HYUNDAI

Terracan

Shop Manual

FORWORD

This shop manual is intended for use by service technicians of authorized Hyundai dealers to help them provide efficient and correct service and maintenance on Hyundai vehicles.

To ensure customer satisfaction with Hyundai products, proper service and maintenance by Hyundai technicians is essential. Consequently, it is important that service personnel fully understand the contents of this manual, which should be kept in a handy place for quick and easy reference.

All the contents of this manual, including photographs, drawings, and specifications, are the latest available at the time of printing. As modifications affecting service occur, dealers will be provided technical service bulletins or supplementary volumes. This manual should be kept carefully up-to date upon receipt of the new information.

Hyundai Motor Company reserves the right to make changes in design or to make additions to or improvements in its products without imposing any obligations upon itself to install them on its products previously manufactured.

MAY. 2004, Printed in Korea

Regarding the information which is not provided in this manual, refer to '02 TERRACAN" Shop Manual (Pub. No. : AH1S - EG11A.)

CAUTION :
Severe engine and transaxle damage may result from the use of poor quality fuels and lubricants that do not meet Hyundai specifications. You must always use high quality fuels and lubricants that meet the specifications.

NOTE : Regarding the groups in small characters, refer to Electrical Troubleshooting Manual. (Pub. No : AH1E-EG45C)

CONTENTS

Fuel System
(G6CV - GSL3.5)

FL

DTC TROUBLESHOOTING PROCEDURES

GENERAL

SPECIFICATION E47442FB

ITEM		SPECIFICATION	
Fuel Tank	Capacity	75 lit. (18.5 U.S.gal., 154 Imp.gal.)	
Fuel Pump	Type	Electrical, in-tank type	
	Fuel Pressure	Vacuum hose disconnection	323 - 343 kPa (3.3 - 3.5 kg/㎠, 47 - 50 psi)
		Vacuum hose connection	264 kPa (2.7 kg/㎠, 38.4 psi)
Throttle Position Sensor (TPS)	Type	Variable resistor type	
	Resistance	3.5 ~ 6.5 kΩ	
	Voltage	C.T	0.3 ~ 0.9 V
		W.O.T	1.5 ~ 5.0 V
Idle Speed Control	Type	Motor Type	
Idle Switch	Type	Contact type (Built in TPS)	
Mass Air Flow (MAF) Sensor	Type	HOT FILM TYPE	
Intake Air Temperature Sensor (ATS)	Type	Thermistor type	
	Resistance	2.33 ~ 2.97 kΩ at 20℃ (68°F)	0.31 ~ 0.43 kΩ at 80℃ (176°F)
	Voltage	2.5 ~ 2.7 V at 20℃ (68°F)	0.6 ~ 0.8 V at 80℃ 176°F)
Engine Coolant Temperature Sensor (ECTS)	Type	Thermistor type	
	Resistance	2.33 ~ 2.97 kΩ at 20℃ (68°F)	0.31 ~ 0.43 kΩ at 80℃ (176°F)
	Voltage	2.5 ~ 2.7 V at 20℃ (68°F)	0.6 ~ 0.8 V at 80℃ (176°F)
Heated Oxygen Sensor (HO2S)	Type	Zirconia (ZrO_2) type	
	Voltage	0 ~ 1 V	
	Heater Resistance	Front HO2S	3.3 Ω
		Rear HO2S	6.0 Ω
Vehicle Speed Sensor (VSS)	Type	Hall IC sensor	
Camshaft Position (TDC) Sensor	Type	Hall effect sensor	
Crankshaft Position (CKP) Sensor	Type	Hall effect sensor	
Injector	Type	Electromagnetic type	
	Resistance	13 ~ 16 Ω	
Purge Control Solenoid Valve (PCSV)	Type	ON/OFF type	
	Resistance	24.5 ~ 27.5 Ω	

SEALANT

Water Temperature Sensor (WTS)	LOCTITE 962T or equivalent

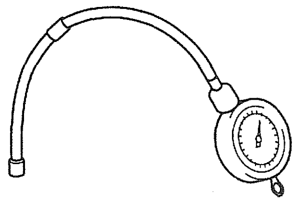
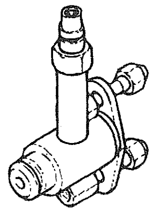
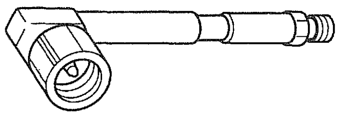
SERVICE STANDARD

Actual ignition timing			BTDC 5° ± 2°
Curb idle speed	N-range	A/CON : OFF	800 ± 100
		A/CON : ON	800 ± 100
	D-range	A/CON : OFF	800 ± 100
		A/CON : ON	800 ± 100

TIGHTENING TORQUE

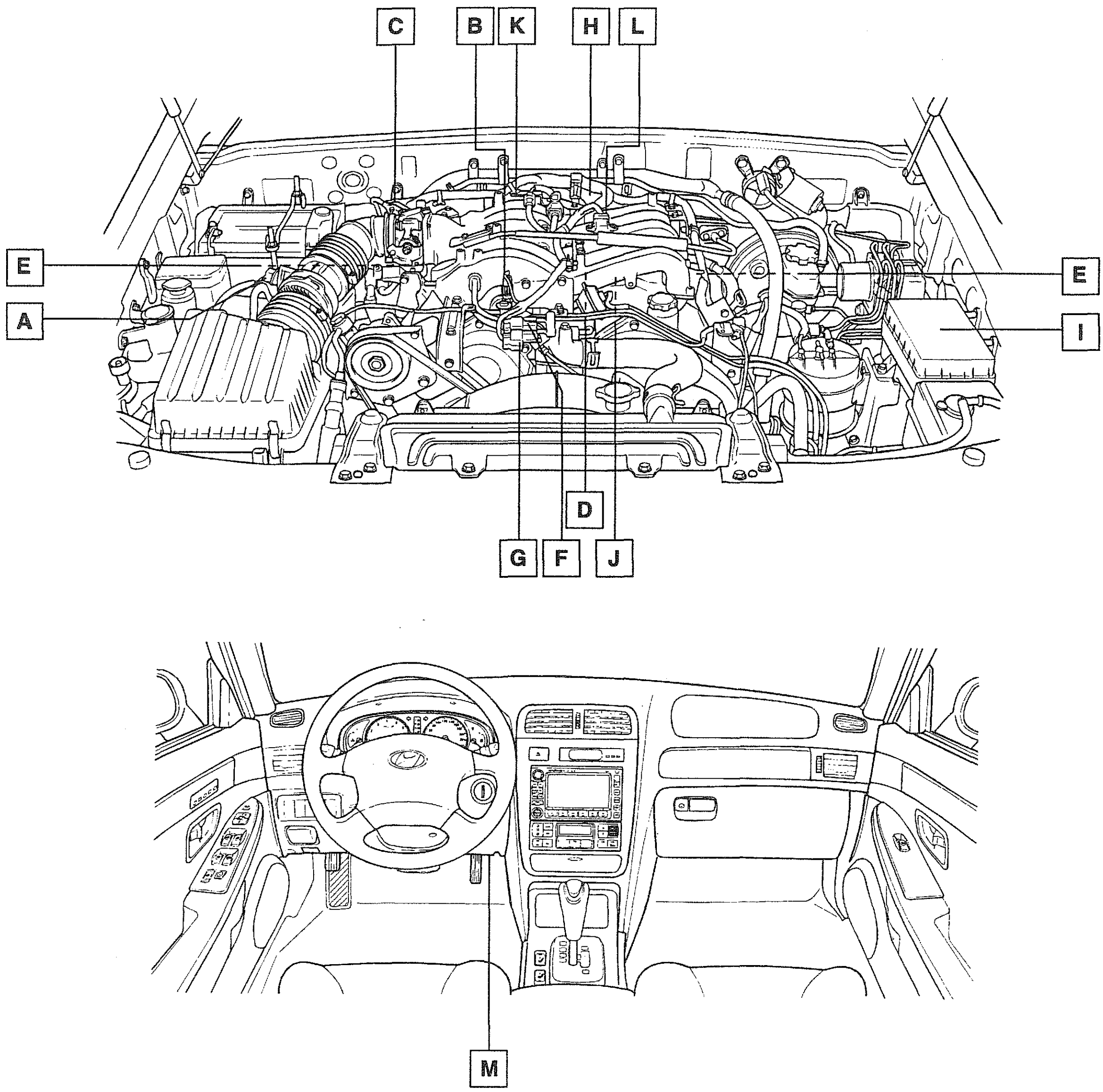
Item	Nm	Kg.cm	lb.ft
Delivery pipe installation bolt	10 - 13	100 - 130	7 - 9
Engine coolant temperature sensor	20 - 40	200 - 400	14 - 29
Heated oxygen sensor	40 - 50	400 - 500	29 - 36
Heated oxygen sensor connector bracket bolt	8 - 12	80 - 120	5.8 - 8.7
Fuel pressure regulator installation bolt	7 - 11	70 - 110	5 - 8
High pressure hose and fuel main pipe	30 - 40	300 - 400	22 - 29
High pressure hose and fuel filter	25 - 35	250 - 350	18 - 25
High pressure hose to delivery pipe	3 - 4	30 - 40	2.2 - 3
Fuel pump assembly to fuel tank	2 - 3	20 - 30	1.4 - 2.2
High pressure hose at fuel tank	30 - 40	300 - 400	22 - 29
Throttle body to surge tank	10 - 13	100 - 130	7.2 - 9
Fuel tank drain plug	15 - 25	150 - 250	11 - 18
Fuel filter mounting bolts	9 - 14	90 - 140	6.5 - 10
Accelerator arm bracket bolts	8 - 12	80 - 120	5.8 - 8.7
ISC motor (stepper motor)	2.5 - 4.5	25 - 45	1.8 - 3.3
Fuel sender to fuel tank	2 - 3	20 - 30	1.4 - 2.2

SPECIAL SERVICE TOOLS EFDAB6FD

Tool (Number and name)	Illustration	Application
09353-24100 Fuel Pressure Gauge	 EFDA003A	Measuring the fuel line pressure
09353-38000 Fuel Pressure Gage Adapter	 BF1A025D	Connection between the delivery pipe and fuel feed line
09353-24000 Fuel Pressure Gage Connector	 EFDA003C	Connection between Fuel Pressure Gage (09353-24100) and Fuel Pressure Gage Adapter (09353-38000)

GASOLINE ENGINE CONTROL SYSTEM

COMPONENT LOCATION E2214D84



A	AFS & IAT-sensor
B	Engine coolant temperature sensor
C	TPS (including idle switch)
D	Knock sensor
E	O2 sensor
F	Crankshaft position sensor
G	Camshaft position sensor
H	PCSV
I	Control relay
J	Injector
K	Ignition coil
L	Ignition failure sensor
M	DLC connector

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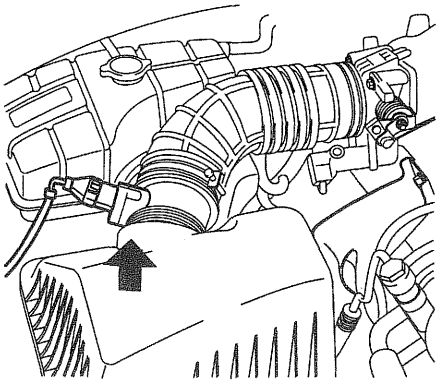
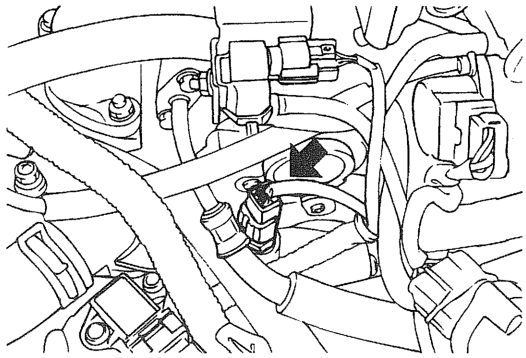
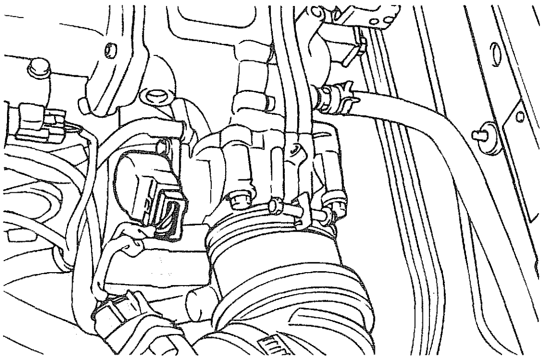
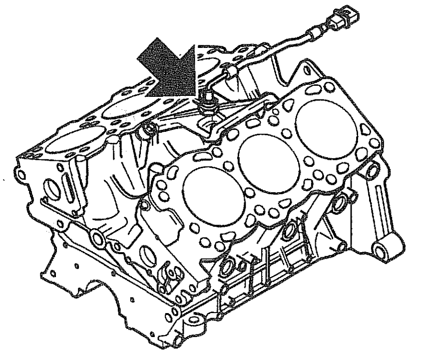
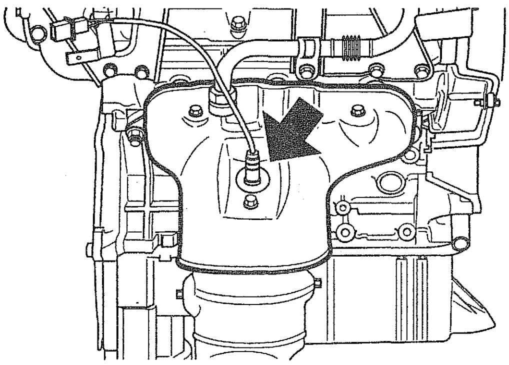
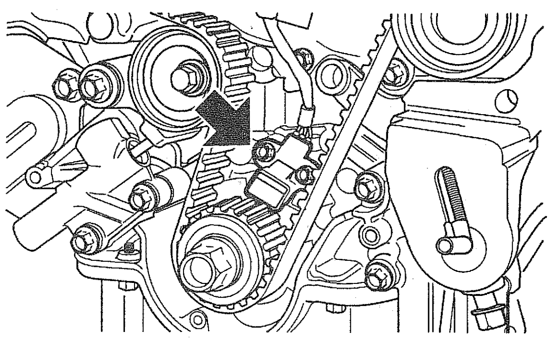
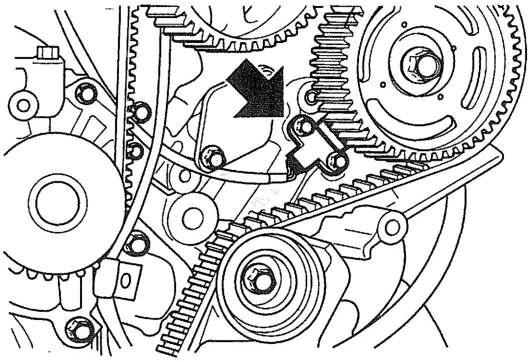
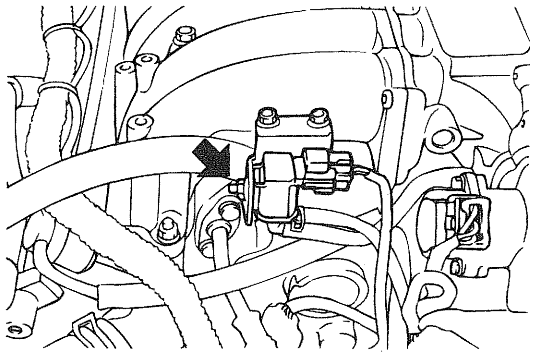
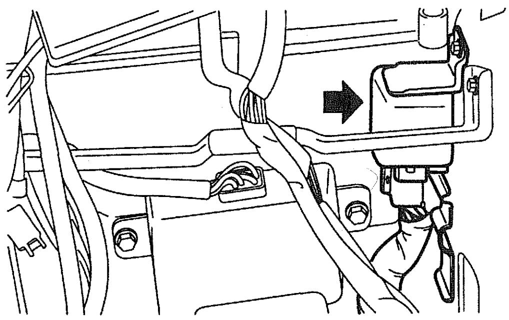
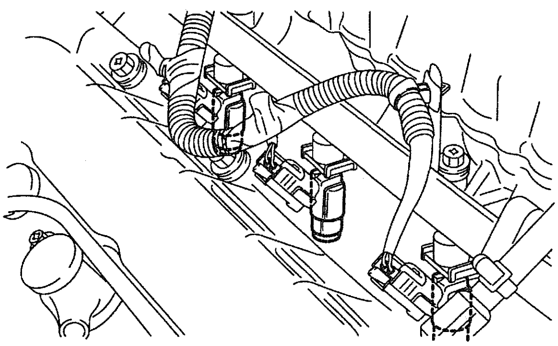
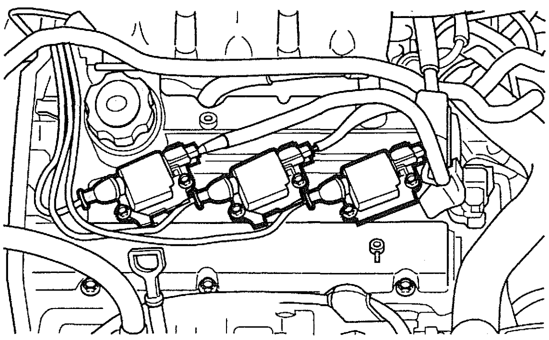
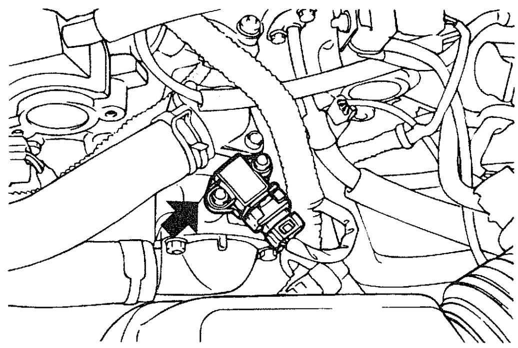
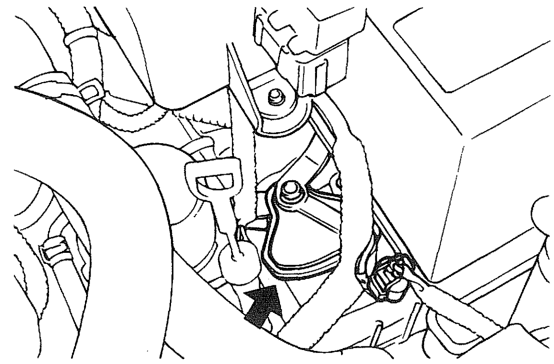
A	AFS & IAT-sensor	B	Engine Coolant temp. sensor
 EFMF009A		 EFMF010A	
C	TPS (Including idle switch) & ETS	D	Knock sensor
 EFMF115A		 EFMF014A	
E	O2 sensor	F	Crankshaft Position Sensor
 EFMF244A		 EFMF202A	

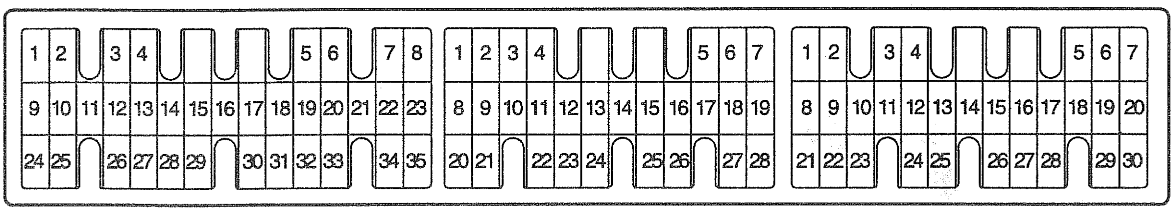
G	Camshaft Position Sensor	H	PCSV
 EFMF203A		 EFMF007A	
I	Control relay	J	Injector
 EFMF221A		 EFMF018A	
K	Ignition coil	L	Igniting failure sensor
 EFMF222A		 EFMF006A	

M	Inhibitor switch	
 EFMF008A		

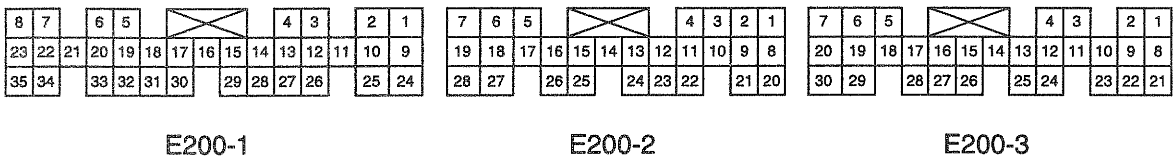
ECM TERMINAL LAYOUT E3BA7C12

1. ECM CONNECTOR

A. ECM CONNECTOR



B. HARNESS SIDE CONNECTOR



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2. ECM TERMINAL FUNCTION

[CONNECTOR E200-1]

PIN	SIGNAL	CONNECTED TO	REMARK
1	Injector (Cylinder #1)	Injector (Cylinder #1)	
2	Injector (Cylinder #4)	Injector (Cylinder #4)	
3	Heated Oxygen Sensor [HO2S] Heater (Bank 2, Sensor 1)	Heated Oxygen Sensor [HO2S] (Bank 2, Sensor 1)	Except for LEAD Engine
4	Heated Oxygen Sensor [HO2S] Heater (Bank 1, Sensor 1)	Heated Oxygen Sensor [HO2S] (Bank 1, Sensor 1)	Except for LEAD Engine
5	-	-	
6	-	-	
7	-	-	
8	Alternator "G" Term	Alternator	
9	Injector (Cylinder #2)	Injector (Cylinder #2)	
10	Injector (Cylinder #5)	Injector (Cylinder #5)	
11	Ignition Coil (Cylinder #1, 4)	Ignition Coil (Cylinder #1, 4)	
12	Ignition Coil (Cylinder #2, 5)	Ignition Coil (Cylinder #2, 5)	
13	Ignition Coil (Cylinder #3, 6)	Ignition Coil (Cylinder #3, 6)	
14	ISC Motor Control	ISC Motor	
15	ISC Motor Control	ISC Motor	
16	Purge Control Sloenoid Control (PWM)	Purge Control Sloenoid Valve	
17	Fan Relay - High (Radiator)	Fan Relay	
18	Fan Relay - Low	Fan Relay	

PIN	SIGNAL		CONNECTED TO	REMARK
19	TPS PWM		TCM, TOD Control Module	
20	Without Immobilizer	Fuel Pump Relay	Fuel Pump Relay	
21		A/C Relay (Power)	A/C Relay	
20	With Immobilizer	A/C Relay (Power)	A/C Relay	
21		Fuel Pump Relay	Fuel Pump Relay	
22	Malfunction Indicator Lamp (MIL)		Malfunction Indicator Lamp (MIL)	
23	Spark Timing Adjustment (+)		Check Connector (for Diagnosis)	
24	Injector (Cylinder #3)		Injector (Cylinder #3)	
25	Injector (Cylinder #6)		Injector (Cylinder #6)	
26	Heated Oxygen Sensor [HO2S] Heater (Bank 2, Sensor 2)		Heated Oxygen Sensor [HO2S] (Bank 2, Sensor 2)	Europe Only
27	Heated Oxygen Sensor [HO2S] Heater (Bank 1, Sensor 2)		Heated Oxygen Sensor [HO2S] (Bank 1, Sensor 2)	Europe Only
28	ISC Motor Control		ISC Motor	
29	ISC Motor Control		ISC Motor	
30	-		-	
31	-		-	
32	Variable Intake Solenoid Control		Variable Intake Solenoid	
33	-		-	
34	Purge Control Solenoid Valve (PCSV)		Purge Control Solenoid Valve (PCSV)	
35	-		-	

[CONNECTOR E200-2]

PIN	SIGNAL	CONNECTED TO	REMARK
1	Water Temp. Switch	TCM	
2	Sensor Power	Sensors	
3	CKP Sensor Signal	CKP Sensor	
4	Engine Coolant Temperature Sensor (ECTS) Signal	Engine Coolant Temperature Sensor (ECTS)	
5	Ignition Detect Signal	Ignition Failure Sensor	
6	Power Ground	Chassis Ground	
7	Battery Voltage	Main Relay	
8	Engine RPM	TCM	
9	Sensor Ground	Sensors	
10	CMP Sensor Signal	CMP Sensor	
11	MAFS Signal	MAF Sensor	
12	Alternaotr "FR" Signal	Alternator	
13	A/C Press Switch (HI/LO)	A/C Press Switch	
14	Power Steering Switch (ON/OFF)	Power Steering Switch	
15	-	-	
16	-	-	
17	-	-	
18	Power Ground	Chassis Ground	
19	Battery Voltage	Main Relay	
20	Battery Voltage (Backup)	IG Switch	
21	-	-	
22	Air Temp. Sensor Signal	Air Temp. Sensor	
23	-	-	
24	-	-	
25	A/C Pressure SW (MIDDLE)	A/C Press Switch	
26	Torque Control	TCM	
27	Neutral Signal	Ignition Switch	AT only
28	Start Signal	Ignition Switch	

[CONNECTOR E200-3]

PIN	SIGNAL	CONNECTED TO	REMARK
1	Heated Oxygen Sensor [HO2S] (Bank 2, Sensor 1) Signal	Heated Oxygen Sensor [HO2S] (Bank 2, Sensor 1)	Except for LEAD Engine
	Variable Resistor Signal	Variable Resistor	LEAD Engine Only
2	Heated Oxygen Sensor [HO2S] (Bank 1, Sensor 1) Signal	Heated Oxygen Sensor [HO2S] (Bank 1, Sensor 1)	Except for LEAD Engine
3	Heated Oxygen Sensor [HO2S] (Bank 2, Sensor 2) Signal	Heated Oxygen Sensor [HO2S] (Bank 2, Sensor 2)	Europe Only
4	Heated Oxygen Sensor [HO2S] (Bank 1, Sensor 2) Signal	Heated Oxygen Sensor [HO2S] (Bank 1, Sensor 2)	Europe Only
5	MIL Request	TCM	
6	-	-	
7	-	-	
8	Throttle Position Sensor Signal	Throttle Position Sensor (TPS)	
9	Idle Switch (Integrated in TPS)	Throttle Position Sensor (TPS)	
10	Vehicle Speed Sensor (VSS) Signal	Vehicle Speed Sensor (VSS)	
11	-	-	
12	-	-	
13	A/C Switch	A/C Switch	
14	Ignition Time Adjusting	Multi-purpose Check Connector	
15	Diagnosis Line (K-Line)	DLC Connector	
16	-	-	
17	-	-	
18	-	-	
19	-	-	
20	-	-	
21	Knock Sensor Signal	Knock Sensor	
22	Manifold Absolute Pressure Sensor Signal	Manifold Absolute Pressure Sensor	
23	Fuel Tank Pressure Sensor Signal	Fuel Tank Pressure Sensor	
24	-	-	
25	-	-	
26	Fuel Temperature Sensor Signal	Fuel Temperature Sensor	
27	Fuel Level Sensor Signal	Fuel Level Sensor	
28	-	-	
29	Ignition Switch (ACC) Signal	Ignition Switch	
30	Flash Power	Multi-purpose Check Connector	

NOTE

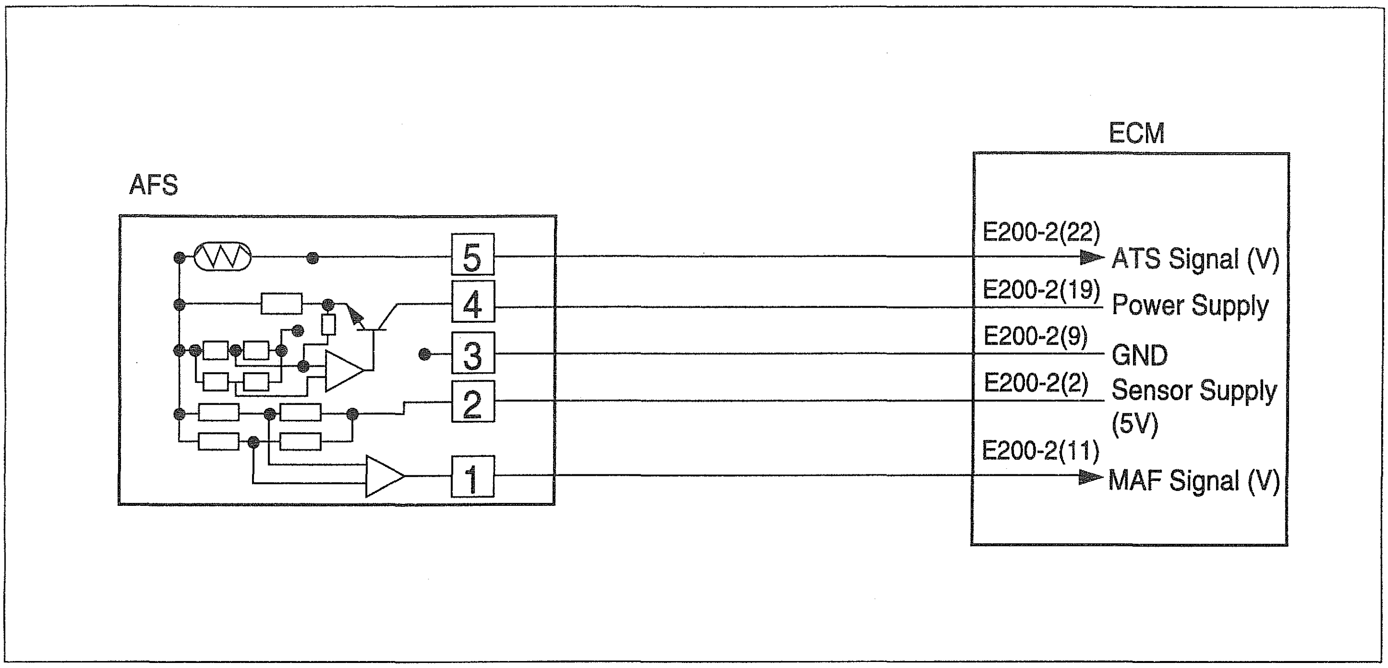
CONNECTOR [D]: TCU Connector (Refer to Gr. "TR")

AIR FLOW SENSOR (AFS): MASS AIR FLOW (MAF) SENSOR & INTAKE AIR TEMPERATURE SENSOR (ATS) EAE3B2CF

This hot film type Air Flow Sensor (AFS) is composed of a hot film sensor, housing and metering duct (hybrid sensor element). Mass air flow rate is measured because the change of the mass air flow rate causes a change in the amount of heat being transferred from the hot film probe surface to the air flow. The air flow sensor generates a pulse so it repeatedly opens and closes between the 5V voltage supplied from the ECM.

The intake air temperature sensor (ATS), located in the intake air hose, is a resistor-based sensor for detecting the intake air temperature. The intake air temperature information from the sensor helps the ECM provide the necessary fuel injection.

[CIRCUIT DIAGRAM (AFS)]



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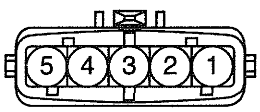
[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECM Terminal 11(E200-2)	MFS Signal Output
2	ECM Terminal 2(E200-2)	Sensor Power
3	ECM Terminal 9(E200-2)	GND
4	ECM Terminal 19(E200-2)	Battery Voltage
5	ECM Terminal 22(E200-2)	ATS Signal Output

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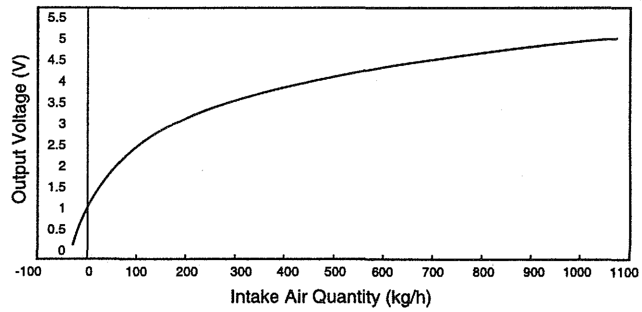
[CHARACTERISTIC OF MAF]

Item	Specification	Remark
Supply Voltage	7.5 ~ 16 V	
Operating Temperature Range	-40℃ ~ 125℃	
Range of Air Flow	7 ~ 640 kg/h	
Output Voltage	0 ~ 5 V	

[OUTPUT VOLTAGE OF MAF]

Output Voltage (V)	Intake Air Quantity (kg/h)	Output Voltage (V)	Intake Air Quantity (kg/h)
1.34	15	3.28	250
1.64	30	3.68	370
2.07	60	3.96	480
2.61	120	4.28	640



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TROUBLESHOOTING PROCEDURES (MAF)

- o Engine : Running

↓ YES

- o Check the wiring harness and connections.
- o Is it normal?

→ NO → o Repair or replace the wiring harness.

↓ YES

- o Check the MAF sensor output voltage.
- o Is it normal?

→ NO → o Repair the MAF sensor.

↓ YES

- o Erase diagnostic trouble codes from memory.
- o Is same code present after rechecking?

↓ YES

- o Replace ECM.

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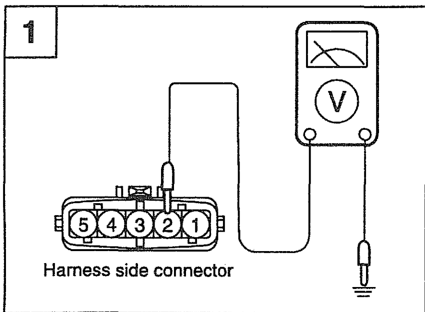
TROUBLESHOOTING HINTS

1. If the engine stalls occasionally, start the engine and shake the MAF sensor harness. If the engine stalls, check for poor contact at the MAF sensor connector.
2. If the MAF sensor output voltage is other than 0 when the ignition switch is turned on (do not start the engine), check for a faulty MAF sensor or ECM.
3. If the engine can idle even if the MAF sensor output voltage is out of specification, check for the following conditions;
   - Disturbed air flow in the MAF sensor, disconnected air duct, and clogged air cleaner filter.
   - Poor combustion in the cylinder, faulty ignition plug, ignition coil, injector, and incorrect comparison.
4. Even if no MAF malfunction occurs, check the mounting direction of the MAF.

⚠ *CAUTION*

- ***When the vehicle is new [within initial operation of about 500 km (300 miles)], the Mass Air Flow (MAF) Sensor air quantity will be about 10% higher.***
- ***Use an accurate digital voltmeter.***
- ***Before checking, warm up the engine until the engine coolant temperature reaches 80 to 90 ℃ (176 to 198 °F).***

HARNESS INSPECTION PROCEDURES (MAF)



Measure the power supply voltage.
- Sensor Connector: Disconnected
- ECM Connector: Connected
- Ignition Switch: ON
- Voltage (V): 4.8 ~ 5.2V

OK ⇒ 2

NG ⇒ Repair the harness

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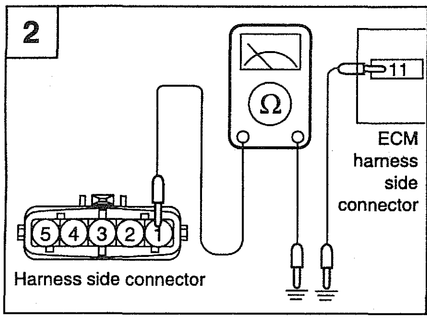

Check for an open circuit or a short circuit between ECM and Mass Air Flow (MAF) Sensor.
- Sensor Connector: Disconnected
- ECM Connector: Disconnected

OK ⇒ 3

NG ⇒ Repair the harness

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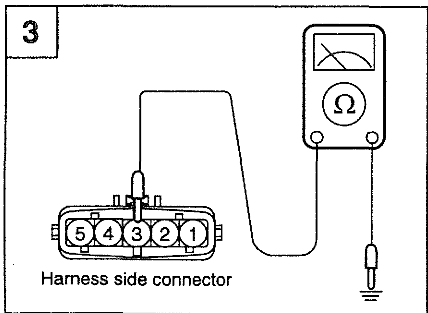

Check for the continuity of the sensor ground.
- Sensor Connector: Disconnected

OK ⇒ **END!**

NG ⇒ Repair the harness

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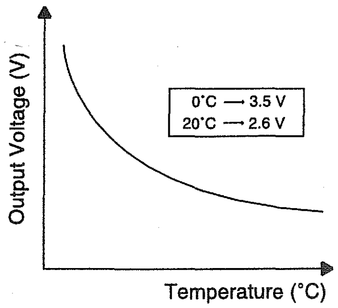
[OUTPUT VOLTAGE OF ATS]



LFCD001C

SENSOR INSPECTION

USING OHMMETER

Check Item	Data Display	Check Condition	Intake Air Temp [℃ (°F)]	Resistance (kΩ)
Intake Air Temperature Sensor (ATS)	Intake Air Temperature	IG ON or Engine Running	-40 (-40)	33.85 ~ 61.20
			20 (68)	2.33 ~ 2.97
			80 (176)	0.31 ~ 0.43

TROUBLESHOOTING PROCEDURE (ATS)

- o Engine : Running

YES

- o Check the wiring harness and connections.
- o Is it normal?

NO → o Repair or replace the wiring harness.

YES

- o Check the ATS output voltage.
- o Is it normal?

NO → o Repair the ATS.

YES

- o Erase diagnostic trouble codes from memory.
- o Is same code present after rechecking?

YES

- o Replace ECM.

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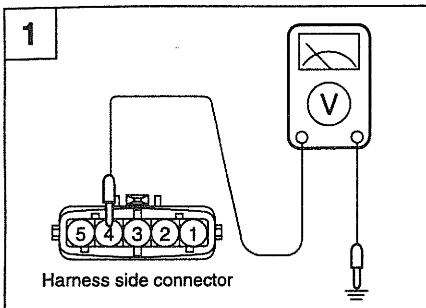
HARNESS INSPECTION PROCEDURES (ATS)

1



Measure the sensor supply voltage.

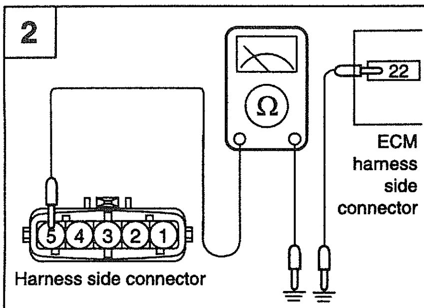
- Sensor Connector: Disconnected
- ECM Connector: Connected
- Ignition Switch: ON
- Voltage (V): Approx. 12V

OK ⇒ 2

NG ⇒ Repair the harness

EFMF005D

2



Check for an open circuit or a short circuit between ECM and Intake Air Temperature Sensor (ATS).

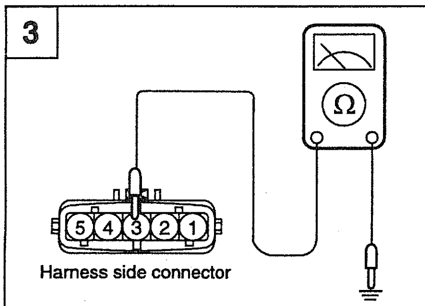
- Sensor Connector: Disconnected
- ECM Connector: Disconnected

OK ⇒ 3

NG ⇒ Repair the harness

EFMF005E

3



Check for the continuity of the sensor ground.

- Sensor Connector: Disconnected

OK ⇒ **END!**

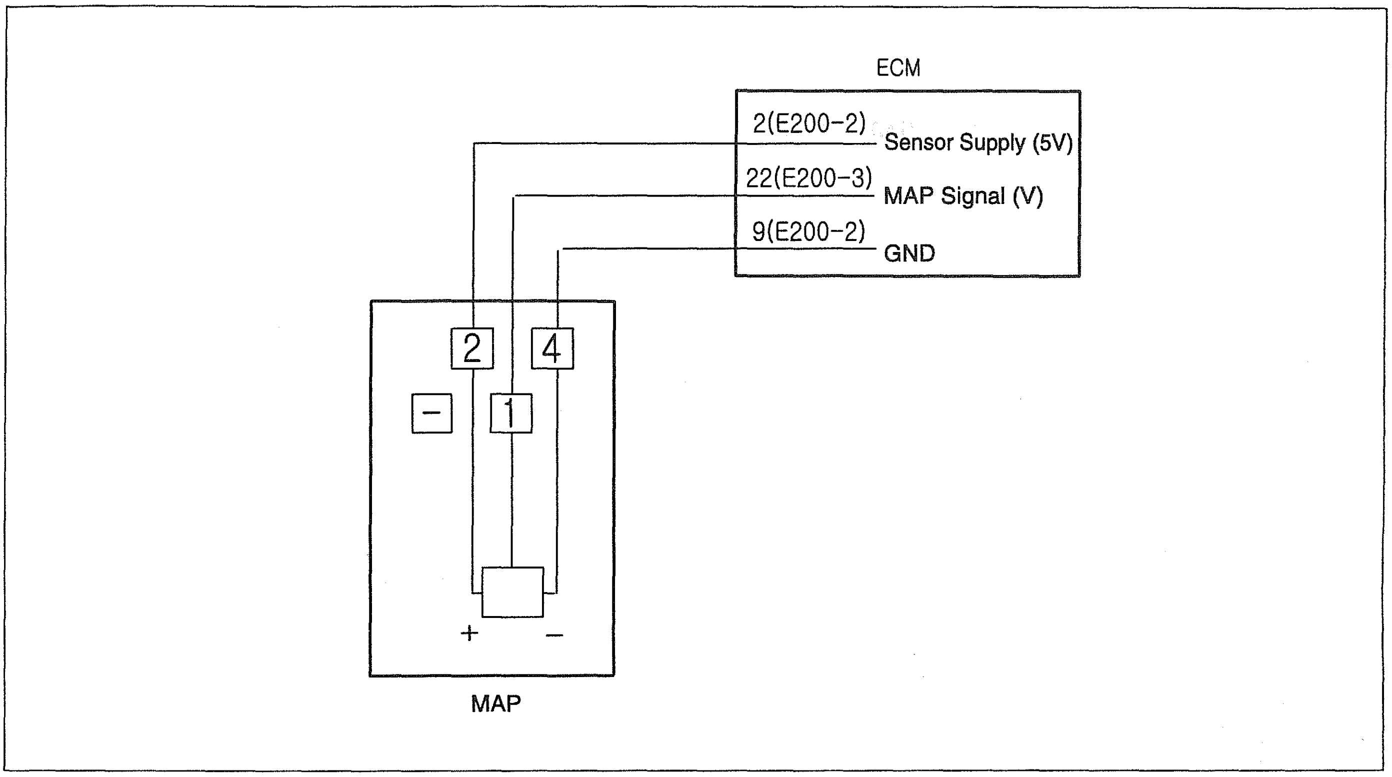
NG ⇒ Repair the harness

LFCD005F

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR EAC8A462

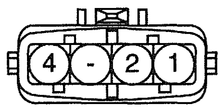
The Manifold Absolute Pressure (MAP) Sensor converts intake manifold pressure into a voltage signal. ECM uses this signal to determine the condition of the Exhaust Gas Recirculation (EGR).

[CIRCUIT DIAGRAM (MAP)]



EFMF002W

[HARNESS CONNECTOR]



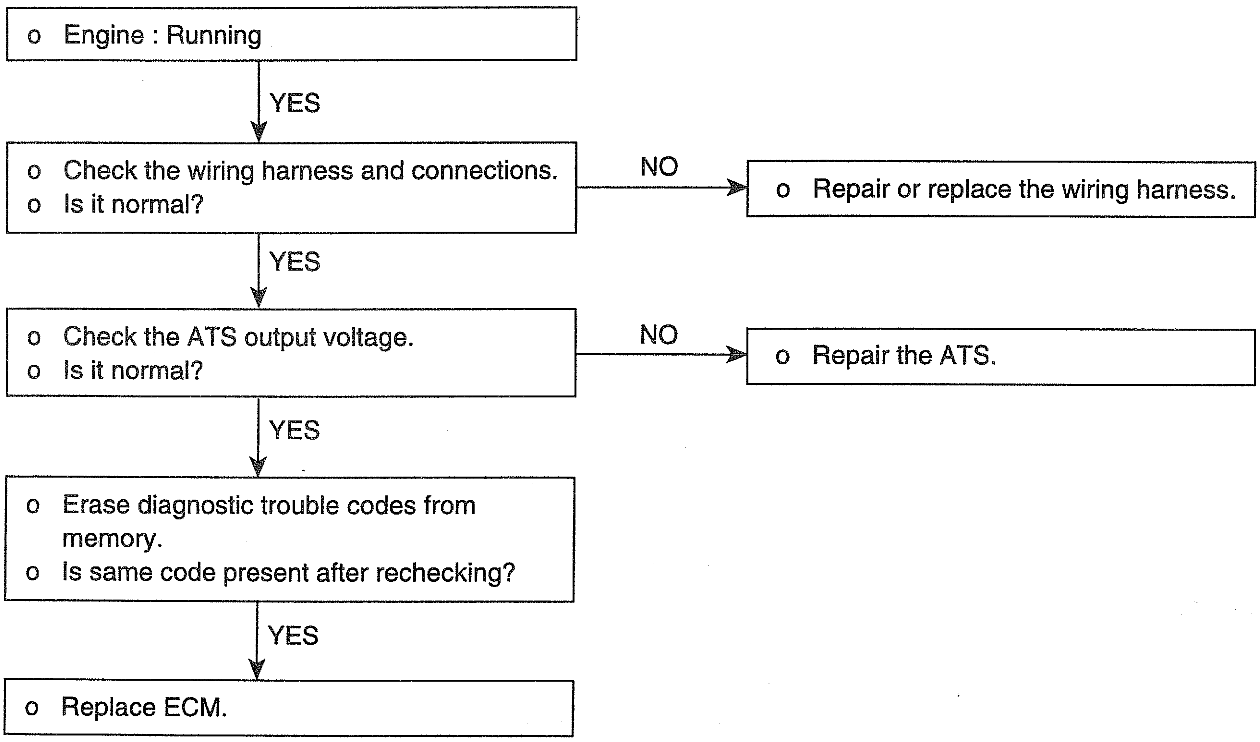
Pin	Connected to	Function
1	ECM Terminal 22(E200-3)	MAP Signal Output
2	ECM Terminal 2(E200-2)	Sensor Supply (5V)
3	Not used	
4	ECM Terminal 9(E200-2)	GND

EFMF003P

USING HI-SCAN (PRO)

Check Item	Data display	Check conditions	Engine state	Test specification
MAP sensor	Inlet manifold pressure	• Engine coolant temperature : 18 ℃ (65.4°F) • Lamps, electric cooling fan, accessory units : All OFF • Transaxle : Neutral (P range for vehicle with A/T) • Steering wheel : Neutral	Idle	0.8-2.4 V
			When the accel. pedal is depressed suddenly at idle	Rise from 0.8-2.4 V

TROUBLESHOOTING PROCEDURES [MAP SENSOR]



EFMF705H

SENSOR INSPECTION

1. Connect the voltmeter between 1 and 4 of MAP sensor connector.
   Terminal 4 : MAP sensor ground
   Terminal 1 : MAP sensor output

2. Measure the voltage of terminals.

Engine state	Test specification
Ignition ON	4 - 5 V
At idle	0.8 - 2.4 V

3. If the voltage deviates from the standard value, replace the MAP sensor assembly.

TROUBLESHOOTING HINTS

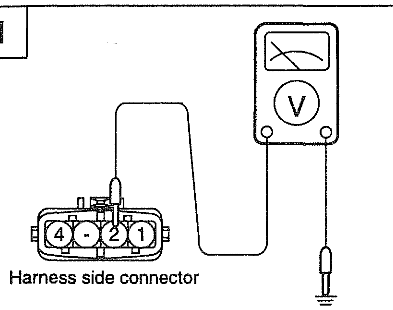
The MIL (Malfunction Indicator Lamp) is ON (or OFF) or the DTC (Diagnostic Trouble Code) is displayed on the HI-SCAN under the following conditions ;

1. When the manifold pressure is 4.5 V or more for 4 second.

2. When the manifold pressure is 0.2 V or lower for 4 second.

HARNESS INSPECTION TROCEDURES (MAP)

1



Measure the sensor supply voltage.

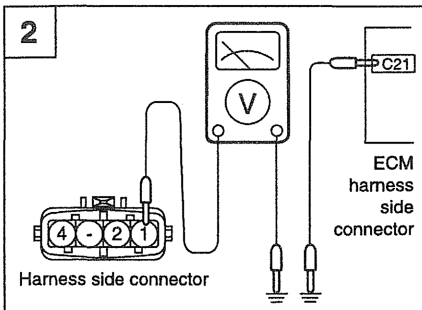
- Sensor Connector: Disconnected
- ECM Connector: Connected
- Ignition Switch: ON
- Voltage (V): 4.8 - 5.2 V

OK ⇒ **2**

NG ⇒ Repair the harness

EFMF007K

2



Check for an open circuit or a short circuit between ECM and Manifold Absdute Pressure (MAP) Sensor.

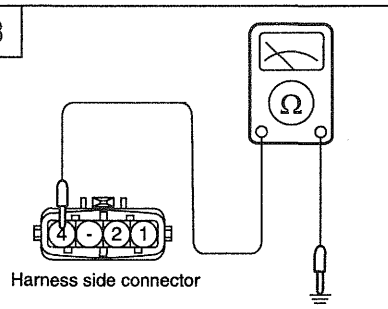
- Sensor Connector: Disconnected
- ECM Connector: Disconnected

OK ⇒ **3**

NG ⇒ Repair the harness

EFMF007L

3



Check for the continuity of the sensor ground.

- Sensor Connector: Disconnected

OK ⇒ **END**

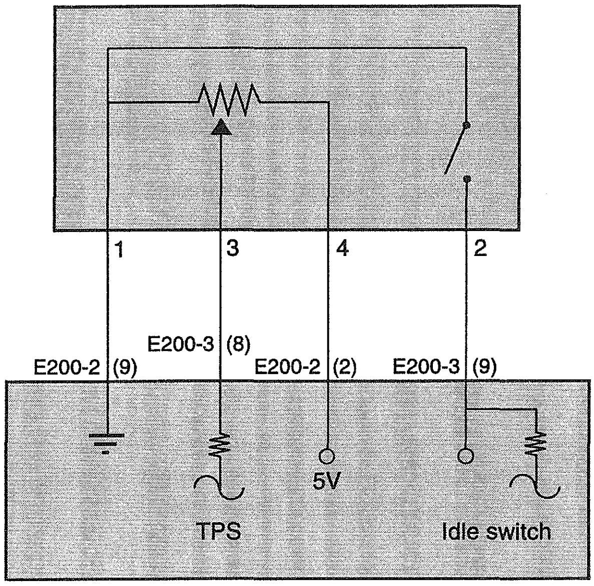
NG ⇒ Repair the harness

LFCD007M

THROTTLE POSITION SENSOR (TPS) EE3F2D34

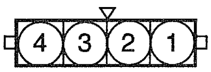
The TPS is a variable resistor type that rotates with the throttle shaft to sense the throttle valve angle. As the throttle shaft rotates, the output voltage of the TPS changes. The ECM detects the throttle valve opening based on this voltage change.

[CIRCUIT DIAGRAM]



EFMF105A

[HARNESS CONNECTOR]

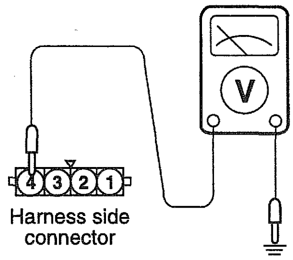


Pin	Connected to	Function
1	ECM Terminal 9(E200-2)	GND
2	ECM Terminal 9(E200-2)	Idle switch
3	ECM Terminal 8(E200-2)	TPS Signal
4	ECM Terminal 2(E200-2)	Sensor Power

EFMF071A

HARNESS INSPECTION PROCEDURES

1



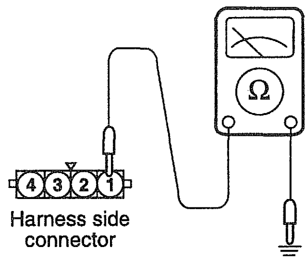
Measure the power supply voltage of the throttle position sensor.
- o Connector : Disconnected
- o Ignition switch : ON
- o Voltage (V) : 4.25 - 4.7

OK ⇨ 2

NG ⇨ Repair the harness.

EFMF105B

2



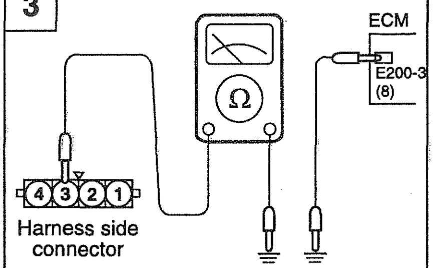
Check for continuity of the ground circuit.
- o Connector : Disconnected

OK ⇨ 3

NG ⇨ Repair the harness.

EFMF105C

3



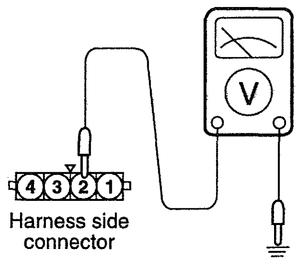
Check for an open-circuit, or a short-circuit to ground between the engine control module and the throttle position sensor.
- o Throttle position sensor connector : Disconnected
- o Engine Control Module connector : Disconnected

OK ⇨ 4

NG ⇨ Repair the harness.

EFMF105D

4



Measure the power supply voltage of the TPS.
- o Connector: Disconnected
- o Ignition switch: ON
- o Voltage (V): 4V or more

OK ⇨ **END !**

NG ⇨ Repair the harness.

EFMF105E

TROUBLESHOOTING HINTS

The TPS signal is important in the control of the automatic transaxle. Shift shock and other trouble will occur if the sensor is faulty.

SENSOR CHECKING

USING HI-SCAN (PRO)

Check item	Data display	Check conditions	Throttle valve	Test specification
Crankshaft position sensor	Sensor voltage	Ignition switch : ON	At idle position	300-900 mV
			Open slowly	Increases with valve opening
			Open wide	4,250-4,700 mV

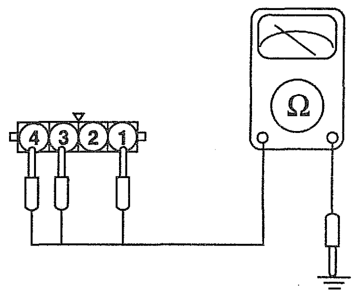
Using voltmeter

1. Disconnect the throttle position sensor connector.
2. Measure resistance between terminal 1 (sensor ground) and terminal 4 (sensor power).

Standard value : 3.5 - 6.5 kΩ

3. Connect a pointer type ohmmeter between terminal 1 (sensor ground) and terminal 3 (sensor output).
4. Operate the throttle valve slowly from the idle position to the full open position and check that the resistance changes smoothly in proportion with the throttle valve opening angle.
5. If the resistance is out of specification, or fails to change smoothly, replace the throttle position sensor.

Tightening torque TP Sensor : 1.5-2.5 Nm (15-25 kg·cm, 1.1-1.8 lb·ft)



EFMF105F

SENSOR CHECKING (IDLE SWITCH)

USING HI-SCAN (PRO)

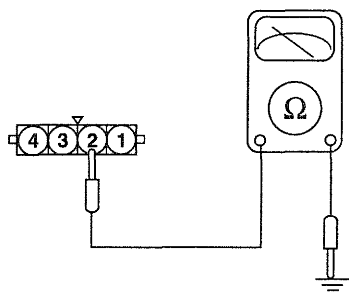
Check item	Data display	Check conditions	Throttle valve	Test specification
Idle position switch • Service data item	Switch state	Ignition switch : ON (check by operating accelerator pedal repeatedly)	At idle position	ON
			Open a little	OFF

Using voltmeter

1. Disconnect the throttle position sensor connector.
2. Check the continuity between terminal 2 and sensor ground.

TPS voltage	Continuity
Higher than 300-900mV	Non-conductive (∞Ω)
300-900mV	Conductive (0Ω)

3. If out of specification, replace the throttle position sensor.

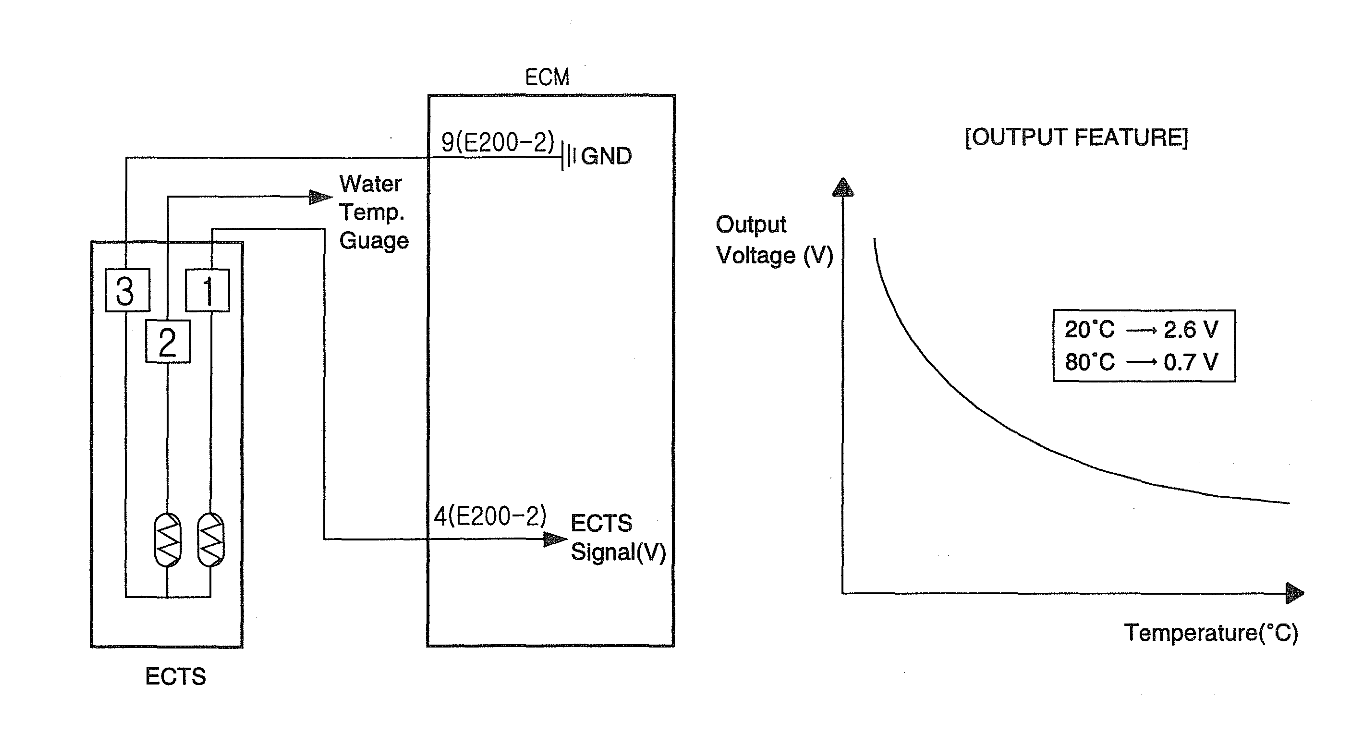


EFMF105G

WATER TEMPERATURE SENSOR (WTS) E3CFEC4D

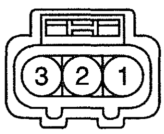
Engine Coolant Temperature Sensor (ECTS) installed in the engine coolant passage of the cylinder head detects the engine coolant temperature and emits signals to the ECM. This part employs a thermistor which is sensitive to changes in temperature. The electric resistance of the thermistor decreases in response to a temperature rise (NTC). The ECM determines engine coolant temperature by the sensor output voltage and provides optimum fuel enrichment when the engine is cold.

[CIRCUIT DIAGRAM AND OUTPUT FEATURE (ECTS)]



EFMF002E

[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECM Terminal 4(E200-2)	ECTS Signal
2	Cluster	Gauge unit
3	ECM Terminal 9(E200-2)	GND

EFMF003D

SENSOR INSPECTION (WTS)

1. USING HI-SCAN (PRO)

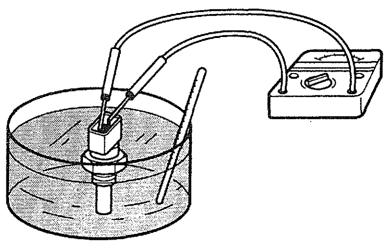
Check Item	Data Display	Check Condition	Coolant Temperature [℃ (°F)]	Resistance (kΩ)
Engine Coolant Temperature Sensor (ECTS)	Engine Coolant Temperature Sensor (ECTS)	IG ON or Engine Running	-40 (-40)	48.14
			20 (68)	2.33 ~ 2.97
			80 (178)	0.31 ~ 0.43
			110 (230)	0.15

2. USING MULTI-METER

1) Remove the Coolant Temperature Sensor (ECTS) from the intake manifold.

2) With the temperature sensing portion of Engine Coolant Temperature Sensor (WTS) immersed in hot engine coolant, check the resistance.

Temperature [℃ (°F)]	Resistance (kΩ)
0 (32)	5.79
20 (68)	2.33 ~ 2.97
40 (104)	0.31 ~ 0.43
80 (176)	0.32



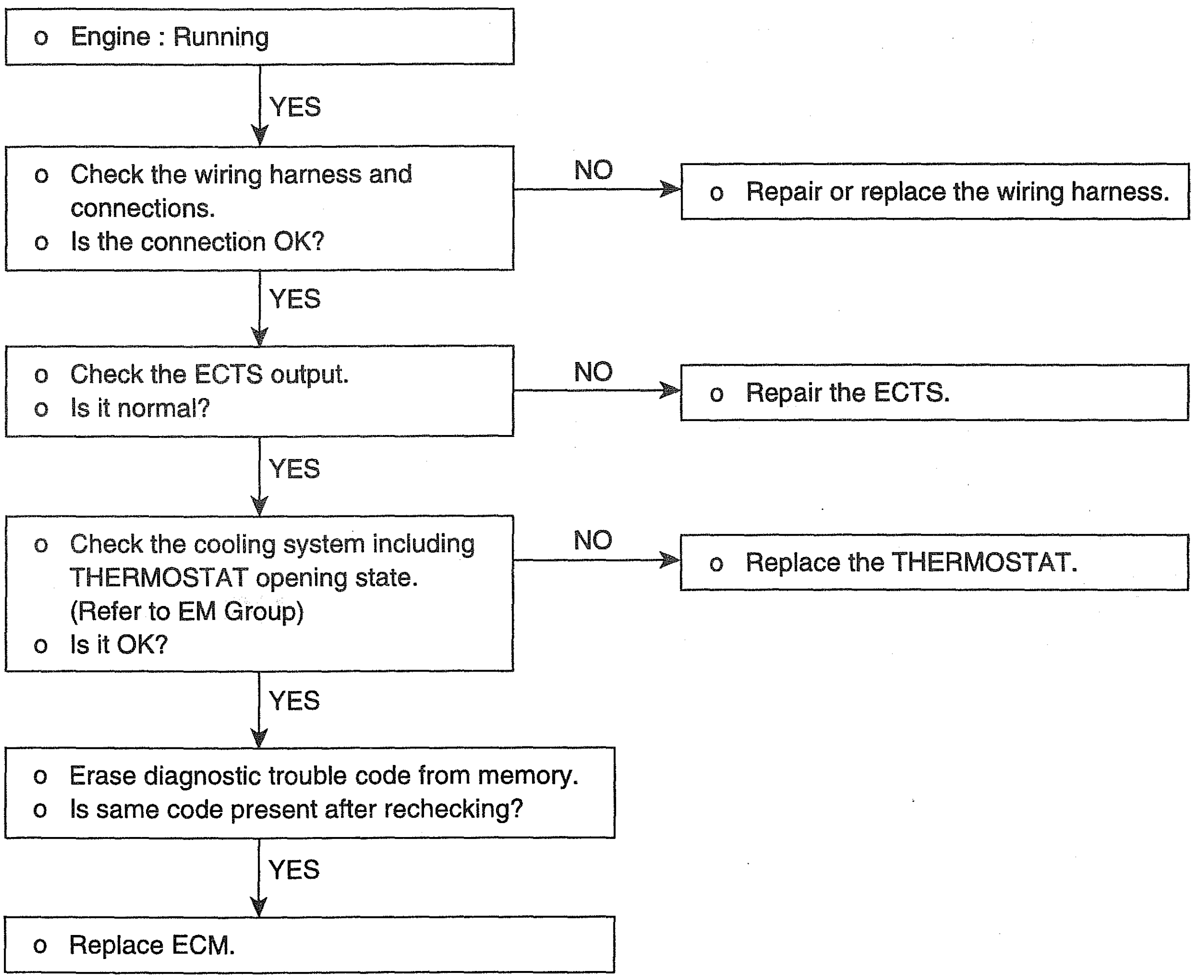
EFMF223A

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

3. USING VOLT-METER

Check Item	Coolant Temperature [℃ (°F)]	Voltage (V)
Engine Coolant Temperature Sensor (ECTS) Signal Output	0 (32)	3.4 - 3.6
	20 (68)	2.5 - 2.7
	40 (104)	1.5 - 1.7
	80 (176)	0.6 - 0.8

TROUBLESHOOTING PROCEDURES



EFMF030A

TROUBLEHSOOTING HINTS

If the fast idle speed is not adequate or the engine gives off dark smoke during warm-up, the Engine Coolant Temperature Sensor (ECTS) might be the cause.

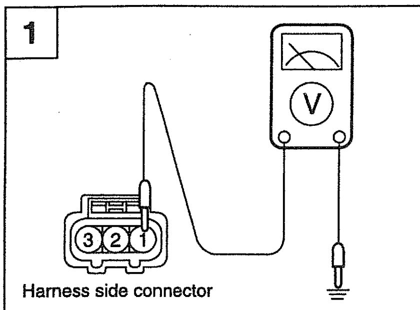
INSTALLATION

1. Apply sealant LOCTITE 962T or the equivalent to the threaded portion.
2. Install the Engine Coolant Temperature Sensor (ECTS) and tighten it to the specified torque.

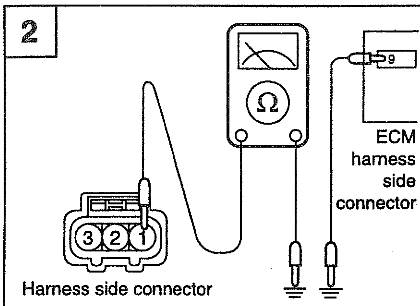
Tightening Torque : 20 ~ 40 N·m (2 ~ 4 kg·m, 14.5 ~ 28.9 lb·ft)

3. Securely connect the harness connector.

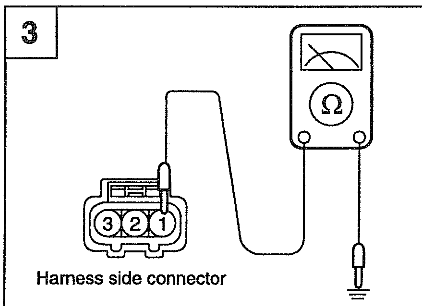
HARNESS INSPECTION PROCEDURES (ECTS)

1		Measure the Power supply voltage. • Sensor Connector: Disconnected • ECM Connector: Connected • Ignition Switch: ON • Voltage (V): Approx. 5V	**OK** ⇒ **NG** ⇒	2 Repair the harness

EFMF005S

2		Check for an open circuit or a short circuit between ECM and Engine Coolant Temperature Sensor (ECTS). • Sensor Connector: Disconnected • ECM Connector: Approx. 5V	**OK** ⇒ **NG** ⇒	3 Repair the harness

EFMF005T

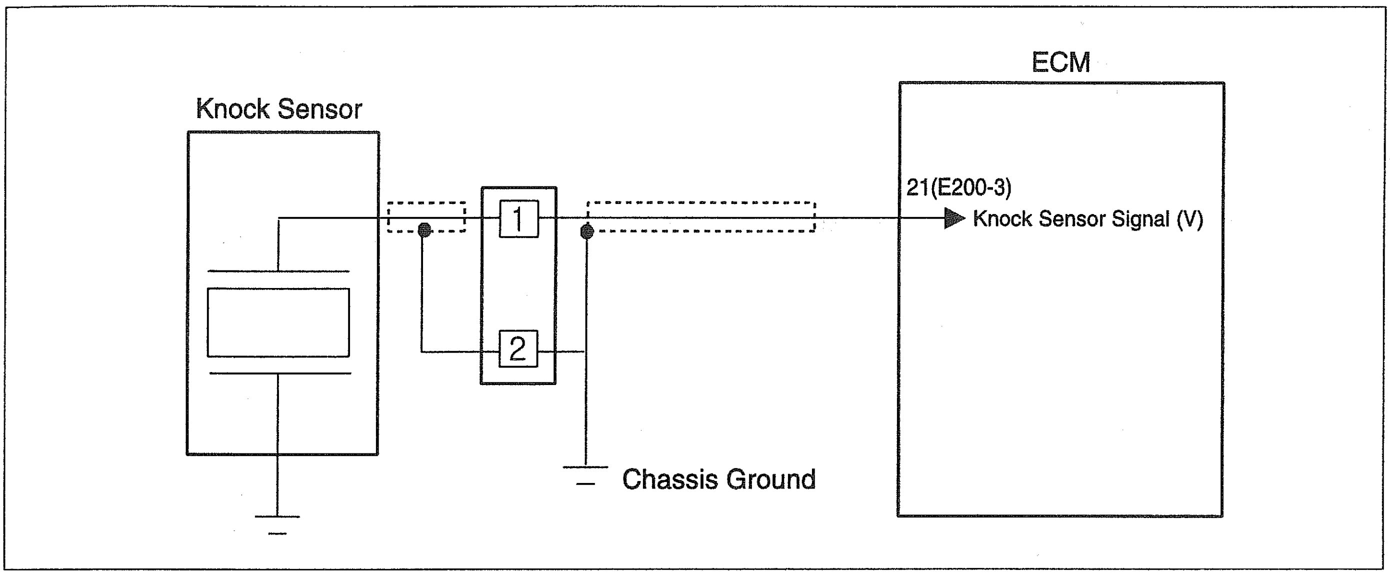
3		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	**OK** ⇒ **NG** ⇒	**END!** Repair the harness

LFCD005U

KNOCK SENSOR EA9D82DF

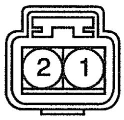
The knock sensor is a piezoelectric device attached to the cylinder block that senses pressure from engine knock conditions. This vibrational pressure is then converted into a voltage signal which is delivered as output. If engine knock occurs, ignition timing is retarded to suppress it.

[CIRCUIT DIAGRAM (KNOCK SENSOR)]



EFMF002F

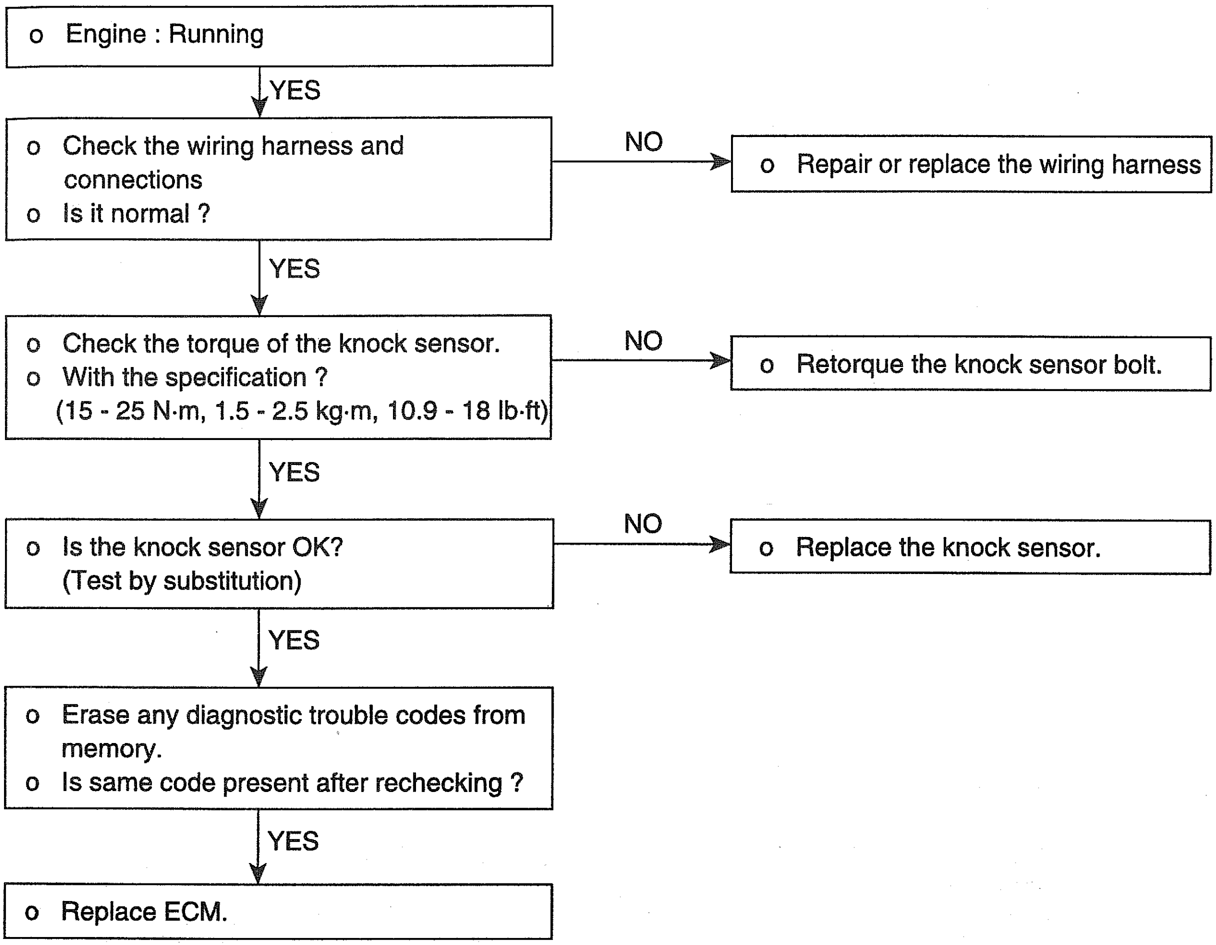
[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECM Terminal 21(E200-3)	Knock Sensor Signal Output
2	Chassis Ground	GND (Shield)

EFMF003E

TROUBLESHOOTING PROCEDURES



EFMF733B

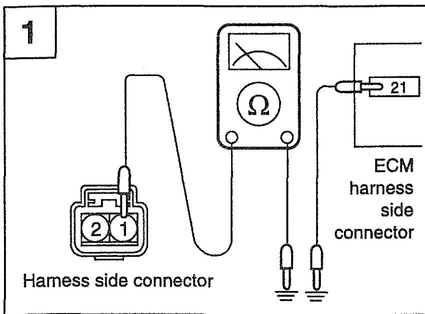
TROUBLESHOOTING HINTS

1. The MIL is ON or the DTC is displayed on the HI-SCAN (PRO) under the following condition:

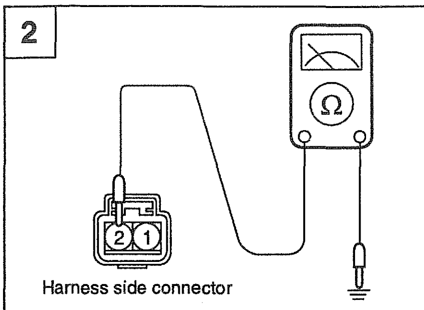
   1) When the knock sensor signal is not detected, even though the engine is in an overload condition.

   2) When the knock sensor signal is abnormally low.

HARNESS INSPECTION PROCEDURES (KNOCK SENSOR)

1 	Check for an open circuit or a short circuit between ECM and Knock Sensor. • Sensor Connector: Disconnected • ECM Connector: Disconnected	**OK** ⇨ **NG** ⇨	2 Repair the harness

EFMF005V

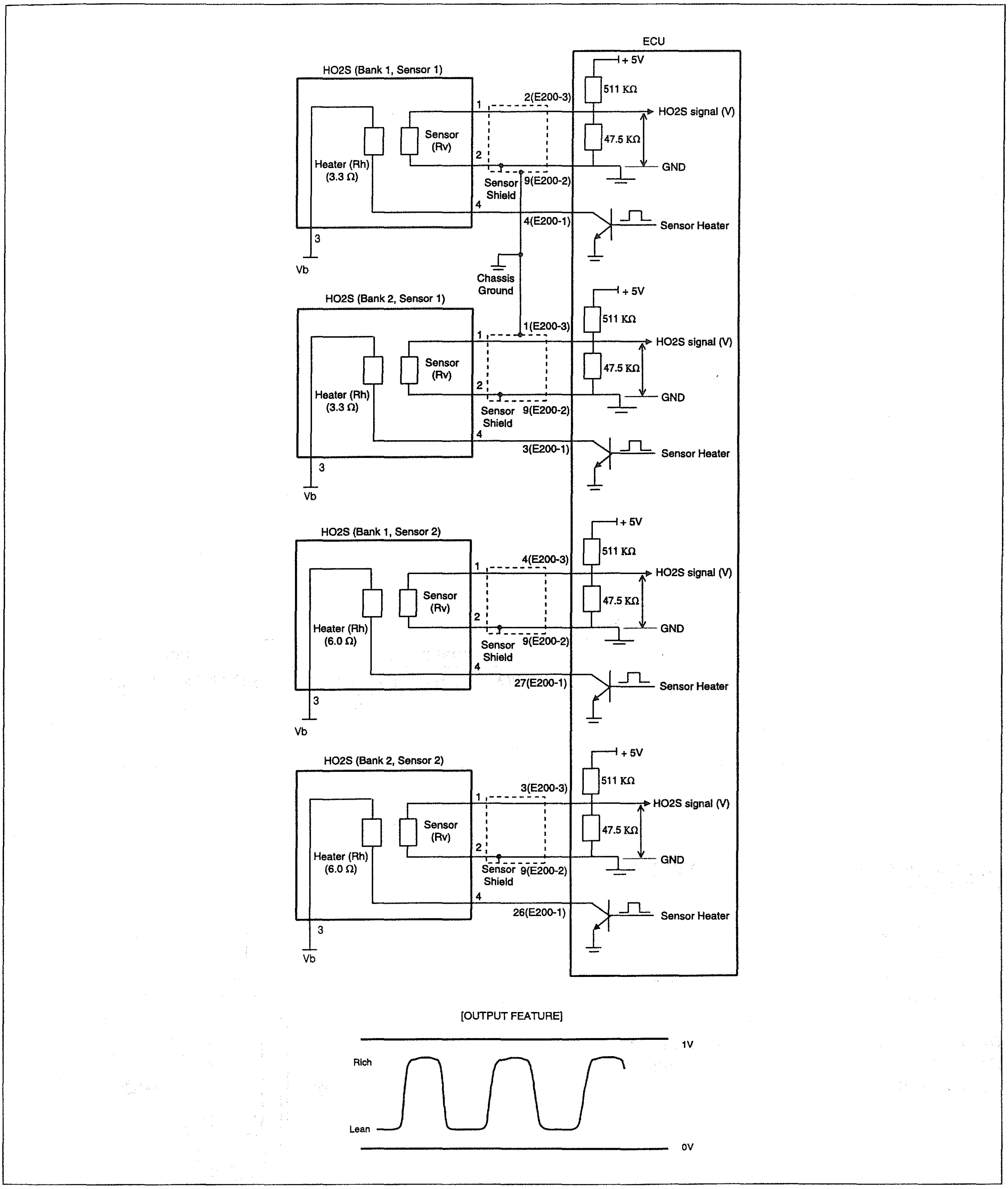
2 	Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	**OK** ⇨ **NG** ⇨	**END** Repair the harness

LFCD005W

HEATED OXYGEN SENSOR (HO2S) - ZIRCONIA (ZrO_2) E1CA4EFB

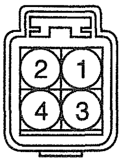
The heated oxygen sensor (HO2S) senses the oxygen concentration in exhaust gas and converts it into a voltage that is sent to the ECM. For Zirconium type sensors, the oxygen sensor outputs about 1V when the air fuel ratio is richer than the theoretical ratio, and outputs about 0V when the ratio is leaner (higher oxygen concentration in exhaust gas). The ECM controls the fuel injection ratio based on this signal so that the air fuel ratio is maintained at the stoichiometric ratio. The oxygen sensor has a heating element that ensures sensor performance during all driving conditions.

[CIRCUIT DIAGRAM (HO2S)]



EFMF002G

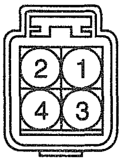
[HARNESS CONNECTOR]



(Bank 1, Sensor 1)

HO2S (Bank 1, Sensor 1)

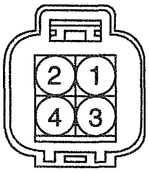
Pin	Connected to	Function
1	ECM Terminal 2(E200-3)	HO2S Signal Output
2	ECM Terminal 9(E200-2)	GND
3	Main Relay	Battery Voltage
4	ECM Terminal 4(E200-1)	Sensor Heater



(Bank 2, Sensor 1)

HO2S (Bank 2, Sensor 1)

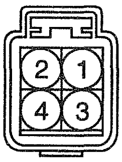
Pin	Connected to	Function
1	ECM Terminal 1(E200-3)	HO2S Signal Output
2	ECM Terminal 9(E200-2)	GND
3	Main Relay	Battery Voltage
4	ECM Terminal 3(E200-1)	Sensor Heater



(Bank 1, Sensor 2)

HO2S (Bank 1, Sensor 2)

Pin	Connected to	Function
1	ECM Terminal 4(E200-3)	HO2S Signal Output
2	ECM Terminal 9(E200-2)	GND
3	Main Relay	Battery Voltage
4	ECM Terminal 27(E200-1)	Sensor Heater



(Bank 2, Sensor 2)

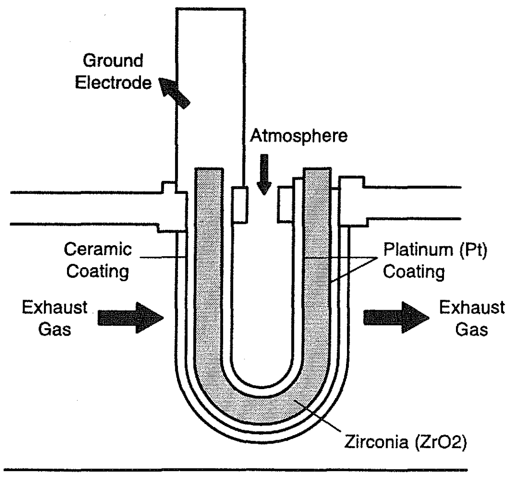
HO2S (Bank 2, Sensor 2)

Pin	Connected to	Function
1	ECM Terminal 3(E200-3)	HO2S Signal Output
2	ECM Terminal 9(E200-2)	GND
3	Main Relay	Battery Voltage
4	ECM Terminal 26(E200-1)	Sensor Heater

EFMF003F

HO2S - ZIRCONIA (ZrO_2) OPERATION PRINCIPLE

The Zirconia (ZrO_2) which is coated with Platinum (Pt) on both sides will generate the voltage if the density of oxygen on atmosphere side and exhaust gas side is different in high temperature.
In other words oxygen ion moves from high-density side (Atmosphere) to low-density side (exhaust gas), at a result Sensor Voltage is generated by Nernst equation between two electrodes.



EFMF004B

TROUBLESHOOTING HINTS

1. If the HO2S is defective, abnormally high emissions may occur.

2. If the HO2S check results are normal, but the sensor output voltage is out of specification, check for the following items (related to air fuel ratio control system):

   1) Defective Injector

   2) Air leaks in the intake manifold

   3) Defective Mass Air Flow (MAF) Sensor

   4) Defective Intake Air Temperature Sensor (ATS)

   5) Defective Engine Coolant Temperature Sensor (WTS)

   6) Defective Manifold Absolute Pressure (MAP) Sensor

SENSOR INSPECTION (HO2S)

1. USING HI-SCAN (PRO)

Check item	Check conditions	Engine state	Test specification
Heated Oxygen Sensor (HO2S)	Engine: Warm-up (make the mixture lean by engine speed reduction, and rich by racing)	When sudden deceleration from 4,000 rpm	200mV or lower
		When engine is suddenly raced	600-1,000 mV
	Engine: Warm-up (using the heated oxygen sensor signal, check the air/fuel mixture ratio, and also check the condition of control by the ECM).	Idle	Oscillate between less than 300 mV and more than 700 mV
		2,000 rpm	

2. USING VOLTMETER

NOTE

- *Before checking, warm up the engine until the engine coolant temperature reaches 80 to 95 ℃ (176 to 205 °F).*
- *Use an accurate digital voltmeter.*

1) Disconnect the Heated Oxygen Sensor (HO2S) connector, and measure the resistance of heater between terminal 3 and terminal 4.

HO2S (Bank 1, Sensor 1): 3.3 Ω
HO2S (Bank 2, Sensor 1): 3.3 Ω
HO2S (Bank 1, Sensor 2): 6.0 Ω
HO2S (Bank 2, Sensor 2): 6.0 Ω

2) Replace the Heated Oxygen Sensor (HO2S) if there is a malfunction.

3) Apply battery voltage directly between terminal 3 and terminal 4.

NOTE

Be careful when applying the voltage. Damage will result if terminals 1 and 2 are connected to any voltage.

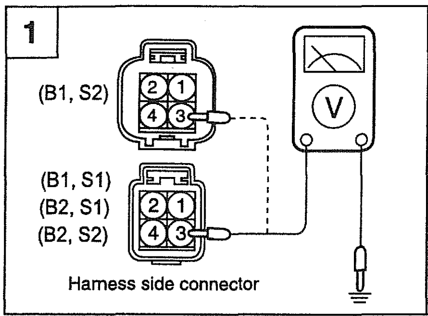
4) Connect a high-impedance digital-type voltmeter between terminal 1 and terminal 2.

5) While repeatedly racing the engine, measure the Heated Oxygen Sensor (HO2S) output voltage.

6) If there is a problem, replace the Heated Oxygen Sensor (HO2S).

Tightening torque: 40 - 50 N·m (4 - 5 kg·m, 29 - 36 lb·ft)

HARNESS INSPECTION PROCEDURES (HO2S)



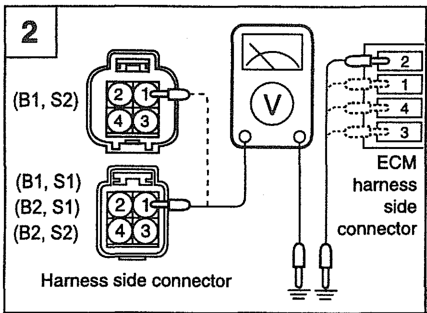
Measure the Power supply voltage.

- Sensor Connector: Disconnected
- ECM Connector: Connected
- Ignition Switch: ON
- Voltage (V): Battery Voltage

OK ⇒ 2

NG ⇒ Repair the harness

EFMF005X



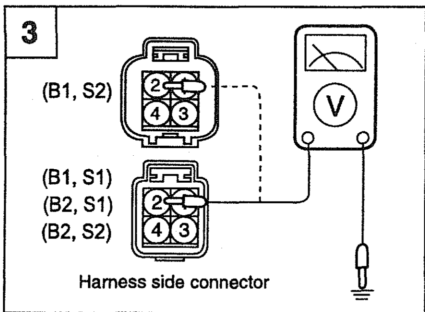
Check for an open circuit or a short circuit between ECM and Heated Oxygen Sensor (HO2S).

- Sensor Connector: Disconnected
- ECM Connector: Disconnected

OK ⇒ 3

NG ⇒ Repair the harness

EFMF005Y



Check for the continuity of the sensor ground.

- Sensor Connector: Disconnected

OK ⇒ **END**

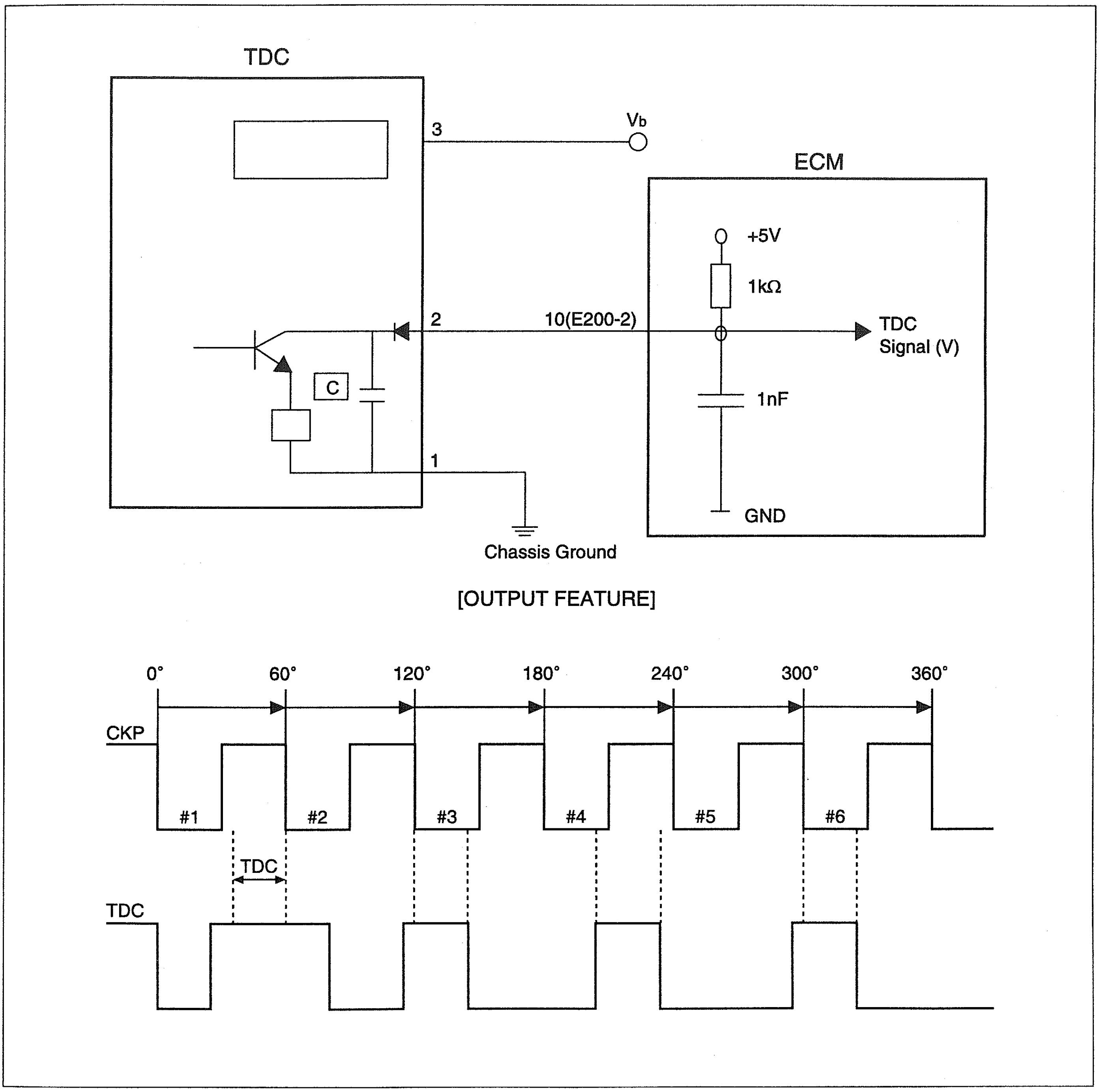
NG ⇒ Repair the harness

LFCD005Z

CAMSHAFT POSITION (TDC) SENSOR E0DBCEAA

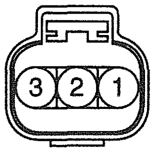
The TDC Sensor is a Hall-effect sensor that detects the camshaft position on the compression stroke of the No.1 cylinder, converts it into a pulse signal, and inputs it to the ECM. The ECM then computes the fuel injection sequence, etc. based on the input signal.

[CIRCUIT DIAGRAM AND OUTPUT FEATURE (TDC)]



EFMF002H

[HARNESS CONNECTOR]



Pin	Connected to	Function
1	Chassis Ground	GND
2	ECM Terminal 10(E200-2)	TDC Signal Output
3	Main Relay	Battery Voltage

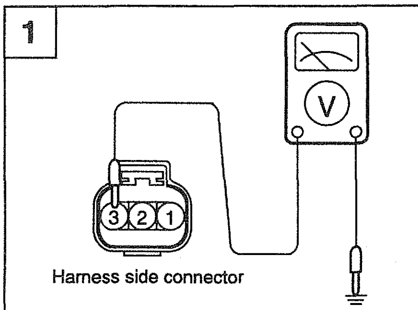
EFMF003G

TROUBLEHSOOTING HINTS

If the TDC Sensor does not operate correctly, sequential injection is may not occur and the engine may stall or run irregularly at idle or fail to accelerate normally.

HARNESS INSPECTION PROCEDURES (TDC)

1



Measure the Power supply voltage.

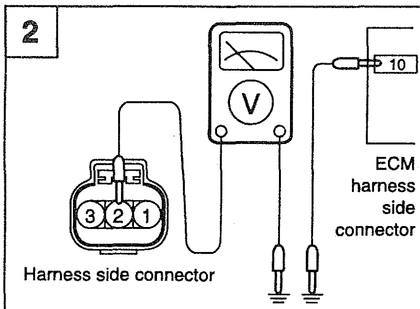
- Sensor Connector: Disconnected
- ECM Connector: Connected
- Ignition Switch: ON
- Voltage (V): Battery Voltage

OK ⇒ 2

NG ⇒ Repair the harness

EFMF006Z

2



Check for an open circuit or a short circuit between ECM and Camshaft Position (TDC) Sensor.

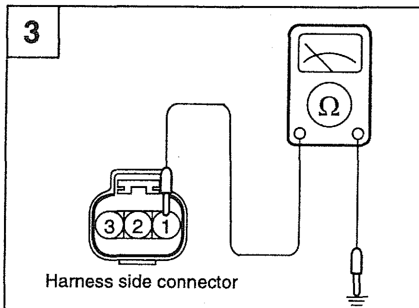
- Sensor Connector: Disconnected
- ECM Connector: Disconnected

OK ⇒ 3

NG ⇒ Repair the harness

EFMF006B

3



Check for the continuity of the sensor ground.

