Fuel System

GENERAL

SPECIFICATION EBF0FF30

FUEL DELIVERY SYSTEM

Items	Specification	
Fuel Tank	Capacity	75 lit. (19.8 U.S.gal., 16.5 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 (㏀)
℃	°F	
-40	-40	100.87㏀
-20	-4	28.58㏀
0	32	9.40㏀
10	50	5.66㏀
20	68	3.51㏀
40	104	1.47㏀
60	140	0.67㏀
80	176	0.33㏀

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

▷ Type: Piezo-resistive pressure type
▷ Specification

Pressure (kPa)	Output Voltage (V)
20.0kPa	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	48.14 kΩ
-20	-4	14.13 ~ 16.83 kΩ
0	32	5.79 kΩ
20	68	2.31 ~ 2.59 kΩ
40	104	1.15 kΩ
60	140	0.59 kΩ
80	176	0.32 kΩ

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℃ (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	0.29 ~ 0.46V
W.O.T	3.85 ~ 4.35V	1.93 ~ 2.18V

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

Fuel System

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)
℃	˚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℃ (68˚F)

PURGE CONTROL SOLENOID VALVE (PCSV)

▷ Type: Duty control type
▷ Specification

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

VARIABLE INTAKE SOLENOID (VIS) VALVE

▷ Specification

Item	Specification
Coil Resistance (Ω)	30.0 ~ 35.0Ω [22℃ (71.6˚F)]

CVVT OIL CONTROL VALVE (OCV)

▷ Specification

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

ETC MOTOR

▷ Specification

Item	Specification
Coil Resistance (Ω)	1.275 ~ 1.725Ω at 20℃ (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 E752D6D5

Ignition Timing	BTDC 10˚ ± 5˚		
Idle Speed	A/CON OFF	Neutral,N,P-range	720 ± 100 rpm
		D-range	650 ± 100 rpm
	A/CON ON	Neutral,N,P-range	720 ± 100 rpm
		D-range	650 ± 100 rpm

TIGHTENING TORQUES ED7DA607

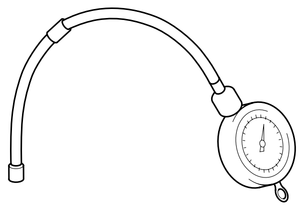
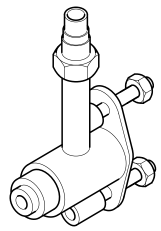
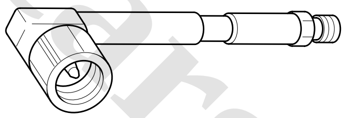
ENGINE CONTROL SYSTEM

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
Power steering pressure sensor installation bolt	0.7 ~ 1.1	6.9 ~ 10.8	5.1 ~ 8.0
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	1.3 ~ 1.6	12.8 ~ 15.7	9.4 ~ 11.6
Delivery pipe installation bolts	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7
Fuel sender installation bolts	0.2 ~ 0.3	2.0 ~2.9	1.4 ~ 2.2
2-Way & Fuel-Cut valve installation bolts	0.2 ~ 0.3	2.0 ~2.9	1.4 ~ 2.2

SPECIAL SERVICE TOOLS E05FA0E4

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

BASIC TROUBLESHOOTING GUIDE ECEDDF41

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	**Confirmation test**

14	**END**

LW8F1001

CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLE INFORMATION

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

2. SYMPTOMS

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

3. ENVIRONMENT

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

4. MIL/DTC

MIL (Malfunction Indicator Lamp)	☐ Remains ON ☐ Sometimes lights up ☐ Does not light
DTC	☐ Normal ☐ DTC (_____________________________________) ☐ Freeze Frame Data

BASIC INSPECTION PROCEDURE

MEASURING CONDITION OF ELECTRONIC PARTS' RESISTANCE

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

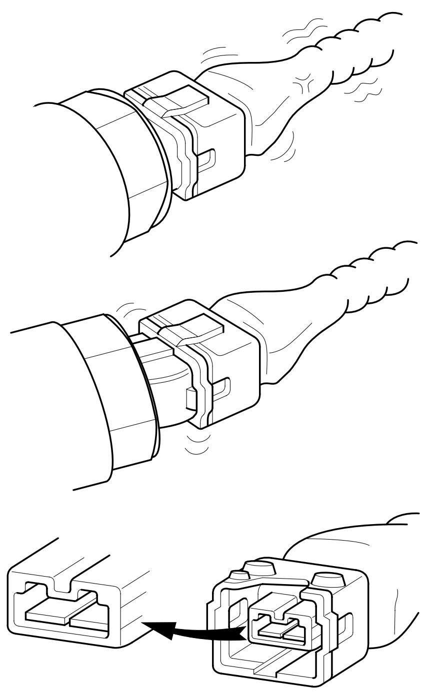
NOTE

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

INTERMITTENT PROBLEM INSPECTION PROCEDURE

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

WARNING

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

● SIMULATING WATER SPRINKLING

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

WARNING

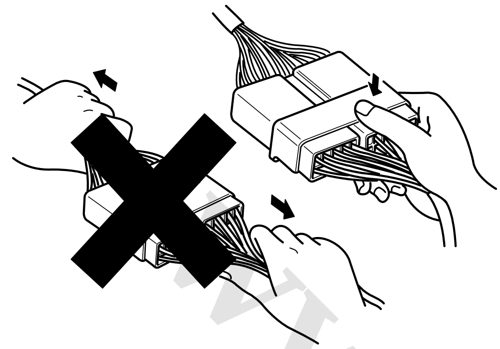
DO NOT sprinkle water directly into the engine compartment or electronic components.

● SIMULATING ELECTRICAL LOAD

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

CONNECTOR INSPECTION PROCEDURE

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



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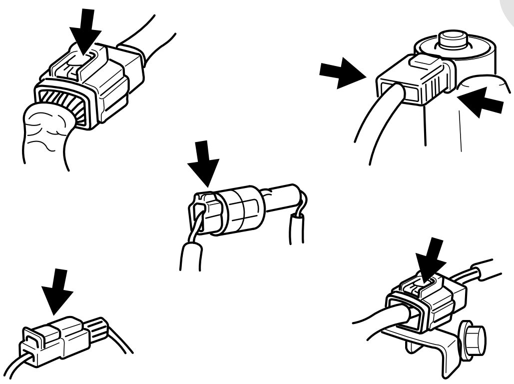
   b. When removing the connector with a lock, press or pull locking lever.



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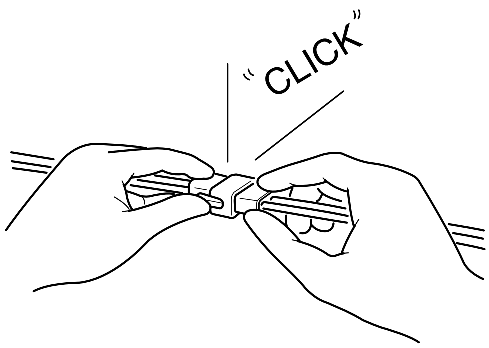
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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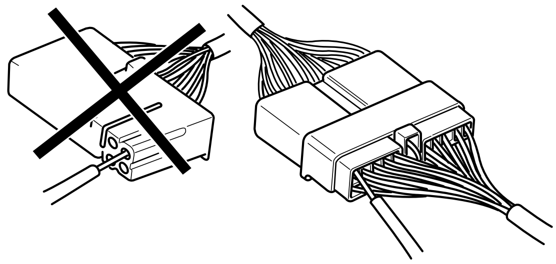
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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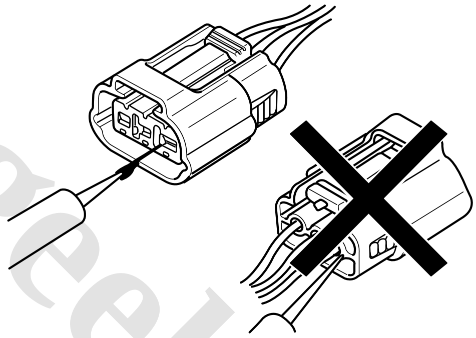
   e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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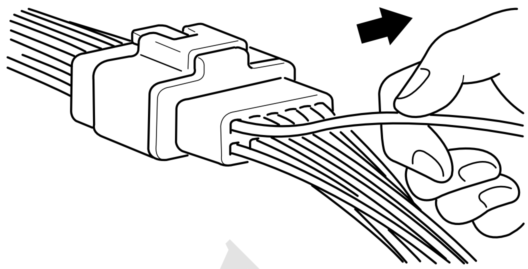
NOTE

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

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

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



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

NOTE

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

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

WIRE HARNESS INSPECTION PROCEDURE

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

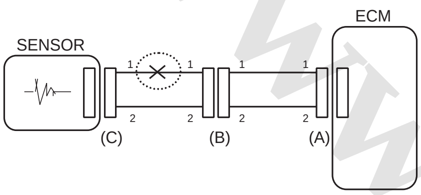
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

● CHECK OPEN CIRCUIT

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

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

FIG 1



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2. Continuity Check Method

   NOTE

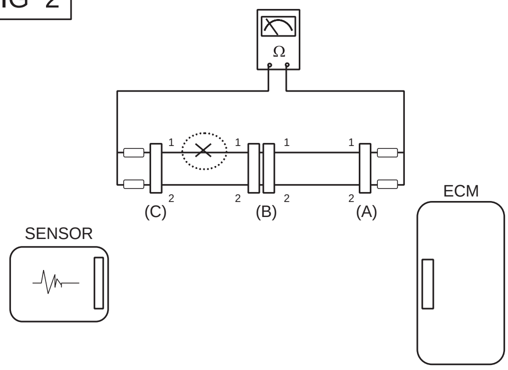
   When measuring for resistance, lightly shake the wire harness above and below or from side to side.

Specification (Resistance) 1Ω or less → Normal Circuit 1㏁ 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 1㏁ 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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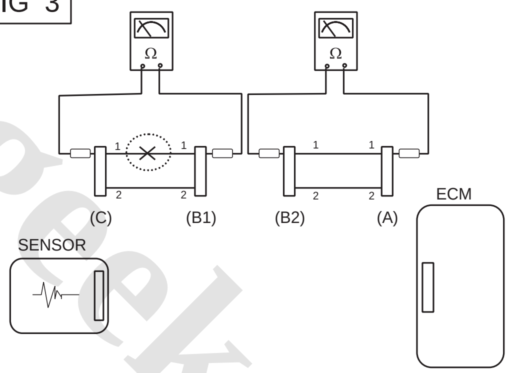
   b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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

FIG 3



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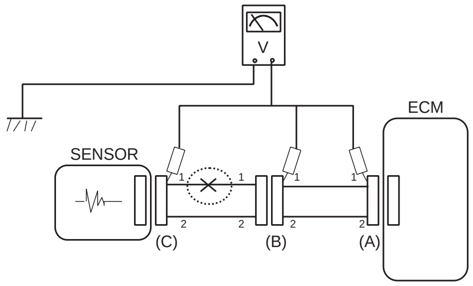
3. Voltage Check Method
   a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

      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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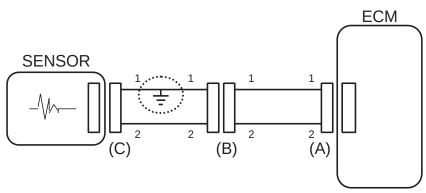
● **CHECK SHORT CIRCUIT**

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.

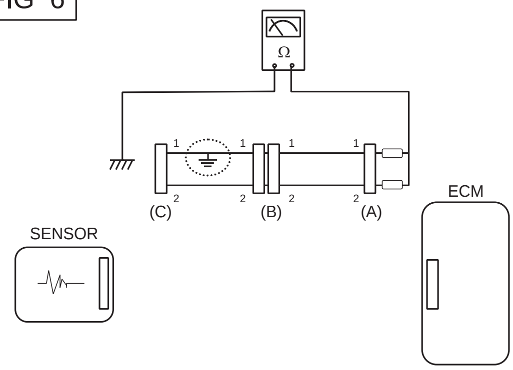
Specification (Resistance)
1Ω or less → Short to Ground Circuit
1MΩ or Higher → Normal Circuit

---

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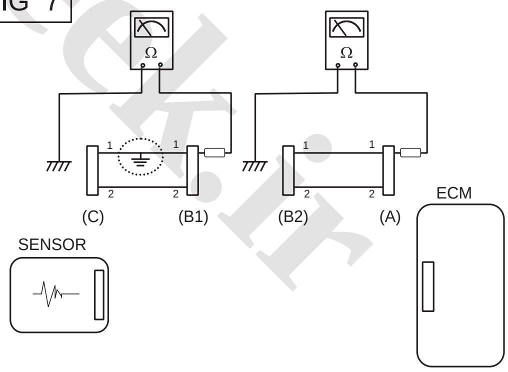
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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. Inspect the fuel filler hose/pipe • Pinched, kinked or blocked? • Filler hose is torn 2. Inspect the fuel tank vapor vent hose between the EVAP. canister and air filter 3. 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 EF1A8F98

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.

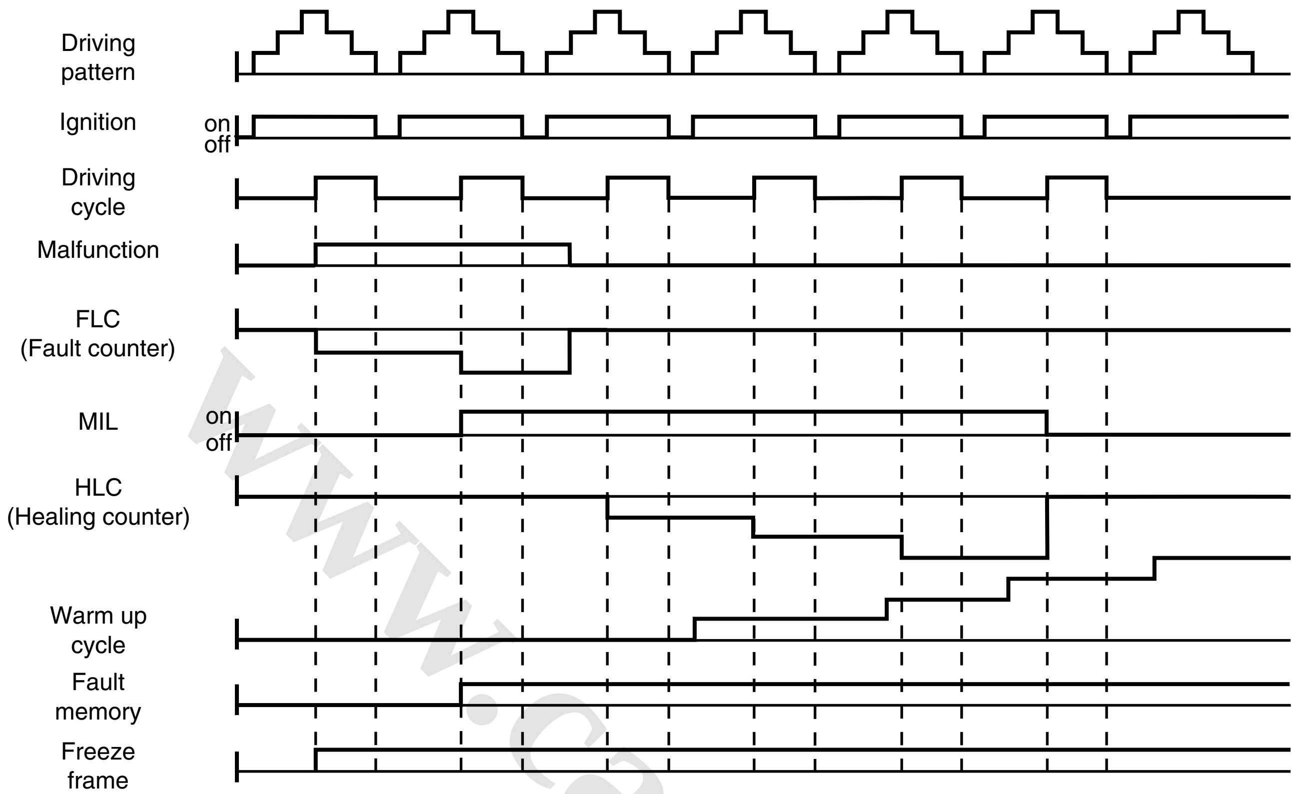
SELF-DIAGNOSIS

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.

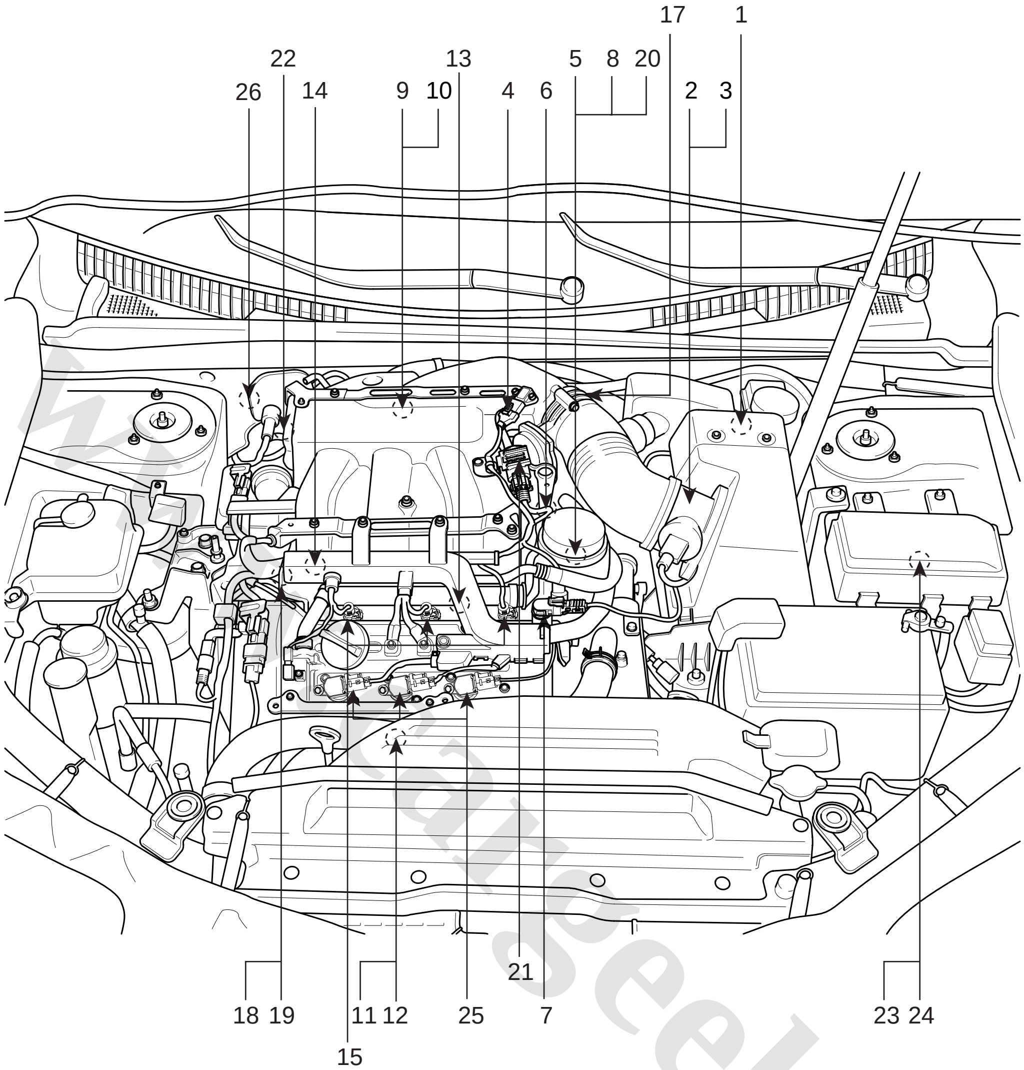
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction is detected after two sequential driving cycles. The MIL will illuminate when the malfunction is detected on the second driving cycle.
If a misfire is detected, a DTC will be recorded, and the MIL will illuminate, immediately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

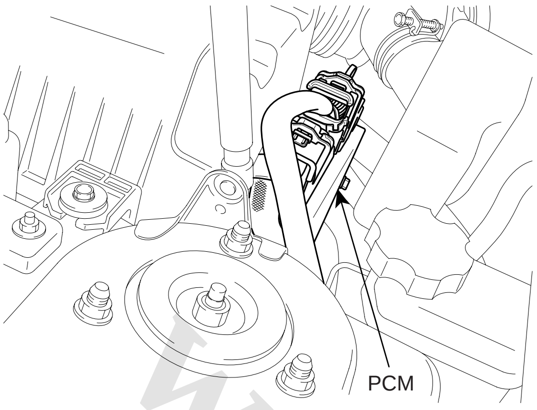
COMPONENT LOCATION E88A1C1A



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. Wheel Speed Sensor (WSS)
    [Without ABS/ESP (Euro-Ⅲ/Ⅳ & JAPAN)]
28. Vehicle Speed Sensor (VSS)
    [Except Euro-Ⅲ/Ⅳ & JAPAN]
29. Data Link Connector (DLC)

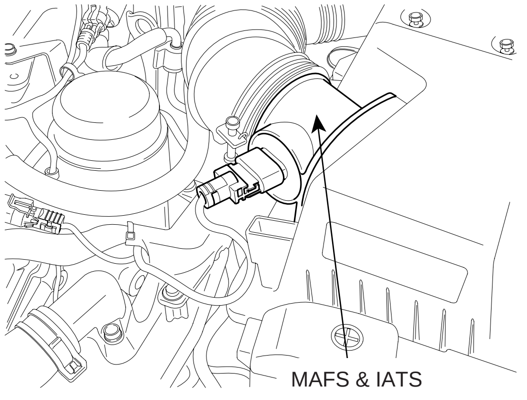
EFBF300A

1. PCM (Powertrain Control Module)



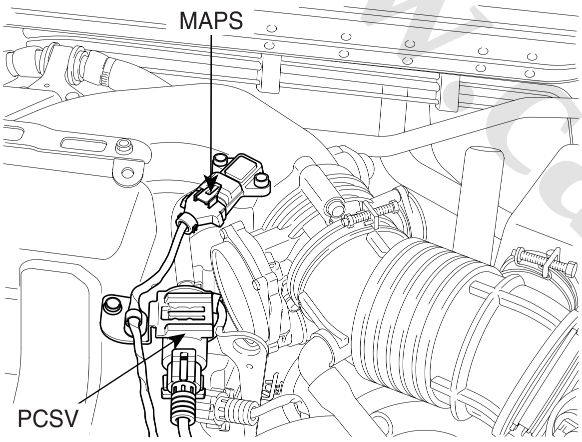
KFBF286A

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



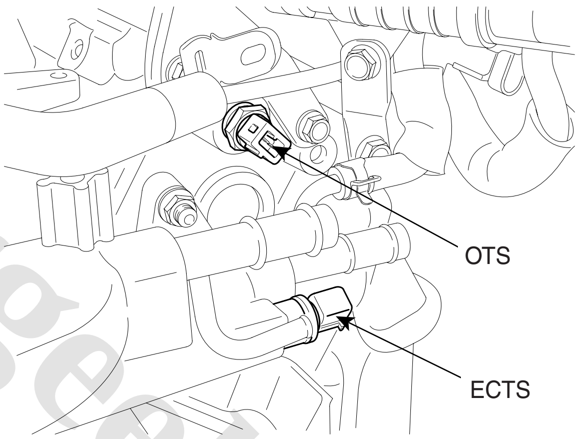
KFBF287A

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



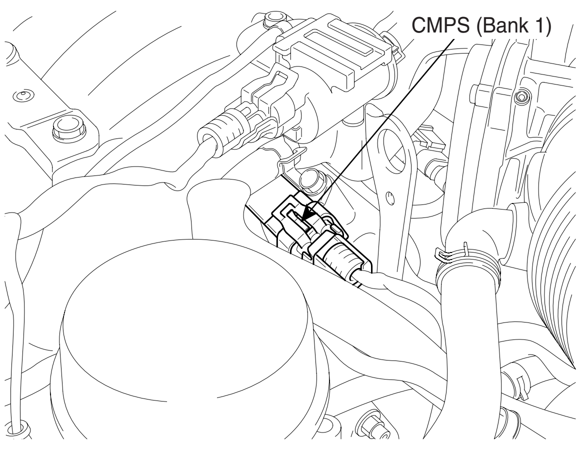
KFCF101C

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



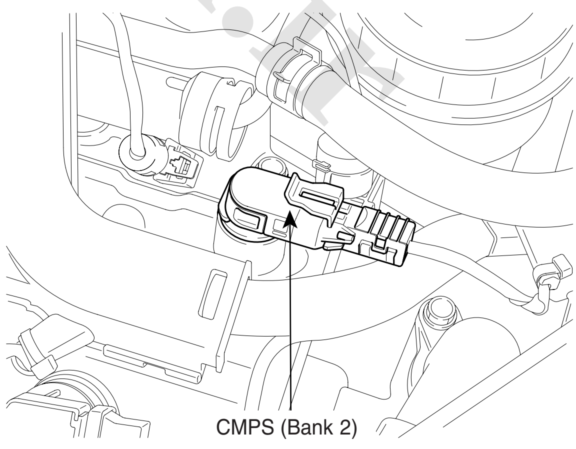
KFCF101D

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



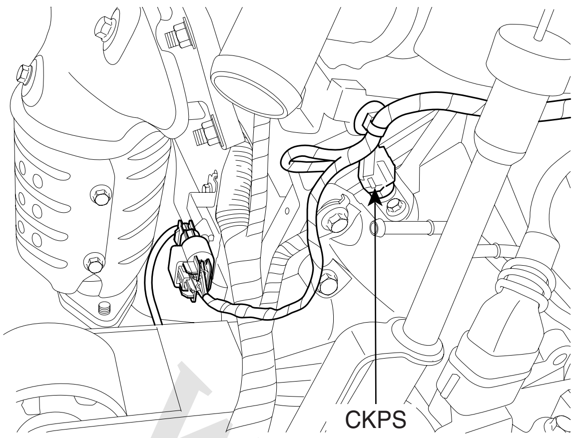
EGRF204A

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



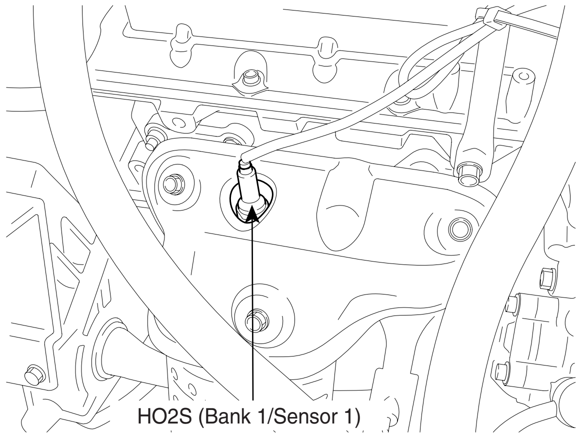
EGRF205A

8. Crankshaft Position Sensor (CKPS)



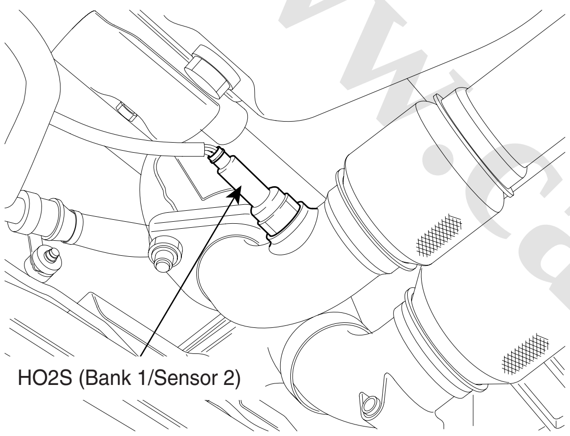
KFCF101G

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



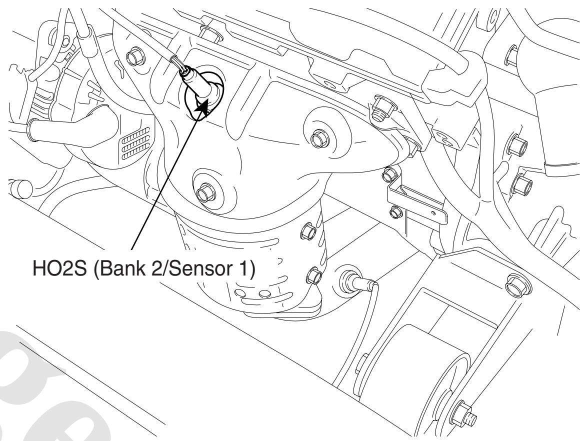
EGRF207A

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



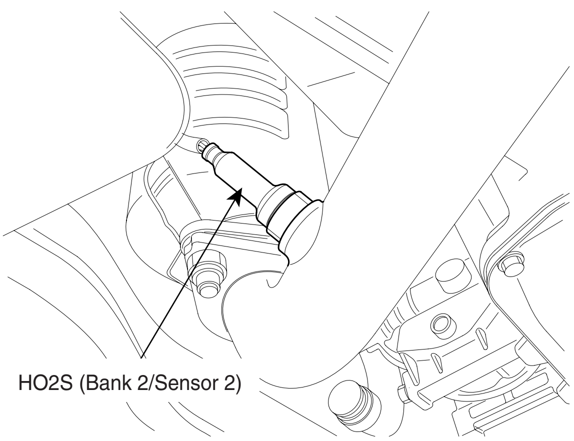
EGRF208A

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



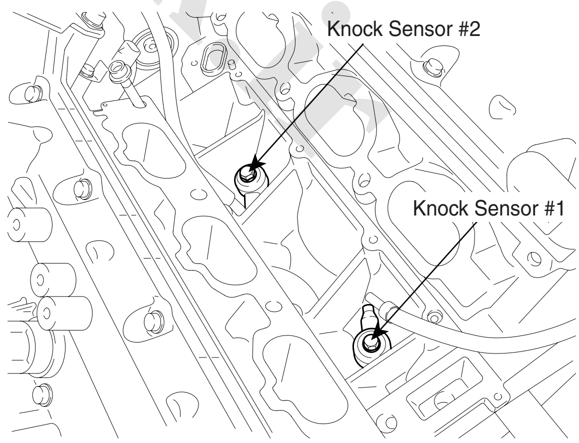
EGRF209A

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



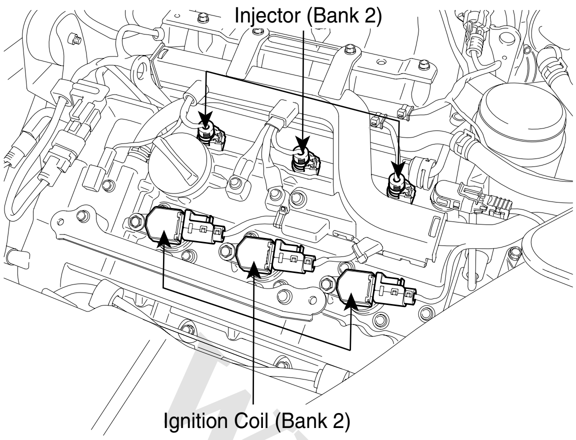
EGRF210A

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



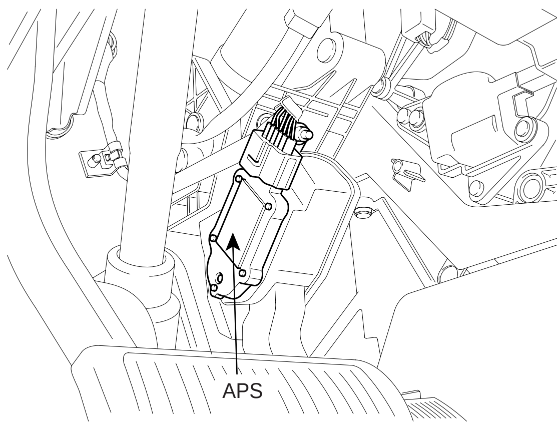
EGRF211A

15. Injector
25. Ignition Coil



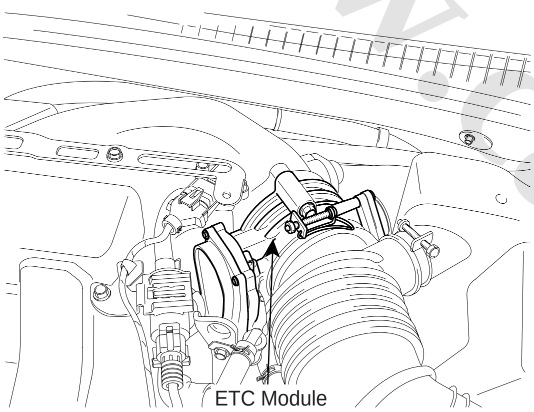
EGRF212A

16. Accelerator Position Sensor (APS)



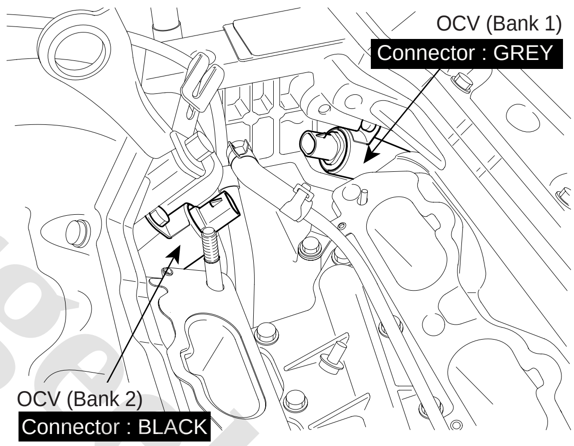
KFBF288A

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



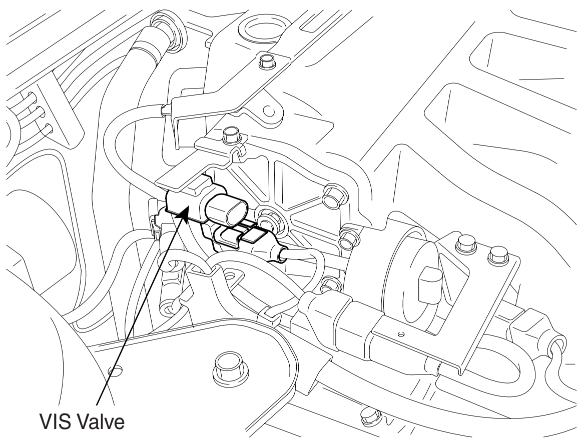
EFBF289A

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



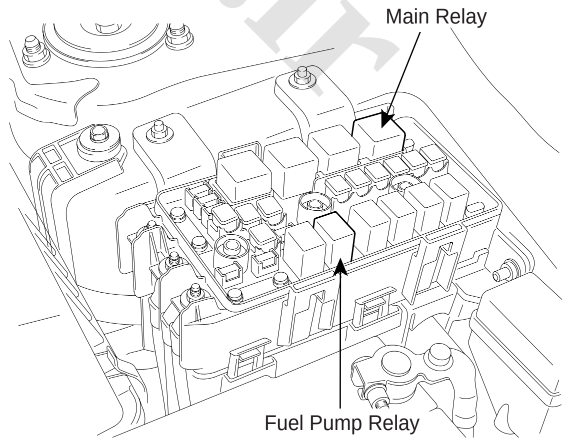
EGRF215A

22. Variable Intake Solenoid (VIS) Valve

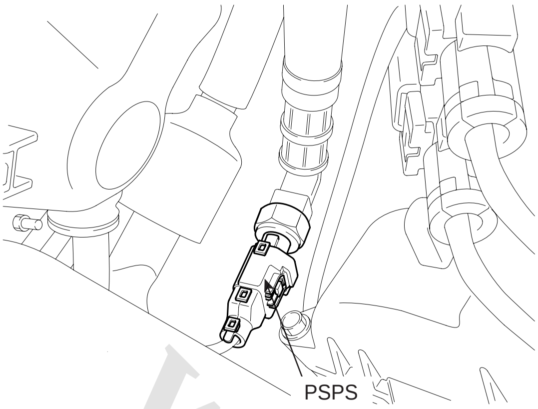
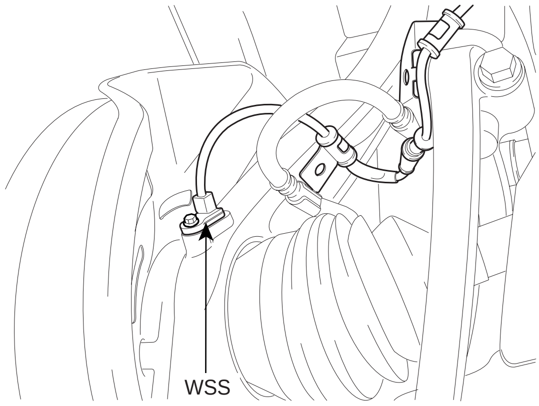
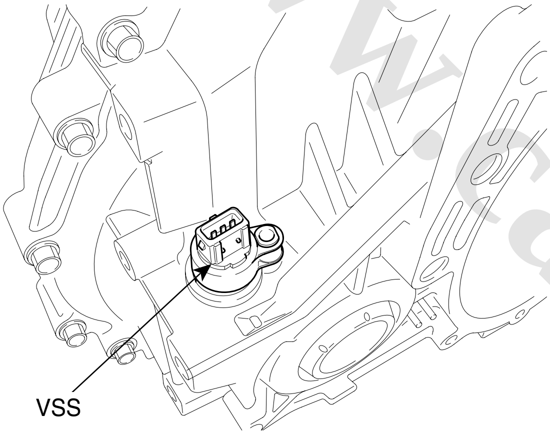
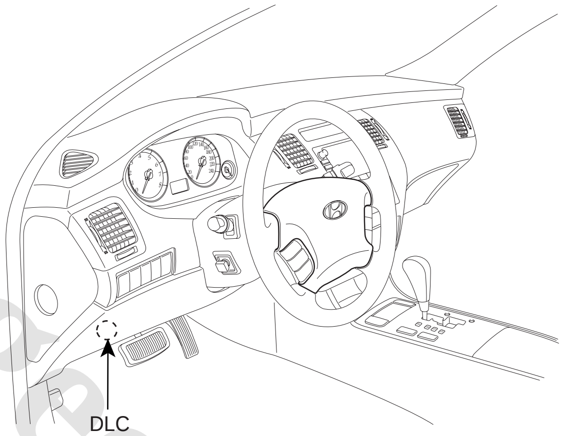
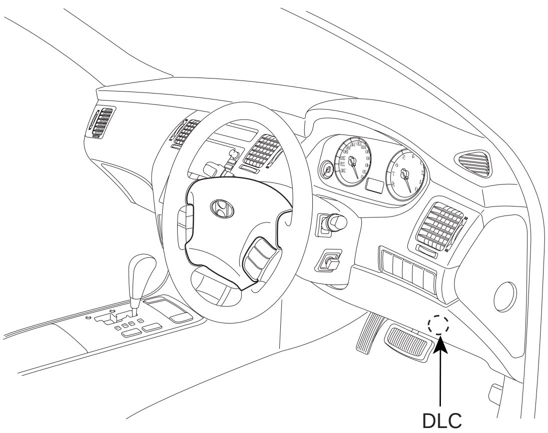


EGRF216A

23. Fuel Pump Relay
24. Main Relay



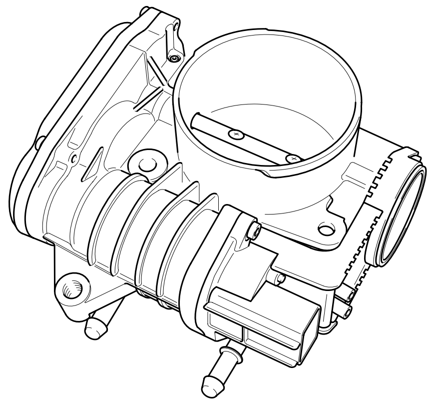
EFBF290A

26. Power Steering Pressure Sensor (PSPS)	27. Wheel Speed Sensor (WSS)
 KFBF291A	 EFBF503Q
28. Vehicle Speed Sensor (VSS)	29. Data Link Connector (DLC)
 KFCF101T	[LHD]  EFBF503R
29. Data Link Connector (DLC)	
[RHD]  EFBF503S	

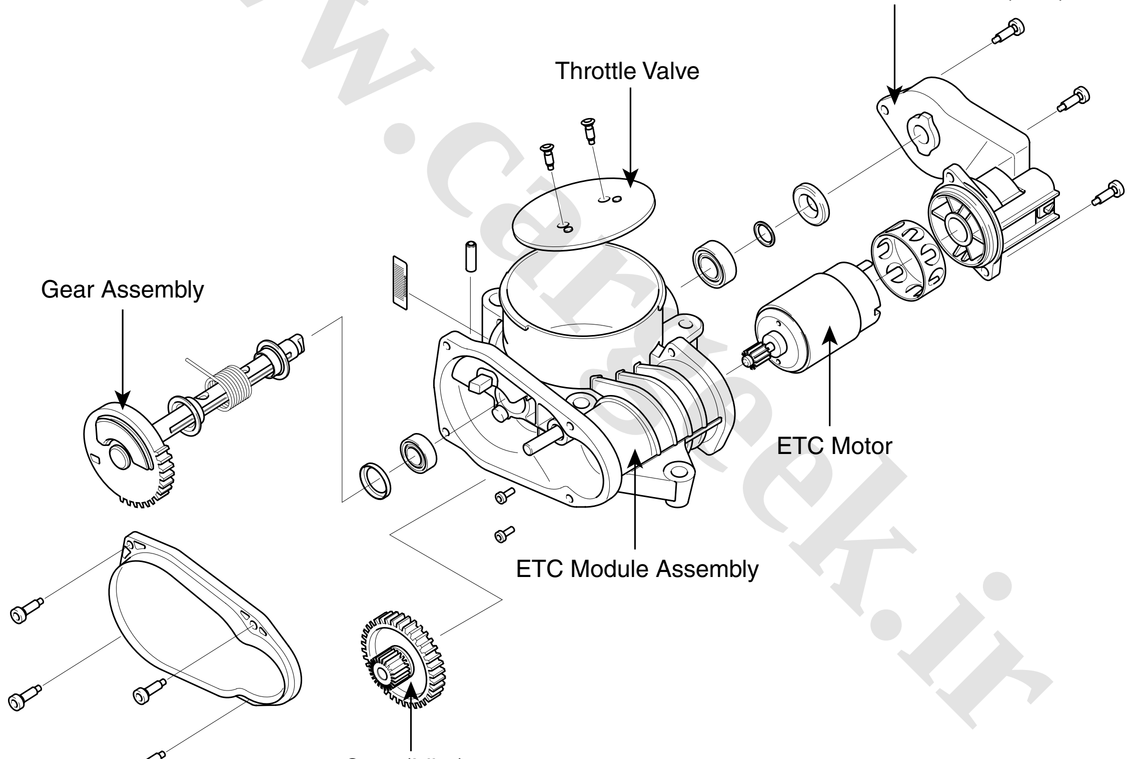
ETC (ELECTRIC THROTTLE CONTROL) SYSTEM

DESCRIPTION E0D0B65C

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

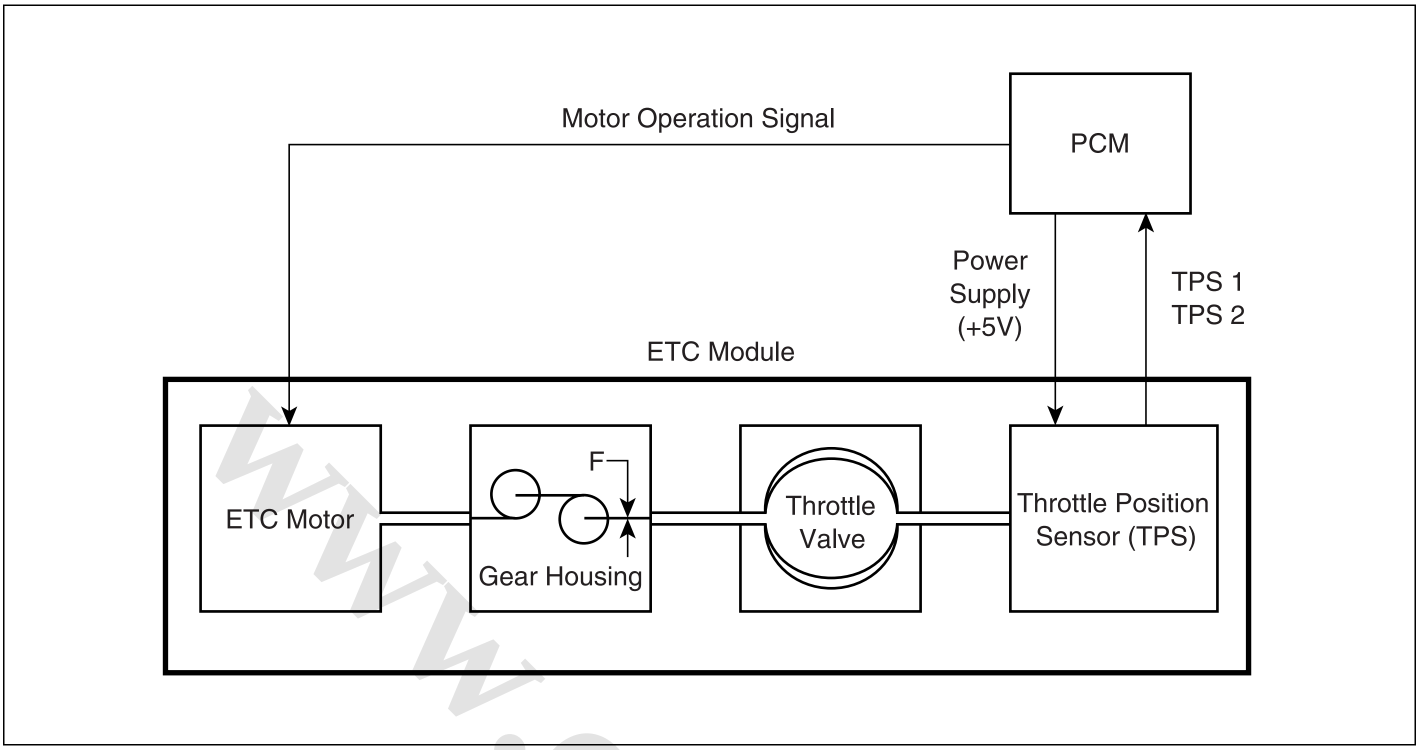


KFCF1020



EGRF233A

COMPONENTS



EGRF234A

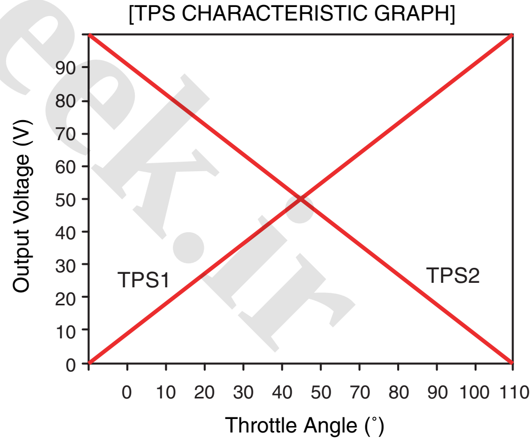
SPECIFICATION

[THROTTLE POSITION SENSOR]

Throttle Angle(˚)	Output Voltage(V) [Vref = 5.0V]	
	TPS1	**TPS2**
0˚	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℃ (68˚F)
TPS2	2.72 ~ 4.08kΩ at 20℃ (68˚F)

[TPS CHARACTERISTIC GRAPH]



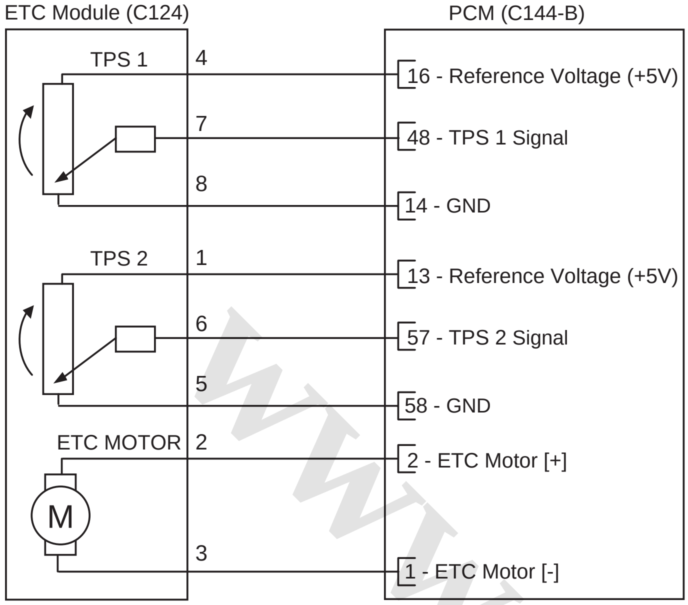
EGRF235A

[ETC MOTOR]

Item	Sensor Resistance
Coil Resistance (Ω)	1.275 ~ 1.725Ω at 20℃ (68˚F)

SCHEMATIC DIAGRAM

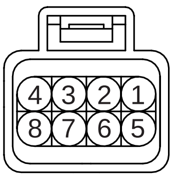
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

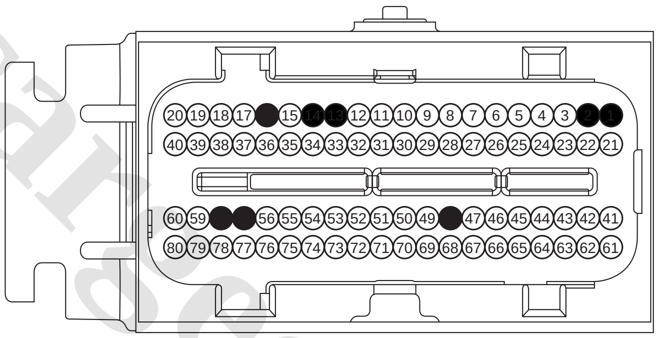
Terminal	Connected to	Funtion
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144- B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM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

[HARNESS CONNECTORS]



C124

ETC MODULE



C144-B

PCM

EFBF236A

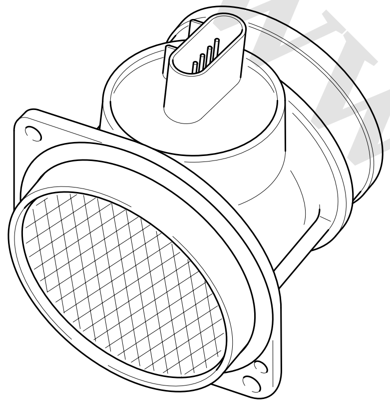
FAIL-SAFE MODE

Mode	Description	Symptom	Possible Cause
MODE 1	FORCED ENGINE SHUTDOWN	Engine stop	• ETC system can't proceed reliable algorithm procedure - Fatal PCM internal programming error - Faulty intake system or throttle body
MODE 2	FORCED IDLE & POWER MANAGEMENT	Forced idle state controlled by fuel quantity regulation and ignition timing adjustment	• ETC system can't control engine power via throttle device • Disabled throttle control or broken throttle position information
MODE 3	FORCED IDLE	Forced idle state and no response for accelerator activation	• No information about the accelerator position - Broken APS 1 and 2, faulty A/D converter or internal controller
MODE 4	LIMIT PERFORMANCE & POWER MANAGEMENT	Engine power is determined by accelerator position and idle power requirement (Limited vehicle running)	• ETC system can't securely control engine power
MODE 5	LIMIT PERFORMANCE	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 E21C899E

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.



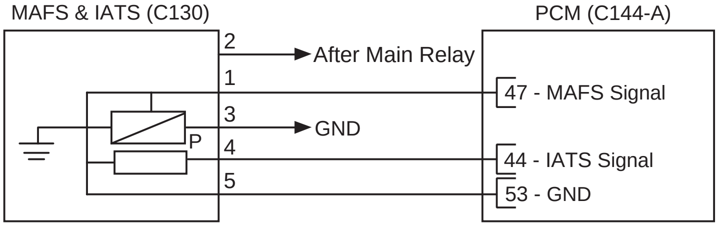
KFCF1021

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

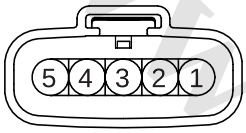
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

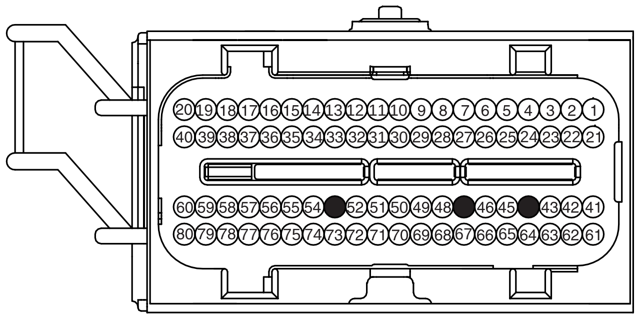
Terminal	Connected to	Funtion
1	PCM C144-A (47)	MAFS Signal
2	Main Relay	Battery Voltage (B+)
3	Chassis Ground	Ground
4	PCM C144-A (44)	IATS Signal
5	PCM C144-A (53)	Sensor Ground

[HARNESS CONNECTORS]



C130

MAFS & IATS



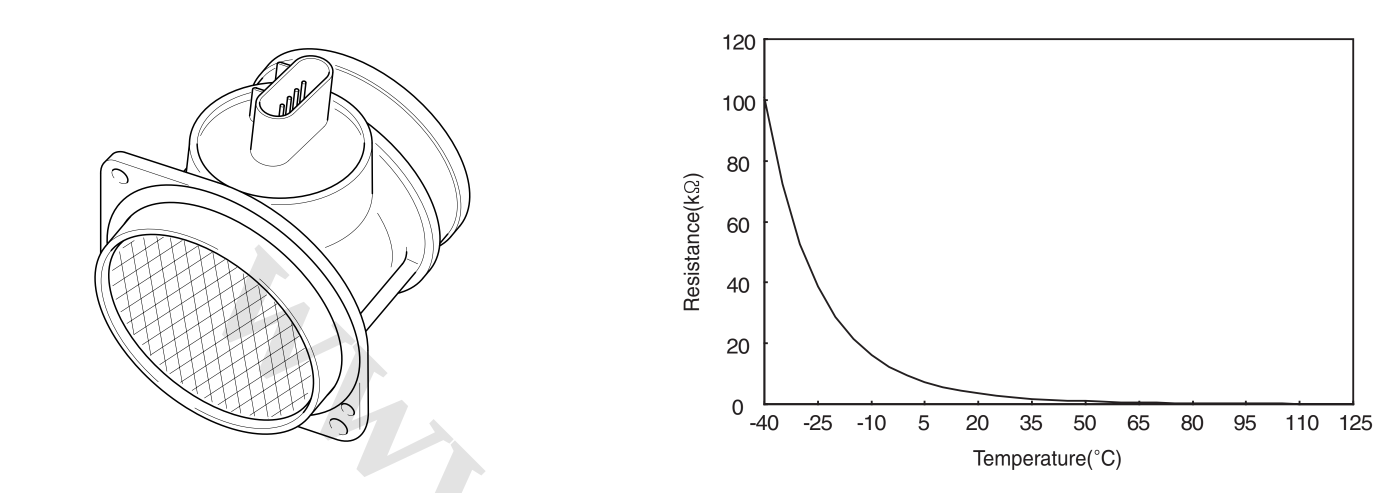
C144-A

PCM

EFBF237A

INTAKE AIR TEMPERATURE SENSOR (IATS)

DESCRIPTION E892F016



EGRF238A

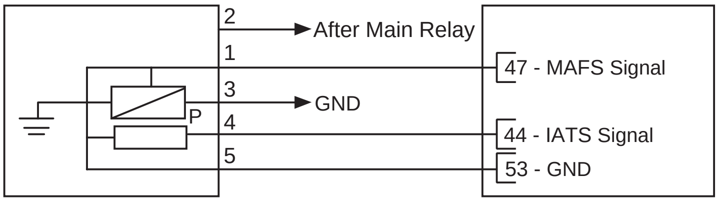
Intake Air Temperature Sensor (IATS) is installed inside the Mass Air Flow Sensor (MAFS) and detects the intake air temperature. To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the PCM uses not only MAFS signal 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	100.87kΩ
-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

SCHEMATIC DIAGRAM

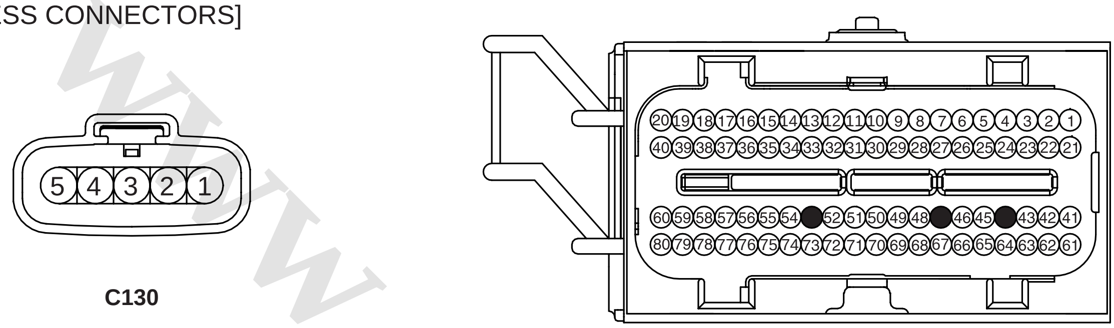
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Funtion
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

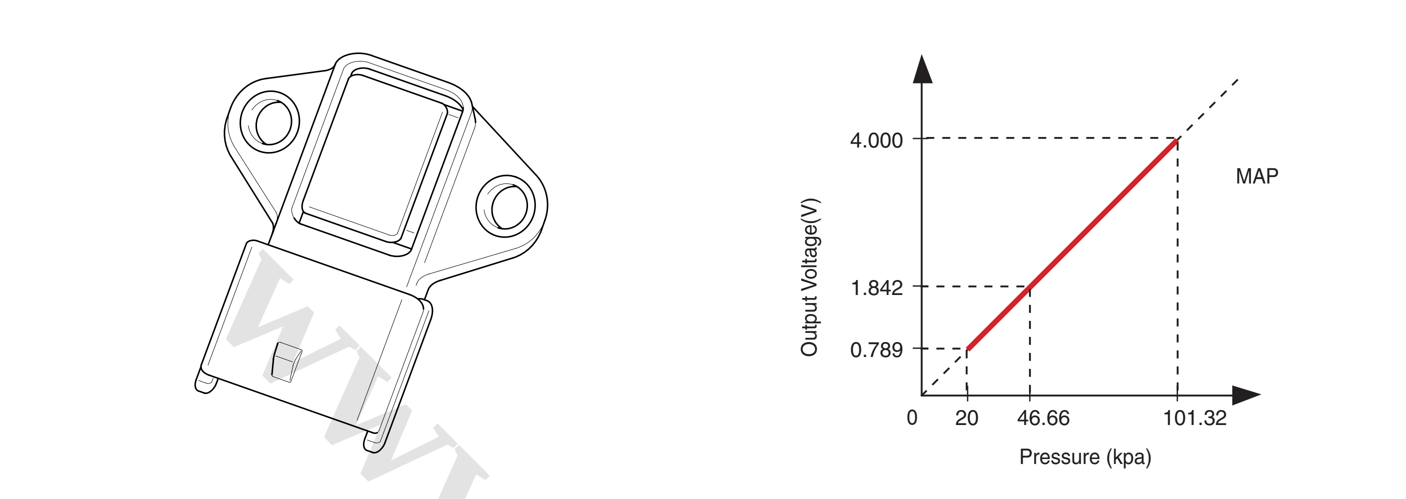
C144-A

PCM

EFBF237A

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

DESCRIPTION E4409782



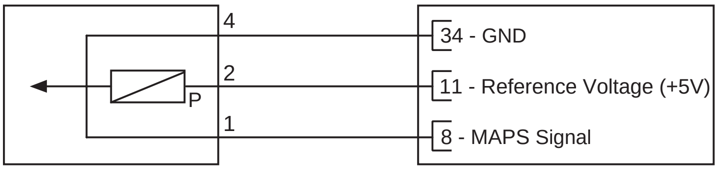
EGRF239A

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

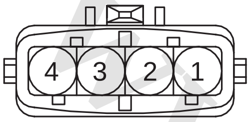
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

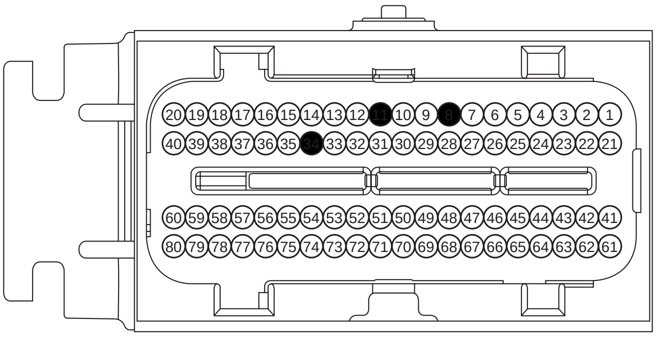
Terminal	Connected to	Funtion
1	PCM C144-B (8)	MAPS Signal
2	PCM C144-B (11)	Reference Voltage (+5V)
3	-	-
4	PCM C144-B (34)	Sensor ground

[HARNESS CONNECTORS]



