

Fuel System

GENERAL

GASOLINE ENGINE CONTROL SYSTEM

ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM
MASS AIR FLOW SENSOR (MAFS)
INTAKE AIR TEMPERATURE SENSOR (IATS)
MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)
ENGINE COOLANT TEMPERATURE SENSOR (ECTS)
CAMSHAFT POSITION SENSOR (CMPS)
CRANKSHAFT POSITION SENSOR (CKPS)
HEATED OXYGEN SENSOR (HO2S)
KNOCK SENSOR (KS)

INJECTOR

CVVT OIL CONTROL VALVE (OCV)
CVVT OIL TEMPERATURE SENSOR(OTS)
PURGE CONTROL SOLENOID VALVE (PCSV)
VARIABLE INTAKE SOLENOID (VIS) VALVE
ACCELERATOR POSITION SENSOR (APS)
ENGINE CONTROL MODULE (ECM)

DTC TROUBLESHOOTING PROCEDURES

FUEL DELIVERY SYSTEM

FUEL PUMP
FUEL TANK
FILLER-NECK ASSEMBLY
ACCELERATOR PEDAL

GENERAL**SPECIFICATION** E1FAFA51**FUEL DELIVERY SYSTEM**

Items	Specification	
Fuel Tank	Capacity	80 lit. (21.1 U.S.gal., 17.6 Imp. gal.)
Fuel Filter (built in Fuel Pump assembly)	Type	High pressure type
Fuel Pressure Regulator (built in Fuel Pump assembly)	Regulated Fuel Pressure	375 ~ 385 kPa(3.82 ~ 3.92 kgf/cm ² , 54.3 ~ 55.8 psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor

SENSORS**MASS AIR FLOW SENSOR (MAFS)**

- ▷ Type: Hot-film type
- ▷ Specification

Air Flow (kg/h)	Frequency (Hz)
12.6	2,617
18.0	2,958
23.4	3,241
32.4	3,653
43.2	4,024
57.6	4,399
72.0	4,704
108.0	5,329
144.0	5,897
198.0	6,553
270.0	7,240
360.0	7,957
486.0	8,738
666.0	9,644
900.0	10,590

INTAKE AIR TEMPERATURE SENSOR (IATS)

- ▷ Type: Thermistor type
- ▷ Specification

Temperature		Resistance (kΩ)
°C	°F	
-40	-40	100.87
-20	-4	28.58
0	32	9.40
10	50	5.66
20	68	3.51
40	104	1.47
60	140	0.67
80	176	0.33

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

- ▷ Type: Piezo-resistive pressure type
- ▷ Specification

Pressure (kPa)	Output Voltage (V)
20.0	0.79
46.66	1.84
101.32	4.0

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ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

- ▷ Type: Thermistor type
- ▷ Specification

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

THROTTLE POSITION SENSOR (TPS)

- ▷ Type: Variable resistor type
- ▷ Specification (When reference voltage = 5.0V)

Throttle Angle (°)	Output Voltage(V)	
	TPS1	TPS2
0°	0	5.0
10°	0.5	4.5
20°	0.9	4.1
30°	1.4	3.6
40°	1.8	3.2
50°	2.3	2.7
60°	2.7	2.3
70°	3.2	1.8
80°	3.6	1.4
90°	4.1	0.9
100°	4.5	0.5
110°	5.0	0

Item	Sensor Resistance (kΩ)
TPS1	4.0 ~ 6.0kΩ at 20°C (68°F)
TPS2	2.72 ~ 4.08kΩ at 20°C (68°F)

ACCELERATOR POSITION SENSOR (APS)

- ▷ Type: Variable resistor type
- ▷ Specification (When reference voltage = 5.0V)

Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.7 ~ 0.8	0.28 ~ 0.48
W.O.T	3.8 ~ 4.4	1.75 ~ 2.35

Item	Sensor Resistance (kΩ)
APS1	0.7 ~ 1.3kΩ at 20°C (68°F)
APS2	1.4 ~ 2.6kΩ at 20°C (68°F)

HEATED OXYGEN SENSOR (HO2S)

- ▷ Type: Zirconia (ZrO₂) type
- ▷ Specification

A/F Ratio	Output Voltage (V)
RICH	0.75 ~ 1.0
LEAN	0 ~ 0.12

Item	Resistance (Ω)
Sensor Heater	8.1 ~ 11.1Ω at 21°C (69.8°F)

CAMSHAFT POSITION SENSOR (CMPS)

- ▷ Type: Hall effect type
- ▷ Specification

Item	Specification
Output Voltage (V)	High: 5.0V
	Low: 0 ~ 0.7V
Air Gap (mm)	0.5 ~ 1.5

CRANKSHAFT POSITION SENSOR (CKPS)

- ▷ Type: Magnetic field sensitive type
- ▷ Specification

Item	Specification
Coil Resistance (Ω)	630 ~ 770Ω at 20°C (68°F)
Air Gap (mm)	0.5 ~ 1.5

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KNOCK SENSOR (KS)

- ▷ Type: Piezo-electricity type
- ▷ Specification

Item	Specification
Capacitance (pF)	1,480 ~ 2,220

CVVT OIL TEMPERATURE SENSOR (OTS)

- ▷ Type: Thermistor type
- ▷ Specification

Temperature		Resistance (kΩ)
°C	°F	
-20	-4	16.52
20	68	2.45
80	176	0.29

ACTUATORS

INJECTOR

- ▷ Number: 6
- ▷ Specification

Item	Specification
Coil Resistance (Ω)	11.4 ~ 12.6Ω at 20°C (68°F)

PURGE CONTROL SOLENOID VALVE (PCSV)

- ▷ Type: Duty control type
- ▷ Specification

Item	Specification
Coil Resistance (Ω)	19.0 ~ 22.0Ω at 20°C (68°F)

VARIABLE INTAKE SOLENOID (VIS) VALVE

- ▷ Specification

Item	Specification
Coil Resistance (Ω)	30.0 ~ 35.0Ω [22°C (71.6°F)]

CVVT OIL CONTROL VALVE (OCV)

- ▷ Specification

Item	Specification
Coil Resistance (Ω)	6.7 ~ 7.7Ω at 20°C (68°F)

ETC MOTOR

- ▷ Specification

Item	Specification
Coil Resistance (Ω)	1.275 ~ 1.725Ω at 20°C (68°F)

IGNITION COIL

- ▷ Type: Stick type
- ▷ Specification

Item	Specification
1st Coil Resistance (Ω)	0.62Ω±10% at 20°C (68°F)
2nd Coil Resistance (kΩ)	7.0kΩ±15% at 20°C (68°F)

SERVICE STANDARD

E474CE10

Ignition Timing	BTDC 7° ± 5°		
Idle Speed	A/CON OFF	Neutral,N,P-range	650 ± 100 rpm
		D-range	650 ± 100 rpm
	A/CON ON	Neutral,N,P-range	650 ± 100 rpm
		D-range	650 ± 100 rpm

TIGHTENING TORQUES

E70F41FC

ENGINE CONTROL SYSTEM

Item	Kgf·m	N·m	lbf·ft
ECM installation bolts (on bracket)	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
ECM bracket installation bolts	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Mass air flow sensor installation bolts	0.3~ 0.5	2.9 ~ 4.9	2.2 ~ 3.6
Mass air flow sensor clamp tightening	0.3 ~ 0.5	2.9 ~ 4.9	2.2 ~ 3.6
Heated oxygen sensor (Bank 1 / Sensor 1) installation	5.0 ~ 6.0	49.1 ~ 58.9	36.2 ~ 43.4
Heated oxygen sensor (Bank 1 / Sensor 2) installation	5.0 ~ 6.0	49.1 ~ 58.9	36.2 ~ 43.4
Heated oxygen sensor (Bank 2 / Sensor 1) installation	5.0 ~ 6.0	49.1 ~ 58.9	36.2 ~ 43.4
Heated oxygen sensor (Bank 2 / Sensor 2) installation	5.0 ~ 6.0	49.1 ~ 58.9	36.2 ~ 43.4
Engine coolant temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Manifold absolute pressure sensor installation bolts	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Camshaft position sensor [Bank 1] installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor [Bank 2] installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Crankshaft position sensor installation	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Knock sensor #1,2 installation	1.6 ~ 2.4	15.7 ~ 23.5	11.6 ~ 17.4
ETC module installation bolt (on throttle body)	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT Oil temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
CVVT Oil control valve [Bank 1] installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT Oil control valve [Bank 2] installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Purge control solenoid valve bracket installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Vacuum valve (Variable intake actuator) installation bolts	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil condenser installation bolt	0.7 ~ 1.1	6.9 ~ 10.8	5.1 ~ 8.0
Ignition coil installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7

FUEL DELIVERY SYSTEM

Item	Kgf·m	N·m	lbf·ft
Fuel Tank installation bolts	5.0 ~ 6.0	49.1 ~ 58.9	36.2 ~ 43.4
Fuel pump assembly mounting bolts	1.1 ~ 1.7	10.7 ~ 16.7	8.0 ~ 12.3

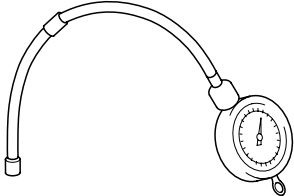
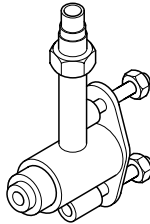
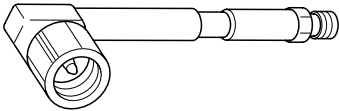
GENERAL

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Accelerator pedal module installation bolts / nut	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Delivery pipe installation bolts	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7

SPECIAL SERVICE TOOLS

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

BASIC TROUBLESHOOTING

E863FF3C

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 <i>To erase DTC and freeze frame data, refer to Step 5.</i>
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 of the DTC Try to recreate or simulate the symptoms and conditions of the malfunction as described by customer. If DTC(s) is/are displayed, simulate the condition according to troubleshooting procedure for the DTC.
8	Confirm Symptoms of Problem If DTC(s) is/are not displayed, go to Step 9. If DTC(s) is/are displayed, go to Step 11.
9	Recreate (Simulate) Symptom Try to recreate or simulate the condition of the malfunction as described by the customer.
10	Check the DTC If DTC(s) does(do) not occur, refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE. If DTC(s) occur(s), go to Step 11.
11	Perform troubleshooting procedure for DTC
12	Adjust or repair the vehicle
13	Confirmation test
14	END

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CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLE INFORMATION

VIN No.		Transmission	☐ M/T ☐ A/T ☐ CVT ☐ etc.
Production date		Driving type	☐ 2WD (FF) ☐ 2WD (FR) ☐ 4WD
Odometer Reading	_____ km/mile		

2. SYMPTOMS

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

3. ENVIRONMENT

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

4. MIL/DTC

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

5. ECM/PCM INFORMATION

ECM/PCM Part No.	
ROM ID	

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°C, 68°F), unless stated otherwise.

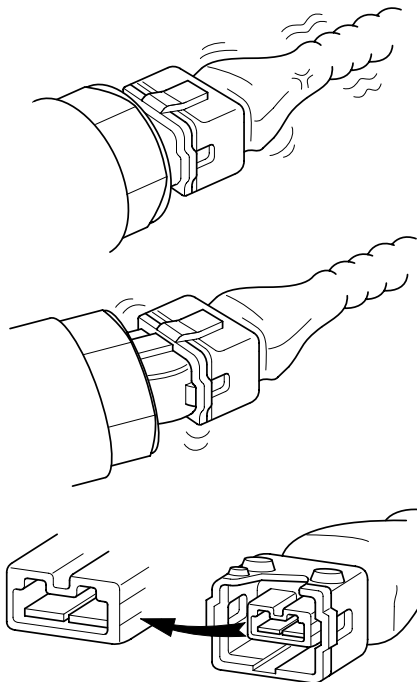


The measured resistance in except for ambient temperature (20°C, 68°F) is reference value.

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, the 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 source.

⊗ 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.

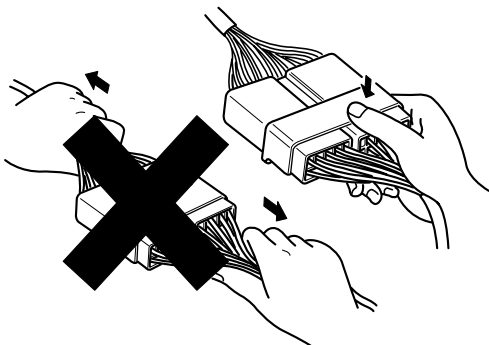
● SIMULATING ELECTRICAL LOAD

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

CONNECTOR INSPECTION PROCEDURE

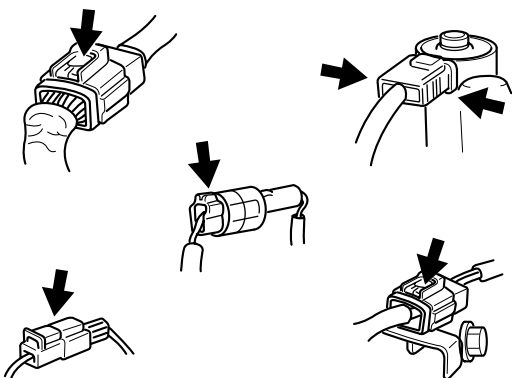
1. Handling of Connector

- a. Never pull on the wiring harness when disconnecting connectors.



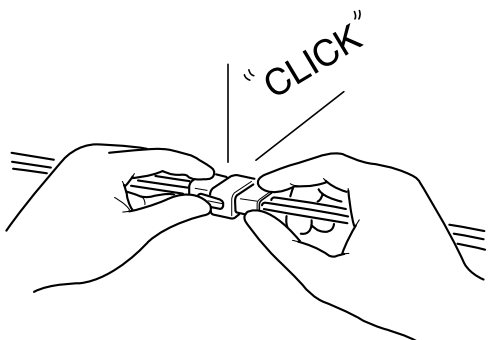
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- b. When removing the connector with a lock, press or pull locking lever.



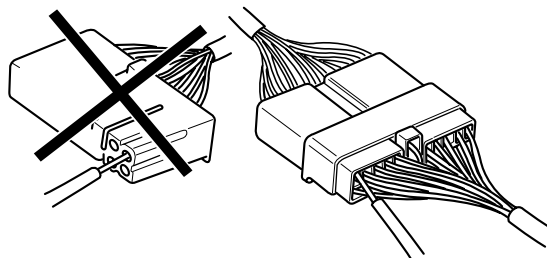
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- c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



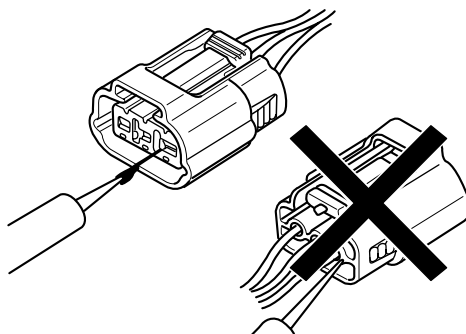
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- d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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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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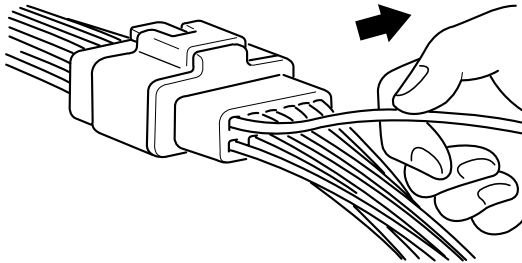
NOTE

- 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.

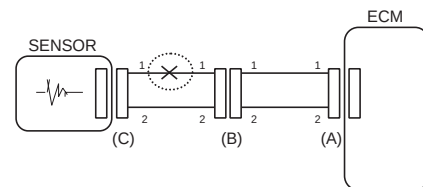
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

● **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

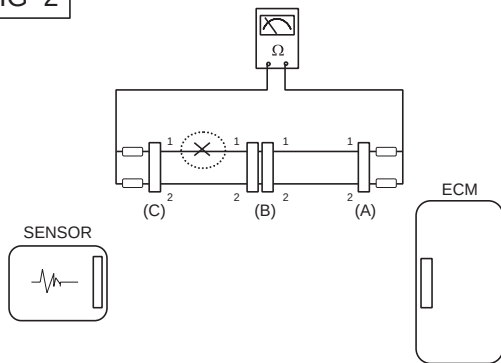
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

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

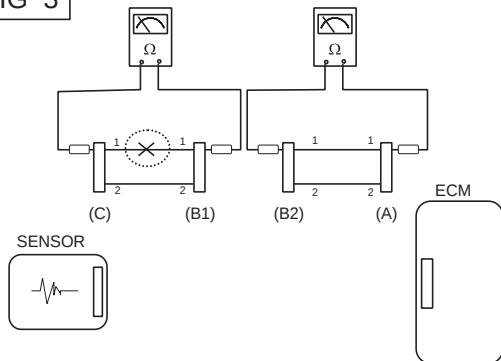


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- b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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

FIG 3



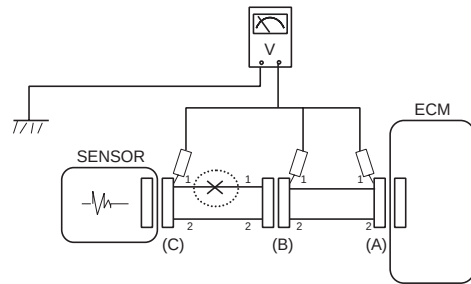
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3. Voltage Check Method

- 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



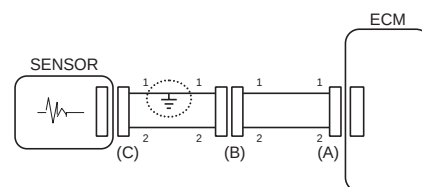
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● CHECK SHORT CIRCUIT

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 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.

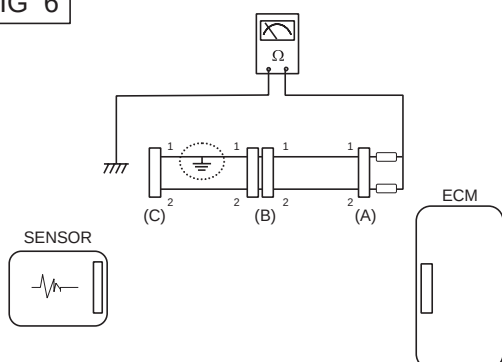
Specification (Resistance)

1Ω or less → Short to Ground Circuit
 $1M\Omega$ 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 $1\ \Omega$ and higher than $1\text{M}\Omega$ 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 following step.

FIG 6

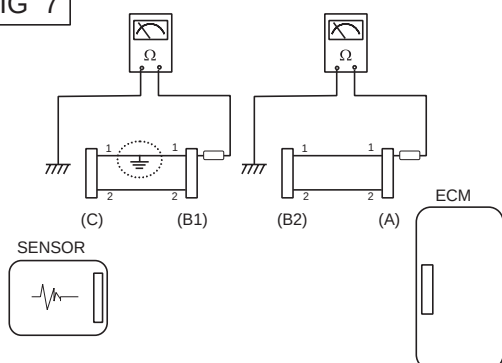


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- b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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



BFG501G

SYMPTOM TROUBLESHOOTING GUIDE CHART

MAIN SYMPTOM	DIAGNOSTIC PROCEDURE	ALSO CHECK FOR
Unable to start (Engine does not turn over)	1. Test the battery 2. Test the starter 3. Inhibitor switch (A/T) or clutch start switch (M/T)	
Unable to start (Incomplete combustion)	1. Test the battery 2. Check the fuel pressure 3. Check the ignition circuit 4. Troubleshooting the immobilizer system (In case of immobilizer lamp flashing)	• DTC • Low compression • Intake air leaks • Slipped or broken timing belt • Contaminated fuel
Difficult to start	1. Test the battery 2. Check the fuel pressure 3. Check the ECT sensor and circuit (Check DTC) 4. Check the ignition circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor idling (Rough, unstable or incorrect Idle)	1. Check the fuel pressure 2. Check the Injector 3. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM) 4. Check the idle speed control circuit (Check DTC) 5. Inspect and test the Throttle Body 6. Check the ECT sensor and circuit (Check DTC)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Engine stall	1. Test the Battery 2. Check the fuel pressure 3. Check the idle speed control circuit (Check DTC) 4. Check the ignition circuit 5. Check the CKPS Circuit (Check DTC)	• DTC • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor driving (Surge)	1. Check the fuel pressure 2. Inspect and test Throttle Body 3. Check the ignition circuit 4. Check the ECT Sensor and Circuit (Check DTC) 5. Test the exhaust system for a possible restriction 6. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Knocking	1. Check the fuel pressure 2. Inspect the engine coolant 3. Inspect the radiator and the electric cooling fan 4. Check the spark plugs	• DTC • Contaminated fuel

MAIN SYMPTOM	DIAGNOSTIC PROCEDURE	ALSO CHECK FOR
Poor fuel economy	1. Check customer's driving habits • Is A/C on full time or the defroster mode on? • Are tires at correct pressure? • Is excessively heavy load being carried? • Is acceleration too much, too often? 2. Check the fuel pressure 3. Check the injector 4. Test the exhaust system for a possible restriction 5. Check the ECT sensor and circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Hard to refuel (Overflow during refueling)	1. Test the canister close valve 2. Inspect the fuel filler hose/pipe • Pinched, kinked or blocked? • Filler hose is torn 3. Inspect the fuel tank vapor vent hose between the EVAP. canister and air filter 4. Check the EVAP. canister	• Malfunctioning gas station filling nozzle (If this problem occurs at a specific gas station during refueling)

GASOLINE ENGINE CONTROL SYSTEM

DESCRIPTION EFE3062A

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

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

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

NOTE

- Before removing or installing any part, read the diagnostic trouble codes and then disconnect the battery negative (-) terminal.
- Before disconnecting the cable from battery terminal, turn the ignition switch to OFF. Removal or connection of the battery cable during engine operation or while the ignition switch is ON could cause damage to the ECM.
- The control harnesses between the ECM and heated oxygen sensor are shielded with the shielded ground wires to the body in order to prevent the influence of ignition noises and radio interference. When the shielded wire is faulty, the control harness must be replaced.
- When checking the generator for the charging state, do not disconnect the battery '+' terminal to prevent the ECM from damage due to the voltage.
- When charging the battery with the external charger, disconnect the vehicle side battery terminals to prevent damage to the ECM.

MALFUNCTION INDICATOR LAMP (MIL)

[EOBD]

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

Faults with the following items will illuminate the MIL.

- Catalyst
- Fuel system
- Mass Air Flow Sensor (MAFS)
- Intake Air Temperature Sensor (IATS)
- Engine Coolant Temperature Sensor (ECTS)
- Throttle Position Sensor (TPS)
- Upstream Oxygen Sensor
- Upstream Oxygen Sensor Heater
- Downstream Oxygen Sensor
- Downstream Oxygen Sensor Heater
- Injector
- Misfire
- Crankshaft Position Sensor (CKPS)
- Camshaft Position Sensor (CMPS)
- Evaporative Emission Control System
- Vehicle Speed Sensor (VSS)
- Idle Speed Control Actuator (ISCA)
- Power Supply
- ECM/ PCM
- MT/AT Encoding
- Acceleration Sensor
- MIL-on Request Signal
- Power Stage

NOTE

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

[NON-EOBD]

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

Faults with the following items will illuminate the MIL

- Heated oxygen sensor (HO2S)
- Mass Air Flow sensor (MAFS)
- Throttle position sensor (TPS)
- Engine coolant temperature sensor (ECTS)
- Idle speed control actuator (ISCA)
- Injectors
- ECM



NOTE

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

[INSPECTION]

1. After turning ON the ignition key, ensure that the light illuminates for about 5 seconds and then goes out.
2. If the light does not illuminate, check for an open circuit in the harness, a blown fuse or a blown bulb.

SELF-DIAGNOSIS

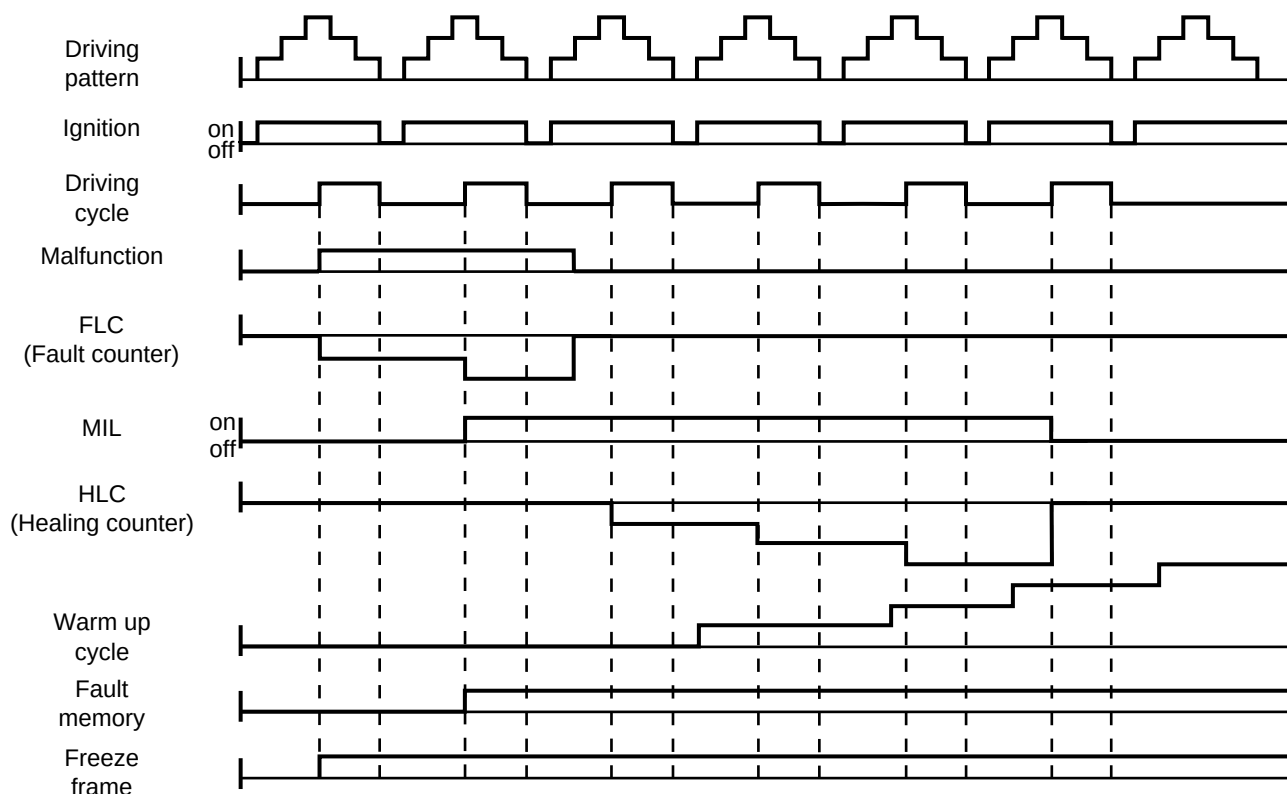
The ECM monitors the input/output signals (some signals at all times and the others under specified conditions). When the ECM detects an irregularity, it records the diagnostic trouble code, and outputs the signal to the Data Link connector. The diagnosis results can be read with the MIL or HI-SCAN (Pro).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



NOTE

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

THE RELATION BETWEEN DTC AND DRIVING PATTERN IN EOBD SYSTEM



LGIF601Q

1. When the same malfunction is detected and maintained during two sequential driving cycles, the MIL will automatically illuminate.
 2. The MIL will go off automatically if no fault is detected after 3 sequential driving cycles.
 3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction is detected after two sequential driving cycles. The MIL will illuminate when the malfunction is detected on the second driving cycle.
If a misfire is detected, a DTC will be recorded, and the MIL will illuminate, immediately after a fault is first detected.
 4. A Diagnostic Trouble Code(DTC) will automatically erase from ECM memory if the same malfunction is not detected for 40 driving cycles.
- A "driving cycle" consists of engine startup, vehicle operation beyond the beginning of closed loop operation.



NOTE

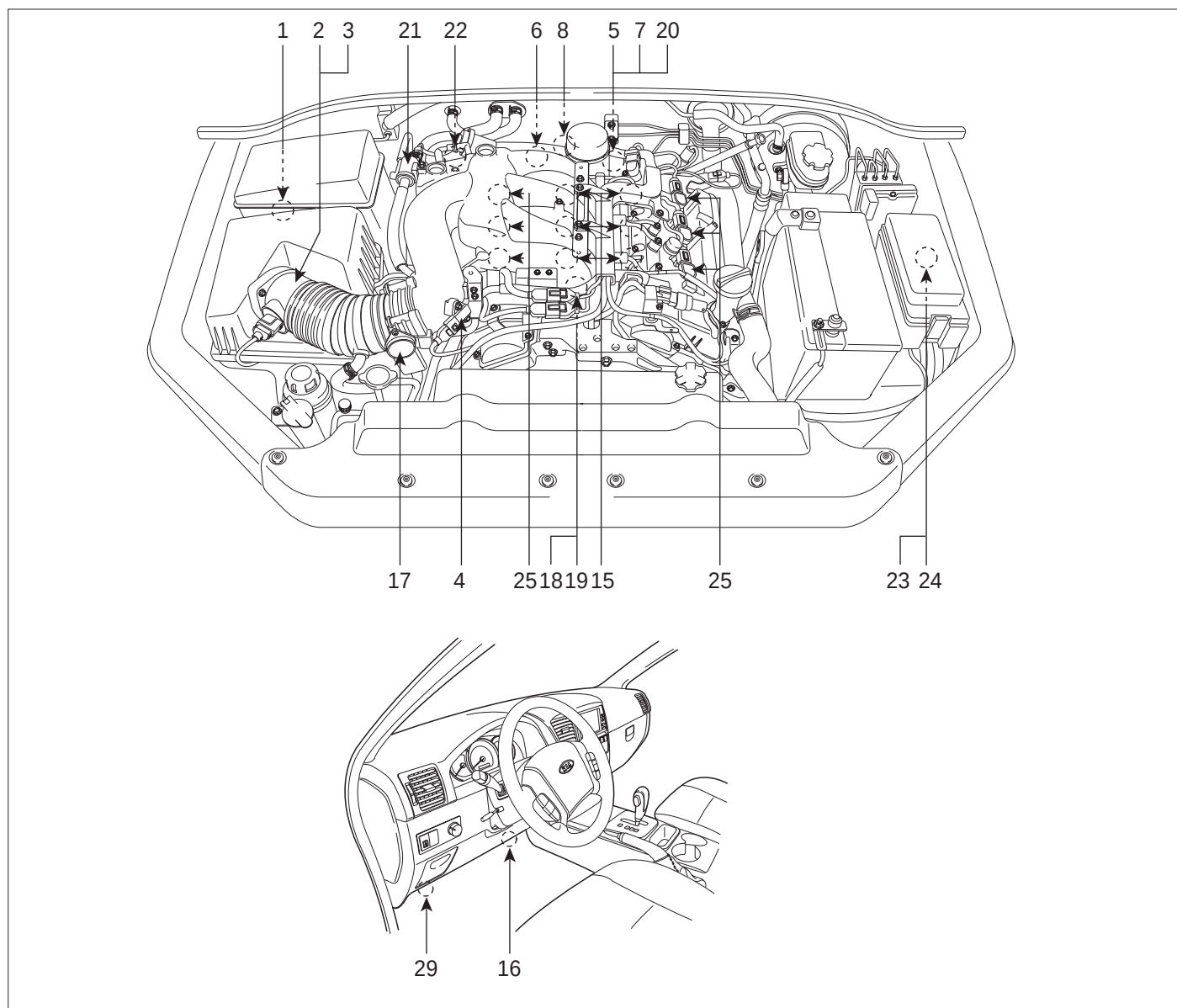
- A "warm-up cycle" means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of 160 degrees Fahrenheit.

GASOLINE ENGINE CONTROL SYSTEM

FLB -21

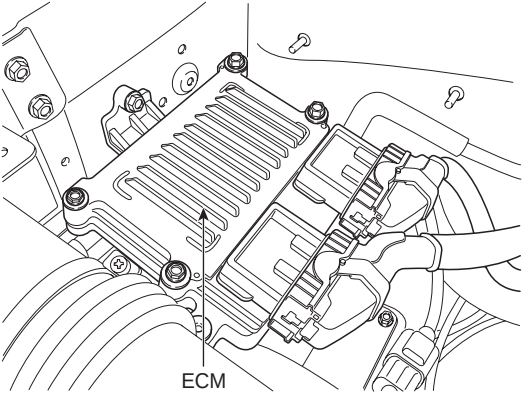
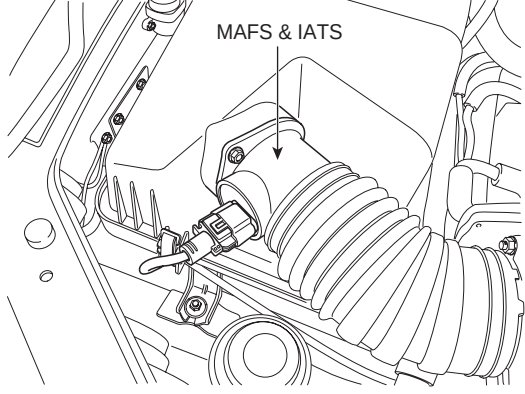
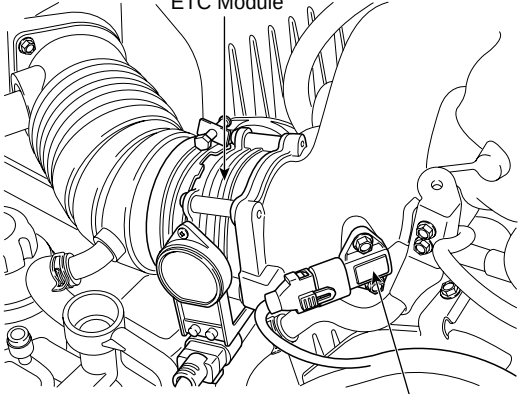
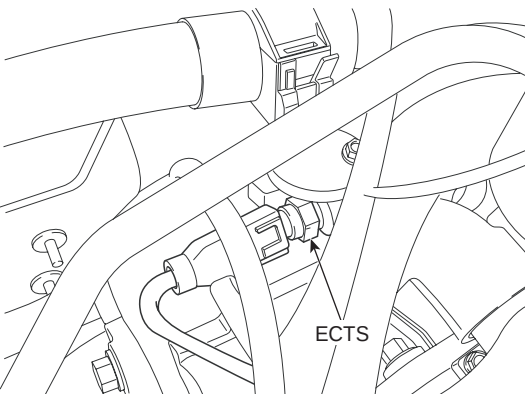
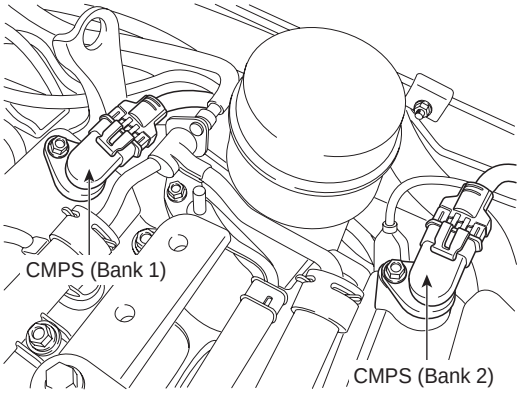
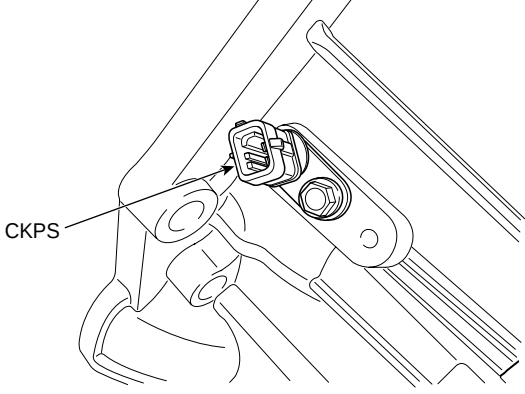
COMPONENT LOCATION

E2492BA9



1. ECM (Engine Control Module)	16. Accelerator Position Sensor (APS)
2. Mass Air Flow Sensor (MAFS)	17. ETC Module [Throttle Position Sensor (TPS) + ETC Motor]
3. Intake Air Temperature Sensor (IATS)	18. CVVT Oil Control Valve (OCV) [Bank 1]
4. Manifold Absolute Pressure Sensor (MAPS)	19. CVVT Oil Control Valve (OCV) [Bank 2]
5. Engine Coolant Temperature Sensor (ECTS)	20. CVVT Oil Temperature Sensor (OTS)
6. Camshaft Position Sensor (CMPS) [Bank 1]	21. Purge Control Solenoid Valve (PCSV)
7. Camshaft Position Sensor (CMPS) [Bank 2]	22. Variable Intake Solenoid (VIS) Valve
8. Crankshaft Position Sensor (CKPS)	23. Fuel Pump Relay
9. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]	24. Main Relay
10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]	25. Ignition Coil
11. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]	26. A/C Pressure Transducer (APT)
12. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]	27. Wheel Speed Sensor (WSS)
13. Knock Sensor (KS) [Bank 1]	[Without ABS/ESP (Euro-III/IV & JAPAN)]
14. Knock Sensor (KS) [Bank 2]	28. Vehicle Speed Sensor (VSS)
15. Injector	[Except Euro-III/IV & JAPAN]
	29. Data Link Connector (DLC)

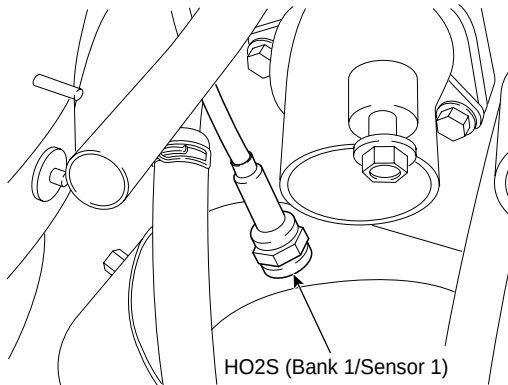
SBLF26100L

1. ECM (Engine Control Module)	2. Mass Air Flow Sensor (MAFS) 3. Intake Air Temperature Sensor (IATS)
 ECM SBLF26101L	 MAFS & IATS SBLF26102L
4. Manifold Absolute Pressure Sensor (MAPS) 17. ETC Module [Throttle Position Sensor (TPS) + ETC Motor]	5. Engine Coolant Temperature Sensor (ECTS)
 ETC Module MAPS SBLF26103L	 ECTS SBLF26104L
6. Camshaft Position Sensor (CMPS) [Bank 1] 7. Camshaft Position Sensor (CMPS) [Bank 2]	8. Crankshaft Position Sensor (CKPS)
 CMPS (Bank 1) CMPS (Bank 2) SBLF26105L	 CKPS SBLF26106L

GASOLINE ENGINE CONTROL SYSTEM

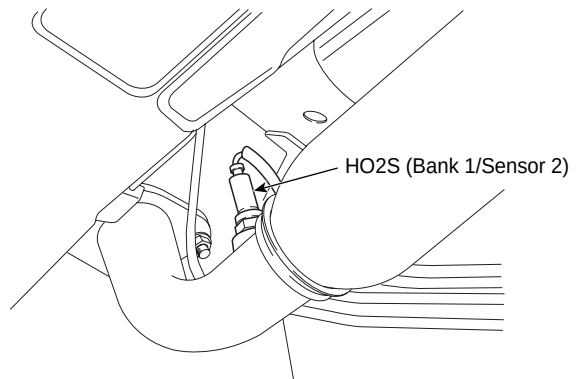
FLB -23

9. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]



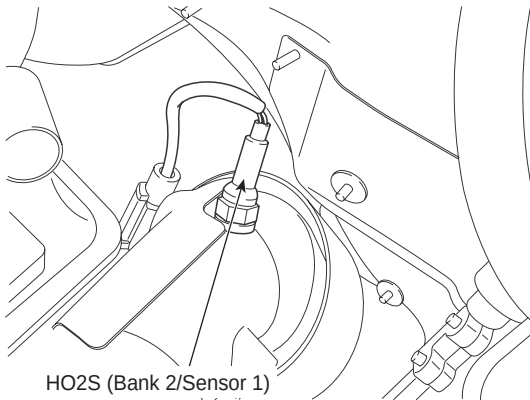
SBLF26107L

10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]



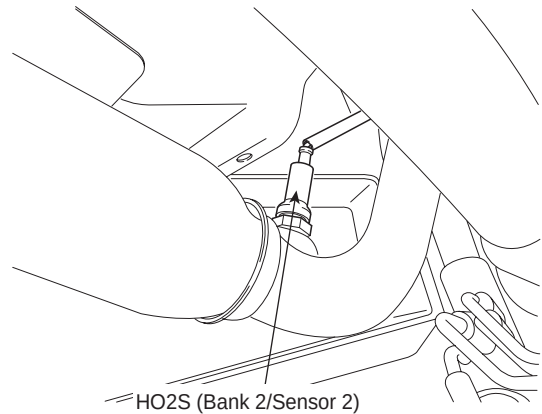
SBLF26108L

11. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]



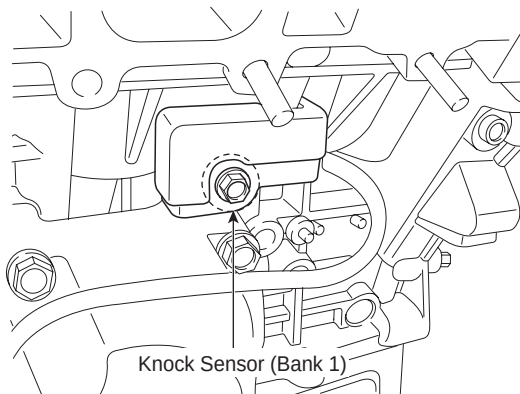
SBLF26109L

12. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]



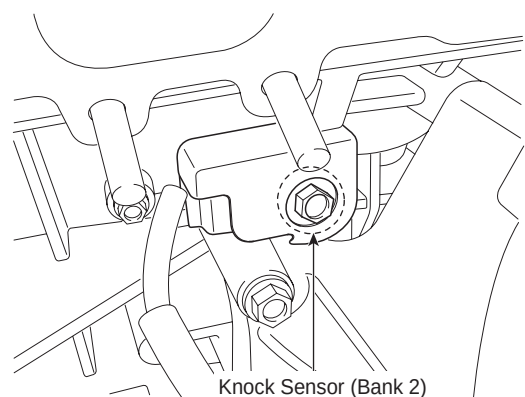
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13. Knock Sensor (KS) [Bank1]

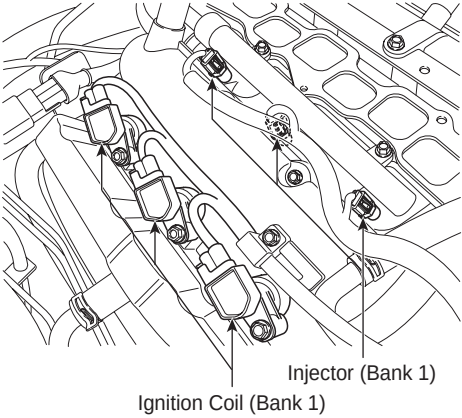
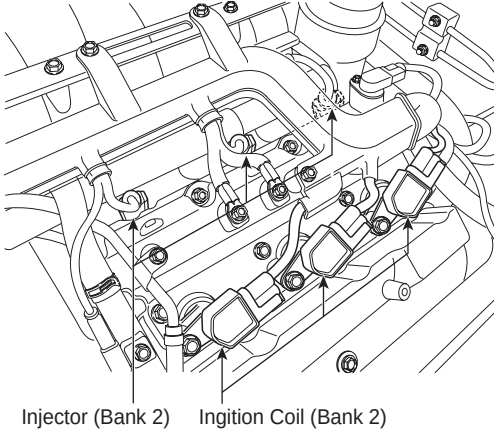
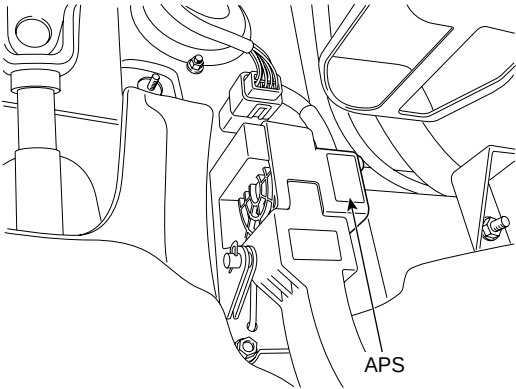
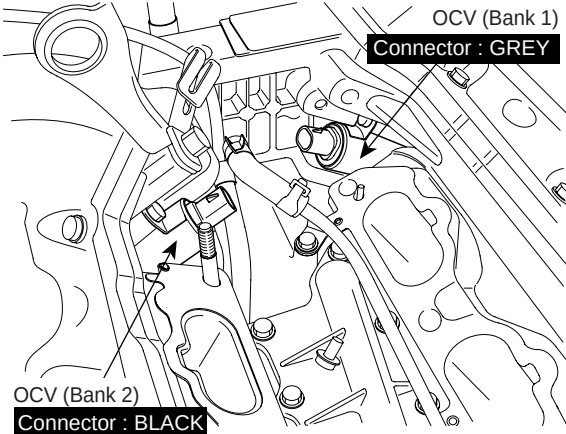
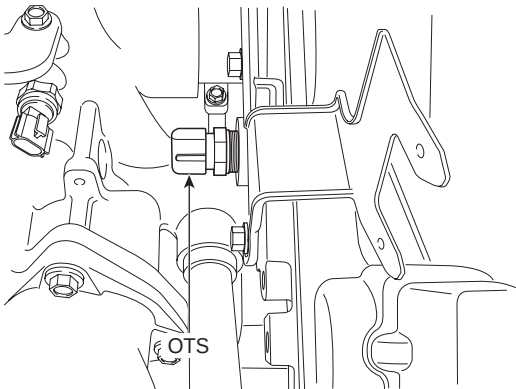
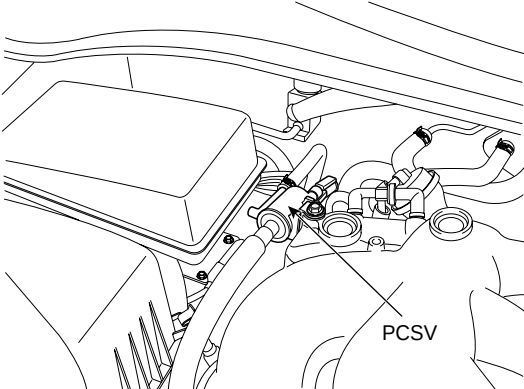


SBLF26111L

14. Knock Sensor [Bank 2]



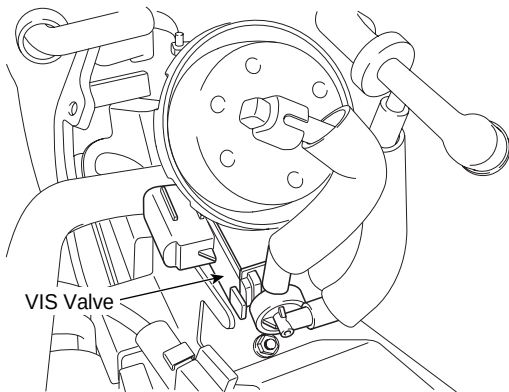
SBLF26112L

15. Injector 25. Ignition Coil	
 Injector (Bank 1) Ignition Coil (Bank 1)  Injector (Bank 2) Ingition Coil (Bank 2) SBLF26113L	
16. Accelerator Position Sensor (APS)	18. CVVT Oil Control Valve (OCV) [Bank 1] 19. CVVT Oil Control Valve (OCV) [Bank 2]
 APS SBLF26115L	 OCV (Bank 1) Connector : GREY OCV (Bank 2) Connector : BLACK EGRF215A
20. CVVT Oil Temperature Sensor (OTS)	21. Purge Control Solenoid Valve (PCSV)
 OTS SBLF26118L	 PCSV SBLF26119L

GASOLINE ENGINE CONTROL SYSTEM

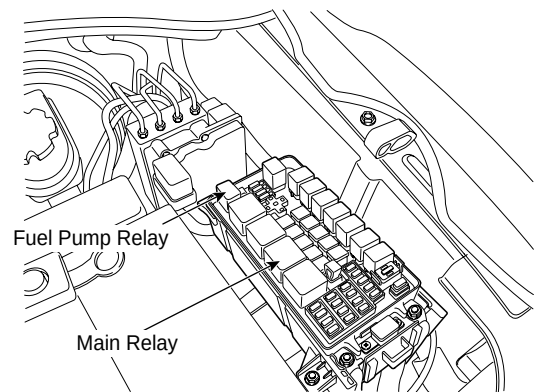
FLB -25

22. Variable Intake Solenoid (VIS) Valve



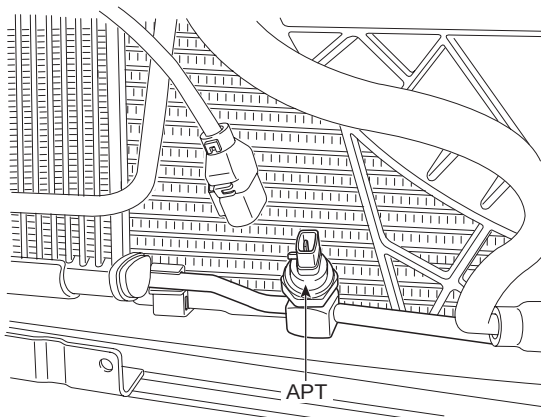
SBLF26116L

23. Fuel Pump Relay
24. Main Relay



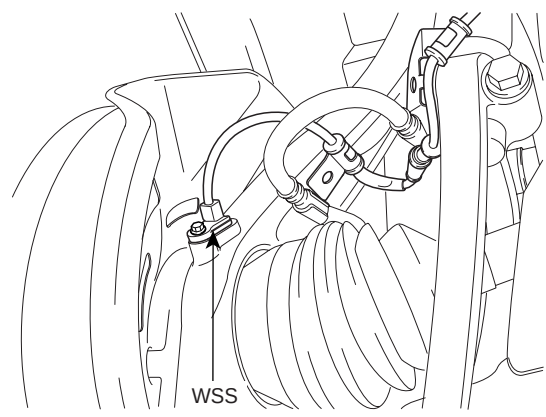
SBLF26117L

26. A/C Pressure Transducer (APT)



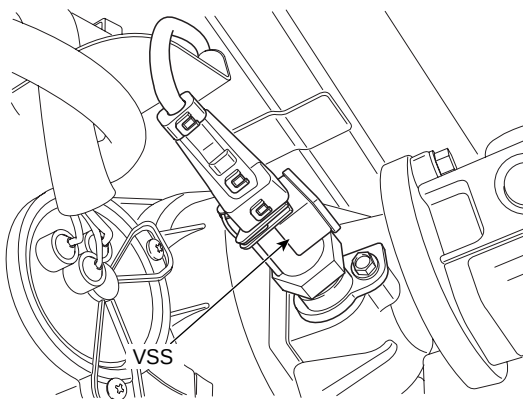
SBLF26121L

27. Wheel Speed Sensor (WSS)



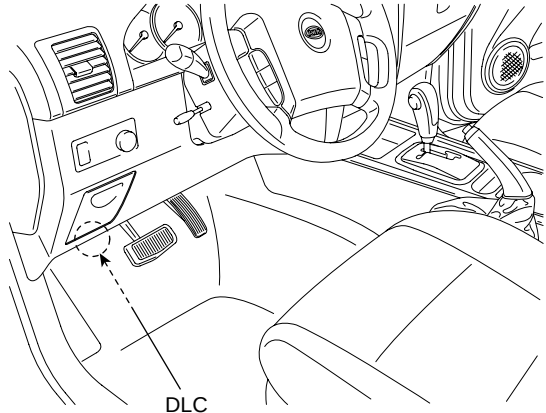
EFBF503Q

28. Vehicle Speed Sensor (VSS)



SBLF26120L

29. Data Link Connector (DLC)



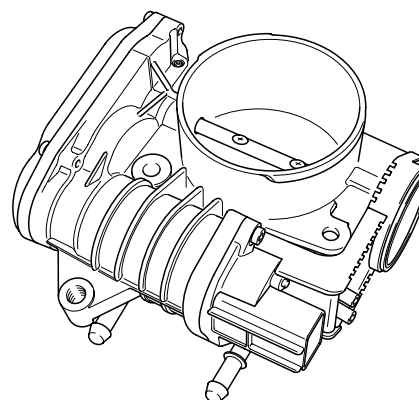
SBLF26122L

ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM

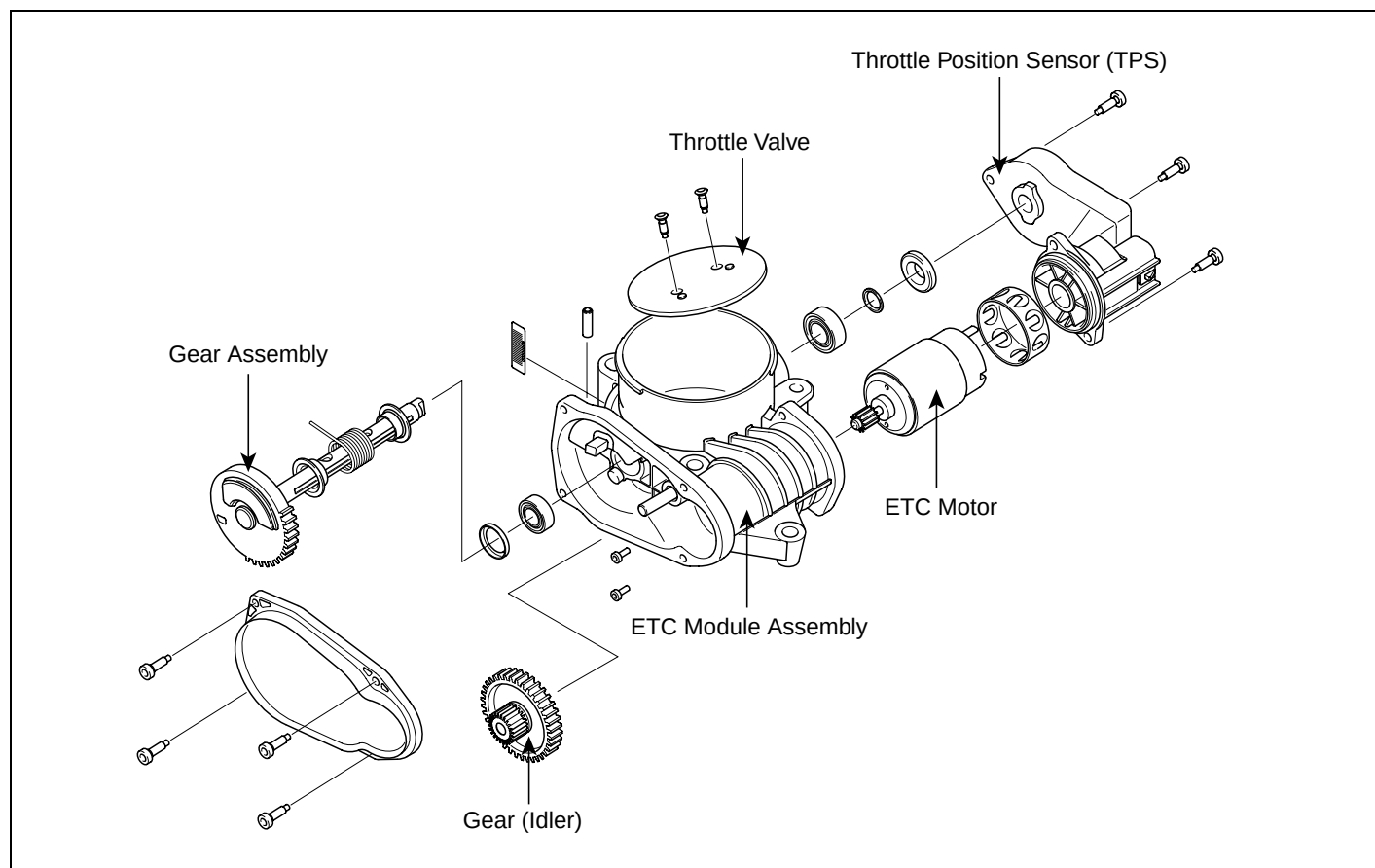
INSPECTION EC635F51

FUNCTION AND OPERATION PRINCIPLE

ETC (Electronic Throttle Control) system is electronically controlled throttle device which controls the throttle valve. It consists of ETC motor, throttle body and throttle position sensor (TPS). A mechanical throttle control system receives a driver's intention via a wire cable between the accelerator and the throttle valve, while this ETC system does the signal from the Accelerator Position Sensor (APS) installed on the accelerator pedal. After the PCM receives the APS signal and calculates the throttle opening angle, it activates the throttle valve by using the ETC motor. Additionally, it can materialize cruise control function without any special devices.

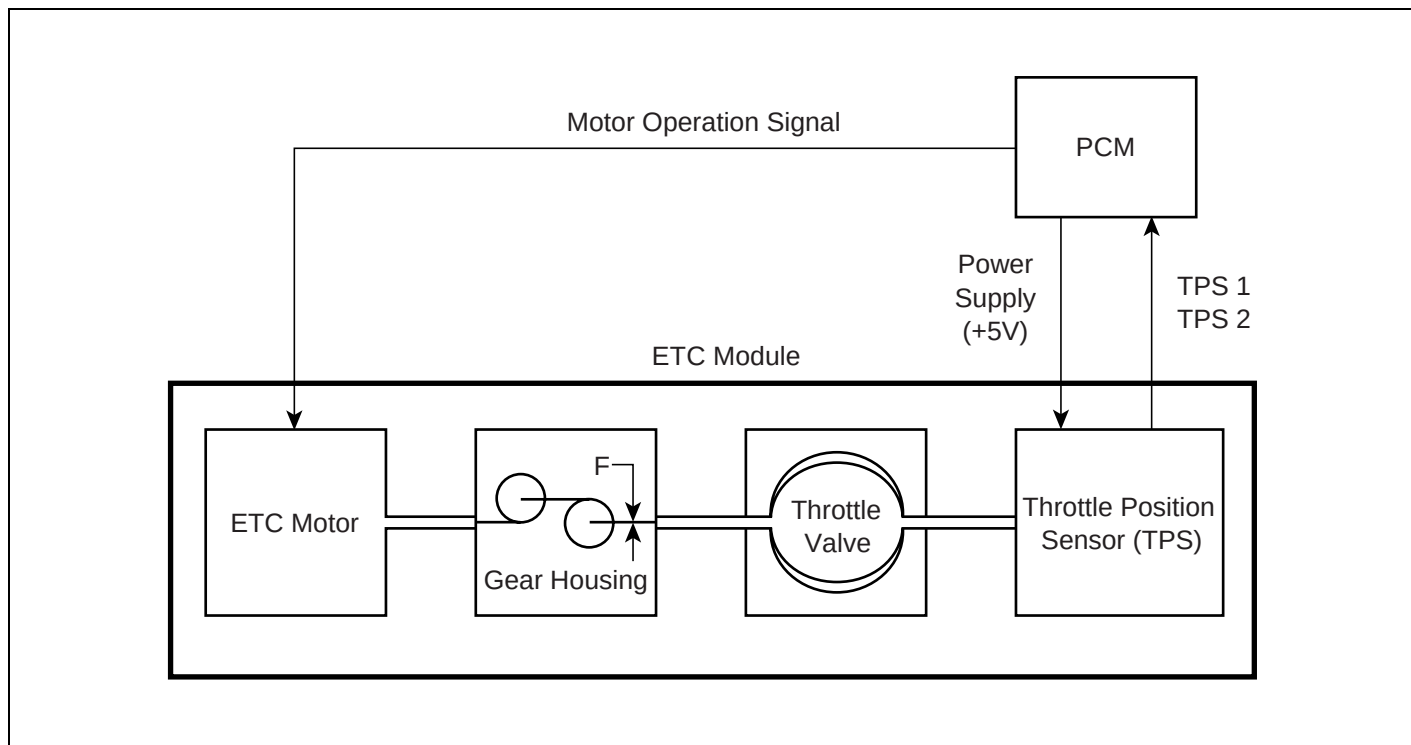


KFCF1020



EGRF233A

COMPONENTS



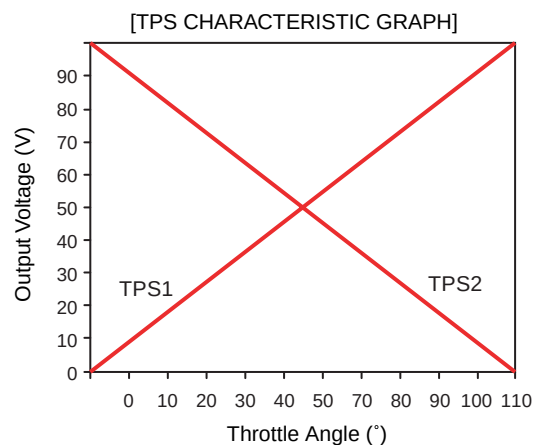
EGRF234A

SPECIFICATION

[THROTTLE POSITION SENSOR]

Throttle Angle(°)	Output Voltage(V) [Vref = 5.0V]	
	TPS1	TPS2
0°	0	5.0
10°	0.5	4.5
20°	0.9	4.1
30°	1.4	3.6
40°	1.8	3.2
50°	2.3	2.7
60°	2.7	2.3
70°	3.2	1.8
80°	3.6	1.4
90°	4.1	0.9
100°	4.5	0.5
110°	5.0	0

Item	Sensor Resistance
TPS1	4.0 ~ 6.0kΩ at 20°C (68°F)
TPS2	2.72 ~ 4.08kΩ at 20°C (68°F)

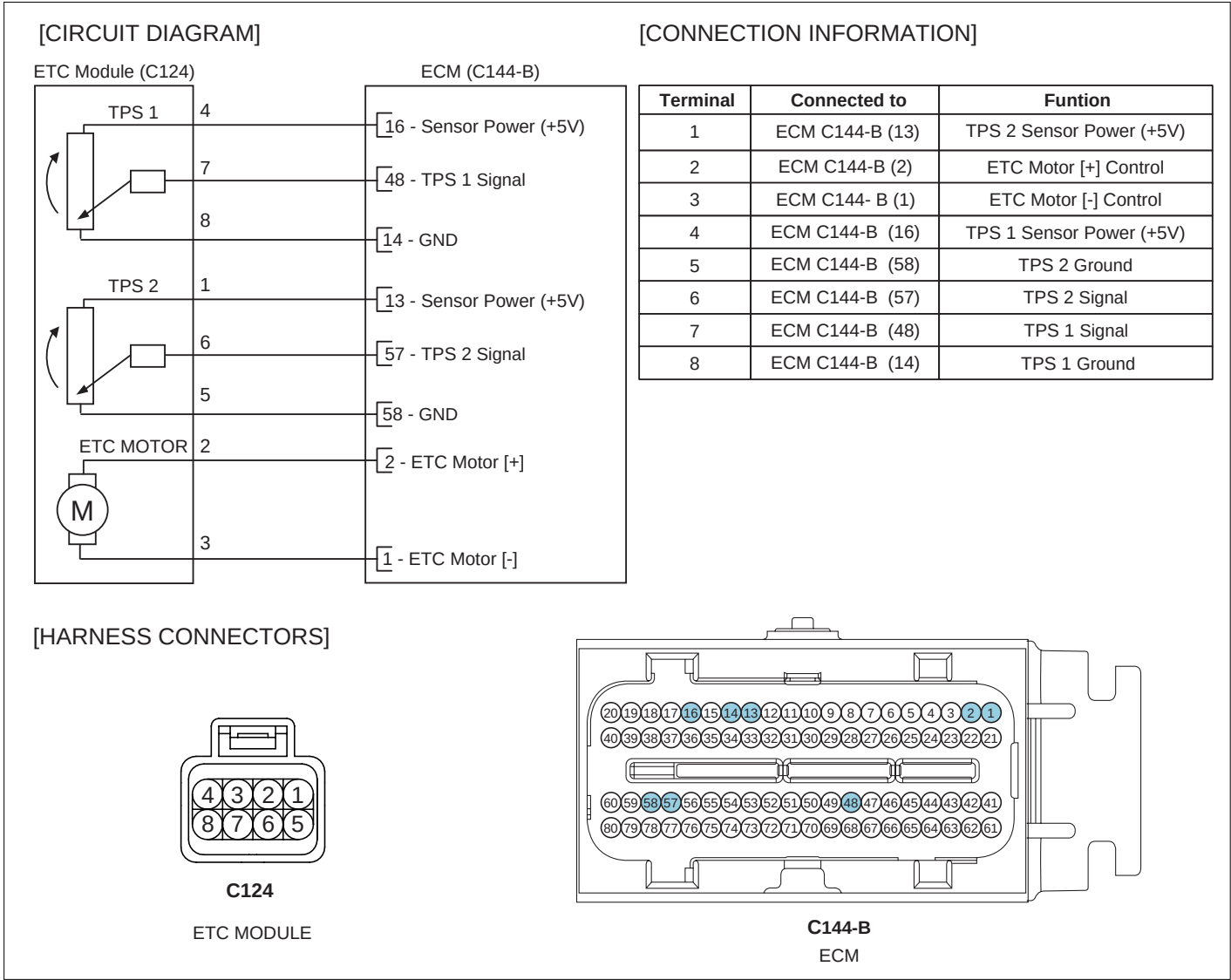


EGRF235A

[ETC MOTOR]

Item	Sensor Resistance
Coil Resistance (Ω)	1.275 ~ 1.725Ω at 20°C (68°F)

SCHEMATIC DIAGRAM



GASOLINE ENGINE CONTROL SYSTEM

FLB -29

FAIL-SAFE MODE

Mode	Description	Symptom	Possible Cause
MODE 1	FORCED ENGINE SHUTDOWN	Engine stop	- ETC system can't proceed reliable algorithm procedure - Fatal PCM internal programming error - Faulty intake system or throttle body
MODE 2	FORCED IDLE & POWER MANAGEMENT	Forced idle state controlled by fuel quantity regulation and ignition timing adjustment	- ETC system can't control engine power via throttle device - Disabled throttle control or broken throttle position information
MODE 3	FORCED IDLE	Forced idle state and no response for accelerator activation	- No information about the accelerator position - Broken APS 1 and 2, faulty A/D converter or internal controller
MODE 4	LIMIT PERFORMANCE & POWER MANAGEMENT	Engine power is determined by accelerator position and idle power requirement (Limited vehicle running)	ETC system can't securely control engine power
MODE 5	LIMIT PERFORMANCE	- Engine power varies with accelerator position, but driver perceives lack of engine power. - MIL ON (Normal vehicle running)	- Not reliable accelerator position signal or bad maximum power generation - Faulty APS, ignition voltage or internal controller
MODE 6	NORMAL	Normal	

COMPONENT INSPECTION

Specification: Refer to SPECIFICATION.

THROTTLE POSITION SENSOR (TPS)

1. Connect a scantool on the Data Link Connector (DLC).
2. Start engine and check output voltages of TPS 1 and 2 at C.T and W.O.T.

Specification: Refer to SPECIFICATION.

3. Turn ignition switch OFF and disconnect the scantool from the DLC.
4. Disconnect ETC module connector and measure resistance between ETC module terminals 4 and 8 (TPS 1).
5. Measure resistance between ETC module terminals 1 and 5 (TPS 2).

ETC MOTOR

6. Disconnect ETC module connector and measure resistance between ETC module terminals 2 and 3.

Specification: Refer to SPECIFICATION.

ETC SYSTEM INITIALIZATION

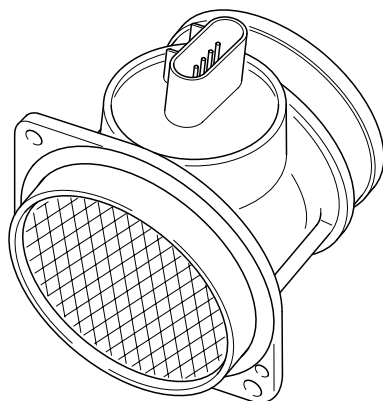
1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

MASS AIR FLOW SENSOR (MAFS)

INSPECTION EFF4B128

FUNCTION AND OPERATION PRINCIPLE

Mass Air Flow Sensor (MAFS) is a hot-film type sensor and is located in between the air cleaner and the throttle body. It consists of a tube, a sensor assembly and honey cell and detects intake air quantity flowing into the intake manifold. While the intake air coming out of the air cleaner flows by the honey cell, it becomes laminar flow, and then it passes the hot-film. At this time, heat transfer is generated by convection and this sensor loses its energy. This sensor detects the mass air flow by using the energy loss and transfers the information to the PCM by frequency. The PCM calculates fuel quantity and ignition timing.

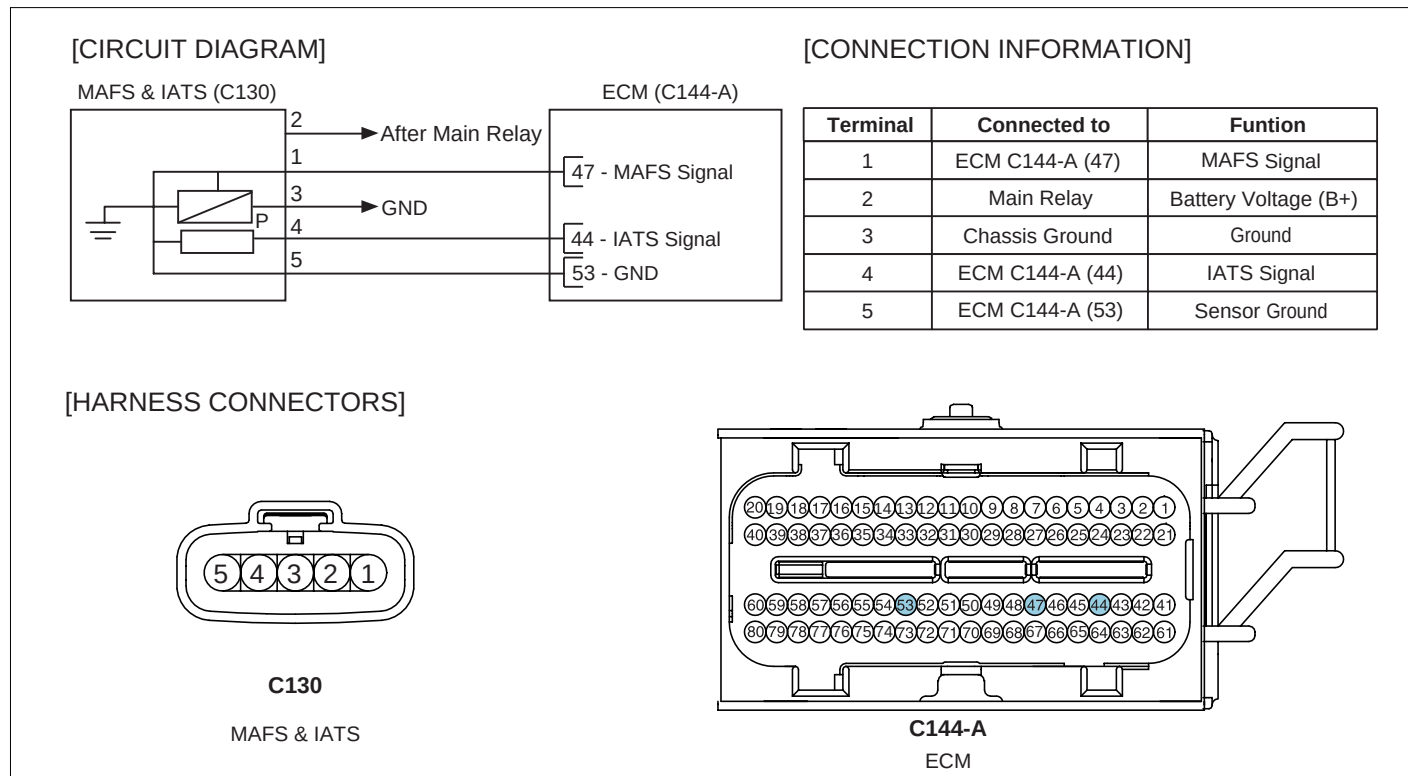


KFCF1021

SPECIFICATION

Air Flow (kg/h)	Output Frequency (Hz)
12.6	2,617
18.0	2,958
23.4	3,241
32.4	3,653
43.2	4,024
57.6	4,399
72.0	4,704
108.0	5,329
144.0	5,897
198.0	6,553
270.0	7,240
360.0	7,957
486.0	8,738
666.0	9,644
900.0	10,590

SCHEMATIC DIAGRAM



SBLF26202L

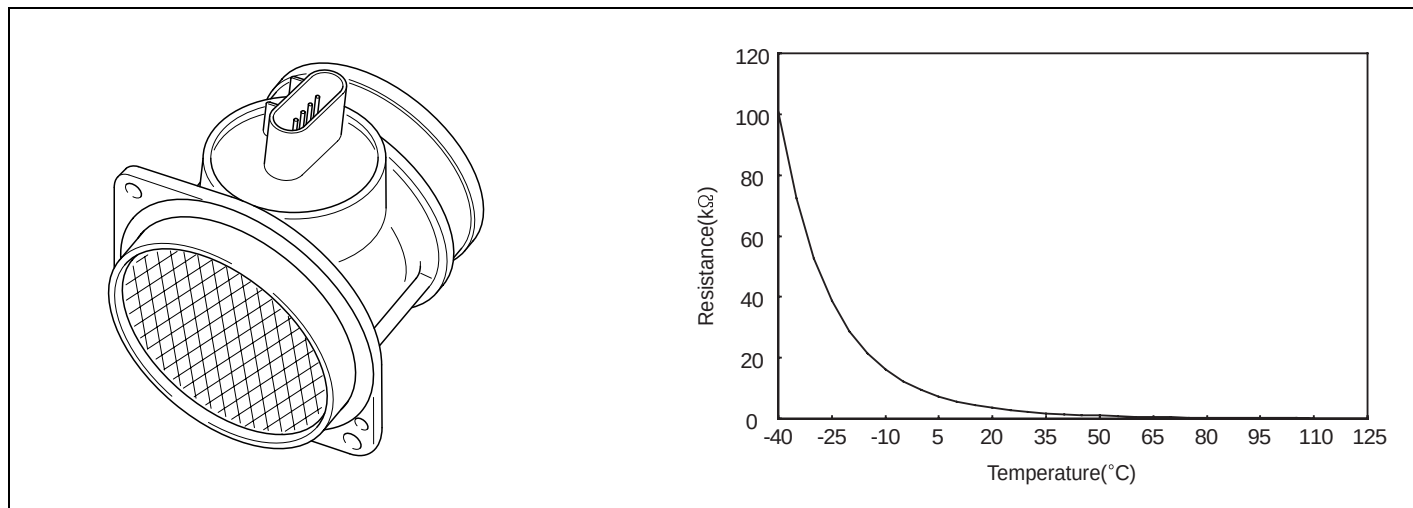
COMPONENT INSPECTION

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

INTAKE AIR TEMPERATURE SENSOR (IATS)

INSPECTION EB69285F

FUNCTION AND OPERATION PRINCIPLE



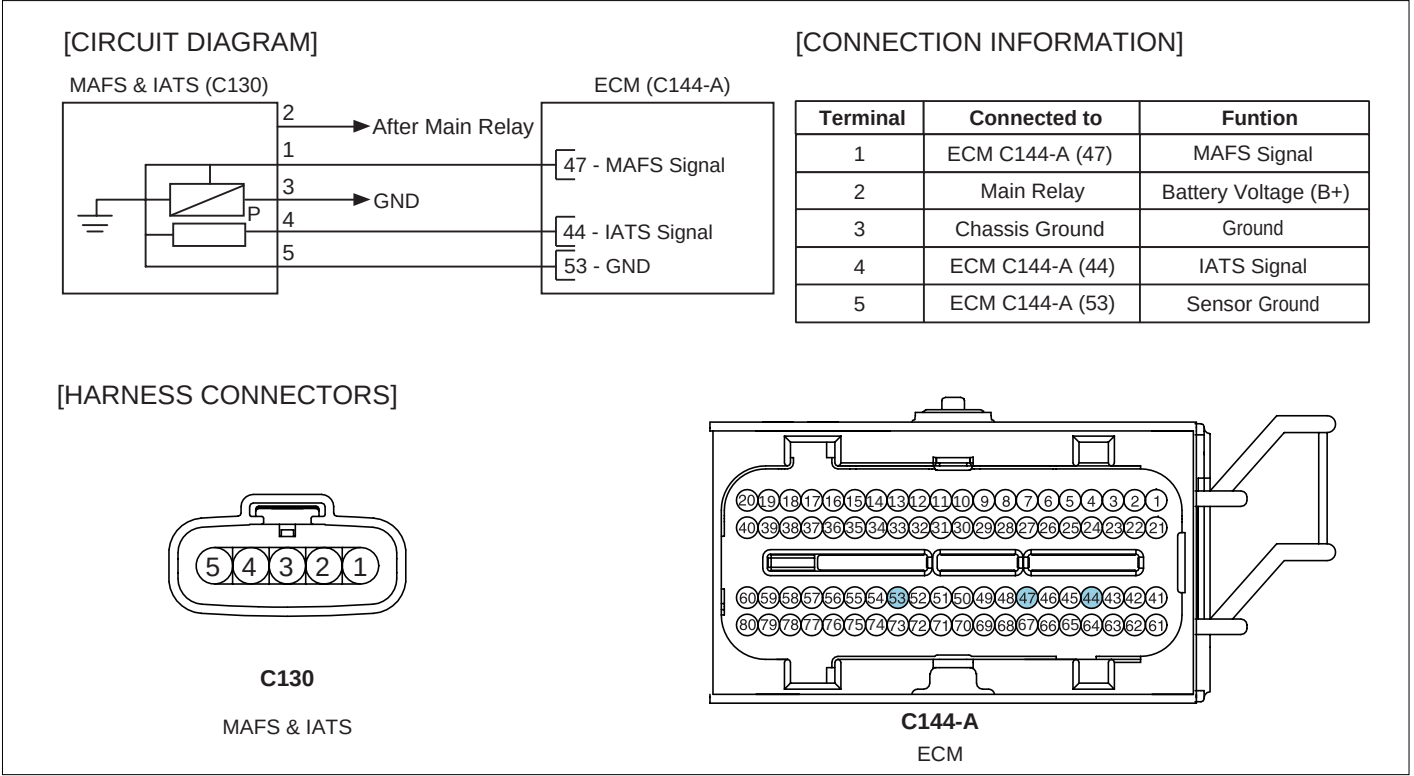
EGRF238A

Intake Air Temperature Sensor (IATS) is installed inside the Mass Air Flow Sensor (MAFS) and detects the intake air temperature. To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the PCM uses not only MAFS signal but also IATS signal. This sensor has a Negative Temperature Coefficient (NTC) and its resistance is in inverse proportion to the temperature.

SPECIFICATION

Temperature		
°C	°F	
-40	-40	100.87
-20	-4	28.58
0	32	9.40
10	50	5.66
20	68	3.51
40	104	1.47
60	140	0.67
80	176	0.33

SCHEMATIC DIAGRAM



SBLF26202L

COMPONENT INSPECTION

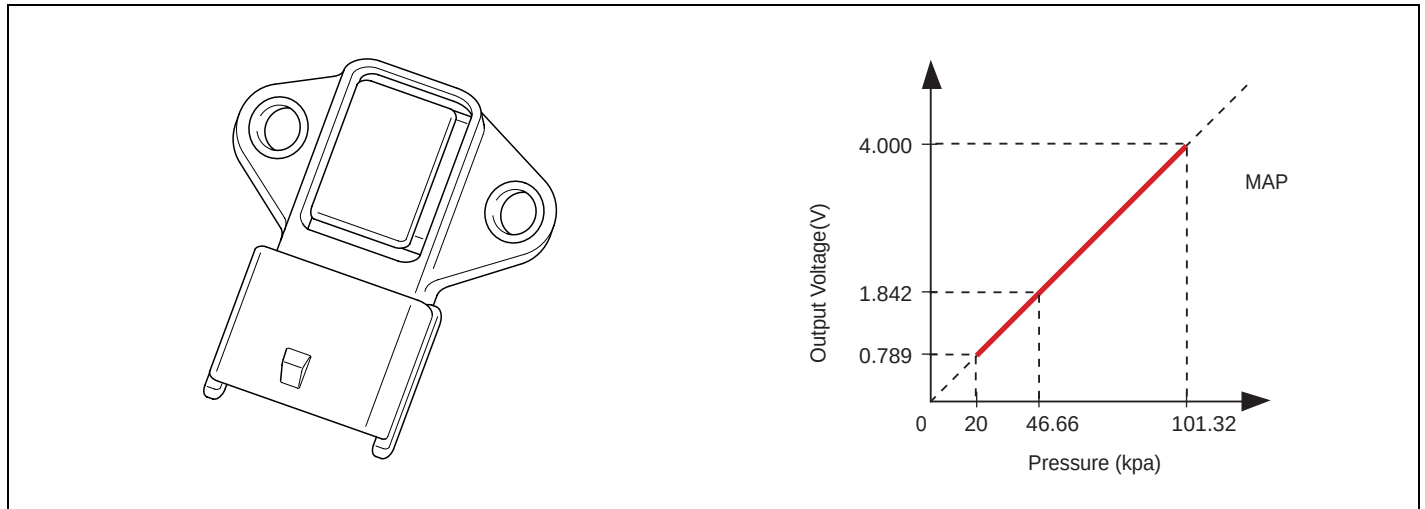
1. Turn ignition switch OFF.
2. Disconnect IATS connector.
3. Measure resistance between IATS terminals 4 and 5.
4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

INSPECTION EBDD165E

FUNCTION AND OPERATION PRINCIPLE



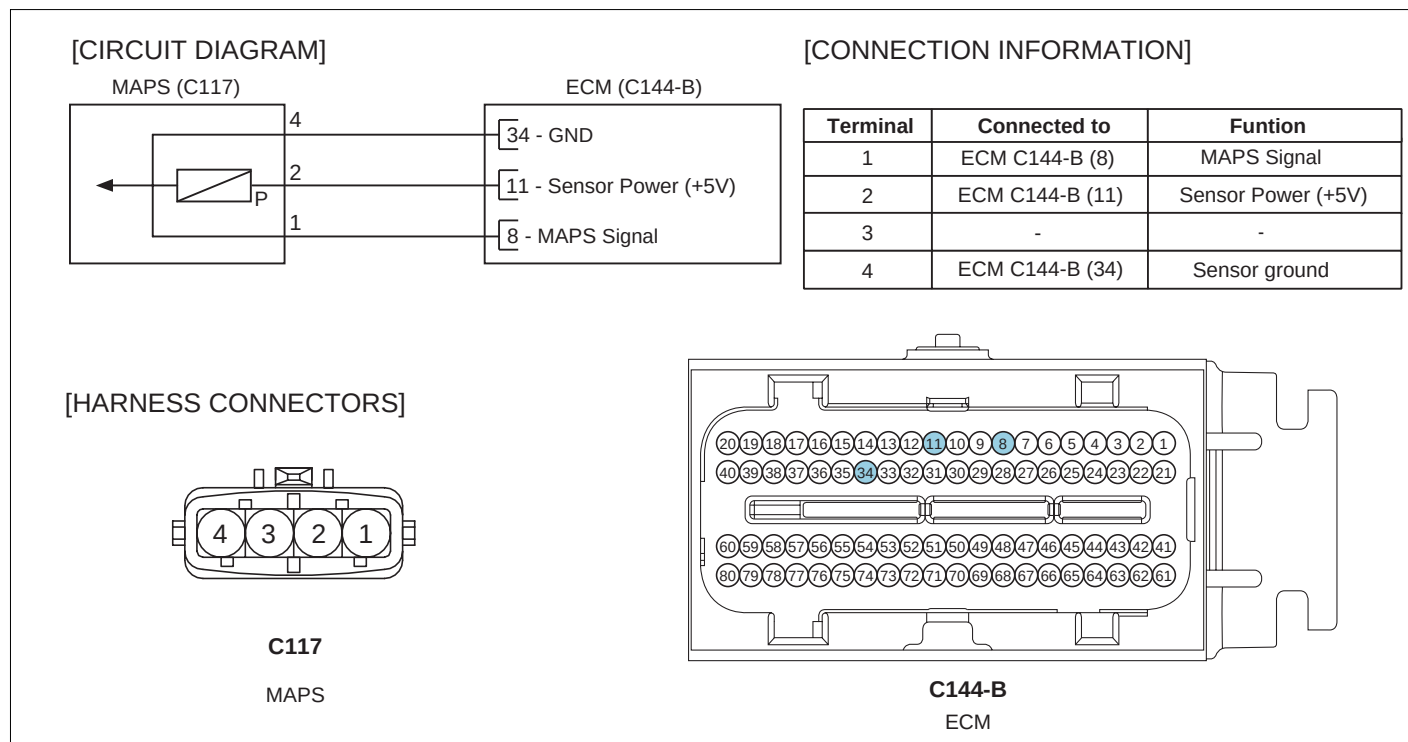
EGRF239A

Manifold Absolute Pressure Sensor (MAPS) is speed-density type sensor and is installed on the surge tank. This MAPS senses absolute pressure in surge tank and transfers this analog signal proportional to the pressure to the PCM. The PCM calculates the intake air quantity and engine speed based on this signal. This MAPS consists of piezo-electric element and hybrid IC that amplifies the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor. 100% vacuum and the manifold pressure applies to both sides of it respectively. That is, this sensor outputs the silicon variation proportional to pressure change by voltage.

SPECIFICATION

Pressure(kPa)	Output Voltage (V)
20.0kPa	0.79
46.66kPa	1.84
101.32kPa	4.0

SCHEMATIC DIAGRAM



SBLF26203L

COMPONENT INSPECTION

1. Connect a scantool on Diagnosis Link Connector (DLC).
2. Check MAPS output voltage at idle and IG ON.

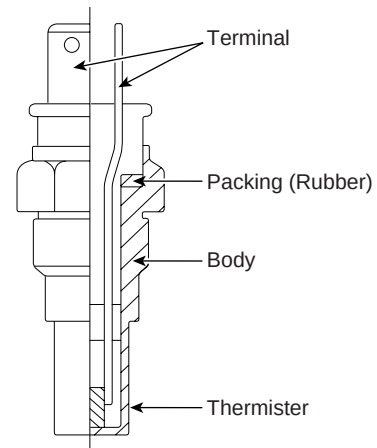
Condition	Output Voltage (V)
IG ON	3.9 ~ 4.1V
Idle	0.8 ~ 1.6V

ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

INSPECTION EB568CFB

FUNCTION AND OPERATION PRINCIPLE

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 PCM is supplied to the ECTS via a resistor in the PCM. That is, the resistor in the PCM 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 PCM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.

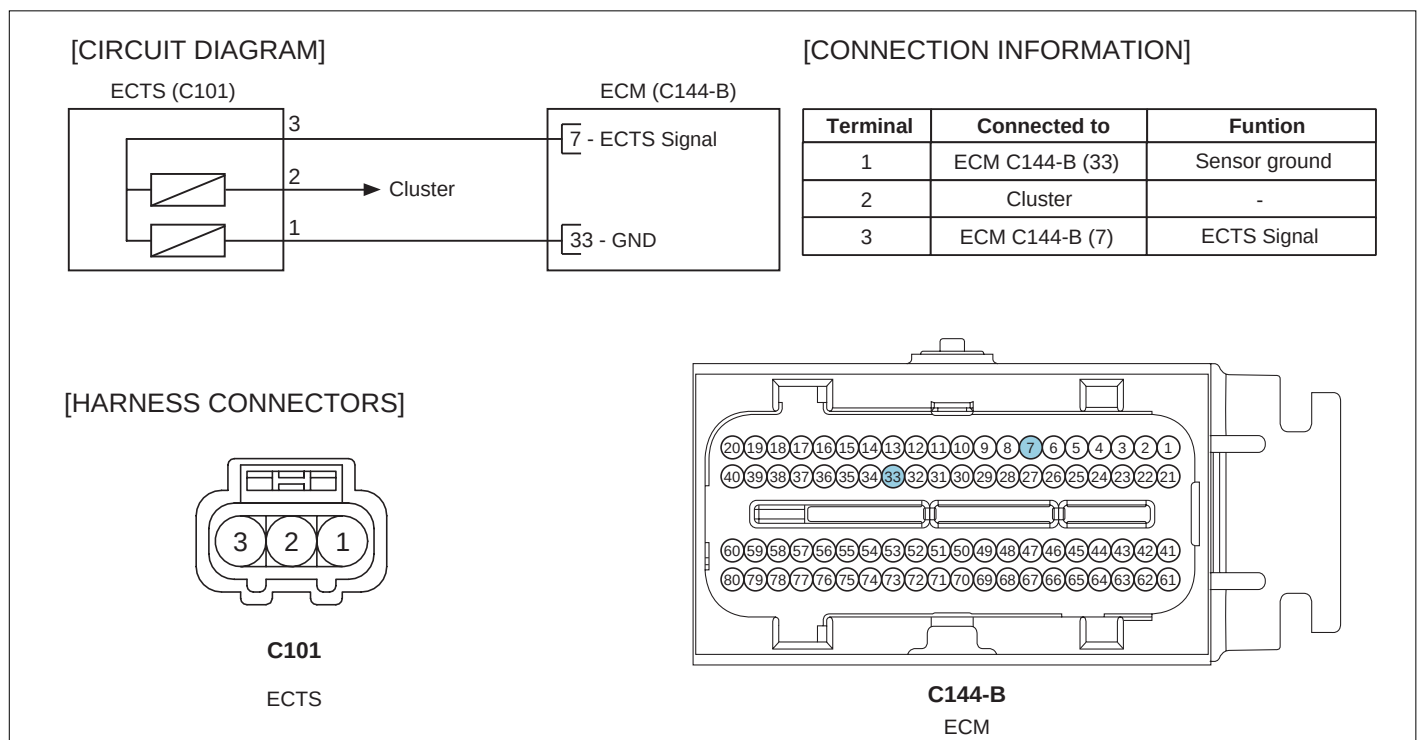


EGRF241A

SPECIFICATION

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

SCHEMATIC DIAGRAM



SBLF26204L

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect ECTS connector.
3. Remove the ECTS.
4. After immersing the thermistor of the sensor into engine coolant, measure resistance between ECTS terminals 1 and 3.
5. Check that the resistance is within the specification.

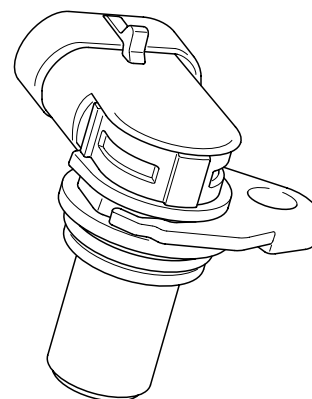
Specification: Refer to SPECIFICATION.

CAMSHAFT POSITION SENSOR (CMPS)

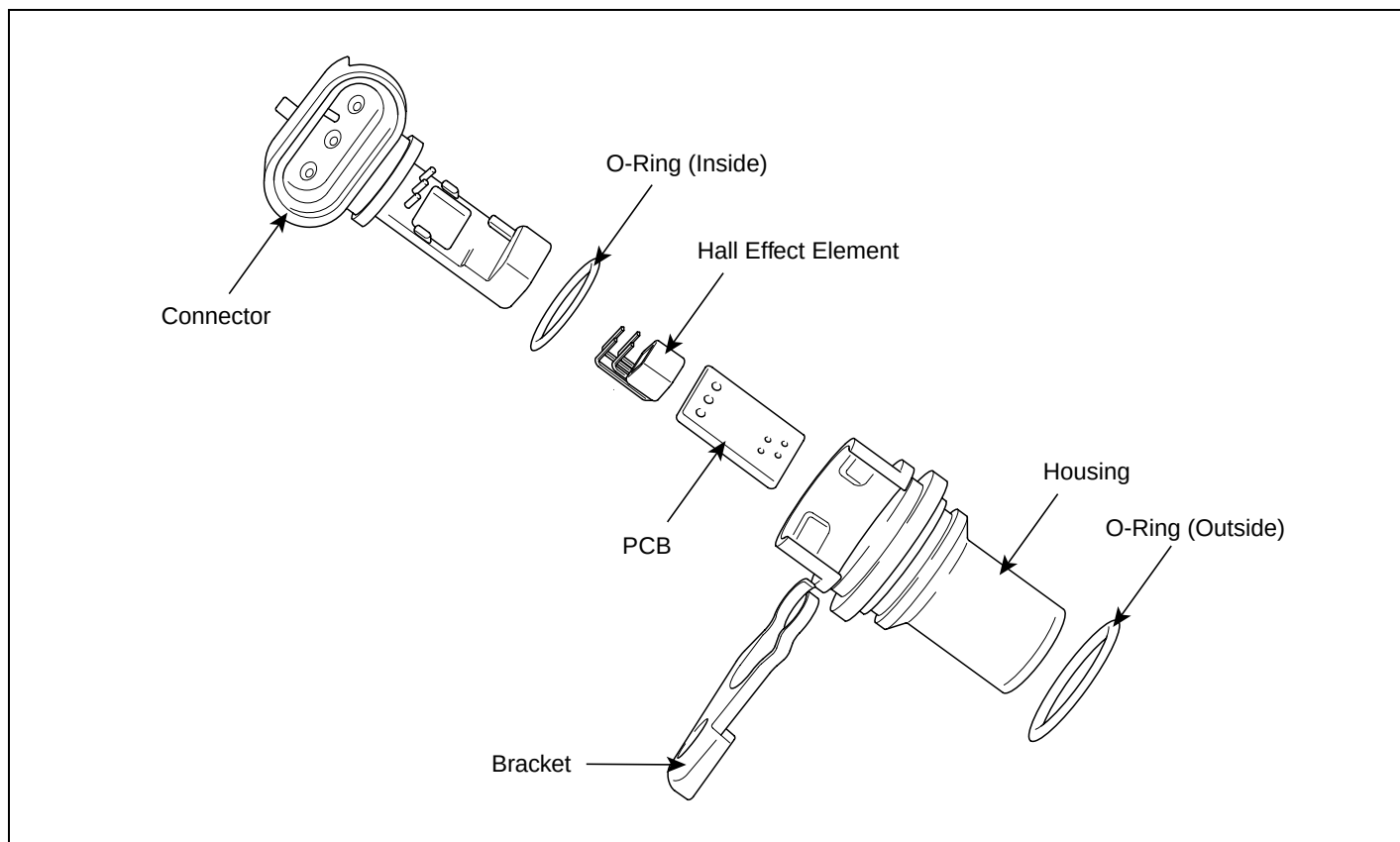
INSPECTION EF2BB5ED

FUNCTION AND OPERATION PRINCIPLE

Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element. It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect. The two CMPS are installed on engine head cover of bank 1 and 2 and uses a target wheel installed on the camshaft. This sensor has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow. So the sequential injection of the 6 cylinders is impossible without CMPS signal.



KFCF1022

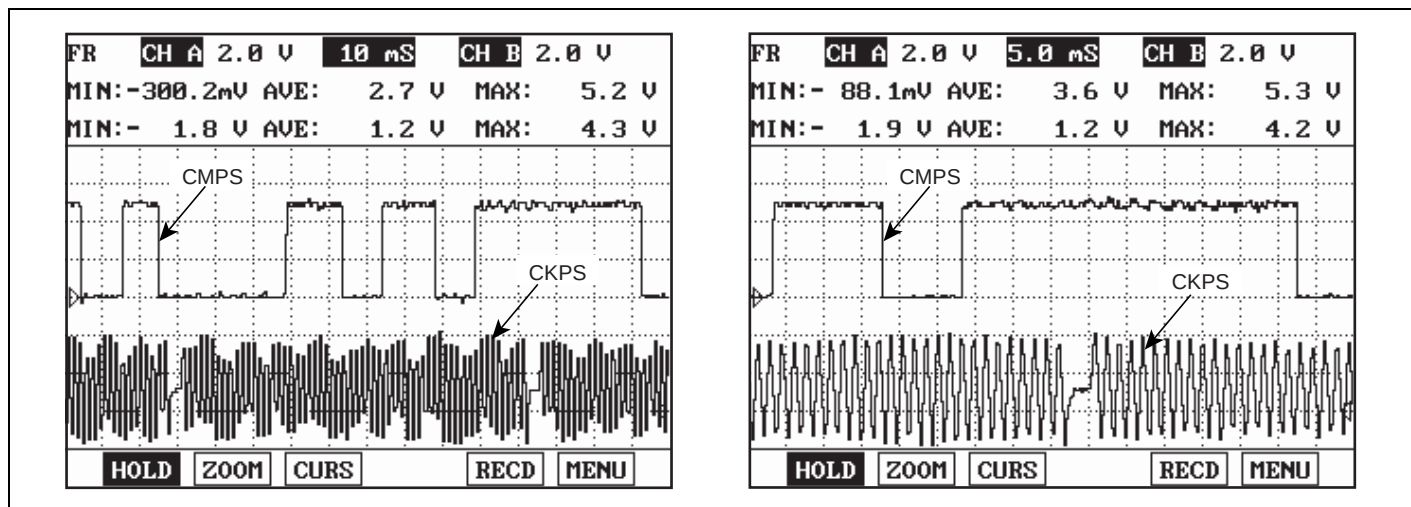


EGRF243A

SPECIFICATION

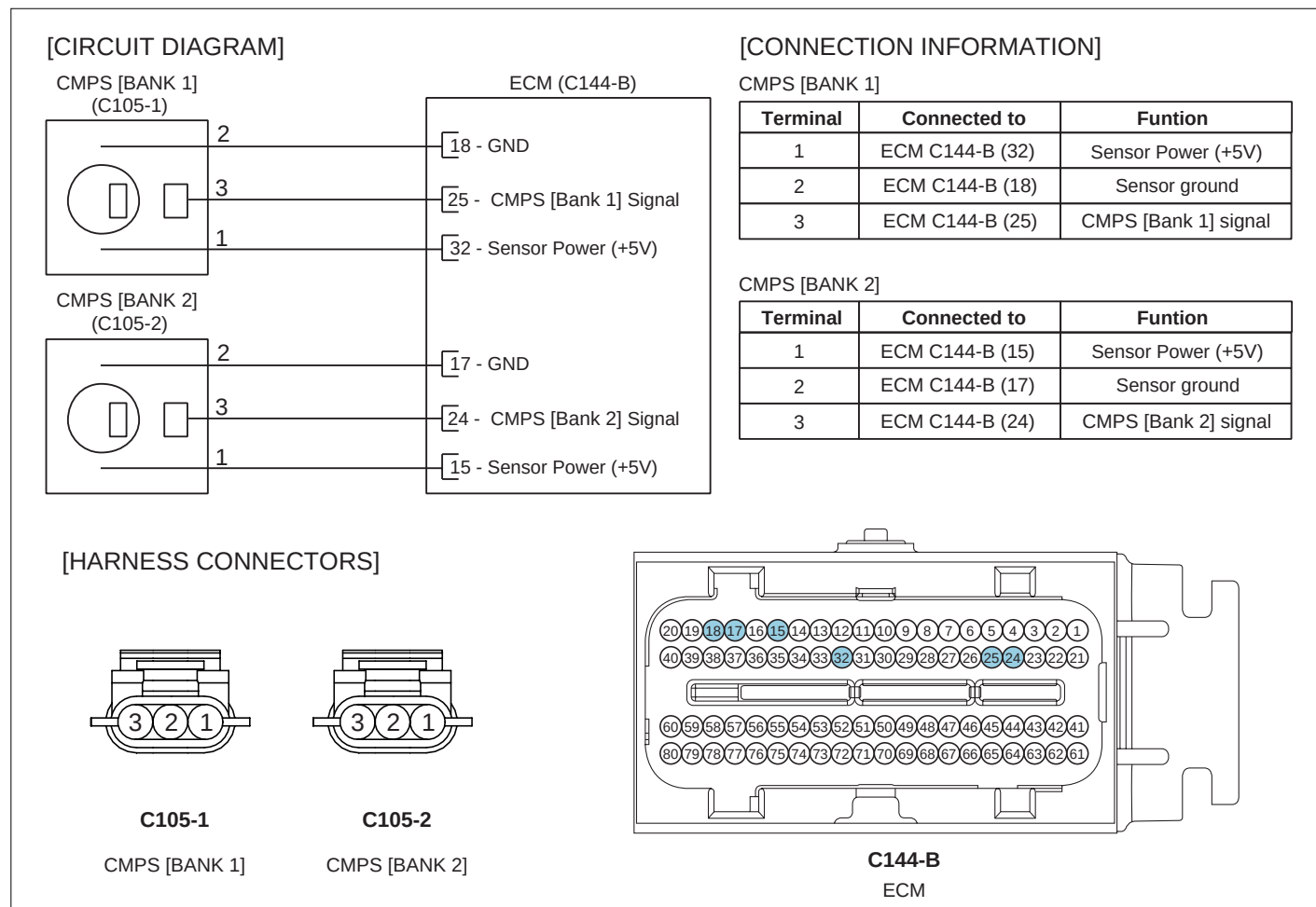
Item	Specification
Output Voltage (V)	High : 5.0V
	Low : 0 ~ 0.7V
Air Gap (mm)	0.5 ~ 1.5

WAVEFORM



KFCF102M

SCHEMATIC DIAGRAM



SBLF26205L

COMPONENT INSPECTION

Specification: Refer to "WAVE FORM"

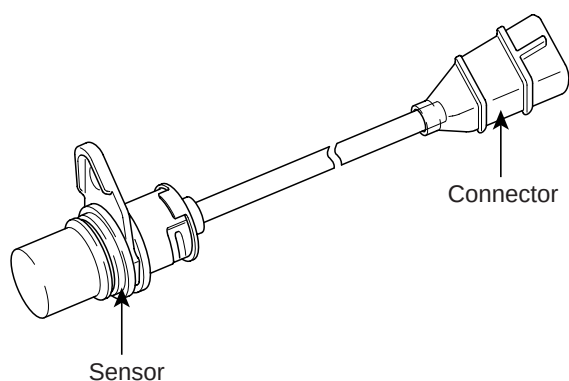
1. Check signal waveform of CMPS and CKPS using a scantool.

CRANKSHAFT POSITION SENSOR (CKPS)

INSPECTION EE4FE9A2

FUNCTION AND OPERATION PRINCIPLE

Crankshaft Position Sensor (CKPS) detects the crankshaft position and is one of the most important sensors of the engine control system. If there is no CKPS signal input, fuel is not supplied and the main relay does not operate. That is, vehicle can't run without CKPS signal. This sensor is installed on transaxle housing and generates alternating current by magnetic flux field which is made by the sensor and the target wheel when engine runs. The magnetic flux increases when the protrusion of the target wheel is getting near to the sensor and does not change in the most close position. When the protrusion becomes estranged from the sensor, magnetic flux disappears and alternating current is generated. The target wheel consists of 58 slots and 2 missing slots on 360 CA (Crank Angle).



EGRF245A

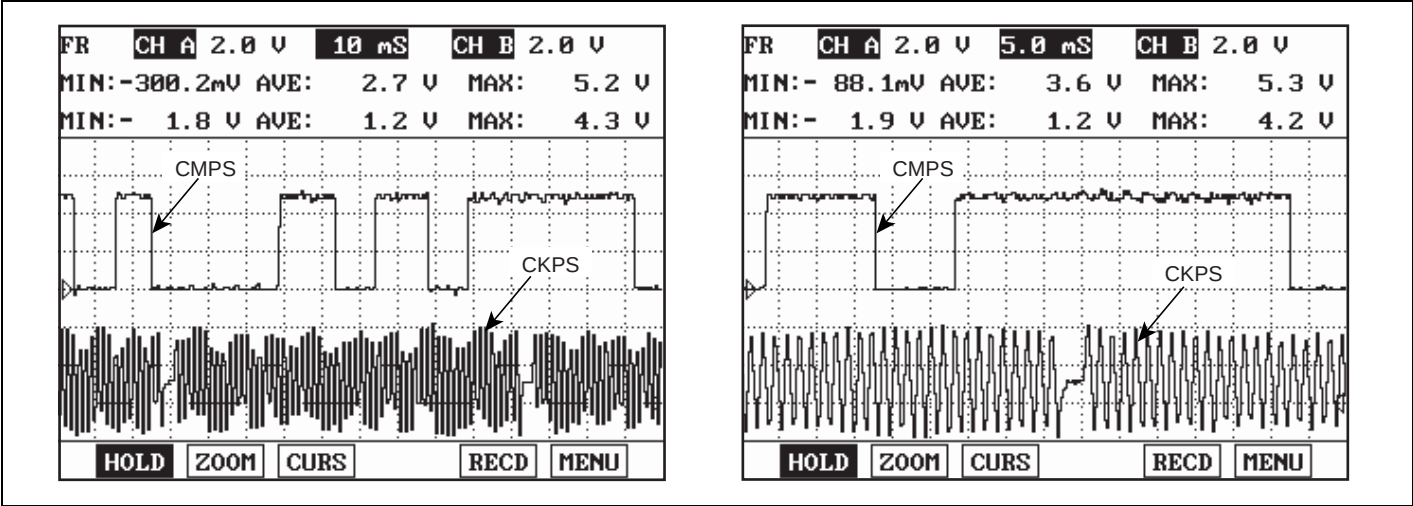
GASOLINE ENGINE CONTROL SYSTEM

FLB -41

SPECIFICATION

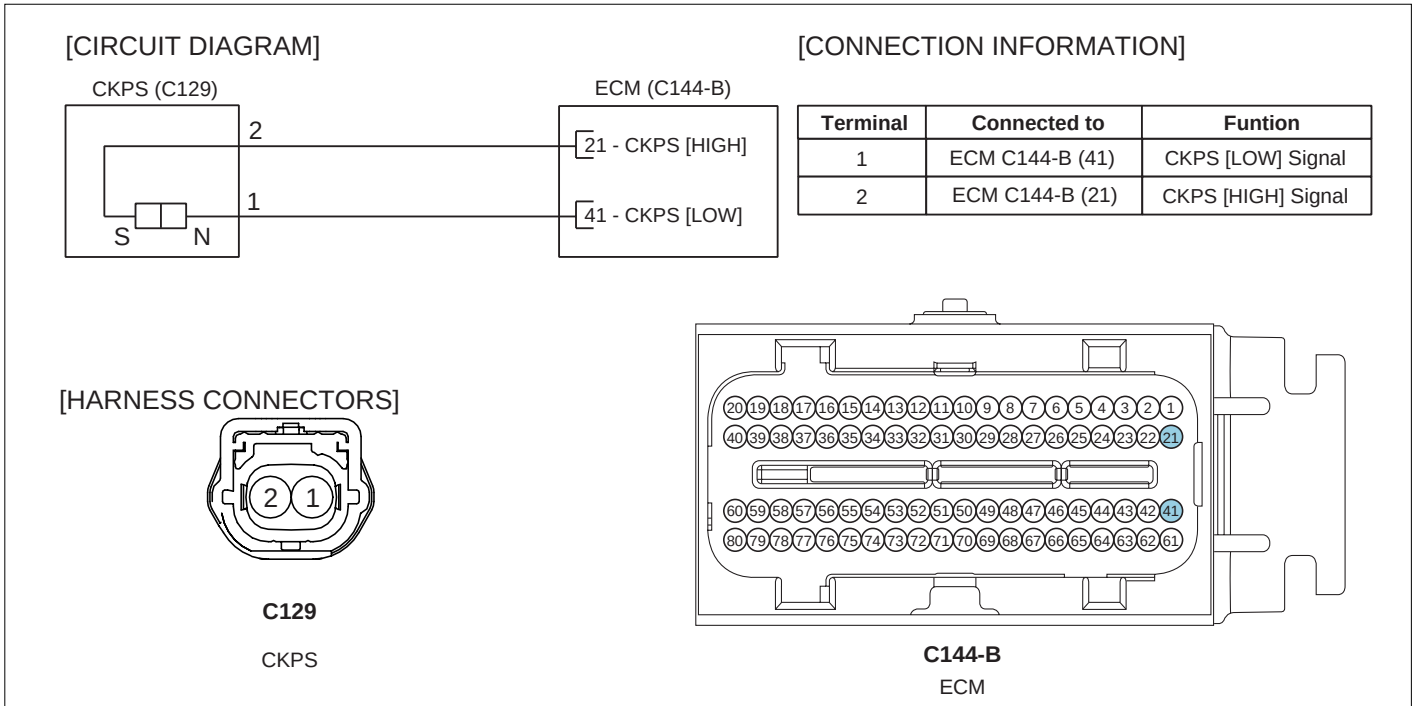
Item	Specification
Coil Resistance (Ω)	630 ~ 770Ω at 20°C (68°F)
Air Gap (mm)	0.5 ~ 1.5

WAVEFORM



KFCF102M

SCHEMATIC DIAGRAM



SBLF26206L

COMPONENT INSPECTION

Specification: Refer to "WAVE FORM"

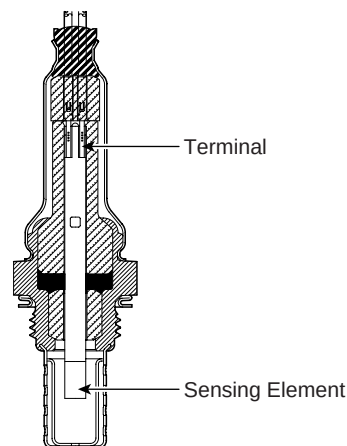
1. Check signal waveform of CMPS and CKPS using a scantool.

HEATED OXYGEN SENSOR (HO2S)

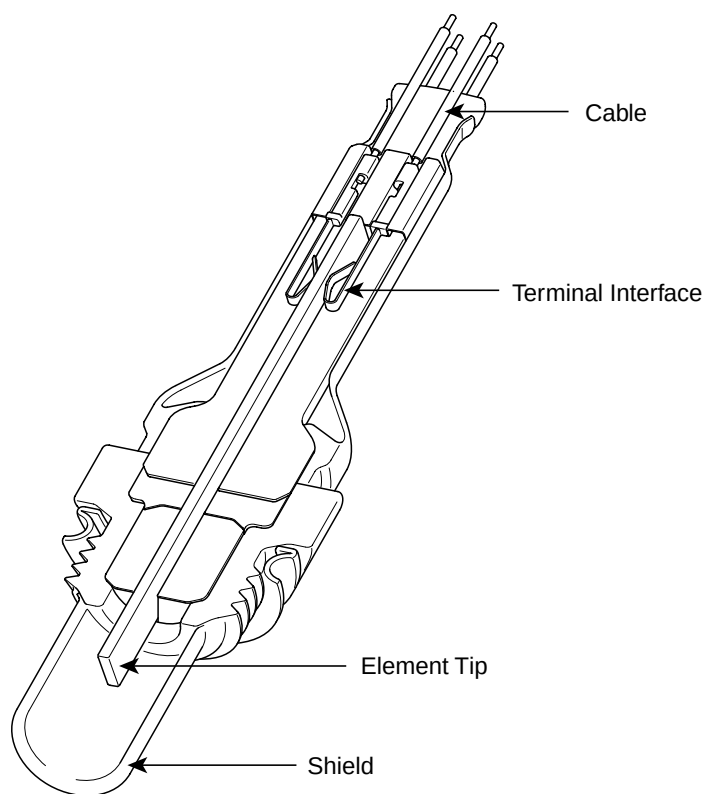
INSPECTION E8FCFC20

FUNCTION AND OPERATION PRINCIPLE

Heated Oxygen Sensor (HO2S) consists of zirconium and alumina and is installed on upstream and downstream of the Manifold Catalyst Converter (MCC). After it compares oxygen consistency of the atmosphere with the exhaust gas, it transfers the oxygen consistency of the exhaust gas to the PCM. When A/F ratio is rich or lean, it generates approximately 1V or 0V respectively. In order that this sensor normally operates, the temperature of the sensor tip is higher than 370°C (698°F). So it has a heater which is controlled by the PCM duty signal. When the exhaust gas temperature is lower than the specified value, the heater warms the sensor tip.



EGRF247A



EGRF248A

GASOLINE ENGINE CONTROL SYSTEM

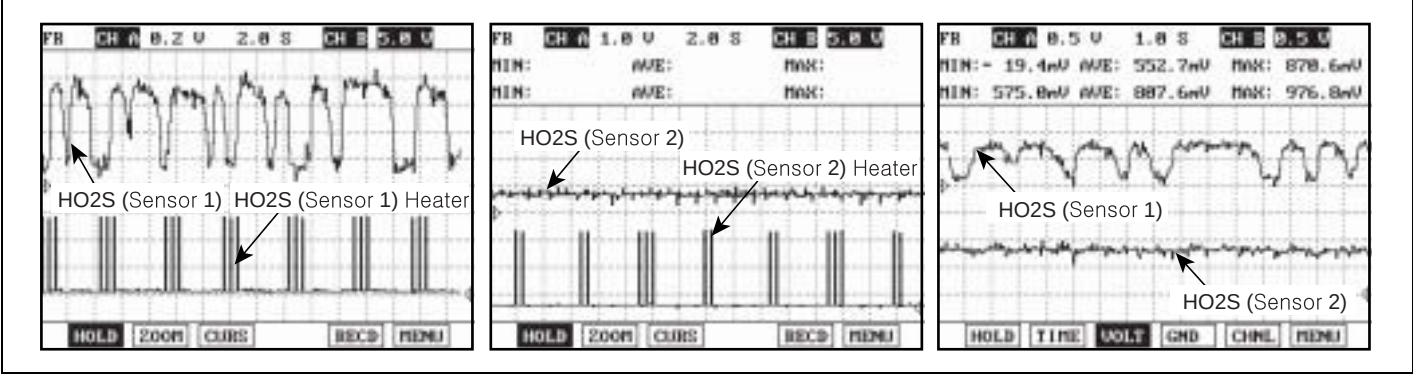
FLB -43

SPECIFICATION

A/F Ratio	Output Voltage (V)
RICH	0.75 ~ 1.0V
LEAN	0 ~ 0.12V

Item	Specification
Heater Resistance (Ω)	8.1 ~ 11.1 Ω at 21°C (69.8°F)

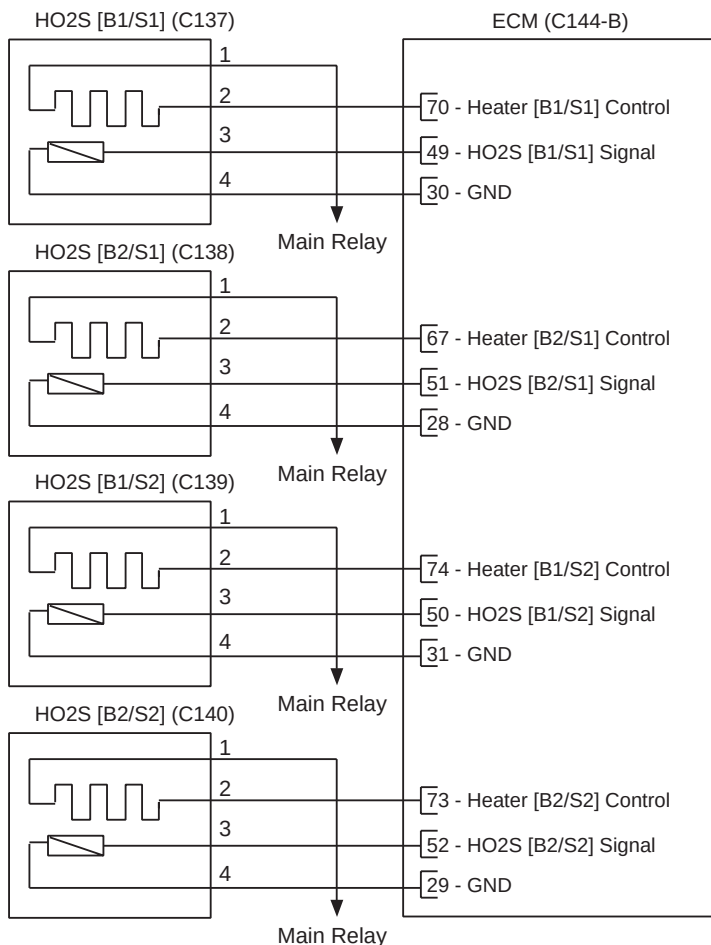
WAVEFORM



EGRF249A

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

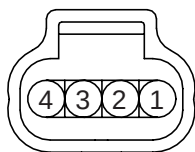
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

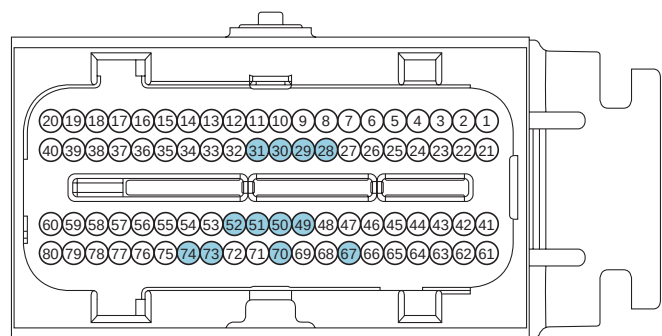
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B

ECM

SBLF26207L

COMPONENT INSPECTION

1. Check signal waveform of HO2S using a scantool.

Specification: Refer to "waveform".

2. Disconnet the HO2S connector.

3. Measure resistance between HO2S heater terminals 3 and 4.

4. Check that the resistance is within the specification.

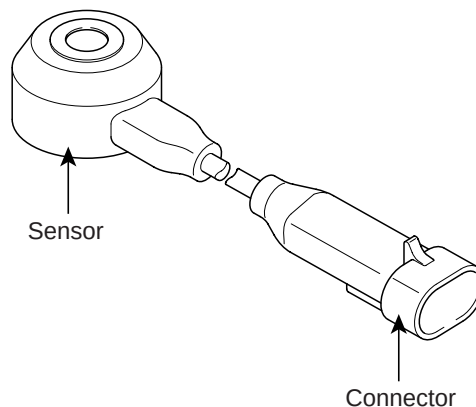
Specification: Refer to SPECIFICATION.

KNOCK SENSOR (KS)

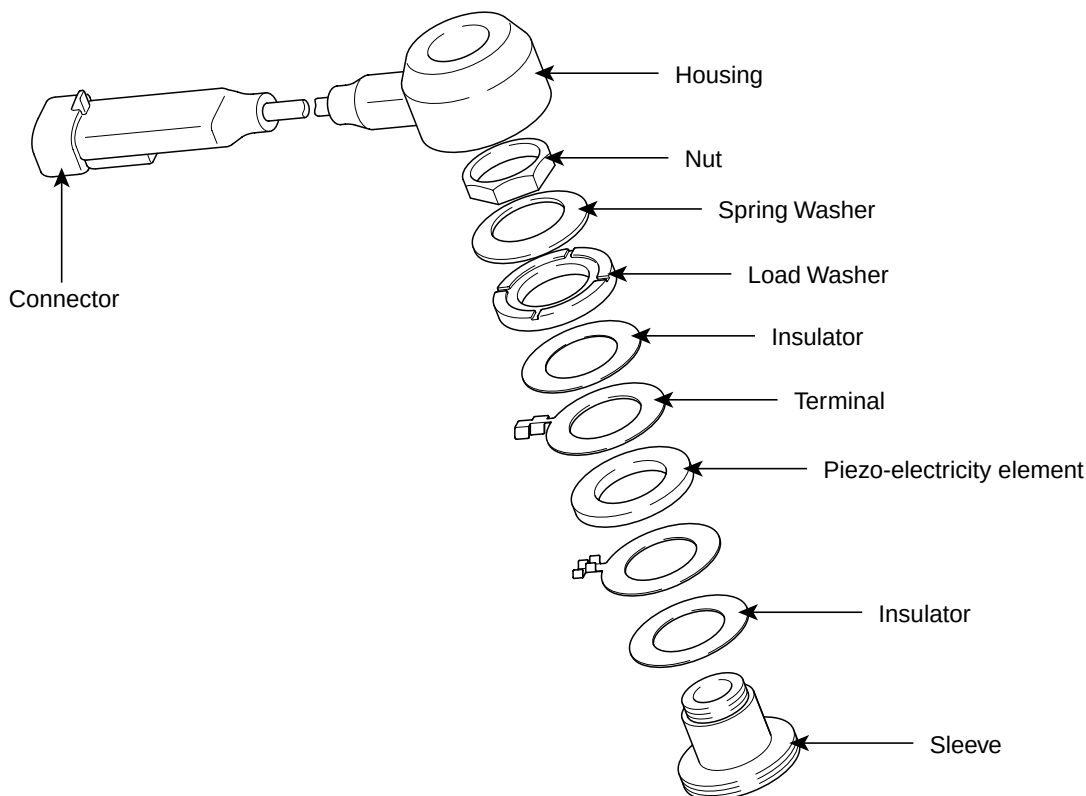
INSPECTION EFB60C8D

FUNCTION AND OPERATION PRINCIPLE

Knocking is a phenomenon characterized by undesirable vibration and noise and can cause engine damage. Knock Sensor (KS) senses engine knocking and the two sensors are installed inside the V-valley of the cylinder block. When knocking occurs, the vibration from the cylinder block is applied as pressure to the piezoelectric element. At this time, this sensor transfers the voltage signal higher than the specified value to the PCM and the PCM retards the ignition timing. If the knocking disappears after retarding the ignition timing, the PCM will advance the ignition timing. This sequential control can improve engine power, torque and fuel economy.



EGRF251A

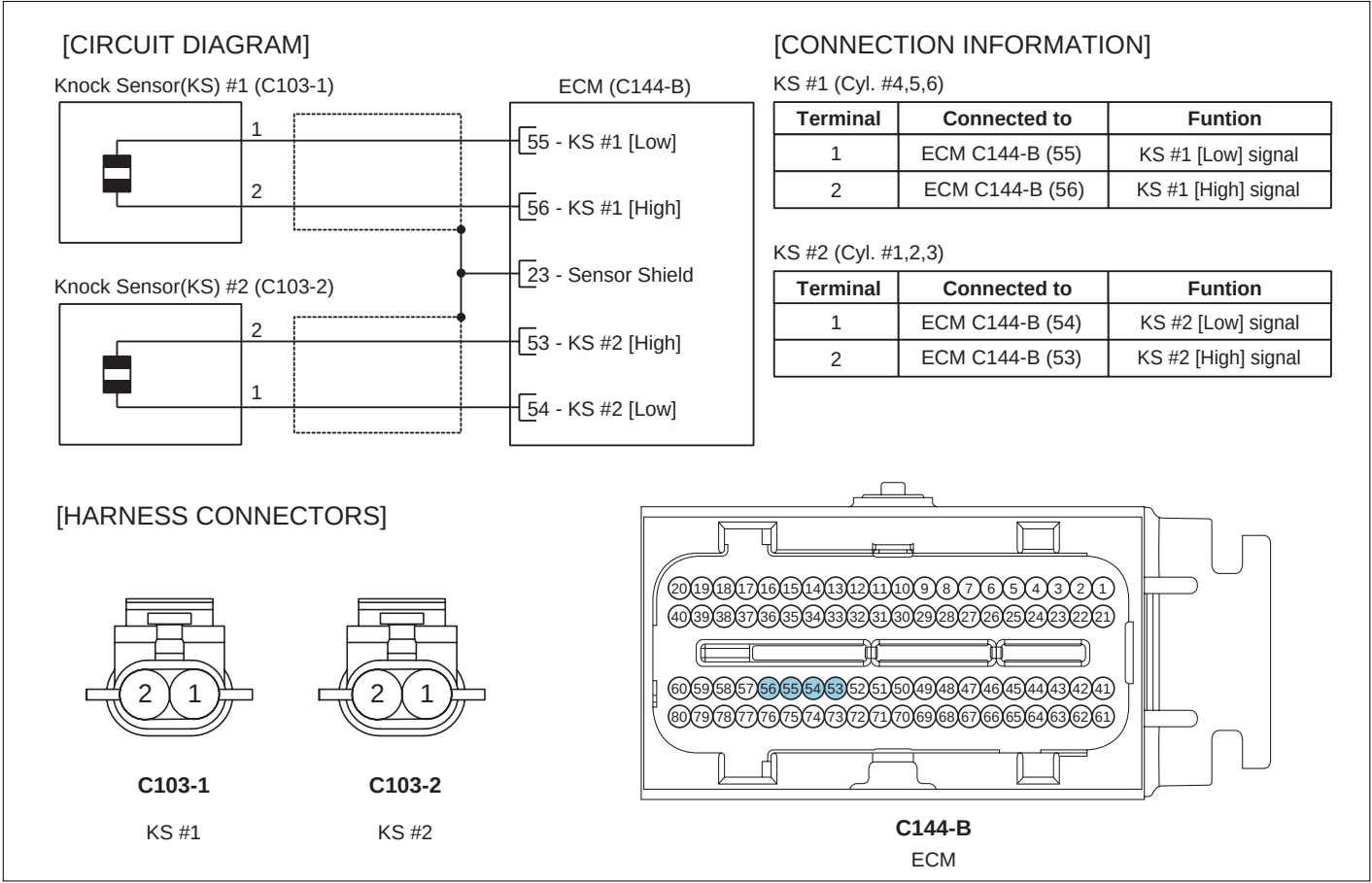


EGRF252A

SPECIFICATION

Item	Specification
Capacitance (pF)	1,480 ~ 2,220pF

SCHEMATIC DIAGRAM



INJECTOR

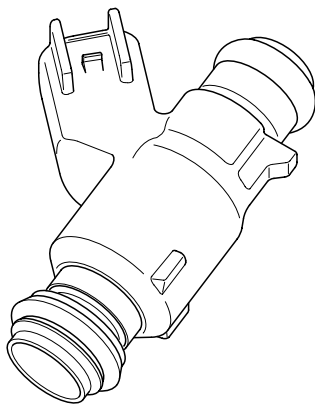
INSPECTION EF835C74

FUNCTION AND OPERATION PRINCIPLE

Based on information from various sensors, the PCM measures the fuel injection amount. The fuel injector is a solenoid-operated valve and the fuel injection amount is controlled by length of time that the fuel injector is held open. The PCM controls each injector by grounding the control circuit. When the PCM energizes the injector by grounding the control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the PCM de-energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should be peak for a moment.

CAUTION

If an injector connector is disconnected for more than 46 seconds while the engine runs, the PCM will determine that the cylinder is misfired and cut fuel supply. So be careful not to exceed 46 seconds. But the engine runs normally in 10 seconds after turning the ignition key off.

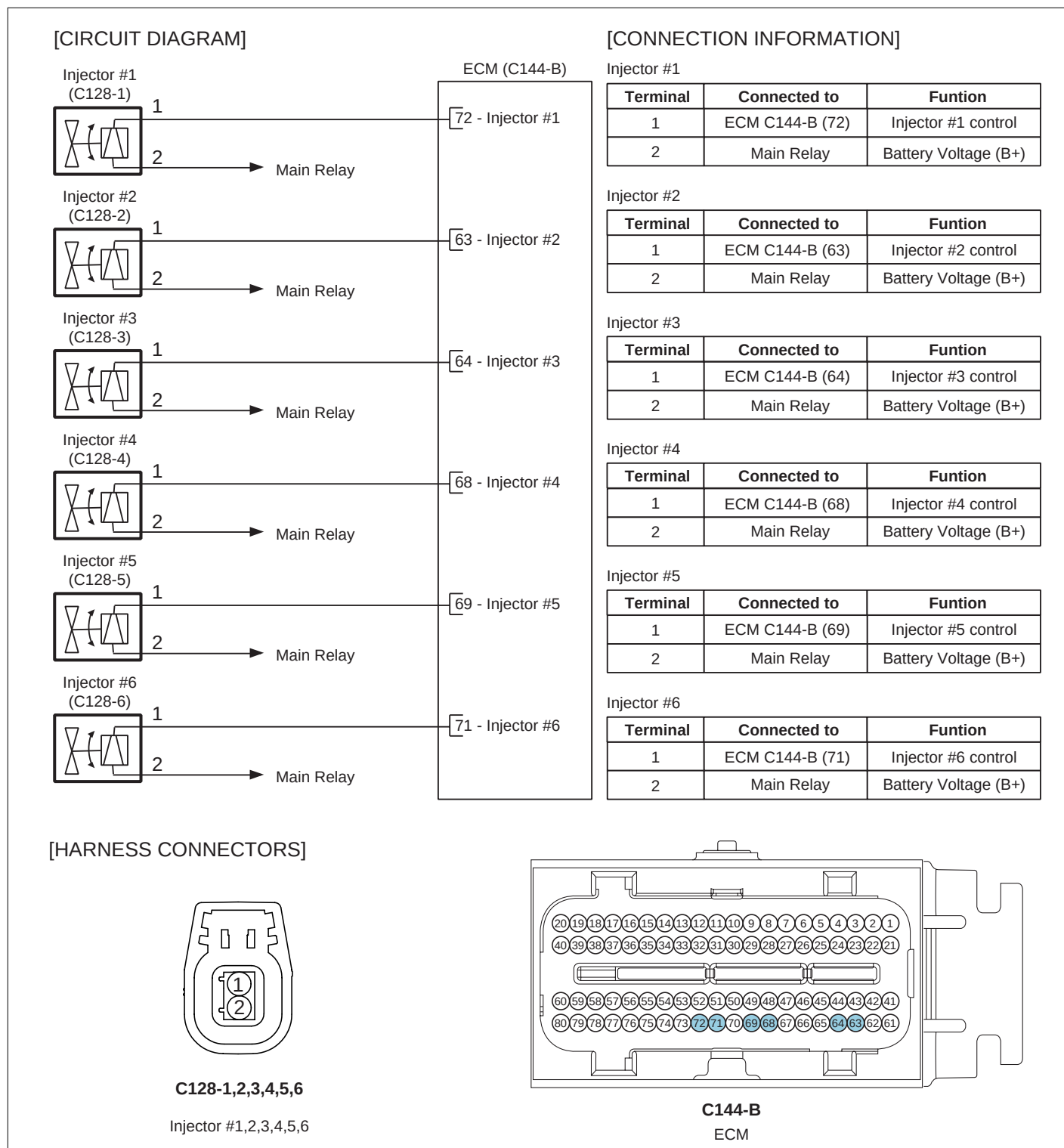


KFCF1026

SPECIFICATION

Item	Specification
Coil Resistance (Ω)	11.4 ~ 12.6 Ω at 20°C (68°F)

SCHEMATIC DIAGRAM



SBLF26209L

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect injector connector.
3. Measure resistance between injector terminals 1 and 2.