- Sensor Connector: Disconnected

OK ⇒ END

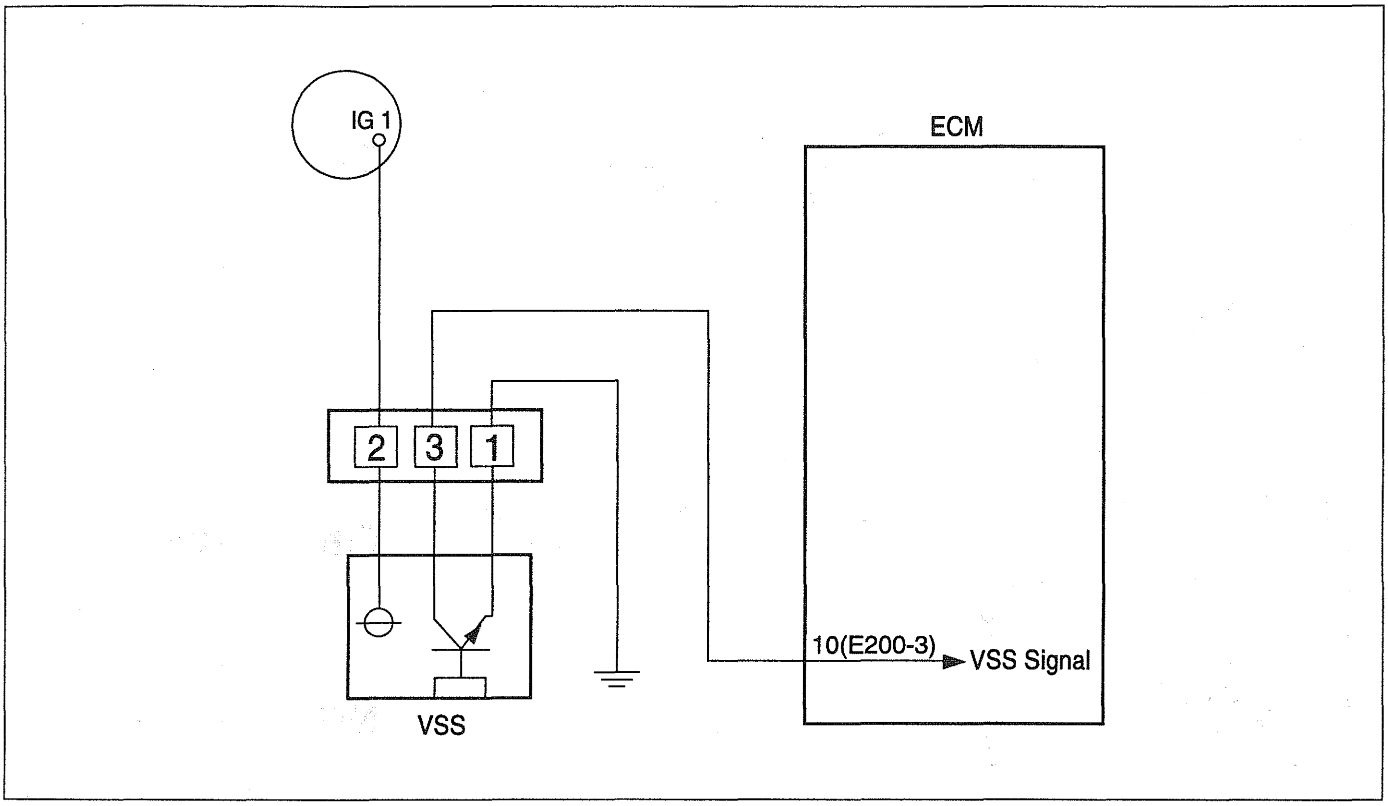
NG ⇒ Repair the harness

LFCD006C

VEHICLE SPEED SENSOR (VSS) E7E3AA92

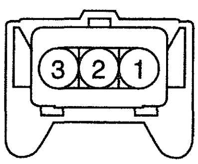
The function of vehicle speed sensor is to sense the TOOTH signal in T/M housing (4 pulses are output per 1 turn) and send relevant signal to ECM. The signal is used for computing the vehicle speed and the speed display on the tachometer as well.
The information is used for idle control correction duty range (the range of correction is limited with the vehicle speed and A/C load), cooling fan control, fuel injection prohibition at over vehicle speed, vehicle jerk control and traction control (At the torque being reduced with the exhaust gas modeling).
The action against malfunctions of the sensor is to fix the speed at 0 KPH. (The highest engine revolution should be limited to 2500 rpm).

[CIRCUIT DIAGRAM (VSS)]



EFMF002C

[HARNESS CONNECTOR]

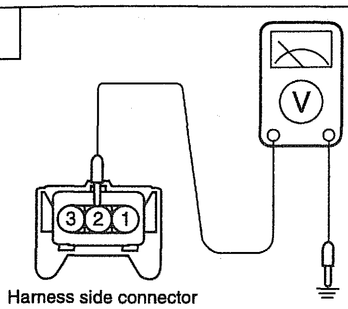


Pin	Connected to	Function
1	GND	GND
2	Ignition Switch	Battery Voltage
3	ECM Terminal 10(E200-3)	VSS Signal Output

EFMF003C

HARNESS INSPECTION PROCEDURES (VSS)

1



Measure the sensor power voltage.

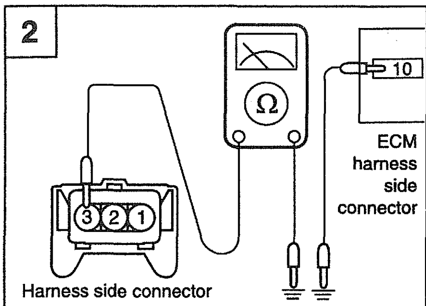
- Sensor Connector: Disconnected
- ECM Connector: Connected
- Ignition Switch: ON
- Voltage (V): Battery Voltage

OK ⇒ 2

NG ⇒ Repair the harness

EFMF005P

2



Check for an open circuit or a short circuit between ECM and Vehicle Speed Sensor (VSS).

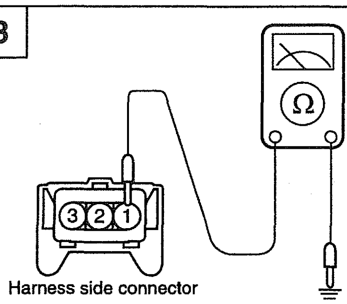
- Sensor Connector: Disconnected
- ECM Connector: Disconnected

OK ⇒ 3

NG ⇒ Repair the harness

EFMF005Q

3



Check for the continuity of the sensor ground.

- Sensor Connector: Disconnected

OK ⇒ **END!**

NG ⇒ Repair the harness

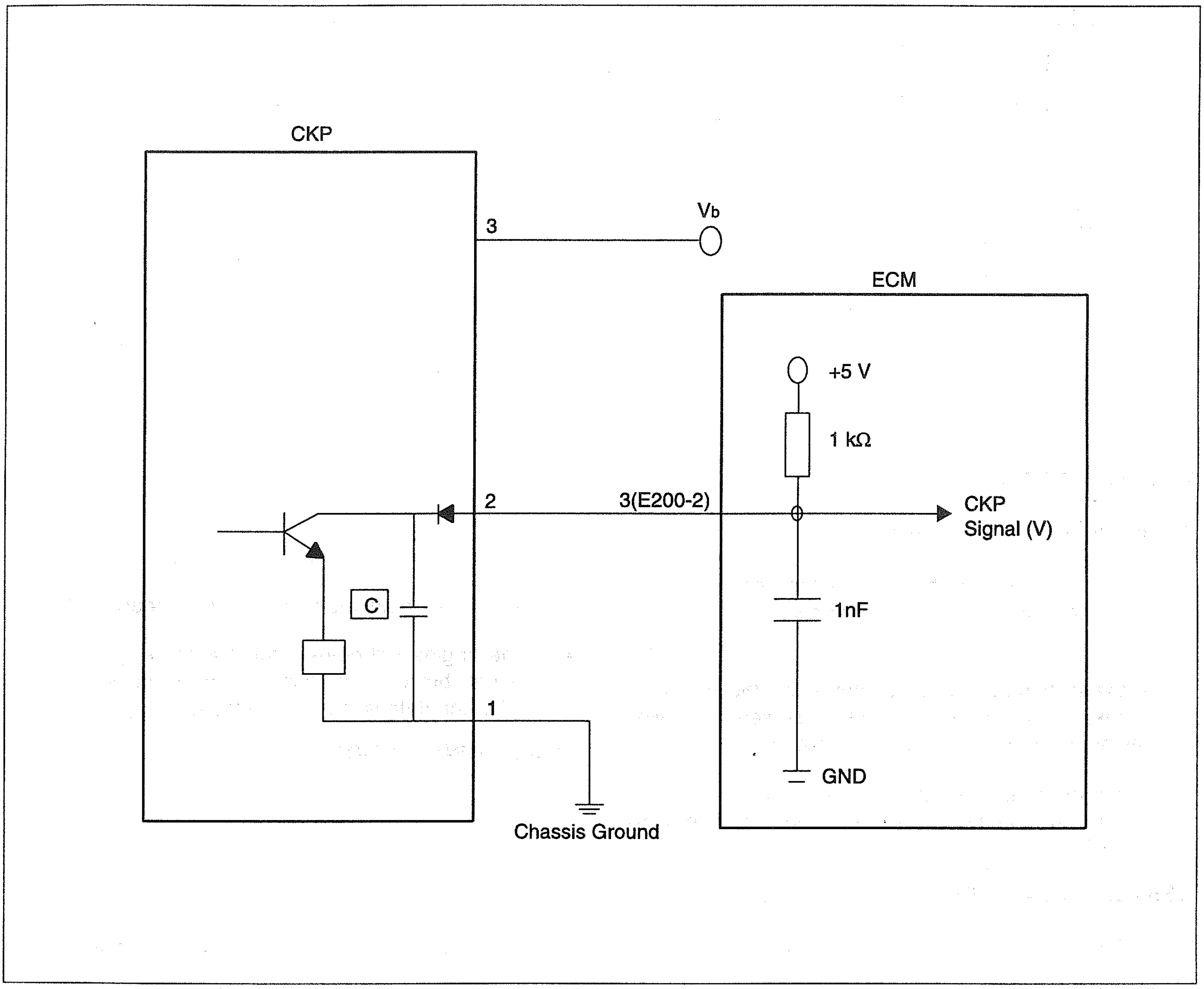
EFMF005R

CRANKSHAFT POSITION (CKP) SENSOR

ED1AD87A

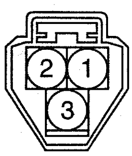
The Crankshaft Position Sensor is a Hall-effect sensor that senses the Crank angle (piston position) of each cylinder and converts it into a pulse signal. Based on the input signal, the ECM computes the engine speed and controls the fuel injection timing and ignition timing.

[CIRCUIT DIAGRAM (CKP)]



EFMF002I

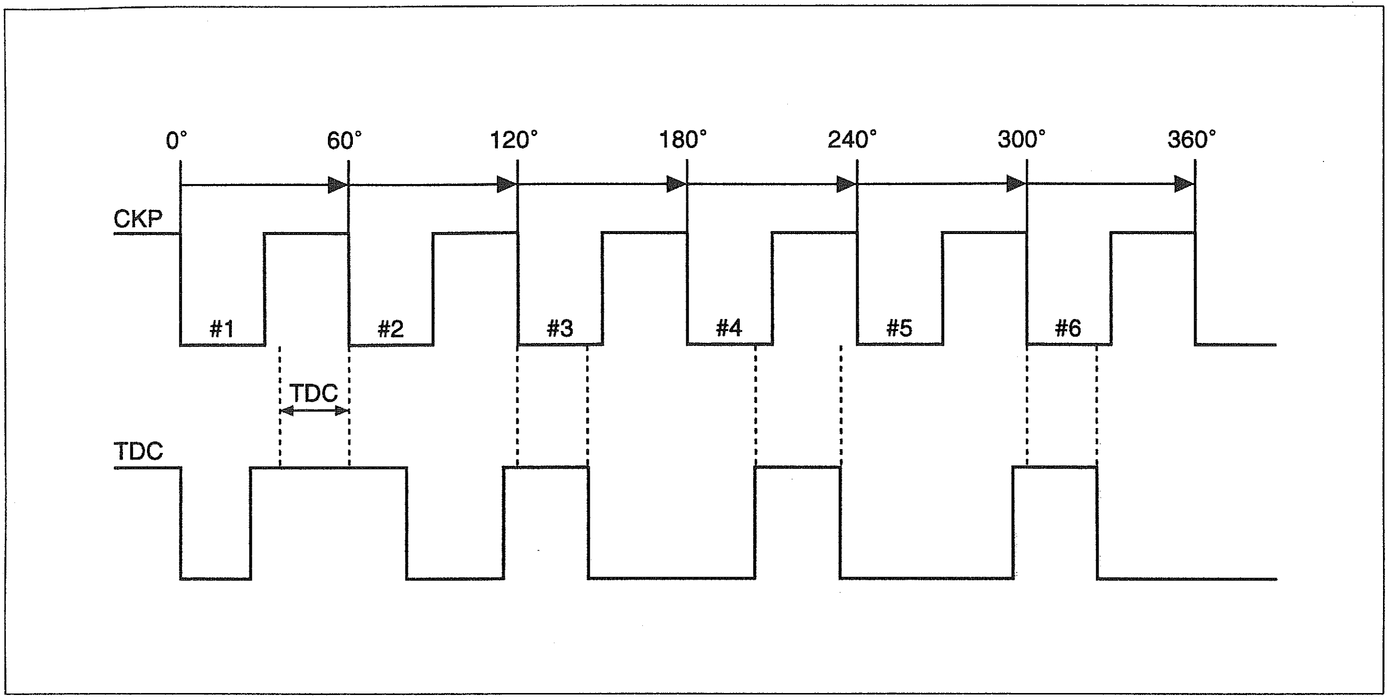
[HARNESS CONNECTOR]



Pin	Connected to	Function
1	Chassis Ground	GND
2	ECM Terminal 3(E200-2)	CKP Signal Output
3	Main Relay	Battery Voltage

EFMF003H

[OUTPUT FEATURE OF CKP]



LFCD143B

TROUBLEHSOOTING HINTS

1. If unexpected shocks are felt during driving or the engine stalls suddenly, shake the crankshaft position sensor harness. If this causes the engine to stall, check for poor sensor connector contact.

2. If the tachometer reads 0 rpm when the engine is cranked, check for faulty crank angle sensor, broken timing belt or ignition system problems.

3. If the engine can be run at idle even if the crank angle sensor reading is out of specification, check the following:

   1) Faulty Engine Coolant Temperature Sensor (ECTS)

   2) Faulty Idle Speed Control System

   3) Poorly adjusted reference idle speed

4. The engine will crank without a crank angle sensor signal, but will not start. Once the sensor detects TDC, the data is stored until the next re-start.

SENSOR INSPECTION

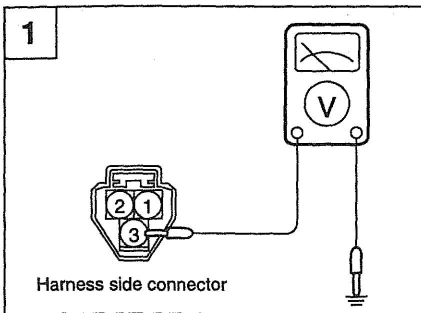
USSING HI-SCAN (PRO)

Check Item	Check conditions	Check content	Normal state
Crankshaft Position (CKP) Sensor	• Engine cranking • Tachometer connected (Check on and off ignition coil by tachometer)	Compare cranking speed and multi-tester reading	Indicated speed agrees

Check Item	Check conditions	Temperature [℃ (°F)]	Test specification (rpm)
Crankshaft Position (CKP) Sensor	• Engine: Running at idle • Idle position switch: ON	-20 (-4)	1,500 ~ 1,700
		0 (32)	1,350 ~ 1,550
		20 (68)	1,200 ~ 1,400
		40 (104)	1,000 ~ 1,200
		80 (176)	650 ~ 850

HARNESS INSPECTION PROCEDURES (TDC)

1



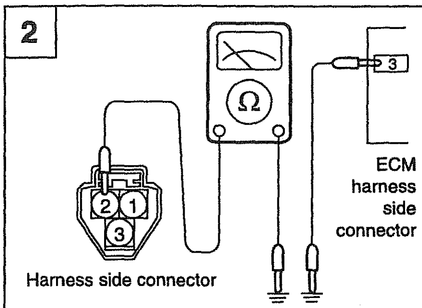
Measure the Power supply voltage.
- Sensor Connector: Disconnected
- ECM Connector: Connected
- Ignition Switch: ON
- Voltage (V): Battery Voltage

OK ⇒ **2**

NG ⇒ Repair the harness

EFMF006D

2



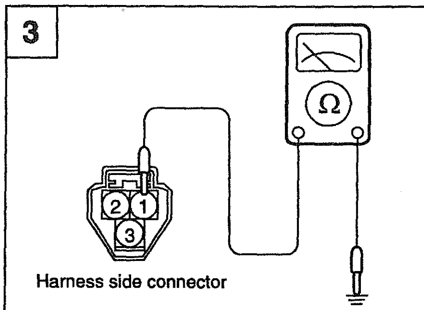
Check for an open circuit or a short circuit between ECM and Crankshaft Position (CKP) Sensor.
- Sensor Connector: Disconnected
- ECM Connector: Disconnected

OK ⇒ **3**

NG ⇒ Repair the harness

EFMF006E

3



Check for the continuity of the sensor ground.
- Sensor Connector: Disconnected

OK ⇒ **END**

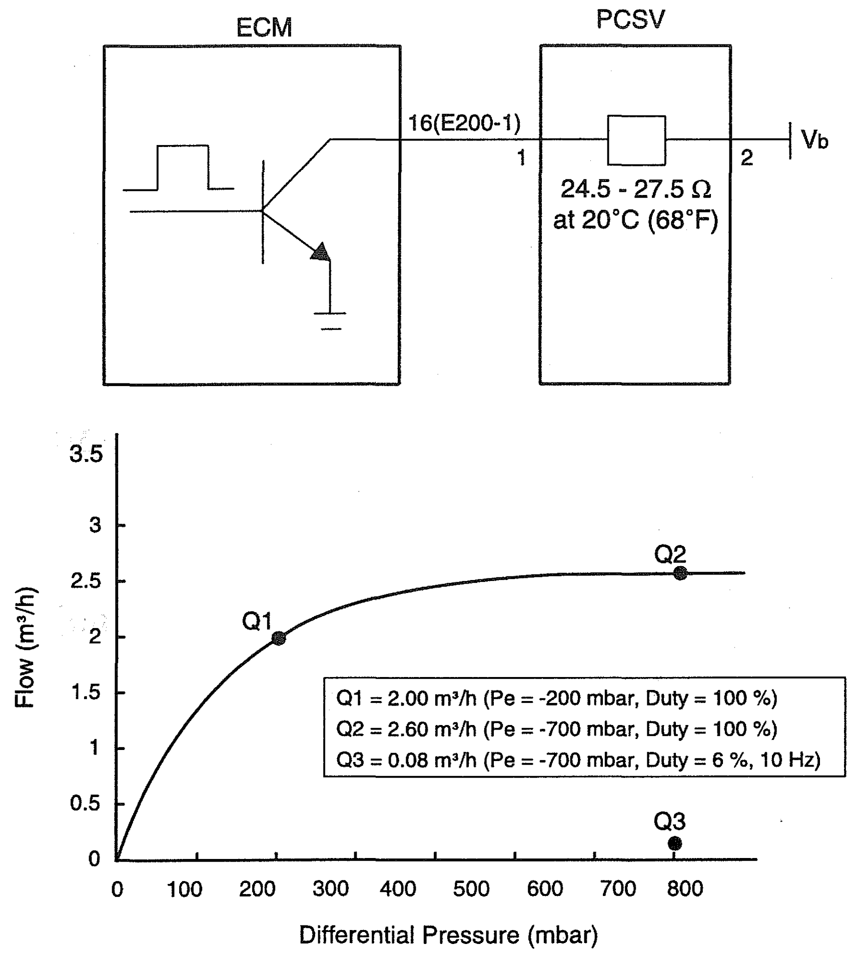
NG ⇒ Repair the harness

LFCD006F

PURGE CONTROL SOLENOID VALVE (PCSV) ED4BA670

Purge Control Valve (PCV) controls evaporative gas gathered in canister. It is divided into duty type controlled by ECU and ON/OFF type controlled by vacuum in intake manifold and ECU.
PCV is closed when water temperature is low or engine is idle and is open when water temperature is in normal temperature. When it is open, evaporative gas in canister is flowed into the intake manifold.
Especially duty type PCV is called Purge Control Solenoid Valve (PCSV). Duty is 0% when it is wholly closed, and 100% when it is wholly open (Generally Idle: 1~3 %, Max: 92%).

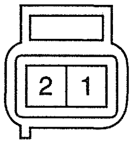
[CIRCUIT DIAGRAM AND OUTPUT FEATURE (PCSV)]



NOTE)
* $Pe = P_{manifold} - P_{inlet}$ ($P_{inlet} = P_{ambient}$)
* Q : Volume flow at the inlet stud at room temperature [20°C (68°F)]

EFMF002J

[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECM Terminal 16(E200-1)	PCSV Control Signal
2	Main Relay	Battery Voltage

EFMF003I

TROUBLESHOOTING PROCEDURES

o Engine : Running

YES ↓

o Check wiring harness and connections.
o Is it normal ?

NO → o Repair or replace the wiring harness.

YES ↓

o Check the PCSV.
o Is it normal ?

NO → o Replace the PCSV.

YES ↓

o Erase any diagnostic trouble codes from memory.
o Is same code present after rechecking?

YES ↓

o Replace ECM.

EFMF731D

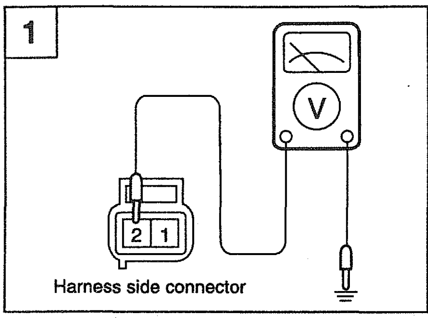
PCSV INSPECTION

USSING HI-SCAN (PRO)

Check Item	Check conditions	Check content	Normal state
Evaporative emission Canister Purge Control Solenoid Valve (PCSV) • Actuator test	IG ON (Do not start)	PCSV	Activate

HARNESS INSPECTION PROCEDURES (PCSV)

1



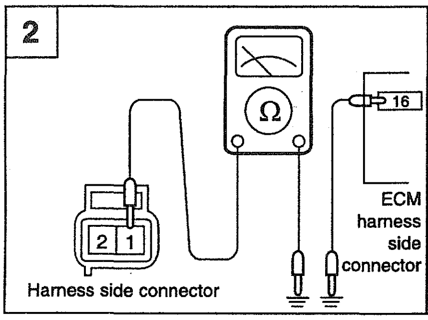
Measure the Power supply voltage.
- PCSV Connector: Disconnected
- ECM Connector: Connected
- Ignition Switch: ON
- Voltage (V): Battery Voltage

OK ⇨ 2

NG ⇨ Repair the harness

EFMF006G

2



Check for an open circuit or a short circuit between ECM and Purge Control Solenoid Valve (PCSV).
- PCSV Connector: Disconnected
- ECM Connector: Disconnected

OK ⇨ END

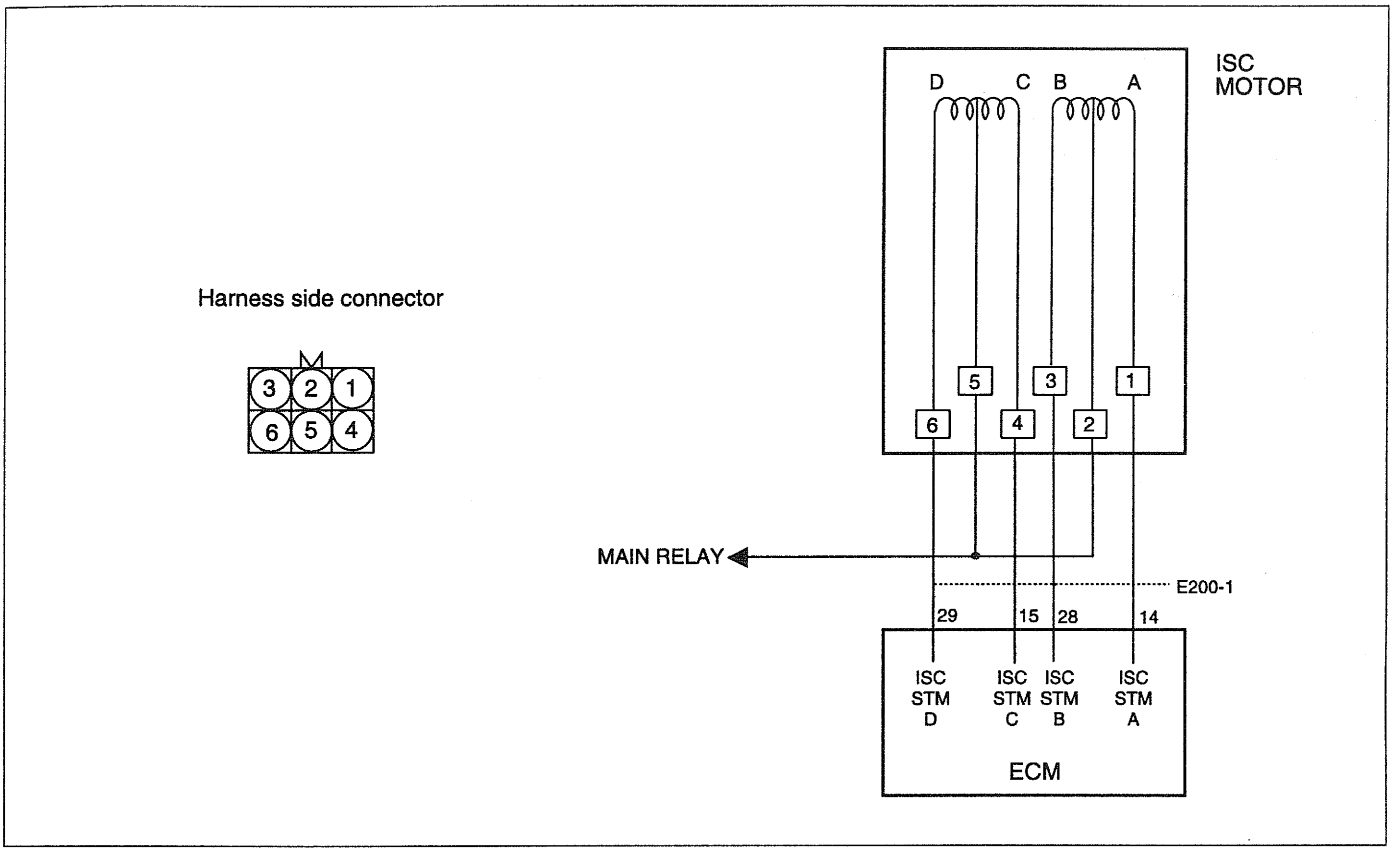
NG ⇨ Repair the harness

EFMF006H

IDLE SPEED CONTROL ACTUATOR EA81ADAE

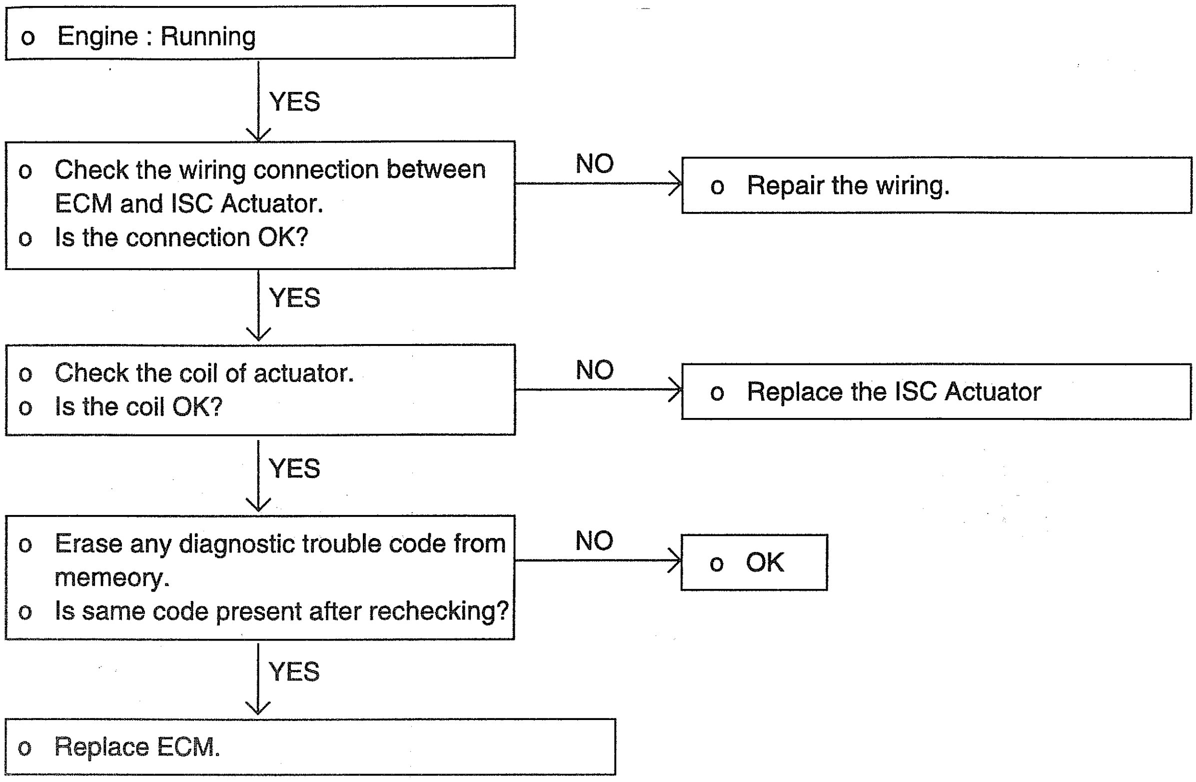
The idle speed control actuator is the double coil type and has two coils. The two coils are driven by separate driver stages in the ECM. Depending on the pulse duty factor, the equilibrium of the magnetic forces of the two coils will result in different angles of the motor.

CIRCUIT DIAGRAM



EFMF315A

TROUBLESHOOTING PROCEDURES



EFMF315B

TROUBLESHOOTING HINTS

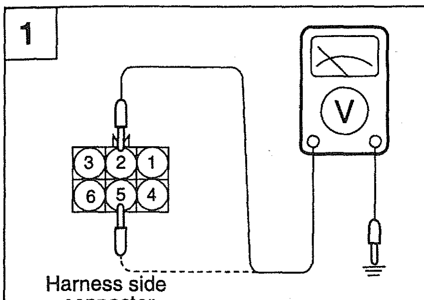
The MIL is ON or the DTC is displayed on the HI-SCAN under the following conditions

- When the primary voltage side in ECM is in short or open circuit.
- The ignition closed loop control in ECM is out of order.
- Open or short circuit is observed in idle air control system when ignition switch is turned onl.

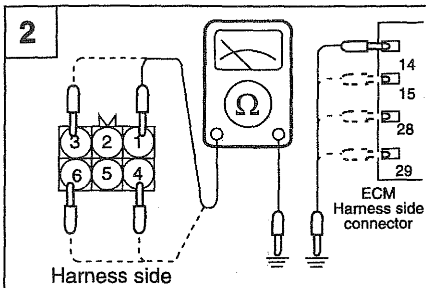
USING HI-SCAN

Check item	Check condition	HI-SCAN display	Type
Idle speed control actuator o Actuator	Start the engine	ISC	Activate

HARNESS INSPECTION PROCEDURE

Step	Procedure	Result	Action
1 	Measure the power supply voltage of the actuator. o Connector: Disconnected o Ignition switch: ON o Voltage (V): Battery voltage	OK ⇨	2
		NG ⇨	Repair the harness. Check the power supply

BFAD315C

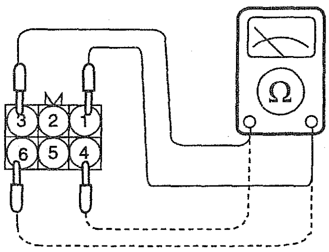
Step	Procedure	Result	Action
2 	Check for an open-circuit, or a short-circuit to ground between the ECM and the idle speed control actuator. o ECM connector : Disconnected o Idle speed actuator connector : Disconnected	OK ⇨	END !
		NG ⇨	Repair the harness.

EFMF315D

ACTUATOR INSPECTION

1. Disconnect the connector at the idle speed control actuator.
2. Measure the resistance between terminals.

Standard value
Terminal 1-3, 4-6 : 36.5-39.5Ω [20°C (68°F)]



Harness side connector

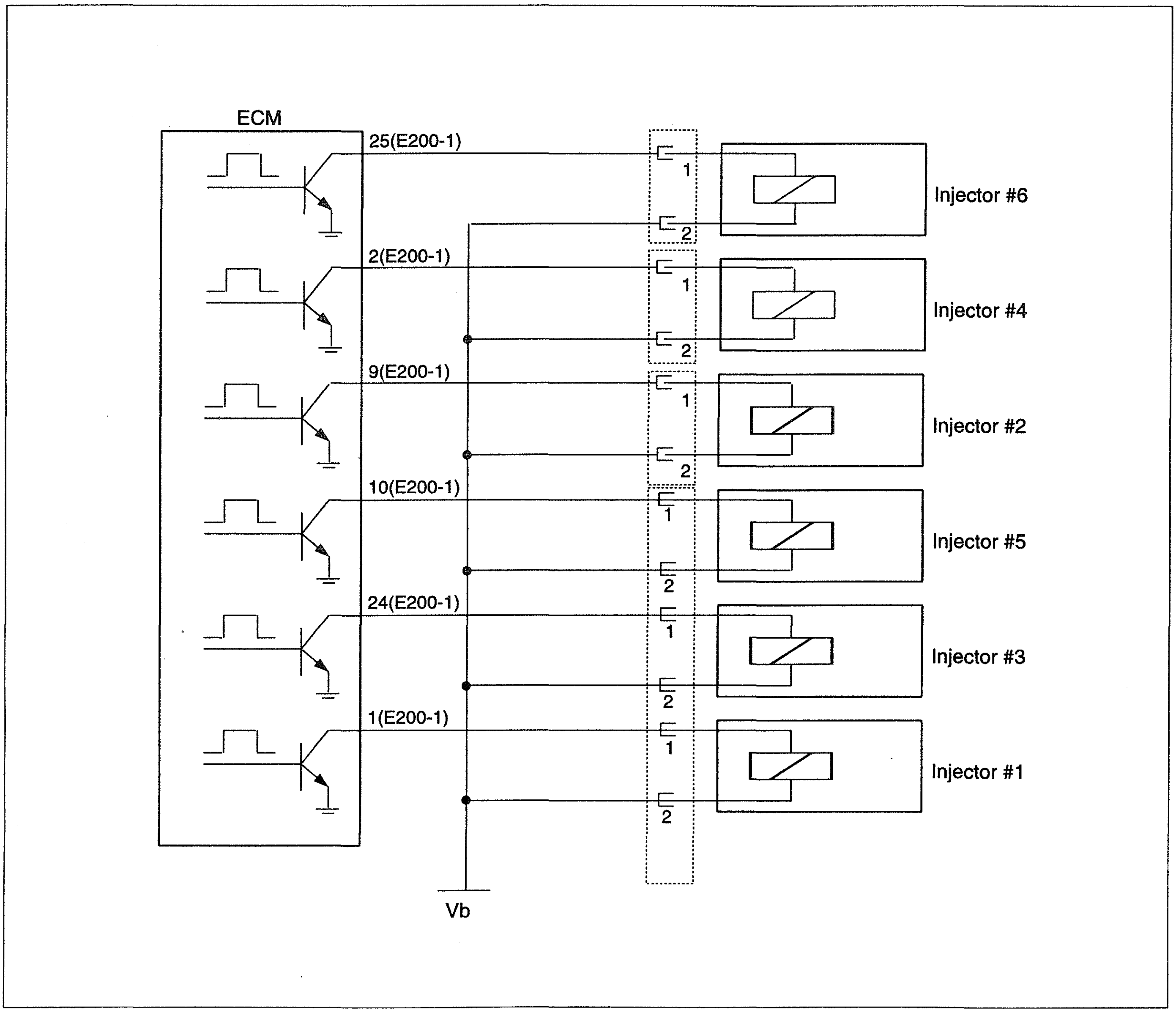
BFAD315E

3. Connector the connector to the idle speed control actuator.

FUEL INJECTOR EE920467

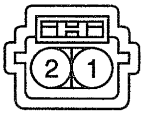
The injectors inject fuel to cylinders according to the signal, suitable to engine condition, from ECM. The ECM drives the injectors by electric current driving mode.
The basic fuel amount is performed by the mapping value based on the air amount and engine rate, and the fuel amount is corrected in the case of fuel amount correction (Air fuel ratio control signal, fuel evaporative emission gas control, learning increase of the fuel amount, warm-up control, catalytic heating control, fuel amount control in deceleration, idle control, fuel amount increase in full load, fuel increase in acceleration and restarting).
The fuel injection is controlled under unavailable state for safety purpose when engine rpm reaches the appropriate engine speed [On driving : 6300 ~ 6800 rpm, Engine stop (N-range) : 4700 rpm]

[CIRCUIT DIAGRAM (INJECTOR)]



EFMF002L

[HARNESS CONNECTOR]



Injector #1

Pin	Connected to	Function
1	Main Relay	Injector #1 Power Supply
2	ECM Terminal 1(E200-1)	Injector #1 Operation Signal

Injector #2

Pin	Connected to	Function
1	Main Relay	Injector #2 Power Supply
2	ECM Terminal 9(E200-1)	Injector #2 Operation Signal

Injector #3

Pin	Connected to	Function
1	Main Relay	Injector #3 Power Supply
2	ECM Terminal 24(E200-1)	Injector #3 Operation Signal

Injector #4

Pin	Connected to	Function
1	Main Relay	Injector #4 Power Supply
2	ECM Terminal 2(E200-1)	Injector #4 Operation Signal

Injector #5

Pin	Connected to	Function
1	Main Relay	Injector #5 Power Supply
2	ECM Terminal 10(E200-1)	Injector #5 Operation Signal

Injector #6

Pin	Connected to	Function
1	Main Relay	Injector#6 Power Supply
2	ECM Terminal 25(E200-1)	Injector #6 Operation Signal

EFMF003J

INJECTOR INSPECTION

1. USING HI-SCAN (PRO)

Check Item	Data display	Check conditions	Check content [℃ (°F)]	Test specification (ms)
Injector	Drive time (at staring)	Engine: Cranking	0 (32)	Approx. 17
			20 (68)	Approx. 35
			80 (176)	Approx. 8.5

Check Item	Data display	Check conditions	Engine state	Test specification
Injector	Drive time	• Engine coolant temperature: 80 to 95℃ (176 to 205°F) • Lamps, electric cooling fan, accessory modules: All OFF • Transaxle: Neutral (P range for vehicle with A/T) • Steering wheel: Neutral	Idle rpm	2.2~2.9 ms
			2,000 rpm	1.8~2.6 ms
			Rapid racing	Increasing

NOTE

- *Drive time indicates the injector activation time when the supply voltage is 11V and the cranking speed is less than 250 rpm.*
- *When engine coolant temperature is lower than 0℃ (32°F), the ECM fires all four cylinders simultaneously.*
- *When the vehicle is new (within initial operation of about 500 km [300 miles]), the injector drive time may be about 10% longer.*

Check Item	Item No.	Drive content	Check condition	Normal state
Injector • Actuator test	01	No. 1 injector shut off	Engine: Idling after warm-up (Shut off the injectors in sequence during and after engine warm-up; check the idle condition)	Idle should become unstable as injector shuts off.
	02	No. 2 injector shut off		
	03	No. 3 injector shut off		
	04	No. 4 injector shut off		
	05	No. 5 injector shut off		
	06	No. 6 injector shut off		

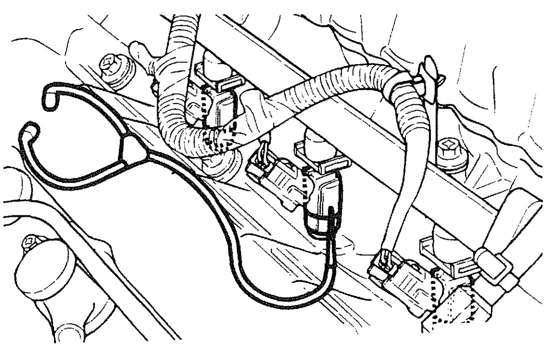
2. USING STETHOSCOPE AND VOLTMETER

1) OPERATION SOUND CHECK

a. Using a stethoscope, check the injectors for a clicking sound at idle. Check that the sound is produced at shorter intervals as the engine speed increases.

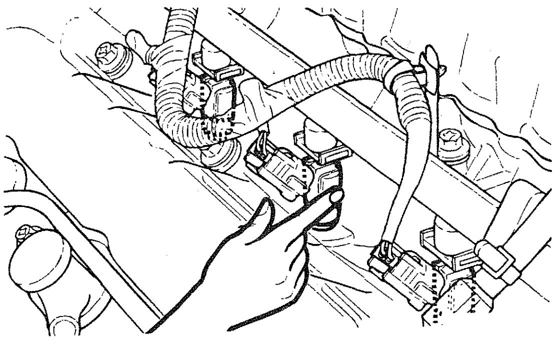
CAUTION

Ensure that the sound from an adjacent injector is not being transmitted along the delivery pipe to an inoperative injector.



EFMF019A

b. If a stethoscope is not available, check the injector operation with your finger. If no vibration is felt, check the wiring connector, injector or injection signal from the ECM.

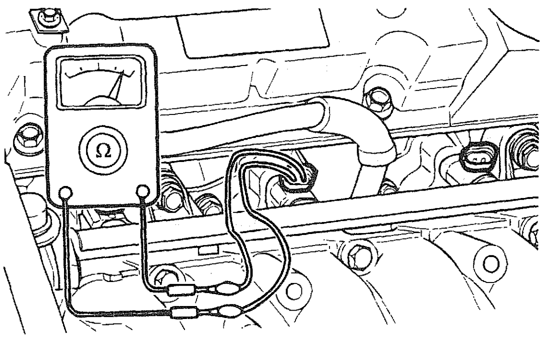


EFMF020A

2) RESISTANCE MEASUREMENT BETWEEN TERMINALS
   a. Disconnect the connector at the injector.
   b. Measure the resistance between terminals.

Standard value : 13 - 16 Ω [at 20℃ (68°F)]

   c. Re-connect the connector to the injector.

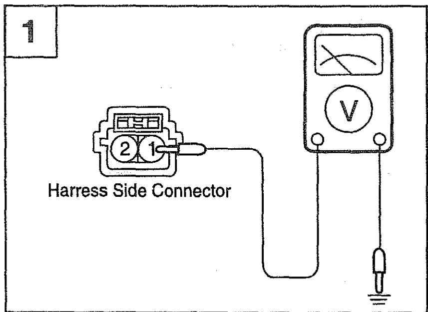
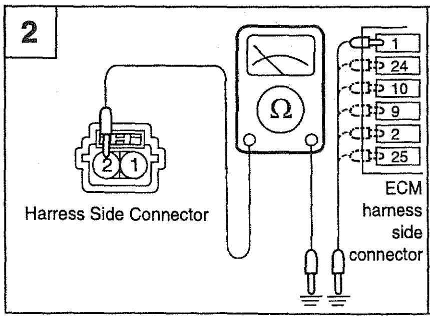


EFMF021A

TROUBLESHOOTING HINTS

1. If the engine is hard to start when hot, check for fuel pressure and injector leaks.
2. If the injectors do not operate when the engine is cranked, then check the followings:
   - Defective power supply circuit to the ECM, faulty ground circuit
   - Defective control relay
   - Defective Crankshaft Position (CKP) Sensor or Camshaft Position (TDC) Sensor
3. If there is any cylinder whose idle state remains unchanged when the fuel injectors are cut one after another during idling, check for the following items about that a cylinder.
   - Injector and harness
   - Ignition plug and high tension cable
   - Compression pressure
4. If the injection system is OK but the injector drive time is out of specification, check for the following items.
   - Poor combustion in the cylinder (faulty ignition plug, ignition coil, compression pressure, etc.)
   - Loose EGR valve seating

HARNESS INSPECTION PROCEDURES

	Measure the Power supply voltage. • Injector Connector: Disconnected • ECM Connector: Connected • Ignition Switch: ON • Voltage (V): Battery Voltage	OK ⇨	2
		NG ⇨	Repair the harness
	Check for an open circuit or a short circuit between ECM and Injector. • Injector Connector: Disconnected • ECM Connector: Disconnected	OK ⇨	END
		NG ⇨	Repair the harness

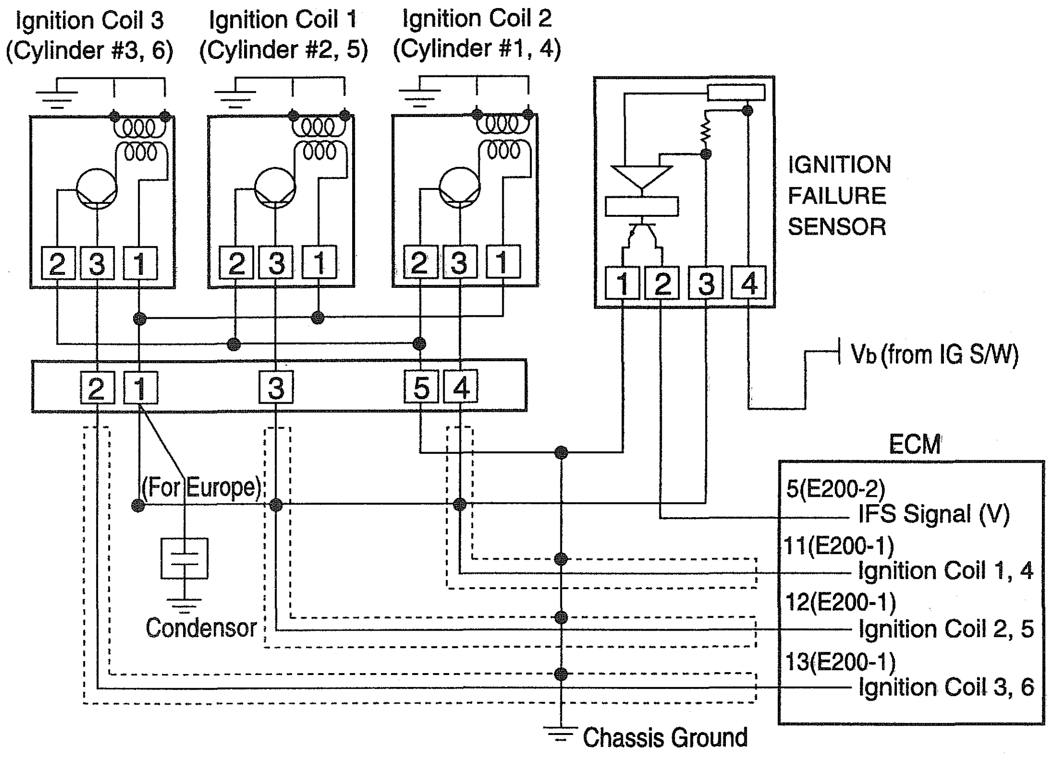
EFMF146B

EFMF006L

IGNITION COIL ED1BE4DA

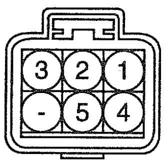
The ignition power transistor functions to control the ignition timing by controlling the ignition coil primary current through signals from the ECM and the ignition coil is of the type of ignition order of (#1/#4), (#2/#5), (#3/#6) and is controlled by the power TR built in the ECM.

[CIRCUIT DIAGRAM (IGNITION COIL)]



EFMF002V

[HARNESS CONNECTOR]

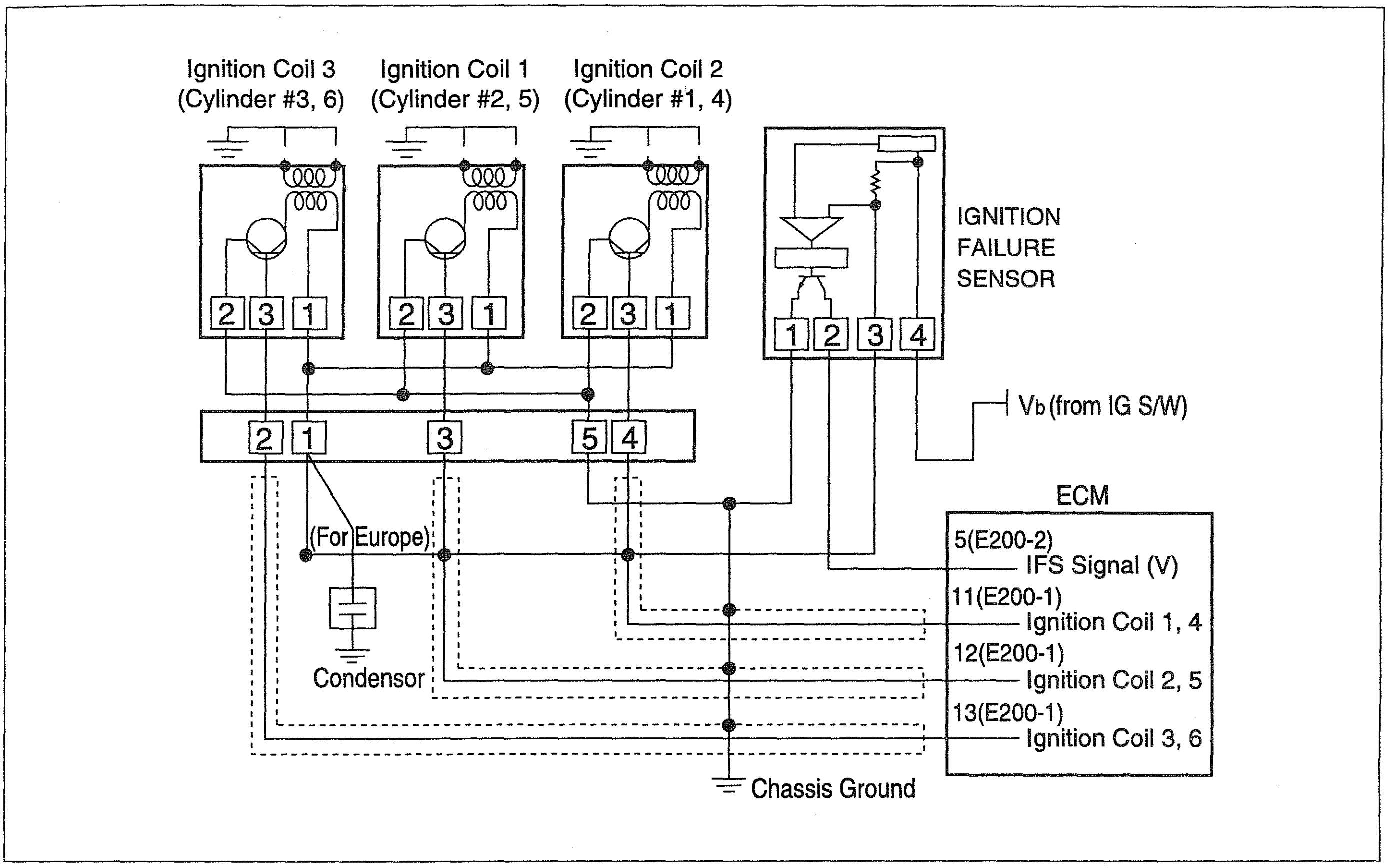


Pin	Connected to	Function
1	IFS	Power Supply
2	ECM Terminal 13(E200-1)	Ignition Coil 3 (Cylinder #3, 6)
3	ECM Terminal 12(E200-1)	Ignition Coil 1 (Cylinder #2, 5)
4	ECM Terminal 11(E200-1)	Ignition Coil 2 (Cylinder #1, 4)
5	Chassis Ground	Ignition Coil GND

EFMF003L

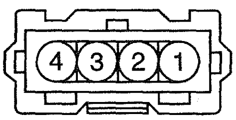
INGITION FAILURE SENSOR (IFS) E64F46BB

[CIRCUIT DIAGRAM(IGNITION COIL AND IFS)]



EFMF002V

[HARNESS CONNECTOR]

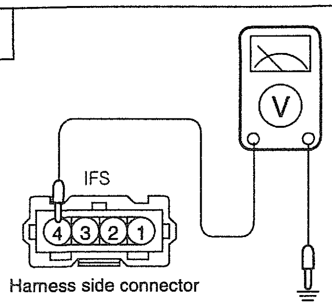


Pin	Connected to	Function
1	Chassis Ground	GND
2	ECM Terminal 5(E200-2)	IFS Signal Output
3	Ignition Coil Terminal 1	Supply B + to Ignition Coil
4	Ignition Switch	Battey Voltage

EFMF003O

HARNESS INSPECTION PROCEDURES (IFS)

1



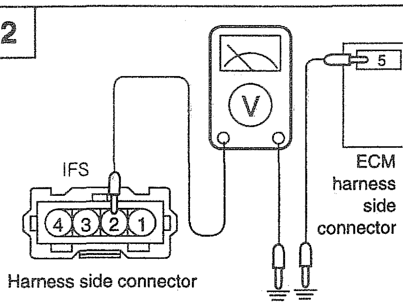
Measure the Power supply voltage.
- Sensor Connector: Disconnected
- ECM Connector: Connected
- Ignition Switch: ON
- Voltage (V): Battery Voltage

OK ⇨ 2

NG ⇨ Repair the harness

EFMF007G

2



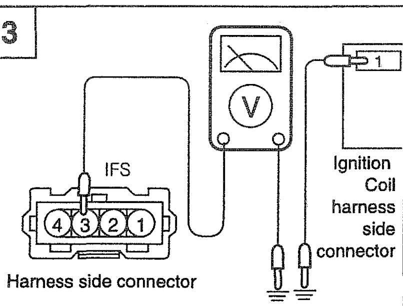
Check for an open circuit or a short circuit between ECM and Ignition Failure Sensor (IFS).
- Sensor Connector: Disconnected
- ECM Connector: Disconnected

OK ⇨ 3

NG ⇨ Repair the harness

EFMF007H

3



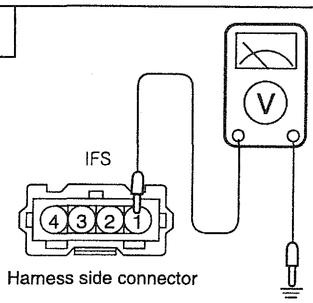
Check for an open circuit or a short circuit between Ignition Coil and Ignition Failure Sensor (IFS).
- Sensor Connector: Disconnected
- Ignition Coil Connector: Disconnected

OK ⇨ 4

NG ⇨ Repair the harness

LFCD007I

4



Check for the continuity of the sensor ground.
- Sensor Connector: Disconnected

OK ⇨ **END**

NG ⇨ Repair the harness

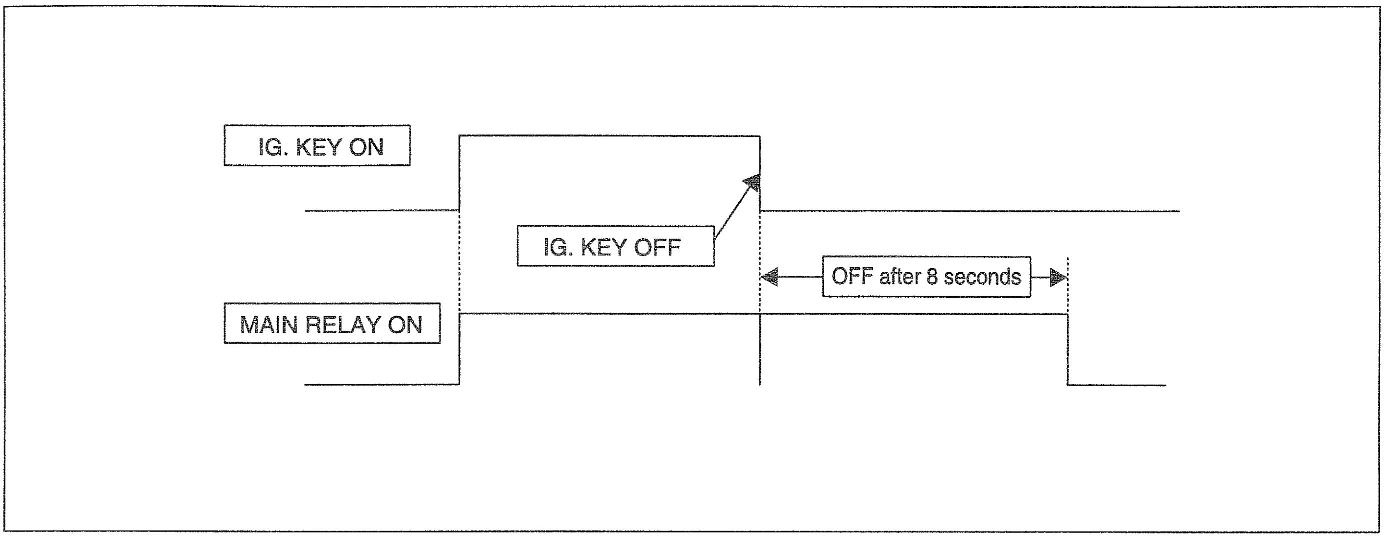
LFCD007J

MAIN RELAY CONTROL E6EB0189

When the ignition switch is turned ON, battery voltage is applied from the ignition switch to the ECM, turning ON the ignition power transistor and energizing the MFI control relay coil. This turns the MFI control relay switch ON, and supplies power from the battery to the ECM through the MFI control relay switch.

After the ignition switch is turned OFF, battery voltage is supplied to Main relay for 8 seconds. So ECM remembers and calculates the data.

[ECM CONTROL DIAGRAM]

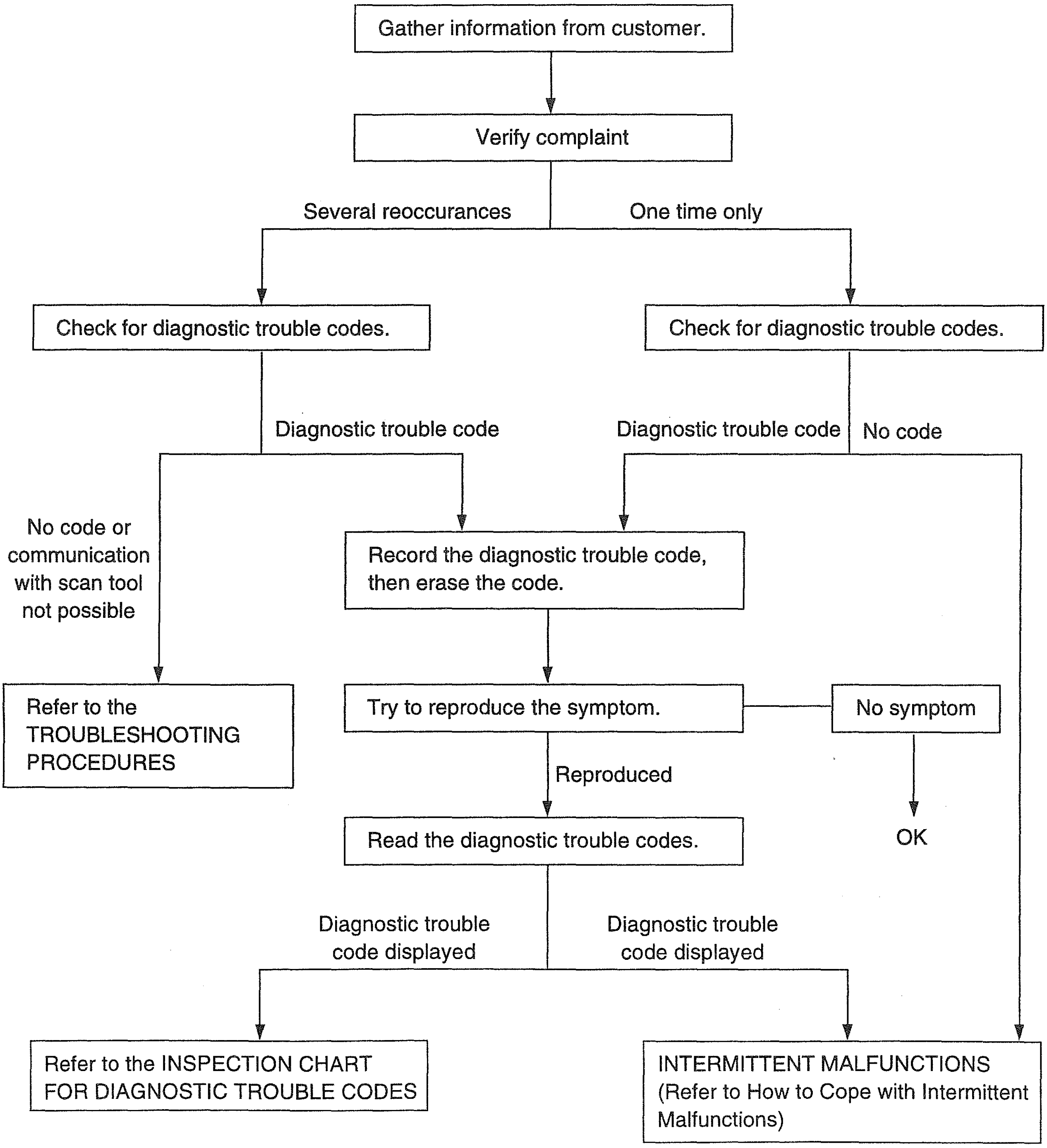


LFCD151A

DTC TROUBLESHOOTING PROCEDURES

DESCRIPTION EE517F9E

DIAGNOSTIC TROUBLESHOOTING FLOW



LFCD022A

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODE

DTC	CONTENT	MIL / MEMORY	
		E-OBD	OBD-1
P0100	Mass Air Flow Circuit Malfunction	-	●
P0101	Mass Air Flow Circuit Range / Performance	●	-
P0102	Mass Air Flow Circuit Low Input	●	-
P0103	Mass Air Flow Circuit high Input	●	-
P0110	Intake Air Temperature Sensor 1 Circuit Malfunction	-	▲
P0112	Intake Air Temperature Sensor 1 Circuit Low Input	●	-
P0113	Intake Air Temperature Sensor 1 Circuit High Input	●	-
P0115	Engine Coolant Temperature Circuit Malfunction	-	●
P0116	Engine Coolant Temperature Circuit Range / Performance	●	-
P0117	Engine Coolant Temperature Circuit Low Input	●	-
P0118	Engine Coolant Temperature Circuit High Input	●	-
P0120	Throttle / Pedal Position Sensor "A" Circuit Malfunction	-	▲
P0121	Throttle / Pedal Position Sensor "A" Circuit Range/Performance	●	-
P0122	Throttle / Pedal Position Sensor "A" Circuit Low Input	●	-
P0123	Throttle / Pedal Position Sensor "A" Circuit High Input	●	-
P0130	O2 Sensor Circuit Malfunction (Bank 1 / Sensor 1)	▲	-
P0132	O2 Sensor Circuit High Voltage(Bank 1 / Sensor 1)	●	-
P0133	O2-Sensor Circuit Slow Response (Bank 1 / Sensor 1)	●	-
P0134	O2 Sensor Circuit No Activity Detected (Bank 1 / Sensor 1)	●	-
P0135	O2 Sensor Heater Circuit (Bank 1 / Sensor 1)	●	-
P0136	O2 Sensor Circuit (Bank 1 / Sensor 2)	●	-
P0140	O2 Sensor Circuit No Activity Detected (Bank 1 / Sensor 2)	●	-
P0141	O2 Sensor Heater Circuit (Bank 1 / Sensor 2)	●	-
P0150	O2 Sensor Circuit Malfunction (Bank 2 / Sensor 1)	▲	-
P0152	O2 Sensor Circuit High Voltage (Bank 2 / Sensor 1)	●	-
P0153	O2-Sensor Circuit Slow Response (Bank 2 / Sensor 1)	●	-
P0154	O2 Sensor Circuit No Activity Detected (Bank 2 / Sensor 1)	●	-
P0155	O2 Sensor Heater Circuit (Bank 2 / Sensor 1)	●	-
P0156	O2 Sensor Circuit (Bank 2 / Sensor 2)	●	-
P0160	O2 Sensor Circuit No Activity Detected (Bank 2 / Sensor 2)	●	-
P0161	O2 Sensor Heater Circuit (Bank 2 / Sensor 2)	●	-
P0171	System Too Lean (Bank 1)	●	-

DTC	CONTENT	MIL / MEMORY	
		E-OBD	OBD-1
P0172	System Too Rich (Bank 1)	●	-
P0174	System Too Lean (Bank 2)	●	-
P0175	System Too Rich (Bank 2)	●	-
P0201	Injector Circuit/Open ? Cylinder 1	●	▲
P0202	Injector Circuit/Open ? Cylinder 2	●	▲
P0203	Injector Circuit/Open ? Cylinder 3	●	▲
P0204	Injector Circuit/Open ? Cylinder 4	●	▲
P0205	Injector Circuit/Open ? Cylinder 5	●	▲
P0206	Injector Circuit/Open ? Cylinder 6	●	▲
P0300	Multiple Cylinder Misfire Detected	●	-
P0301	Cylinder 1 - Misfire detected	●	-
P0302	Cylinder 2 - Misfire detected	●	-
P0303	Cylinder 3 - Misfire detected	●	-
P0304	Cylinder 4 - Misfire detected	●	-
P0305	Cylinder 5 - Misfire detected	●	-
P0306	Cylinder 6 - Misfire detected	●	-
P0320	Ignition Engine Speed Input Circuit	▲	▲
P0325	Knock Sensor 1 Circuit	▲	▲
P0335	Crankshaft Position Sensor A Circuit	●	▲
P0340	Camshaft Position Sensor A Circuit Malfunction(Single Sensor)	●	▲
P0350	Ignition Coil Primary / Secondary Circuit	●	▲
P0421	Warm Up Catalyst Efficiency below Threshold (Bank 1)	●	-
P0431	Warm Up Catalyst Efficiency below Threshold (Bank 2)	●	-
P0441	Evap.Emission System Incorrect Purge Flow	▲	▲
P0443	Evap. Emission System - Purge Ctrl. Valve Circuit	●	-
P0500	Vehicle Speed Sensor Circuit Malfunction	-	▲
P0506	Idle Air Control System - RPM lower than expected	●	-
P0507	Idle Air Control System - RPM higher than expected	●	-
P0510	Closed Throttle Position Switch	●	-
P1330	Spark Timing Adjust	●	▲

NOTE

● : *MIL ON & FAULT CODE MEMORY*
▲ : *MIL OFF & FAULT CODE MEMORY*

TROUBLESHOOTING FOR DTC E1EEBD0A

DTC	Diagnostic Item
P0100	Mass or Volume Air Flow (MAF) Sensor Circuit
P0101	Mass or Volume Air Flow (MAF) Sensor Circuit Range/Performance Problem
P0102	Mass or Volume Air Flow (MAF) Sensor Circuit Low Voltage
P0103	Mass or Volume Air Flow (MAF) Sensor Circuit High Voltage

TEST PROCEDURE

- Start engine and allow engine to idle until engine reaches operating temperature.
- Measure voltage between Mass Air Flow (MAF) Sensor terminal 1 and ground.
  Specification (Voltage): 1.2 V

Is voltage within specification?

YES

NO

B

- Turn ignition OFF and disconnect Mass Air Flow (MAF) Sensor connector.
- Turn ignition ON and measure voltage between Mass Air Flow (MAF) Sensor harness connector terminal 2 and ground.
  Specification (Voltage): Approx. 5V

Is voltage within specification?

YES

NO

- Turn ignition OFF and disconnect ECU connector.
- Measure resistance between Mass Air Flow (MAF) Sensor harness connector terminal 1 and ECM harness connector terminal 11(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

Open or short to ground between Mass Air Flow (MAF) Sensor terminal 2 and Main Relay.
Repair wire or connector as necessary

A

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EFMF901A

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A

YES

- Turn ignition ON and measure voltage between Mass Air Flow (MAF) Sensor harness connector terminal 1 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Open between Mass Air Flow (MAF) Sensor terminal 5 and ECM terminal 11(E200-2).
Repair wire or connector as necessary.

YES

- Check for wire connection at Mass Air Flow (MAF) Sensor.

Is a poor connection found?

NO

Short to battery line between Mass Air Flow (MAF) Sensor harness connector terminal 1 and ECM terminal 11(E200-2).
Repair wire or connector as necessary.

YES

Repair connection as necessary.

NO

B

Temporarily install a known good Mass Air Flow (MAF) Sensor and check for proper operation. If problem is corrected, replace Mass Air Flow (MAF) Sensor.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF901B

TROUBLESHOOTING FOR DTC E17F537E

DTC	Diagnostic Item
P0110	Intake Air Temperature Sensor (ATS) Circuit
P0112	Intake Air Temperature Sensor (ATS) Circuit Low Voltage
P0113	Intake Air Temperature Sensor (ATS) Circuit High Voltage

TEST PROCEDURE

- Turn ignition OFF and disconnect Intake Air Temperature Sensor (ATS) connector.
- Turn ignition ON and measure voltage Intake Air Temperature Sensor (ATS) harness connector terminal 4 and ground.
  Specification (Voltage): Approx.12 V

Is voltage within specification?

YES

- Turn ignition OFF and disconnect ECM connector.
- Measure resistance between Intake Air Temperature Sensor (ATS) harness connector terminal 5 and ECM harness connector terminal 22(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open or short to ground between Intake Air Temperature Sensor (ATS) terminal 4 and ECU terminal 9(E200-2).
Repair wire or connector as necessary.

YES

- Turn ignition ON and measure voltage between Intake Air Temperature Sensor (ATS) harness connector terminal 5 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Open between Intake Air Temperature Sensor (ATS) terminal 5 and ECM terminal 22(E200-2).
Repair wire or connector as necessary.

A

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EFMF901D

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A

YES

- Measure resistance between Intake Air Temperature Sensor (ATS) terminal 4 and 5.
  Specification (Resistance):
  2.33 - 2.97 KΩ at 20 ˚C (68 ˚F)
  0.31 - 0.43 KΩ at 80 ˚C (176 ˚F)

Is resistance within specification?

NO

Short to battery line between Intake Air Temperature Sensor (ATS) terminal 5 and ECU terminal 22(E200-2).
Repair wire or connector as necessary.

YES

Poor terminal contact due to oxidation, bent or misplaced terminal.
Repair as necessary.

NO

Temporarily install a known good Intake Air Temperature Sensor (ATS) and check for proper operation. If problem is corrected, replace Intake Air Temperature Sensor (ATS).

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF901E

TROUBLESHOOTING FOR DTC ED5AD9DE

DTC	Diagnostic Item
P0115	Engine Coolant Temperature Circuit
P0116	Engine Coolant Temperature Circuit Range/Performance
P0117	Engine Coolant Temperature Circuit Low Input
P0118	Engine Coolant Temperature Circuit High Input

TEST PROCEDURE

- Turn ignition OFF and disconnect ECTS connector.
- Turn ignition ON and measure voltage ECTS harness connector terminal 1 and ground.
  Specification (Voltage): 5 V

Is voltage within specification?

YES

- Turn ignition OFF and disconnect ECM connector.
- Measure resistance between ECTS harness connector terminal 3 and ECM harness connector terminal9(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open or short to ground between ECTS terminal 1 and ECM terminal 4(E200-2).
Repair wire or connector as necessary.

YES

- Measure resistance between ECTS terminal 1 and 3.
  Specification (Resistance):
  2.33 - 2.97 KΩ at 20 °C (68 °F)
  0.31 - 0.43 KΩ at 80 °C (176 °F)

Is resistance within specification?

NO

Open between ECTS terminal 3 and ECM terminal 9(E200-2).
Repair wire or connector as necessary.

YES

Poor terminal contact due to oxidation, bent or misplaced terminal.
Repair as necessary.

NO

Temporarily install a known good ECTS and check for proper operation. If problem is corrected,
replace ECTS.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF901F

TROUBLESHOOTING FOR DTC EB0DE2B5

DTC	Diagnostic Item
P0120	Throttle / Pedal Position A Circuit
P0121	Throttle / Pedal Position Circuit Range/Performance
P0122	Throttle / Pedal Position Circuit Low Input
P0123	Throttle / Pedal Position Circuit High Input

TEST PROCEDURE

- Turn ignition OFF and disconnect Throttle Position Sensor (TPS) connector.
- Turn ignition ON and measure voltage Throttle Position Sensor (TPS) harness connector terminal 4 and ground.
  Specification (Voltage): 5 V

Is voltage within specification?

YES

- Turn ignition OFF and measure resistance between Throttle Position Sensor (TPS) harness connector terminal 3 and ground.
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

YES

A

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NO

Open between Throttle Position Sensor (TPS) terminal 3 and ECM terminal 8(E200-3).
Repair wire or connector as necessary.

NO (voltage)

Open or short to ground between Throttle Position Sensor (TPS) terminal 4 and ECM terminal 2(E200-2).
Repair wire or connector as necessary.

EFMF901G

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A

- Connect the Throttle Position Sensor (TPS) connector
- Connect the ECM connector.
- Turn ignition ON.
- Measure voltage between
  Throttle Position Sensor (TPS) terminal 3 and ground.
  Specification (Voltage): Less than 0.5V

Is voltage within specification?

YES

Poor terminal contact due to oxidation, bent or misplaced terminal.
Repair as necessary.

NO

Temporarily install a known good Throttle Position Sensor (TPS) and check for proper operation. If problem is corrected, replace Throttle Position Sensor (TPS).

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF901H

TROUBLESHOOTING FOR DTC EA3ABDC3

DTC	Diagnostic Item
P0130 P0150	O_2 Sensor Circuit [Bank 1 / Sensor 1] O_2 Sensor Circuit [Bank 2 / Sensor 1]

TEST PROCEDURE

- Turn ignition OFF and disconnect Heated Oxygen Sensor (HO2S) connector.
- Disconnect ECM connector.
- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ECM harness connector terminal 2(E200-3) or 1(E200-3).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

YES

- Turn ignition ON and measure voltage between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Open between Heated Oxygan Sensor (HO2S) terminal 1 and ECM terminal 2(E200-3) or 1(E200-3).
Repair wire or connector as necessary.

YES

- Turn ignition OFF and measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ground.
  Specification (Resistance): ∞

Is resistance within specification?

NO

Short to battery line between Heated Oxygen Sensor (HO2S)) terminal 1 and ECM terminal 2(E200-3) or 1(E200-3).
Repair wire or connector as necessary.

YES

- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 2 and ECM harness connector terminal 9(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Short to ground between Heated Oxygen Sensor (HO2S)) terminal 1 and ECM terminal 2(E200-3) or 1(E200-3).
Repair wire or connector as necessary.

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EFMF902K

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A

YES

- Measure HO2S heater resistance between Heated Oxygen Sensor (HO2S) terminal 3 and 4.
  Specification (Resistance): 3.3 Ω

Is resistance within specification?

NO

Open between HO2S terminal 2 and ECM terminal 9(E200-2).
Repair wire or connector as necessary.

YES

- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 3 and 4.
  Specification (Resistance): ∞

Is resistance within specification?

NO

Temporarily install a known good Heated Oxygen Sensor (HO2S) and check for proper operation. If problem is corrected, replace the Heated Oxygen Sensor (HO2S).

YES

- Reconnect the Heated Oxygen Sensor (HO2S) connector end ECM connector.
- Start engine and allow an engine to idle until water temperature reaches operating temperature.
- Measure voltage between Heated Oxygen Sensor (HO2S) terminal 3 and ground.
  Specification (Voltage): Battery Voltage

Is voltage within specification?

NO

Short between HO2S terminal 3 and 4.
Repair wire or connector as necessary.

YES

- Turn ignition OFF and disconnect Heated Oxygen Sensor (HO2S) connector.
- Disconnect ECM connector.
- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 4 and ECM harness connector terminal 4(E200-1) / 3(E200-1).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open or short to ground between Heated Oxygen Sensor (HO2S) terminal 3 and main relay.
Repair wire or connector as necessary.

A

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EFMF902L

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A

YES

- Connect Heated Oxygen Sensor (HO2S) connector and ECM connector.
- Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL, monitor sensor output signal.

Does the sensor signal switch lean to rich or rich to lean over 3 times for 10 seconds?

NO

Open between Heated Oxygen Sensor (HO2S) terminal 4 and ECM terminal 4(E200-1) /3(E200-1).
Repair wire or connector as necessary.

YES

- Check Heated Oxygen Sensor (HO2S) for contamination, deterioration or damage.

Is it contaminated, deteriorated or damaged?

NO

Temporarily install a known good Heated Oxygen Sensor (HO2S) and check for proper operation. If problem is corrected, replace the Heated Oxygen Sensor (HO2S).

NO

- Thoroughly check for loose, bent or corroded connectors at ECM and Heated Oxygen Sensor (HO2S) connectors.

Are connectors normal?

YES

Clean Heated Oxygen Sensor (HO2S) with cleaner before installing.
If damaged or deteriorated, replace Heated Oxygen Sensor (HO2S).

YES

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

NO

Repair as necessary.

EFMF902M

TROUBLESHOOTING FOR DTC E8A1F5B0

DTC	Diagnostic Item
P0132	O_2 Sensor Circuit Low Input [Bank 1 / Sensor 1]
P0136	O_2 Sensor Circuit [Bank 1 / Sensor 2]
P0152	O_2 Sensor Circuit Low Input [Bank 2 / Sensor 1]
P0156	O_2 Sensor Circuit [Bank 2 / Sensor 2]

TEST PROCEDURE

- Turn ignition OFF and disconnect Heated Oxygen Sensor (HO2S) connector.
- Disconnect ECM connector.
- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ECM harness connector terminal 2(E200-3), 1(E200-3), 4(E200-3) or 3(E200-3).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

YES

- Turn ignition ON and measure voltage between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Open between HO2S terminal terminal 1 and ECM terminal 2(E200-3), 1(E200-3), 4(E200-3) or 3(E200-3).
Repair wire or connector as necessary.

YES

- Turn ignition OFF and measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ground.
  Specification (Resistance): ∞

Is resistance within specification?

NO

Short to battery line between Heated Oxygen Sensor (HO2S) terminal 1 and ECM terminal 2(E200-3), 1(E200-3), 4(E200-3) or 3(E200-3).
Repair wire or connector as necessary.

A

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EFMF902N

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A

YES

- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 2 and ECM harness connector terminal 9(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Short to ground between Heated Oxygen Sensor (HO2S)) terminal 1 and ECM terminal 2(E200-3), 1(E200-3), 4(E200-3) or 3(E200-3).
Repair wire or connector as necessary.

YES

- Connect Heated Oxygen Sensor (HO2S) connector and ECM connector.
- Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL, monitor sensor output signal.

Does the sensor signal switch lean to rich or rich to lean over 3 times for 10 seconds?

NO

Open between HO2S terminal 2 and ECM terminal 9(E200-2).
Repair wire or connector as necessary.

YES

- Check Heated Oxygen Sensor (HO2S) for contamination, deterioration or damage.

Is it contaminated, deteriorated or damaged?

NO

Temporarily install a known good Heated Oxygen Sensor (HO2S) and check for proper operation. If problem is corrected, replace the Heated Oxygen Sensor (HO2S).

NO

- Thoroughly check for loose, bent or corroded connectors at ECM and Heated Oxygen Sensor (HO2S) connectors.

Are connectors normal?

YES

Clean Heated Oxygen Sensor (HO2S) with cleaner before installing.
If damaged or deteriorated, replace Heated Oxygen Sensor (HO2S).

YES

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

NO

Repair as necessary.

EFMF902O

TROUBLESHOOTING FOR DTC E15FE12B

DTC	Diagnostic Item
P0133	O_2 Sensor Circuit Slow Response [Bank 1, Sensor 1]
P0153	O_2 Sensor Circuit Slow Response [Bank 2, Sensor 1]

TEST PROCEDURE

- First check for DTC relating to misfire , purge control system and front HO2S heater.

Do DTCs exist?

YES → Repair all other malfunction on DTCs.

NO ↓

- Visually check for leak from exhaust system (especially between MCC and front exhaust pipe).

Any leaks present?

NO → Repair exhunst system leaks as necessary.

YES ↓

- Visually check for leak from intake system.

Are any vacuum leaks present?

NO → Repair intake system leaks as necessary.

YES ↓

- Start engine after installing fuel pressure gauge at service valve in fuel rail.
  Specification (Fuel pressure at idle)
  : 320 ~ 340kPa (46 ~ 49 psi, 3.26 ~ 3.47kg/cm²)

With engine running at operating temperature, is fuel pressure within specification?

↓ A

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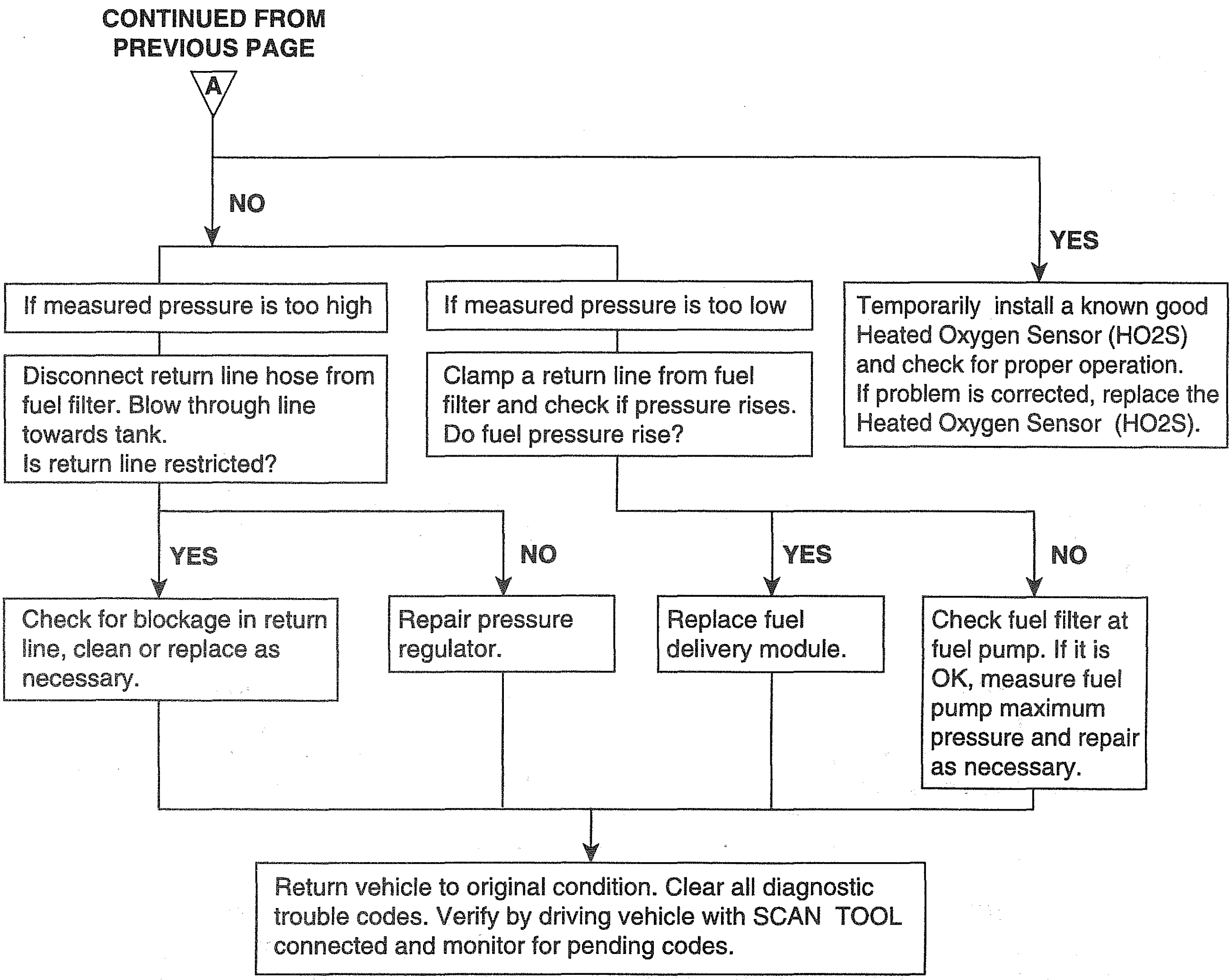
LFCD902P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A
NO
YES
If measured pressure is too high
If measured pressure is too low
Temporarily install a known good Heated Oxygen Sensor (HO2S) and check for proper operation. If problem is corrected, replace the Heated Oxygen Sensor (HO2S).
Disconnect return line hose from fuel filter. Blow through line towards tank. Is return line restricted?
Clamp a return line from fuel filter and check if pressure rises. Do fuel pressure rise?
YES
NO
YES
NO
Check for blockage in return line, clean or replace as necessary.
Repair pressure regulator.
Replace fuel delivery module.
Check fuel filter at fuel pump. If it is OK, measure fuel pump maximum pressure and repair as necessary.
Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

LFCD902Q

TROUBLESHOOTING FOR DTC E6E3BB9D

DTC	Diagnostic Item
P0134 P0154	O_2 Sensor Circuit No Activity Detected [Bank 1 / Sensor 1] O_2 Sensor Circuit No Activity Detected [Bank 2 / Sensor 1]

TEST PROCEDURE

- Turn ignition OFF and disconnect Heated Oxygen Sensor (HO2S) connector.
- Disconnect ECU connector.
- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ECM harness connector terminal 2(E200-3), 1(E200-3), 4(E200-3) or 3(E200-3).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

YES

- Turn ignition ON and measure voltage between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Open between HO2S terminal terminal 1 and ECM terminal 2(E200-3), 1(E200-3), 4(E200-3) or 3(E200-3).
Repair wire or connector as necessary.

YES

- Turn ignition OFF and measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ground.
  Specification (Resistance): ∞

Is resistance within specification?

NO

Short to battery line between Heated Oxygen Sensor (HO2S) terminal 1 and ECM terminal 2(E200-3), 1(E200-3), 4(E200-3) or 3(E200-3).
Repair wire or connector as necessary.

YES

- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 2 and ECM harness connector terminal 9(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Short to ground between Heated Oxygen Sensor (HO2S)) terminal 1 and ECM terminal 2(E200-3), 1(E200-3), 4(E200-3) or 3(E200-3).
Repair wire or connector as necessary.

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YES

- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 3 and 4.
  Specification (Resistance): ∞

Is resistance within specification?

NO

Open between HO2S terminal 2 and ECM terminal 9(E200-2).
Repair wire or connector as necessary.

YES

- Reconnect the Heated Oxygen Sensor (HO2S) connector end ECM connector.
- Start engine and allow an engine to idle until water temperature reaches operating temperature.
- Measure voltage between Heated Oxygen Sensor (HO2S) terminal 3 and ground.
  Specification (Voltage): Battery Voltage

Is voltage within specification?

NO

Short between HO2S terminal 3 and 4.
Repair wire or connector as necessary.

YES

- Turn ignition OFF and disconnect Heated Oxygen Sensor (HO2S) connector.
- Disconnect ECM connector.
- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 4 and ECM harness connector terminal 4(E200-1), 3(E200-1), 27(E200-1) or 26(E200-1).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open or short to ground between Heated Oxygen Sensor (HO2S) terminal 3 and main relay.
Repair wire or connector as necessary.

YES

- Connect Heated Oxygen Sensor (HO2S) connector and ECM connector.
- Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL, monitor sensor output signal.

Does the sensor signal switch lean to rich or rich to lean over 3 times for 10 seconds?

NO

Open between Heated Oxygen Sensor (HO2S) terminal 4 and ECM terminal 4(E200-1), 3(E200-1), 27(E200-1) or 26(E200-1).
Repair wire or connector as necessary.

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YES

- Check Heated Oxygen Sensor (HO2S) for contamination, deterioration or damage.

Is it contaminated, deteriorated or damaged?

NO

Temporarily install a known good Heated Oxygen Sensor (HO2S) and check for proper operation. If problem is corrected, replace the Heated Oxygen Sensor (HO2S).

NO

- Thoroughly check for loose, bent or corroded connectors at ECM and Heated Oxygen Sensor (HO2S) connectors.

Are connectors normal?

YES

Clean Heated Oxygen Sensor (HO2S) with cleaner before installing.
If damaged or deteriorated, replace Heated Oxygen Sensor (HO2S).

YES

- Visually check for leak from exhaust system (especially between MCC and front exhaust pipe).

Any leaks present?

NO

Repair as necessary.

YES

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

NO

Repair exhaust system leaks as necessary.

EFMF902T

TROUBLESHOOTING FOR DTC E5C0EFCF

DTC	Diagnostic Item
P0135	O_2 Sensor Heater Circuit [Bank 1 / Sensor 1]
P0141	O_2 Sensor Heater Circuit [Bank 1 / Sensor 2]
P0155	O_2 Sensor Heater Circuit [Bank 2 / Sensor 1]
P0161	O_2 Sensor Heater Circuit [Bank 2 / Sensor 2]

TEST PROCEDURE

- Turn ignition OFF and disconnect Heated Oxygen Sensor (HO2S) connector.
- Start engine and allow an engine to idle until water temperature reaches operating temperature.
- Measure voltage between Heated Oxygen Sensor (HO2S) terminal 3 and ground.
  Specification (Voltage): Battery Voltage

Is voltage within specification?

YES

- Turn ignition ON and measure voltage between Heated Oxygen Sensor (HO2S) terminal 4 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Open or short to ground between Heated Oxygen Sensor (HO2S) terminal 3 and main relay.
Repair wire or connector as necessary.

YES

- Turn ignition OFF and disconnect ECM connector.
- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 4 and ECM harness connector terminal 4(E200-1), 3(E200-1), 27(E200-1) or 26(E200-1).
  Specification (Resistance): ∞

Is resistance within specification?

NO

Short to battery line between Heated Oxygen Sensor (HO2S) terminal 4 and ECM terminal 4(E200-1), 3(E200-1), 27(E200-1) or 26(E200-1).
Repair wire or connector as necessary.

YES

- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 3 and 4.
  Specification (Resistance): ∞

Is resistance within specification?

NO

Open between Heated Oxygen Sensor (HO2S) terminal 4 and ECM terminal 4(E200-1), 3(E200-1), 27(E200-1) or 26(E200-1).
Repair wire or connector as necessary.

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YES

- Measure HO2S heater resistance between Heated Oxygen Sensor (HO2S) terminal 3 and 4.
  Specification (Resistance):
  - Front HO2S: 3.3 Ω
  - Rear HO2S: 6.0 Ω

Is resistance within specification?

NO

Short between HO2S terminal 3 and 4. Repair wire or connector as necessary.

YES

- Check Heated Oxygen Sensor (HO2S) for contamination, deterioration or damage.

Is it contaminated, deteriorated or damaged?

NO

Temporarily install a known good Heated Oxygen Sensor (HO2S) and check for proper operation. If problem is corrected, replace the Heated Oxygen Sensor (HO2S).

NO

- Thoroughly check for loose, bent or corroded connectors at ECM and Heated Oxygen Sensor (HO2S) connectors.

Are connectors normal?

YES

Clean Heated Oxygen Sensor (HO2S) with cleaner before installing.
If damaged or deteriorated, replace Heated Oxygen Sensor (HO2S).

YES

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

NO

Repair as necessary

EFMF902V

TROUBLESHOOTING FOR DTC E04ED56F

DTC	Diagnostic Item
P0140 P0160	O_2 Sensor Circuit No Activity Detected [Bank 1, Sensor 2] O_2 Sensor Circuit No Activity Detected [Bank 2, Sensor 2]

TEST PROCEDURE

- Turn ignition OFF and disconnect Heated Oxygen Sensor (HO2S) connector.
- Disconnect ECM connector.
- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ECM harness connector terminal 4(E200-3), 3(E200-3).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

YES →

- Turn ignition ON and measure voltage between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO → Open between HO2S terminal terminal 1 and ECM terminal 4(E200-3), 3(E200-3). Repair wire or connector as necessary.

YES →

- Turn ignition OFF and measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 1 and ground.
  Specification (Resistance): ∞

Is resistance within specification?

NO → Short to battery line between Heated Oxygen Sensor (HO2S) terminal 1 and ECM terminal 4(E200-3), 3(E200-3). Repair wire or connector as necessary.

YES →

- Measure resistance between Heated Oxygen Sensor (HO2S) harness connector terminal 2 and ECM harness connector terminal 9(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO → Short to ground between Heated Oxygen Sensor (HO2S) terminal 1 and ECM terminal 4(E200-3), 3(E200-3). Repair wire or connector as necessary.

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YES

- Check Heated Oxygen Sensor (HO2S) for contamination, deterioration or damage.

Is it contaminated, deteriorated or damaged?

NO

Open between HO2S terminal 2 and ECM terminal 9(E200-2).
Repair wire or connector as necessary.

NO

- Thoroughly check for loose, bent or corroded connectors at ECM and Heated Oxygen Sensor (HO2S) connectors.

Are connectors normal?

YES

Clean Heated Oxygen Sensor (HO2S) with cleaner before installing.
If damaged or deteriorated, replace Heated Oxygen Sensor (HO2S).

YES

Temporarily install a known good Heated Oxygen Sensor (HO2S) and check for proper operation.
If problem is corrected, replace the Heated Oxygen Sensor (HO2S).

NO

Repair as necessary.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF902X

TROUBLESHOOTING FOR DTC E5C8C2CC

DTC	Diagnostic Item
P0171	Fuel System (Bank 1) Too Lean
P0172	Fuel System (Bank 1) Too Rich
P0174	Fuel System (Bank 2) Too Lean
P0175	Fuel System (Bank 2) Too Rich

TEST PROCEDURE

- Connect SCAN TOOL to diagnosis connector.
- Turn ignition ON and monitor DTCs.

Are any other codes set?

NO

YES

Do all repairs associated with those codes before proceeding this procedure.

- Using SCAN TOOL, monitor long-term on fuel trim data.
  Long-term: -12 ~ 12 %

Is long-term within the specifications indicated?

NO

YES

Problem is intermittent or was repaired and ECM memory was not cleared.

- Visually/physically inspect the following items:
  - Throttle body gasket
  - Gasket between intake manifold and surge tank
  - Seals between intake manifold and fuel injectors
  - Seals between surge tank and Purge Control Solenoid Valve (PCSV)
  - PCV (Positive Crankcase Ventilation Valve) and/or system for leaks
  - Contaminated fuel

Are the above items okay?

YES

NO

Repair or replace as necessary.

- Visually/physically inspect the following items:
  - Air cleaner element for being restricted.
  - Mass Air Flow (MAF) Sensor for poor installation and foreign objects
  - Exhaust system for leaks

Are the above items okay?

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YES

- Check vacuum hoses for splits and proper connections to engine dynamic chamber (especially vacuum hose, throttle body, intake manifold, and brake booster).

Are connections OK?

NO

Repair or replace as necessary.

YES

- With engine idling disconnect hose between PCSV and canister. Check for vacuum at PCSV.

Is vacuum available at PCSV valve when PCSV is not operating?

NO

Repair or replace as necessary.

NO

- After installing fuel pressure gauge to service port on fuel rail, connect Fuel Pump and Battery Voltage terminal in Check Connector (10 pin) with a jumper wire.
  Specification (Fuel pressure at idle)
  : 320 ~ 340kPa (46 ~ 49 psi, 3.26 ~ 3.47 kg/cm²)

Is fuel line pressure correct with ignition switch ON?

YES

PCSV or circuit failure.
Repair according to DTC P0441 or P0443 repair procedures.

YES

- Start engine and check for engine rpm decrease when disconnecting each injector connector in sequence.
- Measure the decreasing engine rpm of all 6 cylinders.

Is there any cylinder with no change in rpm or only a small rpm change?

NO

1. Low pressure:
   Clamp return-line and check if pressure rises:
   - If pressure rises: replace pressure regulator
   - If pressure does not rise: check the strainer at the fuel pump.

2. High pressure:
   Disconnect return-line from fuel filter side and blow through line towards tank.
   - If line is clear: replace fuel delivery module.
   - If line is blocked: check for blockage in return line and clear or replace as necessary.

If it is OK, check fuel.

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NO

- Remove spark plugs and inspect spark plug tips. Check for abnormal color of spark plug tips compared to other cylinders.

Are any spark plugs with abnormal color compared to other cylinders?

YES

Repair as necessary.

NO

- Check for ECU input signal from Mass Air Flow (MAF) Sensor, Heated Oxygen Sensor (HO2S), Throttle Position Sensor (TPS) and other input signals.

Are input signals within specification?

YES

Check for engine mechanical failure. If it is OK, replace spark plugs.

YES

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

NO

Replace all failed parts.

LFCD901K

TROUBLESHOOTING FOR DTC EFC2674C

DTC	Diagnostic Item
P0201	Cylinder 1 Malfunction
P0202	Cylinder 2 Malfunction
P0203	Cylinder 3 Malfunction
P0204	Cylinder 4 Malfunction
P0205	Cylinder 5 Malfunction
P0206	Cylinder 6 Malfunction

TEST PROCEDURE

- Turn ignition OFF and disconnect injector connector.
- Turn ignition ON and measure voltage between injector harness connector terminal 2 and ground.
  Specification (Voltage): Battery Voltage

Is voltage within specification?

