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)
- POWERTRAIN CONTROL MODULE (PCM)

DTC TROUBLESHOOTING PROCEDURES

FUEL DELIVERY SYSTEM

- FUEL PUMP
- FUEL TANK
- FILLER-NECK ASSEMBLY
- ACCELERATOR PEDAL

GENERAL

SPECIFICATION E7287EDD

FUEL DELIVERY SYSTEM

Items	Specification	
Fuel Tank	Capacity	70 lit. (18.4 U.S.gal., 15.4 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/㎠, 54.3 ~ 55.8 psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor

SENSOR

MASS AIR FLOW SENSOR (MAFS)

▷ Type: Hot-film type
▷ Specification

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

INTAKE AIR TEMPERATURE SENSOR (IATS)

▷ Type: Thermistor type
▷ Specification

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

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

▷ Type: Piezo-resistive pressure type
▷ Specification

Pressure (kPa)	Output Voltage (V)
20.0kPa	0.79V
46.66kPa	1.84V
101.32kPa	4.00V

ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

▷ Type: Thermistor type
▷ Specification

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

THROTTLE POSITION SENSOR (TPS)

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

Throttle Angle (˚)	Output Voltage(V)	
	TPS1	TPS2
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	0V

Item	Sensor Resistance (kΩ)
TPS1	4.0 ~ 6.0kΩ at 20℃ (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 ~ 0.8V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V

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

HEATED OXYGEN SENSOR (HO2S)

▷ Type: Zirconia (ZrO2) type
▷ Specification

A/F Ratio	Output Voltage (V)
RICH	0.75 ~ 1.00V
LEAN	0 ~ 0.12V

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

CAMSHAFT POSITION SENSOR (CMPS)

▷ Type: Hall effect type
▷ Specification

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

CRANKSHAFT POSITION SENSOR (CKPS)

▷ Type: Magnetic field sensitive type
▷ Specification

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

KNOCK SENSOR (KS)

▷ Type: Piezo-electricity type
▷ Specification

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

CVVT OIL TEMPERATURE SENSOR (OTS)

▷ Type: Thermistor type
▷ Specification

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

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℃ (68°F)
2nd Coil Resistance (kΩ)	7.0kΩ±15% at 20℃ (68°F)

SERVICE STANDARD E393CE90

Ignition Timing	BTDC 10° ± 5°		
Idle Speed	A/CON OFF	Neutral,N,P-range	650 ± 100 rpm
		D-range	
	A/CON ON	Neutral,N,P-range	
		D-range	

TIGHTENING TORQUES E53C4B54

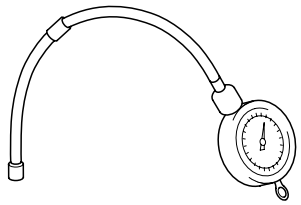
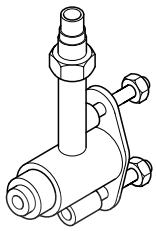
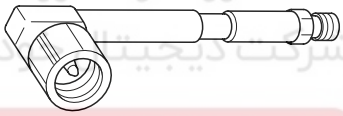
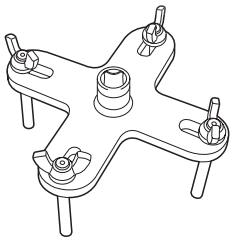
ENGINE CONTROL SYSTEM

Item	Kgf·m	N·m	lbf·ft
PCM installation bolts	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
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 bolt	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 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)	0.7 ~ 1.1	6.9 ~ 10.8	5.1 ~ 8.0
ETC module installation bolt (on ETC stay)	1.6 ~ 2.6	15.7 ~ 25.5	11.6 ~ 18.8
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
Vacuum valve (Variable intake actuator) installation bolts	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7
Ignition coil condenser installation bolt	0.7 ~ 1.1	6.9 ~ 10.8	5.1 ~ 8.0
Ignition coil installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3

FUEL DELIVERY SYSTEM

Item	Kgf·m	N·m	lbf·ft
Fuel Tank band mounting nuts	4.0 ~ 5.5	39.2 ~ 53.9	28.9 ~ 39.8
Fuel pump assembly mounting bolts	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Accelerator pedal module installation bolts	0.8 ~ 1.2	7.8 ~ 11.8	6.5 ~ 8.7
Delivery pipe installation bolts	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7
2-Way & Fuel-Cut valve installation bolts	0.2 ~ 0.3	2.0 ~2.9	1.4 ~ 2.2

SPECIAL SERVICE TOOLS E0ACF289

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)
09310-2B200 Fuel Pump Plate Cover Wrench	 SHDF16100L	Removing and installing the fuel pump plate cover

BASIC TROUBLESHOOTING E530375D

BASIC TROUBLESHOOTING GUIDE

1	**Bring Vehicle to Workshop**

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

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

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

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

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

7	**Recreate (Simulate) Symptoms 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	**Confirm test**

14	**END**

LW8F1001

CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLEINFORMAITON

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	

SCMFL6150L

BASIC INSPECTION PROCEDURE

MEASURING CONDITION OF ELECTRONIC PARTS' RESISTANCE

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

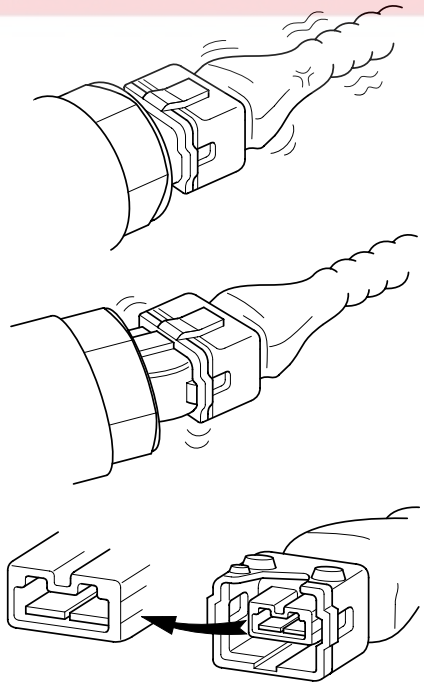
NOTE

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

INTERMITTENT PROBLEM INSPECTION PROCEDURE

Sometimes the most difficult case in troubleshooting is when a problem symptom occurs but does not occur again during testing. An example would be if a problem appears only when the vehicle is cold but has not appeared when warm. In this case, 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.



BFGE321A

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

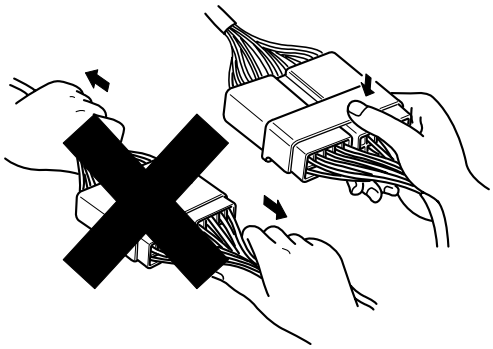
DO NOT sprinkle water directly into the engine compartment or electronic components.

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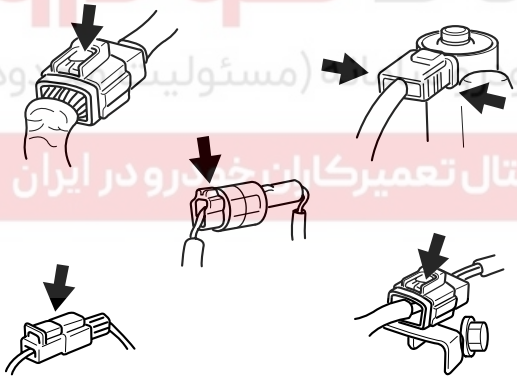
   b. When removing the connector with a lock, press or pull locking lever.



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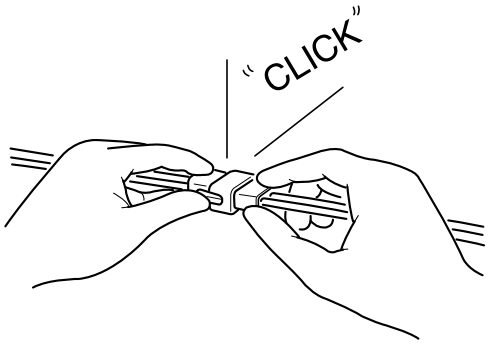
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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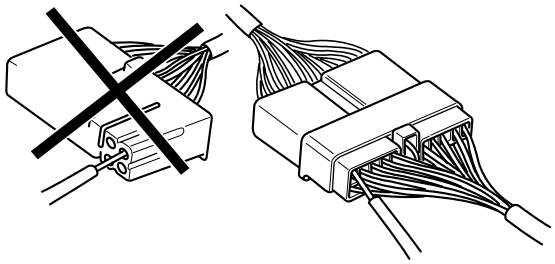
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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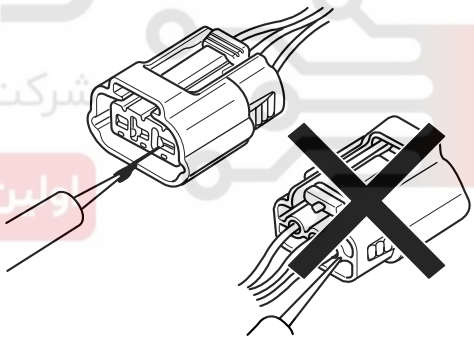
   e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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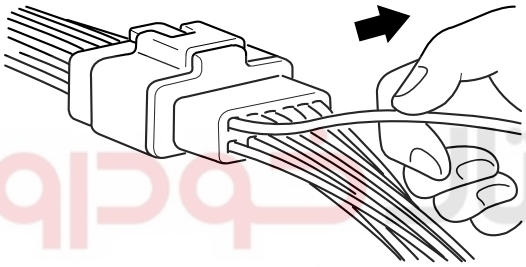
NOTE

- *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.

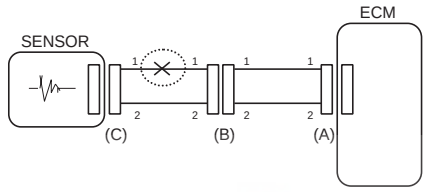
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

● 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

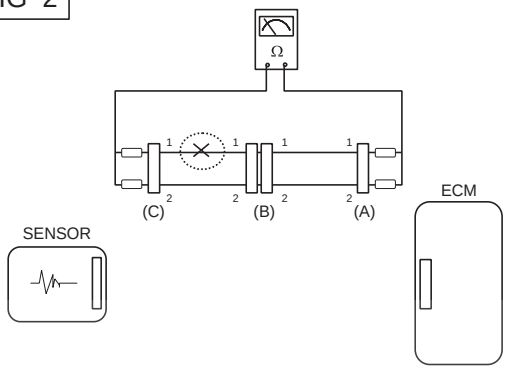
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

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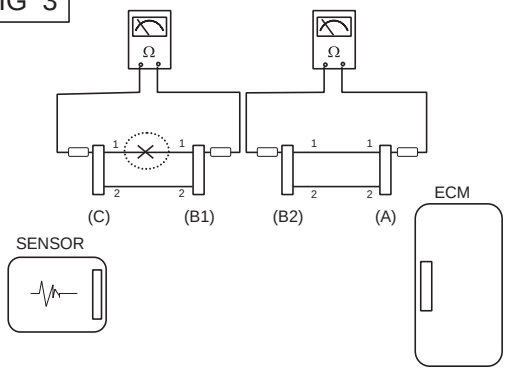
b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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

FIG 3



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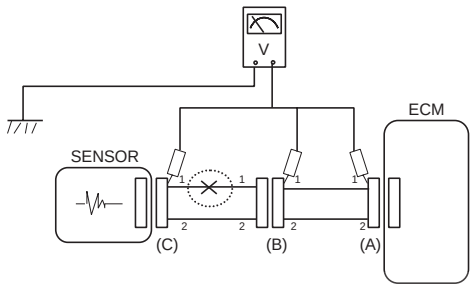
3. Voltage Check Method
   a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

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

FIG 4



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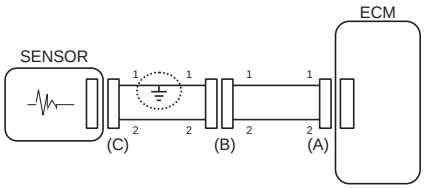
● CHECK SHORT CIRCUIT

4. Test Method for Short to Ground Circuit
   • Continuity Check with Chassis Ground

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

FIG 5



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5. Continuity Check Method (with Chassis Ground)

   NOTE

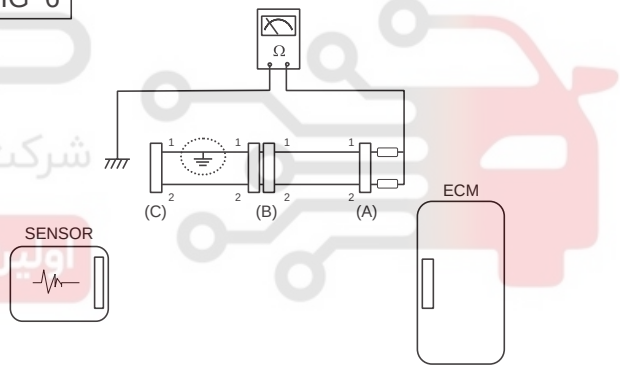
   Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

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

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

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

FIG 6



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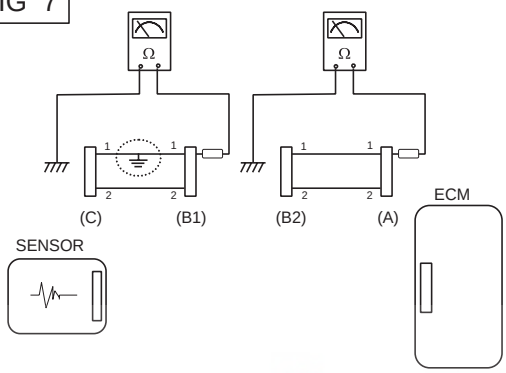
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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



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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 ON)	• 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 E474CA7E

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
- 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.

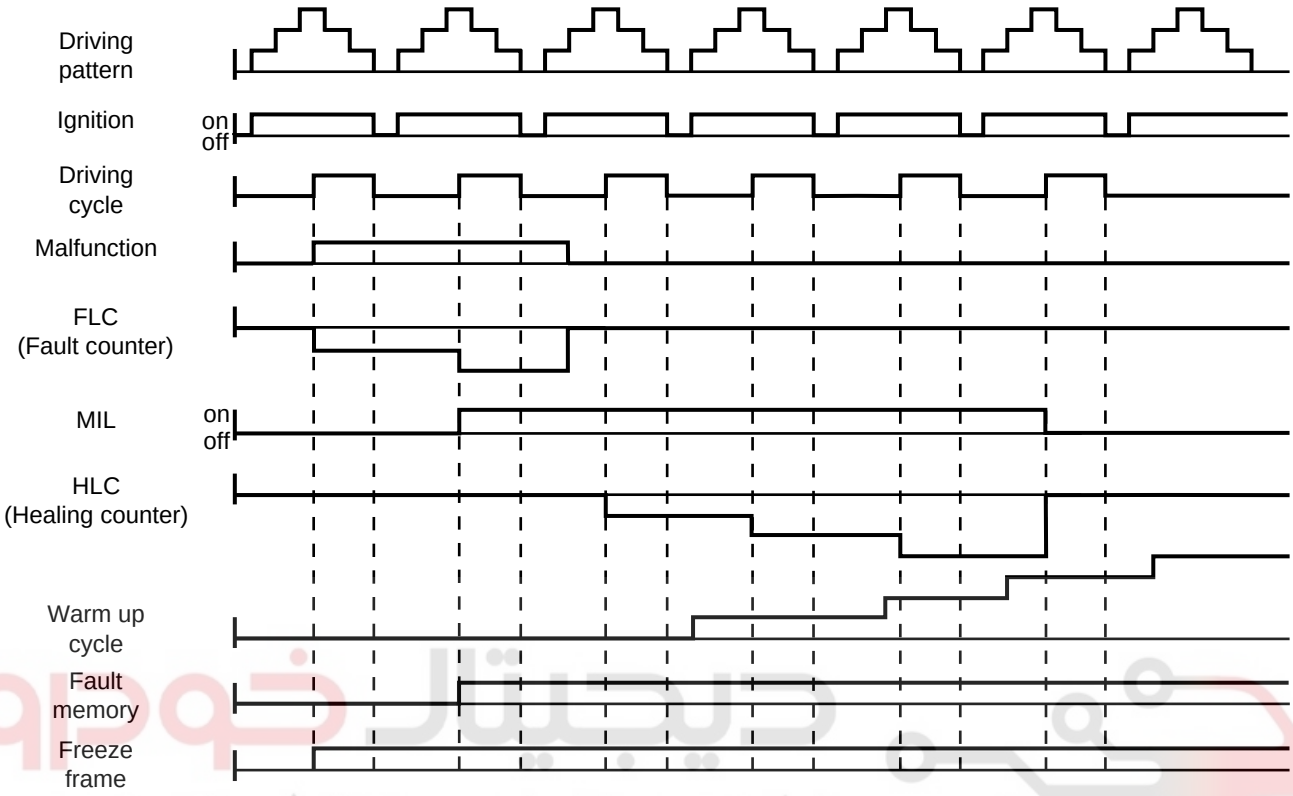
SELF-DIAGNOSIS

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.

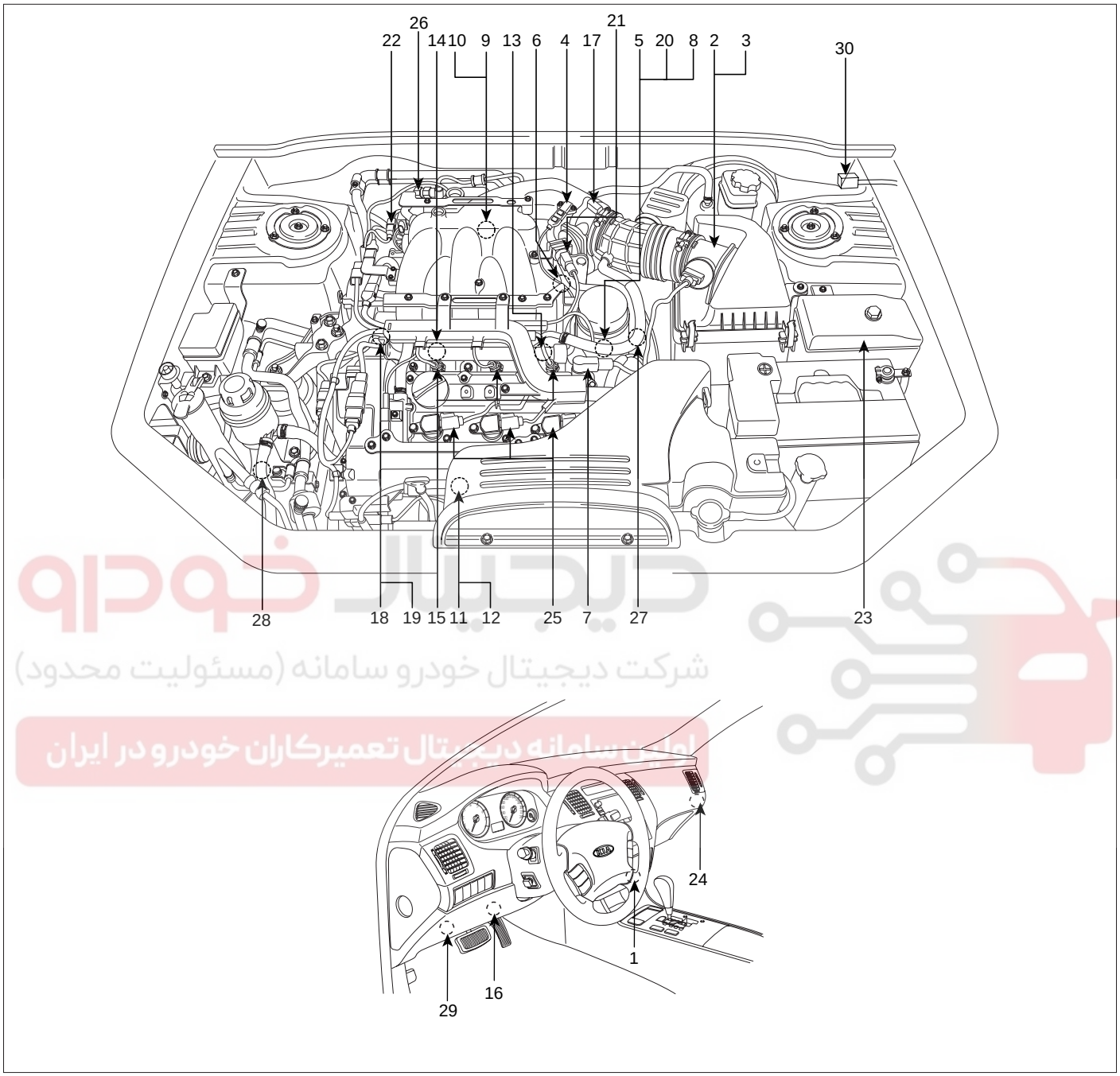
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction is detected after two sequential driving cycles. The MIL will illuminate when the malfunction is detected on the second driving cycle.
   If a misfire is detected, a DTC will be recorded, and the MIL will illuminate, immediately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

NOTE

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

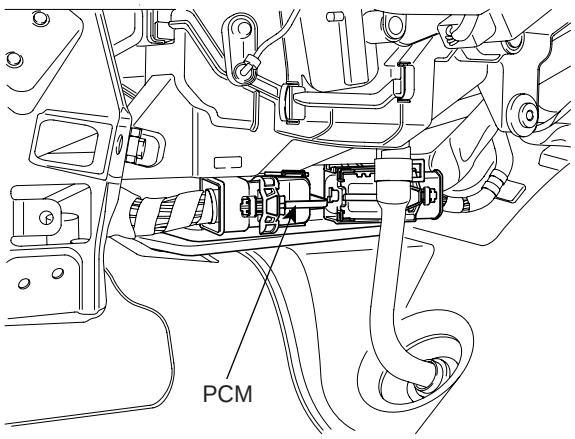
COMPONENTS ED366272



1. PCM (Powertrain Control Module)
2. Mass Air Flow Sensor (MAFS)
3. Intake Air Temperature Sensor (IATS)
4. Manifold Absolute Pressure Sensor (MAPS)
5. Engine Coolant Temperature Sensor (ECTS)
6. Camshaft Position Sensor (CMPS) [Bank 1]
7. Camshaft Position Sensor (CMPS) [Bank 2]
8. Crankshaft Position Sensor (CKPS)
9. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]
10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]
11. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]
12. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]
13. Knock Sensor (KS) #1
14. Knock Sensor (KS) #2
15. Injector
16. Accelerator Position Sensor (APS)
17. ETC Module [Throttle Position Sensor (TPS) + ETC Motor]
18. CVVT Oil Control Valve (OCV) [Bank 1]
19. CVVT Oil Control Valve (OCV) [Bank 2]
20. CVVT Oil Temperature Sensor (OTS)
21. Purge Control Solenoid Valve (PCSV)
22. Variable Intake Solenoid (VIS) Valve
23. Fuel Pump Relay
24. Main Relay
25. Ignition Coil
26. Power Steering Pressure Sensor (PSPS)
27. Vehicle Speed Sensor (VSS)
28. A/C Pressure Transducer
29. Data Link Connector (DLC)
30. Multi - Purpose Check Connector

SGHFL7100L

1. PCM (Powertrain Control Module)



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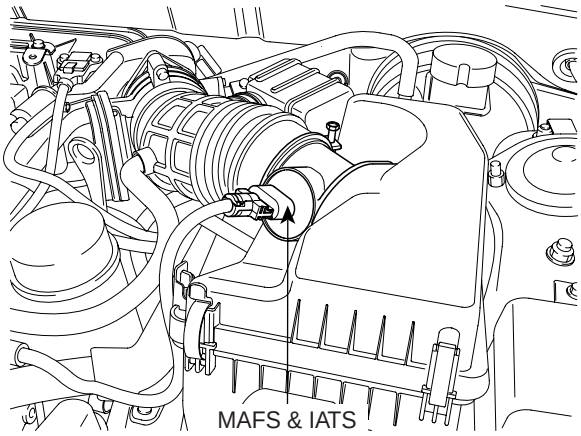
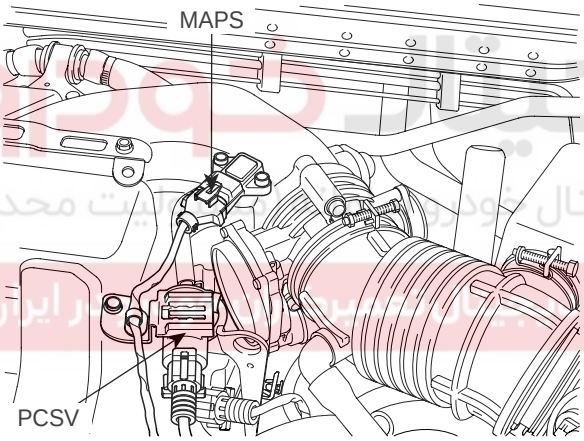
2. Mass Air Flow Sensor (MAFS)
3. Intake Air Temperature Sensor (IATS)



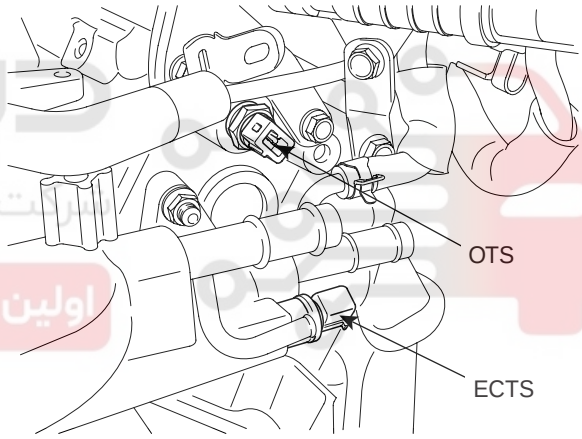
AFCF101B

4. Manifold Absolute Pressure Sensor (MAPS)
21. Purge Control Solenoid Valve (PCSV)



KFCF101C

5. Engine Coolant Temperature Sensor (ECTS)
20. CVVT Oil Temperature Sensor (OTS)



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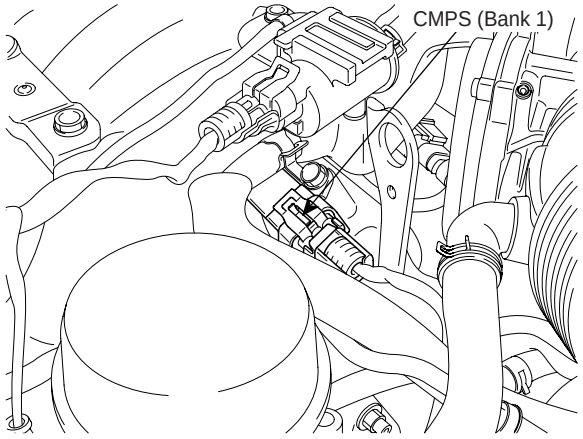
6. Camshaft Position Sensor (CMPS) [Bank 1]



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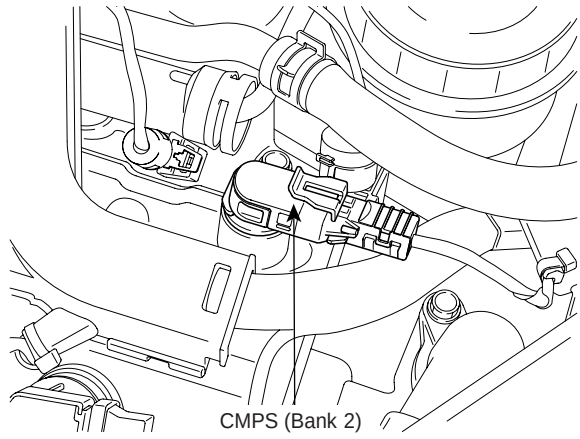
7. Camshaft Position Sensor (CMPS) [Bank 2]



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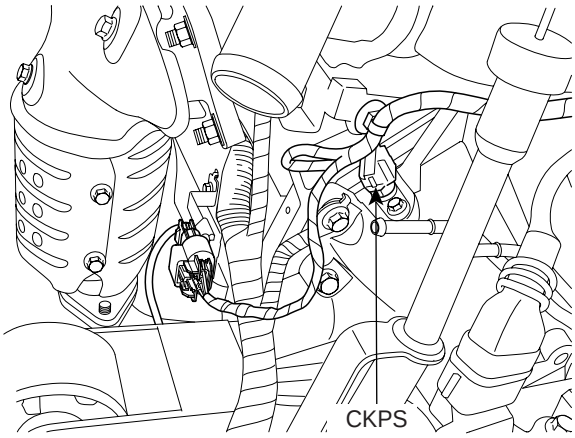
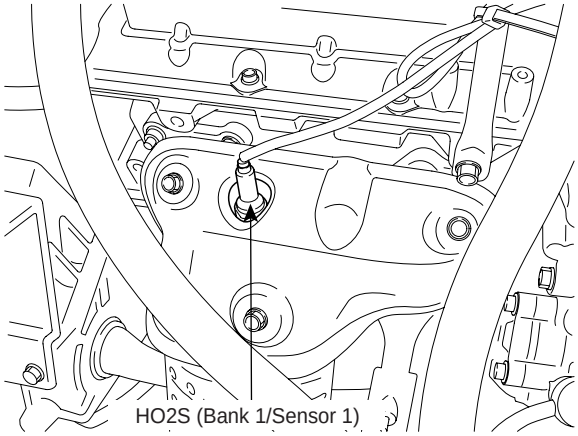
8. Crankshaft Position Sensor (CKPS)



KFCF101G

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



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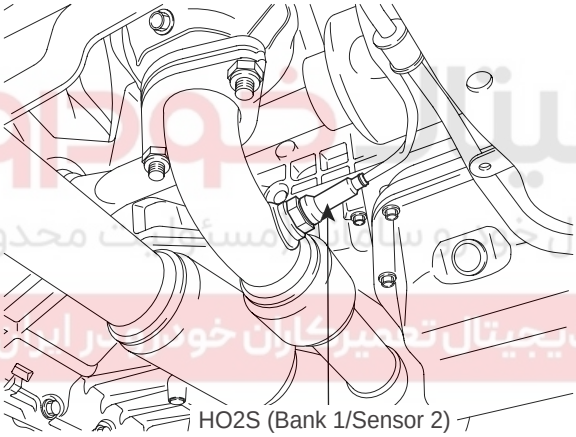
10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]



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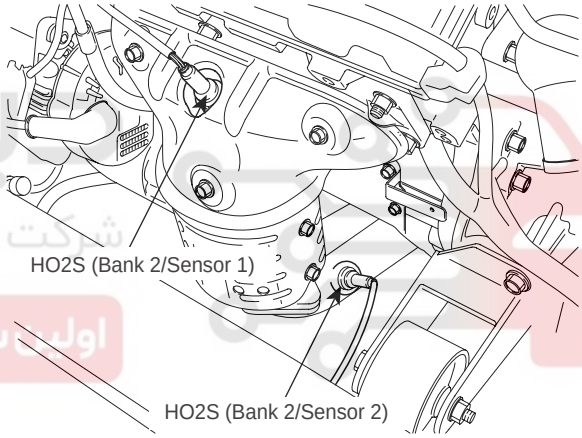
11. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]
12. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]



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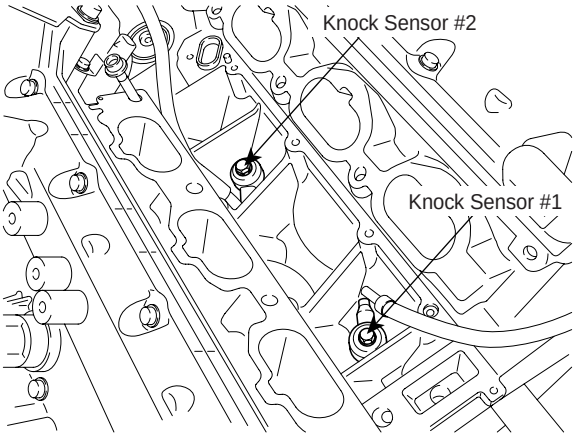
13. Knock Sensor (KS) #1
14. Knock Sensor (KS) #2



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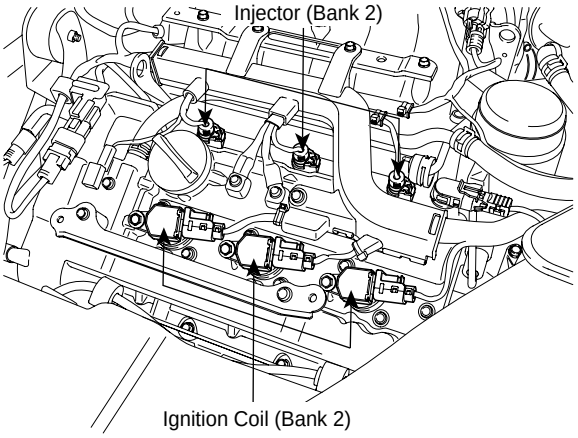
15. Injector
25. Ignition Coil



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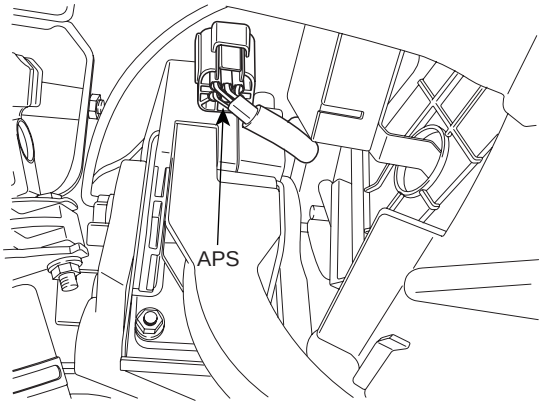
16. Accelerator Position Sensor (APS)



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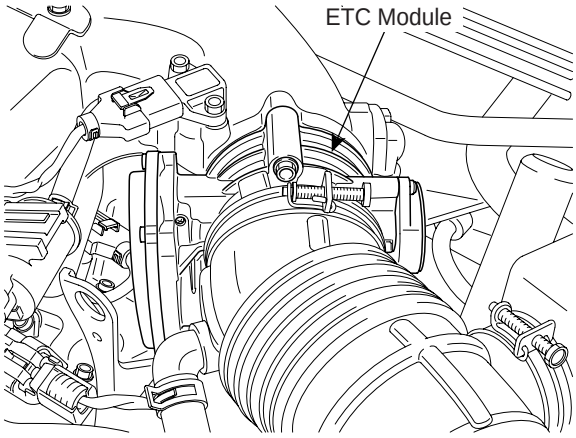
17. ETC Module [Throttle Position Sensor (TPS) + ETC Motor]



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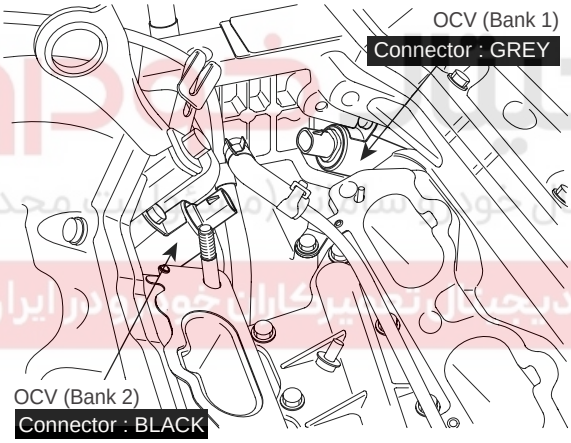
18. CVVT Oil Control Valve (OCV) [Bank 1]
19. CVVT Oil Control Valve (OCV) [Bank 2]



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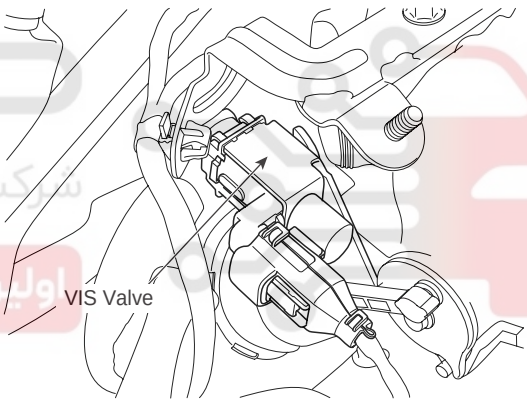
22. Variable Intake Solenoid (VIS) Valve



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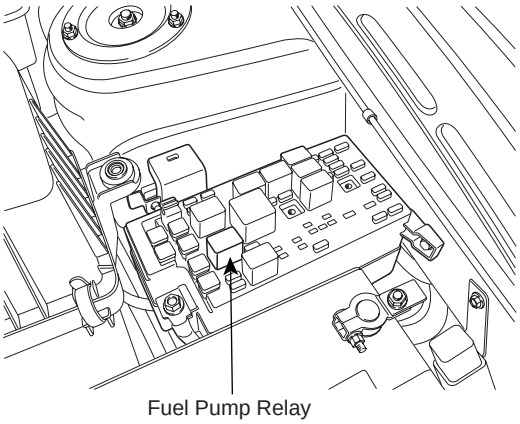
23. Fuel Pump Relay



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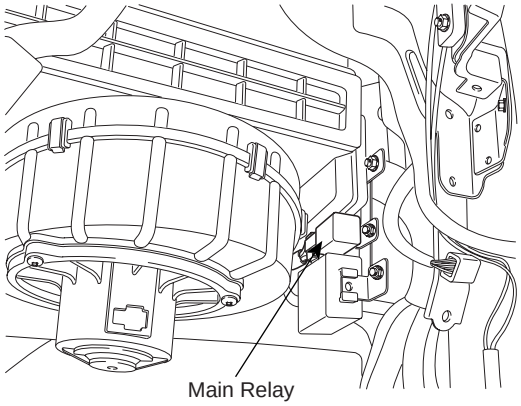
24. Main Relay



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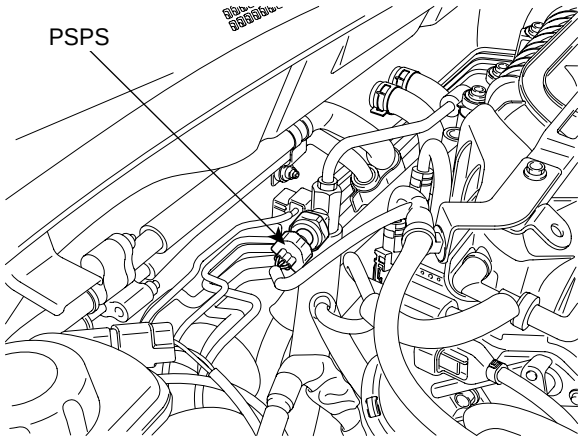
26. Power Steering Pressure Sensor (PSPS)



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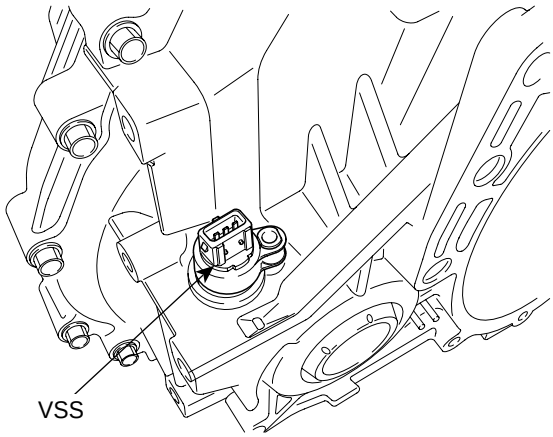
27. Vehicle Speed Sensor (VSS)



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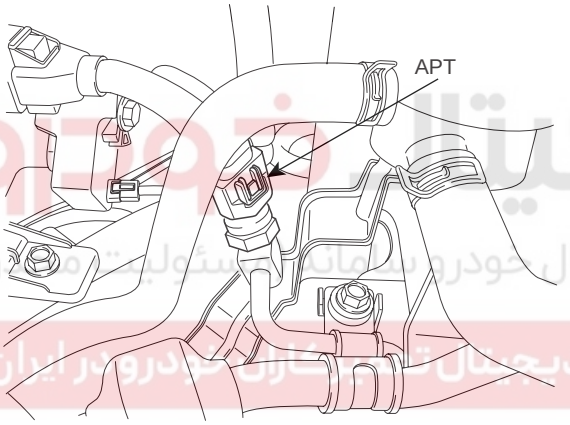
28. A/C Pressure Transducer (APT)



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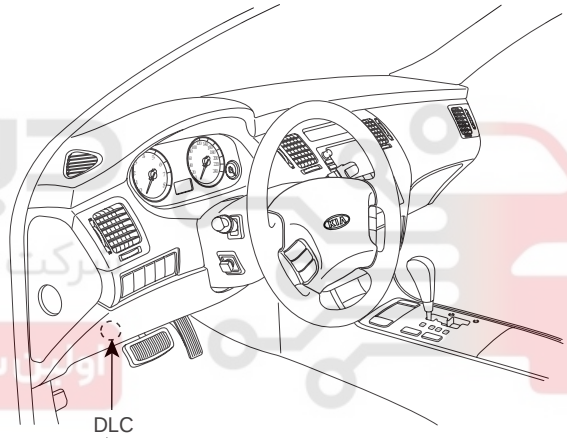
29. Date Link Connector (DLC)

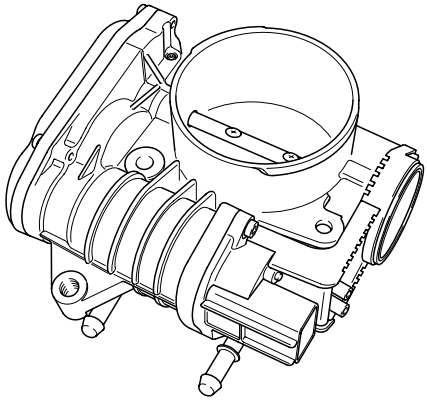


SGHFL6010D

ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM

DESCRIPTION EF48F0B6

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.



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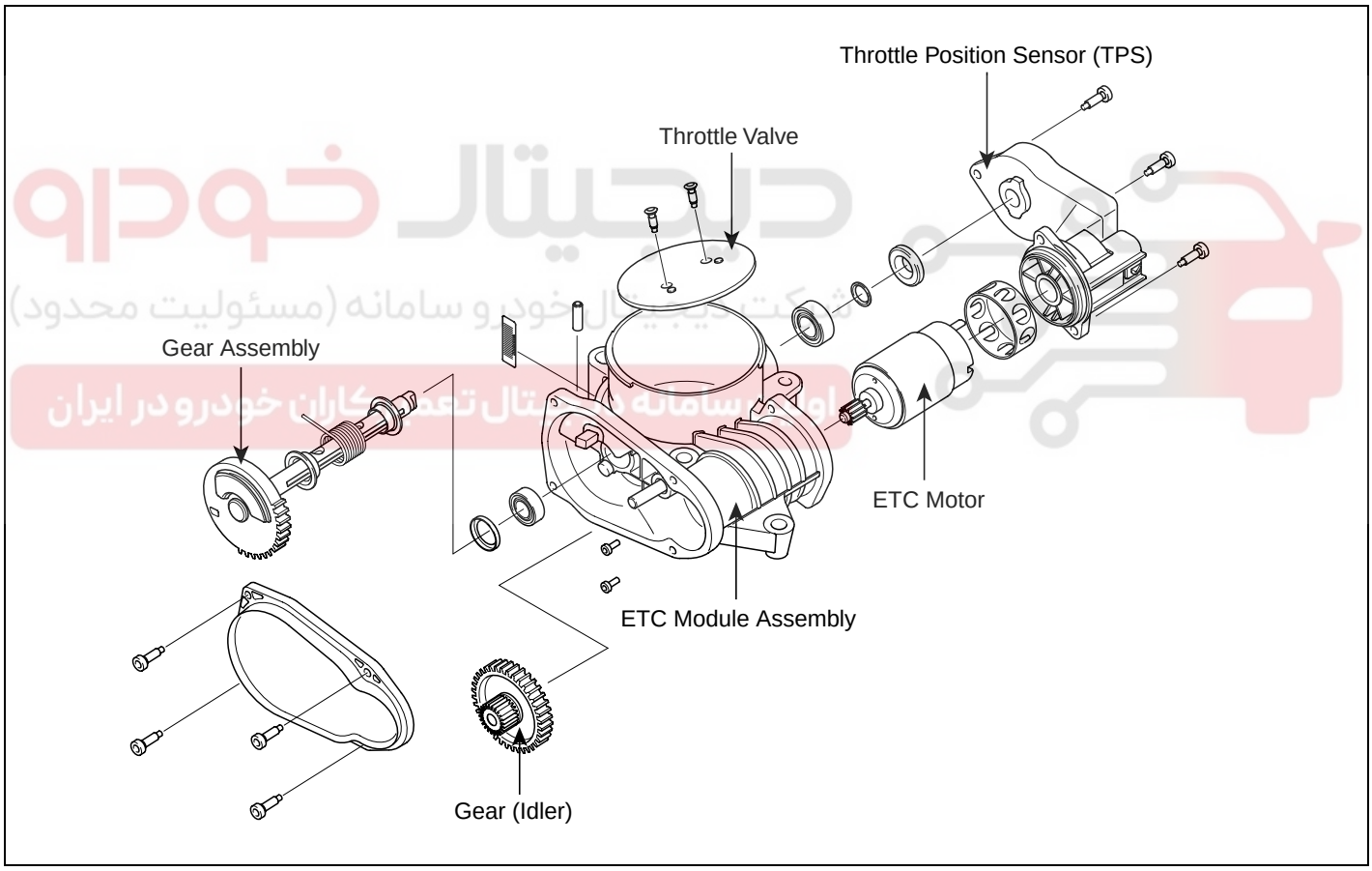

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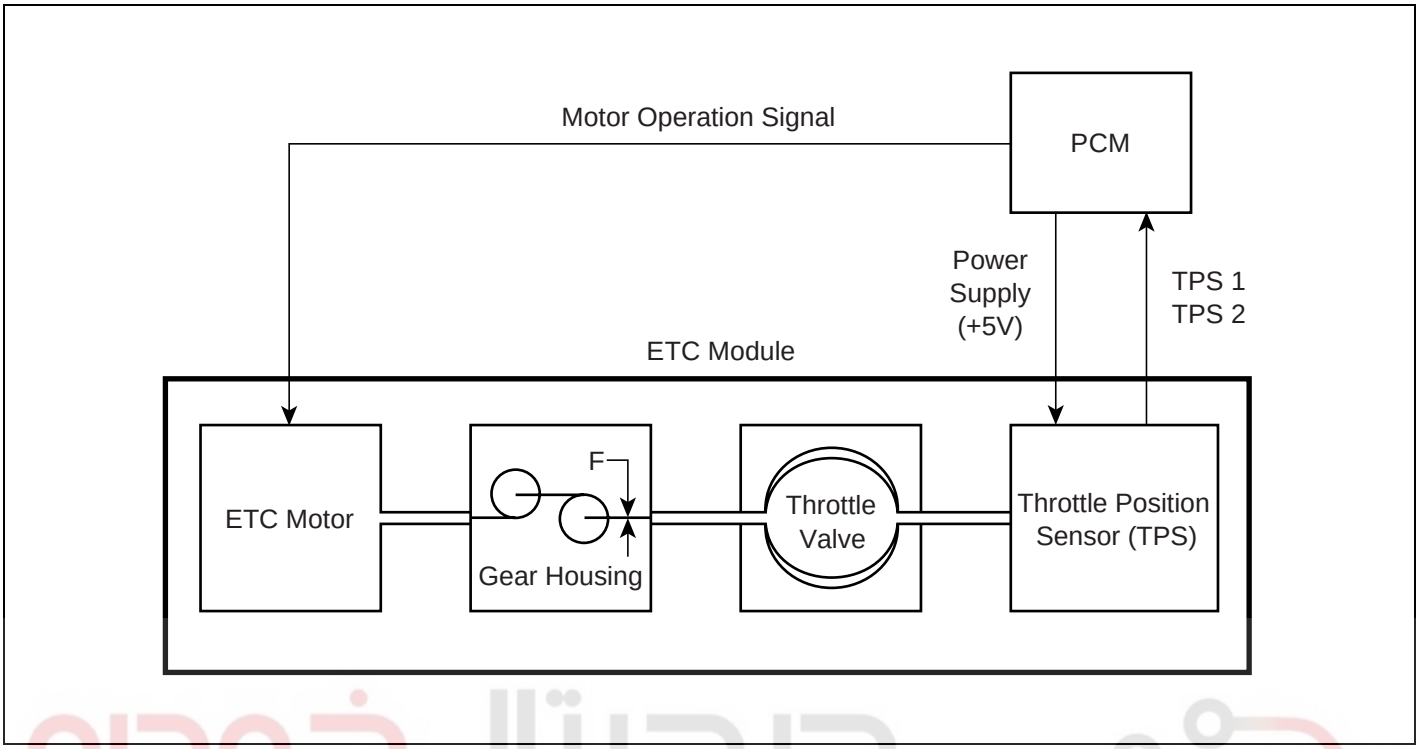
COMPONENTS



EGRF234A

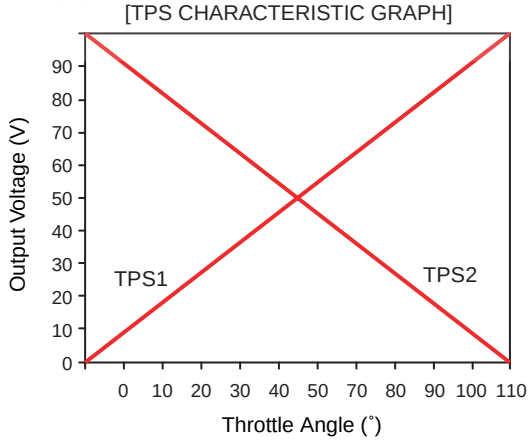
SPECIFICATION

[THROTTLE POSITION SENSOR]

Throttle Angle(˚)	Output Voltage(V) [Vref = 5.0V]	
	TPS1	TPS2
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	0V

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

[TPS CHARACTERISTIC GRAPH]



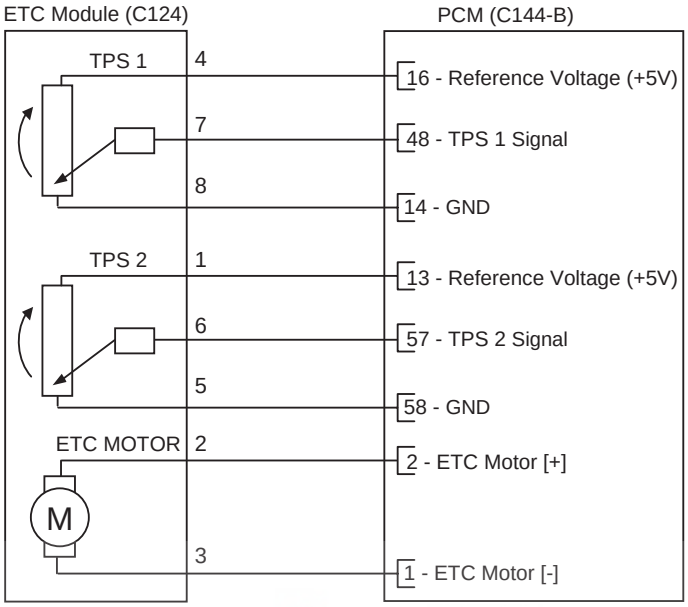
EGRF235A

[ETC MOTOR]

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

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



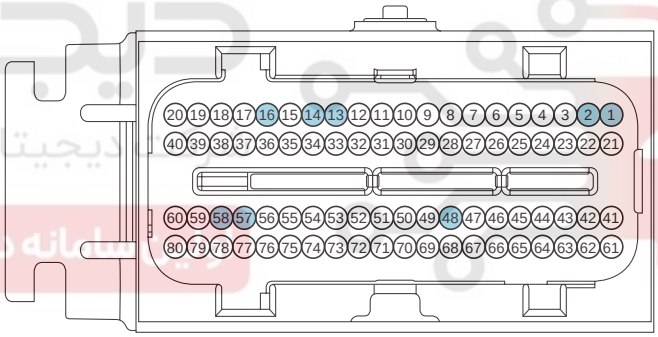
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE



C144-B

PCM

UFBG236A

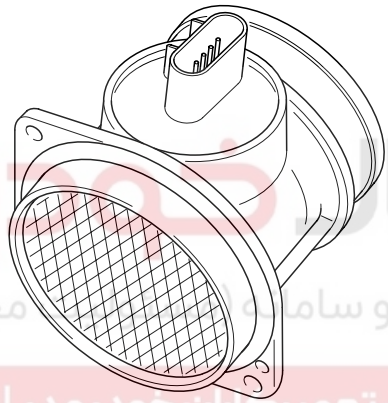
FAIL-SAFE MODE

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 PERFOR-MANCE & 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 PERFOR-MANCE	1. Engine power varies with accelerator position, but driver perceives lack of engine power. 2. 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	

MASS AIR FLOW SENSOR (MAFS)

DESCRIPTION EBBCA1C4

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.



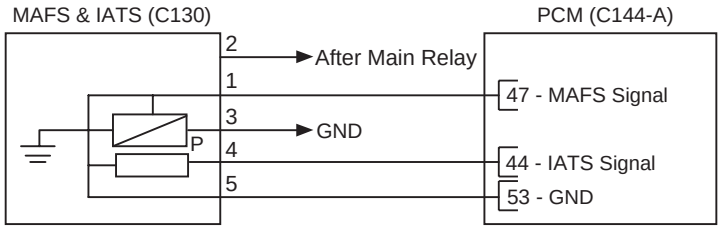
KFCF1021

SPECIFICATION

Air Flow (kg/h)	Output Frequency (Hz)
12.6 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

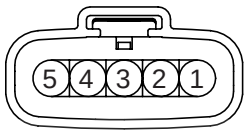
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

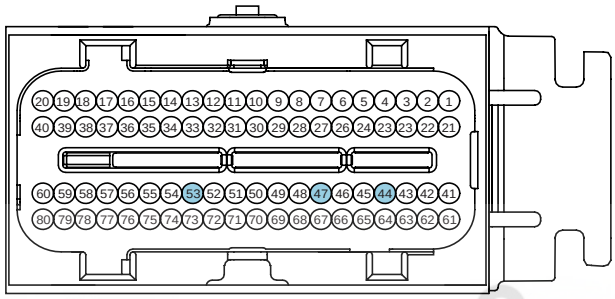
Terminal	Connected to	Function
1	PCM C144-A (47)	MAFS Signal
2	Main Relay	Battery Voltage (B+)
3	Chassis Ground	Ground
4	PCM C144-A (44)	IATS Signal
5	PCM C144-A (53)	Sensor Ground

[HARNESS CONNECTORS]



C130

MAFS & IATS



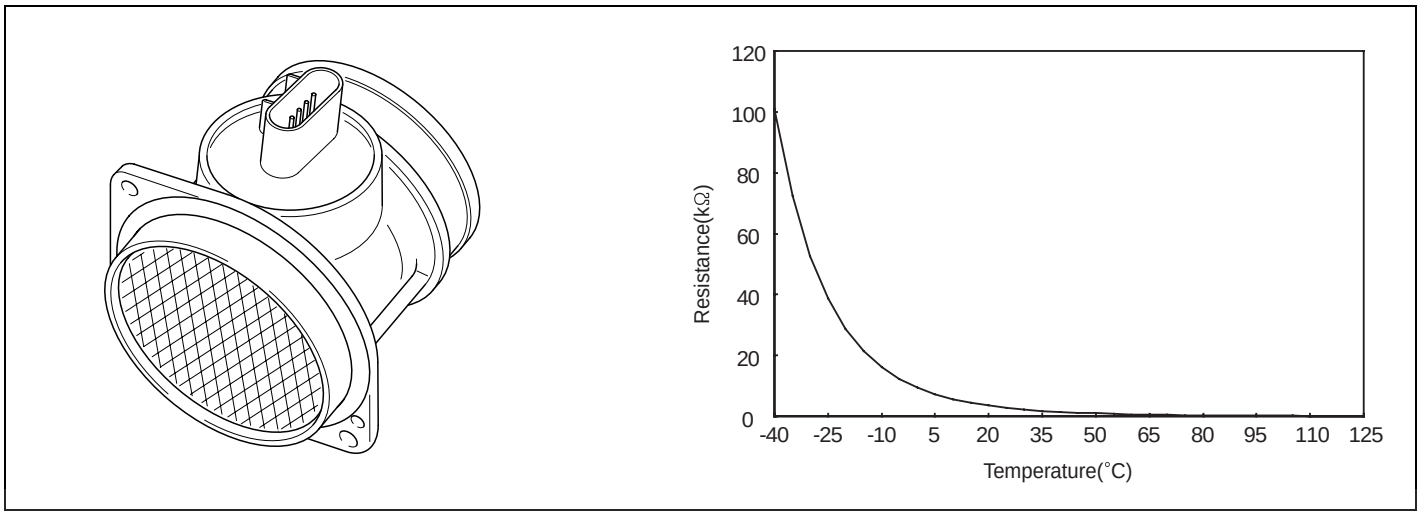
C144-A

PCM

SGHF17008N

INTAKE AIR TEMPERATURE SENSOR (IATS)

DESCRIPTION E4C1EF07



EGRF238A

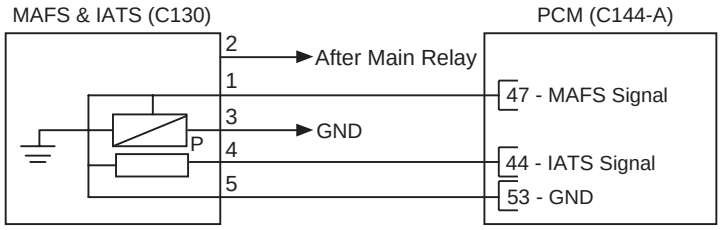
Intake Air Temperature Sensor (IATS) is installed inside the Mass Air Flow Sensor (MAFS) and detects the intake air temperature. To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the PCM uses not only MAFS signal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

SPECIFICATION

Temperature		
℃	°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

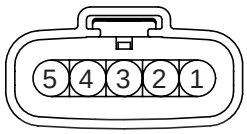
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

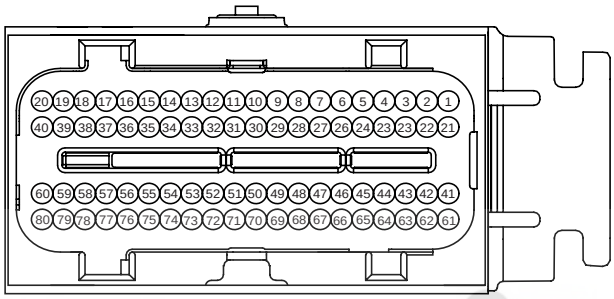
Terminal	Connected to	Function
1	PCM C144-A (47)	MAFS Signal
2	Main Relay	Battery Voltage (B+)
3	Chassis Ground	Ground
4	PCM C144-A (44)	IATS Signal
5	PCM C144-A (53)	Sensor Ground

[HARNESS CONNECTORS]



C130

MAFS & IATS



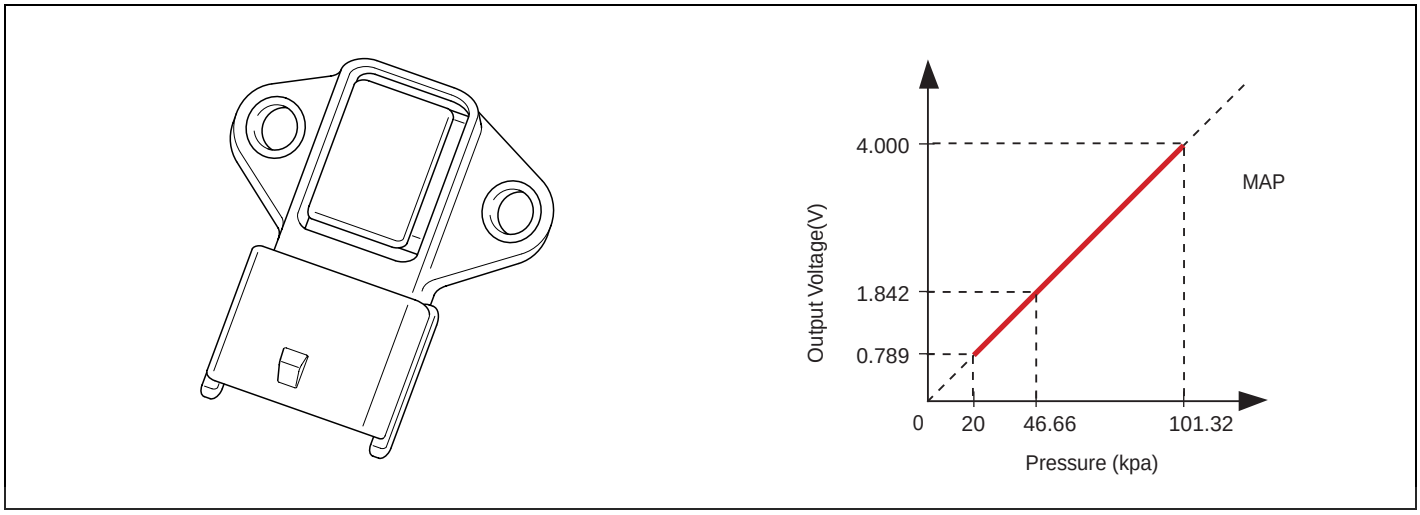
C144-A

PCM

SGHF17009N

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

DESCRIPTION EAFFB5B1



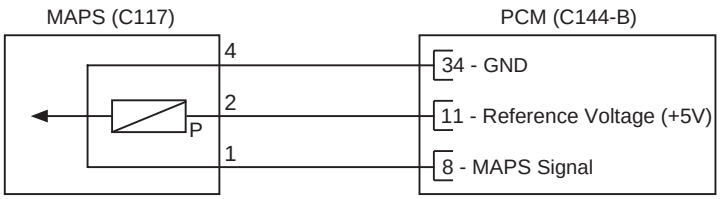
EGRF239A

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	0.79V
46.66kPa	1.84V
101.32kPa	4.00V

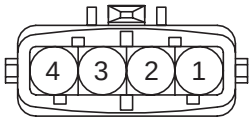
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

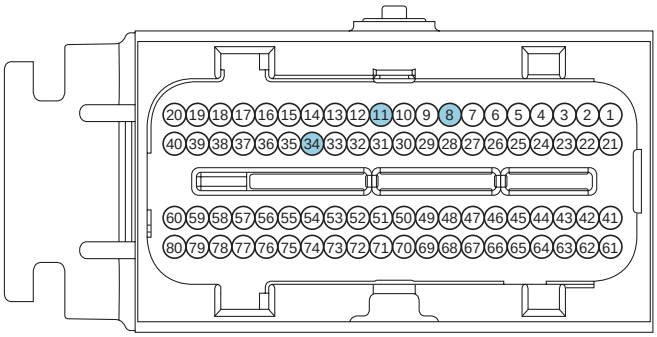
Terminal	Connected to	Function
1	PCM C144-B (8)	MAPS Signal
2	PCM C144-B (11)	Reference Voltage (+5V)
3	-	-
4	PCM C144-B (34)	Sensor ground

[HARNESS CONNECTORS]



C117

MAPS



C144-B

PCM

UFBG240A

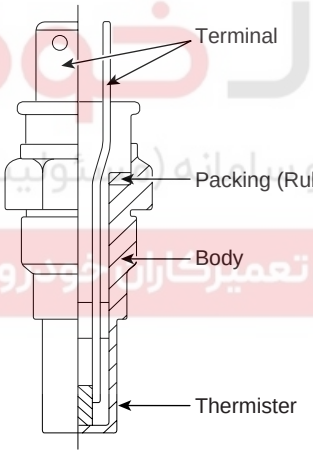
ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

DESCRIPTION E9AF4BED

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.

SPECIFICATION

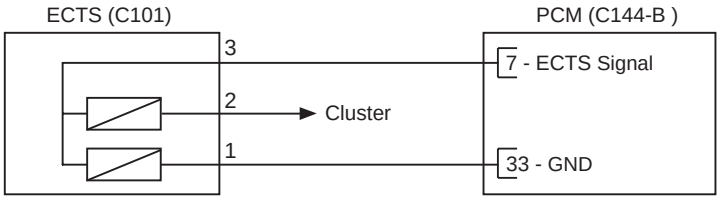
Temperature		Resistance(kΩ)
°C	°F	
-40	-40	48.14kΩ
-20	-4	14.13 ~ 16.83kΩ
0	32	5.79kΩ
20	68	2.31 ~ 2.59kΩ
40	104	1.15kΩ
60	140	0.59kΩ
80	176	0.32kΩ



EGRF241A

SCHEMATIC DIAGRAM

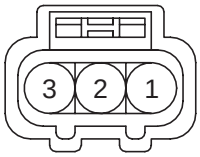
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

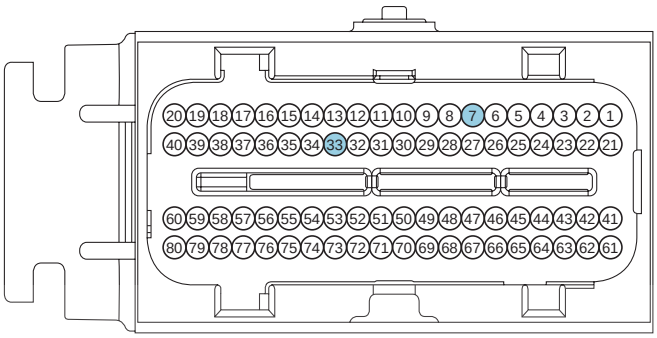
Terminal	Connected to	Function
1	PCM C144-B (33)	Sensor ground
2	Cluster	-
3	PCM C144-B (7)	ECTS Signal

[HARNESS CONNECTORS]



C101

ECTS

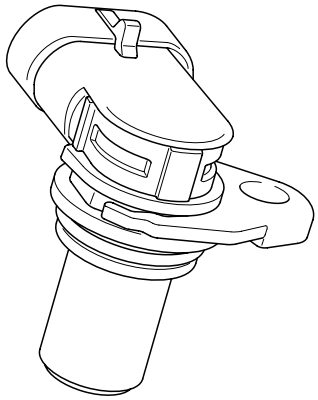


C144-B

PCM

UFBG242A

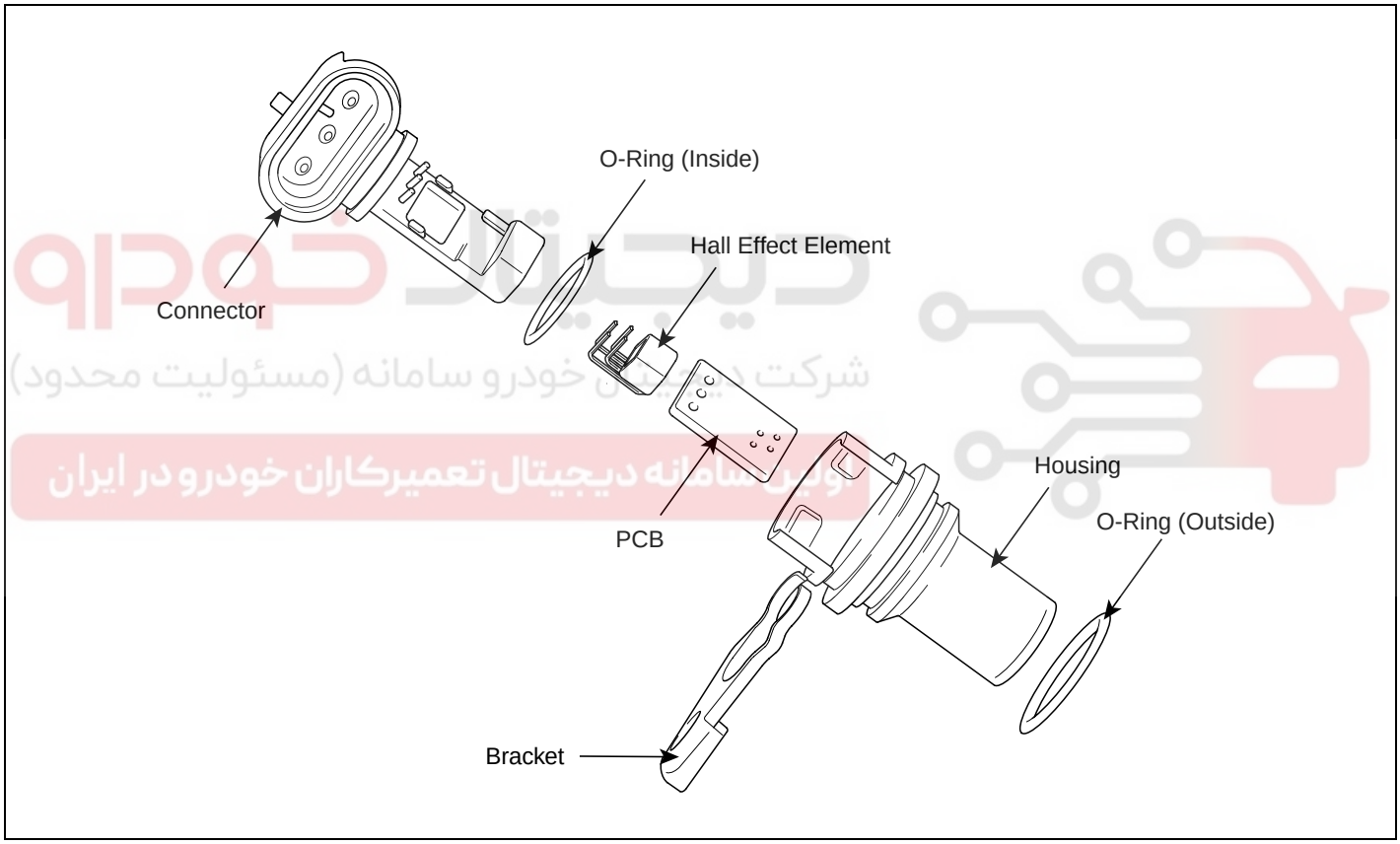
CAMSHAFT POSITION SENSOR (CMPS)



KFCF1022

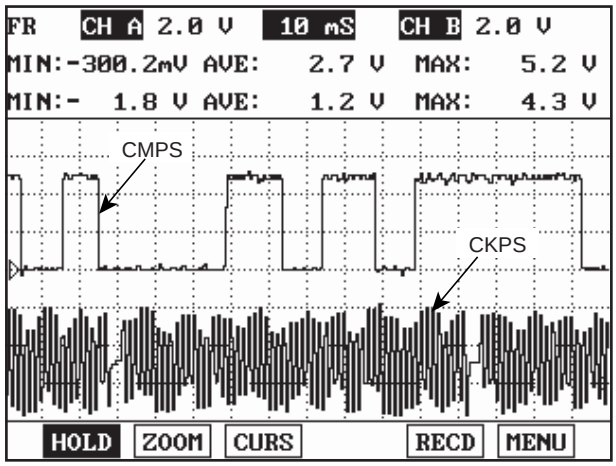
DESCRIPTION EB2985E8

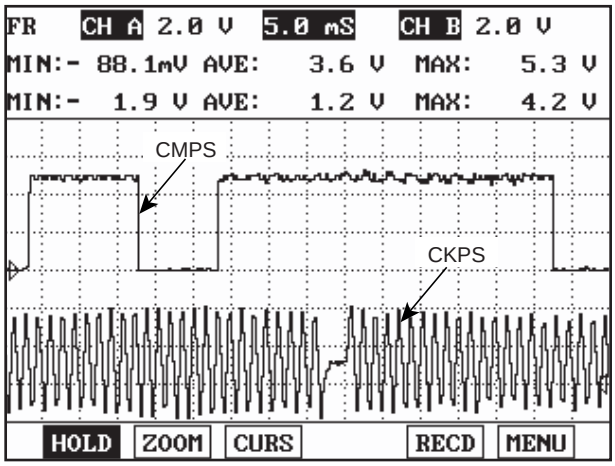
Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element. It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect. The two CMPS are installed on engine head cover of bank 1 and 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.



EGRF243A

WAVEFORM

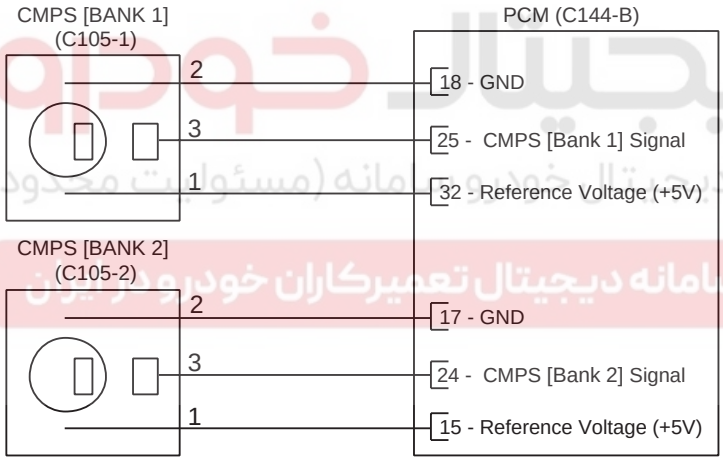




KFCF102M

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

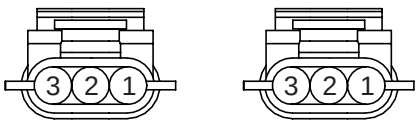
CMPS [BANK 1]

Terminal	Connected to	Function
1	PCM C144-B (32)	Reference Voltage (+5V)
2	PCM C144-B (18)	Sensor ground
3	PCM C144-B (25)	CMPS [Bank 1] signal

CMPS [BANK 2]

Terminal	Connected to	Function
1	PCM C144-B (15)	Reference Voltage (+5V)
2	PCM C144-B (17)	Sensor ground
3	PCM C144-B (24)	CMPS [Bank 2] signal

[HARNESS CONNECTORS]

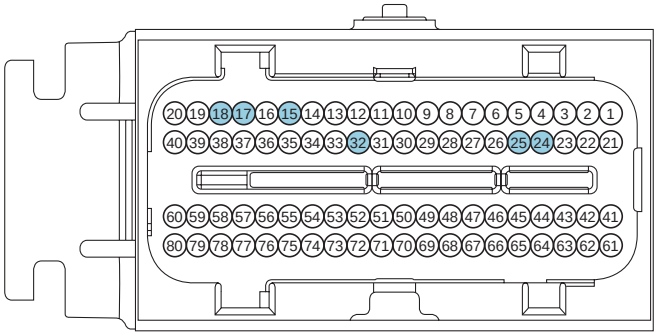


C105-1

CMPS [BANK 1]

C105-2

CMPS [BANK 2]



C144-B

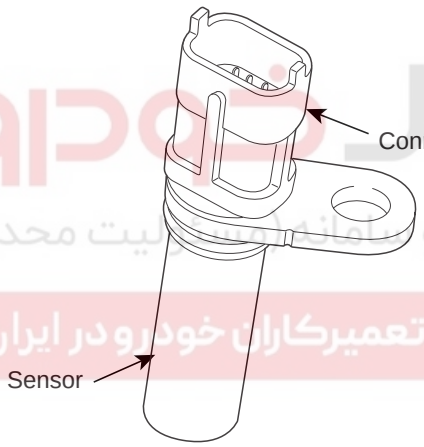
PCM

UFBG244A

CRANKSHAFT POSITION SENSOR (CKPS)

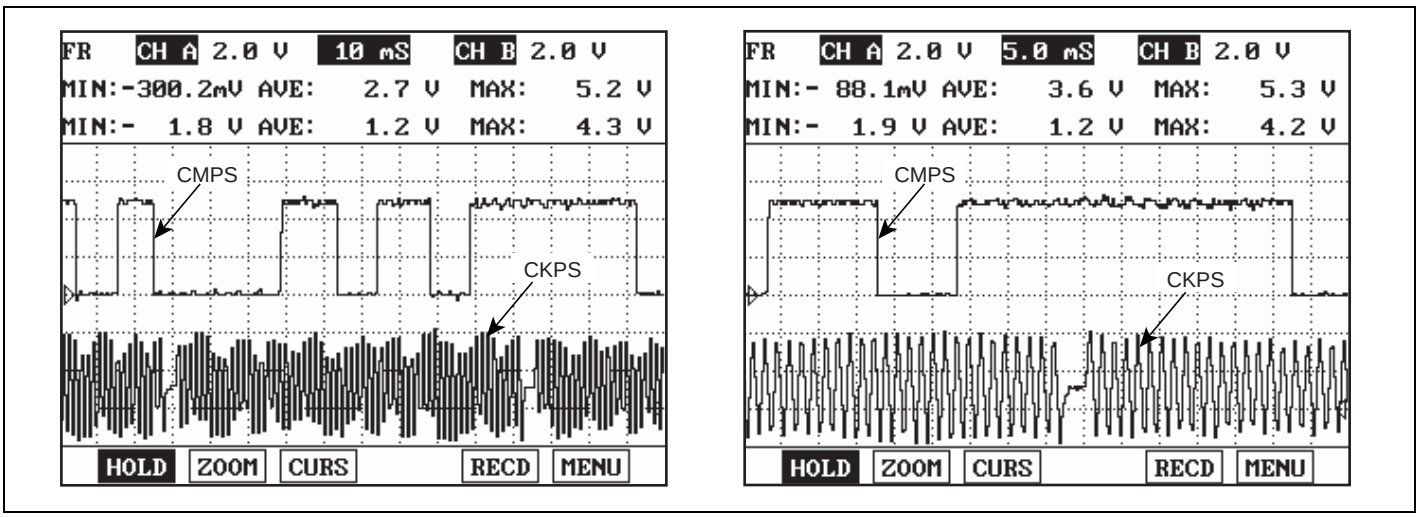
DESCRIPTION E510444C

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).



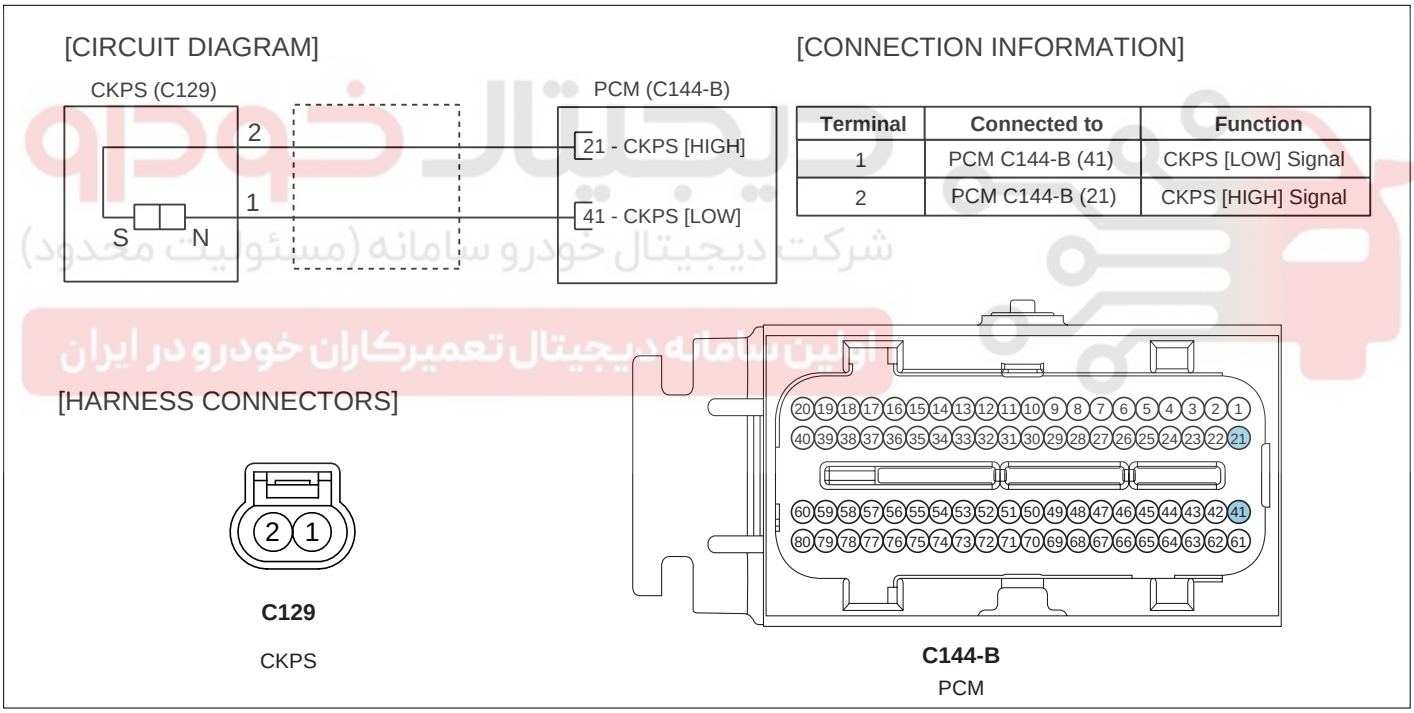
UFBG245A

WAVEFORM



KFCF102M

SCHEMATIC DIAGRAM

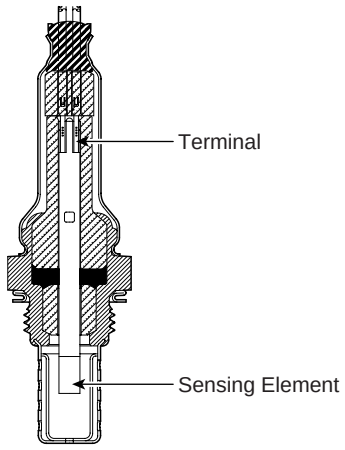


SGHF17010N

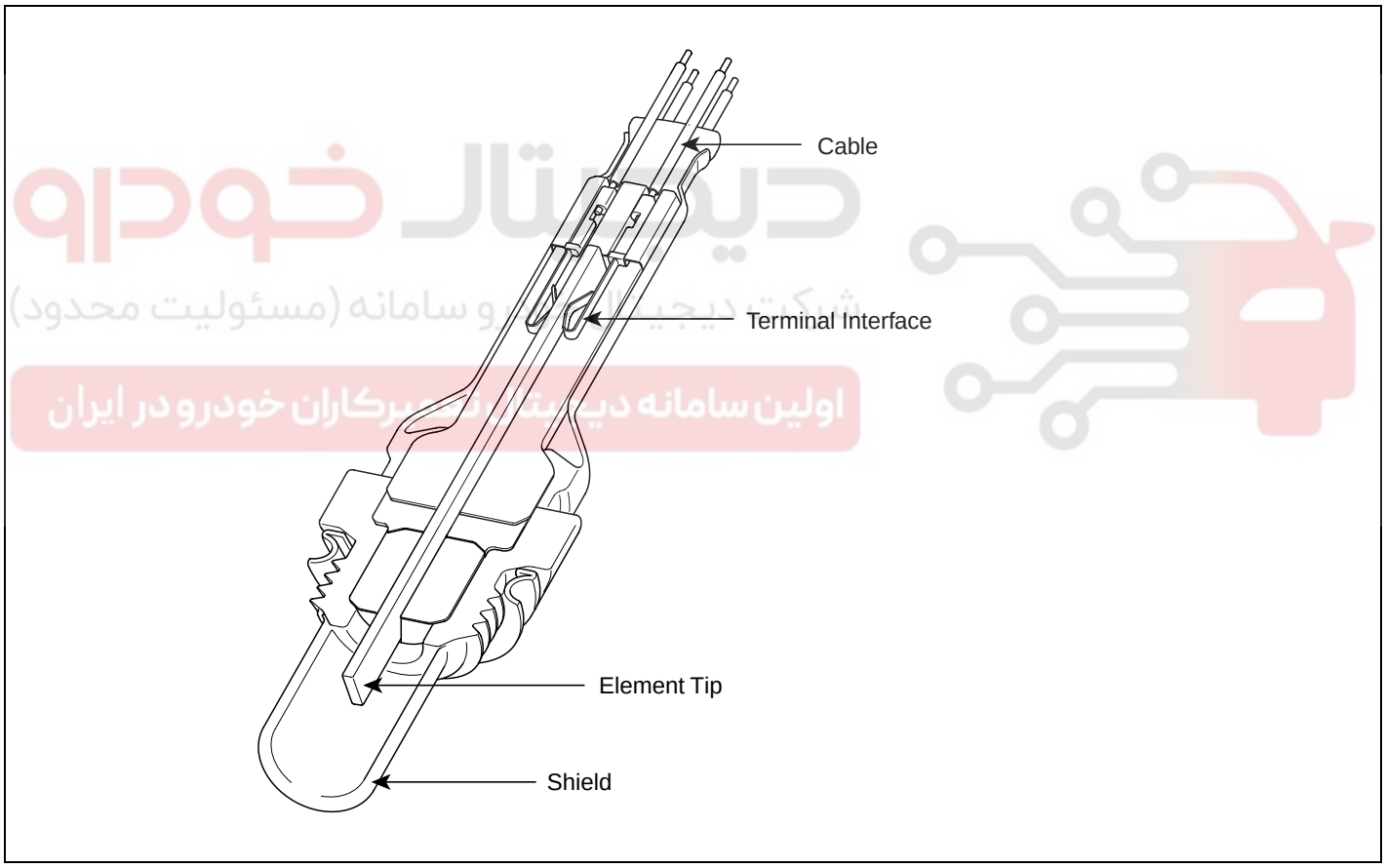
HEATED OXYGEN SENSOR (HO2S)

DESCRIPTION E19D96F7

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℃ (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



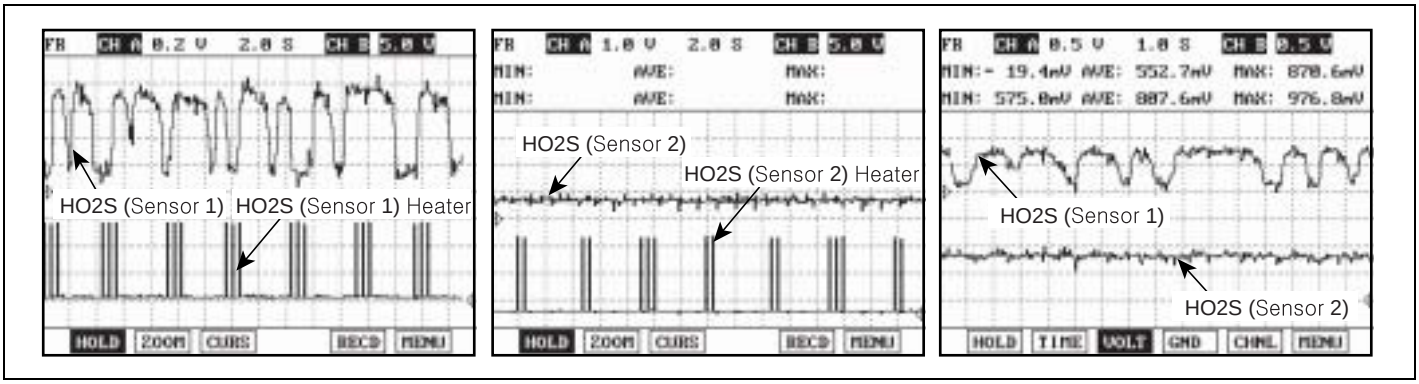
EGRF248A

SPECIFICATION

A/F Ratio	Output Voltage (V)
RICH	0.75 ~ 1.00V
LEAN	0 ~ 0.12V

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

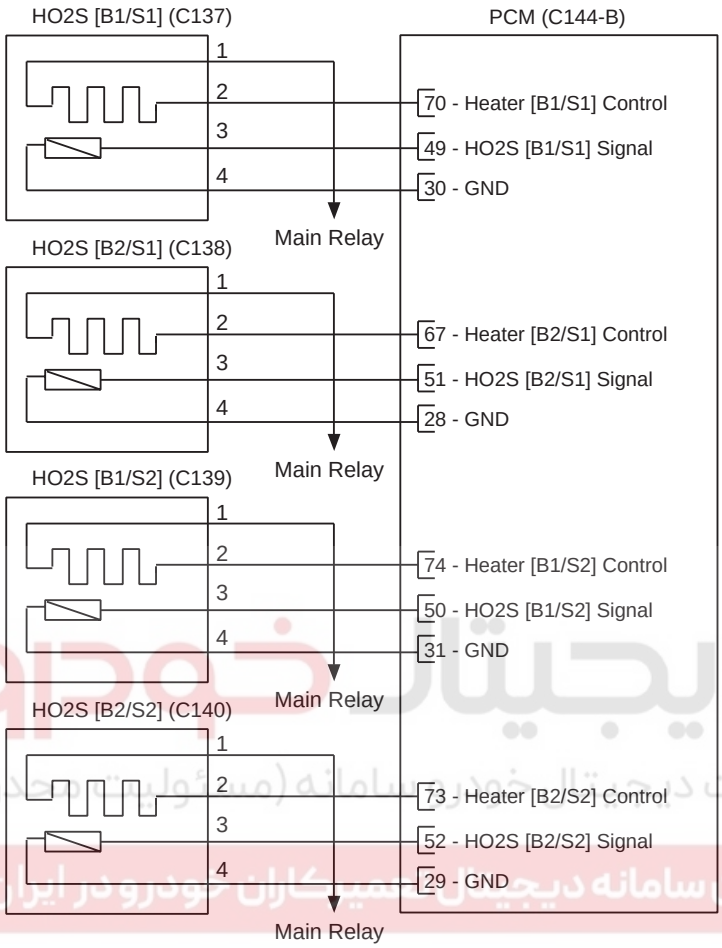
WAVEFORM



EGRF249A

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

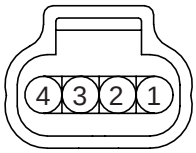
HO2S [B1/S2]

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

HO2S [B2/S2]

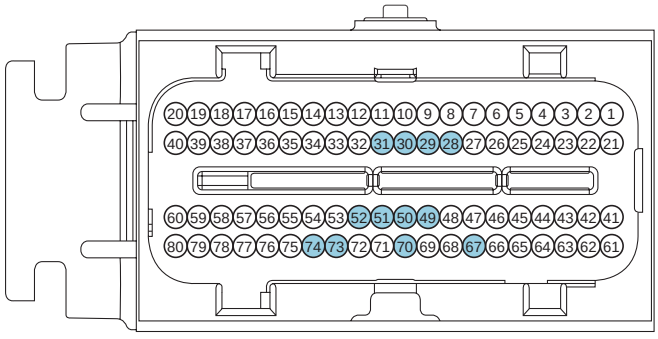
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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]



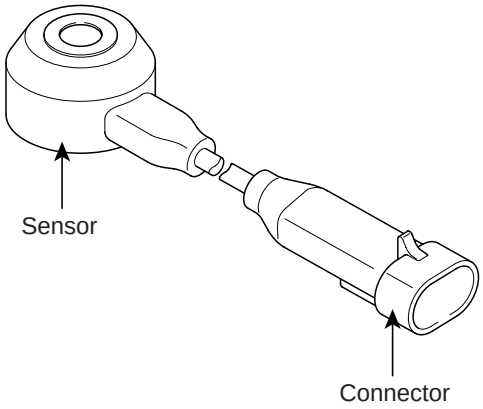
C144-B
PCM

UFBG250B

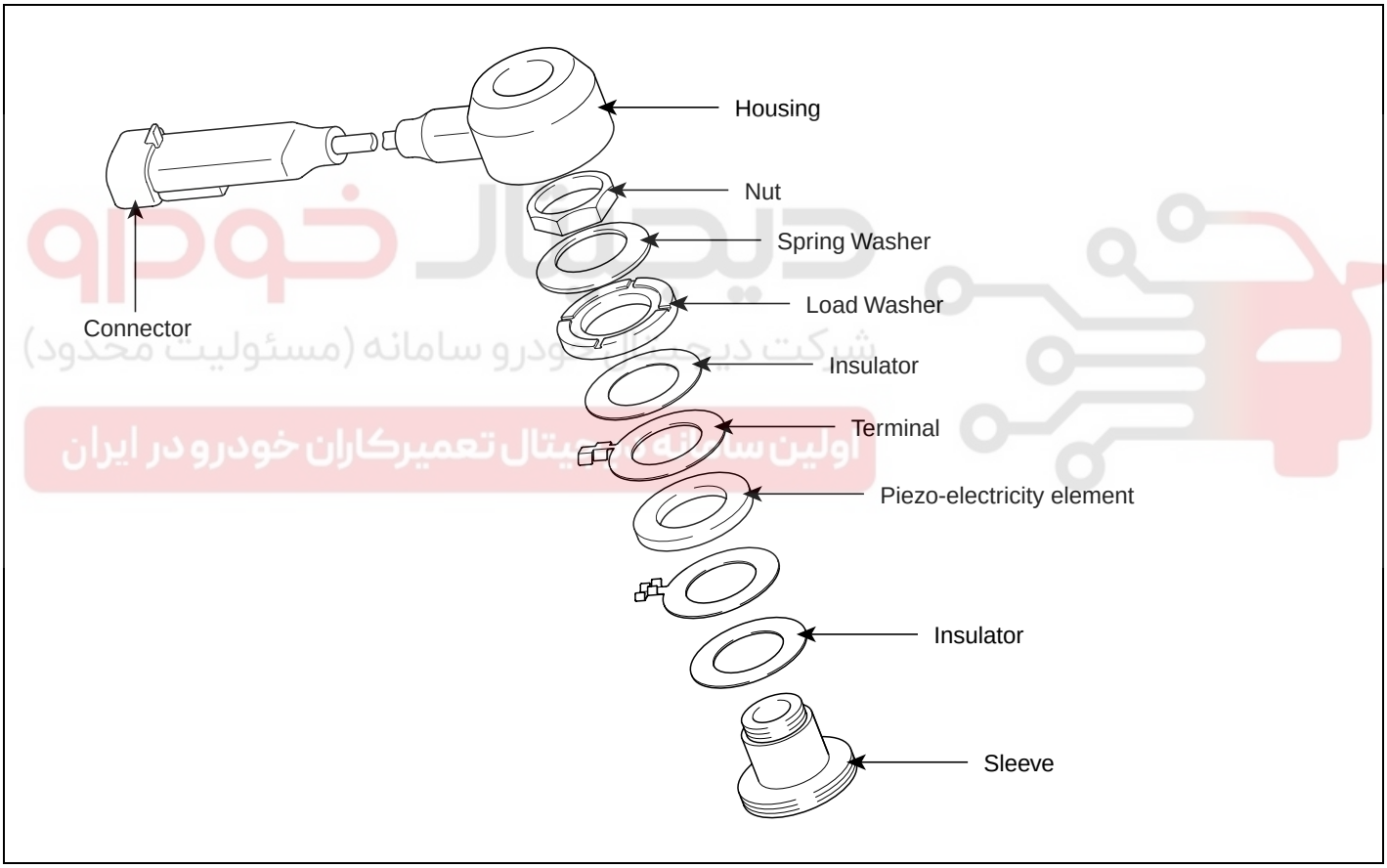
KNOCK SENSOR (KS)

DESCRIPTION EA0A843A

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



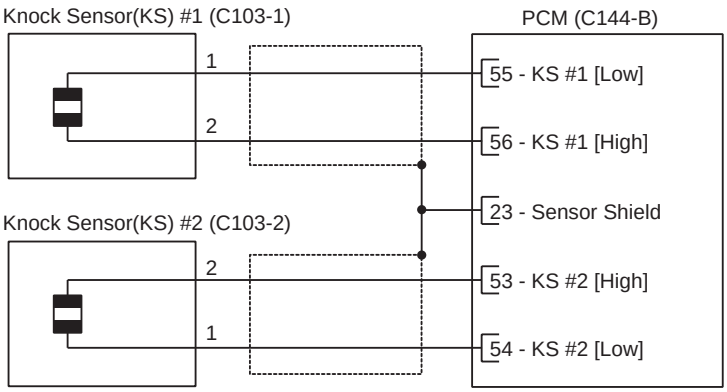
EGRF252A

SPECIFICATION

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

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

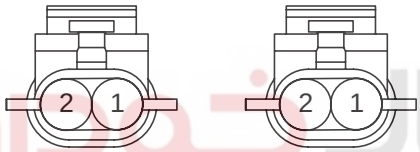
KS #1

Terminal	Connected to	Function
1	PCM C144-B (55)	KS #1 [Low] signal
2	PCM C144-B (56)	KS #1 [High] signal

KS #2

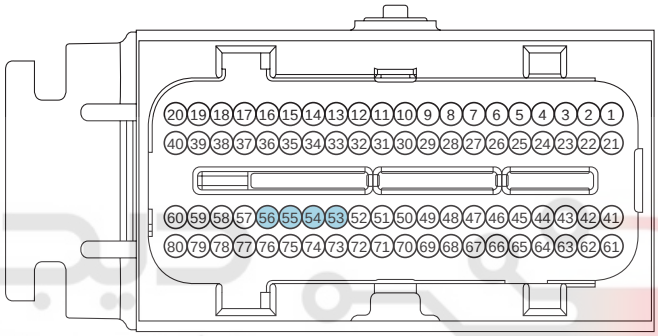
Terminal	Connected to	Function
1	PCM C144-B (54)	KS #2 [Low] signal
2	PCM C144-B (53)	KS #2 [High] signal

[HARNESS CONNECTORS]



C103-1
KS #1

C103-2
KS #2



C144-B
PCM

UFBG253A

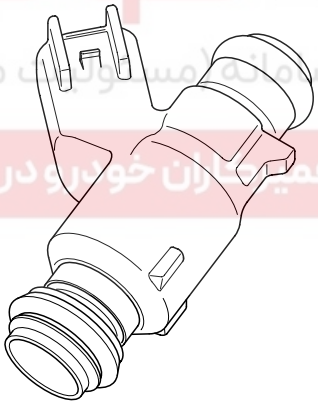
INJECTOR

DESCRIPTION E23C3670

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.



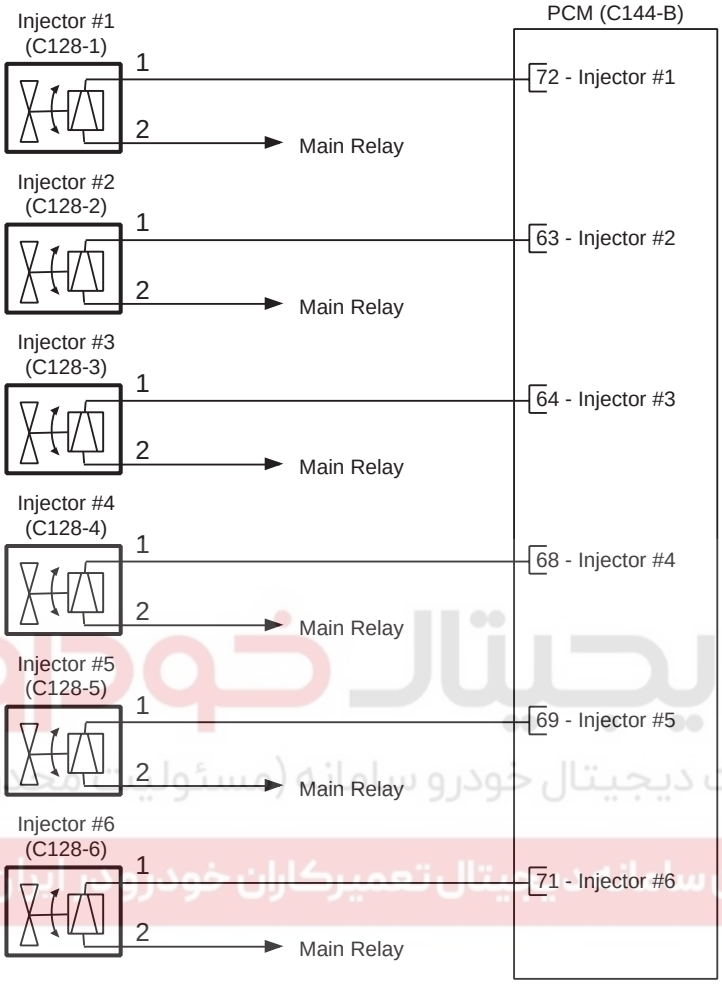
KFCF1026

SPECIFICATION

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

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1

Terminal	Connected to	Function
1	PCM C144-B (72)	Injector #1 control
2	Main Relay	Battery Voltage (B+)

Injector #2

Terminal	Connected to	Function
1	PCM C144-B (63)	Injector #2 control
2	Main Relay	Battery Voltage (B+)

Injector #3

Terminal	Connected to	Function
1	PCM C144-B (64)	Injector #3 control
2	Main Relay	Battery Voltage (B+)

Injector #4

Terminal	Connected to	Function
1	PCM C144-B (68)	Injector #4 control
2	Main Relay	Battery Voltage (B+)

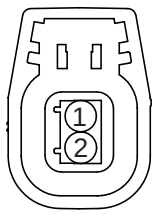
Injector #5

Terminal	Connected to	Function
1	PCM C144-B (69)	Injector #5 control
2	Main Relay	Battery Voltage (B+)

Injector #6

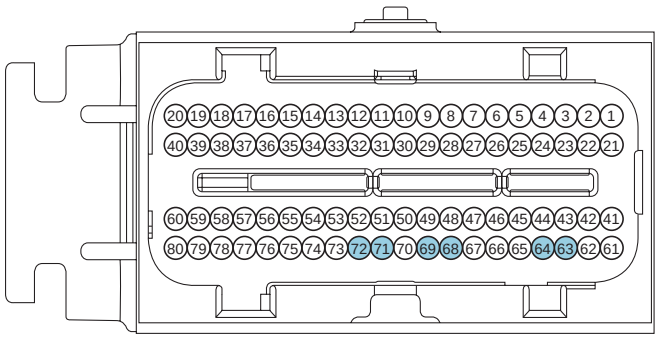
Terminal	Connected to	Function
1	PCM C144-B (71)	Injector #6 control
2	Main Relay	Battery Voltage (B+)

[HARNESS CONNECTORS]



C128-1,2,3,4,5,6

Injector #1,2,3,4,5,6



C144-B

PCM

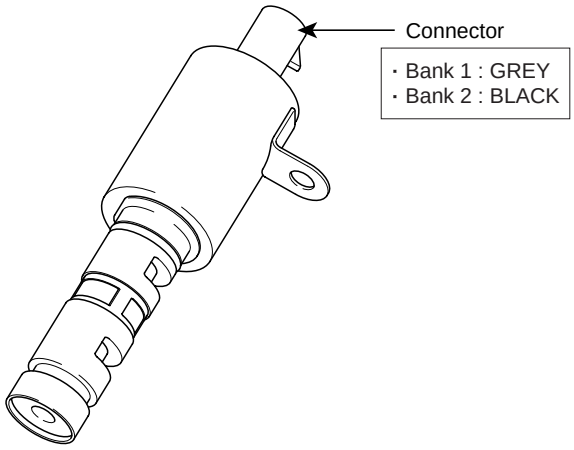
UFBG254A

CVVT OIL CONTROL VALVE (OCV)

DESCRIPTION E0FC7093

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 Valves (OCV) in each bank which supplies oil to cam phaser according to PWM (Pulse Width 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



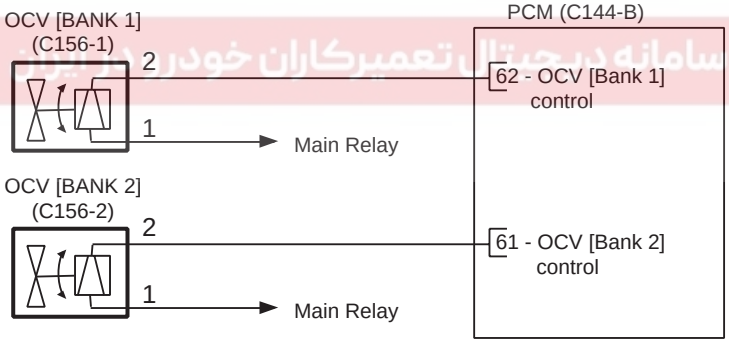
EFBF1027

SPECIFICATION

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

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

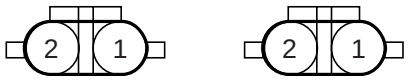
OCV [BANK 1]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (62)	OCV [Bank 1] control

OCV [BANK 2]

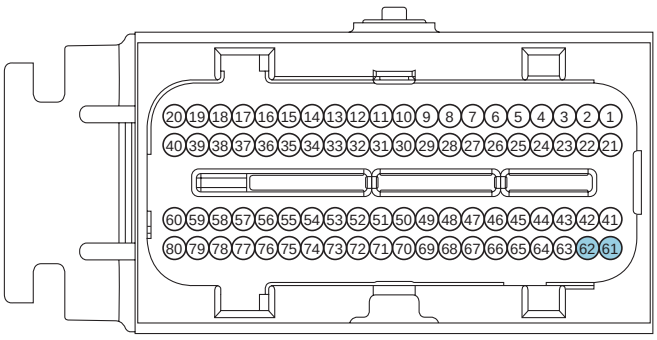
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (61)	OCV [Bank 2] control

[HARNESS CONNECTORS]



C156-1
OCV [Bank 1]

C156-2
OCV [Bank 2]



C144-B
PCM

UFBG255A

INSTALLATION E9A0F589

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]

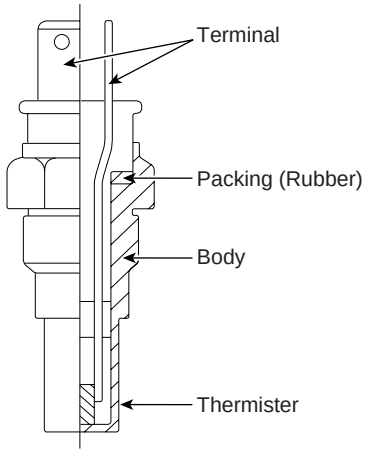
Bank	Component side	Harness side
Bank 1 (RH)	Grey	Grey
Bank 2 (LH)	Black	Black

CVVT OIL TEMPERATURE SENSOR(OTS)

DESCRIPTION EF74A5DE

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



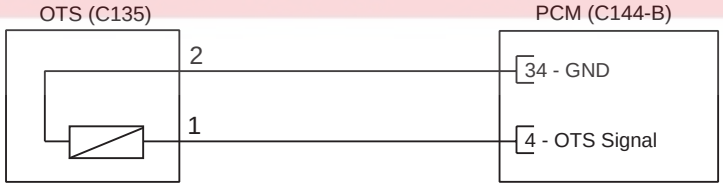
EGRF241A

SPECIFICATION

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

SCHEMATIC DIAGRAM

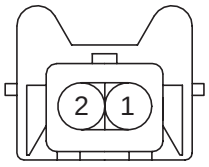
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

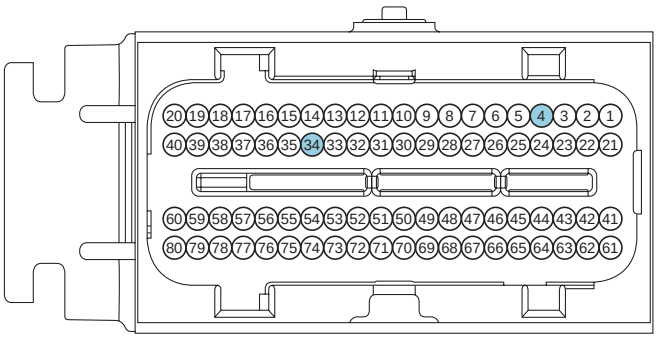
Terminal	Connected to	Function
1	PCM C144-B (4)	OTS Signal
2	PCM C144-B (34)	Sensor ground

[HARNESS CONNECTORS]



C135

OTS



C144-B

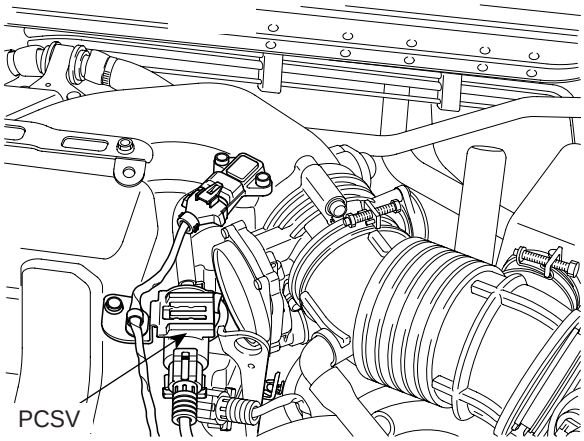
PCM

UFBG256A

PURGE CONTROL SOLENOID VALVE (PCSV)

DESCRIPTION E1027B3C

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.