C117

MAPS



C144-B

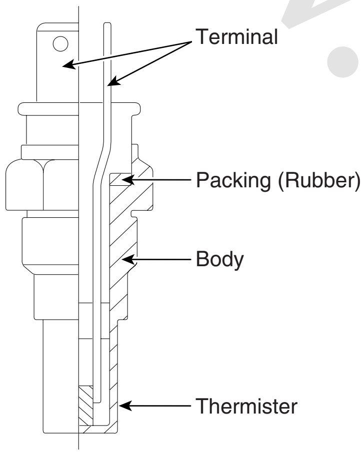
PCM

EFBF240A

ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

DESCRIPTION E6D353D8

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



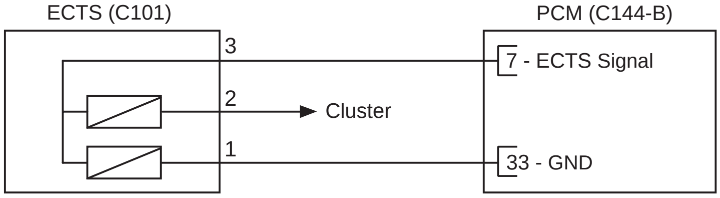
EGRF241A

SPECIFICATION

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

SCHEMATIC DIAGRAM

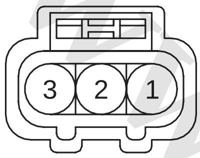
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

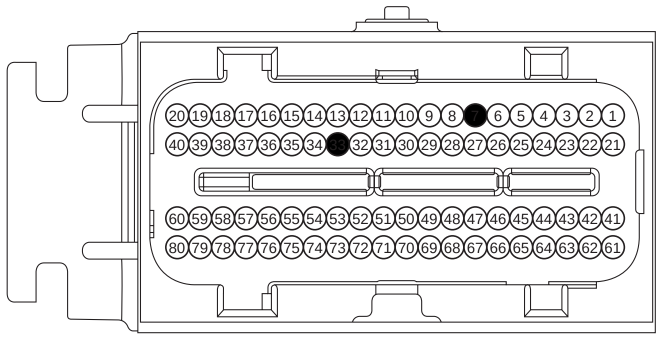
Terminal	Connected to	Funtion
1	PCM C144-B (33)	Sensor ground
2	Cluster	-
3	PCM C144-B (7)	ECTS Signal

[HARNESS CONNECTORS]



C101

ECTS



C144-B

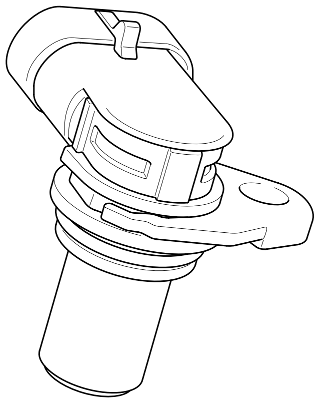
PCM

EFBF242A

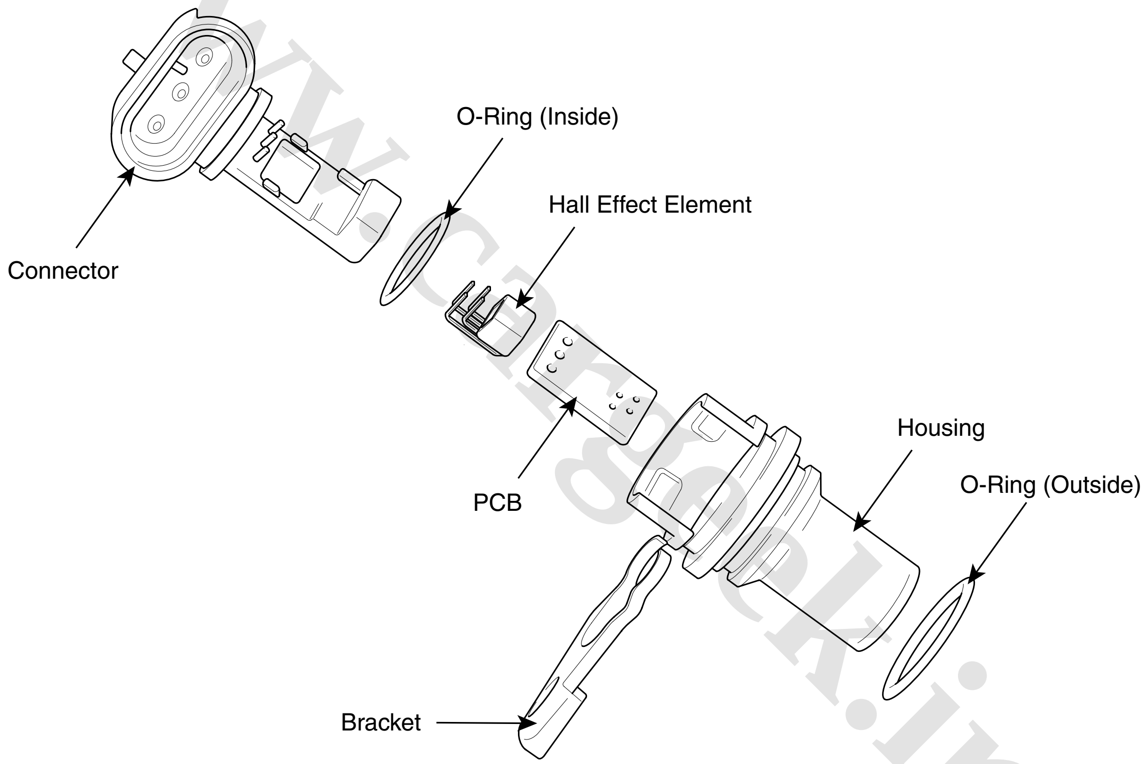
CAMSHAFT POSITION SENSOR (CMPS)

DESCRIPTION E757C28E

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

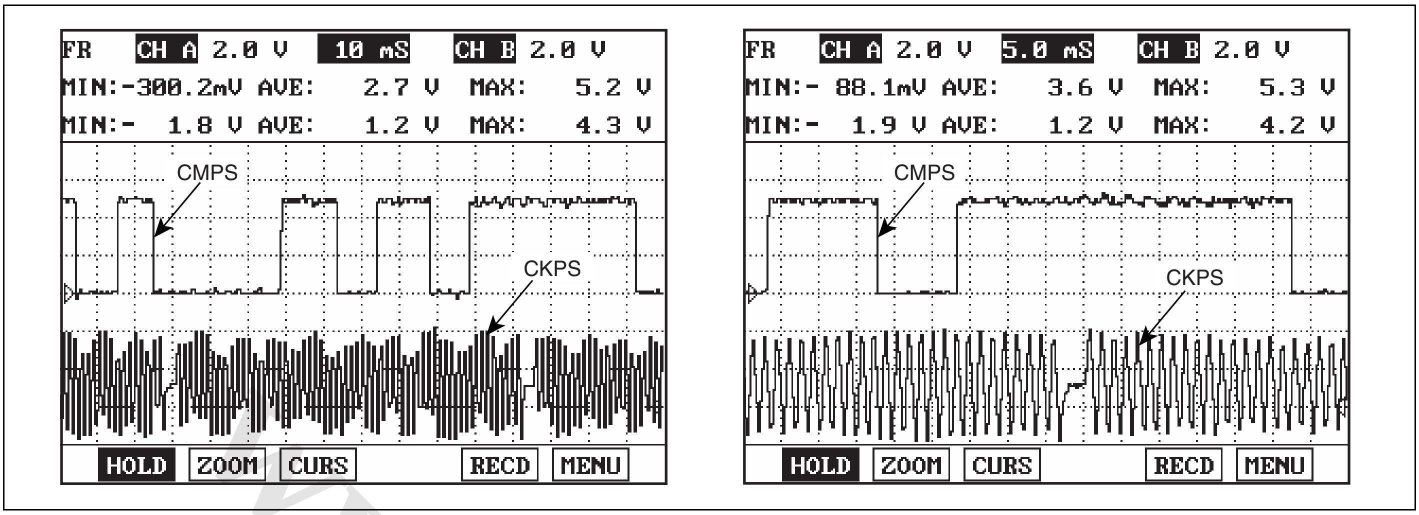


KFCF1022



EGRF243A

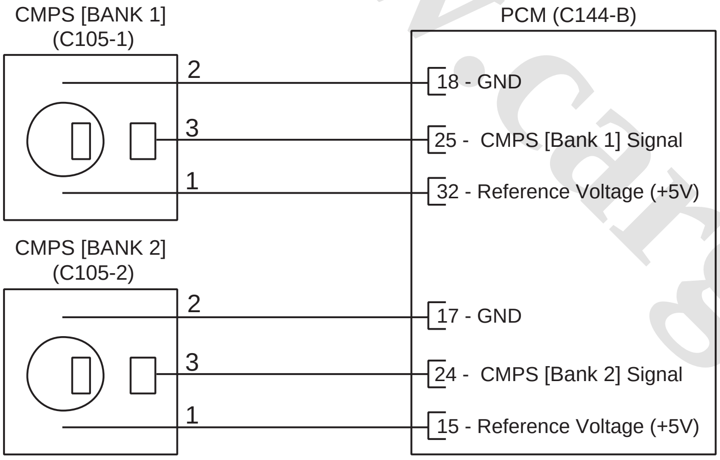
WAVEFORM



KFCF102M

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

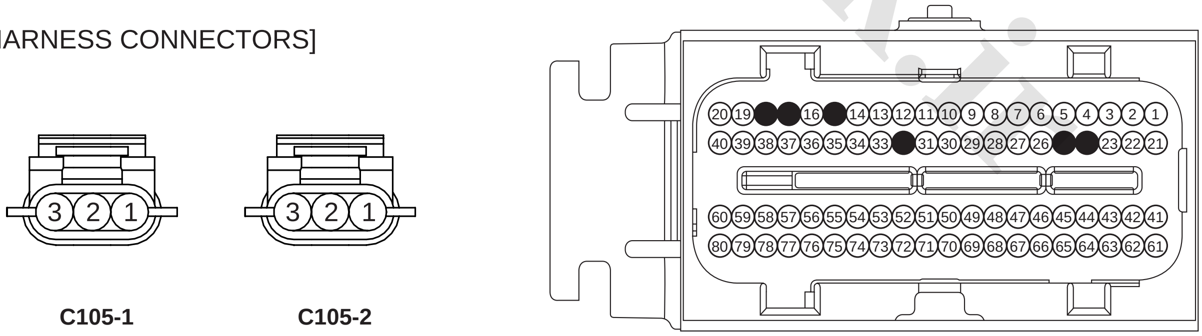
CMPS [BANK 1]

Terminal	Connected to	Funtion
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	Funtion
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

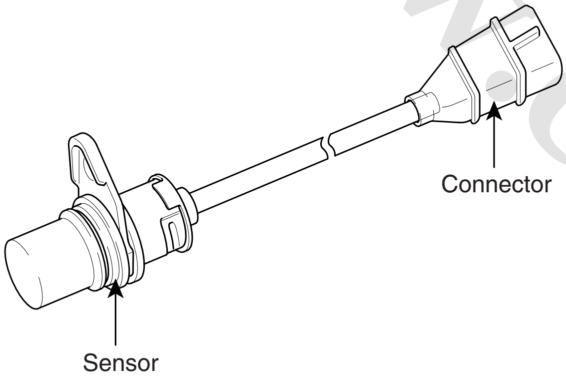
PCM

EFBF244A

CRANKSHAFT POSITION SENSOR (CKPS)

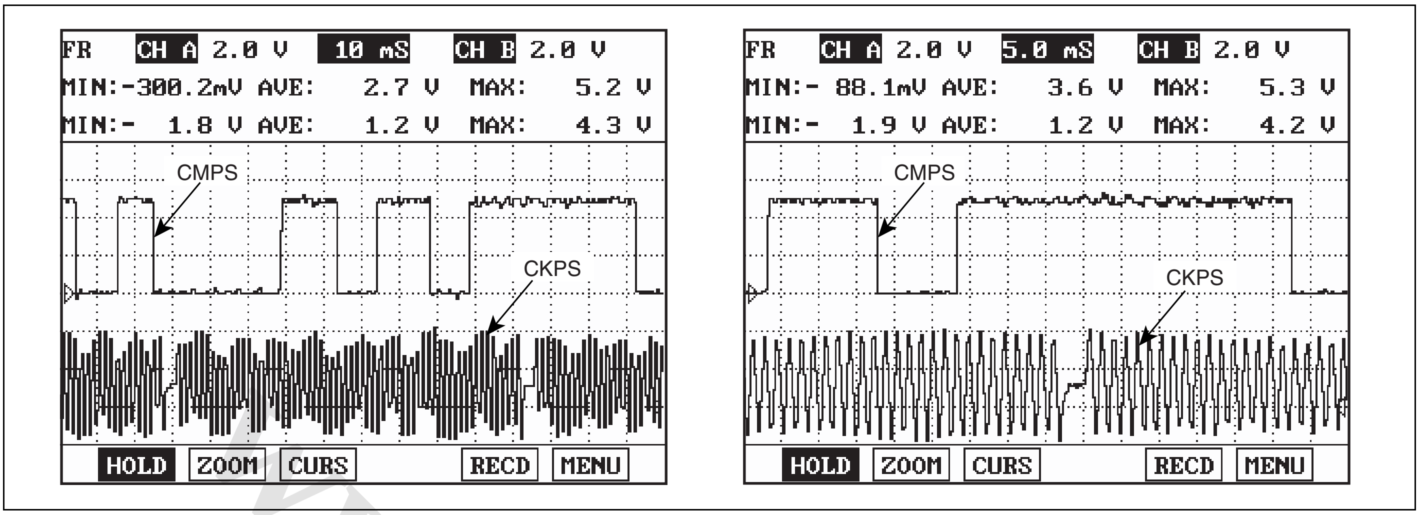
DESCRIPTION EBED26E7

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 operates. That is, vehicle can't run without CKPS signal. This sensor is installed on transaxle housing and generates alternating current by magnetic flux field which is made by the sensor and the target wheel when engine runs. The magnetic flux increases when the protrusion of the target wheel is getting near to the sensor and does not change in the most close position. When the protrusion becomes estranged from the sensor, magnetic flux disappears and alternating current is generated. The target wheel consists of 58 slots and 2 missing slots on 360 CA (Crank Angle).



EGRF245A

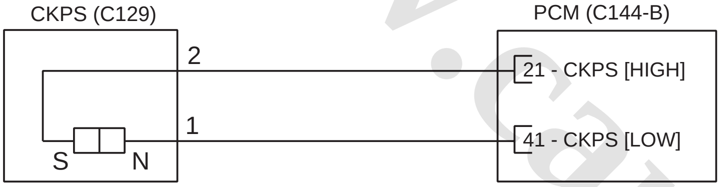
WAVEFORM



KFCF102M

SCHEMATIC DIAGRAM

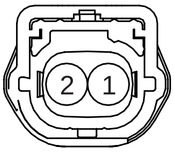
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

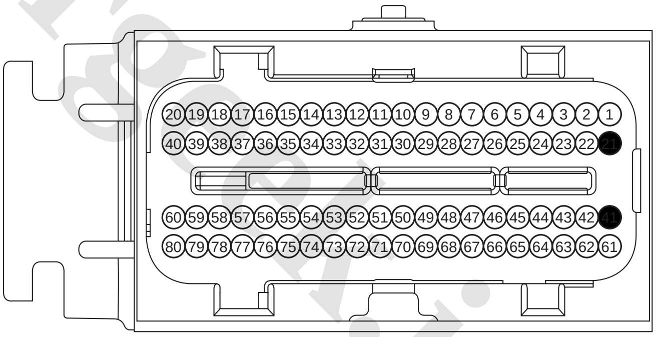
Terminal	Connected to	Funtion
1	PCM C144-B (41)	CKPS [LOW] Signal
2	PCM C144-B (21)	CKPS [HIGH] Signal

[HARNESS CONNECTORS]



C129

CKPS



C144-B

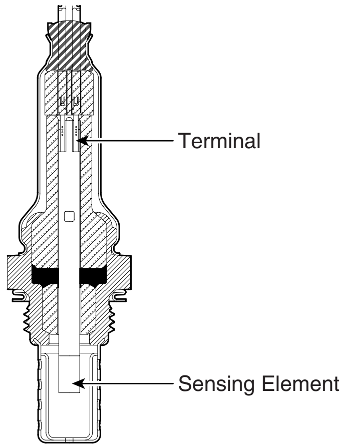
PCM

EFBF246A

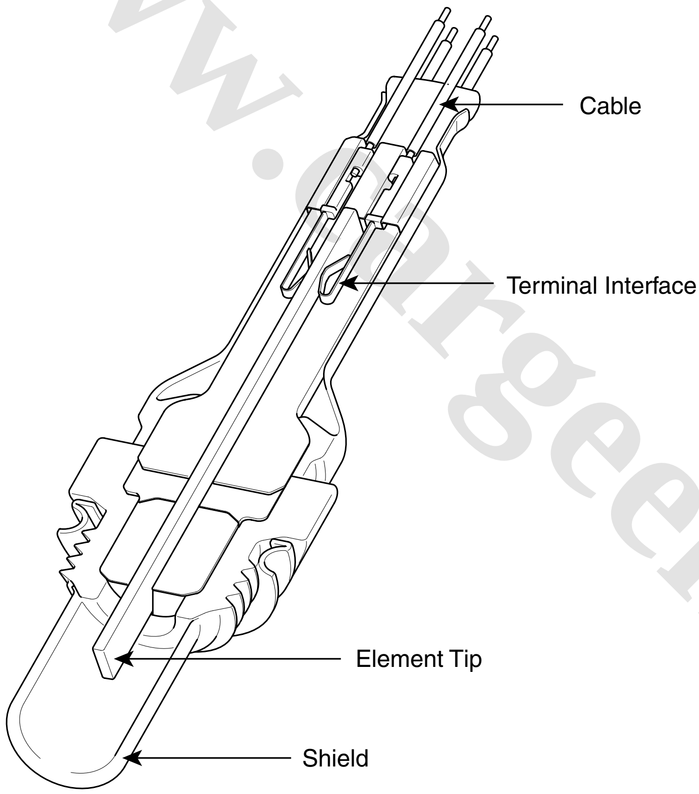
HEATED OXYGEN SENSOR (HO2S)

DESCRIPTION E1FB85A9

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



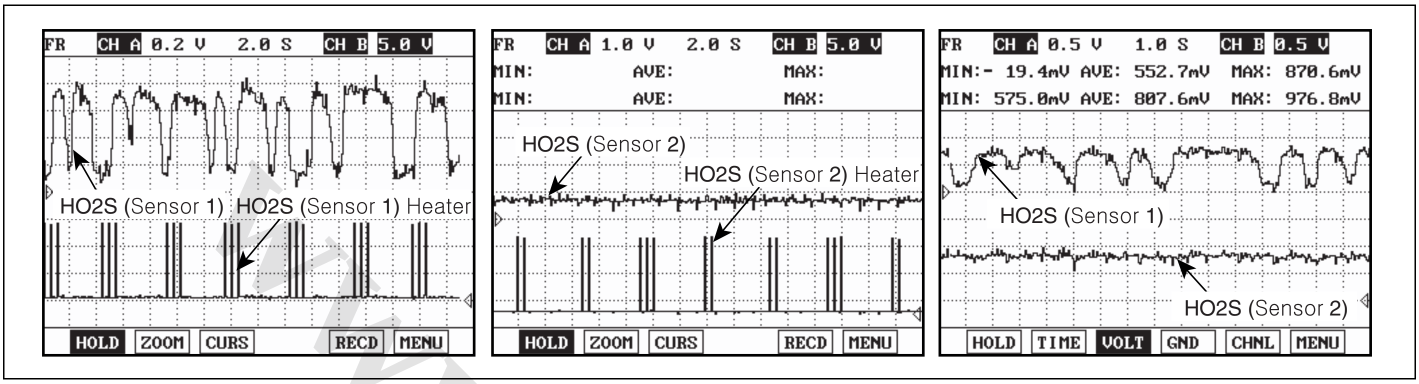
EGRF248A

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)

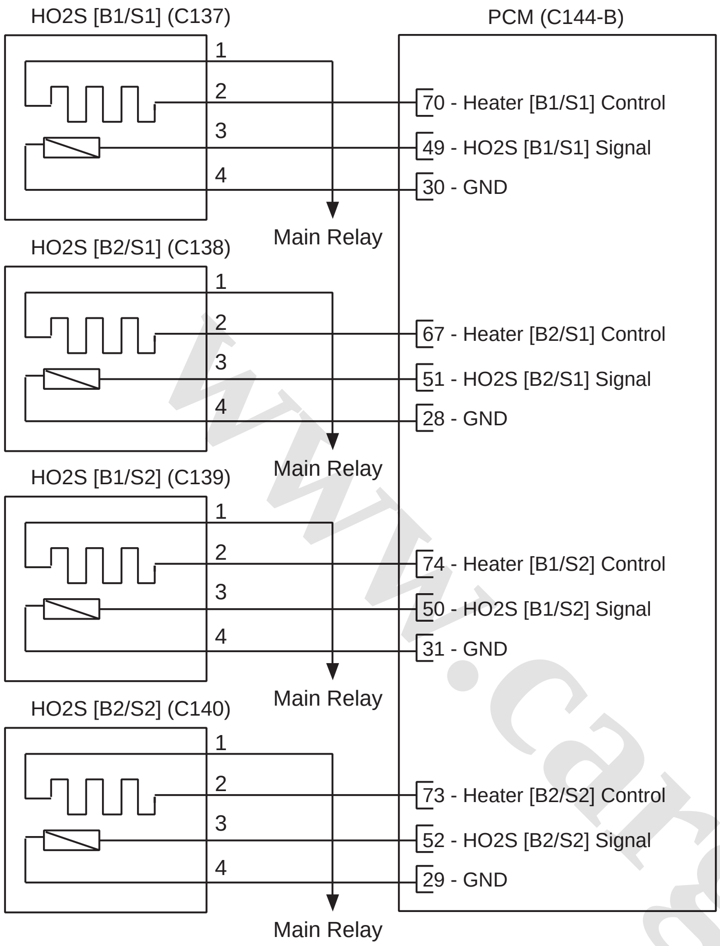
WAVEFORM



EGRF249A

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

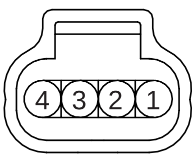
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

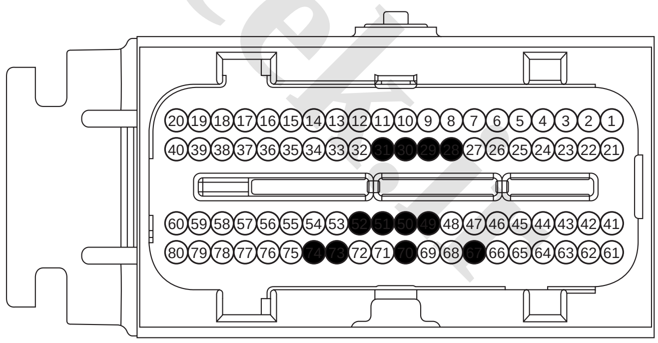
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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

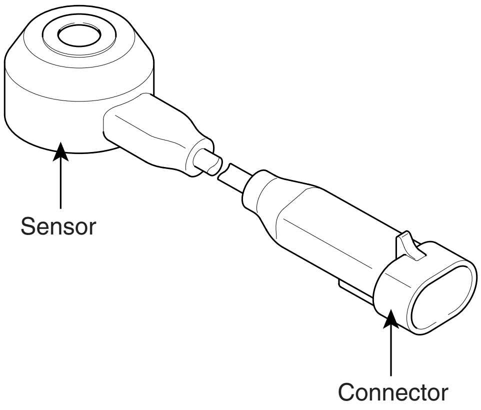
PCM

EFBF250A

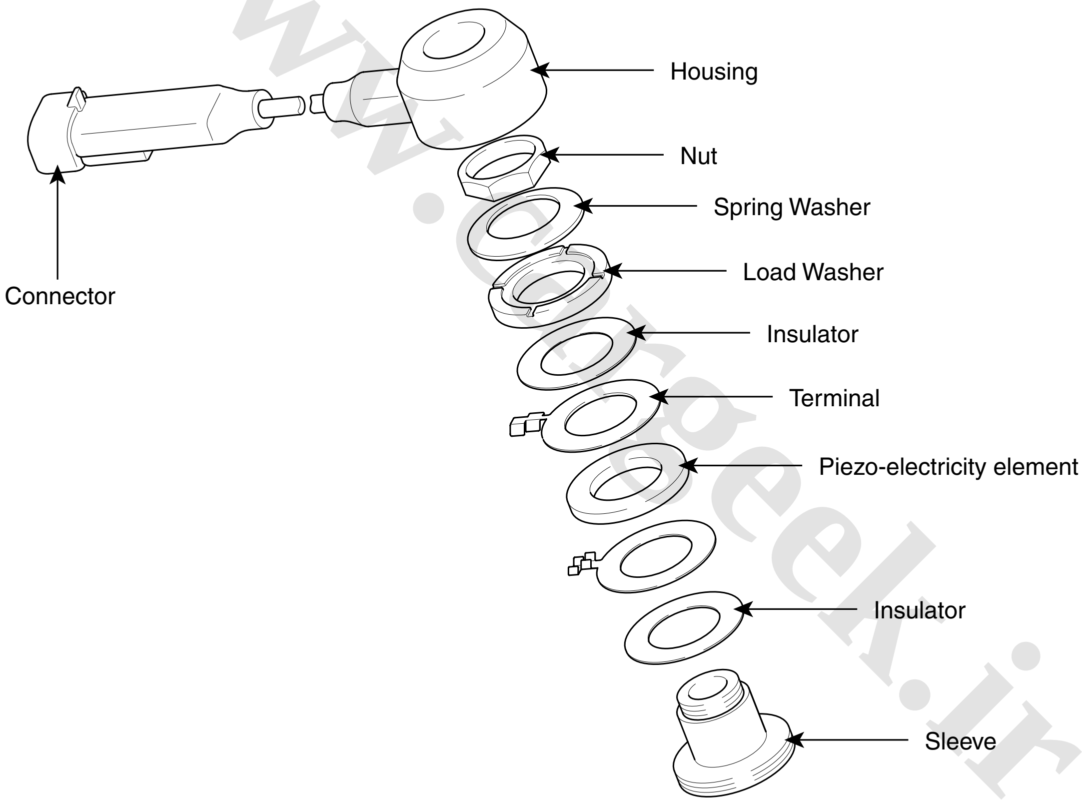
KNOCK SENSOR (KS)

DESCRIPTION EFC059BD

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



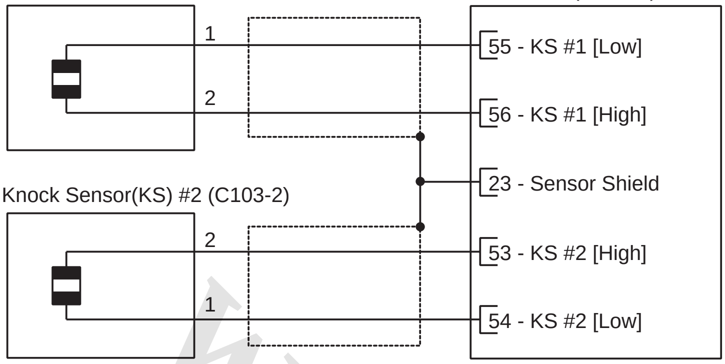
EGRF252A

SPECIFICATION

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

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

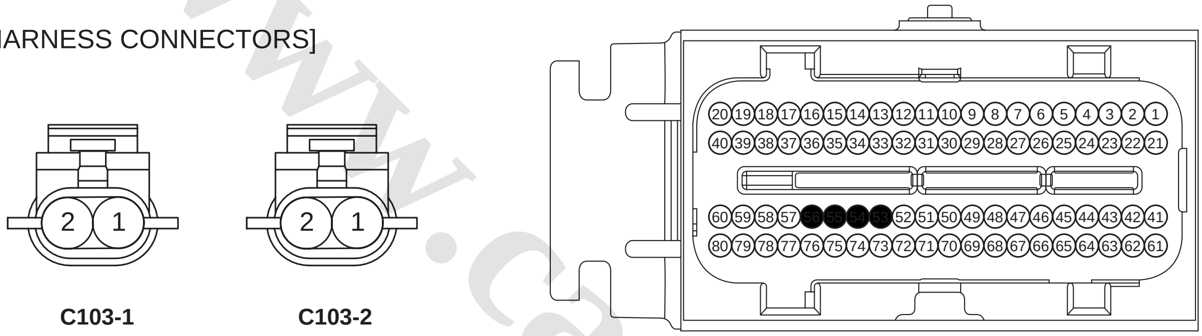
KS #1 (Cyl. #4,5,6)

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

KS #2 (Cyl. #1,2,3)

Terminal	Connected to	Funtion
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

EFBF253A

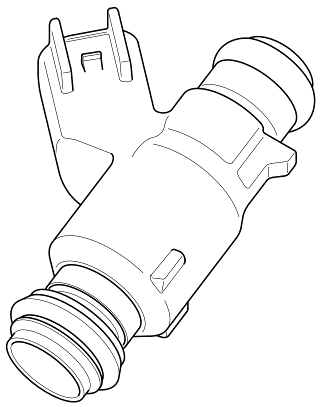
INJECTOR

DESCRIPTION E19AB14D

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.



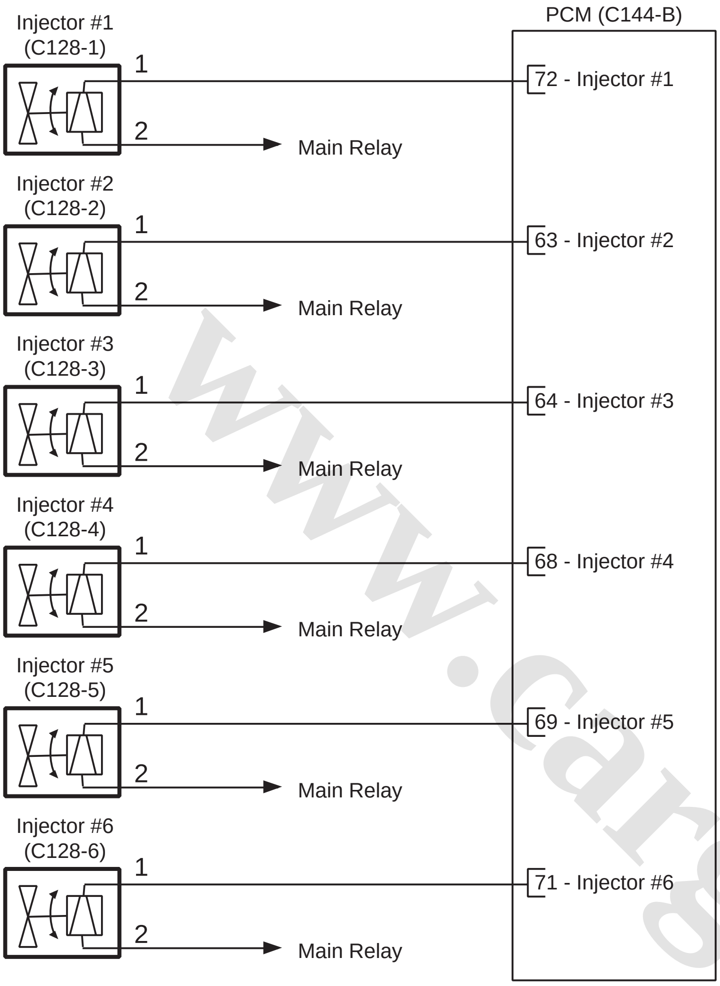
KFCF1026

SPECIFICATION

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

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1

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

Injector #2

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

Injector #3

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

Injector #4

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

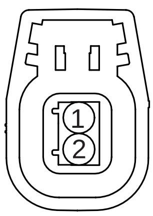
Injector #5

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

Injector #6

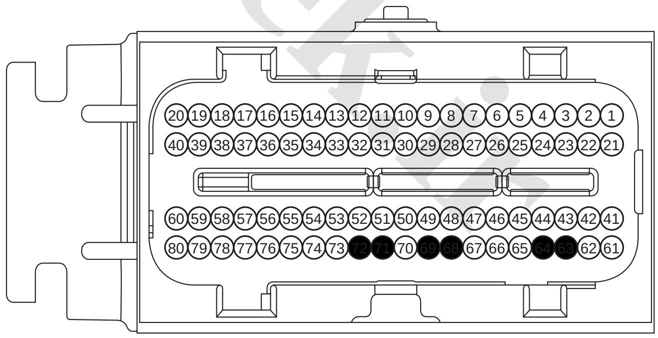
Terminal	Connected to	Funtion
1	PCM C144-B (71)	Injector #6 control
2	Main Relay	Battery Voltage (B+)

[HARNESS CONNECTORS]



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

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



C144-B

PCM

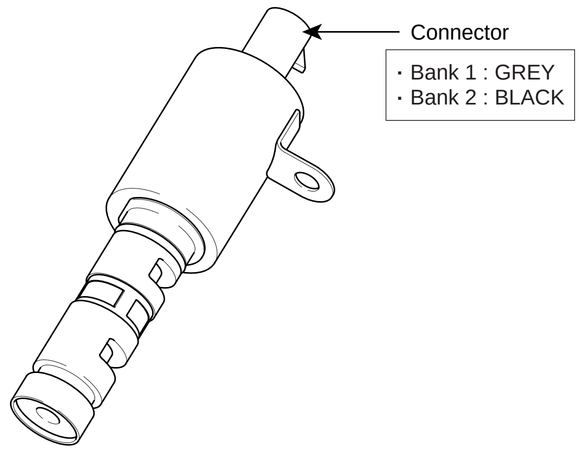
EFBF254A

CVVT OIL CONTROL VALVE (OCV)

DESCRIPTION EAEA14BA

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

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



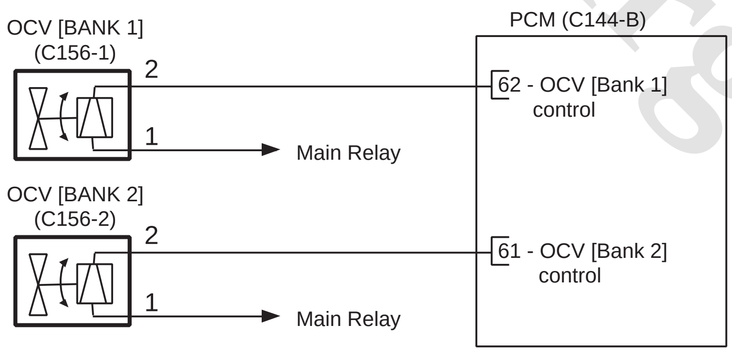
EFBF1027

SPECIFICATION

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

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

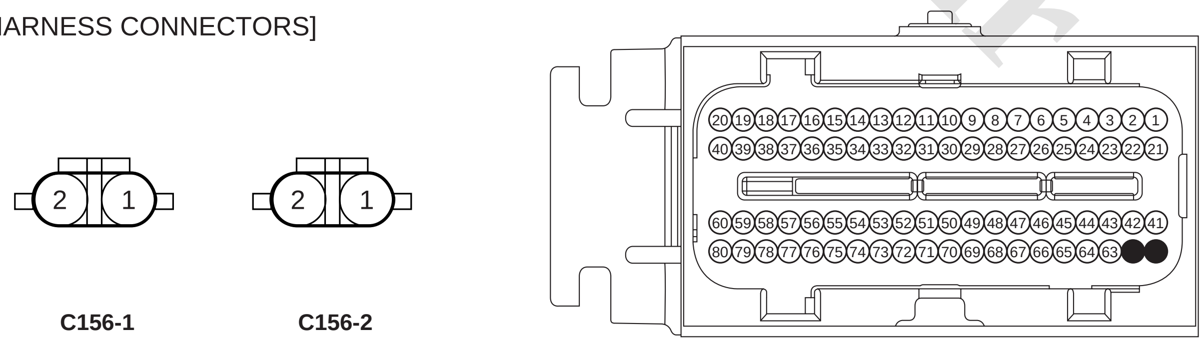
OCV [BANK 1]

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

OCV [BANK 2]

Terminal	Connected to	Funtion
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

EFBF255A

INSTALLATION E8CA4EA4

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]

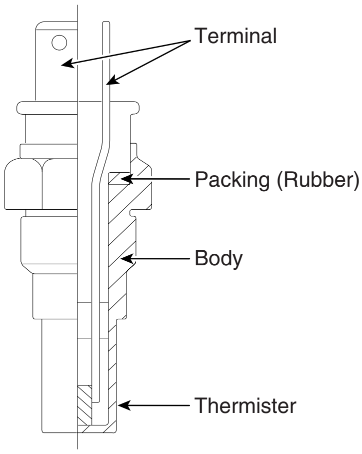
Bank	Component side	Harness side
Bank 1 (RH)	Grey	Grey
Bank 2 (LH)	Black	Black

CVVT OIL TEMPERATURE SENSOR(OTS)

DESCRIPTION EC1E4AF9

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



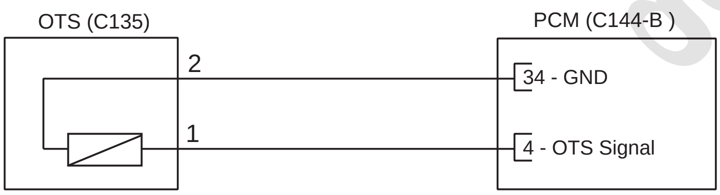
EGRF241A

SPECIFICATION

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

SCHEMATIC DIAGRAM

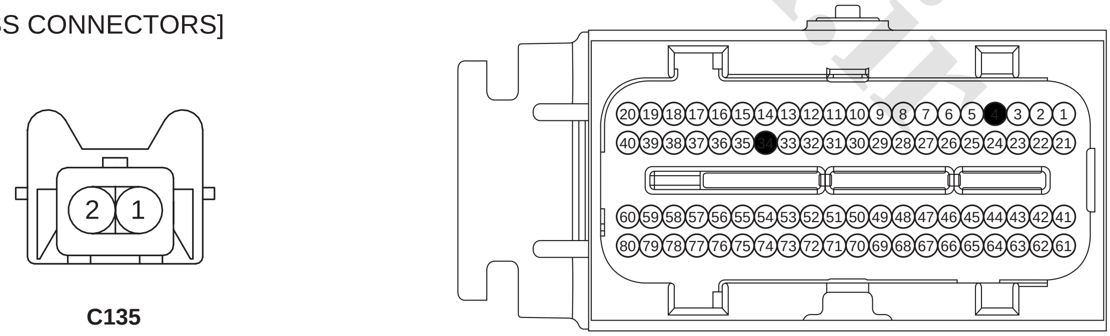
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

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

[HARNESS CONNECTORS]



C135

OTS

C144-B

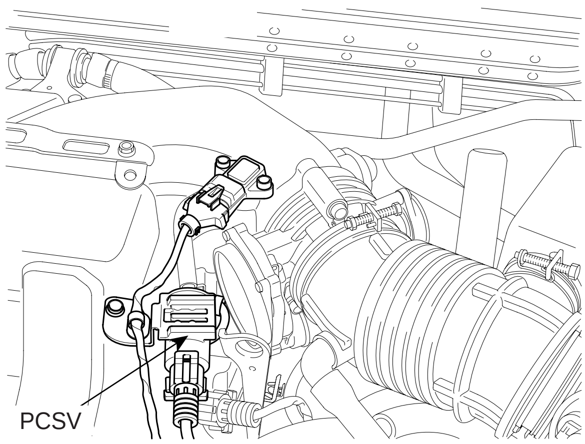
PCM

EFBF256A

PURGE CONTROL SOLENOID VALVE (PCSV)

DESCRIPTION E6435C93

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.



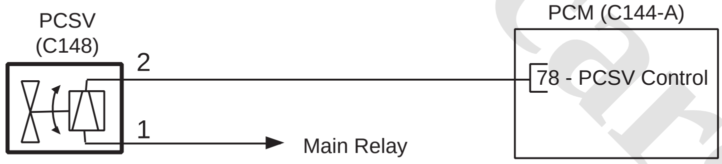
KFBF312A

SPECIFICATION

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

SCHEMATIC DIAGRAM

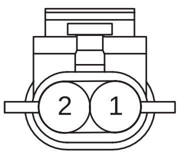
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

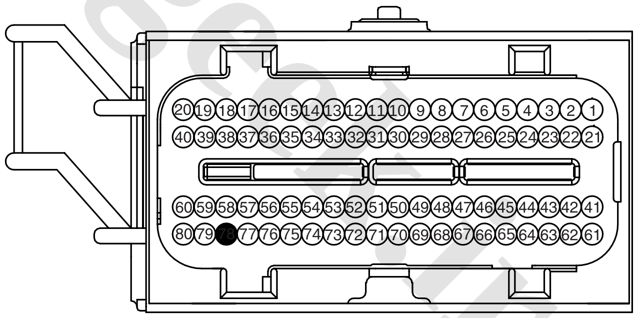
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-A (78)	PCSV Control

[HARNESS CONNECTORS]



C148

PCSV



C144-A

PCM

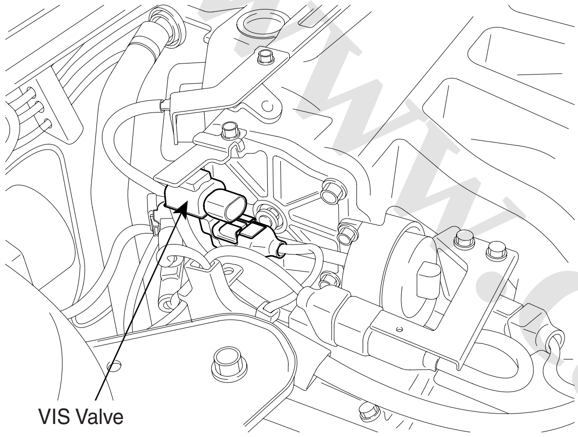
EFBF257A

VARIABLE INTAKE SOLENOID (VIS) VALVE

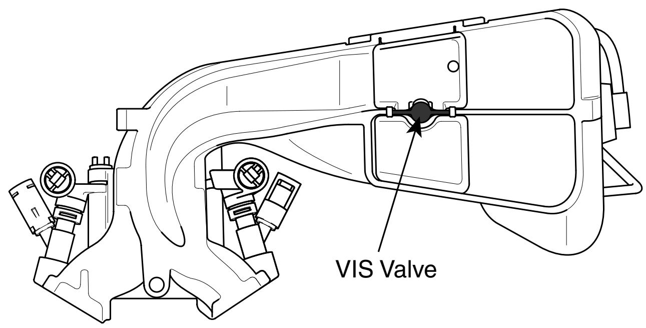
DESCRIPTION E3E6ED1A

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



EGRF216A



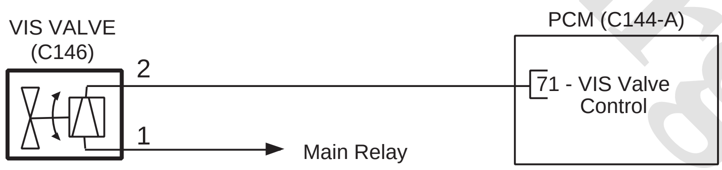
EGRF258A

SPECIFICATION

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

SCHEMATIC DIAGRAM

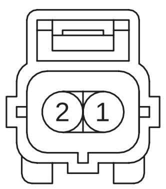
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

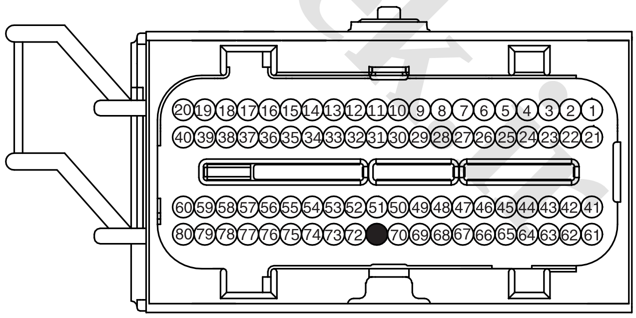
Terminal	Connected to	Funtion
1	Main Relay	Battery voltage (B+)
2	PCM C144-A (71)	VIS Valve control

[HARNESS CONNECTORS]



C146

VIS VALVE



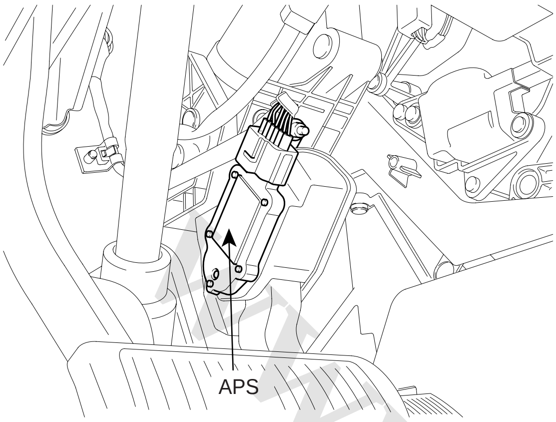
C144-A

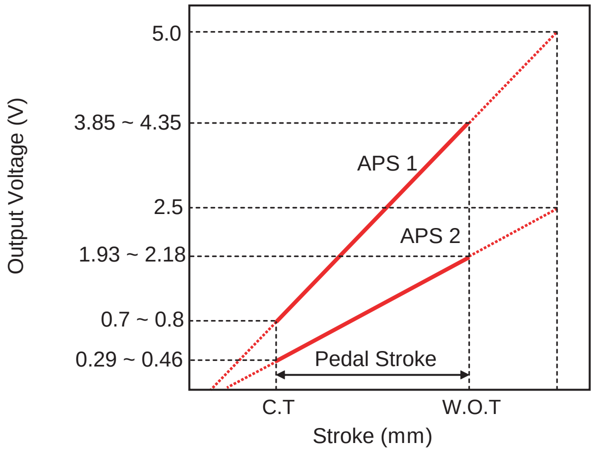
PCM

EFBF259A

ACCELERATOR POSITION SENSOR (APS)

DESCRIPTION ECD73BED





EFBF260A

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.

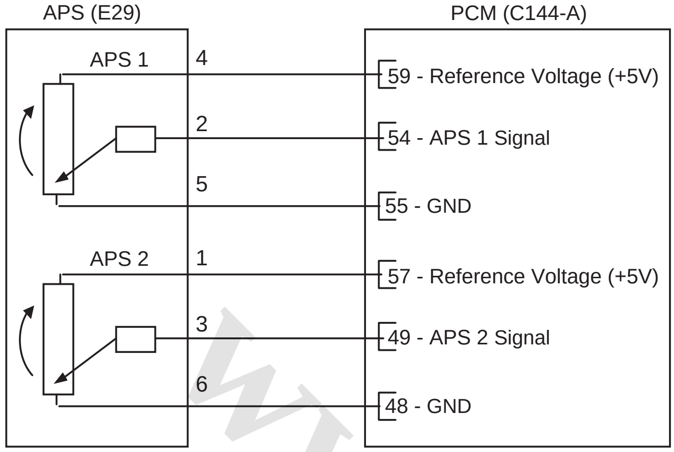
SPECIFICATION

Pedal Position	Output Voltage (V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8V	0.29 ~ 0.46V
W.O.T	3.85 ~ 4.35V	1.93 ~ 2.18V

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

SCHEMATIC DIAGRAM

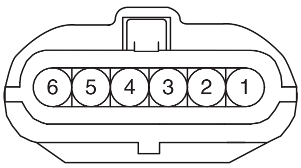
[CIRCUIT DIAGRAM]



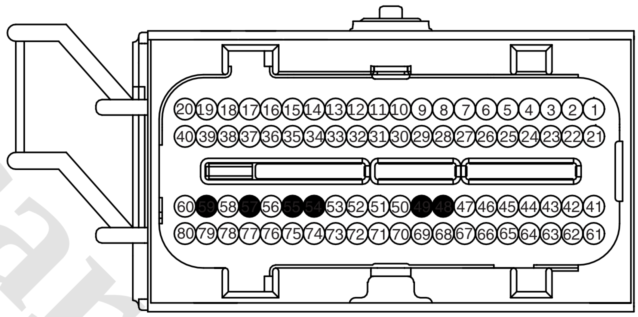
[CONNECTION INFORMATION]

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

[HARNESS CONNECTORS]



E29
APS



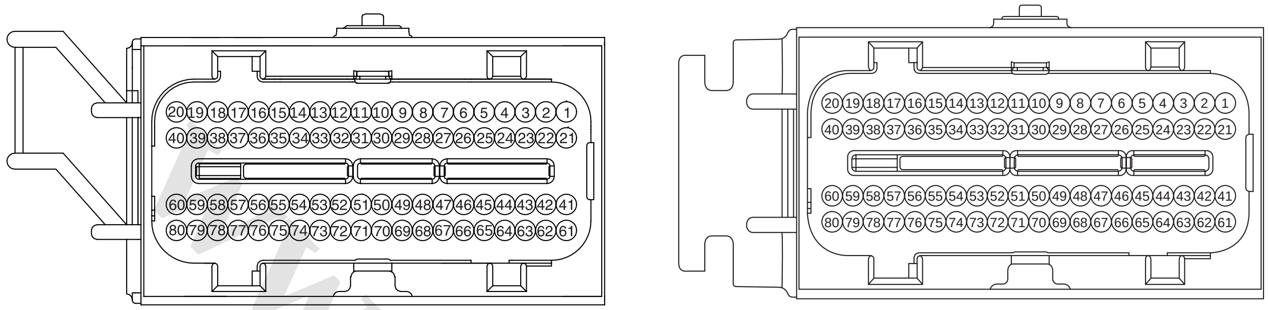
C144-A
PCM

EFBF261A

POWERTRAIN CONTROL MODULE (PCM)

POWERTRAIN CONTROL MODULE (PCM) EDFB68EE

1. PCM HARNESS CONNECTOR



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

EFBF222A

2. PCM TERMINAL FUNCTION

CONNECTOR [C144-A]

Pin No.	Description	Connected to
1	2nd CAN [High]	Multi-Purpose Check Connector
2	2nd CAN [Low]	Multi-Purpose Check Connector
3	For Autotransaxle Control	
4	For Autotransaxle Control	
5	For Autotransaxle Control	
6	For Autotransaxle Control	
7	For Autotransaxle Control	
8	For Autotransaxle Control	
9	For Autotransaxle Control	
10	For Autotransaxle Control	
11	For Autotransaxle Control	
12	-	
13	For Autotransaxle 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	-	

Pin No.	Description	Connected to
20	For Autotransaxle Control	
21	Brake switch signal input	Brake Switch
22	For Autotransaxle Control	
23	Brake lamp signal input	Brake Lamp
24	For Autotransaxle 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	Air Conditioner Pressure Sensor signal input	Air Conditioner Pressure Sensor
33	Sensor ground	Air Conditioner Pressure Sensor, Power Steering Pressure Sensor (PSPS)
34	-	
35	For Autotransaxle 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, ESP Control Module
42	CAN [Low]	ABS Control Module, ESP 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/ESP Control Module (With ABS/ESP [Euro-Ⅲ/Ⅳ & JAPAN]
		Vehicle Speed Sensor (Except Euro-Ⅲ/Ⅳ & JAPAN)
53	Intake Air Temperature Sensor ground	Intake Air Temperature Sensor (IATS)
54	Accelerator Position Sensor #1 signal input	Accelerator Position Sensor (APS) #1

Pin No.	Description	Connected to
55	Accelerator Position Sensor #1 ground	Accelerator Position Sensor (APS) #1
56	-	
57	Accelerator Position Sensor #2 power supply	Accelerator Position Sensor (APS) #2
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 Autotransaxle 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 Autotransaxle Control	
66	Cooling Fan control output (PWM)	Cooling Fan Control Module
67	For Autotransaxle 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 Autotransaxle Control	
74	For Autotransaxle Control	
75	For Autotransaxle Control	
76	For Autotransaxle Control	
77	For Autotransaxle Control	
78	Purge Control Solenoid Valve control output	Purge Control Solenoid Valve (PCSV)
79	Wheel Speed Sensor [Low] signal input	Wheel Speed Sensor (WSS)(Without ABS/ESP [Euro-Ⅲ/Ⅳ & JAPAN])
80	Wheel Speed Sensor [High] signal input	Wheel Speed Sensor (WSS)(Without ABS/ESP [Euro-Ⅲ/Ⅳ & JAPAN])

CONNECTOR [C144-B]

Pin No.	Description	Connected to
1	ETC Motor [-] control output	ETC Motor (in ETC Module)
2	ETC Motor [+] control output	ETC Motor (in ETC Module)
3	For Autotransaxle 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 Autotransaxle Control	
10	For Autotransaxle Control	
11	Manifold Absolute Pressure Sensor power supply	Manifold Absolute Pressure Sensor (MAPS)
12	Battery voltage supply after ignition switch	Ignition Switch
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 Autotransaxle 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) [Except for LEADED]
29	Heated Oxygen Sensor [Bank 2 / Sensor 2] ground	HO2S (B2/S2) [Euro-Ⅲ/Ⅳ & JAPAN]
30	Heated Oxygen Sensor [Bank 1 / Sensor 1] ground	HO2S (B1/S1) [Except for LEADED]
31	Heated Oxygen Sensor [Bank 1 / Sensor 2] ground	HO2S (B1/S2) [Euro-Ⅲ/Ⅳ & JAPAN]
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

Pin No.	Description	Connected to
36	Power ground	Chassis Ground
37	Power ground	Chassis Ground
38	Power ground	Chassis Ground
39	Power ground	Chassis Ground
40	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4)
41	Crankshaft Position Sensor [Low] signal input	Crankshaft Position Sensor (CKPS)
42	For Autotransaxle Control	
43	For Autotransaxle Control	
44	For Autotransaxle Control	
45	For Autotransaxle 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) [Except for LEADED]
50	Heated Oxygen Sensor [Bank 1 / Sensor 2] signal input	HO2S (B1/S2) [Euro-Ⅲ/Ⅳ & JAPAN]
51	Heated Oxygen Sensor [Bank 2 / Sensor 1] signal input	HO2S (B2/S1) [Except for LEADED]
52	Heated Oxygen Sensor [Bank 2 / Sensor 2] signal input	HO2S (B2/S2) [Euro-Ⅲ/Ⅳ & JAPAN]
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 Autotransaxle 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) [Except for LEADED]
68	Injector (Cylinder #4) control output	Injector (Cylinder #4)
69	Injector (Cylinder #5) control output	Injector (Cylinder #5)

Pin No.	Description	Connected to
70	Heated Oxygen Sensor [Bank 1 / Sensor 1] Heater control output	HO2S (B1/S1) [Except for LEADED]
71	Injector (Cylinder #6) control output	Injector (Cylinder #6)
72	Injector (Cylinder #1) control output	Injector (Cylinder #1)
73	Heated Oxygen Sensor [Bank 2 / Sensor 2] Heater control output	HO2S (B2/S2) [Euro-Ⅲ/Ⅳ ＆ JAPAN]
74	Heated Oxygen Sensor [Bank 1 / Sensor 2] Heater control output	HO2S (B1/S2) [Euro-Ⅲ/Ⅳ ＆ JAPAN]
75	For Autotransaxle 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	DC	2.0 ~ 3.0V	2.5V
3	For Autotransaxle Control				
4	For Autotransaxle Control				
5	For Autotransaxle Control				
6	For Autotransaxle Control				
7	For Autotransaxle Control				
8	For Autotransaxle Control				
9	For Autotransaxle Control				
10	For Autotransaxle Control				
11	For Autotransaxle Control				
12	-				
13	For Autotransaxle 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	-	Idle	DC	Max. 50mV	30mV
18	Air conditioner switch "ON" signal input	A/CON Relay OFF	DC	Battery Voltage	9.1V
		A/CON Relay ON		Max. 1.0V	0.1V
19	-				
20	For Autotransaxle Control				
21	Brake switch signal input	Brake pedal releasing	DC	Battery Voltage	12.7V
		Brake pedal pressing		Max. 0.5V	0.03V
22	For Autotransaxle Control				
23	Brake lamp signal input	Brake pedal releasing	DC	Max. 0.5V	0V
		Brake pedal pressing		Battery Voltage	13.0V
24	For Autotransaxle Control				
25	Cruise Switch signal input				
26	Air conditioner blower switch signal input	A/CON OFF	DC	Max. 1.0V	0V
		A/CON ON		Battery Voltage	11.9V

Pin No.	Description	Condition	Type	Level	Test Result
27	Diagnostic Data Line (K-Line)	When transmitting	PULSE	High: Min. Vbatt * 80%	11.3V
				Low: Max. Vbatt * 20%	0.14V
		When receiving		High: Min. Vbatt * 70%	11.3V
				Low: Max. Vbatt * 30%	0.32V
28	-				
29	-				
30	-				
31	-				
32	Air Conditioner Pressure Sensor signal input	A/CON OFF	DC	0 ~ 5.0V	
		A/CON ON			1.85 ~ 2.2V
33	Sensor ground	Idle	DC	Max. 50mV	40mV
34	-				
35	For Autotransaxle 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 Autotransaxle 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	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	Max. 50mV	36mV
56	-				
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	DC	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 Autotransaxle 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 Autotransaxle 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 Autotransaxle 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 Autotransaxle Control				
74	For Autotransaxle Control				
75	For Autotransaxle Control				
76	For Autotransaxle Control				
77	For Autotransaxle Control				
78	Purge Control Solenoid Valve control output	Inactive Active	PULSE	High: Battery Voltage	13.2V
				Low: Max. 1.0V	0.08V
					16Hz
79	Wheel Speed Sensor [Low] signal input				
80	Wheel Speed Sensor [High] signal input				

CONNECTOR [C144-B]

Pin No.	Description	Condition	Type	Level	Test Result
1	ETC Motor [-] control output	Idle	PULSE	High: Battery Voltage	13.3V
				Low: Max. 1.0V	0.3V
					3.14KHz
2	ETC Motor [+] control output	Idle	PULSE	High: Battery Voltage	13.3V
				Low: Max. 1.0V	0.4V
					3.14KHz
3	For Autotransaxle Control				
4	CVVT Oil Temperature Sensor signal input	Idle	Analog	0.5 ~ 4.5V	1.68V
5	-				
6	For Autotransaxle Control				
7	Engine Coolant Temperature Sensor signal input	Idle	Analog	0.5 ~ 4.5V	0.47V
8	Manifold Absolute Pressure Sensor signal input	IG ON	Analog	3.9 ~ 4.1V	4.01V
		Idle		0.8 ~ 1.6V	1.59V
9	For Autotransaxle Control				
10	For Autotransaxle 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

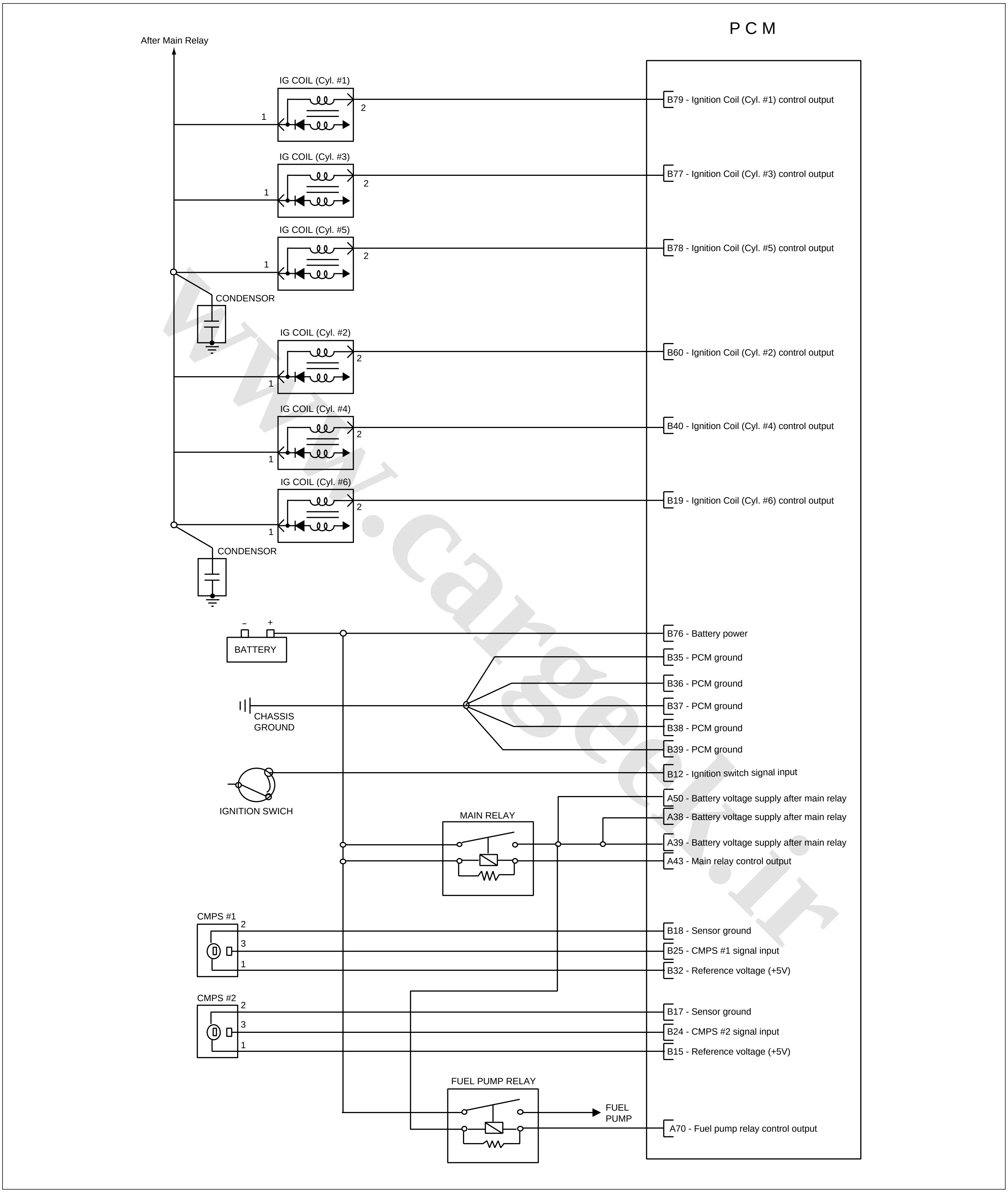
Pin No.	Description	Condition	Type	Level	Test Result
22	For Autotransaxle Control				
23	Sensor Shield	Idle	DC	Max. 50mV	32mV
24	Camshaft Position Sensor [Bank 2] signal input	Idle	PULSE	High: Vref	5.08V
				Low: Max. 0.5V	0.06V
					40Hz
25	Camshaft Position Sensor [Bank 1] signal input	Idle	PULSE	High: 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
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 Autotransaxle Control				
43	For Autotransaxle Control				
44	For Autotransaxle Control				
45	For Autotransaxle Control				
46	-				
47	-				

