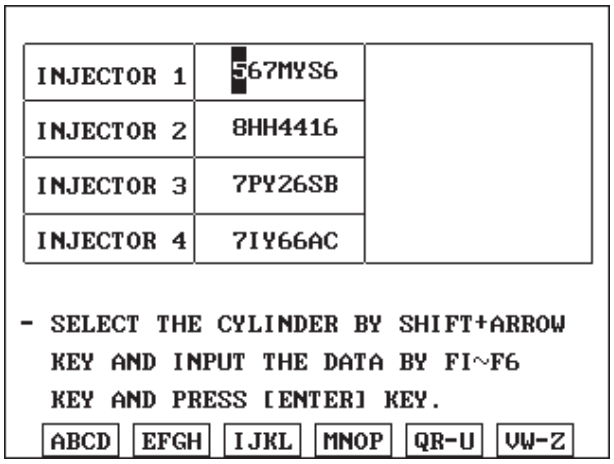
DTC DETECTING CONDITION E2BC4631

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• EEPROM monitorting</td><td rowspan="6">• IQA not inputted to ECM</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• IQA code is not inputted to ECM.</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• Immediately</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Engine Check Lamp blinks.</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

COMPONENT INSPECTION E9CA5ACD

1. Check injector class input state
   1) IG KEY "OFF", ENGINE "OFF".
   2) Using Scantool, select "ENGINE CONTROL" - "INJECTOR CORRECTION".
   3) Check currently inputted "injector class input state".

Specification : IQA data inputted to ECM should be identical with IQA data of injector.



EGNG004U

4) Are both data identical?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ If error is not corrected after reperforming "INJECTOR CORRECTION" procedure, replace ECM.

NOTE

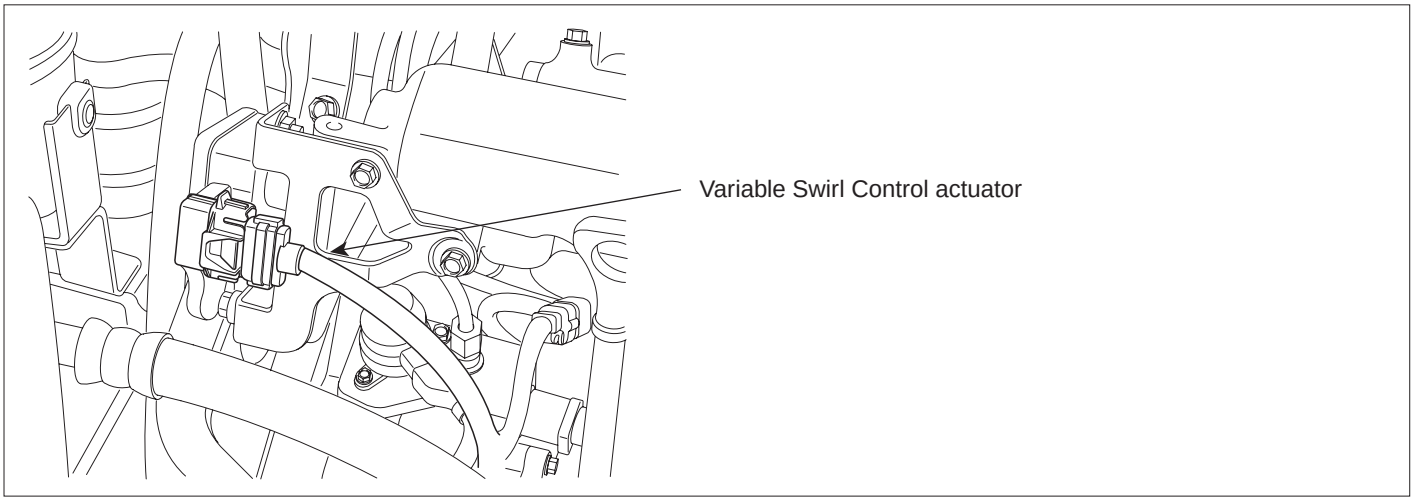
Input iQA data of injector mounted at cylinder at replacing ECM using scantool.
If this process is not performed, engine check lamp on cluster blinks and normal engine power generation is impossible.

VERIFICATION OF VEHICLE REPAIR EE66D5CF

Refer to DTC P1670.

DTC P2009 INTAKE MANIFOLD RUNNER CONTROL CIRCUIT LOW(BANK 1)

COMPONENT LOCATION EB20D89B



EGNG011D

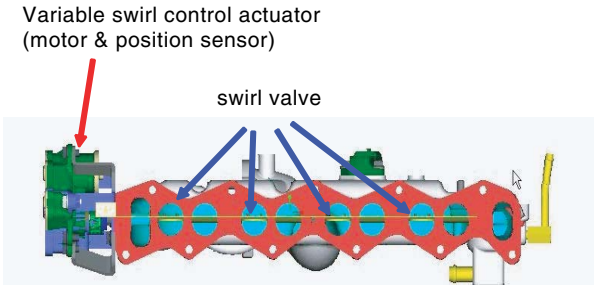
GENERAL DESCRIPTION EAACBFCE

Variable swirl control actuator consists of DC motor and motor position sensor(potentiometer) which detects the position of swirl valve.As closing one intake port out of two at idle and below 3000RPM, swirl effect is taken on intake air. This swirl effect increases air flow rate.

However, because air flow rate is too high, swirl effect is neglectable thus, swirl valve is opened for efficient intake of air.

To prevent swirl valve and shaft form being stuck by foreign metarial, and to learn max opening and closing position of swirl valve, it is fully opened and closed twice at turning engine OFF.

※Swirl
The air flow which indicates Intake air swirls with respect to the axis passing through the centre of piston with length-direction by intake port which is eccentric from the centre of combustion chamber.



EGNG011E

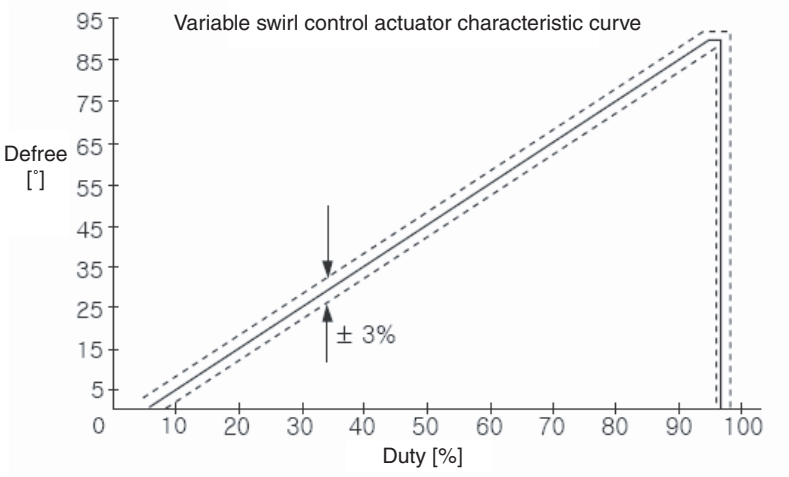
DTC DESCRIPTION E81F6542

P2009 is set when open or short to ground in variable swirl actuator driving motor (+) output terminal. The polarity of (+) and (-) lines shift each other in accordance with the condition of swirl valve(opened or closed) thus, checking both (+) and (-) circuits is required.

DTC DETECTING CONDITION EF775754

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Variable swirl valve motor circuit
Enable Conditions	• Engine running			
ThresholdValue	• Short to ground in motor output terminal • Open in motor circuit			
DiagnosticTime	• 200ms			
Fail Safe	Fuel Cut	NO	• Swirl valve opened at variable swirl control actuator failure	
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

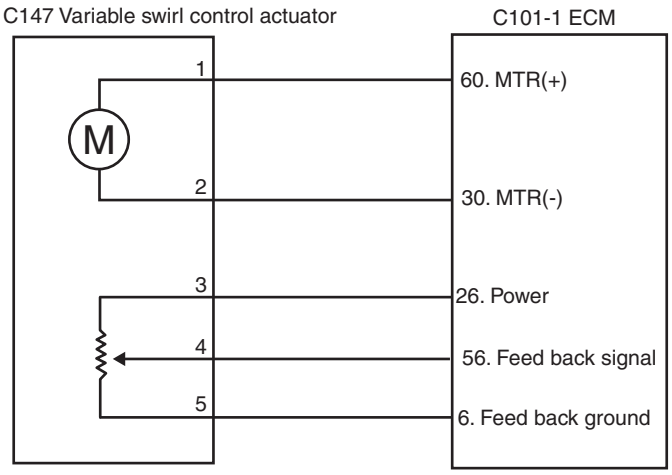
SPECIFICATION EA9E2873



EGNG011F

SCHEMATIC DIAGRAM EB2DB46F

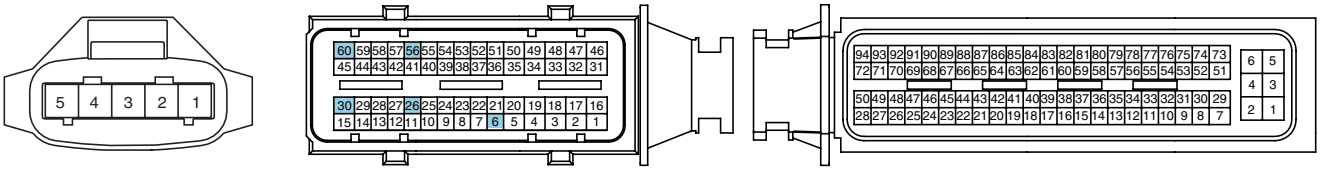
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-1 terminal 60	MTR(+)
2	C101-1 terminal 30	MTR(-)
3	C101-1 terminal 26	Power
4	C101-1 terminal 56	Feed back signal
5	C101-1 terminal 6	Feed back ground

[HARNESS CONNECTOR]



C147 Variable swirl control actuator | C101-1 ECM | C101-2 ECM

EGNG011G

SIGNAL WAVEFORM AND DATA E1F789AA

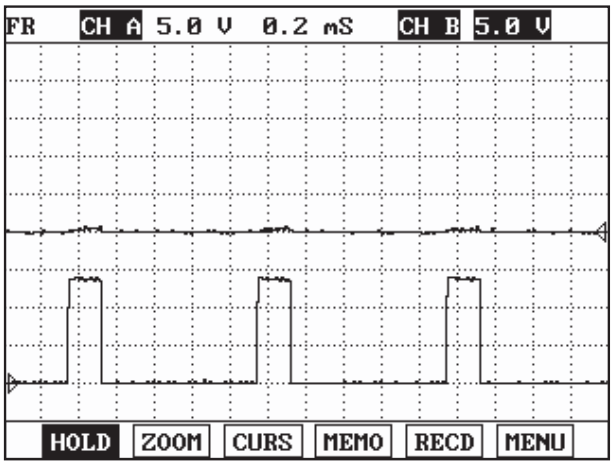


Fig.1

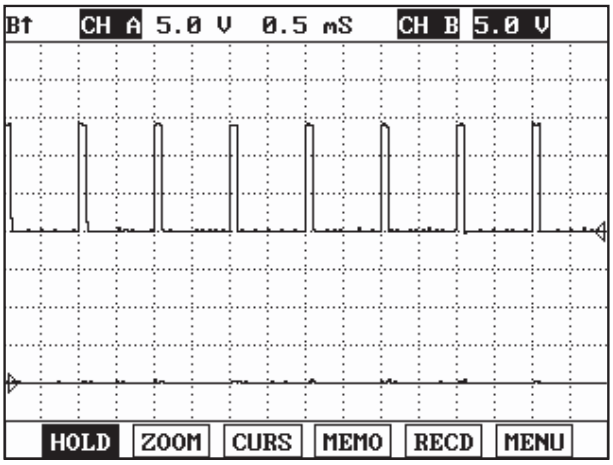


Fig.2

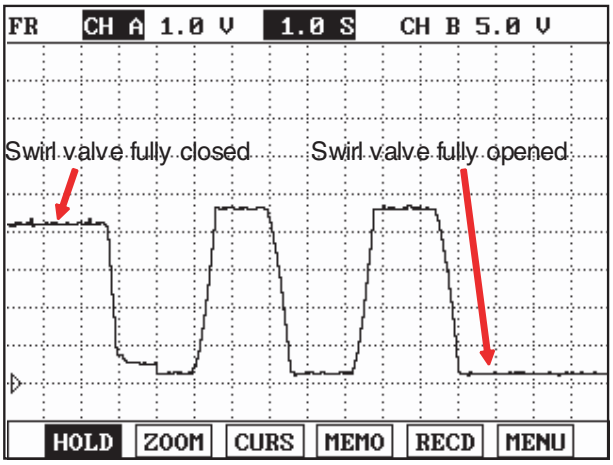


Fig.3

Fig. 1) Waveform when variable swirl valve closed at idle. Terminal 1 is (+) and 2 is (-).
Fig. 2) Waveform when variable swirl valve opened at above 3000RPM. Terminal 1 is (-) and 2 is (+).
Fig. 3) Waveform of variable swirl control actuator motor position sensor at the point of turning engine OFF.
4.3V at swirl valve closed and 0.3V at swirl valve opened. Swirl valve is opened and closed twice at engine "OFF".

EGNG011H

TERMINAL AND CONNECTOR INSPECTION E7BC703E

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Control Circuit Inspection".

CONTROL CIRCUIT INSPECTION E0DF1D85

1. Check short to ground in control circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect variable swirl control actuator connector and ECM connector.
   3) Check continuity between variable swirl control actuator connector terminal 1(or 2) and chassis ground.

Specification : Discontinuity(Infinite Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "2.Check open in motor circuit" as follows.

NO

▶ Repair short to ground in variable swirl control actuator motor circuit and go to "Verification of Vehicle Repair".

2. Check open in motor circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect variable swirl control actuator connector and ECM connector.
   3) Check continuity between variable swirl control actuator connector terminal 1 and ECM connector terminal 60.
   4) Check continuity between variable swirl control actuator connector terminal 2 and ECM connector terminal 30.

Specification : Continuity (below 1.0Ω)

   5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

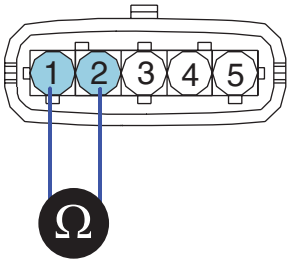
COMPONENT INSPECTION E1B5A12F

1. Check motor coil resistance
   1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect variable swirl control actuator connector.

3) Measure the resistance between variable swirl control actuator component terminal 1 and 2.

Specification : 15.0 ± 3 Ω (20℃)



EGNG011K

4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check motor operation".

NO

▶ Replace variable swirl control actuator assy'.

2. Check motor operation

1) IG KEY "ON" , ENGINE "ON".

2) Keep engine at idle state.

3) Monitor the waveform of variable swirl control actuator terminal 1and 2 with two channel oscilloscope.

4) Accelerating engine to above 3000RPM, let variable swirl control actuator be opened(operates).

Specification : Refer to Signal Waveform & Data "Fig.1)", " Fig.2)".

5) Does variable swirl control actuator operate correctly?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace variable swirl control actuator assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E0E94E2A

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".

4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P2010 INTAKE MANIFOLD RUNNER CONTROL CIRCUIT HIGH(BANK 1)

COMPONENT LOCATION EBF21D87

Refer to DTC P2009.

GENERAL DESCRIPTION E2DE4B5C

Refer to DTC P2009.

DTC DESCRIPTION ED2E2BDF

P2010 is set when short to battery in variable swirl control actuator driving motor (+) output terminal. The polarigy of (+) and (-) lines shift each other in accordance with the condition of swirl valve(opened or closed) thus, checking both (+) and (-) circuits is required.

DTC DETECTING CONDITION E4EA197E

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="9">• Variable swirl valve motor circuit</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery in motor output terminal</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 200ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Swirl valve opened at variable swirl control actuator failure</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E35103F0

Refer to DTC P2009.

SCHEMATIC DIAGRAM ED35264D

Refer to DTC P2009.

SIGNAL WAVEFORM AND DATA E9FEDD55

Refer to DTC P2009.

TERMINAL AND CONNECTOR INSPECTION E94BBC05

Refer to DTC P2009.

CONTROL CIRCUIT INSPECTION ECB5B1ED

1. Check control circuit voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect variable swirl control actuator connector.

3) IG KEY "ON".

4) Measure the voltage of variable swirl control actuator connector terminal 1 and 2.

Specification : 0.0V~0.1V

5) Is the measured voltage within the specification?

YES

▶ Repair short to battery in variable swirl control actuator motor circuit and go to "Verification of Vehicle Repair".

NO

▶ Check "2. Check open in motor circuit" as follows.

2. Check open in motor circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect variable swirl control actuator connector and ECM connector.

3) Check continuity between variable swirl control actuator connector terminal 1 and ECM connector terminal 60.

4) Check continuity between variable swirl control actuator connector terminal 2 and ECM connector terminal 30.

Specification : Continuity (below 1.0Ω)

5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E4642CDB

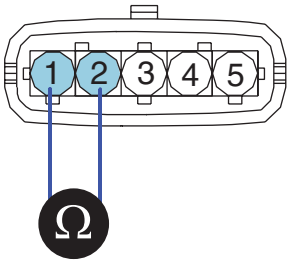
1. Check motor coil resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect variable swirl control actuator connector.

3) Measure the resistance between variable swirl control actuator component terminal 1 and 2.

Specification : 15.0 ± 3 Ω (20℃)



EGNG011K

4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check motor operation".

NO

▶ Replace variable swirl control actuator assy'.

2. Check motor operation

1) IG KEY "ON" , ENGINE "ON".

2) Keep engine at idle state.

3) Monitor the waveform of variable swirl control actuator terminal 1and 2 with two channel oscilloscope.

4) Accelerating engine to above 3000RPM, let variable swirl control actuator be opened(operates).

Specification : Refer to Signal Waveform & Data "Fig.1)", " Fig.2)".

5) Does variable swirl control actuator operate correctly?

YES

▶ Go to "Verification of Vehicle Repair".

NO

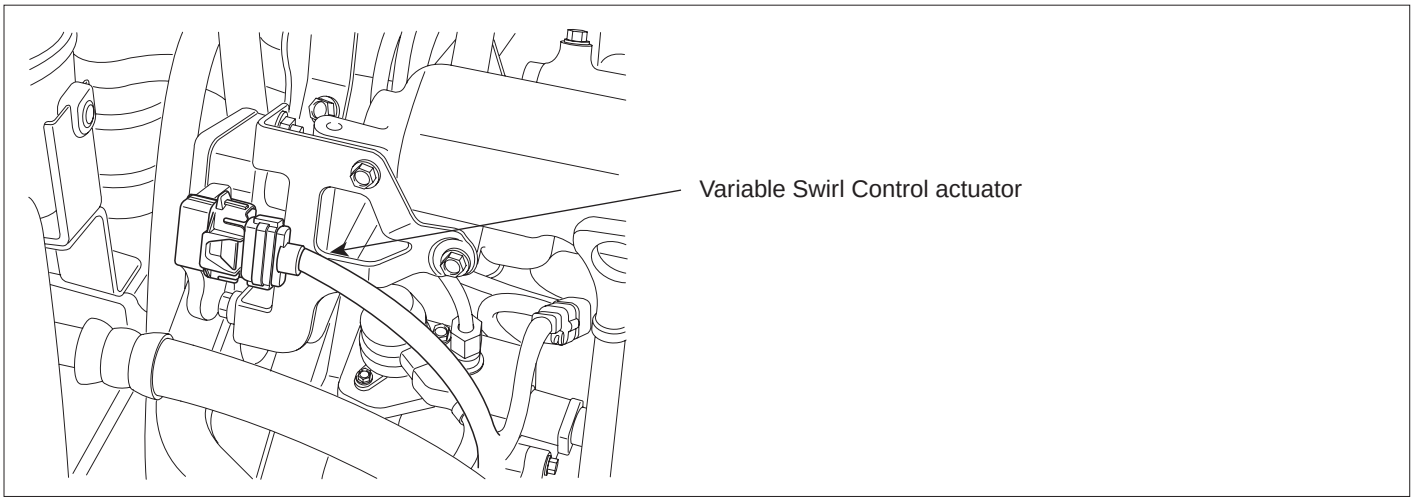
▶ Replace variable swirl control actuator assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E430C7D3

Refer to DTC P2009.

DTC P2015 INTAKE MANIFOLD RUNNER POSITION SENSOR/SWITCH CIRCUIT RANGE/PERFORMANCE(BANK 1)

COMPONENT LOCATION EEC48DBE



EGNG011D

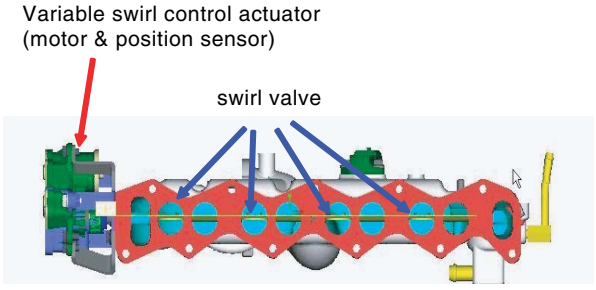
GENERAL DESCRIPTION E6E0CC10

Variable swirl control actuator consists of DC motor and motor position sensor(potentiometer) which detects the position of swirl valve.As closing one intake port out of two at idle and below 3000RPM, swirl effect is taken on intake air. This swirl effect increases air flow rate.

However, because air flow rate is too high, swirl effect is neglectable thus, swirl valve is opened for efficient intake of air.

To prevent swirl valve and shaft form being stuck by foreign metarial, and to learn max opening and closing position of swirl valve, it is fully opened and closed twice at turning engine OFF.

※Swirl
The air flow which indicates Intake air swirls with respect to the axis passing through the centre of piston with length-direction by intake port which is eccentric from the centre of combustion chamber.



EGNG011E

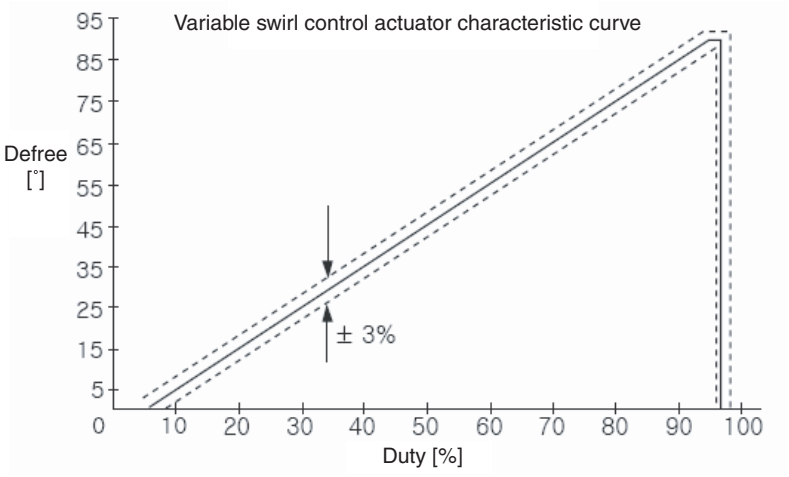
DTC DESCRIPTION EB3DDCD5

P2015 is set if variable swirl valve position fails to reach target position within 3 sec. while ECM already outputted motor driving signal(swirl valve fully open or close signal). This code is due to 1)swirl valve shaft stuck or problem of link device or 2)variable swirl valve position sensor output value stuck.

DTC DETECTING CONDITION E0C0C2CA

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Variable swirl valve shaft stuck • Variable swirl valve link device problem • Variable swirl valve position sensor component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• Variable swirl valve operating motor mechanically stuck			
DiagnosticTime	• 3.0 sec.			
Fail Safe	Fuel Cut	NO	• Swirl valve opened at variable swirl control actuator failure	
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

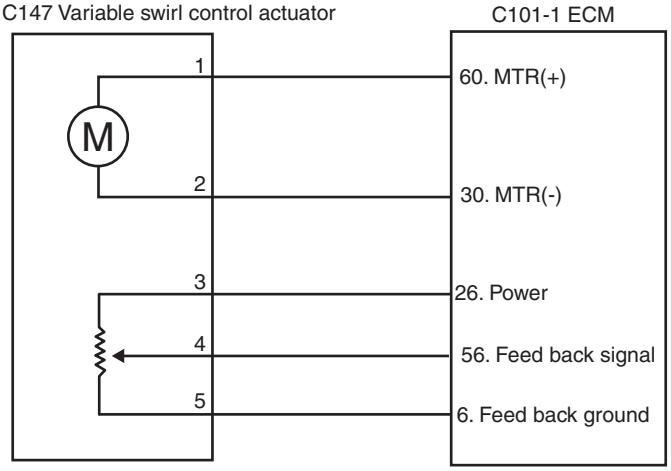
SPECIFICATION E4B5E972



EGNG011F

SCHEMATIC DIAGRAM EC21A3A5

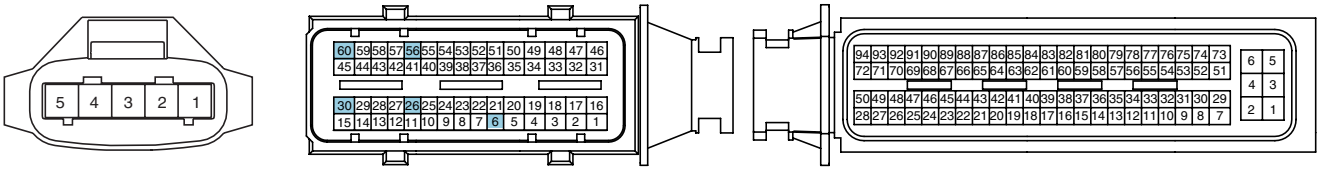
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-1 terminal 60	MTR(+)
2	C101-1 terminal 30	MTR(-)
3	C101-1 terminal 26	Power
4	C101-1 terminal 56	Feed back signal
5	C101-1 terminal 6	Feed back ground

[HARNESS CONNECTOR]



C147 Variable swirl control actuator | C101-1 ECM | C101-2 ECM

EGNG011G

SIGNAL WAVEFORM AND DATA E6192CFF

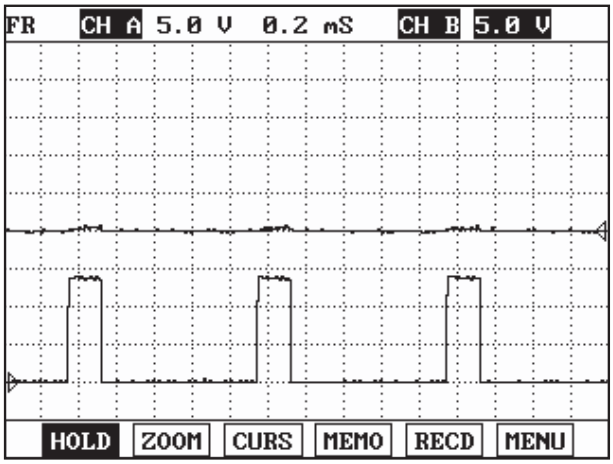


Fig.1

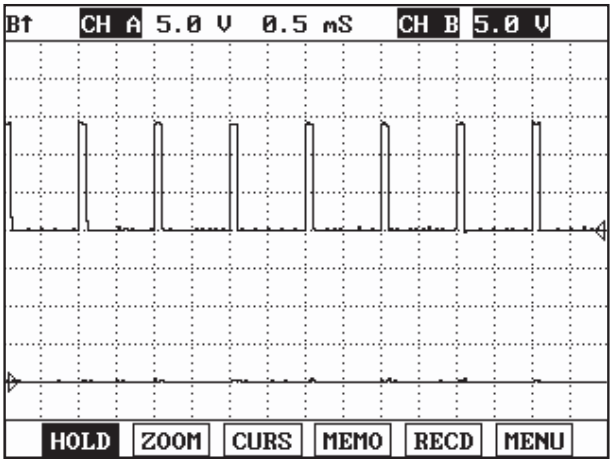


Fig.2

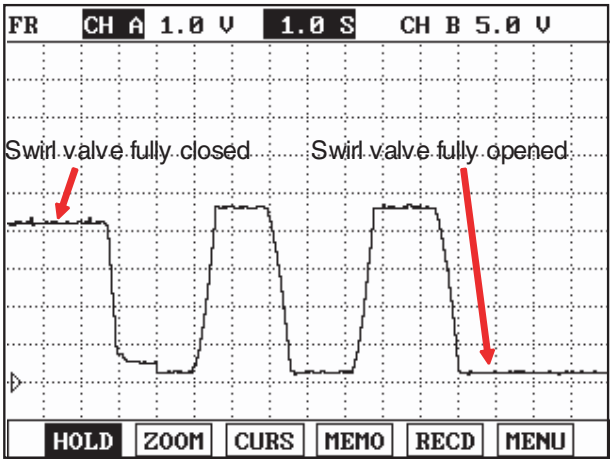


Fig.3

Fig. 1) Waveform when variable swirl valve closed at idle. Terminal 1 is (+) and 2 is (-).
Fig. 2) Waveform when variable swirl valve opened at above 3000RPM. Terminal 1 is (-) and 2 is (+).
Fig. 3) Waveform of variable swirl control actuator motor position sensor at the point of turning engine OFF.
4.3V at swirl valve closed and 0.3V at swirl valve opened. Swirl valve is opened and closed twice at engine "OFF".

EGNG011H

COMPONENT INSPECTION E0C565F0

1. Check variable swirl control actuator link device operation

   1) IG KEY "OFF", ENGINE "OFF".

   2) Wait for approx. 20 sec. and check Main relay turns "OFF".

   3) Disconnect variable swirl control actuator connector.

   4) Pressing variable swirl control actuator link with hands, check if shaft stuck, tightness or problem of link device is detected.

Specification : variable swirl control actuator link device should move smoothly.

   5) Does variable swirl control actuator move slowly?

YES

▶ Go to "2. Check motor coil resistance".

NO

▶ Replace stuck or too tight parts of component(intake manifold assy' or swirl actuator) and go to "Verification of Vehicle Repair".