4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

CVVT OIL CONTROL VALVE (OCV)

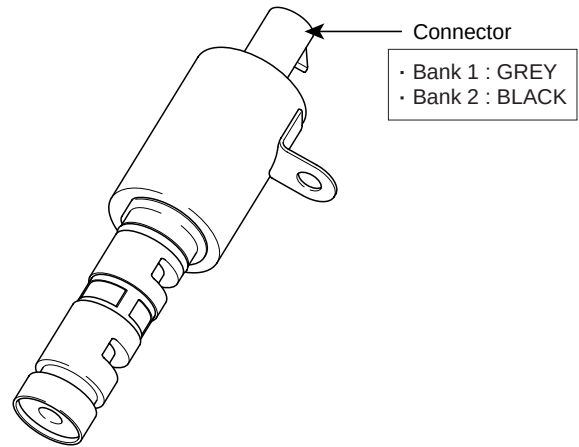
INSPECTION EECFB1EE

FUNCTION AND OPERATION PRINCIPLE

Continuously Variable Valve Timing (CVVT) system controls valve overlap with forcibly activating the camshaft and adjusts EGR (Exhaust Gas Recirculation) amount. It decreases exhaust gas (NOx, HC) and improves fuel economy, idle state, torque in low speed and power in high speed. This system uses engine oil pressure and consists of the two CVVT Oil Control Valve (OCV) in each bank which supplies oil to cam phaser according to PWM (Pulse With Modulator) signal of the PCM, a CVVT Oil Temperature Sensor (OTS) which detects the oil temperature and a cam phaser which is installed on the end of the camshaft and converts camshaft phase. The oil getting out of the CVVT oil control valve flows into the cam phaser and rotates the rotor inside cam phaser. At this time, the camshaft rotates with the rotor and the cam phase is changed.

1. When camshaft rotates engine rotation-wise: Intake-Advance / Exhaust-Retard

2. When camshaft rotates counter engine rotation-wise: Intake- Retard / Exhaust- Advance

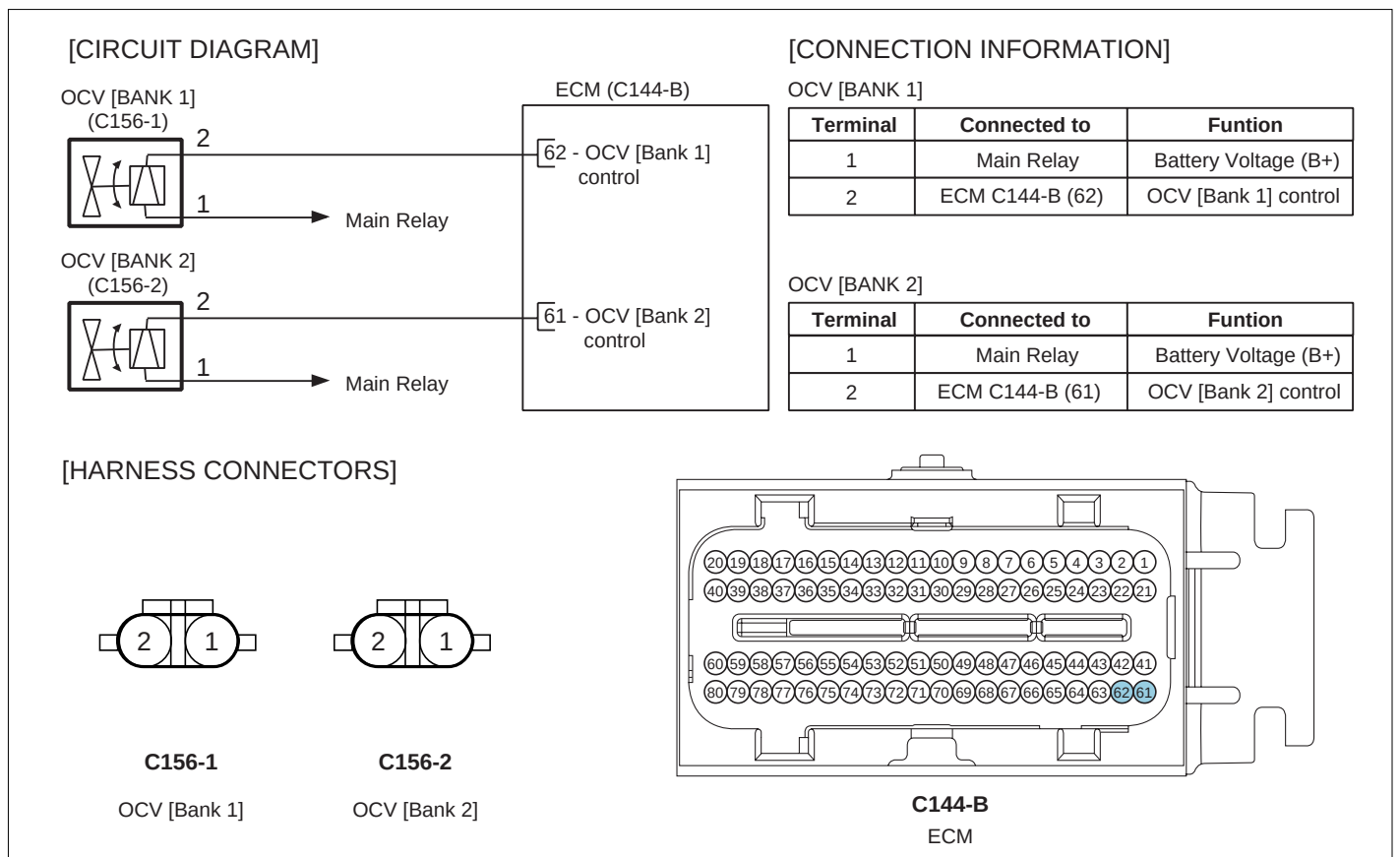


EFBF1027

SPECIFICATION

Item	Specification
Coil Resistance (Ω)	6.7 ~ 7.7Ω at 20°C (68°F)

SCHEMATIC DIAGRAM



SBLF26210L

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect OCV connector.
3. Measure resistance between OCV terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

INSTALLATION

EE53FF89



CAUTION

If the OCVs are installed incorrectly, the vehicle may be damaged.

So when installing them, be careful its connector color (Components and harness side).

[BANK AND ITS COLOR]

Bank	Component side	Harness side
Bank 1 (RH)	Grey	Grey
Bank 2 (LH)	Black	Black

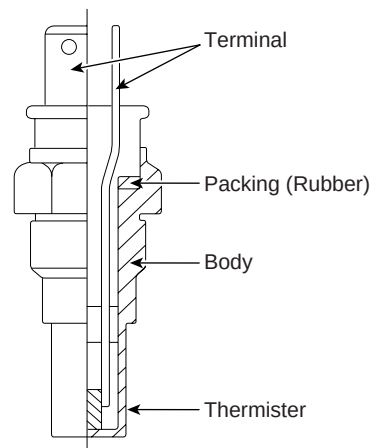
CVVT OIL TEMPERATURE SENSOR(OTS)

INSPECTION EFEFF646

FUNCTION AND OPERATION PRINCIPLE

Continuously Variable Valve Timing (CVVT) system controls valve overlap by forcibly activating the camshaft and adjusts EGR (Exhaust Gas Recirculation) amount. It decreases exhaust gas (NOx, HC) and improves fuel economy, idle state, torque in low speed and power in high speed. This system uses engine oil pressure and consists of the two CVVT Oil Control Valves (OCV) in each bank which supplies oil to cam phaser according to PWM (Pulse With Modulator) signal of the PCM, a CVVT Oil Temperature Sensor (OTS) which detects the oil temperature and a cam phaser which is installed on the end of the camshaft and converts camshaft phase. The oil getting out of the CVVT oil control valve flows into the cam phaser and rotates the rotor inside camphaser. At this time, the camshaft rotates with the rotor and the cam phase is changed.

1. When camshaft rotates engine rotation-wise: Intake-Advance / Exhaust-Retard
2. When camshaft rotates counter engine rotation-wise: Intake- Retard / Exhaust- Advance

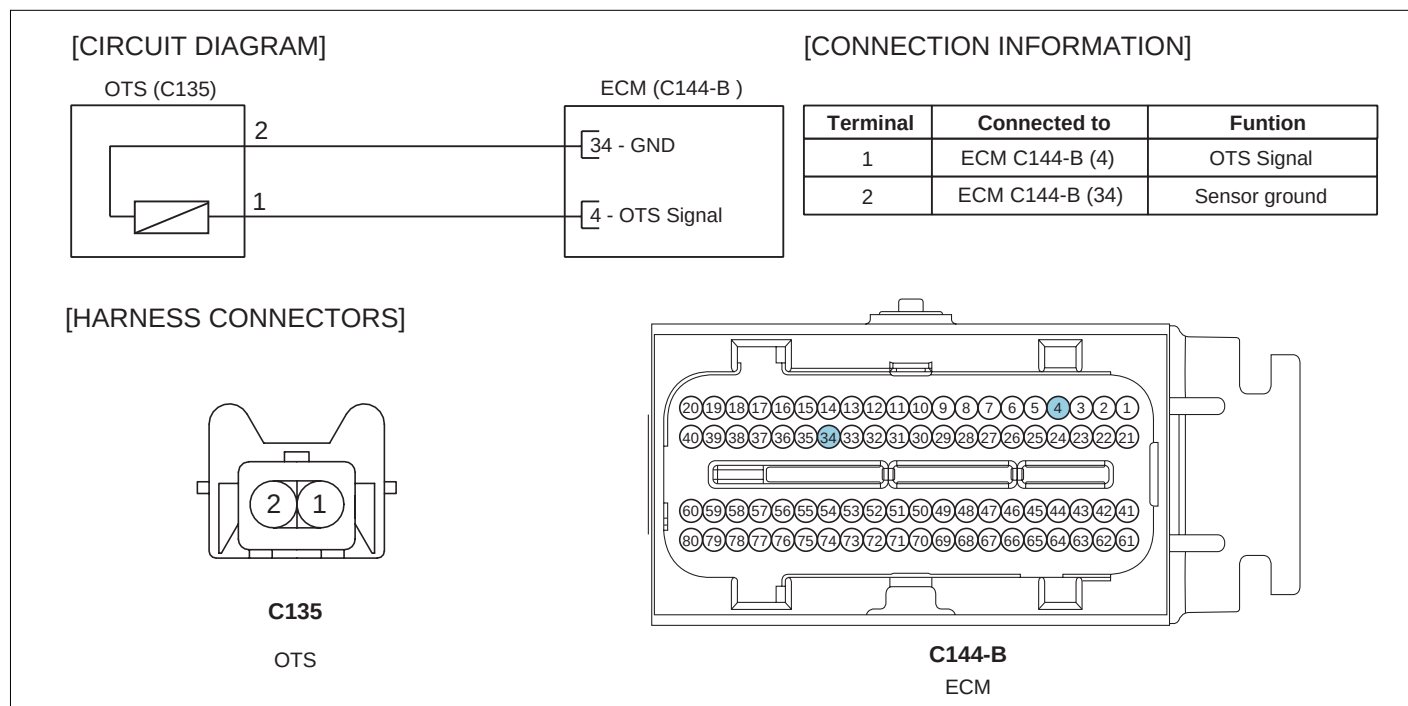


EGRF241A

SPECIFICATION

Temperature		
°C	°F	
-20	-4	16.52 kΩ
20	32	2.45 kΩ
80	176	0.29 kΩ

SCHEMATIC DIAGRAM



SBLF26211L

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect OTS connector.
3. Remove the OTS.
4. After immersing the thermistor of the sensor into water (or engine coolant), measure resistance between OTS terminals 1 and 2.
5. Check that the resistance is within the specification.

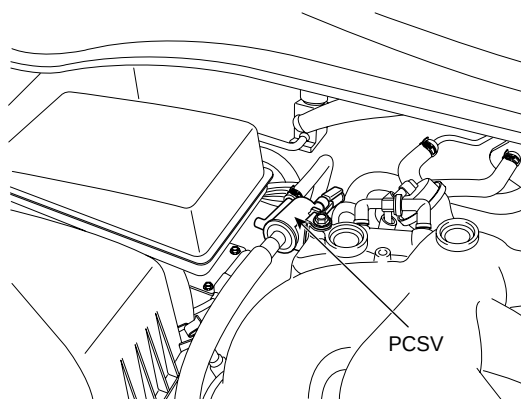
Specification: Refer to SPECIFICATION.

PURGE CONTROL SOLENOID VALVE (PCSV)

INSPECTION E2EAD08B

FUNCTION AND OPERATION PRINCIPLE

Purge Control Solenoid Valve (PCSV) is installed on the surge tank and controls the passage between the canister and the intake manifold. It is a solenoid valve and is open when the PCM grounds the valve control line. When the passage is open (PCSV ON), fuel stored in the canister is transferred to the intake manifold.

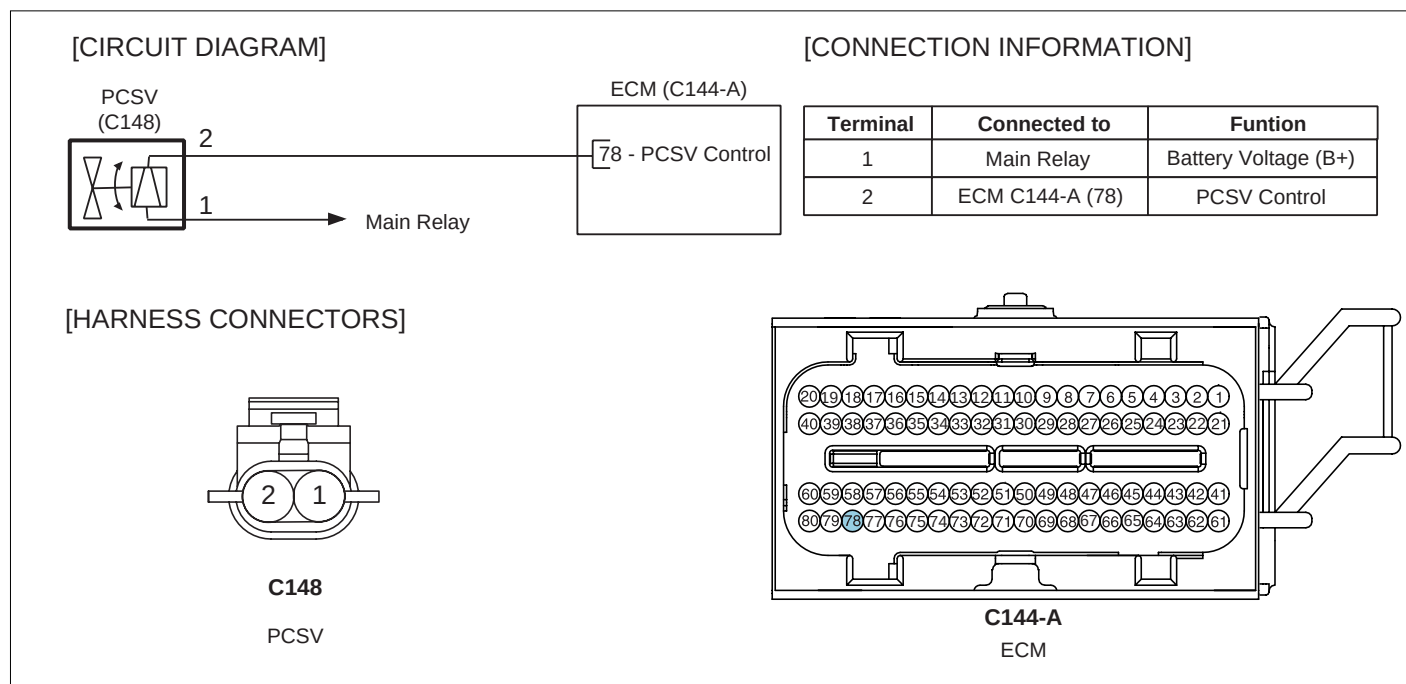


SBLF26119L

SPECIFICATION

Item	Specification
Coil Resistance (Ω)	19.0 ~ 22.0 Ω at 20°C (68°F)

SCHEMATIC DIAGRAM



SBLF26212L

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect PCSV connector.
3. Measure resistance between PCSV terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

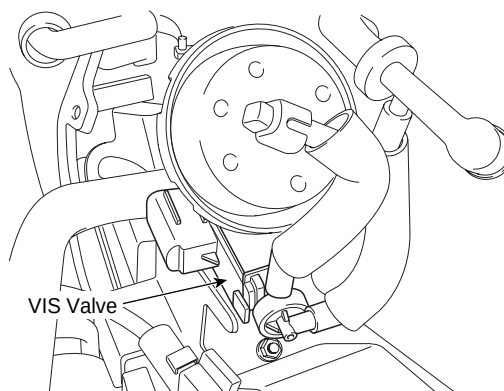
VARIABLE INTAKE SOLENOID (VIS) VALVE

INSPECTION E3D6CF87

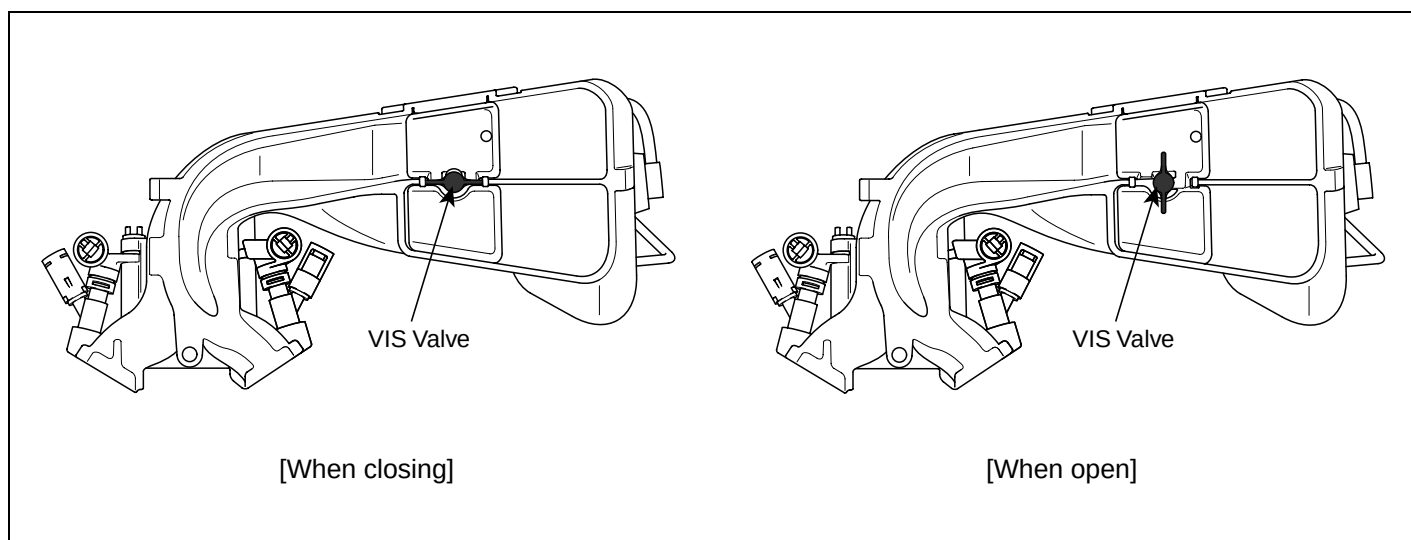
FUNCTION AND OPERATION PRINCIPLE

Variable Intake Solenoid (VIS) Valve is installed on the intake manifold and isolates or not the one bank from the other banks to improve the intake efficiency.

1. Low/Middle Speed: VIS Valve Close → Resonance Effect → Improving Intake Efficiency
2. High Speed: VIS Valve Open → Improving Intake Inertia Effect → Improving Intake Efficiency



SBLF26116L

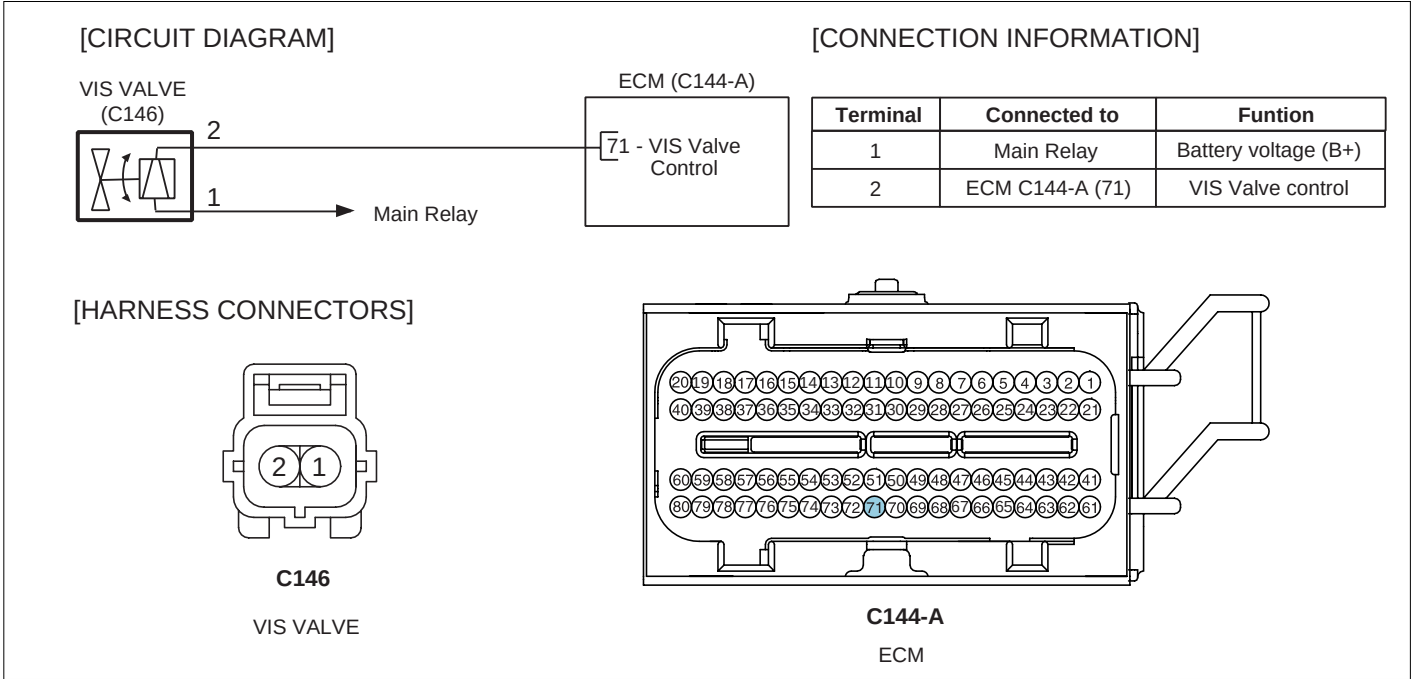


EGRF258A

SPECIFICATION

Item	Specification
Coil Resistance (Ω)	30.0 ~ 35.0 Ω at 22°C (71.6°F)

SCHEMATIC DIAGRAM



SBLF26213L

COMPONENT INSPECTION

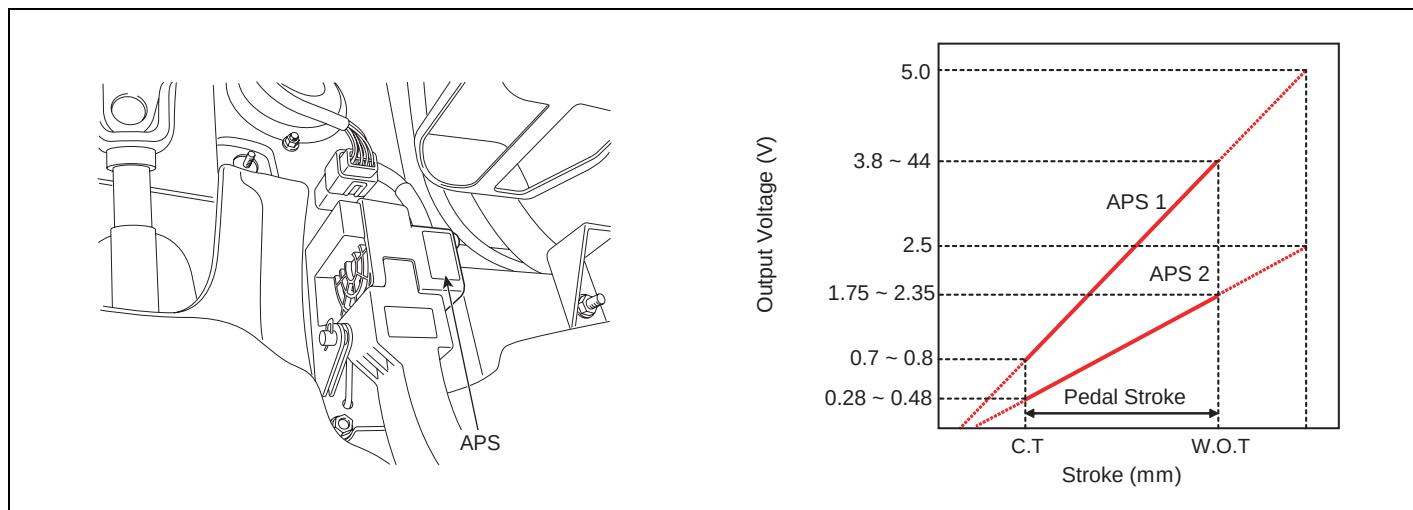
1. Turn ignition switch OFF.
2. Disconnect VIS Valve connector.
3. Measure resistance between VIS Valve terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

ACCELERATOR POSITION SENSOR (APS)

INSPECTION E7862B97

FUNCTION AND OPERATION PRINCIPLE



SBLF26214L

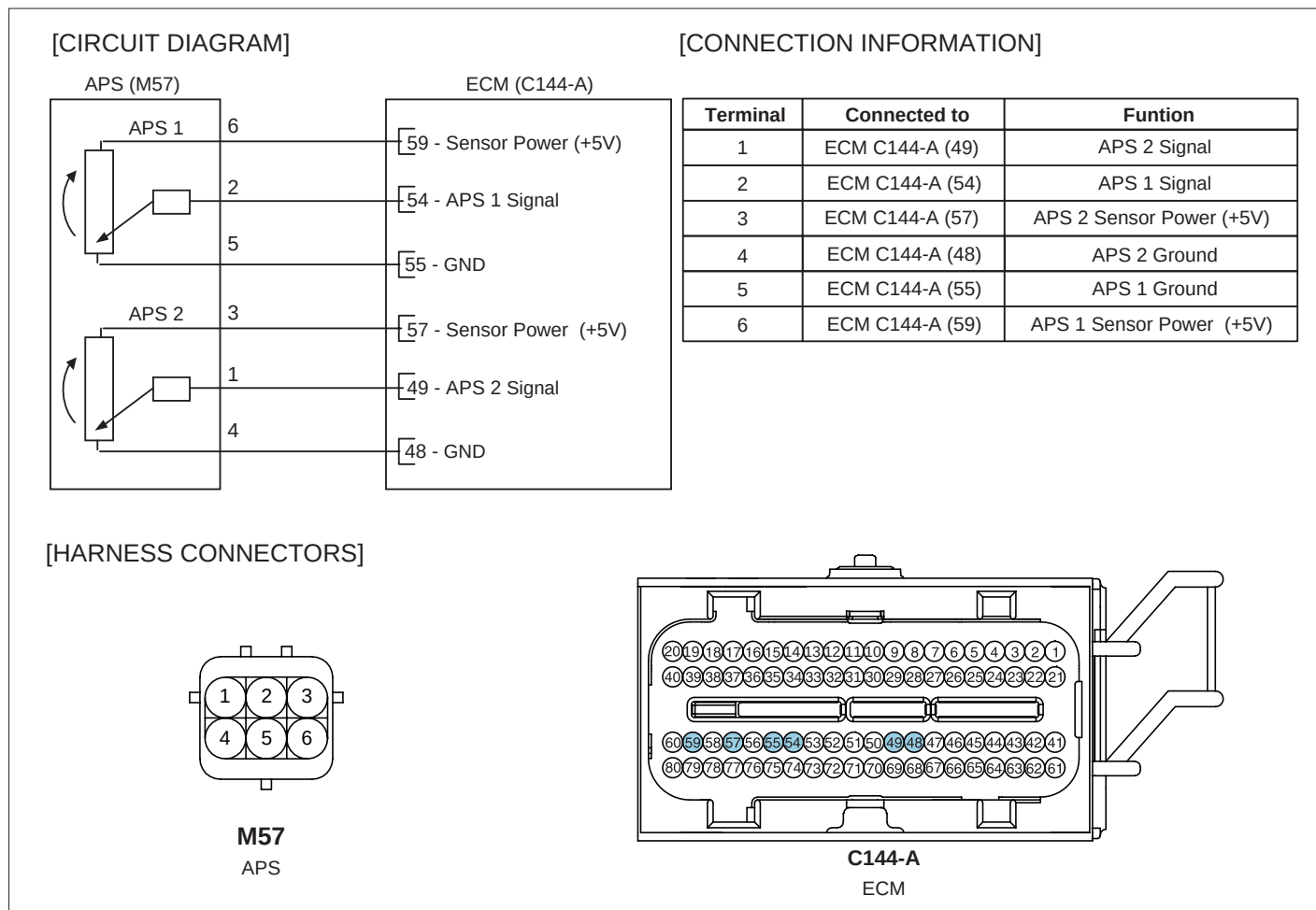
Accelerator Position Sensor (APS) is installed on the accelerator pedal module and detects the rotation angle of the accelerator pedal. The APS is one of the most important sensors in engine control system, so it consists of the two sensors which adapt individual sensor power and ground line. The second sensor monitors the first sensor and its output voltage is half of the first one. If the ratio of the sensor 1 and 2 is out of the range (approximately 1/2), the diagnostic system judges that it is abnormal.

SPECIFICATION

Pedal Position	Output Voltage (V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8	0.28 ~ 0.48
W.O.T	3.8 ~ 4.4	1.75 ~ 2.35

Item	Sensor Resistance
APS1	0.7 ~ 1.3kΩ at 20°C (68°F)
APS2	1.4 ~ 2.6kΩ at 20°C (68°F)

SCHEMATIC DIAGRAM



SBLF26215L

COMPONENT INSPECTION

1. Connect a scantool on Diagnosis Link Connector (DLC).
2. Start engine and check output voltages of APS 1 and 2 at C.T and W.O.T.

Specification: Refer to SPECIFICATION.

3. Turn ignition switch OFF and disconnect the scantool from the DLC.
4. Disconnect APS connector and measure resistance between APS terminals 5 and 6 (APS 1).

Specification: Refer to SPECIFICATION.

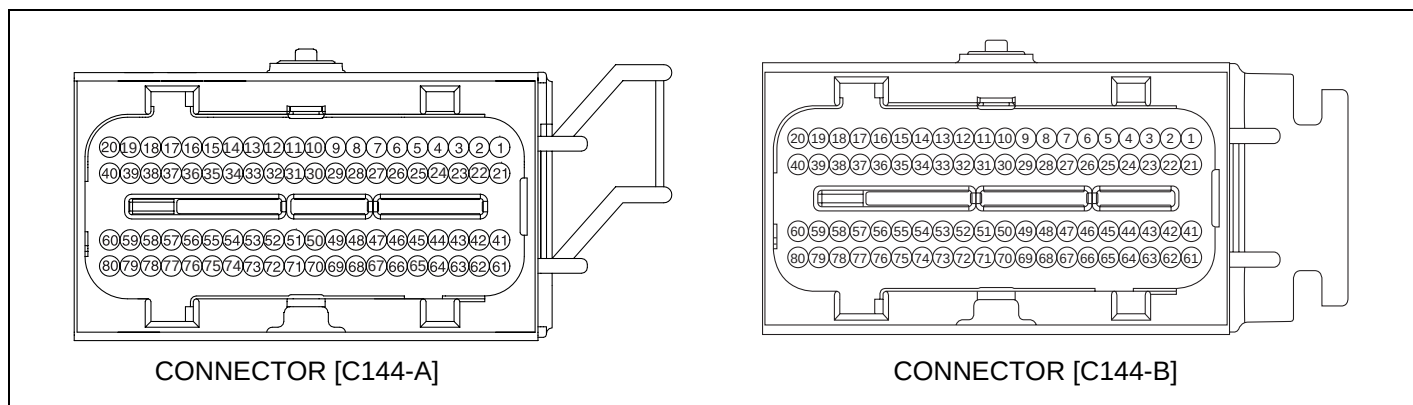
5. Disconnect APS connector and measure resistance between APS terminals 3 and 4 (APS 2).

Specification: Refer to SPECIFICATION.

ENGINE CONTROL MODULE (ECM)

ENGINE CONTROL MODULE (ECM) E5201EB5

1. ECM HARNESS CONNECTOR



SBLFL6216L

2. ECM TERMINAL FUNCTION

CONNECTOR [C144-A]

Pin No.	Description	Connected to
1	2nd CAN [High]	Multi-Purpose Check Connector
2	2nd CAN [Low]	Multi-Purpose Check Connector
3	-	
4	-	
5	-	
6	-	
7	-	
8	-	
9	-	
10	-	
11	-	
12	-	
13	-	
14	-	
15	Alternator load signal input	Alternator
16	Cruise Switch ground	Cruise Switch
17	-	
18	Air conditioner switch "ON" signal input	Air Conditioner Control Module
19	-	
20	-	
21	Brake switch signal input	Brake Switch

GASOLINE ENGINE CONTROL SYSTEM

FLB -59

Pin No.	Description	Connected to
22	-	
23	Brake lamp signal input	Brake Lamp
24	-	
25	Cruise Switch signal input	Cruise Switch
26	Air conditioner blower switch signal input	Air Conditioner Control Module
27	Diagnostic Data Line (K-Line)	Data Link Connector (DLC), Multi-Purpose Check Connector
28	-	
29	-	
30	-	
31	-	
32	A/C Pressure Transducer signal input	A/C Pressure Transducer (APT)
33	Sensor ground	A/C Pressure Transducer (APT)
34	-	
35	-	
36	-	
37	-	
38	Battery voltage supply after main relay	Main Relay
39	Battery voltage supply after main relay	Main Relay
40	Battery voltage supply after main relay	Main Relay
41	CAN [High]	ABS/ESP Control Module, 4WD Control Module
42	CAN [Low]	ABS/ESP Control Module, 4WD Control Module
43	Main Relay control output	Main Relay
44	Intake Air Temperature Sensor signal input	Intake Air Temperature Sensor (IATS)
45	Immobilizer communication line	Immobilizer
46	-	
47	Mass Air Flow Sensor signal input	Mass Air Flow Sensor (MAFS)
48	Sensor Ground	Accelerator Position Sensor (APS) #2
49	Accelerator Position Sensor #2 signal input	Accelerator Position Sensor (APS) #2
50	-	
51	Cruise "SET" lamp control output	Cruise "SET" Lamp (Cluster)
52	Vehicle speed signal input	ABS/ESP Control Module (With ABS/ESP [Euro-III/IV])
		Vehicle Speed Sensor (Except Euro-III/IV)
53	Sensor ground	Intake Air Temperature Sensor (IATS)
54	Accelerator Position Sensor #1 signal input	Accelerator Position Sensor (APS) #1
55	Sensor ground	Accelerator Position Sensor (APS) #1
56	-	
57	Sensor power (+5V)	Accelerator Position Sensor (APS) #2

Pin No.	Description	Connected to
58	Sensor power (+5V)	A/C pressure Transducer (APT)
59	Sensor Power (+5V)	Accelerator Position Sensor (APS) #1
60	-	
61	Engine speed signal output	Cluster (Tachometer)
62	Fuel consumption signal output	Trip Computer
63	Malfunction Indicator Lamp (MIL) control output	Cluster (Malfunction Indicator Lamp)
64	Air Conditioner Compressor Relay control output	Air Conditioner Compressor Relay
65	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
66	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
67	-	
68	Throttle Position Sensor signal (PWM) output	ABS Control Module, ESP Control Module
69	Cruise "MAIN" lamp control output	Cruise "MAIN" Lamp (Cluster)
70	Fuel Pump Relay control output	Fuel Pump Relay
71	Variable Intake Solenoid Valve control output	Variable Intake Solenoid (VIS) Valve
72	Immobilizer lamp control output	Immobilizer Lamp
73	-	
74	-	
75	-	
76	-	
77	-	
78	Purge Control Solenoid Valve control output	Purge Control Solenoid Valve (PCSV)
79	Wheel Speed Sensor [Low] signal input	Wheel Speed Sensor (WSS)(Without ABS/ESP [Euro-III/IV])
80	Wheel Speed Sensor [High] signal input	Wheel Speed Sensor (WSS)(Without ABS/ESP [Euro-III/IV])

GASOLINE ENGINE CONTROL SYSTEM

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CONNECTOR [C144-B]

Pin No.	Description	Connected to
1	ETC Motor [-] control output	ETC Motor (in ETC Module)
2	ETC Motor [+] control output	ETC Motor (in ETC Module)
3	-	
4	CVVT Oil Temperature Sensor signal input	CVVT Oil Temperature Sensor (OTS)
5	-	
6	-	
7	Engine Coolant Temperature Sensor signal input	Engine Coolant Temperature Sensor (ECTS)
8	Manifold Absolute Pressure Sensor signal input	Manifold Absolute Pressure Sensor (MAPS)
9	-	
10	-	
11	Sensor power (+5V)	Manifold Absolute Pressure Sensor (MAPS)
12	Battery voltage supply after ignition switch	Ignition Switch
13	Sensor power (+5V)	Throttle Position Sensor (TPS) #2
14	Sensor ground	Throttle Position Sensor (TPS) #1
15	Sensor power (+5V)	Camshaft Position Sensor (CMPS) [Bank 2]
16	Sensor power (+5V)	Throttle Position Sensor (TPS) #1
17	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 2]
18	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1]
19	Ignition Coil (Cylinder #6) control output	Ignition Coil (Cylinder #6)
20	-	
21	Crankshaft Position Sensor [High] signal input	Crankshaft Position Sensor (CKPS)
22	-	
23	Sensor Shield	Crankshaft Position Sensor (CKPS), Knock Sensor (KS) #1,2
24	Camshaft Position Sensor [Bank 2] signal input	Camshaft Position Sensor (CMPS) [Bank 2]
25	Camshaft Position Sensor [Bank 1] signal input	Camshaft Position Sensor (CMPS) [Bank 1]
26	-	
27	-	
28	Sensor ground	HO2S (B2/S1) [Except for LEADED]
29	Sensor ground	HO2S (B2/S2) [Euro-III/IV]
30	Sensor ground	HO2S (B1/S1) [Except for LEADED]
31	Sensor ground	HO2S (B1/S2) [Euro-III/IV]
32	Sensor power (+5V)	Camshaft Position Sensor (CMPS) [Bank 1]
33	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
34	Sensor ground	Manifold Absolute Pressure Sensor (MAPS), CVVT Oil Temperature Sensor (OTS)
35	Power ground	Chassis Ground

Pin No.	Description	Connected to
36	Power ground	Chassis Ground
37	Power ground	Chassis Ground
38	Power ground	Chassis Ground
39	Power ground	Chassis Ground
40	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4)
41	Crankshaft Position Sensor [Low] signal input	Crankshaft Position Sensor (CKPS)
42	-	
43	-	
44	-	
45	-	
46	-	
47	-	
48	Throttle Position Sensor #1 signal input	Throttle Position Sensor (TPS) #1
49	Heated Oxygen Sensor [Bank 1 / Sensor 1] signal input	HO2S (B1/S1) [Except for LEADED]
50	Heated Oxygen Sensor [Bank 1 / Sensor 2] signal input	HO2S (B1/S2) [Euro-III/IV]
51	Heated Oxygen Sensor [Bank 2 / Sensor 1] signal input	HO2S (B2/S1) [Except for LEADED]
52	Heated Oxygen Sensor [Bank 2 / Sensor 2] signal input	HO2S (B2/S2) [Euro-III/IV]
53	Knock Sensor (KS) #2 [High] signal input	Knock Sensor (KS) #2 [High]
54	Knock Sensor (KS) #2 [Low] signal input	Knock Sensor (KS) #2 [Low]
55	Knock Sensor (KS) #1 [Low] signal input	Knock Sensor (KS) #1 [Low]
56	Knock Sensor (KS) #1 [High] signal input	Knock Sensor (KS) #1 [High]
57	Throttle Position Sensor #2 signal input	Throttle Position Sensor (TPS) #2
58	Sensor ground	Throttle Position Sensor (TPS) #2
59	-	
60	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2)
61	CVVT Oil Control Valve [Bank 2] control output	CVVT Oil Control Valve (OCV) [Bank 2]
62	CVVT Oil Control Valve [Bank 1] control output	CVVT Oil Control Valve (OCV) [Bank 1]
63	Injector (Cylinder #2) control output	Injector (Cylinder #2)
64	Injector (Cylinder #3) control output	Injector (Cylinder #3)
65	-	
66	-	
67	Heated Oxygen Sensor [Bank 2 / Sensor 1] Heater control output	HO2S (B2/S1) [Except for LEADED]
68	Injector (Cylinder #4) control output	Injector (Cylinder #4)
69	Injector (Cylinder #5) control output	Injector (Cylinder #5)

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Pin No.	Description	Connected to
70	Heated Oxygen Sensor [Bank 1 / Sensor 1] Heater control output	HO2S (B1/S1) [Except for LEADED]
71	Injector (Cylinder #6) control output	Injector (Cylinder #6)
72	Injector (Cylinder #1) control output	Injector (Cylinder #1)
73	Heated Oxygen Sensor [Bank 2 / Sensor 2] Heater control output	HO2S (B2/S2) [Euro-III/IV]
74	Heated Oxygen Sensor [Bank 1 / Sensor 2] Heater control output	HO2S (B1/S2) [Euro-III/IV]
75	-	
76	Power Supply (B+)	Battery
77	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3)
78	Ignition Coil (Cylinder #5) control output	Ignition Coil (Cylinder #5)
79	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1)
80	-	

3. ECM TERMINAL INPUT/OUTPUT SIGNAL

CONNECTOR [C144-A]

Pin No.	Description	Condition	Type	Level	Test Result
1	2nd CAN [High]	Idle	DC	2.0 ~ 3.0V	2.5V
2	2nd CAN [Low]	Idle	DC	2.0 ~ 3.0V	2.5V
3	-				
4	-				
5	-				
6	-				
7	-				
8	-				
9	-				
10	-				
11	-				
12	-				
13	-				
14	-				
15	Alternator load signal input	Idle	PULSE	High: Battery Voltage	13.6V
				Low: Max. 1.5V	0V
				140 ~ 190Hz	160Hz
16	Cruise Switch ground				
17	-	Idle	DC	Max. 50mV	30mV
18	Air conditioner switch "ON" signal input	A/CON Relay OFF	DC	Battery Voltage	9.1V
		A/CON Relay ON		Max. 1.0V	0.1V
19	-				
20	-				
21	Brake switch signal input	Brake pedal releasing	DC	Battery Voltage	12.7V
		Brake pedal pressing		Max. 0.5V	0.03V
22	-				
23	Brake lamp signal input	Brake pedal releasing	DC	Max. 0.5V	0V
		Brake pedal pressing		Battery Voltage	13.0V
24	-				
25	Cruise Switch signal input				

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Pin No.	Description	Condition	Type	Level	Test Result
26	Air conditioner blower switch signal input	A/CON OFF	DC	Max. 1.0V	0V
		A/CON ON		Battery Voltage	11.9V
27	Diagnostic Data Line (K-Line)	When transmitting	PULSE	High: Min. Vbatt ✱ 80%	11.3V
				Low: Max. Vbatt ✱ 20%	0.14V
		When receiving		High: Min. Vbatt ✱ 70%	11.3V
				Low: Max. Vbatt ✱ 30%	0.32V
28	-				
29	-				
30	-				
31	-				
32	Air Conditioner Pressure Sensor signal input	A/CON OFF	DC	0 ~ 5.0V	
		A/CON ON			1.85 2.2V
33	Sensor ground	Idle	DC	Max. 50mV	40mV
34	-				
35	-				
36	-				
37	-				
38	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0V	0V
		IG ON		Battery Voltage	12.1V
39	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0V	0V
		IG ON		Battery Voltage	12.1V
40	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0V	0V
		IG ON		Battery Voltage	12.1V
41	CAN [High]	RECES-SIVE	PULSE	2.0 ~ 3.0V	3.85V
		DOMINANT		2.75 4.5V	2.5V
42	CAN [Low]	RECES-SIVE	PULSE	2.0 ~ 3.0V	2.55V
		DOMINANT		2.75 4.5V	1.34V
43	Main Relay control output	Relay ON	DC	Battery Voltage	12.3V
		Relay OFF		Max. 1.0V	0.87V
44	Intake Air Temperature Sensor signal input	Idle	Analog	0 ~ 5.0V	1.86V
45	Immobilizer communication line				
46	-				

Pin No.	Description	Condition	Type	Level	Test Result
47	Mass Air Flow Sensor signal input	Idle	PULSE	High: Vref	5.04V
				Low: Max. 0.5V	0.27V
				Idle: 3.0KHz	
		3,000 rpm		High: Vref	5.04V
				Low: Max. 0.5V	0.27V
				3000rpm: 4.5 kHz	
48	Sensor ground	Idle	DC	Max. 50mV	35mV
49	Accelerator Position Sensor #2 signal input	C.T	Analog	0.3 ~ 0.9V	0.4V
		W.O.T		1.5 ~ 3.0V	2.1V
50	-				
51	Cruise "SET" lamp control output				
52	Vehicle speed signal input	Vehicle running	PULSE	High: Min. 5.0V	12.6V
				Low: Max. 1.0V	0.2V
53	Sensor ground	Idle	DC	Max. 50mV	34mV
54	Accelerator Position Sensor #1 signal input	C.T	Analog	0.3 ~ 0.9V	0.77V
		W.O.T		4.0 ~ 4.8V	4.23V
55	Sensor ground	Idle	DC	Max. 50mV	36mV
56	-				
57	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.08V
58	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.08V
59	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.08V
60	-				
61	Engine speed signal output	Idle	PULSE	High: Battery Voltage	13.0V
				Low: Max. 0.5V	0V
				20~26Hz	35Hz
62	Fuel consumption signal output	Idle	PULSE	High: Battery Voltage or Vref	12.8V
				Low: Max. 0.5V	0V
63	Malfunction Indicator Lamp (MIL) control output	MIL OFF	DC	High: Battery Voltage	4.24V
		MIL ON		Low: Max. 2.0V	0V
64	Air Conditioner Compressor Relay control output	A/CON OFF	DC	Battery Voltage	13.0V
		A/CON ON		Max. 1.0V	0.14V
65	Cooling Fan Relay [Low] control output				

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Pin No.	Description	Condition	Type	Level	Test Result
66	Cooling Fan Relay [High] control output				
67	-				
68	Throttle Position Sensor signal (PWM) output	Idle	PULSE	High: Battery Voltage	12.3V
				Low: 0 ~ 0.5 V	0V
					100Hz
69	Cruise "CRUISE" lamp control output				
70	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage	12.5V
		Relay ON		Max. 1.0V	0.09V
71	Variable Intake Solenoid Valve control output	Active	DC	Max. 1.0V	0.1V
		Inactive		Battery Voltage	12.4V
72	Immobilizer lamp control output				
73	-				
74	-				
75	-				
76	-				
77	-				
78	Purge Control Solenoid Valve control output	Inactive Active	PULSE	High: Battery Voltage	13.2V
				Low: Max. 1.0V	0.08V
					16Hz
79	Wheel Speed Sensor [Low] signal input				
80	Wheel Speed Sensor [High] signal input				

CONNECTOR [C144-B]

Pin No.	Description	Condition	Type	Level	Test Result
1	ETC Motor [-] control output	Idle	PULSE	High: Battery Voltage	13.3V
				Low: Max. 1.0V	0.3V
					3.14KHz
2	ETC Motor [+] control output	Idle	PULSE	High: Battery Voltage	13.3V
				Low: Max. 1.0V	0.4V
					3.14KHz
3	-				
4	CVVT Oil Temperature Sensor signal input	Idle	Analog	0.5 ~ 4.5V	1.68V
5	-				
6	-				
7	Engine Coolant Temperature Sensor signal input	Idle	Analog	0.5 ~ 4.5V	0.47V
8	Manifold Absolute Pressure Sensor signal input	IG ON	Analog	3.9 ~ 4.1V	4.01V
		Idle		0.8 ~ 1.6V	1.59V
9	-				
10	-				
11	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.08V
12	Battery voltage supply after ignition switch	IG OFF	DC	Max. 0.5V	0V
		IG ON		Battery Voltage	12.2V
13	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.05V
14	Sensor ground	Idle	DC	Max. 50mV	30mV
15	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.06V
16	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.06V
17	Sensor ground	Idle	DC	Max. 50mV	30mV
18	Sensor ground	Idle	DC	Max. 50mV	30mV
19	Ignition Coil (Cylinder #6) control output	Idle	PULSE	1st: 300~400V	272V
				ON: Max. 2V	1.2V
					5.8Hz
20	-				
21	Crankshaft Position Sensor [High] signal input	Idle	Sine Wave	Vp_p: Min.1.0V	8V
					700Hz

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Pin No.	Description	Condition	Type	Level	Test Result
22	-				
23	Sensor Shield	Idle	DC	Max. 50mV	32mV
24	Camshaft Position Sensor [Bank 2] signal input	Idle	PULSE	High: Vref	5.08V
				Low: Max. 0.5V	0.06V
					40Hz
25	Camshaft Position Sensor [Bank 1] signal input	Idle	PULSE	High: Vref	5.08V
				Low: Max. 0.5V	0.06V
					40Hz
26	-				
27	-				
28	Sensor ground	Idle	DC	Max. 50mV	27mV
29	Sensor ground	Idle	DC	Max. 50mV	27mV
30	Sensor ground	Idle	DC	Max. 50mV	26V
31	Sensor ground	Idle	DC	Max. 50mV	27mV
32	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.06V
33	Sensor ground	Idle	DC	Max. 50mV	13mV
34	Sensor ground	Idle	DC	Max. 50mV	13mV
35	Power ground	Idle	DC	Max. 50mV	0mV
36	Power ground	Idle	DC	Max. 50mV	0mV
37	Power ground	Idle	DC	Max. 50mV	0mV
38	Power ground	Idle	DC	Max. 50mV	2mV
39	Power ground	Idle	DC	Max. 50mV	2mV
40	Ignition Coil (Cylinder #4) control output	Idle	PULSE	1st: 300~400V	263V
				ON: Max. 2V	1.4V
					5.8Hz
41	Crankshaft Position Sensor [Low] signal input	Idle	Sine Wave	Vp_p: Min.1.0V	8V
					700Hz
42	-				
43	-				
44	-				
45	-				
46	-				
47	-				
48	Throttle Position Sensor #1 signal input	C.T	Analog	0.25 ~ 0.9V	
		W.O.T		Min. 4.0V	
49	Heated Oxygen Sensor [Bank 1 / Sensor 1] signal input	Engine Running	DC	Rich: 0.6 1.0V	0.95V
				Lean: 0 ~ 0.4V	0.13V

Pin No.	Description	Condition	Type	Level	Test Result
50	Heated Oxygen Sensor [Bank 1 / Sensor 2] signal input	Engine Running	DC	Rich: 0.6 1.0V	0.88V
				Lean: 0 ~ 0.4V	0.21V
51	Heated Oxygen Sensor [Bank 2 / Sensor 1] signal input	Engine Running	DC	Rich: 0.6 1.0V	0.91V
				Lean: 0 ~ 0.4V	0.18V
52	Heated Oxygen Sensor [Bank 2 / Sensor 2] signal input	Engine Running	DC	Rich: 0.6 1.0V	0.89V
				Lean: 0 ~ 0.4V	0.22V
53	Knock Sensor (KS) #2 [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	1.7V
		Normal		0 V	
54	Knock Sensor (KS) #2 [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	1.7V
		Normal		0 V	
55	Knock Sensor (KS) #1 [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	1.7V
		Normal		0 V	
56	Knock Sensor (KS) #1 [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	1.7V
		Normal		0 V	
57	Throttle Position Sensor #2 signal input	C.T	Analog	Min. 4.0V	
		W.O.T		0.25 ~ 0.9V	
58	Sensor ground	Idle	DC	Max. 50mV	17mV
59	-				
60	Ignition Coil (Cylinder #2) control output	Idle	PULSE	1st: 300~400V	266V
				ON: Max. 2V	1.3V
					5.8Hz
61	CVVT Oil Control Valve [Bank 2] control output	Idle	PULSE	Battery Voltage	14.5V
				Max. 1.0V	0.1V
				Duty variance when operating the accelerator	128Hz
62	CVVT Oil Control Valve [Bank 1] control output	Idle	PULSE	Battery Voltage	14.3V
				Max. 1.0V	0.1V
				Duty variance when operating the accelerator	128Hz
63	Injector (Cylinder #2) control output	Idle	PULSE	High: Battery Voltage	13.8V
				Low: Max. 1.0V	0.13V
				Vpeak: Max. 80V	57.5V
					5.8Hz

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Pin No.	Description	Condition	Type	Level	Test Result
64	Injector (Cylinder #3) control output	Idle	PULSE	High: Battery Voltage	13.8V
				Low: Max. 1.0V	0.13V
				Vpeak: Max. 80V	56.8V
					5.8Hz
65	-				
66	-				
67	Heated Oxygen Sensor [Bank 2 / Sensor 1] Heater control output	Engine Running	PULSE	High: Battery Voltage	13.8V
				Low: Max. 1.0V	0.17V
					16Hz
68	Injector (Cylinder #4) control output	Idle	PULSE	High: Battery Voltage	13.8V
				Low: Max. 1.0V	0.13V
				Vpeak: Max. 80V	56.8V
					5.8Hz
69	Injector (Cylinder #5) control output	Idle	PULSE	High: Battery Voltage	13.7V
				Low: Max. 1.0V	0.13V
				Vpeak: Max. 80V	56.8V
					5.8Hz
70	Heated Oxygen Sensor [Bank 1 / Sensor 1] Heater control output	Engine Running	PULSE	High: Battery Voltage	13.8V
				Low: Max. 1.0V	0.17V
					16Hz
71	Injector (Cylinder #6) control output	Idle	PULSE	High: Battery Voltage	13.8V
				Low: Max. 1.0V	0.13V
				Vpeak: Max. 80V	56.8V
					5.8Hz
72	Injector (Cylinder #1) control output	Idle	PULSE	High: Battery Voltage	13.8V
				Low: Max. 1.0V	0.13V
				Vpeak: Max. 80V	56.8V
					5.8Hz
73	Heated Oxygen Sensor [Bank 2 / Sensor 2] Heater control output	Engine Running	PULSE	High: Battery Voltage	13.9V
				Low: Max. 1.0V	0.19V
					16Hz

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FUEL SYSTEM

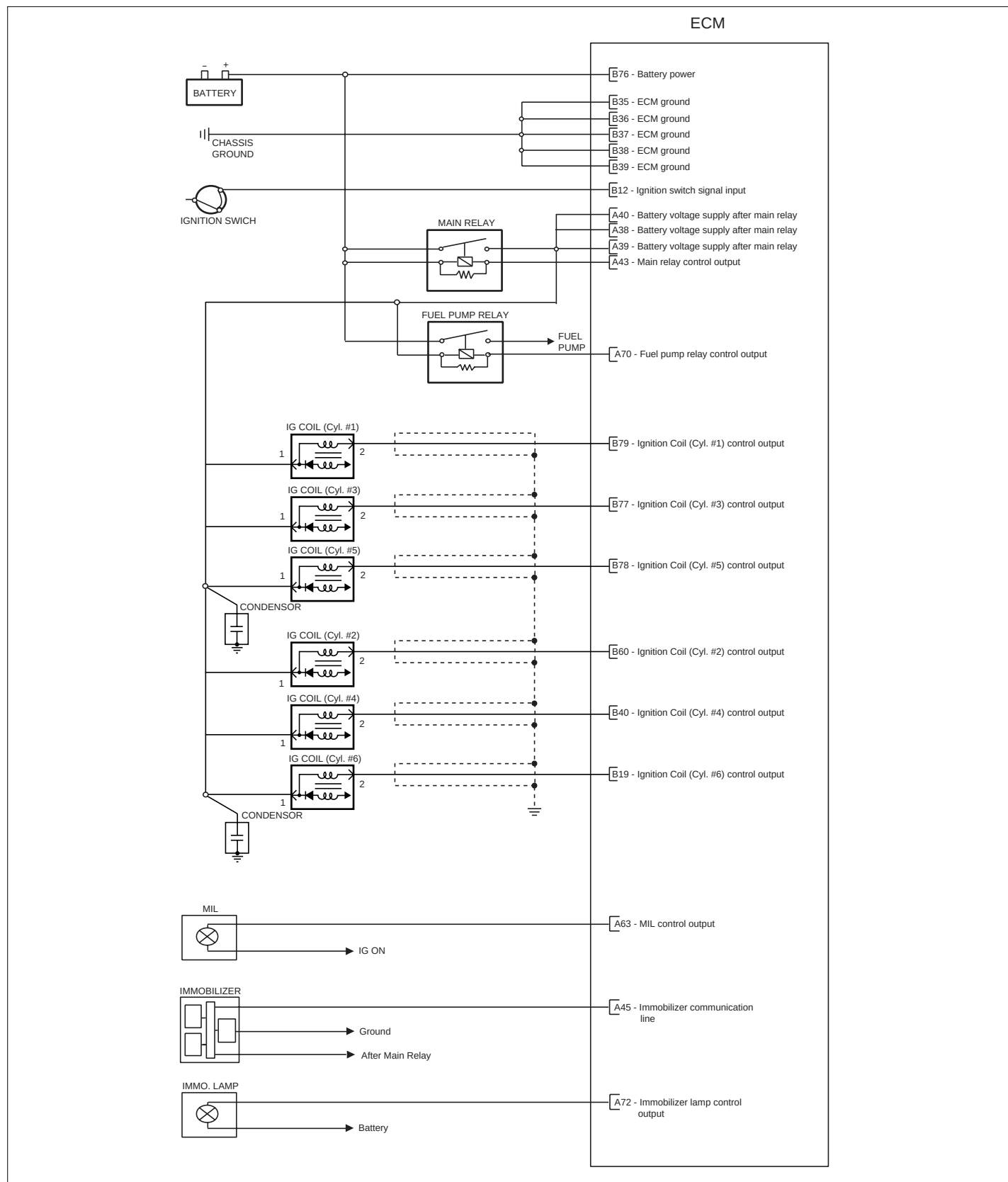
Pin No.	Description	Condition	Type	Level	Test Result
74	Heated Oxygen Sensor [Bank 1 / Sensor 2] Heater control output	Engine Running	PULSE	High: Battery Voltage	13.9V
				Low: Max. 1.0V	0.18V
					16Hz
75	-				
76	Power Supply (B+)	Always	DC	Battery Voltage	13.0V
77	Ignition Coil (Cylinder #3) control output	Idle	PULSE	1st: 300~400V	266V
				ON: Max. 2V	1.4V
					5.8Hz
78	Ignition Coil (Cylinder #5) control output	Idle	PULSE	1st: 300~400V	267V
				ON: Max. 2V	1.4V
					5.8Hz
79	Ignition Coil (Cylinder #1) control output	Idle	PULSE	1st: 300~400V	268V
				ON: Max. 2V	1.4V
					5.8Hz
80	-				

GASOLINE ENGINE CONTROL SYSTEM

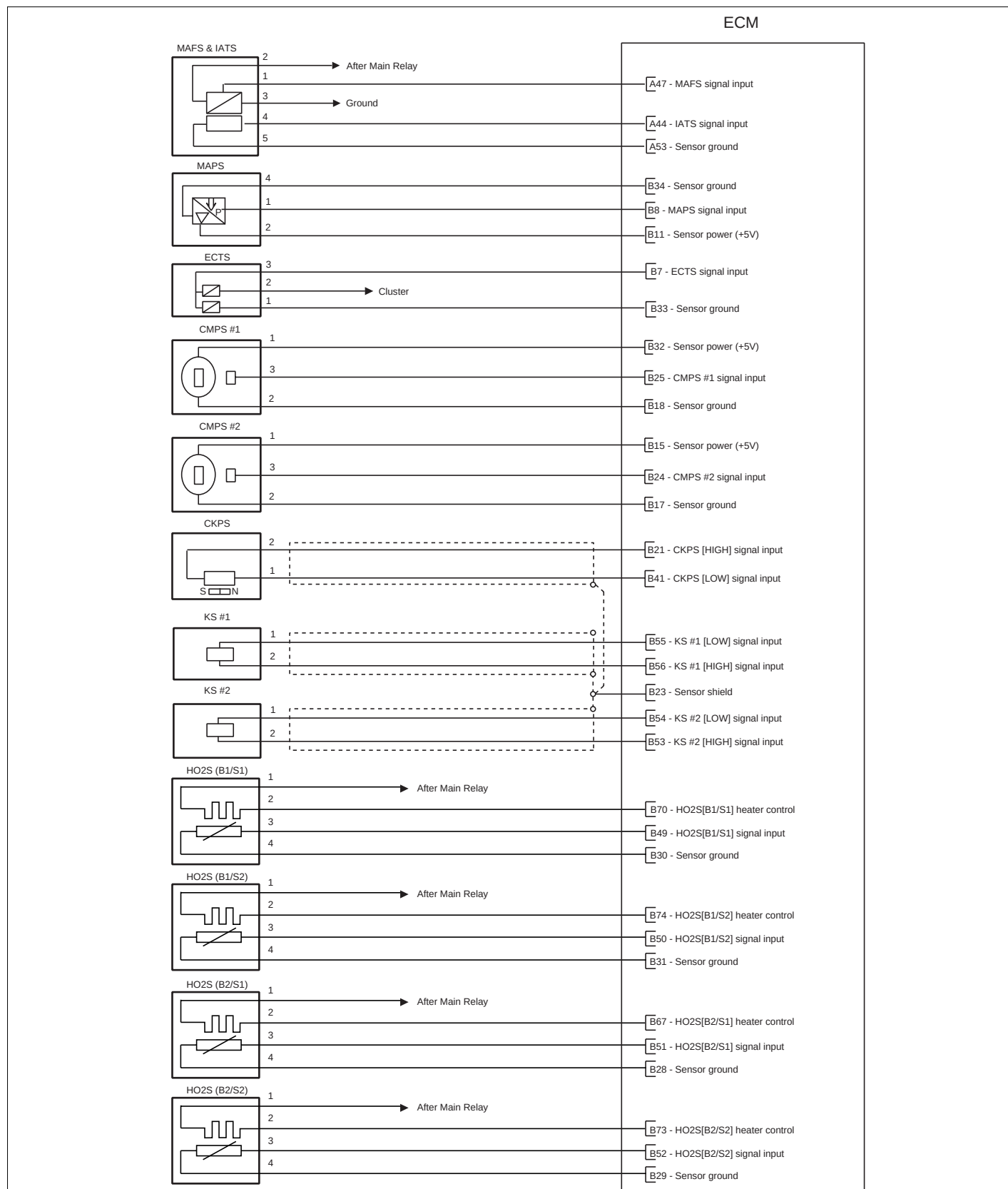
FLB -73

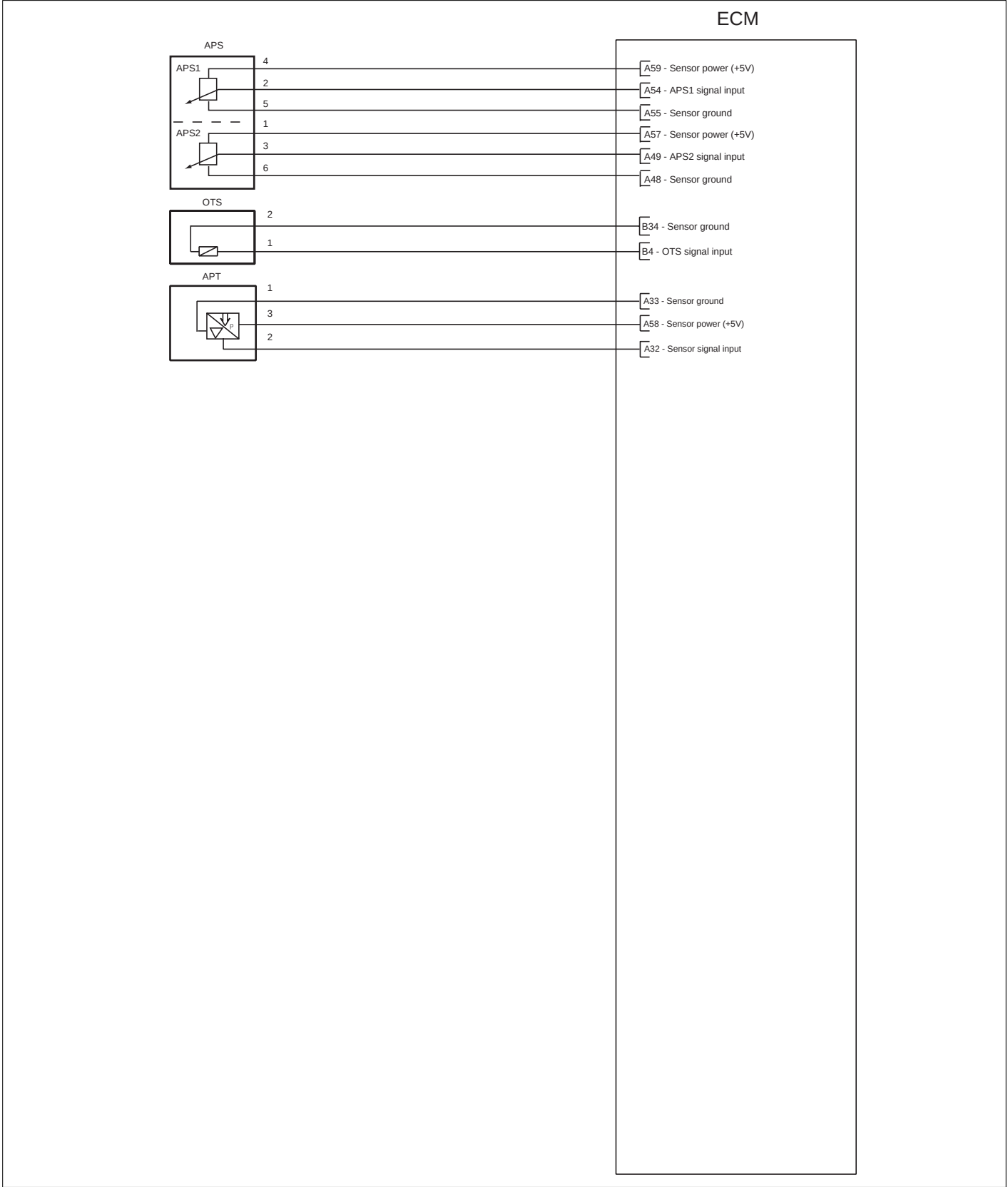
CIRCUIT DIAGRAM

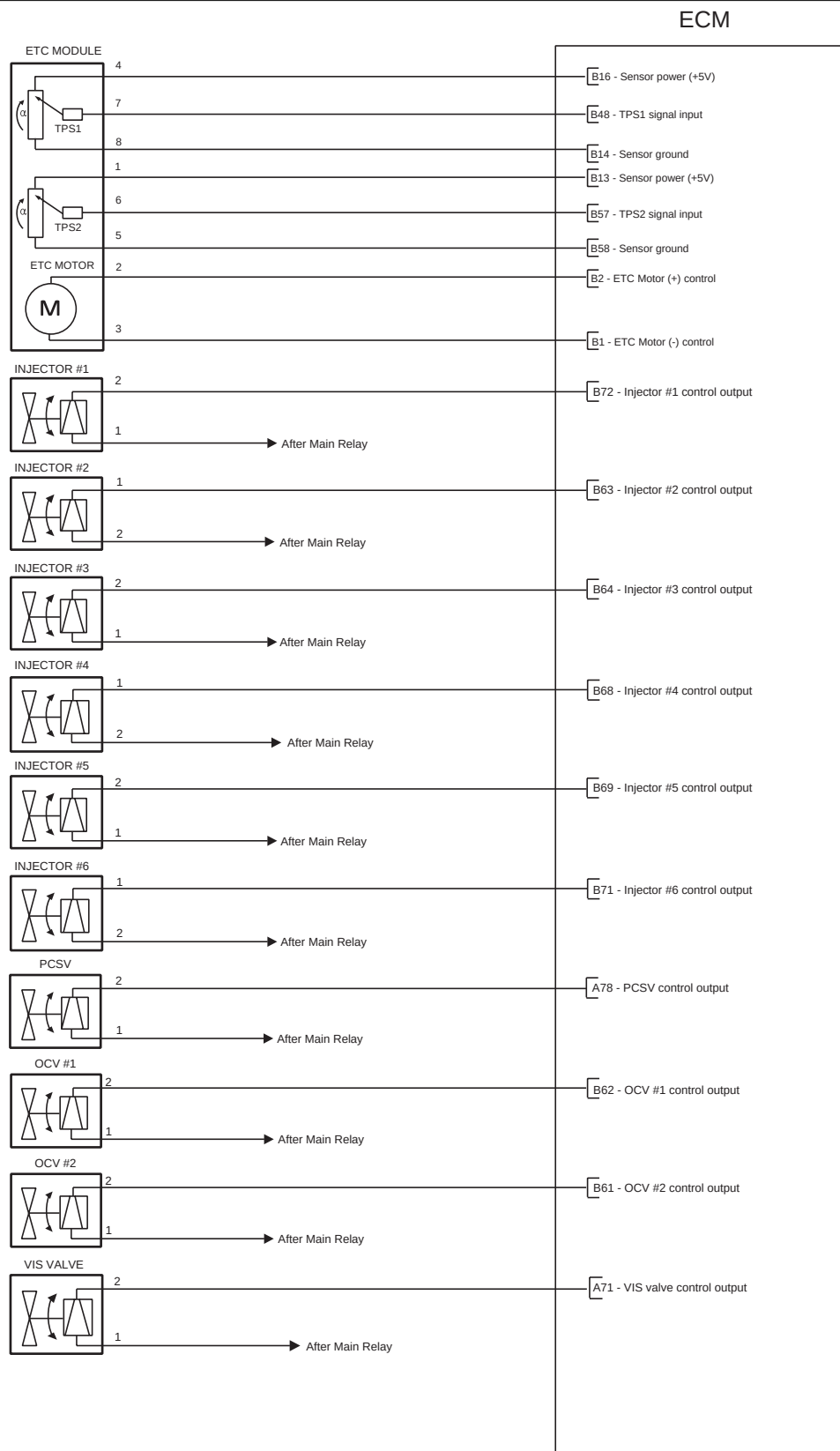
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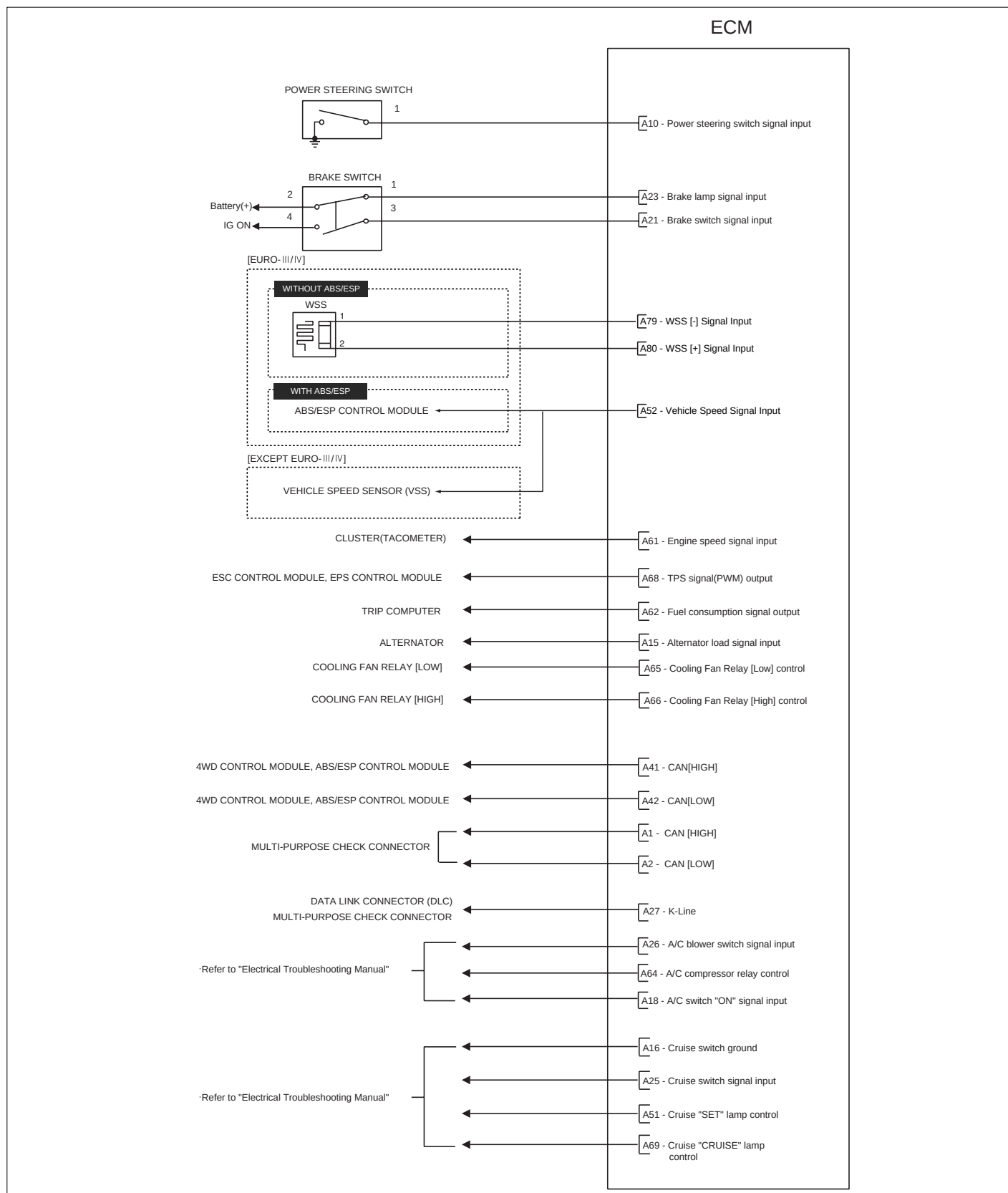


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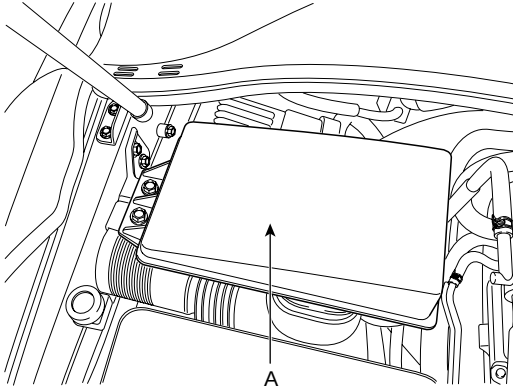






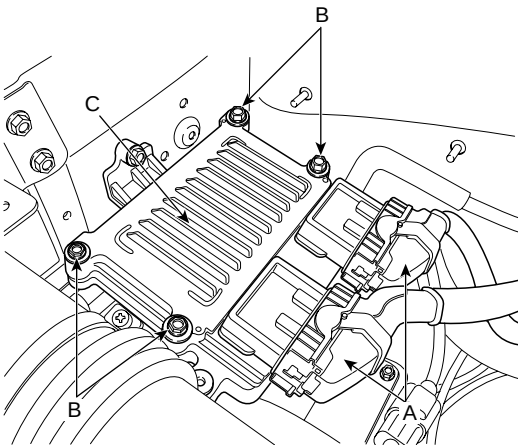
REPLACEMENT E6B880CE

1. Turn ignition switch off.
2. Disconnect the battery (-) cable from the battery.
3. Remove the resonator (A).



SBLF26222L

4. Disconnect the ECM connectors (A).



SBLF26223L

5. Unscrew the ECM mounting bolts (B) and remove the ECM from the bracket (C).
6. Install a new ECM

ECM installation bolts : 9.8 ~ 11.8 N·m (1.0 ~ 1.2 kgf·m, 7.2 ~ 8.7 lbf·ft)

ECM PROBLEM INSPECTION PROCEDURE EE79BF93

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 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 PCM.
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).

DTC TROUBLESHOOTING PROCEDURES

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC)

E63AF28D

DTC	Description	MIL			Page
		Euro-III/IV	Euro-II	Leaded	
P0012	A Camshaft Position-Timing Over-Retarded (Bank 1)	●	▲	▲	FLB - 85
P0016	Crankshaft Position-Camshaft Position Correlation (Bank 1 Sensor A)	●	▲	▲	FLB - 90
P0018	Crankshaft Position-Camshaft Position Correlation (Bank 2 Sensor A)	●	▲	▲	FLB - 97
P0022	A Camshaft Position-Timing Over-Retarded (Bank 2)	●	▲	▲	FLB - 85
P0026	Intake Valve Control Solenoid Circuit Range/Performance (Bank 1)	●	▲	▲	FLB - 101
P0028	Intake Valve Control Solenoid Circuit Range/Performance (Bank 2)	●	▲	▲	FLB - 101
P0030	HO2S Heater Control Circuit (Bank 1 / Sensor 1)	●			FLB - 108
P0031	HO2S Heater Circuit Low (Bank 1 / Sensor 1)	●	▲		FLB - 113
P0032	HO2S Heater Circuit High (Bank 1 / Sensor 1)	●	▲		FLB - 116
P0036	HO2S Heater Control Circuit (Bank 1 / Sensor 2)	●			FLB - 119
P0037	HO2S Heater Circuit Low (Bank 1 / Sensor 2)	●			FLB - 124
P0038	HO2S Heater Circuit High (Bank 1 / Sensor 2)	●			FLB - 127
P0050	HO2S Heater Control Circuit (Bank 2 / Sensor 1)	●			FLB - 130
P0051	HO2S Heater Circuit Low (Bank 2 / Sensor 1)	●	▲		FLB - 135
P0052	HO2S Heater Circuit High (Bank 2 / Sensor 1)	●	▲		FLB - 138
P0056	HO2S Heater Control Circuit (Bank 2 / Sensor 2)	●			FLB - 141
P0057	HO2S Heater Circuit Low (Bank 2 / Sensor 2)	●			FLB - 146
P0058	HO2S Heater Circuit High (Bank 2 / Sensor 2)	●			FLB - 149
P0076	Intake Valve Control Solenoid Circuit Low (Bank 1)	●	▲	▲	FLB - 152
P0077	Intake Valve Control Solenoid Circuit High (Bank 1)	●	▲	▲	FLB - 158
P0082	Intake Valve Control Solenoid Circuit Low (Bank 2)	●	▲	▲	FLB - 152
P0083	Intake Valve Control Solenoid Circuit High (Bank 2)	●	▲	▲	FLB - 158
P0101	Mass or Volume Air Flow Circuit Range/Performance	●	▲	▲	FLB - 161
P0102	Mass or Volume Air Flow Circuit Low Input	●	●	●	FLB - 165
P0103	Mass or Volume Air Flow Circuit High Input	●	●	●	FLB - 170

DTC	Description	MIL			Page
		Euro-III/IV	Euro-II	Leaded	
P0105	Manifold Absolute Pressure/Barometric Pressure Circuit	▲			FLB - 173
P0106	Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance	▲			FLB - 177
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input	●	●	●	FLB - 180
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input	●	●	●	FLB - 184
P0110	Intake Air Temperature Sensor1 Circuit	▲			FLB - 188
P0111	Intake Air Temperature Sensor1 Circuit Range/Performance	▲			FLB - 193
P0112	Intake Air Temperature Sensor1 Circuit Low Input	●	▲	▲	FLB - 196
P0113	Intake Air Temperature Sensor1 Circuit High Input	●	▲	▲	FLB - 200
P0116	Engine Coolant Temperature Circuit Range/Performance	▲			FLB - 205
P0117	Engine Coolant Temperature Circuit Low Input	●	●	●	FLB - 210
P0118	Engine Coolant Temperature Circuit High Input	●	●	●	FLB - 214
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input	●	●	●	FLB - 219
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	●	●	●	FLB - 225
P0131	HO2S Circuit Low Voltage (Bank 1 / Sensor 1)	●	▲		FLB - 229
P0132	HO2S Circuit High Voltage (Bank 1 / Sensor 1)	●	▲		FLB - 236
P0133	HO2S Circuit Slow Response (Bank 1 / Sensor 1)	●			FLB - 239
P0134	HO2S Circuit No Activity Detected (Bank 1 / Sensor 1)	●	▲		FLB - 241
P0137	HO2S Circuit Low Voltage (Bank 1 / Sensor 2)	●			FLB - 244
P0138	HO2S Circuit High Voltage (Bank 1 / Sensor 2)	●			FLB - 251
P0140	HO2S Circuit No Activity Detected (Bank 1 / Sensor 2)	●			FLB - 254
P0151	HO2S Circuit Low Voltage (Bank 2 / Sensor 1)	●	▲		FLB - 258
P0152	HO2S Circuit High Voltage (Bank 2 / Sensor 1)	●	▲		FLB - 265
P0153	HO2S Circuit Slow Response (Bank 2 / Sensor 1)	●			FLB - 268
P0154	HO2S Circuit No Activity Detected (Bank 2 / Sensor 1)	●	▲		FLB - 270
P0157	HO2S Circuit Low Voltage (Bank 2 / Sensor 2)	●			FLB - 273
P0158	HO2S Circuit High Voltage (Bank 2 / Sensor 2)	●			FLB - 280
P0160	HO2S Circuit No Activity Detected (Bank 2 / Sensor 2)	●			FLB - 283
P0171	System Too Lean (Bank 1)	●	▲		FLB - 286
P0172	System Too Rich (Bank 1)	●	▲		FLB - 290
P0174	System Too Lean (Bank 2)	●	▲		FLB - 286
P0175	System Too Rich (Bank 2)	●	▲		FLB - 290

DTC TROUBLESHOOTING PROCEDURES

FLB -81

DTC	Description	MIL			Page
		Euro-III/IV	Euro-II	Leaded	
P0196	Engine Oil Temperature Sensor Range / Performance	▲			FLB - 293
P0197	Engine Oil Temperature Sensor Low Input	●	▲	▲	FLB - 297
P0198	Engine Oil Temperature Sensor High Input	●	▲	▲	FLB - 300
P0217	Engine Coolant Over Temperature Condition	▲			FLB - 304
P0222	Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input	●	●	●	FLB - 308
P0223	Throttle/Pedal Position Sensor/Switch "B" Circuit High Input	●	●	●	FLB - 315
P0230	Fuel Pump Primary Circuit	▲	▲	▲	FLB - 319
P0261	Cylinder 1-Injector Circuit Low	●	●	●	FLB - 325
P0262	Cylinder 1-Injector Circuit High	●	●	●	FLB - 331
P0264	Cylinder 2-Injector Circuit Low	●	●	●	FLB - 325
P0265	Cylinder 2-Injector Circuit High	●	●	●	FLB - 331
P0267	Cylinder 3-Injector Circuit Low	●	●	●	FLB - 325
P0268	Cylinder 3-Injector Circuit High	●	●	●	FLB - 331
P0270	Cylinder 4-Injector Circuit Low	●	●	●	FLB - 325
P0271	Cylinder 4-Injector Circuit High	●	●	●	FLB - 331
P0273	Cylinder 5-Injector Circuit Low	●	●	●	FLB - 325
P0274	Cylinder 5-Injector Circuit High	●	●	●	FLB - 331
P0276	Cylinder 6-Injector Circuit Low	●	●	●	FLB - 325
P0277	Cylinder 6-Injector Circuit High	●	●	●	FLB - 331
P0300	Random/Multiple Cylinder Misfire Detected	●			FLB - 334
P0301	Cylinder 1-Misfire Detected	●			FLB - 334
P0302	Cylinder 2-Misfire Detected	●			FLB - 334
P0303	Cylinder 3-Misfire Detected	●			FLB - 334
P0304	Cylinder 4-Misfire Detected	●			FLB - 334
P0305	Cylinder 5-Misfire Detected	●			FLB - 334
P0306	Cylinder 6-Misfire Detected	●			FLB - 334
P0315	Segment Time Acquisition Incorrect	▲			FLB - 340
P0325	Knock Sensor 1 Circuit	▲	▲	▲	FLB - 343
P0326	Knock Sensor 1 Circuit Range/Performance (Bank 1)	▲	▲	▲	FLB - 347
P0330	Knock Sensor 2 Circuit	▲	▲	▲	FLB - 349
P0331	Knock Sensor 2 Circuit Range/Performance (Bank 2)	▲	▲	▲	FLB - 353
P0335	Crankshaft Position Sensor "A" Circuit	●	▲	▲	FLB - 355

DTC	Description	MIL			Page
		Euro-III/IV	Euro-II	Leaded	
P0336	Crankshaft Position Sensor "A" Circuit Range/Performance	●	▲	▲	FLB - 361
P0340	Camshaft Position Sensor "A" Circuit Malfunction (Bank 1 or Single Sensor)	●	▲	▲	FLB - 365
P0341	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 1 or Single Sensor)	●	▲	▲	FLB - 371
P0346	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 2)	●	▲	▲	FLB - 374
P0351	Ignition Coil "A" Primary / Secondary Circuit	●	▲	▲	FLB - 379
P0352	Ignition Coil "B" Primary / Secondary Circuit	●	▲	▲	FLB - 379
P0353	Ignition Coil "C" Primary / Secondary Circuit	●	▲	▲	FLB - 379
P0354	Ignition Coil "D" Primary / Secondary Circuit	●	▲	▲	FLB - 379
P0355	Ignition Coil "E" Primary / Secondary Circuit	●	▲	▲	FLB - 379
P0356	Ignition Coil "F" Primary / Secondary Circuit	●	▲	▲	FLB - 379
P0420	Catalyst System Efficiency below Threshold (Bank 1)	●			FLB - 387
P0430	Catalyst System Efficiency below Threshold (Bank 2)	●			FLB - 387
P0444	Evap. Emission System-Purge Ctrl. Valve Circuit Open	●			FLB - 390
P0445	Evap. Emission System-Purge Ctrl. Valve Circuit Shorted	●			FLB - 396
P0501	Vehicle Speed Sensor A Range/Performance	●	●	●	FLB - 399
P0504	Brake Switch "A"/"B" Correlation	●	▲	▲	FLB - 413
P0506	Idle Air Control System-RPM Lower Than Expected	●			FLB - 419
P0507	Idle Air Control System-RPM Higher Than Expected	●			FLB - 421
P0532	A/C Refrigerant Pressure Sensor "A" Circuit Low Input	▲	▲	▲	FLB - 422
P0533	A/C Refrigerant Pressure Sensor "A" Circuit High Input	▲	▲	▲	FLB - 428
P0562	System Voltage Low	●	▲	▲	FLB - 432
P0563	System Voltage High	●	▲	▲	FLB - 439
P0571	Brake Switch "A" Circuit	●	▲	▲	FLB - 443
P0601	EEPROM-Check Sum Error	●	▲	▲	FLB - 449
P0602	EEPROM-Programing Error	●	▲	▲	FLB - 452
P0604	Internal Control Module Random Access Memory (RAM) Error	●	▲	▲	FLB - 453
P0606	ECM/PCM Processor(ECM-SELF TEST Failed)	●	▲	▲	FLB - 454
P061B	Internal Control Module Torque Calculation Performance				FLB - 455
P0638	Throttle Actuator Control Range/Performance	●	▲	▲	FLB - 456
P0641	Sensor Reference Voltage "A" Circuit Open	●	▲	▲	FLB - 464
P0646	A/C Clutch Relay Control Circuit Low	▲	▲	▲	FLB - 469

DTC TROUBLESHOOTING PROCEDURES

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DTC	Description	MIL			Page
		Euro-III/IV	Euro-II	Leaded	
P0647	A/C Clutch Relay Control Circuit High	▲	▲	▲	FLB - 475
P0650	Malfunction Indicator Lamp(MIL) Control Circuit	▲			FLB - 478
P0651	Sensor Reference Voltage "B" Circuit Open	●	▲	▲	FLB - 483
P0660	Intake Manifold Tuning Valve Control Circuit/Open (Bank 1)	●	▲	▲	FLB - 488
P0685	ECM/PCM Power Relay Control Circuit /Open	▲	▲	▲	FLB - 493
P1106	Manifold Absolute Pressure Sensor Circuit Short - Intermittent High Input	▲	▲	▲	FLB - 499
P1107	Manifold Absolute Pressure Sensor Circuit Short - Intermittent Low Input	▲	▲	▲	FLB - 506
P1111	Intake Air Temperature Sensor Circuit Short - Intermittent High Input	▲	▲	▲	FLB - 510
P1112	Intake Air Temperature Sensor Circuit Short - Intermittent Low Input	▲	▲	▲	FLB - 517
P1114	Engine Coolant Temperature Sensor Circuit -Intermittent Low Input	▲	▲	▲	FLB - 521
P1115	Engine Coolant Temperature Sensor Circuit - Intermittent High Input	▲	▲	▲	FLB - 527
P1295	ETC (Electronic Throttle Control) System Malfunction - Power Management	●	●	●	FLB - 531
P1523	ETC (Electronic Throttle Control) System Malfunction - Throttle Valve Stuck	▲	▲	▲	FLB - 534
P2104	ETC (Electronic Throttle Control) System Malfunction - Forced Idle	●	●	●	FLB - 539
P2105	ETC (Electronic Throttle Control) System Malfunction - Forced Engine Shutdown	●	●	●	FLB - 542
P2106	ETC (Electronic Throttle Control) System Malfunction - Forced Limited Power	●	●	●	FLB - 544
P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input	●	▲	▲	FLB - 546
P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input	●	▲	▲	FLB - 552
P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input	●	▲	▲	FLB - 555
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High Input	●	▲	▲	FLB - 559
P2135	Throttle/Pedal Position Sensor/Switch "A" / "B" Voltage Correlation	●	▲	▲	FLB - 562
P2138	Throttle/Pedal Position Sensor/Switch "D" / "E" Voltage Correlation	●	▲	▲	FLB - 568
P2173	ETC (Electronic Throttle Control) System Malfunction - High Air flow Detected	●	▲	▲	FLB - 574
P2187	System Too Lean at Idle (←Additive) (Bank 1)	●	▲		FLB - 579
P2188	System Too Rich at Idle (Bank 1)	●	▲		FLB - 583
P2189	System Too Lean at Idle (←Additive) (Bank 2)	●	▲		FLB - 579

DTC	Description	MIL			Page
		Euro-III/IV	Euro-II	Leaded	
P2190	System Too Rich at Idle (Bank 2)	●	▲		FLB - 583
P2195	HO2S Signal Stuck Lean (Bank 1 / Sensor 1)	●	▲		FLB - 586
P2196	HO2S Signal Stuck Rich (Bank 1 / Sensor 1)	●	▲		FLB - 592
P2197	HO2S Signal Stuck Lean (Bank 2 / Sensor 1)	●	▲		FLB - 594
P2198	HO2S Signal Stuck Rich (Bank 2 / Sensor 1)	●	▲		FLB - 600
P2270	HO2S Signal Stuck Lean (Bank 1 / Sensor 2)	●			FLB - 602
P2271	HO2S Signal Stuck Rich (Bank 1 / Sensor 2)	●			FLB - 608
P2272	HO2S Signal Stuck Lean (Bank 2 / Sensor 2)	●			FLB - 610
P2273	HO2S Signal Stuck Rich (Bank 2 / Sensor 2)	●			FLB - 616
P2507	ECM/PCM Power Input Signal Low	●	▲	▲	FLB - 618
P2610	ECM/PCM Internal Engine Off Timer Performance	●	▲	▲	FLB - 622
U0001	CAN Communication Malfunction	●	▲	▲	FLB - 625
U0101	Serial Communication Problem with TCU (Timeout)	●	▲	▲	FLB - 633



NOTE

- : MIL ON & MEMORY
▲ : MIL OFF & MEMORY

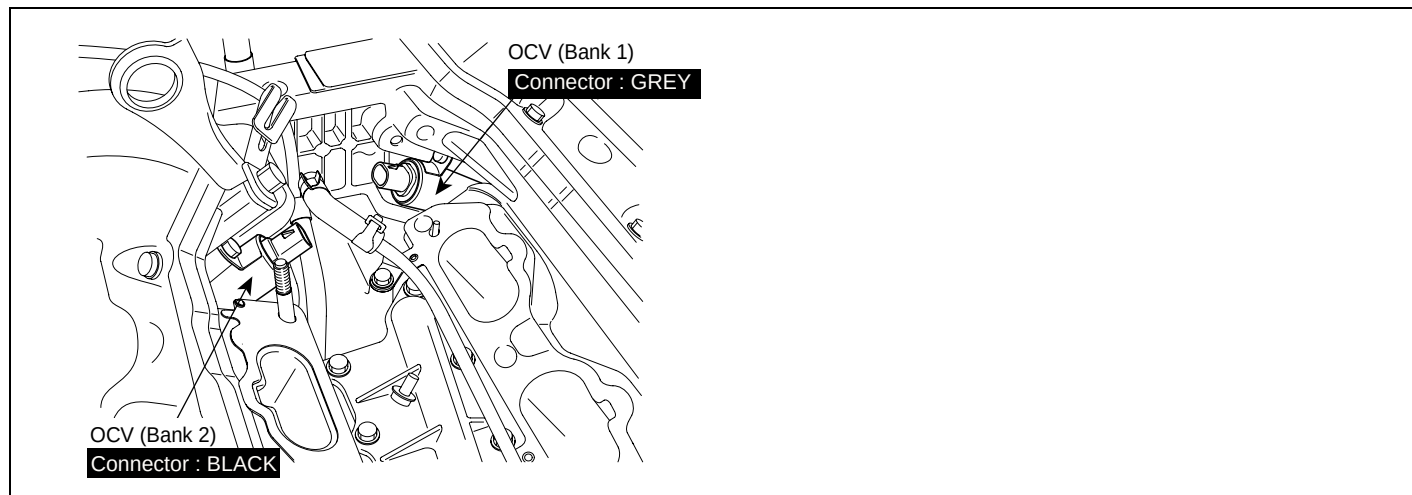
DTC TROUBLESHOOTING PROCEDURES

FLB -85

DTC P0012	"A" CAMSHAFT POSITION-TIMING OVER-RETARDED (BANK 1)
DTC P0022	"A" CAMSHAFT POSITION-TIMING OVER-RETARDED (BANK 2)

COMPONENT LOCATION

E555F638



EGRF600A

GENERAL DESCRIPTION

ED8BCBE5

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC DESCRIPTION

E95193A1

ECM monitors CAM phaser error while CMP signal is normally generating and vehicle is driving in 2000 ~ 3000rpm .If the CAM phaser does not move although ECM commands OCV duty cycle ECM determines that a fault exists and a DTC is stored.

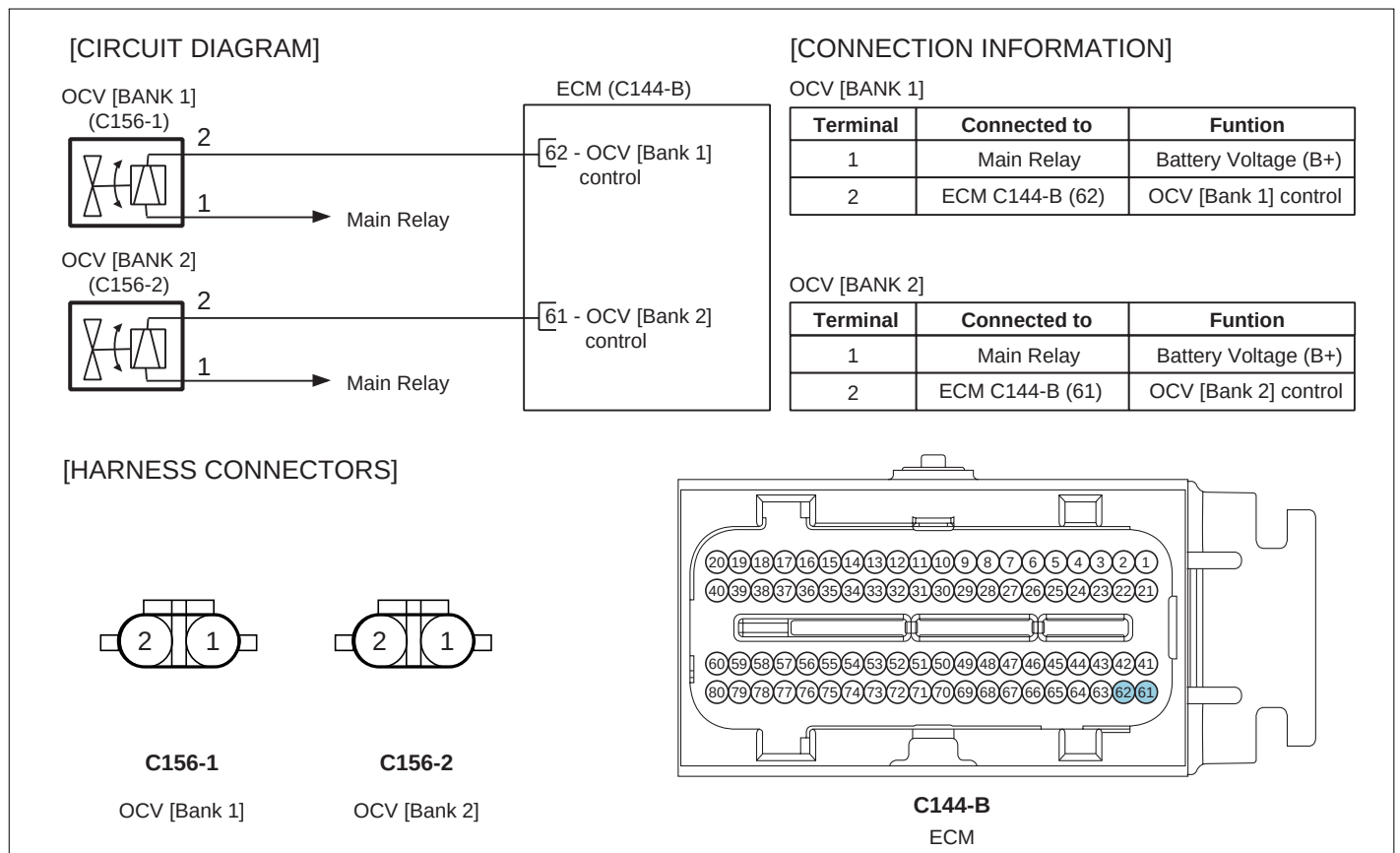
DTC DETECTING CONDITION

E96AB0BA

Item		Detecting Condition	Possible cause
DTC Strategy		Determines if the phaser is stuck or has steady-state error	- Engine Oil - OCV stuck - CVVT stuck
Enable Conditions		- CAM signal is normally generating - Vehicle is on driving (2000 ~ 3000RPM) for 5 minutes.	
Thresh old value	Case 1	5 CAD < Cam Actual Position < 50 CAD - Duty Cycle > 90% or Duty Cycle < 10%	
	Case 2	- Cam Position error > 15 CAD(Difference between Actual Postion and Desire Position is more than 15°) - Timing Counter > 80	
Diagnosis Time		Continuous (within 5min.)	
MIL On Condition		2 Driving Cycles	

SCHEMATIC DIAGRAM

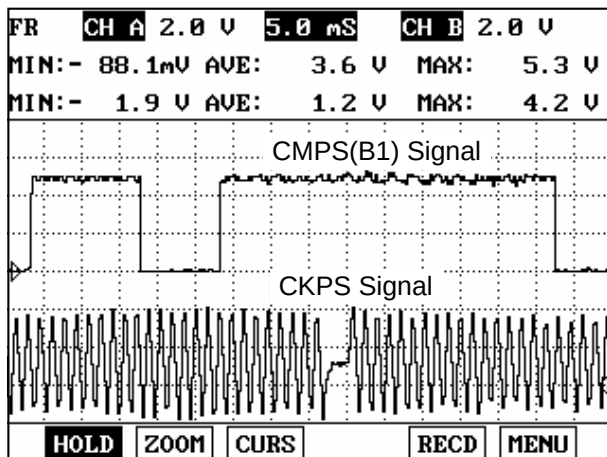
EE34202E



SBLF26210L

SIGNAL WAVEFORM AND DATA

EB9C1898



This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle. If the 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

SBLF26724L

MONITOR DTC STATUS

EF3A34BE

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select ""Diagnostic Trouble Codes(DTCs)"" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "System Inspection" procedure.

NO

► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable codition then, go to "System Inspection" procedure.

SYSTEM INSPECTION

ECA48E24

1. Visual Inspection

- 1) Check oil level is O.K.
- 2) Check Oil and OCV is contaminated
- 3) Has a problem been found ?

YES

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO

► Go to "Component Inspection" procedure.

COMPONENT INSPECTION

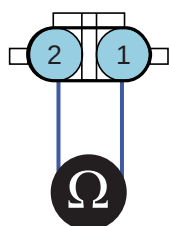
EAEA0876

1. Check OCV resistance

- 1) IG "OFF" and disconnect OCV connector.
- 2) Measure resistance between terminal 1 and 2 of OCV. (Component Side)

SPECIFICATION :

Resistance (Ω)	6.7 ~ 7.7



1. OCV Power
2. OCV Control

SBLF26999L

- 3) Is the measured resistance within specification ?

YES

► Go to "Check CAM PHASER with actuation test" as follows.

NO

► Substitute with a known - good OCV and check for proper operation.
If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

2. Check CAM PHASER with actuation test

- 1) Connect scantool and IG "ON"
- 2) Select "CAM PHASER INTAKE BANK 1" on the Actuation Test

DTC TROUBLESHOOTING PROCEDURES

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- 3) Select "OIL CONTROL VALVE" on the Actuation Test
- 4) Activates "CAM PHASER INTAKE BANK 1" by pressing "STRT(F1)" key
- 5) Activates "OIL CONTROL VALVE" by pressing "STRT(F1)" key
- 6) Repeat this procedure 4 or 5 times to ensure CAM PHASER and intake valve control solenoid reliability

1.4 ACTUATION TEST		24/29
CAM PHASER INTAKE BANK 1		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE RUNNING	
PRESS [STRT], IF YOU ARE READY ! SELECT TEST ITEM USING UP/DOWN KEY		
STRT STOP		

1.11 ACTUATION TEST		12/25
OIL CONTROL VALVE		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE OFF	
PRESS [STRT], IF YOU ARE READY ! SELECT TEST ITEM USING UP/DOWN KEY		
STRT STOP		

SEPFL6403N

- 7) Has a problem been found ?

YES

- Substitute with a known - good CVVT or OCV and check for proper operation.
If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO

- Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E18EE670

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

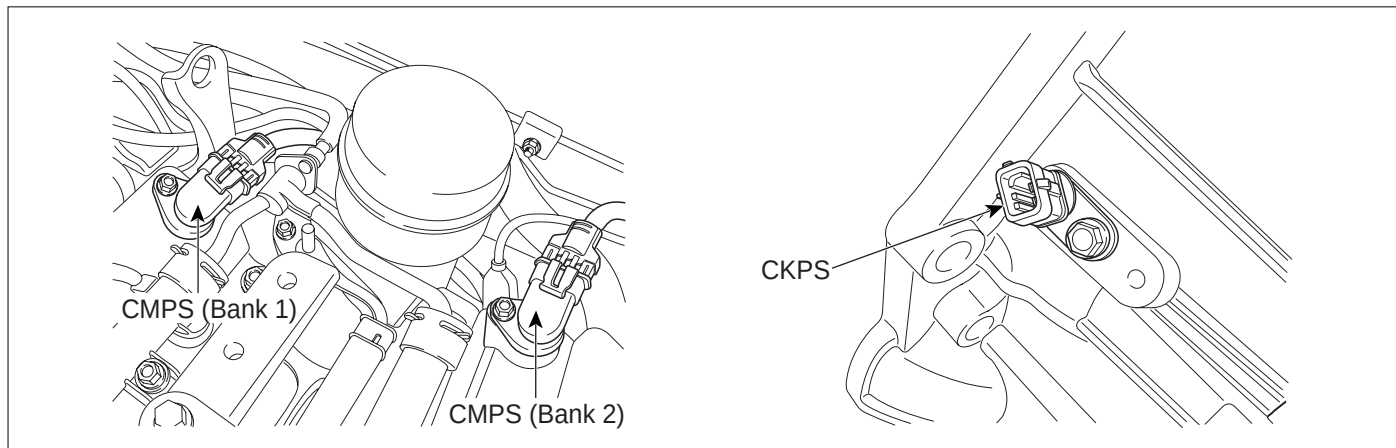
- System performing to specification at this time. Clear the DTC

NO

- Go to the applicable troubleshooting procedure.

DTC P0016 CRANKSHAFT POSITION-CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR A)

COMPONENT LOCATION EA8BF2A1



SBLF26725L

GENERAL DESCRIPTION EC6CBD23

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC DESCRIPTION E2259458

ECM monitors timing misalignment while no active faults is present and fully warmed up engine oil at idle. If the timing is misaligned ECM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E487E04B

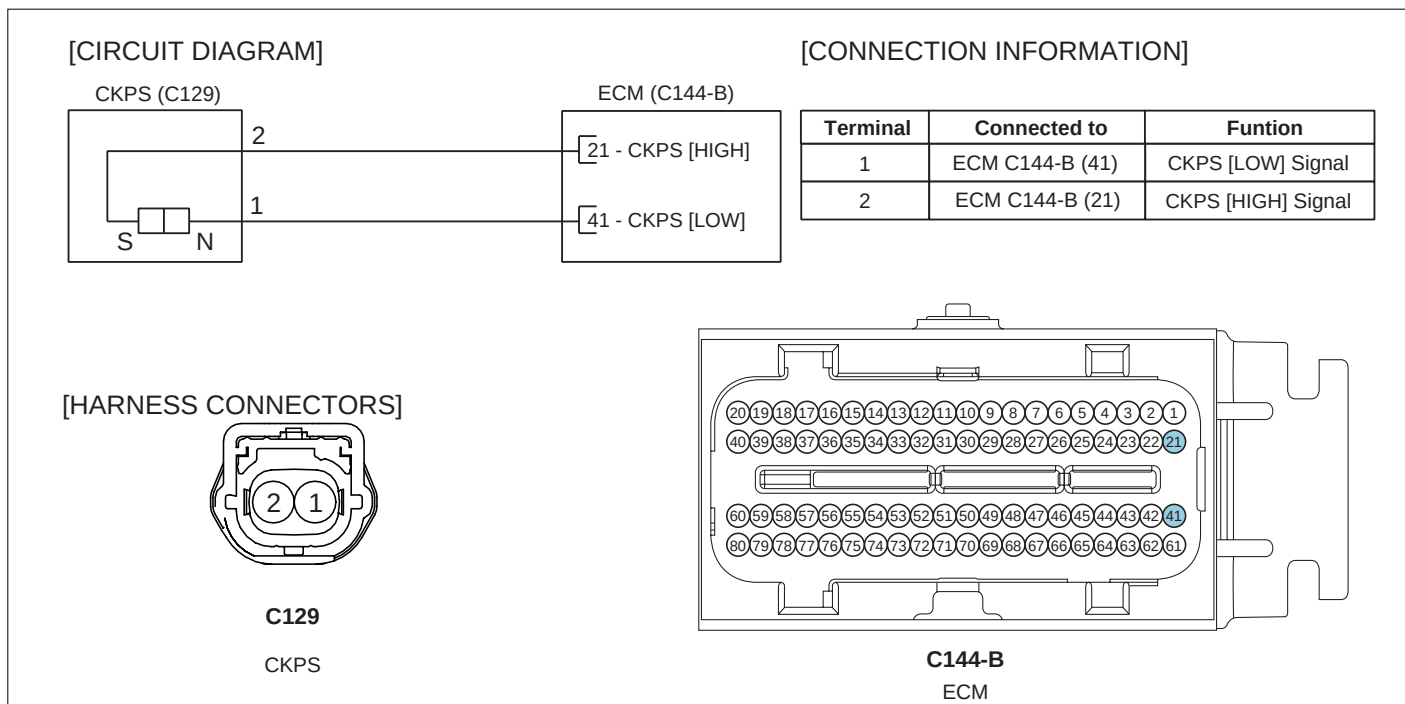
Item		Detecting Condition	Possible cause
DTC Strategy		Determines if CAM target is aligned correctly to crank	- Loosened CKPS - Timing Misalignment
Enable Conditions		- No active faults - Fully warmed up at idle	
Thresh old value	Case 1	1 teeth misalignment at 80 °C(176 °F) < Oil Temperature < 90 °C(194°F)	
	Case 2	2 tooth misalignment at Lower than 80 °C(176 °F) or Higher than 90 °C(194°F)	
Diagnosis Time		Continuous (Within 1min.)	
MIL On Condition		2 driving Cycles	

DTC TROUBLESHOOTING PROCEDURES

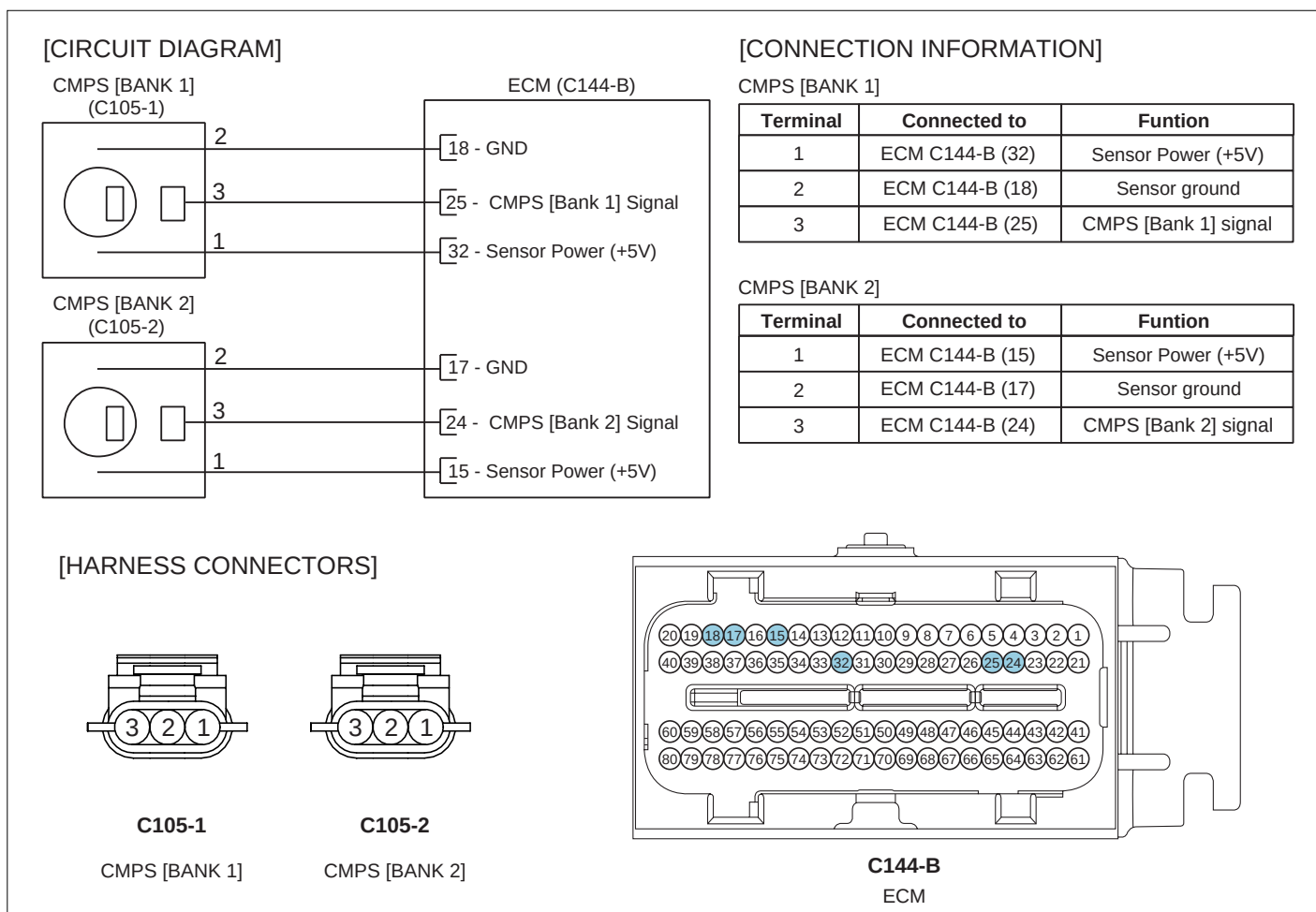
FLB -91

SCHEMATIC DIAGRAM

ECCEF345



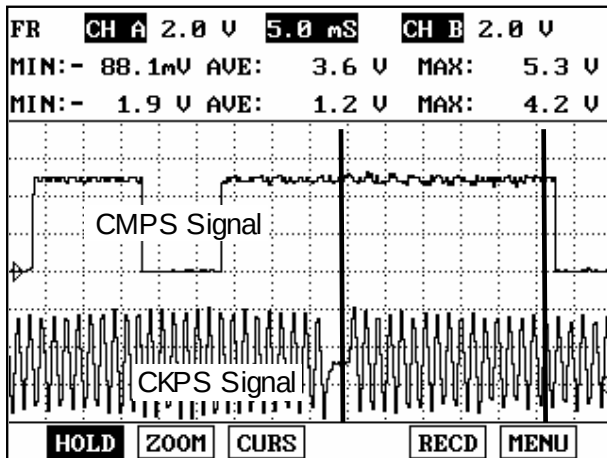
SBLF26206L



SBLF26205L

SIGNAL WAVEFORM AND DATA

E9E4B1E1



This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle. If the 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

SBLF26994L

MONITOR DTC STATUS

E4F1BAE9

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select ""Diagnostic Trouble Codes(DTCs)"" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "System Inspection" procedure.

NO

► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable codition then, go to " System Inspection" procedure.

SYSTEM INSPECTION EA24F583

1. Visual Inspection

- 1) Check oil level is O.K.
- 2) Check Oil and OCV is contaminated
- 3) Has a problem been found ?

YES

► Repair or replace as necessary and then, go to " Verification of Vehicle Repair" procedure.

NO

► Go to "Visually check CKPS and target wheel" as follow.

2. Visually check CKPS and target wheel

- 1) IG "OFF"
- 2) Visually check CKPS is loosened or target wheel is deformed or damaged.
- 3) Is the above items normal ?

YES

► Go to "Check CAM PHASER with actuation test" as follows.

NO

► Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

3. Check CAM PHASER with actuation test

- 1) Connect scantool and IG "ON"
- 2) Select "CAM PHASER INTAKE BANK 1" on the Actuation Test
- 3) Select "OIL CONTROL VALVE" on the Actuation Test
- 4) Activates "CAM PHASER INTAKE BANK 1" by pressing "STRT(F1)" key
- 5) Activates "OIL CONTROL VALVE" by pressing "STRT(F1)" key
- 6) Repeat this procedure 4 or 5 times to ensure CAM PHASER and intake valve control solenoid reliability

1.4 ACTUATION TEST		24/29
CAM PHASER INTAKE BANK 1		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE RUNNING	
PRESS [STRT], IF YOU ARE READY ! SELECT TEST ITEM USING UP/DOWN KEY		
STRT STOP		

1.11 ACTUATION TEST		12/25
OIL CONTROL VALVE		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE OFF	
PRESS [STRT], IF YOU ARE READY ! SELECT TEST ITEM USING UP/DOWN KEY		
STRT STOP		

SEPFL6403N

7) Has a problem been found ?

YES

► Substitute with a known - good CVVT or OCV and check for proper operation.
If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO

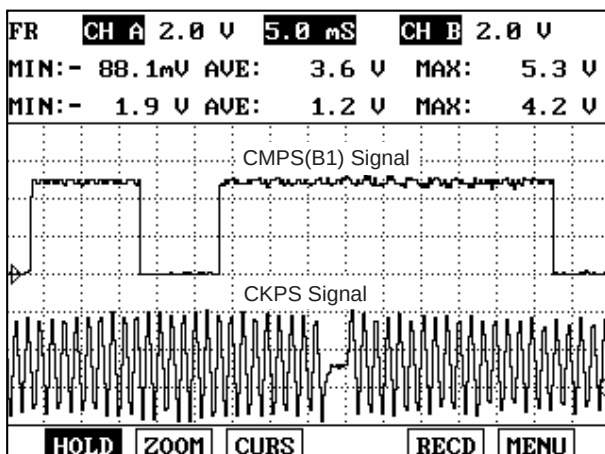
► Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Component Inspection" procedure.

COMPONENT INSPECTION E6A8CF3D

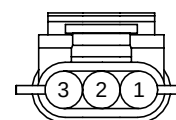
1. CMPS, CKPS Inspection

- 1) IG "OFF" and connect scantool.
- 2) ENG "ON" and Measure signal waveform at terminal 3 of CMPS.
- 3) Measure signal waveform at terminal 1 or 2 of CKPS.

Specification : 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

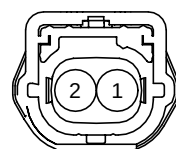


CMPS



1. Sensor Power
2. Sensor Ground
3. CMPS Signal

CKPS



1. CKPS Signal LOW
2. CKPS Signal HIGH

SEPFL6404N

DTC TROUBLESHOOTING PROCEDURES

FLB -95

4) Is the measured signal waveform O.K ?

YES

► Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

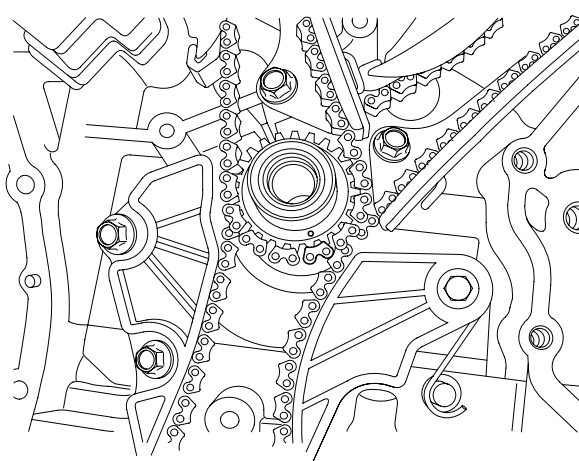
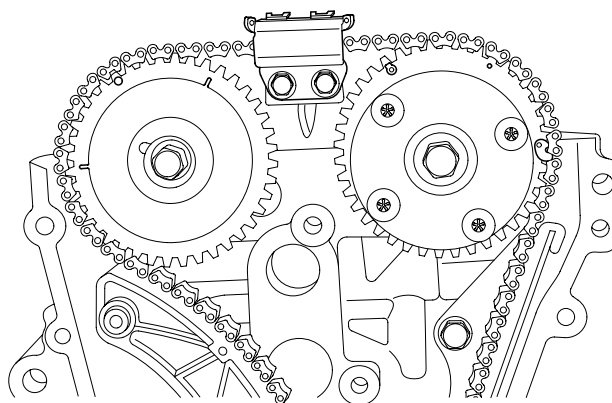
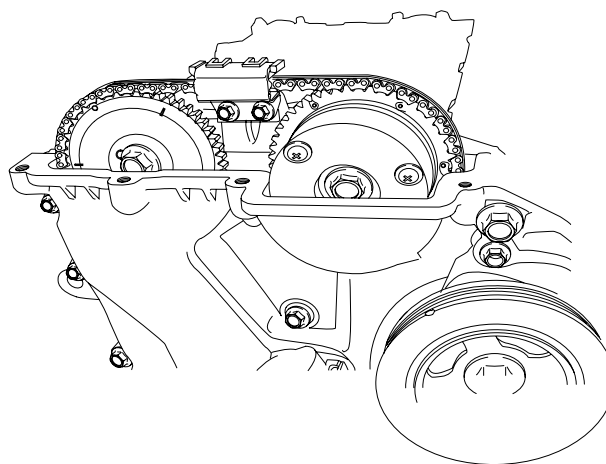
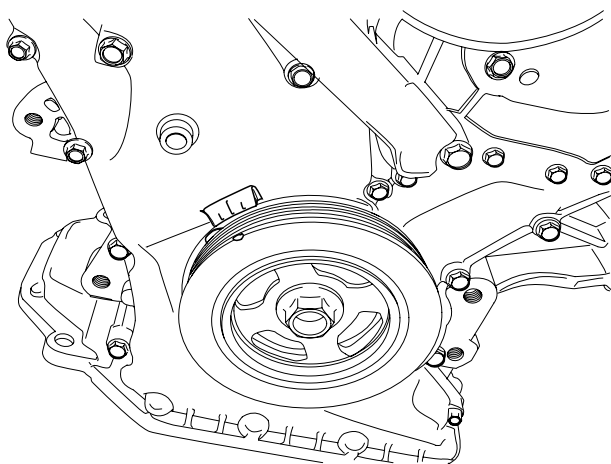
NO

► Go to "Timing Mark Inspection" procedure as follow.

2. Timing Mark Inspection.

1) IG "OFF" and check the timing mark is correctly aligned.

REFERENCE :



KGRF305C

2) Is the timing mark correctly aligned ?

YES

► Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

NO

- Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E32526EF

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- System performing to specification at this time. Clear the DTC

NO

- Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -97

DTC P0018 CRANKSHAFT POSITION-CAMSHAFT POSITION CORRELATION (BANK 2 SENSOR A)

COMPONENT LOCATION E7B8C3C8

Refer to DTC P0016.

GENERAL DESCRIPTION E2758C97

Refer to DTC P0016.

DTC DESCRIPTION E5E0AB60

ECM monitors timing misalignment while no active faults is present and fully warmed up engine oil at idle. If the timing is misaligned ECM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E57D87C2

Item		Detecting Condition	Possible cause
DTC Strategy		Determines if CAM target is aligned correctly to crank	- Loosened CKPS - Timing Misalignment
Enable Conditions		- No active faults - Fully warmed up at idle	
Thresh old value	Case 1	1 teeth misalignment at 80 °C(176 °F) < Oil Temperature < 90 °C(194°F)	
	Case 2	2 tooth misalignment at Lower than 80 °C(176 °F) or Higher than 90 °C(194°F)	
Diagnosis Time		Continuous (Within 1min.)	
MIL On Condition		2 driving Cycles	

SCHEMATIC DIAGRAM E26906F6

Refer to DTC P0016.

SIGNAL WAVEFORM AND DATA EBD60282

Refer to DTC P0016.

MONITOR DTC STATUS EC1924BC

Refer to DTC P0016.

SYSTEM INSPECTION E3714F05

- Visual Inspection
 - Check oil level is O.K.
 - Check Oil and OCV is contaminated

3) Has a problem been found ?

YES

► Repair or replace as necessary and then, go to " Verification of Vehicle Repair" procedure.

NO

► Go to "Visually check CKPS and target wheel" as follow.

2. Visually check CKPS and target wheel

1) IG "OFF"

2) Visually check CKPS is loosened or target wheel is deformed or damaged.

3) Is the above items normal ?

YES

► Go to "Check CAM PHASER with actuation test" as follows.

NO

► Repair or replace as necessary and then go to"Verification of Vehicle Repair" procedure.

3. Check CAM PHASER with actuation test

1) Connect scantool and IG "ON"

2) Select "CAM PHASER INTAKE BANK 1" on the Actuation Test

3) Select "OIL CONTROL VALVE" on the Actuation Test

4) Activates "CAM PHASER INTAKE BANK 1" by pressing "STRT(F1)" key

5) Activates "OIL CONTROL VALVE" by pressing "STRT(F1)" key

6) Repeat this procedure 4 or 5 times to ensure CAM PHASER and intake valve control solenoid reliability

1.4 ACTUATION TEST		24/29
CAM PHASER INTAKE BANK 2		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE RUNNING	
PRESS [STRT], IF YOU ARE READY ! SELECT TEST ITEM USING UP/DOWN KEY		
[STRT] [STOP]		

1.11 ACTUATION TEST		12/25
OIL CONTROL VALVE		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE OFF	
PRESS [STRT], IF YOU ARE READY ! SELECT TEST ITEM USING UP/DOWN KEY		
[STRT] [STOP]		

SEPFL6407N

7) Has a problem been found ?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -99

- Substitute with a known - good CVVT or OCV and check for proper operation.
If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO

- Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Component Inspection" procedure.

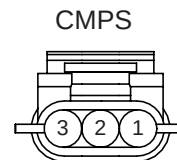
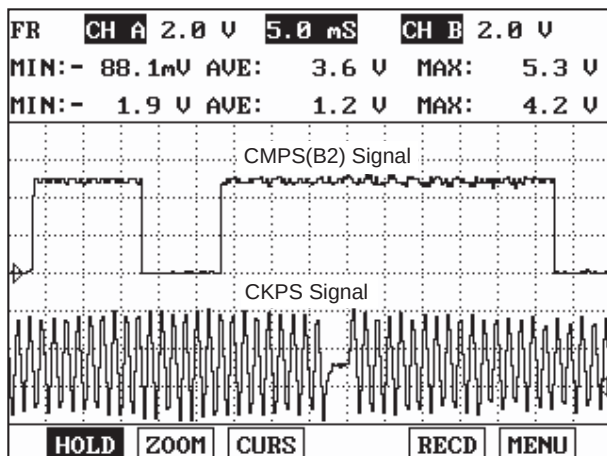
COMPONENT INSPECTION

EB02BEA3

1. CMPS, CKPS Inspection

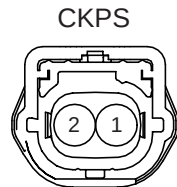
- 1) IG "OFF" and connect scantool.
- 2) ENG "ON" and Measure signal waveform at terminal 3 of CMPS.
- 3) Measure signal waveform at terminal 1 or 2 of CKPS.

Specification : 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.



CMPS

1. Sensor Power
2. Sensor Ground
3. CMPS Signal



CKPS

1. CKPS Signal LOW
2. CKPS Signal HIGH

SEPFL6408N

- 4) Is the measured signal waveform O.K ?

YES

- Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

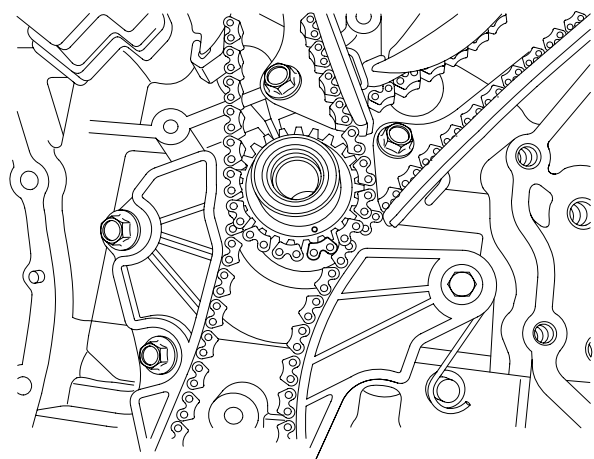
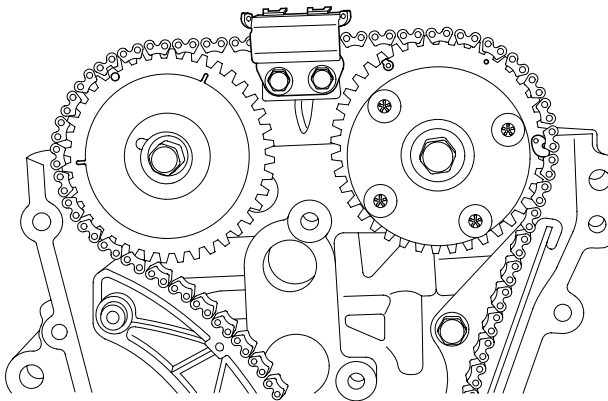
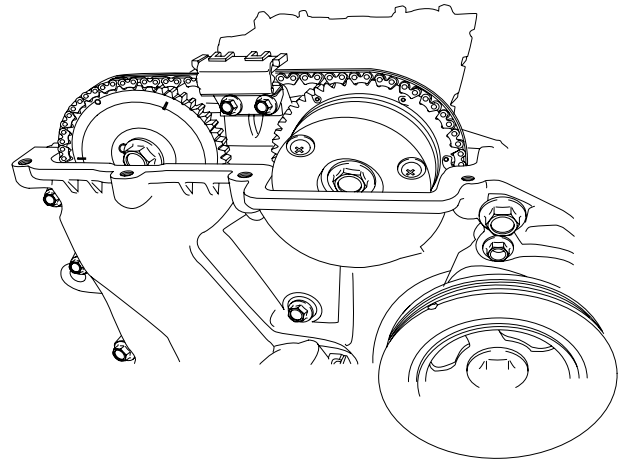
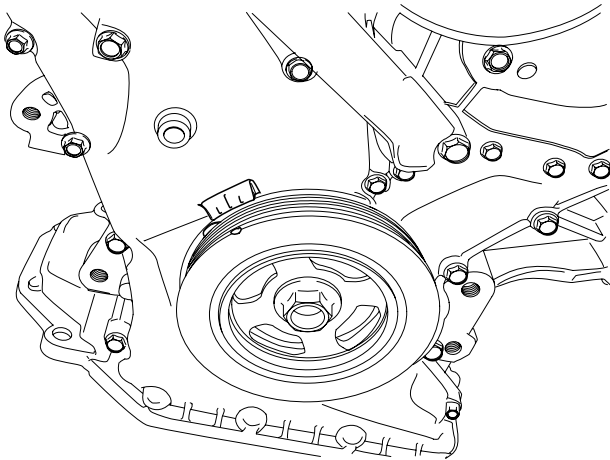
NO

- Go to "Timing Mark Inspection" procedure as follow.

2. Timing Mark Inspection.

- 1) IG "OFF" and check the timing mark is correctly aligned.

REFERENCE :



KGRF305C

2) Is the timing mark correctly aligned ?