Pin No.	Description	Condition	Type	Level	Test Result
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	
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 Autotransaxle 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

Pin No.	Description	Condition	Type	Level	Test Result
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
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

Pin No.	Description	Condition	Type	Level	Test Result
75	For Autotransaxle 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 E5F4F6AD



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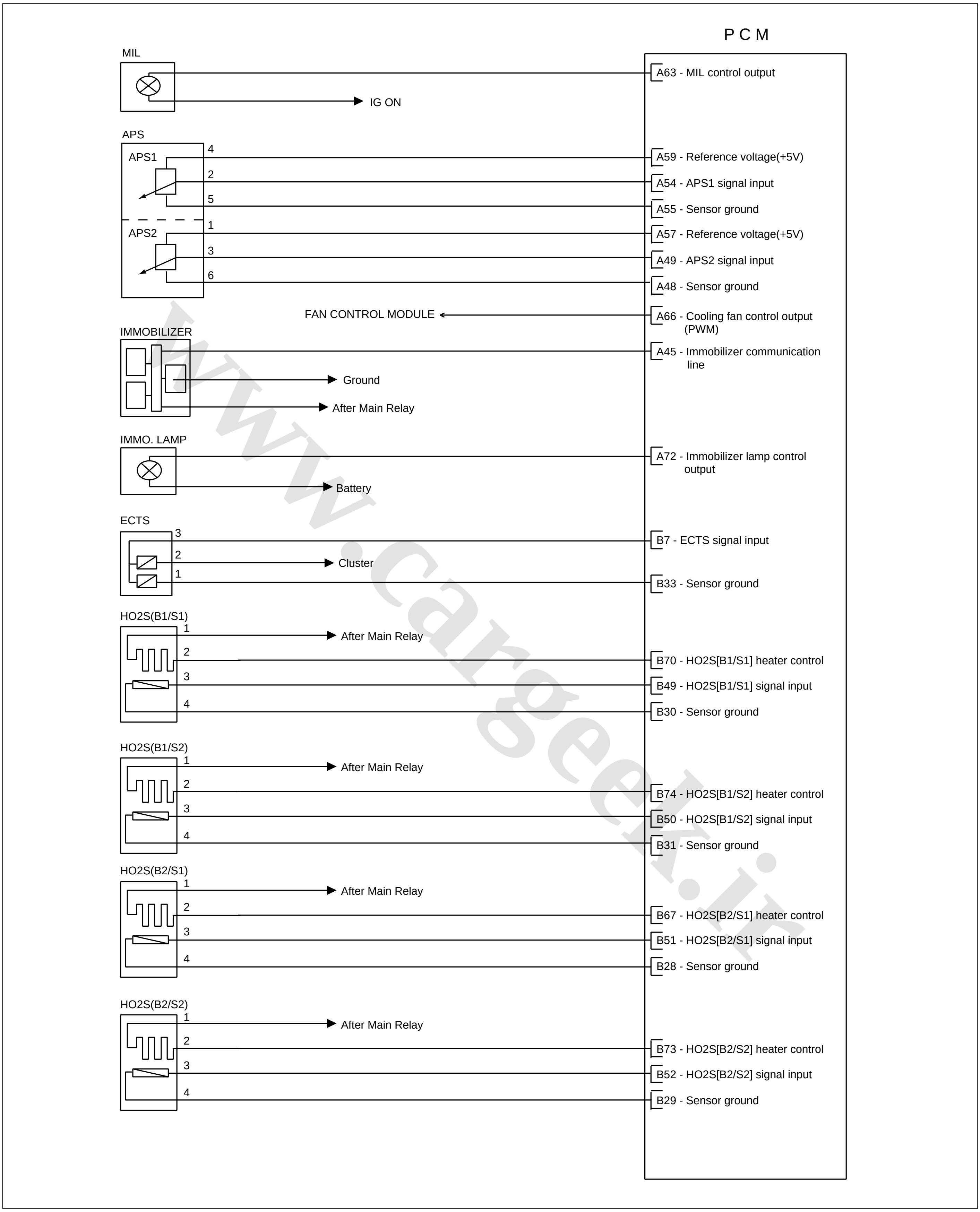

P C M
MIL
A63 - MIL control output
IG ON
APS
APS1
4
2
5
APS2
1
3
6
A59 - Reference voltage(+5V)
A54 - APS1 signal input
A55 - Sensor ground
A57 - Reference voltage(+5V)
A49 - APS2 signal input
A48 - Sensor ground
FAN CONTROL MODULE
A66 - Cooling fan control output (PWM)
IMMOBILIZER
A45 - Immobilizer communication line
Ground
After Main Relay
IMMO. LAMP
A72 - Immobilizer lamp control output
Battery
ECTS
3
2
1
B7 - ECTS signal input
Cluster
B33 - Sensor ground
HO2S(B1/S1)
1
2
3
4
After Main Relay
B70 - HO2S[B1/S1] heater control
B49 - HO2S[B1/S1] signal input
B30 - Sensor ground
HO2S(B1/S2)
1
2
3
4
After Main Relay
B74 - HO2S[B1/S2] heater control
B50 - HO2S[B1/S2] signal input
B31 - Sensor ground
HO2S(B2/S1)
1
2
3
4
After Main Relay
B67 - HO2S[B2/S1] heater control
B51 - HO2S[B2/S1] signal input
B28 - Sensor ground
HO2S(B2/S2)
1
2
3
4
After Main Relay
B73 - HO2S[B2/S2] heater control
B52 - HO2S[B2/S2] signal input
B29 - Sensor ground

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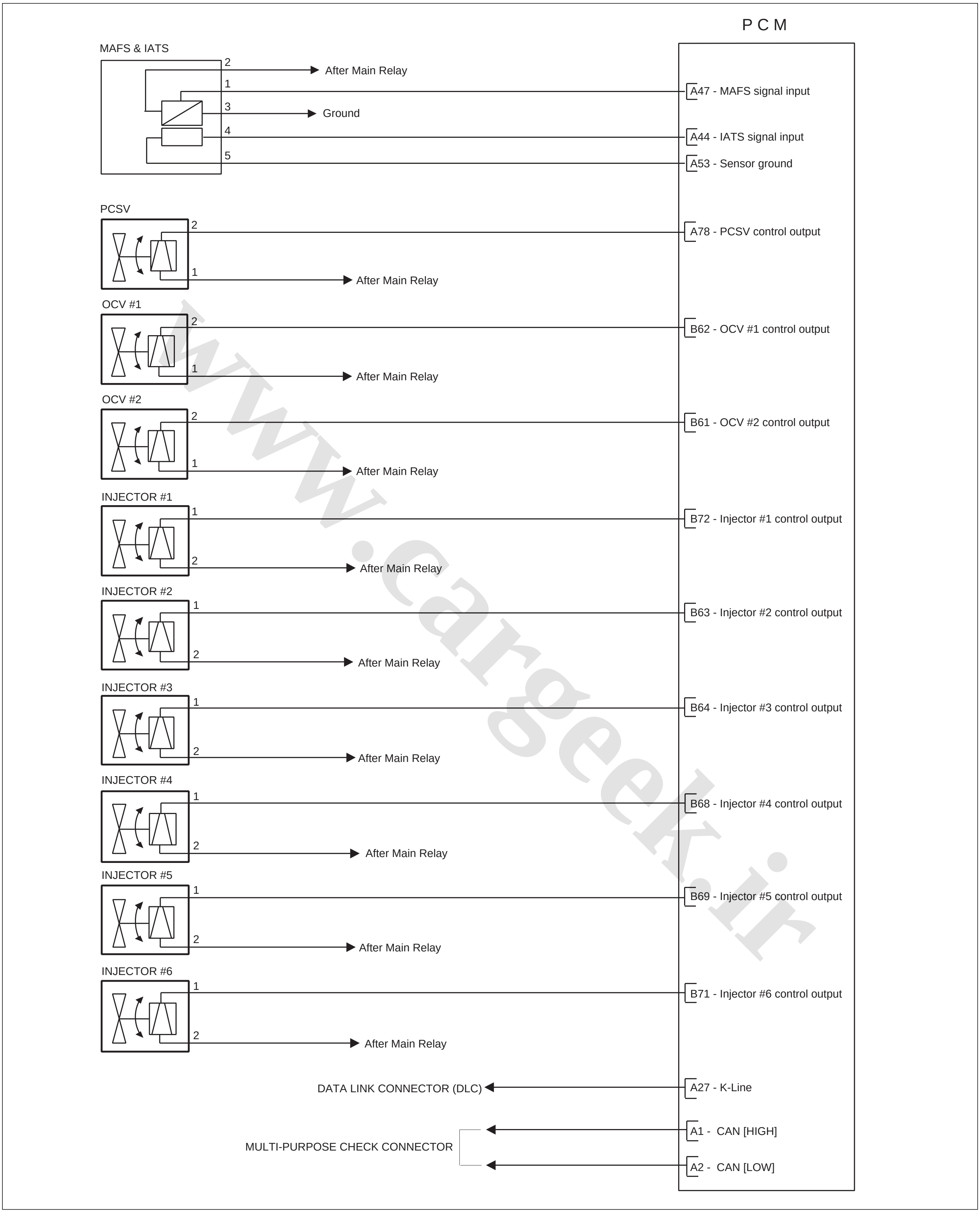
PCM
MAFS & IATS
After Main Relay
Ground
A47 - MAFS signal input
A44 - IATS signal input
A53 - Sensor ground
PCSV
A78 - PCSV control output
OCV #1
B62 - OCV #1 control output
OCV #2
B61 - OCV #2 control output
INJECTOR #1
B72 - Injector #1 control output
INJECTOR #2
B63 - Injector #2 control output
INJECTOR #3
B64 - Injector #3 control output
INJECTOR #4
B68 - Injector #4 control output
INJECTOR #5
B69 - Injector #5 control output
INJECTOR #6
B71 - Injector #6 control output
DATA LINK CONNECTOR (DLC)
A27 - K-Line
MULTI-PURPOSE CHECK CONNECTOR
A1 - CAN [HIGH]
A2 - CAN [LOW]

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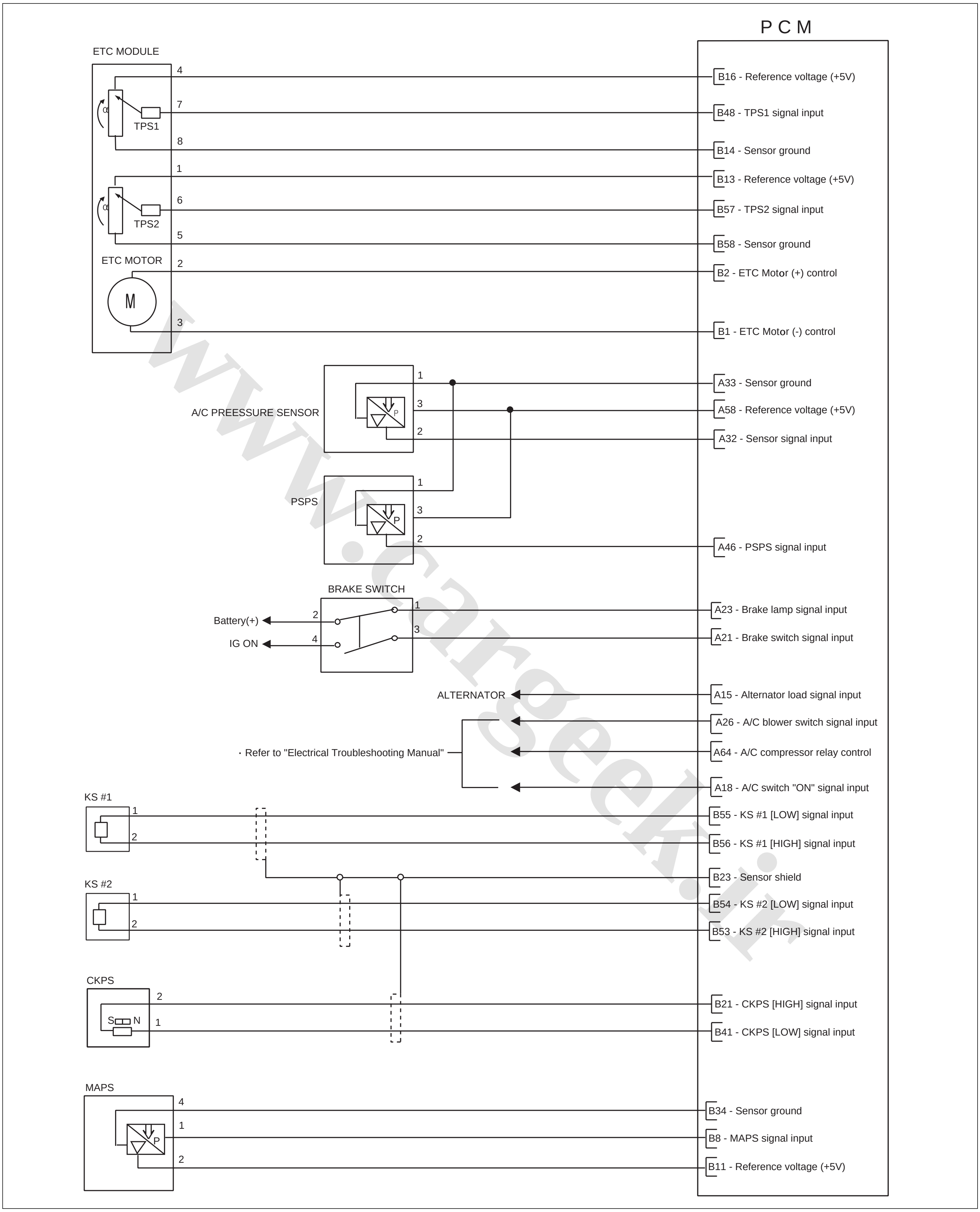
P C M
ETC MODULE
TPS1
TPS2
ETC MOTOR
M
B16 - Reference voltage (+5V)
B48 - TPS1 signal input
B14 - Sensor ground
B13 - Reference voltage (+5V)
B57 - TPS2 signal input
B58 - Sensor ground
B2 - ETC Motor (+) control
B1 - ETC Motor (-) control
A/C PREESSURE SENSOR
A33 - Sensor ground
A58 - Reference voltage (+5V)
A32 - Sensor signal input
PSPS
A46 - PSPS signal input
BRAKE SWITCH
Battery(+)
IG ON
A23 - Brake lamp signal input
A21 - Brake switch signal input
ALTERNATOR
A15 - Alternator load signal input
A26 - A/C blower switch signal input
· Refer to "Electrical Troubleshooting Manual"
A64 - A/C compressor relay control
A18 - A/C switch "ON" signal input
KS #1
B55 - KS #1 [LOW] signal input
B56 - KS #1 [HIGH] signal input
B23 - Sensor shield
KS #2
B54 - KS #2 [LOW] signal input
B53 - KS #2 [HIGH] signal input
CKPS
S N
B21 - CKPS [HIGH] signal input
B41 - CKPS [LOW] signal input
MAPS
B34 - Sensor ground
B8 - MAPS signal input
B11 - Reference voltage (+5V)

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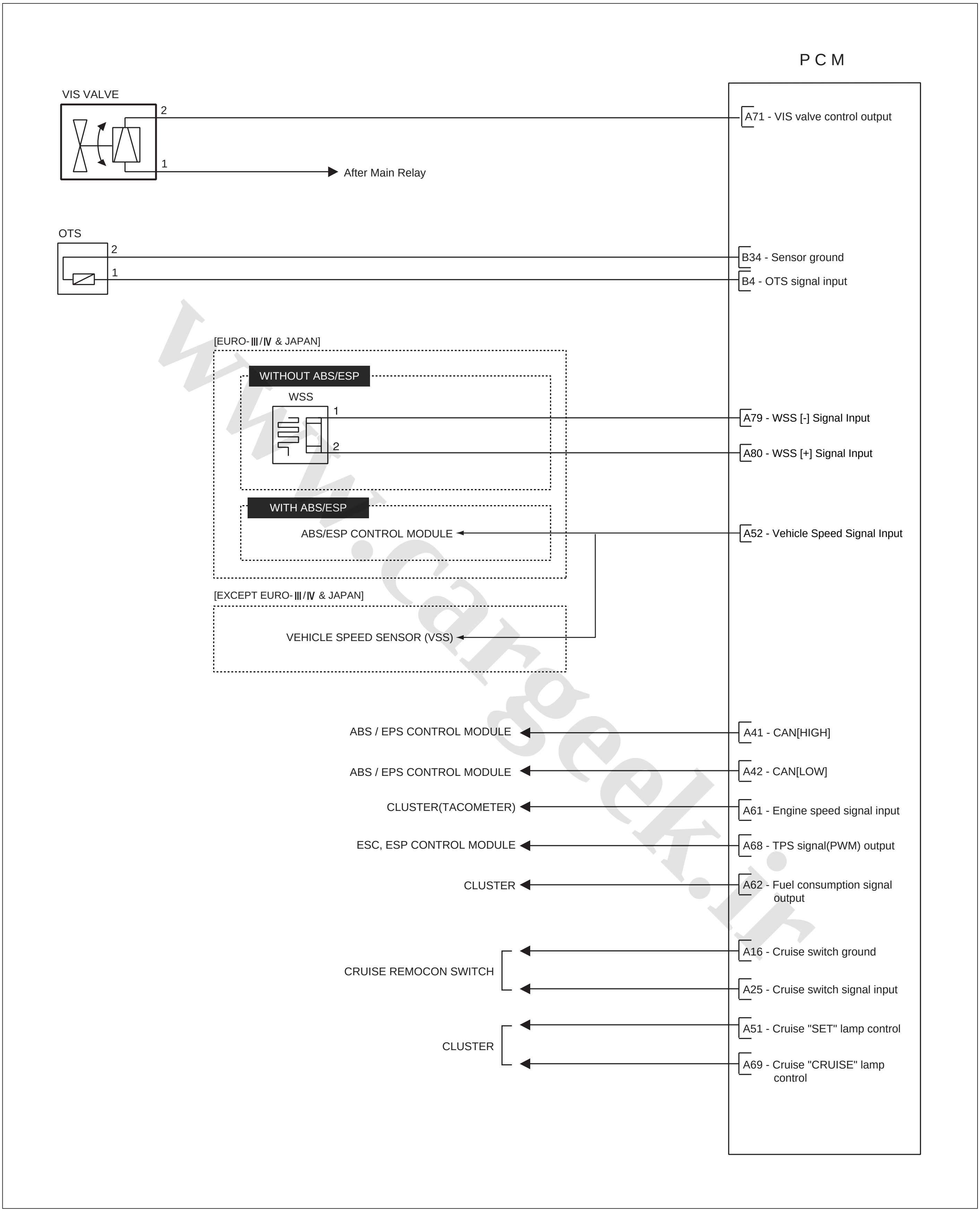

P C M
VIS VALVE
A71 - VIS valve control output
After Main Relay
OTS
B34 - Sensor ground
B4 - OTS signal input
[EURO-Ⅲ/Ⅳ & JAPAN]
WITHOUT ABS/ESP
WSS
A79 - WSS [-] Signal Input
A80 - WSS [+] Signal Input
WITH ABS/ESP
ABS/ESP CONTROL MODULE
A52 - Vehicle Speed Signal Input
[EXCEPT EURO-Ⅲ/Ⅳ & JAPAN]
VEHICLE SPEED SENSOR (VSS)
ABS / EPS CONTROL MODULE
A41 - CAN[HIGH]
ABS / EPS CONTROL MODULE
A42 - CAN[LOW]
CLUSTER(TACOMETER)
A61 - Engine speed signal input
ESC, ESP CONTROL MODULE
A68 - TPS signal(PWM) output
CLUSTER
A62 - Fuel consumption signal output
CRUISE REMOCON SWITCH
A16 - Cruise switch ground
A25 - Cruise switch signal input
CLUSTER
A51 - Cruise "SET" lamp control
A69 - Cruise "CRUISE" lamp control

EFBF297A

PCM PROBLEM INSPECTION PROCEDURE E84D084C

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).

DTC TROUBLESHOOTING PROCEDURES

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC) ECD79C65

DTC	Description	MIL					PAGE
		EURO-III/IV	JAPAN	EURO-II	CHINA	LEADED	
P0011	A Camshaft Position-Timing Over-Advanced or System Performance (Bank 1)	●	●	▲	▲	▲	FL-85
P0012	A Camshaft Position-Timing Over-Retarded (Bank 1)	●	●	▲	▲	▲	FL-91
P0016	Crankshaft Position-Camshaft Position Correlation (Bank 1 Sensor A)	●	●	▲	▲	▲	FL-94
P0018	Crankshaft Position-Camshaft Position Correlation (Bank 2 Sensor A)	●	●	▲	▲	▲	FL-102
P0021	"A" Camshaft Position-Timing Over-Advanced or System Performance (Bank 2)	●	●	▲	▲	▲	FL-85
P0022	"A" Camshaft Position-Timing Over-Retarded (Bank 2)	●	●	▲	▲	▲	FL-91
P0026	Intake Valve Control Solenoid Circuit Range/Performance (Bank 1)	●	●	▲	▲	▲	FL-110
P0028	Intake Valve Control Solenoid Circuit Range/Performance (Bank 2)	●	●	▲	▲	▲	FL-110
P0031	HO2S Heater Circuit low (Bank 1 / Sensor 1)	●	●	▲	▲		FL-117
P0032	HO2S Heater Circuit high (Bank 1 / Sensor 1)	●	●	▲	▲		FL-123
P0037	HO2S Heater Circuit low (Bank 1 / Sensor 2)	●	●				FL-126
P0038	HO2S Heater Circuit high (Bank 1 / Sensor 2)	●	●				FL-132
P0051	HO2S Heater Circuit low (Bank 2 / Sensor 1)	●	●	▲	▲		FL-135
P0052	HO2S Heater Circuit high (Bank 2 / Sensor 1)	●	●	▲	▲		FL-141
P0057	HO2S Heater Circuit low (Bank 2 / Sensor 2)	●	●				FL-144
P0058	HO2S Heater Circuit high (Bank 2 / Sensor 2)	●	●				FL-150
P0076	Intake Valve Control Solenoid Circuit Low (Bank 1)	●	●	▲	▲	▲	FL-153
P0077	Intake Valve Control Solenoid Circuit High (Bank 1)	●	●	▲	▲	▲	FL-160
P0082	Intake Valve Control Solenoid Circuit Low (Bank 2)	●	●	▲	▲	▲	FL-153
P0083	Intake Valve Control Solenoid Circuit High (Bank 2)	●	●	▲	▲	▲	FL-160
P0101	Mass or Volume Air Flow Circuit Range/Performance	●	●				FL-163

DTC	Description	MIL					PAGE
		EURO-III/IV	JAPAN	EURO-II	CHINA	LEADED	
P0102	Mass or Volume Air Flow Circuit Low Input	●	●	●	▲	●	FL-171
P0103	Mass or Volume Air Flow Circuit high Input	●	●	●	▲	●	FL-176
P0106	Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance	●	●				FL-179
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input	●	●	●	▲	●	FL-187
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input	●	●	●	▲	●	FL-192
P0110	Intake Air Temperature Sensor 1 Circuit	●	●				FL-196
P0111	Intake Air Temperature Sensor 1 Circuit Range/Performance	●	●	▲	▲	▲	FL-203
P0112	Intake Air Temperature Sensor 1 Circuit Low Input	●	●	▲	▲	▲	FL-207
P0113	Intake Air Temperature Sensor 1 Circuit High Input	●	●	▲	▲	▲	FL-211
P0115	Engine Coolant Temperature Circuit	●					FL-216
P0117	Engine Coolant Temperature Circuit Low Input	●	●	●	▲	●	FL-222
P0118	Engine Coolant Temperature Circuit High Input	●	●	●	▲	●	FL-226
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input	●	●	●	▲	●	FL-230
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	●	●	●	▲	●	FL-237
P0131	HO2S Circuit Low Voltage (Bank 1 / Sensor 1)	●	●	▲	▲		FL-241
P0132	HO2S Circuit High Voltage (Bank 1 / Sensor 1)	●	●	▲	▲		FL-247
P0133	HO2S Circuit Slow Response (Bank 1 / Sensor 1)	●	●				FL-249
P0134	HO2S Circuit No Activity Detected (Bank 1 / Sensor 1)	●	●	▲			FL-253
P0135	HO2S Heater Circuit (Bank 1 / Sensor 1)	●					FL-256
P0137	HO2S Circuit Low Voltage (Bank 1 / Sensor 2)	●	●				FL-259
P0138	HO2S Circuit High Voltage (Bank 1 / Sensor 2)	●	●				FL-264
P0139	HO2S Circuit Slow Response (Bank 1 / Sensor 2)	●	●				FL-266
P0140	HO2S Circuit No Activity Detected (Bank 1 / Sensor 2)	●	●				FL-269
P0141	HO2S Heater Circuit (Bank 1 / Sensor 2)	●					FL-272
P0151	HO2S Circuit Low Voltage (Bank 2 / Sensor 1)	●	●	▲	▲		FL-275
P0152	HO2S Circuit High Voltage (Bank 2 / Sensor 1)	●	●	▲	▲		FL-281

DTC	Description	MIL					PAGE
		EURO-III/IV	JAPAN	EURO-II	CHINA	LEADED	
P0153	HO2S Circuit Slow Response (Bank 2 / Sensor 1)	●	●				FL-283
P0154	HO2S Circuit No Activity Detected (Bank 2 / Sensor 1)	●	●	▲			FL-287
P0155	HO2S Heater Circuit (Bank 2 / Sensor 1)	●					FL-290
P0157	HO2S Circuit Low Voltage (Bank 2 / Sensor 2)	●	●				FL-293
P0158	HO2S Circuit High Voltage (Bank 2 / Sensor 2)	●	●				FL-298
P0159	HO2S Circuit Slow Response (Bank 2 / Sensor 2)	●	●				FL-301
P0160	HO2S Circuit No Activity Detected (Bank 2 / Sensor 2)	●	●				FL-304
P0161	HO2S Heater Circuit (Bank 2 / Sensor 2)	●					FL-307
P0171	System Too Lean (Bank 1)	●	●	▲			FL-310
P0172	System Too Rich (Bank 1)	●	●	▲			FL-315
P0174	System Too Lean (Bank 2)	●	●	▲			FL-310
P0175	System Too Rich (Bank 2)	●	●	▲			FL-315
P0196	Engine Oil Temp. Sensor Range / Performance	●	●				FL-319
P0197	Engine Oil Temp. Sensor Low Input	●	●	▲	▲	▲	FL-326
P0198	Engine Oil Temp. Sensor High Input	●	●	▲	▲	▲	FL-329
P0217	Engine Coolant Over Temperature Condition	●					FL-333
P0222	Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input	●	●	●	▲	●	FL-340
P0223	Throttle/Pedal Position Sensor/Switch "B" Circuit High Input	●	●	●	▲	●	FL-347
P0230	Fuel Pump Primary Circuit	▲	▲	▲	▲	▲	FL-351
P0261	Cylinder 1-Injector Circuit Low	●	●	●	▲	●	FL-356
P0262	Cylinder 1-Injector Circuit High	●	●	●	▲	●	FL-362
P0264	Cylinder 2-Injector Circuit Low	●	●	●	▲	●	FL-356
P0265	Cylinder 2-Injector Circuit High	●	●	●	▲	●	FL-362
P0267	Cylinder 3-Injector Circuit Low	●	●	●	▲	●	FL-356
P0268	Cylinder 3-Injector Circuit High	●	●	●	▲	●	FL-362
P0270	Cylinder 4-Injector Circuit Low	●	●	●	▲	●	FL-356
P0271	Cylinder 4-Injector Circuit High	●	●	●	▲	●	FL-362
P0273	Cylinder 5-Injector Circuit Low	●	●	●	▲	●	FL-356
P0274	Cylinder 5-Injector Circuit High	●	●	●	▲	●	FL-362

DTC	Description	MIL					PAGE
		EURO-III/IV	JAPAN	EURO-II	CHINA	LEADED	
P0276	Cylinder 6-Injector Circuit Low	●	●	●	▲	●	FL-356
P0277	Cylinder 6-Injector Circuit High	●	●	●	▲	●	FL-362
P0300	Random/Multiple Cylinder Misfire Detected	●	●				FL-365
P0301	Cylinder 1-Misfire detected	●	●				FL-365
P0302	Cylinder 2-Misfire detected	●	●				FL-365
P0303	Cylinder 3-Misfire detected	●	●				FL-365
P0304	Cylinder 4-Misfire detected	●	●				FL-365
P0305	Cylinder 5-Misfire detected	●	●				FL-365
P0306	Cylinder 6-Misfire detected	●	●				FL-365
P0315	Segment Time Acquisition Incorrect	▲	▲				FL-371
P0325	Knock Sensor 1 Circuit	●	▲	▲	▲	▲	FL-373
P0326	Knock Sensor 1 Circuit Range/Performance (Bank 1)	●	▲	▲	▲	▲	FL-377
P0330	Knock Sensor 2 Circuit	●	▲	▲	▲	▲	FL-373
P0331	Knock Sensor 2 Circuit Range/Performance (Bank 2)	●	▲	▲	▲	▲	FL-377
P0335	Crankshaft Position Sensor A Circuit	●	●	▲	▲	▲	FL-379
P0336	Crankshaft Position Sensor A Circuit Range/Performance	●	●	▲	▲	▲	FL-385
P0340	Camshaft Position Sensor A Circuit Malfunction (Bank 1 or Single Sensor)	●	●	▲	▲	▲	FL-389
P0341	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or Single Sensor)	●	●	▲	▲	▲	FL-395
P0346	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 2)	●	●	▲	▲	▲	FL-398
P0351	Ignition Coil ’A’ Primary / Secondary Circuit	●	▲	▲	▲	▲	FL-403
P0352	Ignition Coil ’B’ Primary / Secondary Circuit	●	▲	▲	▲	▲	FL-403
P0353	Ignition Coil ’C’ Primary / Secondary Circuit	●	▲	▲	▲	▲	FL-403
P0354	Ignition Coil ’D’ Primary / Secondary Circuit	●	▲	▲	▲	▲	FL-403
P0355	Ignition Coil ’E’ Primary / Secondary Circuit	●	▲	▲	▲	▲	FL-403
P0356	Ignition Coil ’F’ Primary / Secondary Circuit	●	▲	▲	▲	▲	FL-403
P0420	Catalyst System Efficiency below Threshold (Bank 1)	●					FL-410
P0430	Catalyst System Efficiency below Threshold (Bank 2)	●					FL-410
P0444	Evap. Emission System-Purge Ctrl. Valve Circuit Open	●	●				FL-414

DTC	Description	MIL					PAGE
		EURO-III/IV	JAPAN	EURO-II	CHINA	LEADED	
P0445	Evap. Emission System-Purge Ctrl. Valve Circuit Shorted	●	●				FL-420
P0501	Vehicle Speed Sensor A Range/Performance	●	●	●	▲	●	FL-423
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-443
P0532	A/C Refrigerant Pressure Sensor "A" Circuit Low Input	▲	▲	▲	▲	▲	FL-446
P0533	A/C Refrigerant Pressure Sensor "A" Circuit High Input	▲	▲	▲	▲	▲	FL-452
P0552	Power Steering Pressure Sensor/Switch Circuit Low Input	●	▲				FL-456
P0553	Power Steering Pressure Sensor/Switch Circuit High Input	●	▲				FL-461
P0562	System Voltage Low	●	▲	▲	▲	▲	FL-464
P0563	System Voltage High	●	▲	▲	▲	▲	FL-471
P0564	Cruise Control Multi-Function Input "A" Circuit	▲	▲	▲	▲	▲	FL-475
P0565	Cruise Control "ON" Signal	▲	▲	▲	▲	▲	FL-480
P0566	Cruise Control "CANCEL" Signal	▲	▲	▲	▲	▲	FL-482
P0567	Cruise Control "RESUME" Signal	▲	▲	▲	▲	▲	FL-484
P0568	Cruise Control "SET" Signal	▲	▲	▲	▲	▲	FL-486
P0571	Brake Switch "A" Circuit	●	▲	▲	▲	▲	FL-488
P0601	EEPROM-Check sum Error	●	▲	▲	▲	▲	FL-493
P0602	EEPROM-Programming Error	●	▲	▲	▲	▲	FL-495
P0604	Internal Control Module Random Access Memory (RAM) Error	●	▲	▲	▲	▲	FL-496
P0606	ECM/PCM Processor(ECM-SELF TEST Failed)	●/▲	●/▲	●/▲	●/▲	●/▲	FL-497
P061B	Internal Control Module Torque Calculation Performance	●	●	▲	▲	▲	FL-498
P0638	Throttle Actuator Control Range/Performance	●	●	▲	▲	▲	FL-499
P0641	Sensor Reference Voltage "A" Circuit Open	●	●	▲	▲	▲	FL-507
P0646	A/C Clutch Relay Control Circuit Low	▲	▲	▲	▲	▲	FL-512
P0647	A/C Clutch Relay Control Circuit High	▲	▲	▲	▲	▲	FL-518
P0650	Malfunction Indicator Lamp(MIL) Control Circuit	▲	▲				FL-521
P0651	Sensor Reference Voltage "B" Circuit Open	●	●	▲	▲	▲	FL-525

DTC	Description	MIL					PAGE
		EURO-III/IV	JAPAN	EURO-II	CHINA	LEADED	
P0660	Intake Manifold Tuning Valve Control Circuit/Open (Bank 1)	●	●	▲	▲	▲	FL-530
P0685	ECM/PCM Power Relay Control Circuit /Open	▲	▲	▲	▲	▲	FL-535
P1106	Manifold Absolute Pressure Sensor Circuit Short - Intermittent High Input	▲	▲	▲	▲	▲	FL-540
P1107	Manifold Absolute Pressure Sensor Circuit Short - Intermittent Low Input	▲	▲	▲	▲	▲	FL-548
P1111	Intake Air Temperature Sensor Circuit Short - Intermittent High Input	▲	▲	▲	▲	▲	FL-552
P1112	Intake Air Temperature Sensor Circuit Short - Intermittent Low Input	▲	▲	▲	▲	▲	FL-560
P1114	Engine Coolant Temperature Sensor Circuit - Intermittent Low Input	▲	▲	▲	▲	▲	FL-564
P1115	Engine Coolant Temperature Sensor Circuit - Intermittent High Input	▲	▲	▲	▲	▲	FL-570
P1295	ETC (Electronic Throttle Control) System Malfunction - Power Management	●	●	●	●	●	FL-574
P1523	ETC (Electronic Throttle Control) System Malfunction - Throttle Valve Stuck	▲	▲	▲	▲	▲	FL-577
P161B	ECM/PCM Internal Error - Torque Calculation	●	●	▲	▲	▲	FL-581
P2104	ETC (Electronic Throttle Control) System Malfunction - Forced Idle	●	●	●	●	●	FL-586
P2105	ETC (Electronic Throttle Control) System Malfunction - Forced Engine Shutdown	●	●	●	●	●	FL-589
P2106	ETC (Electronic Throttle Control) System Malfunction - Forced Limited Power	●	●	●	●	●	FL-591
P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input	●	●	▲	▲	▲	FL-593
P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input	●	●	▲	▲	▲	FL-600
P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input	●	●	▲	▲	▲	FL-603
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High Input	●	●	▲	▲	▲	FL-610
P2135	Throttle/Pedal Position Sensor/Switch "A" / "B" Voltage Correlation	●	●	▲	▲	▲	FL-614
P2138	Throttle/Pedal Position Sensor/Switch "D" / "E" Voltage Correlation	●	●	▲	▲	▲	FL-621
P2173	ETC (Electronic Throttle Control) System Malfunction - High Air flow Detected	●	●	▲	▲	▲	FL-627
P2187	System Too Lean at Idle (←Additive) (Bank 1)	●	●	▲	▲		FL-633
P2188	System Too Rich at Idle (Bank 1)	●	●	▲	▲		FL-639

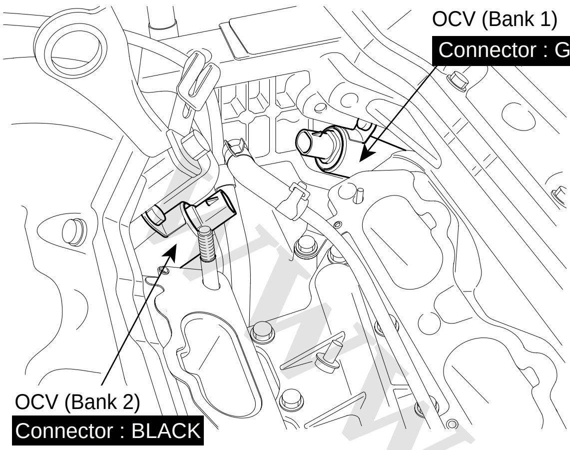
DTC	Description	MIL					PAGE
		EURO-III/IV	JAPAN	EURO-II	CHINA	LEADED	
P2189	System Too Lean at Idle (←Additive) (Bank 2)	●	●	▲	▲		FL-633
P2190	System Too Rich at Idle (Bank 2)	●	●	▲	▲		FL-639
P2195	HO2S Signal Stuck Lean (Bank 1 / Sensor 1)	●	●	▲	▲		FL-643
P2196	HO2S Signal Stuck Rich (Bank 1 / Sensor 1)	●	●	▲	▲		FL-649
P2197	HO2S Signal Stuck Lean (Bank 2 / Sensor 1)	●	●	▲	▲		FL-652
P2198	HO2S Signal Stuck Rich (Bank 2 / Sensor 1)	●	●	▲	▲		FL-658
P2270	HO2S Signal Stuck Lean (Bank 1 / Sensor 2)	●	●				FL-661
P2271	HO2S Signal Stuck Rich (Bank 1 / Sensor 2)	●	●				FL-666
P2272	HO2S Signal Stuck Lean (Bank 2 / Sensor 2)	●	●				FL-669
P2273	HO2S Signal Stuck Rich (Bank 2 / Sensor 2)	●	●				FL-675
P2610	ECM/PCM Internal Engine Off Timer Performance	●	▲	▲	▲	▲	FL-678
U0001	CAN Communication Malfunction	●	●	▲	▲	▲	FL-680

NOTE

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

DTC P0011 "A" CAMSHAFT POSITION-TIMING OVER-ADVANCED OR SYSTEM PERFORMANCE (BANK 1)
DTC P0021 "A" CAMSHAFT POSITION-TIMING OVER-ADVANCED OR SYSTEM PERFORMANCE (BANK 2)

COMPONENT LOCATION EE4E0BB6



EGRF600A

GENERAL DESCRIPTION EDC6DF7A

Different from the existing fixed cam phase angle type, CVVT(Continuously Variable Valve Timing) is the device which varies cam phase angle continuously to be optimum. And with engine oil pressure, it operates. CVVT consists of OCV(Oil Control Valve) and cam phaser. OCV, mounted on cylinder head, controlls the amount and direction of oil delivered to cam phaser by oil valve which is connected to a solenoid. Cam phaser, rotating cam phaser rotor with pressure and amount of oil produced by OCV, rotates cam shaft forcefully for or against the rotating direction and finally, cam shaft phase changes. With the appliance of CVVT, engine power,fuel efficiency and the quality of exhause gas are improved.

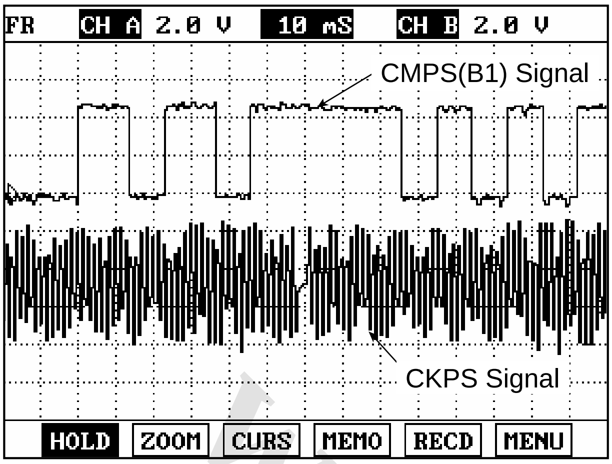
DTC DESCRIPTION E8F7655D

PCM detects CAM phasing average rate while cam offset is available. If the CAM phasing rate is failure in 12 times out of 15 CAM phasing test PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E6CD4B8E

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if the phaser is moving at an expected rate	• Excessive phasing system leakage • Insufficient Oil Pressure (ex. Blockage in OCV filter) • Faulty PCM
Enable Conditions	• Cam Offset is available	
Threshold value	• Cam phasing average rate is out of threshold programmed in PCM	
Diagnosis Time	• Continuous (12 tests failure for 15 cam edge tests)	
MIL On Condition	• 2 driving cycles	

SIGNAL WAVEFORM AND DATA EDE402BE

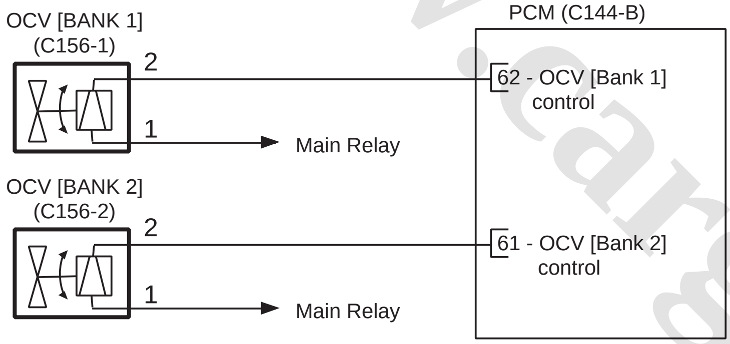


This example shows a typical Crankshaft Position Sensor(CKPS) and Camshaft Position Sensor(CMPS) waveform at idle.
If the Cam Phasing is generated by PCM, the offset of cam target wheel tooth varies against 58X reference tooth of CKPS.
Cam phasing can be detected from offset variation.

EFBF600B

SCHEMATIC DIAGRAM EFE85255

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

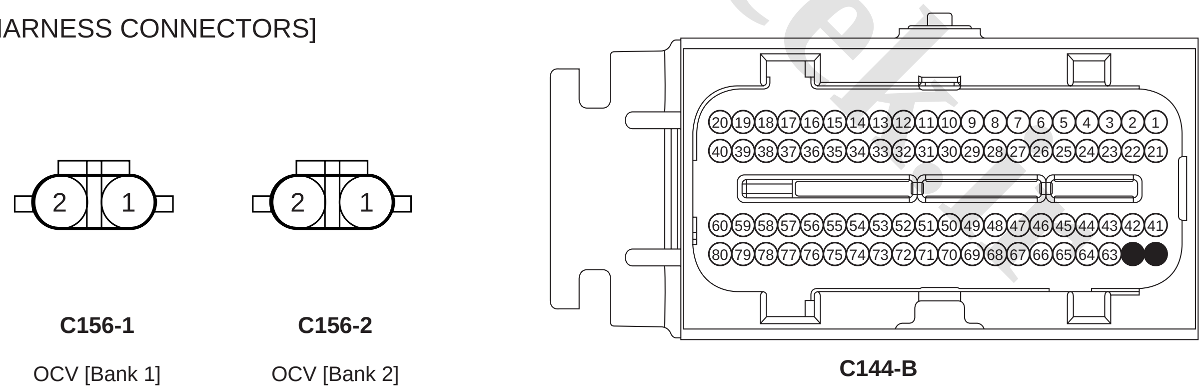
OCV [BANK 1]

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

OCV [BANK 2]

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

[HARNESS CONNECTORS]

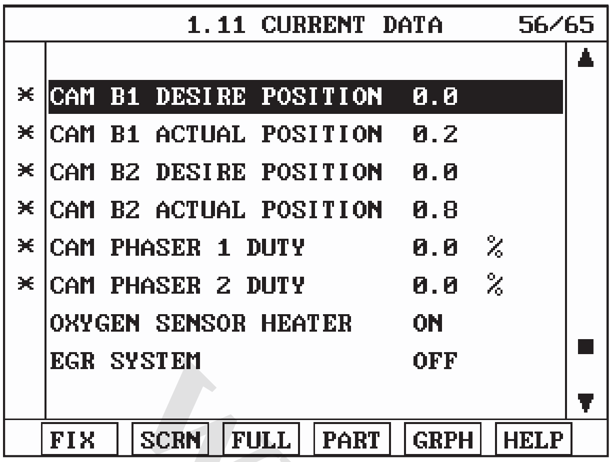


EFBF255A

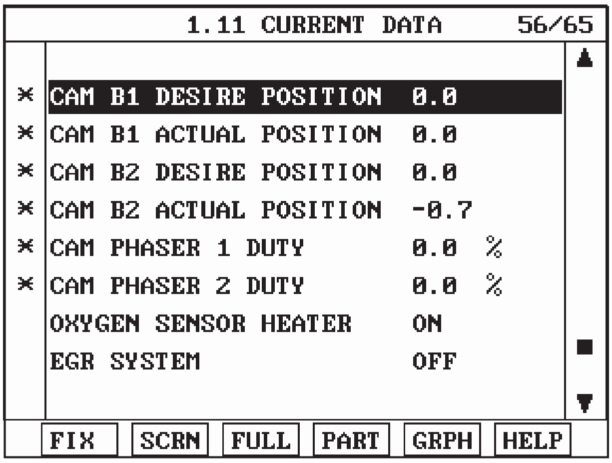
MONITOR SCANTOOL DATA E9DC6B64

1. Connect scantool and ENG "ON".
2. Monitor "CMPS(B1/B2)" on the service data.

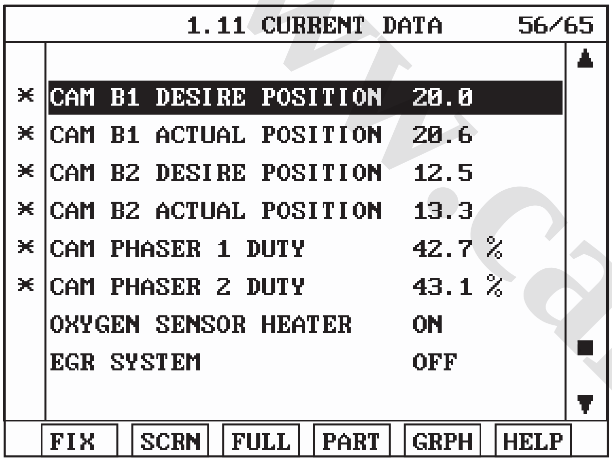
[P0011]



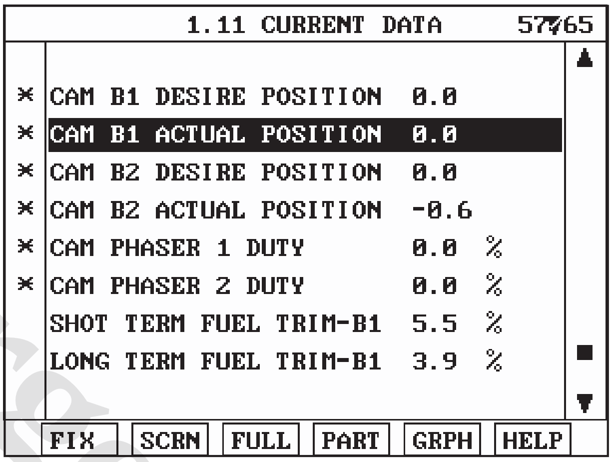
Normal data - idle



Open circuit - idle



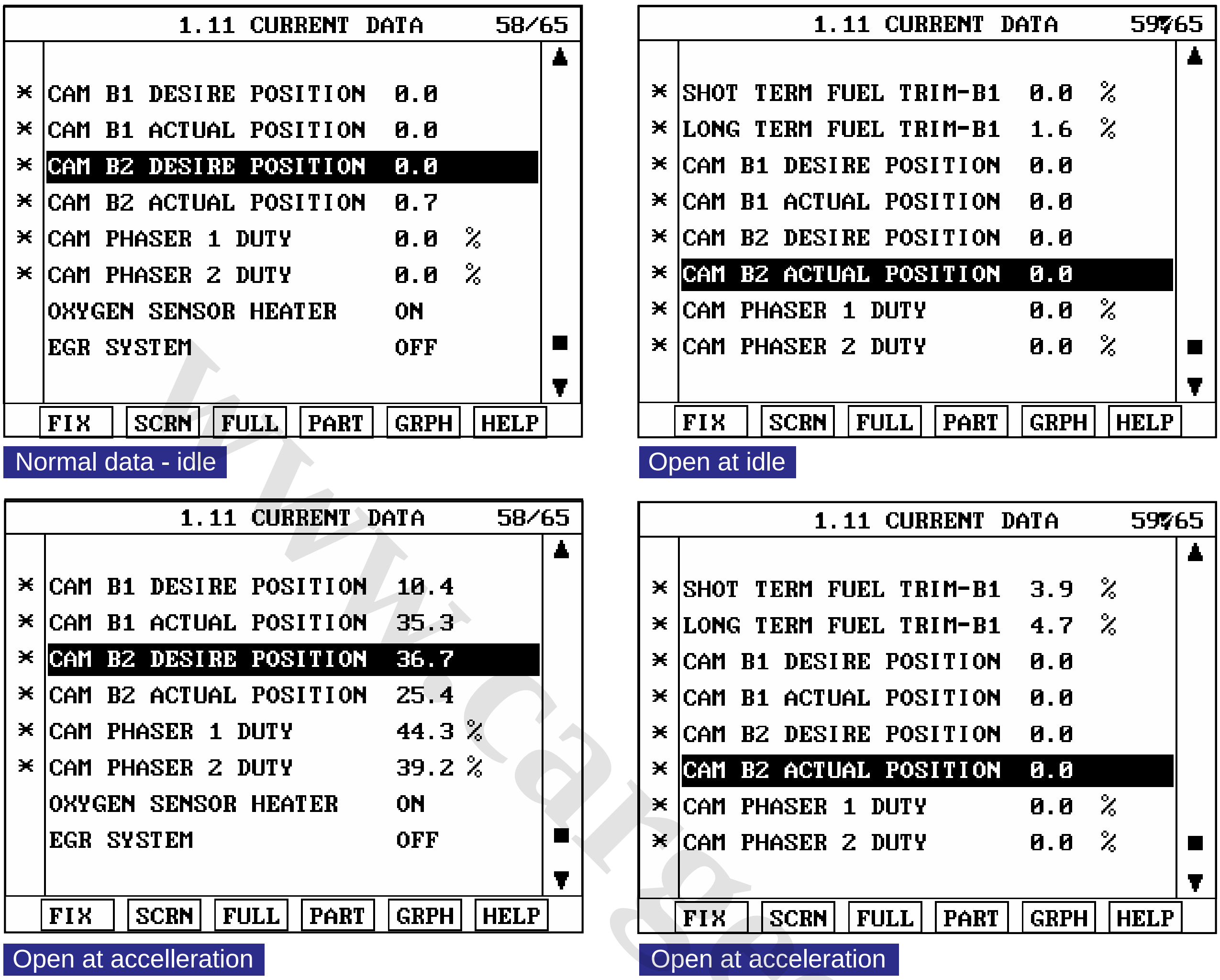
Normal at accelleration



Open at accelleration

EGRF600C

[P0021]



Normal data - idle

Open at idle

Open at accelleration

Open at acceleration

EGRF600Q

3. Are the "CMPS(B1)" data displayed correctly ?

YES

▶ 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, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "System Inspection" procedure.

SYSTEM INSPECTION EC74F4B2

1. Visual Inspection

   1) Check oil level is O.K.

   2) Check oil is contaminated.

   3) Check that any oil leakage or blockage is occurred on the parts related to CVVT.

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 E525ECAC

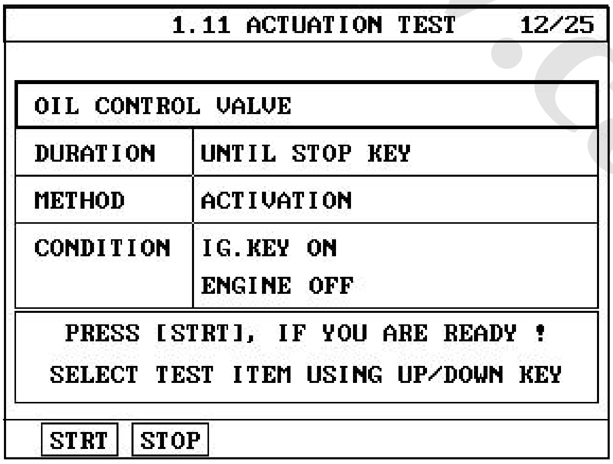
1. Check OCV

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



EGRF600D

5) Has a problem been found ?

YES

▶ 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.

NO

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

VERIFICATION OF VEHICLE REPAIR EFE0D7FD

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.

2. Using a Scantool, Clear the DTCs

3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E75A42A4

Refer to DTC P0011.

GENERAL DESCRIPTION E477C5EB

Refer to DTC P0011.

DTC DESCRIPTION E8934643

Figure1. illustrates the method for detecting unresolved phasing steady-state error.
The figure shows two cases, case 1 to the left of the dashed line, and case 2 to the right of the dashed line. In case 1,the duty cycle command is considered high, or above a calibration threshold memorized in PCM. This should cause the cam phaser to move toward the maximum position, but the position remains at a medium level. The range of positions considered ‘ medium’ is defined by calibrations.
In case 2, the duty cycle command is considered low, or below a calibration threshold memorized in PCM. This should cause the cam phaser to move toward the minimum position, but the position remains at a medium level.
Each of these cases is a phaser position error failure. Each case is also considered to be due to a phaser seizure. When either case is detected, a timing counter begins to increment. If the counter exceeds a calibration threshold memorized in PCM, the failure criteria is TRUE.
Another similar diagnostic test is performed to check steady-state error. In this test, no consideration is given to the duty cycle command versus phaser position. This test is only a check of the phasing position error. In the test, if the phaser error is greater than a calibration threshold memorized in PCM,a timing counter increments. If the counter exceeds the calibration threshold memorized in PCM,the failure criteria is TRUE.

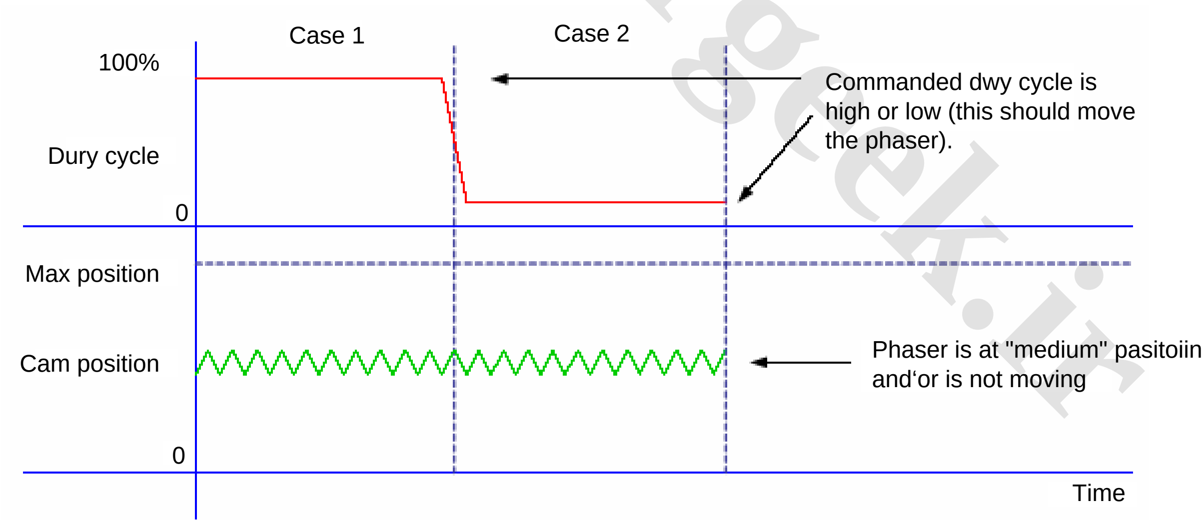


Fig. 1

EGRF600F

PCM monitors CAM phaser error while both cam offset is available and cam velocity is below 15CAD/s .If the CAM phaser does not move although PCM commands OCV duty cycle, PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E28C01DF

Item		Detecting Condition	Possible cause
DTC Strategy		• Determines if the phaser is stuck or has steady-state error	• Engine Oil • OCV • CVVT stuck • PCM
Enable Conditions		• Offsets available • Cam velocity below threshold 〈 15 CAD/s	
Thresh old value	Case 1	• 5 CAD 〈 Cam position 〈 50 CAD • Duty Cycle 〉 90% • Duty Cycle 〈 10% • Timing Counter 〉 80	
	Case 2	• Cam Position error 〉 15 CAD • Timing Counter 〉 80	
Diagnosis Time		• Continuous (More than 0.75sec. Test failure for every 90sec tests)	
MIL On Condition		• 2 Driving Cycles	

SCHEMATIC DIAGRAM E35F3AE4

Refer to DTC P0011.

SIGNAL WAVEFORM AND DATA EEEC5C63

Refer to DTC P0011.

MONITOR SCANTOOL DATA E9073BE5

Refer to DTC P0011.

SYSTEM INSPECTION E7620D4E

1. Visual Inspection

   1) Check oil level is O.K.

   2) Check oil is contaminated.

   3) Has a problem been found ?

   YES

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

   NO

   ▶ Go to "Component Inspection" procedure.

COMPONENT INSPECTION ECBF6E8A

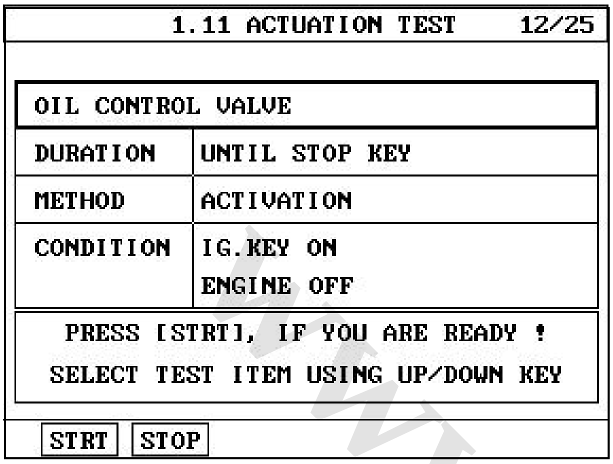
1. Check OCV

   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



EGRF600H

5) Has a problem been found ?

YES

▶ 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.

NO

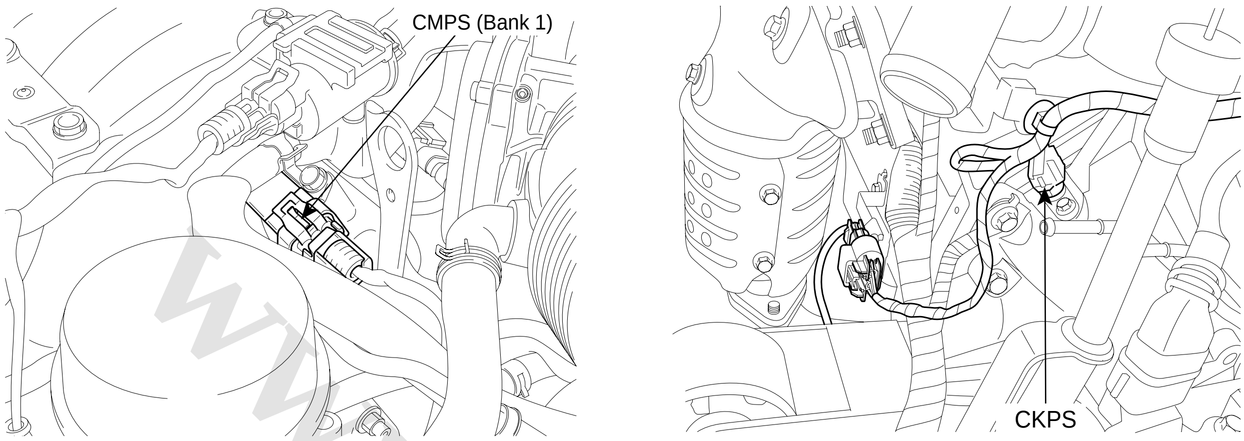
▶ Substitute with a known - good CVVT and check for proper operation. If the problem is corrected, replace CVVT and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E876A33D

Refer to DTC P0011.

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

COMPONENT LOCATION EDAFA785



EGRF990F

GENERAL DESCRIPTION E144D534

Different from the existing fixed cam phase angle type, CVVT(Continuously Variable Valve Timing) is the device which varies cam phase angle continuously to be optimum. And with engine oil pressure, it operates. CVVT consists of OCV(Oil Control Valve) and cam phaser. OCV, mounted on cylinder head, controlls the amount and direction of oil delivered to cam phaser by oil valve which is connected to a solenoid. Cam phaser, rotating cam phaser rotor with pressure and amount of oil produced by OCV, rotates cam shaft forcefully for or against the rotating direction and finally, cam shaft phase changes. With the appliance of CVVT, engine power,fuel efficiency and the quality of exhause gas are improved.