YES → next step

NO → Open or short to ground between injector terminal 2 and Main Relay. Repair wire or connector as necessary.

- Turn ignition OFF and disconnect ECM connector.
- Measure resistance between the injector harness connector terminal 1 and ECM harness connector E200-1 terminal 1, 9, 24, 2, 10 or 25 (for injector #1, #2, #3, #4, #5, #6 respectively).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

YES → next step

NO → Open between injector terminal 1 and ECM terminal 1, 9, 24, 2, 10 or 25 (for injector #1, #2, #3, #4, #5, #6 respectively). Repair wire or connector as necessary.

- Turn ignition ON and measure voltage between injector harness connector terminal 1 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

YES → next step

NO → Short to battery line between injector terminal 1 and ECM terminal 1, 9, 24, 2, 10 or 25 (for injector #1, #2, #3, #4, #5, #6 respectively). Repair wire or connector as necessary.

- Measure resistance between injector terminal 1 and 2.
  Specification (Resistance)
  : 13 - 16 Ω at 20 °C (68 °F)

Is resistance within specification?

YES → Poor terminal contact due to oxidation, bent or misplaced terminal. Repair as necessary.

NO → Temporarily install a known good injector and check for proper operation. If problem is corrected, replace injector.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF901L

TROUBLESHOOTING FOR DTC E34DACA2

DTC	Diagnostic Item
P0300	Multiple Cylinder Misfire Detected
P0301	Cylinder 1 - Misfire detected
P0302	Cylinder 2 - Misfire detected
P0303	Cylinder 3 - Misfire detected
P0304	Cylinder 4 - Misfire detected
P0305	Cylinder 5 - Misfire detected
P0306	Cylinder 6 - Misfire detected

TEST PROCEDURE

- Connect SCAN TOOL to diagnosis connector.
- Turn ignition ON and monitor DTCs.

Are any other codes set?

NO →

- Check for any split, disconnected or perforated vacuum hoses. Also, check Positive Crankcase Ventilation Valve (PCV) for proper operation.

Are vacuum hoses and PCV okay?

YES →

Do all repairs associated with those codes before proceeding this procedure.

YES →

- Turn ignition OFF and disconnect Ignition Coil connector.
- Turn ignition ON and measure voltage of Ignition Coil battery voltage between Ignition Coil harness connector terminal 1 and ground.
  Specification (Voltage): Battery Voltage

Is battery voltage within specifications?

NO →

Replace faulty vacuum hoses or PCV.

YES →

- Turn ignition OFF and check Ignition Coils and plug wires for cracks or carbon tracing.
- Check resistance of primary coils and secondary coils.
  Specification (Resistance)
  - Primary Coils: 0.78 Ω at 20 °C (68 °F)
  - Secondary Coils: 10.4 ~ 15.6 KΩ at 20 °C (68 °F)
- Check for resistance of plug wires.
  Specification (Resistance): 4.48 ~ 6.72 KΩ per 1m

Are Ignition Coils and plug wires OK?

NO →

Open circuit or short circuit to ground between Ignition Coil terminal 1 and Ignition Switch. Repair as necessary.

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YES

- Disconnect Crankshaft Position (CKP) Sensor connector
- Measure resistance between CKP sensor terminal 1 and 2.
  Specification: 800 ~ 900 Ω at 20 °C (68 °F)
- Remove Crankshaft Position (CKP) sensor and calculate air gap between sensor and flywheel or torque converter.
  Specification (Air Gap)
  : 0.0354~0.0433 in (0.9-1.1 mm)

(NOTE)
Air Gap = A - B
A: Distance from housing to teeth on flywheel/torque converter
B: Distance from mounting surface on sensor to sensor tip

Are air gap within specification?

NO

Repair or replace as necessary.

YES

- Release fuel pressure and attach fuel pressure gauge to service port on fuel rail.
- Start an engine and warm up to operating temperature.
- Check for fuel pressure at idle.
  Specification (Fuel pressure at idle)
  : 320 ~ 340 kPa (46 ~ 49 psi, 3.26 ~ 3.47 kg/cm²)

Is fuel pressure within specification?

NO

- Thoroughly check for loose, bent or corroded terminals between CKP sensor and ECM.
- Measure resistance between CKP sensor terminal 1 and ground.
  Specification (Resistance): Less than 1 Ω

Repair as necessary.

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NO →

- Remove spark plugs and check gap and plug condition.
  Specification (Air Gap): 0.039~0.043 in (1.0-1.1 mm)

Are spark plugs gapped properly and in good condition?

YES →

Check fuel delivery system.

(From spark plug check) YES →

- Perform compression test.
  Specification (Pressure)
  : approximately 12,750 kPa (184 psi, 13.0 kg/cm²) at 300 rpm (no more than 10% between highest and lowest cylinder).

Is compression OK?

(From spark plug check) NO →

Repair as necessary.

(From compression test) YES →

Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

(From compression test) NO →

Perform leak down test to determine source of low compression and repair as necessary.

LFCD902B

TROUBLESHOOTING FOR DTC E89B77DB

DTC	Diagnostic Item
P0320	Ignition Failure Sensor 1 Open / Short

TEST PROCEDURE

- Turn ignition OFF and disconnect Ignition Failure Sensor (IFS) connector.
- Turn ignition ON and measure voltage Ignition Failure Sensor (IFS) harness connector terminal 4 and ground.
  Specification (Voltage): Battery Voltage

Is voltage within specification?

YES

- Turn ignition OFF.
- Measure resistance between Ignition Failure Sensor (IFS) harness connector terminal 1 and ground.
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open or short to ground between Ignition Failure Sensor (IFS) terminal 4 and Ignition Switch.
Repair wire or connector as necessary.

YES

- Turn ignition OFF and disconnect Ignition Coil connector.
- Measure resistance between Ignition Failure Sensor (IFS) harness connector terminal 3 and Ignition Coil harness connector terminal 1.
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open between Ignition Failure Sensor (IFS) terminal 1 and chassis ground.
Repair wire or connector as necessary.

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NO:

Open between Ignition Failure Sensor (IFS) terminal 3 and Ignition Coil terminal 1.
Repair wire or connector as necessary.

YES:

- Turn ignition OFF and disconnect ECM connector.
- Measure resistance between Ignition Failure Sensor (IFS) harness connector terminal 2 and ECM, harness connector terminal 5(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

YES:

Temporarily install a known good Ignition Failure Sensor (IFS) and check for proper operation. If problem is corrected, replace Ignition Failure Sensor (IFS).

NO:

Open between Ignition Failure Sensor (IFS) terminal 2 and ECM terminal 5(E200-2).
Repair wire or connector as necessary.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF902C

TROUBLESHOOTING FOR DTC EDB8D071

DTC	Diagnostic Item
P0325	Knock Sensor Circuit Malfunction

TEST PROCEDURE

- Turn ignition OFF and disconnect knock sensor connector.
- Disconnect ECM connector.
- Measure resistance between knock sensor harness connector terminal 1 and ECM harness connector terminal 21(E200-3).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

YES

- Measure resistance between knock sensor harness connector terminal 2 and ground.
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open between knock sensor terminal 1 and ECM terminal 21(E200-3).
Repair wire or connector as necessary.

YES

- Measure resistance between knock sensor terminal 1 and ground.
  Specification (Resistance): 4.87 MΩ at 20 ˚C (68 ˚F)

Is resistance within specification?

NO

Open between knock sensor terminal 2 and ground.
Repair wire or connector as necessary.

YES

Poor terminal contact due to oxidation, bent or misplaced terminal.
Repair as necessary.

NO

Temporarily install a known good knock sensor and check for proper operation. If problem is corrected, replace knock sensor.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF901R

TROUBLESHOOTING FOR DTC EEE49BA6

DTC	Diagnostic Item
P0335	Crankshaft Position Sensor Circuit Malfunction

TEST PROCEDURE

- Turn ignition OFF and disconnect Crankshaft Position (CKP) Sensor connector.
- Turn ignition ON and measure voltage between Crankshaft Position (CKP) Sensor harness connector terminal 3 and ground.
  Specification (Voltage): Battery Voltage

Is voltage within specification?

YES

- Measure resistance between Crankshaft Position (CKP) Sensor harness connector terminal 1 and ground.
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open or short to ground between Crankshaft Position (CKP) Sensor terminal 3 and Main Relay.
Repair wire or connector as necessary.

YES

- Turn ignition OFF and disconnect ECM connector.
- Measure resistance between Crankshaft Position (CKP) Sensor harness connector terminal 2 and ECM harness connector terminal 3(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open between Crankshaft Position (CKP) Sensor terminal 1 and ground.
Repair wire or connector as necessary.

YES

- Measure resistance between Crankshaft Position (CKP) Sensor terminal 2 and 3.
  Specification (Resistance): ∞

Is resistance within specification?

NO

Open between Crankshaft Position (CKP) Sensor terminal 2 and ECM terminal 3(E200-2).
Repair wire or connector as necessary.

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YES

- Turn ignition ON and measure voltage between Crankshaft Position (CKP) Sensor harness connector terminal 2 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Short between Crankshaft Position (CKP) Sensor terminal 2 and 3.
Repair wire or connector as necessary.

YES

- Remove Crankshaft Position (CKP) sensor and calculate air gap between sensor and flywheel or torque converter.
  Specification (Air Gap): 0.035 - 0.043 in (0.9 - 1.1 mm)

(NOTE)
Air Gap = A - B
A: Distance from housing to teeth on flywheel/torque converter
B: Distance from mounting surface on sensor to sensor tip

Are air gap within specification?

NO

Short to battery line between Crankshaft Position (CKP) Sensor terminal 2 and ECM terminal 3(E200-2).
Repair wire or connector as necessary.

YES

Temporarily install a known good Crankshaft Position (CKP) sensor and check for proper operation. If problem is corrected, replace Crankshaft Position (CKP) sensor.

NO

Remove Crankshaft Position (CKP) sensor and install it correctly.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF901T

TROUBLESHOOTING FOR DTC E7B0700E

DTC	Diagnostic Item
P0340	Camshaft Position Sensor Circuit Malfunction

TEST PROCEDURE

- Turn ignition OFF and disconnect Camshaft Position (TDC) Sensor connector.
- Turn ignition ON and measure voltage between Camshaft Position (TDC) Sensor harness connector terminal 3 and ground.
  Specification (Voltage): Battery Voltage

Is voltage within specification?

YES

- Measure resistance between Camshaft Position (TDC) Sensor harness connector terminal 1 and ground.
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open or short to ground between Camshaft Position (TDC) Sensor terminal 3 and Main Relay.
Repair wire or connector as necessary.

YES

- Turn ignition OFF and disconnect ECM connector.
- Measure resistance between Camshaft Position (TDC) Sensor terminal 2 and ECM harness connector terminal 10(E200-2).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open between Camshaft Position (TDC) Sensor terminal 1 and ground.
Repair wire or connector as necessary.

YES

- Measure resistance between Camshaft Position (TDC) Sensor terminal 2 and 3.
  Specification (Resistance): ∞

Is resistance within specification?

NO

Open between Camshaft Position (TDC) Sensor terminal 2 and ECM terminal 10(E200-2).
Repair wire or connector as necessary.

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YES

- Turn ignition ON and measure voltage between Camshaft Position (TDC) Sensor harness connector terminal 2 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Short between Camshaft Position (TDC) Sensor terminal 2 and 3.
Repair wire or connector as necessary.

YES

- Turn ignition OFF and disconnect Camshaft Position (TDC) Sensor connector.
- Check for Camshaft Position (TDC) Sensor installation.

Is Camshaft Position (TDC) Sensor installed properly?

NO

Short to battery line between Camshaft Position (TDC) Sensor terminal 2 and ground.
Repair wire or connector as necessary.

YES

Temporarily install a known good Camshaft Position (TDC) Sensor and check for proper operation. If problem is corrected, replace Camshaft Position (TDC) Sensor.

NO

Remove Camshaft Position (TDC) Sensor and install it correctly.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

LFCD901V

TROUBLESHOOTING FOR DTC EAD3D773

DTC	Diagnostic Item
P0350	Ignition Coil Primary / Secondary Circuit Malfunction

TEST PROCEDURE

- Turn ignition OFF and disconnect Ignition Coil connector.
- Turn ignition ON and measure voltage between Ignition Coil harness connector terminal 1 and ground.
  Specification (Voltage): Battery Voltage

Is voltage within specification?

YES

- Turn ignition OFF and disconnect ECM connector.
- Measure resistance between Ignition Coil harness connector terminal 4 and ECM harness connector terminal 11(E200-1).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open between Ignition Coil terminal 1 and Ignition Switch.
Repair wire or connector as necessary.

YES

- Measure resistance between Ignition Coil harness connector terminal 3 and ECM harness connector terminal 12(E200-1).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open between Ignition Coil terminal 4 and ECM terminal 11(E200-1).
Repair wire or connector as necessary.

YES

- Measure resistance between Ignition Coil harness connector terminal 2 and ECM harness connector terminal 13(E200-1).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open between Ignition Coil terminal 3 and ECM terminal 12(E200-1).
Repair wire or connector as necessary.

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YES

- Turn ignition ON and measure voltage between Ignition Coil harness connector terminal 4 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Open between Ignition Coil terminal 2 and ECM terminal 13(E200-1).
Repair wire or connector as necessary.

YES

- Turn ignition ON and measure voltage between Ignition Coil harness connector terminal 3 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Short to battery line between Ignition Coil harness connector terminal 4 and ECM terminal 11(E200-1).
Repair wire or connector as necessary.

YES

- Turn ignition ON and measure voltage between Ignition Coil harness connector terminal 2 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Short to battery line between Ignition Coil harness connector terminal 3 and ECM terminal 12(E200-1).
Repair wire or connector as necessary.

YES

- Turn ignition OFF and measure resistance of Primary coil and Secondary coil.
- Check resistance of primary coils and secondary coils.
  Specification (Resistance)
  - **Primary Coils: 0.78 Ω at 20 °C (68 °F)**
  - **Secondary Coils: 10.4 ~ 15.6 KΩ at 20 °C (68 °F)**

Is resistance within specification?

NO

Short to battery line between Ignition Coil harness connector terminal 2 and ECM terminal 13(E200-1).
Repair wire or connector as necessary.

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YES

Poor terminal contact due to oxidation, bent or misplaced terminal.
Repair as necessary.

NO

Temporarily install a known good Ignition Coil and check for proper operation. If problem is corrected, replace Ignition Coil.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

LFCD901X

TROUBLESHOOTING FOR DTC E42B0BB2

DTC	Diagnostic Item
P0421 P0431	Warm Up Catalyst Efficiency below Threshold [Bank 1] Warm Up Catalyst Efficiency below Threshold [Bank 2]

TEST PROCEDURE

- Connect SCAN TOOL to diagnosis connector.
- Turn ignition ON and monitor DTCs.

Are DTC P0300~P0306, P0115~P0118, P0130~P0161 and/or P0171~P0175 set?

NO

- Start engine and warm up to operating temperature.
- Using SCAN TOOL monitor both front HO2S and rear HO2S signals.

Do both signals switch lean to rich and rich to lean?

YES

Do all repairs associated with those codes before proceeding this procedure.

NO

- Release fuel pressure and attach fuel pressure gauge to service port on fuel rail.
- Start an engine and warm up to operating temperature.
- Check for fuel pressure at idle.
  Specification (Fuel pressure at idle)
  : 320 ~ 340 kPa (46 ~ 49 psi, 3.26 ~ 3.47 kg/cm²)

Is fuel pressure within specification?

YES

Replace Catalytic Converter.

YES

- Check exhaust system for leaks, cracks, loose connection (especially Exhaust Manifold, Catalyst around rear HO2S, etc)

Is exhaust system okay?

NO

Check fuel delivery system.

YES

- Check for any split, disconnected or perforated vacuum hoses. Also, check PCV valve for proper operation.

Are vacuum hoses and PCV okay?

NO

Repair or replace as necessary.

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YES

- Check for fuel injector operation.

Are fuel injectors working normal and dispensing proper volume?

NO

Replace faulty vacuum hoses or PCV.

YES

- Check intake system for leaks, cracks, loose connection as following items:
  - Throttle body gasket
  - Gasket between intake manifold and surge tank
  - Seals between intake manifold and fuel injectors
  - Seals between surge tank and PCV valves

Is intake system okay?

NO

Repair as necessary.

YES

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

NO

Repair as necessary.

LFCD902A

TROUBLESHOOTING FOR DTC E4542E51

DTC	Diagnostic Item
P0441 P0443	Evap. Emission Ctrl. System Incorrect Purge Flow Evap. Emission Ctrl. System - Purge Ctrl. Valve Circuit

TEST PROCEDURE

- Turn ignition OFF and disconnect Purge Control Solenoid Valve (PCSV) connector.
- Turn ignition ON and measure voltage between Purge Control Solenoid Valve (PCSV) harness connector terminal 2 and ground.
  Specification (Voltage): Battery Voltage

Is voltage within specification?

YES

- Turn ignition OFF and disconnect ECU connector.
- Measure resistance between Purge Control Solenoid Valve (PCSV) harness connector terminal 1 and ECM harness connector terminal 16(E200-1).
  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open or short to ground between Purge Control Solenoid Valve (PCSV) terminal 2 and Main Relay.
Repair wire or connector as necessary.

YES

- Turn ignition ON and measure voltage between Purge Control Solenoid Valve (PCSV) harness connector terminal 1 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Open between Purge Control Solenoid Valve (PCSV) terminal 1 and ECM terminal 16(E200-1).
Repair wire or connector as necessary.

YES

- Measure resistance between Purge Control Solenoid Valve (PCSV) terminal 1 and 2.
  Specification (Resistance)
  : 24.5 - 27.5 Ω at 20 °C (68 °F)

Is resistance within specification?

NO

Short to battery line between Purge Control Solenoid Valve (PCSV) terminal 1 and ECM terminal 16(E200-1).
Repair wire or connector as necessary.

YES

Poor terminal contact due to oxidation, bent or misplaced terminal.
Repair as necessary.

NO

Temporarily install a known good Purge Control Solenoid Valve (PCSV) and check for proper operation. If problemis corrected, replace Purge Control Solenoid Valve (PCSV).

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF902E

TROUBLESHOOTING FOR DTC ECBEBEB1

DTC	Diagnostic Item
P0500	Vehicle Speed Sensor (VSS) Circuit Malfunction

TEST PROCEDURE

- Turn ignition OFF and disconnect Vehicle Speed Sensor (VSS) connector.
- Turn ignition ON and measure voltage Vehicle Speed Sensor (VSS) harness connector terminal 1 and ground.

  Specification (Voltage): Battery voltage

Is voltage within specification?

YES

- Turn ignition OFF and disconnect ECM connector.
- Measure resistance between Vehicle Speed Sensor (VSS) harness connector terminal 3 and ECM harness connector terminal 10(E200-3).

  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open or short to ground between Vehicle Speed Sensor (VSS) terminal 2 and ignition switch.
Repair wire or connector as necessary.

YES

- Measure resistance between Vehicle Speed Sensor (VSS) harness connector terminal 1 and ground.

  Specification (Resistance): Less than 1 Ω

Is resistance within specification?

NO

Open between Vehicle Speed Sensor (VSS) terminal 3 and ECM terminal 10(E200-3).
Repair wire or connector as necessary.

YES

- Measure resistance between Vehicle Speed Sensor (VSS) terminal 1 and 3.

  Specification (Resistance): ∞

Is resistance within specification?

NO

Open between Vehicle Speed Sensor (VSS) terminal 1 and ground.
Repair wire or connector as necessary.

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YES

- Turn ignition OFF and connect ECM connector.
- Turn ignition ON and measure voltage between Vehicle Speed Sensor (VSS) harness connector terminal 3 and ground.
  Specification (Voltage): Less than 0.5 V

Is voltage within specification?

NO

Short between Vehicle Speed Sensor (VSS) terminal 1 and 3.
Repair wire or connector as necessary.

YES

Check for poor terminal contact due to oxidation, bent or misplaced terminal.
Repair as necessary.
If Ok, temporarily install a known good Vehicle Speed Sensor (VSS) and check for proper operation. If problem is corrected, replace Vehicle Speed Sensor (VSS).

NO

Short to battery line between Vehicle Speed Sensor (VSS) terminal 3 and ECM terminal 10(E200-3).
Repair wire or connector as necessary.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF902G

TROUBLESHOOTING FOR DTC E3E9BBE8

DTC	Diagnostic Item
P0506	Idle Air Control System - RPM lower than expected

TEST PROCEDURE

- Connect a Hi-Scan(Pro) to the Data Link Connector (DLC).
- Turn ignition switch to ON position and monitor any other DTCS.

Are any DTC relating to MAFS and TPS also set?

NO

- Check the below items
  - Air Intake System
  - PCV hose connection
  - Throttle plate for blockage or varbon deposits.

Do the above items have normal condition?

YES

Do all repair associated with those codes before proceeding with this procedure.

YES

Problem is intermittent or was repaired and ECM memory was not cleared.

NO

Clean or replace it.

Return to vehicle to original condition.
Clear all Diagnostic Trouble codes. Veryfy by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF401B

TROUBLESHOOTING FOR DTC EEC0CAF5

DTC	Diagnostic Item
P0507	Idle Air Control System - RPM higher than expected

TEST PROCEDURE

- Connect a Hi-Scan(Pro) to the Data Link Connector (DLC).
- Turn ignition switch to ON position and monitor any other DTCS.

Are any DTC relating to MAFS and TPS also set?

NO →

- Check the below items
  - PCSV open stuck
  - Throttle plate open stuck
  - Air leakage in air intake system

Do the above items have normal condition?

YES → Problem is intermittent or was repaired and ECM memory was not cleared.

NO → Clean or replace it.

YES → Do all repair associated with those codes before proceeding with this procedure.

Return to vehicle to original condition.
Clear all Diagnostic Trouble codes. Veryfy by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF401C

TROUBLESHOOTING FOR DTC E89B7724

DTC	Diagnostic Item
P0510	Closed Throttle Position Switch

TEST PROCEDURE

- Turn the ignition switch off.
- Disconnect TPS and ECM connectors.
- Measure resistance between the terminal 2 of TPS harness connector and 9 of ECM harness connector(E200-3).
  Specification (Voltage): Less than 1 Ω

YES

- Turn the ignition switch on with the engine idling.
- Measure voltage between the terminal 2 of TPS harness connector and chassis ground.
  Specification (Voltage): Less than 1V

NO

Open between the terminal 2 of TPS connector and 9 of ECM connector(E200-3). Repair wire or connector as necessary.

YES

- Connect TPS and ECM connectors.
- Turn the ignition switch on with the accelerator depressed.
- Measure voltage between the terminal 9 of ECM harness connector(E200-3).
  Specification (Voltage): Approx. 5V

NO

Open or short to ground between the terminal 2 of TPS connector and 9 of ECM connector (E200-3).
Repair wire or connector as necessary.

YES

- Temporarily install a known good TPS and check for proper operation.
  If problem is corrected, replace TPS.

NO

- Replace TPS.

Return vehicle to original condition. Clear all Diagnostic Trouble codes. Veryfy by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFMF401A

Fuel System (D4BH - DSL2.5)

GENERAL

SPECIFICATION E2B0B1EC

ENGINE INFORMATION	Engine	D4BH
	Displacement Volume	2476 cc
	Number of Cylinders	4-Cylinders, in-line
	Valve Mechanism	SOHC
	Fuel	Diesel

Items		Specification		
SENSORS	Manifold Absolute Pressure Sensor (MAPS)	Type	Piezo-Resistive Sensor	
		Output Voltage	20 kPa	0.32 ~ 0.48V (23℃)
			100 kPa	1.82 ~ 1.94V (23℃)
			190 kPa	3.48 ~ 3.60V (23℃)
			250 kPa	4.57 ~ 4.73V (23℃)
	Intake Air Temperature Sensor (IATS)	Type	Thermister Type	
		Resistance	-40℃	40.93 ~ 48.35kΩ
			-20℃	13.89 ~ 16.03kΩ
			0℃	5.38 ~ 6.09kΩ
			20℃	2.31 ~ 2.56kΩ
			40℃	1.07 ~ 1.21kΩ
			80℃	0.29 ~ 0.34kΩ
	Accelerator Position Sensor (APS)	Output Voltage	C.T	0.33 ~ 0.43V
			W.O.T	3.8 ~ 4.4V
	Crankshaft Position Sensor (CKPS)	Type	Variable Reluctance (VR) Speed Sensor	
	Fuel Temperature Sensor (FTS)	Type	Thermister Type	
		Resistance	-40℃	52.97kΩ
			-20℃	16.15kΩ
			0℃	5.86kΩ
			20℃	2.44kΩ
			40℃	1.14kΩ
			60℃	0.58kΩ

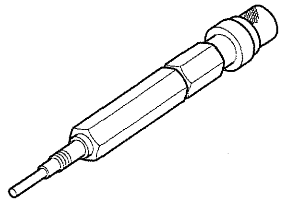
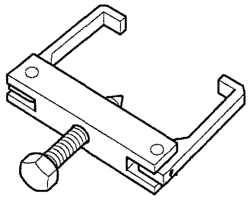
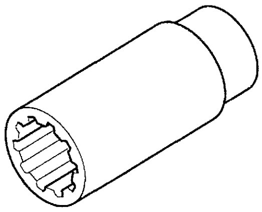
Items		Specification		
SENSORS	Engine Coolant Temperature Sensor (ECTS)	Type	Thermister Type	
		Resistance	-40℃	48.14kΩ
			-20℃	14.13 ~ 16.83kΩ
			0℃	5.79kΩ
			20℃	2.31 ~ 2.59kΩ
			40℃	1.15kΩ
			80℃	0.32kΩ
	Timing Position Sensor (TPS)	Resistance	MDL ~ OSC [+]	76.3 ~ 87.7kΩ (25 ± 10 ℃)
			MDL ~ OSC [-]	
	Control Sleeve Position Sensor (CSPS)	Resistance	OSC [+] ~ OSC [-]	11.2 ~ 12.4Ω (23 ℃)
			MDL ~ OSC [+]	5.6 ~ 6.2Ω (23 ℃)
			MDL ~ OSC [-]	
	Compensation Resistor	No.(Distinguishing number) and resistance	No.1 (945)	0.18 kΩ
			No.2 (946)	0.30 kΩ
			No.3 (947)	0.43 kΩ
			No.4 (948)	0.62 kΩ
			No.5 (949)	0.82 kΩ
			No.6 (950)	1.10 kΩ
			No.7 (951)	1.50 kΩ
			No.8 (952)	2.00 kΩ
			No.9 (953)	2.70 kΩ
			No.10 (954)	3.90 kΩ
			No.11 (955)	5.60 kΩ
			No.12 (956)	8.20 kΩ
			No.13 (957)	15.00 kΩ
	NP Sensor	Resistance	1.5 ~ 1.8kΩ (25 ± 5 ℃)	
		Gap	0.8 ~ 1.2mm	
ACTUATORS	Timing Control Valve (TCV)	Resistance	10.3 ~ 11.7Ω (20 ℃)	
	Fuel Cut Valve (FCV)	Resistance	7.5 ~ 9.7Ω (23 ± 10 ℃)	
	GE Actuator	Resistance	0.55 ~ 0.81Ω (23 ℃)	
	EGR Solenoid Valve 1	Type	Duty Control Type	
	EGR Solenoid Valve 2	Type	ON/OFF Control Type	

Items		Specification
FUEL TANK	Capacity	75ℓ
INJECTION PUMP	Type	COVEC-F (COmputed VE pump Control system - Full)
	Number of cylinders	4
	Maximum Speed (Injection Pump)	Approximately 3,000 rpm
	Direction of rotation	Clockwise viewed from driven end
	Governor type	Electronic (GE Actuator)
	Injection timing control	TCV duty ratio control on the base of feed back TPS
	Injection quantity control	Electronic control of control sleeve position on the base of feed-back CSPS
	Prevention of reverse rotation	Constructed so that fuel injection is not performed at reverse rotation
	Injection timing	ATDC 9° ± 0.5°
	Plunger stroke	1 ± 0.03 mm
NOZZLE AND HOLDER	Opening pressure	14.7 MPa (150 kgf/㎠, 2,132 psi)
	Initial opening pressure	15.2 ~ 16.2 MPa (155 ~ 165 kgf/㎠, 2,204 ~ 2,346 psi)
	Spring constant	21 kgf/mm

TIGHTENING TORQUES E51E9B79

Items	Nm	kgf·cm	lbf·ft
Injection pipe clamp bolts	4 ~ 6	40 ~ 60	3 ~ 4
Injection pipe union nuts	23 ~ 37	230 ~ 370	17 ~ 27
Pump bracket-to-cylinder block bolts	18 ~ 25	180 ~ 250	13 ~ 18
Injection pump-to-pump bracket bolts	20 ~ 27	200 ~ 270	14 ~ 19
Injection pump mounting nuts	15 ~ 22	150 ~ 220	11 ~ 16
Fuel return pipe nuts	30 ~ 40	300 ~ 400	22 ~ 29
Injection nozzle	50 ~ 60	500 ~ 600	36 ~ 43
Retaining nut-to-nozzle body	35 ~ 40	350 ~ 400	25 ~ 29
Pump sprocket nut	80 ~ 90	800 ~ 900	58 ~ 65
Fuel filler neck mounting bolt	4 ~ 6	40 ~ 60	3 ~ 4
Fuel filter bracket mounting bolts	4 ~ 6	40 ~ 60	3 ~ 4
Injection pump wire harness bracket mounting bolt	8 ~ 10	80 ~ 100	6 ~ 7
Fuel pump opening nut	30 ~ 40	300 ~ 400	22 ~ 29

SPECIAL SERVICE TOOL EBEC04F7

Tool (Number and name)	Illustration	Application
09310-43000 Prestroke measuring adapter	 LF9E018A	Injection timing adjustment
09314-43000 Injection pump sprocket puller	 LF9E019A	Removal of injection pump sprocket
09314-43100 Nozzle holder socket	 LF9E020A	Removal of nozzle holder

BASIC TROUBLESHOOTING E72D5A2A

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 BASIC INSPECTION in INTERMITTENT PROBLEM 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

CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLE INFORMATION

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

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.

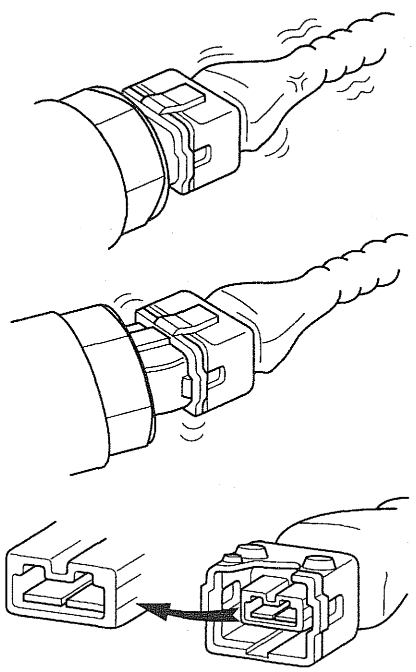
NOTE

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

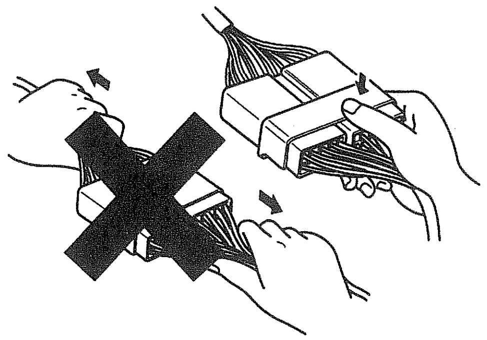
DO NOT sprinkle water directly into the engine compartment or electronic components.

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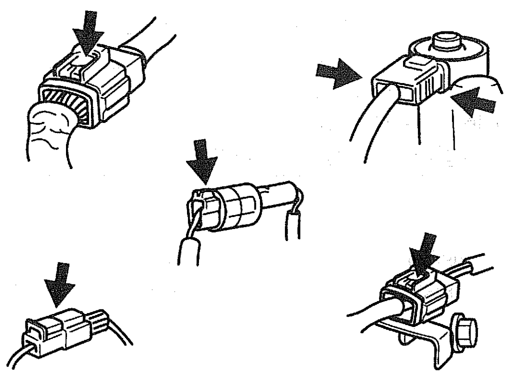
   b. When removing the connector with a lock, press or pull locking lever.



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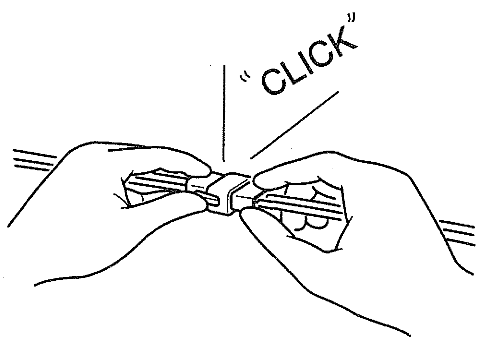
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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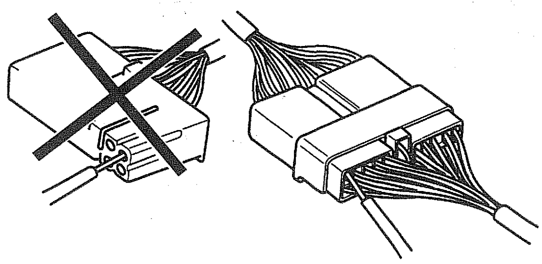
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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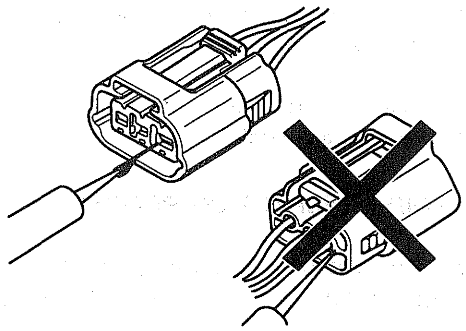
   e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



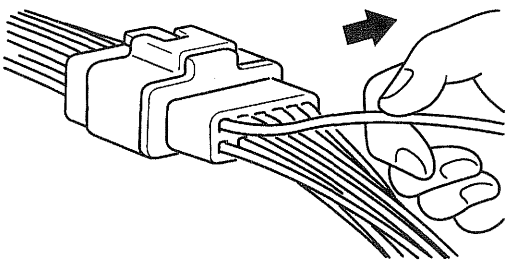
BFGE015J

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.



BFGE015K

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.

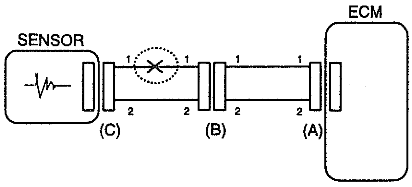
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

● 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

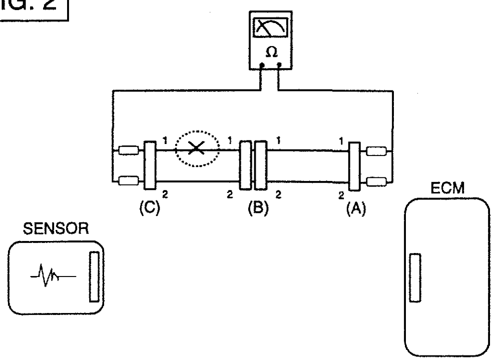
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

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

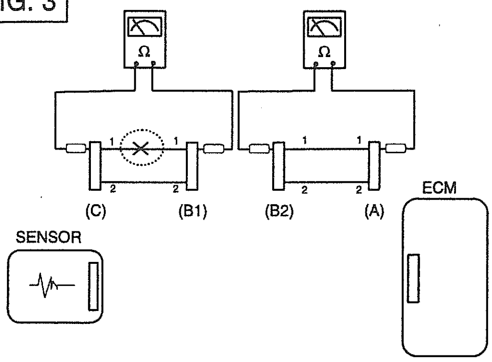


BFGE501B

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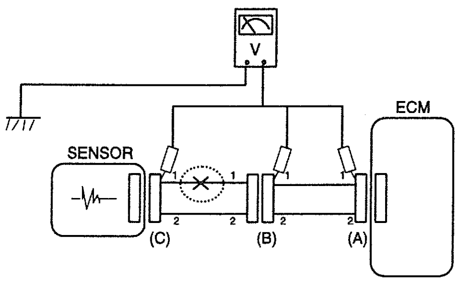
3. Voltage Check Method
   a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

   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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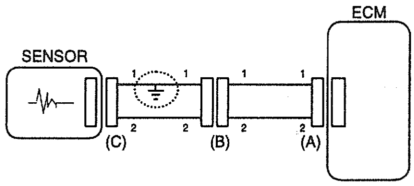
● CHECK SHORT CIRCUIT

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

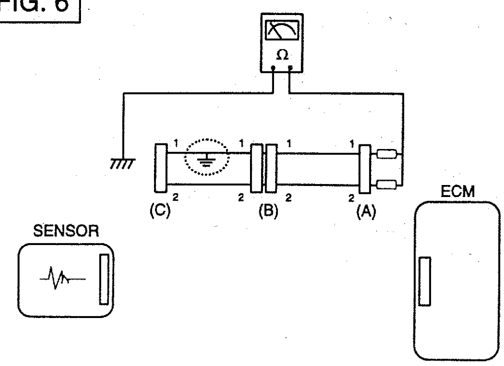
Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

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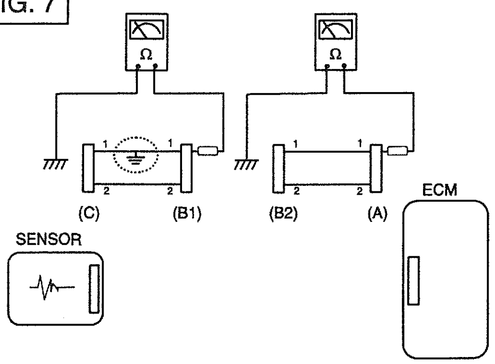
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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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ECM PROBLEM INSPECTION PROCEDURE

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): 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).

SYMPTOM TROUBLESHOOTING GUIDE CHART (I)

Symptom	Probable cause	Remedy
Engine does not start	Cranking speed too low	Repair starting system or charge or replace battery so that engine cranks at a minimum of 150 rpm.
	No voltage at fuel cut valve on injection pump	Check for voltage with test light. If necessary, replace fuse or faulty wires.
	Fuel cut valve on injection pump loose or faulty	Tighten solenoid. Check that the valve clicks when key is turned off and on. Replace faulty solenoid.
	No voltage at glow plug bus	If test light shows no voltage at bus with key at "ON" position, test relay and wiring.
	Glow plug faulty	Test and, if necessary, replace glow plug.
	Air in fuel system	Bleed fuel system.
	Injection pump not delivering fuel	If no fuel emerges from a looseness injection pipe during cranking, check timing belt and fuel supply from filter.
	Injection pipes misconnected	Connect pipes in correct location.
	Injection timing incorrect	Adjust injection timing.
	Faulty injection nozzles	Check and, if necessary, repair or replace nozzles.
	Engine mechanical faults, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Try to start engine with new pump installed. If necessary, replace pump permanently
Idle speed incorrect or idle rough irregular	Idle speed incorrectly adjusted	Check and, if necessary, adjust the idle speed.
	Accelerator control binding	Check that accelerator lever on pump is not loose, then adjust accelerator cable.
	Loose fuel hose between filter and injection pump	Replace hose or secure with clamps, bleed air from system.
	Air in fuel system	Bleed fuel system.
	Inadequate fuel supply owing to clogged fuel filter, or fuel returnline and injection pipes leaking, dirty, kinked, or squeezed at connections	Inspect and, if necessary, replace lines and hoses or replace fuel filter.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Engine mechanical faults, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Try engine at idle with new pump installed. If necessary, replace pumppermanently
	Engine lugging in too high a gear	Observe correct shift speeds.

Symptom	Probable cause	Remedy
Smoky exhaust (black, blue or white)	Engine not reaching correct operating temperature	Check and, if necessary, replace cooling system thermostat.
	Maximum rpm incorrect	Check and if necessary, replace injection pump.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Restricted exhaust system	Check exhaust system for dents and obstructions.
	Engine mechanical faulty, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Observe exhaust with new pump installed if necessary, replace pump permanently.
Poor power output, slow acceleration (speedometer accurate, clutch not slipping)	Injection pump accelerator lever loose or not reaching maximum rpm adjustingscrew	Tighten lever, check that accelerator pedal travel is not restricted, then adjust accelerator cable.
	Maximum rpm incorrect	Check and, if necessary, replace injection pump.
	Air cleaner filter dirty	Clean or replace air cleaner filter.
	Inadequate fuel supply owing to clogged fuel filter, or fuel return line and injection pipes leaking, dirty, kinked, or squeezed at connections	Inspect and, if necessary, replace lines and hoses, replaced fuel filter.
	Air in fuel system	Bleed fuel system.
	Ice or solidified wax in fuel lines. (winter time only)	Move car to a warm garage until ice or wax has become liquid, then bleed fuel system.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Engine mechanical faults, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Check acceleration and speed with new pump installed. If necessary, replace pump permanently.
Excessive fuel consumption	Air cleaner filter dirty	Clean or replace air cleaner filter.
	Fuel leaks	Check and, if necessary, replace or tighten all pipes, hoses and connections.
	Return pipe and hose blocked	Check return line for kinks and dents. Replace faulty lines. If line is clogged, blow it out with compressed air, then bleed fuel system.
	Idle speed too fast or maximum rpm too high	Check and, if necessary, adjust idle speed or replace injection pump.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Engine mechanical fault, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Check fuel consumption with new pump installed, if unnecessary, replacepump permanently.

Symptom	Probable cause	Remedy
Excessive accelerator pedal effort required (Incomplete pedal return included)	Rusty pedal arm	Clean and lubricate.
	Incorrect routing	Ensure bending radius of 150 mm or more and correct excessively bent portion.
	Rusty cable	Replace
	Shift throttle cable	Lubricate link and shaft.
Broken accelerator control cable	Binding cable end	Remove rust and burrs from cable end.
	Incorrect perpendicularity of cable end mounting point	Correct ends on the lever side.
	Incorrect perpendicularity between cable end and cable	Correct or replace parts.
Engine does not stop	Faulty starting switch operation	Correct or replace part.
	Broken harness between starting switch and fuel cut solenoid	Replace harness

SYMPTOM TROUBLESHOOTING GUIDE CHART (II)

ENGINE WILL NOT START

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Abnormal symptom				Check point	Remedy
Engine will not start	Engine will not start due to the fail safe	Malfunction of both NP sensor and CKPS		Measure the resistance of the sensor coil	Replace the sensor coil
		Malfunction of CSPS		Measure the resistance of the sensor coil	Replace the pump
		Short circuit of FCV		Measure the resistance of the FCV coil	Replace the FCV
		Malfunction of *GE Actuator			
	Engine will not start due to the FCV stuck	Engine stall due to the fail safe			
		Low supply voltage	Open or short circuit	Measure the resistance of the wire	Repair the open or short circuit
			Low voltage supplied to ECM	Check the battery voltage	Repalce the battery
	No fuel suppling to the pump	High flow resistance in the fuel line		Check the fuel filter	Replace the fuel filter
		Air incoming from the fuel tank		Check the fuel tank	Refuel
	No complete combustion occurs due to the bad glow system				
	Improper injection timing at starting				

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Abnormal symptom				Check point	Remedy
Sudden engine stall in driving	Engine stall due to the fail safe	Malfunction of both NP sensor and CKPS		Measure the resistance of the sensor coil	Replace the sensor coil
		Malfunction of CSPS		Measure the resistance of the sensor coil	Replace the pump
		Malfunction of GE Actuator			
	Engine stall due to the FCV close	Engine stall due to the fail safe			
		Low supply voltage	Open or short circuit	Measure the resistance of the wire	Repair the open or short circuit
			Low voltage supplied to ECM	Check the battery voltage	Repalce the battery
	Engine stall due to the no fuel suppling to the pump	High flow resistance in the fuel line		Check the fuel filter	Replace the fuel filter
		Air incoming from the fuel tank		Check the fuel tank	Refuel

SUDDEN RISE OF ENGINE RPM

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Abnormal symptom				Check point	Remedy
Sudden rise of engine rpm	Sudden rise of engine rpm without changing of fuel quantity	Incorrect voltage of GE	Incorrect output of CSPS	Looseness of sensor plate	Tighten the nut
				Looseness of moving plate	Tighten the nut
				Looseness of CSPS coil	Tighten
			Malfunction of the CSPS	CSPS stuck to the low side	Repair the open circuit of CSPS[-]
					Repair the open circuit of CSPS[Middle]
					Repair the short circuit of CSPS[+], CSPS[Middle]
					Repair the bad continuity
		Malfunction of the GE Actuator	GE Actuator stuck to the FULL side	Open circuit of GE Actuator ground	Repair the open circuit of GE Actuator ground
				Open circuit of wiring	Repair the open circuit of wiring
		Incorrect signal of FTS	Incorrect signal of FTS	Bad FTS sensor	Replace the sensor
				Bad continuity	Repair the bad continuity

A

Continued on next page

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From previous page

A

Abnormal symptom		Check point		Remedy
Sudden rise of engine rpm with changing of fuel quantity	Incorrect signal of APS	Bad reference voltage	Bad circuit of ECM	Replace the ECM
			Bad continuity	Repair the bad continuity
		Bad accelerator sensor	Measure the output voltage of the sensor	Replace the sensor
		Noise at the sensor		
		Bad continuity		Repair the bad continuity
	Bad return of accelerator pedal	Bad return of the sensor		Replace the sensor
		Bad return of accelerator pedal		Replace the pedal
	Incorrect adjustment of fuel quantity	Malfunction of compensation resistor	Malfunction of compensation resistor	Replace the compensation resistor
			Bad continuity	Repair the bad continuity
		Bad tolerance among the component	Malfunction of the ECTS	Replace the sensor
			Bad continuity	Repair the bad continuity

SYMPTOM TROUBLESHOOTING GUIDE CHART (III)

○ : Effect much
△ : Effect little

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ITEM	Symptom / Main cause	Hard to start	Rough idling	Lack of power/ poor acceleration	Bad return of overrun rpm	Engine stop	Much black smoke	Much white smoke	Knocking and vibrtion	Poor fuel economy	Impossible to stop the engine	Sudden rise of engine rpm	Check point
FCV	Poor connection or looseness of terminal	○				○			△				Tightening torque : 2.0-2.5kg·m
	Valve fail (Open or being stuck)	○				○					○		Check the resistance or output signal Inspect the part after removal
TCV	Poor connection or looseness of connector	○	○	○	△	△	○	○	○	○			Check the installation condition
	Malfunction of TCV (Open or being stuck)	○	○	○	△	△	○	○	○	○			Check the resistance or output signal
	TCV filter clogged (O-ring torn)	○	○	○	△	△	○	○	○	○			
CSPS	Bad output of CSPS	○	○	○	○	○	○	○	○	○		○	Check the resistance or output signal
	Malfunction of CSPS (open or short)	○	○	○	○	○	○	○	○	○			
GE actuator	Bad output of GE Actuator coil	○	○	○	○	○	○	○	○	○	△	△	Check the resistance or output signal
	Malfunction of GE Actuator coil (open or short)	○	○	○	○	○	○	○	○	○	△		
FTS	Malfunction of fuel temp. sensor	○	○				○	○		○			Check the resistance or output signal
	Bad output of sensor	○	○		△		○	○		○			Check the characteristic of resistance for temp. range
Compensation resistor	Compensation resistor poor connection	○	○	○	△	△	○	○	△	○			Check the open or short
	Wrong resistor	○	○	○	△	△	○	○	△	○			Check the compensation resistor
NP sensor (CKPS is good)	Bad installation noise				○								Tightening torque : 2.0-2.5kg·m Compensation resistor

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ITEM	Symptom / Main cause	Hard to start	Rough idling	Lack of power/ poor accelera-tion	Bad return of overrun rpm	Engine stop	Much black smoke	Much white smoke	Knocking and vibrtion	Poor fuel economy	Impossible to stop the engine	Sudden rise of engine rpm	Check point
NP sensor (CKPS is good)	Malfunction of sensor (open or short)				○				△				Check the resistance and output signal
NP sensor (with faulty CKPS)	Bad installation, noise		○			○							Tightening torque:2.0-2.5kg·m Check the output signal
	Malfunction of sensor (open or short)					○							Check the resistance and output signal
TPS	Bad installation and output signal	○	○	○	△	△	○	○	○	○			Tightening torque:0.7-0.9kg·m Check the output signal
	Malfunction of sensor (open or short)	○	○	○	△	△	○	○	○	○			Check the resistance
MAPS	Bad installation and output signal			○			△	△		△			Inspect the installation condition
	Malfunction of sensor (open or short)			○			△	△		△			Check the output signal's characteristic
CKPS (with good NP sensor)	Bad installation, noise Malfunction of sensor (open or short)		○	○			○	○	○	○		○	Inspect the installation condition and fly wheel Check the output signal's characterstic
CKPS (with faulty NP sensor)	Bad installation, noise Malfunction of sensor (open or short)		○	○	○	○	○	○	○	○			
ECTS	Bad installation and output signal	○	○	△			○	○	△	○		△	Inspect the installation condition
	Malfunction of sensor (open or short)	△	○	△			○	○	△	○		△	Check the output signal's characteristic
VSS	Bad installation and output signal			○					○				Check the output signal's characteristic
	Malfunction of sensor (open or short)			○					○				Check the wiring harness
APS	Malfunction of sensor (open or short)	△	○	○	○		○	○		○		○	Check the output signal's characteristic

ITEM	Symptom / Main cause	Hard to start	Rough idling	Lack of power/ poor acceleration	Bad return of overrun rpm	Engine stop	Much black smoke	Much white smoke	Knocking and vibrtion	Poor fuel economy	Impossible to stop the engine	Sudden rise of engine rpm	Check point
IDLE switch	Open or short		○		○					△		○	Check the resistance and output signal
Neutral switch	Bad installation and output signal (open and short)					△							Tightening torque:2.0-2.5kg·m Check the output signal
ECM	Power system (open or short)	○											Check the resistance and output signal
	Bad output signal of PWM signal for TCM (open or short)			○					○				Tightening torque:0.7-0.9kg·m Check the output signal
	Bad output signal of barometric pressure sensor			○			○	○		○			Check the resistance
	Bad communication for Immobilizer (open or short)	○				○							Inspect the installation condition
Turbo Charger waste gate (boost hose)	Malfunction (stuck)			○			○			○			Check the output signal's characteristic
Glow relay	Open or short	○	○					○					Inspect the installation condition and fly wheel Check the output signal's characterstic
EGR solenoid valve	Being stuck, bad operation			○			○			○			

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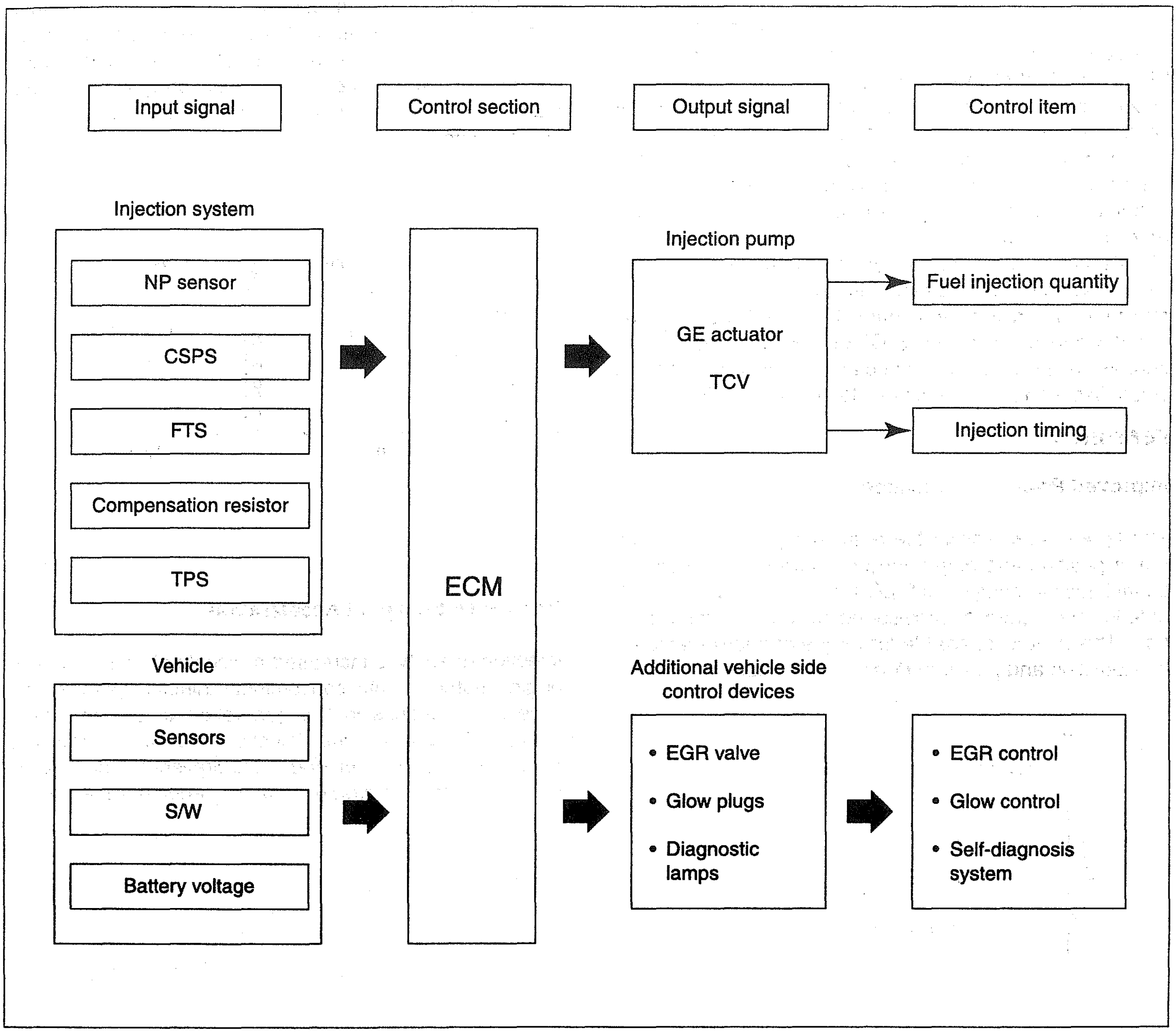
NOTE

NP Sensor : Injection Pump Speed Sensor
CSPS : Control Sleeve Position Sensor
FCV : Fuel Cut Valve
GE Actuator : Electronic Governor Actuator
FTS : Fuel Temperature Sensor
APS : Accelerator Position Sensor
ECTS : Engine Coolant Temperature Sensor
VSS : Vehicle Speed Sensor
MAPS : Manifold Absolute Pressure Sensor
CKPS : Crankshaft Position Sensor
TCV : Timing Control Valve

DIESEL CONTROL SYSTEM

SCHEMATIC DIAGRAM E38402C5



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Part name	Function
NP sensor	Detects pump speed
Control Sleeve Position Sensor (CSPS)	Detects control sleeve position
Fuel Temperature Sensor (FTS)	Detects fuel temperature
Compensation Resistor	Compensation
Timing Position Sensor (TPS)	Detects timing pistong position
Timing Control Valve (TCV)	Adjusts injection timing

SYSTEM OVERVIEW

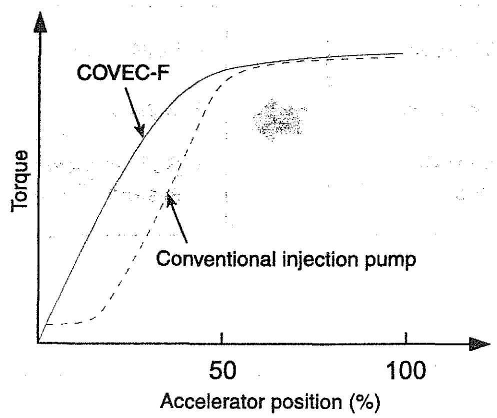
This manual consists of two parts, service manual for construction & operation and self-diagnosis system. The first part, describes construction and operation of the micro-computor controlled fuel injection quantity and injection timing control system, COVEC-F (Computed VE pump Control system Full). And the second part, describes the self-diagnosis system of the microcomputer controlled fuel injection quantity and injection timing control system, COVEC-F (Computed VE pump Control system-Full). This is intended for use by vehicle maintenance technicians or people with an adequate knowledge of injection pumps.

The COVEC-F fuel injection system (Computed VE pump Control system-Full) is a distributor type fuel injection system that uses a micro-computor to control fuel injection quantity and injection timing. COVEC-F was developed to improve the power performance and the driving comfort of small diesel engines, as well as to decrease pollution.

FEATURES

Improved Power Performance

The figure below shows the relationship between accelerator position and output torque. Compared to conventional injection pumps, COVEC-F provides the most suitable injection quantity corresponding to accelerator position. This makes it possible for torque at a lower accelerator position and power performance to improve.



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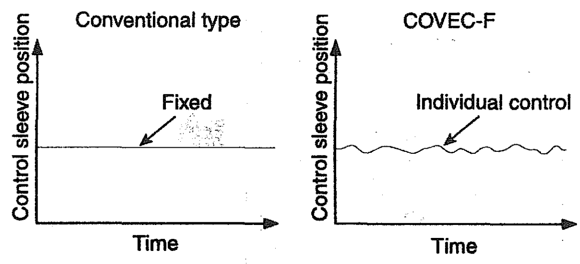
Increased Comfort

On conventional injection pumps, minute variations of control sleeve position are not performed. COVEC-F, however, detects variations just like each engine combustion at idling, and in response to this, controls the control sleeve position by increasing as decreaing the fuel injection quantity. In this way, each cylinder's injection quantity is controlled for each injection to decrease engine vibration and improve comfort.



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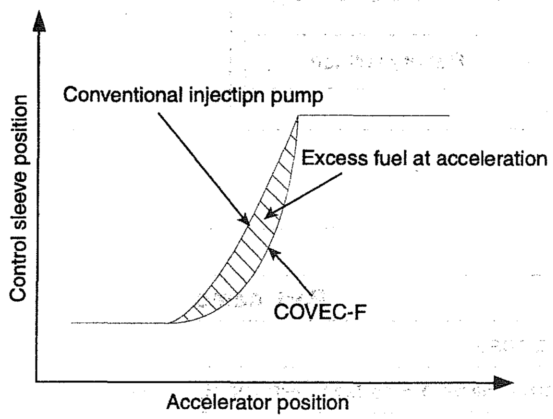
Decreased Smoke at Acceleration

Injection quantity is increased at acceleration to increase engine output. With conventional injection pumps, this excess fuel results in the generation of smoke. With COVEC-F, however, fuel injection quantity is precisely controlled, even at acceleration, to prevent the generation of smoke without adversely affecting engine response.



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Additional Devices Unnecessary

dditional devices such as a boost compensator, aneroid compensator, or injection timing compensation devices are unnecessary as compensation is performed electronically in response to signals from the various sensors. Because of this, the exterior of the injection pump is greatly simplified, enabling better utilization of space around the injection pump.

SYSTEM CONTROL

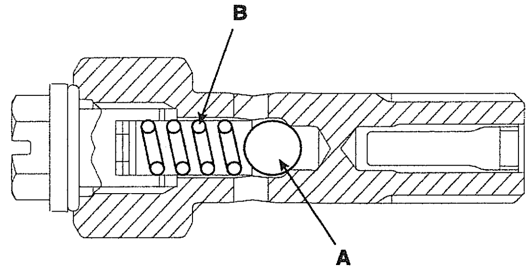
COVEC-F detects electrical signals from physical signals by sensors and switches. The control unit processes this information to control injection timing and injection quantity electronically.
Informational signals detected by sensors and switches are input to the micro-computer in the control unit. Based on these informational signals, characteristic data as well as compensation data recorded in the ROM(read only memory) are read in the CPU(central processing unit). Comparative calculations are then performed utilizing this data and informational signals are output.
The control signals output by the micro-computor are then converted to the drive signals. These are then input to the GE actuator and the TCV(Timing Control Valve) to control fuel injection quantity and timing.
In addition COVEC-F also has a function that continually compensates real values with target ones(feedback control) to perform optimum control of the diesel engine and ensure precision and endurance.

Fuel intake and pressure delivery by COVEC-F is done in the same way as that of the conventional injection pump. The inside of the pump is devided into a governor chamber, where fuel injection quantity control is performed, and a pump chamber, where fuel intake and delivery are performed.

The conventional injection pump is controlled by a centrifugal governor. COVEC-F, however, utilizes an electronic governor (ie, a GE actuator). Flyweights are not used. Therefore, there is no control lever at the upper cover. Instead, the control unit cable is connected to the upper part of the injection pump. Also, the conventional injection pump utilizes a flyweight holder gear (with 23 teeth) to detect pump speed. COVEC-F, however, utilizes sensing gear plates provided on the drive shaft to detect pump speed. The number ofprojections on the gear plate corresponds to the number of engine cylinders.
A TCV (timing control valve) is provided at the lower part of the pump body between the timer's high pressure and low pressure chambers to adjust pressure for the necessary timing advanced. The conventional injection pump is equipped with a check valve partly inside the overflow valve. With COVEC-F, however, the overflow valve is totally equipped with a check valve to prevent it from overflow until a fixed pressure is reached. COVEC-F is provided with a TPS (timing position sensor) at the lower part of the injection pump to detect timer piston position.

Overflow Valve (With Check Valve)

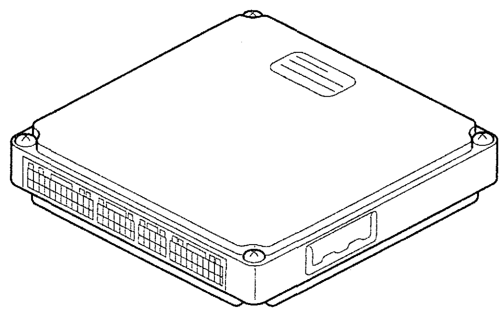
The overflow valve is installed on the end face of the GE actuator cover (ie, on the distributor head side). The check valve is constructed with a ball(A) and spring(B) to prevent overflow until the pump chamber pressure reaches a specified value.



LF9E009A

ECM

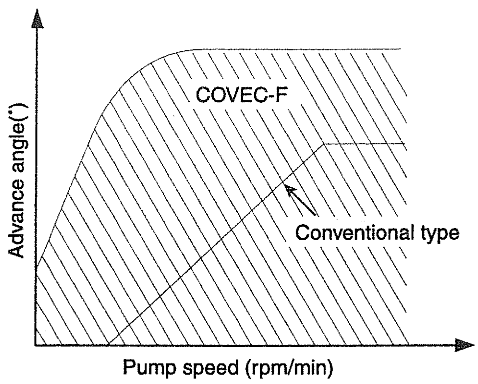
The ECM is installed on the vehicle. The ECM receives information signals detected by each sensor. Based on this information, the ECM then performs comparative calculations using programmed set values, and then instantaneously outputs optimum control signals to each control section. The ECM also includes a fault diagnosis system.



LF9E010A

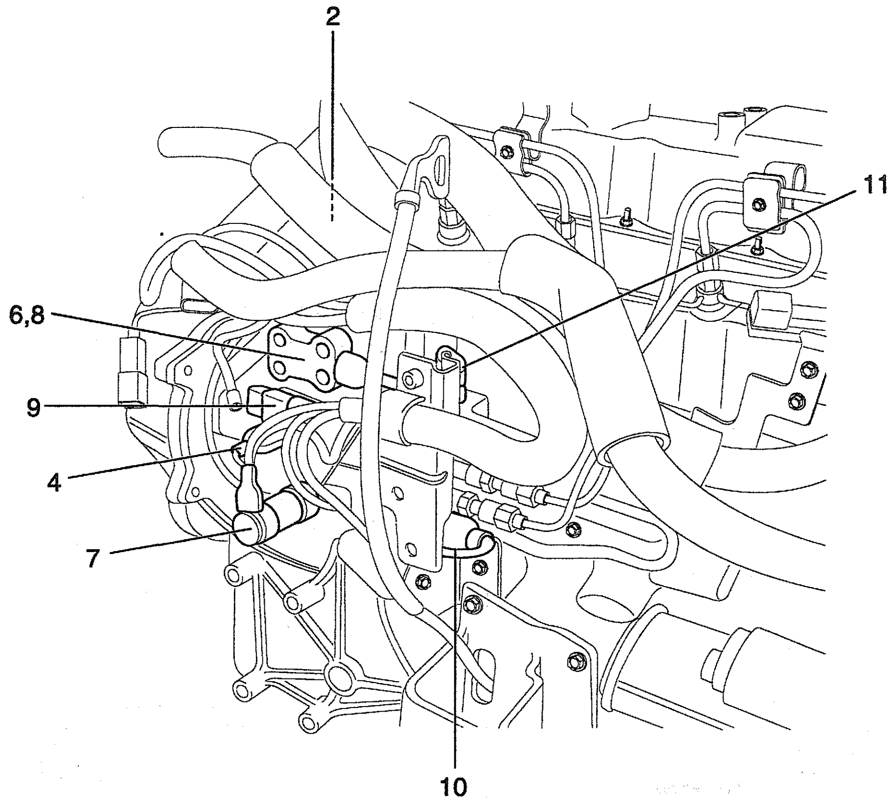
Check Valve

The graph shows the advance characteristics of the conventional injection pump and the possible range of advance control of COVEC-F.
With the conventional VE type injection pump, fuel pressure is increased in accordance with increases in speed to obtain advance characteristics.
With COVEC-F, the overflow valve is equipped with a check valve so that even at starting rotation, there is sufficient pressure to control advance. Therefore, as shown at left, the possible control range is much wider.



LF9E017A

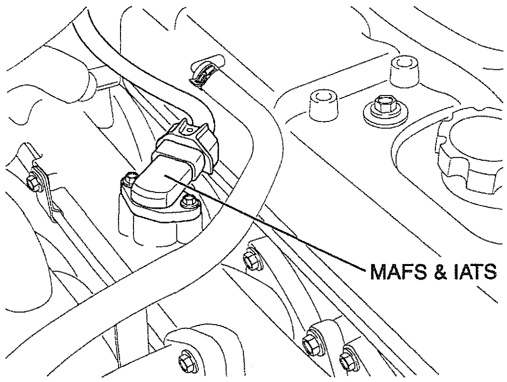
COMPONENTS LOCATION ED0AB909



1. Manifold Absolute Pressure Sensor (MAPS)
2. Intake Air Temperature Sensor (IATS)
3. Engine Coolant Temperature Sensor (ECTS)
4. NP Sensor
5. Crankshaft Position Sensor (CKPS)
6. GE Actuator
7. Timing Position Sensor (TPS)
8. Control Sleeve Position Sensor (CSPS)
9. Compensation Resistor
10. Timing Control Valve (TCV)
11. Fuel Cut Valve (FCV)
12. EGR Solenoid Valve
13. Accelerator Position Sensor (APS)
14. Fuel Temperature Sensor (FTS)
15. Vehicle Speed Sensor (VSS)

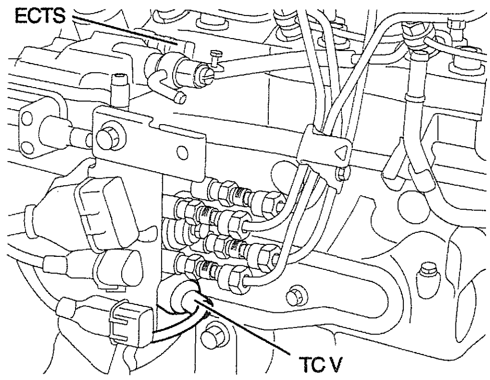
LF9E201A

1. Manifold Absolute Pressure Sensor (MAPS)
2. Intake Air Temperature Sensor (IATS)



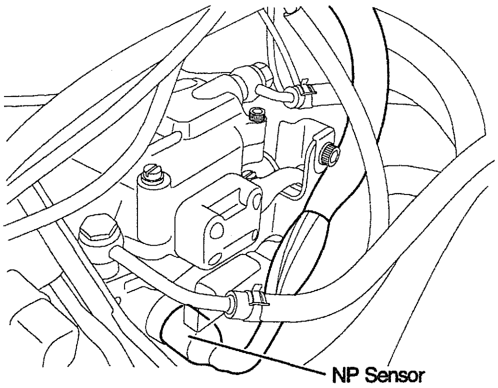
LF9E201B

3. Engine Coolant Temperature Sensor (ECTS)
10. Timing Control Valve (TCV)



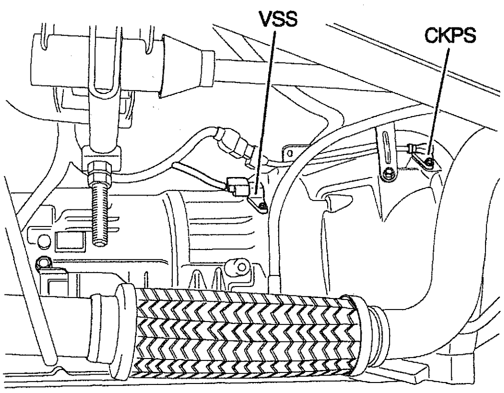
LF9E201C

4. NP Sensor



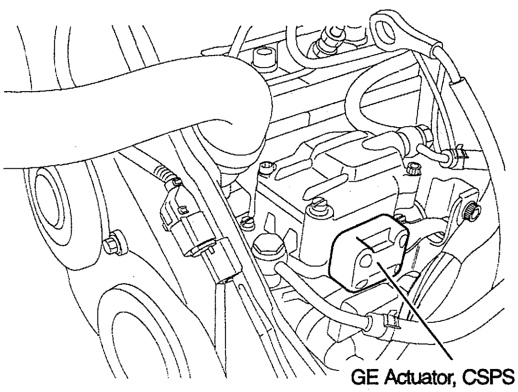
LF9E201D

5. Crankshaft Position Sensor (CKPS)
15. Vehicle Speed Sensor (VSS)



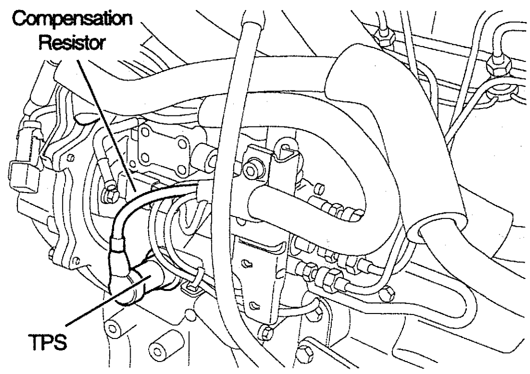
LF9E201E

6. GE Actuator
8. Control Sleeve Position Sensor (CSPS)



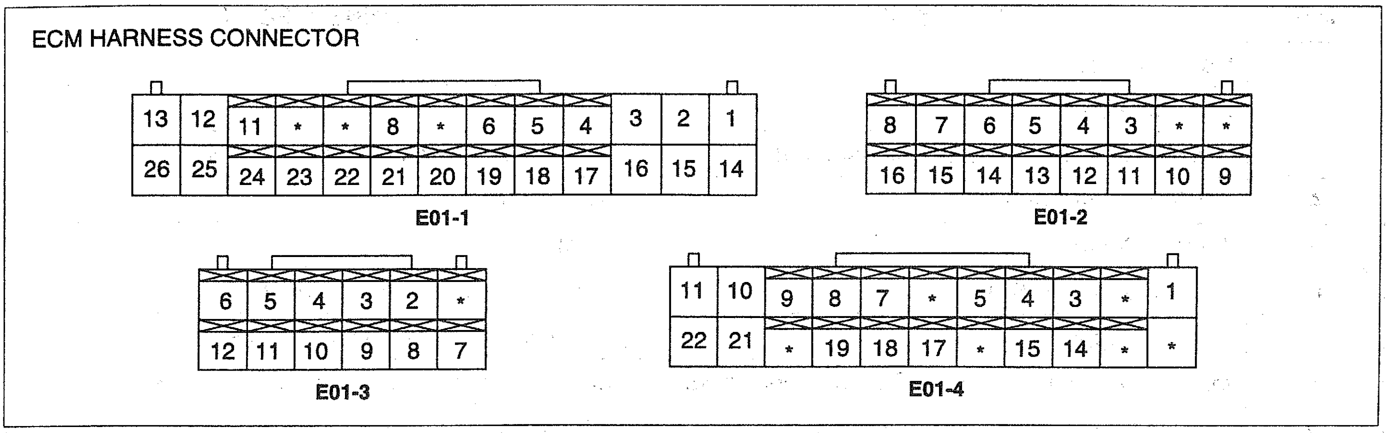
LF9E201F

7. Timing Position Sensor (TPS)
9. Compensation Resistor



LF9E201G

ECM CONNECTOR EA0B62CB



EGMF101A

CONNECTOR [E01-1]

PIN	FUNCTION	CONNECTED TO
1	GE Actuator (+) control output	GE Actuator
2	GE Actuator (-) control output	GE Actuator
3	Battery Voltage Supply after Main Relay	Main Relay
4	"START" Switch signal	Ignition Switch
5	A/C Switch signal	Triple Switch
6	M/T: Neutral Switch Signal, A/T: P/N Signal	M/T: Neutral Switch, A/T: Inhibitor Switch
7	Memory Clear Switch signal	Memory Switch
8	Idle Switch signal	Accelerator Position Sensor (APS)
9	Not connected	-
10	Not connected	-
11	Not connected	-
12	Ground	-
13	Timing Control Valve control output	Timing Control Valve (TCV)
14	GE Actuator (+) control output	GE Actuator
15	GE Actuator (-) control output	GE Actuator
16	Battery Voltage Supply after Main Relay	Main Relay
17	Engine Coolant Temperature Sensor signal input	Engine Coolant Temperature Sensor (ECTS)
18	Fuel Temperature Sensor signal input	Fuel Temperature Sensor (FTS)
19	Intake Air Temperature Sensor signal input	Intake Air Temperature Sensor (IATS)
20	Compensation Resistor signal input	Compensation Resistor
21	Ignition Switch signal	Ignition Switch
22	Immobilizer Switch 1	With Immobilizer: B+, Without Immobilizer : Open
23	Glow Plug Check line	Glow Plug and Glow Relay
24	Immobilizer Switch 2	With Immobilizer: Open, Without Immobilizer: B+
25	Ground	-
26	Fuel Cut Valve control output	Fuel Cut Valve (FCV)

CONNECTOR [E01-2]

PIN	FUNCTION	CONNECTED TO
1	Not connected	
2	Not connected	
3	Crankshaft Position Sensor signal input	Crankshaft Position Sensor (CKPS)
4	NP Sensor signal input	NP Sensor
5	Torque Control	TCM
6	Sensor Supply (+5V)	Accelerator Position Sensor (APS)
7	Sensor Supply (+5V)	Manifold Absolute Pressure Sensor (MAPS)
8	Manifold Absolute Pressure Sensor signal input	Manifold Absolute Pressure Sensor (MAPS)
9	Intercooler Fan Relay control output	Intercooler Fan Relay
10	Engine Speed signal output	Tachometer
11	Sensor Ground	Crankshaft Position Sensor (CKPS)
12	Sensor Ground	NP Sensor
13	Sensor Ground	Accelerator Position Sensor (APS)
14	Accelerator Position Sensor signal input	Accelerator Position Sensor (APS)
15	Sensor Ground	MAPS, IATS, ECTS, FTS and Compensation Resistor
16	Sensor Ground	MAPS, IATS, ECTS, FTS and Compensation Resistor

CONNECTOR [E01-3]

PIN	FUNCTION	CONNECTED TO
1	Control Sleeve Position Sensor [+] signal input	Control Sleeve Position Sensor (CSPS)
2	Control Sleeve Position Sensor [Middle] signal input	Control Sleeve Position Sensor (CSPS)
3	Control Sleeve Position Sensor [-] signal input	Control Sleeve Position Sensor (CSPS)
4	Timing Position Sensor signal [+] input	Timing Position Sensor (TPS)
5	MT/AT auto recognition signal	AT: Open, MT: IG1
6	Not connected	
7	Control Sleeve Position Sensor [+] signal input	Control Sleeve Position Sensor (CSPS)
8	Control Sleeve Position Sensor [Middle] signal input	Control Sleeve Position Sensor (CSPS)
9	Control Sleeve Position Sensor [-] signal input	Control Sleeve Position Sensor (CSPS)
10	Timing Position Sensor signal [Middle] input	Timing Position Sensor (TPS)
11	Timing Position Sensor signal [-] input	Timing Position Sensor (TPS)
12	L-Line	Data Link Connector (DLC)

CONNECTOR [E01-4]

PIN	FUNCTION	CONNECTED TO
1	Glow Relay control output	Glow Relay
2	Not connected	
3	Water Temperature Signal	TCM
4	EGR Solenoid Valve 1 (Duty) control output	EGR Solenoid Valve 1 (Duty)
5	A/C Fan Relay control output	A/C Fan Relay
6	Not connected	
7	K-Line	Data Link Connector (DLC)
8	Malfunction Indicator Lamp control output	Malfunction Indicator Lamp (MIL)
9	Glow Lamp control output	Glow Lamp
10	Battery Voltage Supply after Main Relay	Main Relay
11	Ground	-
12	Not connected	
13	Not connected	
14	EGR Solenoid Valve 2 (ON/OFF) control output	EGR Solenoid Valve 2 (ON/OFF)
15	TPS (PWM) Signal Output	TCM
16	Not connected	
17	Vehicle Speed Sensor (VSS) signal input	Vehicle Speed Sensor (VSS)
18	A/C Compressor Relay control output	A/C Compressure Relay
19	Main Relay control output	Main Relay
20	Not connected	
21	Battery Voltage Supply after Main Relay	Main Relay
22	Ground	-

DTC TROUBLESHOOTING PROCEDURES

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES ED4BB080

DTC	DESCRIPTION	MIL
P0105	Barometric Pressure Sensor Range/Performance Problem	▲
P0110	Intake Air Temperature Sensor Range/Performance Problem	▲
P0115	Engine Coolant Temperature Sensor Range/Performance Problem	●
P0120	Accelerator Position Sensor Malfunction - Irregular Sensor Output	▲
P0120	Accelerator Position Sensor Malfunction - Learning Error	▲
P0121	Accelerator Position Sensor Range/Performance Problem	●
P0180	Fuel Temperature Sensor Range/Performance Problem	▲
P0320	NP Sensor Range/Performance Problem	▲
P0335	Crankshaft Position Sensor Range/Performance Problem	▲
P0500	Vehicle Speed Sensor Range/Performance Problem	▲
P0600	Immobilizer Communication Malfunction	●
P0605	Internal Control Module Read Only Memory (ROM) Error	▲
P1116	Manifold Absolute Pressure Sensor Range/Performance Problem	●
P1120	GE Actuator Circuit Malfunction	●
P1122	Manifold Absolute Pressure Too High	●
P1123	Timing Position Sensor Range/Performance Problem	▲
P1127	Control Sleeve Position Sensor Range/Performance Problem	●
P1131	Compensation Resistor Range/Performance Problem	▲
P1135	Injection Timing Control System Malfunction	▲
P1324	Glow Relay Circuit Malfunction	●
P1522	Battery Voltage Malfunction	●
P1525	Sensor Supply Voltage (+5V) Malfunction	▲
P1613	ECM Error (A/D Converter)	▲
P1621	Fuel Cut Valve Circuit Malfunction	●

NOTE

● : Memory & MIL ON
▲ : Memory & MIL OFF

NOTE

Refer to the Group "BE" for the troubleshooting procedures of the DTC P0600.

TROUBLESHOOTING FOR DTC EF4DDF84

DTC	P0105	Barometric Pressure Sensor Range/Performance Problem

DESCRIPTION

The barometric pressure sensor is mounted in the internal of ECM. It senses the atmospheric pressure and converts it to the voltage, and it is sent to the ECM. Using this signal, the ECM calculates the altitude of the vehicle location and corrects the fuel injection timing and the fuel quantity. This barometric pressure sensor ensures the improved driveability at high altitudes.

DTC DETECTING CONDITION

DTC No	Detecting Condition & Limp Home	Suspect area
P0105	**Detecting Condition** • DTC Strategy - Rationality Check - Voltage range check • Enable condition - IG ON or engine running • Threshold Value - Barometric pressure sensor signal < 0.2V or barometric pressure sensor signal > 4.8V or for 1 second **Limp-Home Function** • Barometric pressure = 101.325 kPa • EGR CUT	• ECM

INSPECTION PROCEDURES

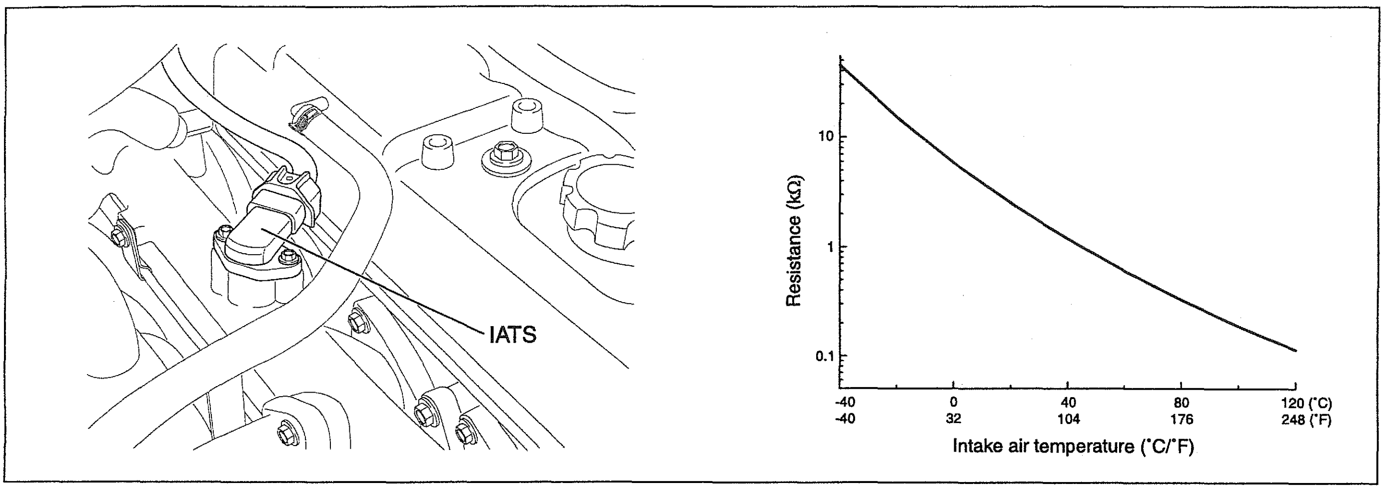
- Because this sensor is in the internal of ECM, there is no inspection of service possible for this diagnostic trouble code.
- Cancel the fault memory and perform test drive.
- If the fault cannot be cancelled, temporarily install a good ECM and check for proper operation.

LWGE004E

TROUBLESHOOTING FOR DTC EBC94ABE

DTC	P0110	Intake Air Temperature Sensor Range/Performance Problem

COMPONENT LOCATION



LF9E505I

DESCRIPTION

The Intake Air Temperature Sensor (IATS) is installed into the Manifold Absolute Pressure Sensor (MAPS). The IATS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the IATS decreases as the temperature increases, and increases as the temperature decreases. The 5 V power source in the ECM is supplied to the IATS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the IATS are connected in series. When the resistance value of the thermistor in IATS changes according to the intake air temperature, the signal voltage also changes. Using this signal, the information of the intake air temperature, the ECM corrects basic fuel injection duration and ignition timing.

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0110 if the ECM detects signal voltage higher or lower than the possible range of a properly operating IATS.

2. Conditions for Setting the DTC

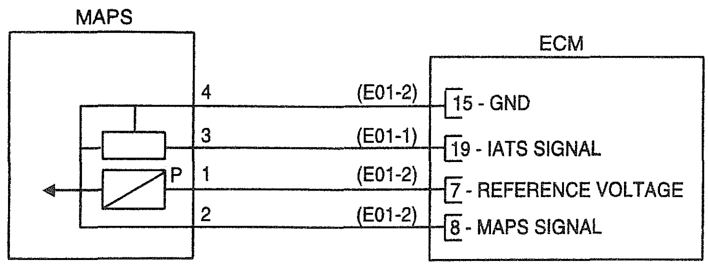
DTC No	Detecting Condition & Limp Home	Suspect area
P0110	**Detecting Condition** • DTC Strategy - Rationality Check - Voltage range check • Enable condition - IG ON or engine running • Threshold Value - IATS signal < 0.1V or IATS signal > 4.6V for 5 seconds **Limp-Home Function** • When ECTS has normal condition, - Engine coolant temperature < 25℃: intake air temperature = engine coolant temperature - Engine coolant temperature ≥ 25℃: intake air temperature = 25℃ • When ECTS is out of order, - Intake air temperature = 25℃	• Open or short in IATS circuit • IATS • ECM

SPECIFICATION

Temperature		IATS Resistance	Temperature		IATS Resistance
-40 °C	-40 °F	40.93 ~ 48.35 kΩ	40 °C	104 °F	1.07 ~ 1.21 kΩ
-20 °C	-4 °F	13.89 ~ 16.03 kΩ	60 °C	140 °F	0.54 ~ 0.62 kΩ
0 °C	32 °F	5.38 ~ 6.09 kΩ	80 °C	176 °F	0.29 ~ 0.34 kΩ
20 °C	68 °F	2.31 ~ 2.56 kΩ			

SCHEMATIC DIAGRAM

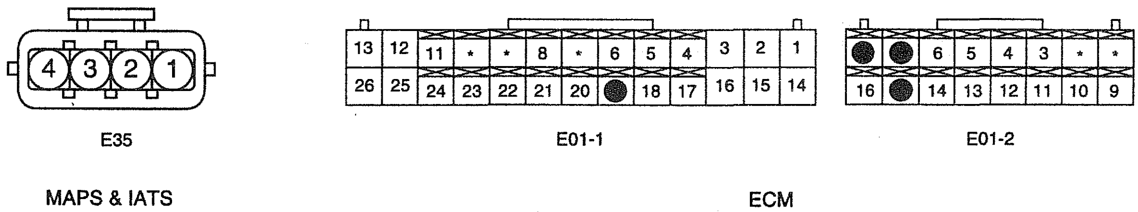
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E01-2(7)	Reference Voltage
2	ECM E01-2(8)	MAPS signal
3	ECM E01-1(19)	IATS signal
4	ECM E01-2(15)	Sensor ground

[HARNESS CONNECTORS]



EGMF4010

INSPECTION PROCEDURE

1. CHECK IATS AND ECM CONNECTORS

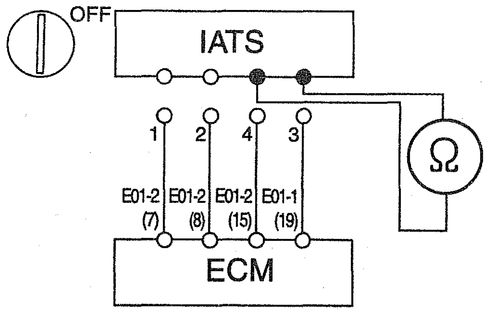
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK IATS RESISTANCE



1. Turn ignition switch to OFF position and disconnect IATS connector.
2. Measure resistance between terminals 3 and 4 of the IATS connector.
   - **Specification (IATS resistance):**

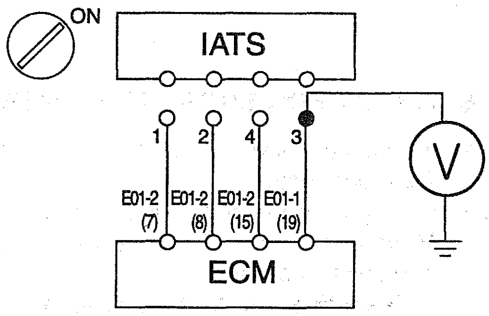
Temperature		Resistance	Temperature		Resistance
-40 °C	-40 °F	40.93 ~ 48.35	40 °C	104 °F	1.07 ~ 1.21
-20 °C	-4 °F	13.89 ~ 16.03	60 °C	140 °F	0.54 ~ 0.62
0 °C	32 °F	5.38 ~ 6.09	80 °C	176 °F	0.29 ~ 0.34
20 °C	68 °F	2.31 ~ 2.56			

Is resistance within specification?

Yes

No	Replace IATS.

3. CHECK REFERENCE VOLTAGE TO IATS



1. Turn ignition switch to OFF position and disconnect IATS connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the IATS harness connector and chassis ground.
   - **Specification (Voltage): approximately 5V**

Is voltage within specification?

Yes

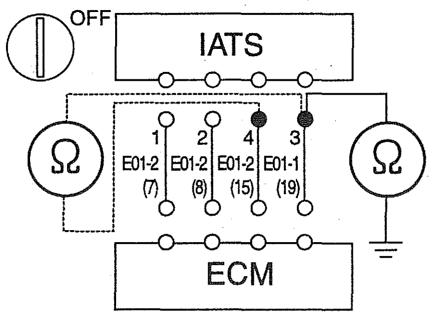
No	Repair open or short to chassis ground in harness.

EGMF601X

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect IATS and ECM connector.
2. Measure resistance between terminal 3 of the IATS harness connector and chassis ground.
3. Measure resistance between terminal 3 and 4 of the IATS harness connector.
   - **Specification (Resistance): infinite**

Does each resistance indicate open?



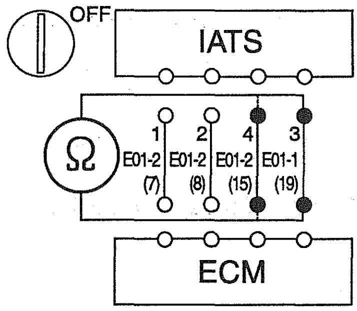
Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR OPEN IN HARNESS

1. Turn ignition to OFF position, and then disconnect IATS and ECM connector.
2. Measure resistance between terminal 3 of the IATS harness connector and 19 of the ECM harness connector(E01-1).
3. Measure resistance between terminal 4 of the IATS harness connector and 15 of the ECM harness connector(E01-2).
   - **Specification (Resistance): below 1Ω**

Does the resistance indicate continuity?



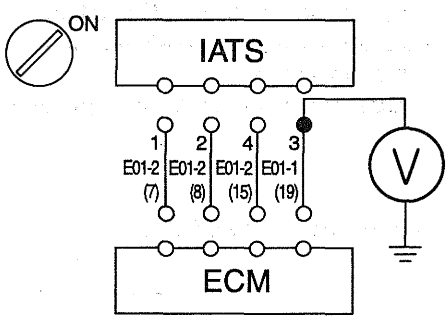
Yes

No	Repair open in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position and disconnect IATS and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the IATS harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**

Is voltage within specification?



Yes

No	Repair short to power in harness.

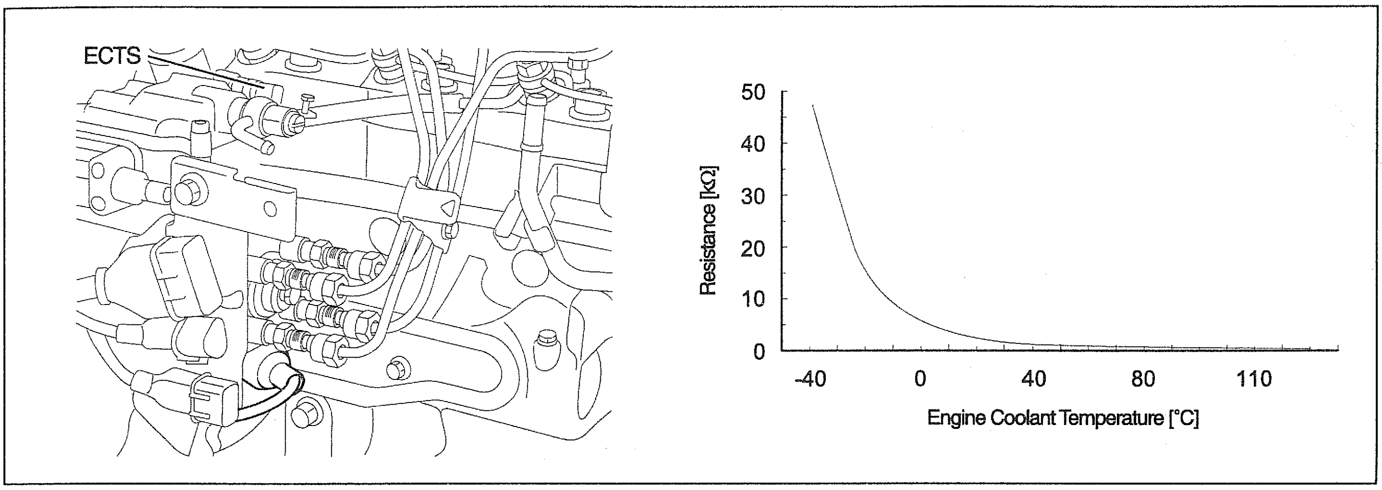
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF601Y

TROUBLESHOOTING FOR DTC EF021F0B

DTC	P0115	Engine Coolant Temperature Sensor Range/Performance Problem

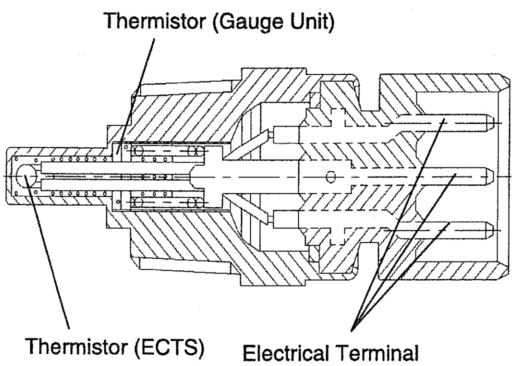
COMPONENT LOCATION



LF9E0622

DESCRIPTION

The Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases. The reference 5 V in the ECM is supplied to the ECTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in the ECTS changes according to the engine coolant temperature, the output voltage also changes. During cold engine operation the ECM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.



BFGE505K

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0115 if the ECM detects signal voltage higher or lower than the possible range of a properly operating ECTS.

2. Conditions for Setting the DTC

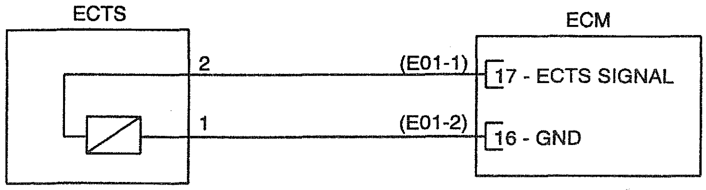
DTC No	Detecting Condition & Limp Home	Suspect area
P0115	**Detecting Condition** • DTC Strategy - Rationality Check - Voltage range check • Enable condition - IG ON or engine running • Threshold Value - ECTS signal < 0.1V or ECTS signal > 4.6V for 5 seconds **Limp-Home Function** • Engine coolant temperature = 80℃ • During starting, engine coolant temperature = fuel temperature • When FTS is out of order, engine coolant temperature = -20℃	• Open or short in ECTS circuit • ECTS • ECM

SPECIFICATION

Temperature		ECTS Resistance	Temperature		ECTS Resistance
-40 °C	-40 °F	48.14 kΩ	40 °C	104 °F	1.15 kΩ
-20 °C	-4 °F	14.13 ~ 16.83 kΩ	60 °C	140 °F	0.59 kΩ
0 °C	32 °F	5.79 kΩ	80 °C	176 °F	0.32 kΩ
20 °C	68 °F	2.31 ~ 2.59 kΩ			

SCHEMATIC DIAGRAM

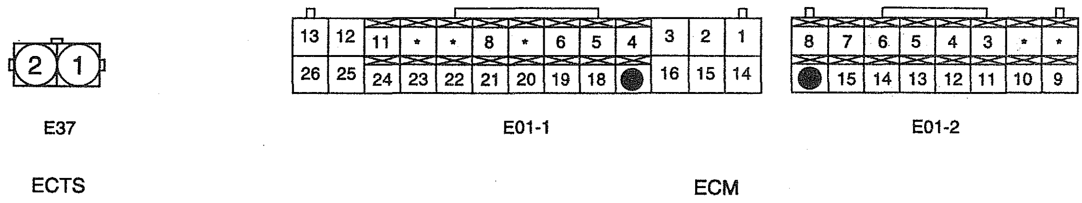
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E01-2 (16)	Sensor ground
2	ECM E01-1 (17)	ECTS signal

[HARNESS CONNECTORS]



EGMF401L

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start the engine and monitor the ECTS signals while warming up engine to normal operating temperature.