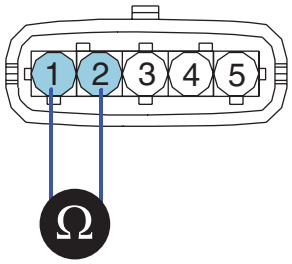
2. Check motor coil resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect variable swirl control actuator.

3) Measure the resistance between variable swirl control actuator component terminal 1 and 2.

Specification : 15.0 ± 3 Ω (20℃)



EGNG011K

4) Is the measured resistance within the specification?

YES

▶ Go to "3. Check variable swirl control actuator position sensor resistance".

NO

▶ Replace variable swirl control actuator and go to "Verification of Vehicle Repair".

3. Check variable swirl control actuator position sensor resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect variable swirl control actuator.

3) Measure the resistance of variable swirl control actuator component terminal 3,4,5 referring "Terminal resistance table" as follows.

Specification : Terminal resistance table

	Detecting terminal	Resistance (KΩ 20℃)		Characteristic	Component connector shape
		valve fully opend	valve fully closed		
variable swirl control actuator position sensor	3(power)-5(ground)	4.47±0.1KΩ	4.47±0.1KΩ	stable	 EGNG011L
	3(power)-4(signal)	4.81±0.1KΩ	0.85±0.1KΩ	resistance drops	
	4(signal)-5(ground)	0.75±0.1KΩ	4.71±0.1KΩ	resistance rises	

4) Is the measured resistance within the specification?

YES

▶ Go to "4. Check motor operation" as follows.

NO

▶ Replace variable swirl control actuator assy' and go to "Verification of Vehicle Repair".

4. Check motor operation

1) IG KEY "ON" , ENGINE "ON".

2) Keep engine at idle state.

3) Monitor the waveform of variable swirl control actuator terminal 1and 2 with two channel oscilloscope.

4) Accelerating engine to above 3000RPM, let variable swirl control actuator be opened(operates).

Specification : Refer to Signal Waveform & Data "Fig.1)", " Fig.2)".

5) Does variable swirl control actuator operate correctly?

YES

▶ Go to "5. Check variable swirl control actuator position sensor operation".

NO

▶ Replace variable swirl control actuator assy' and go to "Verification of Vehicle Repair".

5. Check variable swirl control actuator position sensor operation

1) IG KEY "ON", ENGINE "ON".

2) Keep engine at idle state.

3) Monitor the waveform of variable swirl control actuator terminal 4 with oscilloscope.

4) Turning off engine, monitor the waveform of variable swirl control actuator at the point of operation stop.

Specification : Refer to Signal Waveform & Data "Fig.3)"

5) Does variable swirl control actuator and position sensor operations are OK?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace variable swirl control actuator assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR ED77233C

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P2016 INTAKE MANIFOLD RUNNER POSITION SENSOR/SWITCH CIRCUIT LOW(BANK 1)

COMPONENT LOCATION E60D5871

Refer to DTC P2015.

GENERAL DESCRIPTION EDFD6886

Refer to DTC P2015.

DTC DESCRIPTION EC4FDA2A

P2016 is set when variable swirl valve position sensor output voltage below 0.18V is detected for more than 0.6 sec. This code is due to open in power circuit or short to ground in signal circuit.

DTC DETECTING CONDITION E642E59E

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Variable swirl valve position sensor circuit
• Variable swirl valve position sensor component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Output voltage below minimum value(below 180mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 600ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Swirl valve opened at variable swirl control actuator failure</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION ECCDED91

Refer to DTC P2015.

SCHEMATIC DIAGRAM E48BE295

Refer to DTC P2015.

SIGNAL WAVEFORM AND DATA EC0E5BC9

Refer to DTC P2015.

TERMINAL AND CONNECTOR INSPECTION E0803308

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E34BD825

1. Check power circuit voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect variable swirl control actuator connector.

3) IG KEY "ON".

4) Measure the voltage of variable swirl control actuator connector terminal 3.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in power circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E0FBE4AD

1. Check signal circuit voltage

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect variable swirl control actuator connector.

3) IG KEY "ON".

4) Measure the voltage of variable swirl control actuator connector terminal 4.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Go to "2. Check short to ground in signal circuit" as follows.

2. Check short to ground in signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect variable swirl control actuator connector and ECM connector.

   3) Check continuity between variable swirl control actuator connector terminal 4 and chassis ground.

Specification : Discontinuity(Infinite Ω)

   4) Is the measured resistance within the specificaiton?

YES

▶ Go to "Component Inspection".

NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E7C16FBA

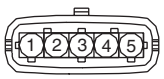
1. Check variable swirl control actuator position sensor resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect variable swirl control actuator.

   3) Measure the resistance of variable swirl control actuator component terminal 3,4,5 referring "Terminal resistance table" as follows.

Specification : Terminal resistance table

	Detecting terminal	Resistance (KΩ 20℃)		Characteristic	Component connector shape
		valve fully opend	valve fully closed		
variable swirl control actuator position sensor	3(power)-5(ground)	4.47±0.1KΩ	4.47±0.1KΩ	stable	 EGNG011L
	3(power)-4(signal)	4.81±0.1KΩ	0.85±0.1KΩ	resistance drops	
	4(signal)-5(ground)	0.75±0.1KΩ	4.71±0.1KΩ	resistance rises	

   4) Is the measured resistance within the specification?

YES

▶ "2. Check variable swirl control actuator position sensor operation".

NO

▶ Replace variable swirl control actuator assy' and go to "Verification of Vehicle Repair".

2. Check variable swirl control actuator position sensor operation

1) IG KEY "ON", ENGINE "ON".

2) Keep engine at idle state.

3) monitor the waveform of variable swirl control actuator terminal 4 with oscilloscope.

4) Turning off engine, monitor the waveform of variable swirl control actuator at the point of operation stop.

Specification : Refer to Signal Waveform & Data "Fig.3)"

5) Does variable swirl control actuator and position sensor operations are OK?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace variable swirl control actuator assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E4A71BC2

Refer to DTC P2015.

DTC P2017 INTAKE MANIFOLD RUNNER POSITION SENSOR/SWITCH CIRCUIT HIGH(BANK 1)

COMPONENT LOCATION E7520E1A

Refer to DTC P2015.

GENERAL DESCRIPTION E333EFEB

Refer to DTC P2015.

DTC DESCRIPTION E5AEB5A3

P2017 is set when variable swirl valve position sensor output voltage above 4.9V is detected for more than 0.6 sec. This code is due to 1)open in signal circuit or ground circuit or 2)short to battery in power circuit or signal circuit.

DTC DETECTING CONDITION E4B42D06

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Variable swirl valve position sensor circuit
• Variable swirl valve position sensor component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Output voltage above minimum value(above 4900mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 600ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• Swirl valve opened at variable swirl control actuator failure</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E52A0B07

Refer to DTC P2015.

SCHEMATIC DIAGRAM E834F408

Refer to DTC P2015.

SIGNAL WAVEFORM AND DATA E1654208

Refer to DTC P2015.

TERMINAL AND CONNECTOR INSPECTION EB7E8AEF

Refer to DTC P2015.

POWER CIRCUIT INSPECTION E5D33003

1. Check power circuit voltage

1) IG KEY "OFF", ENGINE "OFF".
2) Disconnect variable swirl control actuator connector.
3) IG KEY "ON".
4) Measure the voltage of variable swirl control actuator connector terminal 3.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in power circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E3E6B1B3

1. Check signal circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect variable swirl control actuator connector.
   3) IG KEY "ON".
   4) Measure the voltage of variable swirl control actuator connector terminal 4.

Specification : 4.8V~5.1V

5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Go to "2. Check open in signal circuit" as follows.

2. Check open in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect variable swirl control actuator connector and ECM connector.
   3) Check continuity between variable swirl control actuator connector terminal 4 and ECM connector terminal 56.

Specification : Discontinuity(Infinite Ω)

4) Is the measured resistance within the specificaiton?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION ED4C00D3

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect variable swirl control actuator connector.
3. IG KEY "ON".
4. Measure the voltage of variable swirl control actuator connector terminal 3. [TEST "A"]
5. Measure the voltage between variable swirl control actuator connector terminal 3 and 5. [TEST "B"]
   (terminal 3 : Check + prove , terminal 5 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

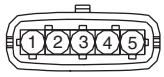
NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION ED445F06

1. Check variable swirl control actuator position sensor resistance
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect variable swirl control actuator.
   3) Measure the resistance of variable swirl control actuator component terminal 3,4,5 referring "Terminal resistance table" as follows.

Specification : Terminal resistance table

	Detecting terminal	Resistance (KΩ 20℃)		Characteristic	Component connector shape
		valve fully opend	valve fully closed		
variable swirl control actuator position sensor	3(power)-5(ground)	4.47±0.1KΩ	4.47±0.1KΩ	stable	 EGNG011L
	3(power)-4(signal)	4.81±0.1KΩ	0.85±0.1KΩ	resistance drops	
	4(signal)-5(ground)	0.75±0.1KΩ	4.71±0.1KΩ	resistance rises	

4) Is the measured resistance within the specification?

YES

▶ "2. Check variable swirl control actuator position sensor operation".

NO

▶ Replace variable swirl control actuator assy' and go to "Verification of Vehicle Repair".

2. Check variable swirl control actuator position sensor operation

1) IG KEY "ON", ENGINE "ON".

2) Keep engine at idle state.

3) monitor the waveform of variable swirl control actuator terminal 4 with oscilloscope.

4) Turning off engine, monitor the waveform of variable swirl control actuator at the point of operation stop.

Specification : Refer to Signal Waveform & Data "Fig.3)"

5) Does variable swirl control actuator and position sensor operations are OK?

YES

▶ Go to "Verification of Vehicle Repair".

NO

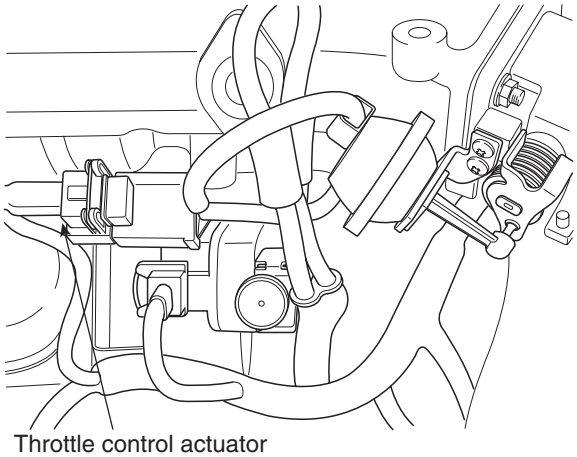
▶ Replace variable swirl control actuator assy' and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E3A15F12

Refer to DTC P2015.

DTC P2111 THROTTLE CONTROL ACTUATOR CIRCUIT HIGH

COMPONENT LOCATION E46D4F66



EGNG010V

GENERAL DESCRIPTION E6A5977A

As closing or opening vacuum line from vacuum pump which is installed at the end of cam shaft, with the method of duty control, Throttle control Actuator controls throttle flap valve when engine is turning OFF.When turning engines OFF, Throttle flap valve cuts intake air to prevent overrun phenomena.(In spite of turning engine OFF, engine does not stop and runs for a while due to rotating inertia of engine and fuel leakage at injector nozzle.) To check its operation, watch if it operate when turning engine OFF.

DTC DESCRIPTION E4915506

P2111 is set when excessive current in throttle control actuator is detected for more than 0.11 sec. this code is due to short to battery in control circuit or internal short of actuator component.

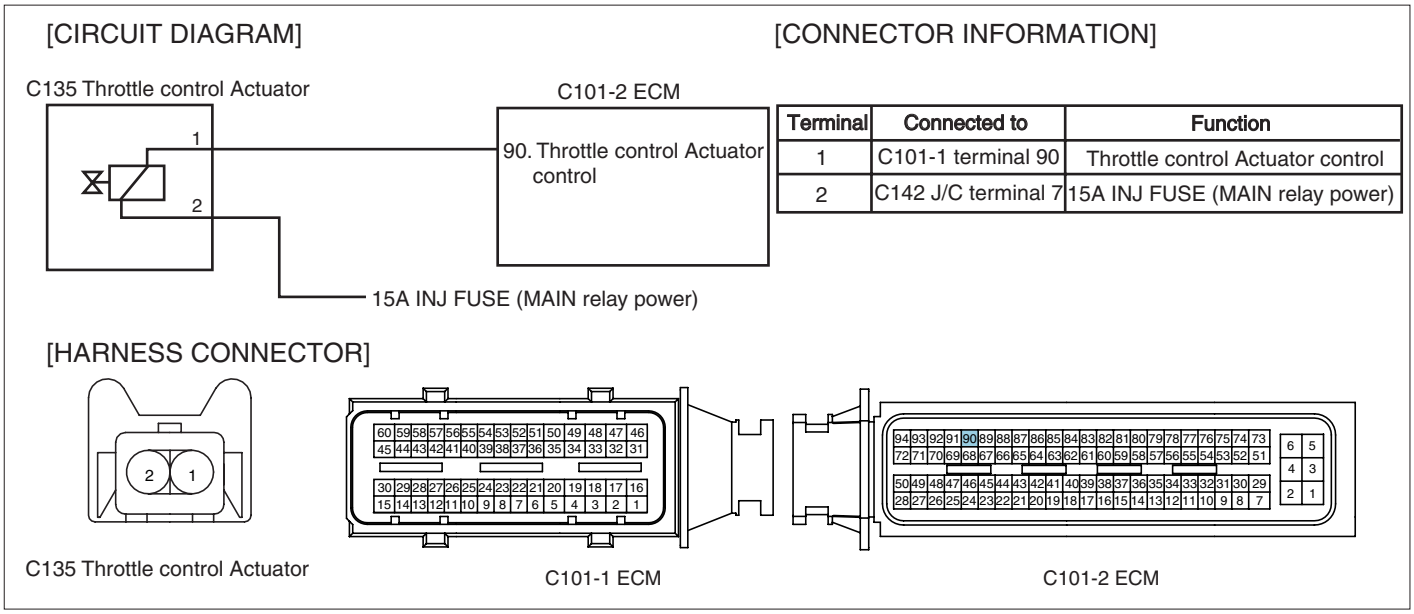
DTC DETECTING CONDITION E27D6A17

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Throttle contor actuator circuit
• Throttle contor actuator component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 110ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E1D4993C

Throttle control actuator component resistance	Throttle control actuator operating Hz	Throttle control actuator operating duty
23.8~31.3Ω (20℃)	300Hz	38%(no vacuum)~90%(vacuum)

SCHEMATIC DIAGRAM E88A78D4



EGNG010W

SIGNAL WAVEFORM AND DATA EB851DBE

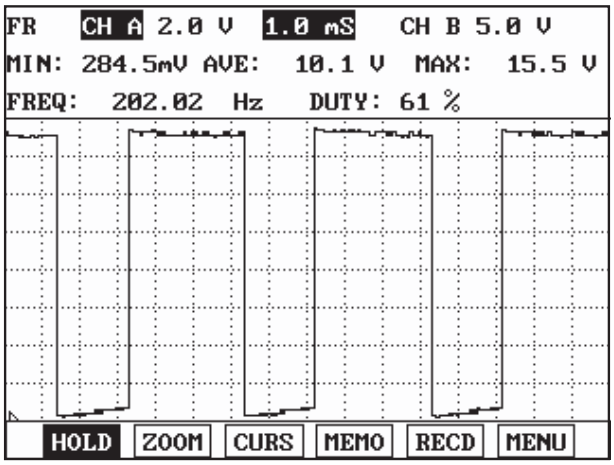


Fig.1

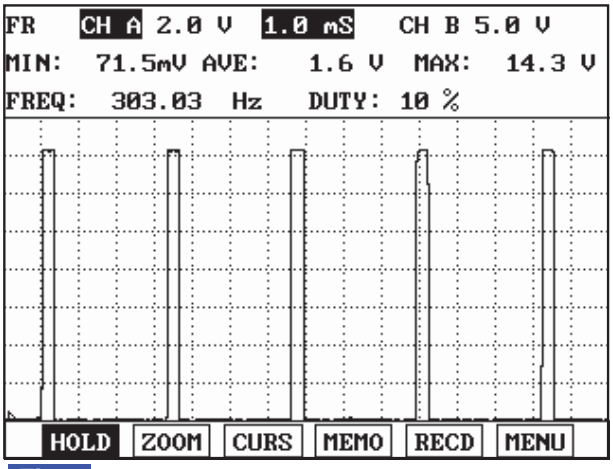


Fig.2

Fig.1) Waveform of Throttle control actuator without throttle flap operation(idle) : At IG KEY "ON", ENGINE "ON", 38% duty is outputted continuously.
Fig.2) Waveform of Throttle control actuator with throttle flap operation(engine "OFF") : At IG KEY "OFF", 90% duty is outputted for about 1 sec.

EGNG010X

MONITOR SCANTOOL DATA EEA0C3E4

1. Connect Scantool to Data Link Connector (DLC).

2. Warm engine up to normal operating temperature.

3. Turn "OFF" electrical devices and A/C.

4. Monitor "INLET THROTTLE ACTU." parameter on the Scantool.

Specification : 94.5% duty outputted except the operation of throttle flap
9.4% duty outputted at the operation of throttle flap

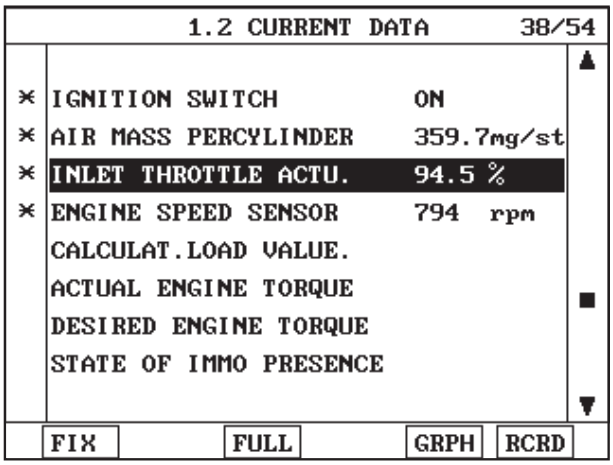


Fig.1

Fig 1) The duty of "INLET THROTTLE ACTU." is 94.5% at IG KEY "ON" and ENGINE "ON".
The duty of "INLET THROTTLE ACTU." is 9.4% at IG KEY "OFF" and ENGINE "OFF".

EGNG010Y

TERMINAL AND CONNECTOR INSPECTION E6E2B570

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E21F2AC6

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Throttle control actuator.

   3) IG KEY "ON".

   4) Measure the voltage of Throttle control actuator connector terminal 2.

Specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Control Circuit Inspection".

   NO

   ▶ Repair E/R FUSE & RELAY BOX 15A INJ fuse and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E347EACA

1. Check monitoring voltage in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Throttle control actuator connector.

   3) IG KEY "ON".

   4) Measure the voltage of Throttle control actuator connector terminal 1.

specification : 3.2V~3.7V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Component Inspection".

   NO

   ▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
   ▶ When high voltage is detected : Repair short to battery in control circuit and go to "Verification of Vehicle Repair".

2. Check open in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Throttle control actuator connector and ECM connector.

   3) Check continuity between Throttle control actuator connector terminal 1 and ECM connector terminal 90.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E10CD28F

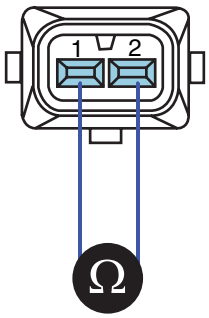
1. Check Throttle control actuator component resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Throttle control actuator.

   3) Check the resistance of Throttle control actuator.

Specification : 23.8~31.3Ω (20℃)



EGNG011C

   4) Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace Throttle control actuator and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E4BAA960

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.

2. Clear recorded DTC using Scantool.

3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P2112 THROTTLE CONTROL ACTUATOR CIRCUIT LOW

COMPONENT LOCATION E058AE56

Refer to DTC P2111.

GENERAL DESCRIPTION EB631726

Refer to DTC P2111.

DTC DESCRIPTION ED0F4C80

P2112 is set when "0"A in throttle control actuator is detected for more than 0.11 sec. this code is due to 1)open or short to ground in control circuit or 2)internal open in actuator component.

DTC DETECTING CONDITION EE479F35

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="8">• Throttle control actuator circuit
• Throttle control actuator component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to GND, Wiring open</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 110ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>YES</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION EC4EABB4

Refer to DTC P2111.

SCHEMATIC DIAGRAM EE52E6F8

Refer to DTC P2111.

SIGNAL WAVEFORM AND DATA E7B354A1

Refer to DTC P2111.

MONITOR SCANTOOL DATA E38765F7

1. Connect Scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "INLET THROTTLE ACTU." parameter on the Scantool.

Specification : 94.5% duty outputted except the operation of throttle flap
9.4% duty outputted at the operation of throttle flap

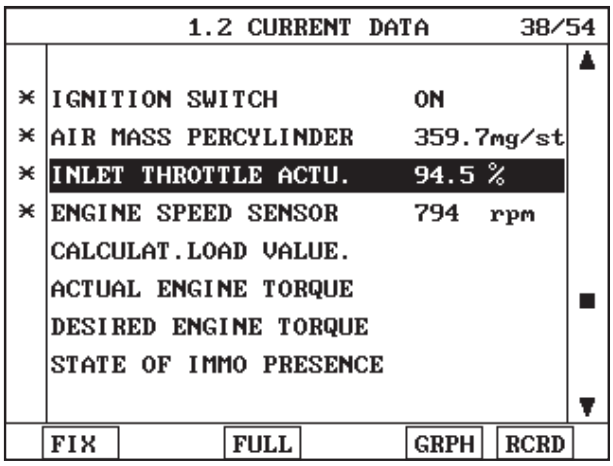


Fig.1

Fig 1) The duty of "INLET THROTTLE ACTU." is 94.5% at IG KEY "ON" and ENGINE "ON".
The duty of "INLET THROTTLE ACTU." is 9.4% at IG KEY "OFF" and ENGINE "OFF".

EGNG010Y

TERMINAL AND CONNECTOR INSPECTION E65A1010

Refer to DTC P2111.

POWER CIRCUIT INSPECTION E4654148

1. Check power circuit voltage

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Throttle control actuator.

   3) IG KEY "ON".

   4) Measure the voltage of Throttle control actuator connector terminal 2.

Specification : 11.5V~13.0V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "Control Circuit Inspection".

   NO

   ▶ Repair E/R FUSE & RELAY BOX 15A INJ fuse and related circuit and go to "Verification of Vehicle Repair".

CONTROL CIRCUIT INSPECTION E615D8AE

1. Check monitoring voltage in control circuit

   1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect throttle Throttle control actuator.

3) IG KEY "ON".

4) Measure the voltage of Throttle control actuator connector terminal 1.

specification : 3.2V~3.7V

5) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When voltage is not detected : Go to "2. Check open in control circuit" as follows.
▶ When high voltage is detected : Repair short to battery in control circuit and go to "Verification of Vehicle Repair".

2. Check open in control circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Throttle control actuator connector and ECM connector.

3) Check continuity between Throttle control actuator connector terminal 1 and ECM connector terminal 90.

specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in control circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in control circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E1235EF8

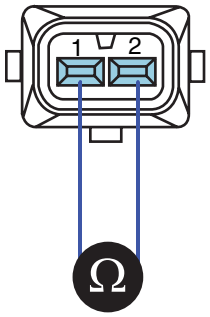
1. Check throttle flap actuator component resistance

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Throttle control actuator.

3) Check the resistance of Throttle control actuator.

Specification : 23.8~31.3Ω (20℃)



EGNG011C

4) Is the measured resistance within the specification?

YES

▶ Go to "Verification of Vehicle Repair".

NO

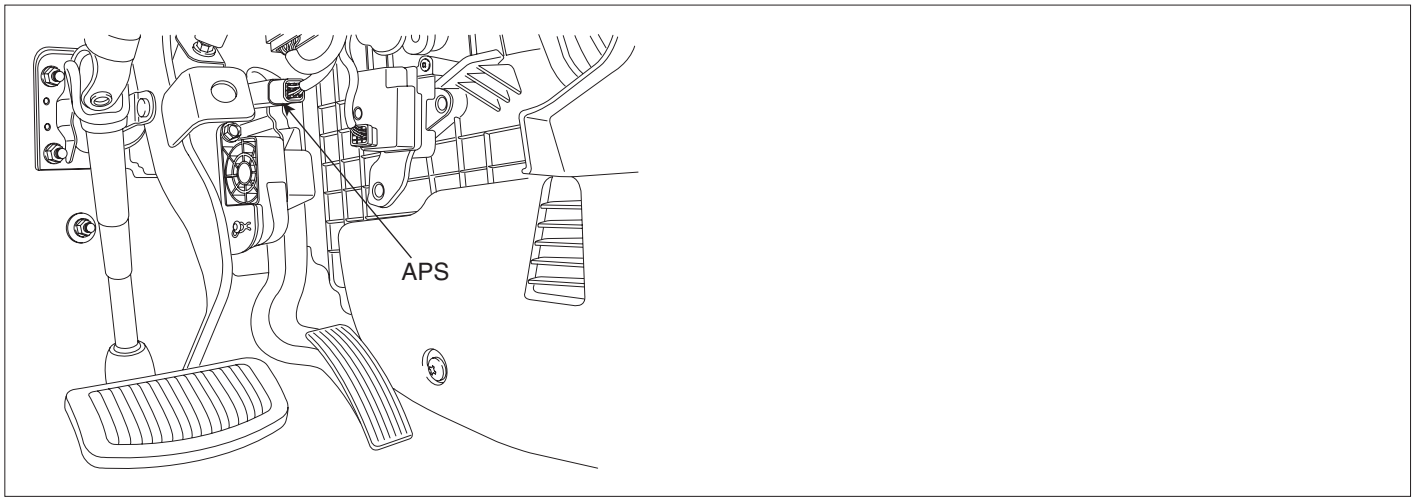
▶ Replace Throttle control actuator and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E511129F

Refer to DTC P2111.

DTC P2123 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT HIGH INPUT

COMPONENT LOCATION E0693F7D



EGNG002G

GENERAL DESCRIPTION E0DBF9CD

Driver's intension to accelerate is transmitted to ECM through Accelerator Pedal Sensor(APS) . And APS, whose mechanism is same as TPS, is required for ECM to determine optimum fuel injection quantity. As fidelity of APS is strongly required, APS is devided into two. One is APS1, which outputs main signals and the other is APS2, which monitors APS1 performance.APS1 and 2 do not share power supply and ground. Normally, APS2 output voltage is the half of APS1 and if the ratio of two signal is out of specified value, error is recognized then, Limp Home mode is activated.When Limp Home mode is activated, engine speed is fixed at 1200RPM and driving performance is limited to prevent excessive power generation due to APS false signal.

DTC DESCRIPTION EDFB2F16

P2123 is set when output voltage of APS 1 is above the maximum value of 4.9V for more than 0.18 sec. This code is due to the short to battery in APS 1 power circuit and signal circuit or open in sensor ground circuit.

DTC DETECTING CONDITION EAAD54CE

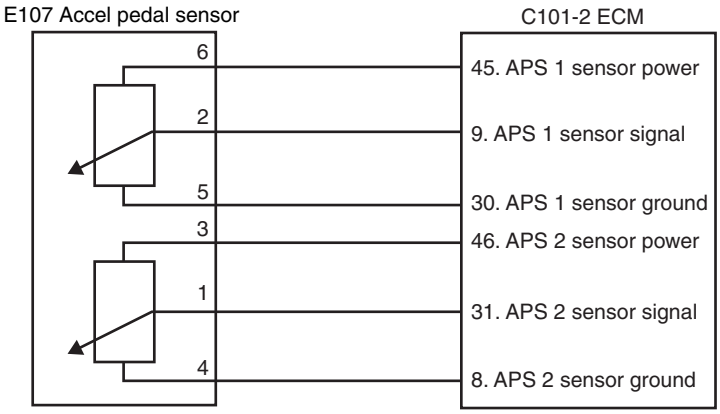
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• APS 1 Circuit
• APS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• When output signal is above the maximum value (above 4910mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 180ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• APS standard value is 0%.
• Limp home idle is fixed at (1200RPM)
• A/C operation stops according to Vehicle/Engine speed
• Cruise control deactivated (for Cruise control option applied vehicle)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION EB8404BF

	Pedal released	Pedal depressed	Sensor Type
APS 1	0.7V~0.8V	3.8V~4.4V	Variable resistance type(Potentiometer)
APS 2	0.275V~0.475V	1.75V~2.35V	

SCHEMATIC DIAGRAM EF2AD4E5

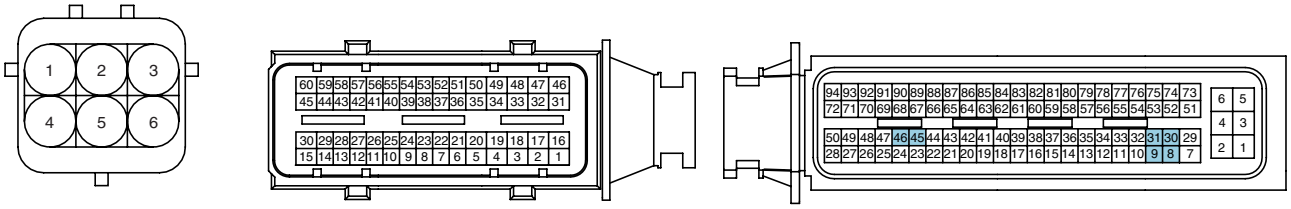
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-2 terminal 31	APS 2 sensor signal
2	C101-2 terminal 9	APS 1 sensor signal
3	C101-2 terminal 46	APS 2 sensor power
4	C101-2 terminal 8	APS 2 sensor ground
5	C101-2 terminal 30	APS 1 sensor ground
6	C101-2 terminal 45	APS 1 sensor power

[HARNESS CONNECTOR]



EGNG002H

SIGNAL WAVEFORM AND DATA E9FCB379

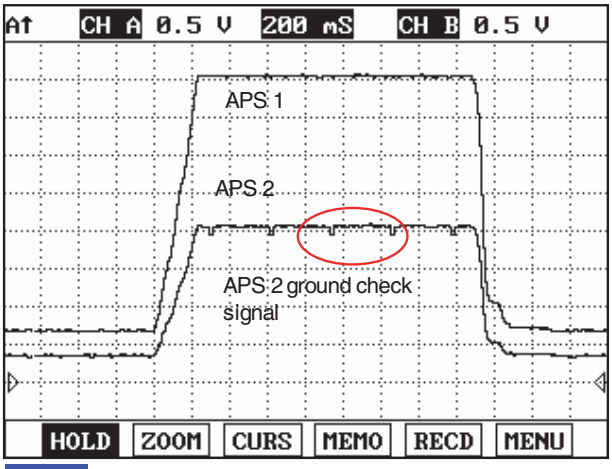


Fig.1

Fig.1) APS 1 and APS 2 signals are measured simultaneously, Check if output value is rising and APS 2 is 1/2 of APS 1 signal.