DTC DESCRIPTION E0A42341

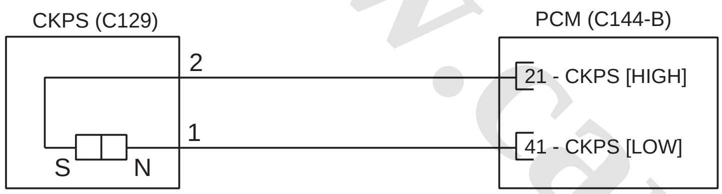
Tooth offsets are learned, updated, stored and initialized. For a given cam target wheel and systemcalibration, the tooth offsets should maintain relatively steady values. If the values of tooth offsets are observed to drift outside of an established range, then a failure is present for measuring cam phasing.
This diagnosis is to verify that learned tooth offsets are within an acceptable range.
PCM monitors tooth offset while no active faults is present.If the tooth offsets is out of threshold during more than 6 offset learning for 36 offset learning, PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E6CEB109

Item		Detecting Condition	Possible cause
DTC Strategy		• Determines if CAM target is aligned correctly to crank	• CKPS, CMPS • CVVT • Timing Misalignment • PCM
Enable Conditions		• No active faults	
Thresh old value	Case 1	• Real Offset Value 〈 Min. Cam Offset programmed in PCM	
	Case 2	• Real Offset Value 〉 Max. Cam Offset programmed in PCM	
Diagnosis Time		• Continuous (More than 6 offset learning failure for 36 offset learning)	
MIL On Condition		• 2 driving Cycles	

SCHEMATIC DIAGRAM EABD6BA2

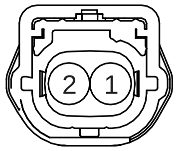
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

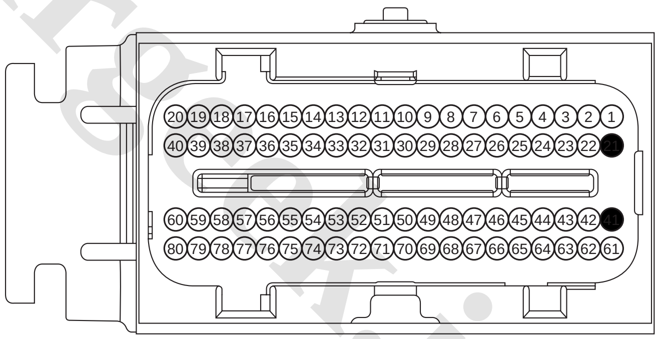
Terminal	Connected to	Funtion
1	PCM C144-B (41)	CKPS [LOW] Signal
2	PCM C144-B (21)	CKPS [HIGH] Signal

[HARNESS CONNECTORS]



C129

CKPS

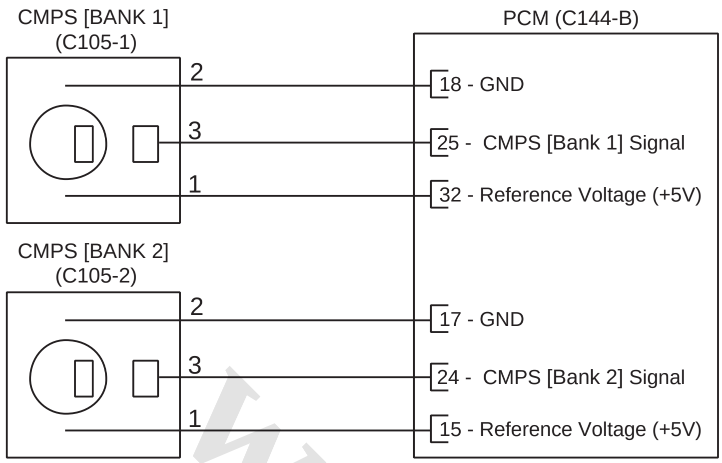


C144-B

PCM

EFBF246A

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

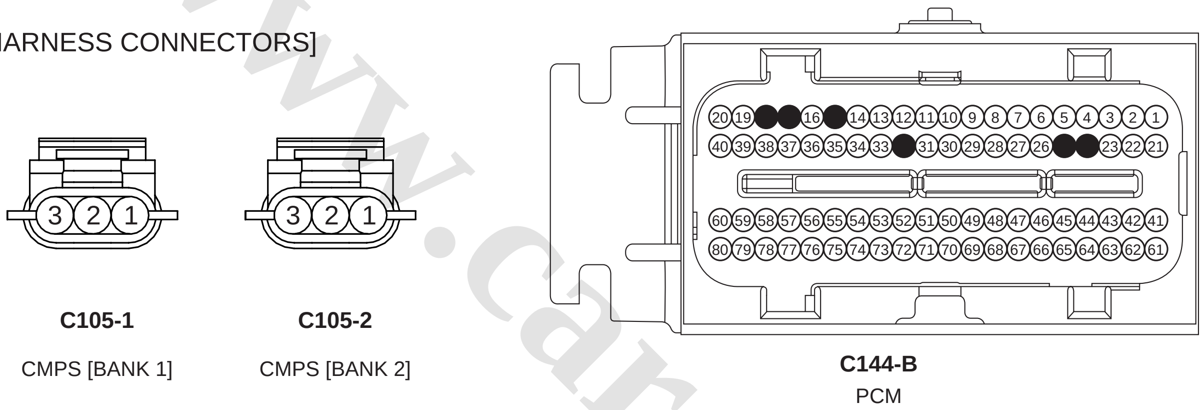
CMPS [BANK 1]

Terminal	Connected to	Funtion
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]

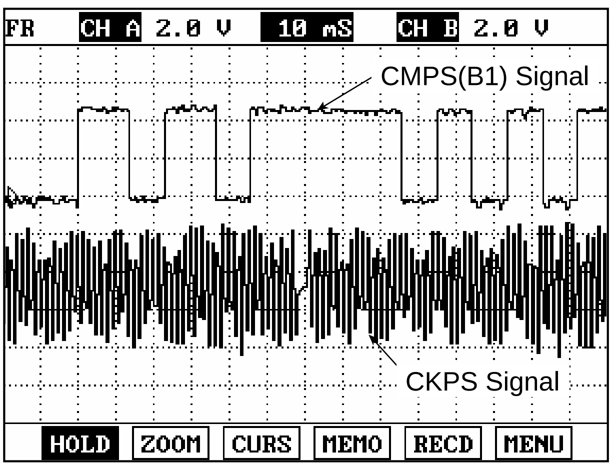
Terminal	Connected to	Funtion
1	PCM C144-B (15)	Reference Voltage (+5V)
2	PCM C144-B (17)	Sensor ground
3	PCM C144-B (24)	CMPS [Bank 2] signal

[HARNESS CONNECTORS]



EFBF244A

SIGNAL WAVEFORM AND DATA E67BB7AC

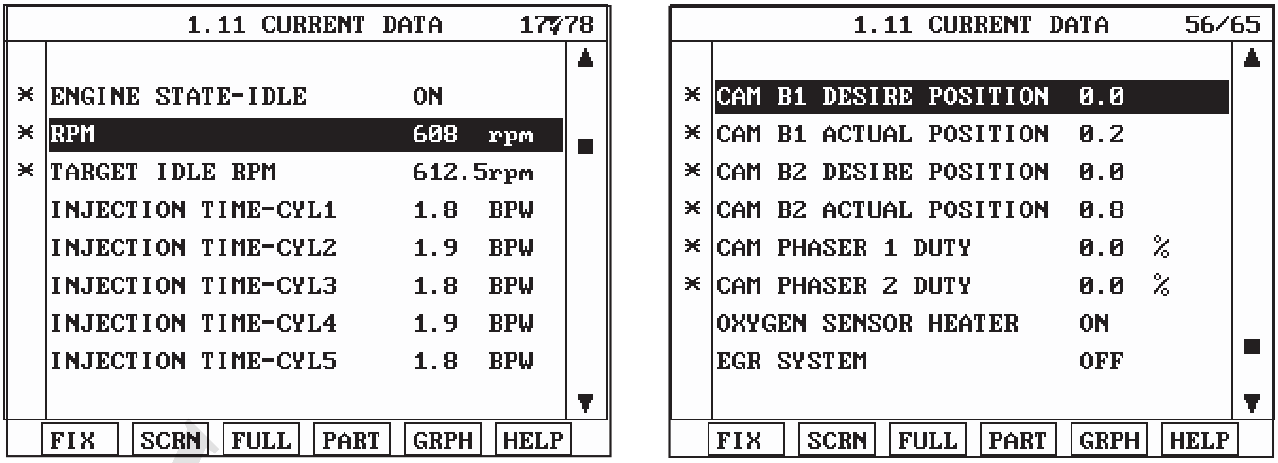


This example shows a typical Crankshaft Position Sensor(CKPS) and Camshaft Position Sensor(CMPS) waveform at idle.
If the Cam Phasing is generated by PCM, the offset of cam target wheel tooth varies against 58X reference tooth of CKPS.
Cam phasing can be detected from offset variation.

EFBF600B

MONITOR SCANTOOL DATA EFE9D9D8

1. Connect scantool and warm -up the engine until normal operating temperature.
2. Monitor "CAM, Engine speed" on service data.



EGRF987O

3. Are the "CMPS(B1) & Engine RPM" data displayed correctly ?

YES

▶ 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, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Terminaal and connector inpection" procedure.

TERMINAL AND CONNECTOR INSPECTION E73FEC81

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

▶ 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, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "System inspection" procedure.

SYSTEM INSPECTION EC54F815

1. Check CMPS

   1) IG "OFF" & Disconnect CMPS connector.

   2) IG "ON" & Measure voltage between terminal 1,2 & 3 of CMPS(B1) harness connector and chassis ground.

Specification :
Terminal 1. approx. 5V
Terminal 2. approx. below 1V
Terminal 3. approx. 5V

3) Is the measured voltage within specification ?

YES

▶ Go to Check "CKPS" as follow.

NO

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

2. Check CKPS

1) IG "OFF" and disconnect CKPS connector.

2) IG "ON" ＆ Measure voltage between terminal 1 ＆ 2 of CKPS harness connecotor and chassis ground.

Specification : Approximately 1.4V

3) 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 E7C940BA

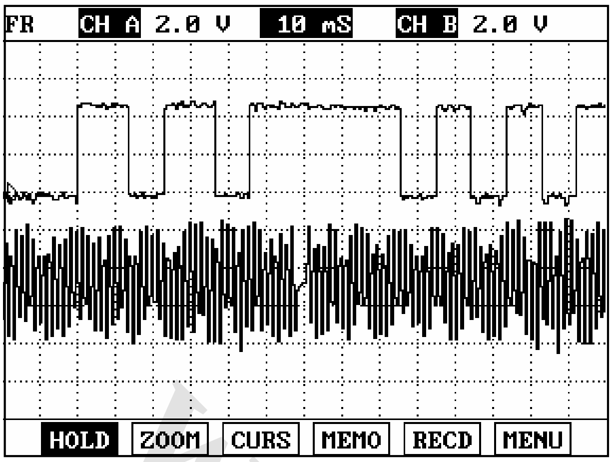
1. CMPS, CKPS Inspection

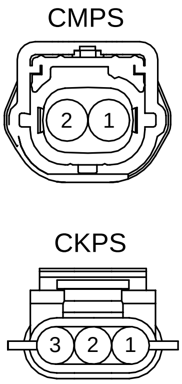
1) IG "OFF" and connect scantool.

2) ENG "ON" and Measure signal waveform at terminal 3 of CMPS.

3) Measure signal waveform at terminal 1 or 2 of CKPS.

SPECIFICATION :





EGRF987R

4) 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 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 to reuse the PCM on the others.

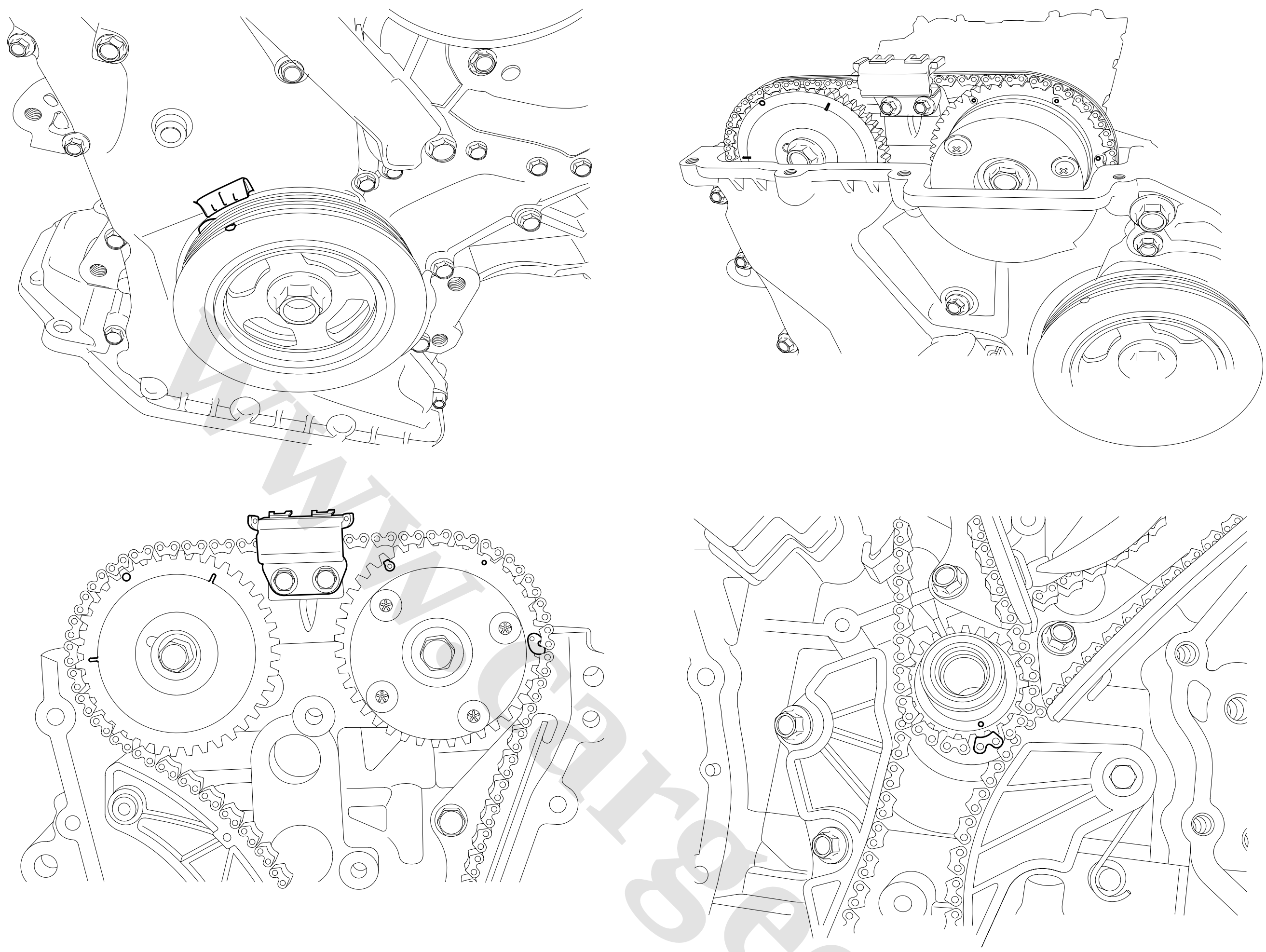
NO

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

2. Timing Mark Inspection.

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

REFERENCE :



KGRF305C

2) Is the timing mark correctly aligned ?

YES

▶ Substitute with a known - good CVVT and check for proper operation. If the problem is corrected, replace CVVT 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 E8DCBA84

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions

4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

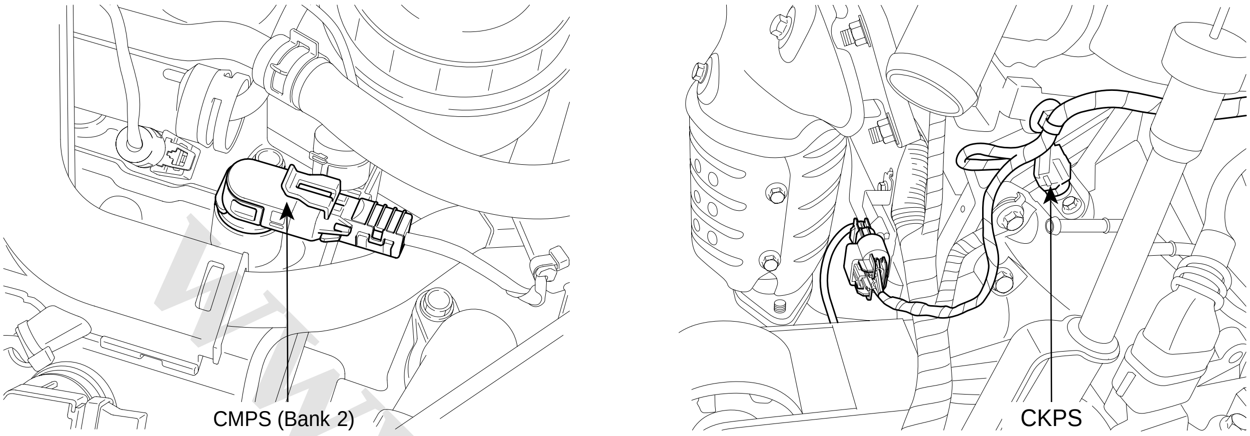
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION EAF241EB



EGRF600O

GENERAL DESCRIPTION EA7449FD

Different from the existing fixed cam phase angle type, CVVT(Continuously Variable Valve Timing) is the device which varies cam phase angle continuously to be optimum. And with engine oil pressure, it operates. CVVT consists of OCV(Oil Control Valve) and cam phaser. OCV, mounted on cylinder head, controlls the amount and direction of oil delivered to cam phaser by oil valve which is connected to a solenoid. Cam phaser, rotating cam phaser rotor with pressure and amount of oil produced by OCV, rotates cam shaft forcefully for or against the rotating direction and finally, cam shaft phase changes. With the appliance of CVVT, engine power,fuel efficiency and the quality of exhause gas are improved.

DTC DESCRIPTION EF635F5D

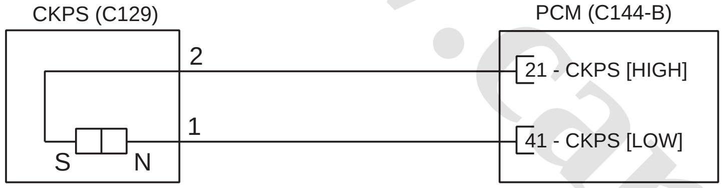
Tooth offsets are learned, updated, stored and initialized. For a given cam target wheel and systemcalibration, the tooth offsets should maintain relatively steady values. If the values of tooth offsets are observed to drift outside of an established range, then a failure is present for measuring cam phasing.
This diagnosis is to verify that learned tooth offsets are within an acceptable range.
PCM monitors tooth offset while no active faults is present. If the tooth offsets is out of threshold during more than 6 offset learning for 36 offset learning, PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E53F6AD6

Item		Detecting Condition	Possible cause
DTC Strategy		• Determines if CAM(B2) target is aligned correctly to crank	• CKPS, CMPS(B2) • CVVT • Timing Misalignment • PCM
Enable Conditions		• No active faults	
Thresh old value	Case 1	• Real Offset Value 〈 Min. Cam Offset programmed in PCM	
	Case 2	• Real Offset Value 〉 Max. Cam Offset programmed in PCM	
Diagnosis Time		• Continuous (More than 6 offset learning failure for 36 offset learning)	
MIL On Condition		• 2 driving Cycles	

SCHEMATIC DIAGRAM E547DD47

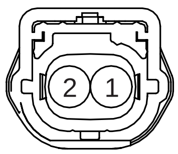
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

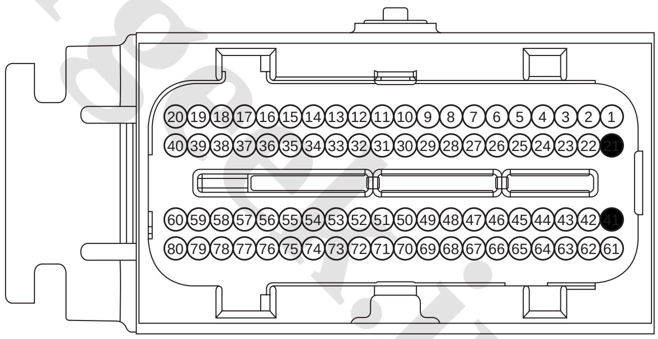
Terminal	Connected to	Funtion
1	PCM C144-B (41)	CKPS [LOW] Signal
2	PCM C144-B (21)	CKPS [HIGH] Signal

[HARNESS CONNECTORS]



C129

CKPS

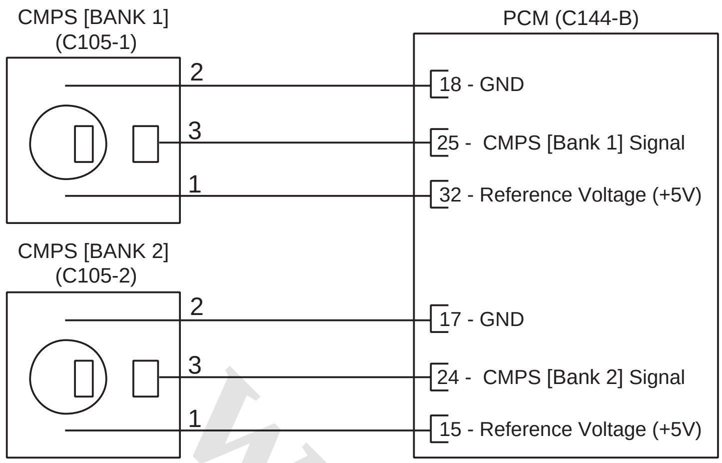


C144-B

PCM

EFBF246A

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

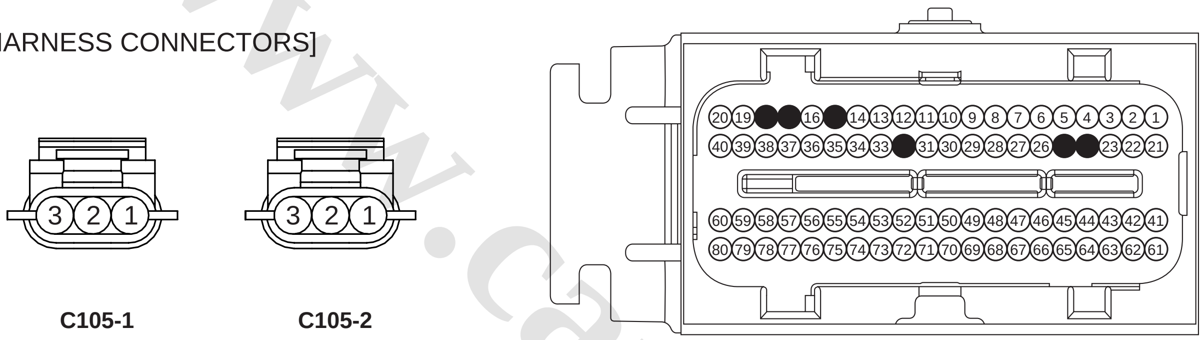
CMPS [BANK 1]

Terminal	Connected to	Funtion
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	Funtion
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

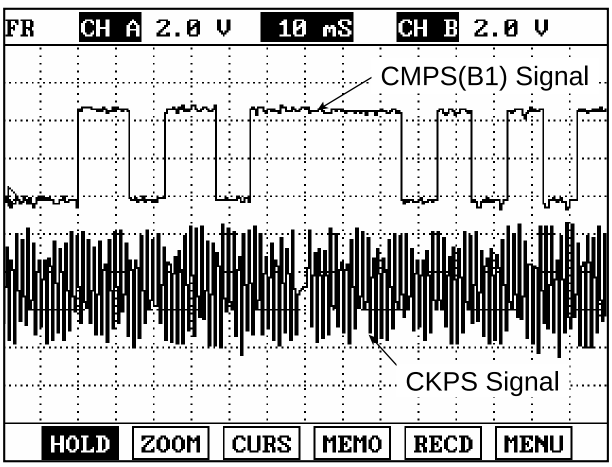
CMPS [BANK 2]

C144-B

PCM

EFBF244A

SIGNAL WAVEFORM AND DATA E3FC2888

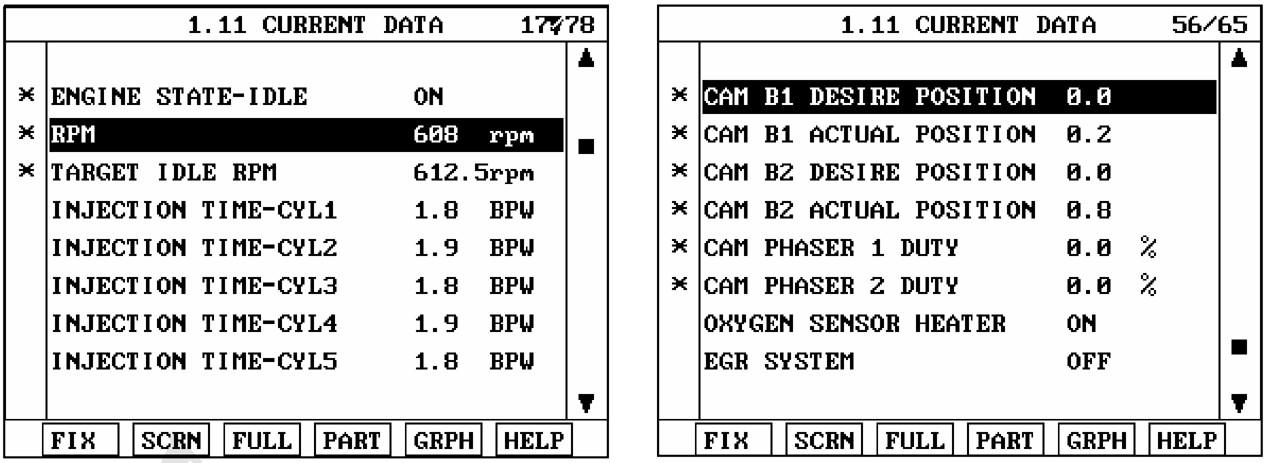


This example shows a typical Crankshaft Position Sensor(CKPS) and Camshaft Position Sensor(CMPS) waveform at idle. If the Cam Phasing is generated by PCM, the offset of cam target wheel tooth varies against 58X reference tooth of CKPS. Cam phasing can be detected from offset variation.

EFBF600B

MONITOR SCANTOOL DATA E556CF3F

1. Connect scantool and warm -up the engine until normal operating temperature.
2. Monitor "CAM, Engine speed" on service data.



EGRF600K

3. Are the "CMPS(B2) & Engine RPM" data displayed correctly ?

YES

▶ 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, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Terminaal and connector inpection" procedure.

TERMINAL AND CONNECTOR INSPECTION EE8530AA

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 "System Inspection" procedure.

SYSTEM INSPECTION E3DF6675

1. Check CMPS

1) IG "OFF" & Disconnect CMPS connector.

2) IG "ON" & Measure voltage between terminal 1,2 & 3 of CMPS(B2) harness connector and chassis ground.

Specification :
Terminal 1. approx. 5V
Terminal 2. approx. below 1V
Terminal 3. approx. 5V

3) Is the measured voltage within specification ?

YES

▶ Go to Check "CKPS" as follow.

NO

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

2. Check CKPS

1) IG "OFF" and disconnect CKPS connector.

2) IG "ON" ＆ Measure voltage between terminal 1 ＆ 2 of CKPS harness connecotor and chassis ground.

Specification : Approximately 1.4V

3) 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 E112783C

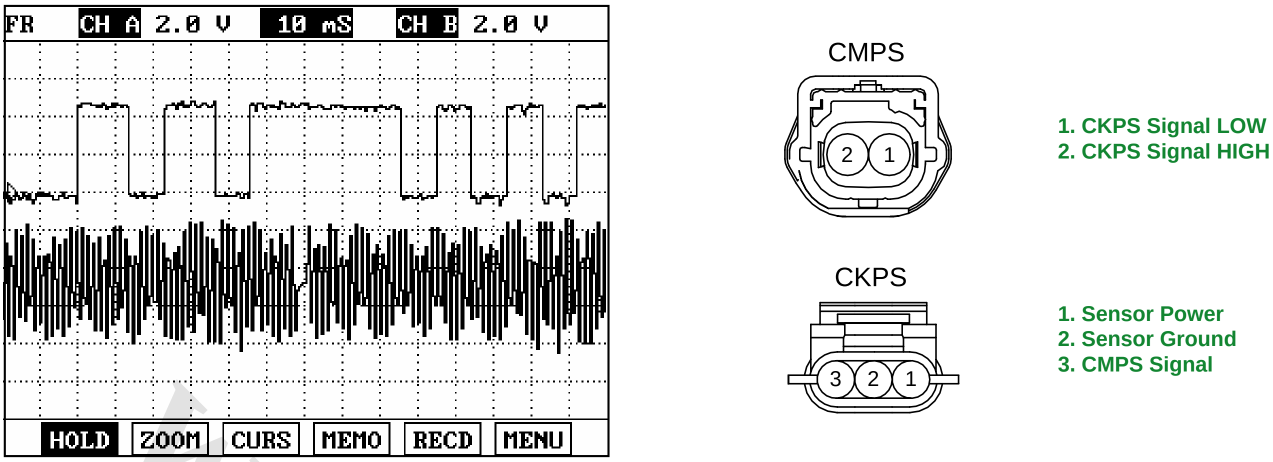
1. CMPS, CKPS Inspection

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 :



EGRF987R

4) 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 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 to reuse the PCM on the others

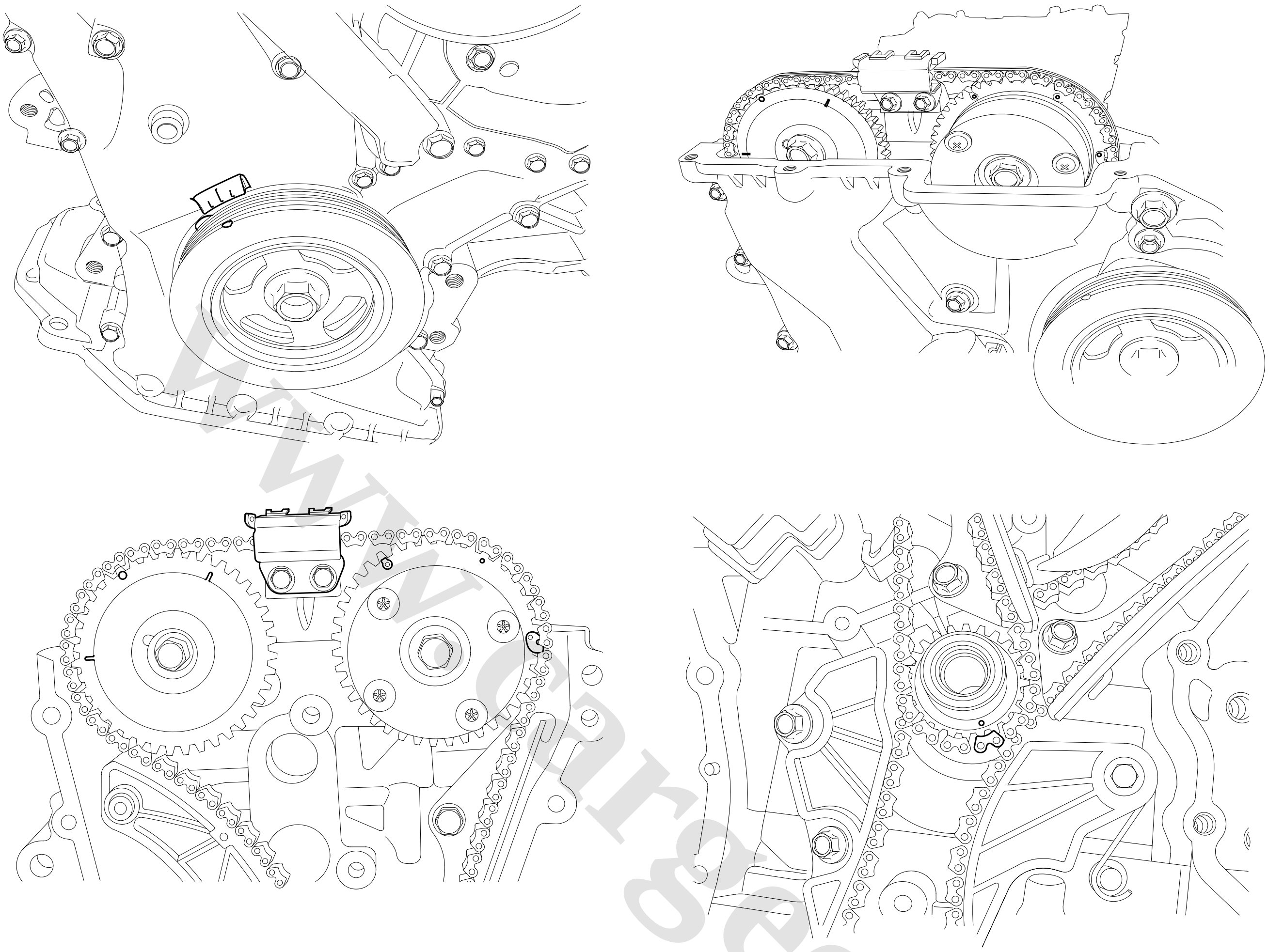
NO

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

2. Timing Mark Inspection

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

REFERNCE :



KGRF305C

2) Is the timing mark correctly aligned ?

YES

▶ Substitute with a known - good CVVT and check for proper operation. If the problem is corrected, replace CVVT 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 E199EA1D

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions

4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

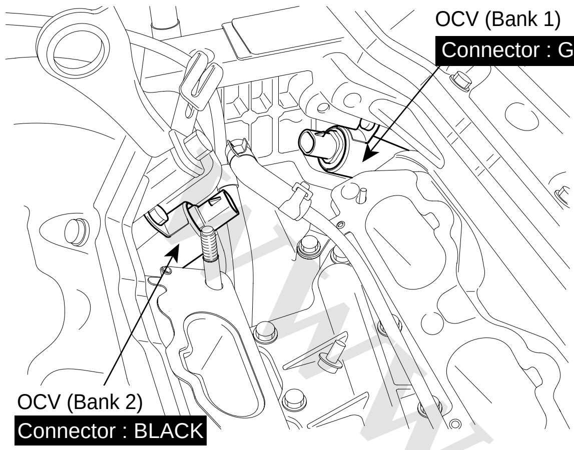
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E605F3B1



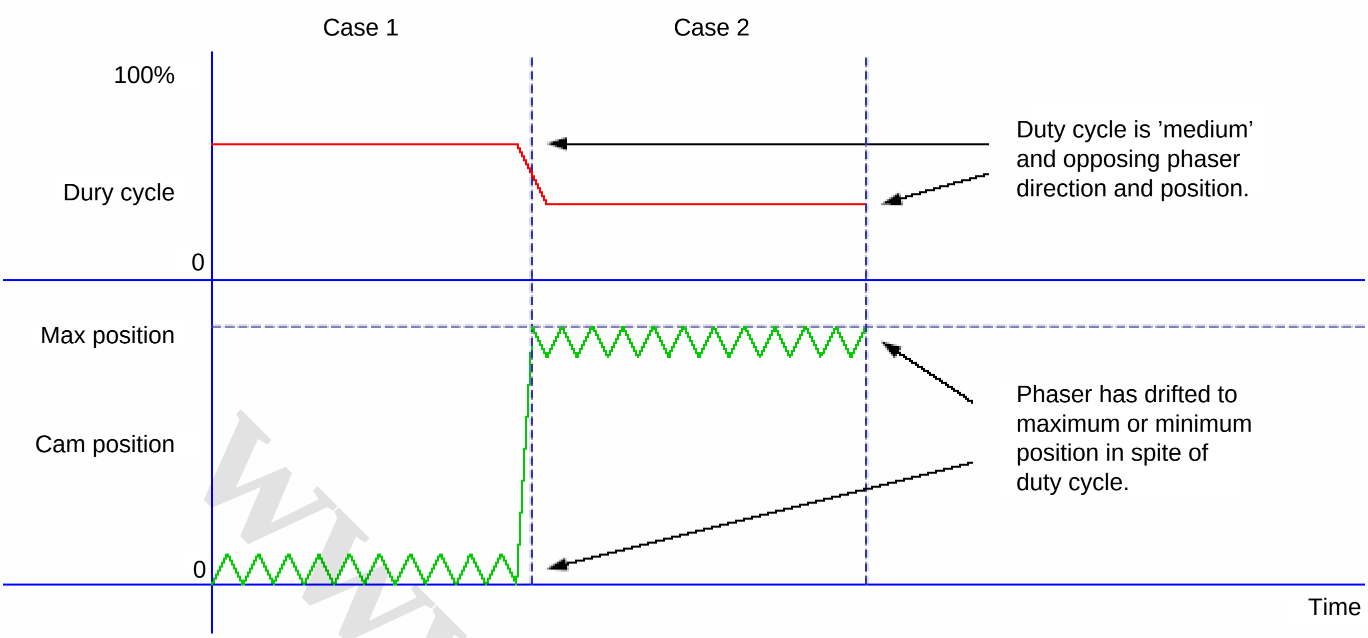
EGRF600A

GENERAL DESCRIPTION E11FFAF3

Different from the existing fixed cam phase angle type, CVVT(Continuously Variable Valve Timing) is the device which varies cam phase angle continuously to be optimum. And with engine oil pressure, it operates. CVVT consists of OCV(Oil Control Valve) and cam phaser. OCV, mounted on cylinder head, controlls the amount and direction of oil delivered to cam phaser by oil valve which is connected to a solenoid. Cam phaser, rotating cam phaser rotor with pressure and amount of oil produced by OCV, rotates cam shaft forcefully for or against the rotating direction and finally, cam shaft phase changes. With the appliance of CVVT, engine power,fuel efficiency and the quality of exhause gas are improved.

DTC DESCRIPTION EC99E69B

Small particles in the engine oil may cause the oil control valve to bind or otherwise get stuck at certain spool positions. A test is used in this diagnostic to detect a stuck valve spool. A cleaning function is then used to try and free the spool. If unsuccessful, the diagnostic test is failed.
Figure 1. illustrates the principle of the valve stuck diagnostic test. As in the phaser error diagnostic illustration, there are two cases shown in the figure. The case on the left shows a case where the dutycycle is above a calibration threshold, yet the phaser position is near the minimum position. Under normal operation, such a duty cycle command would move the phaser toward its maximum position.The case on the right shows the opposite situation. The duty cycle command is below a threshold, yet the phaser position is near its maximum.



EGRF600S

PCM monitors OCV stuck while cam offset is available and Valve cleaning is not in progress .If the PCM detects that CAM position angle is over 20 CAD(Crank Angle Degree) than expected cam positionthat PCM controls the OCV while cam position is in designated crank angle degree, PCM determines that a faultexists and a DTC is stored.

DTC DETECTING CONDITION E2990C4E

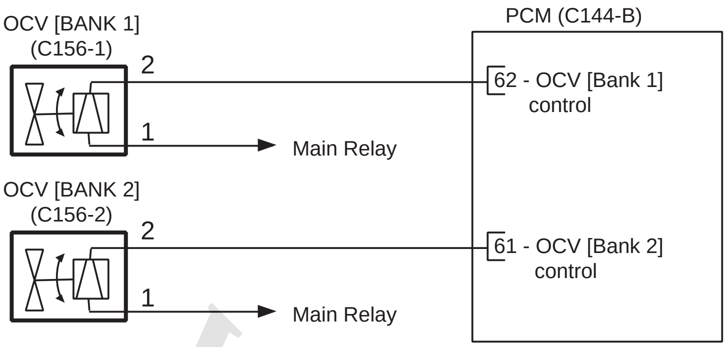
Item		Detecting Condition	Possible cause
DTC Strategy		• Determines if oil control valve is stuck	• Oil Pressure Loss • OCV seizure • PCM
Enable Conditions		• Valve cleaning not in progress • Offsets available	
Thresh old value	Case 1	• Cam position 〉 50 CAD • Cam position Error 〉 20 CAD • Timing counter 〉 56 count	
	Case 2	• Cam position 〈 5 CAD • Cam position Error 〉 20 CAD • Timing counter 〉 56 count	
Diagnosis Time		• Continuous (More than 0.75sec failure for every 56.25 sec. tests)	
MIL On Condition		• 2 driving Cycle	

SPECIFICATION E6599D3B

Resistance (Ω)	6.7 ~ 7.7

SCHEMATIC DIAGRAM E5ACAE49

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

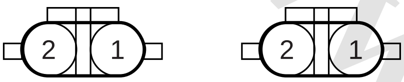
OCV [BANK 1]

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

OCV [BANK 2]

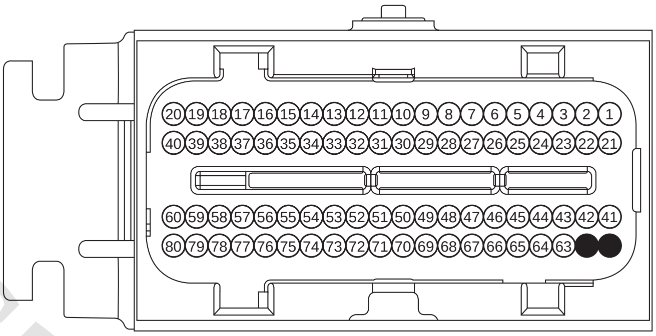
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (61)	OCV [Bank 2] control

[HARNESS CONNECTORS]



C156-1
OCV [Bank 1]

C156-2
OCV [Bank 2]



C144-B
PCM

EFBF255A

SIGNAL WAVEFORM AND DATA E028BEA9

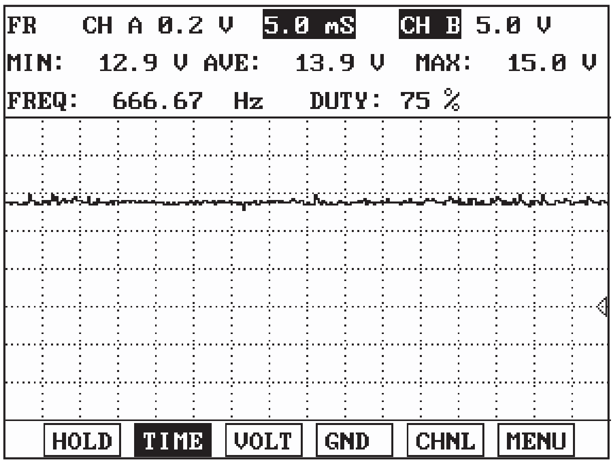


Fig. 1

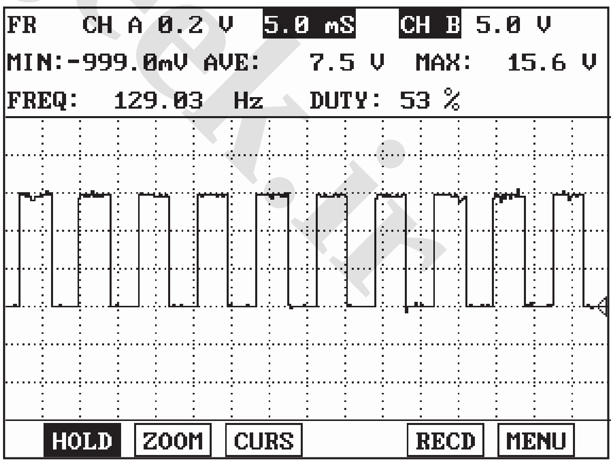


Fig. 2

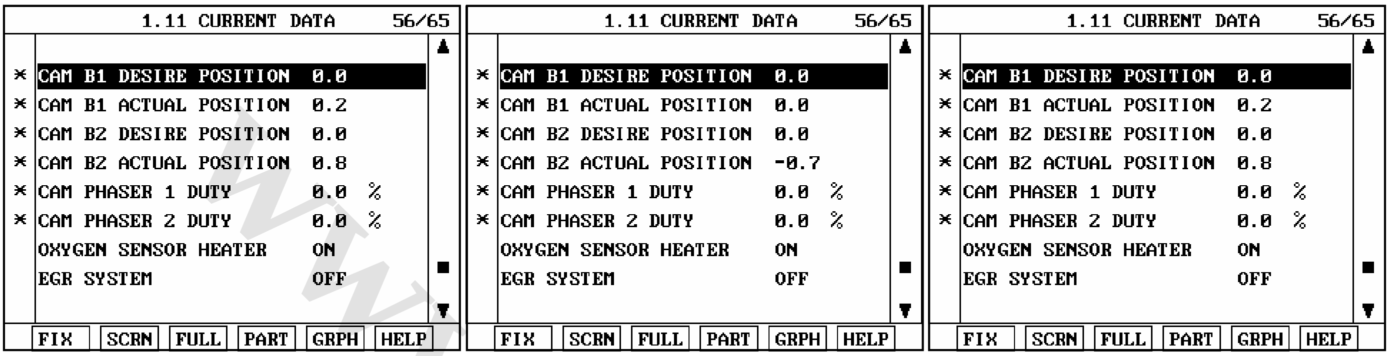
Fig. 1 : Idle - normal Condition
Fig. 2 : Acceleration

EGRF600T

MONITOR SCANTOOL DATA EA879A8A

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "CAM(B1/B2)" status on the service data.

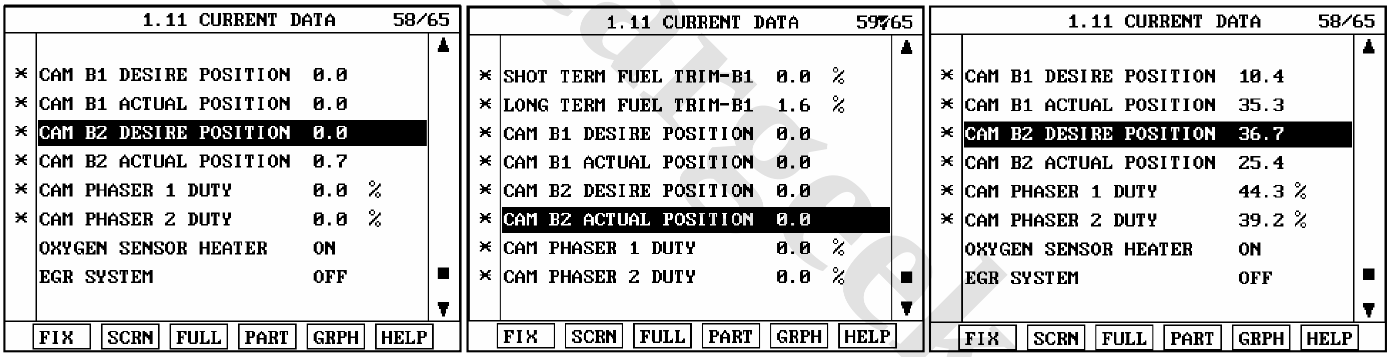
[P0026]



Normal data - idle | Open circuit(CAM B1) - idle | Normal data - acceleration

EGRF600U

[P0028]



Normal data - idle | Open circuit(CAM B1) - idle | Normal data - acceleration

EGRF601A

4. Are the "CMP(B1/B2)" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E48C5924

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to " Power Circuit Inspection " as follow

POWER CIRCUIT INSPECTION E60175AA

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.

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 EDD597FB

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 EBBDA5D4

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

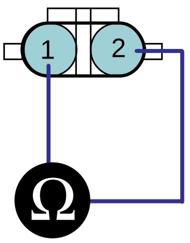
▶ Go to "Component Inspection" procedure

COMPONENT INSPECTION EE76D649

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

SPECIFICATION :

Resistance (Ω)	6.7 ~ 7.7



1. OCV Power
2. OCV Control

EFBF991C

3) Is the measured resistance within specification?

YES

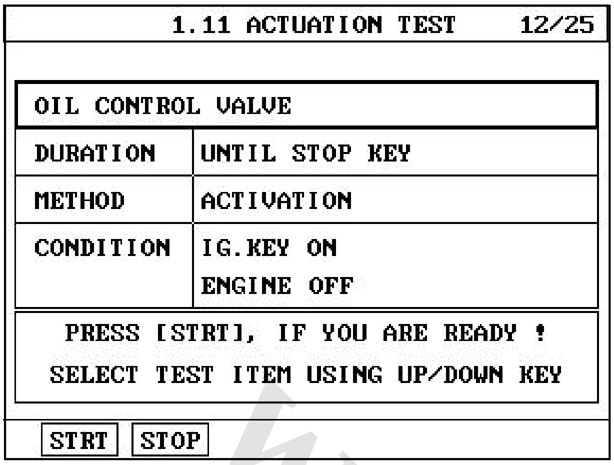
▶ Go to "Actuation Test" as follow.

NO

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

2. Actuation Test
   1) IG "OFF" and connect OCV connector
   2) IG "ON" & ENG "OFF"

3) Check that click sound can be heard when actuation operates with scantool.



EGRF600Y

4) Does the OCV operate corectly when actuation operates ?

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 to reuse the PCM on the others.

NO

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

VERIFICATION OF VEHICLE REPAIR E9C4DF0B

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

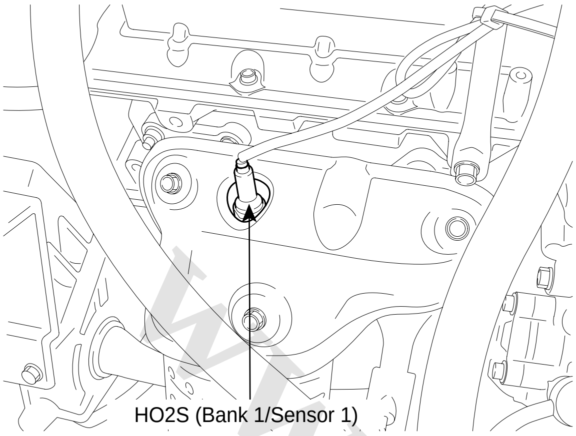
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E24C7594



EGRF601B

GENERAL DESCRIPTION EC5B1BE4

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 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.

DTC DESCRIPTION E0F0A268

If the HO2S heater output voltage is lower than threshold value for more than 5 seconds 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 E4B8C7EF

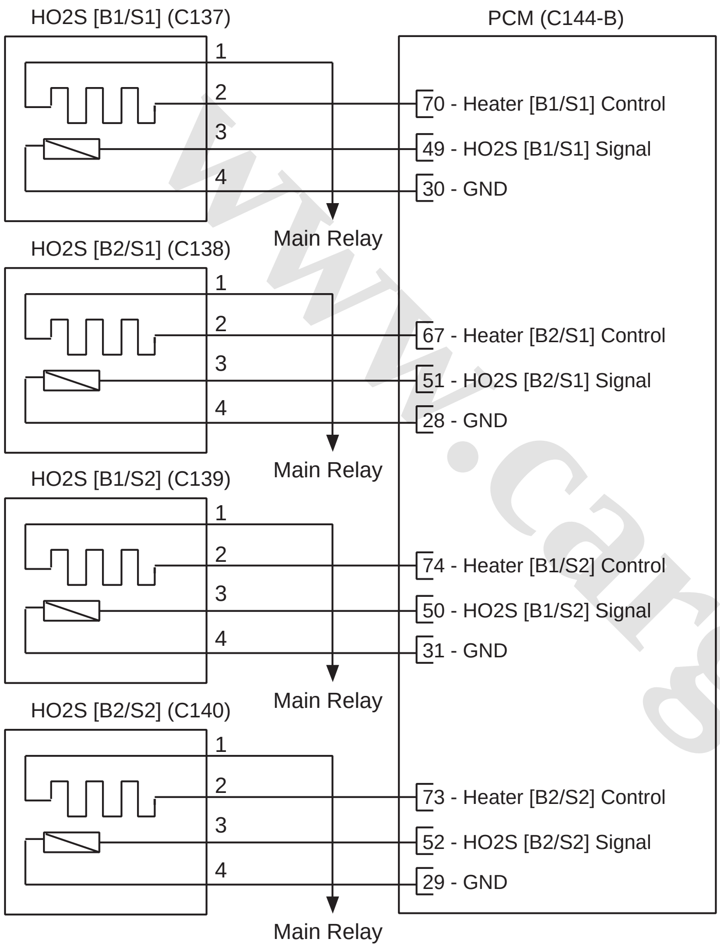
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground or open circuit of O2 sensor heater circuit output	• Poor Connection • Open in Power Circuit • Open or short to ground in control circuit • HO2S(B1/S1) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 E974C936

Heater	
Resistance (Ω)	9.6 ± 1.5

SCHEMATIC DIAGRAM EAD980D3

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

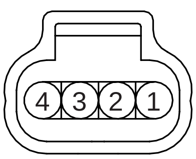
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

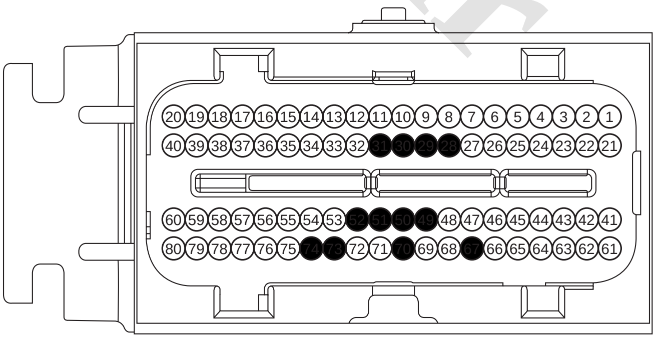
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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]

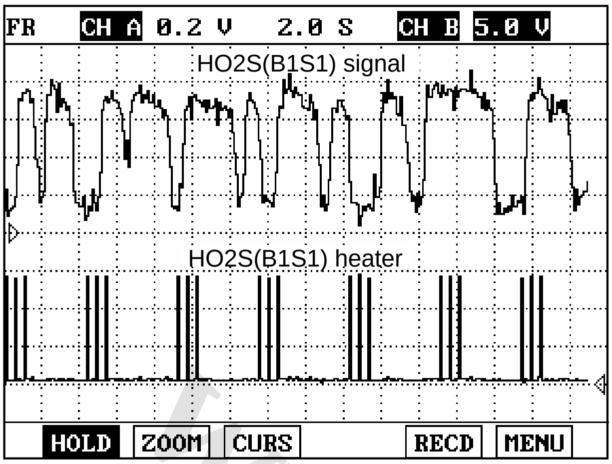


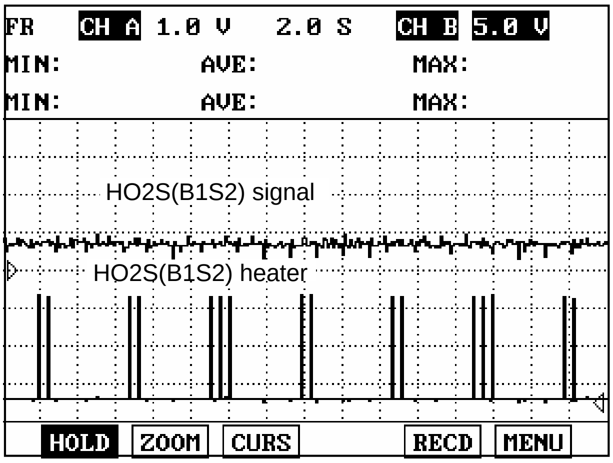
C144-B

PCM

EFBF250A

SIGNAL WAVEFORM AND DATA E22F16FB



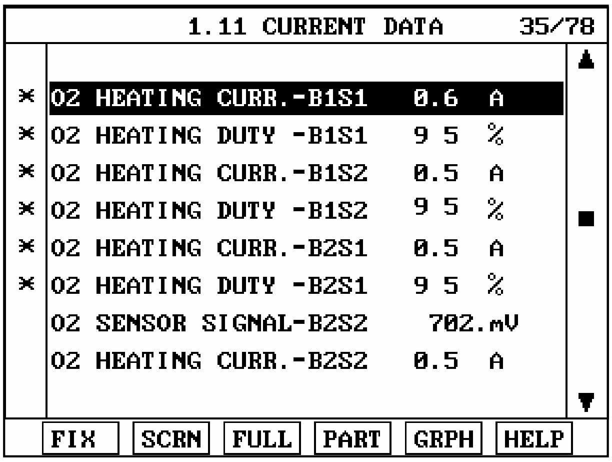


EGRF601C

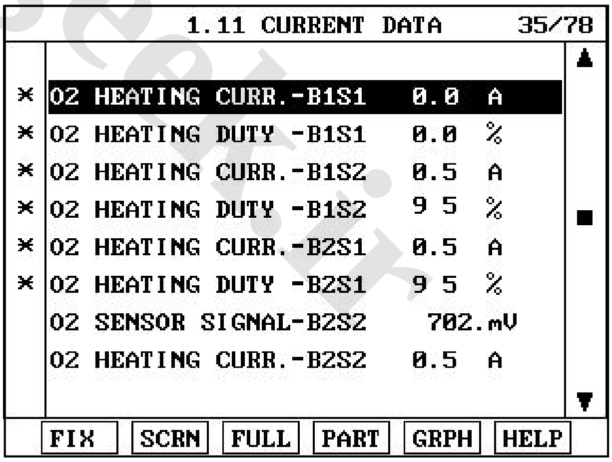
The HO2S requires a minimum temperature to provide a closed loop fuel control system. So the HO2S contains a heater element to reduce its warm-up time and ensure its performance during all driving conditions. The PCM controls this heater element by duty cycle. The main relay supplies voltage to the heater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

MONITOR SCANTOOL DATA E9684266

1. IG "OFF" ＆ connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B1/S1)" status on the service data.



Normal data - idle



Open circuit(HO2S heater-B1S1)

EGRF601D

4. Is the "HO2S Heater(B1/S1)" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EBDFC8C9

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 ED2C99CA

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 E74A8ADD

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 70 of PCM harness connector.

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 "Verifiction of Vehicle Repair" procedure.

COMPONENT INSPECTION EC46511C

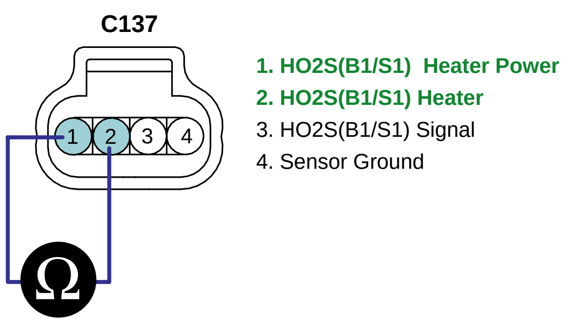
1. Check HO2S(B1/S1) Heater resistance.

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)	9.6 ± 1.5



EFBF601H

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 to reuse the PCM on the others.

NO

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

VERIFICATION OF VEHICLE REPAIR EB6C08D0

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E6DB0906

Refer to DTC P0031.

GENERAL DESCRIPTION EC24FD49

Refer to DTC P0031.

DTC DESCRIPTION EC58CD63

If the HO2S heater output voltage is higher than threshold value for more than 5 seconds 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 E286D3F8

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery in O2 sensor heater circuit output	• Poor Connection • short to battery in control circuit • HO2S(B1/S1) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 E51D6180

Refer to DTC P0031.

SCHEMATIC DIAGRAM EAFDA425

Refer to DTC P0031.

SIGNAL WAVEFORM AND DATA E2262C14

Refer to DTC P0031.

MONITOR SCANTOOL DATA E1DFE71F

Refer to DTC P0031.

TERMINAL AND CONNECTOR INSPECTION E8A5EEA5

Refer to DTC P0031.

POWER CIRCUIT INSPECTION EE45ECDD

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

▶ Check output voltage from alternator then repair or replace as necessary. Go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E3D0DDC2

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

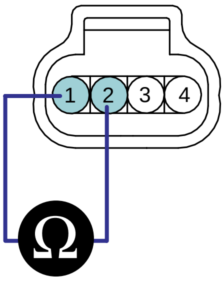
▶ Repair short to battery in HO2S(B1/S1) Heater control circuit and go to "Verification of Vhicle Repair" procedure.

COMPONENT INSPECTION EB2A238A

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)	9.6 ± 1.5



EFBF601H

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 to reuse the PCM on the others.

NO

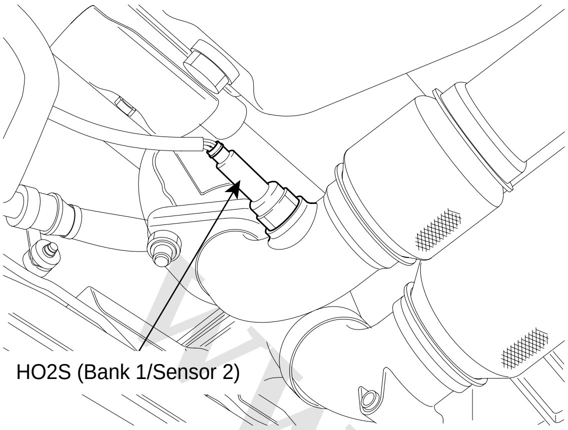
▶ Substitute with a known - good HO2S(B1/S1) and check for proper operation. If the problem is corrected, replace HO2S(B1/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E490D4E6

Refer to DTC P0031.