Scanned temperature on the Hi-Scan (Pro) should be close to actual engine coolant temperature, shouldn't it?

No

Yes	Problem is intermittent or was repaired and ECM memory was not cleared. Refer to "INTERMITTENT PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

2. CHECK ECTS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

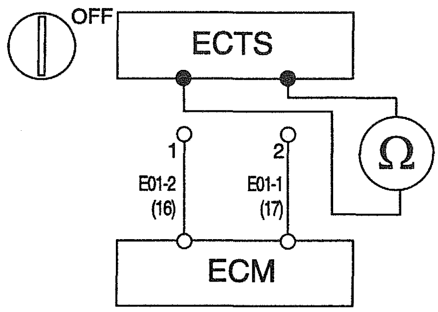
Yes

No	Repair or replace it.

3. CHECK ECTS RESISTANCE

1. Turn ignition switch to OFF and disconnect ECTS connector.
2. Measure resistance between the terminals 1 and 2 of ECTS connector.
   - **Specification (ECTS resistance):**

Temperature		ECTS Resistance	Temperature		ECTS Resistance
-40 °C	-40 °F	48.14 kΩ	40 °C	104 °F	1.15 kΩ
-20 °C	-4 °F	14.13 ~ 16.83 kΩ	60 °C	140 °F	0.59 kΩ
0 °C	32 °F	5.79 kΩ	80 °C	176 °F	0.32 kΩ
20 °C	68 °F	2.31 ~ 2.59 kΩ			



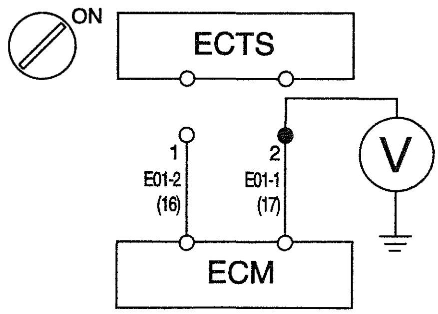
Is resistance within specification?

Yes

No	Replace ECTS.

4. CHECK REFERENCE VOLTAGE TO ECTS

1. Turn ignition switch to OFF position and disconnect ECTS connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the ECTS harness connector and chassis ground.
   - **Specification (Voltage): approximately 5V**



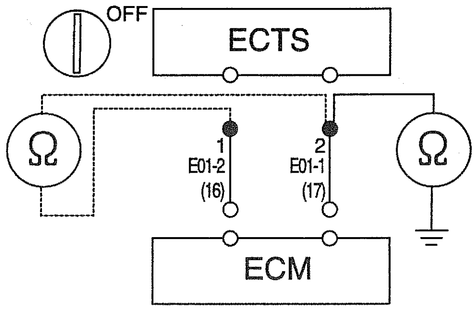
Is voltage within specification?

EGMF602B

Yes

No	Repair open or short to chassis ground in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS



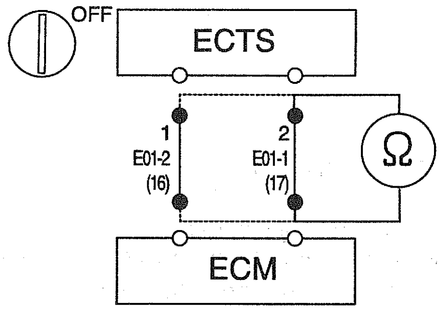
1. Turn ignition switch to OFF position, and then disconnect ECTS and ECM connectors.
2. Measure resistance between terminal 2 of the ECTS harness connector and chassis ground.
3. Measure resistance between terminal 2 and 1 of the ECTS harness connector.
   - **Specification (Resistance): infinite**

Does the resistance indicate open?

Yes

No	Repair short or short to chassis ground in harness.

6. CHECK FOR OPEN IN HARNESS



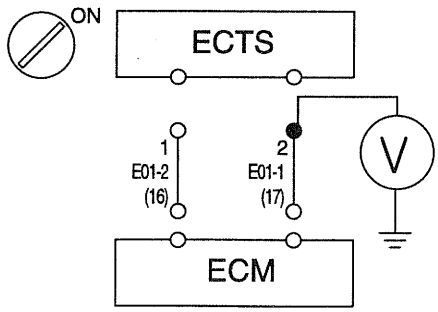
1. Turn ignition to OFF position, and then disconnect ECTS and ECM connector.
2. Measure resistance between terminal 2 of the ECTS harness connector and 19 of the ECM harness connector(E01-1).
3. Measure resistance between terminal 1 of the ECTS harness connector and 16 of the ECM harness connector(E01-2).
   - **Specification (Resistance): below 1Ω**

Does the resistance indicate continuity?

Yes

No	Repair open in harness.

7. CHECK FOR SHORT TO POWER IN HARNESS



1. Turn ignition switch to OFF position, and then disconnect ECTS and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the ECTS harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**

Is voltage within specification?

Yes

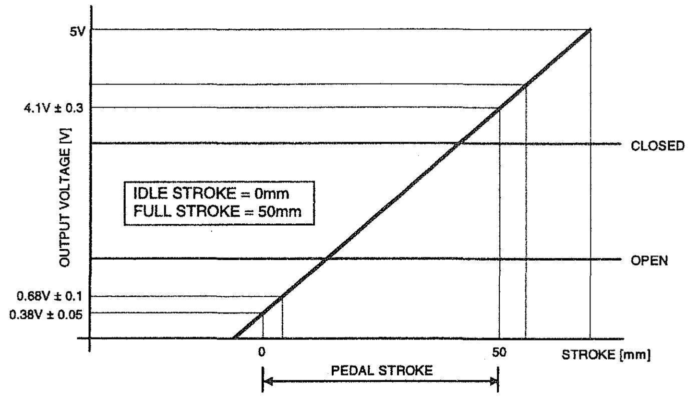
No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF602C

TROUBLESHOOTING FOR DTC E030E617

DTC	P0120	Accelerator Position Sensor Malfunction - Irregular Sensor Output
	P0120	Accelerator Position Sensor Malfunction - Learning Error
	P0121	Accelerator Position Sensor Range/Performance Problem



LF9E0633

DESCRIPTION

On electronic injection systems, there is no longer a load lever that mechanically controls the fuelling. The flow is calculated by the ECM depending on a number of parameters, including pedal position, which is measured using a potentiometer. The absence of a mechanical link between the accelerator pedal and the injection system presents a risk of loss of control of the engine in the event of a failure of the component in charge of providing the driver's request information to the injection system. The pedal sensor therefore has a potentiometers whose slides are mechanically solid. A voltage is generated across the potentiometer in the acceleration position sensor as a function of the accelerator-pedal setting. Using a programmed characteristic curve, the pedal's position is then calculated from this voltage.

DTC DETECTING CONDITION

<table>
<tr><th>DTC No</th><th>Detecting Condition & Limp Home</th><th>Suspect area</th></tr>
<tr><td rowspan="2">P0120</td><td>Detecting Condition
• DTC Strategy
- Irregular sensor output

• Enable condition
- Idle switch = ON
- No failure on VSS
- Vehicle speed ≤ 0km/h

• Threshold Value
- Engine speed > 2,000 rpm for 3 seconds

Limp-Home Function
• Back-up idle state (Accelerator angle = 0%)
- Idle Switch = OFF: Sensor output is increased to 30% slowly
- Idle Switch = ON: Sensor output is decreased to 0% slowly</td><td rowspan="2">• Open or short in APS circuit
• APS
• ECM</td></tr>
<tr><td>Detecting Condition
• DTC Strategy
- APS learning error

• Enable condition
- Idle switch = ON

• Threshold Value
- APS signal < 0.2V or APS signal > 0.56V

Limp-Home Function
• APS signal 0.38V = 0% (If the APS outputs 0.38V, the ECM will recognize that the accelerator angle is 0%)</td></tr>
<tr><td>P0121</td><td>Detecting Condition
• DTC Strategy
- Rationality Check
- Voltage range check

• Enable condition
- IG ON or engine running

• Threshold Value
- APS signal < 0.2V or APS signal > 4.8V for 0.5 second

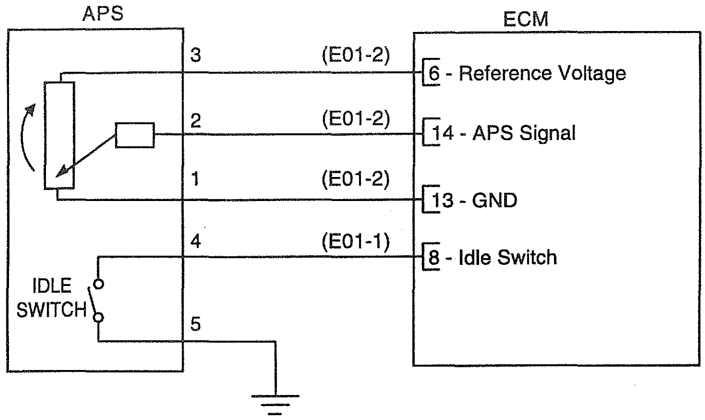
Limp-Home Function
• Back-up idle state
- Idle Switch = OFF: Sensor output is increased to 30% slowly
- Idle Switch = ON: Sensor output is decreased to 0% slowly</td><td>• Open or short in APS circuit
• APS
• ECM</td></tr>
</table>

SPECIFICATIONS

Pedal Stroke	APS Output Voltage
Idle Stroke	0.33 ~ 0.43 V
Full Stroke	3.8 ~ 4.4 V

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]

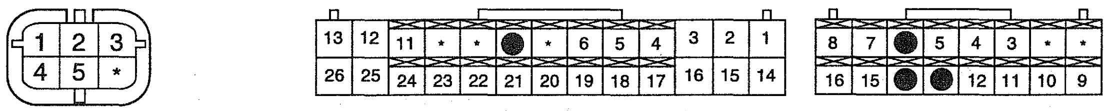


[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E01-2 (13)	Sensor Ground
2	ECM E01-2 (14)	APS Signal
3	ECM E01-2 (6)	Reference Voltage
4	ECM E01-1 (8)	Idle Switch Signal
5	Chassis Ground	Idle Switch Ground
6	-	-

ECM Terminal A8

[HARNESS CONNECTORS]



E61 E01-1 E01-2

APS ECM

EGMF0634

INSPECTION PROCEDURES

1. CHECK APS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

• **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

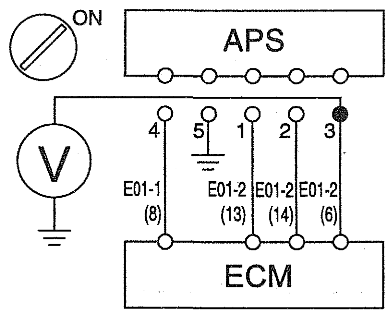
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK REFERENCE VOLTAGE OF APS

1. Turn ignition switch to OFF and disconnect APS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 3 of APS harness connector and chassis ground.



• **Specification: approximately 5V**

Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

3. CHECK APS SIGNAL

1. Turn ignition switch to OFF and reconnect APS connector.
2. Connect Hi-Scan (Pro) to APS.
3. Turn ignition switch to ON.
4. Using Hi-Scan (Pro), monitor APS signal while slowly stepping the accelerator position.

• **Specification (APS signal voltage):**
0.33 ~ 0.43 V at Idle Stroke
3.8 ~ 4.4 V at Full Stroke

Is sensor output voltage within specification?

Yes

No	Replace APS.

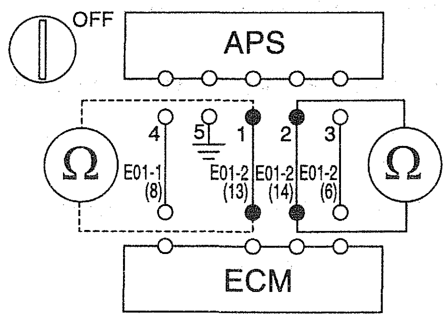
EGMF002I

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF and disconnect APS and ECM connector.
2. Measure resistance between terminals 2 of APS harness connector and 14 of ECM harness connector(E01-2).
3. Measure resistance between terminals 1 of APS harness connector and 13 of ECM harness connector(E01-2).

• Specifications: below 1Ω

Does each resistance indicate continuity?



Yes

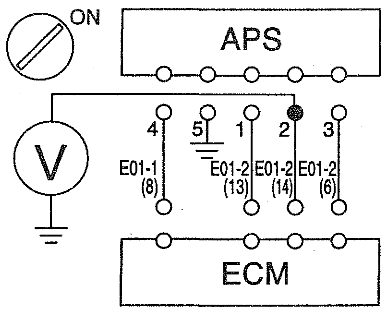
No	Repair open in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to ON.
2. Measure voltage between terminal 2 of APS harness connector and chassis ground.

• Specification: below 0.5V

Is voltage within specification?



Yes

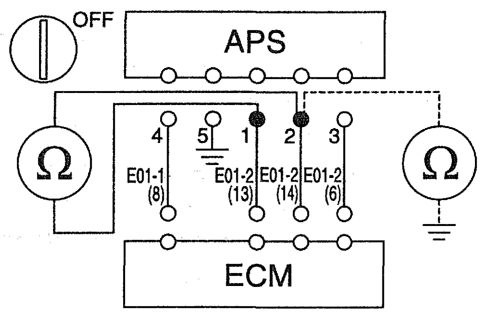
No	Repair short to power in harness.

6. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF.
2. Measure resistance between terminals 2 and 1 of APS harness connector.
3. Measure resistance between terminals 2 of APS harness connector and chassis ground.

• Specification: infinite

Does resistance indicate open?



Yes

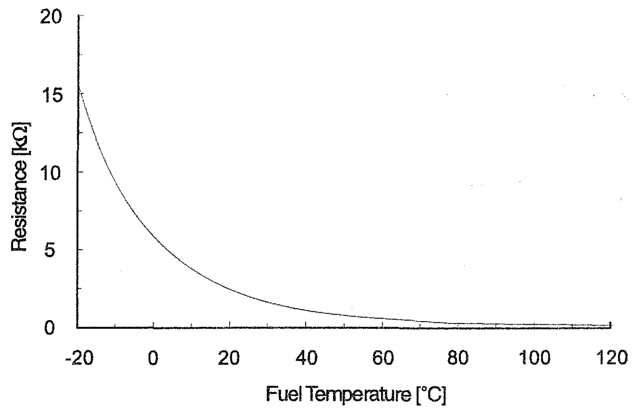
No	Repair short or short to chassis ground in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF002J

TROUBLESHOOTING FOR DTC E627850A

DTC	P0180	Fuel Temperature Sensor Range/Performance Problem



LF9E0643

DESCRIPTION

The fuel temperature sensor (FTS) is located in the fuel-Inlet line to measure the fuel temperature. The FTS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the FTS decreases as the fuel temperature increases, and increases as the fuel temperature decreases.The 5 V power source in the ECM is supplied to the FTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the FTS are connected in series. When the resistance value of the thermistor in FTS changes according to the fuel temperature, the signal voltage also changes. This information of fuel temperature is used in correcting fuel quantity.

DTC DETECTING CONDITION

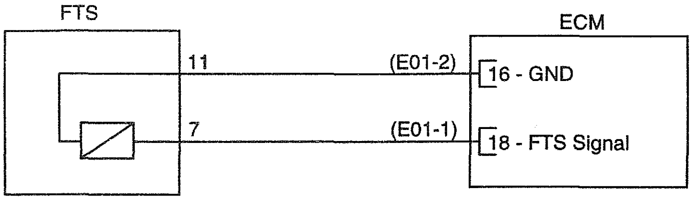
DTC No	Detecting Condition & Limp Home	Suspect area
P0180	**Detecting Condition** • DTC Strategy - Rationality Check - Voltage range check • Enable condition - IG ON or engine running • Threshold Value - FTS signal < 0.1V or FTS signal > 4.6V for 5 seconds **Limp-Home Function** • Fuel temperature = 50℃	• Open or short in FTS circuit • FTS • ECM

SPECIFICATIONS

Temperature		FTS Resistance	Temperature		FTS Resistance
-40 °C	-40 °F	52.97 kΩ	20 °C	68 °F	2.44 kΩ
-20 °C	-4 °F	16.15 kΩ	40 °C	104 °F	1.14 kΩ
0 °C	32 °F	5.86 kΩ	60 °C	140 °F	0.58 kΩ

SCHEMATIC DIAGRAM

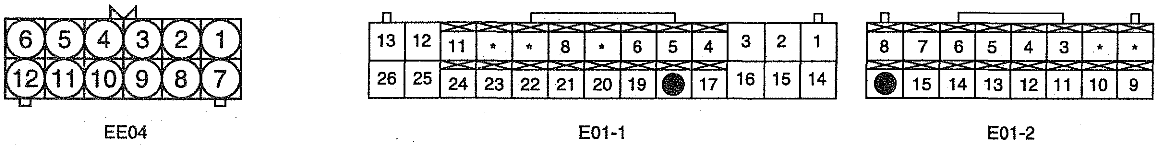
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
7	ECM E01-1 (18)	FTS Signal
11	ECM E01-2 (16)	Sensor Ground

[HARNESS CONNECTORS]



EGMF0644

INSPECTION PROCEDURES

1. CHECK FTS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

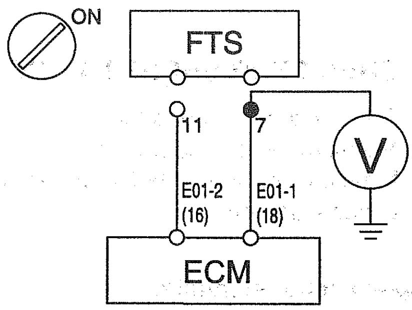
• Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK REFERENCE VOLTAGE TO FTS



1. Turn ignition switch to OFF and disconnect FTS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 7 of FTS harness connector and chassis ground.

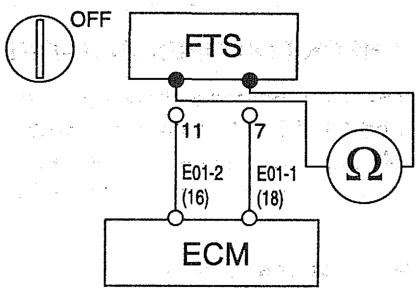
• Specification: approximately 5V

Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

3. CHECK FTS RESISTANCE



1. Measure resistance between terminals 7 and 11 of FTS connector.

• Specification (FTS resistance):

Temperature		FTS Resistance	Temperature		FTS Resistance
-40 °C	-40 °F	52.97 kΩ	20 °C	68 °F	2.44 kΩ
-20 °C	-4 °F	16.15 kΩ	40 °C	104 °F	1.14 kΩ
0 °C	32 °F	5.86 kΩ	60 °C	140 °F	0.58 kΩ

Is resistance within specification?

Yes

No	Replace FTS.

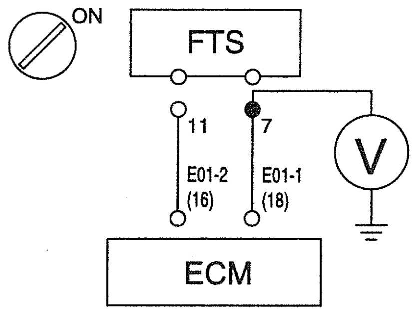
EGMF002K

4. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF and disconnect ECM connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 7 of FTS harness connector and chassis ground.

• Specifications: below 0.5V

Is voltage within specification?



Yes

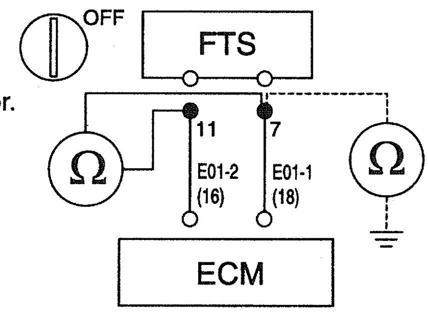
No	Repair short to power in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF .
2. Measure resistance between terminals 7 and 11 of FTS harness connector.
3. Measure resistance between terminal 7 of FTS harness connector and chassis ground.

• Specifications: infinite

Does resistance indicate open?



Yes

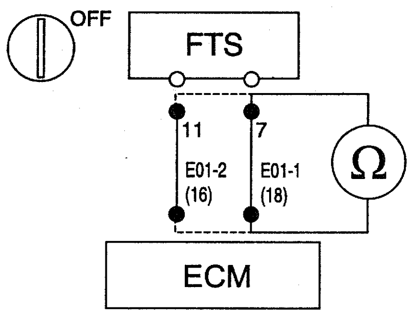
No	Repair short or short to chassis ground in harness.

6. CHECK FOR OPEN IN HARNESS

1. Measure resistance between terminals 7 of FTS harness connector and 18 of ECM harness connector(E01-1).
2. Measure resistance between terminals 11 of FTS harness connector and 16 of ECM harness connector(E01-2).

• Specifications: infinite

Does resistance indicate open?



Yes

No	Repair open in harness.

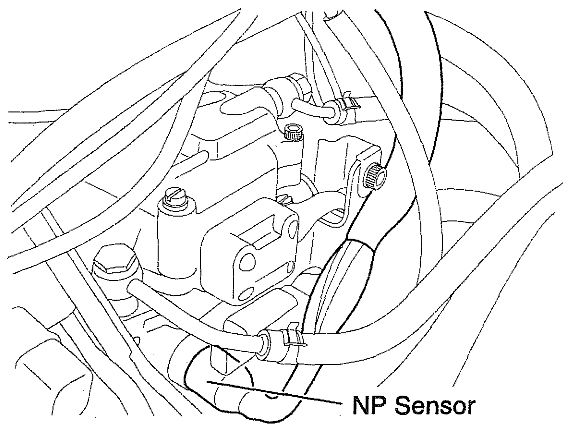
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF002L

TROUBLESHOOTING FOR DTC ECD8FFCB

DTC	P0320	NP Sensor Range/Performance Problem

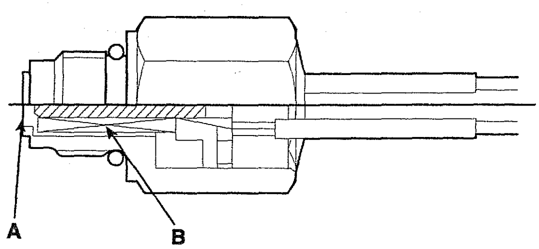
COMPONENT LOCATION



LF9E0156

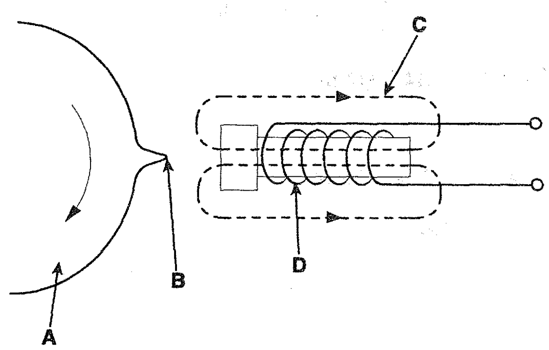
DESCRIPTION

The Np sensor detects pump speed necessary for the various controls, and outputs signals to the control unit. The Np sensor is constructed of a permanent magnet(A) and an iron pole, and a coil(B). The magnetic field is varied by sensing gear movement, and the voltage generated is detected as a speed signal.



LF9E007A

When the drive shaft rotates, the sensing gear plate(A) projections(B) pass through the pump speed sensor's magnetic field(C) to generate AC voltage at the coil(D). This voltage is input to the control unit, converted to a pulse signal, and used as a pump speed signal.



LF9E015A

DTC DETECTING CONDITION

1. DTC Description

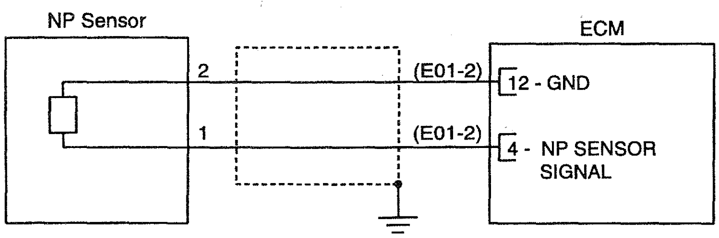
The ECM monitors the range of the analog input signal from NP sensor to check sensor failure that is short circuit or open circuit.
If the ECM detects abnormal NP snesor operation, it sets DTC P0320.

2. Conditions for Setting the DTC

DTC	Detecting Condition & Limp Home	Possible Cause
P0320	Detecting Condition • DTC Strategy - Monitoring NP sensor signal • Enable condition - Engine speed ≥ 400 rpm - No failure on CKPS • Threshold Value - No consecutive 40-pulses for 10 engine revolution Limp-Home Function • Using CKPS signal	• Open or short in NP Sensor circuit • Air gap out of specification • NP Sensor interfered with electrical noise • NP Sensor • ECM

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E01-2 (4)	NP Sensor signal
2	ECM E01-2 (12)	Sensor Ground

[HARNESS CONNECTORS]

E49

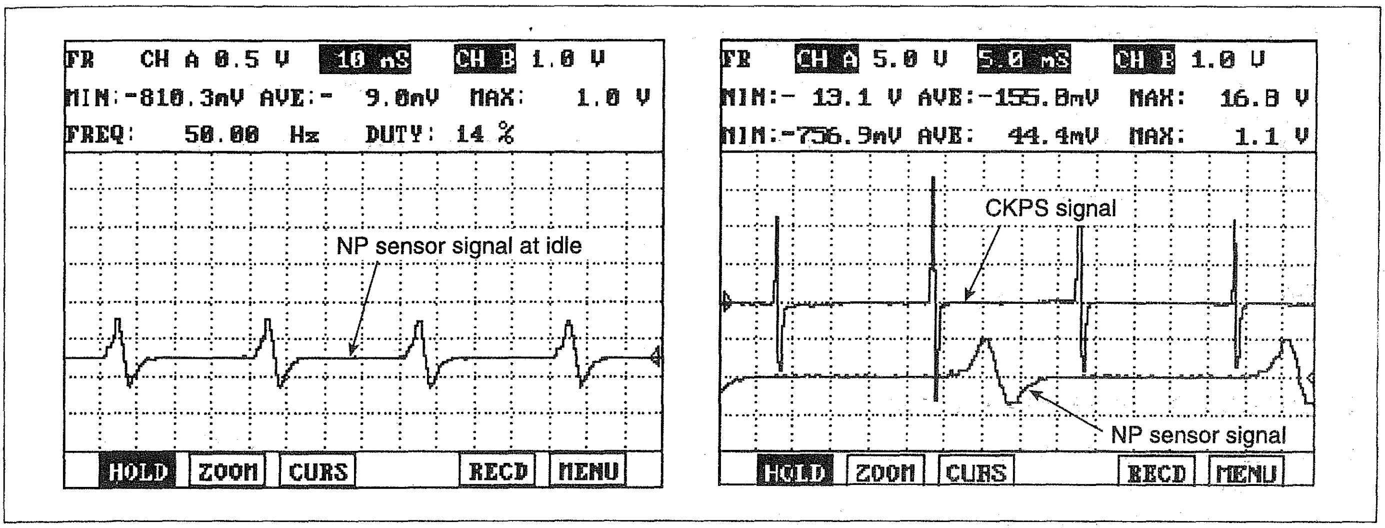
NP SENSOR

E01-2

ECM

EGMF402C

SIGNAL WAVE FORM



LF9E0021

INSPECTION PROCEDURE

1. CHECK NP SENSOR AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

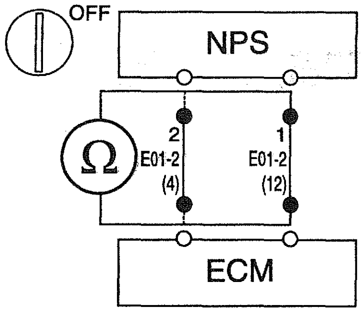
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect NP sensor and ECM connector.
2. Measure resistance between terminal 1 of the NP sensor harness connector and 4 of the ECM harness connector(E01-2).
3. Measure resistance between terminal 2 of the NP sensor harness connector and 12 of the ECM harness connector(E01-2).
   - **Specification (Resistance): below 1Ω**



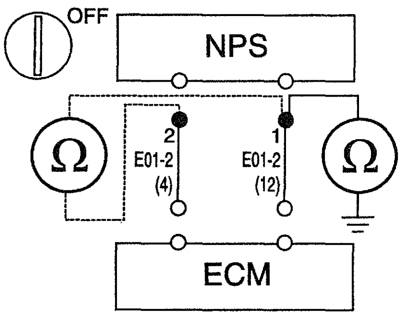
Does each resistance indicate continuity?

Yes

No	Repair open in harness.

3. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect NP sensor and ECM connector.
2. Measure resistance between terminal 1 of the NP sensor harness connector and chassis ground.
3. Measure resistance between terminal 1 and 2 of the NP sensor harness connector.
   - **Specification (Resistance): infinite**



Does each resistance indicate open?

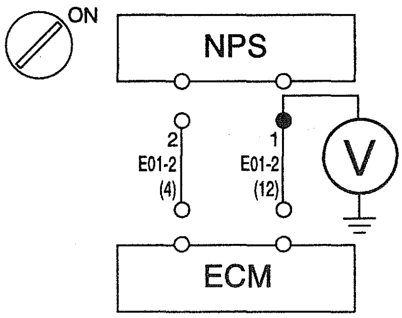
Yes

No	Repair short or short to chassis ground in harness.

EGMF603N

4. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect NP sensor and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 1 of the NP sensor harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**



Is voltage within specification?

Yes

No	Repair short to power in harness.

5. CHECK SENSOR SHIELD LINE

1. Turn ignition switch to OFF position, and then disconnect NP sensor and ECM connector.
2. Measure resistance between NP sensor shield line and chassis ground.
   - **Specification (Resistance): below 1Ω**

Does each resistance indicate continuity?

Yes

No	Repair open in NP sensor shield line.

6. CHECK NP SENSOR AIR GAP

1. Check NP sensor air gap.
   - **Specification (Air gap): 0.8 ~ 1.2 mm**

Is the measured air gap within specification?

Yes

No	Adjust the air gap.

7. CHECK NP SENSOR SIGNAL

1. Reconnect the ECM and NP sensor connectors.
2. Connect a Hi-Scan (Pro) to the knock sensor.
3. Start the engine and monitor the NP sensor signal at idle.
   - **Refer to "SIGNAL WAVEFORM" for more information.**

Is KS signal normal?

Yes

No	Replace NP sensor.

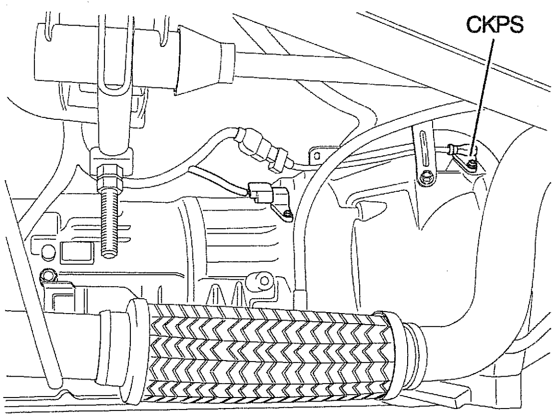
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF603O

TROUBLESHOOTING FOR DTC EEC20AAC

DTC	P0335	Crankshaft Position Sensor Range/Performance Problem

COMPONENT LOCATION



LF9E9232

DESCRIPTION

The Crankshaft Position Sensor (CKPS) is a Variable Reluctance (VR) type sensor that generates voltage using a sensor and a target wheel mounted on the crankshaft; there are 36 slots in the target wheel. The ECM calculates engine RPM by using the sensor's signal and controls injection timing.

DTC DETECTING CONDITION

1. DTC Description

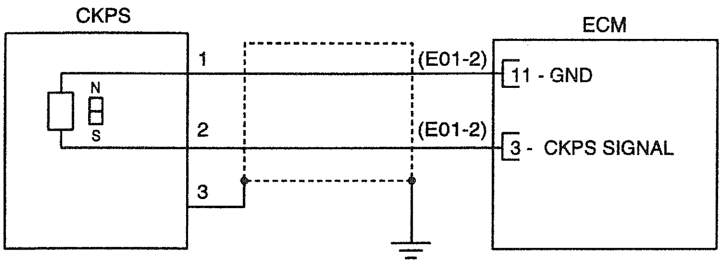
The ECM sets DTC P0335 when there is abnormal CKPS operation.

2. Conditions for Setting the DTC

DTC No	Detecting Condition & Limp Home	Suspect area
P0335	**Detecting Condition** • DTC Strategy - Monitoring CKPS signal • Enable condition - Engine speed ≥ 400 rpm - No failure on NP sensor • Threshold Value - No consecutive 20-pulses for 10 engine revolution **Limp-Home Function** • Using NP sensor signal	• Open or short in CKPS circuit • Air gap out of specification • CKPS interfered with electrical noise • CKPS • ECM

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



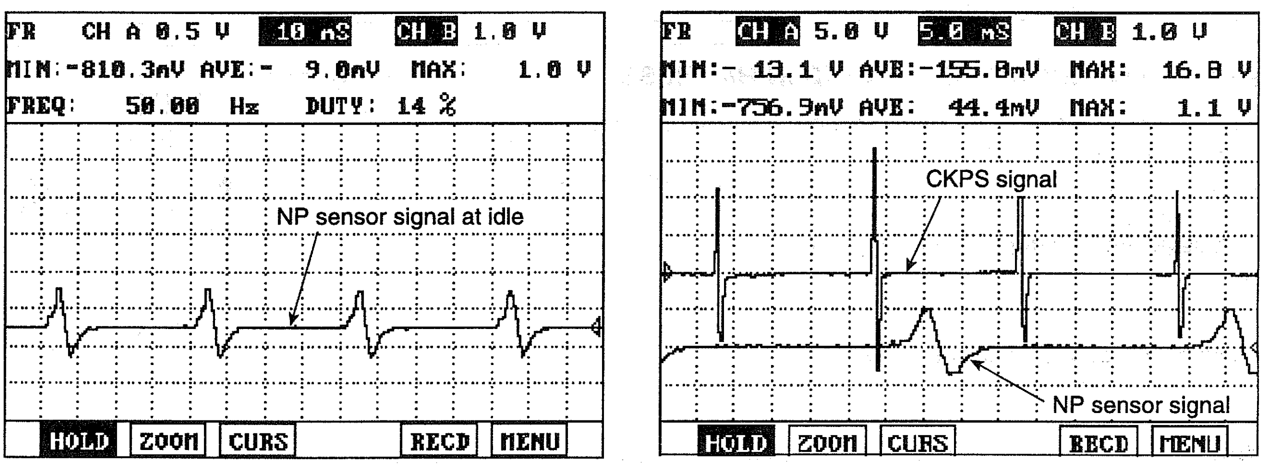
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E01-2 (11)	Sensor Ground
2	ECM E01-2 (3)	CKPS signal
3	Chassis Ground	Sensor Shield

[HARNESS CONNECTORS]

EGMF402E

SIGNAL WAVE FORM



LF9E0021

INSPECTION PROCEDURE

1. CHECK CKPS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

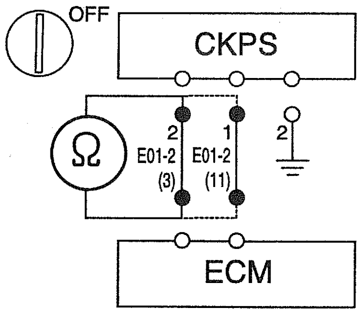
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect CKPS and ECM connector.
2. Measure resistance between terminal 2 of the CKPS harness connector and 3 of the ECM harness connector(E01-2).
3. Measure resistance between terminal 1 of the CKPS harness connector and 11 of the ECM harness connector(E01-2).
   - **Specification (Resistance): below 1Ω**



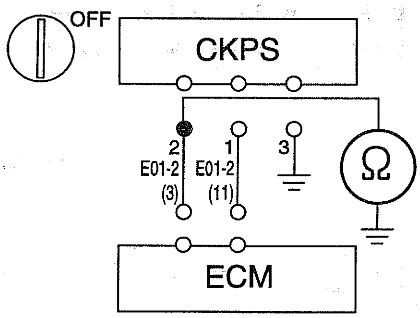
Does each resistance indicate continuity?

Yes

No	Repair open in harness.

3. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect CKPS and ECM connector.
2. Measure resistance between terminal 2 of the CKPS harness connector and chassis ground.
   - **Specification (Resistance): infinite**



Does each resistance indicate open?

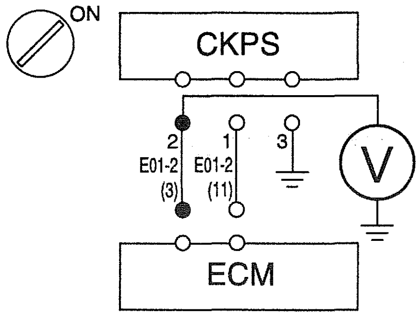
Yes

No	Repair short or short to chassis ground in harness.

EGMF603P

4. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect CKPS and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the CKPS harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**



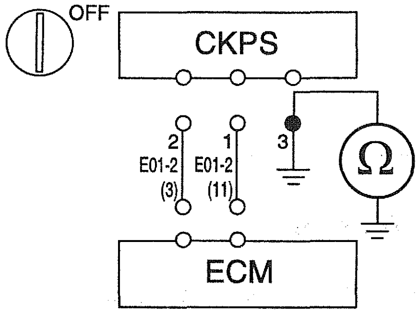
Is voltage within specification?

Yes

No	Repair short to power in harness.

5. CHECK SENSOR SHIELD LINE

1. Turn ignition switch to OFF position, and then disconnect CKPS and ECM connector.
2. Measure resistance between terminal 3 of the CKPS harness connector and chassis ground.
   - **Specification (Resistance): below 1Ω**



Does each resistance indicate continuity?

Yes

No	Repair open in harness.

6. CHECK CKPS SIGNAL

1. Reconnect the ECM and CKPS connectors.
2. Connect a Hi-Scan (Pro) to the CKPS.
3. Start the engine and monitor the CKPS signal at normal operating temperature.
   - **Refer to "SIGNAL WAVEFORM" for more information.**

Is CKPS signal normal?

Yes

No	Replace CKPS.

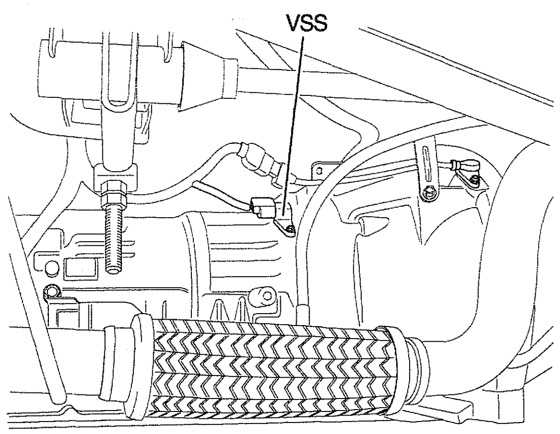
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF603Q

TROUBLESHOOTING FOR DTC E230E548

DTC	P0500	Vehicle Speed Sensor Range/Performance Problem

COMPONENT LOCATION



LF9E0193

DESCRIPTION

The vehicle Speed Sensor (VSS) generates a waveform with a frequency according to the speed of the vehicle. The signal generated by the VSS informs the ECM not only if the vehicle speed is low or high but also is stopped the vehicle or not. The ECM uses this signal to control the fuel injection, ignition timing, transmission/transaxle shift scheduling and torque converter clutch scheduling. Also the VSS signal is used to detect rough road driving condition.

DTC DETECTING CONDITION

1. DTC Description

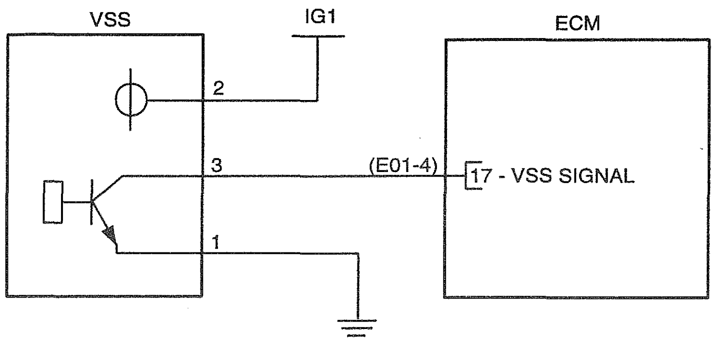
The ECM sets DTC P0500 if signal from VSS is abnormal.

2. Conditions for Setting the DTC

DTC No	Detecting Condition & Limp Home	Suspect area
P0500	**Detecting Condition** • DTC Strategy - Vehicle speed sensor monitoring • Enable condition - Engine running - Engine speed > 2500 rpm - Accelerator angle > 30% - Neutral switch = OFF • Threshold Value - Vehicle speed ≤ 5km/h for 10 seconds **Limp-Home Function** • Vehicle operates normally but it is impossible to change the vehicle speed according to the fuel quantity dumping map.	• Open or short in VSS circuit • VSS • ECM

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]

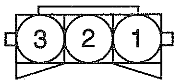


[CONNECTION INFORMATION]

VSS

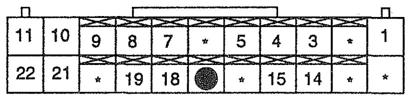
Terminal	Connected to	Function
1	Chassis Ground	Sensor Ground
2	IG 1	Battery Voltage
3	ECM E01-4 (17)	VSS Signal

[HARNESS CONNECTORS]



C01

VSS



E01-4

ECM

EGMF402M

INSPECTION PROCEDURE

1. CHECK VSS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

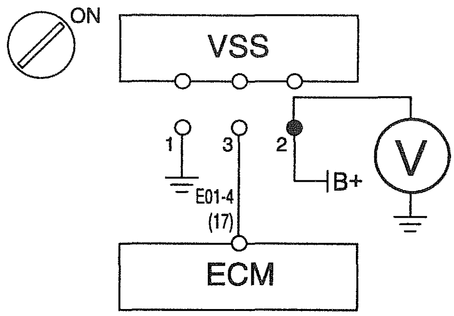
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK POWER TO VSS

1. Turn ignition switch to OFF position, and then disconnect VSS connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the VSS harness connector and chassis ground.
   - **Specification (Voltage): approximately B+**



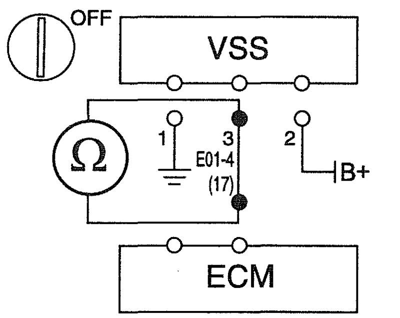
Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect VSS and ECM connector.
2. Measure resistance between terminal 3 of the VSS harness connector and 17 of the ECM harness connector(E01-4).
   - **Specification (Resistance): below 1Ω**



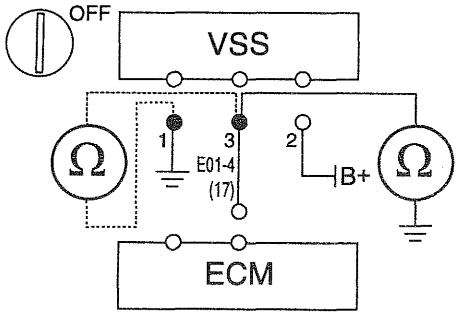
Does each resistance indicate continuity?

Yes

No	Repair open in harness.

EGMF001E

4. CHECK FOR SHORT TO GROUND IN HARNESS



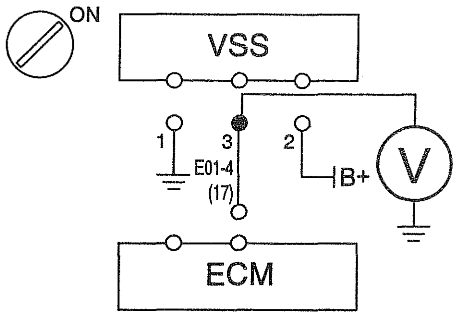
1. Turn ignition switch to OFF position, and then disconnect VSS and ECM connector.
2. Measure resistance between terminal 3 of the VSS harness connector and chassis ground.
3. Measure resistance between terminal 3 and 1 of the VSS harness connector.
   - **Specification (Resistance): infinite**

Does each resistance indicate open?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS



1. Turn ignition switch to OFF position, and then disconnect VSS and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the VSS harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**

Is voltage within specification?

Yes

No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF001F

TROUBLESHOOTING FOR DTC E4C4C7DD

DTC	P0605	Internal Control Module Read Only Memory (ROM) Error

DESCRIPTION

A malfunction is detected by using a checksum technique for verifying data. The digital data is composed of zeros and ones. A checksum is the total of all ones in a string of data. By comparing the checksum value with a stored value, a malfunction can be detected.

DTC DETECTING CONDITION

1. DTC Description

The ECM monitors RAM areas and communication connections between microcontroller and output drivers and sets DTC P0605 if failure is detected.

2. Conditions for Setting the DTC

<table>
<tr><th>DTC No</th><th>Detecting Condition & Limp Home</th><th>Suspect area</th></tr>
<tr><td>P0605</td><td>

Detecting Condition

- DTC Strategy
  - EEPROM error
- Enable condition
  - IG ON or engine running
- Threshold Value
  - "READY"/"BUSY" is not changed to "HIGH" for 100ms or "VERIFY" error occurs more than 3 times

Limp-Home Function

- TPS learning error → Learn the TPS again
- Revised compensation resistor → Back-up with No.7
- Deleting DTCs stored in ECM
- "READY"/"BUSY" error

<table>
<tr><th></th><th>With Immobilizer</th><th>Without Immobilizer</th></tr>
<tr><td>Engine</td><td>Impossible</td><td>Possible</td></tr>
<tr><td>MIL</td><td>ON</td><td>OFF</td></tr>
</table>

LF9E101C

- "VERIFY" error (with immobilizer)

<table>
<tr><th></th><th>Possible data reading</th><th>Impossible data reading</th></tr>
<tr><td>Engine</td><td>Possible</td><td>Impossible</td></tr>
<tr><td>MIL</td><td>OFF</td><td>ON</td></tr>
</table>

LF9E101D

- "VERIFY" error (without immobilizer)
  - Engine operation: impossible
  - MIL: OFF

</td><td>• ECM</td></tr>
</table>

INSPECTION PROCEDURE

1. CHECK ECM SOFTWARE VERSION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Turn ignition to ON position.
3. Check ECM software version.

Is the version newest one?

Yes

No	Upgrade the ECM software.

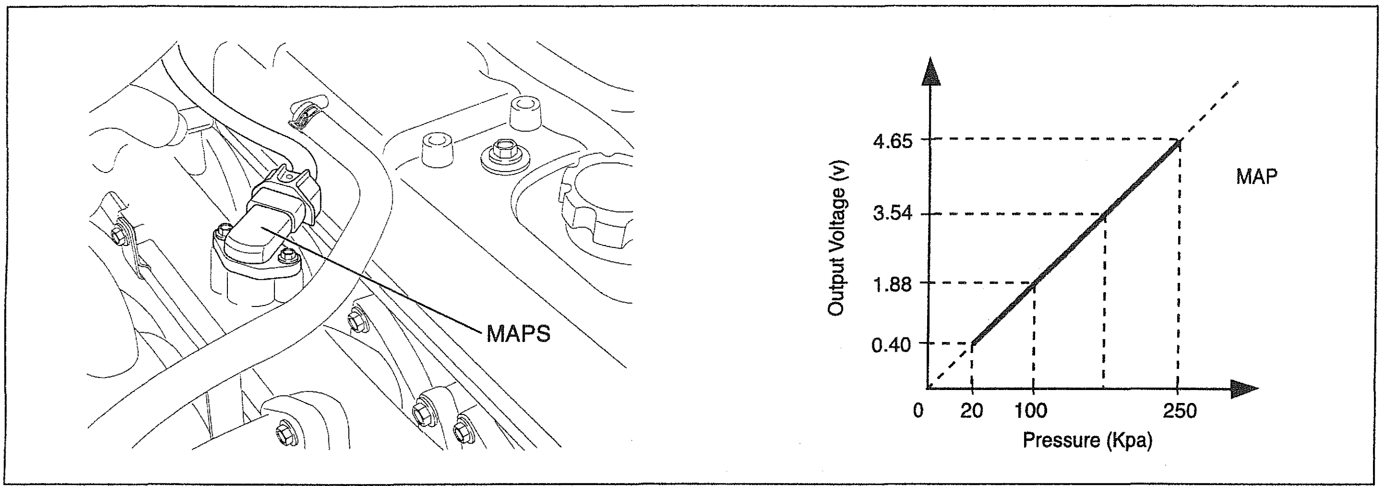
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

BFGE605B

TROUBLESHOOTING FOR DTC E755EC62

DTC	P1116	Manifold Absolute Pressure Sensor Range/Performance Problem

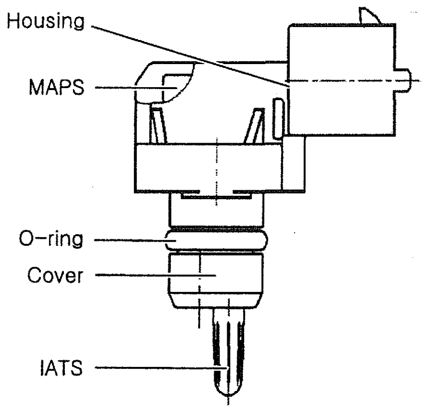
COMPONENT LOCATION



LF9E0882

DESCRIPTION

The manifold absolute pressure sensor (MAPS) is a pressure sensitive variable resistor. It measures changes in the intake manifold pressure which result from engine load and speed changes, and converts this to a voltage output. The ECM supplies 5 volts to the MAP sensor and monitors the voltage on a signal line. The sensor provides a path to ground through its variable resistor. The MAP sensor input affects fuel delivery and engine controls in the ECM.



LGGE002I

DTC DETECTING CONDITION

1. DTC Description

The ECM compares the actual measured Manifold Absolute Pressure signal to the modeled Manifold Absolute Pressure value and sets the DTC P1116 when the difference between these two value is too high or too low.

2. Conditions for Setting the DTC

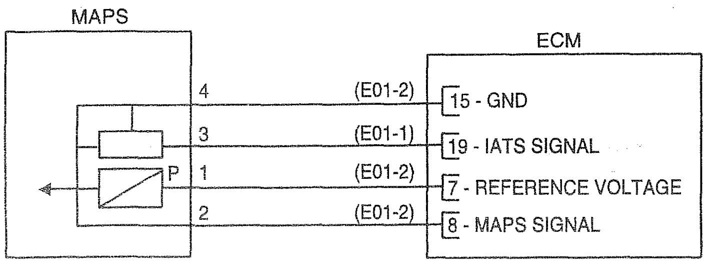
DTC No	Detecting Condition & Limp Home	Suspect area
P1116	**Detecting Condition** • DTC Strategy - Rationality Check - Voltage range check • Enable condition - IG ON or engine running • Threshold Value - MAPS signal < 0.2V or MAPS signal > 4.8V for 1 second **Limp-Home Function** • Manifold absolute pressure on full quantity map = 101.325 kPa	• Open or short in MAPS circuit • MAPS • ECM

SPECIFICATION

Manifold Absolute Pressure	MAPS Output Voltage
20 kPa	0.32 ~ 0.48 V
100 kPa	1.82 ~ 1.94 V
190 kPa	3.48 ~ 3.60 V
250 kPa	4.57 ~ 4.73 V

SCHEMATIC DIAGRAM

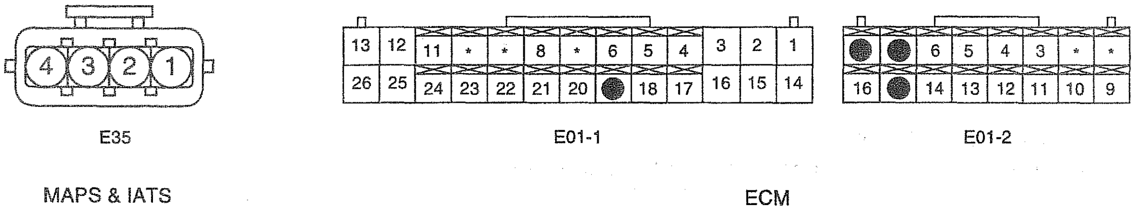
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E01-2(7)	Reference Voltage
2	ECM E01-2(8)	MAPS signal
3	ECM E01-1(19)	IATS signal
4	ECM E01-2(15)	Sensor ground

[HARNESS CONNECTORS]



EGMF4010

INSPECTION PROCEDURE

1. CHECK MAPS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK AIR CLEANER

1. Check air cleaner for dirt, blockage, or damage.

Is air cleaner good?

Yes

No	Clean or replace it.

3. CHECK INTAKE SYSTEM FOR LEAKAGE

1. Check entire air intake system for leaks or blockages.

Is entire air intake system good?

Yes

No	Repair or replace it.

4. CHECK MAPS SIGNAL AGAIN

1. Reconnect the ECM and MAPS connectors.
2. Connect a Hi-Scan (Pro) to the data link connector.
3. Start the engine and monitor the MAPS signals.
   - **Specification (MAPS signal voltage):**
     0.32 ~ 0.48 V at 20 kPa
     1.82 ~ 1.94 V at 100 kPa
     3.48 ~ 3.60 V at 190 kPa
     4.57 ~ 4.73 V at 250 kPa

Is signal within specification?

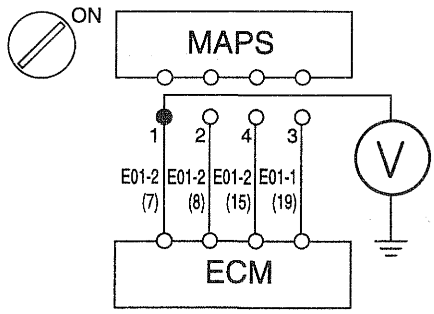
Yes

No	Replace MAPS.

LF9E001C

5. CHECK POWER TO MAPS

1. Turn ignition switch to OFF position and disconnect MAPS connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 1 of the MAPS harness connector and chassis ground.
   - **Specification : approximately 5V**



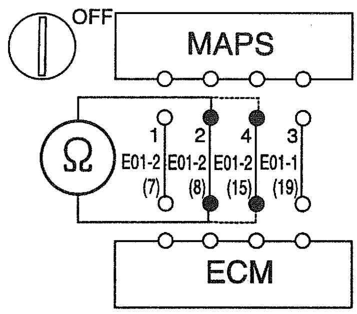
Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

6. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect MAPS and ECM connector.
2. Measure resistance between terminal 2 of the MAPS harness connector and 8 of the ECM harness connector(E01-2).
3. Measure resistance between terminal 4 of the MAPS harness connector and 15 of the ECM harness connector(E01-2).
   - **Specification (Resistance) : below 1Ω**



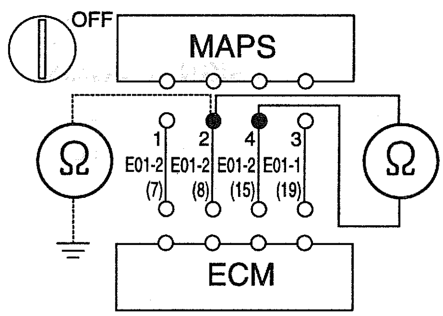
Does resistance indicate continuity?

Yes

No	Repair open in harness.

7. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect MAPS and ECM connector.
2. Measure resistance between terminal 2 of the MAPS harness connector and chassis ground.
3. Measure resistance between terminal 2 and 4 of the MAPS harness connector.
   - **Specification (Resistance) : infinite**



Does the resistance indicate open?

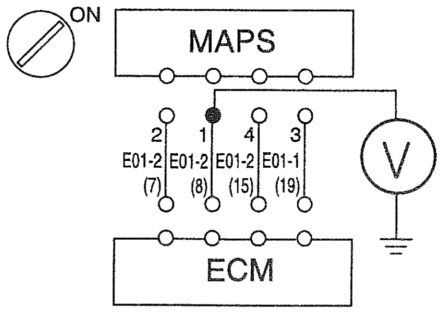
Yes

No	Repair short or short to chassis ground in harness.

EGMF601T

8. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position and disconnect MAPS and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the MAPS harness connector and chassis ground.
   - **Specification (Resistance): below 0.5 V**



Is voltage within specification?

Yes

No	Repair short to power in harness.

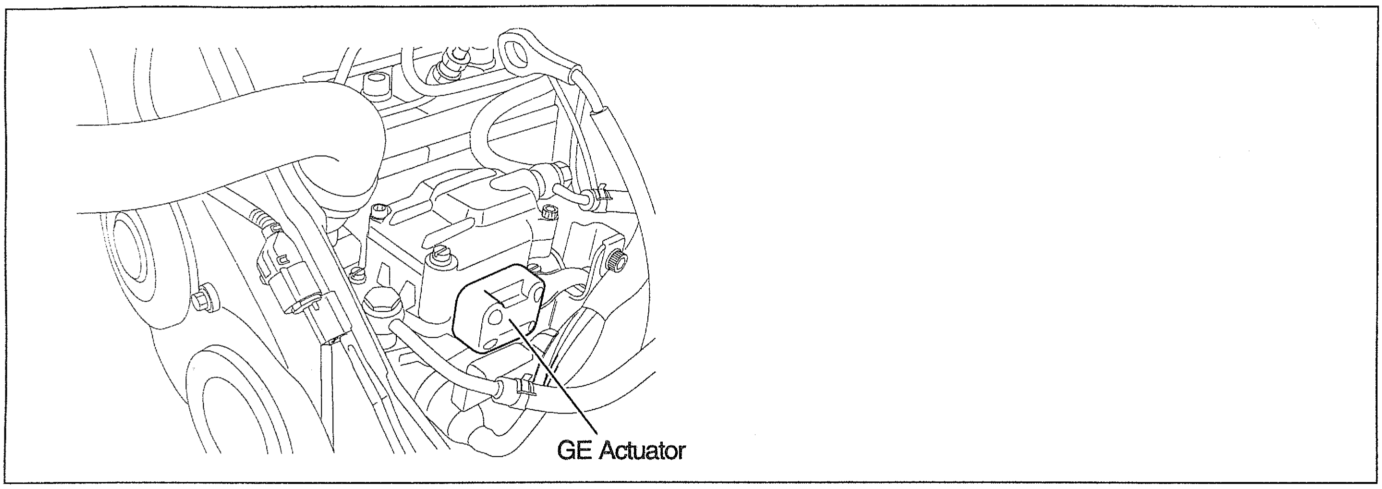
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF601V

TROUBLESHOOTING FOR DTC EE708DE9

DTC	1120	GE Actuator Circuit Malfunction

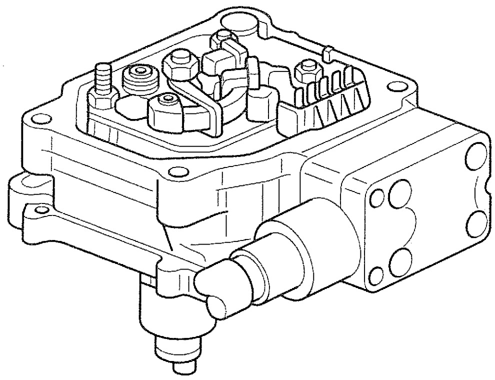
COMPINENT LOCATION



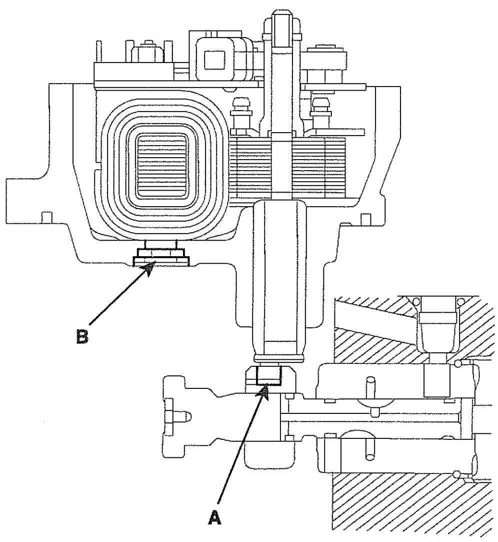
LF9E0001

DESCRIPTION

The GE actuator is attached to the governor chamber at the upper part of the injection pump.



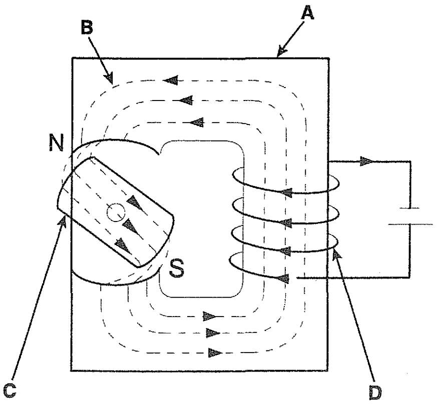
LF9E004A



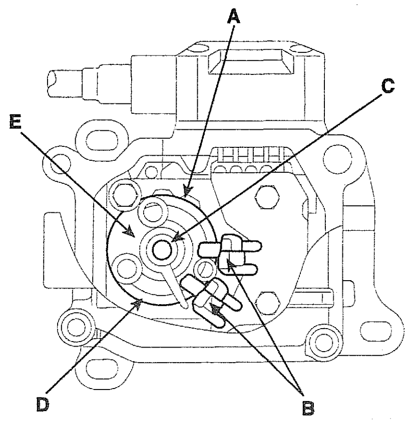
LF9E005A

There is a magnet filter between the governor chamber. And the fuel oil flowing into the governor chamber cools the coil because the two chambers are connected each other.
The magnet filter(B) also prevents iron dregs from entering the GE actuator. The ball pin(A) which is eccentric to the pressfitted shaft through the rotor is inserted into a hole in the control sleeve.

Unlike the conventional injection pump, COVEC-F adjusts fuel injection quantity electromagnetically. Control sleeve position is detected by the control sleeve position sensor and fed back to the control unit.
When the coil(D) is energized, the core(A) generates magnetic(B) flux to rotate the rotor(C) within a specific range. The intensity of the magnetic flux generated by the coil is determined by the input current. The rotor is rotated until the intensity of the core's magnetic flux equals the force of the rotor's return spring.



LF9E011A



LF9E012A

The control sleeve position sensor detects rotational angle. It is installed at the top of the GE actuator to detect whether the control sleeve position (ie, the rotor's angle of rotation) specified by the current is in fact the correct position. The control sleeve position sensor consists of a sensor yoke(A), a sensor coil(B), a movable plate(D) and a fixed plate(C). The movable plateis connected directly to and rotates with the shaft(E).
The fixed plate compensates for temperature induced inductance variations.

The control sleeve position sensor converts differences in the inductances of the upper and lower coils into angles, and feeds this back to the control unit. The control unit compares the target angle with the actual angle measured, and compensates the current so that the angle corresponds to the target angle.

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P1120 if the ECM detects that the GE actuator does not operate normally.

2. Conditions for Setting the DTC

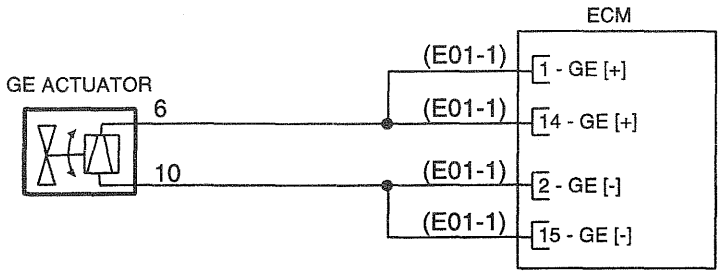
DTC No	Detecting Condition & Limp Home	Suspect area
P1120	**Detecting Condition** • DTC Strategy - Check open or short circuit • Enable condition - IG ON or engine running • Threshold Value - |(GE actuator target value) - (GE actuator actual value)| > 1.0V for 0.5 second **Limp-Home Function** • FCV OFF • GE actuator OFF • Target value of fuel quantity = 0 mm/st • Target value = 0 V	• Open or short in GE actuator circuit • Abnormal yoke/rotor of GE actuator • High viscosity fuel on low temperature • CSPS error • GE actuator • ECM

SPECIFICATION

Temperature		GE Actuator Resistance
23 °C	73.4 °F	0.55 ~ 0.81 Ω

SCHEMATIC DIAGRAM

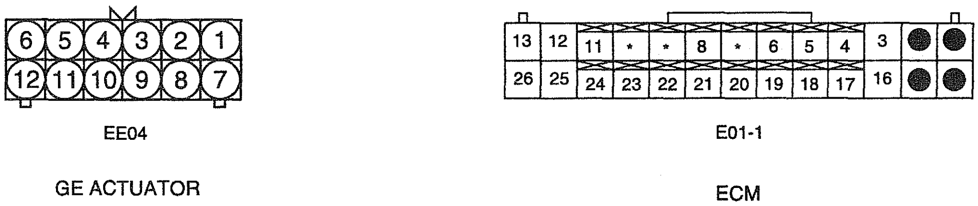
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

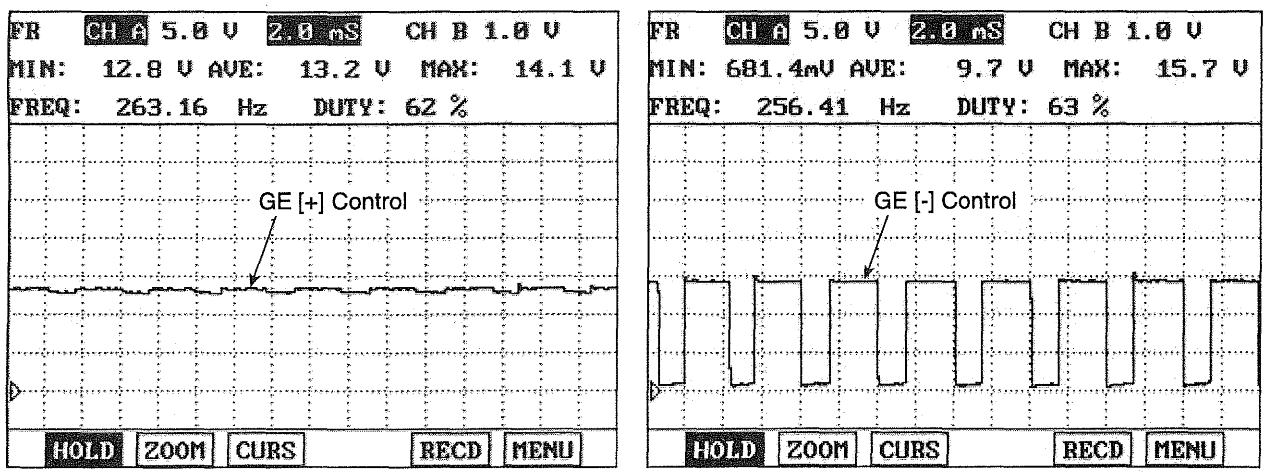
Terminal	Connected to	Function
6	ECM E01-1 (1)	GE [+] Control
	ECM E01-1 (14)	
10	ECM E01-1 (2)	GE [-] Control
	ECM E01-1 (15)	

[HARNESS CONNECTORS]



EGMF402I

SIGNAL WAVE FROM



LF9E0003

INSPECTION PROCEDURE

1. CHECK GE ACUTATOR AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
    - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

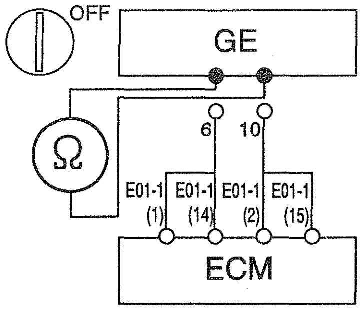
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK GE ACUTATOR RESISTANCE

1. Turn ignition switch to OFF and disconnect GE actuator connector.
2. Measure resistance between the terminal 6 and 10 of GE actuator connector.
    - **Specification (GE actuator resistance): 0.55 ~ 0.81 Ω at 23 °C**



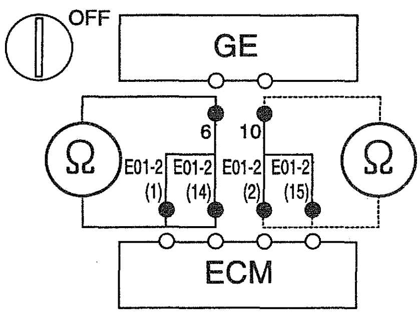
Is resistance within specification?

Yes

No	Replace GE Actuator.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition to OFF position, and then disconnect GE actuator and ECM connector.
2. Measure resistance between terminal 6 of the GE actuator harness connector and terminals 1/14 of the ECM harness connector(E01-1).
3. Measure resistance between terminal 10 of the GE actuator harness connector and terminals 2/15 of the ECM harness connector(E01-1).
    - **Specification (Resistance): below 1Ω**



Does each resistance indicate continuity?

Yes

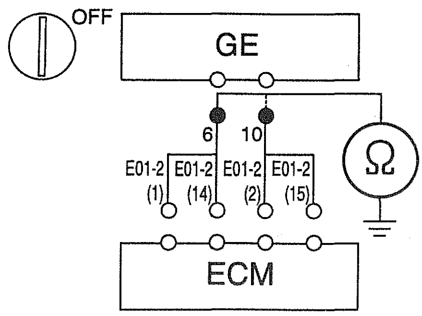
No	Repair open in harness.

EGMF6030

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect GE actuator and ECM connectors.
2. Measure resistance between terminal 6 of the GE actuator harness connector and chassis ground.
2. Measure resistance between terminal 10 of the GE actuator harness connector and chassis ground.
   - **Specification (Resistance): infinite**

Does the resistance indicate open?



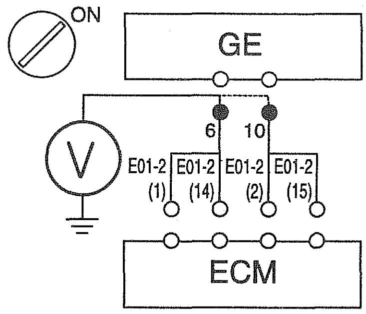
Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect GE actuator and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 6 of the GE actuator harness connector and chassis ground.
4. Measure voltage between terminal 10 of the GE actuator harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**

Is voltage within specification?



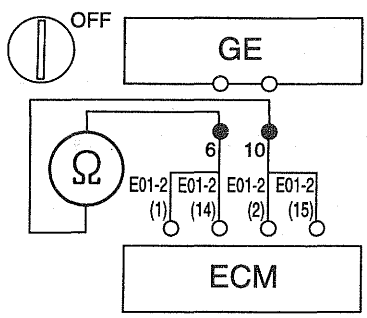
Yes

No	Repair short to power in harness.

6. CHECK FOR SHORT IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect GE actuator and ECM connectors.
2. Measure resistance between terminal 6 and 10 of GE actuator harness connector.
   - **Specification: infinite**

Is voltage within specification?



Yes

No	Repair short in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF603Y

TROUBLESHOOTING FOR DTC EF4EF739

DTC	1122	Manifold Absolute Pressure Too High

DTC DETECTING CONDITION

1. DTC Description

The ECM sets DTC P1122 if the ECM detects that manifold absolute pressure is too high.

2. Conditions for Setting the DTC

DTC No	Detecting Condition & Limp Home	Suspect area
P1122	**Detecting Condition** • DTC Strategy - Rationality check • Enable condition - Engine running • Threshold Value - Manifold absolute pressure ≥ 209.3 kPa for 1 second (consecutive 60 times) **Limp-Home Function** • Manifold absolute pressure on full quantity map = 101.3 kPa	• Too much injection fuel • Retarded injection timing • Disabled waste gate actuator • Disabled turbo charger • ECM

INSPECTION PROCEDURE

1. CHECK THE SYSTEM RELATED TO MANIFOLD PRESSURE

1. Check the below items.
   - Injection fuel quantity
   - Injection timing
   - Waste gate actuator
   - Turbo charger

Are all item have normal condition?

Yes

No	Repair it.

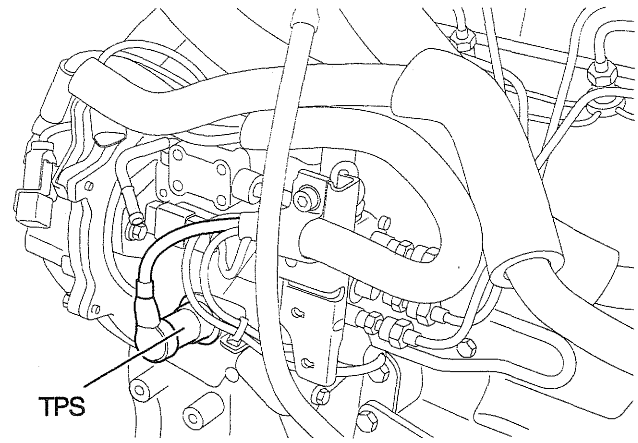
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

LF9E101E

TROUBLESHOOTING FOR DTC E8AF9BFC

DTC	1123	Timing Position Sensor Range/Performance Problem

COMPONENTS LOCATION

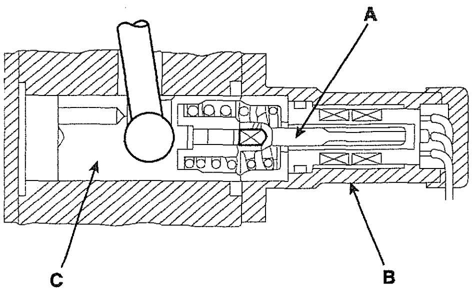


LF9E0028

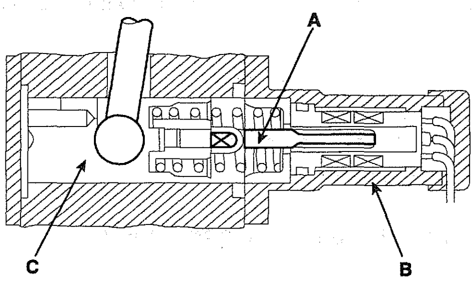
DESCRIPTION

The TPS is installed on the timer's low pressure side. The TPS is constructed of a core rod (A) and a bobbin (B), and detects timer piston (C) position electrically. The TPS detects variations in the core rod (A) inductance to measure timer piston (C) position.

Reference (Standard point): TA = 0mm



LF9E008A



LF9E016A

Reference (Operation): TA = advance angle direction

DTC DETECTING CONDITION

1. DTC Description

The ECM sets DTC P1123 if the ECM detects fault in the TPS circuit.

2. Conditions for Setting the DTC

<table>
<tr><th>DTC No</th><th>Detecting Condition & Limp Home</th><th>Suspect area</th></tr>
<tr><td rowspan="2">P1123</td><td>Detecting Condition
• DTC Strategy
- Rationality Check
- Voltage range check

• Enable condition
- IG ON or engine running

• Threshold Value
- TPS signal < 0.3V or TPS signal > 4.5V for 1 second

Limp-Home Function
• Timing position = 0 mm
• Injection timing is controlled on open loop</td><td>• Open or short in TPS circuit
• TPS
• ECM</td></tr>
<tr><td>Detecting Condition
• DTC Strategy
- TPS learning error

• Enable condition
- After ignition switch "START" position
- Engine speed ≤ 300 rpm
- TPS didn't learn

• Threshold Value
- TPS signal < 0.3V or TPS signal > 0.7V

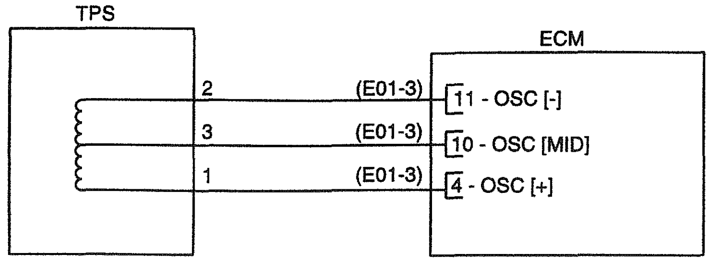
Limp-Home Function
• TPS signal 0.5V = 1mm (If the TPS outputs 0.5V, the ECM will recognize that the timing position is 0mm)
• Injection timing is controlled on open loop</td><td>• Abnormal installation of timer piston
• EEPROM error
• TCV error
• ECM</td></tr>
</table>

SPECIFICATION

<table>
<tr><th colspan="2">Temperature</th><th>TPS Coil</th><th>Resistance</th></tr>
<tr><td>25 ± 10 °C</td><td>77 ± 18 °F</td><td>OSC[MID] ↔ OSC[+]</td><td rowspan="2">76.3 ~ 87.7 kΩ</td></tr>
<tr><td>25 ± 10 °C</td><td>77 ± 18 °F</td><td>OSC[MID] ↔ OSC[-]</td></tr>
</table>

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



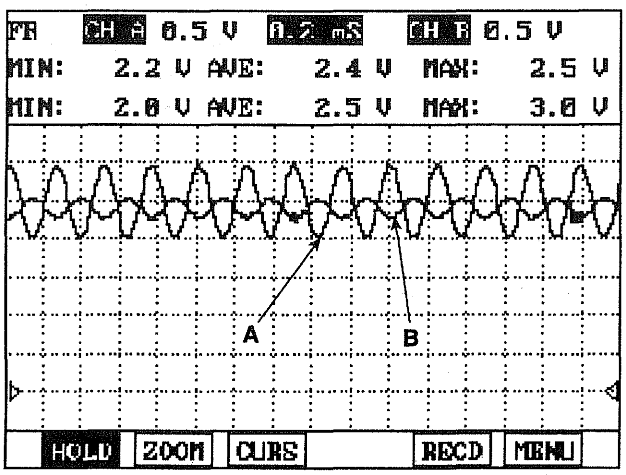
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E01-3 (4)	OSC [+]
2	ECM E01-3 (11)	OSC [-]
3	ECM E01-3 (10)	OSC [MIDDLE]

[HARNESS CONNECTORS]

EGMF101F

SIGNAL WAVE FROM



A : At idle, terminal 1 and 3

B : At idle, terminal 2 and 3

LF9E0023

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO EEPROM OR TCV

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Turn ignition to ON position and monitor other DTCs.

Is any DTC relating to EEPROM OR TCV set?

No ↓

Yes	Do all repairs associated with those codes before proceeding with this procedure.

2. CHECK TIMER PISTON

1. Check the installation status or damage of the timer piston.

Does the timer piston have normal condition?

Yes ↓

No	Repair or adjust the timer piston.

3. CHECK TPS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to ""CONNECTOR INSPECTION PROCEDURE"" in BASIC INSPECTION PROCEDURE."**

Are all connectors good?

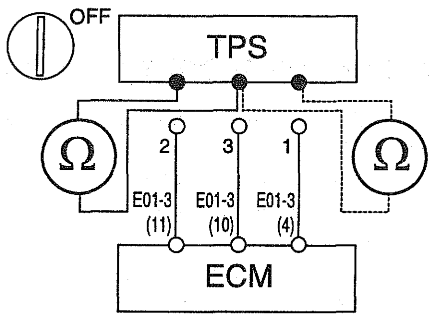
Yes ↓

No	Repair or replace it.

4. CHECK TPS

1. Turn ignition switch to OFF position, and then disconnect TPS connector.
2. Measure resistance between terminal 3 and 2 of the TPS connector.
3. Measure resistance between terminal 3 and 1 of the TPS connector.
   - **Specification (Resistance):**

OSC[MID] ↔ OSC[+]: 76.3 ~ 87.7 kΩ (at 25 ± 10 °C)
OSC[MID] ↔ OSC[-]: 76.3 ~ 87.7 kΩ (at 25 ± 10 °C)



Are the measured resistances within specification?

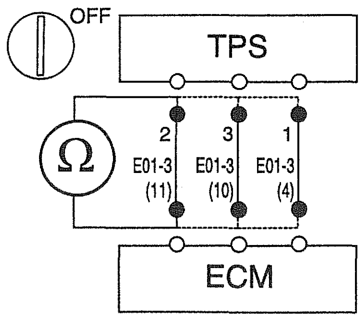
Yes ↓

No	Replace or repair the TPS.

EGMF101G

5. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect TPS and ECM connector.
2. Measure resistance between terminal 2 of the TPS harness connector and terminal 11 of the ECM harness connector(E01-3).
3. Measure resistance between terminal 3 of the TPS harness connector and terminal 10 of the ECM harness connector(E01-3).
4. Measure resistance between terminal 1 of the TPS harness connector and terminal 4 of the ECM harness connector(E01-3).
   - **Specification (Resistance): below 1Ω**



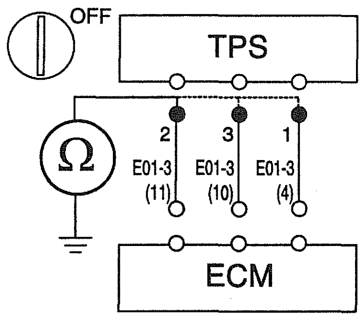
Are the measured resistances within specification?

Yes

No	Repair open in harness.

6. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect TPS and ECM connector.
2. Measure resistance between terminal 2 of the TPS harness connector and chassis ground.
3. Measure resistance between terminal 3 of the TPS harness connector and chassis ground.
4. Measure resistance between terminal 1 of the TPS harness connector and chassis ground.
   - **Specification (Resistance): infinite**



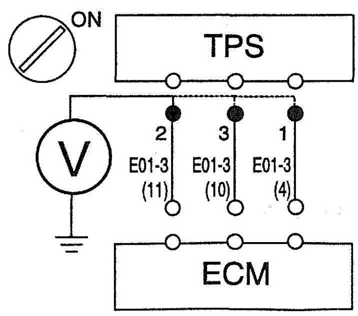
Are the measured resistances within specification?

Yes

No	Repair short to ground in harness.

7. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect TPS and ECM connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the TPS harness connector and chassis ground.
4. Measure voltage between terminal 3 of the TPS harness connector and chassis ground.
5. Measure voltage between terminal 1 of the TPS harness connector and chassis ground.
   - **Specification (Voltage): about 0.5V**



Are the measured voltages within specification?

EGMF101H

Yes

No	Repair short to power in harness.

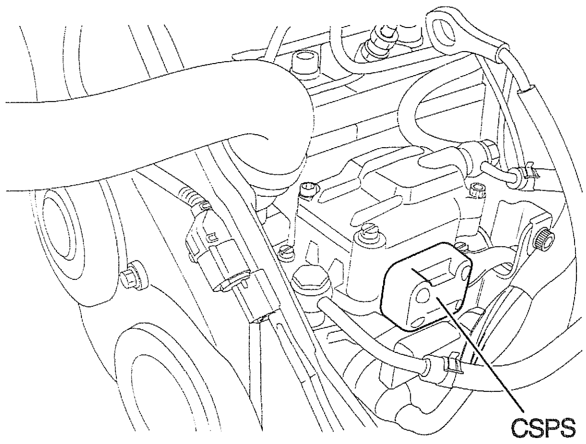
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

LF9E101I

TROUBLESHOOTING FOR DTC E9FCAE3C

DTC	1127	Control Sleeve Position Sensor Range/Performance Problem

COMPINENT LOCATION



LF9E101J

DESCRIPTION

Control Sleeve Position Sensor (CSPS) is installed on GE actuator and monitors the Electronic Governor operation. The movable plate connected with the shaft rotates with the shaft and the fixed plate adjusts inductive coefficient according to temperature variation. The CSPS calculates the angle by using the difference between the inductive coefficients of the upper and the lower sensing coils. If the actual value is differ from the target value, the ECM will make that the actual value is equal to the target value by adjusting the current.

DTC DETECTING CONDITION

1. DTC Description

The ECM sets DTC P1127 if the ECM detects the abnormal CSPS operation.

2. Conditions for Setting the DTC

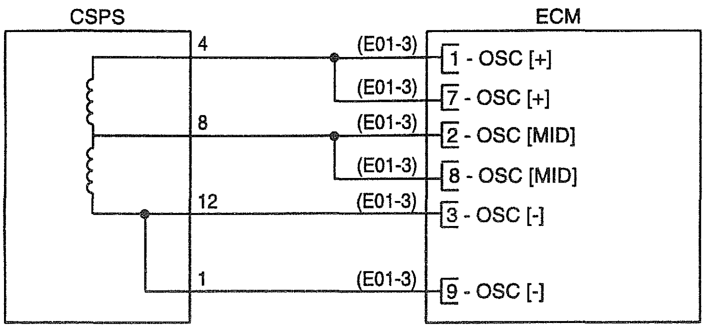
DTC No	Detecting Condition & Limp Home	Suspect area
P1127	**Detecting Condition** • DTC Strategy - Rationality check - Voltage range check • Enable condition - IG ON or engine running • Threshold Value - CSPS output signal < 0.3V or CSPS output signal > 4.5V for 0.3 second **Limp-Home Function** • FCV OFF • GE actuator OFF • Target value of fuel quantity = 0 mm/st • Target value = 0 V	• Open or short in CSPS circuit • CSPS • ECM

SPECIFICATION

Temperature		CSPS Coil	Resistance
23 °C	73.4 °F	OSC[+] ↔ OSC[-]	11.2 ~ 12.4 Ω
23 °C	73.4 °F	OSC[MID] ↔ OSC[+]	5.6 ~ 6.2 Ω
23 °C	73.4 °F	OSC[MID] ↔ OSC[-]	

SCHEMATIC DIAGRAM

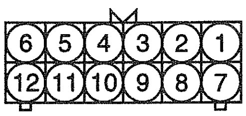
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

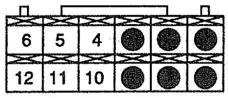
Terminal	Connected to	Function
1	ECM E01-3 (9)	OSC [-]
4	ECM E01-3 (1)	OSC [+]
	ECM E01-3 (7)	OSC [+]
8	ECM E01-3 (2)	OSC [MIDDLE]
	ECM E01-3 (8)	OSC [MIDDLE]
12	ECM E01-3 (3)	OSC [-]

[HARNESS CONNECTORS]



EE04

CSPS



E01-3

ECM

EGMF101K

INSPECTION PROCEDURE

1. CHECK CSPS AND ECM CONNECTORS

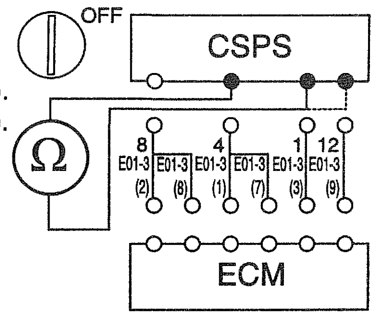
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE."**

Are all connectors good?

Yes

No	Repair or replace it.

2-1. CHECK CSPS (WHOLE COIL RESISTANCE)



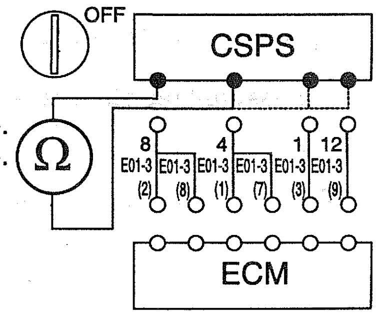
1. Turn ignition switch to OFF position, and then disconnect CSPS connector.
2. Measure resistance between terminal 8 and 11 of the CSPS connector(E01-3).
3. Measure resistance between terminal 8 and 10 of the CSPS connector(E01-3).
   - **Specification (Resistance):**
     OSC[+] ↔ OSC[-]: 11.2 ~ 12.4 Ω at 23 °C (73.4 °F)

Are the measured resistances within specification?

Yes

No	Replace or repair the CSPS.

2-2. CHECK CSPS (UPPER AND LOWER COIL RESISTANCE)



1. Turn ignition switch to OFF position, and then disconnect CSPS connector.
2. Measure resistance between terminal 9 and 8 of the CSPS connector(E01-3).
3. Measure resistance between terminal 9 and 11 of the CSPS connector(E01-3).
4. Measure resistance between terminal 9 and 10 of the CSPS connector(E01-3).
   - **Specification (Resistance):**
     OSC[MID] ↔ OSC[+]: 5.6 ~ 6.2 Ω at 23 °C (73.4 °F)
     OSC[MID] ↔ OSC[-]: 5.6 ~ 6.2 Ω at 23 °C (73.4 °F)

Are the measured resistances within specification?

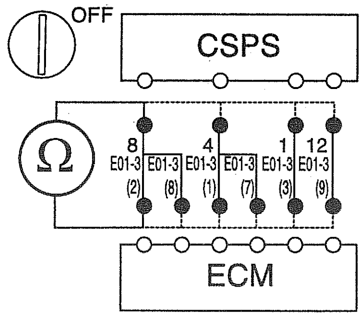
Yes

No	Replace or repair the CSPS.

EGMF101L

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect CSPS and ECM connector.
2. Measure resistance between terminal 8 of the CSPS harness connector and terminal 2/8 of the ECM harness connector(E01-3).
3. Measure resistance between terminal 4 of the CSPS harness connector and terminal 1/7 of the ECM harness connector(E01-3).
4. Measure resistance between terminal 1 of the CSPS harness connector and terminal 3 of the ECM harness connector(E01-3).
5. Measure resistance between terminal 12 of the CSPS harness connector and terminal 9 of the ECM harness connector(E01-3).
   - **Specification (Resistance): below 1 Ω**



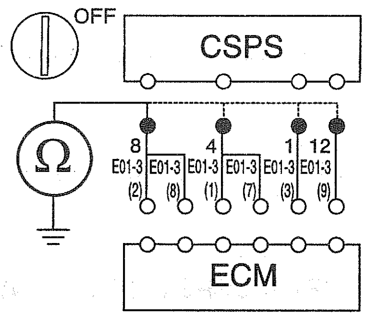
Are the measured resistances within specification?

Yes

No	Repair open in harness.

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect CSPS and ECM connector.
2. Measure resistance between terminal 8 of the CSPS harness connector and chassis ground.
3. Measure resistance between terminal 4 of the CSPS harness connector and chassis ground.
4. Measure resistance between terminal 1 of the CSPS harness connector and chassis ground.
5. Measure resistance between terminal 12 of the CSPS harness connector and chassis ground.
   - **Specification (Resistance): infinite**



Are the measured resistances within specification?

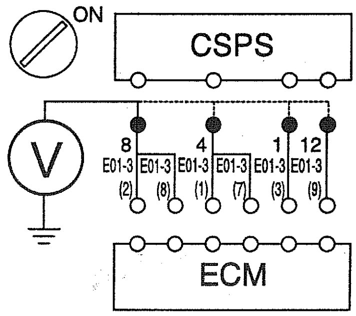
Yes

No	Repair short to ground in harness.

EGMF101M

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect CSPS and ECM connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 8 of the CSPS harness connector and chassis ground.
4. Measure voltage between terminal 4 of the CSPS harness connector and chassis ground.
5. Measure voltage between terminal 1 of the CSPS harness connector and chassis ground.
6. Measure voltage between terminal 12 of the CSPS harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**



Are the measured voltages within specification?

Yes

No	Repair short to power in harness.

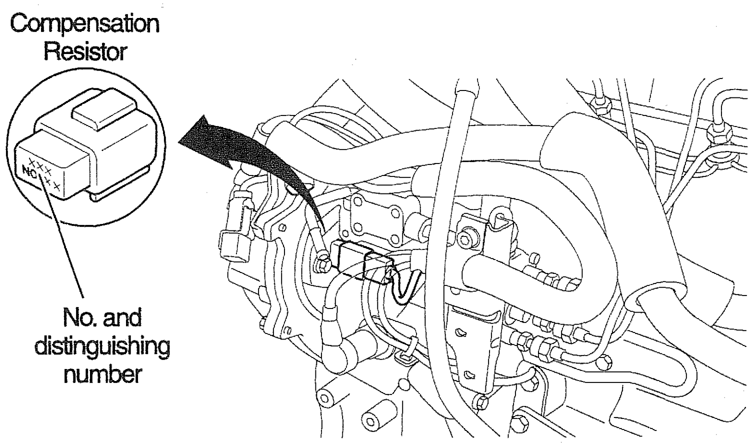
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF101N

TROUBLESHOOTING FOR DTC EC8B325D

DTC	1131	Compensation Resistor Range/Performance Problem

COMPINENT LOCATION



LF9E083C

DESCRIPTION

The Compensation Resistor is simple resistor, but it has different resistance in accordance with the number written on the compensation resistor boby. The ECM adjusts the fuel quantity according to the resistance of the compensation resistor installed in the engine.
When replacing the compensation resistor, compare the number of the new compensation resistor with the number of the old one. If the numbers are different, delete the DTC memorized in the ECM using the Hi-Scan (Pro). Otherwise the ECM determins that the compensation resistor is out of order.

NOTE

Hi-Scan (Pro) displays the number smaller than the actual number of compensation resistor by 7. For example, if the actual number is No.9, Hi-Scan (Pro) will display "No.2".

DTC DETECTING CONDITION

1. DTC Description

The ECM sets DTC P1131 if the ECM detects fault in the compensation resistor circuit.

2. Conditions for Setting the DTC

<table>
<tr><th>DTC No</th><th>Detecting Condition & Limp Home</th><th>Suspect area</th></tr>
<tr><td rowspan="2">P1131</td><td>Detecting Condition
• DTC Strategy
- Rationality Check
- Voltage range check

• Enable condition
- IG ON or engine running

• Threshold Value
- Output signal < 0.1V or output signal > 4.6V for 5 seconds

Limp-Home Function
• Using saved value.</td><td rowspan="2">• Open or short in compensation resistor circuit
• EEPROM error
• Compensation resistor
• ECM</td></tr>
<tr><td>Detecting Condition
• DTC Strategy
- EEPROM error

• Enable condition
- IG ON or engine running

• Threshold Value
- Output signal is not equal to the saved in EEPROM for 12.75 seconds

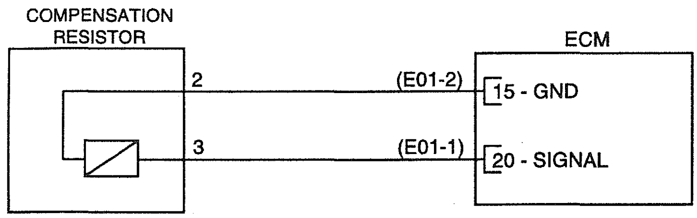
Limp-Home Function
• Compensation resistor number = No.7</td></tr>
</table>

SPECIFICATION

No.	Distinguishing No.	Resistance	No.	Distinguishing No.	Resistance
1	945	0.18 kΩ	8	952	2.00 kΩ
2	946	0.30 kΩ	9	953	2.70 kΩ
3	947	0.43 kΩ	10	954	3.90 kΩ
4	948	0.62 kΩ	11	955	5.60 kΩ
5	949	0.82 kΩ	12	956	8.20 kΩ
6	950	1.10 kΩ	13	957	15.00 kΩ
7	951	1.50 kΩ			

SCHEMATIC DIAGRAM

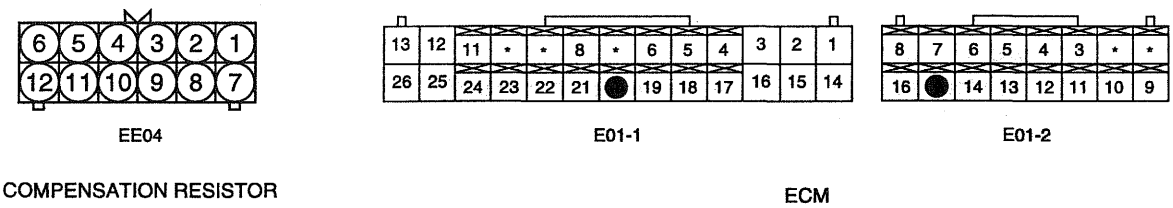
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
2	ECM E01-2 (15)	Sensor Ground
3	ECM E01-1 (20)	Resistor Signal

[HARNESS CONNECTORS]



EGMF101O

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO EEPROM

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Turn ignition to ON position and monitor other DTCs.