KFBF312A

SPECIFICATION

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

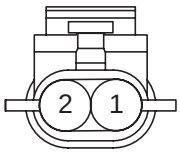
SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]

[CONNECTION INFORMATION]

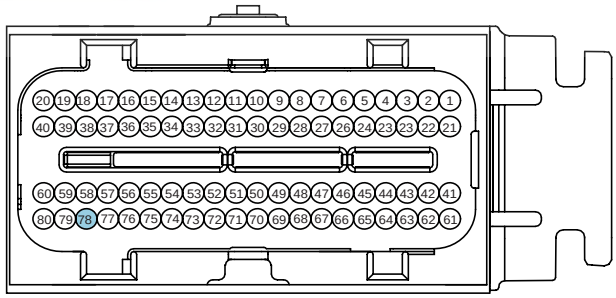
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-A (78)	PCSV Control

[HARNESS CONNECTORS]



C148

PCSV



C144-A

PCM

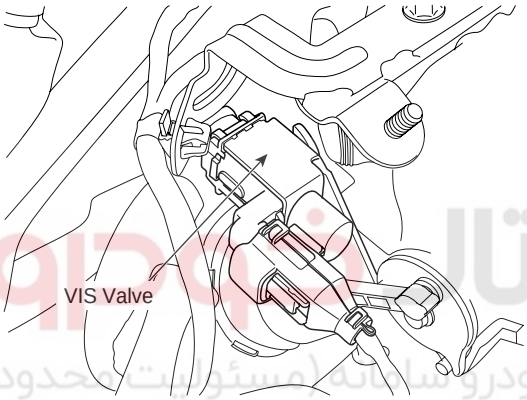
SGHF17011N

VARIABLE INTAKE SOLENOID (VIS) VALVE

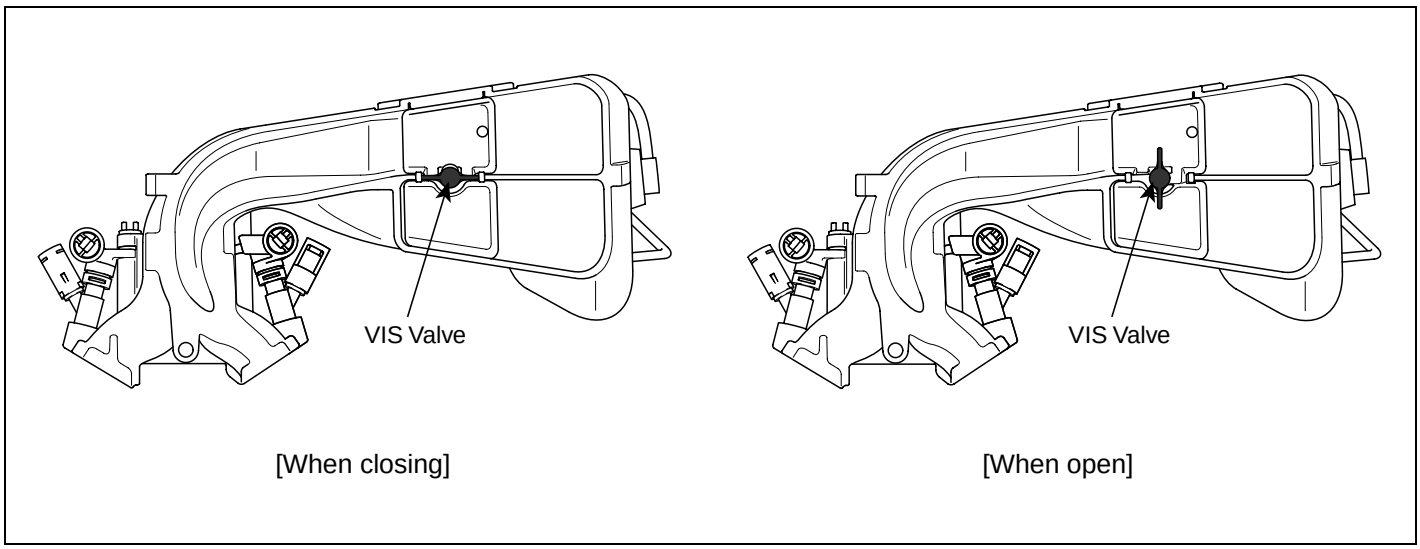
DESCRIPTION E5051AC7

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 → Resonation Effect → Improving Intake Efficiency
2. High Speed: VIS Valve Open → Improving Intake Inertia Effect → Improving Intake Efficiency



SGHF17005N

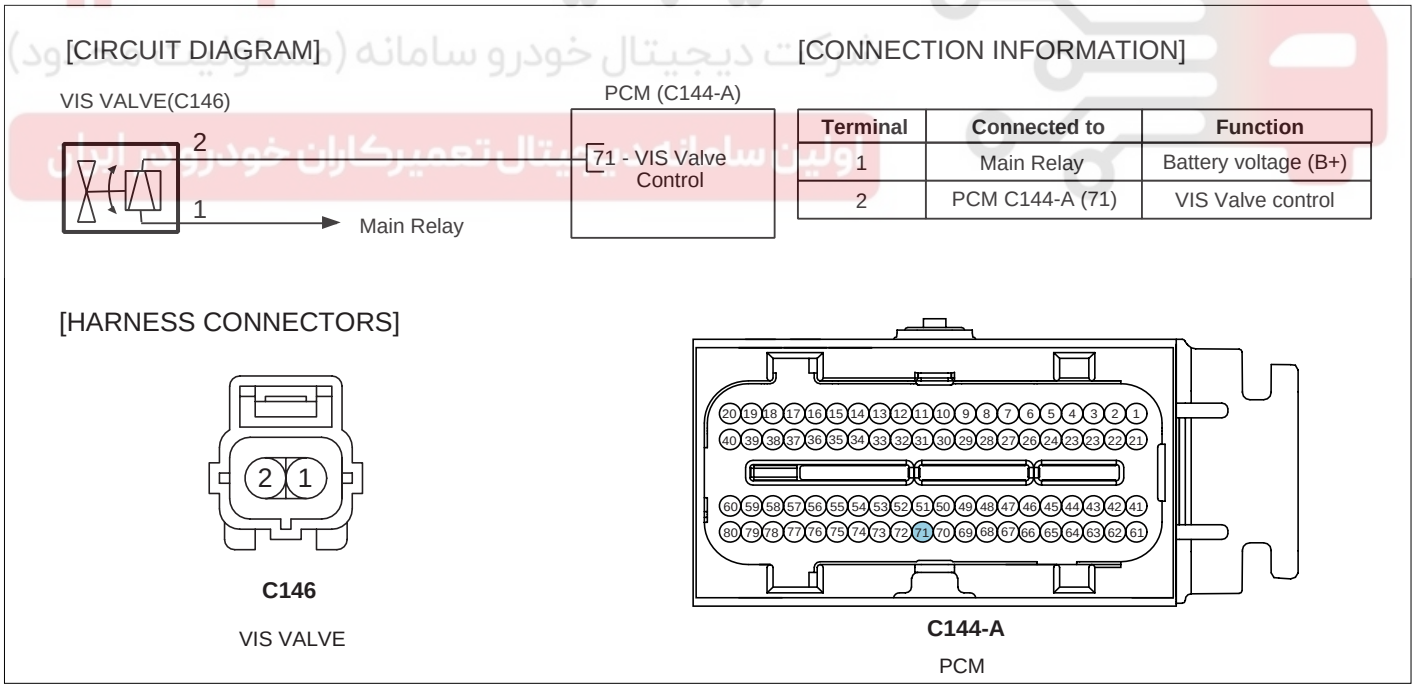


EGRF258A

SPECIFICATION

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

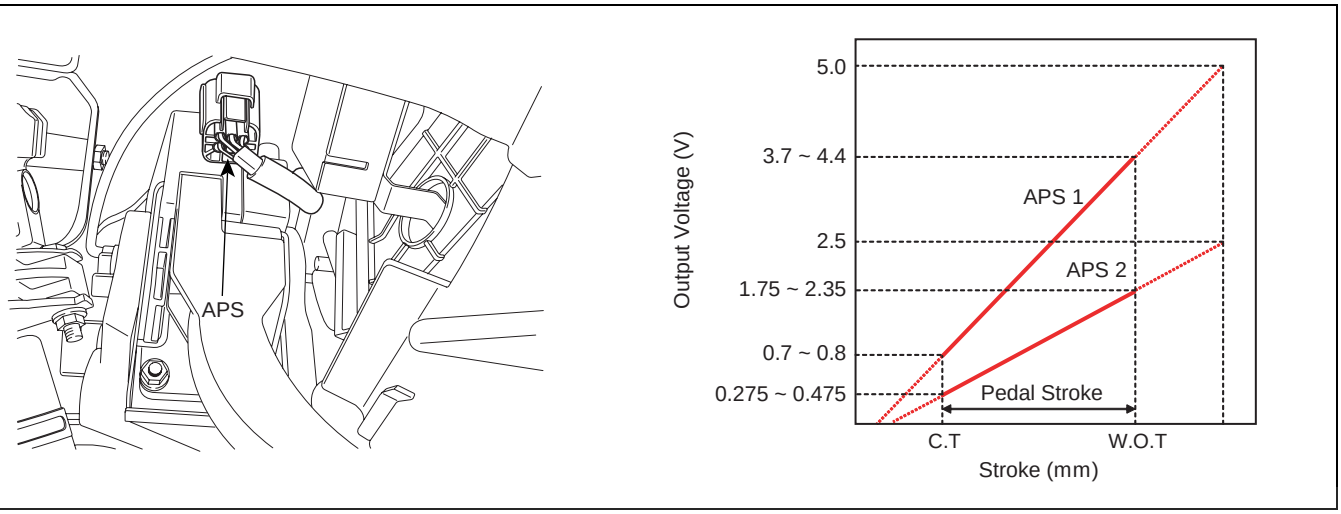
SCHEMATIC DIAGRAM



SGHF17012N

ACCELERATOR POSITION SENSOR (APS)

DESCRIPTION E57A3E43



SGHF17013N

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.

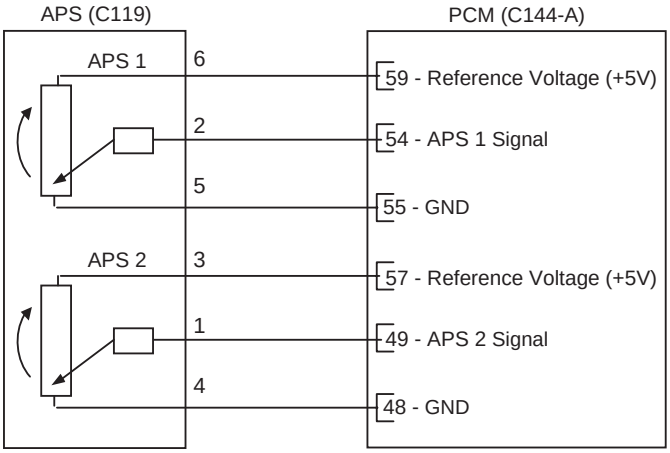
SPECIFICATION

Pedal Position	Output Voltage (V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V

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

SCHEMATIC DIAGRAM

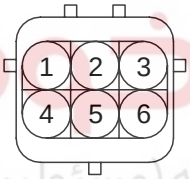
[CIRCUIT DIAGRAM]



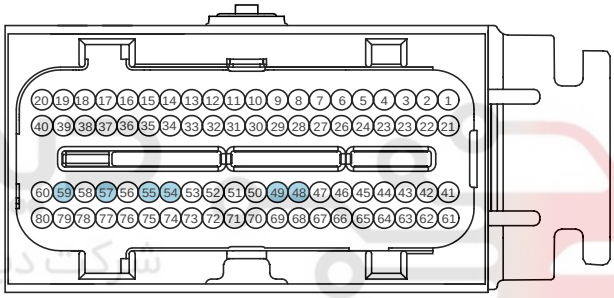
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-A (49)	APS 2 Signal
2	PCM C144-A (54)	APS 1 Signal
3	PCM C144-A (57)	APS 2 Reference Voltage (+5V)
4	PCM C144-A (48)	APS 2 Ground
5	PCM C144-A (55)	APS 1 Ground
6	PCM C144-A (59)	APS 1 Reference Voltage (+5V)

[HARNESS CONNECTORS]



C119
APS



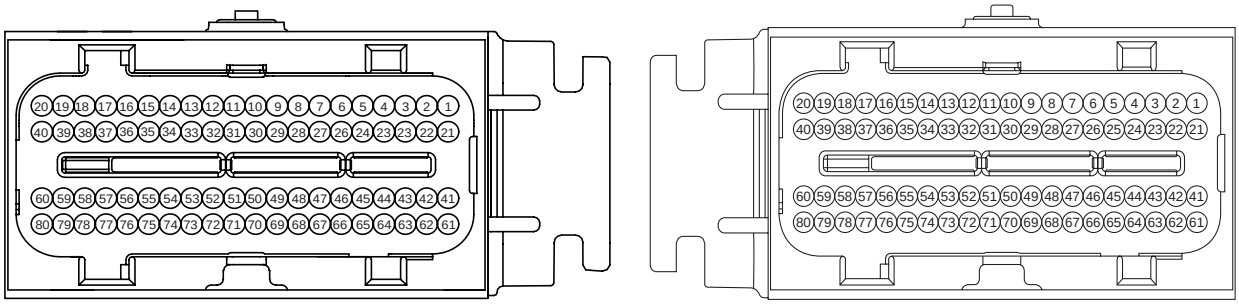
C144-A
PCM

SGHF17014N

POWERTRAIN CONTROL MODULE (PCM)

POWERTRAIN CONTROL MODULE (PCM) E9599480

1. PCM HARNESS CONNECTOR



CONNECTOR [C144-A] CONNECTOR [C144-B]

SGHF17018N

2. PCM TERMINAL FUNCTION

CONNECTOR [C144-A]

PinNo.	Description	Connected to
1	2nd CAN [High]	Multi-Purpose Check Connector
2	2nd CAN [Low]	Multi-Purpose Check Connector
3	For Auto transaxle Control	
4	For Auto transaxle Control	
5	For Auto transaxle Control	
6	For Auto transaxle Control	
7	For Auto transaxle Control	
8	For Auto transaxle Control	
9	For Auto transaxle Control	
10	For Auto transaxle Control	
11	For Auto transaxle Control	
12	-	
13	For Auto transaxle Control	
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	For Auto transaxle Control	

PinNo.	Description	Connected to
21	Brake switch signal input	Brake Switch
22	For Auto transaxle Control	
23	Brake lamp signal input	Brake Lamp
24	For Auto transaxle Control	
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)
28	-	
29	-	
30	-	
31	-	
32	A/C Pressure Sensor signal input	A/C Pressure Transducer
33	Sensor ground	A/C Pressure Transducer, Power Steering Pressure Sensor (PSPS)
34	-	
35	For Auto transaxle Control	
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 Control Module, ESC Control Module
42	CAN [Low]	ABS Control Module, ESC 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	Power Steering Pressure Sensor signal input	Power Steering Pressure Sensor (PSPS)
47	Mass Air Flow Sensor signal input	Mass Air Flow Sensor (MAFS)
48	Accelerator Position Sensor #2 ground	Accelerator Position Sensor (APS) #2
49	Accelerator Position Sensor #2 signal input	Accelerator Position Sensor (APS) #2
50	For Autotransaxle Control	
51	Cruise "SET" lamp control output	Cruise "SET" Lamp (Cluster)
52	Vehicle speed signal input	ABS/ESC Control Module
53	Intake Air Temperature Sensor ground	Intake Air Temperature Sensor (IATS)
54	Accelerator Position Sensor #1 signal input	Accelerator Position Sensor (APS) #1
55	Accelerator Position Sensor #1 ground	Accelerator Position Sensor (APS) #1
56	-	
57	Accelerator Position Sensor #2 power supply	Accelerator Position Sensor (APS) #2

PinNo.	Description	Connected to
58	Sensor Power Supply (+5V)	Air Conditioner Pressure Sensor, Power Steering Pressure Sensor (PSPS)
59	Accelerator Position Sensor #1 power supply	Accelerator Position Sensor (APS) #1
60	For Auto transaxle Control	
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	For Auto transaxle Control	
66	Cooling Fan control output (PWM)	Cooling Fan Control Module
67	For Auto transaxle Control	
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	For Auto transaxle Control	
74	For Auto transaxle Control	
75	For Auto transaxle Control	
76	For Auto transaxle Control	
77	For Auto transaxle Control	
78	Purge Control Solenoid Valve control output	Purge Control Solenoid Valve (PCSV)
79	-	-
80	-	-

CONNECTOR [C144-B]

PinNo.	Description	Connected to
1	ETC Motor [-] control output	ETC Motor (in ETC Module)
2	ETC Motor [+] control output	ETC Motor (in ETC Module)
3	For Auto transaxle Control	
4	CVVT Oil Temperature Sensor signal input	CVVT Oil Temperature Sensor (OTS)
5	-	
6	For Autotransaxle Control	
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	For Auto transaxle Control	
10	For Auto transaxle Control	
11	Manifold Absolute Pressure Sensor power supply	Manifold Absolute Pressure Sensor (MAPS)
12	Battery voltage supply after ignition switch	Ignition Switch

PinNo.	Description	Connected to
13	Throttle Position Sensor #2 power supply	Throttle Position Sensor (TPS) #2
14	Throttle Position Sensor #1 ground	Throttle Position Sensor (TPS) #1
15	Camshaft Position Sensor [Bank 2] power supply	Camshaft Position Sensor (CMPS) [Bank 2]
16	Throttle Position Sensor #1 power supply	Throttle Position Sensor (TPS) #1
17	Camshaft Position Sensor [Bank 2] ground	Camshaft Position Sensor (CMPS) [Bank 2]
18	Camshaft Position Sensor [Bank 1] 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	For Auto transaxle Control	
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	Heated Oxygen Sensor [Bank 2 / Sensor 1] ground	HO2S (B2/S1)
29	Heated Oxygen Sensor [Bank 2 / Sensor 2] ground	HO2S (B2/S2)
30	Heated Oxygen Sensor [Bank 1 / Sensor 1] ground	HO2S (B1/S1)
31	Heated Oxygen Sensor [Bank 1 / Sensor 2] ground	HO2S (B1/S2)
32	Camshaft Position Sensor [Bank 1] power supply	Camshaft Position Sensor (CMPS) [Bank 1]
33	Engine Coolant Temperature 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
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	For Auto transaxle Control	
43	For Auto transaxle Control	
44	For Auto transaxle Control	
45	For Auto transaxle Control	
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)

PinNo.	Description	Connected to
50	Heated Oxygen Sensor [Bank 1 / Sensor 2] signal input	HO2S (B1/S2)
51	Heated Oxygen Sensor [Bank 2 / Sensor 1] signal input	HO2S (B2/S1)
52	Heated Oxygen Sensor [Bank 2 / Sensor 2] signal input	HO2S (B2/S2)
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	Throttle Position Sensor #2 ground	Throttle Position Sensor (TPS) #2
59	For Auto transaxle Control	
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)
68	Injector (Cylinder #4) control output	Injector (Cylinder #4)
69	Injector (Cylinder #5) control output	Injector (Cylinder #5)
70	Heated Oxygen Sensor [Bank 1 / Sensor 1] Heater control output	HO2S (B1/S1)
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)
74	Heated Oxygen Sensor [Bank 1 / Sensor 2] Heater control output	HO2S (B1/S2)
75	For Auto transaxle Control	
76	Battery Power	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. PCM 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		2.0 ~ 3.0V	2.5V
3	For Auto transaxle Control				
4	For Auto transaxle Control				
5	For Auto transaxle Control				
6	For Auto transaxle Control				
7	For Auto transaxle Control				
8	For Auto transaxle Control				
9	For Auto transaxle Control				
10	For Auto transaxle Control				
11	For Auto transaxle Control				
12	-				
13	For Auto transaxle Control				
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	-				
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	For Auto transaxle Control				
21	Brake switch signal input	Brake pedal releasing	DC	Battery Voltage	12.7V
		Brake pedal pressing		Max. 0.5V	0.03V
22	For Auto transaxle Control				
23	Brake lamp signal input	Brake pedal releasing	DC	Max. 0.5V	0V
		Brake pedal pressing		Battery Voltage	13.0V
24	For Auto transaxle Control				
25	Cruise Switch signal input				

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	A/C Pressure Sensor signal input	A/C OFF	DC	0 ~ 5.0V	
		A/C ON			1.85 2.2V
33	Sensor ground	Idle	DC	Max. 50mV	40mV
34	-				
35	For Auto transaxle Control				
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]	RECESSIVE	PULSE	2.0 ~ 3.0V	3.85V
		DOMINANT		2.75 4.5V	2.5V
42	CAN [Low]	RECESSIVE	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	Power Steering Pressure Sensor signal input	Neutral	Analog	0 ~ 5.0V	0.89V
		Full-Turn			4.16V

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	Accelerator Position Sensor #2 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	For Auto transaxle Control				
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	Intake Air Temperature Sensor ground	Idle	DC	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	Accelerator Position Sensor #1 ground	Idle	DC	DC Max. 50mV	36mV
56	Fuel Tank Pressure Sensor power supply	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.01V
57	Accelerator Position Sensor #2 power supply	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.08V
58	Sensor Power Supply (+5V)	IG OFF		Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.08V
59	Accelerator Position Sensor #1 power supply	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.08V
60	For Auto transaxle Control				
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	For Auto transaxle Control				

Pin No.	Description	Condition	Type	Level	Test Result
66	Cooling Fan control output (PWM)	A/CON ON	PULSE	High: Vref	12.3V
				Low: 0 ~ 0.5 V	0V
					300Hz
67	For Auto transaxle Control				
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	For Auto transaxle Contro				
74	For Auto transaxle Contro				
75	For Auto transaxle Contro				
76	For Auto transaxle Contro				
77	For Auto transaxle Contro				
78	Purge Control Solenoid Valve control output	Inactive Active	PULSE	High: Battery Voltage	13.2V
				Low: Max. 1.0V	0.08V
					16Hz
79	-				
80	-				

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	For Autotransaxle Control				
4	CVVT Oil Temperature Sensor signal input	Idle	Analog	0.5 ~ 4.5V	1.68V
5	-				
6	For Auto transaxle Control				
7	Engine Coolant Temperature Sensor signal input	Idle	Analog	0.5 ~ 4.5V	0.47V

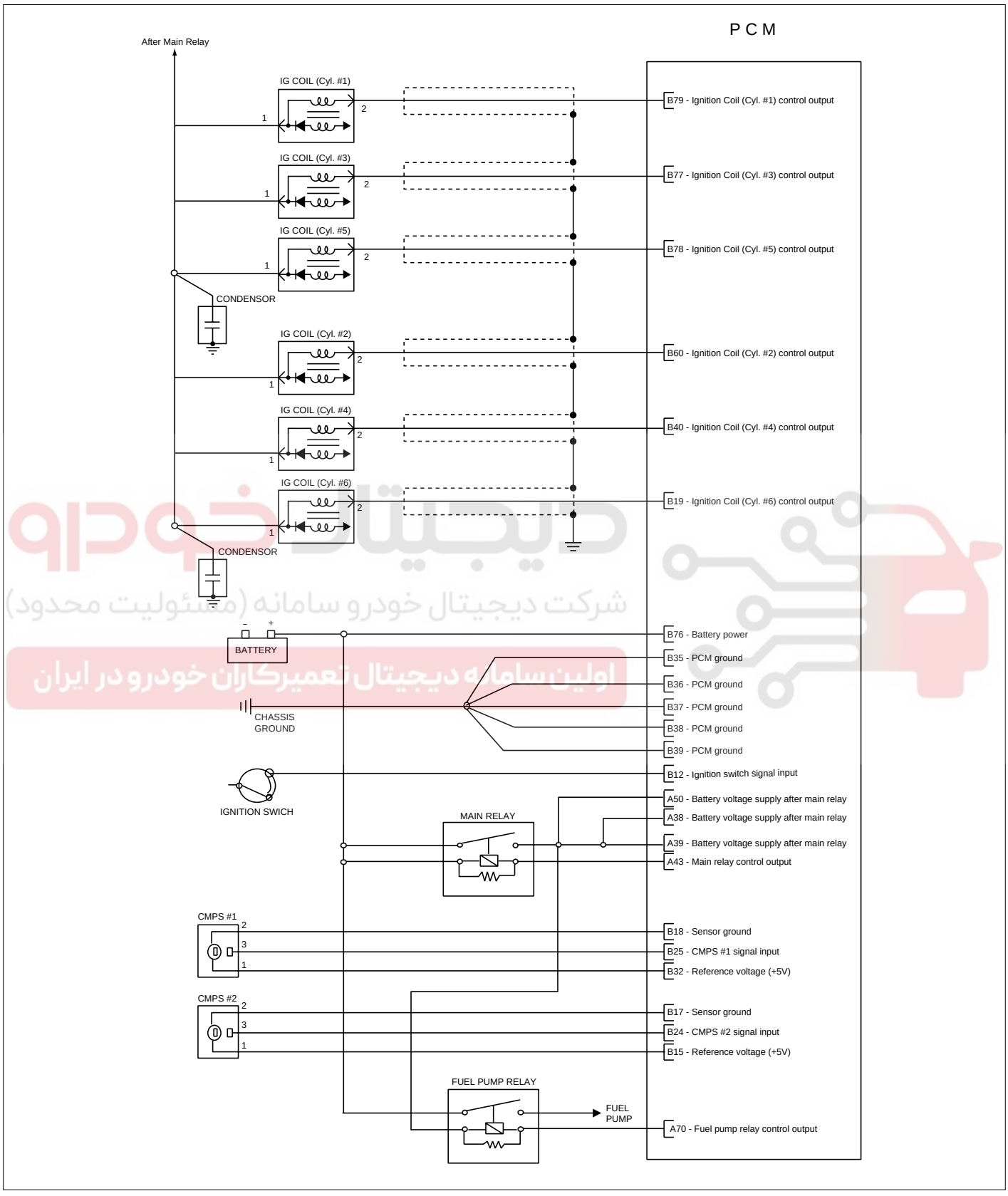
Pin No.	Description	Condition	Type	Level	Test Result
8	Manifold Absolute Pressure Sensor signal input	IG ON	Analog	3.9 ~ 4.1V	4.01V
		Idle		0.8 ~ 1.6V	1.59V
9	For Auto transaxle Control				
10	For Auto transaxle Control				
11	Manifold Absolute Pressure Sensor power supply	IG OFF	DC	Max. 0.5V	0V
		IG 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	Throttle Position Sensor #2 power supply	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.05V
14	Throttle Position Sensor #1 ground	Idle	DC	Max. 50mV	30mV
15	Camshaft Position Sensor [Bank 2] power supply	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.06V
16	Throttle Position Sensor #1 power supply	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.06V
17	Camshaft Position Sensor [Bank 2] ground	Idle	DC	Max. 50mV	30mV
18	Camshaft Position Sensor [Bank 1] 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
22	For Autotransaxle Control				
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	Heated Oxygen Sensor [Bank 2 / Sensor 1] ground	Idle	DC	Max. 50mV	27mV
29	Heated Oxygen Sensor [Bank 2 / Sensor 2] ground	Idle	DC	Max. 50mV	27mV
30	Heated Oxygen Sensor [Bank 1 / Sensor 1] ground	Idle	DC	Max. 50mV	26V

Pin No.	Description	Condition	Type	Level	Test Result
31	Heated Oxygen Sensor [Bank 1 / Sensor 2] ground	Idle	DC	Max. 50mV	27mV
32	Camshaft Position Sensor [Bank 1] power supply	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.06V
33	Engine Coolant Temperature 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	For Auto transaxle Control				
43	For Auto transaxle Control				
44	For Auto transaxle Control				
45	For Auto transaxle Control				
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
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 Fre-quency	-0.3 ~ 0.3 V	1.7V
		Normal		0 V	
54	Knock Sensor (KS) #2 [Low] signal input	Knocking	Variable Fre-quency	-0.3 ~ 0.3 V	1.7V
		Normal		0 V	

Pin No.	Description	Condition	Type	Level	Test Result
55	Knock Sensor (KS) #1 [Low] signal input	Knocking	Variable Fre-quency	-0.3 ~ 0.3 V	1.7V\
		Normal		0 V	
56	Knock Sensor (KS) #1 [High] signal input	Knocking	Variable Fre-quency	-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	Throttle Position Sensor #2 ground	Idle	DC	Max. 50mV	17mV
59	For Auto transaxle Control				
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
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

Pin No.	Description	Condition	Type	Level	Test Result
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
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	For Auto transaxle Control				
76	Battery Power	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	-				

CIRCUIT DIAGRAM E9C132A9



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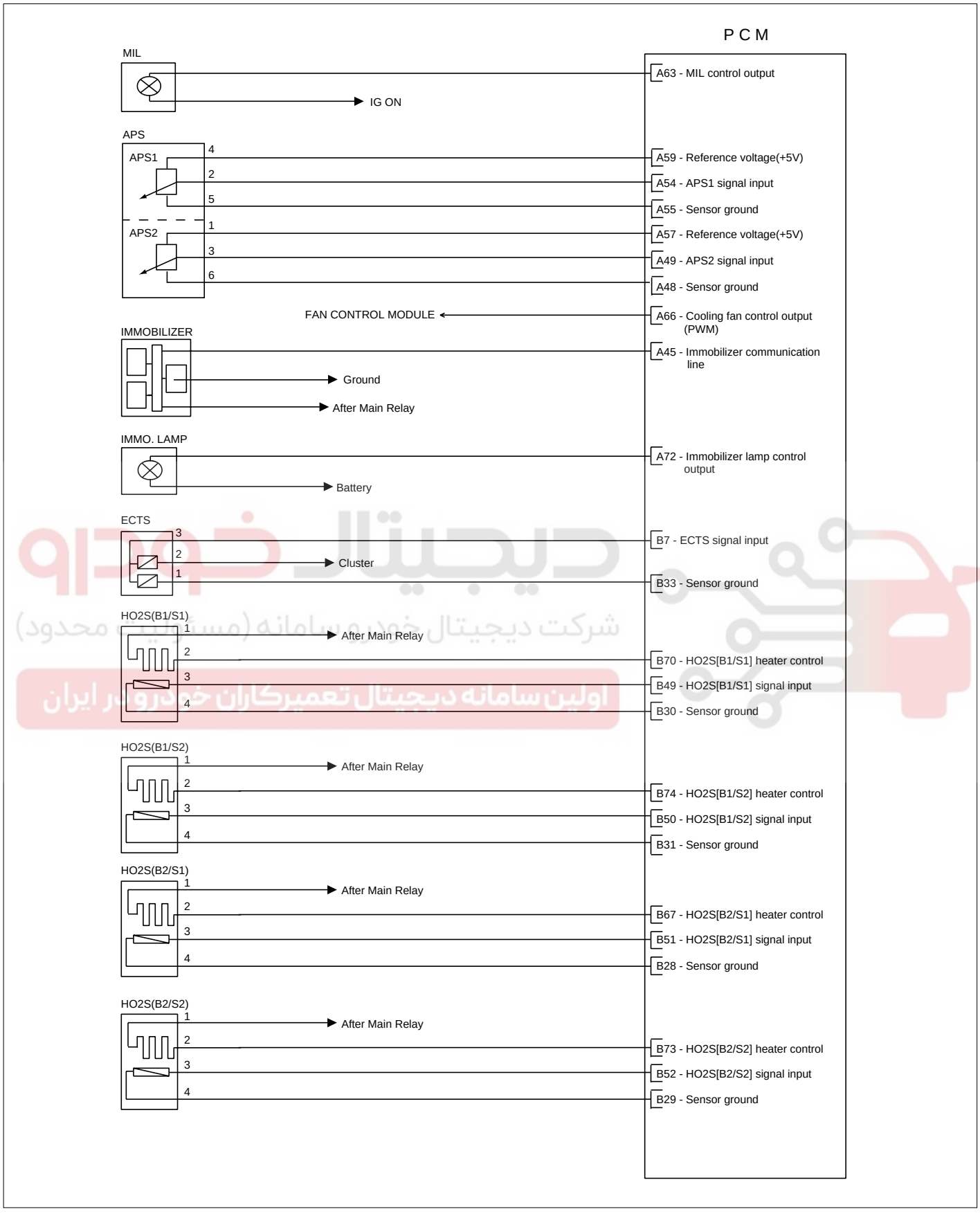

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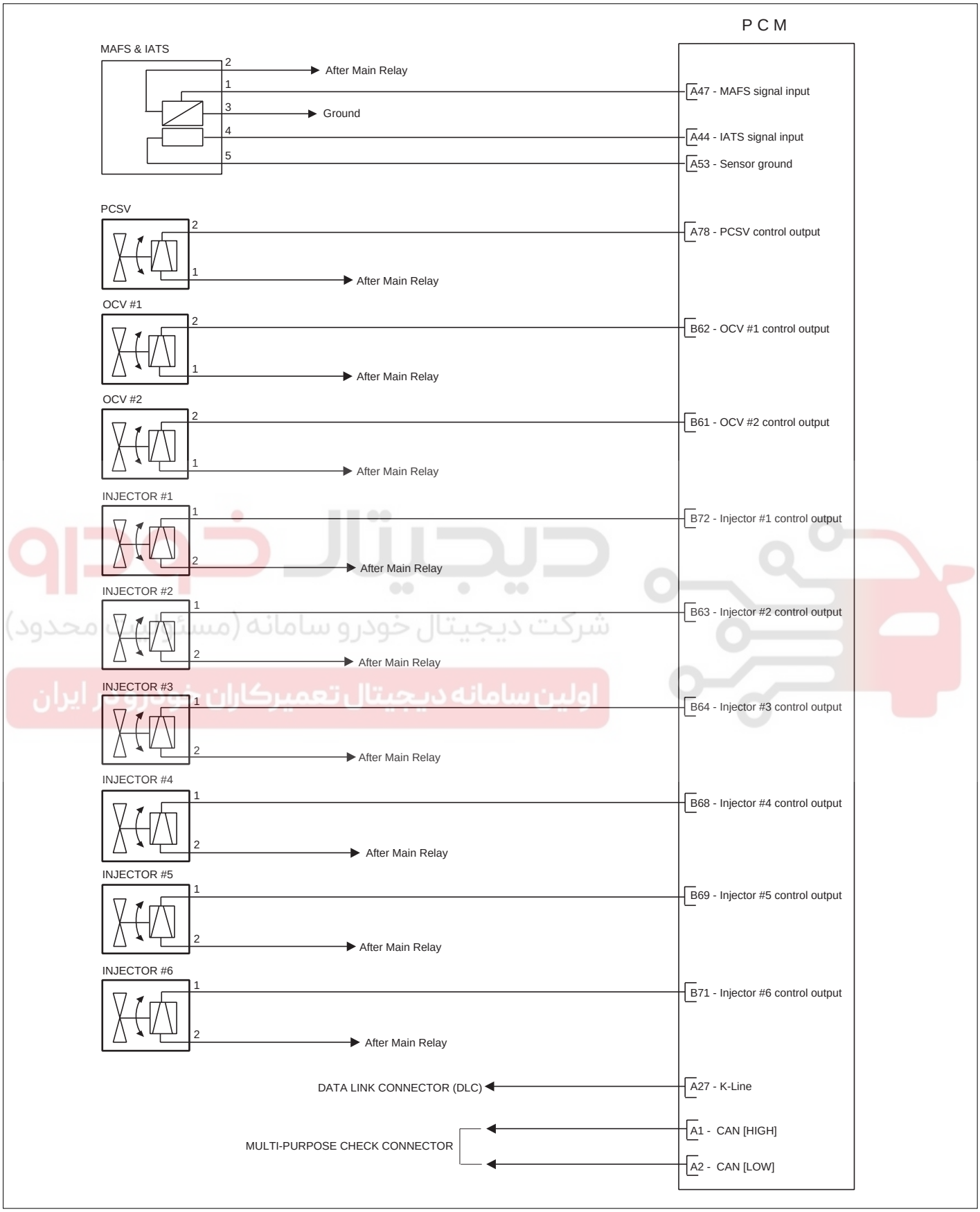

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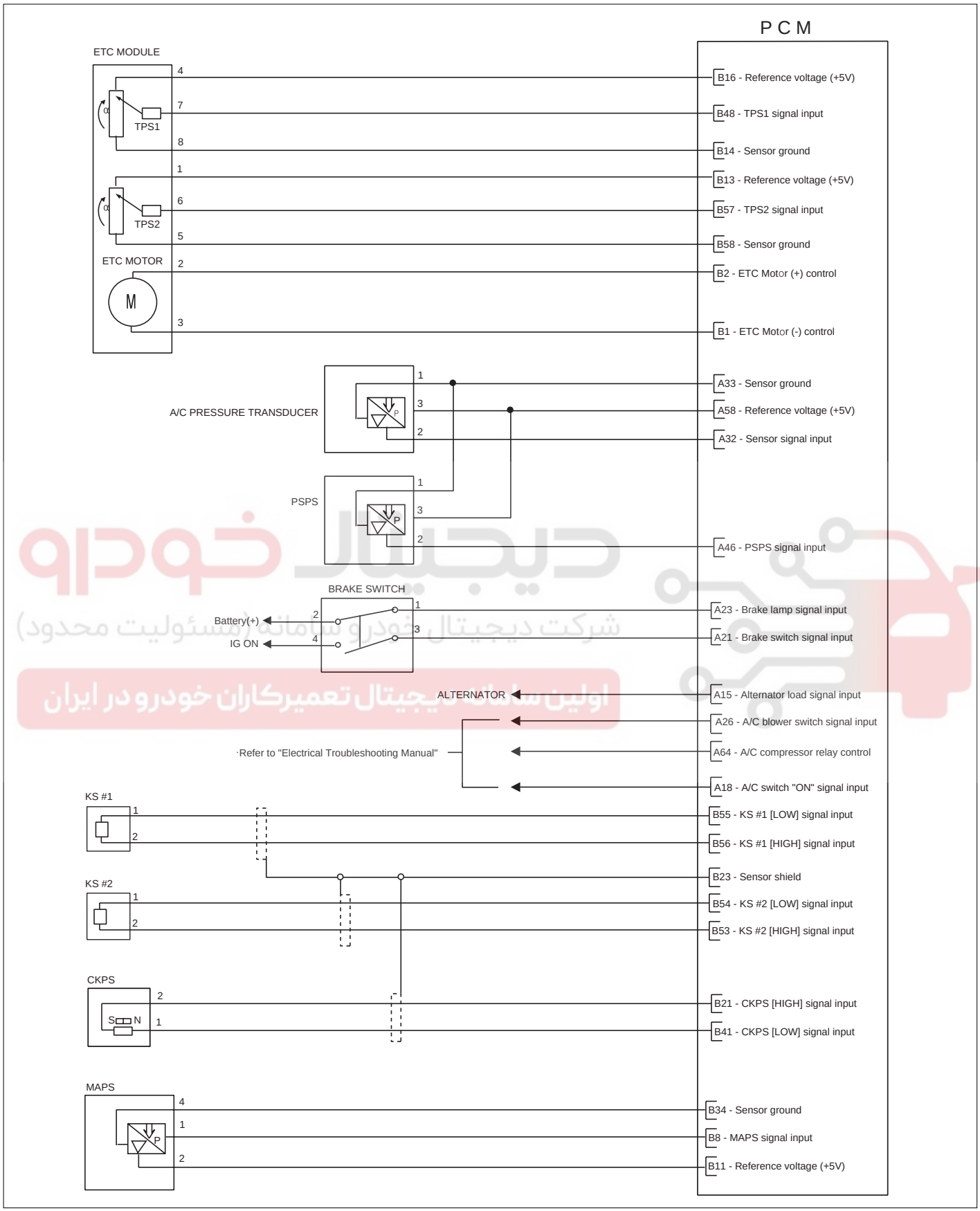

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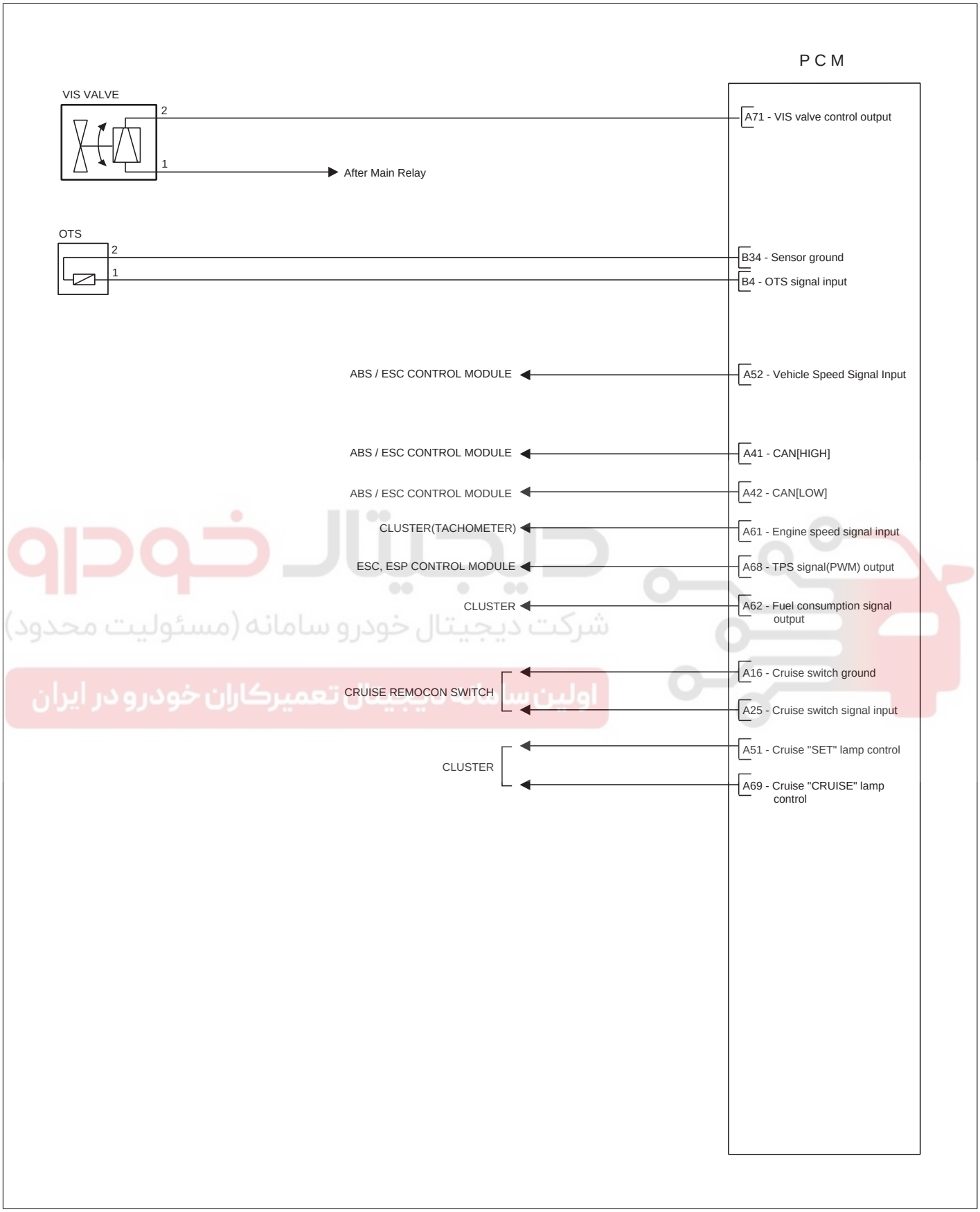

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PCM PROBLEM INSPECTION PROCEDURE E09F82D6

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

Specification (Resistance): 1Ω or less

2. TEST PCM CONNECTOR: Disconnect the PCM connector and visually check the ground terminals on PCM 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 PCM could be faulty. If so, replace the PCM 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 PCM : Install the original PCM (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original PCM with a new one. If problem does not occur, this is intermittent problem (Refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE).

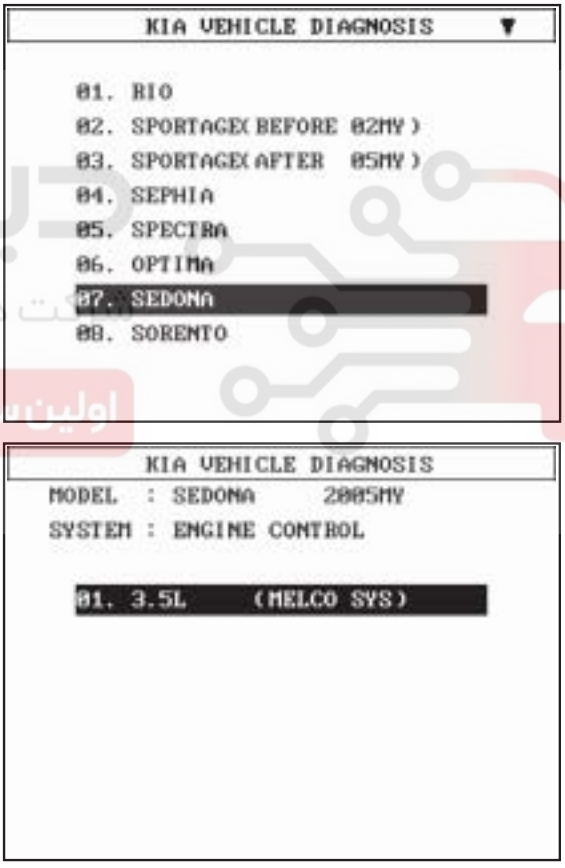
VIN PROGRAMMING PROCEDURE

VIN (Vehicle Identification Number) is a number that has the vehicle's information (Maker, Vehicle Type, Vehicle Line/Series, Body Type, Engine Type, Transmission Type, Model Year, Plant Location and so forth. For more information, please refer to the group "GI" in this SERVICE MANUAL). When replacing a PCM, the VIN must be programmed in the PCM. If there is no VIN in PCM memory, the fault code (DTC P0630) is set.

CAUTION

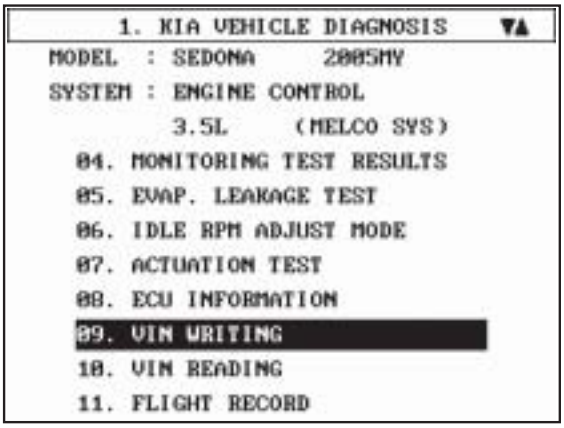
The programmed VIN cannot be changed. When writing the VIN, confirm the VIN carefully

1. Select "Vehicle" and "Engine" (For example, SEDONA 3.5L V6).



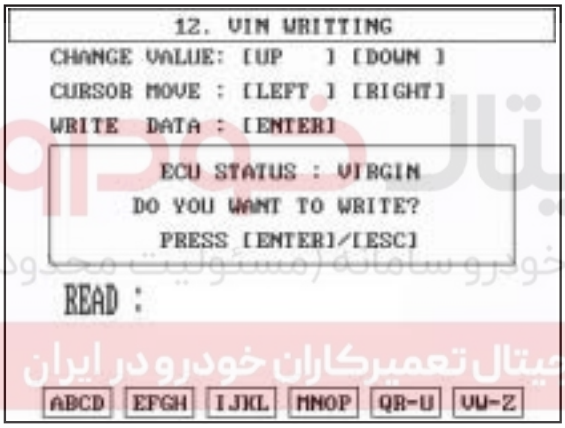
BFIF4600

2. Select "VIN WRITING".



BFIF4601

3. Check the PCM status.



BFIF4602

NOTE

- *VIRGIN: VIN is not programmed*
- *LEARNT: VIN has been already programmed*

Is the PCM status "VIRGIN"?

YES

▶ Go to next step 4.

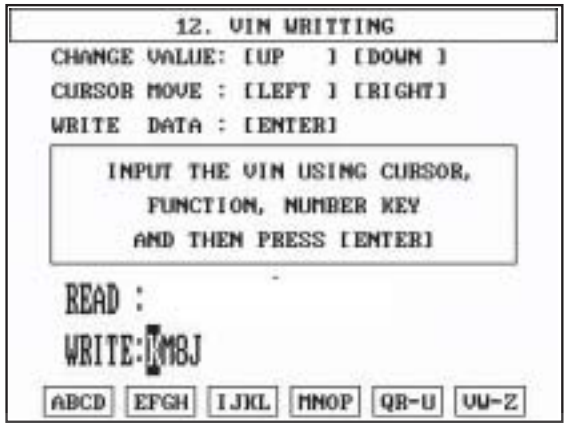
NO

▶ END

4. Write the VIN with cursor, function and number keys.

WARNING

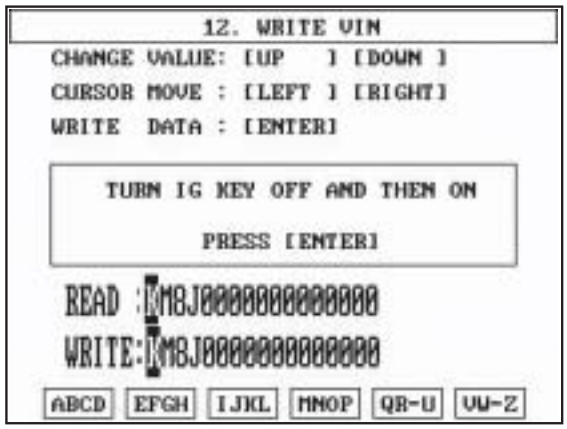
Before pressing the "ENTER" key, confirm the VIN again because the programmed VIN cannot be changed.



BFIF4603

5. After verifying the written VIN, press the "ENTER" key.

6. Turn the ignition switch OFF, and then turn ON.



BFIF4604

7. Verify the programmed VIN in the PCM memory.

DTC TROUBLESHOOTING PROCEDURES

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC) E176F9AE

DTC	Description	MIL	PAGE
P0012	A Camshaft Position-Timing Over-Retarded (Bank 1)	●	FL-83
P0016	Crankshaft Position-Camshaft Position Correlation (Bank 1 / Sensor A)	●	FL-88
P0018	Crankshaft Position-Camshaft Position Correlation (Bank 2 / Sensor A)	●	FL-95
P0022	A Camshaft Position-Timing Over-Retarded (Bank 2)	●	FL-99
P0026	Intake Valve Control Solenoid Circuit Range/Performance (Bank 1)	●	FL-102
P0028	Intake Valve Control Solenoid Circuit Range/Performance (Bank 2)	●	FL-109
P0030	HO2S Heater Control Circuit (Bank 1 / Sensor 1)	●	FL-113
P0031	HO2S Heater Circuit low (Bank 1 / Sensor 1)	●	FL-118
P0032	HO2S Heater Circuit high (Bank 1 / Sensor 1)	●	FL-121
P0036	HO2S Heater Control Circuit (Bank 1 / Sensor 2)	●	FL-124
P0037	HO2S Heater Circuit low (Bank 1 / Sensor 2)	●	FL-129
P0038	HO2S Heater Circuit high (Bank 1 / Sensor 2)	●	FL-132
P0050	HO2S Heater Control Circuit (Bank 2 / Sensor 1)	●	FL-135
P0051	HO2S Heater Circuit low (Bank 2 / Sensor 1)	●	FL-140
P0052	HO2S Heater Circuit high (Bank 2 / Sensor 1)	●	FL-143
P0056	HO2S Heater Control Circuit (Bank 2 / Sensor 2)	●	FL-146
P0057	HO2S Heater Circuit low (Bank 2 / Sensor 2)	●	FL-151
P0058	HO2S Heater Circuit high (Bank 2 / Sensor 2)	●	FL-154
P0076	Intake Valve Control Solenoid Circuit Low (Bank 1)	●	FL-157
P0077	Intake Valve Control Solenoid Circuit High (Bank 1)	●	FL-163
P0082	Intake Valve Control Solenoid Circuit Low (Bank 2)	●	FL-166
P0083	Intake Valve Control Solenoid Circuit High (Bank 2)	●	FL-172
P0101	Mass or Volume Air Flow Circuit Range/Performance	●	FL-175
P0102	Mass or Volume Air Flow Circuit Low Input	●	FL-179
P0103	Mass or Volume Air Flow Circuit high Input	●	FL-184
P0105	Manifold Absolute Pressure/Barometric Pressure Circuit	●	FL-188
P0106	Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance	●	FL-192
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input	●	FL-195
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input	●	FL-199

DTC	Description	MIL	PAGE
P0110	Intake Air Temperature Sensor 1 Circuit	●	FL-203
P0111	Intake Air Temperature Sensor 1 Circuit Range/Performance	●	FL-208
P0112	Intake Air Temperature Sensor 1 Circuit Low Input	●	FL-211
P0113	Intake Air Temperature Sensor 1 Circuit High Input	●	FL-215
P0116	Engine Coolant Temperature Circuit Range/Performance	●	FL-220
P0117	Engine Coolant Temperature Circuit Low Input	●	FL-224
P0118	Engine Coolant Temperature Circuit High Input	●	FL-228
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input	●	FL-233
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	●	FL-239
P0131	HO2S Circuit Low Voltage (Bank 1 / Sensor 1)	●	FL-243
P0132	HO2S Circuit High Voltage (Bank 1 / Sensor 1)	●	FL-250
P0133	HO2S Circuit Slow Response (Bank 1 / Sensor 1)	●	FL-253
P0134	HO2S Circuit No Activity Detected (Bank 1 / Sensor 1)	●	FL-255
P0137	HO2S Circuit Low Voltage (Bank 1 / Sensor 2)	●	FL-259
P0138	HO2S Circuit High Voltage (Bank 1 / Sensor 2)	●	FL-266
P0140	HO2S Circuit No Activity Detected (Bank 1 / Sensor 2)	●	FL-269
P0151	HO2S Circuit Low Voltage (Bank 2 / Sensor 1)	●	FL-273
P0152	HO2S Circuit High Voltage (Bank 2 / Sensor 1)	●	FL-280
P0153	HO2S Circuit Slow Response (Bank 2 / Sensor 1)	●	FL-283
P0154	HO2S Circuit No Activity Detected (Bank 2 / Sensor 1)	●	FL-285
P0157	HO2S Circuit Low Voltage (Bank 2 / Sensor 2)	●	FL-289
P0158	HO2S Circuit High Voltage (Bank 2 / Sensor 2)	●	FL-296
P0160	HO2S Circuit No Activity Detected (Bank 2 / Sensor 2)	●	FL-299
P0171	System Too Lean (Bank 1)	●	FL-303
P0172	System Too Rich (Bank 1)	●	FL-307
P0174	System Too Lean (Bank 2)	●	FL-303
P0175	System Too Rich (Bank 2)	●	FL-307
P0196	Engine Oil Temp. Sensor Range / Performance	●	FL-310
P0197	Engine Oil Temp. Sensor Low Input	●	FL-314
P0198	Engine Oil Temp. Sensor High Input	●	FL-318
P0217	Engine Coolant Over Temperature Condition	●	FL-322
P0222	Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input	●	FL-326
P0223	Throttle/Pedal Position Sensor/Switch "B" Circuit High Input	●	FL-333

DTC	Description	MIL	PAGE
P0230	Fuel Pump Primary Circuit	▲	FL-337
P0261	Cylinder 1-Injector Circuit Low	●	FL-342
P0262	Cylinder 1-Injector Circuit High	●	FL-348
P0264	Cylinder 2-Injector Circuit Low	●	FL-342
P0265	Cylinder 2-Injector Circuit High	●	FL-348
P0267	Cylinder 3-Injector Circuit Low	●	FL-342
P0268	Cylinder 3-Injector Circuit High	●	FL-348
P0270	Cylinder 4-Injector Circuit Low	●	FL-342
P0271	Cylinder 4-Injector Circuit High	●	FL-348
P0273	Cylinder 5-Injector Circuit Low	●	FL-342
P0274	Cylinder 5-Injector Circuit High	●	FL-348
P0276	Cylinder 6-Injector Circuit Low	●	FL-342
P0277	Cylinder 6-Injector Circuit High	●	FL-348
P0300	Random/Multiple Cylinder Misfire Detected	●	FL-354
P0301	Cylinder 1-Misfire detected	●	FL-360
P0302	Cylinder 2-Misfire detected	●	FL-360
P0303	Cylinder 3-Misfire detected	●	FL-360
P0304	Cylinder 4-Misfire detected	●	FL-360
P0305	Cylinder 5-Misfire detected	●	FL-360
P0306	Cylinder 6-Misfire detected	●	FL-360
P0315	Segment Time Acquisition Incorrect	▲	FL-366
P0325	Knock Sensor 1 Circuit	▲	FL-369
P0326	Knock Sensor 1 Circuit Range/Performance (Bank 1)	▲	FL-373
P0330	Knock Sensor 2 Circuit	▲	FL-375
P0331	Knock Sensor 2 Circuit Range/Performance (Bank 2)	▲	FL-379
P0335	Crankshaft Position Sensor A Circuit	●	FL-381
P0336	Crankshaft Position Sensor A Circuit Range/Performance	●	FL-387
P0340	Camshaft Position Sensor A Circuit Malfunction (Bank 1 or Signal Sensor)	●	FL-391
P0341	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or Single Sensor)	●	FL-397
P0346	Camshaft Position Sensor A Circuit Range/Performance (Bank 2)	●	FL-400
P0351	Ignition Coil 'A' Primary / Secondary Circuit	●	FL-405
P0352	Ignition Coil 'B' Primary / Secondary Circuit	●	FL-405
P0353	Ignition Coil 'C' Primary / Secondary Circuit	●	FL-405

DTC	Description	MIL	PAGE
P0354	Ignition Coil 'D' Primary / Secondary Circuit	●	FL-405
P0355	Ignition Coil 'E' Primary / Secondary Circuit	●	FL-405
P0356	Ignition Coil 'F' Primary / Secondary Circuit	●	FL-405
P0420	Catalyst System Efficiency below Threshold (Bank 1)	●	FL-412
P0430	Catalyst System Efficiency below Threshold (Bank 2)	●	FL-415
P0444	Evap. Emission System-Purge Ctrl. Valve Circuit Open	●	FL-417
P0445	Evap. Emission System-Purge Ctrl. Valve Circuit Shorted	●	FL-423
P0501	Vehicle Speed Sensor A Range/Performance	●	FL-426
P0504	Brake Switch "A"/"B" Correlation	●	FL-434
P0506	Idle Air Control System-RPM lower than expected	●	FL-439
P0507	Idle Air Control System-RPM higher than expected	●	FL-441
P0532	A/C Refrigerant Pressure Sensor "A" Circuit Low Input	▲	FL-442
P0533	A/C Refrigerant Pressure Sensor "A" Circuit High Input	▲	FL-448
P0562	System Voltage Low	●	FL-452
P0563	System Voltage High	●	FL-459
P0571	Brake Switch "A" Circuit	●	FL-463
P0601	EEPROM-Check sum Error	●	FL-468
P0602	EEPROM-Programming Error	●	FL-471
P0604	Internal Control Module Random Access Memory (RAM) Error	●	FL-472
P0606	ECM/PCM Processor(ECM-SELF TEST Failed)	●	FL-475
P0638	Throttle Actuator Control Range/Performance	●	FL-476
P0641	Sensor Reference Voltage "A" Circuit Open	●	FL-484
P0646	A/C Clutch Relay Control Circuit Low	▲	FL-489
P0647	A/C Clutch Relay Control Circuit High	▲	FL-495
P0650	Malfunction Indicator Lamp(MIL) Control Circuit	▲	FL-498
P0651	Sensor Reference Voltage "B" Circuit Open	●	FL-503
P0660	Intake Manifold Tuning Valve Control Circuit/Open (Bank 1)	●	FL-508
P0685	ECM/PCM Power Relay Control Circuit /Open	▲	FL-513
P1106	Manifold Absolute Pressure Sensor Circuit Short - Intermittent High Input	▲	FL-519
P1107	Manifold Absolute Pressure Sensor Circuit Short - Intermittent Low Input	▲	FL-526
P1111	Intake Air Temperature Sensor Circuit Short - Intermittent High Input	▲	FL-530
P1112	Intake Air Temperature Sensor Circuit Short - Intermittent Low Input	▲	FL-537
P1114	Engine Coolant Temperature Sensor Circuit - Intermittent Low Input	▲	FL-541

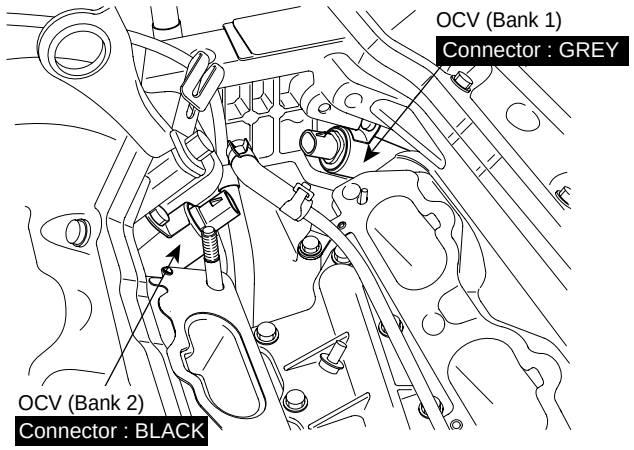
DTC	Description	MIL	PAGE
P1115	Engine Coolant Temperature Sensor Circuit - Intermittent High Input	▲	FL-547
P1295	ETC (Electronic Throttle Control) System Malfunction - Power Management	●	FL-552
P1523	ETC (Electronic Throttle Control) System Malfunction - Throttle Valve Stuck	▲	FL-555
P2104	ETC (Electronic Throttle Control) System Malfunction - Forced Idle	●	FL-558
P2105	ETC (Electronic Throttle Control) System Malfunction - Forced Engine Shutdown	●	FL-561
P2106	ETC (Electronic Throttle Control) System Malfunction - Forced Limited Power	●	FL-562
P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input	●	FL-564
P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input	●	FL-570
P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input	●	FL-573
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High Input	●	FL-579
P2135	Throttle/Pedal Position Sensor/Switch "A" / "B" Voltage Correlation	●	FL-582
P2138	Throttle/Pedal Position Sensor/Switch "D" / "E" Voltage Correlation	●	FL-589
P2173	ETC (Electronic Throttle Control) System Malfunction - High Air flow Detected.	●	FL-593
P2187	System Too Lean at Idle (←Additive) (Bank 1)	●	FL-599
P2188	System Too Rich at Idle (Bank 1)	●	FL-603
P2189	System Too Lean at Idle (←Additive) (Bank 2)	●	FL-599
P2190	System Too Rich at Idle (Bank 2)	●	FL-603
P2195	HO2S Signal Stuck Lean (Bank 1 / Sensor 1)	●	FL-606
P2196	HO2S Signal Stuck Rich (Bank 1 / Sensor 1)	●	FL-612
P2197	HO2S Signal Stuck Lean (Bank 2 / Sensor 1)	●	FL-615
P2198	HO2S Signal Stuck Rich (Bank 2 / Sensor 1)	●	FL-621
P2270	HO2S Signal Stuck Lean (Bank 1 / Sensor 2)	●	FL-624
P2271	HO2S Signal Stuck Rich (Bank 1 / Sensor 2)	●	FL-630
P2272	HO2S Signal Stuck Lean (Bank 2 / Sensor 2)	●	FL-633
P2273	HO2S Signal Stuck Rich (Bank 2 / Sensor 2)	●	FL-639
P2507	ECM/PCM Power Input Signal Low	●	FL-642
P2610	ECM/PCM Internal Engine Off Timer Performance	●	FL-645
U0001	CAN Communication Malfunction	●	FL-648

NOTE

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

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

COMPONENT LOCATION EA83D35B



EGRF600A

GENERAL DESCRIPTION E5E4C4FB

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. The PCM 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.

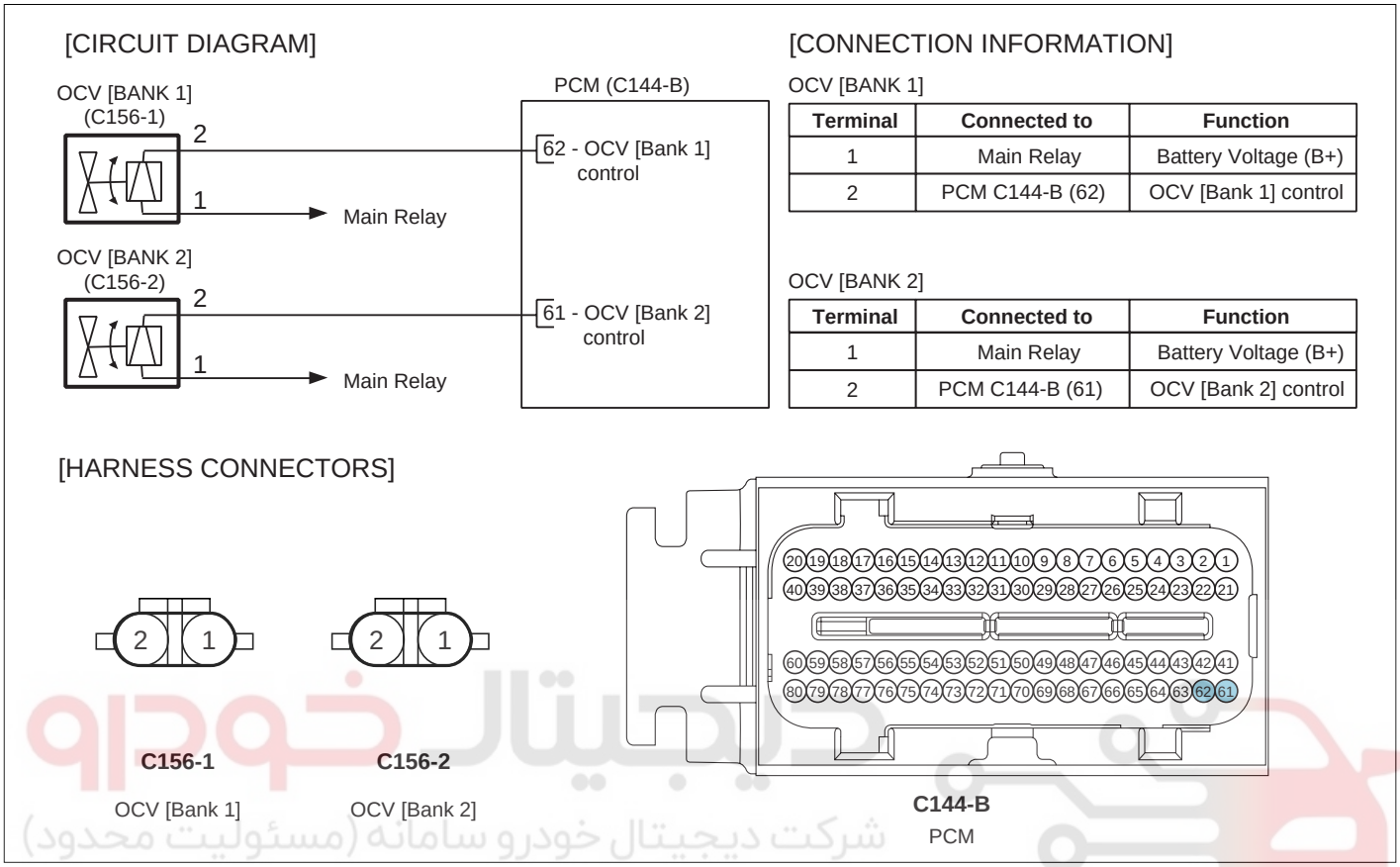
DTC DESCRIPTION E79DC16A

PCM 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 PCM commands OCV duty cycle PCM determines that a faultexists and a DTC is stored.

DTC DETECTING CONDITION E7959093

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 • Engine running (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 Desired Position is more than 15°) • Timing Counter > 80	
Diagnosis Time		• Continuous (within 5min.)	
MIL On Condition		• 2 Driving Cycles	

SCHEMATIC DIAGRAM EADBC3D0



OCV [BANK 1]

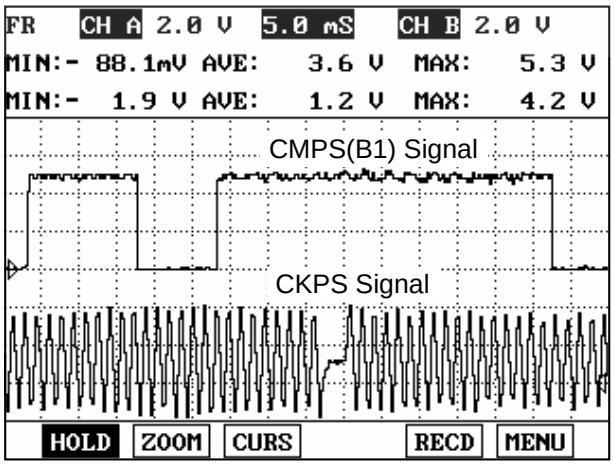
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (62)	OCV [Bank 1] control

OCV [BANK 2]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (61)	OCV [Bank 2] control

UFBG255A

SIGNAL WAVEFORM AND DATA E6E0A965



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.

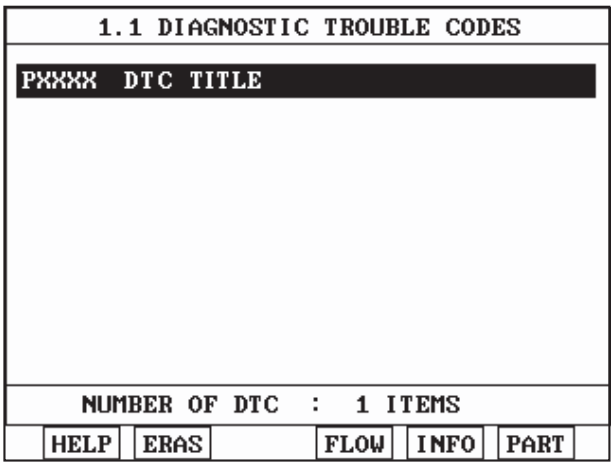
SBLF26724L

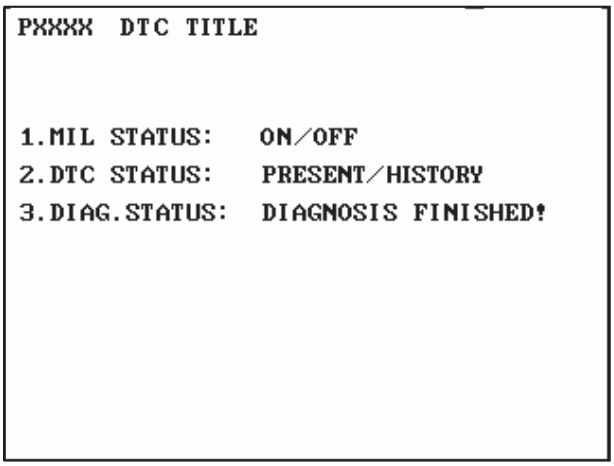
MONITOR DTC STATUS E37FA2D9

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 F5(INFO) to check DTC's information from the DTCs menu.

4) Read "DTC Status" parameter.





SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "System Inspection" procedure.

NO

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

SYSTEM INSPECTION E0126B9D

1. Visual Inspection

1) Check oil level is O.K.

2) Check for contamination of engine oil and OCV

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 EB65DDC4

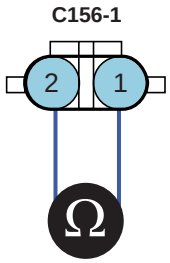
1. Check OCV resistance

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(B1) Power
2. OCV(B1) Control

SBLF26400L

3) Is the measured resistance within specification ?

YES

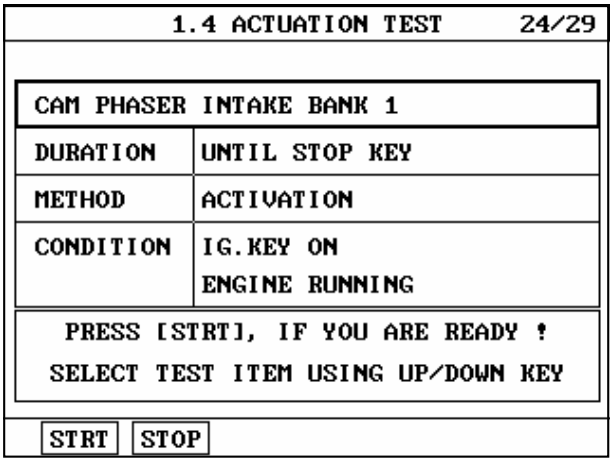
▶ Go to "Check CAM PHASER with actuation test" as follows.

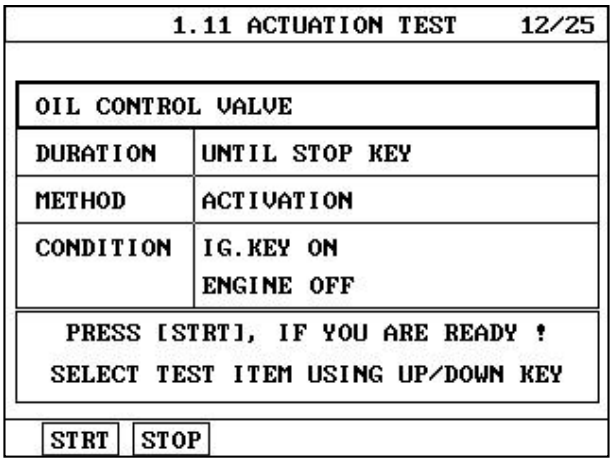
NO

▶ 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
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





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 E811947D

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

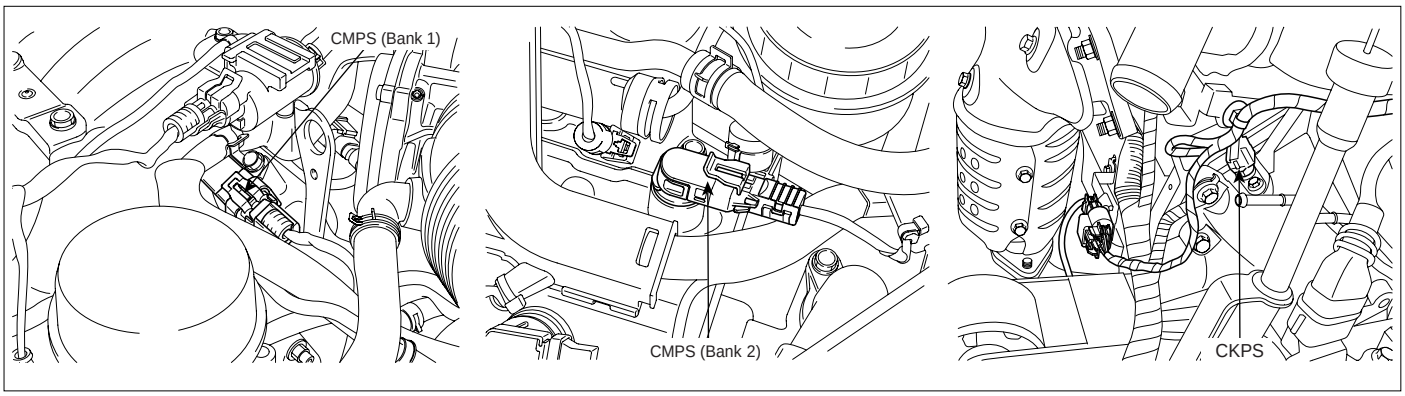
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION ECB9C7D6



SGHFL7309N

GENERAL DESCRIPTION E7CC0422

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. The PCM 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 EDE59201

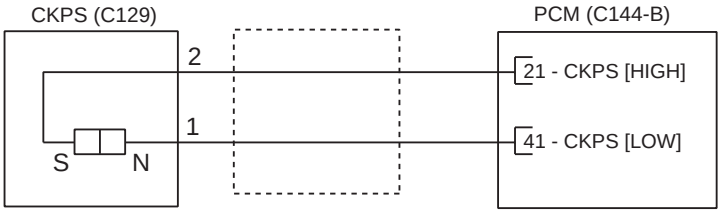
PCM monitors timing misalignment while no active faults are present and fully warmed up engine oil at idle.
If the timing is misaligned PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E3934940

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	
Threshold 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 EE8E7A27

[CIRCUIT DIAGRAM]



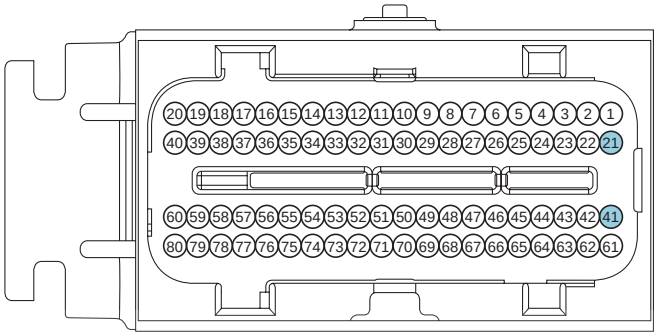
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (41)	CKPS [LOW] Signal
2	PCM C144-B (21)	CKPS [HIGH] Signal

[HARNESS CONNECTORS]

C129

CKPS

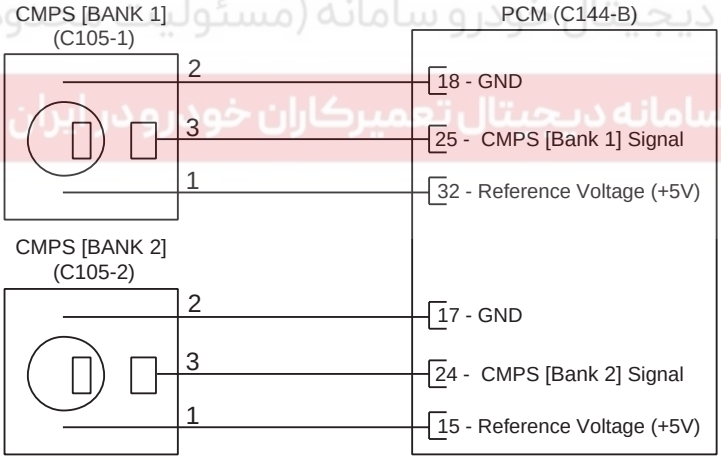


C144-B

PCM

SGHF17010N

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

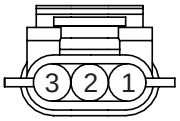
CMPS [BANK 1]

Terminal	Connected to	Function
1	PCM C144-B (32)	Reference Voltage (+5V)
2	PCM C144-B (18)	Sensor ground
3	PCM C144-B (25)	CMPS [Bank 1] signal

CMPS [BANK 2]

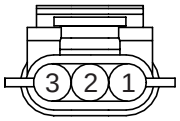
Terminal	Connected to	Function
1	PCM C144-B (15)	Reference Voltage (+5V)
2	PCM C144-B (17)	Sensor ground
3	PCM C144-B (24)	CMPS [Bank 2] signal

[HARNESS CONNECTORS]



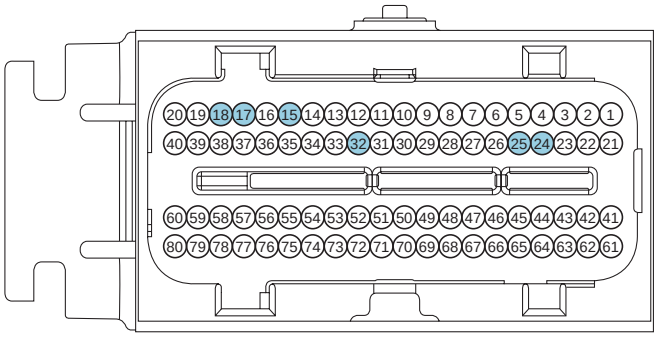
C105-1

CMPS [BANK 1]



C105-2

CMPS [BANK 2]

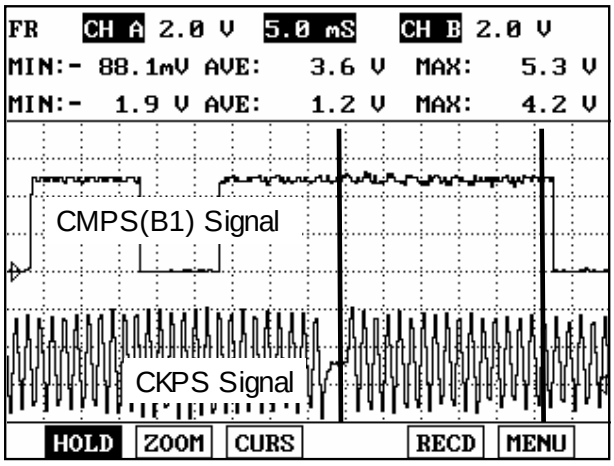


C144-B

PCM

UFBG244A

SIGNAL WAVEFORM AND DATA E009AC3C



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.

SBLF26726L

MONITOR DTC STATUS E6F279F8

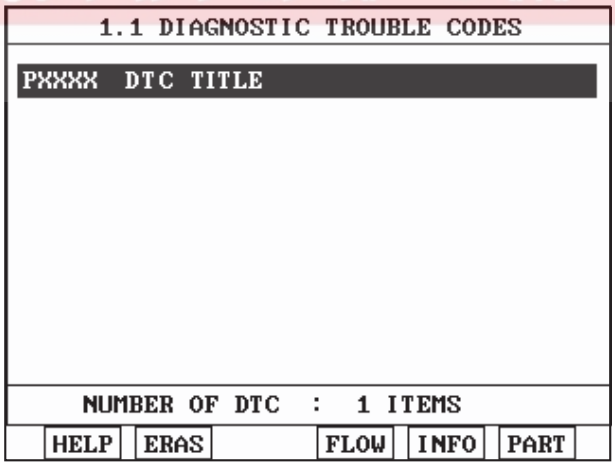
1. Check DTC Status

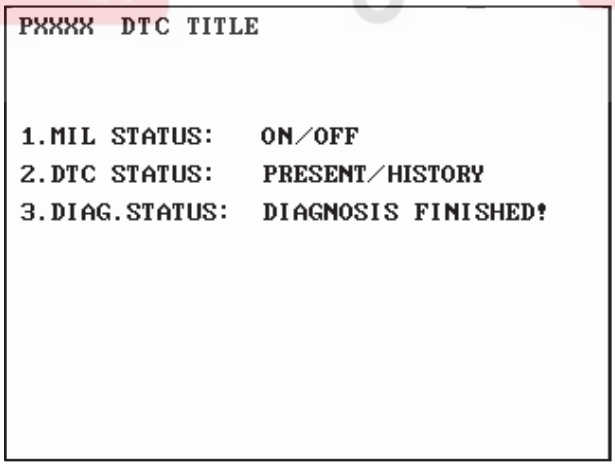
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select ""Diagnostic Trouble Codes(DTCs)"" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "System Inspection" procedure.

NO

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

SYSTEM INSPECTION E6856EF5

1. Visual Inspection

   1) Check oil level is O.K.

   2) Check for contamination of engine oil and OCV

   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 follows.

2. Visually check CKPS and target wheel

   1) IG "OFF"

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

   3) Are normal conditions present ?

   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"

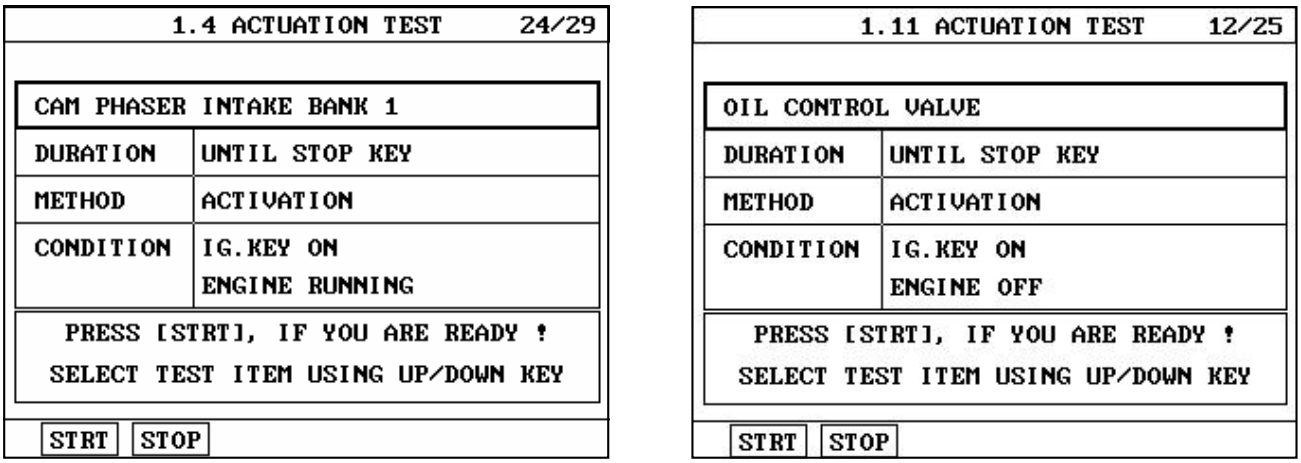
   2) Select "CAM PHASER INTAKE BANK 1" on the Actuation Test

   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



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 E879E7CE

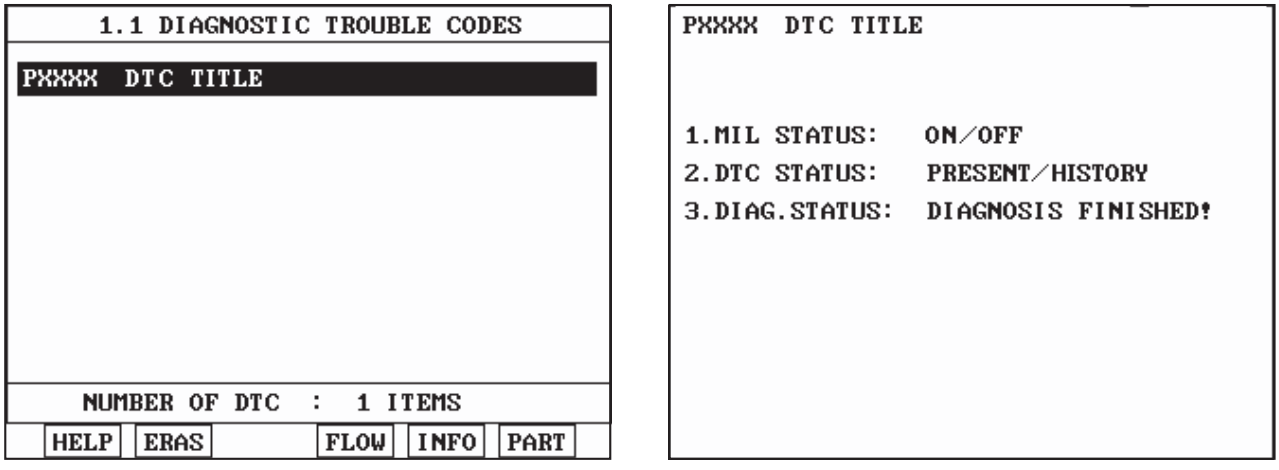
1. CMPS, CKPS Inspection

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, PCM recognizes that Synchronization between CKPS and CMPS is completed.



SGHFL7305L

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.

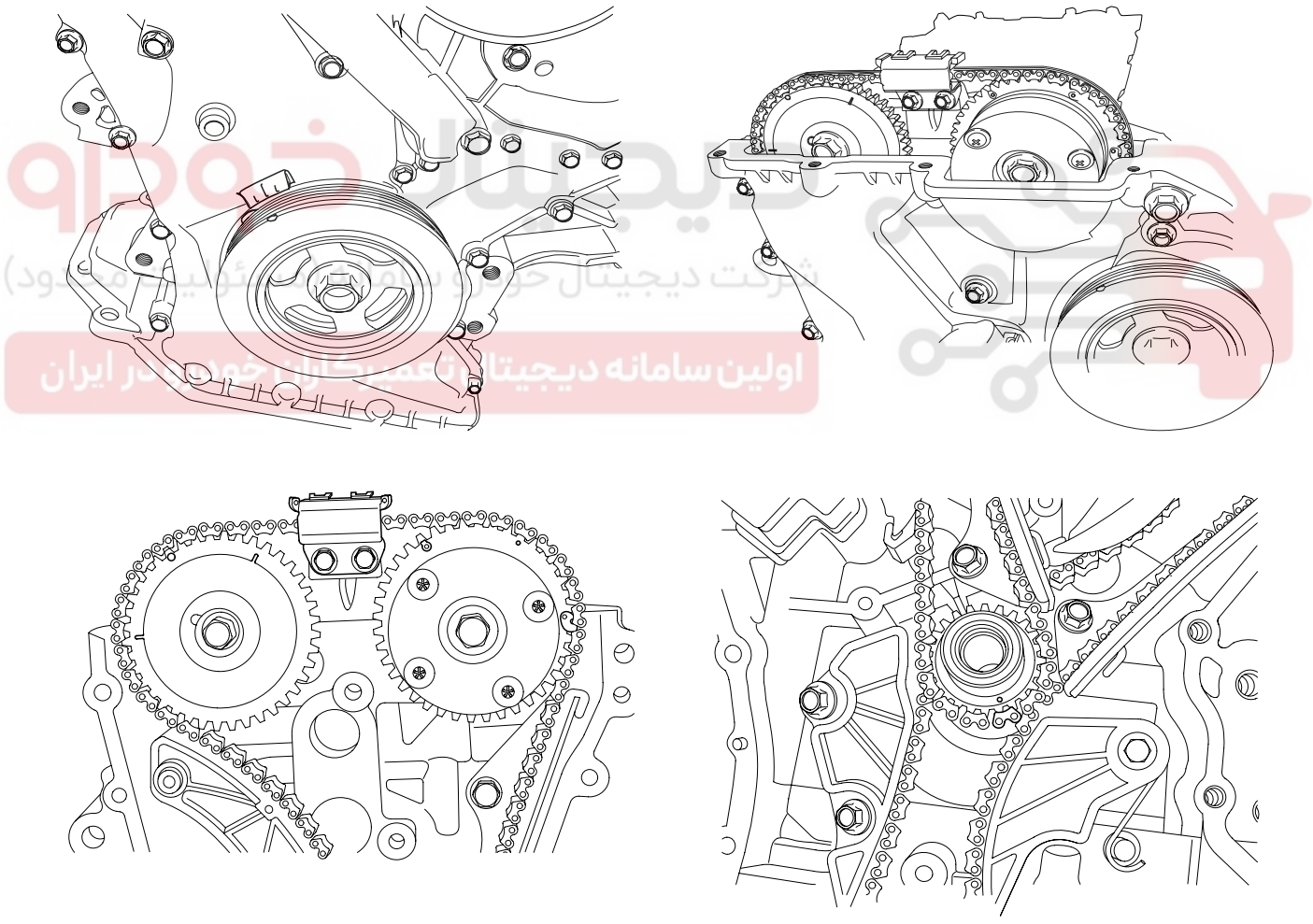
NO

▶ Go to "Timing Mark Inspection" procedure as follows.

2. Timing Mark Inspection.

1) IG "OFF" and check for correct timing mark alignment.

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 E2A8A1DD

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E277EA1C

Refer to DTC P0016.

GENERAL DESCRIPTION E0422B7D

Refer to DTC P0016.

DTC DESCRIPTION E2B30826

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

DTC DETECTING CONDITION EEAE9896

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 ℃(176 ℉) < Oil Temperature < 90 ℃(194℉)	
	Case 2	• 2 tooth misalignment at Lower than 80 ℃(176 ℉) or Higher than 90 ℃(194℉)	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 driving Cycles	

SCHEMATIC DIAGRAM E8ED682F

Refer to DTC P0016.

SIGNAL WAVEFORM AND DATA E98C4157

Refer to DTC P0016.

MONITOR DTC STATUS EA80C85E

Refer to DTC P0016.

SYSTEM INSPECTION EBD5D4A2

1. Visual Inspection
   1) Check oil level is O.K.
   2) Check for contamination of engine oil and OCV
   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 follows.

2. Visually check CKPS and target wheel

   1) IG "OFF"

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

   3) Are normal conditions present ?

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"

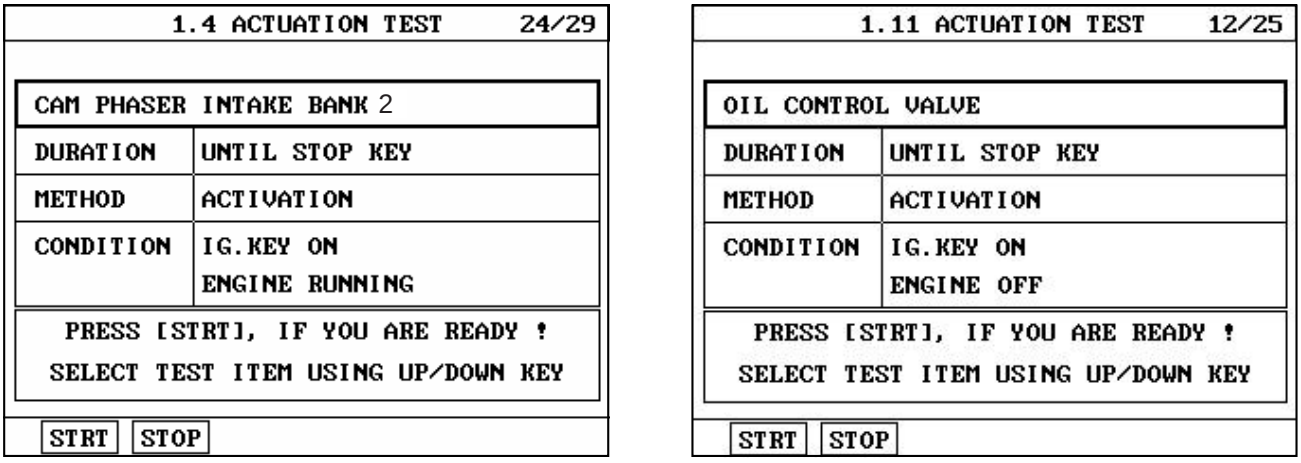
   2) Select "CAM PHASER INTAKE BANK 1" on the Actuation Test

   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



SEPFL6407N

   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 E7C9C8D8

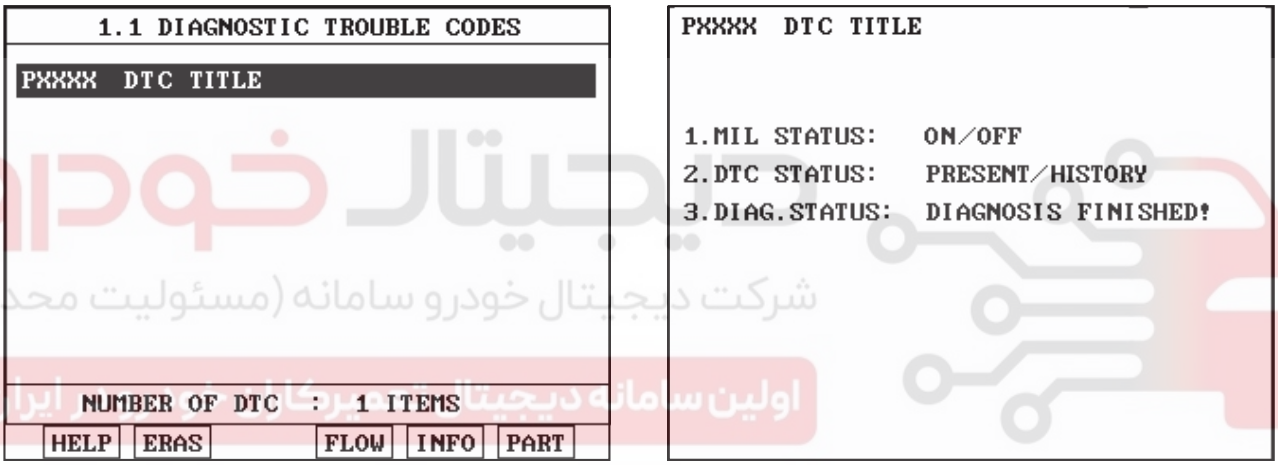
1. CMPS, CKPS Inspection

   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, PCM recognizes that Synchronization between CKPS and CMPS is completed.



SGHFL7305L

   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.

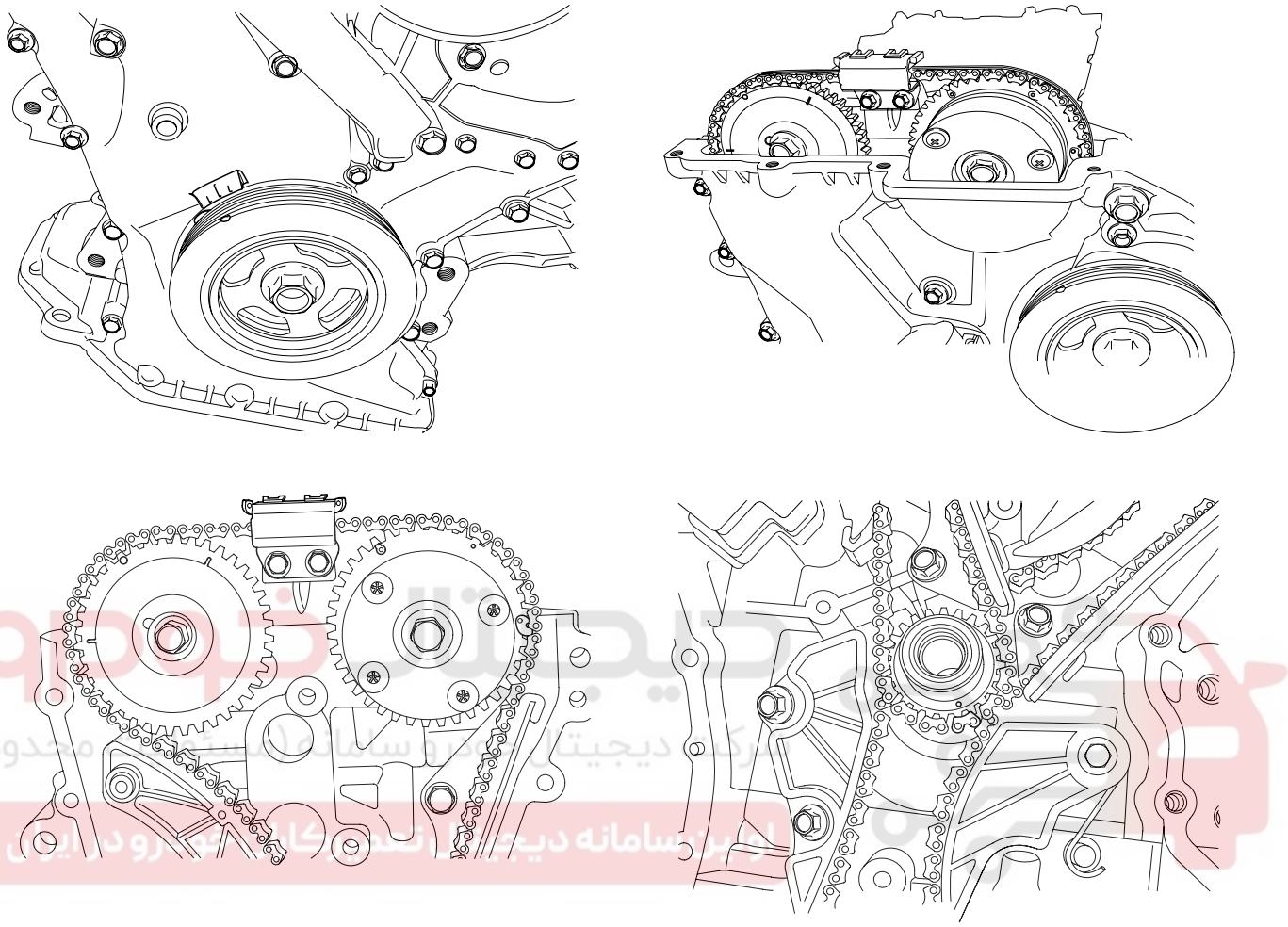
NO

▶ Go to "Timing Mark Inspection" procedure as follows.

2. Timing Mark Inspection.

   1) IG "OFF" and check for correct timing mark alignment.

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 EC5E3E81

Refer to DTC P0016.

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

COMPONENT LOCATION E8423ECE

Refer to DTC P0012.

GENERAL DESCRIPTION E5F29B7D

Refer to DTC P0012.

DTC DESCRIPTION E35DEC3A

PCM 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 PCM commands OCV duty cycle PCM determines that a faultexists and a DTC is stored.

DTC DETECTING CONDITION EE2C0190

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 Desired Position is more than 15°) • Timing Counter > 80	
Diagnosis Time		• Continuous (within 5min.)	
MIL On Condition		• 2 Driving Cycles	

SCHEMATIC DIAGRAM EFA29B4E

Refer to DTC P0012.

SIGNAL WAVEFORM AND DATA E103B9AE

Refer to DTC P0012.

MONITOR DTC STATUS EDCFAF00

Refer to DTC P0012.

SYSTEM INSPECTION EBBC3C03

1. Visual Inspection
   1) Check oil level is O.K.
   2) Check for contamination of engine oil and OCV.

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 E7940815

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

SBLF26402L

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"

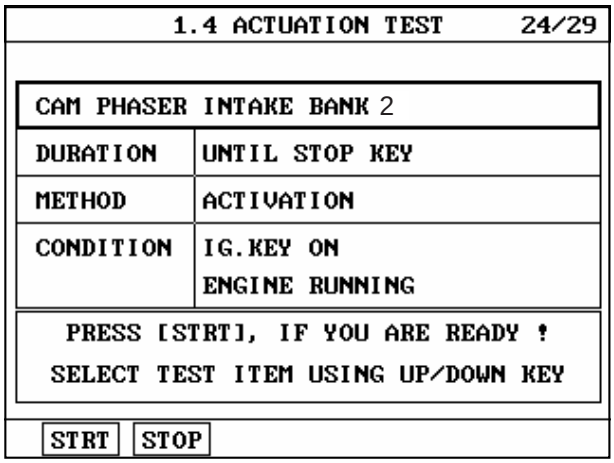
2) Select "CAM PHASER INTAKE BANK 2" on the Actuation Test

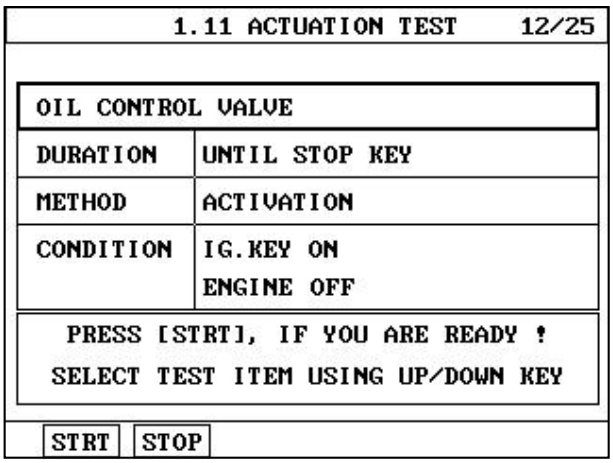
3) Select "OIL CONTROL VALVE" on the Actuation Test

4) Activates "CAM PHASER INTAKE BANK 2" 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





SEPFL6407N

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

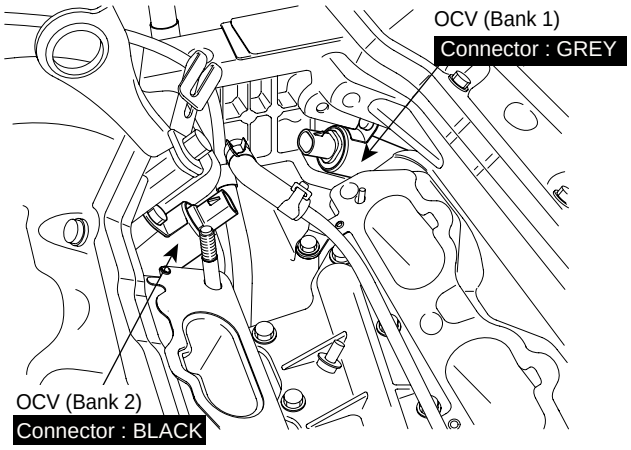
▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E5E62B89

Refer to DTC P0012.

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

COMPONENT LOCATION E52DE2D4



EGRF600A

GENERAL DESCRIPTION E4D85FEF

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. The PCM 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 EE997295

PCM monitors OCV stuck while cam signal 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 Desired Position is higher than 20° PCM determines that a fault exists and a DTC is stored.

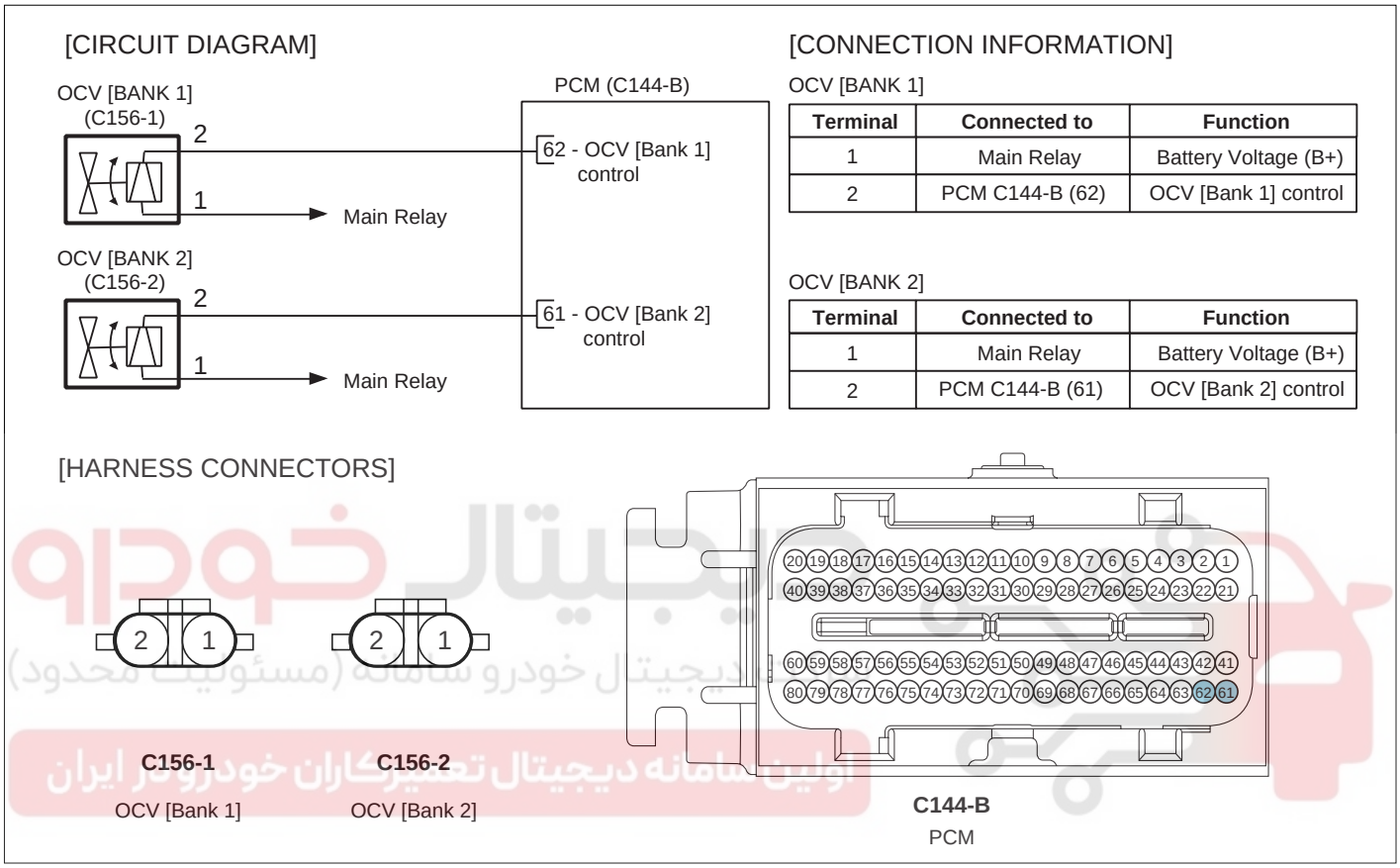
DTC DETECTING CONDITION E301107D

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 Desired Position > 20 CAD	
	Case 2	• Cam Actual Position < 5 CAD or Difference between CAM Actual Position and Desired Position > 20 CAD	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 driving Cycle	

SPECIFICATION E61519D6

Resistance (Ω)	6.7 ~ 7.7

SCHEMATIC DIAGRAM EE1CA544



[CONNECTION INFORMATION]

OCV [BANK 1]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (62)	OCV [Bank 1] control

OCV [BANK 2]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (61)	OCV [Bank 2] control

UFBG255A

SIGNAL WAVEFORM AND DATA E6F494D4

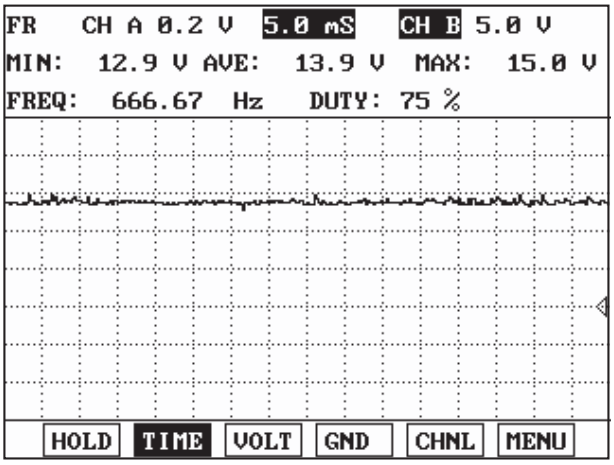


Fig. 1

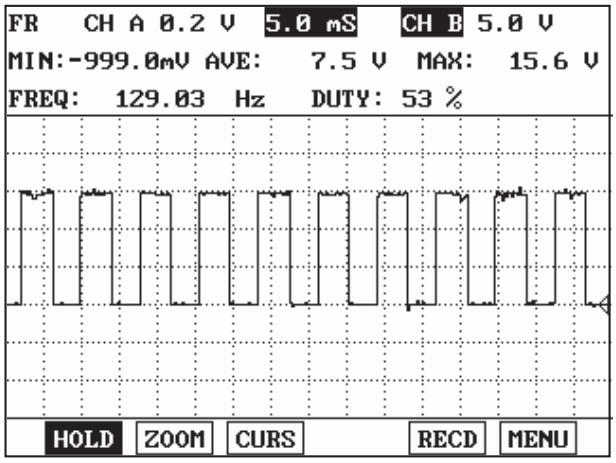


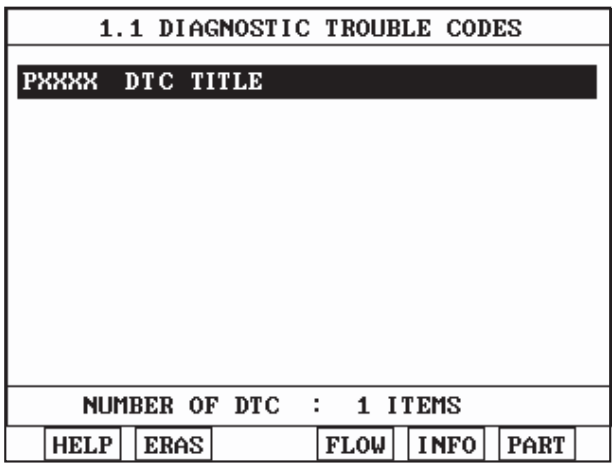
Fig. 2

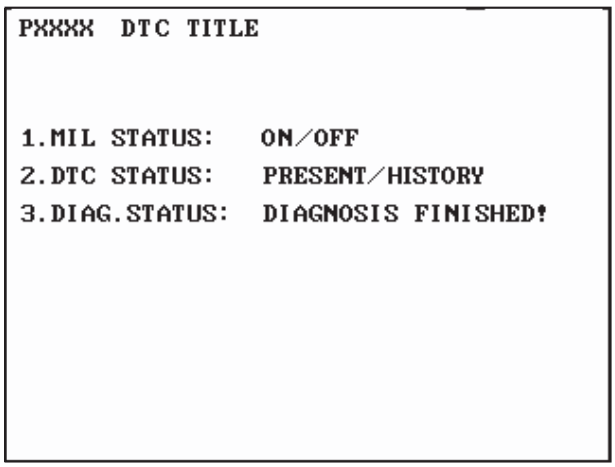
Fig. 1 : Idle - normal Condition
Fig. 2 : Acceleration

EGRF600T

MONITOR DTC STATUS E007D5DF

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 F5(INFO) to check DTC's information from the DTCs menu.
   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and Connector inspection" procedure.

NO

▶ Fault is intermittent caused by PCM 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 ECC75C9F

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 EB4A963E

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 necessay go to "Verification of Vehicle Repair " procedure.

CONTROL CIRCUIT INSPECTION EB7FC8FB

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.

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 E6493954

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 EFA8812E

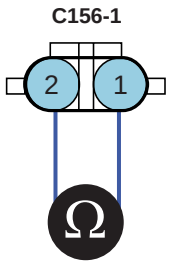
1. OCV Inspection

   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(B1) Power
2. OCV(B1) Control

SBLF26400L

   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"

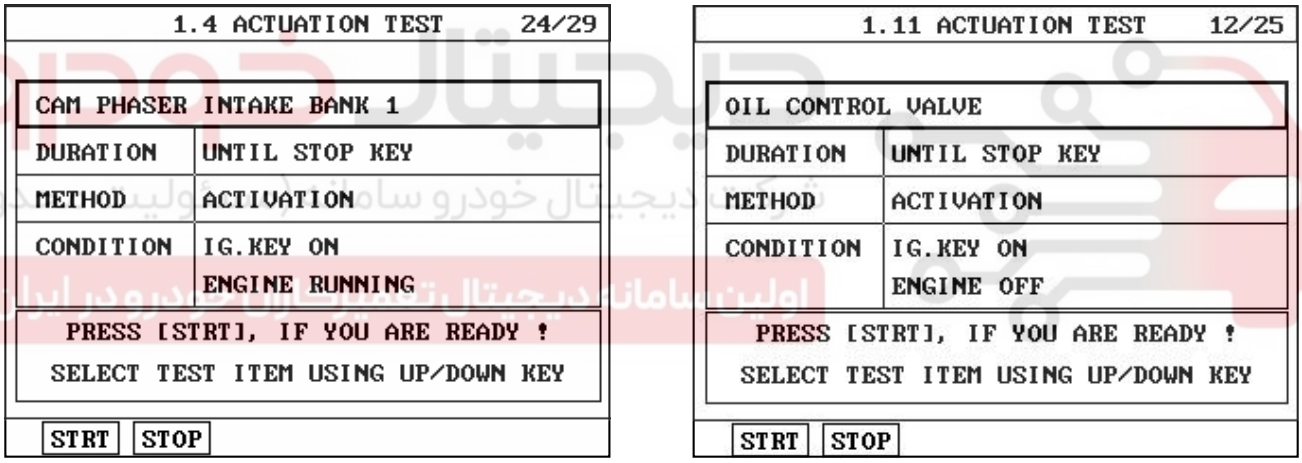
   2) Select "CAM PHASER INTAKE BANK 1" on the Actuation Test

   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



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 E66D8DE0

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E4222333

Refer to DTC P0026.

GENERAL DESCRIPTION E8F4395C

Refer to DTC P0026.

DTC DESCRIPTION E97F5C3E

PCM monitors OCV stuck while cam signal 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 Positionand Desired Position is higher than 20° PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E3851CEC

Item		Detecting Condition	Possible cause
DTC Strategy		• Determines if oil control valve is stuck	• Oil Pressure • 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 Desired Position > 20 CAD	
	Case 2	• Cam Actual Position < 5 CAD or Difference between CAM Actual Position and Desired Position > 20 CAD	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 driving Cycle	

SPECIFICATION E21726C5

Resistance (Ω)	6.7 ~ 7.7

SCHEMATIC DIAGRAM E06A13FA

Refer to DTC P0026.

SIGNAL WAVEFORM AND DATA EADCC187

Refer to DTC P0026.

MONITOR DTC STATUS EEBA4B24

Refer to DTC P0026.

TERMINAL AND CONNECTOR INSPECTION E6A1125C

Refer to DTC P0026.

POWER CIRCUIT INSPECTION E62B9A47

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 necessay go to "Verification of Vehicle Repair " procedure.

CONTROL CIRCUIT INSPECTION ED85005B

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.

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 E34DD61D

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 EF2DB15E

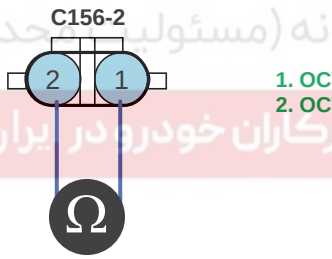
1. OCV Inspection

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



SBLF26402L

3) Is the measured resistance within specification ?