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

COMPONENT LOCATION E44CFEB2



EGRF601J

GENERAL DESCRIPTION EC4238F4

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter which is able to detect the 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 E4130BD8

If the HO2S heater output voltage is lower than threshold value for more than 5 seconds 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 E1900B70

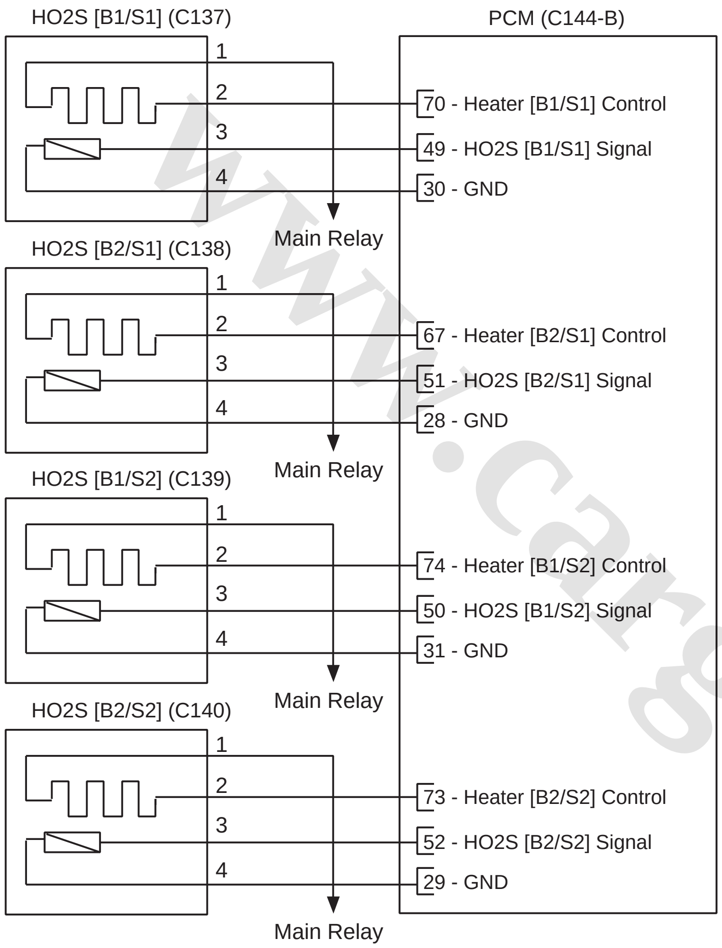
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground or open circuit of O2 sensor heater circuit output	• Poor Connection • Open in Power Circuit • Open or short to ground in control circuit • HO2S(B1/S2) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 E1EBA6DC

Heater	
Resistance (Ω)	9.6 ± 1.5

SCHEMATIC DIAGRAM ED64A0E3

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

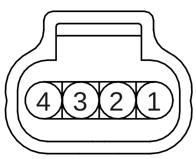
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

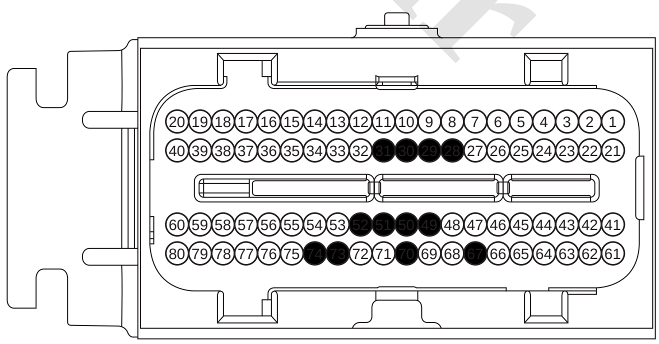
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[HARNESS CONNECTORS]



C137,C138,C139,C140

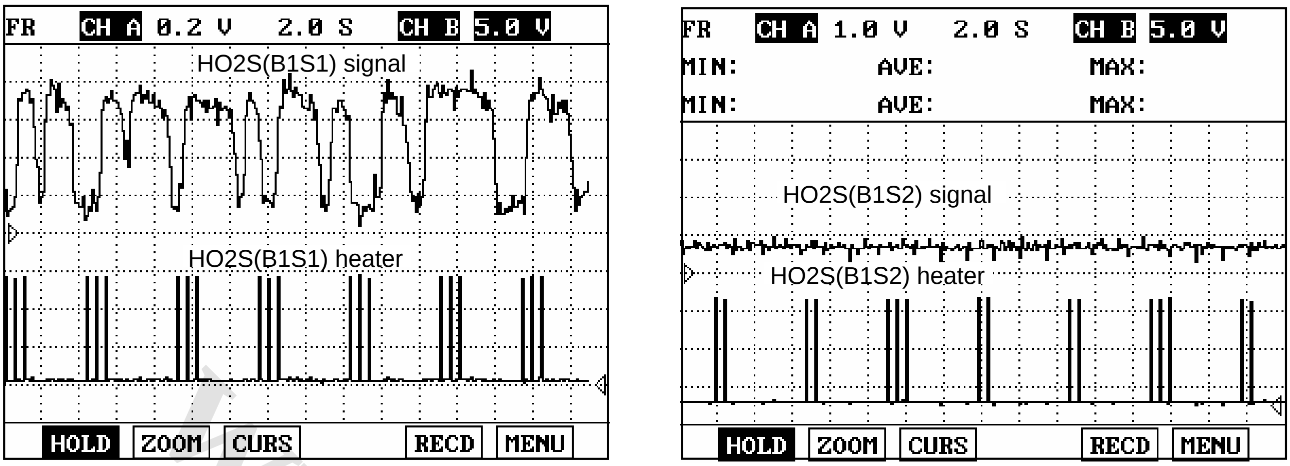
HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



C144-B
PCM

EFBF250A

SIGNAL WAVEFORM AND DATA E5D17E9A



EGRF601C

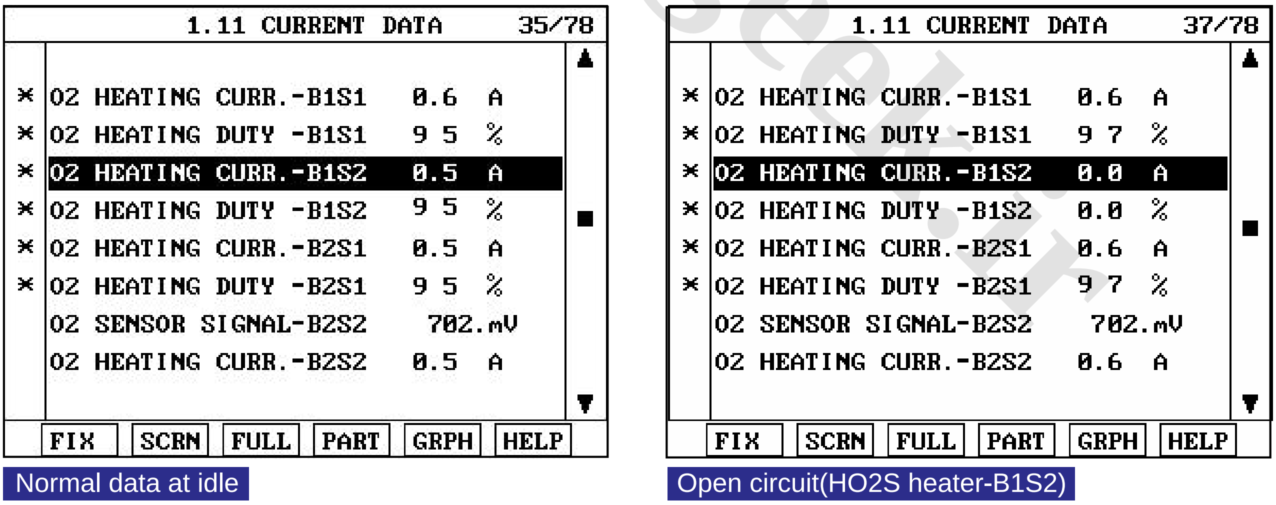
The HO2S requires a minimum temperature to provide a closed loop fuel control system. So the HO2S contains a heater element to reduce its warm-up time and ensure its performance during all driving conditions. The PCM controls this heater element by duty cycle. The main relay supplies voltage to the heater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

MONITOR SCANTOOL DATA E7876189

1. IG "OFF" ＆ connect scantool.

2. ENG "ON" and warm -up the engine to normal operating temperature.

3. Monitor "HO2S(B1/S2)" status on the service data.



EGRF601K

4. Is the "HO2S Heater(B1/S2)" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E299C52E

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 EC86382F

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 E7A99D35

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.

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 "Verifiction of Vehicle Repair" procedure.

COMPONENT INSPECTION ECAF36F4

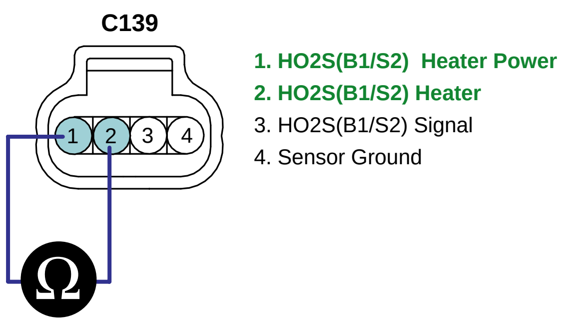
1. Check HO2S(B1/S2) Heater resistance

 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)	9.6 ± 1.5



EFBF987V

 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 to reuse the PCM on the others.

NO

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

VERIFICATION OF VEHICLE REPAIR E487E5A7

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E707449F

Refer to DTC P0037.

GENERAL DESCRIPTION E0550677

Refer to DTC P0037.

DTC DESCRIPTION E9EDB5A4

If the HO2S heater output voltage is higher than threshold value for more than 5 seconds 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 E6A717BB

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery in O2 sensor heater circuit output	• Poor Connection • short to battery in control circuit • HO2S(B1/S2) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 E7B24464

Refer to DTC P0037.

SCHEMATIC DIAGRAM E124637D

Refer to DTC P0037.

SIGNAL WAVEFORM AND DATA EFA385D9

Refer to DTC P0037.

MONITOR SCANTOOL DATA E2544EAE

Refer to DTC P0037.

TERMINAL AND CONNECTOR INSPECTION E1B14637

Refer to DTC P0037.

POWER CIRCUIT INSPECTION EACF196E

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 E5B39163

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

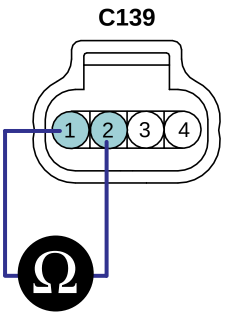
▶ Repair short to battery in HO2S (B1/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E3E9CE08

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)	9.6 ± 1.5



1. HO2S(B1/S2) Heater Power
2. HO2S(B1/S2) Heater
3. HO2S(B1/S2) Signal
4. Sensor Ground

EFBF987V

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 to reuse the PCM on the others.

NO

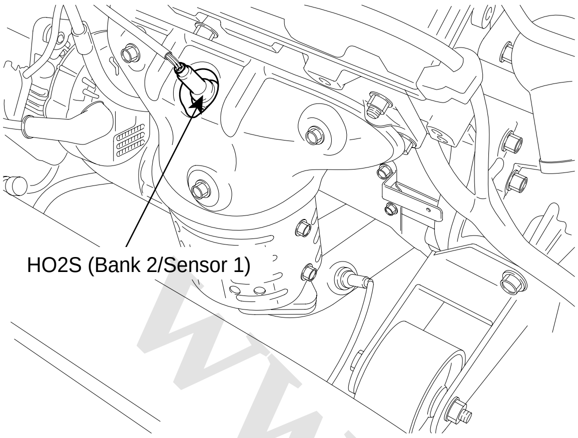
▶ Substitute with a known - good HO2S(B1/S2) and check for proper operation. If the problem is corrected, replace HO2S(B1/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EC05990A

Refer to DTC P0037.

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

COMPONENT LOCATION E0F7B050



EGRF601Q

GENERAL DESCRIPTION EAAF90D6

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 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.

DTC DESCRIPTION E4CBDB35

If the HO2S heater output voltage is lower than threshold value for more than 5 seconds 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 E0A9A8C7

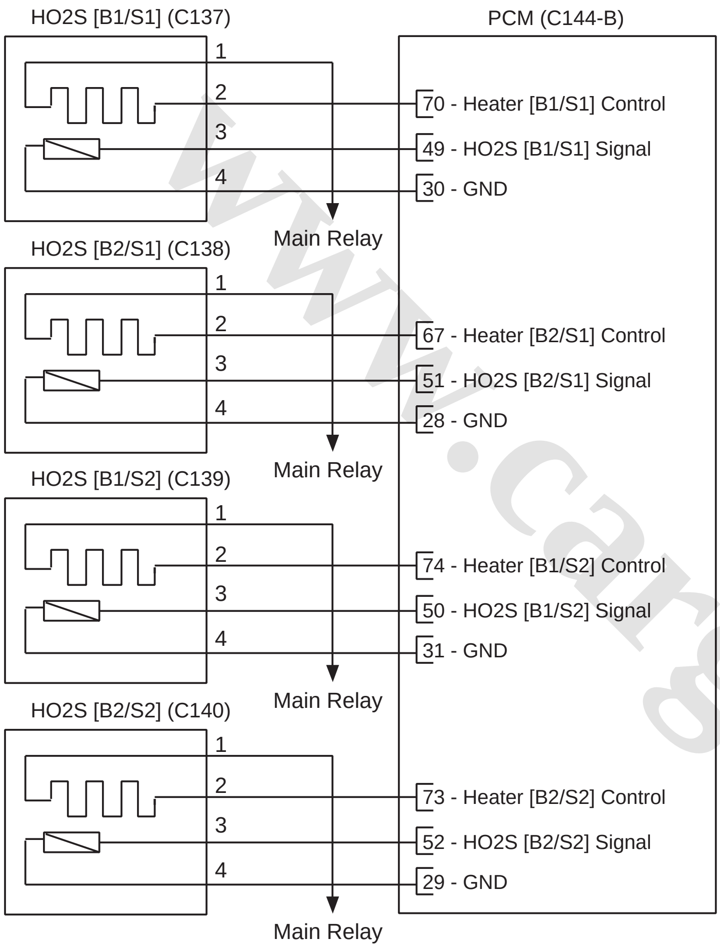
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground or open circuit of O2 sensor heater circuit output	• Poor Connection • Open in Power Circuit • Open or short to ground in control circuit • HO2S(B2/S1) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 E61FC1C9

Heater	
Resistance (Ω)	9.6 ± 1.5

SCHEMATIC DIAGRAM E06C43BE

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

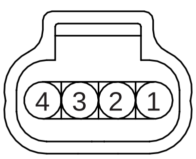
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

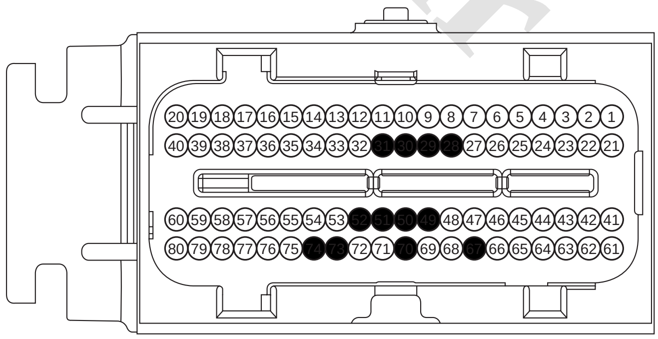
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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]

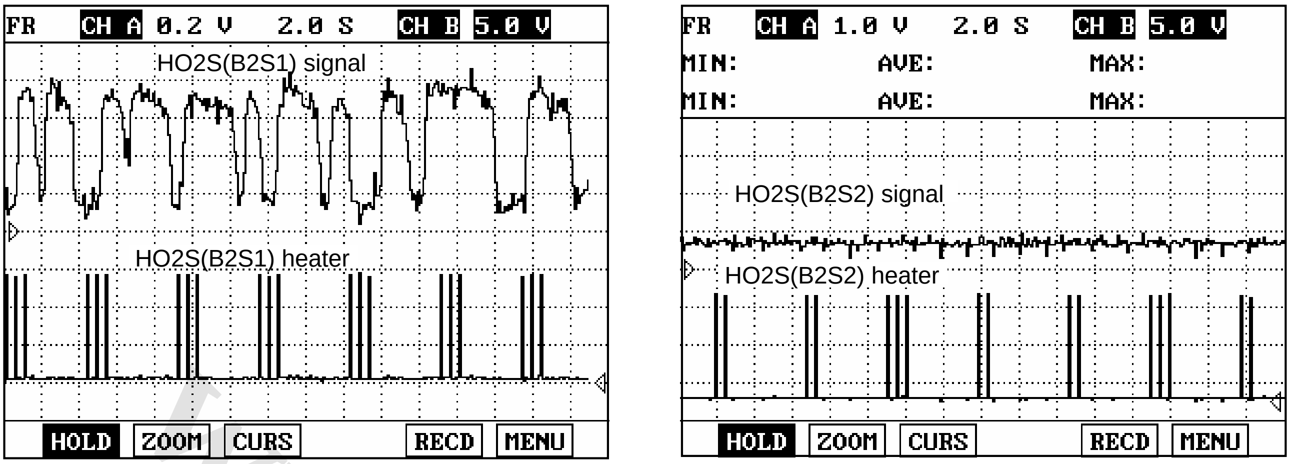


C144-B

PCM

EFBF250A

SIGNAL WAVEFORM AND DATA EC7F3A9B



EGRF601R

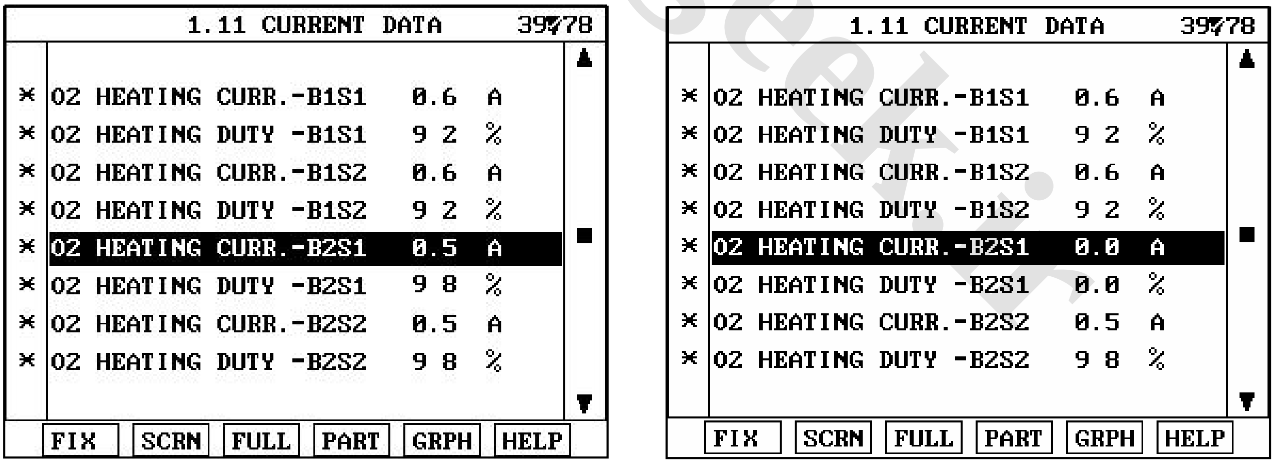
The HO2S requires a minimum temperature to provide a closed loop fuel control system. So the HO2S contains a heater element to reduce its warm-up time and ensure its performance during all driving conditions. The PCM controls this heater element by duty cycle. The main relay supplies voltage to the heater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

MONITOR SCANTOOL DATA E1E9100F

1. IG "OFF" & connect scantool.

2. ENG "ON" and warm -up the engine to normal operating temperature.

3. Monitor "HO2S(B2/S1)" status on the service data.



Normal data - idle

Open circuit(HO2S heater-B2S1)

EGRF601S

4. Is the "HO2S Heater(B2/S1)" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E8768967

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

YES

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

NO

▶ Go to " Power Circuit Inspection " as follows

POWER CIRCUIT INSPECTION EE530B07

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 E3F71DB9

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.

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 "Verifiction of Vehicle Repair" procedure.

COMPONENT INSPECTION E93F857F

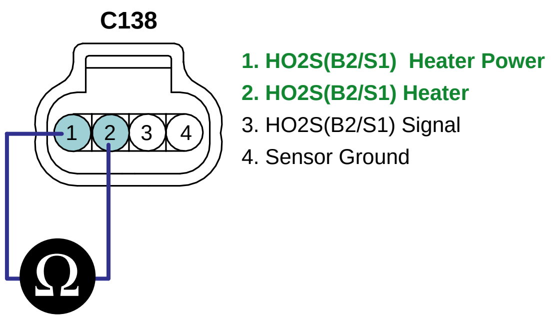
1. Check HO2S(B2/S1) Heater resistance

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)	9.6 ± 1.5



EFBF601W

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 to reuse the PCM on the others.

NO

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

VERIFICATION OF VEHICLE REPAIR E7DFD1E8

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs.
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions.
4. Monitor that all rediness test have been verified as " Complete ".
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E3780BBA

Refer to DTC P0051.

GENERAL DESCRIPTION E7F009E5

Refer to DTC P0051.

DTC DESCRIPTION E5DF16FB

If the HO2S heter output voltage is higher than threshold value for more than 5 seconds 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 E4A74A13

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery in O2 sensor heater circuit output	• Poor Connection • Short to battery in control circuit • HO2S(B2/S1) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 E6ACC42F

Refer to DTC P0051.

SCHEMATIC DIAGRAM EFE026B6

Refer to DTC P0051.

SIGNAL WAVEFORM AND DATA E4A3B353

Refer to DTC P0051.

MONITOR SCANTOOL DATA ED460E29

Refer to DTC P0051.

TERMINAL AND CONNECTOR INSPECTION E43BE183

Refer to DTC P0051.

POWER CIRCUIT INSPECTION EEA35163

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 E51ADE09

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 ECFBCBC7

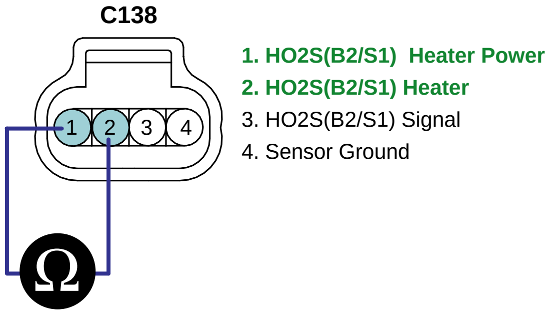
1. Check HO2S(B2/S1) Heater resistance

   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)	9.6 ± 1.5



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 to reuse the PCM on the others.

NO

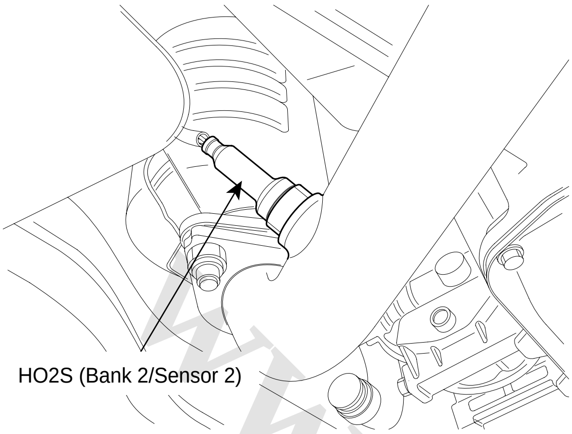
▶ Substitute with a known - good HO2S(B2/S1) and check for proper operation. If the problem is corrected, replace HO2S(B2/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ED7657B7

Refer to DTC P0051.

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

COMPONENT LOCATION EA1A1BFB



EGRF601Y

GENERAL DESCRIPTION E9B71A0E

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter which is able to detect the 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 EC4AE57B

If the HO2S heater output voltage is lower than threshold value for more than 5 seconds 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 E466E812

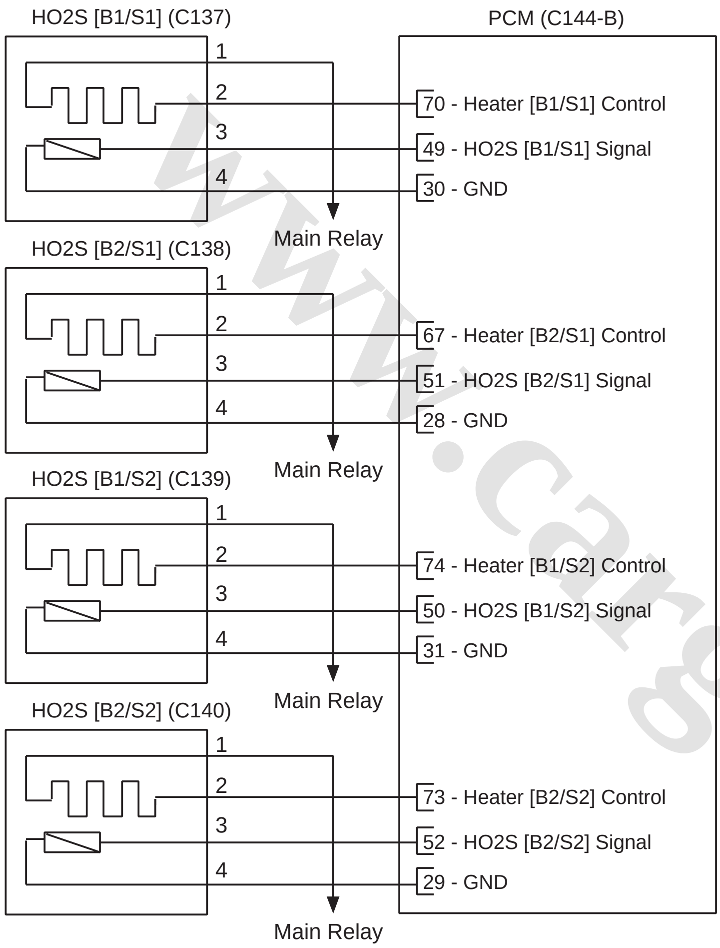
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground or open circuit of O2 sensor heater circuit output	• Poor Connection • Open in Power Circuit • Open or short to ground in control circuit • HO2S(B2/S2) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 EF58CCF9

Heater	
Resistance (Ω)	9.6 ± 1.5

SCHEMATIC DIAGRAM E5AF8663

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

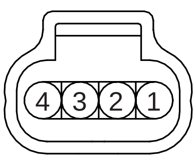
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

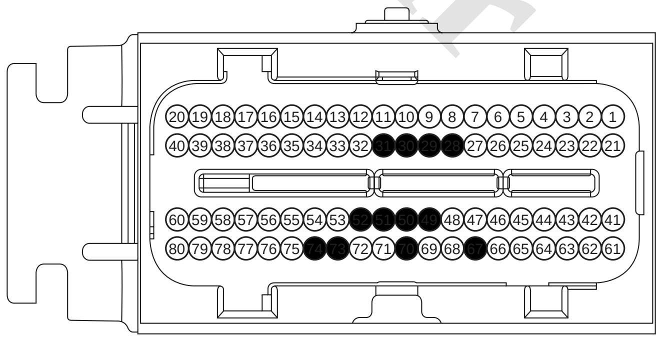
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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]

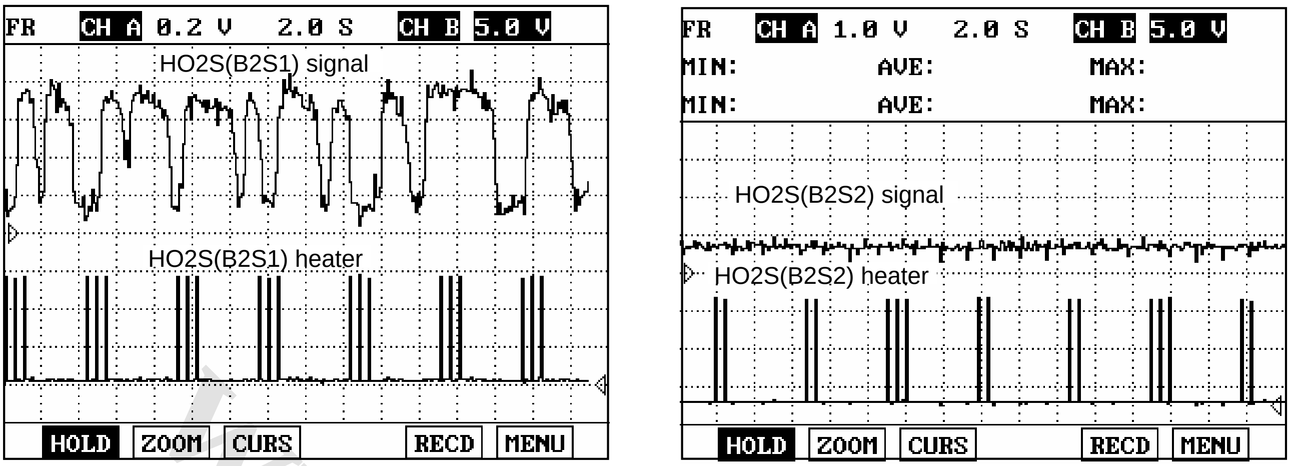


C144-B

PCM

EFBF250A

SIGNAL WAVEFORM AND DATA E3067783

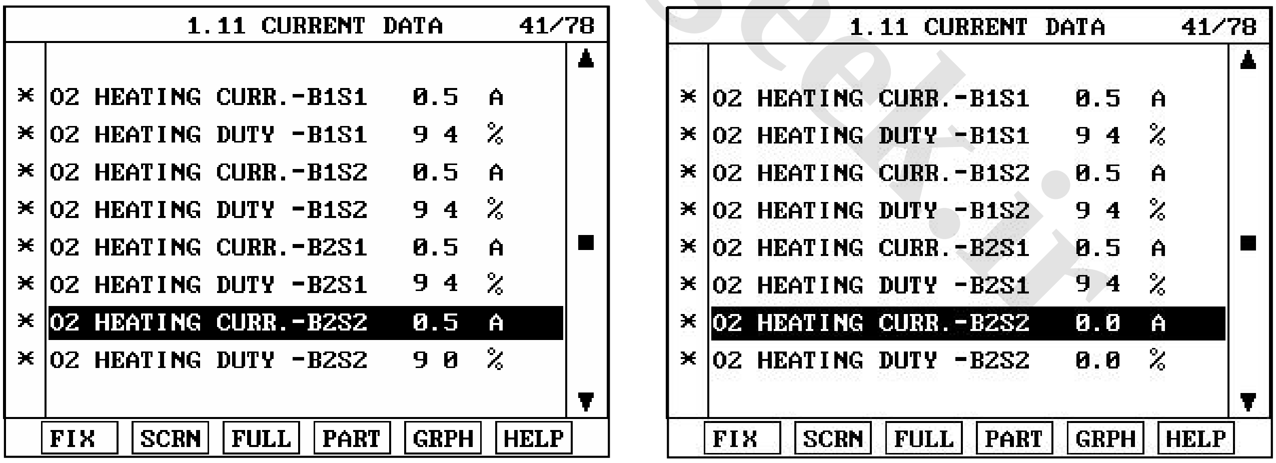


EGRF601Z

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 SCANTOOL DATA E9A57197

1. IG "OFF" ＆ connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B2/S2)" status on the service data.



Normal data - idle

Open circuit(HO2S heater-B2S2)

EGRF987L

4. Is the "HO2S Heater(B2/S2)" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E42873DE

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 EB6C2A00

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 ED99DAC9

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.

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 "Verifiction of Vehicle Repair" procedure.

COMPONENT INSPECTION E139F612

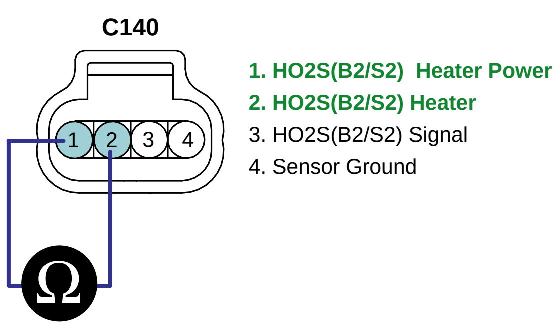
1. Check HO2S(B2/S2) Heater resistance

   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)	9.6 ± 1.5



EFBF602D

   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 to reuse the PCM on the others.

NO

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

VERIFICATION OF VEHICLE REPAIR EA6EFB97

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E041820D

Refer to DTC P0057.

GENERAL DESCRIPTION E82C4F5E

Refer to DTC P0057.

DTC DESCRIPTION E53D40E5

If the HO2S heater output voltage is higher than threshold value for more than 5 seconds 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 EC50C8FC

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery in O2 sensor heater circuit output	• Poor Connection • Short to battery in control circuit • HO2S(B2/S2) • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 E24EADD0

Refer to DTC P0057.

SCHEMATIC DIAGRAM E20F406C

Refer to DTC P0057.

SIGNAL WAVEFORM AND DATA EA247084

Refer to DTC P0057.

MONITOR SCANTOOL DATA E9C743A9

Refer to DTC P0057.

TERMINAL AND CONNECTOR INSPECTION E94B13F0

Refer to DTC P0057.

POWER CIRCUIT INSPECTION E14E6C4E

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 E19D080E

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

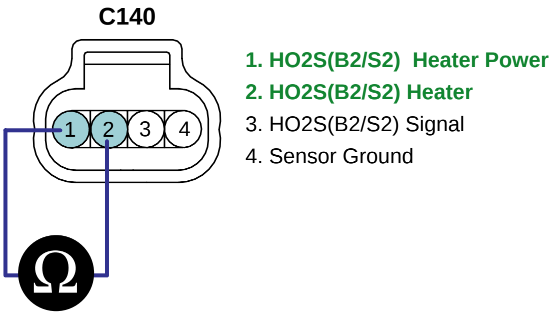
▶ Repair short to battery in HO2S (B2/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EFBF5EBB

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)	9.6 ± 1.5



EFBF602D

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 to reuse the PCM on the others.

NO

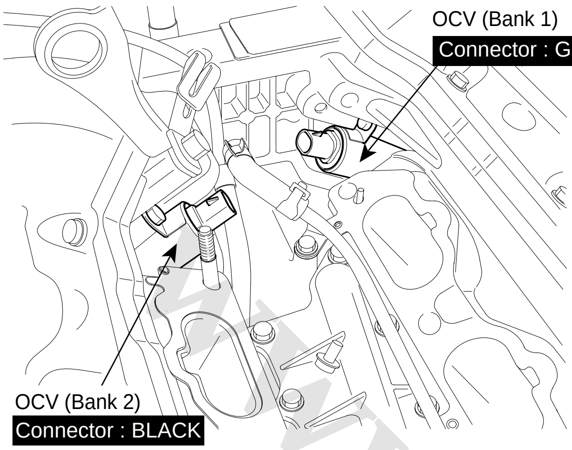
▶ Substitute with a known - good HO2S(B2/S2) and check for proper operation. If the problem is corrected, replace HO2S(B2/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EF5193FE

Refer to DTC P0057.

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

COMPONENT LOCATION E861BFEA



EGRF602F

GENERAL DESCRIPTION EA3CC1B7

PCM controls OCV(Oil Contol Valve) with PWM (Pulse Width Modulator) signal to change oil passages supplying oil to CVVT that makes CAM postion changes (advance or retard). OCV is integrated with oil filter and located at the nearest CVVT on the engine block.
As the cam phaser is advanced and retarded, its position is measured using a toothed wheel.
The wheel is attached to the camshaft, or to the cam phaser rotor. A sensor picks up the signal from the wheel and its output is read by the engine control unit. A cam signal is generated for each cam phaser on the engine. This requires a separate toothed wheel and cam sensor combination for each cam phaser. The cam signal and crankwheel signal are compared as the engine turns, and the phasing position is determined. The position is displayed in crank angle degrees, relative position from default. This position measurement is used as feedback for the position control software, which determines the required percent duty cycle commanded to the oil control valve.

DTC DESCRIPTION EE7A6C94

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 Indicatin Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E9F77ACF

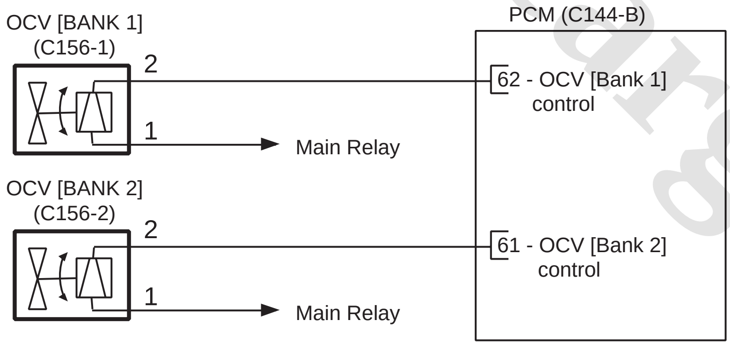
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground or open circuit of OCV circuit	• Poor Connection • Open in Power Circuit • Open or short to ground in control circuit • OCV • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 ED2C0056

Resistance (Ω)	6.7 ~ 7.7

SCHEMATIC DIAGRAM EEF6B717

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

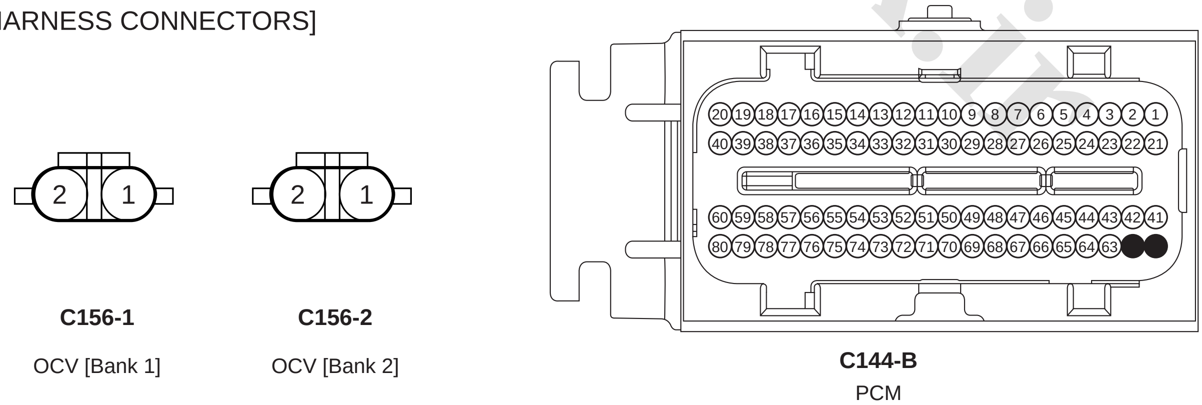
OCV [BANK 1]

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

OCV [BANK 2]

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

[HARNESS CONNECTORS]



EFBF255A

SIGNAL WAVEFORM AND DATA E0E04162

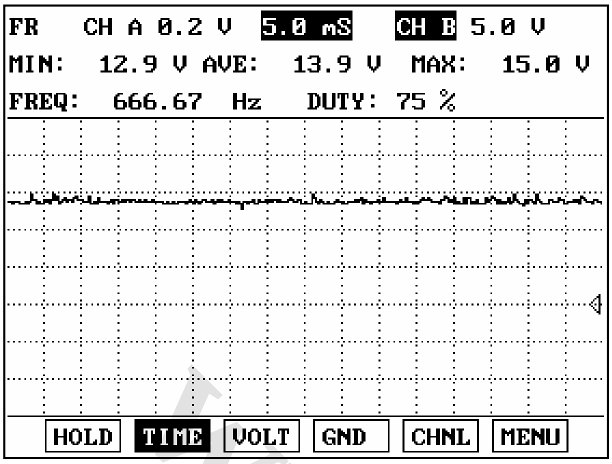


Fig. 1

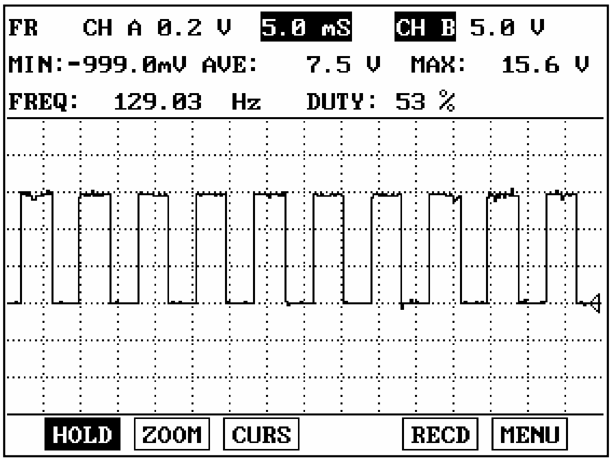


Fig. 2

Fig. 1 : Idle
Fig. 2 : Accelleration

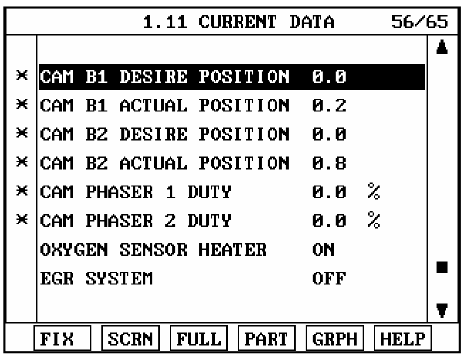
EGRF602G

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.

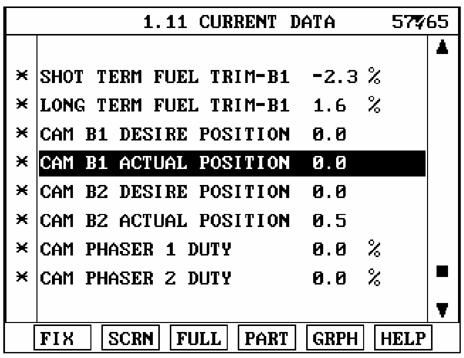
MONITOR SCANTOOL DATA E5E91508

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "Cam Duty, Cam Desired Position and Cam Actual Position" on the service data.

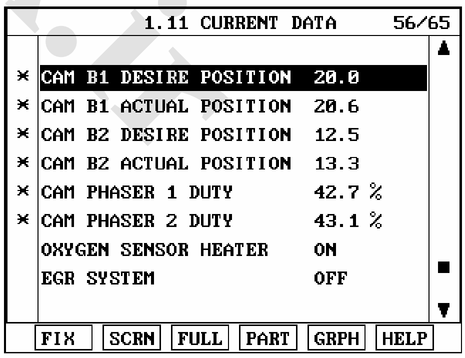
[P0076]



Normal data - idle



Open circuit - idle



Normal data - acceleration

EGRF602H

[P0082]

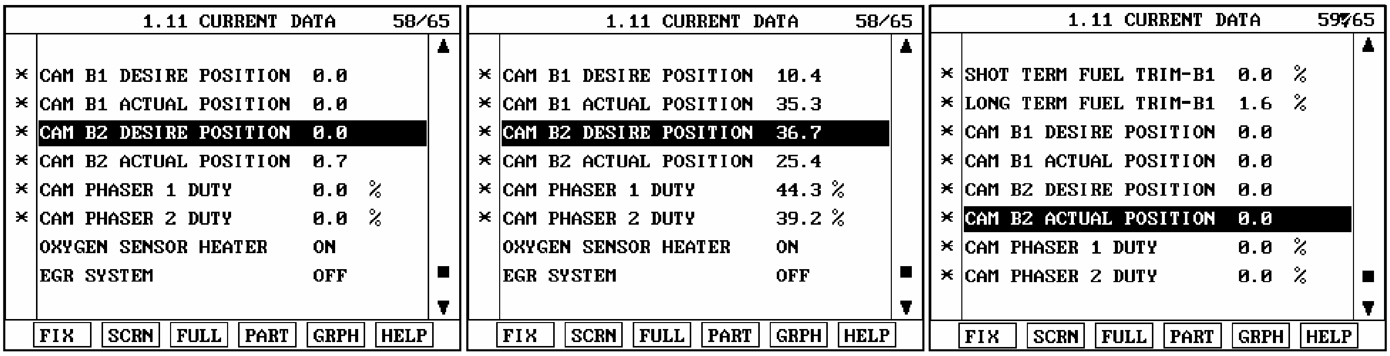


Fig.1 Fig.2 Fig.3

Fig. 1 : Normal at idle
Fig. 2 : Accelleration at idle
Fig. 3 : Open at idle

EGRF602R

4. Are the "CAM" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EF7B7701

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 E44EC01E

1. IG "OFF" & Disconnect OCV(B1) connector.

2. IG "ON" & ENG "OFF".

3. Measure voltage between terminal 1 of OCV(B1/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 ECAE696A

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.

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 E4D78F02

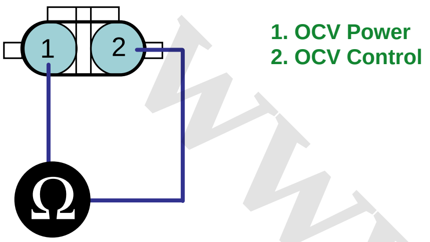
1. Check OCV

   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



EFBF991C

   3) Is the measured resistance within specification ?

   YES

   ▶ Go to "OCV Actuation Test" as follows.

   NO

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

2. OCV Actuation Test

   1) Connect scantool and IG "ON".

   2) Select "OCV" on the Actuation Test.

   3) Activate "OCV" by pressing "STRT(F1)" key.
   (should hear a faint click from Oil Control solenoid Valve)

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

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

EGRF602M

5) Does OCV generate click sound during acutation test ?

YES

▶ Substitute with a known - good 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 to reuse the PCM on the others

NO

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

VERIFICATION OF VEHICLE REPAIR ECFE8456

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E1D75ED4

Refer to DTC P0076.

GENERAL DESCRIPTION E8F5401A

Refer to DTC P0076.

DTC DESCRIPTION E3DBD4F4

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 E732270E

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to battery of OVC circuit	• Poor Connection • Short to battery in Control Circuit • OCV • PCM
Enable Conditions	• No disabling Faults Present • Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec	
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 EFBEE0B7

Refer to DTC P0076.

SCHEMATIC DIAGRAM E3DC6422

Refer to DTC P0076.

SIGNAL WAVEFORM AND DATA E9CD91C8

Refer to DTC P0076.

MONITOR SCANTOOL DATA EDD319EF

Refer to DTC P0076.

TERMINAL AND CONNECTOR INSPECTION E921EE48

Refer to DTC P0076.

CONTROL CIRCUIT INSPECTION EC1966AC

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

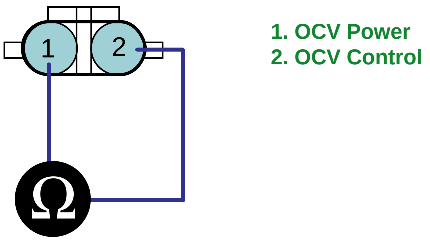
▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E12A8D04

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



EFBF991C

   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.

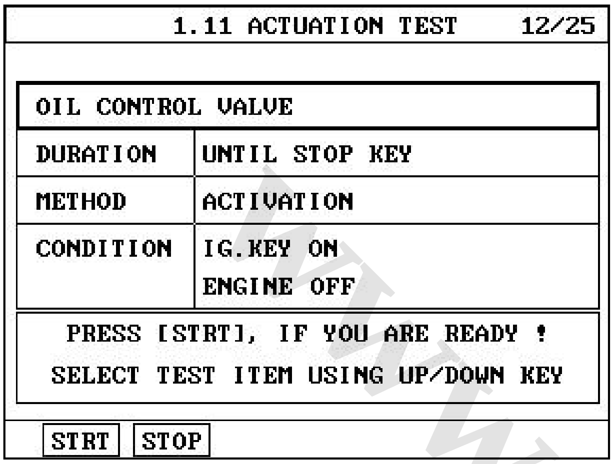
2. OCV Actuation Test

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 to reuse the PCM on the others

NO

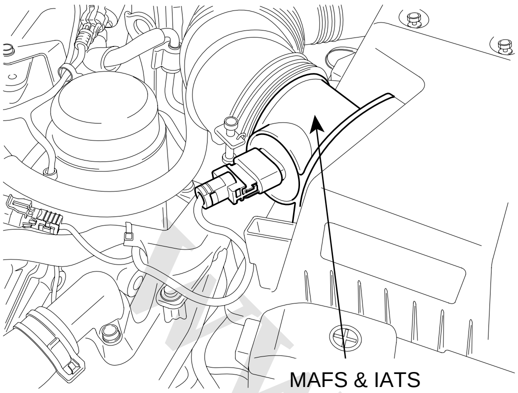
▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E0ADC8E9

Refer to DTC P0076.

DTC P0101 MASS OR VOLUME AIR FLOW CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION EBE0EED0



EFBF602Y

GENERAL DESCRIPTION E8E9F41C

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 EB828281

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 MAFS output to calculated flow rate value while enable condition is met.
If the actual air flow is higher than Maximum threshold, or lower than Minimum threshold for more than 75 seconds failure for every 125 seconds test. PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E7C684ED

Item	Detecting Condition	Possible cause
DTC Strategy	• Compares the difference between MAF Sensor output and calculated flow rate value to a calibration value	
Enable Conditions	• Barometric Pressure enable conditions criteria met • Engine Coolant Temperature ≥ 60℃ • 600rpm 〈 Engine Speed 〈 3000rpm • Air Conditioning Clutch not transitioning • Torque Control is not Active • Traction Control is not Active • Brake switch is not active • Current Transmission Torque Converter Clutch State same as previous • Power Steering is not Cramped • Engine Speed difference ≤ 300rpm • TPS value difference ≤ 5% • MAP value difference ≤ 7 kPa • Idle Airflow difference ≤ 10% • Cam phasing control changes ≤ 10% • MAP/TPS Rationality High Power Condition Fail Criteria Not Met • MAP/TPS Rationality Low Power Condition Fail Criteria Not Met • MAP/TPS Rationality Decel. Condition Fail Criteria Not Met • BARO Update Enable Criteria Met • Enable Timer ≥ 1.5s	• Poor connection • Open or short in harness • Clogged air cleaner • MAFS • PCM
Thresh old value	• Comparision result value is out of calibration value	
Diagnosis Time	• Continuous (More than 75 seconds failure for every 125 seconds test)	
MIL On Condition	• 2 driving cycles	

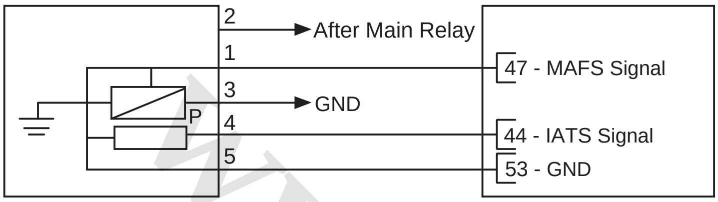
SPECIFICATION EA64B7D9

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 E6A45FD9

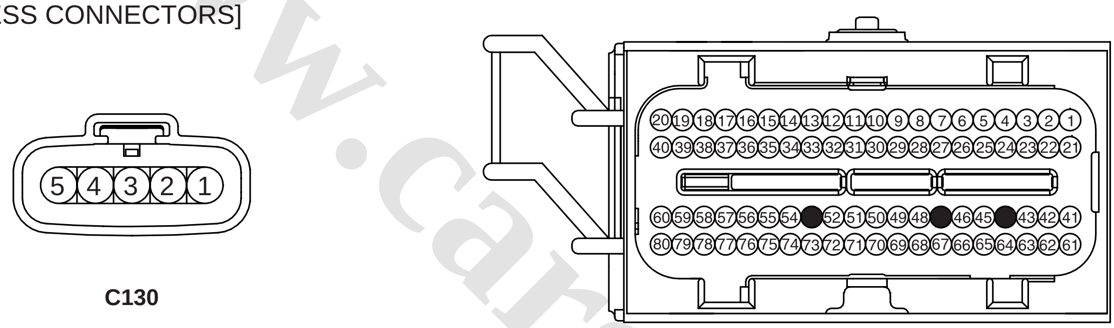
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Funtion
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

EFBF237A

MONITOR SCANTOOL DATA E60A7DB8

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "Air Flow" status on the service data.

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

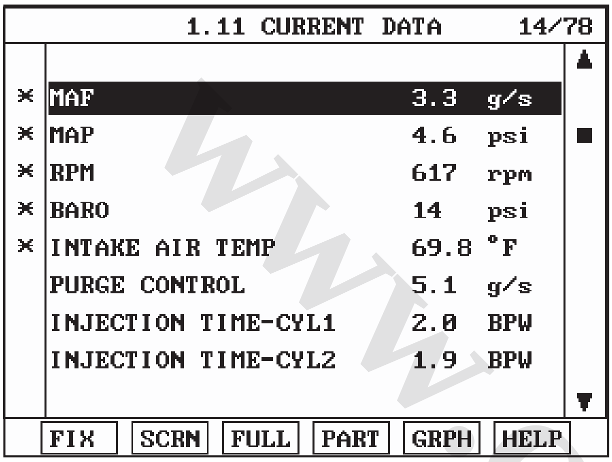


Fig.1

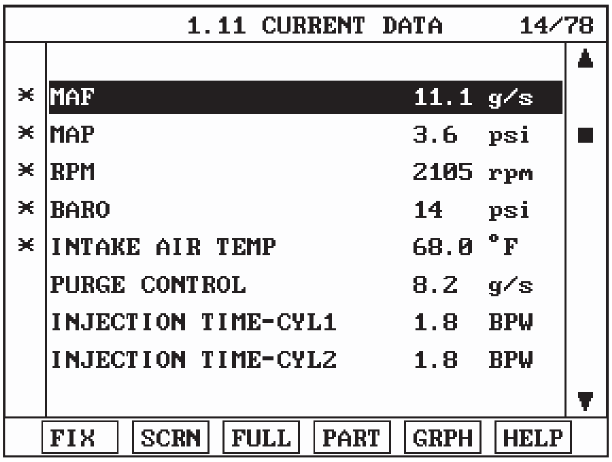


Fig.2

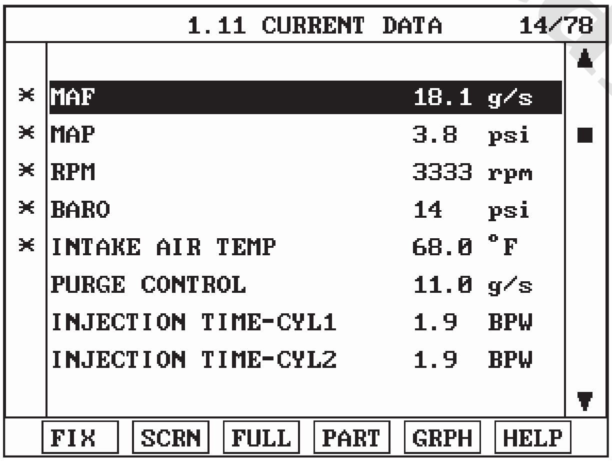


Fig.3

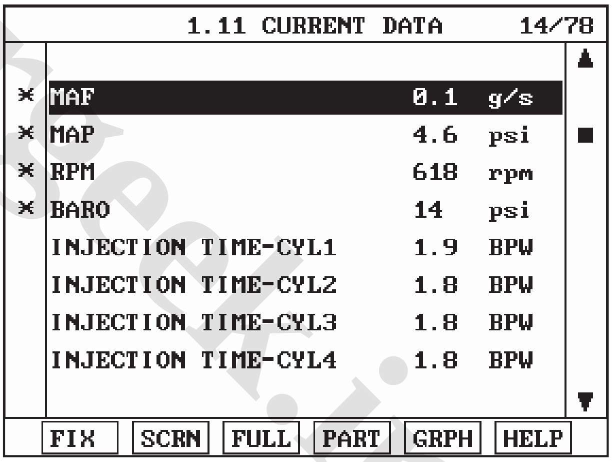


Fig.4

Fig.1: Idle
Fig.3: 3000 rpm

Fig.2: 2000 rpm
Fig.4: Open in signal harness

EGRF990G

4. Are the "Air Flow" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EEE7AA3A

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 E119D17C

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 "Ground Circuit Inspection" proceudure.

NO

▶ Check that fuse between MAFS and Main Relay is open or not installed.
▶ Check open in power circuit between MAFS and Main Relay.
▶ Go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EADD134A

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

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

4. Is the measured voltage within specification ?

YES

▶ Go to "Signal Circuit Inspection" procedure.

NO

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

SIGNAL CIRCUIT INSPECTION E770C6B0

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 "Component Inspection" procedure.

NO

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

COMPONENT INSPECTION E396A98F

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.)

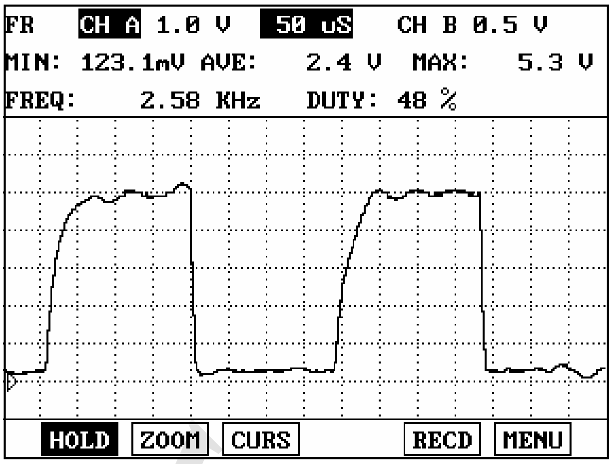


Fig. 1

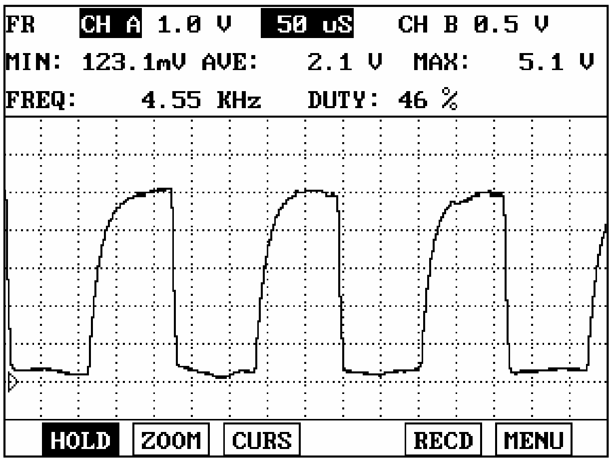


Fig. 2

Fig. 1 : Idle
Fig. 2 : Acceleration

EGRF603D

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

YES

▶ 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 to reuse the PCM on the others

NO

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

VERIFICATION OF VEHICLE REPAIR E03AFCBD

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

- ▶ System is performing to specification at this time.

DTC P0102 MASS OR VOLUME AIR FLOW CIRCUIT LOW INPUT

COMPONENT LOCATION EDDFFE25

Refer to DTC P0101.

GENERAL DESCRIPTION EB4EDDDA

Refer to DTC P0101.

DTC DESCRIPTION E0F1F351

The PCM compares the airmeter input frequency to low and high limits. When the frequency is outside the allowable limits, the circuit is determined to be failed.
If PCM detects that frequency signal of MAFS is lower than 1000Hz for more than 75 second failure 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 ECE1FBB5

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 • Conditions met delay time ≥ 1 second	
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 E1843BEB

Refer to DTC P0101.

SCHEMATIC DIAGRAM E46F1E99

Refer to DTC P0101.

MONITOR SCANTOOL DATA E9A358FF

Refer to DTC P0101.

TERMINAL AND CONNECTOR INSPECTION E3B4BC42

Refer to DTC P0101.

POWER CIRCUIT INSPECTION E90AD0AE

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 ECB14B5C

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.

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 EA1EA3DF

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

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

4. Is the measured voltage within specification ?

YES

▶ Go to "Component Inspection" procedure.

NO

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

COMPONENT INSPECTION E9C4F3DE

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.)

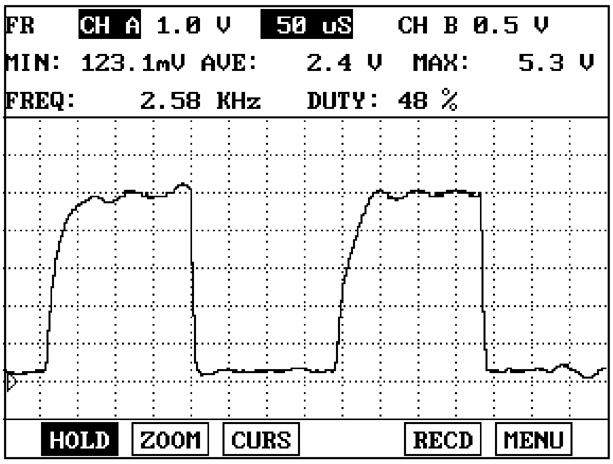


Fig. 1

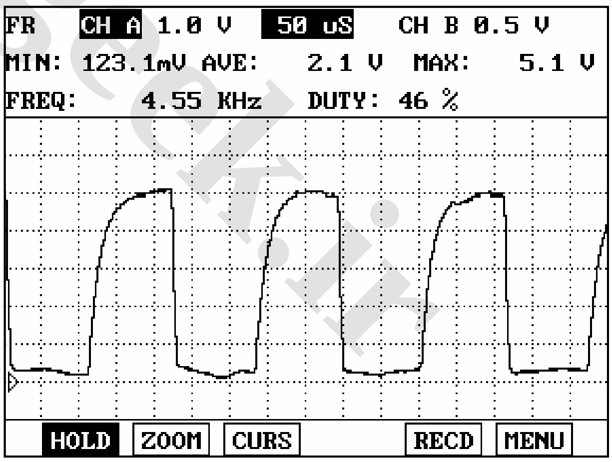


Fig. 2

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 to reuse the PCM on the others

NO

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

VERIFICATION OF VEHICLE REPAIR EA8B54F2

Refer to DTC P0101.

DTC P0103 MASS OR VOLUME AIR FLOW CIRCUIT HIGH INPUT

COMPONENT LOCATION EACD9759

Refer to DTC P0101.

GENERAL DESCRIPTION E9E7044B

Refer to DTC P0101.

DTC DESCRIPTION EEC78FC4

The PCM compares the airmeter input frequency to low and high limits.
If PCM detects that frequency signal of MAFS is higher than 11900Hz for more than 75 second failure during 125 second dignostic test while enable condition is met, PCM determines that a fault exists and a DTC is stored.MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EFA3316D

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 • Conditions met delay time ≥ 1 second	
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 EB3056B0

Refer to DTC P0101.