YES

► Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

NO

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

EE368F9C

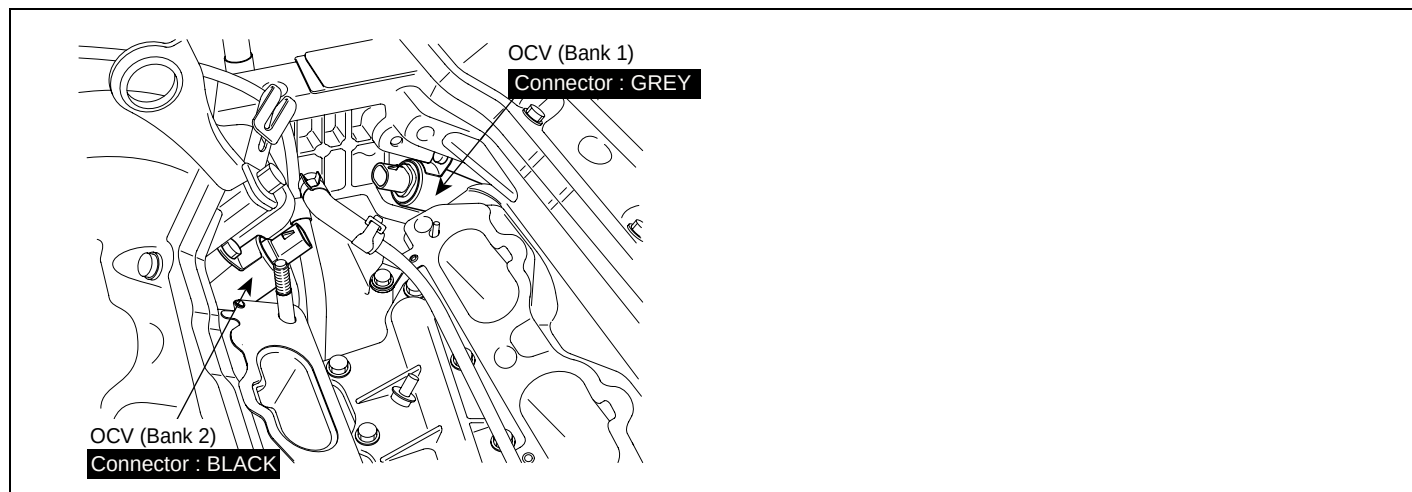
Refer to DTC P0016.

DTC TROUBLESHOOTING PROCEDURES

FLB -101

**DTC P0026 INTAKE VALVE CONTROL SOLENOID
CIRCUIT RANGE/PERFORMANCE (BANK 1)**
**DTC P0028 INTAKE VALVE CONTROL SOLENOID CIRCUIT
RANGE/PERFORMANCE (BANK 2)**

COMPONENT LOCATION E2CB1FF4



EGRF600A

GENERAL DESCRIPTION E03E9921

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC DESCRIPTION E80934FB

ECM monitors OCV stuck while cam sinal is normally generating and Valve cleaning is not in progress. If the CAM Acutal Position is too high or low and Difference between Cam Actual Position and Desire Position is higher than 20° ECM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION

EC941594

Item		Detecting Condition	Possible cause
DTC Strategy		Determines if oil control valve is stuck	- Oil Pressure Loss - OCV seizure
Enable Conditions		- Valve cleaning not in progress - CAM signal is normally generating	
Thresh old value	Case 1	Cam Actual Position > 50 CAD or Difference between CAM Actual Position and Desire Position > 20 CAD	
	Case 2	Cam Actual Position < 5 CAD or Difference between CAM Actual Position and Desire Position > 20 CAD	
Diagnosis Time		Continuous (Within 1min.)	
MIL On Condition		2 driving Cycle	

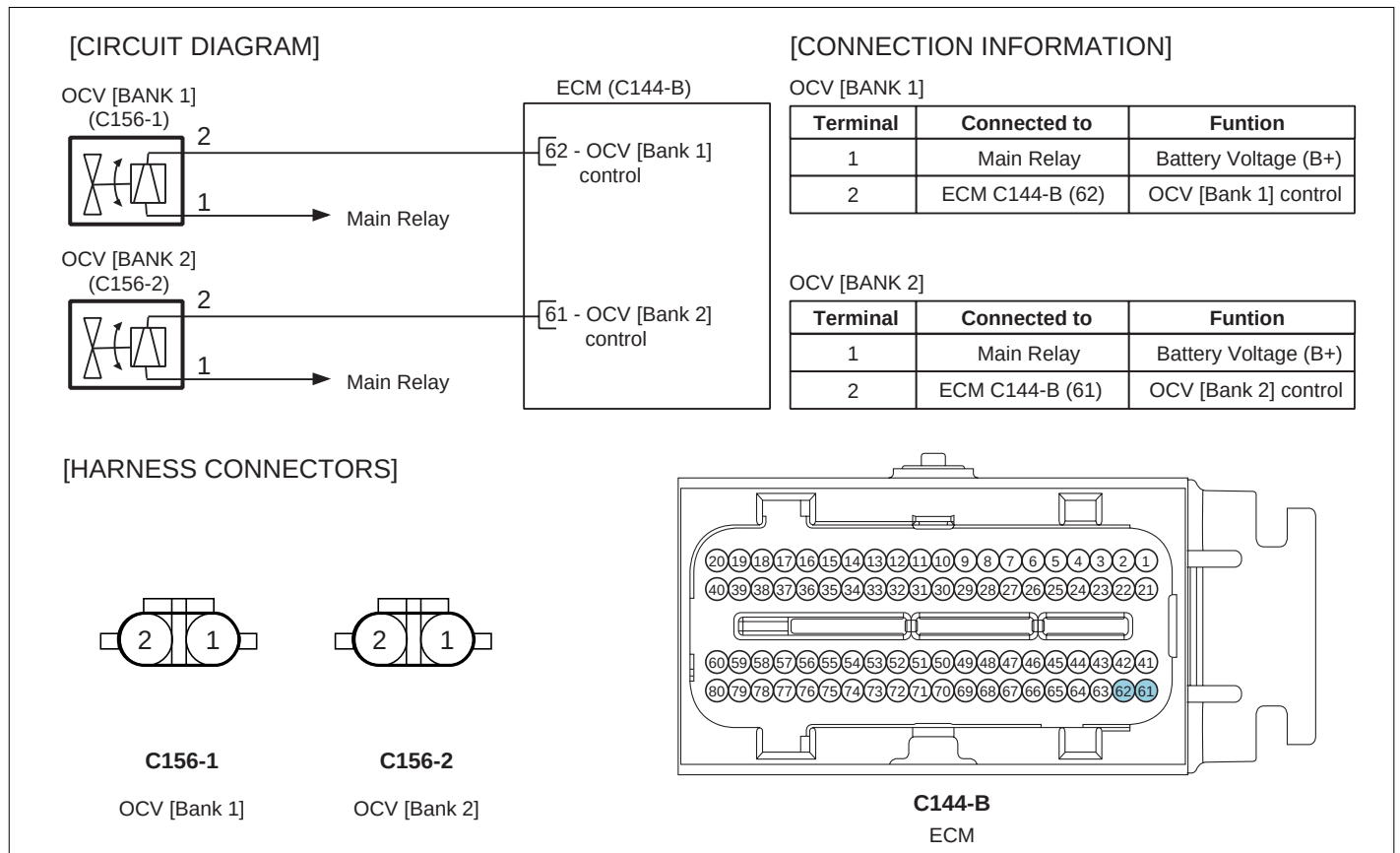
SPECIFICATION

E9C21BEF

Resistance (Ω)	6.7 ~ 7.7

SCHEMATIC DIAGRAM

EB56FB1F



SBLF26210L

SIGNAL WAVEFORM AND DATA E6BB84E7

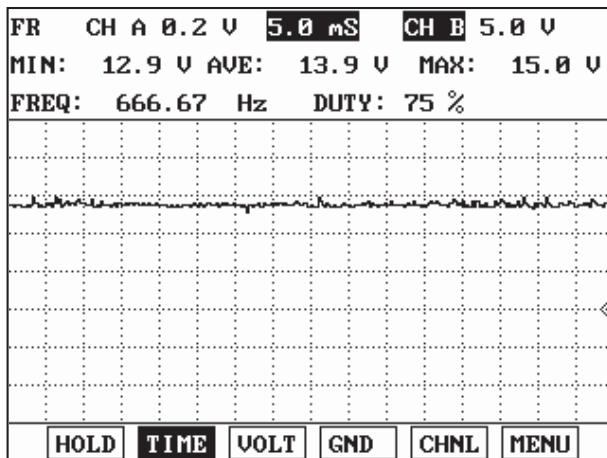


Fig. 1

Fig. 1 : Idle - normal Condition

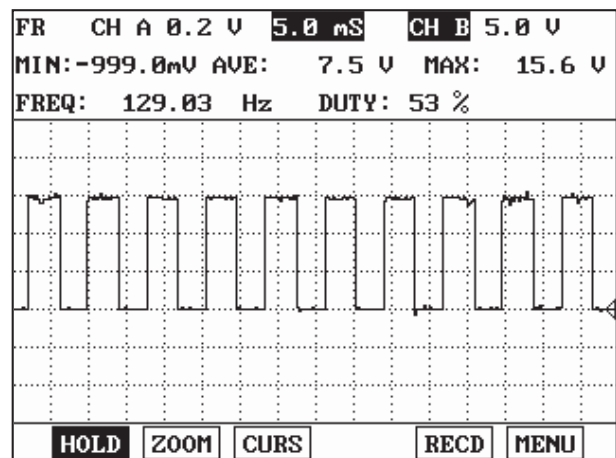


Fig. 2

Fig. 2 : Acceleration

EGRF600T

MONITOR DTC STATUS E362D1F6

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and Connector inspection" procedure.

NO

► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "System Inspection" procedure..

TERMINAL AND CONNECTOR INSPECTION E34CF6B4

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to "Power Circuit Inspection" as follow

POWER CIRCUIT INSPECTION EE55D1D6

1. IG "OFF" and disconnect OCV connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 1 of OCV harness connector and chassis ground.



NOTE

Be careful not to change the connectors for B1 and B2

Specification : B+

4. Is the measured voltage within specification ?

YES

► Go to "Control Circuit Inspection" procedure.

NO

- Check that Fuse between Main Relay and OCV is open.
- Check open between main relay and OCV.
- Check short to ground between Main Relay and OCV.
- Repair or replace as necessary go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E0475030

1. IG "OFF" and disconnect OCV connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 2 of OCV harness connector and chassis ground.

DTC TROUBLESHOOTING PROCEDURES

FLB -105

Specification : Approx. below 1V

4. Is the measured voltage within specification ?

YES

► Go to "System Inspection" procedure.

NO

► Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

SYSTEM INSPECTION E14A1D9A

1. Visual Inspection

- 1) Check oil level is O.K.
- 2) Check oil is contaminated.
- 3) Check that any oil leakage is occurred around CVVT system.
- 4) Has a problem been found ?

YES

► Repair or replace as necessary and then, go to " Verification of Vehicle Repair" procedure.

NO

► Go to "Component Inspection" procedure

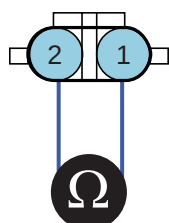
COMPONENT INSPECTION E2E1B624

1. OCV Inspection

- 1) IG "OFF" & Disconnect OCV connector.
- 2) Measure resistance between terminal 1 and 2 of OCV connector (Component Side)

SPECIFICATION :

Resistance (Ω)	6.7 ~ 7.7



1. OCV Power
2. OCV Control

3) Is the measured resistance within specification?

YES

► Go to "Check CAM PHASER with actuation test" as follow.

NO

► Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

2. Check CAM PHASER with actuation test

- 1) Connect scantool and IG "ON"
- 2) Select "CAM PHASER INTAKE BANK 1" on the Actuation Test
- 3) Select "OIL CONTROL VALVE" on the Actuation Test
- 4) Activates "CAM PHASER INTAKE BANK 1" by pressing "STRT(F1)" key
- 5) Activates "OIL CONTROL VALVE" by pressing "STRT(F1)" key
- 6) Repeat this procedure 4 or 5 times to ensure CAM PHASER and intake valve control solenoid reliability

1.4 ACTUATION TEST		24/29
CAM PHASER INTAKE BANK 1		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE RUNNING	
PRESS [STRT], IF YOU ARE READY ? SELECT TEST ITEM USING UP/DOWN KEY		
STRT STOP		

1.11 ACTUATION TEST		12/25
OIL CONTROL VALVE		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE OFF	
PRESS [STRT], IF YOU ARE READY ? SELECT TEST ITEM USING UP/DOWN KEY		
STRT STOP		

SEPFL6403N

7) Has a problem been found ?

YES

► Substitute with a known - good CVVT or OCV and check for proper operation.
If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO

► Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR ECA8E148

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode

DTC TROUBLESHOOTING PROCEDURES

FLB -107

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P0030 HO2S HEATER CONTROL CIRCUIT (BANK 1 / SENSOR 1)

COMPONENT LOCATION E872C844



SBLF26707L

GENERAL DESCRIPTION E5295E24

The normal operating temperature of the HO2S(Heated Oxygen Sensor) ranges from 350 to 850°C(662 to 1562°F). The HO2S heater greatly decreases the amount of time required for fuel control to become active. The ECM provides a pulse width modulated control circuit to adjust current through the heater. When the HO2S is cold, the value of the resistance is low and the current in the circuit is high. On the contrary, if the temperature in the resistor of the sensor rises, the current drops gradually.

DTC DESCRIPTION EE345CFA

Checking current from HO2S under detecting condition,if the heater current is below a certain threshold for more than predetermine time, ECM sets P0030. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E366B194

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the current through the heater	- Poor Connection - HO2S(B1/S1) - ECM
Enable Conditions	- Engine Running > 60 sec. - Heater Duty Cycle > 40% - Max. Duty Cycle - Min. Duty Cycle < 5%	
Threshold value	Filtered Heater Current < threshold value	
Diagnosis Time	Continuous (More than 2.5 second failure for every 5 second test)	
MIL On Condition	2 Driving Cycles	

DTC TROUBLESHOOTING PROCEDURES

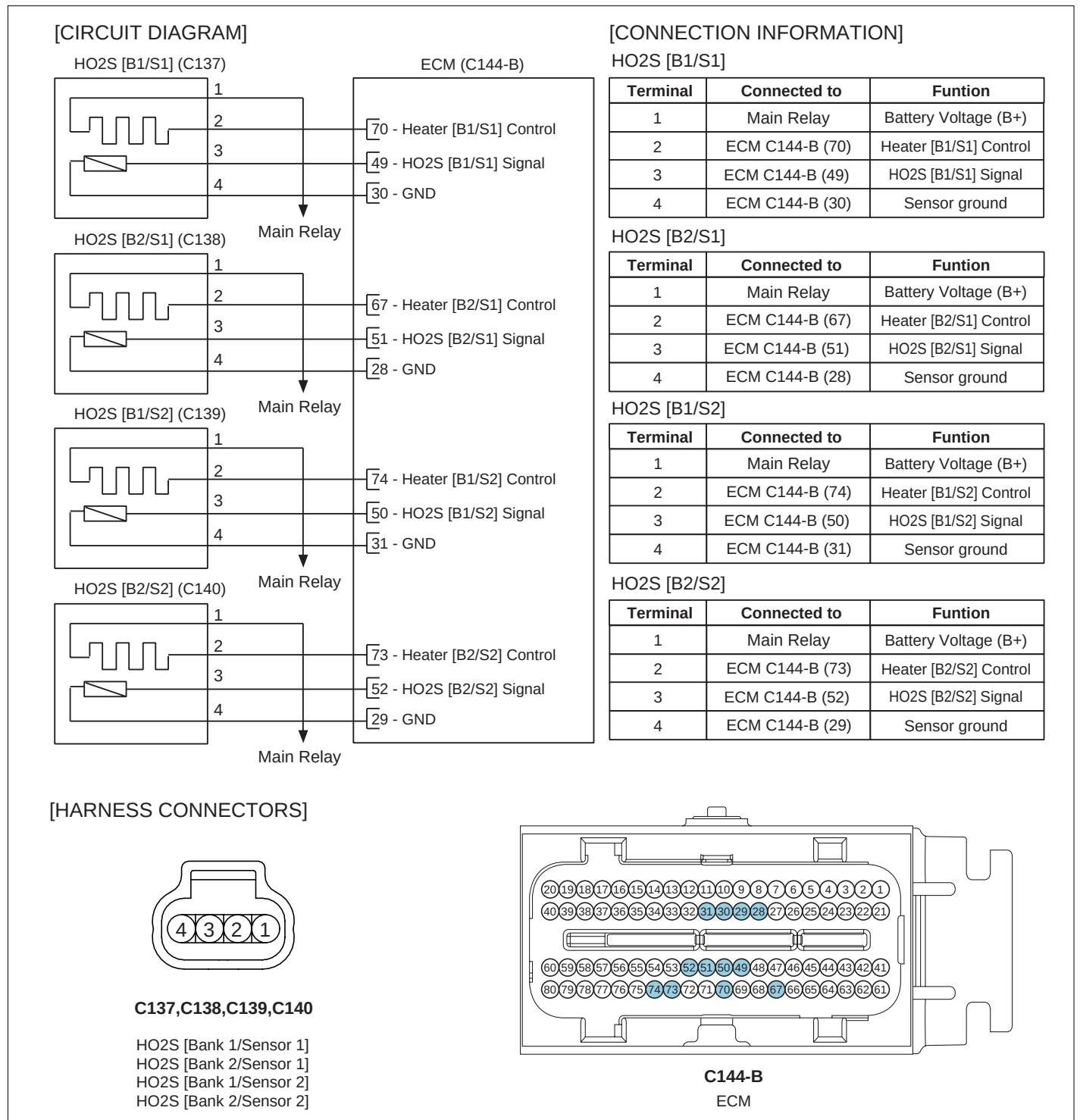
FLB -109

SPECIFICATION EA6BC377

(REFERENCE ONLY)

Condition	Current(A)
Heater Current at 13.5V, 450°C(842°F) Exhaust	0.52 ± 0.1

SCHEMATIC DIAGRAM EB8EB723



SBLF26207L

SIGNAL WAVEFORM AND DATA

EC2DACC0

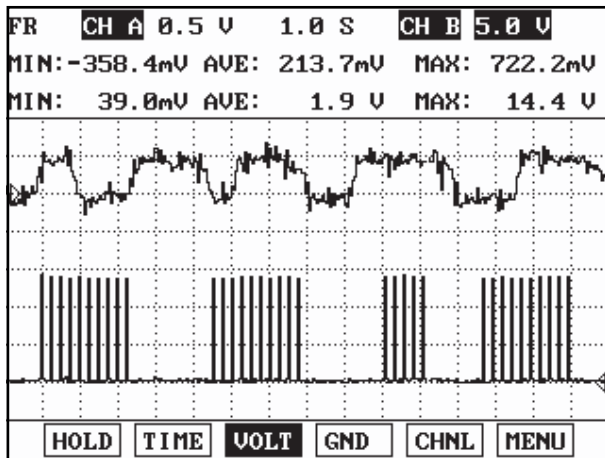


Fig. 1

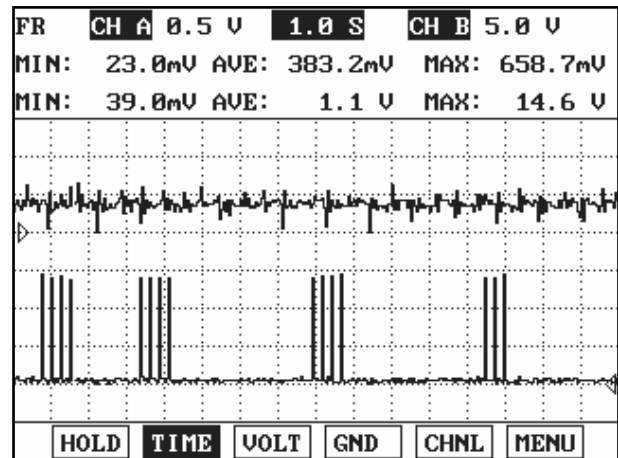


Fig. 2

Fig. 1: The signal waveforms of front HO2S(the upper) and heater(the lower) at idle

Fig. 2: The signal waveforms of rear HO2S(the upper) and heater(the lower) at idle

SEPFL6412N

The HO2S requires a minimum temperature to provide a closed loop fuel control system. So the HO2S contains a heater element to reduce its warm-up time and ensure its performance during all driving conditions. The ECM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the ECM provides a ground circuit for activating the heater.

MONITOR DTC STATUS

E8A79F0B

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

DTC TROUBLESHOOTING PROCEDURES

FLB -111

YES

- ▶ Go to "Terminal and connector inspection" procedure.

NO

- ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EF6DCEEE

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

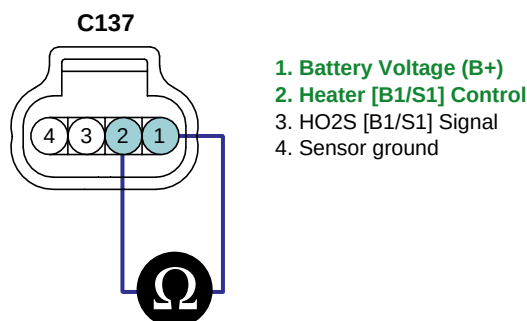
NO

- ▶ Go to " Component Inspection " procedure.

COMPONENT INSPECTION EADB0934

1. Check HO2S(B1/S1) Heater resistance
 - 1) IG "OFF" and disconnect HO2S(B1/S1) connector
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B1/S1)(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)



SBLF26415L

3) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known - good HO2S(B1/S1) and check for proper operation. If the problem is corrected, replace HO2S(B1/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E57382BF

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -113

DTC P0031 HO2S HEATER CIRCUIT LOW (BANK 1 / SENSOR 1)

COMPONENT LOCATION E9D9F82C

Refer to DTC P0030.

GENERAL DESCRIPTION ED2AED88

Refer to DTC P0030.

DTC DESCRIPTION E9CA5730

If the ECM detects short to ground or open in heater under detecting conditions, ECM sets P0031. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle..

DTC DETECTING CONDITION E7C52C60

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground or open	• Poor Connection • Open in Power Circuit • Open or short to ground in control circuit • HO2S(B1/S1) • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• short to ground or open circuit	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E3131089

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)

SCHEMATIC DIAGRAM EA6BAF47

Refer to DTC P0030.

SIGNAL WAVEFORM AND DATA EEBF76E5

Refer to DTC P0030.

MONITOR DTC STATUS E322DC6D

Refer to DTC P0030.

TERMINAL AND CONNECTOR INSPECTION ED8F40F5

Refer to DTC P0030.

POWER CIRCUIT INSPECTION

E5F9667A

1. IG "OFF" & Disconnect HO2S(B1/S1) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 1 of HO2S(B1/S1) harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES

- ▶ Go to HO2S(B1/S1) heater "Control Circuit Inspection" procedure.

NO

- ▶ Repair open or short to ground in HO2S(B1/S1) Heater power circuit then, go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION

EEBF8488

1. Check short to ground in harness.
 - 1) IG "OFF" and disconnect HO2S(B1/S1) connector.
 - 2) Measure resistance between terminal 2 of HO2S(B1/S1) harness connector and chassis ground.

Specification : Infinite

- 3) Is the measured resistance within specification ?

YES

- ▶ Go to HO2S(B1/S1) "Check Open in harness" as follows.

NO

- ▶ Repair short to ground in HO2S (B1/S1) heater control circuit and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness
 - 1) IG "OFF" and disconnect HO2S(B1/S1) and ECM connector.
 - 2) Measure resistance between terminal 2 of HO2S(B1/S1) harness connector and terminal 49 of ECM harness connector(C144-B).

Specification : Approx. below 1Ω

- 3) Is the measured resistance within specification ?

YES

- ▶ Go to HO2S(B1/S1) "Component Inspection" procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -115

NO

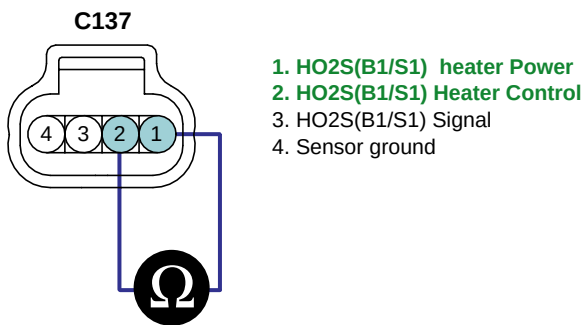
- Repair open in HO2S(B1/S1) heater control circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E322DF5B

1. Check HO2S(B1/S1) Heater resistance.
 - 1) IG "OFF" and disconnect HO2S(B1/S1) connector.
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B1/S1)connector (Component Side)

SPECIFICATION :

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)



SBLF26408L

- 3) Is the measured resistance within specification ?

YES

- Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO

- Substitute with a known - good HO2S(B1/S1) and check for proper operation. If the problem is corrected, replace HO2S(B1/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EAB6A97F

Refer to DTC P0030.

DTC P0032 HO2S HEATER CIRCUIT HIGH (BANK 1 / SENSOR 1)

COMPONENT LOCATION E8C4BED1

Refer to DTC P0030.

GENERAL DESCRIPTION E84DCE26

Refer to DTC P0030.

DTC DESCRIPTION E74BF676

If the ECM detects short to battery in heater under detecting conditions, ECM sets P0032. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E5303FA0

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • short to battery in control circuit • HO2S(B1/S1) • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• short to battery	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EB4AFDB3

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)

SCHEMATIC DIAGRAM ED5AE7E7

Refer to DTC P0030.

SIGNAL WAVEFORM AND DATA E6A0E95C

Refer to DTC P0030.

MONITOR DTC STATUS ECABFC7B

Refer to DTC P0030.

TERMINAL AND CONNECTOR INSPECTION E44927F0

Refer to DTC P0030.

DTC TROUBLESHOOTING PROCEDURES

FLB -117

CONTROL CIRCUIT INSPECTION ED057128

1. IG "OFF" & disconnect HO2S(B1/S1) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 2 of HO2S(B1/S1) harness connector and chassis ground.

Specification : Approx. 0 V

4. Is the measured voltage within specification ?

YES

► Go to HO2S(B1/S1) "Component Inspection" procedure.

NO

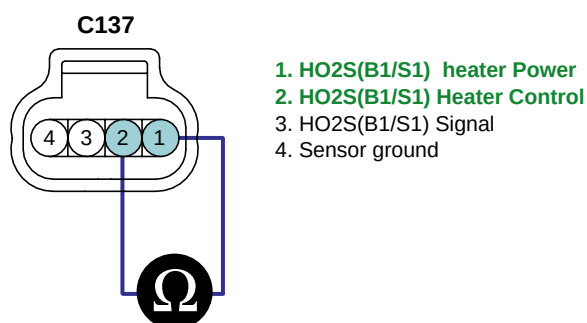
► Repair short to battery in HO2S(B1/S1) Heater control circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EC6263D6

1. Check HO2S(B1/S1) Heater resistance.
 - 1) IG "OFF" and disconnect HO2S(B1/S1) connector.
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B1/S1)connector (Component Side)

SPECIFICATION :

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)



SBLF26408L

- 3) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO

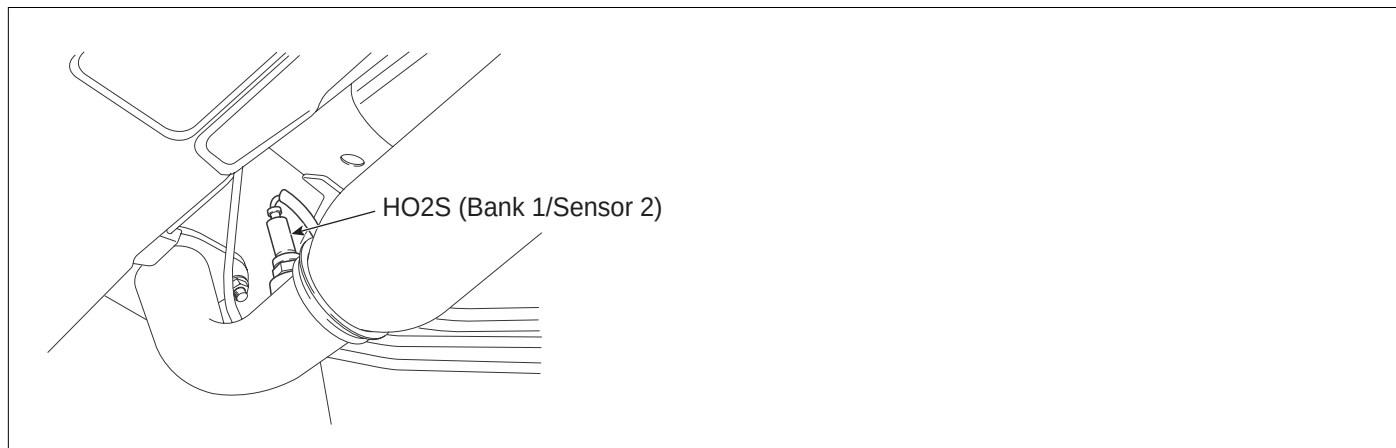
► Substitute with a known - good HO2S(B1/S1) and check for proper operation. If the problem is corrected, replace HO2S(B1/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EAF3915D

Refer to DTC P0030.

DTC P0036 HO2S HEATER CONTROL CIRCUIT (BANK 1 / SENSOR 2)

COMPONENT LOCATION ED3FD0D7



SBLF26708L

GENERAL DESCRIPTION EEBDD0C2

The normal operating temperature of the HO2S(Heated Oxygen Sensor) ranges from 350 to 850°C(662 to 1562°F). The HO2S heater greatly decreases the amount of time required for fuel control to become active. The ECM provides a pulse width modulated control circuit to adjust current through the heater. When the HO2S is cold, the value of the resistance is low and the current in the circuit is high. On the contrary, if the temperature in the resistor of the sensor rises, the current drops gradually.

DTC DESCRIPTION E68D37F0

Checking current from HO2S under detecting condition,if the heater current is below a certain threshold for more than predetermine time, ECM sets P0036. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E66AD883

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the current through the heater	- Poor Connection - HO2S(B1/S2) - ECM
Enable Conditions	- Engine Running > 60 sec. - Heater Duty Cycle > 18% - Max. Duty Cycle - Min. Duty Cycle < 5%	
Threshold value	Filtered Heater Current < threshold value	
Diagnosis Time	Continuous (More than 2.5 second failure for every 5 second test)	
MIL On Condition	2 Driving Cycles	

FLB -120

FUEL SYSTEM

SPECIFICATION

EC7882C3

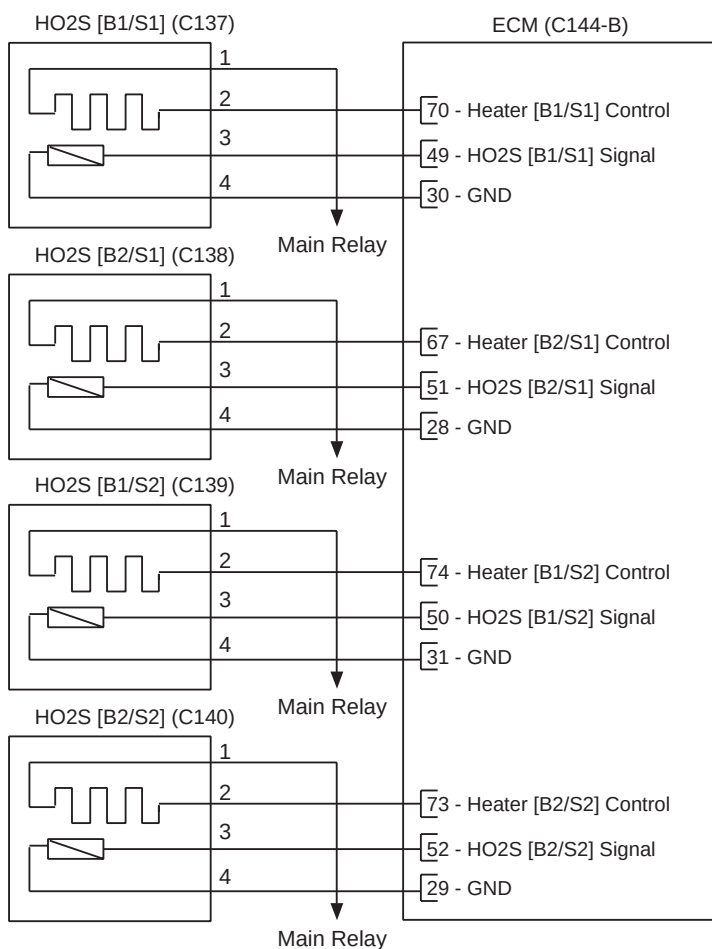
(REFERENCE ONLY)

Condition	Current(A)
Heater Current at 13.5V, 450°C(842°F) Exhaust	0.52 ± 0.1

SCHEMATIC DIAGRAM

E07D4F96

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

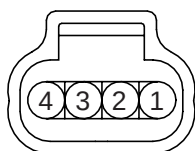
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

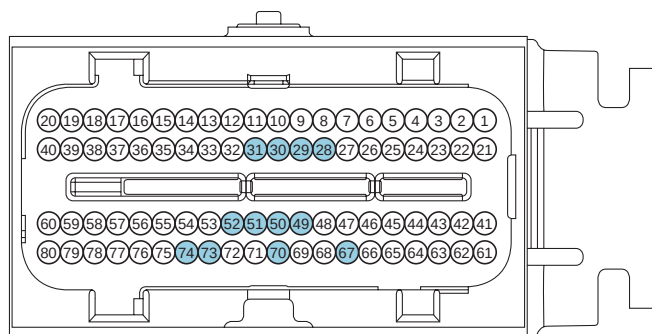
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SBLF26207L

SIGNAL WAVEFORM AND DATA EC5270D5

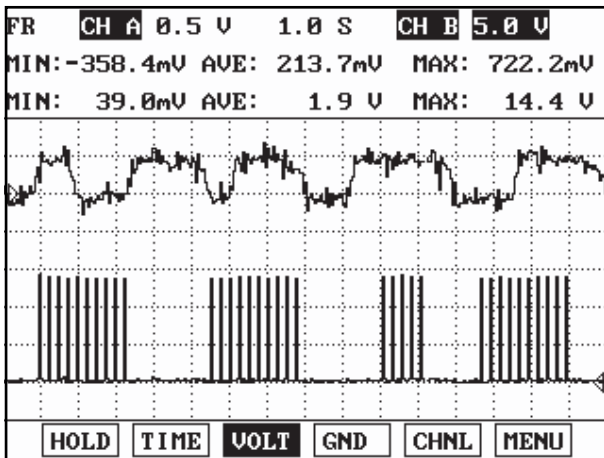


Fig. 1

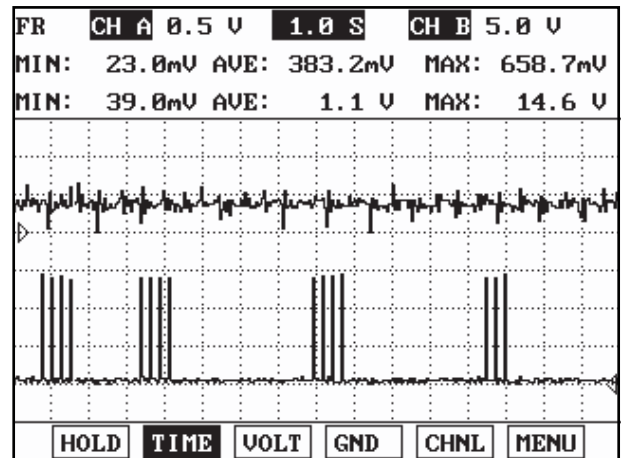


Fig. 2

Fig. 1: The signal waveforms of front HO2S(the upper) and heater(the lower) at idle

Fig. 2: The signal waveforms of rear HO2S(the upper) and heater(the lower) at idle

SEPFL6412N

The HO2S requires a minimum temperature to provide a closed loop fuel control system. So the HO2S contains a heater element to reduce its warm-up time and ensure its performance during all driving conditions. The ECM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the ECM provides a ground circuit for activating the heater.

MONITOR DTC STATUS ECD1A138

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

- ▶ Go to "Terminal and connector inspection" procedure.

NO

- ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E42F19EC

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

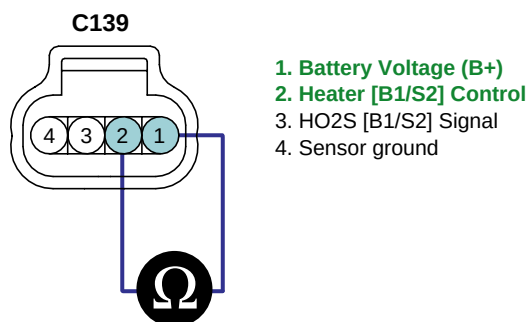
NO

- ▶ Go to " Component Inspection " procedure.

COMPONENT INSPECTION EDC21543

1. Check HO2S(B1/S2) Heater resistance
 - 1) IG "OFF" and disconnect HO2S(B1/S2) connector
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B1/S2)(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)



SBLF26416L

- 3) Is the measured resistance within specification ?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -123

- ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

- ▶ Substitute with a known - good HO2S(B1/S2) and check for proper operation. If the problem is corrected, replace HO2S(B1/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E3BAB7B4

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P0037 HO2S HEATER CIRCUIT LOW (BANK 1 / SENSOR 2)

COMPONENT LOCATION E83C15AE

Refer to DTC P0036.

GENERAL DESCRIPTION ED925D2F

Refer to DTC P0036.

DTC DESCRIPTION EA41A32E

If the ECM detects short to ground or open in heater under detecting conditions, ECM sets P0037. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2F47F1D

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground or open	• Poor Connection • Open in Power Circuit • Open or short to ground in control circuit • HO2S(B1/S2) • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• short to ground or open circuit	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E124D364

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)

SCHEMATIC DIAGRAM E7953AD2

Refer to DTC P0036.

SIGNAL WAVEFORM AND DATA E0266A31

Refer to DTC P0036.

MONITOR DTC STATUS E28FABA5

Refer to DTC P0036.

TERMINAL AND CONNECTOR INSPECTION EA729063

Refer to DTC P0036.

DTC TROUBLESHOOTING PROCEDURES

FLB -125

POWER CIRCUIT INSPECTION EF070D5F

1. IG "OFF" & Disconnect HO2S(B1/S2) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 1 of HO2S(B1/S2) harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES

▶ Go to HO2S(B1/S2) heater "Control Circuit Inspection" procedure.

NO

▶ Repair open or short to ground in HO2S(B1/S2) Heater power circuit then, go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E31C4BA2

1. Check short to ground in harness.
 - 1) IG "OFF" and disconnect HO2S(B1/S2) connector.
 - 2) Measure resistance between terminal 2 of HO2S(B1/S2) harness connector and chassis ground.

Specification : Infinite

- 3) Is the measured resistance within specification ?

YES

▶ Go to HO2S(B1/S2) "Check Open in harness" as follows.

NO

▶ Repair short to ground in HO2S (B1/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness
 - 1) IG "OFF" and disconnect HO2S(B1/S2) and ECM connector.
 - 2) Measure resistance between terminal 2 of HO2S(B1/S2) harness connector and terminal 50 of ECM harness connector(C144-B).

Specification : Approx. below 1Ω

- 3) Is the measured resistance within specification ?

YES

▶ Go to HO2S(B1/S2) "Component Inspection" procedure.

NO

► Repair open in HO2S(B1/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

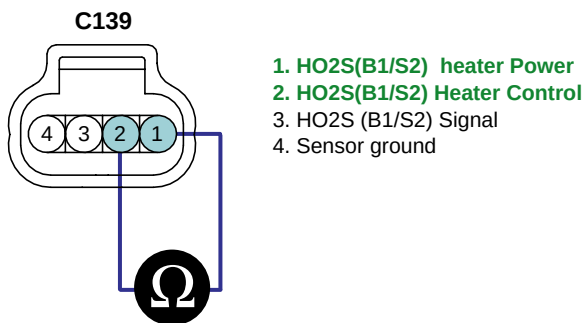
COMPONENT INSPECTION E71FCCD2

1. Check HO2S(B1/S2) Heater resistance

- 1) IG "OFF" and disconnect HO2S(B1/S2) connector
- 2) Measure resistance between terminal 1 and 2 of HO2S(B1/S2)(Component Side)

SPECIFICATION :

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)



SBLF26420L

3) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO

► Substitute with a known - good HO2S(B1/S2) and check for proper operation. If the problem is corrected, replace HO2S(B1/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E69EEF7B

Refer to DTC P0036.

DTC TROUBLESHOOTING PROCEDURES

FLB -127

DTC P0038 HO2S HEATER CIRCUIT HIGH (BANK 1 / SENSOR 2)

COMPONENT LOCATION EEA667D0

Refer to DTC P0036.

GENERAL DESCRIPTION E2BE9252

Refer to DTC P0036.

DTC DESCRIPTION EFCB369F

If the ECM detects short to battery in heater under detecting conditions, ECM sets P0038. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EB020999

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • short to battery in control circuit • HO2S(B1/S2) • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• short to battery	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E558DE3A

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)

SCHEMATIC DIAGRAM EB82892F

Refer to DTC P0036.

SIGNAL WAVEFORM AND DATA E5DC729D

Refer to DTC P0036.

MONITOR DTC STATUS EEEEC1A42

Refer to DTC P0036.

TERMINAL AND CONNECTOR INSPECTION E63AD5EB

Refer to DTC P0036.

CONTROL CIRCUIT INSPECTION

EF366618

1. IG "OFF" & disconnect HO2S(B1/S2) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 2 of HO2S(B1/S2) harness connector and chassis ground.

Specification : Approx. 0 V

4. Is the measured voltage within specification ?

YES

► Go to HO2S(B1/S2) "Component Inspection" procedure.

NO

► Repair short to battery in HO2S (B1/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

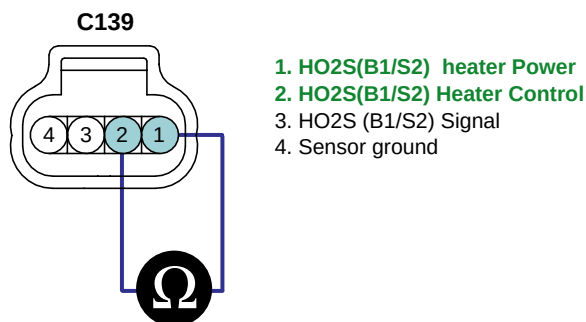
COMPONENT INSPECTION

EFCD11FE

1. Check HO2S(B1/S2) Heater resistance
 - 1) IG "OFF" and disconnect HO2S(B1/S2) connector
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B1/S2)(Component Side)

SPECIFICATION :

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)



SBLF26420L

- 3) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO

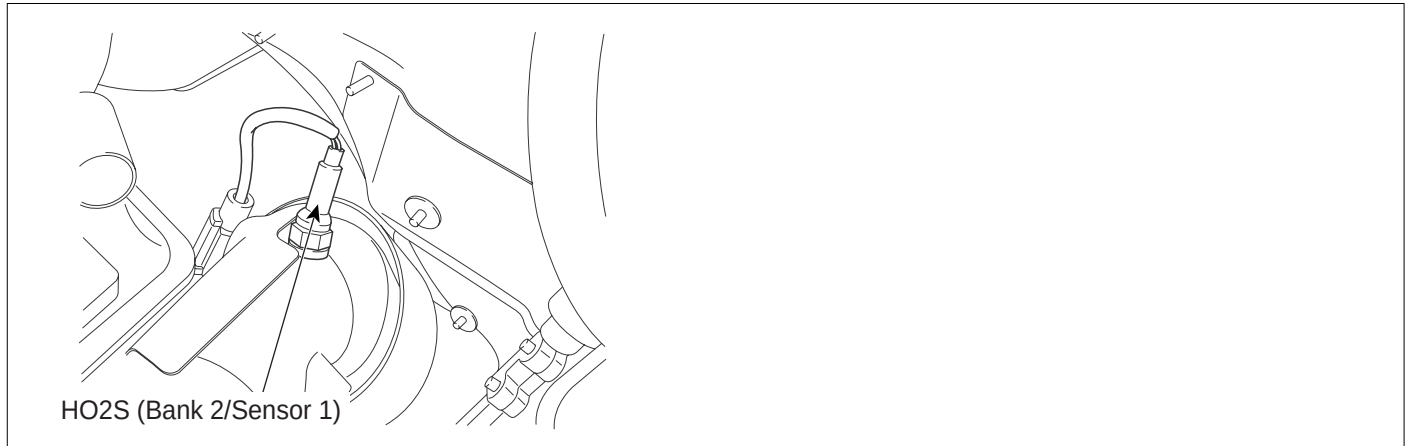
► Substitute with a known - good HO2S(B1/S2) and check for proper operation. If the problem is corrected, replace HO2S(B1/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E1CC01D5

Refer to DTC P0036.

DTC P0050 HO2S HEATER CONTROL CIRCUIT (BANK 2 / SENSOR 1)

COMPONENT LOCATION E78C8F7A



SBLF26709L

GENERAL DESCRIPTION E23EE970

The normal operating temperature of the HO2S(Heated Oxygen Sensor) ranges from 350 to 850°C(662 to 1562°F). The HO2S heater greatly decreases the amount of time required for fuel control to become active. The ECM provides a pulse width modulated control circuit to adjust current through the heater. When the HO2S is cold, the value of the resistance is low and the current in the circuit is high. On the contrary, if the temperature in the resistor of the sensor rises, the current drops gradually.

DTC DESCRIPTION EC8D1E0F

Checking current from HO2S under detecting condition,if the heater current is below a certain threshold for more than predetermine time, ECM sets P0050. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ED1774E0

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the current through the heater	- Poor Connection - HO2S(B2/S1) - ECM
Enable Conditions	- Engine Running > 60 sec. - Heater Duty Cycle > 40% - Max. Duty Cycle - Min. Duty Cycle < 5%	
Threshold value	Filtered Heater Current < threshold value	
Diagnosis Time	Continuous (More than 2.5 second failure for every 5 second test)	
MIL On Condition	2 Driving Cycles	

DTC TROUBLESHOOTING PROCEDURES

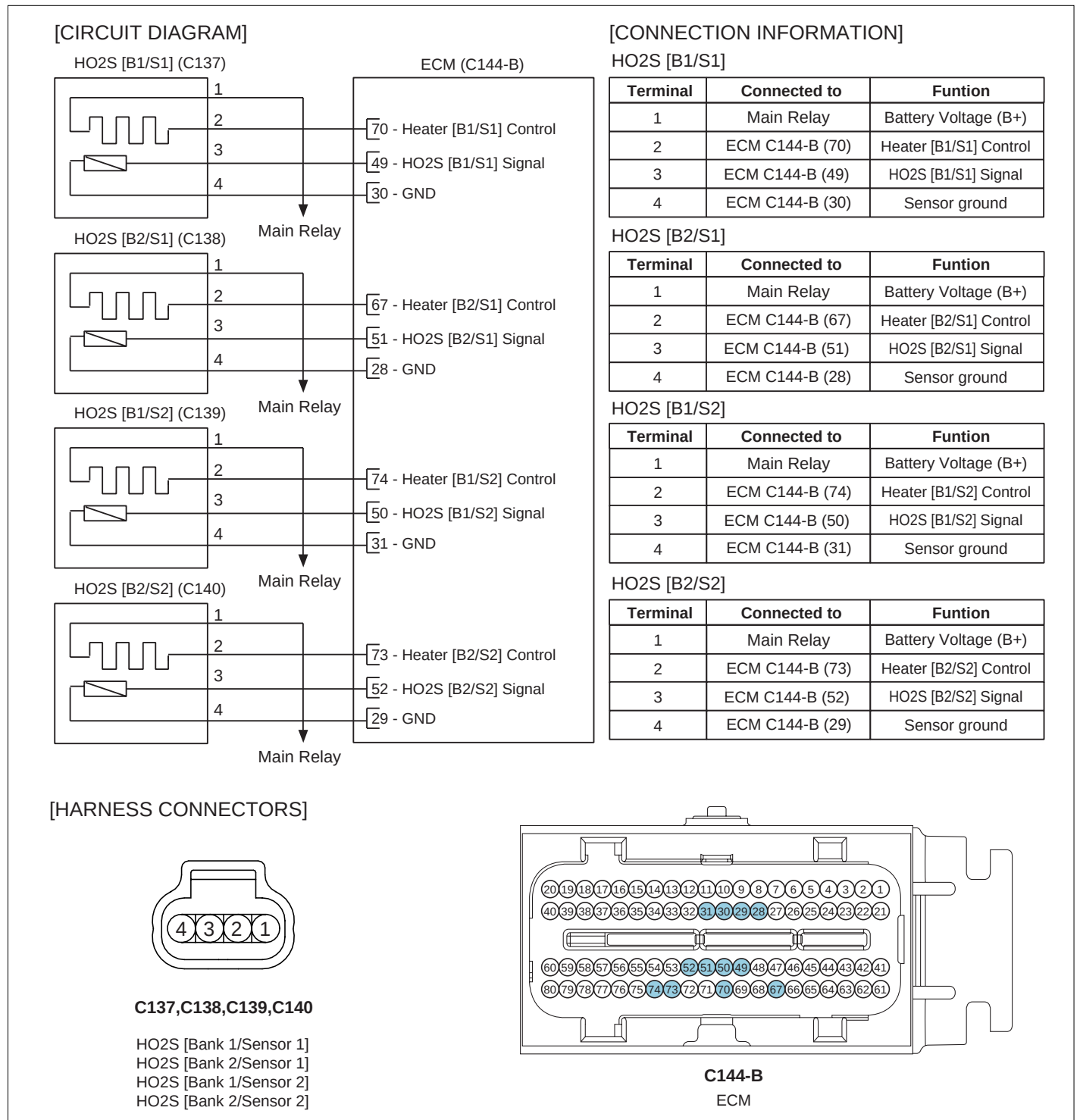
FLB -131

SPECIFICATION EC955BCC

(REFERENCE ONLY)

Condition	Current(A)
Heater Current at 13.5V, 450°C(842°F) Exhaust	0.52 ± 0.1

SCHEMATIC DIAGRAM E824E7A3



SBLF26207L

SIGNAL WAVEFORM AND DATA

EEC0A0C8

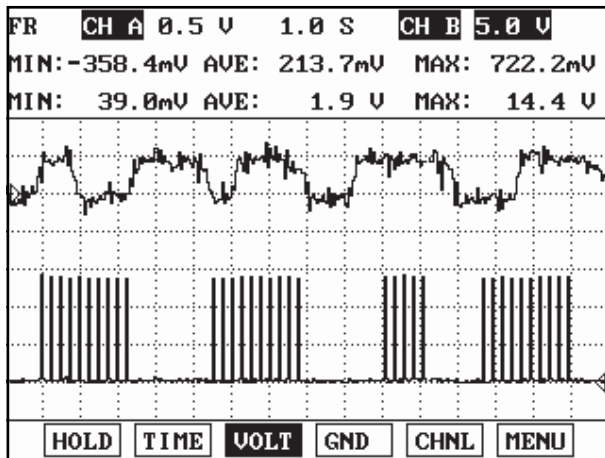


Fig. 1

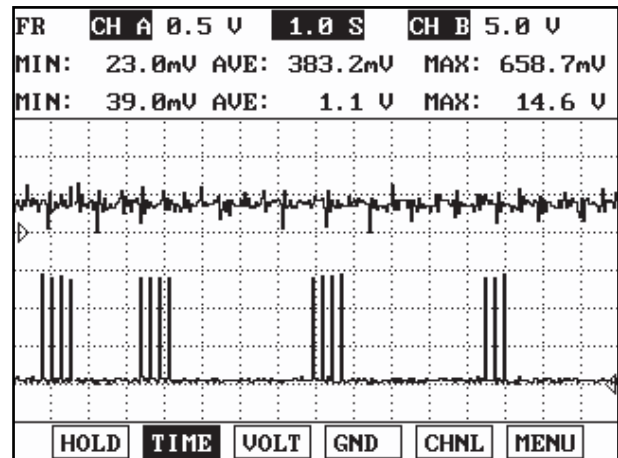


Fig. 2

Fig. 1: The signal waveforms of front HO2S(the upper) and heater(the lower) at idle

Fig. 2: The signal waveforms of rear HO2S(the upper) and heater(the lower) at idle

SEPFL6412N

The HO2S requires a minimum temperature to provide a closed loop fuel control system. So the HO2S contains a heater element to reduce its warm-up time and ensure its performance during all driving conditions. The ECM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the ECM provides a ground circuit for activating the heater.

MONITOR DTC STATUS

E6549B07

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

DTC TROUBLESHOOTING PROCEDURES

FLB -133

YES

- Go to "Terminal and connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E7F20D4C

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- Repair as necessary and go to "Verification of Vehicle Repair" procedure

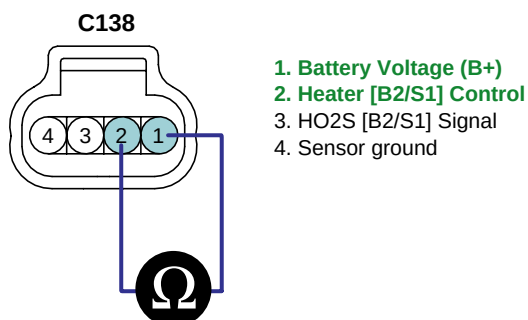
NO

- Go to "Component Inspection" procedure.

COMPONENT INSPECTION E8479219

1. Check HO2S(B2/S1) Heater resistance
 - 1) IG "OFF" and disconnect HO2S(B2/S1) connector
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B2/S1)(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)



SBLF26422L

- 3) Is the measured resistance within specification ?

YES

- ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

- ▶ Substitute with a known - good HO2S(B2/S1) and check for proper operation. If the problem is corrected, replace HO2S(B2/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E58A00A1

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -135

DTC P0051 HO2S HEATER CIRCUIT LOW (BANK 2 / SENSOR 1)

COMPONENT LOCATION EFAE3739

Refer to DTC P0050.

GENERAL DESCRIPTION E1E0D2E3

Refer to DTC P0050.

DTC DESCRIPTION E5827B8B

If the ECM detects short to ground or open in heater under detecting conditions, ECM sets P0051. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E92A57FE

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground or open	• Poor Connection • Open in Power Circuit • Open or short to ground in control circuit • HO2S(B2/S1) • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• short to ground or open circuit	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E404398B

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)

SCHEMATIC DIAGRAM E7098A4A

Refer to DTC P0050.

SIGNAL WAVEFORM AND DATA E8B0A0B3

Refer to DTC P0050.

MONITOR DTC STATUS E37C6C1B

Refer to DTC P0050.

TERMINAL AND CONNECTOR INSPECTION EC639623

Refer to DTC P0050.

POWER CIRCUIT INSPECTION

EEE28AC2

1. IG "OFF" & Disconnect HO2S(B2/S1) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 1 of HO2S(B2/S1) harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES

- Go to HO2S(B2/S1) heater "Control Circuit Inspection" procedure.

NO

- Repair open or short to ground in HO2S(B2/S1) Heater power circuit then, go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION

EA99132

1. Check short to ground in harness.
 - 1) IG "OFF" and disconnect HO2S(B2/S1) connector.
 - 2) Measure resistance between terminal 2 of HO2S(B2/S1) harness connector and chassis ground.

Specification : Infinite

- 3) Is the measured resistance within specification ?

YES

- Go to HO2S(B2/S1) "Check Open in harness" as follows.

NO

- Repair short to ground in HO2S (B2/S1) heater control circuit and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness
 - 1) IG "OFF" and disconnect HO2S(B2/S1) and ECM connector.
 - 2) Measure resistance between terminal 2 of HO2S(B2/S1) harness connector and terminal 51 of ECM harness connector(C144-B).

Specification : Approx. below 1Ω

- 3) Is the measured resistance within specification ?

YES

- Go to HO2S(B2/S1) "Component Inspection" procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -137

NO

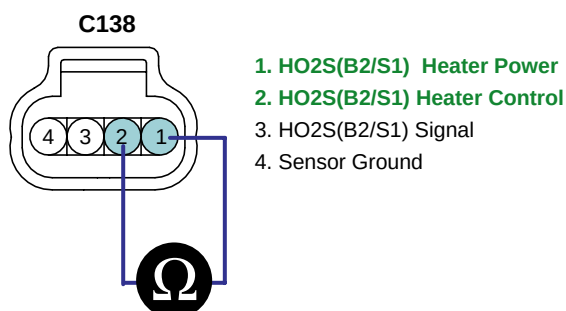
- Repair open in HO2S(B2/S1) heater control circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E60564C9

1. Check HO2S(B2/S1) Heater resistance
 - 1) IG "OFF" and disconnect HO2S(B2/S1) connector
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B2/S1)(Component Side)

SPECIFICATION :

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)



SBLF26426L

- 3) Is the measured resistance within specification ?

YES

- Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO

- Substitute with a known - good HO2S(B2/S1) and check for proper operation. If the problem is corrected, replace HO2S(B2/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ECD FEB6D

Refer to DTC P0050.

DTC P0052 HO2S HEATER CIRCUIT HIGH (BANK 2 / SENSOR 1)

COMPONENT LOCATION E7EEA2AE

Refer to DTC P0050.

GENERAL DESCRIPTION EF0B0A3E

Refer to DTC P0050.

DTC DESCRIPTION E7FA53B0

If the ECM detects short to battery in heater under detecting conditions, ECM sets P0052. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E6C3650E

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in control circuit • HO2S(B2/S1) • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• short to battery	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E51E5914

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)

SCHEMATIC DIAGRAM E1747DE6

Refer to DTC P0050.

SIGNAL WAVEFORM AND DATA EE2A0C7D

Refer to DTC P0050.

MONITOR DTC STATUS EBABB099

Refer to DTC P0050.

TERMINAL AND CONNECTOR INSPECTION E40596D7

Refer to DTC P0050.

DTC TROUBLESHOOTING PROCEDURES

FLB -139

CONTROL CIRCUIT INSPECTION ED9CA5C7

1. IG "OFF" & disconnect HO2S(B2/S1) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 2 of HO2S(B2/S1) harness connector and chassis ground.

Specification : Approx. 0 V

4. Is the measured voltage within specification ?

YES

► Go to HO2S(B2/S1) "Component Inspection" procedure.

NO

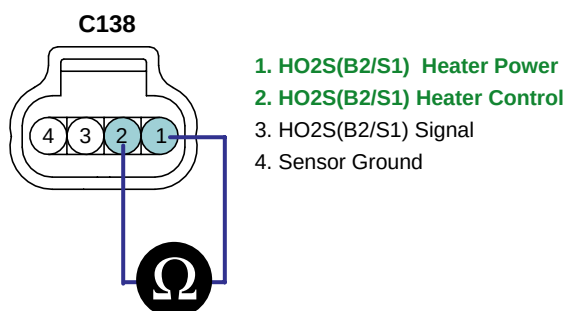
► Repair short to battery in HO2S(B2/S1) Heater control circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E46BBE34

1. Check HO2S(B2/S1) Heater resistance
 - 1) IG "OFF" and disconnect HO2S(B2/S1) connector
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B2/S1)(Component Side)

SPECIFICATION :

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21°C(69.8°F)



SBLF26426L

- 3) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO

► Substitute with a known - good HO2S(B2/S1) and check for proper operation. If the problem is corrected, replace HO2S(B2/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EFB70CD5

Refer to DTC P0050.

DTC TROUBLESHOOTING PROCEDURES

FLB -141

DTC P0056 HO2S HEATER CONTROL CIRCUIT (BANK 2 / SENSOR 2)

COMPONENT LOCATION EBD8F770



SBLF26710L

GENERAL DESCRIPTION ECA88688

The normal operating temperature of the HO2S(Heated Oxygen Sensor) ranges from 350 to 850°C(662 to 1562°F). The HO2S heater greatly decreases the amount of time required for fuel control to become active. The ECM provides a pulse width modulated control circuit to adjust current through the heater. When the HO2S is cold, the value of the resistance is low and the current in the circuit is high. On the contrary, if the temperature in the resistor of the sensor rises, the current drops gradually.

DTC DESCRIPTION E3CD6897

Checking current from HO2S under detecting condition,if the heater current is below a certain threshold for more than predetermine time, ECM sets P0056. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E41DD07F

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the current through the heater	- Poor connection - HO2S(B2/S2) - ECM
Enable Conditions	- Engine Running > 60 sec. - Heater Duty Cycle > 18% - Max. Duty Cycle - Min. Duty Cycle < 5%	
Threshold value	Filtered Heater Current < threshold value	
Diagnosis Time	Continuous (More than 2.5 second failure for every 5 second test)	
MIL On Condition	2 Driving Cycles	

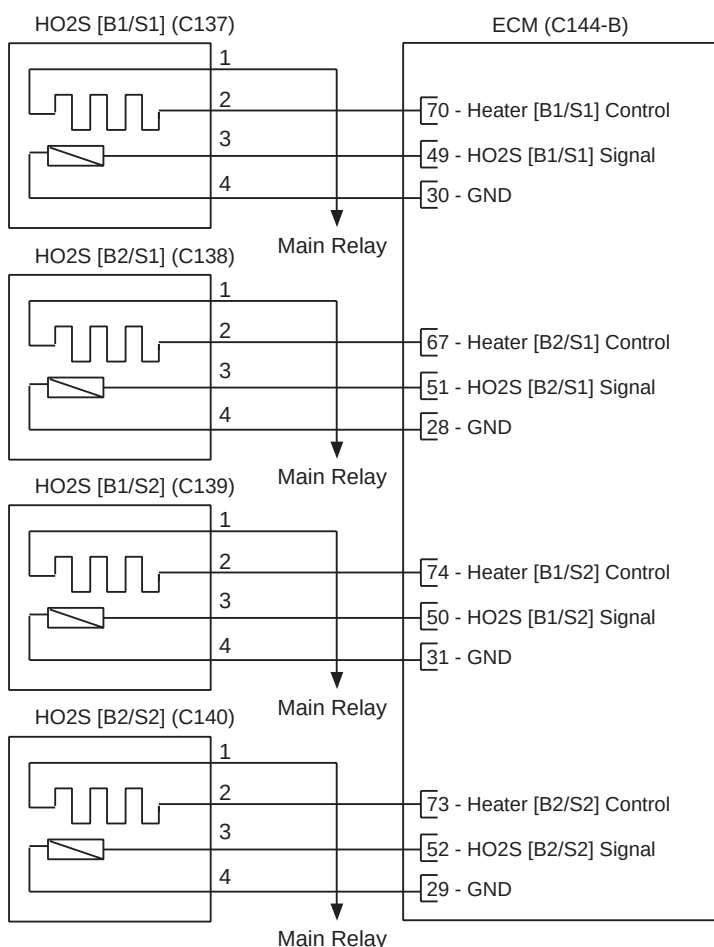
SPECIFICATION ED23000D

(REFERENCE ONLY)

Condition	Current(A)
Heater Current at 13.5V, 450°C(842°F) Exhaust	0.52 ± 0.1

SCHEMATIC DIAGRAM EA6736BC

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

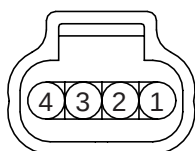
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

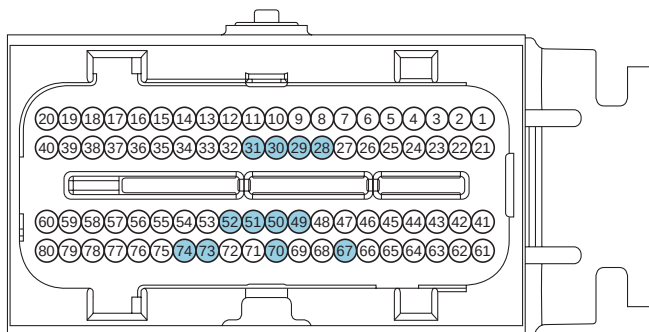
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SIGNAL WAVEFORM AND DATA E55FBA2E

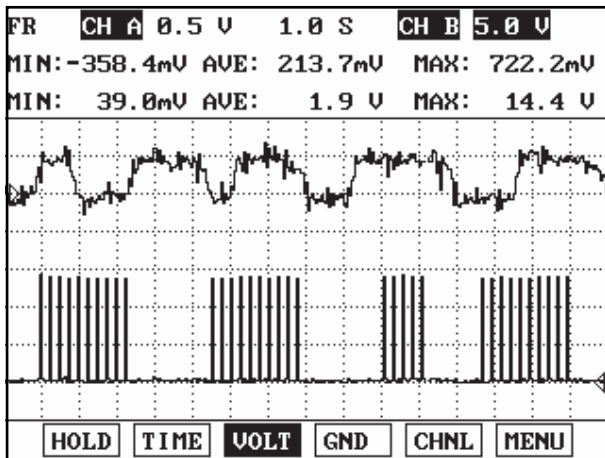


Fig. 1

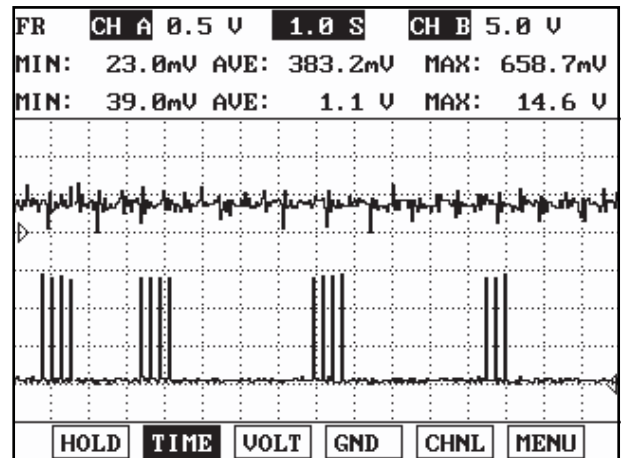


Fig. 2

Fig. 1: The signal waveforms of front HO2S(the upper) and heater(the lower) at idle

Fig. 2: The signal waveforms of rear HO2S(the upper) and heater(the lower) at idle

SEPFL6412N

The HO2S requires a minimum temperature to provide a closed loop fuel control system. So the HO2S contains a heater element to reduce its warm-up time and ensure its performance during all driving conditions. The ECM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the ECM provides a ground circuit for activating the heater.

MONITOR DTC STATUS E3F4B04E

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

TERMINAL AND CONNECTOR INSPECTION E1F8EA0B

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

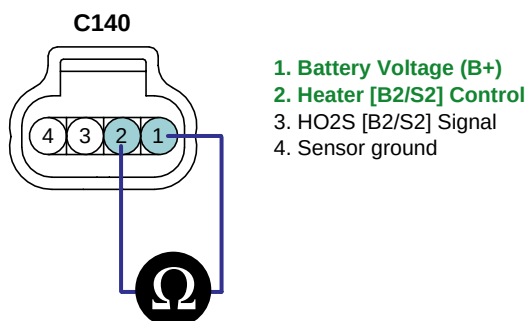
NO

► Go to " Component Inspection " procedure.

COMPONENT INSPECTION E71C1F3A

1. Check HO2S(B2/S2) Heater resistance
 - 1) IG "OFF" and disconnect HO2S(B2/S2) connector
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B2/S2)(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)



SBLF26428L

DTC TROUBLESHOOTING PROCEDURES

FLB -145

2. Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known - good HO2S(B2/S2) and check for proper operation. If the problem is corrected, replace HO2S(B2/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

EE05472F

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P0057 HO2S HEATER CIRCUIT LOW (BANK 2 / SENSOR 2)

COMPONENT LOCATION EC02B5D4

Refer to DTC P0056.

GENERAL DESCRIPTION EEA03177

Refer to DTC P0056.

DTC DESCRIPTION EF634B0F

If the ECM detects short to ground or open in heater under detecting conditions, ECM sets P0057. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ECCAEFE7

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground or open	• Poor Connection • Open in Power Circuit • Open or short to ground in control circuit • HO2S(B2/S2) • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• short to ground or open circuit	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EEE16198

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)

SCHEMATIC DIAGRAM E0E7A381

Refer to DTC P0056.

SIGNAL WAVEFORM AND DATA E2F83FC6

Refer to DTC P0056.

MONITOR DTC STATUS ED2CB44A

Refer to DTC P0056.

TERMINAL AND CONNECTOR INSPECTION E3EF9E8C

Refer to DTC P0056.

DTC TROUBLESHOOTING PROCEDURES

FLB -147

POWER CIRCUIT INSPECTION E8E1E51F

1. IG "OFF" & Disconnect HO2S(B2/S2) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 1 of HO2S(B2/S2) harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES

► Go to HO2S(B2/S2) heater "Control Circuit Inspection" procedure.

NO

► Repair open or short to ground in HO2S(B2/S2) Heater power circuit then, go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EB3336F3

1. Check short to ground in harness.
 - 1) IG "OFF" and disconnect HO2S(B2/S2) connector.
 - 2) Measure resistance between terminal 2 of HO2S(B2/S2) harness connector and chassis ground.

Specification : Infinite

- 3) Is the measured resistance within specification ?

YES

► Go to HO2S(B2/S2) "Check Open in harness" as follows.

NO

► Repair short to ground in HO2S (B2/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness
 - 1) IG "OFF" and disconnect HO2S(B2/S2) and ECM connector.
 - 2) Measure resistance between terminal 2 of HO2S(B2/S2) harness connector and terminal 52 of ECM harness connector(C144-B).

Specification : Approx. below 1Ω

- 3) Is the measured resistance within specification ?

YES

► Go to HO2S(B2/S2) "Component Inspection" procedure.

NO

► Repair open in HO2S(B2/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

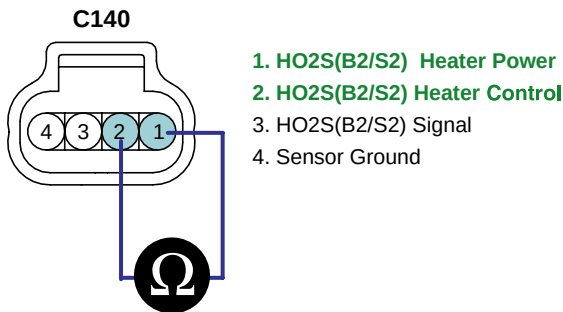
COMPONENT INSPECTION E733C398

1. Check HO2S(B2/S2) Heater resistance

- 1) IG "OFF" and disconnect HO2S(B2/S2) connector
- 2) Measure resistance between terminal 1 and 2 of HO2S(B2/S2)(Component Side)

SPECIFICATION :

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)



SBLF26432L

3) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO

► Substitute with a known - good HO2S(B2/S2) and check for proper operation. If the problem is corrected, replace HO2S(B2/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E9EBFF28

Refer to DTC P0056.

DTC TROUBLESHOOTING PROCEDURES

FLB -149

DTC P0058 HO2S HEATER CIRCUIT HIGH (BANK 2 / SENSOR 2)

COMPONENT LOCATION E87928C0

Refer to DTC P0056.

GENERAL DESCRIPTION EE643CDD

Refer to DTC P0056.

DTC DESCRIPTION E5D13319

If the ECM detects short to battery in heater under detecting conditions, ECM sets P0058. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E5507DC4

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in control circuit • HO2S(B2/S2) • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• Short to battery	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EBAD72DA

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)

SCHEMATIC DIAGRAM E6D5DF67

Refer to DTC P0056.

SIGNAL WAVEFORM AND DATA E06EA1ED

Refer to DTC P0056.

MONITOR DTC STATUS E6BA8B05

Refer to DTC P0056.

TERMINAL AND CONNECTOR INSPECTION E08057D1

Refer to DTC P0056.

CONTROL CIRCUIT INSPECTION E16E1CAE

1. IG "OFF" & disconnect HO2S(B2/S2) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 2 of HO2S(B2/S2) harness connector and chassis ground.

Specification : Approx. 0 V

4. Is the measured voltage within specification ?

YES

► Go to HO2S(B2/S2) "Component Inspection" procedure.

NO

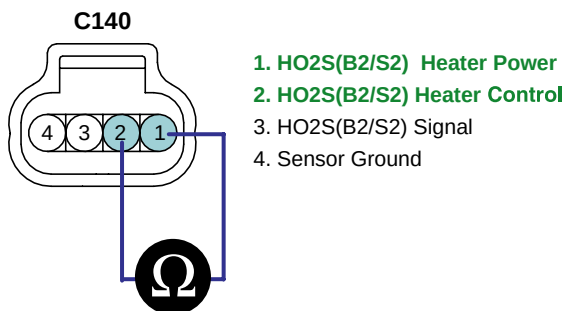
► Repair short to battery in HO2S (B2/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E57F7DC0

1. Check HO2S(B2/S2) Heater resistance
 - 1) IG "OFF" and disconnect HO2S(B2/S2) connector
 - 2) Measure resistance between terminal 1 and 2 of HO2S(B2/S2)(Component Side)

SPECIFICATION :

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 °C (69.8 °F)



SBLF26432L

- 3) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO

► Substitute with a known - good HO2S(B2/S2) and check for proper operation. If the problem is corrected, replace HO2S(B2/S2) and go to "Verification of Vehicle Repair" procedure.

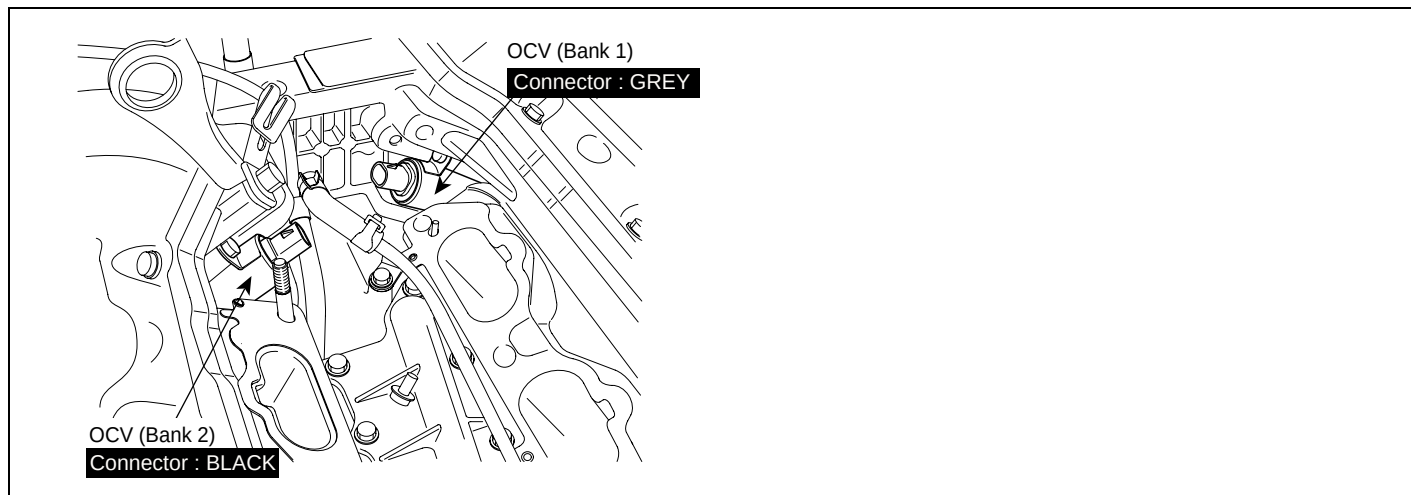
VERIFICATION OF VEHICLE REPAIR EA75F671

Refer to DTC P0056.

DTC P0076 INTAKE VALVE CONTROL SOLENOID CIRCUIT LOW (BANK 1)
DTC P0082 INTAKE VALVE CONTROL SOLENOID CIRCUIT LOW (BANK 2)

COMPONENT LOCATION

E480487B



EGRF602F

GENERAL DESCRIPTION

ED6597E0

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC DESCRIPTION

EC6B2B04

When the enable condition is satisfied, The ECM checks that OCV outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented. If the failure threshold is exceeded 5 seconds during one diagnostic test(10second), the test is failed and DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION

E7809DCA

Item	Detecting Condition	Possible cause
DTC Strategy	Detects a short to ground or open	- Poor Connection - Open in Power Circuit - Open or short to ground in control circuit - OCV - ECM
Enable Conditions	- No disabling Faults Present - Engine Running $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	Short to ground or open circuit	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 Driving Cycles	

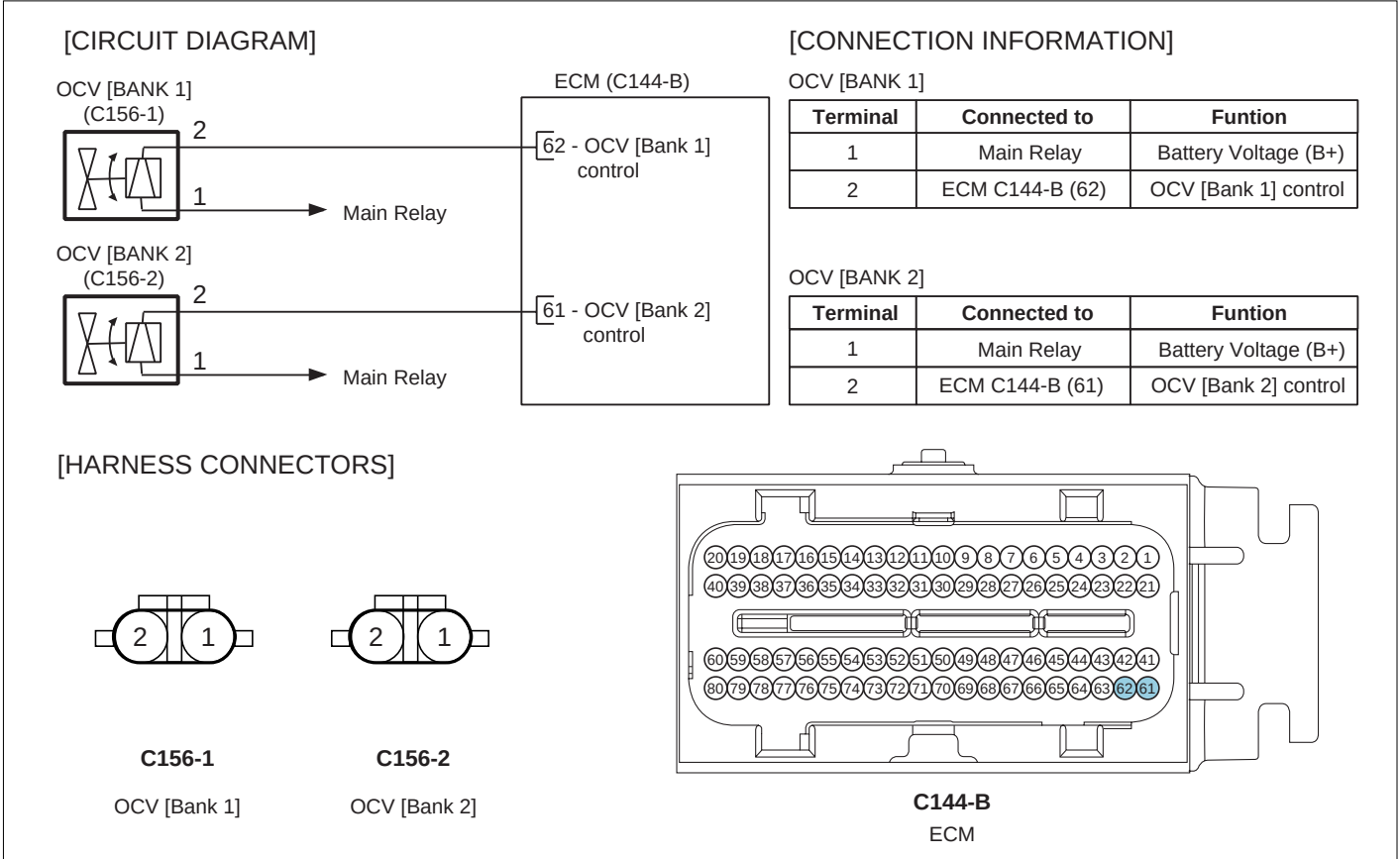
DTC TROUBLESHOOTING PROCEDURES

FLB -153

SPECIFICATION EFF0CC2F

Resistance (Ω)	6.7 ~ 7.7 Ω at 20 °C (68 °F)

SCHEMATIC DIAGRAM E3FE7E34



SBLF26210L

SIGNAL WAVEFORM AND DATA E5B06F78

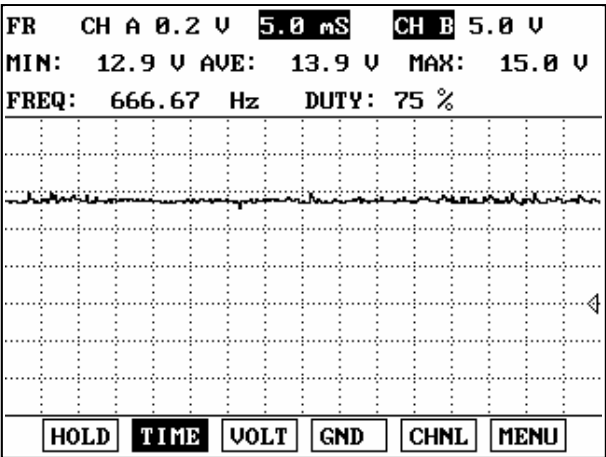


Fig. 1

Fig. 1 : Idle

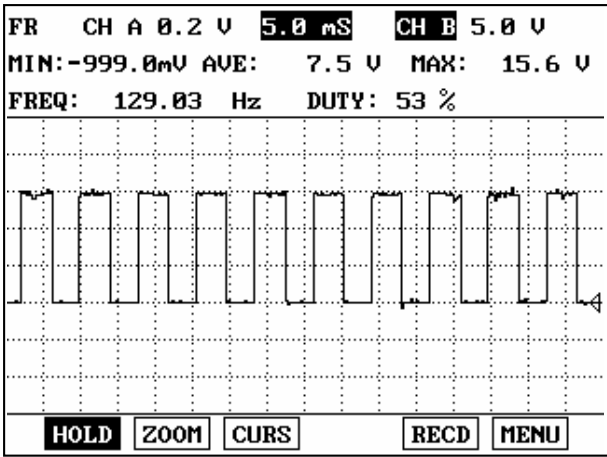


Fig. 2

Fig. 2 : Accelleration

EGRF602G

The oil control valve is commanded by a pulse-width-modulated signal from the engine control unit. A duty cycle of zero commands the cam phaser to its default position. A duty cycle of 100% commands the phaser to its maximum phased position. When the phaser must be controlled to an intermediate position, the duty cycle is maintained in the region of the 'hold position'. This is a medium duty cycle, usually between 35% and 65%, depending on temperature and voltage conditions.

MONITOR DTC STATUS E70C4A9F

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure..

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EF99A833

1. Many malfunctions in the electrical system are caused by poor harness and terminals.
Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Go to " Power Circuit Inspection " procedure

POWER CIRCUIT INSPECTION E3D295EF

1. IG "OFF" & Disconnect OCV(B1) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 1 of OCV harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES

- ▶ Go to "Control Circuit Inspection" procedure.

NO

- ▶ Check fuse between Main Relay and OCV is open or not installed.
- ▶ Check open in power circuit between Main Relay and OCV power circuit.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E7DD789B

1. Check short to ground in harness.
 - 1) IG "OFF" and disconnect OCV connector.
 - 2) IG "ON" & ENG "OFF".
 - 3) Measure resistance between terminal 2 of OCV harness connector and chassis ground.

Specification : Infinite

- 4) Is the measured resistance within specification ?

YES

- ▶ Go to "Check open in harness" as follows

NO

- ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness
 - 1) IG "OFF" and disconnect OCV and ECM connector.

- 2) [P0076] Measure resistance between terminal 2 of OCV harness connector and terminal 62 of ECM harness connector(C144-B).
[P0082] Measure resistance between terminal 2 of OCV harness connector and terminal 61 of ECM harness connector(C144-B).

Specification : Approx. below 1Ω

- 3) Is the measured resistance within specification ?

YES

► Go to "Component Inspection" procedure.

NO

- 4) ► Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

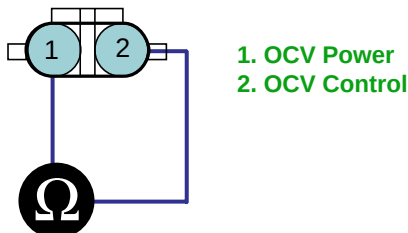
E2B31C7F

1. Check OCV

- 1) IG "OFF" and disconnect OCV connector.
- 2) Measure resistance between terminal 1 and 2 of OCV. (Component Side)

SPECIFICATION :

Resistance (Ω)	6.7 ~ 7.7 Ω at 20 °C (68 °F)



SBLF26998L

- 3) Is the measured resistance within specification ?

YES

► Go to "OCV Actuation Test" as follows.

NO

► Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

2. OCV Actuation Test

- 1) Connect scantool and IG "ON".
- 2) Select "OCV" on the Actuation Test.
- 3) Activate "OCV" by pressing "STRT(F1)" key.

DTC TROUBLESHOOTING PROCEDURES

FLB -157

(should hear a faint click from Oil Control solenoid Valve)

- 4) Repeat this procedure 4 or 5 times to ensure reliability.

1.11 ACTUATION TEST		12/25
OIL CONTROL VALVE		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE OFF	
PRESS [STRT], IF YOU ARE READY ? SELECT TEST ITEM USING UP/DOWN KEY		
STRT STOP		

EGRF602M

- 5) Does OCV generate click sound during acutation test ?

YES

- Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

- Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E099F879

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- System performing to specification at this time. Clear the DTC

NO

- Go to the applicable troubleshooting procedure.

FLB -158

FUEL SYSTEM

DTC P0077	INTAKE VALVE CONTROL SOLENOID CIRCUIT HIGH (BANK 1)
DTC P0083	INTAKE VALVE CONTROL SOLENOID CIRCUIT HIGH (BANK 2)

COMPONENT LOCATION E59CD1BE

Refer to DTC P0076.

GENERAL DESCRIPTION E71C1937

Refer to DTC P0076.

DTC DESCRIPTION E32C16E8

When the enable condition is satisfied, The ECM checks that OCV outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented. If the failure threshold is exceeded 5 seconds during one diagnostic test(10second),the test is failed and DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E74C7953

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in Control Circuit • OCV • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• Short to battery	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EC27C7A1

Refer to DTC P0076.

SCHEMATIC DIAGRAM E6A383BA

Refer to DTC P0076.

SIGNAL WAVEFORM AND DATA E74CE559

Refer to DTC P0076.

MONITOR DTC STATUS E91B28DF

Refer to DTC P0076.

TERMINAL AND CONNECTOR INSPECTION EF713890

Refer to DTC P0076.

DTC TROUBLESHOOTING PROCEDURES

FLB -159

CONTROL CIRCUIT INSPECTION EF769C55

1. IG "OFF" and Disconnect OCV connector.
2. Measure resistance between terminal 1 and 2 of OCV harness connector.

Specification : Infinite

3. Is the measured resistance within specification ?

YES

► Go to "Component Inspection" procedure.

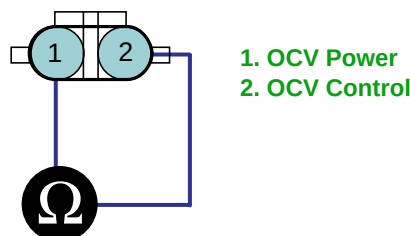
NO

► Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E0A12590

1. Check OCV
 - 1) IG "OFF" and disconnect OCV connector.
 - 2) Measure resistance between terminal 1 and 2 of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω at 20°C(68°F)



SBLF26998L

- 3) Is the measured resistance within specification ?

YES

► Go to "OCV Actuation Test" as follows.

NO

► Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

2. OCV Actuation Test

- 1) Connect scantool and IG "ON".
- 2) Select "OCV" on the Actuation Test.
- 3) Activate "OCV" by pressing "STRT(F1)" key.
(should hear a faint click from Oil Control solenoid Valve)

- 4) Repeat this procedure 4 or 5 times to ensure reliability.

1.11 ACTUATION TEST		12/25
OIL CONTROL VALVE		
DURATION	UNTIL STOP KEY	
METHOD	ACTIVATION	
CONDITION	IG.KEY ON ENGINE OFF	
PRESS [STRT], IF YOU ARE READY ! SELECT TEST ITEM USING UP/DOWN KEY		
STRT STOP		

EGRF602M

- 5) Does OCV generate click sound during acutation test ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E819D703

Refer to DTC P0076.

DTC P0101 MASS OR VOLUME AIR FLOW CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION E5382FD6



SBLF26702L

GENERAL DESCRIPTION EDCCA3A6

The Delphi MAF Sensor is an air mass flowmeter, which operates on the principle of hot film anemometry. A heated element is placed within the air stream, and maintained at a constant temperature above the air temperature. The amount of electrical power required to maintain the heated element at the proper temperature is a direct function of the flow rate of the air mass past the element. ECM uses this information to determine the injection duration and ignition timing for the desired air/fuel ratio.

DTC DESCRIPTION EC23FCBF

The difference between values coming from the MAF Sensor and those are calculated is analyzed. This difference, or error, is then compared to high and low limit calibration values, which are functions of engine speed. ECM compares the difference between MAFS output and calculated flow rate value while enable condition is met.

If the actual air flow is higher or lower than calculated value(threshold) for more than 2min. ECM determines that a fault exists and a DTC is stored. MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EAE86B51

Item	Detecting Condition	Possible cause
DTC Strategy	The MAF Rationality Diagnostic compares the difference between MAF Sensor output and calculated flow rate value to a calibration value	- Clogged air cleaner - MAFS
Enable Conditions	- Engine Coolant Temperature $\geq 60^{\circ}\text{C}$ (Fully Warmed up state) 600rpm < Engine Speed < 3000rpm	
Threshold value	Actual Air Mass Value is higher or lower than calculated value	
Diagnosis Time	Continuous (2 min.)	
MIL On Condition	2 Driving Cycles	

FLB -162

FUEL SYSTEM

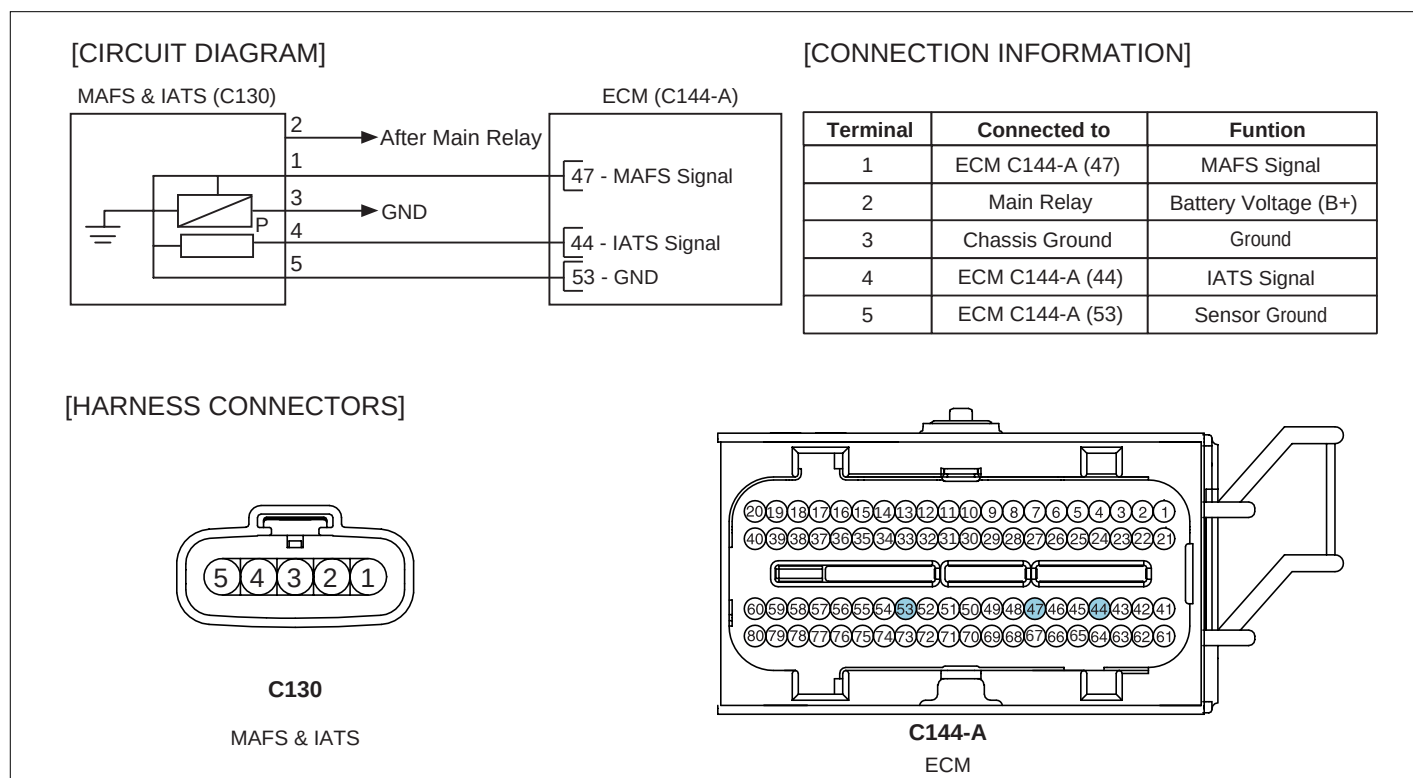
SPECIFICATION

E5577650

Air Flow (kg/h)	Frequency (Hz)
12.6 kg/h	2,617Hz
18.0 kg/h	2,958Hz
23.4 kg/h	3,241Hz
32.4 kg/h	3,653Hz
43.2 kg/h	4,024Hz
57.6 kg/h	4,399Hz
72.0 kg/h	4,704Hz
108.0 kg/h	5,329Hz
144.0 kg/h	5,897Hz
198.0 kg/h	6,553Hz
270.0 kg/h	7,240Hz
360.0 kg/h	7,957Hz
486.0 kg/h	8,738Hz
666.0 kg/h	9,644Hz
900.0 kg/h	10,590Hz

SCHEMATIC DIAGRAM

E20C1BB8



SBLF26202L

MONITOR DTC STATUS

E19FEA28

1. Check DTC Status

DTC TROUBLESHOOTING PROCEDURES

FLB -163

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

SEPFL6413N

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "Component Inspection" procedure.

COMPONENT INSPECTION

E5A04D6F

1. Visual Inspection

- 1) Check that MAFS is damaged, contaminated or deformed.
- 2) Check the air cleaner is clogged.
- 3) Has a problem been found ?

YES

► Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

► Go to "Check MAFS" as follows

2. Check MAFS

- 1) IG "OFF" and install a scantool
- 2) ENG "ON" and monitor "MAFS" data on the service data.

- 3) Monitor signal waveform at terminal 1 of MAFS with scantool.

Specification :Signal waveform will be displayed as follows. (Be aware that the signal of MAFS is not voltage display but frequency display.)

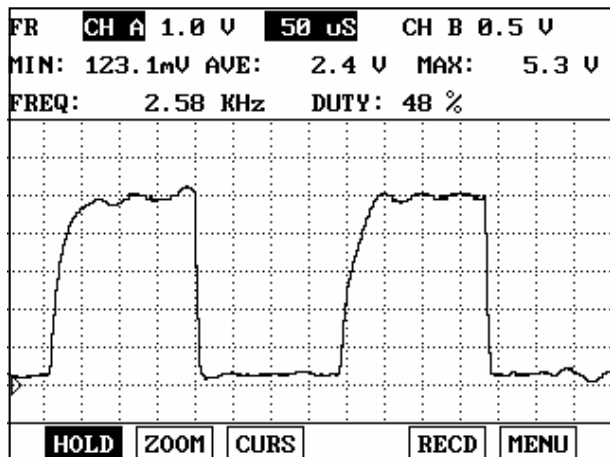


Fig. 1

Fig. 1 : Idle

Fig. 2 : Acceleration

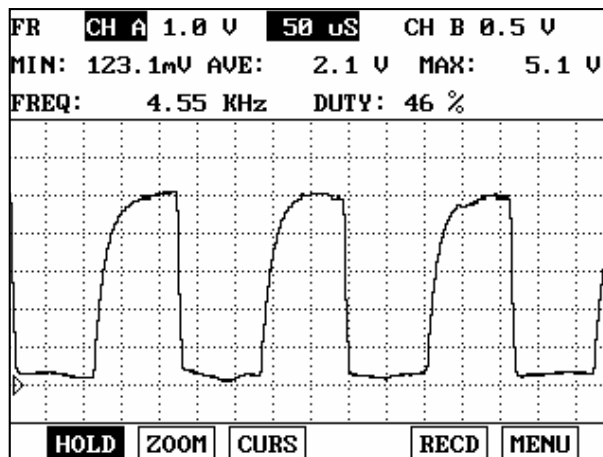


Fig. 2

EGRF603D

- 4) Are both service data and signalwave form displayed correctly ?

YES

- Go to "Verification of Vehicle Repair" procedure.

NO

- Substitute with a known - good MAFS and check for proper operation. If the problem is corrected, replace MAFS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E2344E1E

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- System performing to specification at this time. Clear the DTC

NO

- Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -165

DTC P0102 MASS OR VOLUME AIR FLOW CIRCUIT LOW INPUT

COMPONENT LOCATION E0EBB8B3

Refer to DTC P0101.

GENERAL DESCRIPTION EE28E739

Refer to DTC P0101.

DTC DESCRIPTION EF4CF881

If ECM detects that frequency signal of MAFS is lower than 1000 Hz for more than 75 second during one diagnostic test (125 second) while enable condition is met, ECM determines that a fault exists and a DTC is stored. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ECB71809

Item	Detecting Condition	Possible cause
DTC Strategy	Compares the airmeter input frequency to a low limit	- Poor Connection - Open or short in harness - MAFS - ECM
Enable Conditions	- Engine Speed $\geq$ 500 rpm - Engine Running Time $\geq$ 5 second - Ignition Voltage $\geq$ 11V	
Threshold value	MAF frequency signal $<$ 1000Hz	
Diagnosis Time	Continuous (More than 75 second failure for every 125 second tests)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION E01A95C2

Refer to DTC P0101.

SCHEMATIC DIAGRAM E5B91E3E

Refer to DTC P0101.

MONITOR DTC STATUS ED964CFE

Refer to DTC P0101.

TERMINAL AND CONNECTOR INSPECTION E7ED099E

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION EC0C9C0E

1. IG "OFF" and Disconnect MAFS connector.
2. IG "ON" & ENG "OFF"
3. Measure voltage between terminal 2 of MAFS harness connector and chassis ground

Specification : B+

4. Is the measured voltage within specification ?

YES

- ▶ Go to "Signal Circuit Inspection" Procedure.

NO

- ▶ Check fuse between MAFS and main relay is open or not installed.
- ▶ Repair open in power harness between MAFS and main relay and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E0851D16

1. Check voltage
 - 1) IG "OFF" and disconnect MAFS connector.
 - 2) IG "ON" & ENG "OFF".
 - 3) Measure voltage between terminal 1 of MAFS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification ?

YES

- ▶ Go to "Ground circuit inspection" procedure.

NO

- ▶ If the measured voltage is "0", go to "Check open in harness" as follows. If the measured voltage is over "5V", go to " Check short to battery in harness" as follows.

2. Check short to battery in harness
 - 1) IG "OFF" and disconnect MAFS and ECM connector.
 - 2) Measure resistance between terminal 1 and 2 of MAFS harness connector.

DTC TROUBLESHOOTING PROCEDURES

FLB -167

- 3) Measure resistance between terminal 1 and 4 of MAFS harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification ?

YES

- ▶ Go to "Check short to ground in harness" as follows.

NO

- ▶ Repair short to battery in harness and go to "Verification of Vehicle Repair" procedure.

3. Check short to ground in harness

- 1) IG "OFF" and disconnect MAFS and ECM connector.
- 2) Measure resistance between terminal 1 of MAFS harness connector and chassis ground.

Specification : Infinite

- 3) Is the measured resistance within specification ?

YES

- ▶ Go to "Check open in harness" as follows.

NO

- ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

4. Check open in harness

- 1) IG "OFF" and disconnect MAFS and ECM connector.
- 2) Measure resistance between terminal 1 of MAFS harness connector and terminal 47 of ECM harness connector(C144-A).

Specification : Approx. below 1Ω .

- 3) Is the measured resistance within specification ?

YES

- ▶ Go to "Ground circuit Inspection" procedure.

NO

- ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E97D9386

1. IG "OFF" and disconnect MAFS connector.
2. Measure voltage between terminal 1 of MAFS harness connector and chassis ground.

3. Measure voltage between terminal 1 and 3 of MAFS harness connector.

Specification : Voltage difference between Measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES

- ▶ Go to "Component Inspection" procedure.

NO

- ▶ Repair contact resistance or open in harnesss and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EDC6FF4C

1. Visual Inspection

- 1) Check that MAFS is damaged, contaminated or deformed.
- 2) Has a problem been found ?

YES

- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Go to "Check MAFS" as follows

2. Check MAFS

- 1) IG "OFF" and install a scantool
- 2) ENG "ON" and monitor "MAFS" data on the service data.
- 3) Monitor signal waveform at terminal 1 of MAFS with scantool.

Specification :Signal waveform will be displayed as follows. (Be aware that the signal of MAFS is not voltage display but frequency display.)

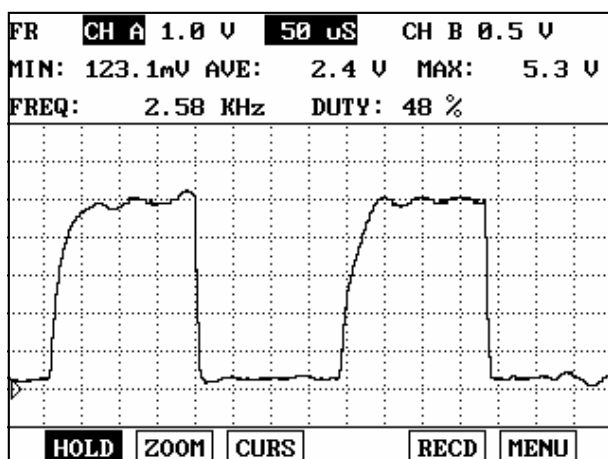


Fig. 1

Fig. 1 : Idle

Fig. 2 : Acceleration

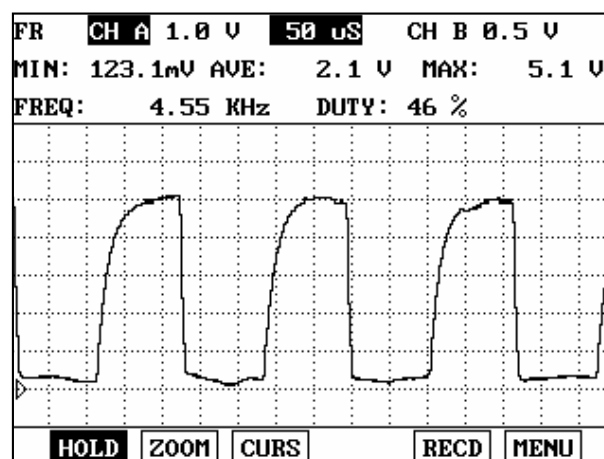


Fig. 2

EGRF603D

- 4) Are both service data and signalwave form displayed correctly ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known - good MAFS and check for proper operation. If the problem is corrected, replace MAFS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E37D2FB6

Refer to DTC P0101.

FLB -170

FUEL SYSTEM

DTC P0103 MASS OR VOLUME AIR FLOW CIRCUIT HIGH INPUT

COMPONENT LOCATION EB8015D2

Refer to DTC P0101.

GENERAL DESCRIPTION E64AA4B9

Refer to DTC P0101.

DTC DESCRIPTION EB6BC429

If ECM detects that frequency signal of MAFS is higher than 11900 Hz for more than 75 second during 125 second diagnostic test while enable condition is met, ECM determines that a fault exists and a DTC is stored. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EE201724

Item	Detecting Condition	Possible cause
DTC Strategy	Compares the airmeter input frequency to a high limit	- Noise - MAFS - ECM
Enable Conditions	- Engine Speed $\geq$ 500 rpm - Engine Running Time $\geq$ 5 second - Ignition Voltage $\geq$ 11V	
Threshold value	MAF frequency signal $>$ 11900Hz	
Diagnosis Time	Continuous (More than 75 second failure for every 125 second tests)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION E228E253

Refer to DTC P0101.

SCHEMATIC DIAGRAM E4FEFC25

Refer to DTC P0101.

MONITOR DTC STATUS E6025775

Refer to DTC P0101.

TERMINAL AND CONNECTOR INSPECTION E992D470

Refer to DTC P0102.

GROUND CIRCUIT INSPECTION EDCD0AB4

- IG "OFF"
- Disconnect MAFS connector.

DTC TROUBLESHOOTING PROCEDURES

FLB -171

3. Measure the voltage between terminal 1 of MAFS harness connector.
4. Measure the voltage between terminal 1 and 3 of MAFS harness connector.

Specification : Voltage difference and "A" and B" is below 200mV

5. Is the measured voltage within the specification?

YES

▶ Go to "Component Inspection".

NO

▶ After repairing or replacing contact resistance in ground circuit and open in the MAFS circuit, go to "Verification and Vehicle Repair".

COMPONENT INSPECTION

EF8E47BF

1. Visual Inspection

- 1) Check that MAFS is damaged, contaminated or deformed.
- 2) Has a problem been found ?

YES

▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Check MAFS" as follows

2. Check MAFS

- 1) IG "OFF" and install a scantool
- 2) ENG "ON" and monitor "MAFS" data on the service data.
- 3) Monitor signal waveform at terminal 1 of MAFS with scantool.

Specification :Signal waveform will be displayed as follows. (Be aware that the signal of MAFS is not voltage display but frequency display.)

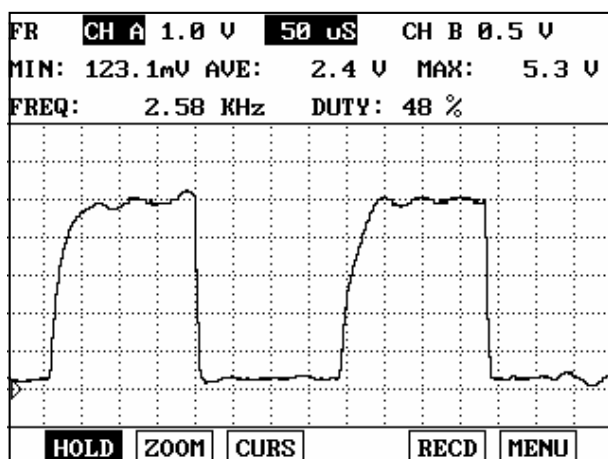


Fig. 1

Fig. 1 : Idle

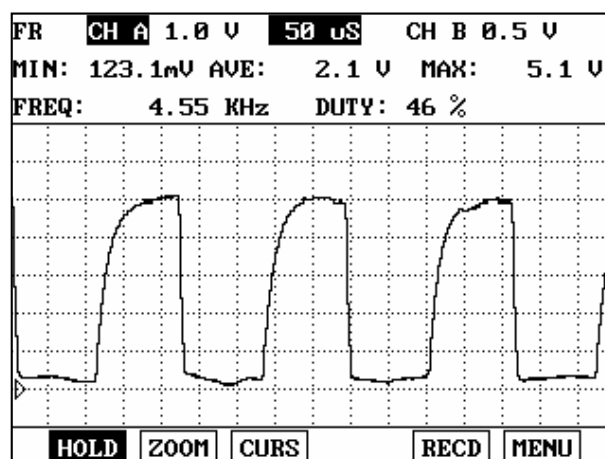


Fig. 2

Fig. 2 : Acceleration

EGRF603D

- 4) Are both service data and signalwave form displayed correctly ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known - good MAFS and check for proper operation. If the problem is corrected, replace MAFS and go to "Verification of Vehicle Repair" procedure.

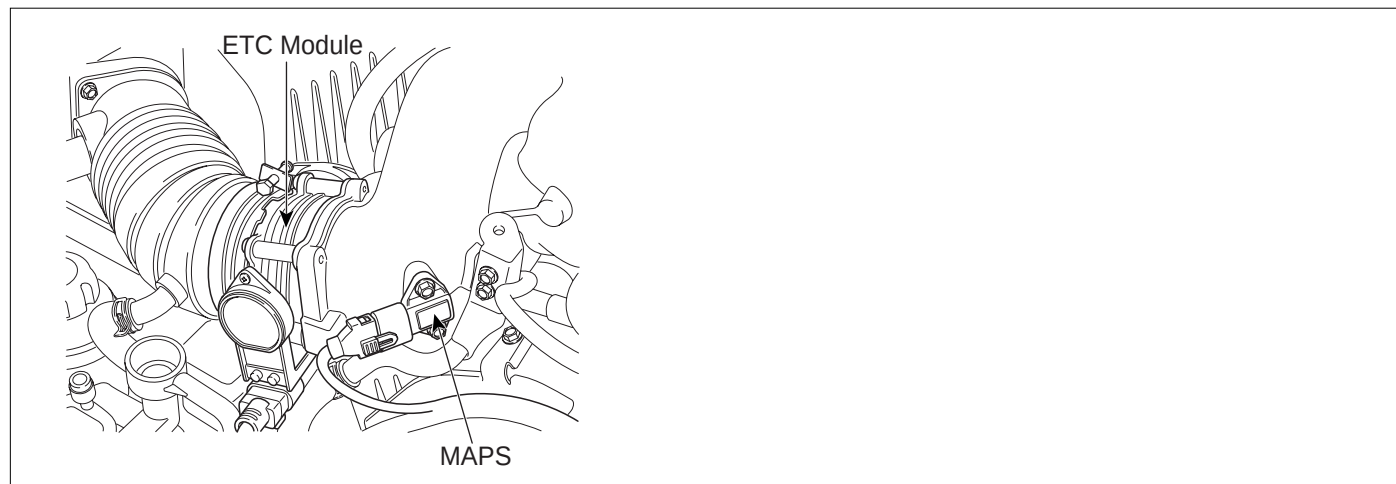
VERIFICATION OF VEHICLE REPAIR

EDE2D0FD

Refer to DTC P0101.

DTC P0105 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT

COMPONENT LOCATION E615CDC3



SBLF26703L

GENERAL DESCRIPTION E64F0077

The amount of intake air flow must be inputted to ECM in order to determine the fuel injection quantity. To measure the pressure inside of intake manifold, MAFS is used at idle and MAPS is required at accelerating. MAPS(Manifold Absolute Pressure) calculates the amount of air indirectly as measuring the pressure inside of intake manifold. This mechanism is also called Speed-Density Type. MAPS transfers analog output signal which is proportional to the change of intake manifold pressure, then, with this signal and RPM, ECM calculates the amount of intake air flow. MAPS is mounted on surge tank to measure the pressure inside of intake manifold, and it consists of a piezo electric element and hybrid IC which amplifies output signal from the element. A piezo electric element is a sort of a diaphragm using piezo electric effect. One side of the diaphragm is surrounded with vacuum chamber while intake pressure is applied to the other side. Thus, signals are output by the transformation of diaphragm according to the change of pressure inside of intake manifold.

DTC DESCRIPTION E1845E54

If the signal output of MAP sensor is stuck under enable conditions, ECM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E224D5C5

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the MAP sensor's signal	Faulty MAPS
Enable Conditions	- No Disabling Fault Present - Shutdown time > 20 minutes - Engine running	
Thresh old value	The difference between the signal at key-on and the signal at engine start < 0.5 kPa	
Diagnosis Time	For 3 seconds out of 5 seconds	
MIL On Condition	2 driving cycles	

FLB -174

FUEL SYSTEM

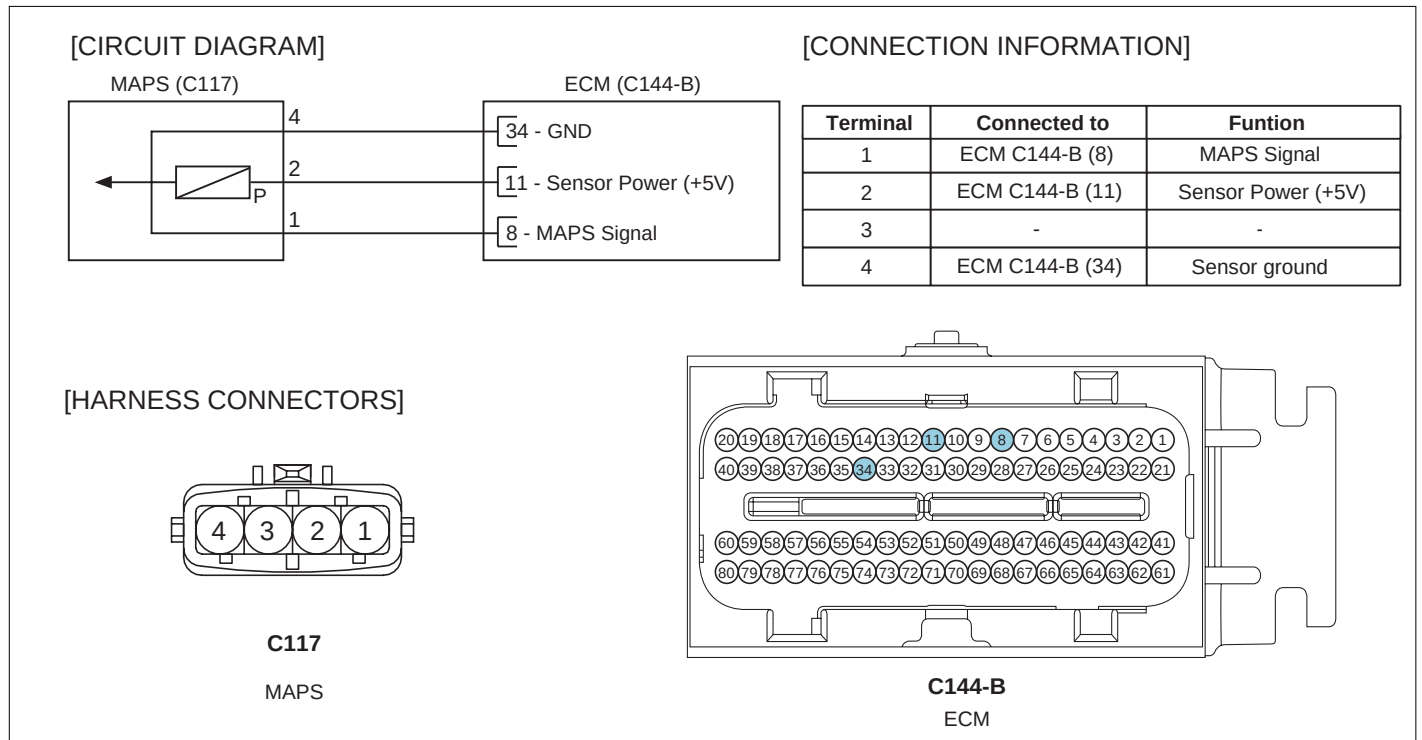
SPECIFICATION

E5EE07F4

Pressure(kPa)	20	35	60	95	101.32
Voltage(V)	0.789	1.382	2.369	3.75	4
Tolerance(V)	± 0.045				

SCHEMATIC DIAGRAM

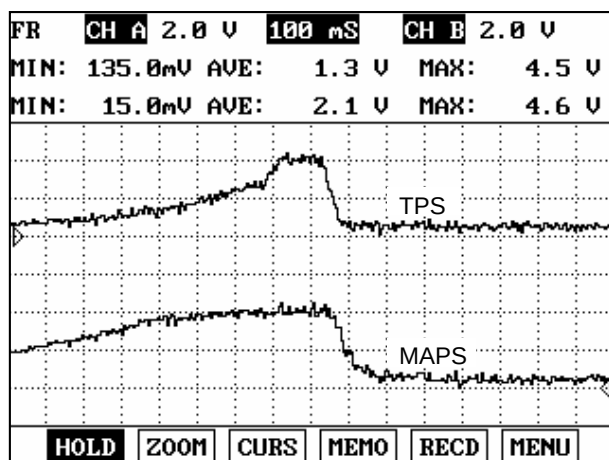
E9238FFB



SBLF26203L

SIGNAL WAVEFORM AND DATA

EEE9BA30



EGRF6030

It is necessary that MAPS should be checked along with TPS. Because The MAP/TPS Rationality Diagnostic is comprised of two tests. A deceleration test is performed to provide a robust method for detection of an altitude compensated MAP value that is too high for the deceleration condition. The second test compares the altitude compensated MAP value to both high and low limits, dependent upon throttle position and engine speed. When the MAP value is out of the threshold range, the MAP/TPS system is determined to be failed.

DTC TROUBLESHOOTING PROCEDURES

FLB -175

MONITOR DTC STATUS E1D8FC1F

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES		
PXXXX DTC TITLE		
NUMBER OF DTC : 1 ITEMS		
PART	ERAS	DTAL

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SCMF16159L

5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable codition then,go to " Component Inspection" procedure.

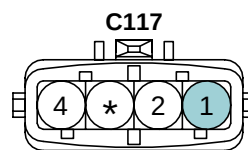
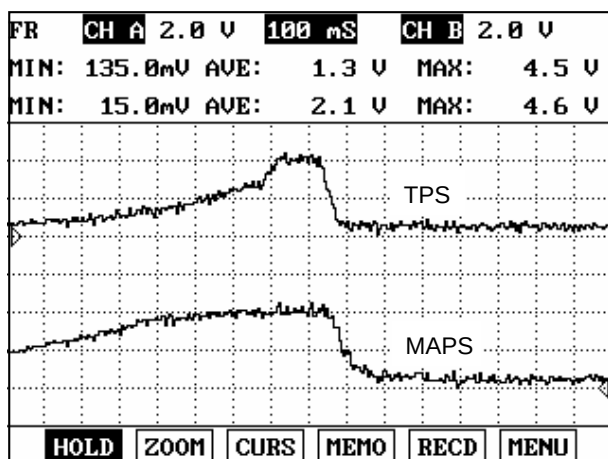
COMPONENT INSPECTION EFD309EF

1. Check MAPS Performance

- 1) IG "OFF" and install scatool.
- 2) Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.
- 3) ENG "ON" and monitor signal waveform during accelleration and decelleration.

■ SPECIFICATON :

Pressure(kPa)	20	35	60	95	101.32
Voltage(V)	0.789	1.382	2.369	3.75	4
Tolerance(V)	± 0.045				



- 1. MAPS Signal
- 2. MAPS Power
-
- 4. MAPS Ground

SBLF26450L

4) Is the measured signal waveform(MAP/TPS Rationality) O.K ?

YES

► Go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good MAPS and check for proper operation.

► If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E9AF1751

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC.

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -177

DTC P0106 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION EAA333F4

Refer to DTC P0105.

GENERAL DESCRIPTION EA611000

Refer to DTC P0105.

DTC DESCRIPTION E92CAE0E

ECM compares the difference between MAPS output and calculated MAPS value while enable condition is met. If the actual MAP value or lower than calculated(threshold) value for 2 min failure during tip in-out driving, ECM determines that a fault exists and a DTC is stored. MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC DETECTING CONDITION ESC72E5E

Item		Detecting Condition	Possible cause
DTC Strategy		The MAP reading is compared to expected MAP high and low limits based on engine speed & Throttle Position	- Faulty TPS - Faulty MAPS
Enable Conditions	Case 1	- Engine Coolant Temperature $\geq 60^{\circ}\text{C}$ (Fully Warmed up state) 600rpm < Engine Speed < 3000rpm	
	Case 2	- Power Test - Altitude compensated MAP < Calculated min. MAP data - Altitude compensated MAP > Calculated max. MAP data	
Threshold value	Case 1	- Power Test - Altitude compensated MAP < Calculated min. MAP data - Altitude compensated MAP > Calculated max. MAP data	
	Case 2	Deceleration Test - Altitude compensated MAP < Memorized MAP data	
Diagnosis Time		Continuous (For 2min. in mild tip in - out Driving)	
MIL On Condition		2 Driving Cycles	

SPECIFICATION E0450916

Refer to DTC P0105.

SCHEMATIC DIAGRAM E6E3CDCD

Refer to DTC P0105.

SIGNAL WAVEFORM AND DATA

EB35F92C

Refer to DTC P0105.

MONITOR DTC STATUS

E3F83C5C

Refer to DTC P0105.

COMPONENT INSPECTION

EE939F49

1. Check TPS

- 1) Visually check that TPS is contaminated by foreign materials, deformed, or damaged
- 2) Has a problem been found ?

YES

► Go to "Check MAPS Performance" as follows.

NO

► Substitute with a known - good TPS and check for proper operation.

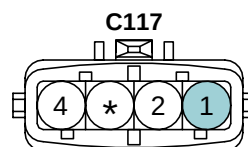
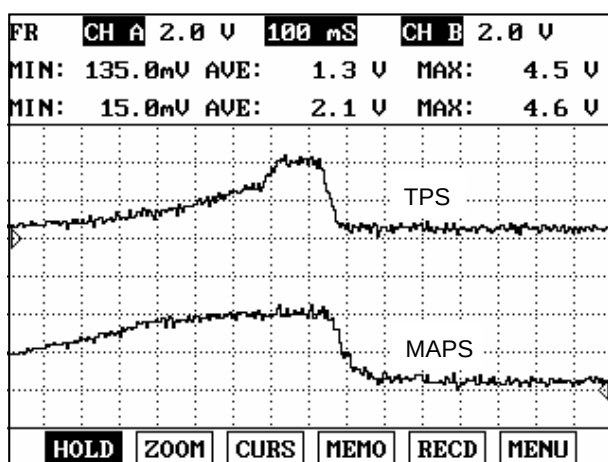
If the problem is corrected, replace TPS and go to "Verification of Vehicle Repair" procedure.

2. Check MAPS Performance

- 1) IG "OFF" and install scatool.
- 2) Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.
- 3) ENG "ON" and monitor signal waveform during acceleration and deceleration.

SPECIFICATON :

Pressure (kPa)	20	35	60	95	101.32
Voltage (V)	0.789	1.382	2.369	3.75	4
Tolerance (V)	± 0.045				



1. MAPS Signal
2. MAPS Power
-
4. MAPS Ground

SBLF26450L

- 4) Is the measured signal waveform(MAP/TPS Rationality) O.K ?

DTC TROUBLESHOOTING PROCEDURES

FLB -179

YES

- ▶ Go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Substitute with a known - good MAPS and check for proper operation. If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E7349875

Refer to DTC P0105.

DTC P0107 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT LOW INPUT

COMPONENT LOCATION EC435684

Refer to DTC P0105.

GENERAL DESCRIPTION E1D60F37

Refer to DTC P0105.

DTC DESCRIPTION E1C7FE9C

Checking output signals of MAPS every 5 sec. under detecting condition, if an output signal is below 0.25V for more than 2.5 sec., ECM sets P0107. MIL(Malfuction Indication Lamp) turns on when the malfunction lasts till continuous 2 driving cycle.

DTC DETECTING CONDITION E4E2AE7C

Item		Detecting Condition	Possible cause
DTC Strategy		This code detects a continuous short to low or open in either the signal circuit or the MAP	- Connecting condition - Open or short to ground in power circuit - Open or short to ground in signal circuit - MAPS - ECM
Enable Conditions	Case 1	- No TPS Active Fault Present - Ignition Voltage $\geq 11V$ - Engine Speed $\leq 1000rpm$ - Throttle Position $\geq 0\%$	
	Case 2	- No TPS Active Fault Present - Ignition Voltage $\geq 11V$ - Engine Speed $> 1000rpm$ - Throttle Position $\geq 30\%$	
Threshold value		MAP Signal $< 0.25V$	
Diagnosis Time		Continuous (More than 2.5 seconds failure for every 5 seconds test)	
MIL On Condition		2 Driving Cycle	

SPECIFICATION E130E183

Refer to DTC P0105.

SCHEMATIC DIAGRAM E2F7B1CD

Refer to DTC P0105.

SIGNAL WAVEFORM AND DATA E7C2B11E

Refer to DTC P0105.

DTC TROUBLESHOOTING PROCEDURES

FLB -181

MONITOR DTC STATUS E934DFD0

Refer to DTC P0105.

TERMINAL AND CONNECTOR INSPECTION EA6C9D8C

Refer to DTC P0105.

POWER CIRCUIT INSPECTION E48693F7

1. IG "OFF"
2. Disconnect MAPS connector.
3. IG "ON"
4. Measure the voltage between terminal 2 of MAPS harness connector and ground.

Specification : Approx. 5V

5. Is the measured voltage within specification ?

YES

► Go to "Signal Circuit Inspection" of MAPS.

NO

► After repairing open or short to ground in circuits and go to "Verification of Vehicle Repair"

SIGNAL CIRCUIT INSPECTION E8879624

1. Check short to ground in harness.
 - 1) IG "OFF"
 - 2) Disconnect MAPS and ECM connector.
 - 3) Measure the resistance between terminal 1 of MAPS harness connector and ground.

Specification : Infinite

- 4) Is the measured resistance within the specification?

YES

► Go to "Check open in the harness" procedure.

NO

► After repairing short to ground in harness and go to "Verification of Vehicle Repair"

2. Check open in the harness

- 1) IG "OFF"
- 2) Disconnect MAPS and ECM connector.

- 3) Measure the resistance between terminal 1 of MAPS harness connector and terminal 8 of ECM harness connector(C144-B).

Specification : Approx. below 1 Ω

- 4) Is the measured resistance within the specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair open in the harness and go to "Verification of Vehicle Repair".

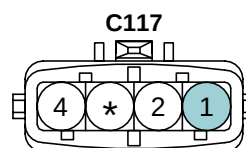
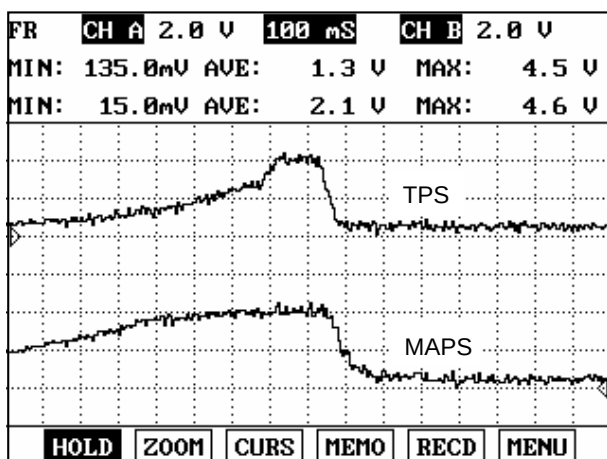
COMPONENT INSPECTION E46DD8D9

1. MAPS performance test

- 1) IG "OFF"
- 2) Connect scantool to Data Link Connector(DLC) and select "Oscilloscope" then, connect probes to output signal lines of MAPS and TPS.
- 3) Start engine and monitor the signal waveforms during accelerating and decelerating

SPECIFICATON :

Pressure (kPa)	20	35	60	95	101.32
Voltage (V)	0.789	1.382	2.369	3.75	4
Tolerance (V)	± 0.045				



1. MAPS Signal
2. MAPS Power
-
4. MAPS Ground

SBLF26450L

- 4) Is the waveform displayed correctly?(Compare the response time of TPS and MAPS)

YES

► Go to "Check ECM".

NO

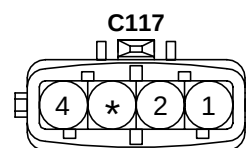
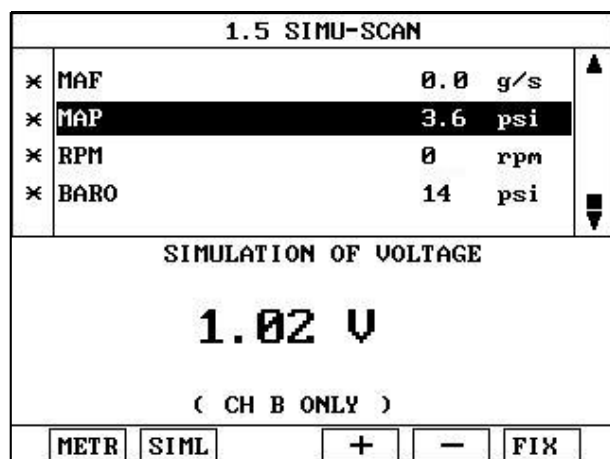
DTC TROUBLESHOOTING PROCEDURES

FLB -183

► After replacing MAPS with new one, if it operates normally, replace MAPS and go to "Verification of Vehicle Repair".

2. Check ECM

- 1) IG "OFF" disconnect MAPS connector
- 2) Connect Scantool and IG "ON" & ENG "OFF"
- 3) Select simulation function on scantool.
- 4) Simulate voltage at terminal 1 of MAPS harness connector.



1. MAPS Signal
2. MAPS Power
-
4. MAPS Ground

SBLF26454L

- 5) Does the output voltage response to the change of signal by simulation?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace if necessary and go to "Verification of Vehicle Repair" procedure

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E271A4D7

Refer to DTC P0105.

DTC P0108 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT HIGH INPUT

COMPONENT LOCATION E7DA504A

Refer to DTC P0105.

GENERAL DESCRIPTION EA679706

Refer to DTC P0105.

DTC DESCRIPTION EE0AAB13

Checking output signals of MAPS every 5 sec. under detecting condition, if an output signal is above 4.5V for more than 2.5 sec., ECM sets P0108. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EAB4EC26

Item		Detecting Condition	Possible cause
DTC Strategy		This code detects a continuous short to high in either the signal circuit or the MAP sensor	- Connecting condition - Short to battery in Signal Circuit - Open in Ground Circuit - Faulty MAPS - Faulty ECM
Enable Conditions	Case 1	- No TPS Active Fault Present - Engine Running Time > 10sec. - Engine Speed ≤ 2500rpm - Throttle Position ≤ 30%	
	Case 2	- No TPS Active Fault Present - Engine Running Time > 10sec. - Engine Speed > 2500rpm - Throttle Position ≤ 40%	
Threshold value		MAP Signal > 4.5V	
Diagnosis Time		Continuous (More than 2.5 seconds failure for every 5 seconds test)	
MIL On Condition		2 Driving Cycle	

SPECIFICATION E82A8313

Refer to DTC P0105.

SCHEMATIC DIAGRAM E95D454E

Refer to DTC P0105.

SIGNAL WAVEFORM AND DATA E4787227

Refer to DTC P0105.

DTC TROUBLESHOOTING PROCEDURES

FLB -185

MONITOR DTC STATUS EBBA5BCF

Refer to DTC P0105.

TERMINAL AND CONNECTOR INSPECTION E9732A1C

Refer to DTC P0105.

POWER CIRCUIT INSPECTION E6867740

1. IG "OFF"
2. Disconnect MAPS connector
3. IG "ON"
4. Measure the voltage between terminal 2 of MAPS harness connector and ground.