YES

▶ Go to "Check CAM PHASER with acuation 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"

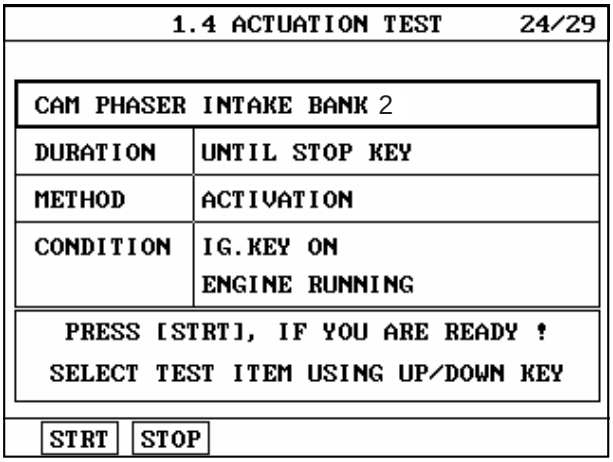
2) Select "CAM PHASER INTAKE BANK 2" on the Actuation Test

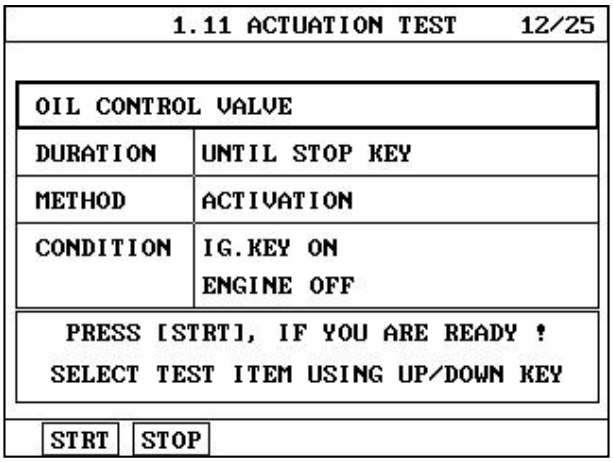
3) Select "OIL CONTROL VALVE" on the Actuation Test

4) Activates "CAM PHASER INTAKE BANK 2" 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





SEPFL6407N

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

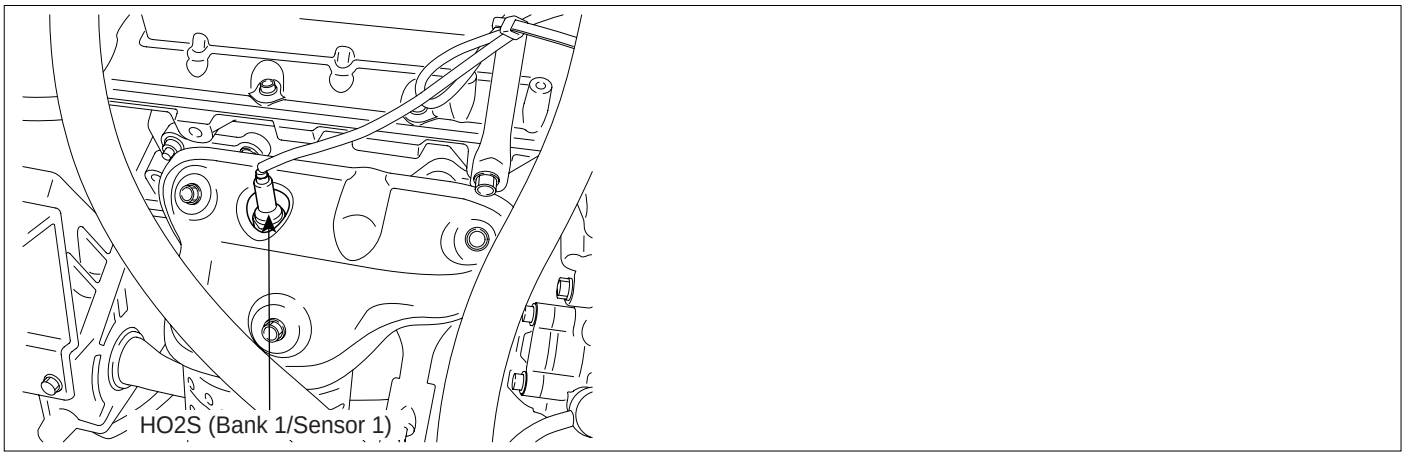
▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EE2D5E84

Refer to DTC P0026.

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

COMPONENT LOCATION E642DBBF



SGHFL7310N

GENERAL DESCRIPTION E6D104D9

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 PCM 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 EDC0EA83

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

DTC DETECTING CONDITION E852268C

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor the current through the heater	• Poor Connection • HO2S(B1/S1) • PCM
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	

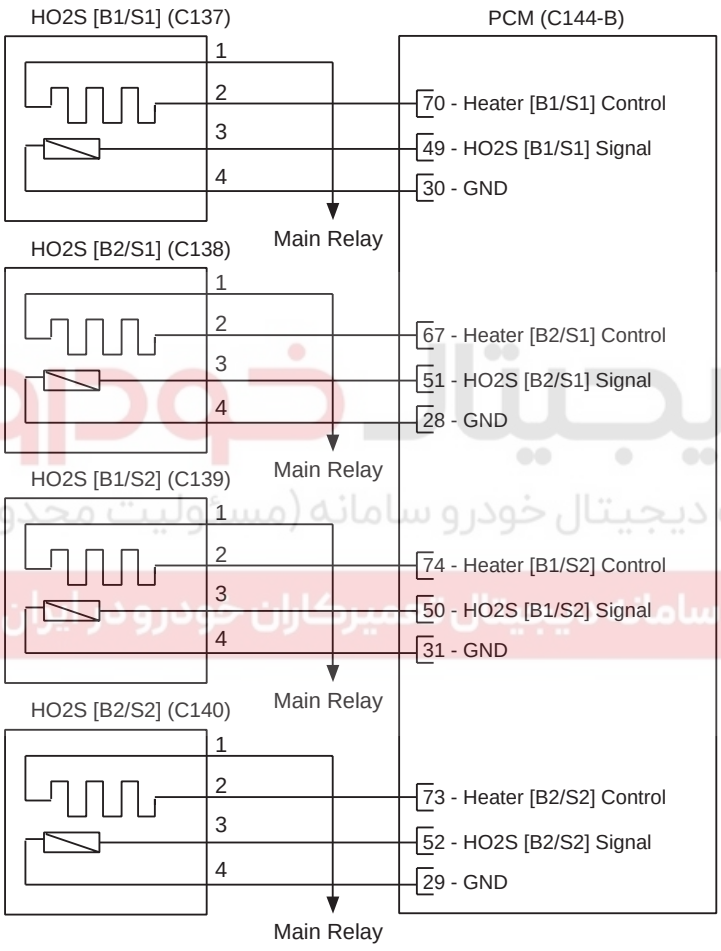
SPECIFICATION E4EEF3F0

(REFERENCE ONLY)

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

SCHEMATIC DIAGRAM E4AFFE3E

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

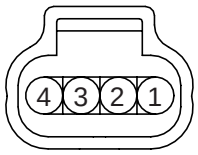
HO2S [B1/S2]

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

HO2S [B2/S2]

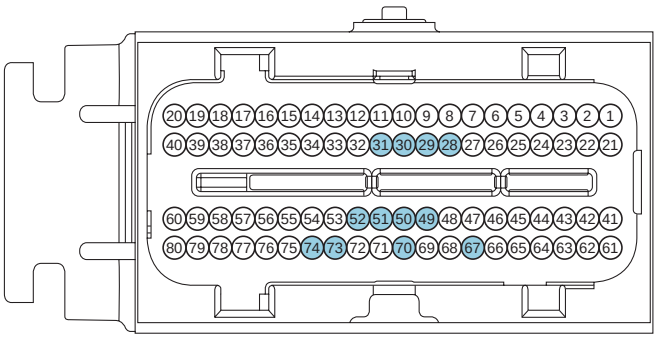
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFORM AND DATA E5D096BE

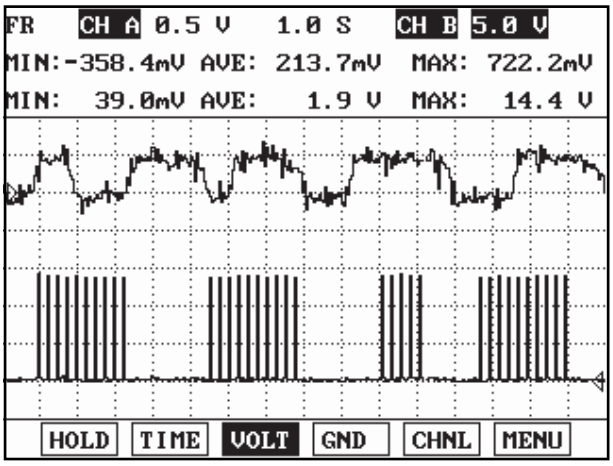


Fig. 1

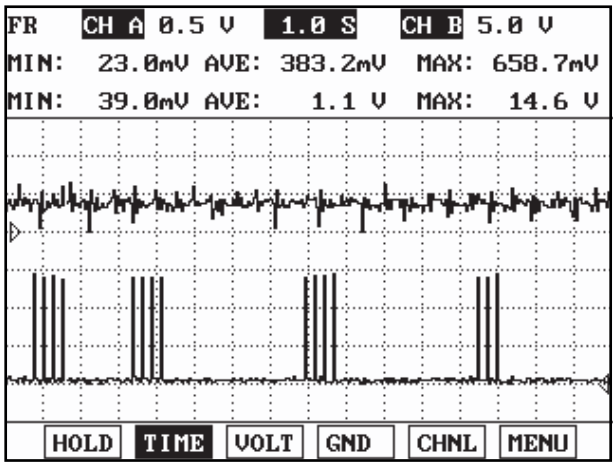


Fig. 2

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 PCM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the PCM provides a ground circuit for activating the heater.

MONITOR DTC STATUS ED8E5DEC

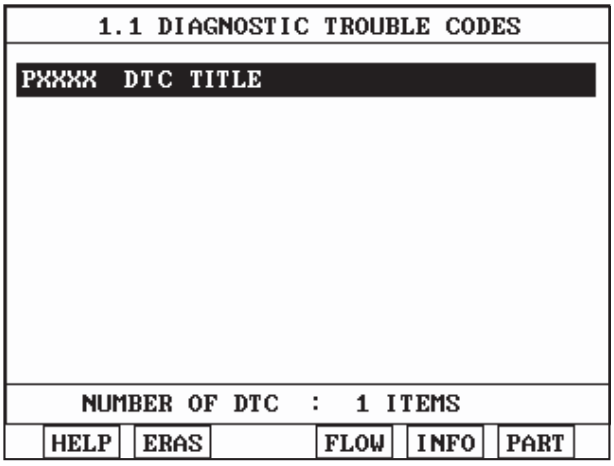
1. Check DTC Status

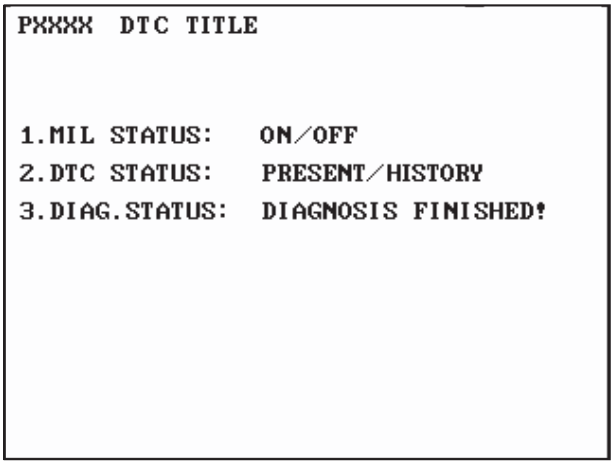
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E02523F9

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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.

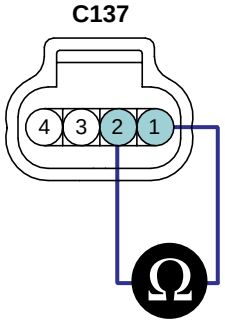
COMPONENT INSPECTION EA133A60

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℃(69.8°F)



1. Battery Voltage (B+)
2. Heater [B1/S1] Control
3. HO2S [B1/S1] Signal
4. Sensor ground

SBLF26415L

   3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

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 E40E30EA

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E5C304E6

Refer to DTC P0030.

GENERAL DESCRIPTION E196821D

Refer to DTC P0030.

DTC DESCRIPTION E5BB7DEA

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

DTC DETECTING CONDITION E22D808F

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) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E69B9B46

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 ℃ (69.8 ℉)

SCHEMATIC DIAGRAM E52977D7

Refer to DTC P0030.

SIGNAL WAVEFORM AND DATA E17EE66E

Refer to DTC P0030.

MONITOR DTC STATUS E3765785

Refer to DTC P0030.

TERMINAL AND CONNECTOR INSPECTION E77EF520

Refer to DTC P0030.

POWER CIRCUIT INSPECTION E312DCD4

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 E773F253

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 PCM connector.
   2) Measure resistance between terminal 2 of HO2S(B1/S1) harness connector and terminal 49 of PCM harness connector(C144-B).

Specification : Approx. below 1Ω

   3) Is the measured resistance within specification ?

YES

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

NO

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

COMPONENT INSPECTION E7810F8A

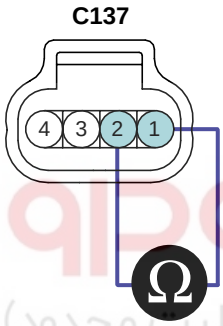
1. Check HO2S(B1/S1) Heater resistance.

   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 ℃ (69.8 °F)



1. **HO2S(B1/S1) heater Power**
2. **HO2S(B1/S1) Heater Control**
3. HO2S(B1/S1) Signal
4. Sensor ground

SBLF26408L

3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

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 EB0D277D

Refer to DTC P0030.

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

COMPONENT LOCATION E04E7241

Refer to DTC P0030.

GENERAL DESCRIPTION E7480FDF

Refer to DTC P0030.

DTC DESCRIPTION EAFF2C05

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

DTC DETECTING CONDITION ED575B4F

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • short to battery in control circuit • HO2S(B1/S1) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 EC46734B

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 ℃ (69.8 ℉)

SCHEMATIC DIAGRAM EC521B3A

Refer to DTC P0030.

SIGNAL WAVEFORM AND DATA E7F621EF

Refer to DTC P0030.

MONITOR DTC STATUS E45CBD5E

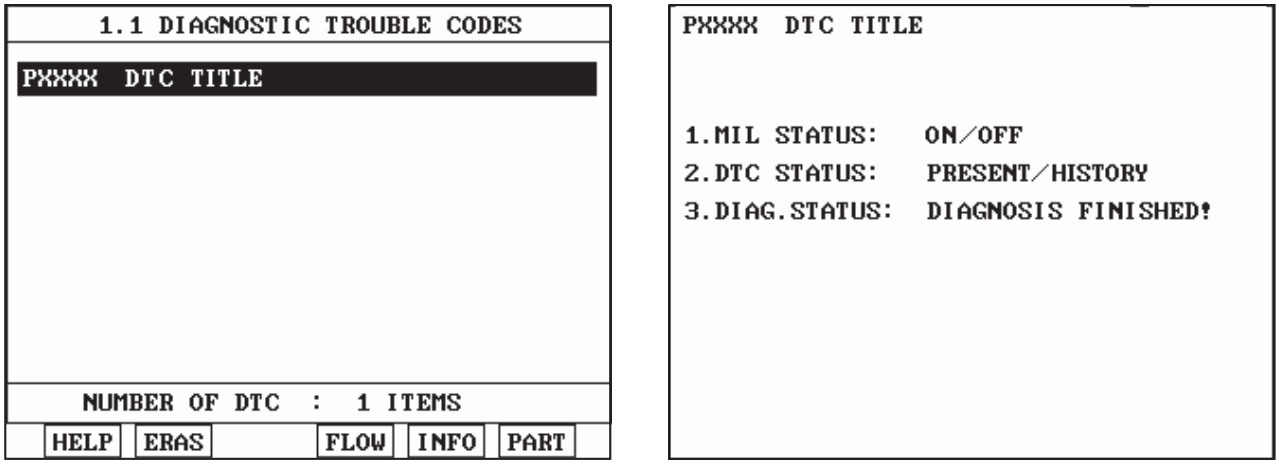
1. Check DTC Status

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

   2) IG "ON".

3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E592A3D5

Refer to DTC P0030.

CONTROL CIRCUIT INSPECTION ED873479

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 Vhicle Repair" procedure.

COMPONENT INSPECTION EBCA6B63

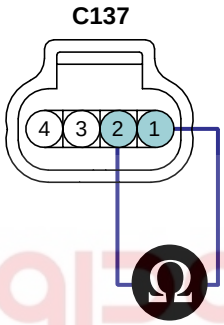
1. Check HO2S(B1/S1) Heater resistance.

   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 ℃ (69.8 ℉)



1. HO2S(B1/S1) heater Power
2. HO2S(B1/S1) Heater Control
3. HO2S(B1/S1) Signal
4. Sensor ground

SBLF26408L

3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

NO

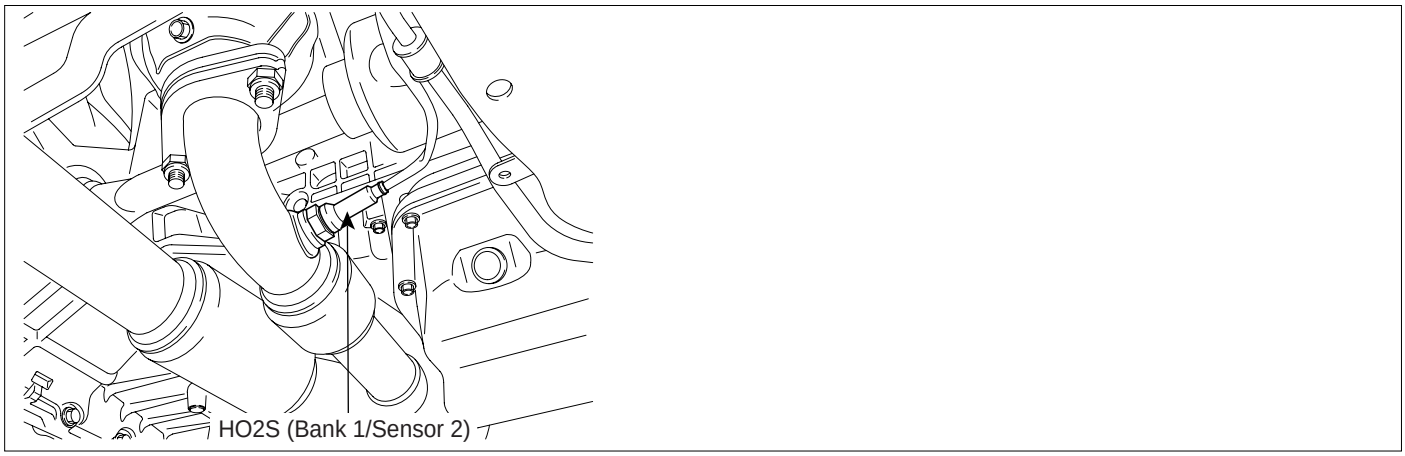
▶ Substitute with a known - good HO2S(B1/S1) and check for proper operation. If the problem is corrected, replace HO2S(B1/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E022789B

Refer to DTC P0030.

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

COMPONENT LOCATION EEF13DB6



SGHFL7311N

GENERAL DESCRIPTION E9986CA3

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 PCM 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 E4ADDD51

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

DTC DETECTING CONDITION ECBD9477

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor the current through the heater	• Poor Connection • HO2S(B1/S2) • PCM
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	

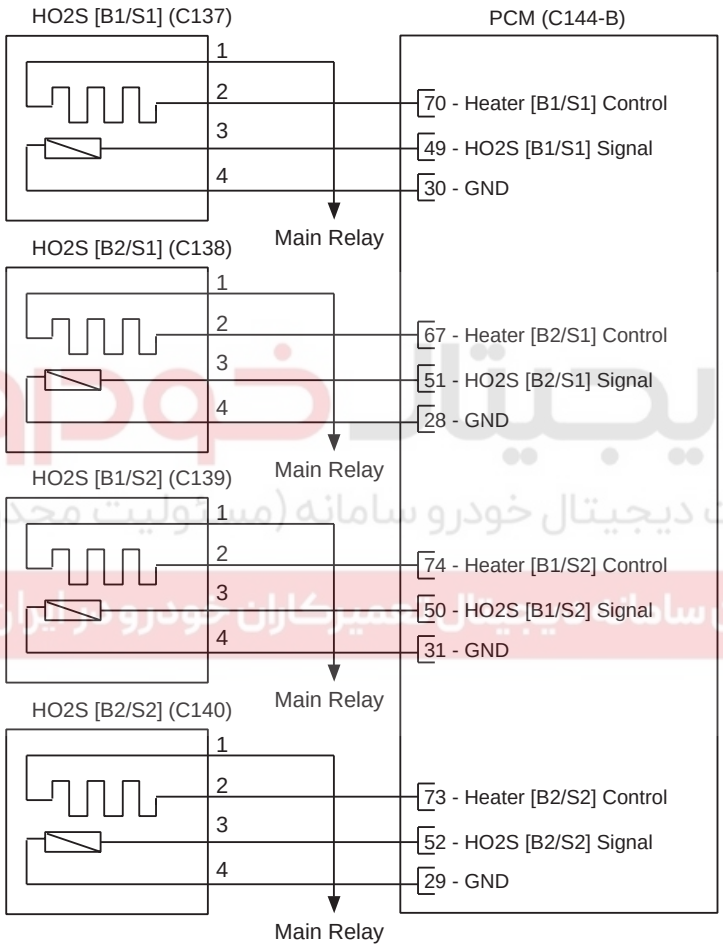
SPECIFICATION E99F80B6

(REFERENCE ONLY)

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

SCHEMATIC DIAGRAM E90439EC

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

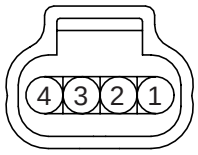
HO2S [B1/S2]

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

HO2S [B2/S2]

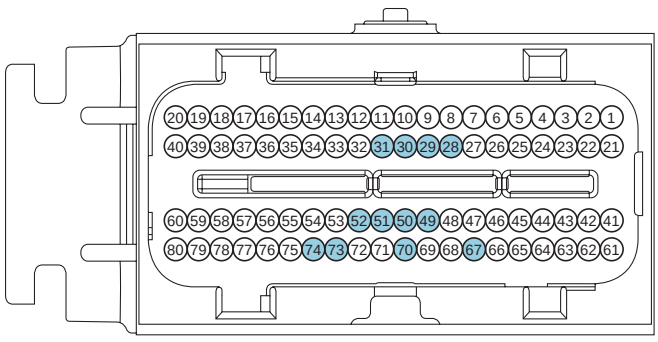
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFORM AND DATA EF26675E

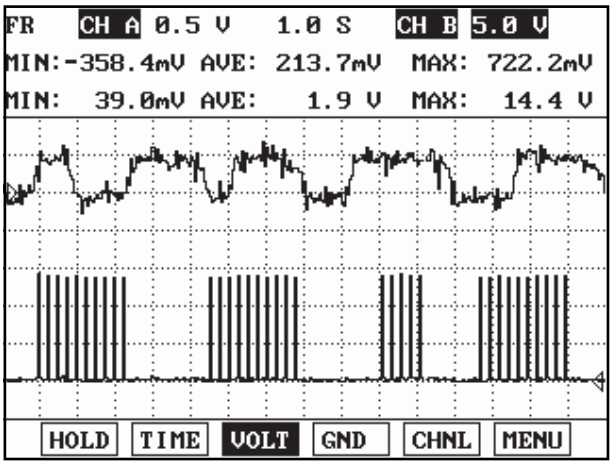


Fig. 1

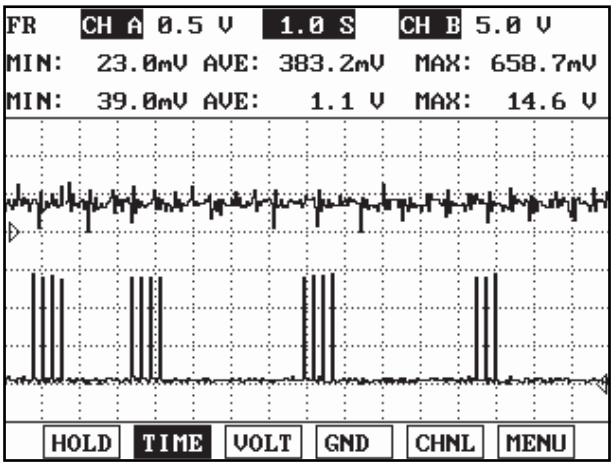


Fig. 2

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 PCM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the PCM provides a ground circuit for activating the heater.

MONITOR DTC STATUS EDCEF7EA

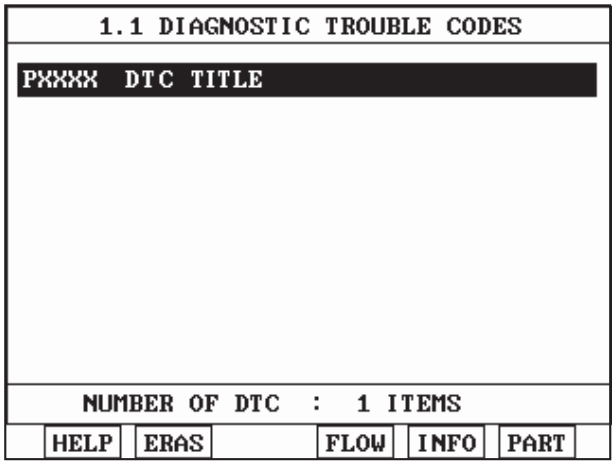
1. Check DTC Status

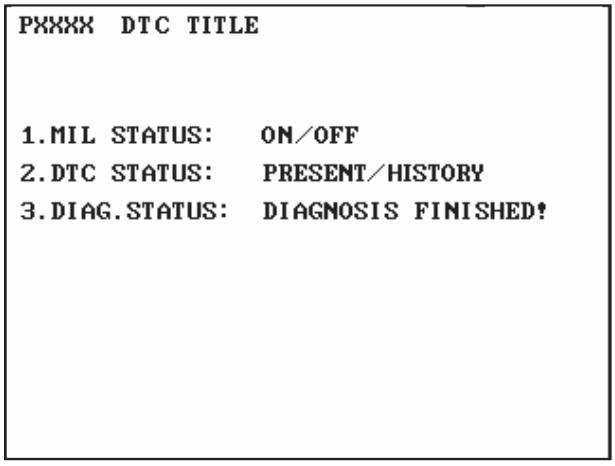
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E4CAD22D

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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

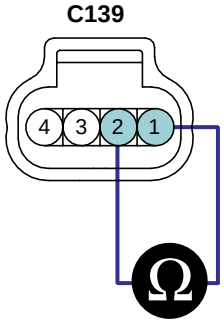
NO

▶ Go to " Component Inspection " procedure.

COMPONENT INSPECTION E8EBD4C3

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℃(69.8°F)



1. Battery Voltage (B+)
2. Heater [B1/S2] Control
3. HO2S [B1/S2] Signal
4. Sensor ground

SBLF26416L

   3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

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 E309497D

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 E440EB1A

Refer to DTC P0036.

GENERAL DESCRIPTION E053347B

Refer to DTC P0036.

DTC DESCRIPTION E6C81407

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

DTC DETECTING CONDITION E31AFB47

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) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E194E319

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 ℃ (69.8 ℉)

SCHEMATIC DIAGRAM E65E20C2

Refer to DTC P0036.

SIGNAL WAVEFORM AND DATA EDD53437

Refer to DTC P0036.

MONITOR DTC STATUS EE1529D0

Refer to DTC P0036.

TERMINAL AND CONNECTOR INSPECTION E12A92E7

Refer to DTC P0036.

POWER CIRCUIT INSPECTION E372DAA1

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 ED545BBD

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 PCM connector.
   2) Measure resistance between terminal 2 of HO2S(B1/S2) harness connector and terminal 74 of PCM 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 EA451FD7

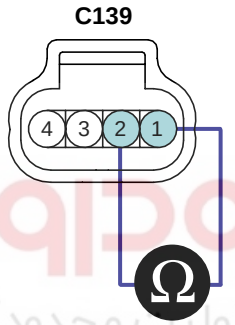
1. Check HO2S(B1/S2) Heater resistance

   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 ℃ (69.8 °F)



1. HO2S(B1/S2) heater Power
2. HO2S(B1/S2) Heater Control
3. HO2S (B1/S2) Signal
4. Sensor ground

SBLF26420L

3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

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 ED4A67EE

Refer to DTC P0036.

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

COMPONENT LOCATION E473436E

Refer to DTC P0036.

GENERAL DESCRIPTION E235EEF0

Refer to DTC P0036.

DTC DESCRIPTION E0724472

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

DTC DETECTING CONDITION EABDA37E

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • short to battery in control circuit • HO2S(B1/S2) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 EED5CB7E

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 ℃ (69.8 ℉)

SCHEMATIC DIAGRAM EF85C7E3

Refer to DTC P0036.

SIGNAL WAVEFORM AND DATA E9AB6C47

Refer to DTC P0036.

MONITOR DTC STATUS E71E05E6

Refer to DTC P0036.

TERMINAL AND CONNECTOR INSPECTION ED9FD918

Refer to DTC P0036.

CONTROL CIRCUIT INSPECTION E59C935C

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

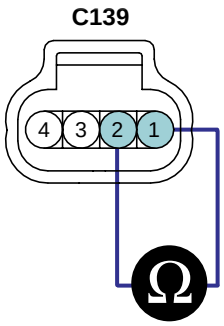
▶ Repair short to battery in HO2S (B1/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E05C4845

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 ℃ (69.8 ℉)



1. HO2S(B1/S2) heater Power
2. HO2S(B1/S2) Heater Control
3. HO2S (B1/S2) Signal
4. Sensor ground

SBLF26420L

3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

NO

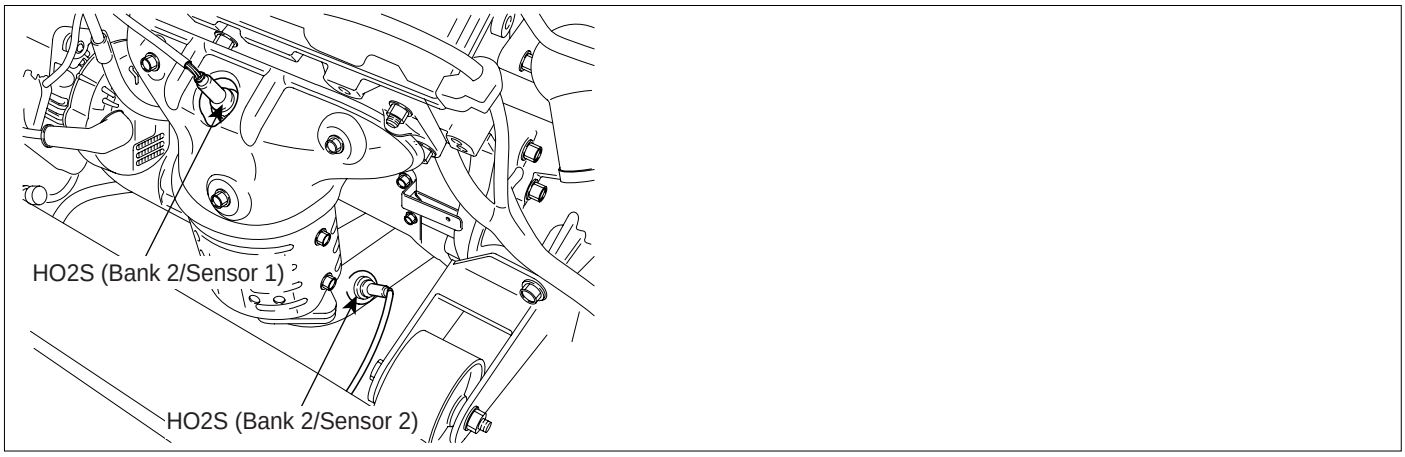
▶ Substitute with a known - good HO2S(B1/S2) and check for proper operation. If the problem is corrected, replace HO2S(B1/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E24E2367

Refer to DTC P0036.

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

COMPONENT LOCATION E8FF8418



SGHFL7312N

GENERAL DESCRIPTION E529FCDA

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 PCM 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 E77D9E41

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

DTC DETECTING CONDITION E87A0C49

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor the current through the heater	• Poor Connection • HO2S(B2/S1) • PCM
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	

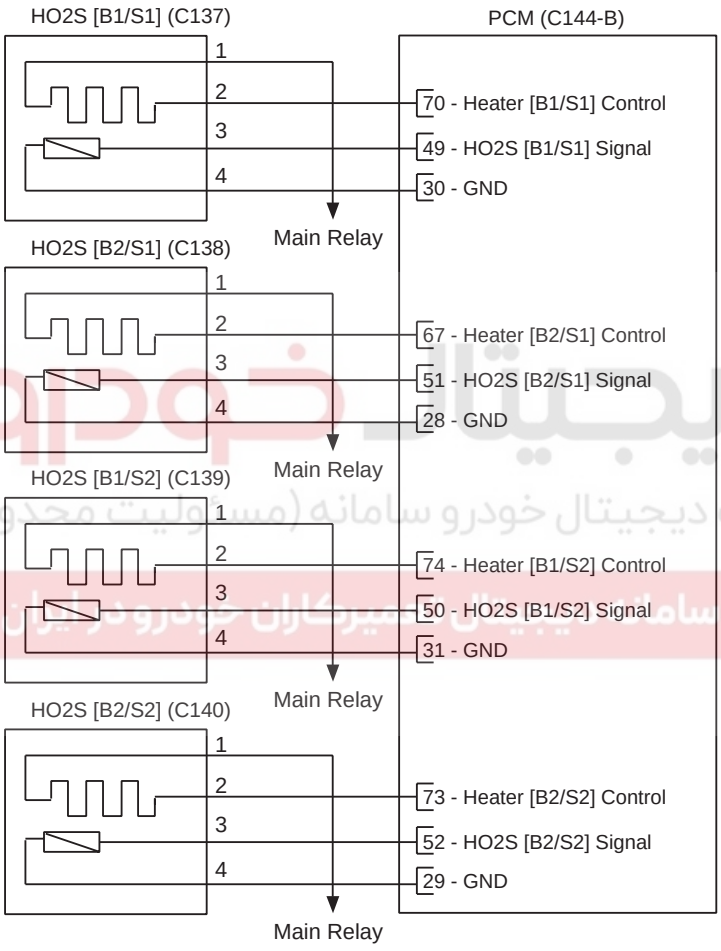
SPECIFICATION E1A0DEA3

(REFERENCE ONLY)

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

SCHEMATIC DIAGRAM ECAB737D

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

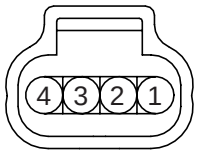
HO2S [B1/S2]

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

HO2S [B2/S2]

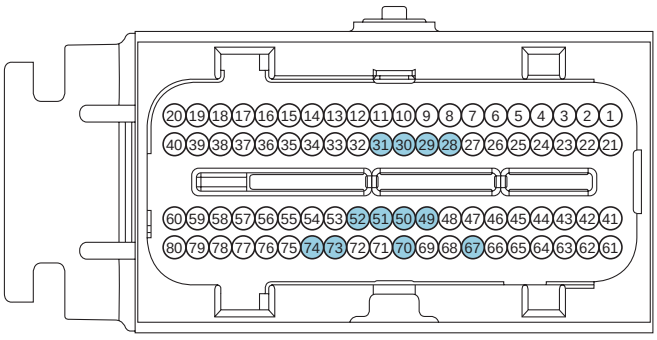
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFORM AND DATA E54805BA

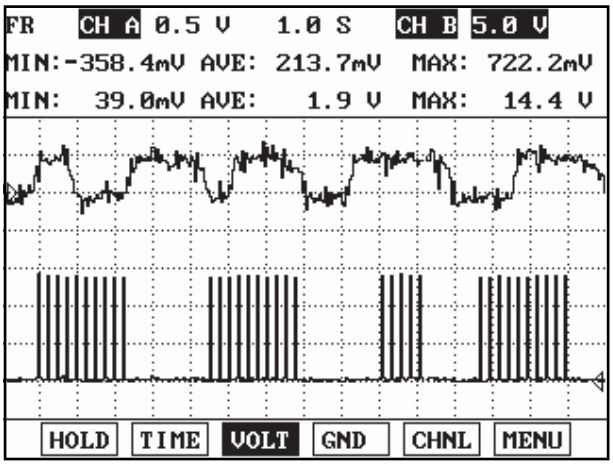


Fig. 1

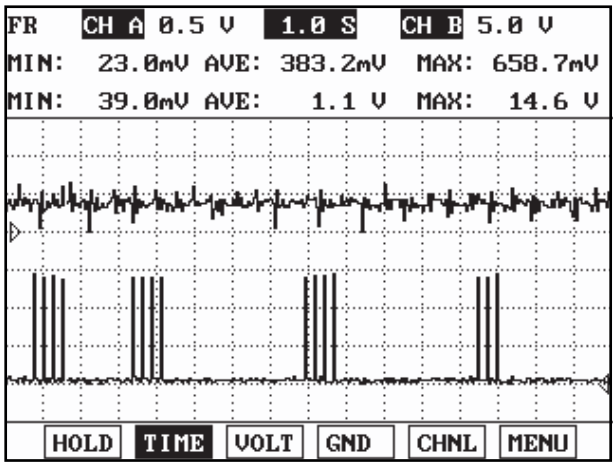


Fig. 2

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 PCM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the PCM provides a ground circuit for activating the heater.

MONITOR DTC STATUS E531AE7A

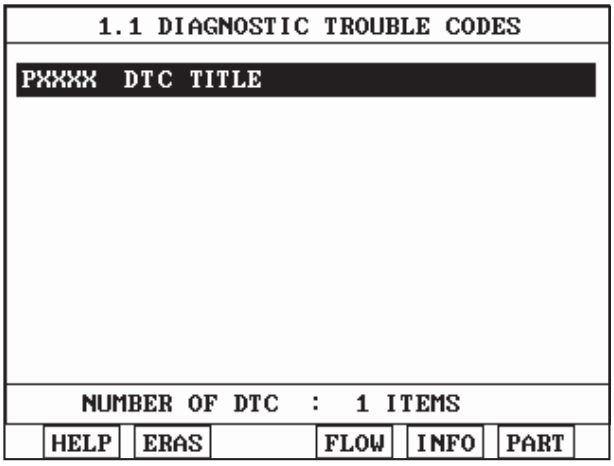
1. Check DTC Status

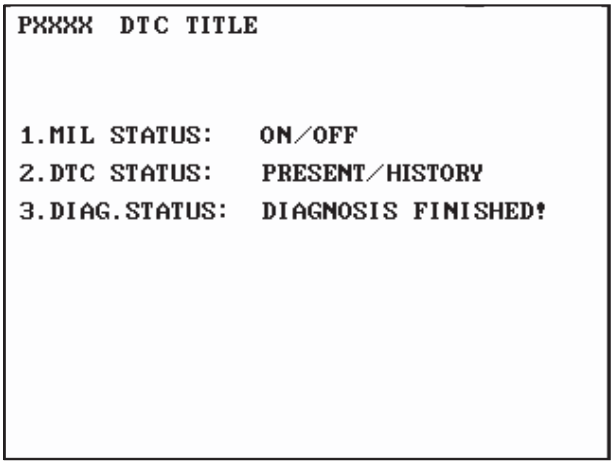
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E586AA5D

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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

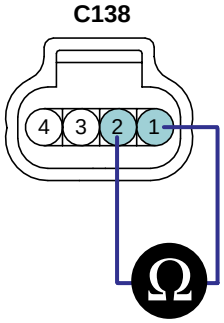
NO

▶ Go to "Component Inspection" procedure.

COMPONENT INSPECTION E3F72CDD

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℃(69.8°F)



1. Battery Voltage (B+)
2. Heater [B2/S1] Control
3. HO2S [B2/S1] Signal
4. Sensor ground

SBLF26422L

   3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

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 EF05F3CB

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E1F9BFF3

Refer to DTC P0050.

GENERAL DESCRIPTION E3132DDB

Refer to DTC P0050.

DTC DESCRIPTION E4E4C3A1

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

DTC DETECTING CONDITION E2E759FC

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) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E7DBB366

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 ℃ (69.8 ℉)

SCHEMATIC DIAGRAM E9E8B77B

Refer to DTC P0050.

SIGNAL WAVEFORM AND DATA E3E1AF74

Refer to DTC P0050.

MONITOR DTC STATUS E5A58276

Refer to DTC P0050.

TERMINAL AND CONNECTOR INSPECTION E65FBA1E

Refer to DTC P0050.

POWER CIRCUIT INSPECTION E8A0E099

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 EC6E05FE

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 PCM connector.
   2) Measure resistance between terminal 2 of HO2S(B2/S1) harness connector and terminal 67 of PCM harness connector(C144-B).

Specification : Approx. below 1Ω

   3) Is the measured resistance within specification ?

YES

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

NO

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

COMPONENT INSPECTION E3253513

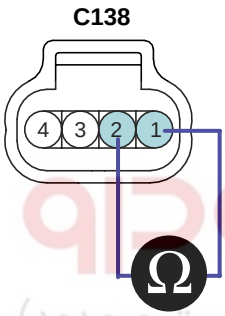
1. Check HO2S(B2/S1) Heater resistance

   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 ℃ (69.8 °F)



1. HO2S(B2/S1) Heater Power
2. HO2S(B2/S1) Heater Control
3. HO2S(B2/S1) Signal
4. Sensor Ground

SBLF26426L

3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

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 ECF3346E

Refer to DTC P0050.

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

COMPONENT LOCATION E143EF97

Refer to DTC P0050.

GENERAL DESCRIPTION EBBBAA27

Refer to DTC P0050.

DTC DESCRIPTION E12626DB

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

DTC DETECTING CONDITION E371941E

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in control circuit • HO2S(B2/S1) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E36DD25B

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 ℃ (69.8 ℉)

SCHEMATIC DIAGRAM E2B69204

Refer to DTC P0050.

SIGNAL WAVEFORM AND DATA E46915FE

Refer to DTC P0050.

MONITOR DTC STATUS E6779C7A

Refer to DTC P0050.

TERMINAL AND CONNECTOR INSPECTION EE68E64C

Refer to DTC P0050.

CONTROL CIRCUIT INSPECTION E8F9B5F3

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

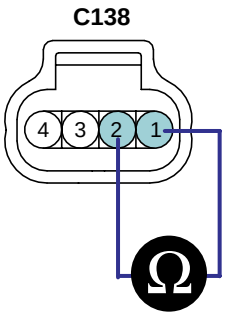
▶ Repair short to battery in HO2S(B2/S1) Heater control circuit and go to "Verification of Vhicle Repair" procedure.

COMPONENT INSPECTION ECCCB86F

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℃(69.8°F)



1. HO2S(B2/S1) Heater Power
2. HO2S(B2/S1) Heater Control
3. HO2S(B2/S1) Signal
4. Sensor Ground

SBLF26426L

3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

NO

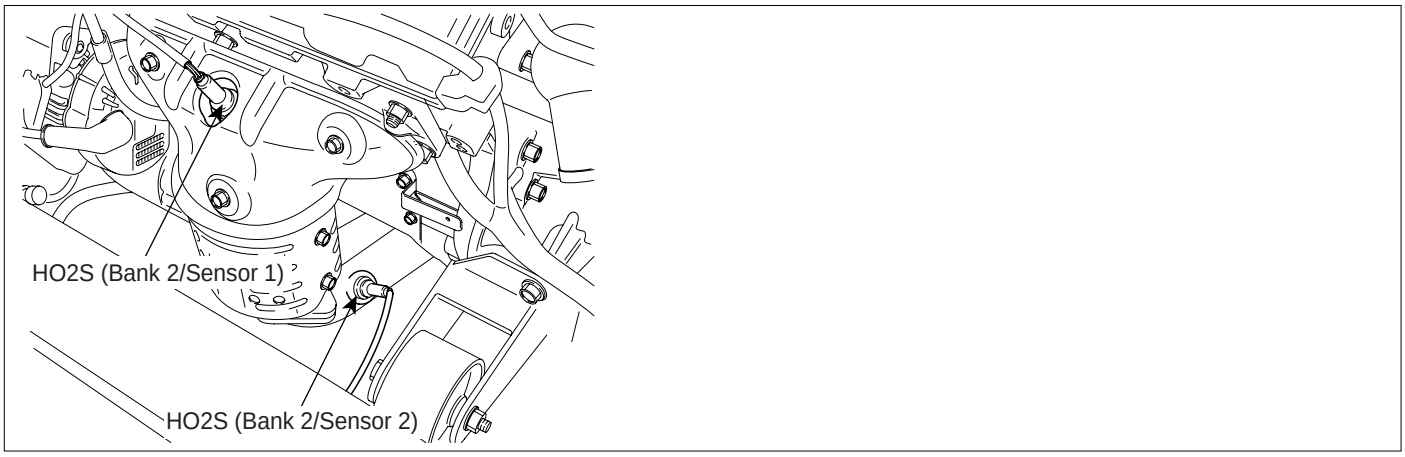
▶ Substitute with a known - good HO2S(B2/S1) and check for proper operation. If the problem is corrected, replace HO2S(B2/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E8D77CA8

Refer to DTC P0050.

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

COMPONENT LOCATION EA6693FB



SGHFL7312N

GENERAL DESCRIPTION E975588A

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 PCM 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 EDEF88A2

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

DTC DETECTING CONDITION EC3AD4E3

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor the current through the heater	• Poor connection • HO2S(B2/S2) • PCM
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	

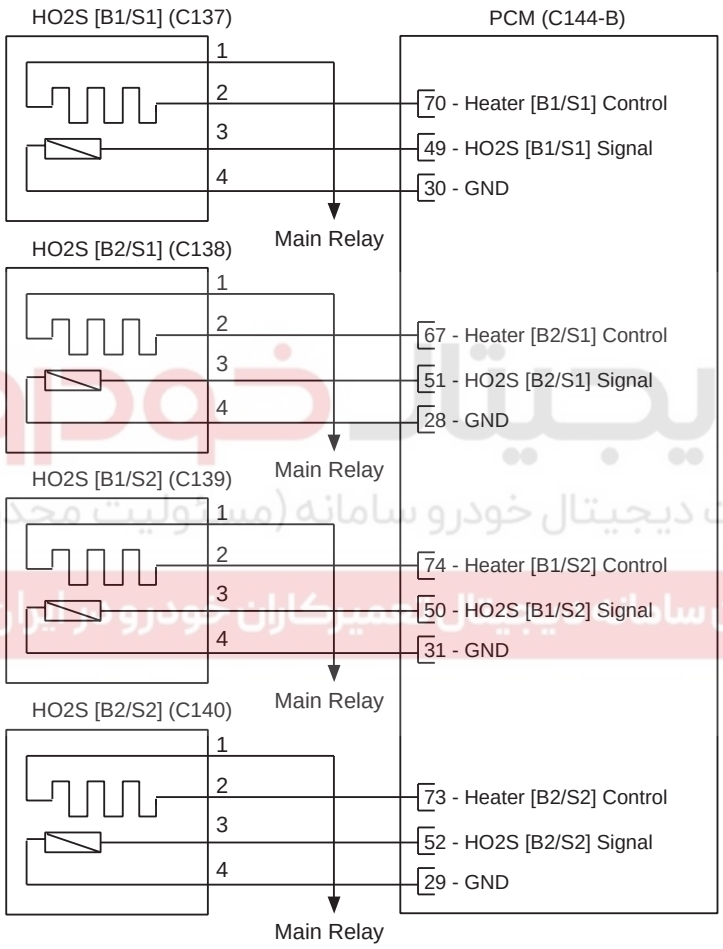
SPECIFICATION E36B45B4

(REFERENCE ONLY)

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

SCHEMATIC DIAGRAM E1698293

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

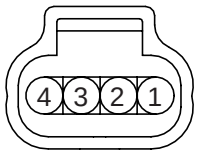
HO2S [B1/S2]

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

HO2S [B2/S2]

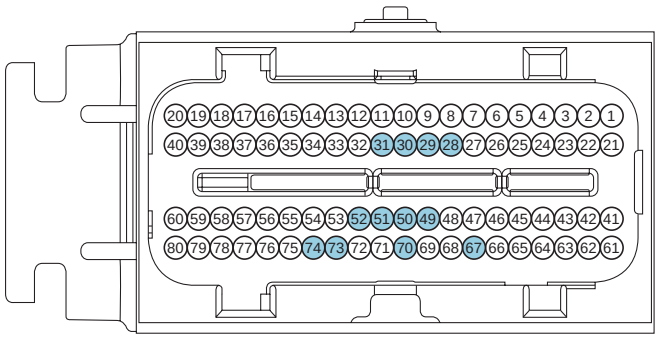
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFORM AND DATA EE01A85D

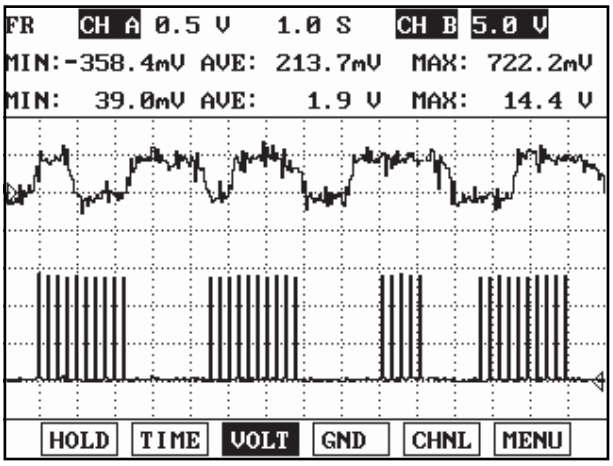


Fig. 1

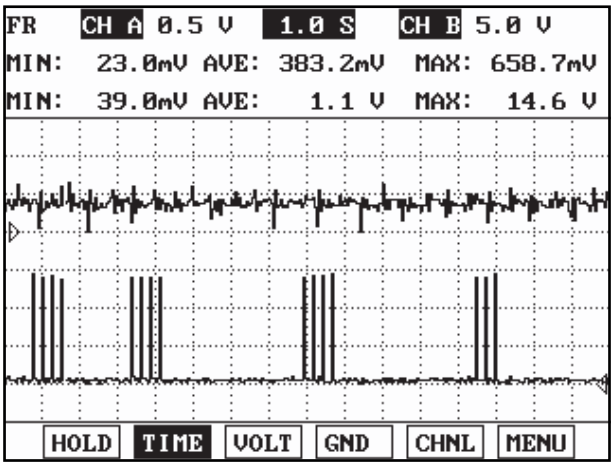


Fig. 2

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 PCM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the PCM provides a ground circuit for activating the heater.

MONITOR DTC STATUS E5AF5E9F

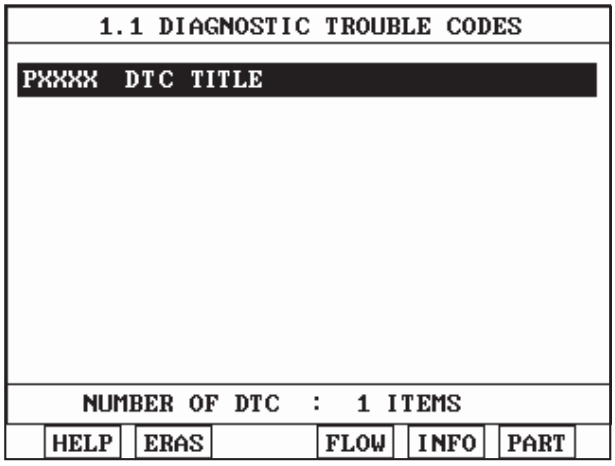
1. Check DTC Status

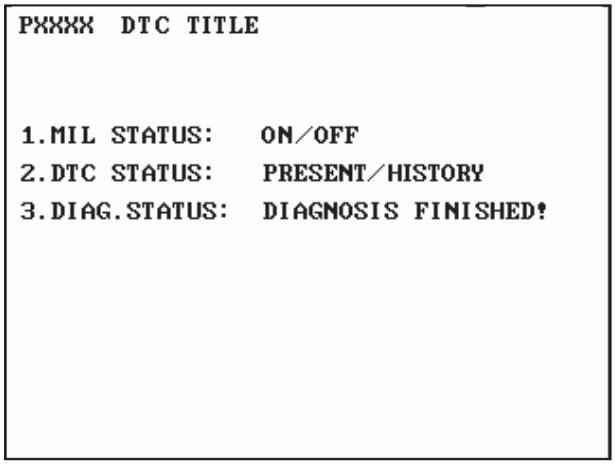
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E739D0D2

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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

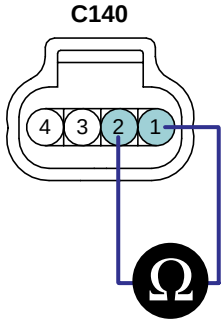
NO

▶ Go to " Component Inspection " procedure.

COMPONENT INSPECTION EF023AAC

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℃(69.8°F)



1. Battery Voltage (B+)
2. Heater [B2/S2] Control
3. HO2S [B2/S2] Signal
4. Sensor ground

SBLF26428L

2. Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

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 E9E7D3F4

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 EA630861

Refer to DTC P0056.

GENERAL DESCRIPTION E3FA12E1

Refer to DTC P0056.

DTC DESCRIPTION E9B9127E

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

DTC DETECTING CONDITION EA96CEBD

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) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E51A7B53

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 ℃ (69.8 ℉)

SCHEMATIC DIAGRAM ED446D90

Refer to DTC P0056.

SIGNAL WAVEFORM AND DATA ED42916D

Refer to DTC P0056.

MONITOR DTC STATUS EDF5EC14

Refer to DTC P0056.

TERMINAL AND CONNECTOR INSPECTION EE02EBFB

Refer to DTC P0056.

POWER CIRCUIT INSPECTION E1115F58

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 ED90BFAA

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 PCM connector.
   2) Measure resistance between terminal 2 of HO2S(B2/S2) harness connector and terminal 73 of PCM 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 E3AA93BE

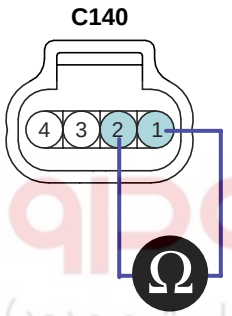
1. Check HO2S(B2/S2) Heater resistance

   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 ℃ (69.8 °F)



1. HO2S(B2/S2) Heater Power
2. HO2S(B2/S2) Heater Control
3. HO2S(B2/S2) Signal
4. Sensor Ground

SBLF26432L

3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

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 EB446184

Refer to DTC P0056.

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

COMPONENT LOCATION E2A26E0C

Refer to DTC P0056.

GENERAL DESCRIPTION E6809915

Refer to DTC P0056.

DTC DESCRIPTION EC93FE9D

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

DTC DETECTING CONDITION E183856D

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in control circuit • HO2S(B2/S2) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E396E010

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21 ℃ (69.8 ℉)

SCHEMATIC DIAGRAM E30EA368

Refer to DTC P0056.

SIGNAL WAVEFORM AND DATA E1CB4F50

Refer to DTC P0056.

MONITOR DTC STATUS E9BDFDF9

Refer to DTC P0056.

TERMINAL AND CONNECTOR INSPECTION E4D663F5

Refer to DTC P0056.

CONTROL CIRCUIT INSPECTION EA243A91

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 EAF2CDDF

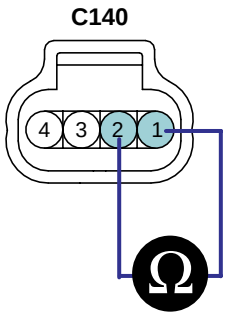
1. Check HO2S(B2/S2) Heater resistance

   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 ℃ (69.8 ℉)



1. HO2S(B2/S2) Heater Power
2. HO2S(B2/S2) Heater Control
3. HO2S(B2/S2) Signal
4. Sensor Ground

SBLF26432L

   3) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

NO

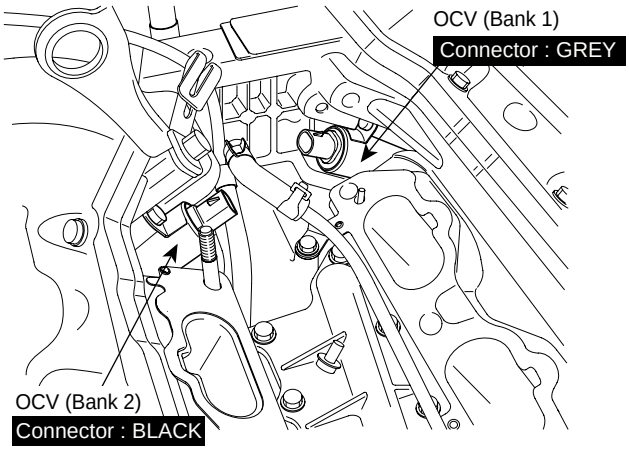
▶ Substitute with a known - good HO2S(B2/S2) and check for proper operation. If the problem is corrected, replace HO2S(B2/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E7A99321

Refer to DTC P0056.

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

COMPONENT LOCATION E8595423



EGRF602F

GENERAL DESCRIPTION EF2305FD

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. The PCM 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 E6E0F769

When the enable condition is satisfied, The PCM 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.

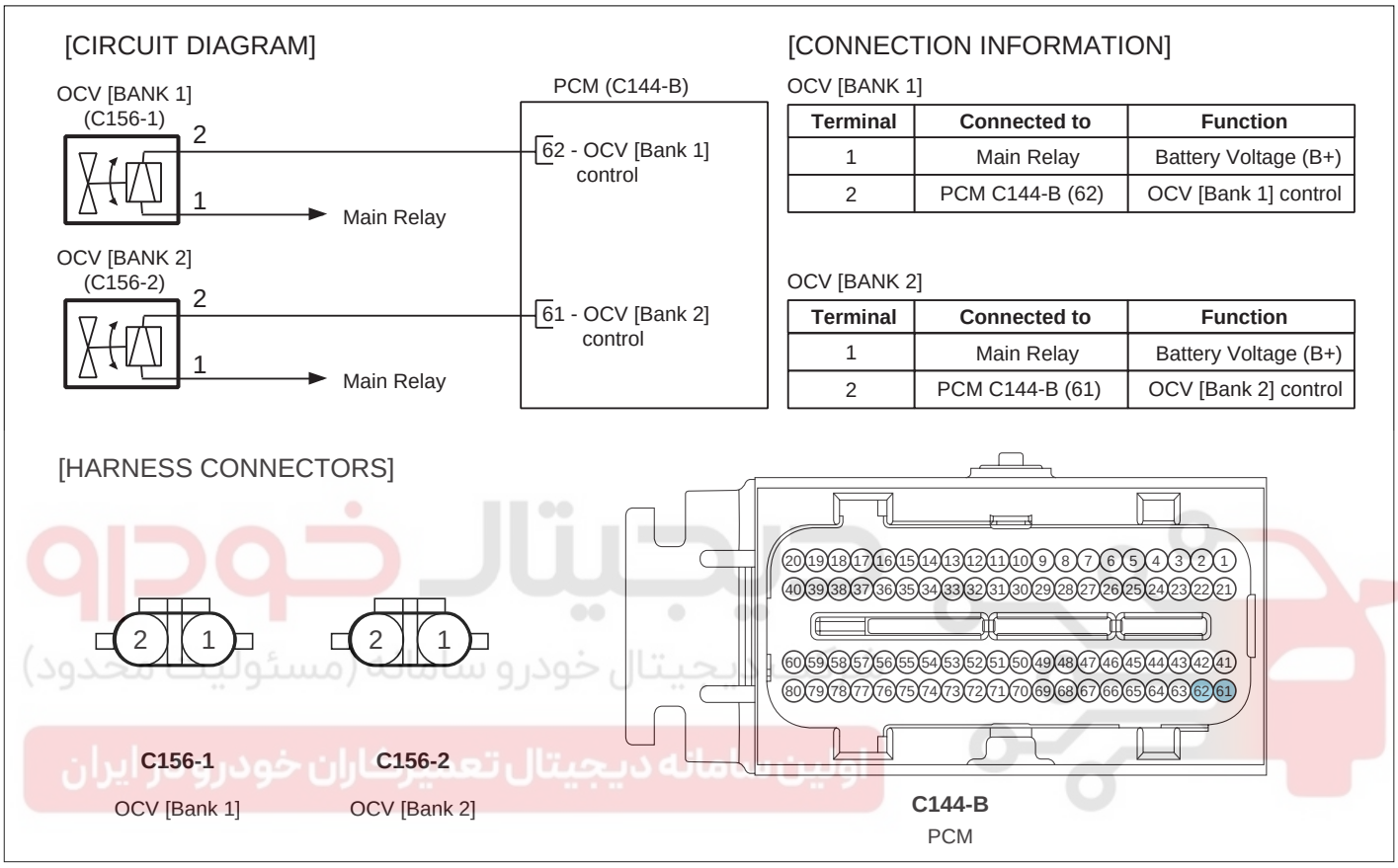
DTC DETECTING CONDITION EF7961C5

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 • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E7CAACAE

Resistance (Ω)	6.7 ~ 7.7 Ω at 20 ℃ (68 ℉)

SCHEMATIC DIAGRAM EAADC225



OCV [BANK 1]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (62)	OCV [Bank 1] control

OCV [BANK 2]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (61)	OCV [Bank 2] control

UFBG255A

SIGNAL WAVEFORM AND DATA EE23572F

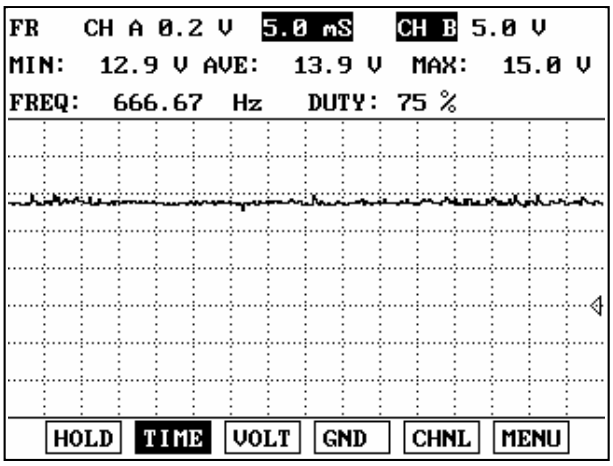


Fig. 1

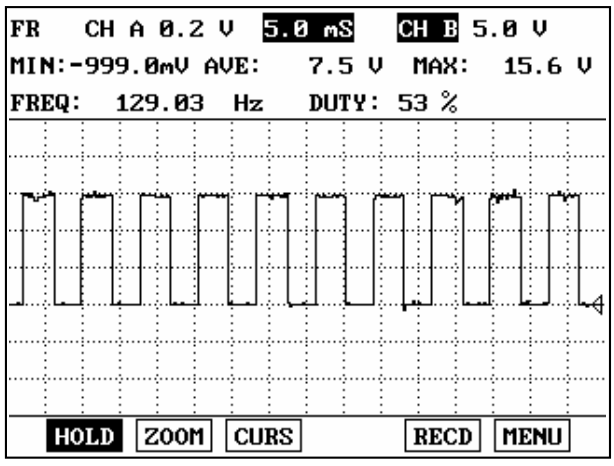


Fig. 2

Fig. 1 : Idle
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 EA959D01

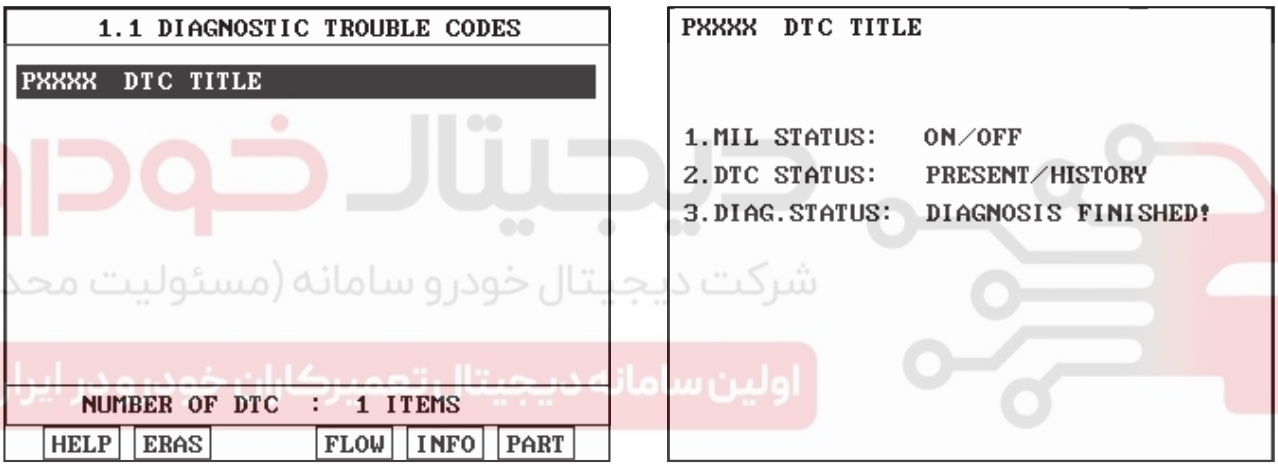
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC’s information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’s and/or PCM’s connector or was repaired and PCM 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 EC3C8F05

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition.
   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 E0E76451

1. IG "OFF" & Disconnect OCV(B1) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 1 of OCV(B1) 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 repalce as necessary and then go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EEA9D296

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 PCM connector.

2) Measure resistance between terminal 2 of OCV harness connector and terminal 62 of PCM 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 E79B8168

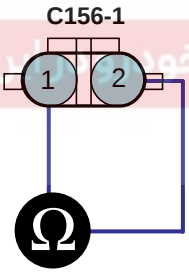
1. Check OCV

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 ℃ (68 ℉)



1. OCV(B1) Power
2. OCV(B1) Control

SBLF26437L

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.

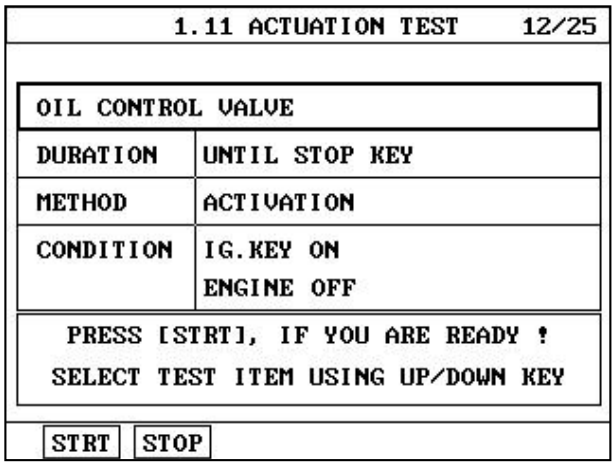
2. OCV Actuation Test

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.



EGRF602M

5) Does OCV generate click sound during acutation test ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

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 EC804BA6

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E713BA03

Refer to DTC P0076.

GENERAL DESCRIPTION EEFC741C

Refer to DTC P0076.

DTC DESCRIPTION E7771110

When the enable condition is satisfied, The PCM 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 E3F253A6

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in Control Circuit • OCV • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E4E7B2CE

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

SCHEMATIC DIAGRAM EA10C1DD

Refer to DTC P0076.

SIGNAL WAVEFORM AND DATA E68E9FBA

Refer to DTC P0076.

MONITOR DTC STATUS E00B9FEE

Refer to DTC P0076.

TERMINAL AND CONNECTOR INSPECTION EA147CF4

Refer to DTC P0076.

CONTROL CIRCUIT INSPECTION E2A2FDA7

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.

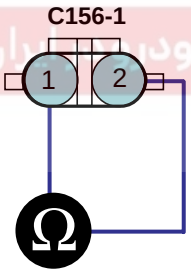
NO

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

COMPONENT INSPECTION E6D806A5

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)



1. OCV(B1) Power
2. OCV(B1) Control

SBLF26437L

   3) Is the measured resistance within specification ?

YES

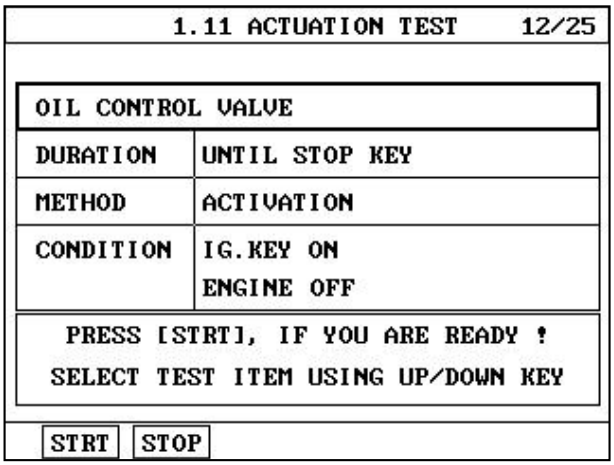
▶ Go to "OCV Actuation Test" as follows.

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.



EGRF602M

5) Does OCV generate click sound during acutation test ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

NO

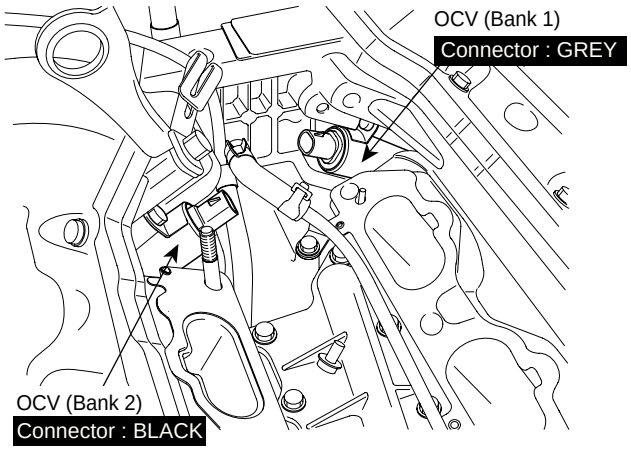
▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ED5A0FBF

Refer to DTC P0076.

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

COMPONENT LOCATION E24018DB



EGRF602Q

GENERAL DESCRIPTION ED456CBC

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. The PCM 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 E60E2FAD

When the enable condition is satisfied, The PCM checks that CCV 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.

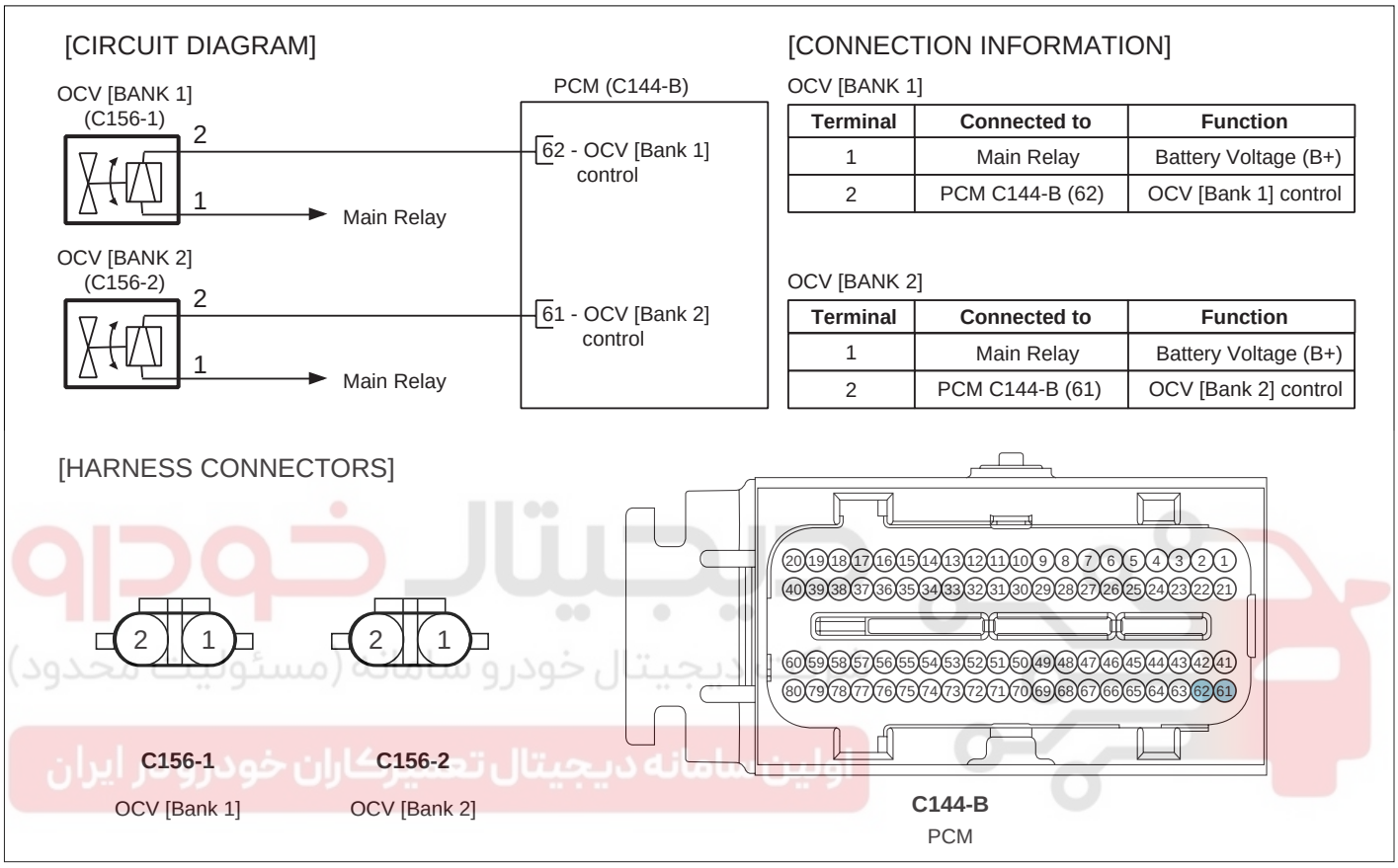
DTC DETECTING CONDITION E721CFB9

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 • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E7D26E5A

Resistance (Ω)	6.7 ~ 7.7 Ω at 20 ℃ (68 ℉)

SCHEMATIC DIAGRAM E72F1BD0



[CONNECTION INFORMATION]

OCV [BANK 1]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (62)	OCV [Bank 1] control

OCV [BANK 2]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (61)	OCV [Bank 2] control

UFBG255A

SIGNAL WAVEFORM AND DATA EE81EB08

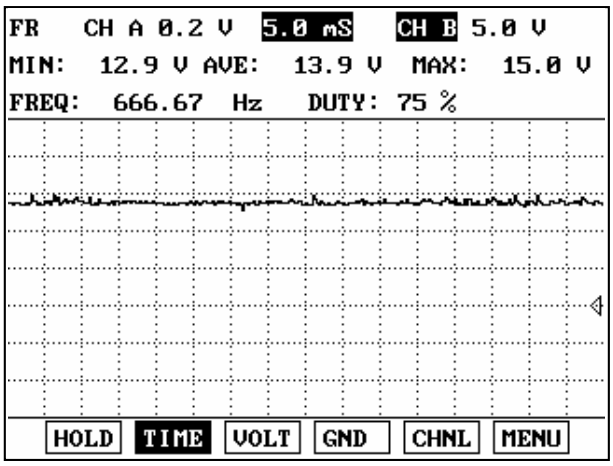


Fig. 1

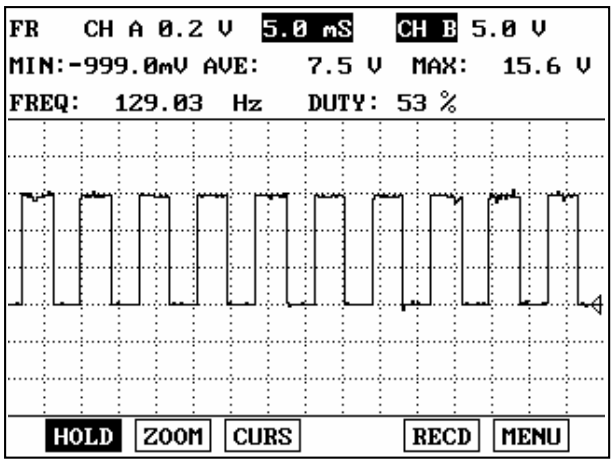


Fig. 2

Fig. 1 : Idle
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 E8C6CF8D

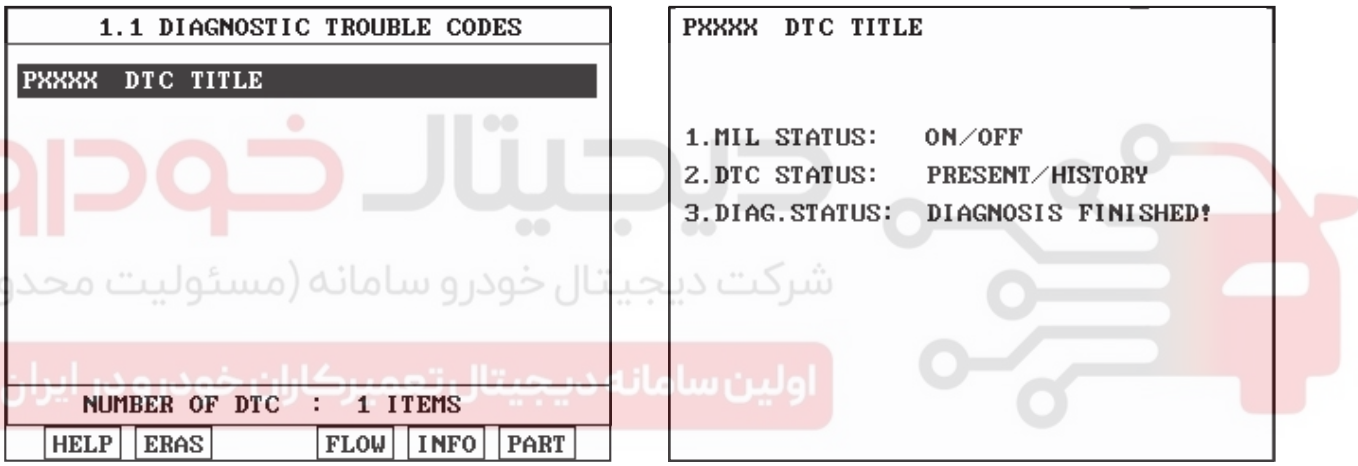
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EE35850C

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E7C2AC9A

1. IG "OFF" & Disconnect OCV(B2) connector.
2. IG "ON" & ENG "OFF".
3. Measure voltage between terminal 1 of OCV(B2) 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 repalce as necessary and then go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E3DD9898

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 PCM connector.

2) Measure resistance between terminal 2 of OCV harness connector and terminal 61 of PCM harness connector(C144-B).

Specification : Approx. below 1Ω

3) 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.

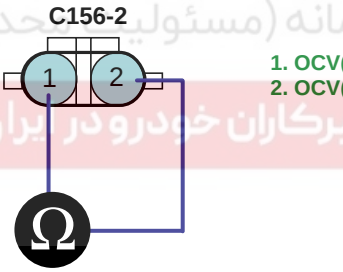
COMPONENT INSPECTION E430454C

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℃(68°F)



SBLF26442L

3) Is the measured resistance within specification ?

YES

4) ▶ 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.

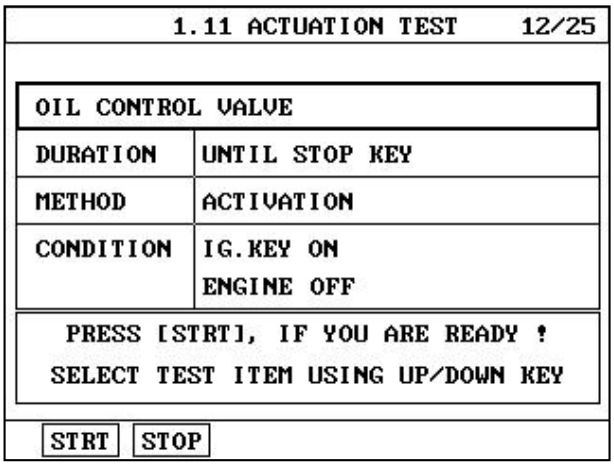
2. OCV Actuation Test

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.



EGRF602W

5) Does OCV generate click sound during acutation test ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

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 EED17FD8

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E5706769

Refer to DTC P0082.

GENERAL DESCRIPTION EFAABE78

Refer to DTC P0082.

DTC DESCRIPTION EE6F6265

When the enable condition is satisfied, The PCM 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 EBE82615

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in Control Circuit • OCV • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 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 E4CE2EC0

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

SCHEMATIC DIAGRAM EAC248CE

Refer to DTC P0082.

SIGNAL WAVEFORM AND DATA E5E3710D

Refer to DTC P0082.

MONITOR DTC STATUS E5AA9C5D

Refer to DTC P0082.

TERMINAL AND CONNECTOR INSPECTION E4786E18

Refer to DTC P0082.

CONTROL CIRCUIT INSPECTION E449F7BA

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.

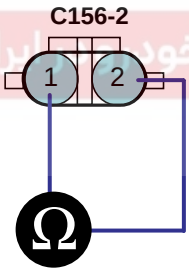
NO

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

COMPONENT INSPECTION E99C75E2

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℃(68°F)



1. OCV(B2) Power
2. OCV(B2) Control

SBLF26442L

   3) Is the measured resistance within specification ?

YES

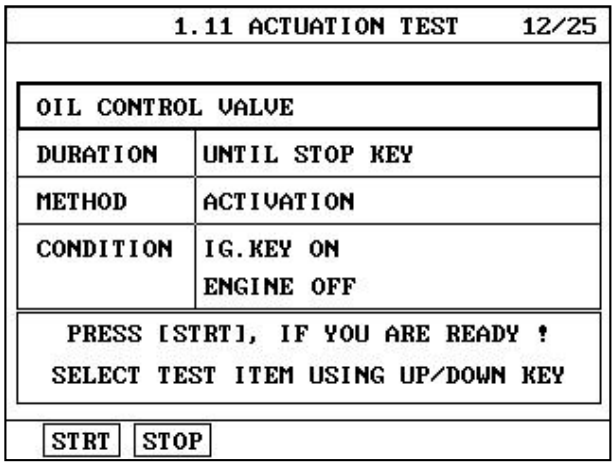
   4) ▶ Go to "OCV Actuation Test" as follows.

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.



EGRF602W

5) Does OCV generate click sound during acutation test ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

NO

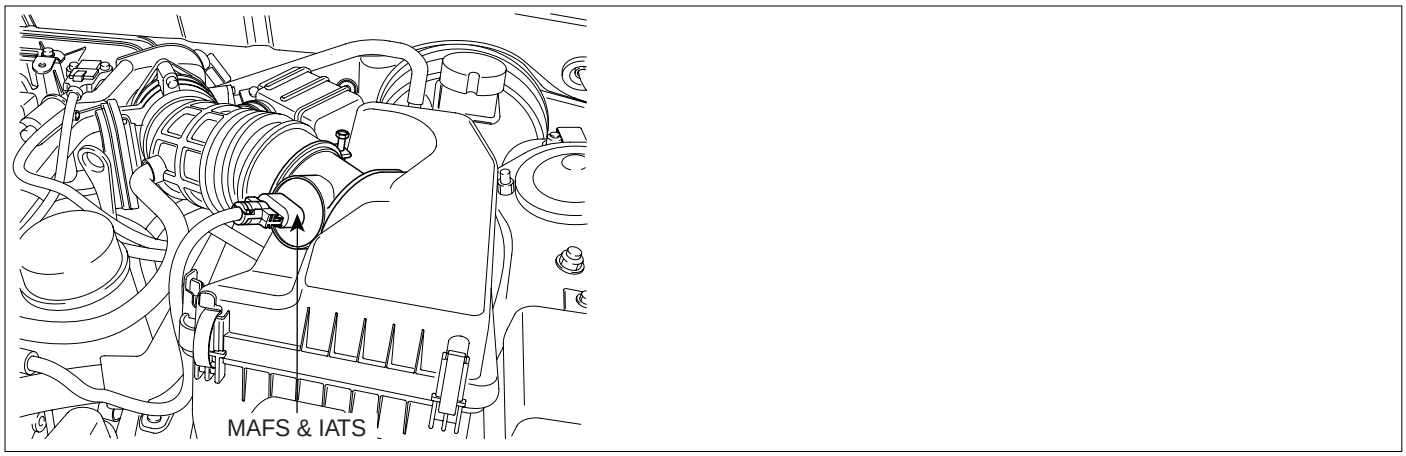
▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ED7C8C63

Refer to DTC P0082.

DTC P0101 MASS OR VOLUME AIR FLOW CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION E3E1DC1A



SGHFL7313N

GENERAL DESCRIPTION EEC6F7B7

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. PCM uses this information to determine the injection duration and ignition timing for the desired air/fuel ratio.

DTC DESCRIPTION E8CB67C2

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. PCM compares the difference between MAFS output and calculated flow rate value while enable condition is met.
If the acutal air flow is higher or lower than calculated value(threshold) for more than 2min. PCM determines that a fault exists and a DTC is stored. MIL(Malfunction Indicator Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ED027155

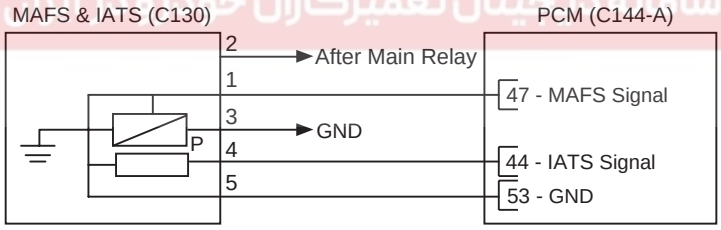
Item	Detecting Condition	Possible cause
DTC Strategy	• The MAF Rationality Diagnostic compares the difference between MAF Sensor output and calculated flow rate value to a calibration value	• Clogged air cleaner • MAFS
Enable Conditions	• Engine Coolant Temperature ≥ 60℃ (Fully Warmed up state) • 600rpm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

SPECIFICATION E679E6F2

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 EE7C78BB

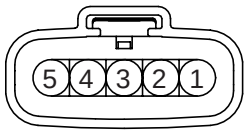
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

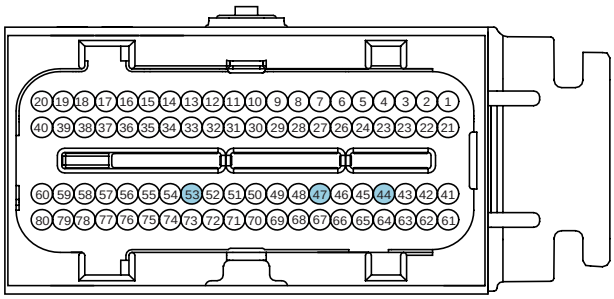
Terminal	Connected to	Function
1	PCM C144-A (47)	MAFS Signal
2	Main Relay	Battery Voltage (B+)
3	Chassis Ground	Ground
4	PCM C144-A (44)	IATS Signal
5	PCM C144-A (53)	Sensor Ground

[HARNESS CONNECTORS]



C130

MAFS & IATS



C144-A

PCM

SGHF17008N

MONITOR DTC STATUS EEF3D472

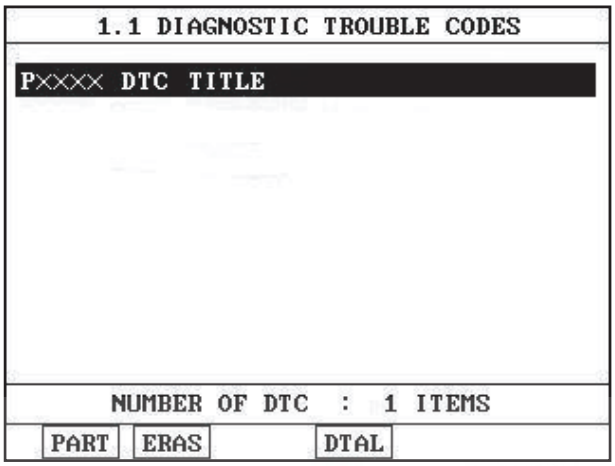
1. Check DTC Status

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

2) IG "ON".

3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

4) Read "DTC Status" parameter.



SEPFL6413N

5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Fault is intermittent caused by PCM 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 EB429658

1. Visual Inspection

1) Check that MAFS is damaged, contaminated or deformed.

2) Check tha 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.)

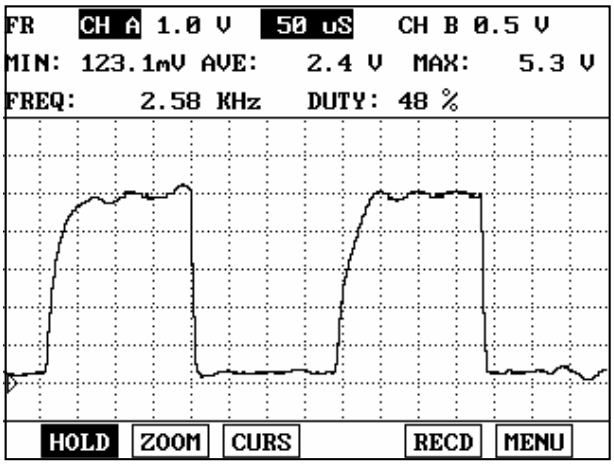


Fig. 1

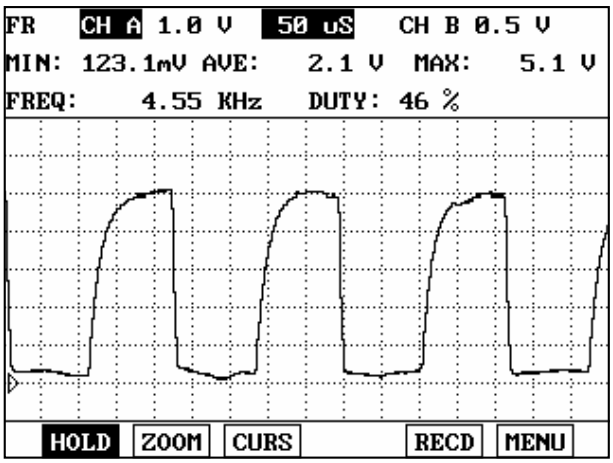


Fig. 2

Fig. 1 : Idle
Fig. 2 : Acceleration

EGRF603D

4) Are both service data and signalwave form dispayed 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 EEF12858

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0102 MASS OR VOLUME AIR FLOW CIRCUIT LOW INPUT

COMPONENT LOCATION EBD1FABE

Refer to DTC P0101.

GENERAL DESCRIPTION EDB59B02

Refer to DTC P0101.

DTC DESCRIPTION EC745EFD

If PCM detects that frequency signal of MAFS is lower than1000 Hz for more than 75 second during one dignostic test(125 second) while enable condition is met PCM 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 EDC58CA4

Item	Detecting Condition	Possible cause
DTC Strategy	• Compares the airmeter input frequency to a low limit	• Poor Connection • Open or short in harness • MAFS • PCM
Enable Conditions	• Engine Speed ≥ 500 rpm • Engine Running Time ≥ 5 second • Ignition Voltage ≥ 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 E73B774F

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 E395EAB4

Refer to DTC P0101.

MONITOR DTC STATUS E4FACF01

Refer to DTC P0101.

TERMINAL AND CONNECTOR INSPECTION E7503B1B

Refer to DTC P0101.

POWER CIRCUIT INSPECTION E0632F6E

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 E600E271

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 PCM connector.

   2) Measure resistance between terminal 1 and 2 of MAFS harness connector.

   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 PCM 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 PCM connector.

2) Measure resistance between terminal 1 of MAFS harness connector and terminal 47 of PCM 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 E21F603E

1. IG "OFF" and disconnect MAFS connector and then turn the ignition ON.
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 E26C1291

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.)

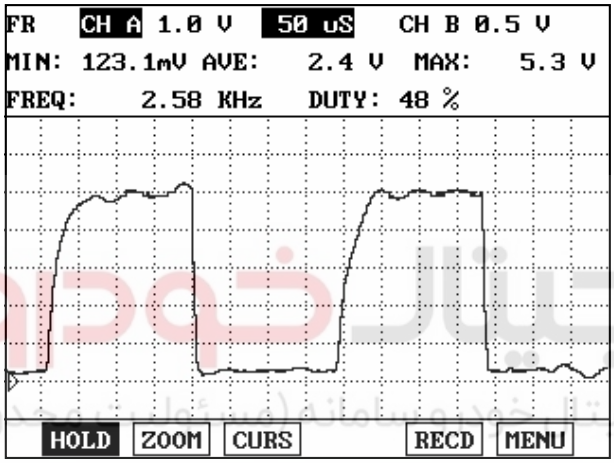


Fig. 1

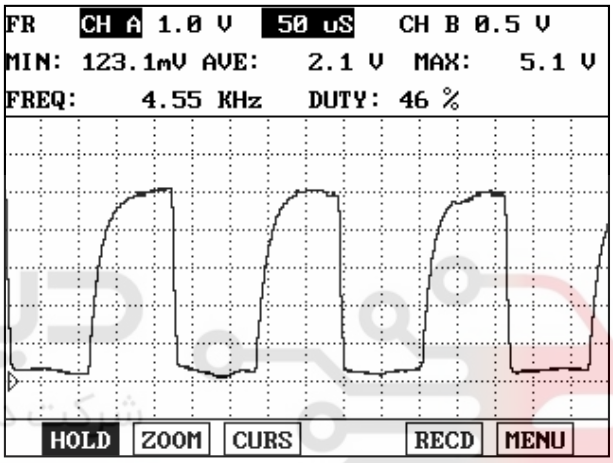


Fig. 2

Fig. 1 : Idle
Fig. 2 : Acceleration

EGRF603D

4) Are both service data and signalwave form dispayed correctly ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

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 ED514C24

Refer to DTC P0101.

DTC P0103 MASS OR VOLUME AIR FLOW CIRCUIT HIGH INPUT

COMPONENT LOCATION EAB16B31

Refer to DTC P0101.

GENERAL DESCRIPTION E5CA50A7

Refer to DTC P0101.

DTC DESCRIPTION E04F4FD3

If PCM detects that frequency signal of MAFS is higher thatn 11900 Hz for more than 75 second during 125 second dignostic test while enable condition is met, PCM 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 E77FB10F

Item	Detecting Condition	Possible cause
DTC Strategy	• Compares the airmeter input frequency to a high limit	• Noise • MAFS • PCM
Enable Conditions	• Engine Speed ≥ 500 rpm • Engine Running Time ≥ 5 second • Ignition Voltage ≥ 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 E59A5794

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 EB7E9A5E

Refer to DTC P0101.

MONITOR DTC STATUS E978E450

Refer to DTC P0101.

TERMINAL AND CONNECTOR INSPECTION E15A4C6D

Refer to DTC P0101.

GROUND CIRCUIT INSPECTION EFEB55F0

1. IG "OFF"
2. Disconnector MAFS connector and then turn the ignition ON.
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 E71AD84F

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.)

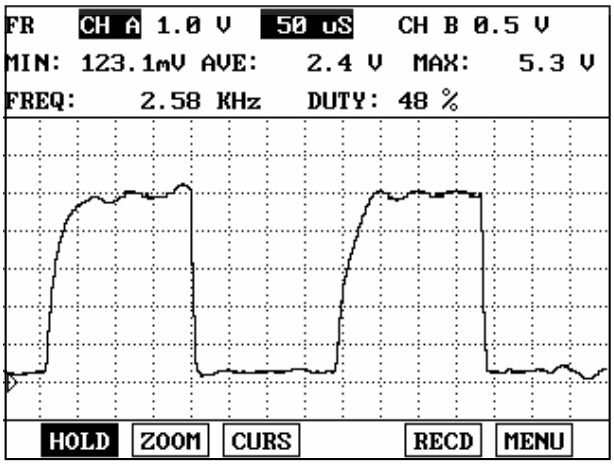


Fig. 1

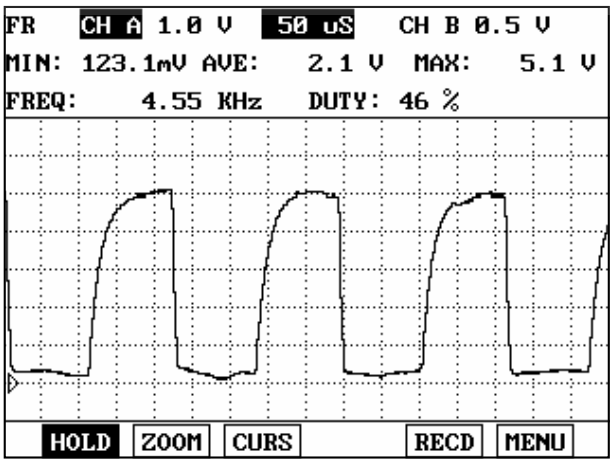


Fig. 2

Fig. 1 : Idle
Fig. 2 : Acceleration

EGRF603D

4) Are both service data and signalwave form dispayed correctly ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

NO

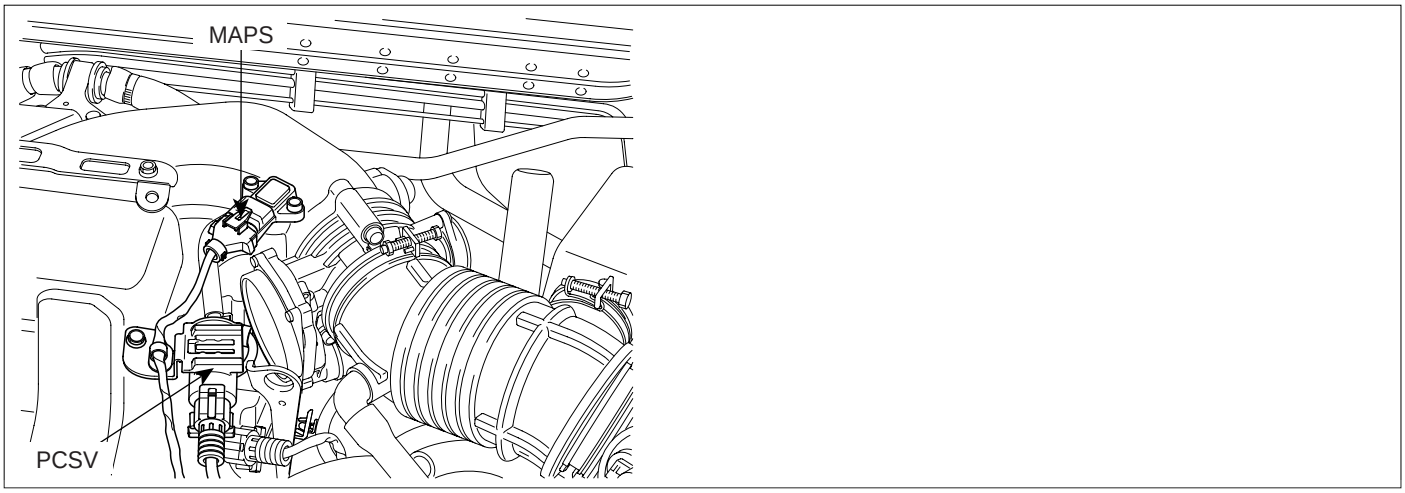
▶ Substitute with a known - good MAFS and check for proper operation. If the problem is corrected, replace MAFS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E2422F24

Refer to DTC P0101.

DTC P0105 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT

COMPONENT LOCATION E18FEC00



SGHFL7314N

GENERAL DESCRIPTION E6DF6E01

The amount of intake air flow must be inputted to PCM 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 during acceleration. 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, PCM 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 E9F44C1A

If the signal output of MAP sensor is stuck under enable conditions, PCM 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.

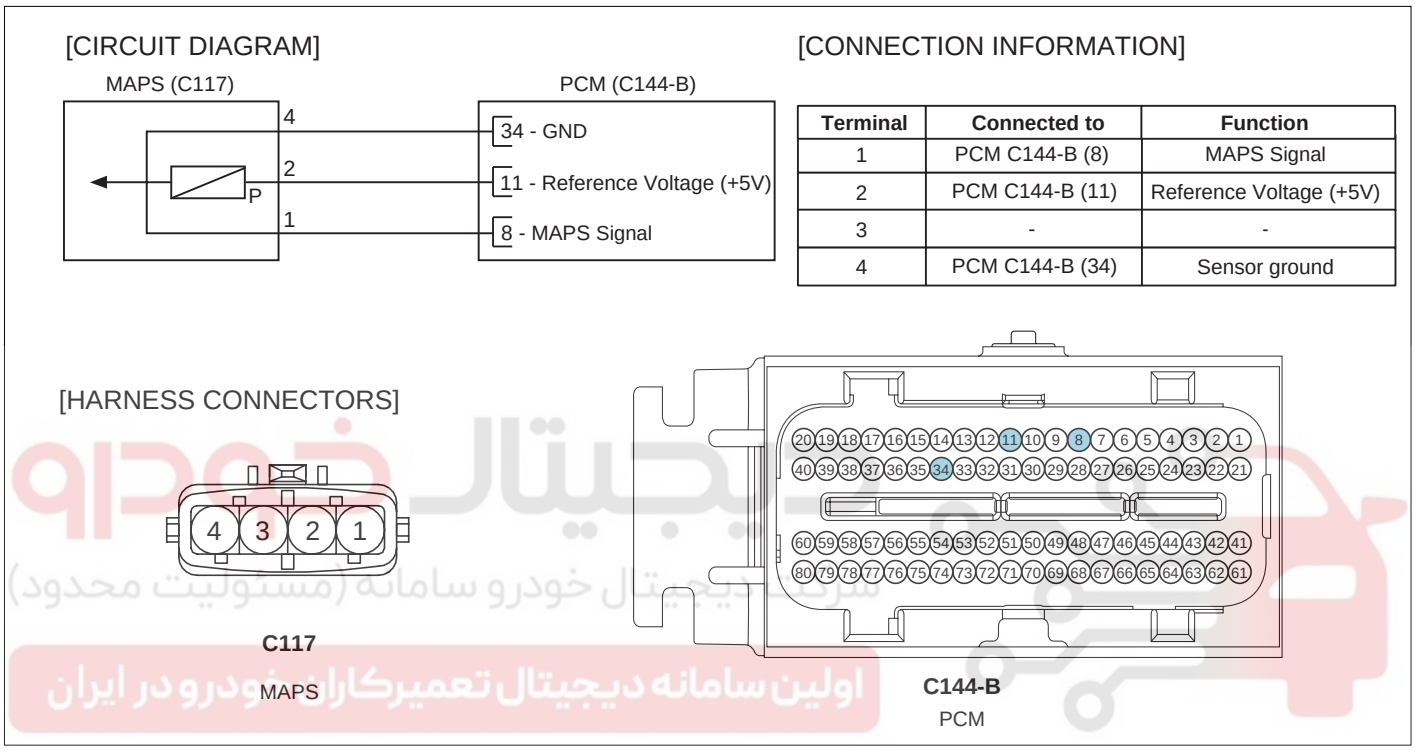
DTC DETECTING CONDITION E1D8EE13

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	

SPECIFICATION E0A30654

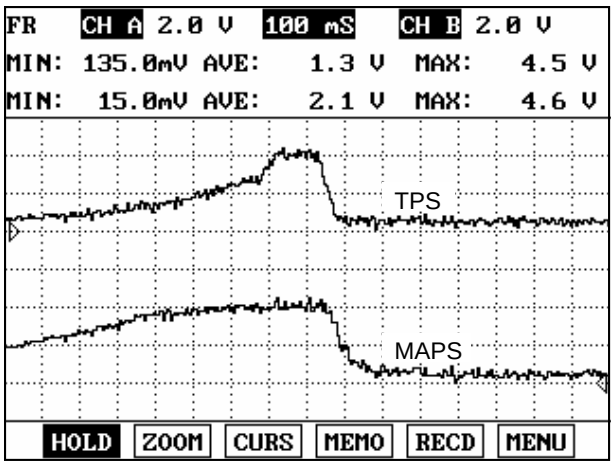
Pressure(kPa)	20	35	60	95	101.32
Voltage(V)	0.789	1.382	2.369	3.75	4
Tolerance(V)	± 0.045				

SCHEMATIC DIAGRAM EBDA27C4



UFBG240A

SIGNAL WAVEFORM AND DATA EE1AE2E1



EGRF603O

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.

MONITOR DTC STATUS EA1F32AD

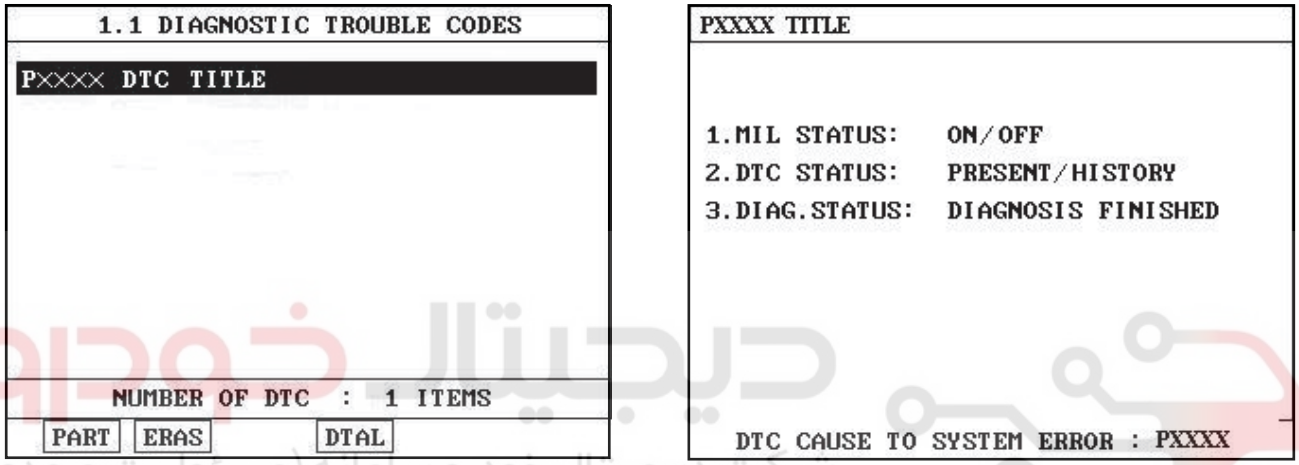
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SCMF16159L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Fault is intermittent caused by PCM 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 E5471146

1. Check MAPS Performance

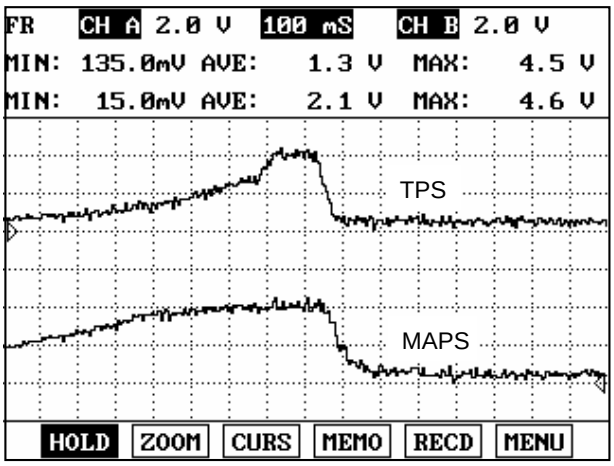
   1) IG "OFF" and install scantool.

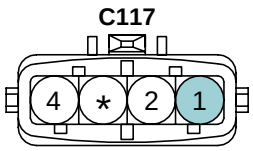
   2) Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.

   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 ?

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 E7F94173

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E54A27F3

Refer to DTC P0105.

GENERAL DESCRIPTION E449ECE2

Refer to DTC P0105.

DTC DESCRIPTION E744FA8F

PCM compares the difference between MAPS output and calculated MAPS value while enable condition is met. If the acutal MAP value or lower than calculated(threshold) value for 2 min failure during acceleration/deceleration, PCM determines that a fault exists and a DTC is stored. MIL(Malfunction Indicator Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E7B388FD

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 ≥ 60℃ (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		• NO MIL ON(DTC only)	

SPECIFICATION E052E7A1

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 E74D56DF

Refer to DTC P0105.

SIGNAL WAVEFORM AND DATA EC93849D

Refer to DTC P0105.

MONITOR DTC STATUS E51A888A

Refer to DTC P0105.

COMPONENT INSPECTION EFE13B22

1. Check TPS

   1) Visually check that TPS is contaminated by foreign materials, deformed, or damaged

   2) Has a problem been found ?

   YES

   ▶ 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.

   NO

   ▶ Go to "Check MAPS Performance" as follows.

2. Check MAPS Performance

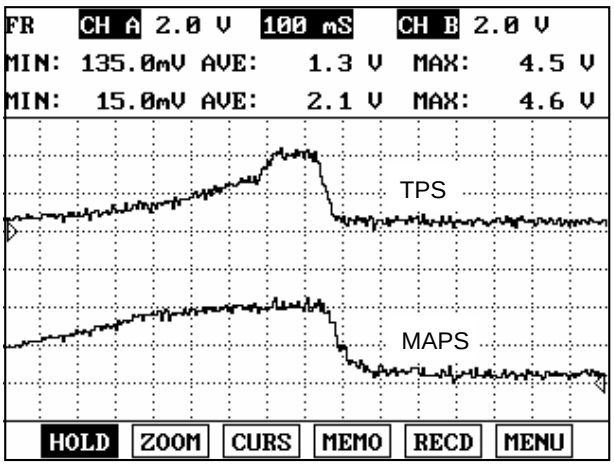
   1) IG "OFF" and install scantool.

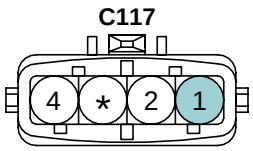
   2) Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.

   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 ?

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 E5D39FF6

Refer to DTC P0105.

DTC P0107 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT LOW INPUT

COMPONENT LOCATION EA080E84

Refer to DTC P0105.

GENERAL DESCRIPTION EA49D9E5

Refer to DTC P0105.

DTC DESCRIPTION EBF58AFA

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., PCM sets P0107. MIL(Malfuction Indication Lamp) turns on when the malfunction lasts till continuous 2 driving cycle.

DTC DETECTING CONDITION E774A59C

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 • PCM
Enable Condi-tions	Case 1	• No TPS Active Fault Present • Ignition Voltage ≥ 11V • Engine Speed ≤ 1000rpm • Throttle Position ≥ 0%	
	Case 2	• No TPS Active Fault Present • Ignition Voltage ≥ 11V • Engine Speed > 1000rpm • Throttle Position ≥ 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 EE8B99CF

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 E561ED36

Refer to DTC P0105.

SIGNAL WAVEFORM AND DATA E2D72DE2

Refer to DTC P0105.

MONITOR DTC STATUS E2A51555

Refer to DTC P0105.

TERMINAL AND CONNECTOR INSPECTION E9E408AE

Refer to DTC P0105.

POWER CIRCUIT INSPECTION E58B1205

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 EC17219C

1. Check short to ground in harness.
   1) IG "OFF"
   2) Disconnect MAPS and PCM 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 for open circuit" procedure.

NO

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

2. Check for open circuit
   1) IG "OFF"
   2) Disconnect MAPS and PCM connector.

3) Measure the resistance between terminal 1 of MAPS harness connector and terminal 8 of PCM 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 E48DD673

1. MAPS performance test

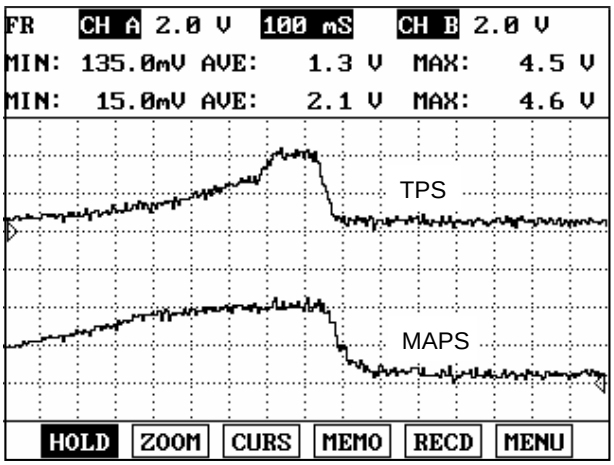
1) IG "OFF"

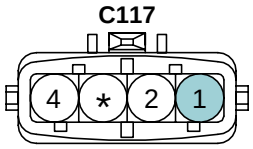
2) Connect scantool to Data Link Connector(DLC) and select "Oscilloscope" then, connect probes to output signal lines of MAPS and TPS.

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 PCM".

NO

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

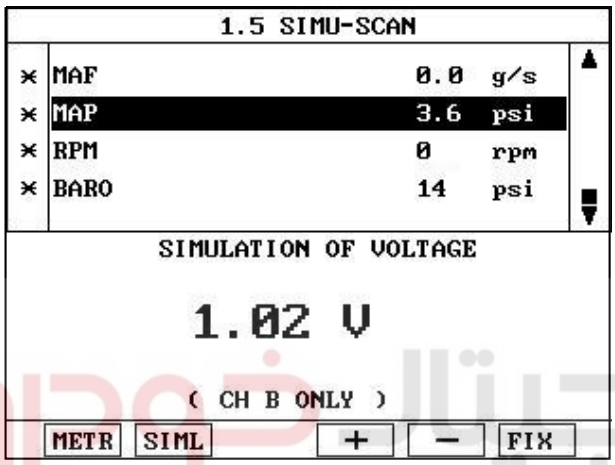
2. Check PCM

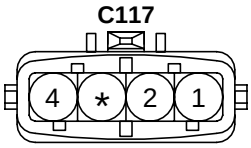
1) IG "OFF" disconnect MAPS connector

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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E0A49A4C

Refer to DTC P0105.