EGNG014R

NOTE

APS 2 Ground checking signal is for ECM to monitor APS 2. This signal drops APS 2 output voltage to below 200.39mV per 200msec. If APS 2 output voltage does not drop to below 200.39mV, ECM sets DTC as recognizing ground circuit error of APS 2 .

※ The waveform below 200.39mV is not detectable in Ground checking signal waveform of APS 2 signal. Instead, the waveform which drops a little is detected. If APS 2 data of "SERVICE DATA" on the Scantool varies from 350mV to 0mV periodically, it means it works well.

MONITOR SCANTOOL DATA EBE0377E

1. Connect scantool to Data Link Cable (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "ACCEL PEDAL SENSOR", "ACCEL PEDAL SENSOR 1", "ACCEL PEDAL SENSOR 2 " parameter on the scantool.

Specification : at idle(0%) ACCEL PEDAL SENSOR 1 : 600mV~800mV
ACCEL PEDAL SENSOR 2 : 1/2 of ACCEL PEDAL SENSOR 1

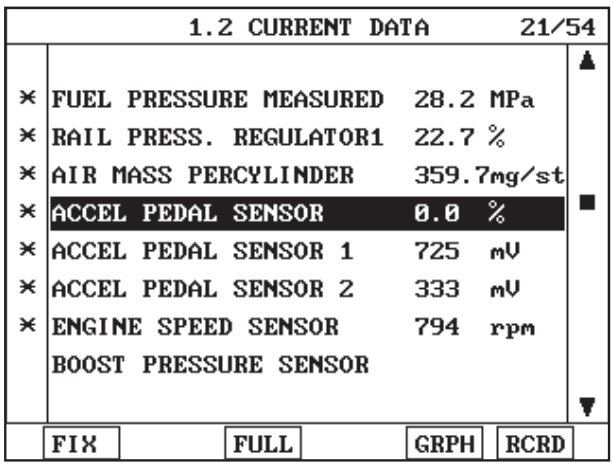


Fig.1

Fig.1) APS output data at warm idle. Check if output value is rising and "ACCEL PEDAL SENSOR 2" is 1/2 of "ACCEL PEDAL SENSOR 1" signal.

EGNG002J

TERMINAL AND CONNECTOR INSPECTION EDAA39CF

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damage of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at mail connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection" as follows.

POWER CIRCUIT INSPECTION E8E689F1

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect APS connector.
3. IG KEY "ON".
4. Measure the voltage of terminal 6 of APS connector.

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ If the measured voltage is not within the specified value, find and repair short to battery in APS 1 power circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION EAE98BD2

1. Check open in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect APS connector and ECM connector.
   3) Check continuity between APS connector terminal 2 and ECM connector terminal 9

Specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Check short to battery in signal circuit" as follows.

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

2. Check short to battery in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect APS connector and ECM connector.

3) IG KEY "ON".

4) Measure the voltage of terminal 2 of APS connector.

Specification : 0.0V~0.1V

5) Is abnormal voltage detected in signal circuit with both connector disconnected?

YES

▶ Repair short to battery and go to "Verification of Vehicle Repair".

NO

▶ Go to "Ground Circuit Inspection".

GROUND CIRCUIT INSPECTION E82E3062

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect APS connector.
3. IG KEY "ON".
4. Measure the voltage of APS terminal 6. [TEST "A"]
5. Measure the voltage of APS terminal 6 and terminal 5. [TEST "B"]
   (terminal 6 : Check + prove , terminal 5 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E1CD32B2

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect APS connector (M41).
3. Check resistance for each terminal refering to Resistance characteristic table.

Specification : Resistance characteristic table for each terminal

	checking point	Resistance(KΩ 20℃)		Characteristic	Component Connector Shape
		Pedal Depressed	Pedal released		
APS 1	6(power)-5(ground)	1.0±0.1KΩ	1.0±0.1KΩ	Unchanged	 EGNG002O
	6(power)-2(signal)	1.8±0.1KΩ	1.1±0.1KΩ	Resistance drops	
	2(signal)-5(ground)	1.1±0.1KΩ	1.8±0.1KΩ	Resistance rises	
APS 2	3(power)-4(ground)	2.0±0.1KΩ	2.0±0.1KΩ	Unchanged	
	3(power)-1(signal)	2.9±0.1KΩ	2.1±0.1KΩ	Resistance drops	
	1(signal)-4(ground)	1.1±0.1KΩ	1.8±0.1KΩ	Resistance rises	

4. Are resistances for each terminal measured correctly?

YES

▶ Go to "Verification of Vehicle Rapair".

NO

▶ Replace APS and go to "Verification of Vehicle Rapair".

VERIFICATION OF VEHICLE REPAIR EF69407D

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P2128 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT HIGH INPUT

COMPONENT LOCATION EBC0F942

Refer to DTC P2123.

GENERAL DESCRIPTION ECEED404

Refer to DTC P2123.

DTC DESCRIPTION E8E4BA5E

P2128 is set when output voltage of APS 2 is above the maximum value of 2463 mV for more than 0.18 sec. This code is due to the short to battery in APS 2 power circuit and signal circuit or open in sensor ground circuit.

DTC DETECTING CONDITION E6C31901

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• APS 2 Circuit
• APS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• When output signal is above the maximum value (above 2464mV)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 180ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• APS standard value is 0%.
• Limp home idle is fixed at (1200RPM)
• A/C operation stops according to Vehicle/Engine speed
• Cruise control deactivated (for Cruise control option applied vehicle)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION EA589ECF

Refer to DTC P2123.

SCHEMATIC DIAGRAM E5ADC17C

Refer to DTC P2123.

SIGNAL WAVEFORM AND DATA E064F34F

Refer to DTC P2123.

MONITOR SCANTOOL DATA EA89D7BC

Refer to DTC P2123.

TERMINAL AND CONNECTOR INSPECTION E702CBE8

Refer to DTC P2123.

POWER CIRCUIT INSPECTION E7FD68FF

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect APS connector.
3. IG KEY "ON".
4. Measure the voltage of terminal 3 of APS connector.

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ If the measured voltage is not within the specified value, find and repair short to battery in APS 2 power circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E6C22A83

1. Check open in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect APS connector and ECM connector.
   3) Check continuity between APS connector terminal 1 and ECM connector terminal 31.

Specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Check short to battery in signal circuit" as follows.

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

2. Check short to battery in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect APS connector and ECM connector.
   3) IG KEY "ON".
   4) Measure the voltage of terminal 1 of APS connector.

Specification : 0.0V~0.1V

5) Is abnormal voltage detected in signal circuit with both connector disconnected?

YES

▶ Repair short to battery and go to "Verification of Vehicle Repair".

NO

▶ Go to "Ground Circuit Inspection".

GROUND CIRCUIT INSPECTION E768AF29

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect APS connector.
3. IG KEY "ON".
4. Measure the voltage of APS terminal 3. [TEST "A"]
5. Measure the voltage of APS terminal 3 and terminal 4. [TEST "B"]
   (terminal 3 : Check + prove , terminal 4 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E0345A2C

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect APS connector (M41).
3. Check resistance for each terminal refering to Resistance characteristic table.

Specification : Resistance characteristic table for each terminal

	checking point	Resistance(KΩ 20℃)		Characteristic	Component Connector Shape
		Pedal Depressed	Pedal released		
APS 1	6(power)-5(ground)	1.0±0.1KΩ	1.0±0.1KΩ	Unchanged	 EGNG002O
	6(power)-2(signal)	1.8±0.1KΩ	1.1±0.1KΩ	Resistance drops	
	2(signal)-5(ground)	1.1±0.1KΩ	1.8±0.1KΩ	Resistance rises	
APS 2	3(power)-4(ground)	2.0±0.1KΩ	2.0±0.1KΩ	Unchanged	
	3(power)-1(signal)	2.9±0.1KΩ	2.1±0.1KΩ	Resistance drops	
	1(signal)-4(ground)	1.1±0.1KΩ	1.8±0.1KΩ	Resistance rises	

4. Are resistances for each terminal measured correctly?

YES

▶ Go to "Verification of Vehicle Rapair".

NO

▶ Replace APS and go to "Verification of Vehicle Rapair".

VERIFICATION OF VEHICLE REPAIR EFB02923

Refer to DTC P2123.

DTC P2138 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" / "E" VOLTAGE CORRELATION

COMPONENT LOCATION EA41C946

Refer to DTC P2123.

GENERAL DESCRIPTION ED2B1843

Refer to DTC P2123.

DTC DESCRIPTION ECF69238

P2138 is set when APS 2 output voltage which is not 1/2 of APS 1 output voltage is detected for more than 0.24 sec. Careful inspection of poor connection between APS 1 and APS 2, resistance characteristic of APS component is needed.

DTC DETECTING CONDITION E107832B

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="8">• APS 1 Circuit
• APS 2 Circuit
• APS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"(APS depressed)</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• When APS 1,2 is depressed 1.8~6%, the difference between APS 1 and 2is above 308mV
• When APS 1,2 is depressed above 7%, the difference between APS 1and 2 is above 406mV</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 240ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• APS standard value is 0%.
• Limp home idle is fixed at (1200RPM)
• A/C operation stops according to Vehicle/Engine speed
• Cruise control deactivated (for Cruise control option applied vehicle)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>YES</td></tr>
</table>

SPECIFICATION E15A9A7A

Refer to DTC P2123.

SCHEMATIC DIAGRAM EC179F30

Refer to DTC P2123.

SIGNAL WAVEFORM AND DATA E2422F63

Refer to DTC P2123.

MONITOR SCANTOOL DATA EF693E28

Refer to DTC P2123.

TERMINAL AND CONNECTOR INSPECTION E490386A

Refer to DTC P2123.

POWER CIRCUIT INSPECTION E440B0FF

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect APS connector (M41).
3. IG KEY "ON".
4. Measure the voltage of terminal 3 and 6 of APS connector.

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ If the measured voltage is not within the specified value, find and repair trouble causing part in circuits and go to go to "Verification of Vehicle Repair".
When the measured voltage is higher than the specified value :
Refer to P0643 Circuit Inspection. (APS1)
Refer to P0653 Circuit Inspection.(APS2)
When the measured voltage is lower than the specified value :
Refer to P0642 Circuit Inspection.(APS1)
Refer to P0652 Circuit Inspection.(APS2)

SIGNAL CIRCUIT INSPECTION E11C02D3

1. Check open in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect APS connector and ECM connector.
   3) Check continuity between APS connector terminal 2 and ECM connector terminal 9. (APS 1)
      Check continuity between APS connector terminal 1 and ECM connector terminal 31. (APS 2)

Specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Check short in signal circuit".

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

2. Check short in signal circuit (APS 1)

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect APS connector and ECM connector.

3) IG KEY "ON".

4) Check continuity between APS connector terminal 2 and chassis ground. (check short to ground)
Measure the voltage of terminal 2 of APS connector. (check short to battery)

Specification : Check short to ground : Discontinuity (Infinite Ω)
Check short to battery : 0.0V~0.1V

5) Is APS 1 signal circuit insulated normally?

YES

▶ Go to "3.Signal Circuit Inspection (APS 2)" as follows.

NO

▶ Repair short in circuit and go to "Verification of Vehicle Repair".

3. Signal Circuit Inspection (APS 2)

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect APS connector and ECM connector.

3) IG KEY "ON".

4) Check continuity between APS connector terminal 1 and chassis ground. (check short to ground)
Measure the voltage of terminal 1 of APS connector. (check short to battery)

Specification : Check short to ground : Discontinuity (Infinite Ω)
Check short to battery : 0.0V~0.1V

5) Is APS 2 signal circuit insulated normally?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair short in circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION EA2874BC

1. Check ground circuit (APS1)

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect APS connector.

3) IG KEY "ON".

4) Measure the voltage of APS terminal 6. [TEST "A"]

5) Measure the voltage of APS terminal 6 and terminal 5. [TEST "B"]
(terminal 6: Check + prove , terminal 5 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6) Is the measured voltage within the specification?

YES

▶ Go to "2. Check ground circuit (APS2)".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

2. Check ground circuit (APS2)

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect APS connector.

3) IG KEY "ON".

4) Measure the voltage of APS terminal 3. [TEST "A"]

5) Measure the voltage of APS terminal 3 and terminal 4. [TEST "B"]
(terminal 3: Check + prove , terminal 4 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION ECB4DC68

1. IG KEY "OFF", ENGINE "OFF".

2. Disconnect APS connector (M41).

3. Check resistance for each terminal refering to Resistance characteristic table.

Specification : Resistance characteristic table for each terminal

	checking point	Resistance(KΩ 20℃)		Characteristic	Component Connector Shape
		Pedal Depressed	Pedal released		
APS 1	6(power)-5(ground)	1.0±0.1KΩ	1.0±0.1KΩ	Unchanged	 EGNG002O
	6(power)-2(signal)	1.8±0.1KΩ	1.1±0.1KΩ	Resistance drops	
	2(signal)-5(ground)	1.1±0.1KΩ	1.8±0.1KΩ	Resistance rises	
APS 2	3(power)-4(ground)	2.0±0.1KΩ	2.0±0.1KΩ	Unchanged	
	3(power)-1(signal)	2.9±0.1KΩ	2.1±0.1KΩ	Resistance drops	
	1(signal)-4(ground)	1.1±0.1KΩ	1.8±0.1KΩ	Resistance rises	

4. Are resistances for each terminal measured correctly?

YES

▶ Go to "Verification of Vehicle Rapair".

NO

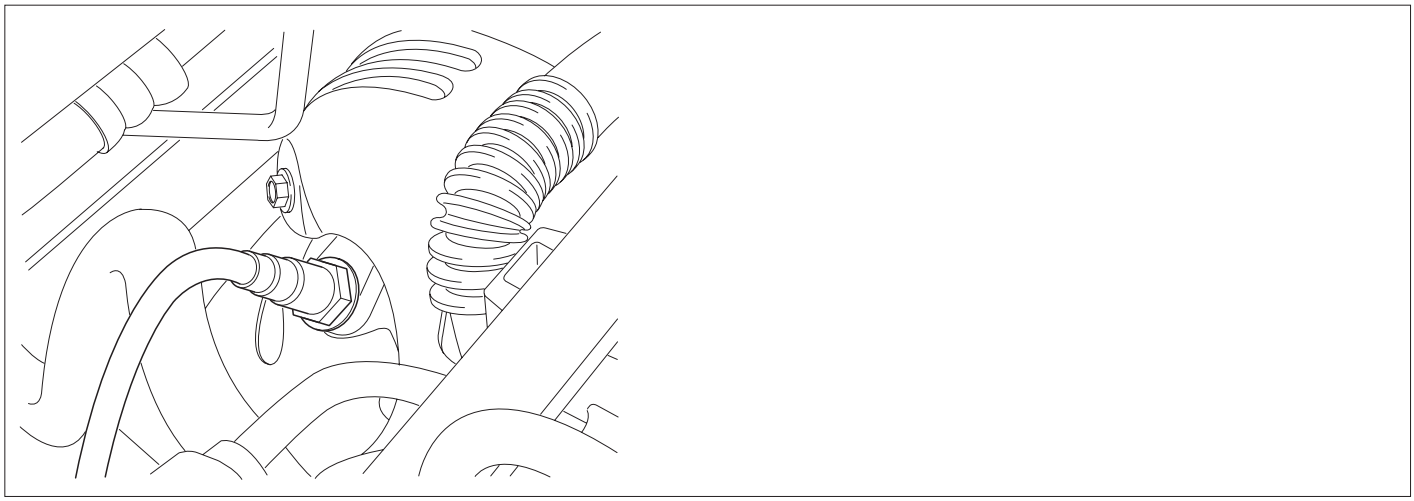
▶ Replace APS and go to "Verification of Vehicle Rapair".

VERIFICATION OF VEHICLE REPAIR E991DC54

Refer to DTC P2123.

DTC P2238 LAMBDA SENSOR PUMPING CURRENT CIRCUIT LOW (BANK 1 / SENSOR 1)

COMPONENT LOCATION E7732682



EGNG009C

GENERAL DESCRIPTION ED3F1F43

Lambda sensor installed at exhaust manifold is linear Lambda sensor and it senses Lambda density of exhaust gas for accurate EGR control through fuel correction. It also limits smoke which is generated by reach air-fuel mixture at engine maximum loading condition. ECM controls pumping current in order to fit λ -value from linear Lambda sensor to 1.0.

Lean air-fuel mixture($1.0 < \lambda < 1.1$) : ECM supplies pumping current to Lambda sensor (+pumping current) and activates it for Lambda sensor to have the characteristic at λ =1.0 (0.0 pumping current). With the value of pumping current supplied to Lambda sensor, ECM detects Lambda density of exhaust gas.

Rich air-fuel mixture($0.9 < \lambda < 1.0$) : ECM takes away pumping current from Lambda sensor (-pumping current) and deactivates it for Lambda sensor to have the characteristic at λ =1.0 (0.0 pumping current). With the value of pumping current taken away from Lambda sensor, ECM detects Lambda density of exhaust gas.

This performance is the most active and fast at normal operating temp.(450℃~600℃) thus, in order to reach normal operating temp. and last at that temp., heater(heating coil) is integrated with Lambda sensor.Heater coil is controlled by ECM as PWM. the resistance of heater coil is low when coil is cold thus, current through it increases while resistance is high when coil is hot thus, current decreases. With this principle, Lambda sensor temp. is measured and Lambda sensor heater operation varies based on the data.

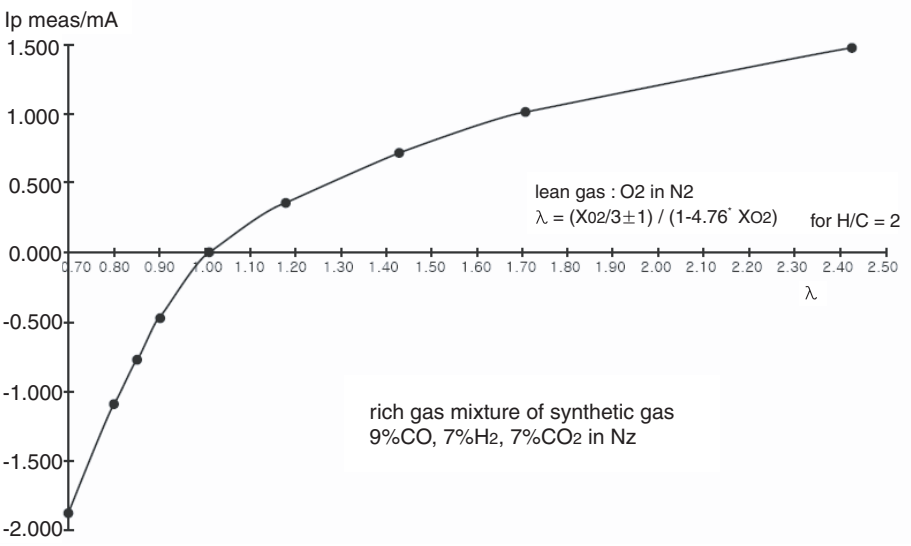
DTC DESCRIPTION E0011D07

P2238 is set when 1) short to ground in signal line(terminal 4), ground line(terminal 3), power line(terminal 1), pumping current line(terminal 6) or 2) open in ground line is detected. This code is due to the problem of Lambda sensor circuit.

DTC DETECTING CONDITION E961B743

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Lambda sensor circuit • Lambda sensor component
Enable Conditions	• Engine running			
ThresholdValue	• Short to GND in Lambda sensor circuit • Open in Lambda sensor circuit			
DiagnosticTime	• 2.0 sec.			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION EAC9D850

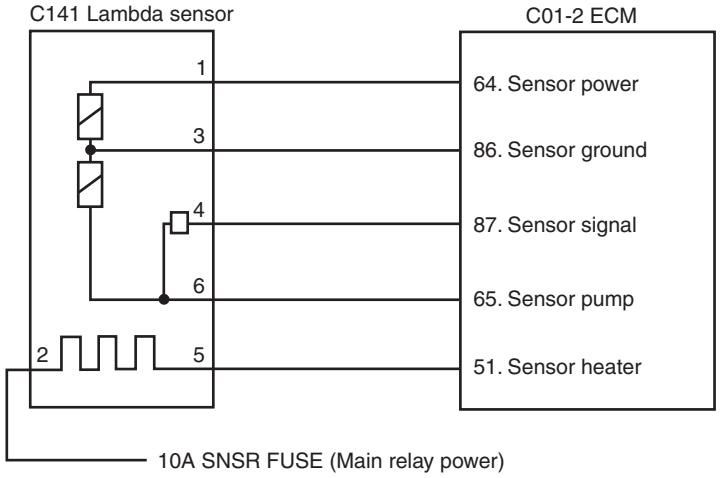


EGNG009D

λ value	0.65	0.70	0.80	0.90	1.01	1.18	1.43	1.70	2.42	Air
Pumping current	-2.22	-1.82	-1.11	-0.50	0.00	0.33	0.67	0.94	1.38	2.54

SCHEMATIC DIAGRAM E109AFD4

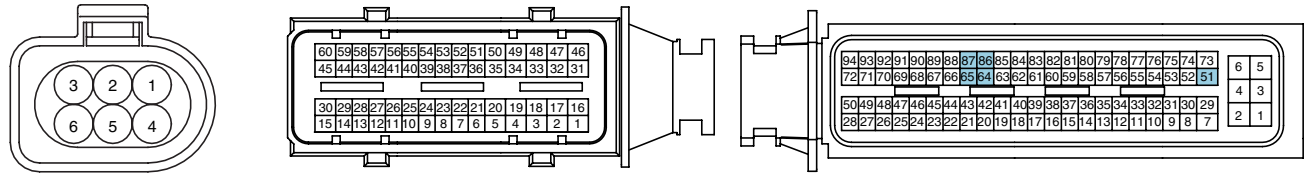
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-2 terminal 64	Sensor power
2	10A SNSR FUSE	Main relay power
3	C101-2 terminal 86	Sensor ground
4	C101-2 terminal 87	Sensor signal
5	C101-2 terminal 51	Sensor heater
6	C101-2 terminal 65	Sensor pump

[HARNESS CONNECTOR]



C141 Lambda sensor C101-1 ECM C101-2 ECM

EGNG009E

SIGNAL WAVEFORM AND DATA E424DC09

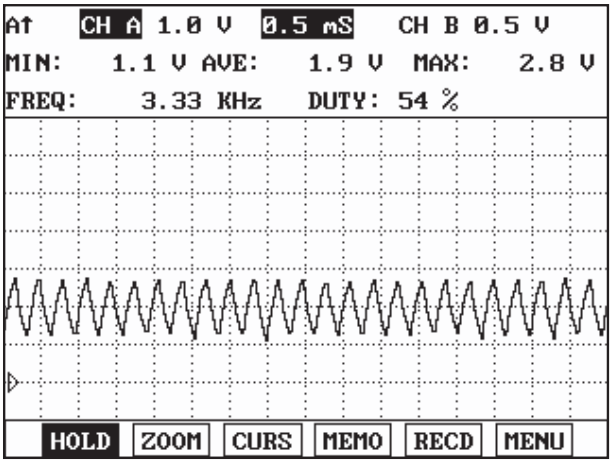


Fig.1

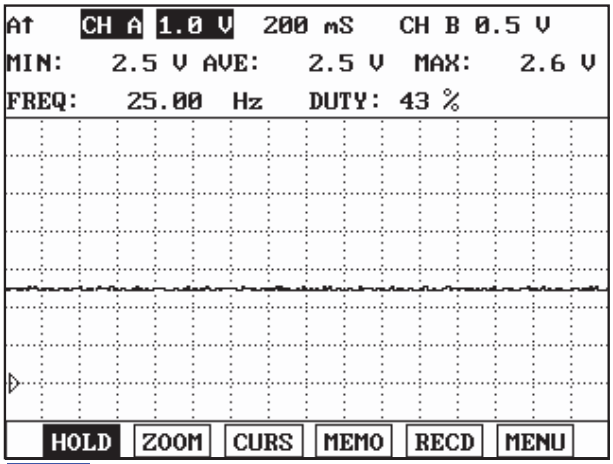


Fig.2

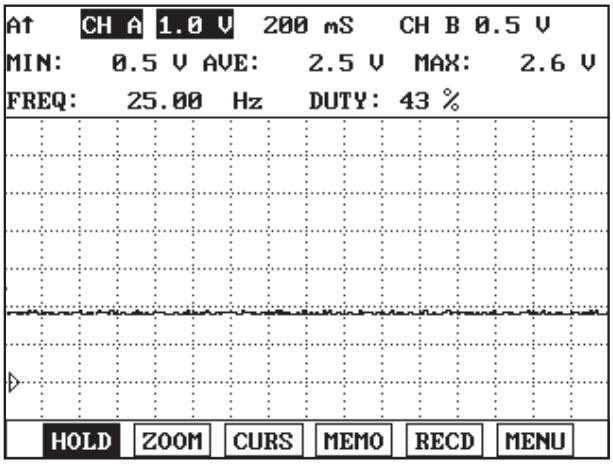


Fig.3

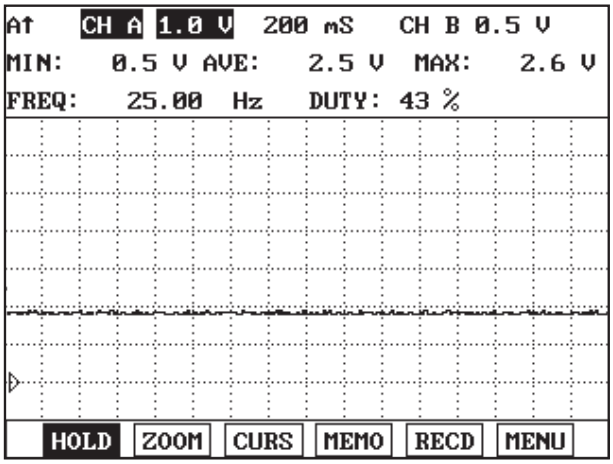


Fig.4

Fig.1) Waveform of Lambda sensor power(terminal 1) at IG KEY "ON" and Engine running. It fluctuates between 1V and 3V periodically.
Fig.2) Waveform of Lambda sensor ground(terminal 3) at IG KEY "ON" and Engine running. 2.5V is displayed.
Fig.3) Waveform of Lambda sensor signal(terminal 4) at IG KEY "ON" and Engine running. 850mV is displayed. (same value at idle and acceleration)
Fig.4) Waveform of Lambda sensor pump(terminal 6) at IG KEY "ON" and Engine running. 850mV is displayed. (same value at idle and acceleration)

EGNG009F

TERMINAL AND CONNECTOR INSPECTION E35B5F56

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION EC40DF80

1. Check voltage & waveform in sensor power circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Lambda sensor connector.

   3) IG KEY "ON".

   4) Measure the voltage of Lambda sensor connector terminal 1.

   5) Monitor the waveform in Lambda sensor connector terminal 1.

Specification : Measured voltage : 2.0 V
waveform : Refer to "Signal Waveform & Data" of "General Information". The waveform similar to Fig.1) is displayed.

   6) Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ No voltage detected in Lambda sensor power circuit : Go to "2. Check open in sensor power circuit" as follows.
▶ High voltage detected in Lambda sensor power circuit : Repair short to battery in Lambda sensor power circuit and go to "Verification of Vehicle Repair".

2. Check open in Lambda sensor power circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Lambda sensor connector and ECM connector.

   3) Check continuity between Lambda sensor connector terminal 1 and ECM connector terminal 64.

Specification : Continuity(below 1.0Ω)

   4) Is the measured voltage within the specification?

YES

▶ Repair short to ground in Lambda sensor power circuit and go to "Verification of Vehicle Repair".

NO

▶ Reapir open in Lambda sensor power circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E22D42B3

1. Check voltage in sensor signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Lambda sensor connector.

   3) IG KEY "ON".

   4) Measure the voltage of Lambda sensor connector terminal 4.

Specification : 0.8V~0.9 V

   5) Is the measured voltage within the specification?

   YES

   ▶ Go to "3. Check sensor pump circuit".

   NO

   ▶ No voltage detected in Lambda sensor signal circuit : Go to "2. Check open in sensor signal circuit" as follows.
   ▶ High voltage detected in Lambda sensor power circuit : Repair short to battery in O2 sensor signal circuit and go to "Verification of Vehicle Repair".

2. Check open in Lambda sensor signal circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Lambda sensor connector and ECM connector.

   3) Check continuity between Lambda sensor connector terminal 4 and ECM connector terminal 87.

Specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

   YES

   ▶ Repair short to ground in Lambda sensor signal circuit and go to "Verification of Vehicle Repair".

   NO

   ▶ Repair open in Lambda sensor signal circuit and go to "Verification of Vehicle Repair".

3. Check voltage in sensor pump circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Lambda sensor connector.

   3) IG KEY "ON".