Specification : Approx. 5V

5. Is the measured voltage within specification ?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

- ▶ If the voltage is over 5.1V, check short to battery in harness.
- ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E4B88200

1. IG "OFF".
2. Disconnect MAPS connector.
3. IG "ON" & ENG "OFF"
4. Measure the voltage between terminal 2 of MAPS harness connector and chassis ground.
5. Measure the voltage between terminal 2 and 4 of MAPS harness connector.

Specification : "A" - "B" = : Approx. below 200mV

6. Is the measured voltage within specification ?

YES

▶ Go to "Signal Circuit Inspection" procedure.

NO

▶ Repair contact resistance or open in harness and then go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION

E621818A

1. IG "OFF"
2. Disconnect MAPS and ECM connector.
3. Measure resistance between terminal 1 and 2 of MAPS harness connector.

Specification : Infinite

4. Is the measured resistance within specification ?

YES

- Go to "Component Inspection" procedure.

NO

- Repair short to battery in harness and then go to "Verification of Vehicle Repair" procedure.

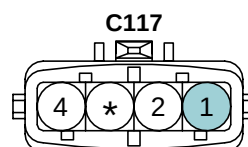
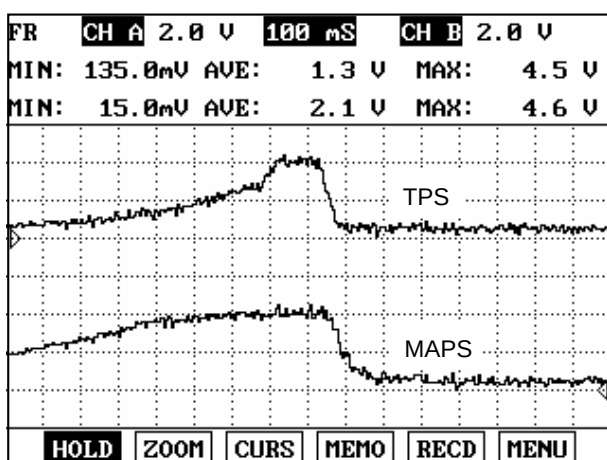
COMPONENT INSPECTION

E064ACF2

1. MAPS performance test
 - 1) IG "OFF"
 - 2) Connect scantool to Data Link Connector(DLC) and select "Oscilloscope" then, connect probes to output signal lines of MAPS and TPS.
 - 3) Start engine and monitor the signal waveforms during accelerating and decelerating

SPECIFICATON :

Pressure (kPa)	20	35	60	95	101.32
Voltage (V)	0.789	1.382	2.369	3.75	4
Tolerance (V)	± 0.045				



1. MAPS Signal
2. MAPS Power
-
4. MAPS Ground

SBLF26450L

- 4) Is the waveform displayed correctly?(Compare the response time of TPS and MAPS)

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -187

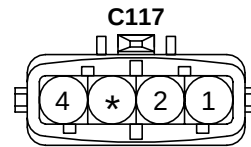
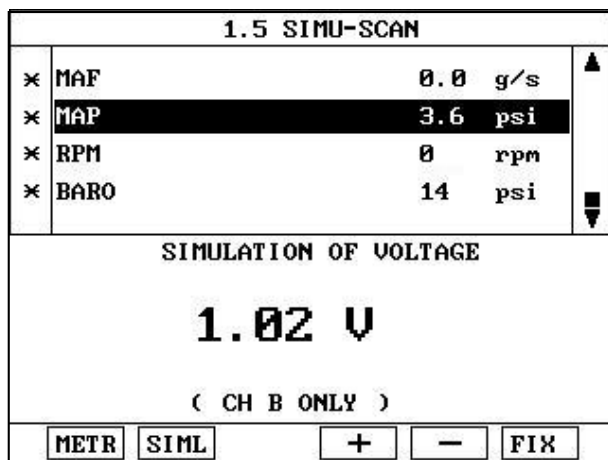
► Go to "Check ECM".

NO

► After replacing MAPS with new one, if it operates normally, replace MAPS and go to "Verification of Vehicle Repair".

2. Check ECM

- 1) IG "OFF" disconnect MAPS connector
- 2) Connect Scantool and IG "ON" & ENG "OFF"
- 3) Select simulation function on scantool.
- 4) Simulate voltage at terminal 1 of MAPS harness connector.



1. MAPS Signal
2. MAPS Power
-
4. MAPS Ground

SBLF26454L

- 5) Does the output voltage response to the change of signal by simulation?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace if necessary and go to "Verification of Vehicle Repair" procedure

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EDAE5551

Refer to DTC P0105.

DTC P0110 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT

COMPONENT LOCATION EF3AAE7A



SBLF26702L

GENERAL DESCRIPTION E43D50CA

The Intake Air Temperature Sensor (IATS) is installed into the Mass Air Flow Sensor (MAFS). 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 DESCRIPTION EDE2FD98

ECM monitors temperature difference between MAX. and MIN IATS in order to detect movement in IATS not only Start Test but Drive Test while enable condition is met. If ECM detects intake air temperature changes less than 5.4 °F ECM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC TROUBLESHOOTING PROCEDURES

FLB -189

DTC DETECTING CONDITION

ED00B60C

Item		Detecting Condition	Possible cause
DTC Strategy	Case 1	Start Test: Monitors the difference between max and min IAT in order to detect movement in IAT for a certain time.	Faulty IATS
	Case 2	Drive test: Performs the max and min delta check while driving under load for a length of time followed by an idle for a certain time..	
Enable Conditions		- Engine soaked time > 360min - Engine Running State - No fault present - IAT stored previous trip - No IAT Tests pending	
Thresh old value	Case 1	Max IAT - Min IAT ≤ 3°C(5.4 °F)	
	Case 2	Continuous (10 min.)	
MIL On Condition		2 driving Cycles	

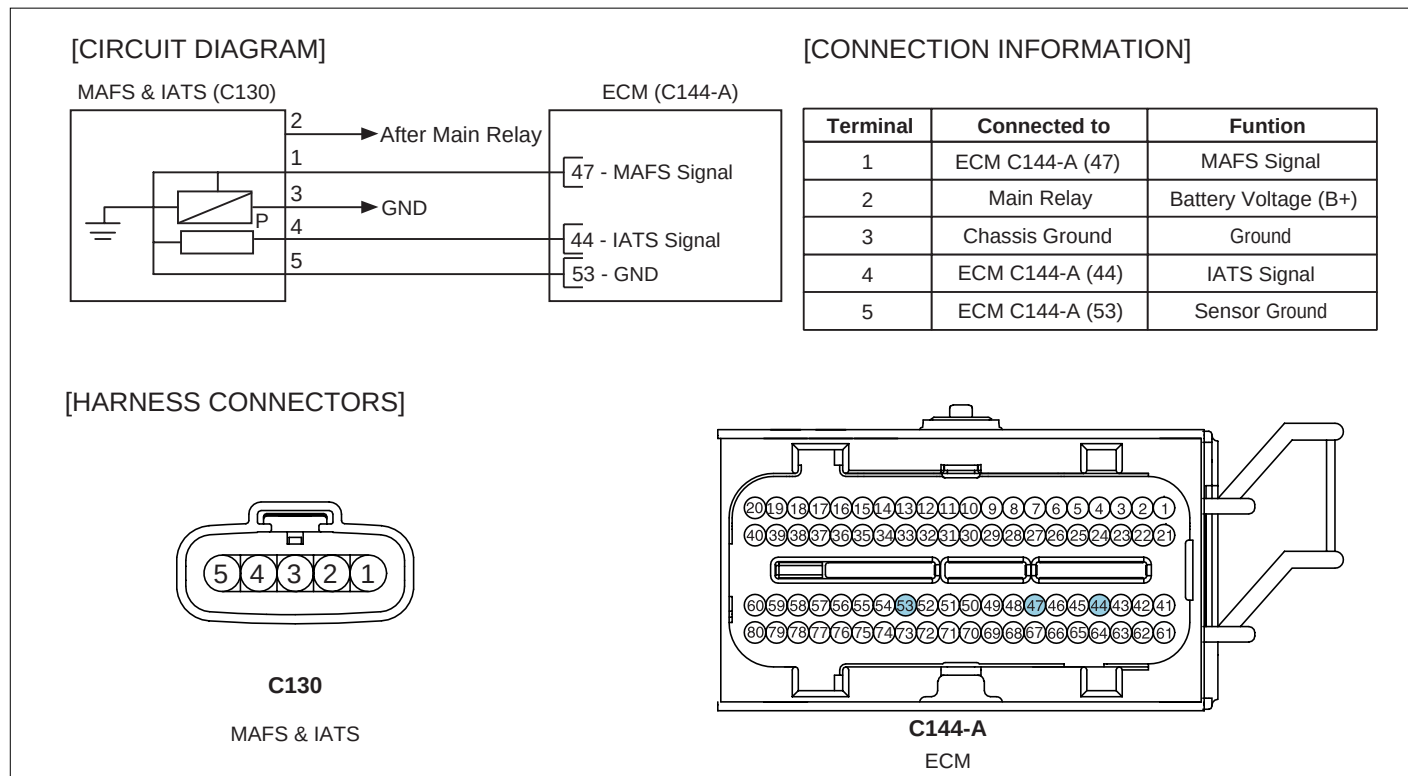
SPECIFICATION

E35C9B0B

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	95.95 ~ 105.78	20(68)	3.42 ~ 3.61
-20(-4)	27.4 ~ 29.77	40(104)	1.43 ~ 1.5
0(32)	9.08 ~ 9.72	60(140)	0.66 ~ 0.69
10(50)	5.49 ~ 5.83	80(176)	0.33 ~ 0.34

SCHEMATIC DIAGRAM

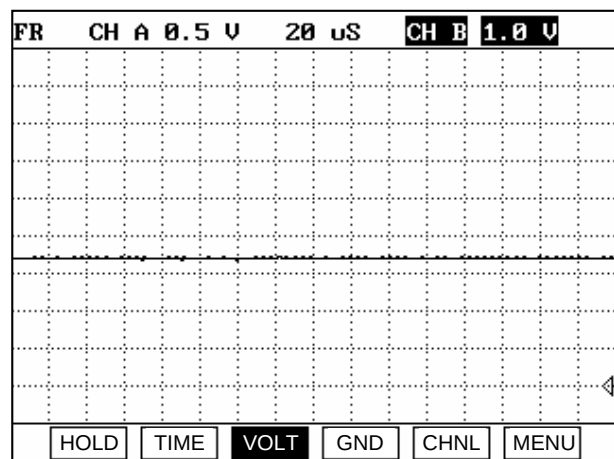
E363C840



SBLF26202L

SIGNAL WAVEFORM AND DATA

E7D1A4D6



EGRF604E

The output signals of IATS & ECTS change smoothly without any rapid changes. Those have almost same characteristic signal during the early period after start. It means that the temperatures of intake air and engine coolant are depended on the temperature of atmosphere. Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air.

MONITOR DTC STATUS

E487F985

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).

DTC TROUBLESHOOTING PROCEDURES

FLB -191

- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

E2D6A998

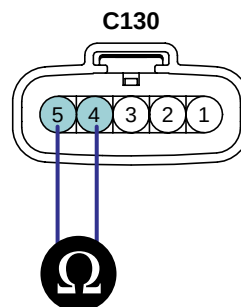
1. Check resistance of IATS

- 1) IG "OFF" and disconnect IATS connector.
- 2) Measure resistance between terminal 4 and 5 of IATS connector after checking out the temperature of IATS with scantool

SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	95.95 ~ 105.78	20(68)	3.42 ~ 3.61
-20(-4)	27.4 ~ 29.77	40(104)	1.43 ~ 1.5
0(32)	9.08 ~ 9.72	60(140)	0.66 ~ 0.69
10(50)	5.49 ~ 5.83	80(176)	0.33 ~ 0.34

1.2 CURRENT DATA		07/79
* BATTERY VOLTAGE	12.4 V	
* COOLANT TEMP. SNSR	194.0°F	
* MASS AIR FLOW	16.0 g/s	
* INT. AIR TEMP. SNSR	95.0 °F	
* MAP SENSOR	14.5 psi	
* ENGINE SPEED	0 rpm	
* ETC THROTTLE POSITION	16.92%	
OIL TEMPERATURE	195.8°F	
FIX		SCRN
FULL		PART
GRPH		HELP



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26457L

3) Is the measured resistance within specification ?

YES

► Go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E6ACC7F0

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -193

DTC P0111 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION E478FAEA

Refer to DTC P0110.

GENERAL DESCRIPTION E7F66B96

Refer to DTC P0110.

DTC DESCRIPTION E5661EEC

ECM monitors temperature changes resulting from soaking the vehicle. Therefore, Coolant temperature and Intake temperature should be changed. If ECM detects intake air temperature correlated to coolant temperature does not change ECM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EAED3688

Item		Detection condition	Possible cause
DTC Strategy	Case 1	Monitors the difference between the startup coolant and IAT values	IATS
	Case 2	Monitors the difference between the startup IAT and coolant values	
Enable Conditions	Case 1	- Engine soaked time $\geq$ 360min - Engine running state - No faults present - IAT stored previous trip - Startup Coolant Temperature $>$ -20°C - Airflow $>$ 15 g/s - Vehicle speed $>$ 40kph	
	Case 2	- Engine soaked time $\geq$ 360min - Engine running state - No faults present - IAT stored previous trip - Airflow $>$ 15 g/s - Vehicle speed $>$ 40kph	
Thresh old value	Case 1	Startup Coolant - Startup IAT $\geq$ 30°C	
	Case 2	Startup IAT - Startup Coolant $\geq$ 20°C	
Diagnosis Time		Continuous (More than 1.25 second failure)	
MIL On Condition		2 Driving Cycles	

SPECIFICATION EFED26A4

Refer to DTC P0110.

SCHEMATIC DIAGRAM E7467429

Refer to DTC P0110.

SIGNAL WAVEFORM AND DATA E21F0A7C

Refer to DTC P0110.

MONITOR DTC STATUS ED2CB5F3

Refer to DTC P0110.

COMPONENT INSPECTION EAD8FE34

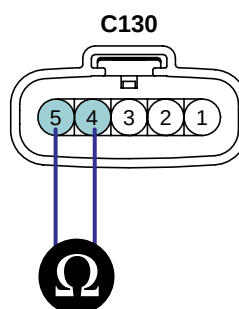
1. Check resistance of IATS

- 1) IG "OFF" and disconnect IATS connector.
- 2) Measure resistance between terminal 4 and 5 of IATS connector after checking out the temperature of IATS with scantool

SPECIFICATON :

Temp. (°C/°F)	Resistance (k Ω)	Temp. (°C/°F)	Resistance (k Ω)
-40(-40)	95.95 ~ 105.78	20(68)	3.42 ~ 3.61
-20(-4)	27.4 ~ 29.77	40(104)	1.43 ~ 1.5
0(32)	9.08 ~ 9.72	60(140)	0.66 ~ 0.69
10(50)	5.49 ~ 5.83	80(176)	0.33 ~ 0.34

1.2 CURRENT DATA		07/79
✖ BATTERY VOLTAGE	12.4 V	
✖ COOLANT TEMP. SNSR	194.0°F	
✖ MASS AIR FLOW	16.0 g/s	
✖ INT. AIR TEMP. SNSR	95.0 °F	
✖ MAP SENSOR	14.5 psi	
✖ ENGINE SPEED	0 rpm	
✖ ETC THROTTLE POSITION	16.92%	
OIL TEMPERATURE	195.8°F	
FIX		SCRN
FULL		PART
GRPH		HELP



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26457L

3) Is the measured resistance within specification ?

YES

► Go to "Verification of Vehicle Repair" procedure.

NO

DTC TROUBLESHOOTING PROCEDURES

FLB -195

- ▶ Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E0D4FCF8

Refer to DTC P0110.

DTC P0112 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT LOW INPUT

COMPONENT LOCATION E5323B7D

Refer to DTC P0110.

GENERAL DESCRIPTION E3AD8936

Refer to DTC P0110.

DTC DESCRIPTION E15EE5A4

Checking output signals of IATS every 20 sec. under detecting condition, if an output signal is below 0.1V for more than 10 sec., ECM sets P0112. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EB23E689

Item		Detecting Condition	Possible Cause
DTC Strategy		This code detects a continuous short to ground in either the signal circuit or the sensor	- Poor connection - Short to ground in harness - IATS - ECM
Enable Conditions	Case 1	- Engine running state - No Vehicle speed sensor fault - Vehicle speed > 50kph(30mph)	
	Case 2	Engine running time > 120 sec. or Time from IG "OFF" to IG "ON" > 360 min.	
Threshold value		Intake air temperature sensor's voltage < 0.1V	
Diagnosis Time		Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition		2 Driving Cycles	

SPECIFICATION E1097A5B

Refer to DTC P0110.

SCHEMATIC DIAGRAM E0E234CC

Refer to DTC P0110.

SIGNAL WAVEFORM AND DATA ECA4028A

Refer to DTC P0110.

MONITOR DTC STATUS E0E7EFA3

Refer to DTC P0110.

DTC TROUBLESHOOTING PROCEDURES

FLB -197

TERMINAL AND CONNECTOR INSPECTION EBD25344

Refer to DTC P0110.

SIGNAL CIRCUIT INSPECTION E9724C3D

1. Check voltage

- 1) IG "OFF" and disconnect IATS connector.
- 2) IG "ON" and ENG "OFF"
- 3) Measure voltage between terminal 4 of IATS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification ?

YES

► Go to "Component Inspection" procedure.

NO

► Go to " Check short to ground in harness" procedure.

2. Check short to ground in harness

- 1) IG "OFF" and disconnect IATS connector and ECM connector.
- 2) Measure resistance between terminal 4 of IATS harness connector and chassis ground.
- 3) Measure resistance between terminals 4 and 5 of IATS harness connector.
- 4) Measure resistance between terminals 4 and 3 of IATS harness connector.

Specification : Infinite

- 5) Is the measured resistance within specification?

YES

► Go to "Component inspection" procedure.

NO

► Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

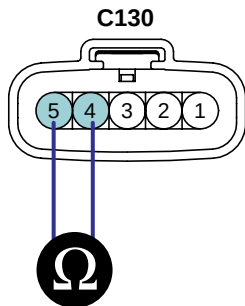
COMPONENT INSPECTION ECB15190

1. Check IATS

- 1) IG "OFF" and disconnect IATS connector.
- 2) Measure resistance between terminals 4 and 5 of IATS connector.(Component side)

SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	95.95 ~ 105.78	20(68)	3.42 ~ 3.61
-20(-4)	27.4 ~ 29.77	40(104)	1.43 ~ 1.5
0(32)	9.08 ~ 9.72	60(140)	0.66 ~ 0.69
10(50)	5.49 ~ 5.83	80(176)	0.33 ~ 0.34



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26460L

3) Is the measured resistance within specification ?

YES

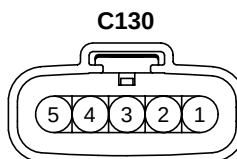
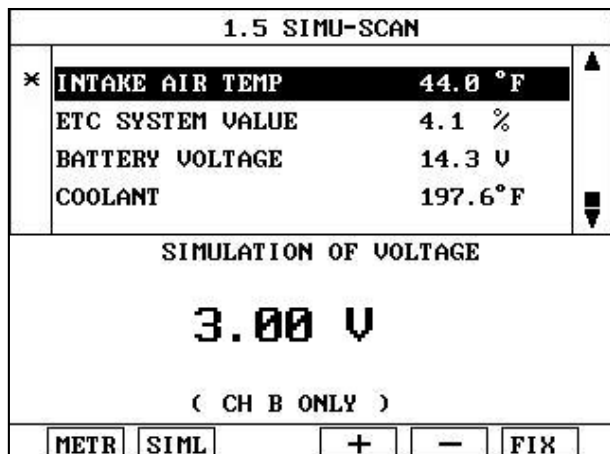
► Go to "Check ECM" as follows.

NO

► Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) IG "OFF" and connect scantool.
- 2) Disconnect IATS connector and connect probe to terminal 4 of IATS harness connector.
- 3) IG "ON" and ENG "OFF" and simulation Function on scantool.
- 4) Simulate voltage at terminal 4 of IATS harness connector.



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26461L

- 5) Does the signal value of IAT sensor change according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

VERIFICATION OF VEHICLE REPAIR

E9597B6F

Refer to DTC P0110.

DTC P0113 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT HIGH INPUT

COMPONENT LOCATION E7743F27

Refer to DTC P0110.

GENERAL DESCRIPTION EFBE32A8

Refer to DTC P0110.

DTC DESCRIPTION E47FF3A5

Checking output signals of IATS every 20 sec. under detecting condition, if an output signal is over 4.9V for more than 10 sec., ECM sets P0113. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E46C343E

Item	Detecting Condition	Possible cause
DTC Strategy	This code detects a continuous short to high in either the signal circuit or the sensor	- Poor connection - Open or short to battery in harness - Open in ground harness - IATS - ECM
Enable Conditions	- No vehicle speed sensor fault - No ECTS fault - No MAFS fault - Vehicle speed < 25kph(9.3mph) - Intake airflow < 15 g/s - ECT > 50°C(122°F) and Engine running time > 120s (or Time from IG "OFF" to IG "ON" > 360 min and ECT > -10°C(14°F)) - Engine running state	
Threshold value	Intake air temperature sensor's voltage > 4.9V	
Diagnosis Time	Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION E697C475

Refer to DTC P0110.

SCHEMATIC DIAGRAM E6EC7F38

Refer to DTC P0110.

SIGNAL WAVEFORM AND DATA E996A6FF

Refer to DTC P0110.

MONITOR DTC STATUS EFC4EC91

Refer to DTC P0110.

DTC TROUBLESHOOTING PROCEDURES

FLB -201

TERMINAL AND CONNECTOR INSPECTION EFD2B683

Refer to DTC P0110.

SIGNAL CIRCUIT INSPECTION E260A443

1. Check voltage

- 1) IG "OFF" and disconnect IATS connector.
- 2) IG "ON" and ENG "OFF"
- 3) Measure voltage between terminal 4 of IATS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification ?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► If the voltage is 0V, go to "Check open in harness" as follows. If the voltage is more than 5.1V, go to "Check short to battery in harness" as follows.

2. Check short to battery in harness

- 1) IG "OFF" and disconnect IATS connector and ECM connector.
- 2) Measure resistance between terminals 2 and 4 of IATS harness connector.
- 3) Measure resistance between terminals 1 and 4 of IATS harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair short to battery in harness and go to "Verification of Vehicle Repair" procedure.

3. Check open in harness

- 1) IG "OFF" and disconnect IATS connector and ECM connector.
- 2) Measure resistance between terminal 4 of IATS harness connector and 44 of ECM harness connector(C144-A).

Specification : below 1Ω

- 3) Is the measured resistance within specification?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair open in harness and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EDEB61EF

1. IG "OFF" and disconnect IATS connector.
2. Measure voltage between terminal 4 of IATS harness connector and chassis ground.
3. Measure voltage between terminals 4 and 5 of IATS harness connector.

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES

► Go to "Component Inspection" procedure.

NO

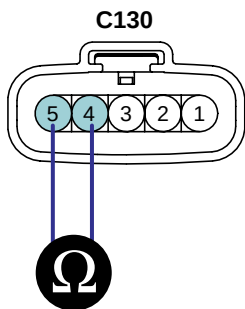
► Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E61E2266

1. Check IATS
 - 1) IG "OFF" and disconnect IATS connector.
 - 2) Measure resistance between terminals 4 and 5 of IATS connector.(Component side)

SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	95.95 ~ 105.78	20(68)	3.42 ~ 3.61
-20(-4)	27.4 ~ 29.77	40(104)	1.43 ~ 1.5
0(32)	9.08 ~ 9.72	60(140)	0.66 ~ 0.69
10(50)	5.49 ~ 5.83	80(176)	0.33 ~ 0.34



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26460L

3) Is the measured resistance within specification ?

YES

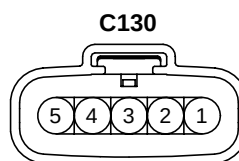
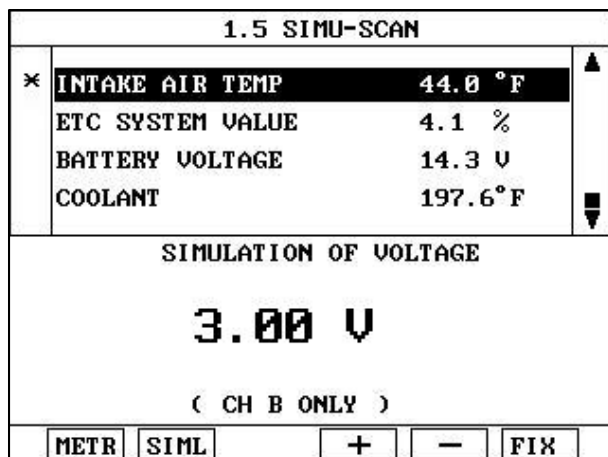
► Go to "Check ECM" as follows.

NO

► Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) IG "OFF" and connect scantool.
- 2) Disconnect IATS connector and connect probe to terminal 4 of IATS harness connector.
- 3) IG "ON" and ENG "OFF" and simulation Function on scantool.
- 4) Simulate voltage at terminal 4 of IATS harness connector.



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26461L

5) Does the signal value of IAT sensor change according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

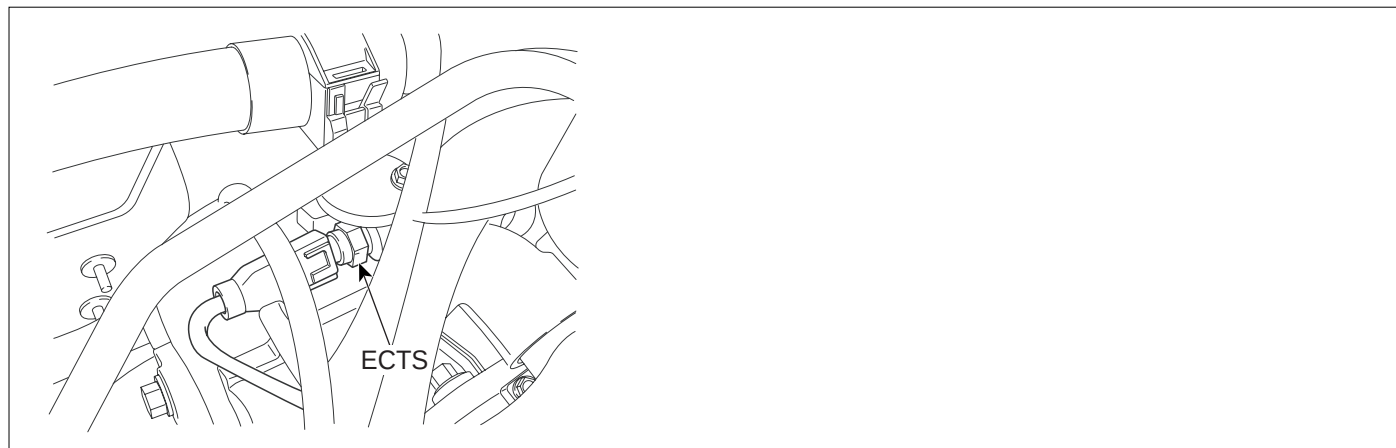
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

VERIFICATION OF VEHICLE REPAIR EBC71C30

Refer to DTC P0110.

DTC P0116 ENGINE COOLANT TEMPERATURE CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION E542DAE1



SBLF26704L

GENERAL DESCRIPTION E4B7F0C9

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.

DTC DESCRIPTION E17AAD5F

Checking the engine coolant temperature under detecting condition, if the engine coolant temperature's signal is temporarily stuck above the lowest enable temperature to enable other diagnostic, ECM sets P0116. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E19E184D

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the engine coolant temperature	ECTS
Enable Conditions	- Shutdown time > 180 minutes - Intake air-temperature at start-up < 40°C(104°F) - No disabling faults(ECTS) - Engine running > 60 seconds - Minimum airflow is satisfied for a certain time.	
Threshold value	When the start-up engine coolant temperature does not rise by 3 °C(5.4°F).	
Diagnosis Time	Immediately	
MIL On Condition	2 Driving Cycles	

FLB -206

FUEL SYSTEM

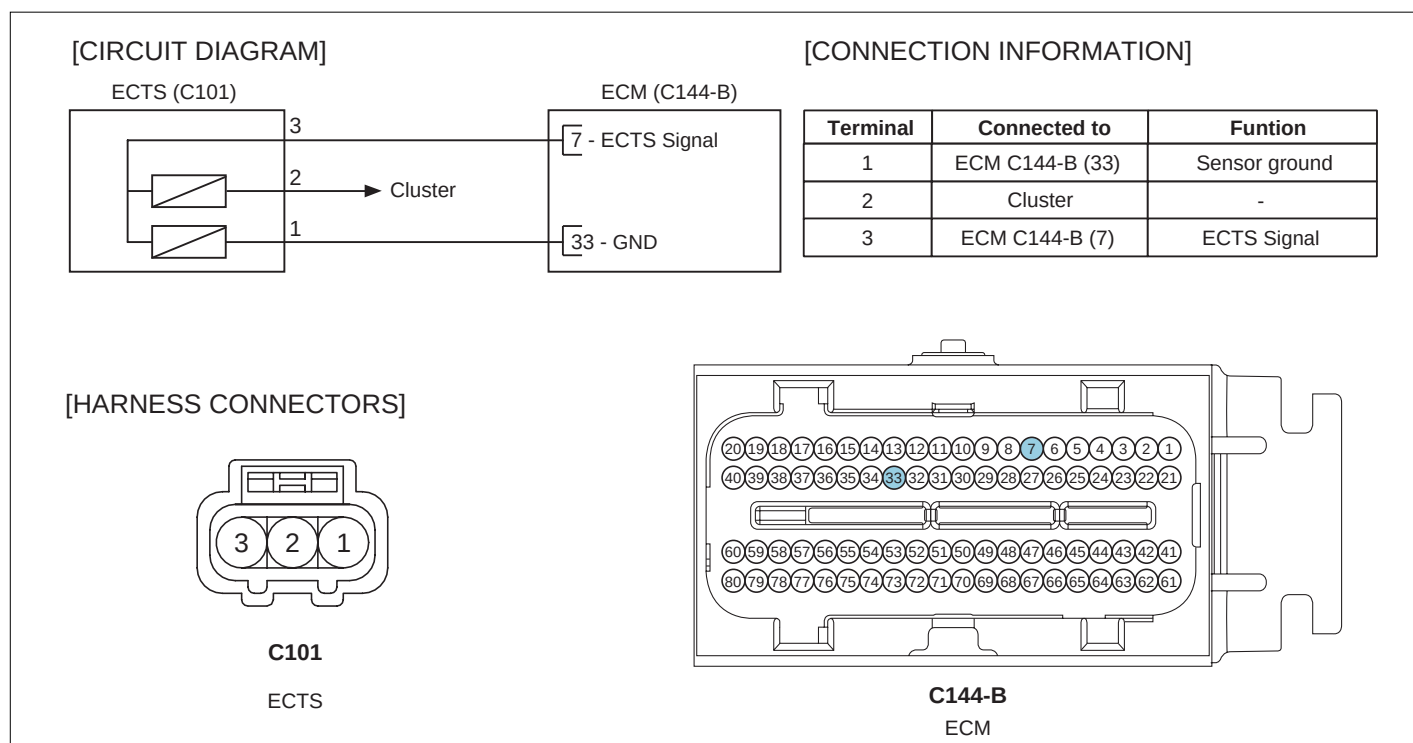
SPECIFICATION

E7A4B720

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		

SCHEMATIC DIAGRAM

E14E1C75



SBLF26204L

SIGNAL WAVEFORM AND DATA E83042A8

1.2 CURRENT DATA		04/79
✖	COOLANT TEMP. SNSR	89.6 °F
✖	OIL TEMPERATURE	91.4 °F
✖	INT. AIR TEMP. SNSR	86.0 °F
	ENGINE STATE-IDLE	OFF
	VEHICLE SPEED	0 MPH
	THROTTLE POS.1 DUTY	21.2 %
	THROTTLE POS.1 VOLT.	1.1 V
	THROTTLE POS.2 DUTY	21.2 %

Fig1) Service data before startup

1.2 CURRENT DATA		04/79
✖	COOLANT TEMP. SNSR	145.4°F
✖	OIL TEMPERATURE	113.0°F
✖	INT. AIR TEMP. SNSR	84.2 °F
	ENGINE STATE-IDLE	ON
	VEHICLE SPEED	0 MPH
	THROTTLE POS.1 DUTY	14.9 %
	THROTTLE POS.1 VOLT.	0.7 V
	THROTTLE POS.2 DUTY	14.5 %

Fig2) Service data in a few minutes since startup

The output signals of IATS & ECTS change smoothly without any rapid changes. Those have almost same characteristic signal during the early period after start. It means that the temperatures of intake air and engine coolant are depended on the temperature of atmosphere. Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air.

SCMF16818N

MONITOR DTC STATUS

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES					
PXXXX DTC TITLE					
NUMBER OF DTC : 1 ITEMS					
PART	ERAS		DTAL		

PXXXX TITLE
1.MIL STATUS: ON/OFF 2.DTC STATUS: PRESENT/HISTORY 3.DIAG.STATUS: DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX

SCMF16159L

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent, go to "Verification of vehicle Repair" procedure.

COMPONENT INSPECTION EE339FB8

1. IG "OFF" and disconnect ECTS connector.
2. Remove it.
3. Measure resistance between terminals 1 and 3 of ECTS connector as the temperature rises.

SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		

- 1) Are the measured resistance within specification?

YES

► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, recheck it thoroughly. If not, it is intermittent fault, go to "Verification of vehicle Repair" procedure.

NO

- Substitute with a known - good ECTS and check for proper operation.
- If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ED4949E6

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC.

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P0117 ENGINE COOLANT TEMPERATURE CIRCUIT LOW INPUT

COMPONENT LOCATION E3640584

Refer to DTC P0116.

GENERAL DESCRIPTION E65516EC

Refer to DTC P0116.

DTC DESCRIPTION E391FC7F

Checking output signals from ECTS every 80 sec. under detecting condition, if an output signal is below 0.1V for more than 40 sec., ECM sets P0117. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EB56BF33

Item		Detecting Condition	Possible cause
DTC Strategy		Signal low	- Poor connection - Short to ground in harness - ECTS - ECM
Enable Conditions	Case 1	Time after start-up > 120 sec.	
	Case 2	- Time from IG "OFF" to IG "ON" > 360 min. - Engine running state	
Threshold value		Engine coolant temperature sensor's voltage < 0.1V	
Diagnosis Time		Continuous (More than 40 seconds failure for every 80 second test)	
MIL On Condition		2 Driving Cycle	

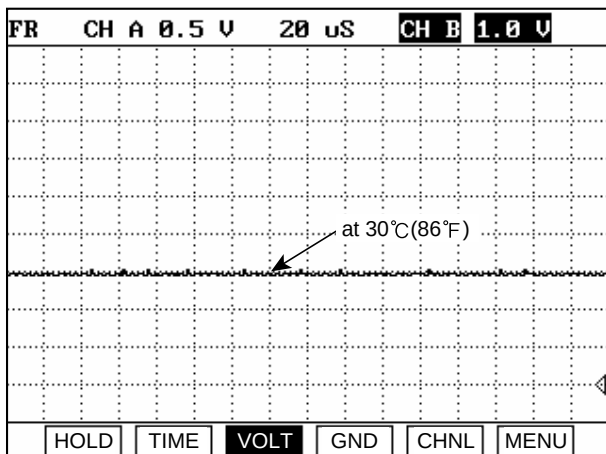
SPECIFICATION E345C742

Refer to DTC P0116.

SCHEMATIC DIAGRAM E260C078

Refer to DTC P0116.

SIGNAL WAVEFORM AND DATA EB1A02EE



EGRF604P

The output signals of IATS & ECTS change smoothly without any rapid changes. Those have almost same characteristic signal during the early period after start. It means that the temperatures of intake air and engine coolant are depended on the temperature of atmosphere. Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air.

MONITOR DTC STATUS E9B62A51

Refer to DTC P0116.

TERMINAL AND CONNECTOR INSPECTION EF256380

Refer to DTC P0116.

SIGNAL CIRCUIT INSPECTION E2506184

1. Check voltage
 - 1) IG "OFF" and disconnect ECTS connector.
 - 2) IG "ON" and ENG "OFF"
 - 3) Measure voltage between terminal 3 of ECTS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification ?

YES

► Go to "Component Inspection" procedure.

NO

► Go to "Check short to ground in harness" as follows.

2. Check short to ground in harness

- 1) IG "OFF" and disconnect ECTS connector and ECM connector.

FLB -212

FUEL SYSTEM

- 2) Measure resistance between terminal 3 of ECTS harness connector and chassis ground.
- 3) Measure resistance between terminals 1 and 3 of ECTS harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

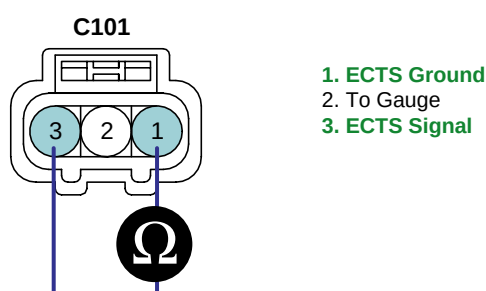
COMPONENT INSPECTION EC6601E7

1. Check ECTS

- 1) IG "OFF" and disconnect ECTS connector.
- 2) Measure resistance between terminals 1 and 3 of ECTS connector.(Component side)

SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		



SBLF26467L

- 3) Is the measured resistance within specification?

YES

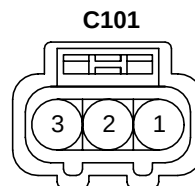
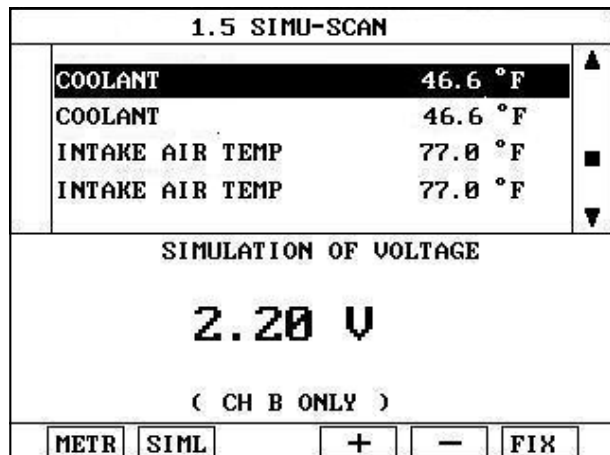
► Go to "Check ECM" as follows.

NO

► Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, replace ECTS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) IG "OFF" and connect scantool.
- 2) Connect probe to terminal 3 of ECTS harness connector.
- 3) IG "ON" and ENG "OFF" and simulation Function on scantool.
- 4) Simulate voltage at terminal 3 of ECTS harness connector.



1. ECTS Ground
2. To Gauge
3. ECTS Signal

SBLF26468L

- 5) Does the signal value of ECT sensor change according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

VERIFICATION OF VEHICLE REPAIR

E4C2A22A

Refer to DTC P0116.

FLB -214

FUEL SYSTEM

DTC P0118 ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT

COMPONENT LOCATION E43339DA

Refer to DTC P0116.

GENERAL DESCRIPTION EDD29207

Refer to DTC P0116.

DTC DESCRIPTION EB5E9DCF

Checking output signals from ECTS every 80 sec. under detecting condition, if an output signal is above 4.9V for more than 40 sec., ECM sets P0118. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF1F8766

Item		Detecting Condition	Possible cause
DTC Strategy		Open, Signal high	- Poor connection - Open or short to battery in signal harness - Open in ground harness - ECTS - ECM
Enable Conditions	Case 1	Time after start-up > 120 sec.	
	Case 2	- Time from IG "OFF" to IG "ON" > 360 min. - Intake air temperature ≥ -10°C(14°F) - Engine running state	
Threshold value		Engine coolant temperature sensor's voltage > 4.9V	
Diagnosis Time		Continuous (More than 40 sec. failure for every 80 sec. test)	
MIL On Condition		2 Driving Cycle	

SPECIFICATION E18FC374

Refer to DTC P0116.

SCHEMATIC DIAGRAM E61D83A8

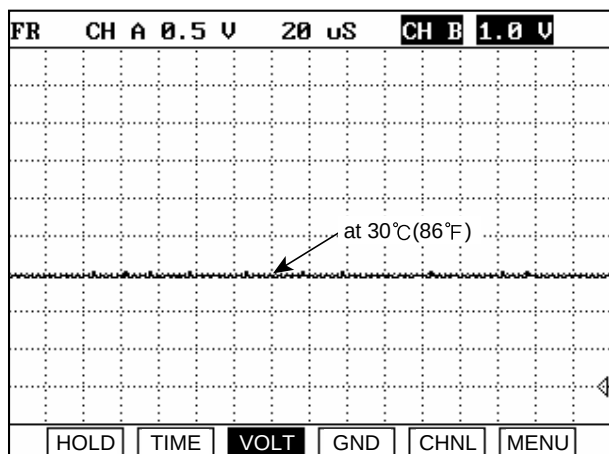
Refer to DTC P0116.

DTC TROUBLESHOOTING PROCEDURES

FLB -215

SIGNAL WAVEFORM AND DATA

E024251E



EGRF604P

The output signals of IATS & ECTS change smoothly without any rapid changes. Those have almost same characteristic signal during the early period after start. It means that the temperatures of intake air and engine coolant are depended on the temperature of atmosphere. Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air.

MONITOR DTC STATUS

E024251E

Refer to DTC P0116.

TERMINAL AND CONNECTOR INSPECTION

E07A9DBB

Refer to DTC P0116.

SIGNAL CIRCUIT INSPECTION

ED593A32

1. Check voltage
 - 1) IG "OFF" and disconnect ECTS connector.
 - 2) IG "ON" and ENG "OFF"
 - 3) Measure voltage between terminal 3 of ECTS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification ?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► If voltage is 0V, go to "Check open in harness" as follows. If it is more than 5.1V, go to "Check short to battery in harness" as follows

2. Check short to battery in harness

FLB -216

FUEL SYSTEM

- 1) IG "OFF" and disconnect ECTS connector and ECM connector.
- 2) Measure resistance between terminals 2 and 3 of ECTS harness connector.

Specification : Infinite

- 3) Is the measured resistance within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

3. Check open in harness

- 1) IG "OFF" and disconnect ECTS connector and ECM connector.
- 2) Measure resistance between terminal 3 of ECTS harness connector and terminal 7 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E537BC76

1. IG "OFF" and disconnect ECTS connector.
2. Measure voltage between terminal 3 of ECTS harness connector and chassis ground.
3. Measure voltage between terminals 1 and 3 of ECTS harness connector.

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -217

COMPONENT INSPECTION

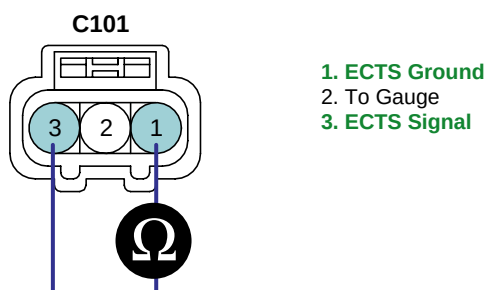
E466793B

1. Check ECTS

- 1) IG "OFF" and disconnect ECTS connector.
- 2) Measure resistance between terminals 1 and 3 of ECTS connector.(Component side)

SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		



SBLF26467L

- 3) Is the measured resistance within specification?

YES

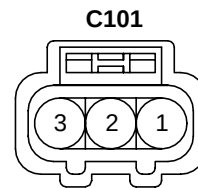
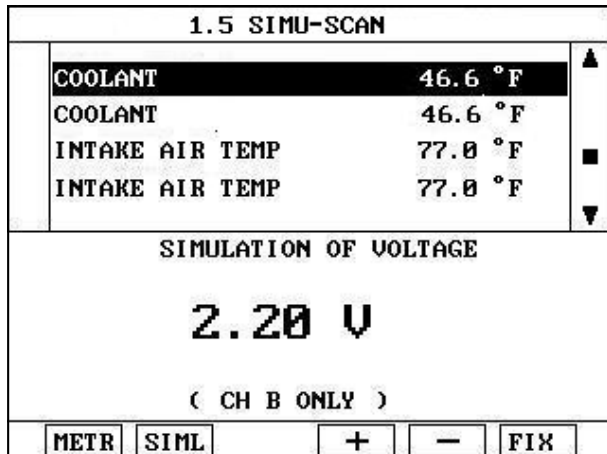
► Go to "Check ECM" as follows.

NO

► Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, replace ECTS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) IG "OFF" and connect scantool.
- 2) Connect probe to terminal 3 of ECTS harness connector.
- 3) IG "ON" and ENG "OFF" and simulation Function on scantool.
- 4) Simulate voltage at terminal 3 of ECTS harness connector.



1. ECTS Ground
2. To Gauge
3. ECTS Signal

SBLF26468L

5) Does the signal value of ECT sensor change according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

VERIFICATION OF VEHICLE REPAIR

EB878753

Refer to DTC P0116.

DTC P0122 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT LOW INPUT

COMPONENT LOCATION ED034772



SBLF26703L

GENERAL DESCRIPTION EF9E6402

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1 & 2 and Accelerator Position Sensor(APS) 1 & 2. TPS1 & 2 are sharing the same source voltage and ground. The throttle valve opening is control by throttle motor which is controlled by Engine Control Module(ECM). The opposite position indicator shows inverted signal characteristics. TPS1 output voltage increases smoothly in proportion with the throttle valve opening angle after starting. TPS2 output voltage decreases in inverse proportion with the throttle valve opening angle after starting. TPS provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION EF7242F7

Checking output signals from TPS1 every 8.5 sec. under detecting condition, if an output signal is below 0.25V for more than 0.1 sec., ECM sets P0122. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E54DC0EC

Item	Detecting Condition	Possible Cause
DTC Strategy	• signal low	• Poor connection • Open or short to ground in power harness • Short to ground in signal harness • TPS • ECM
Enable condition	• IG "ON	
threshold value	• The voltage of TPS < 0.25V	
diagnosis time	• Continuous (more than 0.1 sec. failure for every 8.5 sec.test)	
MIL ON condition	• 2 driving cycles	

SPECIFICATION EBB80DF4

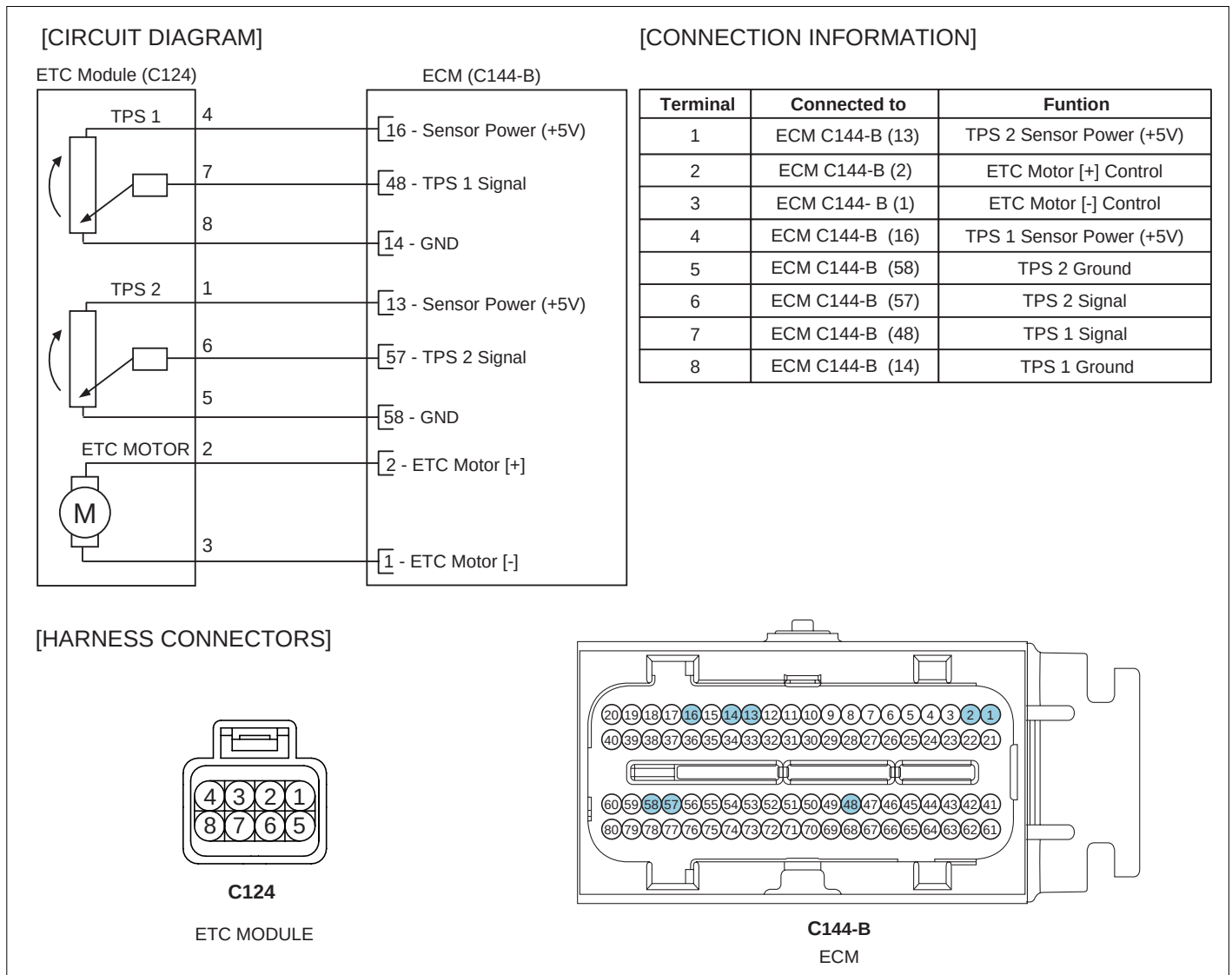
Throttle opening (°)	Output voltage(V) [Vref=5.0]	
	TPS1	TPS2
0°	0.0V	5.0V
10°	0.5V	4.5V
20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V

DTC TROUBLESHOOTING PROCEDURES

FLB -221

SCHEMATIC DIAGRAM

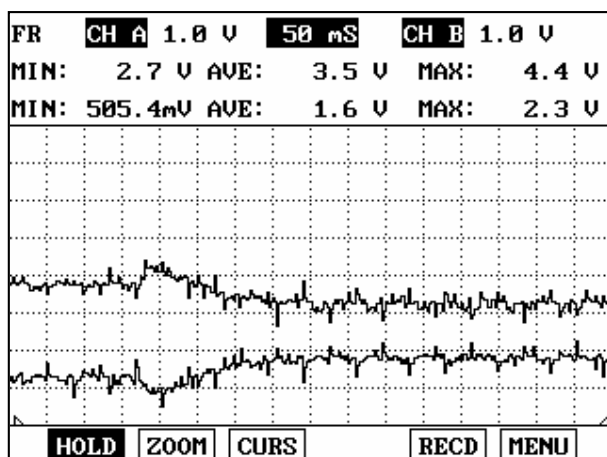
E31F0A39



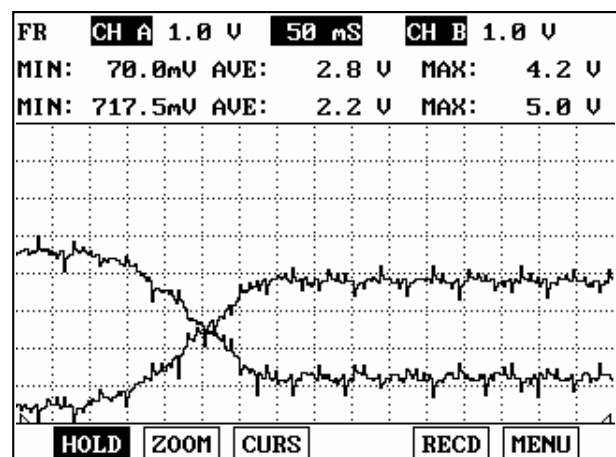
SBLF26201L

SIGNAL WAVEFORM AND DATA

E36E9A69



Hit the accelerator at IG ON



Open the throttle valve by force at IG ON

EGRF604Z

MONITOR DTC STATUS

EE9803A6

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

E22E73A5

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

DTC TROUBLESHOOTING PROCEDURES

FLB -223

- ▶ Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION EB1DDAA7

1. IG "OFF" and disconnect TPS connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 4 of TPS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES

- ▶ Go to "Signal circuit inspection" procedure.

NO

- ▶ Repair open or short to ground in power harness, and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E476A804

1. Check short to ground in harness
 - 1) IG "OFF" and disconnect TPS connector and ECM connector.
 - 2) Measure resistance between terminal 7 of TPS harness connector and chassis ground.
 - 3) Measure resistance between terminals 7 and 5(8) of TPS harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification?

YES

- ▶ Go to "Component Inspection" procedure.

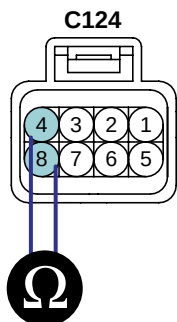
NO

- ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION ED45E99B

1. Check TPS
 - 1) IG "OFF" and disconnect TPS connector.
 - 2) Measure resistance between terminals 4 and 8 of TPS connector.(component side)

Specifcaton : 4 ~ 6kΩ



1. TPS2 supply
2. ETS motor control(+)
3. ETS motor control(-)
4. **TPS1 supply**
5. TPS2 ground
6. TPS2 signal
7. TPS1 signal
8. **TPS1 ground**

SBLF26474L

3) Is the measured resistance within specification?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECT motor & TPS and check for proper operation. If the problem is corrected, replace ECT motor & TPS and go to "Verification of Vehicle Repair" procedure.



CAUTION

Procedure of ETS Initialization

1. **Erase the trouble codes on ECM**
2. **Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)**
3. **Turn ignition key on more than 1second to record the throttle motor position on the EEPROM**

VERIFICATION OF VEHICLE REPAIR

EAF6CF1E

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -225

DTC P0123 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT HIGH INPUT

COMPONENT LOCATION EFB6DCA2

Refer to DTC P0122.

GENERAL DESCRIPTION E573C913

Refer to DTC P0122.

DTC DESCRIPTION EC235597

Checking output signals from TPS1 every 8.5 sec. under detecting condition, if an output signal is above 4.75V for more than 0.1 sec., ECM sets P0123. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E6E978EE

Item	Detecting Condition	Possible Cause
DTC Strategy	• signal high	• Poor connection • Open or short to battery in signal harness • Open in ground harness • TPS • ECM
Enable condition	• IG "ON	
threshold value	• The voltage of TPS > 4.75V	
diagnosis time	• Continuous (more than 0.1 sec. failure for every 8.5 sec.test)	
MIL ON condition	• 2 driving cycles	

SPECIFICATION EA5D1447

Refer to DTC P0122.

SCHEMATIC DIAGRAM E67E7173

Refer to DTC P0122.

SIGNAL WAVEFORM AND DATA EC35C394

Refer to DTC P0122.

MONITOR DTC STATUS E161EB0E

Refer to DTC P0122.

TERMINAL AND CONNECTOR INSPECTION E65F6F61

Refer to DTC P0122.

SIGNAL CIRCUIT INSPECTION

E7B654FC

1. Check voltage

- 1) IG "OFF" and disconnect TPS connector.
- 2) IG "ON" and ENG "OFF"
- 3) Measure voltage between terminal 7 of TPS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification?

YES

► Go to "Check short to battery in harness" as follows.

NO

► Go to "Check open in harness" as follows.

2. Check open in harness

- 1) IG "OFF" and disconnect TPS connector and ECM connector.
- 2) Measure resistance between terminal 7 of TPS harness connector and terminal 48 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

3. Check short to battery in harness

- 1) IG "OFF" and disconnect TPS connector and ECM connector.
- 2) Measure resistance between terminals 4 and 7 of TPS harness connector.
- 3) Measure resistance between terminals 1 and 7 of TPS harness connector.
- 4) Measure resistance between terminals 2 and 7 of TPS harness connector.
- 5) Measure resistance between terminals 3 and 7 of TPS harness connector.

Specification : Infinite

- 6) Is the measured resistance within specification?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -227

- Go to "Ground circuit inspection " procedure.

NO

- Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EE3DFC6E

1. IG "OFF" and disconnect TPS connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 4 of TPS harness connector and chassis ground.
4. Measure voltage between terminals 4 and 8 of TPS harness connector.

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

5. Is the measured voltage within specification?

YES

- Go to "Component inspection" procedure.

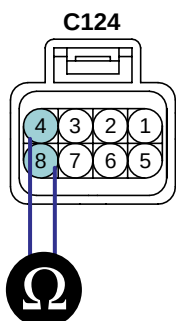
NO

- Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION ED4FE327

1. Check TPS
 - 1) IG "OFF" and disconnect TPS connector.
 - 2) Measure resistance between terminals 4 and 8 of TPS connector.(component side)

Specifcaton : 4 ~ 6k Ω



1. TPS2 supply
2. ETS motor control(+)
3. ETS motor control(-)
4. **TPS1 supply**
5. TPS2 ground
6. TPS2 signal
7. TPS1 signal
8. **TPS1 ground**

SBLF26474L

- 3) Is the measured resistance within specification?

YES

- Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECT motor & TPS and check for proper operation. If the problem is corrected, replace ECT motor & TPS and go to "Verification of Vehicle Repair" procedure.



CAUTION

Procedure of ETS Initialization

- 1. Erase the trouble codes on ECM***
- 2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)***
- 3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM***

VERIFICATION OF VEHICLE REPAIR

E0670DA5

Refer to DTC P0122.

DTC P0131 HO2S CIRCUIT LOW VOLTAGE (BANK 1 / SENSOR 1)

COMPONENT LOCATION E0216435



SBLF26707L

GENERAL DESCRIPTION EBB2BE74

In order to control emissions of the CO, HC and NO_x components of the exhaust gas, heated oxygen sensor (HO2S), mounted on the front side and rear side of catalytic converter, detects the oxygen content in the exhaust gas. The front HO2S signal is used to control air/fuel ratio (closed loop fuel control) and the rear HO2S signal is used to monitor front HO2S and catalyst for proper operation. The HO2S requires a minimum temperature to operate properly and provide a closed loop fuel control system. The HO2S contains the heater element to reduce its warming-up time and ensure its performance during all driving conditions. The oxygen sensor generates a voltage that indicates the difference between the oxygen content of the exhaust stream and the oxygen content of ambient air. When the exhaust stream is "rich," there is more oxygen in the ambient air than in the exhaust stream, so the voltage will be higher.

DTC DESCRIPTION E081D9B8

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermine time, ECM sets P0131. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EB8CFCEd

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to ground in harness - HO2S(B1/S1) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state	
Threshold value	The voltage of HO2S(B1/S1) $< 0.04V$	
Diagnosis Time	Continuous (more than 12.5 sec. failure for every 15 sec.test)	
MIL On Condition	2 Driving Cycles	

FLB -230

FUEL SYSTEM

SPECIFICATION E31F3678

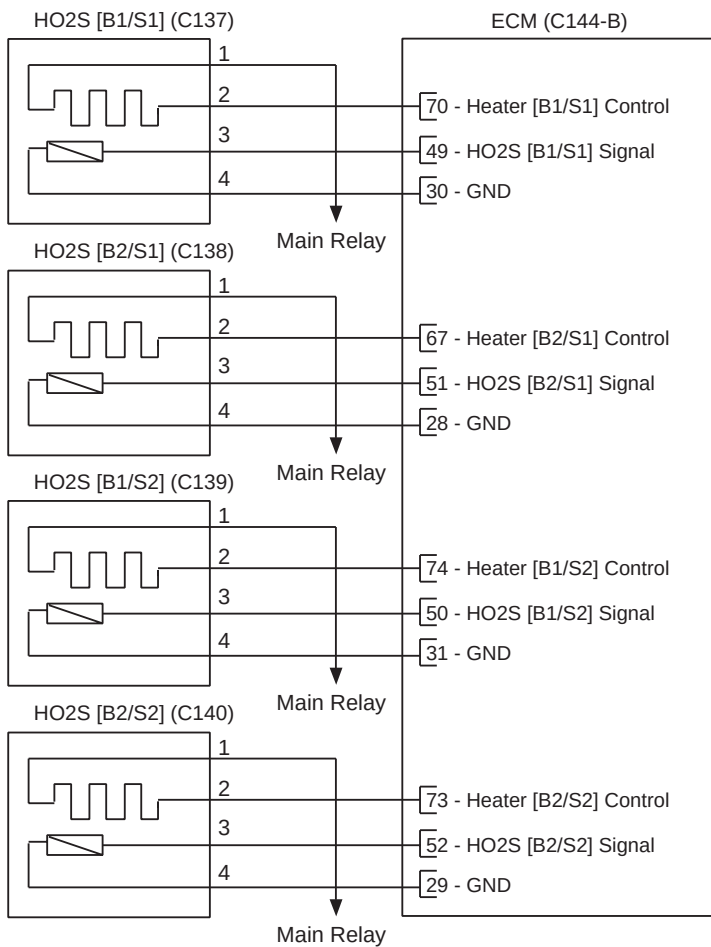
(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit (Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit (Pumping current ON)	Approx. 3.5V	

SCHEMATIC DIAGRAM

E1CAFD93

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

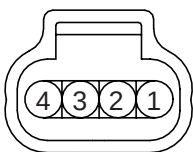
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

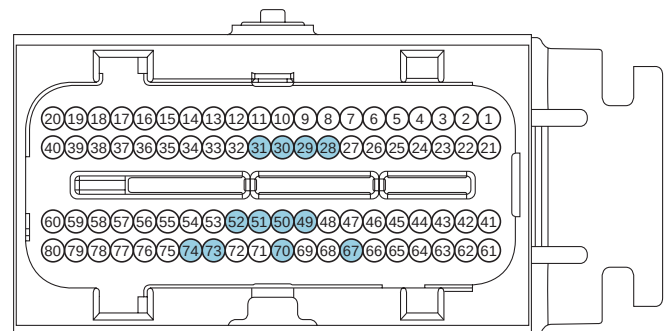
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SBLF26207L

SIGNAL WAVEFORM AND DATA

EE9111F9

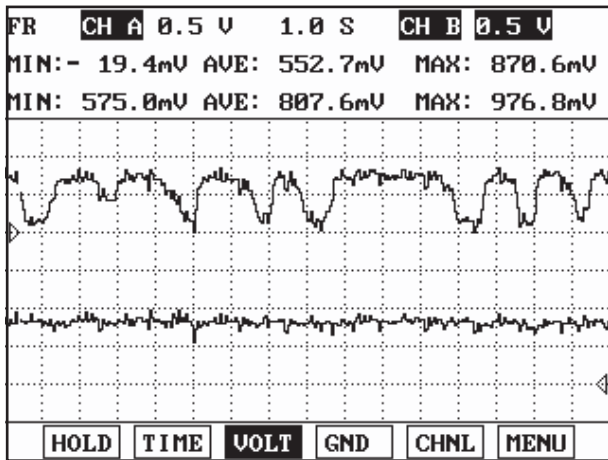


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6415N

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~ 1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

MONITOR DTC STATUS

E152019B

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -233

- ▶ Go to "Terminal and connector inspection" procedure.

NO

- ▶ Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E6C651C7

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E73C74C2

1. IG "OFF" and disconnect HO2S(B1/S1) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B1/S1) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON
Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

- ▶ Go to "Component Inspection" procedure.

NO

- ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E49FE650

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

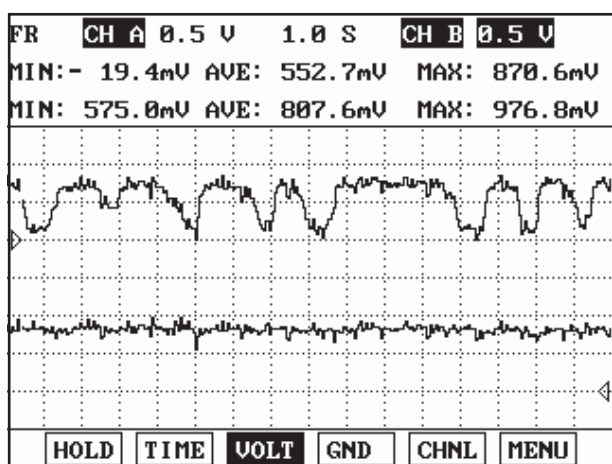


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E4E07B92

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode

DTC TROUBLESHOOTING PROCEDURES

FLB -235

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

FLB -236

FUEL SYSTEM

DTC P0132 HO2S CIRCUIT HIGH VOLTAGE (BANK 1 / SENSOR 1)

COMPONENT LOCATION E3F05C76

Refer to DTC P0131.

GENERAL DESCRIPTION EAB3324E

Refer to DTC P0131.

DTC DESCRIPTION E6753C14

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predetermine time, ECM sets P0132. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EFD87E78

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to battery in harness - HO2S(B1/S1) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state	
Threshold value	The voltage of HO2S(B1/S1) $\geq 1.3V$	
Diagnosis Time	Continuous (more than 12.5 sec.failure for every 15 sec.test)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION E2DDDBB7

Refer to DTC P0131.

SCHEMATIC DIAGRAM E4E32020

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA E1BE9A03

Refer to DTC P0131.

MONITOR DTC STATUS ECED49F2

Refer to DTC P0131.

TERMINAL AND CONNECTOR INSPECTION E196BCC4

Refer to DTC P0131.

DTC TROUBLESHOOTING PROCEDURES

FLB -237

SIGNAL CIRCUIT INSPECTION E16CDEF5

1. IG "OFF" and disconnect HO2S(B1/S1) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B1/S1) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON
Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EE0F3A12

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

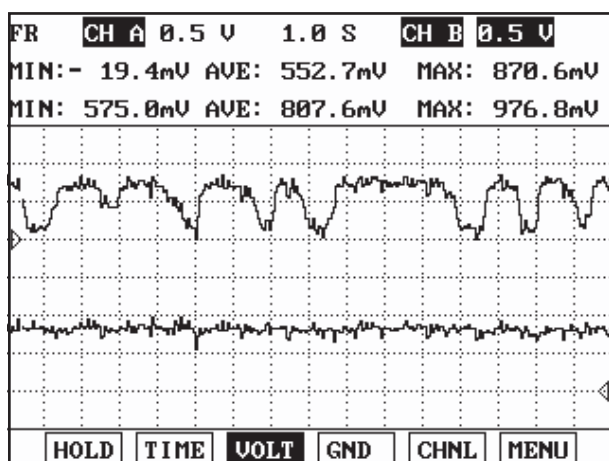


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E96834F9

Refer to DTC P0131.

DTC TROUBLESHOOTING PROCEDURES

FLB -239

DTC P0133 HO2S CIRCUIT SLOW RESPONSE (BANK 1 / SENSOR 1)

COMPONENT LOCATION EDAA33F6

Refer to DTC P0131.

GENERAL DESCRIPTION E2E5EE66

Refer to DTC P0131.

DTC DESCRIPTION E7766A36

Checking output signals from HO2S under detecting condition, if ECM judges it's signals too slow, ECM sets P0133. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E76C4F71

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's response rate	- Poor connection - Faulty HO2S - Faulty ECM
Enable Conditions	- Engine warm-up sufficiently - Engine run time > 60sec - Drive at a steady speed between 45-55 mph(72-88 km/h) - Engine Coolant > 70°C(158 °F) - No disabling faults	
Threshold value	The calculated response rate is too slow (out of threshold in ECM)	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

SPECIFICATION ED54B3C6

Refer to DTC P0131.

SCHEMATIC DIAGRAM E771CB78

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA E70D73D3

Refer to DTC P0131.

MONITOR DTC STATUS EBA26E10

Refer to DTC P0131.

COMPONENT INSPECTION E4CB76F7

1. Replace the HO2S.

2. Clear DTC with scantool.
3. Start the engine and warm it up until the radiator fan comes on(more than at least 10 minutes).
4. Drive at a steady speed between 45-55 mph(72-88 km/h) for 120 sec.
5. Stop and then maintain idle state.
6. Check if O2 sensor monitoring readiness is complete.
7. Does the scan tool show DTC P0133?

YES

▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

▶ Troubleshooting is finished.

VERIFICATION OF VEHICLE REPAIR E78DE885

Refer to DTC P0131.

DTC TROUBLESHOOTING PROCEDURES

FLB -241

DTC P0134 HO2S CIRCUIT NO ACTIVITY DETECTED (BANK 1 / SENSOR 1)

COMPONENT LOCATION EEA66780

Refer to DTC P0131.

GENERAL DESCRIPTION E3FF8C61

Refer to DTC P0131.

DTC DESCRIPTION E4B21EA3

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predeterminate time, ECM sets P0134. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EE10C413

Item		Detecting Condition	Possible cause
DTC Strategy		Monitor signal voltage	- Poor connection - Open in harness - HO2S(B1/S1) - ECM
Enable Conditions		- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state - No disable faults	
Thresh old value	Case 1	$1.2V \leq \text{Voltage of HO2S} \leq 3.9V$ (at pumping current ON)	
	Case 2	$0.415V \leq \text{Voltage of HO2S} \leq 0.515V$ (at pumping current OFF)	
Diagnosis Time		Continuous (more than 76.5 sec.failure for every 90 sec.test)	
MIL On Condition		2 Driving Cycles	

SPECIFICATION E7526CB5

Refer to DTC P0131.

SCHEMATIC DIAGRAM E7426282

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA EF739B7B

Refer to DTC P0131.

MONITOR DTC STATUS EEA8D9FC

Refer to DTC P0131.

TERMINAL AND CONNECTOR INSPECTION EB4636FB

Refer to DTC P0131.

SIGNAL CIRCUIT INSPECTION EA50A456

1. IG "OFF" and disconnect HO2S(B1/S1) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B1/S1) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON
Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

▶ Go to "Ground circuit inspection" procedure.

NO

▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EFFD5E7E

1. IG "ON" and disconnect HO2S(B1/S1) connector.
2. Measure voltage between terminal 3 of HO2S(B1/S1) harness connector and chassis ground.
3. Measure voltage between terminals 3 and 4 of HO2S(B1/S1) harness connector.

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification?

YES

▶ Go to "Component inspection" procedure.

NO

▶ Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E199DA02

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

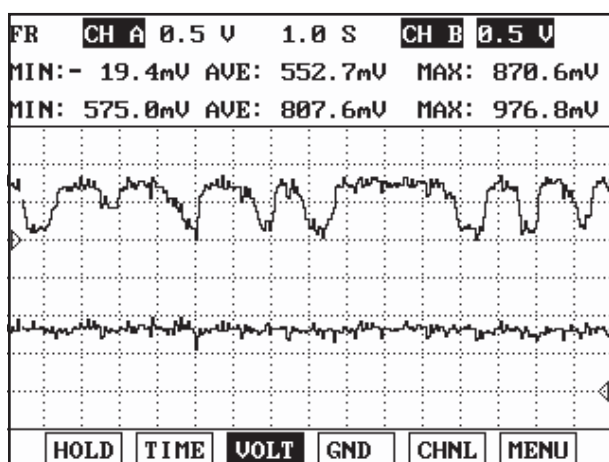


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

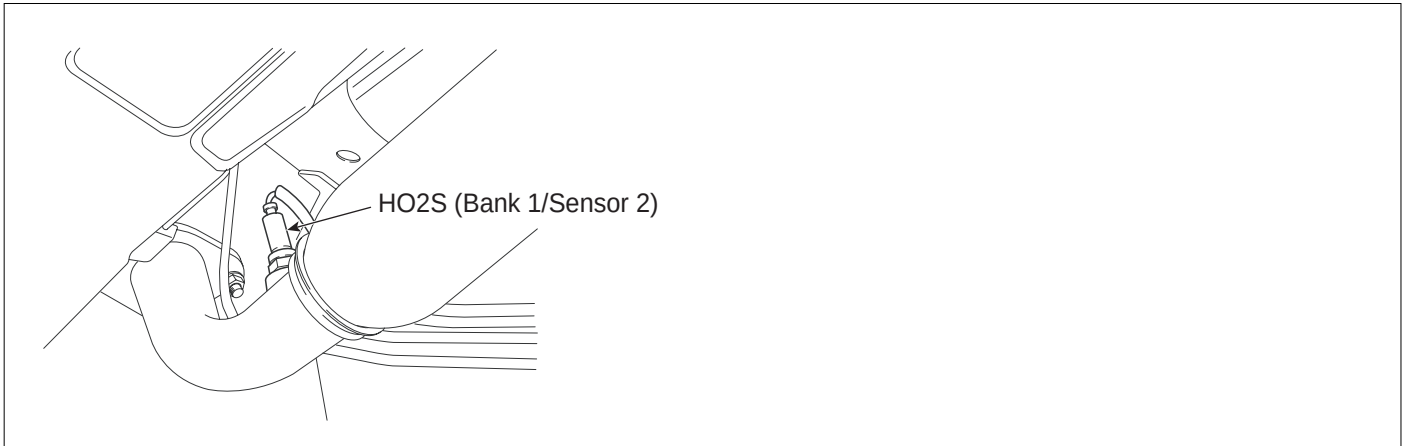
VERIFICATION OF VEHICLE REPAIR

EC833F65

Refer to DTC P0131.

DTC P0137 HO2S CIRCUIT LOW VOLTAGE (BANK 1 / SENSOR 2)

COMPONENT LOCATION E14423C1



SBLF26708L

GENERAL DESCRIPTION E6017798

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter (warm-up catalytic converter) or in the rear exhaust pipe, which is able to detect catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC DESCRIPTION EE027911

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermine time, ECM sets P0137. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E5846D6E

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to ground in harness - HO2S(B1/S2) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state	
Threshold value	The voltage of HO2S(B1/S2) $< 0.04V$	
Diagnosis Time	Continuous (more than 12.5 sec. failure for every 15 sec.test)	
MIL On Condition	2 Driving Cycles	

DTC TROUBLESHOOTING PROCEDURES

FLB -245

SPECIFICATION EDF1AB64

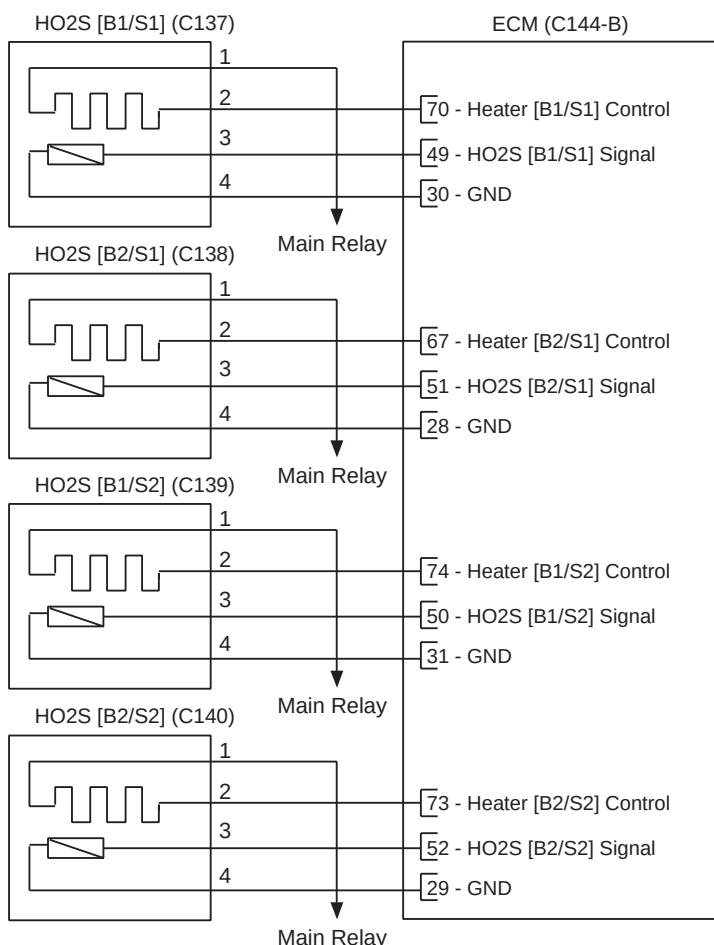
(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit (Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit (Pumping current ON)	Approx. 3.5V	

SCHEMATIC DIAGRAM

EF197A76

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

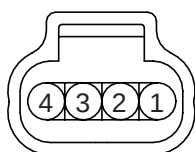
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

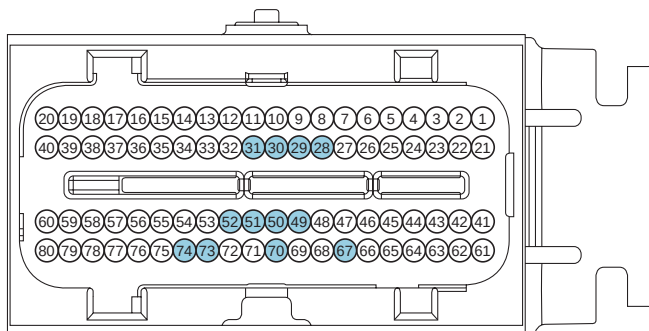
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

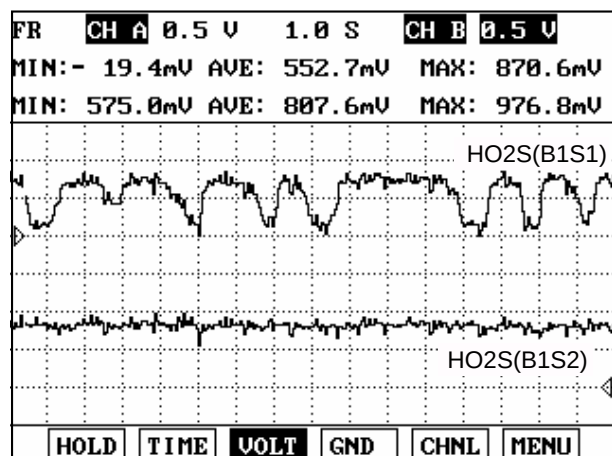
HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SBLF26207L

SIGNAL WAVEFORM AND DATA E9F43575



EGRF605X

The amplitude of the signal output of the rear HO2S is small compared to the front HO2S because the rear HO2S detects emission gas purified by the catalytic converter. This is the normal signal waveform of the rear HO2S at idle.

MONITOR DTC STATUS EC24F270

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

E82A4B20

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION

E0D61DA2

1. IG "OFF" and disconnect HO2S(B1/S2)
2. IG "ON"
3. Measure voltage between terminal 3 of HO2S(B1/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON
Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

E0F7969A

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

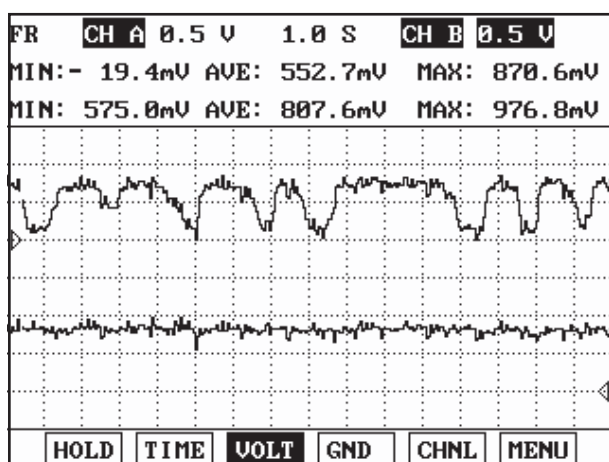


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

 NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E432F1E2

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -251

DTC P0138 HO2S CIRCUIT HIGH VOLTAGE (BANK 1 / SENSOR 2)

COMPONENT LOCATION E640EFD9

Refer to DTC P0137.

GENERAL DESCRIPTION ECA58AF0

Refer to DTC P0137.

DTC DESCRIPTION E4781AA7

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predetermine time, ECM sets P0138. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ED136BF6

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to battery in harness - HO2S(B1/S2) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state	
Threshold value	The voltage of HO2S(B1/S2) $> 1.3V$	
Diagnosis Time	Continuous (more than 12.5 sec.failure for every 15 sec.test)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION EBE7D476

Refer to DTC P0137.

SCHEMATIC DIAGRAM E76F84BB

Refer to DTC P0137.

SIGNAL WAVEFORM AND DATA E21B0A7F

Refer to DTC P0137.

MONITOR DTC STATUS E240DCAD

Refer to DTC P0137.

TERMINAL AND CONNECTOR INSPECTION E7F32D23

Refer to DTC P0137.

SIGNAL CIRCUIT INSPECTION

E546CD85

1. IG "OFF" and disconnect HO2S(B1/S2) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B1/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON
Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

EAC891D2

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

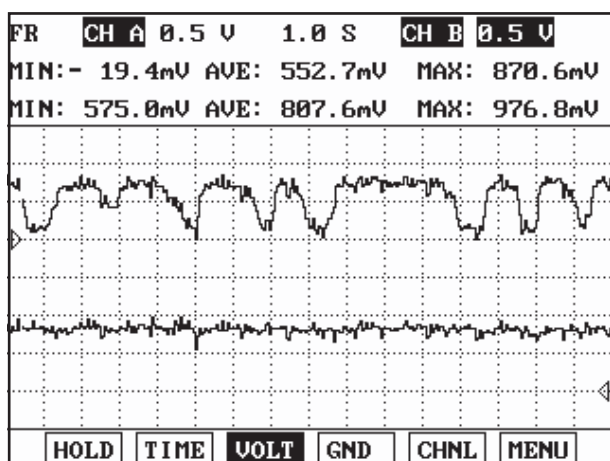


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

DTC TROUBLESHOOTING PROCEDURES

FLB -253

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E94473AE

Refer to DTC P0137.

FLB -254

FUEL SYSTEM

DTC P0140 HO2S CIRCUIT NO ACTIVITY DETECTED (BANK 1 / SENSOR 2)

COMPONENT LOCATION E114552B

Refer to DTC P0137.

GENERAL DESCRIPTION EB5132BD

Refer to DTC P0137.

DTC DESCRIPTION EDBD2CA2

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermine time, ECM sets P0140. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EFFBDE74

Item		Detecting Condition	Possible cause
DTC Strategy		Monitor signal voltage	- Poor Connection - Open in harness - HO2S(B1/S2) - ECM
Enable Conditions		- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state - No disable faults	
Thresh- old value	Case 1	$1.2V \leq \text{Voltage of HO2S} \leq 3.9V$ (at pumping current ON)	
	Case 2	$0.415V \leq \text{Voltage of HO2S} \leq 0.515V$ (at pumping current OFF)	
Diagnosis Time		Continuous (more than 76.5 sec.failure for every 90 sec.test)	
MIL On Condition		2 driving cycles	

SPECIFICATION E5F4D37E

Refer to DTC P0137.

SCHEMATIC DIAGRAM ED6C13FA

Refer to DTC P0137.

SIGNAL WAVEFORM AND DATA E67ADE7F

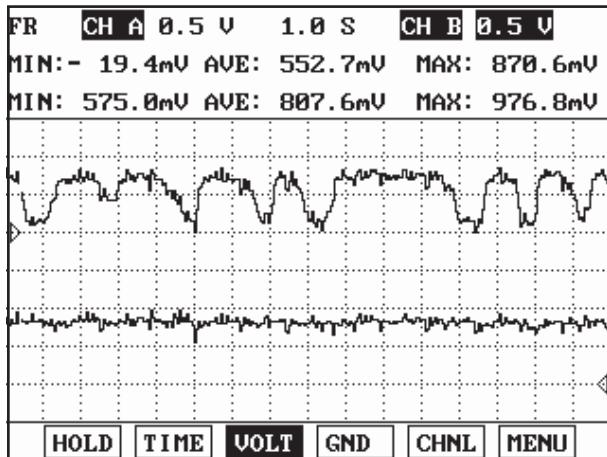


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6415N

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~ 1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

MONITOR DTC STATUS EACA4464

Refer to DTC P0137.

TERMINAL AND CONNECTOR INSPECTION E24D8E5D

Refer to DTC P0137.

SIGNAL CIRCUIT INSPECTION E333CB2A

1. IG "OFF" and disconnect HO2S(B1/S2) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B1/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON
Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION

E4BC7001

1. IG "ON" and disconnect HO2S(B1/S2) connector.
2. Measure voltage between terminal 3 of HO2S(B1/S2) harness connector and chassis ground.
3. Measure voltage between terminals 3 and 4 of HO2S(B1/S2) harness connector.

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification?

YES

- Go to "Component inspection" procedure.

NO

- Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

E6E7D46E

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

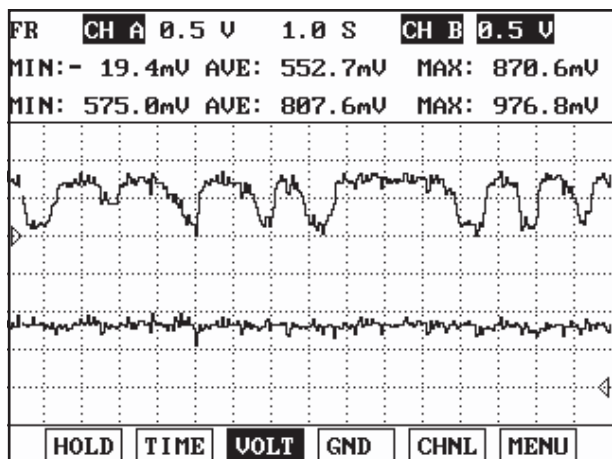


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

- Go to "Check HO2S" as below.

NO

- Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -257

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

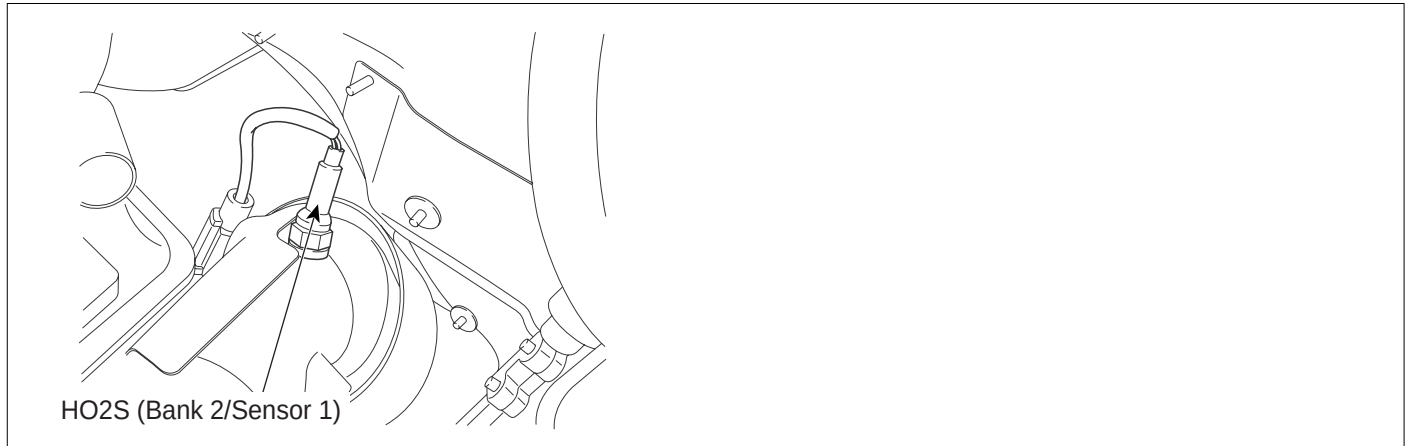
VERIFICATION OF VEHICLE REPAIR

EEA35E53

Refer to DTC P0137.

DTC P0151 HO2S CIRCUIT LOW VOLTAGE (BANK 2 / SENSOR 1)

COMPONENT LOCATION E10C8FCD



SBLF26709L

GENERAL DESCRIPTION EEA87714

In order to control emissions of the CO, HC and NOx components of the exhaust gas, heated oxygen sensor (HO2S), mounted on the front side and rear side of catalytic converter, detects the oxygen content in the exhaust gas. The front HO2S signal is used to control air/fuel ratio (closed loop fuel control) and the rear HO2S signal is used to monitor front HO2S and catalyst for proper operation.

The HO2S requires a minimum temperature to operate properly and provide a closed loop fuel control system. The HO2S contains the heater element to reduce its warming-up time and ensure its performance during all driving conditions. The oxygen sensor generates a voltage that indicates the difference between the oxygen content of the exhaust stream and the oxygen content of ambient air. When the exhaust stream is “ rich,” there is more oxygen in the ambient air than in the exhaust stream, so the voltage will be higher.

DTC DESCRIPTION EC2039D8

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermine time, ECM sets P0151. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E005EA67

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to ground in harness - HO2S(B2/S1) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state	
Threshold value	The voltage of HO2S(B2/S1) $< 0.04V$	
Diagnosis Time	Continuous (more than 12.5 sec. failure for every 15 sec.test)	
MIL On Condition	2 Driving Cycles	

DTC TROUBLESHOOTING PROCEDURES

FLB -259

SPECIFICATION EA2BCD98

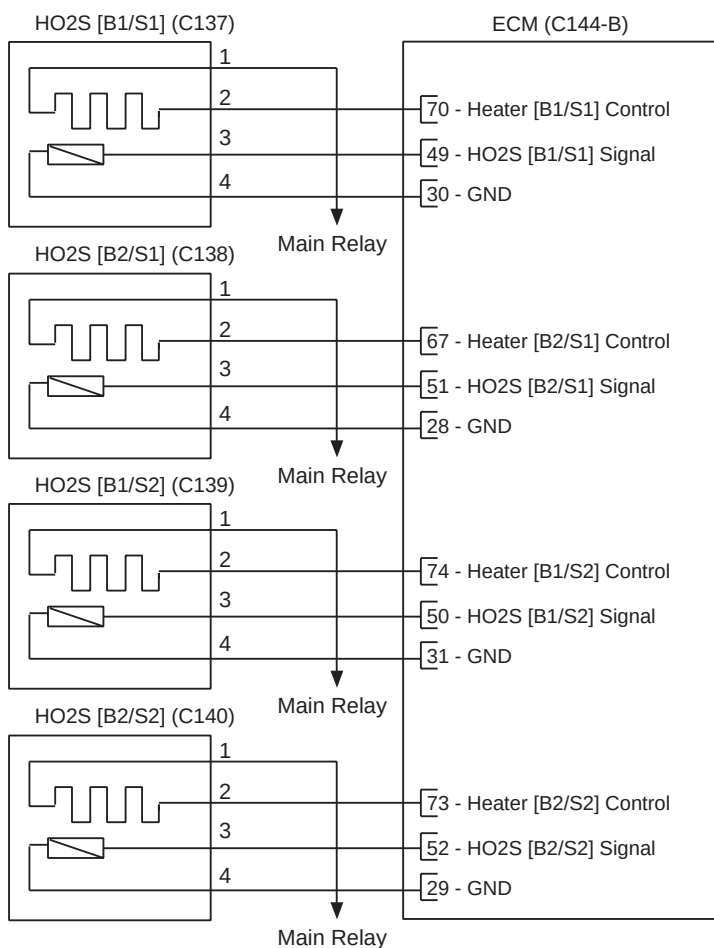
(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit (Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit (Pumping current ON)	Approx. 3.5V	

SCHEMATIC DIAGRAM

E8497CB7

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

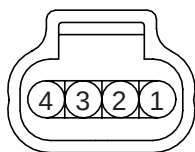
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

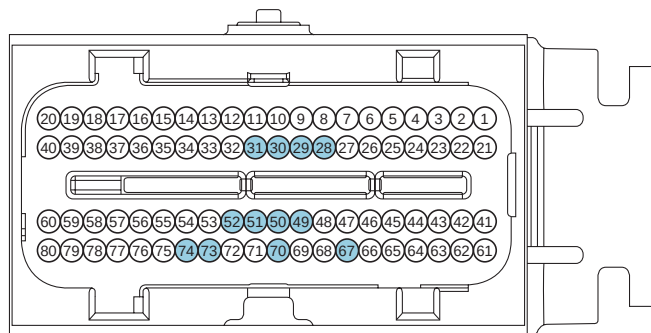
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SBLF26207L

SIGNAL WAVEFORM AND DATA EEF3B26B

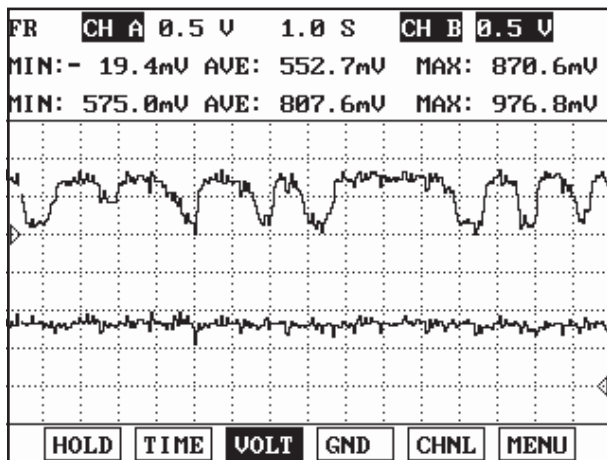


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6415N

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

MONITOR DTC STATUS E513750C

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

- Go to "Inspection & Repair" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EE956B28

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found ?

YES

- Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E10782ED

1. IG "OFF" and disconnect HO2S(B2/S1) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B2/S1) harness connector and chassis ground.

Specification :

Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

- Go to "Component Inspection" procedure.

NO

- Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E45EED93

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.

- 3) After warming-up, monitor signal waveform of HO2S with scantool.

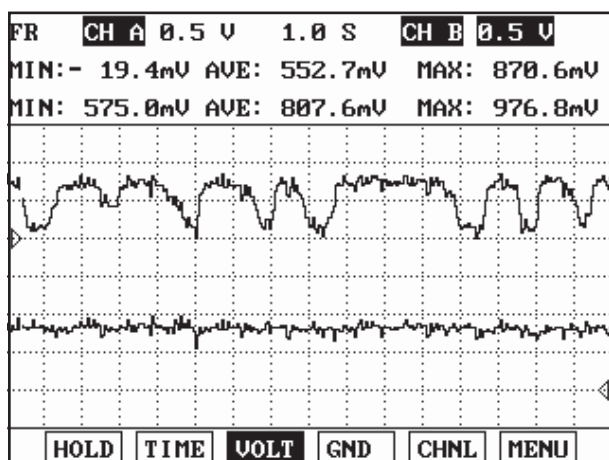


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

ED56B504

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -265

DTC P0152 HO2S CIRCUIT HIGH VOLTAGE (BANK 2 / SENSOR 1)

COMPONENT LOCATION E059FF5C

Refer to DTC P0151.

GENERAL DESCRIPTION E1E18925

Refer to DTC P0151.

DTC DESCRIPTION E8E8D056

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predetermine time, ECM sets P0152. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E5ADA8AE

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to battery in harness - HO2S(B2/S1) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state	
Threshold value	The voltage of HO2S(B2/S1) $> 1.3V$	
Diagnosis Time	Continuous more than 12.5 sec.failure for every 15 sec.test)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION E25CCA19

Refer to DTC P0151.

SCHEMATIC DIAGRAM E34BF392

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA EDE5999A

Refer to DTC P0151.

MONITOR DTC STATUS E258539C

Refer to DTC P0151.

TERMINAL AND CONNECTOR INSPECTION E783DAA8

Refer to DTC P0151.

SIGNAL CIRCUIT INSPECTION

E280B057

1. IG "OFF" and disconnect HO2S(B2/S1) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B2/S1) harness connector and chassis ground.

Specification :

Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

EF724B07

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

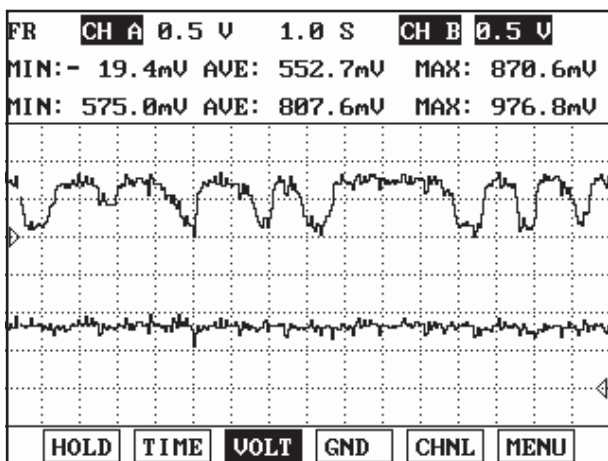


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

DTC TROUBLESHOOTING PROCEDURES

FLB -267

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EF48FC13

Refer to DTC P0151.

FLB -268

FUEL SYSTEM

DTC P0153 HO2S CIRCUIT SLOW RESPONSE (BANK 2 / SENSOR 1)

COMPONENT LOCATION EB760A6D

Refer to DTC P0151.

GENERAL DESCRIPTION E98607C7

Refer to DTC P0151.

DTC DESCRIPTION EF862C12

Checking output signals from HO2S under detecting condition, if ECM judges it's signals too slow, ECM sets P0153. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E67ACF5E

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's response rate	- Poor connection - Faulty HO2S - Faulty ECM
Enable Conditions	- Engine warm-up sufficiently - Engine run time > 60sec - Drive at a steady speed between 45-55 mph(72-88 km/h) - Engine Coolant > 70°C(158 °F) - No disabling faults	
Threshold value	The calculated response rate is too slow (out of threshold in ECM)	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

SPECIFICATION E5EDF257

Refer to DTC P0151.

SCHEMATIC DIAGRAM ECE6FFBC

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA EA04BA68

Refer to DTC P0151.

MONITOR DTC STATUS EDE45548

Refer to DTC P0151.

COMPONENT INSPECTION E523F469

1. Replace the HO2S.

DTC TROUBLESHOOTING PROCEDURES

FLB -269

2. Clear DTC with scantool.
3. Start the engine and warm it up until the radiator fan comes on(more than at least 10 minutes).
4. Drive at a steady speed between 45-55 mph(72-88 km/h) for 120 sec.
5. Stop and then maintain idle state.
6. Check if O2 sensor monitoring readiness is complete.
7. Does the scan tool show DTC P0153?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Troubleshooting is finished.

VERIFICATION OF VEHICLE REPAIR E75D74FD

Refer to DTC P0151.

FLB -270

FUEL SYSTEM

DTC P0154 HO2S CIRCUIT NO ACTIVITY DETECTED (BANK 2 / SENSOR 1)

COMPONENT LOCATION E600FD88

Refer to DTC P0151.

GENERAL DESCRIPTION EDB700D1

Refer to DTC P0151.

DTC DESCRIPTION E8807BA8

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermine time, ECM sets P0154. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E4D5508B

Item		Detecting Condition	Possible cause
DTC Strategy		Monitor signal voltage	- Poor connection - Open in harness - HO2S(B2/S1) - ECM
Enable Conditions		- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state - No disable faults	
Thresh-old value	Case 1	$1.2V \leq \text{Voltage of HO2S} \leq 3.9V$(at pumping current ON)	
	Case 2	$0.415V \leq \text{Voltage of HO2S} \leq 0.515V$(at pumping current OFF)	
Diagnosis Time		Continuous (more than 76.5 sec.failure for every 90 sec.test)	
MIL On Condition		2 driving cycles	

SPECIFICATION E571F4C7

Refer to DTC P0151.

SCHEMATIC DIAGRAM E8C32750

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA E5BA93DD

Refer to DTC P0151.

MONITOR DTC STATUS ED6D79DC

Refer to DTC P0151.

DTC TROUBLESHOOTING PROCEDURES

FLB -271

TERMINAL AND CONNECTOR INSPECTION E2D2305A

Refer to DTC P0151.

SIGNAL CIRCUIT INSPECTION EFFD7522

1. IG "OFF" and disconnect HO2S(B2/S1) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B2/S1) harness connector and chassis ground.

Specification :

Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

▶ Go to "Ground circuit inspection" procedure.

NO

▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EE2A3BBE

1. IG "ON" and disconnect HO2S(B2/S1) connector.
2. Measure voltage between terminal 3 of HO2S(B2/S1) harness connector and chassis ground.
3. Measure voltage between terminals 3 and 4 of HO2S(B2/S1) harness connector.

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification?

YES

▶ Go to "Component inspection" procedure.

NO

▶ Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EFC4A88B

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

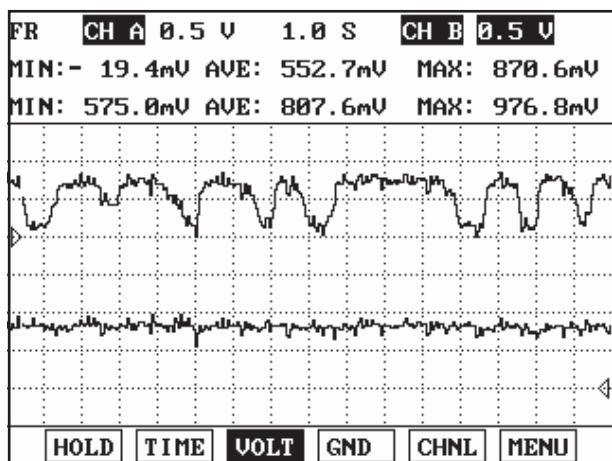


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

VERIFICATION OF VEHICLE REPAIR

E5BD4489

Refer to DTC P0151.

DTC P0157 HO2S CIRCUIT LOW VOLTAGE (BANK 2 / SENSOR 2)

COMPONENT LOCATION E42C074B



SBLF26710L

GENERAL DESCRIPTION E0565942

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter (warm-up catalytic converter) or in the rear exhaust pipe, which is able to detect catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC DESCRIPTION E5064491

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermine time, ECM sets P0157. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E990263A

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to ground in harness - HO2S(B2/S2) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state	
Threshold value	The voltage of HO2S(B2/S2) $< 0.04V$	
Diagnosis Time	Continuous (more than 12.5 sec. failure for every 15 sec.test)	
MIL On Condition	2 Driving Cycles	

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FUEL SYSTEM

SPECIFICATION E17F2FD0

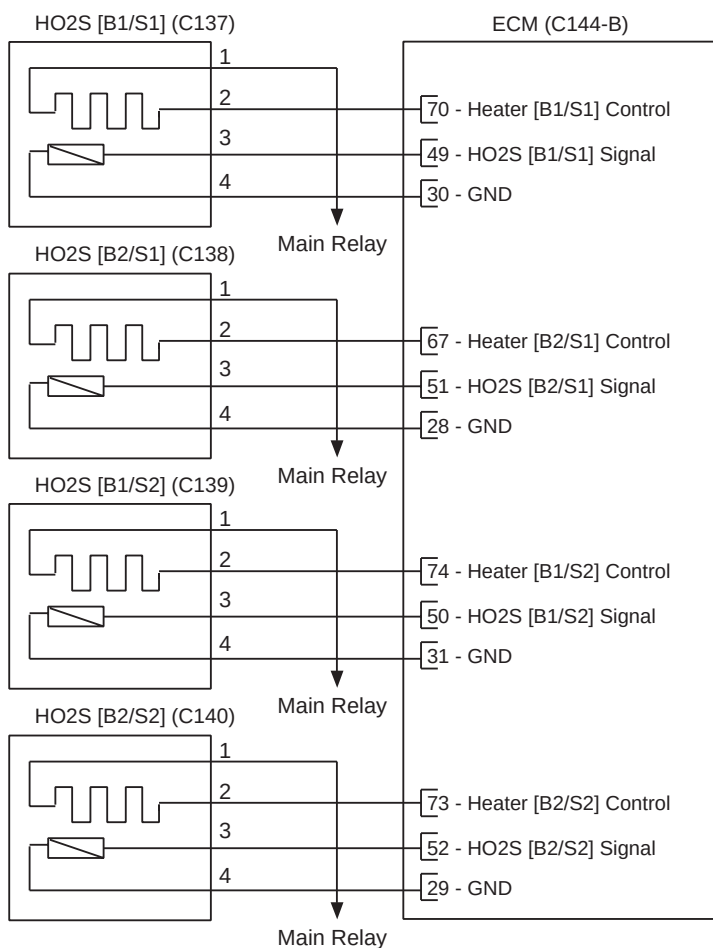
(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit (Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit (Pumping current ON)	Approx. 3.5V	

SCHEMATIC DIAGRAM

E070FDDE

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

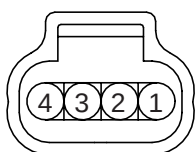
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

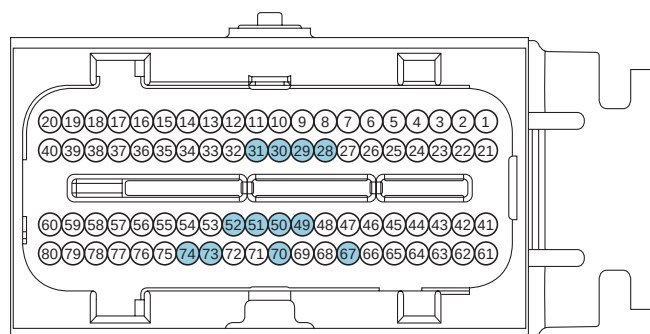
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SBLF26207L

SIGNAL WAVEFORM AND DATA

E7F78806

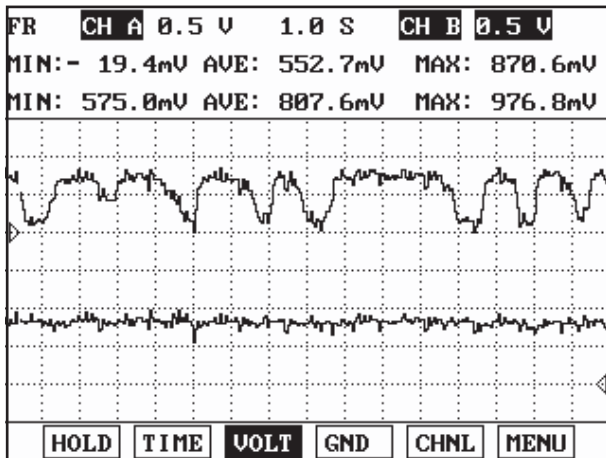


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6415N

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

MONITOR DTC STATUS

E36C4BEC

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -277

- ▶ Go to "Terminal and connector inspection" procedure.

NO

- ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E58341B0

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E1697F48

1. IG "OFF" and disconnect HO2S(B2/S2)
2. IG "ON"
3. Measure voltage between terminal 3 of HO2S(B2/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON
Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

- ▶ Go to "Component Inspection" procedure.

NO

- ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E223EDDD

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

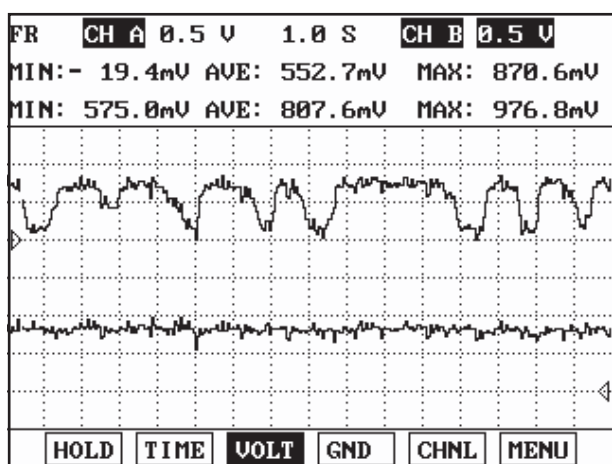


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EEFB078

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode

DTC TROUBLESHOOTING PROCEDURES

FLB -279

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

FLB -280

FUEL SYSTEM

DTC P0158 HO2S CIRCUIT HIGH VOLTAGE (BANK 2 / SENSOR 2)

COMPONENT LOCATION E418C044

Refer to DTC P0157.

GENERAL DESCRIPTION E3FD1D51

Refer to DTC P0157.

DTC DESCRIPTION E72F032B

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predetermine time, ECM sets P0158. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF6F50BF

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to battery in harness - HO2S(B2/S2) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state	
Threshold value	The voltage of HO2S(B2/S2) $> 1.3V$	
Diagnosis Time	Continuous (more than 12.5 sec.failure for every 15 sec.test)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION E456F8F8

Refer to DTC P0157.

SCHEMATIC DIAGRAM EE755D89

Refer to DTC P0157.

SIGNAL WAVEFORM AND DATA E82CEAAC

Refer to DTC P0157.

MONITOR DTC STATUS E726BA08

Refer to DTC P0157.

TERMINAL AND CONNECTOR INSPECTION E298CEF9

Refer to DTC P0157.

DTC TROUBLESHOOTING PROCEDURES

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SIGNAL CIRCUIT INSPECTION E4D7CFC2

1. IG "OFF" and disconnect HO2S(B2/S2) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B2/S2) harness connector and chassis ground.

Specification :

Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

- Go to "Component Inspection" procedure.

NO

- Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EE943DBE

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

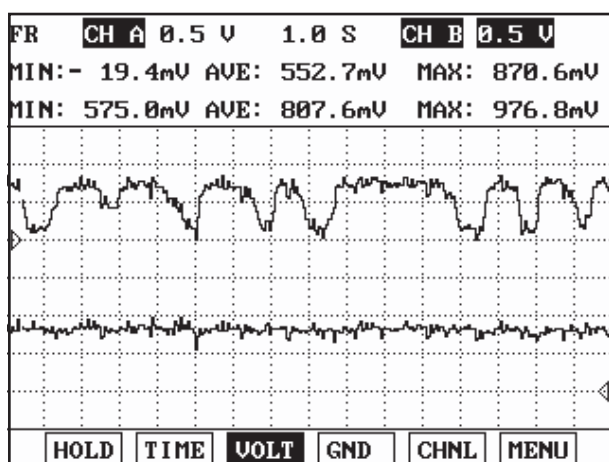


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

- Go to "Check HO2S" as below.

NO

▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EFB98109

Refer to DTC P0157.

DTC TROUBLESHOOTING PROCEDURES

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DTC P0160 HO2S CIRCUIT NO ACTIVITY DETECTED (BANK 2 / SENSOR 2)

COMPONENT LOCATION E07B83A1

Refer to DTC P0157.

GENERAL DESCRIPTION E216412E

Refer to DTC P0157.

DTC DESCRIPTION E02249A1

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predeterminate time, ECM sets P0160. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EE1450AA

Item		Detecting Condition	Possible cause
DTC Strategy		Monitor signal voltage	- Poor connection - Open in harness - HO2S(B2/S2) - ECM
Enable Conditions		- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec. - Engine warm-up state - No disable faults	
Thresh- old value	Case 1	$1.2V \leq \text{Voltage of HO2S} \leq 3.9V$ (at pumping current ON)	
	Case 2	$0.415V \leq \text{Voltage of HO2S} \leq 0.515V$ (at pumping current OFF)	
Diagnosis Time		Continuous (more than 76.5 sec.failure for every 90 sec.test)	
MIL On Condition		2 Driving Cycles	

SPECIFICATION E6B098F0

Refer to DTC P0157.

SCHEMATIC DIAGRAM EC93748B

Refer to DTC P0157.

SIGNAL WAVEFORM AND DATA E888319A

Refer to DTC P0157.

MONITOR DTC STATUS EAA0362A

Refer to DTC P0157.

TERMINAL AND CONNECTOR INSPECTION EBF3D61C

Refer to DTC P0157.

SIGNAL CIRCUIT INSPECTION E5A4B7D9

1. IG "OFF" and disconnect HO2S(B2/S2) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 3 of HO2S(B2/S2) harness connector and chassis ground.

Specification :

Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E0C10CA5

1. IG "ON" and disconnect HO2S(B2/S2) connector.
2. Measure voltage between terminal 3 of HO2S(B2/S2) harness connector and chassis ground.
3. Measure voltage between terminals 3 and 4 of HO2S(B2/S2) harness connector.

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EC5D685F

1. Check the Signal waveform of HO2S
 - 1) IG "OFF" and connect HO2S connector.
 - 2) Engine start.
 - 3) After warming-up, monitor signal waveform of HO2S with scantool.

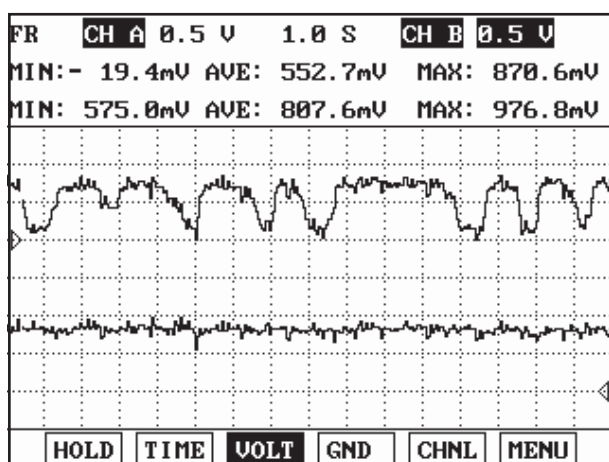


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

- 4) Is the sensor switching properly?

YES

► Go to "Check HO2S" as below.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

2. Check HO2S

- 1) IG "OFF" and disconnect HO2S connector.
- 2) Check that the HO2S is securely installed.
- 3) Check the HO2S for contamination or damage
- 4) Is the sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E2A3BD28

Refer to DTC P0157.

DTC P0171 SYSTEM TOO LEAN (BANK 1)
DTC P0174 SYSTEM TOO LEAN (BANK 2)

GENERAL DESCRIPTION E29F2185

In order to provide the best possible combination of drivability, fuel economy and emission control, the ECM uses a closed loop air/fuel metering system. The ECM monitors the HO2S signal voltage and adjusts fuel delivery based it in closed loop fuel control. Changes in fuel delivery will be indicated by the long-term and the short-term fuel trim values. The ideal fuel trim value is around 0%. The ECM will add fuel when the HO2S signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are above 0%. The ECM will reduce fuel when the HO2S signal is indicating a rich condition. Reduction in fuel is indicated by fuel trim values that are below 0%. The DTC relevant to fuel trim will be set when the amount reaches excessive levels because of a lean or rich condition.

DTC DESCRIPTION EBF3981D

Checking the fuel trime value under detecting condition, if its average exceeds the limit over certain period, ECM sets P0171/P0174. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2F0D503

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the fuel trim value	- Air leakage - Improper fuel pressure - PCV valve stuck - Clogging of injector
Enable Conditions	- Engine warm-up sufficiently - Drive at a steady speed over 5 minutes (Vehicle speed $\leq$ 130km/h) 60°C(140°F) $\leq$ Engine coolant temperature $\leq$ 115°C(239°F) - No disabling faults (DTCs related to HO2S, purge valve,catalyst)	
Threshold value	Average of short term fuel trim $>$ 0.8 and Average of long term fuel trim $>$ 1.2	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

MONITOR DTC STATUS E27DEBB0

- Monitor DTCs related to MAFS, MAPS, ECTS, Injector or CVVT items with scantool.
- Are there the DTCs above-mentioned?

YES

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

NO

► Go to "System Inspection" procedure.

SYSTEM INSPECTION EA1D4882

- Check air leakage

- 1) Visually/physically inspect the air leakage in intake/exhaust system for following items
 - ▶ Vacuum hoses for splits, kinks and improper connections.
 - ▶ Throttle body gasket
 - ▶ Gasket between intake manifold and cylinder head
 - ▶ Seals between intake manifold and fuel injectors
 - ▶ Exhaust system between HO2S and three way catalyst for air leakage

- 2) Has a problem found in this procedure?

YES

- ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Go to "Check the fuel line" as follows

2. Check the fuel line

- 1) Check the fuel line for following items
 - ▶ Connector connection state
 - ▶ Damage/ connection state for vacuum hoses connected to fuel line
 - ▶ Bent/ pressed/ twisted fuel line or fuel leakage

- 2) Has a problem found in this procedure?

YES

- ▶ Repair or replace it which has a problem, and go to " Verification of Vehicle Repair" procedure.

NO

- ▶ Go to "Check fuel pressure" as follows

3. Check fuel pressure



NOTE

1. *Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.*
2. *The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.*

- 1) IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
- 2) Start-up and wait until it stops itself.
- 3) IG "OFF" and connect Fuel Pump Relay.
- 4) Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
- 5) Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
- 6) Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7) Is the measured fuel pressure within specifications ?

YES

► Go to "Component Inspection" procedure.

NO

► Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair"procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter,fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

COMPONENT INSPECTION

E12366E4

1. Check PCV

- 1) IG "OFF" and remove PCV valve from rocker cover.
- 2) Insert a thin stick into the PCV valve from the threaded side and verify that the plunger is moving.
- 3) Is the PCV valve normally moving?

YES

► Go to "Check injector" as follows.

NO

► Replace it, and go to "Verification of Vehicle Repair" procedure.

2. Check injector for normal operation

- 1) Start engine.
- 2) Check its RPM decrease when doing the injector's actuation test.
- 3) Is there any cylinder with no change in RPM or only a small change in RPM?

YES

► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection &&& Repair" procedure. If not, troubleshooting is completed.

NO

► Replace injector, and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E4644C6C

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode

DTC TROUBLESHOOTING PROCEDURES

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2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P0172 SYSTEM TOO RICH (BANK 1)
DTC P0175 SYSTEM TOO RICH (BANK 2)

GENERAL DESCRIPTION EBD66F49

Refer to DTC P0171.

DTC DESCRIPTION E43D2D9E

Checking the fuel trime value under detecting condition, if its average exceeds the limit over certain period, ECM sets P0172/P0175. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF252EA3

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor the fuel trim value	• Blocking of intake system • Fuel leakage in injector • Improper fuel pressure
Enable Conditions	• Engine warm-up sufficiently • Drive at a steady speed over 5 minutes (Vehicle speed $\leq$ 130km/h) • $60^{\circ}\text{C}(140^{\circ}\text{F}) \leq$ Engine coolant temperature $\leq$ $115^{\circ}\text{C}(239^{\circ}\text{F})$ • No disabling faults (DTCs related to HO2S, purge valve,catalyst)	
Threshold value	• Average of short term fuel trim $<$ 1.2 and Average of long term fuel trim $<$ 0.8	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 Driving Cycles	

MONITOR DTC STATUS EE01B1A6

Refer to DTC P0171.

SYSTEM INSPECTION E82F2149

1. Check blocking of intake system

- 1) Visually/physically inspect the blocking in intake system for following items
 - ▶ Throttle body gasket and damage
 - ▶ Blocking in intake manifold and injector caused by any foreign substance

2) Has a problem found?

YES

- ▶ Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Go to " Check fuel pressure" as follows.

2. Check fuel pressure

 NOTE

1. *Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.*
 2. *The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of presonal injury or fire damage to vehicle components.*
- 1) IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
 - 2) Start-up and wait until it stops itself.
 - 3) IG "OFF" and connect Fuel Pump Relay.
 - 4) Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
 - 5) Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
 - 6) Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

- 7) Is the measured fuel pressure within specifications ?

YES

► Go to "Check fuel leakage in injector" as follow.

NO

► Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair"procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter,fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

3. Check fuel leakage in injector

- 1) IG "OFF" after checking the fuel pressure test.
- 2) Stop engine and check for a change in the fuel pressure gauge reading for 5 minutes.

Specification : After engine stops, fuel gauge reading is maintained for 5 minutes.

- 3) Is the fuel gauge reading maintained ?

YES

► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

NO

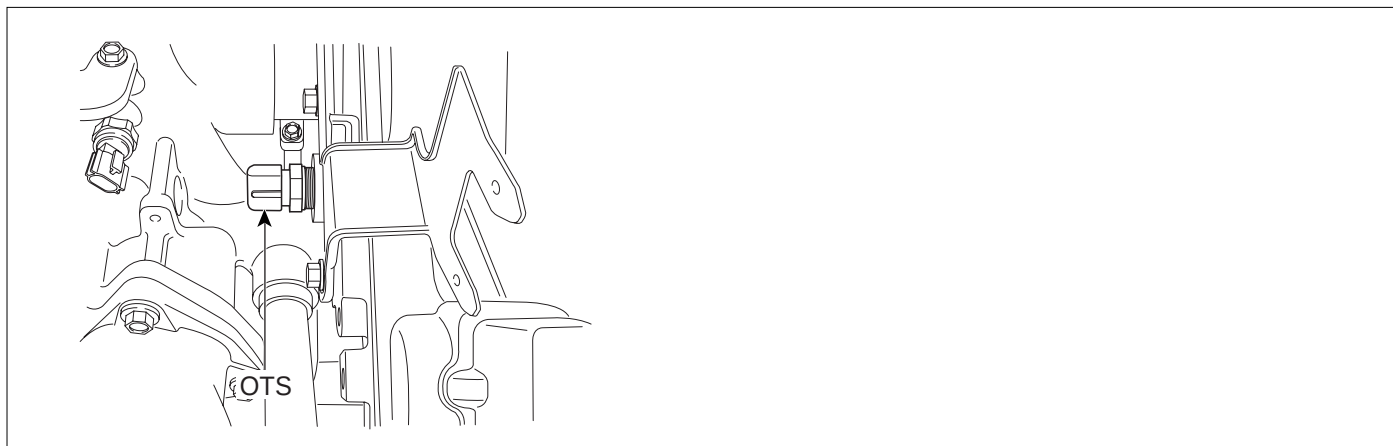
► There is a fuel leakage in injector. Replace it, and go to " Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EF22BC61

Refer to DTC P0171.

DTC P0196 ENGINE OIL TEMP. SENSOR RANGE / PERFORMANCE

COMPONENT LOCATION E792B8B9



SBLF26716L

GENERAL DESCRIPTION EE980E70

The fluid of the CVVT is the engine oil and its density changes according to the engine oil temperature. At this time the Oil Temperature Sensor (OTS) helps compensation against the temperature differences. The Oil Temperature Sensor measures the engine oil temperature before the engine oil comes into the Oil-flow Control Valve (OCV). According to the measured temperature, the Engine Control Module (ECM) compensates the oil-flow control valve operation time.

DTC DESCRIPTION E76AA6E6

Checking the oil temperature, coolant temperature and intake air temperature every 25 sec. under detecting condition, if the difference in temperature at start-up exceeds threshold value, ECM sets P0196. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E5553CD0

Item		Detecting Condition	Possible cause
DTC Strategy		Determines if the oil temperature value is rational, compared to coolant and intake air temperature.	- Faulty OTS - ECM
Enable Conditions	Case1	- Engine run time after startup < 30 sec - Soak period required > 300 min	
	Case2	Minimum engine run time > 800 sec	
Threshold value	Case1	The difference in temperature between oil and coolant temperatures at startup. > 35°C(63°F)	
	Case2	The difference in temperature between oil temperature and intake air temperature at startup &gt; 35°C(63°F)	
Diagnosis Time		Continuous (More than 800 sec.)	
MIL On Condition		2 Driving Cycles	

FLB -294

FUEL SYSTEM

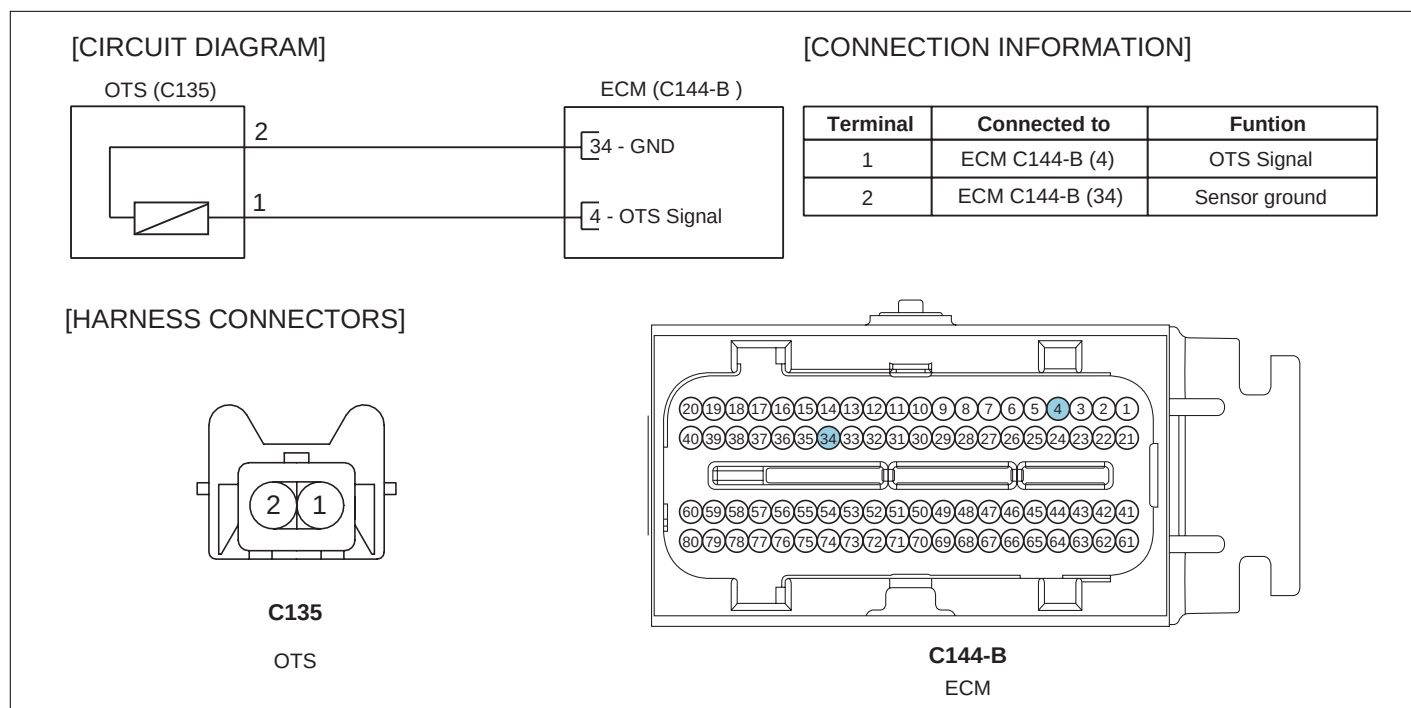
SPECIFICATION

E68BAD9E

Temperature(°C/°F)	Resistance(kΩ)
-20°C/ -4°F	16.52kΩ
20°C/ 68°F	2.45kΩ
80°C/ 176°F	0.29kΩ

SCHEMATIC DIAGRAM

E37A7DD4



SBLF26211L

MONITOR DTC STATUS

EED6213C

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable codition then, go to " Component Inspection" procedure.

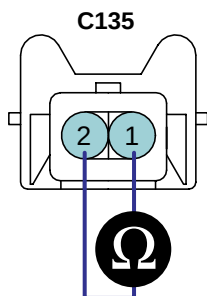
COMPONENT INSPECTION EE73CBB4

1. Check resistance of OTS

- 1) IG "ON" & ENG "OFF"
- 2) Monitor Oil Temperature parameter on the scantool
- 3) IG "OFF" & ENG "OFF"
- 4) Disconnect OTS connector.
- 5) Measure resistance between terminal 1 and 2 of OTS connector after checking out the oil temperature with scantool

SPECIFICATION :

Temperature(°C/°F)	Resistance(kΩ)
-20°C/ -4°F	16.52kΩ
20°C/ 68°F	2.45kΩ
80°C/ 176°F	0.29kΩ



- 1. OTS Signal
- 2. OTS Ground

1.2 CURRENT DATA		05/79
✖	COOLANT TEMP. SNSR	195.8°F
✖	OIL TEMPERATURE	201.2°F
✖	INT. AIR TEMP. SNSR	96.8 °F
	MAL.INDICATOR LAMP	OFF
	BATTERY VOLTAGE	12.3 V
	MAIN RELAY	ON
	MASS AIR FLOW	1.1 g/s
	MAP SENSOR	14.5 psi
FIX		SCRN
FULL		PART
GRPH		HELP

SBLF26826L

6) Is the measured resistance within specification ?

YES

► Go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good OTS and check for proper operation. If the problem is corrected, replace OTS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E454B967

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -297

DTC P0197 ENGINE OIL TEMP. SENSOR LOW INPUT

COMPONENT LOCATION EE449976

Refer to DTC P0196.

GENERAL DESCRIPTION E0CC62CC

Refer to DTC P0196.

DTC DESCRIPTION E50986C0

Checking output signals from oil temperature sensor every 15 sec. under detecting condition, if an signal is low for more than 12.5 sec., ECM sets P0197. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ECE11015

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal low	• Poor connection • Short to ground in harness • Oil temp.sensor • ECM
Enable Conditions	Case 1	• Engine running state > 60 sec • Coolant temperature < 110 °C(230°F)	
	Case 2	• Engine running state > 90 sec.	
Thresh old value		• Oil temperature sensor's signal < 0.1V	
Diagnosis Time		• Continuous (More than 12.5 sec.failure for every 15 sec.test)	
MIL On Condition		• 2 Driving Cycles	

SPECIFICATION E104C15D

Refer to DTC P0196.

SCHEMATIC DIAGRAM ED8405AB

Refer to DTC P0196.

MONITOR DTC STATUS E9764CE2

Refer to DTC P0196.

TERMINAL AND CONNECTOR INSPECTION E24EB835

Refer to DTC P0196.

SIGNAL CIRCUIT INSPECTION E4420B5C

1. Check Voltage
 - 1) IG "OFF" & ENG "OFF"

- 2) Disconnect OTS connector
- 3) IG "ON" & ENG "OFF"
- 4) Measure voltage between harness terminal 1 of OTS and chassis ground.

Specification : Approx. 5V

- 5) Is the measured voltage within specification ?

YES

► Go to " Component Inspection" procedure.

NO

► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

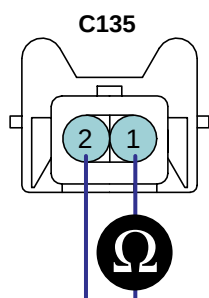
COMPONENT INSPECTION E6577BB2

1. Check resistance of OTS

- 1) IG "ON" & ENG "OFF"
- 2) Monitor Oil Temperature parameter on the scantool
- 3) IG "OFF" & ENG "OFF"
- 4) Disconnect OTS connector.
- 5) Measure resistance between terminal 1 and 2 of OTS connector(Component Side)

SPECIFICATION :

Temperature(°C/°F)	Resistance(kΩ)
-20°C/ -4°F	16.52kΩ
20°C/ 68°F	2.45kΩ
80°C/ 176°F	0.29kΩ



1. OTS Signal
2. OTS Ground

SBLF26487L

- 6) Is the measured resistance within specification ?