DTC P0108 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT HIGH INPUT

COMPONENT LOCATION EF04FA39

Refer to DTC P0105.

GENERAL DESCRIPTION E0048624

Refer to DTC P0105.

DTC DESCRIPTION E45E5543

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., PCM sets P0108. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EB354EAA

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 PCM
Enable Condi-tions	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 E069DE5D

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 E9B562AD

Refer to DTC P0105.

SIGNAL WAVEFORM AND DATA EDFB5CB6

Refer to DTC P0105.

MONITOR DTC STATUS E8C869FA

Refer to DTC P0105.

TERMINAL AND CONNECTOR INSPECTION E2CD214E

Refer to DTC P0105.

POWER CIRCUIT INSPECTION EB80659C

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 E5B448B1

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 reistance or open in harness and then go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E71F343E

1. IG "OFF"
2. Disconnect MAPS and PCM 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

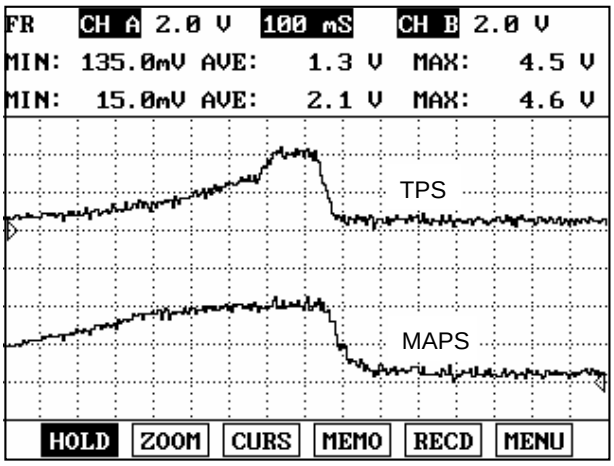
▶ Repair short to battery in harness and then go to "Verification of Vehicle Repair" procedure.

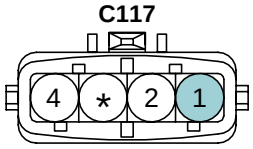
COMPONENT INSPECTION E3950078

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 PCM".

NO

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

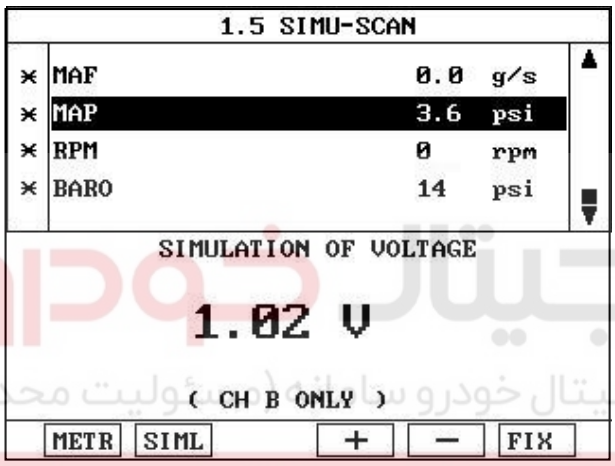
2. Check PCM

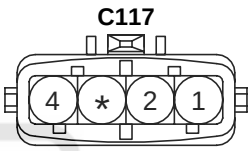
1) IG "OFF" disconnect MAPS connector

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 PCM and check for proper operation. If the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NOTE

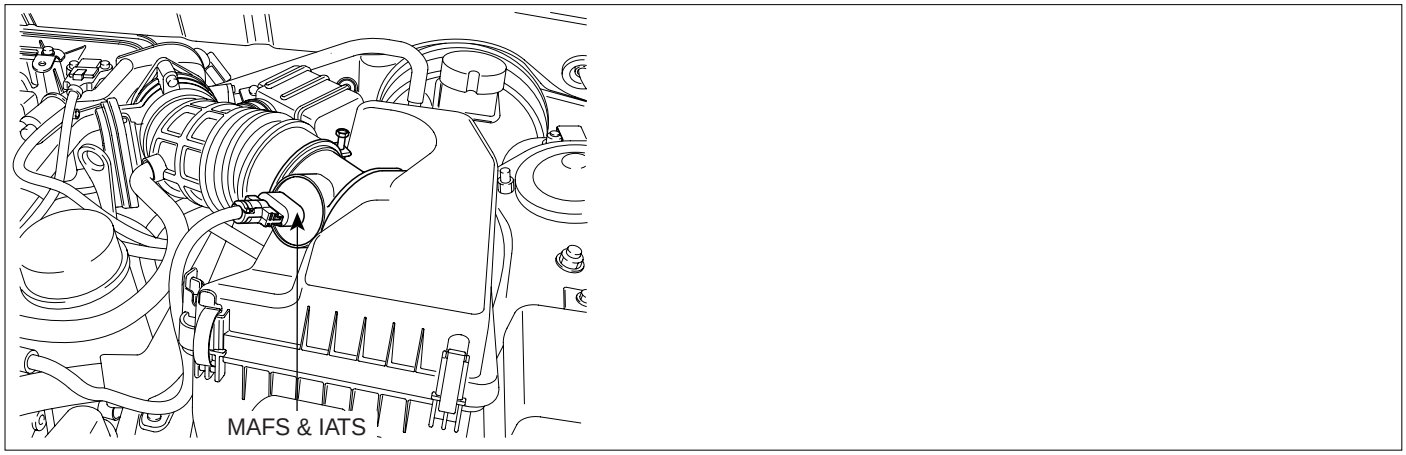
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM.Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E02920B1

Refer to DTC P0105.

DTC P0110 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT

COMPONENT LOCATION E1F1FBB4



SGHFL7313N

GENERAL DESCRIPTION EC4610E4

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 PCM is supplied to the IATS via a resistor in the PCM. That is, the resistor in the PCM 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 PCM corrects basic fuel injection duration and ignition timing.

DTC DESCRIPTION E04A15A7

PCM monitors temperature difference betwen MAX. and MIN IATS in order to detect movement in IATS not only Start Test but Drive Test while enable condition is met. If PCM detects intake air temperature changes less than 5.4 °F PCM 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 EDE8BF3E

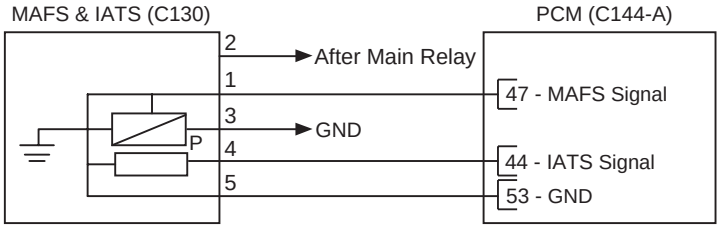
Item		Detecting Condition	Possible cause
DTC Strategy	Case 1	• Start Test: Monitors the difference between max and min IAT in order to detect movement in IAT for a certain time.	• Faulty IATS
	Case 2	• Drive test: Performs the max and min delta check while driving under load for a length of time followed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

SPECIFICATION ECCAAB4F

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 EFF2E64F

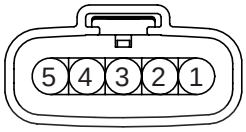
[CIRCUIT DIAGRAM]



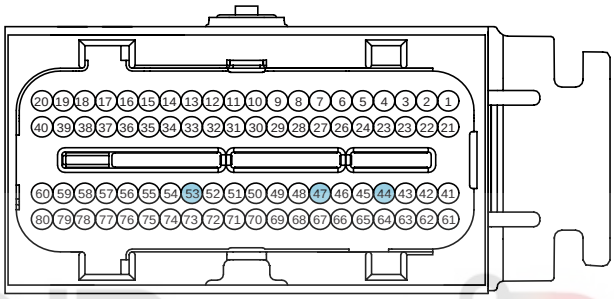
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-A (47)	MAFS Signal
2	Main Relay	Battery Voltage (B+)
3	Chassis Ground	Ground
4	PCM C144-A (44)	IATS Signal
5	PCM C144-A (53)	Sensor Ground

[HARNESS CONNECTORS]



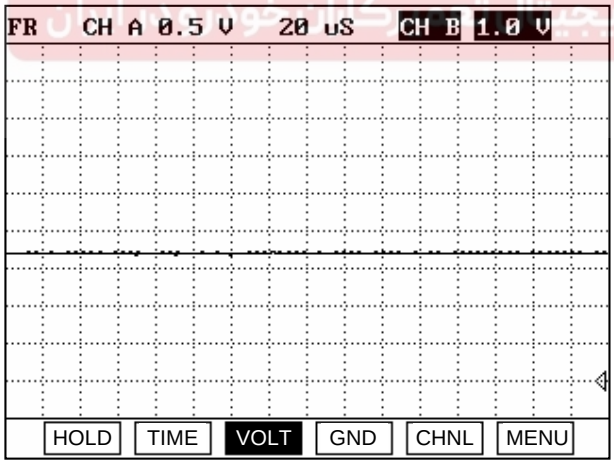
C130
MAFS & IATS



C144-A
PCM

SGHF17008N

SIGNAL WAVEFORM AND DATA EDC65926



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 E5ACF8D4

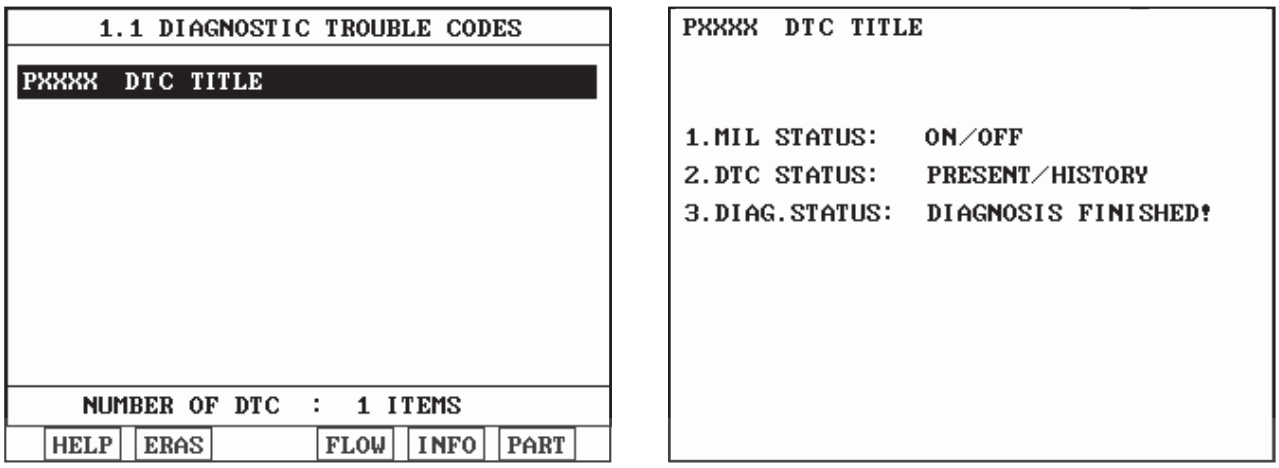
1. Check DTC Status

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

2) IG "ON".

3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E5BDDD82

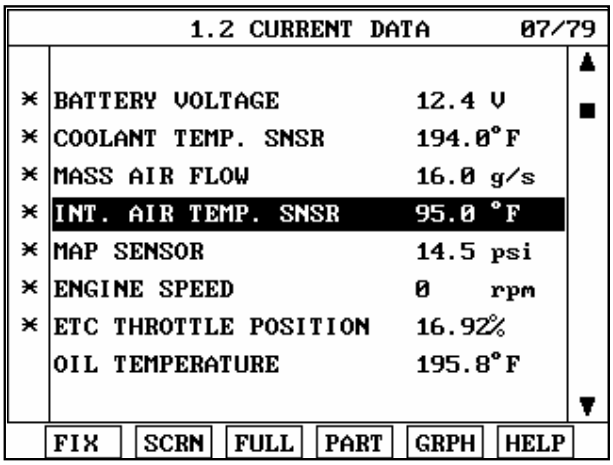
1. Check resistance of IATS

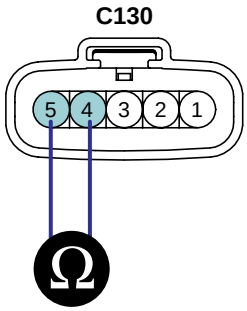
1) IG "OFF" and disconnect IATS connector.

2) Measure resistance between terminal 4 and 5 of IATS connector after checking out the temperature of IATS with scantool

SPECIFICATON :

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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

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 EA27D8DD

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0111 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION EFBC1B93

Refer to DTC P0110.

GENERAL DESCRIPTION E11FC3A4

Refer to DTC P0110.

DTC DESCRIPTION EE4AAC28

PCM monitors temperature changes resulting from soaking the vehicle. Therefore, Coolant temperature and Intake temperature should be changed. If PCM detects intake air temperature correlated to coolant temperature does not change PCM 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 E01E7220

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 soak time ≥ 360min • Engine running • No faults present • IAT stored previous trip • Startup Coolant Temperature > -20°C • Airflow > 15 g/s • Vehicle speed > 40kph	
	Case 2	• Engine soak time ≥ 360min • Engine running • No faults present • IAT stored previous trip • Airflow > 15 g/s • Vehicle speed > 40kph	
Threshold value	Case 1	• Startup Coolant - Startup IAT ≥ 30°C	
	Case 2	• Startup IAT - Startup Coolant ≥ 20°C	
Diagnosis Time		• Continuous (More than 1.25 second failure)	
MIL On Condition		• NO MIL ON(DTC only)	

SPECIFICATION E5375A78

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 E8EBB710

Refer to DTC P0110.

SIGNAL WAVEFORM AND DATA EBD999F0

Refer to DTC P0110.

MONITOR DTC STATUS EF9AABEE

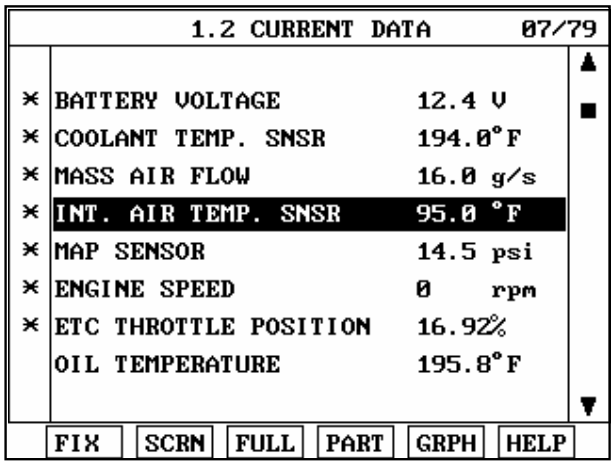
Refer to DTC P0110.

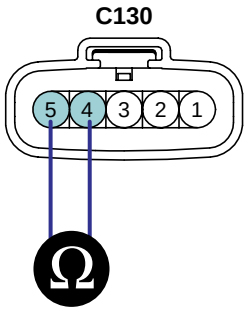
COMPONENT INSPECTION EBF84070

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. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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

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 EA976872

Refer to DTC P0110.

DTC P0112 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT LOW INPUT

COMPONENT LOCATION ED7F61A1

Refer to DTC P0110.

GENERAL DESCRIPTION E96A0023

Refer to DTC P0110.

DTC DESCRIPTION EA9AC1F1

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

DTC DETECTING CONDITION E1119D2B

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 • PCM
Enable Condi-tions	Case 1	• Engine running • 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 EE59E922

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 E8C21393

Refer to DTC P0110.

SIGNAL WAVEFORM AND DATA EF735657

Refer to DTC P0110.

MONITOR DTC STATUS EB0A3C49

Refer to DTC P0110.

TERMINAL AND CONNECTOR INSPECTION E6F752FA

Refer to DTC P0110.

SIGNAL CIRCUIT INSPECTION EF8631B1

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 PCM 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.

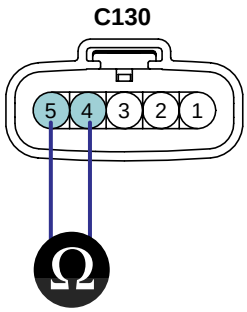
COMPONENT INSPECTION E6EF5A3A

1. Check IATS
   1) IG "OFF" and disconnect IATS connector.

2) Measure resistance between teminals 4 and 5 of IATS connector.(Component side)

SPECIFICATON :

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 PCM" 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.

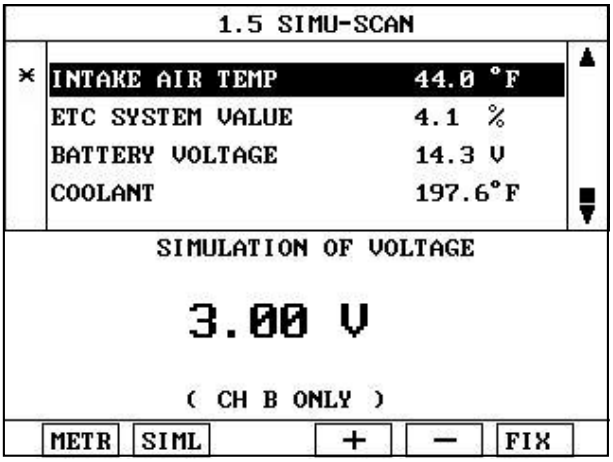
2. Check PCM

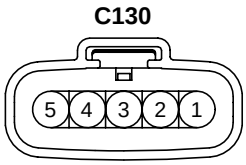
1) IG "OFF" and connect scantool.

2) Disconnect IATS connector and connect probe to terminal 4 of IATS harness connector.

3) IG "ON" and ENG "OFF" and select the 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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM.

VERIFICATION OF VEHICLE REPAIR E3CF75D6

Refer to DTC P0110.

DTC P0113 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT HIGH INPUT

COMPONENT LOCATION EB30B267

Refer to DTC P0110.

GENERAL DESCRIPTION EB3FEAFD

Refer to DTC P0110.

DTC DESCRIPTION E18BFBC3

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

DTC DETECTING CONDITION E836561F

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 • PCM
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	
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 E7EB938C

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 EB296B2E

Refer to DTC P0110.

SIGNAL WAVEFORM AND DATA ED03819A

Refer to DTC P0110.

MONITOR DTC STATUS E8909E8B

Refer to DTC P0110.

TERMINAL AND CONNECTOR INSPECTION E1E55447

Refer to DTC P0110.

SIGNAL CIRCUIT INSPECTION EE5193A4

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 PCM 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 PCM connctor.

2) Measure resistance between terminal 4 of IATS harness connector and 44 of PCM 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 EBEACFE3

1. IG "OFF" and disconnect IATS connector and then turn the ignition ON.
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.

SBLF26464L

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 EC128A13

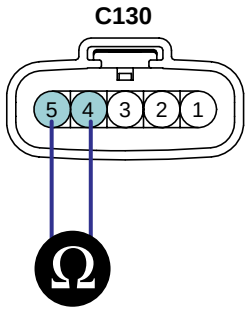
1. Check IATS

1) IG "OFF" and disconnect IATS connector.

2) Measure resistance between teminals 4 and 5 of IATS connector.(Component side)

SPECIFICATON :

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 PCM" 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.

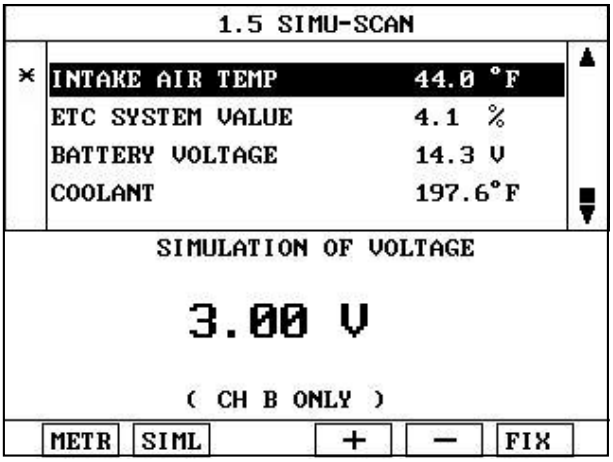
2. Check PCM

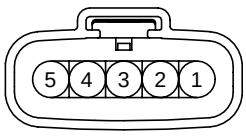
1) IG "OFF" and connect scantool.

2) Disconnect IATS connector and connect probe to terminal 4 of IATS harness connector.

3) IG "ON" and ENG "OFF" and select the 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 PCM and check for proper operation. If the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NOTE

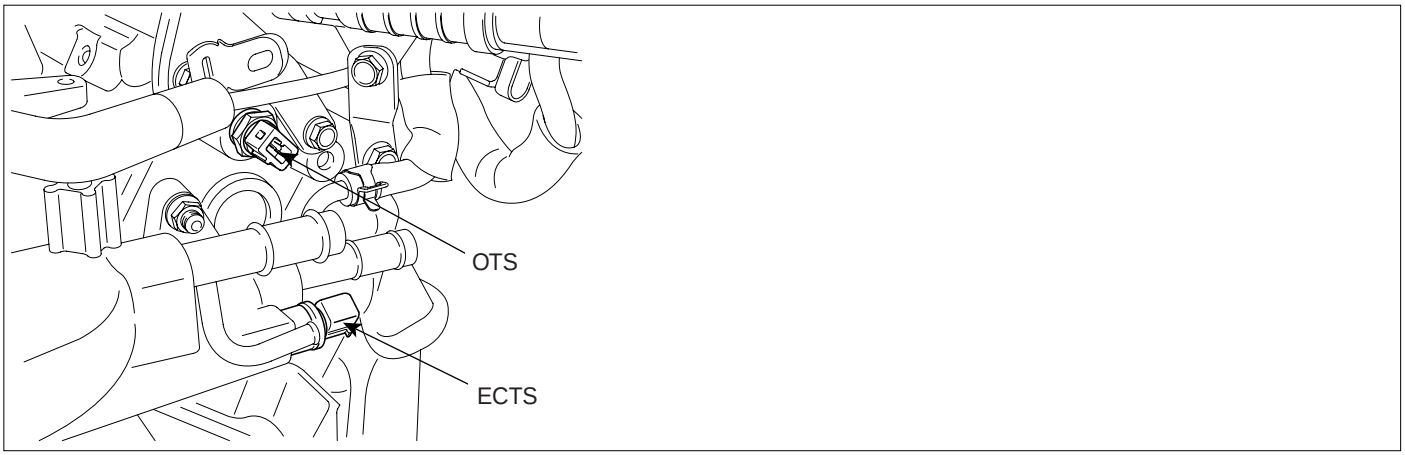
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM.

VERIFICATION OF VEHICLE REPAIR EC9B3ACC

Refer to DTC P0110.

DTC P0116 ENGINE COOLANT TEMPERATURE CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION EAED5465



SGHFL7315N

GENERAL DESCRIPTION E0D2B0B3

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 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.

DTC DESCRIPTION E5B9853E

If the ECT signal is stuck above the lowest enabling temperature value, P0116 is set. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

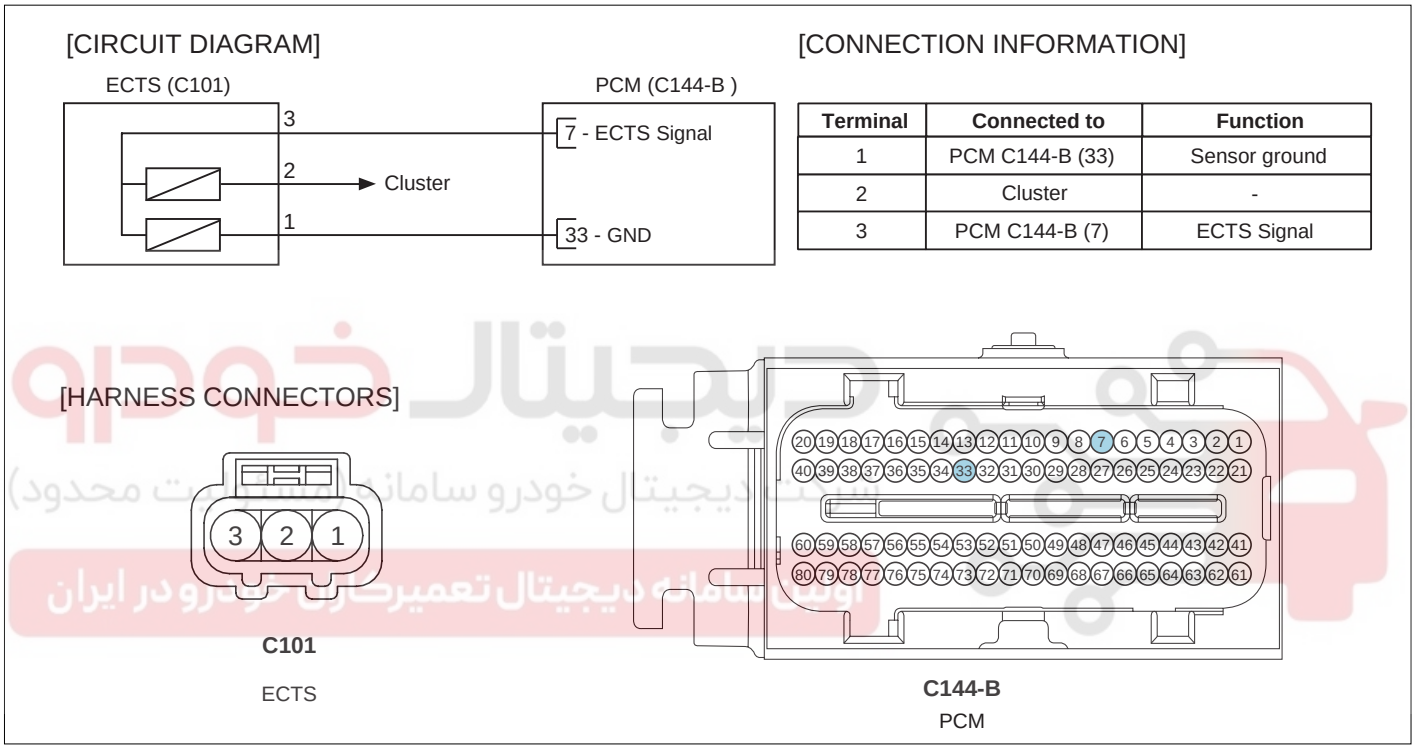
DTC DETECTING CONDITION E51D275A

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	

SPECIFICATION E77D941D

Temp. (℃/℉)	Resistance (kΩ)	Temp. (℃/℉)	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 EFB54310



UFBG242A

SIGNAL WAVEFORM AND DATA E46723DD

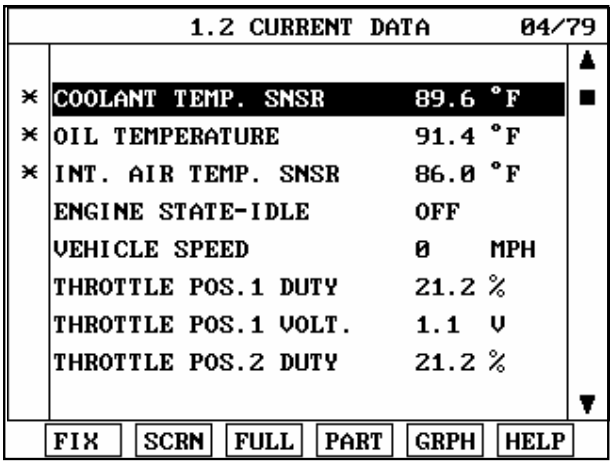


Fig1) Service data before startup

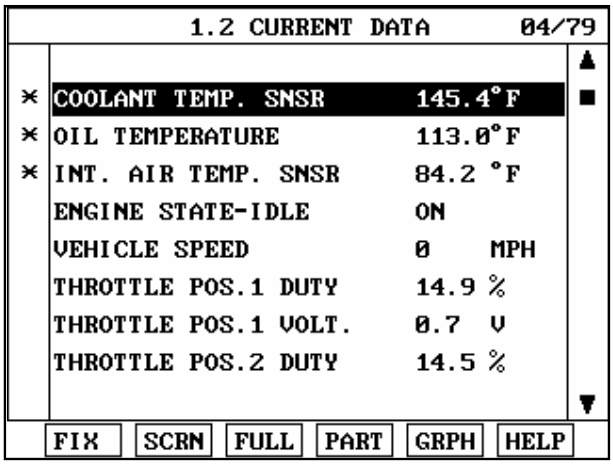


Fig2) Service data in a few minutes since startup

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 ED2493E2

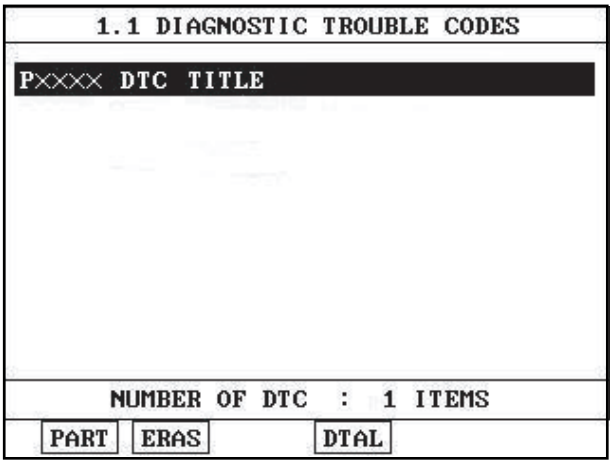
1. Check DTC Status

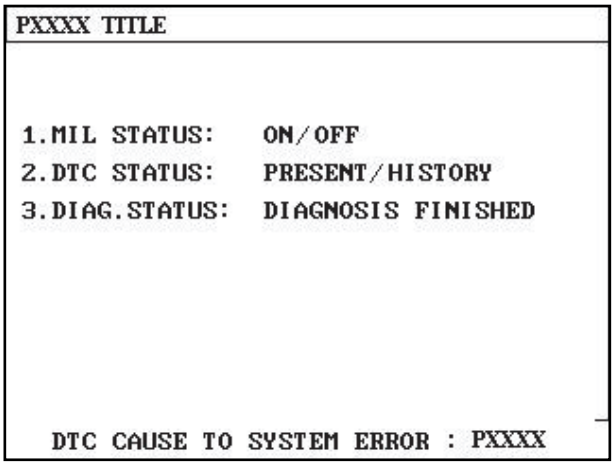
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SCMF16159L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

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

COMPONENT INSPECTION E137EF85

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. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 E65E8205

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 EF6E87CF

Refer to DTC P0116.

GENERAL DESCRIPTION EE7B3A72

Refer to DTC P0116.

DTC DESCRIPTION E81BF19C

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

DTC DETECTING CONDITION E1517CEA

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal low	• Poor connection • Short to ground in harness • ECTS • PCM
Enable Condi-tions	Case 1	• Time after start-up 〉 120 sec.	
	Case 2	• Time from IG "OFF" to IG "ON" 〉 360 min. • Engine running	
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 E80C122A

Temp. (℃/℉)	Resistance (kΩ)	Temp. (℃/℉)	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 EA3D6F31

Refer to DTC P0116.

SIGNAL WAVEFORM AND DATA EFAD82B4

Refer to DTC P0116.

MONITOR DTC STATUS E0052B33

Refer to DTC P0116.

TERMINAL AND CONNECTOR INSPECTION E7E53ECF

Refer to DTC P0116.

SIGNAL CIRCUIT INSPECTION EECE662B

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 PCM 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

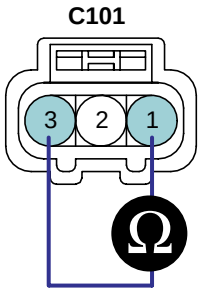
▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E88C69E3

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. (℃/℉)	Resistance (kΩ)	Temp. (℃/℉)	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

SBLF26467L

3) Is the measured resistance within specification?

YES

▶ Go to "Check PCM" 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.

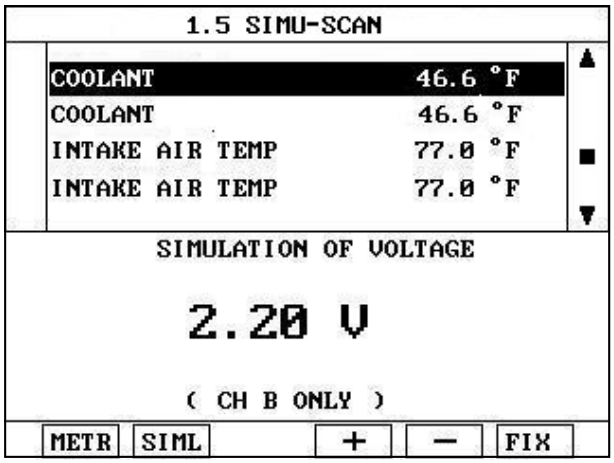
2. Check PCM

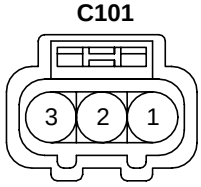
1) IG "OFF" and connect scantool.

2) Connect probe to terminal 3 of ECTS harness connector.

3) IG "ON" and ENG "OFF" and select the 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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM.

VERIFICATION OF VEHICLE REPAIR E9484DD7

Refer to DTC P0116.

DTC P0118 ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT

COMPONENT LOCATION EDBC553A

Refer to DTC P0116.

GENERAL DESCRIPTION E29BCF2E

Refer to DTC P0116.

DTC DESCRIPTION E1B28E0C

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

DTC DETECTING CONDITION E0232BDB

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 • PCM
Enable Condi-tions	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	
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 E70B25D7

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 E5593F7D

Refer to DTC P0116.

SIGNAL WAVEFORM AND DATA EFBA1651

Refer to DTC P0116.

MONITOR DTC STATUS EB9F4E74

Refer to DTC P0116.

TERMINAL AND CONNECTOR INSPECTION E9B369B2

Refer to DTC P0116.

SIGNAL CIRCUIT INSPECTION EA2AFFC1

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 PCM 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 PCM connector.

   2) Measure resistance between terminal 3 of ECTS harness connector and terminal 7 of PCM 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 E320D658

1. IG "OFF" and disconnect ECTS connector and then turn the ignition ON.
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 EFDCD0E3

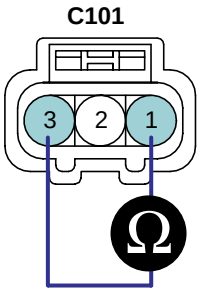
1. Check ECTS

1) IG "OFF" and disconnect ECTS connector.

2) Measure resistance between terminals 1 and 3 of ECTS connector.(Component side)

SPECIFICATON :

Temp. (℃/℉)	Resistance (kΩ)	Temp. (℃/℉)	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

SBLF26467L

3) Is the measured resistance within specification?

YES

▶ Go to "Check PCM" 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.

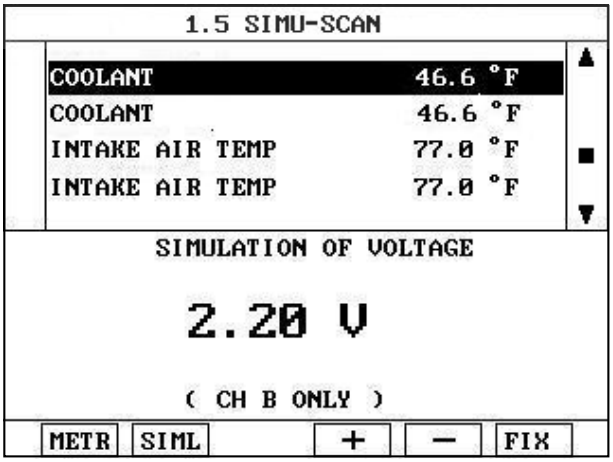
2. Check PCM

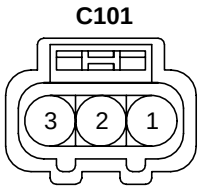
1) IG "OFF" and connect scantool.

2) Connect probe to terminal 3 of ECTS harness connector.

3) IG "ON" and ENG "OFF" and select the 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 PCM and check for proper operation. If the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NOTE

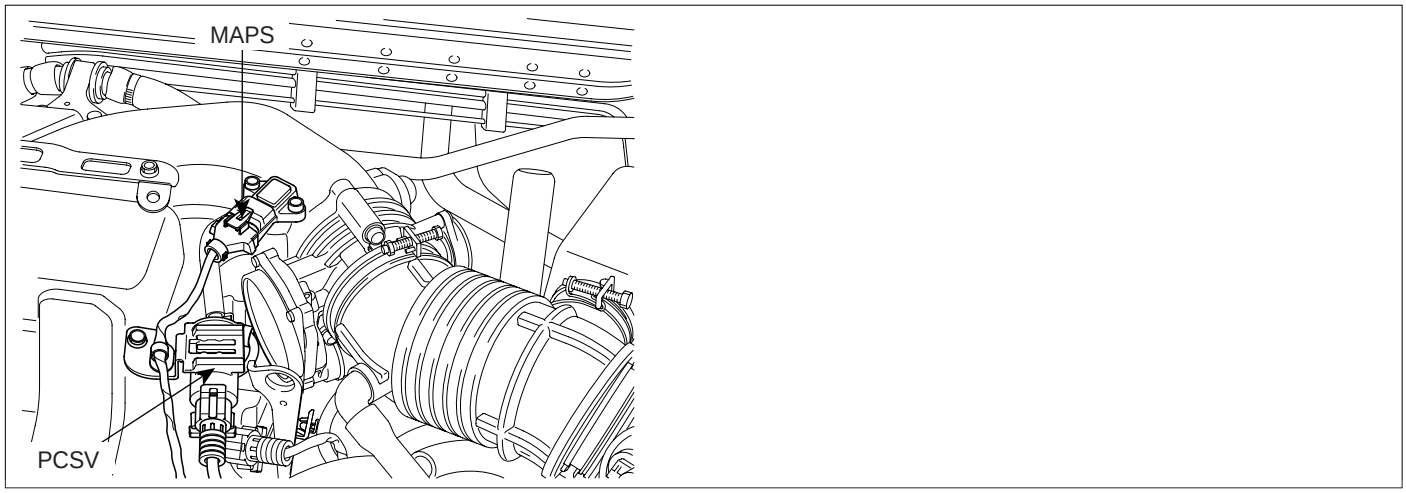
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM.

VERIFICATION OF VEHICLE REPAIR E5C273BE

Refer to DTC P0116.

DTC P0122 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT LOW INPUT

COMPONENT LOCATION EA6603AC



SGHFL7314N

GENERAL DESCRIPTION E6BA4D62

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(PCM).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 PCM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E62744E2

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., PCM sets P0122. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E59ACBE9

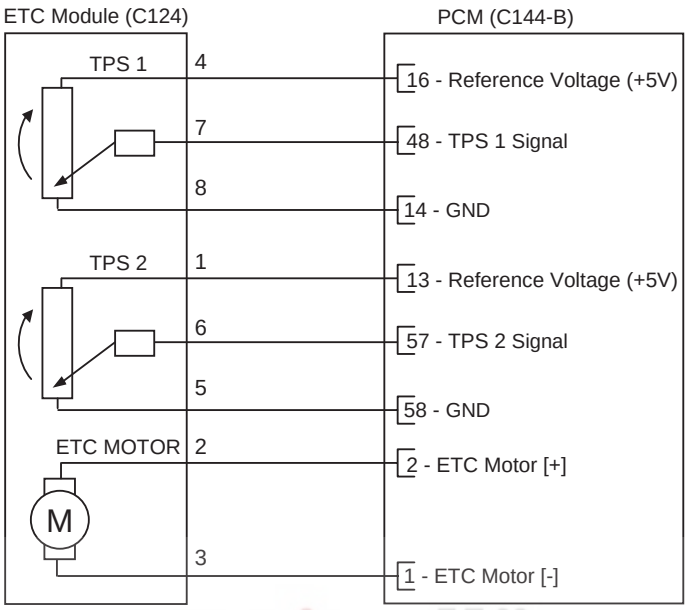
Item	Detecting Condition	Possible Cause
DTC Strategy	• signal low	• Poor connection • Open or short to ground in power harness • Short to ground in signal harness • TPS • PCM
Enable condition	• IG "ON	
threshold value	• The voltage of TPS 〈 0.25V	
diagnosis time	• Continuous (more than 0.1 sec. failure for every 8.5 sec.test)	
MIL ON condition	• 2 driving cycles	

SPECIFICATION E2BF887D

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 E6372C6C

[CIRCUIT DIAGRAM]



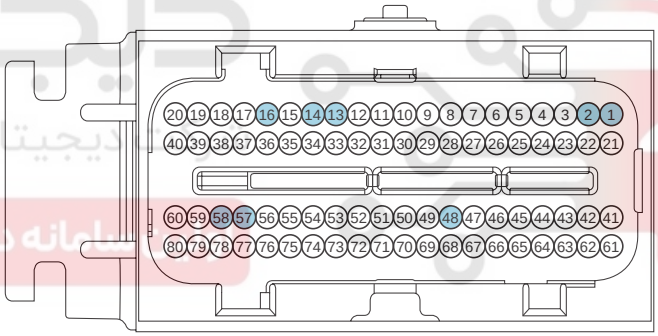
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE

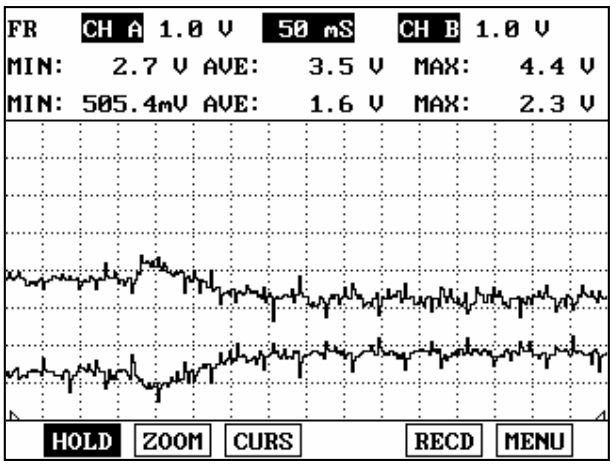


C144-B

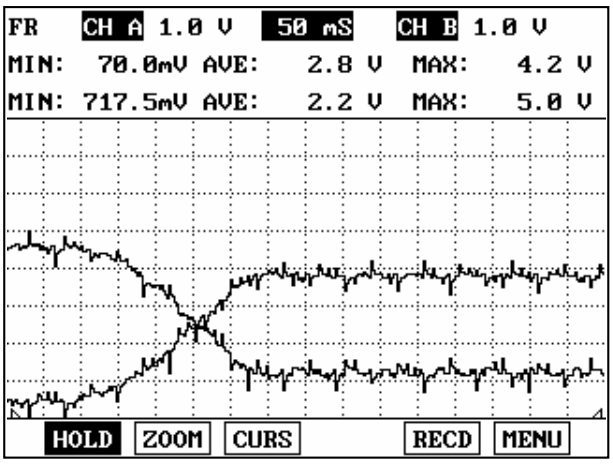
PCM

UFBG236A

SIGNAL WAVEFORM AND DATA E1C71CC8



Hit the accelerator at IG ON



Open the throttle valve by force at IG ON

EGRF604Z

MONITOR DTC STATUS EACCDEF9

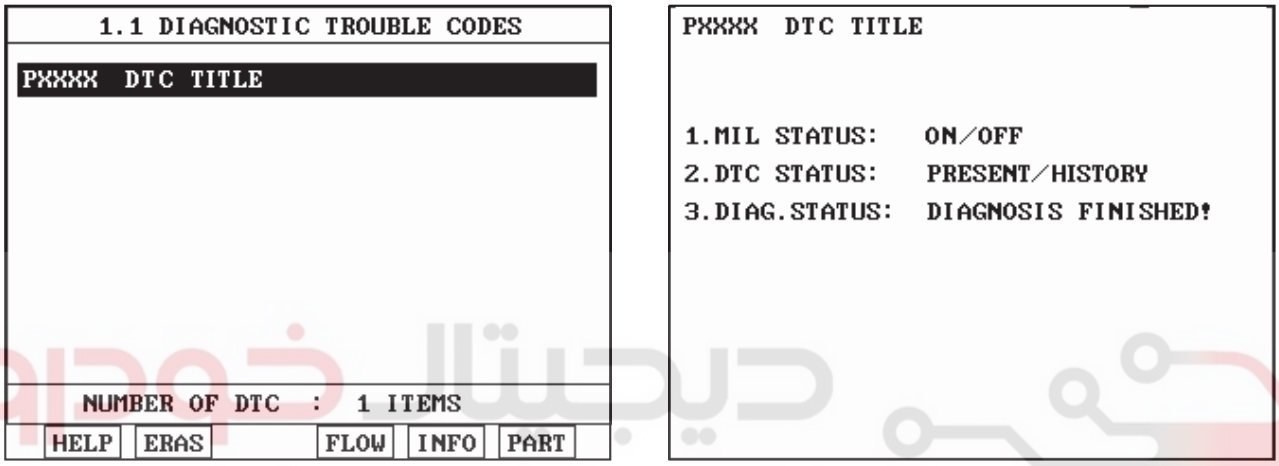
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EB01A128

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E9B3E80E

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 E51612D1

1. Check short to ground in harness
   1) IG "OFF" and disconnect TPS connector and PCM 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.

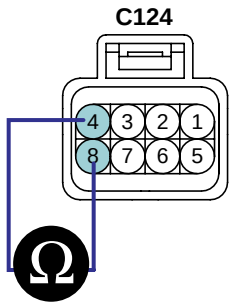
NO

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

COMPONENT INSPECTION E9285491

1. Check TPS
   1) IG "OFF" and disconnect TPS connector.
   2) Measure resistance between terminals 4 and 8 of TPS connector.(component side)

Specificaton : 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**

SBLFL7005N

3) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM***
2. ***Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec.)***
3. ***Turn ignition key on more than 1second to record the throttle motor position on the EEPROM***

VERIFICATION OF VEHICLE REPAIR ECC5E2AE

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0123 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT HIGH INPUT

COMPONENT LOCATION E36FF71A

Refer to DTC P0122.

GENERAL DESCRIPTION EE3D0817

Refer to DTC P0122.

DTC DESCRIPTION EB650363

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., PCM sets P0123. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EDCF9A90

Item	Detecting Condition	Possible Cause
DTC Strategy	• signal high	• Poor connection • Open or short to battery in signal harness • Open in ground harness • TPS • PCM
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 EC661BE6

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 E2475AA4

Refer to DTC P0122.

SIGNAL WAVEFORM AND DATA E7D02AD8

Refer to DTC P0122.

MONITOR DTC STATUS E9B2BD74

Refer to DTC P0122.

TERMINAL AND CONNECTOR INSPECTION E9A65BF2

Refer to DTC P0122.

SIGNAL CIRCUIT INSPECTION EC4E056A

1. Check voltgae

   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 PCM connector.

   2) Measure resistance between terminal 7 of TPS harness connector and terminal 48 of PCM 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 PCM 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

   ▶ Go to "Ground circuit inspection " procedure.

   NO

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

GROUND CIRCUIT INSPECTION E72A49BD

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.

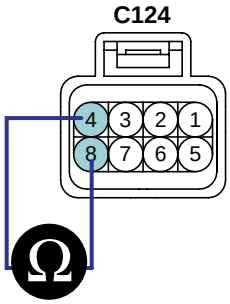
COMPONENT INSPECTION E3A8A55A

1. Check TPS

   1) IG "OFF" and disconnect TPS connector.

   2) Measure resistance between terminals 4 and 8 of TPS connector.(component side)

Specificaton : 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**

SBLFL7005N

3) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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

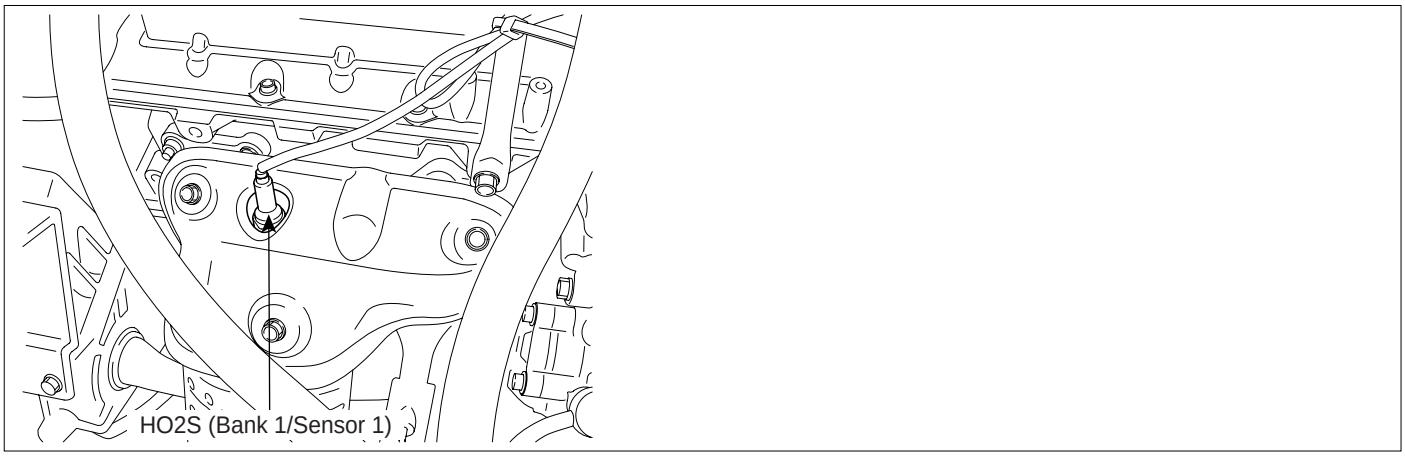
1. ***Erase the trouble codes on PCM***
2. ***Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec.)***
3. ***Turn ignition key on more than 1second to record the throttle motor position on the EEPROM***

VERIFICATION OF VEHICLE REPAIR E344C834

Refer to DTC P0122.

DTC P0131 HO2S CIRCUIT LOW VOLTAGE (BANK 1 / SENSOR 1)

COMPONENT LOCATION E0D98241



SGHFL7310N

GENERAL DESCRIPTION E709CC47

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 E43E543D

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermined time, PCM sets P0131. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E46CDE5F

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor signal voltage	• Poor connection • Short to ground in harness • HO2S(B1/S1) • PCM
Enable Conditions	• Battery voltage ≥ 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	

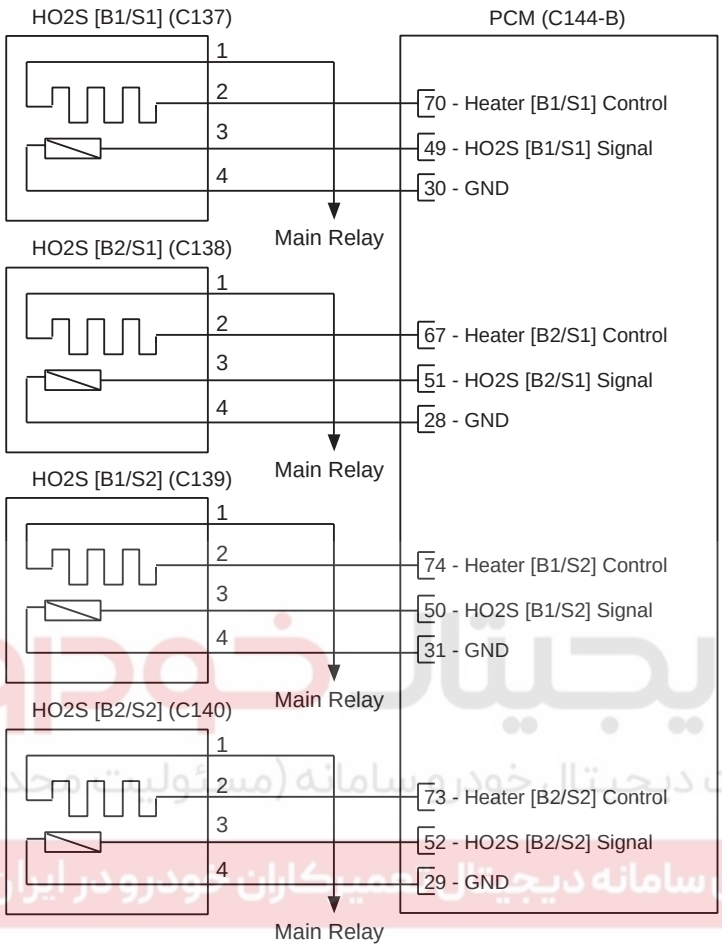
SPECIFICATION E585DBF4

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 EB326608

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

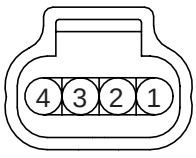
HO2S [B1/S2]

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

HO2S [B2/S2]

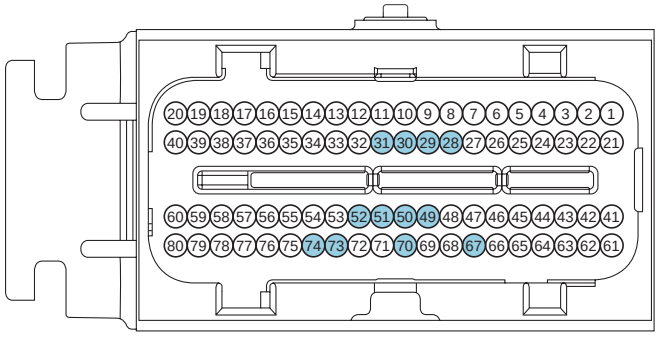
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFORM AND DATA E093D442

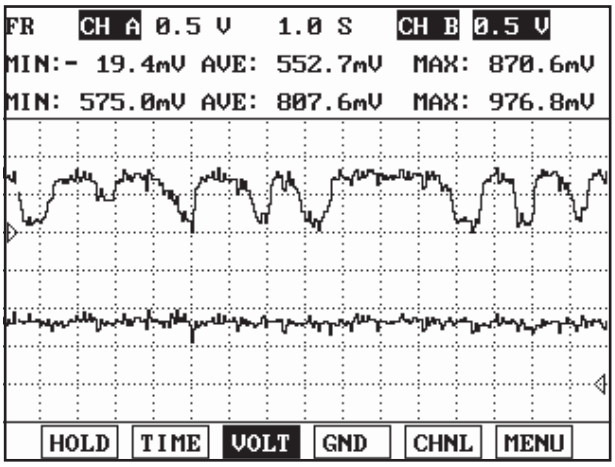


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

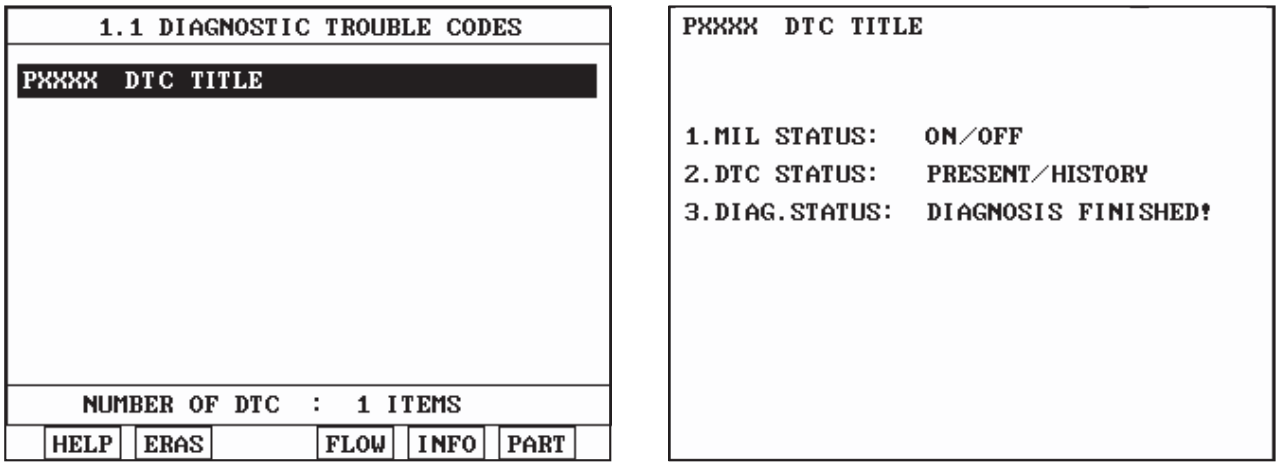
SEPFL6415N

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. At higher engine RPM, the switching frequency increases.

MONITOR DTC STATUS E444D24A

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 F5(INFO) to check DTC's information from the DTCs menu.
   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 E882C56D

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E22ABC21

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 E83EB627

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.

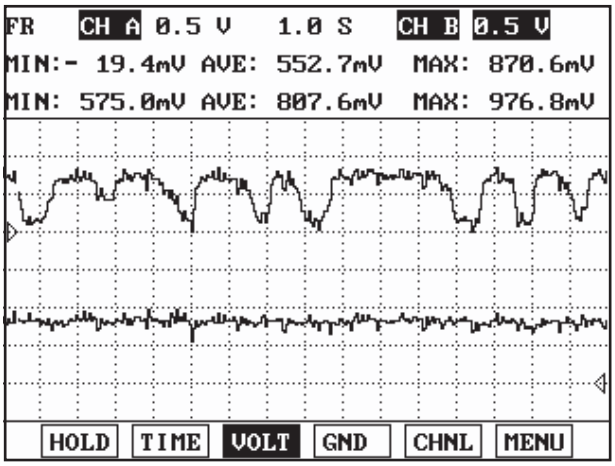


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

4) Is the sensor switching properly?

YES

▶ Go to "Check HO2S" as indicated 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 PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E13A5FE2

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0132 HO2S CIRCUIT HIGH VOLTAGE (BANK 1 / SENSOR 1)

COMPONENT LOCATION EFF5CE75

Refer to DTC P0131.

GENERAL DESCRIPTION E6ABC36F

Refer to DTC P0131.

DTC DESCRIPTION E946983B

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predetermined time, PCM sets P0132. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2F20A43

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor signal voltage	• Poor connection • Short to battery in harness • HO2S(B1/S1) • PCM
Enable Conditions	• Battery voltage ≥ 10V • Engine running ≥ 60 sec. • Engine warm-up state	
Threshold value	• The voltage of HO2S(B1/S1) > 1.3V	
Diagnosis Time	• Continous (more than 12.5 sec.failure for every 15 sec.test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E18A2778

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E522459F

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA E81303D9

Refer to DTC P0131.

MONITOR DTC STATUS EC192A36

Refer to DTC P0131.

TERMINAL AND CONNECTOR INSPECTION EEFCF50E

Refer to DTC P0131.

SIGNAL CIRCUIT INSPECTION E3B1676D

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 EFC0C64A

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.

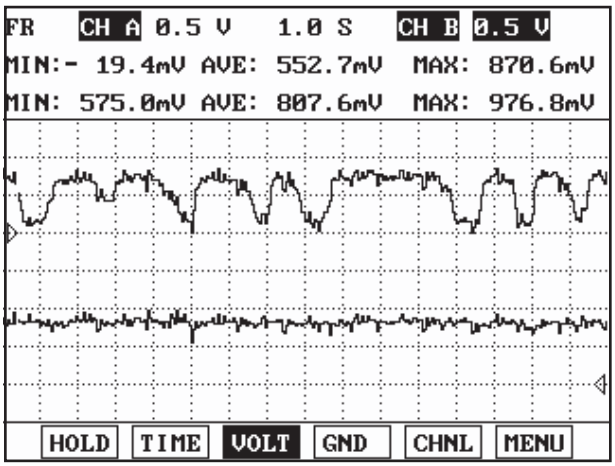


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

4) Is the sensor switching properly?

YES

▶ Go to "Check HO2S" as indicated 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 PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EA275B93

Refer to DTC P0131.

DTC P0133 HO2S CIRCUIT SLOW RESPONSE (BANK 1 / SENSOR 1)

COMPONENT LOCATION E8D409C5

Refer to DTC P0131.

GENERAL DESCRIPTION E7AA9A4C

Refer to DTC P0131.

DTC DESCRIPTION E57220A3

Checking output signals from HO2S under detecting condition, if PCM judges it's signals too slow, PCM sets P0133. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E5869A14

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's response rate	• Poor connection • Faulty HO2S • Faulty PCM
Enable Conditions	• Engine at operating temperature • Engine run time > 60sec • Drive at a steady speed between 45-55 mph(72-88 km/h) • Engine Coolant > 70℃(158 °F) • No disabling faults	
Threshold value	• The calculated response rate is too slow (out of threshold in PCM)	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EEEEA819

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 EFBE8777

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA E62EBFBC

Refer to DTC P0131.

MONITOR DTC STATUS E8BBB167

Refer to DTC P0131.

COMPONENT INSPECTION EA6BF947

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 PCM 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 EC47FEE3

Refer to DTC P0131.

DTC P0134 HO2S CIRCUIT NO ACTIVITY DETECTED (BANK 1 / SENSOR 1)

COMPONENT LOCATION EE1A7632

Refer to DTC P0131.

GENERAL DESCRIPTION E8B47A6D

Refer to DTC P0131.

DTC DESCRIPTION E0D31511

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermined time, PCM sets P0134. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF31B37F

Item		Detecting Condition	Possible cause
DTC Strategy		• Monitor signal voltage	• Poor connection • Open in harness • HO2S(B1/S1) • PCM
Enable Conditions		• Battery voltage ≥ 10V • Engine running ≥ 60 sec. • Engine warm-up state • No disable faults	
Thresh old value	Case 1	• 1.2V ≤ Voltage of HO2S ≤ 3.9V (at pumping current ON)	
	Case 2	• 0.415V ≤ Voltage of HO2S ≤ 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 E6CC6202

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E4A3849D

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA EF5F48B6

Refer to DTC P0131.

MONITOR DTC STATUS E24595CE

Refer to DTC P0131.

TERMINAL AND CONNECTOR INSPECTION E3B6D570

Refer to DTC P0131.

SIGNAL CIRCUIT INSPECTION EF158CD9

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" prcedure.

GROUND CIRCUIT INSPECTION E52173D8

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" prcedure.

COMPONENT INSPECTION EDDB891C

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.

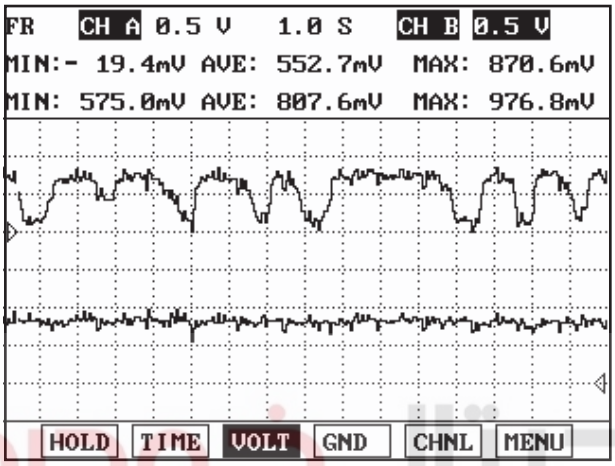


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

   4) Is the sensor switching properly?

   YES

   ▶ Go to "Check HO2S" as indicated 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 PCM 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

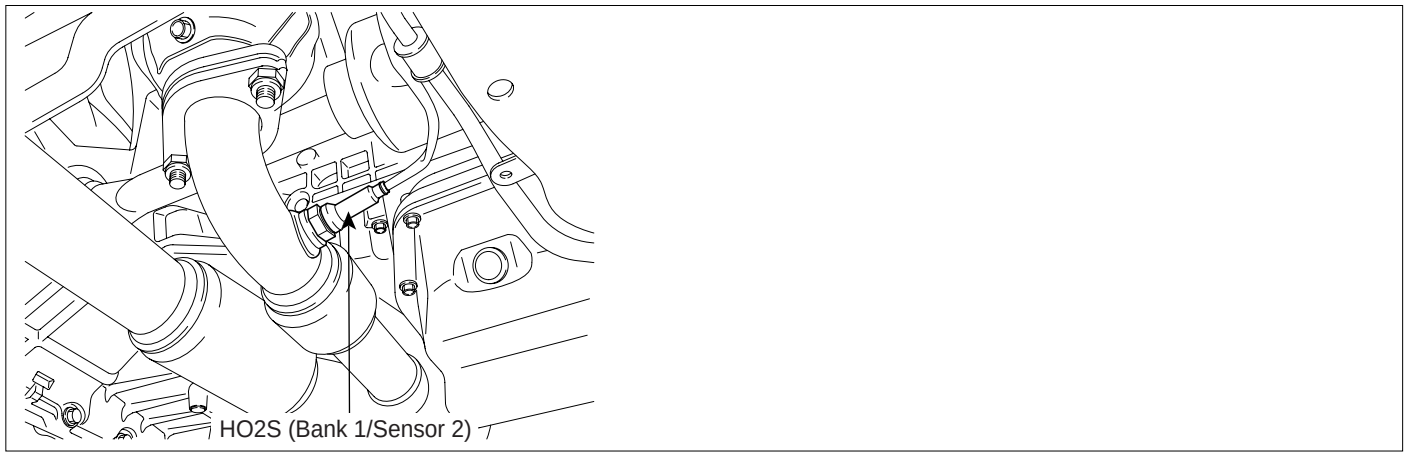
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EED5C452

Refer to DTC P0131.

DTC P0137 HO2S CIRCUIT LOW VOLTAGE (BANK 1 / SENSOR 2)

COMPONENT LOCATION EE7CFB10



SGHFL7311N

GENERAL DESCRIPTION E48C25C7

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 EF4F73C5

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermined time, PCM sets P0137. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E3A6DF18

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor signal voltage	• Poor connection • Short to ground in harness • HO2S(B1/S2) • PCM
Enable Conditions	• Battery voltage ≥ 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	

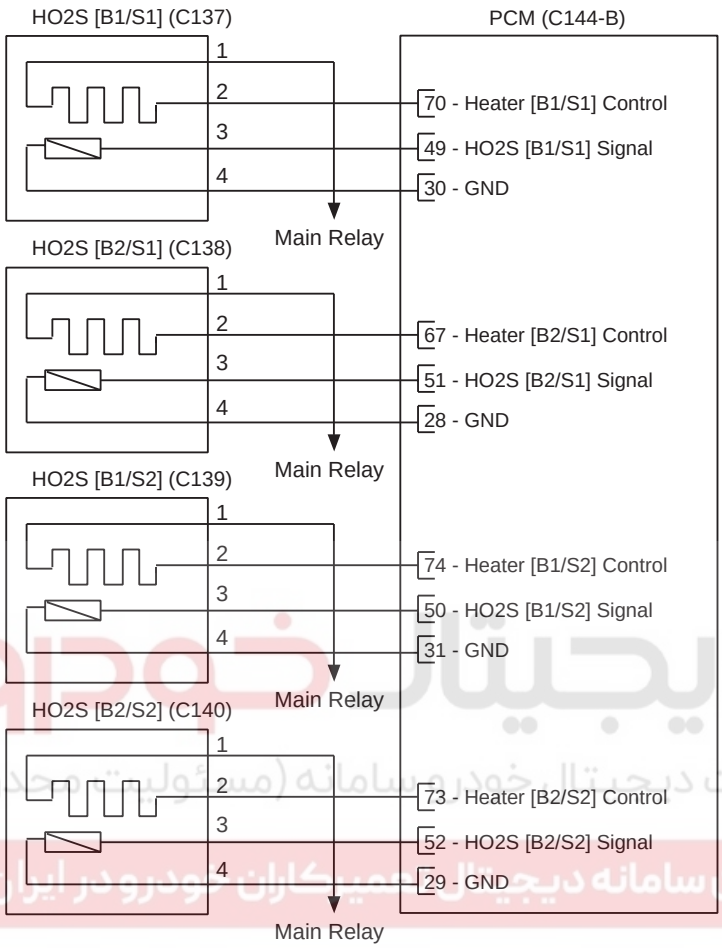
SPECIFICATION E3C07FB6

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E847651B

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

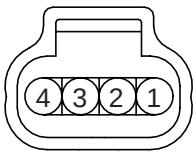
HO2S [B1/S2]

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

HO2S [B2/S2]

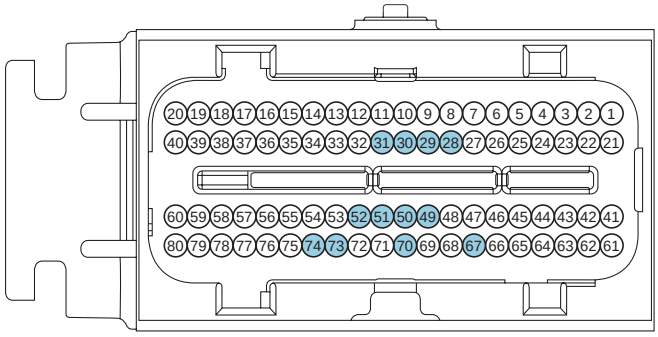
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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]

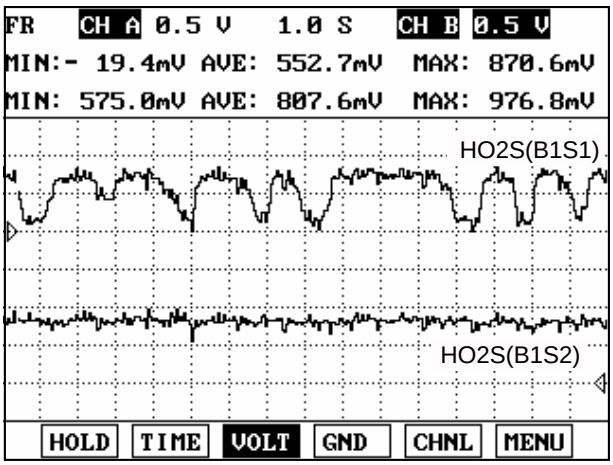


C144-B

PCM

UFBG250B

SIGNAL WAVEFORM AND DATA E4CC089D



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 E62F6171

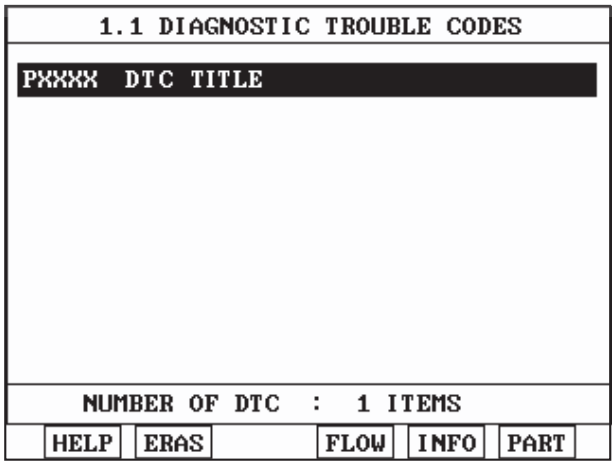
1. Check DTC Status

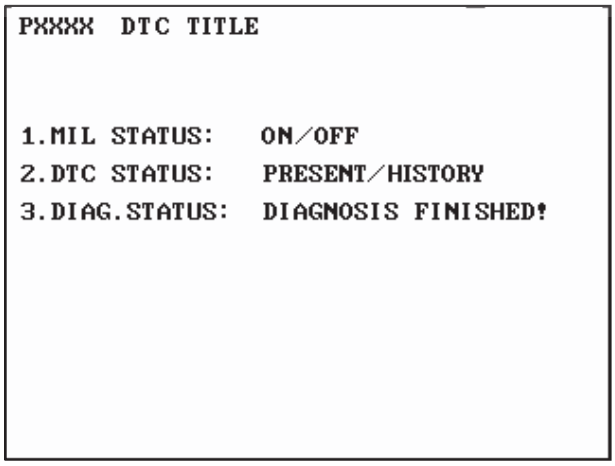
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E1709BB3

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E88E3EF4

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 EA522119

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.

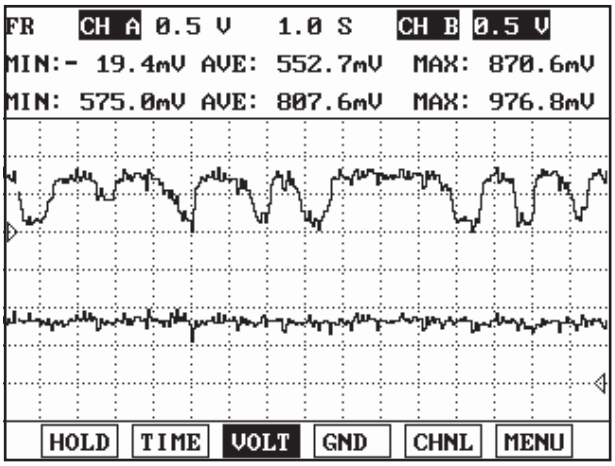


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

4) Is the sensor switching properly?

YES

▶ Go to "Check HO2S" as indicated 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 PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EEBFF9C6

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0138 HO2S CIRCUIT HIGH VOLTAGE (BANK 1 / SENSOR 2)

COMPONENT LOCATION E5BB80C7

Refer to DTC P0137.

GENERAL DESCRIPTION E2AF6CCF

Refer to DTC P0137.

DTC DESCRIPTION E255A684

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predetermined time, PCM sets P0138. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E83D93FA

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor signal voltage	• Poor connection • Short to battery in harness • HO2S(B1/S2) • PCM
Enable Conditions	• Battery voltage ≥ 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 E730DD63

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E8F78B65

Refer to DTC P0137.

SIGNAL WAVEFORM AND DATA EB55B9A0

Refer to DTC P0137.

MONITOR DTC STATUS E28EF557

Refer to DTC P0137.

TERMINAL AND CONNECTOR INSPECTION E20344D6

Refer to DTC P0137.

SIGNAL CIRCUIT INSPECTION EC5C83AF

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 E068CD98

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.

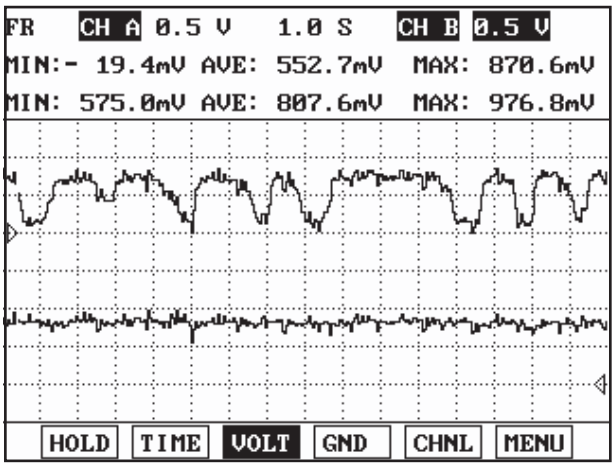


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

4) Is the sensor switching properly?

YES

▶ Go to "Check HO2S" as indicated 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 PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EF62234E

Refer to DTC P0137.

DTC P0140 HO2S CIRCUIT NO ACTIVITY DETECTED (BANK 1 / SENSOR 2)

COMPONENT LOCATION EC4CA85A

Refer to DTC P0137.

GENERAL DESCRIPTION EDC70FB2

Refer to DTC P0137.

DTC DESCRIPTION EDE0A7DB

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermined time, PCM sets P0140. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF1C064D

Item		Detecting Condition	Possible cause
DTC Strategy		• Monitor signal voltage	• Poor Connection • Open in harness • HO2S(B1/S2) • PCM
Enable Conditions		• Battery voltage ≥ 10V • Engine running ≥ 60 sec. • Engine warm-up state • No disable faults	
Thresh-old value	Case 1	• 1.2V ≤ Voltage of HO2S ≤ 3.9V (at pumping current ON)	
	Case 2	• 0.415V ≤ Voltage of HO2S ≤ 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 EC43BC5C

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E84C7AF6

Refer to DTC P0137.

SIGNAL WAVEFORM AND DATA E0F8A303

Refer to DTC P0137.

MONITOR DTC STATUS EDE13865

Refer to DTC P0137.

TERMINAL AND CONNECTOR INSPECTION EFC693E9

Refer to DTC P0137.

SIGNAL CIRCUIT INSPECTION EFB5A847

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 E40A9F9C

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" prcedure.

COMPONENT INSPECTION EFE5003B

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.

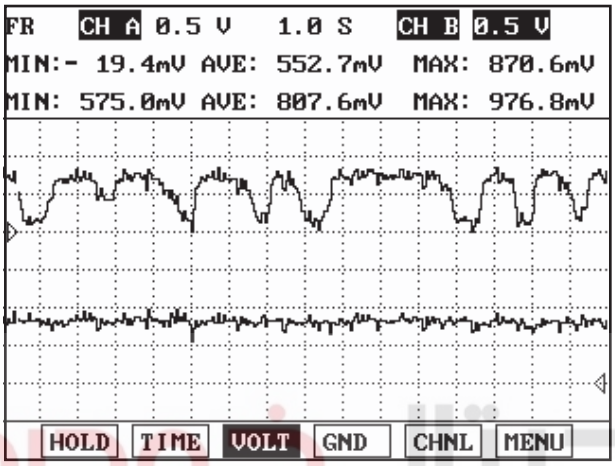


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

   4) Is the sensor switching properly?

   YES

   ▶ Go to "Check HO2S" as indicated 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 PCM 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

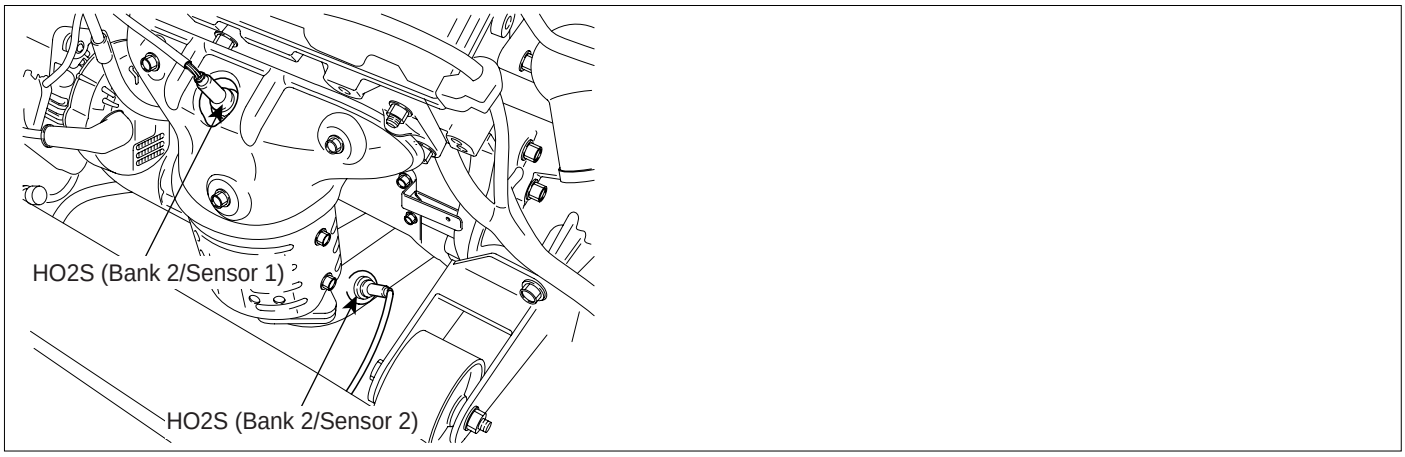
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E25A3A1F

Refer to DTC P0137.

DTC P0151 HO2S CIRCUIT LOW VOLTAGE (BANK 2 / SENSOR 1)

COMPONENT LOCATION EC6AF7A9



SGHFL7312N

GENERAL DESCRIPTION EE14E877

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 E8CAB23D

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermined time, PCM sets P0151. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ECE16229

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor signal voltage	• Poor connection • Short to ground in harness • HO2S(B2/S1) • PCM
Enable Conditions	• Battery voltage ≥ 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	

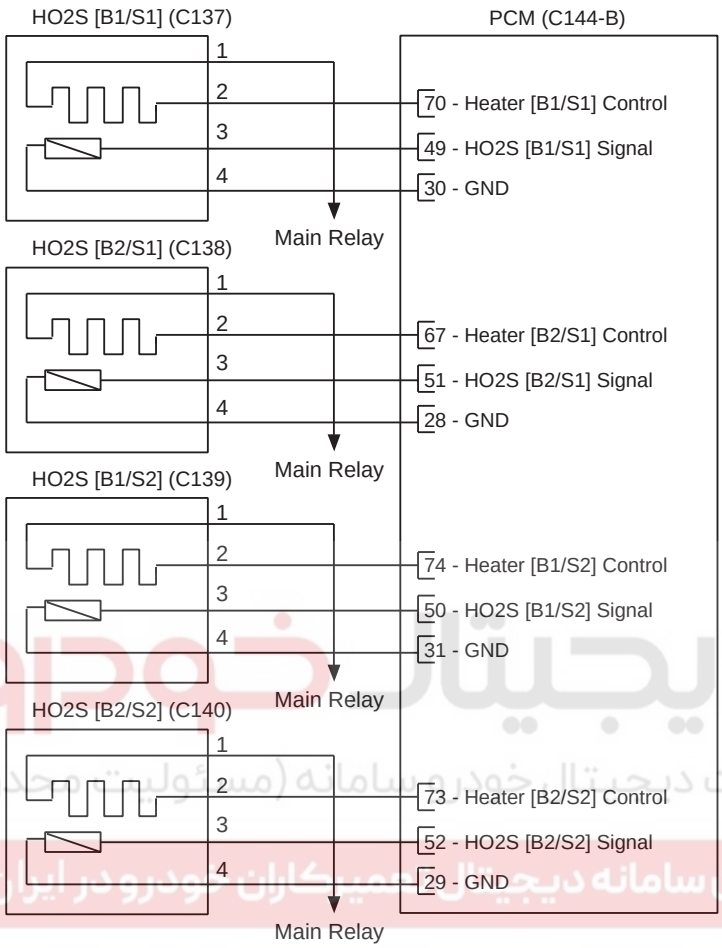
SPECIFICATION E0B82911

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E93BE815

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

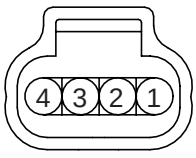
HO2S [B1/S2]

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

HO2S [B2/S2]

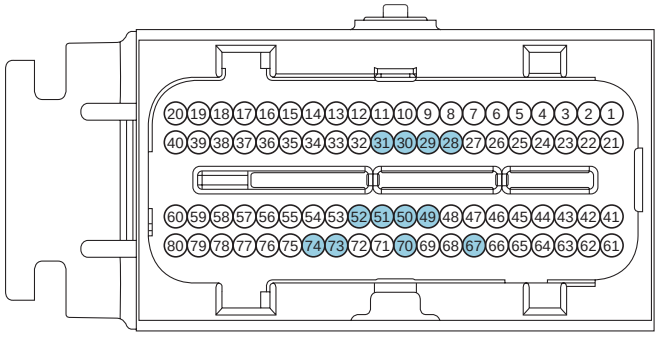
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFORM AND DATA E878EE36

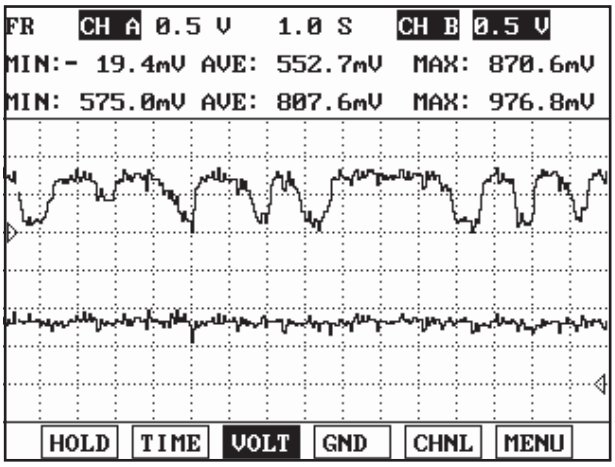


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

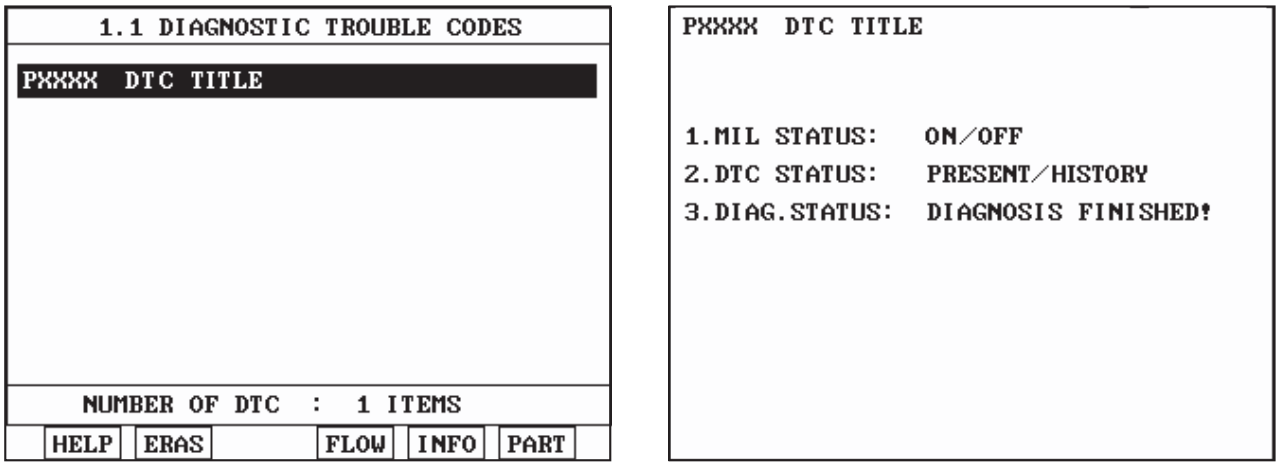
SEPFL6415N

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. At higher engine RPM, the switching frequency increases.

MONITOR DTC STATUS E0D4C343

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 F5(INFO) to check DTC's information from the DTCs menu.
   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Inspection & Repair" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E71140CD

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E42A9375

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 EB65AD3B

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.

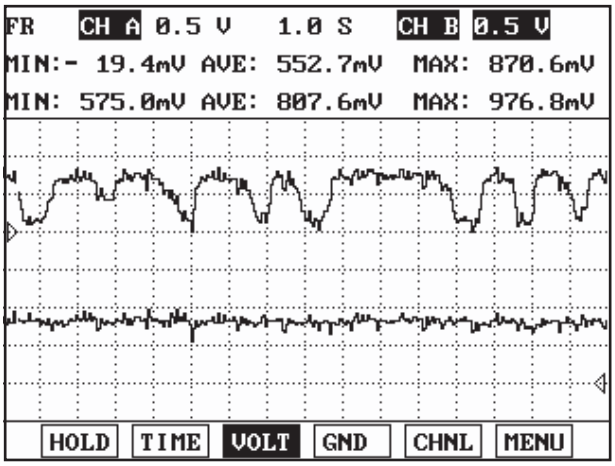


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

4) Is the sensor switching properly?

YES

▶ Go to "Check HO2S" as indicated 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 PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E1438BA8

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0152 HO2S CIRCUIT HIGH VOLTAGE (BANK 2 / SENSOR 1)

COMPONENT LOCATION E26706C0

Refer to DTC P0151.

GENERAL DESCRIPTION E716436F

Refer to DTC P0151.

DTC DESCRIPTION E4E37249

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predetermined time, PCM sets P0152. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E71C3A97

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor signal voltage	• Poor connection • Short to battery in harness • HO2S(B2/S1) • PCM
Enable Conditions	• Battery voltage ≥ 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 ED7614AD

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 ED85DD18

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA EE4A9FF1

Refer to DTC P0151.

MONITOR DTC STATUS E43741B0

Refer to DTC P0151.

TERMINAL AND CONNECTOR INSPECTION EABAF410

Refer to DTC P0151.

SIGNAL CIRCUIT INSPECTION E9D881E9

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 E0E27C87

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.

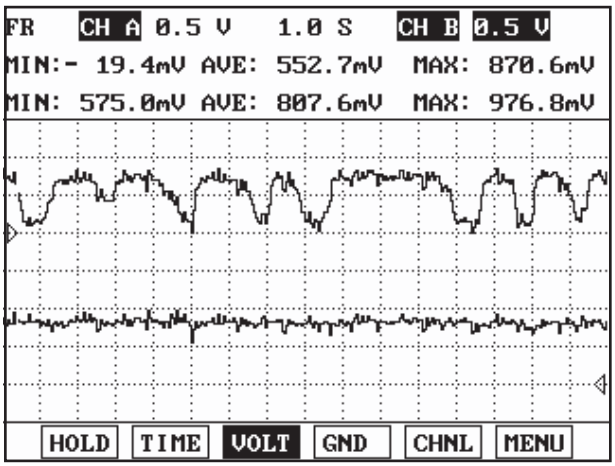


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

4) Is the sensor switching properly?

YES

▶ Go to "Check HO2S" as indicated 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 PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EEB387AE

Refer to DTC P0151.

DTC P0153 HO2S CIRCUIT SLOW RESPONSE (BANK 2 / SENSOR 1)

COMPONENT LOCATION E2D15594

Refer to DTC P0151.

GENERAL DESCRIPTION EA0FBB9E

Refer to DTC P0151.

DTC DESCRIPTION EA3D5B80

Checking output signals from HO2S under detecting condition, if PCM judges it's signals too slow, PCM sets P0153. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E44ED939

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's response rate	• Poor connection • Faulty HO2S • Faulty PCM
Enable Conditions	• Engine at operating temperature • Engine run time > 60sec • Drive at a steady speed between 45-55 mph(72-88 km/h) • Engine Coolant > 70℃(158 °F) • No disabling faults	
Threshold value	• The calculated response rate is too slow (out of threshold in PCM)	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E1105098

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E8A65428

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA ED064682

Refer to DTC P0151.

MONITOR DTC STATUS E45A0499

Refer to DTC P0151.

COMPONENT INSPECTION EB17CCAC

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 P0153?

YES

▶ Substitute with a known - good PCM 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 ED5A78FE

Refer to DTC P0151.

DTC P0154 HO2S CIRCUIT NO ACTIVITY DETECTED (BANK 2 / SENSOR 1)

COMPONENT LOCATION E7423299

Refer to DTC P0151.

GENERAL DESCRIPTION E7FDA2FA

Refer to DTC P0151.

DTC DESCRIPTION E03768B5

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermined time, PCM sets P0154. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E02D8310

Item		Detecting Condition	Possible cause
DTC Strategy		• Monitor signal voltage	• Poor connection • Open in harness • HO2S(B2/S1) • PCM
Enable Conditions		• Battery voltage ≥ 10V • Engine running ≥ 60 sec. • Engine warm-up state • No disable faults	
Thresh-old value	Case 1	• 1.2V ≤ Voltage of HO2S ≤ 3.9V(at pumping current ON)	
	Case 2	• 0.415V ≤ Voltage of HO2S ≤ 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 EEAC4EF0

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E46D2B2A

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA E01E55D1

Refer to DTC P0151.

MONITOR DTC STATUS EAB3A8C1

Refer to DTC P0151.

TERMINAL AND CONNECTOR INSPECTION EA0211DE

Refer to DTC P0151.

SIGNAL CIRCUIT INSPECTION E195176C

1. IG "OFF" and disconnect HO2S(B2/S1) connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between termianl 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" prcedure.

GROUND CIRCUIT INSPECTION EABF430F

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" prcedure.

COMPONENT INSPECTION E34361F7

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.

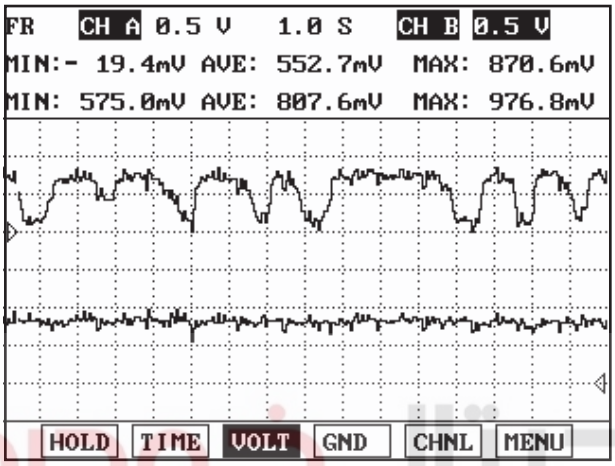


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

   4) Is the sensor switching properly?

   YES

   ▶ Go to "Check HO2S" as indicated 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 PCM 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

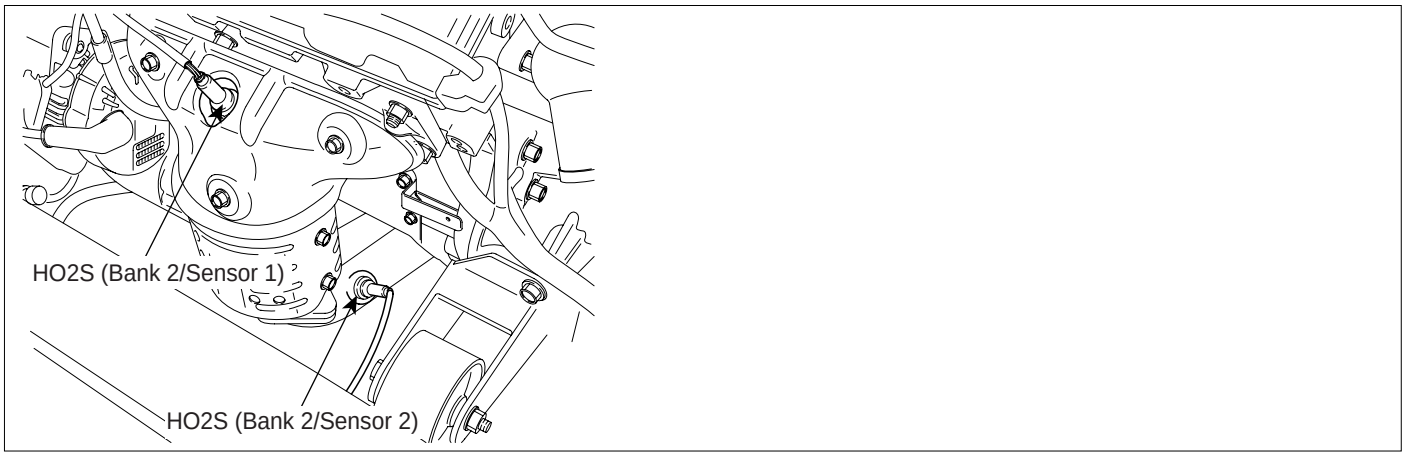
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM.

VERIFICATION OF VEHICLE REPAIR EBFFFAE1

Refer to DTC P0151.

DTC P0157 HO2S CIRCUIT LOW VOLTAGE (BANK 2 / SENSOR 2)

COMPONENT LOCATION E1EB46F6



SGHFL7312N

GENERAL DESCRIPTION E564568C

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 E6A0EC21

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermined time, PCM sets P0157. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E38D629D

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor signal voltage	• Poor connection • Short to ground in harness • HO2S(B2/S2) • PCM
Enable Conditions	• Battery voltage ≥ 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	

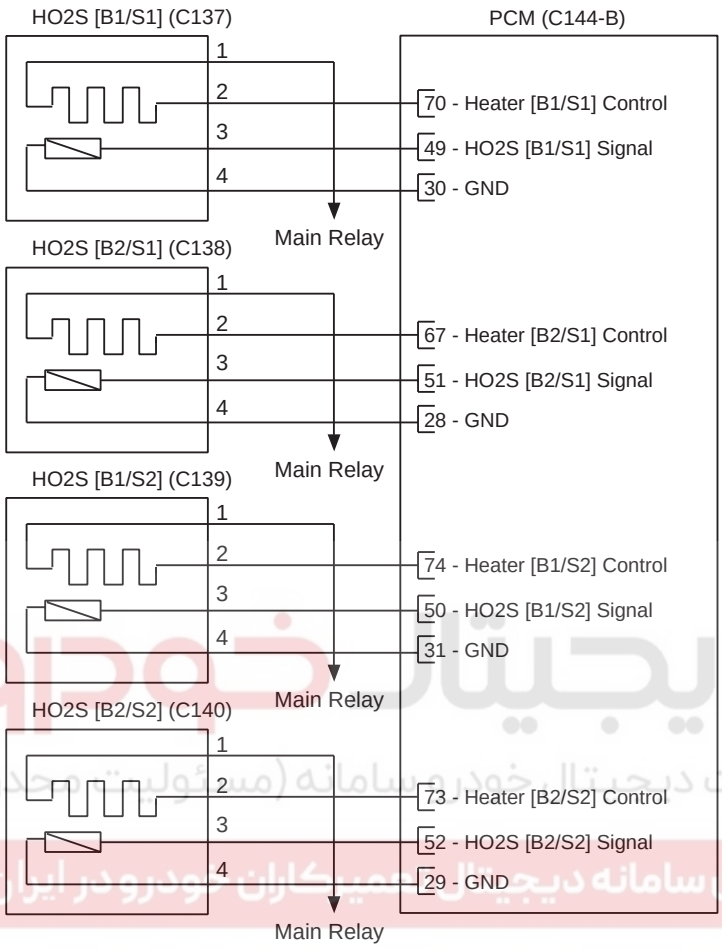
SPECIFICATION E489B2AA

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 EC03F7DF

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

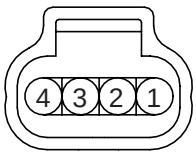
HO2S [B1/S2]

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

HO2S [B2/S2]

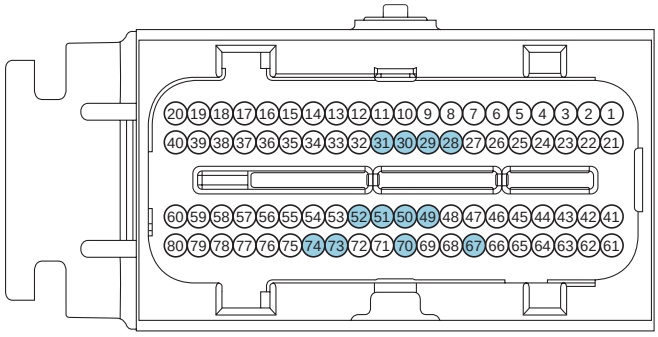
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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

PCM

UFBG250B

SIGNAL WAVEFORM AND DATA EF55AB69

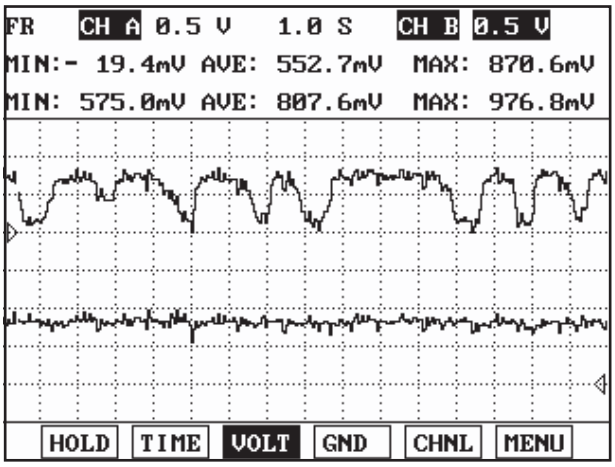


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

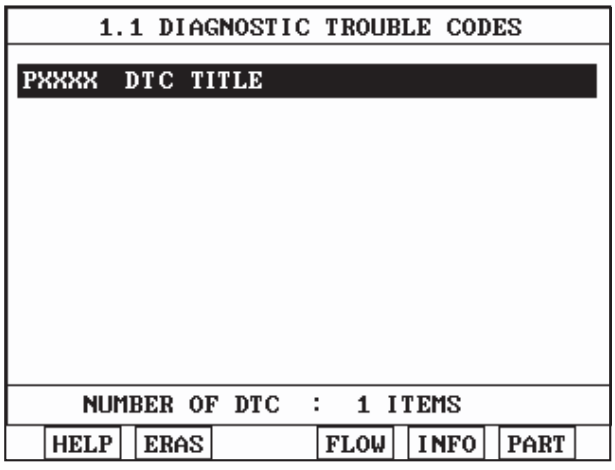
SEPFL6415N

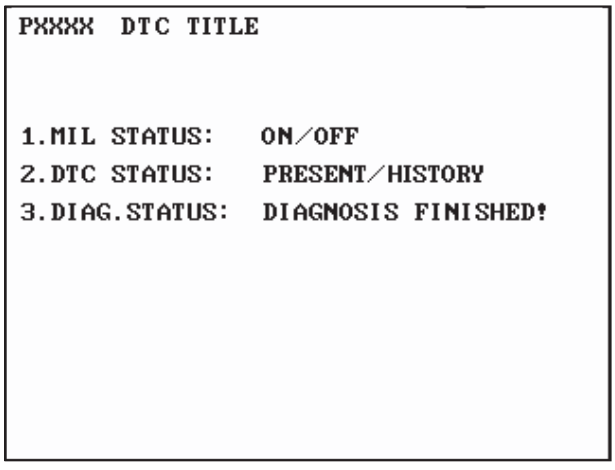
After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. At higher engine RPM, the switching frequency increases.

MONITOR DTC STATUS E2CEE118

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 F5(INFO) to check DTC's information from the DTCs menu.
   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E0BA757E

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E60E2156

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 ED7E2D18

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.

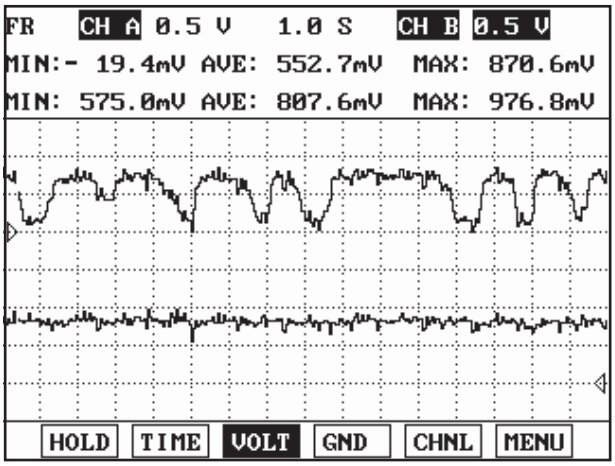


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

4) Is the sensor switching properly?

YES

▶ Go to "Check HO2S" as indicated 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 PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR ECF25F13

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0158 HO2S CIRCUIT HIGH VOLTAGE (BANK 2 / SENSOR 2)

COMPONENT LOCATION E548C426

Refer to DTC P0157.

GENERAL DESCRIPTION EC320676

Refer to DTC P0157.

DTC DESCRIPTION E26DF812

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predetermined time, PCM sets P0158. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ED97B553

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor signal voltage	• Poor connection • Short to battery in harness • HO2S(B2/S2) • PCM
Enable Conditions	• Battery voltage ≥ 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 E74F0485

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E599F728

Refer to DTC P0157.

SIGNAL WAVEFORM AND DATA EF8BA8C2

Refer to DTC P0157.

MONITOR DTC STATUS EE00D9D3

Refer to DTC P0157.

TERMINAL AND CONNECTOR INSPECTION ED9EFD38

Refer to DTC P0157.

SIGNAL CIRCUIT INSPECTION E75D5B2D

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 E200BEBE

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.

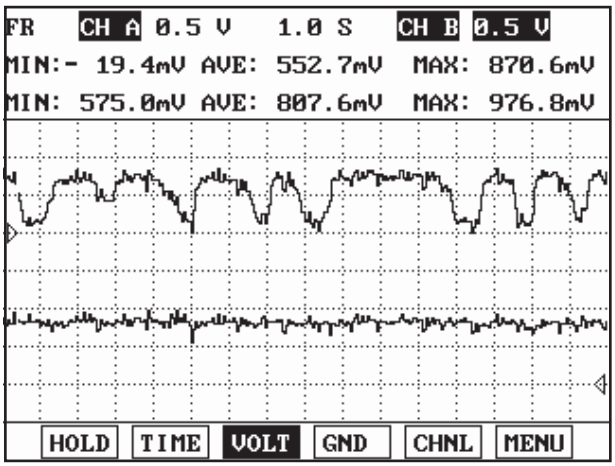


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

4) Is the sensor switching properly?

YES

▶ Go to "Check HO2S" as indicated 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 PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E638BA30

Refer to DTC P0157.

DTC P0160 HO2S CIRCUIT NO ACTIVITY DETECTED (BANK 2 / SENSOR 2)

COMPONENT LOCATION E6879410

Refer to DTC P0157.

GENERAL DESCRIPTION EA953F00

Refer to DTC P0157.

DTC DESCRIPTION E05D96B6

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermined time, PCM sets P0160. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E01753E4

Item		Detecting Condition	Possible cause
DTC Strategy		• Monitor signal voltage	• Poor connection • Open in harness • HO2S(B2/S2) • PCM
Enable Conditions		• Battery voltage ≥ 10V • Engine running ≥ 60 sec. • Engine warm-up state • No disable faults	
Thresh-old value	Case 1	• 1.2V ≤ Voltage of HO2S ≤ 3.9V (at pumping current ON)	
	Case 2	• 0.415V ≤ Voltage of HO2S ≤ 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 E2A07954

(REFERENCE ONLY)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E1F76729

Refer to DTC P0157.

SIGNAL WAVEFORM AND DATA E6207B7C

Refer to DTC P0157.

MONITOR DTC STATUS E9745980

Refer to DTC P0157.

TERMINAL AND CONNECTOR INSPECTION E3ECCC1C

Refer to DTC P0157.

SIGNAL CIRCUIT INSPECTION E154D939

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 ECCFF515

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 E7059A1D

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.

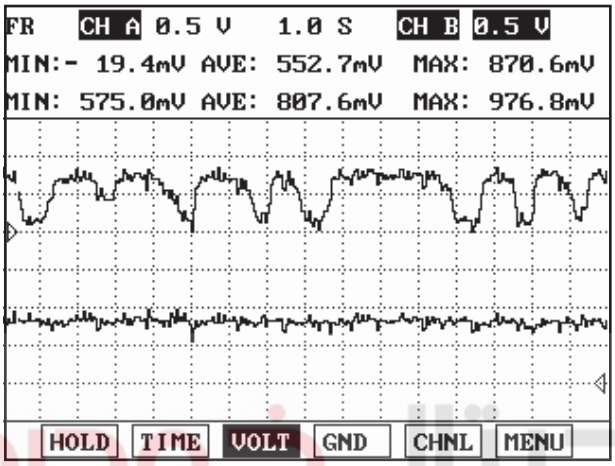


Fig) Signal waveform of front(the upper) and rear(the lower) HO2S at idle

SEPFL6416N

   4) Is the sensor switching properly?

   YES

   ▶ Go to "Check HO2S" as indicated 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 PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E51B6AC5

Refer to DTC P0157.

DTC P0171 SYSTEM TOO LEAN (BANK 1)
DTC P0174 SYSTEM TOO LEAN (BANK 2)

GENERAL DESCRIPTION E8EC0FCD

In order to provide the best possible combination of drivability, fuel economy and emission control, the PCM uses a closed loop air/fuel metering system. The PCM monitors the HO2S signal voltage and adjusts fuel delivery as needed. 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 PCM 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 PCM 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 E8267376

Checking the fuel trim value under detecting condition, if its average exceeds the limit over certain period, PCM sets P0171/P0174. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E3452337

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 at operating temperature • Drive at a steady speed over 5 minutes (Vehicle speed ≤ 130km/h) • 60℃(140°F) ≤ Engine coolant temperature ≤ 115℃(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 E2B25BD8

1. Monitor DTCs related to MAFS, MAPS, ECTS, Injector or CVVT items with scantool.
2. Are related DTCs present?

YES

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

NO

▶ Go to "System Inspection" procedure.

SYSTEM INSPECTION EFFA03CD

1. Check air leakage

1) Visually/physically inspect the 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 been found?

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 been found?

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 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/㎠, 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 EC94CD77

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 for RPM drop during injector 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 E7B7A400

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 E4843F17

In order to provide the best possible combination of drivability, fuel economy and emission control, the PCM uses a closed loop air/fuel metering system. The PCM monitors the HO2S signal voltage and adjusts fuel delivery as needed. 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 PCM 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 PCM 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 E6AEA85C

Checking the fuel trim value under detecting condition, if its average exceeds the limit over certain period, PCM sets P0172/P0175. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF72491E

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 at operating temperature • Drive at a steady speed over 5 minutes (Vehicle speed ≤ 130km/h) • 60℃(140°F) ≤ Engine coolant temperature ≤ 115℃(239°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 EB483D29

1. Monitor DTCs related to MAFS, MAPS, ECTS, Injector or CVVT items with scantool.
2. Are related DTCs present?

YES

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

NO

▶ Go to "System Inspection" procedure.

SYSTEM INSPECTION E264BD54

1. Check blocking of intake system

1) Inspect the intake system for the following items:
   ▶ Throttle body gasket and damage
   ▶ Blocking in intake manifold and injector caused by any foreign substance

2) Has a problem been 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 the engine and wait until the engine stalls.

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/㎠, 54.3 ~ 55.8 psi)

7) Is the measured fuel pressure within specifications ?

YES

▶ Go to "Check fuel leakage in injector" as follows.

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 EB59DF93

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

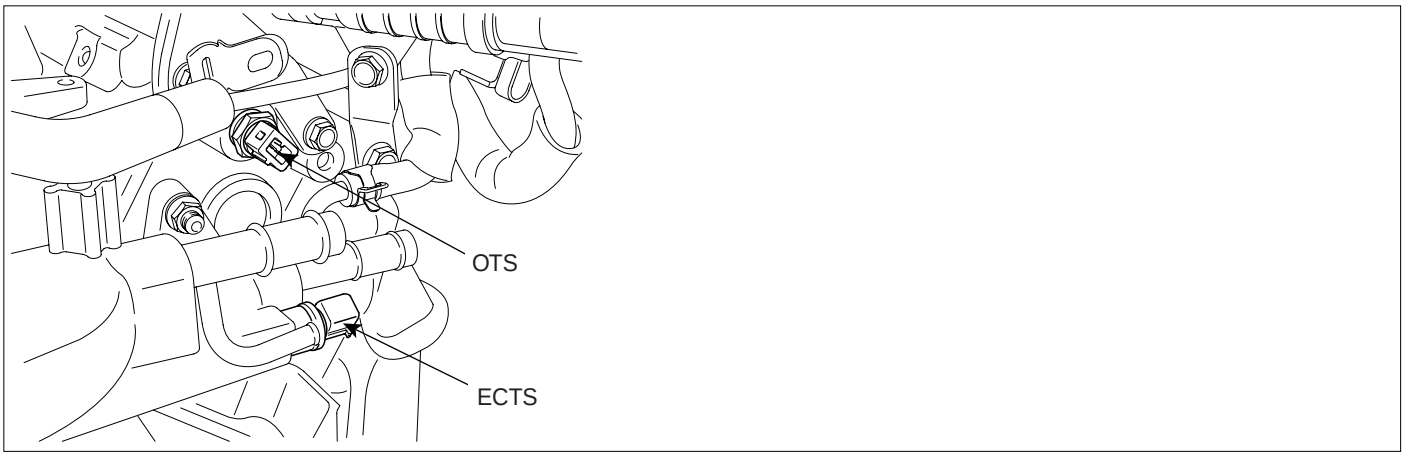
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0196 ENGINE OIL TEMP. SENSOR RANGE / PERFORMANCE

COMPONENT LOCATION EE3D28E4



SGHFL7315N

GENERAL DESCRIPTION EBA78525

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 compensate 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 (PCM) compensates the oil-flow control valve operation time.