   4) Measure the voltage of Lambda sensor connector terminal 6.

Specification : 0.8V~0.9 V

   5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ No voltage detected in Lambda sensor pumpl circuit : Go to "4. Check open in sensor pump circuit" as follows.
▶ High voltage detected in Lambda sensor power circuit : Repair short to battery in Lambda sensor pump circuit and go to "Verification of Vehicle Repair".

4. Check open in sensor pump circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between Lambda sensor connector terminal 6 and ECM connector terminal 65.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Lambda sensor pump circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor pump circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E707402E

1. Check voltage in sensor ground circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of Lambda sensor connector terminal 3.

Specification : 2.3V~2.7V

5) Is the measured voltage within the specification?

YES

▶ Go to"Component Inspection".

NO

▶ No voltage detected in Lambda sensor ground circuit : Go to "2. Check open in sensor ground circuit" as follows.
▶ High voltage detected in Lambda sensor ground circuit : Repair short to battery in Lambda sensor ground circuit and go to "Verification of Vehicle Repair".

2. Check open in sensor ground circuit

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Lambda sensor connector and ECM connector.

   3) Check continuity between Lambda sensor connector terminal 3 and ECM connector terminal 86.

Specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Lambda sensor ground circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor ground circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EC12AC81

1. Lambda sensor Visual Inspection

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Lambda sensor connector.

   3) Perform visual inspection for each checking point as follows.
      a. Check corrosion inside of Lambda sensor terminal.
      b. Check damaged coverring and open in component wiring.
      c. Check connecting torque(poor connection) of Lambda sensor component.
      d. Disconnect Lambda sensor and check deformation, clogging, melting of Lambda detecting prove.

Specification : Everyting OK

   4) Is any problem of Lambda sensor detected?

YES

▶ Replace Lambda sensor and go to "Verification of Vehicle Repair".

NO

▶ Refer to "NOTE" as follows.

NOTE

In diesel engine, ultra lean combustion generates at normal operating condition. Therefore, Lambda sensor signal change in accordance with engine acceleration and various loading condition rarely happens, unlikely to linear Lambda sensor of gasoline engine. Moreover, pumping current is not measurable with normal measuring device(ampere meter) because maximum value is 3mA. If DTC code is recorded continuously eventhough circuit inspection is correctly performed and no problem at visual inspection of component is detected, replace Lambda sensor.

VERIFICATION OF VEHICLE REPAIR E4163054

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P2239 LAMBDA SENSOR PUMPING CURRENT CIRCUIT HIGH (BANK 1 / SENSOR 1)

COMPONENT LOCATION ED38DDD8

Refer to DTC P2238.

GENERAL DESCRIPTION E13561E3

Refer to DTC P2238.

DTC DESCRIPTION E52BEB28

P2239 is set when 1) short to battery in signal line(terminal 4), ground line(terminal 3), power line(terminal 1), pumping current line(terminal 6) or 2) short to ground is detected. This code is due to the problem of Lambda sensor circuit.

DTC DETECTING CONDITION E82B2917

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Lambda sensor circuit
• Lambda sensor component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Short to battery in Lambda sensor circuit
• Open in Lambda sensor circuit</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION EDA711EA

Refer to DTC P2238.

SCHEMATIC DIAGRAM E8942733

Refer to DTC P2238.

SIGNAL WAVEFORM AND DATA E4F4275E

Refer to DTC P2238.

TERMINAL AND CONNECTOR INSPECTION E3F38081

Refer to DTC P2238.

POWER CIRCUIT INSPECTION EFEF42E5

1. Check voltage & waveform in sensor power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of Lambda sensor connector terminal 1.

5) Monitor the waveform in Lambda sensor connector terminal 1.

Specification : Measured voltage : 2.0 V
waveform : Refer to "Signal Waveform & Data" of "General Information". The waveform similar to Fig.1) is displayed.

6) Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ No voltage detected in Lambda sensor power circuit : Go to "2. Check open in sensor power circuit" as follows.
▶ High voltage detected in Lambda sensor power circuit : Repair short to battery in Lambda sensor power circuit and go to "Verification of Vehicle Repair".

2. Check open in Lambda sensor power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between Lambda sensor connector terminal 1 and ECM connector terminal 64.

Specification : Continuity(below 1.0Ω)

4) Is the measured voltage within the specification?

YES

▶ Repair short to ground in Lambda sensor power circuit and go to "Verification of Vehicle Repair".

NO

▶ Reapir open in Lambda sensor power circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION EB8FC1D4

1. Check voltage in sensor signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of Lambda sensor connector terminal 4.

Specification : 0.8V~0.9 V

5) Is the measured voltage within the specification?

YES

▶ Go to "3. Check sensor pump circuit".

NO

▶ No voltage detected in Lambda sensor signal circuit : Go to "2. Check open in sensor signal circuit" as follows.
▶ High voltage detected in Lambda sensor power circuit : Repair short to battery in Lambda sensor signal circuit and go to "Verification of Vehicle Repair".

2. Check open in Lambda sensor signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between Lambda sensor connector terminal 4 and ECM connector terminal 87.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Lambda sensor signal circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor signal circuit and go to "Verification of Vehicle Repair".

3. Check voltage in sensor pump circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of Lambda sensor connector terminal 6.

Specification : 0.8V~0.9 V

5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ No voltage detected in Lambda sensor pumpl circuit : Go to "4. Check open in sensor pump circuit" as follows.
▶ High voltage detected in Lambda sensor power circuit : Repair short to battery in Lambda sensor pump circuit and go to "Verification of Vehicle Repair".

4. Check open in sensor pump circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between Lambda sensor connector terminal 6 and ECM connector terminal 65.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Lambda sensor pump circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor pump circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION ED2C2CEB

1. Check voltage in sensor ground circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of Lambda sensor connector terminal 3.

Specification : 2.3V~2.7V

5) Is the measured voltage within the specification?

YES

▶ Go to"Component Inspection".

NO

▶ No voltage detected in Lambda sensor ground circuit : Go to "2. Check open in sensor ground circuit" as follows.
▶ High voltage detected in Lambda sensor ground circuit : Repair short to battery in Lambda sensor ground circuit and go to "Verification of Vehicle Repair".

2. Check open in sensor ground circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between Lambda sensor connector terminal 3 and ECM connector terminal 86.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Lambda sensor ground circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor ground circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E2874034

1. Lambda sensor Visual Inspection

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Lambda sensor connector.

   3) Perform visual inspection for each checking point as follows.
      a. Check corrosion inside of Lambda sensor terminal.
      b. Check damaged coverring and open in component wiring.
      c. Check connecting torque(poor connection) of Lambda sensor component.
      d. Disconnect Lambda sensor and check deformation, clogging, melting of Lambda detecting prove.

Specification : Everyting OK

   4) Is any problem of Lambda sensor detected?

YES

▶ Replace Lambda sensor and go to "Verification of Vehicle Repair".

NO

▶ Refer to "NOTE" as follows.

NOTE

In diesel engine, ultra lean combustion generates at normal operating condition. Therefore, Lambda2 sensor signal change in accordance with engine acceleration and various loading condition rarely happens, unlikely to linear Lambda sensor of gasoline engine. Moreover, pumping current is not measurable with normal measuring device(ampere meter) because maximum value is 3mA. If DTC code is recorded continuously eventhough circuit inspection is correctly performed and no problem at visual inspection of component is detected, replace Lambda sensor.

VERIFICATION OF VEHICLE REPAIR E0D0A246

Refer to DTC P2238.

DTC P2251 LAMBDA SENSOR REFERENCE GROUND CIRCUIT/OPEN (BANK 1 / SENSOR 1)

COMPONENT LOCATION EE98E563

Refer to DTC P2238.

GENERAL DESCRIPTION E7A8EFD8

Refer to DTC P2238.

DTC DESCRIPTION EF160269

P2251 is set when ground line(terminal 3) is opened. This code is due to the problem of Lambda sensor circuit.

DTC DETECTING CONDITION E881FD8F

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Lambda sensor circuit
• Lambda sensor component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine running</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Open in Lambda sensor ground circuit</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 2.0 sec.</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E358671F

Refer to DTC P2238.

SCHEMATIC DIAGRAM EC04CF75

Refer to DTC P2238.

SIGNAL WAVEFORM AND DATA E55D9F39

Refer to DTC P2238.

TERMINAL AND CONNECTOR INSPECTION E3C4F5A7

Refer to DTC P2238.

POWER CIRCUIT INSPECTION E70B5E0A

1. Check voltage & waveform in sensor power circuit

   1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of Lambda sensor connector terminal 1.

5) Monitor the waveform in Lambda sensor connector terminal 1.

Specification : Measured voltage : 2.0 V
waveform : Refer to "Signal Waveform & Data" of "General Information". The waveform similar to Fig.1) is displayed.

6) Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ No voltage detected in Lambda sensor power circuit : Go to "2. Check open in sensor power circuit" as follows.
▶ High voltage detected in Lambda sensor power circuit : Repair short to battery in Lambda sensor power circuit and go to "Verification of Vehicle Repair".

2. Check open in Lambda sensor power circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between OLambda sensor connector terminal 1 and ECM connector terminal 64.

Specification : Continuity(below 1.0Ω)

4) Is the measured voltage within the specification?

YES

▶ Repair short to ground in Lambda sensor power circuit and go to "Verification of Vehicle Repair".

NO

▶ Reapir open in Lambda sensor power circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E23B326A

1. Check voltage in sensor signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of Lambda sensor connector terminal 4.

Specification : 0.8V~0.9 V

5) Is the measured voltage within the specification?

YES

▶ Go to "3. Check sensor pump circuit".

NO

▶ No voltage detected in Lambda sensor signal circuit : Go to "2. Check open in sensor signal circuit" as follows.
▶ High voltage detected in Lambda sensor power circuit : Repair short to battery in Lambda sensor signal circuit and go to "Verification of Vehicle Repair".

2. Check open in Lambda sensor signal circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between Lambda sensor connector terminal 4 and ECM connector terminal 87.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Lambda sensor signal circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor signal circuit and go to "Verification of Vehicle Repair".

3. Check voltage in sensor pump circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of Lambda sensor connector terminal 6.

Specification : 0.8V~0.9 V

5) Is the measured voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ No voltage detected in Lambda sensor pumpl circuit : Go to "4. Check open in sensor pump circuit" as follows.
▶ High voltage detected in Lambda sensor power circuit : Repair short to battery in Lambda sensor pump circuit and go to "Verification of Vehicle Repair".

4. Check open in sensor pump circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between Lambda sensor connector terminal 6 and ECM connector terminal 65.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Lambda sensor pump circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor pump circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION EFBBCBA8

1. Check voltage in sensor ground circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector.

3) IG KEY "ON".

4) Measure the voltage of OLambda sensor connector terminal 3.

Specification : 2.3V~2.7V

5) Is the measured voltage within the specification?

YES

▶ Go to"Component Inspection".

NO

▶ No voltage detected in Lambda sensor ground circuit : Go to "2. Check open in sensor ground circuit" as follows.
▶ High voltage detected in Lambda sensor ground circuit : Repair short to battery in Lambda sensor ground circuit and go to "Verification of Vehicle Repair".

2. Check open in sensor ground circuit

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Lambda sensor connector and ECM connector.

3) Check continuity between Lambda sensor connector terminal 3 and ECM connector terminal 86.

Specification : Continuity (below 1.0Ω)

4) Is the measured resistance within the specification?

YES

▶ Repair short to ground in Lambda sensor ground circuit and go to "Verification of Vehicle Repair".

NO

▶ Repair open in Lambda sensor ground circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EEBA7EE5

1. Lambda sensor Visual Inspection

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect Lambda sensor connector.

   3) Perform visual inspection for each checking point as follows.
      a. Check corrosion inside of Lambda sensor terminal.
      b. Check damaged coverring and open in component wiring.
      c. Check connecting torque(poor connection) of Lambda sensor component.
      d. Disconnect Lambda sensor and check deformation, clogging, melting of Lambda detecting prove.

Specification : Everyting OK

   4) Is any problem of Lambda sensor detected?

YES

▶ Replace Lambda sensor and go to "Verification of Vehicle Repair".

NO

▶ Refer to "NOTE" as follows.

NOTE

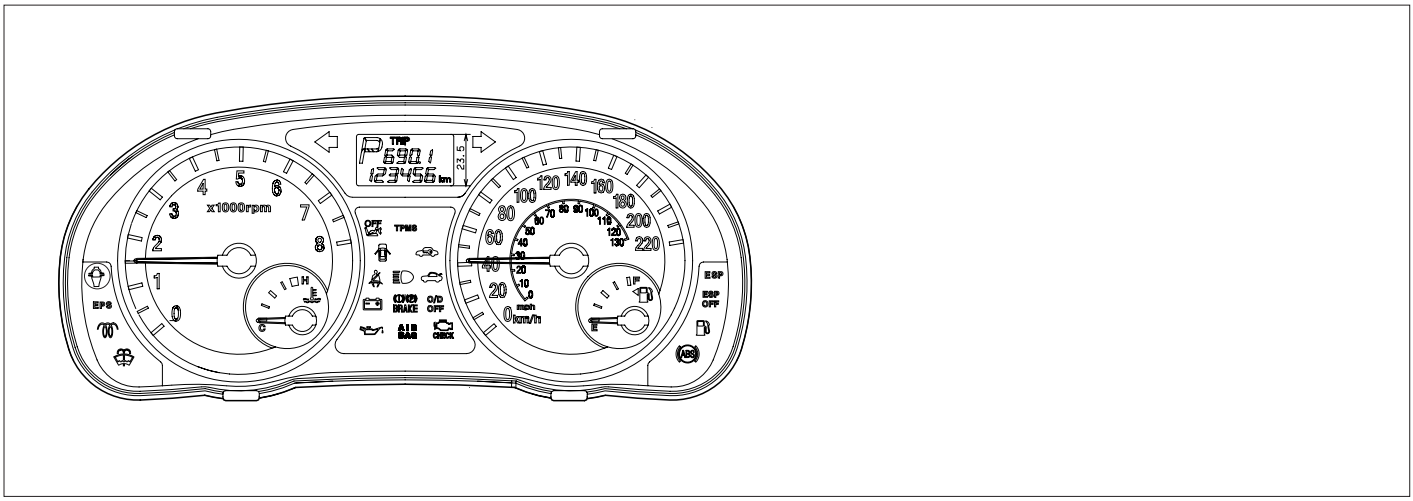
In diesel engine, ultra lean combustion generates at normal operating condition. Therefore, Lambda sensor signal change in accordance with engine acceleration and various loading condition rarely happens, unlikely to linear Lambda sensor of gasoline engine. Moreover, pumping current is not measurable with normal measuring device(ampere meter) because maximum value is 3mA. If DTC code is recorded continuously eventhough circuit inspection is correctly performed and no problem at visual inspection of component is detected, replace Lambda sensor.

VERIFICATION OF VEHICLE REPAIR E8EDD0DF

Refer to DTC P2238.

DTC P2264 DETECTION OF WATER IN FUEL

COMPONENT LOCATION E739C25B



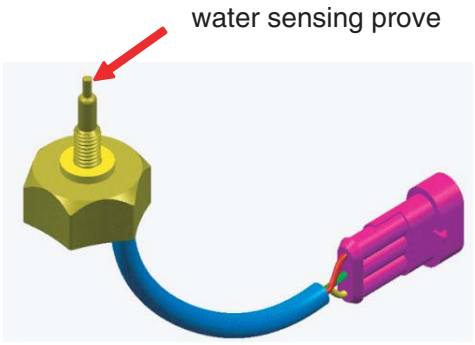
EGNG006M

GENERAL DESCRIPTION ED50F276

Diesel fuel filter can seperate water from fuel. If water more than specified amount is detected by "water sensor" installed at the bottom of fuel filter, "Fuel warning lamp" on cluster turns ON.Especially for high pressure pump or injectors of common rail diesel engine is fatal. because water causes poor lubrication and corrosion in such accurate devices, furthermore, it leads engine hesitation. In order to prevent this harsh condition to engine, "Water warning lamp" turns ON to let driver relief the gathered water from the filter and engine power generation is limited.

NOTE

If sensing prove of water sensor contacts with water, impressed voltage on prove is grounded to chassis ground, then 12V is outputted from signal line. With this method, ECM recognizes the amount of water.



EGNG006N

DTC DESCRIPTION E0FC45BF

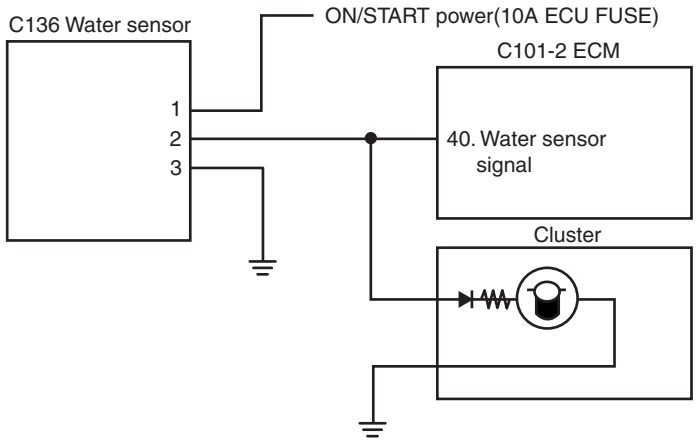
P2246 is set when water sensor operates for more than 4 sec. Water warning lamp turns on and engine power generation is limited in this condition. When this code is set, water in the filter should be removed to prevent engine from water contained fuel. If same code is set even after removing water, check short to battery in water in fuel sensor signal circuit or component failure.

DTC DETECTING CONDITION E62F0E1D

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		• Water stored inside of fuel filter (remove water inside of filter) • Water sensor circuit(short to battery) • Water sensor component
Enable Conditions	• IG KEY "ON"		
ThresholdValue	• Signal voltage detected at Water sensor		
DiagnosticTime	• 4.0sec.		
Fail Safe	Fuel Cut	NO	
	EGR Off	NO	
	Fuel Limit	YES	
	MIL	NO	

SCHEMATIC DIAGRAM E8726ABD

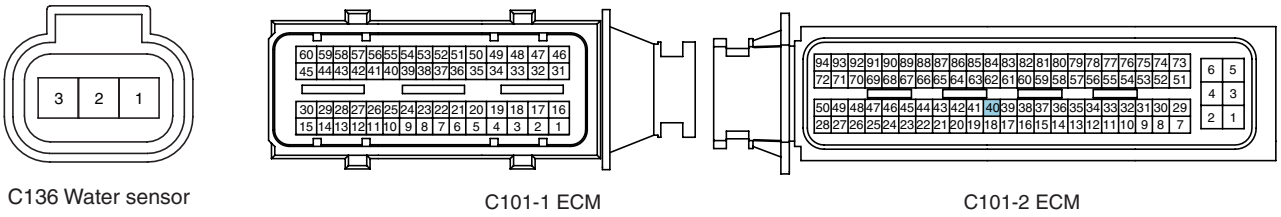
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C142 J/C terminal 3	IG power
2	C101-2 terminal 40	Water sensor signal
3	G102 ground point	Water lamp signal

[HARNESS CONNECTOR]



EGNG006O

TERMINAL AND CONNECTOR INSPECTION EE7A97AB

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector or checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION EE2765E9

1. Ignition "OFF", Turn Engine "OFF".
2. Disconnect Water sensor connector.
3. IG KEY "ON".
4. Measure the voltage of terminal 1 of Water sensor connector.

Specification : 11.0V~12.5V

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ Repair open in In-pannel junction box 10A ECU fuse and related circuit and go to "Verification of Vehicle Repair".

SIGNAL CIRCUIT INSPECTION E7F94168

1. Check signal circuit voltage
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect Water sensor connector.
   3) IG KEY "ON".
   4) Measure the voltage of terminal 2 of Water sensor connector.

Specification : 0.0V~0.1V

   5) Is the measured voltage within the specification?

YES

▶ Go to "2. Water warning lamp operation test" as follows.

NO

▶ Repair short to battery and go to "Verification of Vehicle Repair".

2. Water warning lamp operation test

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect Water sensor connector.

3) IG KEY "ON".

4) Connect water sensor connector terminal 1 and 2 using jump wire.

Specification : Water warning lamp on cluster turns ON. 12V battery voltage is detected at ECM connector(C101-2) terminal 40.

5) Does water warning lamp turn ON? And is 12V battery voltage detected at ECM connector(C01-2) terminal 40?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair open in water warning lamp filament and related circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION EA863B08

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect Water sensor connector.
3. Check continuity between Water sensor connector terminal 3 and chassis ground.

Specification : Discontinuity (Infinite Ω)

4. Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair short to ground in signal circuit and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E569C3AD

1. Check water inside of fuel filter

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect fuel filter assy' from vehicle. (note : fuel filter should be maintained to stand up vertically at disconnecting.)

3) Set up clean vessel like beaker to collect fuel outflowed from filter.

4) Disconnect Water sensor and collect fuel and water mixed to it.

Specification : Outflowed fuel must not contain much water.

5) Does fuel contains much water?

YES

▶ Checking odometer and filter used duration, replace fuel filter if needed. If too much water flowed to fuel filter, check if water flowed into fuel tank and clean up inside of fuel tank.
After replacing filter and clean up fuel tank and go to "Verification of Vehicle Repair".

NO

▶ Go to "2.Check Water sensor component" as follows.

2. Check Water sensor component

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect fuel filter assy' from vehicle. (note : fuel filter should be maintained to stand up vertically at disconnecting.)

3) Set up clean vessel like beaker to collect fuel outflowed from filter.

4) Disconnect fuel warning sensor from disconnected fuel filter.

5) Connect Water sensor to disconnected wiring connector.

6) IG KEY "ON".

7) Touch water sensing prove of Water sensor to chassis ground.

Specification : Water warning lamp turns ON when touching water sensing prove to chassis ground.

8) Does water warning lamp operate well?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace Water sensor and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E94BF282

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".

4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

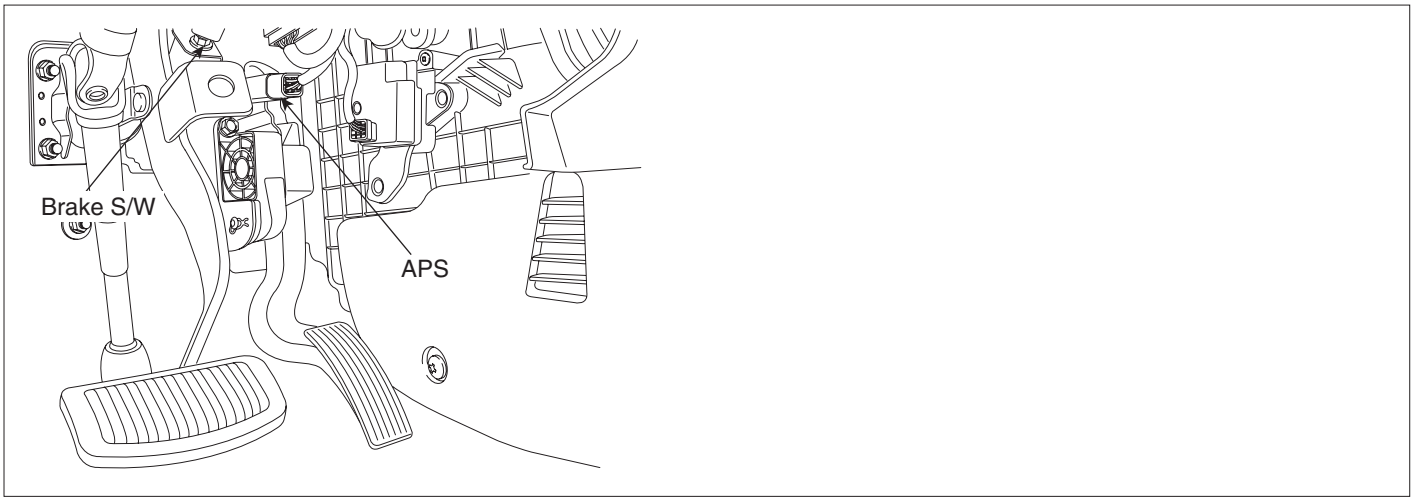
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC P2299 BRAKE PEDAL POSITION / ACCELERATOR PEDAL POSITION INCOMPATIBLE

COMPONENT LOCATION E197B6F0



EGNG001Z

GENERAL DESCRIPTION E8C600E1

Brake switch monitors malfunction of accel pedal sensor(APS).Drivers depress brake pedal when 1).the voltage higher than driver's intension is detected due to APS malfunction(signal circuit short to high voltage) 2).engine power generates excessively due to fault signal.Like previous example, if driver's intension to decelerate is transmitted to ECM(brake pedal depressed) when APS signal is high, ECM consider APS to be fault and Limp Home mode is activated.When Limp Home mode is activated, engine speed is fixed at 1200RPM and driving performance is limited, later, if correct APS signal is detected, Limp Home mode is deactivated immediately.

DTC DESCRIPTION E1B8E6DA

P2299 is set when brake signal is inputted to ECM for more than 0.5 sec. while APS is depressed more than 5% at above 870RPM, 2Km/h. And Limp Home mode is activated with the DTC code occurence. Later, if correct APS signal is detected, Limp Home mode is deactivated immediately. This code is set when APS signal is a bit higher than the voltage at accelerator released position and driver's pedal manipulation, therfore careful inspection of APS and checking driver's pedal depressing habit is required.

DTC DETECTING CONDITION E0FEC0D5

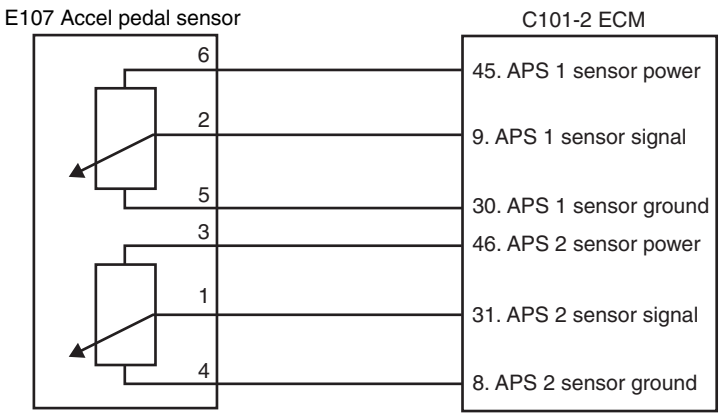
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• APS 1 Circuit
• APS 2 Circuit
• APS component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Engine run (engine speed below 870RPM, vehicle speed below 2Km/h)</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Brake pedal singal inputted at APS output voltage above 5%
(Enabled when brake pedal released or accelerator pedal depressed 200% per sec.)</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 500ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4">• APS standard value is 0%.
• Limp home idle is fixed at (1200RPM)
• A/C operation stops according to Vehicle/Engine speed
• Cruise control deactivated (for Cruise control option applied vehicle)</td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>YES</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E57FB36A

	Pedal released	Pedal depressed	Sensor Type
APS 1	0.7V~0.8V	3.8V~4.4V	Variable resistance type(Potentiometer)
APS 2	0.275V~0.475V	1.75V~2.35V	

SCHEMATIC DIAGRAM E2BEF1B4

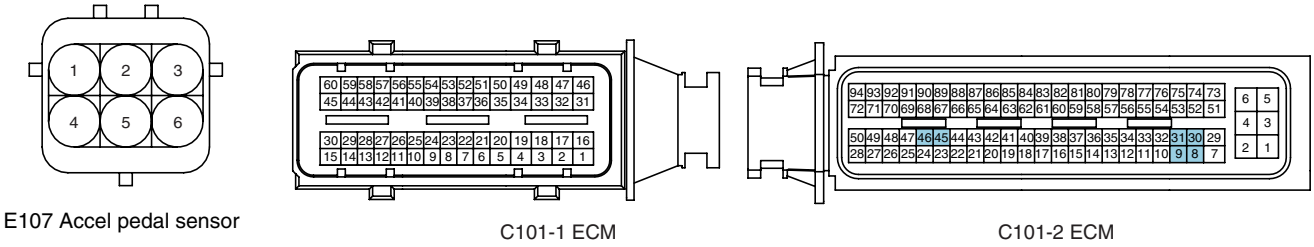
[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Terminal	Connected to	Function
1	C101-2 terminal 31	APS 2 sensor signal
2	C101-2 terminal 9	APS 1 sensor signal
3	C101-2 terminal 46	APS 2 sensor power
4	C101-2 terminal 8	APS 2 sensor ground
5	C101-2 terminal 30	APS 1 sensor ground
6	C101-2 terminal 45	APS 1 sensor power

[HARNESS CONNECTOR]



EGNG002H

SIGNAL WAVEFORM AND DATA E38795B0

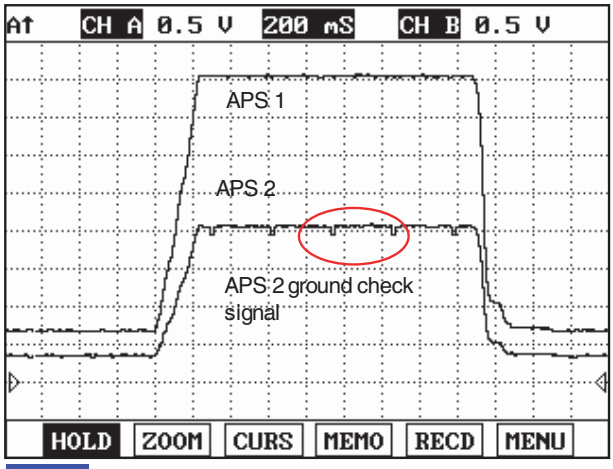


Fig.1

Fig.1) APS 1 and APS 2 signals are measured simultaneously, Check if output value is rising and APS 2 is 1/2 of APS 1 signal.

EGNG014R

NOTE

APS 2 Ground checking signal is for ECM to monitor APS 2. This signal drops APS 2 output voltage to below 200.39mV per 200msec. If APS 2 output voltage does not drop to below 200.39mV, ECM sets DTC as recognizing ground circuit error of APS 2 .