Is any DTC relating to EEPROM set?

No

Yes	Do all repairs associated with those codes before proceeding with this procedure.

2. CHECK FOR COMPENSATION RESISTOR NUMBER

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Turn ignition to ON position and check the number of compensation resistor.

NOTE

Hi-Scan (Pro) displays the number smaller than the actual number of compensation resistor by 7.
For example, if the actual number is No.9, Hi-Scan (Pro) will display "No.2".

3. Compare the number written on the compensation resistor body and the number displayed on Hi-Scan (Pro).

Are the numbers equal?

Yes

No	Delete the DTC in accordance with the the compensation resistor. If the DTC occurs again, go to Step. 3.

3. CHECK COMPENSATION RESISTOR AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE."**

Are all connectors good?

Yes

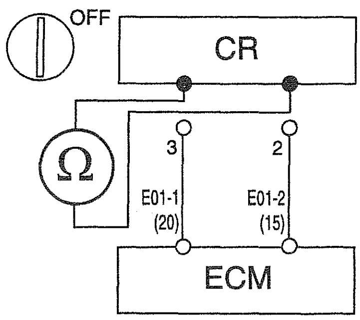
No	Repair or replace it.

LF9E101P

4. CHECK COMPENSATION RESISTOR

1. Turn ignition switch to OFF position, and then disconnect Compensation Resistor connector.
2. Measure resistance between terminal 3 and 2 of the Compensation Resistor connector, and then check the resistance in accordance with the number written in the resistor body.
   - **Specification (Resistance):**

No.	Distinguishing No.	Resistance	No.	Distinguishing No.	Resistance
1	945	0.18 kΩ	8	952	2.00 kΩ
2	946	0.30 kΩ	9	953	2.70 kΩ
3	947	0.43 kΩ	10	954	3.90 kΩ
4	948	0.62 kΩ	11	955	5.60 kΩ
5	949	0.82 kΩ	12	956	8.20 kΩ
6	950	1.10 kΩ	13	957	15.00 kΩ
7	951	1.50 kΩ			



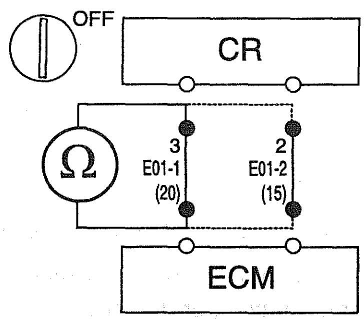
Is the measured resistance within specification?

Yes

No	Replace or repair the Compensation Resistor.

5. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect Compensation Resistor and ECM connector.
2. Measure resistance between terminal 3 of the Compensation Resistor harness connector and terminal 20 of the ECM harness connector(E01-1).
3. Measure resistance between terminal 2 of the Compensation Resistor harness connector and terminal 15 of the ECM harness connector(E01-2).
   - **Specification (Resistance): below 1Ω**



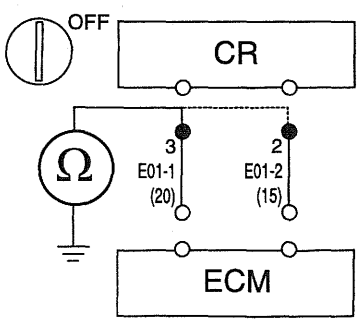
Is the measured resistances within specification?

Yes

No	Repair open in harness.

6. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect Compensation Resistor and ECM connector.
2. Measure resistance between terminal 3 of the Compensation Resistor harness connector and chassis ground.
3. Measure resistance between terminal 2 of the Compensation Resistor harness connector and chassis ground.
   - **Specification (Resistance): infinite**



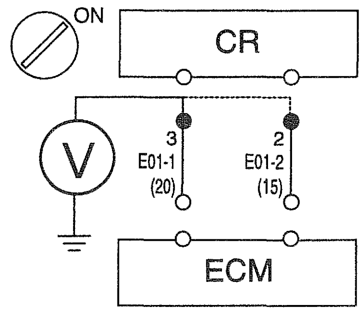
Is the measured resistances within specification?

EGMF101Q

Yes

No	Repair short to ground in harness.

7. CHECK FOR SHORT TO POWER IN HARNESS



1. Turn ignition switch to OFF position, and then disconnect Compensation Resistor and ECM connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the Compensation Resistor harness connector and chassis ground.
4. Measure voltage between terminal 2 of the Compensation Resistor harness connector and chassis ground.
   - **Specification (Voltage): about 0.5V**

Is the measured voltages within specification?

Yes

No	Repair short to power in harness.

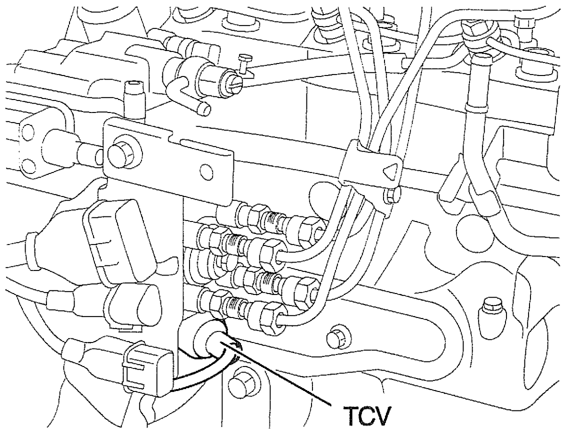
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF101R

TROUBLESHOOTING FOR DTC EA3E4B67

DTC	1135	Injection Timing Control System Malfunction

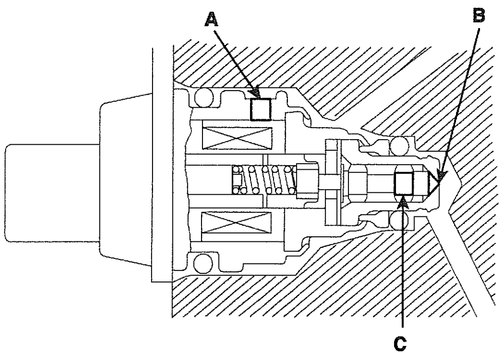
COMPINENT LOCATION



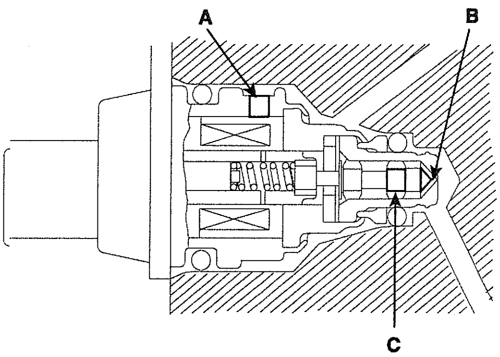
EGMF0010

DESCRIPTION

The TCV has a fuel inlet(A) located in the center of the side of the TCV body. The fuel inlet is equipped with a filter. This inlet connects through the inside of the TCV to a hole(B) in the end of the TCV body. A needle valve(C) inside the TCV seats inside this end hole(B). When current is applied to the TCV, the needle valve is pulled to the left (see right hand figure) by a magnet to open the end seat. Injection timing is varied by timer piston movement transferred to the roller holder, as with conventional injection pumps. Previously, though, the pressure inside the timer's high pressure chamber controlling the timer piston varied in accordance with pump speed. With COVEC-F, however, the TCV controls pressure inside the high pressure chamber.



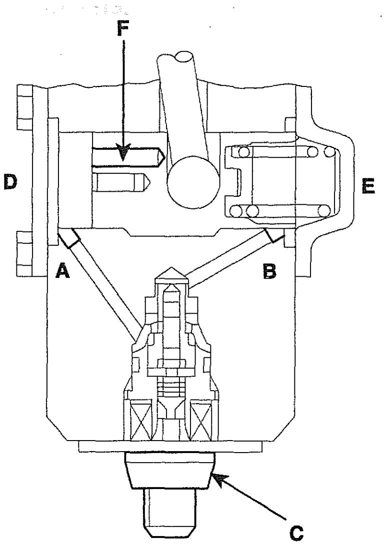
<Case I : No current in TCV>



<Case II : Current flows in TCV>

LF9E006A

The TCV(C) is located at the lower part of the injection pump. Two holes (A and B) in the pump housing connect to the TCV.
Hole A connects the timer piston's high pressure chamber(D) to the fuel inlet side of the TCV. A filter is installed at this inlet to exclude foreign matter.
Hole B connects the timer piston's low pressure chamber(E) to the fuel outlet at the tip of the TCV. Installed between the timer piston's(F) high and low pressure chambers, the TCV adjusts high pressure chamber pressure by opening and closing the needle.
When current is not flowing to the TCV, the tip of the needle completely separates the high and low pressure chambers. When current is applied, the needle tip seat is opened, the high and low pressure chambers are connected, and the high pressure chamber pressure decreases. The timer piston(F) is then moved by the timer spring to a position that balances the high pressure chamber pressure.
Accompanying this, the roller holder rotates to vary the injection timing. Injection timing can therefore be varied by utilizing the ON-OFF duty ratio of the current flowing to the TCV. Injection timing is controlled by duty. All characteristics and control signals are processed with TCV drive signal duty ratios. Also, the frequency of the TCV drive signal can be varied to correspond to the frequency of injection pump speed.



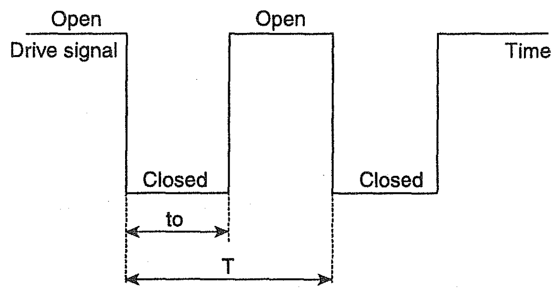
LF9E050A

Duty ratio is the ratio of the time that the timing control valve is closed per unit of time (ie, per cycle).

Duty ratio = to/T x 100(%)

NOTE

Injection timing is retarded when the duty ratio decreases from 100%.



LF9E014A

DTC DETECTING CONDITION

1. DTC Description

The ECM sets DTC P1135 if the ECM detects fault in the injection timing control system.

2. Conditions for Setting the DTC

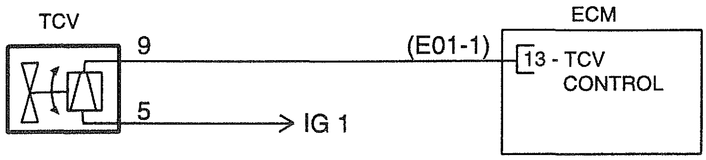
DTC No	Detecting Condition & Limp Home	Suspect area
P1135	**Detecting Condition** • DTC Strategy - Check injection timing control system • Enable condition - Engine speed ≥ 600rpm - Engine coolant temperature ≥ -5℃ • Threshold Value - |(TPS target value) - (TPS actual value)| > 5mm for 5 seconds **Limp-Home Function** • TPS = 0mm and injection timing control system is controlled on open loop	• Open or short in TPS or TCV circuit • Abnormal timer piston • High viscosity fuel on low temperature • TPS • TCV • ECM

SPECIFICATION

Temperature		TCV Resistance
20 °C	68 °F	10.3 ~ 11.7 Ω

SCHEMATIC DIAGRAM

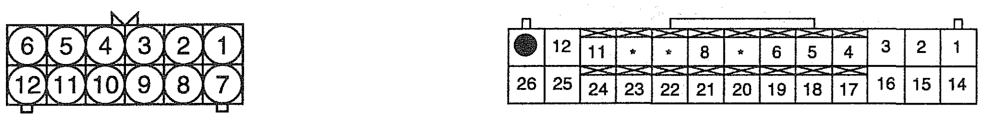
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
5	IG 1	Battery Voltage
9	ECM E01-1 (13)	TCV Control

[HARNESS CONNECTORS]



EE04

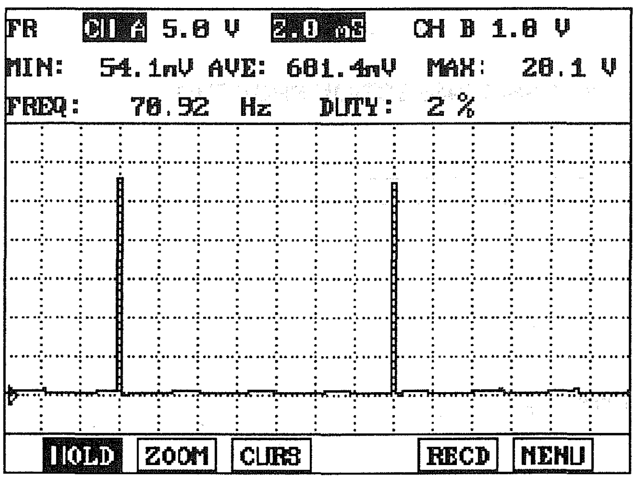
TCV

E01-1

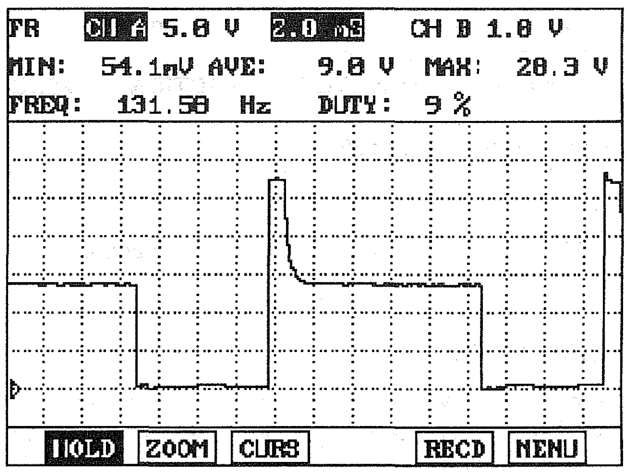
ECM

EGMF101S

SIGNAL WAVE FROM



At idle



At acceleration

LF9E0012

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO EEPROM OR TPS

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Turn ignition to ON position and monitor other DTCs.

Is any DTC relating to EEPROM OR TPS set?

No

Yes	Do all repairs associated with those codes before proceeding with this procedure.

2. CHECK FOR INJECTION TIMING SYSTEM

1. Check the installation status or damage of the timer piston.
2. Check the fuel (If fuel temperature is low and viscosity is high, this DTC occurs).

Do the above item have normal condition?

Yes

No	Repair it.

3. CHECK TCV AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

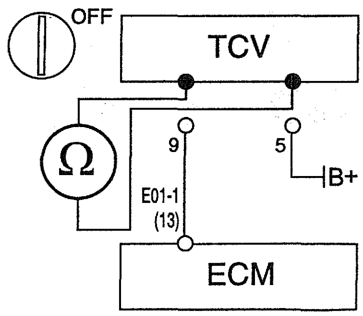
Are all connectors good?

Yes

No	Repair or replace it.

4. CHECK TCV

1. Turn ignition switch to OFF position, and then disconnect TCV connector.
2. Measure resistance between terminal 5 and 9 of the TCV connector.
   - **Specification (Resistance): 10.3 ~ 11.7 Ω (at 20 °C)**



Is the measured resistance within specification?

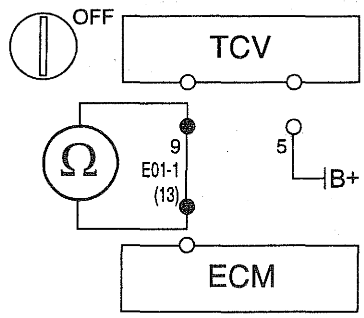
Yes

No	Replace or repair the TCV.

EGMF101T

5. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect TCV connector.
2. Measure resistance between terminal 9 of the TCV harness connector and terminal 13 of the ECM harness terminal(E01-1).
   - **Specification (Resistance): below 1 Ω**

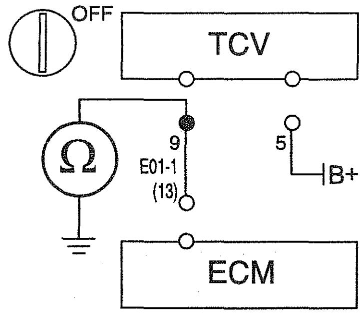


Is the measured resistance within specification?

Yes	No	Repair open in harness.

6. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect TCV connector.
2. Measure resistance between terminal 9 of the TCV harness connector and chassis ground.
   - **Specification (Resistance): infinite**

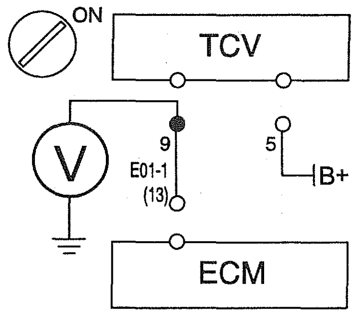


Is the measured resistance within specification?

Yes	No	Repair short to ground in harness.

7. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect TCV connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 9 of the TCV harness connector and chassis ground.
   - **Specification (Voltage): infinite**



Is the measured voltage within specification?

Yes	No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF101U

TROUBLESHOOTING FOR DTC E0ED1A4C

DTC	P1324	Glow Relay Circuit Malfunction

DESCRIPTION

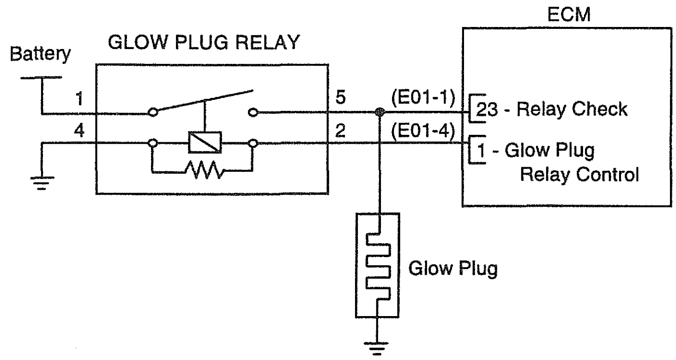
Glow plug plays an efficient role at cold start. It also shortens the warm-up period, a fact that is highly relevant for exhaust emissions. The time of preheating is determined by a number of parameters that include the engine speed and the coolant temperature. The ECM controls the glow plug via glow plug relay.

DTC DETECTING CONDITION

<table>
<tr><th>DTC No</th><th>Detecting Condition & Limp Home</th><th>Suspect area</th></tr>
<tr><td rowspan="2">P1324</td><td>Detecting Condition
• DTC Strategy
- Check short circuit to battery line
• Enable condition
- Glow relay OFF
• Threshold Value
- "HIGH" level appears on glow relay check terminal for 10 seconds
Limp-Home Function
• Glow relay OFF</td><td rowspan="2">• Open or short in glow relay circuitcircuit
• Voltage overflow
• Glow relay
• ECM</td></tr>
<tr><td>Detecting Condition
• DTC Strategy
- Check open or short circuit to ground
• Enable condition
- Glow relay ON
• Threshold Value
- "LOW" level appears on glow relay check terminal for 0.1 seconds
Limp-Home Function
• Glow relay OFF</td></tr>
</table>

SCHEMATIC DIAGRAM

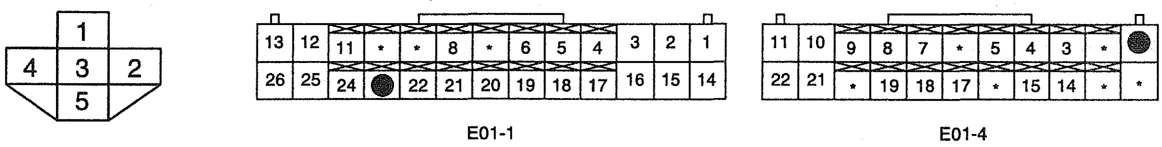
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Battery	Battery Supply
2	ECM E01-4 (1)	Glow Relay Control
3	-	-
4	Chassis Ground	Relay Ground
5	ECM E01-1 (23)	Glow Relay Control
	Glow Plug	-

[HARNESS CONNECTORS]



GLOW PLUG RELAY

ECM

EGMF0793

INSPECTION PROCEDURES

1. CHECK GLOW PLUG RELAY FOR WORKING

1. Connect Hi-Scan (Pro) to data link connector.
2. Turn ignition switch to ON.
3. Operate glow plug relay by Actuator Test mode of Hi-Scan (Pro).

Does glow plug relay function normally?

No

Yes	Problem is intermittent or was repaired and ECM memory was not cleared. Refer to "INTERMITTENT PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

2. CHECK GLOW PLUG RELAY, GLOW PLUG AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

- **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

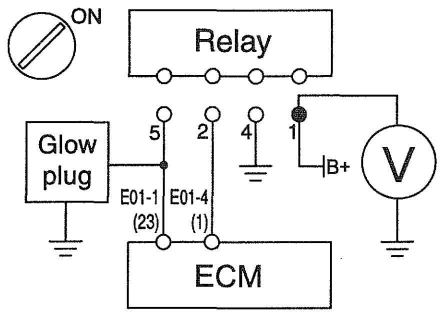
Yes

No	Repair or replace it.

3. CHECK POWER TO GLOW PLUG RELAY

1. Turn ignition switch to ON and disconnect glow plug relay connector.
2. Measure voltage between the terminal 1 of glow plug relay harness connector and chassis ground.

- **Specification: approximately B+**



Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

4. CHECK GLOW PLUG RELAY

1. Turn ignition switch to OFF and remove glow plug relay.
2. Apply power to the terminal 2 of glow plug relay and ground terminal 2.
3. Check if glow plug relay works well.
   (If glow plug relay works normally, a click sound can be heard.)

Does glow plug relay operate normally?

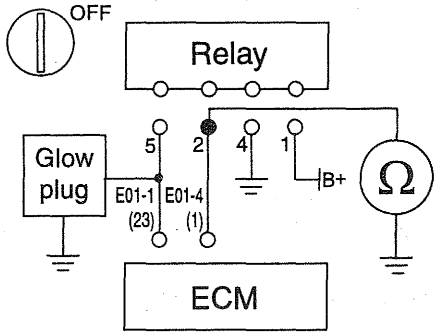
Yes

No	Repair glow plug relay

EGMF003S

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF and disconnect ECM connector.
2. Measure resistance between the terminal 2 of glow plug relay harness connector and chassis ground.



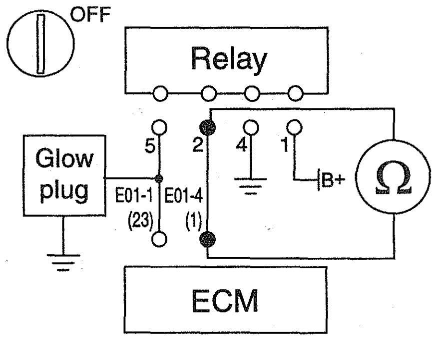
• Specifications: infinite

Does resistance indicate open?

Yes	No	Repair short to chassis ground in harness.

6. CHECK FOR OPEN IN HARNESS

1. Measure resistance between the terminals 2 of glow plug relay harness connector and 1 of ECM harness connector(E01-4).



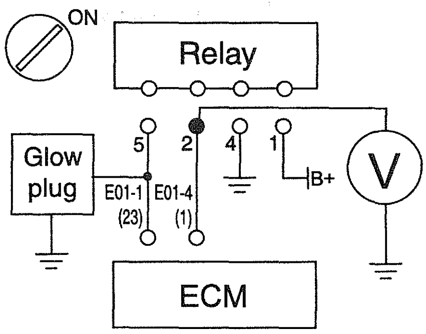
• Specifications: below 1Ω

Does resistance indicate continuity?

Yes	No	Replace open in harness.

7. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to ON.
2. Measure voltage between the terminal 2 of glow plug relay harness connector and chassis ground.



• Specification: below 0.5V

Is voltage within specification?

Yes	No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF003T

TROUBLESHOOTING FOR DTC E0D8BF70

DTC	P1522	Battery Voltage Malfunction

DESCRIPTION

The ECM provides ground to one side of the coil of the main relay and the other side is connected to the battery. The ECM monitors battery voltage and the voltage after the main relay.

DTC DETECTING CONDITION

1. DTC Description

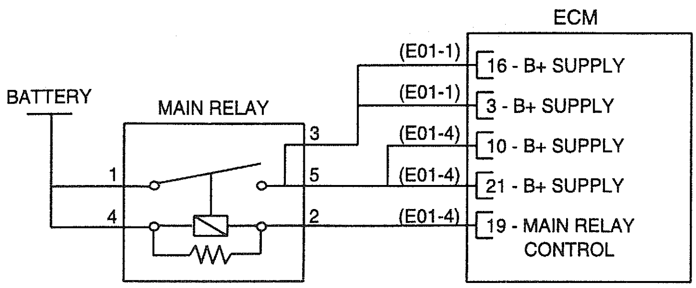
ECM sets DTC P1522 if the ECM detects system voltage lower or higher than the possible range of battery voltage.

2. Conditions for Setting the DTC

DTC No	Detecting Condition & Limp Home	Suspect area
P1522	**Detecting Condition** • DTC Strategy - System voltage too low or high • Enable condition - IG ON or engine running • Threshold Value - Battery voltage after main relay < 0V or battery voltage after main relay >30V for 30 seconds **Limp-Home Function** • Battery voltage = 14V	• Open or short in main relay circuit • Charging system • ECM

SCHEMATIC DIAGRAM

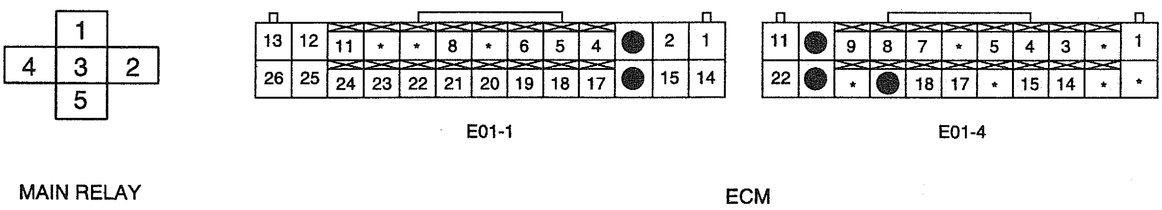
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	ECM E01-4 (19)	Main Relay Control
3	ECM E01-1 (16)	B+ Supply
	ECM E01-1 (3)	B+ Supply
4	Battery	Battery Voltagel
5	ECM E01-4 (10)	B+ Supply
	ECM E01-4 (21)	B+ Supply

[HARNESS CONNECTORS]



EGMF402Q

INSPECTION PROCEDURE

1. CHECK MAIN RELAY AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK MAIN RELAY

1. Remove the main relay.
2. Apply power to the main relay terminal 4 and ground terminal 2.
3. Check if the main relay works well when it is energized.
   (If the main relay works normally, a clicking sound can be heard.)

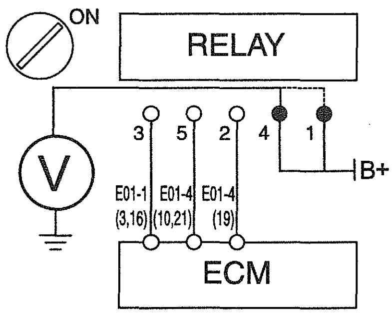
Does the main relay operate normally?

Yes

No	Replace main relay.

3. CHECK POWER TO MAIN RELAY

1. Remove the main relay.
2. Turn ignition switch to ON position.
3. Measure the voltage between terminal 4 of the main relay harness connector and chassis ground.
4. Measure the voltage between terminal 1 of the main relay harness connector and chassis ground.
   - **Specification : approximately B+**



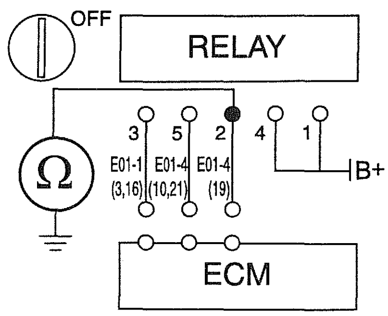
Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect main relay and ECM connectors.
2. Measure resistance between terminal 2 of the main relay harness connector and chassis ground.
   - **Specification (Resistance): infinite**



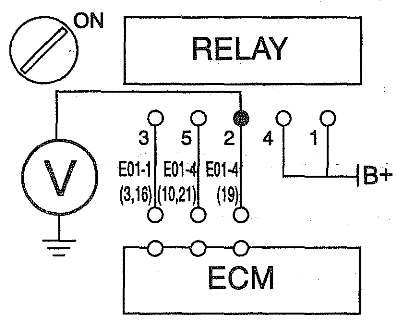
Does the resistance indicate open?

EGMF604Y

Yes	No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect main relay and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the main relay harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**

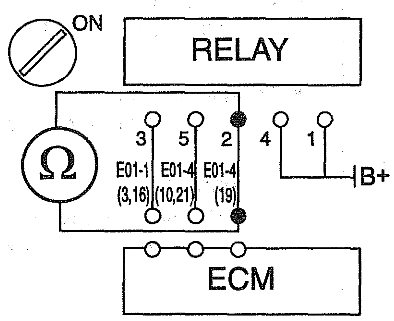


Is voltage within specification?

Yes	No	Repair short to power in harness.

6. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect main relay and ECM connectors.
2. Measure resistance between terminal 2 of the injector harness connector and terminal 19 of ECM harness connector(E01-4).
   - **Specification (Resistance): below Ω**



Does resistance indicate continuity?

Yes	No	Repair open in harness.

7. CHECK CHARGING SYSTEM

1. Check charging system (including battery) for proper operation.
   - **Refer to CHARGING SYSTEM in "EE" Group.**

Is charging system okay

Yes	No	Repair or replace it.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF604Z

TROUBLESHOOTING FOR DTC EAFFE2ED

DTC	P1525	Sensor Supply Voltage (+5V) Malfunction

DESCRIPTION

The +5V power source in the ECM is supplied to the Accelerator Position Sensor (APS) and Manifold Absolute Pressure Sensor (MAPS). The ECM monitors this sensor supply voltage.

DTC DETECTING CONDITION

1. DTC Description

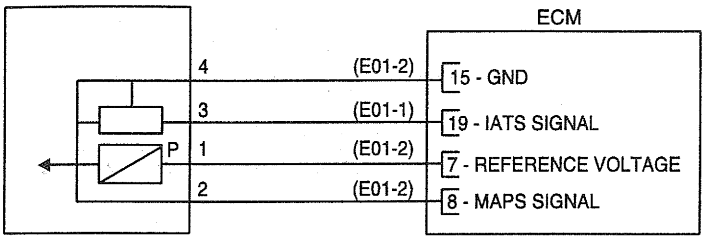
The ECM sets DTC P1525 if the sensor supply voltage is higher or lower than the predetermined range.

2. Conditions for Setting the DTC

DTC No	Detecting Condition & Limp Home	Suspect area
P1525	**Detecting Condition** • DTC Strategy - Check APS or MAPS supply voltage • Enable condition - IG ON or engine running • Threshold Value - Sensor supply voltage < 4.5V or sensor supply voltage > 5.0V for 1 second **Limp-Home Function** • It is impossible to adjust APS or MAPS output voltage	• Open or short in APS or MAPS circuit • ECM internal error

SCHEMATIC DIAGRAM (I) - MAPS

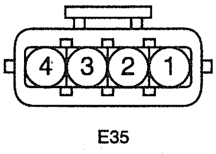
[CIRCUIT DIAGRAM]



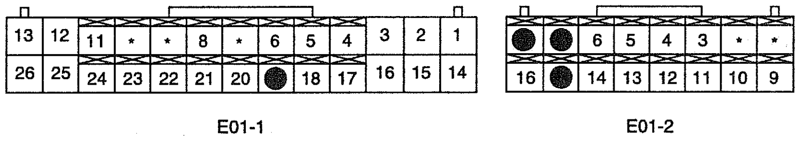
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E01-2(7)	Reference Voltage
2	ECM E01-2(8)	MAPS signal
3	ECM E01-1(19)	IATS signal
4	ECM E01-2(15)	Sensor ground

[HARNESS CONNECTORS]



MAPS & IATS

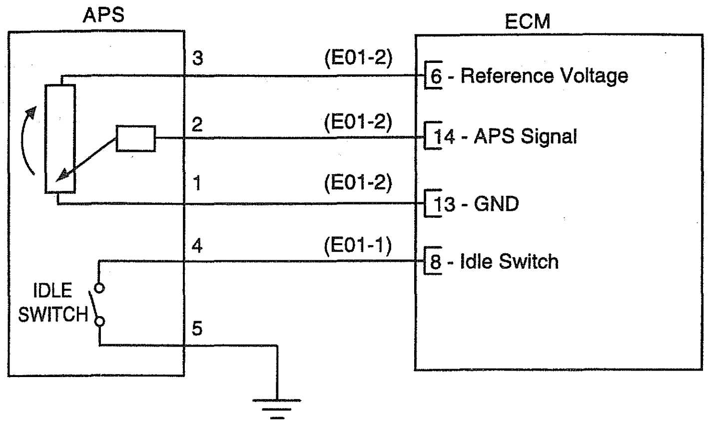


ECM

EGMF4010

SCHEMATIC DIAGRAM (II) - APS

[CIRCUIT DIAGRAM]

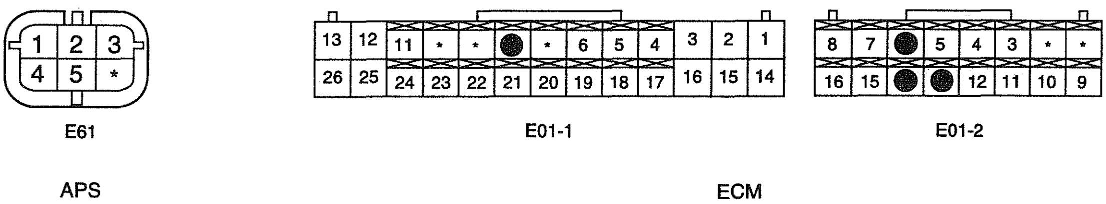


[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E01-2 (13)	Sensor Ground
2	ECM E01-2 (14)	APS Signal
3	ECM E01-2 (6)	Reference Voltage
4	ECM E01-1 (8)	Idle Switch Signal
5	Chassis Ground	Idle Switch Ground
6	-	-

ECM Terminal A8

[HARNESS CONNECTORS]



EGMF0634

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO MAPS AND APS

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Turn ignition switch to ON position and monitor other DTCs.

Is any DTC relating to MAPS or APS set?

No

Yes	Do all repairs associated with those codes before proceeding with this procedure.

2. CHECK MAPS, APS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

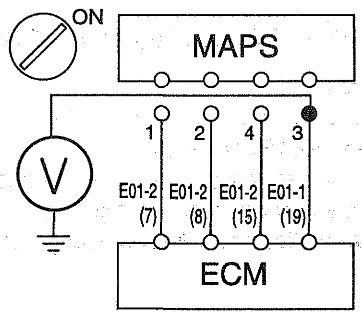
Yes

No	Repair or replace it.

3. CHECK SENSOR SUPPLY VOLTAGE

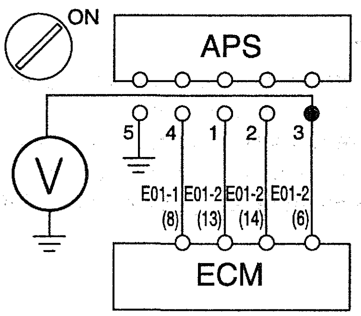
[MAPS]

1. Turn ignition switch to OFF position, and then disconnect MAPS connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the MAPS harness connector and chassis ground.
- **Specification (Voltage) : about +5V**



[APS]

1. Turn ignition switch to OFF position, and then disconnect APS connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the APS harness connector and chassis ground.
- **Specification (Voltage) : about +5V**



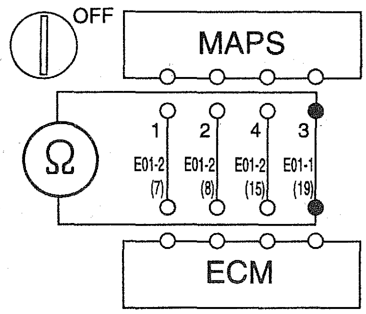
Are the measured voltages within specification?

Yes

No	Problem is intermittent or was repaired and ECM memory was not cleared. Refer to "INTERMITTENT PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF101V

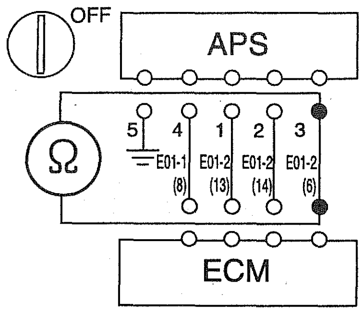
4. CHECK FOR OPEN IN HARNESS



[MAPS]

1. Turn ignition switch to OFF position, and then disconnect MAPS and ECM connector.
2. Measure resistance between terminal 2 of the MAPS harness connector and terminal 7 of the ECM harness connector(E01-2).

- **Specification (Resistance): below 1Ω**



[APS]

1. Turn ignition switch to OFF position, and then disconnect APS and ECM connector.
2. Measure resistance between terminal 3 of the APS harness connector and terminal 6 of the ECM harness connector(E01-2).

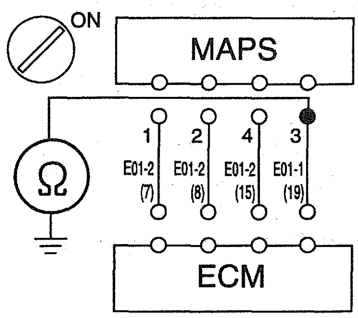
- **Specification (Resistance): below 1Ω**

Are the measured resistances within specification?

Yes

No	Repair open in harness.

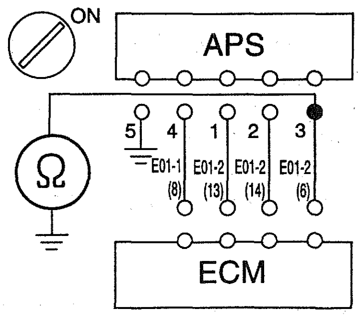
5. CHECK FOR SHORT TO GROUND IN HARNESS



[MAPS]

1. Turn ignition switch to OFF position, and then disconnect MAPS and ECM connector.
2. Measure resistance between terminal 2 of the MAPS harness connector and chassis ground.

- **Specification (Resistance): infinite**



[APS]

1. Turn ignition switch to OFF position, and then disconnect APS and ECM connector.
2. Measure resistance between terminal 3 of the APS harness connector and chassis ground.

- **Specification (Resistance): infinite**

Are the measured resistances within specification?

Yes

No	Repair short to ground in harness.

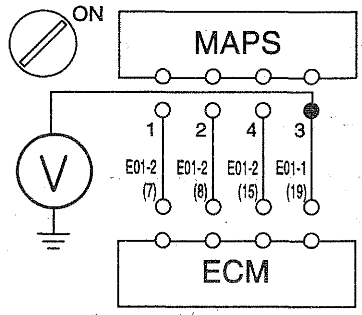
EGMF101W

6. CHECK FOR SHORT TO POWER IN HARNESS

[MAPS]

1. Turn ignition switch to OFF position, and then disconnect MAPS and ECM connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the MAPS harness connector and chassis ground.

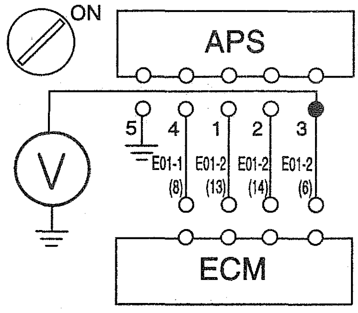
- **Specification (Voltage): below 0.5V**



[APS]

1. Turn ignition switch to OFF position, and then disconnect APS and ECM connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the APS harness connector and chassis ground.

- **Specification (Voltage): below 0.5V**



Are the measured voltages within specification?

Yes

No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF101X

TROUBLESHOOTING FOR DTC EABE1F8E

DTC	P1613	ECM Error (A/D Converter)

DESCRIPTION

An ECM ROM malfunction is detected by using a checksum technique for verifying data. Digital data is composed of zeros and ones. A checksum is the total of all ones in a string of data. By comparing the checksum value with a stored value, a malfunction can be detected.

DTC DETECTING CONDITION

DTC No	Detecting Condition & Limp Home	Suspect area
P1613	**Detecting Condition** • DTC Strategy - ECM error • Enable condition - IG ON or engine running • Threshold Value - A/D conversion end signal is not detected **Limp-Home Function** • Using the data saved in ECM just after occurrence of the error	• ECM internal error

INSPECTION PROCEDURES

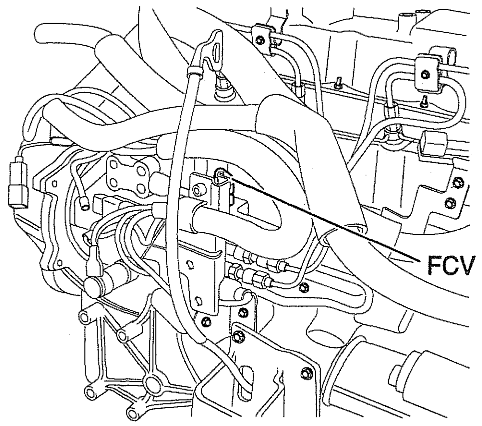
- Internal fault. There is no inspection of service possible for this diagnostic trouble code.
- Temporarily install a good ECM and check for proper operation. If problem is corrected, replace ECM.

LWGE004F

TROUBLESHOOTING FOR DTC E0D01BBF

DTC	P1621	Fuel Cut Valve Circuit Malfunction

COMPINENT LOCATION



LF9E505Z

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P1621 if the ECM detects that the FCV control line is open or short to ground.

2. Conditions for Setting the DTC

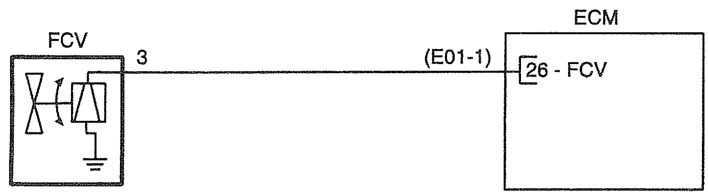
DTC No	Detecting Condition & Limp Home	Suspect area
P1621	**Detecting Condition** • DTC Strategy - Check open or short circuit • Enable condition - IG ON or engine running • Threshold Value - "LOW" level appears on FCV control terminal for 30 seconds **Limp-Home Function** • FCV OFF • GE actuator OFF • Target value of fuel quantity = 0 mm/st • Target value = 0 V	• Open or short in FCV circuit • FCV • ECM

SPECIFICATION

Temperature		FCV Resistance
23 ± 10 °C	73.4 ± 18 °F	7.5 ~ 9.7 Ω

SCHEMATIC DIAGRAM

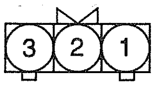
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

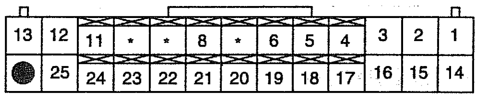
Terminal	Connected to	Function
3	ECM E01-1 (26)	FCV operation

[HARNESS CONNECTORS]



E49

FCV



E01-1

ECM

EGMF101Y

INSPECTION PROCEDURE

1. CHECK FCV AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

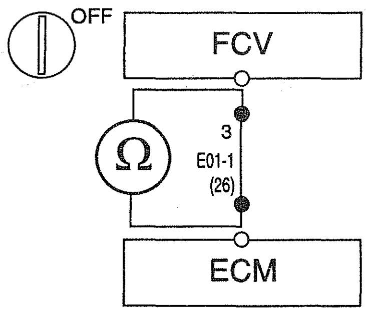
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK FOR OPEN IN HARNESS

1. Turn ignition to OFF position, and then disconnect FCV and ECM connector.
2. Measure resistance between terminal 3 of the FCV harness connector and 26 of the ECM harness connector(E01-1).
   - **Specification (Resistance): below 1Ω**



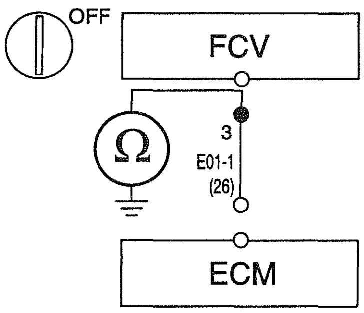
Does each resistance indicate continuity?

Yes

No	Repair open in harness.

3. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect FCV and ECM connectors.
2. Measure resistance between terminal 3 of the FCV harness connector and chassis ground.
   - **Specification (Resistance): infinite**



Does the resistance indicate open?

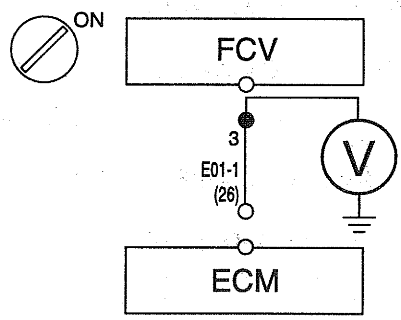
Yes

No	Repair short or short to chassis ground in harness.

EGMF101Z

4. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect FCV and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the FCV harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**



Is voltage within specification?

Yes

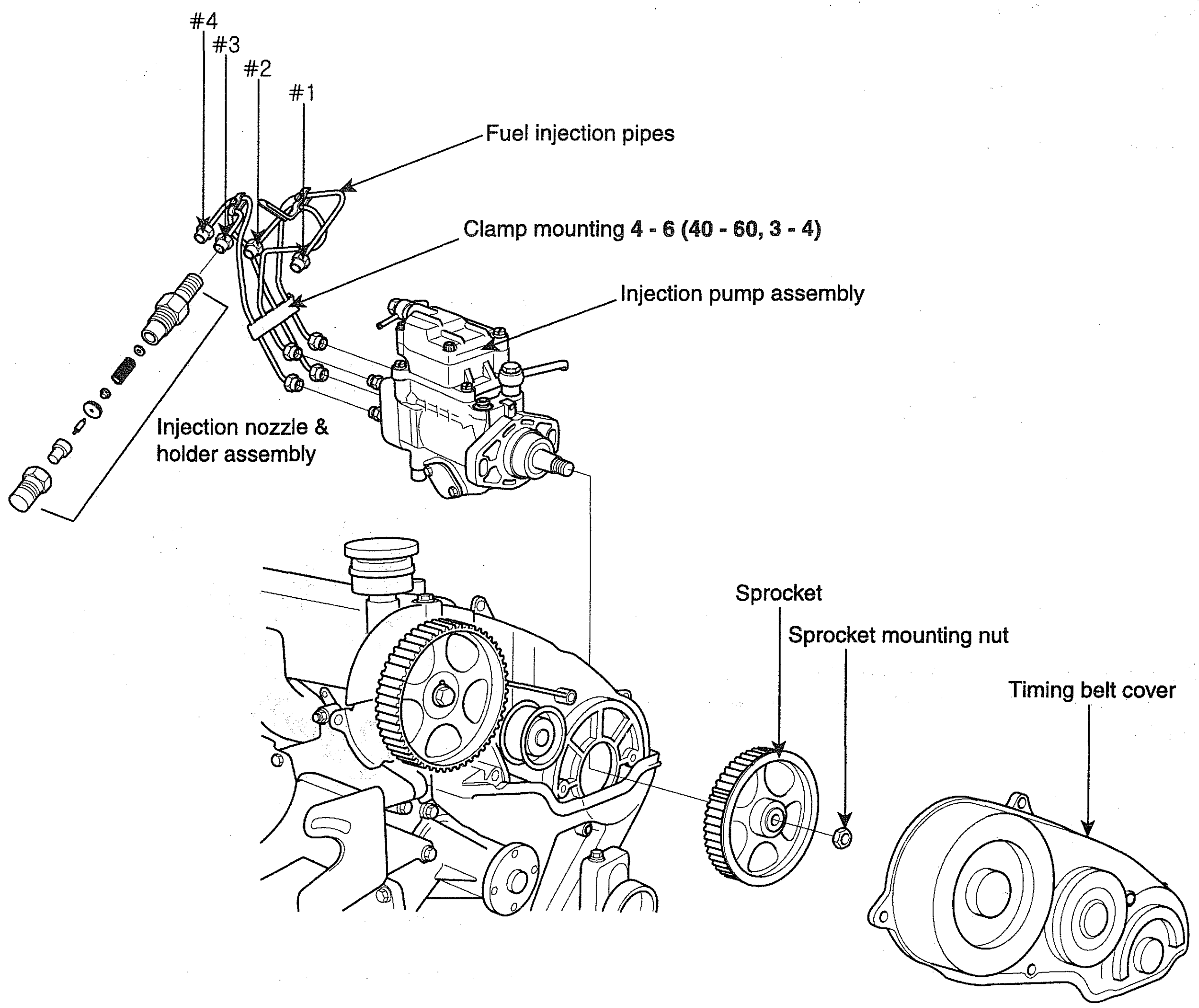
No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EGMF102A

INJECTION PUMP-ELECTRONIC

COMPONENTS ED2B7DDB

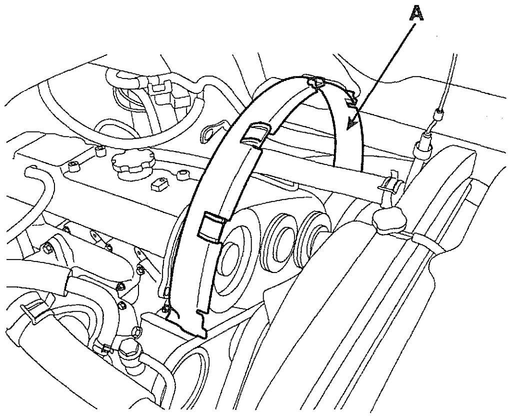


TORQUE : Nm (kgf·m, lbf·ft)

LF9E026A

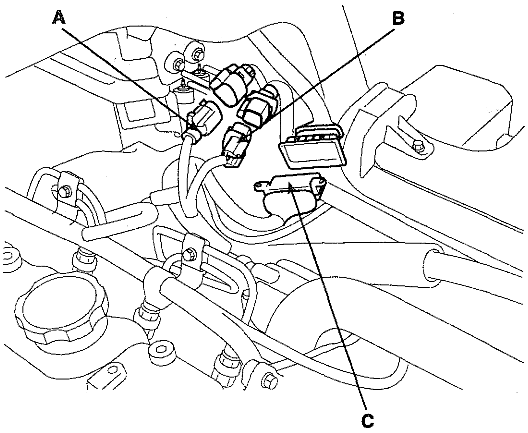
REMOVAL E19CB902

1. The driver's seat should be firstly removed in order to remove the injection pump. The assistant's seat, however, doesn't need to be. It is possible to make progress this step just by pulling back the assistant's seat.
2. Remove the parking brake cover and console assembly (Refer to grounp "BE" in this WORKSHOP MANUAL)
3. Disconnect the (-) terminal from the battery.
4. Remove the fan shield(A) from the radiator assembly.



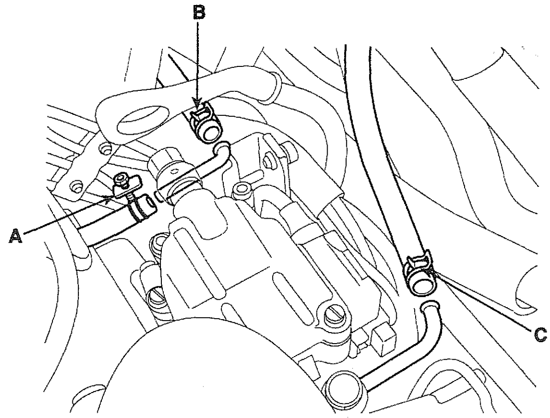
LF9E030A

5. Disconnect the sensor wire connectors (Np sensor connector(A), TPS connector(B) and pump connector(C)).



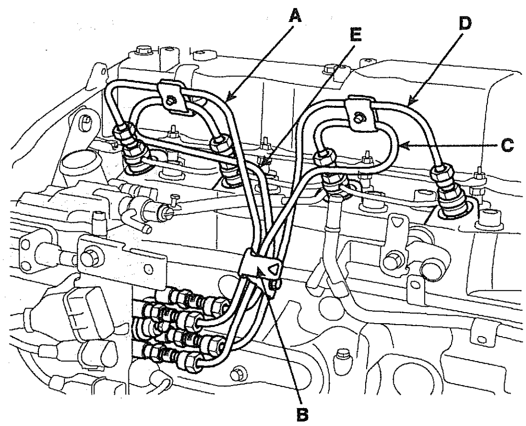
LF9E031A

6. Disconnect the fuel hoses (A, B and C) which are clamped to the injection pump.



LF9E032A

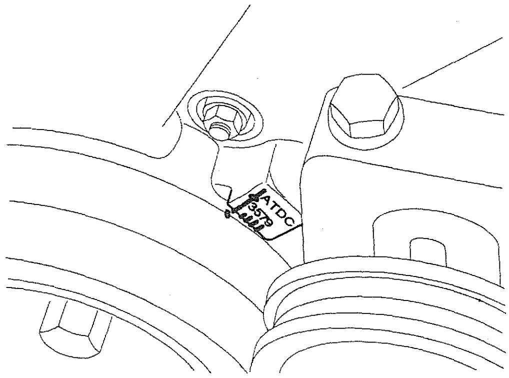
7. Remove the fuel injection pipes
   a. Remove the bracket(B) firstly.
   b. Remove the two upper pipes(A, C) then.
   c. Remove the rest(D, E).



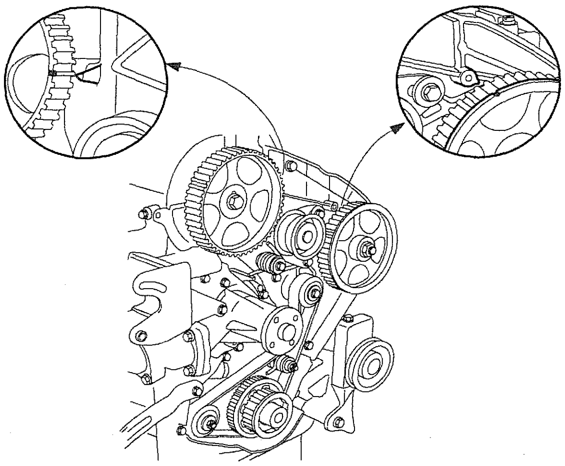
LF9E024A

8. Remove the fan.
9. Remove the timing cover.

10. Align the timing marks using a 19mm spanner.

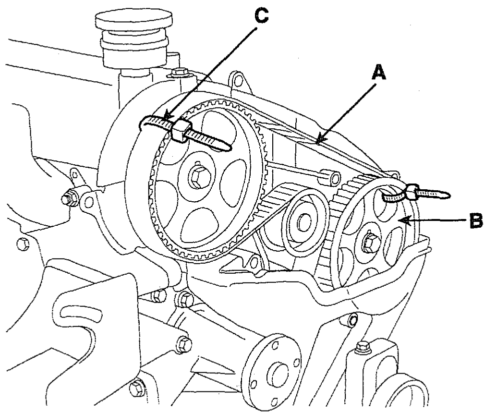


LF9E024C



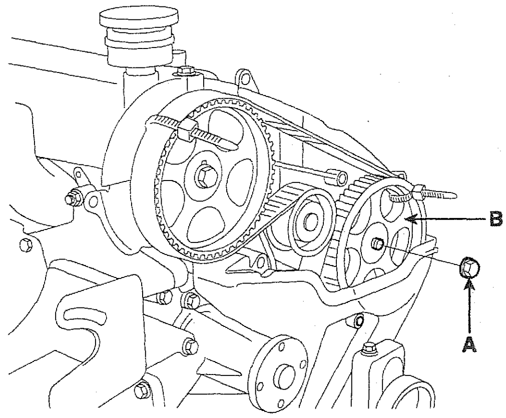
LF9E024D

11. Strap(C) the timing belt(A) and sprocket(B) to hold them tight.



LF9E033A

12. Remove the sprocket(B) mounting nut(A) which is jointed to the injection pump shaft.



LF9E034A

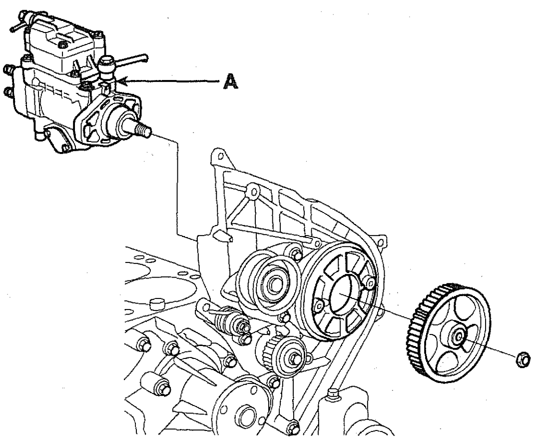
13. Remove the injection pump mounting bolts(2EA) and nuts(2EA). The engine oil gauge tube can be removed in this step.

14. With using the SST (09314-43000), pull back the injection pump shaft from the sprocket.

CAUTION

There is a separative key on the injection pump shaft. Be careful not to loose it in this step.

15. Remove the injection pump assembly(A).



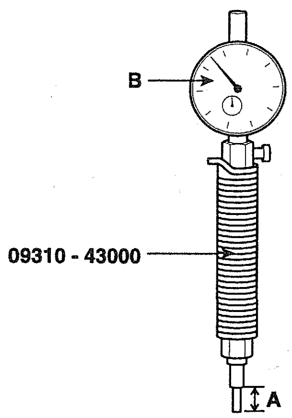
LF9E139A

INSTALLATION EA15B8D6

1. Install the injection pump assembly with the key on the shaft.
2. Tight the sprocket nut temporarily.
3. Tight the injection pump mounting bolts and nuts temporarily.
4. Loosen the straps between the sprocket and the belt.
5. Remove the injection pump timing adjusting bolt (12mm) from the injection pump.
6. Attach the prestroke measuring adapter (09310-43000) and dial indicator(B) to the injection pump.

NOTE

Before installing the adapter(09310-43000), make sure that the push rod projects 10mm. Push rod(A) projection can be adjusted by means of the interior nut.



LF9E052A

a. Set the notch on the crank pulley at approximately 330° ~335° ATDC of the compression stroke of the No.1 cylinder. Turn the crankshaft pulley slightly in both clockwise and counterclockwise directions to make sure that the dial indicator pointer does not move.
   On certain point that the dial indicator does not move, set the dial indicator pointer to zero.
b. Turn the crankshaft clockwise to bring the notch on the pulley to ATDC 9° ± 0.5°, and then make sure that the dial indicator is indicating the standard value (plunger stroke).

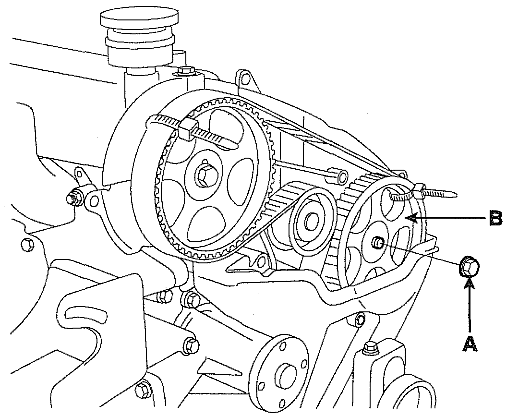
Standard value: 1 ± 0.03mm (0.97~1.03mm)

c. Tilt the injcetion pump body to the right or left until the indicator does indicate the standard value.

NOTE

- *When lower then standard value :*
  Tilt the injection pump body to the engine side until the reading is within the standard value range.
  Check to be sure that the dial indicator reading is within the standard value range.
- *When higher than standard value :*
  Tilt the injection pump body to the opposite of the engine side until the reading is within the standard value range.
  Check to be sure that the dial indicator reading is within the standard value range.

7. Tighten the sprocket(B) mounting nut(A) completely.

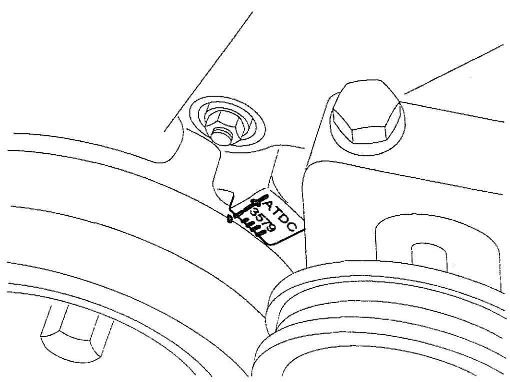


LF9E034A

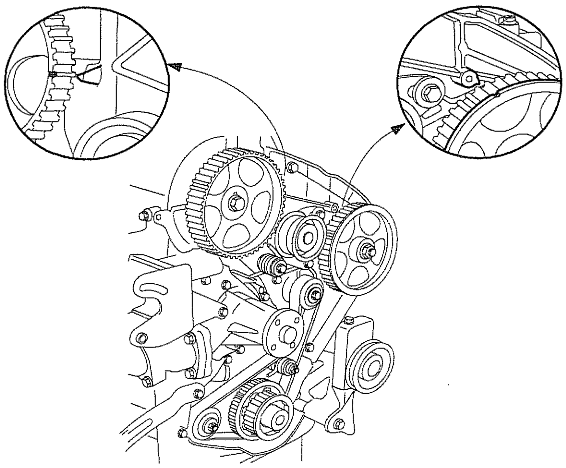
8. Tighten the injection pump mounting bolts and nuts completely. The engine oil gauge tube is fixed in this step.

Tightening torque:
18~25Nm (180~250 kg·cm, 13~18 lb·ft)

9. Repeat steps 6) and 7) to make sure that the adjustment has been correctly performed. Align the timing marks - NO.1 TDC.



LF9E024C



LF9E024D

10. Remove the dial indicator and prestroke measuring adapter from the injection pump.

11. Install the injection pump timing adjusting bolt (12mm) after replacing the copper gasket with a new one. Tighten the timing adjusting bolt to specification.

Tightening torque:
15~20Nm (150~200 kg·cm, 10~14 lb·ft)

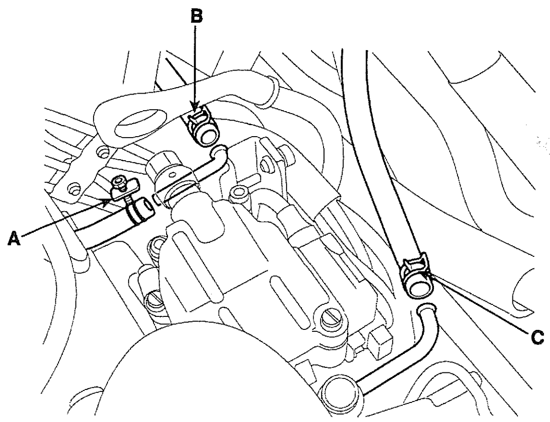
12. Assemble the fan.

13. Fix the timing cover.

14. Install and tighten the No.1/2/3/4 fuel injection pipe to specification.

Tightening torque:
23~27Nm (230~370 kg·cm, 16~27 lb·ft)

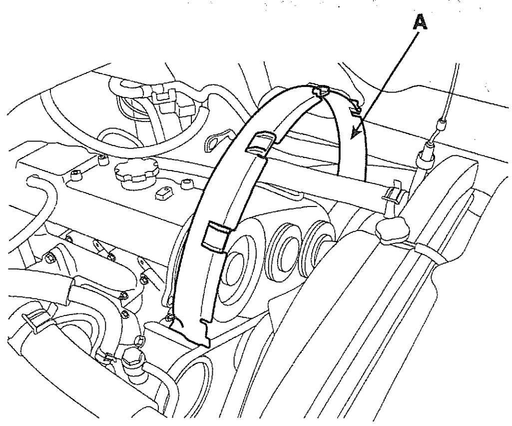
15. Clamp the fuel hoses(A, B and C) to the injection pump.



LF9E032A

16. Connect the sensor wire connectors (Np sensor connector, TPS connector and pump connector).

17. Install the fan shield from the radiator assembly.



LF9E030A

18. Install the parking brake cover and console assembly (Refer to grounp "BD" in this WORKSHOP MANUAL).

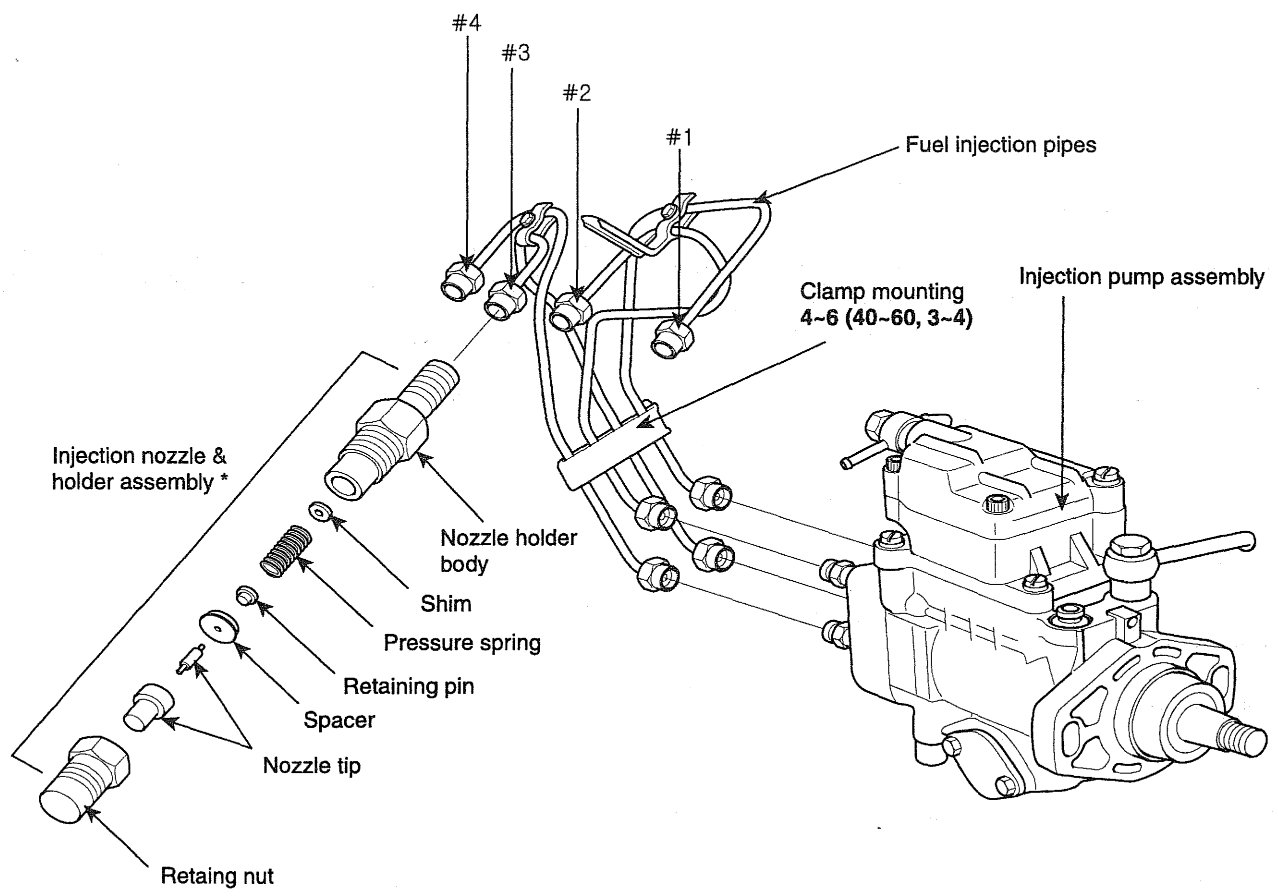
19. Connect the (-) terminal from the battery.

20. Install the seats.

FUEL DELIVERY SYSTEM-DIESEL

FUEL INJECTION NOZZLE

COMPONENTS E9D6A9DC



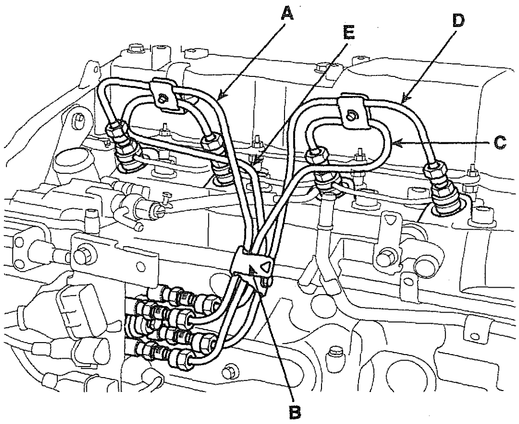
*** This part is supplied as an assembly**

TORQUE : Nm (kgf·cm, lbf·ft)

LF9E051A

REMOVAL EFD62BE7

1. **INJECTION PIPE**
   When loosening the union nuts, hold delivery valve holder on fuel injection pump head or hexagon nut of fuel return pipe with a wrench to prevent it from rotating along with the union nut.

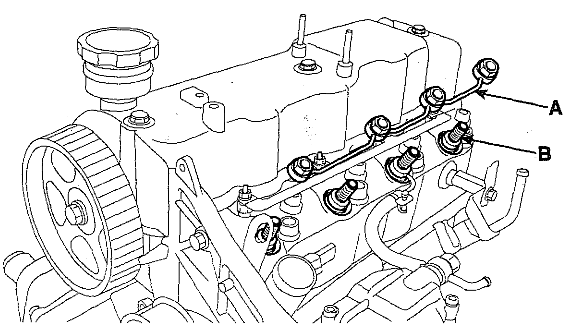


LF9E024A

2. **FUEL RETURN PIPE**
   When removing the fuel return pipe nut(B), hold the fuel return pipe(A) by the hexagon nut with a wrench.

   CAUTION

   If you remove the hexagon nut without holding the fuel return pipe nut, the pipe might be damaged. So you must remove the hexagon nut with holding return pipe.



LF9E027A

3. **INJECTION NOZZLE**
   Using a SST(09314-43100), loosen the injection nozzle and remove.

   CAUTION

   Write the number of the cylinder on the injection nozzle that has been removed.
   Cover the opening with an appropriate cap to prevent entry of dust, water and foreign material into the fuel passage land combustion chamber.

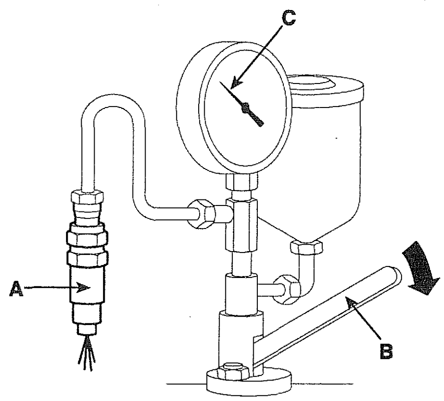
DISASSEMBLY EC6A3AAE

1. **RETAINING NUT**
   a. Lightly clamp the retaining nut with a cushion bracket.
   b. Hold the retaining nut with a box wrench, and loosen the nozzle holder body using a deep socket wrench.

INSPECTION E8EEACF3

1. **INJECTION START PRESSURE**
   a. Set injection nozzle in nozzle(A) tester and check the following.
   b. Move nozzle tester handle(B) at about one stroke per second.
   c. The pressure gauge(C) pointer rises slowly and swings when injection is made. Read the position at which the pointer started to swing. Check the injection start pressure is the standard value.

Standard value
● Opening pressure : 14,710 kPa (150 kgf/cm², 2,132 psi)
● Initial opening pressure : 15,200~16,181 kPa (155 ~ 165 kg/cm², 2,204 ~ 2,346 psi)



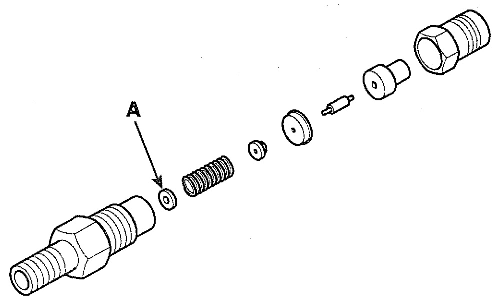
LF9E022A

   d. If the nozzle is faulty, disassemble and adjust injection start pressure to the standard value by changing the shim thickness. Injection pressure increases by approx. 1,000 kPa (10 kg/cm², 142 psi) as shim thickness is increased by 0.1 mm (0.0039 in.).

⚠ ***CAUTION***

When disassembling nozzle holder, be careful not to allow entry of dirt or water.

   e. If the injection start pressure can not be adjusted by changingthe shim thickness, replace nozzle assembly.

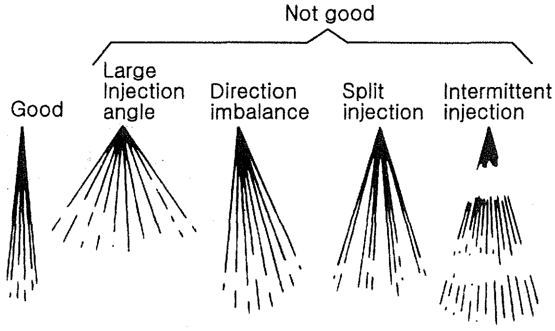


LF9E023A

2. **INJECTION STATUS**
   a. Move nozzle tester handle at about 1 stroke per second.

      [Needle valve vibration]
      Inject on is normal if the characteristic intermittent sound is heard as the handle is operated, and vibration of the needle valve is felt at the handle.

      [Spray]
      Check that the spray is good, as illustrated in the figure, in the test, the spray may be bolt shaped with a course mist and fuel may remain. This is phenomenon common in this type of inspection, and the nozzle function is normal.



LF9E018C

   b. Move nozzle tester handle at 4 to 6 strokes per second.
   c. Confirm the spray is cone shaped with an angle of about 15°. This indicates a good condition.
   d. If the injection is not good, disassemble nozzle and replace nozzle tip or entire assembly.
   e. Confirm fuel does not drip after injection.
   f. If dripping, disassemble injection nozzle and replace nozzle tip or entire assembly.

3. **NOZZLE OIL-SEAL**
   a. Maintain internal nozzle pressure (pressure gauge indication value) with the nozzle tester at 10,000-11,000 kPa (100-110 kg/cm², 1,422-1,565 psi). Check for fuel leaking from nozzle tip in this condition.
   b. If there is leakage, disassemble injection nozzle and replace nozzle tip or entire assembly.

4. **NOZZLE TIP**
   a. Check the nozzle tip for carbon deposits: Scrape off carbon deposits with a piece of wood land clean each part with patrol. After cleaning, keep parts submerged in diesel fuel. Take particular care to protect the nozzle tip needle valve from damage.
   b. While the nozzle tip is submerged in diesel fuel, check that the needle valve slides smoothly. If the needle valve does not slide smoothly, replace the nozzle tip. When replacing the nozzle tip, completely wash off the anticorrosive oil from the new nozzle tip with clean diesel fuel before using it.
   c. Check plunger tip "A" for deformation and breakage. If "A" is damaged or broken replace it.

5. **DISTANCE PIECE**
   Check the surface in contact with the nozzle holder body by using minimum.

6. **RESSURE SPRING**
   Check spring for weakness and breakage.

REASSEMBLY EB4BFF76

1. **RETAINING NUT**
   a. Finger-tighten the nozzle holder body.
   b. Lightly clamp the retaining nut in a vise with cushion plates.
   c. While holding the retaining nut with a box wrench, tighten the nozzle holder body to the specified torque with a deep socket wrench.

Tightening torque : 35~40 Nm (3.5~4.0 kgm)

INSTALLATION EED9C99C

1. **NOZZLE GASKET AND HOLER GASKET**
   a. Clean nozzle holder installation area of the cylinder head.
   b. Fit a new nozzle gasket and holder gasket into the nozzle holder hole in the cylinder head.

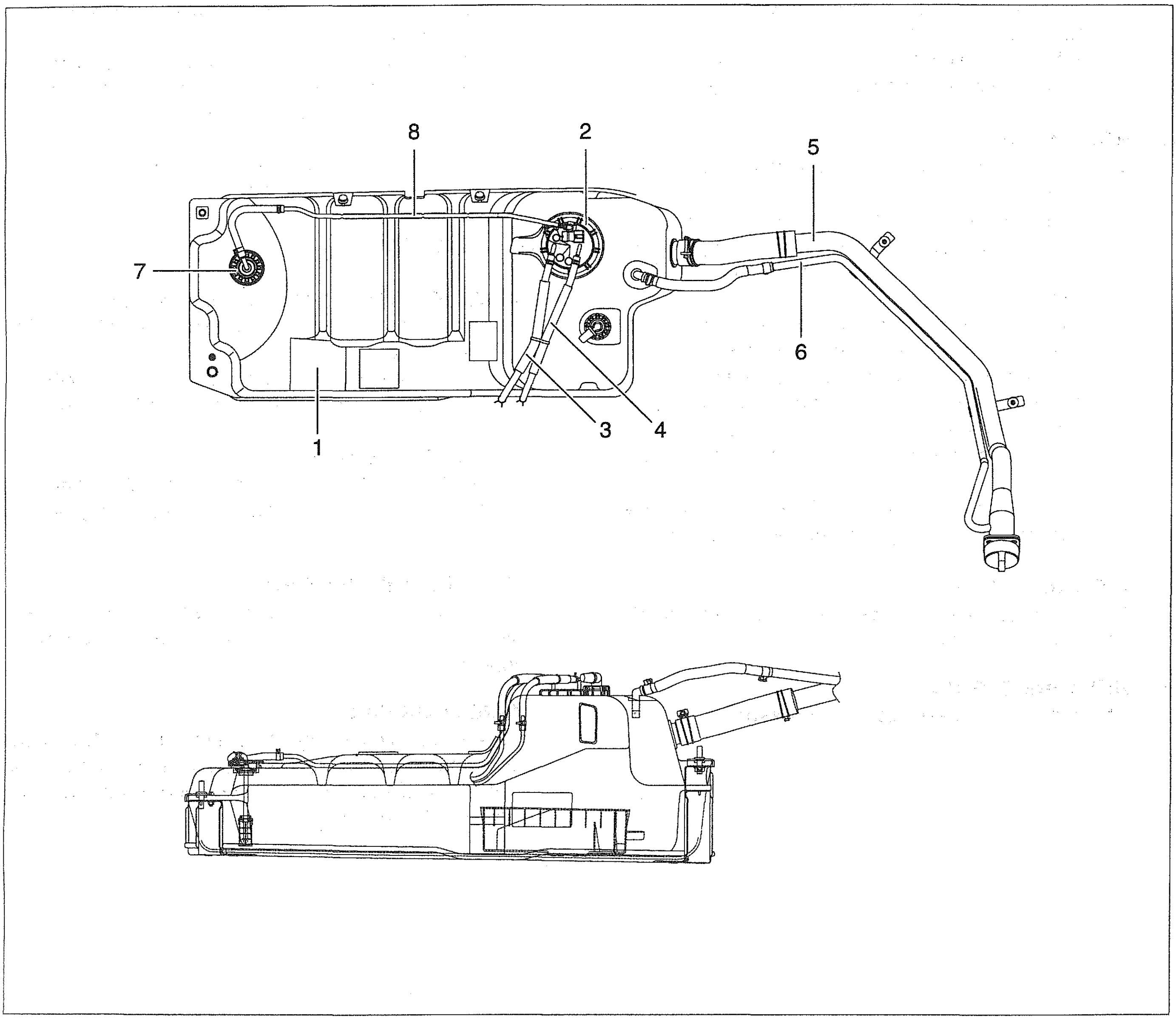
2. **INJECTION NOZZLE**
   Install the injection nozzle in the cylinder head and tighten to the specified torque, using a deep socket wrench.

3. **FUEL RETURN PIPE NUT**
   While holding the fuel return pipe by the hexagon nut with a wrench, tighten the fuel return pipe nut to the specified torque.

4. **INJECTION PIPE**
   When tightening the injection pipe nuts, hold the delivery valve holder or the fuel return pipe by the hexagon nut with a wrench in order to prevent it from rotating along with the nut.

FUEL TANK

COMPONENTS ECCE994A



1. Fuel Tank
2. Fuel Sender
3. Pipe - Return
4. Pipe - Feed
5. Fuel Filler Hose
6. Breather Hose
7. Fuel Sender (Sub)
8. Fuel Suction Hose

EGMF100R

FUEL FILTER

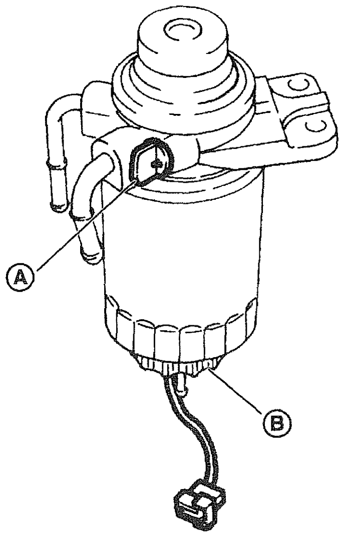
INSPECTION EF99FC0D

AIR BLEEDING

⚠ *CAUTION*

In case that air is present in the injection system because of lack of fuel during engine operation, or the injection pump is replaced, air bleeding should be performed according to the following procedures, and then start engine and verify if fuel is not leaked.

1. Remove the fuel filter air bleeding plug (A).



LG9E001D

2. Depress and release repeatedly the head of fuel filter until only fuel flows out.
3. Install the air bleeding plug while depressing the head of fuel filter.

DRAINING WATER

NOTE

If the sedimentor warning light is lit, drain the water in the steps as shown below.

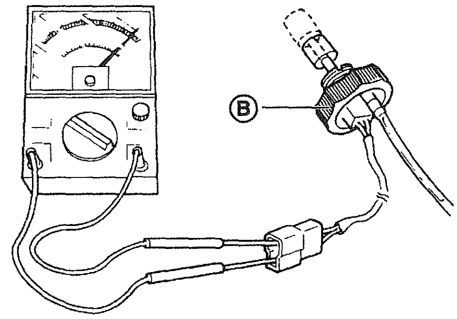
1. Remove the drain plug, and then drain the water while depressing and releasing repeatedly the head of fuel filter.
2. After draining the water, do air bleeding for the fuel filter.

DETECTOR

1. Remove the detector (B) from the sedimentor.
2. Do the continuity test and verify that it is closed if the detector is moved upward and opened if downward.

⚠ *CAUTION*

After installing the detector, air bleeding should be done.



LG9E001E

Fuel System
(J3 TCI - DSL2.9)

FL

GENERAL

SPECIFICATION EB2FEC9C

Items		Specification		
Fuel Tank		Capacity	75ℓ	
Fuel Pump		Type	High pressure pump (Gear driven type)	
Fuel Filter		Type	High pressure type	
Fuel Pressure (at common rail)		Pressure	1,600 bar (1,631.5kgf/cm²)	
SEN-SORS	Mass Air Flow Sensor (MAFS)	Type	HOT FILM type	
	Intake Air Temperature Sensor (IATS)	Type	Thermister type	
		Specification	-40°C (-40°F)	39.3kΩ
			-20°C(-4°F)	13.9kΩ
			0°C(32°F)	5.5kΩ
			20°C(68°F)	2.4kΩ
			40°C(104°F)	1.2kΩ
			60°C(140°F)	0.6kΩ
			80°C(176°F)	0.3kΩ
	Accelerator Position Sensor (APS)	Type	Thermister type	
	Camshaft Position Sensor (CMPS)	Type	Hall sensor type	
	Crankshaft Position Sensor (CKPS)	Type	Magnetic type	
	Rail Pressure Sensor (RPS)	Type	Piezo electricity type	
	Fuel Temperature Sensor (FTS)	Type	Thermister type	
		Specification	-30°C(-22°F)	22.2 ~ 31.8kΩ
			-20°C(-4°F)	13.2 ~ 18.1kΩ
			0°C(32°F)	5.2 ~ 6.6kΩ
			20°C(68°F)	2.3 ~ 2.7kΩ
			40°C(104°F)	1.1 ~ 1.3kΩ
			60°C(140°F)	0.54 ~ 0.65kΩ
			80°C(176°F)	0.30 ~ 0.32kΩ
	Engine Coolant Temperature Sensor (ECTS)	Type	Thermister type	
		Specification	-40°C (-40°F)	44.4kΩ
			-20°C(-4°F)	13.4 ~ 16.8kΩ
			0°C(32°F)	5.74kΩ
			20°C(68°F)	2.3 ~ 2.6kΩ
			40°C(104°F)	1.15kΩ
			60°C(140°F)	0.58kΩ
			80°C(176°F)	0.32kΩ

Items		Specification	
ACTUA-TORS	Injector	Type	Solenoid type
		Number	4
	Inlet Metering Valve (IMV)	Resistance	5.5Ω at 20°C(68°F)
	EGR Solenoid Valve	Resistance	15.0 ~ 16.0Ω at 20°C(68°F)

SEALANT EE554B8A

Engine Coolant Temperature Sensor (ECTS)	LOCTITE 962T

SERVICE STANDARD

Idle Speed	800±100 rpm

TIGHTENING TORQUES

Items		Kgf·m	N·m	lbf·ft
ENGINE CONTROL SYSTEM	Engine Coolant Temperature Sensor (ECTS)	2.00	19.61	14.47
	Knock Sensor (KS)	1.50 ~ 2.50	14.71 ~ 24.52	10.85 ~ 18.08
	Crankshaft Position Sensor (CKPS)	0.90 ~ 1.00	8.83 ~ 9.81	6.51 ~ 7.23
	EGR Solenoid Valve	0.80 ~ 1.10	7.85 ~ 10.79	5.79 ~ 7.96
FUEL DELIVERY SYSTEM	High pressure pump mounting bolts (on timing case)	2.20 ~ 2.60	21.57 ~ 25.50	15.91 ~ 18.81
	High pressure pump mounting bolts (on bracket)	2.20 ~ 2.60	21.57 ~ 25.50	15.91 ~ 18.81
	High Pressure Pipe connecting between high pressure pump and common rail	3.65 ~ 4.35	35.79 ~ 42.66	26.40 ~ 31.46
	High Pressure Pipe connecting between common rail and injectors	3.65 ~ 4.35	35.79 ~ 42.66	26.40 ~ 31.46
	Common rail mounting bolts	1.90 ~ 2.30	18.63 ~ 22.56	13.74 ~ 16.64
	Injector clamp bolt	2.00 ~ 2.20	19.61 ~ 21.57	14.47 ~ 15.91

BASIC TROUBLESHOOTING E40A46A4

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 BASIC INSPECTION in INTERMITTENT PROBLEM 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

CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLE INFORMATION

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

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 ☐ 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.

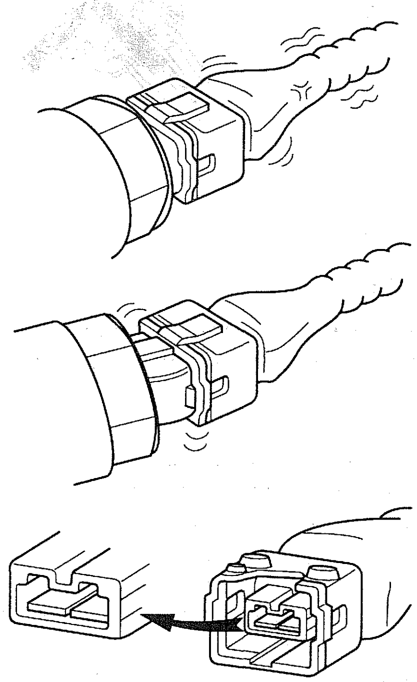
NOTE

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

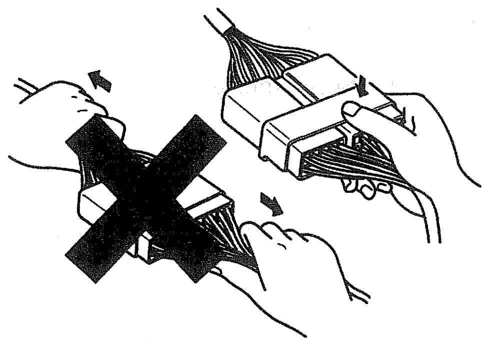
DO NOT sprinkle water directly into the engine compartment or electronic components.

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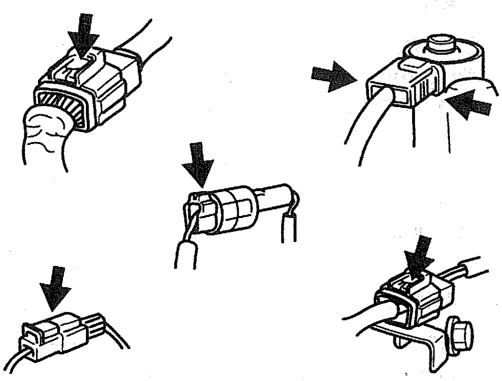
   b. When removing the connector with a lock, press or pull locking lever.



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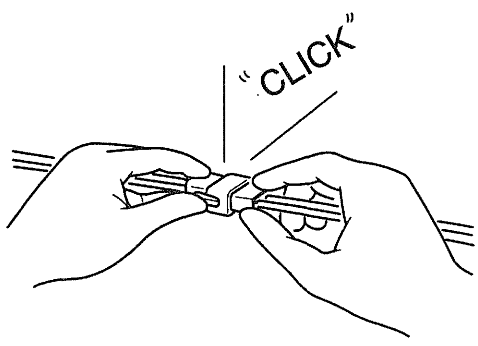
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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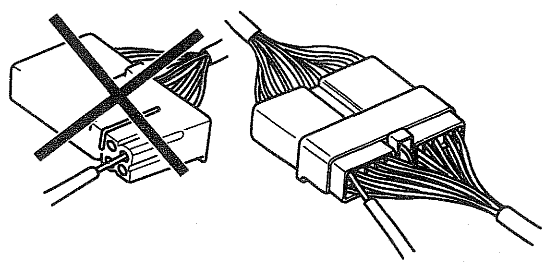
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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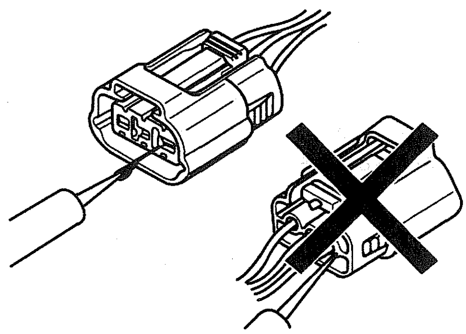
   e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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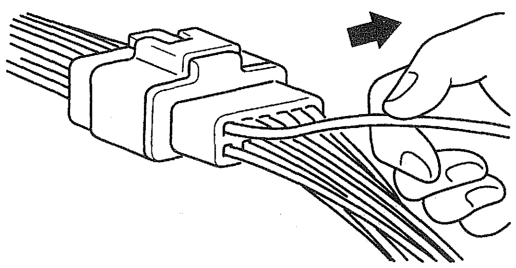
NOTE

- *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.

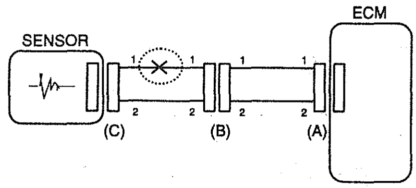
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

● 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

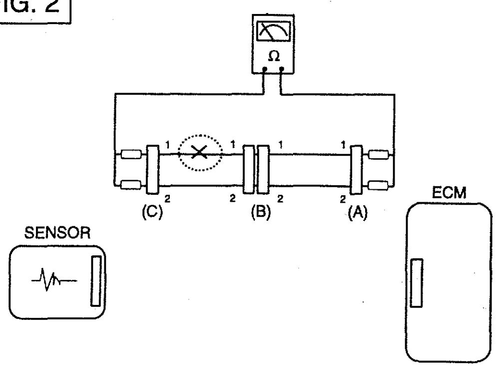
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

Specification (Resistance)
1Ω or less → Normal Circuit
1MΩ 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 1MΩ 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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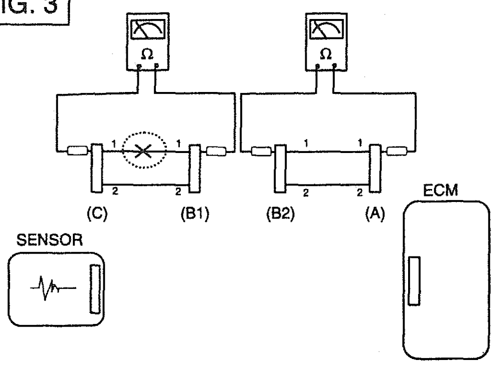
b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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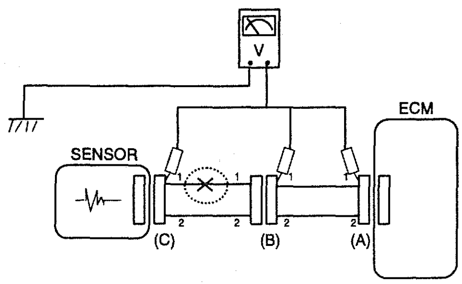
3. Voltage Check Method
   a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

   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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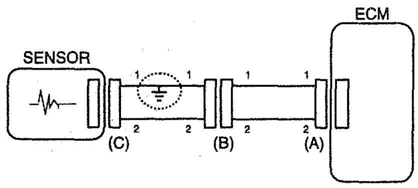
● CHECK SHORT CIRCUIT

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

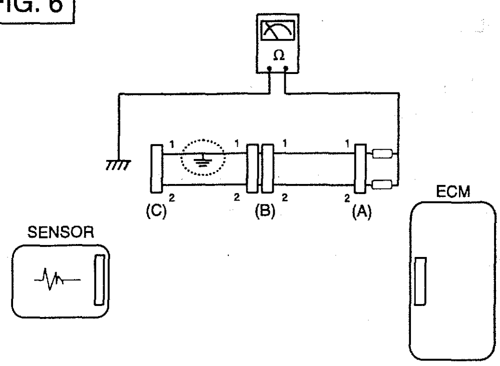
Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

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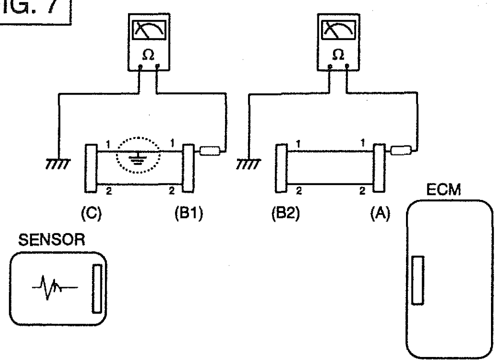
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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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ECM PROBLEM INSPECTION PROCEDURE

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): 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).