YES

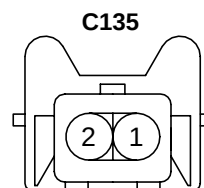
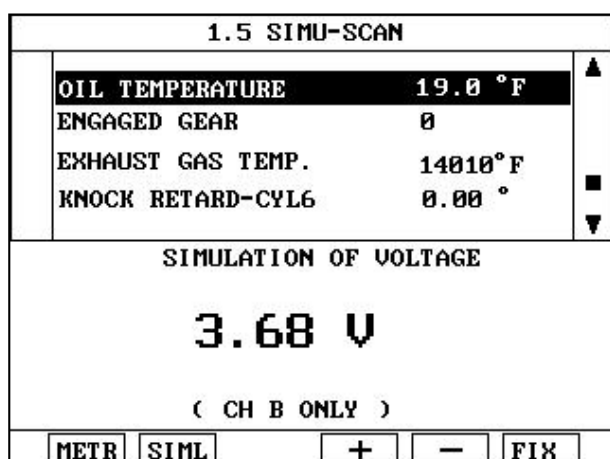
► Go to "Check ECM" as follows.

NO

► Substitute with a known - good OTS and check for proper operation. If the problem is corrected, replace OTS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) Ignition "OFF" and Connect Scantool
- 2) Ignition"ON " & Engine "OFF"
- 3) Select simulation function on scantool.
- 4) Simulate voltage at terminal "1" of OTS signal harness connector.



1. OTS Signal
2. OTS Ground

SBLF26489L

- 5) Does the OTS signal value changes according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace if necessary and go to "Verification of Vehicle Repair" procedure

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E35580EA

Refer to DTC P0196.

FLB -300

FUEL SYSTEM

DTC P0198 ENGINE OIL TEMP. SENSOR HIGH INPUT

COMPONENT LOCATION EAB2C790

Refer to DTC P0196.

GENERAL DESCRIPTION E382C915

Refer to DTC P0196.

DTC DESCRIPTION EE18ACF3

Checking output signals from oil temperature sensor every 15 sec. under detecting condition, if an signal is high for more than 12.5 sec., ECM sets P0198. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EA1BACAE

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal low	• Poor connection • Open or short to battery in signal harness • Open in ground harness • Oil temp.sensor • ECM
Enable Conditions	Case 1	• Engine running state > 60 sec • Coolant temperature < 110 °C(230°F)	
	Case 2	• Engine running state > 90 sec.	
Thresh old value		• Oil temperature sensor's signal > 4.9V	
Diagnosis Time		• Continuous (More than 12.5 sec.failure for every 15 sec.test)	
MIL On Condition		• 2 Driving Cycles	

SPECIFICATION E747E2B9

Refer to DTC P0196.

SCHEMATIC DIAGRAM EF1328CC

Refer to DTC P0196.

MONITOR DTC STATUS EBBBD9EC

Refer to DTC P0196.

TERMINAL AND CONNECTOR INSPECTION E3A1BF24

Refer to DTC P0196.

SIGNAL CIRCUIT INSPECTION E9B5C195

1. Check Voltage
 - 1) IG "OFF" & ENG "OFF"

DTC TROUBLESHOOTING PROCEDURES

FLB -301

- 2) Disconnect OTS connector
- 3) IG "ON" & ENG "OFF"
- 4) Measure voltage between harness terminal 1 of OTS and chassis ground.

Specification : Approx. 5V

- 5) Is the measured voltage within specification ?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Go to "Check open in harness" as follow.

2. Check open in harness

- 1) IG "OFF" & ENG "OFF"
- 2) Disconnect OTS and ECM connector.
- 3) Measure resistance between terminal 1 of OTS harness connector and terminal 4 of ECM harness connector(C144-B).

Specification : Approx. below 1Ω

- 4) Is the measured resistance within specification ?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair or replace open in harness, and then go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E39E21EF

1. IG "OFF" & ENG "OFF"
2. Disconnect OTS connector
3. Measure voltage between terminal 1 of OTS harness connector and chassis ground.
4. Measure voltage between terminals 1 and 2 of OTS harness connector.

Specification : Measurement "A" - Measurement 'B' = Approx. below 200mV

5. Is the measured voltage within specification ?

YES

► Go to "Component Inspection" procedure

NO

► Repair or replace contact resistance or open in harness and then, go to "Verification of Vehicle Repair" procedure.

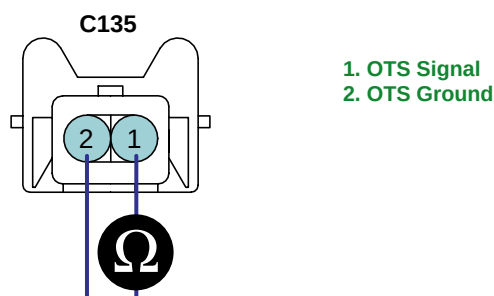
COMPONENT INSPECTION EDDA33C0

1. Check resistance of OTS

- 1) IG "ON" & ENG "OFF"
- 2) Monitor Oil Temperature parameter on the scantool
- 3) IG "OFF" & ENG "OFF"
- 4) Disconnect OTS connector.
- 5) Measure resistance between terminal 1 and 2 of OTS connector(Component Side)

SPECIFICATION :

Temperature(°C/°F)	Resistance(kΩ)
-20°C/ -4°F	16.52kΩ
20°C/ 68°F	2.45kΩ
80°C/ 176°F	0.29kΩ



SBLF26487L

6) Is the measured resistance within specification ?

YES

► Go to "Check ECM" as follows.

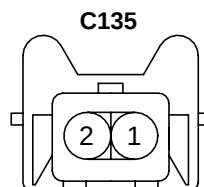
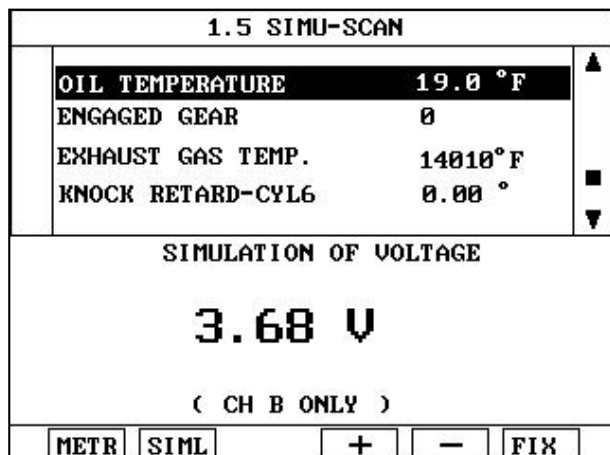
NO

► Substitute with a known - good OTS and check for proper operation. If the problem is corrected, replace OTS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) Ignition "OFF" and Connect Scantool
- 2) Ignition"ON " & Engine "OFF"

- 3) Select simulation function on scantool.
- 4) Simulate voltage at terminal "1" of OTS signal harness connector.



1. OTS Signal
2. OTS Ground

SBLF26489L

- 5) Does the OTS signal value changes according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace if necessary and go to "Verification of Vehicle Repair" procedure

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

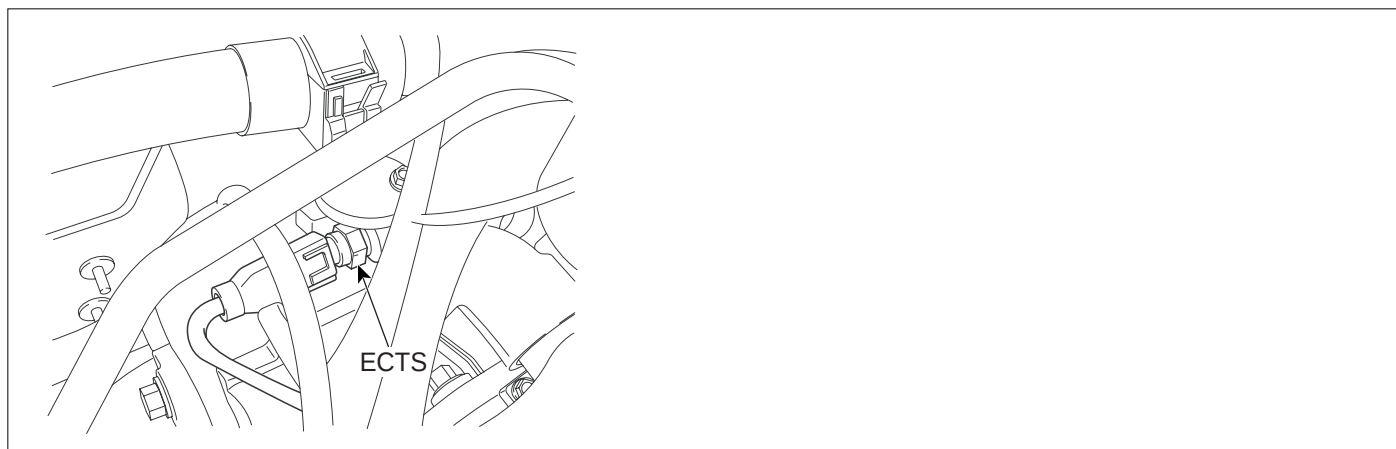
VERIFICATION OF VEHICLE REPAIR

E54E4A27

Refer to DTC P0196.

DTC P0217 ENGINE COOLANT OVER TEMPERATURE CONDITION

COMPONENT LOCATION E5F96166



SBLF26704L

GENERAL DESCRIPTION ECE36202

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.

DTC DESCRIPTION E98CF93D

Checking the coolant temperature under detecting condition, if the coolant temperature exceeds the threshold temperature under normal operation loads, ECM sets P0217. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC TROUBLESHOOTING PROCEDURES

FLB -305

DTC DETECTING CONDITION

E1882321

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the coolant temperature	ECTS
Enable Conditions	- Coolant sensor is normal - No disabling faults present(DTCs related to MAFS/MAPS, catalyst, fuel system or engine oil temperature sensor) - Coolant Temperature at startup < 45°C(113 °F) - Engine running state - Coolant temperature > 50°C(122 °F) - Intake air temperature < 35°C(95 °F)	
Thresh old value	Coolant temperature ≥ 110°C (230 °F)(Average airflow < 30 g/sec and filtered airflow < 50 g/sec)	
Diagnosis Time	Once per driving cycle (about 2 minutes)	
MIL On Condition	2 Driving Cycles	

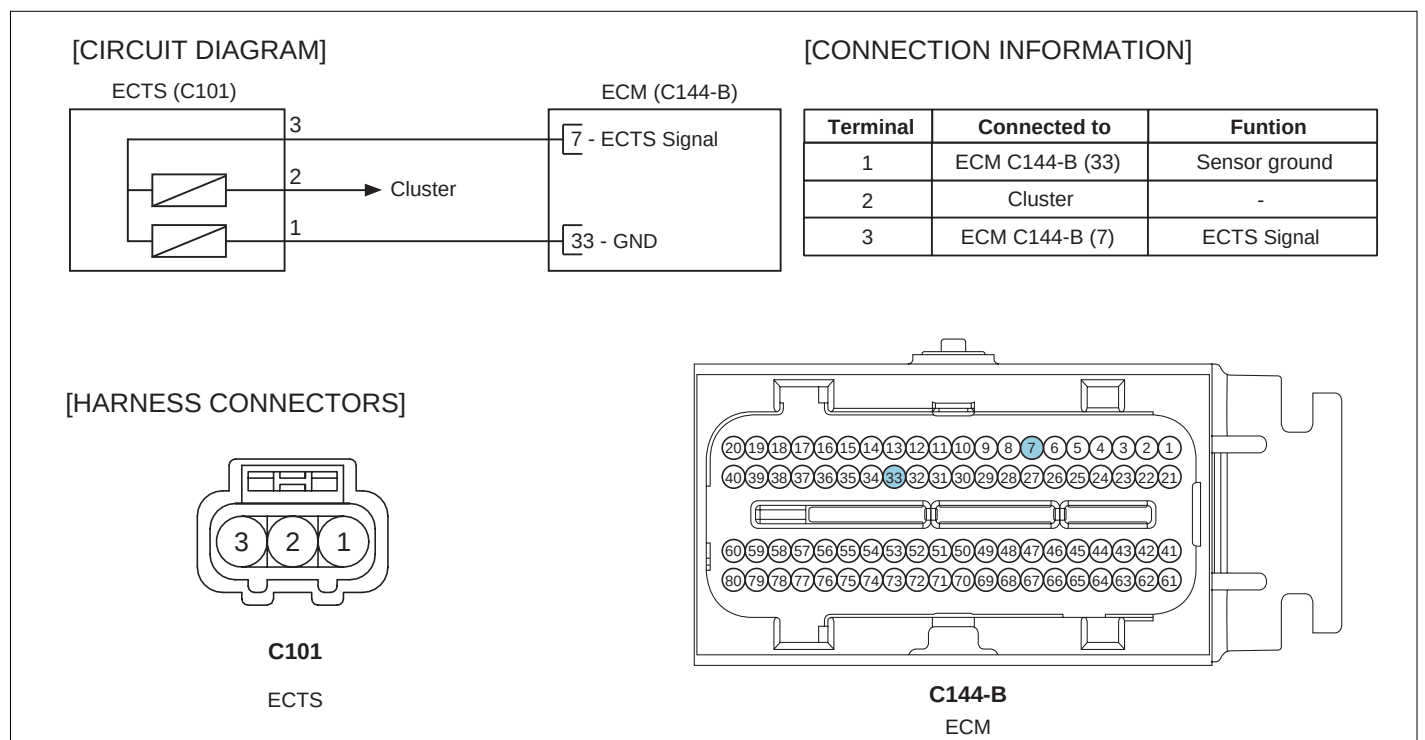
SPECIFICATION

E5B0D192

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		

SCHEMATIC DIAGRAM

E5F1BB88



SBLF26204L

MONITOR DTC STATUS

EBA7B16B

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent, go to "Verification of vehicle Repair" procedure.

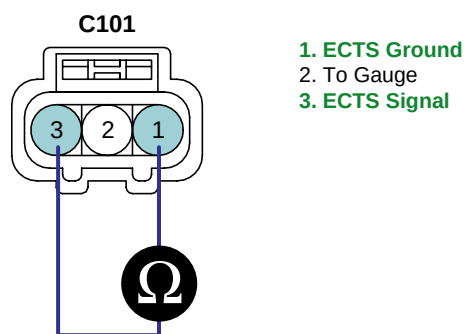
COMPONENT INSPECTION

E6895E79

1. IG "OFF" and disconnect ECTS connector.
2. Remove it.
3. Measure resistance between terminals 1 and 3 of ECTS connector as the temperature rises.

SPECIFICATION :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		



SBLF26492L

4. Are the measured resistance within specification?

YES

► Clear DTC and Test-drive under enable conditions above-mentioned.

After the test, If this DTC is set, recheck it thoroughly. If not, it is intermittent fault, go to "Verification of vehicle Repair" procedure.

NO

► Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E2F8E8B3

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P0222 THROTTLE/PEDAL POSITION SENSOR/SWITCH "B" CIRCUIT LOW INPUT

COMPONENT LOCATION E08CE9A1



SBLF26703L

GENERAL DESCRIPTION E04F1189

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1 & 2 and Accelerator Position Sensor(APS) 1 & 2. TPS1 & 2 are sharing the same source voltage and ground. The throttle valve opening is control by throttle motor which is controlled by Engine Control Module(ECM). The opposite position indicator shows inverted signal characteristics. TPS1 output voltage increases smoothly in proportion with the throttle valve opening angle after starting. TPS2 output voltage decreases in inverse proportion with the throttle valve opening angle after starting. TPS provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION EE420F12

Checking output signals from TPS2 every 8.5 sec. under detecting condition, if an output signal is below 0.25V for more than 0.1 sec, ECM sets P0222. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EAFF3351

Item	Detecting Condition	Possible Cause
DTC Strategy	• signal low	• Poor connection • Open or short to ground in power harness • Open or short to ground in signal harness • TPS • ECM
Enable condition	• IG "ON"	
threshold value	• The signal voltage of TPS < 0.25V	
diagnosis time	• Continuous (more than 0.1 sec. failure for every 8.5 sec.test)	
MIL ON condition	• 2 driving cycles	

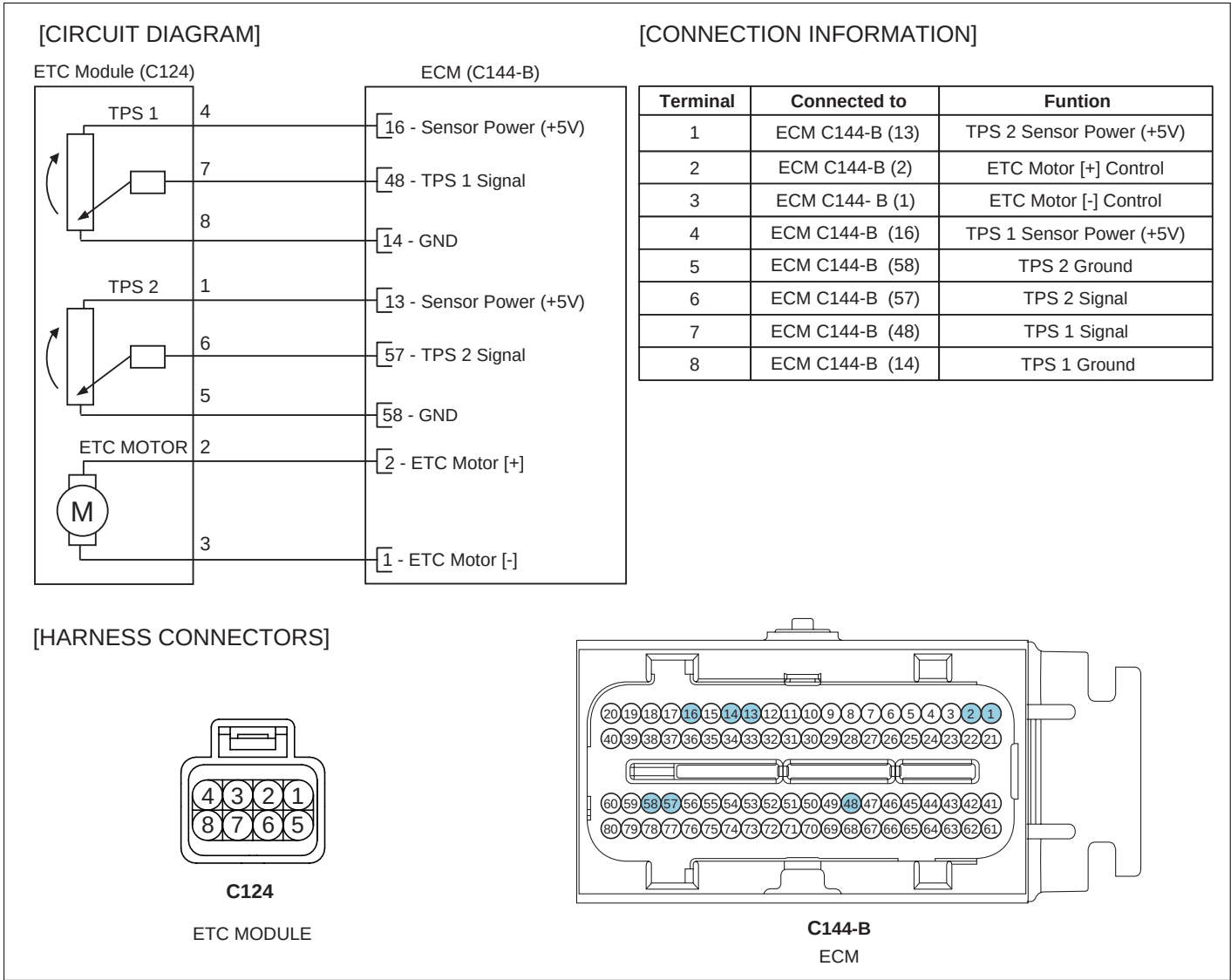
DTC TROUBLESHOOTING PROCEDURES

FLB -309

SPECIFICATION E717D190

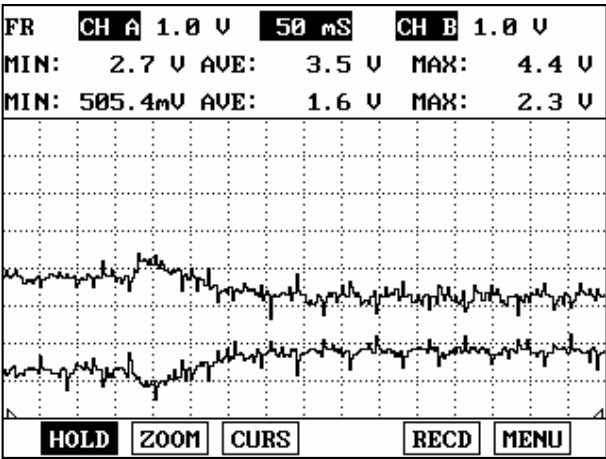
Throttle opening (°)	Output voltage(V) [Vref=5.0]	
	TPS1	TPS2
0°	0.0V	5.0V
10°	0.5V	4.5V
20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V

SCHEMATIC DIAGRAM EB8E1A8A

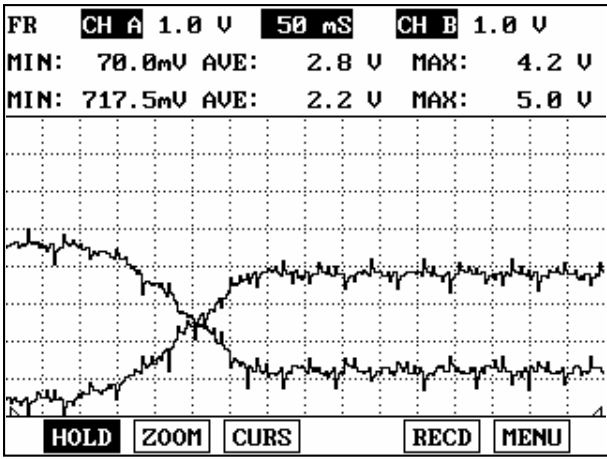


SBLF26201L

SIGNAL WAVEFORM AND DATA E585C476



Hit the accelerator at IG ON



Open the throttle valve by force at IG ON

EGRF604Z

DTC TROUBLESHOOTING PROCEDURES

FLB -311

MONITOR DTC STATUS ECDDF579

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E55FA974

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION E875F6F1

1. IG "OFF" and disconnect TPS connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 1 of TPS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES

- Go to "Signal circuit inspection" procedure.

NO

- Repair open or short to ground in power harness, and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION EDCCB82B

1. Check short to ground in harness
 - 1) IG "OFF" and disconnect TPS connector and ECM connector.
 - 2) Measure resistance between terminal 6 of TPS harness connector and chassis ground.
 - 3) Measure resistance between terminals 6 and 5(8) of TPS harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification?

YES

- Go to "Check open in harness" as follows

NO

- Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness

- 1) IG "OFF" and disconnect TPS connector and ECM connector.
- 2) Measure resistance between terminal 6 of TPS harness connector and terminal 57 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -313

- ▶ Go to "Component Inspection" procedure.

NO

- ▶ Repair open in harness, and go to "Verification of Repair" procedure.

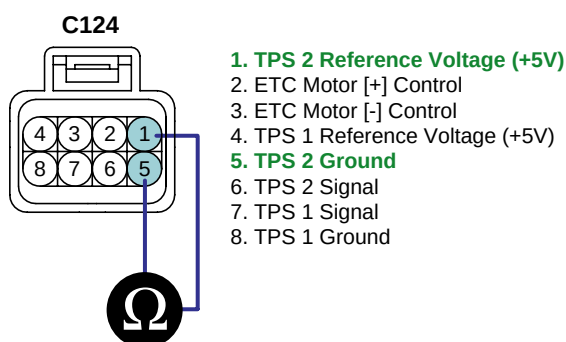
COMPONENT INSPECTION

E077A534

1. Check TPS

- 1) IG "OFF" and disconnect TPS connector.
- 2) Measure resistance between terminals 1 and 5 of TPS connector.(Component side)

Specification : 2.7 ~ 4.1k Ω



SBLF26496L

- 3) Is the measured resistance within specification?

YES

- ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Substitute with a known - good TPS and check for proper operation. If the problem is corrected, replace TPS and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

CAUTION

Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR

EF749FC7

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -315

DTC P0223 THROTTLE/PEDAL POSITION SENSOR/SWITCH "B" CIRCUIT HIGH INPUT

COMPONENT LOCATION EB960FF0

Refer to DTC P0222.

GENERAL DESCRIPTION E2F0051B

Refer to DTC P0222.

DTC DESCRIPTION E29B33EB

Checking output signals from TPS2 every 8.5 sec. under detecting condition, if an output signal is above 4.75V for more than 0.1 sec., ECM sets P0223. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E644D2D2

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal High	• Poor connection • Short to battery in signal harness • Open in ground harness • TPS • ECM
Enable condition	• IG "ON"	
threshold value	• The signal voltage of TPS $> 4.75V$	
diagnosis time	• Continuous (more than 0.1 sec. failure for every 8.5 sec.test)	
MIL ON condition	• 2 driving cycles	

SPECIFICATION EC69DD13

Refer to DTC P0222.

SCHEMATIC DIAGRAM E48E5FC3

Refer to DTC P0222.

SIGNAL WAVEFORM AND DATA E00A56A1

Refer to DTC P0222.

MONITOR DTC STATUS EDAE4171

Refer to DTC P0222.

TERMINAL AND CONNECTOR INSPECTION EEDA341D

Refer to DTC P0222.

SIGNAL CIRCUIT INSPECTION

EB012E2C

1. Check voltage

- 1) IG "OFF" and disconnect TPS connector.
- 2) IG "ON and ENG "OFF"
- 3) Measure voltage between terminal 6 of TPS harness connector and chassis ground.

Specification : Approx. 0V

- 4) Is the measured voltage within specification?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Go to "Check short to battery in harness" as follows.

2. Check short to battery in harness

- 1) IG "OFF" and disconnect TPS connector and ECM connector.
- 2) Measure resistance between terminals 1 and 6 of TPS harness connector.
- 3) Measure resistance between terminals 4 and 6 of TPS harness connector.
- 4) Measure resistance between terminals 2 and 6 of TPS harness connector.
- 5) Measure resistance between terminals 3 and 6 of TPS harness connector.

Specification : Infinite

- 6) Is the measured resistance within specification?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION

E722DCF8

1. IG "OFF" and disconnect TPS connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 1 of TPS harness connector and chassis ground.
4. Measure voltage between terminals 1 and 5 of TPS harness connector.

Specification : Measurement "A" - Measurement 'B' = Approx. below 200mV

DTC TROUBLESHOOTING PROCEDURES

FLB -317

5. Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

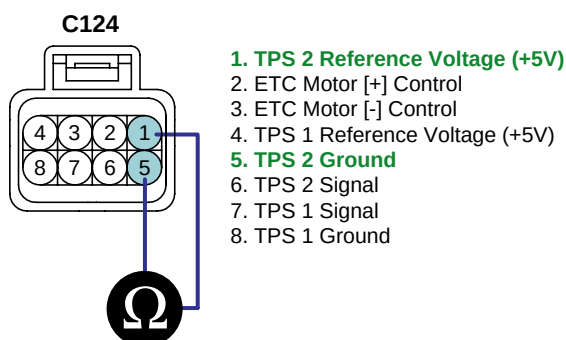
E6A425E3

1. Check TPS

1) IG "OFF" and disconnect TPS connector.

2) Measure resistance between terminals 1 and 5 of TPS connector.(Component side)

Specification : 2.7 ~ 4.1k Ω



SBLF26496L

3) Is the measured resistance within specification?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good TPS and check for proper operation. If the problem is corrected, replace TPS and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others



CAUTION

Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E76138CE

Refer to DTC P0222.

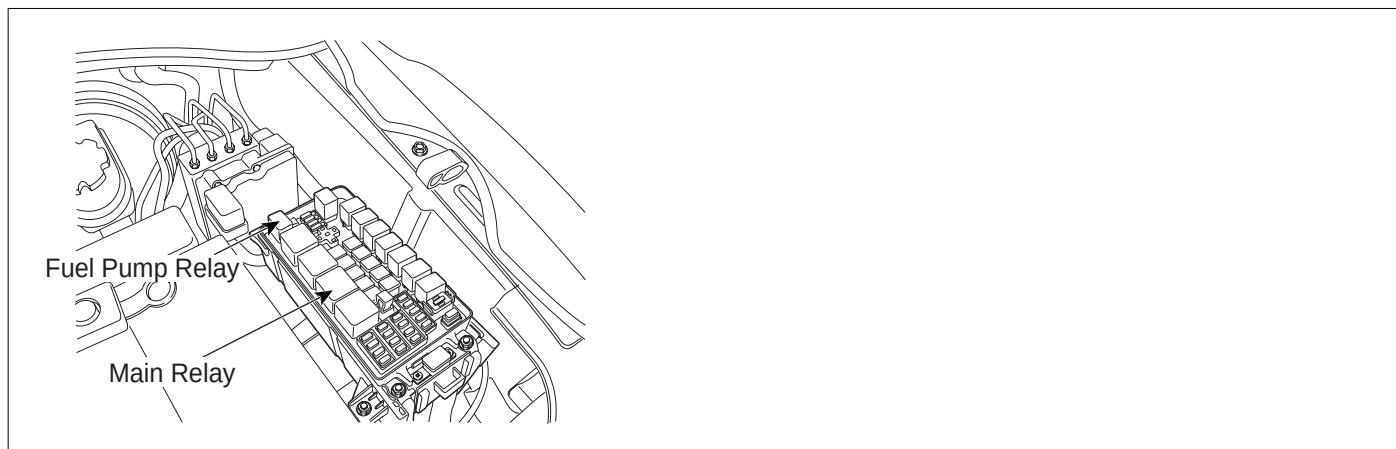
DTC TROUBLESHOOTING PROCEDURES

FLB -319

DTC P0230 FUEL PUMP PRIMARY CIRCUIT

COMPONENT LOCATION

E1F2CE82



SBLF26719L

GENERAL DESCRIPTION

E1E42AE5

The ECM provides ground to one side of the coil in the fuel pump relay to control the fuel pump relay. The other side of the fuel pump relay coil is connected to main relay, which activates when the ignition switch is ON. The ECM monitors the control circuit between the fuel pump relay and the ECM. When the ignition switch is turned ON, the ECM energizes the fuel pump relay, which sends power to the fuel pump.

DTC DESCRIPTION

ECF9F806

Checking fuel pump relay circuit continuously under detecting condition, if open or short in the circuit is detected, ECM sets P0230. In addition, Take note that open circuit in Main Relay may cause this P0230 code.

※ In addition, Take note that open circuit in Main Relay may cause this P0230 code.

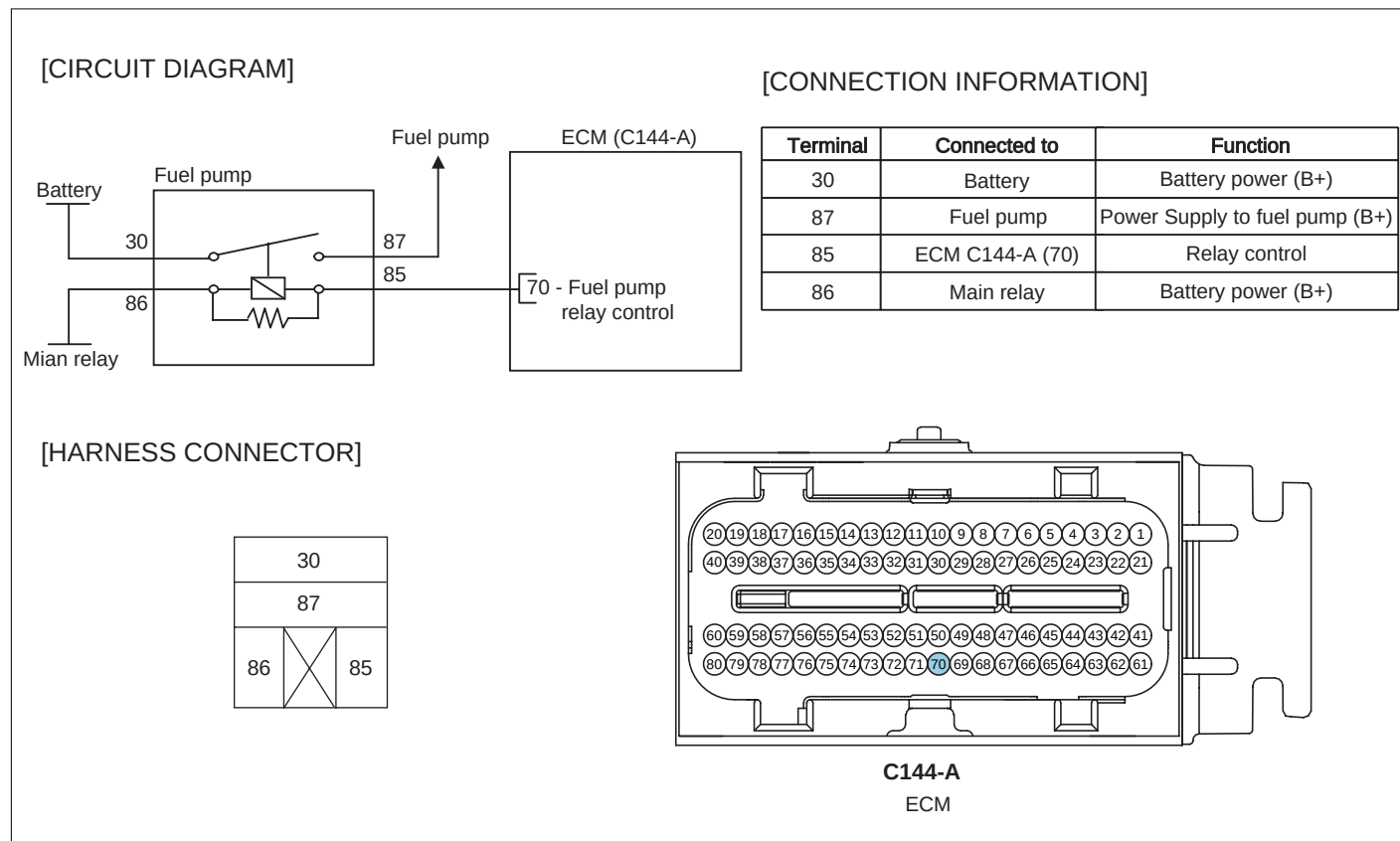
DTC DETECTING CONDITION

E6F51B26

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Low or High	- Poor connection - Open or short in fuel pump relay circuit - Open in Main Relay circuit - Fuel Pump Relay - ECM
Enable condition	$11V \leq \text{Battery Voltage} \leq 16V$	
threshold value	Open or short	
diagnosis time	Continuous	
MIL ON condition	NO MIL ON(DTC only)	

SCHEMATIC DIAGRAM

E5032804



SBLF26836L

MONITOR DTC STATUS

ED9A0C8A

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

E2FCC4A8

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair or replace if necessary and go to "Verification of Vehicle Repair" procedure

NO

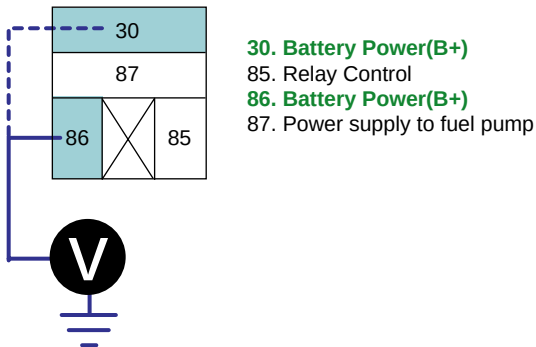
► Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION

E1831D2B

1. IG "OFF" & ENG "OFF"
2. Disconnect fuel pump relay.
3. IG "ON" & ENG "OFF"
4. Measure voltage between harness terminal 30(86) of chassis ground.

Specification : B+



SBLF26500L

5. Is the measured voltage within specification ?

YES

► Go to "Control Circuit Inspection" procedure.

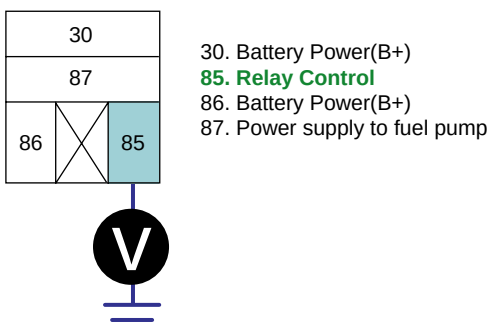
NO

- Check "Fuse" between fuel pump relay and main relay is not installed or blown off
- Check "Fuse" between fuel pump relay and battery is not installed or blown off
- Especially, if battery voltage at terminal 85 is not detected, replace the Main Relay.
- Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION ED6EFBF1

1. IG "OFF"
2. Disconnect fuel pump relay.
3. IG "ON" & ENG "OFF"
4. Measure voltage between harness terminal 85 and chassis ground.

Specification : Approx. 2.5V ~ 3V



SBLF26501L

5. Is the measured voltage within specification ?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -323

► Go to "Component Inspection" procedure.

NO

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

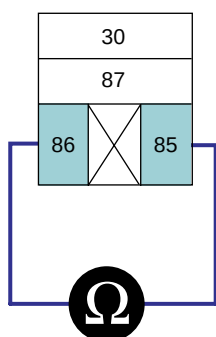
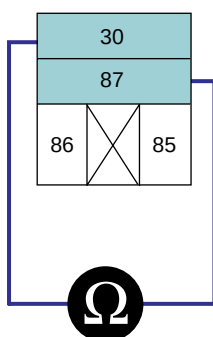
E78DDEEC

1. Check fuel pump relay

- 1) IG "OFF"
- 2) Disconnect Fuel Pump Relay
- 3) Measure resistance between terminal 30 and 87 of Fuel Pump Relay
- 4) Measure resistance between terminal 85 and 86 of Fuel Pump Relay

SPECIFICATION :

Terminal	continuity
30 ~ 87	NO
85 ~ 86	YES (Approx. $70\Omega \sim 120\Omega$)



30. Battery Power(B+)
85. Relay Control
86. Battery Power(B+)
87. Power supply to fuel pump

SBLF26502L

5) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E53C400B

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

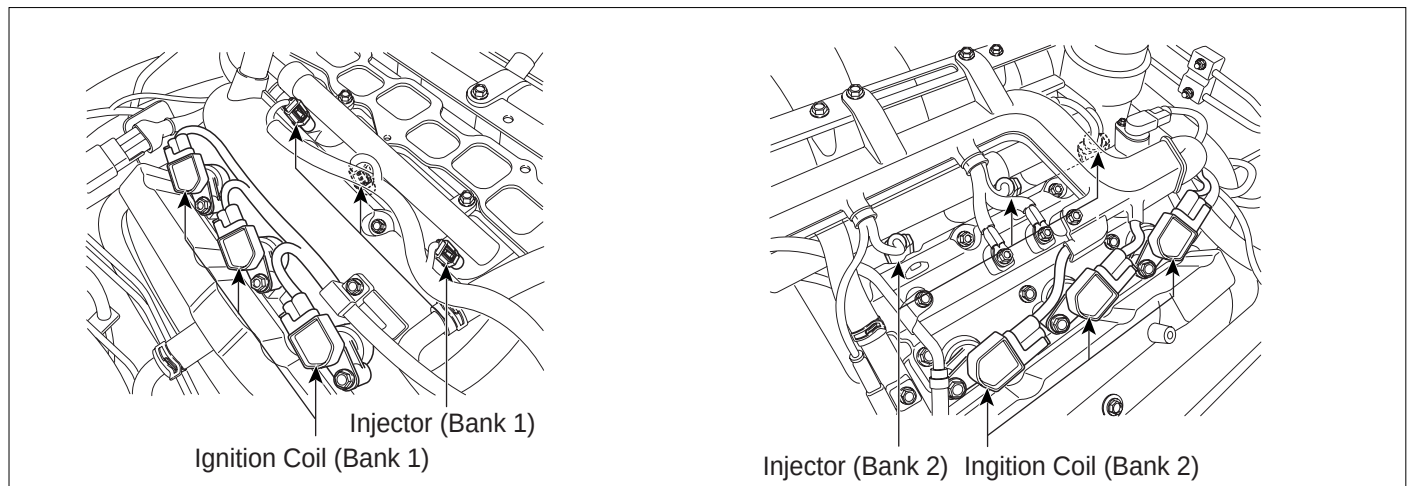
- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -325

DTC P0261	CYLINDER 1-INJECTOR CIRCUIT LOW
DTC P0264	CYLINDER 2-INJECTOR CIRCUIT LOW
DTC P0267	CYLINDER 3-INJECTOR CIRCUIT LOW
DTC P0270	CYLINDER 4-INJECTOR CIRCUIT LOW
DTC P0273	CYLINDER 5-INJECTOR CIRCUIT LOW
DTC P0276	CYLINDER 6-INJECTOR CIRCUIT LOW

COMPONENT LOCATION E0E12F33



SBLF26713L

GENERAL DESCRIPTION EA317583

Based on information from various sensors, the ECM measures the fuel injection amount. The fuel injector is a solenoid-operated valve and the fuel injection amount is controlled by length of time the fuel injector is held open. The ECM controls each injector by grounding the control circuit. When the ECM energizes the injector by grounding the control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the ECM de-energizes the injector by opening the control circuit, the fuel injector is closed and circuit voltage should momentarily peak.

DTC DESCRIPTION ED7F8D7D

Checking output signals from injectors under detecting condition, if an output signal is low, ECM sets P0261/P0264/P0267/P0270/P0273/P0276. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EE34DEF8

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Low	- Poor connection - Open or short to ground in power harness - Open or short to ground in control harness - Injector - ECM
Enable condition	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - No disabling faults present - Above conditions are met $> 0.5\text{sec.}$	
threshold value	Open or short to ground	
diagnosis time	Continuous	
MIL ON condition	2 driving cycles	

SPECIFICATION

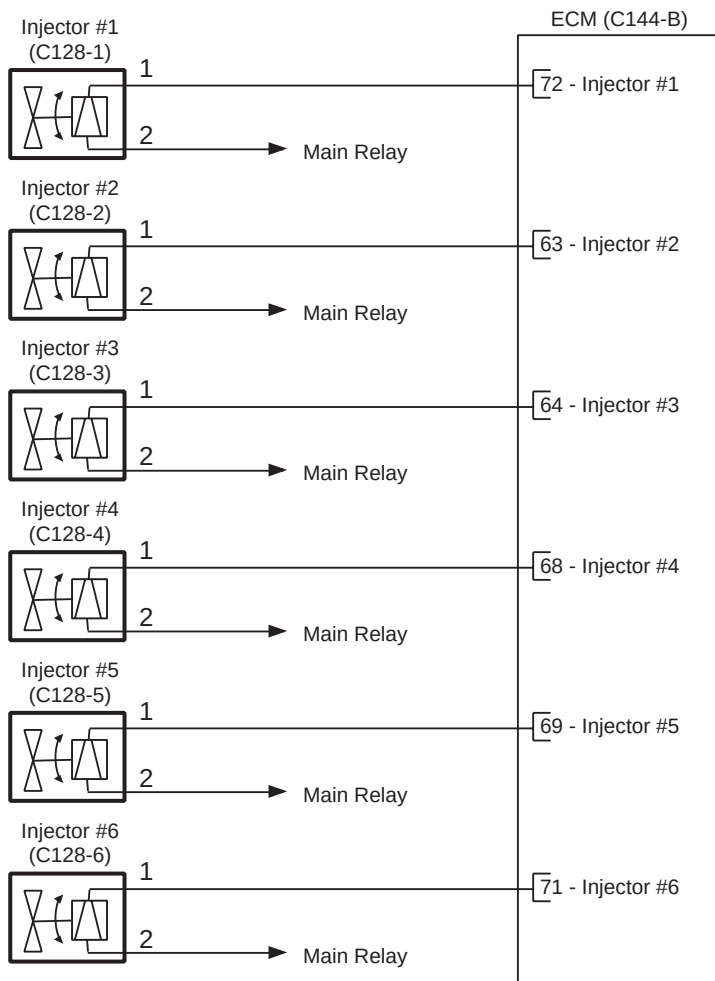
E8AAB979

Item	Coil resistance(Ω)
Injector	11.4 ~ 12.6 Ω (at 20°C/ 68°F)

SCHEMATIC DIAGRAM

ED6B2A93

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1

Terminal	Connected to	Funtion
1	ECM C144-B (72)	Injector #1 control
2	Main Relay	Battery Voltage (B+)

Injector #2

Terminal	Connected to	Funtion
1	ECM C144-B (63)	Injector #2 control
2	Main Relay	Battery Voltage (B+)

Injector #3

Terminal	Connected to	Funtion
1	ECM C144-B (64)	Injector #3 control
2	Main Relay	Battery Voltage (B+)

Injector #4

Terminal	Connected to	Funtion
1	ECM C144-B (68)	Injector #4 control
2	Main Relay	Battery Voltage (B+)

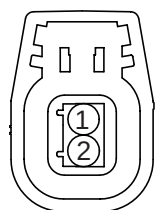
Injector #5

Terminal	Connected to	Funtion
1	ECM C144-B (69)	Injector #5 control
2	Main Relay	Battery Voltage (B+)

Injector #6

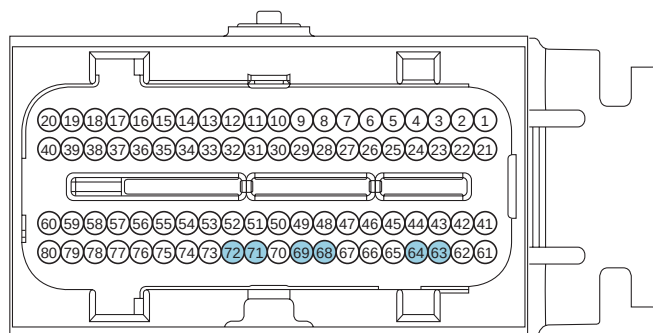
Terminal	Connected to	Funtion
1	ECM C144-B (71)	Injector #6 control
2	Main Relay	Battery Voltage (B+)

[HARNESS CONNECTORS]



C128-1,2,3,4,5,6

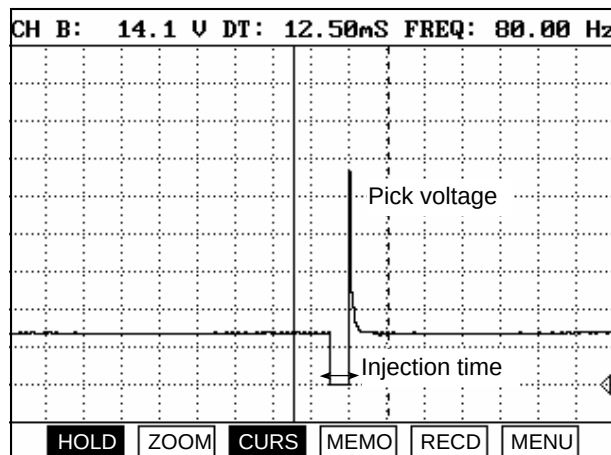
Injector #1,2,3,4,5,6



C144-B

ECM

SIGNAL WAVEFORM AND DATA EC813234



EGRF607S

When the ECM energizes the injector by grounding control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the ECM de-energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should be peak at a moment.

MONITOR DTC STATUS EEF9FFBA

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E573EF2B

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION EF37EB85

1. IG "ON" and disconnect injector connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 2 of injector harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification?

YES

► Go to "Control Circuit Inspection" procedure.

NO

- Check open or connection of the fuse connected to injector power supply.
- Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E91D2961

1. Check short to ground in harness
 - 1) IG "OFF" and disconnect injector connector and ECM connector.
 - 2) Measure resistance between terminal 1 of injector harness connector and chassis ground.

Specification : Infinite

DTC TROUBLESHOOTING PROCEDURES

FLB -329

- 3) Is the measured resistance within specification?

YES

► Go to "Check open in harness" as follows.

NO

► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness

- 1) IG "OFF" and disconnect injector connector and ECM connector.
- 2) [P0261] Measure resistance between terminal 1 of injector harness connector and 72 of ECM harness connector(C144-B).
[P0264] Measure resistance between terminal 1 of injector harness connector and 63 of ECM harness connector(C144-B).
[P0267] Measure resistance between terminal 1 of injector harness connector and 64 of ECM harness connector(C144-B).
[P0270] Measure resistance between terminal 1 of injector harness connector and 68 of ECM harness connector(C144-B).
[P0273] Measure resistance between terminal 1 of injector harness connector and 69 of ECM harness connector(C144-B).
[P0276] Measure resistance between terminal 1 of injector harness connector and 71 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

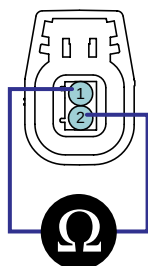
E1674688

1. Check injector

- 1) IG "OFF" and disconnect injector connector.
- 2) Measure resistance between terminals 1 and 2 of injector connector.(Component side)

SPECIFICATION :

Item	Coil resistance(Ω)
Injector	11.4 ~ 12.6Ω (at 20°C/ 68°F)



- 1. Injector control
- 2. Battery voltage

SBLF26996L

3) Is the measured resistance within specification?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good injector and check for proper operation. If the problem is corrected, replace injector and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EFC132EE

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -331

DTC P0262	CYLINDER 1-INJECTOR CIRCUIT HIGH
DTC P0265	CYLINDER 2-INJECTOR CIRCUIT HIGH
DTC P0268	CYLINDER 3-INJECTOR CIRCUIT HIGH
DTC P0271	CYLINDER 4-INJECTOR CIRCUIT HIGH
DTC P0274	CYLINDER 5-INJECTOR CIRCUIT HIGH
DTC P0277	CYLINDER 6-INJECTOR CIRCUIT HIGH

COMPONENT LOCATION E32677ED

Refer to DTC P0261.

GENERAL DESCRIPTION E1632314

Refer to DTC P0261.

DTC DESCRIPTION E1C26C0C

Checking output signals from injectors under detecting condition, if an output signal is high, ECM sets P0262/P0265/P0268/P0271/P0274/P0277. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle

DTC DETECTING CONDITION E51C5B5F

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal High	- Poor connection - Short to battery in harness - Injector - ECM
Enable condition	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - No disabling faults present - Above conditions are met $> 0.5\text{sec.}$	
threshold value	Short to battery	
diagnosis time	Continuous	
MIL ON condition	2 driving cycles	

SPECIFICATION ED839D83

Refer to DTC P0261.

SCHEMATIC DIAGRAM E5E8D788

Refer to DTC P0261.

SIGNAL WAVEFROM AND DATA E3CC867A

Refer to DTC P0261.

MONITOR DTC STATUS ED948047

Refer to DTC P0261.

TERMINAL AND CONNECTOR INSPECTION EC4E1886

Refer to DTC P0261.

CONTROL CIRCUIT INSPECTION E71E2070

1. Check voltage

- 1) IG "OFF" and disconnect injector connector.
- 2) IG "ON" and ENG "OFF"
- 3) Measure voltage between terminal 1 of injector harness connector and chassis ground.

Specification : Approx. 0V

- 4) Is the measured voltage within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Go to "Check short to battery in harness" as follows.

2. Check short to battery in harness

- 1) IG "OFF" and disconnect injector connector and ECM connector.
- 2) Measure resistance between terminals 1 and 2 of injector harness connector.

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

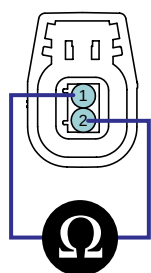
COMPONENT INSPECTION EB312552

1. Check injector

- 1) IG "OFF" and disconnect injector connector.
- 2) Measure resistance between terminals 1 and 2 of injector connector.(Component side)

SPECIFICATION :

Item	Coil resistance(Ω)
Injector	11.4 ~ 12.6Ω (at 20°C/ 68°F)



- 1. Injector control
- 2. Battery voltage

SBLF26997L

3) Is the measured resistance within specification?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good injector and check for proper operation. If the problem is corrected, replace injector and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

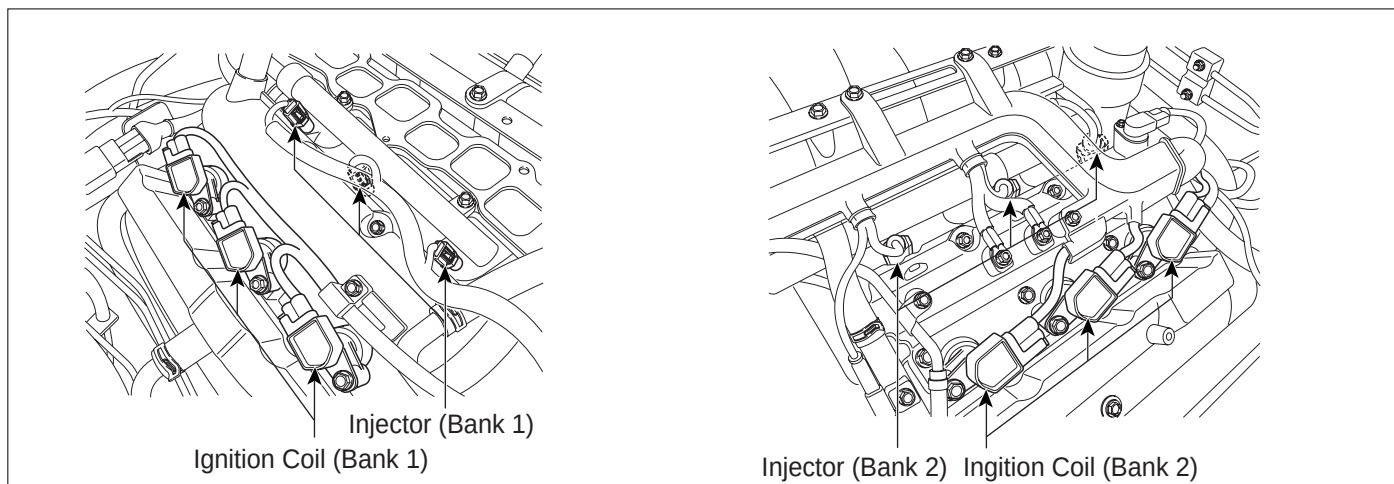
VERIFICATION OF VEHICLE REPAIR

E41AA108

Refer to DTC P0261.

DTC P0300	RANDOM/MULTIPLE CYLINDER MISFIRE DETECTED
DTC P0301	CYLINDER 1-MISFIRE DETECTED
DTC P0302	CYLINDER 2-MISFIRE DETECTED
DTC P0303	CYLINDER 3-MISFIRE DETECTED
DTC P0304	CYLINDER 4-MISFIRE DETECTED
DTC P0305	CYLINDER 5-MISFIRE DETECTED
DTC P0306	CYLINDER 6-MISFIRE DETECTED

COMPONENT LOCATION EE95C591



SBLF26713L

GENERAL DESCRIPTION E9EAD191

Misfires can be caused by lack of combustion in a cylinder due to absence of spark, poor fuel metering, poor compression, or many other causes. Even a small number of misfires may result in excessive exhaust emissions due to the unburned mixture. Increased misfire rates cause damage to the catalytic converter. The ECM monitors the crankshaft speed variation to determine if any misfiring generated. The ECM identifies the specific cylinder in which the misfire has occurred and counts individual misfire events by monitoring changes in the crankshaft rotation for each cylinder. A random misfire indicates two or more cylinders are misfiring.

DTC DESCRIPTION EC696267

The ECM measures reference event times and calculates the positive and negative acceleration of the crank wheel to determine whether a misfire has occurred. When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can occur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire causes a loss of torque produced from that cylinder. ECM sets this DTC. In case that misfire affects Catalyst damage, MIL (Malfunction Indicator Lamp) will be illuminating and blinking at 1HZ frequency. However, in case of individual and emission damaging misfire, MIL will be turned on when the malfunction is detected. Especially, if injector connector / Ignition coil is disconnected for more than 46 sec., ECM sets DTC relating to misfire and conducts the fuel-cut to protect the catalyst.

DTC TROUBLESHOOTING PROCEDURES

FLB -335

DTC DETECTING CONDITION

E4503AB5

Item		Detecting Condition	Possible Cause
DTC strategy		Determine if a multiple cylinder misfire or a cylinder specific misfire is occurring by monitoring crankshaft acceleration	- Faulty Spark plugs - Faulty Spark plug cables - Air Leakage - Belt deflection and Air gap of CKPS - Incorrect timing - Faulty injector - Improper fuel pressure - Improper engine compression - Faulty ECM
Enable condition		No disabling faults present / No disabling Active Faults - P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 - P0103 / P0102 / P0108 / P0107 / P0106 / P0501 - Engine speed between 550 and 5800 RPM - System voltage between 9 and 18 volts - The ECT indicates an engine temperature between -6°C(20°F) and 120°C(248°F)	
Threshold Value	Case 1	Individual cylinder misfire detection	
	Case 2	Emissions damaging - 18 times in 600 ignitions (In case that the misfire affects more than 1.5 times than FTP emissions)	
	Case 3	Catalyst damaging - 95 times in 600 ignitions at idle (It is going to be changeable according to the load or the temperature which is not in the range where it does not melt catalyst)	
Diagnosis time		Continuous	
MIL ON condition		2 driving cycles	

MONITOR DTC STATUS

E5AF6BC7

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "System Inspection" procedure.

NO

► Although the misfire does not occur when the vehicle is brought to workshop, misfire can be reproduced when the condition is met. Drive the vehicle according to the freeze frame data in order to satisfy the condition.

SYSTEM INSPECTION EF7B43BB

1. Check Spark Pulg

- 1) Remove cylinder' s spark plugs
- 2) Visually/physically inspect the following items:
 - Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
 - Check for plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)
 - Check if the spark plug for the relevant cylinder is lighter in color than the other plugs.
- 3) Has a problem been found in any of the above areas?

YES

► Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to "Check Air Leakage " as below

2. Check Air Leakage

- 1) Visually/physically inspect the air leakage in intake/exhaust system as following items,
 - Vacuum hoses for splits, kinks and improper connections.
 - Throttle body gasket
 - Gasket between intake manifold and cylinder head
 - Seals between intake manifold and fuel injectors
 - Exhaust system between HO2S and Three way catalyst for air leakage

DTC TROUBLESHOOTING PROCEDURES

FLB -337

- 2) Has a problem been found in any of the above areas?

YES

► Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to "Check for air leakage in Positive Crankcase Ventilation Valve(PCV)

3. Check for air leakage in Positive Crankcase Ventilation Valve(PCV)

- 1) Remove PCV valve from cylinder head cover by pulling ventilation hose
- 2) With engine idling block PCV valve opening
- 3) Verify that vacuum is felt
- 4) Remove PCV valve
- 5) Blow through valve from port "A" and verify that air comes out of port "B"
- 6) Blow through valve from port "B" and verify that no air comes out of port "A"
- 7) Has a problem been found ?

YES

► Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to "Check Compression pressure" as below

4. Check Compression pressure

- 1) Warm up the engine to normal operating temperature
- 2) Disconnect the spark plug cables and remove the spark plugs.
- 3) Crank the engine to remove any foreign material in the cylinders.
- 4) Put compression pressure gauge into spark plug hole
- 5) Crank the engine with widely open throttle valve and check compression pressure at each cylinder
- 6) Is compression pressure for each cylinder displayed within specifications ?

Specification : 1323kPa(13.5 kg/cm²,192 psi)

YES

► Go to "Check Timing " as below

NO

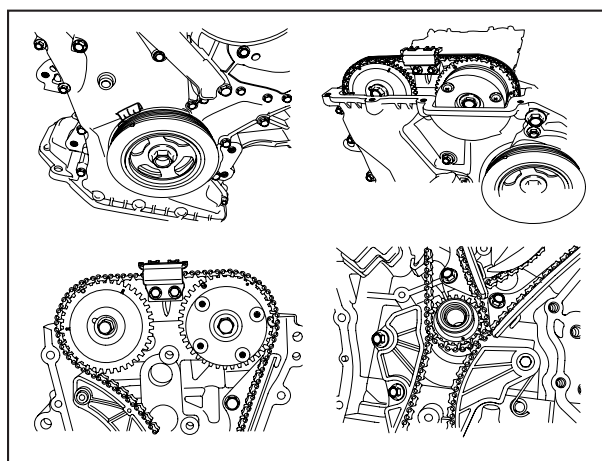
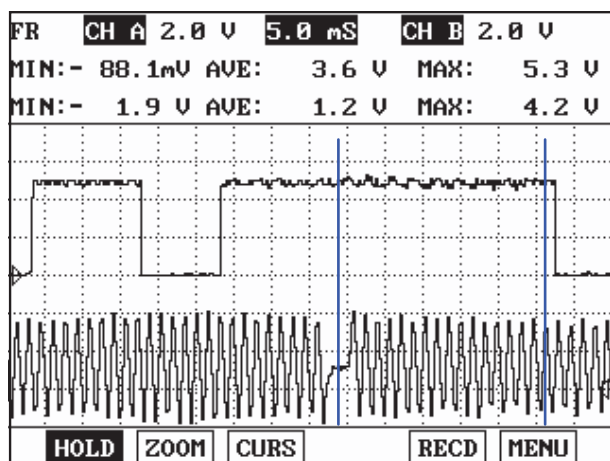
► Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.

► If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

5. Check Timing

- 1) Ignition "OFF"
- 2) Monitor these signal waveforms from CAM and Crank shaft position Sensor are correctly aligned.

Reference : The 17th of CKP signal from missing tooth is aligned with high of CMP signal



- 3) Are all timing marks aligned correctly ?

YES

► Go to "Check Fuel Pressure" as below

NO

► Check that Cam, Crank and Oil pump sprocket timing marks are correctly aligned. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure

6. Check Fuel Pressure



NOTE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.
 2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.
- 1) IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
 - 2) Start-up and wait until it stops itself.
 - 3) IG "OFF" and connect Fuel Pump Relay.
 - 4) Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
 - 5) Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
 - 6) Measure the fuel pressure at idle.

DTC TROUBLESHOOTING PROCEDURES

FLB -339

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7) Is the measured fuel pressure within specifications ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair"procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter,fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

VERIFICATION OF VEHICLE REPAIR ECF0ACF8

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P0315 SEGMENT TIME ACQUISITION INCORRECT

GENERAL DESCRIPTION EC517A75

The Crankshaft Position Sensor (CKPS) is a magnetic field sensitive type sensor that generates voltage using a sensor and a target wheel mounted on the crankshaft; there are 58 slots in the target wheel where one is longer than the others. During one crankshaft rotation there are 58 rectangular signals and one longer signal. The ECM calculates engine RPM by using the sensor's signal and controls the injection duration and the ignition timing. Using the signal differences caused by the longer slot, the ECM identifies which cylinder is at top dead center.

DTC DESCRIPTION E5F50CF4

Checking tooth error correction under detecting condition, if the TEC(Tooth Error Correction) is out of Threshold value, ECM sets P0315.

DTC DETECTING CONDITION E2A7CCAA

Item	Detecting Condition	Possible cause
DTC Strategy	This DTC indicates that crankwheel tooth error has not been learned.	- Loosened CKPS - Target wheel - ECM
Enable Conditions	10% ≤ Engine load &lt; 90% 2000 rpm ≤ engine speed ≤ 4000 rpm - TEC(Tooth Error Correction) RPM stability timer > 10sec 0°C(32°F) < coolant temperature < 110°C(230°F) - Not active disabling faults	
Threshold value	- Distance driven without learning(during fuel cut off) tooth error ≥ 6500km(4038.91275 mile) - Actual Value is higher or lower than calibrated value	
Diagnosis Time	Continuous	
MIL On Condition	DTC only	

MONITOR DTC STATUS E1BBBCEF

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "Component Inspection" procedure.

COMPONENT INSPECTION

E388CDCD

1. Visually check CKPS and target wheel

- 1) IG "OFF"
- 2) Visually check CKPS is loosened or target wheel is deformed or damaged.
- 3) Is the above items normal ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure..

NO

► Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E7BC9F6F

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter

4. Is parameter displayed "History(Not Present) fault"?

YES

▶ System performing to specification at this time. Clear the DTC

NO

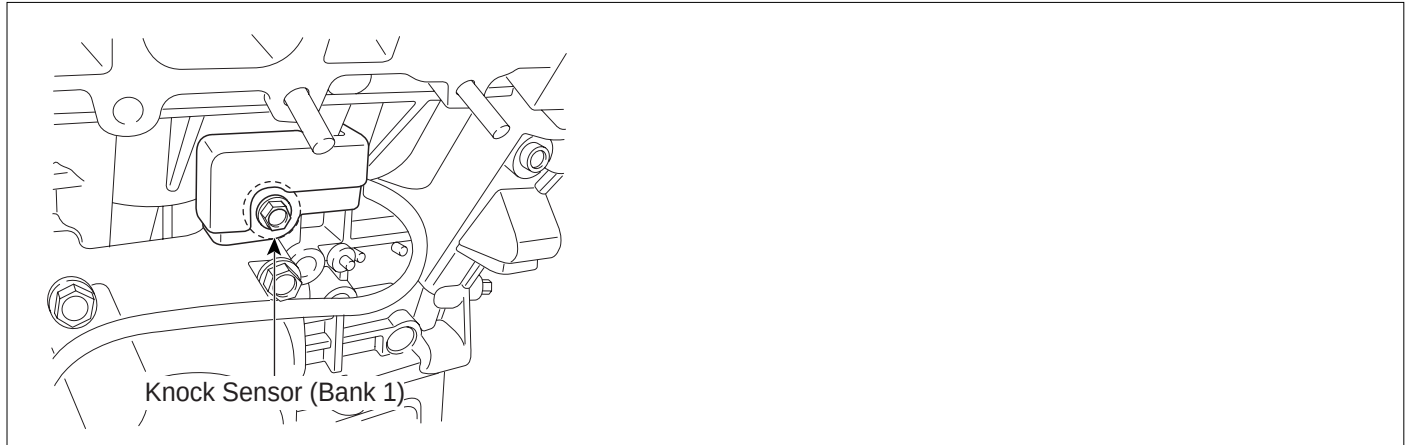
▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -343

DTC P0325 KNOCK SENSOR 1 CIRCUIT

COMPONENT LOCATION E7ED65C4



SBLF26711L

GENERAL DESCRIPTION ECFEB147

The knock sensor is attached to the cylinder block and senses engine knocking. The sensor contains a piezoelectric element that converts vibration (or noise) into voltage signal and sends this signal to ECM. With input signals from camshaft position and crankshaft position sensor, ECM can identify which cylinder is knocking. ECM filters vibrations and determines if the vibrations are knocking signal. The Engine Control Module (ECM) uses this signal to suppress knocking by retarding ignition timing. The ECM will set a code (Malfunction Indicator Lamp will Not turn on) if during two driving cycles the Knock sensor's output voltage falls below minimum threshold. This code indicates an unexpected vibration is being read by the Knock sensor or ECM under normal engine operation.

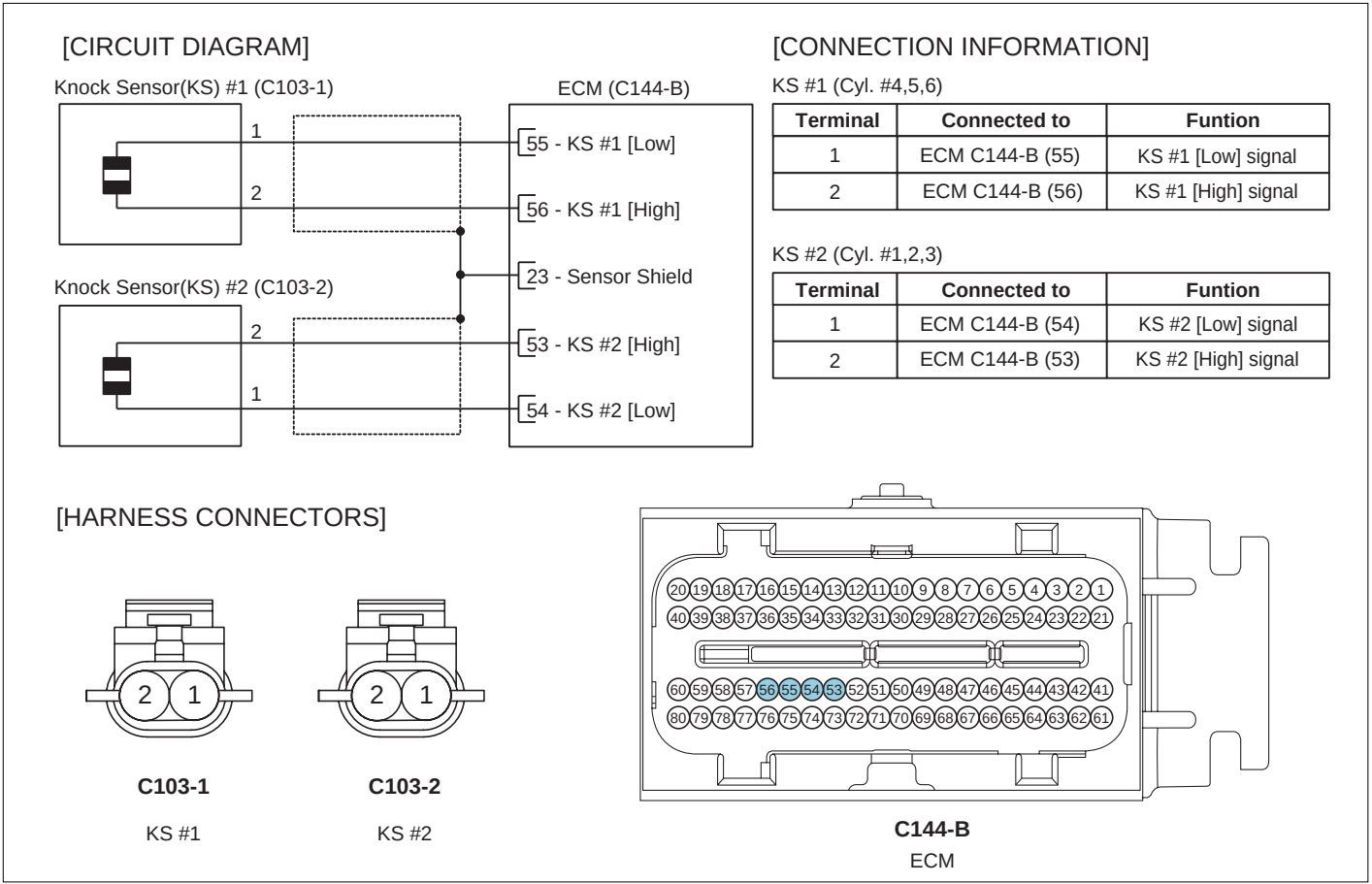
DTC DESCRIPTION EA9FA253

Checking the range of input signal with a knock sensor under detecting condition, ECM senses open in knock sensor circuit or malfunction of sensor. If a knock signal or noise level is inputted without the specified value during standard duration, ECM sets P0325.

DTC DETECTING CONDITION E5B328E3

Item	Detecting Condition	Possible cause
DTC Strategy	Signal open	- Poor connection - Open in harness - Knock sensor - ECM
Enable Conditions	- Pressure in intake manifold is normal. - Engine speed $\geq$ 2000 rpm	
Threshold value	Filter coefficient < 1.0	
Diagnosis Time	Continuous	
MIL On Condition	DTC Only	

SCHEMATIC DIAGRAM EA6C93C2



SBLF26208L

SIGNAL WAVEFROM AND DATA ED35EDBD

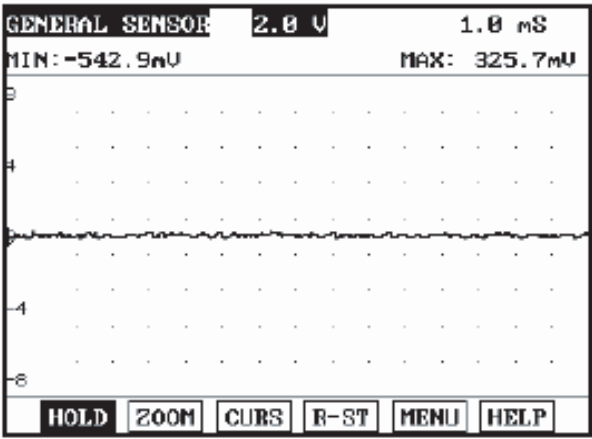


Fig. 1

The knock sensor is installed at cycliner block to detect the vibration effectively during engine running. The above waveform shows the signal waveform of knock sensor when knock dosen't happen. Generally, knock signal has more noise than other sensor.

EGRF610B

DTC TROUBLESHOOTING PROCEDURES

FLB -345

MONITOR DTC STATUS E5BCF87E

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E0D2221E

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E44B8A20

1. Check open in harness
 - 1) IG "OFF" and disconnect knock sensor connector and ECM connector.
 - 2) Measure resistance between terminal 1 of knock sensor harness connector and terminal 79 of ECM harness connector(C144-B).
 - 3) Measure resistance between terminal 2 of knock sensor harness connector and terminal 80 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 4) Is the measured resistance within specification?

YES

► If the problem is corrected after substituting with a known - good knock sensor, replace it. If the problem is pending, check for proper operating after substituting with a known - good ECM. and then if the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR E1D1056F

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -347

DTC P0326 KNOCK SENSOR 1 CIRCUIT RANGE/PERFORMANCE (BANK 1)

COMPONENT LOCATION E840EA9E

Refer to DTC P0325.

GENERAL DESCRIPTION E7AB3C17

Refer to DTC P0325.

DTC DESCRIPTION E90C2B85

Checking the range of input signal with a knock sensor under detecting condition, ECM senses short in knock sensor circuit or malfunction of sensor. If the filtered knock signals are out of the threshold value, ECM sets P0326.

DTC DETECTING CONDITION EEB362EC

Item	Detecting Condition	Possible cause
DTC Strategy	Signal short	- Poor connection - Short in harness - Knock sensor - ECM
Enable Conditions	- Pressure in intake manifold is normal. - Engine speed $\geq$ 2000 rpm	
Threshold value	Knock Filtered Value < 5 or > 65	
Diagnosis Time	Continuous	
MIL On Condition	DTC Only	

SCHEMATIC DIAGRAM E34986B5

Refer to DTC P0325.

SIGNAL WAVEFROM AND DATA E533D947

Refer to DTC P0325.

MONITOR DTC STATUS EE3F3154

Refer to DTC P0325.

TERMINAL AND CONNECTOR INSPECTION E91D307E

Refer to DTC P0325.

SIGNAL CIRCUIT INSPECTION E0788B58

1. Check short to battery in harness
 - 1) IG "OFF" and disconnect knock sensor connector.
 - 2) IG "ON" and ENG "OFF"
 - 3) Measure voltage between terminal 1 of knock sensor harness connector and chassis ground.

- 4) Measure voltage between terminal 2 of knock sensor harness connector and chassis ground.

Specification : Approx. 1.5V

- 5) Is the measured voltage within specification?

YES

- Go to "Check short to ground in harness" as follows.

NO

- Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

2. Check short to ground in harness

- 1) IG "OFF" and disconnect knock sensor connector and ECM connector.
- 2) Measure resistance between terminal 1 of knock sensor harness connector and chassis ground.
- 3) Measure resistance between terminal 2 of knock sensor harness connector and chassis ground.

Specification : Infinite

- 4) Is the measured resistance within specification ?

YES

- If the problem is corrected after substituting with a known - good knock sensor, replace it. If the problem is pending, check for proper operating after substituting with a known - good ECM. and then if the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

- Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

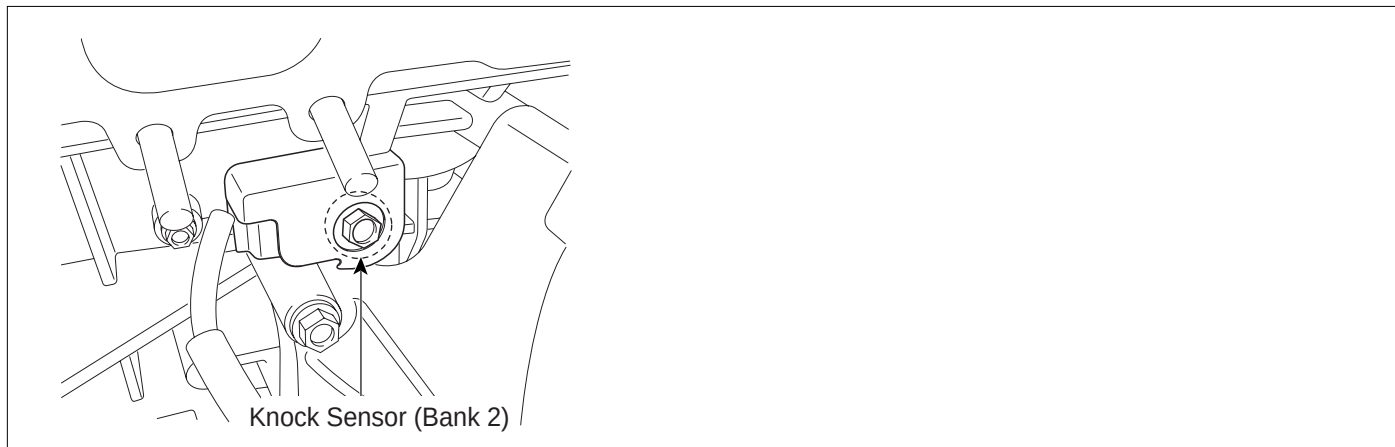
VERIFICATION OF VEHICLE REPAIR

E45698B6

Refer to DTC P0325.

DTC P0330 KNOCK SENSOR 2 CIRCUIT

COMPONENT LOCATION EEC4F2F1



SBLF26712L

GENERAL DESCRIPTION EF9E2A6F

The knock sensor is attached to the cylinder block and senses engine knocking. The sensor contains a piezoelectric element that converts vibration (or noise) into voltage signal and sends this signal to ECM. With input signals from camshaft position and crankshaft position sensor, ECM can identify which cylinder is knocking. ECM filters vibrations and determines if the vibrations are knocking signal. The Engine Control Module (ECM) uses this signal to suppress knocking by retarding ignition timing. The ECM will set a code (Malfunction Indicator Lamp will Not turn on) if during two driving cycles the Knock sensor's output voltage falls below minimum threshold. This code indicates an unexpected vibration is being read by the Knock sensor or ECM under normal engine operation.

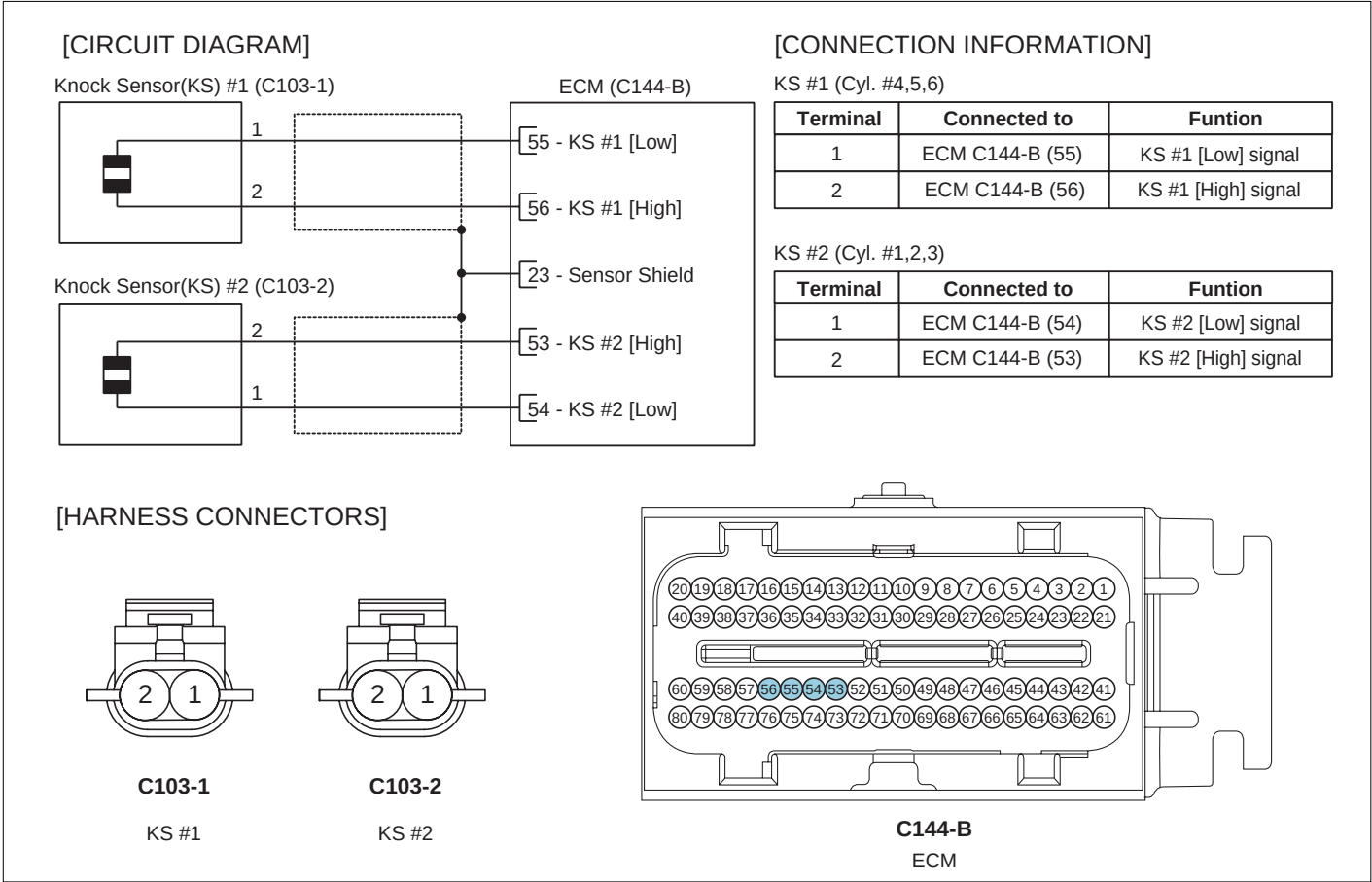
DTC DESCRIPTION E484B2A7

Checking the range of input signal with a knock sensor under detecting condition, ECM senses open in knock sensor circuit or malfunction of sensor. If a knock signal or noise level is inputted without the specified value during standard duration, ECM sets P0330.

DTC DETECTING CONDITION ED113344

Item	Detecting Condition	Possible cause
DTC Strategy	Signal open	- Poor connection - Open in harness - Knock sensor - ECM
Enable Conditions	- Pressure in intake manifold is normal. - Engine speed $\geq$ 2000 rpm	
Threshold value	Filter coefficient < 1.0	
Diagnosis Time	Continuous	
MIL On Condition	DTC Only	

SCHEMATIC DIAGRAM E9F8B7EE



SBLF26208L

SIGNAL WAVEFROM AND DATA E17FCDF3

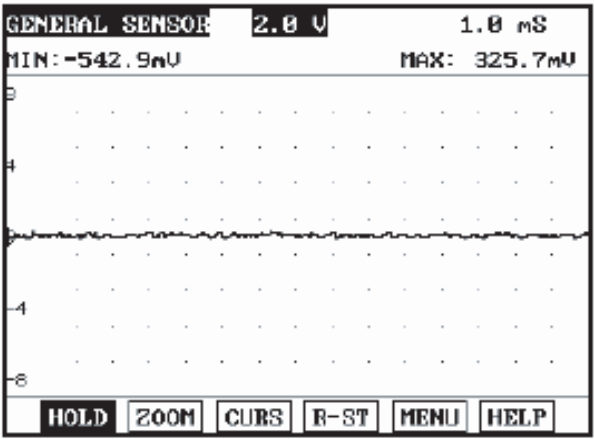


Fig. 1

The knock sensor is installed at cycliner block to detect the vibration effectively during engine running. The above waveform shows the signal waveform of knock sensor when knock dosen't happen. Generally, knock signal has more noise than other sensor.

EGRF610B

DTC TROUBLESHOOTING PROCEDURES

FLB -351

MONITOR DTC STATUS E81C348F

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E50A20F4

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION

E9932627

1. Check open in harness
 - 1) IG "OFF" and disconnect knock sensor connector and ECM connector.
 - 2) Measure resistance between terminal 1 of knock sensor harness connector and terminal 54 of ECM harness connector(C144-B).
 - 3) Measure resistance between terminal 2 of knock sensor harness connector and terminal 53 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 4) Is the measured resistance within specification?

YES

▶ If the problem is corrected after substituting with a known - good knock sensor, replace it. If the problem is pending, check for proper operating after substituting with a known - good ECM. and then if the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EF886957

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -353

DTC P0331 KNOCK SENSOR 2 CIRCUIT RANGE/PERFORMANCE (BANK 2)

COMPONENT LOCATION E287DD3C

Refer to DTC P0330.

GENERAL DESCRIPTION E2EFDCEA

Refer to DTC P0330.

DTC DESCRIPTION EB29CBB0

Checking the range of input signal with a knock sensor under detecting condition, ECM senses short in knock sensor circuit or malfunction of sensor. If the filtered knock signals are out of the threshold value. During standard duration, ECM sets P0331.

DTC DETECTING CONDITION EAC6ACCE

Item	Detecting Condition	Possible cause
DTC Strategy	Signal short	- Poor connection - Short in harness - Knock sensor - ECM
Enable Conditions	- Pressure in intake manifold is normal. - Engine speed $\geq$ 2000 rpm	
Threshold value	Knock Filtered Value $\langle$ 5 or $\rangle$ 65	
Diagnosis Time	Continuous	
MIL On Condition	DTC Only	

SCHEMATIC DIAGRAM E32EDB11

Refer to DTC P0330.

SIGNAL WAVEFORM AND DATA EB0781B6

Refer to DTC P0330.

MONITOR DTC STATUS E93B0BAA

Refer to DTC P0330.

TERMINAL AND CONNECTOR INSPECTION E97D1EAE

Refer to DTC P0330.

SIGNAL CIRCUIT INSPECTION EB3F1731

1. Check short to battery in harness
 - 1) IG "OFF" and disconnect knock sensor connector.
 - 2) IG "ON" and ENG "OFF"

- 3) Measure voltage between terminal 1 of knock sensor harness connector and chassis ground
- 4) Measure voltage between terminal 2 of knock sensor harness connector and chassis ground.

Specification : Approx. 1.5V

- 5) Is the measured voltage within specification?

YES

► Go to "Check short to ground in harness" as follows.

NO

► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

2. Check short to ground in harness

- 1) IG "OFF" and disconnect knock sensor connector and ECM connector.
- 2) Measure resistance between terminal 1 of knock sensor harness connector and chassis ground.
- 3) Measure resistance between terminal 2 of knock sensor harness connector and chassis ground.

Specification : Infinite

- 4) Is the measured resistance within specification?

YES

► If the problem is corrected after substituting with a known - good knock sensor, replace it. If the problem is pending, check for proper operating after substituting with a known - good ECM. and then if the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.



NOTE

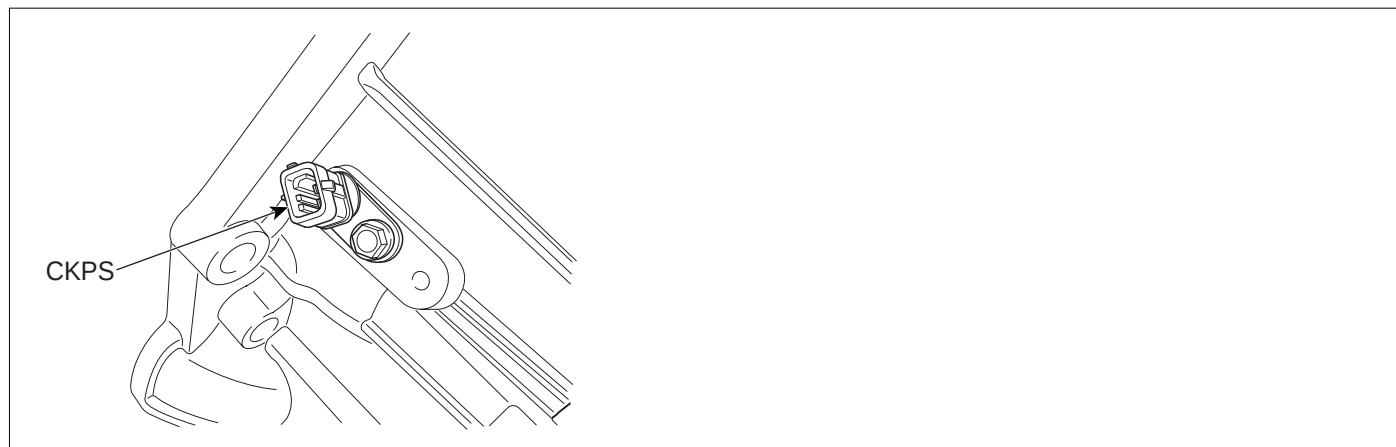
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR EE82D5E8

Refer to DTC P0330.

DTC P0335 CRANKSHAFT POSITION SENSOR A CIRCUIT

COMPONENT LOCATION E6A28DE8



SBLF26706L

GENERAL DESCRIPTION EA8B222B

The Crankshaft Position Sensor (CKPS) is a magnetic field sensitive type sensor that generates voltage using a sensor and a target wheel mounted on the crankshaft; there are 58 slots in the target wheel where one is longer than the others. During one crankshaft rotation there are 58 rectangular signals and one longer signal. The ECM calculates engine RPM by using the sensor's signal and controls the injection duration and the ignition timing. Using the signal differences caused by the longer slot, the ECM identifies which cylinder is at top dead center.

DTC DESCRIPTION EFBETC74

Checking reference signals from CKPS under detecting condition, if any signal is not detected for more than 0.15 sec., ECM sets P0335. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

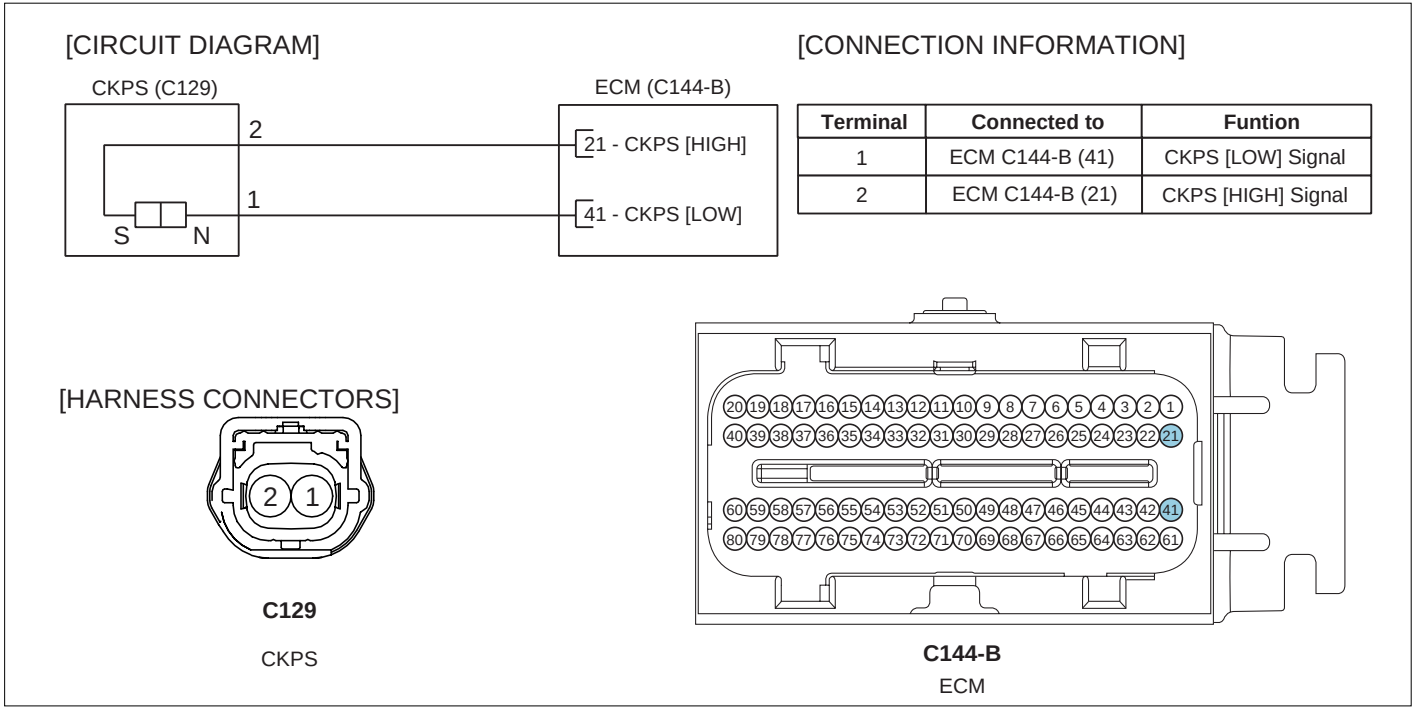
DTC DETECTING CONDITION E3CD5CF7

Item	Detecting Condition	Possible cause
DTC Strategy	Check reference wave during cranking	- Poor connection - Open in harness - CKP sensor - ECM
Enable Conditions	- IG "ON", Cranking or engine-off during driving - No DTC related to CAM - Camshaft position sensor state change	
Threshold value	No reference signal over 0.15 sec.	
Diagnosis Time	0.15 sec.	
MIL On Condition	2 driving cycles	

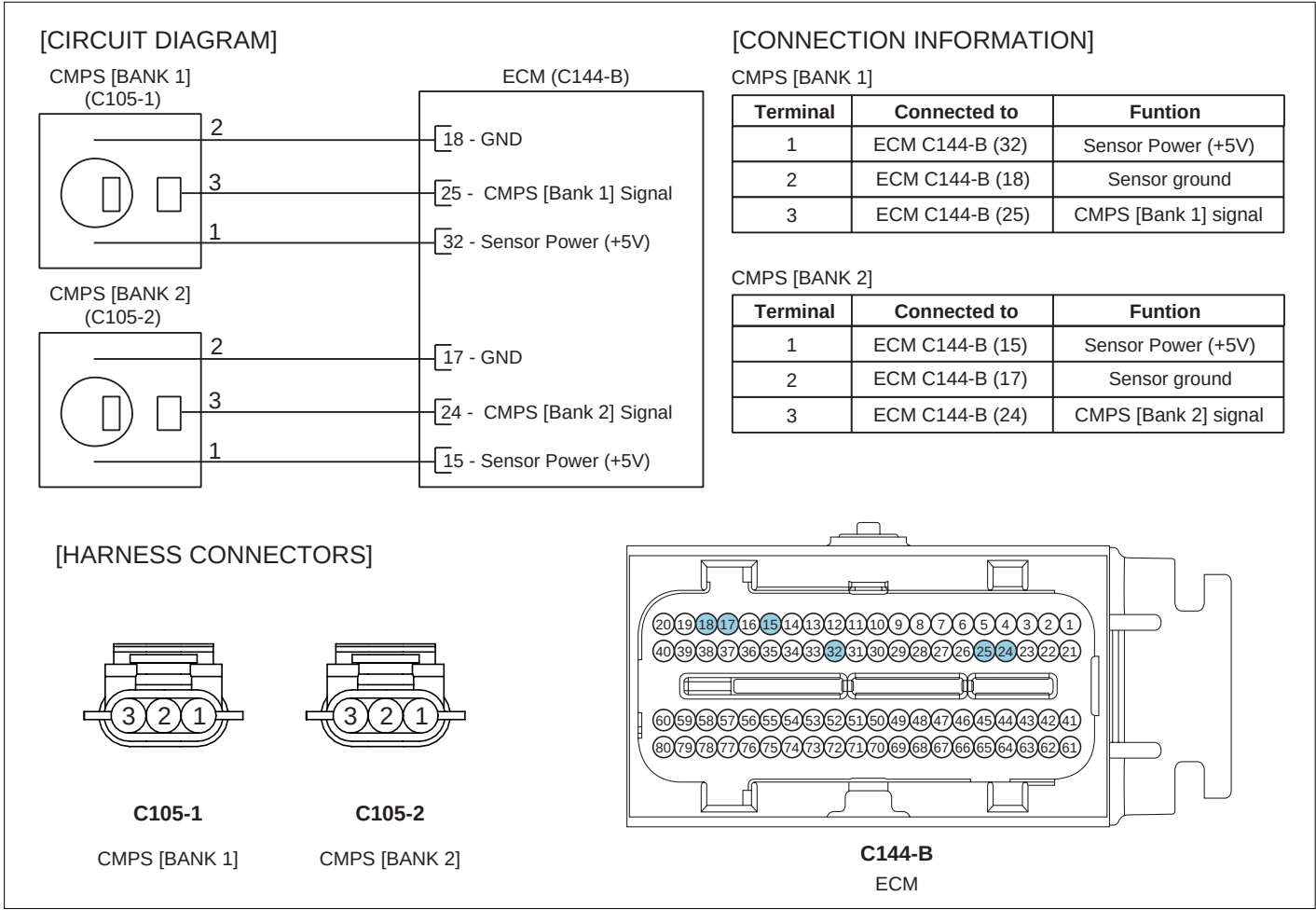
SPECIFICATION EF849F01

Resistance	700 ± 70Ω

SCHEMATIC DIAGRAM E948392C

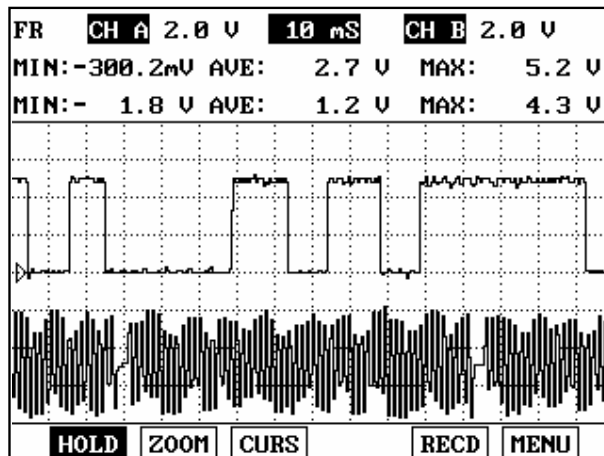
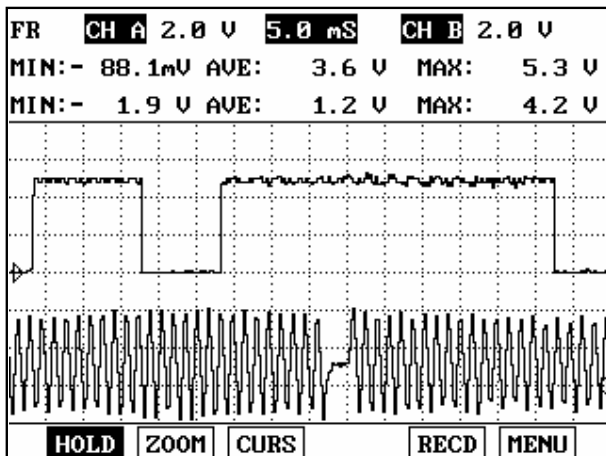


SBLF26206L



SBLF26205L

SIGNAL WAVEFORM AND DATA E1A43258



EGRF610K

MONITOR DTC STATUS EAE93840

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EC27ECF1

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION EB1C8F5D

1. Check voltage
 - 1) IG "OFF" and disconnect CKPS connector.
 - 2) IG "ON" and ENG "OFF"
 - 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 : Approx. 1.4V

- 5) Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Go to "Check open in harness" as follows.

2. Check open in harness
 - 1) IG "OFF" and disconnect CKPS connector and ECM connector.
 - 2) Measure resistance between terminal 1 of CKPS harness connector and terminal 41 of ECM harness connector(C144-B).
 - 3) Measure resistance between terminal 2 of CKPS harness connector and terminal 21 of ECM harness connector(C144-B).

DTC TROUBLESHOOTING PROCEDURES

FLB -359

Specification : Below 1Ω

- 4) Is the measured resistance within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

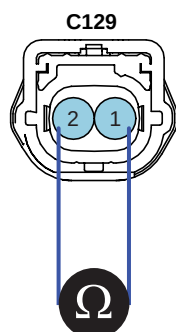
EC2AA0B6

1. Check CKPS

- 1) IG "OFF" and disconnect CKPS connector.
- 2) Measure resistance between terminals 1 and 2 of CKPS connector.(Component side)

SPECIFICATION :

Resistance	$700 \pm 70\Omega$



1. CKPS [LOW] Signal
2. CKPS [HIGH] Signal

SBLF26541L

- 3) Is the measured resistance within specification?

YES

► Go to "Check signal waveform of CKPS" as follows.

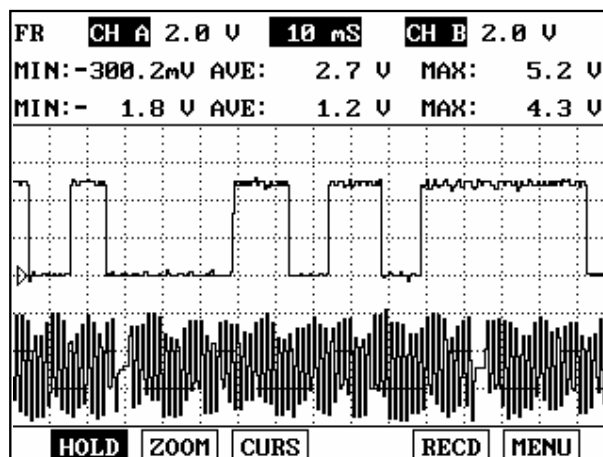
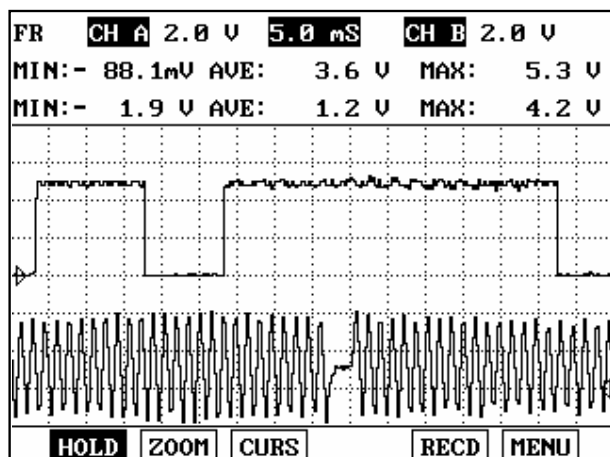
NO

► Substitute with a known - good CKPS and check for proper operation. If the problem is corrected, replace CKPS and go to "Verification of Vehicle Repair" procedure.

2. Check signal waveform of CKPS

- 1) IG "OFF" and connect scantool.
- 2) ENG "ON" and Measure signal waveform at terminal 1 or 2 of CKPS.

REFERENCE SIGNAL WAVEFORM :



EGRF610K

3) Is the measured signal waveform normal?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary, and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR EC07EA0E

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -361

DTC P0336 CRANKSHAFT POSITION SENSOR A CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION EC249212

Refer to DTC P0335.

GENERAL DESCRIPTION EE835224

Refer to DTC P0335.

DTC DESCRIPTION EA0AA1DA

Checking output signals from CKPS every 7.8 sec. under detecting condition, if an output signal is missing or redundant for more than 1.56 sec., ECM sets P0336. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2B82F6A

Item	Detecting Condition	Possible cause
DTC Strategy	Detecting extra/missing pulses between consecutive 58X reference pulses	- Poor connection - Noise - Short in harness - Target wheel - ECM
Enable Conditions	Engine running state	
Threshold value	Extra/ missing pulses > 2 pulses	
Diagnosis Time	Continuous (More than 1.56 sec.failure for every 7.8 sec.test)	
MIL On Condition	2 driving cycles	

SPECIFICATION E7E7C98B

Refer to DTC P0335.

SCHEMATIC DIAGRAM E949482F

Refer to DTC P0335.

SIGNAL WAVEFROM AND DATA E68DDDF A

Refer to DTC P0335.

MONITOR DTC STATUS E7F76E4A

Refer to DTC P0335.

TERMINAL AND CONNECTOR INSPECTION E1AA31C4

Refer to DTC P0335.

SIGNAL CIRCUIT INSPECTION

E47060E8

1. Check voltage

- 1) IG "OFF" and disconnect CKPS connector.
- 2) IG "ON" and ENG "OFF"
- 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 : Approx. 1.4V

- 5) Is the measured voltage within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Go to "Check short in harness" as follows.

2. Check short in harness

- 1) IG "OFF" and disconnect CKPS connector and ECM connector.
- 2) Measure resistance between terminal 1(2) of CKPS harness connector and chassis ground.
- 3) Measure resistance between terminals 1 and 2 of CKPS harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

EB5C6023

1. Visually check CKPS and Target wheel

- 1) IG "OFF"
- 2) Check CKPS and target wheel for deformation or damage visually
- 3) Is the above items normal ?

YES

▶ Go to "Check CKPS resistance" as follows.

DTC TROUBLESHOOTING PROCEDURES

FLB -363

NO

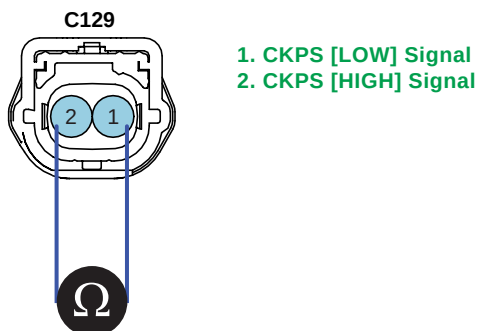
► Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

2. Check CKPS resistance

- 1) IG "OFF" and disconnect CKPS connector.
- 2) Measure resistance between terminals 1 and 2 of CKPS connector. (Component side)

SPECIFICATION :

Resistance	$700 \pm 70\Omega$



SBLF26541L

3) Is the measured resistance within specification?

YES

► Go to "Check signal waveform of CKPS" as follows.

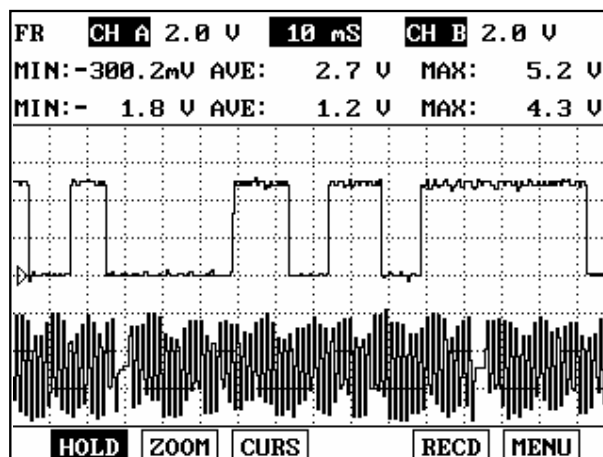
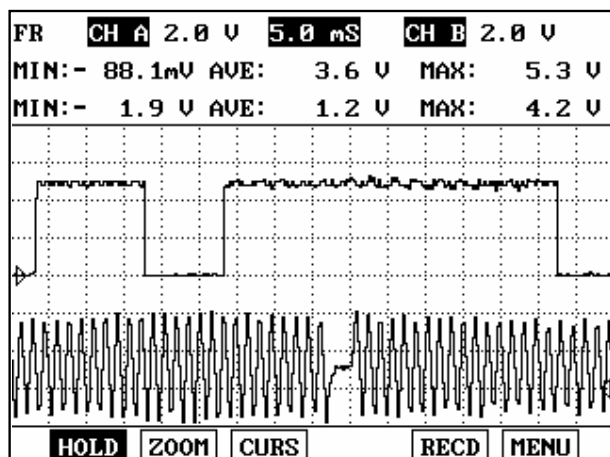
NO

► Substitute with a known - good CKPS and check for proper operation. If the problem is corrected, replace CKPS and go to "Verification of Vehicle Repair" procedure.

3. Check signal waveform of CKPS

- 1) IG "OFF" and connect scantool.
- 2) ENG "ON" and Measure signal waveform at terminal 1 or 2 of CKPS.

REFERENCE SIGNAL WAVEFORM :



EGRF610K

3) Is the measured signal waveform normal?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary, and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

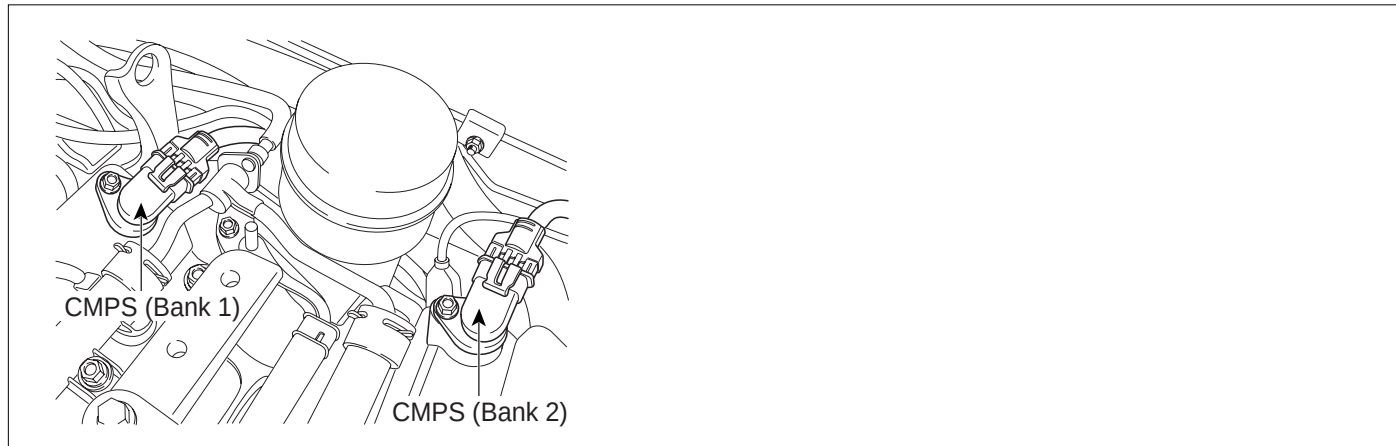
VERIFICATION OF VEHICLE REPAIR

E1284C40

Refer to DTC P0335.

DTC P0340 CAMSHAFT POSITION SENSOR A CIRCUIT MALFUNCTION (BANK 1 OR SINGLE SENSOR)

COMPONENT LOCATION EFA62881



SBLF26705L

GENERAL DESCRIPTION E2763AB3

The Camshaft Position Sensor (CMPS) is a sensor that detects the compression TDC of the NO. 1 cylinder. The CMPS consists of a hall type sensor and a target on the end of the intake camshaft. When the target triggers the sensor, the sensor voltage is 5V. If not, the sensor voltage is 0V. These CMPS signal is sent to the ECM and the ECM uses the CMPS signal for synchronizing the firing of sequential fuel injectors.

DTC DESCRIPTION E2102C75

If ECM detects that cam event signal count is over 3 under detecting condition, ECM sets P0340. MIL(Malfunction Indication Lamp) turns on.

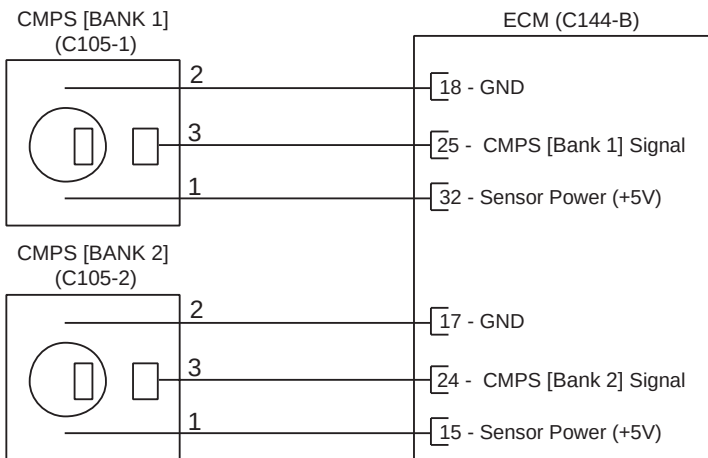
DTC DETECTING CONDITION ED79E24C

Item	Detecting Condition	Possible cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Open in harness • CMPS(Bank 1) • ECM
Enable Conditions	• Engine running state	
Threshold value	• Cam event signal count ≥ 3	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycles	

SCHEMATIC DIAGRAM

EA4831BB

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

CMPS [BANK 1]

Terminal	Connected to	Funtion
1	ECM C144-B (32)	Sensor Power (+5V)
2	ECM C144-B (18)	Sensor ground
3	ECM C144-B (25)	CMPS [Bank 1] signal

CMPS [BANK 2]

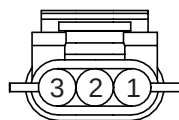
Terminal	Connected to	Funtion
1	ECM C144-B (15)	Sensor Power (+5V)
2	ECM C144-B (17)	Sensor ground
3	ECM C144-B (24)	CMPS [Bank 2] signal

[HARNESS CONNECTORS]



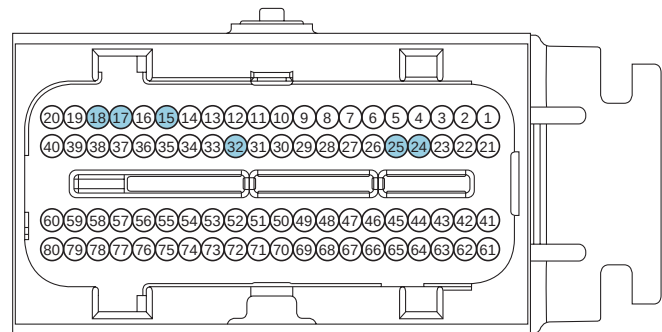
C105-1

CMPS [BANK 1]



C105-2

CMPS [BANK 2]



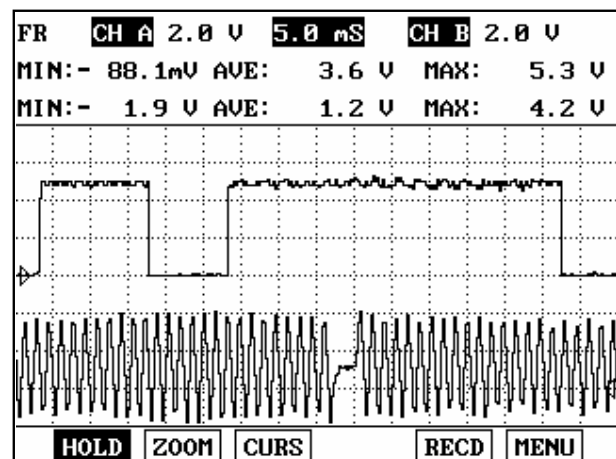
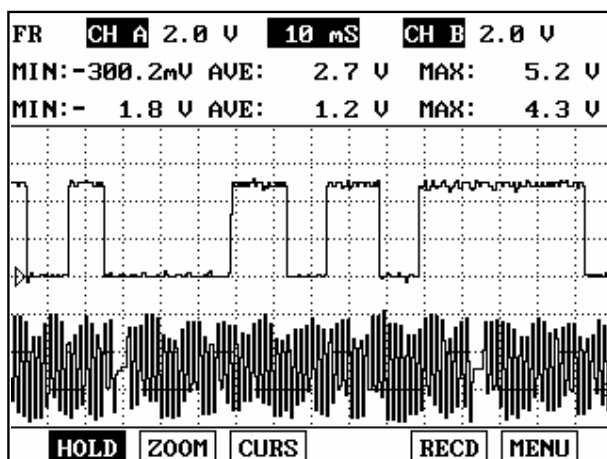
C144-B

ECM

SBLF26205L

SIGNAL WAVEFROM AND DATA

E5304C6A



This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle. The PCM controls the injection and ignition timing by using these signals. Generally CKPS signal is used to detect the piston's position and CMPS signal is used to detect the Top Dead Center of each cylinder.

EGRF610R

DTC TROUBLESHOOTING PROCEDURES

FLB -367

MONITOR DTC STATUS ED39CE2B

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu.
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E533C64C

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION E9C28F7C

1. IG "OFF" and disconnect CMPS connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 1 of CMPS(B1) harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification?

YES

- Go to "Signal Circuit Inspection" procedure.

NO

- Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E069542C

1. Check voltage
 - 1) IG "OFF" and disconnect CMPS connector.
 - 2) IG "ON" and ENG "OFF"
 - 3) Measure voltage between terminal 3 of CMPS(B1) harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification?

YES

- Go to "Component Inspection" as follows.

NO

- Go to "Check open in harness" as follows.

2. Check open in harness

- 1) IG "OFF" and disconnect CMPS connector and ECM connector.
 - 2) Measure resistance between terminal 3 of CMPS harness connector and terminal 23 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -369

- Go to "Ground Circuit Inspection" procedure.

NO

- Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E48888D1

1. IG "OFF" and disconnect CMPS connector.
2. Measure voltage between terminal 3 of CMPS harness connector and chassis ground.
3. Measure voltage between terminals 2 and 3 of CMPS harness connector.

Specification : Measurement "A" - Measurement 'B' = Approx. below 200mV

4. Is the measured voltage within specification?

YES

- Go to "Component Inspection" procedure.

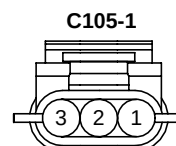
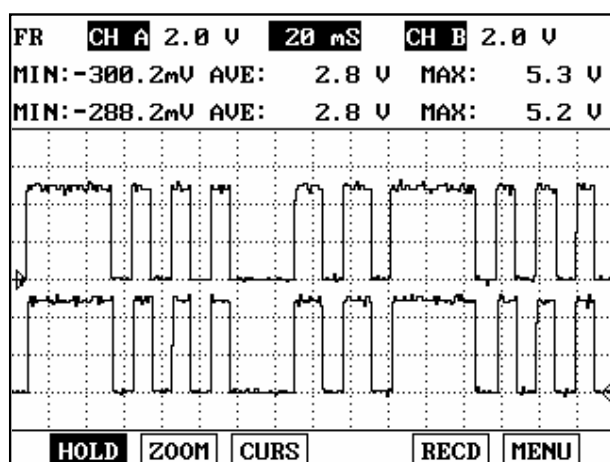
NO

- Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E5E2A59B

1. Check CMPS
 - 1) IG "OFF" and connect scantool.
 - 2) ENG "ON" and Measure signal waveform at terminal 3 of CMPS.

REFERENCE SIGNAL WAVEFORM :



1. Reference Voltage (+5V)
2. Sensor ground
3. CMPS [Bank 1] signal

SBLF26547L

- 3) Is the measured signal waveform normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good CMPS and check for proper operation. If the problem is corrected, replace CMPS and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR E8213A54

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -371

DTC P0341 CAMSHAFT POSITION SENSOR A CIRCUIT RANGE/PERFORMANCE (BANK 1 OR SINGLE SENSOR)

COMPONENT LOCATION EF7A83EC

Refer to DTC P0340.

GENERAL DESCRIPTION E97C7693

Refer to DTC P0340.

DTC DESCRIPTION EF96D31E

Checking output signals from CMP during engine running, if the expected number of cam tooth count is not observed, ECM sets P0341. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EFCBD27D

Item	Detecting Condition	Possible cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Short in harness • electrical noise • Target wheel • CMPS • ECM
Enable Conditions	• Engine running state	
Threshold value	• Cam tooth count $\neq$ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM EF26AF6D

Refer to DTC P0340.

SIGNAL WAVEFROM AND DATA E0031AF3

Refer to DTC P0340.

MONITOR DTC STATUS EEDA5B07

Refer to DTC P0340.

TERMINAL AND CONNECTOR INSPECTION EAF42ADE

Refer to DTC P0340.

POWER CIRCUIT INSPECTION E4A177F0

1. IG "OFF" and disconnect CMPS connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 1 of CMPS(B1) harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification?

YES

▶ Go to "Signal Circuit Inspection" procedure.

NO

▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E2D67778

1. Check short in harness

- 1) IG "OFF" and disconnect CMPS connector.
- 2) Measure resistance between terminals 1 and 3 of CMPS(B1) harness connector.

Specification : Infinite

3) Is the measured resistance within specification?

YES

▶ Go to "Check short to ground in harness" as follows.

NO

▶ Repair short in harness, and go to "Verification of Vehicle Repair" procedure.

2. Check short to ground in harness

- 1) IG "OFF" and disconnect CMPS connector and ECM connector.
- 2) Measure resistance between terminal 3 of CMPS(B1) harness connector and chassis ground.

Specification : Infinite

3) Is the measured resistance within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

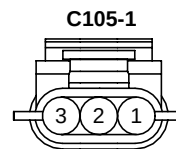
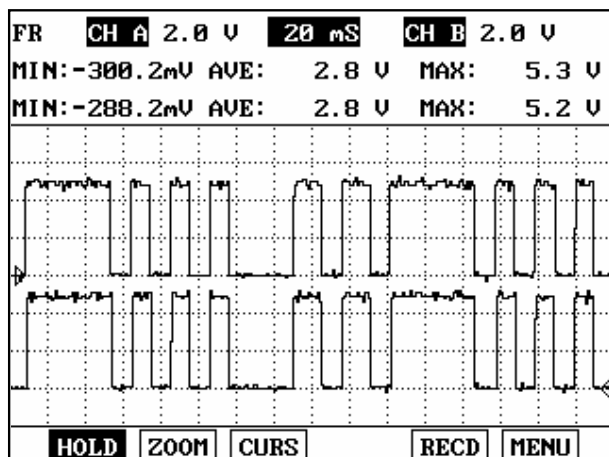
▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E8C433F1

1. Check CMPS

- 1) IG "OFF" and connect scantool.
- 2) ENG "ON" and Measure signal waveform at terminal 3 of CMPS.

REFERENCE SIGNAL WAVEFORM :



1. Reference Voltage (+5V)
2. Sensor ground
3. CMPS [Bank 1] signal

SBLF26547L

3) Is the measured signal waveform normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good CMPS and check for proper operation. If the problem is corrected, replace CMPS and go to "Verification of Vehicle Repair" procedure.

 NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EDFAF4E3

Refer to DTC P0340.

FLB -374

FUEL SYSTEM

DTC P0346 CAMSHAFT POSITION SENSOR "A" CIRCUIT RANGE/PERFORMANCE (BANK 2)

COMPONENT LOCATION E08F233C

Refer to DTC P0340.

GENERAL DESCRIPTION EB3A62E5

Refer to DTC P0340.

DTC DESCRIPTION E95CEE68

Checking output signals from CMP during engine running, if the expected number of cam tooth count is not observed, ECM sets P0346. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EE3B3A4A

Item	Detecting Condition	Possible cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Open or short in harness • electrical noise • Target wheel • CMPS • ECM
Enable Conditions	• Engine running state	
Threshold value	• Cam tooth count $\neq$ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM EAA68DAA

Refer to DTC P0340.

SIGNAL WAVEFORM AND DATA EB0C7FCA

Refer to DTC P0340.

MONITOR DTC STATUS E82DBAAC

Refer to DTC P0340.

TERMINAL AND CONNECTOR INSPECTION E5E8AE35

Refer to DTC P0340.

POWER CIRCUIT INSPECTION EB80B2F1

Refer to DTC P0340.

SIGNAL CIRCUIT INSPECTION ED28448D

1. Check voltage

DTC TROUBLESHOOTING PROCEDURES

FLB -375

- 1) IG "OFF" and disconnect CMPS connector.
- 2) IG "ON" and ENG "OFF"
- 3) Measure voltage between terminal 3 of CMPS(B2) harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification?

YES

▶ Go to "Check short in harness" as follows.

NO

▶ Go to "Check open in harness" as follows.

2. Check short in harness

- 1) IG "OFF" and disconnect CMPS connector.
- 2) Measure resistance between terminals 1 and 3 of CMPS(B2) harness connector.

Specification : Infinite

- 3) Is the measured resistance within specification?

YES

▶ Go to "Check short to ground in harness" as follows.

NO

▶ Repair short in harness, and go to "Verification of Vehicle Repair" procedure.

3. Check short to ground in harness

- 1) IG "OFF" and disconnect CMPS connector and ECM connector.
- 2) Measure resistance between terminal 3 of CMPS(B2) harness connector and chassis ground.

Specification : Infinite

- 3) Is the measured resistance within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

4. Check open in harness

- 1) IG "OFF" and disconnect CMPS connector and ECM connector.

- 2) Measure resistance between terminal 3 of CMPS harness connector and terminal 26 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EC7C39D1

1. IG "OFF" and disconnect CMPS connector.
2. Measure voltage between terminal 3 of CMPS harness connector and chassis ground.
3. Measure voltage between terminals 2 and 3 of CMPS harness connector.

Specification : Measurement "A" - Measurement 'B' = Approx. below 200mV

4. Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

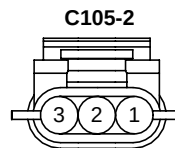
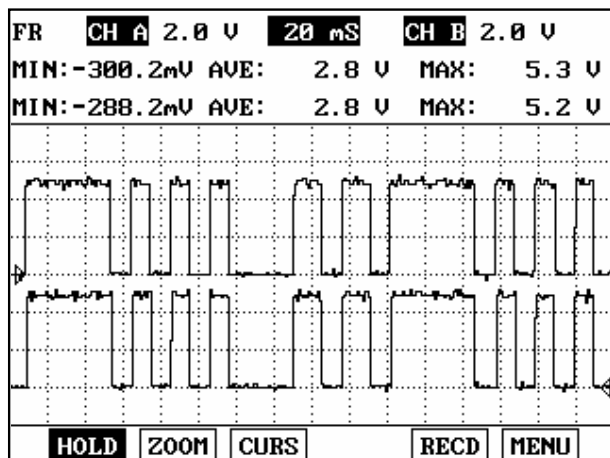
NO

► Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E86A54A7

1. Check CMPS
 - 1) IG "OFF" and connect scantool.
 - 2) ENG "ON" and Measure signal waveform at terminal 3 of CMPS.

REFERENCE SIGNAL WAVEFORM :



1. Reference Voltage
2. Sensor ground
3. CMPS [Bank 2]

SBLF26556L

3) Is the measured signal waveform normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

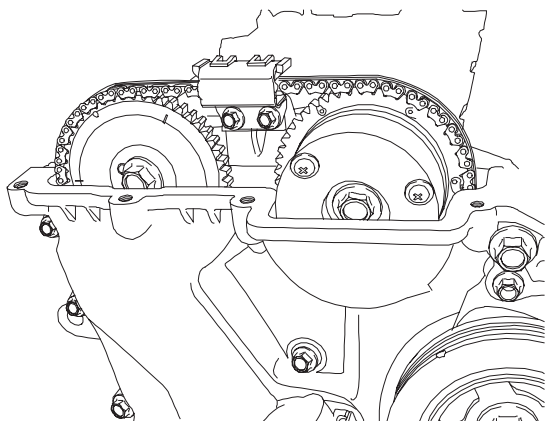
► Check the electrical noise of signal waveform, and go to "Check target wheel of CAM shaft" as follows.

 NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

2. Check target wheel of CAM shaft

- 1) IG "OFF"
- 2) Remove the cover of cylinder head and check target wheel state of bank 2.



EGRF611I

3) Is the target wheel state normal?

YES

► Substitute with a known - good CMPS and check for proper operation. If the problem is corrected, replace CMPS and go to "Verification of Vehicle Repair" procedure.

NO

► Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EB1B1699

Refer to DTC P0340.

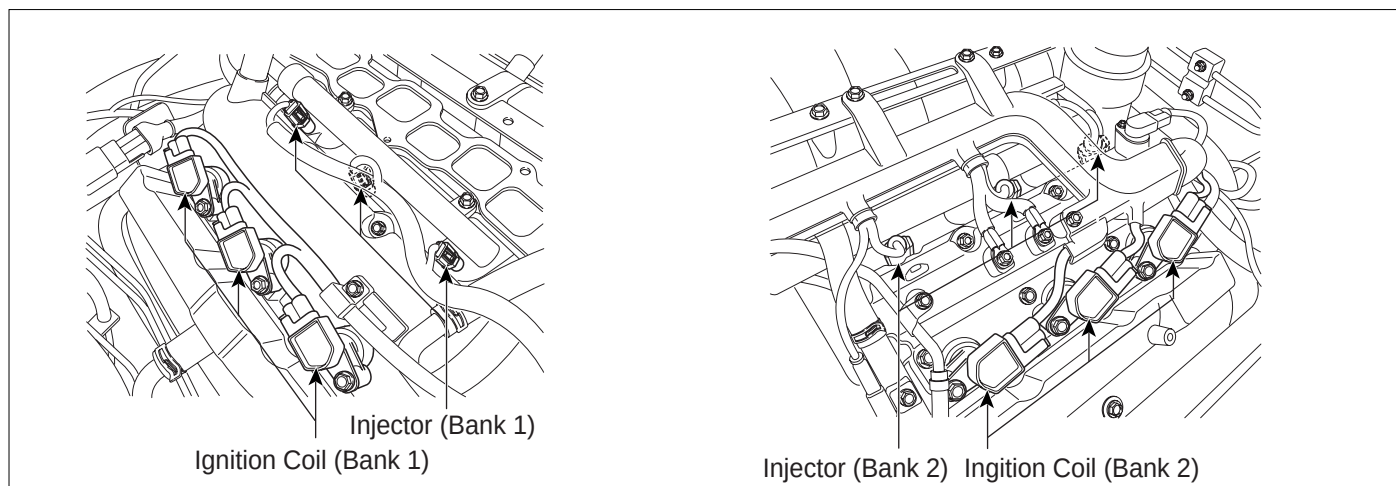
DTC TROUBLESHOOTING PROCEDURES

FLB -379

DTC P0351	IGNITION COIL "A" PRIMARY / SECONDARY CIRCUIT
DTC P0352	IGNITION COIL "B" PRIMARY / SECONDARY CIRCUIT
DTC P0353	IGNITION COIL "C" PRIMARY / SECONDARY CIRCUIT
DTC P0354	IGNITION COIL "D" PRIMARY / SECONDARY CIRCUIT
DTC P0355	IGNITION COIL "E" PRIMARY / SECONDARY CIRCUIT
DTC P0356	IGNITION COIL "F" PRIMARY / SECONDARY CIRCUIT

COMPONENT LOCATION

EDFCD029



SBLF26713L

GENERAL DESCRIPTION

E8D685FC

With the ignition switch in the ON or START position, voltage is applied to the ignition coil. Each ignition coil consists of two coils. High tension leads go to each cylinder from the ignition coils. The ignition coils fire two spark plugs on every power stroke (the cylinder under compression and the cylinder on the exhaust stroke). The Engine Control Module (ECM) provides a switching circuit to ground for energizing the primary ignition coils. The ECM uses the crankshaft position sensor and camshaft position sensor signal to time the energizing of the coil. When a primary ignition coil is energized and de-energized, the secondary coil produces a high voltage spike to the attached spark plugs.