DTC DESCRIPTION EBCA0A0C

Checking the oil temperture , coolant temperature and intake air temperature every 25 sec. under detecting condition, if the difference in temperature at start-up exceeds threshold value, PCM sets P0196. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

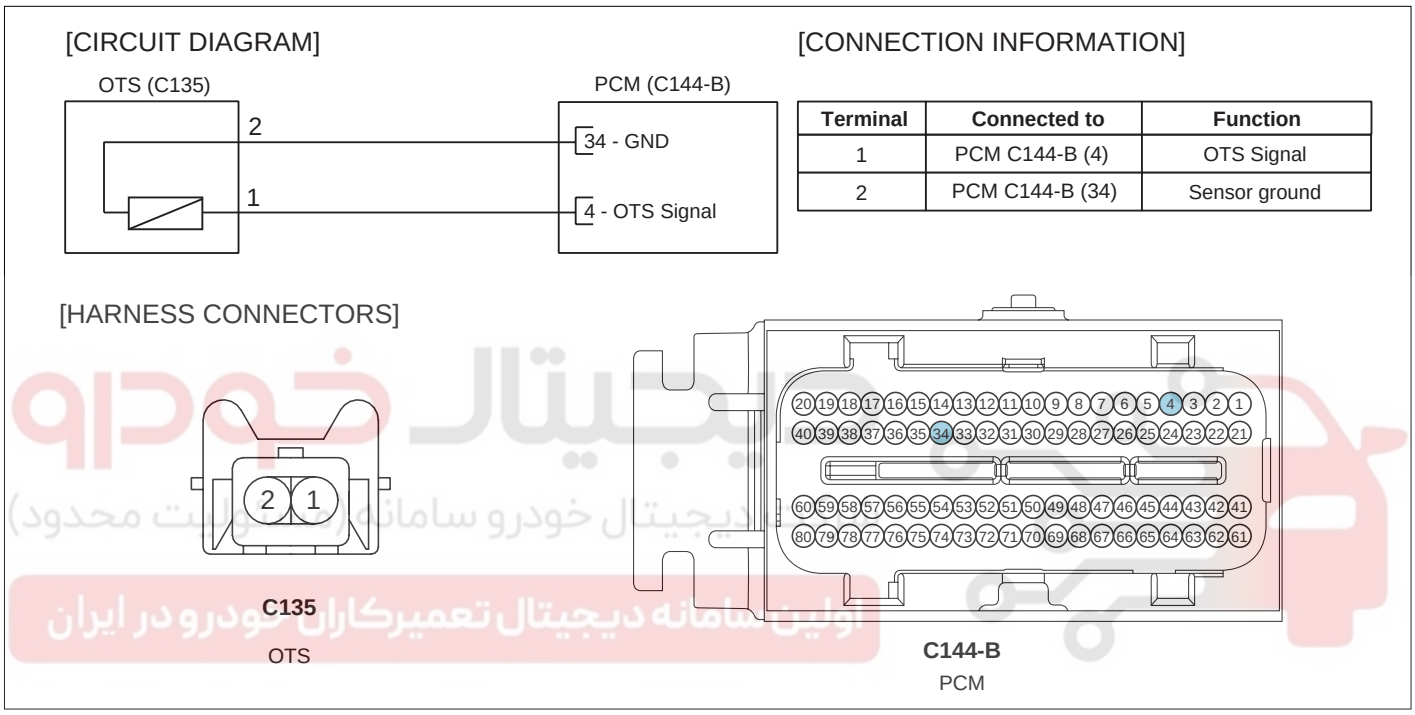
DTC DETECTING CONDITION EE27F6A7

Item		Detecting Condition	Possible cause
DTC Strategy		• Determines if the oil temperature value is rational, compared to coolant and intake air temperature.	• Faulty OTS • PCM
Enable Condi-tions	Case1	• Engine run time after startup < 30 sec • Soak period required > 300 min	
	Case2	• Minimum engine run time > 800 sec	
Thresh-old value	Case1	• The difference in temperature between oil and coolant temperatures at startup. > 35℃(63°F)	
	Case2	• The difference in temperature between oil temperature and intake air temperature at startup amp;amp;gt; 35℃(63°F)	
Diagnosis Time		• Continuous (More than 800 sec.)	
MIL On Condition		• NO MIL ON(DTC only)	

SPECIFICATION ECB0DEC6

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 E9AEB721



UFBG256A

MONITOR DTC STATUS EE7270A7

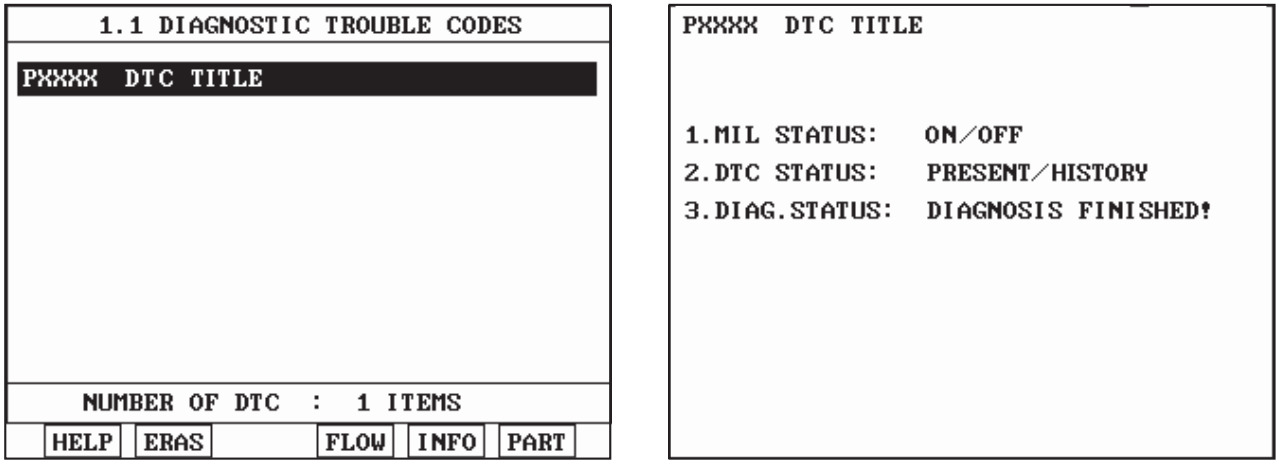
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Fault is intermittent caused by PCM 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 E0F892B0

1. Check resistance of OTS

1) IG "ON" & ENG "OFF"

2) Monitor Oil Temperature parameter on the scantool

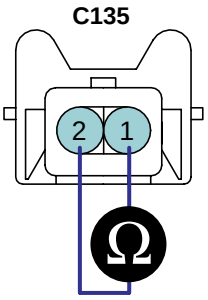
3) IG "OFF" & ENG "OFF"

4) Disconnect OTS connector.

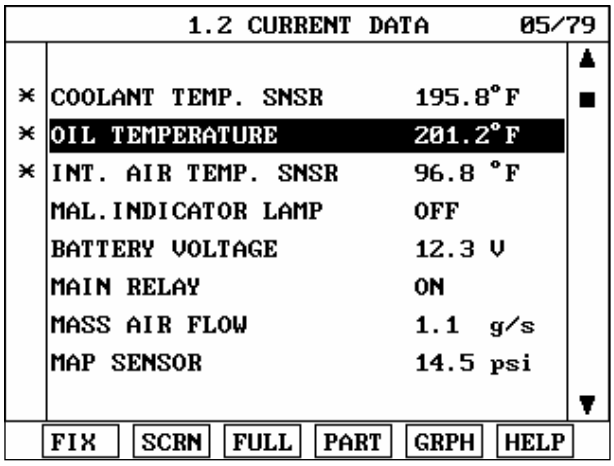
5) Measure resistance between terminal 1 and 2 of OTS connector after checking out the oil temperature with scantool

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



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 EF161B7B

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0197 ENGINE OIL TEMP. SENSOR LOW INPUT

COMPONENT LOCATION EAE91C94

Refer to DTC P0196.

GENERAL DESCRIPTION E32F8550

Refer to DTC P0196.

DTC DESCRIPTION EA217CDA

Checking output signals from oil temperture sensor every 15 sec. under detecting condition, if an signal is low for more than 12.5 sec., PCM sets P0197. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EB51F826

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal low	• Poor connection • Short to ground in harness • Oil temp.sensor • PCM
Enable Condi-tions	Case 1	• Engine running 〉 60 sec • Coolant temperature 〈 110 ℃(230°F)	
	Case 2	• Engine running 〉 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 E0DB844E

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

SCHEMATIC DIAGRAM EF2C7F77

Refer to DTC P0196.

MONITOR DTC STATUS E90E5A29

Refer to DTC P0196.

TERMINAL AND CONNECTOR INSPECTION E2E4025B

Refer to DTC P0196.

SIGNAL CIRCUIT INSPECTION ECF7C807

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 ED050959

1. Check resistance of OTS

   1) IG "ON" & ENG "OFF"

   2) Monitor Oil Temperature parameter on the scantool

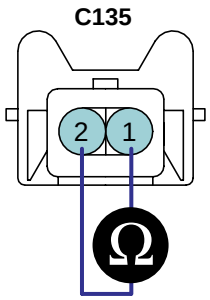
   3) IG "OFF" & ENG "OFF"

   4) Disconnect OTS connector.

   5) Measure resistance between terminal 1 and 2 of OTS connector(Component Side)

SPECIFICATION :

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



1. OTS Signal
2. OTS Ground

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6) Is the measured resistance within specification ?

YES

▶ Go to "Check PCM" 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.

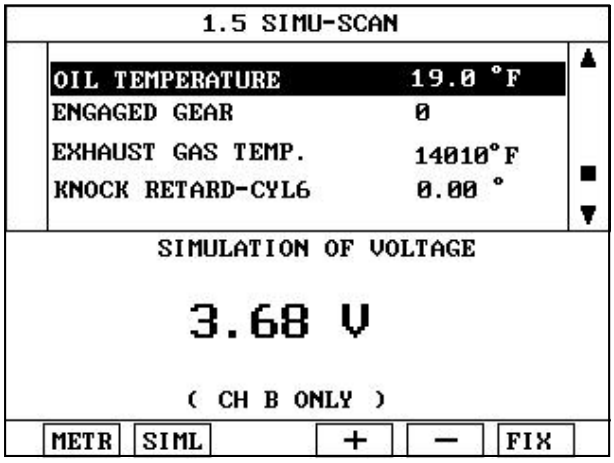
2. Check PCM

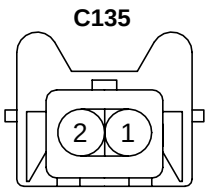
1) Ignition "OFF" and Connect Scantool

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

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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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E341B669

Refer to DTC P0196.

DTC P0198 ENGINE OIL TEMP. SENSOR HIGH INPUT

COMPONENT LOCATION EAD9855F

Refer to DTC P0196.

GENERAL DESCRIPTION E8C37119

Refer to DTC P0196.

DTC DESCRIPTION E878A100

Checking output signals from oil temperture sensor every 15 sec. under detecting condition, if an signal is high for more than 12.5 sec., PCM sets P0198. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E4F72A3D

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 • PCM
Enable Condi-tions	Case 1	• Engine running 〉 60 sec • Coolant temperature 〈 110 ℃(230°F)	
	Case 2	• Engine running 〉 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 E25C4D4F

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

SCHEMATIC DIAGRAM E69DE59B

Refer to DTC P0196.

MONITOR DTC STATUS ED9AC82D

Refer to DTC P0196.

TERMINAL AND CONNECTOR INSPECTION E84D519A

Refer to DTC P0196.

SIGNAL CIRCUIT INSPECTION E25D5551

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 "Ground Circuit Inspection" procedure.

   NO

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

2. Check open in harness

   1) IG "OFF" & ENG "OFF"

   2) Disconnect OTS and PCM connector.

   3) Measure resistance between terminal 1 of OTS harness connector and terminal 4 of PCM 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 EF6F3306

1. IG "OFF" & ENG "OFF"
2. Disconnect OTS connector and IG "ON"
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 E80663FF

1. Check resistance of OTS

   1) IG "ON" & ENG "OFF"

   2) Monitor Oil Temperature parameter on the scantool

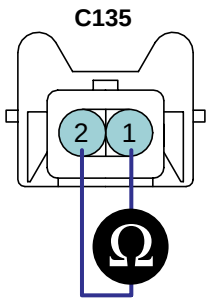
   3) IG "OFF" & ENG "OFF"

   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 PCM" 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.

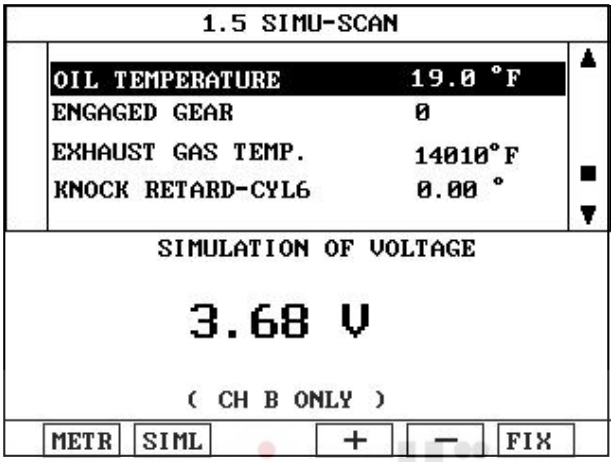
2. Check PCM

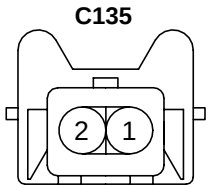
1) Ignition "OFF" and Connect Scantool

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 PCM and check for proper operation. If the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NOTE

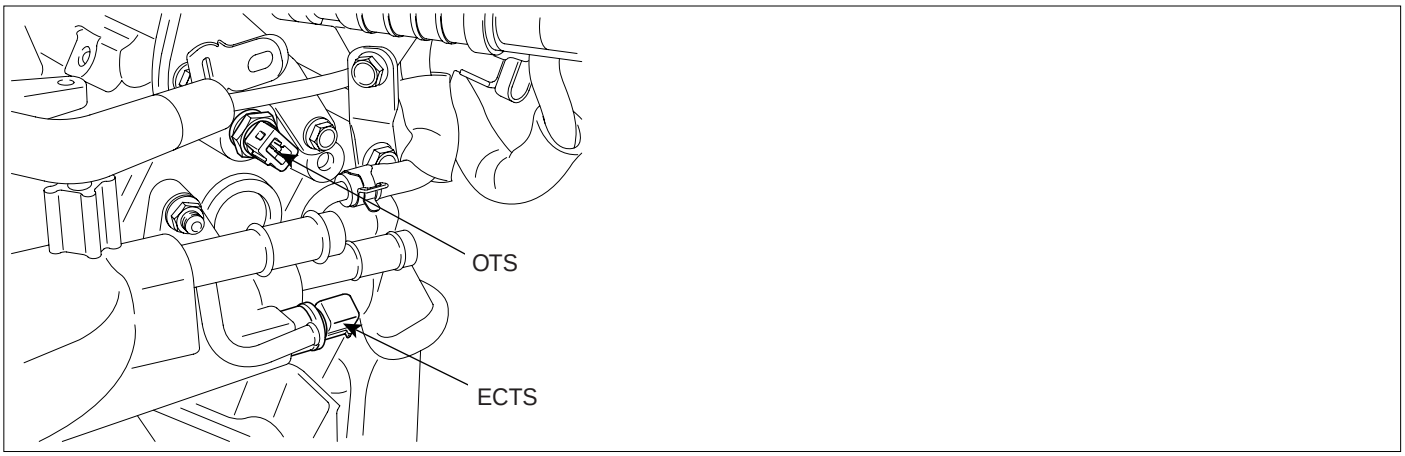
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E7D943D2

Refer to DTC P0196.

DTC P0217 ENGINE COOLANT OVER TEMPERATURE CONDITION

COMPONENT LOCATION EA163AFF



SGHFL7315N

GENERAL DESCRIPTION E0969D45

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 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.

DTC DESCRIPTION EBE2C862

Checking the coolant temperature under detecting condition, if the coolant temperature exceeds the threshold temperature under normal operation loads, PCM sets P0217. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

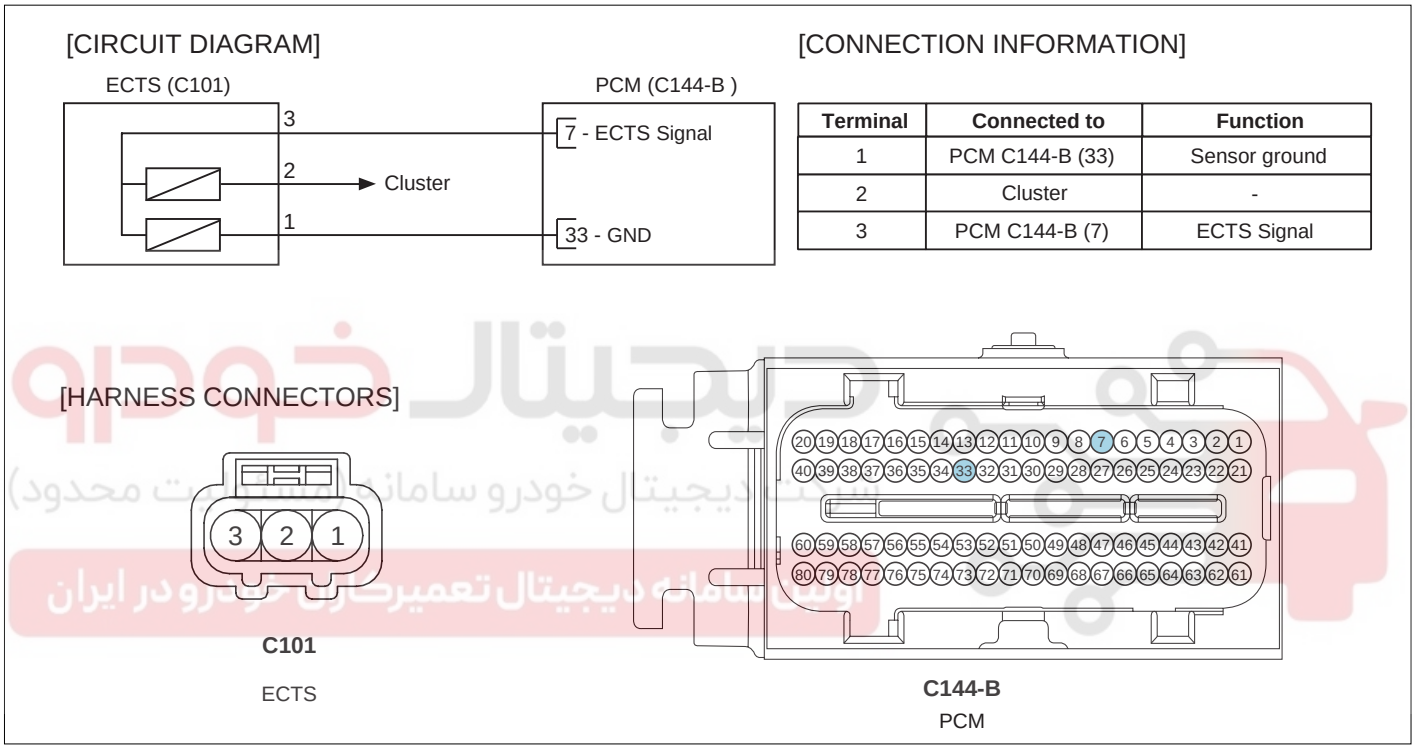
DTC DETECTING CONDITION EDFA9BA9

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℃(113 ℉) • Engine running • Coolant temperature > 50℃(122 ℉) • Intake air temperature < 35℃(95 ℉)	
Thresh old value	• Coolant temperature ≥ 110℃ (230 ℉)(Average airflow < 30 g/sec and filtered airflow < 50 g/sec)	
Diagnosis Time	• Once per driving cycle (about 2 minutes)	
MIL On Condition	• NO MIL ON(DTC only)	

SPECIFICATION EB75509C

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 EC151AD2



UFBG242A

MONITOR DTC STATUS E1729B8E

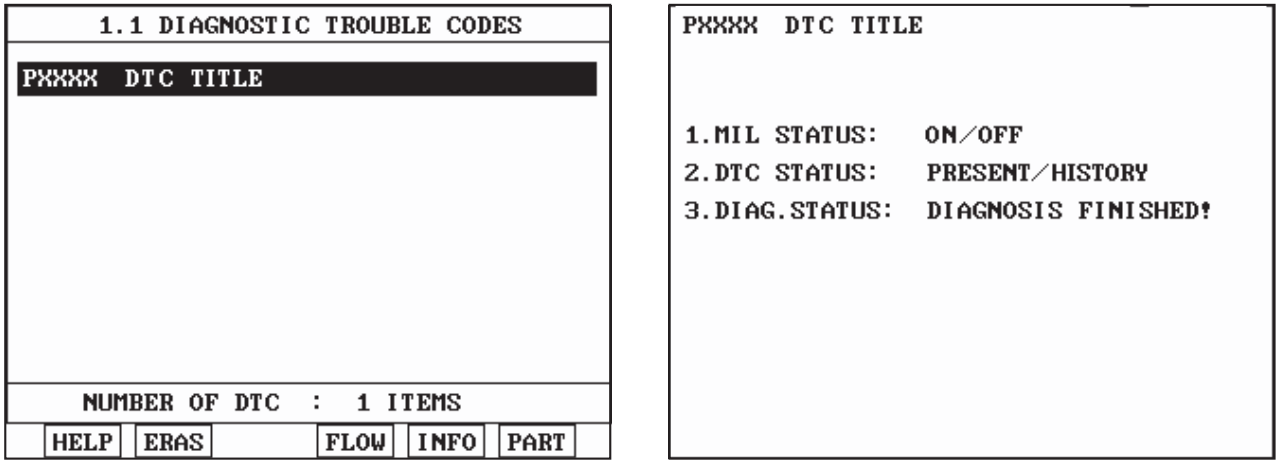
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

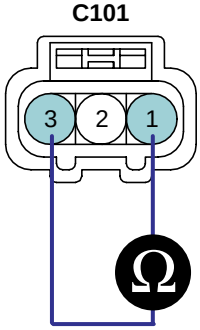
▶ Fault is intermittent, go to "Verification of vehicle Repair" procedure.

COMPONENT INSPECTION E1B7D29F

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. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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

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 EAB218CF

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

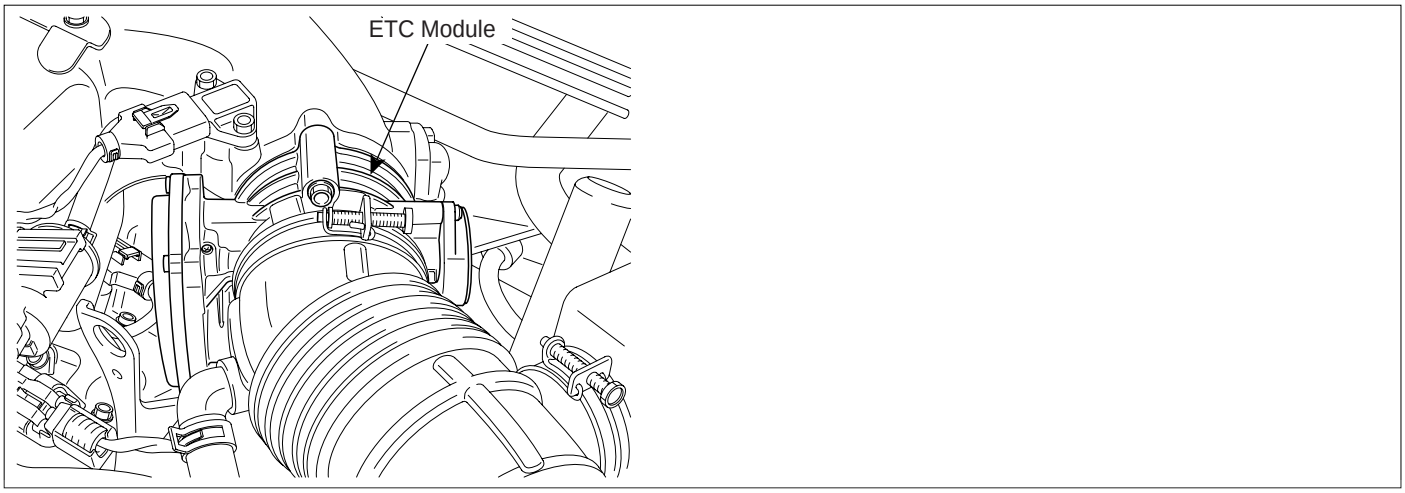
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0222 THROTTLE/PEDAL POSITION SENSOR/SWITCH "B" CIRCUIT LOW INPUT

COMPONENT LOCATION E8DC3589



SGHFL7316N

GENERAL DESCRIPTION ED8AE0AA

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(PCM).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 PCM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E9FCD80B

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, PCM sets P0222. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2BCC9C1

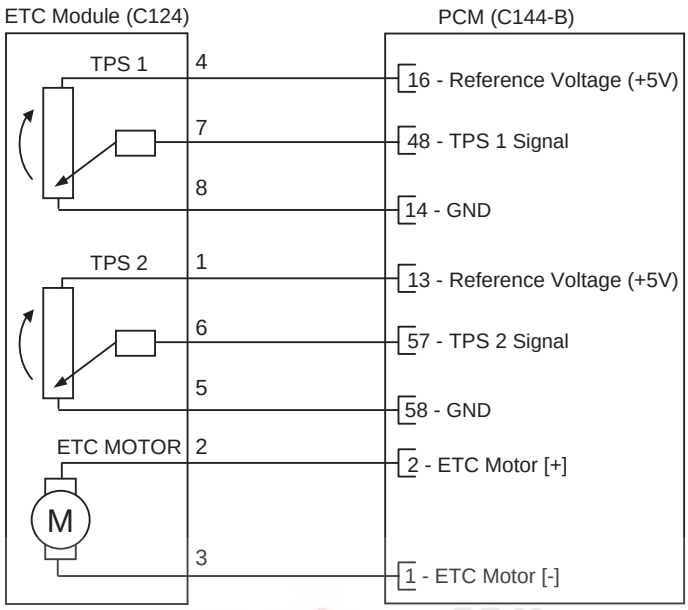
Item	Detecting Condition	Possible Cause
DTC Strategy	• signal low	• Poor connection • Open or short to ground in power harness • Open or short to ground in signal harness • TPS • PCM
Enable condition	• IG "ON"	
threshold value	• The signal voltage of TPS 〈 0.25V	
diagnosis time	• Continuous (more than 0.1 sec. failure for every 8.5 sec.test)	
MIL ON condition	• 2 driving cycles	

SPECIFICATION ECA9B590

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 E23D2E13

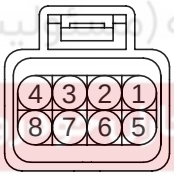
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

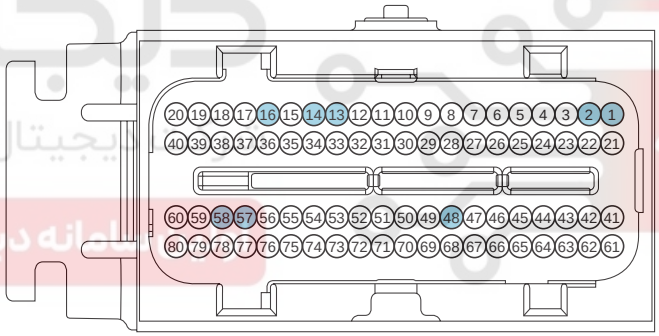
Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]



C124

ETC MODULE

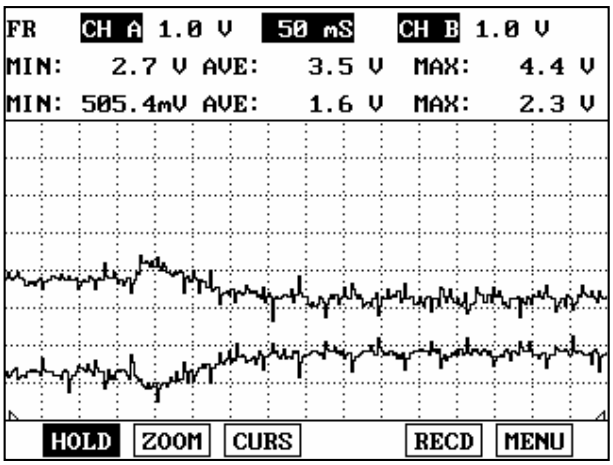


C144-B

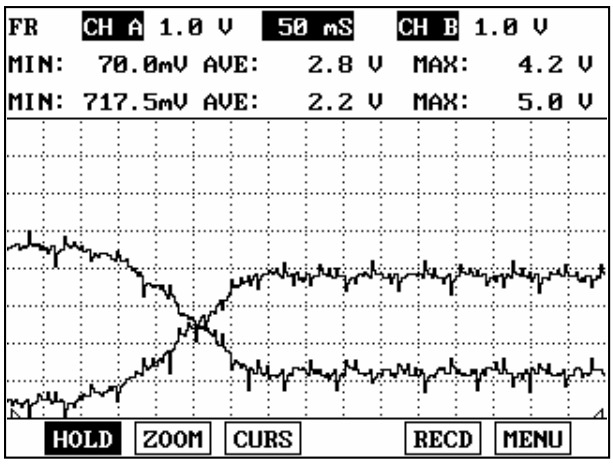
PCM

UFBG236A

SIGNAL WAVEFORM AND DATA EAE43137



Hit the accelerator at IG ON



Open the throttle valve by force at IG ON

EGRF604Z

MONITOR DTC STATUS E12E0402

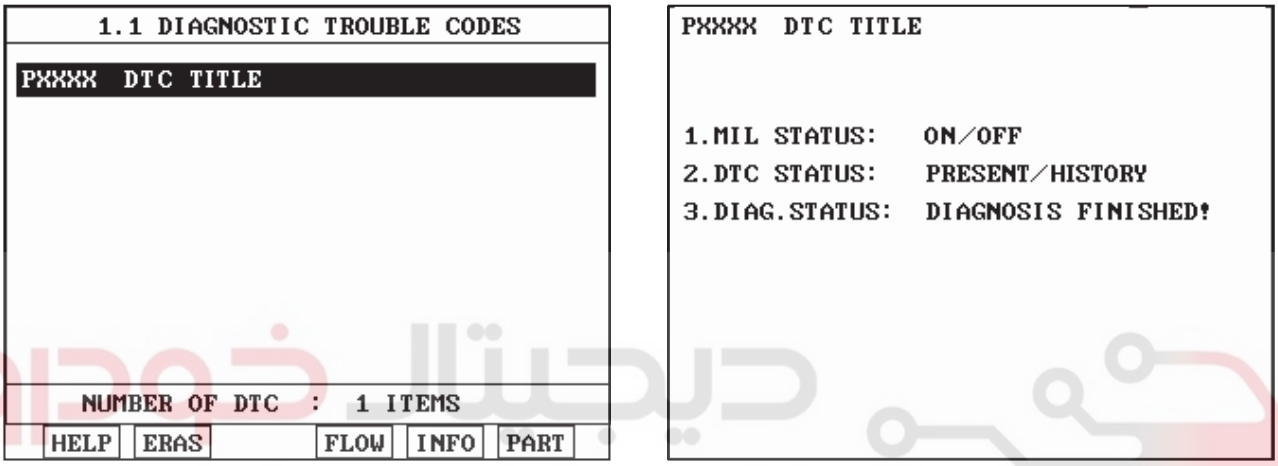
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 ED6BC757

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E3F172D7

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 EE1EC216

1. Check short to ground in harness
   1) IG "OFF" and disconnect TPS connector and PCM 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 PCM connector.
   2) Measure resistance between terminal 6 of TPS harness connector and terminal 57 of PCM 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 Repair" procedure.

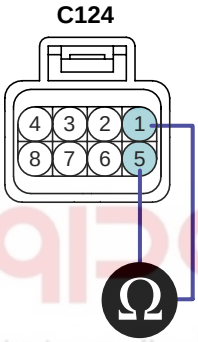
COMPONENT INSPECTION EE757839

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 ~ 4.1kΩ



1. TPS 2 Reference Voltage (+5V)
2. ETC Motor [+] Control
3. ETC Motor [-] Control
4. TPS 1 Reference Voltage (+5V)
5. TPS 2 Ground
6. TPS 2 Signal
7. TPS 1 Signal
8. TPS 1 Ground

SBLF26496L

3) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

CAUTION

Procedure of ETS Initialization

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

VERIFICATION OF VEHICLE REPAIR EB8C67F5

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0223 THROTTLE/PEDAL POSITION SENSOR/SWITCH "B" CIRCUIT HIGH INPUT

COMPONENT LOCATION E14B57E2

Refer to DTC P0222.

GENERAL DESCRIPTION E05D3775

Refer to DTC P0222.

DTC DESCRIPTION EEDEE43C

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., PCM sets P0223. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EC2F3AC5

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal High	• Poor connection • Short to battery in signal harness • Open in ground harness • TPS • PCM
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 E9583B29

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 E4537CE0

Refer to DTC P0222.

SIGNAL WAVEFORM AND DATA E4403F88

Refer to DTC P0222.

MONITOR DTC STATUS E0C9980F

Refer to DTC P0222.

TERMINAL AND CONNECTOR INSPECTION E56D20A7

Refer to DTC P0222.

SIGNAL CIRCUIT INSPECTION E198334F

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 PCM 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 EA02E485

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

5. Is the measured voltage within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open or contact resistance inharness, and go to "Verification of Vehicle Repair: procedure.

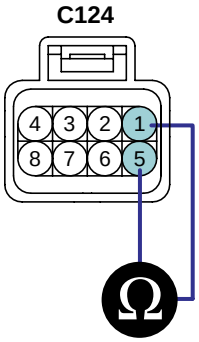
COMPONENT INSPECTION EAB8D8AA

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 ~ 4.1kΩ



1. TPS 2 Reference Voltage (+5V)
2. ETC Motor [+] Control
3. ETC Motor [-] Control
4. TPS 1 Reference Voltage (+5V)
5. TPS 2 Ground
6. TPS 2 Signal
7. TPS 1 Signal
8. TPS 1 Ground

SBLF26496L

   3) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

CAUTION

Procedure of ETS Initialization

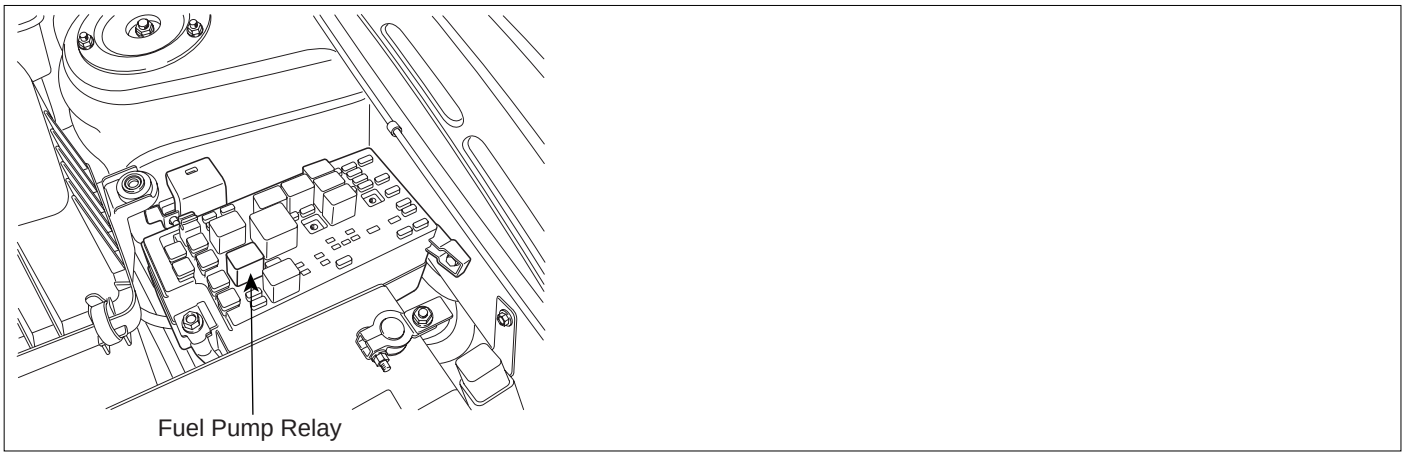
1. ***Erase the trouble codes on PCM***
2. ***Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec.)***
3. ***Turn ignition key on more than 1second to record the throttle motor position on the EEPROM***

VERIFICATION OF VEHICLE REPAIR E160339B

Refer to DTC P0222.

DTC P0230 FUEL PUMP PRIMARY CIRCUIT

COMPONENT LOCATION E23ED5B8



SGHFL7317N

GENERAL DESCRIPTION E4EEF708

The PCM 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 PCM monitors the control circuit between the fuel pump relay and the PCM. When the ignition switch is turned ON, the PCM energizes the fuel pump relay, which sends power to the fuel pump.

DTC DESCRIPTION EDECABE5

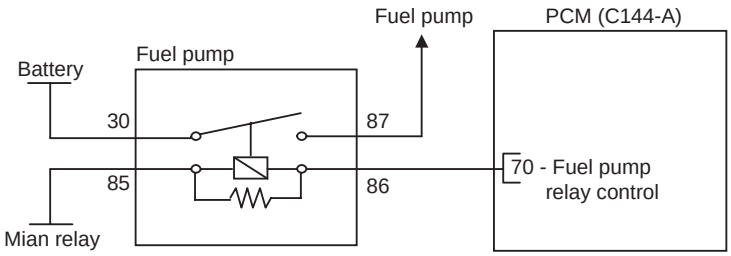
Checking fuel pump relay circuit continuously under detecting condition, if open or short in the circuit is detected, PCM sets P0230.In addition, Take note that open circuit in Main Relay may cause this P0230 code.
※ In addition, Take note that open circuit in Main Relay may cause this P0230 code.

DTC DETECTING CONDITION EAF8D7DE

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 • PCM
Enable condition	• 11V ≤ Battery Voltage ≤ 16V	
threshold value	• Open or short	
diagnosis time	• Continuous	
MIL ON condition	• NO MIL ON(DTC only)	

SCHEMATIC DIAGRAM E8A356D3

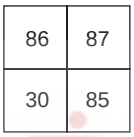
[CIRCUIT DIAGRAM]

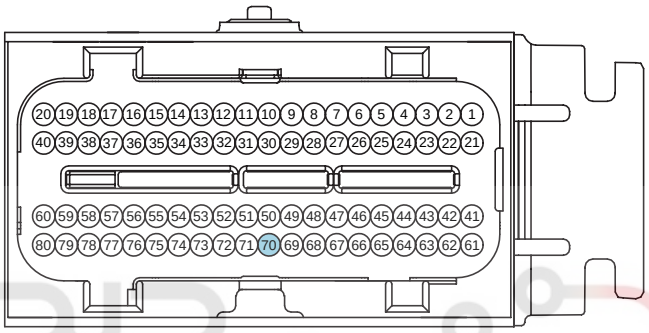


[CONNECTION INFORMATION]

Terminal	Connected to	Function
30	Battery	Battery power (B+)
87	Fuel pump	Power Supply to fuel pump (B+)
85	Main relay	Battery power (B+)
86	PCM C144-A (70)	Relay control

[HARNESS CONNECTOR]





C144-A
PCM

SGHFL7318N

MONITOR DTC STATUS EF5677B8

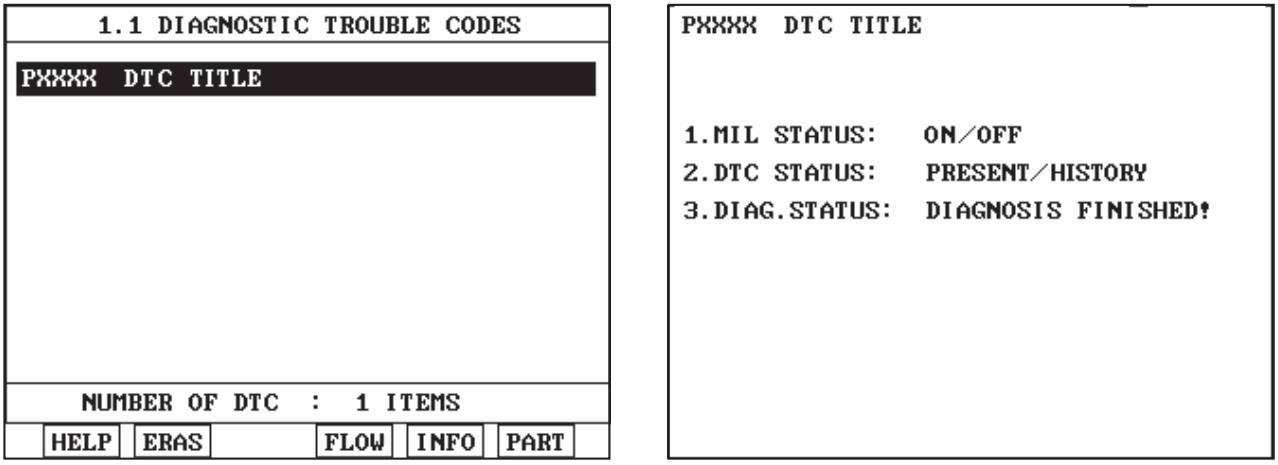
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E0F21058

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E89668B0

1. IG "OFF" & ENG "OFF"
2. Disconnect fuel pump relay.
3. IG "ON" & ENG "OFF"
4. Measure voltage between harness terminal 30(85) of chassis ground.

Specification : B+

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 E2271FF1

1. IG "OFF"
2. Disconnect fuel pump relay.
3. IG "ON" & ENG "OFF"
4. Measure voltage between harness terminal 86 and chassis ground.

Specification : Approx. 2.5V ~ 3V

5. Is the measured voltage within specification ?

YES

▶ Go to "Component Inspection" procedure.

NO

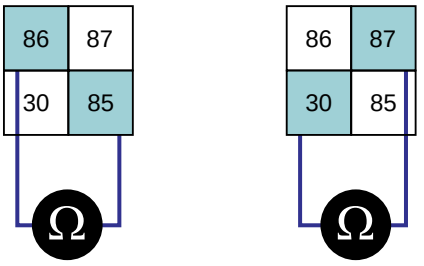
▶ Repair or repalce as necessary and then, go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION ED6D7F2F

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. 70Ω ~ 120Ω)



30. Battery Power(B+)
85. Battery Power(B+) from main relay
86. Relay Control
87. Power supply to fuel pump

SGHFL7214N

5) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

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 E8696309

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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 E9CD04B3

SGHFL7319N

GENERAL DESCRIPTION E3C766AE

Based on information from various sensors, the PCM calculates 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 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 the control circuit, the fuel injector is closed and circuit voltage should momentarily peak.

DTC DESCRIPTION E158E7A6

Checking output signals from injectors under detecting condition, if an output signal is low, PCM 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 E60175BF

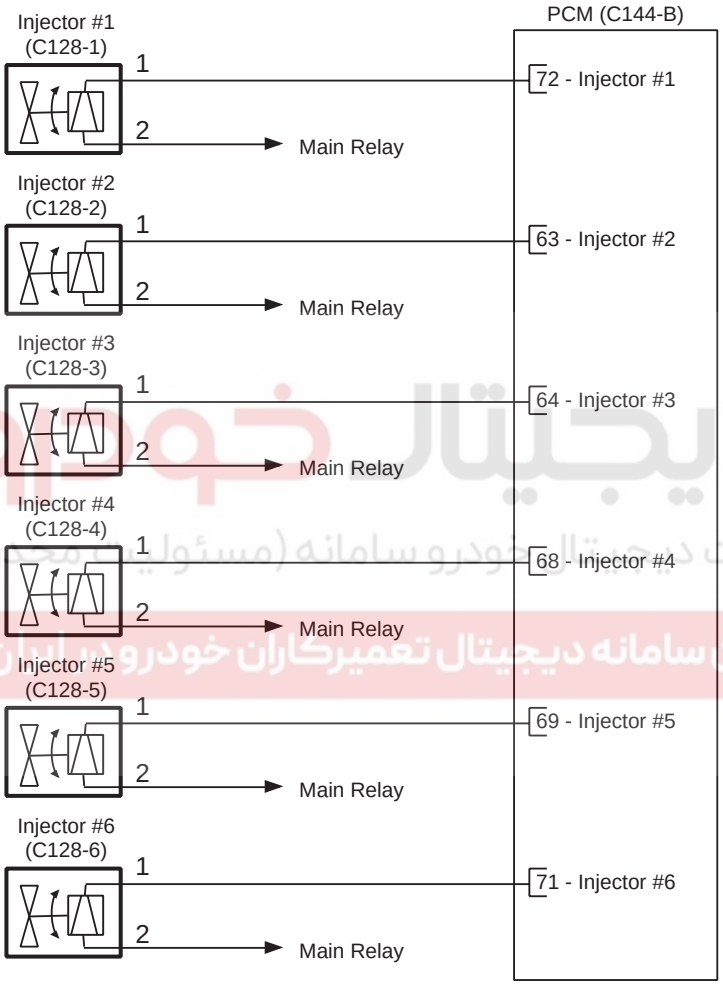
Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal Low	• Poor connection • Open or short to ground in power harness • Open or short to ground in control harness • Injector • PCM
Enable condition	• Engine running • 11V ≤ Battery voltage ≤ 16V • No disabling faults present • Above conditions are met > 0.5sec.	
threshold value	• Open or short to ground	
diagnosis time	• Continuous	
MIL ON condition	• 2 driving cycles	

SPECIFICATION ECA33543

Item	Coil resistance(Ω)
Injector	11.4 ~ 12.6Ω (at 20℃/ 68°F)

SCHEMATIC DIAGRAM EFDAF961

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1

Terminal	Connected to	Function
1	PCM C144-B (72)	Injector #1 control
2	Main Relay	Battery Voltage (B+)

Injector #2

Terminal	Connected to	Function
1	PCM C144-B (63)	Injector #2 control
2	Main Relay	Battery Voltage (B+)

Injector #3

Terminal	Connected to	Function
1	PCM C144-B (64)	Injector #3 control
2	Main Relay	Battery Voltage (B+)

Injector #4

Terminal	Connected to	Function
1	PCM C144-B (68)	Injector #4 control
2	Main Relay	Battery Voltage (B+)

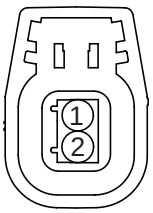
Injector #5

Terminal	Connected to	Function
1	PCM C144-B (69)	Injector #5 control
2	Main Relay	Battery Voltage (B+)

Injector #6

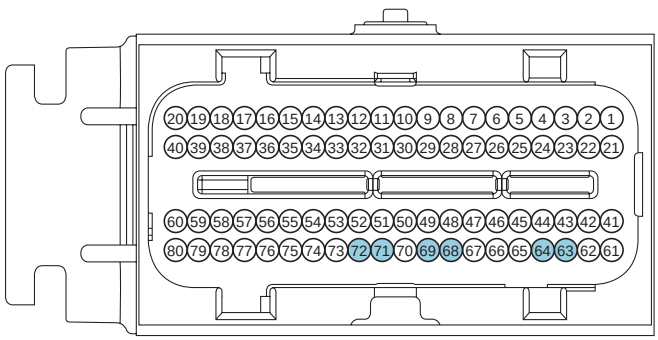
Terminal	Connected to	Function
1	PCM C144-B (71)	Injector #6 control
2	Main Relay	Battery Voltage (B+)

[HARNESS CONNECTORS]



C128-1,2,3,4,5,6

Injector #1,2,3,4,5,6

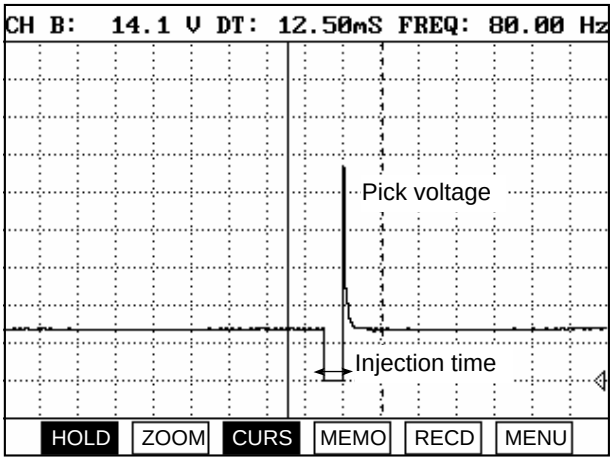


C144-B

PCM

UFBG254A

SIGNAL WAVEFROM AND DATA ED49A023



EGRF607S

When the PCM energizes the injector by grounding 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 momentarily peak.

MONITOR DTC STATUS E9A0A952

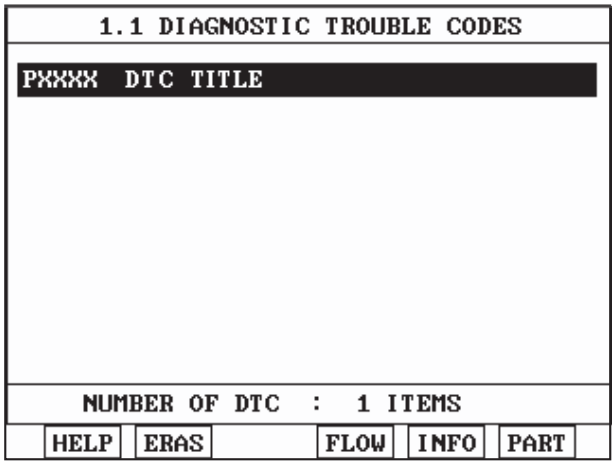
1. Check DTC Status

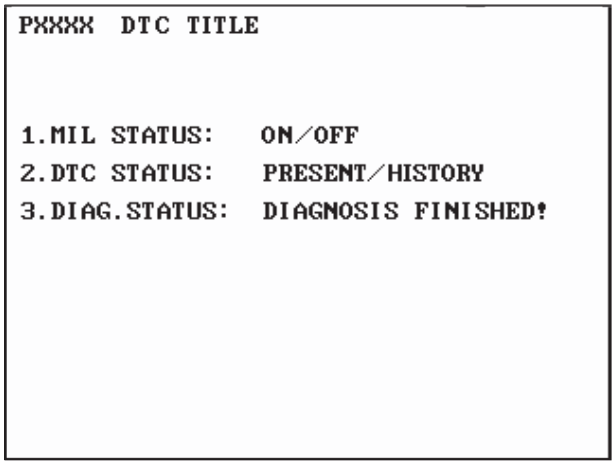
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E057333B

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E0EC618D

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 E7E36FA0

1. Check short to ground in harness
   1) IG "OFF" and disconnect injector connector and PCM connector.
   2) Measure resistance between terminal 1 of injector 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.

2. Check open in harness

1) IG "OFF" and disconnect injector connector and PCM connector.

2) P0261) Measure resistance between terminal 1 of injector harness connector and 72 of PCM harness connector(C144-B).
P0264) Measure resistance between terminal 1 of injector harness connector and 63 of PCM harness connector(C144-B).
P0267) Measure resistance between terminal 1 of injector harness connector and 64 of PCM harness connector(C144-B).
P0270) Measure resistance between terminal 1 of injector harness connector and 68 of PCM harness connector(C144-B).
P0273) Measure resistance between terminal 1 of injector harness connector and 69 of PCM harness connector(C144-B).
P0276) Measure resistance between terminal 1 of injector harness connector and 71 of PCM 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 E686BDC7

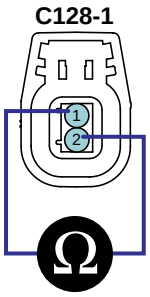
1. Check injector

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 #1 control
2. Battery voltage

SBLF26506L

3) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E30FCC52

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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 E7D4D5BF

SGHFL7319N

GENERAL DESCRIPTION EBFED76B

Based on information from various sensors, the PCM calculates 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 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 the control circuit, the fuel injector is closed and circuit voltage should momentarily peak.

DTC DESCRIPTION E6AAFB81

Checking output signals from injectors under detecting condition, if an output signal is high, PCM 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 EB2A79B0

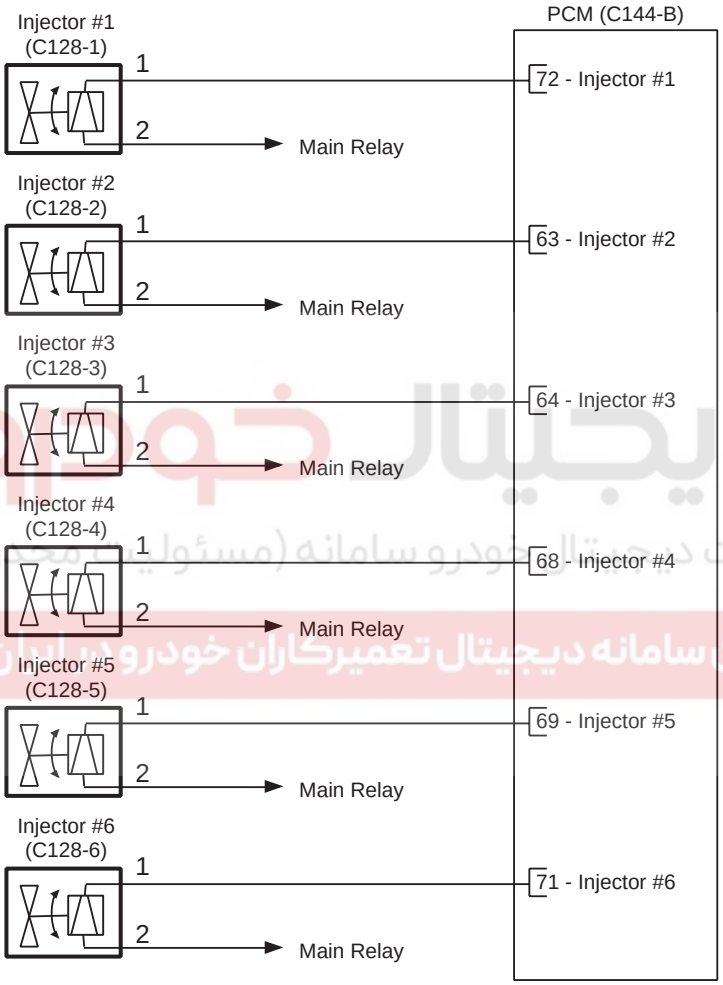
Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal High	• Poor connection • Short to battery in harness • Injector • PCM
Enable condition	• Engine running • 11V ≤ Battery voltage ≤ 16V • No disabling faults present • Above conditions are met 〉 0.5sec.	
threshold value	• Short to battery	
diagnosis time	• Continuous	
MIL ON condition	• 2 driving cycles	

SPECIFICATION E392B80F

Item	Coil resistance(Ω)
Injector	11.4 ~ 12.6Ω (at 20℃/ 68°F)

SCHEMATIC DIAGRAM EDCB618C

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1

Terminal	Connected to	Function
1	PCM C144-B (72)	Injector #1 control
2	Main Relay	Battery Voltage (B+)

Injector #2

Terminal	Connected to	Function
1	PCM C144-B (63)	Injector #2 control
2	Main Relay	Battery Voltage (B+)

Injector #3

Terminal	Connected to	Function
1	PCM C144-B (64)	Injector #3 control
2	Main Relay	Battery Voltage (B+)

Injector #4

Terminal	Connected to	Function
1	PCM C144-B (68)	Injector #4 control
2	Main Relay	Battery Voltage (B+)

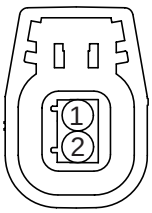
Injector #5

Terminal	Connected to	Function
1	PCM C144-B (69)	Injector #5 control
2	Main Relay	Battery Voltage (B+)

Injector #6

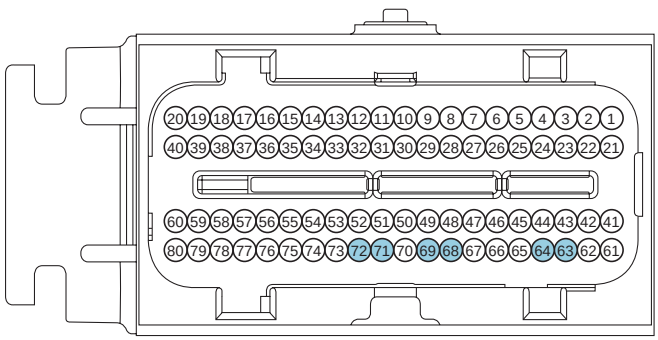
Terminal	Connected to	Function
1	PCM C144-B (71)	Injector #6 control
2	Main Relay	Battery Voltage (B+)

[HARNESS CONNECTORS]



C128-1,2,3,4,5,6

Injector #1,2,3,4,5,6

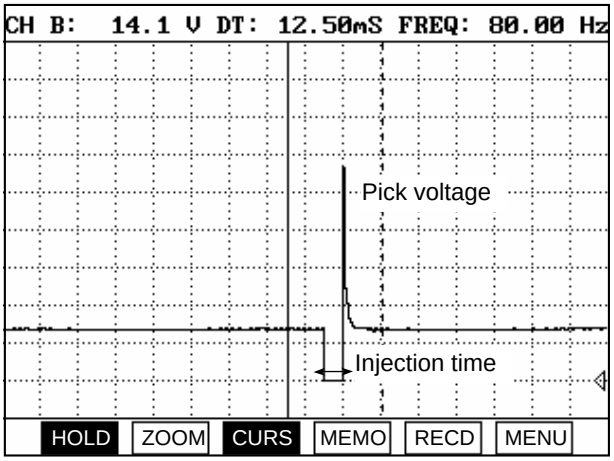


C144-B

PCM

UFBG254A

SIGNAL WAVEFROM AND DATA E239BBBD



EGRF607S

When the PCM energizes the injector by grounding 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 momentarily peak.

MONITOR DTC STATUS EE9D96F8

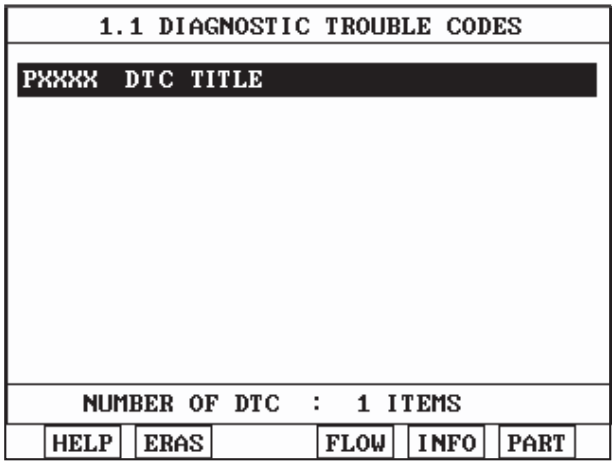
1. Check DTC Status

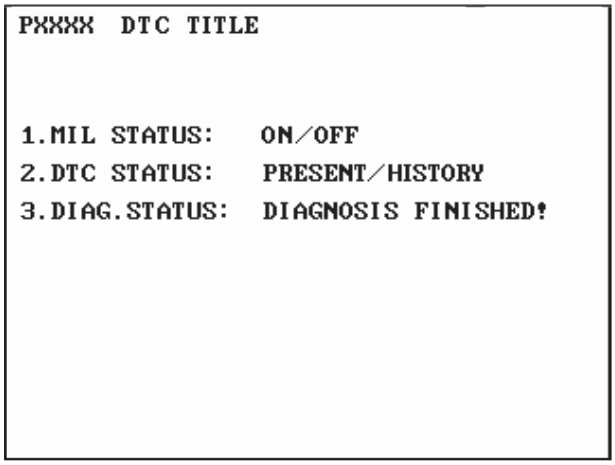
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EE69A72F

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 ED84579B

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 PCM 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 E00DB280

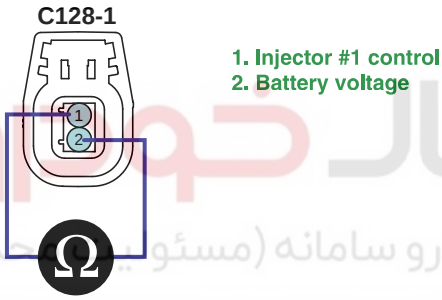
1. Check injector

   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)



SBLF26507L

   3) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E6C84350

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

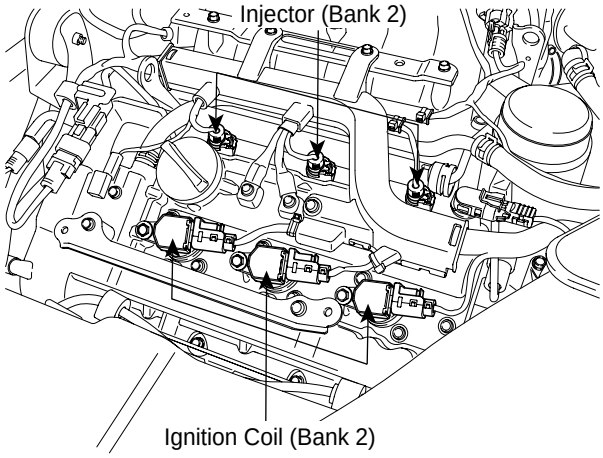
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0300 RANDOM/MULTIPLE CYLINDER MISFIRE DETECTED

COMPONENT LOCATION E3F08A4B



SGHFL7319N

GENERAL DESCRIPTION E8A1471D

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 PCM monitors the crankshaft speed variation to determine if any misfiring generated. The PCM 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 E74785CE

The PCM measures reference event times and calculates the positive and negative acceleration of the crank wheel to detrmine whether a misfire has occurred.When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can ocur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire cause a loss of torque produced from that cylinder. PCM 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 Indivisual 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., PCM sets DTC relating to misfire and conducts the fuel-cut to protect the catalyst.

DTC DETECTING CONDITION E30D2B4A

Item		Detecting Condition	Possible Cause
DTC strategy		• Determine ir a muliple cylinder misfire or a cylinder specific misfire is occurring by monitoring crnckshaft 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 PCM
Enable condition		No disabling faults present / No disabiling Active Faults • P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 P0103 / P0102 / 0108 / 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)	
Thresh-old 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 emissins)	
	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 EF784615

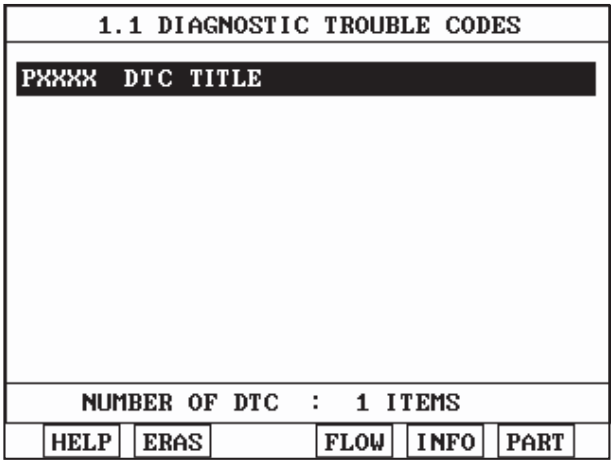
1. Check DTC Status

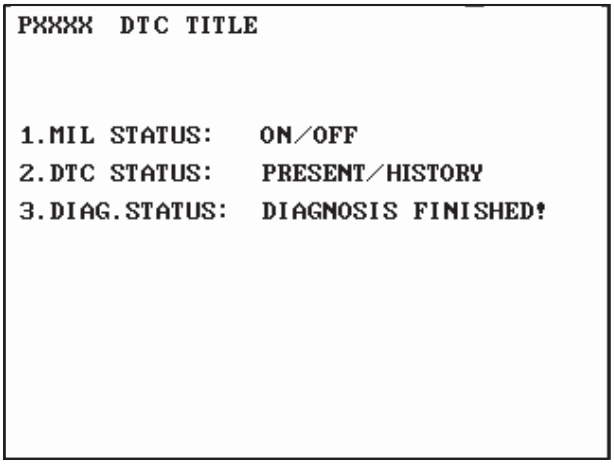
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

5) Is "Present" Fault displayed?

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 EB91C579

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 indicated below

2. Check Air Leakage

1) Visually/physically inspect the 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

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 puling 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 prot "A" and verify that air comes out of prot "B"

6) Blow through valve from prot "B" and verifty 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 indicated 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 pulg hole

5) Crank the engine at wide open throttle 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 indicated below

NO

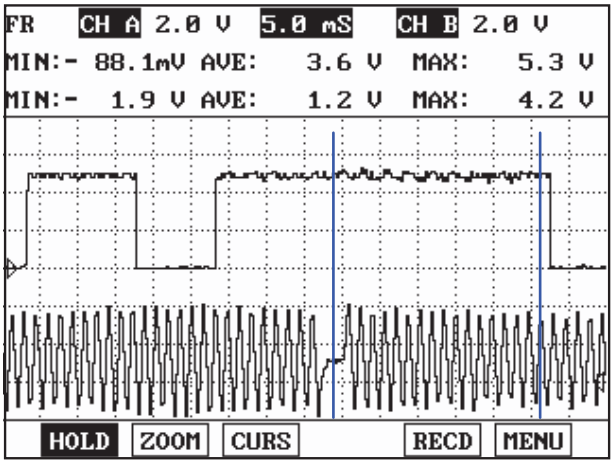
▶ Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.
▶ If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

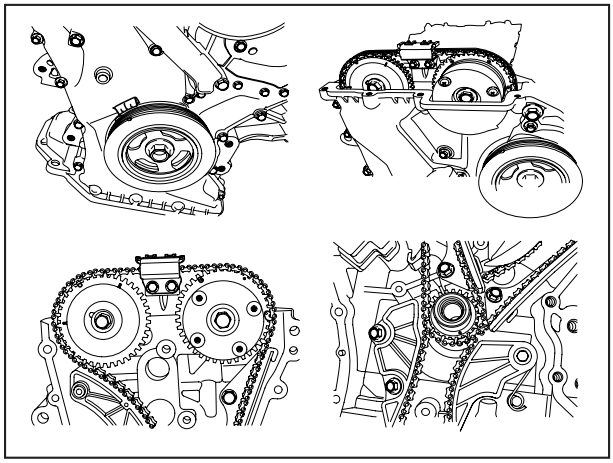
5. Check Timing

1) Ignition "OFF"

2) Check for correct alignment of CMP and CKP signals.

Reference : The 17th of CKP signal from missing tooth is aligned with high of CMP signal





SEPFL6417N

3) Are all timing marks alligned correctly ?

YES

▶ Go to "Check Fuel Pressure" as indicated 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 presonal injury or fire damage to vehicle components.*

1) IG "OFF" and disconnect Fuel Pump Relay in Junction Box.

2) Start the engine and wait until the engine stalls.

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/㎠, 54.3 ~ 55.8 psi)

7) Is the measured fuel pressure within specifications ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 E67AD217

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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 EE69261D

SGHFL7319N

GENERAL DESCRIPTION EBC9CB99

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 PCM monitors the crankshaft speed variation to determine if any misfiring generated. The PCM 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 ED69233B

The PCM measures reference event times and calculates the positive and negative acceleration of the crank wheel to detrmine whether a misfire has occurred.When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can ocur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire cause a loss of torque produced from that cylinder. PCM 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 Indivisual 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., PCM sets DTC relating to misfire and conducts the fuel-cut to protect the catalyst.

DTC DETECTING CONDITION EA559DBF

Item		Detecting Condition	Possible Cause
DTC strategy		• Determine ir a muliple cylinder misfire or a cylinder specific misfire is occurring by monitoring crnckshaft 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 PCM
Enable condition		No disabling faults present / No disabiling Active Faults • P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 P0103 / P0102 / 0108 / 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)	
Thresh-old 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 emissins)	
	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 E2AF2B9C

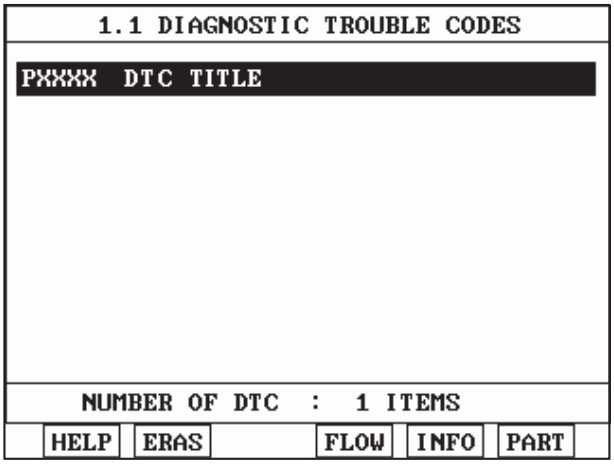
1. Check DTC Status

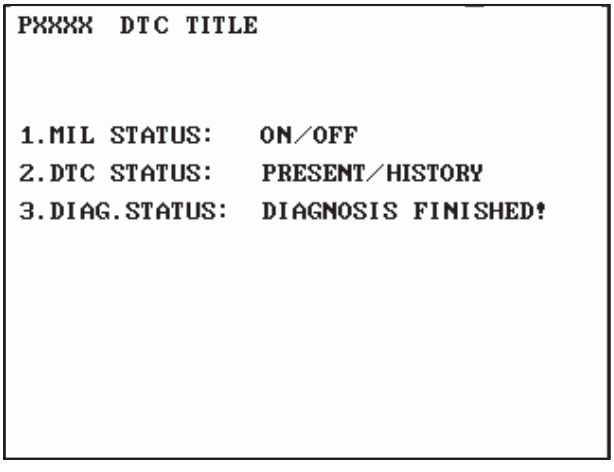
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

5) Is "Present" Fault displayed?

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 EE573C24

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 indicated below

2. Check Air Leakage

1) Visually/physically inspect the 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

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 puling 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 prot "A" and verify that air comes out of prot "B"

6) Blow through valve from prot "B" and verifty 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 indicated 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 pulg hole

5) Crank the engine with widely opend throttle valve and check compression pressure at each cylinder

Specification : 1323kPa(13.5 kg/cm²,192 psi)

6) Is compression pressure for each cylinder displayed within specifications ?

YES

▶ Go to "Check Timing " as indicated below

NO

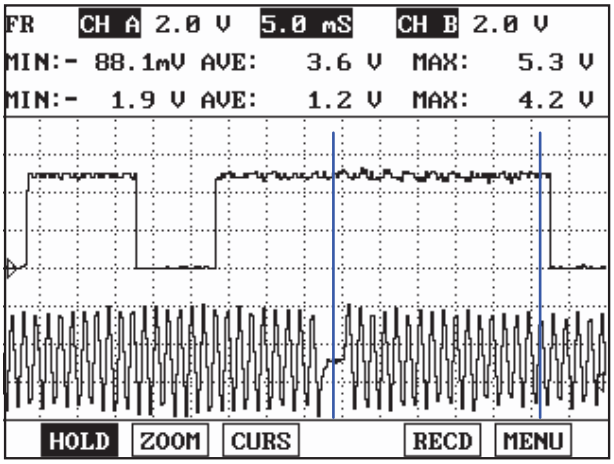
▶ Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.
▶ If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

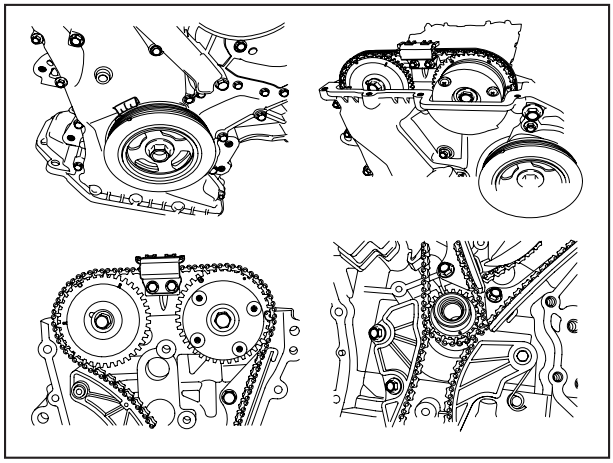
5. Check Timing

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





SEPFL6417N

3) Are all timing marks alligned correctly ?

YES

▶ Go to "Check Fuel Pressure" as indicated 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 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/㎠, 54.3 ~ 55.8 psi)

7) Is the measured fuel pressure within specifications ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 EC7A3BB9

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 EC7CF343

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 PCM 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 PCM identifies which cylinder is at top dead center.

DTC DESCRIPTION E1F05755

Checking tooth error correction under detecting condition, if the TEC(Tooth Error Correction) is out of Threshold value, PCM sets P0315.

DTC DETECTING CONDITION E8494BC2

Item	Detecting Condition	Possible cause
DTC Strategy	• This DTC indicates that crankwheel tooth error has not been learned.	• Loosened CKPS • Target wheel • PCM
Enable Conditions	• 10% ≤ Engine load < 90% • 2000 rpm ≤ engine speed ≤ 4000 rpm • TEC(Tooth Error Correction) RPM stability timer > 10sec • 0℃(32°F) < coolant temperature < 110℃(230°F) • Not active disabling faults	
Threshold value	• Distance driven without learning(during fuel cut off) tooth error ≥ 6500km(4038.91275 mile) • Acutal Value is higher or lower than calibrated value	
Diagnosis Time	• Continuous	
MIL On Condition	• DTC only	

MONITOR DTC STATUS E092040F

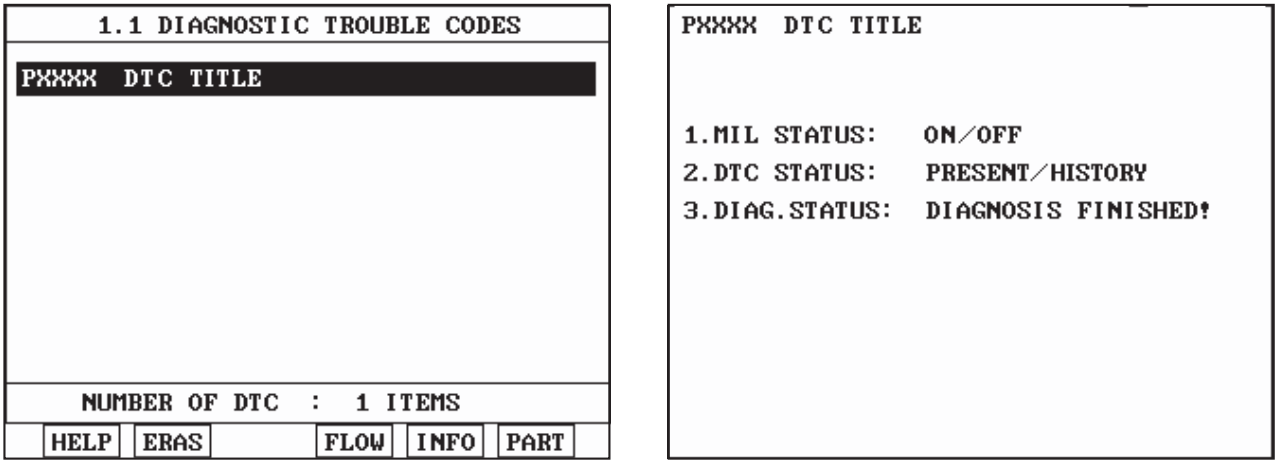
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC’s information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Fault is intermittent caused by PCM 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 E9FB5821

1. Visually check CKPS and target wheel

   1) IG "OFF"

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

   3) Are normal conditions present ?

   YES

   ▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 EC4F9988

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

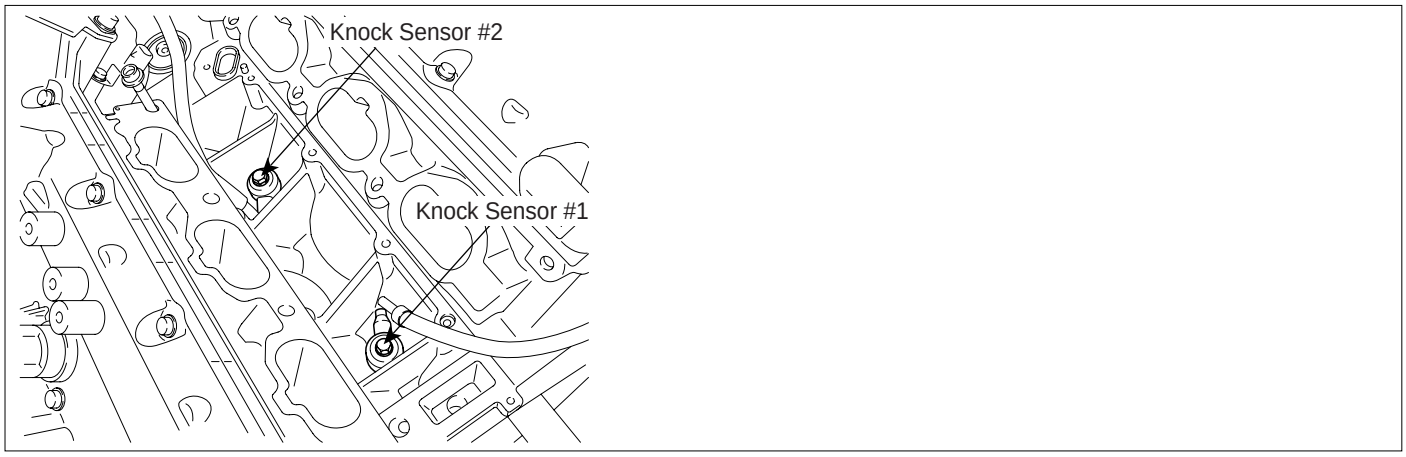
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0325 KNOCK SENSOR 1 CIRCUIT

COMPONENT LOCATION E10716EF



SGHFL7320N

GENERAL DESCRIPTION E50A31B2

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 PCM. With input signals from camshaft position and crankshaft position sensor, PCM can identify which cylinder is knocking. PCM filters vibrations and determines if the vibrations are knocking signal. The Engine Control Module (PCM) uses this signal to suppress knocking by retarding ignition timing. The PCM 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 PCM under normal engine operation.

DTC DESCRIPTION E8416761

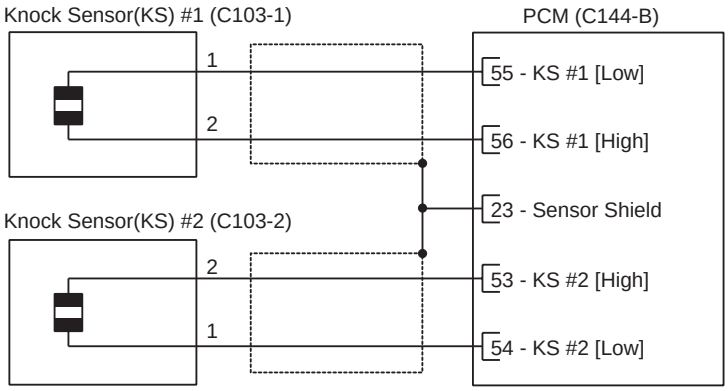
Checking the range of input signal with a knock sensor under detecting condition, PCM senses open in knock sensor circuit or malfunction of sensor. If a knock signal or noise level is inputted without the specified value during standard duration, PCM sets P0325.

DTC DETECTING CONDITION E3494B71

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal open	• Poor connection • Open in harness • Knock sensor • PCM
Enable Conditions	• Pressure in intake manifold is normal. • Engine speed ≥ 2000 rpm	
Threshold value	• Filter coefficient < 1.0	
Diagnosis Time	• Continuous	
MIL On Condition	• DTC Only	

SCHEMATIC DIAGRAM E211DD2E

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

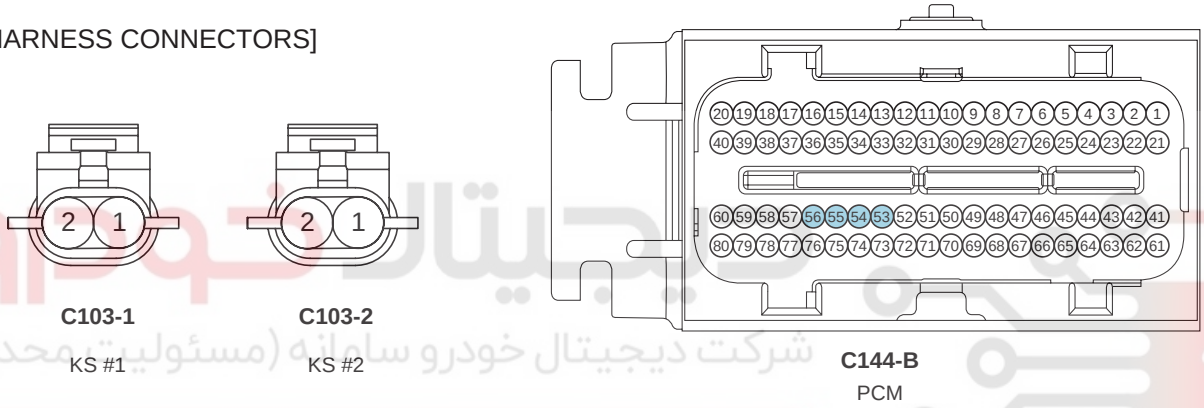
KS #1

Terminal	Connected to	Function
1	PCM C144-B (55)	KS #1 [Low] signal
2	PCM C144-B (56)	KS #1 [High] signal

KS #2

Terminal	Connected to	Function
1	PCM C144-B (54)	KS #2 [Low] signal
2	PCM C144-B (53)	KS #2 [High] signal

[HARNESS CONNECTORS]



C103-1
KS #1

C103-2
KS #2

C144-B
PCM

UFBG253A

MONITOR DTC STATUS EEBF642C

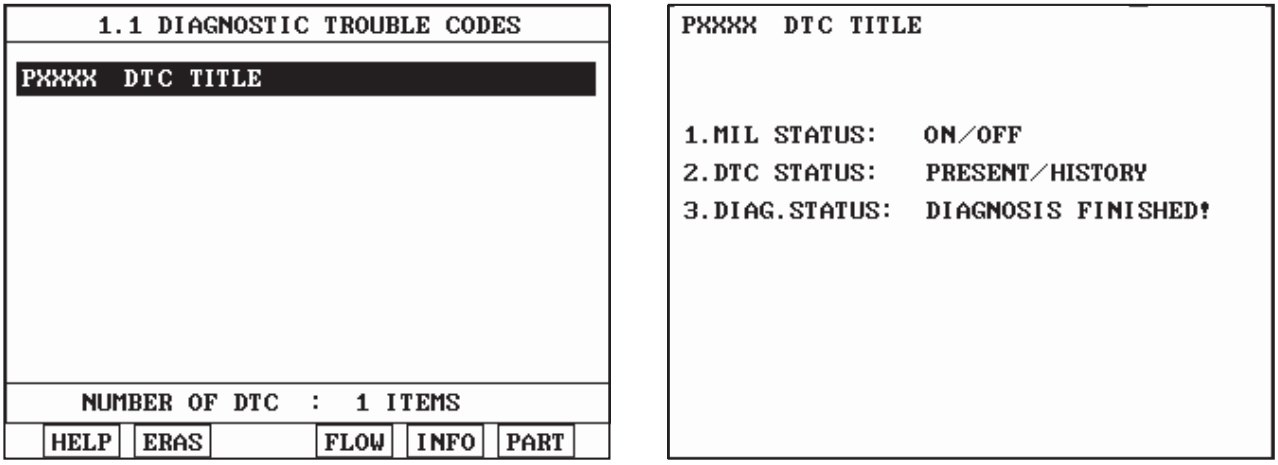
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EF7CB990

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E5786078

1. Check open in harness
   1) IG "OFF" and disconnect knock sensor connector and PCM connector.
   2) Measure resistance between terminal 1 of knock sensor harness connector and terminal 55 of PCM harness connector(C144-B).

3) Measure resistance between terminal 2 of knock sensor harness connector and terminal 56 of PCM 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 PCM. and then if the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EE6F16AD

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0326 KNOCK SENSOR 1 CIRCUIT RANGE/PERFORMANCE (BANK 1)

COMPONENT LOCATION E07066E6

Refer to DTC P0325.

GENERAL DESCRIPTION E7187021

Refer to DTC P0325.

DTC DESCRIPTION E6D4A955

Checking the range of input signal with a knock sensor under detecting condition, PCM senses short in knock sensor circuit or malfunction of sensor. If the filtered knock signals are out of the threshold value, PCM sets P0326.

DTC DETECTING CONDITION E2CA9C8B

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal short	• Poor connection • Short in harness • Knock sensor • PCM
Enable Conditions	• Pressure in intake manifold is normal. • Engine speed ≥ 2000 rpm	
Threshold value	• Knock Filtered Value < 5 or > 65	
Diagnosis Time	• Continuous	
MIL On Condition	• DTC Only	

SCHEMATIC DIAGRAM E00F769C

Refer to DTC P0325.

MONITOR DTC STATUS ECA4B6EA

Refer to DTC P0325.

TERMINAL AND CONNECTOR INSPECTION EC3F3BE4

Refer to DTC P0325.

SIGNAL CIRCUIT INSPECTION E2813CB5

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 PCM 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 PCM. and then if the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NO

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

NOTE

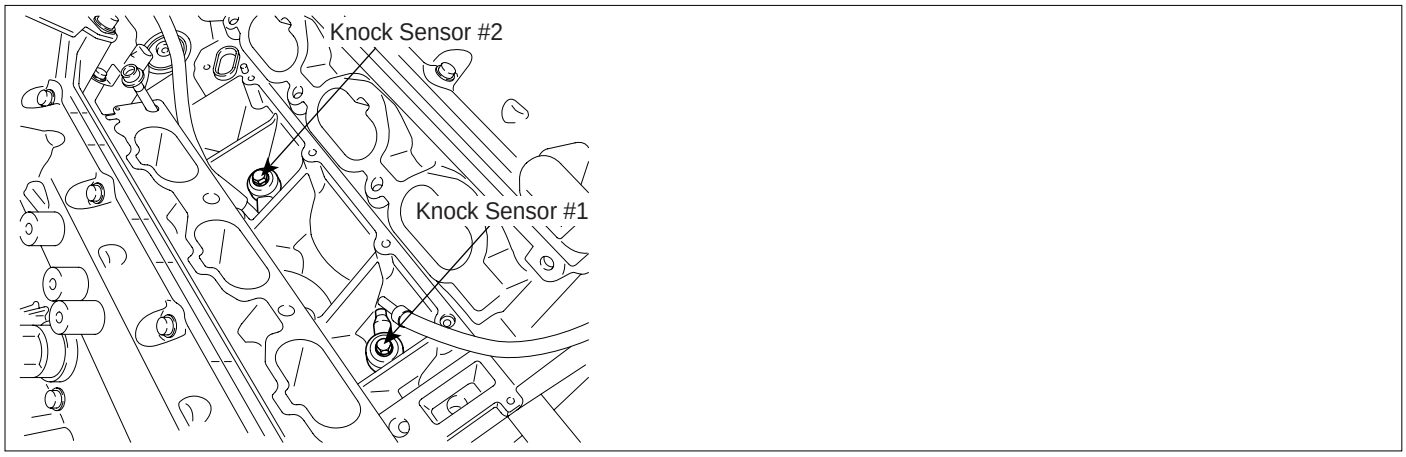
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E54464DC

Refer to DTC P0325.

DTC P0330 KNOCK SENSOR 2 CIRCUIT

COMPONENT LOCATIONS EE3B9EA0



SGHFL7320N

GENERAL DESCRIPTION EC77A153

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 PCM. With input signals from camshaft position and crankshaft position sensor, PCM can identify which cylinder is knocking. PCM filters vibrations and determines if the vibrations are knocking signal. The Engine Control Module (PCM) uses this signal to suppress knocking by retarding ignition timing. The PCM 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 PCM under normal engine operation.

DTC DESCRIPTION EB2370F9

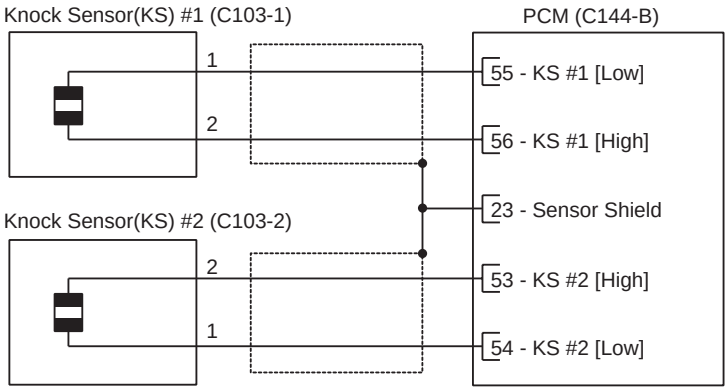
Checking the range of input signal with a knock sensor under detecting condition, PCM senses open in knock sensor circuit or malfunction of sensor. If a knock signal or noise level is inputted without the specified value during standard duration, PCM sets P0330.

DTC DETECTING CONDITION E5D73A42

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal open	• Poor connection • Open in harness • Knock sensor • PCM
Enable Conditions	• Pressure in intake manifold is normal. • Engine speed ≥ 2000 rpm	
Threshold value	• Filter coefficient < 1.0	
Diagnosis Time	• Continuous	
MIL On Condition	• DTC Only	

SCHEMATIC DIAGRAM E9B3E29E

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

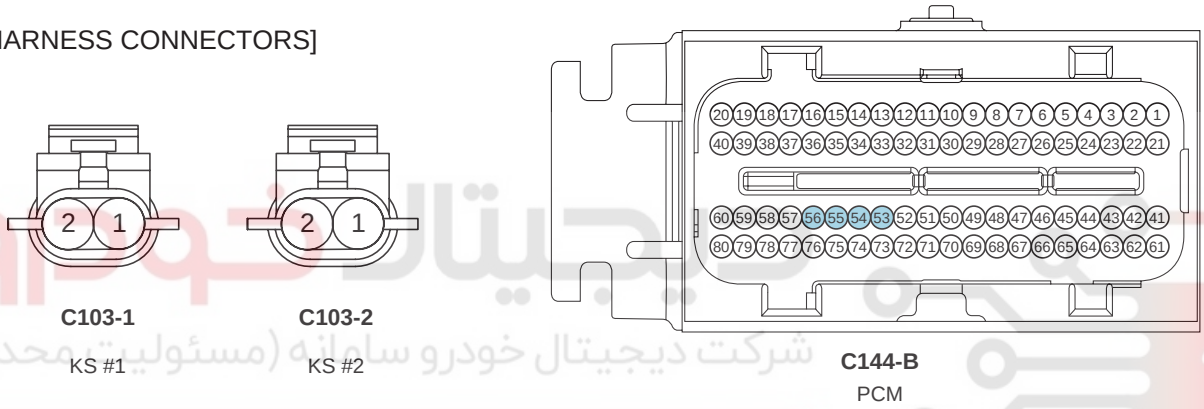
KS #1

Terminal	Connected to	Function
1	PCM C144-B (55)	KS #1 [Low] signal
2	PCM C144-B (56)	KS #1 [High] signal

KS #2

Terminal	Connected to	Function
1	PCM C144-B (54)	KS #2 [Low] signal
2	PCM C144-B (53)	KS #2 [High] signal

[HARNESS CONNECTORS]



UFBG253A

MONITOR DTC STATUS EE75D5E3

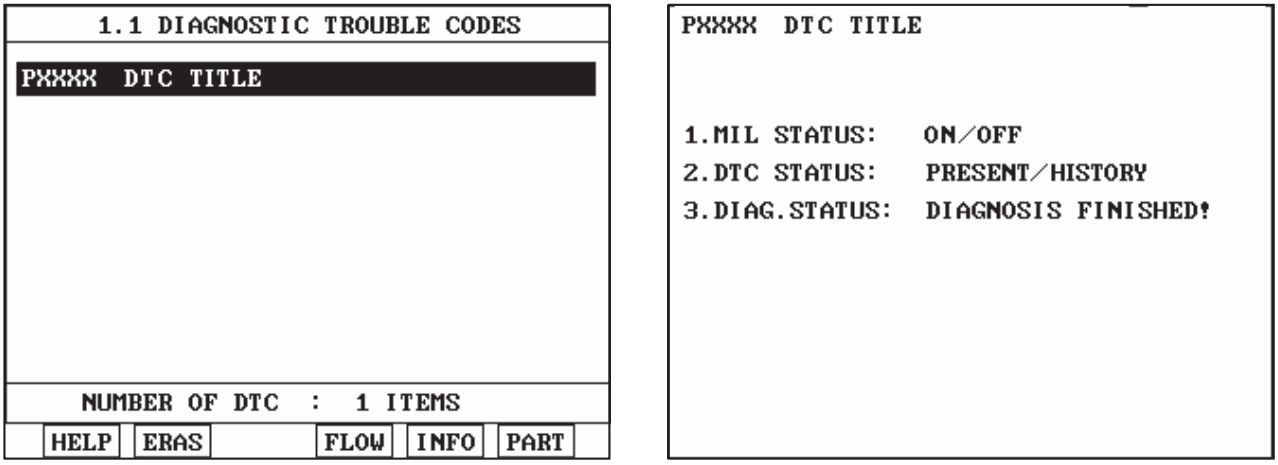
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 ECD3B84D

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 ED23245A

1. Check open in harness

   1) IG "OFF" and disconnect knock sensor connector and PCM connector.

   2) Measure resistance between terminal 1 of knock sensor harness connector and terminal 54 of PCM harness connector(C144-B).

3) Measure resistance between terminal 2 of knock sensor harness connector and terminal 53 of PCM 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 PCM. and then if the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E361B698

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0331 KNOCK SENSOR 2 CIRCUIT RANGE/PERFORMANCE (BANK 2)

COMPONENT LOCATION EB286D34

Refer to DTC P0330.

GENERAL DESCRIPTION E49DF60D

Refer to DTC P0330.

DTC DESCRIPTION EAFEED14

Checking the range of input signal with a knock sensor under detecting condition, PCM senses short in knock sensor circuit or malfunction of sensor. If the filtered knock signals are out of the thresold value. uring standard duration, PCM sets P0331.

DTC DETECTING CONDITION EB8CFCA9

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal short	• Poor connection • Short in harness • Knock sensor • PCM
Enable Conditions	• Pressure in intake manifold is normal. • Engine speed ≥ 2000 rpm	
Threshold value	• Knock Filtered Value 〈 5 or 〉 65	
Diagnosis Time	• Continuous	
MIL On Condition	• DTC Only	

SCHEMATIC DIAGRAM E31F5FBB

Refer to DTC P0330.

MONITOR DTC STATUS E3646EB4

Refer to DTC P0330.

TERMINAL AND CONNECTOR INSPECTION E22D90C9

Refer to DTC P0330.

SIGNAL CIRCUIT INSPECTION E815E89F

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 PCM 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 PCM. and then if the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NO

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

NOTE

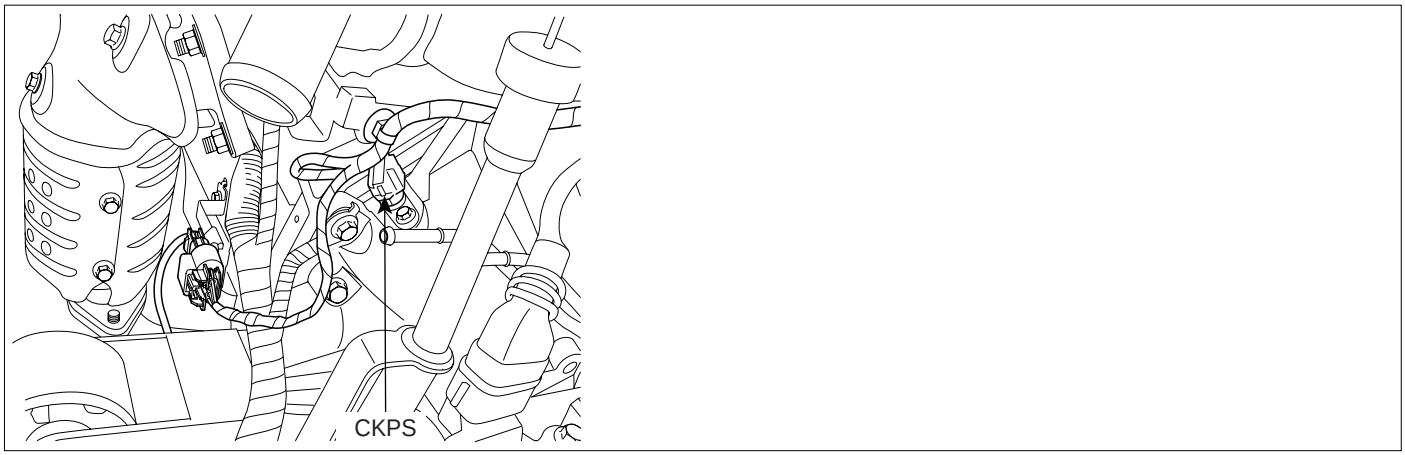
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E5C2CC19

Refer to DTC P0330.

DTC P0335 CRANKSHAFT POSITION SENSOR A CIRCUIT

COMPONENT LOCATION EB72017A



SGHFL7321N

GENERAL DESCRIPTION E2CB1554

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 PCM 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 PCM identifies which cylinder is at top dead center.

DTC DESCRIPTION EAD9E423

Checking reference signals from CKPS under detecting condition, if any signal is not detected for more than 0.15 sec., PCM sets P0335. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

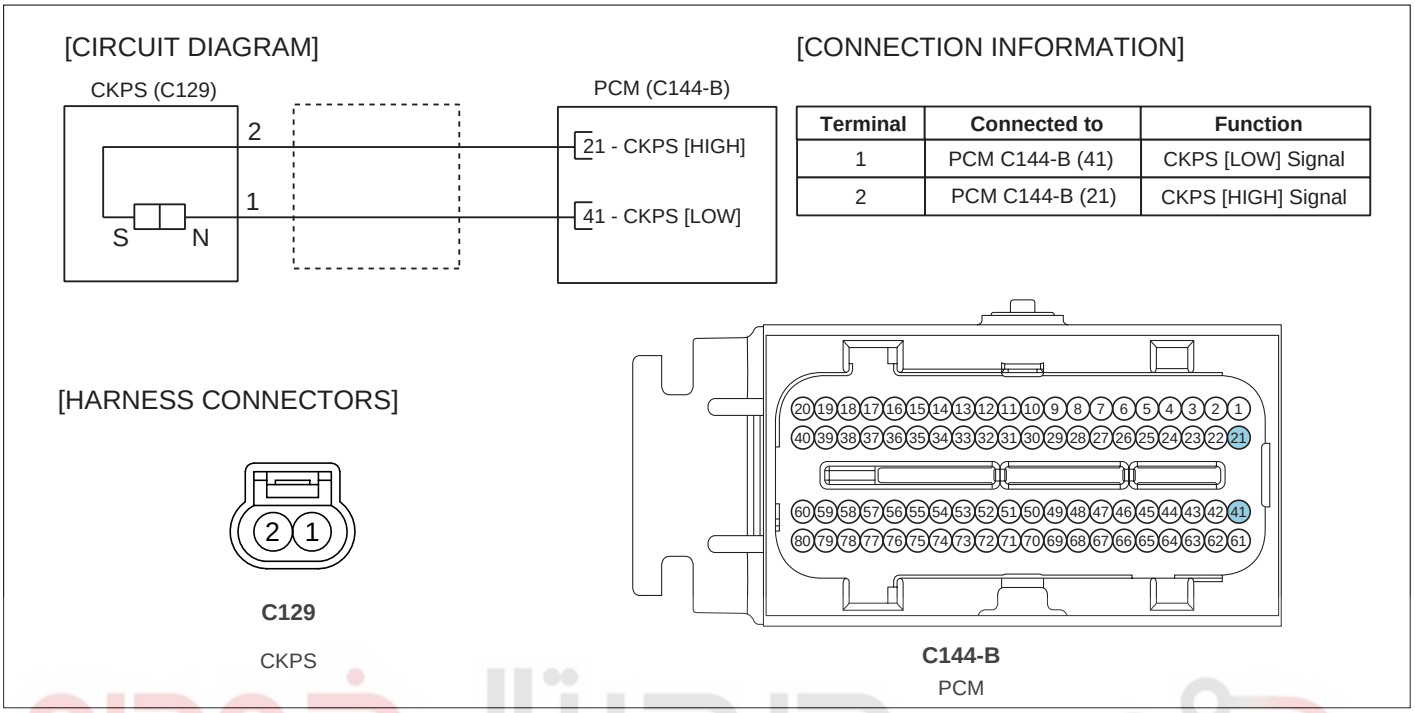
DTC DETECTING CONDITION E79AFB74

Item	Detecting Condition	Possible cause
DTC Strategy	• Check reference wave during cranking	• Poor connection • Open in harness • CKP sensor • PCM
Enable Conditions	• IG "ON", Cranking or engine-off during driving • No DTC related to CAM • Camshaft positon sensor state change	
Threshold value	• No reference signal over 0.15 sec.	
Diagnosis Time	• 0.15 sec.	
MIL On Condition	• 2 driving cycles	

SPECIFICATION EA8C5FCD

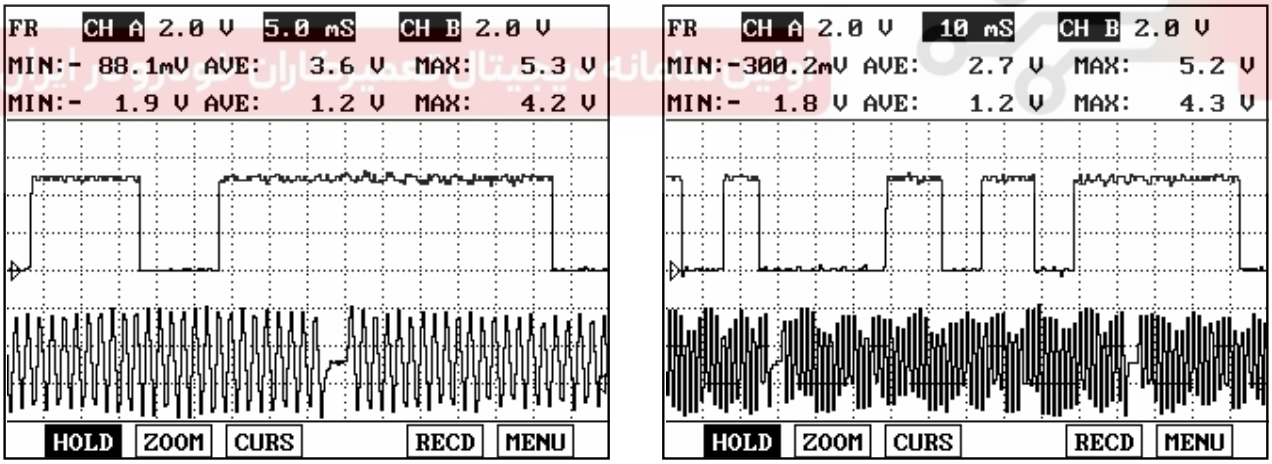
Resistance	700 ± 70Ω

SCHEMATIC DIAGRAM E10AE4A3



SGHF17010N

SIGNAL WAVEFROM AND DATA E362672E



EGRF610K

MONITOR DTC STATUS E5E262A1

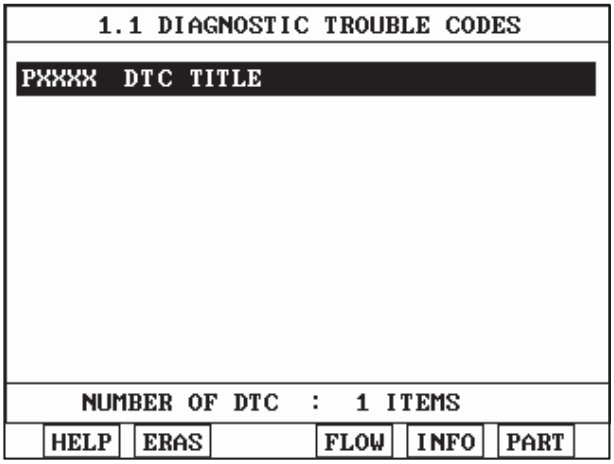
1. Check DTC Status

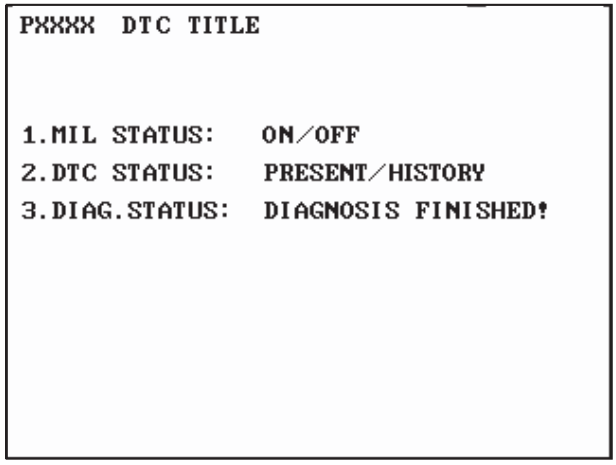
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.





SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EC5A6738

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E83C5227

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 PCM connector.

2) Measure resistance between terminal 1 of CKPS harness connector and terminal 41 of PCM harness connector(C144-B).

3) Measure resistance between terminal 2 of CKPS harness connector and terminal 21 of PCM harness connector(C144-B).

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 E641DC8D

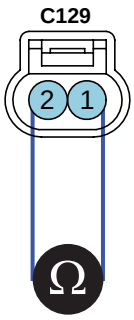
1. Check CKPS

1) IG "OFF" and disconnect CKPS connector.

2) Measure resistance between terminals 1 and 2 of CKPS connector.(Component side)

SPECIFIATION :

Resistance	700 ± 70Ω



1. CKPS [LOW] Signal
2. CKPS [HIGH] Signal

SGHFL7225N

3) Is the measured resistance within specification?

YES

▶ Go to "Check signal waveform of CKPS" as follows.

NO

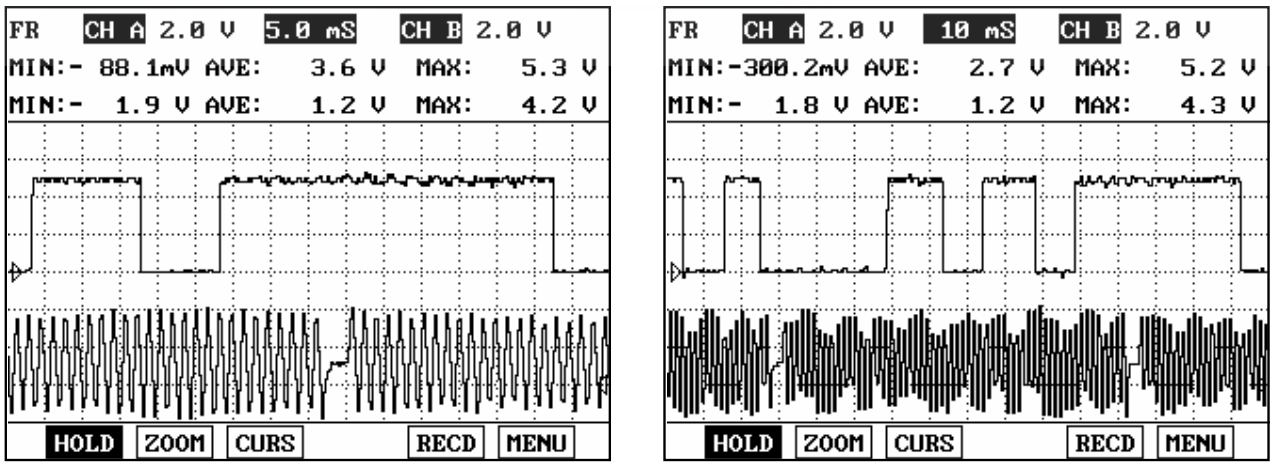
▶ Substitute with a known - good CKPS and check for proper operation. If the problem is corrected, replace CKPS and go to "Verification of Vehicle Repair" procedure.

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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EDF6B496

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0336 CRANKSHAFT POSITION SENSOR A CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION E2DA9B62

Refer to DTC P0335.

GENERAL DESCRIPTION ECA89724

Refer to DTC P0335.

DTC DESCRIPTION E6497997

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., PCM sets P0336. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EFF15DB7

Item	Detecting Condition	Possible cause
DTC Strategy	• Detecting extra/missing pulses between consecutive 58X reference pulses	• Poor connection • Noise • Short in harness • Target wheel • PCM
Enable Conditions	• Engine running	
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 EAB07F70

Resistance	700 ± 70Ω

SCHEMATIC DIAGRAM E520B678

Refer to DTC P0335.

SIGNAL WAVEFROM AND DATA E18C7EC6

Refer to DTC P0335.

MONITOR DTC STATUS E465742D

Refer to DTC P0335.

TERMINAL AND CONNECTOR INSPECTION E9665069

Refer to DTC P0335.

SIGNAL CIRCUIT INSPECTION ECCDD942

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 PCM 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 E17FF00A

1. Visually check CKPS and Target wheel

   1) IG "OFF"

   2) Check CKPS and target wheel for deformation or damage visually

   3) Are normal conditions present ?

   YES

   ▶ Go to "Check CKPS resistance" as follows.

NO

▶ Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

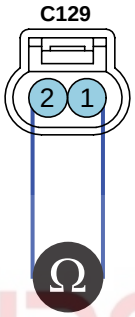
2. Check CKPS resistance

1) IG "OFF" and disconnect CKPS connector.

2) Measure resistance between terminals 1 and 2 of CKPS connector. (Component side)

SPECIFIATION :

Resistance	700 ± 70Ω



1. CKPS [LOW] Signal
2. CKPS [HIGH] Signal

SGHFL7225N

3) Is the measured resistance within specification?

YES

▶ Go to "Check signal waveform of CKPS" as follows.

NO

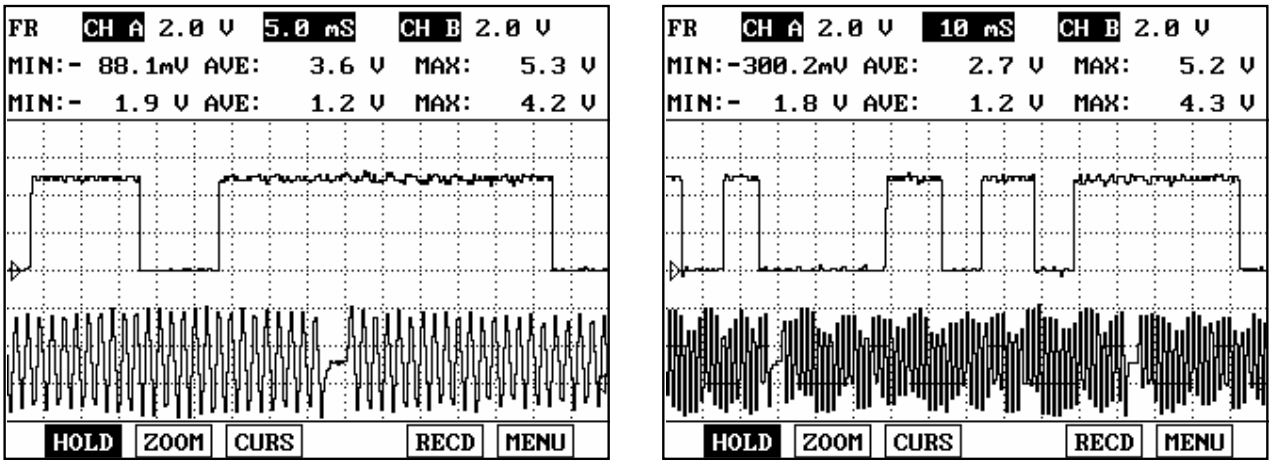
▶ Substitute with a known - good CKPS and check for proper operation. If the problem is corrected, replace CKPS and go to "Verification of Vehicle Repair" procedure.

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 PCM and check for proper operation. If the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NOTE

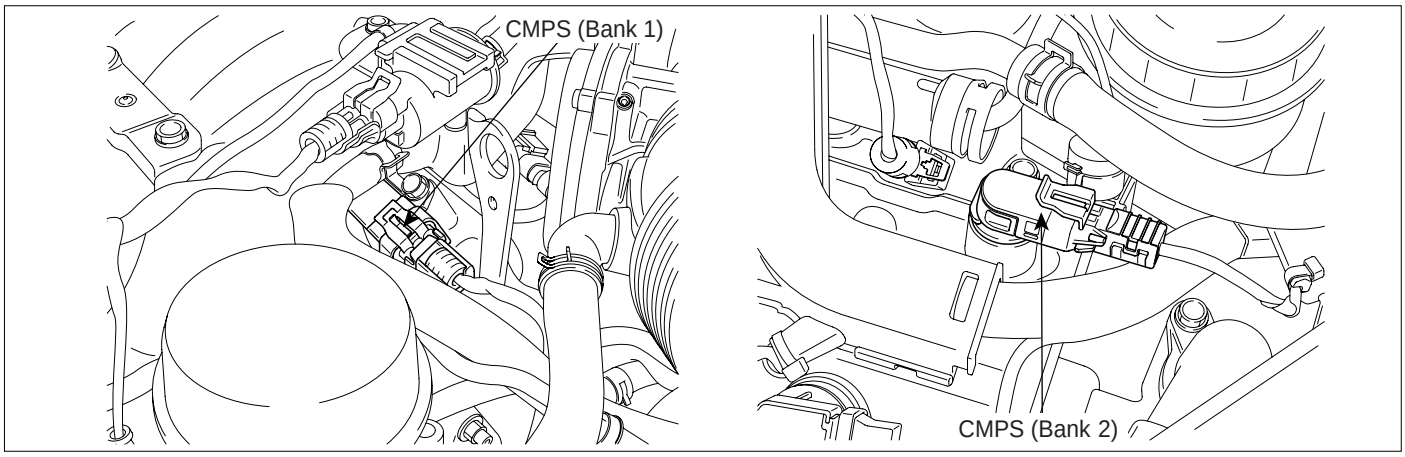
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E709328D

Refer to DTC P0335.

DTC P0340 CAMSHAFT POSITION SENSOR A CIRCUIT MALFUNCTION (BANK 1 OR SINGLE SENSOR)

COMPONENT LOCATION EB59FEE1



SGHFL7322N

GENERAL DESCRIPTION EBC71D58

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 PCM and the PCM uses the CMPS signal for synchronizing the firing of sequential fuel injectors.