SYMPTOM TROUBLESHOOTING GUIDE CHART

Problem	Possible cause
Engine does not start	Run out of petrol
	Starter out of order
	Pump hose supply cut
	High pressure leakage
	Fuse out of order
	The compensation of individual injector not adapted
	Drift of the engine coolant temperature sensor not detected
	Drift of the rail pressure sensor not detected
	Cam and Crank signals missing simultaneously
	Battery voltage too low
	Faulty antitheft
	EGR valve blocked open (engine doesn't start)
	IMV 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
	Air heaters out of order
	Engine compression too low
	Leakage at the injector valve
	Transfer pump out of order
	High pressure pump out of order
	Injector jammed open
	Bug soft or hardware fault not detected

Problem	Possible cause
Engine starts with difficulty or starts and stalls	Run out of petrol
	Fuel return hose of nozzle holder cut
	High pressure leakage
	Fuse out of order
	Air filter sealed
	Alternator or voltage regulator out of order
	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 (engine doesn't start)
	IMV 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
	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
	Air heaters out of order
	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 soft 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
	Drift of the engine coolant temperature sensor not detected
	EGR valve blocked open (engine doesn't start)
	IMV contaminated, stuck, jammed
	Air filter sealed
	Fuel filter not adapted
	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 soft 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
	Drift of the sensors used to evaluate the air flow not detected
	Harness resistance increased
	Fuel filter not adapted
	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
	Air heaters out of order
	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

Problem	Possible cause
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 out of order
	Clutch not well set
	Bug soft or hardware fault not detected
Blue, white, black smokes	The compensation of individual injector not adapted
	Drift of the sensors used to evaluate the air flow not detected
	Drift of the engine coolant temperature sensor not detected
	Drift of the rail pressure sensor not detected
	EGR valve blocked open (engine doesn't start)
	IMV 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)
	Air heaters out of order
	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 (engine doesn't start)
	Drift of the engine coolant temperature sensor not detected
	Drift of the sensors used to evaluate the air flow not detected
	Air heaters out of order
	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

Problem	Possible cause
Burst noise	The compensation of individual injector not adapted
	Intermittent fault connection
	Drift of the rail pressure sensor not detected
	IMV contaminated, stuck, jammed
	Bug soft or hardware fault not detected
Untimely acceleration/deceleration and engine racing	Pedal sensor blocked (cable jammed)
	EGR valve blocked open (engine doesn't start)
	Intermittent fault connection
	Oil suction (engine racing)
	Drift of the rail pressure sensor not detected
	Bug soft 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
	Pedal sensor blocked (cable jammed)
	EGR valve blocked open (engine doesn't start)
	Turbo charger damaged
	Fuel filter not adapted
	Sealed fuel filter
	Engine compression too low
	High pressure leakage
	IMV contaminated, stuck, jammed
	Needle stuck (injection possible over a certain pressure)
	Bug soft or hardware fault not detected

Problem	Possible cause
Engine stop/ stalling	Run out of petrol
	Pump hose supply cut
	High pressure leakage
	Fuse out of order
	Fuel quality / presence of water
	Low pressure fuel circuit sealed
	Sealed fuel filter
	Cam and Crank signals missing simultaneously
	EGR valve blocked open (engine doesn't start)
	IMV contaminated, stuck, jammed
	Alternator or voltage regulator out of order
	Intermittent fault connection
	Catalytic converter sealed or damaged
	Oil suction (engine racing)
	Transfer pump out of order
	High pressure pump out of order
	Faulty ignition key
	Petrol in fuel
	Bug soft or hardware fault not detected

Problem	Possible cause
Engine judder	Run out of petrol
	Fuel return hose of nozzle holder cut
	Incorrect state of the electrical pack devices
	The compensation of individual injector not adapted
	Drift of the sensors used to evaluate the air flow not detected
	EGR valve blocked open (engine doesn't start)
	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
	Air heaters out of order
	Engine compression too low
	Fuel return hose of nozzle holder sealed
	Valve clearance
	Transfer pump out of order
	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 soft or hardware fault not detected

Problem	Possible cause
Lack of power	The compensation of individual injector not adapted
	Pedal sensor blocked (cable jammed)
	Incorrect state of the electrical pack devices
	Drift of the sensors used to evaluate the air flow not detected
	EGR valve blocked open (engine doesn't start)
	Air inlet circuit open
	Air filter sealed
	Oil level too high/too low
	Catalytic converter sealed or damaged
	Turbo charger damaged
	Fuel filter not adapted
	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
Too much power	EGR valve blocked closed (noisy engine)
	The compensation of individual injector not adapted
	Oil suction (engine racing)
	Injector not adapted
	Bug soft or hardware fault not detected

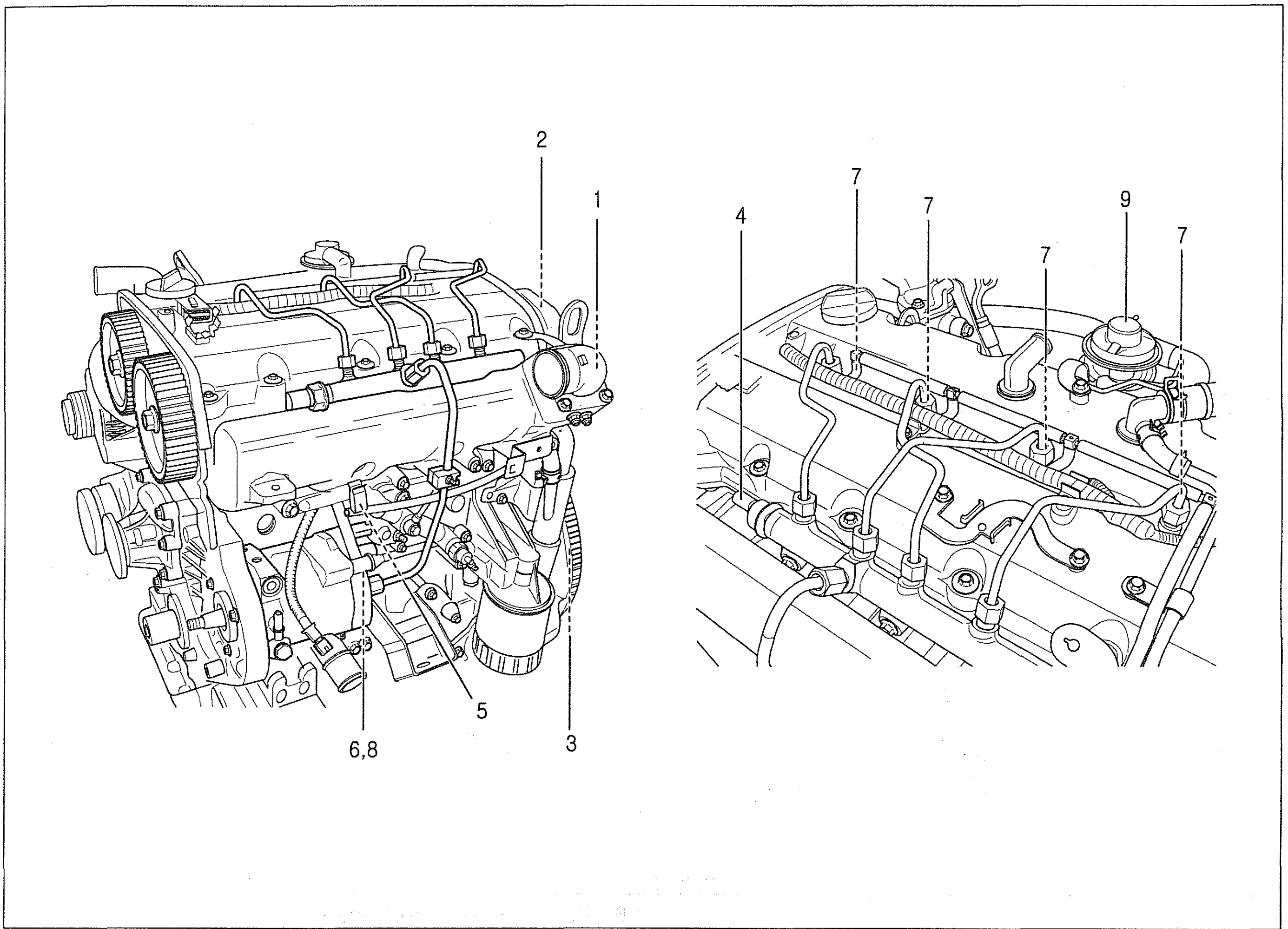
Problem	Possible cause
Excessive fuel consumption	Fuel return hose of nozzle holder cut
	Leakage at the IMV
	Leakage at fuel temperature sensor
	Leakage at the spacers
	High pressure leakage
	Air inlet circuit open
	Air filter sealed
	The compensation of individual injector not adapted
	EGR valve blocked open (engine doesn't start)
	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 soft or hardware fault not detected
Over speed engine when changing the gear box ratio	Pedal sensor blocked (cable jammed)
	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 soft or hardware fault not detected
Exhaust smells	EGR valve blocked open (engine doesn't start)
	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 soft or hardware fault not detected

Problem	Possible cause
Smokes (black, white, blue) when accelerating	The compensation of individual injector not adapted
	EGR valve blocked open (engine doesn't start)
	Drift of the sensors used to evaluate the air flow not detected
	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 soft or hardware fault not detected
Fuel smells	Pump hose supply cut
	Fuel return hose of nozzle holder cut
	Leakage at the IMV
	Leakage at fuel temperature sensor
	Leakage at the spacers
	High pressure leakage

Problem	Possible cause
The engine collapses at take off	Pedal sensor blocked (cable jammed)
	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
	IMV contaminated, stuck, jammed
	Petrol in fuel
	Bug soft or hardware fault not detected
The engine does not stop	Faulty ignition key
	Oil suction (engine racing)
	Bug soft 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

DIESEL CONTROL SYSTEM

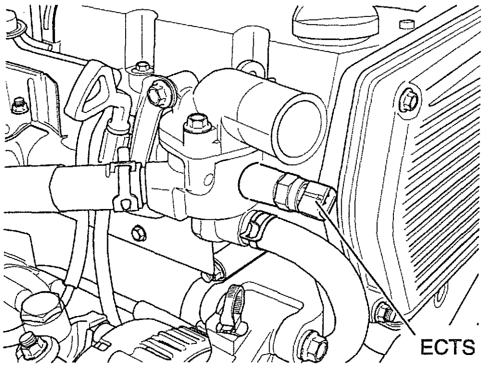
COMPONENTS EE257321



1. Engine Coolant Temperature Sensor (ECTS)
2. Camshaft Position Sensor (CMPS)
3. Crankshaft Position Sensor (CKPS)
4. Rail Pressure Sensor (RPS)
5. Knock Sensor (KS)
6. Fuel Temperature Sensor (FTS)
7. Injector
8. Inlet Metering Valve (IMV)
9. EGR Valve
10. EGR Solenoid Valve
11. Accelerator Position Sensor (APS)
12. Mass Air Flow Sensor (MAFS)
13. Intake Air Temperature Sensor (IATS)

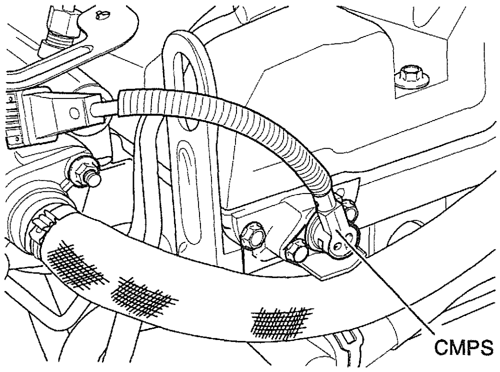
EWMF100F

1. Engine Coolant Temperature Sensor (ECTS)



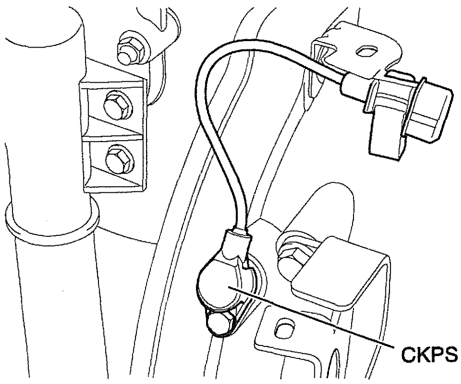
AFBE100G

2. Camshaft Position Sensor (CMPS)



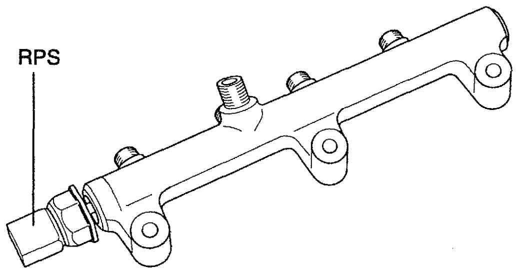
AFBE100H

3. Crankshaft Position Sensor (CKPS)



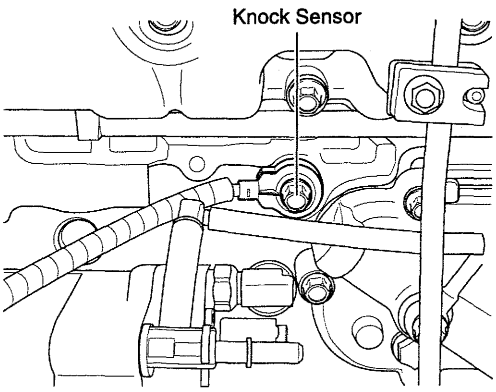
AFBE100I

4. Rail Pressure Sensor (RPS)



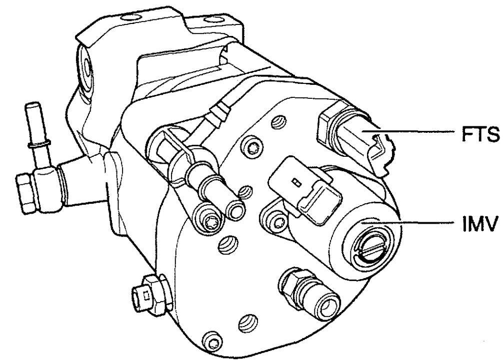
AFBE100J

5. Knock Sensor (KS)

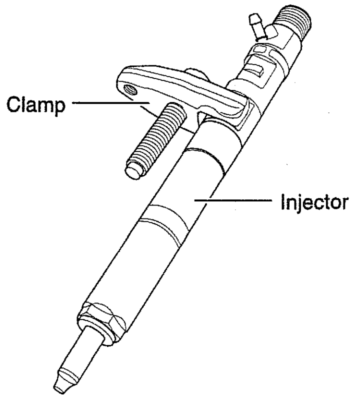
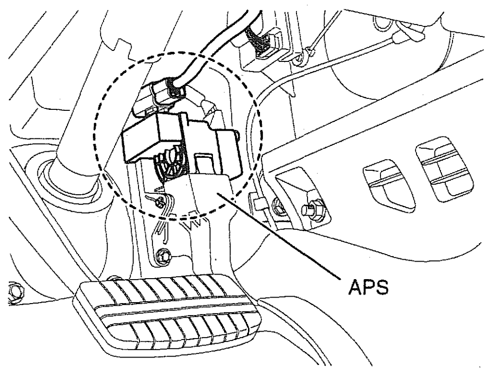
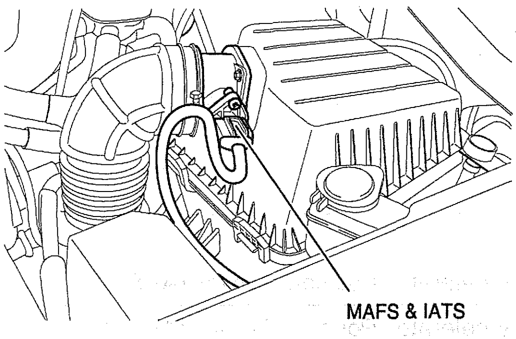


EWMF100K

6. Fuel Temperature Sensor (FTS)
8. Inlet Metering Valve (IMV)

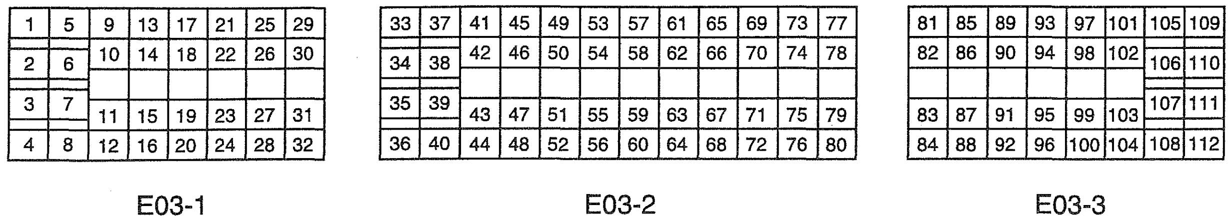


AFBE100L

7. Injector	9. Accelerator Position Sensor (APS)
 EWMF100M	 KFME100P
10. Mass Air Flow Sensor (MAFS) 11. Intake Air Temperature Sensor (IATS)	
 KFME100Q	

ECM CONNECTOR E0AE603B

ECM Harness Connector



EWMF100A

CONNECTOR [E03-1]

Pin	Function	Connected to
1	-	
2	Accelerator position sensor signal input 1	Accelerator Position Sensor (APS) 1
3	Sensor ground	Accelerator Position Sensor (APS) 1
4	Power ground	Chassis Ground
5	Power supply (Battery voltage)	Main Relay
6	Sensor power supply	Accelerator Position Sensor (APS) 1
7	-	
8	Power ground	Chassis Ground
9	Malfunction indicator lamp control output	Cluster
10	Sensor power supply	Accelerator Position Sensor (APS) 2
11	Accelerator position sensor signal input 2	Accelerator Position Sensor (APS) 2
12	Sensor ground	Accelerator Position Sensor (APS) 2
13	-	
14	Immobilizer lamp control output	Cluster
15		
16	Brake switch 1 signal input	Brake Switch
17	Ignition switch sense	Ignition Switch
18	-	
19	-	
20	-	
21	Auto cruise indicator lamp control output	Auto Cruise Indicator Lamp
22	-	
23	-	
24	Clutch switch (M/T only)	Clutch Switch
25	-	
26	Engine speed signal output	Cluster
27	Immobilizer diagnosis line	Immobilizer

Pin	Function	Connected to
28	Diagnosis line (K-LINE)	Data Link Connector (DLC)
29	Glow indicator lamp control output	Cluster
30	A/T: P/N switch signal input	Inhibitor switch
	M/T: 1st gear switch signal input	1st Gear Switch
31	CAN - LOW	TCM
32	CAN - HIGH	TCM

CONNECTOR [E03-2]

Pin	Function	Connected to
33	Sensor shield	Knock Sensor (KS)
34	-	
35	Intake throttle solenoid valve control output	Intake Throttle Solenoid Valve
36	Inlet metering valve control output	Inlet Metering Valve (IMV)
37	Sensor shield	Crankshaft Position Sensor (CKPS)
38	Water indicator lamp control output	Cluster
39	EGR solenoid valve control output	EGR Solenoid Valve
40	-	
41	-	
42	Intake air temperature sensor signal input	Intake Air Temperature Sensor (IATS)
43	-	
44	-	
45	-	
46	Glow relay 2 diagnosis line	Glow Relay 2
47	-	
48	-	
49	-	
50	Engine coolant temperature sensor signal input	Engine Coolant Temperature Sensor (ECTS)
51	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
52	Injector (Cylinder #4) Low	Injector (Cylinder #4)
53	Knock sensor signal input	Knock Sensor (KS)
54	Fuel temperature sensor signal input	Fuel Temperature Sensor (FTS)
55	Sensor ground	Fuel Temperature Sensor (FTS)
56	Injector (Cylinder #4) High	Injector (Cylinder #4)
57	Sensor ground	Knock Sensor (KS)
58	Crankshaft position sensor [+] signal input	Crankshaft Position Sensor (CKPS)
59	Crankshaft position sensor [-] signal input	Crankshaft Position Sensor (CKPS)
60	Injector (Cylinder #3) Low	Injector (Cylinder #3)
61	Sensor power supply	Camshaft Position Sensor (CMPS)
62	Camshaft position sensor signal input	Camshaft Position Sensor (CMPS)

Pin	Function	Connected to
63	Sensor ground	Camshaft Position Sensor (CMPS)
64	Injector (Cylinder #3) High	Injector (Cylinder #3)
65	Sensor power supply	Rail Pressure Sensor (RPS)
66	Rail pressure sensor signal input	Rail Pressure Sensor (RPS)
67	Sensor ground	Rail Pressure Sensor (RPS)
68	Injector (Cylinder #2) Low	Injector (Cylinder #2)
69	-	
70	-	
71	-	
72	Injector (Cylinder #2) High	Injector (Cylinder #2)
73	-	
74	-	
75	-	
76	Injector (Cylinder #1) Low	Injector (Cylinder #1)
77	Sensor power supply	Mass Air Flow Sensor (MAFS)
78	Mass air flow sensor signal input	Mass Air Flow Sensor (MAFS)
79	Sensor ground	Mass Air Flow Sensor (MAFS)
		Intake Air Temperature Sensor (IATS)
80	Injector (Cylinder #1) High	Injector (Cylinder #1)

CONNECTOR [E03-3]

Pin	Function	Connected to
81	-	
82	-	
83	-	
84	Compressor fan relay control output	Compressor Fan Relay
85	-	
86	Brake switch 2 signal input	Brake Switch
87	-	
88	-	
89	Auto cruise switch signal input	Auto Cruise Switch
90	-	
91	Glow relay 1 control output	Glow Relay 1
92	-	
93	Blower switch signal input	Blower switch
94	Glow relay 1 diagnosis line	Glow Relay 1
95	Glow relay 2 control output	Glow Relay 2
96	-	
97	MT/AT switch signal input	A/T: Chassis Ground, M/T: not used
98	Torque reduction signal input	TCM
99	A/C switch signal input	A/C Switch
100	Vehicle speed sensor signal input	Vehicle Speed Sensor (VSS)
101	-	
102	Water sensor signal input	Water Sensor in Fuel Filter
103	Accelerator position signal input (4WD only)	4WD: TOD (Torque On Demand), A/T: TCM
104	Main relay control output	Main Relay
105	A/C relay control output	A/C Relay
106	-	
107	Power supply (Battery voltage)	Main Relay
108	Power ground	Chassis Ground
109	-	
110	-	
111	Power supply (Battery voltage)	Main Relay
112	Power ground	Chassis Ground

DTC TROUBLESHOOTING PROCEDURES

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC) E6EB026F

DTC	CC - CODE	Description	MIL
P0100		**EGR Control Malfunction**	△
	04	Parameter at minimum limit	
	05	Parameter at maximum limit	
P0101		**Mass Air Flow Sensor (MAFS) Circuit Malfunction**	△
	0a	Signal low (Open circuit or short circuit to ground)	
	0b	Signal high (Short circuit to battery line)	
P0102		**Mass Air Flow Sensor (MAFS) Range/Performance Problem**	△
	04	Signal lower than lower limit	
	05	Signal higher than upper limit	
P0115		**Engine Coolant Temperature Sensor (ECTS) Circuit Malfunction**	△
	0b	Signal low (Open circuit or short circuit to battery line)	
	02	Signal high (Short circuit to ground)	
P0120		**Accelerator Position Sensor (APS) 1 Circuit Malfunction**	△
	0a	Signal low (Open circuit or short circuit to ground)	
	0b	Signal high (Short circuit to battery line)	
	06	Value incoherent	
P0180		**Fuel Temperature Sensor (FTS) Circuit Malfunction**	△
	0b	Signal low (Open circuit or short circuit to battery line)	
	02	Signal high (Short circuit to ground)	
P0190		**Rail Pressure Sensor (RPS) Range/Performance Problem**	△
	0a	Signal low (Short ciruict to ground)	
	0b	Signal high (Open circuit or short circuit to battery line)	
	06	Rail pressure incoherent	
	08	Signal low	
	09	Signal high	
	05	Parameter at maximum limit	
	8d	Above the average threshold	

DTC	CC - CODE	Description	MIL
P0201		**Inector #1 (Cylinder #1) Circuit Malfunction**	△
	04	Signal low	
	91	Injector stuck (Open)	
	86	Injector stuck (Close)	
	01	Open Circuit	
	0c	Short Circuit	
P0202		**Inector #2 (Cylinder #3) Circuit Malfunction**	△
	04	Signal low	
	91	Injector stuck (Open)	
	86	Injector stuck (Close)	
	01	Open Circuit	
	0c	Short Circuit	
P0203		**Inector #3 (Cylinder #4) Circuit Malfunction**	△
	04	Signal low	
	91	Injector stuck (Open)	
	86	Injector stuck (Close)	
	01	Open Circuit	
	0c	Short Circuit	
P0204		**Inector #4 (Cylinder #2) Circuit Malfunction**	△
	04	Signal low	
	91	Injector stuck (Open)	
	86	Injector stuck (Close)	
	01	Open Circuit	
	0c	Short Circuit	
P0220		**Accelerator Position Sensor (APS) 2 Circuit Malfunction**	△
	0a	Signal low (Open circuit or short circuit to ground)	
	0b	Signal high (Short circuit to battery line)	
	02	Signal low	
	03	Signal high	
P0226		**Accelerator Position Sensor (APS) 2 Range/Performance Problem**	△
	06	APS 1/2 signal incoherent	
	0b	Abnormal signal	
P0325		**Knock Sensor Circuit Malfunction**	△
	09	Signal high	
	07	No signal	

DTC	CC - CODE	Description	MIL
P0335		**Crankshaft Position Sensor (CKPS) Circuit Malfunction**	△
	93	Too many extra teeth detected	
	95	Extra teeth detected	
	07	No signal	
	94	Missing teeth detected	
	06	Abnormal airgap	
	92	Too many missing teeth detected	
P0340		**Camshaft Position Sensor (CMPS) Circuit Malfunction**	△
	07	No signal	
	06	CMPS/CKPS signal incoherent	
P0380		**Glow Relay 1 Circuit Malfunction**	△
	0a	Signal low (Open circuit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P0381		**Glow Indicator Lamp Circuit Malfunction**	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P0382		**Glow Relay 2 Circuit Malfunction**	△
	0a	Signal low (Open circuit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P0400		**EGR Solenoid Valve Circuit Malfucntion**	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P0560		**Battery Voltage Malfunction**	△
	08	Battery voltage too low	
	09	Battery voltage too high	
P0600		**CAN Communication Error**	△
	07	No signal	
	06	No signal or TCM error	
	0a	No signal or TCS(or ESP) error	
P0650		**Malfunction Indicator Lamp Circuit Malfunction**	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	

DTC	CC - CODE	Description	MIL
P1119		**Inlet Metering Valve (IMV) Control Malfunction**	△
	96	Fuel leakage	
	97	Fuel leakage	
	98	Fuel leakage	
	99	Fuel leakage	
P1120		**Inlet Metering Valve (IMV) Circuit Malfunction**	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
	05	Fuel leakage	
	04	Fuel leakage	
	08	Fuel leakage	
P1140		**Intake Air Temperature Sensor (IATS) Circuit Malfunction**	△
	0b	Signal low (Open circuit or short circuit to battery line)	
	02	Signal high (Short circuit to ground)	
P1150		**Atmospheric Pressure Sensor Fault**	△
	0a	Signal low (Open circuit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	
P1190		**Throttle Drive Fault**	△
	0a	Signal low (Open circuit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	
P1300		**Injector Specific Data Fault**	△
	04	Injector parameters incorrect	
P1310		**Injector Control Circuit Fault**	△
	03	Short circuit to battery line	
	02	Short circuit to ground	
P1458		**A/C Switch Fault**	△
	06	Value incoherent	
P1500		**Vehicle Speed Sensor (VSS) Circuit Malfunction**	△
	06	Abnormal signal after running	
	06	Abnormal signal after running	
	06	Abnormal signal after running	
	07	No signal before running	
P1543		**Brake Switch Signal Fault**	△
	03	Short to battery line in brake switch 1 circuit	
	02	Short to gound in brake switch 1 circuit	
	0b	Short to battery line in brake switch 2 circuit	
	0a	Short to gound in brake switch 2 circuit	
	0c	Barke 1/2 signal incoherent	

DTC	CC - CODE	Description	MIL
P1603		**CAN BUS OFF**	△
	07	CAN BUS OFF Fault	
P1608		**ECM Fault**	△
	81	ECM internal fault	
	82	ECM internal fault	
	82	ECM internal fault	
	82	ECM internal fault	
P1610		**Sensor External Voltage Fault**	△
	08	Sensor supply voltage too low	
	09	Sensor supply voltage too high	
P1614		**ECM Programming Error**	△
	85	ECM internal fault	
	83	ECM internal fault	
	8b	ECM internal fault	
	88	ECM internal fault	
	87	ECM internal fault	
	8a	ECM internal fault	
	8c	ECM internal fault	
	8a	ECM internal fault	
P1620		**A/C Relay Circuit Malfunction**	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P1640		**Main Relay Circuit Malfunction**	●
	0a	Open circuit or short circuit to ground	
	0b	Short circuit to battery line	
P1674		**A/C Fan Relay Circuit Malfunction**	●
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P1780		**Torque Reduction Signal Fault**	△
	06	Abnormal signal	
	09	Abnormal signal	
	0a	Signal low (Open circuit or short circuit to ground)	
	0b	Signal high (Short circuit to battery line)	
P1786		**Tachometer Output Fault**	△
	0a	Signal low (Short circuit to ground)	
	03	Signal high (Short ciruict to battery line)	
P2264		**Water Sensor Circuit Malfunction**	△
	0b	Permanent low level	

DTC	CC - CODE	Description	MIL
P2269		**Water in Fuel Filter Indicator Lamp Circuit Malfunction**	△
	0a	Signal low (Open cirucit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	

NOTE

● : *MIL ON & FAULT CODE MEMORY*
△ : *MIL OFF & FAULT CODE MEMORY*

NOTE

- *Refer to the Group "BE" for the troubleshooting procedures of DTC P1611, P1612, P1613 and P1626.*
- *Refer to the Group "EE" for the troubleshooting procedures of DTC P1660 and P1661.*

TROUBLESHOOTING FOR DTC E4392AED

DTC	P0100	EGR Control Malfunction
CC-CODE	04	Parameter at minimum limit
	05	Parameter at maximum limit

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
04	• (Target intake air mass - Actual intake air mass) < 200 mg/stroke	• EGR valve • EGR solenoid valve • Pipe connecting EGR valve and exhaust manifold • ECM
05	• (Target intake air mass - Actual intake air mass) > 900 mg/stroke	

INSPECTION PROCEDURE

1. CHECK DTC

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Is P0400 also set?

No ↓

Yes	Do all repairs associated with those codes before proceeding with this procedure.

2. EGR VALVE INSPECTION

1. Inspect below items.
   - **EGR valve**
   - **Pipe connecting EGR valve and exhaust manifold**

Are all items have normal condition?

Yes ↓

No	Repair or replace it.

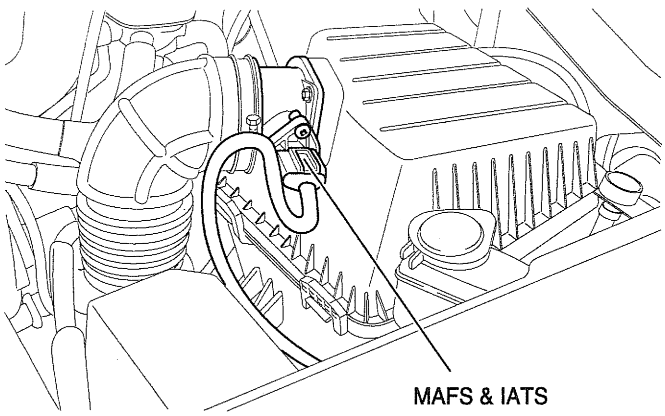
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF202L

TROUBLESHOOTING FOR DTC EFED28F4

DTC	P0101	Mass Air Flow Sensor (MAFS) Circuit Malfunction
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	0b	Signal high (Short circuit to battery line)

DTC	P0102	Mass Air Flow Sensor (MAFS) Range/Performance Problem
CC-CODE	04	Signal lower than lower limit
	05	Signal higher than upper limit



KFME200N

DESCRIPTION

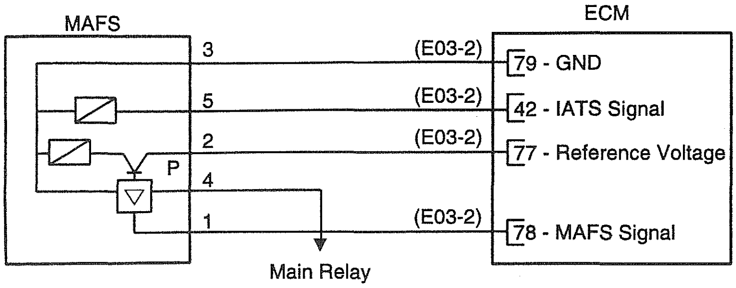
The mass air flow sensor (MAFS) has an intake air temperature sensor built-in and is located between the air cleaner assembly and the throttle device. The MAFS uses a hot film type sensing-element to measure the mass of intake air entering the engine. Mass air flow rate is measured by detection of heat transfer from a hot film probe. The change in air flow rate causes change in the amount of heat being transferred from the hot film probe surface to the air flow. 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.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Mass air flow < 50 mg/stroke	• Open or short in MAFS ciruict • MAFS • ECM
0b	• Mass air flow > 1,000 mg/stroke	
04	• Mass air flow sensor fault	
05		

[SCHEMATIC DIAGRAM]

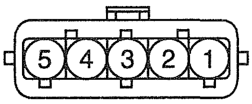
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

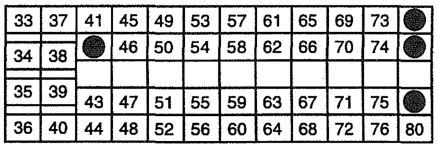
Terminal	Connected to	Function
1	ECM E03-2 (78)	MAFS Signal
2	ECM E03-2 (77)	Reference Voltage
3	ECM E03-2 (79)	Sensor Ground
4	Main Relay	Battery Voltage
5	ECM E03-2 (42)	IATS Signal

[HARNESS CONNECTORS]



E17

MAFS & IATS



E03-2

ECM

EWMF200A

INSPECTION PROCEDURE

1. CHECK MAFS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

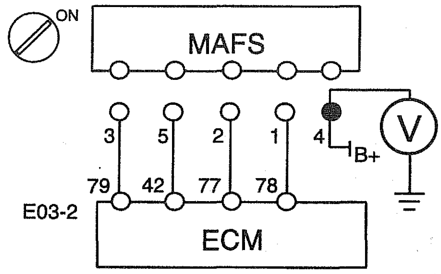
Are all connectors good?

Yes

No	Repair or replace it

2. CHECK POWER TO MAFS

1. Turn ignition switch to OFF and disconnect MAFS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 4 of MAFS harness connector and chassis ground.
   - **Specification: approximately B+**



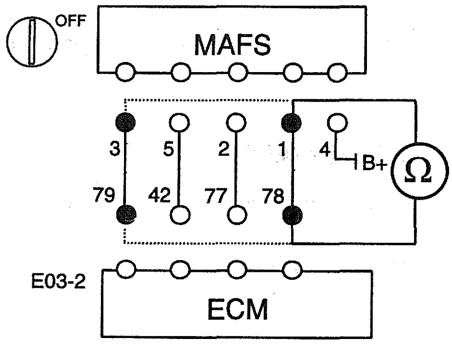
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Measure resistance between terminal 1 of MAFS harness connector and terminal E03-2(78) of ECM harness connector.
3. Measure resistance between terminal 3 of MAFS harness connector and terminal E03-2(79) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

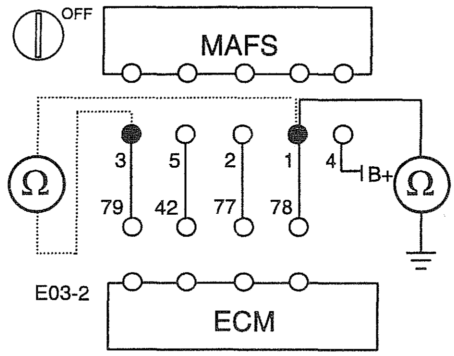
Yes

No	Repair open circuit in harness.

EWMF200B

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Measure resistance between terminal 1 of MAFS harness connector and chassis ground.
3. Measure resistance between terminal 1 and 3 of MAFS harness connector.
   - **Specification: infinite**

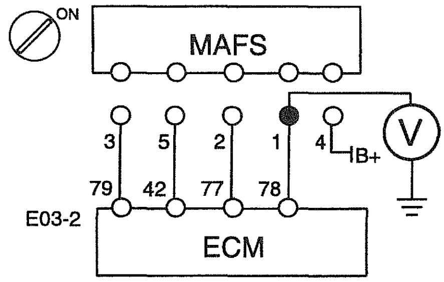


Is(Are) resistance(s) within specification?

Yes	No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of MAFS harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes	No	Repair short to power in harness.

6. CHECK MAFS

1. Replace the MAFS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Are these problem fixed?

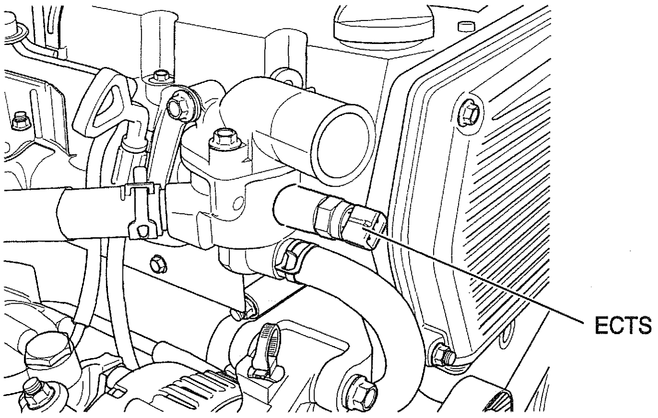
Yes	No	Replace the MAFS.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF200C

TROUBLESHOOTING FOR DTC E91DF16A

DTC	P0115	Engine Coolant Temperature Sensor (ECTS) Circuit Malfunction
CC-CODE	0b	Signal low (Open circuit or short circuit to battery line)
	02	Signal high (Short circuit to ground)



AFBE200O

DESCRIPTION

The engine coolant temperature sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the ECTS decreases as the engine coolant temperature increases, and increases as the engine coolant temperature decreases.The 5 V power source in the ECM is supplied to the ECTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in ECTS changes according to the engine coolant temperature, the signal voltage also changes. This information of engine coolant temperature is used in determination of basic fuel quantity and cooling fan control.

DTC DETECTING CONDITION

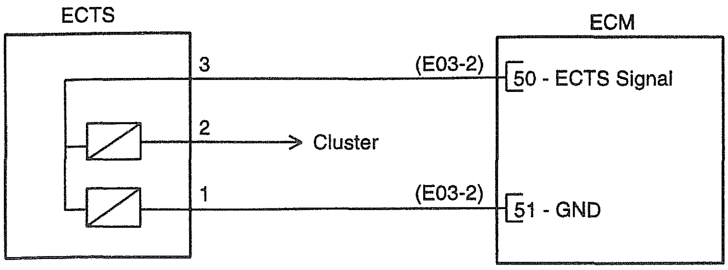
CC-CODE	Detecting Condition	Suspect Area
0b	• Engine coolant temperature < -49°C(-56.2°F)	• Open or short in ECTS cirucit • ECTS • ECM
02	• Engine coolant temperature > 139°C(282.2°F)	

SPECIFICATION

Temperature [°C (°F)]	-40(-40)	-20(-4)	0(32)	20(68)	40(104)	60(140)	80(176)
Resistance (kΩ)	44.4	13.4 ~ 16.8	5.74	2.3 ~ 2.6	1.15	0.58	0.32

[SCHEMATIC DIAGRAM]

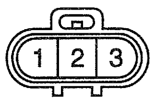
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

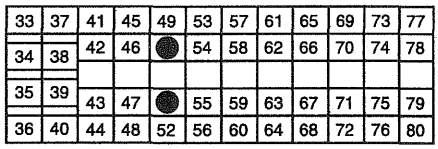
Terminal	Connected to	Function
1	ECM E03-2 (51)	Sensor Ground
2	Cluster	-
3	ECM E03-2 (50)	ECTS Signal

[HARNESS CONNECTORS]



E43

ECTS



E03-2

ECM

EWMF200D

INSPECTION PROCEDURE

1. CHECK ECTS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

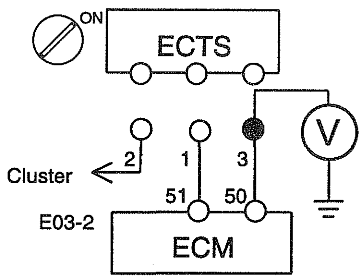
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK REFERENCE VOLTAGE TO ECTS

1. Turn ignition switch to OFF and disconnect ECTS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 3 of ECTS harness connector and chassis ground.
   - **Specification: approximately 5V**



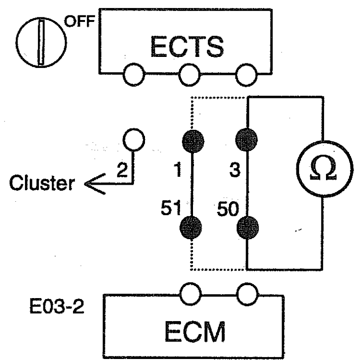
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and ECTS connector.
2. Measure resistance between terminal 3 of ECTS harness connector and terminal E03-2(50) of ECM harness connector.
3. Measure resistance between terminal 1 of ECTS harness connector and terminal E03-2(51) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

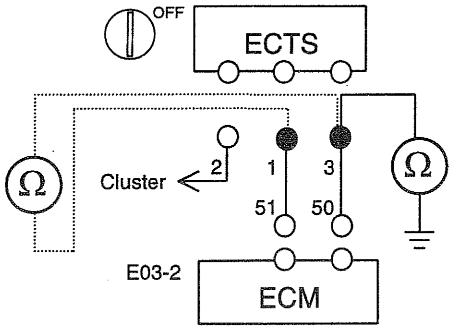
Yes

No	Repair open circuit in harness.

EWMF200E

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and ECTS connector.
2. Measure resistance between terminal 3 of ECTS harness connector and chassis ground.
3. Measure resistance between terminal 3 and 1 of ECTS harness connector.
   - **Specification: infinite**



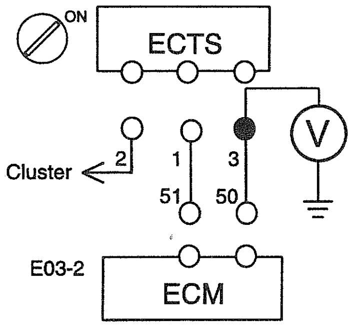
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and ECTS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 3 of ECTS harness connector and chassis ground.
   - **Specification: below 0.5V**



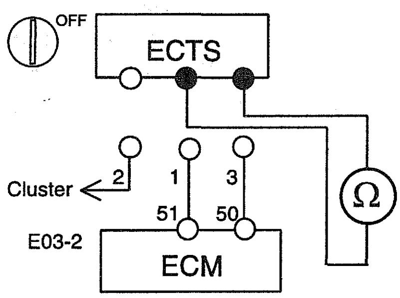
Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

6. CHECK ECTS RESISTANCE

1. Turn ignition switch to OFF and disconnect ECTS connector.
2. Measure resistance between terminal 3 and 1 of ECTS connector.
   - **Refer to "SPECIFICATION" for more information.**



Is(Are) resistance(s) within specification?

Yes

No	Replace the ECTS.

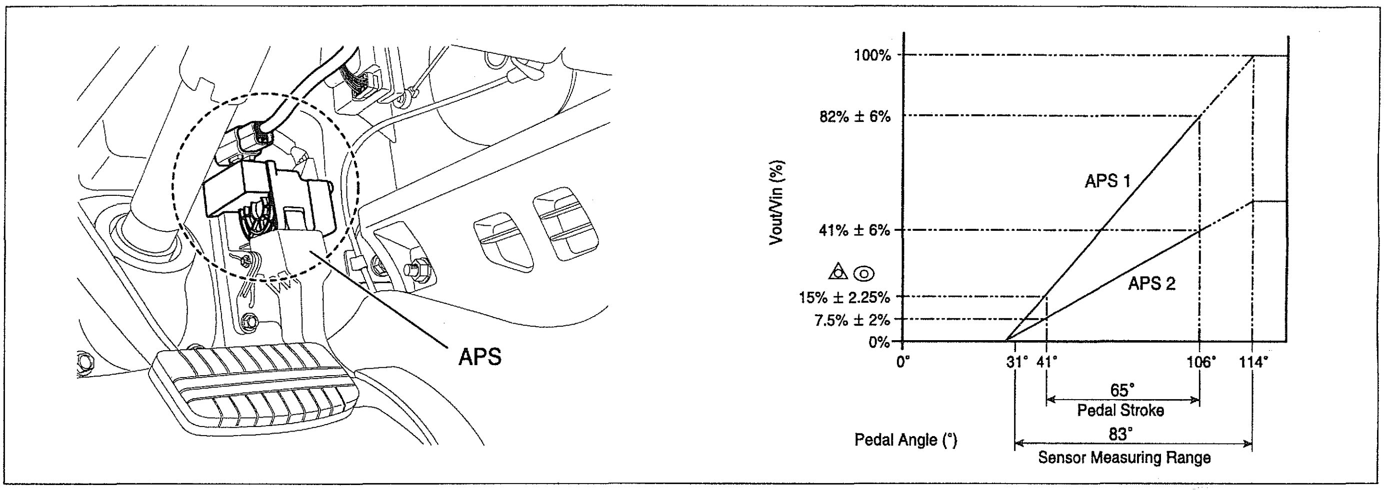
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF200F

TROUBLESHOOTING FOR DTC ECAFD836

DTC	P0120	Accelerator Position Sensor (APS) 1 Circuit Malfunction
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	0b	Signal high (Short circuit to battery line)
	06	Value incoherent

DTC	P0220	Accelerator Position Sensor (APS) 2 Circuit Malfunction
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	0b	Signal high (Short circuit to battery line)
	02	Signal low
	03	Signal high



EWMF200P

DESCRIPTION

On electronic injection systems, there is no longer a load lever that mechanically controls the fuelling. The flow is calculated by the ECM depending on a number of parameters, including pedal position, which is measured using a potentiometer. The absence of a mechanical link between the accelerator pedal and the injection system presents a risk of loss of control of the engine in the event of a failure of the component in charge of providing the driver's request information to the injection system. The pedal sensor therefore has two potentiometers whose slides aremechanically 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 programmed characteristic curve, the pedal's position is then calculated from this voltage.

DTC DETECTING CONDITION

(P0120)

CC-CODE	Detecting Condition	Suspect Area
0a	• Accelerator pedal angle (APS 1) < 4%	• Open or short in APS ciruict • APS • ECM
0b	• Accelerator pedal angle (APS 1) > 95%	
06	• |Accelerator pedal angle (APS 1) - Accelerator pedal angle (APS 2)| > 8%	

(P0220)

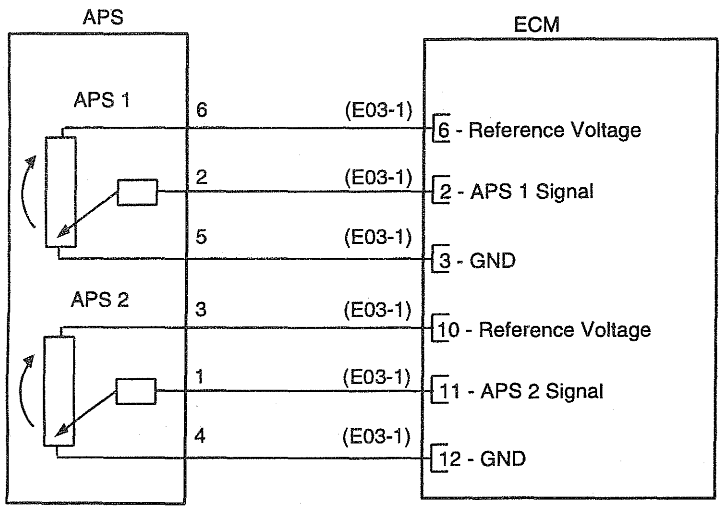
CC-CODE	Detecting Condition	Suspect Area
0a	• Accelerator pedal angle (APS 2) < 2%	• Open or short in APS ciruicit • APS • ECM
0b	• Accelerator pedal angle (APS 2) > 49.5%	
02	• Sensor supply voltage < 3.17V	
03	• Sensor supply voltage > 4.63V	

SPECIFICATION

Condition		C.T	W.O.T
Pedal Angle		41°	106°
Vout/Vin (%)	APS 1	14.66 ~ 15.34%	77.08 ~ 86.92%
	APS 2	7.35 ~ 7.65%	38.5 ~ 43.5%

[SCHEMATIC DIAGRAM]

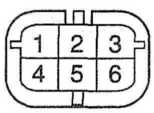
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

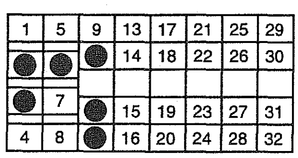
Terminal	Connected to	Function
1	ECM E03-1 (11)	APS 2 Signal
2	ECM E03-1 (2)	APS 1 Signal
3	ECM E03-1 (10)	Reference Voltage
4	ECM E03-1 (12)	Sensor Ground
5	ECM E03-1 (3)	Sensor Ground
6	ECM E03-1 (6)	Reference Voltage

[HARNESS CONNECTORS]



M07

ECTS



E03-1

ECM

EWMF200G

INSPECTION PROCEDURE

1. CHECK APS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

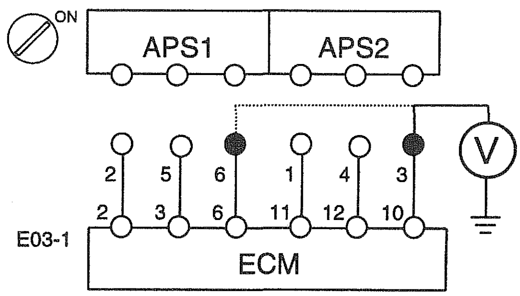
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK REFERENCE VOLTAGE TO APS

1. Turn ignition switch to OFF and disconnect APS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 6 of APS harness connector and chassis ground [APS 1].
4. Measure voltage in harness between terminal 2 of APS harness connector and chassis ground [APS 2].
   - **Specification: approximately 5V**



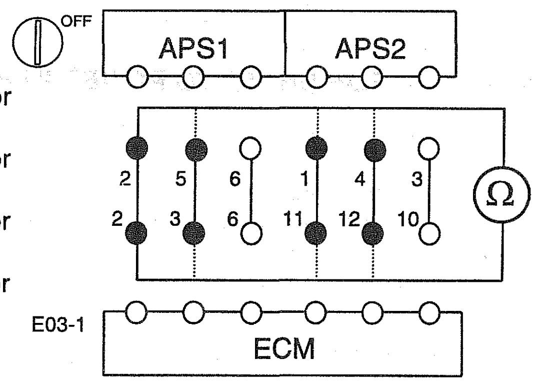
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
2. Measure resistance between terminal 2 of APS harness connector and terminal E03-1(2) of ECM harness connector [APS 1].
3. Measure resistance between terminal 5 of APS harness connector and terminal E03-1(3) of ECM harness connector [APS 1]
4. Measure resistance between terminal 1 of APS harness connector and terminal E03-1(11) of ECM harness connector [APS 2].
5. Measure resistance between terminal 4 of APS harness connector and terminal E03-1(12) of ECM harness connector [APS 2]
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

Yes

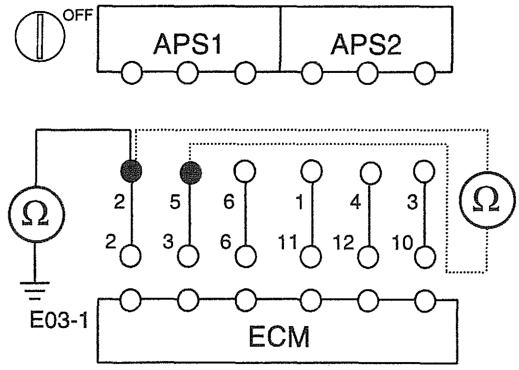
No	Repair open circuit in harness.

EWMF200H

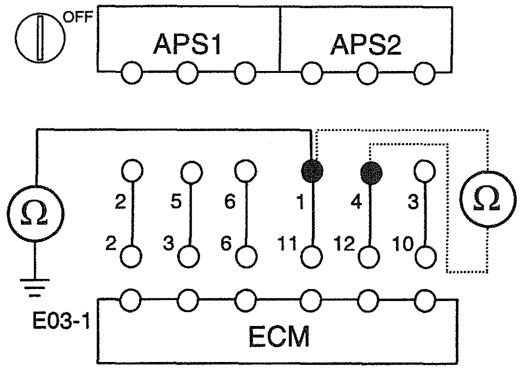
4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
2. Measure resistance between terminal 2 of APS harness connector and chassis ground [APS 1].
3. Measure resistance between terminal 2 and 5 of APS harness connector [APS 1].
4. Measure resistance between terminal 1 of APS harness connector and chassis ground [APS 2].
5. Measure resistance between terminal 1 and 4 of APS harness connector [APS 2].
   - **Specification: infinite**

(SENSOR 1)



(SENSOR 2)



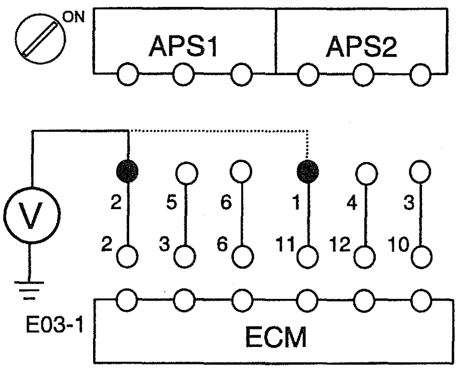
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of APS harness connector and chassis ground [APS 1].
4. Measure voltage between terminal 1 of APS harness connector and chassis ground [APS 2].
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

EWMF200I

Yes

No	Repair short to power in harness.

6. CHECK APS SIGNAL

1. Turn ignition switch to OFF and connect APS connector.
2. connect Hi-Scan (Pro) to APS.
3. Turn ignition switch to ON.
4. Using Hi-Scan (Pro), monitor APS signal while slowly stepping the accelerator position.
   - **Refer to "SPECIFICATION" for more information.**

Is signal within specification and consistent with the normal curve?

Yes

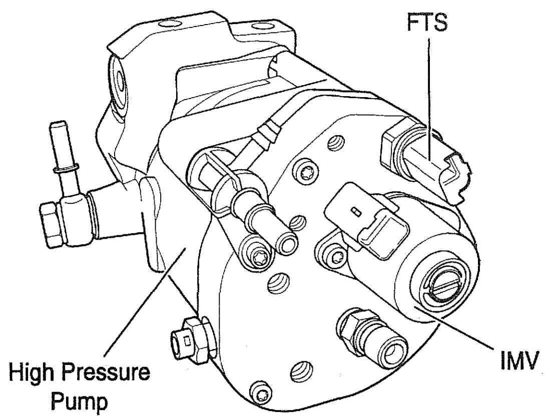
No	Replace the APS.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF200J

TROUBLESHOOTING FOR DTC ED8D1F3D

DTC	P0180	Fuel Temperature Sensor (FTS) Circuit Malfunction
CC-CODE	0b	Signal low (Open circuit or short circuit to battery line)
	02	Signal high (Short circuit to ground)



EWMF200Q

DESCRIPTION

The fuel temperature sensor (FTS) is located in the high-pressure pump assembly to measure the fuel temperature. The FTS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the FTS decreases as the fuel temperature increases, and increases as the fuel temperature decreases.The 5 V power source in the ECM is supplied to the FTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the FTS are connected in series. When the resistance value of the thermistor in FTS changes according to the fuel temperature, the signal voltage also changes. This information of fuel temperature is used in correcting fuel quantity.

DTC DETECTING CONDITION

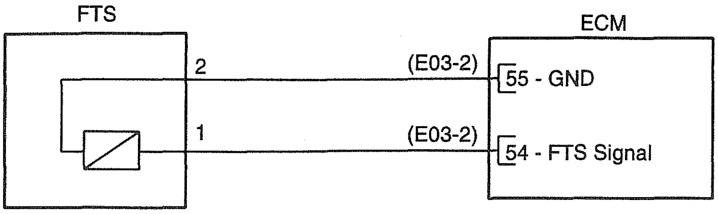
CC-CODE	Detecting Condition	Suspect Area
0b	• Fuel temperature < -40°C(-40°F)	• Open or short in FTS cirucit • FTS • ECM
02	• Fuel temperature > 140°C(284°F)	

SPECIFICATION

Temperature [°C (°F)]	-30(-22)	-20(-4)	0(32)	20(68)	40(104)	60(140)	80(176)
Resistance (kΩ)	22.2 ~ 31.8	13.2 ~ 18.1	5.2 ~ 6.6	2.3 ~ 2.7	1.1 ~ 1.3	0.54 ~ 0.65	0.30 ~ 0.32

[SCHEMATIC DIAGRAM]

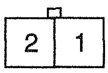
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

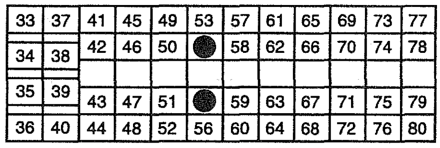
Terminal	Connected to	Function
1	ECM E03-2 (54)	FTS Signal
2	ECM E03-2 (55)	Sensor Ground

[HARNESS CONNECTORS]



E85

FTS



E03-2

ECM

EWMF200K

INSPECTION PROCEDURE

1. CHECK FTS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

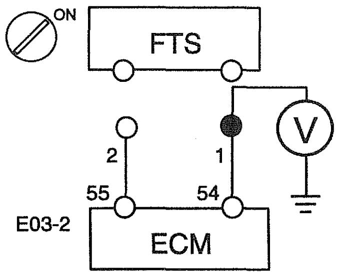
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK REFERENCE VOLTAGE TO FTS

1. Turn ignition switch to OFF and disconnect FTS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of FTS harness connector and chassis ground.
   - **Specification: approximately 5V**



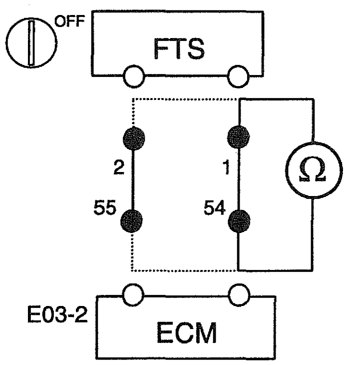
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and FTS connector.
2. Measure resistance between terminal 1 of FTS harness connector and terminal E03-2(54) of ECM harness connector.
3. Measure resistance between terminal 2 of FTS harness connector and terminal E03-2(55) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

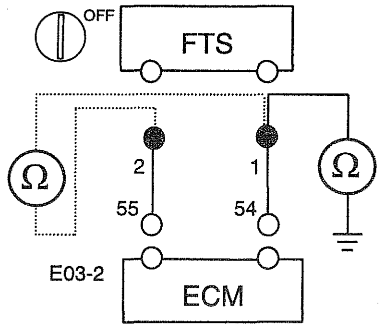
Yes

No	Repair open circuit in harness.

EWMF200L

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and FTS connector.
2. Measure resistance between terminal 1 of FTS harness connector and chassis ground.
3. Measure resistance between terminal 1 and 2 of FTS harness connector.
   - **Specification: infinite**



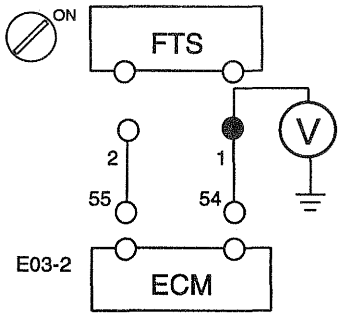
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and FTS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of FTS harness connector and chassis ground.
   - **Specification: below 0.5V**



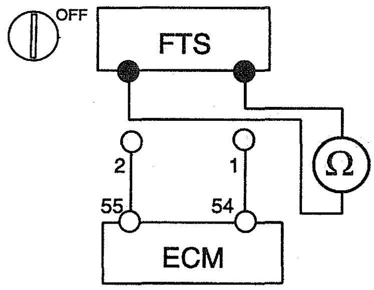
Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

6. CHECK FTS RESISTANCE

1. Turn ignition switch to OFF and disconnect FTS connector.
2. Measure resistance between terminal 1 and 2 of FTS connector.
   - **Refer to "SPECIFICATION" for more information.**



Is(Are) resistance(s) within specification?

Yes

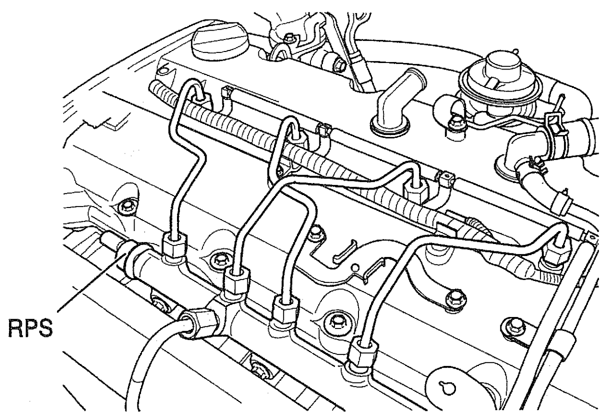
No	Replace the FTS.

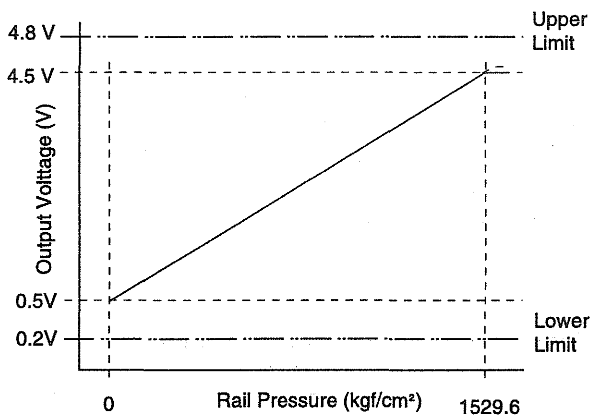
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF200M

TROUBLESHOOTING FOR DTC E6FE4E7A

DTC	P0190	Rail Pressure Sensor (RPS) Range/Performance Problem
CC-CODE	0a	Signal low (Short ciruict to ground)
	0b	Signal high (Open circuit or short circuit to battery line)
	06	Rail pressure incoherent
	08	Signal low
	09	Signal high
	05	Parameter at maximum limit
	8d	Above the average threshold





EWMF200R

DESCRIPTION

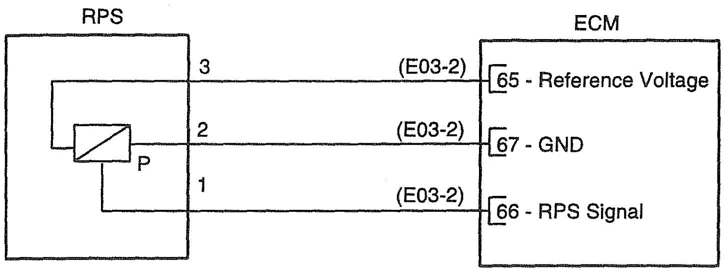
The aim of the Rail Pressure Sensor (RPS) is to provide to the ECM the voltage signal corresponding to fuel pressure in the rail. This information is used for fueling and timing calculation. The sensor element (semiconductor device) for converting the pressure to an electric signal is mounted on the diaphragm. The sensor operates as an analog resistor. The change in resistance is proportional to the rail pressure acting upon this diaphragm. A rail pressure change lead to a geometry change. This movement changes the electrical resistance. A bridge circuit on the diaphragm supplies a voltage that is amplified to a range from 0.5 V to 4.5 V (respectively 0 and 1,800 kgf/cm²).

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Rail pressure < -114.7 kgf/cm²	• Open or short in RPS ciruict • RPS • ECM
0b	• Rail pressure > 1,950.2 kgf/cm²	
06	• Pressure variation greater than 255 kgf/cm² between two successive measurements.	
08	• Rail pressure < -91.8 kgf/cm² when IG ON	
09	• Rail pressure when IG ON is more than 255 kgf/cm² higher than the rail pressure at the previous IG OFF (upwards sensor drift).	
05	• Rail pressure > 1,753.9 kgf/cm²	
8d	• The rail pressure is > 91.8 kgf/cm² for 20 consecutive IG ON (upwards sensor drift).	

[SCHEMATIC DIAGRAM]

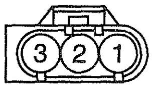
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

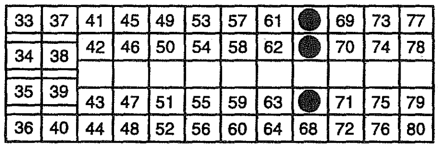
Terminal	Connected to	Function
1	ECM E03-2 (66)	RPS Signal
2	ECM E03-2 (67)	Sensor Ground
3	ECM E03-2 (65)	Reference Voltage

[HARNESS CONNECTORS]



E88

RPS



E03-2

ECM

EWMF200S

INSPECTION PROCEDURE

1. CHECK DTC

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Are the DTCs related to IMV (P1119 or P11200) also set?

Yes

No	Do all repairs associated with those codes before proceeding with this procedure.

2. CHECK RPS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

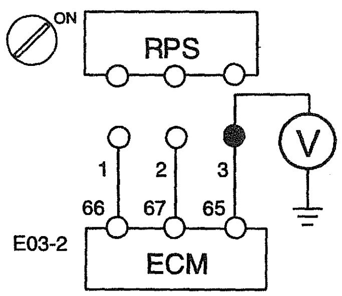
Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK REFERENCE VOLTAGE TO RPS

1. Turn ignition switch to OFF and disconnect RPS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 3 of RPS harness connector and chassis ground.
   - **Specification: approximately 5V**



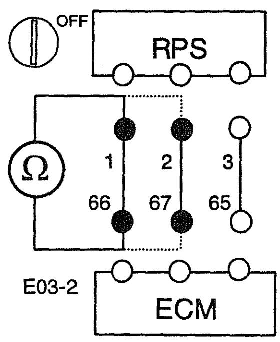
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Measure resistance between terminal 1 of RPS harness connector and terminal E03-2(66) of ECM harness connector.
3. Measure resistance between terminal 2 of RPS harness connector and terminal E03-2(67) of ECM harness connector.
   - **Specification: below 1Ω**



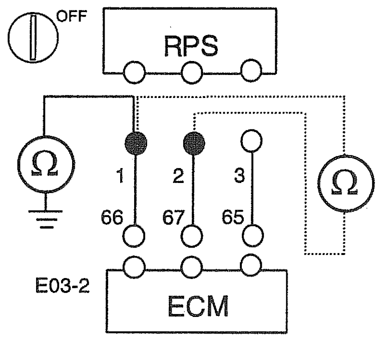
Is(Are) resistance(s) within specification?

EWMF200T

Yes	No	Repair open circuit in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Measure resistance between terminal 1 of RPS harness connector and chassis ground.
3. Measure resistance between terminal 1 and 2 of RPS harness connector.
   - **Specification: infinite**

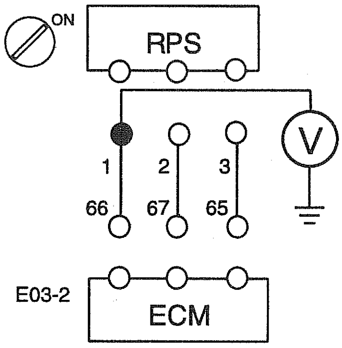


Is(Are) resistance(s) within specification?

Yes	No	Repair short or short to chassis ground in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of RPS harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes	No	Repair short to power in harness.

7. CHECK RPS

1. Replace the RPS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

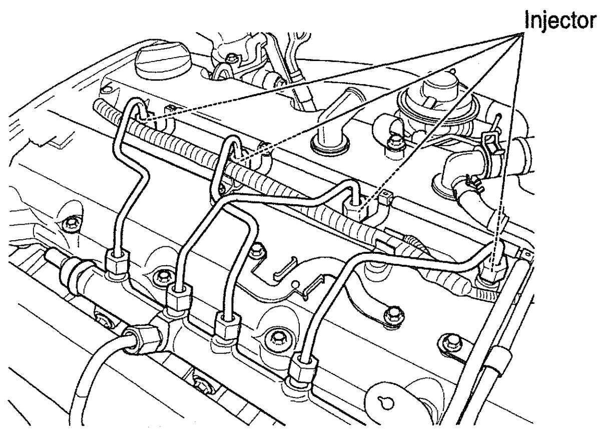
Yes	No	Replace the RPS.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF200U

TROUBLESHOOTING FOR DTC E35C1F2A

DTC	**P0201**	**Inector #1 (Cylinder #1) Circuit Malfunction**
DTC	**P0202**	**Inector #2 (Cylinder #3) Circuit Malfunction**
DTC	**P0203**	**Inector #3 (Cylinder #4) Circuit Malfunction**
DTC	**P0204**	**Inector #4 (Cylinder #2) Circuit Malfunction**
CC-CODE	04	Signal low
	91	Injector stuck (Open)
	86	Injector stuck (Close)
	01	Open Circuit
	0c	Short Circuit



EWMF202M

DESCRIPTION

The injector of the Common Rail System is electronically controlled. It has been designed to allow multiple injection with short intervals, to be fully electronically controlled, and to release a small amount of heat. The nozzle of injector opens when the solenoid valve is triggered and permits the flow of fuel. They inject the fuel directly into the engine's combustion chamber. The fuel is stored in the Rail ready for injection and the injected fuel quantity is defined by the injector opening time and the rail pressure.

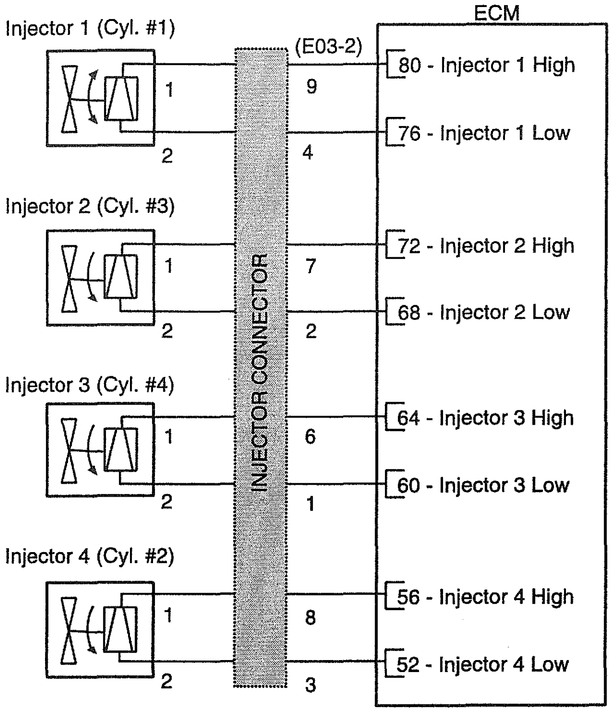
The excess fuel, which was needed for opening the nozzle of injector, flows back to the tank through a collector line. The return fuel from the pressure-control valve and from the low-pressure stage is also led into this collector line together with the fuel used to lubricate the high-pressure pump.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
04	• MDP (Minimum Drive Pulse) correction determined by the knock sensor strategy exceeds a calibrated value.	• Open or short circuit in injector • Injector • Compression pressure • Fuel line • ECM
91	• Injector stuck (Open)	
86	• Injector stuck (Close)	
01	• Open circuit	
0c	• Short circuit	

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1 (Cylinder #1)

Terminal	Injector Connector	Connected to	Function
1	7	ECM E03-2 (80)	Injector1 (Cyl. #1) High
2	2	ECM E03-2 (76)	Injector1 (Cyl. #1) Low

Injector #2 (Cylinder #3)

Terminal	Injector Connector	Connected to	Function
1	9	ECM E03-2 (72)	Injector2 (Cyl. #3) High
2	4	ECM E03-2 (68)	Injector2 (Cyl. #3) Low

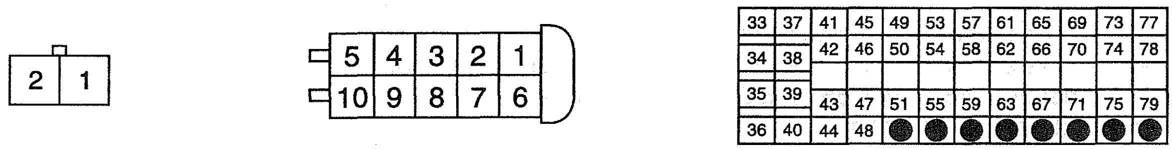
Injector #3 (Cylinder #4)

Terminal	Injector Connector	Connected to	Function
1	10	ECM E03-2 (64)	Injector3 (Cyl. #4) High
2	5	ECM E03-2 (60)	Injector3 (Cyl. #4) Low

Injector #4 (Cylinder #2)

Terminal	Injector Connector	Connected to	Function
1	8	ECM E03-2 (56)	Injector4 (Cyl. #2) High
2	3	ECM E03-2 (52)	Injector4 (Cyl. #2) Low

[HARNESS CONNECTORS]



E157
INJECTOR

INJECTOR CONNECTOR

E03-2
ECM

EWMF202N

INSPECTION PROCEDURE

1. CHECK DTC

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Are the CC-codes 86, 91, or 04 also set?

Yes

No	• CC-CODE 86 or 91 - Inspect the cylinder compression pressure (refer to group "EM" in this Shop Manual) - Inspect the fuel delivery line (refer to "FUEL DELIVERY SYSTEM-DIESEL") • CC-CODE 04 - Replace the injector

2. CHECK INJECTOR AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

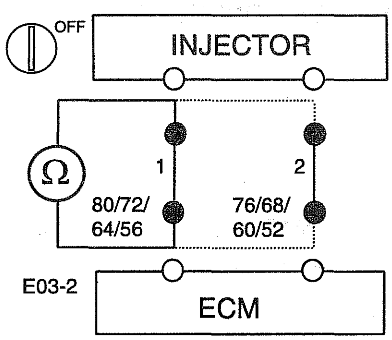
Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect ECM and injector connector.
3. Measure resistance between terminal 1 of injector harness connector and terminal E03-2(80/72/64/56) of ECM harness connector (respectively injector #1/2/3/4).
4. Measure resistance between terminal 2 of injector harness connector and terminal E03-2(76/68/60/52) of ECM harness connector (respectively injector #1/2/3/4).
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

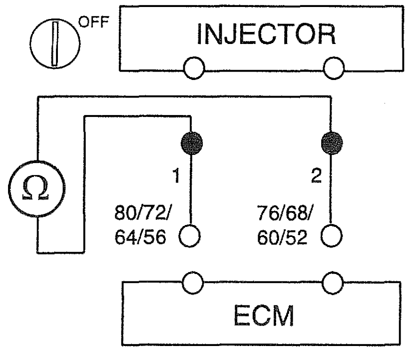
Yes

No	Repair open circuit in harness.

EWMF202O

4. CHECK FOR SHORT IN HARNESS

1. Turn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect ECM and injector connector.
3. Measure resistance between terminal 1 and 2 of injector harness connector.
   - **Specification: infinite**



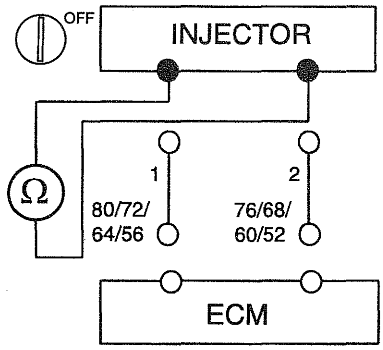
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK INJECTOR

1. Turn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect injector connector.
3. Measure resistance between terminal 1 and 2 of injector connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

Yes

No	Replace the injector.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF202P

TROUBLESHOOTING FOR DTC E133D74F

DTC	P0226	Accelerator Position Sensor (APS) 2 Range/Performance Problem
CC-CODE	06	APS 1/2 signal incoherent
	0b	Abnormal signal

DTC DETECTING CONDITION

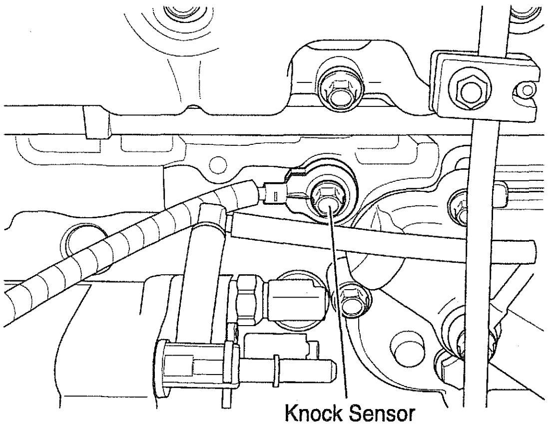
CC-CODE	Detecting Condition	Suspect Area
06	• APS 1/2 circuit malfunction	• Refer to P0120, P0220
0b	• Accelerator pedal fault • Brake switch circuit malfunction	• Accelerator pedal • Open or short in brake switch circuit • Brake switch • ECM

INSPECTION PROCEDURE

- CC-CODE 06: Refer to troubleshooting procedure for DTC P0120, P0220
- CC-CODE 06
  - Inspect accelerator pedal
  - Inspect brake switch circuit (Refer to troubleshooting procedure for DTC P1543)

TROUBLESHOOTING FOR DTC EA19DE6F

DTC	P0325	Knock Sensor Circuit Malfunction
CC-CODE	09	Signal High
	07	No Signal



EWMF200V

DESCRIPTION

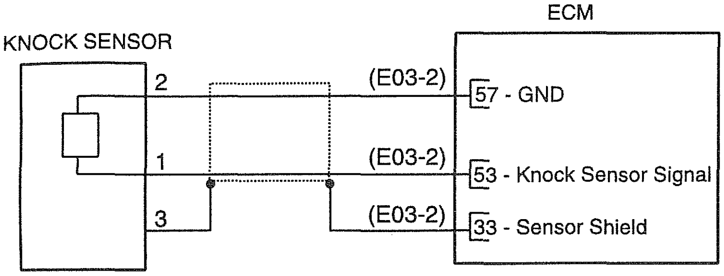
A knock sensor with piezoelectric element (ceramic) is attached to the center of cylinder block to sense the engine knocking condition (Check for knocking for each cylinder). The piezoelectric device output (V) = Q/C =2dF/C (d = piezoelectric integer, C = Electrostatic capacity). The ECM performs the knocking control to make the engine to operate in optimum condition before the knocking limit.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
09	• Abnormal signal	• Open or short in Knock Sensor ciruict • Knock Sensor • ECM
07		

[SCHEMATIC DIAGRAM]

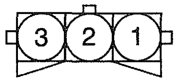
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

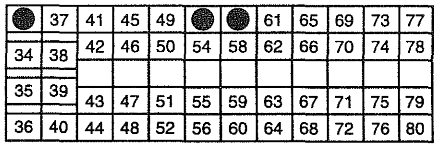
Terminal	Connected to	Function
1	ECM E03-2 (53)	Knock Sensor Signal
2	ECM E03-2 (57)	Sensor Ground
3	ECM E03-2 (33)	Sensor Shield

[HARNESS CONNECTORS]



E89

KNOCK SENSOR



E03-2

ECM

EWMF200W

INSPECTION PROCEDURE

1. CHECK DTC

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Are the DTC related to ECTS, MAFS, IATS, or Atmospheric Pressure Sensor also set?

Yes

No	Do all repairs associated with those codes before proceeding with this procedure

2. CHECK KNOCK SENSOR AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

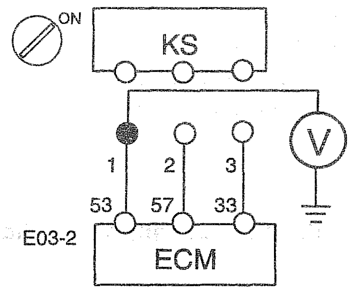
Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK REFERENCE VOLTAGE TO KNOCK SENSOR

1. Turn ignition switch to OFF and disconnect knock sensor connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of knock sensor harness connector and chassis ground.
   - **Specification: approximately 5V**



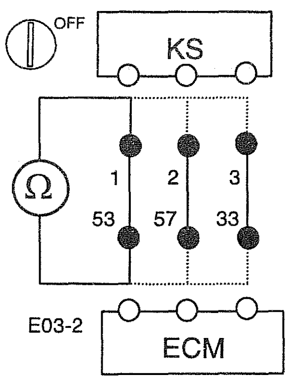
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and knock sensor connector.
2. Measure resistance between terminal 1 of knock sensor harness connector and terminal E03-2(53) of ECM harness connector.
3. Measure resistance between terminal 2 of knock sensor harness connector and terminal E03-2(57) of ECM harness connector.
4. Measure resistance between terminal 3 of knock sensor harness connector and terminal E03-2(33) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

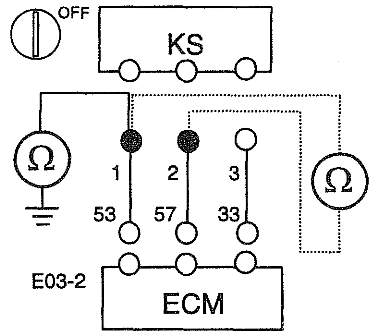
EWMF200X

Yes	No	Repair open circuit in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and knock sensor connector.
2. Measure resistance between terminal 1 of knock sensor harness connector and chassis ground.
3. Measure resistance between terminal 1 and 2 of knock sensor harness connector.
   - **Specification: infinite**

Is(Are) resistance(s) within specification?

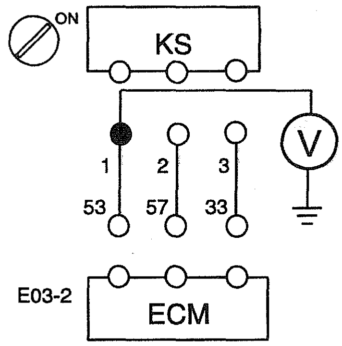


Yes	No	Repair short or short to chassis ground in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and knock sensor connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of knock sensor harness connector and chassis ground.
   - **Specification: below 0.5V**

Is(Are) voltage(s) within specification?



Yes	No	Repair short to power in harness.

7. CHECK KNOCK SENSOR

1. Replace the knock sensor with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

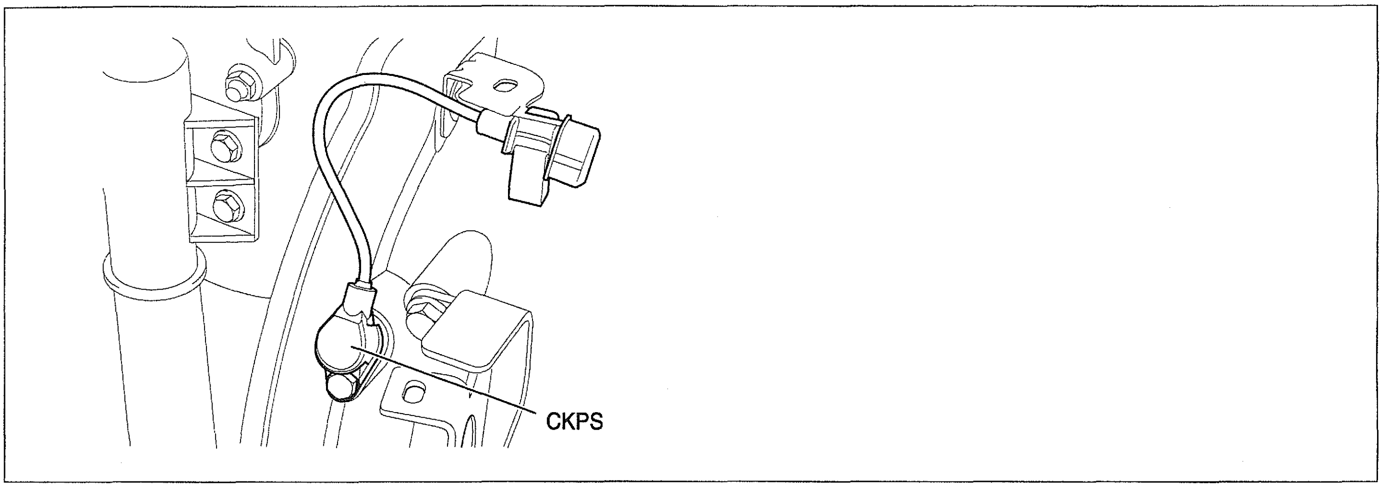
Yes	No	Replace the knock sensor.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF200Y

TROUBLESHOOTING FOR DTC E73A1AE4

DTC	P0335	Crankshaft Position Sensor (CKPS) Circuit Malfunction
CC-CODE	06	Abnormal airgap
	07	No signal
	92	Too many missing teeth detected
	93	Too many extra teeth detected
	94	Missing teeth detected
	95	Extra teeth detected



AFBE200Z

DESCRIPTION

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. Crankshaft position sensor (CKPS) senses the information concerning all piston positions and uses this signal to calculate the injection timing and engine speed. Camshaft position sensor (CMPS) senses the position of camshaft in reference to the upper dead point of compression of cylinder and sends this signal, based on which the ECM determines the injection sequence of each cylinder and the fuel injection timing.

DTC DETECTING CONDITION

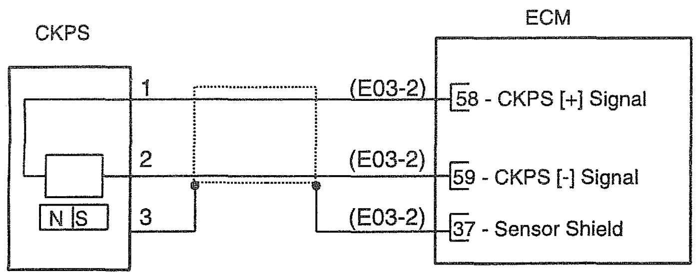
CC-CODE	Detecting Condition	Suspect Area
06	• No gap detection on the engine flywheel, but no extra or mission teeth detected	• Open or short in CKPS • CKPS • ECM
07	• Loss of engine speed sensor signal	
92	• More than 4 missing teeth detected on an engine flywheel rotation	
93	• More than 2 extra teeth detected on an engine flywheel rotation	
94	• 4 missing teeth detected on an engine flywheel rotation	
95	• 2 extra teeth detected on an engine flywheel rotation	

SPECIFICATION

Air gab between target wheel and CKPS	0.5 ~ 1.5 mm

[SCHEMATIC DIAGRAM]

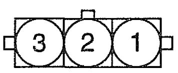
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

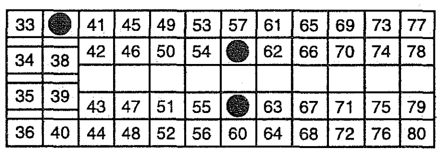
Terminal	Connected to	Function
1	ECM E03-2 (58)	CKPS [+] Signal
2	ECM E03-2 (59)	CKPS [-] Signal
3	ECM E03-2 (37)	Sensor Shield

[HARNESS CONNECTORS]



C04

CKPS



E03-2

ECM

EWMF201A

INSPECTION PROCEDURE

1. CHECK CKPS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

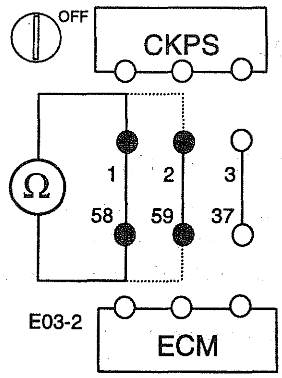
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and CKPS connector.
2. Measure resistance between terminal 1 of CKPS harness connector and terminal E03-2(58) of ECM harness connector.
3. Measure resistance between terminal 2 of CKPS harness connector and terminal E03-2(59) of ECM harness connector.
   - **Specification: below 1Ω**



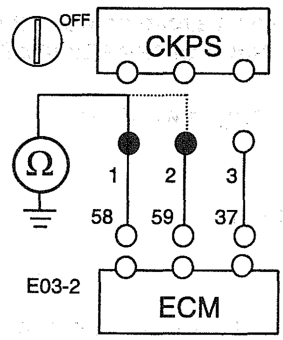
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.

3. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and CKPS connector.
2. Measure resistance between terminal 1 of CKPS harness connector and chassis ground.
3. Measure resistance between terminal 2 of CKPS harness connector and chassis ground.
   - **Specification: infinite**



Is(Are) resistance(s) within specification?

Yes

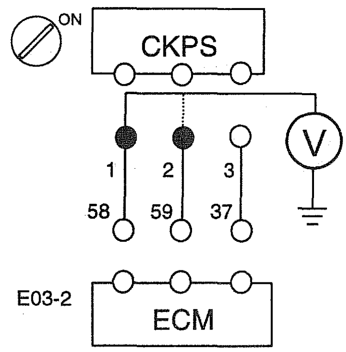
No	Repair short or short to chassis ground in harness.

EWMF201B

4. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and CKPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of CKPS harness connector and chassis ground.
4. Measure voltage between terminal 2 of CKPS harness connector and chassis ground.
   - **Specification: below 0.5V**

Is(Are) voltage(s) within specification?



Yes

No	Repair short to power in harness.

5. CHECK CKPS

1. Replace the CKPS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).
   - **Specification: below 0.5V**

Is this problem fixed?

Yes

No	Replace the knock sensor.

6. CHECK CKPS AIRGAP

1. Inspect airgap between the target-wheel and CKPS.
   - **Refer to "SPECIFICATION" for more information.**

Is the airgap within specification?

Yes

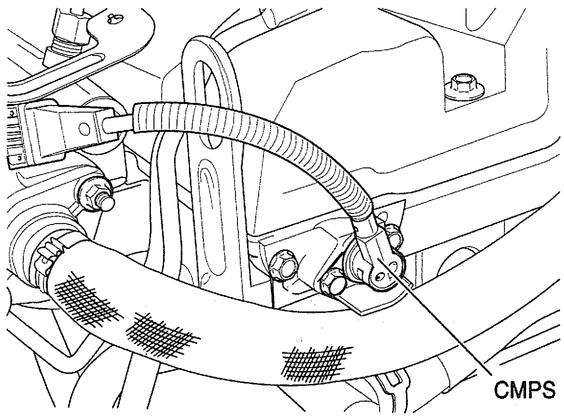
No	Adjust airgap between target-wheel and CKPS.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF201C

TROUBLESHOOTING FOR DTC E37B3222

DTC	P0340	Camshaft Position Sensor (CMPS) Circuit Malfunction
CC-CODE	07	No signal
	06	CMPS/CKPS signal incoherent



AFBE204D

DESCRIPTION

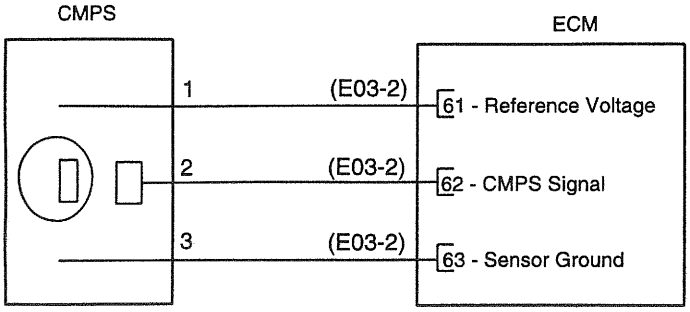
Piston position on combustion chamber is the substantial to define the starting of injection timing. All engine pistons are connected to crankshaft by connecting rod. Crankshaft position sensor (CKPS) senses the information concerning all piston positions and uses this signal to calculate the injection timing and engine speed. Camshaft position sensor (CMPS) senses the position of camshaft in reference to the upper dead point of compression of cylinder and sends this signal, based on which the ECM determines the injection sequence of each cylinder and the fuel injection timing.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
07	• No signal	• Open or short in CMPS ciruict • CMPS • ECM
06	• CMPS/CKPS incoherent	

[SCHEMATIC DIAGRAM]

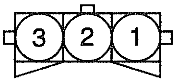
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

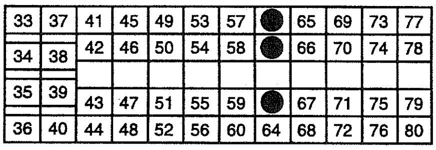
Terminal	Connected to	Function
1	ECM E03-2 (61)	Reference Voltage
2	ECM E03-2 (62)	CMPS Signal
3	ECM E03-2 (63)	Sensor Ground

[HARNESS CONNECTORS]



E90

CMPS



E03-2

ECM

EWMF201D

INSPECTION PROCEDURE

1. CHECK CMPS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

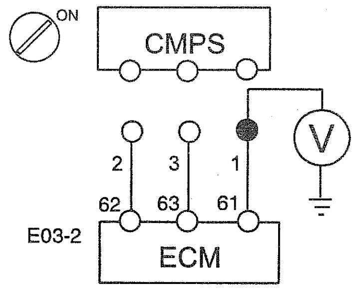
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK REFERENCE VOLTAGE TO CMPS

1. Turn ignition switch to OFF and disconnect CMPS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of CMPS harness connector and chassis ground. connector and chassis ground.
   - **Specification: approximately 5V**



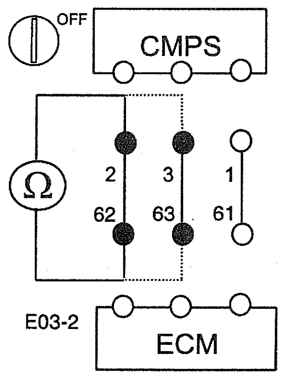
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Measure resistance between terminal 2 of CMPS harness connector and terminal E03-2(62) of ECM harness connector.
3. Measure resistance between terminal 3 of CMPS harness connector and terminal E03-2(63) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

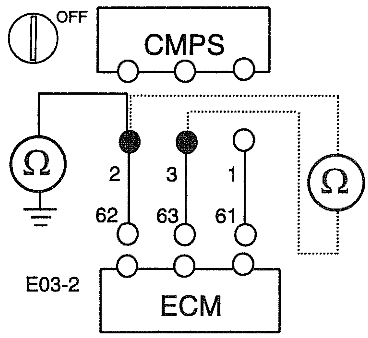
Yes

No	Repair open circuit in harness.

EWMF201E

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Measure resistance between terminal 2 of CMPS harness connector and chassis ground.
3. Measure resistance between terminal 2 and 3 of CMPS harness connector.
   - **Specification: infinite**

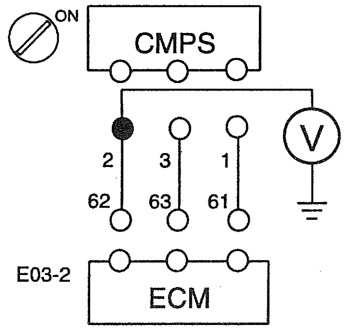


Is(Are) resistance(s) within specification?

Yes	No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of CMPS harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes	No	Repair short to power in harness.

6. CHECK TIMING BELT

1. Inspect the timing belt installation condition (Refer to the group "EM" in this Shop Manual).

Is the timing belt installed correctly?

Yes	No	Adjust or replace the timing belt.