※ The waveform below 200.39mV is not detectable in Ground checking signal waveform of APS 2 signal. Instead, the waveform which drops a little is detected. If APS 2 data of "SERVICE DATA" on the Scantool varies from 350mV to 0mV periodically, it means it works well.

MONITOR SCANTOOL DATA E6DCDC84

1. Connect scantool to Data Link Cable (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor "ACCEL PEDAL SENSOR", "ACCEL PEDAL SENSOR 1", "ACCEL PEDAL SENSOR 2 " parameter on the scantool.

Specification : at idle(0%) ACCEL PEDAL SENSOR 1 : 600mV~800mV
ACCEL PEDAL SENSOR 2 : 1/2 of ACCEL PEDAL SENSOR 1

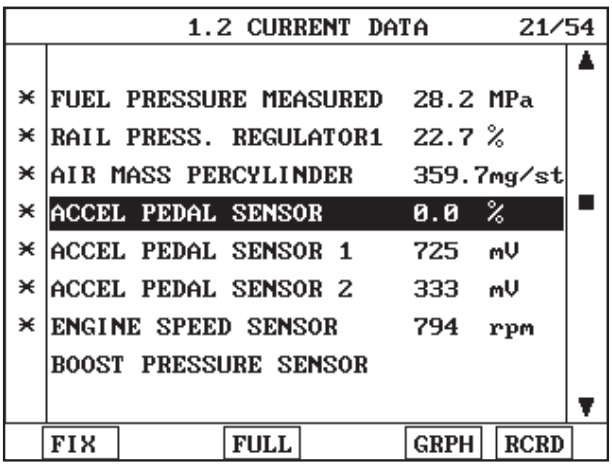


Fig.1

Fig.1) APS output data at warm idle. Check if output value is rising and "ACCEL PEDAL SENSOR 2" is 1/2 of "ACCEL PEDAL SENSOR 1" signal.

EGNG002J

TERMINAL AND CONNECTOR INSPECTION ED494EF5

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damage of component.
2. Perform checking procedure as follows.
   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.
   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

NOTE

Disconnect the pin which requires checking at mail connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position)

3. Is the problem found?

YES

▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

NO

▶ Go to "Power Circuit Inspection".

POWER CIRCUIT INSPECTION E34887D7

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect APS connector (M41).
3. IG KEY "ON".
4. Measure the voltage of terminal 3 and 6 of APS connector.

Specification : 4.8V~5.1V

5. Is the measured voltage within the specification?

YES

▶ Go to "Signal Circuit Inspection".

NO

▶ If the measured voltage is not within the specified value, find and repair trouble causing part in circuits and go to "Verification of Vehicle Repair".
When the measured voltage is higher than the specified value :
Refer to P0643 Circuit Inspection. (APS1)
Refer to P0653 Circuit Inspection.(APS2)
When the measured voltage is lower than the specified value :
Refer to P0642 Circuit Inspection.(APS1)
Refer to P0652 Circuit Inspection.(APS2)

SIGNAL CIRCUIT INSPECTION E4658BDC

1. Check open in signal circuit
   1) IG KEY "OFF", ENGINE "OFF".
   2) Disconnect APS connector and ECM connector.
   3) Check continuity between APS connector terminal 2 and ECM connector terminal 9 (APS 1)
      Check continuity between APS connector terminal 1 and ECM connector terminal 31 (APS 2)

Specification : Continuity (below 1.0Ω)

   4) Is the measured resistance within the specification?

YES

▶ Go to "Check short in signal circuit".

NO

▶ Repair open in signal circuit and go to "Verification of Vehicle Repair".

2. Check short in signal circuit (APS 1)

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect APS connector and ECM connector.

3) IG KEY "ON"

4) Check continuity between APS connector terminal 2 and chassis ground. (check short to ground)
Measure the voltage of terminal 2 of APS connector. (check short to battery)

Specification : Check short to ground : Discontinuity (Infinite Ω)
Check short to battery : 0.0V~0.1V

5) Is APS 1 signal circuit insulated normally?

YES

▶ Go to "3.Signal Circuit Inspection (APS 2)" as follows.

NO

▶ Repair short in circuit and go to "Verification of Vehicle Repair".

3. Signal Circuit Inspection (APS 2)

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect APS connector and ECM connector.

3) IG KEY "ON"

4) Check continuity between APS connector terminal 1 and chassis ground. (check short to ground)
Measure the voltage of terminal 1 of APS connector. (check short to battery)

Specification : Check short to ground : Discontinuity (Infinite Ω)
Check short to battery : 0.0V~0.1V

5) Is APS 2 signal circuit insulated normally?

YES

▶ Go to "Ground Circuit Inspection".

NO

▶ Repair short in circuit and go to "Verification of Vehicle Repair".

GROUND CIRCUIT INSPECTION E679E3A5

1. Check ground circuit (APS1)

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect APS connector.

3) IG KEY "ON".

4) Measure the voltage of APS terminal 6. [TEST "A"]

5) Measure the voltage of APS terminal 6 and terminal 5. [TEST "B"]
(terminal 6: Check + prove , terminal 5 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6) Is the measured voltage within the specification?

YES

▶ Go to "2. Check ground circuit (APS2)".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

2. Check ground circuit (APS2)

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect APS connector.

3) IG KEY "ON".

4) Measure the voltage of APS terminal 3. [TEST "A"]

5) Measure the voltage of APS terminal 3 and terminal 4. [TEST "B"]
(terminal 3: Check + prove , terminal 4 : Check - prove)

Specification : [TEST "A"] Voltage - [TEST "B"] Voltage = below 200mV

6) Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ When "B" voltage is not detected : Repair open in ground circuit and go to "Verification of Vehicle Repair".
▶ When the voltage difference between "A" and "B" is above 200mV : Eliminate the causes of excessive resistance and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E4B78178

1. IG KEY "OFF", ENGINE "OFF".
2. Disconnect APS connector (M41).
3. Check resistance for each terminal refering to Resistance characteristic table.

Specification : Resistance characteristic table for each terminal

	checking point	Resistance(KΩ 20℃)		Characteristic	Component Connector Shape
		Pedal Depressed	Pedal released		
APS 1	6(power)-5(ground)	1.0±0.1KΩ	1.0±0.1KΩ	Unchanged	 EGNG002O
	6(power)-2(signal)	1.8±0.1KΩ	1.1±0.1KΩ	Resistance drops	
	2(signal)-5(ground)	1.1±0.1KΩ	1.8±0.1KΩ	Resistance rises	
APS 2	3(power)-4(ground)	2.0±0.1KΩ	2.0±0.1KΩ	Unchanged	
	3(power)-1(signal)	2.9±0.1KΩ	2.1±0.1KΩ	Resistance drops	
	1(signal)-4(ground)	1.1±0.1KΩ	1.8±0.1KΩ	Resistance rises	

4. Are resistances for each terminal measured correctly?

YES

▶ Go to "Verification of Vehicle Rapair".

NO

▶ Replace APS and go to "Verification of Vehicle Rapair".

VERIFICATION OF VEHICLE REPAIR ECD35DA4

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

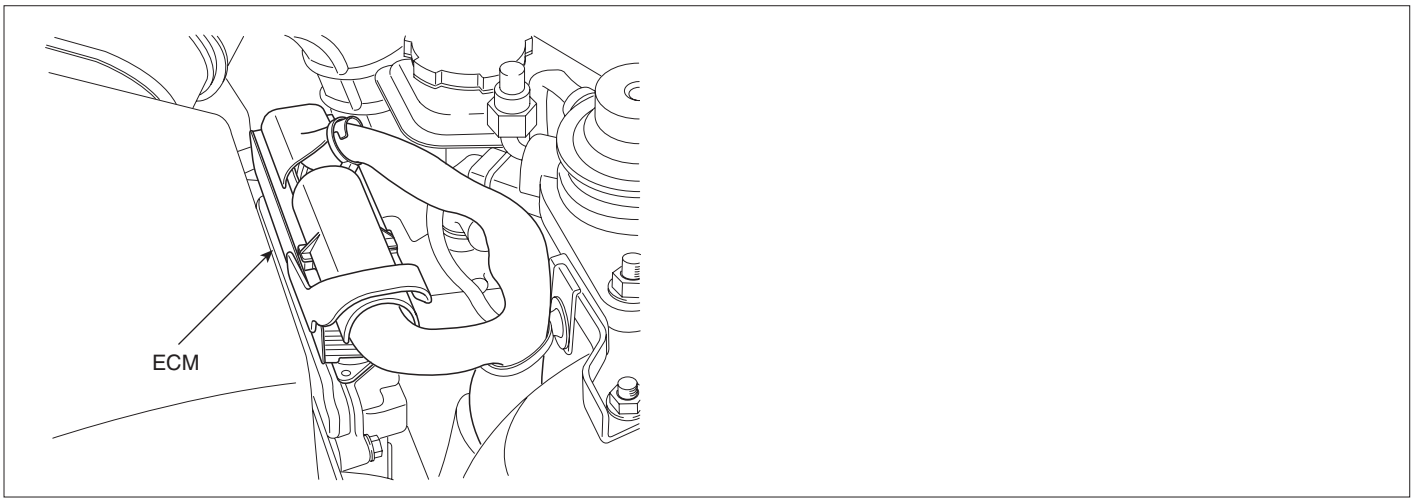
▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC U0001 CAN COMMUNICATION MALFUNCTION

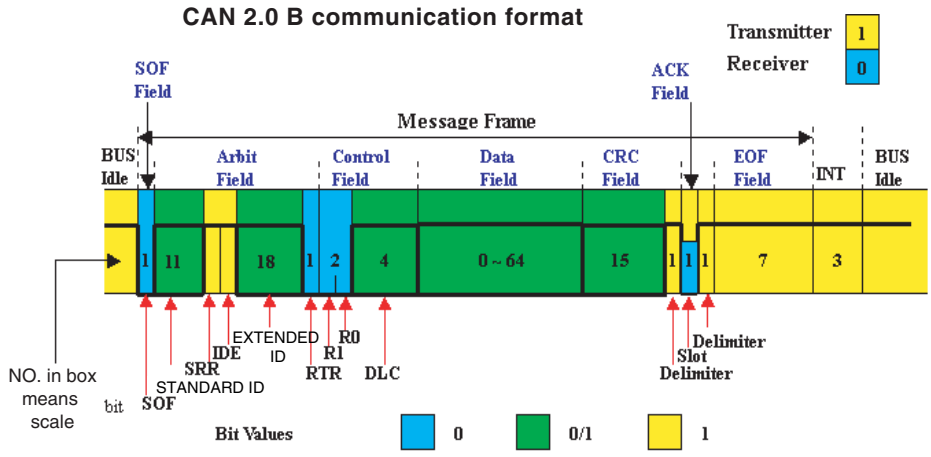
COMPONENT LOCATION EB9C381B



EGNG014G

GENERAL DESCRIPTION E6EC6484

Several control units are applied to electronically controlled vehicles. These units perform each control with informations from various sensors. Thus, sharing signal information from sensors is needed, so CAN communication type whose communication speed is high and insensitive to electrical noise by spark generation is adopted to controlling power-train(engine, atutomatic transaxle, ABS, TCS, ECS)As sharing signals of engine speed, APS, engaged gear and torque reduction through CAN communication, ECM and TCM modules control vehicle actively.



EGNG014H

DTC DESCRIPTION EBAB6371

U0001 is set when signal transmission through CAN communication line is impossible for more than 0.1 sec. because of open or short to ground in CAN communication line. Checking CAN communication BUS and signals from ECM, TCM module is required.

DTC DETECTING CONDITION E5460F8E

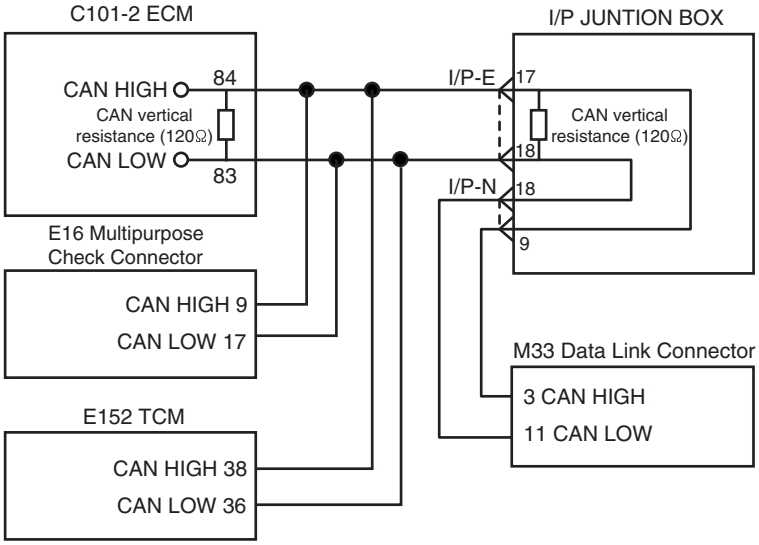
Item	Detecting Condition			Possible Cause
DTC Strategy	• Signal monitoring			• CAN BUS • CAN communication module component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• CAN BUS error			
DiagnosticTime	• 100ms			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION E49E97B9

Communication Format	DIGITAL "0"		DIGITAL "1"(BUS IDLE)		CAN Communication Line Resistance	
	HIGH	LOW	HIGH	LOW	Inside of ECM	Inside of In-pannel junction box
CAN 2.0B	3.5V	1.5V	2.5V	2.5V	120Ω (20℃)	120Ω (20℃)

SCHEMATIC DIAGRAM E3150397

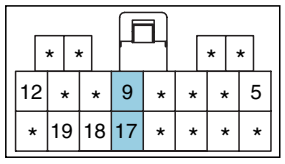
[CIRCUIT DIAGRAM]



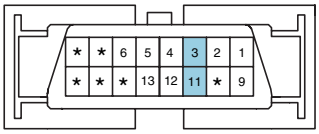
[CONNECTOR INFORMATION]

Terminal	Connected to	Function
84	I/P-E terminal 17 E16 terminal 9 E152 terminal 38 M33 terminal 3	CAN HIGH
83	I/P-E terminal 18 E16 terminal 17 E152 terminal 36 M33 terminal 11	CAN LOW

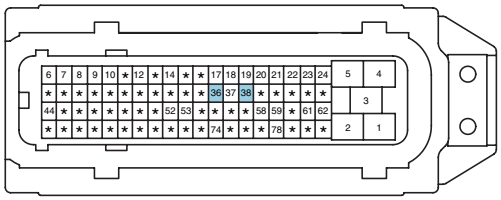
[HARNESS CONNECTOR]



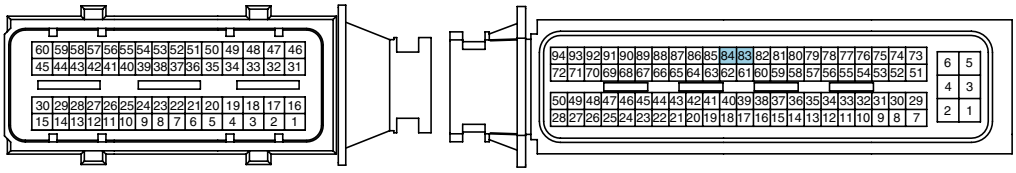
E16 Multipurpose Check Connector



M33 Data Link Connector



E152 TCM



C101-1 ECM C101-2 ECM

EGNG014I

SIGNAL WAVEFORM AND DATA EE8CCCD8

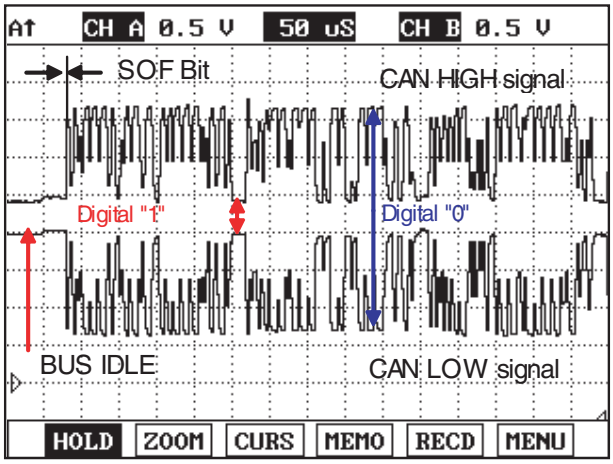


Fig.1

Fig.1) CAN communication waveform

Monitoring CAN HIGH and LOW simultaneously is important in monitoring CAN communication waveform. When CAN HIGH signal rise to 3.5V and LOW signal drops to 1.5V - voltage difference between HIGH and LOW signal is 2V - at BUS IDLE state (DIGITAL "1") whose reference voltage is 2.5V, "0" is recognized. Besides, comparing HIGH and LOW signal if opposite waveform is detected with the reference voltage of 2.5V, Check if current cam signal transfers correctly.
Continuous "0"signal above 6BIT means the occurence of error in CAN communication.
1BIT is easily distinguished as calculating the time when "SOF"(START OF FRAME) which notifies the start of frame occurs.
Check if "0"signal above 6BIT is detected continuously when monitoring CAN communication waveform.

EGNG014J

TERMINAL AND CONNECTOR INSPECTION E57F8AD7

1. Electrical systems consist of a lot of harness and connectors, poor connection of terminals can cause various problems and damge of component.

2. Perform checking procedure as follows.

   1) Check damage of harness and terminals : Check terminals for contact resistance, corrosion and deformation.

   2) Check connecting condition of ECM and component connector : Check terminal seperation, damage of locking device and connecting condition between terminal and wiring.

   NOTE

   Disconnect the pin which requires checking at male connector and insert it to the terminal at female connector for checking connecting condition. (after checking, reconnect the pin at correct position.)

3. Is the problem found?

   YES

   ▶ Repair the trouble causing part and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Signal Circuit Inspection".

SIGNAL CIRCUIT INSPECTION E2049F42

1. Check CAN BUS resistance

   1) IG KEY "OFF", ENGINE "OFF".

   2) Measure the resistance between diagnostic connector 3 and 11.

   3) Disconnect ECM and TCM connector.

   4) Measure the resistance between diagnostic connector 3 and 11.

Specification : Both ECM and TCM connected : 60 ± 3Ω (Test 1)
Both ECM and TCM disconnected : 120 ± 3Ω (Test 2)

---

   5) Is CAN BUS resistance within the specification?

   YES

   ▶ Go to "2.Check short to ground in CAN BUS" as follows.

   NO

   ▶ Below 10Ω for both conditions(disconnected, connected) : Repair short between CAN BUS and go to "Verification of Vehicle Repair".
   ▶ 120Ω for both conditions(disconnected, connected) : Go to "4. Check CAN BUS continuity".
   ▶ Infinite Ω for both conditions(disconnected, connected) :Repair open in CAN communication circuit between DLC terminal and In-pannel junction box.

2. Check short to ground in CAN BUS

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect ECM and TCM connectors.

   3) Check continuity between DLC terminal 3 and chassis ground. (CAN HIGH)

   4) Check continuity between DLC terminal 11 and chassis ground. (CAN LOW)

Specification : Discontinuity (Infinite Ω)

---

   5) Is measured resistance within the specification?

   YES

   ▶ Go to "3. Check short to battery in CAN BUS".

   NO

   ▶ Repair short to ground in circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in CAN BUS

   1) IG KEY "OFF", ENGINE "OFF".

   2) Disconnect ECM and TCM connectors.

   3) IG KEY "ON".

4) Measure the voltage of DLC terminal 3. (CAN HIGH)

5) Measure the voltage of DLC terminal 11. (CAN LOW)

Specification : 0.0V~0.1V

6) Is measured resistance within the specification with both connector disconnected?

YES

▶ Go to"4. Check CAN BUS continuity" as follows.
▶ Repair short to battery and go to "Verification of Vehicle Repair".

4. Check CAN BUS continuity

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) Check continuity between DLC terminal 3 and CAN HIGH terminal of each module.
(CAN HIGH : ECM connector terminal 84, TCM connector terminal 38, multipurpose check connector terminal 9)

4) Check continuity between DLC terminal 11 and CAN LOW terminal of each module.
(CAN LOW : ECM connector terminal 83, TCM connector terminal 36, multipurpose check connector terminal 17)

Specification : Continuity(below 1.0Ω)

5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open in CAN BUS and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E1831DDF

1. Check CAN communication waveform generation

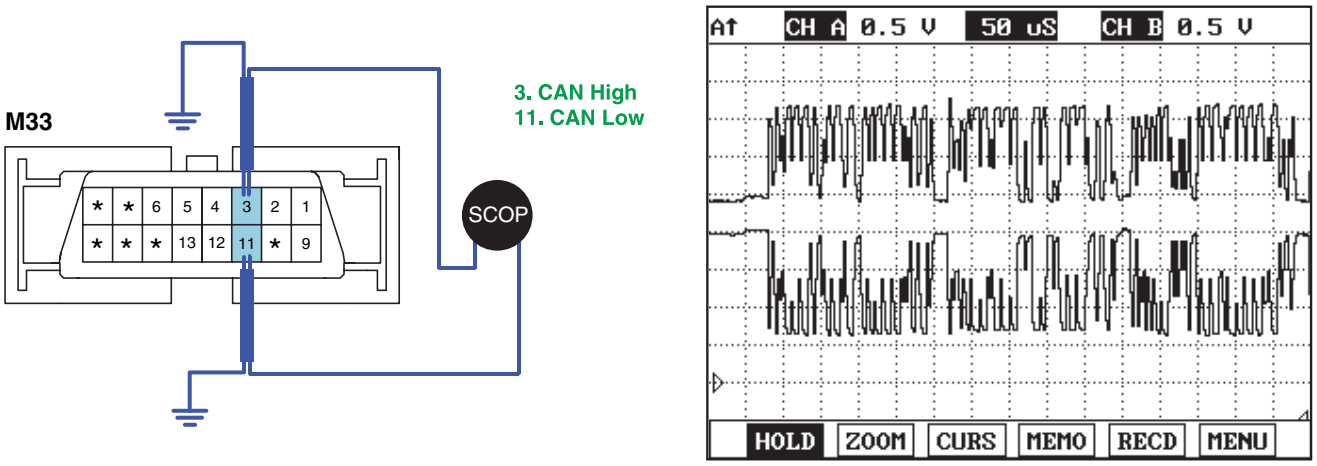
1) IG KEY "OFF", ENGINE "OFF".

2) Connect 2 channel scope to DLC terminal 3(CAN HIGH) and 11(CAN LOW).

3) IG KEY "ON" after connecting only ECM to CAN BUS.

4) IG KEY "ON" after connecting only TCM to CAN BUS.

Specification : At IG KEY "ON", the waveform same as "Signal Waveform & Data" of this code generates.
※ Different from "Signal Waveform & Data", if 1) both CAN HIGH and LOW signal are fixed at 2.5 V or
2) HIGH and LOW signal are fixed at 3.5 V and 1.5 V, respectively, it is due to communication error between modules.



EGNG014O

5) Does correct waveform generate from each module?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace the module which generates poor communication waveform, and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E6DB3912

After a repair, it is essential to verify that the fault is corrected.

1. After connecting Scantool select "DIAGNOSTIC TROUBLE CODES(DTCs)" mode.
2. Clear recorded DTC using Scantool.
3. Drive the vehicle within DTC "Enable conditions" in "General information".
4. After selecting "DIAGNOSTIC TROUBLE CODES(DTCs)" mode and check if DTC is recorded again.
5. Are any DTCs recorded ?

YES

▶ Go to the DTC guide of recorded NO. in Scantool.

NO

▶ System operates within specification.

DTC U0100 CAN-TIME OUT ECU

COMPONENT LOCATION EC794911

Refer to DTC U0001.

GENERAL DESCRIPTION E53785B5

Refer to DTC U0001.

DTC DESCRIPTION EF8CEC73

U0100 is set when no signal transmission through CAN BUS occurs for more than 0.5 sec.. This code is due to CAN BUS problem or CAN communication module failure.

DTC DETECTING CONDITION ED75B955

Item	Detecting Condition			Possible Cause
DTC Strategy	• Signal monitoring			• CAN BUS • CAN communication module component
Enable Conditions	• IG KEY "ON"			
ThresholdValue	• No signal transmission through CAN BUS			
DiagnosticTime	• 500ms			
Fail Safe	Fuel Cut	NO		
	EGR Off	NO		
	Fuel Limit	NO		
	MIL	NO		

SPECIFICATION E5081CCD

Refer to DTC U0001.

SCHEMATIC DIAGRAM EE5D4D91

Refer to DTC U0001.

SIGNAL WAVEFORM AND DATA E4486F4F

Refer to DTC U0001.

TERMINAL AND CONNECTOR INSPECTION E8D4FF00

Refer to DTC U0001.

SIGNAL CIRCUIT INSPECTION E2181768

1. Check CAN BUS resistance

    1) IG KEY "OFF", ENGINE "OFF".

2) Measure the resistance between diagnostic connector 3 and 11.

3) Disconnect ECM and TCM connector.

4) Measure the resistance between diagnostic connector 3 and 11.

Specification : Both ECM and TCM connected : 60 ± 3Ω (Test 1)
Both ECM and TCM disconnected : 120 ± 3Ω (Test 2)

---

5) Is CAN BUS resistance within the specification?

YES

▶ Go to "2.Check short to ground in CAN BUS" as follows.

NO

▶ Below 10Ω for both conditions(disconnected, connected) : Repair short between CAN BUS and go to "Verification of Vehicle Repair".
▶ 120Ω for both conditions(disconnected, connected) : Go to "4. Check CAN BUS continuity".
▶ Infinite Ω for both conditions(disconnected, connected) :Repair open in CAN communication circuit between DLC terminal and In-pannel junction box.

2. Check short to ground in CAN BUS

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) Check continuity between DLC terminal 3 and chassis ground. (CAN HIGH)

4) Check continuity between DLC terminal 11 and chassis ground. (CAN LOW)

Specification : Discontinuity (Infinite Ω)

---

5) Is measured resistance within the specification?

YES

▶ Go to "3. Check short to battery in CAN BUS".

NO

▶ Repair short to ground in circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in CAN BUS

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) IG KEY "ON".

4) Measure the voltage of DLC terminal 3. (CAN HIGH)

5) Measure the voltage of DLC terminal 11. (CAN LOW)

Specification : 0.0V~0.1V

---

6) Is measured resistance within the specification with both connector disconnected?

YES

▶ Go to"4. Check CAN BUS continuity" as follows.

NO

▶ Repair short to battery and go to "Verification of Vehicle Repair".

4. Check CAN BUS continuity

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) Check continuity between DLC terminal 3 and CAN HIGH terminal of each module.
(CAN HIGH : ECM connector terminal 84, TCM connector terminal 38, multipurpose check connector terminal 9)

4) Check continuity between DLC terminal 11 and CAN LOW terminal of each module.
(CAN LOW : ECM connector terminal 83, TCM connector terminal 36, multipurpose check connector terminal 17)

Specification : Continuity(below 1.0Ω)

5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open in CAN BUS and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EB2BC521

1. Check CAN communication waveform generation

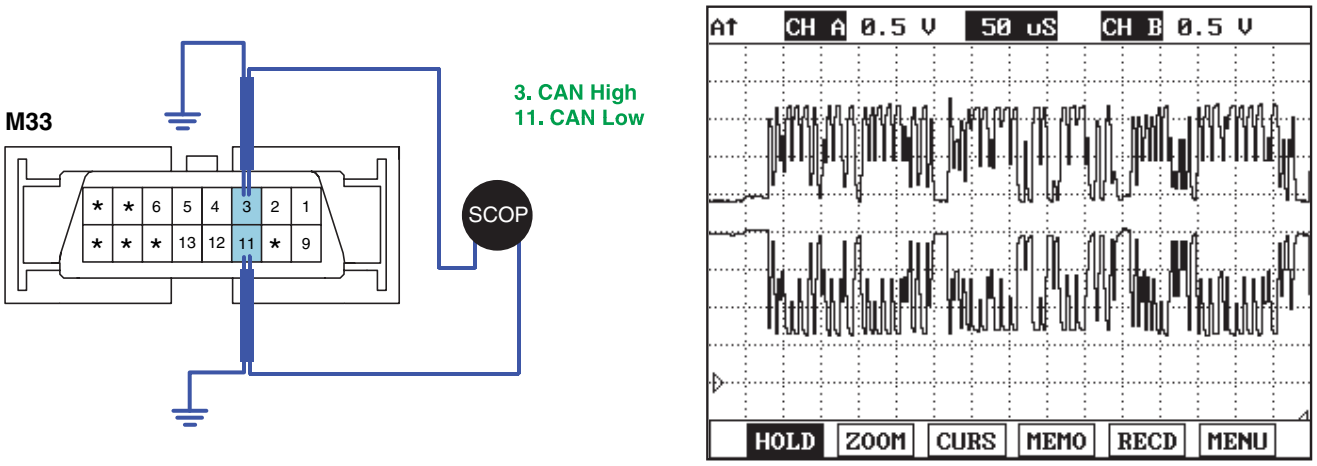
1) IG KEY "OFF", ENGINE "OFF".

2) Connect 2 channel scope to DLC terminal 3(CAN HIGH) and 11(CAN LOW).

3) IG KEY "ON" after connecting only ECM to CAN BUS.

4) IG KEY "ON" after connecting only TCM to CAN BUS.

Specification : At IG KEY "ON", the waveform same as "Signal Waveform & Data" of this code generates.
※ Different from "Signal Waveform & Data", if 1) both CAN HIGH and LOW signal are fixed at 2.5 V or
2) HIGH and LOW signal are fixed at 3.5 V and 1.5 V, respectively, it is due to communication error between modules.



EGNG014O

5) Does correct waveform generate from each module?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace the module which generates poor communication waveform, and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E52922D3

Refer to DTC U0001.

DTC U0101 SERIAL COMMUNICATION PROBLEM WITH TCU (TIMEOUT)

COMPONENT LOCATION E99076AA

Refer to DTC U0001.