SCHEMATIC DIAGRAM E59C6774

Refer to DTC P0101.

MONITOR SCANTOOL DATA E5E3B775

Refer to DTC P0101.

TERMINAL AND CONNECTOR INSPECTION E7C01B58

Refer to DTC P0101.

GROUND CIRCUIT INSPECTION E846054A

1. IG "OFF"

2. Disconnector MAFS connector.
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 EAA82B97

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.)

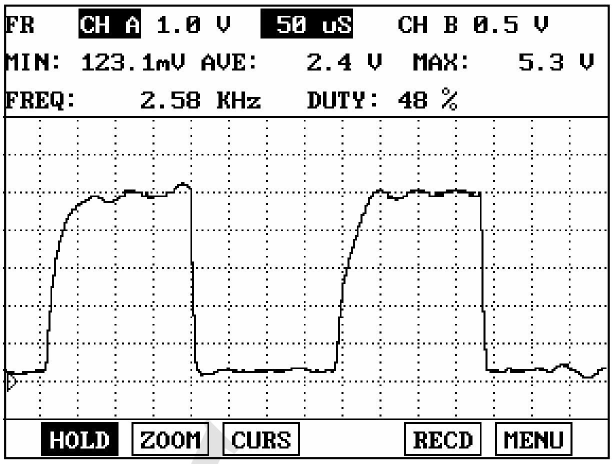


Fig. 1

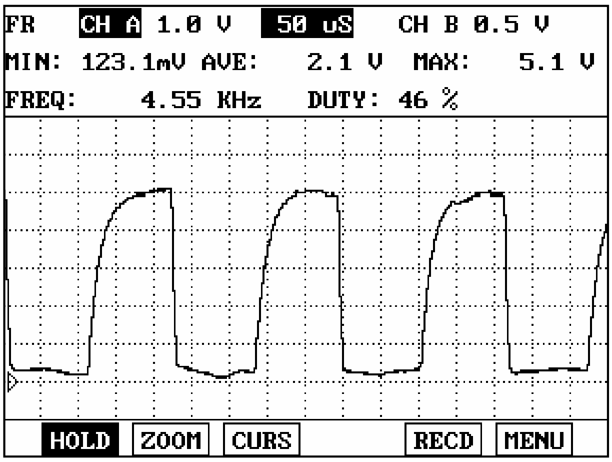


Fig. 2

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 to reuse the PCM on the others

NO

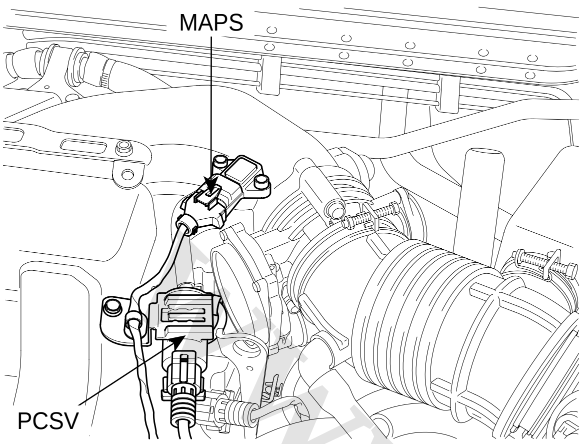
▶ Substitute with a known - good MAFS and check for proper operation. If the problem is corrected, replace MAFS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ECEE5AB0

Refer to DTC P0101.

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

COMPONENT LOCATION EBEADD9A



EGRF603N

GENERAL DESCRIPTION E602F175

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 diagphragm according to the change of pressure inside of intake manifold.

DTC DESCRIPTION E6A5F244

PCM compares the MAPS output and calculated MAPS value while enable condition ismet. If the acutal MAP value is higher than Maximum threshold or lower than Minimum threshold for 15 secondfailure during one diagnostic test(32 second),PCM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfuction lasts till cosecutive 2 driving cycle.

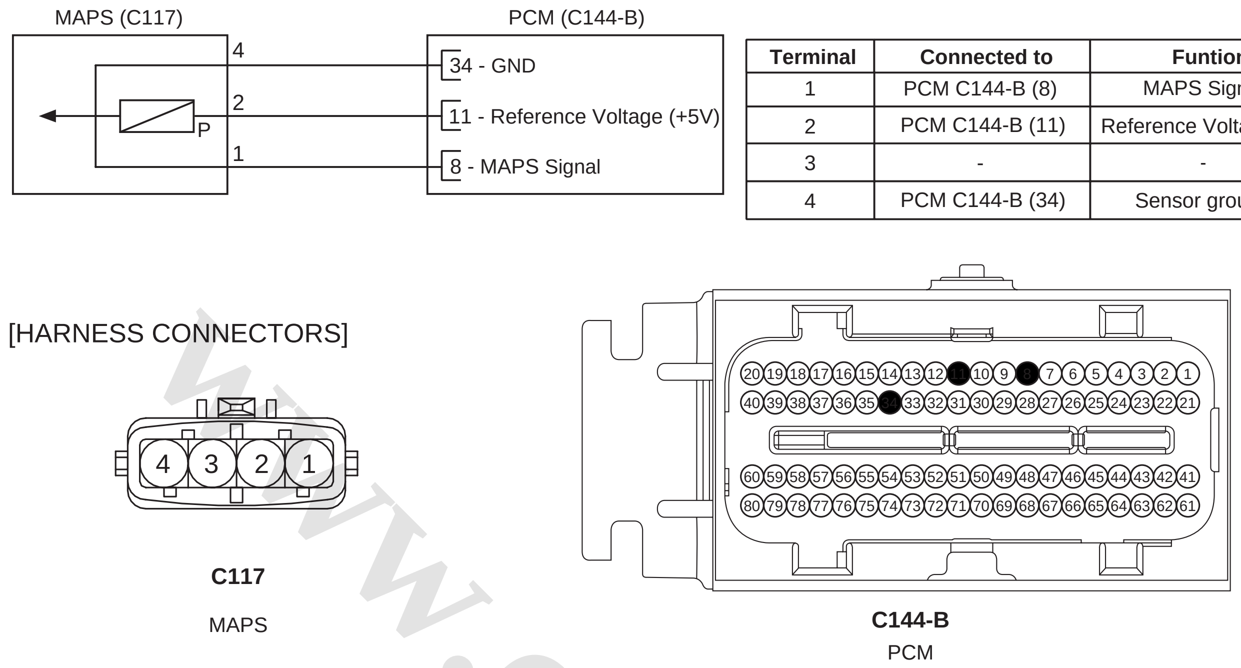
DTC DETECTING CONDITION E06AC437

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	• Poor connection • Open or short in harness • MAPS • PCM
Enable	Case 1	**Power conditions** • Engine running • Disabling faults present • Power stable conditions present • 1300rpm ≤ Engine speed ≤ 4000rpm • The minimum consecutive time 〉 1.5 s	
	Case 2	**Deceleration conditions** • Engine running • Disabling faults present • Transmission torque convert clutch condition stable • Decel stable conditions present • 1200rpm ≤ Engine speed ≤ 4500rpm • Trottle position 〈 7.9% • Vehicle speed ≥ 30kph • The minimum consecutive time 〉 1.5 s	
Thresh-old	Case 1	**Power Test** • Altitude compensated MAP 〈 Memorized min. MAP data • Altitude compensated MAP 〉 Memorized max. MAP data	
	Case 2	**Deceleration Test** • Altitude compensated MAP 〈 Memorized MAP data	
Diagnosis Time		• Continuous (More than 15 seconds failure for every 32 seconds test)	
MIL On Condition		• 2 driving cycles	

SPECIFICATION EED10E85

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 EE46338B

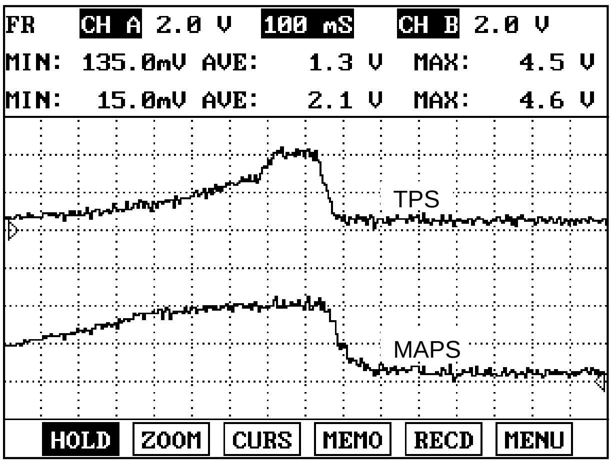


[CONNECTION INFORMATION]

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

EFBF240A

SIGNAL WAVEFORM AND DATA E38BA454



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 SCANTOOL DATA EB22A2A5

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "MAPS" status on the service data.

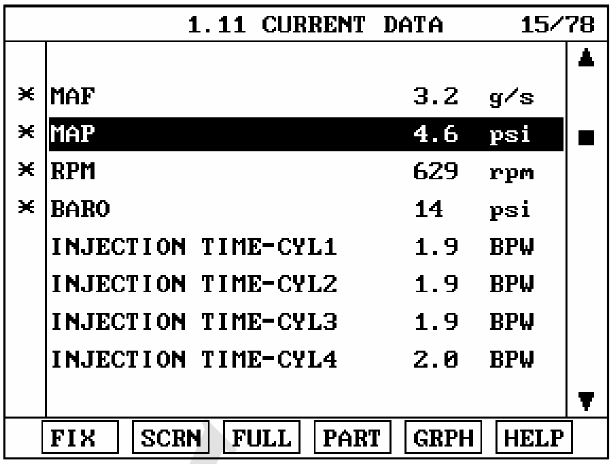


Fig. 1

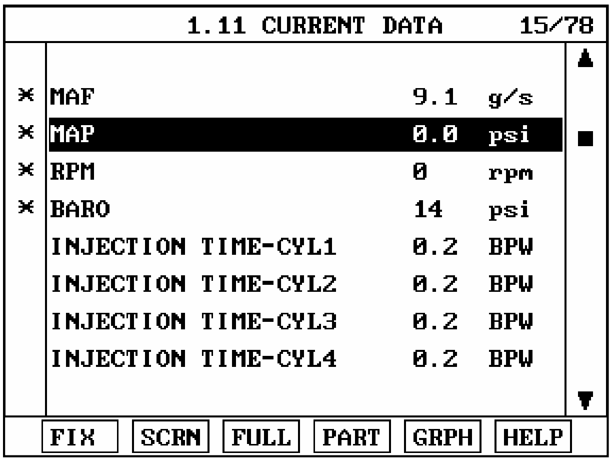


Fig. 2

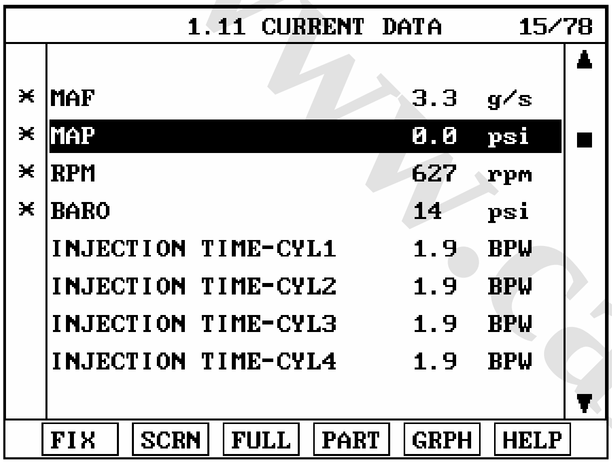


Fig. 3

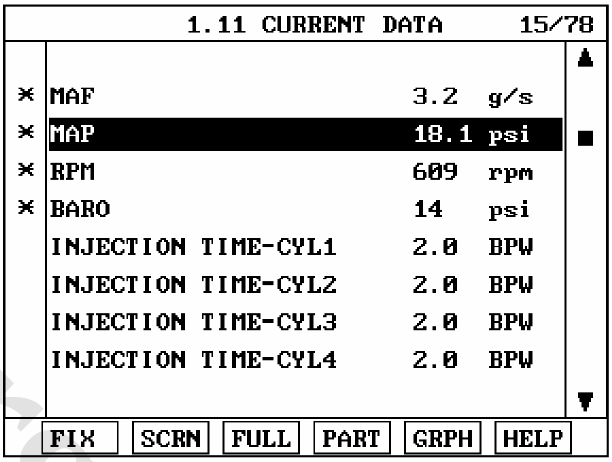


Fig. 4

Fig. 1 : Normal at idle
Fig. 2 : Open at idle
Fig. 3 : Short to ground at idle
Fig. 4 : Shrot to 5V at idle

EGRF603P

4. Are the "MAPS" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E7591265

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 E8F3940A

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

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES

▶ Go to "Ground circuit inspection" procedure.

NO

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

GROUND CIRCUIT INSPECTION EE7BB8CF

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

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

4. 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 ED9B1CC1

1. Check voltage
   1) IG "OFF" and disconnect MAPS connector.
   2) IG "ON" & ENG "OFF"

3) Measure voltage between terminal 1 of MAPS harness connector and chassis ground.

Specification : Approx. 0V

4) Is the measured voltage within specification ?

YES

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

NO

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

2. Check open in harness

1) IG "OFF" and disconnet MAPS and PCM connector.

2) Measure resistance between terminal 1 of MAPS harness connector and terminal 8 of PCM harness connector.

Specification : Approx. Below 1 Ω

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 ECB5893B

1. Check MAPS Performance

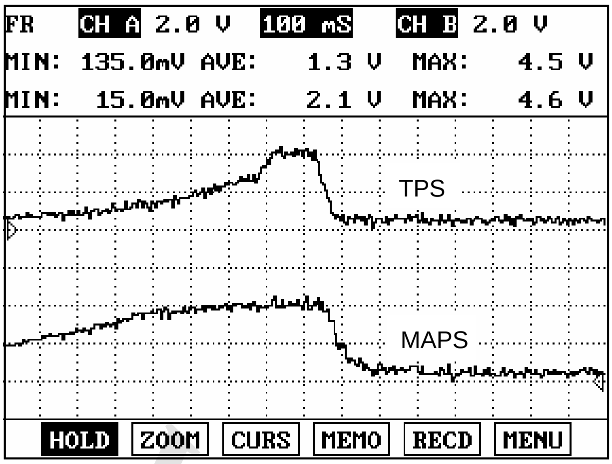
1) IG "OFF" and install scatool.

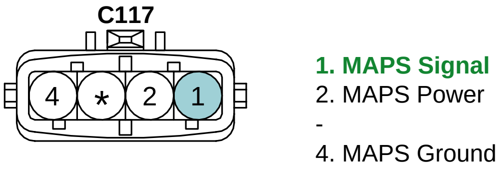
2) Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.

3) ENG "ON" and monitor signal waveform during accelleration and decelleration.

SPECIFICATON :

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





EFBF603U

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

YES

▶ Go to "Check PCM" as follows.

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.

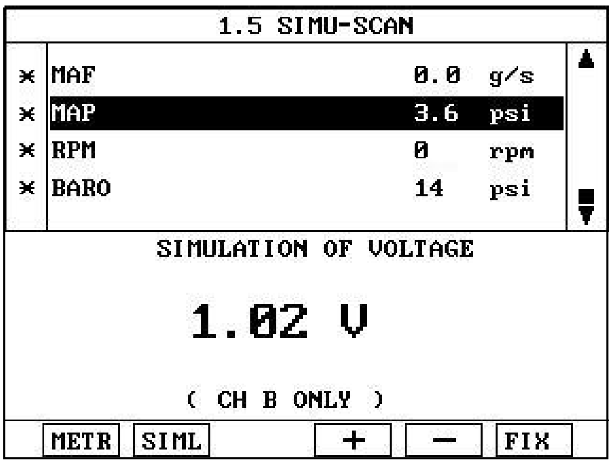
2. Check PCM

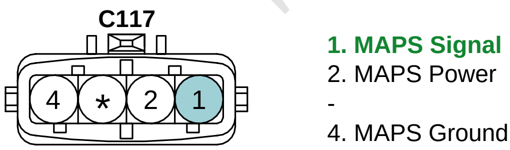
1) IG "OFF" disconnect MAPS connector

2) Connect Scantool and IG "ON" ＆ ENG "OFF"

3) Select simulation function on scantool.

4) Simulate voltage at terminal 1 of MAPS harness connector.





EFBF603V

5) Does the signal value of MAP 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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EB94B999

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0107 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT LOW INPUT

COMPONENT LOCATION E03276B0

Refer to DTC P0106.

GENERAL DESCRIPTION EDAF64DA

Refer to DTC P0106.

DTC DESCRIPTION E6ED5611

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 EAF8D8C1

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	

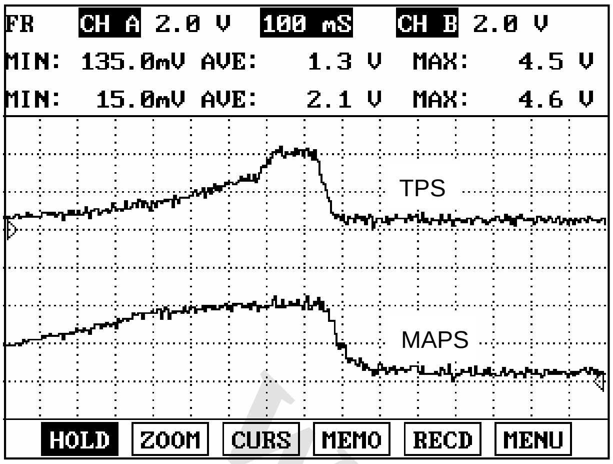
SPECIFICATION E25FE13E

Refer to DTC P0106.

SCHEMATIC DIAGRAM EB42C8B8

Refer to DTC P0106.

SIGNAL WAVEFORM AND DATA E0BB292F



EGRF603X

Comparing MAPS and TPS, The signals of MAPS and TPS increasess and decrease simultaneously.

MONITOR SCANTOOL DATA EB1CEC27

Refer to DTC P0106.

TERMINAL AND CONNECTOR INSPECTION EDD19DBB

Refer to DTC P0106.

POWER CIRCUIT INSPECTION EC5D96C0

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 E86CD073

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 open in the harness" procedure.

NO

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

2. Check open in the harness

1) IG "OFF"

2) Disconnect MAPS and PCM connector.

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

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 EE3D1FC8

1. MAPS performance test

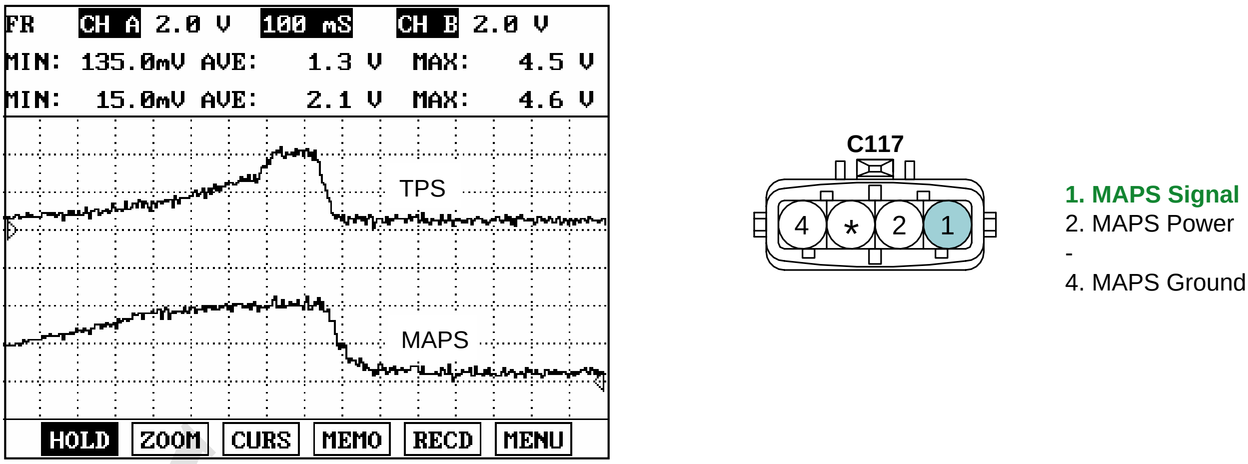
1) IG "OFF"

2) Connect scantool to Data Link Connector(DLC) and selest "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 accelleration and decelleration.

SPECIFICATON :

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



EFBF603U

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".

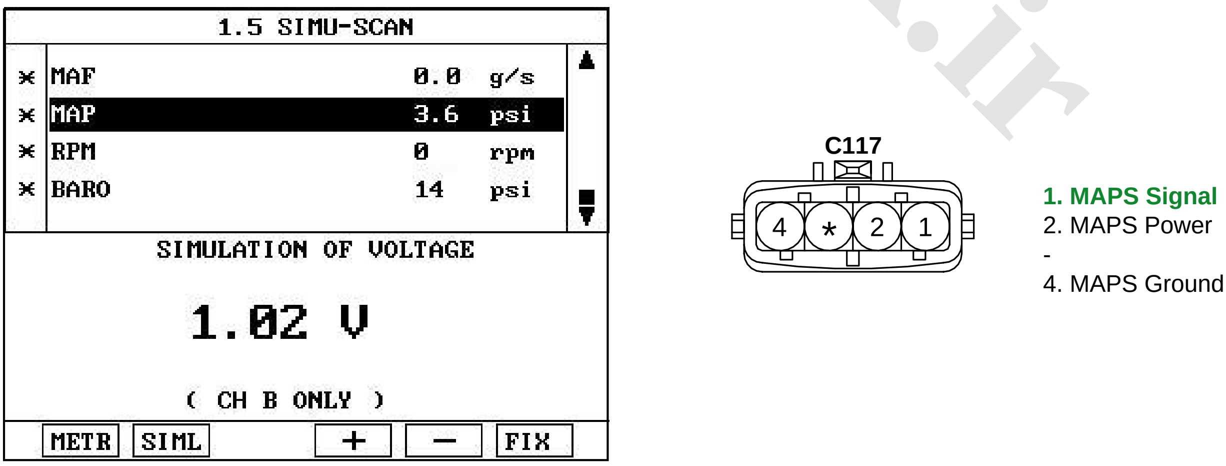
2. Check PCM

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.



EFBF604D

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E5168171

Refer to DTC P0106.

DTC P0108 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT HIGH INPUT

COMPONENT LOCATION EA0B6629

Refer to DTC P0106.

GENERAL DESCRIPTION EB290F4E

Refer to DTC P0106.

DTC DESCRIPTION E8F35F81

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 EA8D23E2

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• This code detects a continuous short to high in either the signal circuit or the MAP sensor</td><td rowspan="6">• Connecting condition
• Short to battery in Signal Circuit
• Open in Ground Circuit
• Faulty MAPS
• Faulty PCM</td></tr>
<tr><td rowspan="2">Enable Condi-tions</td><td>Case 1</td><td>• No TPS Active Fault Present
• Engine Running Time 〉 10sec.
• Engine Speed ≤ 2500rpm
• Throttle Position ≤ 30%</td></tr>
<tr><td>Case 2</td><td>• No TPS Active Fault Present
• Engine Running Time 〉 10sec.
• Engine Speed 〉 2500rpm
• Throttle Position ≤ 40%</td></tr>
<tr><td colspan="2">Threshold value</td><td>• MAP Signal 〉 4.5V</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(More than 2.5 seconds failure for every 5 seconds test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• 2 Driving Cycle</td></tr>
</table>

SPECIFICATION E39B7DF9

Refer to DTC P0106.

SCHEMATIC DIAGRAM E4D0C261

Refer to DTC P0106.

SIGNAL WAVEFORM AND DATA E988EF90

Refer to DTC P0107.

MONITOR SCANTOOL DATA EE48249E

Refer to DTC P0106.

TERMINAL AND CONNECTOR INSPECTION E27F947E

Refer to DTC P0106.

POWER CIRCUIT INSPECTION E0D73854

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 E8F07B8F

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 E89AAA39

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

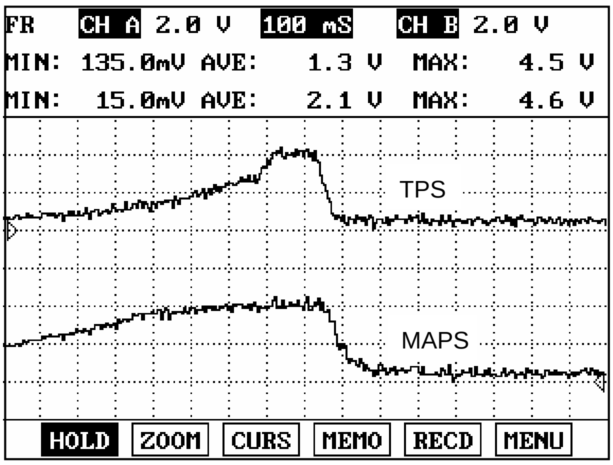
▶ Repair short to battery in harness and then go to "Verification of Vehicle Repair" procedure.

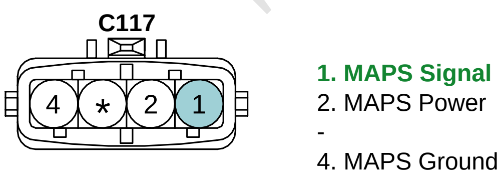
COMPONENT INSPECTION EF1ED533

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 accelleration and decelleration.

SPECIFICATON :

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





EFBF603U

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".

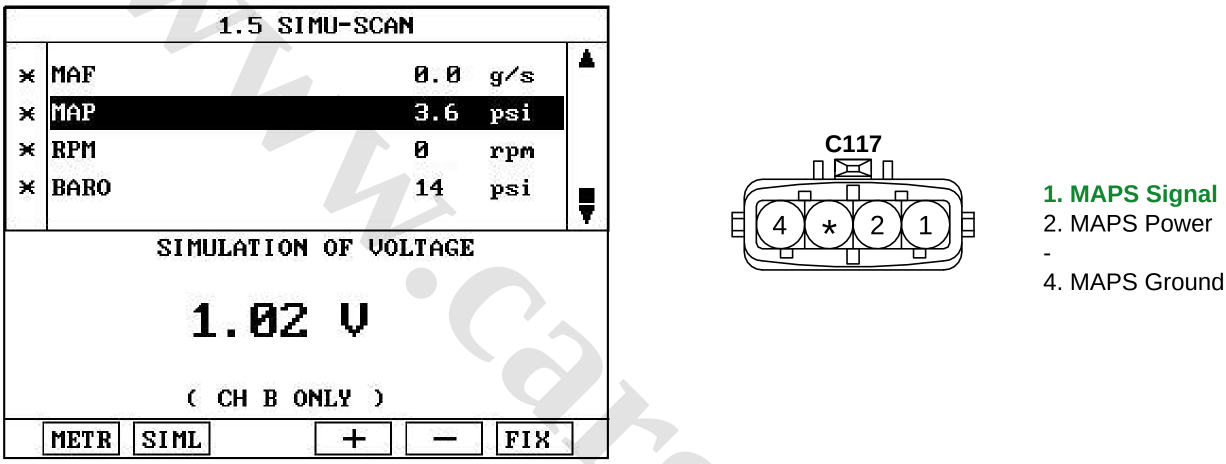
2. Check PCM

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.



EFBF604D

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

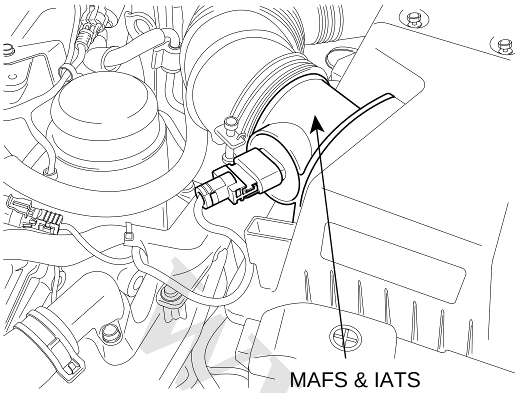
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM.Before or after testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EB0C9DE3

Refer to DTC P0106.

DTC P0110 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT

COMPONENT LOCATION E22BA707



EFBF604C

GENERAL DESCRIPTION E3D183B5

The Intake Air Temperature (IAT) sensor measures the temperature of engine intake air. The Intake Air Temperature (IAT) sensor is a thermistor (a variable resistor that changes along with outside air temperature) in series with a fixed resistor in the PCM. The PCM applies 5volts to the IAT sensor. The PCM monitors the voltage across the IAT sensor and converts it into a temperature reading. When the outside air temperature is cold the IAT sensor resistance is high, and when the outside air temperature is warm the IAT sensor resistance is low. Therefore, when the air temperature is cold the PCM will receive a high voltage input, and when the air temperature is warm the PCM will receive a low voltage input. The signal from IAT sensor is used for injection time correction (Cold post start correction), ignition angle correction(Air temperature correction) and idle speed correction(Air-density correction).

DTC DESCRIPTION ED787FE5

PCM monitors difference between MAX. and MIN IATS in order to detect movement in IATS therough Start Test and Drive Test while enable condition is met. If PCM detects intake air temperature does not change, PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E17B98BE

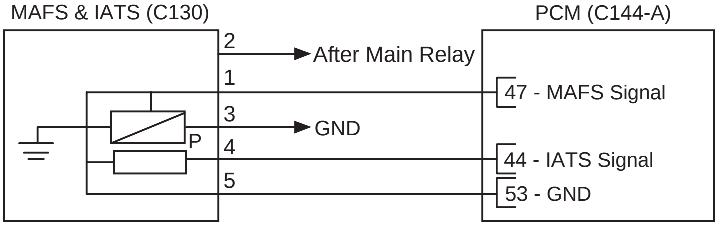
Item		Detecting Condition	Possible cause
DTC Strategy	Case 1	• Start Test: Monitors the difference between max and min IAT in order to detect movement in IAT for a certain time.	• Poor connection • Open or short in harness • IATS • PCM
	Case 2	• Drive test: Performs the max and min delta check while driving under load for a length of time followed by an idle for a certain time.	
Enable Conditions		• Engine soaked time 〉 360min • Engine Running State • No disabling fault present • IAT stored previous trip • No IAT Tests pending	
Thresh old value	Case 1	• Max IAT - Min IAT ≤ 3℃ • Start Test Counter ≥ 120	
	Case 2	• Max IAT - Min IAT ≤ 3℃ • Idle Test Counter ≥ 120	
MIL On Condition		• 2 driving cycles	

SPECIFICATION E61DB811

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

SCHEMATIC DIAGRAM E264DC62

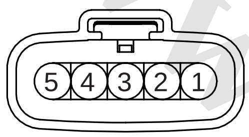
[CIRCUIT DIAGRAM]



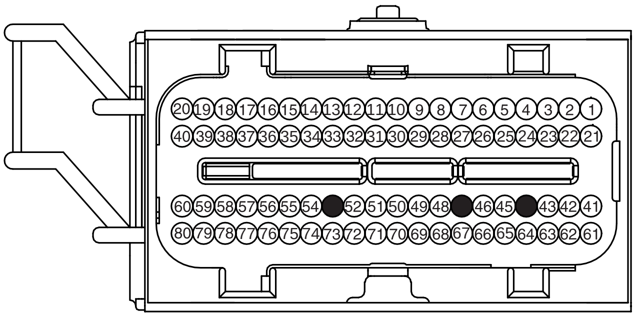
[CONNECTION INFORMATION]

Terminal	Connected to	Funtion
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]



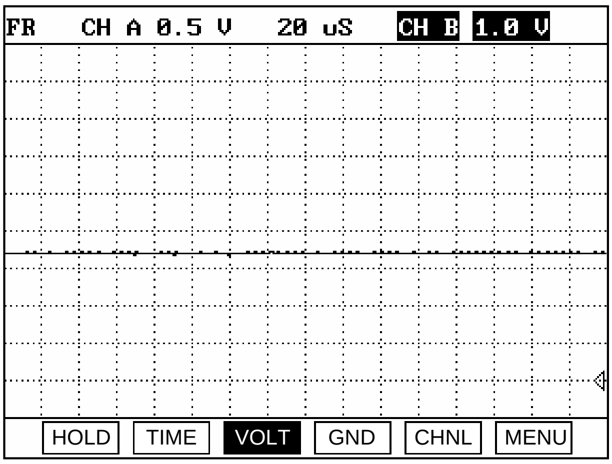
C130
MAFS & IATS



C144-A
PCM

EFBF237A

SIGNAL WAVEFORM AND DATA E34933C9



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 SCANTOOL DATA E9AD0681

1. IG "OFF" ＆ connect scantool.

2. ENG "ON" and warm -up the engine to normal operating temperature.

3. Monitor "IATS" item on the service data.

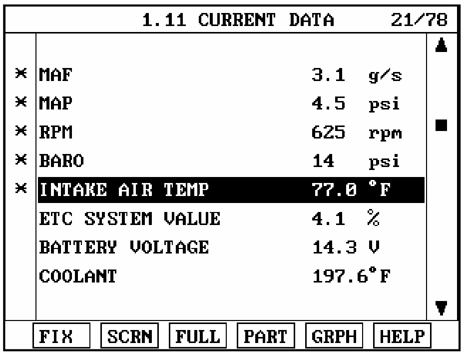


Fig. 1

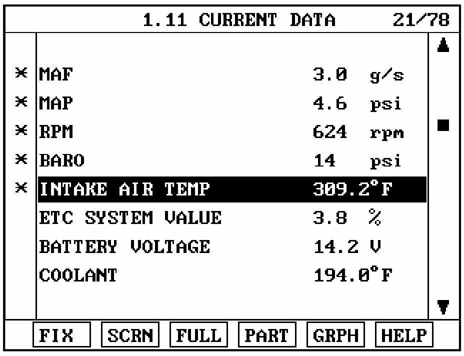


Fig. 2

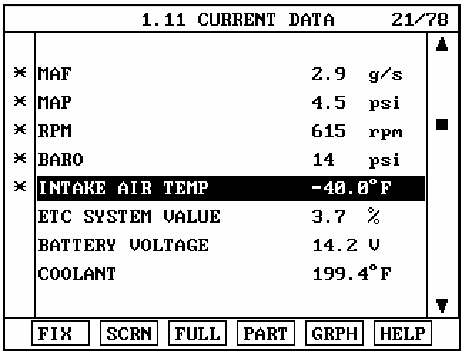


Fig. 3

Fig. 1 : Open at idle
Fig. 2 : Short to ground
Fig. 3 : Short to battery

EGRF604F

4. Is the "IATS" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EC3E9B95

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found ?

YES

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

NO

▶ Go to " Signal Circuit Inspection " procedure.

SIGNAL CIRCUIT INSPECTION E6F4B577

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

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

GROUND CIRCUIT INSPECTION E7609105

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

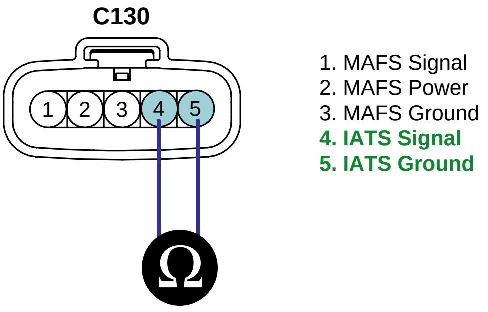
▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EDBF4277

1. Check resistance of IATS
   1) IG "OFF" and disconnect IATS connector.
   2) Measure resistance between terminal 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



EFBF604I

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.

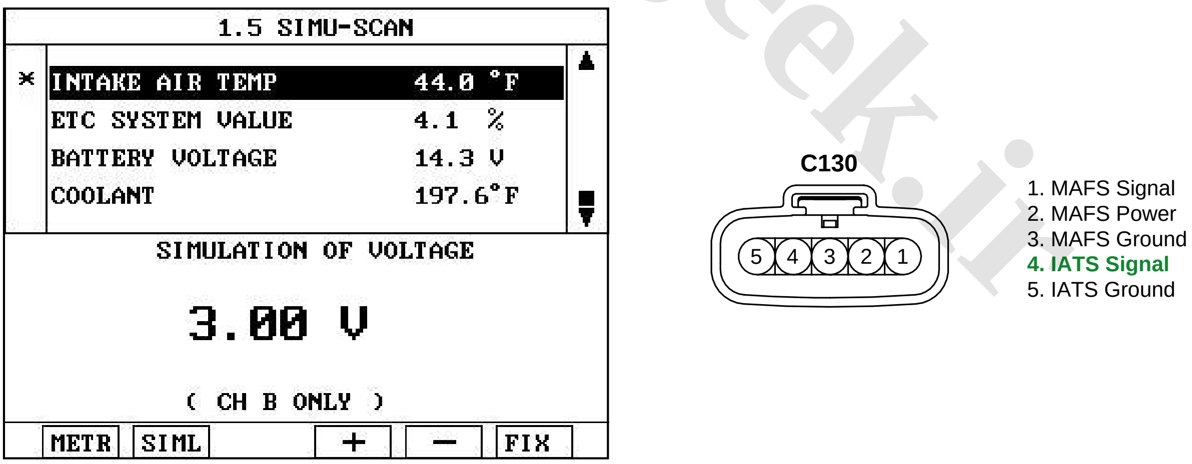
2. Check PCM

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 simulation Function on scantool.

4) Simulate voltage at terminal 4 of IATS harness connector.



EGRF604J

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 to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR E448B9BF

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0111 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION EC96CB04

Refer to DTC P0110.

GENERAL DESCRIPTION EE350F47

Refer to DTC P0110.

DTC DESCRIPTION E43F5A9F

PCM monitors difference between the startup coolant and IAT values. If the difference between the startup coolant and startup IAT exceeds a maximum allowed value, PCM determines that a fault exists and a DTC is started. MIL(Malfuction Indication Lamp) turms on when malfuction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2DBA9AF

Item		Detection condition	Possible cause
DTC Strategy	Case 1	• Skew Low Test: Monitors the difference between the startup coolant and IAT values	• Poor Connection • Open or short in harness • IATS • PCM
	Case 2	• Skew High Test: Monitors the difference between the startup IAT and coolant values	
Enable-Condi-tions	Case 1	• Engine soaked time ≥ 360min • Engine running state • No disabling faults present • IAT stored previous trip • IAT Skewed Test Not Complete • Startup Coolant Temperature 〉 -20°C • Airflow 〉 15 g/s • Vehicle speed 〉 40kph	
	Case 2	• Engine soaked time ≥ 360min • Engine running state • No disabling faults present • IAT stored previous trip • IAT Skewed Test Not Complete • Airflow 〉 15 g/s • Vehicle speed 〉 40kph	
Thresh old 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		• 2 driving cycles	

SPECIFICATION E11360F4

Refer to DTC P0110.

SCHEMATIC DIAGRAM E7BF2043

Refer to DTC P0110.

SIGNAL WAVEFORM AND DATA E4791313

Refer to DTC P0110.

MONITOR SCANTOOL DATA E6DDEDCB

Refer to DTC P0110.

TERMINAL AND CONNECTOR INSPECTION E99C063B

Refer to DTC P0110.

SIGNAL CIRCUIT INSPECTION EC355050

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

- ▶ Check short to battery in harness.
- ▶ If O.K, go to "Ground Circuit Inspection" procedure.
- ▶ If N.G, repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

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

GROUND CIRCUIT INSPECTION EED511C5

1. IG "OFF" and disconnect IATS connector.
2. Measure voltage terminal 4 of IATS harness connector and chassis ground.
3. Measure voltage terminal 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 EC307F93

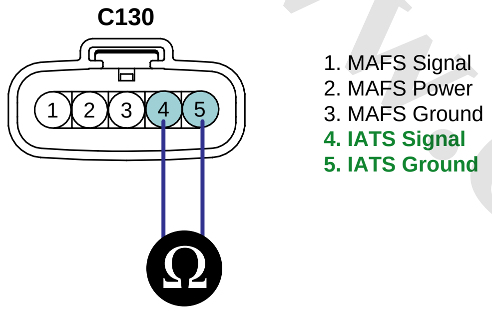
1. Check resistance of IATS

   1) IG "OFF" and disconnect IATS connector.

   2) Measure resistance between terminal 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



EFBF604I

   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.

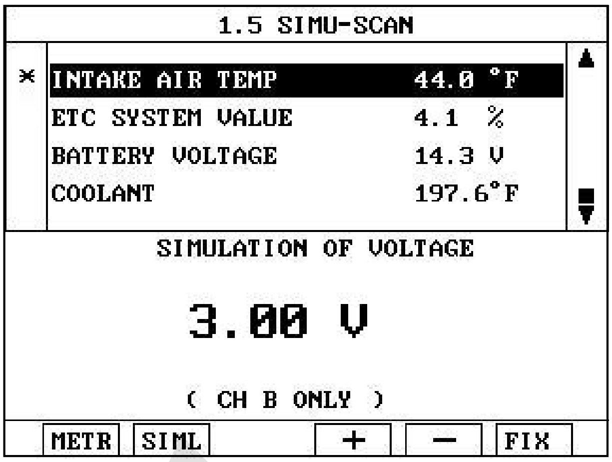
2. Check PCM

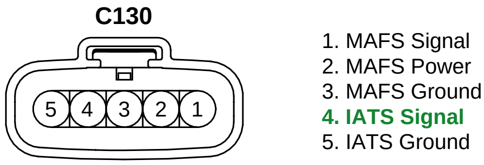
   1) IG "OFF" and connect scantool.

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

   3) IG "ON" and ENG "OFF" and simulation Function on scantool.

   4) Simulate voltage at terminal 4 of IATS harness connector.





EGRF604J

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 to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR E60BB15F

Refer to DTC P0110.

DTC P0112 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT LOW INPUT

COMPONENT LOCATION ED5441B7

Refer to DTC P0110.

GENERAL DESCRIPTION E862367A

Refer to DTC P0110.

DTC DESCRIPTION E5D784B5

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 E8B5D3AD

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• This code detects a continuous short to ground in either the signal circuit or the sensor</td><td rowspan="6">• Poor connection
• Short to ground in harness
• IATS
• PCM</td></tr>
<tr><td rowspan="2">Enable-Condi-tions</td><td>Case 1</td><td>• Engine running state
• No Vehicle speed sensor fault
• Vehicle speed 〉 50kph(30mph)</td></tr>
<tr><td>Case 2</td><td>• Engine running time 〉 120 sec. or Time from IG "OFF" to IG "ON" 〉 360 min.</td></tr>
<tr><td colspan="2">Threshold value</td><td>• Intake air temperature sensor's voltage 〈 0.1V</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(More than 10 seconds failure for every 20 seconds test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• 2 Driving Cycles</td></tr>
</table>

SPECIFICATION E30BE0A2

Refer to DTC P0110.

SCHEMATIC DIAGRAM EC360378

Refer to DTC P0110.

SIGNAL WAVEFORM AND DATA E874D320

Refer to DTC P0110.

MONITOR SCANTOOL DATA E21FDC4A

Refer to DTC P0110.

TERMINAL AND CONNECTOR INSPECTION EACB69A4

Refer to DTC P0110.

SIGNAL CIRCUIT INSPECTION E47E3CFB

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 E95E1DBF

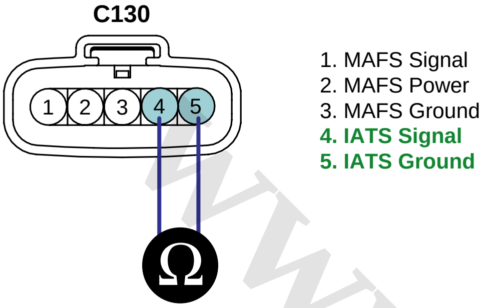
1. Check IATS

   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



EFBF604I

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.

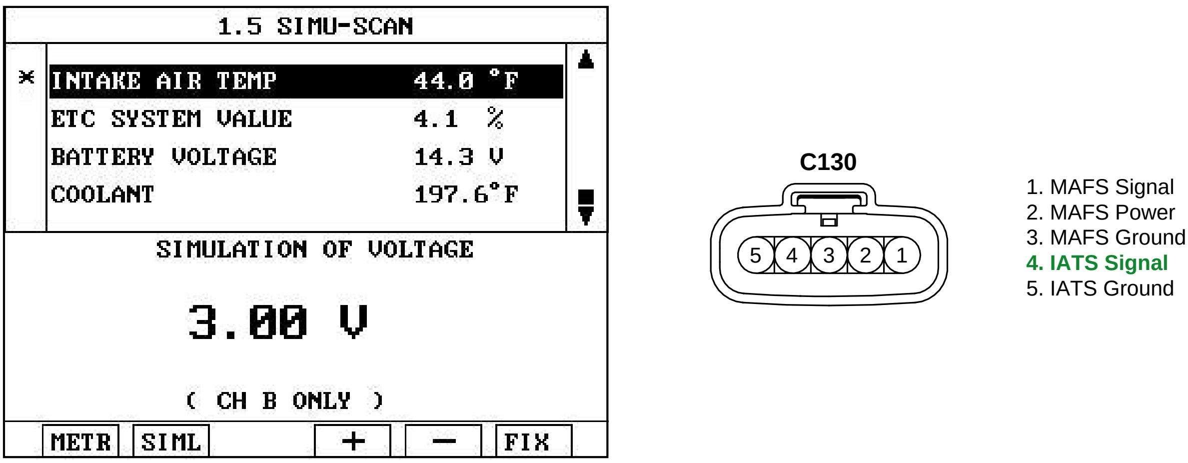
2. Check PCM

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 simulation Function on scantool.

4) Simulate voltage at terminal 4 of IATS harness connector.



EGRF604J

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 to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR E5C2AB3E

Refer to DTC P0110.

DTC P0113 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT HIGH INPUT

COMPONENT LOCATION E040EBE2

Refer to DTC P0110.

GENERAL DESCRIPTION EEA2CD2D

Refer to DTC P0110.

DTC DESCRIPTION E6468556

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 Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E75ACC44

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 〈 25 kph (9.3 mph) • Intake airflow 〈 15 g/s • 50°C (122°F) and Engine running time 〉 120 s or Time from IG "OFF" to IG "ON" 〉 360 min and ECT 〉 -10°C (14°F) • Engine running state	
Threshold value	• Intake air temperature sensor's voltage 〉 4.9V	
Diagnosis Time	• Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E6A64633

Refer to DTC P0110.

SCHEMATIC DIAGRAM E0D7672C

Refer to DTC P0110.

SIGNAL WAVEFORM AND DATA ED1042EE

Refer to DTC P0110.

MONITOR SCANTOOL DATA EF63C036

Refer to DTC P0110.

TERMINAL AND CONNECTOR INSPECTION E2AA58D6

Refer to DTC P0110.

SIGNAL CIRCUIT INSPECTION E638F7BA

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.

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 E81EF01C

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

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

4. Is the measured voltage within specification ?

YES

▶ Go to "Component Inspection" procedure.

NO

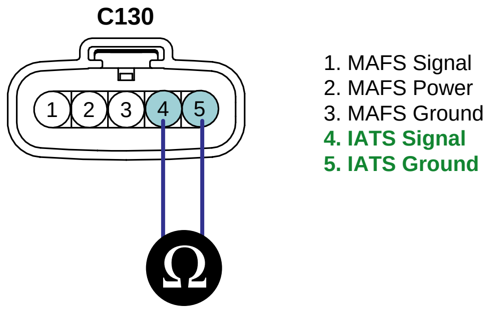
▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EF2A7CD9

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



EFBF604I

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.

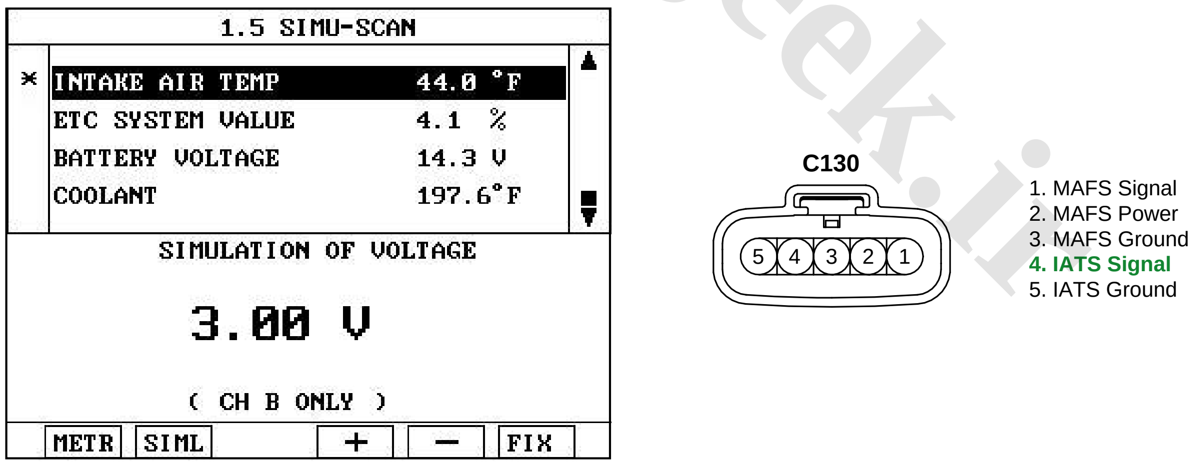
2. Check PCM

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 simulation Function on scantool.

4) Simulate voltage at terminal 4 of IATS harness connector.



EGRF604J

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

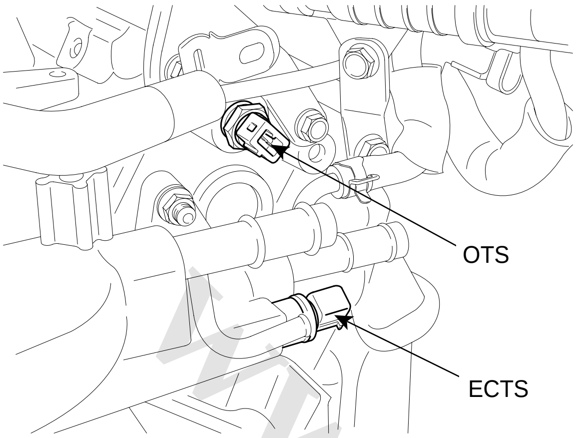
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. Before or after testing PCM on the vehicle, use this function to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR E1797C3A

Refer to DTC P0110.

DTC P0115 ENGINE COOLANT TEMPERATURE CIRCUIT

COMPONENT LOCATION E8002C7D



EGRF604O

GENERAL DESCRIPTION EE51A97A

The Engine Coolant Temperature(ECT) Sensor measures the temperature of engine coolant. The Engine Coolant Temperature (ECT) Sensor is located near the thermostat housing of the cylinder head. ECT Sensor is a thermistor (A Variable Resistor that Changes Along with ECT) in series with a fixed resistor in the Engine Control Module (PCM). The PCM applies 5 volts to the ECT sensor. The PCM monitors the voltage across the ECT sensor and converts it into a temperature reading. When the engine is cold the ECT sensor resistance is high, and when the engine is warm the ECT sensor resistance is low. Therefore, when the engine is cold the PCM will receive a high voltage input, and when the engine is warm the PCM will receive a low voltage input. The signal from ECT sensor is used for Injection, ignition timing, idle speed and cooling fan control.

DTC DESCRIPTION E524FDE9

PCM calculates the difference between the starup and current coolant temperatures and compares against the threshold. So if the difference is less than 3°C over certain period of time. PCM determines that a fault exists and a DTC is stored. MIL(Malfuction Indication Lamp) turns on when the malfuction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E3C4C103

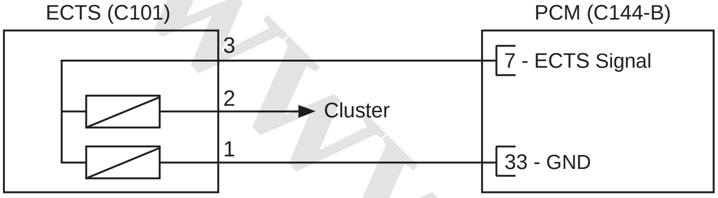
Item	Detecting Condition	Possible cause
DTC Strategy	• Rationality check	• Poor connection • Low level of Engine Coolant • Improperly installed ECTS • Open or short in circuit • ECTS • PCM
Enable Conditions	• Engine Run state • Time from IG "OFF" to IG "ON" 〉 360min • No Disabling Faults Present	
Threshold value	• Difference between startup and current ECT 〈 3 ℃(5.4˚F)	
Diagnosis Time	• Continuous (More than 120 seconds failure within 150 second test)	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E4F01E0C

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 EBD1AA0C

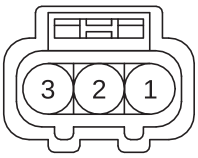
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

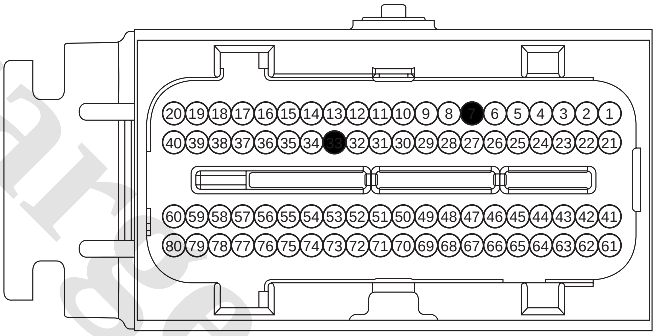
Terminal	Connected to	Funtion
1	PCM C144-B (33)	Sensor ground
2	Cluster	-
3	PCM C144-B (7)	ECTS Signal

[HARNESS CONNECTORS]



C101

ECTS

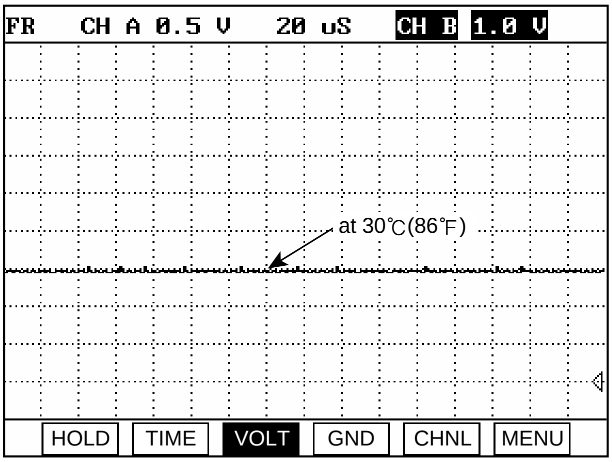


C144-B

PCM

EFBF242A

SIGNAL WAVEFORM AND DATA E5DB4F69



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 SCANTOOL DATA E053AA87

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "Monitor "ECTS" status on the service data." item on the service data.

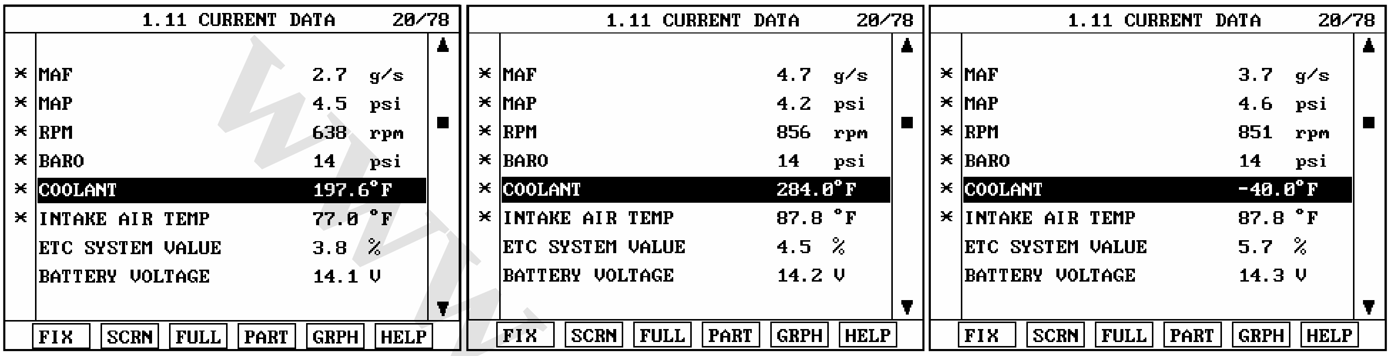


Fig. 1 Fig. 2 Fig. 3

Fig. 1 : Normal at Idle
Fig. 2 : Short to ground at idle
Fig. 3 : Open or short to battery at idle

EGRF604Q

4. Is the "ECTS" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E6091147

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

YES

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

NO

▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E268B183

1. IG "OFF" and disconnect ECTS connector.
2. IG "ON" ＆ 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

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

GROUND CIRCUIT INSPECTION EBDB827B

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

NO

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

SYSTEM INSPECTION E1AC194C

1. Check Engine coolant level is O.K
2. Check that ECTS is correctly installed.
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 E0AFBF19

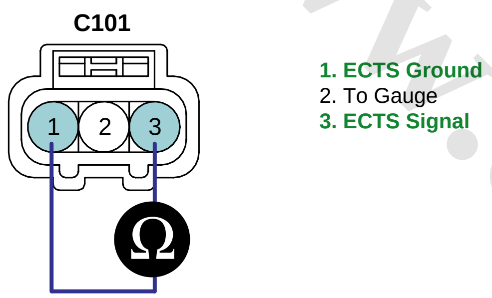
1. Check resistance of ECTS

   1) IG "OFF" and disconnect ECTS connector.

   2) Measure resistance between terminal 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		



EFBF604T

   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.

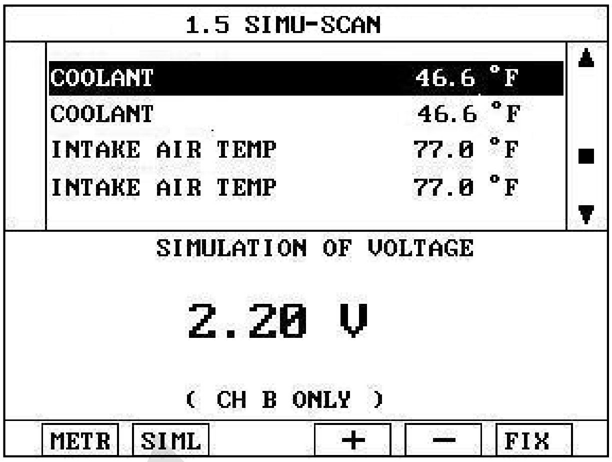
2. Check PCM

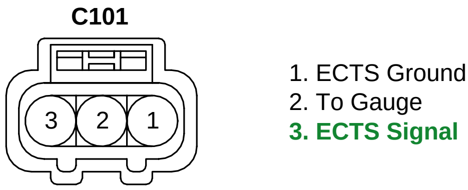
   1) IG "OFF" and connect scantool.

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

   3) IG "ON" and ENG "OFF" and simulation Function on scantool.

   4) Simulate voltage at terminal 3 of ECTS harness connector.





EGRF604U

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 to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR E80C942B

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0117 ENGINE COOLANT TEMPERATURE CIRCUIT LOW INPUT

COMPONENT LOCATION E802B12B

Refer to DTC P0115.

GENERAL DESCRIPTION E20E4F13

Refer to DTC P0115.

DTC DESCRIPTION EE13A21F

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 EBC2108E

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

SPECIFICATION E14A81C7

Refer to DTC P0115.

SCHEMATIC DIAGRAM E6D724E2

Refer to DTC P0115.

SIGNAL WAVEFORM AND DATA E3C2FB76

Refer to DTC P0115.

MONITOR SCANTOOL DATA E47F0BDF

Refer to DTC P0115.

TERMINAL AND CONNECTOR INSPECTION E1B19FA5

Refer to DTC P0115.

SIGNAL CIRCUIT INSPECTION E6A9CEA6

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 EB9AAA0E

1. Check ECTS

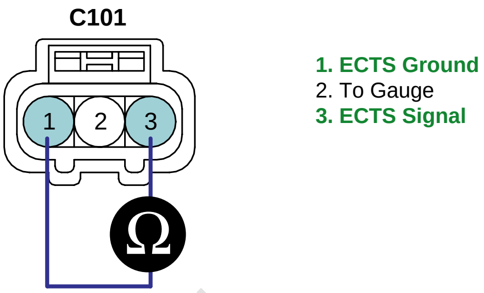
   1) IG "OFF" and disconnect ECTS connector.

   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		



EFBF604T

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.

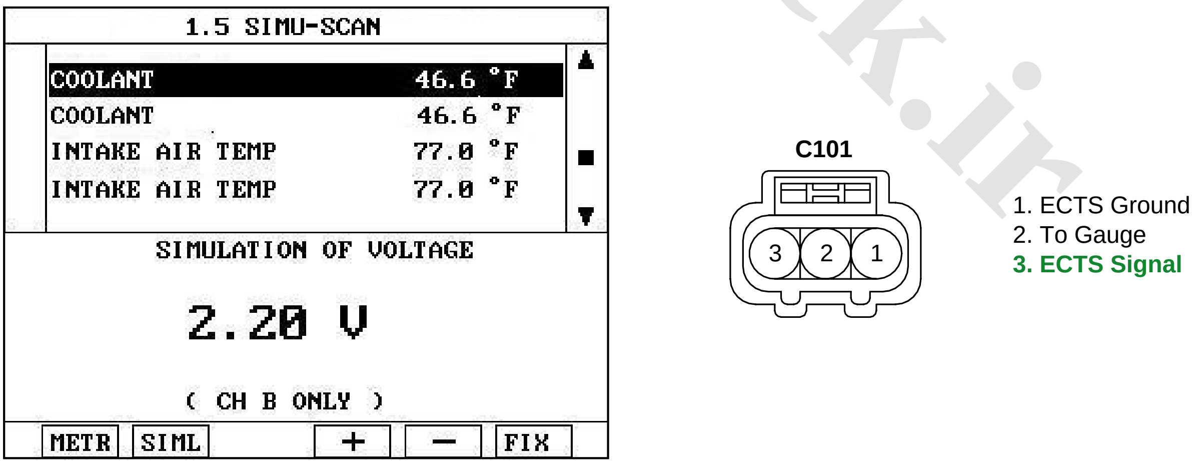
2. Check PCM

1) IG "OFF" and connect scantool.