DTC DESCRIPTION E93815FE

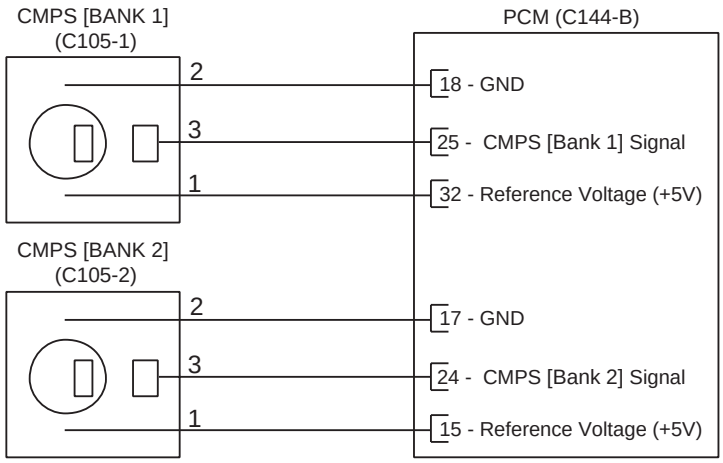
If PCM detects that cam event signal count is over 3 under detecting condition, PCM sets P0340. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E954C956

Item	Detecting Condition	Possible cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Open in harness • CMPS(Bank 1) • PCM
Enable Conditions	• Engine running	
Threshold value	• Cam event signal count ≥ 3	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycles	

SCHEMATIC DIAGRAM E513B4F4

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

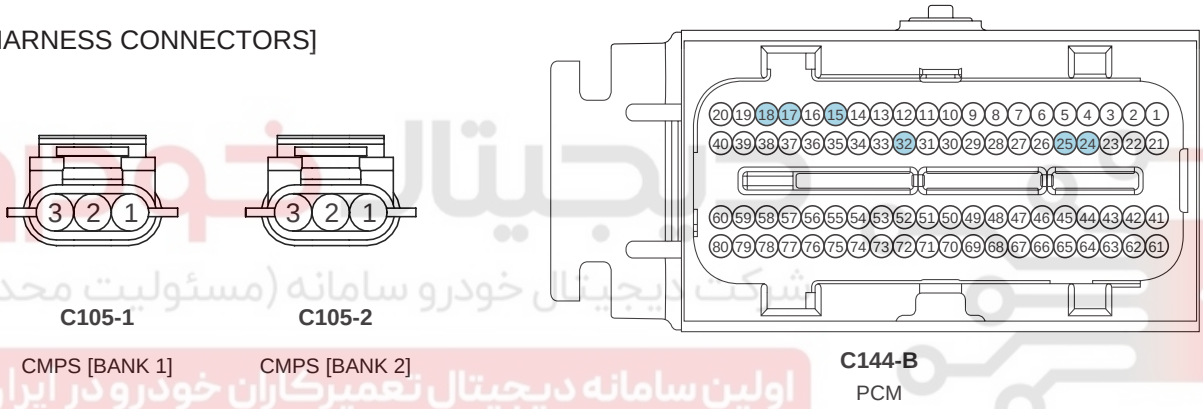
CMPS [BANK 1]

Terminal	Connected to	Function
1	PCM C144-B (32)	Reference Voltage (+5V)
2	PCM C144-B (18)	Sensor ground
3	PCM C144-B (25)	CMPS [Bank 1] signal

CMPS [BANK 2]

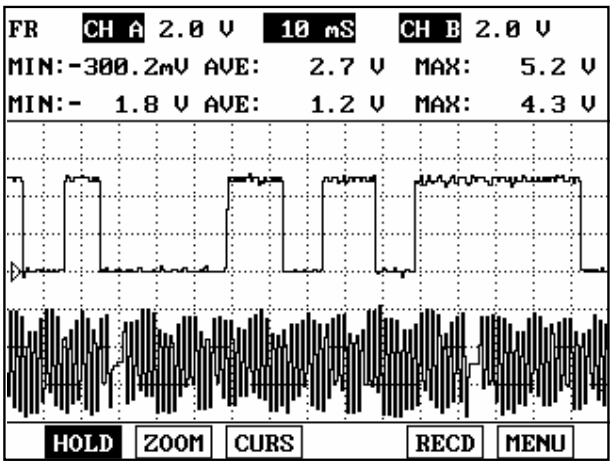
Terminal	Connected to	Function
1	PCM C144-B (15)	Reference Voltage (+5V)
2	PCM C144-B (17)	Sensor ground
3	PCM C144-B (24)	CMPS [Bank 2] signal

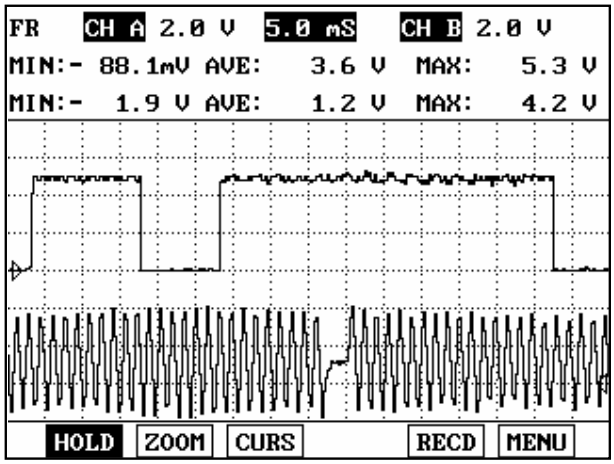
[HARNESS CONNECTORS]



UFBG244A

SIGNAL WAVEFROM AND DATA E634DFB8





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

MONITOR DTC STATUS EFBD79C4

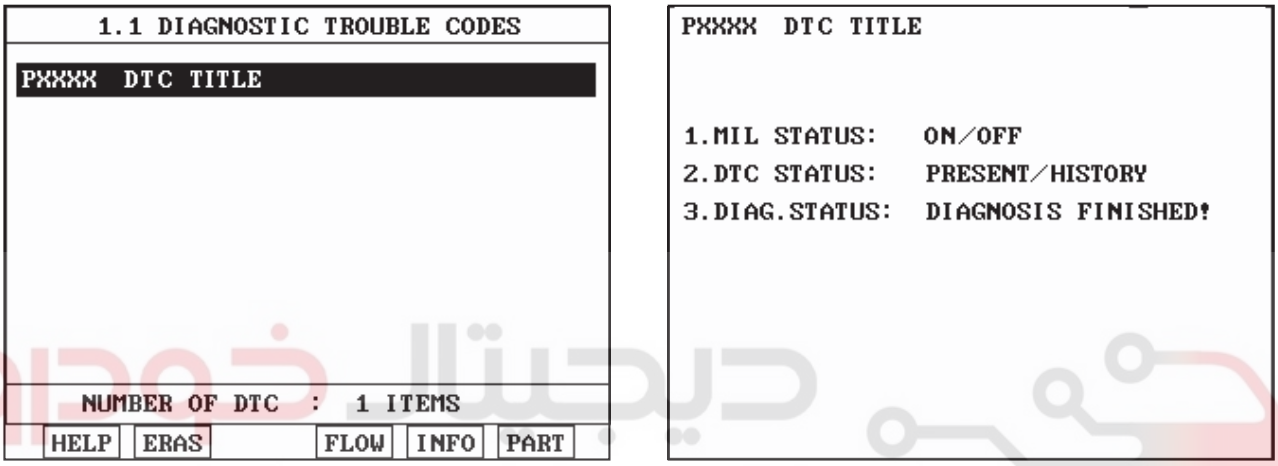
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu.

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E76DFB7E

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 ECD97626

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 E67AEC19

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 PCM connector.
   2) Measure resistance between terminal 3 of CMPS harness connector and terminal 25 of PCM 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 EAB731AB

1. IG "OFF" and disconnect CMPS connector and then turn the ignition ON.
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.

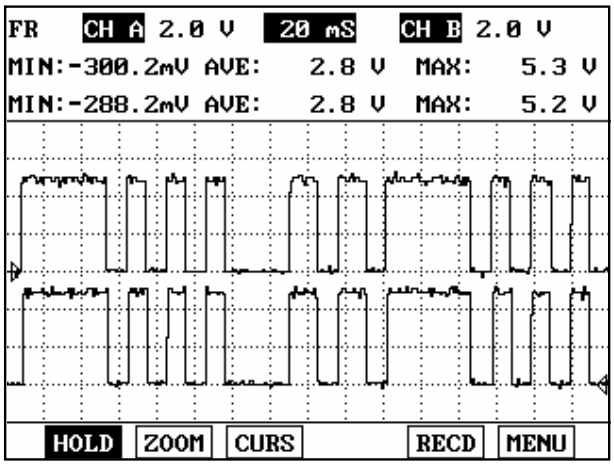
COMPONENT INSPECTION E88EAB43

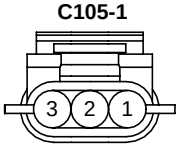
1. Check CMPS

   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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EFDCA8B8

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0341 CAMSHAFT POSITION SENSOR A CIRCUIT RANGE/PERFORMANCE (BANK 1 OR SINGLE SENSOR)

COMPONENT LOCATION EA2CFFDA

Refer to DTC P0340.

GENERAL DESCRIPTION E9C0DDA8

Refer to DTC P0340.

DTC DESCRIPTION E8F41B6F

Checking oputput signals from CMP during engine running, if the expected number of cam tooth count is not observed, PCM sets P0341. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E8B1A033

Item	Detecting Condition	Possible cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Short in harness • electrical noise • Target wheel • CMPS • PCM
Enable Conditions	• Engine running	
Threshold value	• Cam tooth count ≠ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM E76B6126

Refer to DTC P0340.

SIGNAL WAVEFROM AND DATA EAFBABAC

Refer to DTC P0340.

MONITOR DTC STATUS E0872256

Refer to DTC P0340.

TERMINAL AND CONNECTOR INSPECTION EBFEC344

Refer to DTC P0340.

POWER CIRCUIT INSPECTION E9E2F12C

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 EBA7D8ED

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 PCM 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.

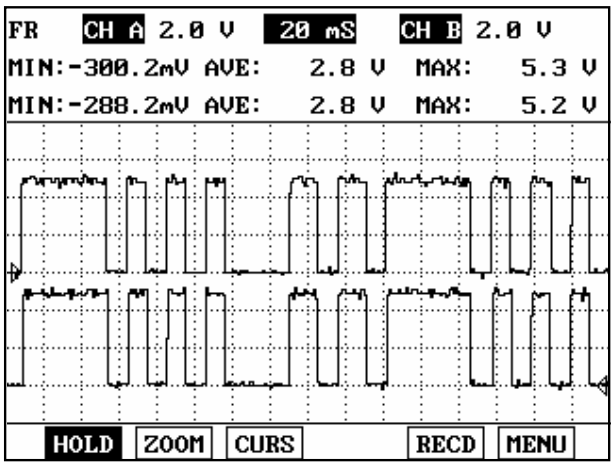
COMPONENT INSPECTION E011D72B

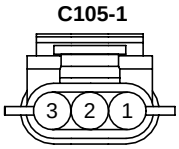
1. Check CMPS

   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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E4DAA537

Refer to DTC P0340.

DTC P0346 CAMSHAFT POSITION SENSOR "A" CIRCUIT RANGE/PERFORMANCE (BANK 2)

COMPONENT LOCATION E4A8415D

Refer to DTC P0340.

GENERAL DESCRIPTION E63048F0

Refer to DTC P0340.

DTC DESCRIPTION E88070FE

Checking oputput signals from CMP during engine running, if the expected number of cam tooth count is not observed, PCM sets P0346. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF2720E8

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 • PCM
Enable Conditions	• Engine running	
Threshold value	• Cam tooth count ≠ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM E4197E04

Refer to DTC P0340.

SIGNAL WAVEFROM AND DATA E4B8BD62

Refer to DTC P0340.

MONITOR DTC STATUS EB65C2D9

Refer to DTC P0340.

TERMINAL AND CONNECTOR INSPECTION E8206F99

Refer to DTC P0340.

POWER CIRCUIT INSPECTION E4D1FB56

1. IG "OFF" and disconnect CMPS connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 1 of CMPS(B2) 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 E1987884

1. Check voltage

   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 PCM 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 PCM connector.

2) Measure resistance between terminal 3 of CMPS harness connector and terminal 24 of PCM 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 E1F1164F

1. IG "OFF" and disconnect CMPS connector and then turn the ignition ON.
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.

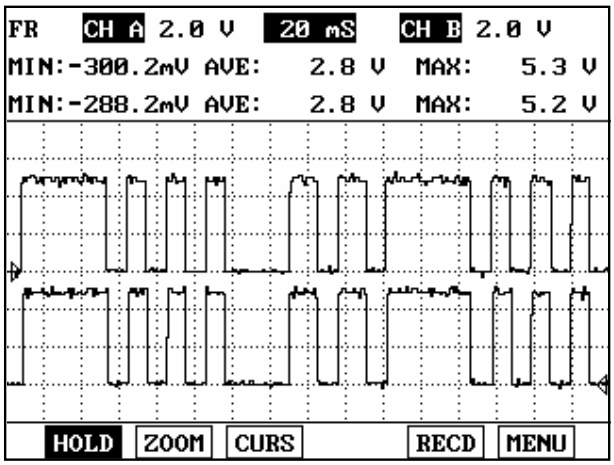
COMPONENT INSPECTION E87E82F3

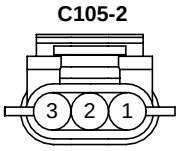
1. Check CMPS

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 PCM and check for proper operation. If the problem is corrected, replace PCM 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.

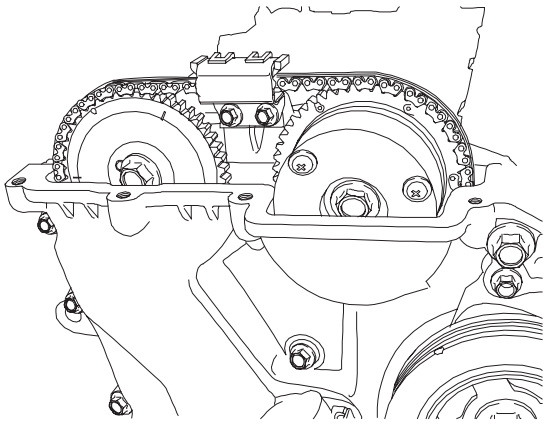
NOTE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function before reusing the PCM

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 E52AD893

Refer to DTC P0340.

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 EBD608AF

SGHFL7319N

GENERAL DESCRIPTION EF38628D

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 (PCM) provides a switching circuit to ground for primary coil circuit control. The PCM 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 E86FF6FB

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., PCM sets this DTC. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2D804A3

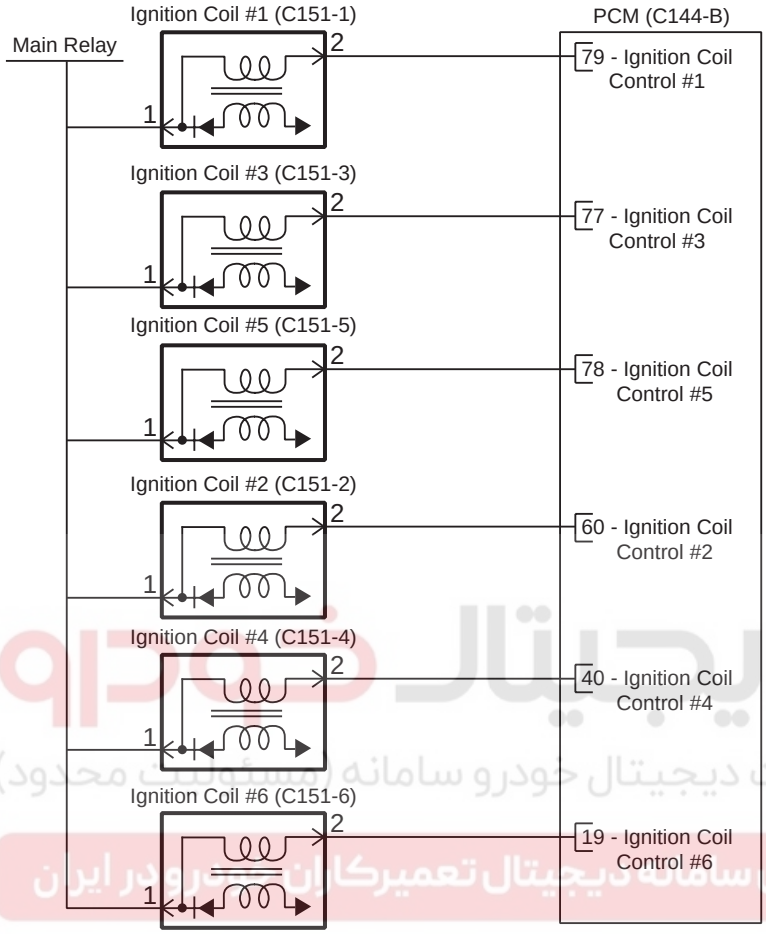
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground, to battery or open circuit	• Poor connection • Open or short in harness • Ignition Coil • PCM
EnableConditions	• NO DTC related to this item • Engine running • 11V ≤ Battery voltage ≤ 16V • The above conditions are met > 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 E114AA77

	Primary Coil	Secondary Coil
Resistance (Ω)	0.62 ± 10% (Ω)	7.0 ± 15% (kΩ)

SCHEMATIC DIAGRAM E146FBDE

[CIRCUIT DIAGRAM]



[CONNECTOR INFORMATION]

Ignition Coil #1

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (79)	Ignition Coil #1

Ignition Coil #2

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (60)	Ignition Coil #2

Ignition Coil #3

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (77)	Ignition Coil #3

Ignition Coil #4

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (40)	Ignition Coil #4

Ignition Coil #5

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (78)	Ignition Coil #5

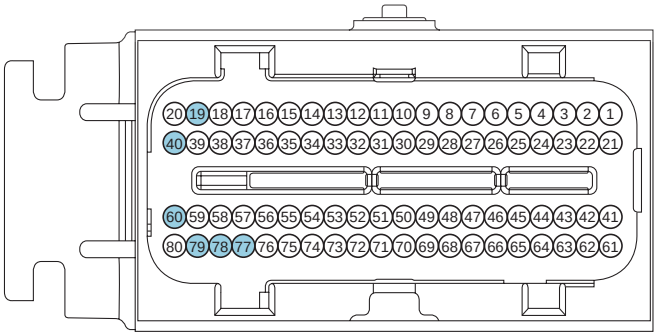
Ignition Coil #6

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (19)	Ignition Coil #6

[HARNESS CONNECTOR]

C151-1,2,3,4,5,6

Ignition Coil



C144-B

PCM

SGHFL7306L

MONITOR DTC STATUS E00AC99B

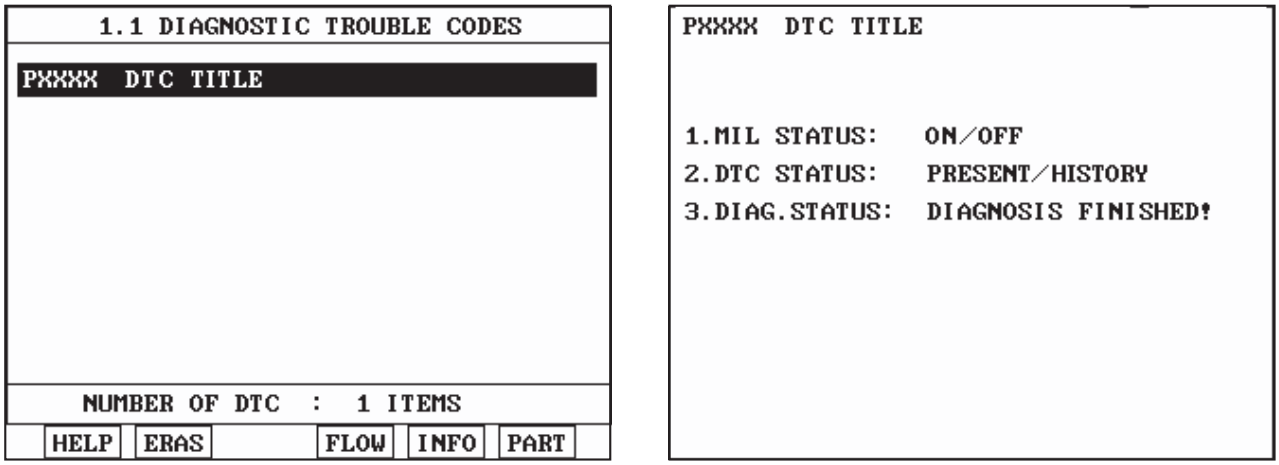
1. Check DTC Status

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

   2) IG "ON".

3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EB1C0A9D

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E2AF7DB3

1. Check voltage

1) IG "OFF" and disconnect Ignition Coil connector.

2) IG "ON" and ENG "OFF"

3) Measure voltage between terminal 1 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 E5892841

1. Check short to battery in harness.

1) IG "OFF" and disconnect ignitioncoil connector and PCM 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 PCM 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 PCM connector.

2) P0351) Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 79 of PCM harness connector[C144-B].
P0352) Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 60 of PCM harness connector[C144-B].
P0353) Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 77 of PCM harness connector[C144-B].
P0354) Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 40 of PCM harness connector[C144-B].
P0355) Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 78 of PCM harness connector[C144-B].
P0356) Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 19 of PCM 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 E9EB714F

1. Check Ignition Coil

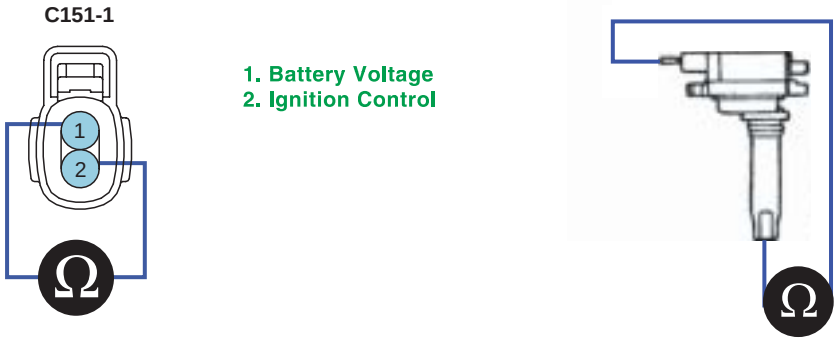
1) IG "OFF" and disconnect ignition coil connector.

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 ± 10% (Ω)	7.0 ± 15% (kΩ)



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4) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation
▶ If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EDDCF446

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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)

GENERAL DESCRIPTION ED7E4AE4

The PCM 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 EE6D7E95

If the oxygen storage time for Bank 1 is lower than threshold , the PCM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION ED0FBB50

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 ≥ 580 sec. • Purge Concentration Learned • 3 g/s ≤ Airflow ≤ 10 g/s • Throttle closed ≤ 1.5% • 70℃(158 ℉) ≤ Coolant Temp. ≤ 120℃(248 ℉) • -7℃(19.4 ℉) ≤ Ambient Temp. ≤ 105℃(221 ℉) • Barometer ≥ 72 kPa • Max number of test attempts ≤ 12 • Closed Loop • 250℃(482 ℉) ≤ Catalyst Temp. ≤ 950℃(1742 ℉) • Fuel learning completed • Vehicle speed ≤ 3 kph(1.8 mph) • Not airfuel ramping • Max idle time(about 60 sec.) not exceeded • No disabling faults present	
Threshold value	• Oxygen Storage Time < 3.25 sec.	
DiagnosisTime	• 15 sec.	
MIL On Condition	• 1 Driving cycle	

MONITOR SCANTOOL DATA EAD28FD4

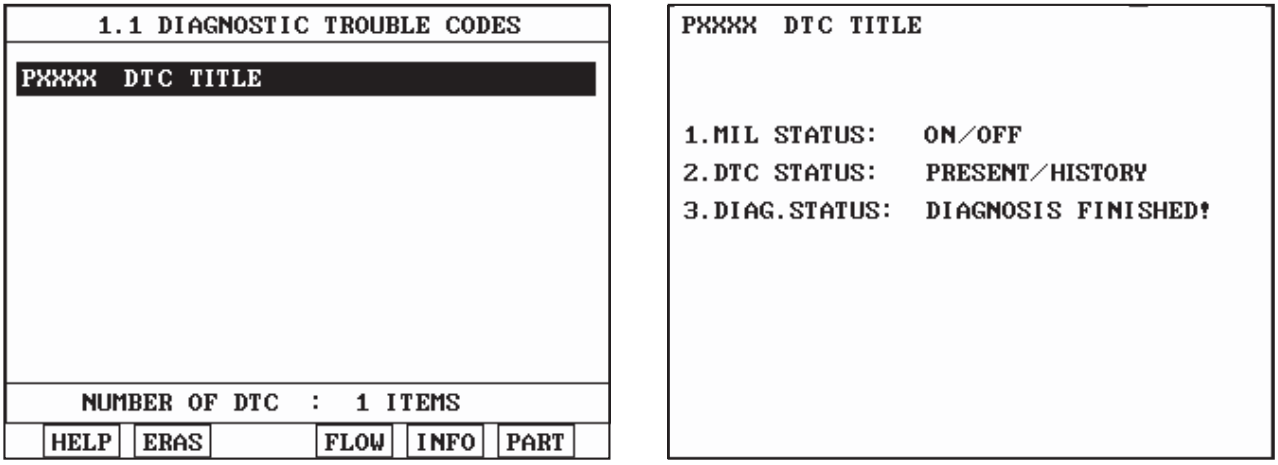
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



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5) Is "Present" Fault displayed?

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 EFD8D4E1

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 ED9B36ED

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0430 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 2)

GENERAL DESCRIPTION E3D0BD55

Refer to DTC P0420.

DTC DESCRIPTION EEF1B865

If the oxygen storage time for Bank 2 is lower than threshold , the PCM determines that a fault exists and a DTC is stored and MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E6F46B0F

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 ≥ 580 sec. • Purge Concentration Learned • 3 g/s ≤ Airflow ≤ 10 g/s • Throttle closed ≤ 1.5% • 70℃(158 ℉) ≤ Coolant Temp. ≤ 120℃(248 ℉) • -7℃(19.4 ℉) ≤ Ambient Temp. ≤ 105℃(221 ℉) • Barometer ≥ 72 kPa • Max number of test attempts ≤ 12 • Closed Loop • 250℃(482 ℉) ≤ Catalyst Temp. ≤ 950℃(1742 ℉) • Fuel learning completed • Vehicle speed ≤ 3 kph(1.8 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 sec.	
DiagnosisTime	• 15 sec.	
MIL On Condition	• 1 Driving cycle	

MONITOR SCANTOOL DATA E3986CFC

Refer to DTC P0420.

COMPONENT INSPECTION EE3F1C90

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 P0430?

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

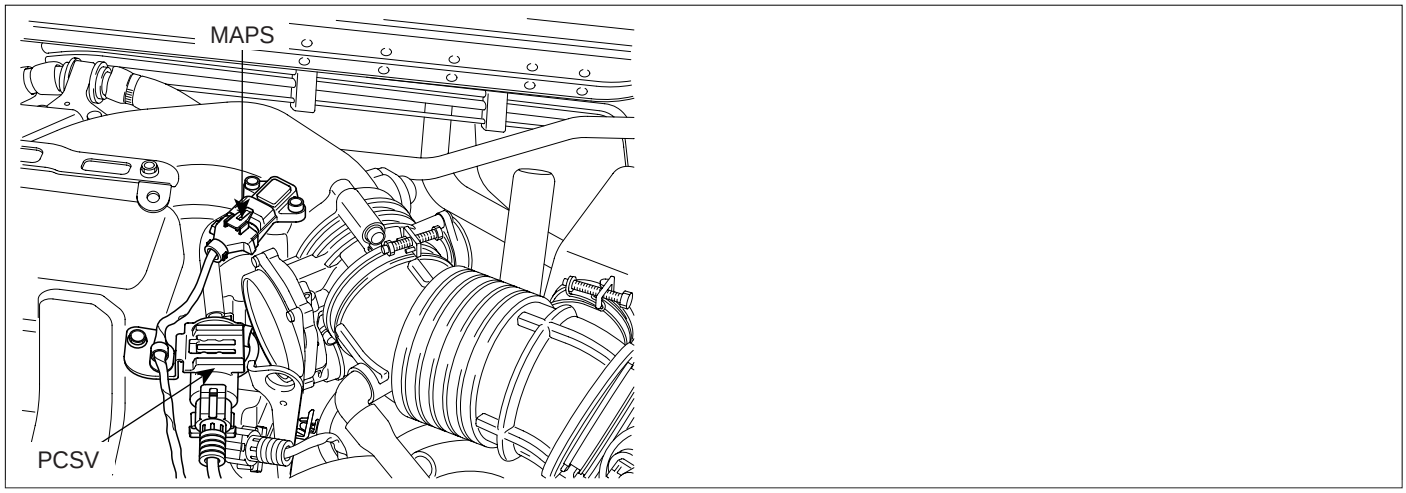
▶ It was intermittent failure.

VERIFICATION OF VEHICLE REPAIR E371717D

Refer to DTC P0420.

DTC P0444 EVAP. EMISSION SYSTEM-PURGE CTRL. VALVE CIRCUIT OPEN

COMPONENT LOCATION EF5C806E



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GENERAL DESCRIPTION E10B3FB8

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 PCM 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 PCM and controls fuel vapor from the canister to the intake manifold.

DTC DESCRIPTION ED11A85B

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., PCM sets P0444. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

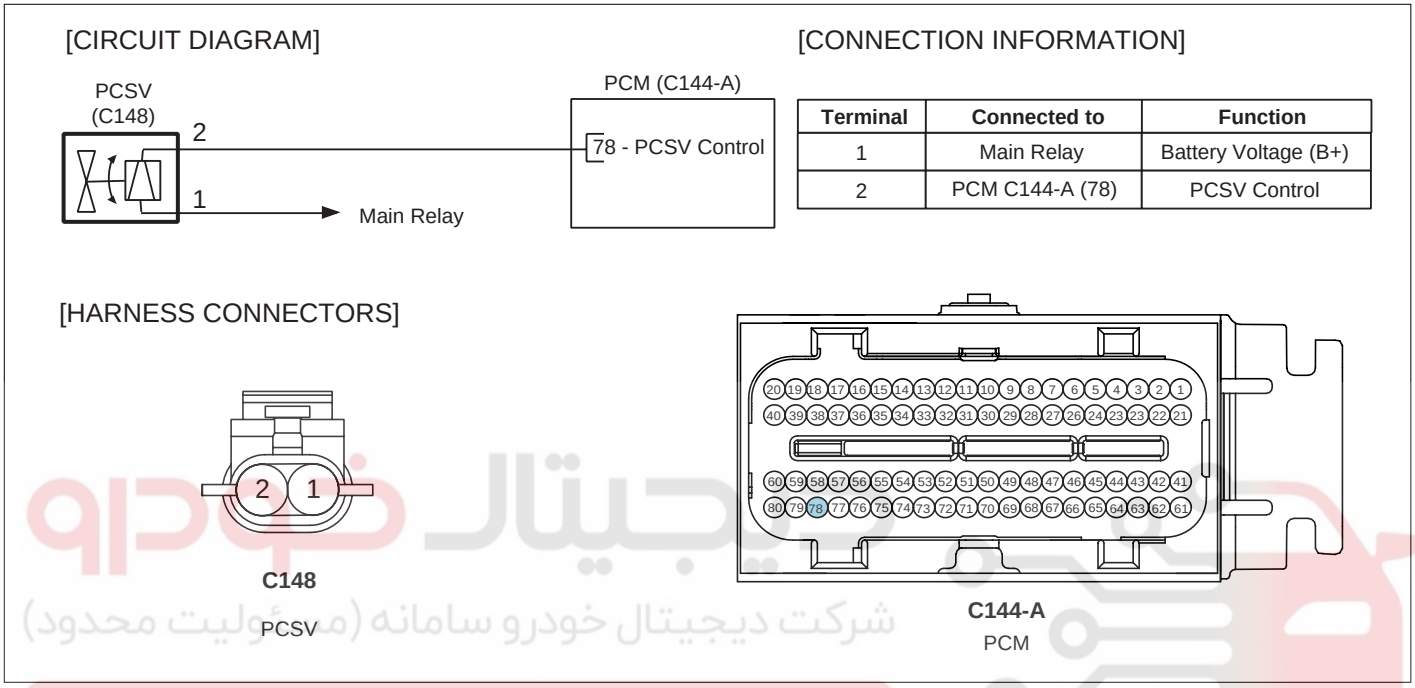
DTC DETECTING CONDITION EC62C052

Item	Detecting Condition	Possible cause
DTC Strategy	• Open, short to ground	• Poor connection • Open or short to ground in harness • PCSV • PCM
EnableConditions	• Engine running • 11V ≤ Battery voltage ≤ 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 EB07A1E4

Item	Coil resistance(Ω)
PCSV	19.0 ~ 22.0Ω (at 20℃ / 68°F)

SCHEMATIC DIAGRAM E16AC501



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SIGNAL WAVEFORM AND DATA E4E0535F

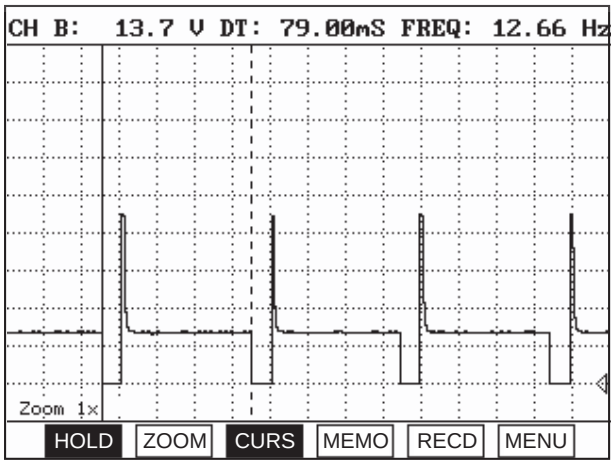


Fig. 1

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.
This photo shows the signal waveform of PCSV operating normally.

SBLFL7889N

MONITOR DTC STATUS E46AA35E

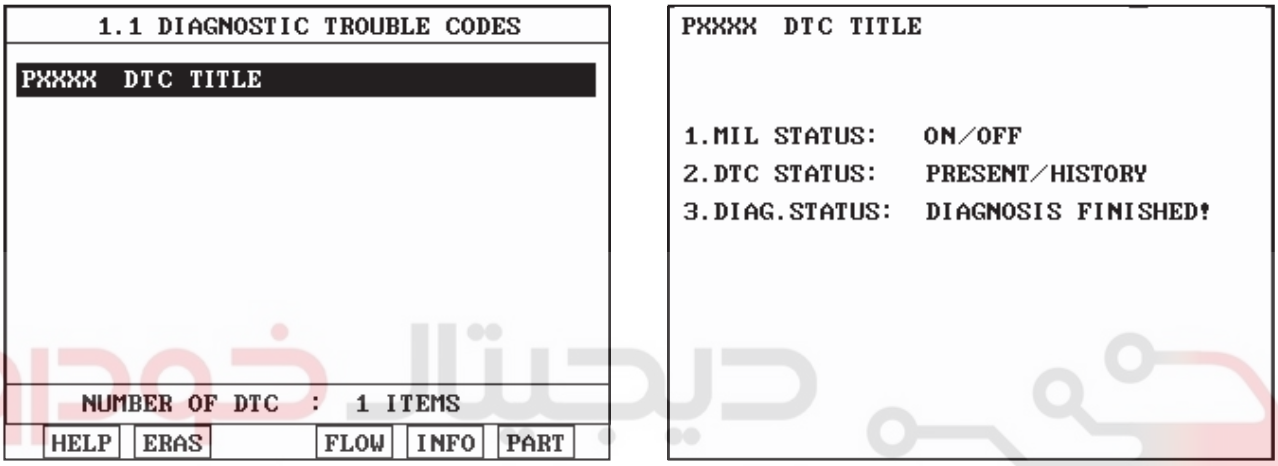
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



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   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EA40D6D2

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 EC52E12C

1. IG "OFF" and disconnect PCSV connector.
2. IG "ON" and ENG "OFF"
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 E8D8DB89

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 V

   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 PCM connector.
   2) Measure resistance between terminal 2 of PCSV harness connector and terminal 78 of PCM 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 E6E18680

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 ~ 22.0Ω (at 20℃ / 68°F)

   3) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation.
▶ If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EBC23A0E

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0445 EVAP. EMISSION SYSTEM-PURGE CTRL. VALVE CIRCUIT SHORTED

COMPONENT LOCATION E57D3A65

Refer to DTC P0444.

GENERAL DESCRIPTION EACA347F

Refer to DTC P0444.

DTC DESCRIPTION E4CDB20E

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., PCM sets P0445. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E67329C0

Item	Detecting Condition	Possible cause
DTC Strategy	• Short to battery	• Poor connection • Short to battery in harness • PCSV • PCM
EnableConditions	• Engine running • 11V ≤ Battery voltage ≤ 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 EC8516D2

Item	Coil resistance(Ω)
PCSV	19.0 ~ 22.0Ω (at 20℃ / 68°F)

SCHEMATIC DIAGRAM ED092E47

Refer to DTC P0444.

SIGNAL WAVEFORM AND DATA ED0EA909

Refer to DTC P0444.

MONITOR DTC STATUS E369A703

Refer to DTC P0444.

TERMINAL AND CONNECTOR INSPECTION EEBB253F

Refer to DTC P0444.

CONTROL CIRCUIT INSPECTION E2C0A97F

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 V

4. Is the measured voltage within specification?

YES

▶ Go to "Component Insepction" procedure.

NO

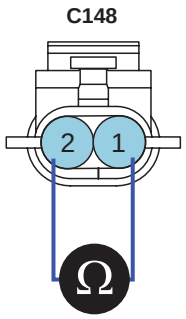
▶ Repair short to battery in harness, and go to " Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EA0D7B52

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 ~ 22.0Ω (at 20℃ / 68°F)



1. Battery voltage(B+)
2. PCSV Control

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   3) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation.
▶ If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR ECE43D57

Refer to DTC P0444.

DTC P0501 VEHICLE SPEED SENSOR A RANGE/PERFORMANCE

GENERAL DESCRIPTION E752B8EE

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 PCM not only if the vehicle speed is low or high but also if the vehicle is or is not moving. The PCM 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 EC82EB4B

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., PCM sets P0501. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

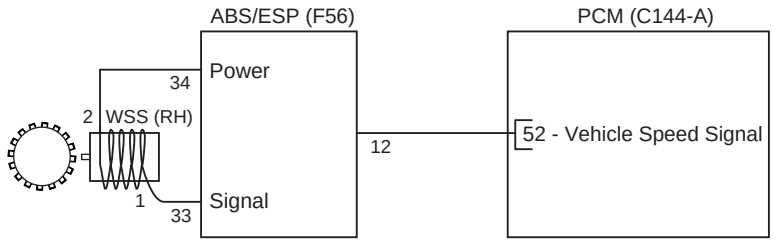
DTC DETECTING CONDITION E81AE52E

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(FR) • ABS or ESP control unit • PCM
Enable Condi-tions	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 ED04431E

[EURO-III/IV]

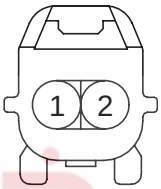
[CIRCUIT DIAGRAM]



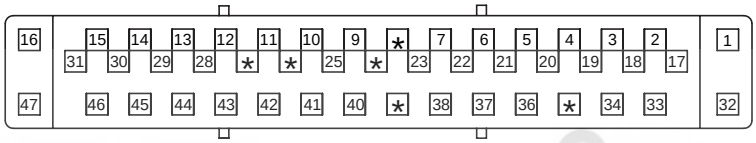
[CONNECTION INFORMATION]

Terminal	Connected to	Function
12	PCM C144-A (52)	Vehicle Speed Signal

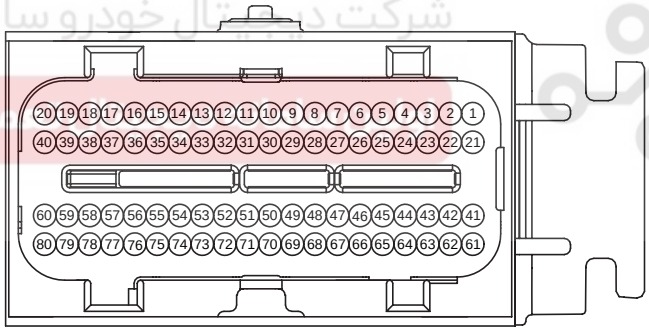
[HARNESS CONNECTOR]



F60
WSS (RH)



F56
ABS/ESP CONTROL MODULE

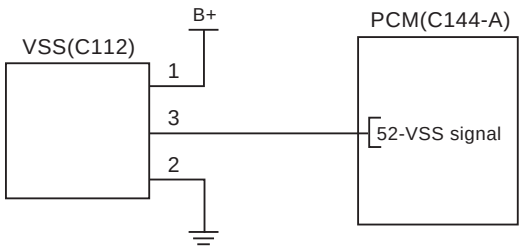


C144-A
PCM

SGHFL7307L

[EURO-III/IV]

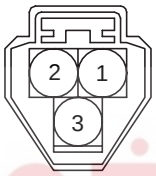
[CIRCUIT DIAGRAM]



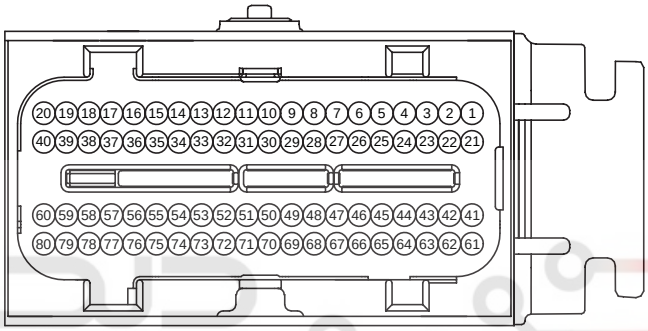
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Engine compartment juntion block	Battery voltage(B+)
2	Chassis ground	Sensor ground
3	PCM C144-A (52)	VSS signal

[HARNESS CONNECTOR]



C112
VSS



C144-A
PCM

SGHFL7308L

MONITOR DTC STATUS EBA8F4E9

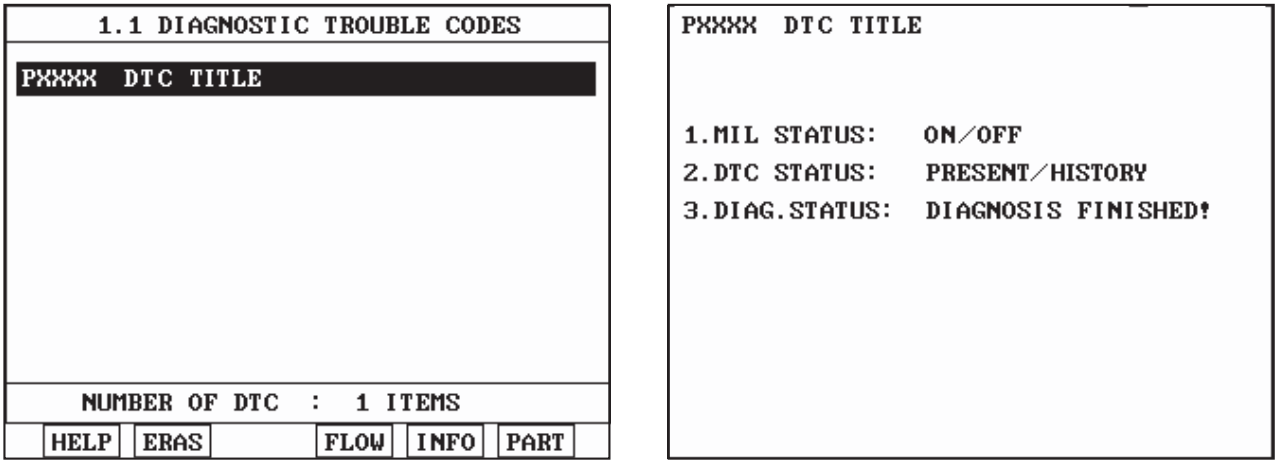
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’s and/or PCM’s connector or was repaired and PCM 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]

TERMINAL AND CONNECTOR INSPECTION

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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

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 PCM connector and ABS or ESP control module connector.

3) Measure resistance between terminal 52 of PCM harness connector(C144-A) and chassis ground.

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 PCM connector and ABS or ESP control module connector.

3) Measure resistance between terminal "52" of PCM harness connector and terminal "12" of ESP control module harness connector.

Specification : Approx. below 1Ω

NOTE

This picture is only applicable 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 "C1203 Wheel speed sensor front-RH open/short")

3) Is the wheel speed sensor normal?

YES

▶ Substitute with a known - good PCM/ ESP control unit and check for proper operation. If the problem is corrected, replace PCM/ 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 PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

[EXCEPT EURO-III/IV]

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 vehicle speed sensor connector.
   3) IG "ON" and ENG "OFF"
   4) Measure voltage between terminal 1 of vehicle speed sensor harness connector and chassis ground.

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

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 and chassis ground.

Specification : Approx. 8 ~ 11.5V

5) Is the measured voltage within specifications?

YES

▶ Go to "Check voltae from PCM side" as follows.

NO

▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

2. Check voltage from PCM side

1) IG "OFF"

2) Disconnect PCM connector and vehicle speed sensor connector.

3) IG "ON" and ENG "OFF"

4) Measure voltage between terminal "52" of PCM harness connector and chassis ground.

Specification : Approx. 8 ~ 11.5V

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.

GROUND CIRCUIT INSPECTION

1. IG "OFF"
2. Disconnect vehicle speed sensor connector.
3. IG "ON" and ENG "OFF"
4. Measure voltage between terminal 1 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)

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 correctd, substitute with a known - good PCM 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 PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E13A951E

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0504 BRAKE SWITCH "A"/"B" CORRELATION

GENERAL DESCRIPTION E476E567

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 E8E13659

Checking output signals from both Stop lamp 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, PCM sets P0504. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E936EBAB

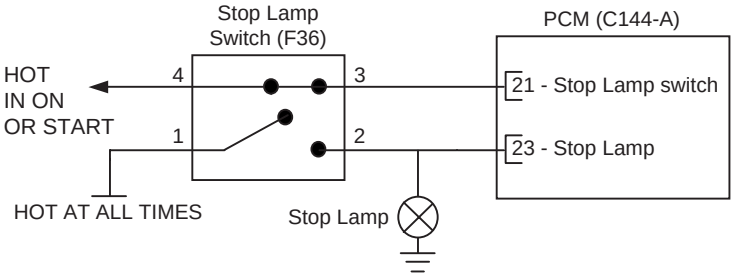
Item		Detecting Condition	Possible cause
DTC Strategy		• Comparing 2 brake signals during driving	• Poor connection • Open or short in Stop lamp switch • Faulty Stop lamp switch
Enable Condi-tions	Case 1	• Engine running • Vehicle Speed Sensor is abnormal.	
	Case 2	• Engine running • Vehicle Speed Sensor is normal and Vehicle Speed is over 20kph druing 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 E49F2F28

Item	Brake OFF	Brake ON
Stop Lamp	0V	Battery voltage
Stop Lamp Switch	Battery voltage	0V

SCHEMATIC DIAGRAM E8F64C57

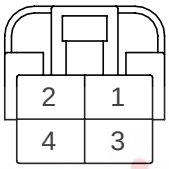
[CIRCUIT DIAGRAM]



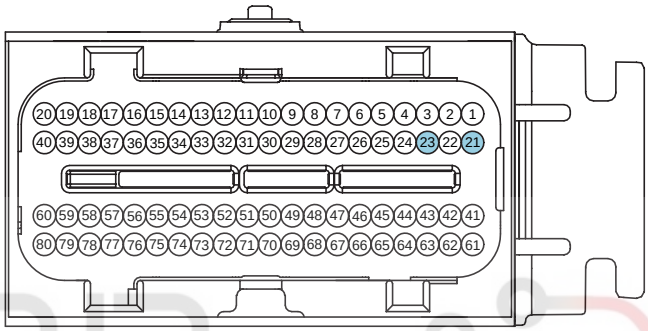
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Engine compartment Junction block	Power Supply (12V)
2	PCM C144-A (23)	Stop Lamp
3	PCM C144-A (21)	Stop Lamp switch
4	Engine compartment Junction block	Power Supply (12V)

[HARNESS CONNECTOR]



F36
STOP LAMP SWITCH



C144-A
PCM

SGHFL7330N

MONITOR DTC STATUS E8596823

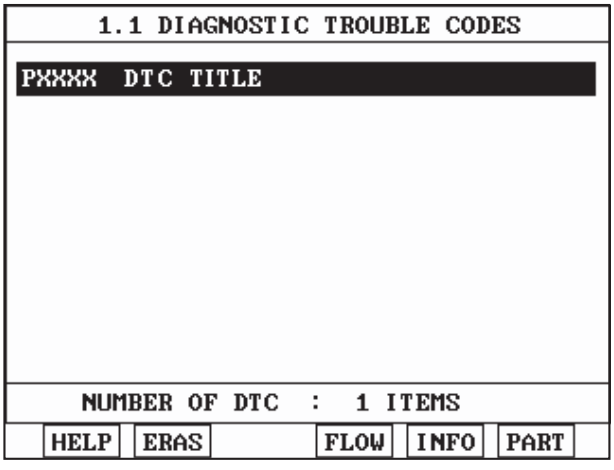
1. Check DTC Status

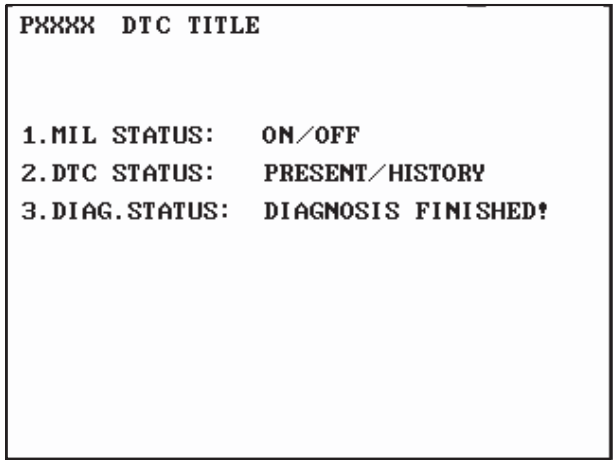
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 ED4854D1

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 EA265F67

1. Votage check
   1) IG Key "OFF".
   2) Disconnect the PCM connector.
   3) IG Key "ON" and keep the brake taking off.
   4) Measure the voltage between terminal 21 of PCM harness connector(C144-A) and chassis ground.
   5) Measure the voltage between terminal 23 of PCM harness connector(C144-A) and chassis ground .
   6) Keep the brake stepping on.
   7) Measure the voltage between terminal 21 of PCM harness connector(C144-A) and chassis ground.
   8) Measure the voltage between terminal 23 of PCM harness connector(C144-A) and chassis ground.

SPECIFICATION :

Item	Brake OFF	Brake ON
Stop Lamp	0V	Battery voltage
Stop Lamp Switch	Battery voltage	0V

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 stop lamp switch and PCM connector.

3) Measure the resistance between terminal 21 of PCM harness connector and terminal 3 of Stop lamp switch harness side.

4) Measure the resistance between terminal 23 of PCM harness connector and terminal 2 of Stop lamp switch harness side.

Specification : Approx. below 1Ω

5) Is the measured resistance within specification ?

YES

▶ Go to "Check Battery voltagen" 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 stop lamp switch connector.

3) Measure the voltage between stop lamp switch harness connector terminal 1 and chassis ground.

4) Measure the voltage between stop lamp switch harness connector terminal 4 and chassis ground.

5) IG Key "ON".

6) Measure the voltage between stop lamp switch harness connector terminal 1 and chassis ground.

7) Measure the voltage between stop lamp switch harness connector terminal 4 and chassis ground.

SPECIFICATION :

Item	Brake OFF	Brake ON
Stop Lamp	Battery voltage	Battery voltage
Stop Lamp Switch	0V	Battery voltage

8) Is the measured voltage within specification ?

YES

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

NO

▶ Check the fuse between battery and stop lamp switch.
▶ Repair open or short in power circuit of stop lamp switch and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EB8212D7

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0506 IDLE AIR CONTROL SYSTEM-RPM LOWER THAN EXPECTED

GENERAL DESCRIPTION E94B2F43

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 PCM controls the throttle motor to provide the proper throttle valve opening angle for the target idle speed.

DTC DESCRIPTION E547FAB9

Checking idle RPM under detecting condition, if if the real idle speed is lower than desired idle speed by 100 RPM over 10 sec., PCM sets P0506. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E3FC284A

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 E7C25D1E

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 related DTCs present?

YES

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

NO

▶ Go to "System Inspection" procedure

SYSTEM INSPECTION E0ACC293

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 E3D7B637

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0507 IDLE AIR CONTROL SYSTEM-RPM HIGHER THAN EXPECTED

GENERAL DESCRIPTION EA24BFC4

Refer to DTC P0506.

DTC DESCRIPTION EBAE5260

Checking idle RPM under detecting condition, if if the real idle speed is higher than desired idle speed by 200 RPM over 10 sec., PCM sets P0507. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E3059C01

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 E0FD7AE1

Refer to DTC P0506.

SYSTEM INSPECTION E4EB3023

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

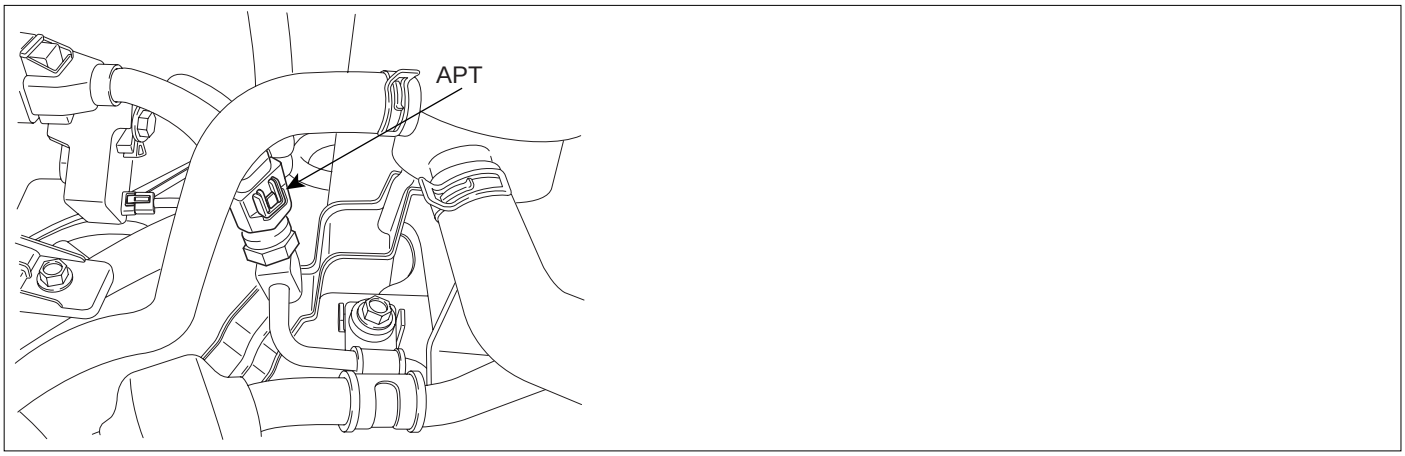
      ▶ Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection amp;amp; Repair" procedure. If not, troubleshooting is completed.

VERIFICATION OF VEHICLE REPAIR E4932FDA

Refer to DTC P0506.

DTC P0532 A/C REFRIGERANT PRESSURE SENSOR "A" CIRCUIT LOW INPUT

COMMPONENT LOCATION E83BF023



SGHFL7331N

GENERAL DESCRIPTION EC2AF27B

The PCM(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 PCM 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 PCM, 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 EBD51233

Checking output signals from A/C pressure sensor under detecting condition, if an signal below 0.25V lasts for more than 10 sec., PCM sets P0532.

DTC DETECTING CONDITION E46D46A0

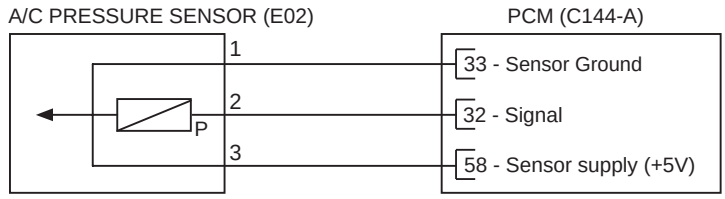
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects sensor signal short to low voltage	• Poor connection • Open in power circuit • Open or short to ground in signal circuit • Faulty A/C pressure sensor • Faulty PCM
Enable Conditions	• Engine running	
Thresh old value	• Sensor output voltage 〈 0.25V	
Diagnosis Time	• Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION E21C5759

Pressure(psi)	14.7	128.5	242.3	356.1	469.9
Voltage(V)	0.5	1.5	2.5	3.5	4.5

SCHEMATIC DIAGRAM EEDBE1DD

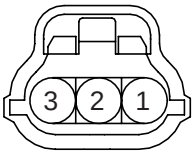
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

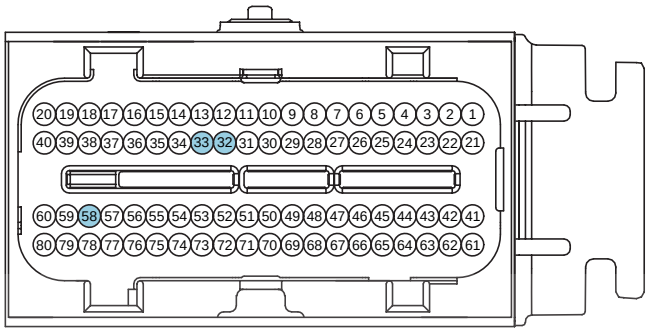
Terminal	Connected to	Function
1	PCM C144-A (33)	Sensor Ground
2	PCM C144-A (32)	Signal
3	PCM C144-A (58)	Sensor supply (+5V)

[HARNESS CONNECTOR]



E02

A/C PRESSURE SENSOR

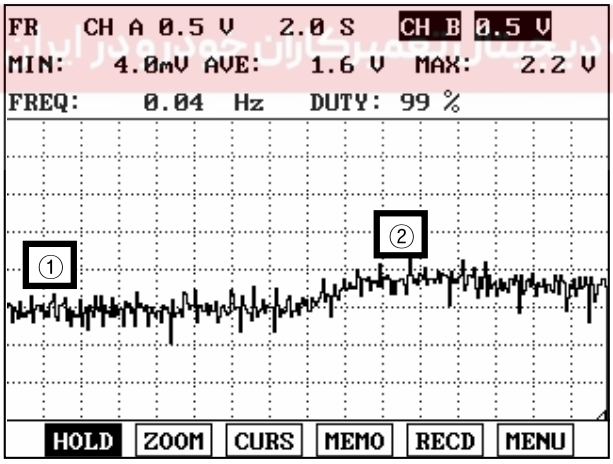


C144-A

PCM

SGHFL7332N

SIGNAL WAVEFORM AND DATA ED549388



① - A/C OFF & idle state
② - A/C ON & idle state

EGRF884A

MONITOR DTC STATUS E8A15AE1

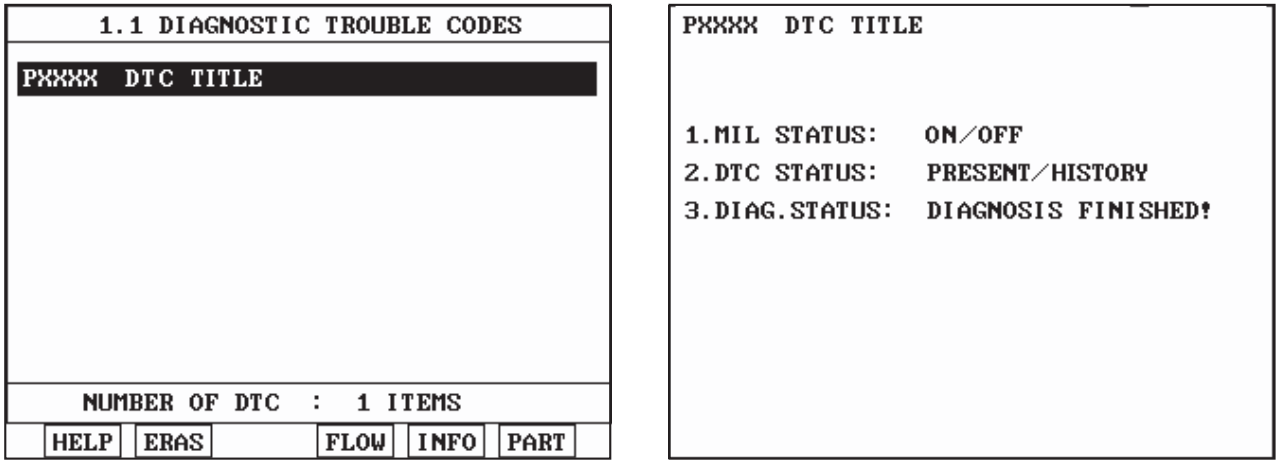
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



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5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EB6EAB94

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E5088726

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.

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 ECC134EC

1. Check short to ground inspection

   1) IG Key "OFF".

   2) Disconnect A/C pressure sensor and PCM 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 PCM connector.

   3) Measure the resistance between terminal 2 of A/C pressure sensor harness connector and terminal 32 of PCM harness connector.

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 EC4EA5E9

1. A/C pressure sensor inspection

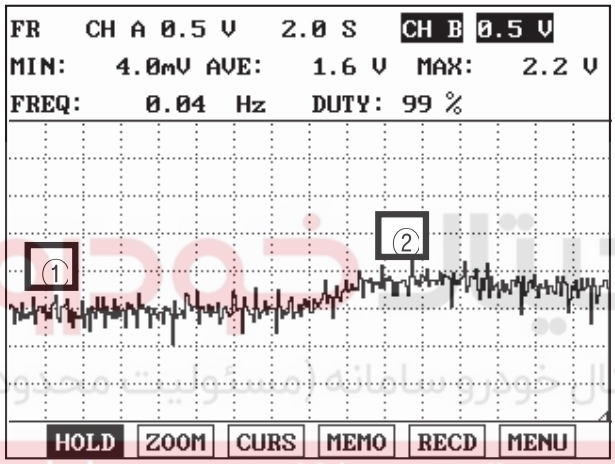
   1) IG Key "OFF" and connect the scantool.

   2) Connect the probe to A/C pressure sensor signal and select the oscilloscope in the menu.

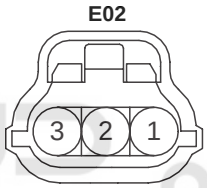
   3) Check the waveform with acceleration and deceleration after engine start.

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 OFF & Idle
② - A/C ON & Idle



1. A/C pressure sensor ground
2. A/C pressure sensor signal
3. A/C pressure sensor power

SGHFL7268N

4) Is the measured waveform of A/C pressure sensor normal?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EB773C58

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0533 A/C REFRIGERANT PRESSURE SENSOR "A" CIRCUIT HIGH INPUT

COMMPONENT LOCATION E1D2E273

Refer to DTC P0532.

GENERAL DESCRIPTION E14601F3

Refer to DTC P0532.

DTC DESCRIPTION E7085E80

Checking output signals from A/C pressure sensor under detecting condition, if an signal above 4.65V lasts for more than 10 sec., PCM sets P0533.

DTC DETECTING CONDITION EDD8FD89

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 PCM
Enable Conditions	• Engine running	
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 EAA47D6C

Pressure(psi)	14.7	128.5	242.3	356.1	469.9
Voltage(V)	0.5	1.5	2.5	3.5	4.5

SCHEMATIC DIAGRAM EAA90E5C

Refer to DTC P0532.

SIGNAL WAVEFORM AND DATA EBD467B6

Refer to DTC P0532.

MONITOR DTC STATUS E753AF0A

Refer to DTC P0532.

TERMINAL AND CONNECTOR INSPECTION E7617491

Refer to DTC P0532.

POWER CIRCUIT INSPECTION EC3FB238

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 EF28E6A8

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 E5DD2884

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 PCM 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 EE80A308

1. A/C pressure sensor inspection

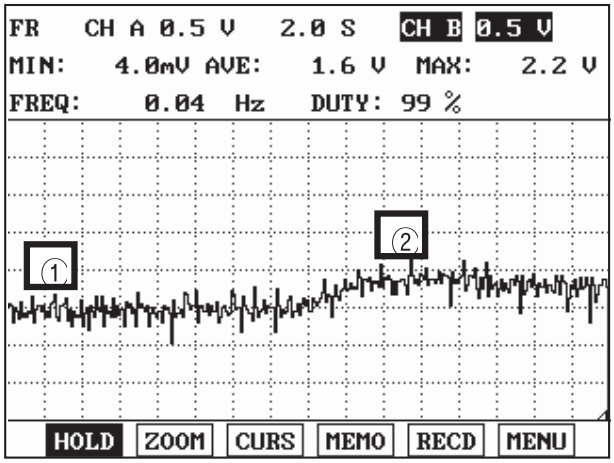
1) IG Key "OFF" and connect the scantool.

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.

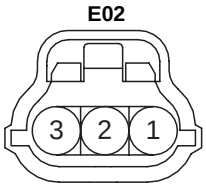
SPECIFICATION :

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 OFF & Idle

② - A/C ON & Idle



1. A/C pressure sensor ground
2. A/C pressure sensor signal
3. A/C pressure sensor power

SGHFL7268N

4) Is the measured waveform of A/C pressure sensor normal?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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

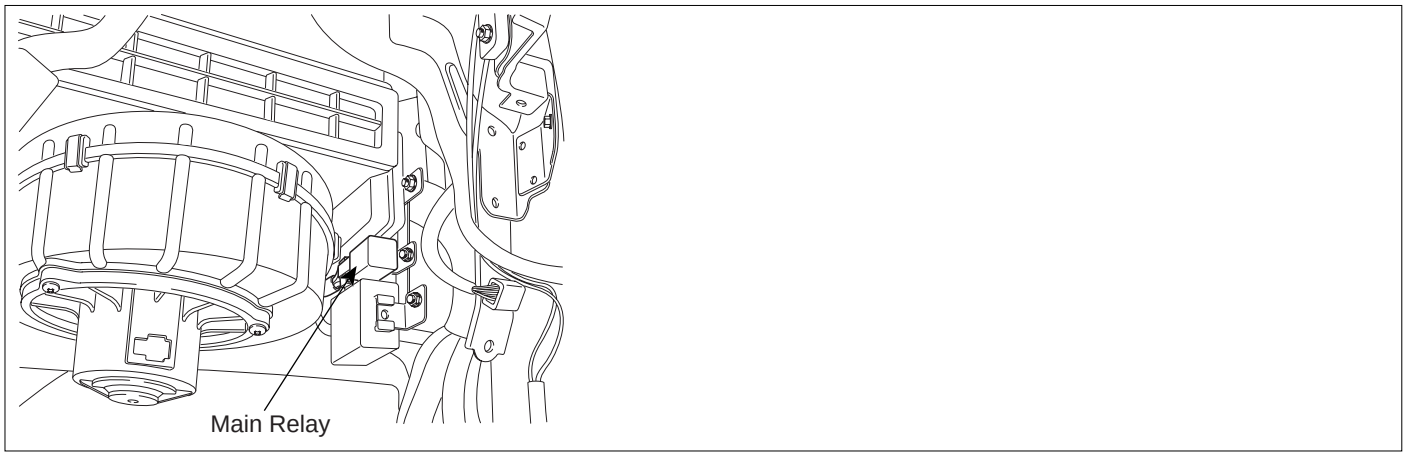
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E0A85FE0

Refer to DTC P0532.

DTC P0562 SYSTEM VOLTAGE LOW

COMMPONENT LOCATION ECA04B7E



SGHFL7333N

GENERAL DESCRIPTION EDD4C775

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

DTC DESCRIPTION ED1EEACF

If system voltage is below 11V, PCM sets P0562. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EDBFCBD9

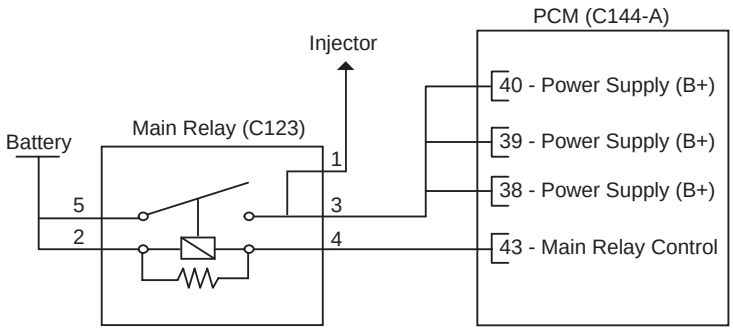
Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage too low	• Poor connection • Open in power circuit • Faulty charging system • Faulty main relay • Faulty PCM
Enable Conditions	• Engine running • 11V ≤ Battery voltage ≤ 16V	
Thresh old value	• System voltage 〈 11V	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SPECIFICATION EAF683B2

Coil Resistance	70Ω ~ 120Ω

SCHEMATIC DIAGRAM E7AD23A3

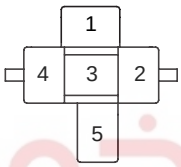
[CIRCUIT DIAGRAM]



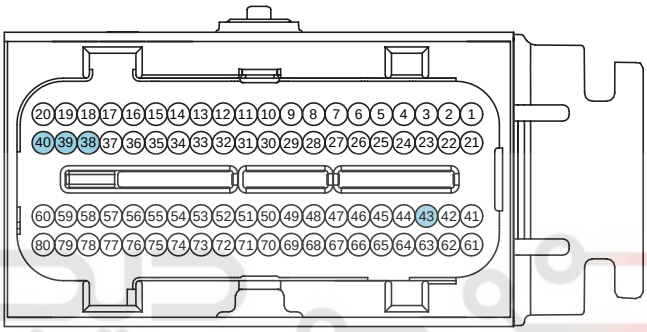
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Injector	Power to injector
2	Battery	Battery Power (B+)
3	PCM C144-A (38)	Power Supply (B+)
	PCM C144-A (39)	
	PCM C144-A (40)	
4	PCM C144-A (43)	Main Relay Control
5	Battery	Battery Power (B+)

[HARNESS CONNECTOR]



C123
Main Relay



C144-A
PCM

SGHFL7334N

MONITOR DTC STATUS E2A6AAA4

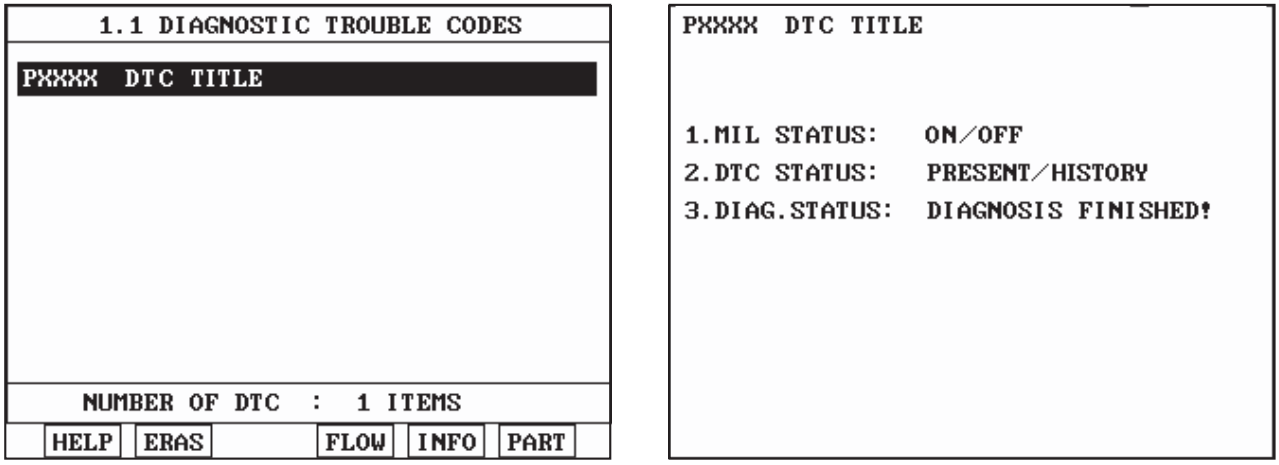
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’s and/or PCM’s connector or was repaired and PCM 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 E2677342

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E63EF34D

1. Check voltage
   1) IG "OFF".
   2) Disconnect the main relay.
   3) IG "ON" and ENG "OFF"

4) Measure the voltage between terminal 2 of main relay harness connector and chassis ground.

5) Measure the voltage between terminal 5 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 PCM connector.

3) Measure the resistance between terminal 3 of main relay harness connector and terminals 38, 39, 40 of PCM harness connector.

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 PCM connector.

3) Measure the resistance between terminal 3 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 ED791330

1. Check short in harness
   1) IG "OFF".
   2) Disconnect main relay and PCM connector.
   3) Measure the resistance between terminal 4 of main relay harness connector and chasses 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 PCM connector.
   3) Measure the resistance between terminal 4 of main relay harness connector and terminal 43 of PCM harness connector.

Specification : Approx. below 1Ω

   4) Is the measured resistance within specification ?

YES

▶ Go to "System inspection" procedure.

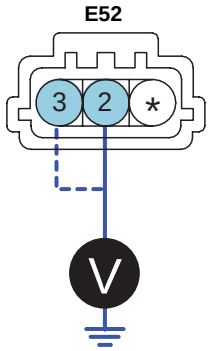
NO

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

SYSTEM INSPECTION ECD405B5

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 gound.
   5) Measure the voltage between terminal 3 of alternator and chassis gound.

Specification : B+



2. Cluster (Charging MIL)
3. Sensing

SGHFL7277N

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 ECD24CA5

1. Check Main relay

1) IG "OFF".

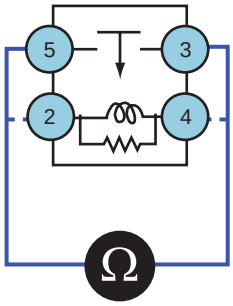
2) Disconnect the main relay.

3) Measure the resistance between terminal 2 and 4 of main relay.

4) Measure the resistance between terminal 5 and 3 of main relay.

Specification : 70 ~ 120Ω

Terminal	Power approval
3 ~ 5	NO
2 ~ 4	YES (Approx. 70Ω ~ 120Ω)



SGHFL7278N

5) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E220E275

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0563 SYSTEM VOLTAGE HIGH

COMMPONENT LOCATION E551C1A9

Refer to DTC P0562.

GENERAL DESCRIPTION E020E732

Refer to DTC P0562.

DTC DESCRIPTION E2384B20

If system voltage is above 16V, PCM sets P0563. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E99533F5

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage too high	• Poor connection • Short in circuit • Faulty charging system • Faulty main relay • Faulty PCM
Enable Conditions	• Engine running	
Thresh old value	• System voltage 〉 16V	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E811EA1E

Coil Resistance	70Ω ~ 120Ω

SCHEMATIC DIAGRAM E3EE16BC

Refer to DTC P0562.

MONITOR DTC STATUS E84B5358

Refer to DTC P0562.

TERMINAL AND CONNECTOR INSPECTION E96D8C9A

Refer to DTC P0562.

POWER CIRCUIT INSPECTION EEB49AC7

1. Power circuit inspection

   1) IG "OFF".

   2) Disconnect the main relay connector.

   3) IG "ON" and ENG "OFF".

4) MeMeasure the voltage between terminal 2 of main relay harness connector and chassis ground.

5) Measure the voltage between terminal 5 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 PCM 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 E88D37C8

1. Check Alternator circuit

1) IG "OFF".

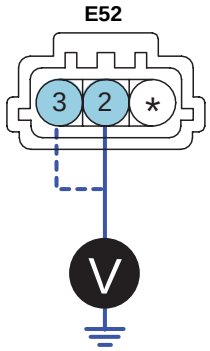
2) Disconnect alternator connector.

3) IG "ON" and ENG "OFF"

4) Measure the voltage between terminal 2 of alternator and chassis gound.

5) Measure the voltage between terminal 3 of alternator and chassis gound.

Specification : B+



2. Cluster (Charging MIL)
3. Sensing

SGHFL7277N

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 E965C724

1. Check Main relay

1) IG "OFF".

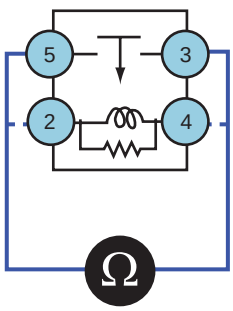
2) Disconnect the main relay.

3) Measure the resistance between terminal 2 and 4 of main relay.

4) Measure the resistance between terminal 5 and 3 of main relay.

Specification : 70 ~ 120Ω

Terminal	Power approval
3 ~ 5	NO
2 ~ 4	YES (Approx. 70Ω ~ 120Ω)



SGHFL7278N

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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E2EB60F3

Refer to DTC P0562.

DTC P0571 BRAKE SWITCH "A" CIRCUIT

GENERAL DESCRIPTION E20BD3C6

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 E1D944BB

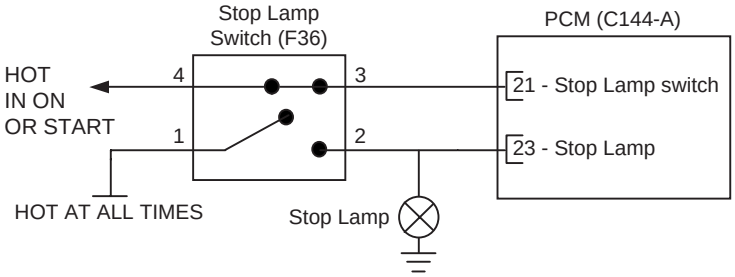
Checking input signals from stop lamp switch under detecting condition, if the operation state of stop lamp switch does not change for more than 3 sec., PCM sets P0571. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E295E531

Item	Detecting Condition	Possible cause
DTC Strategy	• PCM detects stop lamp input signal when vehicle stops.	• Poor connection • Open or short to ground in signal circuit • Faulty PCM
Enable onditions	• Engine running • Vehicle speed signal is normal. • Vehicle speed ＞ 20kph (during 1sec or more)	
Threshold value	• Vehicle speed 〈 3kph • Vehicle acceleration 〈 -6kph/s • Stop lamp "OFF" and not changing of stop lamp signal for more 3 sec.	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM EB2E35B4

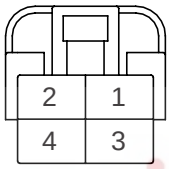
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

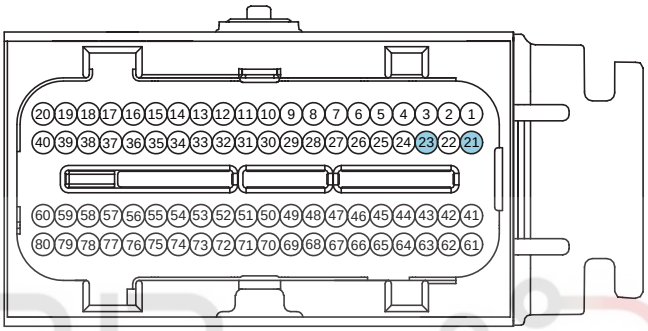
Terminal	Connected to	Function
1	Engine compartment Junction block	Power Supply (12V)
2	PCM C144-A (23)	Stop Lamp
3	PCM C144-A (21)	Stop Lamp switch
4	Engine compartment Junction block	Power Supply (12V)

[HARNESS CONNECTOR]



F36

STOP LAMP SWITCH



C144-A

PCM

SGHFL7330N

MONITOR DTC STATUS E36E12B6

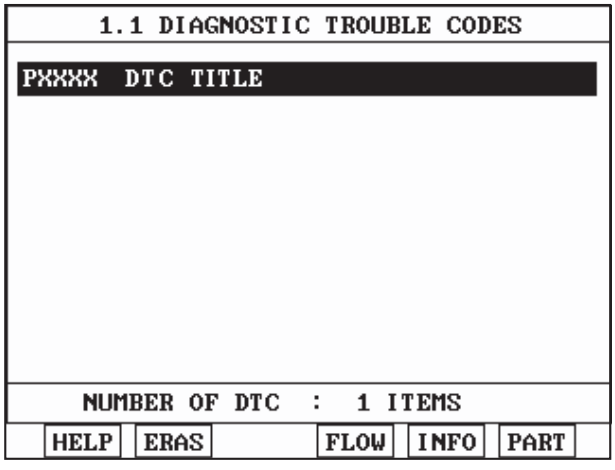
1. Check DTC Status

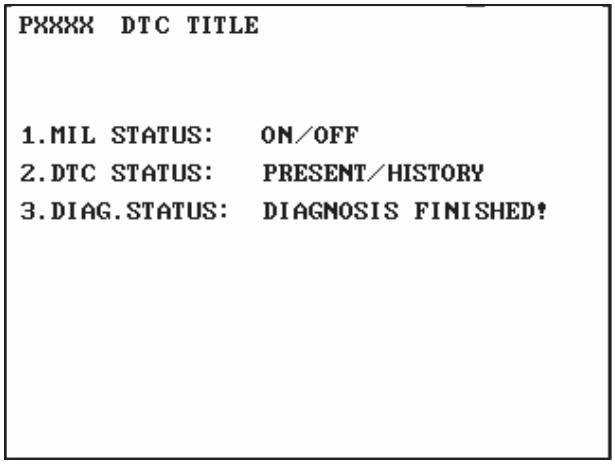
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 E7AC2CC1

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E2995144

1. Check voltage

1) IG "OFF".

2) Disconnect the PCM connector.

3) IG "ON" and ENG "OFF"

4) Brake OFF : Measure the voltage between terminal 23 of PCM harness connector(C144-A) and chassis ground.

5) Brake ON : Measure the voltage between terminal 23 of PCM harness connector(C144-A) and chassis ground

SPECIFICATION :

Item	Brake OFF	Brake ON
Stop Lamp	0V	Battery voltage
Stop Lamp Switch	Battery voltage	0V

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 PCM connector.

3) Measure the resistance between terminal 23 of PCM harness connector and terminal 2 of Stop lamp switch harness connector.

Specification : Approx. below 1Ω

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 stop lamp switch harness connector terminal 1 and chassis ground.

4) Measure the voltage between stop lamp switch harness connector terminal 4 and chassis ground.

5) IG Key "ON".

6) Measure the voltage between stop lamp switch harness connector terminal 1 and chassis ground.

7) Measure the voltage between stop lamp switch harness connector terminal 4 and chassis ground.

SPECIFICATION :

Item	Brake OFF	Brake ON
Stop Lamp	Battery voltage	Battery voltage
Stop Lamp Switch	0V	Battery voltage

8) Is the measured voltage within specification ?

YES

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

NO

▶ Check the fuse between battery and stop lamp switch.
▶ Repair open or short in power harness of stop lamp switch and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E8D5D550

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

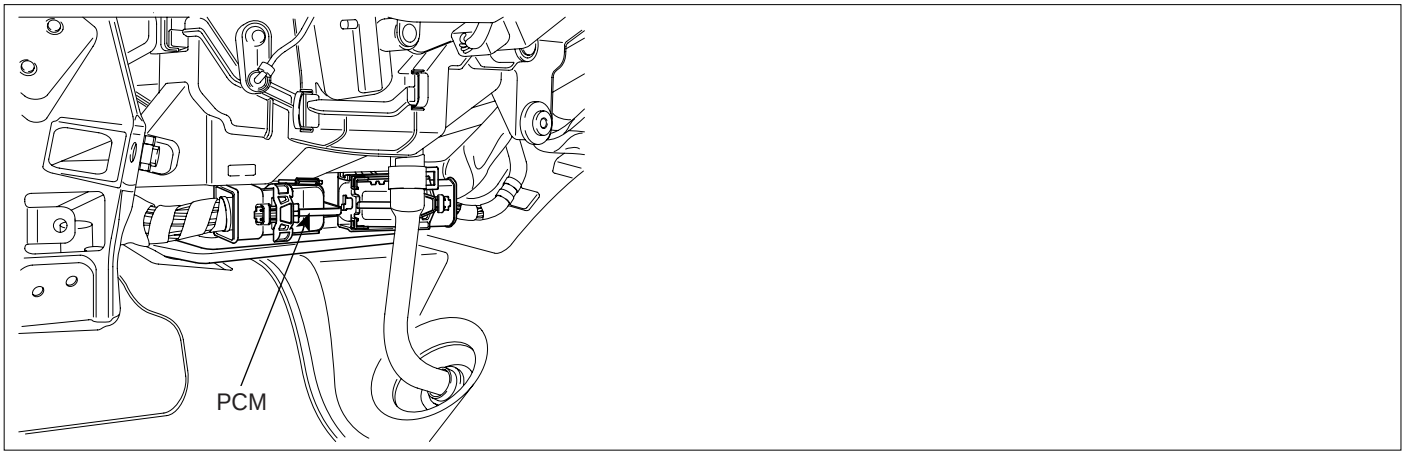
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0601 EEPROM-CHECK SUM ERROR

COMPONENT LOCATION E90D156C



SGHFL7335N

GENERAL DESCRIPTION E8822DD1

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 EC4DE08F

If real checksum does not accord with memory checksum, PCM sets P0601 and MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E990224F

Item	Detecting Condition	Possible cause
DTC Strategy	• Checksum check	• Faulty PCM
Enable onditions	• -	
Threshold value	• Discordance between the real checksum and the memorized checksum	
Diagnosis Time	• -	
MIL On Condition	• 1 driving cycle	

MONITOR DTC STATUS E74A7E4B

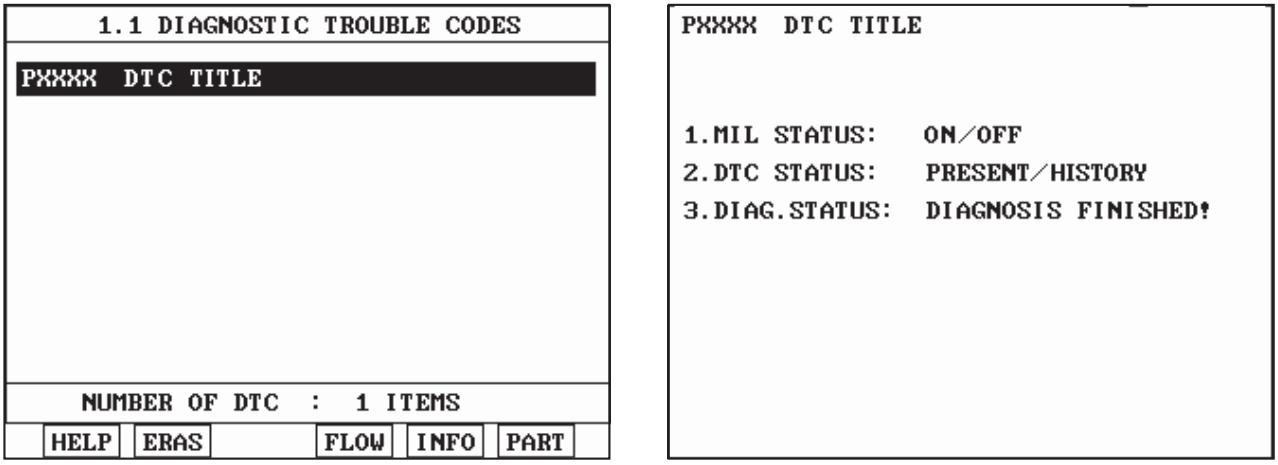
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EBF73C9E

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EE7A7C7C

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0602 EEPROM-PROGRAMING ERROR

COMPONENT LOCATION E0311F59

Refer to DTC P0601.

GENERAL DESCRIPTION E8FF5A32

Refer to DTC P0601.

DTC DESCRIPTION E6143E0D

If CPU software version does not accord with main CPU, PCM sets P0602.

DTC DETECTING CONDITION E940CEDA

Item	Detecting Condition	Possible cause
DTC Strategy	• Check internal CPU	• Faulty PCM
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 EF221B61

Refer to DTC P0601.

TERMINAL AND CONNECTOR INSPECTION EA18FD3D

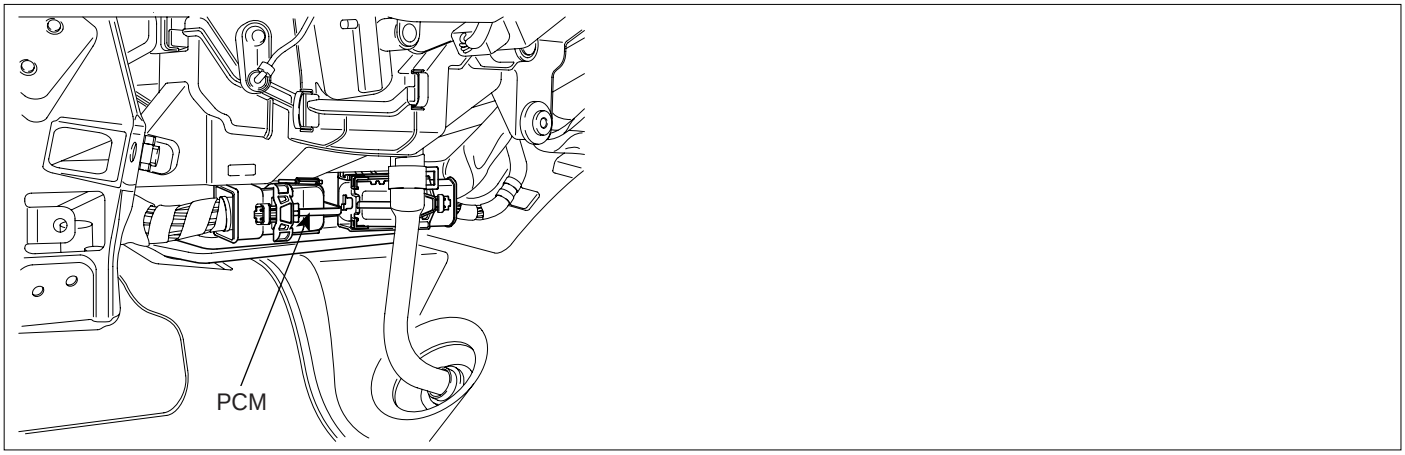
Refer to DTC P0601.

VERIFICATION OF VEHICLE REPAIR E5E7CA0C

Refer to DTC P0601.

DTC P0604 INTERNAL CONTROL MODULE RANDOM ACCESS MEMORY (RAM) ERROR

COMPONENT LOCATION E4931C77



SGHFL7335N

GENERAL DESCRIPTION ECDF2322

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 E2515DD5

If the RAM in PCM has errors, PCM sets P0604 and MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E62CF3DB

Item	Detecting Condition	Possible cause
DTC Strategy	• Check internal CPU	• Faulty PCM
Enable onditions	• -	
Threshold value	• RAM has errors.	
Diagnosis Time	• -	
MIL On Condition	• 1 driving cycle	

MONITOR DTC STATUS E53F6FF1

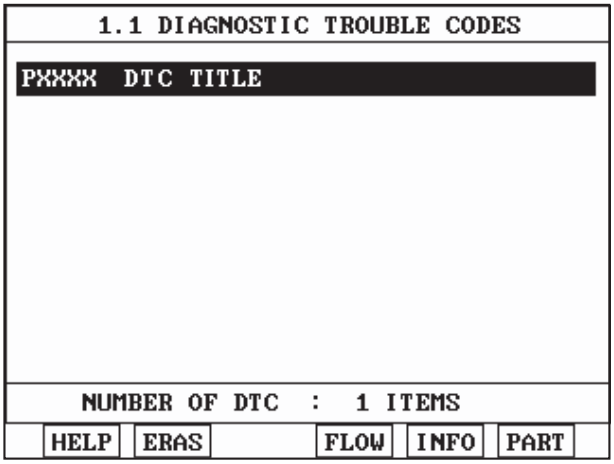
1. Check DTC Status

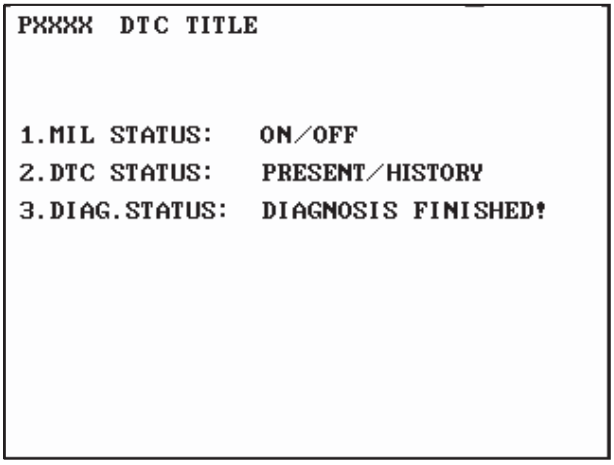
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E13FA521

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR ED097896

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0606 ECM/PCM PROCESSOR(ECM-SELF TEST FAILED)

COMPONENT LOCATION EE107275

Refer to DTC P0604.

GENERAL DESCRIPTION EAC618DC

Refer to DTC P0604.

DTC DESCRIPTION E86DC756

Checking PCM under detecting condition, if internal error is detected, PCM sets P0606. And MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E7919731

Item	Detecting Condition	Possible cause
DTC Strategy	• Check PCM internal error	• Faulty PCM
Enable onditions	• 7V 〈 Battery voltage 〈 20V	
Threshold value	• PCM internal error (A/D unit error)	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycle	

MONITOR DTC STATUS EAF8EFA4

Refer to DTC P0604.

TERMINAL AND CONNECTOR INSPECTION ED317A0F

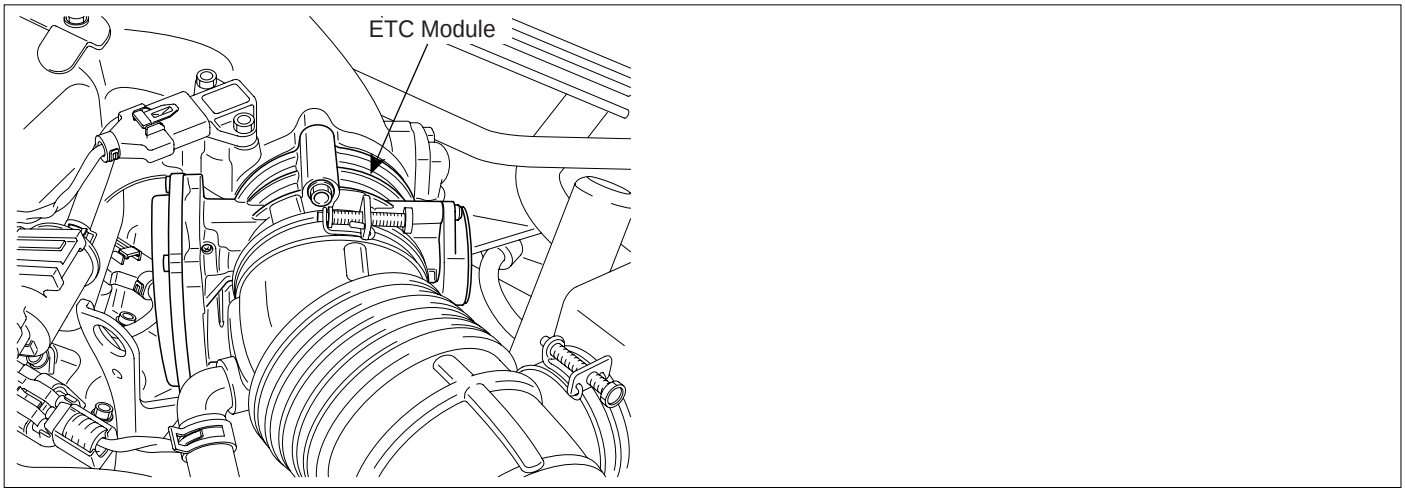
Refer to DTC P0604.

VERIFICATION OF VEHICLE REPAIR E88AAD15

Refer to DTC P0604.

DTC P0638 THROTTLE ACTUATOR CONTROL RANGE/PERFORMANCE

COMPONENT LOCATION E5132C9F



SGHFL7316N

GENERAL DESCRIPTION E75577BB

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 PCM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E308E324

Checking output signals from TPS under detecting condition, if the difference between real and target throttle position is above the specified value, PCM sets P0638 and then MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E13D0C05

Item		Detecting Condition	Possible cause
DTC Strategy		• Monitor the throttle position	• Throttle stuck • Open in motor circuit • Faulty motor • Faulty PCM
Enable Conditions		• Engine running • 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	

※ If Main relay has a fault(ex. Open) while the engine is running, the DTCs,P0638/P0685/P1295/P2106, can happen at the same time.

＜DTC Name＞

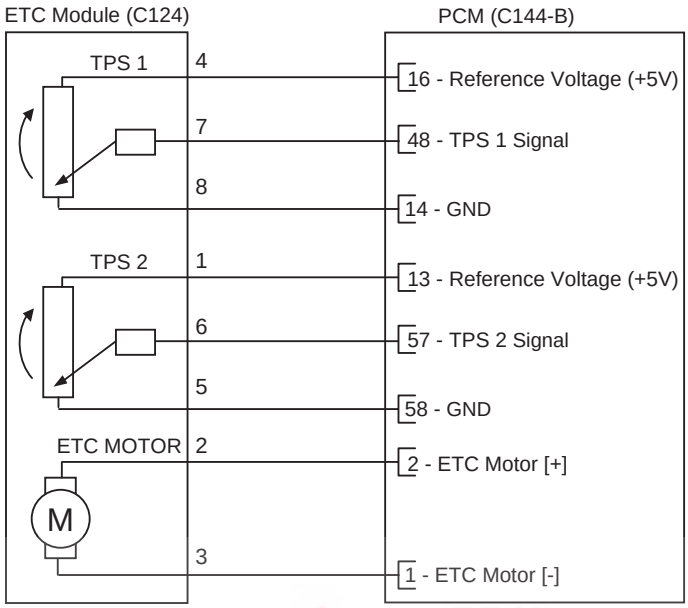
- P0638 Throttle Actuator Control Range/Performance(Bank 1)
- P0685 PCM/PCM Power Relay Control Circuit /Open
- P1295 Throttle Actuator Control System - Power Management
- P2106 Throttle Actuator Control System - Forced Limited Power

SPECIFICATION EED25AF1

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 E521A824

[CIRCUIT DIAGRAM]



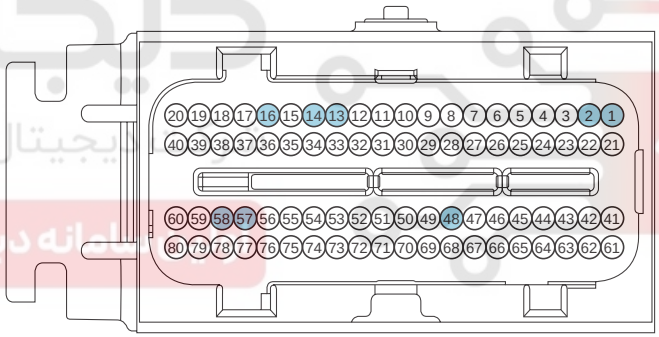
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE



C144-B

PCM

UFBG236A

SIGNAL WAVEFORM AND DATA E4FC4FCA

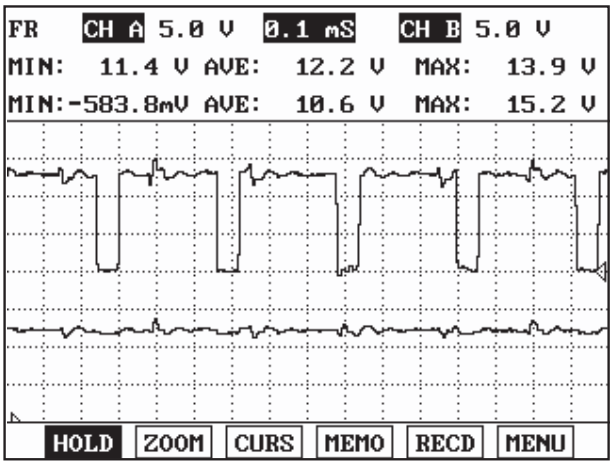


Fig. 1

Fig1) Signal waveform(+/-) while accelerating

SBLFL7921N

MONITOR DTC STATUS E625F6E9

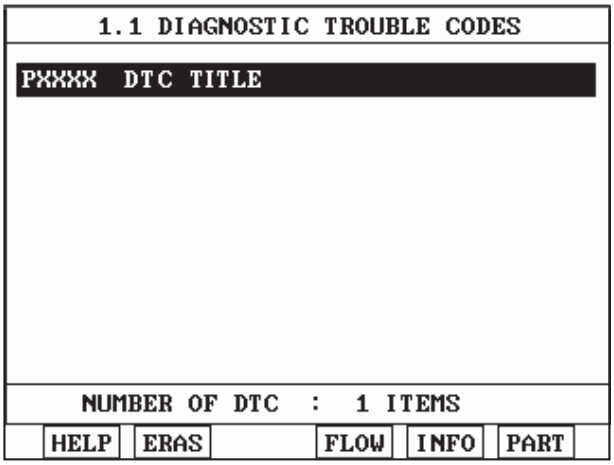
1. Check DTC Status

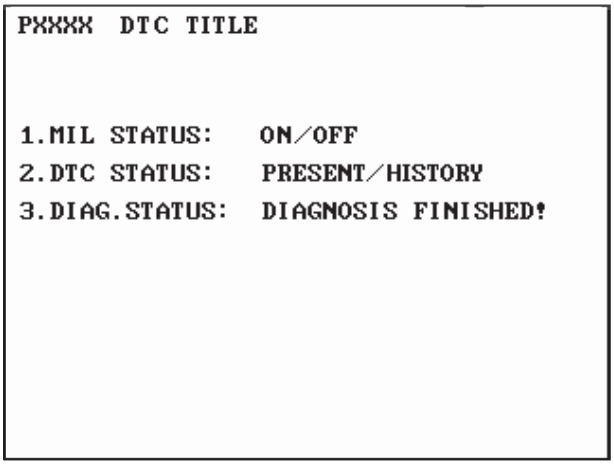
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 E7B75E37

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E06F2C06

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 PCM connector.
   3) Measure the resistance between terminal 2 of ETS motor & TPS harness connector and terminal 2 of PCM harness connector(C144-A).
   4) Measure the resistance between terminal 3 of ETS motor & TPS harness connector and terminal 1 of PCM harness connector(C144-A).

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 E5CD48CF

1. Check for sticking throttle valve

1) IG "OFF".

2) Disconnect the air hose between throttle body and air mass flow sensor.

3) Check for sticking throttle valve.

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.

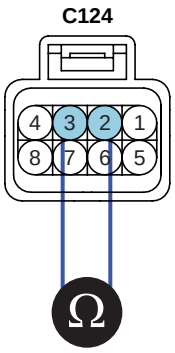
2. Check ETS motor resistance

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 ~ 1.725Ω @ 23℃ (73.4℉)



1. TPS2 power
2. ETS motor control A(+)
3. ETS motor control B(-)
4. TPS1 power
5. TPS2 ground
6. TPS2 signal
7. TPS1 signal
8. TPS1 ground

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.

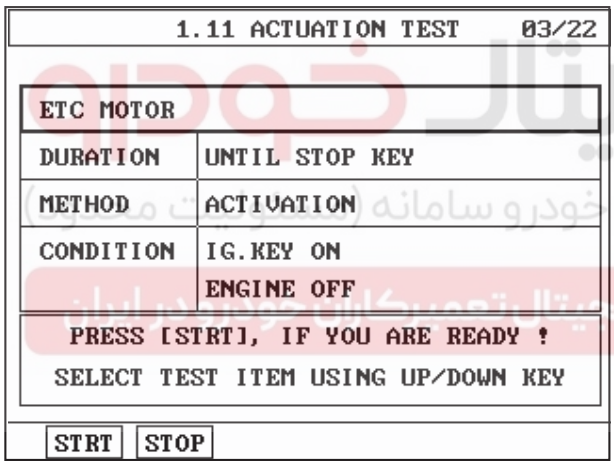
※ Procedure of ETS Initialization
1. Erase the trouble codes on PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

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.



EGRF926A

4) Does the "ETC motor actuation test" execute normally?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E4BD5074

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 EF58D287

The PCM provides a 5volt reference voltage to Throttle Position Sensor 1(TPS1). The PCM monitors reference voltage deviation from the power supply circuit of the sensors

DTC DESCRIPTION E6E5781D

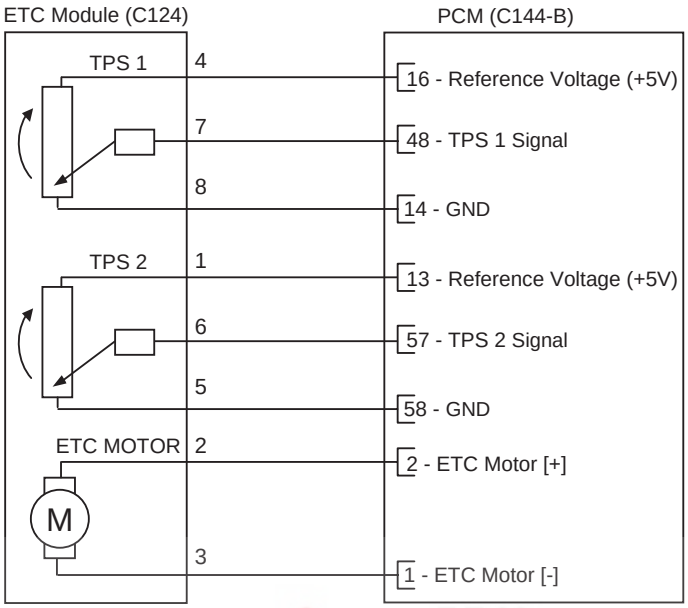
Checking the voltage from sensor power supply every 1.87 sec. under detecting condition, if the value within detecting condition lasts for more than 0.2 sec., PCM sets P0641. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E108BE4C

Item	Detecting Condition	Possible cause
DTC Strategy	• Sensor reference voltage check	• Short in sensor power supply line • Faulty PCM
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	

SCHEMATIC DIAGRAM E81DEA30

[CIRCUIT DIAGRAM]



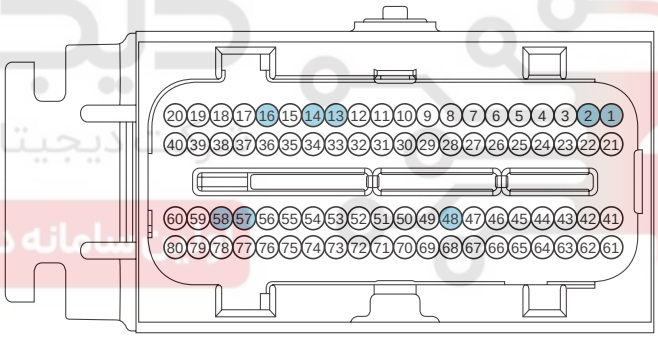
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE



C144-B

PCM

UFBG236A

MONITOR DTC STATUS E73EE665

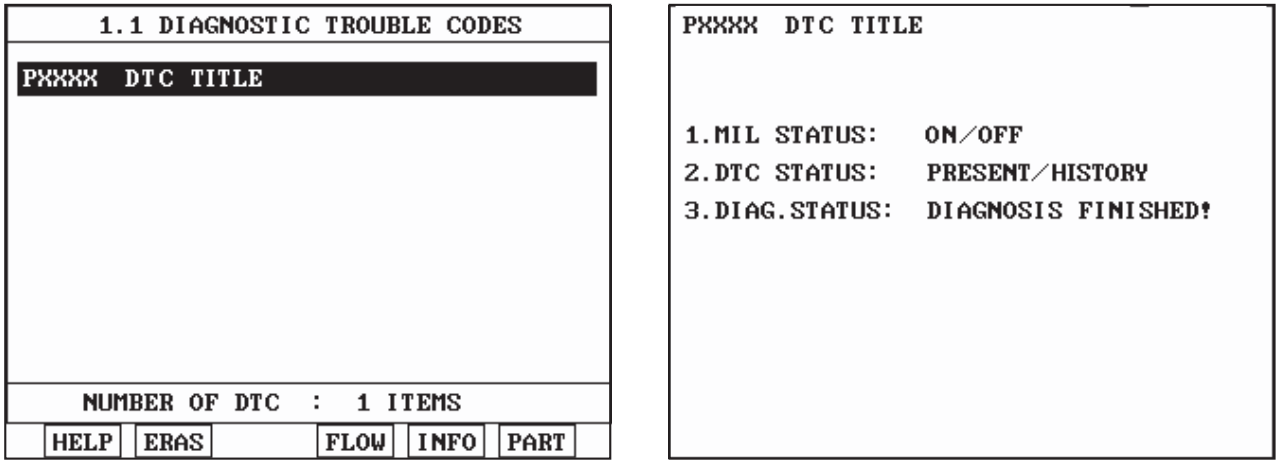
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’s and/or PCM’s connector or was repaired and PCM 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 E89F77B3

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E85DE660

1. Check voltage
   1) IG "OFF".
   2) Disconnect TPS connector.
   3) IG "ON" and ENG "OFF"

4) Measure the voltage between terminal 4 of TPS harness connector and chassis ground.

Specification : Approx. 5V

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 PCM 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

7) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation.
▶ If the problem is corrected, replace PCM 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 PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E9022761

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 E3229CBD

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 PCM. When A/C is requested, the Engine Control Module(PCM) 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 PCM delays grounding the relay circuit for a short time, so the PCM can adjust the engine idle speed for the additional load. The PCM 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 E59045C6

PCM monitors 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., PCM sets P0646.

DTC DETECTING CONDITION E071EA8A

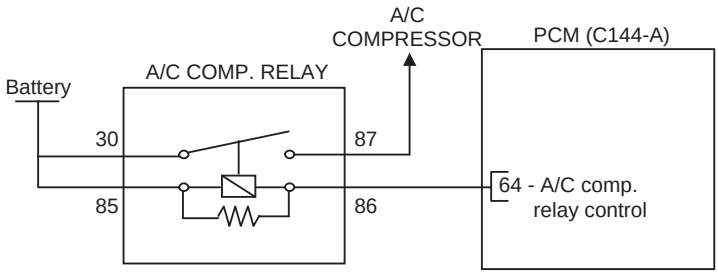
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects circuit short to low voltage	• Poor connection • Open or short to ground in A/C relay circuit • Faulty A/C relay • Faulty PCM
Enable Conditions	• After 0.5 sec under conditions below • No DTC exists • Engine running • 11V ≤ Battery voltage ≤ 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 E1024500

Coil Resistance
70Ω ~ 120Ω

SCHEMATIC DIAGRAM E635DE93

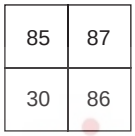
[CIRCUIT DIAGRAM]



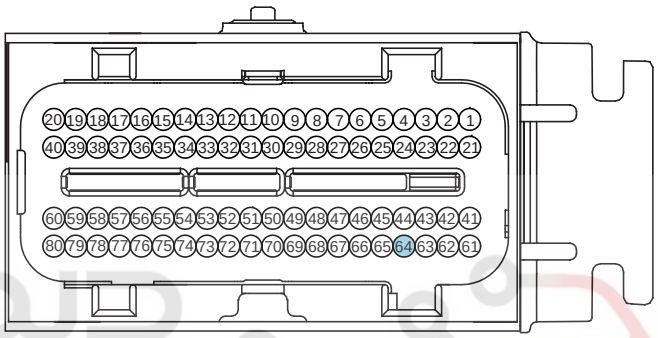
[CONNECTION INFORMATION]

Terminal	Connected to	Function
87	A/C COMPRESSOR	Power to A/C compressor
85	Battery	Power Supply (B+)
86	PCM C144-A (64)	A/C comp. relay control
30	Battery	Power Supply (B+)

[HARNESS CONNECTOR]



A/C COMP RELAY



C144-A
PCM

SGHFL7336N

MONITOR DTC STATUS E326118F

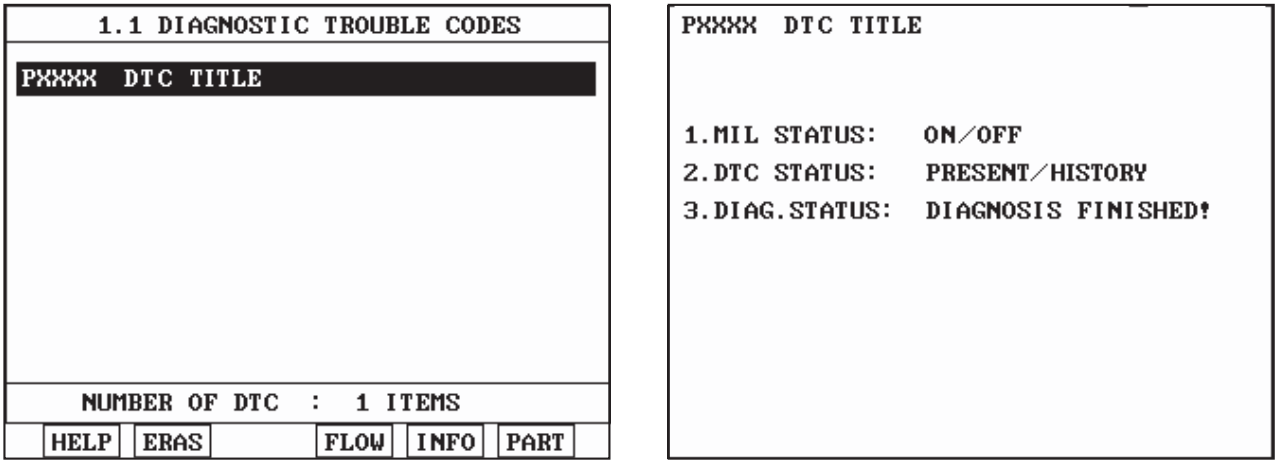
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E62B9487

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E6213D7A

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.