DTC DESCRIPTION

EC973708

Checking output signals from ignition coils every 10 sec. under detecting condition, if the signals indicating open or short in the circuit are detected for more than 5 sec., ECM sets this DTC. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

FLB -380

FUEL SYSTEM

DTC DETECTING CONDITION

ECA4ACC5

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground, to battery or open circuit	• Poor connection • Open or short in harness • Ignition Coil • ECM
EnableConditions	• NO DTC related to this item • Engine running state • $11V \leq \text{Battery voltage} \leq 16V$ • The above conditions are met > 0.5 sec.	
Threshold value	• Open or short	
DiagnosisTime	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 2 driving cycles	

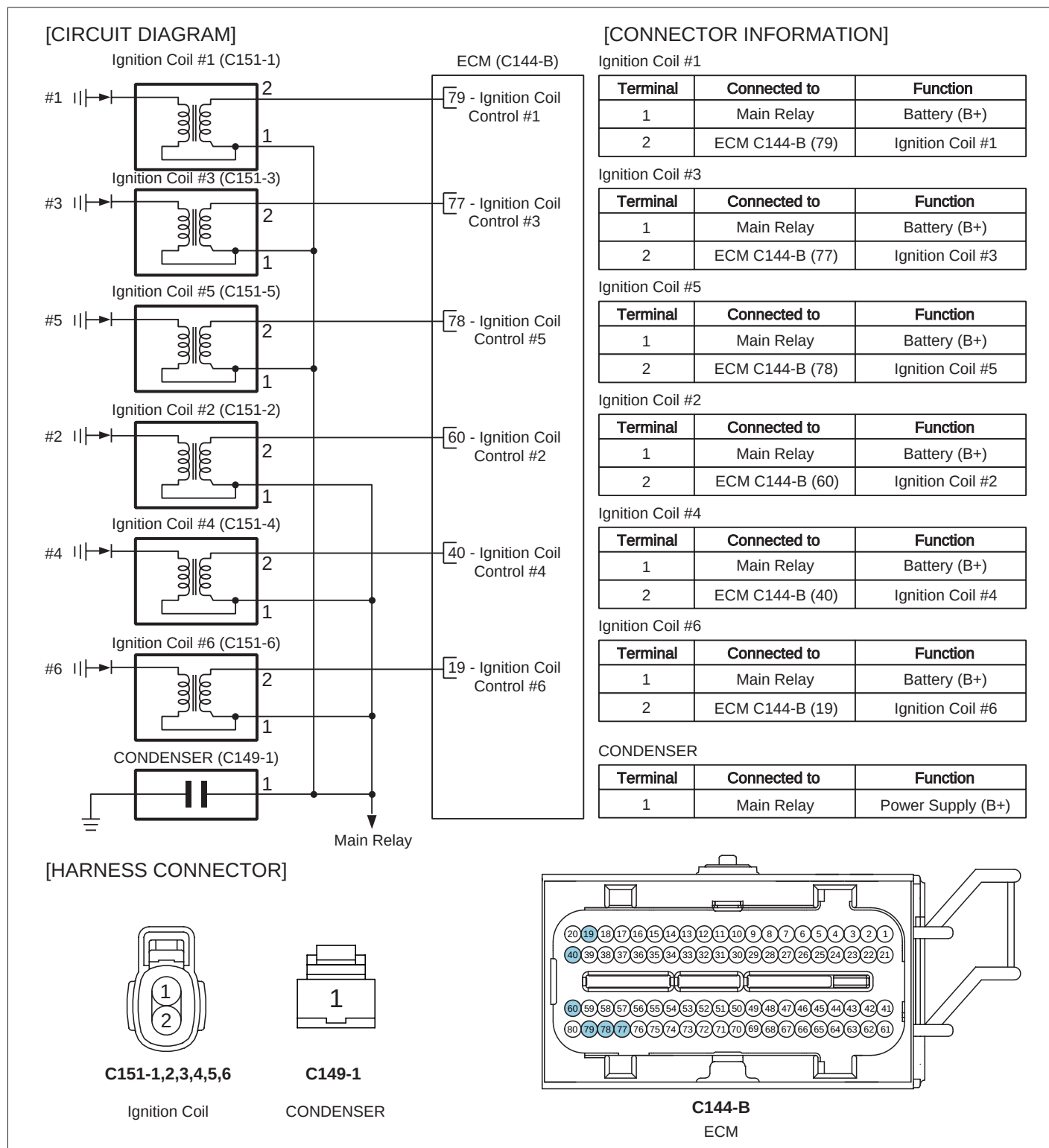
SPECIFICATION

E585BA26

Resistance (Ω)	Primary Coil	Secondary Coil
	$0.62 \pm 10\% (\Omega)$	$7.0 \pm 15\% (k\Omega)$

SCHEMATIC DIAGRAM

E6EC1099



SBLF26837L

E783B8CD

1.1 DIAGNOSTIC TROUBLE CODES					
PXXXX DTC TITLE					
NUMBER OF DTC : 1 ITEMS					
PART	ERAS		DTAL		

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- YES**

- NO

- E8B7C376

- YES**

- NO**

DTC TROUBLESHOOTING PROCEDURES

FLB -383

- Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSEPTION EDD7C16E

1. Check voltage
 - 1) IG "OFF" and disconnect Ignition Coil connector.
 - 2) IG "ON" and ENG "OFF"
 - 3) Measure voltage between terminal 2 of ignition coil harness connector and chassis ground.

Specification : Approx. B+

- 4) Is the measured voltage within specification ?

YES

- Go to "Control Circuit Inspection" procedure.

NO

- Check fuse connected to ignition coil for open.
► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION ED5CCC68

1. Check short to battery in harness.
 - 1) IG "OFF" and disconnect ignitioncoil connector and ECM connector.
 - 2) Measure resistance between terminals 1 and 2 of ignition coil harness connector.

Specification : Infinite

- 3) Is the measured resistance within specification?

YES

- Go to "Check short to ground in harness" as follows.

NO

- Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

2. Check short to ground in harness
 - 1) IG "OFF" and disconnect ignition coil connector and ECM connector.
 - 2) Measure resistance between terminal 2 of ignition coil harness connector and chassis ground.

Specification : Infinite

- 3) Is the measured resistance within specification?

YES

► Go to "Check open in harness" as follows.

NO

► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

3. Check open in harness

- 1) IG "OFF" and disconnect Ignition Coil connector and ECM connector.
- 2) [P0351] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 79 of ECM harness connector(C144-B).
[P0352] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 60 of ECM harness connector(C144-B).
[P0353] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 77 of ECM harness connector(C144-B).
[P0354] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 40 of ECM harness connector(C144-B).
[P0355] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 78 of ECM harness connector(C144-B).
[P0356] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 19 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -385

COMPONENT INSPECTION

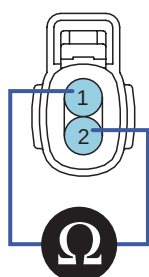
E9809A91

1. Check Ignition Coil

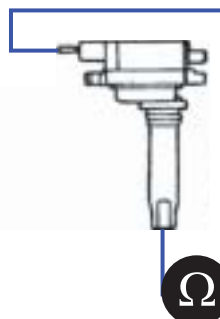
- 1) IG "OFF" and disconnect ignition coil connector.
- 2) Measure resistance between terminals 1 and 2 of ignition coil connector.(Component side)
- 3) Measure resistance between terminal 1 of ignition coil connector and out terminal of secondary ignition coil.

SPECIFICATION :

Resistance (Ω)	Primary Coil (A)	Secondary Coil (B)
	$0.62 \pm 10\% (\Omega)$	$7.0 \pm 15\% (k\Omega)$



1. Battery Voltage
2. Ignition Control



SBLF26995L

4) Is the measured resistance within specification?

YES

- ▶ Substitute with a known - good ECM and check for proper operation
- ▶ If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Substitute with a known - good Ignition Coil and check for proper operation.
- ▶ If the problem is corrected, replace Ignition Coil and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E04EE00B

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

**DTC P0420 CATALYST SYSTEM
EFFICIENCY BELOW THRESHOLD (BANK 1)
DTC P0430 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD
(BANK 2)**

GENERAL DESCRIPTION EBB1B03B

The ECM uses dual oxygen sensors to monitor the efficiency of the manifold catalytic converter (warm-up catalytic converter). By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream (front) HO₂S is used to detect the amount of oxygen in the exhaust gas before it enters the catalytic converter. A low voltage indicates high oxygen contents (lean air mixture). A high voltage indicates low oxygen contents (rich air mixture). When the catalyst efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same at the rear as it is at the front.

DTC DESCRIPTION EB2FD26F

If the oxygen storage time for Bank 1 is lower than threshold , the ECM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E0EFCB7E

Item	Detecting Condition	Possible cause
DTC Strategy	Manipulates Airfuel and stores the times it takes for the pre and post converter oxygen sensors to switch.	Catalyst Converter
EnableConditions	- Engine Runtime $\geq$ 580 sec. - Purge Concentration Learned $3 \text{ g/s} \leq \text{Airflow} \leq 10 \text{ g/s}$ - Throttle closed $\leq 1.5\%$ $70^{\circ}\text{C}(158^{\circ}\text{F}) \leq \text{Coolant Temp.} \leq 120^{\circ}\text{C}(248^{\circ}\text{F})$ $-7^{\circ}\text{C}(19.4^{\circ}\text{F}) \leq \text{Ambient Temp.} \leq 105^{\circ}\text{C}(221^{\circ}\text{F})$ - Barometer $\geq 72 \text{ kPa}$ - Max number of test attempts ≤ 12 - Closed Loop $250^{\circ}\text{C}(482^{\circ}\text{F}) \leq \text{Catalyst Temp.} \leq 950^{\circ}\text{C}(1742^{\circ}\text{F})$ - Fuel learning completed - Vehicle speed $\leq 3 \text{ kph}(1.8 \text{ mph})$ - Not airfuel ramping - Max idle time(about 60 sec.) not exceeded - No disabling faults present - No instrumentation slews active	
Threshold value	Oxygen Storage Time $< 3.25 \text{ sec.}$	
DiagnosisTime	15 sec.	
MIL On Condition	1 Driving cycle	

MONITOR SCANTOOL DATA E91ADB30

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".

- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

► Substitute with a known - good Catalyst Converter and check for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

NO

► Go to "Component Inspection" procedure.

COMPONENT INSPECTION

E9B82BE0

1. Monitor the Catalyst Converter
 - 1) Clear DTC.
 - 2) Start the engine and warm it up until the radiator fan comes on(more than at least 10 minutes).
 - 3) Drive at a steady speed between 45-55 mph(72-88 km/h) for 30 seconds.
 - 4) Stop and then maintain idle state for 120 seconds in D-position.
 - 5) Repeat step 3 once again.
 - 6) Stop and then keep it in idle state(D-positon) for 120 seconds.
 - 7) Repeat step 3 once again.
 - 8) Stop and then maintain idle state for 120 seconds in D-position.
 - 9) IG "OFF"
 - 10) Repeat steps 3 through 9 three times.
 - 11) Check if catalyst monitoring readiness is complete. so, if the readiness is incomplete, repeat steps 2 through 10.
 - 12) Does the scan tool show DTC P0420?

YES

► Substitute with a known - good Catalyst Converter and check the signal waveform of HO2S for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

NO

► It was intermittent failure.

VERIFICATION OF VEHICLE REPAIR E156E685

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

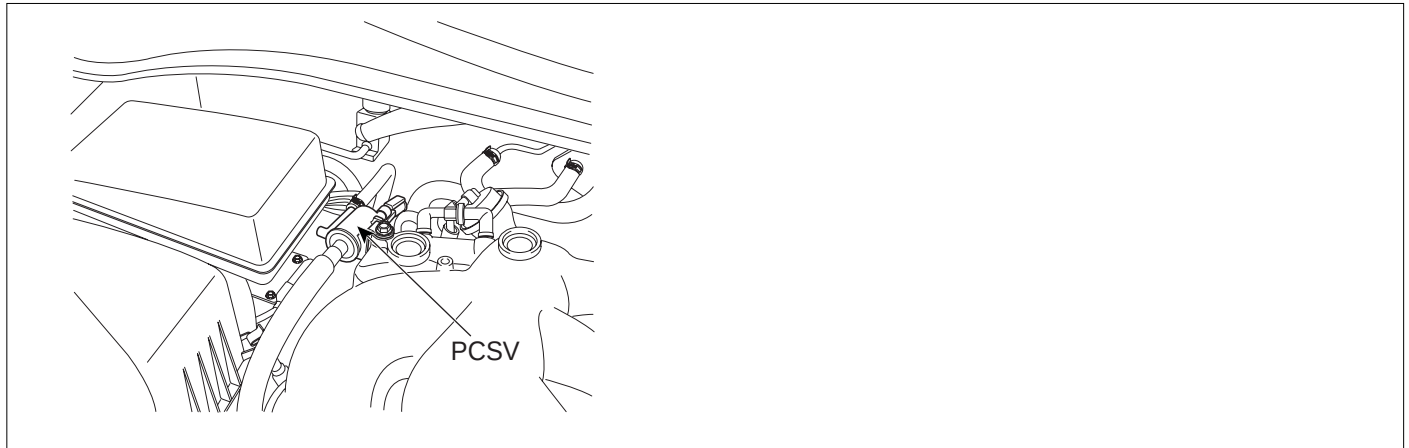
► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P0444 EVAP. EMISSION SYSTEM-PURGE CTRL. VALVE CIRCUIT OPEN

COMPONENT LOCATION ED56036E



SBLF26717L

GENERAL DESCRIPTION E7C18649

The evaporative emission control system prevents hydrocarbon (HC) vapors from the fuel tank from escaping into the atmosphere where they could form photochemical smog. Gasoline vapors are collected in the charcoal canister. The ECM controls the Purge Control Solenoid Valve (PCSV) to purge any collected vapors from the canister back to the engine for combustion. This valve is actuated by the purge control signal from the ECM and controls fuel vapor from the canister to the intake manifold.

DTC DESCRIPTION EE035CE5

Checking output signals from PCSV every 10 sec. under detecting condition, if signals indicating open or short to ground in the circuit are detected for more than 5 sec., ECM sets P0444. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ECD60D85

Item	Detecting Condition	Possible cause
DTC Strategy	Open, short to ground	- Poor connection - Open or short to ground in harness - PCSV - ECM
EnableConditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above enable conditions are met > 0.5 sec.	
Threshold value	Open or short to ground	
DiagnosisTime	Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	2 driving cycles	

SPECIFICATION ED3E2962

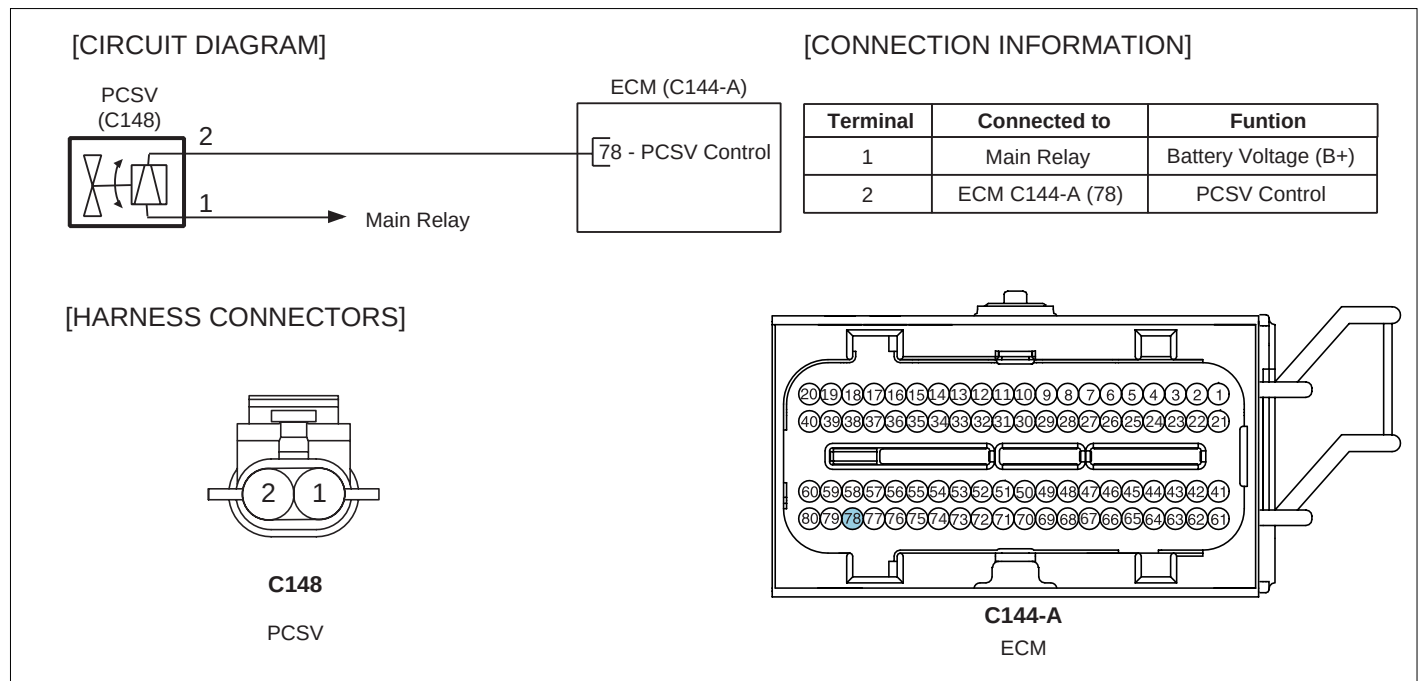
Item	Coil resistance(Ω)
PCSV	19.0 ~ 22.0 Ω (at 20°C / 68°F)

DTC TROUBLESHOOTING PROCEDURES

FLB -391

SCHEMATIC DIAGRAM

E3D8DC9C



SBLF26212L

SIGNAL WAVEFORM AND DATA

E116844B

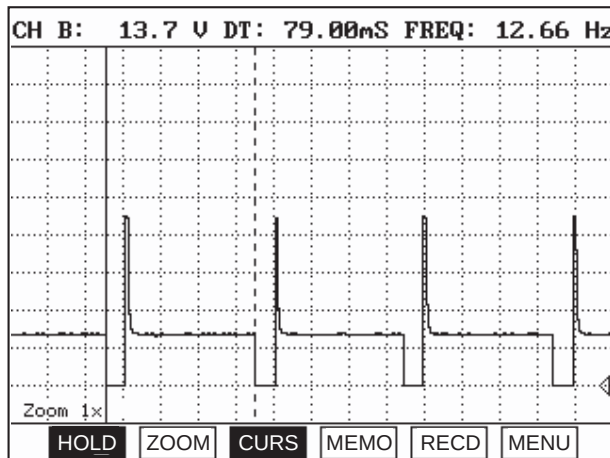


Fig. 1

The Purge Control Solenoid Valve(PCSV) is open or closed by PCM and vacuum of intake manifold. At opening, fuel vapor from canister enters into intake manifold. To prevent vacuum from forming inside canister, PCM controls to open it. This photo shows the signal waveform of PCSV operating normally.

EGRF848A

MONITOR DTC STATUS

E4488E63

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".

- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

E4332EDD

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSEPCTION

E5CCD975

1. IG "OFF" and disconnect PCSV connector.
2. IG "ON" and ENG "OFF"

DTC TROUBLESHOOTING PROCEDURES

FLB -393

3. Measure voltage between terminal 1 of PCSV harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification?

YES

- ▶ Go to "Control Circuit Inspection" procedure.

NO

- ▶ Repair open or short to ground in harness, and go to " Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E590202D

1. Check short to ground in harness.

- 1) IG "OFF" and disconnect PCSV connector.
- 2) IG "ON"
- 3) Measure voltage between terminal 2 of PCSV harness connector and chassis ground.

Specification : Approx. 0.5V

- 4) Is the measured voltage within specification?

YES

- ▶ Go to "Check open in harness" as follows.

NO

- ▶ Repair short to ground in harness, and go to " Verification of Vehicle Repair" procedure.

2. Check open in harness.

- 1) IG "OFF" and disconnect PCSV connector and ECM connector.
- 2) Measure resistance between terminal 2 of PCSV harness connector and terminal 78 of ECM harness connector(C144-A).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

- ▶ Go to " Component Inspection" procedure.

NO

- ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

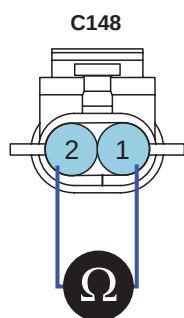
E700F2E6

1. Check PCSV

- 1) IG "OFF" and disconnect PCSV connector.
- 2) Measure resistance between terminals 1 and 2 of PCSV connector.(Component side)

SPECIFICATION :

Item	Coil resistance(Ω)
PCSV	19.0 ~ 22.0 Ω (at 20°C / 68°F)



1. Battery voltage(B+)
2. PCSV Control

SBLF26590L

3) Is the measured resistance within specification?

YES

- ▶ Substitute with a known - good ECM and check for proper operation.
- ▶ If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Substitute with a known - good PCSV and check for proper operation.
- ▶ If the problem is corrected, replace PCSV and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EE268910

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

FLB -396

FUEL SYSTEM

DTC P0445 EVAP. EMISSION SYSTEM-PURGE CTRL. VALVE CIRCUIT SHORTED

COMPONENT LOCATION E7E8DC58

Refer to DTC P0444.

GENERAL DESCRIPTION E4FD2EDD

Refer to DTC P0444.

DTC DESCRIPTION EEF742F2

Checking output signals from PCSV every 10 sec. under detecting condition, if signals indicating short to battery in the circuit are detected for more than 5 sec., ECM sets P0445. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EFA658FE

Item	Detecting Condition	Possible cause
DTC Strategy	Short to battery	- Poor connection - Short to battery in harness - PCSV - ECM
EnableConditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above enable conditions are met > 0.5 sec.	
Threshold value	Short to battery	
DiagnosisTime	Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	2 driving cycles	

SPECIFICATION E4836516

Refer to DTC P0444.

SCHEMATIC DIAGRAM E2B5ABB9

Refer to DTC P0444.

SIGNAL WAVEFORM AND DATA EFD93AE9

Refer to DTC P0444.

MONITOR DTC STATUS E3E76820

Refer to DTC P0444.

TERMINAL AND CONNECTOR INSPECTION E9FAE1E3

Refer to DTC P0444.

DTC TROUBLESHOOTING PROCEDURES

FLB -397

CONTROL CIRCUIT INSPECTION EC3C88D2

1. IG "OFF" and disconnect PCSV connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 2 of PCSV harness connector and chassis ground.

Specification : Approx. 0.5V

4. Is the measured voltage within specification?

YES

► Go to "Component Inseption" procedure.

NO

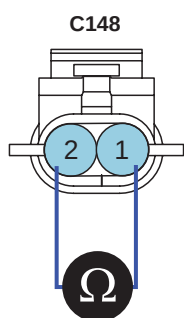
► Repair short to battery in harness, and go to " Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EA0BCF0B

1. Check PCSV
 - 1) IG "OFF" and disconnect PCSV connector.
 - 2) Measure resistance between terminals 1 and 2 of PCSV connector.(Component side)

SPECIFICATION :

Item	Coil resistance(Ω)
PCSV	19.0 ~ 22.0 Ω (at 20°C / 68°F)



1. Battery voltage(B+)
2. PCSV Control

SBLF26590L

- 3) Is the measured resistance within specification?

YES

- Substitute with a known - good ECM and check for proper operation.
- If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

- Substitute with a known - good PCSV and check for proper operation.
- If the problem is corrected, replace PCSV and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E2B31BC8

Refer to DTC P0444.

DTC P0501 VEHICLE SPEED SENSOR A RANGE/PERFORMANCE

GENERAL DESCRIPTION

EB4AD9E0

The Vehicle Speed Sensor(VSS) or Wheel Speed Sensor (WSS) generates a waveform with a frequency proportional to the speed of the vehicle. The signal generated by the VSS or WSS informs the ECM not only if the vehicle speed is low or high but also if the vehicle is or is not moving. The ECM uses this signal to control the fuel injection, ignition timing, transaxle shift scheduling and torque converter clutch scheduling. The VSS or WSS signal is also used to detect rough road conditions.

DTC DESCRIPTION

E6C7F77E

Checking vehicle speed signal every from vehicle speed sensor or ABS(or ESP) control every 30 sec. under detecting condition, if an signal is in the detecting condition for more than 20 sec., ECM sets P0501. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

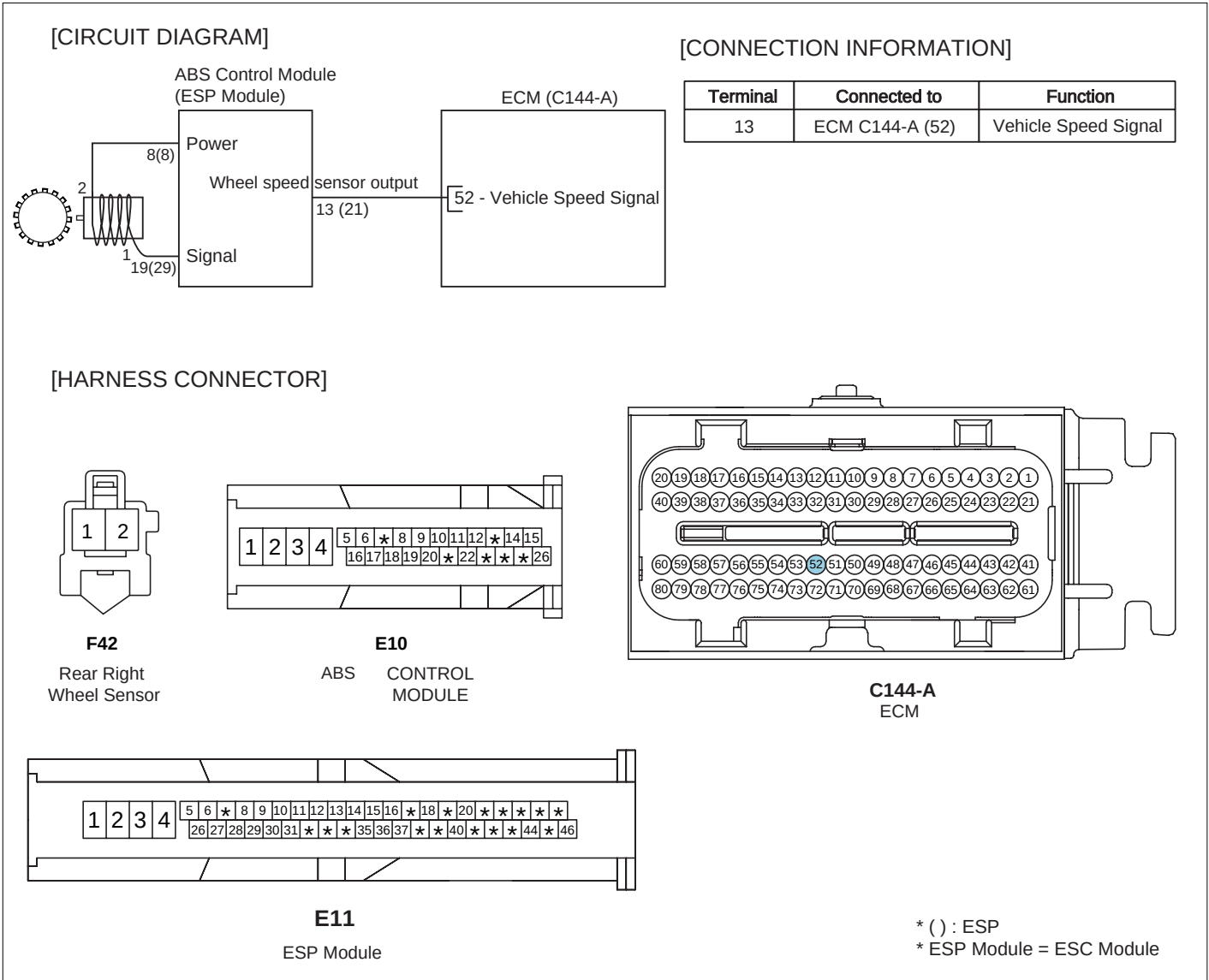
DTC DETECTING CONDITION

EC093E14

Item		Detecting Condition	Possible cause
DTC Strategy		• Detects the lack of vehicle speed signal	• Poor connection • Open or short in harness • Vehicle Speed Sensor or Wheel speed sensor(RR) • ABS or ESP control unit • ECM
Enable Conditions	Case 1(Power)	• Engine Running • No VSS disabling malfunction present • No TPS fault present • No MAP fault present • 11V < Ignition Voltage < 16V • Engine Coolant Temperature > 60°C (140°F) • MAP > 55kPa • 25% ≤ TPS ≤ 60% • 1200rpm ≤ Engine Speed ≤ 4000rpm • Vehicle Speed derived from transmission ≥ 10 kph(6.2 mph)	
	Case 2(Decel)	• Engine Running • No VSS disabling malfunction present • No TPS fault present • No MAP fault present • 11V < Ignition Voltage < 16V • Engine Coolant Temperature > 60°C (140°F) • MAP < 32kPa • TPS < 1% • 1800rpm ≤ Engine Speed ≤ 6000rpm • Transmission in gear	
Thresh old value	Case 1(Power)	• Vehicle Speed ≤ 10kph	
	Case 2(Decel)	• Vehicle Speed < 5kph • Delta Engine Speed ≥ 100rpm	
Diagnosis Time		• Continuous (More than 20 seconds failure for every 30 seconds test)	
MIL On Condition		• 2 driving cycles	

SCHEMATIC DIAGRAM E986A967

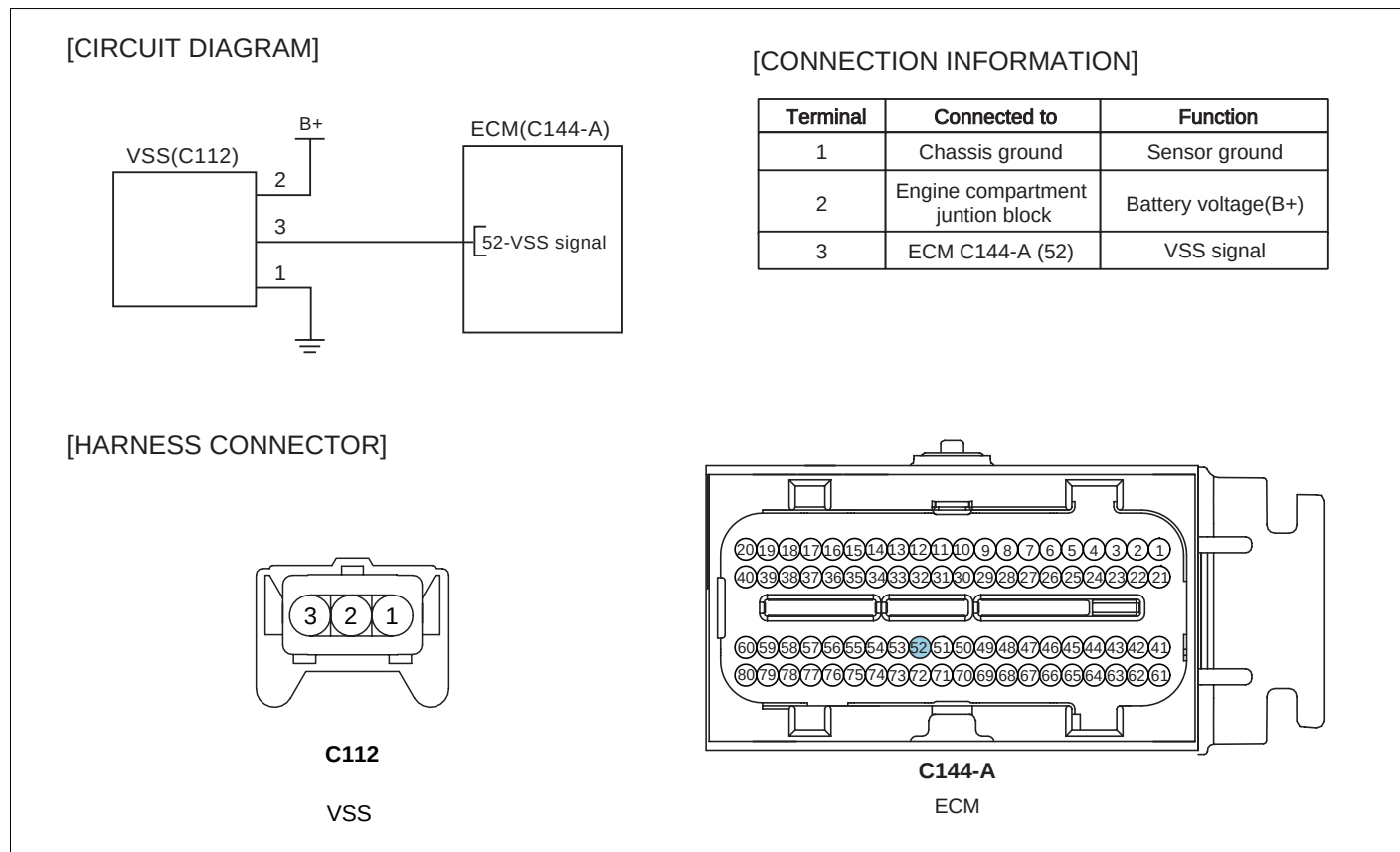
[EURO-III/IV WITH ABS(OR ESP)]



DTC TROUBLESHOOTING PROCEDURES

FLB -401

[EXCEPT EURO-III/IV]



SBLF26845L

SIGNAL WAVEFROM AND DATA

EE71D0CD

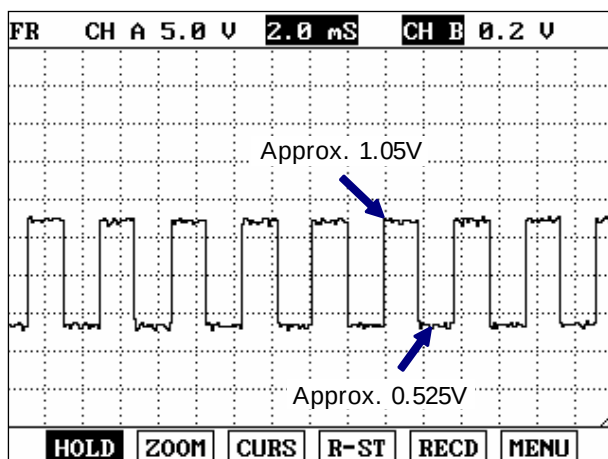


Fig. 1

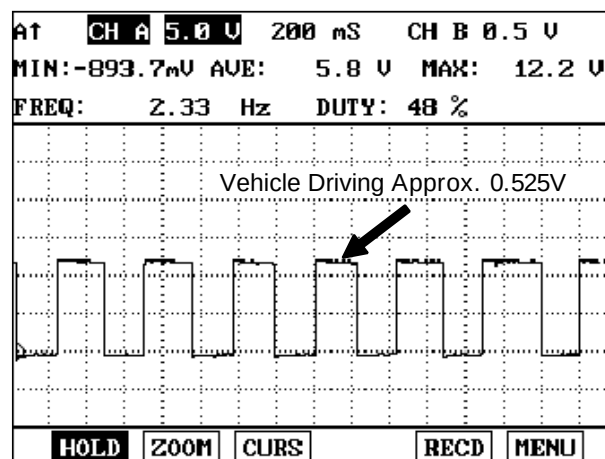


Fig. 2

Fig1) Normal signal waveform of wheel speed sensor at driving

Fig2) Normal signal waveform of vehicle speed sensor at driving

SBLF26827L

MONITOR DTC STATUS

E04F9B9E

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

[EURO-III/IV] ED9AF8AF

TERMINAL AND CONNECTOR INSPECTION

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- Go to " Signal Circuit Inspection " procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -403

[EXCEPT EURO-III/IV] E2BEE61B

TERMINAL AND CONNECTOR INSPECTION

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

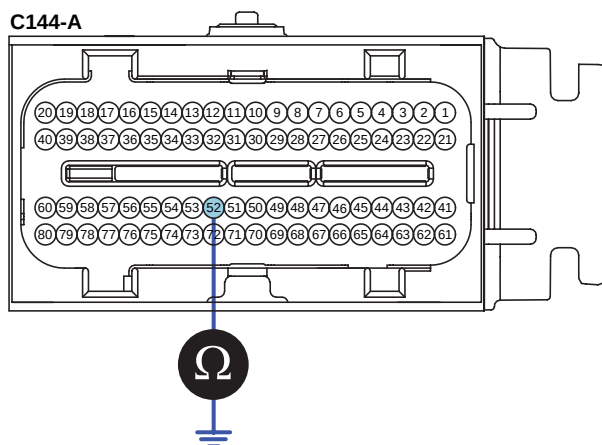
SIGNAL CIRCUIT INSPECTION EEDC66D6

NOTE

This procedure is applied to vehicle with ABS (or ESP) In case of no ABS(or ESP), refer to "C1203 Wheel speed sensor front-RH open/short".

1. Check short to ground in harness
 - 1) IG "OFF"
 - 2) Disconnect ECM connector and ABS or ESP control module connector.
 - 3) Measure resistance between terminal 52 of ECM harness connector(C144-A) and chassis ground.

52. Vehicle Speed Input



SBLF26608L

Specification : Infinite

- 4) Is the measured resistance within specifications?

YES

- Go to "Check open in harness" as follows.

NO

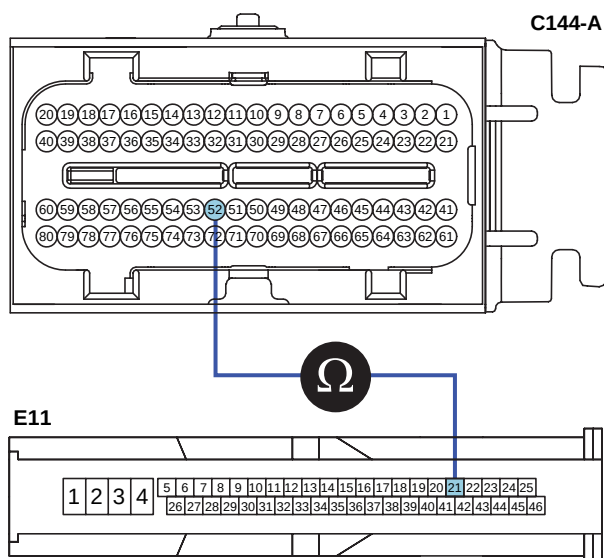
- Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

2. Check for open in harness

- 1) Ignition "OFF"
- 2) Disconnect ECM connector and ABS or ESP control module connector.
- 3) Measure resistance between terminal "52" of ECM harness connector(C144-A) and terminal "21" of ESC control module harness connector(E11).

Specification : Approx. below 1Ω

52. Vehicle Speed Input



SBLF26609L



NOTE

This picture is only applied to vehicle with ESP

- 4) Is the measured resistance within specifications?

YES

- Go to " Check wheel speed sensor " procedure.

NO

- Check open in harenss.
- Repair or replace as necessary and then, go to " Verification of Vehicle Repair" procedure.

3. Check wheel speed sensor

- 1) IG "OFF"
- 2) Check open or short in wheel speed sensor (Refer to "C1209 Wheel speed sensor rear-RH open/short")

DTC TROUBLESHOOTING PROCEDURES

FLB -405

- 3) Is the wheel speed sensor normal?

YES

▶ Substitute with a known - good ECM/ ESP control unit and check for proper operation.
If the problem is corrected, replace ECM/ ABS or ESP control unit and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Repair or replace it as necessary.
▶ And then go to " Verification of Vehicle Repair" procedure.



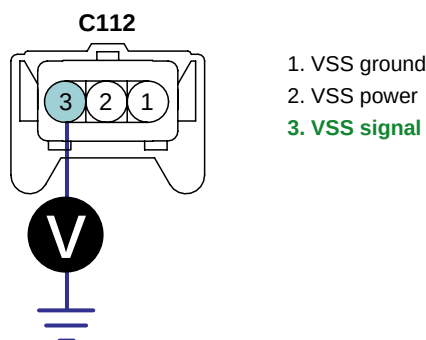
NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

SIGNAL CIRCUIT INSPECTION

E08F16D0

1. Check voltage from sensor side
 - 1) IG "OFF"
 - 2) Disconnect vehicle speed sensor connector.
 - 3) IG "ON" and ENG "OFF"
 - 4) Measure voltage between terminal 3 of vehicle speed sensor harness connector(C144-A) and chassis ground.



SBLF26829L

Specification : Approx. 8 ~ 11.5V

- 5) Is the measured voltage within specifications?

YES

▶ Go to "Check voltage from ECM side" as follows.

NO

▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

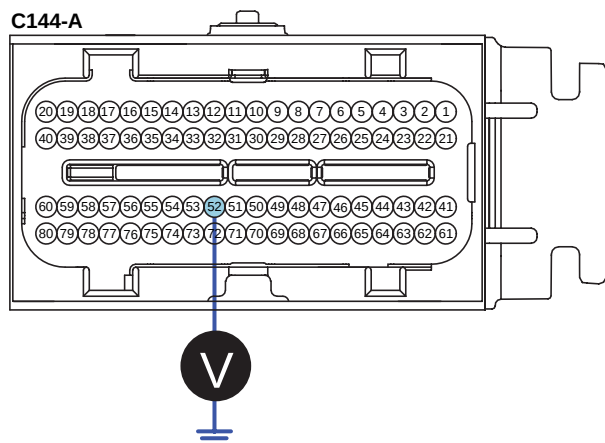
2. Check voltage from ECM side

- 1) IG "OFF"

- 2) Disconnect ECM connector and vehicle speed sensor connector.
- 3) IG "ON" and ENG "OFF"
- 4) Measure voltage between terminal "52" of ECM harness connector(C144-A) and chassis ground.

Specification : Approx. 8 ~ 11.5V

52. Vehicle Speed Input



SBLF26830L

- 5) Is the measured voltage within specifications?

YES

► Go to " Ground circuit inspection " procedure.

NO

► Check open in harenss.

► Repair or replace as necessary and then, go to " Verification of Vehicle Repair" procedure.

[EURO-III/IV] ED9AF8AF

TERMINAL AND CONNECTOR INSPECTION

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Signal Circuit Inspection " procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -407

[EXCEPT EURO-III/IV] E2BEE61B

TERMINAL AND CONNECTOR INSPECTION

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

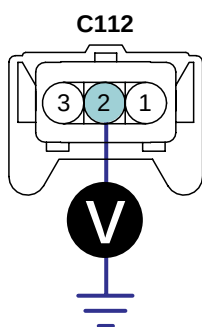
► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION E4C86C27

1. Check voltage.
 - 1) IG "OFF"
 - 2) Disconnect vehicle speed sensor connector.
 - 3) IG "ON" and ENG "OFF"
 - 4) Measure voltage between terminal 2 of vehicle speed sensor harness connector and chassis ground.



1. VSS ground
2. VSS power
3. VSS signal

SBLF26828L

Specification : Approx. 11.5 ~ 13V

- 5) Is the measured voltage within specifications?

YES

► Go to "Signal circuit inspection" procedure.

NO

- Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.
- Especially Check the fuse related to Power for blown-off.

SIGNAL CIRCUIT INSPECTION

EEDC66D6

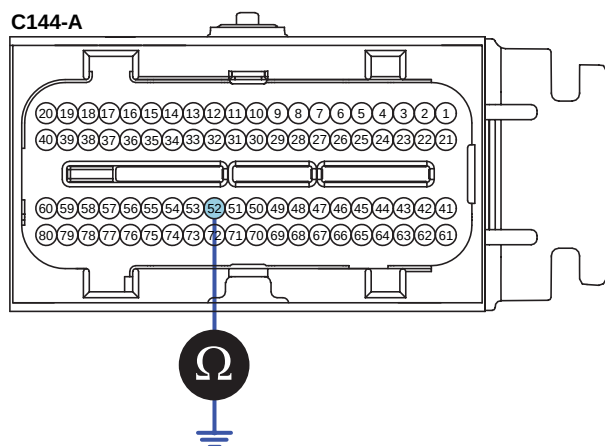


NOTE

This procedure is applied to vehicle with ABS (or ESP) In case of no ABS(or ESP), refer to "C1203 Wheel speed sensor front-RH open/short".

1. Check short to ground in harness
 - 1) IG "OFF"
 - 2) Disconnect ECM connector and ABS or ESP control module connector.
 - 3) Measure resistance between terminal 52 of ECM harness connector(C144-A) and chassis ground.

52. Vehicle Speed Input



SBLF26608L

Specification : Infinite

- 4) Is the measured resistance within specifications?

YES

► Go to "Check open in harness" as follows.

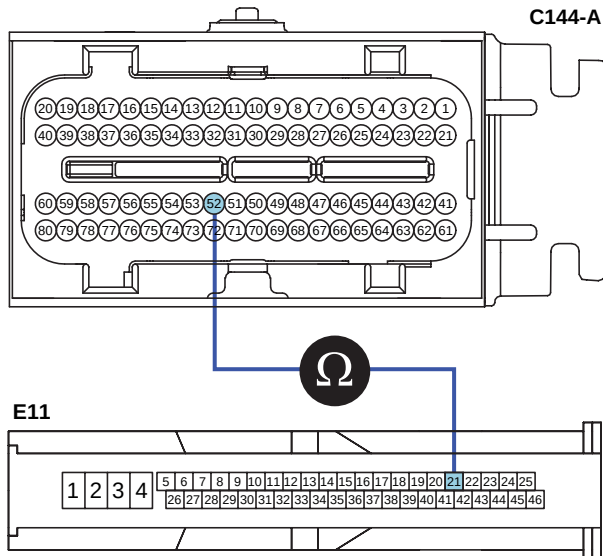
NO

► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

2. Check for open in harness
 - 1) Ignition "OFF"
 - 2) Disconnect ECM connector and ABS or ESP control module connector.
 - 3) Measure resistance between terminal "52" of ECM harness connector(C144-A) and terminal "21" of ESC control module harness connector(E11).

Specification : Approx. below 1Ω

52. Vehicle Speed Input



SBLF26609L

 NOTE

This picture is only applied to vehicle with ESP

- 4) Is the measured resistance within specifications?

YES

- Go to " Check wheel speed sensor " procedure.

NO

- Check open in harness.
► Repair or replace as necessary and then, go to " Verification of Vehicle Repair" procedure.

3. Check wheel speed sensor

- 1) IG "OFF"
- 2) Check open or short in wheel speed sensor (Refer to "C1209 Wheel speed sensor rear-RH open/short")
- 3) Is the wheel speed sensor normal?

YES

- Substitute with a known - good ECM/ ESP control unit and check for proper operation.
If the problem is corrected, replace ECM/ ABS or ESP control unit and go to "Verification of Vehicle Repair" procedure.

NO

- Repair or replace it as necessary.
► And then go to " Verification of Vehicle Repair" procedure.

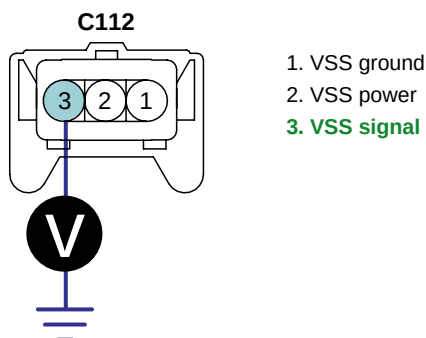
 NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

SIGNAL CIRCUIT INSPECTION

E08F16D0

1. Check voltage from sensor side
 - 1) IG "OFF"
 - 2) Disconnect vehicle speed sensor connector.
 - 3) IG "ON" and ENG "OFF"
 - 4) Measure voltage between terminal 3 of vehicle speed sensor harness connector(C144-A) and chassis ground.



SBLF26829L

Specification : Approx. 8 ~ 11.5V

- 5) Is the measured voltage within specifications?

YES

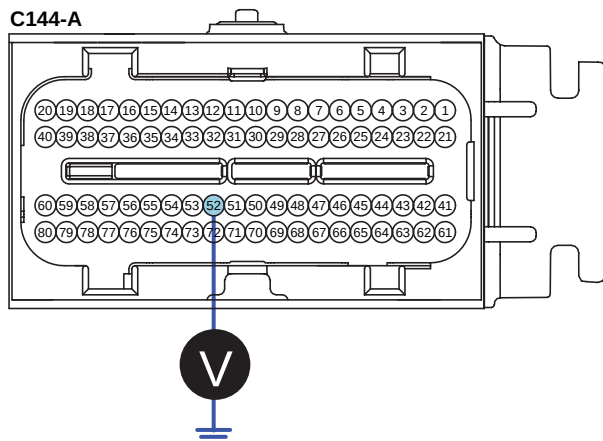
▶ Go to "Check voltage from ECM side" as follows.

NO

▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.
2. Check voltage from ECM side
 - 1) IG "OFF"
 - 2) Disconnect ECM connector and vehicle speed sensor connector.
 - 3) IG "ON" and ENG "OFF"
 - 4) Measure voltage between terminal "52" of ECM harness connector(C144-A) and chassis ground.

Specification : Approx. 8 ~ 11.5V

52. Vehicle Speed Input



SBLF26830L

5) Is the measured voltage within specifications?

YES

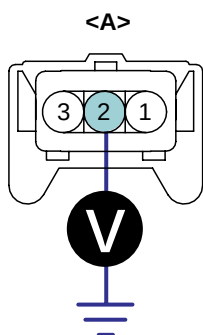
► Go to " Ground circuit inspection " procedure.

NO

- Check open in harness.
- Repair or replace as necessary and then, go to " Verification of Vehicle Repair" procedure.

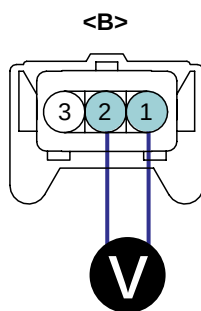
GROUND CIRCUIT INSPECTION EF3938E9

1. IG "OFF"
2. Disconnect vehicle speed sensor connector.
3. IG "ON" and ENG "OFF"
4. Measure voltage between terminal 2 of vehicle speed sensor harness connector and chassis ground.(Fig.A)
5. Measure voltage between terminals 1 and 2 of vehicle speed sensor harness connector.(Fig.B)



C112

- 1. VSS ground
- 2. VSS power
- 3. VSS signal



SBLF26831L

Specification : Measurement "A" - Measurement 'B' = Approx. below 200mV

6. Is the measured voltage within specifications?

YES

- ▶ Substitute with a known - good vehicle speed sensor and check for proper operation. If the problem is not corrected, substitute with a known - good ECM and check for proper operation. And go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E84F47F5

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -413

DTC P0504 BRAKE SWITCH "A"/"B" CORRELATION

GENERAL DESCRIPTION E2021D4E

The Stop lamp switch is used to judge whether the acceleration system is abnormal or not. The stop lamp switch has a duplex system(signals brake test or brake light) to memorize the abnormality when the signals of depressing and releasing the brake pedal are detected simultaneously.

DTC DESCRIPTION E925CC3E

Checking output signals from both brake switch when all of them are On or OFF simultaneously, if abnormal signal is detected for more than 0.5 sec., an error is recognized. And if this condition lasts for certain period, ECM sets P0504. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF97BB6F

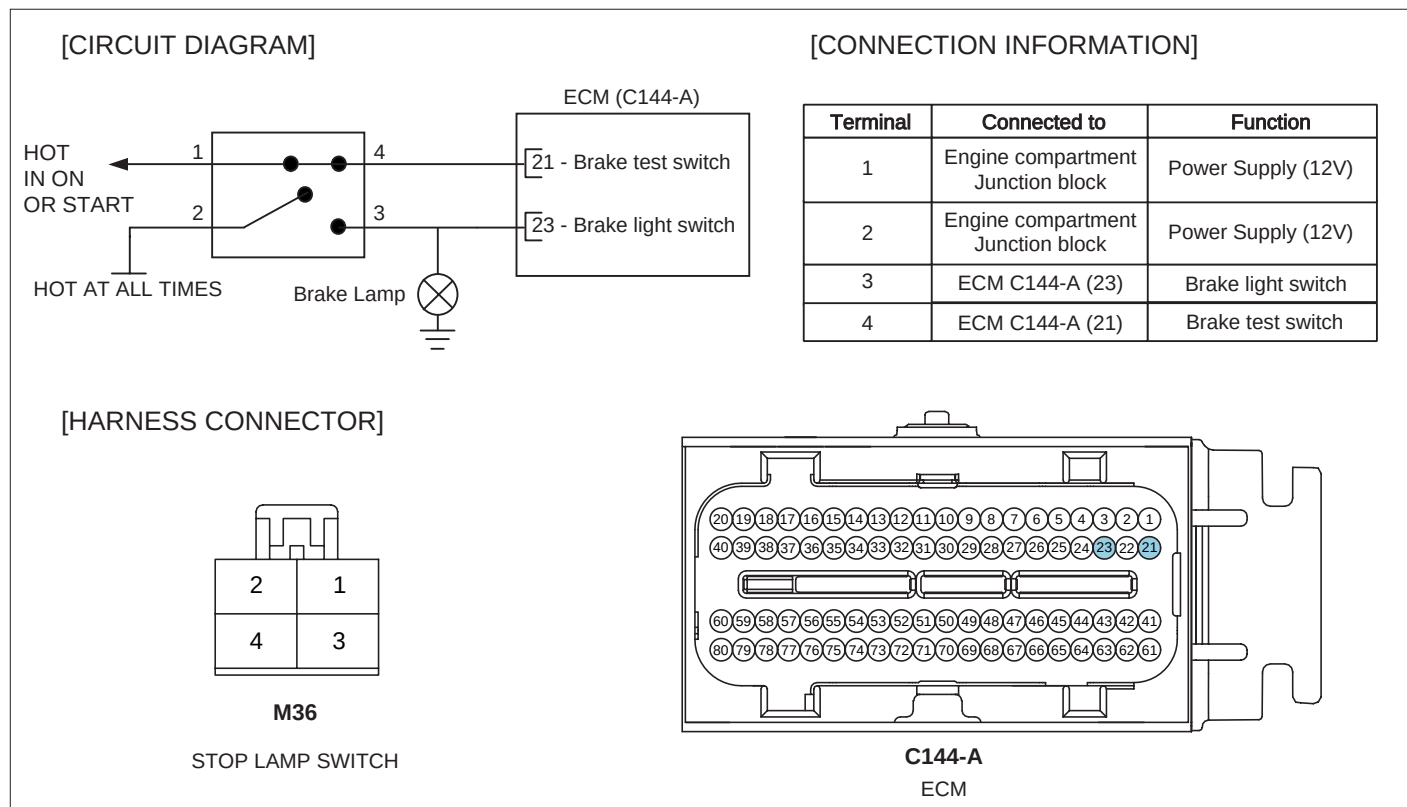
Item		Detecting Condition	Possible cause
DTC Strategy		Comparing 2 brake signals during driving	- Poor connection - Open or short in brake switch - Faulty Brake switch
Enable Conditions	Case 1	- Engine works - Vehicle Speed Sensor is abnormal.	
	Case 2	- Engine works - Vehicle Speed Sensor is normal and Vehicle Speed is over 20kph during 1sec or more.	
Threshold value		The one brake signal's change duration when another signal has been changed > 0.5 sec	
Diagnosis Time		Continuous	
MIL On Condition		2 driving cycles	

SPECIFICATION E9164B8A

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	0V	Battery voltage
Brake Switch	Battery voltage	0V

SCHEMATIC DIAGRAM

E5204A7C



SBLF26839L

MONITOR DTC STATUS

EA6BC8A3

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

DTC TROUBLESHOOTING PROCEDURES

FLB -415

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E48E4DEC

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

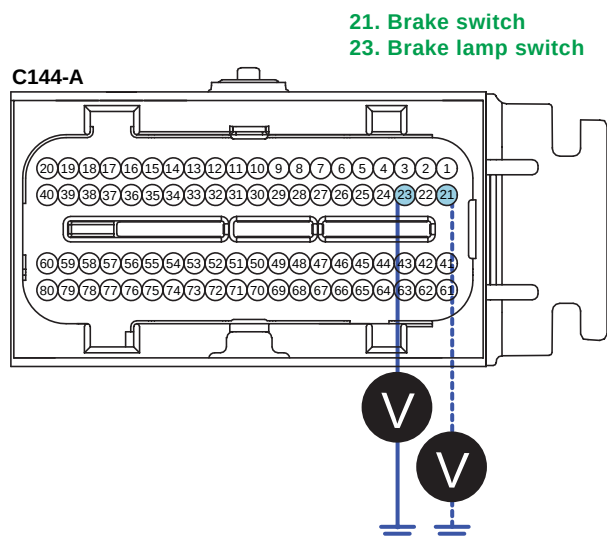
► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION E21B7089

1. Votage check
 - 1) IG Key "OFF".
 - 2) Disconnect the ECM connector.
 - 3) IG Key "ON" and keep the brake taking off.
 - 4) Measure the voltage between terminal 21 of ECM harness connector(C144-A) and chassis ground.
 - 5) Measure the voltage between terminal 23 of ECM harness connector(C144-A) and chassis ground .
 - 6) Keep the brake stepping on.
 - 7) Measure the voltage between terminal 21 of ECM harness connector(C144-A) and chassis ground.
 - 8) Measure the voltage between terminal 23 of ECM harness connector(C144-A) and chassis ground.

SPECIFICATION :

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	0V	Battery voltage
Brake Switch	Battery voltage	0V



SBLF26610L

9) Is the measured voltage within specification ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair as necessary and go to "Verification of Vehicle Repair" procedure..

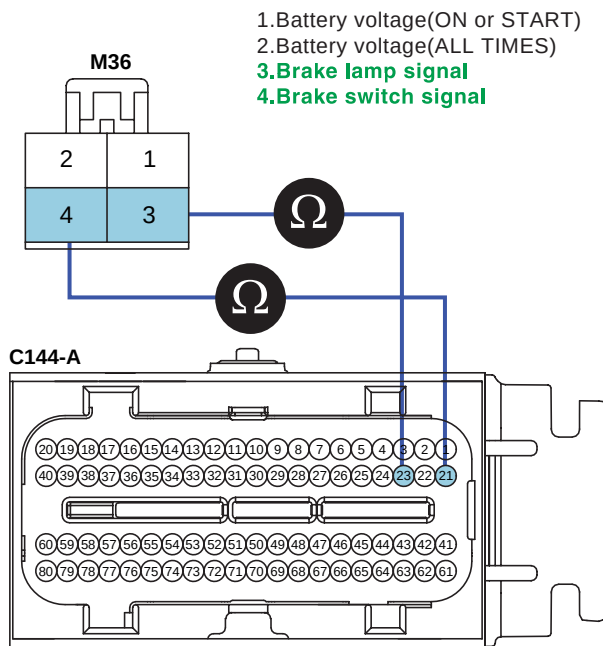
NO

► Go to "Check open in harness" as follows.

2. Check open in harness

- 1) IG Key "OFF".
- 2) Disconnect the brake switch and ECM connector.
- 3) Measure the resistance between terminal 21 of ECM harness connector(C144-A) and terminal 4 of Brake switch harness side.
- 4) Measure the resistance between terminal 23 of ECM harness connector(C144-A) and terminal 3 of Brake switch harness side.

Specification : Approx. below 1Ω



SBLF26611L

5) Is the measured resistance within specification ?

YES

► Go to "Check Battery voltage" procedure.

NO

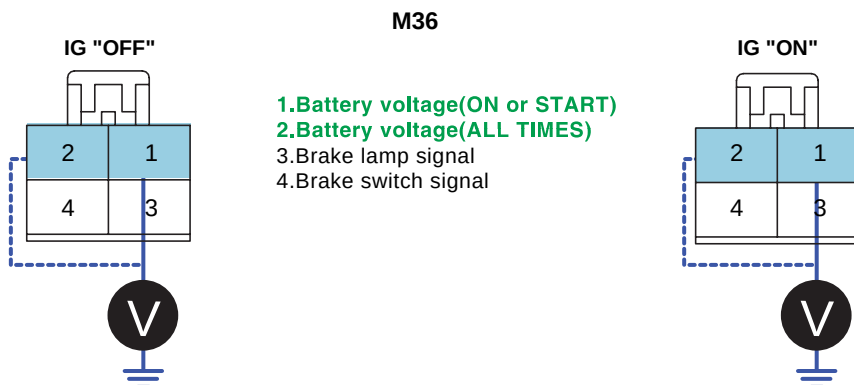
► Repair open in circuit and go to "Verification of Vehicle Repair" procedure.

3. Check Battery voltage

- 1) IG Key "OFF".
- 2) Disconnect the brake switch connector.
- 3) Measure the voltage between brake switch harness connector terminal 1 and chassis ground.
- 4) Measure the voltage between brake switch harness connector terminal 2 and chassis ground.
- 5) IG Key "ON".
- 6) Measure the voltage between brake switch harness connector terminal 1 and chassis ground.
- 7) Measure the voltage between brake switch harness connector terminal 2 and chassis ground.

SPECIFICATION :

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	Battery voltage	Battery voltage
Brake Switch	0V	Battery voltage



SBLF26612L

8) Is the measured voltage within specification ?

YES

► Substitute with a known - good brake switch and check for proper operation. If the problem is corrected, replace brake switch and go to "Verification of Vehicle Repair" procedure.

NO

- Check the fuse between battery and brake switch.
- Repair open or short in power circuit of brake switch and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E4967EE9

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -419

DTC P0506 IDLE AIR CONTROL SYSTEM-RPM LOWER THAN EXPECTED

GENERAL DESCRIPTION E861909B

The idle speed is controlled by the Electrical Throttle Control(ETC) System. ETC system is composed of the throttle motor to operate the throttle valve and the throttle position sensor to detect the opening angle of the throttle valve, the accelerator pedal position sensor to detect the accelerator pedal position and the one valve type throttle body. The ECM controls the throttle motor to provide the proper throttle valve opening angle for the target idle speed.

DTC DESCRIPTION EF137FDF

Checking idle RPM under detecting condition, if if the real idle speed is lower than desired idle speed by 100 RPM over 10 sec., ECM sets P0506. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E641FD8D

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor idle speed	• Intake system for blockage
Enable Conditions	• Normal idle conditions	
Thresh old value	• Real engine speed is lower than target engine speed by 100 RPM	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

MONITOR SCANTOOL DATA EF9FD938

1. Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector, CVVT items, ETC system, A/C system, or power steering system with scantool.
2. Are there the DTCs above-mentioned?

YES

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

NO

► Go to "System Inspection" procedure

SYSTEM INSPECTION E4C98ECA

1. Check intake/exhaust system for blockage
 - 1) Visually/physically inspect the following items:
 - Air cleaner filter element for excessive dirt or for any foreign objects
 - Hoses of intake system for blockage
 - Throttle body inlet for damage or for any foreign objects
 - Throttle plate for carbon deposits
 - 2) Has a problem been found in any of the above areas?

YES

- ▶ Repair it and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

VERIFICATION OF VEHICLE REPAIR E2CD4D23

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -421

DTC P0507 IDLE AIR CONTROL SYSTEM-RPM HIGHER THAN EXPECTED

GENERAL DESCRIPTION E43ACA39

Refer to DTC P0506.

DTC DESCRIPTION E9035A89

Checking idle RPM under detecting condition, if the real idle speed is higher than desired idle speed by 200 RPM over 10 sec., ECM sets P0507. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E38681C8

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor idle speed	• Intake system for air leakage
Enable Conditions	• Normal idle conditions	
Thresh old value	• Real engine speed is higher than target engine speed by 200 RPM	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

MONITOR SCANTOOL DATA E1D96297

Refer to DTC P0506.

SYSTEM INSPECTION EC700BD6

1. Check intake/exhaust system for blockage
 - 1) Visually/physically inspect the following items:
 - Intake system for air leakage
 - Vapor hoses for cracks or disconnection
 - 2) Has a problem been found in any of the above areas?

YES

► Repair it and go to "Verification of Vehicle Repair" procedure

NO

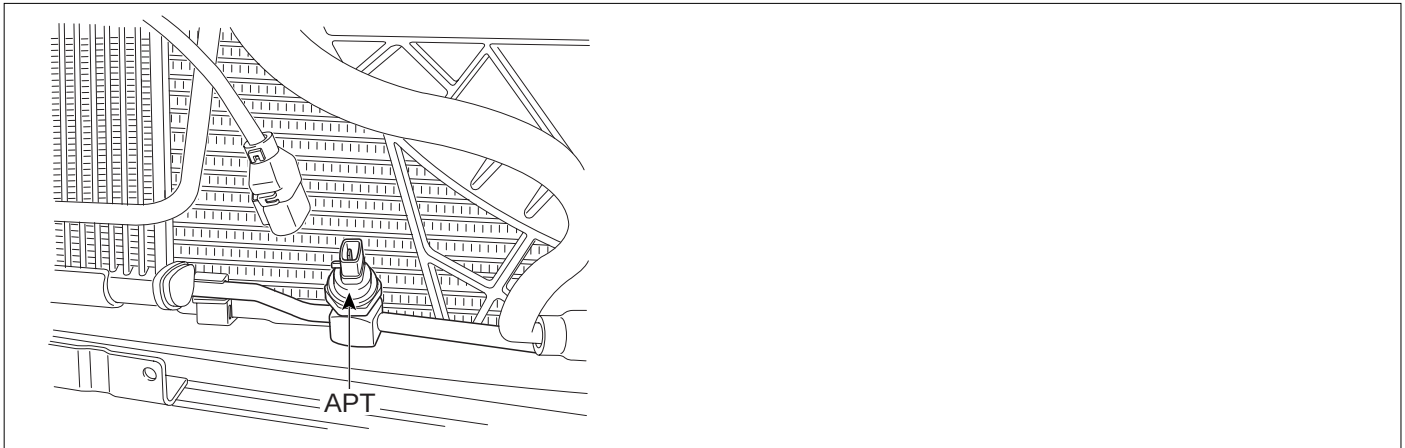
► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

VERIFICATION OF VEHICLE REPAIR ED4F1BF2

Refer to DTC P0506.

DTC P0532 A/C REFRIGERANT PRESSURE SENSOR "A" CIRCUIT LOW INPUT

COMPONENT LOCATION EF3F6BFA



SBLF26720L

GENERAL DESCRIPTION EF4194FC

The ECM(Engine Control Module) receives pressure signal in the A/C refrigerant high pressure side from the A/C refrigerant pressure sensor. This input indicates how much load the A/C compressor is putting on the engine and is one of the factors used by the ECM in order to determine the idle air control position for the idle speed. The circuits consist of a 5V reference and a ground, both provided by the ECM, and a signal from the sensor. The signal is a voltage which is proportional to the A/C pressure from 0 to 5V. Low pressure produces a low voltage signal and high pressure a high-voltage signal.

DTC DESCRIPTION E2515437

Checking output signals from A/C pressure sensor under detecting condition, if an signal below 0.25V lasts for more than 10 sec., ECM sets P0532.

DTC DETECTING CONDITION E905C94E

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects sensor signal short to low voltage	• Poor connection • Open in power circuit • Open or short to ground in signal circuit • Faulty A/C pressure sensor • Faulty ECM
Enable Conditions	• Engine works	
Thresh old value	• Sensor output voltage < 0.25V	
Diagnosis Time	• Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION E6547143

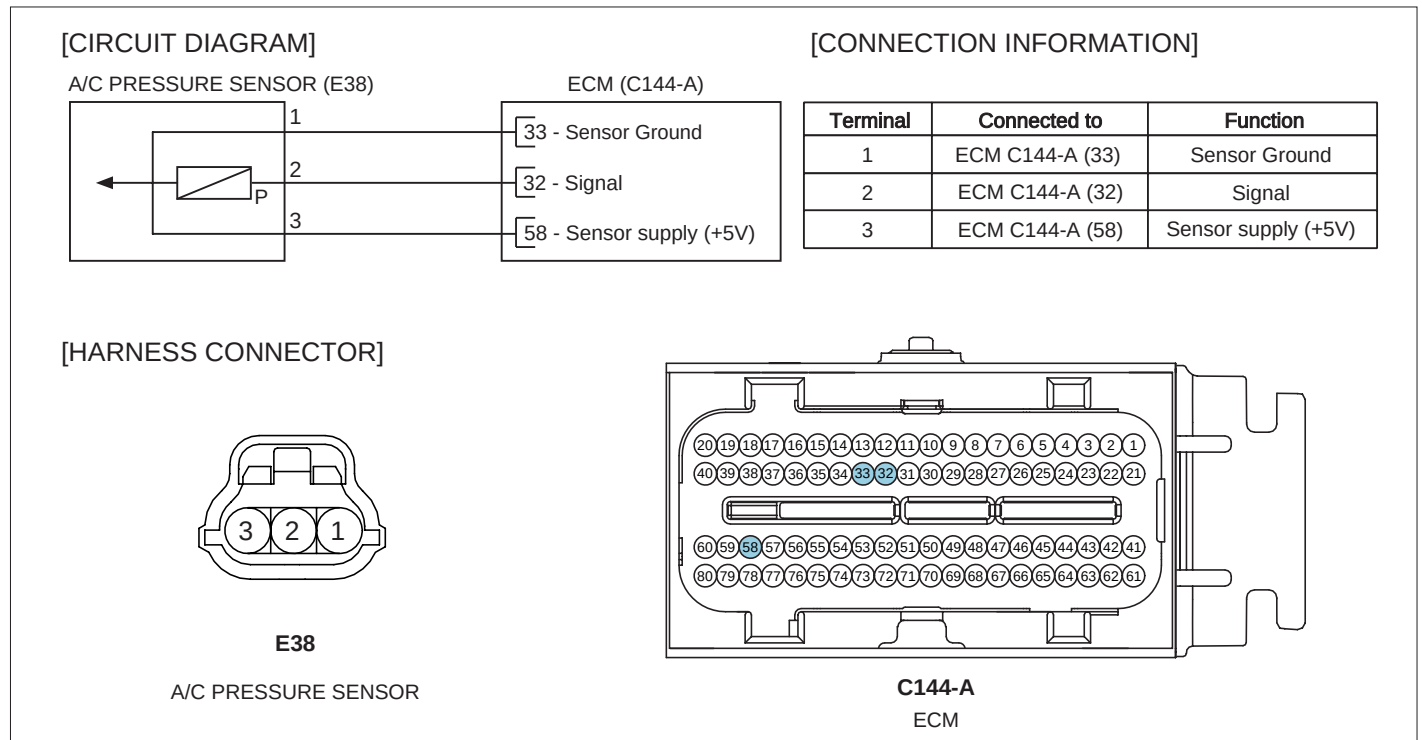
Pressure(psi)	14.7	128.5	242.3	356.1	469.9
Voltage(V)	0.5	1.5	2.5	3.5	4.5

DTC TROUBLESHOOTING PROCEDURES

FLB -423

SCHEMATIC DIAGRAM

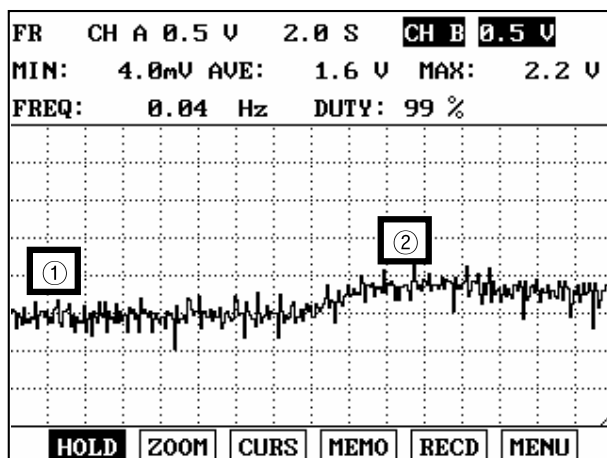
E6A11E99



SBLF26840L

SIGNAL WAVEFORM AND DATA

EACD1437



- ① - A/C OFF & idle state
- ② - A/C ON & idle state

EGRF884A

MONITOR DTC STATUS

E123A68F

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES				
PXXXX DTC TITLE				
NUMBER OF DTC : 1 ITEMS				
PART	ERAS		DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

EAF5B428

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION

E623BF6C

1. Key "OFF".
2. Disconnect the A/C pressure sensor connector.
3. Key "ON".
4. Measure the voltage between terminal 3 of A/C pressure sensor harness connector and chassis ground.

DTC TROUBLESHOOTING PROCEDURES

FLB -425

Specification : approx. 5V

5. Is the measured voltage within specification ?

YES

► Go to "Signal circuit inspection" procedure.

NO

► Repair Open or Short to ground in A/C pressure sensor power circuit and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION

EA810B12

1. Check short to ground inspection

- 1) IG Key "OFF".
- 2) Disconnect A/C pressure sensor and ECM connector.
- 3) Measure the resistance between terminal 2 of A/C pressure sensor harness connector and chassis ground.

Specification : Infinite

4) Is the measured resistance within specification ?

YES

► Go to "Check open in harness" procedure.

NO

► Repair Short to ground in A/C pressure sensor signal circuit and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness

- 1) IG Key "OFF".
- 2) Disconnect A/C pressure sensor and ECM connector.
- 3) Measure the resistance between terminal 2 of A/C pressure sensor harness connector and terminal 58 of ECM harness connector(C144-A).

Specification : Approx. below 1Ω

4) Is the measured resistance within specification ?

YES

► Go to "Component inspection" procedure.

NO

► Repair Open in A/C pressure signal circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

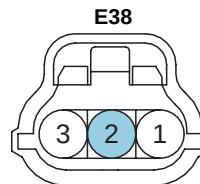
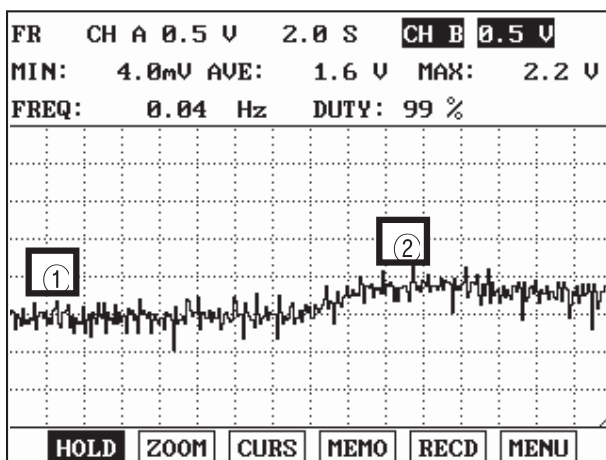
E851C0C0

1. A/C pressure sensor inspection

- 1) IG Key "OFF" and connect the scantool.
- 2) Connect the probe to A/C pressure sensor signal and select the oscilloscope in the menu.
- 3) Check the waveform with acceleration and deceleration after engine start.

SPECIFICATION :

Pressure(psi)	14.7	128.5	242.3	356.1	469.9
Voltage(V)	0.5	1.5	2.5	3.5	4.5



1. A/C pressure sensor ground
2. A/C pressure sensor signal
3. A/C pressure sensor power

- ① - A/C OFF & Idle
- ② - A/C ON & Idle

SBLF26616L

4) Is the measured waveform of A/C pressure sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good A/C pressure sensor and check for proper operation. If the problem is corrected, replace A/C pressure sensor and go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EBACF0A1

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode

DTC TROUBLESHOOTING PROCEDURES

FLB -427

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

FLB -428

FUEL SYSTEM

DTC P0533 A/C REFRIGERANT PRESSURE SENSOR "A" CIRCUIT HIGH INPUT

COMPONENT LOCATION EA7103AC

Refer to DTC P0532.

GENERAL DESCRIPTION EE233A04

Refer to DTC P0532.

DTC DESCRIPTION EF2C877B

Checking output signals from A/C pressure sensor under detecting condition, if an signal above 4.65V lasts for more than 10 sec., ECM sets P0533.

DTC DETECTING CONDITION EB187B33

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects sensor signal short to high voltage	• Poor connection • Short battery in signal circuit • Open in ground circuit • Faulty A/C pressure sensor • Faulty ECM
Enable Conditions	• Engine works	
Thresh old value	• Sensor output voltage > 4.65V	
Diagnosis Time	• Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION E6A3BC6A

Refer to DTC P0532.

SCHEMATIC DIAGRAM E742E015

Refer to DTC P0532.

SIGNAL WAVEFORM AND DATA E2C6F50C

Refer to DTC P0532.

MONITOR DTC STATUS E5E31D54

Refer to DTC P0532.

TERMINAL AND CONNECTOR INSPECTION EAC7EB3B

Refer to DTC P0532.

DTC TROUBLESHOOTING PROCEDURES

FLB -429

POWER CIRCUIT INSPECTION EF7A8AF4

1. IG Key "OFF".
2. Disconnect the A/C pressure sensor connector.
3. IG Key "ON".
4. Measure the voltage between terminal 3 of A/C pressure sensor harness connector and chassis ground.

Specification : approx. 5V

5. Is the measured voltage within specification ?

YES

▶ Go to "Ground circuit inspection" procedure.

NO

▶ Repair Open in power circuit and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E1146150

1. IG Key "OFF".
2. Disconnect the A/C pressure sensor connector.
3. IG Key "ON".
4. Measure the voltage between terminal 3 of A/C pressure sensor harness connector and chassis ground. (Fig A)
5. Measure the voltage between terminal 3 and terminal 1 of A/C pressure sensor harness connector. (Fig B)

Specification : The Difference between "A" and "B" is below 200mV.

6. Is the measured voltage within specification ?

YES

▶ Go to "Signal circuit inspection" procedure.

NO

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION EA621622

1. Voltage inspection
 - 1) IG Key "OFF".
 - 2) Disconnect the A/C pressure sensor connector.
 - 3) IG Key "ON".
 - 4) Measure the voltage between terminal 2 of A/C pressure sensor harness connector and chassis ground.

Specification : Approx. 0V

- 5) Is the measured voltage within specification ?

YES

► Go to "Component inspection" procedure.

NO

► Go to "Check short to battery in harness" procedure.

2. Check short to battery in harness

- 1) IG Key "OFF".
- 2) Disconnect A/C pressure sensor connector and ECM connector.
- 3) Measure the resistance between terminal 2 and terminal 3 of A/C pressure sensor harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification ?

YES

► Go to "Component inspection" procedure.

NO

► Repair Short in signal circuit and go to "Verification of Vehicle Repair" procedure.

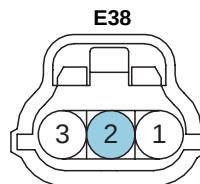
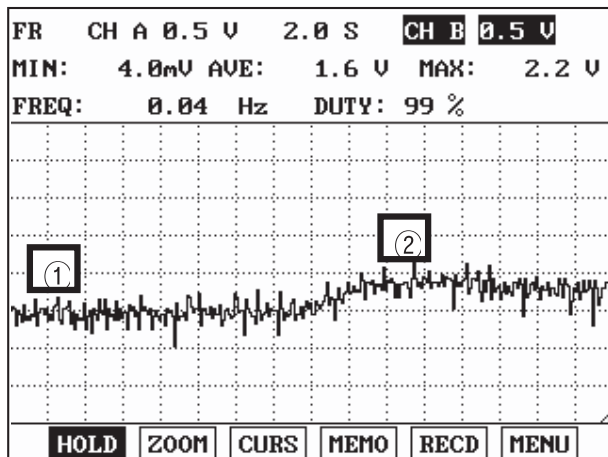
COMPONENT INSPECTION E656E606

1. A/C pressure sensor inspection

- 1) IG Key "OFF" and connect the scantool.
- 2) Connect the probe to A/C pressure sensor signal and select the oscilloscope in the menu.
- 3) Check the waveform with acceleration and deceleration after engine start.

SPECIFICATION :

Pressure(psi)	14.7	128.5	242.3	356.1	469.9
Voltage(V)	0.5	1.5	2.5	3.5	4.5



1. A/C pressure sensor ground
2. A/C pressure sensor signal
3. A/C pressure sensor power

SBLF26616L

4) Is the measured waveform of A/C pressure sensor normal?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good A/C pressure sensor and check for proper operation. If the problem is corrected, replace A/C pressure sensor and go to "Verification of Vehicle Repair" procedure.

 NOTE

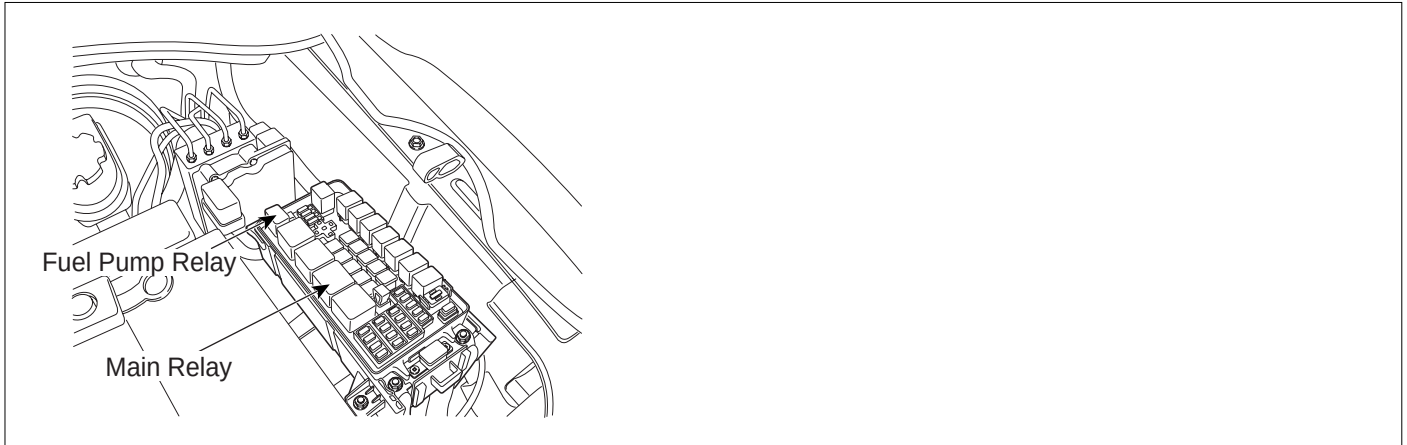
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR E7CE9B0C

Refer to DTC P0532.

DTC P0562 SYSTEM VOLTAGE LOW

COMPONENT LOCATION E45F2B8E



SBLF26719L

GENERAL DESCRIPTION E628A825

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 DESCRIPTION E7E8B5AF

During engine running, if system voltage is below 11V, ECM sets P0562. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E848C644

Item	Detecting Condition	Possible cause
DTC Strategy	Voltage too low	- Poor connection - Open in power circuit - Faulty charging system - Faulty main relay - Faulty ECM
Enable Conditions	- Engine works $11V \leq \text{Battery voltage} \leq 16V$	
Thresh old value	System voltage $< 11V$	
Diagnosis Time	Continuous	
MIL On Condition	2 driving cycles	

SPECIFICATION E48AC3D1

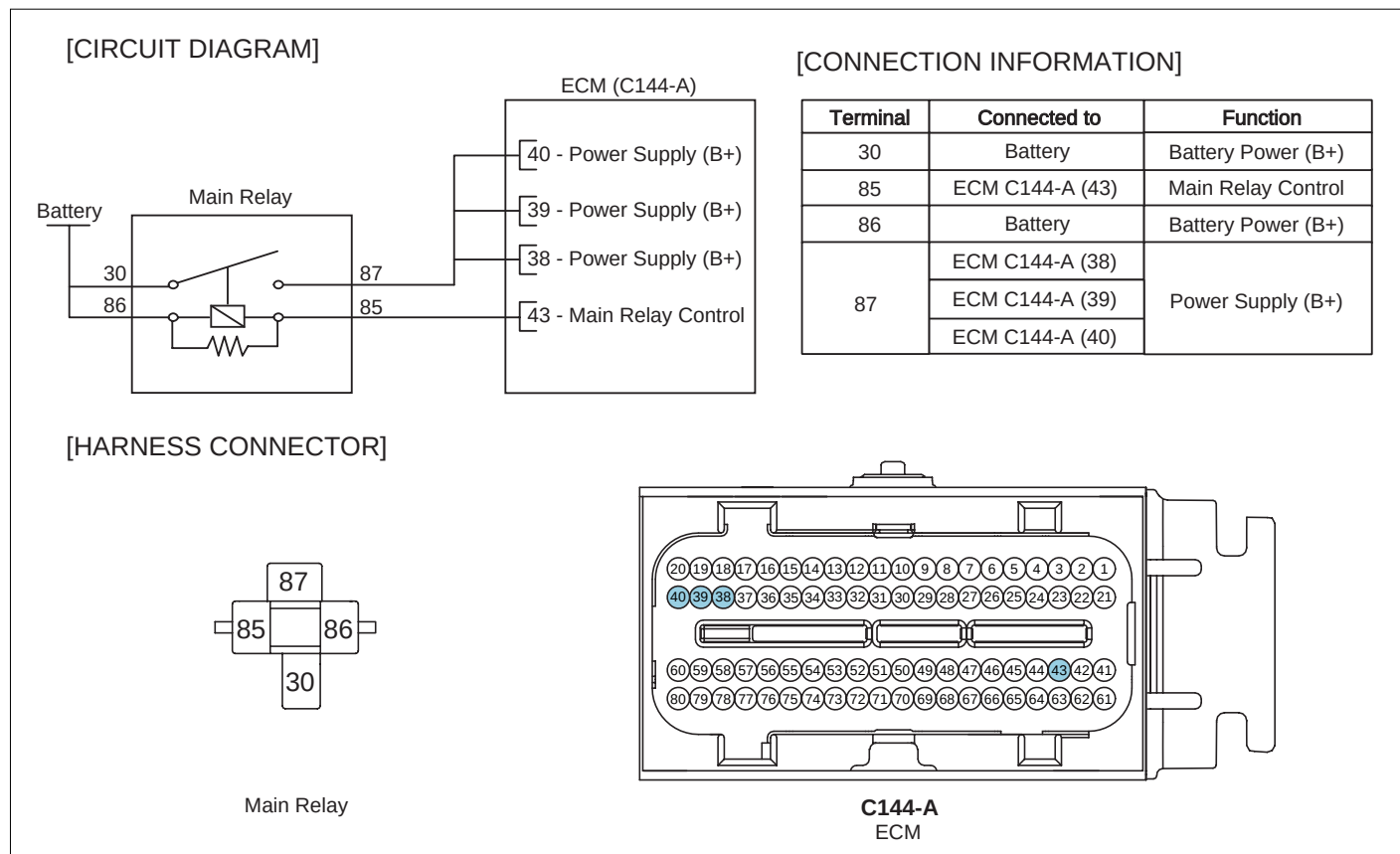
Coil Resistance	$70\Omega \sim 120\Omega$

DTC TROUBLESHOOTING PROCEDURES

FLB -433

SCHEMATIC DIAGRAM

EEE5663F



SBLF26841L

MONITOR DTC STATUS

EBF212AE

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES				
PXXXX DTC TITLE				
NUMBER OF DTC : 1 ITEMS				
PART	ERAS		DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

E1BFE8D8

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION

E9CD4022

1. Check voltage
 - 1) IG "OFF".
 - 2) Disconnect the main relay.
 - 3) IG "ON" and ENG "OFF"

DTC TROUBLESHOOTING PROCEDURES

FLB -435

- 4) Measure the voltage between terminal 30 of main relay harness connector and chassis ground.
- 5) Measure the voltage between terminal 86 of main relay harness connector and chassis ground.

Specification : B+

- 6) Is the measured voltage within specification ?

YES

- Go to "Check open in harness" procedure.

NO

- Check the fuse between battery and main relay.
► Repair Open or Short to ground in power circuit and go to "Verification of Vehicle Repair" procedure

2. Check open in harness

- 1) IG "OFF".
- 2) Disconnect main relay and ECM connector.
- 3) Measure the resistance between terminal 87 of main relay harness connector and terminals 38, 39, 40 of ECM harness connector(C144-A).

Specification : Approx. below 1Ω

- 4) Is the measured resistance within specification ?

YES

- Go to "Check short in harness" procedure.

NO

- Repair open in harness and go to "Verification of Vehicle Repair" procedure .

3. Check short in harness

- 1) IG "OFF".
- 2) Disconnect main relay and ECM connector.
- 3) Measure the resistance between terminal 87 of main relay harness connector and chassis ground.

Specification : Infinite

- 4) Is the measured resistance within specification ?

YES

- Go to "Control circuit inspection" procedure.

NO

- Repair short in harness and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION

EF41AF56

1. Check short in harness

- 1) IG "OFF".
- 2) Disconnect main relay and ECM connector.
- 3) Measure the resistance between terminal 85 of main relay harness connector and chassis ground.

Specification : Infinite

4) Is the measured resistance within specification ?

YES

▶ Go to "Check open in harness" procedure.

NO

5) ▶ Repair short in control harness and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness

- 1) IG "OFF".
- 2) Disconnect main relay and ECM connector.
- 3) Measure the resistance between terminal 85 of main relay harness connector and terminal 43 of ECM harness connector(C144-A).

Specification : Approx. below 1Ω

4) Is the measured resistance within specification ?

YES

▶ Go to "Ground circuit inspection" procedure.

NO

▶ Repair Open in control harness and go to "Verification of Vehicle Repair" procedure.

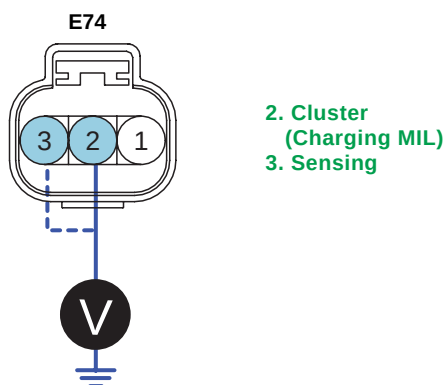
SYSTEM INSPECTION

EA5E1999

1. Check Alternator circuit

- 1) IG "OFF".
- 2) Disconnect alternator connector.
- 3) IG "ON".
- 4) Measure the voltage between terminal 2 of alternator and chassis ground.
- 5) Measure the voltage between terminal 3 of alternator and chassis ground.

Specification : B+



SBLF26626L

6) Is the measured voltage within specification?

YES

► Go to "Component inspection" procedure.

NO

► In case terminal 2 : Repair MIL circuit, MIL resistor or Open in circuit and go to "Verification of Vehicle Repair" procedure.

► In case terminal 3 : Repair the fuse between battery and Ignition switch, the fuse between Ignition switch and alternator or Open in circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

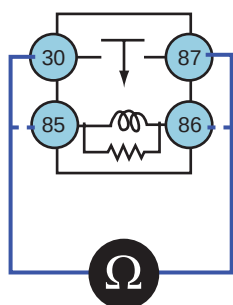
EE8C0541

1. Check Main relay

- 1) IG "OFF".
- 2) Disconnect the main relay.
- 3) Measure the resistance between terminal 30 and 87 of main relay.
- 4) Measure the resistance between terminal 85 and 86 of main relay.

Specification : 70 ~ 120Ω

Terminal	Power approval
30 ~ 87	NO
85 ~ 86	YES (Approx. 70Ω ~ 120Ω)



SCMF16627N

5) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good Main relay and check for proper operation. If the problem is corrected, replace Main relay and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EFC86974

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -439

DTC P0563 SYSTEM VOLTAGE HIGH

COMPONENT LOCATION E4233622

Refer to DTC P0562.

GENERAL DESCRIPTION EE97AE44

Refer to DTC P0562.

DTC DESCRIPTION E84BD128

During engine running, if system voltage is above 16V, ECM sets P0563. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E1C83E00

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage too high	• Poor connection • Short in circuit • Faulty charging system • Faulty main relay • Faulty ECM
Enable Conditions	• Engine works	
Thresh old value	• System voltage > 16V	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E8AE5B36

Refer to DTC P0562.

SCHEMATIC DIAGRAM EC550293

Refer to DTC P0562.

MONITOR DTC STATUS EDE3CA2F

Refer to DTC P0562.

TERMINAL AND CONNECTOR INSPECTION E48CFB6A

Refer to DTC P0562.

POWER CIRCUIT INSPECTION E5121ACE

- Power circuit inspection
 - IG "OFF".
 - Disconnect the main relay connector.
 - IG "ON" and ENG "OFF".
 - Measure the voltage between terminal 30 of main relay harness connector and chassis ground.

FLB -440

FUEL SYSTEM

- 5) Measure the voltage between terminal 86 of main relay harness connector and chassis ground.

Specification : B+

- 6) Is the measured voltage within specification ?

YES

► Go to "Check short in harness" procedure.

NO

► Repair Short in power harness and go to "Verification of Vehicle Repair" procedure.

2. Check short in harness

- 1) IG "ON".
- 2) Measure the voltage between terminal 38, 39, 40 of ECM harness connector(C144-A) and chassis ground.

Specification : B+

- 3) Is the measured voltage within specification ?

YES

► Go to "System inspection" procedure.

NO

► Repair short in power harness and go to "Verification of Vehicle Repair" procedure .

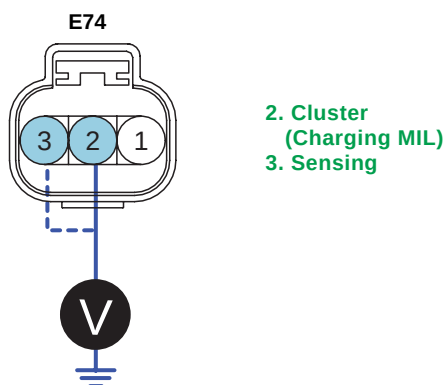
SYSTEM INSPECTION

E974DC52

1. Check Alternator circuit

- 1) IG "OFF".
- 2) Disconnect alternator connector.
- 3) IG "ON" and ENG "OFF"
- 4) Measure the voltage between terminal 2 of alternator and chassis ground.
- 5) Measure the voltage between terminal 3 of alternator and chassis ground.

Specification : B+



SBLF26626L

6) Is the measured voltage within specification?

YES

► Go to "Component inspection" procedure.

NO

► Repair short in Sensing circuit or MIL circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

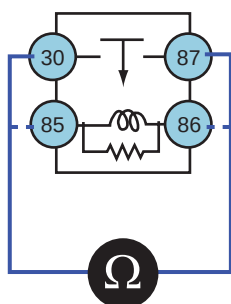
E2DF7B47

1. Check Main relay

- 1) IG "OFF".
- 2) Disconnect the main relay.
- 3) Measure the resistance between terminal 30 and 87 of main relay.
- 4) Measure the resistance between terminal 85 and 86 of main relay.

Specification : 70 ~ 120Ω

Terminal	Power approval
30 ~ 87	NO
85 ~ 86	YES (Approx. 70Ω ~ 120Ω)



SCMF16627N

- 5) Is the measured resistance within specification ?

YES

► Go to "Check Alternator" procedure.

NO

► Substitute with a known - good Main relay and check for proper operation. If the problem is corrected, replace Main relay and go to "Verification of Vehicle Repair" procedure.

2. Check Alternator

- 1) IG "OFF".
- 2) Check the tension of the belt.
- 3) Check Battery terminal and Alternator B+ terminal for looseness, corrosion or damage.
- 4) Engine "ON".
- 5) Operate electric equipments (Head lamp, Hot wire, etc).
- 6) accelerate engine to 2000 RPM and measure the battery voltage.

Specification : Approx. 12.5V ~ 14.5V

- 7) Is the measured voltage within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good Alternator and check for proper operation. If the problem is corrected, replace Alternator and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E073DF81

Refer to DTC P0562.

DTC P0571 BRAKE SWITCH "A" CIRCUIT

GENERAL DESCRIPTION E01B20B5

The Stop lamp switch is used to judge whether the acceleration system is abnormal or not. The stop lamp switch has a duplex system(signals brake test or brake light) to memorize the abnormality when the signals of depressing and releasing the brake pedal are detected simultaneously.

DTC DESCRIPTION EC1E3B28

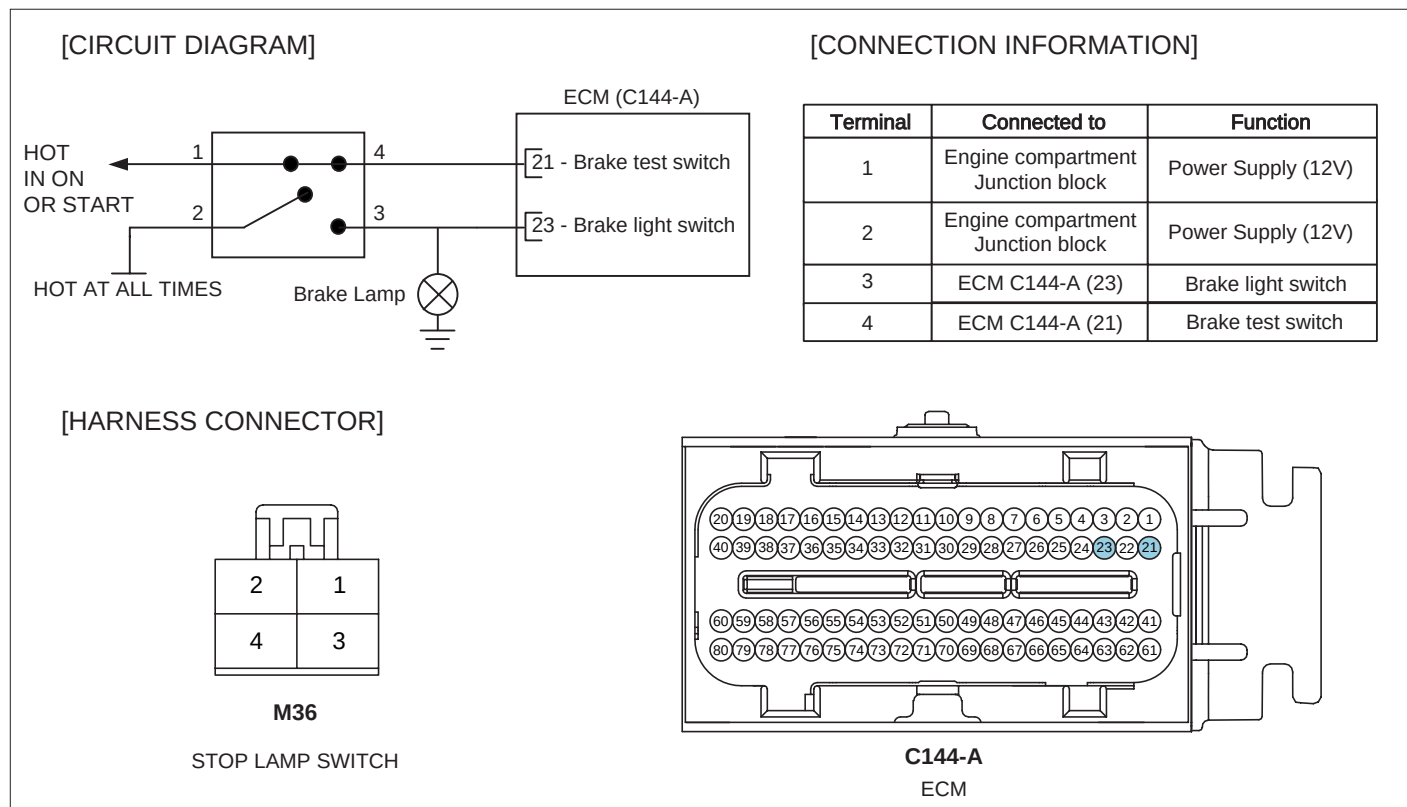
Checking input signals from brake lamp switch under detecting condition, if the operation state of brake lamp switch does not change for more than 3 sec., ECM sets P0571. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EE4B1AFE

Item	Detecting Condition	Possible cause
DTC Strategy	ECM detects brake lamp input signal when vehicle stops.	- Poor connection - Open or short to ground in signal circuit - Faulty ECM
Enable onditions	- Engine works - Vehicle speed signal is normal. - Vehicle speed > 20kph (during 1sec or more)	
Threshold value	- Vehicle speed < 3kph - Vehicle acceleration < -6kph/s - Brake lamp "OFF" and not changing of brake lamp signal for more 3 sec.	
Diagnosis Time	Continuous	
MIL On Condition	2 driving cycles	

SCHEMATIC DIAGRAM

E8EA64D3



SBLF26839L

MONITOR DTC STATUS

EF5A6090

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

DTC TROUBLESHOOTING PROCEDURES

FLB -445

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E726BFEA

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION E9B595E9

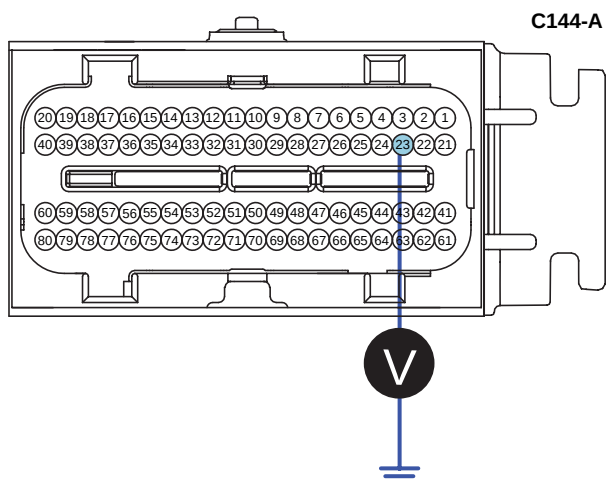
1. Check voltage
 - 1) IG "OFF".
 - 2) Disconnect the ECM connector.
 - 3) IG "ON" and ENG "OFF"
 - 4) During taking off the brake : Measure the voltage between terminal 23 of ECM harness connector(C144-A) and chassis ground.
 - 5) During stepping on the brake : Measure the voltage between terminal 23 of ECM harness connector(C144-A) and chassis ground

SPECIFICATION :

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	0V	Battery voltage
Brake Switch	Battery voltage	0V

21. Brake switch

23. Brake lamp switch



SBLF26638L

6) Is the measured voltage within specification ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

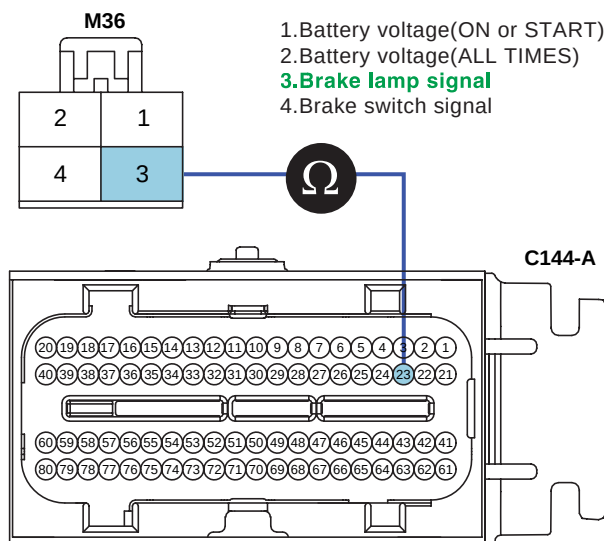
NO

► Go to "Check open in harness" as follows.

2. Check open in harness

- 1) IG "OFF".
- 2) Disconnect the brake switch and ECM connector.
- 3) Measure the resistance between terminal 23 of ECM harness connector(C144-A) and terminal 3 of Brake switch harness connector.

Specification : Approx. below 1Ω



SBLF26639L

4) Is the measured resistance within specification ?

YES

► Go to "Check Battery voltage" as follows.

NO

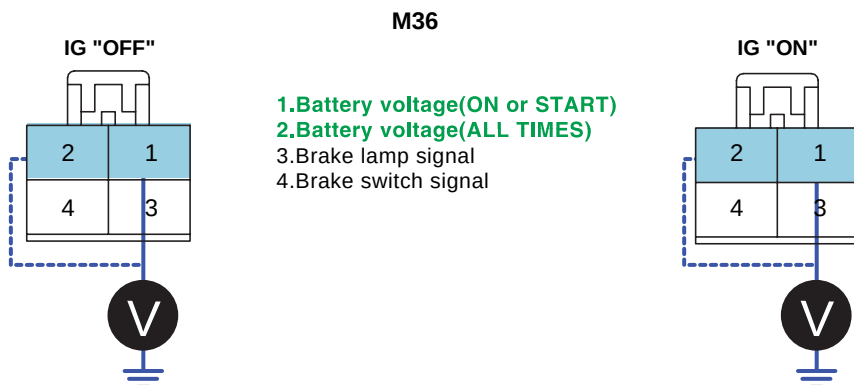
► Repair open in circuit and go to "Verification of Vehicle Repair" procedure.

3. Check Battery voltage

- 1) IG Key "OFF".
- 2) Disconnect the brake switch connector.
- 3) Measure the voltage between brake switch harness connector terminal 1 and chassis ground.
- 4) Measure the voltage between brake switch harness connector terminal 2 and chassis ground.
- 5) IG Key "ON".
- 6) Measure the voltage between brake switch harness connector terminal 1 and chassis ground.
- 7) Measure the voltage between brake switch harness connector terminal 2 and chassis ground.

SPECIFICATION :

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	Battery voltage	Battery voltage
Brake Switch	0V	Battery voltage



SBLF26612L

8) Is the measured voltage within specification ?

YES

► Substitute with a known - good brake switch and check for proper operation. If the problem is corrected, replace brake switch and go to "Verification of Vehicle Repair" procedure..

NO

- Check the fuse between battery and brake switch.
- Repair open or short in power circuit of brake switch and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E18F16FB

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

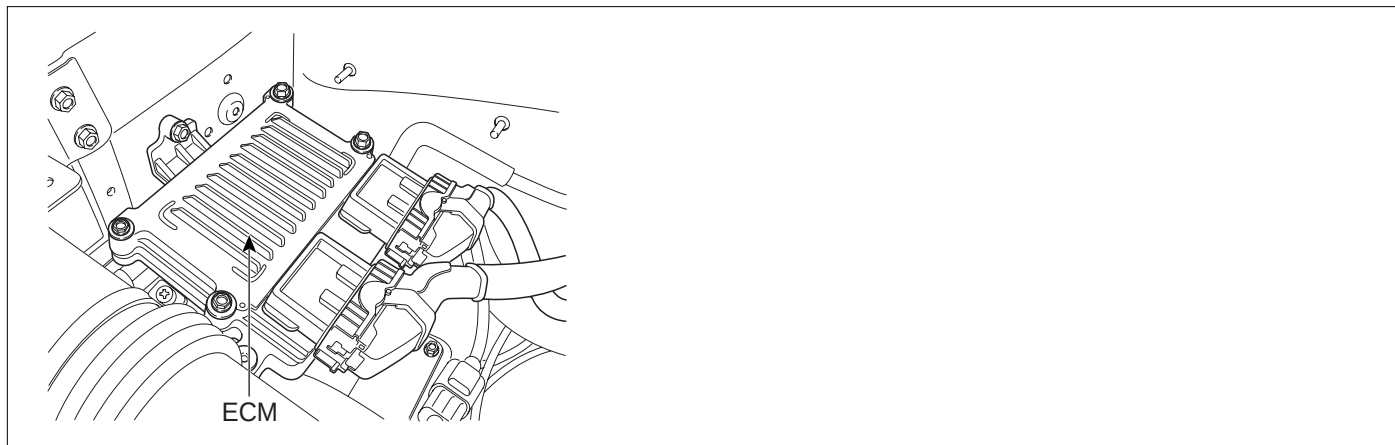
► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -449

DTC P0601 EEPROM-CHECK SUM ERROR

COMPONENT LOCATION E0485386



SBLF26701L

GENERAL DESCRIPTION EBAA6957

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 DESCRIPTION E334F41A

If real checksum does not accord with memory checksum, ECM sets P0601 and MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E9067C34

Item	Detecting Condition	Possible cause
DTC Strategy	• Checksum check	• Faulty ECM
Enable conditions	• -	
Threshold value	• Discordance between the real checksum and the memorized checksum	
Diagnosis Time	• -	
MIL On Condition	• 1 driving cycle	

MONITOR DTC STATUS EB2BCFDA

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES				
PXXXX DTC TITLE				
NUMBER OF DTC : 1 ITEMS				
PART	ERAS		DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E975C0BC

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Substitute with a known-good ECM and check for proper operation. If the problem is corrected,replace ECM and then go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR E9C553E9

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

DTC TROUBLESHOOTING PROCEDURES

FLB -451

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

FLB -452

FUEL SYSTEM

DTC P0602 EEPROM-PROGRAMING ERROR

COMPONENT LOCATION E9AAB773

Refer to DTC P0601.

GENERAL DESCRIPTION E6C202B4

Refer to DTC P0601.

DTC DESCRIPTION E93502DF

If CPU software version dose not accord with main CPU, ECM sets P0602.

DTC DETECTING CONDITION ECB61A3B

Item	Detecting Condition	Possible cause
DTC Strategy	• Check internal CPU	• Faulty ECM
Enable onditions	• -	
Threshold value	• The version discordance among PCU S/W or Calibration	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycle	

MONITOR DTC STATUS E8EC3B74

Refer to DTC P0601.

TERMINAL AND CONNECTOR INSPECTION E810B387

Refer to DTC P0601.

VERIFICATION OF VEHICLE REPAIR EB3FDADD

Refer to DTC P0601.

DTC TROUBLESHOOTING PROCEDURES

FLB -453

DTC P0604 INTERNAL CONTROL MODULE RANDOM ACCESS MEMORY (RAM) ERROR

COMPONENT LOCATION E3FEAD84

Refer to DTC P0601.

GENERAL DESCRIPTION E2F0945A

Refer to DTC P0601.

DTC DESCRIPTION E1BF715D

If the RAM in ECM has errors, ECM sets P0604 and MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EBABBC41

Item	Detecting Condition	Possible cause
DTC Strategy	• Check internal CPU	• Faulty ECM
Enable onditions	• -	
Threshold value	• RAM has errors.	
Diagnosis Time	• -	
MIL On Condition	• 1 driving cycle	

MONITOR DTC STATUS ED544F5C

Refer to DTC P0601.

TERMINAL AND CONNECTOR INSPECTION E1004D8F

Refer to DTC P0601.

VERIFICATION OF VEHICLE REPAIR E3A03493

Refer to DTC P0601.

FLB -454

FUEL SYSTEM

DTC P0606 ECM/PCM PROCESSOR(ECM-SELF TEST FAILED)

COMPONENT LOCATION E4C20E33

Refer to DTC P0601.

GENERAL DESCRIPTION E83851FE

Refer to DTC P0601.

DTC DESCRIPTION E65B231A

Checking ECM under detecting condition, if internal error is detected, ECM sets P0606. And MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EC0F80AE

Item	Detecting Condition	Possible cause
DTC Strategy	• Check ECM internal error	• Faulty ECM
Enable onditions	• 7V < Battery voltage < 20V	
Threshold value	• ECM internal error (A/D unit error)	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycle	

MONITOR DTC STATUS E9600A6C

Refer to DTC P0601.

TERMINAL AND CONNECTOR INSPECTION E630CF07

Refer to DTC P0601.

VERIFICATION OF VEHICLE REPAIR E8ACC51C

Refer to DTC P0601.

DTC TROUBLESHOOTING PROCEDURES

FLB -455

DTC P061B INTERNAL CONTROL MODULE TORQUE CALCULATION PERFORMANCE

COMPONENT LOCATION E2D06C74

Refer to DTC P0601.

GENERAL DESCRIPTION E4655667

Refer to DTC P0601.

DTC DESCRIPTION E77BE70A

If desired torque is calculated much higher than actual torque, ECM senses it and decreases desired torque. Also, ECM sets P061B. The causes of this error are abnormal operation of ECM (RAM,ROM, ALU errors) and hardware malfunction such that actual air flow enters the engine is more than the flow recognized by ECM.

DTC DETECTING CONDITION EC7D1AA0

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor Desired torque and actual torque	• Poor Connection • Faulty ECM
Enable onditions	• Engine works	
Threshold value	• Desired torque is much higher than actual torque.	
Diagnosis Time	• Continuous	
MIL On Condition	• DTC only(NO MIL ON)	

MONITOR DTC STATUS EAD76BBD

Refer to DTC P0601.

TERMINAL AND CONNECTOR INSPECTION E8AF237E

Refer to DTC P0601.

VERIFICATION OF VEHICLE REPAIR E3800021

Refer to DTC P0601.

DTC P0638 THROTTLE ACTUATOR CONTROL RANGE/PERFORMANCE

COMPONENT LOCATION E3C93D17



SBLF26703L

GENERAL DESCRIPTION EB3C450E

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1 & 2 and Accelerator Position Sensor(APS) 1 & 2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E0D2106C

Checking output signals from TPS under detecting condition, if the difference between real and target throttle position is above the specified value, ECM sets P0638 and then MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E0E35BE0

Item		Detecting Condition	Possible cause
DTC Strategy		Monitor the throttle position	- Throttle stuck - Open in motor circuit - Faulty motor - Faulty ECM
Enable Conditions		- Engine works - Battery voltage > 5V	
Thresh old value	Case1	The difference between the real ETS motor & TPS value and the target ETS motor & TPS value is over 4.5°.	
	Case2	When real Throttle position is below 36°, (the real throttle position - the target throttle position) < - 4.5°	
	Case3	(the real throttle position - the target throttle position) < - 18°	
Diagnosis Time		Continuous	
MIL On Condition		1 driving cycle	

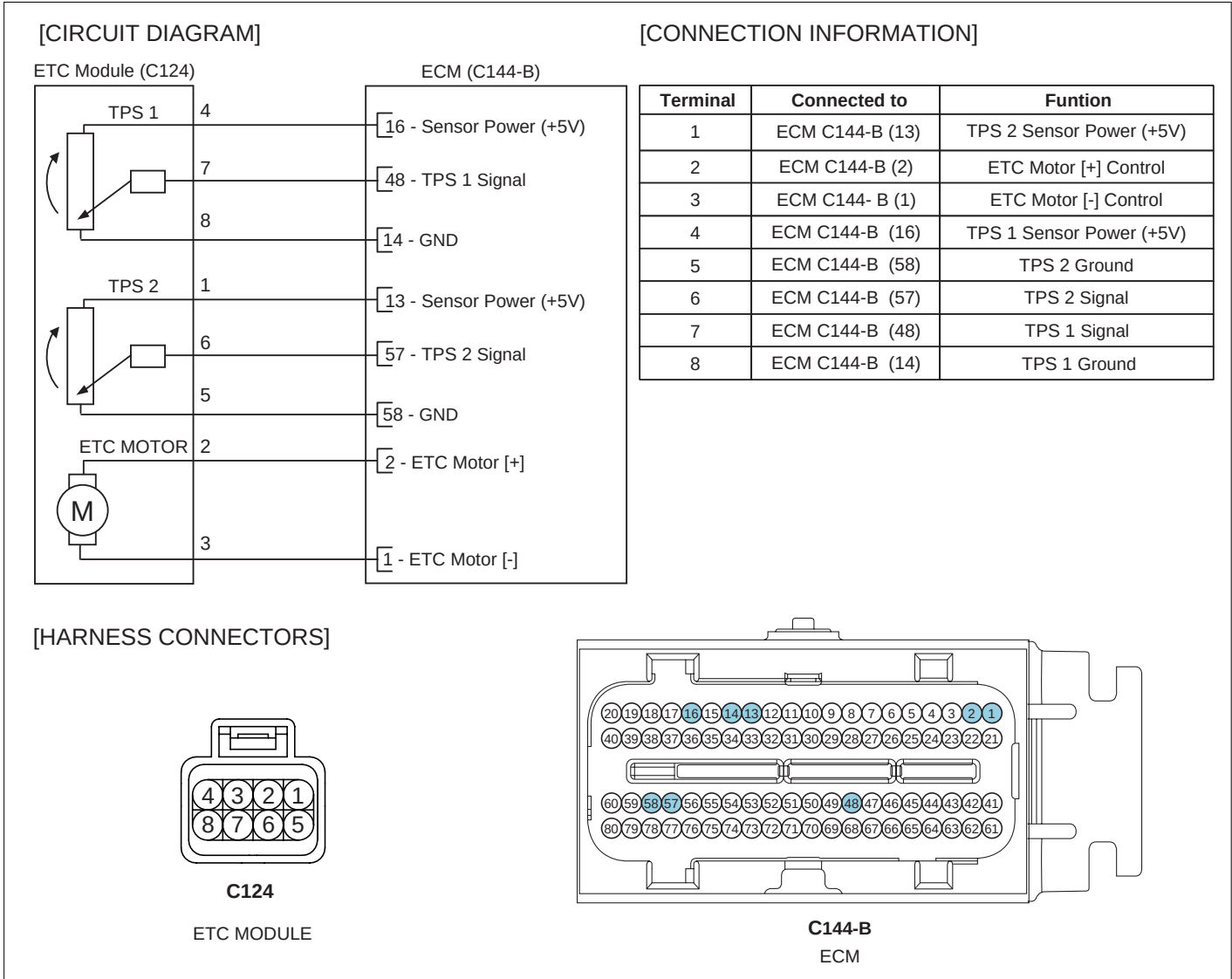
DTC TROUBLESHOOTING PROCEDURES

FLB -457

SPECIFICATION E7E24008

Throttle opening (°)	Output voltage (V) [Vref = 5.0V]	
	TPS1	TPS2
0°	0.0V	5.0V
10°	0.5V	4.5V
20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V

SCHEMATIC DIAGRAM E1540C75



SIGNAL WAVEFORM AND DATA E0429A46

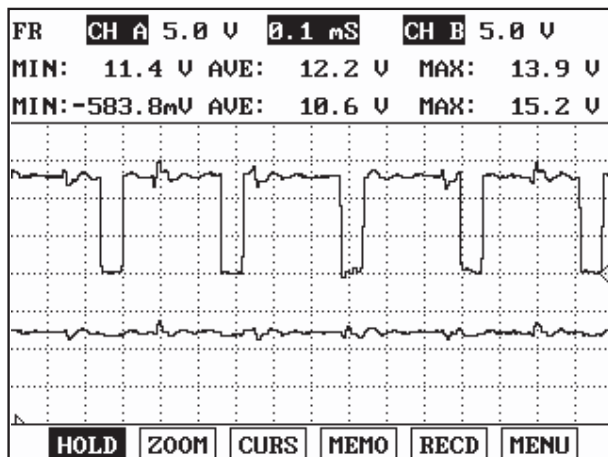


Fig. 1

Fig1) Signal waveform(+/-) instantly with accelerating

EGRF921A

MONITOR DTC STATUS E57D836D

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E152150D

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Control Circuit Inspection " procedure.

CONTROL CIRCUIT INSPECTION E88ADE88

1. Check voltage
 - 1) IG "OFF".
 - 2) Disconnect ETS motor & TPS connector.
 - 3) IG "ON" and ENG "OFF"
 - 4) Measure the voltage between terminal 2,3 of ETS motor & TPS harness connector and chassis ground.

Specification : Approx. 12V

- 5) Is the measured voltage within specification?

YES

► Go to "Component inspection" procedure.

NO

► Go to "Check open in harness" as follows.

2. Check open in harness
 - 1) IG "OFF"
 - 2) Disconnect ETS motor & TPS connector and ECM connector.
 - 3) Measure the resistance between terminal 2 of ETS motor & TPS harness connector and terminal 2 of ECM harness connector(C144-B).
 - 4) Measure the resistance between terminal 3 of ETS motor & TPS harness connector and terminal 1 of ECM harness connector(C144-B).

DTC TROUBLESHOOTING PROCEDURES

FLB -461

Specification : Approx. below 1Ω

- 5) Is the measured resistance within specification ?

YES

► Go to "Component inspection" procedure.

NO

► Repair Open in motor harness and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

E3E848E4

1. Check throttle valve for stuck

- 1) IG "OFF".
- 2) Disconnect the air hose between throttle body and air mass flow sensor.
- 3) Check throttle valve for stuck.
- 4) Is the throttle valve normal?

YES

► Go to "Check ETS motor resistance" as follows.

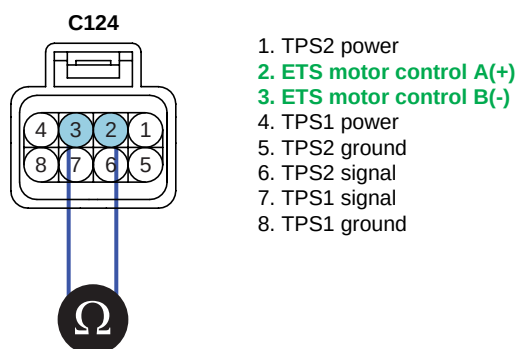
NO

► Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

2. Check ETS motor resistance

- 1) IG "OFF".
- 2) Disconnect ETS motor & TPS connector.
- 3) Measure the resistance between terminal 2 and 3 of ETS motor & TPS connector(component side).

Specification : Approx. $1.275 \sim 1.725\Omega$ @ 23°C (73.4°F)



SBLF26643L

- 4) Is the measured resistance within specification?

YES

► Go to "ETC motor actuation test" procedure.

NO

► Substitute with a known - good ETC motor and check for proper operation. If the problem is corrected, replace ETC motor and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

3. ETC motor actuation test

- 1) IG "OFF".
- 2) Connect ETS motor & TPS connector.
- 3) After IG "ON", execute the "ETC motor actuation test" by Scantool.

1.11 ACTUATION TEST 03/22	
ETC MOTOR	
DURATION	UNTIL STOP KEY
METHOD	ACTIVATION
CONDITION	IG.KEY ON ENGINE OFF
PRESS [STRT], IF YOU ARE READY ! SELECT TEST ITEM USING UP/DOWN KEY	
STRT	STOP

EGRF926A

- 4) Does the "ETC motor actuation test" execute normally?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ETC motor and check for proper operation. If the problem is corrected, replace ETC motor and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E01653F4

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

DTC TROUBLESHOOTING PROCEDURES

FLB -463

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P0641 SENSOR REFERENCE VOLTAGE "A" CIRCUIT OPEN

GENERAL DESCRIPTION EC8ADB12

The ECM provides a 5volt reference voltage to Throttle Position Sensor 1(TPS1). The ECM monitors reference voltage deviation from the power supply circuit of the sensors

DTC DESCRIPTION EB8AE889

Checking the voltage from sensor power supply every 1.87 sec. under detecting condition, if the value within detecting condition lasts for more than 0.2 sec., ECM sets P0641. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E99C0FBB

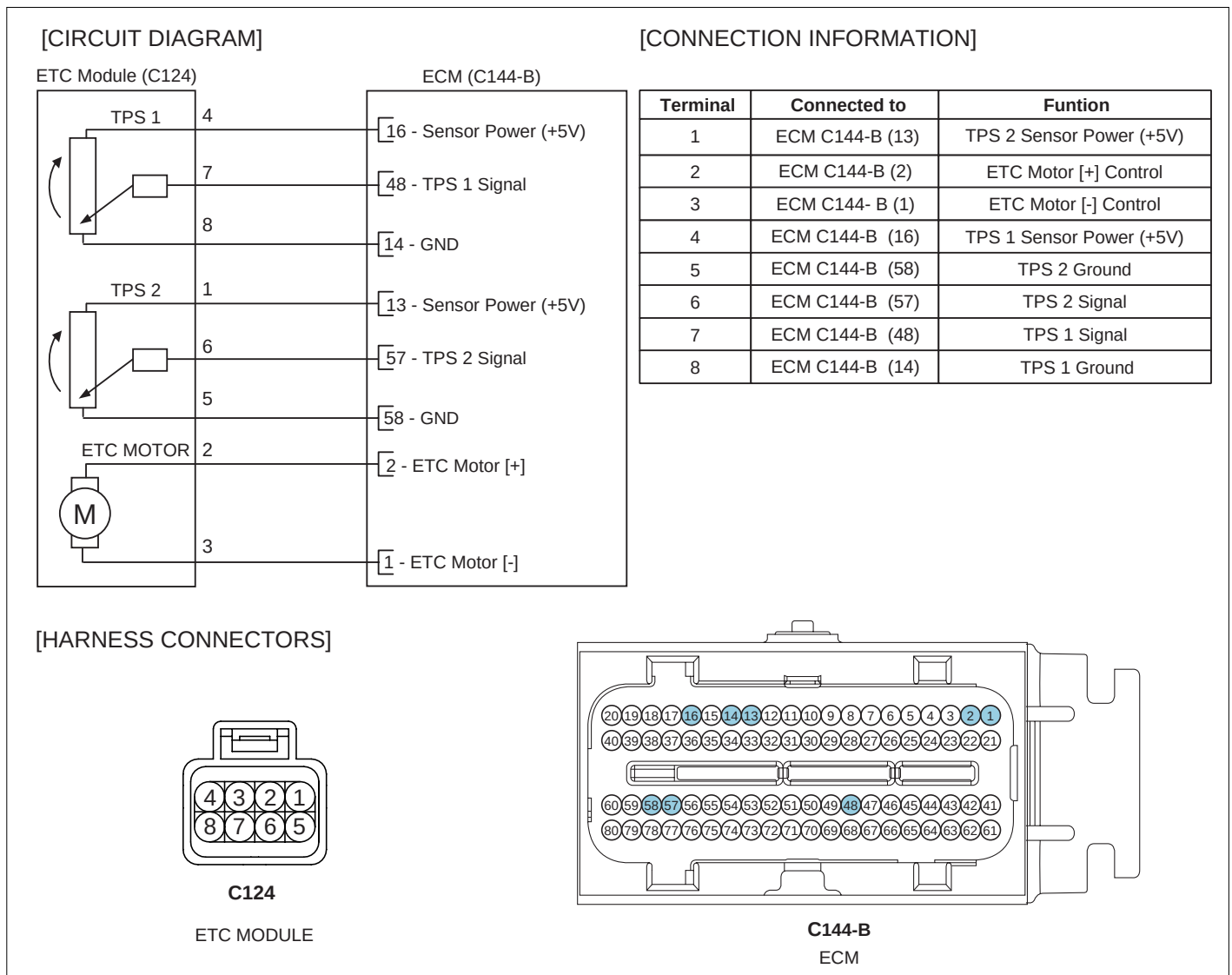
Item	Detecting Condition	Possible cause
DTC Strategy	• Sensor reference voltage check	• Short in sensor power supply line • Faulty ECM
Enable Conditions	• IG "ON"	
Threshold value	• Sensor supply power < 4.5V or > 5.5V	
Diagnosis Time	• Continuous (More than 0.2 seconds failure for every 1.87 seconds test)	
MIL On Condition	• 2 driving cycle	

DTC TROUBLESHOOTING PROCEDURES

FLB -465

SCHEMATIC DIAGRAM

E3808C1F



SBLF26201L

MONITOR DTC STATUS

EB6E558B

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES				
PXXXX DTC TITLE				
NUMBER OF DTC : 1 ITEMS				
PART	ERAS		DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

E7881594

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION

E6F48ADA

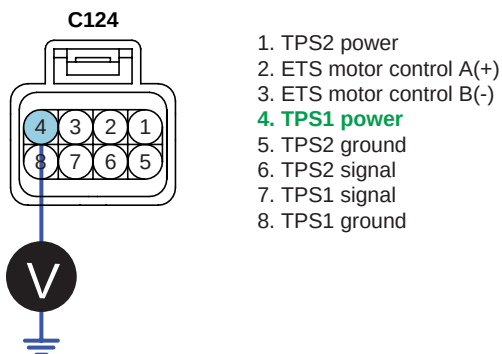
1. Check voltage
 - 1) IG "OFF".
 - 2) Disconnect TPS connector.
 - 3) IG "ON" and ENG "OFF"

DTC TROUBLESHOOTING PROCEDURES

FLB -467

- 4) Measure the voltage between terminal 4 of TPS harness connector and chassis ground.

Specification : Approx. 5V



SBLF26644L

- 5) Is the measured voltage within specification ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

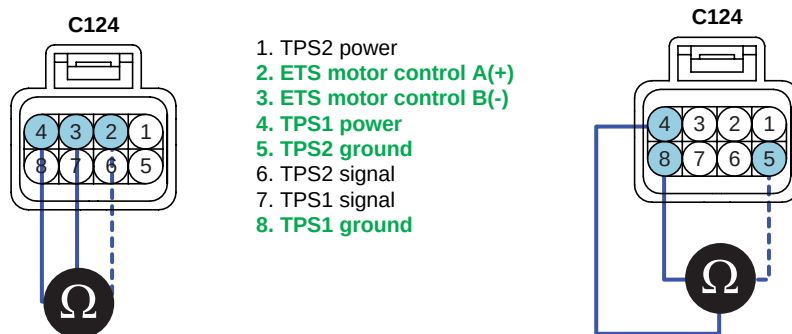
NO

► Go to "Check short in power harness" as follows.

2. Check short in power harness

- 1) IG "OFF".
- 2) Disconnect TPS connector and ECM connector.
- 3) Measure the resistance between terminal 4 and 2 of TPS harness connector.
- 4) Measure the resistance between terminal 4 and 3 of TPS harness connector.
- 5) Measure the resistance between terminal 4 and 5 of TPS harness connector.
- 6) Measure the resistance between terminal 4 and 8 of TPS harness connector.

Specification : Infinite



SBLF26645L

- 7) Is the measured resistance within specification ?

YES

- ▶ Substitute with a known - good ECM and check for proper operation.
- ▶ If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Repair Short in power circuit and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR ED10DBB4

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P0646 A/C CLUTCH RELAY CONTROL CIRCUIT LOW

GENERAL DESCRIPTION EEB50091

The A/C clutch relay is activated if the A/C switch is operated while the blower is running and system operation is enabled by the ECM. When A/C is requested, the Engine Control Module(ECM) provides a ground path to the A/C clutch relay control circuit. When the relay circuit is grounded, the A/C clutch relay is energized. The ECM delays grounding the relay circuit for a short time, so the ECM can adjust the engine idle speed for the additional load. The ECM will temporarily de-energized the A/C clutch relay for one or more of the following conditions:

- Full acceleration when the throttle is at WOT.(Wide Open Throttle)
- Risk of overheating: Engine coolant temp. exceeds threshold value
- A/C system pressure exceeds threshold value
- Engine starting

DTC DESCRIPTION EACF773C

ECM monitors inputted voltage through A/C compressor relay. Checking voltage every 10 sec. under detecting condition, if the voltage lower than the specified value is detected for more than 5 sec., ECM sets P0646.