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

3) IG "ON" and ENG "OFF" and simulation Function on scantool.

4) Simulate voltage at terminal 3 of ECTS harness connector.



EGRF604U

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 to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR E00DAFF9

Refer to DTC P0115.

DTC P0118 ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT

COMPONENT LOCATION EC95CDB2

Refer to DTC P0115.

GENERAL DESCRIPTION EF02FFD6

Refer to DTC P0115.

DTC DESCRIPTION E4086F62

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 E9071A60

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 Conditions	Case 1	• Time after start-up 〉 120 sec.	
	Case 2	• Time from IG "OFF" to IG "ON" 〉 360 min. • Intake air temperature ≥ -10℃(14˚F) • Engine running state	
Threshold value		• Engine coolant temperature sensor's voltage 〉 4.9V	
Diagnosis Time		• Continuous (More than 40 sec. failure for every 80 sec. test)	
MIL On Condition		• 2 Driving Cycle	

SPECIFICATION E074835D

Refer to DTC P0115.

SCHEMATIC DIAGRAM EF346319

Refer to DTC P0115.

SIGNAL WAVEFORM AND DATA E04815DF

Refer to DTC P0115.

MONITOR SCANTOOL DATA E40834C0

Refer to DTC P0115.

TERMINAL AND CONNECTOR INSPECTION EFCB48C3

Refer to DTC P0115.

SIGNAL CIRCUIT INSPECTION E9932669

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.

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 EE713925

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

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

4. Is the measured voltage within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

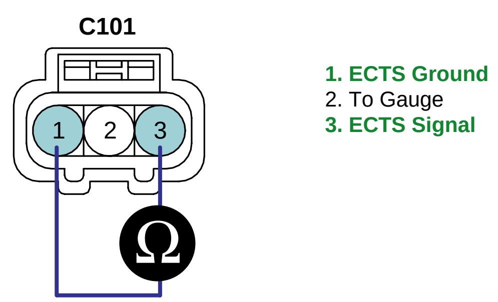
▶ Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E4DB4E90

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		



EFBF604T

   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.

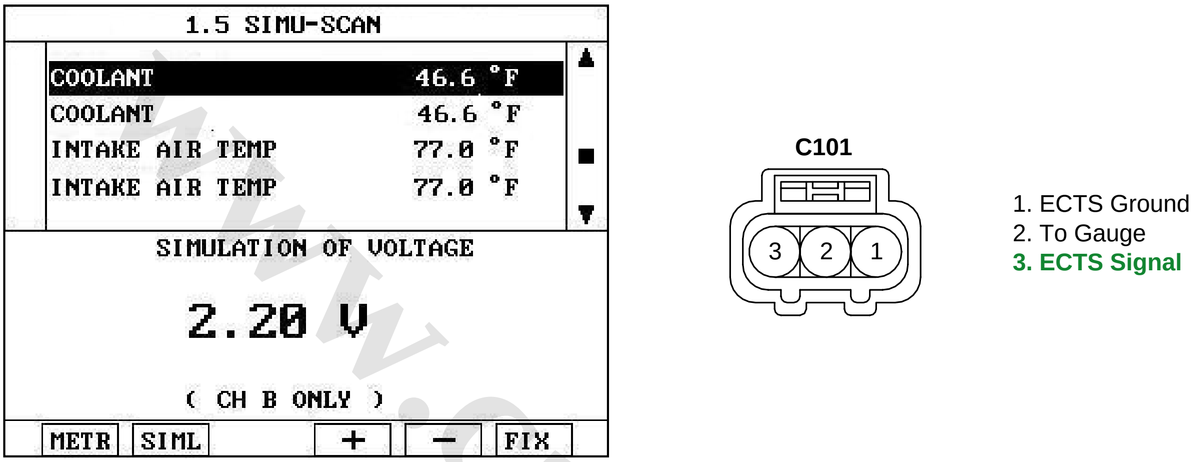
2. Check PCM

1) IG "OFF" and connect scantool.

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

3) IG "ON" and ENG "OFF" and simulation Function on scantool.

4) Simulate voltage at terminal 3 of ECTS harness connector.



EGRF604U

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

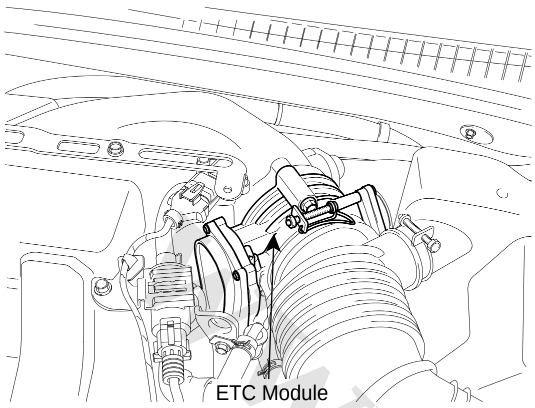
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. Before or after testing PCM on the vehicle, use this function to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR E56FFCE1

Refer to DTC P0115.

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

COMPONENT LOCATION EF656FA1



EFBF604Y

GENERAL DESCRIPTION E727E2F4

ETC(Electronic Throttle Control Valve) is the device controlling amount of air to engine acccording to driver's intension. Different from the existing mechanical throttle valve which is composed of accelerator pecal and connecting wire cable, ETC consists of a motor, a throttle body and a throttle position sensor. Receiving input signals from electronic accelerator pedal module, PCM lets ETC motor control throttle valve. With ETC, cruise control system works without any additional device.

DTC DESCRIPTION E819C3E8

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 EF1EF860

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 E6870326

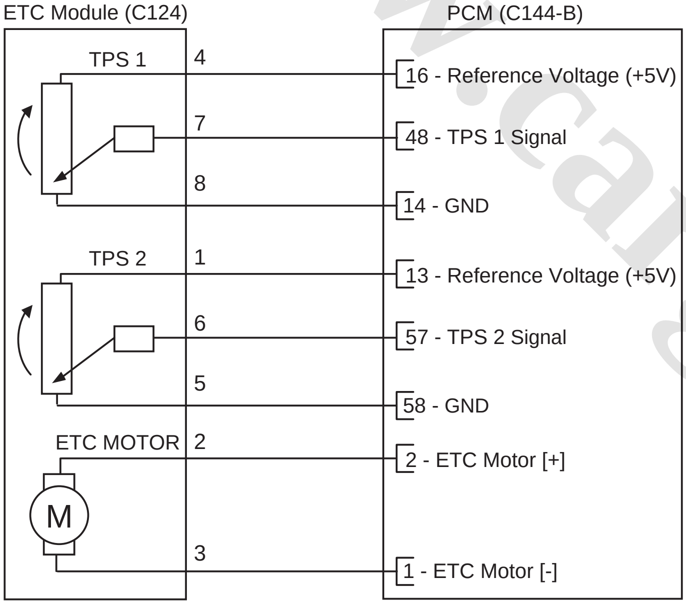
Throttle opening (°)	Output voltage(V) [Vref=5.0]	
	TPS1	TPS2
0°	0.0V	5.0V

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

EC53212B

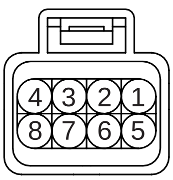
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

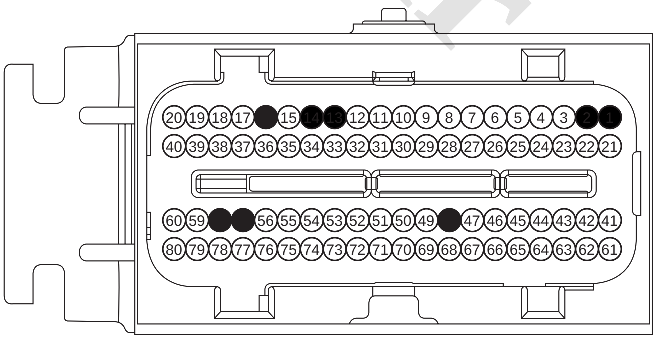
Terminal	Connected to	Funtion
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144- B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM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

[HARNESS CONNECTORS]



C124

ETC MODULE

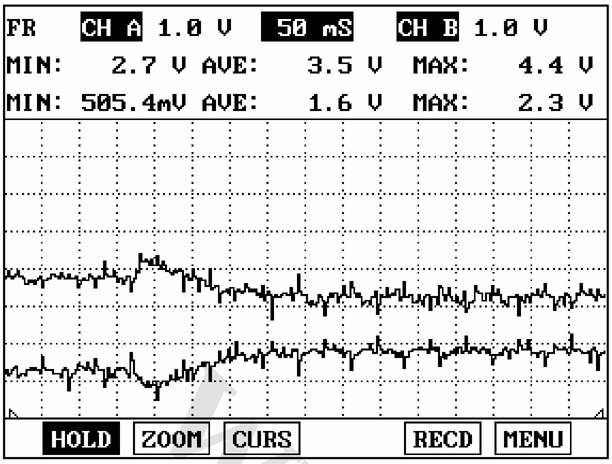


C144-B

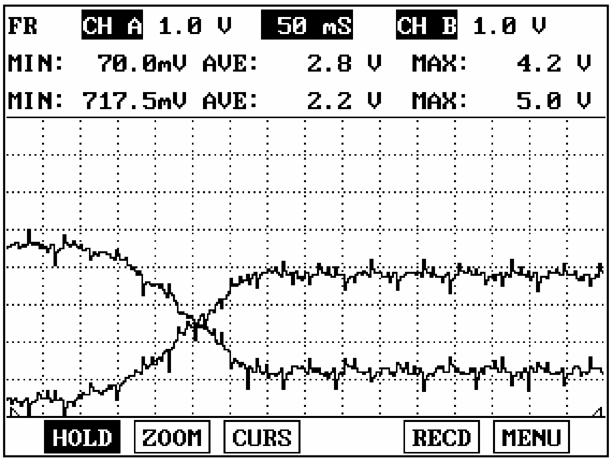
PCM

EFBF236A

SIGNAL WAVEFORM AND DATA E2E244AB



Hit the accelerator at IG ON

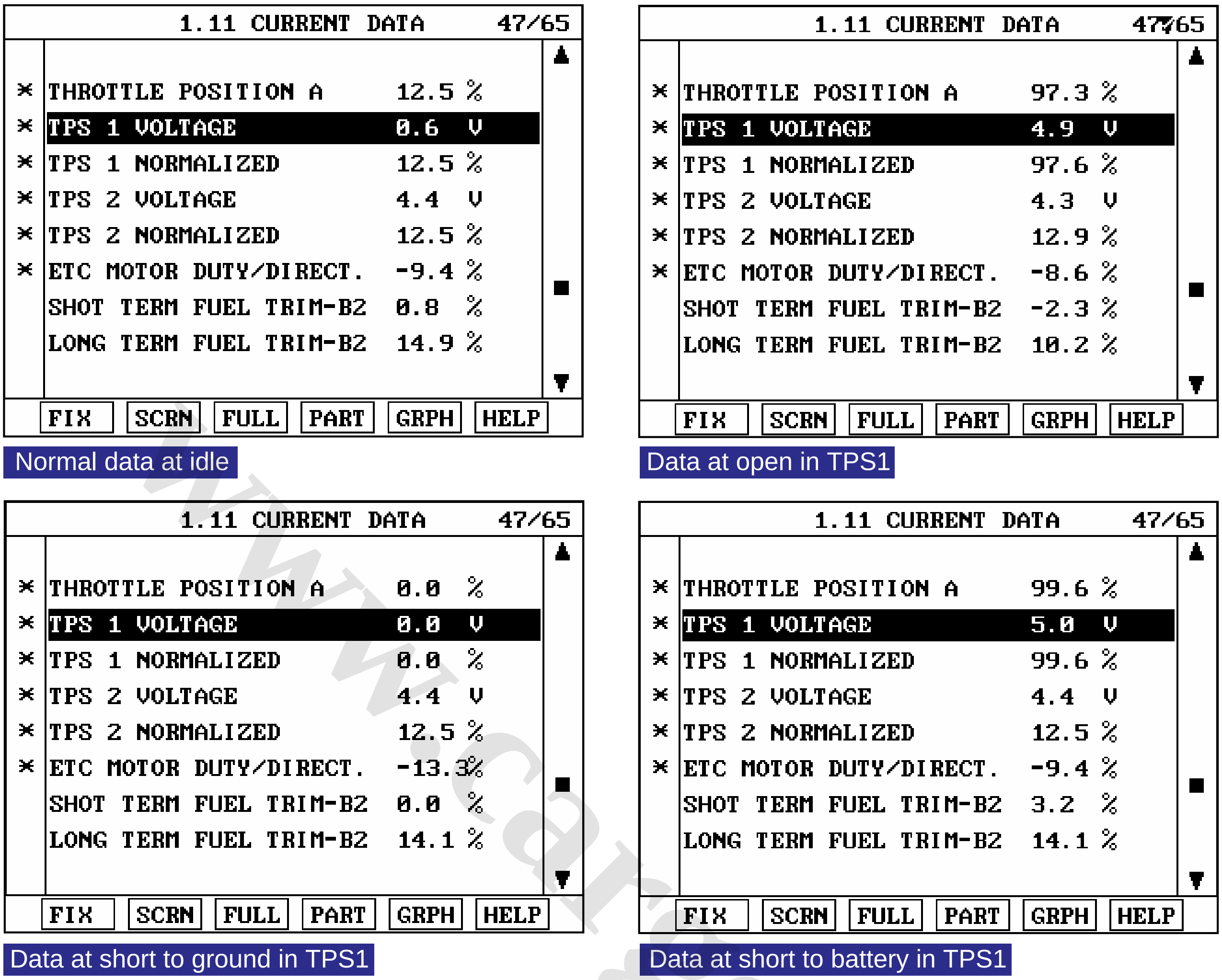


Open the throttle valve by force at IG ON

EGRF604Z

MONITOR SCANTOOL DATA E459ABF0

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "TPS1" item on the service data.



EGRF605A

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.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EC9383E3

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 E12311C0

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 EDA7BF4D

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.

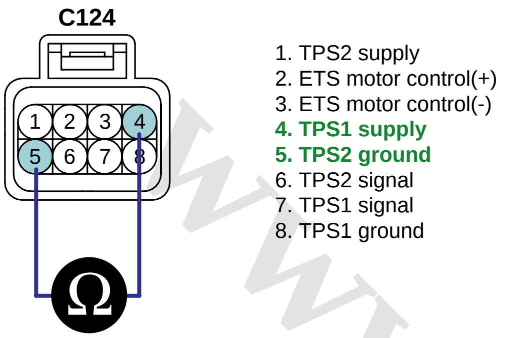
COMPONENT INSPECTION E7FB6156

1. Check TPS

   1) IG "OFF" and disconnect TPS connector.

   2) Measure resistance between terminals 4 and 5 of TPS connector.(component side)

Specificaton : 4 ~ 6kΩ



EFBF605D

   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.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR EC2BB317

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E7214F31

Refer to DTC P0122.

GENERAL DESCRIPTION E61C82E0

Refer to DTC P0122.

DTC DESCRIPTION E7348D7D

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 EA7A646B

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 EFCA852B

Refer to DTC P0122.

SCHEMATIC DIAGRAM EF972CD6

Refer to DTC P0122.

SIGNAL WAVEFORM AND DATA E84A0D10

Refer to DTC P0122.

MONITOR SCANTOOL DATA EA46AE7E

Refer to DTC P0122.

TERMINAL AND CONNECTOR INSPECTION EDD60B07

Refer to DTC P0122.

SIGNAL CIRCUIT INSPECTION E9AA4FFF

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.

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 E769CB85

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.

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

5. Is the measured voltage within specification?

YES

▶ Go to "Component inspection" procedure.

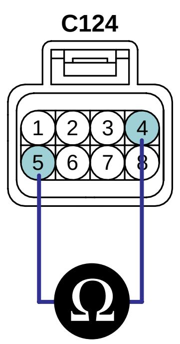
NO

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

COMPONENT INSPECTION EA9E12B8

1. Check TPS
   1) IG "OFF" and disconnect TPS connector.
   2) Measure resistance between terminals 4 and 5 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

EFBF605D

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

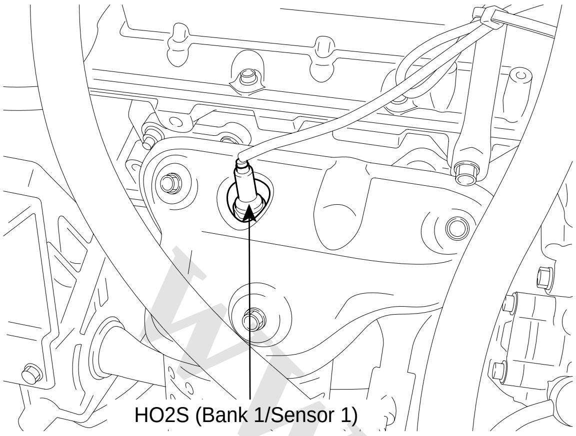
1. ***Erase the trouble codes on PCM***
2. ***Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)***
3. ***Turn ignition key on more than 1second to record the throttle motor position on the EEPROM***

VERIFICATION OF VEHICLE REPAIR E732BE18

Refer to DTC P0122.

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

COMPONENT LOCATION EF044C4E



EGRF601B

GENERAL DESCRIPTION E9566AA1

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 E5C89184

Checking output signals from HO2S every 15 sec. under detecting condition, if an output signal is below 0.04V for more than 12.5 sec., PCM sets P0131. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E6CD3079

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal low	• Poor Connection • Short to ground in harness • HO2S(B1/S1) • PCM
Enable Conditions	• Battery voltage ≥ 10V • The minimum airflow ≥ 2g/s • Engine running state ≥ 60sec. • The coolant temperature ≥ 60℃(140˚F) • The feed-back control (the closed loop) state • No fuel-cut state • Above conditions are met 〉 5 sec. • HO2S heated state • No transient condition	
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	

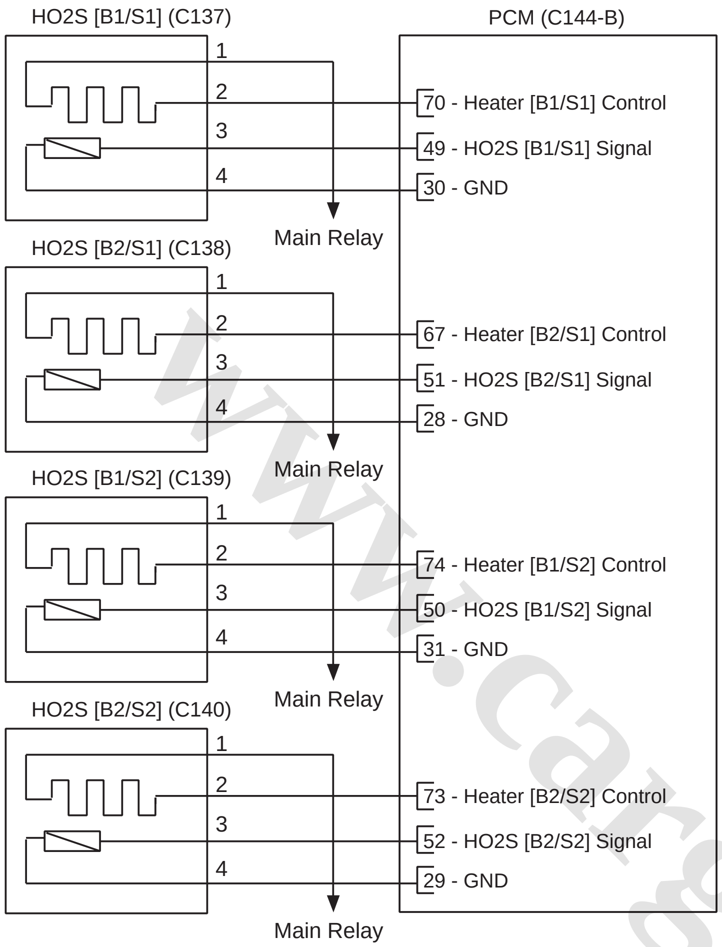
SPECIFICATION EA5EC5A5

Air/fuel mixture	Voltage(V)
Rich	0.75 ~ 1V
Lean	0 ~ 0.12V

※In case of open circuit, voltage is set to 0.45V(Pumping current OFF) or 3.5V(Pumping current ON)

SCHEMATIC DIAGRAM E9800F7F

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

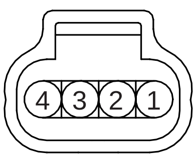
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

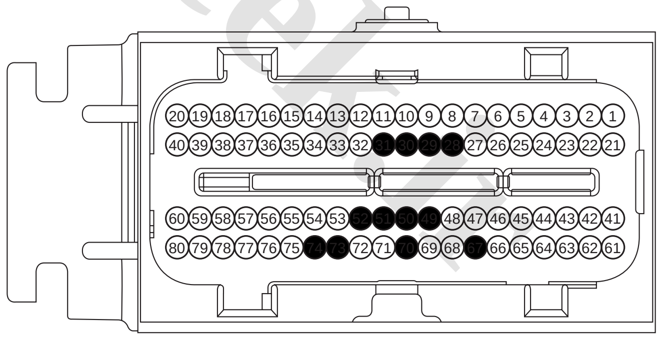
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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

EFBF250A

SIGNAL WAVEFORM AND DATA EF48318B

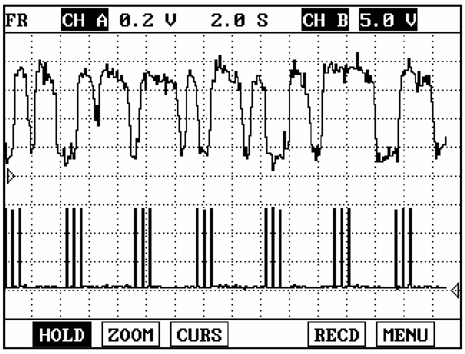


Fig. 1

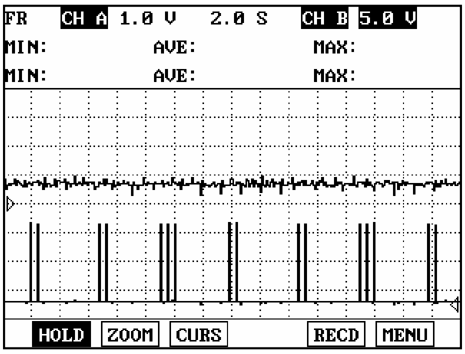


Fig. 2

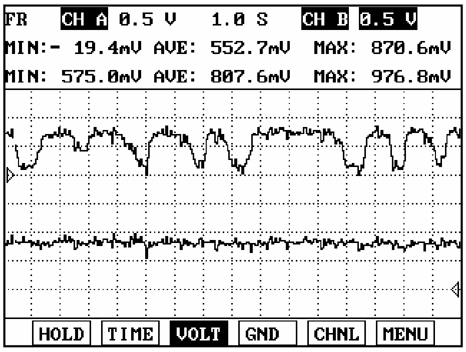


Fig. 3

Fig. 1 : HO2S(B1S1) & Heater
Fig. 2 : HO2S(B1S2) & Heater
Fig. 3 : HO2S(B1S1) & HO2S(B1S2)

EGRF605L

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, HO2S signal will switch from lean to rich normally.

MONITOR SCANTOOL DATA E80ECCAB

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B1/S1)" status on the service data.

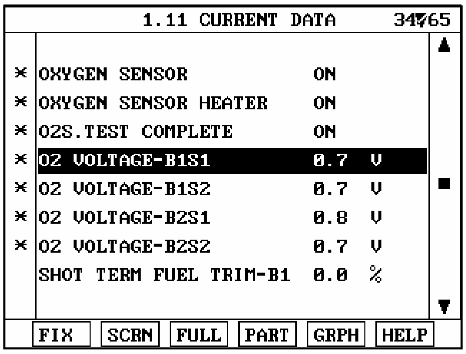


Fig. 1

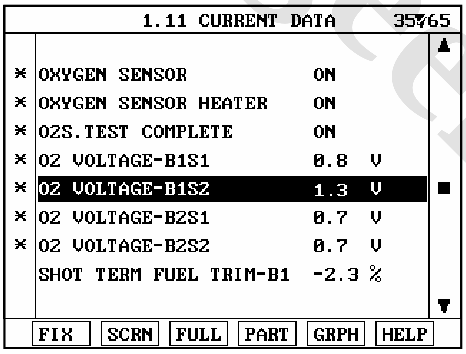


Fig. 2

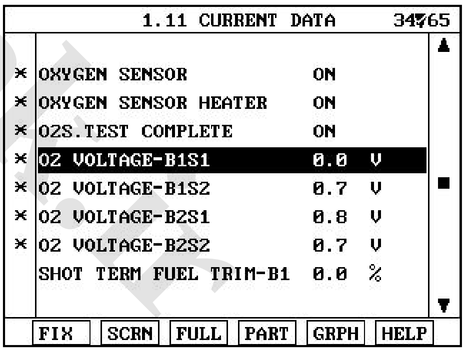


Fig. 3

Fig. 1 : Normal data
Fig. 2 : Open or Short to battery in HO2S(B1/S1)
Fig. 3 : Short to ground in HO2S(B1/S1)

EGRF605M

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E719E28B

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

YES

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

NO

▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E70248FC

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 E44CE061

1. Check HO2S(B1/S1)
   1) IG "OFF" and disconnect HO2S(B1/S1) connector.
   2) Check HO2S(B1/S1) for damage or contamination caused by a foreign substance.
   3) Is the HO2S(B1/S1) 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 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

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EBAA3808

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E2A11048

Refer to DTC P0131.

GENERAL DESCRIPTION E8F000E8

Refer to DTC P0131.

DTC DESCRIPTION E2411EB3

Checking output signals from O2 sensor every 15 sec. under detecting condition, if an output signal is below 1.3V for more than 12.5 sec., PCM sets P0132. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EAF97F9B

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal high	• Poor Connection • Short to battery in harness • HO2S(B1/S1) • PCM
Enable Conditions	• Battery voltage ≥ 10V • The minimum airflow ≥ 2g/s • Engine running state ≥ 60sec. • The coolant temperature ≥ 60℃(140˚F) • The feed-back control (closed loop) state • No fuel-cut state • Above conditions are met 〉 5 sec. • HO2S heated state • No transient condition	
Threshold value	• The voltage of HO2S(B1/S1) 〉 1.3V	
Diagnosis Time	• Continuous (more than 12.5 sec. failure for every 15 sec.test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EBB1D631

Refer to DTC P0131.

SCHEMATIC DIAGRAM E77E9663

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA E5B500A5

Refer to DTC P0131.

MONITOR SCANTOOL DATA E8809EB3

Refer to DTC P0131.

TERMINAL AND CONNECTOR INSPECTION EE3246AF

Refer to DTC P0131.

SIGNAL CIRCUIT INSPECTION E368ED2F

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 EFF56FC4

1. Check HO2S(B1/S1)
   1) IG "OFF" and disconnect HO2S(B1/S1) connector.
   2) Check HO2S(B1/S1) for damage or contamination caused by a foreign substance.
   3) Is the HO2S(B1/S1) 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 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

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E1E7F122

Refer to DTC P0131.

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

COMPONENT LOCATION E8FD3A1E

Refer to DTC P0131.

GENERAL DESCRIPTION EE2FBC18

The HO2S is used to supply the PCM with information regarding the composition of the air/fuel mixture. The HO2S is positioned in the exhaust pipe ahead of the TWC. To measure the oxygen content, the HO2S requires a supply of ambient air as a reference. The HO2S produces a voltage that varies between 0.1V and 0.9V under normal operating conditions. The Powertrain Control Module (PCM) monitors this voltage and determines if the exhaust gas is lean or rich. If the voltage input at the PCM is under approx. 0.45V the exhaust is lean, and if the voltage input is over approx. 0.45V the exhaust is rich. The PCM constantly monitors the HO2S signal during closed loop operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary.

DTC DESCRIPTION E1A95CE3

The response time of an O2 sensor can be impacted by two factors: temperature and poisoning. Poisoning of the O2 sensor is the primary failure mode of O2 sensor response time. Poisoning can come from many sources: silicone from gaskets or even in the fuel, phosphorous from engine oil, carbon from operating in a cooler environment or lead from the fuel. Most poisoning failures have the potential to clear up after the source of the poisoning has been removed. However, sometimes the poisoning may be so severe that the damage is irreversible.
Checking output signals from HO2S under detecting condition, if an output signal is out of threshold, PCM sets P0133.

DTC DETECTING CONDITION EBED7DC2

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines O2 sensor functionality by checking its response rate	
Enable Conditions	• 1200 ≤ Engine RPM ≤ 4300 • 7.5g/s ≤ Air Flow ≤ 40g/s • Engine run time > 60sec • Engine Coolant > 70℃(158 °F) • No Decel Fuel Cut-Off Exit with Rich Bias Fueling • No torque Fuel Reduction in effect • No Disabling Faults • All of the conditions above met for more than 2 sec.	
Threshold value	• Switching counter lean to rich < 13 • Switching counter rich to lean < 13 • Response Lean Rich Transition Counter/Response Lean Rich Switch Counter > 29 • Response Rich Lean Transition Counter/Response Rich Lean Switch Counter > 35 • Response Rich Lean Average/Response Lean Rich Average < 0.3809 • Response Rich Lean Average/Response Lean Rich Average > 3	• Poor connection • Faulty HO2S • Faulty PCM
Diagnosis Time	• -	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EC98907C

HO2S	Response Time (70% Duty at 10Hz)
	lean to rich(Less than 65ms) rich to lean(Less than 80ms)

SCHEMATIC DIAGRAM E6BA0AEA

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA EF1BAF38

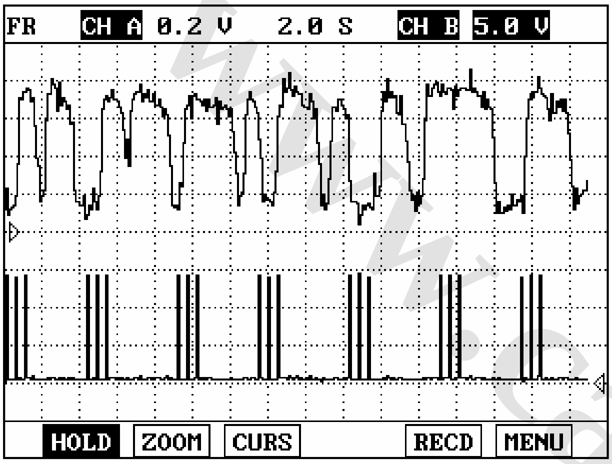


Fig. 1

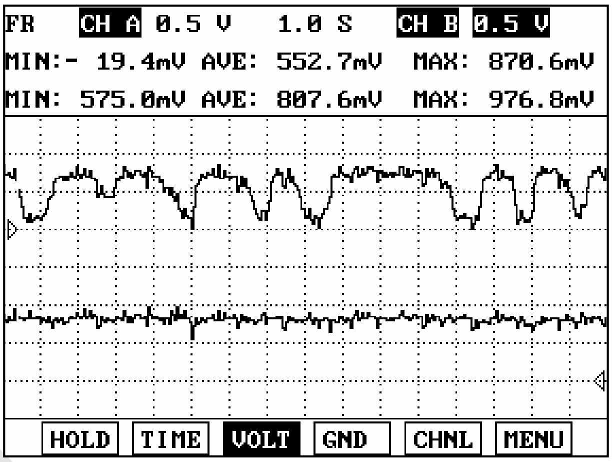


Fig. 2

Fig. 1 : HO2S(B1S1) & Heater
Fig. 2 : HO2S(B1S1) & HO2S(B1S2)

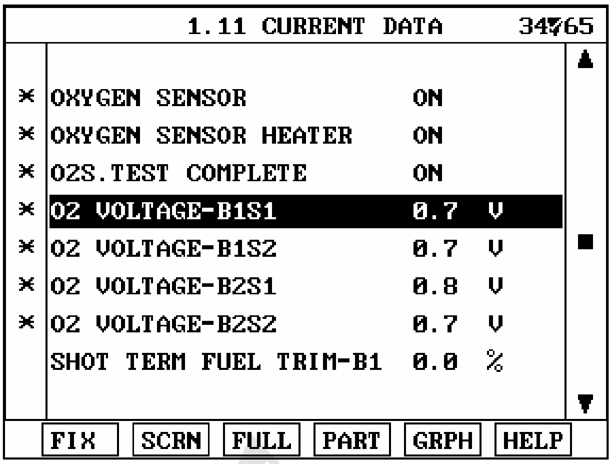
EGRF605O

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, HO2S signal will switch from lean to rich normally.

MONITOR SCANTOOL DATA EB8EB63D

1. Connect Scantool & Engine "ON"
2. Warm up the engine to normal operating temperature.
3. Monitor HO2S voltage(B1/S1) parameter on scantool

Specification : Voltage will vary from 0.1 to 0.9 V



EGRF605P

4. Is the HO2S parameter displayed within specifications ?

YES

▶ 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, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Go to "Component Inspection" procedure

COMPONENT INSPECTION EB680286

1. Visual Inspection of HO2S

   1) Visually/physically inspect following items:
      - Inspect the front HO2S for Contaminated, deteriorated or aged Front HO2S
      - If contamination is evident on the HO2S, replace contaminated sensor

   2) Is the HO2S visually / physically O.K ?

      YES

      ▶ Go to "Check Performance of H02S" as follows

      NO

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

2. Check performance of HO2S

   1) Connect scantool & Engine "ON"

   2) Warm-up the engine to normal engine temperature.

   3) Monitor signal waveform of HO2S with scantool.

HO2S	Response Time (70% Duty at 10Hz)
	lean to rich(Less than 65ms) rich to lean(Less than 80ms)

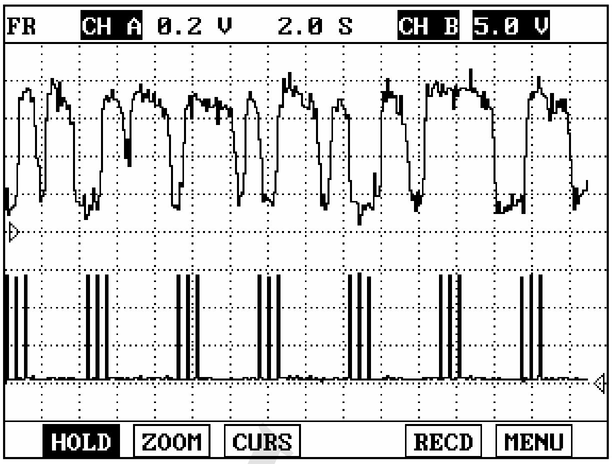


Fig. 1

Fig. 1 : HO2S(B1S1) & Heater

EGRF605Q

4) Is the sensor signal switching properly ?

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 HO2S and check for proper operation. If the problem is corrected, replace HO2S 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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E0302150

Refer to DTC P0131.

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

COMPONENT LOCATION EC53252E

Refer to DTC P0131.

GENERAL DESCRIPTION E7A8F619

Refer to DTC P0131.

DTC DESCRIPTION E2EA42E2

Checking output signals from HO2S every 90 sec. under detecting condition, if an output signal indicating open in the circuit lasts for more than 76.5 sec., PCM sets P0134. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EAC07D39

Item		Detecting Condition	Possible cause
DTC Strategy		• Open	• Poor connection • Open in harness • HO2S(B1/S1) • PCM
Enable Conditions		• No sensor cooled status • The minimum airflow ≥ 2g/s • The battery voltage ≥ 10V • Engine running state 〉 60 sec. • Coolant temperature ≥ 60℃(140˚F) • No fuel reduction • No transient condition • No fuel-cut state • No disabling fault	
Thresh old value	Case 1	• At pumping current ON • 1.2V ≤ Voltage of HO2S ≤ 3.9V	
	Case 2	• At pumping current OFF • 0.415V ≤ Voltage of HO2S ≤ 0.515V	
Diagnosis Time		• Continuous (more than 76.5 sec.failure for every 90 sec.test)	
MIL On Condition		• 2 Driving Cycles	

SPECIFICATION E9961CBC

Refer to DTC P0131.

SCHEMATIC DIAGRAM E518846A

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA E8B53D0B

Refer to DTC P0131.

MONITOR SCANTOOL DATA E8E5FDD7

Refer to DTC P0131.

TERMINAL AND CONNECTOR INSPECTION E0989FF4

Refer to DTC P0131.

SIGNAL CIRCUIT INSPECTION E8E7F0BB

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 E79A19BB

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 E80252D9

1. Check HO2S(B1/S1)
   1) IG "OFF" and disconnect HO2S(B1/S1) connector.
   2) Check HO2S(B1/S1) for damage or contamination caused by a foreign substance.

3) Is the HO2S(B1/S1) 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 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

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E82BB856

Refer to DTC P0131.

DTC P0135 HO2S HEATER CIRCUIT (BANK 1 / SENSOR 1)

COMPONENT LOCATION ED902822

Refer to DTC P0131.

GENERAL DESCRIPTION E07145A7

Refer to DTC P0131.

DTC DESCRIPTION EC0F4D07

If the PCM detects heater current is lower than threshold value for 2.5 seconds or over while enable condition is met PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION EFD64843

Item	Detecting Condition	Possible cause
DTC Strategy	• Compares the current that is passing through the O2 Heater to a low limit	• Poor Connection • Contact Resistance • HO2S(B1/S1) • PCM
Enable Conditions	• Engine Running 〉 60sec. • Heater Duty Cycle 〉 0.4% • Max. Duty Cycle - Min. Duty Cycle 〈 0.05% • Adove conditions are met 〉 5sec.	
Threshold value	• Filtered O2 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 E0C56257

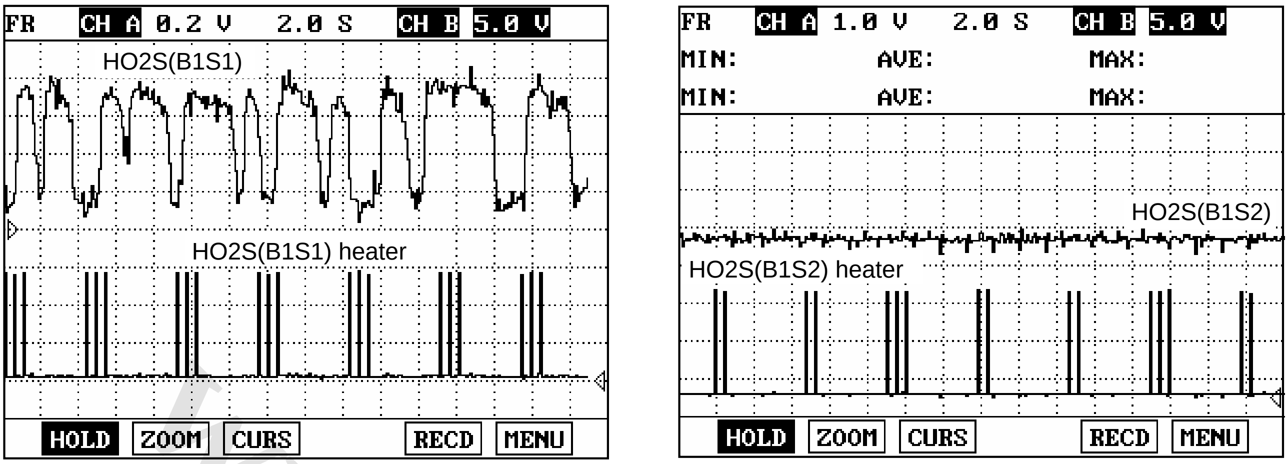
FOR REFERENCE ONLY

Condition	Current(A)
Heater Current at 13.5V, 450℃(842°F) Exhaust	0.52 ± 0.1
Heater In-rush Current at 21℃(69.8°F), 13.5V	1.7 MAX
Heater In-rush Current at -40℃(-40°F), 13.5V	2.2 MAX

SCHEMATIC DIAGRAM E6540FC5

Refer to DTC P0131.

SIGNAL WAVEFORM AND DATA EE156CA4

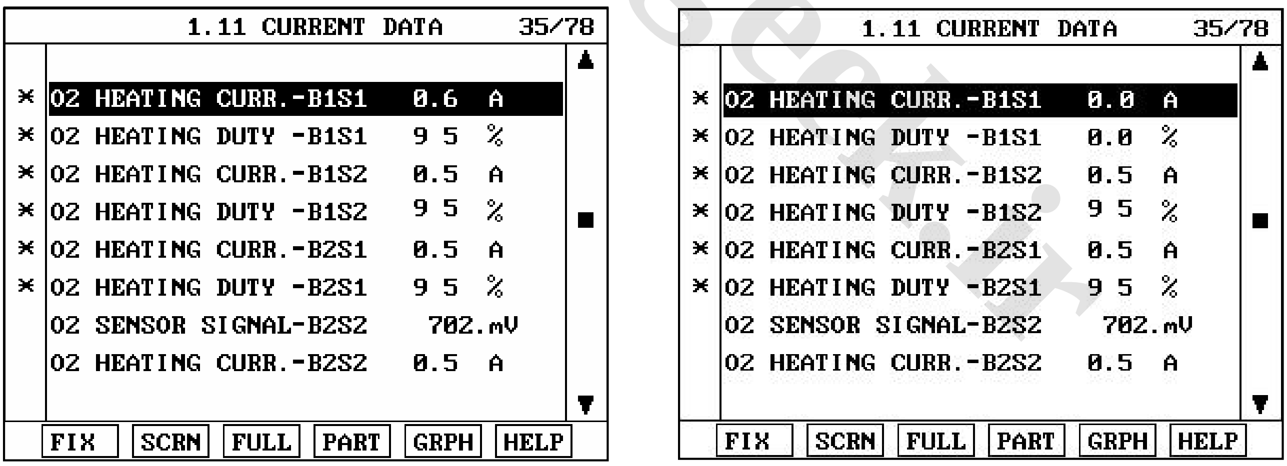


EGRF605U

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 SCANTOOL DATA EFB2D183

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B1/S1) Heater" status on the service data.



EGRF605V

4. Is the "HO2S Heater(B1/S1)" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EE2839EE

Refer to DTC P0131.

COMPONENT INSPECTION E9322AB1

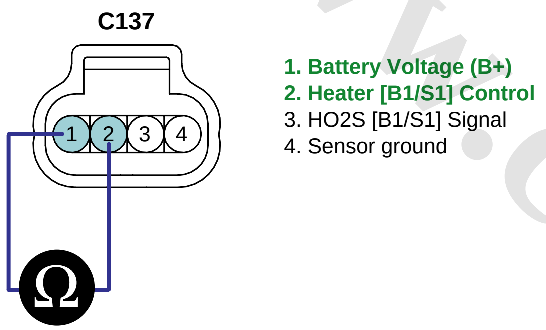
1. Check HO2S(B1/S1) Heater resistance

   1) IG "OFF" and disconnect HO2S(B1/S1) connector

   2) Measure resistance between terminal 1 and 2 of HO2S(B1/S1)(Component Side)

SPECIFICATION :

Heater	
Resistance (Ω)	9.6 ± 1.5 at 21℃(69.8˚F)



EFBF605W

   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 to reuse the PCM on the others

NO

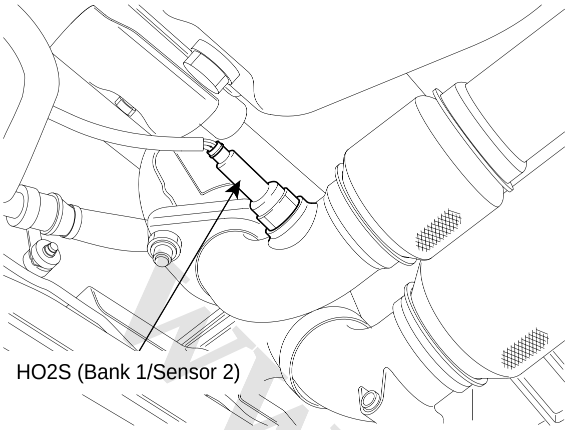
▶ Substitute with a known - good HO2S(B1/S1) and check for proper operation. If the problem is corrected, replace HO2S(B1/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EE4938CB

Refer to DTC P0131.

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

COMPONENT LOCATION E5CC0D7D



EGRF601J

GENERAL DESCRIPTION EA5E2C92

HO2S(B1/S2) is in the back of Catalytic Converter to check the proper operation of catalyst. As Exhaust gas already passed through catalyst, oxygen density in it is within specific range. If the oxygen density changes in accordance with HO2S(B1/S1), it means the poor performance of catalytic converter.

DTC DESCRIPTION EA8A499C

Checking output signals from HO2S every 15 sec. under detecting condition, if an output signal is below 0.04V for more than 12.5 sec. PCM sets P0137. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EEAE17D1

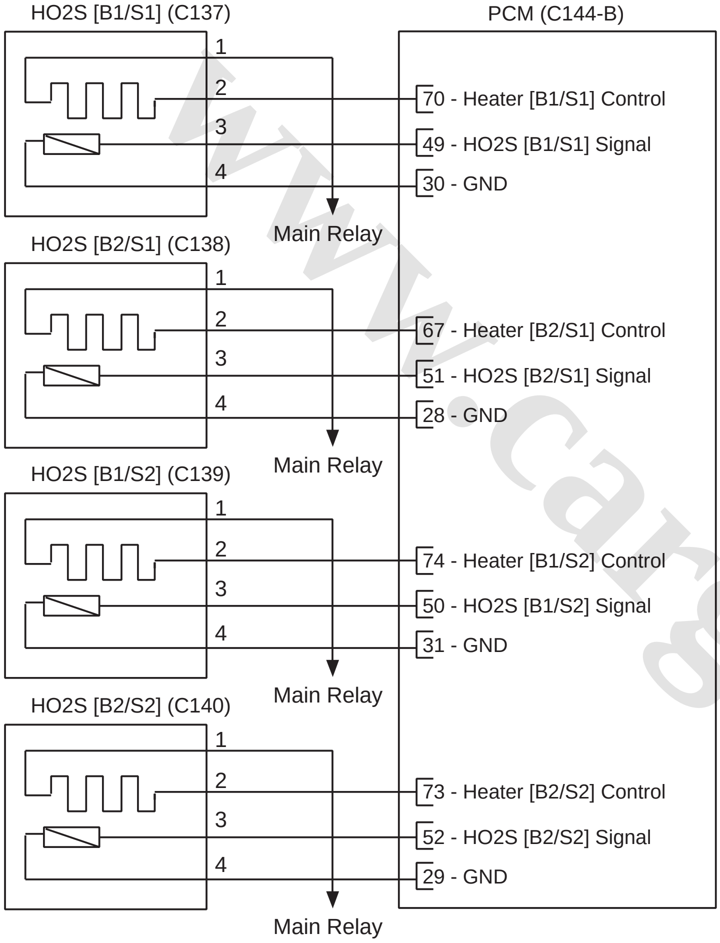
Item	Detecting Condition	Possible cause
DTC Strategy	• Signal low	• Poor Connection • Short to ground in harness • HO2S(B1/S2) • PCM
Enable Conditions	• Battery voltage ≥ 10V • The minimum airflow ≥ 2g/s • Engine running state ≥ 60 sec • The coolant temperature ≥ 60℃(140˚F) • The feed-back control (the closed loop) state • No fuel-cut state • Above conditions are met 〉 5 sec • HO2S heated state • NO transient condition	
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 EA9C6280

Air/fuel mixture	Voltage(V)
Rich	0.75 ~ 1V
Lean	0 ~ 0.12V

SCHEMATIC DIAGRAM E6C4EAEB

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

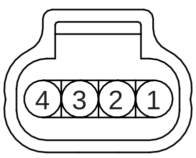
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

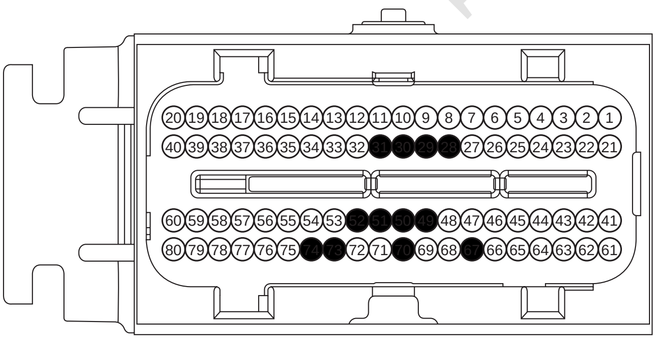
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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]

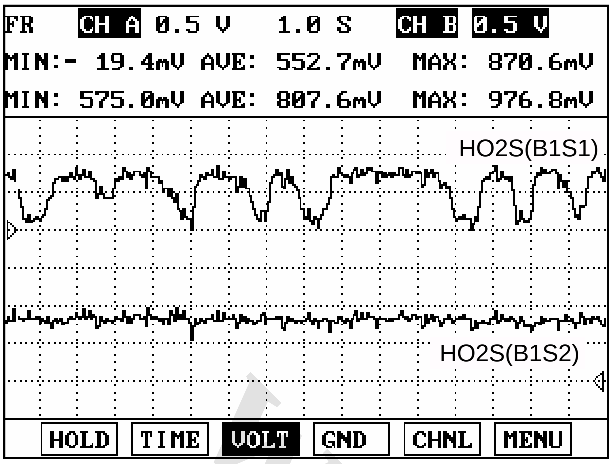


C144-B

PCM

EFBF250A

SIGNAL WAVEFORM AND DATA EEDE5D35



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 SCANTOOL DATA E3896462

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B1/S2)" item on the service data.

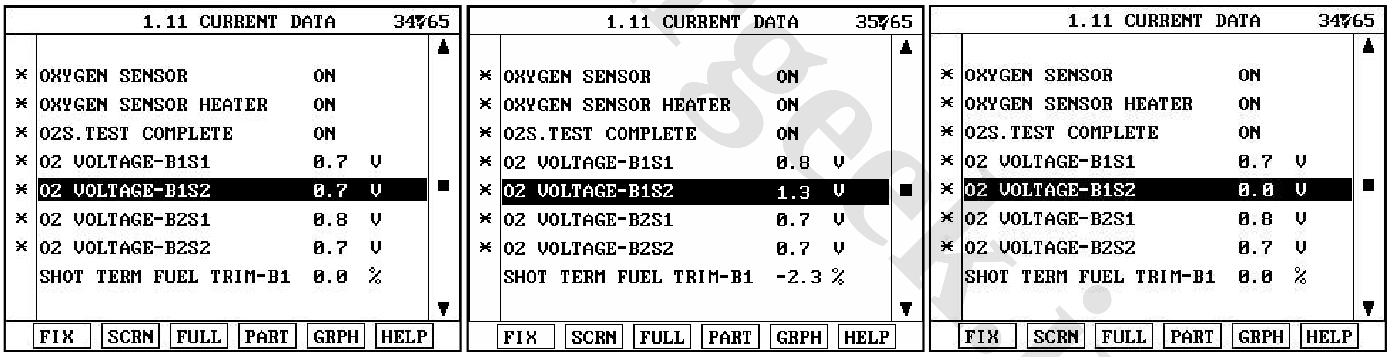


Fig. 1 Fig. 2 Fig. 3

Fig. 1 : Nomal data
Fig. 2 : Open or short to battery in HO2S
Fig. 3 : Short to ground in HO2S

EFBF605Y

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION ECEC2FC6

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

YES

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

NO

▶ Go to " Signal Circuit Inspection " procedure.

SIGNAL CIRCUIT INSPECTION E364243D

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 EC0A5CE3

1. Visual Inspection of HO2S
   Visually/physically inspect following items:
   - Inspect the Rear HO2S for Contaminated, deteriorated or aged Rear HO2S
   - If contamination is evident on the HO2S, replace contaminated sensor
2. Is the HO2S(B1/S2) 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 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.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EB72CB63

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E7D2830A

Refer to DTC P0137.

GENERAL DESCRIPTION E298FBE1

Refer to DTC P0137.

DTC DESCRIPTION E070C5D6

Checking output signals from HO2S every 15 sec. under detecting condition, if an output signal is above 1.3V for more than 12.5 sec. PCM sets P0138. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E0566962

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal high	• Poor connection • Short to battery in harness • HO2S(B1/S2) • PCM
Enable Conditions	• Battery voltage ≥ 10V • The minimum airflow ≥ 2g/s • Engine running state ≥ 60 sec • The coolant temperature ≥ 60℃(140˚F) • Feed-back control(Closed loop) state • No fuel-cut state • Above conditions are met 〉 5 sec • HO2S heated state • NO transient condition	
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 EBEF98BE

Refer to DTC P0137.

SCHEMATIC DIAGRAM E7975136

Refer to DTC P0137.

SIGNAL WAVEFORM AND DATA EB0573F8

Refer to DTC P0137.

MONITOR SCANTOOL DATA E84665F0

Refer to DTC P0137.

TERMINAL AND CONNECTOR INSPECTION E0260D28

Refer to DTC P0137.

SIGNAL CIRCUIT INSPECTION E5286C8D

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 E605430B

1. Visual Inspection of HO2S
   Visually/physically inspect following items:
   - Inspect the Rear HO2S for Contaminated, deteriorated or aged Rear HO2S
   - If contamination is evident on the HO2S, replace contaminated sensor
2. Is the HO2S(B1/S2) 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 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.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EEBA53DF

Refer to DTC P0137.

DTC P0139 HO2S CIRCUIT SLOW RESPONSE (BANK 1 / SENSOR 2)

COMPONENT LOCATION EA95EFDE

Refer to DTC P0137.

GENERAL DESCRIPTION E82A0550

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 the 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 EB2AE1DA

Checking the delayed time between the front sensor response and the rear sensor response to fuel shift under detecting condition, if the fuel shift time is higher than 25sec, PCM determines a fault and sets DTC P0139. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E6FEA3CC

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if Rear O2 Sensor is acceptable for Idle Catalyst Monitor use	• Poor connection • Faulty HO2S • Faulty PCM
Enable Conditions	• Same conditions as idle catalyst monitoring	
Threshold value	• Response time of rear oxygen sensor by shifting airfuel ratio from lean to rich and vice versa. ≥ 25 sec.	
Diagnosis Time	• -	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E542B705

Refer to DTC P0137.

SCHEMATIC DIAGRAM EBDDA69B

Refer to DTC P0137.

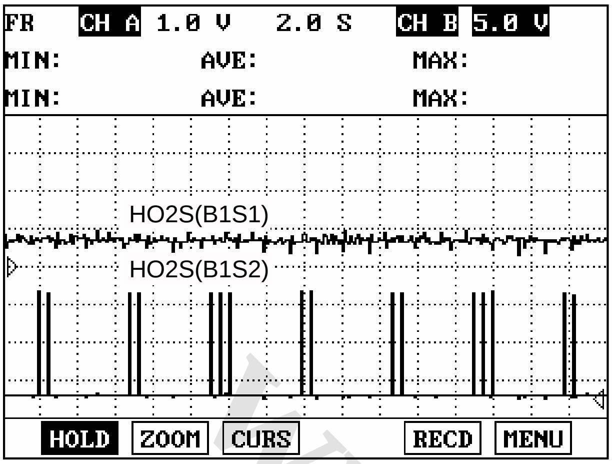
SIGNAL WAVEFORM AND DATA ECDBCAC6

Refer to DTC P0137.

MONITOR SCANTOOL DATA ECDFEFDB

1. Connect Scantool then Engine "ON"
2. Warm up the engine to normal operating temperature.
3. Monitor the signal waveform of HO2S(B1S2) with scantool

Specification : 0.1 ~ 0.9V



EGRF606A

4. Is the shift time from signal waveform within specifications ?

YES

▶ 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, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E9EF3F46

Refer to DTC P0137.

COMPONENT INSPECTION EA0D538D

1. Visual Inspection of HO2S
   Visually/physically inspect following items:
   - Inspect the Rear HO2S for Contaminated, deteriorated or aged Rear HO2S
   - If contamination is evident on the HO2S, replace contaminated sensor

2. Is the HO2S(B1/S2) 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.

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 HO2S(B1S2) and check for proper operation. If the problem is corrected, replace HO2S(B1S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E3424090

Refer to DTC P0137.

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

COMPONENT LOCATION EA372BAD

Refer to DTC P0137.

GENERAL DESCRIPTION EAFD44D3

Refer to DTC P0137.

DTC DESCRIPTION E42CF7DD

Checking output signals from HO2S every 10 sec. under detecting condition, if an output signal indicating open in the circuit lasts for more than 6.3 sec., PCM sets P0140. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EA0301DA

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• Open</td><td rowspan="6">• Poor Connection
• Open in harness
• HO2S(B1/S2)
• PCM</td></tr>
<tr><td colspan="2">Enable Conditions</td><td>• No sensor cooled status
• The minimum airflow ≥ 2g/s
• The battery voltage ≥ 10V
• Engine running state 〉 60 sec.
• Coolant temperature ≥ 60℃(140˚F)
• No fuel reduction
• No transient condition
• No fuel-cut state
• No disabling fault</td></tr>
<tr><td rowspan="2">Thresh-old value</td><td>Case 1</td><td>• At pumping current ON
• 1.2V ≤ Voltage of HO2S ≤ 3.9V</td></tr>
<tr><td>Case 2</td><td>• At pumping current OFF
• 0.415V ≤ Voltage of HO2S ≤ 0.515V</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(more than 6.3 sec.failure for every 10 sec.test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• 2 driving cycles</td></tr>
</table>

SPECIFICATION EBC5F6B5

Refer to DTC P0137.

SCHEMATIC DIAGRAM EE0E517B

Refer to DTC P0137.

SIGNAL WAVEFORM AND DATA E21F2E4F

Refer to DTC P0137.

MONITOR SCANTOOL DATA EFA0373F

Refer to DTC P0137.

TERMINAL AND CONNECTOR INSPECTION EE90B3FE

Refer to DTC P0137.

SIGNAL CIRCUIT INSPECTION E6F924D2

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 E2C2E717

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 EA3DB378

1. Visual Inspection of HO2S
   Visually/physically inspect following items:
   - Inspect the Rear HO2S for Contaminated, deteriorated or aged Rear HO2S
   - If contamination is evident on the HO2S, replace contaminated sensor

2. Is the HO2S(B1/S2) 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 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.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E8B6E447

Refer to DTC P0137.

DTC P0141 HO2S HEATER CIRCUIT (BANK 1 / SENSOR 2)

COMPONENT LOCATION ED3D6C2F

Refer to DTC P0137.

GENERAL DESCRIPTION E9B9C7FE

Refer to DTC P0137.

DTC DESCRIPTION E0FE0B1D

If the PCM detects heater output voltage is lower than threshold value for 5 seconds while enable condition is met, PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E566BC2B

Item	Detecting Condition	Possible cause
DTC Strategy	• Compares the current that is passing through the O2 Heater to a low limit	• Poor Connection • Contact Resistance • HO2S(B1/S2) • PCM
Enable Conditions	• Engine Running 〉 60sec. • Heater Duty Cycle 〉 0.4% • Max. Duty Cycle - Min. Duty Cycle 〈 0.05% • Above conditions are met ≥ 5sec.	
Threshold value	• Filtered O2 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 E0778C6A

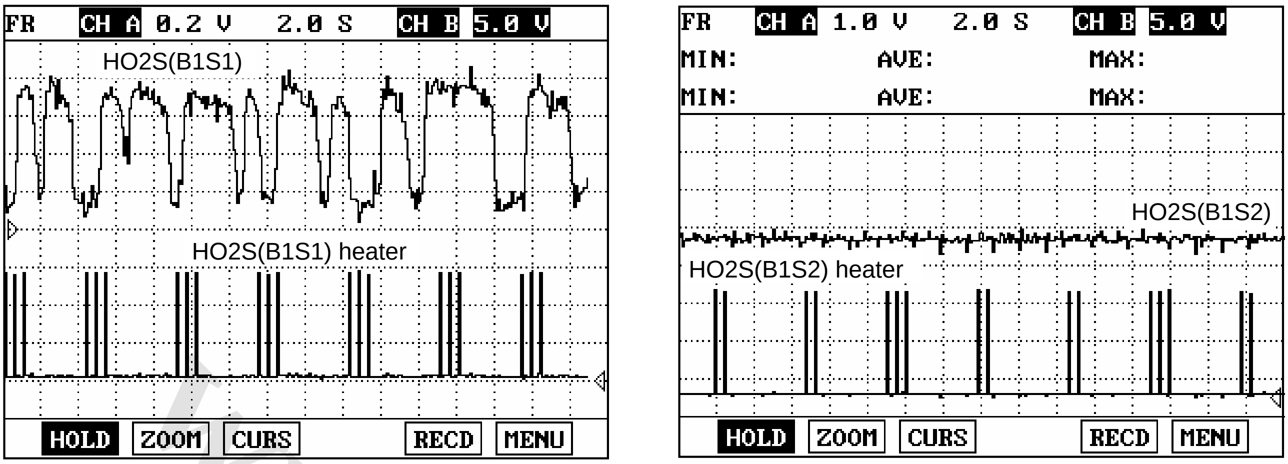
FOR REFERENCE ONLY

Condition	Current(A)
Heater Current at 13.5V, 450℃(842°F) Exhaust	0.52 ± 0.1
Heater In-rush Current at 21℃(69.8°F), 13.5V	1.7 MAX
Heater In-rush Current at -40℃(-40 °F), 13.5V	2.2 MAX

SCHEMATIC DIAGRAM EB22CAF7

Refer to DTC P0137.