5) Measure the voltage between terminal 85 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 E9460385

1. Check short in harness

1) IG "OFF".

2) Disconnect A/C relay and PCM connector.

3) Measure the resistance between terminal 86 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 PCM connector.

3) Measure the resistance between terminal 86 of A/C relay harness connector and terminal 64 of PCM harness connector.

Specification : Approx. below 1Ω

4) Is the measured resistance within specification ?

YES

▶ Go to "Component inspection" procedure.

NO

▶ Repair Open in Coil control harness and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E9045A60

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)

SGHFL7285N

   5) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EBA20D1B

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0647 A/C CLUTCH RELAY CONTROL CIRCUIT HIGH

GENERAL DESCRIPTION ED587901

Refer to DTC P0646.

DTC DESCRIPTION E8B388DC

PCM monitors 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., PCM sets P0647.

DTC DETECTING CONDITION E10BB9AB

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 PCM
Enable Conditions	• After 0.5 sec under conditions below • No DTC exists • Engine running • 11V ≤ Battery voltage ≤ 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 E3013A10

Coil Resistance
70Ω ~ 120Ω

SCHEMATIC DIAGRAM E393DFDE

Refer to DTC P0646.

MONITOR DTC STATUS EF30088B

Refer to DTC P0646.

TERMINAL AND CONNECTOR INSPECTION EB57409C

Refer to DTC P0646.

POWER CIRCUIT INSPECTION EF4C78E1

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.

5) Measure the voltage between terminal 85 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 EA8D2725

1. Check short in harness

1) IG "ON".

2) Disconnect A/C relay.

3) Measure the voltage between terminal 86 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 E0BC7EC6

1. Check A/C relay

1) IG "OFF".

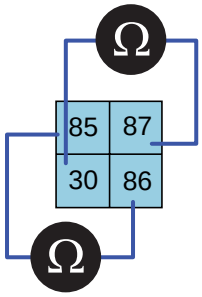
2) Disconnect A/C relay.

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)



87.Power supply to A/C compressor
85.A/C relay control power
86.A/C relay control
30.A/C relay switch power

SGHFL7285N

5) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E3312F72

Refer to DTC P0646.

DTC P0650 MALFUNCTION INDICATOR LAMP(MIL) CONTROL CIRCUIT

GENERAL DESCRIPTION E6D2FD18

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 E439F418

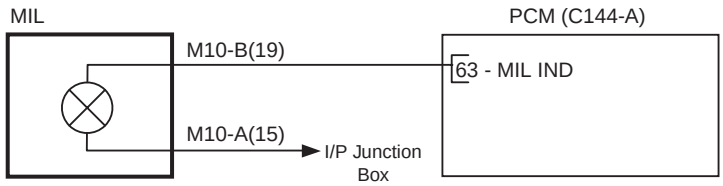
Checking input signal of engine check lamp every 10 sec. under detecting condition, if open, short to battery or ground is detected, PCM sets P0650.

DTC DETECTING CONDITION E13B1BB7

Item	Detecting Condition	Possible cause
DTC Strategy	• Check the MIL	• Poor connection • Open or short in MIL circuit • Faulty MIL • Faulty PCM
Enable Conditions	• After 0.5 sec under conditions below • Engine running • 11V ≤ Battery voltage ≤ 16V	
Threshold value	• Open or short	
Diagnosis Time	• Continuous	
MIL On Condition	• DTC only (NO MIL ON)	

SCHEMATIC DIAGRAM EF95A32E

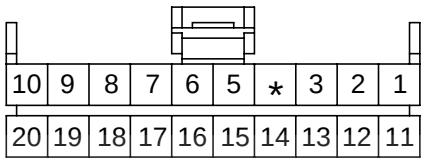
[CIRCUIT DIAGRAM]



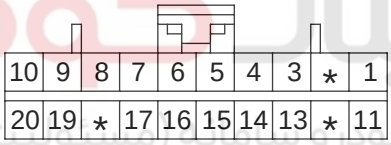
[CONNECTION INFORMATION]

Terminal	Connected to	Function
M10-A(15)	Junction Box	Power Supply (B+)
M10-B(19)	PCM C144-A (63)	MIL IND

[HARNESS CONNECTOR]

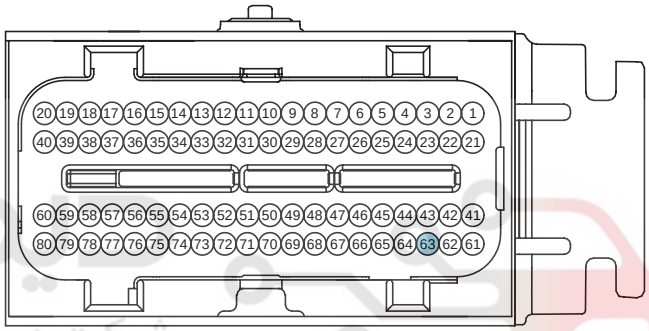


M10-A



M10-B

INSTRUMENT CLUSTER



C144-A

PCM

SGHFL7337N

MONITOR DTC STATUS EFC8DF85

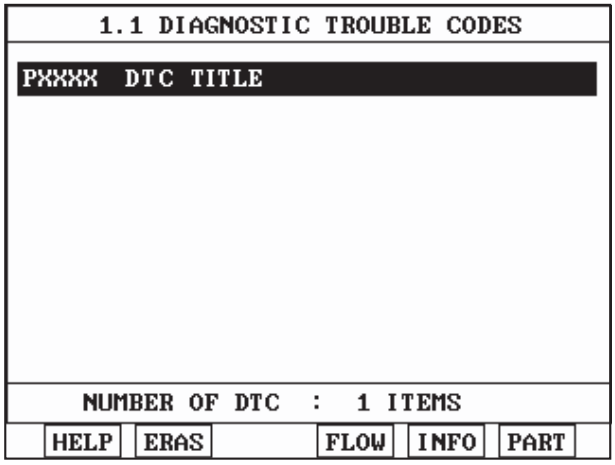
1. Check DTC Status

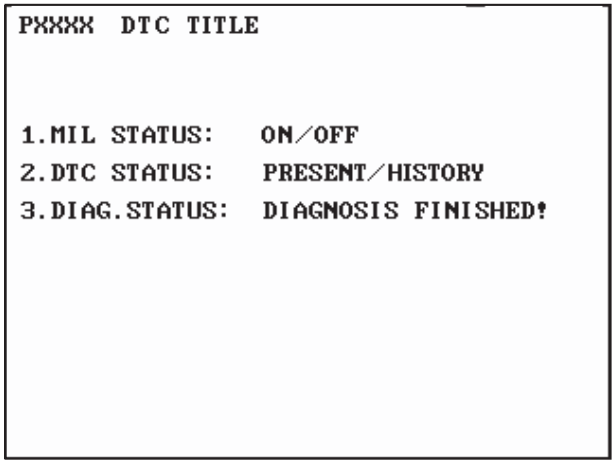
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 E64394E2

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 EA831951

1. IG "OFF" and disconnect Instrument cluster connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 15 of instrument cluster 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 between battery and instrument cluster.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EBB1D83C

1. IG "OFF" and disconnect PCM connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between 63 of PCM harness connector(C144-A) and chassis ground.

Specification : Approx. B+

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 E2AE32BC

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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR ED29D49D

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 E523A97B

The PCM provides a 5volt reference voltage to Throttle Position Sensor 2(TPS2). The PCM monitors reference voltage deviation from the power supply circuit of the sensors.

DTC DESCRIPTION E9622C3E

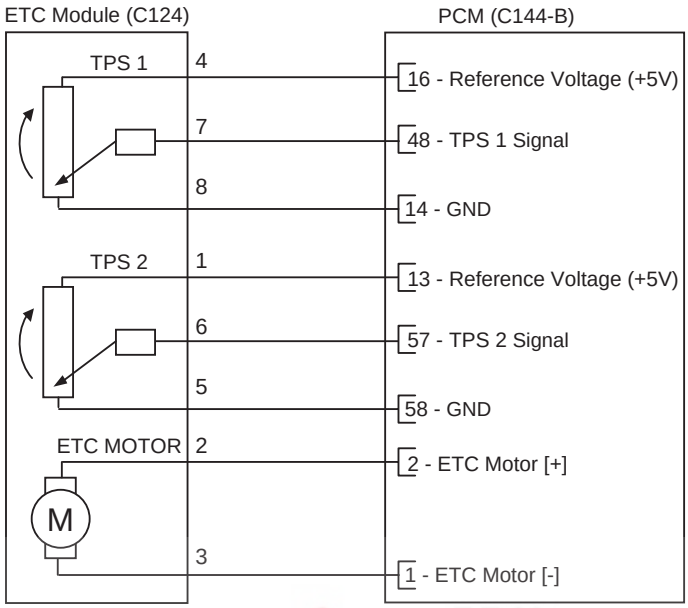
Checking the voltage from sensor power supply every 1.87 sec. under detecting condition, if the value within detecting condition lasts for more than 0.2 sec., PCM sets P0651. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ED597146

Item	Detecting Condition	Possible Cause
DTC Strategy	• Sensor reference voltage check	• Short in sensor power supply line • Faulty PCM
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 EC763175

[CIRCUIT DIAGRAM]



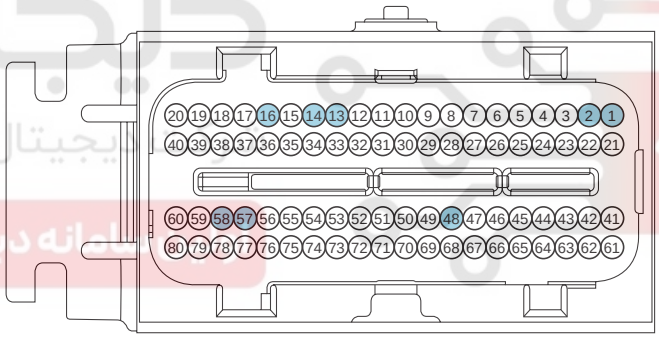
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE



C144-B

PCM

UFBG236A

MONITOR DTC STATUS ED5338D1

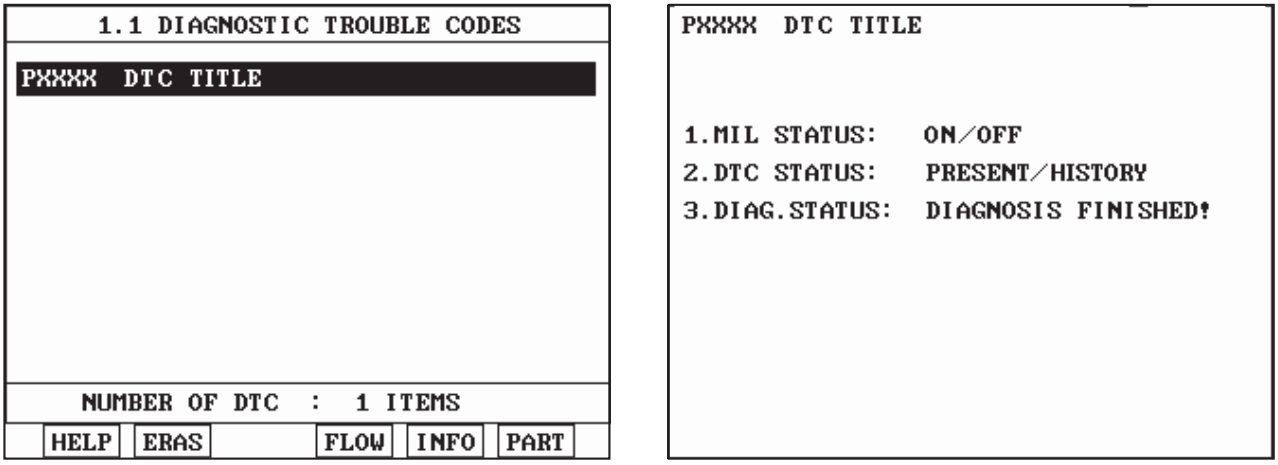
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 ED710EFD

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E860CF13

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

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 PCM 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

7) Is the measured resistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E1FF81EA

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 EF197B02

SGHFL7338N

GENERAL DESCRIPTION E9DF73F8

VIS(Variable intake system) is a device which varies the length of intake manifold to genetate 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 controlls VIS using RPM signal.

DTC DESCRIPTION E5807CC7

Checking the output voltage from VIS every 10 sec. under detecting condition, if the value within detecting condition lasts for more than 5 sec., PCM sets P0660. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E444D8A1

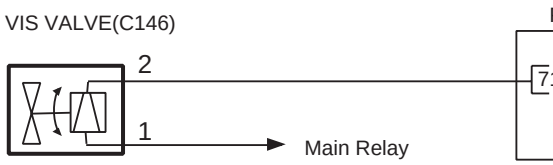
Item	Detecting Condition	Possible Cause
DTC Strategy	• Check VIS	• Poor connection • Open or short in VIS circuit • Faulty VIS • Faulty PCM
Enable condition	• After 0.5 sec under conditions below • Engine running • 11V ≤ Battery voltage ≤ 16V	
Threshold value	• Open or short	
Diagnosis time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL ON condition	• 2 driving cycles	

SPECIFICATION E719439C

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

SCHEMATIC DIAGRAM E81B6647

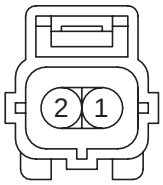
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

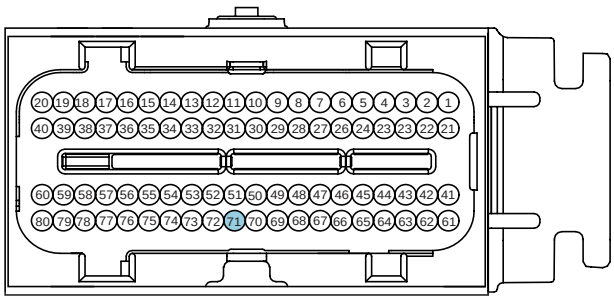
Terminal	Connected to	Function
1	Main Relay	Battery voltage (B+)
2	PCM C144-A (71)	VIS Valve control

[HARNESS CONNECTORS]



C146

VIS VALVE



C144-A

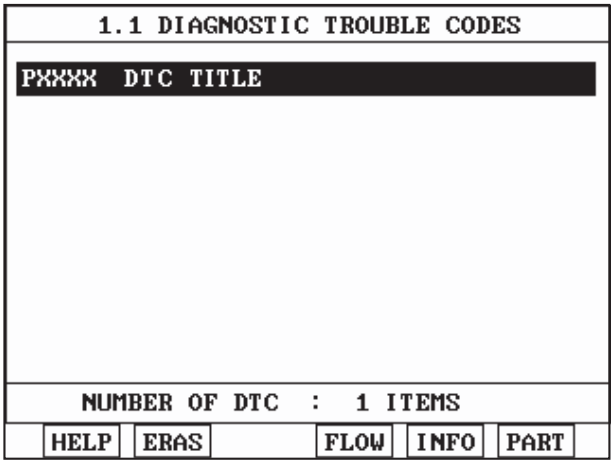
PCM

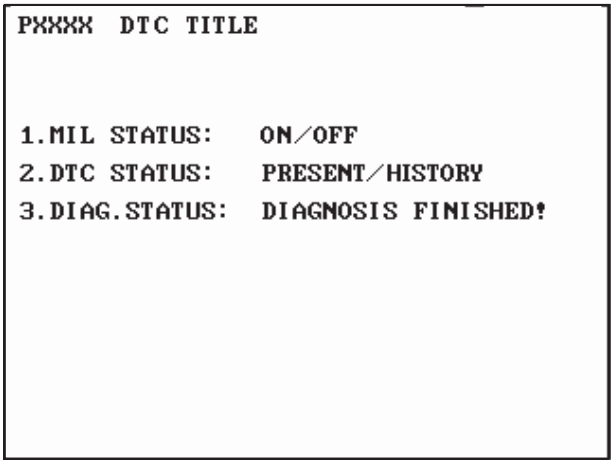
SGHF17012N

MONITOR DTC STATUS E3810B96

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 F5(INFO) to check DTC's information from the DTCs menu
4) Read "DTC Status" parameter.





SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 EC627A35

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E602A1C7

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.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EA6F3843

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.

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 PCM 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 PCM connector.

2) Measure resistance between terminal 2 of VIS harness connector and terminal 71 of PCM 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.

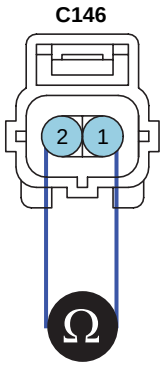
COMPONENT INSPECTION E1FBCA13

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)]



1. VIS Power
2. VIS Control

SBLF26659L

3) Is the measured resistance within specification?

YES

▶ Substitute with a known - good PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E38DAFDF

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

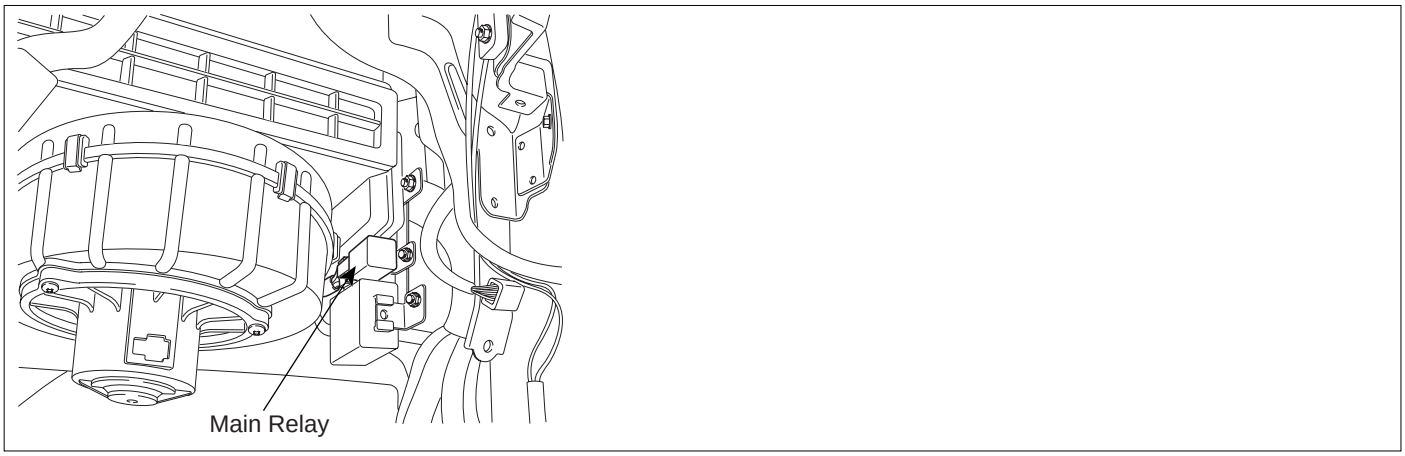
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0685 ECM/PCM POWER RELAY CONTROL CIRCUIT /OPEN

COMPONENT LOCATION EA31D135



SGHFL7333N

GENERAL DESCRIPTION E7E2B574

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

DTC DESCRIPTION E1217702

Checking the contolling state of main relay every 10 sec. under detecting condition, if open or short in the circuit is detected for more than 5 sec., PCM sets P0685.

DTC DETECTING CONDITION E7E31514

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 PCM
EnableConditions	• Engine Running • 11V ≤ Ignition Voltage ≤ 16V	
Threshold value	• Open or Short in circuit	
DiagnosisTime	• Contineous (More than 5sec. Failure for every 10 sec. test)	
MIL On Condition	• DTC only (NO MIL ON)	

※ If Main relay has a fault(ex. Open) while the engine is running, the DTCs,P0638/P0685/P1295/P2106, can happen at the same time.

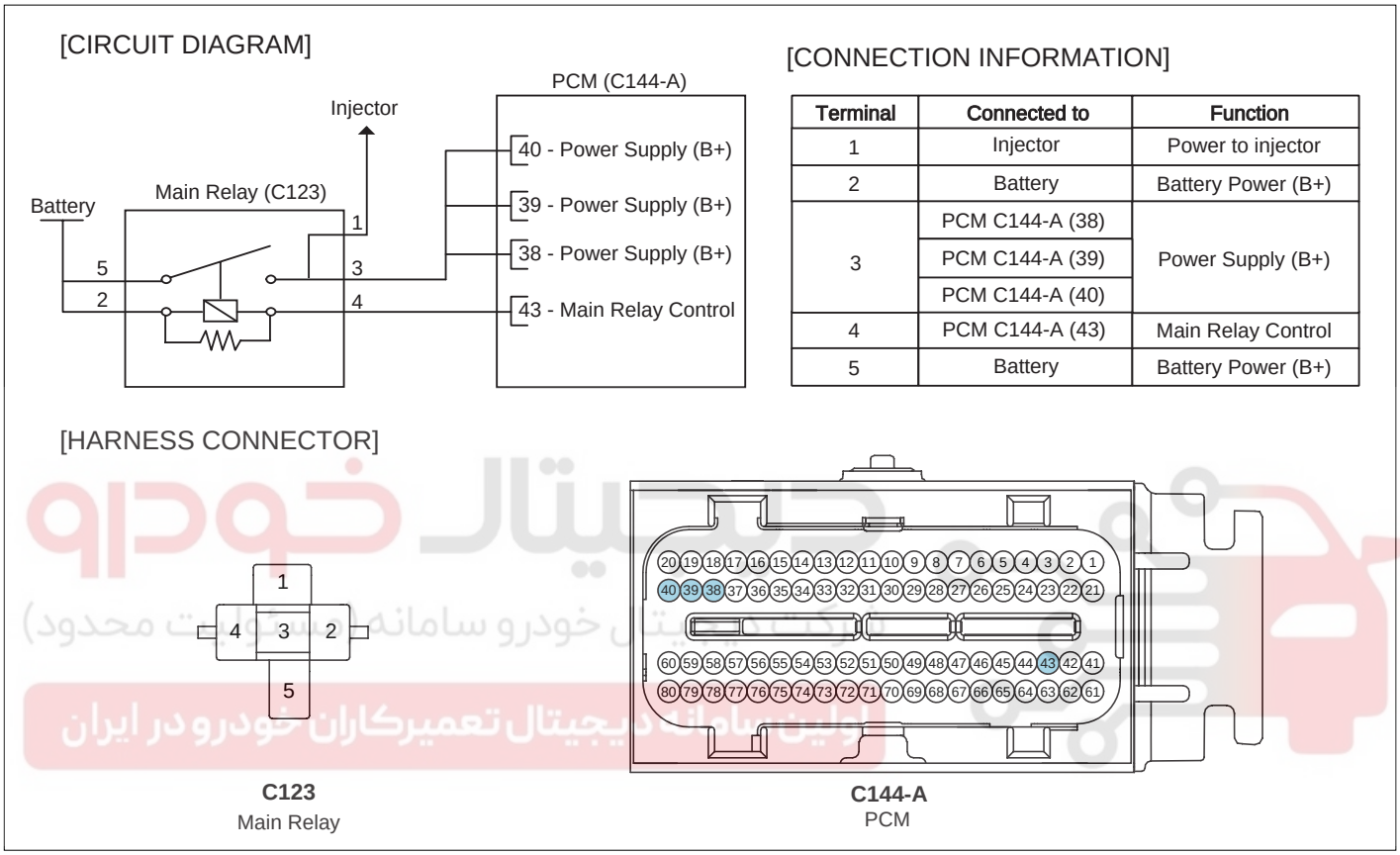
＜DTC Name＞

- P0638 Throttle Actuator Control Range/Performance(Bank 1)
- P0685 PCM/PCM Power Relay Control Circuit /Open
- P1295 Throttle Actuator Control System - Power Management
- P2106 Throttle Actuator Control System - Forced Limited Power

SPECIFICATION E95B6D5B

Coil Resistance
70Ω ~ 120Ω

SCHEMATIC DIAGRAM EA2B7DBD



Terminal	Connected to	Function
1	Injector	Power to injector
2	Battery	Battery Power (B+)
3	PCM C144-A (38)	Power Supply (B+)
	PCM C144-A (39)	
	PCM C144-A (40)	
4	PCM C144-A (43)	Main Relay Control
5	Battery	Battery Power (B+)

SGHFL7334N

MONITOR DTC STATUS E170D9B8

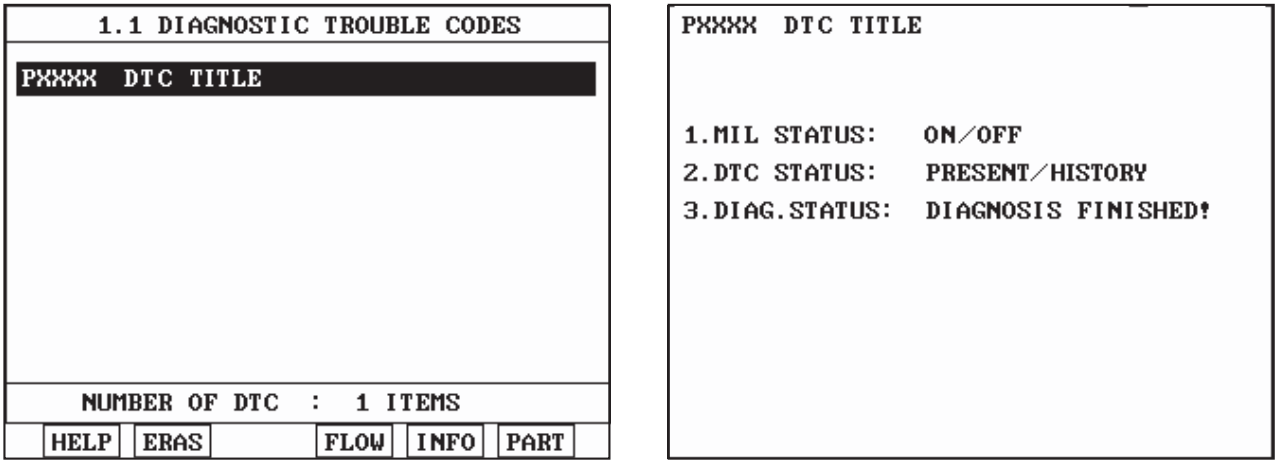
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E9B22D26

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 EE4B136F

1. IG "OFF"
2. Disconnect Main Relay
3. IG "ON" & ENG "OFF".
4. Measure the voltage between terminal 2 of main relay harness connector and chassis ground.

5. Measure the voltage between terminal 5 of main relay harness connector and chassis ground.

Specification : B+

6. Is the measured voltage within specification ?

YES

▶ Go to "Control Circuit Inspecition" 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 ED120465

1. Check short in harness

   1) IG "OFF".

   2) Disconnect Main Relay and PCM connector.

   3) Measure resistance between terminal 4 of Main Relay and chassis ground.

   4) Measure resistance between terminals 4 and 2 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 PCM connector.

   3) Measure resistance between harness terminal 4 of Main Relay and harness terminal 43 of PCM harness connector.

Specification : Approx. below 1Ω

   4) Is the measured resistance within specifications ?

YES

▶ Go to "Component Inspection" procedure.

NO

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

COMPONENT INSPECTION E51BEBFF

1. Check Main Relay

   1) IG "OFF"

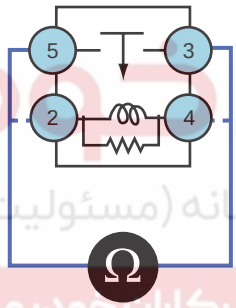
   2) Disconnect Main Relay

   3) Measure the resistance between terminal 2 and 4 of main relay.

   4) Measure the resistance between terminal 5 and 3 of main relay.

SPECIFICATION :

Terminal	continuity
3 ~ 5	NO
2 ~ 4	YES (Approx. 70Ω ~ 120Ω)



SGHFL7278N

5) Is the measured reisistance within specification ?

YES

▶ Substitute with a known - good PCM and check for proper operation.
If the problem is corrected, replace PCM 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 PCM.

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 EF925CD4

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

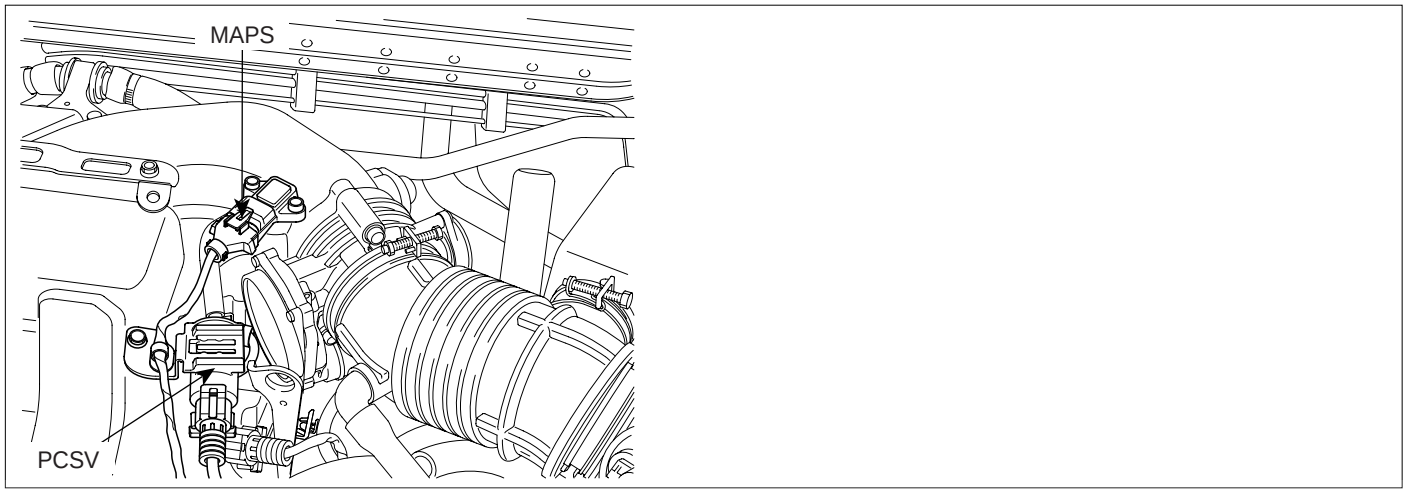
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P1106 MANIFOLD ABSOLUTE PRESSURE SENSOR CIRCUIT SHORT - INTERMITTENT HIGH INPUT

COMPONENT LOCATION E9CB632C



SGHFL7314N

GENERAL DESCRIPTION E9483C83

The amount of intake air flow must be inputted to PCM 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, PCM 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 EA57E077

Checking output signals of MAPS under detecting condition, if an output signal is intermittently above 4.5V ., PCM sets P1106.

DTC DETECTING CONDITION E82AFE3D

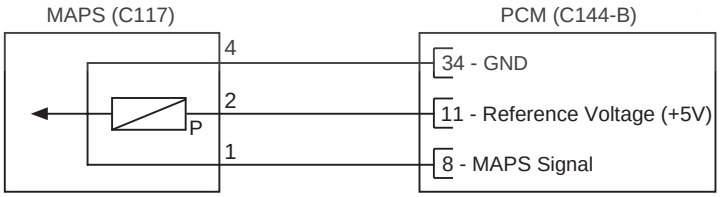
Item		Detecting Condition	Possible Cause
DTC Strategy		• Monitor the signal of MAP sensor	• Poor connection • Short to battery in signal circuit • Open in ground circuit • Faulty MAPS • Faulty PCM
Enable Condi-tions	Case 1	• No TPS Active Fault Present • Engine Running Time > 10sec. • Engine Speed ≤ 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 EF32A797

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 E865F5A3

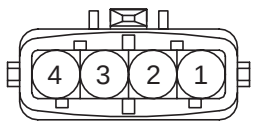
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

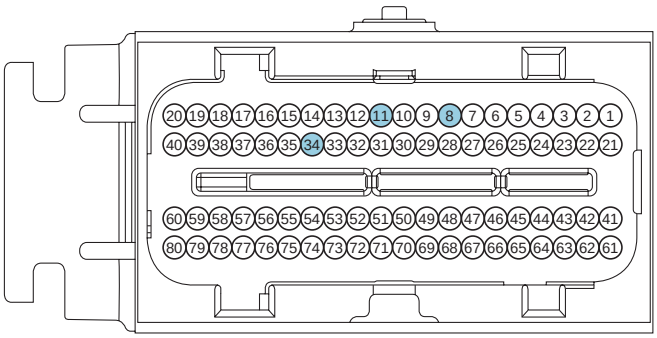
Terminal	Connected to	Function
1	PCM C144-B (8)	MAPS Signal
2	PCM C144-B (11)	Reference Voltage (+5V)
3	-	-
4	PCM C144-B (34)	Sensor ground

[HARNESS CONNECTORS]



C117

MAPS

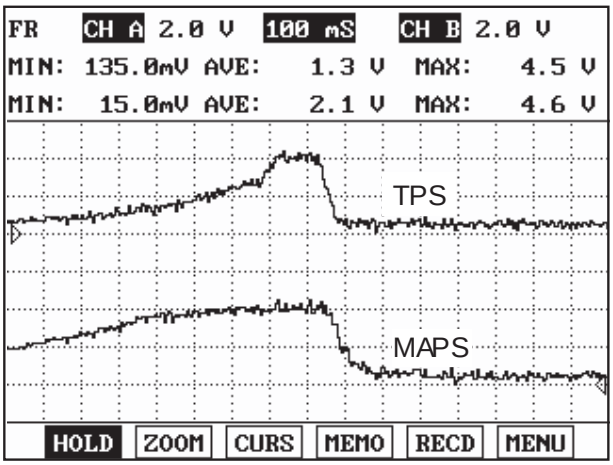


C144-B

PCM

UFBG240A

SIGNAL WAVEFROM AND DATA EB23D46B



Comparing MAPS and TPS, The signals of MAPS and TPS increasess and decrease simultaneously.

EGRF958A

MONITOR DTC STATUS E2B12E15

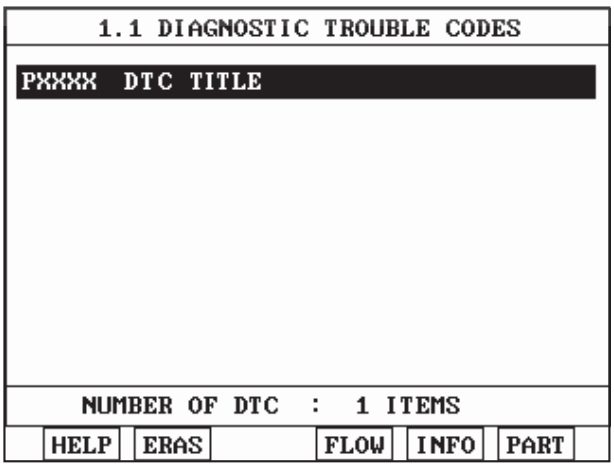
1. Check DTC Status

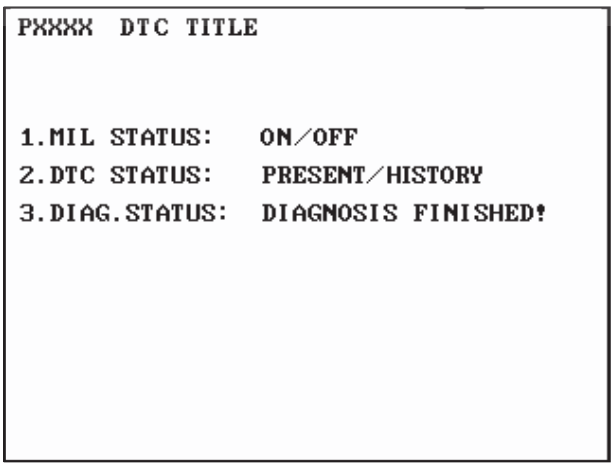
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 EF040D7B

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E9CBBD0A

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 E736E9C4

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 reistance or open in harness and then go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E055C757

1. IG "OFF"
2. Disconnect MAPS and PCM 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

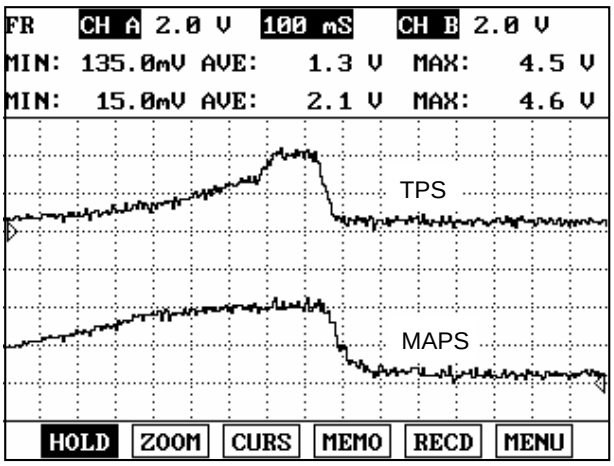
▶ Repair short to battery in harness and then go to "Verification of Vehicle Repair" procedure.

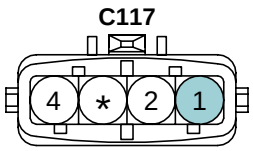
COMPONENT INSPECTION E6940DC7

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.

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 PCM".

NO

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

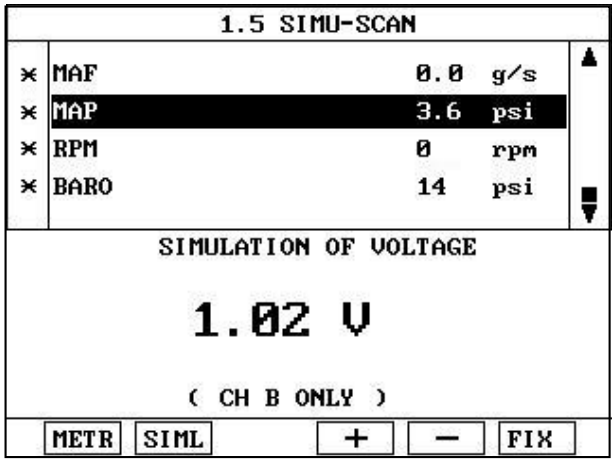
2. Check PCM

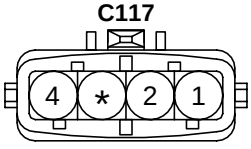
1) IG "OFF" and disconnect MAPS connector.

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

▶ 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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EE9A0DD8

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P1107 MANIFOLD ABSOLUTE PRESSURE SENSOR CIRCUIT SHORT - INTERMITTENT LOW INPUT

COMPONENT LOCATION E332FEBA

Refer to DTC P1106.

GENERAL DESCRIPTION E49C23FE

Refer to DTC P1106.

DTC DESCRIPTION EFF6581C

Checking output signals of MAPS under detecting condition, if an output signal is intermittently below 0.25V, PCM sets P1107.

DTC DETECTING CONDITION E9373E4F

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 PCM
Enable Condi-tions	Case 1	• No TPS Active Fault Present • Ignition Voltage ≥ 11V • Engine Speed ≤ 1000rpm • Throttle Position ≥ 0%	
	Case 2	• No TPS Active Fault Present • Ignition Voltage ≥ 11V • Engine Speed ＞1000rpm • Throttle Position ≥ 30%	
Threshold value		• Intermittently MAP Signal ＜ 0.25V	
Diagnosis Time		• Continuous	
MIL On Condition		• DTC only (NO MIL ON)	

SPECIFICATION E3331F87

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 E97A35C0

Refer to DTC P1106.

SIGNAL WAVEFORM AND DATA E8C1A03E

Refer to DTC P1106.

MONITOR DTC STATUS EB7F8DD6

Refer to DTC P1106.

TERMINAL AND CONNECTOR INSPECTION E120B6A1

Refer to DTC P1106.

POWER CIRCUIT INSPECTION E7219806

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 EB73DB36

1. Check short to ground in harness
   1) IG "OFF"
   2) Disconnect MAPS and PCM 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 for open circuit" of MAPS.

NO

▶ After repairing short to ground in circuits and go to "Verification of Vehicle Repair"

2. Check for open circuit
   1) IG "OFF"
   2) Disconnect MAPS and PCM connector.

3) Measure the resistance between terminal 1 of MAPS harness connector and terminal 8 of PCM 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 E3FDF4AB

1. MAPS performance test

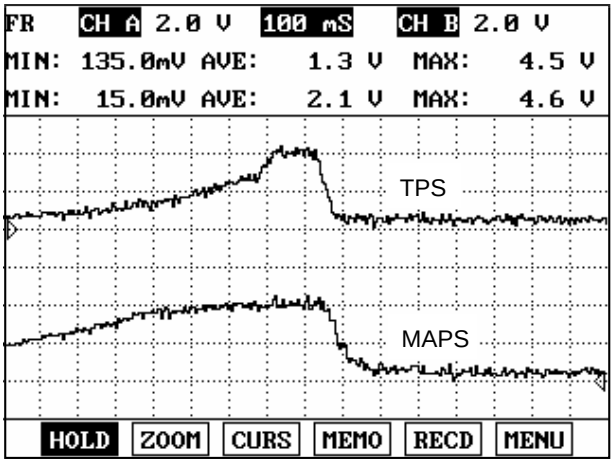
1) IG "OFF"

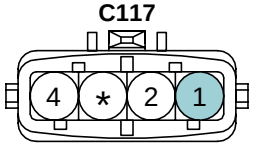
2) Connect scantool to Data Link Connector(DLC) and select "Oscilloscope" then, connect probes to output signal lines of MAPS and TPS.Turn engine "ON" and monitor the waveforms accelerating or decelerating

3) ENG "ON" and monitor signal waveform during acceleration and deceleration.

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 PCM".

NO

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

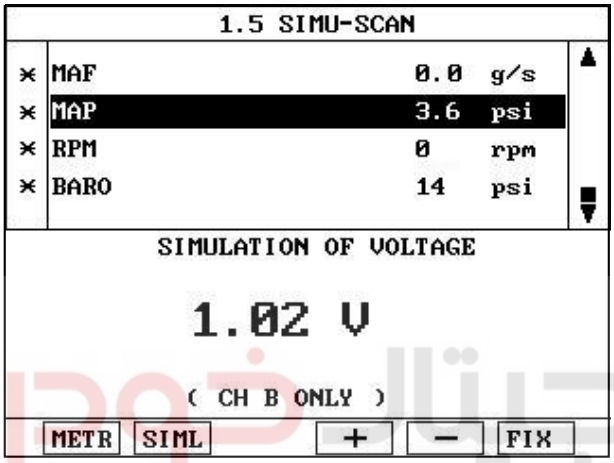
2. Check PCM

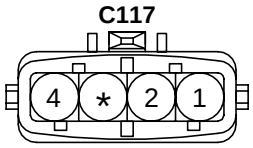
1) IG "OFF" disconnect MAPS connector

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 PCM and check for proper operation. If the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NOTE

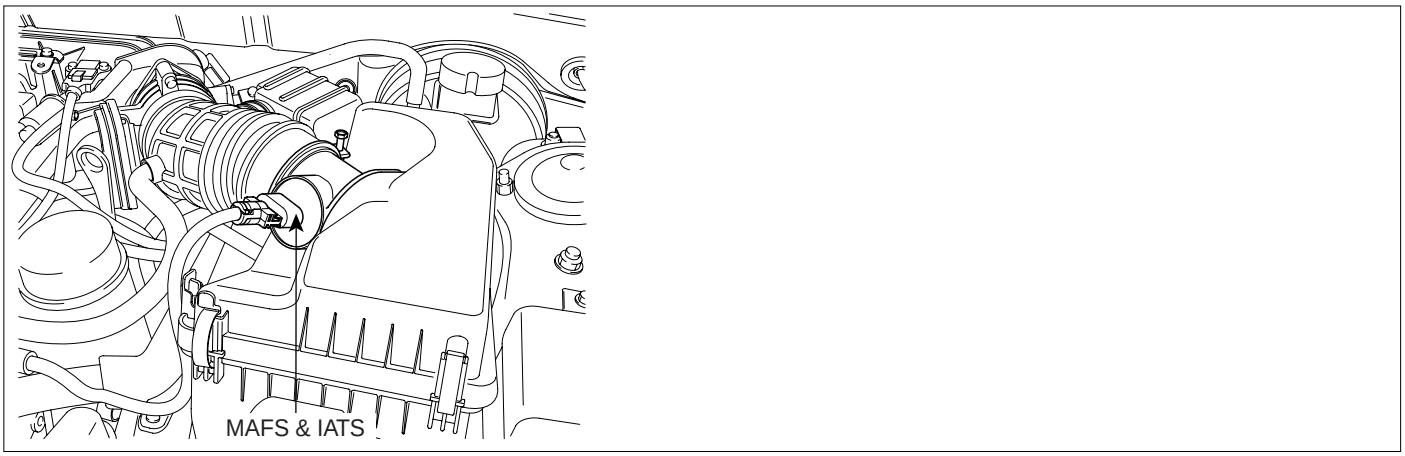
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM.Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E10E809F

Refer to DTC P1106.

DTC P1111 INTAKE AIR TEMPERATURE SENSOR CIRCUIT SHORT - INTERMITTENT HIGH INPUT

COMPONENT LOCATION EE33FC08



SGHFL7313N

GENERAL DESCRIPTION E7565796

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 PCM is supplied to the IATS via a resistor in the PCM. That is, the resistor in the PCM 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 PCM corrects basic fuel injection duration and ignition timing.

DTC DESCRIPTION E114271B

Checking output signals of IATS under detecting condition, if an ouput signal is intermittently over 4.9V, PCM sets P1111.

DTC DETECTING CONDITION E051B7EC

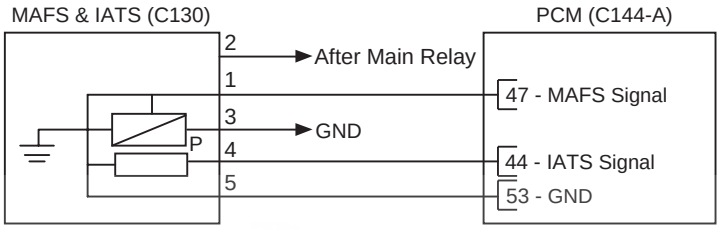
Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitor the signal of IAT sensor	• Poor Connection • Open or short in signal circuit • Open in ground circuit • Faulty IATS • Faulty PCM
Enable Conditions	• Engine running • No Vehicle speed sensor fault • No ECTS fault • No MAFS fault • Intake airflow < 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)	

SPECIFICATION EF3A0737

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 E118EE8D

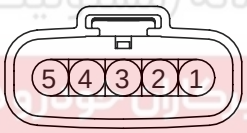
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

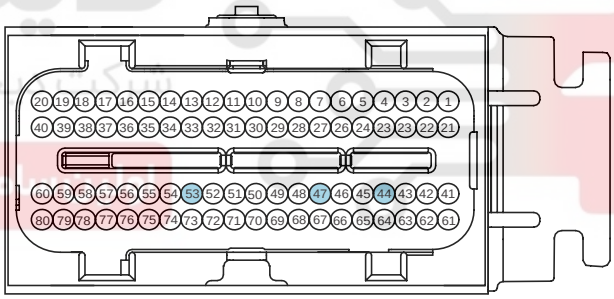
Terminal	Connected to	Function
1	PCM C144-A (47)	MAFS Signal
2	Main Relay	Battery Voltage (B+)
3	Chassis Ground	Ground
4	PCM C144-A (44)	IATS Signal
5	PCM C144-A (53)	Sensor Ground

[HARNESS CONNECTORS]



C130

MAFS & IATS

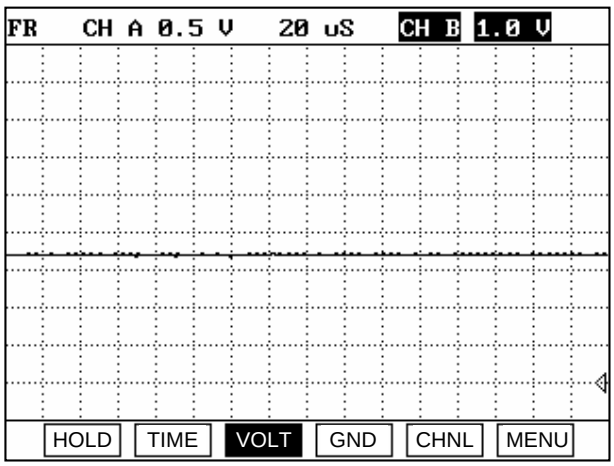


C144-A

PCM

SGHF17008N

SIGNAL WAVEFORM AND DATA E18264D8



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 E7CEB0E5

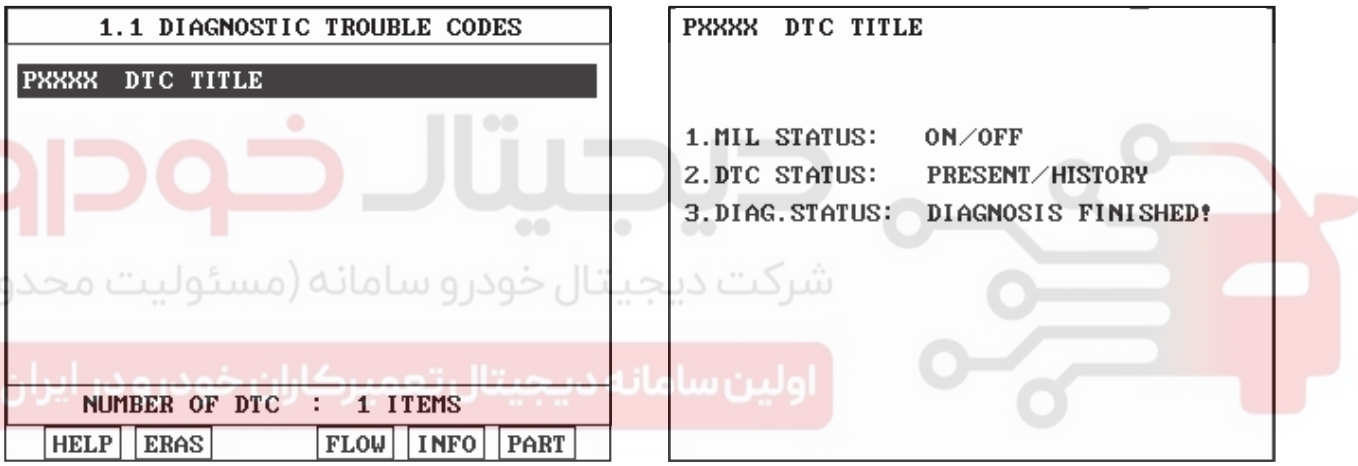
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 EEC47CD3

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 EFBB697F

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 PCM 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 PCM connctor.

   2) Measure resistance between terminal 4 of IATS harness connector and 44 of PCM 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 E25EEF44

1. IG "OFF" and disconnect IATS connector and then IG "ON.
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 E5C89B8D

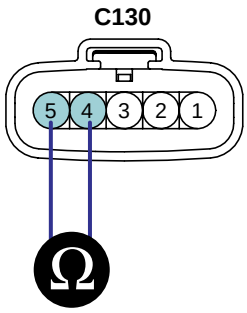
1. Check IATS

1) IG "OFF" and disconnect IATS connector.

2) Measure resistance between teminals 4 and 5 of IATS connector.(Component side)

SPECIFICATON :

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 PCM" 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.

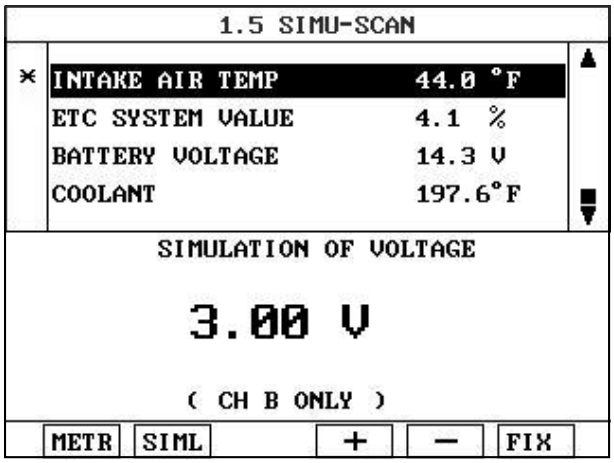
2. Check PCM

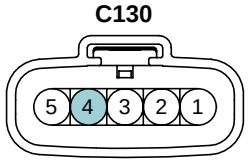
1) IG "OFF" and connect scantool.

2) Disconnect IATS connector and connect probe to terminal 4 of IATS harness connector.

3) IG "ON" and ENG "OFF" and select the 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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

VERIFICATION OF VEHICLE REPAIR EADC2CE6

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P1112 INTAKE AIR TEMPERATURE SENSOR CIRCUIT SHORT - INTERMITTENT LOW INPUT

COMPONENT LOCATION E355F735

Refer to DTC P1111.

GENERAL DESCRIPTION E9DA8125

Refer to DTC P1111.

DTC DESCRIPTION EE3C5651

Checking output signals of IATS under detecting condition, if an ouput signal is intermittently below 0.1V, PCM sets P1112.

DTC DETECTING CONDITION EDE9CA23

Item		Detecting Condition	Possible Cause
DTC Strategy		• Monitor the signal of IAT sensor	• Poor Connection • Short to ground in signal circuit. • Faulty IATS • Faulty PCM
Enable Condi-tions	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 EC1D43B1

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 E283DA96

Refer to DTC P1111.

SIGNAL WAVEFORM AND DATA EABFC025

Refer to DTC P1111.

MONITOR DTC STATUS E10D6CD5

Refer to DTC P1111.

TERMINAL AND CONNECTOR INSPECTION E79A4D49

Refer to DTC P1111.

SIGNAL CIRCUIT INSPECTION EBB54536

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 PCM 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 EEC03FCD

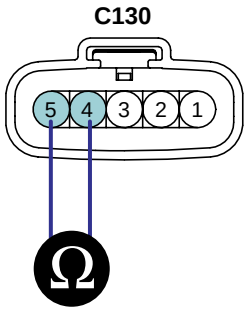
1. Check IATS

   1) IG "OFF" and disconnect IATS connector.

   2) Measure resistance between teminals 4 and 5 of IATS connector.(Component side)

SPECIFICATON :

Temp. (℃/℉)	Resistance (kΩ)	Temp. (℃/℉)	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 PCM" 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.

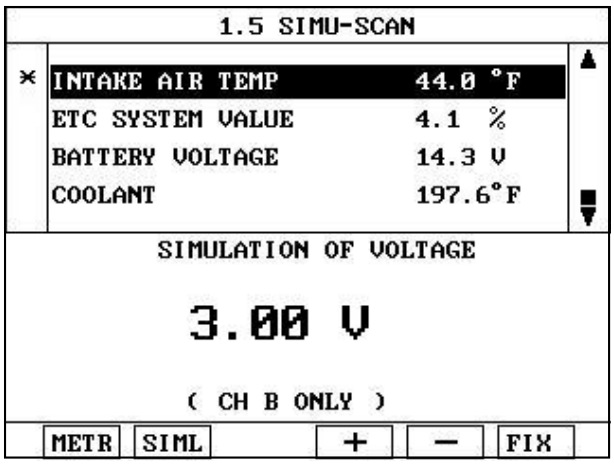
2. Check PCM

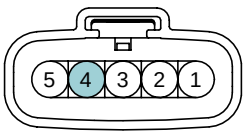
1) IG "OFF" and connect scantool.

2) Disconnect IATS connector and connect probe to terminal 4 of IATS harness connector.

3) IG "ON" and ENG "OFF" and select the 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 PCM and check for proper operation. If the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NOTE

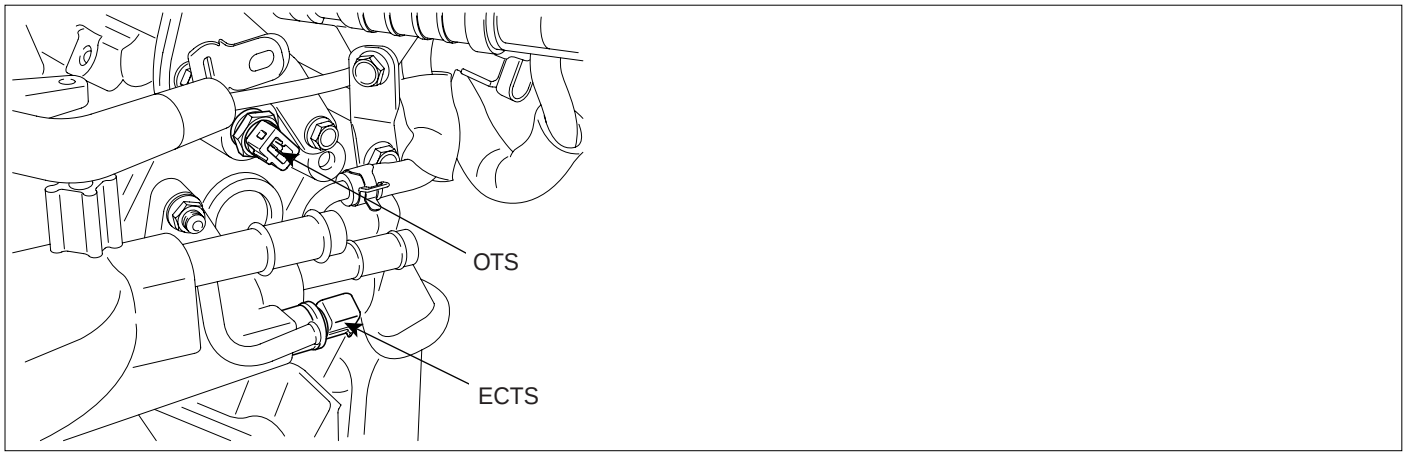
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

VERIFICATION OF VEHICLE REPAIR ECDB8AC1

Refer to DTC P1111.

DTC P1114 ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT INTERMITTENT LOW INPUT

COMPONENT LOCATION E1498F1E



SGHFL7315N

GENERAL DESCRIPTION EF16F2AC

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 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.

DTC DESCRIPTION EA98A0FA

Checking output signals from ECTS under detecting condition, if an output signal is intermittently below 0.1V, PCM sets P1114.

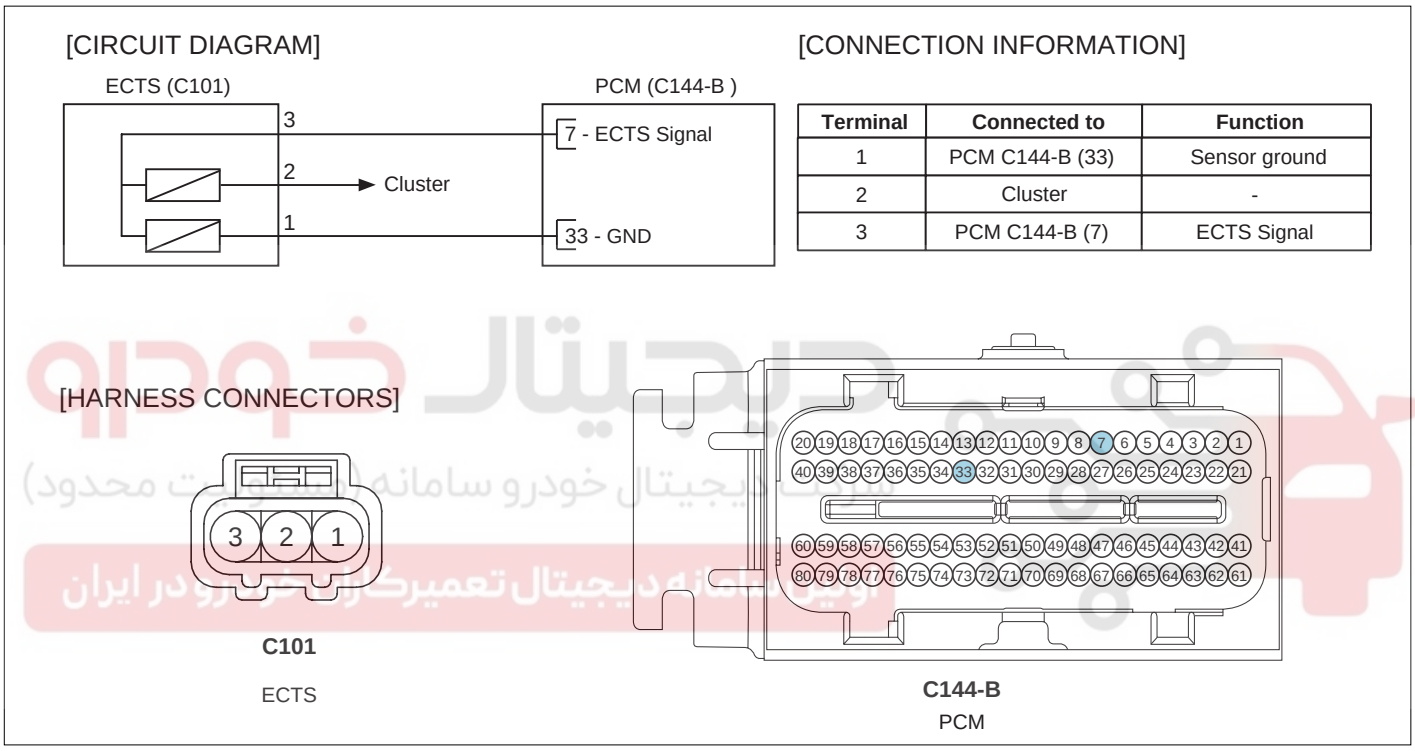
DTC DETECTING CONDITION ED008C3A

Item		Detecting Condition	Possible Cause
DTC Strategy		• Monitor the signal of ECTS	• Poor Connection • Short to ground in signal Circuit • Faulty ECTS • Faulty PCM
Enable Conditions	Case 1	• Time after start-up > 120 sec.	
	Case 2	• Time from IG "OFF" to IG "ON" > 360 min. • Engine running	
Threshold value		• Intermittently engine coolant temperature sensor's voltage amp;lt; 0.1V	
Diagnosis Time		• Continuous	
MIL On Condition		• DTC only (NO MIL ON)	

SPECIFICATION EC39C5F6

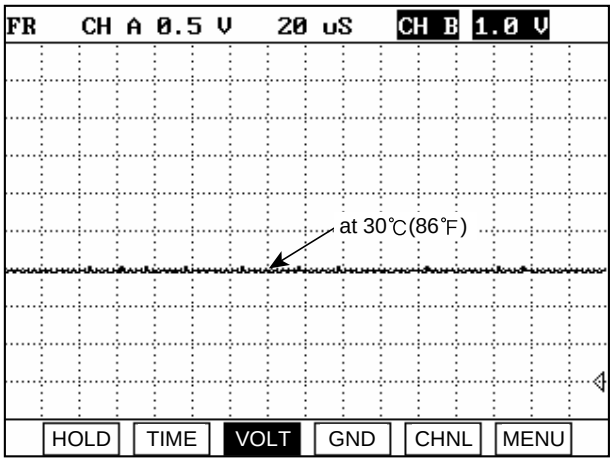
Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°F)	Resistance (kΩ)
-40(-40)	48.14	40(104)	1.15
-20(-4)	14.13 ~ 16.83	60(140)	0.59
0(32)	5.79	80(176)	0.32
20(68)	2.31 ~ 2.59		

SCHEMATIC DIAGRAM E8295A4F



UFBG242A

SIGNAL WAVEFORM AND DATA E735692E



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 EA1DCC64

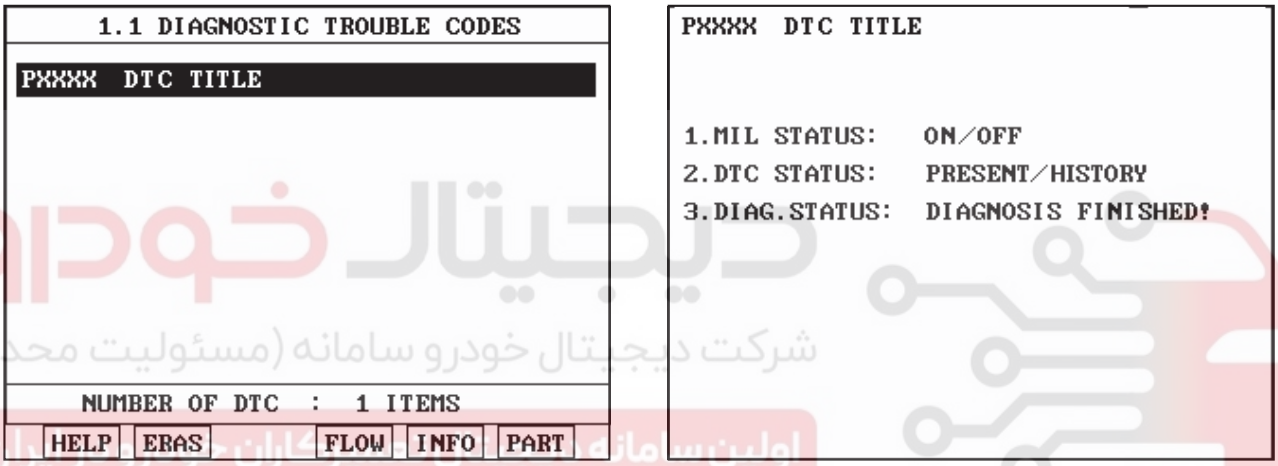
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E0BA383A

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E0300727

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 PCM 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 ED4A644D

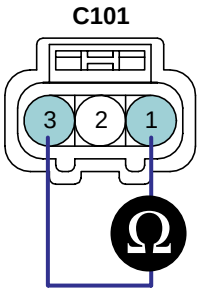
1. Check ECTS

   1) IG "OFF" and disconnect ECTS connector.

   2) Measure resistance between terminals 1 and 3 of ECTS connector.(Component side)

SPECIFICATON :

Temp. (℃/℉)	Resistance (kΩ)	Temp. (℃/℉)	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 PCM" 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.

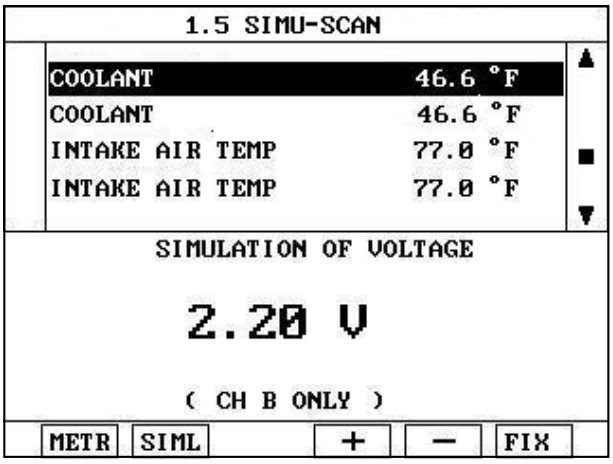
2. Check PCM

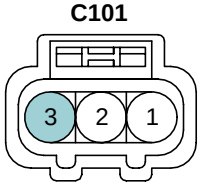
1) IG "OFF" and connect scantool.

2) Connect probe to terminal 3 of ECTS harness connector.

3) IG "ON" and ENG "OFF" and select the 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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

VERIFICATION OF VEHICLE REPAIR E651C7AC

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P1115 ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT - INTERMITTENT HIGH INPUT

COMPONENT LOCATION EEE314EF

Refer to DTC P1114.

GENERAL DESCRIPTION E20F415B

Refer to DTC P1114.

DTC DESCRIPTION E3D9A09C

Checking output signals from ECTS under detecting condition, if an output signal is intermittently above 4.9V, PCM sets P1115.

DTC DETECTING CONDITION EB4C18E8

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 PCM
Enable Condi-tions	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	
Threshold value		• Intermittently engine coolant temperature sensor's voltage > 4.9V	
Diagnosis Time		• Continuous	
MIL On Condition		• DTC only (NO MIL ON)	

SPECIFICATION E2B944B0

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 E0D7F13A

Refer to DTC P1114.

SIGNAL WAVEFORM AND DATA E41117BD

Refer to DTC P1114.

MONITOR DTC STATUS E0B35F83

Refer to DTC P1114.

TERMINAL AND CONNECTOR INSPECTION EAA72588

Refer to DTC P1114.

SIGNAL CIRCUIT INSPECTION E5F6D678

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 PCM 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 PCM connector.

   2) Measure resistance between terminal 3 of ECTS harness connector and terminal 7 of PCM 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 EC03B3CD

1. IG "OFF" and disconnect ECTS connector and then turn the ignition ON.
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 E4E95C5B

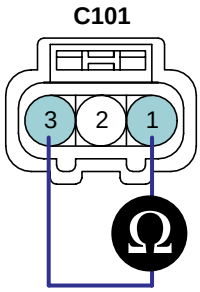
1. Check ECTS

1) IG "OFF" and disconnect ECTS connector.

2) Measure resistance between terminals 1 and 3 of ECTS connector.(Component side)

SPECIFICATON :

Temp. (℃/°F)	Resistance (kΩ)	Temp. (℃/°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 PCM" 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.

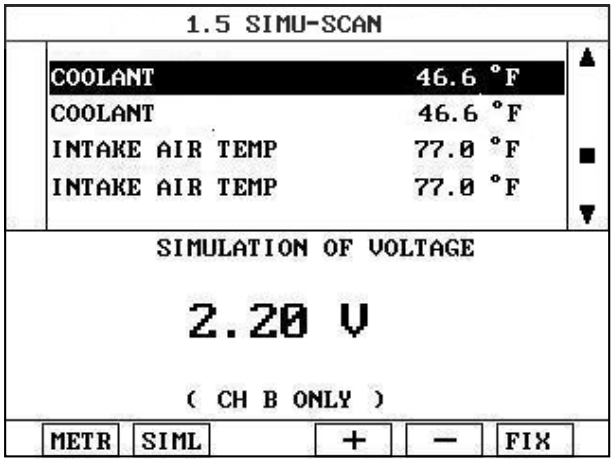
2. Check PCM

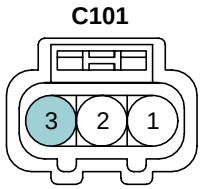
1) IG "OFF" and connect scantool.

2) Connect probe to terminal 3 of ECTS harness connector.

3) IG "ON" and ENG "OFF" and select the 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 PCM and check for proper operation. If the problem is corrected, replace PCM and go to "Verification of Vehicle Repair" procedure.

NOTE

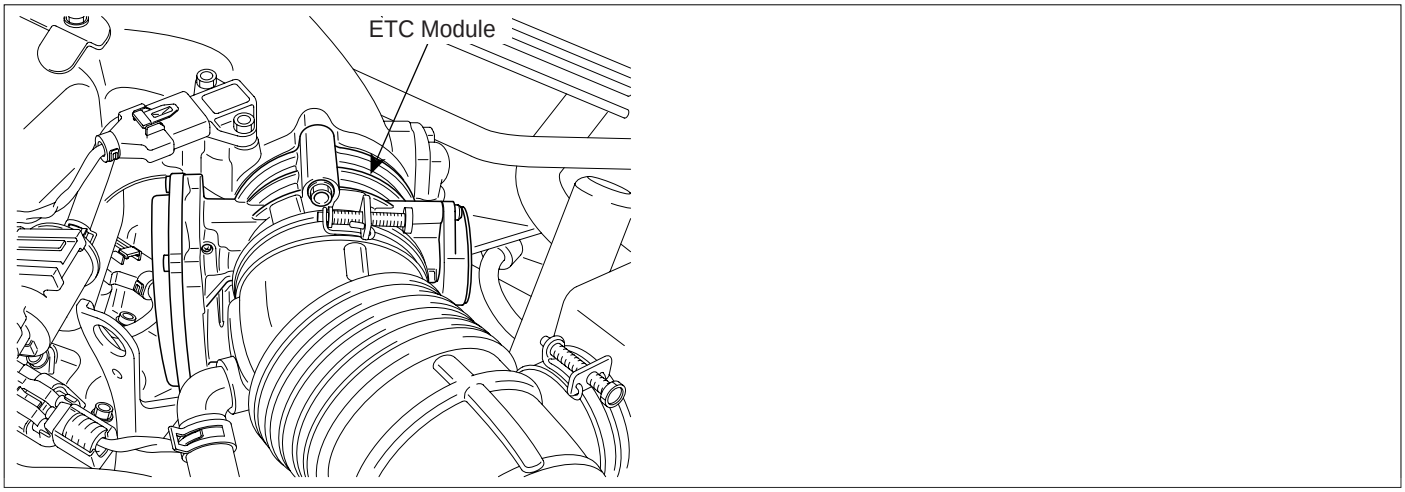
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM.

VERIFICATION OF VEHICLE REPAIR E59DD822

Refer to DTC P1114.

DTC P1295 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - POWER MANAGEMENT

COMPONENT LOCATION E7955102



SGHFL7316N

GENERAL DESCRIPTION E0F1066F

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 PCM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E4033126

If power management mode is recognized under detecting condition, PCM sets P1295. And MIL(Malfunction Indication Lamp) turns on.

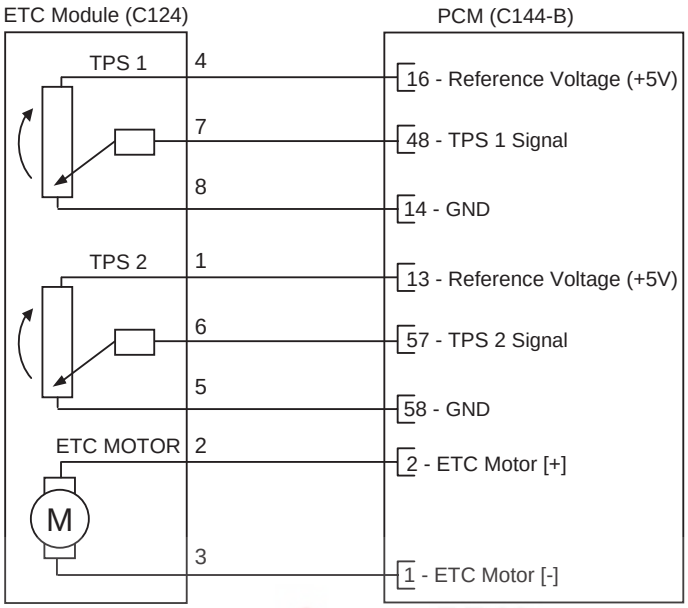
DTC DETECTING CONDITION E291CA5B

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 + TPSMalfunction • Faulty PCM
EnableConditions	• Ignition On	
Threshold value	• Power Management Mode is active	
DiagnosisTime	• -	
MIL On Condition	• 1 Driving Cycle	

※ If Main relay has a fault(ex. Open) while the engine is running, the DTCs,P0638/P0685/P1295/P2106, can happen at the same time.
＜DTC Name＞
- P0638 Throttle Actuator Control Range/Performance(Bank 1)
- P0685 PCM/PCM Power Relay Control Circuit /Open
- P1295 Throttle Actuator Control System - Power Management
- P2106 Throttle Actuator Control System - Forced Limited Power

SCHEMATIC DIAGRAM EC4EEF87

[CIRCUIT DIAGRAM]



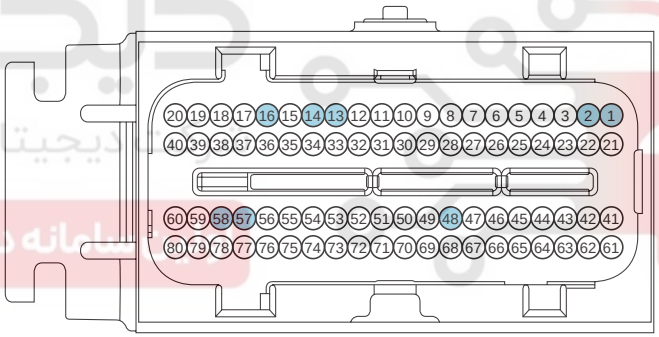
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE



C144-B

PCM

UFBG236A

MONITOR SCANTOOL DATA EF0FB6EC

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. If any of the DTCs listed above are stored, repair those DTCs first, the perform ETS initialization before troubleshooting P1295.
4. Is the same DTC occurred ?

YES

▶Substitute with a known-good PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

NO

▶ Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization
1. Erase the trouble codes on PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E939B649

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 ECFF7C8F

Refer to DTC P1295.

GENERAL DESCRIPTION E546A573

Refer to DTC P1295.

DTC DESCRIPTION E9993ACE

Checking throttle valve return state, under detecting condition, if an output signal is within the threshold value for more than designated time, PCM sets P1523.

DTC DETECTING CONDITION E9648B18

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor throttle valve return state	• Carbon in throttle • Broken Throttle return spring • throttle sticky • throttle icy • PCM
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 EDFDE4CA

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 E1EBB42F

Refer to DTC P1295.

SIGNAL WAVEFROM AND DATA E0C478F9

Refer to DTC P1295.

MONITOR DTC STATUS E9B7B54E

Refer to DTC P1295.

SYSTEM INSPECTION EDF59FC9

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

      ▶ Verify that throttle movement is not obstructed 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.

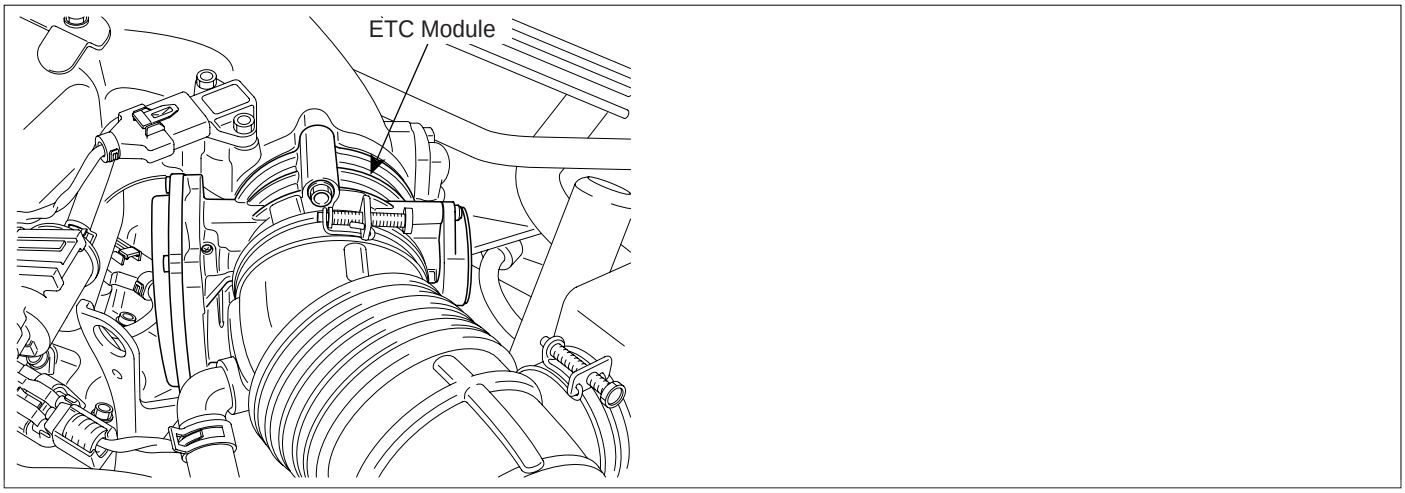
※ Procedure of ETS Initialization
1. Erase the trouble codes on PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR ECB7F773

Refer to DTC P1295.

DTC P2104 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - FORCED IDLE

COMPONENT LOCATION E2BCC8EF



SGHFL7316N

GENERAL DESCRIPTION EEE033CF

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 PCM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E0061525

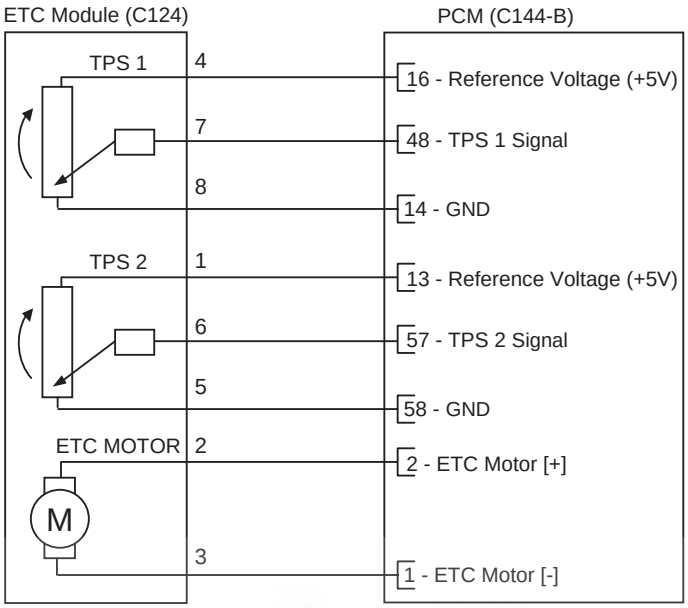
PCM recognizes vehicle state as forced idle under detecting condition, and sets P2104. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E24A8CAF

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 PCM
EnableConditions	• Ignition "ON"	
Threshold value	• Forced Idle Mode is active	
DiagnosisTime	• -	
MIL On Condition	• 1 Driving Cycles	

SCHEMATIC DIAGRAM E1AF65D9

[CIRCUIT DIAGRAM]



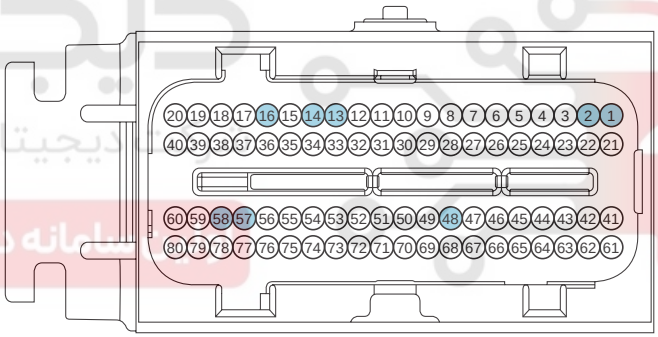
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE



C144-B

PCM

UFBG236A

MONITOR SCANTOOL DATA E1C69466

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. P2104 will be stored in addition to related ETS codes.
   Repair the cause of the related codes and perform ETS initialization before troubleshooting P2104.
4. Is the same DTC occurred ?

   YES

   ▶Substitute with a known-good PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

NO

▶ Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization
1. Erase the trouble codes on PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(10 sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E6A5D242

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 EC0B635F

Refer to DTC P2104.

GENERAL DESCRIPTION E8EC74B9

Refer to DTC P2104.

DTC DESCRIPTION EE469369

If PCM recognizes vehicle state as forced engine shutdown under detecting condition, it sets P2105 and then MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E4488136

Item	Detecting Condition	Possible cause
DTC Strategy	• This code detects if the system is in Forced Engine Shutdown Mode	• Faulty AFS+MAPS+ETS • Faulty PCM
EnableConditions	• Ignition "ON"	
Threshold value	• Forced Engine Shutdown Mode Active	
DiagnosisTime	• -	
MIL On Condition	• 1 Driving Cycle	

SCHEMATIC DIAGRAM E9D1885D

Refer to DTC P2104.

MONITOR SCANTOOL DATA E0DD162E

Refer to DTC P2104.

VERIFICATION OF VEHICLE REPAIR EDCB0374

Refer to DTC P2104.

DTC P2106 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - FORCED LIMITED POWER

COMPONENT LOCATION E32D3049

Refer to DTC P2104.

GENERAL DESCRIPTION EF1AE33C

Refer to DTC P2104.

DTC DESCRIPTION EE48C119

If PCM recognizes vehicle state as forced limited power mode under detecting condition, it sets P2106 and then MIL(Malfunction Indication Lamp) turns on.

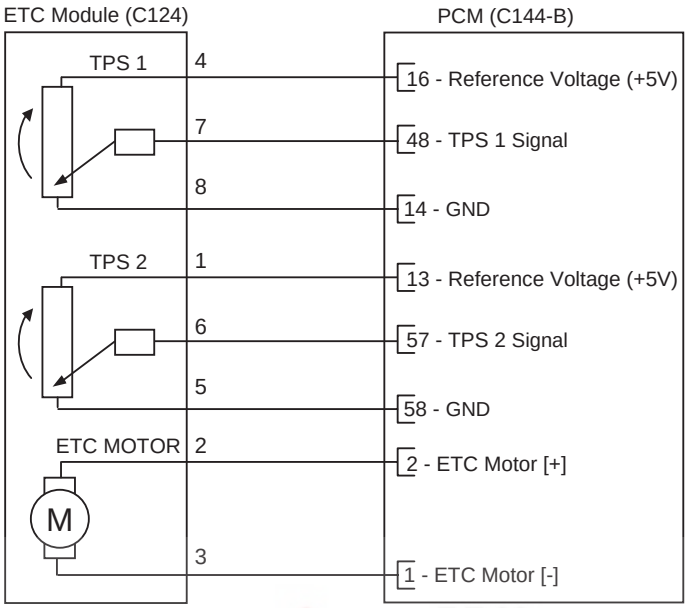
DTC DETECTING CONDITION E9E07917

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 PCM
EnableConditions	• Ignition "ON"	
Threshold value	• Limit Performance Mode is active	
DiagnosisTime	• -	
MIL On Condition	• 1 Driving Cycle	

※ If Main relay has a fault(ex. Open) while the engine is running, the DTCs,P0638/P0685/P1295/P2106, can happen at the same time.
＜DTC Name＞
- P0638 Throttle Actuator Control Range/Performance(Bank 1)
- P0685 PCM/PCM Power Relay Control Circuit /Open
- P1295 Throttle Actuator Control System - Power Management
- P2106 Throttle Actuator Control System - Forced Limited Power

SCHEMATIC DIAGRAM E9EEBFEB

[CIRCUIT DIAGRAM]



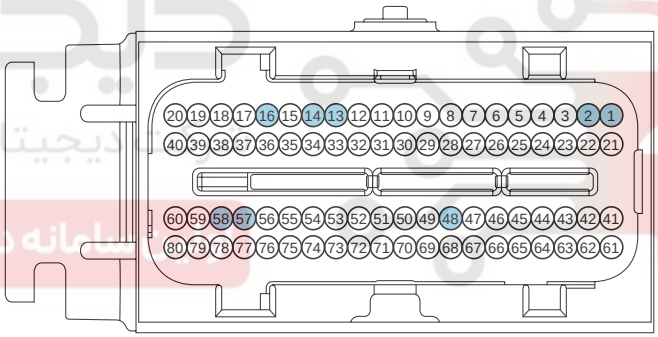
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE



C144-B

PCM

UFBG236A

MONITOR SCANTOOL DATA EDEF416D

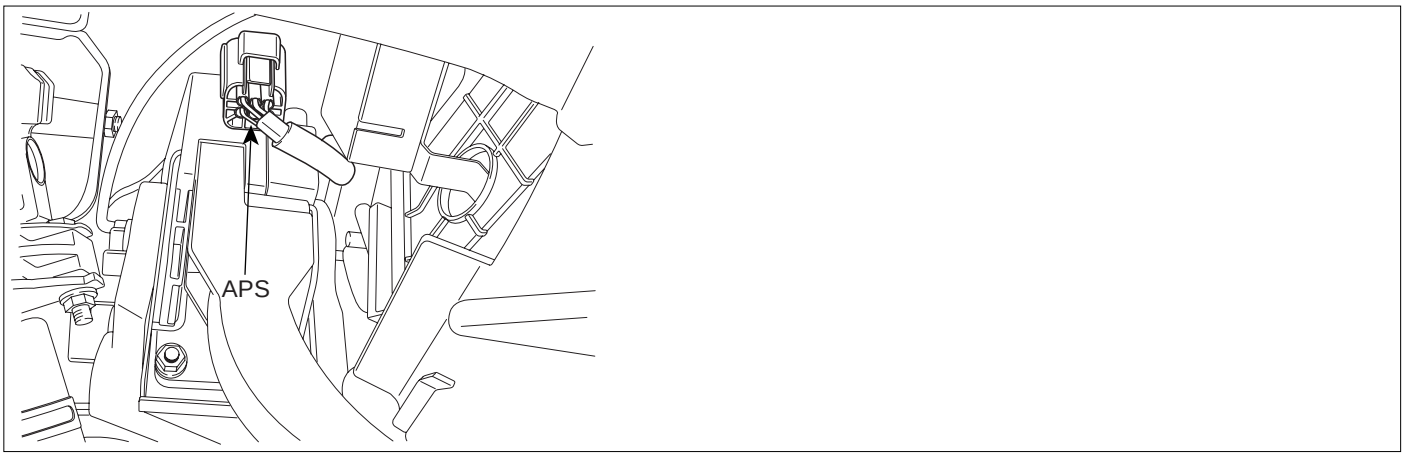
Refer to DTC P2104.

VERIFICATION OF VEHICLE REPAIR ED20D7DA

Refer to DTC P2104.

DTC P2122 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT LOW INPUT

COMPONENT LOCATION E95E15B8



SGHFL7339N

GENERAL DESCRIPTION E744DF2C

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 PCM judges the current opening angle of the accelerator pedal from APS1 & 2, and the PCM controls the throttle motor based on these signals.

DTC DESCRIPTION E8081364

Checking output signals from APS 1, under detecting condition, if output signals are below the threshold, PCM sets P2122. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E84E0A6A

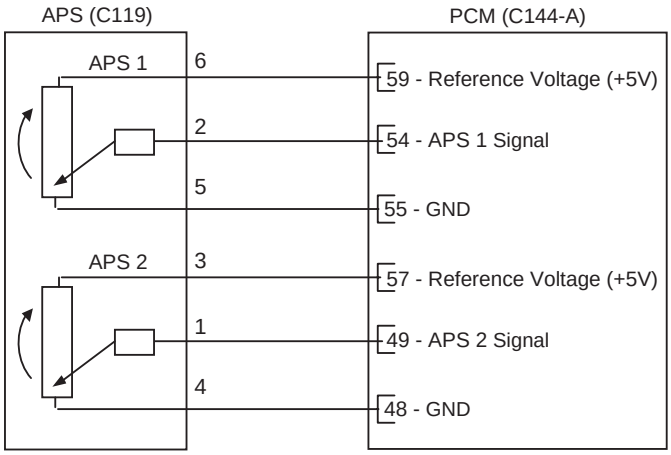
Item	Detecting Condition	Possible Cause
DTC Strategy	• This code detects a continuous short to ground or open in either the circuit or the sensor (0-100%)	• Poor connection • Open or short to ground in Power circuit • Open or short to ground in Signal Circuit • Faulty APS • Faulty PCM
EnableConditions	• Ignition "ON"	
Threshold	• APS1 〈 0.125V	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 Driving Cycle	

SPECIFICATION E0097826

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 E635989F

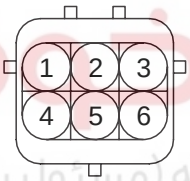
[CIRCUIT DIAGRAM]



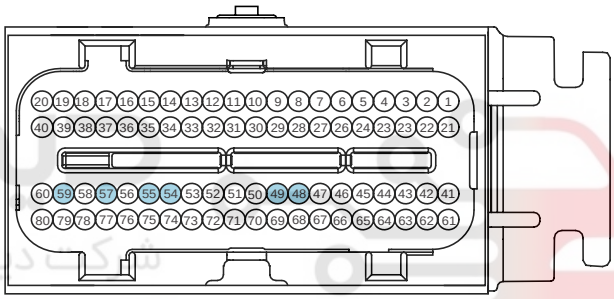
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-A (49)	APS 2 Signal
2	PCM C144-A (54)	APS 1 Signal
3	PCM C144-A (57)	APS 2 Reference Voltage (+5V)
4	PCM C144-A (48)	APS 2 Ground
5	PCM C144-A (55)	APS 1 Ground
6	PCM C144-A (59)	APS 1 Reference Voltage (+5V)

[HARNESS CONNECTORS]



C119
APS



C144-A
PCM

SGHF17014N

SIGNAL WAVEFROM AND DATA E831F377

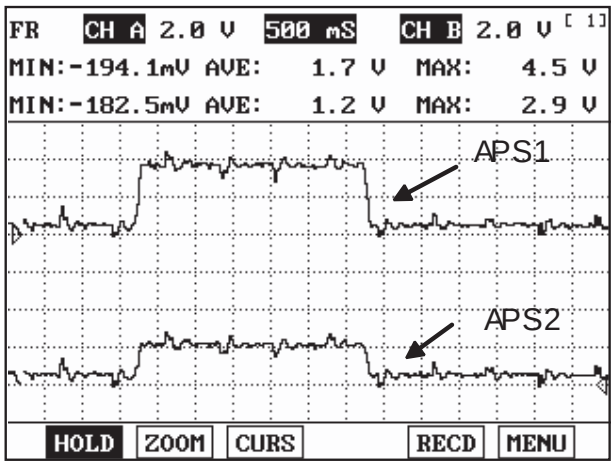


Fig. 1

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 E05EE0F2

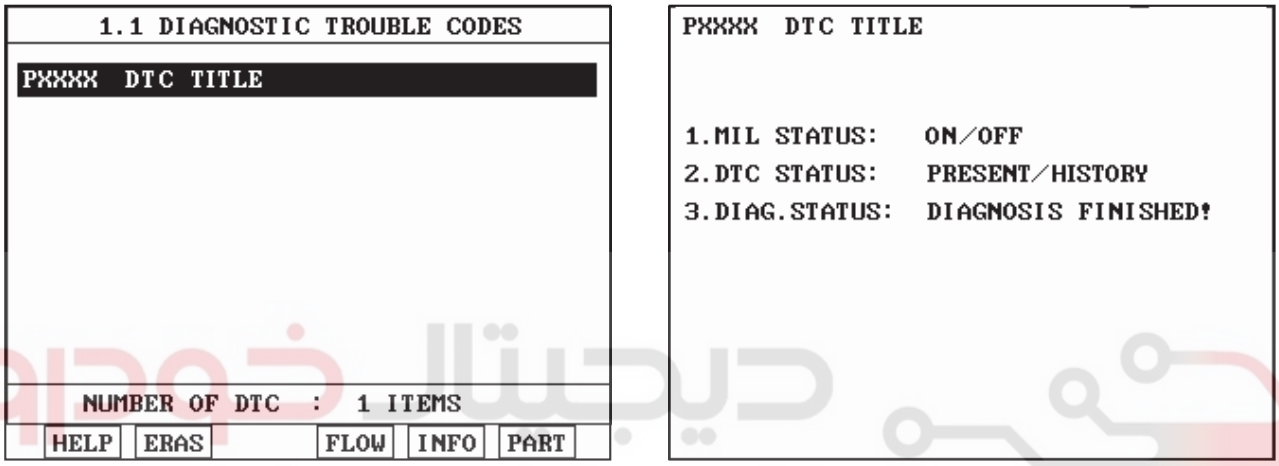
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E91877FC

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E3489021

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 EC9B3FBC

1. Check short to ground in harness
   1) IG "OFF".
   2) Disconnect APS & PCM 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 "PCM" connector.
   3) Measure resistance between terminal 2 of APS harness connector and terminal 54 of PCM 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 ED7BB8AD

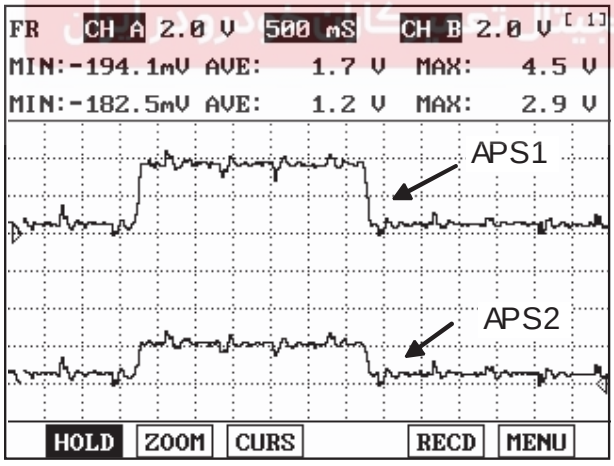
1. Check APS

1) IG "ON" & ENG "OFF".

2) Measure signal waveform of APS by pressing and depressing accelerator 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 PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

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 E7AC31FB

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P2123 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT HIGH INPUT

COMPONENT LOCATION E0FF09D9

Refer to DTC P2122.

GENERAL DESCRIPTION EF61047B

Refer to DTC P2122.

DTC DESCRIPTION ED5EDE7D

Checking output signals from APS 1, under detecting condition, if output signals are above the threshold, PCM sets P2123. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E1559397

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 PCM
EnableConditions	• Ignition "ON"	
Threshold	• APS1 〉 4.5V	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 Driving Cycle	

SPECIFICATION EED5FAFC

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 E467907C

Refer to DTC P2122.

SIGNAL WAVEFROM AND DATA E171802A

Refer to DTC P2122.

MONITOR DTC STATUS EE8FDA11

Refer to DTC P2122.

TERMINAL AND CONNECTOR INSPECTION E1D2B3AA

Refer to DTC P2122.

SIGNAL CIRCUIT INSPECTION EC0C9515

1. Check short to battery in harness

   1) IG "OFF".

   2) Disconnect APS and PCM 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 ED4DC570

1. Check open in harness

   1) IG "OFF".

   2) Disconnect APS connector and then turn the ignition ON.

   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 EFB6DDB6

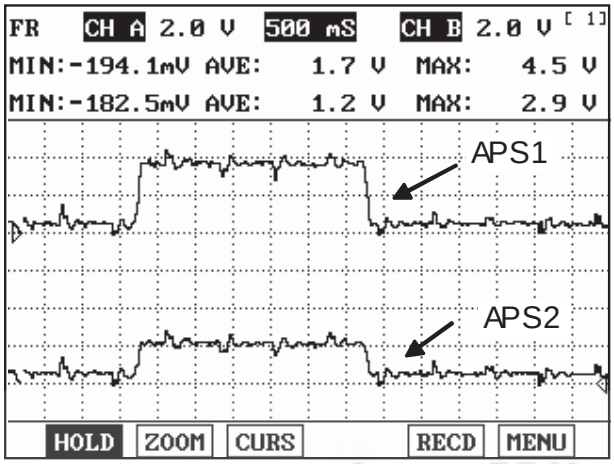
1. Check APS

   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
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 PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

NO

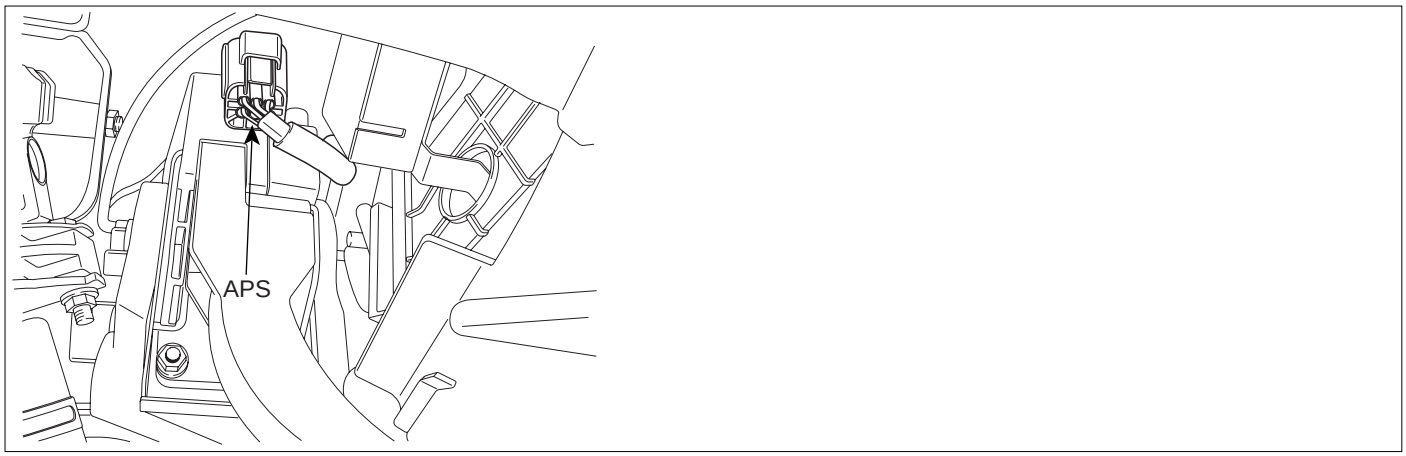
▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected,replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EDCE9FD5

Refer to DTC P2122.

DTC P2127 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT LOW INPUT

COMPONENT LOCATION E3D00B96



SGHFL7339N

GENERAL DESCRIPTION E0903269

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 PCM judges the current opening angle of the accelerator pedal from APS1 & 2, and the PCM controls the throttle motor based on these signals.

DTC DESCRIPTION E5511957

Checking output signals from APS 2, under detecting condition, if output signals are detected below the threshold, PCM sets P2127. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EE39DC1D

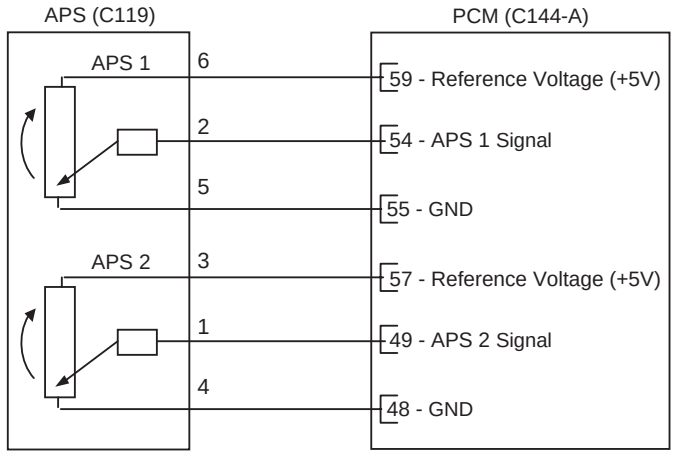
Item	Detecting Condition	Possible Cause
DTC Strategy	• This code detects a continuous short to ground or open in either the circuit or the sensor	• Poor connection • Open or short to ground in Power circuit. • Open or short to ground in signal circuit. • Faulty APS • Faulty PCM
EnableConditions	• Ignition "ON"	
Threshold	• APS2 〈 0.125V	
Diagnosis Time	• Contineous	
MIL On Condition	• 1 Driving Cycle	

SPECIFICATION E7AF66F6

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 E50F15FF

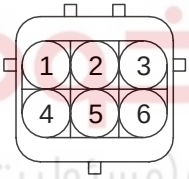
[CIRCUIT DIAGRAM]



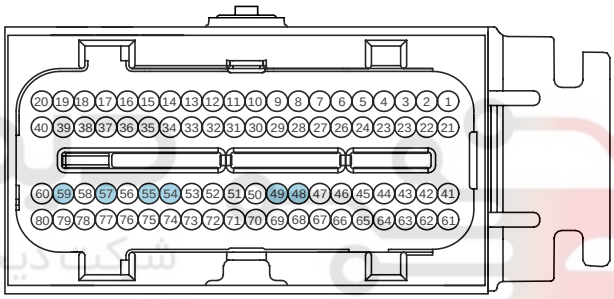
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-A (49)	APS 2 Signal
2	PCM C144-A (54)	APS 1 Signal
3	PCM C144-A (57)	APS 2 Reference Voltage (+5V)
4	PCM C144-A (48)	APS 2 Ground
5	PCM C144-A (55)	APS 1 Ground
6	PCM C144-A (59)	APS 1 Reference Voltage (+5V)

[HARNESS CONNECTORS]



C119
APS



C144-A
PCM

SGHF17014N

SIGNAL WAVEFROM AND DATA EA85CA33

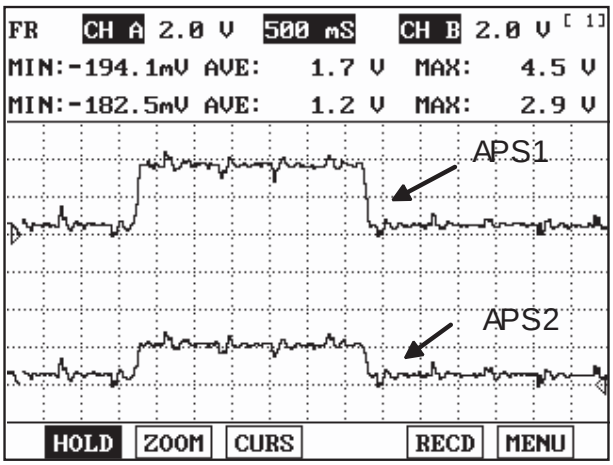


Fig. 1

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 E74D077D

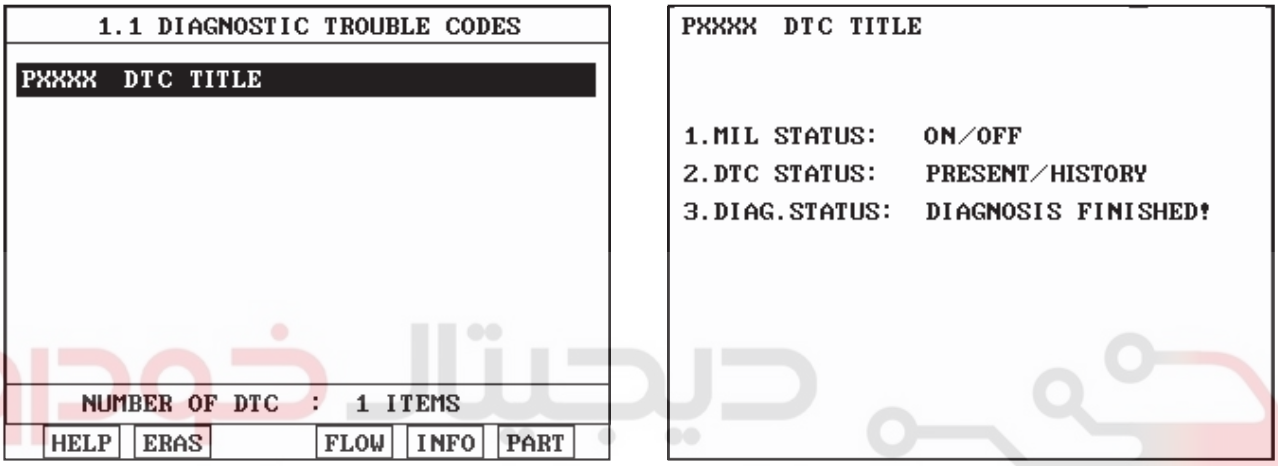
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E9AC9AF7

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 EF2387B1

1. IG "OFF".
2. Disconnect APS connector.
3. IG "ON" & ENG "OFF".
4. Measure voltage between termial 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 ED70C1E8

1. Check short to ground in harness
   1) IG "OFF".
   2) Disconnect APS and PCM 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 PCM connector.
   3) Measure resistance between terminal 1 of APS harness connector and terminal 49 of PCM 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 E4EA03A9

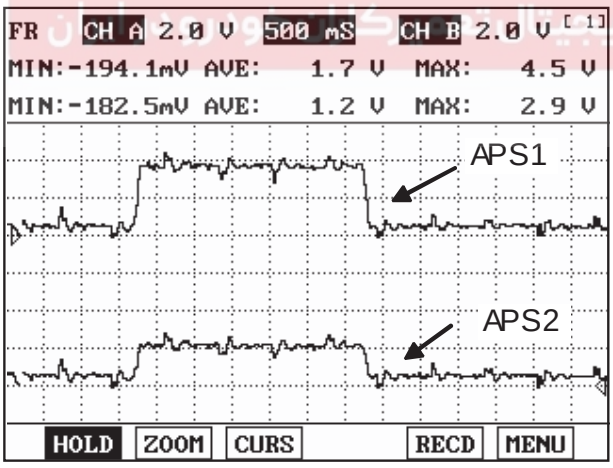
1. Check APS

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
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 PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

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 E9D80636

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P2128 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT HIGH INPUT

COMPONENT LOCATION E550213B

Refer to DTC P2127.

GENERAL DESCRIPTION EBDB1018

Refer to DTC P2127.

DTC DESCRIPTION E7C91BDB

Checking output signals from APS 2, under detecting condition, if output signals are above the threshold, PCM sets P2128. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EFCC64FA

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 PCM
EnableConditions	• Ignition "ON"	
Threshold	• APS2 > 3V	
Diagnosis Time	• Contineous	
MIL On Condition	• 1 Driving Cycle	

SPECIFICATION EE3E4B30

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 E678401F

Refer to DTC P2127.

SIGNAL WAVEFROM AND DATA E6549058

Refer to DTC P2127.

MONITOR DTC STATUS E93C65A0

Refer to DTC P2127.

TERMINAL AND CONNECTOR INSPECTION EF536B86

Refer to DTC P2127.

SIGNAL CIRCUIT INSPECTION EFF8FD53

1. Check short to battery in harness

   1) IG "OFF".

   2) Disconnect APS and PCM 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 reisistance within specification ?

   YES

   ▶ Go to "Ground Circuit Inpsection" procedure.

   NO

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

GROUND CIRCUIT INSPECTION EA66B99F

1. Check open in harness

   1) IG "OFF"

   2) Disconnect APS connector and then turn the ignition ON.

   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 E390D0FB

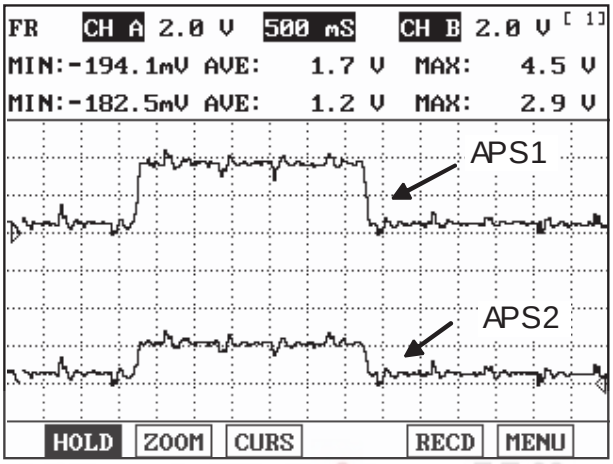
1. Check APS

   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
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 PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

NO

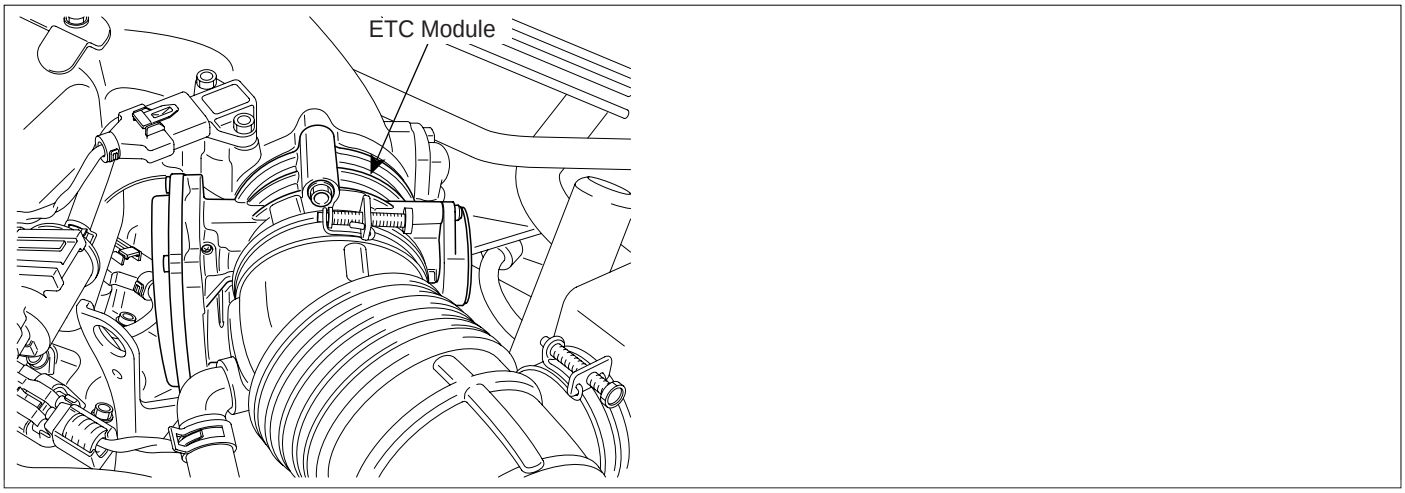
▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected,replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E0211E3C

Refer to DTC P2127.