GENERAL DESCRIPTION E9325B17

Refer to DTC U0001.

DTC DESCRIPTION E152F2B6

U0101 is set when ECM send data requiring signal to TCM, but no return signal is transmitted to ECM within 0.5 sec.. This code is due to TCM CAN line related problem or TCM module failure.

DTC DETECTING CONDITION E8DD8B33

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="6">• CAN BUS
• CAN communication module component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• CAN communication error between ECM and TCS1</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 500ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E5474A2C

Refer to DTC U0001.

SCHEMATIC DIAGRAM E7FF388C

Refer to DTC U0001.

SIGNAL WAVEFORM AND DATA ED2B5DA1

Refer to DTC U0001.

TERMINAL AND CONNECTOR INSPECTION E24A3CE3

Refer to DTC U0001.

SIGNAL CIRCUIT INSPECTION E036E3FA

1. Check CAN BUS resistance

    1) IG KEY "OFF", ENGINE "OFF".

2) Measure the resistance between diagnostic connector 3 and 11.

3) Disconnect ECM and TCM connector.

4) Measure the resistance between diagnostic connector 3 and 11.

Specification : Both ECM and TCM connected : 60 ± 3Ω (Test 1)
Both ECM and TCM disconnected : 120 ± 3Ω (Test 2)

---

5) Is CAN BUS resistance within the specification?

YES

▶ Go to "2.Check short to ground in CAN BUS" as follows.

NO

▶ Below 10Ω for both conditions(disconnected, connected) : Repair short between CAN BUS and go to "Verification of Vehicle Repair".
▶ 120Ω for both conditions(disconnected, connected) : Go to "4. Check CAN BUS continuity".
▶ Infinite Ω for both conditions(disconnected, connected) :Repair open in CAN communication circuit between DLC terminal and In-pannel junction box.

2. Check short to ground in CAN BUS

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) Check continuity between DLC terminal 3 and chassis ground. (CAN HIGH)

4) Check continuity between DLC terminal 11 and chassis ground. (CAN LOW)

Specification : Discontinuity (Infinite Ω)

---

5) Is measured resistance within the specification?

YES

▶ Go to "3. Check short to battery in CAN BUS".

NO

▶ Repair short to ground in circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in CAN BUS

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) IG KEY "ON".

4) Measure the voltage of DLC terminal 3. (CAN HIGH)

5) Measure the voltage of DLC terminal 11. (CAN LOW)

Specification : 0.0V~0.1V

---

6) Is measured resistance within the specification with both connector disconnected?

YES

▶ Go to"4. Check CAN BUS continuity" as follows.
▶ Repair short to battery and go to "Verification of Vehicle Repair".

4. Check CAN BUS continuity

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) Check continuity between DLC terminal 3 and CAN HIGH terminal of each module.
(CAN HIGH : ECM connector terminal 84, TCM connector terminal 38, multipurpose check connector terminal 9)

4) Check continuity between DLC terminal 11 and CAN LOW terminal of each module.
(CAN LOW : ECM connector terminal 83, TCM connector terminal 36, multipurpose check connector terminal 17)

Specification : Continuity(below 1.0Ω)

5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open in CAN BUS and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E1594324

1. Check CAN communication waveform generation

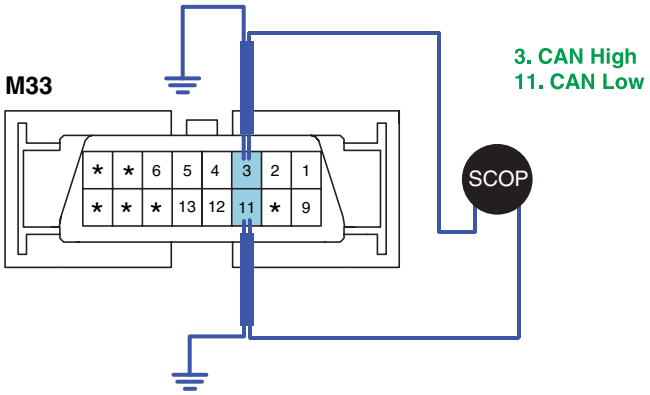
1) IG KEY "OFF", ENGINE "OFF".

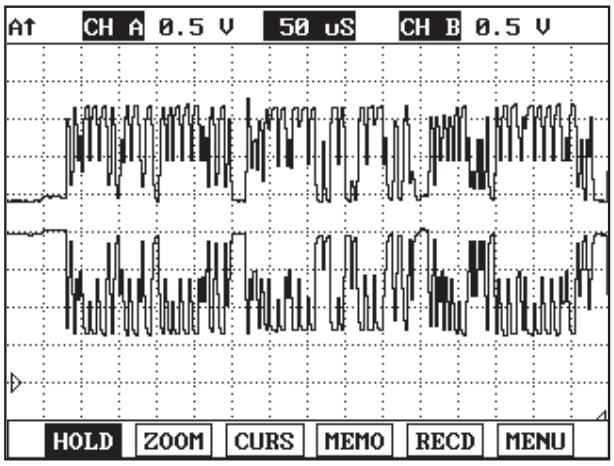
2) Connect 2 channel scope to DLC terminal 3(CAN HIGH) and 11(CAN LOW).

3) IG KEY "ON" after connecting only ECM to CAN BUS.

4) IG KEY "ON" after connecting only TCM to CAN BUS.

Specification : At IG KEY "ON", the waveform same as "Signal Waveform & Data" of this code generates.
※ Different from "Signal Waveform & Data", if 1) both CAN HIGH and LOW signal are fixed at 2.5 V or 2) HIGH and LOW signal are fixed at 3.5 V and 1.5 V, respectively, it is due to communication error between modules.





EGNG014O

5) Does correct waveform generate from each module?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace the module which generates poor communication waveform, and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR E4790900

Refer to DTC U0001.

DTC U0122 ECM-TCS CAN ERROR

COMPONENT LOCATION EFEA188C

Refer to DTC U0001.

GENERAL DESCRIPTION E6CC34AA

Refer to DTC U0001.

DTC DESCRIPTION E1C72893

U0122 is set when ECM sends data requiring signal to TCS, but no return signal is transmitted to ECM by within 0.5 sec.. This code is due to TCS CAN line related problem or TCS module failure.

DTC DETECTING CONDITION E2F94D50

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="6">• CAN BUS
• CAN communication module component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• CAN communication error between ECM and TCS1</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 500ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E695251B

Refer to DTC U0001.

SCHEMATIC DIAGRAM EAD37234

Refer to DTC U0001.

SIGNAL WAVEFORM AND DATA E873CD80

Refer to DTC U0001.

TERMINAL AND CONNECTOR INSPECTION E0B5A0A5

Refer to DTC U0001.

SIGNAL CIRCUIT INSPECTION EC9F6063

1. Check CAN BUS resistance

    1) IG KEY "OFF", ENGINE "OFF".

2) Measure the resistance between diagnostic connector 3 and 11.

3) Disconnect ECM and TCM connector.

4) Measure the resistance between diagnostic connector 3 and 11.

Specification : Both ECM and TCM connected : 60 ± 3Ω (Test 1)
Both ECM and TCM disconnected : 120 ± 3Ω (Test 2)

---

5) Is CAN BUS resistance within the specification?

YES

▶ Go to "2.Check short to ground in CAN BUS" as follows.

NO

▶ Below 10Ω for both conditions(disconnected, connected) : Repair short between CAN BUS and go to "Verification of Vehicle Repair".
▶ 120Ω for both conditions(disconnected, connected) : Go to "4. Check CAN BUS continuity".
▶ Infinite Ω for both conditions(disconnected, connected) :Repair open in CAN communication circuit between DLC terminal and In-pannel junction box.

2. Check short to ground in CAN BUS

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) Check continuity between DLC terminal 3 and chassis ground. (CAN HIGH)

4) Check continuity between DLC terminal 11 and chassis ground. (CAN LOW)

Specification : Discontinuity (Infinite Ω)

---

5) Is measured resistance within the specification?

YES

▶ Go to "3. Check short to battery in CAN BUS".

NO

▶ Repair short to ground in circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in CAN BUS

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) IG KEY "ON".

4) Measure the voltage of DLC terminal 3. (CAN HIGH)

5) Measure the voltage of DLC terminal 11. (CAN LOW)

Specification : 0.0V~0.1V

---

6) Is measured resistance within the specification with both connector disconnected?

YES

▶ Go to"4. Check CAN BUS continuity" as follows.

NO

▶ Repair short to battery and go to "Verification of Vehicle Repair".

4. Check CAN BUS continuity

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) Check continuity between DLC terminal 3 and CAN HIGH terminal of each module.
(CAN HIGH : ECM connector terminal 84, TCM connector terminal 38, multipurpose check connector terminal 9)

4) Check continuity between DLC terminal 11 and CAN LOW terminal of each module.
(CAN LOW : ECM connector terminal 83, TCM connector terminal 36, multipurpose check connector terminal 17)

Specification : Continuity(below 1.0Ω)

5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open in CAN BUS and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION EAED94D7

1. Check CAN communication waveform generation

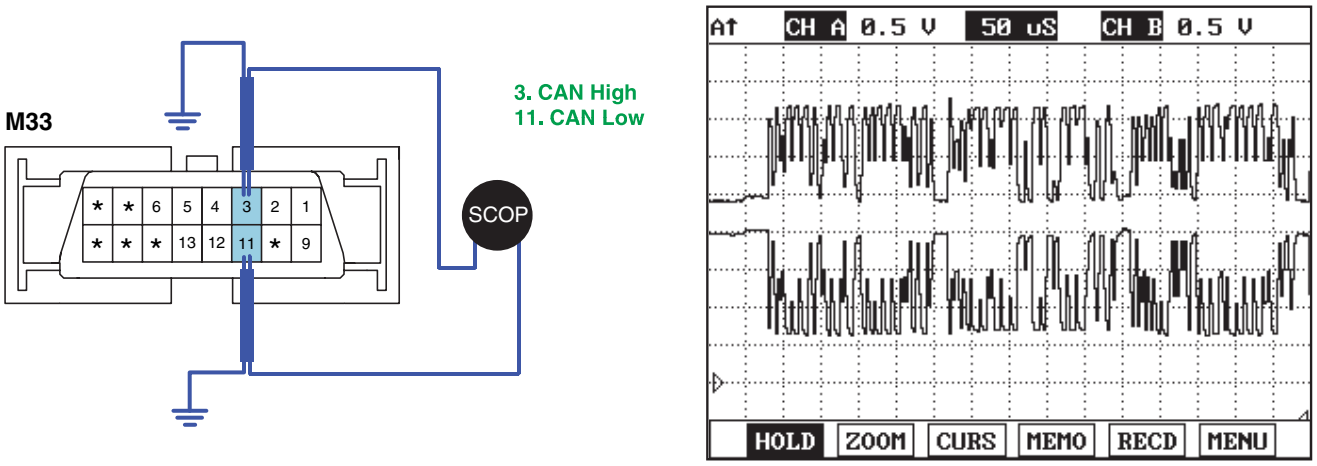
1) IG KEY "OFF", ENGINE "OFF".

2) Connect 2 channel scope to DLC terminal 3(CAN HIGH) and 11(CAN LOW).

3) IG KEY "ON" after connecting only ECM to CAN BUS.

4) IG KEY "ON" after connecting only TCM to CAN BUS.

Specification : At IG KEY "ON", the waveform same as "Signal Waveform & Data" of this code generates.
※ Different from "Signal Waveform & Data", if 1) both CAN HIGH and LOW signal are fixed at 2.5 V or
2) HIGH and LOW signal are fixed at 3.5 V and 1.5 V, respectively, it is due to communication error between modules.



EGNG014O

5) Does correct waveform generate from each module?

YES

▶ Go to "Verification of Vehicle Repair".

NO

▶ Replace the module which generates poor communication waveform, and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EC7FF184

Refer to DTC U0001.

DTC U0416 ABNORMAL TORQUE RISE REQUEST FROM TCS

COMPONENT LOCATION E1E45164

Refer to DTC U0001.

GENERAL DESCRIPTION E8725B43

Refer to DTC U0001.

DTC DESCRIPTION E8F8BA26

U0416 is set when ECM detects the signal requires abnormal torque increase from ECM for more than 0.5 sec. Checking CAN communication line or TCS module is required.

DTC DETECTING CONDITION E51E4243

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Signal monitoring</td><td rowspan="8">• CAN BUS
• CAN communication module component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG KEY "ON"</td></tr>
<tr><td>ThresholdValue</td><td colspan="3">• Abnormal torque increase request from TCS</td></tr>
<tr><td>DiagnosticTime</td><td colspan="3">• 500ms</td></tr>
<tr><td rowspan="4">Fail Safe</td><td>Fuel Cut</td><td>NO</td><td rowspan="4"></td></tr>
<tr><td>EGR Off</td><td>NO</td></tr>
<tr><td>Fuel Limit</td><td>NO</td></tr>
<tr><td>MIL</td><td>NO</td></tr>
</table>

SPECIFICATION E1F441BD

Refer to DTC U0001.

SCHEMATIC DIAGRAM EBBB1352

Refer to DTC U0001.

SIGNAL WAVEFORM AND DATA ED84237A

Refer to DTC U0001.

TERMINAL AND CONNECTOR INSPECTION E185AF2E

Refer to DTC U0001.

SIGNAL CIRCUIT INSPECTION E64BDF9F

1. Check CAN BUS resistance

    1) IG KEY "OFF", ENGINE "OFF".

2) Measure the resistance between diagnostic connector 3 and 11.

3) Disconnect ECM and TCM connector.

4) Measure the resistance between diagnostic connector 3 and 11.

Specification : Both ECM and TCM connected : 60 ± 3Ω (Test 1)
Both ECM and TCM disconnected : 120 ± 3Ω (Test 2)

---

5) Is CAN BUS resistance within the specification?

YES

▶ Go to "2.Check short to ground in CAN BUS" as follows.

NO

▶ Below 10Ω for both conditions(disconnected, connected) : Repair short between CAN BUS and go to "Verification of Vehicle Repair".
▶ 120Ω for both conditions(disconnected, connected) : Go to "4. Check CAN BUS continuity".
▶ Infinite Ω for both conditions(disconnected, connected) :Repair open in CAN communication circuit between DLC terminal and In-pannel junction box.

2. Check short to ground in CAN BUS

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) Check continuity between DLC terminal 3 and chassis ground. (CAN HIGH)

4) Check continuity between DLC terminal 11 and chassis ground. (CAN LOW)

Specification : Discontinuity (Infinite Ω)

---

5) Is measured resistance within the specification?

YES

▶ Go to "3. Check short to battery in CAN BUS".

NO

▶ Repair short to ground in circuit and go to "Verification of Vehicle Repair".

3. Check short to battery in CAN BUS

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) IG KEY "ON".

4) Measure the voltage of DLC terminal 3. (CAN HIGH)

5) Measure the voltage of DLC terminal 11. (CAN LOW)

Specification : 0.0V~0.1V

---

6) Is measured resistance within the specification with both connector disconnected?

YES

▶ Go to"4. Check CAN BUS continuity" as follows.

NO

▶ Repair short to battery and go to "Verification of Vehicle Repair".

4. Check CAN BUS continuity

1) IG KEY "OFF", ENGINE "OFF".

2) Disconnect ECM and TCM connectors.

3) Check continuity between DLC terminal 3 and CAN HIGH terminal of each module.
(CAN HIGH : ECM connector terminal 84, TCM connector terminal 38, multipurpose check connector terminal 9)

4) Check continuity between DLC terminal 11 and CAN LOW terminal of each module.
(CAN LOW : ECM connector terminal 83, TCM connector terminal 36, multipurpose check connector terminal 17)

Specification : Continuity(below 1.0Ω)

5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ Repair open in CAN BUS and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION E721796F

1. Check CAN communication waveform generation

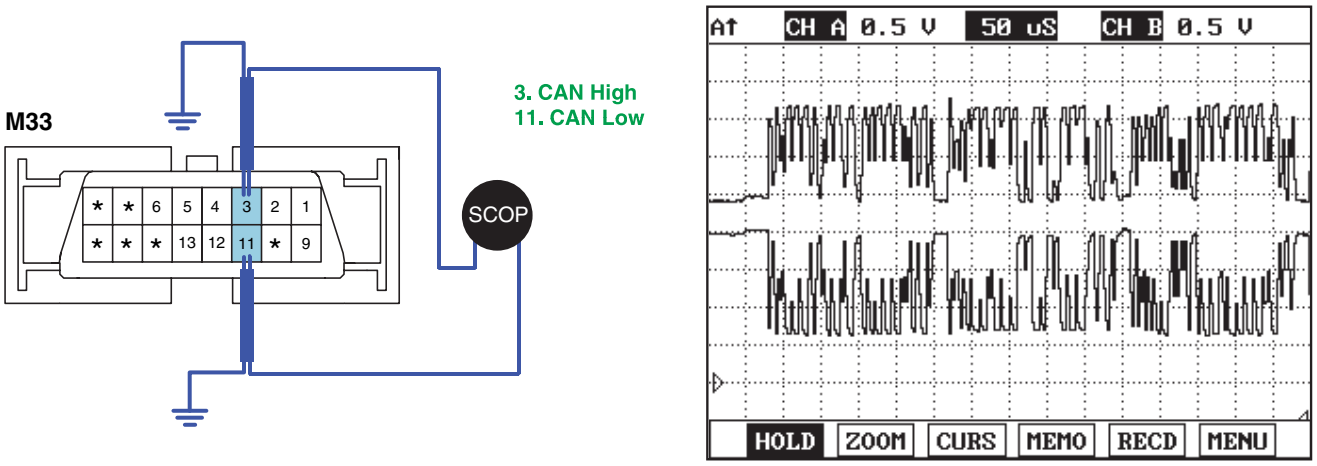
1) IG KEY "OFF", ENGINE "OFF".

2) Connect 2 channel scope to DLC terminal 3(CAN HIGH) and 11(CAN LOW).

3) IG KEY "ON" after connecting only ECM to CAN BUS.

4) IG KEY "ON" after connecting only TCM to CAN BUS.

Specification : At IG KEY "ON", the waveform same as "Signal Waveform & Data" of this code generates.
※ Different from "Signal Waveform & Data", if 1) both CAN HIGH and LOW signal are fixed at 2.5 V or
2) HIGH and LOW signal are fixed at 3.5 V and 1.5 V, respectively, it is due to communication error between modules.



EGNG014O

5) Does correct waveform generate from each module?

YES

▶ Go to "Verification of Vehicle Repair".

NO

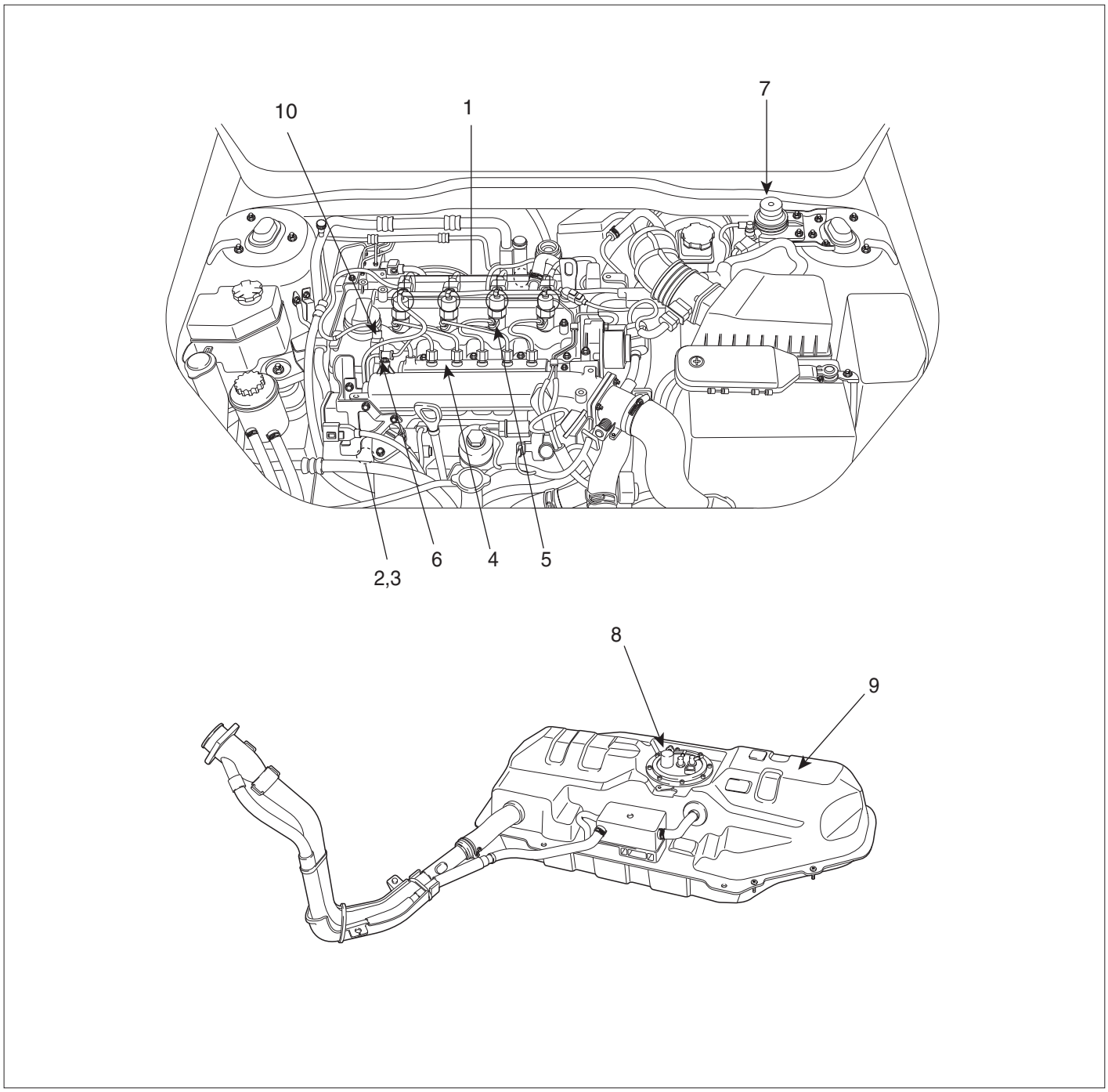
▶ Replace the module which generates poor communication waveform, and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR EC15AE39

Refer to DTC U0001.

FUEL DELIVERY SYSTEM-DIESEL

COMPONENTS LOCATION EDAE0FBF



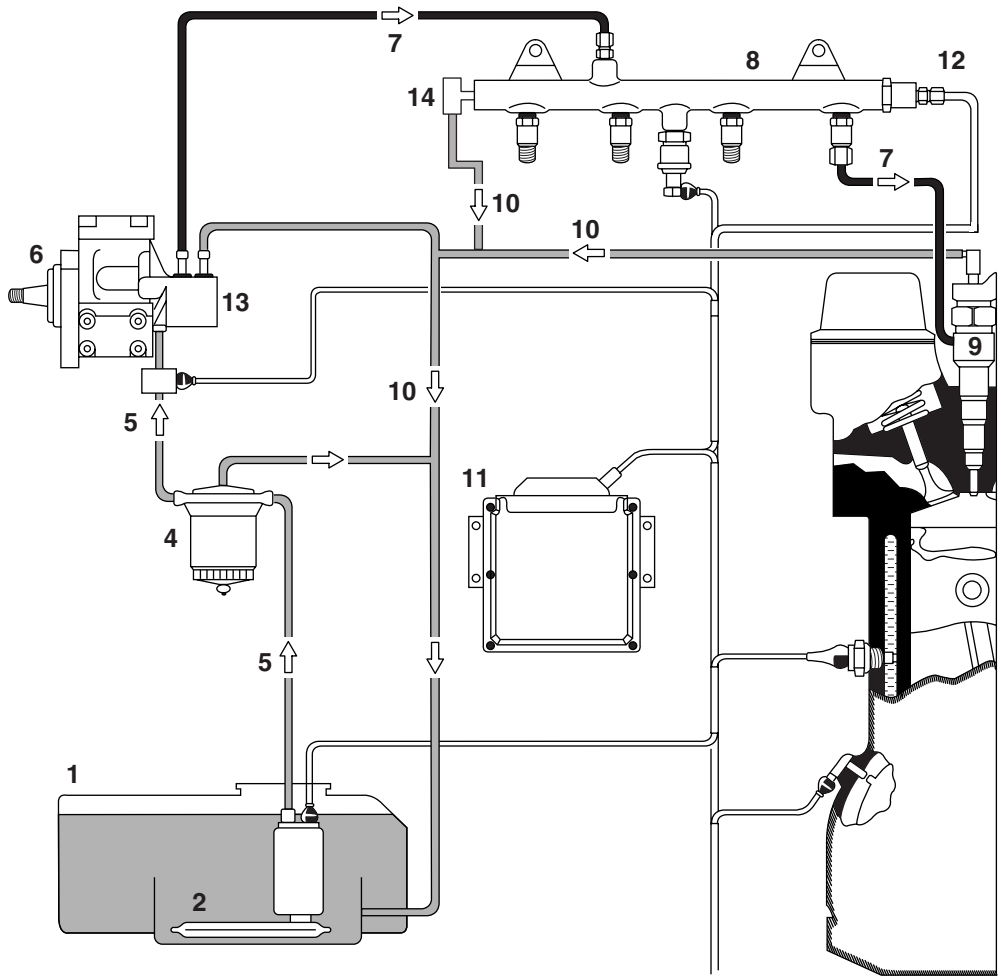
1. Injector
2. High Pressure (HP) Pump
3. Fuel pressure regulator
4. Common rail
5. High pressure pipe (injector ← Common rail)
6. High pressure pipe (common rail ← HP pump)
7. Fuel filter
8. Fuel sender
9. Fuel tank
10. Rail pressure control valve

LGJF502M

CAUTION

- ***Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)***
- ***Never perform any work on injection system wth engine running or within 30 seconds after the engine stops.***
- ***Always pay attention to safety precaution.***
- ***Ensure the absolute cleanliness.***
- ***It is not recommanded to remove the injectors without any notice.***

SCHEMATIC DIAGRAM E351CCC3



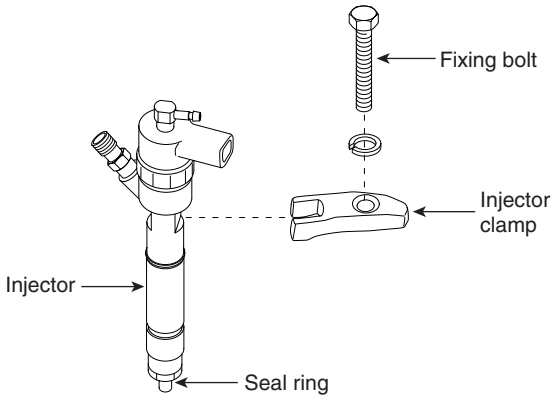
1. Fuel Tank
2. Pre-filter
3. Fuel sender
4. Fuel Filter
5. Low Pressure Fuel Line
6. High Pressure Pump
7. High Pressure Fuel Line
8. Common Rail
9. Injector
10. Fuel Return Line
11. ECM
12. Rail Pressure Sensor
13. Rail Pressure regulator
14. Rail Pressure control valve

LGJF502N

INJECTOR

DESCIRPTION E5AC9A70

COMPONENTS



LGJF502O

CLEANING E6AAA9D1

CAUTION

- ***Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)***
- ***Never perform any work on injection system wth engine running or within 30 seconds after the engine stops.***
- ***Always pay attention to safety precaution.***
- ***Ensure the absolute cleanliness.***
- ***It is not recommanded to remove the injectors without any notice.***

It must be needed to clean the injector when injector is used again.

1. Clean the injector in vertical position in an ultra-sound bath.

2. If necessary, clean the injector body and sealing surface on the nozzle retaining nut also, using a fine cleaning cloth to remove any dirt residue.
   Do not remove the protection caps to do that.

3. The nozzle-shaft must only be cleaned in an ultra-sound bath and in a vertical position.
   A mechanical cleaning of the nozzle-shaft by wire-brush is not permitted.

REMOVAL E1F7B278

CAUTION

- ***Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)***
- ***Never perform any work on injection system with engine running or within 30 seconds after the engine stops.***
- ***Always pay attention to safety precaution.***
- ***Ensure the absolute cleanliness.***
- ***It is not recommended to remove the injectors without any notice.***

1. Turn ignition switch to OFF position.

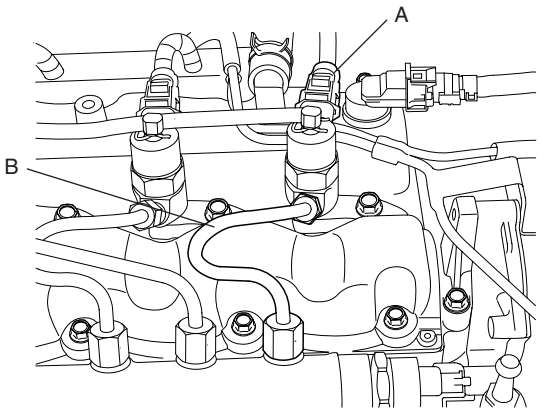
2. Disconnect the negative battery (-) terminal and wait for about 30 seconds.