DTC DETECTING CONDITION E87112CE

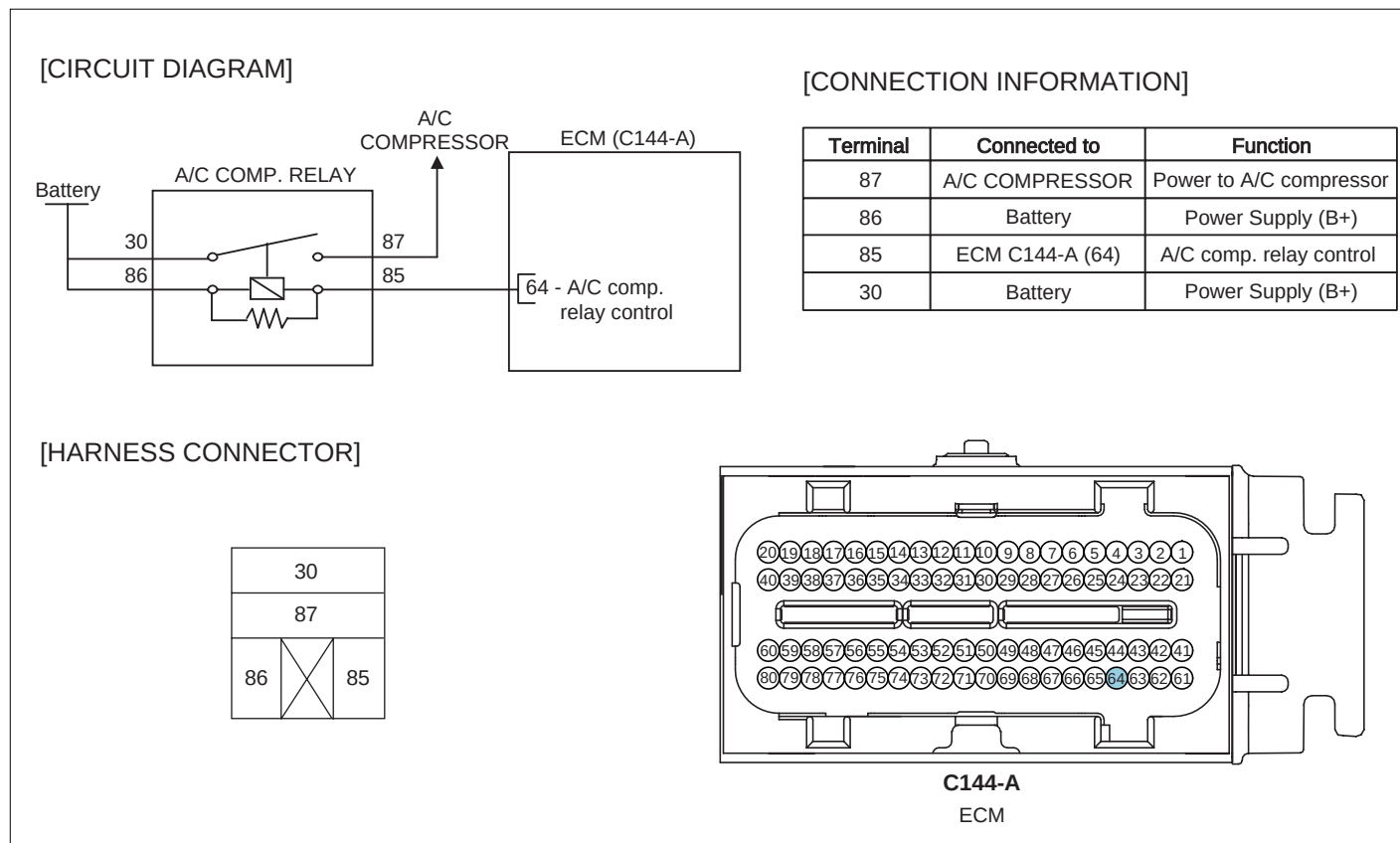
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects circuit short to low voltage	• Poor connection • Open or short to ground in A/C relay circuit • Faulty A/C relay • Faulty ECM
Enable Conditions	• After 0.5 sec under conditions below • No DTC exists • Engine works • $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	• Open or short to ground	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION E31AFCA1

Coil Resistance
$70\Omega \sim 120\Omega$

SCHEMATIC DIAGRAM

E318DCF5



SBLF26842L

MONITOR DTC STATUS

E3DB3856

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION

1. Check voltage
 - 1) IG "OFF".
 - 2) Disconnect A/C relay.
 - 3) IG "ON" and ENG "OFF"

FLB -472

FUEL SYSTEM

- 4) Measure the voltage between terminal 30 of A/C relay harness connector and chassis ground.
- 5) Measure the voltage between terminal 86 of A/C relay harness connector and chassis ground.

Specification : B+

- 6) Is the measured voltage normal?

YES

- Go to "Control circuit inspection" procedure.

NO

- Check the fuse between Battery and A/C relay.
► Check Chassis ground for looseness.
► Repair Open or Short to ground in power circuit and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION

E987A2DE

1. Check short in harness

- 1) IG "OFF".
- 2) Disconnect A/C relay and ECM connector.
- 3) Measure the resistance between terminal 85 of A/C relay harness connector and chassis ground.

Specification : Infinite

- 4) Is the measured resistance within specification ?

YES

- Go to "Check open in harness" as follows.

NO

- Repair Short in Coil control harness and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness

- 1) IG "OFF".
- 2) Disconnect A/C relay and ECM connector.
- 3) Measure the resistance between terminal 85 of A/C relay harness connector and terminal 64 of ECM harness connector(C144-A).

Specification : Approx. below 1Ω

- 4) Is the measured resistance within specification ?

YES

- Go to "Component inspection" procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -473

NO

► Repair Open in Coil control harness and go to "Verification of Vehicle Repair" procedure.

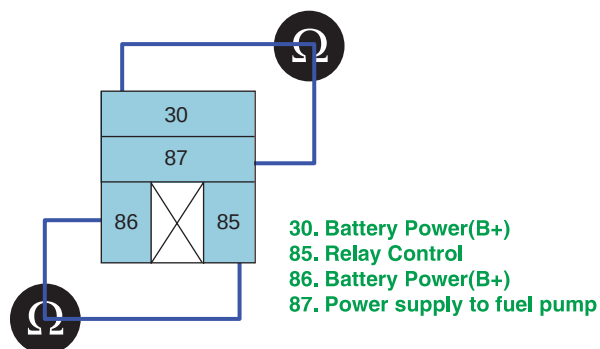
COMPONENT INSPECTION

E9F604A2

1. Check A/C relay

- 1) IG "OFF".
- 2) Disconnect A/C relay.
- 3) Measure the resistance between terminal 30 and 87 of A/C relay.
- 4) Measure the resistance between terminal 85 and 86 of A/C relay.

Terminal	Power approval
30~87	NO
85~86	YES (ABOUT 70 ~ 120Ω)



SBLF26649L

5) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good A/C relay and check for proper operation. If the problem is corrected, replace A/C relay and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E3A4230A

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -475

DTC P0647 A/C CLUTCH RELAY CONTROL CIRCUIT HIGH

GENERAL DESCRIPTION E2B2424B

Refer to DTC P0646.

DTC DESCRIPTION EC2284CA

ECM monitors inputted voltage through A/C compressor relay. Checking voltage every 10 sec. under detecting condition, if the voltage higher than the specified value is detected for more than 5 sec., ECM sets P0647.

DTC DETECTING CONDITION E772F70F

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects circuit short to high voltage	• Poor connection • Short to power in A/C relay circuit • Faulty A/C relay • Faulty ECM
Enable Conditions	• After 0.5 sec under conditions below • No DTC exists • Engine works • $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	• Short to power	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION E8D27255

Refer to DTC P0646.

SCHEMATIC DIAGRAM E83E55A0

Refer to DTC P0646.

MONITOR DTC STATUS E1D0BD2E

Refer to DTC P0646.

TERMINAL AND CONNECTOR INSPECTION EB441D13

Refer to DTC P0646.

POWER CIRCUIT INSPECTION E1BC43AA

1. Check voltage
 - 1) IG "OFF".
 - 2) Disconnect A/C relay.
 - 3) IG "ON" and ENG "OFF".
 - 4) Measure the voltage between terminal 30 of A/C relay harness connector and chassis ground.

FLB -476

FUEL SYSTEM

- 5) Measure the voltage between terminal 86 of A/C relay harness connector and chassis ground.

Specification : B+

- 6) Is the measured voltage normal?

YES

- Go to "Control circuit inspection" procedure.

NO

- Check the fuse between Battery and A/C relay.
► Check Chassis ground for looseness.
► Repair open or short to ground in power harness and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E0FF20EA

1. Check short in harness

- 1) IG "ON".
2) Disconnect A/C relay.
3) Measure the voltage between terminal 85 of A/C relay harness connector and chassis ground.

Specification : Approx. 0V

- 4) Is the measured voltage within specification ?

YES

- Go to "Component inspection" procedure.

NO

- Repair Short in Coil control harness and go to "Verification of Vehicle Repair" procedure.

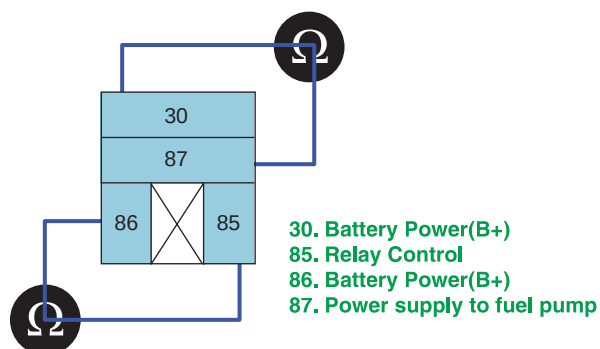
COMPONENT INSPECTION EC99D7BB

1. Check A/C relay

- 1) IG "OFF".
2) Disconnect A/C relay.
3) Measure the resistance between terminal 30 and 87 of A/C relay.
4) Measure the resistance between terminal 85 and 86 of A/C relay.

SPECIFICATION

Terminal	Power approval
30~87	NO
85~86	YES (About 70 ~ 120Ω)



SBLF26649L

5) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good A/C relay and check for proper operation. If the problem is corrected, replace A/C relay and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EA0F0D21

Refer to DTC P0646.

DTC P0650 MALFUNCTION INDICATOR LAMP(MIL) CONTROL CIRCUIT

GENERAL DESCRIPTION E7817EB5

The Malfunction Indicator Lamp (MIL), which is located in the instrument cluster, comes on to notify the driver that there may be a problem with the vehicle and that service is needed. Immediately after the ignition switch turns on, the malfunction indicator lamp is lit to indicate that the MIL operates normally and goes off after starting

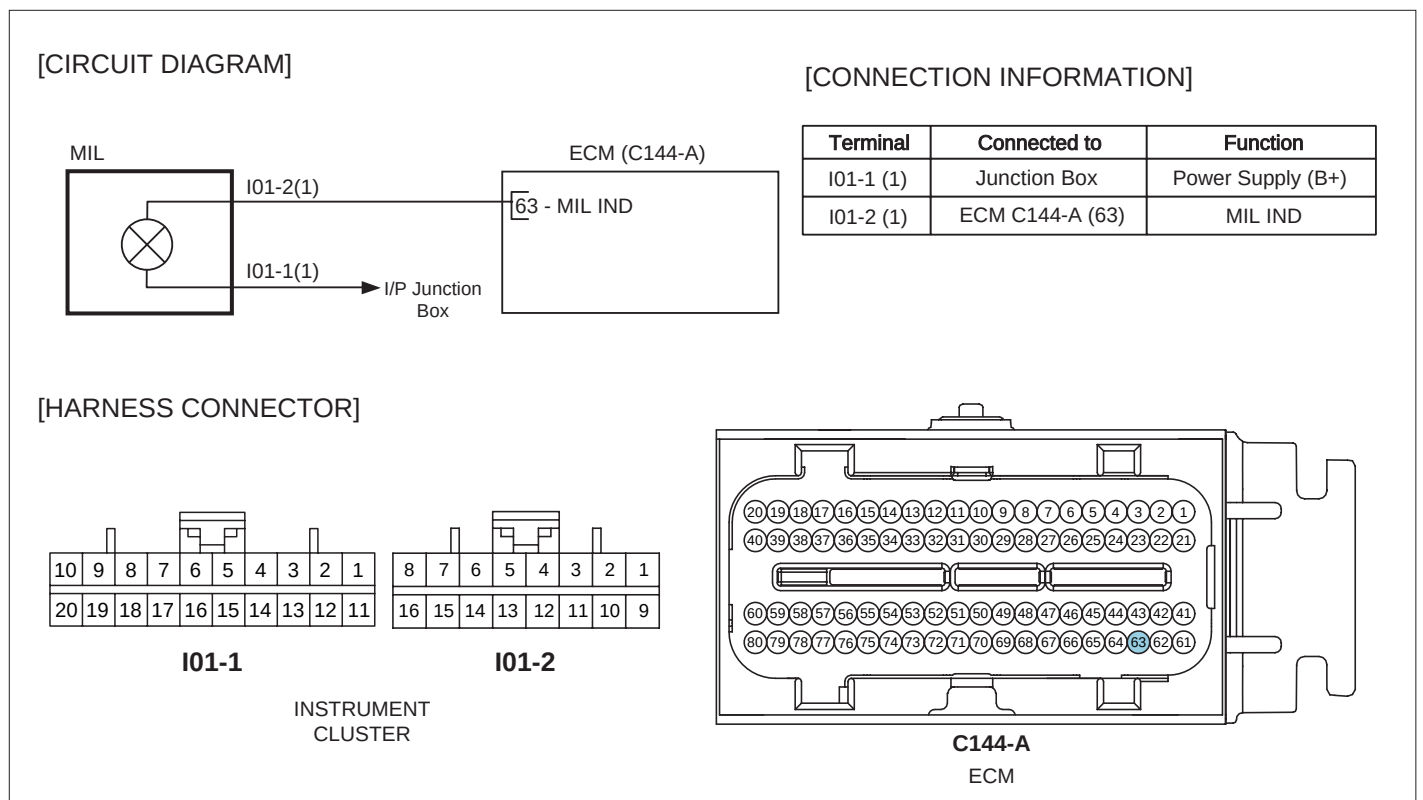
DTC DESCRIPTION EB7A18E0

Checking input signal of engine check lamp every 10 sec. under detecting condition, if open, short to battery or ground is detected, ECM sets P0650.

DTC DETECTING CONDITION E32D4852

Item	Detecting Condition	Possible cause
DTC Strategy	Check the MIL	- Poor connection - Open or short in MIL circuit - Faulty MIL - Faulty ECM
Enable Conditions	- After 0.5 sec under conditions below - Engine works $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	Open or short	
Diagnosis Time	Continuous	
MIL On Condition	DTC only (NO MIL ON)	

SCHEMATIC DIAGRAM E6F79785



DTC TROUBLESHOOTING PROCEDURES

FLB -479

MONITOR DTC STATUS E177F850

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E177950E

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

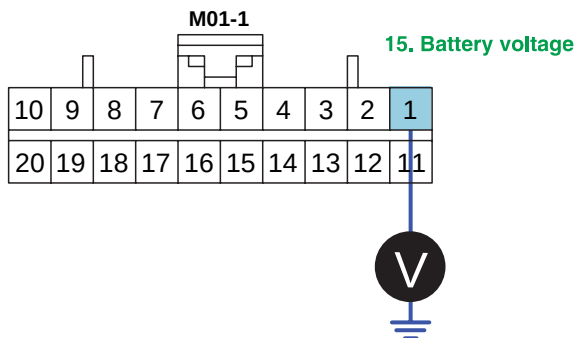
NO

- ▶ Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION E2C5E6CE

1. IG "OFF" and disconnect Instrument cluster connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 1 of instrument cluster harness connector and chassis ground.

Specification : Approx. B+



SBLF26651L

4. Is the measured voltage within specification?

YES

- ▶ Go to "Control Circuit Inspection" procedure.

NO

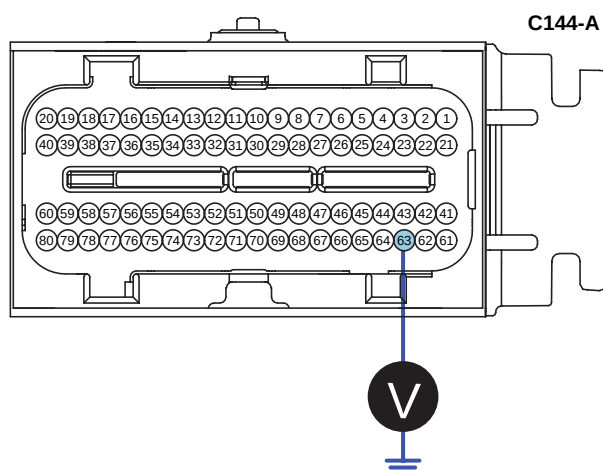
- ▶ Check fuse between battery and instrument cluster for open or blown-off.
- ▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E8EE3576

1. IG "OFF" and disconnect ECM connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between 63 of ECM harness connector(C144-A) and chassis ground.

Specification : Approx. B+

63. MIL indicator control



SBLF26652L

4. Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Check open in Engine warning lamp's filament.

► Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EE89517C

1. Check instrument cluster

- 1) IG "OFF"
- 2) Substitute with a known - good instrument cluster and check for proper operation.
- 3) Does it normally operate after replacement?

YES

► Replace instrument cluster and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR E1FA86A6

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P0651 SENSOR REFERENCE VOLTAGE "B" CIRCUIT OPEN

GENERAL DESCRIPTION E91DC155

The ECM provides a 5volt reference voltage to Throttle Position Sensor 2(TPS2). The ECM monitors reference voltage deviation from the power supply circuit of the sensors.

DTC DESCRIPTION EDC2CC35

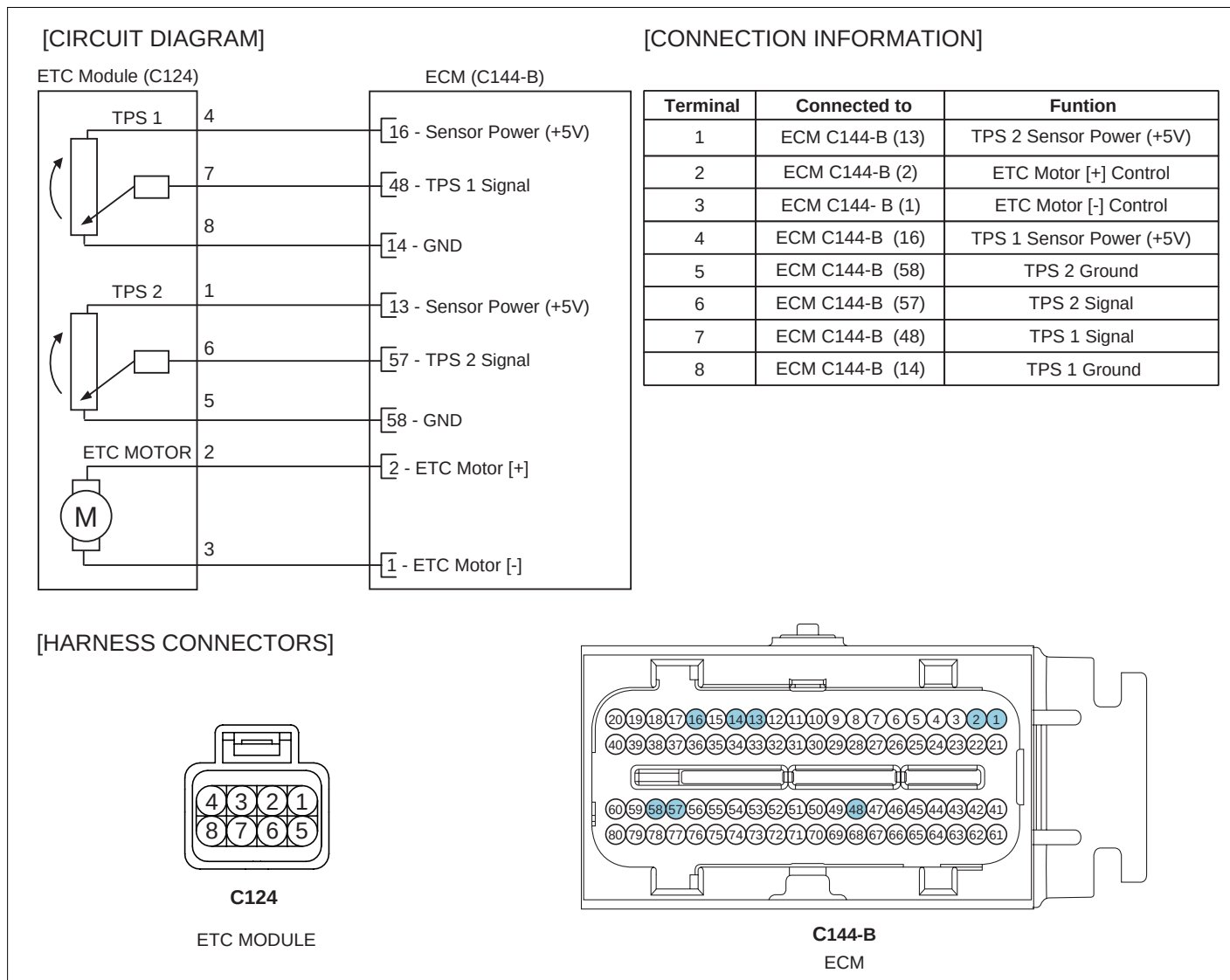
Checking the voltage from sensor power supply every 1.87 sec. under detecting condition, if the value within detecting condition lasts for more than 0.2 sec., ECM sets P0651. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E794042C

Item	Detecting Condition	Possible Cause
DTC Strategy	• Sensor reference voltage check	• Short in sensor power supply line • Faulty ECM
Enable condition	• Key "ON"	
threshold value	• Sensor supply power < 4.5V or > 5.5V	
diagnosis time	• Continuous (More than 0.2 seconds failure for every 1.87 seconds test)	
MIL ON condition	• 2 driving cycles	

SCHEMATIC DIAGRAM

E025C4E7



SBLF26201L

MONITOR DTC STATUS

E6FF2631

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EDEF44B3

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

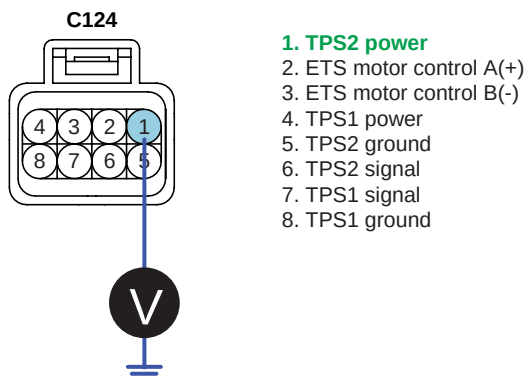
► Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION

1. Check voltage
 - 1) IG "OFF".
 - 2) Disconnect TPS connector.
 - 3) IG "ON" and ENG "OFF"

- 4) Measure the voltage between terminal 1 of TPS harness connector and chassis ground.

Specification : Approx. 5V



SBLF26653L

- 5) Is the measured voltage within specification ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

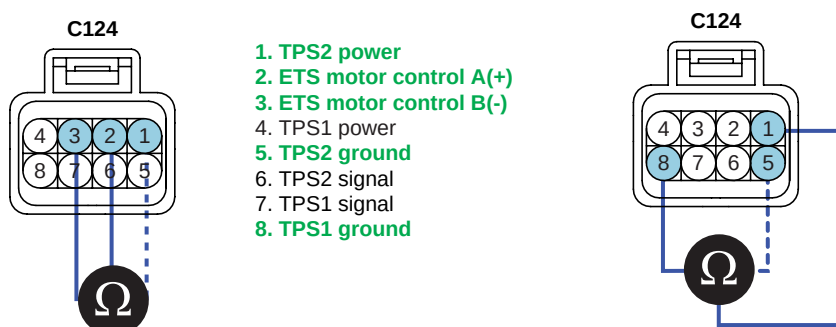
NO

► Go to "Check short in harness" as follows.

2. Check short in harness

- 1) IG "OFF".
- 2) Disconnect TPS connector and ECM connector.
- 3) Measure the resistance between terminal 1 and 2 of TPS harness connector.
- 4) Measure the resistance between terminal 1 and 3 of TPS harness connector.
- 5) Measure the resistance between terminal 1 and 5 of TPS harness connector.
- 6) Measure the resistance between terminal 1 and 8 of TPS harness connector.

Specification : Infinite



SBLF26654L

DTC TROUBLESHOOTING PROCEDURES

FLB -487

7) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Repair Short in power harness and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E8E332A8

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

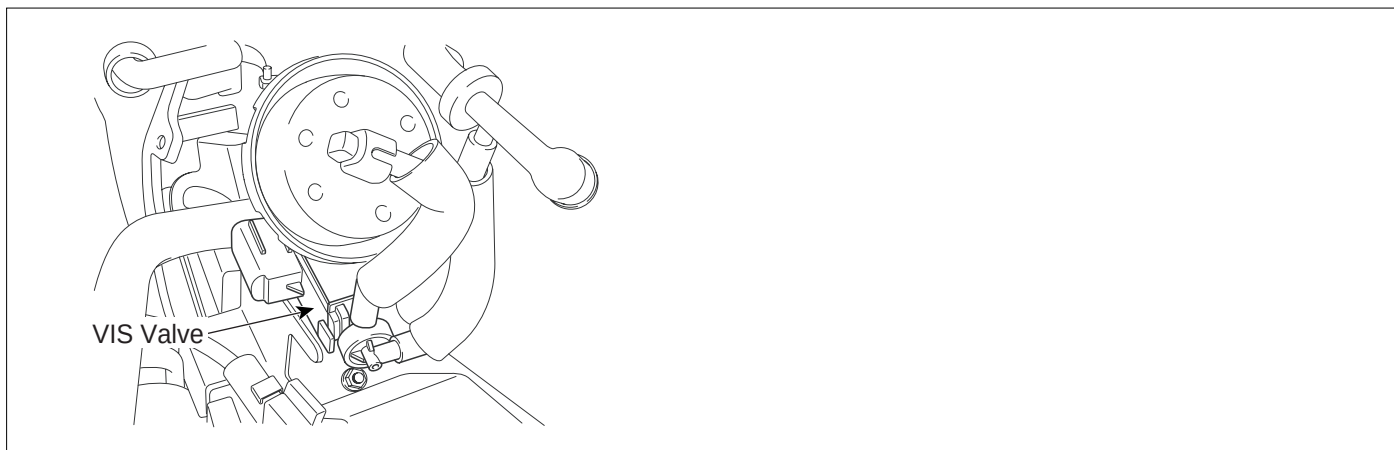
► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P0660 INTAKE MANIFOLD TUNING VALVE CONTROL CIRCUIT/OPEN (BANK 1)

COMPONENT LOCATION E543A2E1



SBLF26718L

GENERAL DESCRIPTION E1D2CA59

VIS(Variable intake system) is a device which varies the length of intake manifold to generate maximum power at certain RPM. VIS lengthens intake manifold to improve the torque at low RPM when vehicle speed is low while it shortens intake manifold to raise torque at high RPM when vehicle speed is high. PCU controls VIS using RPM signal.

DTC DESCRIPTION E7A29A7C

Checking the output voltage from VIS every 10 sec. under detecting condition, if the value within detecting condition lasts for more than 5 sec., ECM sets P0660. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2751AE7

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check VIS	• Poor connection • Open or short in VIS circuit • Faulty VIS • Faulty ECM
Enable condition	• After 0.5 sec under conditions below • Engine works • $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	• Open or short	
Diagnosis time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL ON condition	• 2 driving cycles	

SPECIFICATION EF3E5B99

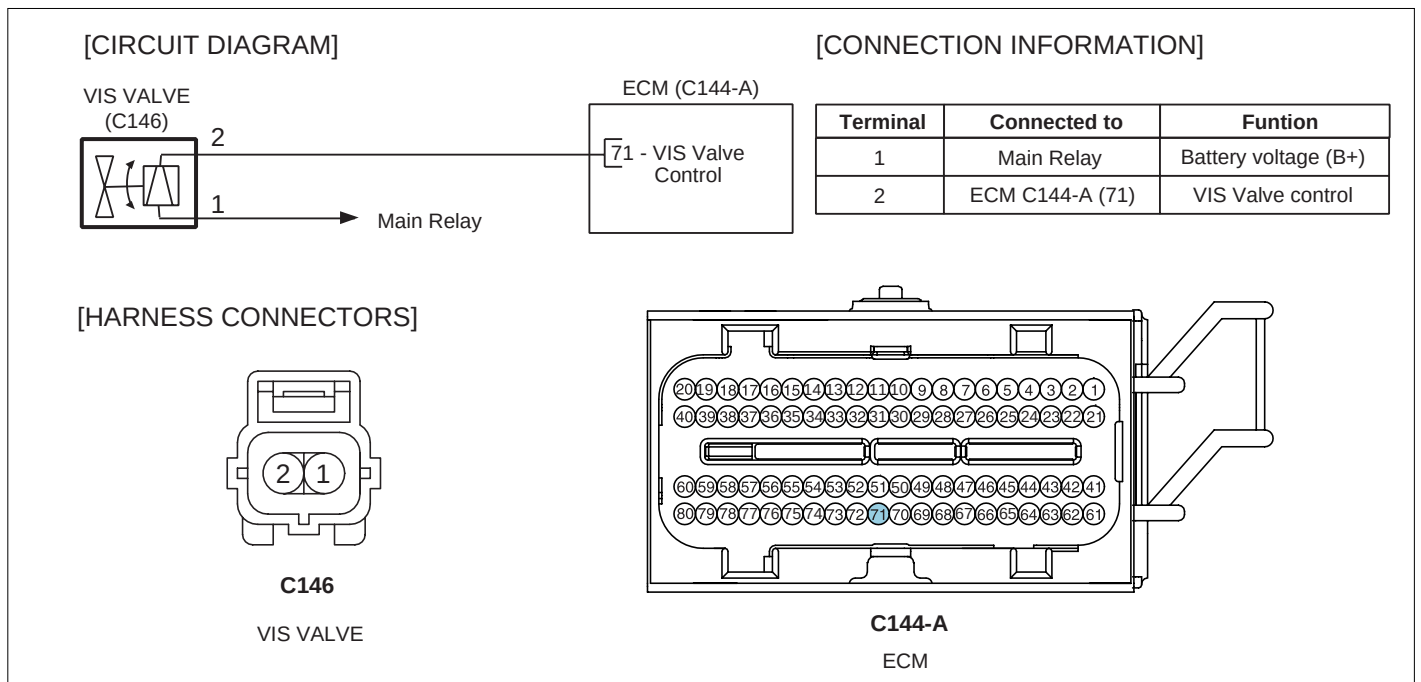
Item	Specification
Coil Resistance (Ω)	30.0 ~ 35.0 Ω [22°C (71.6°F)]

DTC TROUBLESHOOTING PROCEDURES

FLB -489

SCHEMATIC DIAGRAM

E61D16C3



SBLF26213L

MONITOR DTC STATUS

E20404DE

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

- ▶ Go to "Terminal and connector inspection" procedure.

NO

- ▶ Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EDD4282D

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION E89C6C21

1. IG "OFF" and disconnect VIS connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 1 of VIS harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification?

YES

- ▶ Go to "Control Circuit Inspection" procedure.

NO

- ▶ Check fuse connected to power of VIS for open or blown-off.
- ▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E5DD354E

1. Check voltage
 - 1) IG "OFF" and disconnect VIS connector.
 - 2) IG "ON" and ENG "OFF"
 - 3) Measure voltage between terminal 2 of VIS harness connector and chassis ground.

DTC TROUBLESHOOTING PROCEDURES

FLB -491

Specification : Approx. 2.5V

- 4) Is the measured voltage within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Go to "Check short in harness" as follows.

2. Check short in harness

- 1) IG "OFF" and disconnect VIS connector and ECM connector.
- 2) Measure resistance between terminal 2 of VIS harness connector and chassis ground.
- 3) Measure resistance between terminals 1 and 2 of VIS harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification?

YES

► Go to "Check open in harness" as follows.

NO

► Repair short in harness, and go to "Verification of Vehicle Repair" procedure.

3. Check open in harness

- 1) IG "OFF" and disconnect VIS connector and ECM connector.
- 2) Measure resistance between terminal 2 of VIS harness connector and terminal 71 of ECM harness connector (C144-A).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

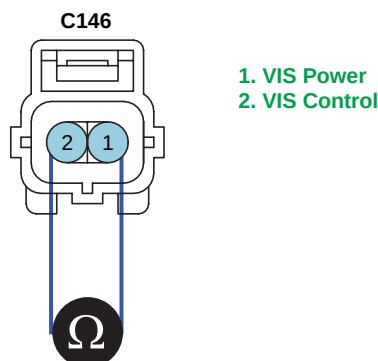
EB4E5DE3

1. Check VIS

- 1) IG "OFF" and disconnect VIS connector.

- 2) Measure resistance between terminals 1 and 2 of VIS connector.(Component side)

Specification : 30.0 ~ 35.0 Ω [22°C(71.6°F)]



SBLF26659L

- 3) Is the measured resistance within specification?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good VIS and check for proper operation. If the problem is corrected, replace VIS and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E85CFA77

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

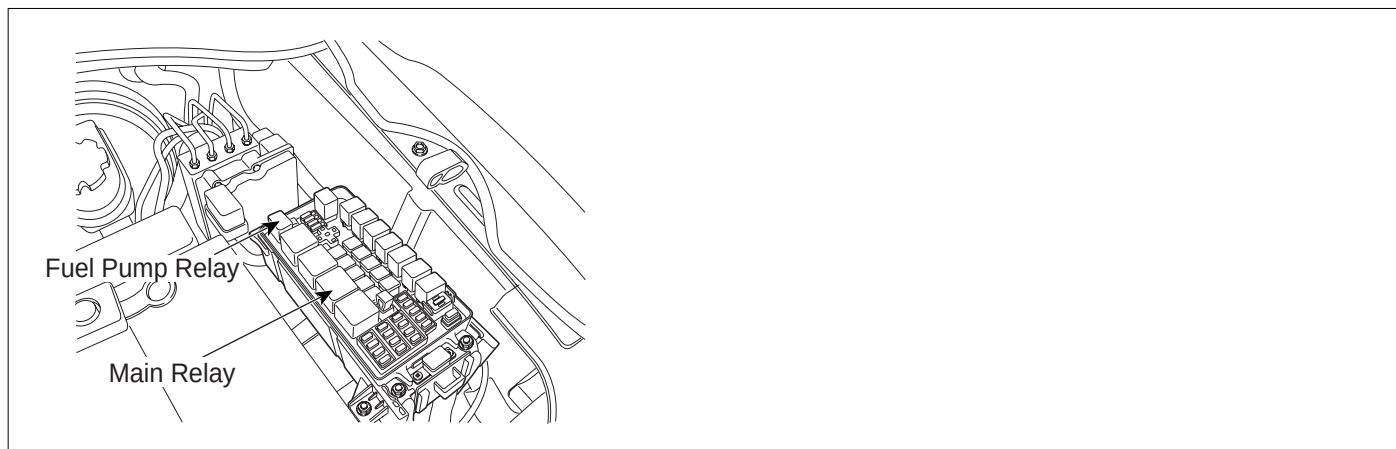
► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -493

DTC P0685 ECM/PCM POWER RELAY CONTROL CIRCUIT /OPEN

COMPONENT LOCATION EC0037C5



SBLF26719L

GENERAL DESCRIPTION E0681873

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 DESCRIPTION E987412C

Checking the controlling state of main relay every 10 sec. under detecting condition, if open or short in the circuit is detected for more than 5 sec., ECM sets P0685.

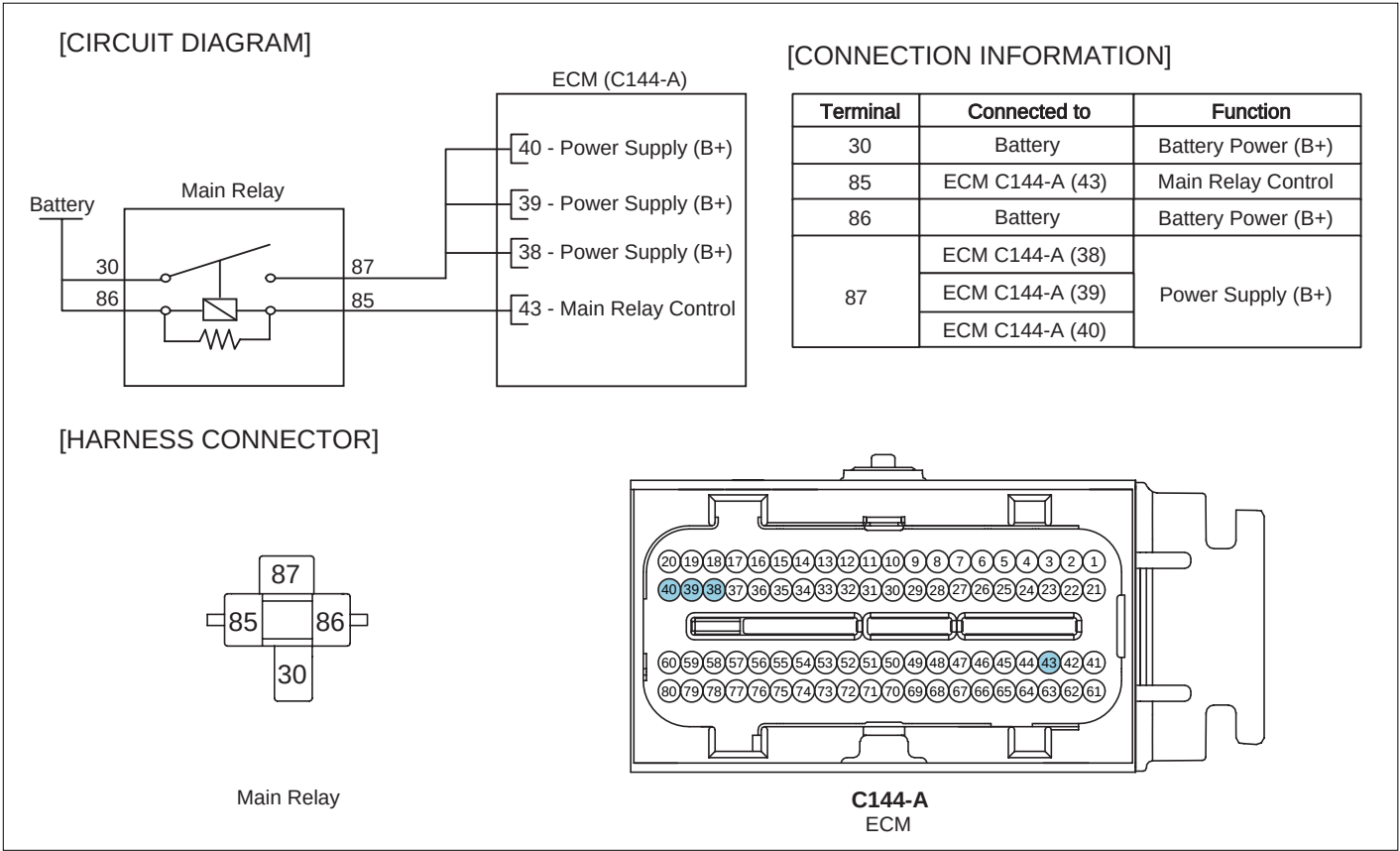
DTC DETECTING CONDITION E84CBF38

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground, to battery or open circuit on the main relay	• Poor Connection • Open or short in control circuit. • Faulty Main Relay • Faulty ECM
EnableConditions	• Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• Open or Short in circuit	
DiagnosisTime	• Continuous (More than 5sec. Failure for every 10 sec. test)	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION EB1D7FC5

Coil Resistance
$70\Omega \sim 120\Omega$

SCHEMATIC DIAGRAM ED2B440B



SBLF26841L

MONITOR DTC STATUS E8DB4B6A

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

E86402C8

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSEPCTION

E6A3140D

1. IG "OFF"
2. Disconnect Main Relay
3. IG "ON" & ENG "OFF".
4. Measure the voltage between terminal 30 of main relay harness connector and chassis ground.

5. Measure the voltage between terminal 86 of main relay harness connector and chassis ground.

Specification : B+

6. Is the measured voltage within specification ?

YES

- ▶ Go to "Control Circuit Inspection" procedure.

NO

- ▶ Check fuse between battery and main relay is disconnected.
▶ Repair or replace open or short in harness and then go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EE4AF862

1. Check short in harness

- 1) IG "OFF".
- 2) Disconnect Main Relay and ECM connector.
- 3) Measure resistance between terminal 86 of Main Relay and chassis ground.
- 4) Measure resistance between terminals 86 and 85 of Main Relay.

Specification : Infinite

- 5) Is the measured resistance within specification ?

YES

- ▶ Go to "Check open in harness" as follows.

NO

- ▶ Repair or replace as necessary and then go to " Verification of Vehicle Repair" procedure.

2. Check open in harness

- 1) IG "OFF".
- 2) Disconnect Main Relay and ECM connector.
- 3) Measure resistance between harness terminal 85 of Main Relay and harness terminal 43 of ECM harness connector(C144-A).

Specification : Approx. below 1Ω

- 4) Is the measured resistance within specifications ?

YES

- ▶ Go to "Component Inspection" procedure.

NO

DTC TROUBLESHOOTING PROCEDURES

FLB -497

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

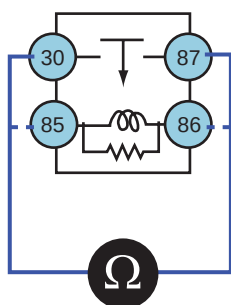
E72548DE

1. Check Main Relay

- 1) IG "OFF"
- 2) Disconnect Main Relay
- 3) Measure the resistance between terminal 30 and 87 of main relay.
- 4) Measure the resistance between terminal 85 and 86 of main relay.

SPECIFICATION :

Terminal	continuity
30 ~ 87	NO
85 ~ 86	YES (Approx. 70Ω ~ 120Ω)



SCMF16627N

5) Is the measured resistance within specification ?

YES

► Substitute with a known - good ECM and check for proper operation.
If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

NO

► Substitute with a known - good Main Relay and check for proper operation.
If the problem is corrected, replace Main Relay and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E8F0DD32

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions

3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

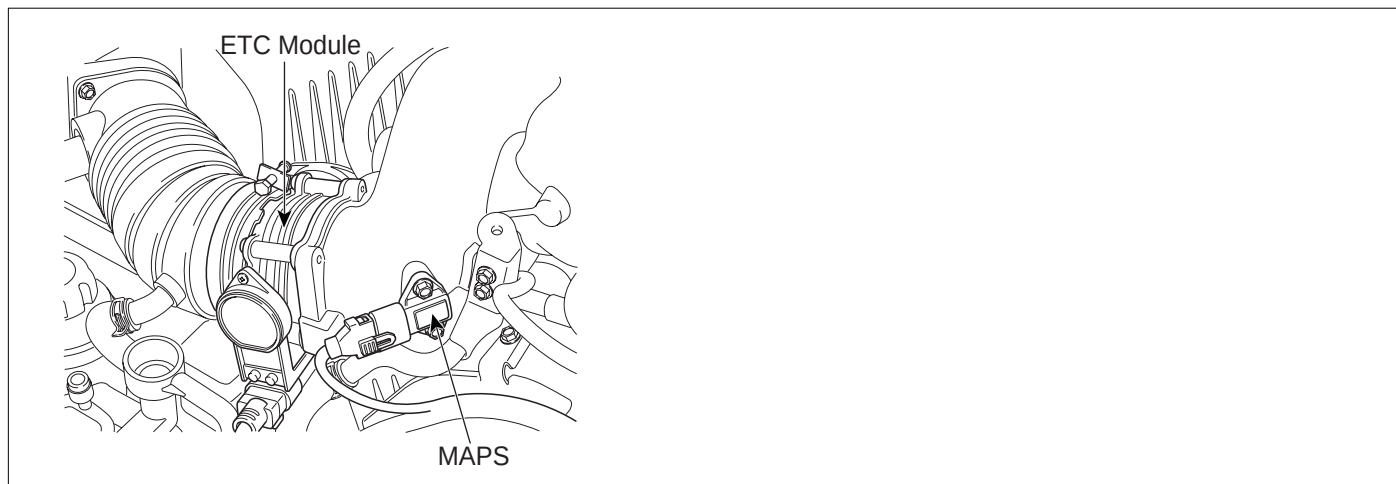
- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P1106 MANIFOLD ABSOLUTE PRESSURE SENSOR CIRCUIT SHORT - INTERMITTENT HIGH INPUT

COMPONENT LOCATION ED829E84



SBLF26703L

GENERAL DESCRIPTION E8801C2A

The amount of intake air flow must be inputted to ECM in order to determine the fuel injection quantity. MAPS(Manifold Absolute Pressure) calculates the amount of air indirectly as measuring the pressure inside of intake manifold. This mechanism is also called Speed-Density Type. MAPS transfers analog output signal which is proportional to the change of intake manifold pressure, then, with this signal and RPM, ECM calculates the amount of intake air flow. MAPS is mounted on surge tank to measure the pressure inside of intake manifold, and it consists of a piezo electric element and hybrid IC which amplifies output signal from the element. A piezo electric element is a sort of a diaphragm using piezo electric effect. One side of the diaphragm is surrounded with vacuum chamber while intake pressure is applied to the other side. Thus, signals are outputted by the transformation of diaphragm according to the change of pressure inside of intake manifold.

DTC DESCRIPTION ED9FBC49

Checking output signals of MAPS under detecting condition, if an output signal is intermittently above 4.5V ., ECM sets P1106.

DTC DETECTING CONDITION

E01A8667

Item		Detecting Condition	Possible Cause
DTC Strategy		Monitor the signal of MAP sensor	- Poor connection - Short to battery in signal circuit - Open in ground circuit - Faulty MAPS - Faulty ECM
Enable Conditions	Case 1	- No TPS Active Fault Present - Engine Running Time > 10sec. - Engine Speed ≤ 2500rpm - Throttle Position ≤ 30%	
	Case 2	- No TPS Active Fault Present - Engine Running Time > 10sec. - Engine Speed > 2500rpm - Throttle Position ≤ 40%	
Threshold value		Intermittently MAP Signal > 4.5V	
Diagnosis Time		Continuous	
MIL On Condition		DTC only (NO MIL ON)	

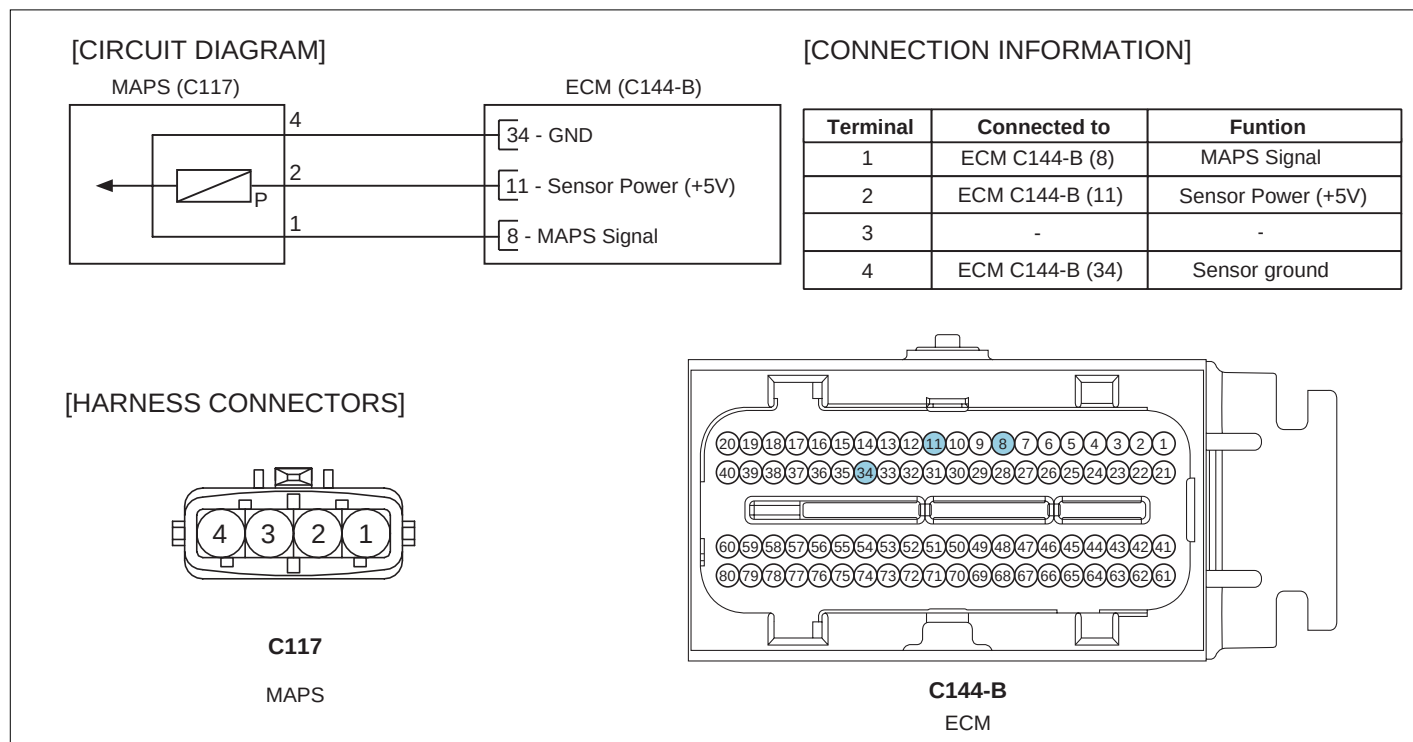
SPECIFICATION

EFD5F097

Pressure(kPa)	20	35	60	95	101.32
Voltage(V)	0.789	1.382	2.369	3.75	4
Allowable error(V)	± 0.045				

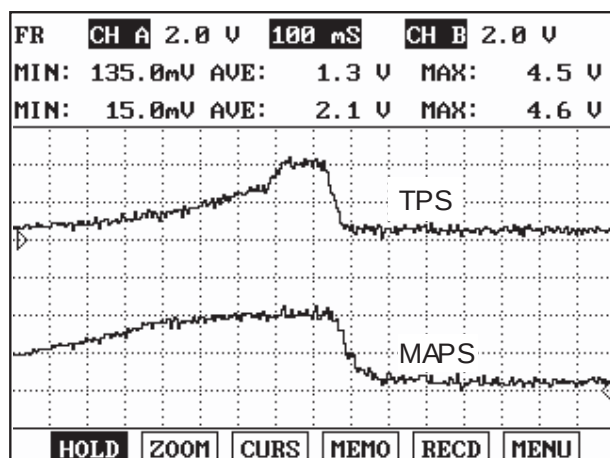
SCHEMATIC DIAGRAM

E1062D03



SBLF26203L

SIGNAL WAVEFROM AND DATA E3D8CE82



Comparing MAPS and TPS, The signals of MAPS and TPS increases and decrease simultaneously.

EGRF958A

MONITOR DTC STATUS EF404417

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EC0ADA7B

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found ?

YES

► Repair or replace if necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION E6507A18

1. IG "OFF"
2. Disconnect MAPS connector
3. IG "ON"
4. Measure the voltage between terminal 2 of MAPS harness connector and ground.

Specification : Approx. 5V

5. Is the measured voltage within specification ?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

- If the voltage is over 5.1V, check short to battery in harness.
- Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E857A626

1. IG "OFF".
2. Disconnect MAPS connector.
3. IG "ON" & ENG "OFF"
4. Measure the voltage between terminal 2 of MAPS harness connector and chassis ground.
5. Measure the voltage between terminal 2 and 4 of MAPS harness connector.

DTC TROUBLESHOOTING PROCEDURES

FLB -503

Specification : "A" - "B" = : Approx. below 200mV

6. Is the measured voltage within specification ?

YES

► Go to "Signal Circuit Inspection" procedure.

NO

► Repair contact resistance or open in harness and then go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E2556D41

1. IG "OFF"

2. Disconnect MAPS and ECM connector.

3. Measure resistance between terminal 1 and 2 of MAPS harness connector.

Specification : Infinite

4. Is the measured resistance within specification ?

YES

► Go to "Component inspection" procedure.

NO

► Repair short to battery in harness and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EBE1CA6D

1. MAPS performance test

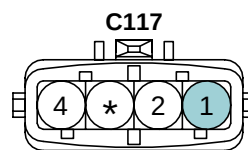
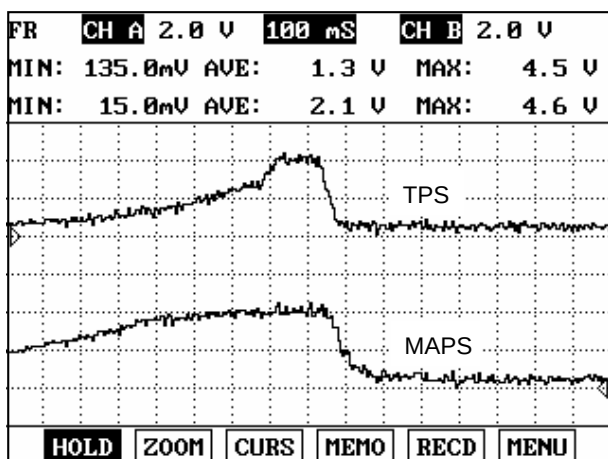
1) IG "OFF"

2) Connect scantool to Data Link Connector(DLC) and select "Oscilloscope" then, connect probes to output signal lines of MAPS and TPS. Turn engine "ON" and monitor the waveforms accelerating or decelerating

3) Start engine and monitor signal waveform during acceleration and deceleration.

SPECIFICATION :

Pressure (kPa)	20	35	60	95	101.32
Voltage (V)	0.789	1.382	2.369	3.75	4
Tolerance (V)	± 0.045				



1. MAPS Signal
2. MAPS Power
-
4. MAPS Ground

SBLF26450L

4) Is the waveform displayed correctly?(Compare the response time of TPS and MAPS)

YES

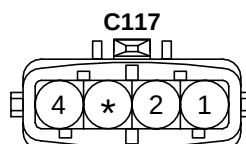
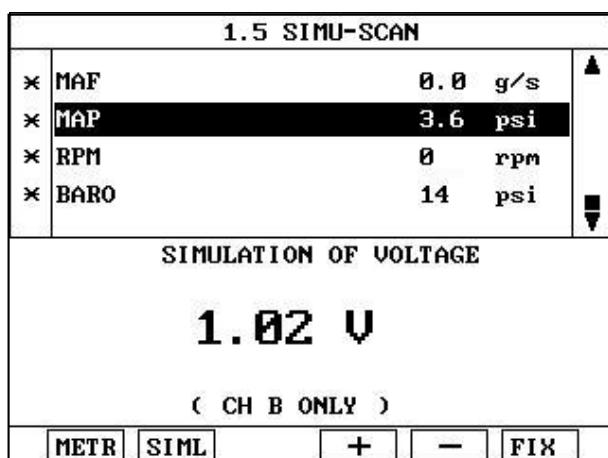
► Go to "Check ECM".

NO

► After replacing MAPS with new one, if it operates normally, replace MAPS and go to "Verification of Vehicle Repair".

2. Check ECM

- 1) IG "OFF" and disconnect MAPS connector.
- 2) Connect scantool and IG "ON" & ENG "OFF"
- 3) Select simulation function on scantool.
- 4) Simulate voltage at terminal 1 of MAPS harness connector.



1. MAPS Signal
2. MAPS Power
-
4. MAPS Ground

SBLF26454L

5) Does the output voltage response to the change of signal by simulation?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -505

- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace if necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR ED5A10CD

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

FLB -506

FUEL SYSTEM

DTC P1107 MANIFOLD ABSOLUTE PRESSURE SENSOR CIRCUIT SHORT - INTERMITTENT LOW INPUT

COMPONENT LOCATION E3F6E210

Refer to DTC P1106.

GENERAL DESCRIPTION EBD65709

Refer to DTC P1106.

DTC DESCRIPTION E1042899

Checking output signals of MAPS under detecting condition, if an output signal is intermittently below 0.25V, ECM sets P1107.

DTC DETECTING CONDITION EE4500D8

Item		Detecting Condition	Possible Cause
DTC Strategy		Monitor the signal of MAP sensor	- Poor Connection - Open or Short to ground in Power Circuit - Open or short to ground in Signal Circuit. - Faulty MAPS - Faulty ECM
Enable Conditions	Case 1	- No TPS Active Fault Present - Ignition Voltage $\geq 11V$ - Engine Speed $\leq 1000rpm$ - Throttle Position $\geq 0\%$	
	Case 2	- No TPS Active Fault Present - Ignition Voltage $\geq 11V$ - Engine Speed $> 1000rpm$ - Throttle Position $\geq 30\%$	
Threshold value		Intermittently MAP Signal $< 0.25V$	
Diagnosis Time		Continuous	
MIL On Condition		DTC only (NO MIL ON)	

SPECIFICATION EEF91BBE

Refer to DTC P1106.

SCHEMATIC DIAGRAM ED63FF1F

Refer to DTC P1106.

SIGNAL WAVEFORM AND DATA EA51B975

Refer to DTC P1106.

MONITOR DTC STATUS E8E22989

Refer to DTC P1106.

DTC TROUBLESHOOTING PROCEDURES

FLB -507

TERMINAL AND CONNECTOR INSPECTION E5FA7759

Refer to DTC P1106.

POWER CIRCUIT INSPECTION E7B99913

1. IG "OFF"
2. Disconnect MAPS connector.
3. IG "ON"
4. Measure the voltage between terminal 2 of MAPS harness connector and ground.

Specification : Approx. 5V

5. Is the measured voltage within specification ?

YES

▶ Go to "Signal Circuit Inspection" of MAPS.

NO

▶ After repairing open or short to ground in harness and go to "Verification of Vehicle Repair"

SIGNAL CIRCUIT INSPECTION E78877F3

1. Check short to ground in harness
 - 1) IG "OFF"
 - 2) Disconnect MAPS and ECM connector.
 - 3) Measure the resistance between terminal 1 of MAPS harness connector and ground.

Specification : Infinite

- 4) Is the measured resistance within the specification?

YES

▶ Go to "Check open in the harness" of MAPS.

NO

▶ After repairing short to ground in circuits and go to "Verification of Vehicle Repair"

2. Check open in the harness
 - 1) IG "OFF"
 - 2) Disconnect MAPS and ECM connector.
 - 3) Measure the resistance between terminal 1 of MAPS harness connector and terminal 8 of ECM harness connector(C144-B).

Specification : Approx. below 1 Ω

- 4) Is the measured resistance within the specification?

YES

► Go to "Component Inspection" of MAPS.

NO

► Repair open in the harness and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION

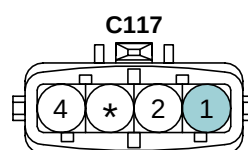
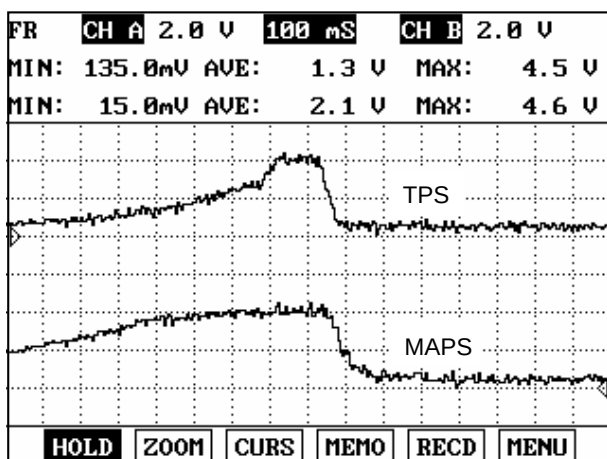
E7220810

1. MAPS performance test

- 1) IG "OFF"
- 2) Connect scantool to Data Link Connector(DLC) and select "Oscilloscope" then, connect probes to output signal lines of MAPS and TPS. Turn engine "ON" and monitor the waveforms accelerating or decelerating
- 3) ENG "ON" and monitor signal waveform during acceleration and deceleration.

SPECIFICATION :

Pressure (kPa)	20	35	60	95	101.32
Voltage (V)	0.789	1.382	2.369	3.75	4
Tolerance (V)	± 0.045				



1. MAPS Signal
2. MAPS Power
-
4. MAPS Ground

SBLF26450L

- 4) Is the waveform displayed correctly?(Compare the response time of TPS and MAPS)

YES

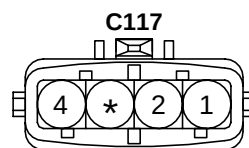
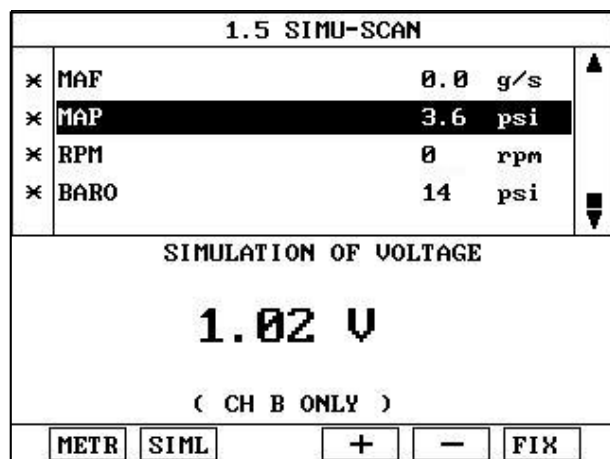
► Go to "Check ECM".

NO

► After replacing MAPS with new one, if it operates normally, replace MAPS and go to "Verification of Vehicle Repair".

2. Check ECM

- 1) IG "OFF" disconnect MAPS connector
- 2) Connect Scantool and IG "ON" & ENG "OFF"
- 3) Select simulation function on scantool.
- 4) Simulate voltage at terminal 1 of MAPS harness connector.



1. MAPS Signal
2. MAPS Power
-
4. MAPS Ground

SBLF26454L

- 5) Does the output voltage response to the change of signal by simulation?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace if necessary and go to "Verification of Vehicle Repair" procedure

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTE

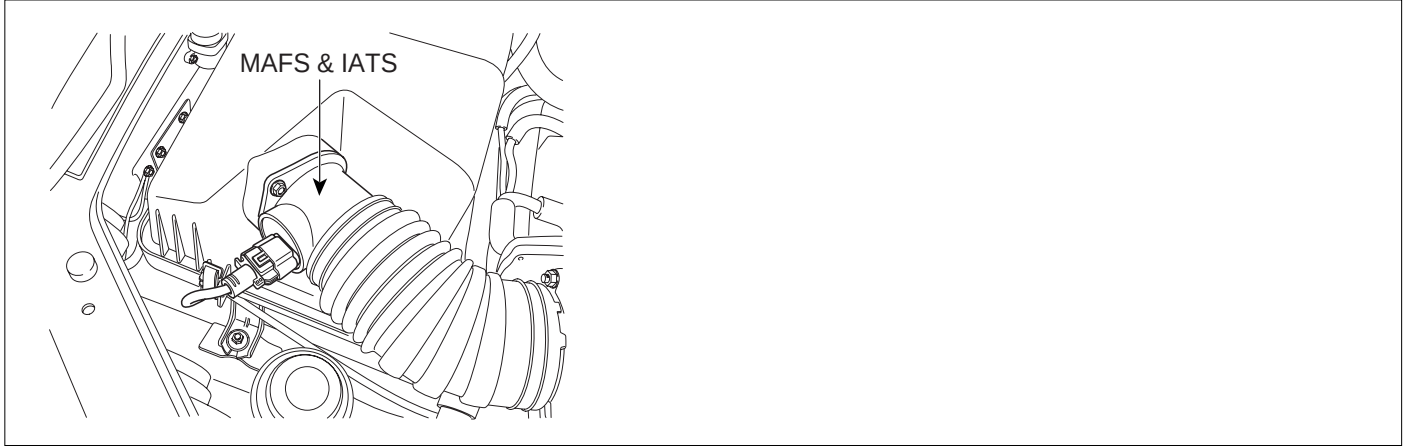
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR EC7CF204

Refer to DTC P1106.

DTC P1111 INTAKE AIR TEMPERATURE SENSOR CIRCUIT SHORT - INTERMITTENT HIGH INPUT

COMPONENT LOCATION EB92344C



SBLF26702L

GENERAL DESCRIPTION E835C1B1

The Intake Air Temperature Sensor (IATS) is installed into the Mass Air Flow Sensor (MAFS). 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 DESCRIPTION E32DE6B6

Checking output signals of IATS under detecting condition, if an output signal is intermittently over 4.9V, ECM sets P1111.

DTC DETECTING CONDITION E08A5517

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor the signal of IAT sensor	- Poor Connection - Open or short in signal circuit - Open in ground circuit - Faulty IATS - Faulty ECM
Enable Conditions	- Engine running state - No Vehicle speed sensor fault - No ECTS fault - No MAFS fault - Intake airflow < 15 g/s - Vehicle speed < 25kph(9.3mph) - Engine coolant temperature > 50°C(122°F)	
Threshold value	Intermittently Intake air temperature sensor's voltage > 4.9V	
Diagnosis Time	Continuous	
MIL On Condition	DTC only (NO MIL ON)	

DTC TROUBLESHOOTING PROCEDURES

FLB -511

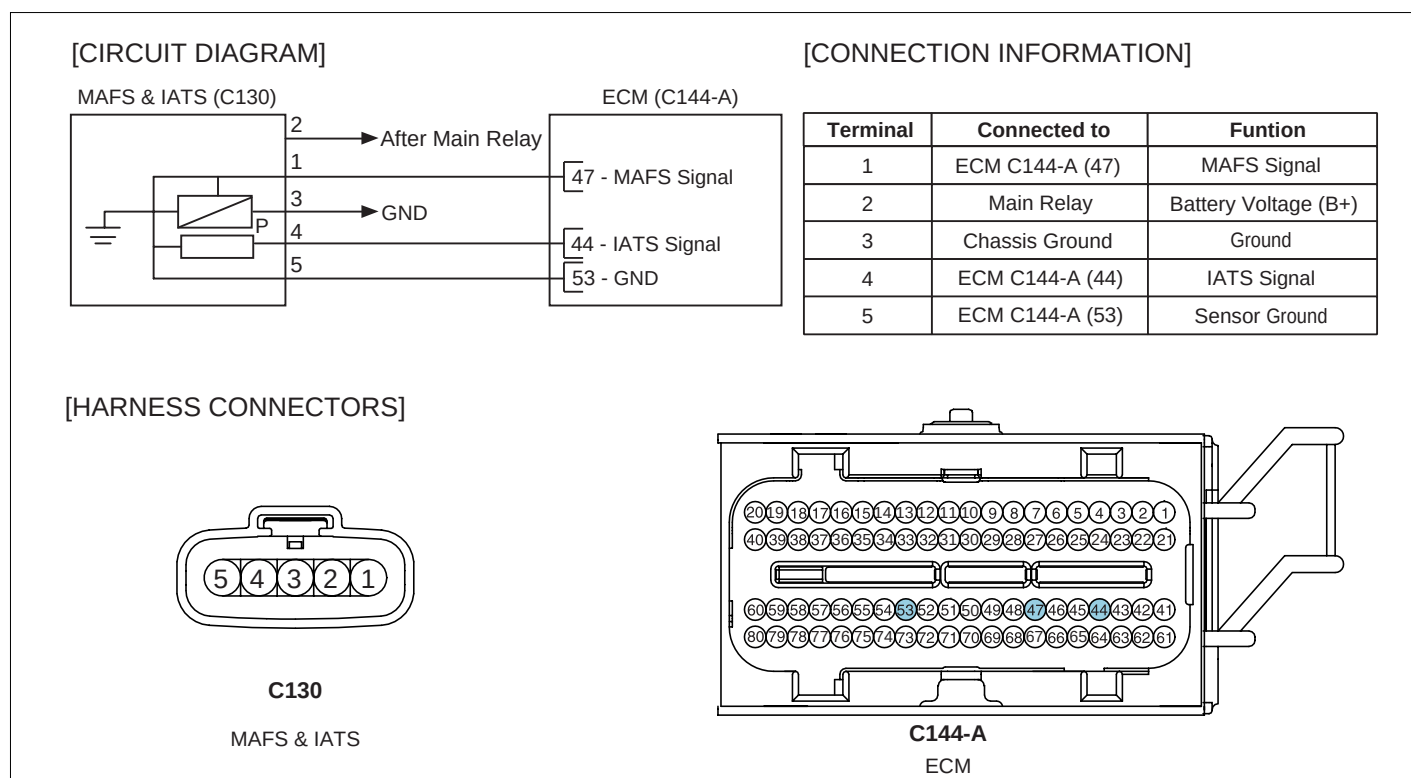
SPECIFICATION

E5F5208F

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	95.95 ~ 105.78	20(68)	3.42 ~ 3.61
-20(-4)	27.4 ~ 29.77	40(104)	1.43 ~ 1.5
0(32)	9.08 ~ 9.72	60(140)	0.66 ~ 0.69
10(50)	5.49 ~ 5.83	80(176)	0.33 ~ 0.34

SCHEMATIC DIAGRAM

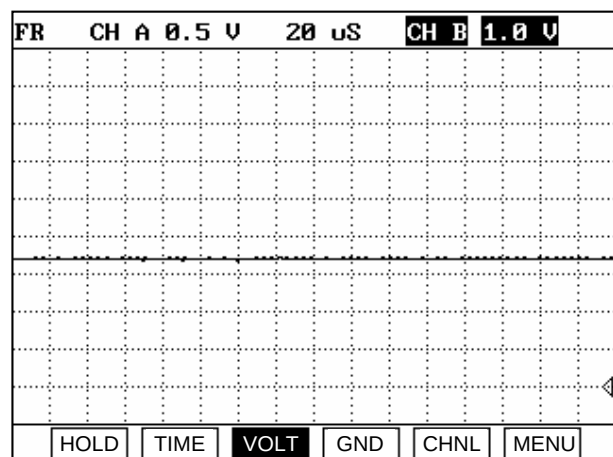
E510E133



SBLF26202L

SIGNAL WAVEFORM AND DATA

EE989C22



EGRF604E

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION ECAFD8F2

1. Check voltage

- 1) IG "OFF" and disconnect IATS connector.
- 2) IG "ON" and ENG "OFF"
- 3) Measure voltage between terminal 4 of IATS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification ?

YES

- ▶ Go to "Ground Circuit Inspection" procedure.

NO

- ▶ If the voltage is 0V, go to "Check open in harness" as follows. If the voltage is more than 5.1V, go to "Check short to battery in harness" as follows.

2. Check short to battery in harness

- 1) IG "OFF" and disconnect IATS connector and ECM connector.
- 2) Measure resistance between terminals 2 and 4 of IATS harness connector.
- 3) Measure resistance between terminals 1 and 4 of IATS harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification?

YES

- ▶ Go to "Component Inspection" procedure.

NO

- ▶ Repair short to battery in harness and go to "Verification of Vehicle Repair" procedure.

3. Check open in harness

- 1) IG "OFF" and disconnect IATS connector and ECM connector.
- 2) Measure resistance between terminal 4 of IATS harness connector and 44 of ECM harness connector(C144-A).

Specification : below 1Ω

- 3) Is the measured resistance within specification?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair open in harness and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EB170815

1. IG "OFF" and disconnect IATS connector.
2. Measure voltage between terminal 4 of IATS harness connector and chassis ground.
3. Measure voltage between terminals 4 and 5 of IATS harness connector.

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES

► Go to "Component Inspection" procedure.

NO

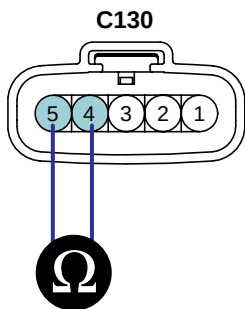
► Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E1541ECC

1. Check IATS
 - 1) IG "OFF" and disconnect IATS connector.
 - 2) Measure resistance between terminals 4 and 5 of IATS connector.(Component side)

SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	95.95 ~ 105.78	20(68)	3.42 ~ 3.61
-20(-4)	27.4 ~ 29.77	40(104)	1.43 ~ 1.5
0(32)	9.08 ~ 9.72	60(140)	0.66 ~ 0.69
10(50)	5.49 ~ 5.83	80(176)	0.33 ~ 0.34



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26665L

3) Is the measured resistance within specification ?

YES

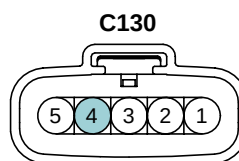
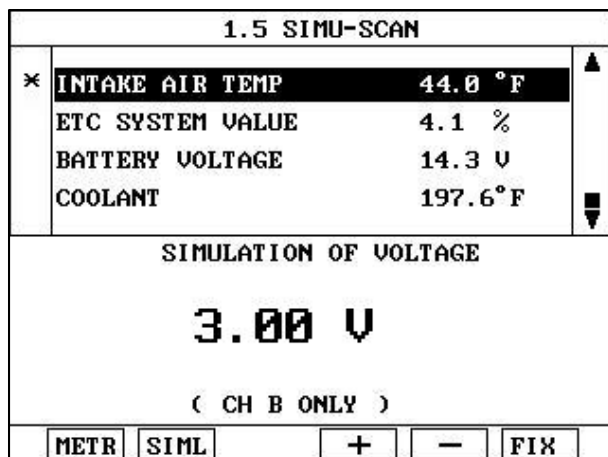
► Go to "Check ECM" as follows.

NO

► Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) IG "OFF" and connect scantool.
- 2) Disconnect IATS connector and connect probe to terminal 4 of IATS harness connector.
- 3) IG "ON" and ENG "OFF" and simulation Function on scantool.
- 4) Simulate voltage at terminal 4 of IATS harness connector.



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26666L

5) Does the signal value of IAT sensor change according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

VERIFICATION OF VEHICLE REPAIR E92EFCC5

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -517

DTC P1112 INTAKE AIR TEMPERATURE SENSOR CIRCUIT SHORT - INTERMITTENT LOW INPUT

COMPONENT LOCATION ED8ECE01

Refer to DTC P1111.

GENERAL DESCRIPTION E79F0027

Refer to DTC P1111.

DTC DESCRIPTION E7F529F4

Checking output signals of IATS under detecting condition, if an output signal is intermittently below 0.1V, ECM sets P1112.

DTC DETECTING CONDITION EC2C7D45

Item		Detecting Condition	Possible Cause
DTC Strategy		Monitor the signal of IAT sensor	- Poor Connection - Short to ground in signal circuit. - Faulty IATS - Faulty ECM
Enable Conditions	Case 1	- Engine Run State - No Vehicle speed sensor fault - Vehicle speed > 50kph(30mph)	
	Case 2	- Engine running time > 120 sec. - Time from IG "OFF" to IG "ON" > 360 min.	
Threshold value		Intermittently Intake air temperature sensor's voltage < 0.1V	
Diagnosis Time		Continuous	
MIL On Condition		DTC only(NO MIL ON)	

SPECIFICATION E6F2853D

Refer to DTC P1111.

SCHEMATIC DIAGRAM EEA863EB

Refer to DTC P1111.

SIGNAL WAVEFORM AND DATA E136C62D

Refer to DTC P1111.

MONITOR DTC STATUS E8134376

Refer to DTC P1111.

TERMINAL AND CONNECTOR INSPECTION ECFD41F7

Refer to DTC P1111.

SIGNAL CIRCUIT INSPECTION

E937548C

1. Check voltage

- 1) IG "OFF" and disconnect IATS connector.
- 2) IG "ON" and ENG "OFF"
- 3) Measure voltage between terminal 4 of IATS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification ?

YES

► Go to "Component Inspection" procedure.

NO

► Go to " Check short to ground in harness" procedure.

2. Check short to ground in harness

- 1) IG "OFF" and disconnect IATS connector and ECM connector.
- 2) Measure resistance between terminal 4 of IATS harness connector and chassis ground.
- 3) Measure resistance between terminals 4 and 5 of IATS harness connector.
- 4) Measure resistance between terminals 4 and 3 of IATS harness connector.

Specification : Infinite

- 5) Is the measured resistance within specification?

YES

► Go to "Component inspection" procedure.

NO

► Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

E693EA4D

1. Check IATS

- 1) IG "OFF" and disconnect IATS connector.
- 2) Measure resistance between terminals 4 and 5 of IATS connector.(Component side)

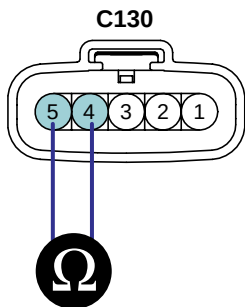
SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	95.95 ~ 105.78	20(68)	3.42 ~ 3.61
-20(-4)	27.4 ~ 29.77	40(104)	1.43 ~ 1.5

DTC TROUBLESHOOTING PROCEDURES

FLB -519

0(32)	9.08 ~ 9.72	60(140)	0.66 ~ 0.69
10(50)	5.49 ~ 5.83	80(176)	0.33 ~ 0.34



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26665L

3) Is the measured resistance within specification ?

YES

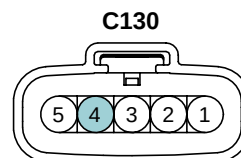
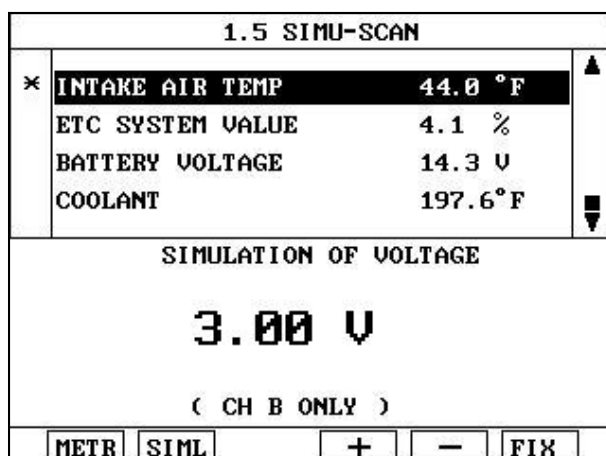
► Go to "Check ECM" as follows.

NO

► Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) IG "OFF" and connect scantool.
- 2) Disconnect IATS connector and connect probe to terminal 4 of IATS harness connector.
- 3) IG "ON" and ENG "OFF" and simulation Function on scantool.
- 4) Simulate voltage at terminal 4 of IATS harness connector.



1. MAFS Signal
2. MAFS Power
3. MAFS Ground
4. IATS Signal
5. IATS Ground

SBLF26666L

5) Does the signal value of IAT sensor change according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

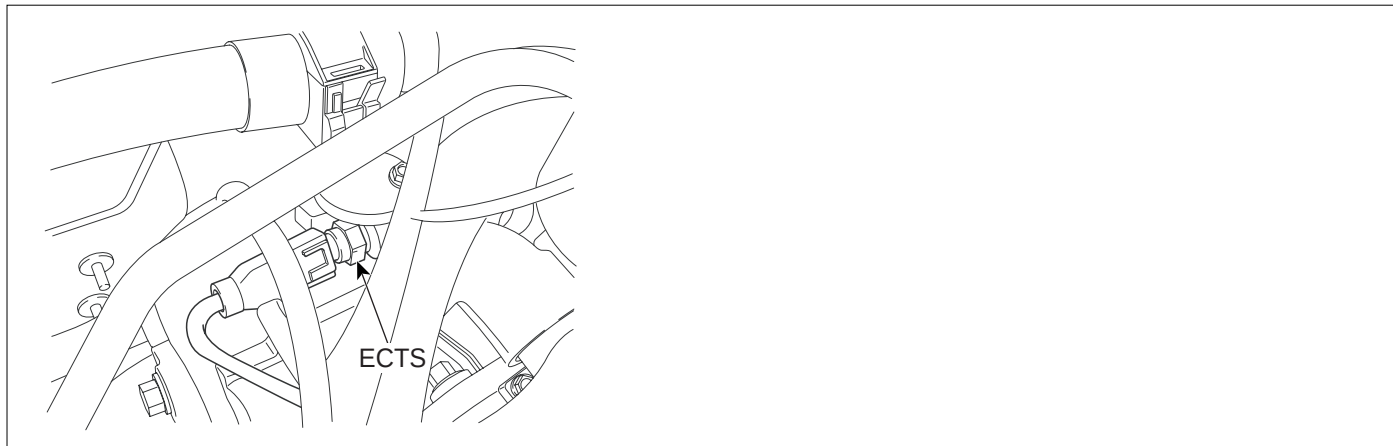
VERIFICATION OF VEHICLE REPAIR

E3CB09B0

Refer to DTC P1111.

DTC P1114 ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT INTERMITTENT LOW INPUT

COMPONENT LOCATION E5E3DC50



SBLF26704L

GENERAL DESCRIPTION ECD5498D

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.

DTC DESCRIPTION E9C91378

Checking output signals from ECTS under detecting condition, if an output signal is intermittently below 0.1V, ECM sets P1114.

DTC DETECTING CONDITION E4C19AC3

Item		Detecting Condition	Possible Cause
DTC Strategy		Monitor the signal of ECTS	- Poor Connection - Short to ground in signal Circuit - Faulty ECTS - Faulty ECM
Enable Conditions	Case 1	Time after start-up > 120 sec.	
	Case 2	- Time from IG "OFF" to IG "ON" > 360 min. - Engine running state	
Threshold value		Intermittently engine coolant temperature sensor's voltage &lt; 0.1V	
Diagnosis Time		Continuous	
MIL On Condition		DTC only (NO MIL ON)	

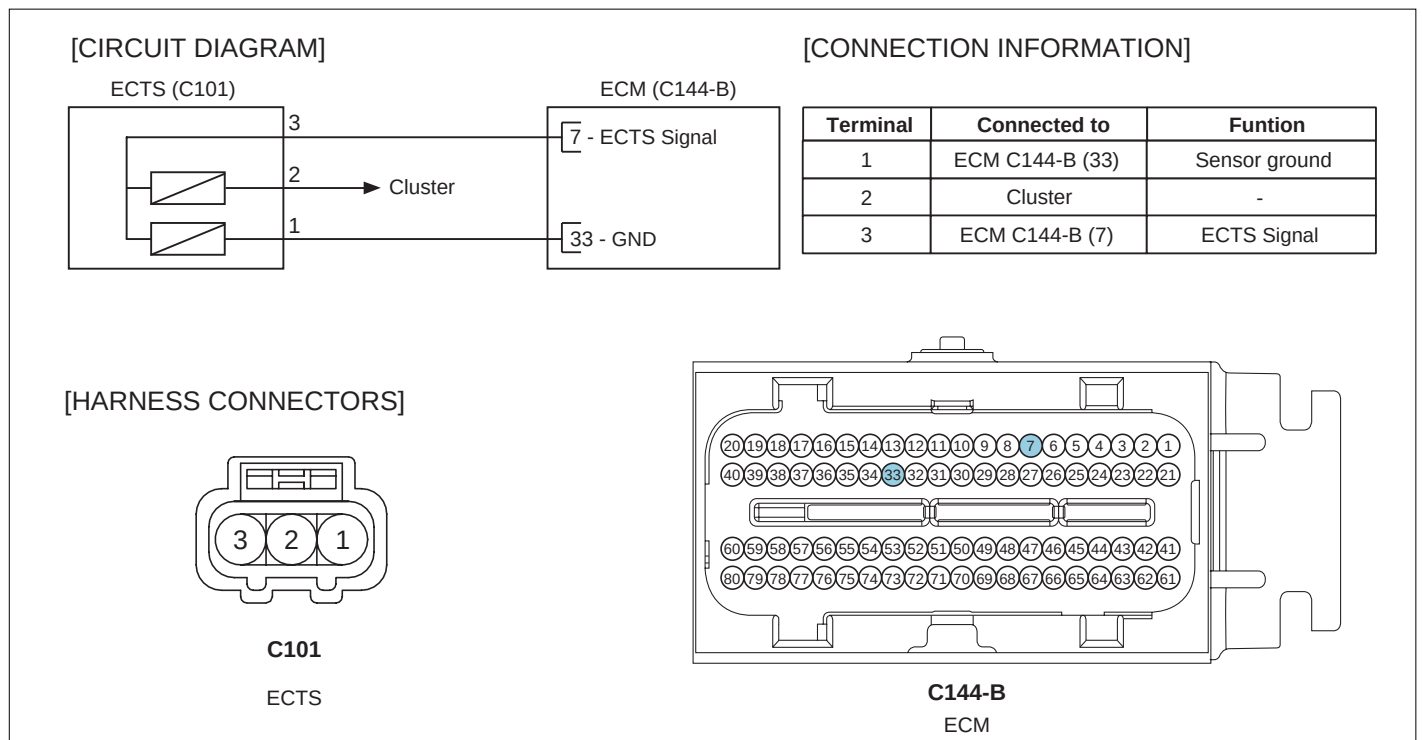
SPECIFICATION

EFBCA777

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		

SCHEMATIC DIAGRAM

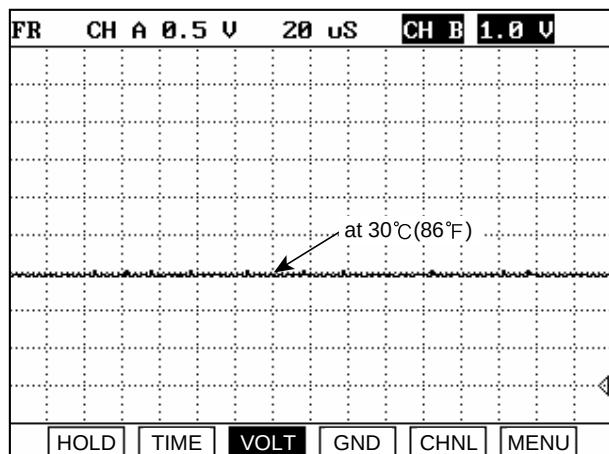
E659C285



SBLF26204L

SIGNAL WAVEFORM AND DATA

EF58AE2C



EGRF604P

The output signals of IATS & ECTS change smoothly without any rapid changes. Those have almost same characteristic signal during the early period after start. It means that the temperatures of intake air and engine coolant are depended on

DTC TROUBLESHOOTING PROCEDURES

FLB -523

the temperature of atmosphere. Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air.

MONITOR DTC STATUS E719B12C

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E4CFB80D

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION

EC73FBE1

1. Check voltage

- 1) IG "OFF" and disconnect ECTS connector.
- 2) IG "ON" and ENG "OFF"
- 3) Measure voltage between terminal 3 of ECTS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification ?

YES

- ▶ Go to "Component Inspection" procedure.

NO

- ▶ Go to "Check short to ground in harness" as follows.

2. Check short to ground in harness

- 1) IG "OFF" and disconnect ECTS connector and ECM connector.
- 2) Measure resistance between terminal 3 of ECTS harness connector and chassis ground.
- 3) Measure resistance between terminals 1 and 3 of ECTS harness connector.

Specification : Infinite

- 4) Is the measured resistance within specification?

YES

- ▶ Go to "Component Inspection" procedure.

NO

- ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

EC2EC977

1. Check ECTS

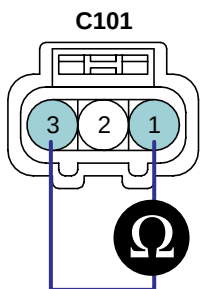
- 1) IG "OFF" and disconnect ECTS connector.
- 2) Measure resistance between terminals 1 and 3 of ECTS connector.(Component side)

DTC TROUBLESHOOTING PROCEDURES

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SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		



1. ECTS Ground
2. To Gauge
3. ECTS Signal

SBLF26670L

3) Is the measured resistance within specification?

YES

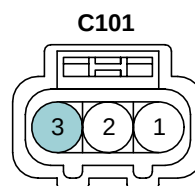
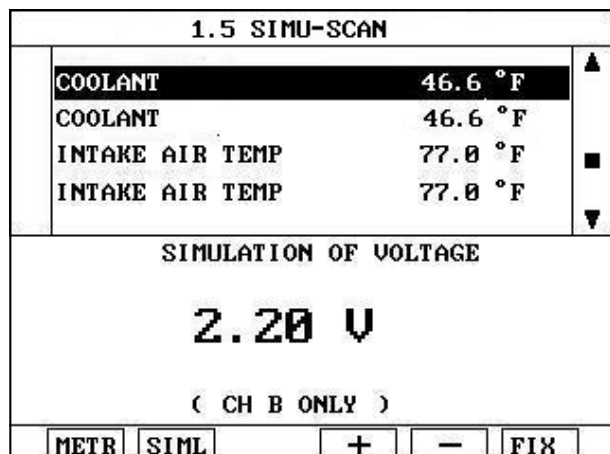
► Go to "Check ECM" as follows.

NO

► Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, replace ECTS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) IG "OFF" and connect scantool.
- 2) Connect probe to terminal 3 of ECTS harness connector.
- 3) IG "ON" and ENG "OFF" and simulation Function on scantool.
- 4) Simulate voltage at terminal 3 of ECTS harness connector.



1. ECTS Ground
2. To Gauge
3. ECTS Signal

SBLF26671L

5) Does the signal value of ECT sensor change according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

VERIFICATION OF VEHICLE REPAIR

E4F8CD48

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -527

DTC P1115 ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT - INTERMITTENT HIGH INPUT

COMPONENT LOCATION E883E4C8

Refer to DTC P1114.

GENERAL DESCRIPTION ED675641

Refer to DTC P1114.

DTC DESCRIPTION E25138CD

Checking output signals from ECTS under detecting condition, if an output signal is intermittently above 4.9V, ECM sets P1115.

DTC DETECTING CONDITION E7631F9B

Item		Detecting Condition	Possible Cause
DTC Strategy		Monitor the signal of ECTS	- Poor Connection - Open or short to battery in signal Circuit - Open in Ground Circuit. - Faulty ECTS - Faulty ECM
Enable Conditions	Case 1	Time after start-up > 120 sec.	
	Case 2	- Time from IG "OFF" to IG "ON" > 360 min. - Intake air temperature $\geq -10^{\circ}\text{C}(14^{\circ}\text{F})$ - Engine running state	
Threshold value		Intermittently engine coolant temperature sensor's voltage > 4.9V	
Diagnosis Time		Continuous	
MIL On Condition		DTC only (NO MIL ON)	

SPECIFICATION E4187003

Refer to DTC P1114.

SCHEMATIC DIAGRAM E1CE6BDD

Refer to DTC P1114.

SIGNAL WAVEFORM AND DATA E567F9E7

Refer to DTC P1114.

MONITOR DTC STATUS E2C44153

Refer to DTC P1114.

TERMINAL AND CONNECTOR INSPECTION E3F1851B

Refer to DTC P1114.

SIGNAL CIRCUIT INSPECTION

E15EF5BD

1. Check voltage

- 1) IG "OFF" and disconnect ECTS connector.
- 2) IG "ON" and ENG "OFF"
- 3) Measure voltage between terminal 3 of ECTS harness connector and chassis ground.

Specification : Approx. 5V

- 4) Is the measured voltage within specification ?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► If voltage is 0V, go to "Check open in harness" as follows. If it is more than 5.1V, go to "Check short to battery in harness" as follows

2. Check short to battery in harness

- 1) IG "OFF" and disconnect ECTS connector and ECM connector.
- 2) Measure resistance between terminals 2 and 3 of ECTS harness connector.

Specification : Infinite

- 3) Is the measured resistance within specification?

YES

► Go to "Component Inspection" procedure.

NO

► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

3. Check open in harness

- 1) IG "OFF" and disconnect ECTS connector and ECM connector.
- 2) Measure resistance between terminal 3 of ECTS harness connector and terminal 7 of ECM harness connector(C144-B).

Specification : Below 1Ω

- 3) Is the measured resistance within specification?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

DTC TROUBLESHOOTING PROCEDURES

FLB -529

- Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E2601FB3

1. IG "OFF" and disconnect ECTS connector.
2. Measure voltage between terminal 3 of ECTS harness connector and chassis ground.
3. Measure voltage between terminals 1 and 3 of ECTS harness connector.

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification?

YES

- Go to "Component Inspection" procedure.

NO

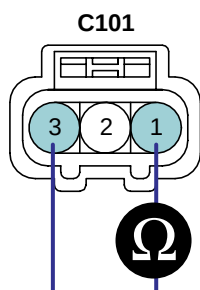
- Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E1D36F0F

1. Check ECTS
 - 1) IG "OFF" and disconnect ECTS connector.
 - 2) Measure resistance between terminals 1 and 3 of ECTS connector.(Component side)

SPECIFICATON :

Temp. (°C/°F)	Resistance (kΩ)	Temp. (°C/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		



1. ECTS Ground
2. To Gauge
3. ECTS Signal

SBLF26670L

- 3) Is the measured resistance within specification?

YES

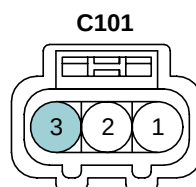
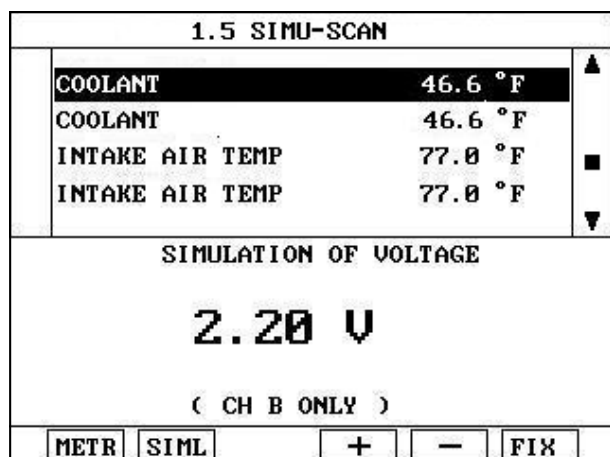
- Go to "Check ECM" as follows.

NO

► Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, replace ECTS and go to "Verification of Vehicle Repair" procedure.

2. Check ECM

- 1) IG "OFF" and connect scantool.
- 2) Connect probe to terminal 3 of ECTS harness connector.
- 3) IG "ON" and ENG "OFF" and simulation Function on scantool.
- 4) Simulate voltage at terminal 3 of ECTS harness connector.



1. ECTS Ground
2. To Gauge
3. ECTS Signal

SBLF26671L

- 5) Does the signal value of ECT sensor change according to simulation voltage ?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

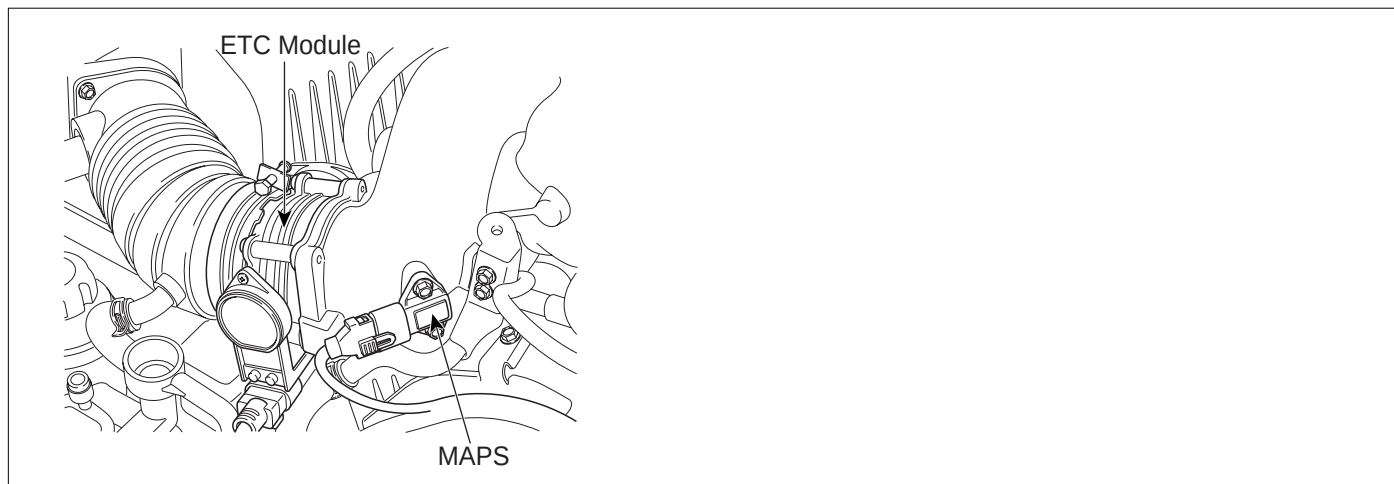
VERIFICATION OF VEHICLE REPAIR

EF33B6E8

Refer to DTC P1114.

DTC P1295 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - POWER MANAGEMENT

COMPONENT LOCATION EC18F80C



SBLF26703L

GENERAL DESCRIPTION EE790C7C

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1 & 2 and Accelerator Position Sensor(APS) 1 & 2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION ED0E9357

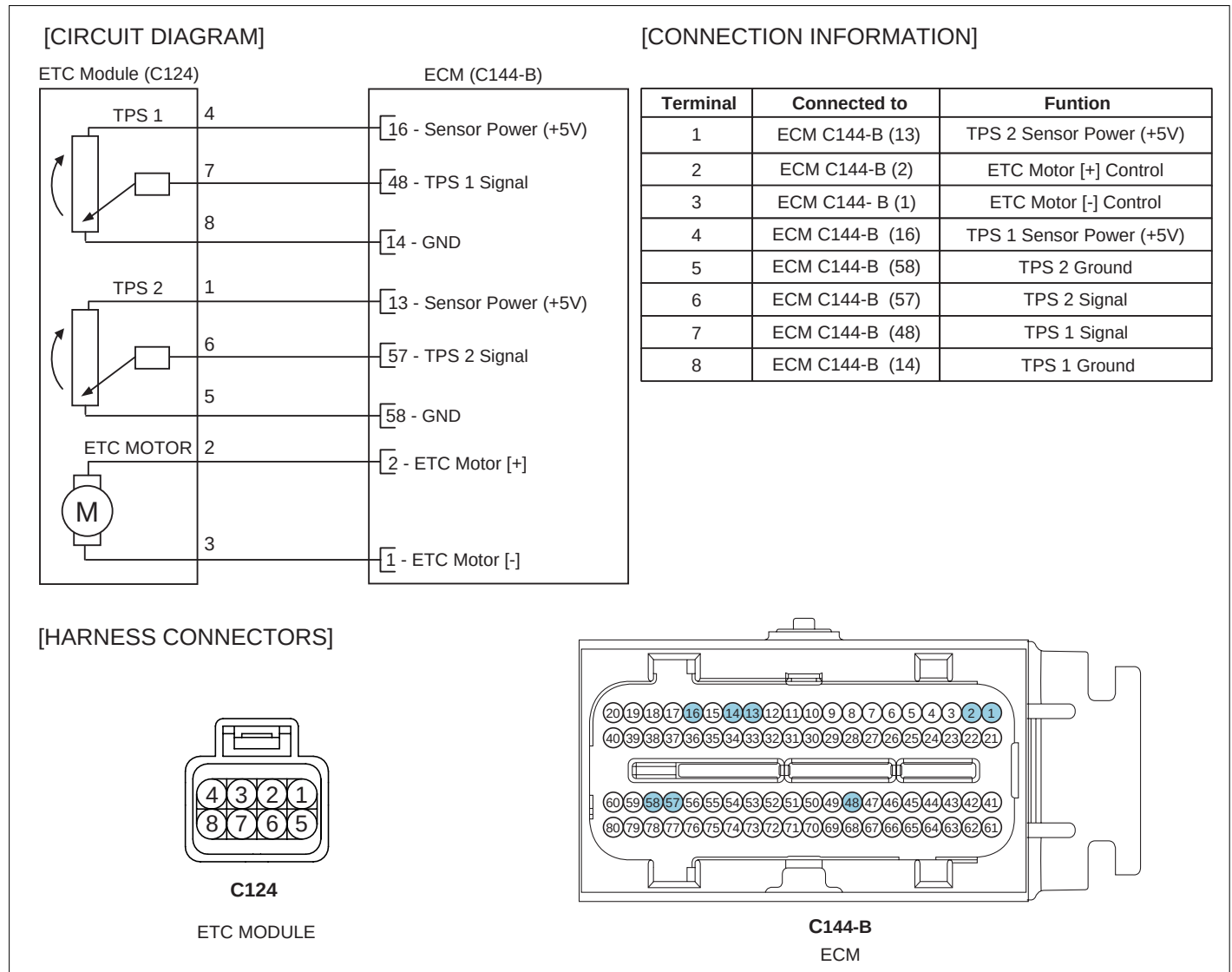
If power management mode is recognized under detecting condition, ECM sets P1295. And MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E26A08B2

Item	Detecting Condition	Possible cause
DTC Strategy	This code detects if the system is in Power Management Mode	- TPS Malfunction - TPS Malfunction + MAFSMalfunction - MAP Malfunction + TPSTMalfunction - Faulty ECM
EnableConditions	Ignition On	
Threshold value	Power Management Mode is active	
DiagnosisTime	-	
MIL On Condition	1 Driving Cycle	

SCHEMATIC DIAGRAM

E497CBB7



SBLF26201L

MONITOR SCANTOOL DATA

E03EF739

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
(There will be at least one more DTC which causes this DTC P1295 to retrieve)
3. Repair the DTCs cause DTC P1295 first according to the designated trouble shooting guide.
(After repairing the DTCs cause DTC P1295, don't forget to do "ETC Initialization" as follows.
4. Is the same DTC occurred ?

YES

►Substitute with a known-good ECM and check for proper operation. If the problem is corrected,replace ECM and then go to "Verification of Vehicle Repair" procedure.

 NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR

E4679F6A

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P1523 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - THROTTLE VALVE STUCK

COMPONENT LOCATION E1B4FAAD



SBLF26703L

GENERAL DESCRIPTION E0CF8BD2

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1 & 2 and Accelerator Position Sensor(APS) 1 & 2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E1495E71

Checking throttle valve return state, under detecting condition, if an output signal is within the threshold value for more than designated time, ECM sets P1523.

DTC DETECTING CONDITION E4C7C5C4

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor throttle valve return state	• Carbon in throttle • Broken Throttle return spring • throttle sticky • throttle icy • ECM
EnableConditions	• ETC Power Control Mode • TPS 1 & 2 = normal • Sensor Supply voltage = Normal	
Threshold value	• The throttle did not return to default range within 1 to 4 seconds of turning off. That is, (TPS1's signal > 0.9V AND TPS1's signal < 1.85V) or (TPS2's signal < 1.85V AND TPS2's signal > 0.9V) when the power to the ETC motor is turned off.	
DiagnosisTime	• Continuous	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION E8F5A81A

Throttle opening (°)	Output voltage (V) [Vref = 5.0V]	
	TPS1	TPS2
0°	0.0V	5.0V
10°	0.5V	4.5V
20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V

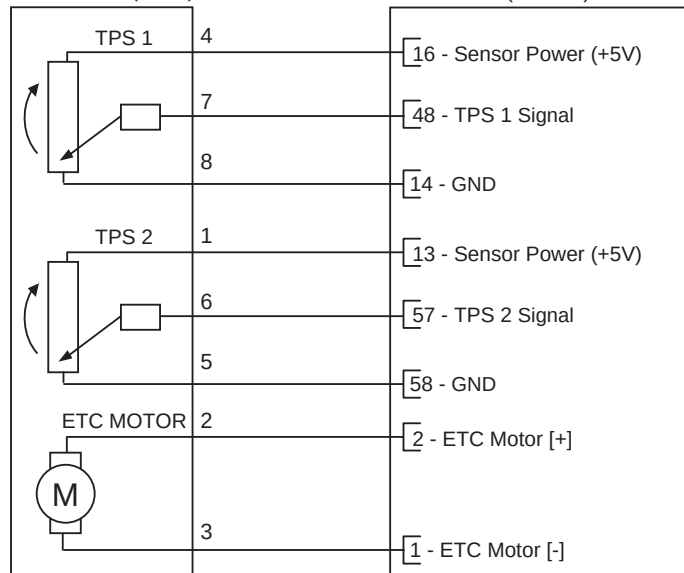
SCHEMATIC DIAGRAM

E29D9790

[CIRCUIT DIAGRAM]

ETC Module (C124)

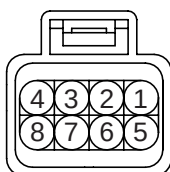
ECM (C144-B)



[CONNECTION INFORMATION]

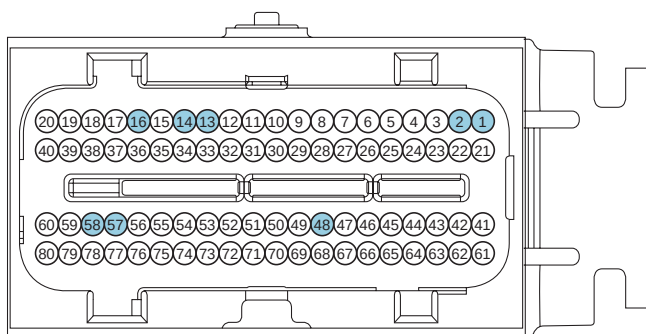
Terminal	Connected to	Funtion
1	ECM C144-B (13)	TPS 2 Sensor Power (+5V)
2	ECM C144-B (2)	ETC Motor [+] Control
3	ECM C144- B (1)	ETC Motor [-] Control
4	ECM C144-B (16)	TPS 1 Sensor Power (+5V)
5	ECM C144-B (58)	TPS 2 Ground
6	ECM C144-B (57)	TPS 2 Signal
7	ECM C144-B (48)	TPS 1 Signal
8	ECM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]



C124

ETC MODULE



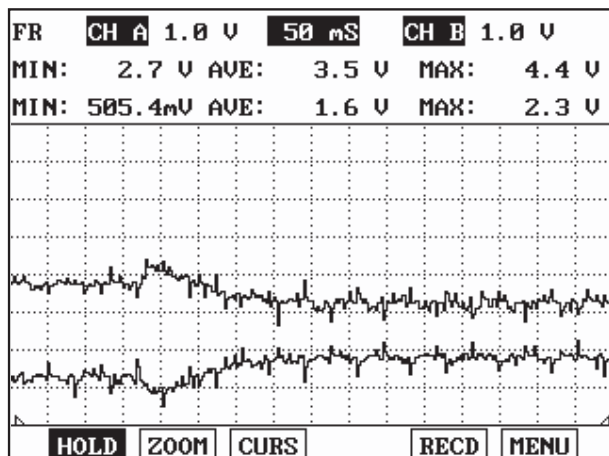
C144-B

ECM

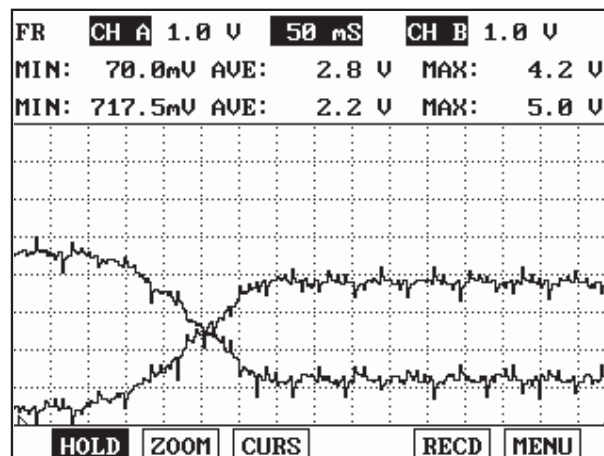
SBLF26201L

SIGNAL WAVEFROM AND DATA

E50042A7



When stepping on accelleraton



When pulling out acceleration cable with hand.

SCMF16675N

MONITOR DTC STATUS

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES					
PXXXX DTC TITLE					
NUMBER OF DTC : 1 ITEMS					
PART	ERAS		DTAL		

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SFPEI 6401N

- 5) Is parameter displayed "Present fault"?

YES

- Go to "System Inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

SYSTEM INSPECTION FD874E3F

1. Visual Inspection
 - 1) IG "OFF".
 - 2) Check throttle valve after removing air duct.
 - Carbon deposit.
 - Throttle icy
 - Broken return spring.
 - Throttle sticky
 - 3) Is the throttle valve return O.K ?

YES

► Thoroughly check that something interferes throttle movement and perform ETS Initialization as follows and then, go to "Verification of Vehicle Repair" procedure.

NO

► Repair or replace as necessary and then, do ETS Initialization" as follows. then, go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E306EDBA

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P2104 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - FORCED IDLE

COMPONENT LOCATION E189CEFE



SBLF26703L

GENERAL DESCRIPTION E4D386F3

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1 & 2 and Accelerator Position Sensor(APS) 1 & 2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E88A8898

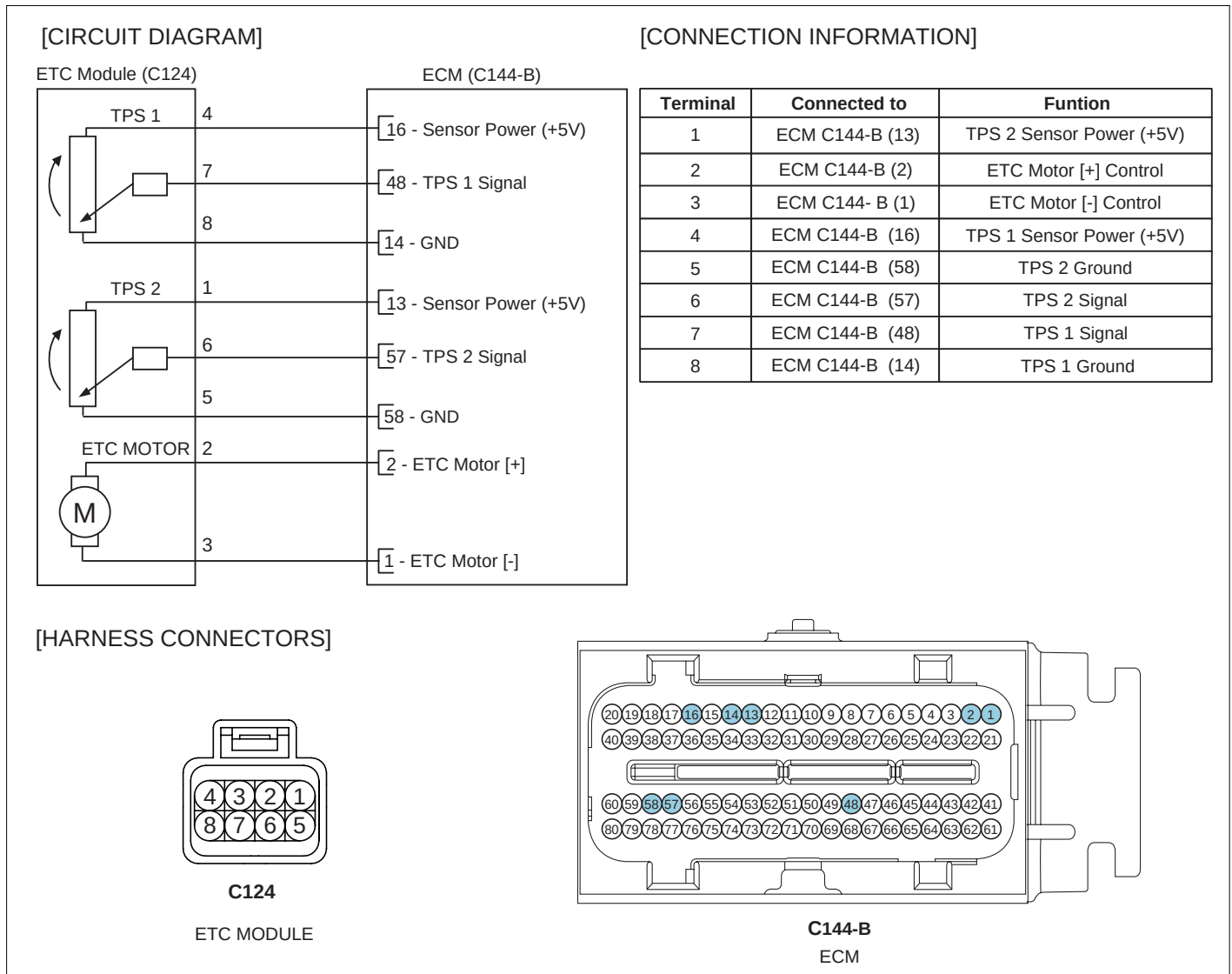
ECM recognizes vehicle state as forced idle under detecting condition, and sets P2104. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E60C5B82

Item	Detecting Condition	Possible cause
DTC Strategy	• This code detects if the system is in Forced Idle Mode	• Faulty APS • Faulty APS+Brake • Faulty APS + Vehicle speed sensor • Faulty APS + Vehicle speed sensor + Brake • Faulty ECM
EnableConditions	• Ignition "ON"	
Threshold value	• Forced Idle Mode is active	
DiagnosisTime	• -	
MIL On Condition	• 1 Driving Cycles	

SCHEMATIC DIAGRAM

E8F707B7



SBLF26201L

MONITOR SCANTOOL DATA

E81A9318

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
(There will be at least one more DTC which causes this DTC P2104 to retrieve)
3. Repair the DTCs cause DTC P2104 first according to the designated trouble shooting guide.
(After repairing the DTCs cause DTC P2104 , don't forget to do "ETC Initialization" as follows.
4. Is the same DTC occurred ?

YES

►Substitute with a known-good ECM and check for proper operation. If the problem is corrected,replace ECM and then go to "Verification of Vehicle Repair" procedure.

 NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR EFA21636

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P2105 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - FORCED ENGINE SHUTDOWN

COMPONENT LOCATION ECA09E3F

Refer to DTC P2104.

GENERAL DESCRIPTION E468E8DD

Refer to DTC P2104.

DTC DESCRIPTION EA60FD5F

If ECM recognizes vehicle state as forced engine shutdown under detecting condition, it sets P2105 and then MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E1E93472

Item	Detecting Condition	Possible cause
DTC Strategy	This code detects if the system is in Forced Engine Shutdown Mode	- Faulty AFS+MAPS+ETS - Faulty ECM
EnableConditions	Ignition "ON"	
Threshold value	Forced Engine Shutdown Mode Active	
DiagnosisTime	-	
MIL On Condition	1 Driving Cycle	

SCHEMATIC DIAGRAM E332902D

Refer to DTC P2104.

MONITOR SCANTOOL DATA EA3D5F7B

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
(There will be at least one more DTC which causes this DTC P2105 to retrieve)
3. Repair the DTCs cause DTC P2105 first according to the designated trouble shooting guide.
(After repairing the DTCs cause DTC P2105 , don't forget to do "ETC Initialization" as follows.
4. Is the same DTC occurred ?

YES

►Substitute with a known-good ECM and check for proper operation. If the problem is corrected,replace ECM and then go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automaticallydetected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR EC8588CD

Refer to DTC P2104.

DTC P2106 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - FORCED LIMITED POWER

COMPONENT LOCATION EC9B68EC

Refer to DTC P2104.

GENERAL DESCRIPTION ECE544D6

Refer to DTC P2104.

DTC DESCRIPTION EC760CDC

If ECM recognizes vehicle state as forced limited power mode under detecting condition, it sets P2106 and then MIL (Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EDB78D6C

Item	Detecting Condition	Possible cause
DTC Strategy	This code detects if the system is in Limit Performance Mode	- Faulty APS - Faulty APS+Brake - Faulty APS + Vehicle speed sensor - Faulty APS + Vehicle speed sensor + Brake - Faulty ECM
EnableConditions	Ignition "ON"	
Threshold value	Limit Performance Mode is active	
DiagnosisTime	-	
MIL On Condition	1 Driving Cycle	

SCHEMATIC DIAGRAM ECA39001

Refer to DTC P2104.

MONITOR SCANTOOL DATA E10A781B

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
(There will be at least one more DTC which causes this DTC P2106 to retrieve)
3. Repair the DTCs cause DTC P2106 first according to the designated trouble shooting guide.
(After repairing the DTCs cause DTC P2106 , don't forget to do "ETC Initialization" as follows.
4. Is the same DTC occurred ?

YES

► Substitute with a known-good ECM and check for proper operation. If the problem is corrected, replace ECM and then go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E837E127

Refer to DTC P2104.

DTC P2122 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT LOW INPUT

COMPONENT LOCATION E4EFA514



SBLF26714L

GENERAL DESCRIPTION E0292735

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS) 1 & 2 and Accelerator Position Sensor(APS) 1 & 2. The APS is mounted in the accelerator pedal to detect the opening angle of the accelerator pedal. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator position sensor. The ECM judges the current opening angle of the accelerator pedal from APS1 & 2, and the ECM controls the throttle motor based on these signals.

DTC DESCRIPTION E94FDD7

Checking output signals from APS 1, under detecting condition, if output signals are below the threshold, ECM sets P2122. MIL(Malfunction Indication Lamp) turns on.

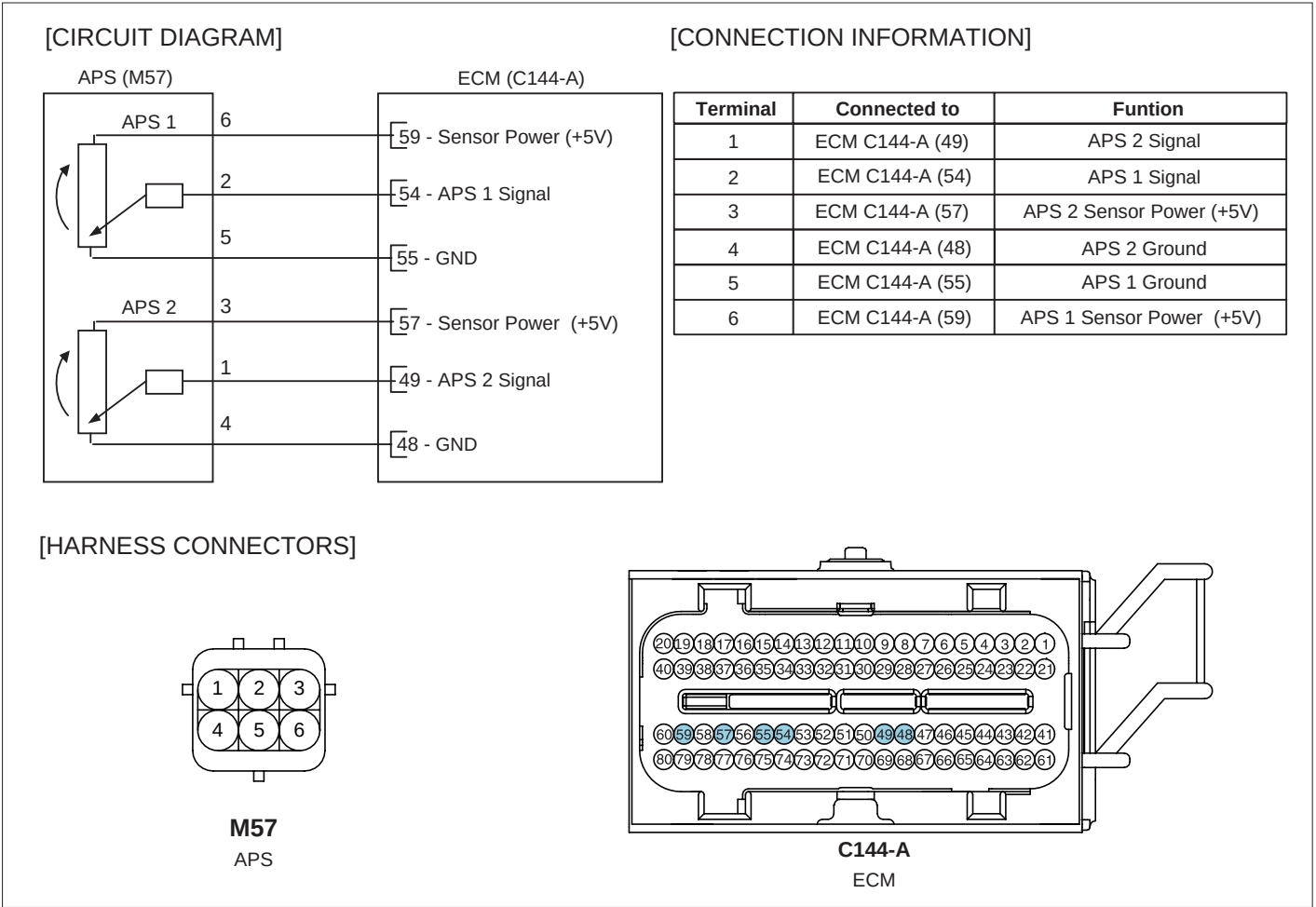
DTC DETECTING CONDITION EFE4396B

Item	Detecting Condition	Possible Cause
DTC Strategy	This code detects a continuous short to ground or open in either the circuit or the sensor (0-100%)	- Poor connection - Open or short to ground in Power circuit - Open or short to ground in Signal Circuit - Faulty APS - Faulty ECM
EnableConditions	Ignition "ON"	
Threshold	APS1 < 0.125V	
Diagnosis Time	Continuous	
MIL On Condition	1 Driving Cycle	

SPECIFICATION E367E699

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V

SCHEMATIC DIAGRAM EF6F3B25



SBLF26215L

SIGNAL WAVEFROM AND DATA E7D578C3

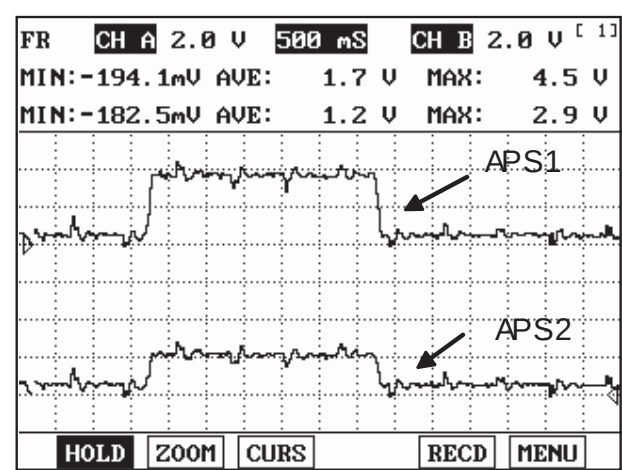


Fig. 1

Fig. 1 : This is a signal waveform of APS 1 & 2 which shows that APS 2 increases voltage just half of APS 1 voltage increase when accelleration.

EGRF970A

MONITOR DTC STATUS

E07BE340

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

EB4ABFEA

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

DTC TROUBLESHOOTING PROCEDURES

FLB -549

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION E35B4CF0

1. IG "OFF" and disconnect APS connector.
2. IG "ON" & ENG "OFF"
3. Measure voltage between harness terminal 6 of APS and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES

► Go to "Signal Circuit Inspection" procedure.

NO

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E76D1CA8

1. Check short to ground in harness
 - 1) IG "OFF".
 - 2) Disconnect APS & ECM connector.
 - 3) Measure resistance between terminal 2 of APS harness connector and chassis ground.
 - 4) Measure resistance between terminal 2 and 4 of APS harness connector.
 - 5) Measure resistance between terminal 2 and 5 of APS harness connector.

Specification : Infinite

- 6) Is the measured resistance within specification ?

YES

► Go to "Check open in harness" as follows.

NO

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

2. Check open in harness

- 1) IG "OFF"
- 2) Disconnect "APS" and "ECM" connector.
- 3) Measure resistance between terminal 2 of APS harness connector and terminal 54 of ECM harness connector(C144-A).

Specification : Approx. below 1Ω

4) Is the measured resistance within in specification ?

YES

► Go to "Component Inspection" procedure.

NO

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

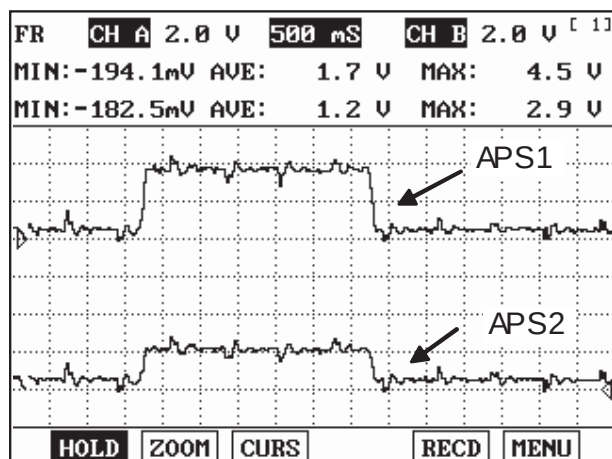
COMPONENT INSPECTION E3BE8611

1. Check APS

- 1) IG "ON" & ENG "OFF".
- 2) Measure signal waveform of APS by pressing and depressing accellerator pedal.

SPECIFICATION :

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V



EGRF975A

3) Is the measured signal waveform O.K ?

YES

► Substitute with a known-good ECM and check for proper operation. If the problem is corrected,replace ECM and then go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automaticallydetected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known-good APS and check for proper operation. If the problem is corrected, replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E85CDB0B

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

FLB -552

FUEL SYSTEM

DTC P2123 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT HIGH INPUT

COMPONENT LOCATION E5BE582F

Refer to DTC P2122.

GENERAL DESCRIPTION E7EF2630

Refer to DTC P2122.

DTC DESCRIPTION EDFAB881

Checking output signals from APS 1, under detecting condition, if output signals are above the threshold, ECM sets P2123. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EE153B41

Item	Detecting Condition	Possible Cause
DTC Strategy	This code detects a short to high in either the circuit or the sensor	- Poor connection - Short to battery in signal circuit. - Open in Ground Circuit. - Faulty APS - Faulty ECM
EnableConditions	Ignition "ON"	
Threshold	APS1 > 4.5V	
Diagnosis Time	Continuous	
MIL On Condition	1 Driving Cycle	

SPECIFICATION EF4376D4

Refer to DTC P2122.

SCHEMATIC DIAGRAM E4D35D97

Refer to DTC P2122.

SIGNAL WAVEFROM AND DATA E976AF2C

Refer to DTC P2122.

MONITOR DTC STATUS ED73CBBF

Refer to DTC P2122.

TERMINAL AND CONNECTOR INSPECTION E381FD00

Refer to DTC P2122.

SIGNAL CIRCUIT INSPECTION EB92AEBE

1. Check short to battery in harness

DTC TROUBLESHOOTING PROCEDURES

FLB -553

- 1) IG "OFF".
- 2) Disconnect APS and ECM connector.
- 3) Measure resistance between terminal 2 and 3 of APS harness connector.
- 4) Measure resistance between terminal 2 and 6 of APS harness connector.

Specification : Infinite

- 5) Is the measured resistance within specification ?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E2A69CED

1. Check open in harness
 - 1) IG "OFF".
 - 2) Disconnect APS connector.
 - 3) Measure voltage between terminal 6 of APS harness connector and chassis ground.(Fig. A)
 - 4) Measure voltage between terminal 6 and 5 of APS harness connector.(Fig. B)

Specification : Fig. "A" - Fig. "B" = approx. below. 200mV.

- 5) Is the measured voltage within specification ?

YES

► Go to "Component Inspection" procedure.

NO

► Repair or replace contact resistance or open in harness and then, go to "Verification of VehicleRepair" procedure.

COMPONENT INSPECTION ED5AEA80

1. Check APS
 - 1) Ignition "ON" & ENG "OFF".
 - 2) Measure waveform of APS by pressing and depressing accellerator pedal with scantool.

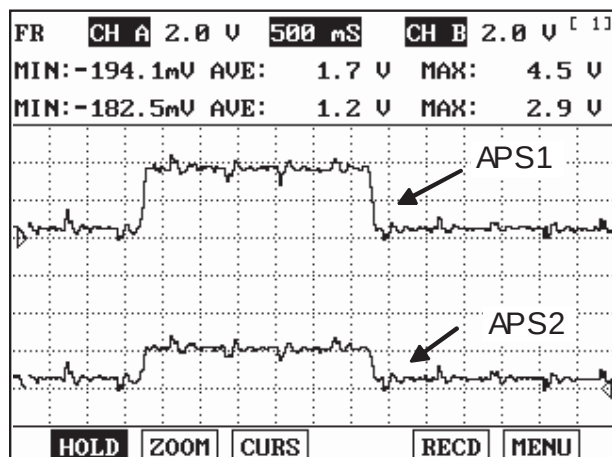
SPECIFICATION :

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2

FLB -554

FUEL SYSTEM

C.T	0.7 ~ 0.8V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V



EGRF975A

3) Is the measured signal waveform O.K ?

YES

► Substitute with a known-good ECM and check for proper operation. If the problem is corrected, replace ECM and then go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known-good APS and check for proper operation. If the problem is corrected, replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E22DD30F

Refer to DTC P2122.

DTC TROUBLESHOOTING PROCEDURES

FLB -555

DTC P2127 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT LOW INPUT

COMPONENT LOCATION E7CF23E1

Refer to DTC P2122.

GENERAL DESCRIPTION E09B4EAB

Refer to DTC P2122.

DTC DESCRIPTION EE9DABF9

Checking output signals from APS 2, under detecting condition, if output signals are detected below the threshold, ECM sets P2127. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E9EBB6A

Item	Detecting Condition	Possible Cause
DTC Strategy	This code detects a continuous short to ground or open in either the circuit or the sensor	- Poor connection - Open or short to ground in Power circuit. - Open or short to ground in signal circuit. - Faulty APS - Faulty ECM
EnableConditions	Ignition "ON"	
Threshold	APS2 < 0.125V	
Diagnosis Time	Continueous	
MIL On Condition	1 Driving Cycle	

SPECIFICATION E567EB38

Refer to DTC P2122.

SCHEMATIC DIAGRAM ECFC119D

Refer to DTC P2122.

SIGNAL WAVEFROM AND DATA E81E61A0

Refer to DTC P2122.

MONITOR DTC STATUS EE241DBB

Refer to DTC P2122.

TERMINAL AND CONNECTOR INSPECTION EB2DD180

Refer to DTC P2122.

POWER CIRCUIT INSPECTION E8DDBDB6

1. IG "OFF".

FLB -556

FUEL SYSTEM

2. Disconnect APS connector.
3. IG "ON" & ENG "OFF".
4. Measure voltage between terminal 3 of APS harness connector and chassis ground.

Specification : Approx. 5V

5. Is the measured voltage within specification ?

YES

- ▶ Go to "Signal Circuit Inspection" procedure.

NO

- ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION

E5E73A55

1. Check short to ground in harness
 - 1) IG "OFF".
 - 2) Disconnect APS and ECM connector.
 - 3) Measure resistance between terminal 1 of APS harness connector and chassis ground.
 - 4) Measure resistance between terminal 1 and 4 of APS harness connector.
 - 5) Measure resistance between terminal 1 and 5 of APS harness connector.