DTC P2135 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" / "B" VOLTAGE CORRELATION

COMPONENT LOCATION EBFE5E7F



SGHFL7316N

GENERAL DESCRIPTION E81DE7B5

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(PCM).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 PCM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E2DDE48F

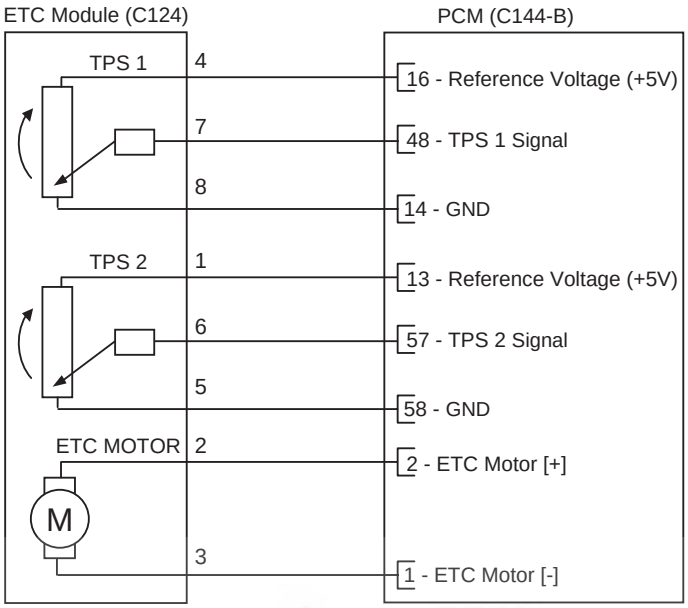
Checking output signals from TPS 1 and 2, under detecting condition, if output signals difference between TPS1 and TPS2 are detected more than 4.5% for the specified number of times., PCM sets P2135. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E99C84AC

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 PCM
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 ECA9185A

[CIRCUIT DIAGRAM]



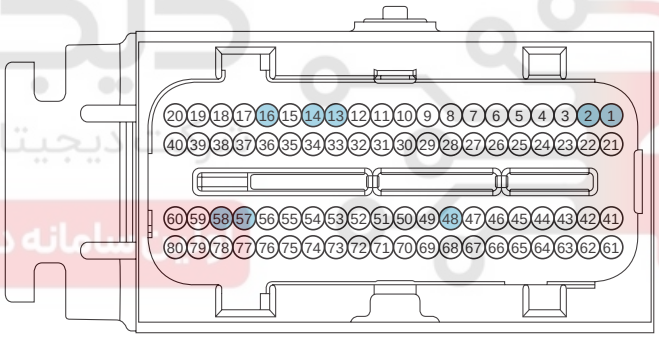
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE



C144-B

PCM

UFBG236A

SPECIFICATION E15B5E68

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

MONITOR DTC STATUS E91C2C74

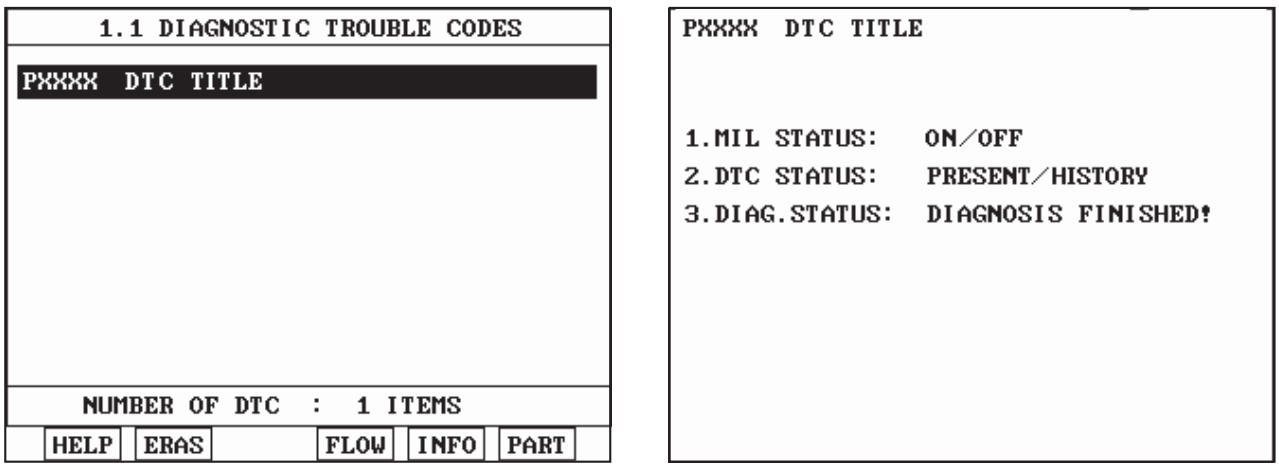
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 E7E0C1C3

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 EE0EE56F

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 E63432D4

1. IG "OFF".
2. Disconnect TPS & PCM 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 ED914D8A

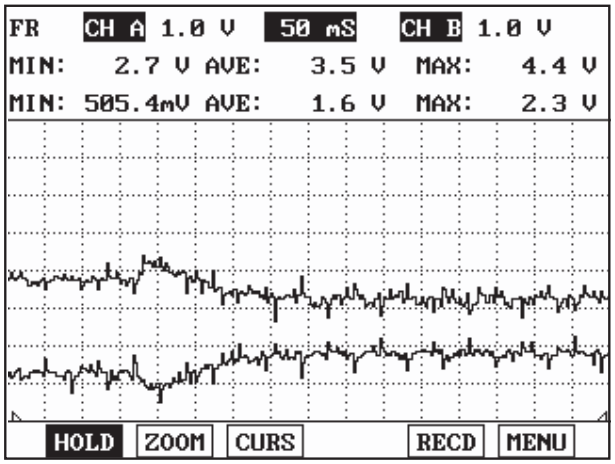
1. Check TPS

   1) Ignition "ON" & ENG "OFF".

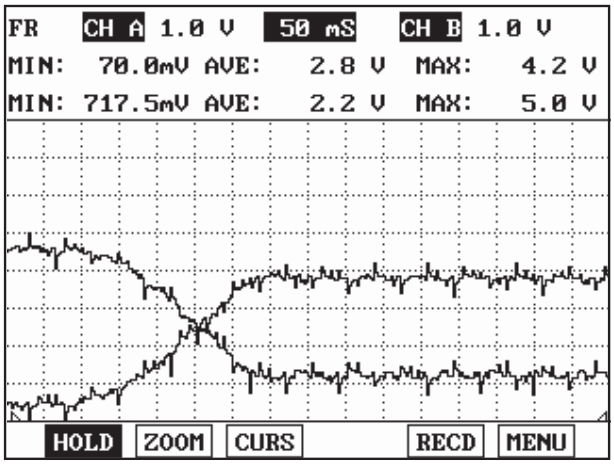
   2) Monitor signal waveform of TPS by stepping on and off the accelerator padel on scantool

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 acclerator pedal at idle



Pulling out accellerator cable with hand at idle

EGRF986A

3) Is the measured signal waveform O.K ?

YES

▶ Substitute with a known-good PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

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

VERIFICATION OF VEHICLE REPAIR E663D092

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 E5AF6EAC

Refer to DTC P2135.

GENERAL DESCRIPTION ED7B16BB

Refer to DTC P2135.

DTC DESCRIPTION E60189B5

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., PCM sets P2138. MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EAD4E293

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 PCM
EnableConditions	• Ignition "ON"	
Threshold	• Difference between APS1 and APS2 Normalized values 〉 4.5%	
Diagnosis Time	• Contineous	
MIL On Condition	• 1 Driving Cycle	

SPECIFICATION ED6106A0

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 EA798FA9

Refer to DTC P2135.

SIGNAL WAVEFROM AND DATA EAE3039A

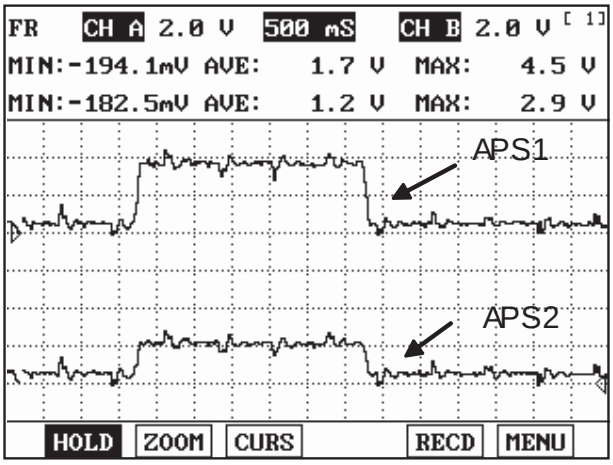


Fig. 1

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 EBB8473D

Refer to DTC P2135.

TERMINAL AND CONNECTOR INSPECTION E7EB6B9E

Refer to DTC P2135.

POWER CIRCUIT INSPECTION EB152443

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 harnesss 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 E3076442

1. IG "OFF".
2. Disconnect APS and PCM 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 E1D3D9C5

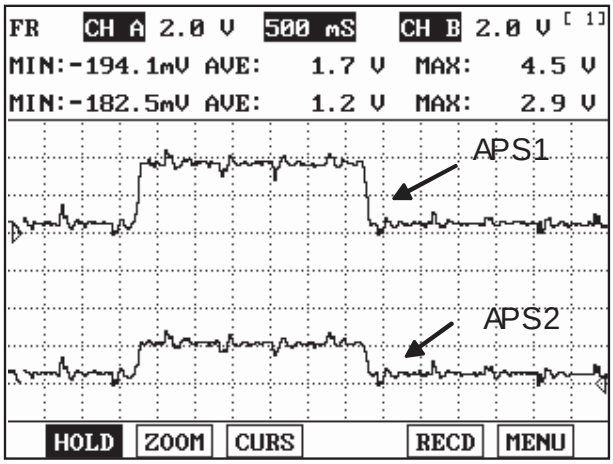
1. Check APS

   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 PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

NO

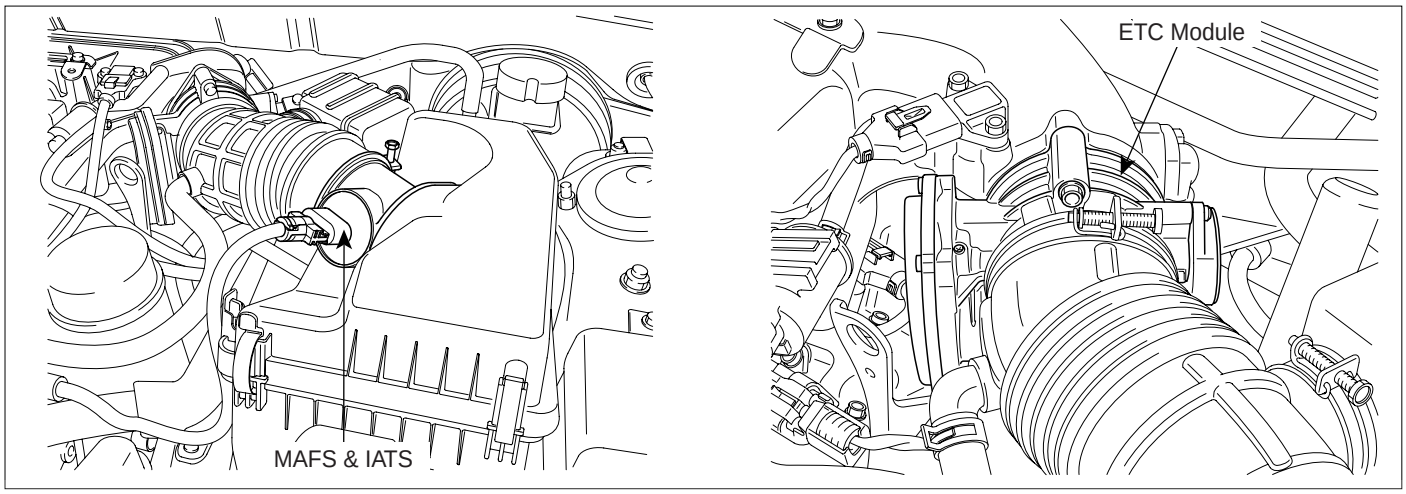
▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected,replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EA7C373A

Refer to DTC P2135.

DTC P2173 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - HIGH AIR FLOW DETECTED

COMPONENT LOCATION EDB24460



SGHFL7340N

GENERAL DESCRIPTION EA5F4112

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 PCM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC DESCRIPTION E9EEBC14

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., PCM sets P2173. And then MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E8A3D448

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 PCM
EnableConditions		• Engine running • No faults present	
Thresh-old	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	

SPECIFICATION E22B48CC

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

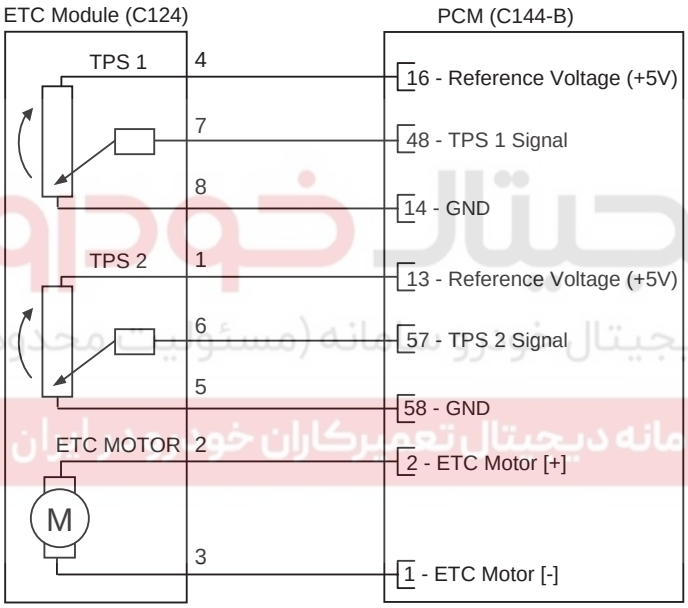
Throttle opening (°)	Output voltage(V) [Vref=5.0V]	
	TPS1	TPS2
0°	0.0V	5.0V
10°	0.5V	4.5V
V20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V

MAPS

Pressure(kPa)	Output voltage(V)
20.0kPa	0.79V
35kPa	1.382V
46.66kPa	1.84V
60kPa	2.369V
90kPa	3.75V
101.32kPa	4.00V

SCHEMATIC DIAGRAM EDE50F2F

[CIRCUIT DIAGRAM]



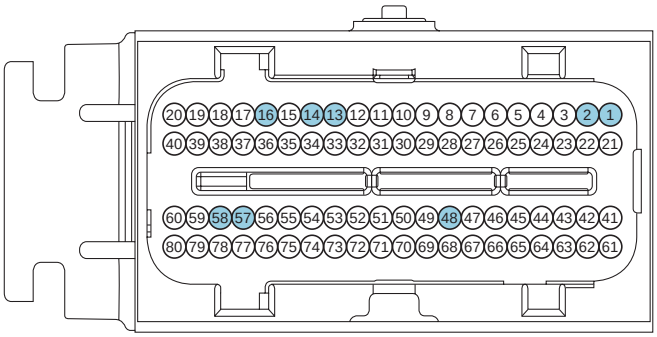
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144-B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM C144-B (14)	TPS 1 Ground

[HARNESS CONNECTORS]

C124

ETC MODULE

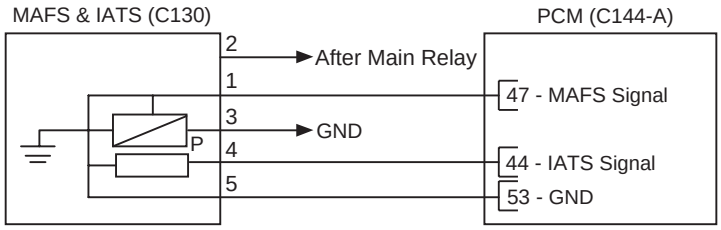


C144-B

PCM

UFBG236A

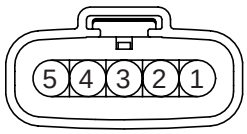
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

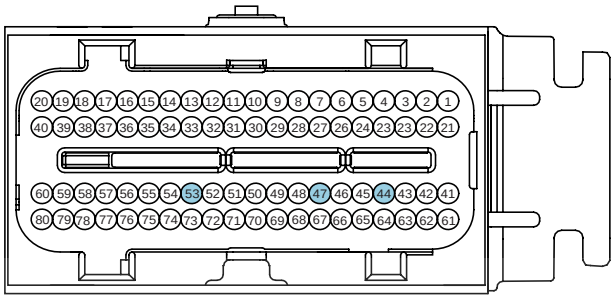
Terminal	Connected to	Function
1	PCM C144-A (47)	MAFS Signal
2	Main Relay	Battery Voltage (B+)
3	Chassis Ground	Ground
4	PCM C144-A (44)	IATS Signal
5	PCM C144-A (53)	Sensor Ground

[HARNESS CONNECTORS]



C130

MAFS & IATS



C144-A

PCM

SGHF17008N

MONITOR DTC STATUS E600AB22

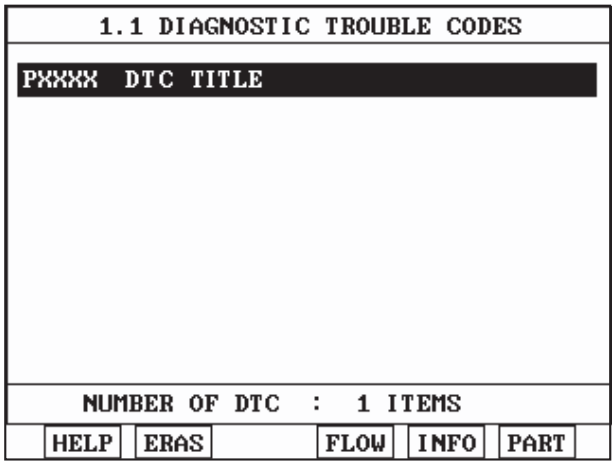
1. Check DTC Status

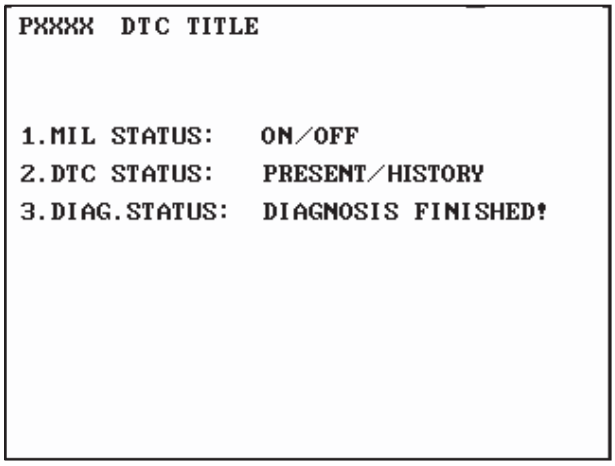
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "System Inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 E37DC2AF

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 PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM.
Before or after testing PCM on the vehicle, use this function before reusing the PCM

※ PROCEDURE OF ETS INITIALIZATION

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

VERIFICATION OF VEHICLE REPAIR E1169B8F

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 F5(INFO) 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 "History (Not Present)" fault displayed?

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 E6C77FE9

In order to provide the best possible combination of drivability, fuel economy and emission control, the PCM uses a closed loop air/fuel metering system. The PCM monitors the HO2S signal voltage and adjusts fuel delivery as needed. 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 PCM 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 PCM 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 E21E596F

Checking the fuel trim value at idle under detecting condition, if its average exceeds the limit over certain period, PCM sets P2187/P2189. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E22C07E4

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 at operating temperature • Engine running under Idle state over 5 minutes • 60℃(140°F) ≤ Engine coolant temperature ≤ 115℃(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 E592A2E6

1. Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector or CVVT items with scantool.
2. Are related DTCs present?

YES

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

NO

▶ Go to "System Inspection" procedure

SYSTEM INSPECTION E842C61B

1. Check Air leakage
   1) Visually/physically inspect the 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 been found?

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 been found?

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 presonal injury or fire damage to vehicle components.*

1) IG "OFF" and disconnect Fuel Pump Relay in Junction Box.

2) Start the engine and wait until the engine stalls.

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/㎠, 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

COMPONENT INSPECTION EE1FCED9

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 for RPM drop during injector 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 amp;amp; Repair" procedure. If not, troubleshooting is completed.

NO

▶ Replace injector, and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E3012620

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P2188 SYSTEM TOO RICH AT IDLE (BANK 1)
DTC P2190 SYSTEM TOO RICH AT IDLE (BANK 2)

GENERAL DESCRIPTION EB136E1B

In order to provide the best possible combination of drivability, fuel economy and emission control, the PCM uses a closed loop air/fuel metering system. The PCM monitors the HO2S signal voltage and adjusts fuel delivery as needed. 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 PCM 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 PCM 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 EDBF70B1

Checking the fuel trim value at idle under detecting condition, if its average exceeds the limit over certain period, PCM sets P2188/P2190. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EEB4A611

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 at operating temperature • Engine running under Idle state over 5 minutes • 60℃(140°F) ≤ Engine coolant temperature ≤ 115℃(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 E57A6DEE

1. Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector or CVVT items with scantool.
2. Are related DTCs present?

YES

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

NO

▶ Go to "System Inspection" procedure

SYSTEM INSPECTION E5B54024

1. Check blocking of intake system
   1) Visually/physically inspect the 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 been 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 the engine and wait until the engine stalls.

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 ㎏/㎠, 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.

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 amp;amp; 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 E988683A

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

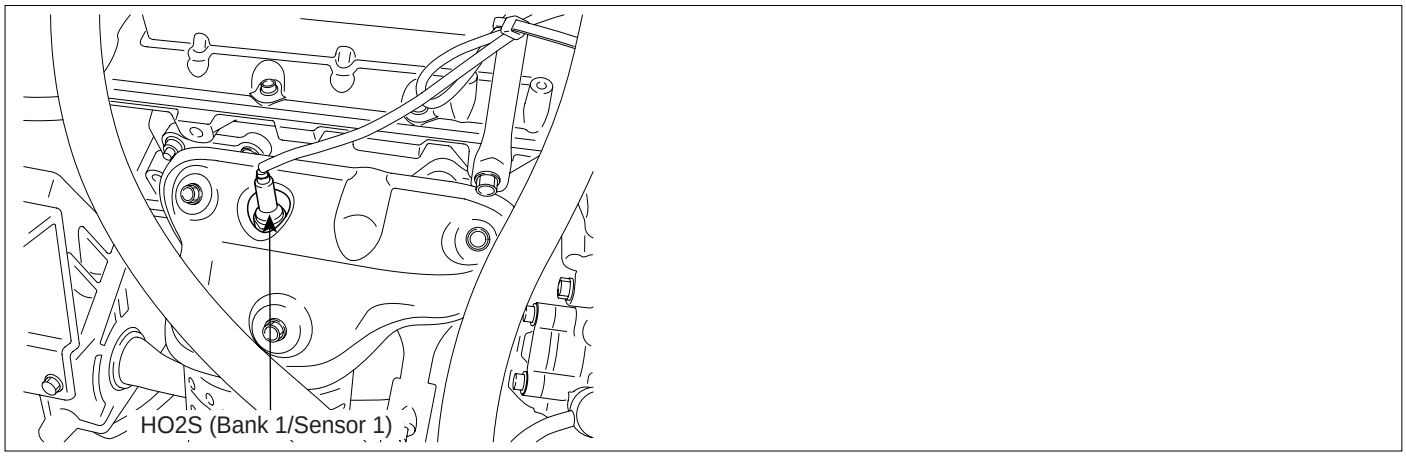
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P2195 HO2S SIGNAL STUCK LEAN (BANK 1 / SENSOR 1)

COMPONENT LOCATION EA134EB2



SGHFL7310N

GENERAL DESCRIPTION EB705336

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 ECDAB25B

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, PCM sets P2195. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EADFCEE2

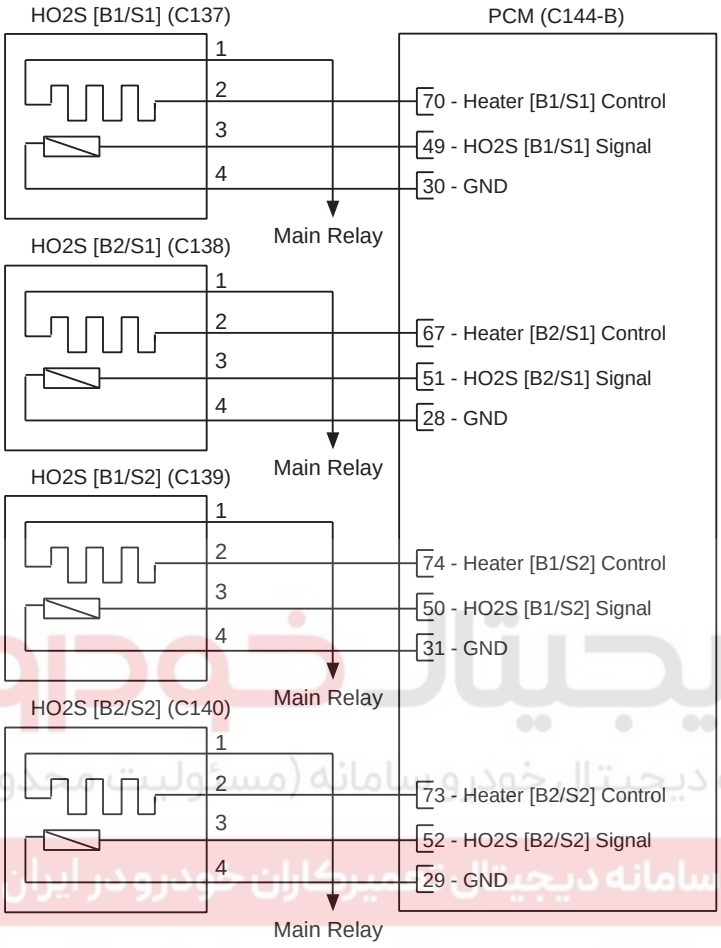
Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's signal	• Poor Connection • Faulty HO2S • Clogging of fuel filter in fuel pump • Faulty PCM
EnableConditions	• Battery voltage ≥ 10V • Engine running ≥ 60sec. • Power Enrichment conditions • Engine warm-up state • Not in Transient Conditions	
Threshold value	• HO2S's signal amp;lt; 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	

SPECIFICATION E5119AA7

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E9702621

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

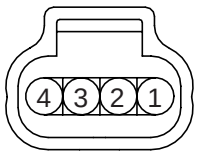
HO2S [B1/S2]

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

HO2S [B2/S2]

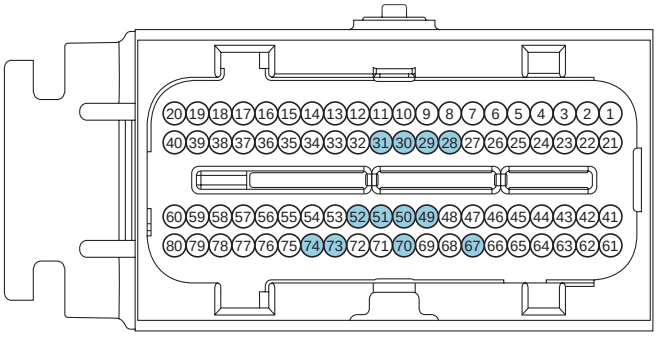
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFROM AND DATA EC09838B

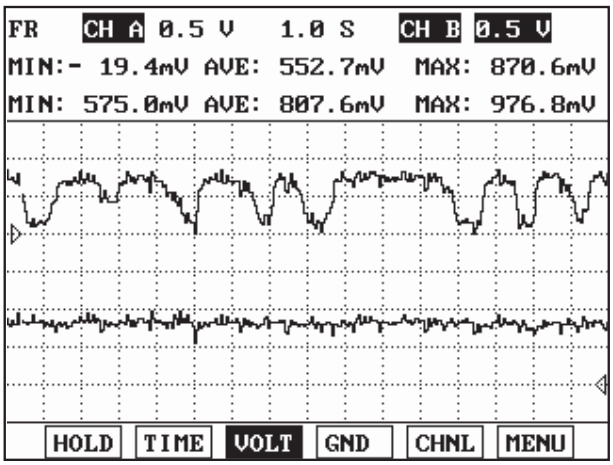


Fig. 1

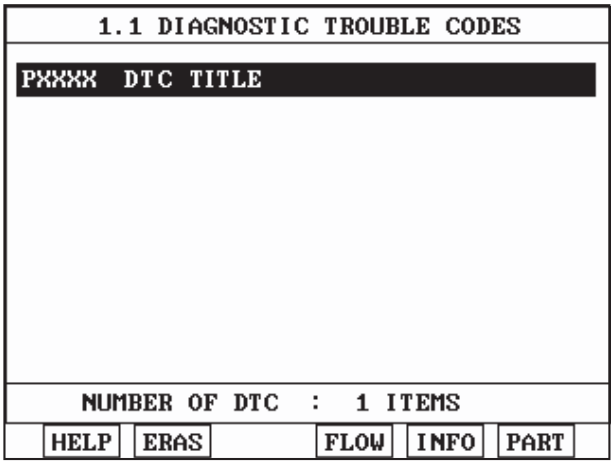
Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

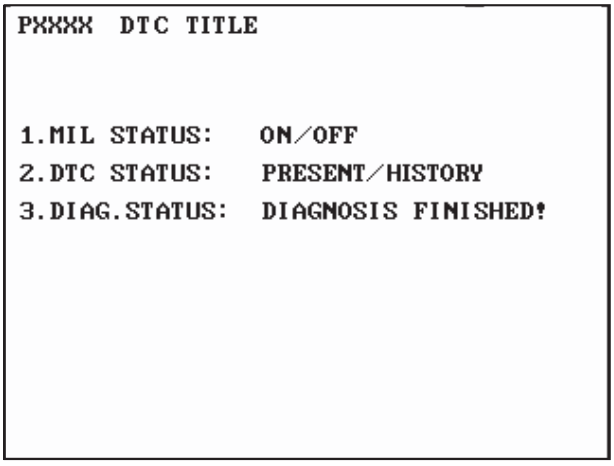
SEPFL6611N

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. At higher engine RPM, the switching frequency increases.

MONITOR DTC STATUS ED1B1E89

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 F5(INFO) to check DTC's information from the DTCs menu
   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 ED615D37

1. Check the condition of HO2S

   1) Check HO2S for poor connection or loose terminal.

   2) Check if HO2S is ensurely installed.

   3) Are 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.

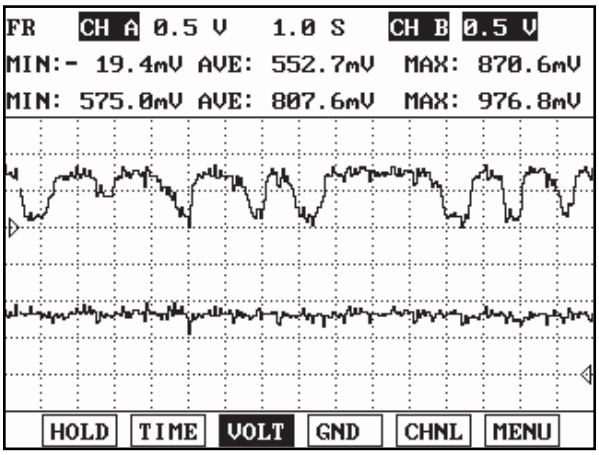


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

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.

3. Check the fuel filter

   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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 automaticallydetected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EC72B15E

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 F5(INFO) 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 "History (Not Present)" fault displayed?

   YES

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

   NO

   ▶ Go to the applicable troubleshooting procedure.

DTC P2196 HO2S SIGNAL STUCK RICH (BANK 1 / SENSOR 1)

COMPONENT LOCATION EA0C8DBF

Refer to DTC P2195.

GENERAL DESCRIPTION E7F81649

Refer to DTC P2195.

DTC DESCRIPTION E37B53AC

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, PCM sets P2196. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF9789C9

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's signal	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Battery voltage ≥ 10V • Engine running ≥ 60sec. • Power Enrichment conditions • Engine warm-up state • Not in Transient Conditions	
Threshold value	• HO2S's signal amp;gt; 0.42V	
DiagnosisTime	• Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E6D88A59

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 ED143C7F

Refer to DTC P2195.

SIGNAL WAVEFROM AND DATA E40B9E12

Refer to DTC P2195.

MONITOR DTC STATUS EE1C40EF

Refer to DTC P2195.

COMPONENT INSPECTION EC3D1F21

1. Check the condition of HO2S

   1) Check HO2S for poor connection or loose terminal.

   2) Check if HO2S is ensurely installed.

   3) Are 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.

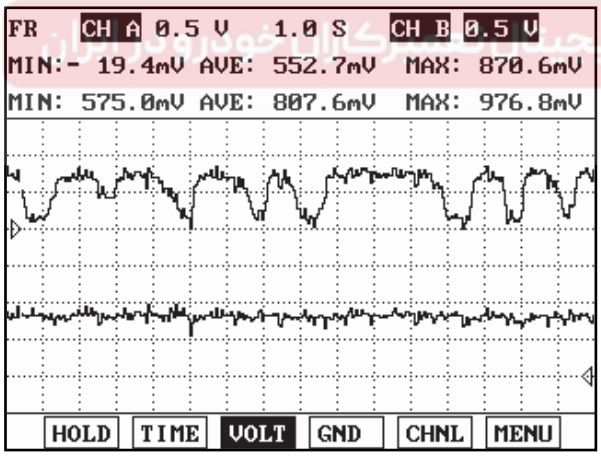


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

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

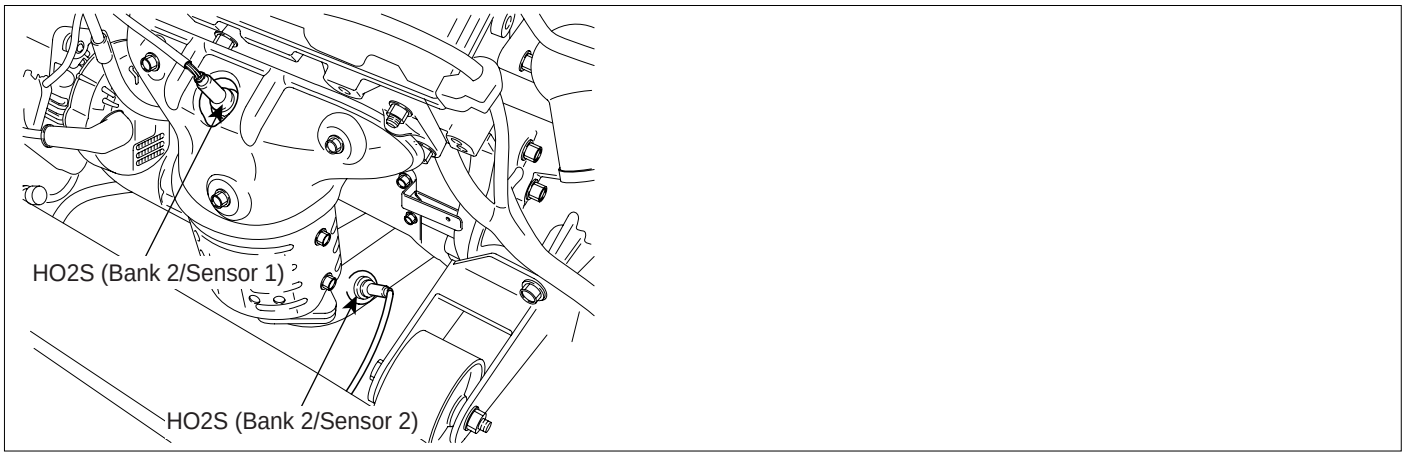
There is a memory reset function on scantool that can erase optional parts automaticallydetected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E9EDBD12

Refer to DTC P2195.

DTC P2197 HO2S SIGNAL STUCK LEAN (BANK 2 / SENSOR 1)

COMPONENT LOCATION E04A144E



SGHFL7312N

GENERAL DESCRIPTION E0AD5E58

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 E94EBE8A

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, PCM sets P2197. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E5FAAEA6

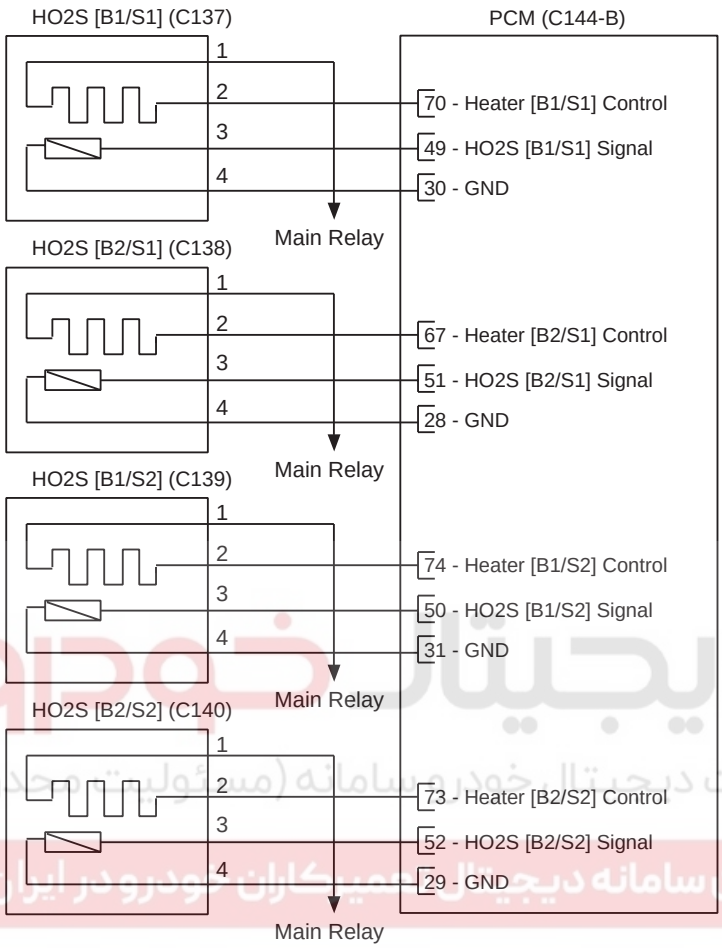
Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's signal	• Poor Connection • Faulty HO2S • Clogging of fuel filter in fuel pump • Faulty PCM
EnableConditions	• Battery voltage ≥ 10V • Engine running ≥ 60sec. • Power Enrichment conditions • Engine warm-up state • Not in Transient Conditions	
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	

SPECIFICATION E896EE29

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E804FBB5

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

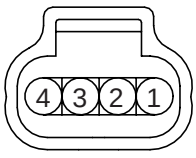
HO2S [B1/S2]

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

HO2S [B2/S2]

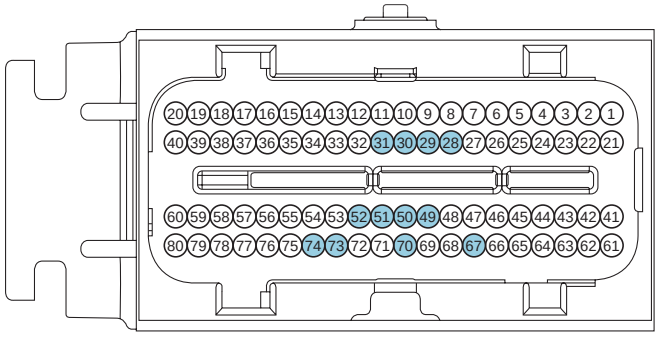
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFROM AND DATA EA41B7E5

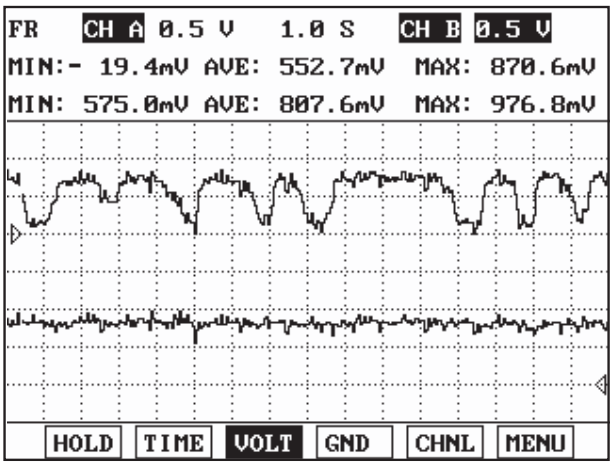


Fig. 1

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. At higher engine RPM, the switching frequency increases.

MONITOR DTC STATUS EB0C79DA

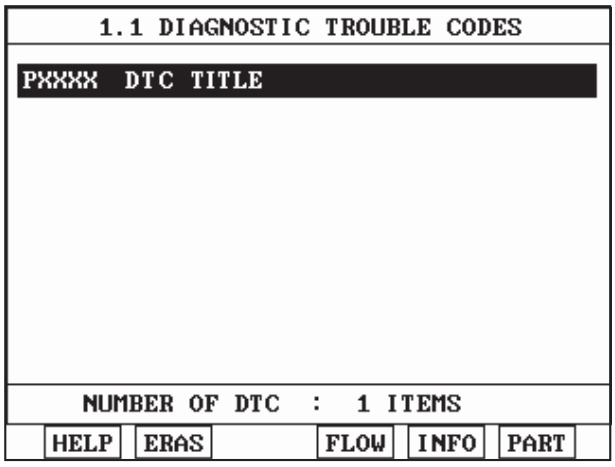
1. Check DTC Status

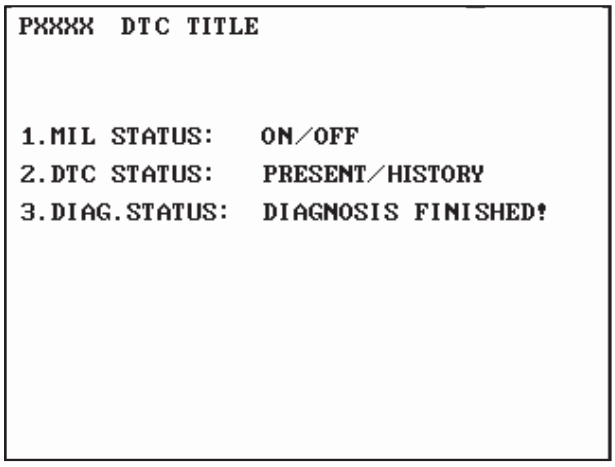
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 EC4E4071

1. Check the condition of HO2S

   1) Check HO2S for poor connection or loose terminal.

   2) Check if HO2S is ensurely installed.

   3) Are 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.

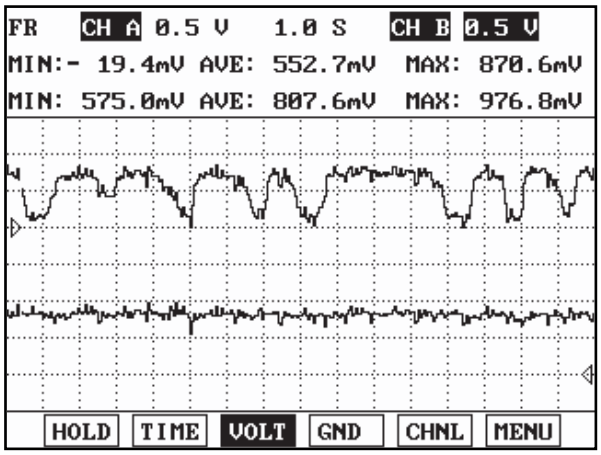


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

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.

3. Check the fuel filter

   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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 automaticallydetected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E965533B

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P2198 HO2S SIGNAL STUCK RICH (BANK 2 / SENSOR 1)

COMPONENT LOCATION E5D4B2DA

Refer to DTC P2197.

GENERAL DESCRIPTION E6D58E8E

Refer to DTC P2197.

DTC DESCRIPTION E368D2E4

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, PCM sets P2198. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2E93B4E

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's signal	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Battery voltage ≥ 10V • Engine running ≥ 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 E05F6E14

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 EB33F263

Refer to DTC P2197.

SIGNAL WAVEFROM AND DATA E1BBC90B

Refer to DTC P2197.

MONITOR DTC STATUS E6134842

Refer to DTC P2197.

COMPONENT INSPECTION EAAE1D86

1. Check the condition of HO2S

   1) Check HO2S for poor connection or loose terminal.

   2) Check if HO2S is ensurely installed.

   3) Are 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.

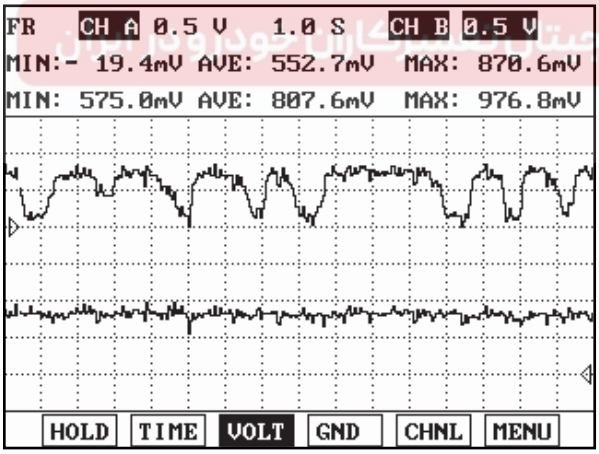


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

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

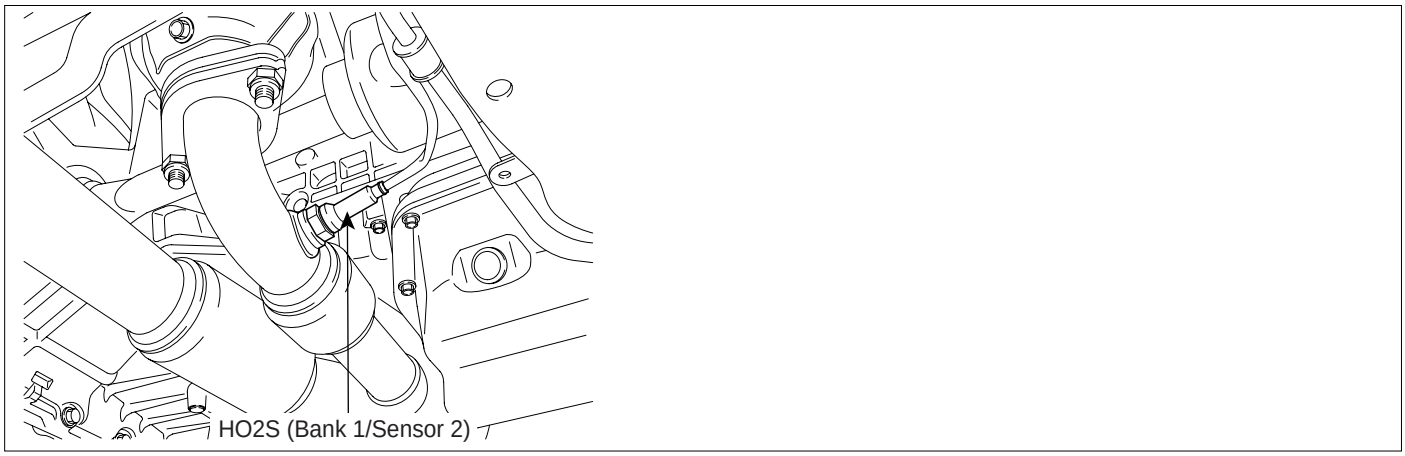
There is a memory reset function on scantool that can erase optional parts automaticallydetected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E77E9E38

Refer to DTC P2197.

DTC P2270 O2 SENSOR SIGNAL STUCK LEAN (BANK 1 / SENSOR 2)

COMPONENT LOCATION E89470AD



SGHFL7311N

GENERAL DESCRIPTION E25E74E2

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 E7F38976

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, PCM sets P2270. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ECACCE1D

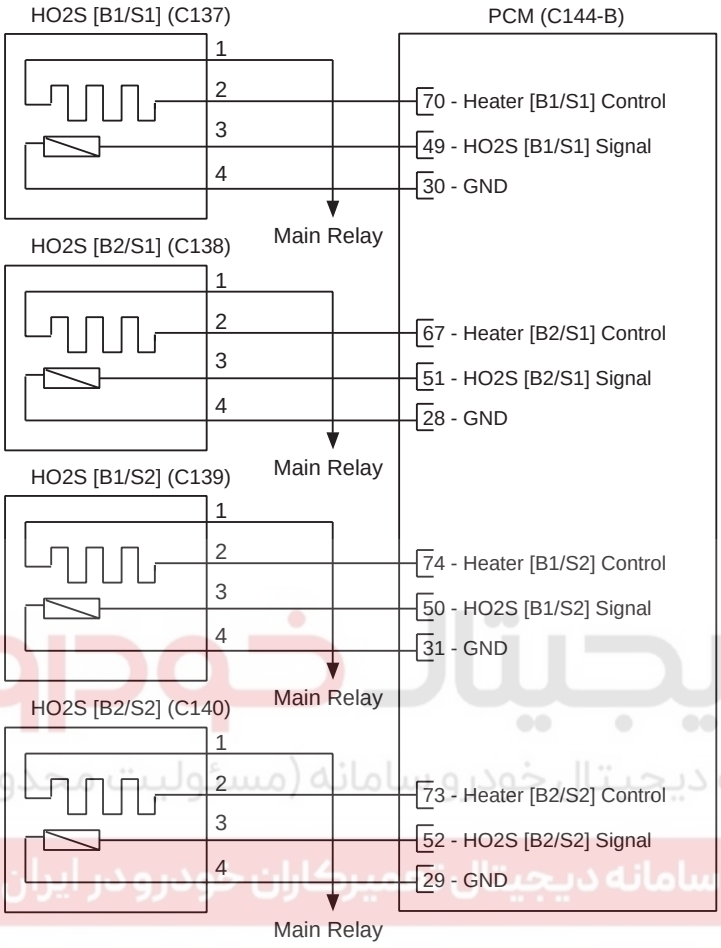
Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's signal	• Poor Connection • Faulty HO2S • Clogging of fuel filter in fuel pump • Faulty PCM
EnableConditions	• Battery voltage ≥ 10V • Engine running ≥ 60sec. • Power Enrichment conditions • Engine warm-up state • Not in Transient Conditions	
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	

SPECIFICATION EACBDCDD

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E854FA8F

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

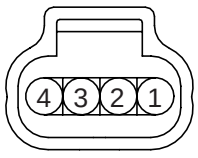
HO2S [B1/S2]

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

HO2S [B2/S2]

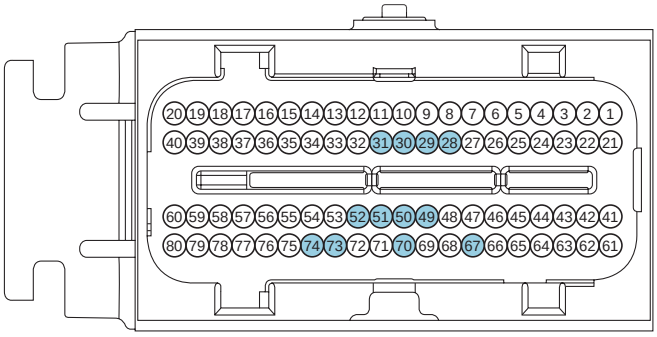
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFROM AND DATA E3E41F35

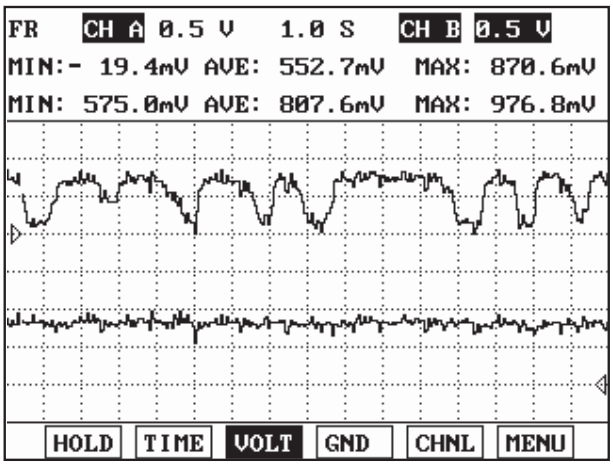


Fig. 1

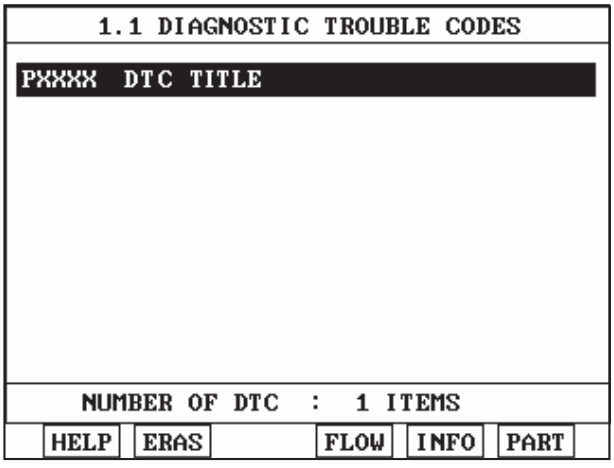
Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

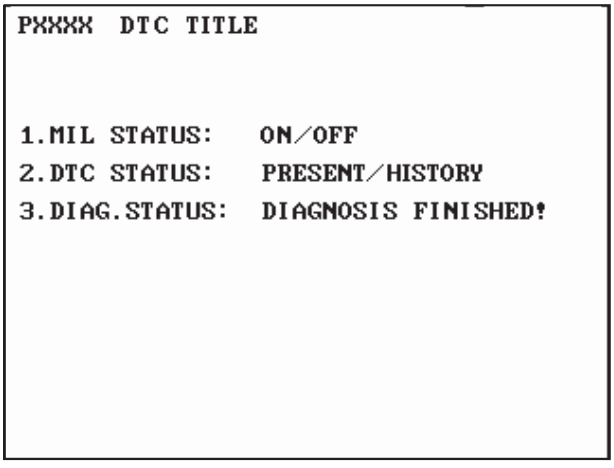
SEPFL6611N

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. At higher engine RPM, the switching frequency increases.

MONITOR DTC STATUS E7A2B487

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 F5(INFO) to check DTC's information from the DTCs menu
   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 E857794B

1. Check the condition of HO2S

   1) Check HO2S for poor connection or loose terminal.

   2) Check if HO2S is ensurely installed.

   3) Are 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.

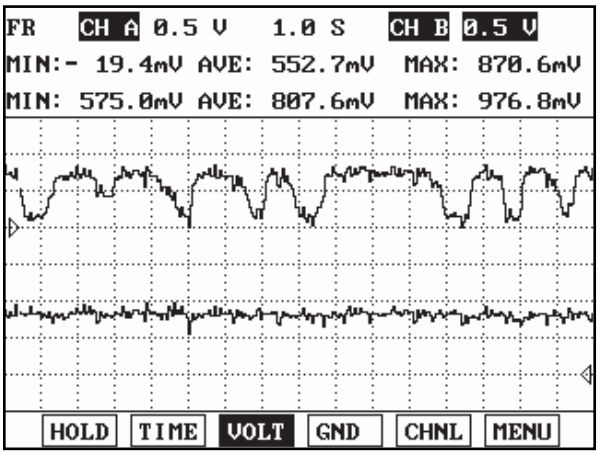


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

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.

3. Check the fuel filter

   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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 automaticallydetected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E78083F6

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P2271 HO2S SIGNAL STUCK RICH (BANK 1 / SENSOR 2)

COMPONENT LOCATION E767B8EC

Refer to DTC P2270.

GENERAL DESCRIPTION EDAC63E4

Refer to DTC P2270.

DTC DESCRIPTION E6952C19

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, PCM sets P2271. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E038891E

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's signal	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Battery voltage ≥ 10V • Engine running ≥ 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 E94EFC85

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 EFA93E49

Refer to DTC P2270.

SIGNAL WAVEFROM AND DATA E113E661

Refer to DTC P2270.

MONITOR DTC STATUS EAC28F6F

Refer to DTC P2270.

COMPONENT INSPECTION EE108B20

1. Check the condition of HO2S

   1) Check HO2S for poor connection or loose terminal.

   2) Check if HO2S is ensurely installed.

   3) Are 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.

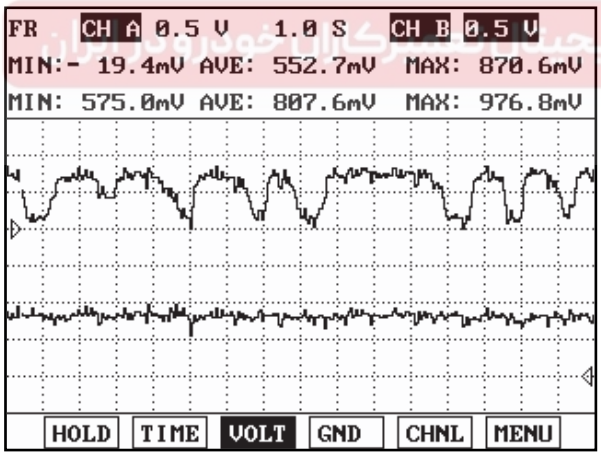


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

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

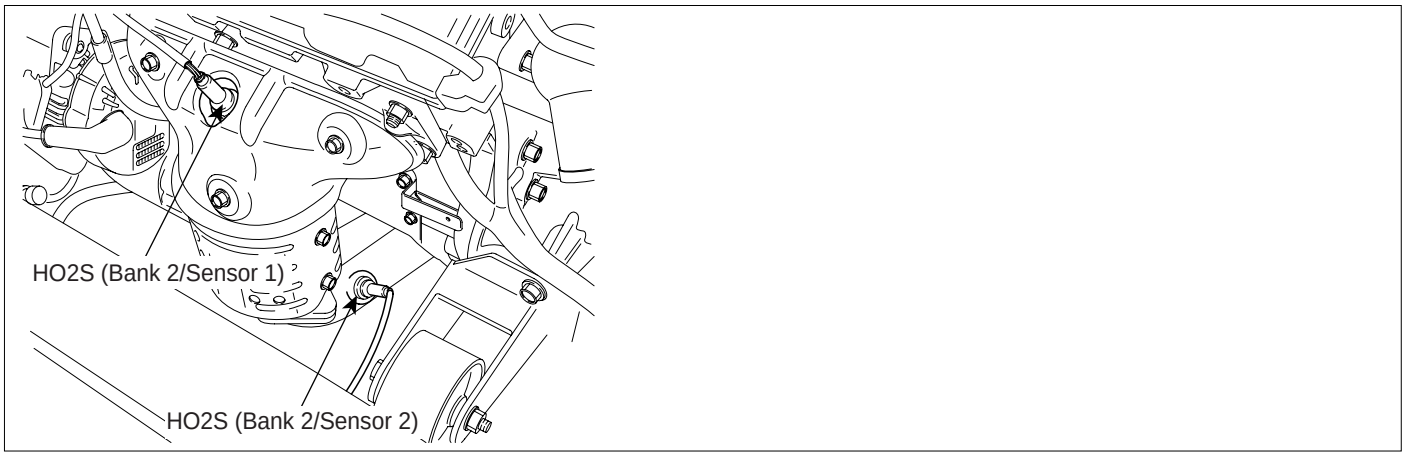
There is a memory reset function on scantool that can erase optional parts automaticallydetected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E2E93633

Refer to DTC P2270.

DTC P2272 HO2S SIGNAL STUCK LEAN (BANK 2 / SENSOR 2)

COMPONENT LOCATION EC80A1CD



SGHFL7312N

GENERAL DESCRIPTION E1B1E39C

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 E3F81623

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, PCM sets P2272. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EAFCAA2F

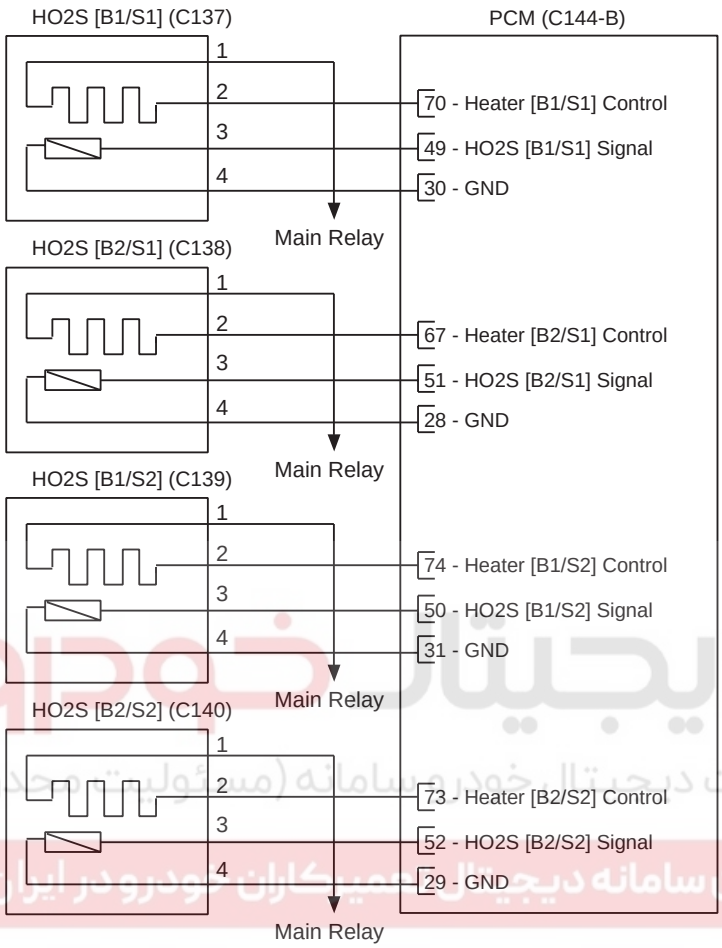
Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's signal	• Poor Connection • Faulty HO2S • Clogging of fuel filter in fuel pump • Faulty PCM
EnableConditions	• Battery voltage ≥ 10V • Engine running ≥ 60sec. • Power Enrichment conditions • Engine warm-up state • Not in Transient Conditions	
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	

SPECIFICATION E2FFB04B

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 ED77D140

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

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

HO2S [B2/S1]

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

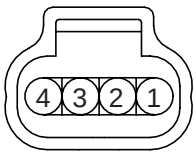
HO2S [B1/S2]

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

HO2S [B2/S2]

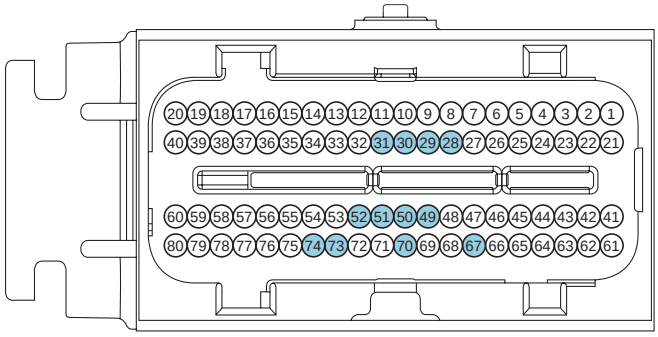
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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
PCM

UFBG250B

SIGNAL WAVEFROM AND DATA EAB2944F

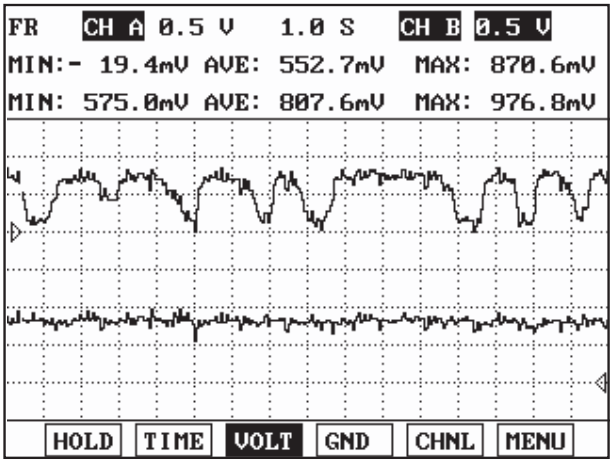


Fig. 1

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. At higher engine RPM, the switching frequency increases.

MONITOR DTC STATUS E33D5D42

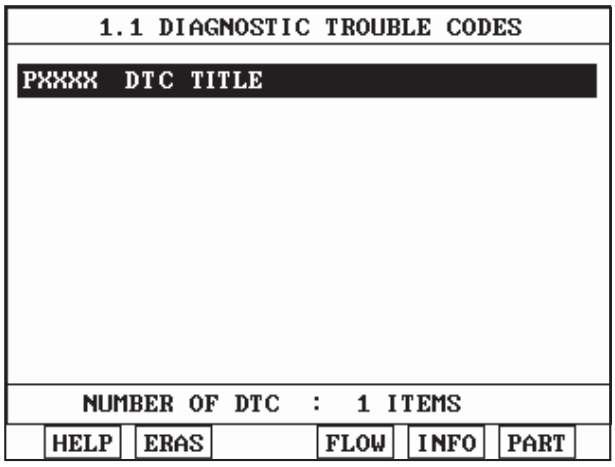
1. Check DTC Status

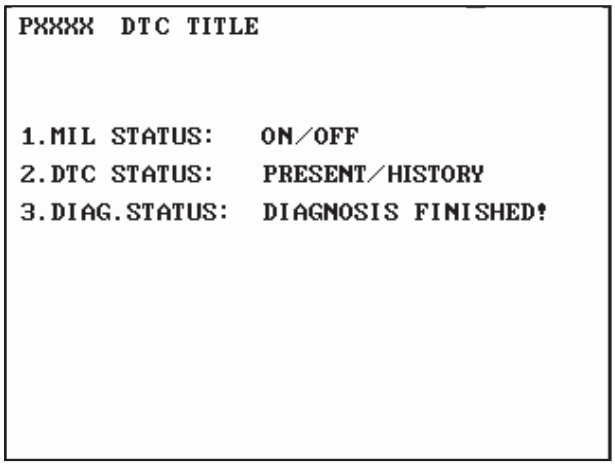
   1) Connect scantool to Data Link Connector(DLC).

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.





SGHFL7305L

   5) Is "Present" Fault displayed?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 E9980C08

1. Check the condition of HO2S

   1) Check HO2S for poor connection or loose terminal.

   2) Check if HO2S is ensurely installed.

   3) Are 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.

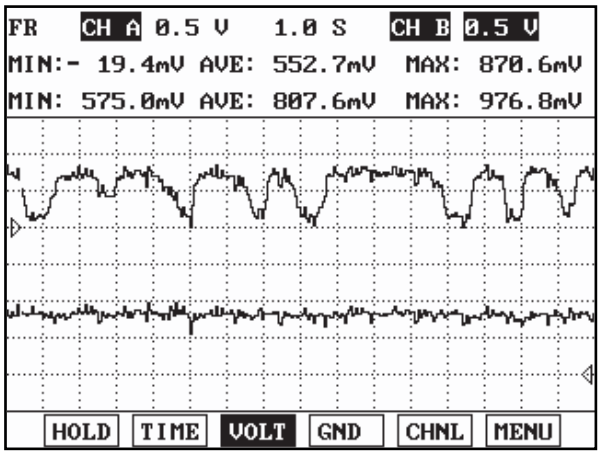


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

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.

3. Check the fuel filter

   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 PCM and check for proper operation. If the problem is corrected, replace PCM 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 automaticallydetected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E11F1EA9

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P2273 HO2S SIGNAL STUCK RICH (BANK 2 / SENSOR 2)

COMPONENT LOCATION E347A90D

Refer to DTC P2272.

GENERAL DESCRIPTION EC5EA167

Refer to DTC P2272.

DTC DESCRIPTION EF323392

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, PCM sets P2273. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EDCB7776

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor HO2S's signal	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Battery voltage ≥ 10V • Engine running ≥ 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 ECAF3940

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is normally switching from rich to lean more than 3 times in 10 sec.	Signal is normally 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 E8A22CA5

Refer to DTC P2272.

SIGNAL WAVEFROM AND DATA E5382CAB

Refer to DTC P2272.

MONITOR DTC STATUS EB94F194

Refer to DTC P2272.

COMPONENT INSPECTION EFDFE0C7

1. Check the condition of HO2S

   1) Check HO2S for poor connection or loose terminal.

   2) Check if HO2S is ensurely installed.

   3) Are 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.

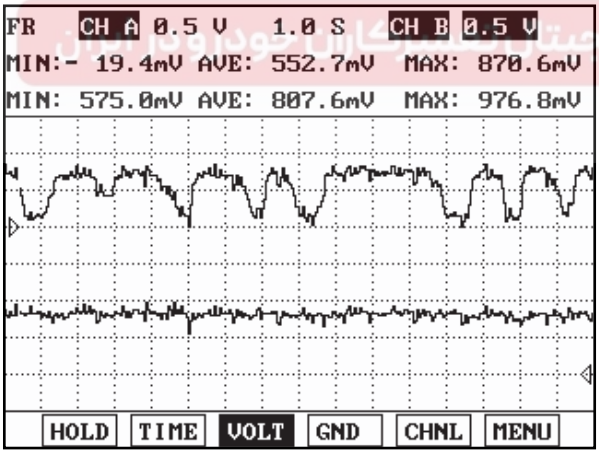


Fig) Signal waveforms of front HO2S(the upper) and rear HO2S(the lower)

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

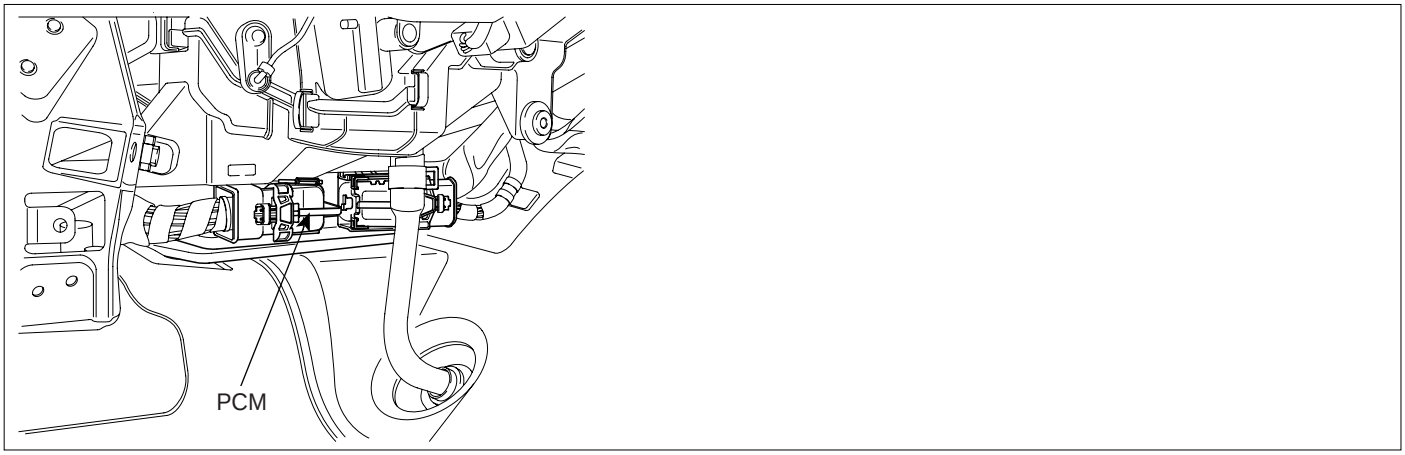
There is a memory reset function on scantool that can erase optional parts automaticallydetected and memorized by PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EFF25103

Refer to DTC P2272.

DTC P2507 ECM/PCM POWER INPUT SIGNAL LOW

COMPONENT LOCATION E8CF9B07



SGHFL7335N

GENERAL DESCRIPTION E486ACB0

When the ignition switch is turned "ON", battery voltage is applied from the battery to the PCM through the main relay. In case that the ignition switch is turned "OFF", the PCM is supplied with power through the battery power input line to control the basic operation of vehicle.

DTC DESCRIPTION E54C163F

If the battery power input line has a problem, PCM sets P2507 and MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E4D1443D

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor the battery power input line	• Poor connection • Open or short to ground in line • Faulty PCM
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 E4087F27

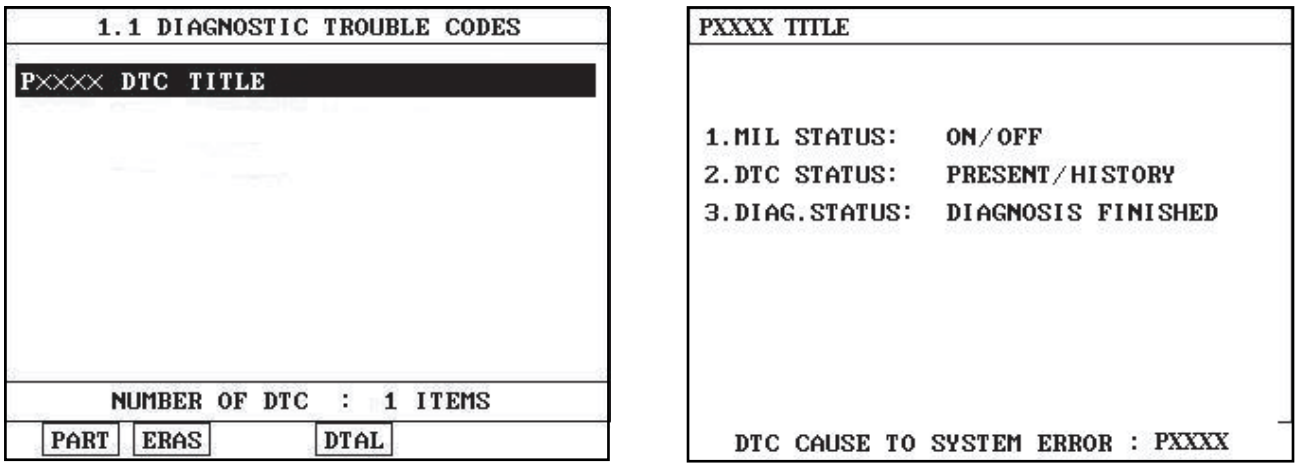
1. Check DTC Status

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

   2) IG "ON".

   3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

   4) Read "DTC Status" parameter.



SCMF16159L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and Connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor’ s and/or PCM’ s connector or was repaired and PCM 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 E030C559

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 E0D76BC1

1. Check Voltage
   1) Ignition "OFF"
   2) Disconnect PCM connector
   3) Ignition "ON" & Engine "OFF"

4) Measure voltage between terminal "76" of PCM harness connector(C144-B) and chassis ground

Specification : B+

5) Is the measured voltage within specifications?

YES

▶ Substitute with a known - good PCM and check for proper operation.
▶ If the problem is corrected, replace PCM 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 PCM. After testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR E8C71B1A

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

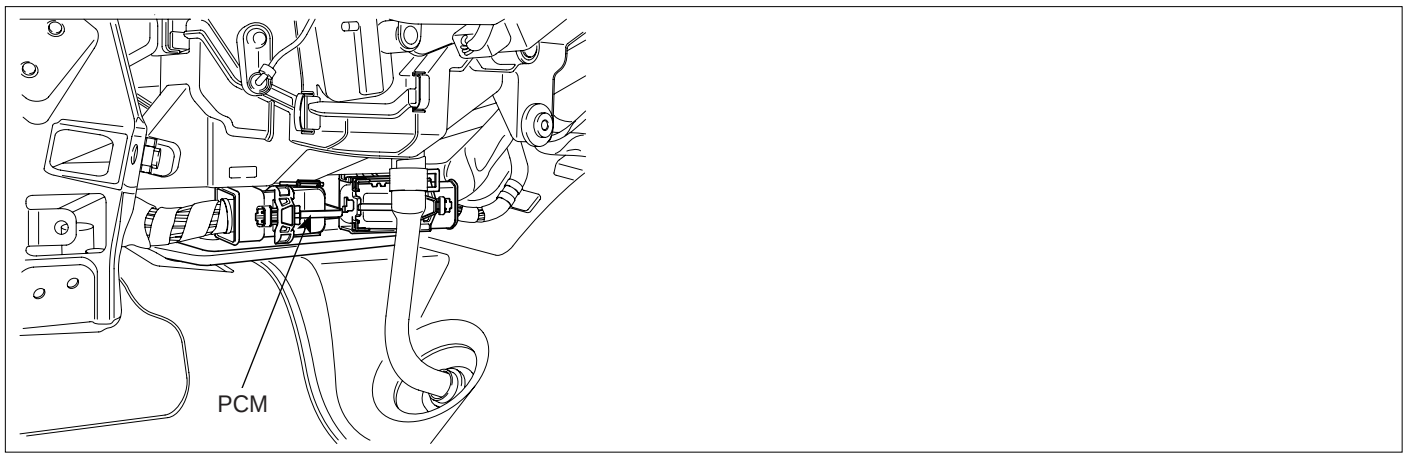
▶ System performing to specification at this time. Clear the DTC.

NO

▶ Go to the applicable troubleshooting procedure.

DTC P2610 ECM/PCM INTERNAL ENGINE OFF TIMER PERFORMANCE

COMPONENT LOCATION E26535CA



SGHFL7335N

GENERAL DESCRIPTION EF250B4A

Continuing to calculate data of several sensor despite turning ignition OFF, when ignition turns ON, this enables PCM to be easy using calculated data.

DTC DESCRIPTION E33A6A90

If abnormal counterdown is detected for a calibratable time, PCM sets P2610. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E15DC80D

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	• PCM
	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	
Thresh-old	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 E85590B2

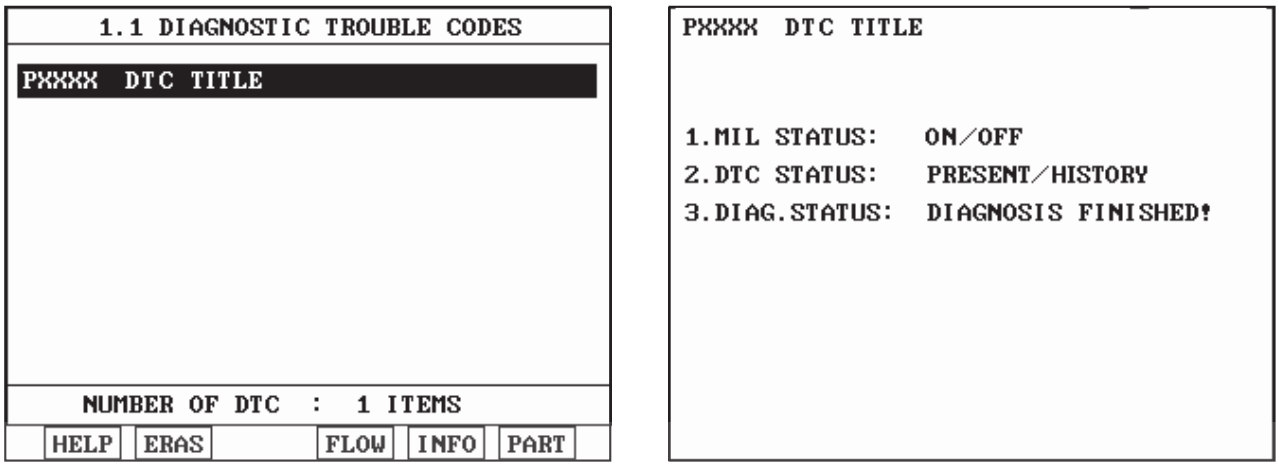
1. Check DTC Status

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

2) IG "ON".

3) Select "Diagnostic Trouble Codes(DTCs)" mode, and then Press F5(INFO) to check DTC's information from the DTCs menu

4) Read "DTC Status" parameter.



SGHFL7305L

5) Is "Present" Fault displayed?

YES

▶ Go to "Terminal and Connector inspection" procedure.

NO

▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM's connector or was repaired and PCM 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 E0CFCA73

1. Many malfunctions in the electrical system are caused by poor harness and terminal condition. 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 PCM and check for proper operation. If the problem is corrected,replace PCM 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 PCM. Before or after testing PCM on the vehicle, use this function before reusing the PCM

VERIFICATION OF VEHICLE REPAIR EA97C36D

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC U0001 CAN COMMUNICATION MALFUNCTION

GENERAL DESCRIPTION E794B6E5

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(PCM, TCM,ESP PCM, ABS PCM)
As sharing signals of engine speed, APS, gear shifting, torque reduction in ESP and various modules, active control is performed.

DTC DESCRIPTION E8588CDF

Checking CAN communication, under detecting condition, if an error within the detecting condition is detected for more than 1.5 sec., PCM sets U0001. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ECF9DF6D

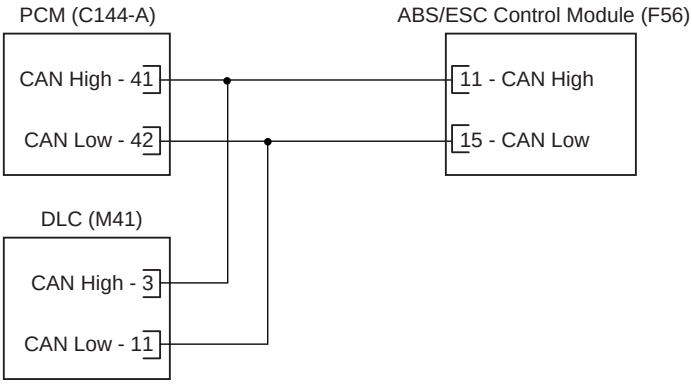
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects failures in communication between the PCM and another or modules in the vehicle which are on the CAN serial bus.	• CAN BUS • CAN communication module component
EnableConditions	• Engine Run Time ≥ 2sec. • Ignition Voltage ≥ 11V	
Threshold value	• CAN communicatin error	
DiagnosisTime	• Continuous	
MIL On Condition	• 2 Driving Cycle	

SPECIFICATION E3428724

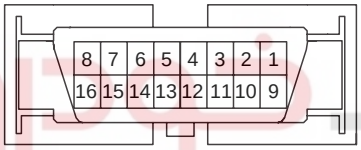
Format	DIGITAL "0"		DIGITAL "1"(BUS IDLE)		CAN Communication Line Resistance	
	HIGH	LOW	HIGH	LOW	PCM	ABS/ESP Control Module
CAN 2.0B	3.5V	1.5V	2.5V	2.5V	120Ω (20℃)	120Ω (20℃)

SCHEMATIC DIAGRAM E0B15BB6

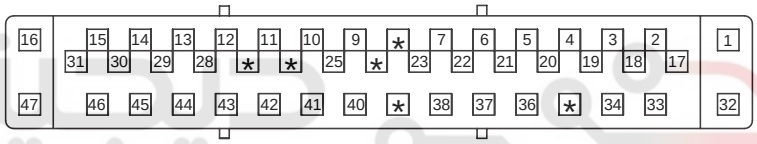
[CIRCUIT DIAGRAM]



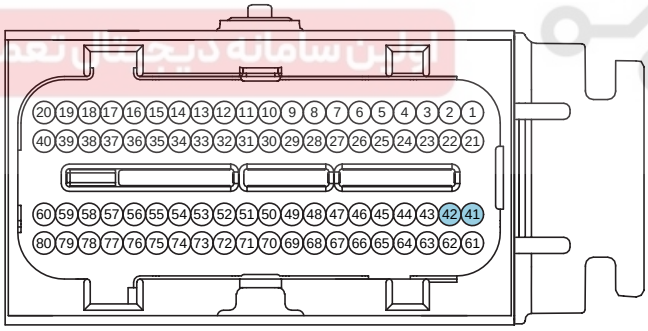
[HARNESS CONNECTOR]



M41
Data Link Connector (DLC)



F56
ABS/ESC CONTROL MODULE



C144-A
PCM

SGHFL7341N

SIGNAL WAVEFROM AND DATA E47AE5C0

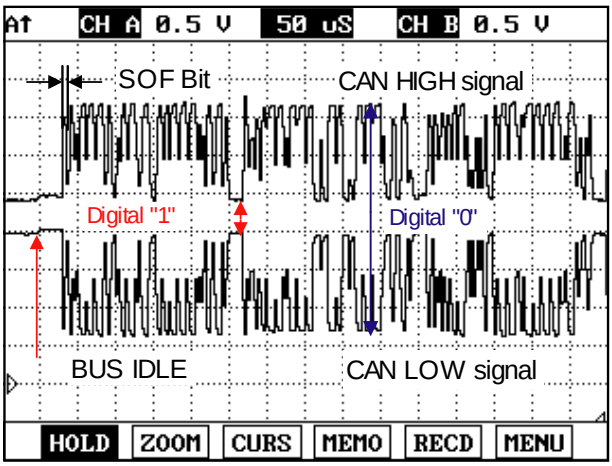


Fig.1

Fig. 1) CAN communication waveform

Monitoring CAN HIGH and LOW simultaneously is important in monitoring CAN communication waveform. When CAN HIGH signal rise to 3.5V and LOW signal drops to 1.5V - voltage difference between HIGH and LOW signal is 2V - at BUS IDLE state(DIGITAL "1") whose reference voltage is 2.5V, "0" is recognized. Besides, comparing HIGH and LOW signal if opposite waveform is detected with the reference voltage of 2.5V, Check if current cam signal transfers correctly.
Continuous "0"signal above 6BIT means the occurence of error in CAN communication. 1BIT is easily distinguished as calculating the time when "SOF"(START OF FRAME) which notifies the start of frame occurs. Check if "0"signal above 6BIT is detected continuously when monitoring CAN communication waveform.

UFBG987F

TERMINAL AND CONNECTOR INSPECTION ED604031

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

2. Perform checking procedure as follows.

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

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

   NOTE

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

3. Is the problem found?

   YES

   ▶ Repair the malfunctioning component and go to "Verification of Vehicle Repair".

   NO

   ▶ Go to "Signal Circuit Inspection".

SIGNAL CIRCUIT INSPECTION E0F8EC76

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 PCM connector.

   4) Measure the resistance between terminals 3 and 11 of data link connector (Test 2)

Specification : PCM and ABS/ESP Control Module connected : 60 ± 3Ω (Test 1)
PCM and ABS/ESP Control Module disconnected : 120 ± 3Ω (Test 2)

   5) Is CAN BUS resistance within the specification?

YES

▶ Go to "2.Check short to ground in CAN BUS" as follows.

NO

▶ Below 10Ω for both conditions(disconnected, connected) : Repair short between CAN BUS 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-panel junction box.

2. Check short to ground in CAN BUS

   1) Ignition "OFF"

   2) Disconnect PCM and and ABS/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)

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 PCM and and ABS/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)

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".

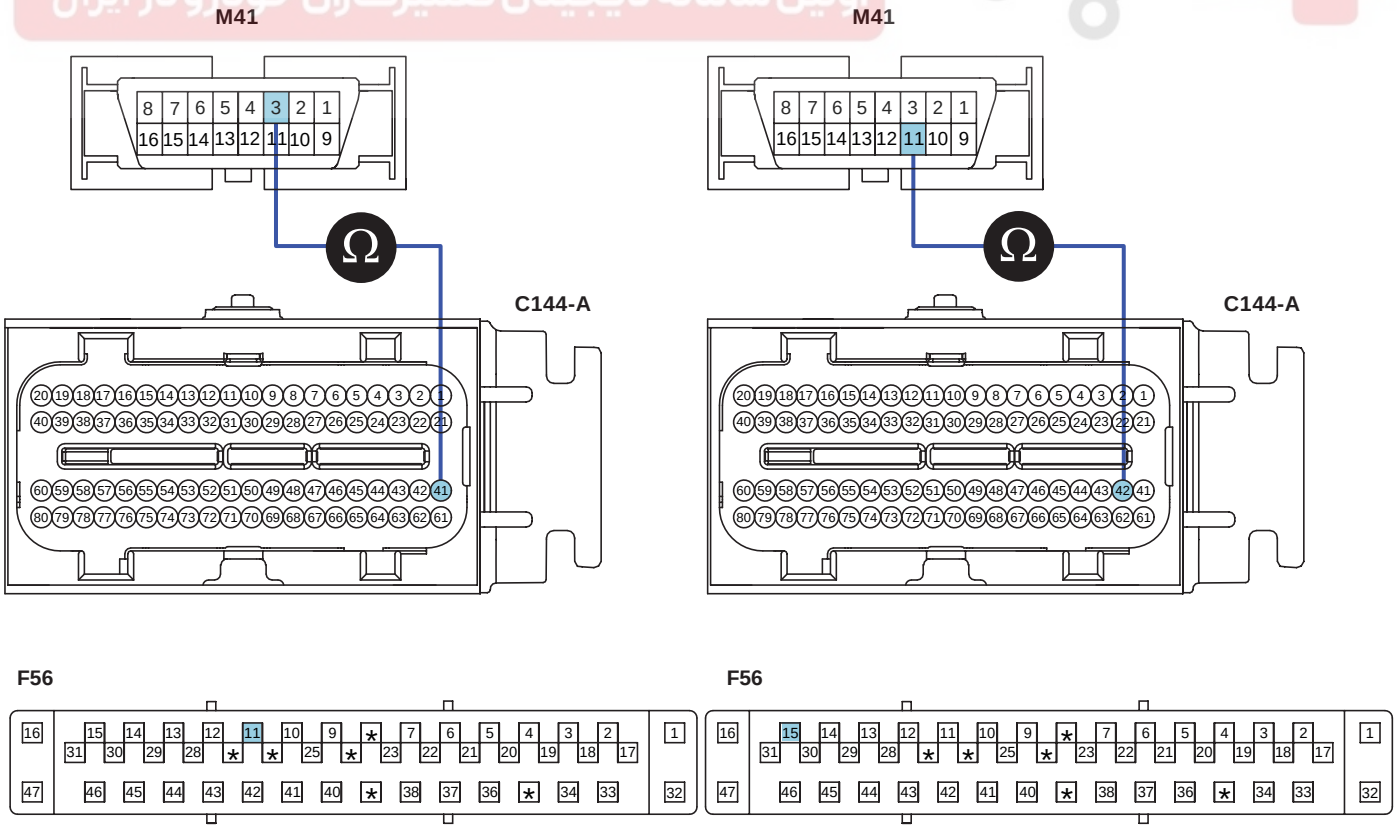
4. Check CAN BUS continuity

1) Ignition "OFF"

2) Disconnect PCM and and ABS/ESP Control Module connector.

3) Check continuity in CAN HIGH line.
(CAN HIGH : PCM connector terminal 41, and ABS/ESP Control Module connector terminal 11, Data link connector(DLC) terminal 3)

4) Check continuity CAN LOW line.
(CAN LOW : PCM connector terminal 42, and ABS/ESP Control Module connector terminal 15, Data link connector(DLC) terminal 11)



SGHFL7307N

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 EF902135

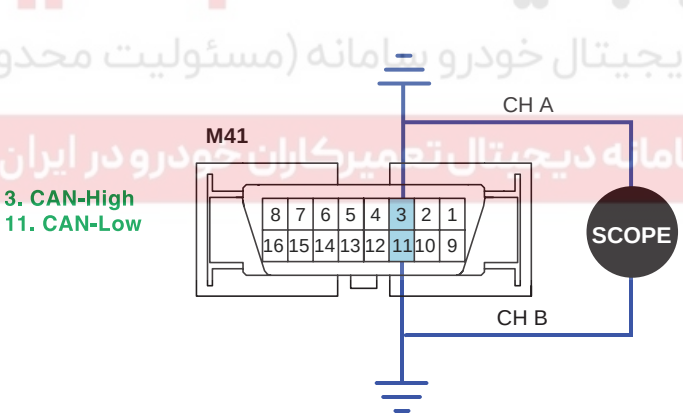
1. Check CAN communication waveform generation

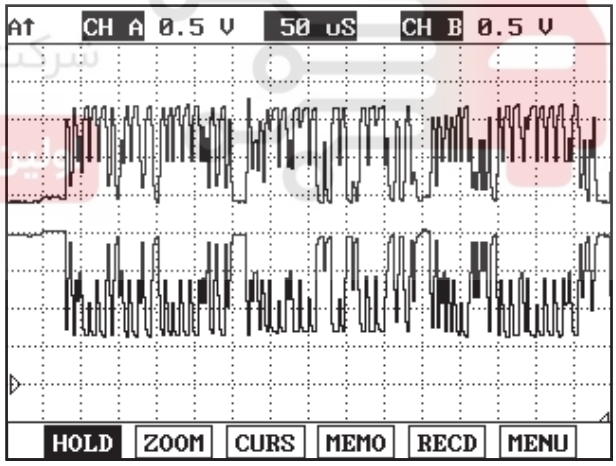
1) Ignition "OFF"

2) Connect 2 channel scope to DLC terminal 3(CAN HIGH) and 11(CAN LOW).

3) Ignition "ON" after connecting only PCM to CAN BUS.

4) Ignition "ON" after connecting only ABS/ESP Control Module to CAN BUS.





SGHFL7308N

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 E06B18A0

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 F5(INFO) 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 "History (Not Present)" fault displayed?

YES

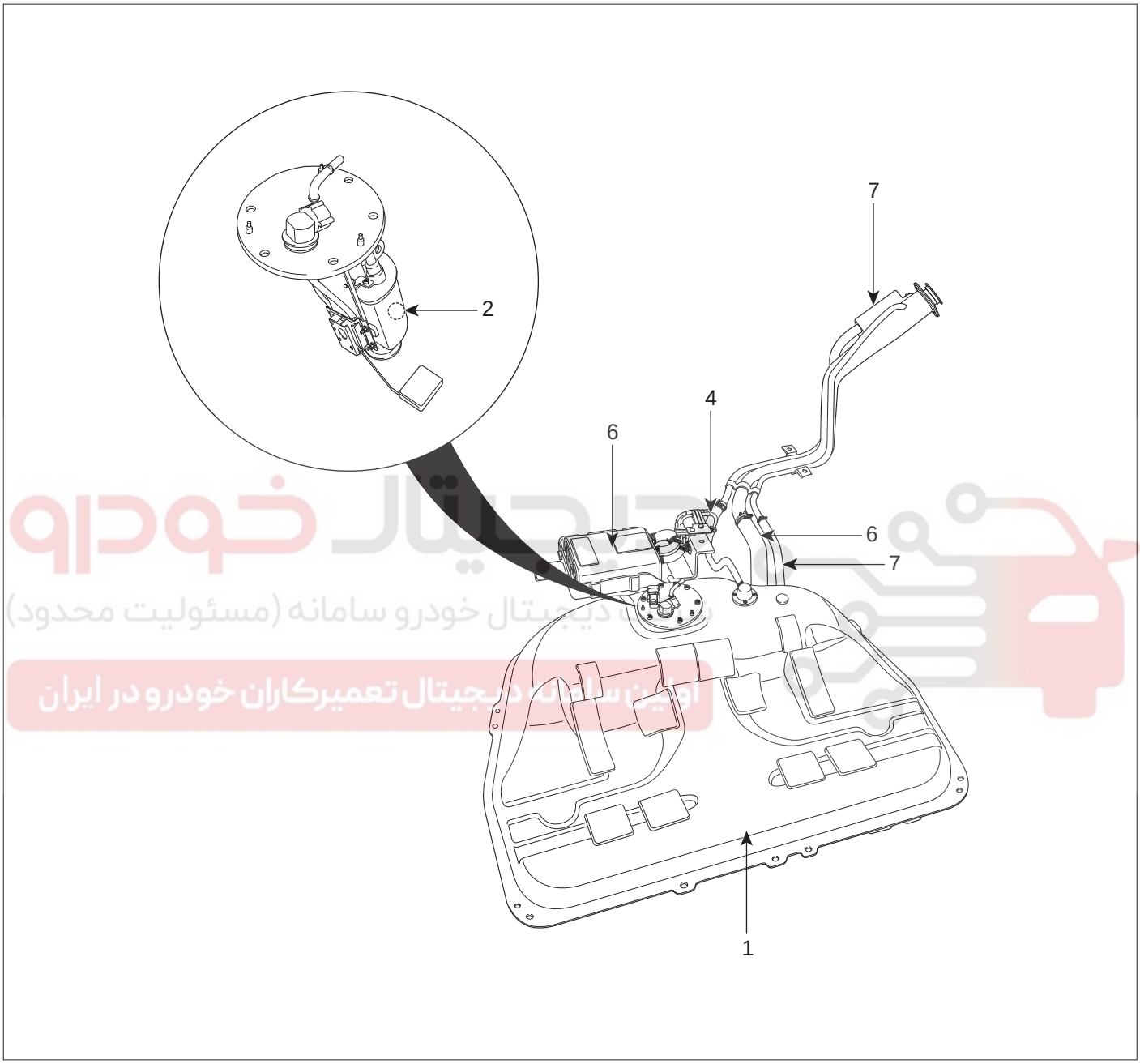
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

FUEL DELIVERY SYSTEM

COMPONENTS E11472C8



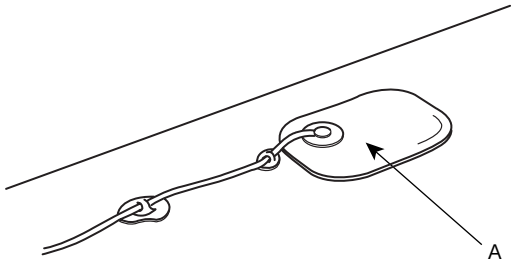
1. Fuel Tank
2. Fuel Pump
   (including Fuel Filter and Fuel Pressure Regulator)
3. Fuel Filler Hose
4. Leveling Hose
5. Ventilation Hose
6. Canister
7. Fuel Tank Air Filter

SGHFL7102L

FUEL PRESSURE TEST EF1BB6AA

1. PREPARING

1. Remove the luggage floor mat in the trunk.
2. Open the service cover (A) in trunk.

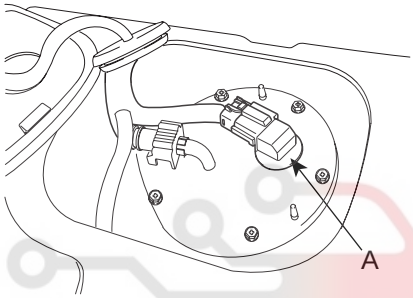


2. RELEASE THE INTERNAL PRESSURE

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.



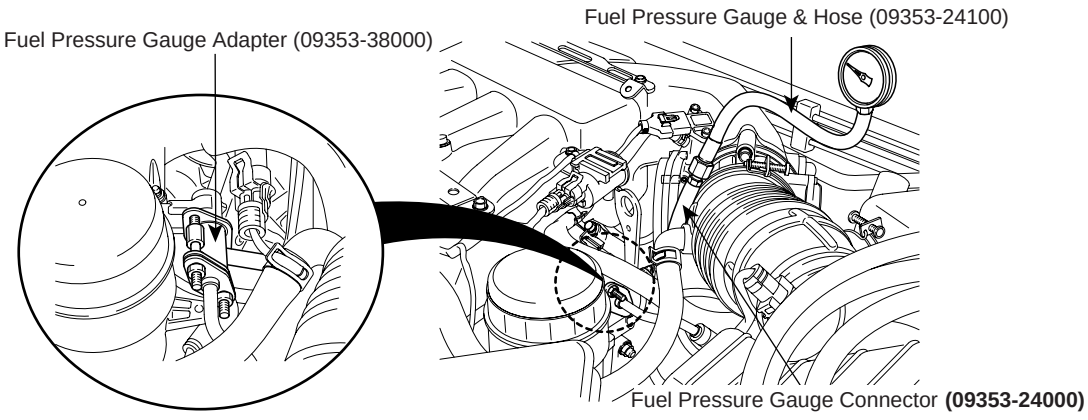
3. INSTALL THE SPECIAL SERVICE TOOL (SST) FOR MEASURING THE FUEL PRESSURE

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 Gauge Adapter (09353-38000) between the delivery pipe and the fuel feed hose.
3. Connect the Fuel Pressure Gauge Connector (09353-24000) to the Fuel Pressure Gauge Adapter (09353-38000).
4. Connect the Fuel Pressure Gauge and Hose (09353-24100) to Fuel Pressure Gauge Connector (09353-24000).
5. Connect the fuel feed hose to the Fuel Pressure Gauge Adapter (09353-38000).



SGHFL7103L

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: 374 ~ 384 kpa (3.82 ~ 3.92 kgf/㎠, 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 gauge reading should hold for about 5 minutes

- Observing the declination of the fuel pressure when the gauge 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

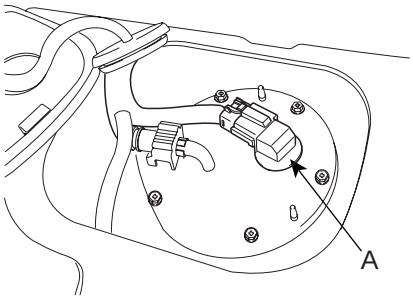
EGRF009J

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.

SGHFL7104L

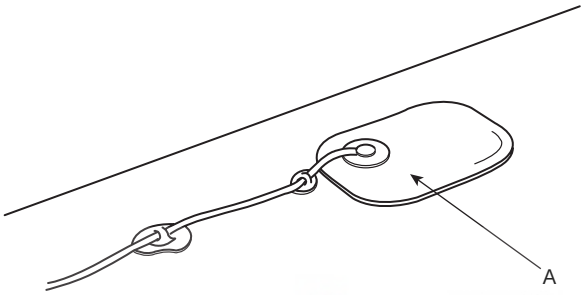
FUEL PUMP

REMOVAL(INCLUDING FUEL FILTER AND FUEL PRESSURE REGULATOR) E4F76DE1

1. Preparation

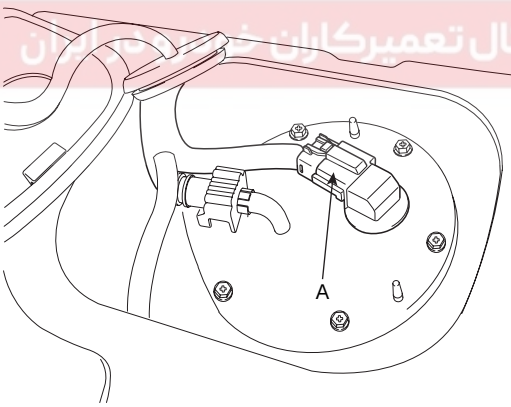
   1) Remove the luggage floor mat in the trunk.

   2) Remove the Service Cover (A).



SGHF16040D

   3) Disconnect the Fuel Pump Connector (A).

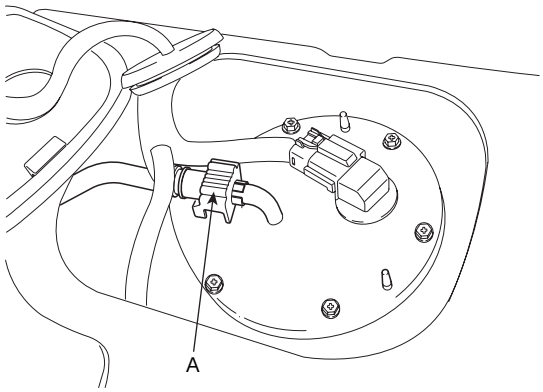


SGHFL7105L

   4) Start the engine and wait until fuel in fuel line is exhausted.

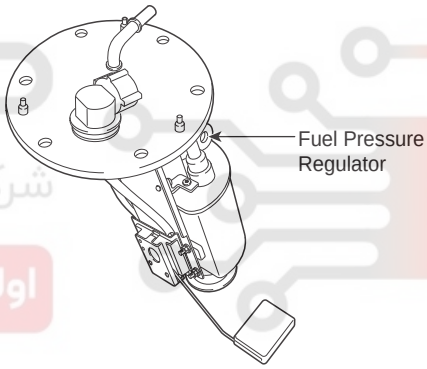
   5) After the engine stalls, turn the ignition switch OFF.

2. Disconnect the Fuel Feed Quick-Connector (A).



SGHFL7106L

3. Remove the fuel pump plate cover with SST (No. : 09310-2B200) and remove the fuel pump assembly.



SGHFL7107L

INSTALLATION E3A0EA5E

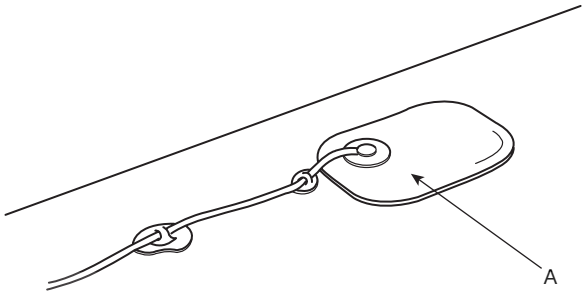
1. Install the Fuel Pump assembly according to the reverse order of "REMOVAL" procedure.

Tightening Torque
78.5 ~ 98.1 N·m (8.0 ~ 10.0 kgf·m, 57.9 ~ 72.4 lbf·ft)

FUEL TANK

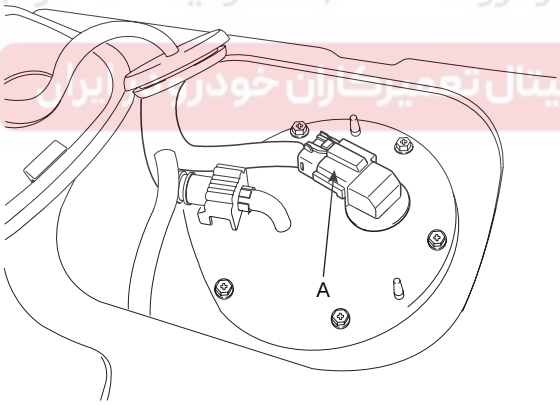
REMOVAL ED12FA2B

1. Preparation
   1) Remove the luggage floor mat in the trunk.
   2) Remove the Service Cover (A).



SGHF16040D

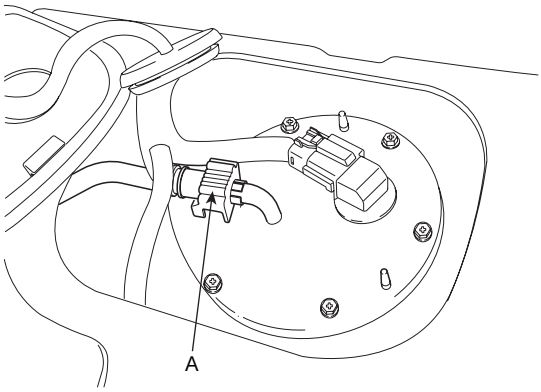
   3) Disconnect the Fuel Pump Connector (A).



SGHFL7105L

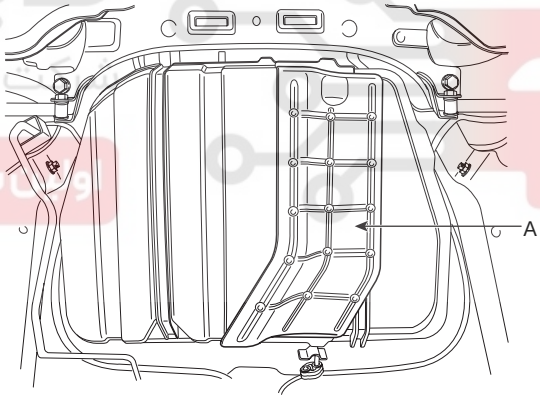
   4) Start the engine and wait until fuel in fuel line is exhausted.
   5) After the engine stalls, turn the ignition switch OFF.

2. Disconnect the Fuel Feed Quick-Connector (A).



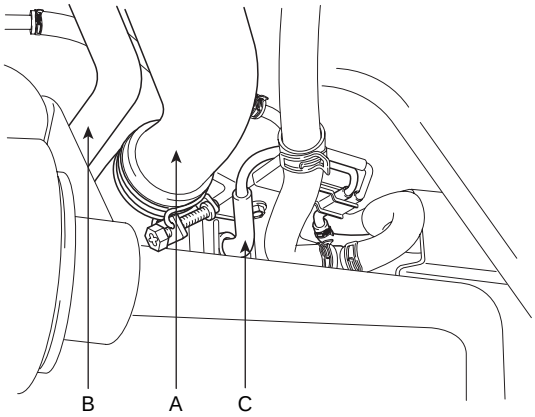
SGHFL7106L

3. Lift the vehicle.
4. Remove the center and main mufflers (Refer to the group "EM").
5. Remove the Fuel tank protector (A).



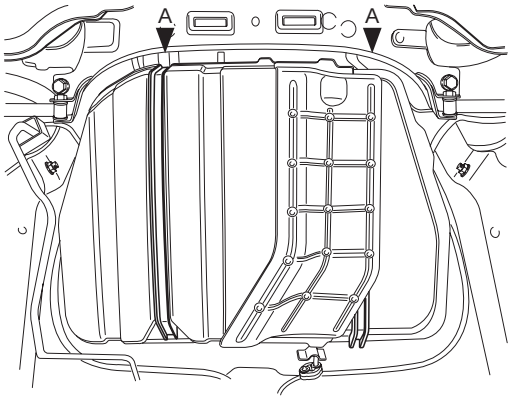
SGHF16045D

6. Disconnect the Fuel Filler Hose (A), the ventilation hose (B) and the canister vacuum hoses (C).



SGHF16046D

7. Support the fuel tank with a jack and remove the Fuel Tank band (A) after unscrewing 2 mounting nut.



SGHF17033N

INSTALLATION EDA6EC40

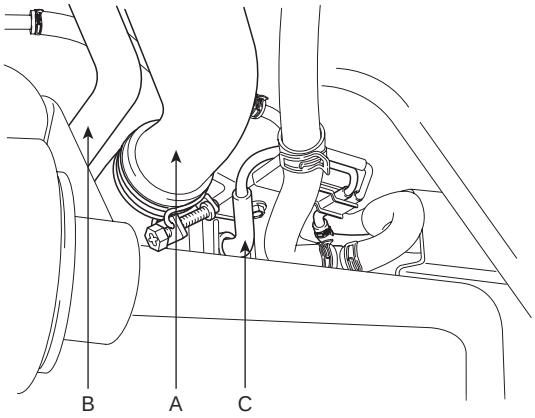
1. Install the Fuel Tank according to the reverse order of "REMOVAL" procedure.

Tightening Torque
39.2 ~ 53.9 N·m (4.0 ~ 5.5 kgf·m, 28.9 ~ 39.8 lbf·ft)

FILLER-NECK ASSEMBLY

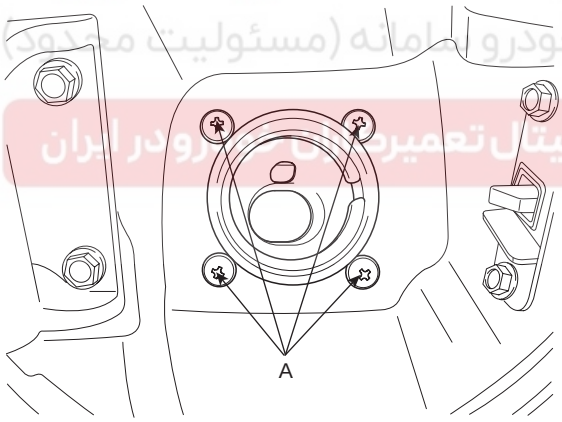
REMOVAL E9968BB7

1. Disconnect the Fuel Filler Hose (A), the ventilation hose (B) and the canister vacuum hoses (C).



SGHF16046D

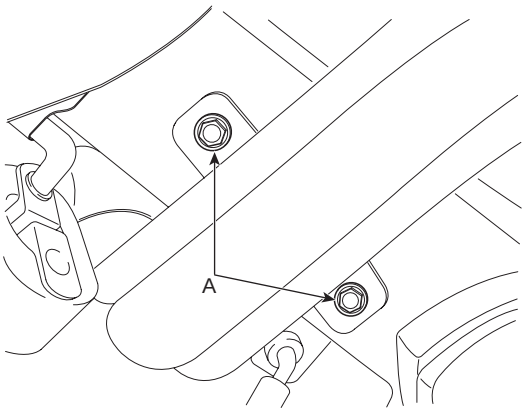
2. Open the fuel filler door, unscrew the filler-neck assembly mounting screw (A).



SCMFL6655D

3. Remove the rear-left wheel & tire and wheel house cover.

4. Remove the filler-neck assembly after unscrewing the bracket mounting bolt (A).



SGHF16049D

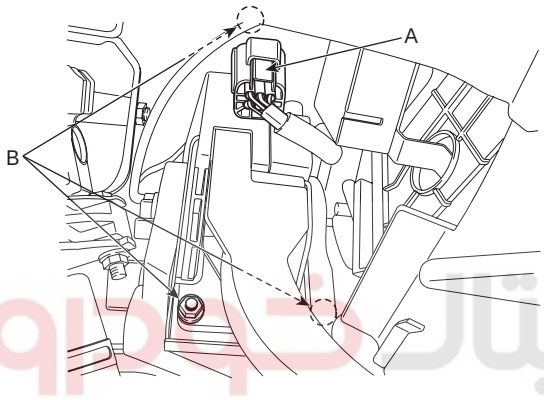
INSTALLATION E59018D0

1. Install the filler-neck assembly according to the reverse order of "REMOVAL" procedure.

ACCELERATOR PEDAL

REMOVAL EC803F7D

1. Turn ignition switch off, disconnect the negative (-) battery cable.
2. Disconnect the accelerator position sensor connector (A).
3. Remove the acceleration pedal assembly after unscrewing 3 mounting bolt (B).



SGHF16050D

INSTALLATION E79E19AB

1. Install the acceleration pedal assembly according to the reverse order of "REMOVAL" procedure.

Tightening Torque :
7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lbf.ft)