3. Pull off the injector electric connector (A).

CAUTION

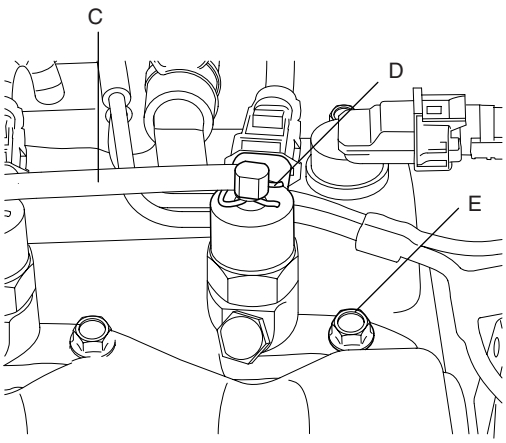
- ***Plugs must be installed and/or uninstalled only with the ignition switch turned OFF.***
- ***Do not extremely bend or squeeze the cable, do not bring them in contact with sharp edges, and also secure cables against vibrations.***

4. Unfasten the high-pressure pipe (B) connecting the common rail and the injector.



LXGF570A

5. Remove the injector return hose (C) by pulling the fixing-clip (D) and unscrew the injector fixing bolt(E).



LGJF502P

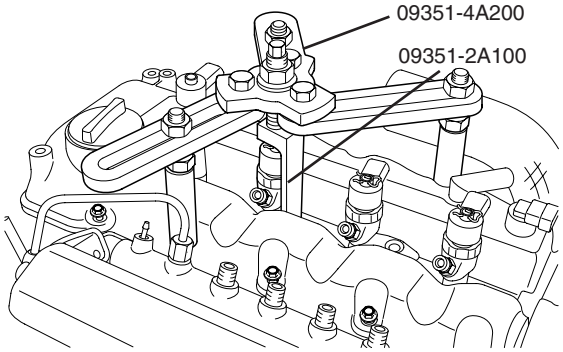
6. Pull the injector assembly.

CAUTION

When pulling the injector, pull the injector upright so that the nozzle needle cannot be scratched or damaged.

NOTE

When the injector is stuck on cylinder head, pull it out with SST (09351-4A200, 09351-2A100).



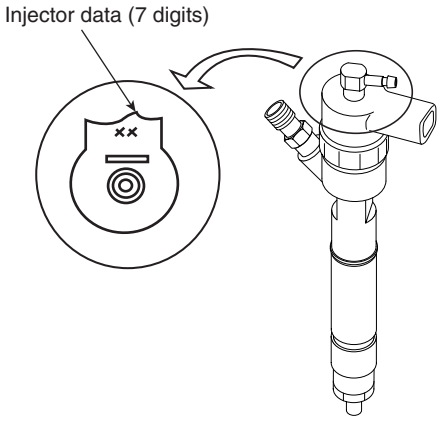
AWJF333Z

REPLACEMENT E9B09C6E

CAUTION

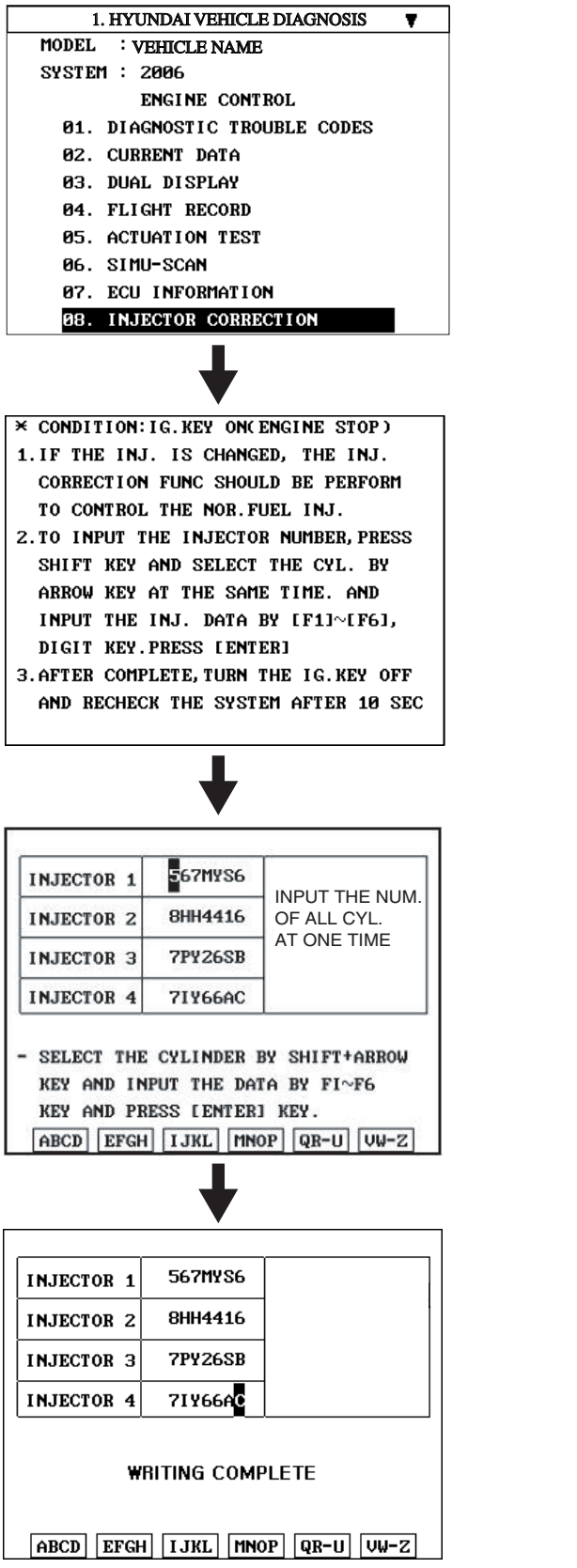
When exchanging injectors be sure to input injector data(7 digits) of new one into the ECM using a Hi-Scan(Pro).

1. Remove the injector according to removal procedure.
2. Check the class of injector, and then replace the used injector with the new one.
3. Check injector data (7 digits) of new injector.



LGJF502Q

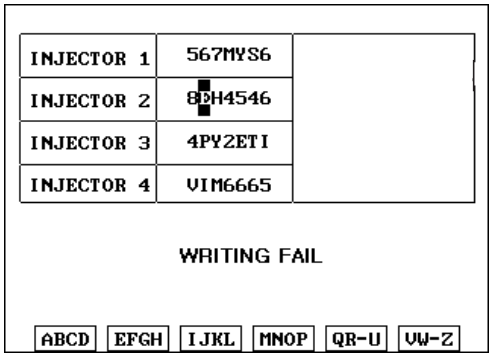
4. Using Hi-Scan(Pro), input the injector data(7 digits) into ECM as next procedure.



EGNG102A

CAUTION

1. ***When displaying "WRITING FAIL" ON Hi-scan(Pro), input injector data (7digits) of each cylinder into a new ECM again as priow procedure.***



LGJF502A

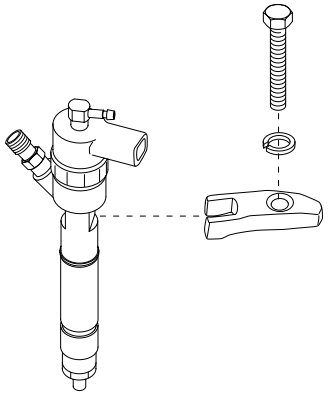
2. ***If the glow lamp is flashed and DTC P1586 is detected ignition switch ON, take proper steps refering to "P1586 DTC Troubleshooting procedure".***

INSTALLATION EE11EE7A

CAUTION

- ***Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)***
- ***Never perform any work on injection system with engine running or within 30 seconds after the engine stops.***
- ***Always pay attention to safety precaution.***
- ***Ensure the absolute cleanliness.***
- ***It is not recommended to remove the injectors without any notice.***

1. Insert the new seal ring.



LXGF573A

CAUTION

- ***Whenever using the used injector again, the clamp fixing bolt and seal-ring are replaced with a new one.***
- ***Before re-installing injector, clean the cylinder head bore and sealing surface.***

2. Insert the injector assembly into the cylinder block.

CAUTION

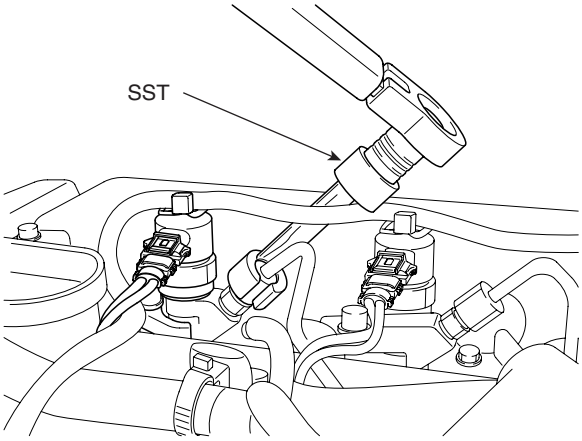
Do not touch the nozzle tip.

3. Spread oil on the injector tip and the cylinder head.

4. Install the injector by installing the clamp with clamp bolt

Tightening Torques (Injector Clamp Bolt installation): 27.5 ~ 29.4 N·m (20.3 ~ 21.7 lbf·ft)

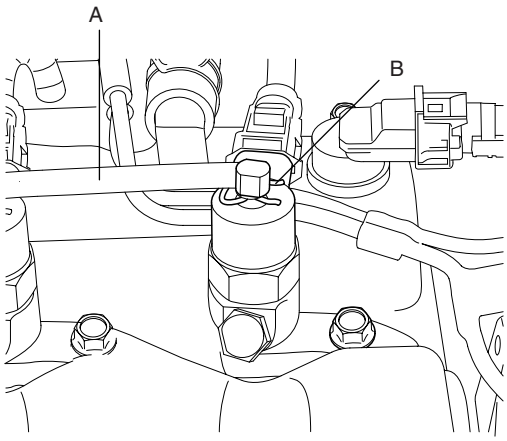
5. After screwing thr high pressure pipe installation nuts by hand, tighten them at accurate torque using special service tools (09354-27110, 09314-27130).



LGJF502R

Tightening Torque (High Pressure Pipe installation nut): 24.5 ~ 28.4 N·m (18.1 ~ 21.0 lbf·ft)

6. Connect the return hose (A) by inserting the fixing clip (B).

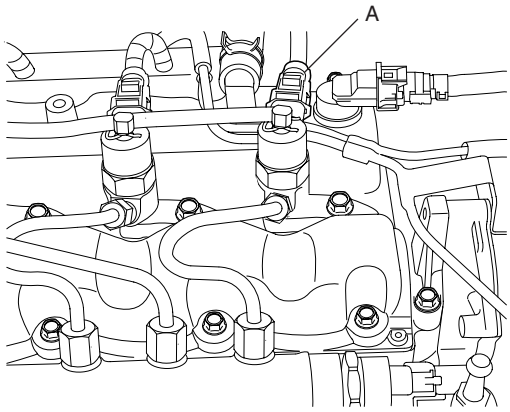


LXGF571A

CAUTION

Do not reuse a fixing clip.

7. Connect the injector electric connector (A).



LXGF570C

8. Connect the battery (-) cable.

9. Start the engine and check for leakage on high pressure fuel line.

CAUTION

Check the fuel-system visually for any leakage. If a leakage is detected even have been used the correct torque, the component(s) must be exchanged.

INSPECTION E0952E37

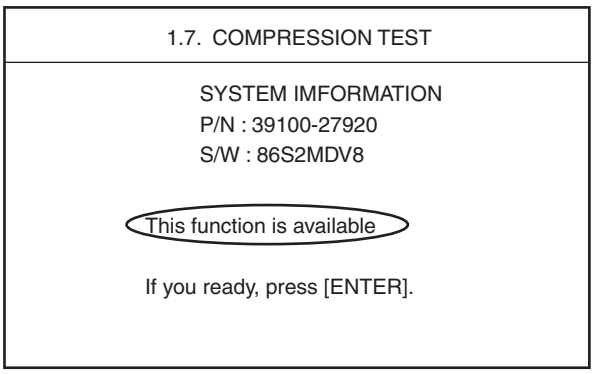
USING HI-SCAN(PRO)

- COMPRESSION TEST
- IDLE SPEED COMPARISON
- INJECT QUANTITY COMPARISON

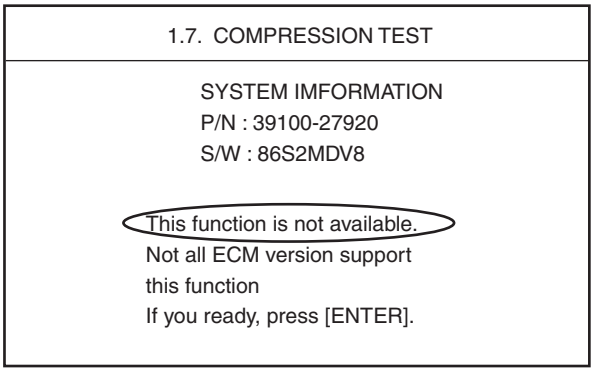
TEST PROCEDURE

1. Connect Hi-Scan(Pro) and select "Vehicle" and "Engine Test Function".

2. Information for ECM version is displayed as below.



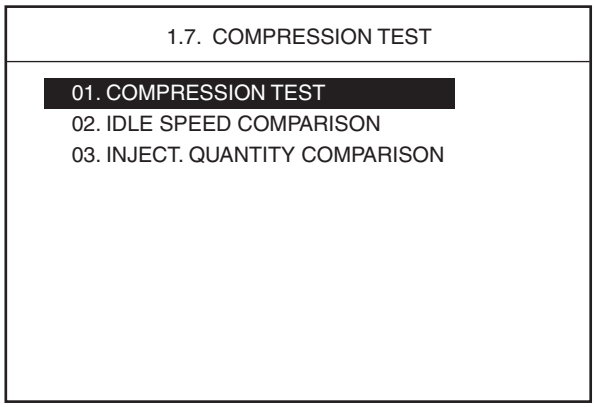
<Available system>



<Not available system>

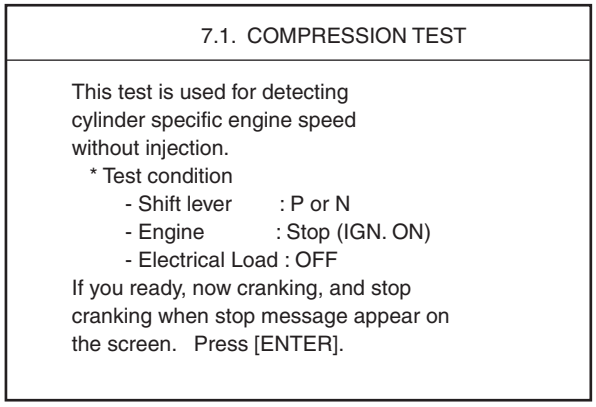
LXGF577A

3. After pressing "[ENTER]", select "COMPRESSION TEST" mode and press "[ENTER]".



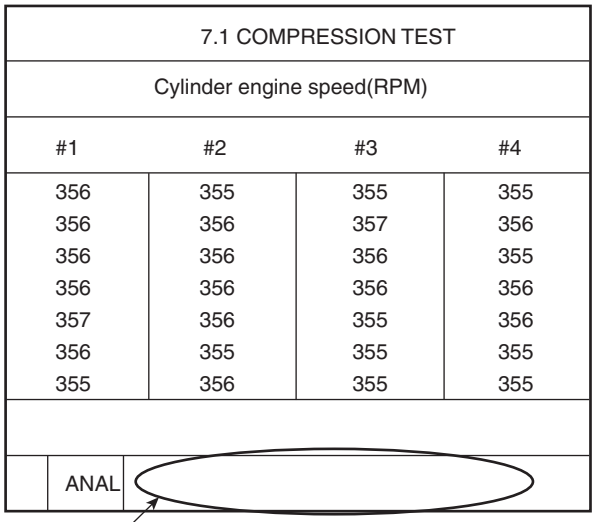
LFIF660D

4. Set the test condition described as below screen and then, crank engine. When engine stop message being appeared, stop cranking.



LFIF660E

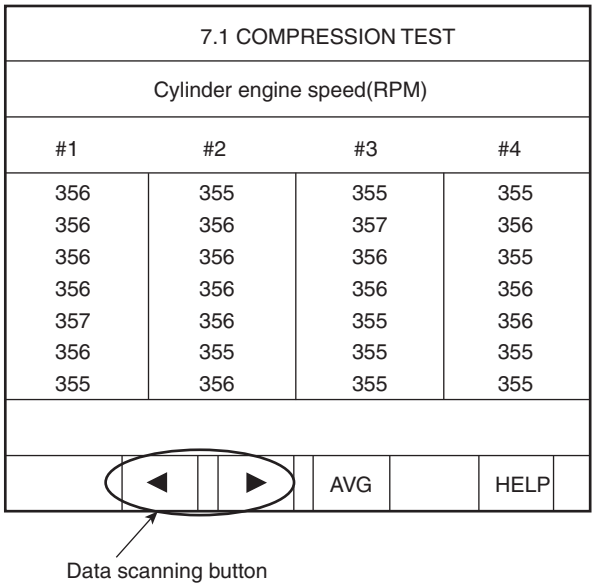
5. Press "ANAL" and the test result is appeared.



LFIF660F

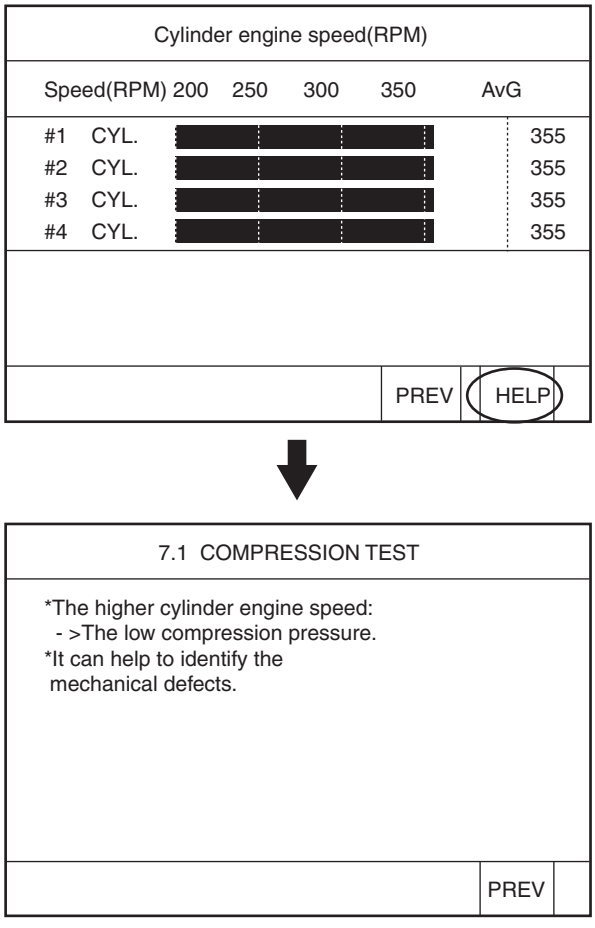
NOTE

During cranking engine does not start.



LFIF660G

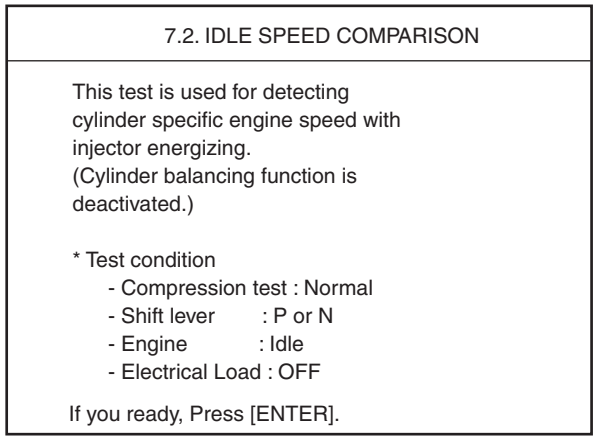
6. Press "AVG" and the data average of each cylinder is appeared.
   Press "HELP" and description of the data is appeared.



LFIF660H

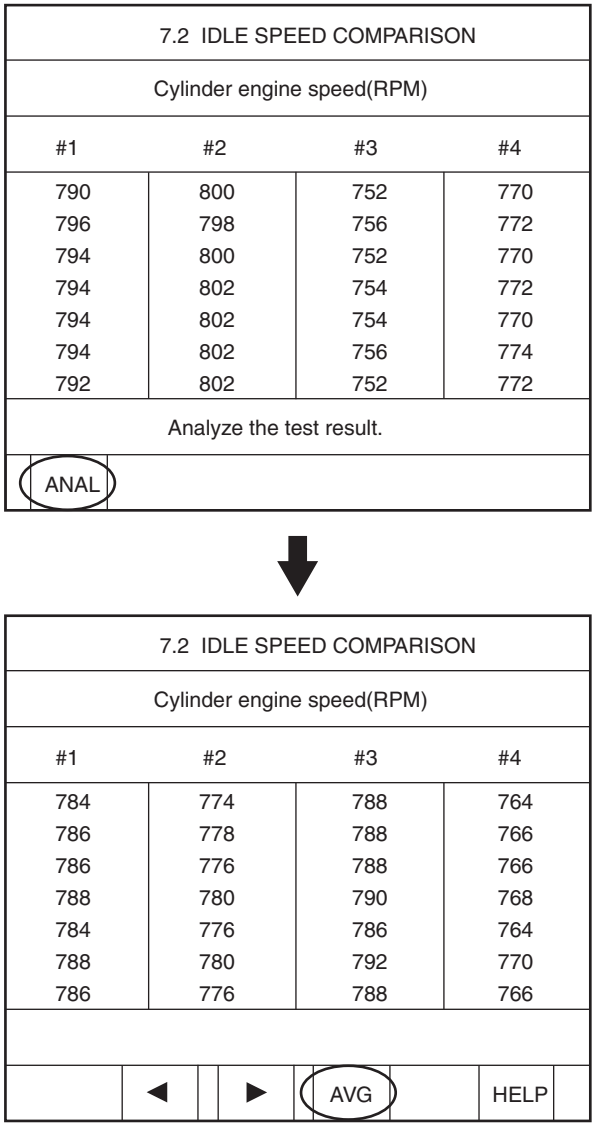
7. After pressing "ESC", select "IDLE SPEED COMPARISON" and press "[ENTER]".

8. Set the test condition described as below screen and press "[ENTER]".



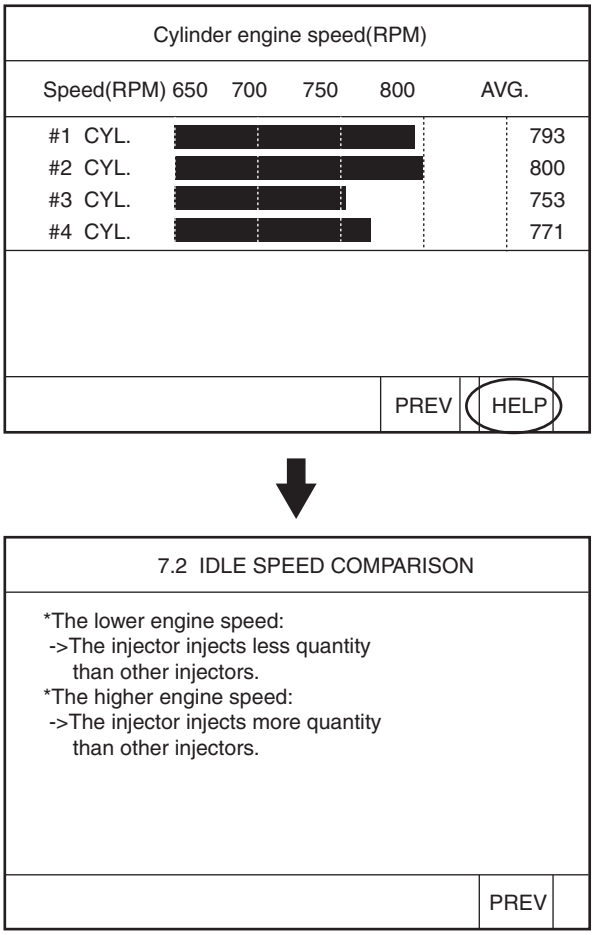
LFIF660J

9. The rpm data of each cylinder is appeared.



LFIF660K

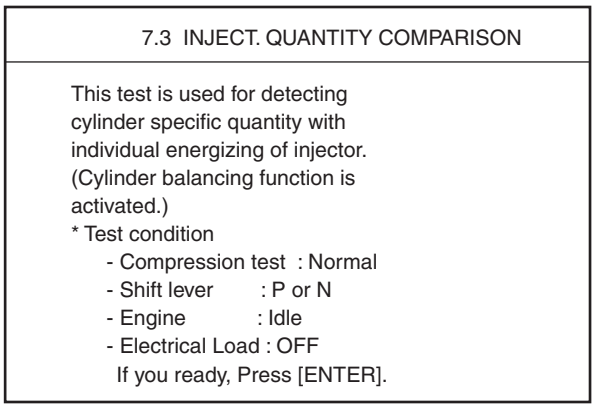
10. Press "AVG" and the data average of each cylinder is appeared.
    Press "HELP" and description of the data is appeared.



LFIF660M

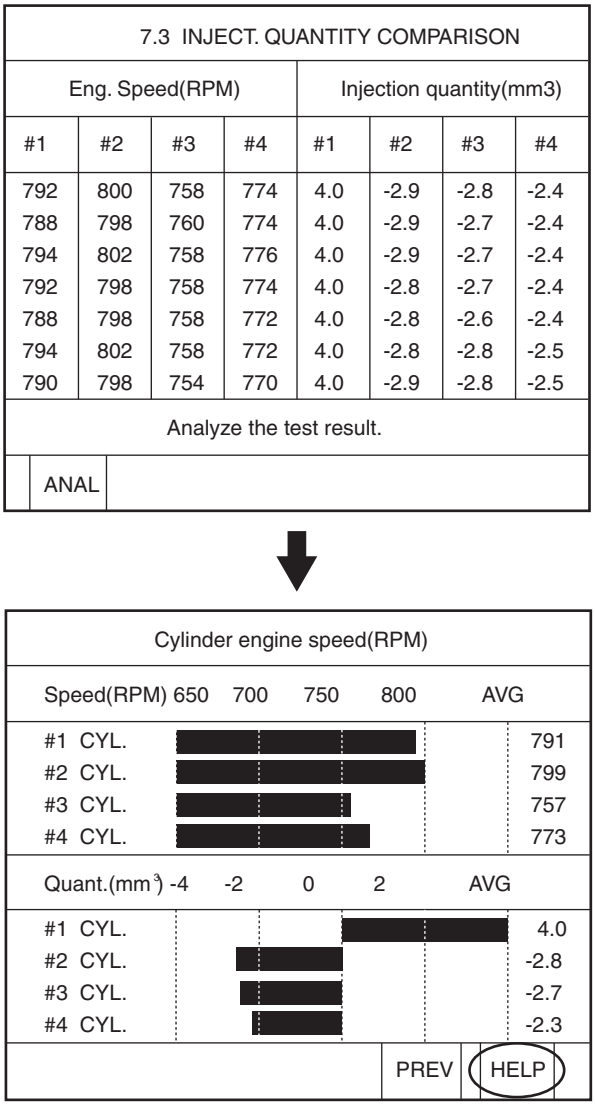
11. After pressing "ESC", select "INJECTOR QUANTITY COMPARISON" and press "[ENTER]".

12. Set the test condition described as below screen and press "[ENTER]".



LFIF660O

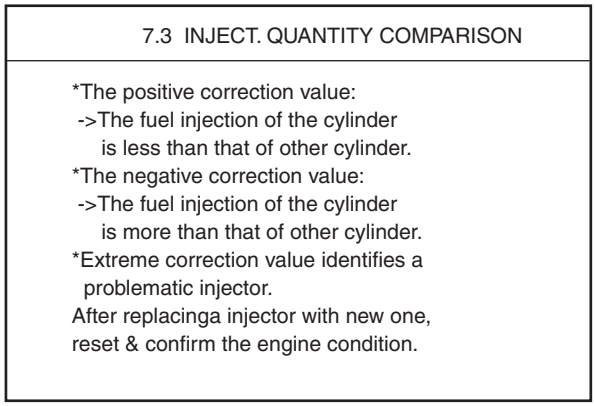
13. The data od each cylinder about RPM and compensating injection quantity is appeared.



<Abnormal state>

LFIF660P

14. Press "HELP" and description of the data is displayed as below.



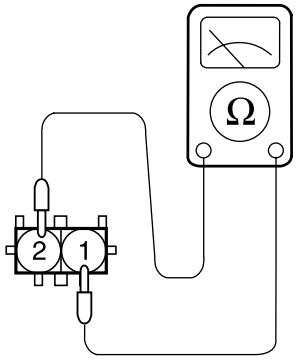
LFIF660R

15. Replace the default injector, and then repeat previous test modes to check if the injector is normal.

COMPONENT INSPECTION

1. Turn ignition switch "OFF".
2. Disconnect injector connector.
3. Measure resistance between the terminals 1 and 2 of injector connector.

Resistance : 0.22 ~ 0.30Ω (20 ~ 70℃)



LFAC220F

COMMON RAIL

DESCRIPTION ED51BCCF

The common rail stores the fuel at high pressure. At the same time, the pressure oscillations which are generated due to the high-pressure pump delivery and the injection of fuel are damped by the rail volume. This common rail is common to all cylinders, hence its name ""common rail"". Even when large quantities of fuel are extracted, the common rail maintains its inner pressure practically constant. This ensures that the injection pressure remains constant from the moment the injector opens.

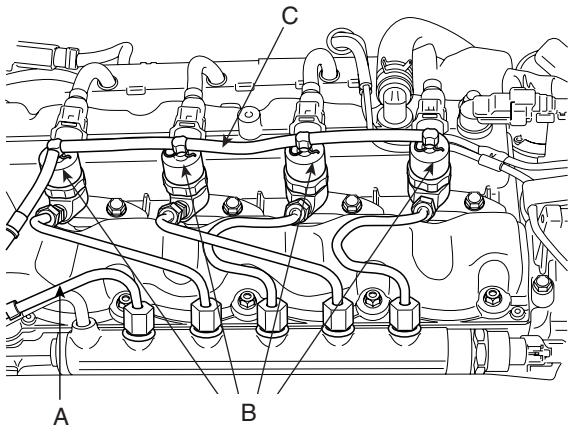
In order to comply with the wide variety of engine installation conditions, the common rail with its flow limiters and the provisions for attaching rail pressure sensor, fuel pressure control valve, and pressure limiter valve is available in a number of different designs.
The available common rail volume is permanently filled with pressurized fuel. The compressibility of the fuel resulting from the high pressure is utilized to achieve the accumulator effect. When fuel leaves the rail for injection, the pressure in the common rail remains practically constant. Similarly, the pressure variations resulting from the pulsating fuel supply from the high-pressure pump are compensated for.