Specification : Infinite

- 6) Is the measured resistance within specification ?

YES

- ▶ Go to "Check open in harness" as follows.

NO

- ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

2. Check open in harness
 - 1) IG "OFF".
 - 2) Disconnect APS and ECM connector.
 - 3) Measure resistance between terminal 1 of APS harness connector and terminal 49 of ECM harness connector(C144-A).

Specification : Approx. below 1Ω

- 4) Is the measured resistance within specification ?

YES

- Go to "Component Inspection" procedure.

NO

- Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

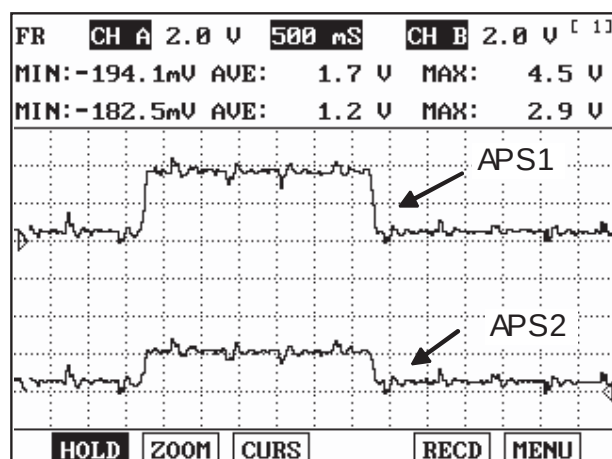
E616C4B6

1. Check APS

- 1) Ignition "ON" & ENG "OFF".
- 2) Measure waveform of APS by pressing and depressing accellerator pedal with scantool.

SPECIFICATION :

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V



EGRF975A

- 3) Is the measured signal waveform O.K ?

YES

- Substitute with a known-good ECM and check for proper operation. If the problem is corrected,replace ECM and then go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automaticallydetected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

- Substitute with a known-good APS and check for proper operation. If the problem is corrected,replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ECEA9FB1

Refer to DTC P2122.

DTC TROUBLESHOOTING PROCEDURES

FLB -559

DTC P2128 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT HIGH INPUT

COMPONENT LOCATION E036D108

Refer to DTC P2122.

GENERAL DESCRIPTION EF8EA1A5

Refer to DTC P2122.

DTC DESCRIPTION EDB4C910

Checking output signals from APS 2, under detecting condition, if output signals are above the threshold, ECM sets P2128. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EFB536A7

Item	Detecting Condition	Possible Cause
DTC Strategy	This code detects a short to high in either the circuit or the sensor	- Poor connection - Short to battery in Signal Circuit - Open in Ground Circuit - Faulty APS - Faulty ECM
EnableConditions	Ignition "ON"	
Threshold	APS2 > 3V	
Diagnosis Time	Continueous	
MIL On Condition	1 Driving Cycle	

SPECIFICATION E5BBC72B

Refer to DTC P2122.

SCHEMATIC DIAGRAM E881DBE7

Refer to DTC P2122.

SIGNAL WAVEFROM AND DATA EAA189F7

Refer to DTC P2122.

MONITOR DTC STATUS E013B9EF

Refer to DTC P2122.

TERMINAL AND CONNECTOR INSPECTION E0AAE301

Refer to DTC P2122.

SIGNAL CIRCUIT INSPECTION E244479B

1. Check short to battery in harness

- 1) IG "OFF".
- 2) Disconnect APS and ECM connector.
- 3) Measure resistance between terminal 1 and 3 of APS harness connector.
- 4) Measure resistance between terminal 1 and 6 of APS harness connector.

Specification : Infinite

- 5) Is the measured resistance within specification ?

YES

► Go to "Ground Circuit Inspection" procedure.

NO

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E0AFCF60

1. Check open in harness

- 1) IG "OFF"
- 2) Disconnect APS connector.
- 3) Measure voltage between terminal 3 of APS harness connector and chassis ground.(Fig. A)
- 4) Measure voltage between terminal 3 and 4 of APS harness connector.(Fig. B)

Specification : Fig."A" - Fig. "B" = Approx. below 200mV

- 5) Is the measured voltage within specification ?

YES

► Go to "Component Inspection" procedure.

NO

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E002CE51

1. Check APS

- 1) Ignition "ON" & ENG "OFF".
- 2) Measure waveform of APS by pressing and depressing accelerator pedal with scantool.

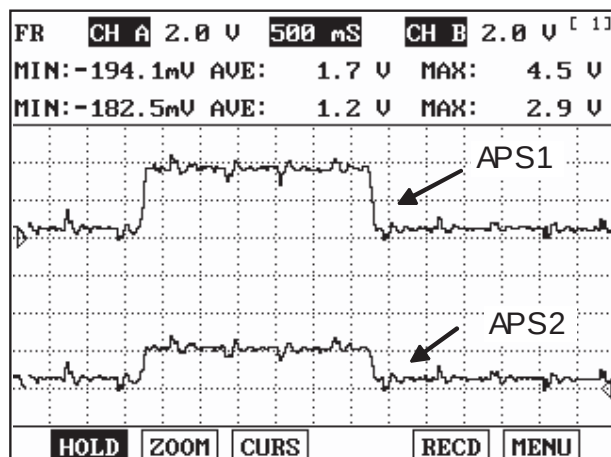
SPECIFICATION :

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2

DTC TROUBLESHOOTING PROCEDURES

FLB -561

C.T	0.7 ~ 0.8V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V



EGRF975A

3) Is the measured signal waveform O.K ?

YES

► Substitute with a known-good ECM and check for proper operation. If the problem is corrected, replace ECM and then go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known-good APS and check for proper operation. If the problem is corrected, replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

E41BC74C

Refer to DTC P2122.

DTC P2135 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" / "B" VOLTAGE CORRELATION

COMPONENT LOCATION E805E061



SBLF26703L

GENERAL DESCRIPTION EDBE048C

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1 & 2 and Accelerator Position Sensor(APS) 1 & 2. TPS1 & 2 are sharing the same source voltage and ground. The throttle valve opening is control by throttle motor which is controlled by Engine Control Module(ECM). The opposite position indicator shows inverted signal characteristics. TPS1 output voltage increases smoothly in proportion with the throttle valve opening angle after starting. TPS2 output voltage decreases in inverse proportion with the throttle valve opening angle after starting. TPS provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E1A6393E

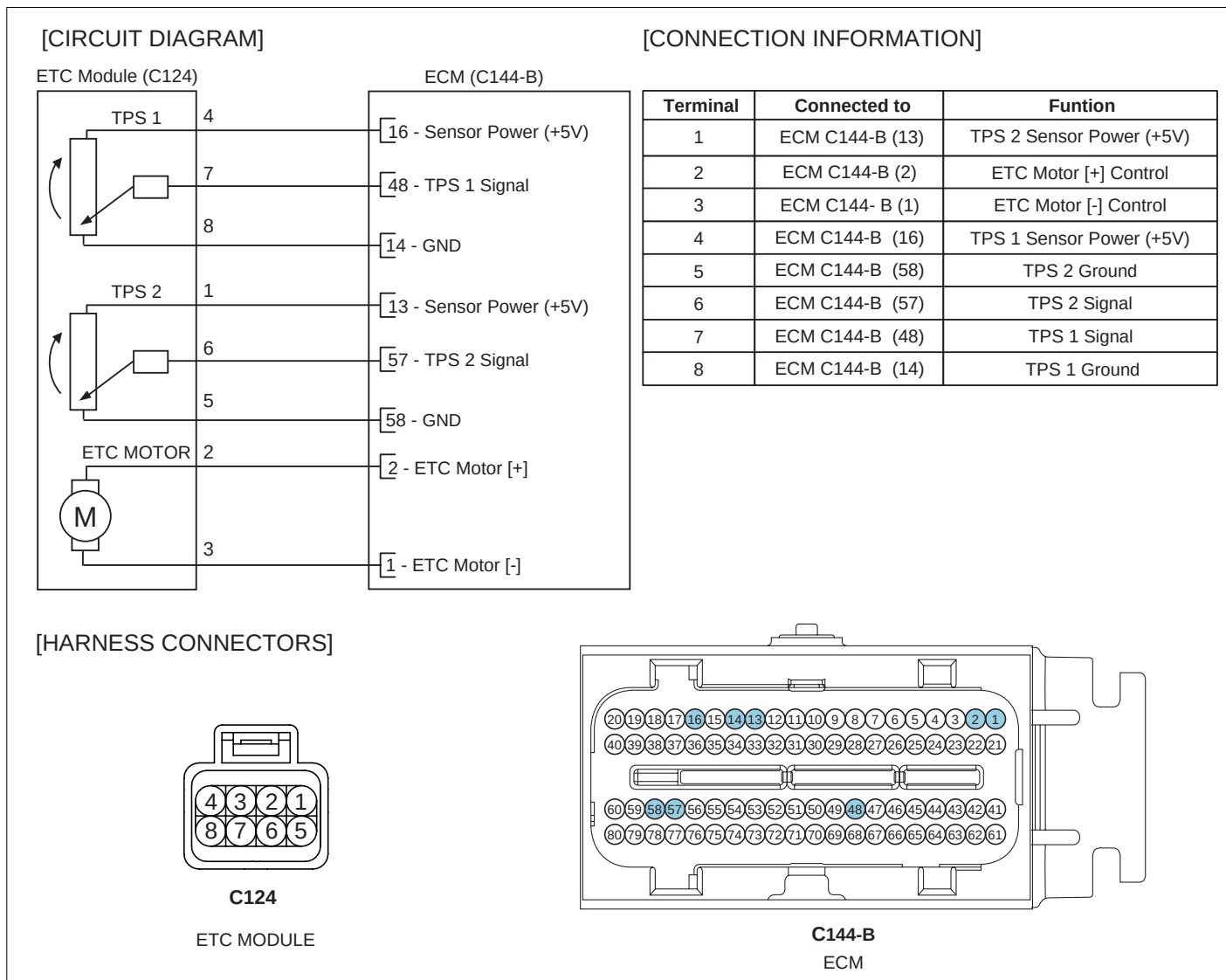
Checking output signals from TPS 1 and 2, under detecting condition, if output signals difference between TPS1 and TPS2 are detected more than 4.5% for the specified number of times., ECM sets P2135. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E7BDDC22

Item	Detecting Condition	Possible Cause
DTC Strategy	• Determines if TPS # 1 disagrees with TPS # 2	• Poor connection • Open or short in TPS circuit • Faulty TPS • Faulty ECM
Enable condition	• Ignition "ON"	
threshold value	• Difference between average values of TPS1 and TPS2 > 4.5%	
diagnosis time	• Continuous	
MIL ON condition	• 1 driving cycle	

SCHEMATIC DIAGRAM

EFB15972



SBLF26201L

SPECIFICATION

E30670AE

Throttle opening (°)	Output voltage(V) [Vref=5.0V]	
	TPS1	TPS2
0°	0.0V	5.0V
10°	0.5V	4.5V
20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V

FLB -564

FUEL SYSTEM

90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V

MONITOR DTC STATUS E6F31021

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E5D8EB83

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

DTC TROUBLESHOOTING PROCEDURES

FLB -565

YES

- ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

- ▶ Go to "Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION EB7A4293

1. IG "OFF".
2. Disconnect TPS connector.
3. IG "ON" & ENG "OFF".
4. Measure voltage between terminal 1 of TPS harness connector and chassis ground.
5. Measure voltage between terminal 4 of TPS harness connector and chassis ground.

Specification : Approx. 5V

6. Is the measured voltage within specification ?

YES

- ▶ Go to "Signal Circuit Inspection" procedure.

NO

- ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION EE6B5DA2

1. IG "OFF".
2. Disconnect TPS & ECM connector.
3. Measure resistance between terminal 6 and 7 of TPS harness connector.

Specification : Infinite

4. Is the measured resistance within specification ?

YES

- ▶ Go to "Component Inspection" procedure.

NO

- ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

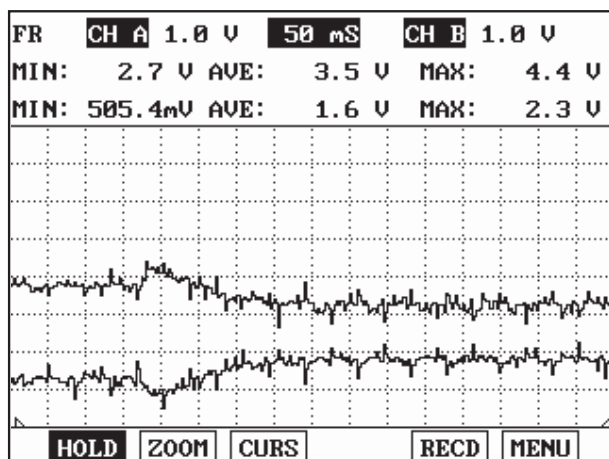
COMPONENT INSPECTION E8949822

1. Check TPS

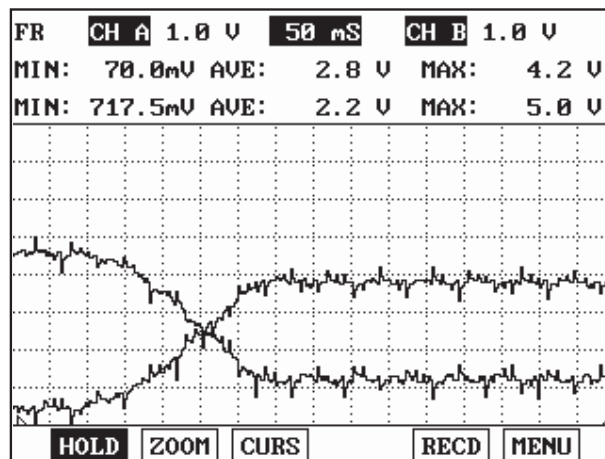
- 1) Ignition "ON" & ENG "OFF".
- 2) Monitor signal waveform of TPS by stepping on and off the accelerator pedal on scantool

SPECIFICATION :

Throttle opening (°)	Output voltage(V) [Vref=5.0V]	
	TPS1	TPS2
0°	0.0V	5.0V
10°	0.5V	4.5V
20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V



Pressing accelerator pedal at idle



Pulling out accelerator cable with hand at idle

EGRF986A

- 3) Is the measured signal waveform O.K ?

YES

► Substitute with a known-good ECM and check for proper operation. If the problem is corrected, replace ECM and then go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

- ▶ Substitute with a known-good TPS and check for proper operation. If the problem is corrected, replace TPS and then go to "Verification of Vehicle Repair" procedure.
(After replacing ETC, do initialization of ETC as follows)

※ **PROCEDURE OF ETS INITIALIZATION**

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off. (It will take 10sec.)
3. Turn ignition key on more than 1 second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E022D83B

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P2138 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" / "E" VOLTAGE CORRELATION

COMPONENT LOCATION E24B9368



SBLF26714L

GENERAL DESCRIPTION E190EB0C

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS) 1 & 2 and Accelerator Position Sensor(APS) 1 & 2. The APS is mounted in the accelerator pedal to detect the opening angle of the accelerator pedal. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator position sensor. The ECM judges the current opening angle of the accelerator pedal from APS1 & 2, and the ECM controls the throttle motor based on these signals.

DTC DESCRIPTION E7394F0E

Checking output signals from APS 1 and 2, under detecting condition, if output signals difference between APS 1 and 2 are detected more than 4.5% for the specified number of times., ECM sets P2138. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E91A3E98

Item	Detecting Condition	Possible Cause
DTC Strategy	This code detects a correlation error between APS 1 and APS 2	- Poor connection - Open or short in APS Circuit - Faulty APS - Faulty ECM
EnableConditions	Ignition "ON"	
Threshold	Difference between APS1 and APS2 Normalized values $> 4.5\%$	
Diagnosis Time	Continuous	
MIL On Condition	1 Driving Cycle	

SPECIFICATION E3569D38

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2

DTC TROUBLESHOOTING PROCEDURES

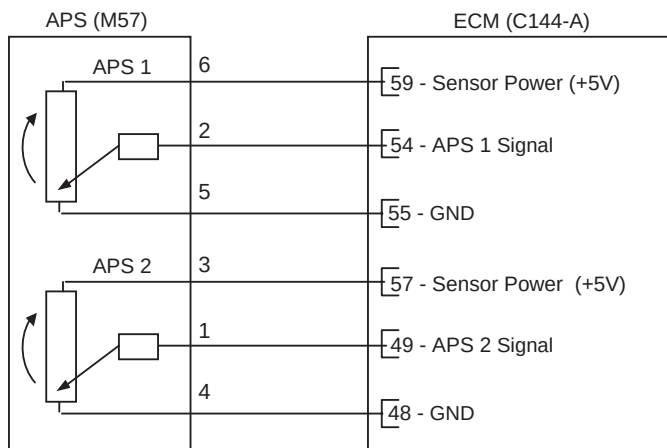
FLB -569

C.T	0.7 ~ 0.8V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V

SCHEMATIC DIAGRAM

EAD0867E

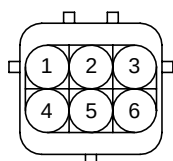
[CIRCUIT DIAGRAM]



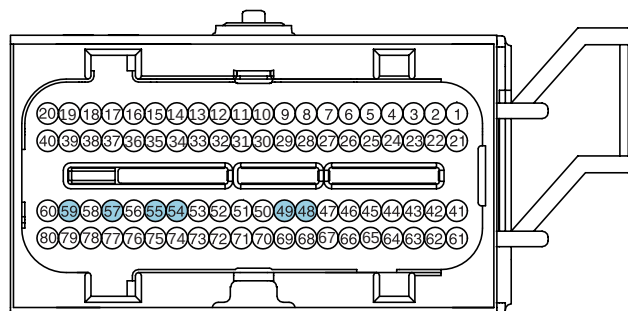
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C144-A (49)	APS 2 Signal
2	ECM C144-A (54)	APS 1 Signal
3	ECM C144-A (57)	APS 2 Sensor Power (+5V)
4	ECM C144-A (48)	APS 2 Ground
5	ECM C144-A (55)	APS 1 Ground
6	ECM C144-A (59)	APS 1 Sensor Power (+5V)

[HARNESS CONNECTORS]



M57
APS



C144-A
ECM

SBLF26215L

SIGNAL WAVEFROM AND DATA

E205FB14

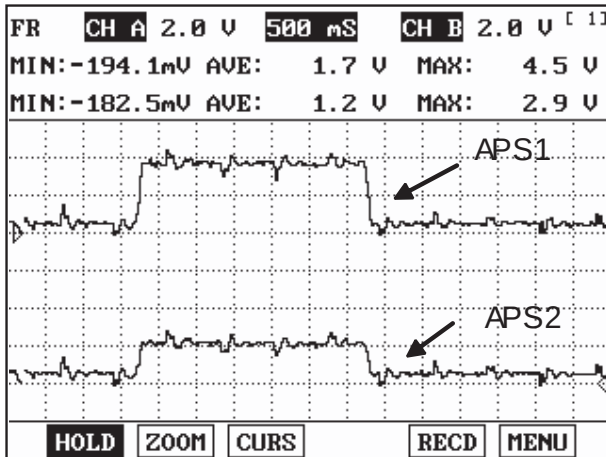


Fig. 1

Fig. 1 : This is a signal waveform of APS 1 & 2 which shows that APS 2 increases voltage just half of APS 1 voltage increase when acceleration.

EGRF970A

MONITOR DTC STATUS

E4796FA7

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EAE9C83A

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSPECTION E8342371

1. IG "OFF"
2. Disconnect APS connector.
3. IG "ON" & ENG "OFF".
4. Measure voltage between terminal 3 of APS harness connector and chassis ground.
5. Measure voltage between terminal 6 of APS harness connector and chassis ground.

Specification : Approx. 5V

6. Is the measured voltage within specification ?

YES

► Go to "Signal Circuit Inspection" procedure.

NO

► Repair or replace as necessary and then, go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E347FC6C

1. IG "OFF".
2. Disconnect APS and ECM connector.
3. Measure resistance between terminal 1 and 2 of APS harness connector.

Specification : Infinite

4. Is the measured resistance within specification ?

YES

► Go to "Component Inspection" procedure.

NO

► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EA9CB53

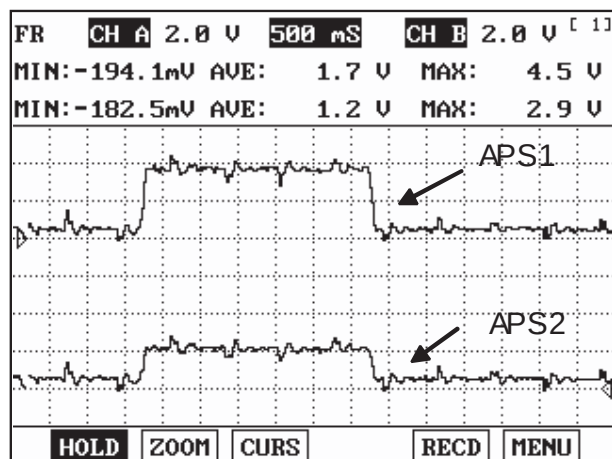
1. Check APS

1) IG "ON" & ENG "OFF".

2) Measure signal waveform of APS 1 and APS 2 by stepping on and off with scantool

SPECIFICATION :

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V



EGRF986E

3) Is the measured signal waveform O.K ?

YES

► Substitute with a known-good ECM and check for proper operation. If the problem is corrected, replace ECM and then go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Substitute with a known-good APS and check for proper operation. If the problem is corrected, replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E1E2C0B1

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

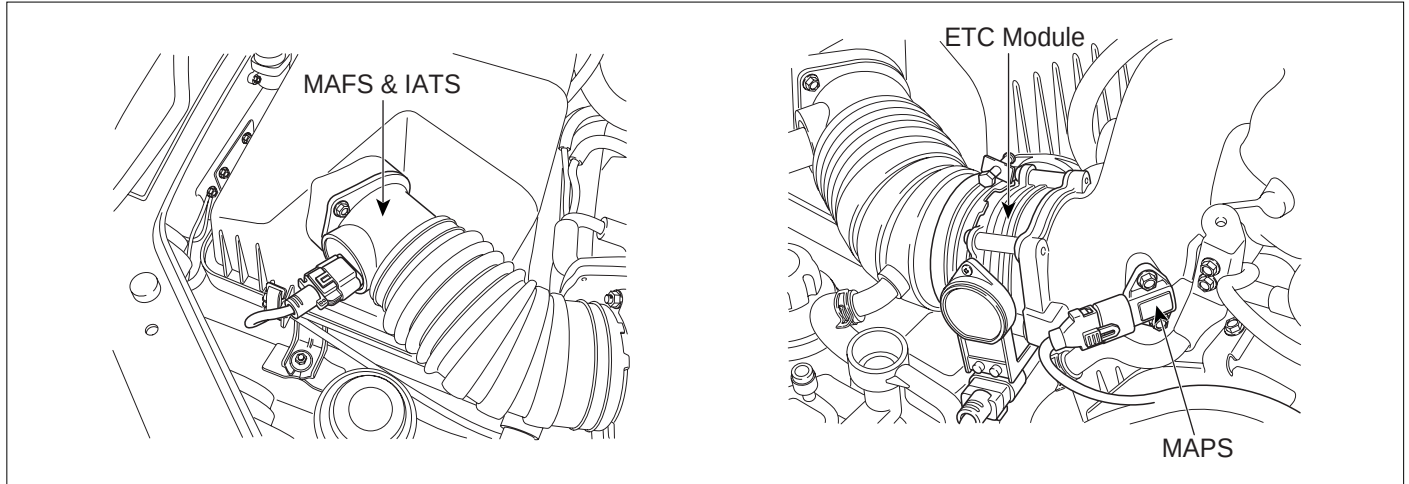
► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P2173 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - HIGH AIR FLOW DETECTED

COMPONENT LOCATION E9E4FC87



SBLF26727L

GENERAL DESCRIPTION E8BB515C

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1 & 2 and Accelerator Position Sensor(APS) 1 & 2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION EB56A7FF

Comparing real intake air flow and the intake air flow calculated by ETS under detecting condition, if the air flow more than threshold value is detected for more than 19 sec., ECM sets P2173. And then MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E8393963

Item		Detecting Condition	Possible Cause
DTC Strategy		Monitor the measured engine airflow and the estimated airflow	- Air Leakage between TPS and MAFS - aulty throttle body or intake manifold - Faulty ECM
EnableConditions		- Engine running - No faults present	
Threshold	Case 1	MAPS reading - ETC estimated airflow > 9 g/s	
	Case 2	MAFS reading - ETC estimated airflow > 7g/s	
Diagnosis Time		Contineous (Within 20 sec.)	
MIL On Condition		1 Driving Cycle	

DTC TROUBLESHOOTING PROCEDURES

FLB -575

SPECIFICATION EAAE0B27

MAFS

Air flow (kg/h)	Frequency (Hz)
0 kg/h	720 ~ 880 Hz
12.6 kg/h	2,595 Hz
18.0 kg/h	2,930 Hz
23.4 kg/h	3,208 Hz
32.4 kg/h	3,609 Hz
43.2 kg/h	3,975 Hz
57.6 kg/h	4,361 Hz
72.0 kg/h	4,683 Hz
108.0 kg/h	5,362 Hz
144.0 kg/h	5,885 Hz
198.0 kg/h	6,527 Hz
270.0 kg/h	7,219 Hz
360.0 kg/h	7,945 Hz
486.0 kg/h	8,736 Hz
666.0 kg/h	9,660 Hz
900.0 kg/h	10,613 Hz

TPS

Throttle opening (°)	Output voltage(V) [Vref=5.0V]	
	TPS1	TPS2
0°	0.0V	5.0V
10°	0.5V	4.5V
V20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V

MAPS

Pressure(kPa)	Output voltage(V)
20.0kPa	0.79V
35kPa	1.382V

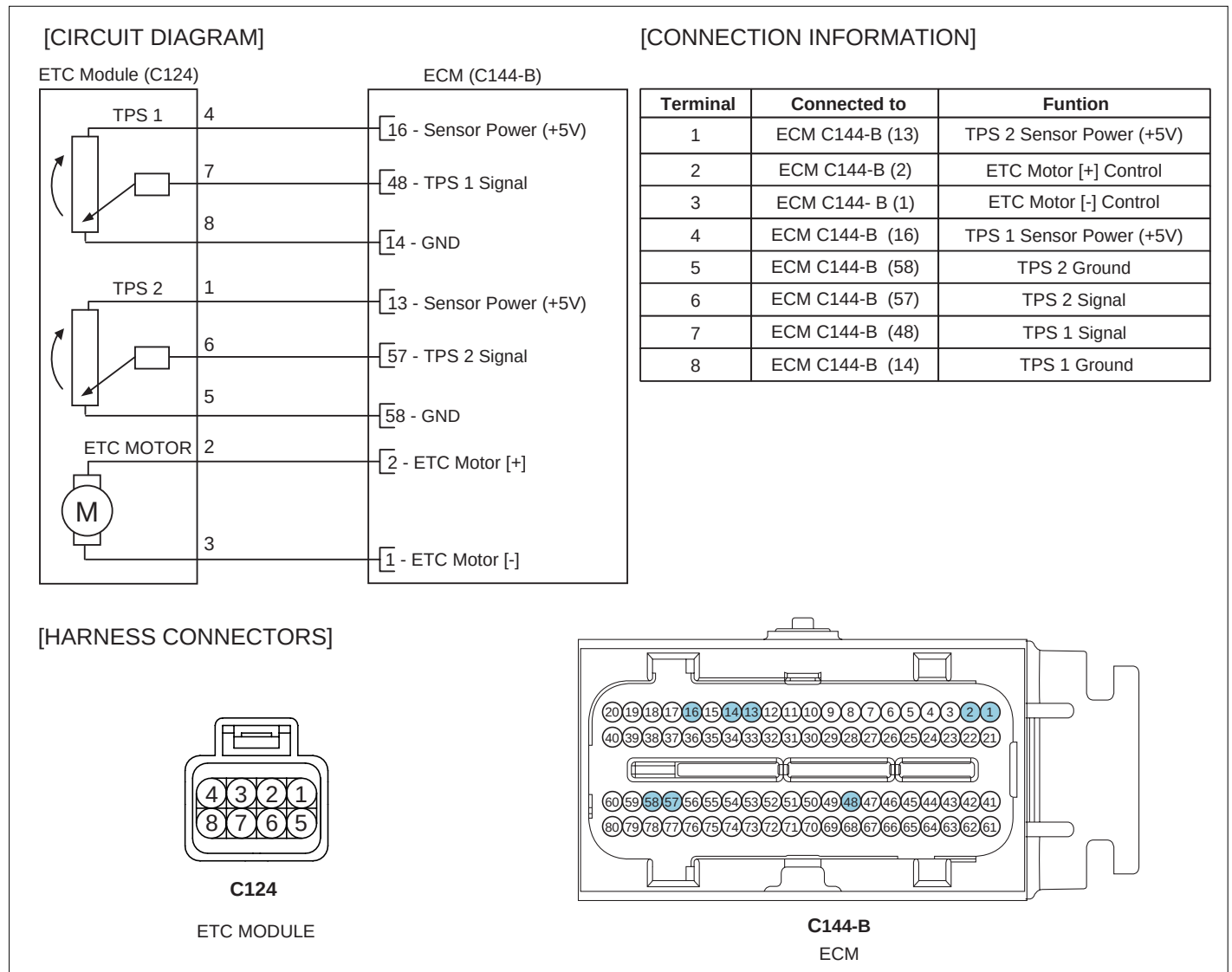
FLB -576

FUEL SYSTEM

46.66kPa	1.84V
60kPa	2.369V
90kPa	3.75V
101.32kPa	4.00V

SCHEMATIC DIAGRAM

E3990194



SBLF26201L

MONITOR DTC STATUS

E314E8FC

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

5) Is parameter displayed "Present fault"?

YES

► Go to "System Inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

SYSTEM INSPECTION E2664D16

1. Visual Inspection

- 1) Check the air hose between MAFS and throttle body is torn or installation.
- 2) Check deforamtion, crack or installation of throttle valve(body)
- 3) Has a problem been found ?

YES

► Substitute with a known-good Air hose or throttle body and check for proper operation. If the problem is corrected,replace air hose or throttle body and then go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known-good ECM and check for proper operation. If the problem is corrected,replace ECM and then go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automaticallydetected and memorized by ECM.

Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

※ PROCEDURE OF ETS INITIALIZATION

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E36703A3

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P2187 SYSTEM TOO LEAN AT IDLE (←ADDITIVE) (BANK 1)
DTC P2189 SYSTEM TOO LEAN AT IDLE (←ADDITIVE) (BANK 2)

GENERAL DESCRIPTION EB9A672E

In order to provide the best possible combination of drivability, fuel economy and emission control, the ECM uses a closed loop air/fuel metering system. The ECM monitors the HO2S signal voltage and adjusts fuel delivery based it in closed loop fuel control. Changes in fuel delivery will be indicated by the long-term and the short-term fuel trim values. The ideal fuel trim value is around 0%. The ECM will add fuel when the HO2S signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are above 0%. The ECM will reduce fuel when the HO2S signal is indicating a rich condition. Reduction in fuel is indicated by fuel trim values that are below 0%. The DTC relevant to fuel trim will be set when the amount reaches excessive levels because of a lean or rich condition.

DTC DESCRIPTION E42D5D9C

Checking the fuel trime value at idle under detecting condition, if its average exceeds the limit over certain period, ECM sets P2187. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EFCCFBFA

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the fuel trim value at idle	- Air leakage - Improper fuel pressure - PCV valve stuck - Clogging of injector
EnableConditions	- Engine warm-up sufficiently - Engine running under Idle state over 5 minutes 60°C(140°F) ≤ Engine coolant temperature ≤ 115°C(239°F) - No disabling faults (DTCs related to HO2S, purge valve,catalyst)	
Threshold value	Average of short term fuel trim > 0.8 and Average of long term fuel trim > 1.24	
DiagnosisTime	Continuous	
MIL On Condition	2 Driving Cycles	

MONITOR SCANTOOL DATA ED1F4422

- Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector or CVVT items with scantool.
- Are there the DTCs above-mentioned?

YES

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

NO

► Go to "System Inspection" procedure

SYSTEM INSPECTION E69371FB

- Check Air leakage
 - 1) Visually/physically inspect the air leakage in intake/exhaust system for following items

- ▶ Vacuum hoses for splits, kinks and improper connections.
- ▶ Throttle body gasket
- ▶ Gasket between intake manifold and cylinder head
- ▶ Seals between intake manifold and fuel injectors
- ▶ Exhaust system between HO2S and three way catalyst for air leakage

2) Has a problem found in this procedure?

YES

- ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Go to "Check the fuel line" as follows

2. Check the fuel line

1) Check the fuel line for following items

- ▶ Connector connection state
- ▶ Damage/ connection state for vacuum hoses connected to fuel line
- ▶ Bent/ pressed/ twisted fuel line or fuel leakage

2) Has a problem found in this procedure?

YES

- ▶ Repair or replace it which has a problem, and go to " Verification of Vehicle Repair" procedure.

NO

- ▶ Go to "Check fuel pressure" as follows

3. Check fuel pressure



NOTE

1. *Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.*
2. *The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.*

- 1) IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
- 2) Start-up and wait until it stops itself.
- 3) IG "OFF" and connect Fuel Pump Relay.
- 4) Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
- 5) Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
- 6) Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7) Is the measured fuel pressure within specifications ?

DTC TROUBLESHOOTING PROCEDURES

FLB -581

YES

- Go to "Component Inspection" procedure.

YES

- Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair"procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter,fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

COMPONENT INSPECTION

EB12E21E

1. Check PCV

- 1) IG "OFF" and remove PCV valve from rocker cover.
- 2) Insert a thin stick into the PCV valve from the threaded side and verify that the plunger is moving.
- 3) Is the PCV valve normally moving?

YES

- Go to "Check injector" as follows

NO

- Replace it, and go to "Verification of Vehicle Repair" procedure.

2. Check injector for normal operation

- 1) Start engine.
- 2) Check its RPM decrease when doing the injector's actuation test.
- 3) Is there any cylinder with no change in RPM or only a small change in RPM?

YES

- Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

NO

- Replace injector, and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

EDDC94C6

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions

3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -583

DTC P2188	SYSTEM TOO RICH AT IDLE (BANK 1)
DTC P2190	SYSTEM TOO RICH AT IDLE (BANK 2)

GENERAL DESCRIPTION E1E1CF85

In order to provide the best possible combination of drivability, fuel economy and emission control, the ECM uses a closed loop air/fuel metering system. The ECM monitors the HO2S signal voltage and adjusts fuel delivery based it in closed loop fuel control. Changes in fuel delivery will be indicated by the long-term and the short-term fuel trim values. The ideal fuel trim value is around 0%. The ECM will add fuel when the HO2S signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are above 0%. The ECM will reduce fuel when the HO2S signal is indicating a rich condition. Reduction in fuel is indicated by fuel trim values that are below 0%. The DTC relevant to fuel trim will be set when the amount reaches excessive levels because of a lean or rich condition.

DTC DESCRIPTION ED85DB4C

Checking the fuel trime value at idle under detecting condition, if its average exceeds the limit over certain period, ECM sets P2188. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E74F5DEC

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the fuel trim value at idle	- Blocking of intake system - Fuel leakage in injector - Improper fuel pressure
EnableConditions	- Engine warm-up sufficiently - Engine running under Idle state over 5 minutes 60°C(140°F) ≤ Engine coolant temperature ≤ 115°C(239°F) - No disabling faults (DTCs related to HO2S, purge valve,catalyst)	
Threshold value	Average of short term fuel trim < 1.5 and Average of long term fuel trim < 0.76	
DiagnosisTime	Continuous	
MIL On Condition	2 Driving Cycles	

MONITOR SCANTOOL DATA E02B6AFB

- Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector or CVVT items with scantool.
- Are there the DTCs above-mentioned?

YES

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

NO

► Go to "System Inspection" procedure

SYSTEM INSPECTION ECC3457D

- Check blocking of intake system
 - 1) Visually/physically inspect the air leakage in intake/exhaust system for following items

- ▶ Throttle body gasket and damage
- ▶ Blocking in intake manifold and injector caused by any foreign substance

2) Has a problem found?

YES

- ▶ Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Go to " Check fuel pressure" as follows.

2. Check fuel pressure



NOTE

1. *Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.*
2. *The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.*

- 1) IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
- 2) Start-up and wait until it stops itself.
- 3) IG "OFF" and connect Fuel Pump Relay.
- 4) Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
- 5) Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
- 6) Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7) Is the measured fuel pressure within specifications ?

YES

- ▶ Go to "Component Inspection" procedure.

YES

- ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

3. Check fuel leakage in injector

- 1) IG "OFF" after checking the fuel pressure test.
- 2) Stop engine and check for a change in the fuel pressure gauge reading for 5 minutes.

DTC TROUBLESHOOTING PROCEDURES

FLB -585

Specification : After engine stops, fuel gauge reading is maintained for 5 minutes.

3) Is the fuel gauge reading maintained ?

YES

► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

NO

► There is a fuel leakage in injector. Replace it, and go to " Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EE659CD4

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

DTC P2195 HO2S SIGNAL STUCK LEAN (BANK 1 / SENSOR 1)

COMPONENT LOCATION E70B308E



SBLF26707L

GENERAL DESCRIPTION EEF539E7

In order to control emissions of the CO, HC and NO_x components of the exhaust gas, heated oxygen sensor (HO2S), mounted on the front side and rear side of catalytic converter, detects the oxygen content in the exhaust gas. The front HO2S signal is used to control air/fuel ratio (closed loop fuel control) and the rear HO2S signal is used to monitor front HO2S and catalyst for proper operation. The HO2S requires a minimum temperature to operate properly and provide a closed loop fuel control system. The HO2S contains the heater element to reduce its warming-up time and ensure its performance during all driving conditions. The oxygen sensor generates a voltage that indicates the difference between the oxygen content of the exhaust stream and the oxygen content of ambient air. When the exhaust stream is “ rich,” there is more oxygen in the ambient air than in the exhaust stream, so the voltage will be higher.

DTC DESCRIPTION E0FBC1AA

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, ECM sets P2195. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF1FB0C9

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Clogging of fuel filter in fuel pump - Faulty ECM
EnableConditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60\text{sec.}$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $\leq 0.35V$ and Air Fuel Ratio ≤ 13.5	
DiagnosisTime	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

DTC TROUBLESHOOTING PROCEDURES

FLB -587

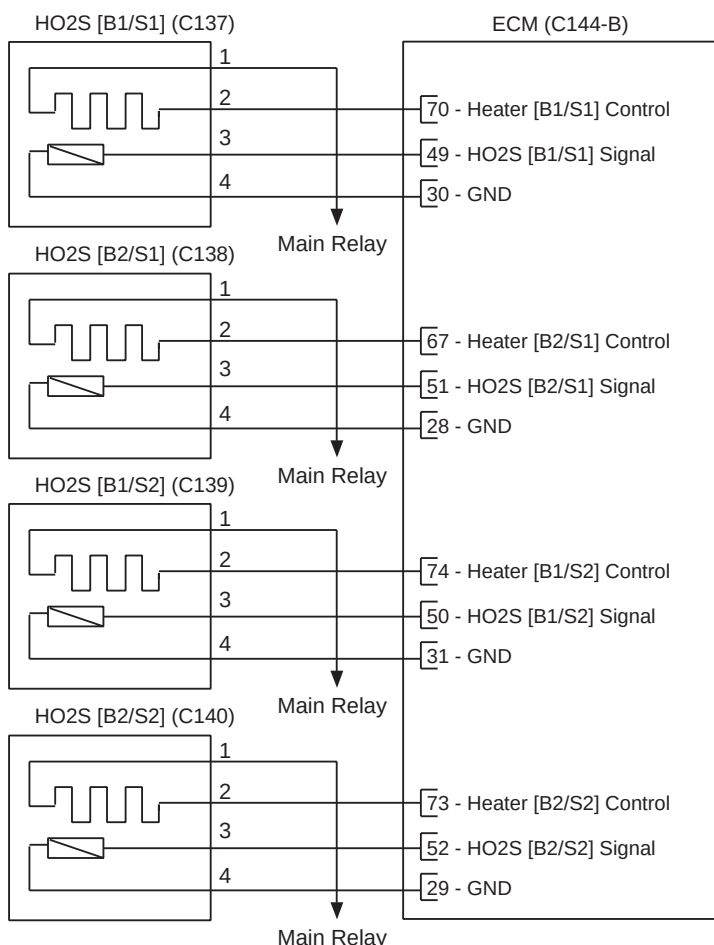
SPECIFICATION E3BB7F8C

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit(Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit(Pumping current ON)	Approx. 3.5V	

SCHEMATIC DIAGRAM

E1181AD2

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

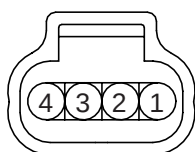
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

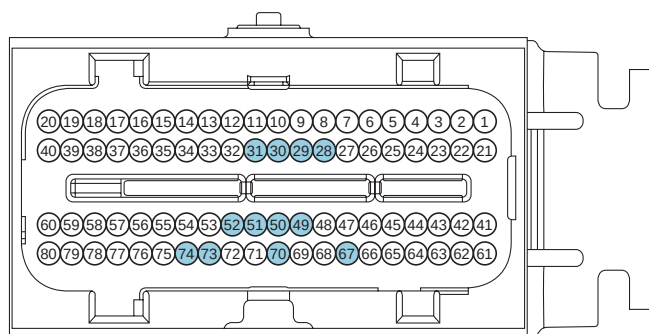
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SIGNAL WAVEFROM AND DATA EC10D4B1

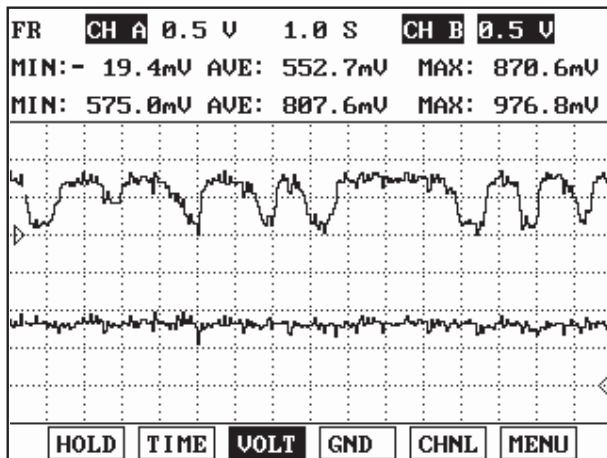


Fig. 1

Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6611N

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

MONITOR DTC STATUS ED394B82

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

E7D959B4

1. Check the condition of HO2S

- 1) Check HO2S for poor connection or loose terminal.
- 2) Check if HO2S is ensurely installed.
- 3) Is the conditions of HO2S normal ?

YES

► Go to "Check the Signal waveform of HO2S" as follows.

NO

► Repair it and then go to "Verification of Vehicle Repair" procedure.

2. Check the Signal waveform of HO2S

- 1) IG "OFF" and connect HO2S connector.
- 2) Engine start.
- 3) After warming-up, monitor signal waveform of HO2S with scantool.

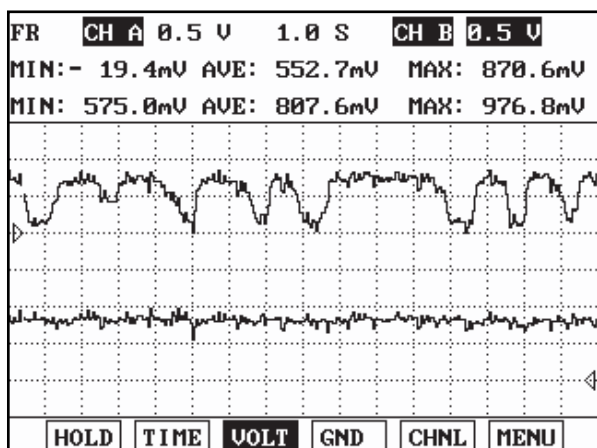


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6612N

- 4) Is the sensor switching properly?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -591

► Go to "Check fuel filter" as follows.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

3. Check the fuel filter of fuel pump

- 1) IG "OFF" and disconnect the fuel pump connector.
- 2) Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, IG "OFF"
- 3) Remove the fuel pump assembly.
- 4) Check the fuel filter for clogging by dust, a foreign substance.
- 5) Is the fuel filter O.K.?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good fuel filter and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E4BB012C

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

FLB -592

FUEL SYSTEM

DTC P2196 HO2S SIGNAL STUCK RICH (BANK 1 / SENSOR 1)

COMPONENT LOCATION E2A93C3E

Refer to DTC P2195.

GENERAL DESCRIPTION E11F3238

Refer to DTC P2195.

DTC DESCRIPTION E0D5F042

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, ECM sets P2196. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E61BB43C

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Faulty ECM
EnableConditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $\geq 0.42V$	
DiagnosisTime	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION E90D1BEC

Refer to DTC P2195.

SCHEMATIC DIAGRAM EA7461B8

Refer to DTC P2195.

SIGNAL WAVEFROM AND DATA E1E39E4F

Refer to DTC P2195.

MONITOR DTC STATUS EDF13406

Refer to DTC P2195.

COMPONENT INSPECTION E8881DD3

- Check the condition of HO2S
 - Check HO2S for poor connection or loose terminal.

DTC TROUBLESHOOTING PROCEDURES

FLB -593

2) Check if HO2S is ensurely installed.

3) Is the conditions of HO2S normal ?

YES

► Go to "Check the Signal waveform of HO2S" as follows.

NO

► Repair it and then go to "Verification of Vehicle Repair" procedure.

2. Check the Signal waveform of HO2S

1) IG "OFF" and connect HO2S connector.

2) Engine start.

3) After warming-up, monitor signal waveform of HO2S with scantool.

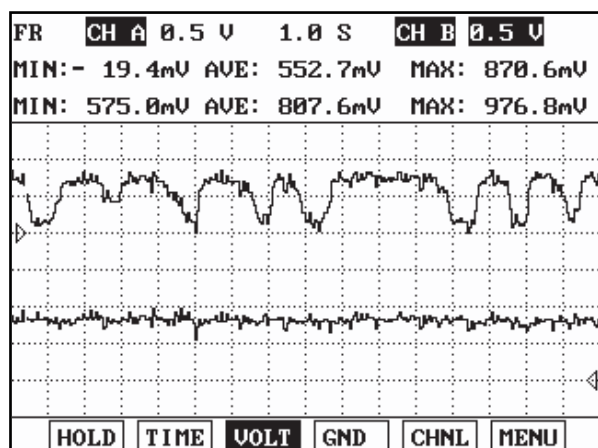


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6612N

4) Is the sensor switching properly?

YES

► Go to "Check fuel filter" as follows.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

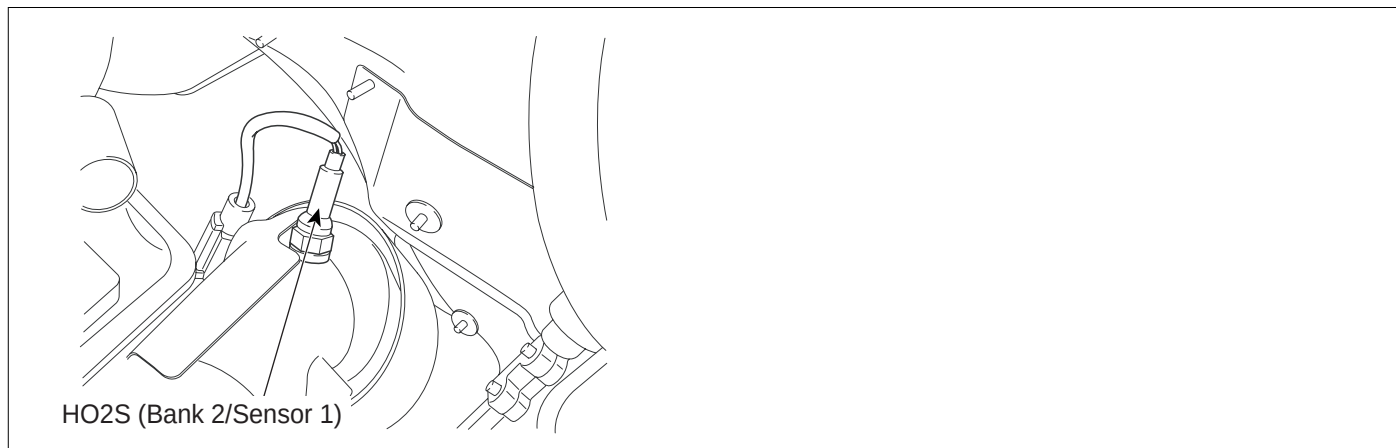
VERIFICATION OF VEHICLE REPAIR

EE284019

Refer to DTC P2195.

DTC P2197 HO2S SIGNAL STUCK LEAN (BANK 2 / SENSOR 1)

COMPONENT LOCATION EAACD52A



SBLF26709L

GENERAL DESCRIPTION E1C46753

In order to control emissions of the CO, HC and NO_x components of the exhaust gas, heated oxygen sensor (HO2S), mounted on the front side and rear side of catalytic converter, detects the oxygen content in the exhaust gas. The front HO2S signal is used to control air/fuel ratio (closed loop fuel control) and the rear HO2S signal is used to monitor front HO2S and catalyst for proper operation. The HO2S requires a minimum temperature to operate properly and provide a closed loop fuel control system. The HO2S contains the heater element to reduce its warming-up time and ensure its performance during all driving conditions. The oxygen sensor generates a voltage that indicates the difference between the oxygen content of the exhaust stream and the oxygen content of ambient air. When the exhaust stream is “ rich,” there is more oxygen in the ambient air than in the exhaust stream, so the voltage will be higher.

DTC DESCRIPTION E07D48CC

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, ECM sets P2197. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EEDBF95D

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Clogging of fuel filter in fuel pump - Faulty ECM
EnableConditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $< 0.35V$ and Air Fuel Ratio ≤ 13.5	
DiagnosisTime	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

DTC TROUBLESHOOTING PROCEDURES

FLB -595

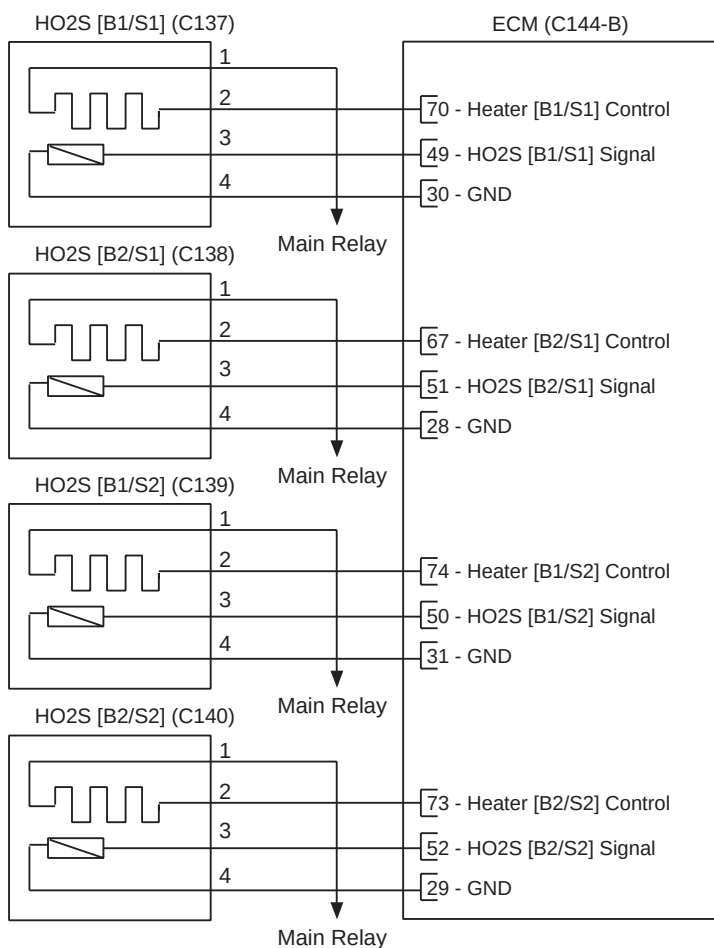
SPECIFICATION E9173568

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit(Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit(Pumping current ON)	Approx. 3.5V	

SCHEMATIC DIAGRAM

E385080E

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

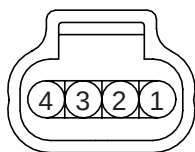
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

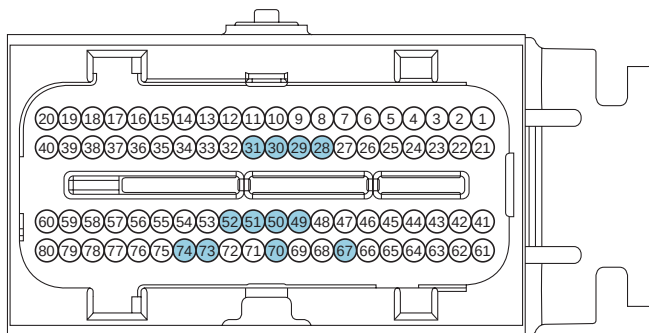
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SIGNAL WAVEFROM AND DATA E67CC65A

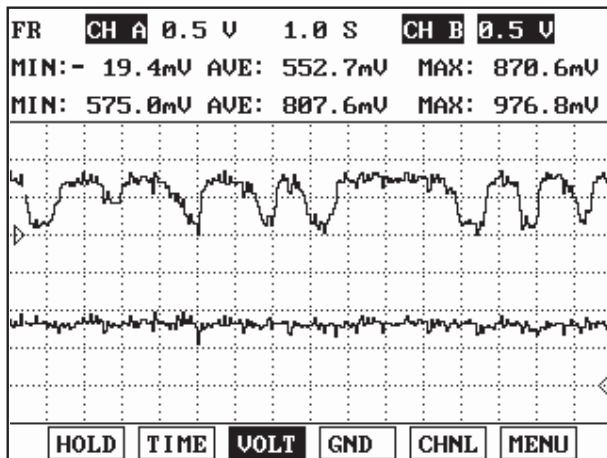


Fig. 1

Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6611N

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

MONITOR DTC STATUS ED94706D

1. Check DTC Status

- 1) Connect scantool to Data Link Connector(DLC).
- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

E55051C7

1. Check the condition of HO2S

- 1) Check HO2S for poor connection or loose terminal.
- 2) Check if HO2S is ensurely installed.
- 3) Is the conditions of HO2S normal ?

YES

► Go to "Check the Signal waveform of HO2S" as follows.

NO

► Repair it and then go to "Verification of Vehicle Repair" procedure.

2. Check the Signal waveform of HO2S

- 1) IG "OFF" and connect HO2S connector.
- 2) Engine start.
- 3) After warming-up, monitor signal waveform of HO2S with scantool.

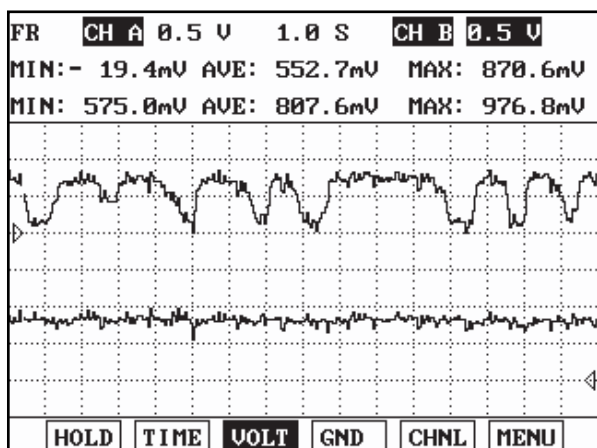


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6612N

- 4) Is the sensor switching properly?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -599

► Go to "Check fuel filter" as follows.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

3. Check the fuel filter of fuel pump

- 1) IG "OFF" and disconnect the fuel pump connector.
- 2) Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, IG "OFF"
- 3) Remove the fuel pump assembly.
- 4) Check the fuel filter for clogging by dust, a foreign substance.
- 5) Is the fuel filter O.K.?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good fuel filter and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E6996ADB

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

FLB -600

FUEL SYSTEM

DTC P2198 HO2S SIGNAL STUCK RICH (BANK 2 / SENSOR 1)

COMPONENT LOCATION E98330A2

Refer to DTC P2197.

GENERAL DESCRIPTION E9E0A1DE

Refer to DTC P2197.

DTC DESCRIPTION E95C535B

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, ECM sets P2198. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EDB4CF36

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Faulty ECM
EnableConditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $> 0.42V$	
DiagnosisTime	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION EBD1B3EC

Refer to DTC P2197.

SCHEMATIC DIAGRAM E29D9D9C

Refer to DTC P2197.

SIGNAL WAVEFROM AND DATA E5351D2E

Refer to DTC P2197.

MONITOR DTC STATUS EE3DBB05

Refer to DTC P2197.

COMPONENT INSPECTION E7D2304E

- Check the condition of HO2S
 - Check HO2S for poor connection or loose terminal.

DTC TROUBLESHOOTING PROCEDURES

FLB -601

- 2) Check if HO2S is ensurely installed.
- 3) Is the conditions of HO2S normal ?

YES

► Go to "Check the Signal waveform of HO2S" as follows.

NO

► Repair it and then go to "Verification of Vehicle Repair" procedure.

2. Check the Signal waveform of HO2S

- 1) IG "OFF" and connect HO2S connector.
- 2) Engine start.
- 3) After warming-up, monitor signal waveform of HO2S with scantool.

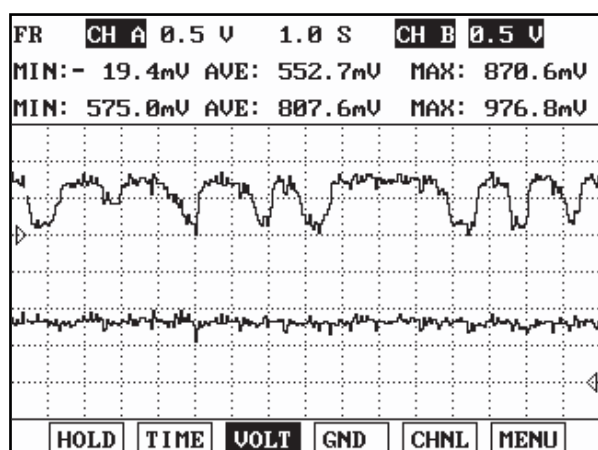


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6612N

- 4) Is the sensor switching properly?

YES

► Go to "Check fuel filter" as follows.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

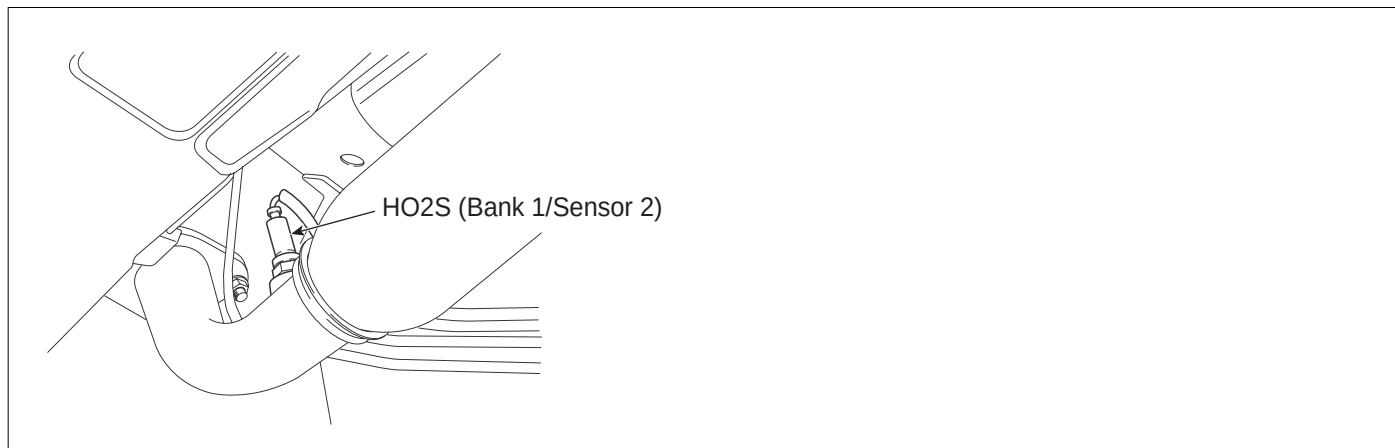
VERIFICATION OF VEHICLE REPAIR

E4DD7F3A

Refer to DTC P2197.

DTC P2270 O2 SENSOR SIGNAL STUCK LEAN (BANK 1 / SENSOR 2)

COMPONENT LOCATION E3A504BB



SBLF26708L

GENERAL DESCRIPTION E8AF4BD6

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter (warm-up catalytic converter) or in the rear exhaust pipe, which is able to detect catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC DESCRIPTION E356993C

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, ECM sets P2270. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EB40F3AD

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Clogging of fuel filter in fuel pump - Faulty ECM
EnableConditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $< 0.35V$ and Air Fuel Ratio ≤ 13.5	
DiagnosisTime	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

DTC TROUBLESHOOTING PROCEDURES

FLB -603

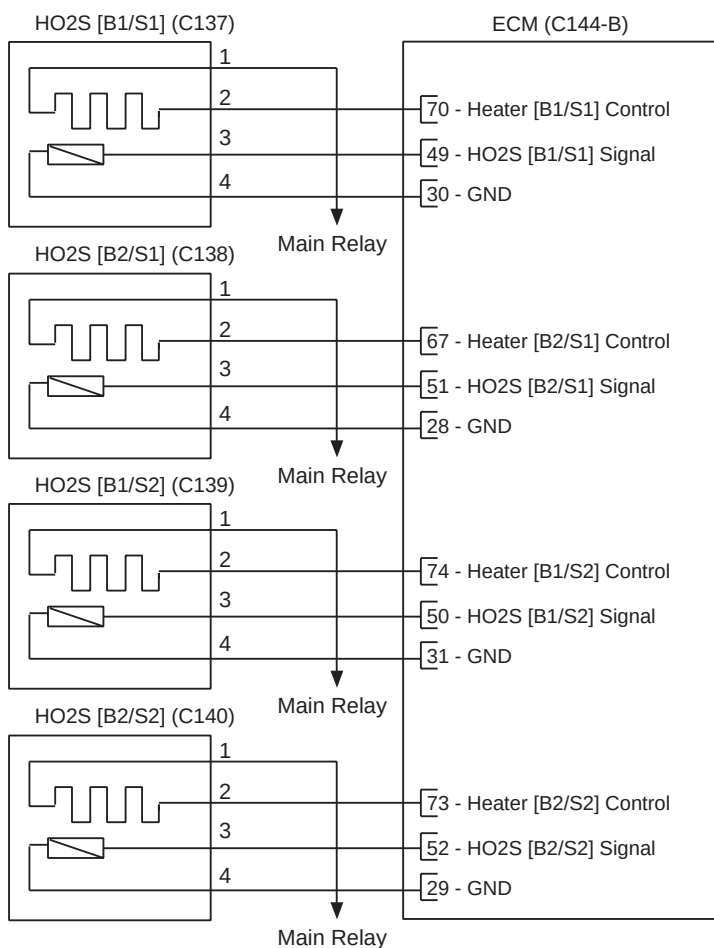
SPECIFICATION E2F04474

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit(Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit(Pumping current ON)	Approx. 3.5V	

SCHEMATIC DIAGRAM

E8CEF10D

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

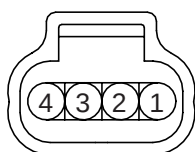
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

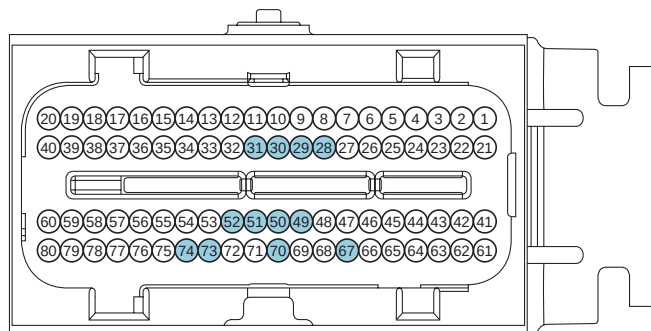
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SIGNAL WAVEFROM AND DATA E76E3260

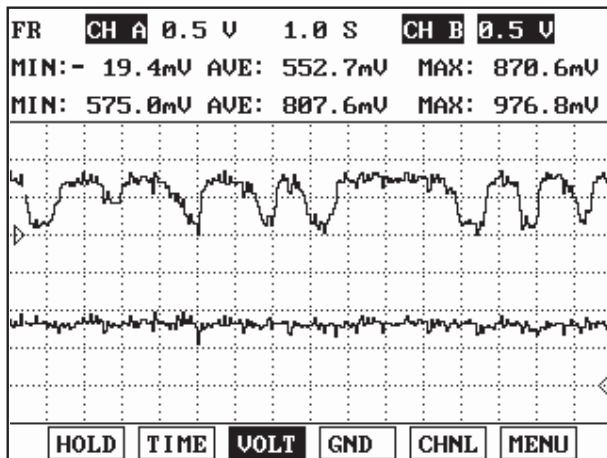


Fig. 1

Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6611N

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

MONITOR DTC STATUS EBD80BF3

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION

EC8A0315

1. Check the condition of HO2S

- 1) Check HO2S for poor connection or loose terminal.
- 2) Check if HO2S is ensurely installed.
- 3) Is the conditions of HO2S normal ?

YES

► Go to "Check the Signal waveform of HO2S" as follows.

NO

► Repair it and then go to "Verification of Vehicle Repair" procedure.

2. Check the Signal waveform of HO2S

- 1) IG "OFF" and connect HO2S connector.
- 2) Engine start.
- 3) After warming-up, monitor signal waveform of HO2S with scantool.

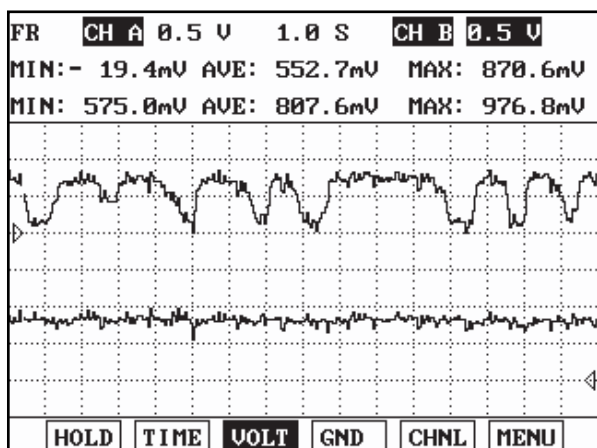


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6612N

- 4) Is the sensor switching properly?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -607

► Go to "Check fuel filter" as follows.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

3. Check the fuel filter of fuel pump

- 1) IG "OFF" and disconnect the fuel pump connector.
- 2) Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, IG "OFF"
- 3) Remove the fuel pump assembly.
- 4) Check the fuel filter for clogging by dust, a foreign substance.
- 5) Is the fuel filter O.K.?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good fuel filter and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E5200506

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

FLB -608

FUEL SYSTEM

DTC P2271 O2 SENSOR SIGNAL STUCK RICH (BANK 1 / SENSOR 1)

COMPONENT LOCATION E08F998D

Refer to DTC P2270.

GENERAL DESCRIPTION E2834FDF

Refer to DTC P2270.

DTC DESCRIPTION E19981C6

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, ECM sets P2271. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E1211AF9

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Faulty ECM
EnableConditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $> 0.42V$	
DiagnosisTime	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION ECF47B1C

Refer to DTC P2270.

SCHEMATIC DIAGRAM E74F50C2

Refer to DTC P2270.

SIGNAL WAVEFROM AND DATA E4D92BE3

Refer to DTC P2270.

MONITOR DTC STATUS E0B54F45

Refer to DTC P2270.

COMPONENT INSPECTION E9AC8F21

- Check the condition of HO2S
 - Check HO2S for poor connection or loose terminal.

DTC TROUBLESHOOTING PROCEDURES

FLB -609

- 2) Check if HO2S is ensurely installed.
- 3) Is the conditions of HO2S normal ?

YES

► Go to "Check the Signal waveform of HO2S" as follows.

NO

► Repair it and then go to "Verification of Vehicle Repair" procedure.

2. Check the Signal waveform of HO2S

- 1) IG "OFF" and connect HO2S connector.
- 2) Engine start.
- 3) After warming-up, monitor signal waveform of HO2S with scantool.

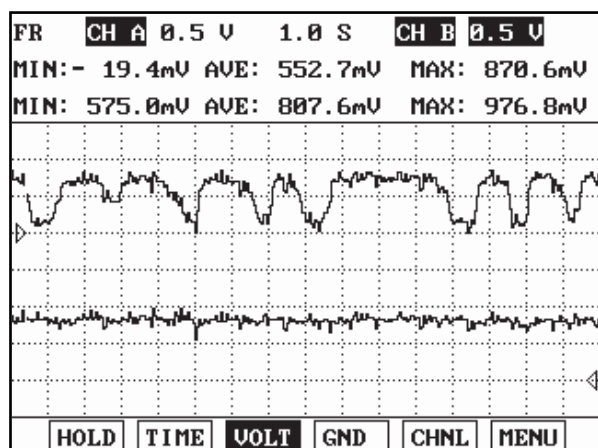


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6612N

- 4) Is the sensor switching properly?

YES

► Go to "Check fuel filter" as follows.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E936FF20

Refer to DTC P2270.

DTC P2272 HO2S SIGNAL STUCK LEAN (BANK 2 / SENSOR 2)

COMPONENT LOCATION E5400387



SBLF26710L

GENERAL DESCRIPTION EB7C165C

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter (warm-up catalytic converter) or in the rear exhaust pipe, which is able to detect catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC DESCRIPTION E6A14863

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, ECM sets P2272. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E5482E01

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Clogging of fuel filter in fuel pump - Faulty ECM
EnableConditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $< 0.35V$ and Air Fuel Ratio ≤ 13.5	
DiagnosisTime	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

DTC TROUBLESHOOTING PROCEDURES

FLB -611

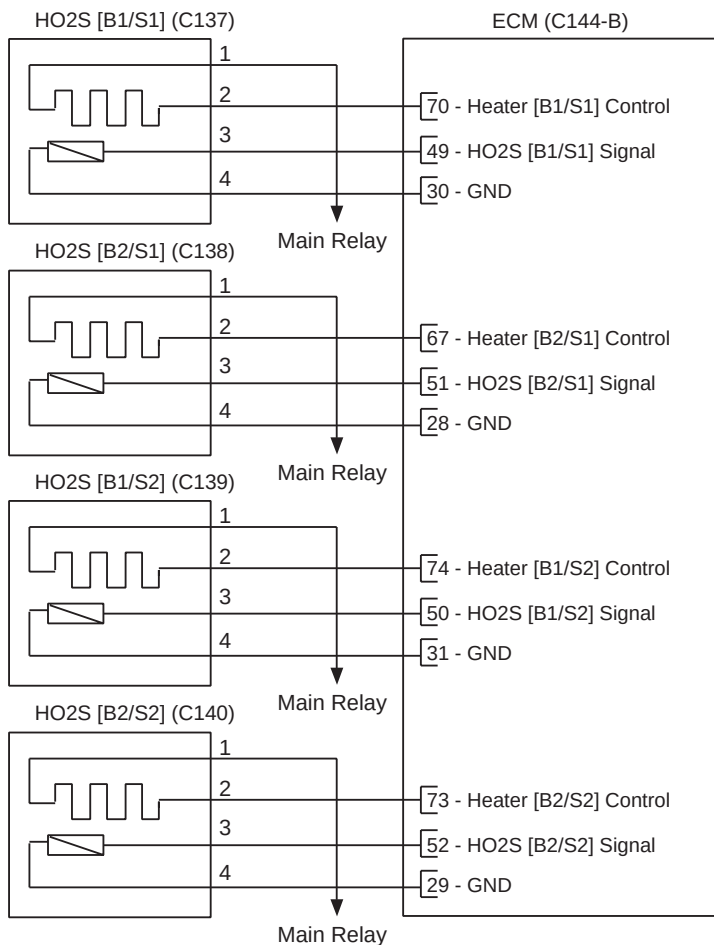
SPECIFICATION E838DE71

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit(Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit(Pumping current ON)	Approx. 3.5V	

SCHEMATIC DIAGRAM

EEE13D93

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (70)	Heater [B1/S1] Control
3	ECM C144-B (49)	HO2S [B1/S1] Signal
4	ECM C144-B (30)	Sensor ground

HO2S [B2/S1]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (67)	Heater [B2/S1] Control
3	ECM C144-B (51)	HO2S [B2/S1] Signal
4	ECM C144-B (28)	Sensor ground

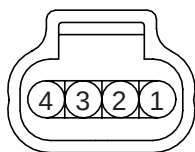
HO2S [B1/S2]

Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (74)	Heater [B1/S2] Control
3	ECM C144-B (50)	HO2S [B1/S2] Signal
4	ECM C144-B (31)	Sensor ground

HO2S [B2/S2]

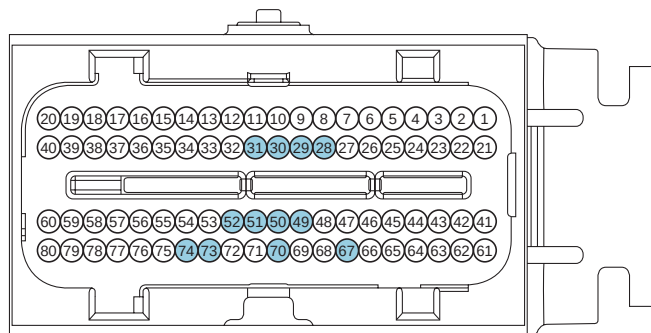
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	ECM C144-B (73)	Heater [B2/S2] Control
3	ECM C144-B (52)	HO2S [B2/S2] Signal
4	ECM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
ECM

SBLF26207L

SIGNAL WAVEFROM AND DATA EA130FFB

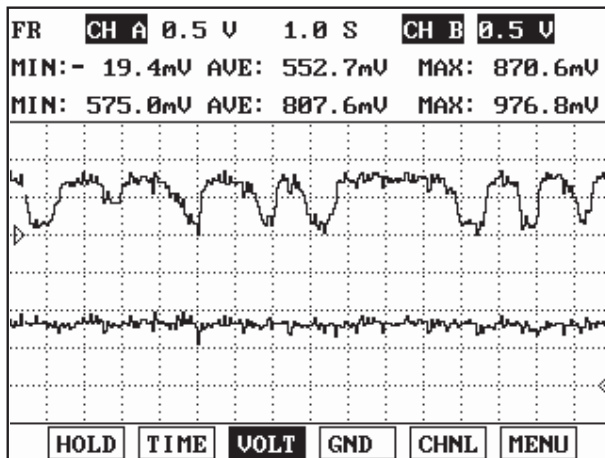


Fig. 1

Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6611N

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

MONITOR DTC STATUS E4C6BA54

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).
 - 2) IG "ON".
 - 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

► Go to "Component Inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EEC2A594

1. Check the condition of HO2S

- 1) Check HO2S for poor connection or loose terminal.
- 2) Check if HO2S is ensurely installed.
- 3) Is the conditions of HO2S normal ?

YES

► Go to "Check the Signal waveform of HO2S" as follows.

NO

► Repair it and then go to "Verification of Vehicle Repair" procedure.

2. Check the Signal waveform of HO2S

- 1) IG "OFF" and connect HO2S connector.
- 2) Engine start.
- 3) After warming-up, monitor signal waveform of HO2S with scantool.

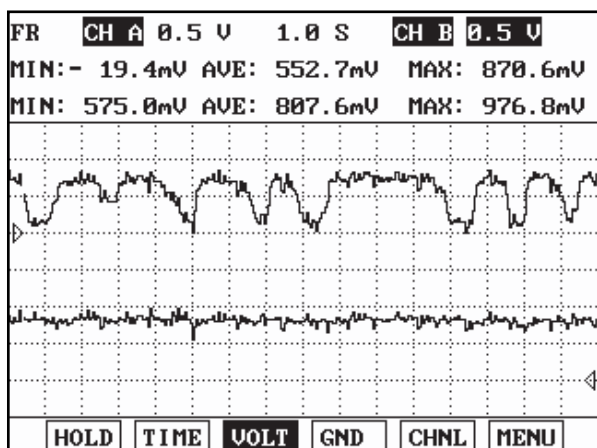


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6612N

- 4) Is the sensor switching properly?

YES

DTC TROUBLESHOOTING PROCEDURES

FLB -615

► Go to "Check fuel filter" as follows.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

3. Check the fuel filter of fuel pump

- 1) IG "OFF" and disconnect the fuel pump connector.
- 2) Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, IG "OFF"
- 3) Remove the fuel pump assembly.
- 4) Check the fuel filter for clogging by dust, a foreign substance.
- 5) Is the fuel filter O.K.?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good fuel filter and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E6A6C6B6

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

► System performing to specification at this time. Clear the DTC

NO

► Go to the applicable troubleshooting procedure.

FLB -616

FUEL SYSTEM

DTC P2273 HO2S SIGNAL STUCK RICH (BANK 2 / SENSOR 2)

COMPONENT LOCATION E84FDC57

Refer to DTC P2272.

GENERAL DESCRIPTION EEE31A10

Refer to DTC P2272.

DTC DESCRIPTION EB32A9A2

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, ECM sets P2273. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E8A85EB2

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Faulty ECM
EnableConditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60\text{sec.}$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $> 0.42V$	
DiagnosisTime	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

SPECIFICATION E747A10E

Refer to DTC P2272.

SCHEMATIC DIAGRAM E75D2D3E

Refer to DTC P2272.

SIGNAL WAVEFROM AND DATA E56DE85C

Refer to DTC P2272.

MONITOR DTC STATUS E3107C69

Refer to DTC P2272.

COMPONENT INSPECTION E66B7573

- Check the condition of HO2S
 - Check HO2S for poor connection or loose terminal.

DTC TROUBLESHOOTING PROCEDURES

FLB -617

- 2) Check if HO2S is ensurely installed.
- 3) Is the conditions of HO2S normal ?

YES

► Go to "Check the Signal waveform of HO2S" as follows.

NO

► Repair it and then go to "Verification of Vehicle Repair" procedure.

2. Check the Signal waveform of HO2S

- 1) IG "OFF" and connect HO2S connector.
- 2) Engine start.
- 3) After warming-up, monitor signal waveform of HO2S with scantool.

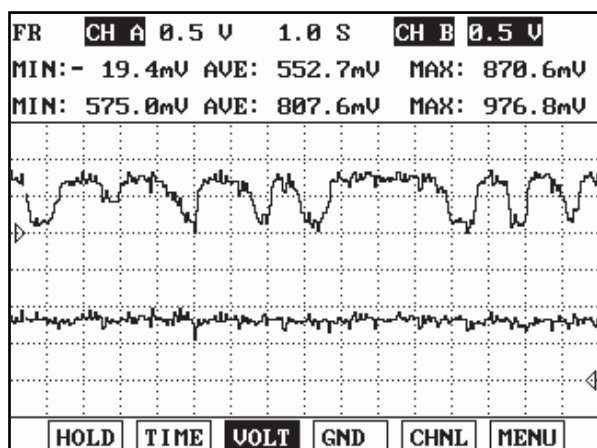


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

SEPFL6612N

- 4) Is the sensor switching properly?

YES

► Go to "Check fuel filter" as follows.

NO

► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EAC1C00A

Refer to DTC P2272.

DTC P2507 ECM/PCM POWER INPUT SIGNAL LOW

COMPONENT LOCATION EDF7442B



SBLF26701L

GENERAL DESCRIPTION EC6C05EB

When the ignition switch is turned "ON", battery voltage is applied from the battery to the ECM through the main relay. In case that the ignition switch is turned "OFF", the ECM is supplied with power through the battery power input line to control the basic operation of vehicle.

DTC DESCRIPTION E0D5909D

If the battery power input line has a problem, ECM sets P2507 and MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EE3196B6

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor the battery power input line	• Poor connection • Open or short to ground in line • Faulty ECM
Enable Conditions	• -	
Threshold value	• Open or short to ground in line	
Diagnosis Time	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 1 Driving Cycles	

MONITOR DTC STATUS E6C3861D

- Check DTC Status
 - Connect scantool to Data Link Connector(DLC).
 - IG "ON".
 - Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
 - Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SCMF16159L

5) Is parameter displayed "Present fault"?

YES

► Go to "Terminal and Connector inspection" procedure.

NO

► Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, ending, corrosion, contamination, deterioration, or damage. Repair or replace asnecessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

EC375ECE

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

► Go to " Power Circuit Inspection " procedure.

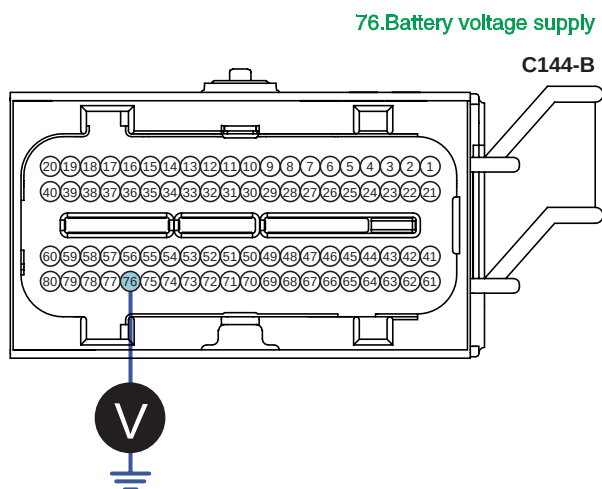
POWER CIRCUIT INSPECTION

E45F1022

1. Check Voltage
 - 1) Ignition "OFF"
 - 2) Disconnect ECM connector
 - 3) Ignition "ON" & Engine "OFF"

- 4) Measure voltage between terminal "76" of ECM harness connector(C144-B) and chassis ground

Specification : B+



SBLF26825L

- 5) Is the measured voltage within specifications?

YES

- ▶ Substitute with a known - good ECM and check for proper operation.
- ▶ If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NO

- ▶ Check for open or short to ground in harness.
- ▶ Check whether fuse is installed or blown off.
- ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. After testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

E16061BD

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC.

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC P2610 ECM/PCM INTERNAL ENGINE OFF TIMER PERFORMANCE

COMPONENT LOCATION E2495025



SBLF26701L

GENERAL DESCRIPTION E1FDE347

Continuing to calculate data of several sensor despite turning ignition OFF, when ignition turns ON, this enables ECM to be easy using calculated data.

DTC DESCRIPTION EED36942

If abnormal countdown is detected for a calibratable time, ECM sets P2610. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E93865D2

ITEM		Detecting Condition	Possible Cause
DTC Strategy	Case 1	• Compares the time elapsed recorded by the LPC(Low Power Counter) against that recorded by the test timer	• ECM
	Case 2	• Checks for abnormal resets of the LPC	
Enable Condition	Case 1	• Engine running > 10sec. • Battery voltage > 8V	
	Case 2	• No Memory Failure Occurred	
Threshold	Case 1	• The difference between the counter the LPC and the calibration the test timer clocks up > 20sec.	
	Case 2	• The LPC is reset to zero abnormally	
Diagnosis Time		• -	
MIL On Condition		• 2 Driving Cycle	

MONITOR DTC STATUS E165AAFE

1. Check DTC Status
 - 1) Connect scantool to Data Link Connector(DLC).

DTC TROUBLESHOOTING PROCEDURES

FLB -623

- 2) IG "ON".
- 3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F4(DTAL) to check DTC's information from the DTCs menu
- 4) Read "DTC Status" parameter.

1.1 DIAGNOSTIC TROUBLE CODES			
PXXXX DTC TITLE			
NUMBER OF DTC : 1 ITEMS			
PART	ERAS	DTAL	

PXXXX TITLE	
1.MIL STATUS:	ON/OFF
2.DTC STATUS:	PRESENT/HISTORY
3.DIAG.STATUS:	DIAGNOSIS FINISHED
DTC CAUSE TO SYSTEM ERROR : PXXXX	

SEPFL6401N

- 5) Is parameter displayed "Present fault"?

YES

- Go to "Terminal and Connector inspection" procedure.

NO

- Fault is intermittent caused by poor contact in the sensor' s and/or ECM' s connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION

E864E5C8

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES

- Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

- Substitute with a known-good ECM and check for proper operation. If the problem is corrected,replace ECM and then go to "Verification of Vehicle Repair" procedure.



NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

VERIFICATION OF VEHICLE REPAIR

EBFC26AC

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions
3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -625

DTC U0001 CAN COMMUNICATION MALFUNCTION

GENERAL DESCRIPTION

EBC9A0C8

Several control units are applied to electronically controlled vehicles. These units perform each control with informations from various sensors. Thus, sharing signal information from sensors is needed, so CAN communication type whose communication speed is high and insensitive to electrical noise by spark generation is adopted to controlling power-train(ECM, TCM,ESP ECM, ABS ECM)

As sharing signals of engine speed, APS, gear shifting, torque reduction in ESP and various modules, active control is performed.

DTC DESCRIPTION

EE7ADF2C

Checking CAN communication, under detecting condition, if an error within the detecting condition is detected for more than 1.5 sec., ECM sets U0001. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION

E1F0D95A

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects failures in communication between the TCM and another or modules in the vehicle which are on the CAN serial bus.	• CAN BUS • CAN communication module component
EnableConditions	• Engine Run Time $\geq$ 2sec. • Ignition Voltage $\geq$ 11V	
Threshold value	• CAN communicatin error	
DiagnosisTime	• Continuous	
MIL On Condition	• 2 Driving Cycle	

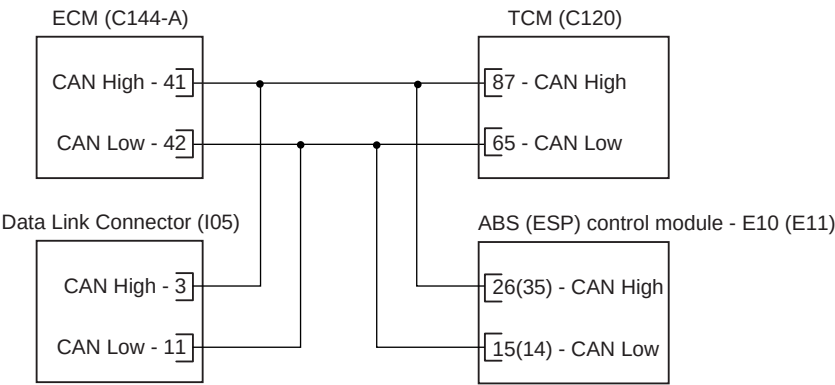
SPECIFICATION

ED16295A

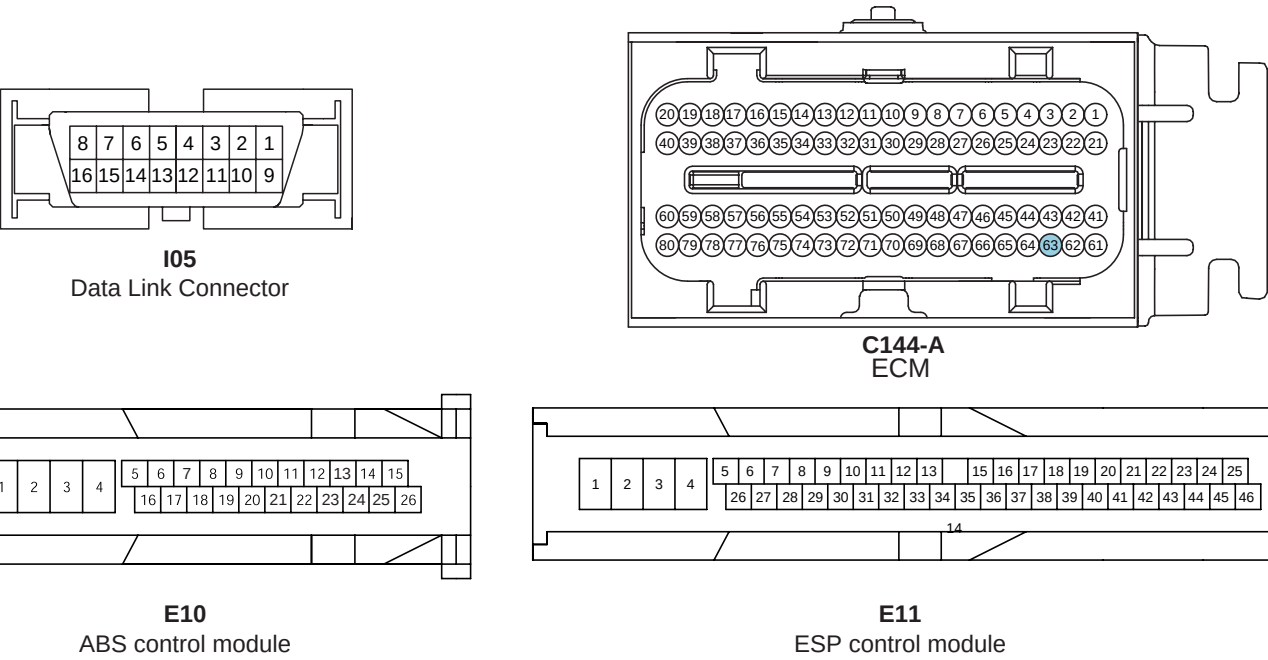
Format	DIGITAL "0"		DIGITAL "1"(BUS IDLE)		CAN Communication Line Resistance	
	HIGH	LOW	HIGH	LOW	ECM	I/P JUNCTION BOX
CAN 2.0B	3.5V	1.5V	2.5V	2.5V	120 Ω (20°C)	120 Ω (20°C)

SCHEMATIC DIAGRAM E1442F4E

[CIRCUIT DIAGRAM]



[HARNESS CONNECTOR]



SIGNAL WAVEFORM AND DATA EF7F1610

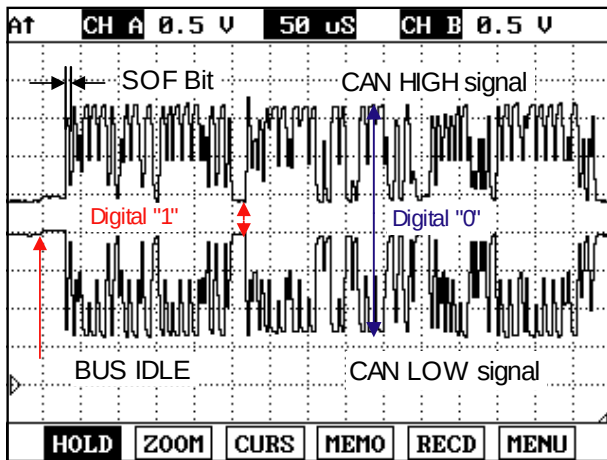


Fig.1

Fig. 1) CAN communication waveform

Monitoring CAN HIGH and LOW simultaneously is important in monitoring CAN communication waveform. When CAN HIGH signal rise to 3.5V and LOW signal drops to 1.5V - voltage difference between HIGH and LOW signal is 2V - at BUS IDLE state(DIGITAL "1") whose reference voltage is 2.5V, "0" is recognized. Besides, comparing HIGH and LOW signal if opposite waveform is detected with the reference voltage of 2.5V, Check if current cam signal transfers correctly. Continuous "0"signal above 6BIT means the occurrence of error in CAN communication. 1BIT is easily distinguished as calculating the time when "SOF"(START OF FRAME) which notifies the start of frame occurs. Check if "0"signal above 6BIT is detected continuously when monitoring CAN communication waveform.

UFBG987F

TERMINAL AND CONNECTOR INSPECTION EA89EA7A

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

 NOTE

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

3. Is the problem found?

YES

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

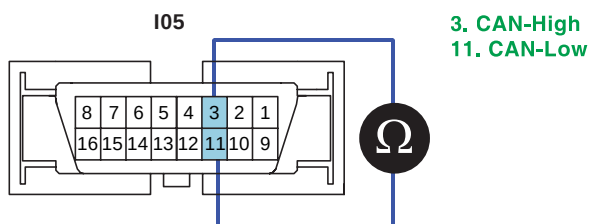
NO

► Go to "Signal Circuit Inspection".

SIGNAL CIRCUIT INSPECTION

ED9C31C0

1. Check CAN BUS resistance in Data Link Connector
 - 1) Ignition "OFF"
 - 2) Measure the resistance between terminals 3 and 11 of data link connector (Test 1)
 - 3) Disconnect ECM connector.
 - 4) Measure the resistance between terminals 3 and 11 of data link connector (Test 2)



SBLF26690L

Specification :

ECM and ESP Control Module connected : $60 \pm 3 \Omega$ (Test 1)

ECM and ESP Control Module disconnected : $120 \pm 3 \Omega$ (Test 2)

- 5) Is CAN BUS resistance within the specification?

YES

► Go to "2.Check short to ground in CAN BUS" as follows.

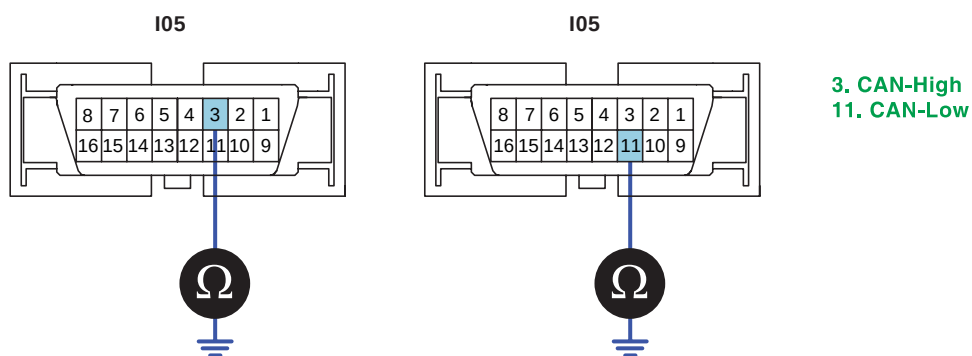
NO

► Below 10Ω for both conditions(disconnected, connected) : Repair short between CAN BUS lines and go to "Verification of Vehicle Repair".

► 120Ω for both conditions(disconnected, connected) : Go to "4. Check CAN BUS continuity".

► Infinite Ω for both conditions(disconnected, connected) :Repair open in CAN communication circuit between DLC terminal and In-pannel junction box.

2. Check short to ground in CAN BUS
 - 1) Ignition "OFF"
 - 2) Disconnect ECM and and ESP Control Module connector.
 - 3) Check continuity between DLC terminal 3 and chassis ground. (CAN HIGH line)
 - 4) Check continuity between DLC terminal 11 and chassis ground. (CAN LOW line)



SBLF26691L

Specification : Discontinuity (Infinite Ω)

5) Is the measured resistance within the specification?

YES

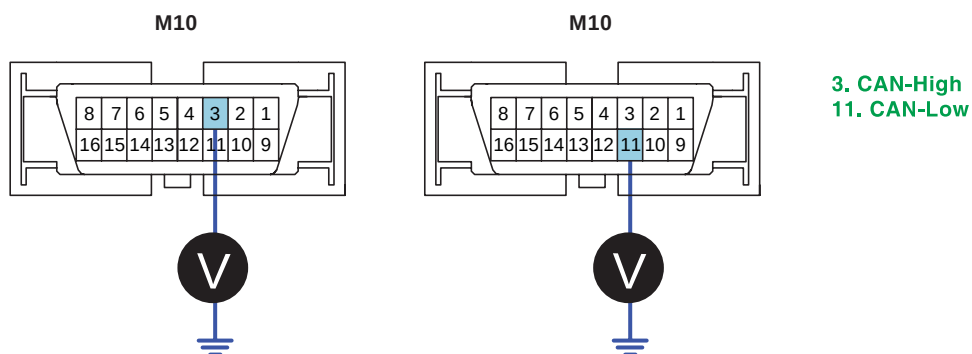
► Go to "3. Check short to battery in CAN BUS".

NO

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

3. Check short to battery in CAN BUS

- 1) Ignition "OFF"
- 2) Disconnect ECM and ESP Control Module connector.
- 3) Ignition "ON"
- 4) Measure the voltage of DLC terminal 3. (CAN HIGH line)
- 5) Measure the voltage of DLC terminal 11. (CAN LOW line)



SBLF26692L

Specification : 0.0V~0.1V

6) Is measured resistance within the specification with both connector disconnected?

YES

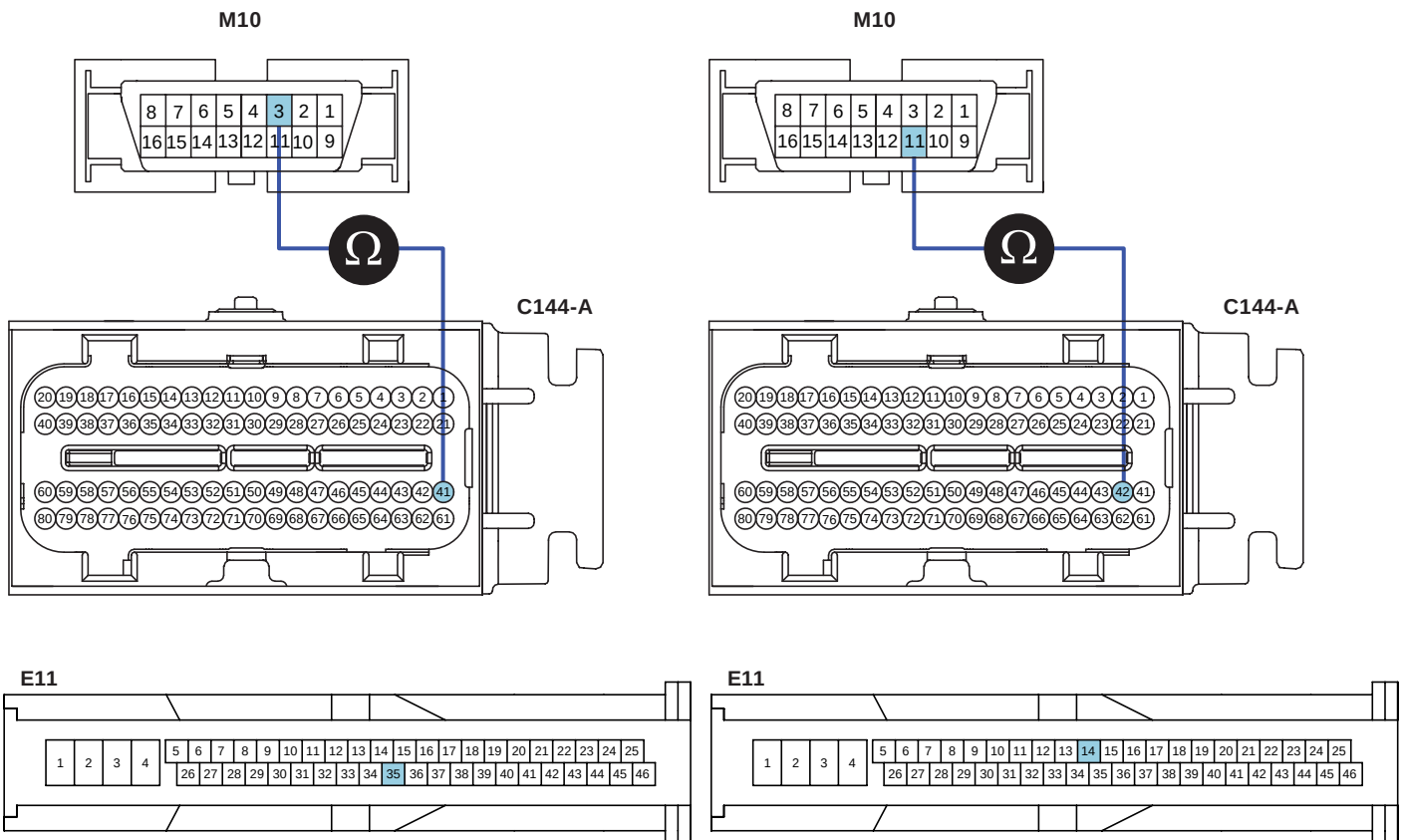
► Go to "4. Check CAN BUS continuity" as follows.

NO

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

4. Check CAN BUS continuity

- 1) Ignition "OFF"
- 2) Disconnect ECM and and ESP Control Module connector.
- 3) Check continuity in CAN HIGH line.
(CAN HIGH : ECM connector terminal 41, and ESP Control Module connector terminal 35, Data link connector(DLC) terminal 3)
- 4) Check continuity CAN LOW line.
(CAN LOW : ECM connector terminal 42, and ESP Control Module connector terminal 14, Data link connector(DLC) terminal 11)



SBLF26693L

Specification : Continuity(below 1.0Ω)

- 5) Is the measured resistance within the specification?

YES

► Go to "Component Inspection".

NO

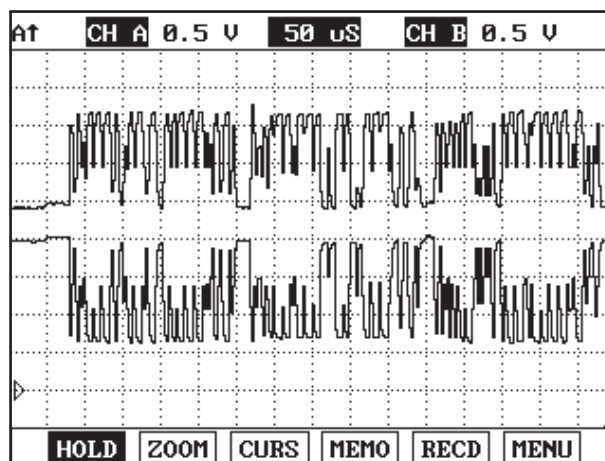
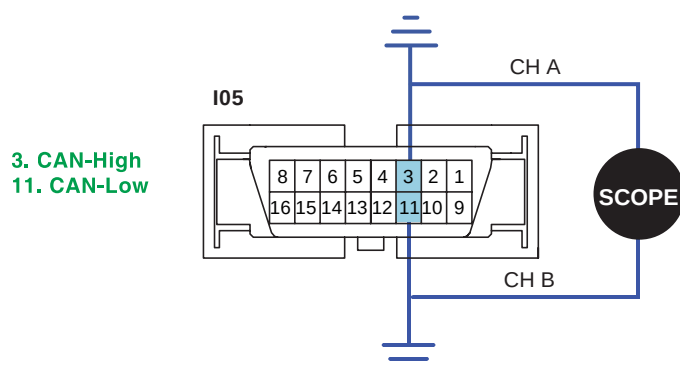
► Repair open in CAN BUS line and go to "Verification of Vehicle Repair".

COMPONENT INSPECTION

E193CA50

1. Check CAN communication waveform generation

- 1) Ignition "OFF"
- 2) Connect 2 channel scope to DLC terminal 3(CAN HIGH) and 11(CAN LOW).
- 3) Ignition "ON" after connecting only ECM to CAN BUS.
- 4) Ignition "ON" after connecting only ESP Control Module to CAN BUS.



SBLF26694L

Specification : At Ignition "ON", the waveform same as "Signal Waveform & Data" of above signal waveform.

- ※ Different from "Signal Waveform & Data", if 1) both CAN HIGH and LOW signal are fixed at 2.5 V or
2) HIGH and LOW signal are fixed at 3.5 V and 1.5 V, respectively, it is due to communication error between modules.

5) Does correct waveform generate from each module?

YES

► Go to "Verification of Vehicle Repair".

NO

► Replace the module which generates poor communication waveform, and go to "Verification of Vehicle Repair".

VERIFICATION OF VEHICLE REPAIR

E3B31130

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions

3. Read "DTC Status" parameter
4. Is parameter displayed "History(Not Present) fault"?

YES

- ▶ System performing to specification at this time. Clear the DTC

NO

- ▶ Go to the applicable troubleshooting procedure.

DTC TROUBLESHOOTING PROCEDURES

FLB -633

DTC U0101 SERIAL COMMUNICATION PROBLEM WITH TCU (TIMEOUT)

GENERAL DESCRIPTION E1AB6BBE

Refer to DTC U0001.

DTC DESCRIPTION EE1646EE

Checking TCM ID under detecting condition, if ECM doesn't take TCM's signal within the certain period, PCM sets U0101. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E01CB422

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects failures in communication between ECM and TCM	• CAN BUS • TCM • ECM
EnableConditions	• Engine Run Time $\geq$ 2sec. • Ignition Voltage $\geq$ 11V	
Threshold value	• When ECM can't get TCU ID for more than 0.5 second	
DiagnosisTime	• Continuous	
MIL On Condition	• 2 Driving Cycle	

SPECIFICATION E5AAEC6F

Refer to DTC U0001.

SCHEMATIC DIAGRAM EF709973

Refer to DTC U0001.

SIGNAL WAVEFROM AND DATA EB74B8CE

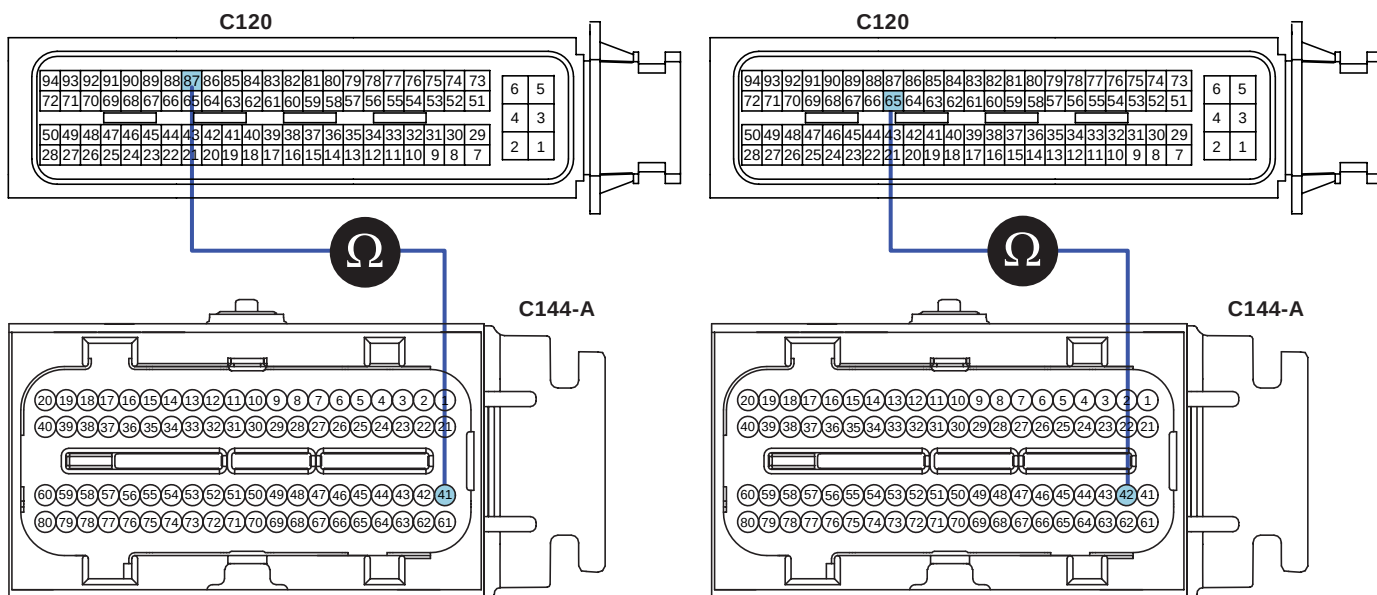
Refer to DTC U0001.

TERMINAL AND CONNECTOR INSPECTION ED00C8D8

Refer to DTC U0001.

SIGNAL CIRCUIT INSPECTION E5F2946F

1. Check CAN BUS continuity between ECM and TCM
 - 1) Ignition "OFF"
 - 2) Disconnect ECM and TCM connector.
 - 3) Check continuity in CAN HIGH line.
(CAN HIGH : ECM connector terminal 41, TCM connector terminal 87)
 - 4) Check continuity CAN LOW line.
(CAN LOW : ECM connector terminal 42, TCM connector terminal 65)



SBLF26835L

Specification : Continuity(below 1.0Ω)

5) Is the measured resistance within the specification?

YES

► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

► Substitute with a known - good ECM or TCM and check for proper operation. If the problem is corrected, replace ECM or TCM and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR

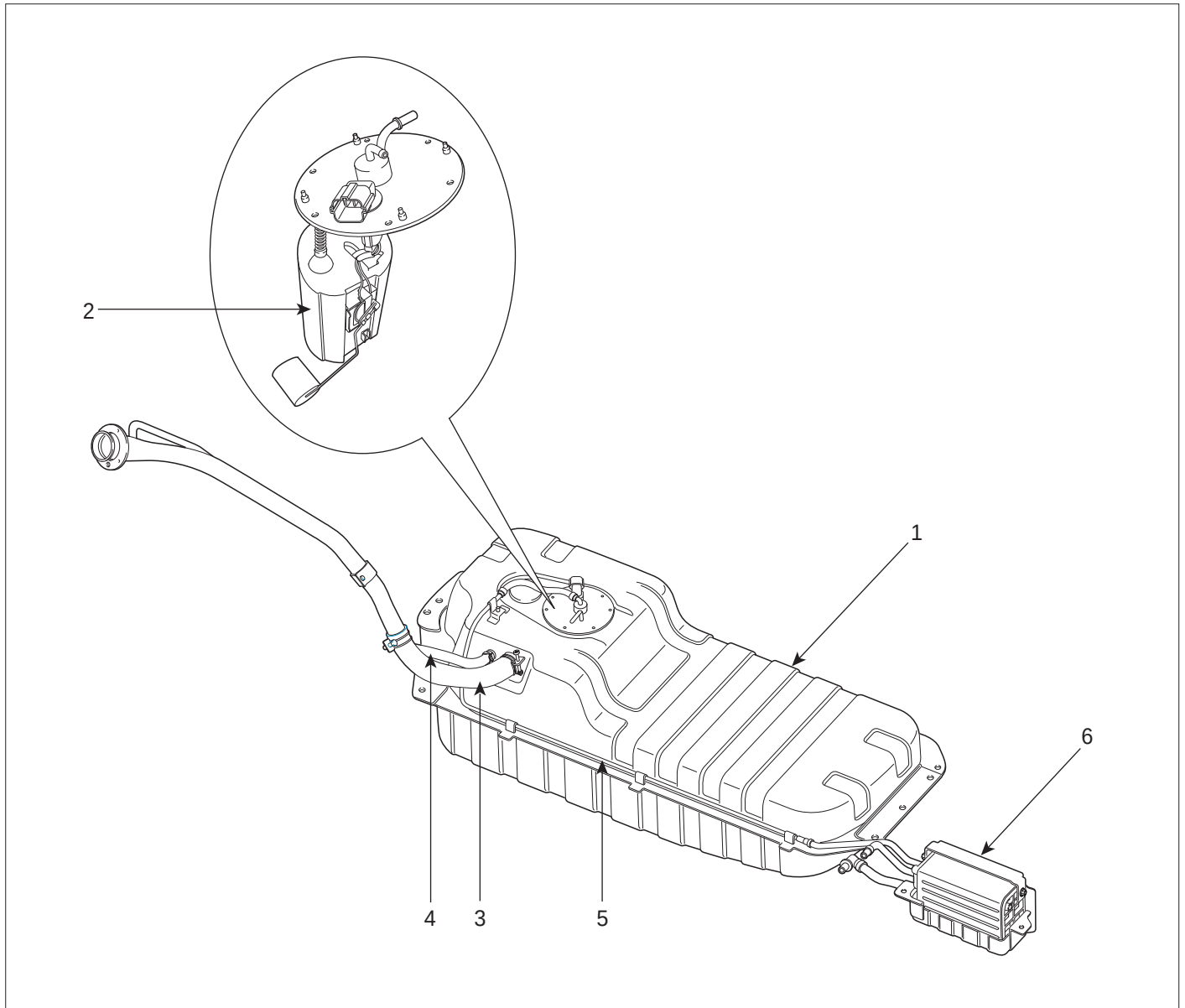
E7334E57

Refer to DTC U0001.

FUEL DELIVERY SYSTEM

COMPONENT LOCATION

EEF24C7D



- 1. Fuel Tank
- 2. Fuel Pump
(including Fuel Filter and Fuel Pressure Regulator)
- 3. Fuel Filler Hose

- 4. Leveling Hose
- 5. Tube (Fuel Tank ↔ Canister)
- 6. Canister

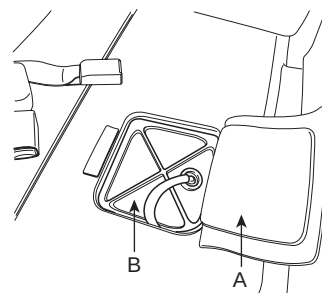
SBLF26224L

FUEL PRESSURE TEST

E7ABBEAB

1. PREPARING

1. Fold the rear seat cushion (Refer to "SEAT" in BD group.)
2. Open the carpet (A) and remove the service cover (B).



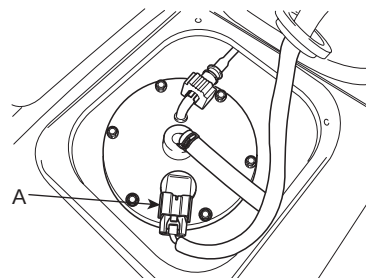
2. RELEASE THE INTERNAL PRESSURE

1. Disconnect the fuel pump connector (A).
2. Start the engine and wait until fuel in fuel line is exhausted.
3. After the engine stalls, turn the ignition switch to OFF position and disconnect the negative (-) terminal from the battery.



NOTE

Be sure to reduce the fuel pressure before disconnecting the fuel feed hose, otherwise fuel will spill out.



3. INSTALL THE SPECIAL SERVICE TOOL (SST) FOR MEASURING THE FUEL PRESSURE

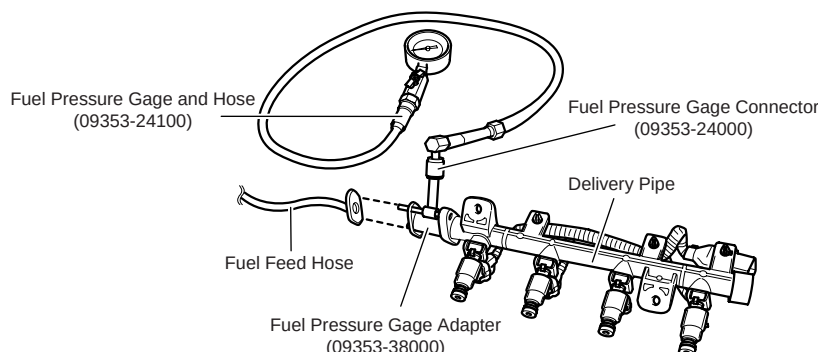
1. Disconnect the fuel feed hose from the delivery pipe.



CAUTION

Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

2. Install the Fuel Pressure Gage Adapter (09353-38000) between the delivery pipe and the fuel feed hose.
3. Connect the Fuel Pressure Gage Connector (09353-24000) to the Fuel Pressure Gage Adapter (09353-38000).
4. Connect the Fuel Pressure Gage and Hose (09353-24100) to Fuel Pressure Gage Connector (09353-24000).
5. Connect the fuel feed hose to the Fuel Pressure Gage Adapter (09353-38000).



4. INSPECT FUEL LEAKAGE ON CONNECTION

1. Connect the battery negative (-) terminal.
2. Apply battery voltage to the fuel pump terminal and activate the fuel pump. With fuel pressure applied, check that there is no fuel leakage from the fuel pressure gauge or connection part.

5. FUEL PRESURE TEST

1. Disconnect the negative (-) terminal from the battery.
2. Connect the fuel pump connector.
3. Connect the battery negative (-) terminal.
4. Start the engine and measure the fuel pressure at idle.

Standard Value: 375 ~ 385 kpa (3.82 ~ 3.92 kgf/cm², 54.3 ~ 55.8 psi)

- If the measured fuel pressure differs from the standard value, perform the necessary repairs using the table below.

Condition	Probable Cause	Suspected Area
Fuel Pressure too low	Clogged fuel filter	Fuel filter
	Fuel leak on the fuel-pressure regulator that is assembled on fuel pump because of poor seating of the fuel-pressure regulator.	Fuel Pressure Regulator
Fuel Pressure too High	Sticking fuel pressure regulator	Fuel Pressure Regulator

5. Stop the engine and check for a change in the fuel pressure gauge reading.

After engine stops, the gage reading should hold for about 5 minutes

- Observing the declination of the fuel pressure when the gage reading drops and perform the necessary repairs using the table below.

Condition	Probable Cause	Supected Area
Fuel pressure drops slowly after engine is stopped	Injector leak	Injector
Fuel pressure drops immediately after engine is stopped	The check valve within the fuel pump is open	Fuel Pump

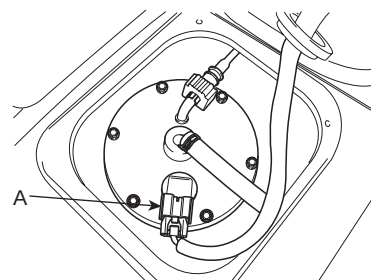
6. RELEASE THE INTERNAL PRESSURE

1. Disconnect the fuel pump connector (A).
2. Start the engine and wait until fuel in fuel line is exhausted.
3. After the engine stalls, turn the ignition switch to OFF position and disconnect the negative (-) terminal from the battery.



NOTE

Be sure to reduce the fuel pressure before disconnecting the fuel feed hose, otherwise fuel will spill out.



7. REMOVE THE SPECIAL SERVICE TOOL (SST) AND CONNECT THE FUEL LINE

1. Disconnect the Fuel Pressure Gauge and Hose (09353-24100) from the Fuel Pressure Gauge Connector (09353-24000).
2. Disconnect the Fuel Pressure Gauge Connector (09353-24000) from the Fuel Pressure Gauge Adapter (09353-38000).
3. Disconnect the fuel feed hose from the Fuel Pressure Gauge Adapter (09353-38000).
4. Disconnect the Fuel Pressure Gauge Adapter (09353-38000) from the delivery pipe.



CAUTION

Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

5. Connect the fuel feed hose to the delivery pipe.

8. INSPECT FUEL LEAKAGE ON CONNECTION

1. Connect the battery negative (-) terminal.
2. Apply battery voltage to the fuel pump terminal and activate the fuel pump. With fuel pressure applied, check that there is no fuel leakage from the fuel pressure gauge or connection part.
3. If the vehicle is normal, connect the fuel pump connector.

SBLF26226L

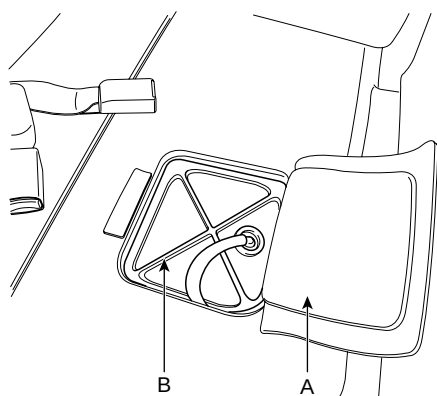
FUEL PUMP

REMOVAL (INCLUDING FUEL FILTER AND FUEL PRESSURE REGULATOR)

E17C1FD6

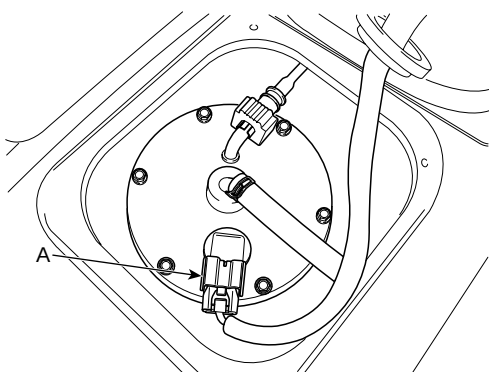
1. Preparation

- 1) Fold the rear seat cushion. (Refer to "SEAT" in BD group)
- 2) Open the carpet (A)



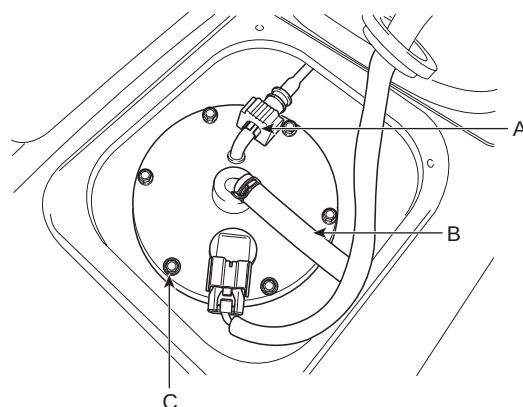
SBLF26227L

- 3) Remove the service cover (B).
- 4) Disconnect the fuel pump connector (A).



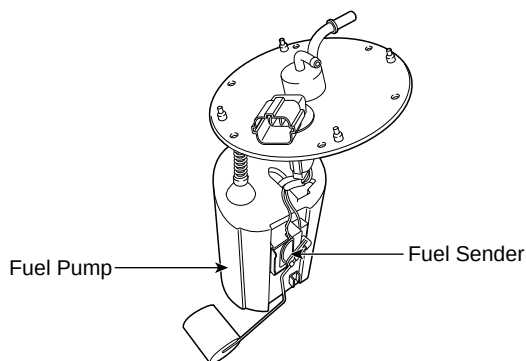
SBLF26228L

- 5) Start the engine and wait until fuel in fuel line is exhausted.
 - 6) After engine stops, turn the ignition switch off.
2. Disconnect the fuel feed quick-connector (A) and the tube connecting with the canister (B).



SBLF26229L

3. Remove the fuel pump mounting bolts (C) and remove the fuel pump from the fuel tank.



SBLF26230L

INSTALLATION

E07F3AB3

1. Install the fuel pump in according to the reverse order of "REMOVAL" procedure.

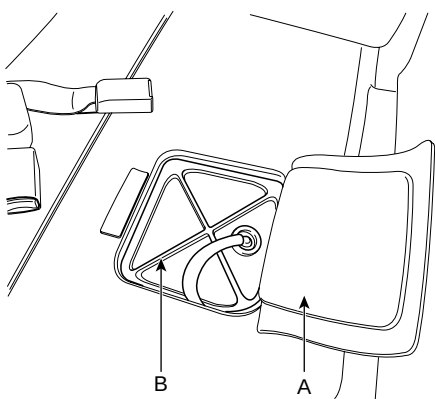
Fuel pump assembly mounting bolts : 10.7 ~ 16.7 N·m (1.1 ~ 1.7 kgf·m, 8.0 ~ 12.3 lbf·ft)

FUEL TANK

REMOVAL ECCCF109

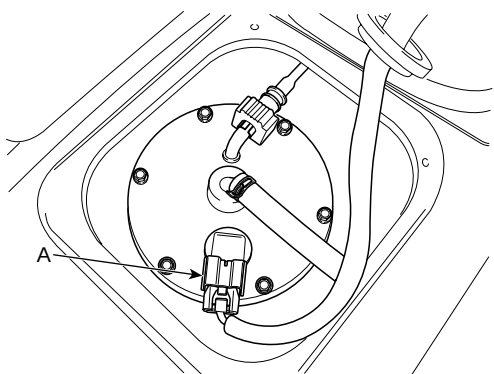
1. Preparation

- 1) Fold the rear seat cushion. (Refer to "SEAT" in BD group)
- 2) Open the carpet (A)



SBLF26227L

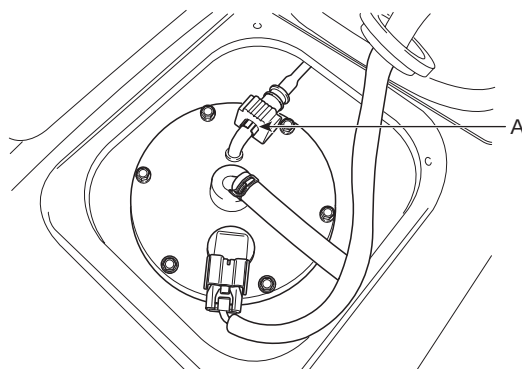
- 3) Remove the service cover (B).
- 4) Disconnect the fuel pump connector (A).



SBLF26228L

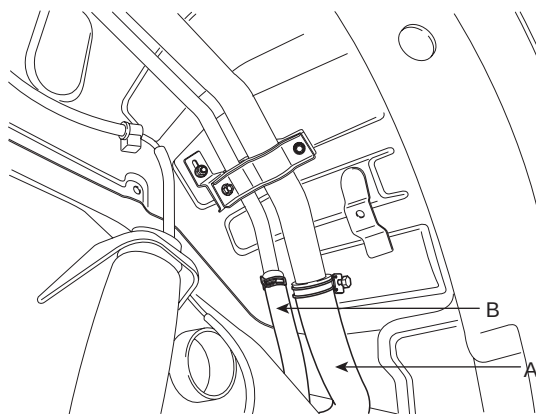
- 5) Start the engine and wait until fuel in fuel line is exhausted.
- 6) After engine stops, turn the ignition switch off.

2. Disconnect the fuel feed quick-connector (A).



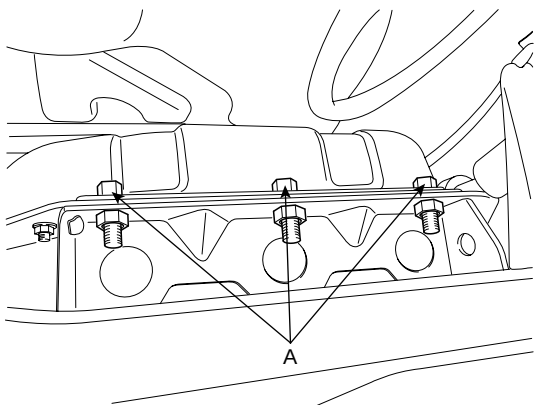
SBLF26231L

3. Remove the RH-rear inner wheel house.
4. Disconnect the fuel filler hose (A) and the leveling hose (B)

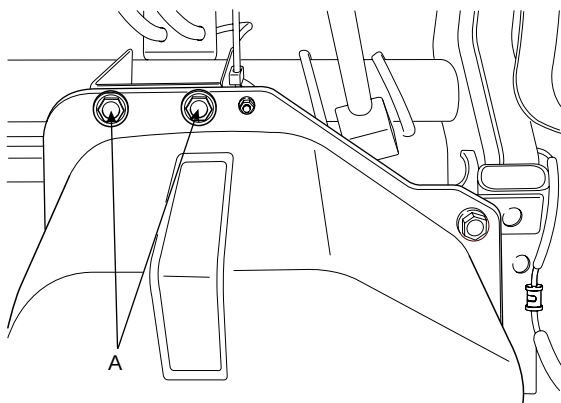


SBLFL6029D

5. Lift the vehicle and support the fuel tank with a jack.
6. Disconnect the tube connecting the fuel tank and the canister from the canister.
7. Remove the fuel tank mounting bolts (A) and remove the fuel tank from the vehicle.



SBLFL6018D



SBLFL6019D

INSTALLATION

EEB5AC8D

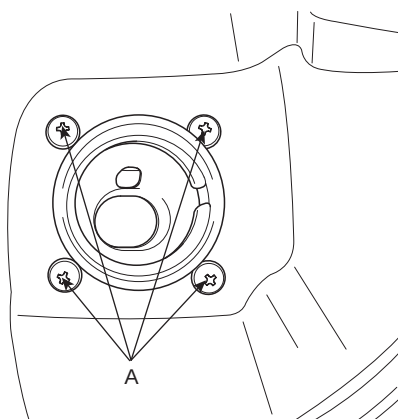
1. Install the fuel tank in according to the reverse order of "REMOVAL" procedure.

Fuel tank installation bolts : 49.1 ~ 58.9N·m (5.0 ~ 6.0 kgf·m, 36.2 ~ 43.4 lbf·ft)

FILLER-NECK ASSEMBLY

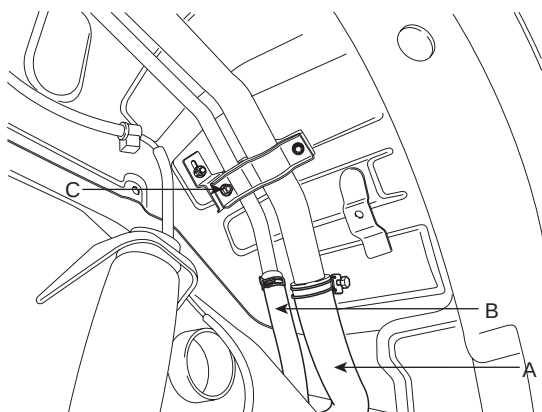
REMOVAL EAF069EB

1. Remove the RH-rear inner wheel house.
2. Open the fuel filler door and unfasten the filler-neck assembly mounting screws (A).



SBLF26232L

3. Disconnect the fuel filler hose (A) and the leveling hose (B)



SBLFL6956D

4. Remove the fuel filler neck assembly mounting bolt (C) and remove the fuel filler neck assembly.

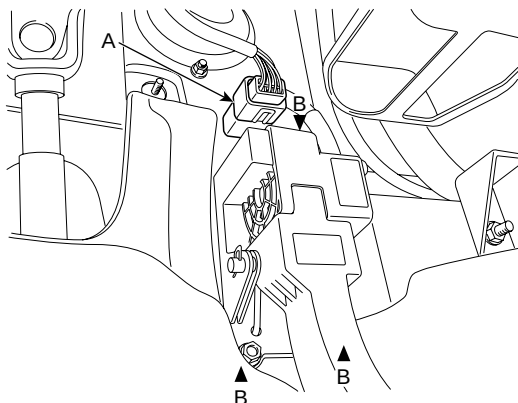
INSTALLATION E39C7C6D

1. Install the filler-neck assembly in according to the reverse order of "REMOVE" procedure.

ACCELERATOR PEDAL

REMOVAL EE381E3B

1. Turn ignition switch off and disconnect the battery (-) cable from the battery.
2. Disconnect the accelerator position sensor connector (A).



SBLF26233L

3. Unfasten the mounting bolt/nuts (B) and remove the accelerator pedal from the vehicle.

INSTALLATION E1255C36

1. Install the accelerator pedal in according to the reverse order of "REMOVAL" procedure.

Accelerator pedal mounting nuts: 7.8 ~ 11.8N·m
(0.8 ~ 1.2kgf·m, 5.8 ~ 8.7lbf·ft)