7. CHECK CKPS

1. Replace the CKPS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

EWMF201F

No

Yes	Replace the CMPS.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF204E

TROUBLESHOOTING FOR DTC E0430229

DTC	P0380	Glow Relay 1 Circuit Malfunction
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	03	Signal high (Short circuit to battery line)
	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

DTC	P0382	Glow Relay 2 Circuit Malfunction
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	03	Signal high (Short circuit to battery line)
	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

DESCRIPTION

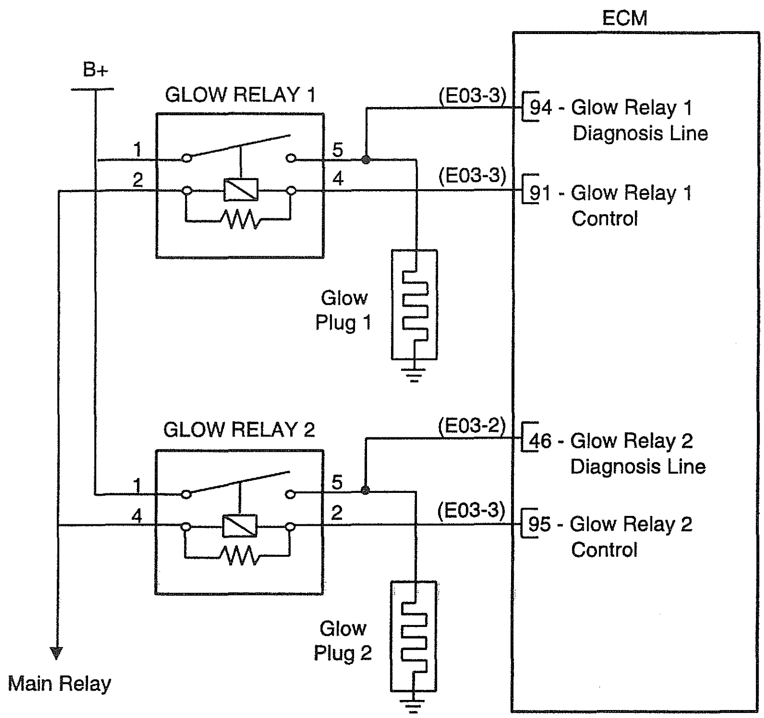
Glow plug plays an efficient role at cold start. It also shortens the warm-up period, a fact that is highly relevant for exhaust emissions. The time of preheating is determined by a number of parameters that include the engine speed and the coolant temperature. The ECM controls the glow plug via glow plug relay.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in glow relay circuit	• Open or short in Glow Relay cirucit • Glow Relay • ECM
03	• Short to battery line in glow relay circuit	

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

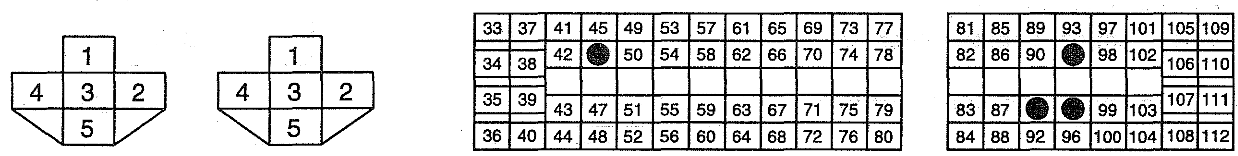
Glow Relay 1

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	Main Relay	Battery Voltage
3	-	-
4	ECM E03-3 (91)	Diagnosis
5	ECM E03-3 (94)	Glow Relay 1 Control
	Glow Plug 1	Glow Plug 1 Control

Glow Relay 2

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	ECM E03-2 (95)	Diagnosis
3	-	-
4	Main Relay	Battery Voltage
5	ECM E03-2 (46)	Glow Relay 2 Control
	Glow Plug 2	Glow Plug 2 Control

[HARNESS CONNECTORS]



E140 **E52** **E03-2** **E03-3**

Glow Relay 1 **Glow Relay 2** **ECM**

EWMF201H

INSPECTION PROCEDURE

1. CHECK GLOW RELAY AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK GLOW RELAY

1. Turn ignition switch to OFF and remove the glow relay.
2. Apply power to the terminal 2(4) and ground termnal 4(2) of glow relay 1(2).
3. Check if glow relay works well. (If glow relay works normally, a "click" sound can be heard).

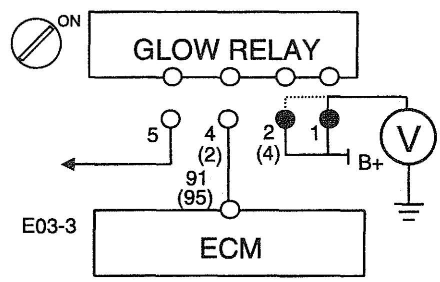
Does the glow relay operate normally?

Yes

No	Replace the glow plug relay

3. CHECK REFERENCE VOLTAGE TO GLOW RELAY

1. Turn ignition switch to OFF and disconnect glow relay connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of glow relay harness connector and chassis ground.
4. Measure voltage in harness between terminal 2(4) of glow relay harness connector and chassis ground.
   - **Specification: approximately B+**



Is(Are) voltage(s) within specification?

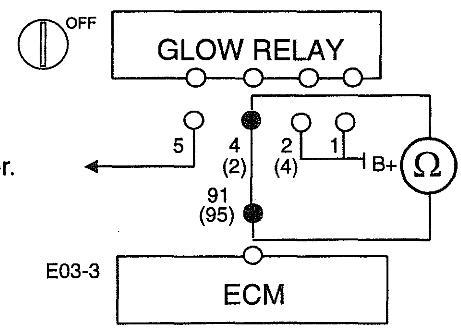
( ): Glow Relay #2

Yes

No	Repair open or short circuit in harness.

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and glow relay connector.
2. Measure resistance between terminal 4(2) of glow relay 1(2)harness connector and terminal E03-3(91)(E03-3(95)) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

( ): Glow Relay #2

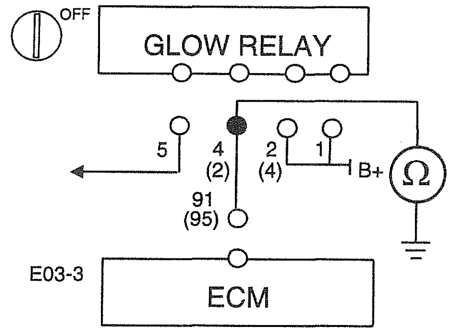
EWMF201I

Yes

No	Repair open circuit in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and glow relay connector.
2. Measure resistance between terminal 4(2) of glow relay 1(2) harness connector and chassis ground.
3. Measure resistance between terminal 2 and 3 of glow relay harness connector.
   - **Specification: infinite**



Is(Are) resistance(s) within specification?

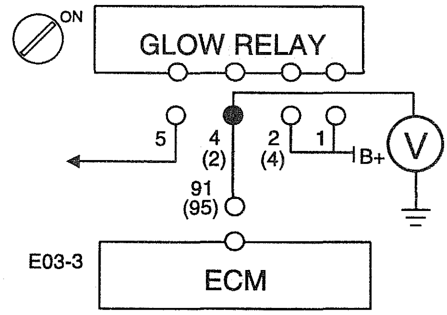
( ): Glow Relay #2

Yes

No	Repair short or short to chassis ground in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and glow relay connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 4(2) of glow relay 1(2) harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

( ): Glow Relay #2

Yes

No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF201J

TROUBLESHOOTING FOR DTC E00C6DA7

DTC	P0381	Glow Indicator Lamp Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

DESCRIPTION

Glow plugs in the diesel engine are small 12 V heating elements with the tip exposed to a small chamber where the volume of air can readily be heated. When the diesel engine is started up, the glow plug preheating current is controlled, taking into account factors such as coolant temperature.

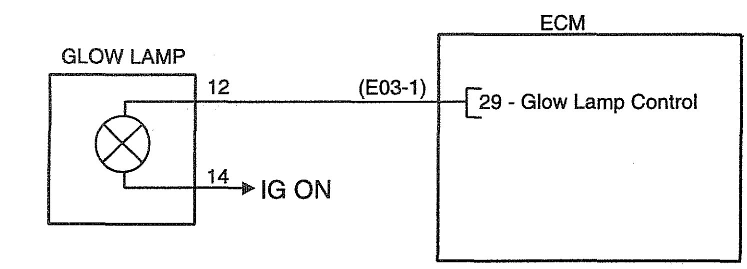
In addition to shortening preheating time, the surface temperature of the glow plug is maintained at a fixed temperature after the engine has been started. This has the effect of stabilizing engine speed and reducing the amount of smoke. The preheating warning light (Glow Indicator Lamp), which is located on the cluster, notifies the driver that the ECM is preheating it to improve the driving performance.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in glow indicator lamp circuit	• Open or short in Glow Indicator Lamp ciruict • Glow Indicator Lamp • ECM
03	• Short to battery line in glow indicator lamp circuit	

[SCHEMATIC DIAGRAM]

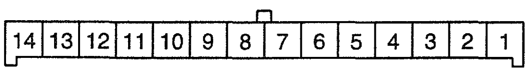
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

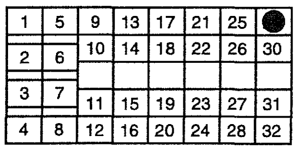
Terminal	Connected to	Function
12	ECM E03-1 (29)	Glow Lamp Control
14	IG	Battery Voltage

[HARNESS CONNECTORS]



I03-1

CLUSTER



E03-1

ECM

EWMF202R

INSPECTION PROCEDURE

1. CHECK GLOW INDICATOR LAMP (CLUSTER) AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

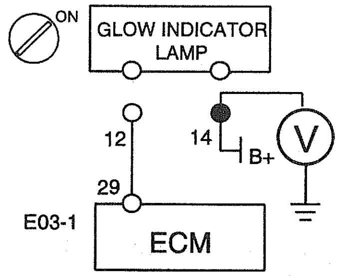
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK REFERENCE VOLTAGE TO GLOW INDICATOR LAMP

1. Turn ignition switch to OFF and disconnect glow indicator lamp (cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 14 of glow indicator lamp (cluster) harness connector and chassis ground.
   - **Specification: approximately B+**



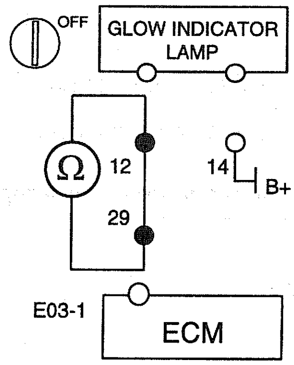
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and glow indicator lamp (cluster) connector.
2. Measure resistance between terminal 12 of glow indicator lamp (cluster) harness connector and terminal E03-1(29) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

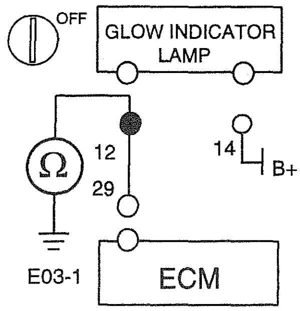
Yes

No	Repair open circuit in harness.

EWMF202S

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and glow indicator lamp (cluster) connector.
2. Measure resistance between terminal 12 of glow indicator lamp (cluster) harness connector and chassis ground.
   - **Specification: infinite**

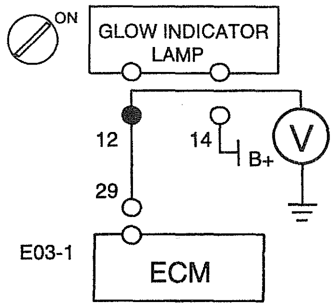


Is(Are) resistance(s) within specification?

Yes	No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and glow indicator lamp (cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 12 of glow indicator lamp (cluster) harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes	No	Repair short to power in harness.

6. CHECK GLOW INDICATOR LAMP

1. Inspect the glow indicator lamp installed on the cluster.

Does the glow indicator lamp have normal condition?

Yes	No	Replace the glow indicator lamp

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF202T

TROUBLESHOOTING FOR DTC E5DD1E09

DTC	P0400	EGR Solenoid Valve Circuit Malfucntion
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

DESCRIPTION

The exhaust-gas recirculation (EGR) system is designed to introduce exhaust gas into the engine' s intake manifold. Up to a certain degree, this system enables to reduce the formation of oxides of nitrogen (NOx) by cooling the combustion process. EGR solenoid valve will not open under all driving conditions. For it to cycle, the engine must be at normal operating temperature and not under heavy load. The amount and timing of exhaust gas introduced into the combustion cycle varies by such factors as engine vacuum, exhaust system back pressure, coolant temperature and accel position. Depending upon the engine's operating point, the air/gas mass drawn into the cylinders can be composed of up to 40%exhaust gas. Using the signal generated by the ECM control circuit, the EGR valve opens so that exhaust gas can flow into the intake manifold. If the EGR valve begins to clog or only partially opens, its flow will be reduced and emissions will increase.

DTC DETECTING CONDITION

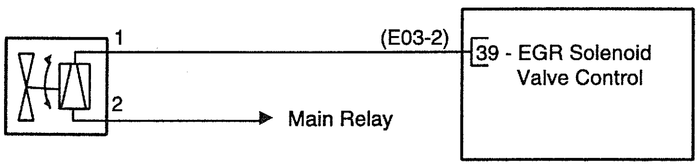
CC-CODE	Detecting Condition	Suspect Area
0a	• EGR solenoid valve duty > 95%	• Open or short in EGR Solenoid Valve cirucit • EGR Solenoid Valve • ECM
03	• EGR solenoid valve duty < 5%	

SPECIFICATION

EGR Solenoid Valve Resistance (Ω)	15.0 ~ 16.0Ω at 20°C (68°F)

[SCHEMATIC DIAGRAM]

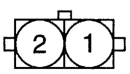
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

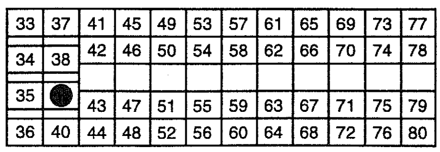
Terminal	Connected to	Function
1	ECM E03-2 (39)	EGR Solenoid Valve Control
2	Main Relay	Battery Voltage

[HARNESS CONNECTORS]



E34

EGR Solenoid Valve Control



E03-2

ECM

EWMF201L

INSPECTION PROCEDURE

1. CHECK EGR SOLENOID VALVE AND ECM CONNECTORS

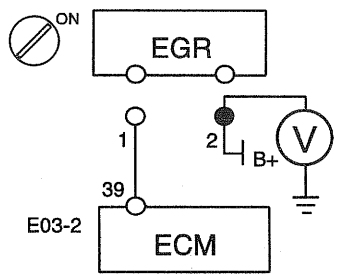
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes	No	Repair or replace it.

2. CHECK REFERENCE VOLTAGE TO EGR SOLENOID VALVE

1. Turn ignition switch to OFF and disconnect EGR solenoid valve connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 2 of EGR solenoid valve harness connector and chassis ground.
   - **Specification: approximately B+**

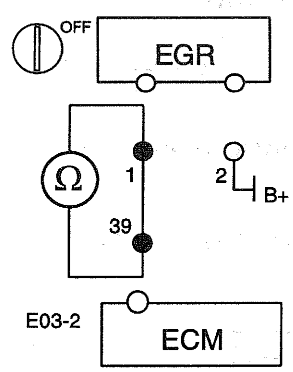


Is(Are) voltage(s) within specification?

Yes	No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and EGR solenoid valve connector.
2. Measure resistance between terminal 1 of EGR solenoid valve harness connector and terminal E03-2(39) of ECM harness connector.
   - **Specification: below 1Ω**

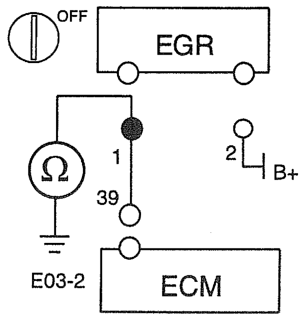


Is(Are) resistance(s) within specification?

Yes	No	Repair open circuit in harness

EWMF201M

4. CHECK FOR SHORT TO GROUND IN HARNESS



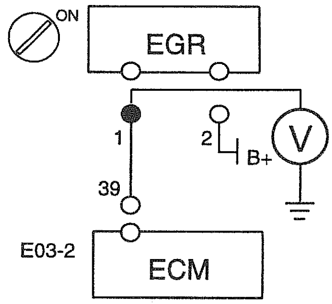
1. Turn ignition switch to OFF, and then disconnect ECM and EGR solenoid valve connector.
2. Measure resistance between terminal 1 of EGR solenoid valve harness connector and chassis ground.
   - **Specification: infinite**

Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS



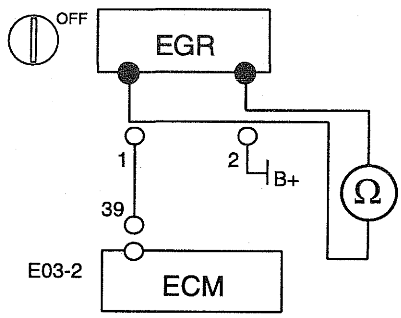
1. Turn ignition switch to OFF, and then disconnect ECM and EGR solenoid valve connector.
2. Turn ignition switch to ON.
3. easure voltage between terminal 1 of EGR solenoid valve harness connector and chassis ground.
   - **Specification: below 0.5V**

Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

6. CHECK EGR SOLENOID VALVE



1. Turn ignition switch to OFF and disconnect EGR solenoid valve connector.
2. Measure resistance between terminal 1 and 2 of EGR solenoid valve connector.
   - **Refer to "SPECIFICATION" for more information.**

Is(Are) resistance(s) within specification?

Yes

No	Replace the EGR solenoid valve

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF201N

TROUBLESHOOTING FOR DTC E5DF4755

DTC	P0560	Battery Voltage Malfunction
CC-CODE	08	Battery voltage too low
	09	Battery voltage too high

DESCRIPTION

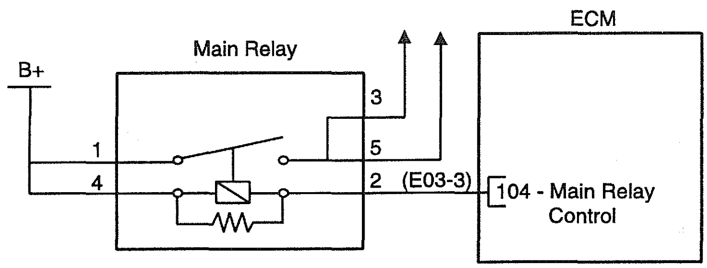
The charging system includes a battery, generator with a built in regulator, the charging indicator light, and connecting wiring. The generator uses diodes to rectify alternating current (AC) to direct current (DC). The ECM provides ground to one side of coil of main relay and the other side is connected to battery. The ECM monitors battery voltage and the voltage after main relay.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
08	• Battery voltage < 6V at engine speed = 700 rpm	• Open or short in Main Relay cirucit • Main Relay • Battery • Alternator • ECM
09	• Battery voltage > 18V at engine speed = 700 rpm	

[SCHEMATIC DIAGRAM]

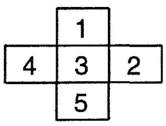
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

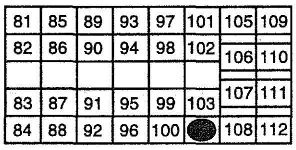
Terminal	Connected to	Function
1	Battery	Battery Voltage
2	ECM E03-3 (104)	Main Relay Control
3	-	-
4	Battery	Battery Voltage
5	-	-

[HARNESS CONNECTORS]



E113

MAIN RELAY



E03-3

ECM

EWMF201P

INSPECTION PROCEDURE

1. CHECK MAIN RELAY, BATTERY CABLE AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK MAIN RELAY

1. Turn ignition switch to OFF and remove the main relay.
2. Apply power to the terminal 4 and ground termnal 2 of main relay.
3. Check if main relay works well.
   (If main relay works normally, a "click" sound can be heard).

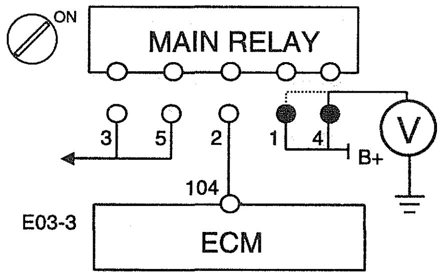
Does the main relay operate normally?

Yes

No	Replace the glow plug relay

3. CHECK POWER TO MAIN RELAY

1. Turn ignition switch to OFF and disconnect main relay connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 4 of main relay harness connector and chassis ground.
4. Measure voltage in harness between terminal 1 of main relay harness connector and chassis ground.
   - **Specification: approximately B+**



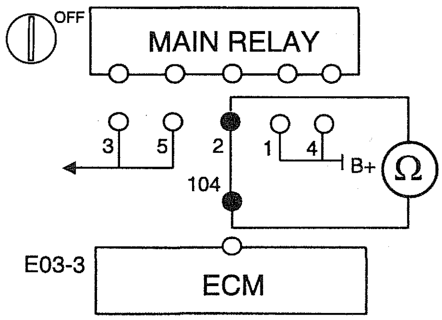
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Measure resistance between terminal 2 of main relay harness connector and terminal E03-3(104) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

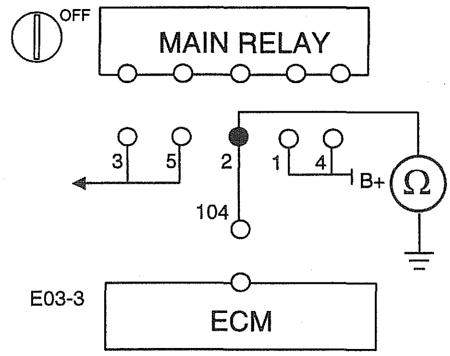
EWMF201Q

Yes

No	Repair open circuit in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Measure resistance between terminal 2 of main relay harness connec tor and chassis ground.
   - **Specification: infinite**



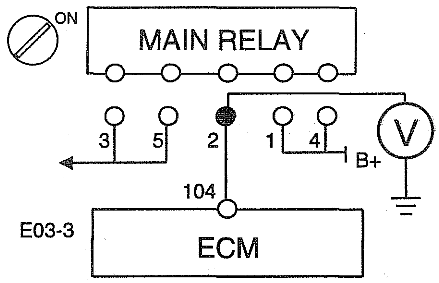
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of main relay harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

7. CHECK BATTERY

1. Check battery.
   - **Refer to the group "EE" in this Shop Manual.**

Is battery okay?

Yes

No	Repair or replace it.

EWMF201R

8. CHECK ALTERNATOR

1. Check alternator.
   - **Refer to the group "EE" in this Shop Manual.**

Is alternator okay?

Yes

No	Repair or replace it.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF201S

TROUBLESHOOTING FOR DTC EC60D8FC

DTC	P0650	Malfunction Indicator Lamp Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

DESCRIPTION

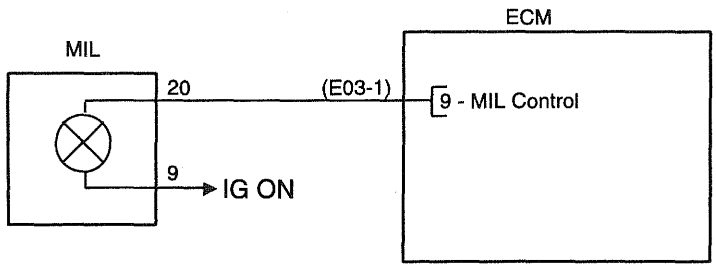
The Malfunction Indicator Lamp (MIL), which is located in the instrument cluster, comes on to notify the driver that theremay be a problem with the vehicle and that service is needed. Immediately after the ignition switch turns on, the malfunction indicator lamp is lit for 5 seconds to indicate that the MIL operates normally.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in MIL circuit	• Open or short in MIL ciruict • MIL • ECM
03	• Short to battery line in MIL circuit	

[SCHEMATIC DIAGRAM]

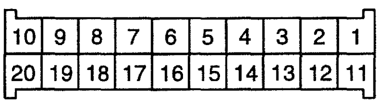
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

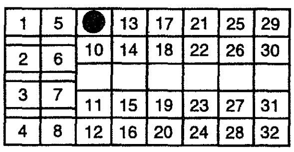
Terminal	Connected to	Function
20	ECM E03-1 (9)	MIL Control
9	IG	Battery Voltage

[HARNESS CONNECTORS]



I03-3

CLUSTER



E03-1

ECM

EWMF201U

INSPECTION PROCEDURE

1. CHECK MIL(CLUSTER) AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

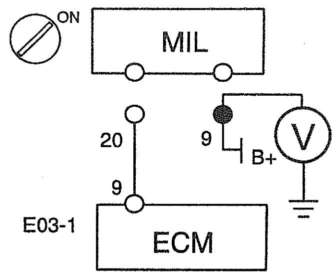
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK POWER TO MIL

1. Turn ignition switch to OFF and disconnect MIL(Cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 9 of MIL(Cluster) harness connector and chassis ground.
   - **Specification: approximately B+**



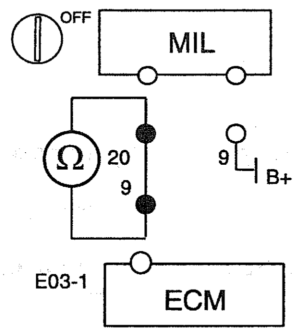
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Measure resistance between terminal 20 of MIL(Cluster) harness connector and terminal E03-1(9) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

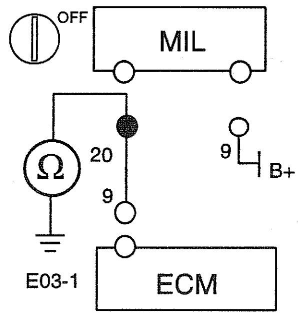
Yes

No	Repair open circuit in harness.

EWMF201V

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Measure resistance between terminal 20 of MIL(Cluster) harness connector and chassis ground.
   - **Specification: infinite**



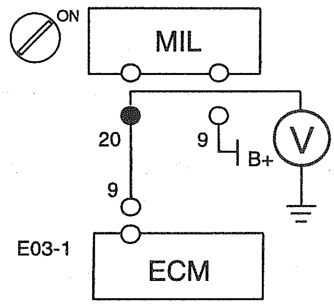
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 20 of MIL(Cluster) harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

6. CHECK MIL(CLUSTER)

1. Inspect the MIL installed on the cluster.

Does the MIL have normal condition?

Yes

No	Replace the MIL.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF201W

TROUBLESHOOTING FOR DTC EDE9BA65

DTC	P1119	Inlet Metering Valve (IMV) Control Malfunction
CC-CODE	96	Fuel leakage
	97	Fuel leakage
	98	Fuel leakage)
	99	Fuel leakage

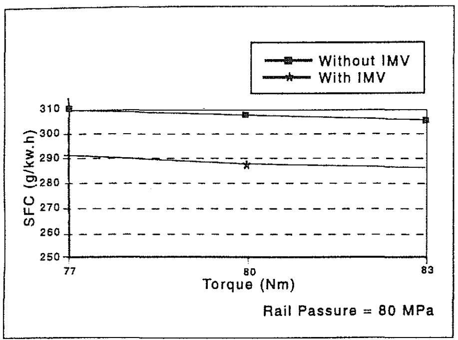
DTC	P1120	Inlet Metering Valve (IMV) Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line
	05	Fuel leakage
	04	Fuel leakage
	08	Fuel leakage

DESCRIPTION

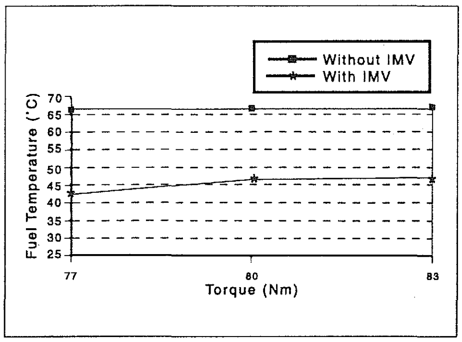
The Inlet Metering Valve (IMV) is used to control the rail pressure by regulating the amount of fuel which is sent to the pumping element of the HP pump. This IMV has two purposes:

1. Firstly, it allows the efficiency of the injection system to be improved, since the HP pump only compresses the amount of fuel necessary to maintain in the rail the level of pressure required by the system as a function of the engine operating conditions.
2. Secondly, it allows the temperature to be reduced in the fuel tank. When the excess fuel is discharged into the back leak circuit, the pressure reduction in the fluid (fromrail pressure down to atmospheric pressure) gives off a large amount of heat. This leads to a temperature rise in the fuel entering the tank. In order to prevent too high a temperature being reached, it is necessary to limit the amount of heat generated by the fuel pressure reduction, by reducing the back leak flow. To reduce the back leak flow, it is sufficient to adapt the flow of the HP pump to the engine requirements throughout its operating range.

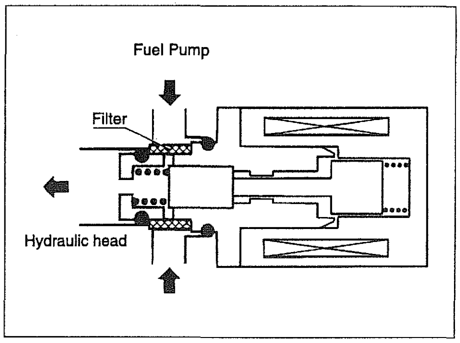
[FIG 1] Inlet Metering Valve Effect



[FIG 2] Fuel Temperature at System Backleak



[FIG 3] Operation Principle



EWMF203R

DTC DETECTING CONDITION

(P1119)

CC-CODE	Detecting Condition	Suspect Area
96	• The rail pressure is slightly lower than the demand.	• Open or short in IMV ciruit • IMV • High pressure fuel circuit • Low pressure fuel circuit • Injector • High pressure pump • ECM
97		
98	• The rail pressure is slightly higher than the demand.	
99		

(P1120)

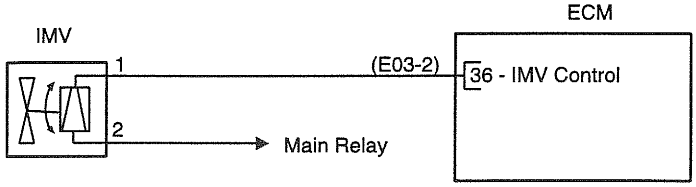
CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in IMV circuit	• Open or short in IMV ciruit • IMV • High pressure fuel circuit • Low pressure fuel circuit • Injector • High pressure pump • ECM
03	• Short to battery line in IMV circuit	
05	• The rail pressure remains 101.9 kgf/cm² above the demand for a variable time depending on the difference.	
04	• The rail pressure remains 101.9 kgf/cm² below the demand for a variable time depending on the difference.	
08	• The pressure rise on starting is too slow.	

SPECIFICATION

Inlet Metering Valve Resistance (Ω)	5.5Ω at 20°C (68°F)

[SCHEMATIC DIAGRAM]

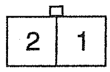
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

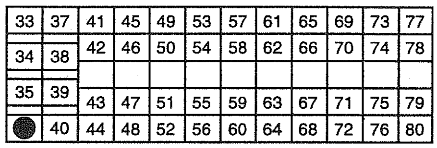
Terminal	Connected to	Function
1	ECM E03-2 (36)	IMV Control
2	Main Relay	Battery Voltage

[HARNESS CONNECTORS]



E86

IMV



E03-2

ECM

EWMF203S

INSPECTION PROCEDURE

1. CHECK DTC

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Is P0190 also set?

Yes

No	Do all repairs associated with those codes before proceeding with this procedure.

2. CHECK IMV AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

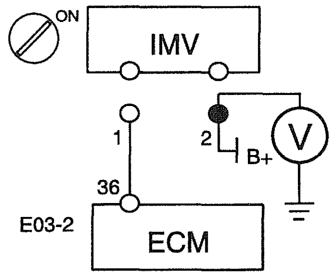
Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK POWER TO IMV

1. Turn ignition switch to OFF and disconnect IMV connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 2 of IMV harness connector and chassis ground.
   - **Specification: approximately B+**



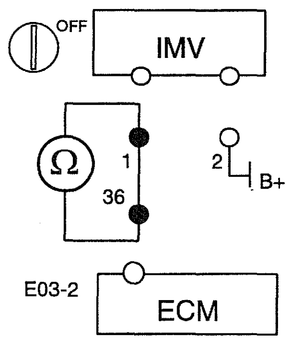
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and IMV connector.
2. Measure resistance between terminal 1 of IMV harness connector and terminal E03-2(36) of ECM harness connector.
   - **SSpecification: below 1Ω**



Is(Are) resistance(s) within specification?

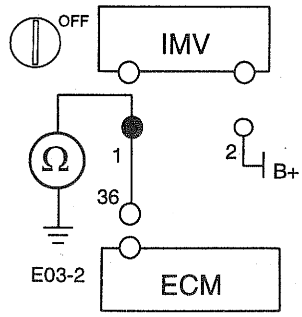
EWMF203T

Yes

No	Repair open circuit in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and IMV connector.
2. Measure resistance between terminal 1 of IMV harness connector and chassis ground.
   - **Specification: infinite**



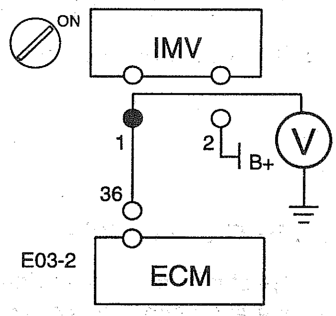
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and IMV connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of IMV harness connector and chassis ground.
   - **Specification: below 0.5V**



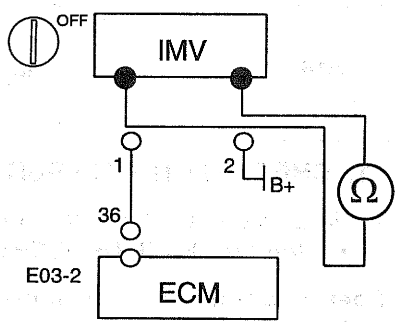
Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

7. CHECK IMV

1. Turn ignition switch to OFF and disconnect IMV connector.
2. Measure resistance between terminal 1 and 2 of IMV connector.
   - **Refer to "SPECIFICATION" for more information.**



Is(Are) resistance(s) within specification?

EWMF203U

Yes	No	Replace the IMV

8. CHECK LOW PRESSURE FUEL CIRCUIT

1. Inspect following items:
   - The presence of fuel in fuel tank
   - Leakage and connection condition of fuel line from fuel tank to high pressure pump
   - Leakage and connection condition of fuel line from fuel tank to injector via high pressure pump
   - The absence of air in the low pressure circuit (If air exists, place a receptacle under the venturi, and then disconnect the pump return hose at the venturi and prime the fuel circuit with the hand-priming pump).

Are all system above normal?

Yes	No	Repair or replace it.

9. CHECK HIGH PRESSURE FUEL CIRCUIT

1. Inspect high pressure fuel circuit.
   - **Refer to "FUEL DELIVERY SYSTEM-DIESEL".**

Does it have normal condition?

Yes	No	Repair or replace it.

10. CHECK INJECTOR

1. Inspect injector as following.
   - Operation condition of injector
   - Leakage on injector
   - Fuel amount of injector return line
   - Installation condition of injector (including the injector gasket and the tightening torques of clamp)
   - **Refer to "FUEL DELIVERY SYSTEM-DIESEL".**

Are all system above normal?

Yes	No	Repair or replace it.

11. CHECK HIGH PRESSURE PUMP

1. Inspect operation condition of high pressure pump.
   - **Refer to "FUEL DELIVERY SYSTEM-DIESEL".**

Does it have normal condition?

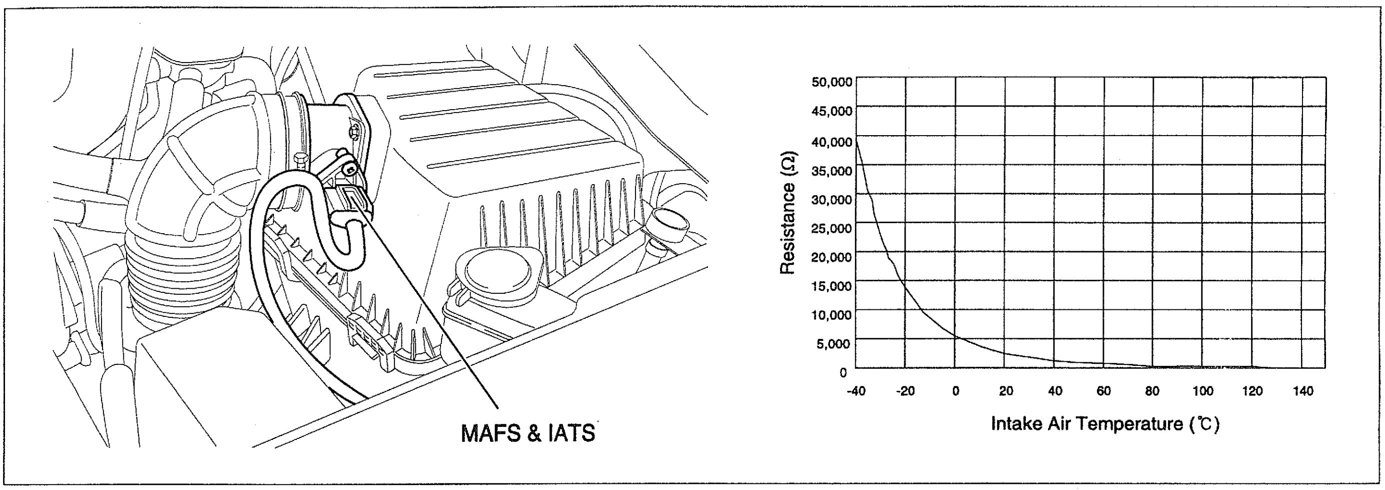
Yes	No	Repair or replace it.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF203V

TROUBLESHOOTING FOR DTC E771E34A

DTC	P1140	Intake Air Temperature Sensor (IATS) Circuit Malfunction
CC-CODE	0b	Signal low (Open circuit or short circuit to battery line)
	02	Signal high (Short circuit to ground)



EWMF201Z

DESCRIPTION

The intake air temperature sensor (IATS) is built in the mass air flowmeter sensor (MAFS). It is located between the air cleaner assembly and the throttle device. The IATS uses a thermistor whose resistance changes with the temperature to check the mass of intake air entering the engine.
The electrical resistance of the IATS decreases as the temperature increases, and increases as the temperature decreases. The 5 V power source in the ECM is supplied to the IATS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the IATS are connected in series. When the resistance value of the thermistor in IATS changes according to the intake air temperature, the signal voltage also changes. Using this signal, the information of the intake air temperature, the ECM corrects fuel flow, injection timing.

DTC DETECTING CONDITION

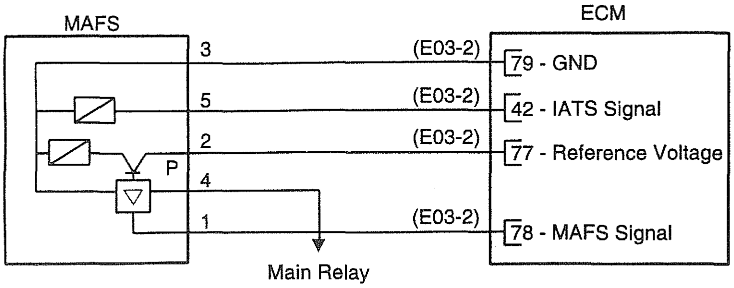
CC-CODE	Detecting Condition	Suspect Area
0b	• Intake air temperature < -49°C(-56.2°F)	• Open or short in IATS cirucit • IATS • ECM
02	• Intake air temperature > 130°C(266°F)	

SPECIFICATION

Temperature [°C (°F)]	-40(-40)	-20(-4)	0(32)	20(68)	40(104)	60(140)	80(176)
Resistance (kΩ)	39.3	13.9	5.5	2.4	1.2	0.6	0.3

[SCHEMATIC DIAGRAM]

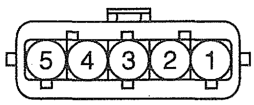
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

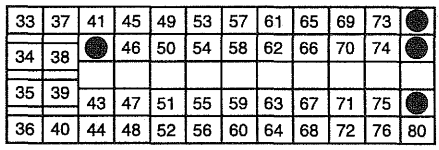
Terminal	Connected to	Function
1	ECM E03-2 (78)	MAFS Signal
2	ECM E03-2 (77)	Reference Voltage
3	ECM E03-2 (79)	Sensor Ground
4	Main Relay	Battery Voltage
5	ECM E03-2 (42)	IATS Signal

[HARNESS CONNECTORS]



E17

MAFS & IATS



E03-2

ECM

EWMF200A

INSPECTION PROCEDURE

1. CHECK IATS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

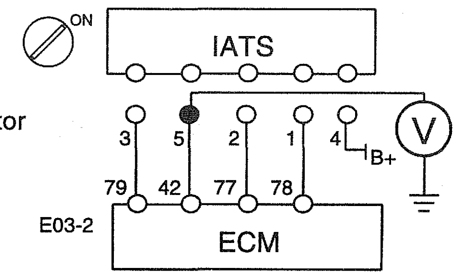
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK REFERENCE VOLTAGE TO IATS

1. Turn ignition switch to OFF and disconnect IATS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 5 of IATS harness connector and chassis ground.
   - **Specification: approximately 5V**



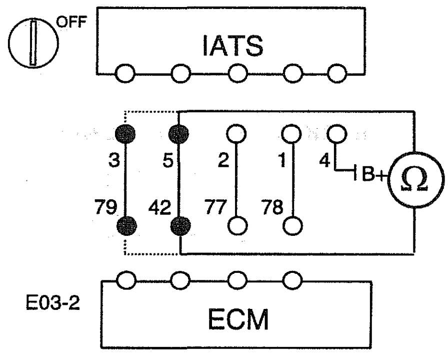
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and IATS connector.
2. Measure resistance between terminal 5 of IATS harness connector and terminal E03-2(42) of ECM harness connector.
3. Measure resistance between terminal 3 of IATS harness connector and terminal E03-2(79) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

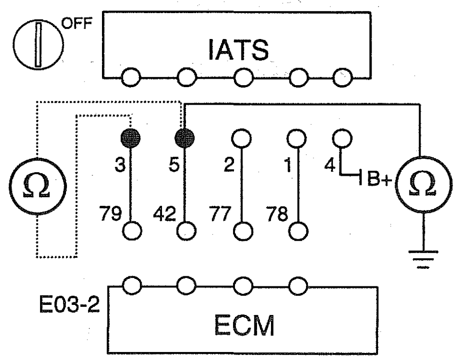
Yes

No	Repair open circuit in harness.

EWMF202B

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and IATS connector.
2. Measure resistance between terminal 5 of IATS harness connector and chassis ground.
3. Measure resistance between terminal 5 and 3 of IATS harness connector.
   - **Specification: infinite**



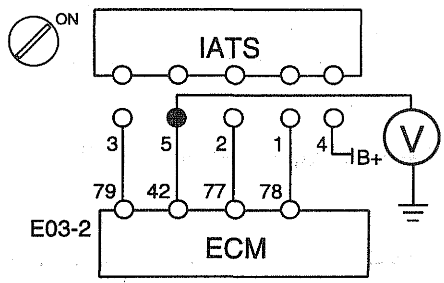
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and IATS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 5 of IATS harness connector and chassis ground.
   - **Specification: below 0.5V**



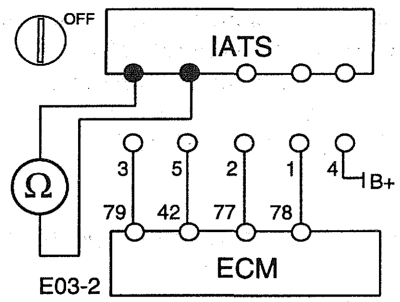
Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

6. CHECK IATS RESISTANCE

1. Turn ignition switch to OFF and disconnect IATS connector.
2. Measure resistance between terminal 5 and 3 of IATS connector.
   - **Refer to "SPECIFICATION" for more information.**



Is(Are) resistance(s) within specification?

Yes

No	Replace the IATS.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF202C

TROUBLESHOOTING FOR DTC E32031F0

DTC	P1150	Atmospheric Pressure Sensor Fault
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	03	Signal high (Short circuit to battery line)

DTC DETECTING CONDITION

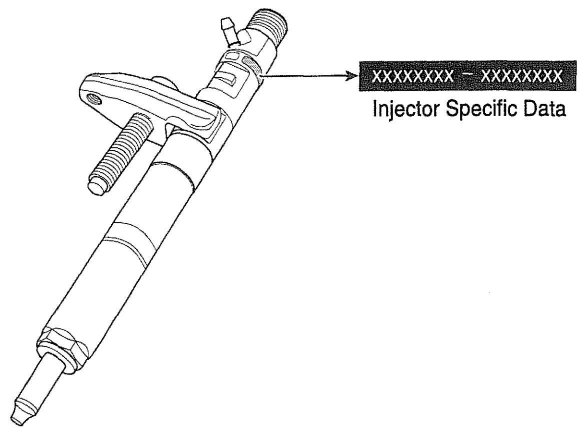
CC-CODE	Detecting Condition	Suspect Area
0a	• Atmospheric pressure < 0.43 kgf/cm^2	• Open or short in ECM internal circuit
03	• Atmospheric pressure > 1.08 kgf/cm^2	

INSPECTION PROCEDURE

Replace the ECM

TROUBLESHOOTING FOR DTC ED6BC73B

DTC	P1300	Injector Specific Data Fault
CC-CODE	04	Injector parameters incorrect



EWMF201X

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
04	• Incorrect injector specific data	• ECM

INSPECTION PROCEDURE

1. VERIFICATION OF INJECTOR SPECIFIC DATA

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Compare the injector specific data memorized in ECM memory with the one written on injector.

Are the two data same?

Yes

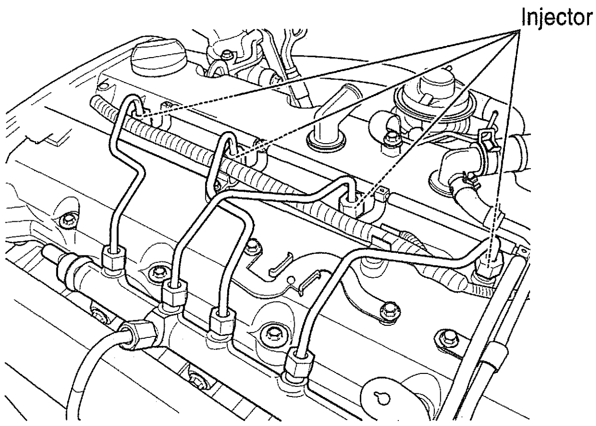
No	Input the injector specific data using Hi-Scan (Pro).

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF201Y

TROUBLESHOOTING FOR DTC E4BCBBF5

DTC	P1310	Injector Control Circuit Fault
CC-CODE	03	Short circuit to battery line
	02	Short circuit to ground



EWMF202M

DESCRIPTION

The injector of the Common Rail System is electronically controlled. It has been designed to allow multiple injection with short intervals, to be fully electronically controlled, and to release a small amount of heat. The nozzle of injector opens when the solenoid valve is triggered and permits the flow of fuel. They inject the fuel directly into the engine's combustion chamber. The fuel is stored in the Rail ready for injection and the injected fuel quantity is defined by the injector opening time and the rail pressure.

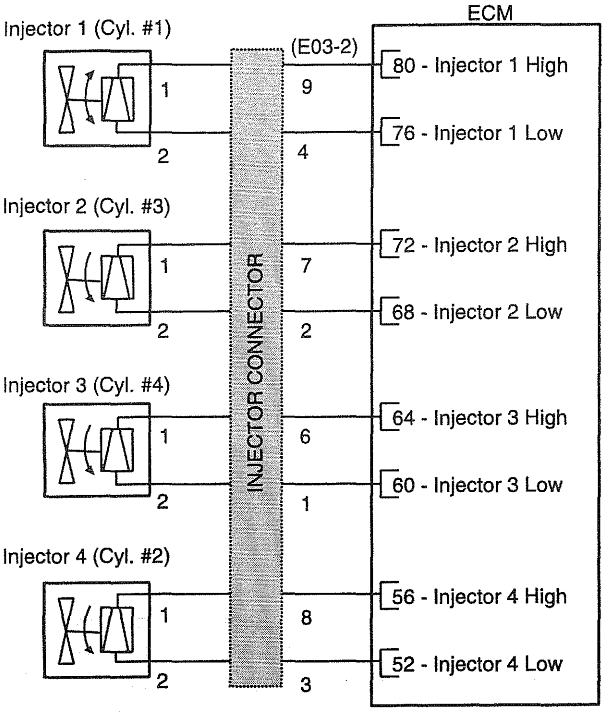
The excess fuel, which was needed for opening the nozzle of injector, flows back to the tank through a collector line. The return fuel from the pressure-control valve and from the low-pressure stage is also led into this collector line together with the fuel used to lubricate the high-pressure pump.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
03	• Short to battery line in injector circuit	• Open or short in injector • Injector • ECM
02	• Short to ground in injector circuit	

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1 (Cylinder #1)

Terminal	Injector Connector	Connected to	Function
1	7	ECM E03-2 (80)	Injector1 (Cyl. #1) High
2	2	ECM E03-2 (76)	Injector1 (Cyl. #1) Low

Injector #2 (Cylinder #3)

Terminal	Injector Connector	Connected to	Function
1	9	ECM E03-2 (72)	Injector2 (Cyl. #3) High
2	4	ECM E03-2 (68)	Injector2 (Cyl. #3) Low

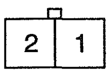
Injector #3 (Cylinder #4)

Terminal	Injector Connector	Connected to	Function
1	10	ECM E03-2 (64)	Injector3 (Cyl. #4) High
2	5	ECM E03-2 (60)	Injector3 (Cyl. #4) Low

Injector #4 (Cylinder #2)

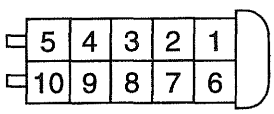
Terminal	Injector Connector	Connected to	Function
1	8	ECM E03-2 (56)	Injector4 (Cyl. #2) High
2	3	ECM E03-2 (52)	Injector4 (Cyl. #2) Low

[HARNESS CONNECTORS]

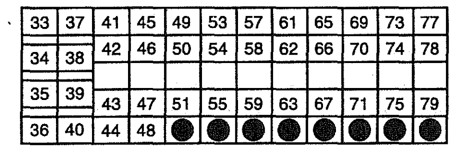


E157

INJECTOR



INJECTOR CONNECTOR



E03-2

ECM

EWMF202N

INSPECTION PROCEDURE

1. CHECK INJECTOR AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK INJECTOR

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

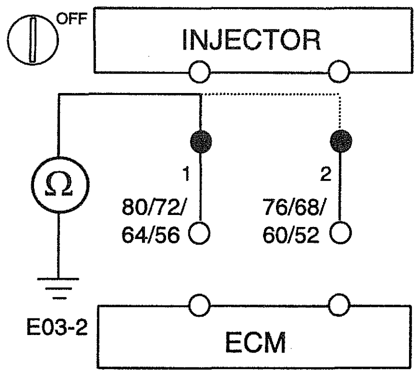
Is this problem fixed?

No

Yes	1. Delete the DTC P1310, and then turn ignition switch to OFF and connect the injector connector again. 2. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC). 3. Turn ignition switch to ON and check again that any other DTC(s) is (are) detected. • **If the DTC P1310 occurs again, replace the injector (injector fault).**

3. CHECK FOR SHORT TO GROUND IN HARNESS

1. TTurn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect ECM and injector connector.
3. Measure resistance between terminal 1 of injector harness connector and chassis ground.
4. Measure resistance between terminal 2 of injector harness connector and chassis ground.
   - **Specification: infinite**



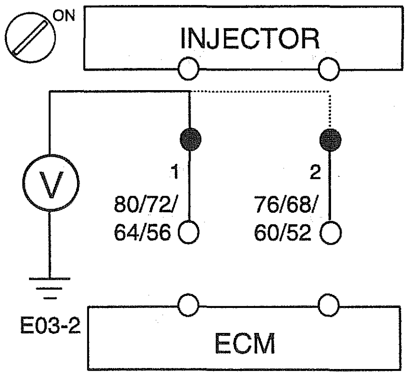
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

EWMF202V

4. CHECK FOR SHORT TO POWER IN HARNESS



1. Turn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect ECM and injector connector.
3. Turn ignition switch to ON.
4. Measure voltage between terminal 1 of injector harness connector and chassis ground.
5. Measure voltage between terminal 2 of injector harness connector and chassis ground.
   - **Specification: below 0.5V**

Is(Are) voltage(s) within specification?

Yes

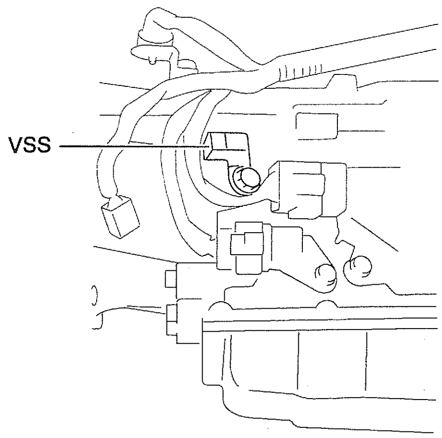
No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF202W

TROUBLESHOOTING FOR DTC EC685BE5

DTC	P1500	Vehicle Speed Sensor (VSS) Circuit Malfunction
CC-CODE	06	Abnormal signal after running
	06	Abnormal signal after running
	06	Abnormal signal after running
	07	No signal before running



EWMF203Z

DESCRIPTION

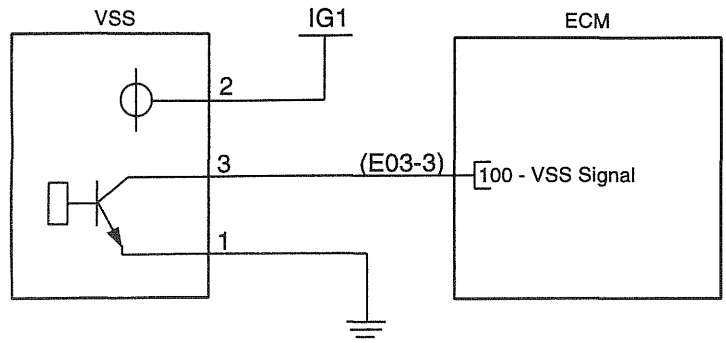
The function of vehicle speed sensor (VSS) is to sense the tooth signal in T/M housing (4 pulses signal for every revolution of the rotor shaft) and send relevant signal to the Engine control module(ECM). The signal is used for computing the vehicle speed and the speed display on the tachometer as well.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
06	• Open or short in VSS circuit • VSS fault	• Open or short in VSS ciruit • VSS • ECM
07		

[SCHEMATIC DIAGRAM]

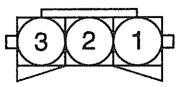
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

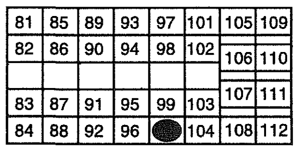
Terminal	Connected to	Function
1	Chassis Ground	Sensor Ground
2	IG	Battery Voltage
3	ECM E03-3 (100)	VSS Signal

[HARNESS CONNECTORS]



C01

VSS



E03-3

ECM

EWMF204A

INSPECTION PROCEDURE

1. CHECK VSS AND ECM CONNECTORS

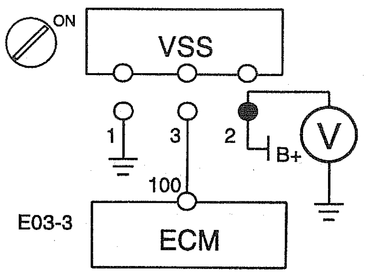
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes	No	Repair or replace it.

2. CHECK POWER TO VSS

1. Turn ignition switch to OFF and disconnect VSS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 2 of VSS harness connector and chassis ground.
   - **Specification: approximately B+**

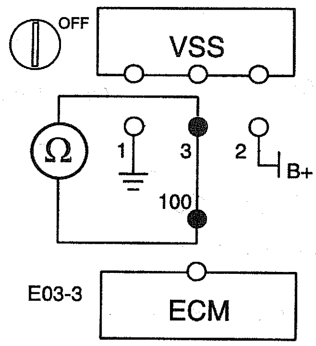


Is(Are) voltage(s) within specification?

Yes	No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and VSS connector.
2. Measure resistance between terminal 3 of VSS harness connector and terminal E03-3(100) of ECM harness connector.
   - **Specification: below 1Ω**



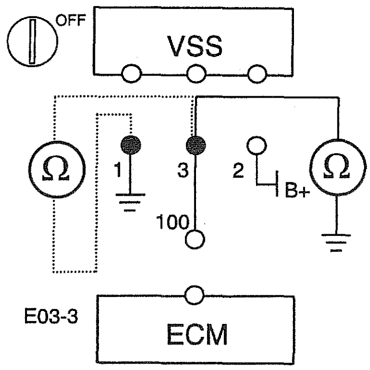
Is(Are) resistance(s) within specification?

Yes	No	Repair open circuit in harness.

EWMF204B

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and VSS connector.
2. Measure resistance between terminal 3 of VSS harness connector and chassis ground.
3. Measure resistance between terminal 3 and 1 of VSS harness connector.
   - **Specification: below 1Ω**

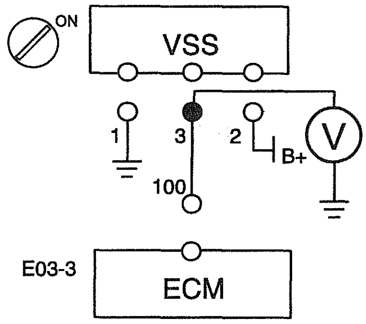


Is(Are) resistance(s) within specification?

Yes	No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and VSS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 3 of VSS harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes	No	Repair short to power in harness.

6. CHECK VSS

1. Replace the VSS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

Yes	No	Replace the VSS.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF204C

DTC DETECTING CONDITION ECD3F5BE

DTC	P1543	Brake Switch Signal Fault
CC-CODE	03	Short to battery line in brake switch 1 circuit
	02	Short to gound in brake switch 1 circuit
	0a	Short to battery line in brake switch 2 circuit
	0b	Short to gound in brake switch 2 circuit
	0c	Barke 1/2 signal incoherent

DESCRIPTION

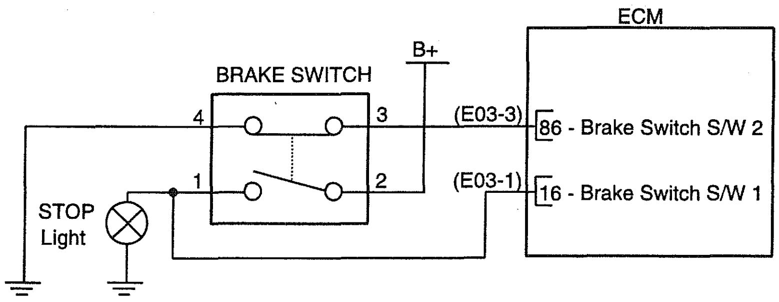
Brake has an energy-absorbing mechanism that converts vehicle movement into heat to stop rotating wheels. Braking system is designed to reduce the speed and stop moving vehicle. The driver exerts a force on a brake pedal and the force on the brake pedal pressurizes brake fluid in a master cylinder. This hydraulic force is transferred through steel lines to a wheel cylinder at each wheel. Hydraulic pressure to each wheel cylinder is used to force friction materials against the brake drum. The ECM senses the state of brake operating through brake switch.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
02	• Short to battery line in brake switch 1 circuit	• Open or short in Brake Switch ciruict • Brake Switch • Brake Pedal • ECM
03	• Short to ground in brake switch 1 circuit	
0a	• Short to battery line in brake switch 2 circuit	
0b	• Short to ground in brake switch 2 circuit	
0c	• Incoherent brake switch 1/2 signal	

[SCHEMATIC DIAGRAM]

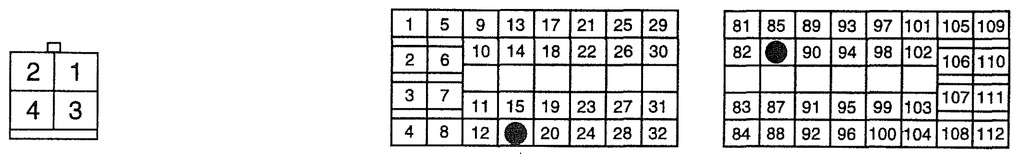
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-1 (16)	Brake Switch 1
	STOP Light	-
2	Battery	Battery Voltage
3	ECM E03-3 (86)	Brake Switch 2
4	Chassis Ground	Ground

[HARNESS CONNECTORS]



M11 E03-1 E03-3

BRAKE SWITCH ECM

EWMF203B

INSPECTION PROCEDURE

1. CHECK BRAKE SWITCH AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

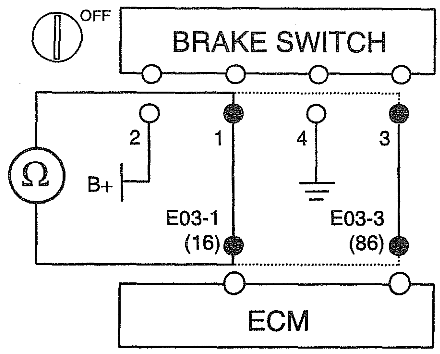
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and brake switch connector.
2. Measure resistance between terminal 1 of brake switch harness connector and terminal E03-1(16) of ECM harness connector.
3. Measure resistance between terminal 3 of brake switch harness connector and terminal E03-3(86) of ECM harness connector.
   - **Specification: below 1Ω**



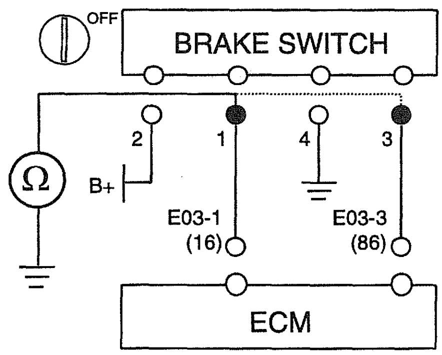
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.

3. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and brake switch connector.
2. Measure resistance between terminal 1 of brake switch harness connector and chassis ground.
3. Measure resistance between terminal 3 of brake switch harness connector and chassis ground.
   - **Specification: infinite**



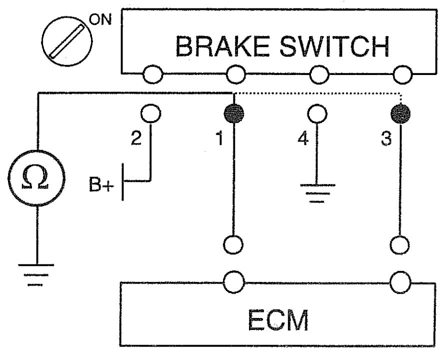
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

EWMF203C

4. CHECK FOR SHORT TO POWER IN HARNESS



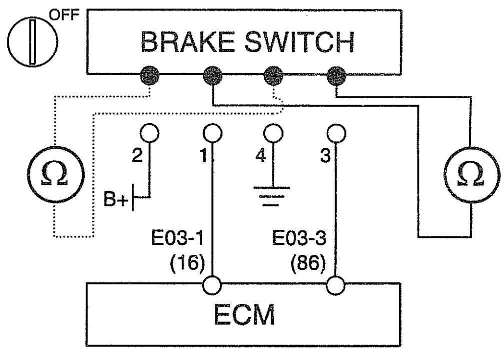
1. Turn ignition switch to OFF, and then disconnect ECM and brake switch connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of brake switch harness connector and chassis ground.
4. Measure voltage between terminal 3 of brake switch harness connector and chassis ground.
   - **Specification: below 0.5V**

Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

5. CHECK BRAKE SWITCH



1. Turn ignition switch OFF and check resistance of brake switch.

- **In case the brake pedal is released**
  - **Between the terminals 1 and 2 of brake S/W connector : infinite**
  - **Between the terminals 3 and 4 of brake S/W connector : below 1Ω**
- **In case the brake pedal is depressed**
  - **Between the terminals 1 and 2 of brake S/W connector : below 1Ω**
  - **Between the terminals 3 and 4 of brake S/W connector : infinite**

Is resistance within specification?

Yes

No	Replace the brake switch.

6. CHECK BRAKE PEDAL

1. Inspect operation condition and free-play of brake pedal.
   - **Refer to the group "BR" in this Shop Manual.**

Does the brake pedal have normal condition?

Yes

No	Replace the brake pedal.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF203D

TROUBLESHOOTING FOR DTC E59F6CB6

DTC	P1608	ECM Fault
CC-CODE	81	ECM internal fault
	82	ECM internal fault
	82	ECM internal fault
	82	ECM internal fault

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
81	• Digital/Analog converter fault	• ECM
82		

INSPECTION PROCEDURE

• Relace the ECM

EWMF213D

TROUBLESHOOTING FOR DTC E5EF0BC6

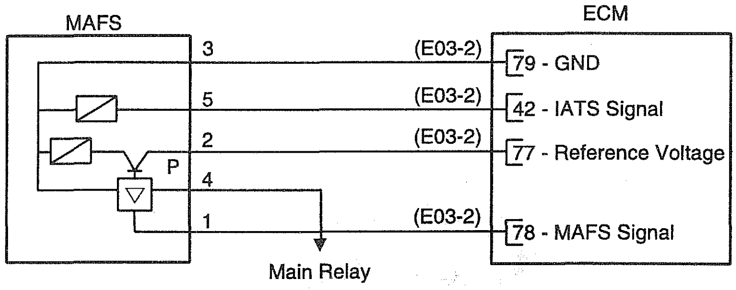
DTC	P1610	Sensor External Voltage Fault
CC-CODE	08	Sensor supply voltage too low
	09	Sensor supply voltage too high

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
08	• Sensor reference voltage < 4.8V	• Short to battery line or ground in MAFS/APS1/RPS/CMPS supply line
09	• Sensor reference voltage > 5.2V	

[SCHEMATIC DIAGRAM] 〈1〉 MASS AIR FLOW SENSOR (MAFS)

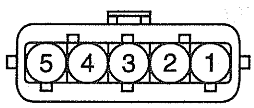
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

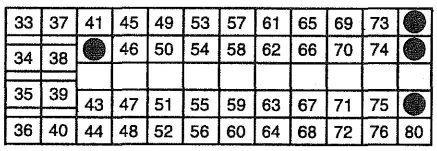
Terminal	Connected to	Function
1	ECM E03-2 (78)	MAFS Signal
2	ECM E03-2 (77)	Reference Voltage
3	ECM E03-2 (79)	Sensor Ground
4	Main Relay	Battery Voltage
5	ECM E03-2 (42)	IATS Signal

[HARNESS CONNECTORS]



E17

MAFS & IATS



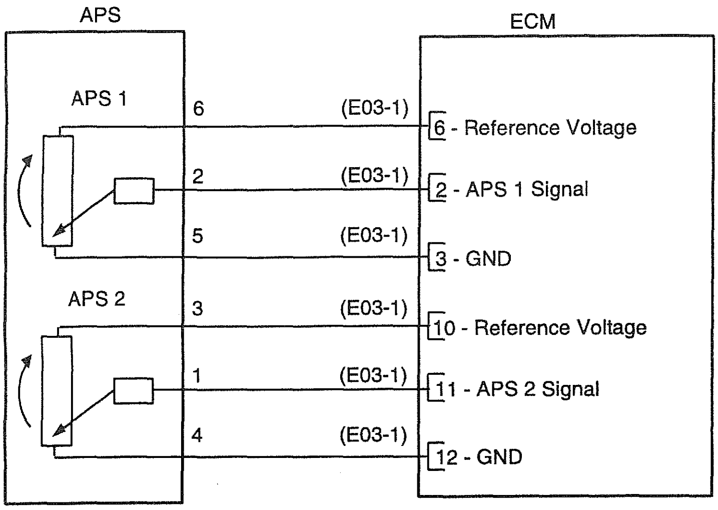
E03-2

ECM

EWMF200A

[SCHEMATIC DIAGRAM] 〈2〉 ACCELERATOR POSITION SENSOR (APS) 1

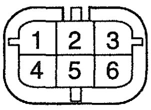
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

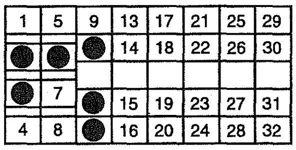
Terminal	Connected to	Function
1	ECM E03-1 (11)	APS 2 Signal
2	ECM E03-1 (2)	APS 1 Signal
3	ECM E03-1 (10)	Reference Voltage
4	ECM E03-1 (12)	Sensor Ground
5	ECM E03-1 (3)	Sensor Ground
6	ECM E03-1 (6)	Reference Voltage

[HARNESS CONNECTORS]



M07

ECTS



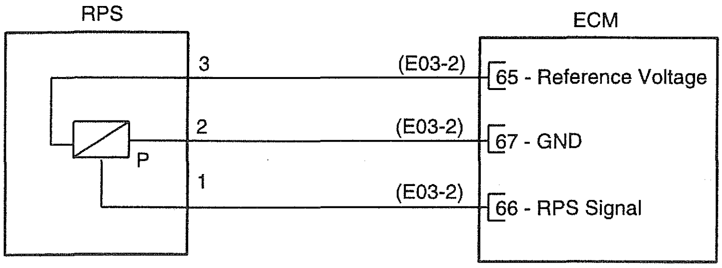
E03-1

ECM

EWMF200G

[SCHEMATIC DIAGRAM] 〈3〉 RAIL PRESSURE SENSOR (RPS)

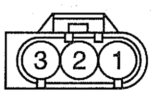
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

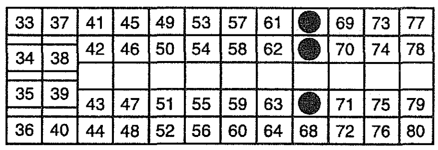
Terminal	Connected to	Function
1	ECM E03-2 (66)	RPS Signal
2	ECM E03-2 (67)	Sensor Ground
3	ECM E03-2 (65)	Reference Voltage

[HARNESS CONNECTORS]



E88

RPS



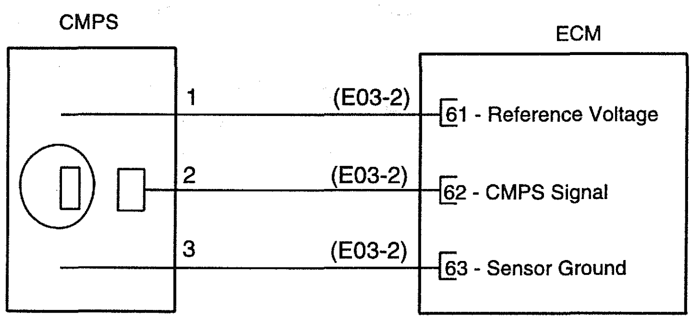
E03-2

ECM

EWMF200S

[SCHEMATIC DIAGRAM] 〈4〉 CAMSHAFT POSITION SENSOR (CMPS)

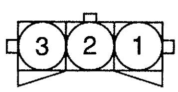
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

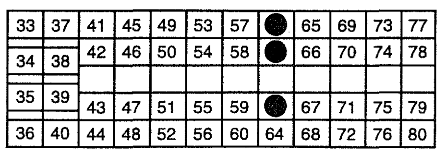
Terminal	Connected to	Function
1	ECM E03-2 (61)	Reference Voltage
2	ECM E03-2 (62)	CMPS Signal
3	ECM E03-2 (63)	Sensor Ground

[HARNESS CONNECTORS]



E90

CMPS



E03-2

ECM

EWMF201D

INSPECTION PROCEDURE

1. CHECK DTC

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Is(Are) any DTC(s) related to MAFS, APS 1, RPS or CMPS also set?

NO

YES	Do all repairs associated with those codes before proceeding with this procedure.

2. CHECK MAFS, APS 1, RPS, CMPS AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

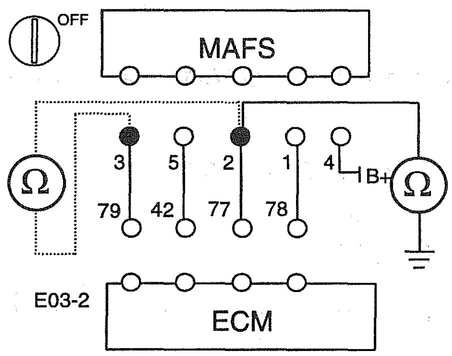
Are all connectors good?

Yes

No	Repair or replace it.

3-1. CHECK FOR SHORT TO GROUND IN HARNESS (MAFS)

1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Measure resistance between terminal 2 of MAFS harness connector and chassis ground.
3. Measure resistance between terminal 2 and 3 of MAFS harness connector.
   - **Specification: infinite**



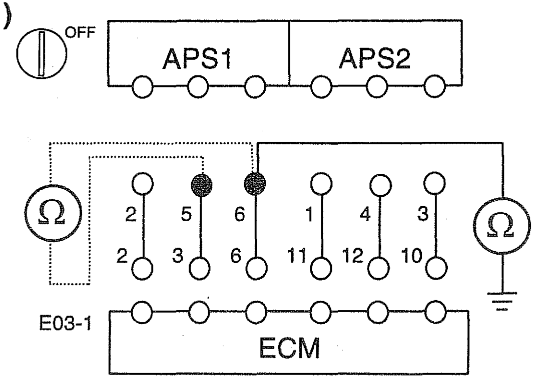
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

EWMF203E

3-2. CHECK FOR SHORT TO GROUND IN HARNESS (APS 1)



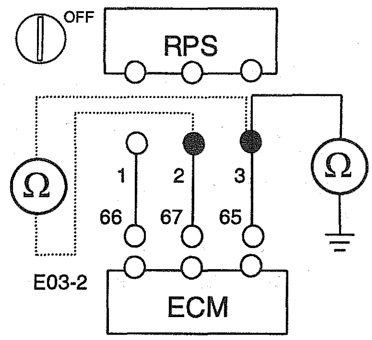
1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
2. Measure resistance between terminal 6 of APS harness connector and chassis ground.
3. Measure resistance between terminal 6 and 5 of APS harness connector.
   - **Specification: infinite**

Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

3-3. CHECK FOR SHORT TO GROUND IN HARNESS (RPS)



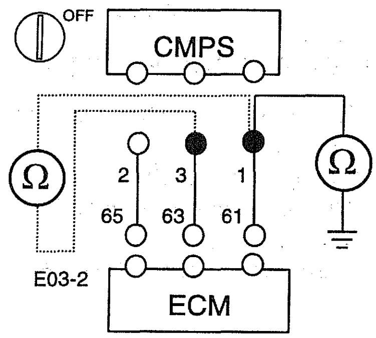
1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Measure resistance between terminal 3 of RPS harness connector and chassis ground.
3. Measure resistance between terminal 3 and 2 of RPS harness connector.
   - **Specification: infinite**

Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

3-4. CHECK FOR SHORT TO GROUND IN HARNESS (CMPS)



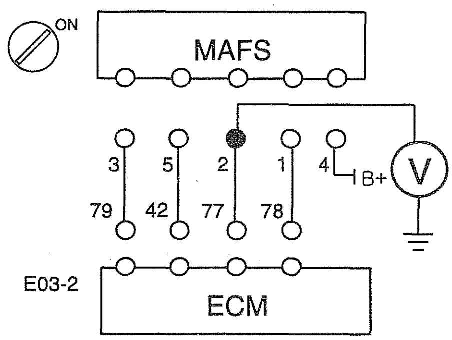
1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Measure resistance between terminal 1 of CMPS harness connector and chassis ground.
3. Measure resistance between terminal 1 and 3 of CMPS harness connector.
   - **Specification: infinite**

Is(Are) resistance(s) within specification?

EWMF203F

Yes	No	Repair short or short to chassis ground in harness.

4-1. CHECK FOR SHORT TO POWER IN HARNESS (MAFS)

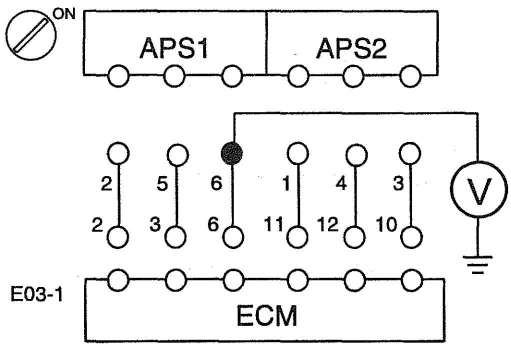


1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of MAFS harness connector and chassis ground.
   - **Specification: below 0.5V**

Is(Are) voltage(s) within specification?

Yes	No	Repair short to power in harness.

4-2. CHECK FOR SHORT TO POWER IN HARNESS (APS 1)

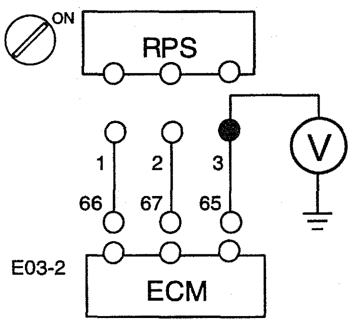


1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 6 of APS harness connector and chassis ground.
   - **Specification: below 0.5V**

Is(Are) voltage(s) within specification?

Yes	No	Repair short to power in harness.

4-3. CHECK FOR SHORT TO POWER IN HARNESS (RPS)



1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 3 of RPS harness connector and chassis ground.
   - **Specification: below 0.5V**

Is(Are) voltage(s) within specification?

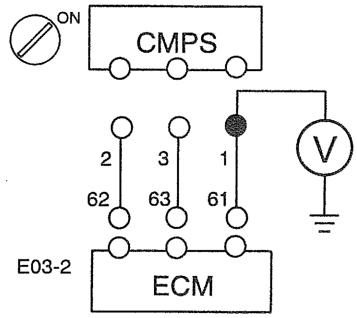
EWMF203G

Yes

No	Repair open circuit in harness.

4-4. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of CMPS harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?"

Yes

No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF203X

TROUBLESHOOTING FOR DTC EF5AE540

DTC	P1614	ECM Programming Error
CC-CODE	85	ECM internal fault
	83	ECM internal fault
	8b	ECM internal fault
	88	ECM internal fault
	87	ECM internal fault
	8a	ECM internal fault
	8c	ECM internal fault
	8a	ECM internal fault

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
85	• Impossibility of reading on the EEPROM	• Injector control line • ECM
83	• Impossibility of writing on the EEPROM	
8b	• Electrical interference on the injector control line	
88	• Fault in the calibration file or in the software.	
87	• One or more cells are found to be defective during the testing of the cells of the entire RAM used by the ECM • Incorrect injector specific data	
8a	• Watchdog operation fault	
8c		
8a		

INSPECTION PROCEDURE

[CASE 1] CC-CODE 8a, 8c, 83, 85, 87, 88

- Relace the ECM

EWMF213D

[CASE 2] CC-CODE 8b

1. VERIFICATION OF INJECTOR SPECIFIC DATA

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Compare the injector specific data memorized in ECM memory with the one written on injector.

Are the two data same?

NO

YES	Input the injector specific data using Hi-Scan (Pro).

2. CHECK INJECTOR CONTROL LINE

1. Inspect the wiring harness between the injector and ECM.

Does this wiring harness have normal condition?"

Yes

No	Repair or replace the wiring harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF203I

TROUBLESHOOTING FOR DTC E6981CE4

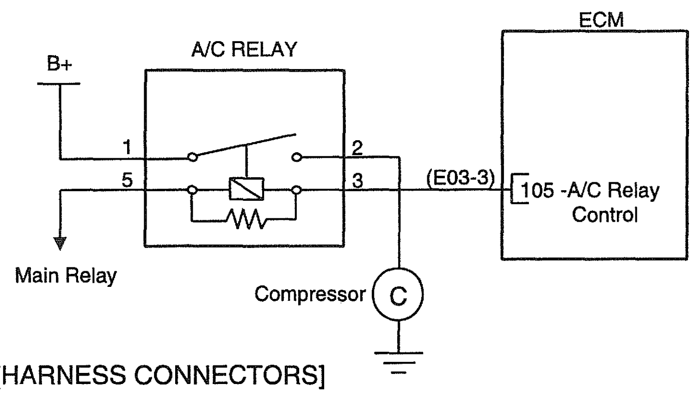
DTC	P1620	A/C Relay Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in A/C relay circuit	• Open or short in A/C Relay cirucit • A/C Relay • ECM
03	• Short to battery line in A/C relay circuit	

[SCHEMATIC DIAGRAM]

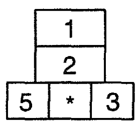
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

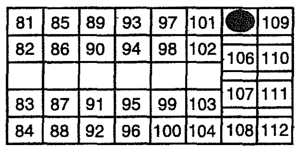
Terminal	Connected to	Function
1	Battery	Battery Voltage
2	Compressor	Compressor Power Supply
3	ECM E03-3 (105)	A/C Relay Control
4	-	-
5	Main Relay	Battery Voltage

[HARNESS CONNECTORS]



E121

AIC RELAY



E03-3

ECM

EWMF203K

INSPECTION PROCEDURE

1. CHECK A/C RELAY AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

NO

YES	Repair or replace it.

2. CHECK A/C RELAY

1. Turn ignition switch to OFF and remove the A/C relay.
2. Apply power to the terminal 5 and ground termnal 3 of A/C relay.
3. Check if A/C relay works well.
   (If A/C relay works normally, a "click" sound can be heard).

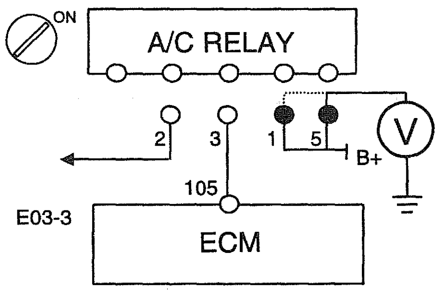
Does the A/C relay operate normally?

Yes

No	Replace the glow plug relay

3. CHECK POWER TO A/C RELAY

1. Turn ignition switch to OFF and disconnect A/C relay connector.
2. Turn ignition switch to ON
3. Measure voltage in harness between terminal 1 of A/C relay harness connector and chassis ground.
4. Measure voltage in harness between terminal 5 of A/C relay harness connector and chassis ground.
   - **Specification: approximately B+**



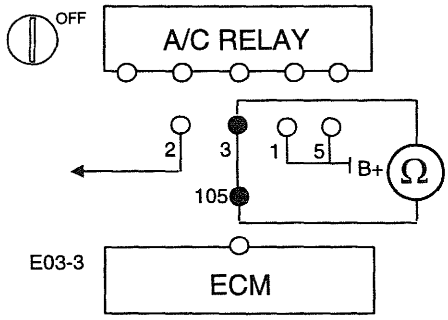
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and A/C relay connector.
2. Measure resistance between terminal 3 of A/C relay harness connector and terminal E03-3(105) of ECM harness connector.
   - **Specification: below 1Ω**



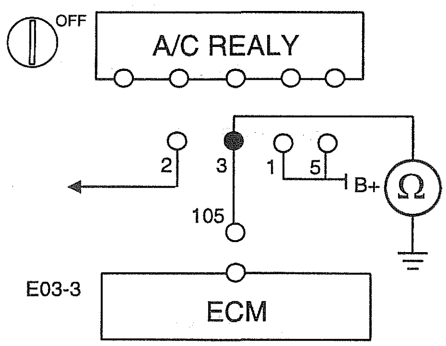
Is(Are) resistance(s) within specification?

EWMF203L

Yes	No	Repair open circuit in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and A/C relay connector.
2. Measure resistance between terminal 3 of A/C relay harness connector and chassis ground.
   - **Specification: infinite**

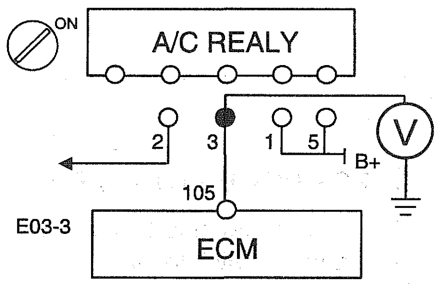


Is(Are) resistance(s) within specification?

Yes	No	Repair short or short to chassis ground in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and A/C relay connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 3 of A/C relay harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes	No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF203M

TROUBLESHOOTING FOR DTC EEC4BFF4

DTC	P1640	Main Relay Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	0b	Short circuit to battery line

DESCRIPTION

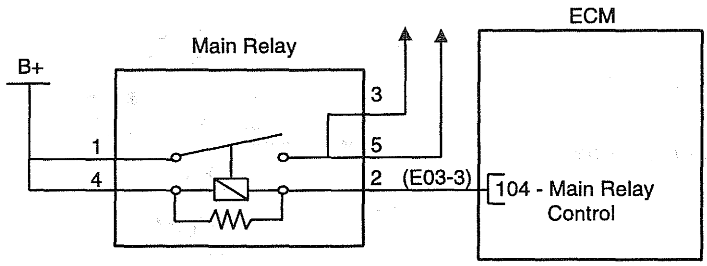
The charging system includes a battery, generator with a built in regulator, the charging indicator light, and connecting wiring. The generator uses diodes to rectify alternating current (AC) to direct current (DC). The ECM provides ground to one side of coil of main relay and the other side is connected to battery. The ECM monitors battery voltage and the voltage after main relay.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in main relay circuit	• Open or short in Main Relay ciruict • Main Relay • ECM
0b	• Short to battery line in main relay circuit	

[SCHEMATIC DIAGRAM]

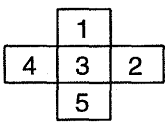
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

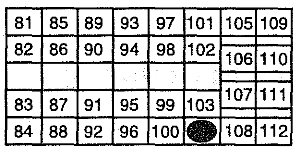
Terminal	Connected to	Function
1	Battery	Battery Voltage
2	ECM E03-3 (104)	Main Relay Control
3	-	-
4	Battery	Battery Voltage
5	-	-

[HARNESS CONNECTORS]



E113

MAIN RELAY



E03-3

ECM

EWMF201P

INSPECTION PROCEDURE

1. CHECK MAIN RELAY AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

YES

NO	Repair or replace it.

2. CHECK MAIN RELAY

1. Turn ignition switch to OFF and remove the main relay.
2. Apply power to the terminal 4 and ground termnal 2 of main relay.
3. Check if main relay works well.
   (If main relay works normally, a "click" sound can be heard).
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Does the main relay operate normally?

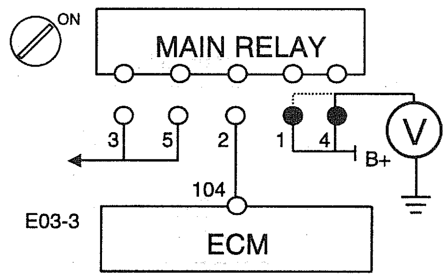
Yes

No	Replace the glow plug relay

3. CHECK POWER TO MAIN RELAY

1. Turn ignition switch to OFF and disconnect main relay connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 4 of main relay harness connector and chassis ground.
4. Measure voltage in harness between terminal 1 of main relay harness connector and chassis ground.
   - **Specification: approximately B+**

Is(Are) voltage(s) within specification?



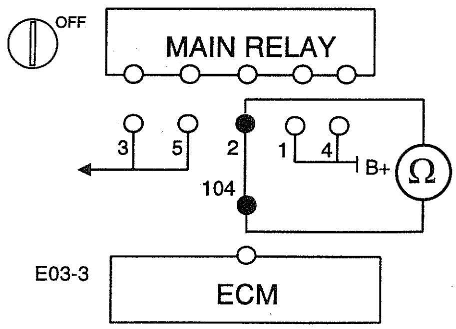
Yes

No	Replace the glow plug relay

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Measure resistance between terminal 2 of main relay harness connector and terminal E03-3(104) of ECM harness connector.
   - **Specification: below 1Ω**

Ils(Are) resistance(s) within specification?



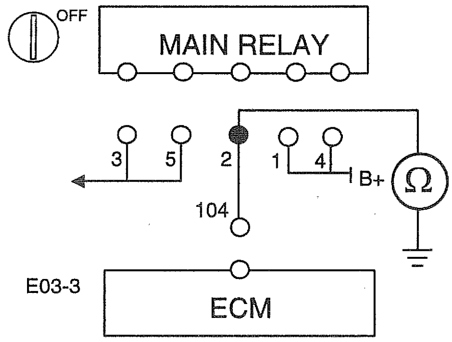
EWMF202I

Yes

No	Repair open or short circuit in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Measure resistance between terminal 2 of main relay harness connector and chassis ground.
   - **Specification: infinite**



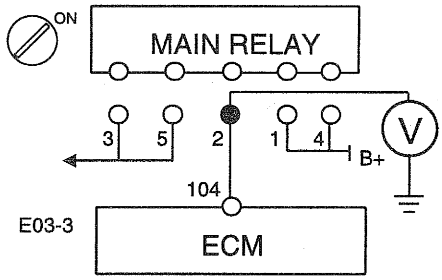
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of main relay harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF202J

TROUBLESHOOTING FOR DTC E0FE59FA

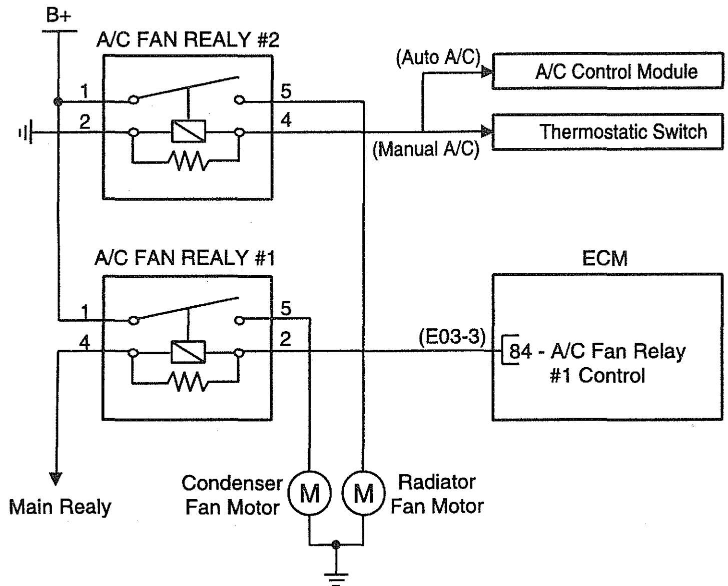
DTC	P1674	A/C Fan Relay Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in A/C fan relay circuit	• Open or short in A/C Fan Relay ciruicit • A/C Fan Relay • ECM
03	• Short to battery line in A/C fan relay circuit	

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

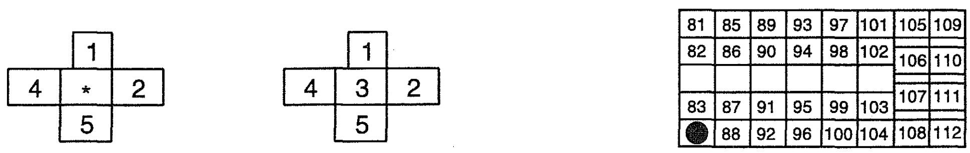
A/C FAN REALY #2

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	Chassis Ground	Ground
3	-	-
4	(Auto A/C) A/C Control Module (Manual A/C) Thermostatic Switch	A/C Fan Relay #2 Control
5	Radiator Fan Motor	Motor Power Supply

A/C FAN REALY #1

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	ECM E03-3 (84)	A/C Fan Relay #1 Control
3	-	-
4	Main Relay	Battery Voltage
5	Condenser Fan Motor	Motor Power Supply

[HARNESS CONNECTORS]



E110 A/C FAN REALY #1

E111 A/C FAN REALY #2

E03-3 ECM

EWMF603K

INSPECTION PROCEDURE

1. CHECK A/C FAN RELAY #1 AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK A/C FAN RELAY #1

1. Turn ignition switch to OFF and remove the A/C fan realy #1.
2. Apply power to the terminal 3 and ground termnal 5 of A/C fan realy #1.
3. Check if A/C fan realy #1 works well.
   (If A/C fan realy #1 works normally, a "click" sound can be heard).

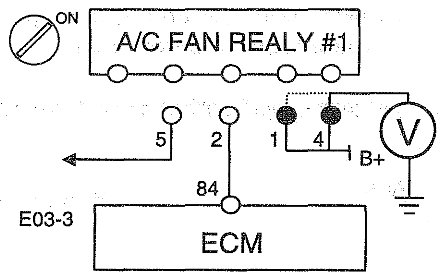
Does the A/C fan realy #1 operate normally?

Yes

No	Replace the glow plug relay

3. CHECK POWER TO A/C FAN RELAY #1

1. Turn ignition switch to OFF and disconnect A/C fan realy #1 connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of A/C fan realy #1 harness connector and chassis ground.
4. Measure voltage in harness between terminal 4 of A/C fan realy #1 harness connector and chassis ground.
   - **Specification: approximately B+**



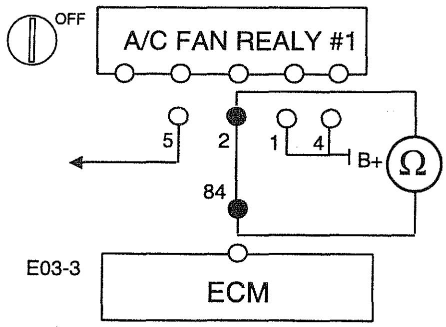
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and A/C fan realy #1 connector.
2. Measure resistance between terminal 2 of A/C fan realy #1 harness connector and terminal E03-3(84) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

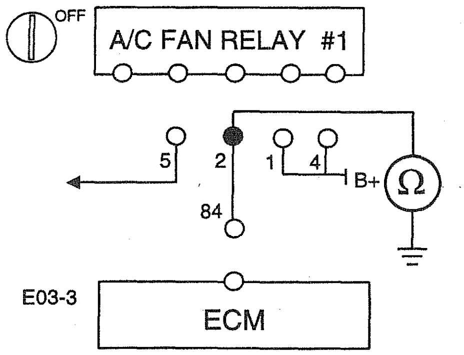
EWMF2030

Yes

No	Repair open circuit in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and A/C fan realy #1 connector.
2. Measure resistance between terminal 2 of A/C fan realy #1 harness connector and chassis ground.
   - **Specification: infinite**



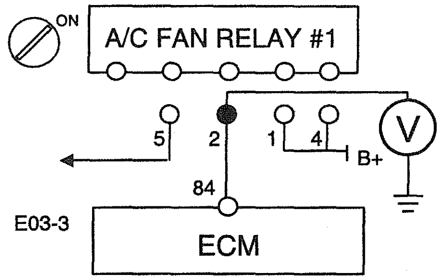
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

1. 1. Turn ignition switch to OFF, and then disconnect ECM and A/C fan realy #1 connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of A/C fan realy #1 harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF2031

TROUBLESHOOTING FOR DTC ED5C53BD

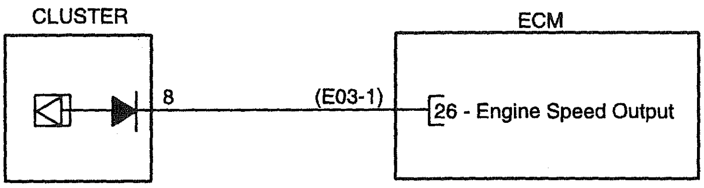
DTC	P1786	Tachometer Output Fault
CC-CODE	0a	Signal low (Short cirucit to ground)
	03	Signal high (Short cirucit to battery line)

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in tachometer output circuit	• Open or short in Tachometer Output cirucit • ECM
03	• Short to battery line in tachometer output circuit	

[SCHEMATIC DIAGRAM]

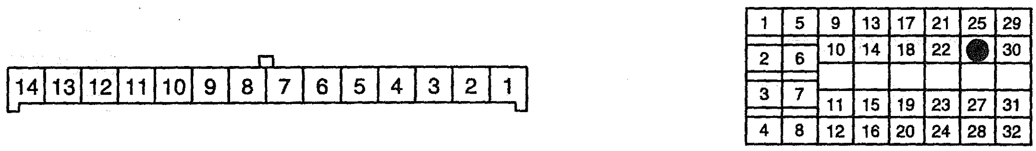
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
8	ECM E03-1 (26)	Engine Speed Output

[HARNESS CONNECTORS]



I03-1 **E03-1**

CLUSTER **ECM**

EWMF203N

INSPECTION PROCEDURE

1. CHECK CLUSTER AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to ""CONNECTOR INSPECTION PROCEDURE"" in BASIC INSPECTION PROCEDURE.**

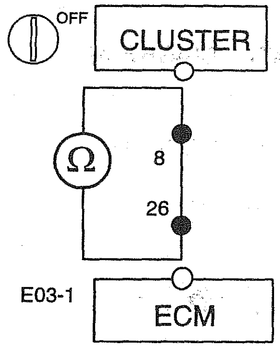
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and cluster connector.
2. Measure resistance between terminal I03-1(8) of cluster harness connector and terminal E03-1(26) of ECM harness connector.
   - **Specification: below 1Ω**



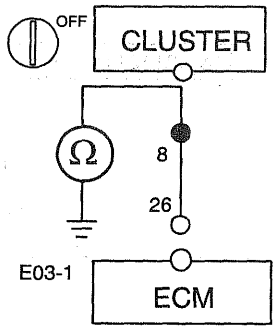
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.

3. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and cluster connector.
2. Measure resistance between terminal I03-1(8) of cluster harness connector and chassis ground.
   - **Specification: infinite**



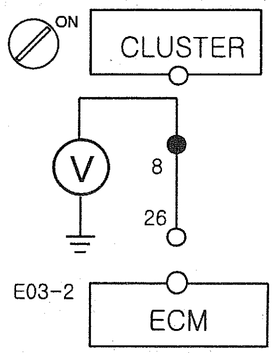
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

EWMF203O

4 . CHECK FOR SHORT TO POWER IN HARNESS



1. Turn ignition switch to OFF, and then disconnect ECM and cluster connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal I03-1(8) of cluster harness connector and chassis ground.
   - **Specification: below 0.5V**

Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF203P

TROUBLESHOOTING FOR DTC E61190DB

DTC	P2264	Water Sensor Circuit Malfunction
CC-CODE	0b	Permanent low level

DESCRIPTION

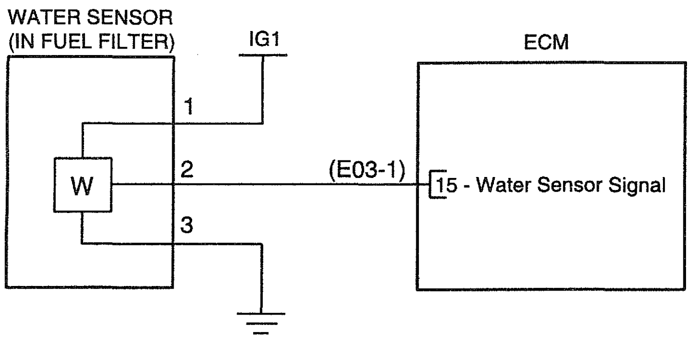
Water Sensor is located in the fuel filter assembly and senses water in fuel. When water is detected, the ECM turns the Indicator Lamp in cluster on.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0b	• Open or short to ground in water sensor circuit	• Open or short in Water Sensor cirucit • Water Sensor • ECM

[SCHEMATIC DIAGRAM]

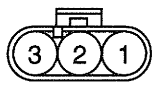
[CIRCUIT DIAGRAM]



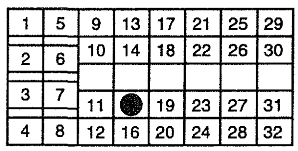
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	IG1	Battery Voltage
2	ECM E03-1 (15)	Water Sensor Signal
3	Chassis Ground	Sensor Ground

[HARNESS CONNECTORS]



WATER SENSOR (IN FUEL FILTER)



E03-1

ECM

EWMF603A

INSPECTION PROCEDURE

1. CHECK WATER SENSOR AND ECM CONNECTORS

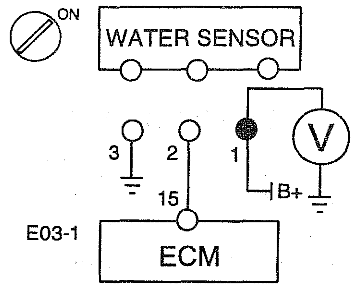
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK POWER TO WATER SENSOR



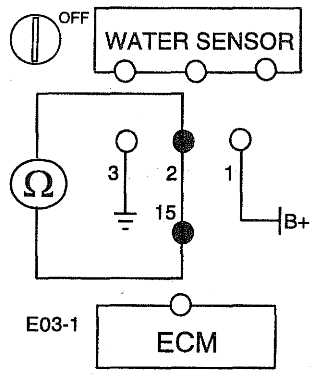
1. Turn ignition switch to OFF and disconnect water sensor connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of water sensor harness connector and chassis ground.
   - **Specification: approximately B+**

Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS



1. Turn ignition switch to OFF, and then disconnect ECM and water sensor connector.
2. Measure resistance between terminal 2 of water sensor harness connector and terminal E03-1(15) of ECM harness connector.
   - **Specification: below 1Ω**

Is(Are) resistance(s) within specification?

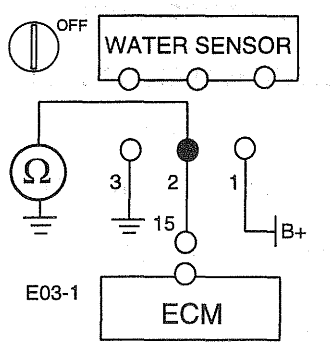
Yes

No	Repair open circuit in harness.

EWMF2010

4 . CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and water sensor connector.
2. Measure resistance between terminal 2 of water sensor harness connector and chassis ground.
   - **Specification: infinite**

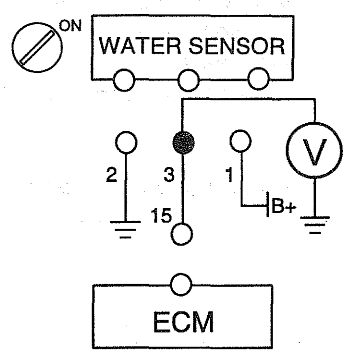


Is(Are) resistance(s) within specification?

Yes	No	Repair short or short to chassis ground in harness.

5 . CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and water sensor connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of water sensor harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes	No	Repair short to power in harness.

6 . CHECK WATER SENSOR

1. Replace the water sensor with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

Yes	No	Replace the water sensor.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF2011

TROUBLESHOOTING FOR DTC EEC2D86D

DTC	P2269	Water in Fuel Filter Indicator Lamp Circuit Malfunction
CC-CODE	0a	Signal low (Open cirucit or short circuit to ground)
	03	Signal high (Short circuit to battery line)

DESCRIPTION

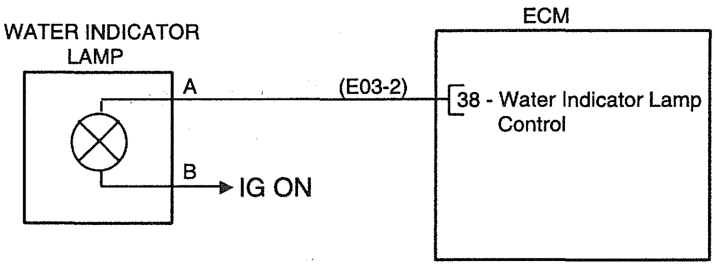
Water Sensor is located in the fuel filter assembly and senses water in fuel. When water is detected, the ECM turns the Indicator Lamp in cluster on.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in Water Indicator Lamp circuit	• Open or short in Water Indicator Lamp ciruict • Water Indicator Lamp • ECM
03	• Short to battery line in Water Indicator Lamp circuit	

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]



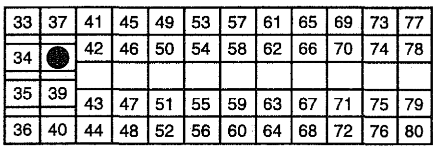
[CONNECTION INFORMATION]

Terminal	Connected to	Function
A	ECM E03-2 (38)	Water Indicator Lamp Control
B	IG	Battery Voltage

NOTE

Refer to "ELECTRICAL TROUBLESHOOTING MANUAL" for the terminals A and B.

[HARNESS CONNECTORS]



E03-2

ECM

EWMF603B

INSPECTION PROCEDURE

1. CHECK WATER INDICATOR LAMP (CLUSTER) AND ECM CONNECTORS

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to ""CONNECTOR INSPECTION PROCEDURE"" in BASIC INSPECTION PROCEDURE.**

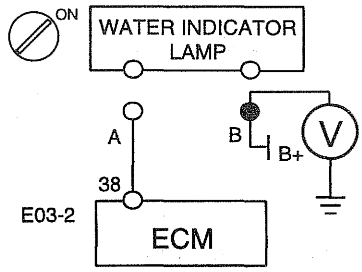
Are all connectors good?

Yes

No	Repair or replace it.

2. CHECK POWER TO WATER INDICATOR LAMP (CLUSTER)

1. Turn ignition switch to OFF and disconnect water indicator lamp(Cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal B of water indicator lamp(Cluster) harness connector and chassis ground.
   - **Specification: approximately B+**



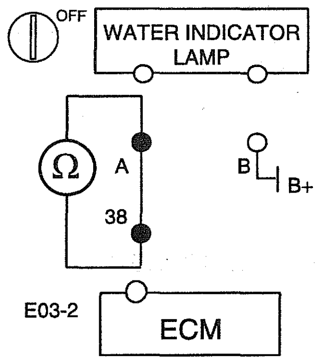
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and water indicator lamp(Cluster) connector.
2. Measure resistance between terminal A of water indicator lamp(Cluster) harness connector and terminal E03-2(38) of ECM harness connector.
   - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

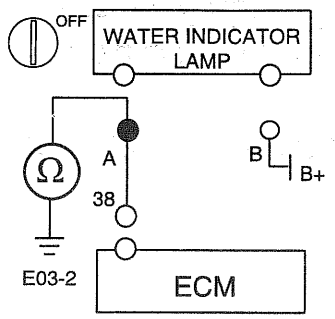
Yes

No	Repair open circuit in harness.

EWMF2012

4 . CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Measure resistance between terminal A of MIL(Cluster) harness connector and chassis ground.
   - **Specification: infinite**



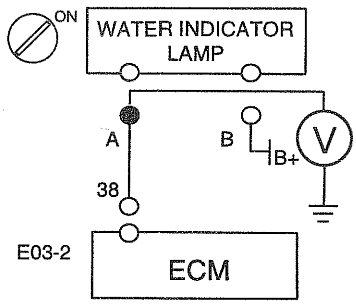
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.

5 . CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal A of MIL(Cluster) harness connector and chassis ground.
   - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.

6 . CHECK MIL(CLUSTER)

1. Inspect the MIL installed on the cluster.

Does the MIL have normal condition?

Yes

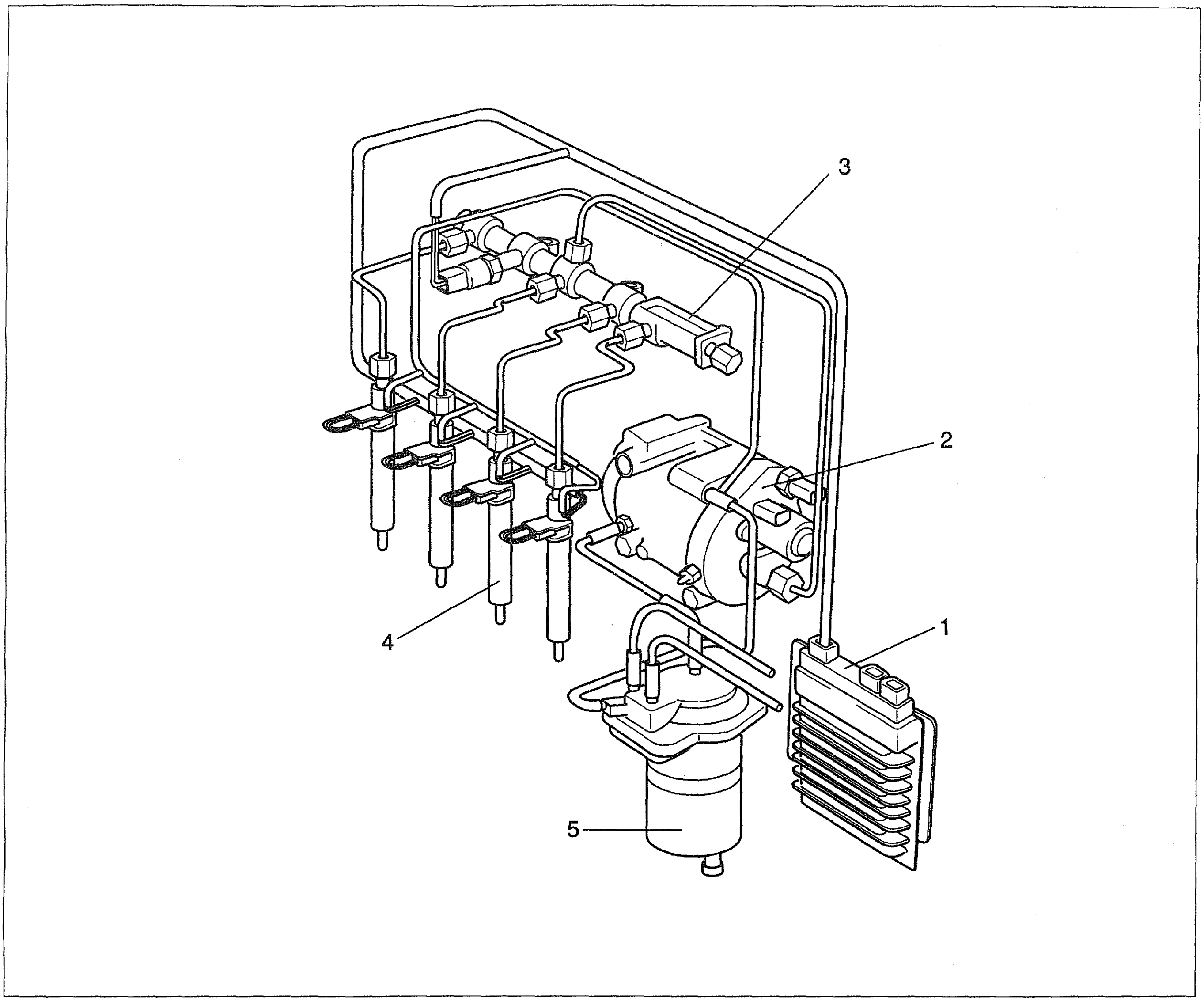
No	Replace the MIL.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF2013

FUEL DELIVERY SYSTEM-DIESEL

COMMON RAIL FUEL INJECTION SYSTEM EBFF6ADE



1. ECM
2. High Pressure Pump (Transfer Pump Integrated)
3. Common Rail
4. Injector
5. Fuel Filter

EWMF125A

Fuel Tank → Fuel Filter → Transfer Pump → IMV → High Pressure Pump → Common Rail → Injector

EWMF101H

WARNING

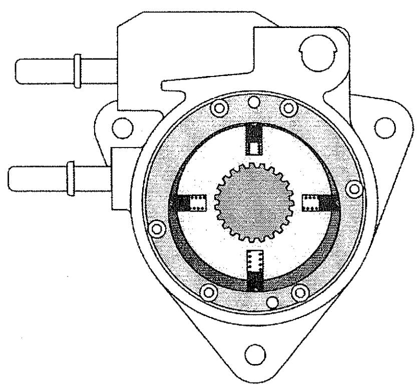
- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.

LOW PRESSURE LINE

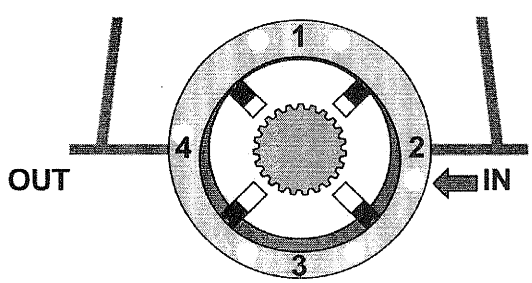
1. FUEL TANK

2. TRANSER PUMP

The transfer pump is included in the housing of the HP pump. The transfer pump is of the volumetric blade type pump. The pump draws the fuel from the fuel tank and continually delivers the required quantity of fuel in the direction of the high-pressure pump.



AFBE145A



AFBE145B

3. FUEL FILTER

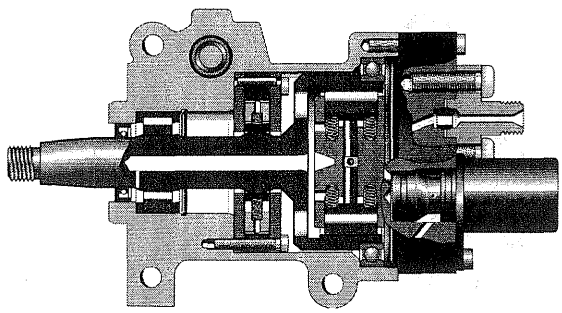
Inadequate filtering can lead to damage at the pump components, delivery valves, and injector nozzles. The fuel filter cleans the fuel before it reaches the lift pump, and thereby prevents premature wear at the pump's sensitive components.

4. HAND PRIME PUMP

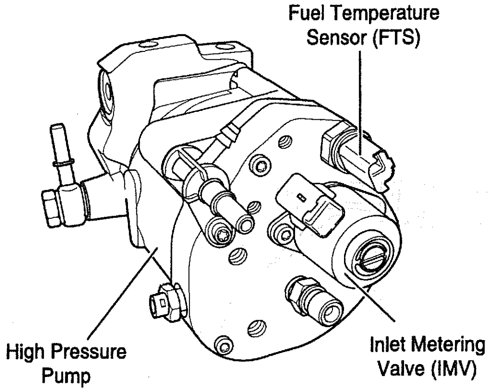
HIGH PRESSURE CIRCUIT

1. HIGH PRESSURE PUMP

The high pressure pump pressurises the fuel to a system pressure of up to 1,600bar. This pressurized fuel then passes through a high-pressure line and into the tubular high-pressure common rail.



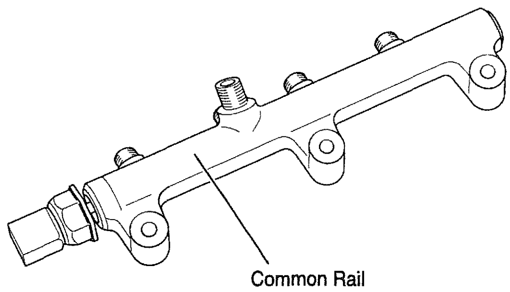
AFBE145F



EWMF101K

2. COMMON RAIL

Even after an injector has taken fuel from the rail in order to inject it, the fuel pressure inside the common rail remains practically constant. This is due to the common rail effect arising from the fuel's inherent elasticity. Fuel pressure is measured by the rail pressure sensor and maintained at the desired level by the pressure control valve. It is the job of the imlet metering valve to limit the fuel pressure in the common rail to maximum 160 MPa (23,206 psi) The highly pressurized fuel is directed from the rail to the injectors by a flow limiter, which prevents excess fuel reaching the combustion chamber.



EWMF101L

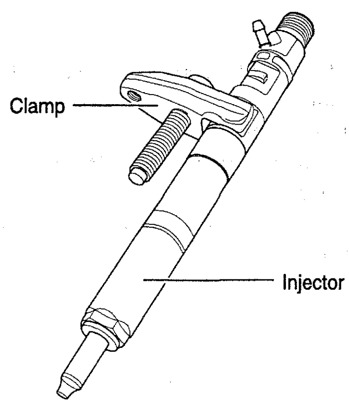
3. HIGH PRESSURE PIPE

These fuel lines carry the high-pressure fuel. They must therefore be able to permanently withstand the maximum system pressure and, during the pauses in injection, the sometimes high frequency pressure fluctuations which occur. They are therefore manufactured from steel tubing. Normally, they have an outside diameter of 6 mm and an internal diameter of 2.4 mm.

The injection lines between the common rail and the injectors must all be of the same length. The differences in length between the common rail and the individual injectors are compensated for by using slight or pronounced bends in the individual lengths of tubing. Nevertheless, the injection lines should be kept as short as possible.

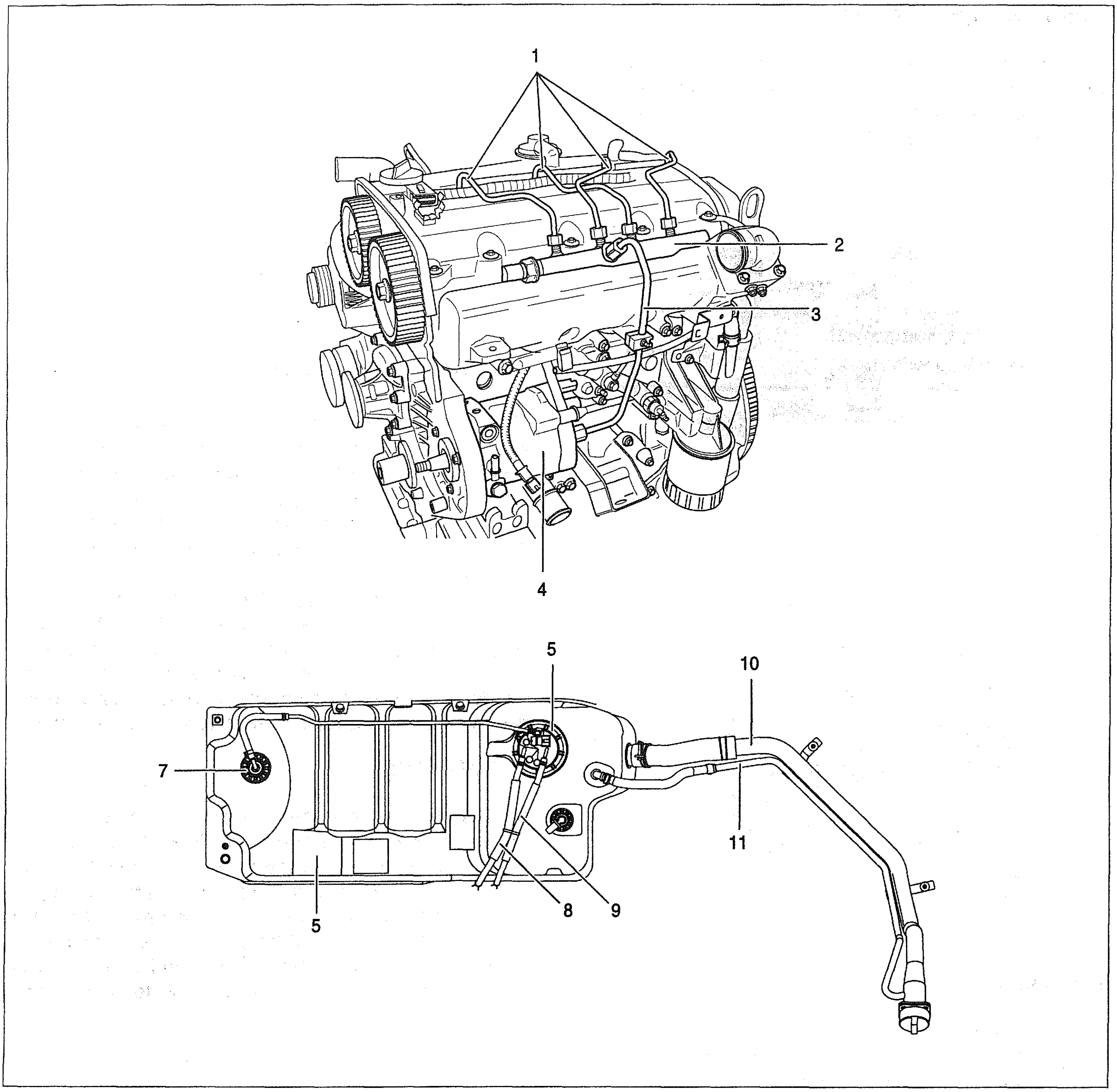
4. INJECTORS

The nozzles of these injectors open when the solenoid valve is triggered and permit the flow of fuel. They inject the fuel directly into the engine's combustion chamber. The excess fuel which was needed for opening the injector nozzles flowsback to the tank through a collector line. The return fuel from the pressure control valve and from the low-pressure stage is also led into this collector line together with the fuel used to lubricate the high-pressure pump.



EWMF101M

COMPONENTS ECCC9D93



1. High Pressure Pipe (Common Rail ↔ Injector)
2. Common Rail
3. High Pressure Pipe
   (High Pressure Pump ↔ Common Rail)
4. High Pressure Pump
   (FTS, IMV and Transfer Pump integrated)
5. Fuel Sender
6. Fuel Tank
7. Fuel Sender (Sub)
8. Return Hose
9. Fuel Feed Hose
10. Fuel Filler Hose
11. Breather Hose

EWMF100R

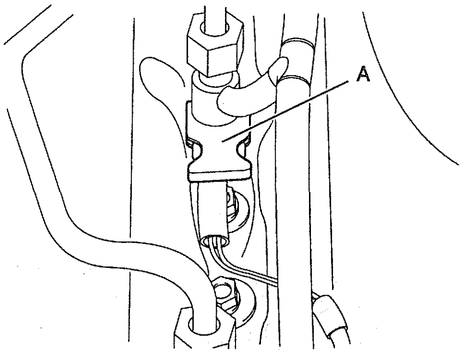
INJECTOR

REMOVAL E0A9B2A1

WARNING

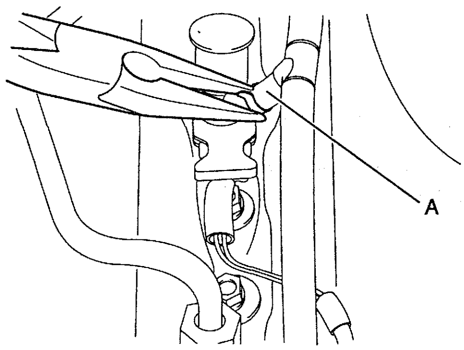
- **Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)**
- **Never perform any work on injection system with engine running or within 30 seconds after the engine stops.**
- **Always pay attention to safety precaution.**
- **Ensure the absolute cleanliness.**
- **It is not recommended to remove the injectors without any notice.**

1. Disconnect the injector connector (A).



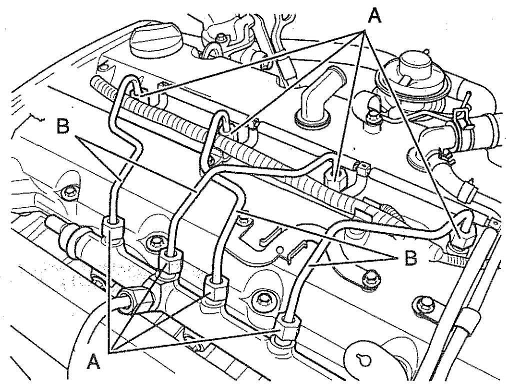
AFBE100T

2. Disconnect the injector return hose (A).



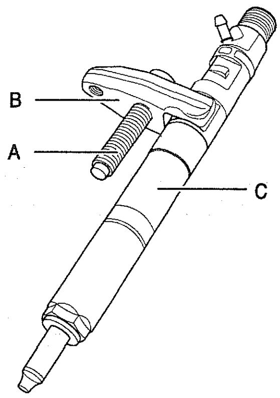
AFBE100U

3. Remove the high pressure pipe mounting nut (A) on the common rail and injector, and then remove the high pressure pipe(B).



AFBE102L

4. Remove the injector clamp bolt (A) using a hexagonal-wrench and remove the clamp(B) and injector(C).

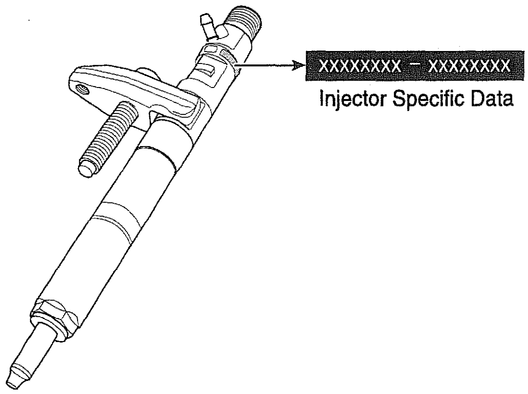


AFBE102M

INSTALLATION E56B54E3

NOTE

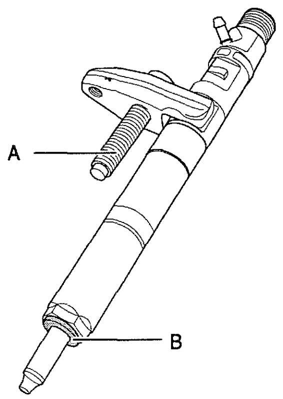
The new injector possesses different characteristics from the one which was originally fitted to the engine. These characteristics are summarized in the 16-character code shown on the label stuck to the top of the injector holder. This code must be entered into the ECM memory with the Hi-Scan (Pro).



EWMF102O

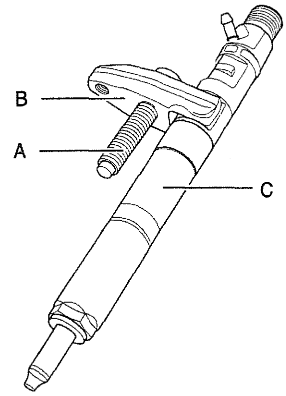
CAUTION

When installing a new injector, MUST replace the injector clamp bolt(A) and gasket(B) with a new one.



AFBE102N

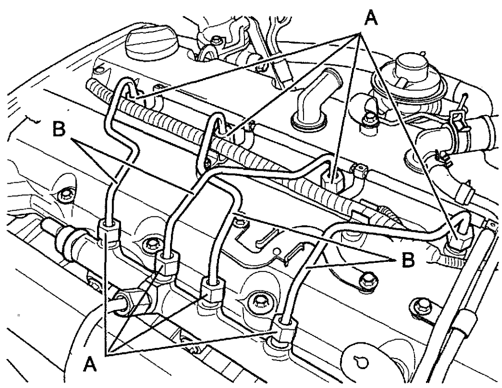
1. Place the injector(C) and clamp(B) on the engine block and intall the injector clamp bolt(A).



AFBE102M

2. Install the high pressure pipe(B) in between the common rail and injector with installing the nut (A).

Tightening Torques: 3.65 ~ 4.35 Kgf·m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf·ft)

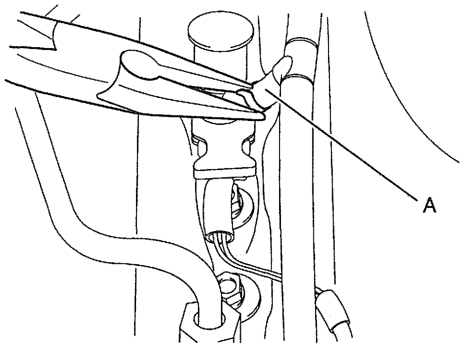


AFBE102L

CAUTION

When installing the high pressure pipe, spread specified lubricating oil on the nut.

3. Connect the injector return hose (A).

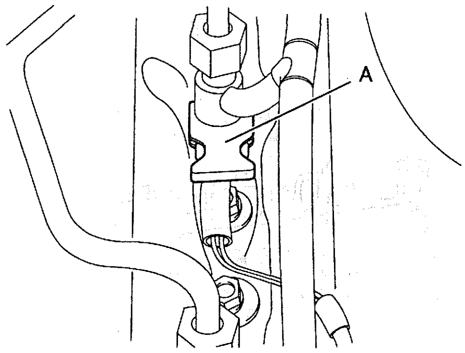


AFBE100U

CAUTION

When installing a new injector, MUST replace the injector return hose clamp with a new one.

4. Connect the injector connector(A).



AFBE100T

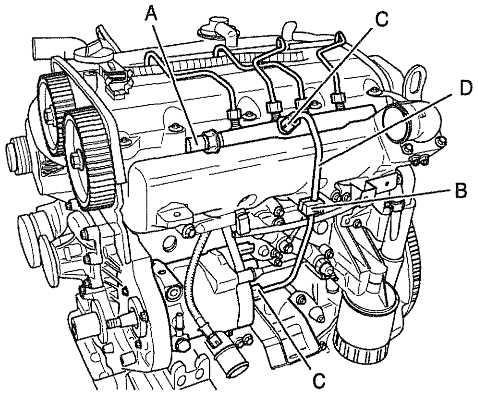
ACCUMULATOR

REMOVAL ED9CD89F

WARNING

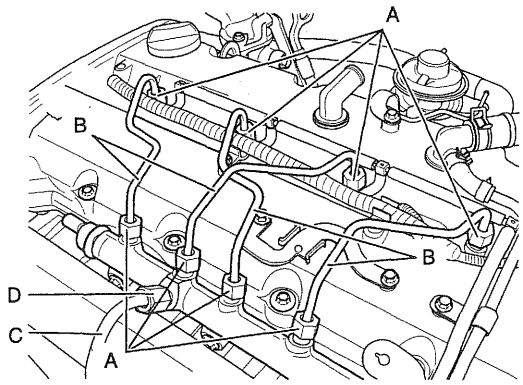
- **Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)**
- **Never perform any work on injection system with engine running or within 30 seconds after the engine stops.**
- **Always pay attention to safety precaution.**
- **Ensure the absolute cleanliness.**
- **It is not recommended to remove the injectors without any notice.**

1. Disconnect the rail pressure sensor connector (A).



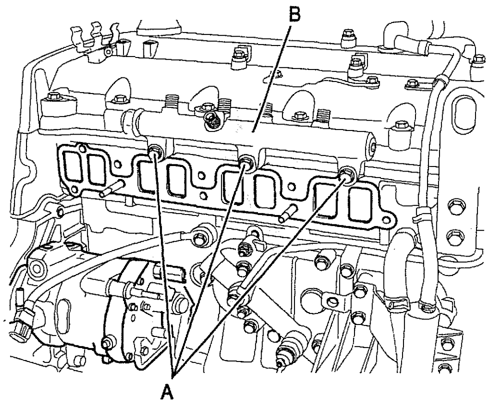
AFBE102Q

2. Remove the high pressure pipe fixing clip(B).
3. Remove the high pressure pipe (D) with unscrewing the mounting nut (C).
4. Remove the intake manifold (Refer to the group "EM" in this Shop Manual).
5. Remove the high pressure pipe mounting nut (A) on the common rail and injector, and then remove the high pressure pipe(B).



AFBE112L

6. Remove the high pressure pipe mounting nut (D) on the common rail and high pressure pump, and then remove the high pressure pipe(C).
7. Remove the common rail mounting bolts (A).



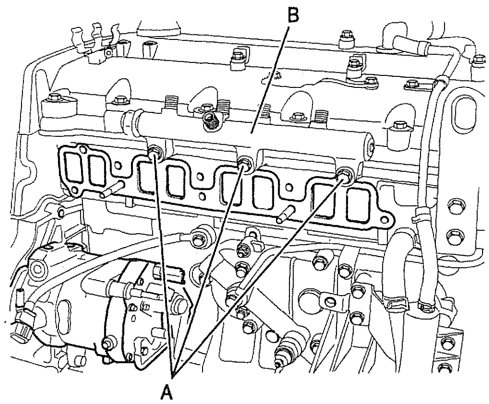
AFBE102P

8. Remove the common rail (B).

INSTALLATION E3C81425

1. Place the common rail (B) on the engine block and screw the mounting bolts (A).

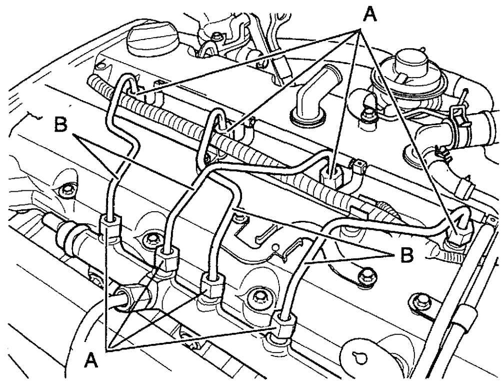
Tightening Torques: 1.90 ~ 2.30 Kgf·m (18.63 ~ 22.56 N·m, 13.74 ~ 16.64 lbf·ft)



AFBE102P

2. Install the high pressure pipe (B) in between injector and common rail with screwing the mounting nut (A).

Tightening Torques: 3.65 ~ 4.35 Kgf·m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf·ft)



AFBE102L

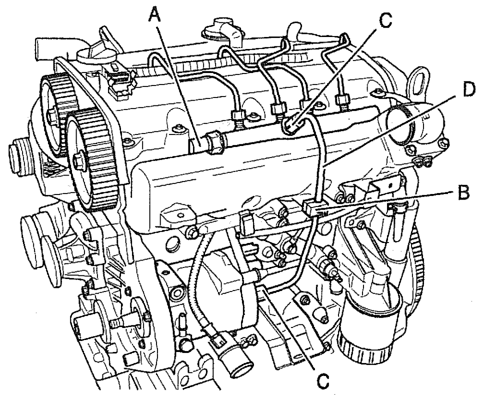
CAUTION

When installing the high pressure pipe, spread specified lubricating oil on the nut.

3. Install the intake manifold (Refer to the group "EM" in this Shop Manual).

4. Install the high pressure pipe (D) in between high pressur pump and the common rail with screwing the mounting nut (C).

Tightening Torques: 3.65 ~ 4.35 Kgf·m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf·ft)



AFBE102Q

CAUTION

When installing the high pressure pipe, spread specified lubricating oil on the nut.

5. Install the fixing clip (B) on the intake manifold.

6. Connect the rail pressure sensor connnector (A).

FUEL LINE

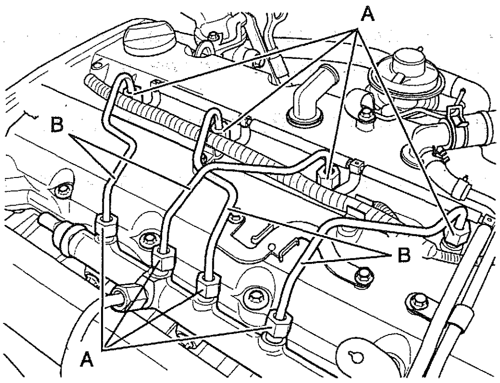
REMOVAL E2DB4DCB

WARNING

- **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.**

HIGH PRESSURE PIPE (INJECTOR ↔ COMMON RAIL)

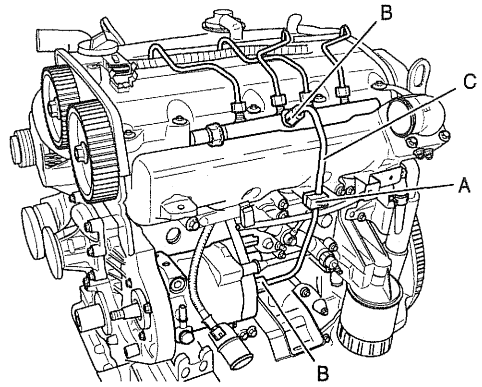
1. Remove the high pressure pipe mounting nut (A) on the common rail and injector, and then remove the high pressure pipe(B).



AFBE102L

HIGH PRESSURE PIPE (COMMON RAIL ↔ HIGH PRESSURE PIPE)

1. Remove the high pressure pipe fixing clip(A).
2. Remove the high pressure pipe mounting nut (B) on the common rail and high pressure pump, and then remove the high pressure pipe(C).

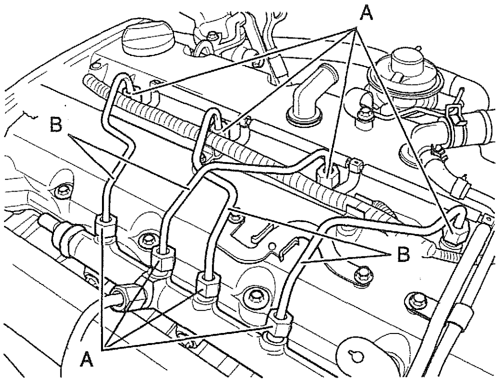


AFBE101O

INSTALLATION E1E0265D

HIGH PRESSURE PIPE (INJECTOR ↔ COMMON RAIL)

1. Install the high pressure pipe (B) in between injector and common rail with screwing the mounting nut (A).



AFBE102L

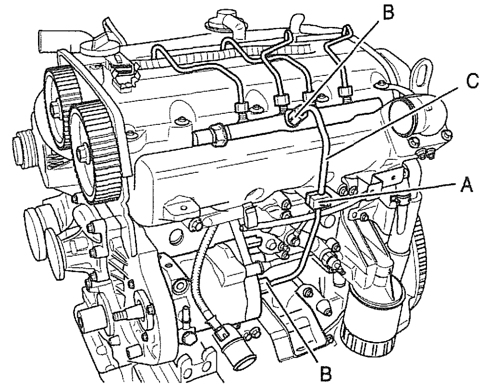
Tightening Torques: 3.65 ~ 4.35 Kgf·m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf·ft)

CAUTION

When installing the high pressure pipe, spread specified lubricating oil on the nut.

HIGH PRESSURE PIPE (COMMON RAIL ↔ HIGH PRESSURE PIPE)

1. Install the high pressure pipe (C) in between injector and common rail with screwing the mounting nut (B).



AFBE101O

Tightening Torques: 3.65 ~ 4.35 Kgf·m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf·ft)

CAUTION

When installing the high pressure pipe, spread specified lubricating oil on the nut.

2. Install the fixing clip (A) on the intake manifold.

Transaxle / Transmission

GENERAL

SPECIFICATION(M/T) EAFD5123

Engine			2.9 TCI	3.5 V6
Manual transmission			M5SR1	
4WD Drive type			PART TIME 4WD (EST) or FULL TIME 4WD (TOD)	
M/T	CLUTCH	COVER	DIAPHIRAM SPRING	
		DISC	Dry single plate	
	CHANGE CONTROL TYPE		FLOOR DIRECT TYPE	
	TRANSMISSION TYPE		Forward 5th Reverse 1st, Constant Synchromesh	
	Gear ratio	1st	3.915	
		2nd	2.126	
		3rd	1.338	
		4th	1.000	
		5th	0.801	
		Reverse	4.270	
	Oil	Gear ratio	API GL-4, SAE 75W-90	
		Capacity(ℓ)	3.2ℓ	
Transfer case	Gear ratio	HIGH(EST), AUTO(YOD)	1.000	
		LOW	2.480	
	Oil	Gerar ratio	ATF DEXRON III	
		Capacity(ℓ)	1.42	

TIGHTENING TORQUE(M/T)

Model	Item	N·m	Kg·cm	lb·ft
M5SR1	Engine to transmission(12×40)	65-85	650-850	48-62
	Engine to transmission(12×55)	80-100	800-1000	59-74
	Poppet spring seal bolt	30-42	300-420	22-30
	Front bearing retainer	15-22	150-220	11-16
	Back-up lamp switch	30-35	300-350	22-25
	Main shft lock nut	250-270	2500-2700	185-200
	Count shft lock nut	250-270	2500-2700	185-200
	Clutch release cylinder	30-42	300-420	22-30
	Transfer dynamic damper	47~52	470-520	35-38
	Control lever mounting	15-22	150-220	11-16
	Magnet plug	60-80	600-800	44-59
	Clutch release level fucrum	55-60	550-600	41-44
	Front oil guide	8-10	80-100	6-7
	Control lever housing cover mounting	15-22	150-220	11-16
	Control housing reamer bolt	31-35	310350	23-26
	Control housing seal plug(2EA)	55-69	550-690	40-51
	(1EA)	30-42	300-420	22-31
	Control housing stopper braket	10-12	100-200	7-9

LUBRICANTS(M/T)

	MODEL	LUBRI-CANTS	CHECK & REPLEN-ISHMENT	CHANGE		METHOD	CA-PAC-ITY
				NOMAL USE	SEVER USE		
TRANSFER ASSY	EST (ELECTRIC SHIFT TRANSFER)	DUXRON III	EVERY 20.000Km	NO SERVICE REOUIRED	EVERY 100.000Km	SUPPLY TO THE LEVEL OF OIL FILLER PLUG HOLE BOTTOM.	1.42L
	ATT(ACTIVE TORQUE TRANSFER) or TOD	DUXRON III	EVERY 20.000Km	NO SERVICE REQUIRED	EVERY 100.000Km	SUPPLY TO THE LEVEL OF OIL FILLER PLUG HOLE BOTTOM.	1.42L

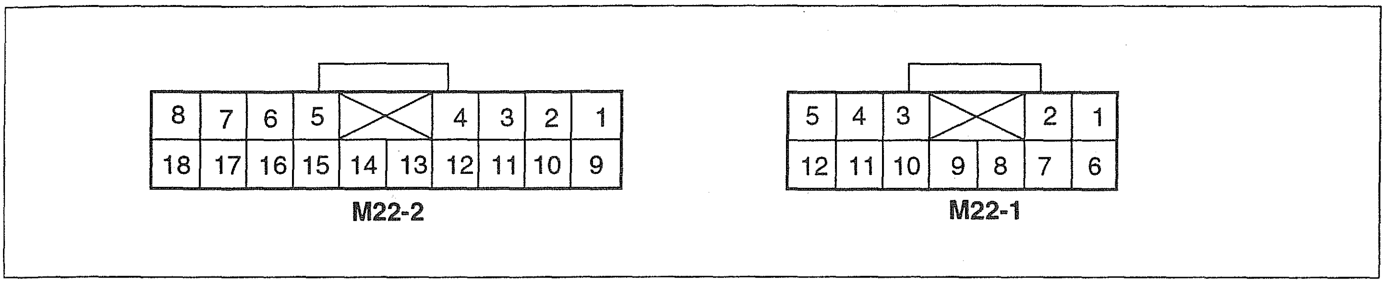
SPECIFICATION(A/T) EA1FAD3F

Engine			2.9 TCI	3.5 V6
Automatic transmission			30 - 40 LEI	
A/T	Gear ratio	1st	2.804	
		2nd	1.531	
		3rd	1.000	
		4th	0.705	
		Reverse	2.393	
		Final ratio	4.222	4.625
	Oil	Type	2WD : CASTLE AUTO FLUID (MOBIL D-II) 4WD : CASTLE AUTO FLUID D II (DIAMOND TF SPI)	
		Capacity(ℓ)	10.2(2WD) 10.5(4WD)	

TRANSFER CASE ASSEMBLY

PIN LIST EEA227BF

TCCM(TOD) PIN LIST

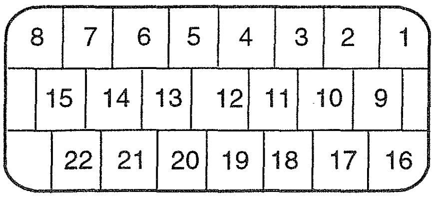


EKME001A

Terminal No.		Wire Color	Terminal Description
M22-1	1	G/B	Ignition
	2	P	Battrty
	3	Y	Emc
	4	L	Motor output(LOW-HI)
	5	G	Motor output(HI-LOW)
	6	R	K-LINE
	7	Br	Battery
	8	B	Ground for ECU
	9	B	Ground for ECU
	10	P	Speed reference
	11	L	Motor output(LOW-HI)
	12	G	Motor output(HI-LOW)

Terminal No.		Wire Color	Terminal Description
M22-2	1	W	Speed sensor(Ground)
	2		-
	3	Gr	Front speed sensor
	4	P	Position encoder2
	5		HI/LOW switch
	6		TPS analog/PWM
	7	Gr/O	Diagnosic display
	8	Gr	Encuder ground
	9	L/O	Position encoger4
	10	R	Rear speed sensor
	11	Y	Position encoger3
	12	G	
	13	L	Brake switch
	14	Y/O	ABS input
	15	G/B	M/T : clutch pedal position switch
		P	A/T : neutral relay
	16		CAN(-)
	17		CAN(+)
	18	Gr	4 LOW display

TCCM(EST) PIN LIST



M23

EKME002A

Terminal No.		Wire Color	Terminal Description
M23	1	W	Mortor 2H-4H-4L
	2	W	Mortor 2H-4H-4L
	3	B	Ground
	4	O	Clutch coil
	5	R	Position 1 motor
	6	L	Speed sensor
	7	Y	2H switch
	8	Br	4H display
	9	P	Battery
	10	P	Battery
	11	B	Ground
	12	G	Position 2 motor
	13	Br	4L switch
	14	G/B	Cluch interlock switch
	15	R	4L display
	16	G	Motor 4L-4H-2H
	17	G	Motor 4L-4H-2H
	18	L	Ground(common return)
	19	O/B	Ignition 1
	20	L	Posion 4 motor
	21	O	Position 4 motor
	22	R	Diagnostic display
	23	Br/B	CenterAxle Disconnect Solenoid

AUTOMATIC TRANSAXLE SYSTEM

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES E614E67D

DTC No.	DESCRIPTION	Fault Type	Warning Lamp
P0707	Transaxle range Sensor	B	-
P0708	Transaxle range Sensor	B	-
P0710	Oil temperature sensor system	B	-
P0716	Input speed sensor range/performasce	B	-
P0717	Pulse generator A	B	○
P0722	Pulse generator B	B	○
P0727	Engine speed signal	B	-
P0743	Torque converter clutch circuit - Electrical	B	-
P0748	Pressure control solenoid circuit malfunction	A	-
P0753	Shift solenoid A circuit malfunction	A	-
P0758	Shift solenoid B circuit malfunction	A	-
P1121	Throttle position sensor signal invalid	B	○
P1630	CAN communication bus off	B	○
P1631	CAN-time out ECU	B	○

Fault Type :

Type A - DTC stored on the 1st driving
Type B - DTC stored on the 2nd driving

MIL/Warning :

"○" - Supported (To be performed at the same tine as DTC steres)
"—" - Not supported

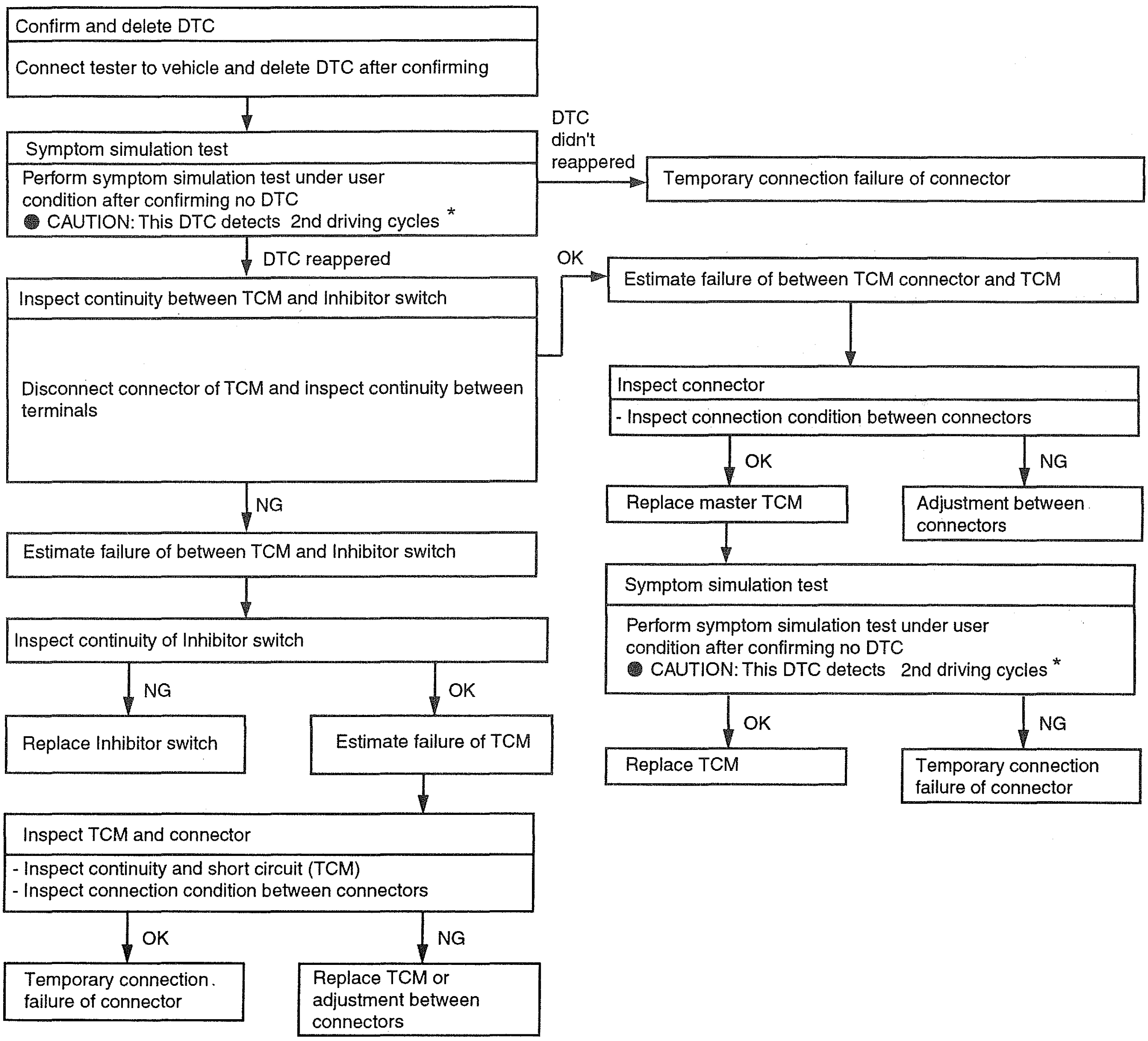
DTC TROUBLESHOOTING PROCEDURE E83E28B9

DTC P0707	TRANSAXLE RANGE SWITCH CIRCUIT LOW INPUT

DTC DETECTING CONDITION

Item	Detecting Condition	Possible cause
DTC Strategy	● check for No signal	●Open or short in circuit ●Faulty TRANSAXLE RANGE SWITCH ●Faulty TCM
Enable Conditions	● Output revolution is more than 1130 rpm. ● Engine revolution is more than 1500rpm. ● 2sec passed from change of range sensor	
Threshold Value	● No signal detected	
Diagnostic Time	● More than 30sec	
Fail Safe	● TCU judges the position of Range Sensor is D range ● To inhibit failure detection(Output Sensor/Input Sensor /Sol Malfunction/L4 SW Malfunction). ●No Coast Down/Up Slope Mode/Down Slope Mode	
Pass Criteria	●To detect no failure more than 2 min.	

INSPECTION PROCEDURE



EKME003A

* The definition of 'Driving cycle' of TCM :
Driving cycle is counted up at 10 senconds passed after Ignition ON or 'Clear code' of scan tool.

DTC TROUBLESHOOTING PROCEDURE EF2ED5EE

DTC P0708	TRANSAXLE RANGE SWITCH CIRCUIT HIGH INPUT

DTC DETECTING CONDITION

<table>
<tr><th>Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td>DTC Strategy</td><td>● check for No signals</td><td rowspan="6">●Open or short in circuit
●Faulty TRANSAXLE RANGE SWITCH
●Faulty TCM</td></tr>
<tr><td>Enable Conditions</td><td>● 2sec passed from change of range sensor</td></tr>
<tr><td>Threshold Value</td><td>● 2 or more signals detected at the same time</td></tr>
<tr><td>Diagnostic Time</td><td>● More than 10sec</td></tr>
<tr><td>Fail Safe</td><td>● TCU judges the position of Range Sensor with following priority. D>2>L>R>N>P
● To inhibit failure detection(Output Sensor/Input Sensor /Sol Malfunction/L4 SW Malfunction).
●No Coast Down/Up Slope Mode/Down Slope Mode</td></tr>
<tr><td>Pass Criteria</td><td>●To detect no failure more than 2 min.</td></tr>
</table>

INSPECTION PROCEDURE

Refer to DTC P0707

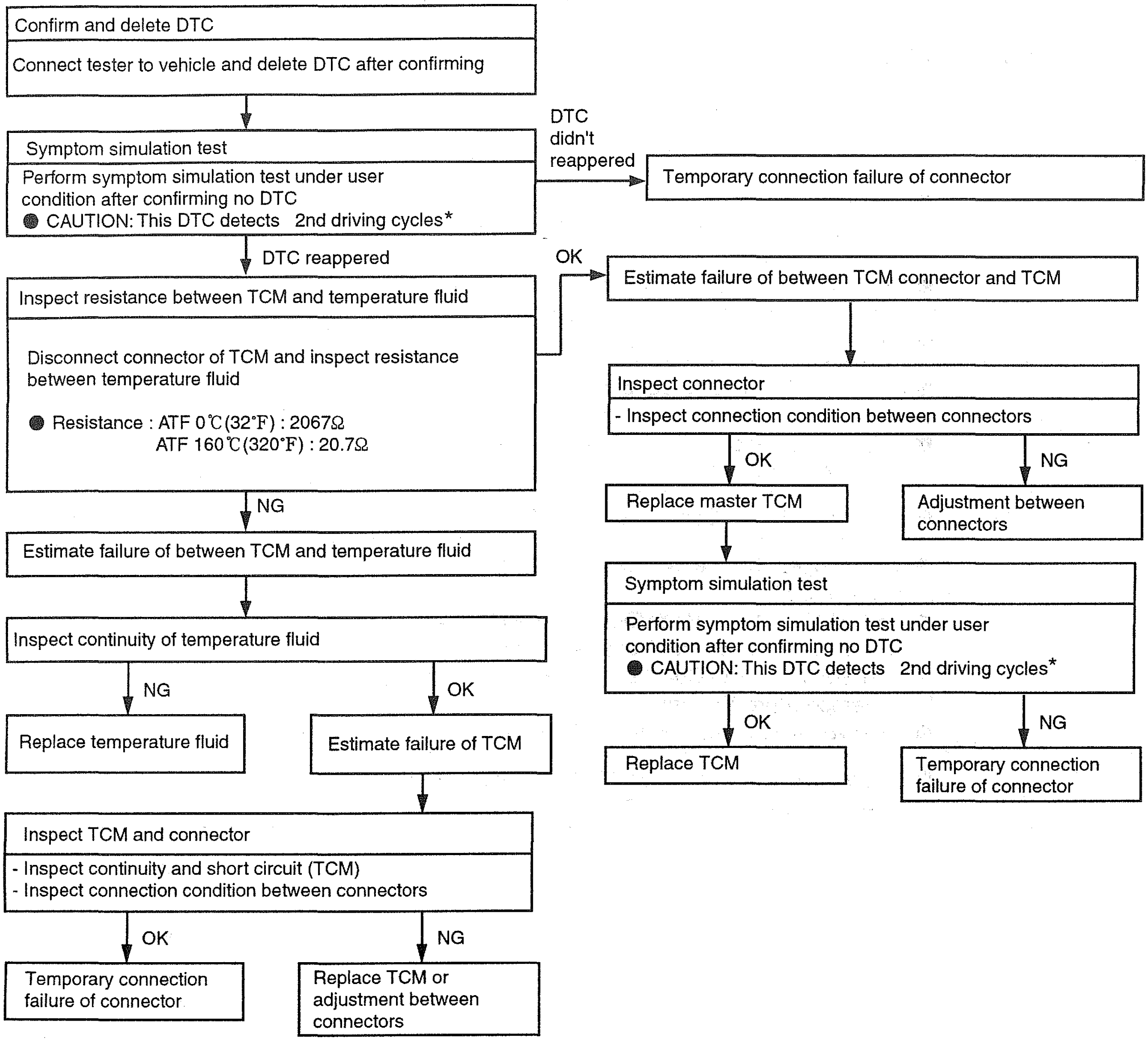
DTC TROUBLESHOOTING PROCEDURE E6A8EFDA

DTC P0710	FLUID(OIL) TEMPERATURE SENSOR SYSTEM MALFUNCTION

DTC DETECTING CONDITION

Item	Detecting Condition	Possible cause
DTC Strategy	● Check for sensor resistance and A/D value	● Faulty sensor
Enable Conditions	● SHORT/ OPEN: During no failure of Engine Speed Signal /CAN(No ID/BUS OFF) Engine revolution ? 400rpm. ● SHORT: No detection of normal condition (between 0℃ and 150℃ for 10sec) after IG ON. ● OPEN: D,2,L,R range continuously.	
Threshold Value	● SHORT: TCU detects out of sensor resistance from operating range for 5min. continuously. ● OPEN:Fluctuation A/D value is less than 15 and minimum A/D value is more than 1000	
Diagnostic Time	● More than 5min. Continuously (SHORT	
Fail Safe	● TCU judges the Transmission Fluid Temperature is 200℃. ● No L-UP/Up Slope Mode/Down Slope Mode/Torque Reduction at shifting/Line Pressure Reduction at shifting/Squat Control/Coast Control/High Transmission Fluid Temperature Warnning ● To inhibit failure detection(SOL Malfunction).	
Pass Criteria	● To detect the Transmission Fluid Temperature is between 0℃ and 150℃ for 15 min. continuously.	

INSPECTION PROCEDURE



EKME004A

* The definition of 'Driving cycle' of TCM :
Driving cycle is counted up at 10 senconds passed after Ignition ON or 'Clear code' of scan tool.

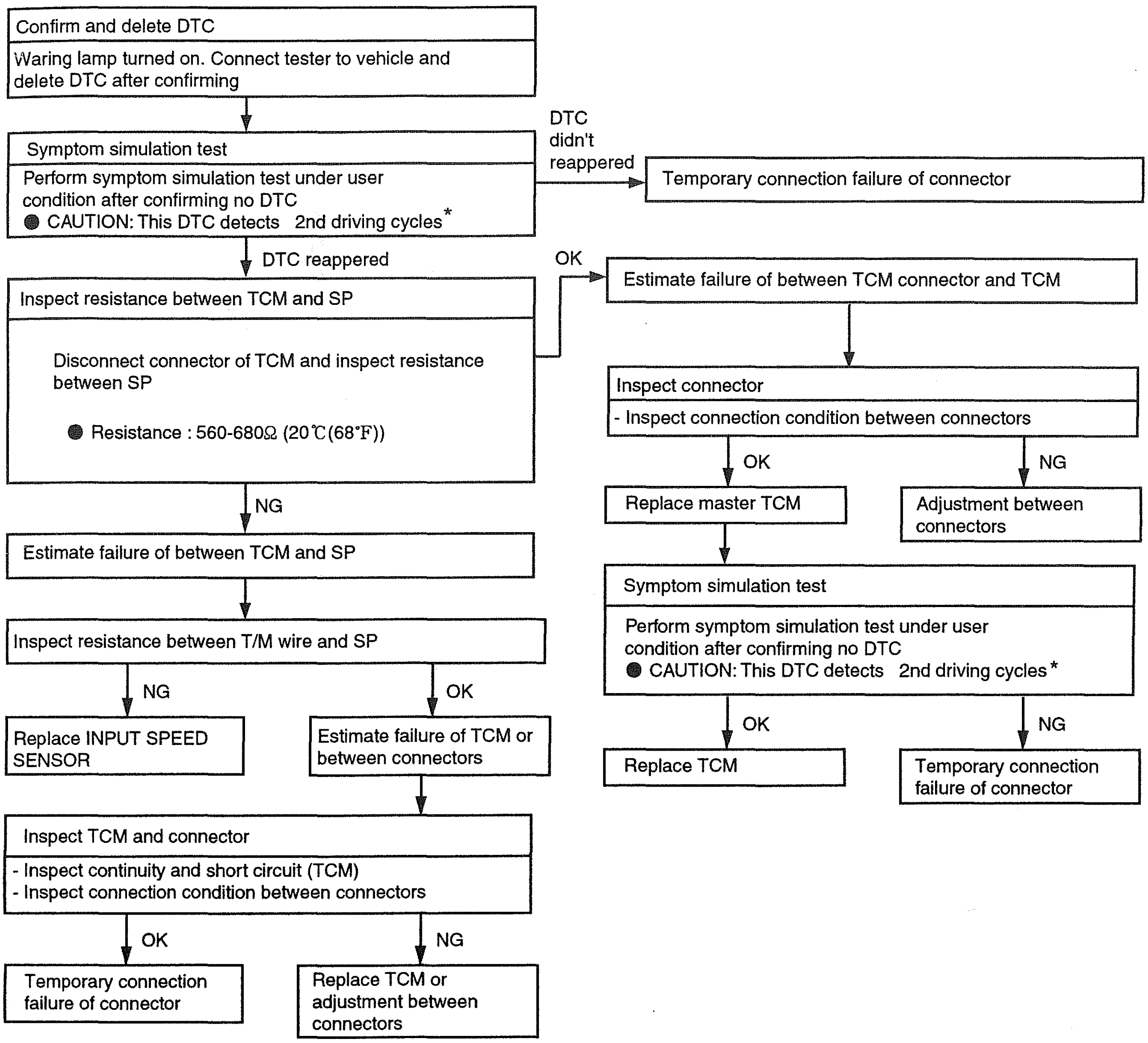
DTC TROUBLESHOOTING PROCEDURE EFACD7BF

DTC P0716	INPUT SPEED SENSOR RANGE/PERFORMANCE

DTC DETECTING CONDITION

Item	Detecting Condition	Possible cause
DTC Strategy	● Check for input revolution	●Signal circuit is open or short. ●Sensor power circuit is open ●Sensor ground circuit is open ●Faulty input speed sensor ●Faulty TCM
Enable Conditions	-	
Threshold Value	● TCU detects Input Revolution ≥ 7000 rpm.	
Diagnostic Time	● for 10.0 sec.	
Fail Safe	-	
Pass Criteria	● 0< Input Revolution < 7000 rpm for 20 sec.	

INSPECTION PROCEDURE



EKME005A

* The definition of 'Driving cycle' of TCM :
Driving cycle is counted up at 10 senconds passed after Ignition ON or 'Clear code' of scan tool.

DTC TROUBLESHOOTING PROCEDURE EA9ECCAD

DTC P0717	PULSE GENERATOR A

DTC DETECTING CONDITION

Item	Detecting Condition	Possible cause
DTC Strategy	● Check for pulses of input/ouput speed sensors.	● Signal circuit is open or short ● Sensor power circuit is open ● Sensor ground circuit is open ● Faulty pulse generator ● Faulty TCM
Enable Conditions	● Output Revolution more than 775 rpm. ● Range Sensor is D,2, L range selected. ● 1st, 2nd, 3rd gear (C0 rotation is stopped at 4th gear). ● 25 sec. later after changing the Range Sensor. ● 3.5 sec. later after changing the Gear. ● Engine Revolution more than 400 rpm. ● During No failure of Shift SOL electrical/Shift SOL Malfunction/Engine Speed Signal/Range Sensor.	
Threshold Value	● TCU detects no pulse of input Speed Sensor Circuit Signal while. TCU detects 12 pulses of output speed sensor. ● The above detection 1000 times continuously. ● No pulse of 2nd gear.	
Diagnostic Time	● for 1 sec. continuously.	
Fail Safe	● No L-UP/Up Slope Mode/Down Slope Mode/Line Pressure Reduction at shifting/Torque Reduction at shifting. ● To inhibit failure detection(Output Sensor)	
Pass Criteria	● To detect Output Revolution more than 400rpm(Calculate by input Sensor) for 70 sec. Continuously.	

INSPECTION PROCEDURE

Refer to DTC P0716

DTC TROUBLESHOOTING PROCEDURE EE8ADCA4

DTC P0722	PULSE GENERATOR B

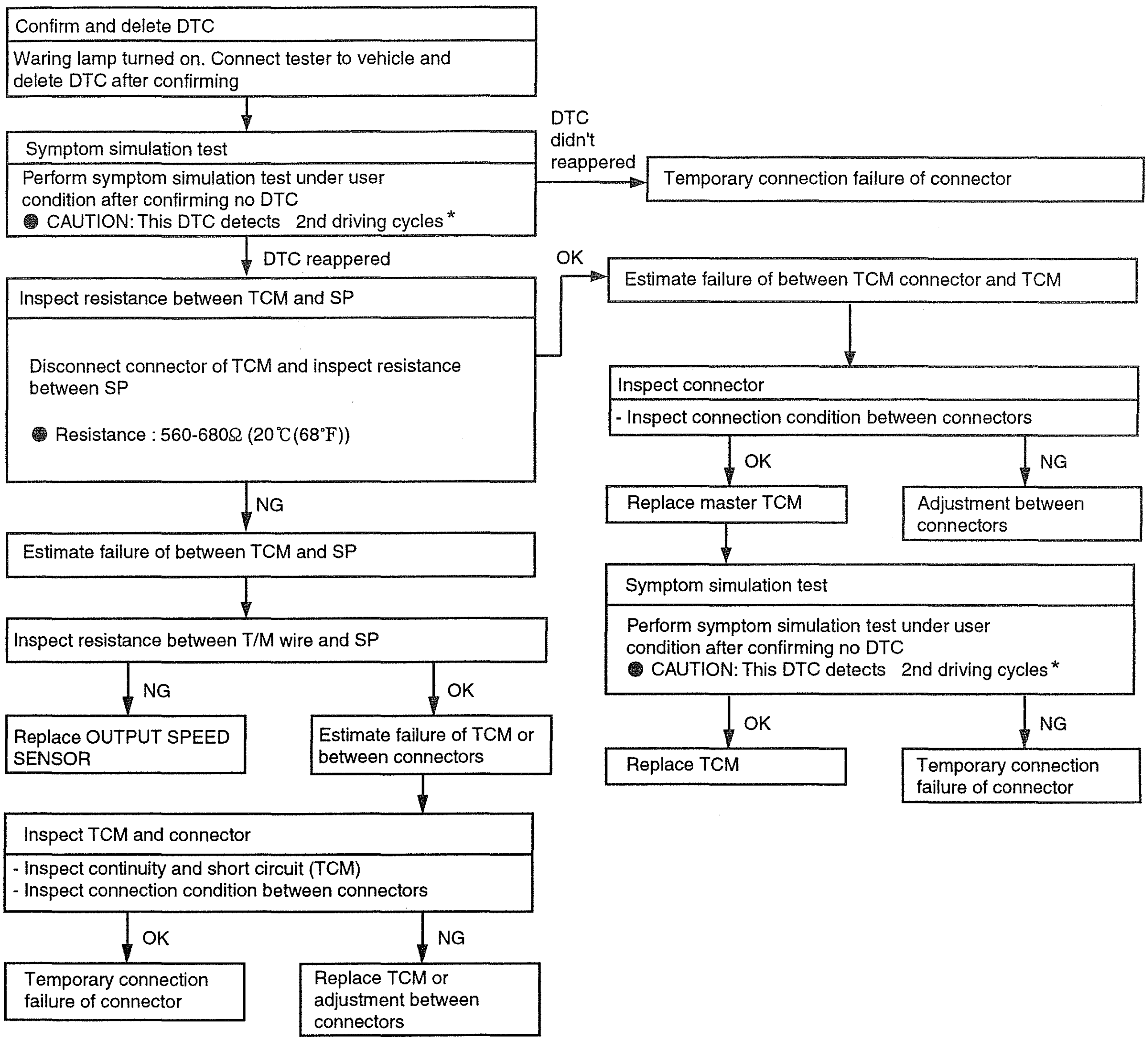
DTC DETECTING CONDITION

<table>
<tr><th>Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td>DTC Strategy</td><td>● Check for pulses of input/ouput speed sensors.</td><td rowspan="7">● Signal circuit is open or short
● Sensor power circuit is open
● Sensor ground circuit is open
● Faulty pulse generator
● Faulty TCM</td></tr>
<tr><td>Enable Conditions</td><td>● Range Sensor is D,2, L range.
● 25sec passed after N-D shifting
● Output Revolution calculated by Input Revolution ≥ 5 Km/h
● To inhibit failure detection Input Sensor/Range Sensor/S1, S2 Electorical</td></tr>
<tr><td>Threshold Value</td><td>(1st,2nd,3rd)
● TCU detects NO pulse of output speed sensor while TCU detects 45 pulses of input speed signal(500 times continuously).

(4th)
● Output speed calculation data decrease over 1500 rpm compare with previous calculation, and 0rpm.</td></tr>
<tr><td>Diagnostic Time</td><td>-</td></tr>
<tr><td>Fail Safe</td><td>(1st,2nd,3rd)
● TCU uses Input Sensor signal as a vehicle speed
● No L-up
● No 4th gear
● No LinePressure Reduction at Shifting
● No Torque Reduction at Shifting
● No Reverse Control
● No squat Control
● No Up Slope Mode/Down Slope Mode
● To inhibit failure detection(Sol Malfunction/L4 SW Malfunction)

(4th)
● L-up off and the following operation is applied.1. E/G revolution > first idle + 300 rpm
- 4th gear fixed2. E/G revolution ≤ first idle + 300 rpm
- OD off after 1 sec.
- To be operated according to failure operation in 1,2,3rd gear after 5 sec. from OD off</td></tr>
<tr><td>Pass Criteria</td><td>● To detect output speed more than 400rpm for 70 seconds continuously.</td></tr>
</table>

INSPECTION PROCEDURE



EKME006A

* The definition of 'Driving cycle' of TCM :
Driving cycle is counted up at 10 senconds passed after Ignition ON or 'Clear code' of scan tool.

DTC TROUBLESHOOTING PROCEDURE E0A1FAC2

DTC P0727	ENGING SPEED SIGNAL INVALID

DTC DETECTING CONDITION

<table>
<tr><th>Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td>DTC Strategy</td><td>● Check for signal of speed sensor</td><td rowspan="6">● Signal circuit is open or short
● Sensor power circuit is open
● Sensor ground circuit is open
● Faulty TCM</td></tr>
<tr><td>Enable Conditions</td><td>—</td></tr>
<tr><td>Threshold Value</td><td>● F_N_ENG bit ON in EMS1 signal from ECU</td></tr>
<tr><td>Diagnostic Time</td><td>● for 2.0 sec.</td></tr>
<tr><td>Fail Safe</td><td>● TCU detects that Engine Revolution is 7000rpm.
● To inhibit failure detection(Engine High Range/Input Sensor/SOL Malfunction/L4 SW Malfunction).
● No Coast Down/Up Slope Mode/Down Slope Mode.</td></tr>
<tr><td>Pass Criteria</td><td>● To detect F_N_ENG bit OFF for 2.0sec.</td></tr>
</table>

DTC TROUBLESHOOTING PROCEDURE

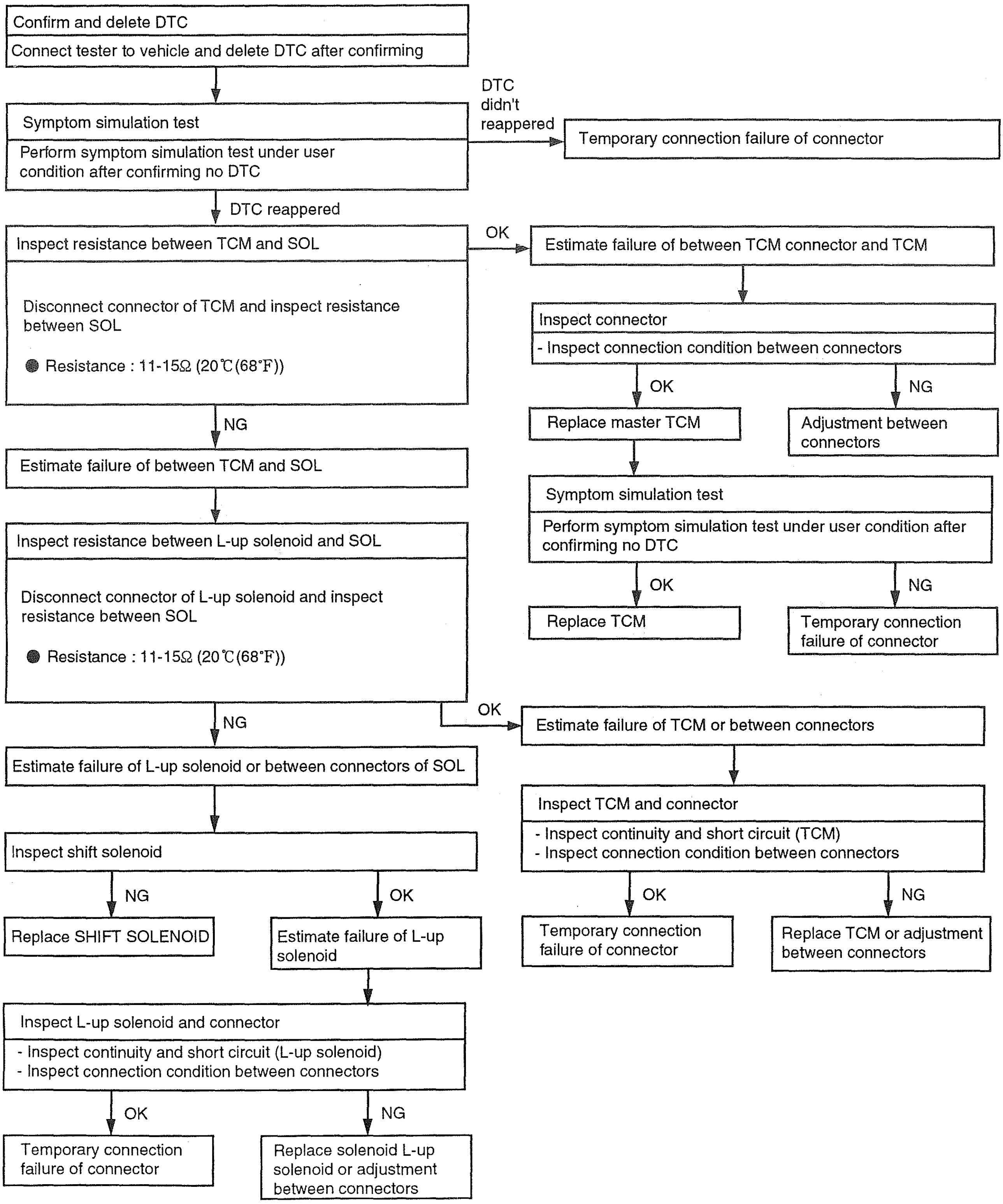
ED7BE99F

DTC P0743	TORQUE CONVERTER CLUTCH CIRCUIT - ELECTRICAL

DTC DETECTING CONDITION

Item	Detecting Condition	Possible cause
DTC Strategy	● Check for GROUND SHORT/OPEN/+B SHORT	※ TORQUE CONVERTER(DAMPER) CLUTCH : TCC ● Open or short in circuit ● Faulty TCC SOLENOID VALVE ● Faulty TCM
Enable Conditions	—	
Threshold Value	● GND SHORT is : To detect the "OFF " signal of the SL monitor during 300msec.when SL driver outputs the "ON" signal.(The above detection 1 times at shifting continuously). ● OPEN / +B SHORT is: To detect the "ON " signal of the SL monitor during 500msec. when SL driver outputs the "OFF" signal. (The above detection 2 times at shifting continuously)	
Diagnostic Time	—	
Fail Safe	● GND SHORT / OPEN / +B SHORT is : · No L-UP · To inhibit failure detection(SOL Malfunction). ● OPEN / +B SHORT is: · 1st gear fixed under the 375 rpm. · No Squat Control.	
Pass Criteria	● GND SHORT To detect no fail for 1 sec. when L-UP on. ● OPEN / +B SHORT To detect no fail for 1 sec. when L-UP off.	

INSPECTION PROCEDURE



EKME007A

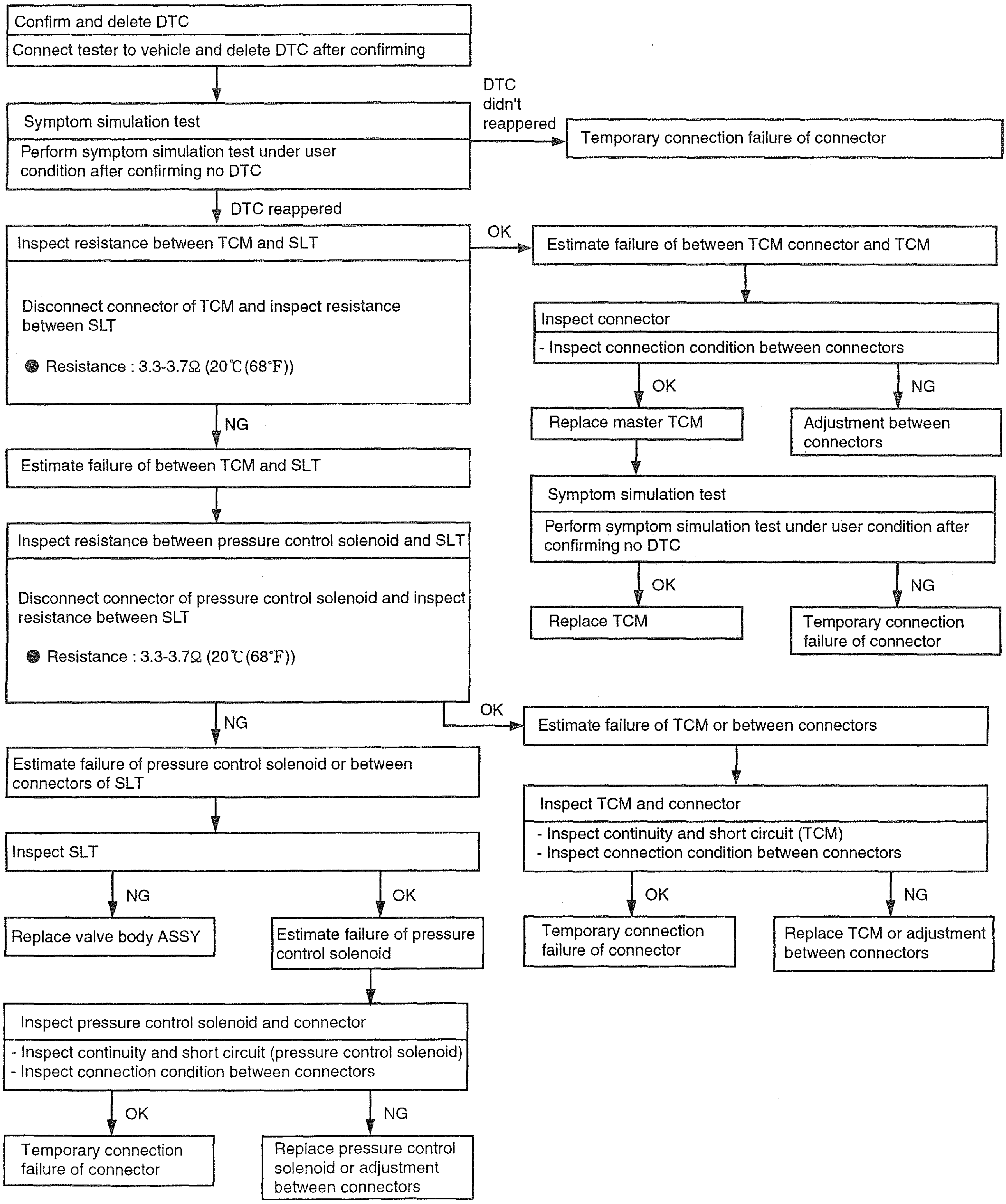
DTC TROUBLESHOOTING PROCEDURE EEDDD6E2

DTC P0748	PRESSURE CONTROL SOLENOID CIRCUIT MALFUNCTION

DTC DETECTING CONDITION

Item	Detecting Condition	Possible cause
DTC Strategy	● Check for GROUND SHORT/OPEN/+B SHORT	● Open or short in circuit
Enable Conditions	—	
Threshold Value	● GND SHORT /OPEN : To detect that the feed back A/D value is less than 15 ● BATTERY SHORT : To detect that the feed back A/D value is more than 1000	
Diagnostic Time	● GND SHORT / OPEN: 12.5sec. continuously ● BATTERY SHORT: for 500msec. continuously.	
Fail Safe	● After failure detection: - NO L- UP/Line Pressure Reduction at shifting/Up Slope Mode/Down Slope Mode/Squat Control. ● After failure decision - Emergency mode	
Pass Criteria	● GND SHORT To detect the no failure detection for 12.5 sec continuously.	

INSPECTION PROCEDURE



EKME008A

DTC TROUBLESHOOTING PROCEDURE EB5CA5DA

DTC P0753	SHIFT SILENOID CIRCUIT MALFUNCTION

DTC DETECTING CONDITION

<table>
<tr><th>Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td>DTC Strategy</td><td>● Check for GROUND SHORT/OPEN</td><td rowspan="7">● Open or short in circuit</td></tr>
<tr><td>Enable Conditions</td><td>—</td></tr>
<tr><td>Threshold Value</td><td>● GND SHORT is :
To detect the “OFF “ signal of the S1 monitor during 300msec when S1 driver outputs the “ON” signal.

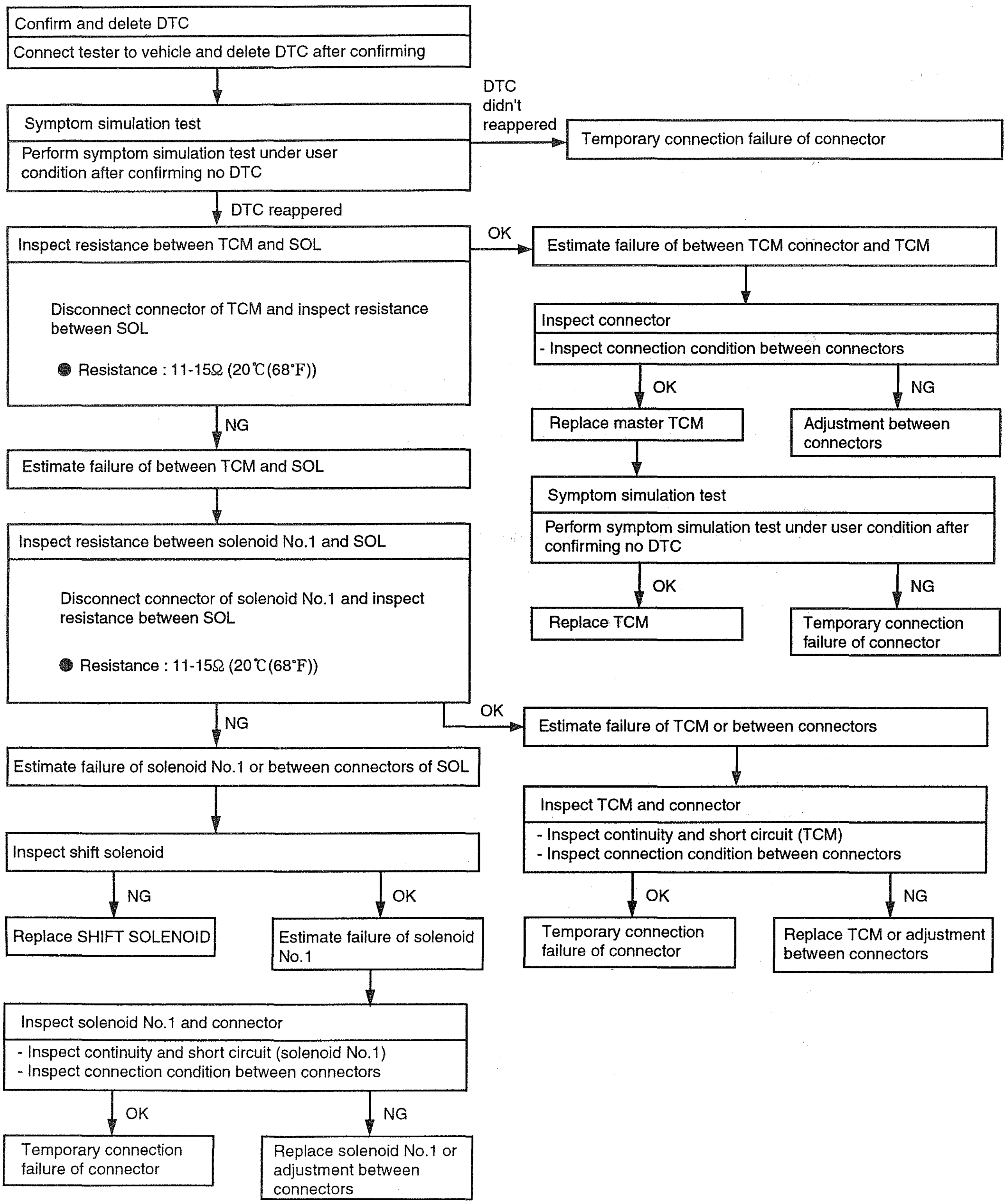
● OPEN is:
To detect the “ON “ signal of the S1 monitor during 500msec when S1 driver outputs the “OFF” signal.

The above detection 2 times at shifting continuously.</td></tr>
<tr><td>Diagnostic Time</td><td>—</td></tr>
<tr><td>Fail Safe</td><td>● After failure detection:
-TCU operates shifting as following pattern
<table>
<tr><th>GEAR</th><th>S1FAIL</th><th>S2FAIL</th><th>S1 & S2 FAIL</th></tr>
<tr><td>1</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td>2</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>3</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>4</td><td>4</td><td>4</td><td>4</td></tr>
</table>
EKME011A

-No L-UP/Torque Reduction at shifting/Line Pressure Reduction at shifting/Squat Control/Up Slope Mode/Down Slope Mode
-To inhibit failure detection(Output Sensor/Input Sensor/SOL Malfunction)

● After failure decision:
-Emergency mode</td></tr>
<tr><td>Pass Criteria</td><td>● GND SHORT
To detect no fail for 1 sec. when Sol. on. (1st, 2nd)
●OPEN
To detect no fail for 1 sec. when Sol. off. (3rd, 4th)</td></tr>
</table>

INSPECTION PROCEDURE



EKME009A

DTC TROUBLESHOOTING PROCEDURE EFEB76F9

DTC P0758	SHIFT SILENOID CIRCUIT MALFUNCTION

DTC DETECTING CONDITION

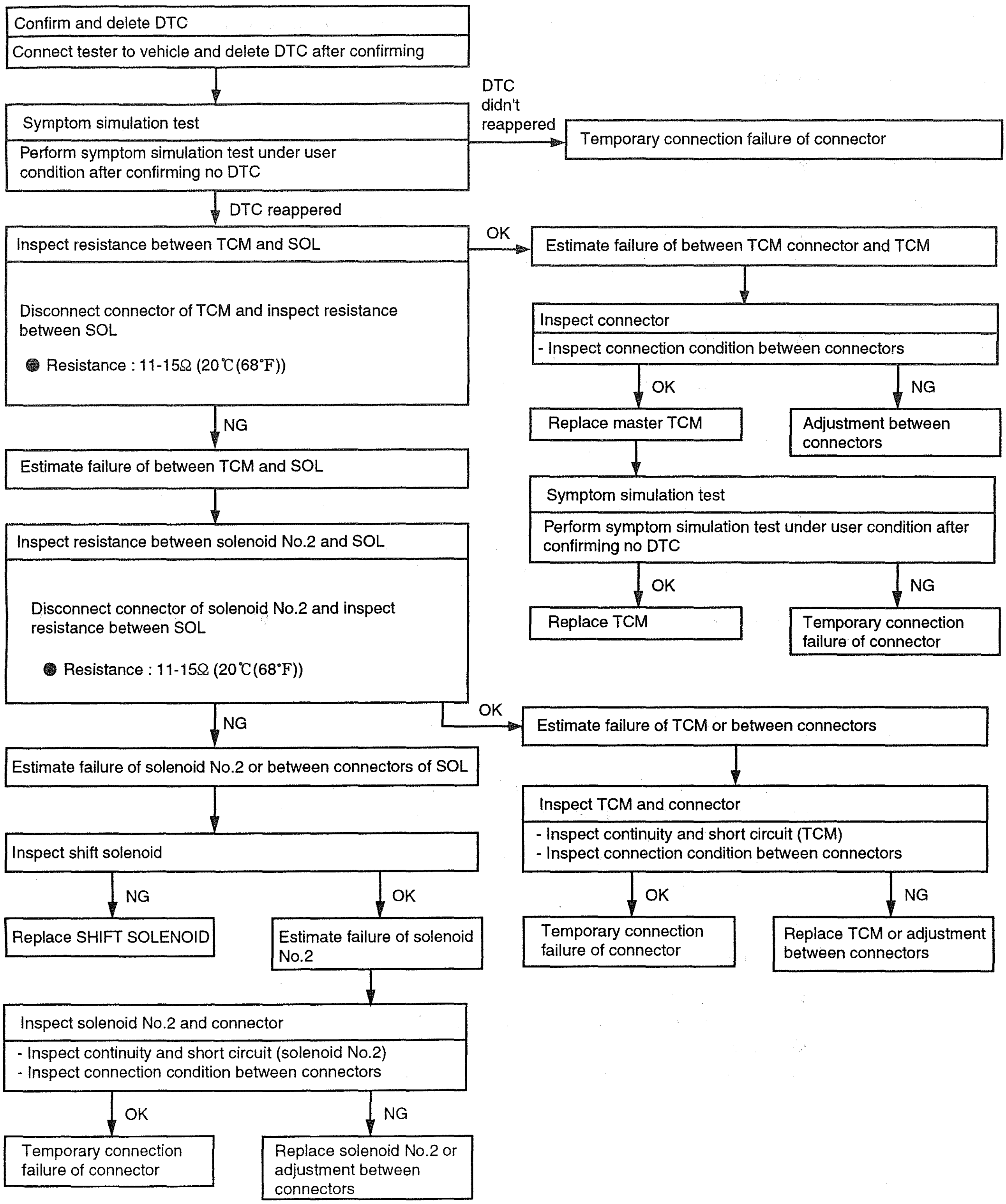
<table>
<tr><th>Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td>DTC Strategy</td><td>● Check for GROUND SHORT/OPEN</td><td rowspan="7">● Open or short in circuit</td></tr>
<tr><td>Enable Conditions</td><td>—</td></tr>
<tr><td>Threshold Value</td><td>● GND SHORT is :
To detect the “OFF “ signal of the S1 monitor during 300msec when S2 driver outputs the “ON” signal.

● OPEN is:
To detect the “ON “ signal of the S1 monitor during 500msec when S2 driver outputs the “OFF” signal.

The above detection 2 times at shifting continuously.</td></tr>
<tr><td>Diagnostic Time</td><td>—</td></tr>
<tr><td>Fail Safe</td><td>● After failure detection:
-TCU operates shifting as following pattern.
<table>
<tr><th>GEAR</th><th>S1FAIL</th><th>S2FAIL</th><th>S1 & S2 FAIL</th></tr>
<tr><td>1</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td>2</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>3</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>4</td><td>4</td><td>4</td><td>4</td></tr>
</table>
EKME011A
-No L-UP/Torque Reduction at shifting/Line Pressure Reduction at shifting/Squat Control/Up Slope Mode/Down Slope Mode
-To inhibit failure detection(Output Sensor/Input Sensor/SOL Malfunction)

● After failure decision:
-Emergency mode</td></tr>
<tr><td>Pass Criteria</td><td>● GND SHORT
To detect no fail for 1 sec. when Sol. on. (2nd,3rd)
●OPEN
To detect no fail for 1 sec. when Sol. off. (1st, 4th)</td></tr>
</table>

INSPECTION PROCEDURE



EKME010A

DTC TROUBLESHOOTING PROCEDURE

ECBDB6BC

DTC P1121	THROTTLE POSITION SENSOR SIGNAL INVALID

DTC DETECTING CONDITION

Item	Detecting Contion	Possible cause
DTC Strategy	● Check for GROUND SHORT/OPE	● Open or short in circuit
Enable Conditions	—	
Threshold Value	● TCU detects TPS data is FFH	
Diagnostic Time	● for 0.2sec	
Fail Safe	● TCU judges Throttle Opening is 0% for shifting. ● Line Pressure is full ● No Torque Reduction at shifting/Coast Down/L-UP.	
Pass Criteria	● To detect TPS data is between 20h~ F5h for 2.0sec. continuously.	

DTC TROUBLESHOOTING PROCEDURE E31BA5E8

DTC P1630	CONTROL MODULE COMMUNICATION ERROR

DTC DETECTING CONDITION

Item	Detecting Contion	Possible cause
DTC Strategy	—	● Open or Short in CAN communication harness ● Faulty ECM ● Faulty TCM
Enable Conditions	● After 0.2sec. passed from IG ON.	
Threshold Value	● To detect the BUS OFF signal in CPU.	
Diagnostic Time	● for 0.2sec.	
Fail Safe	● Line Pressure is full. ● No Torque Reduction at shifting/Squat Control/Up Slope Mode/Down Slope Mode/L-UP/Coast Control. ● TCU judges Throttle Opening is 0% for shifting. ● To inhibit failure detection(No ID/L4 SW Malfunction/Engine High Range/Transmission Fluid Sensor/SOL Malfunction). ● TCU judges Engine Water Temperature is normal condition(80Degrees)/Engine Revolution 7000rpm/Engine Torque 350Nm/Driving cycle Detect.	
Pass Criteria	● To detect the BUS normal signal for 2.0sec continuously	

DTC TROUBLESHOOTING PROCEDURE

E4BB55BD

DTC P1631	COMMUNICATION ERROR WITH ECM

DTC DETECTING CONDITION

Item	Detecting Contion	Possible cause
DTC Strategy	—	● Open or Short in CAN communication harness ● Faulty ECM ● Faulty TCM
Enable Conditions	● After 0.2sec. passed from IG ON. ● During No failure of BUS OFF	
Threshold Value	● To detect the nothing of EMS1 or EMS2 signal on CAN BUS	
Diagnostic Time	● continued for 2.0 sec.	
Fail Safe	● Line Pressure is full. ● No Torque Reduction at shifting/Squat Control/Up Slope Mode/Down Slope Mode/L-UP/Coast Control. ● TCU judges Throttle Opening is 0% for shifting. ● To inhibit failure detection(No ID/L4 SW Malfunction/Engine High Range/Transmission Fluid Sensor/SOL Malfunction). ● TCU judges Engine Water Temperature is normal condition(80Degrees)/Engine Revolution 7000rpm/Engine Torque 350Nm/Driving cycle Detect.	
Pass Criteria	● To detect the BUS normal signal for 2.0sec continuously.	