REMOVAL E0BBB382

CAUTION

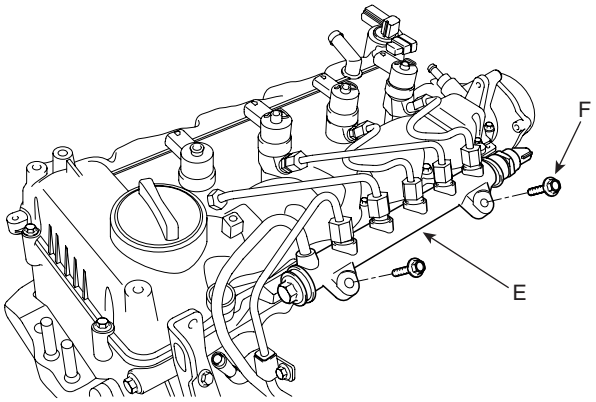
- ***Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)***
- ***Never perform any work on injection system with engine running or within 30 seconds after the engine stops.***
- ***Always pay attention to safety precaution.***
- ***Ensure the absolute cleanliness.***
- ***It is not recommended to remove the injectors without any notice.***

1. urn ignition switch to OFF position.
2. Disconnect the negative battery (-) terminal and wait for about 30 seconds.
3. Remove the high pressure pipe (A) connecting injectors and common rail.
4. Remove the high pressure pipe (B) connecting high pressure pump and common rail.
5. Disconnect the return lines (C).



LGJF502S

6. Disconnect rail pressure sensor and rail pressure control valve connectors.
7. Remove intake manifold. (Refer to "EM" group)
8. Remove the common rail (E) by unscrewing the two mounting bolts (F).

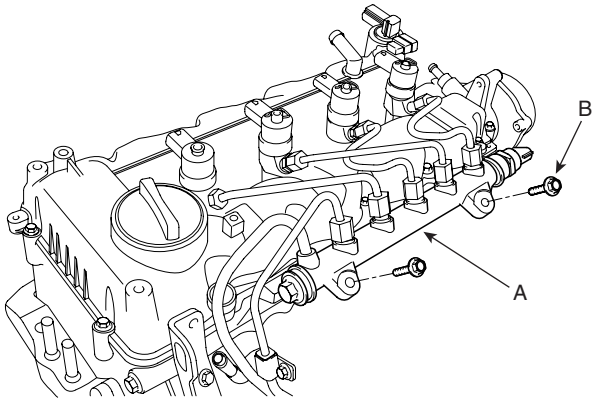


LGJF502T

INSTALLATION EED527BE

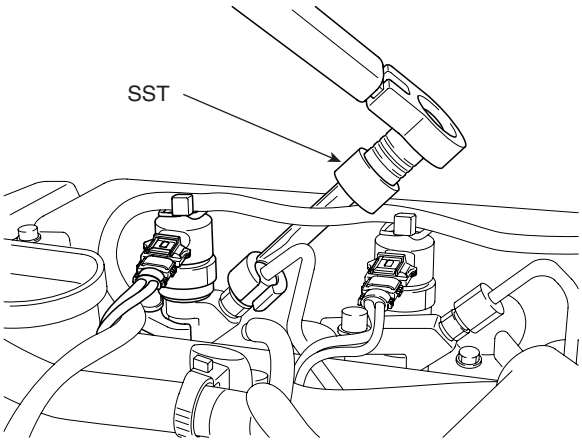
1. Install the common rail(A) with two mounting bolts(B).

Tightening Torque : 14.7 ~ 21.6 N·m (10.9 ~ 15.9 lbf·ft)



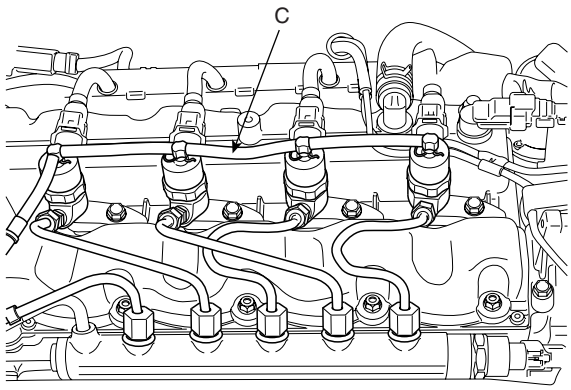
LGJF502U

2. Install the intake manifold. (Refer to "EM" group).
3. Connect rail pressure sensor and rail pressure control valve connectors.
4. After screwing the high pressure pipe installation nuts by hand, tighten them at accutate torque using special service tools(09314-27110, 09314-27130).



LGJF502R

5. Connect return line(C).



AFGF301P

6. Connect the negative battery(-) terminal.
7. Start the engine and check for leakage on fuel line.

HIGH PRESSURE FUEL PUMP

DESCRIPTION EDBA1EB7

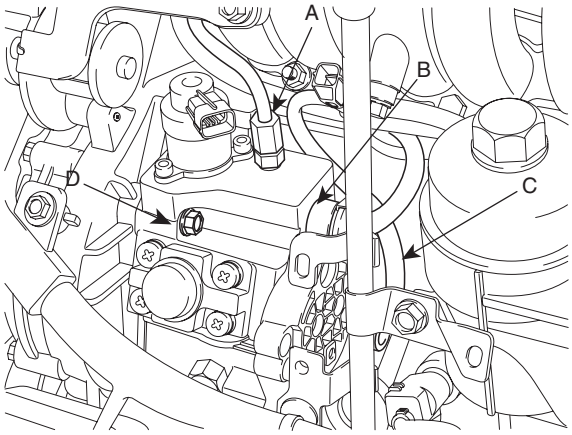
The high-pressure pump is the interface between the low-pressure and the high-pressure stages. Under all operating conditions, it is responsible for providing adequate high-pressure fuel through out the vehicle's complete service life. This also includes the provision of extra fuel as needed for rapid starting and for rapid build-up of pressure in the rail. The high pressure pump continually generates the system pressure as needed in the high-pressure accumulator (common rail). This means therefore, that in contrast to conventional systems, the fuel does not have to be specially compressed for each individual injection process.

REMOVAL EC6BC786

CAUTION

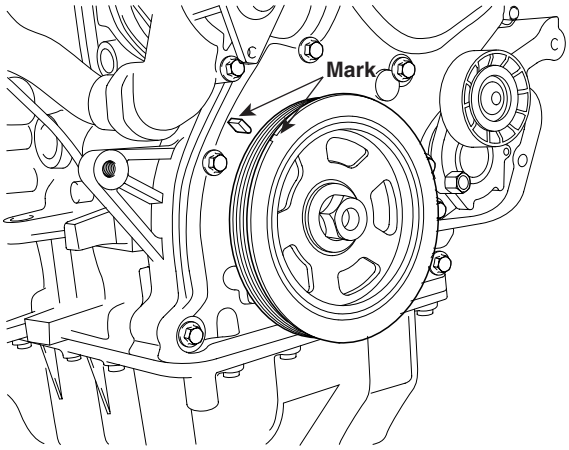
- ***Common Rail Fuel Injection System is subject to extremely high pressure(Approximately 1,600 bar)***
- ***Never perform any work on injection system with engine running or within 30 seconds after the engine stops.***
- ***Always pay attention to safety precaution.***
- ***Ensure the absolute cleanliness***
- ***It is not recommended to remove the injectiors without any notice.***

1. Turn ignition switch OFF position.
2. Disconnect the negative battery(-) terminal and wait for about 30 seconds.
3. Disconnect the wiring connector of fuel pressure regulator.
4. Remove the high pressure pipe (A) connecting high pressure pump and common rail.



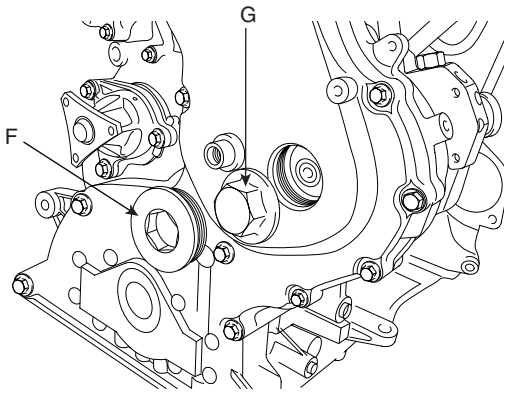
LGJF503E

5. Disconnect the return hose(B) and the hose(C) connecting to the fuel filter.
6. Unscrew the three high pressure mounting bolts(D).
7. Remove the drive belt.(Refer to "EM" group.)
8. Turn the crankshaft pulley and align its groove with timing mark "T" of the timing chain cover.
   (NO.1 cylinder compression TDC position.)



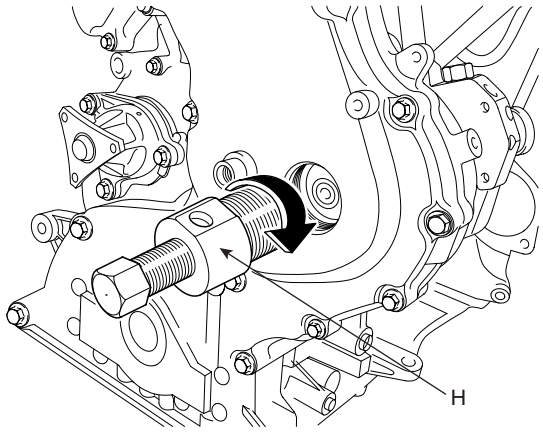
LCGF089A

9. Remove the high pressure pump sprocket nut(G) after removing the timing chain cover plug(F).



LGJF502W

10. Install the high pressure pump sprocket stopper(H) (SST: 09331-2A000) rotating it clockwise.

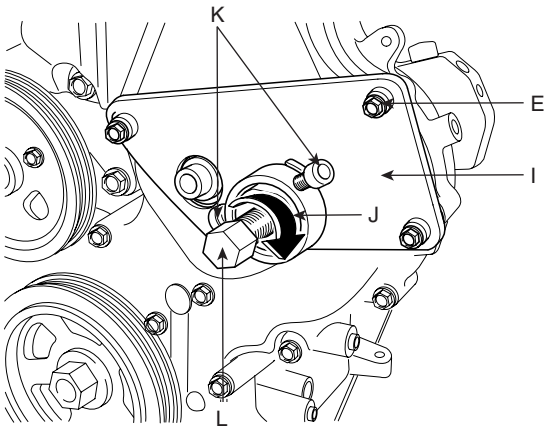


LGJF502X

11. Fix the high pressure pump remover(I) and sprocket stopper(J) with two fixing bolts(K).

12. Install the high pressure pump remover(I) with three mounting bolts(E).

13. Rotate the bolt(L) of the high pressure pump remover(I) clockwise till the high pressure pump is pushed out.

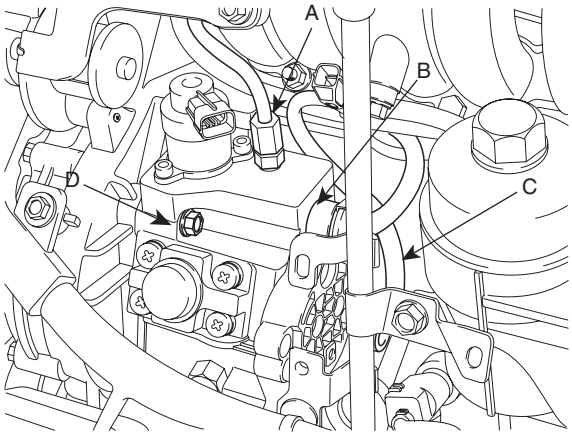


LGJF502Y

INSTALLATION E5B29BAA

1. Install the high pressure pump assembly and screw the three high pressure mounting bolts(D).

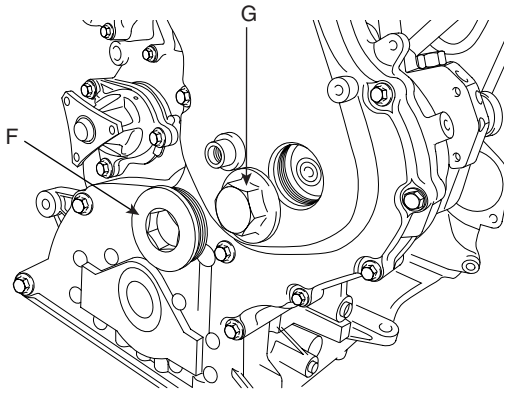
Tightening Torque: 14.7 ~ 19.6 N·m (10.9 ~ 14.5 lbf·ft)



LGJF502Z

2. Install the drive belt.(Refer to "EM" group.)

3. Screw the timing chain cover plug(G) after fastening the high pressure pump sprocket nut(F).

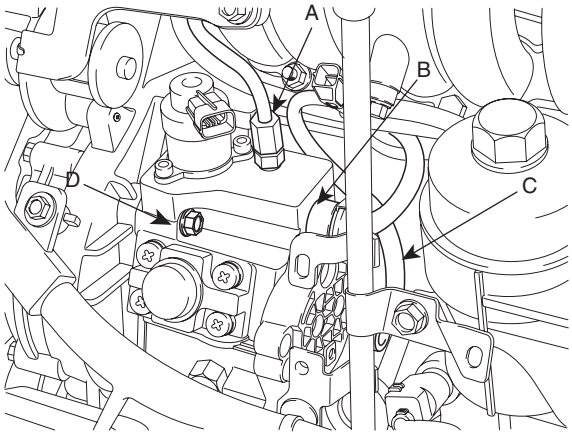


LGJF502W

NOTE

Don't reuse the O-ring of the timing chain cover plug.

4. Connect the return hose(B) and the hose(C) connecting to the fuel filter.



LGJF503A

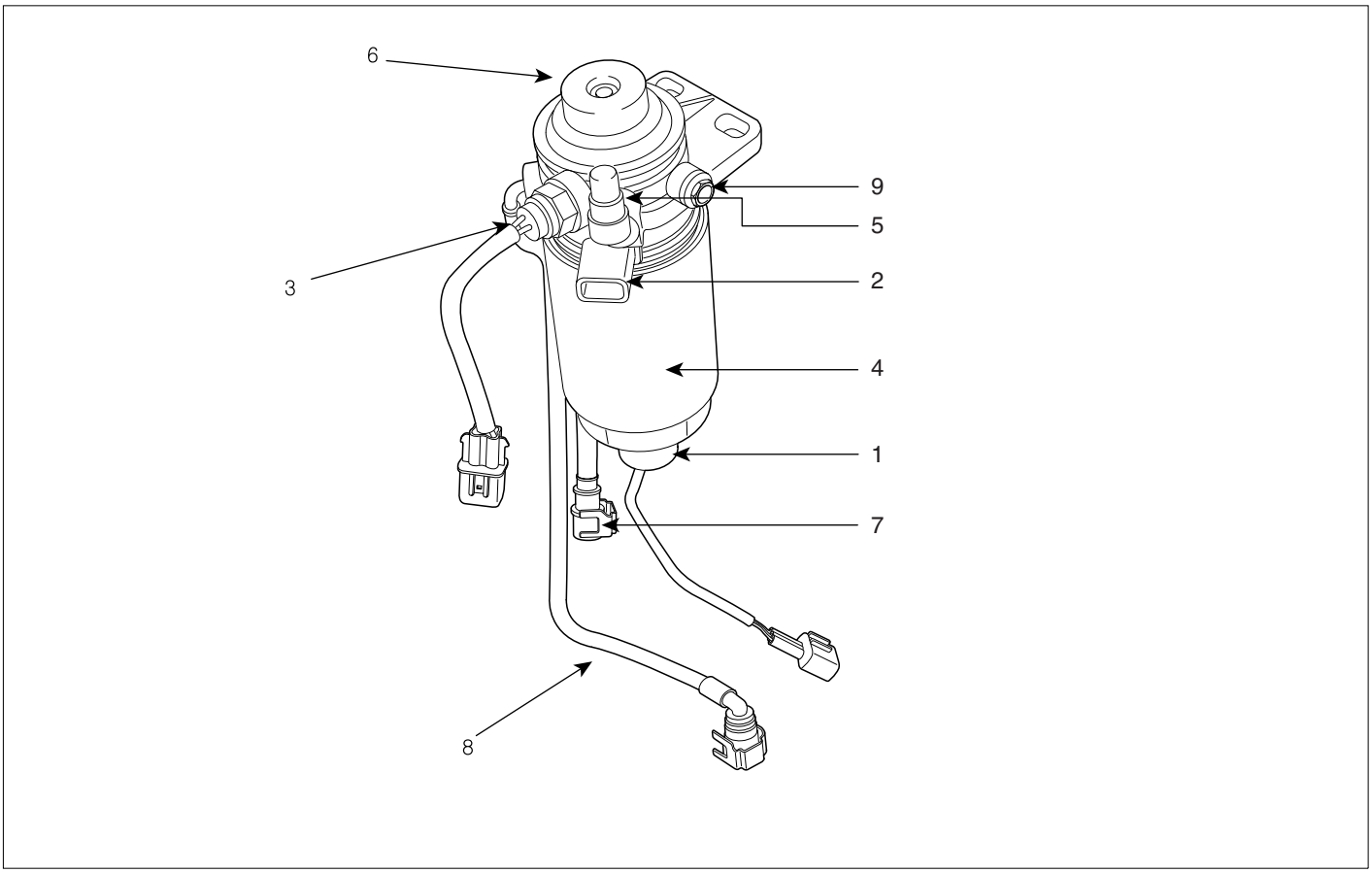
5. Connect the high pressure pipe(A) connecting high pressure pump and common rail.

6. Connect the negative battery(-) terminal.

7. Start the engine and check for leakage on fuel line connected to the high pressure pump.

FUEL FILTER

COMPONENT EAACC008

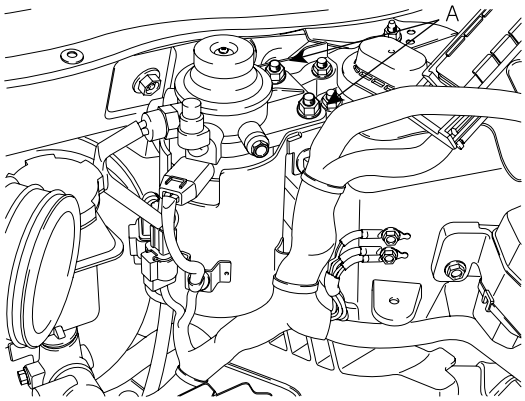


1. Water Sensor
2. Heater
3. Thermo Switch
4. Fuel Filter Cartridge
5. Air plug (for plant)
6. Manual pump
7. Inlet hose
8. Outlet hose
9. Air plug (for service)

LGJF503B

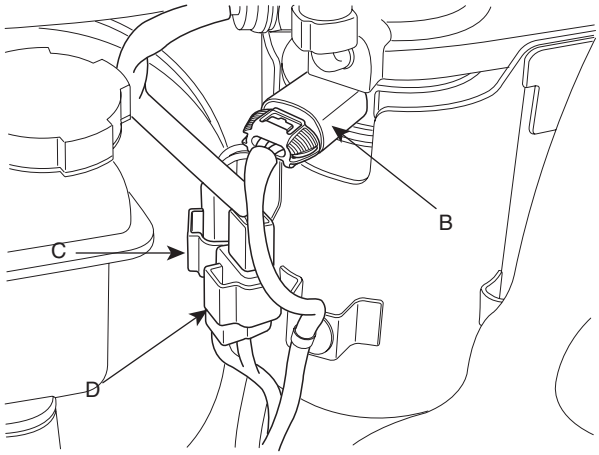
REMOVAL EA5F487B

1. Turn ignition switch to OFF position.
2. Disconnect the negative battery (-) terminal and wait for about 30 seconds.
3. Unscrew the two mounting bolts(A).



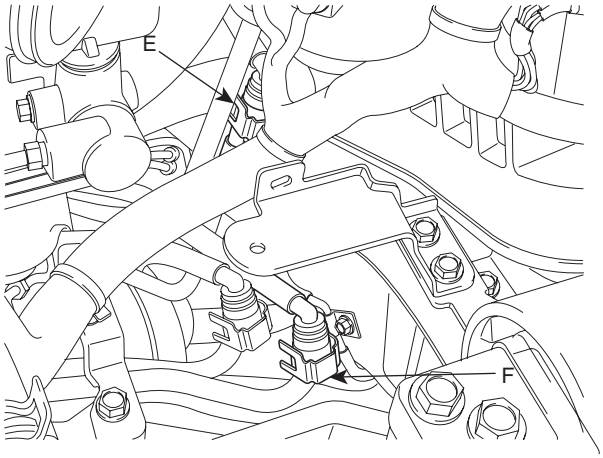
LGJF503H

4. Disconnect the heater connector (B), water sensor connector (C) and thermo switch connector (D).



AWJF302U

5. Remove air cleaner assembly (Refer to "EM" group).
6. Disconnect the fuel inlet hose (E) and fuel outlet hose (F).



AWJF302V

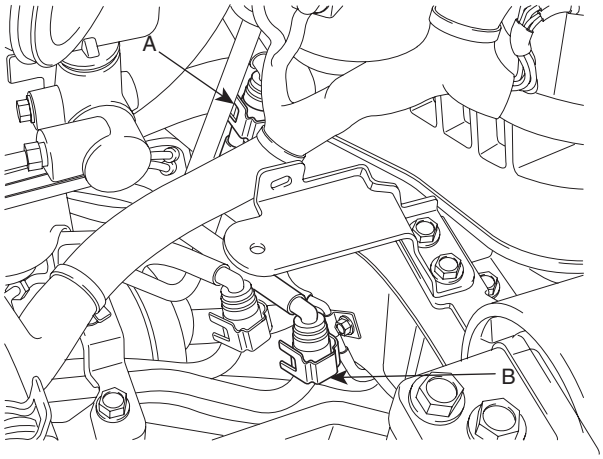
CAUTION

Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

7. Remove the fuel filter assembly.

INSTALLATION EF48CC57

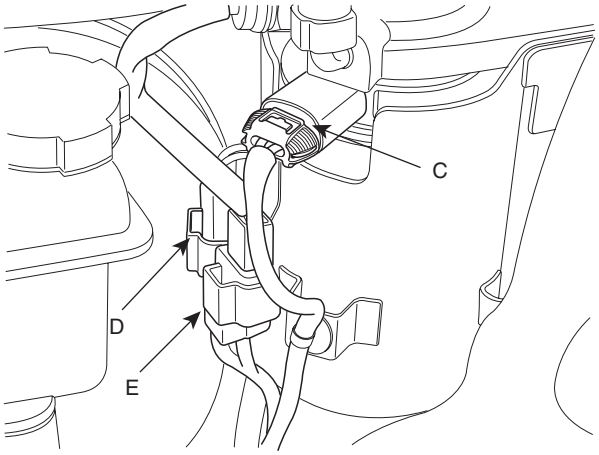
1. Connect the fuel inlet hose(A) and fuel outlet hose(B).



AWJF302W

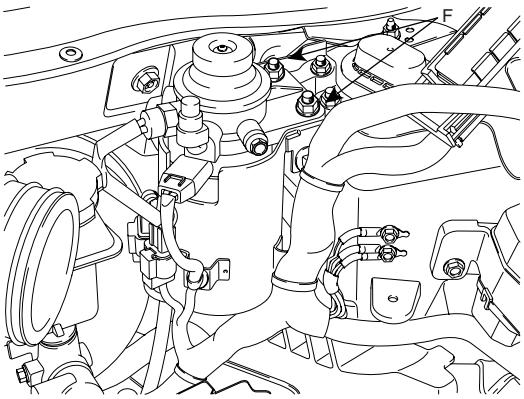
2. Remove air cleaner assembly (Refer to "EM" group).

3. Connect the heater connector(C), water sensor connector(D) and thermo switch connector(E).



AWJF302X

4. Fasten the two mounting bolts(F).



LGJF503J

5. Connect the negative(-) terminal.

6. Start the engine and check for leakage on fuel line connected to fuel filter.

INSPECTION EC40ED42

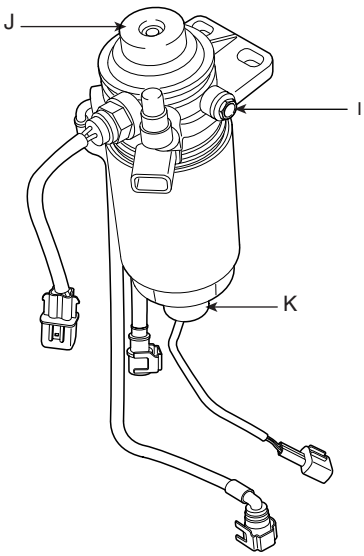
- General insepction.
  a) Hose and pipe for bent, damage, clogging or corrosion.
  b) Fuel filter for cologging and damage.

NOTE

- *The fuel filter inspection must be completes in case of below.*
  a) Draining fuel in fuel tank and then refilling fuel.
  b) Replacing the fuel filter.
  c) Removing the main fuel hose (pipe).

- Fuel filter deflation.
  a) Remove the air plug(I) of fuel filter.
  b) Cover the air plug with service towel, and then push the manual pump(J) until a bubble dose not flow out.
  c) Faten the air plug(I), and then push the manual pump again until pushing the manual pump gets to be difficult.

- Pulling out water from fuel filter.
  a) Unfasten the drain plug(K).
  b) Push the manual pump(J) until water dose not flow out.
  c) Fasten the drain plug(K).

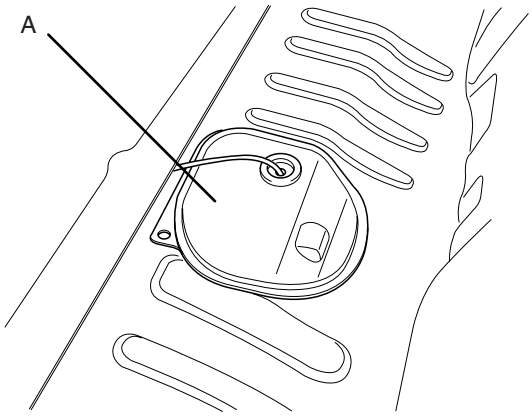


LGJF503I

FUEL TANK

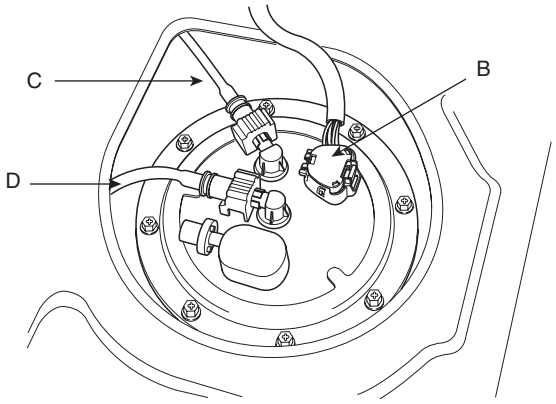
REMOVAL EED0FDE7

1. Remove the rear seat cushion (Refer to " BD" group in this WORKSHOP MANUAL).
2. Open the service cover (A) under the rear seat cushion.



AFJF901C

3. Turn ignition switch to off position and disconnect the battery (-) cable.
4. Disconnector the fuel sender connector (B).



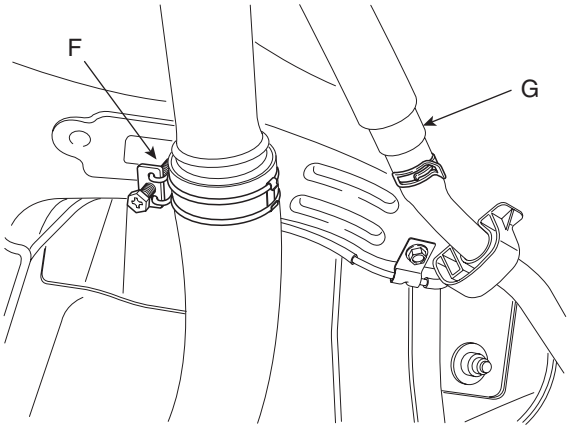
AWJF319A

5. Disconnect the fuel feed hose (C) and the return hose(D).

CAUTION

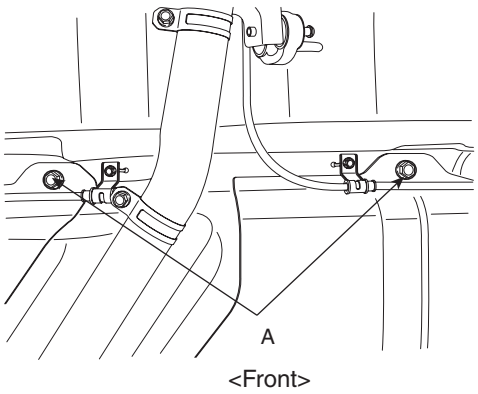
Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line

6. Lift the vehicle.
7. Disconnect the fuel filler hose (F), and the breather hose (G).

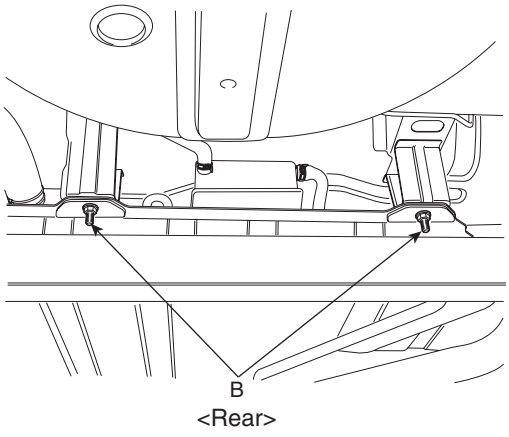


AWJF316A

8. Unfasten the two mounting bolts and the two mounting nuts, and then remove the fuel tank from the vehicle.



LGJF503D



LGJF503C