SIGNAL WAVEFORM AND DATA EC61BE34

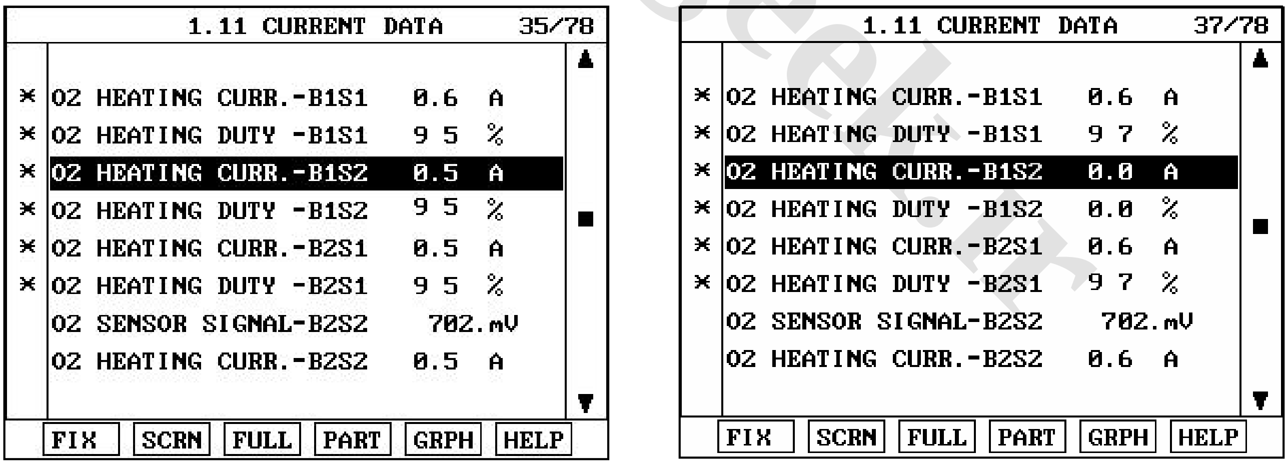


EGRF605U

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 SCANTOOL DATA EDD0A88F

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B1/S2) Heater" item on the service data.



Normal data

Open circuit in HO2S heater

EGRF987W

4. Is the "HO2S Heater(B1/S2)" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EA28220D

Refer to DTC P0137.

COMPONENT INSPECTION EED69E14

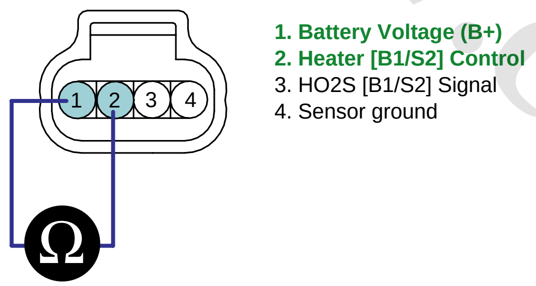
1. Check HO2S(B1/S2) Heater resistance

   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)	9.6 ± 1.5 at 21℃(69.8°F)



EFBF606C

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 to reuse the PCM on the others

NO

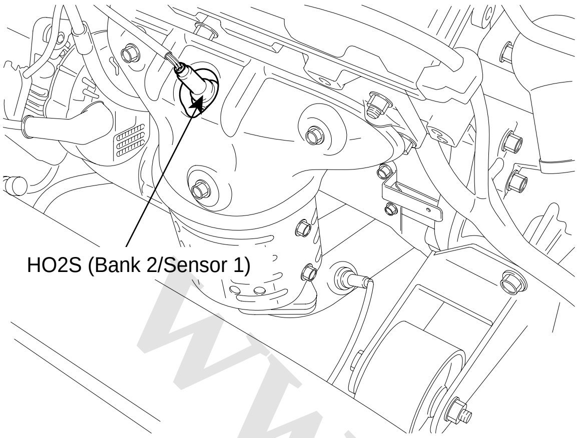
▶ Substitute with a known - good HO2S(B1/S2) and check for proper operation. If the problem is corrected, replace HO2S(B1/S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EBCBE06C

Refer to DTC P0137.

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

COMPONENT LOCATION E5A2EFDB



EGRF601Q

GENERAL DESCRIPTION E9F21EB2

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 E31B0C25

Checking output signals from HO2S every 15 sec. under detecting condition, if an output signal is below 0.05V for more than 12.5 sec., PCM sets P0151. MI (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E74A89A9

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal low	• Poor connection • Short to ground in harness • HO2S(B2/S1) • PCM
Enable Conditions	• Battery voltage ≥ 10V • The minimum airflow ≥ 2g/s • Engine running state ≥ 60sec • The coolant temperature ≥ 60℃(140˚F) • The feed-back control (the closed loop) state • No fuel-cut state • Above conditions are met 〉 5 sec. • HO2S heated state • NO transient condition	
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	

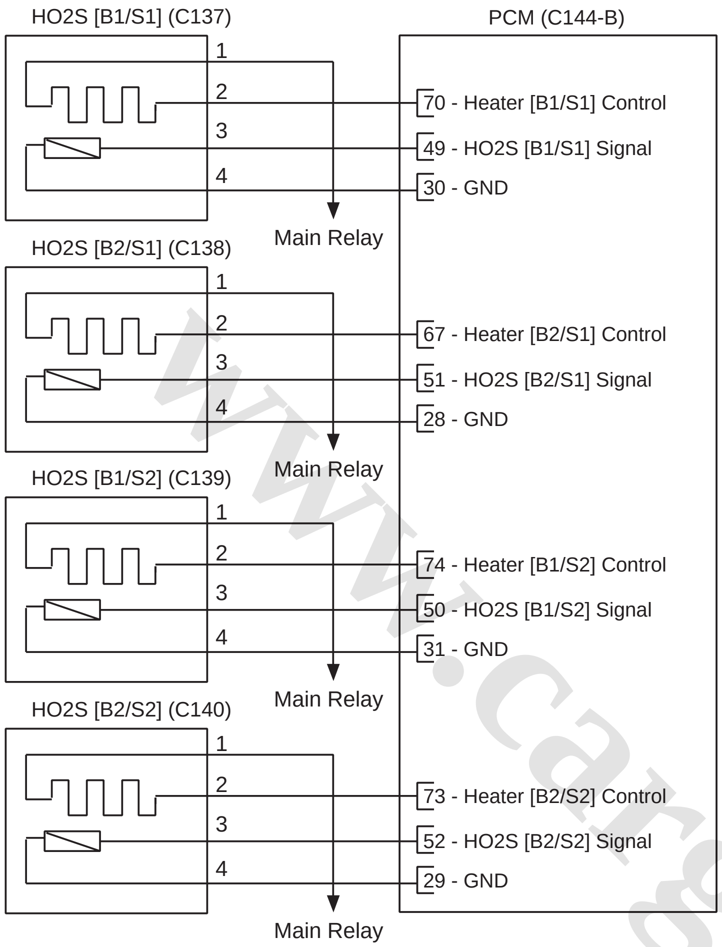
SPECIFICATION EC087E21

Air/fuel mixture	Voltage(V)
Rich	0.75 ~ 1V
Lean	0 ~ 0.12V

※In case of open circuit, voltage is set to 0.45V(Pumping current OFF) or 3.5V(Pumping current ON)

SCHEMATIC DIAGRAM EFF6174F

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

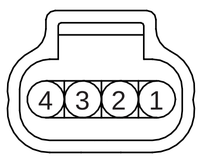
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

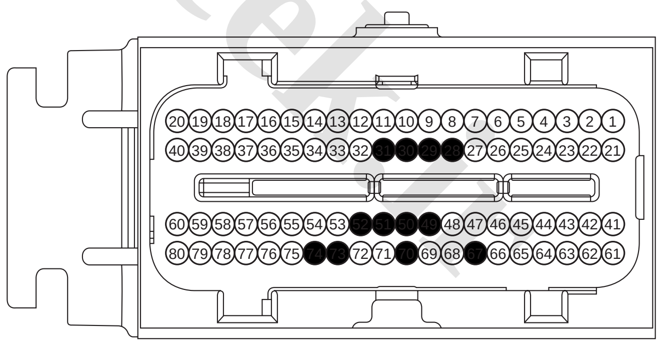
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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

EFBF250A

SIGNAL WAVEFORM AND DATA EB60A1FE

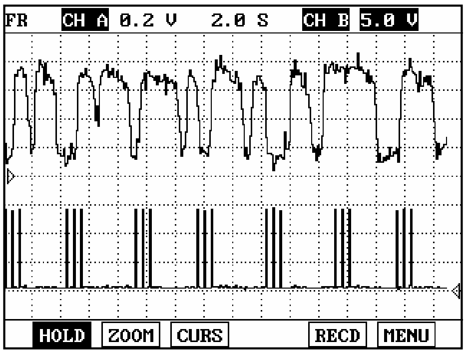


Fig. 1

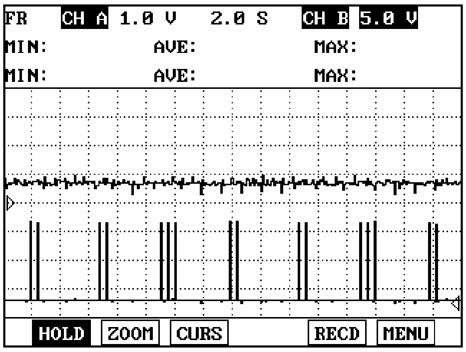


Fig. 2

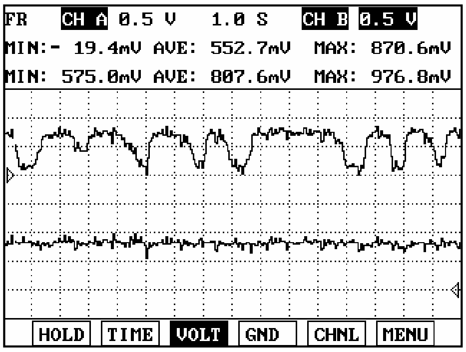


Fig. 3

Fig. 1 : HO2S(B2S1) & Heater
Fig. 2 : HO2S(B2S2) & Heater
Fig. 3 : HO2S(B2S1) & HO2S(B2S2)

EGRF606D

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, HO2S signal will switch from lean to rich normally.

MONITOR SCANTOOL DATA E3B1F35C

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B2/S1)" item on the service data.

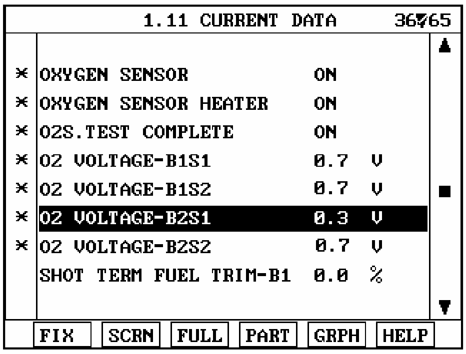


Fig. 1

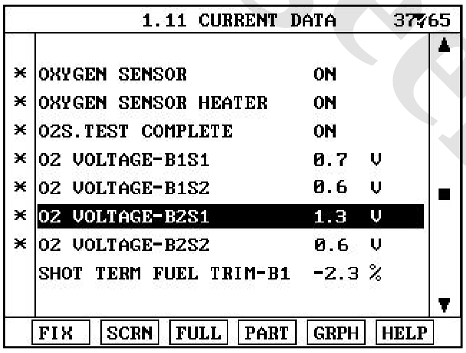


Fig. 2

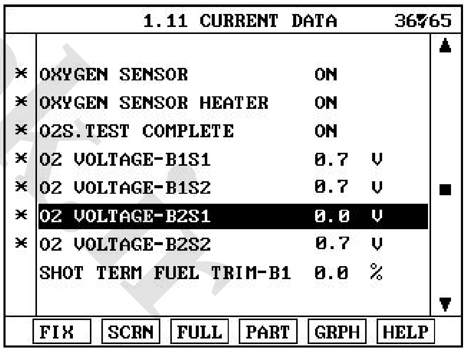


Fig. 3

Fig. 1 : Normal data
Fig. 2 : Open or Short to battery in HO2S(B2/S1)
Fig. 3 : Short to ground in HO2S(B2/S1)

EGRF606E

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E2DAE96D

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

YES

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

NO

▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION ED38D1ED

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 EF12197F

1. Check HO2S(B2/S1)
   1) IG "OFF" and disconnect HO2S(B2/S1) connector.
   2) Check HO2S(B2/S1) for damage or contamination caused by a foreign substance.
   3) Is the HO2S(B2/S1) 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 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.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EA707CD5

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E2FFC46A

Refer to DTC P0151.

GENERAL DESCRIPTION E2E16F01

Refer to DTC P0151.

DTC DESCRIPTION E0185DD6

Checking output signals from HO2S every 15 sec. under detecting condition, if an output signal is above 1.3V for more than 12.5 sec., PCM sets P0152. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E931ABF1

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal high	• Poor connection • Short to battery in harness • HO2S(B2/S1) • PCM
Enable Conditions	• Battery voltage ≥ 10V • The minimum airflow ≥ 2g/s • Engine running state ≥ 60 sec • The coolant temperature ≥ 60℃(140˚F) • Feed-back control(Closed loop) state • No fuel-cut state • Above conditions are met 〉 5 sec • HO2S heated state • NO transient condition	
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 EC25715C

Refer to DTC P0151.

SCHEMATIC DIAGRAM E9E6DC63

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA EB19E794

Refer to DTC P0151.

MONITOR SCANTOOL DATA E4100276

Refer to DTC P0151.

TERMINAL AND CONNECTOR INSPECTION EE4F2F1E

Refer to DTC P0151.

SIGNAL CIRCUIT INSPECTION E8C8483F

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 EA307C73

1. Check HO2S(B2/S1)
   1) IG "OFF" and disconnect HO2S(B2/S1) connector.
   2) Check HO2S(B2/S1) for damage or contamination caused by a foreign substance.
   3) Is the HO2S(B2/S1) 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 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.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E4B31E97

Refer to DTC P0151.

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

COMPONENT LOCATION E7E286E2

Refer to DTC P0151.

GENERAL DESCRIPTION E77D1AA1

The HO2S is used to supply the PCM with information regarding the composition of the air/fuel mixture. The HO2S is positioned in the exhaust pipe ahead of the TWC. To measure the oxygen content, the HO2S requires a supply of ambient air as a reference. The HO2S produces a voltage that varies between 0.1V and 0.9V under normal operating conditions. The Powertrain Control Module (PCM) monitors this voltage and determines if the exhaust gas is lean or rich. If the voltage input at the PCM is under approx. 0.45V the exhaust is lean, and if the voltage input is over approx. 0.45V the exhaust is rich. The PCM constantly monitors the HO2S signal during closed loop operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary.

DTC DESCRIPTION E8510F14

The response time of an O2 sensor can be impacted by two factors: temperature and poisoning. Poisoning of the O2 sensor is the primary failure mode of O2 sensor response time. Poisoning can come from many sources: silicone from gaskets or even in the fuel, phosphorous from engine oil, carbon from operating in a cooler environment or lead from the fuel. Most poisoning failures have the potential to clear up after the source of the poisoning has been removed. However, sometimes thepoisoning may be so severe that the damage is irreversible. Checking output signals from HO2S under detecting condition, if an output signal is out of threshold, PCM sets P0153.

DTC DETECTING CONDITION E2CD9CF1

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines O2 sensor functionality by checking its response rate	• Poor connection • Faulty HO2S • Faulty PCM
Enable Conditions	• 1200 ≤ Engine RPM ≤ 4300 • 40g/s ≤ Air Flow ≤ 7.5g/s • Engine run time 〉 60sec • Engine Coolant 〉 70℃(158 °F) • No DFCO(Decel Fuel Cut-Off) Exit with Rich Bias Fueling • No TORQ Fuel Reduction in effect • No Disabling Faults • All of the conditions above met for more than 2sec	
Threshold value	• Switching counter lean to rich 〈 13 • Switching counter rich to lean 〈 13 • Response Lean Rich Transition Counter/Response Lean Rich Switch Counter 〉 29 • Response Rich Lean Transition Counter/Response Rich Lean Switch Counter 〉 35 • Response Rich Lean Average/Response Lean Rich Average 〈 0.3809 • Response Rich Lean Average/Response Lean Rich Average 〉 3	
Diagnosis Time	• -	
MIL On Condition	• 2 Driving Cycles	

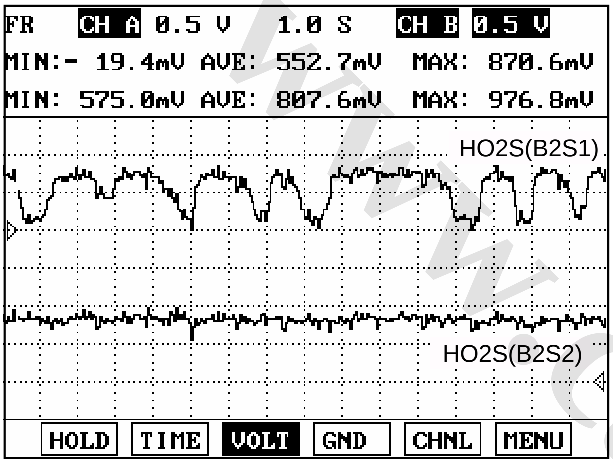
SPECIFICATION E8CBDED4

HO2S	Response Time (70% Duty at 10Hz)
	lean to rich(Less than 0.65sec) rich to lean(Less than 0.8sec)

SCHEMATIC DIAGRAM EED67076

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA EDCC2B98



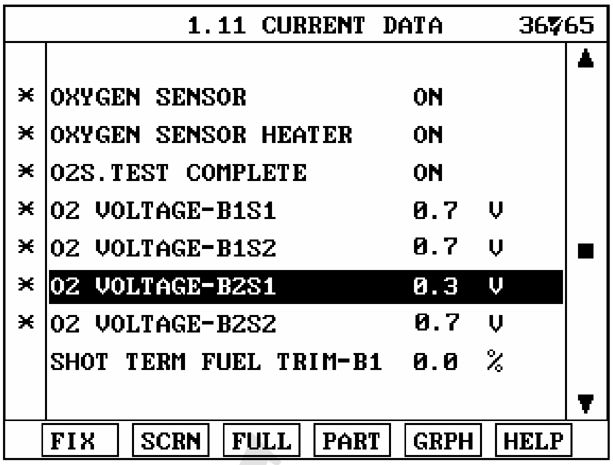
EGRF606G

After warming-up, Releasing accellerator pedal suddenly around 4000rpm the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off. Conversely, sudden depressing accellerator pedal HO2S signal reading will be around 0.6V ~1.0V. At idle, HO2S signal will be switching between lean to rich normally.

MONITOR SCANTOOL DATA E04D80DC

1. Connect Scantool ＆ Engine "ON"
2. Warm up the engine to normal operating temperature.
3. Monitor HO2S voltage(B2/S1) parameter on scantool

Specification : Voltage will vary from 0.1 to 0.9 V



EGRF606H

4. Is the HO2S parameter displayed within specifications ?

YES

▶ 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, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Go to "Component Inspection" procedure

COMPONENT INSPECTION E01B85A4

1. Visual Inspection of HO2S

   1) Visually/physically inspect following items:
   - Inspect the front HO2S for Contaminated, deteriorated or aged Front HO2S
   - If contamination is evident on the HO2S, replace contaminated sensor

   2) Is the HO2S visually / physically O.K ?

   YES

   ▶ Go to "Check Performance of H02S" as follows

   NO

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

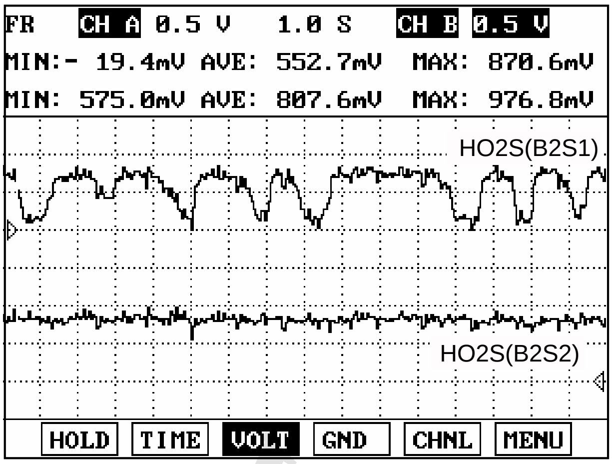
2. Check performance of HO2S

   1) Connect scantool & Engine "ON"

   2) Warm-up the engine to normal engine temperature.

   3) Monitor signal waveform of HO2S with scantool

HO2S	Response Time (70% Duty at 10Hz)
	lean to rich(Less than 0.65sec) rich to lean(Less than 0.8sec)



EFBF605X

4) Is the sensor signal switching properly ?

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 HO2S and check for proper operation. If the problem is corrected, replace HO2S and 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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E0EDF4D3

Refer to DTC P0151.

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

COMPONENT LOCATION E3B8B2DE

Refer to DTC P0151.

GENERAL DESCRIPTION EE602D4F

Refer to DTC P0151.

DTC DESCRIPTION EE4545CC

Checking output signals from HO2S every 90 sec. under detecting condition, if an output signal indicating open in the circuit lasts for more than 76.5 sec., PCM sets P0154. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E85C41F3

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• Open</td><td rowspan="6">• Poor connection
• Open in harness
• HO2S(B2/S1)
• PCM</td></tr>
<tr><td colspan="2">Enable Conditions</td><td>• No sensor cooled status
• The minimum airflow ≥ 2g/s
• The battery voltage ≥ 10V
• Engine running state 〉 60 sec.
• Coolant temperature ≥ 60℃(140˚F)
• No fuel reduction
• No transient condition
• No fuel-cut state
• No disabling fault</td></tr>
<tr><td rowspan="2">Thresh-old value</td><td>Case 1</td><td>• At pumping current ON
• 1.2V ≤ Voltage of HO2S ≤ 3.9V</td></tr>
<tr><td>Case 2</td><td>• At pumping current OFF
• 0.415V ≤ Voltage of HO2S ≤ 0.515V</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(more than 76.5 sec.failure for every 90 sec.test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• 2 driving cycles</td></tr>
</table>

SPECIFICATION EDEBA038

Refer to DTC P0151.

SCHEMATIC DIAGRAM E0225147

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA EC4A8BEF

Refer to DTC P0151.

MONITOR SCANTOOL DATA EACB3E33

Refer to DTC P0151.

TERMINAL AND CONNECTOR INSPECTION EF32F9A5

Refer to DTC P0151.

SIGNAL CIRCUIT INSPECTION E2CDE784

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 E85B0C79

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 EDBBE75A

1. Check HO2S(B2/S1)
   1) IG "OFF" and disconnect HO2S(B2/S1) connector.

2) Check HO2S(B2/S1) for damage or contamination caused by a foreign substance.

3) Is the HO2S(B2/S1) 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 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.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR ED5A0400

Refer to DTC P0151.

DTC P0155 HO2S HEATER CIRCUIT (BANK 2 / SENSOR 1)

COMPONENT LOCATION E5C27E14

Refer to DTC P0151.

GENERAL DESCRIPTION E815707D

Refer to DTC P0151.

DTC DESCRIPTION EA97B95D

If the PCM detects heater output voltage is lower than threshold value for 5 seconds while enable condition is met, PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E48EE14E

Item	Detecting Condition	Possible cause
DTC Strategy	• Compares the current that is passing through the O2 Heater to a low limit	• Poor Connection • Contact Resistance • HO2S(B2/S1) • PCM
Enable Conditions	• Engine Running 〉 60sec • Heater Duty Cycle 〉 0.4% • Max. Duty Cycle - Min. Duty Cycle 〈 0.05% • Above conditions are met 〉 5sec.	
Threshold value	• Filtered O2 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 E349C9E9

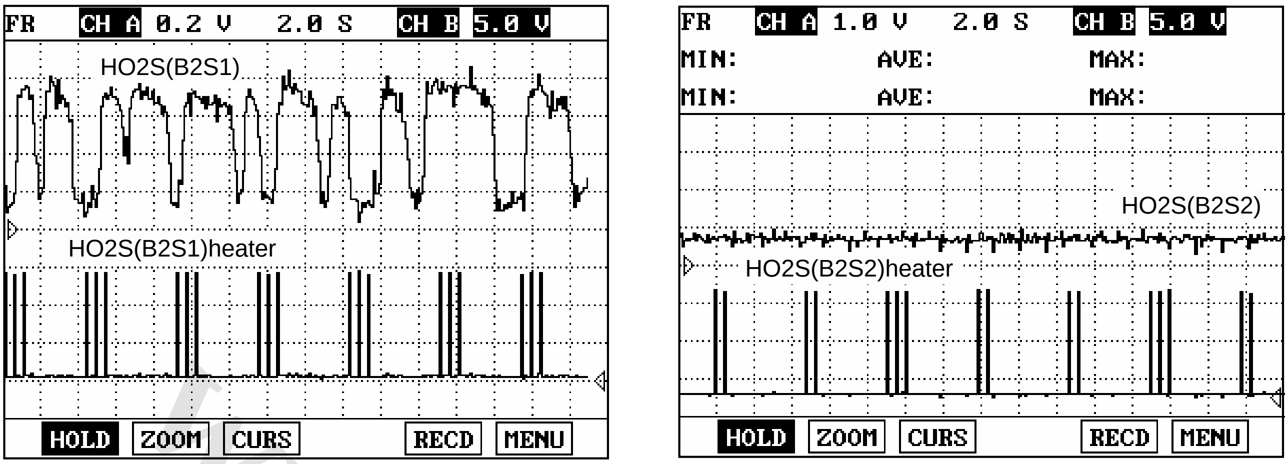
FOR REFERENCE ONLY

Condition	Current(A)
Heater Current at 13.5V, 450℃(842°F) Exhaust	0.25 ± 0.1
Heater In-rush Current at 21℃(69.8°F), 13.5V	1.7 MAX
Heater In-rush Current at -40℃(-40 °F), 13.5V	2.2 MAX

SCHEMATIC DIAGRAM ECC5D738

Refer to DTC P0151.

SIGNAL WAVEFORM AND DATA E8E4033C

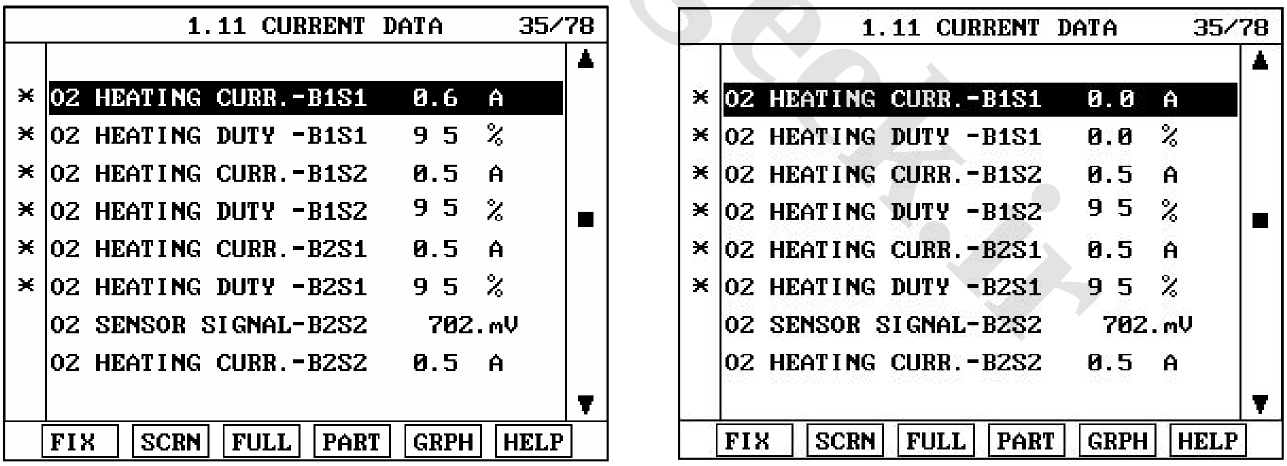


EFBF606P

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 SCANTOOL DATA EDD2DA0C

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B2/S1) Heater" status on the service data.



EGRF605V

4. Is the "HO2S Heater(B2/S1)" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E7300EE4

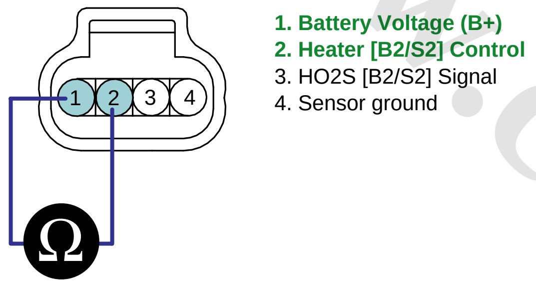
Refer to DTC P0151.

COMPONENT INSPECTION E45C5F30

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)	9.6 ± 1.5 at 21℃(69.8˚F)



EFBF606T

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 to reuse the PCM on the others

NO

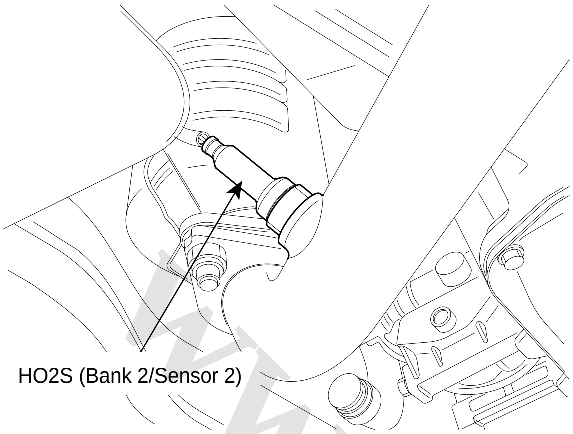
▶ Substitute with a known - good HO2S(B2/S1) and check for proper operation. If the problem is corrected, replace HO2S(B2/S1) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E8E13E83

Refer to DTC P0151.

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

COMPONENT LOCATION EE22C342



EGRF601Y

GENERAL DESCRIPTION E62228F0

HO2S(B2/S2) is in the back of Catalytic Converter to check the proper operation of catalyst. As Exhaust gas already passed through catalyst, oxygen density in it is within specific range. If the oxygen density changes in accordance with HO2S(B2/S1), it means the poor performance of catalytic converter.

DTC DESCRIPTION ED9013E9

Checking output signals from HO2S every 15 sec. under detecting condition, if an output signal is below 0.04V for more than 12.5 sec., PCM sets P0157. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ED963AD8

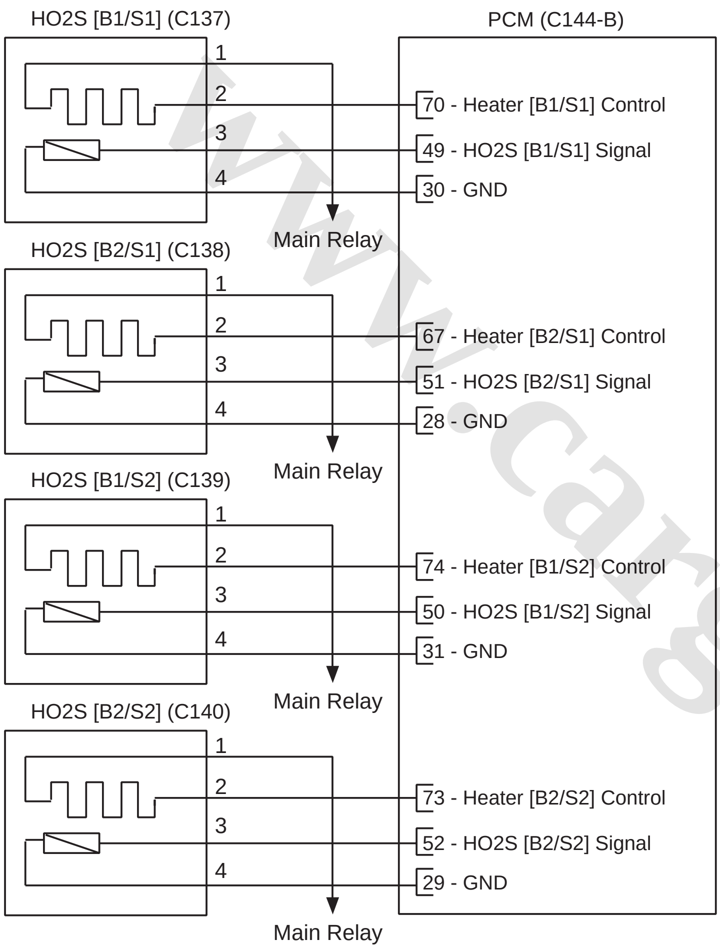
Item	Detecting Condition	Possible cause
DTC Strategy	• Signal low	• Poor connection • Short to ground in harness • HO2S(B2/S2) • PCM
Enable Conditions	• Battery voltage ≥ 10V • The minimum airflow ≥ 2g/s • Engine running state ≥ 60 sec. • The coolant temperature ≥ 60℃(140˚F) • The feed-back control (the closed loop) state • No fuel-cut state • Above conditions are met 〉 5 sec. • HO2 heated state • No transient condition	
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 E2727C84

Air/fuel mixture	Voltage(V)
Rich	0.75 ~ 1V
Lean	0 ~ 0.12V

SCHEMATIC DIAGRAM ED9446A8

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

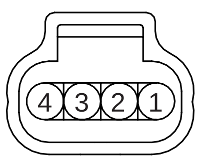
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

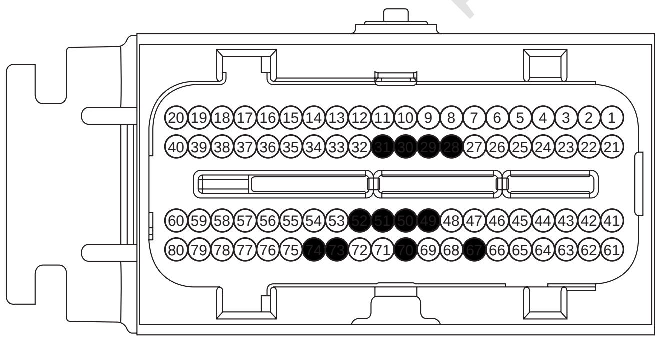
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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]

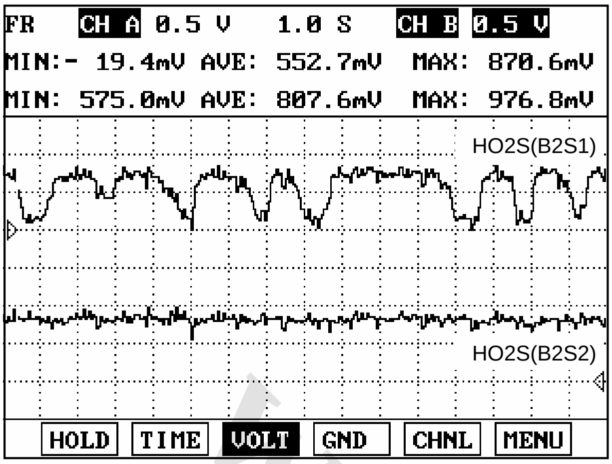


C144-B

PCM

EFBF250A

SIGNAL WAVEFORM AND DATA E792E737



EGRF606L

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 SCANTOOL DATA E54EB82D

1. IG "OFF" ＆ connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B2/S2)" item on the service data.

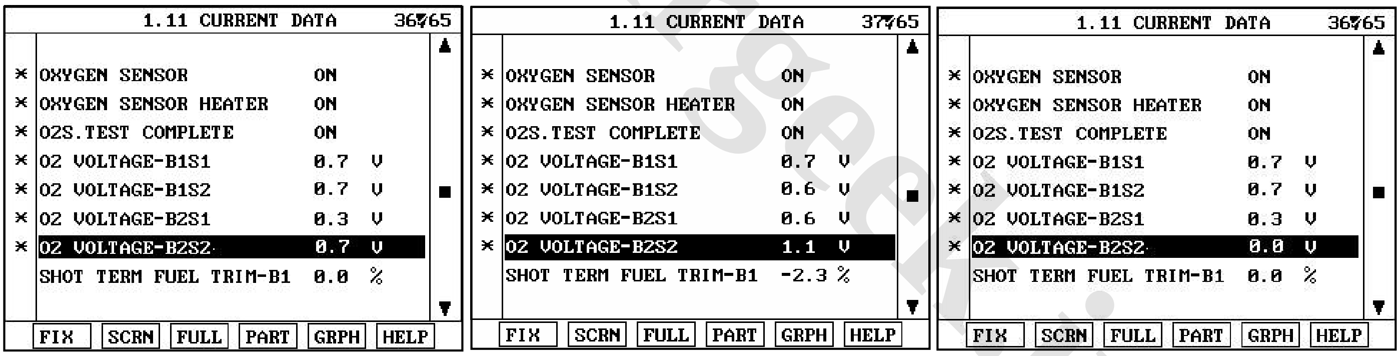


Fig. 1 Fig. 2 Fig. 3

Fig. 1 : Normal data
Fig. 2 : Open or Short to battery in HO2S(B2/S2)
Fig. 3 : Short to ground in HO2S(B2/S2)

EGRF606M

4. Is the service data displayed correctly?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EB34E447

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

YES

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

NO

▶ Go to " Signal Circuit Inspection " procedure.

SIGNAL CIRCUIT INSPECTION E5CC1B83

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 E269A831

1. Visual Inspection of HO2S
   Visually/physically inspect following items:
   - Inspect the Rear HO2S for Contaminated, deteriorated or aged Rear HO2S
   - If contamination is evident on the HO2S, replace contaminated sensor
2. Is the HO2S(B2/S2) 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 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.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EEAFF4E4

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION EA293DBD

Refer to DTC P0157.

GENERAL DESCRIPTION E9C1B1E4

HO2S(B2/S2) is in the back of Catalytic Converter to check the proper operation of catalyst. As Exhaust gas already passed through catalyst, oxygen density in it is within specific range. If the oxygen density changes in accordance with HO2S(B2/S1), it means the poor performance of catalytic converter.

DTC DESCRIPTION E2CD6DFC

Checking output signals from HO2S every 15 sec. under detecting condition, if an output signal is above 1.3V for more than 12.5 sec, PCM sets P0158. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle

DTC DETECTING CONDITION E387E0F4

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal low	• Poor connection • Short to battery in harness • HO2S(B2/S2) • PCM
Enable Conditions	• Battery voltage ≥ 10V • The minimum airflow ≥ 2g/s • Engine running state ≥ 60 sec. • The coolant temperature ≥ 60℃(140˚F) • The feed-back control (the closed loop) state • No fuel-cut state • Above conditions are met 〉 5 sec. • HO2 heated state • No transient condition	
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 E18B537F

Refer to DTC P0157.

SCHEMATIC DIAGRAM EF2E9F55

Refer to DTC P0157.

SIGNAL WAVEFORM AND DATA E6A38E4D

Refer to DTC P0157.

MONITOR SCANTOOL DATA EAE0E670

Refer to DTC P0157.

TERMINAL AND CONNECTOR INSPECTION EDF94F53

Refer to DTC P0157.

SIGNAL CIRCUIT INSPECTION E55602EB

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 ED6FB5DE

1. Visual Inspection of HO2S
   Visually/physically inspect following items:
   - Inspect the Rear HO2S for Contaminated, deteriorated or aged Rear HO2S
   - If contamination is evident on the HO2S, replace contaminated sensor

2. Is the HO2S(B2/S2) 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 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.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E7F447B3

Refer to DTC P0157.

DTC P0159 HO2S CIRCUIT SLOW RESPONSE (BANK 2 / SENSOR 2)

COMPONENT LOCATION ECD3BCBC

Refer to DTC P0157.

GENERAL DESCRIPTION EB1FD19D

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 the 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 ECFB6FBD

Checking the delayed time between the front sensor response and the rear sensor response to the fuel shift under detecting condition, if the fuel shift time is higher than 25sec, PCM determines a fault and sets DTC P0159. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E039B0CF

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if Rear O2 Sensor is acceptable for Idle Catalyst Monitor use	• Poor connection • Faulty HO2S • Faulty PCM
Enable Conditions	• Same conditions as idle catalyst monitoring	
Threshold value	• Response time of rear oxygen sensor by shifting airfuel ratio from lean to rich and vice versa ≥ 25 sec	
Diagnosis Time	• -	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EBEEA8FD

Refer to DTC P0157.

SCHEMATIC DIAGRAM E75EB7BE

Refer to DTC P0157.

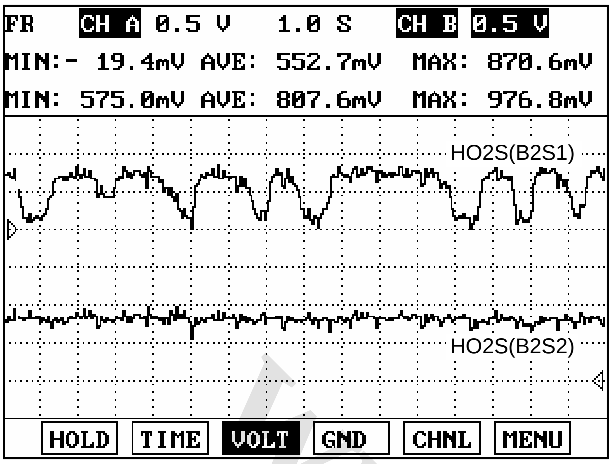
SIGNAL WAVEFORM AND DATA E1BBD2D5

Refer to DTC P0157.

MONITOR SCANTOOL DATA E776FC44

1. Connect Scantool then Engine "ON"
2. Warm up the engine to normal operating temperature.
3. Monitor the signal waveform of HO2S(B2S2) with scantool

Specification : 0.1 ~ 0.9V



EFBF606R

4. Is the HO2S parameter displayed within specifications ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E9BD0E18

Refer to DTC P0157.

COMPONENT INSPECTION EEF5327F

1. Visual Inspection of HO2S
   Visually/physically inspect following items:
   - Inspect the Rear HO2S for Contaminated, deteriorated or aged Rear HO2S
   - If contamination is evident on the HO2S, replace contaminated sensor

2. Is the HO2S(B2S2) 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.

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 HO2S(B2S2) and check for proper operation. If the problem is corrected, replace HO2S(B2S2) and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E2B5D1D8

Refer to DTC P0157.

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

COMPONENT LOCATION EF33F494

Refer to DTC P0157.

GENERAL DESCRIPTION E0598A1A

Refer to DTC P0157.

DTC DESCRIPTION ECE1126B

Checking output signals from HO2S every 10 sec. under detecting condition, if an output signal indicating open in the circuit lasts for more than 6.3 sec. PCM sets P0160. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E7323FFF

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• Open</td><td rowspan="7">• Poor connection
• Open in harness
• HO2S(B2/S2)
• PCM</td></tr>
<tr><td colspan="2">Enable Conditions</td><td>• No sensor cooled status
• The minimum airflow ≥ 2g/s
• The battery voltage ≥ 10V
• Engine running state 〉 60 sec.
• Coolant temperature ≥ 60℃(140˚F)
• No fuel reduction
• No transient condition
• No fuel-cut state
• No disabling fault</td></tr>
<tr><td rowspan="2">Thresh-old value</td><td>Case 1</td><td>• At pumping current ON
• 1.2V ≤ Voltage of HO2S ≤ 3.9V</td></tr>
<tr><td>Case 2</td><td>• At pumping current OFF
• 0.415V ≤ Voltage of HO2S ≤ 0.515V</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(more than 6.3 sec.failure for every 10 sec.test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• 2 Driving Cycles</td></tr>
</table>

SPECIFICATION E35F2381

Refer to DTC P0157.

SCHEMATIC DIAGRAM E9C6AA73

Refer to DTC P0157.

SIGNAL WAVEFORM AND DATA E29417C4

Refer to DTC P0157.

MONITOR SCANTOOL DATA E2542D3B

Refer to DTC P0157.

TERMINAL AND CONNECTOR INSPECTION EB12A512

Refer to DTC P0157.

SIGNAL CIRCUIT INSPECTION E154149A

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 EBCC9AF7

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 E51D684B

1. Visual Inspection of HO2S
   Visually/physically inspect following items:
   - Inspect the Rear HO2S for Contaminated, deteriorated or aged Rear HO2S

- If contamination is evident on the HO2S, replace contaminated sensor

2. Is the HO2S(B2/S2) 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 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.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EA60808B

Refer to DTC P0157.

DTC P0161 HO2S HEATER CIRCUIT (BANK 2 / SENSOR 2)

COMPONENT LOCATION E92DC0F9

Refer to DTC P0157.

GENERAL DESCRIPTION E005CFFC

Refer to DTC P0157.

DTC DESCRIPTION E6E57359

If the PCM detects heater output voltage is lower than threshold value for 5 seconds while enable condition is met, PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION EA416171

Item	Detecting Condition	Possible cause
DTC Strategy	• Compares the current that is passing through the O2 Heater to a low limit	• Poor connection • Contact Resistance • HO2S(B2/S2) • PCM
Enable Conditions	• Engine Running 〉 60sec. • Heater Duty Cycle 〉 0.4% • Max. Duty Cycle - Min. Duty Cycle 〈 0.05% • Above conditions are met 〉 5 sec .	
Threshold value	• Filtered O2 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 EA5159FD

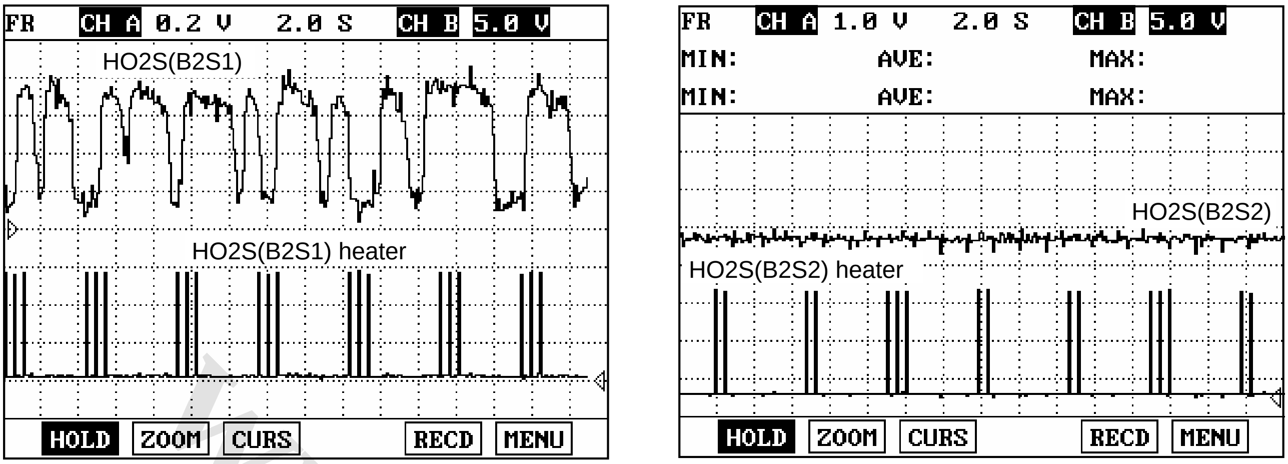
(FOR REFERENCE ONLY)

Condition	Current(A)
Heater Current at 13.5V, 450℃(842°F) Exhaust	0.52 ± 0.1
Heater In-rush Current at 21℃(69.8°F), 13.5V	1.7 MAX
Heater In-rush Current at -40℃(-40°F), 13.5V	2.2 MAX

SCHEMATIC DIAGRAM E761AE22

Refer to DTC P0157.

SIGNAL WAVEFORM AND DATA EF999377

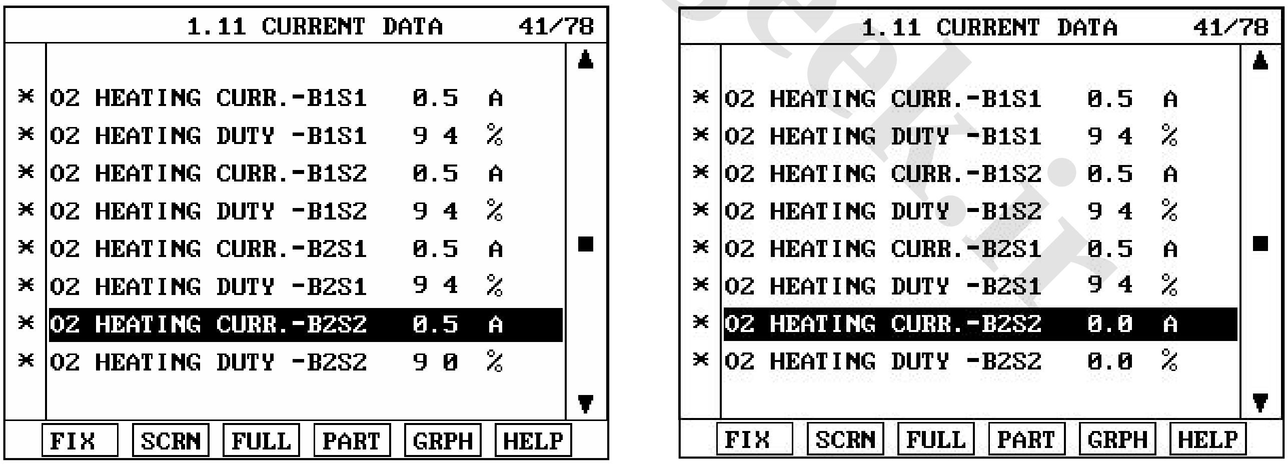


EGRF987X

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 SCANTOOL DATA EE1072F1

1. IG "OFF" & connect scantool.
2. Warm -up the engine to normal operating temperature.
3. Monitor "HO2S(B2/S2) Heater" item on the service data.



Normal data

Open circuit in HO2S heater

EGRF987Y

4. Is the "HO2S Heater(B2/S2)" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E711B710

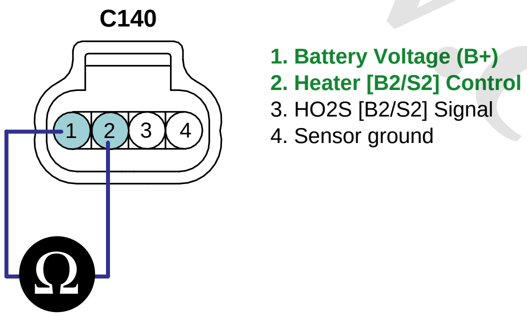
Refer to DTC P0157.

COMPONENT INSPECTION E9766153

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)	9.6 ± 1.5 at 21℃(69.8˚F)



EFBF616T

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 to reuse the PCM on the others

NO

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

VERIFICATION OF VEHICLE REPAIR E59DD4E9

Refer to DTC P0157.

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

GENERAL DESCRIPTION E5614A29

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 based it in closed loop fuel control. Changes in fuel delivery will be indicated by the long-term and the short-term fuel trim values. The ideal fuel trim value is around 0%. The 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 E5D2638D

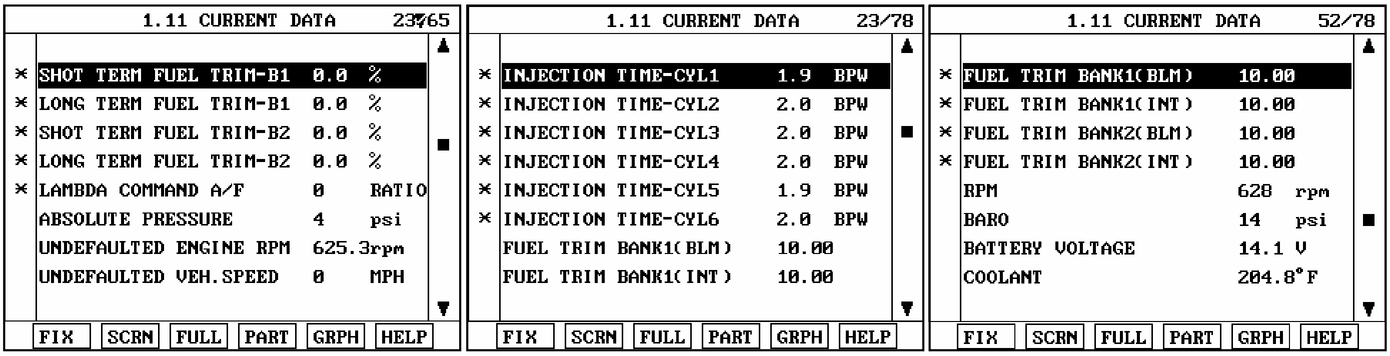
Checking air-fuel ratio correction value every 0.75 sec. under detecting condition, if an value is within detecting condition for more than 0.3 sec., PCM sets P0171/P0174. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EC58BCF0

Item	Detecting Condition	Possible cause
DTC Strategy	• Fuel Trim Limits Exceeded	• Poor connection • Relevant sensor/actuator • Air leakage • PCM
Enable Conditions	• 550rpm ≤ Engine speed ≤ 4000rpm • 60℃(140˚F) ≤ Engine coolant temperature ≤ 115℃(239˚F) • -10℃(14˚F) ≤ Intake air temperature ≤ 60℃(140˚F) • 0° ≤ Throttle position ≤ 80° • 25kPa ≤ Engine load ≤ 90kPa • 1.5g/s ≤ Intake air flow ≤ 80g/s • Barometric pressure ≥ 72kPa • Vehicle speed ≤ 130km/h • System voltage ≥ 11V • Feed-back control state • No other diagnostic fault	
Threshold value	• Average of short term fuel trim 〉1.2 • Average of long term fuel trim 〉0.8	
Diagnosis Time	• Continuous (More than 0.3 second failure for every 0.75 second test)	
MIL On Condition	• 2 Driving Cycles	

MONITOR SCANTOOL DATA E444A990

1. IG "OFF" & connect scantool.
2. Warm -up the engine to normal operating temperature.
3. Monitor "Sensor/actuator related to fuel system(HO2S, MAFS, MAPS, TPS, ECTS, PSCA, Injector, and so on)" items on the service data.



EGRF606U

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E42B1ADF

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 " System Inspection " procedure.

SYSTEM INSPECTION EC737A10

1. Check air leakage

   1) Visually/physically inspect the air leakage in intake/exhaust system for following items
      ▶ Vacuum hoses for splits, kinks and improper connections.
      ▶ Throttle body gasket
      ▶ Gasket between intake manifold and cylinder head
      ▶ Seals between intake manifold and fuel injectors
      ▶ Exhaust system between HO2S and three way catalyst for air leakage

   2) Has a problem found in this procedure?

   YES

▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Check the fuel line" as follows

2. Check the fuel line

   1) Check the fuel line for following items
      ▶ Connector connection state
      ▶ Damage/ connection state for vacuum hoses connected to fuel line
      ▶ Bent/ pressed/ twisted fuel line or fuel leakage

   2) Has a problem found in this procedure?

YES

▶ Repair or replace it which has a problem, and go to " Verification of Vehicle Repair" procedure.

NO

▶ Go to "Check fuel pressure" as follows

3. Check fuel pressure

NOTE

- *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.*
- *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) Refer to "Fuel Pressure Test" in Fuel Delivery System.

   2) Is the measured fuel pressure within specifications ?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair or replace according to the given table in Fuel Pressure Test. And then, go to " Verification of Vehicle Repair"procedure.

COMPONENT INSPECTION EEB8DA04

1. Check PCV

   1) IG "OFF" and remove PCV valve from cylinder head

   2) With engine idling, block PCV valve and confirm that vacuum is felt.

   3) Insert thin stick into the screwed PCV valve and verify that the plunger is moving.

   4) Is the PCV valve normally moving?

YES

▶ Go to "Check PCSV as follows.

NO

▶ Replace it, and go to "Verification of Vehicle Repair" procedure.

2. Check PCSV

1) IG "OFF" and disconnect PCSV and vacuum hose.

2) Connect hand-vacuum gage with PCSV and supply vacuum to it.

3) Is the vacuum maintained ?

YES

▶ Go to " Check injector" as follows.

NO

▶ Repair or replace it, and go to " Verification of Vehicle Repair" procedure.

3. Check injector

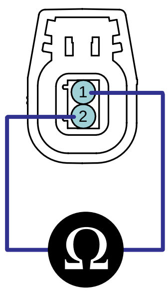
1) IG "OFF" and disconnect injector.

2) Check it for blocking caused by any foreign substance.

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

SPECIFICATION :

Temp	Coil's resistance
20℃(68°F)	11.4 ~ 12.6 Ω



1. Injector control
2. Battery voltage

EFBF606V

4) Is the measured resistance within specification?

YES

▶ Go to "Check sensor/actuator related to fuel system" as follows

NO

▶ Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

4. Check sensor/actuator related to fuel system

1) Check the signal of sensor/actuator related to fuel system(HO2S, MAFS,MAPS, TPS, ECTS, PCSV, Injector and so on) (Refer to each DTC diagnostic procedure)

2) Are all of these items 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

▶ Repair it, and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EDF6DAA8

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0172 SYSTEM TOO RICH (BANK 1)
DTC P0175 SYSTEM TOO RICH (BANK 2)

GENERAL DESCRIPTION E1C04061

Refer to DTC P0171.

DTC DESCRIPTION E3128C13

Checking air-fuel ratio correction value every 0.75 sec. under detecting condition, if an value is within detecting condition for more than 0.3 sec., PCM sets P0172. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EE359840

Item	Detecting Condition	Possible cause
DTC Strategy	• Fuel Trim Limits Exceeded	• Poor connection • Relevant sensor/actuator • Blocking of Intake system • Fuel leakage in injector • Improper fuel line pressure • PCM
Enable Conditions	• 550rpm ≤ Engine speed ≤ 4000rpm • 60℃(140˚F) ≤ Engine coolant temperature ≤ 115℃(239˚F) • -10℃(14˚F) ≤ Intake air temperature ≤ 60℃(140˚F) • 0° ≤ Throttle position ≤ 80° • 25kPa ≤ Engine load ≤ 90kPa • 1.5g/s ≤ Intake air flow ≤ 80g/s • Barometric pressure ≥ 72kPa • Vehicle speed ≤ 130km/h • System voltage ≥ 11V • Feed-back control state • No other diagnostic fault	
Threshold value	• Average of short term fuel trim 〈 0.8 • Average of long term fuel trim 〈 1.23	
Diagnosis Time	• Continuous (More than 0.3 second failure for every 0.75 second test)	
MIL On Condition	• 2 Driving Cycles	

MONITOR SCANTOOL DATA EE30EAAB

Refer to DTC P0171.

TERMINAL AND CONNECTOR INSPECTION E21066E4

Refer to DTC P0171.

SYSTEM INSPECTION EF41121B

1. Check blocking of intake system

   1) Visually/physically inspect the blocking in intake system for following items
      ▶ Throttle body gasket and damage
      ▶ Clogging of Air cleaner

▶ Blocking in intake manifold and injector caused by any foreign substance

2) Has a problem found?

YES

▶ Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to " Check fuel pressure" as follows.

2. Check fuel pressure

NOTE

- *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.*
- *The fuel system remains under pressure when the engine is not running. Release fuel systempressure before disconnecting any fuel line to reduce the chance of presonal injury orfire damage to vehicle components.*

1) Refer to "Fuel Pressure Test" in Fuel Delivery System.

2) Is the measured fuel pressure within specifications ?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair or replace according to the given table in Fuel Pressure Test. And then, go to " Verification of Vehicle Repair"procedure.

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 within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ There is a fuel leakage in injector. Repair or replace it, and go to " Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EE363AE9

1. Check PCV

1) IG "OFF" and remove PCV valve from cylinder head

2) With engine idling, block PCV valve and confirm that vacuum is felt.

3) Insert thin stick into the screwed PCV valve and verify that the plunger is moving.

4) Is the PCV valve normally moving?

YES

▶ Go to "Check PCSV as follows.

NO

▶ Replace it, and go to "Verification of Vehicle Repair" procedure.

2. Check PCSV

1) IG "OFF" and disconnect PCSV and vacuum hose.

2) Connect hand-vacuum gage with PCSV and supply vacuum to it.

3) Is the vacuum maintained ?

YES

▶ Go to " Check injector" as follows.

NO

▶ Repair or replace it, and go to " Verification of Vehicle Repair" procedure.

3. Check injector

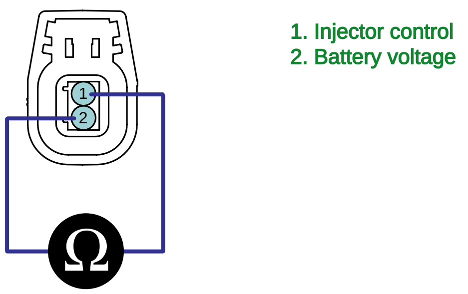
1) IG "OFF" and disconnect injector.

2) Check it for blocking caused by any foreign substance.

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

SPECIFICATION :

Temp	Coil's resistance
20℃(68°F)	11.4 ~ 12.6 Ω



EFBF606V

4) Is the measured resistance within specification?

YES

▶ Go to "Check sensor/actuator related to fuel system" as follows

NO

▶ Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

4. Check sensor/actuator related to fuel system

   1) Check the signal of sensor/actuator related to fuel system(HO2S, MAFS,MAPS, TPS, ECTS, PCSV, Injector and so on) (Refer to each DTC diagnostic procedure)

   2) Are all of these items 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

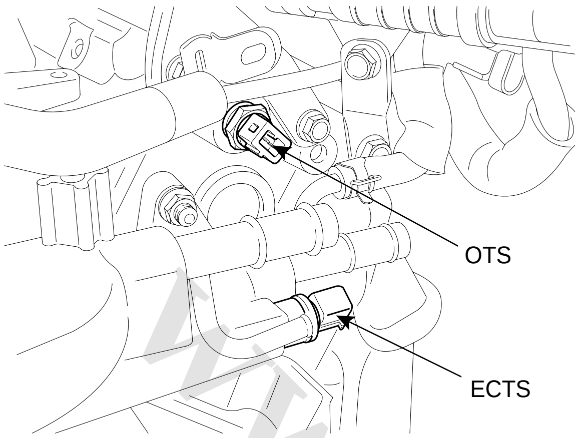
▶ Repair it, and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E02F0F0F

Refer to DTC P0171.

DTC P0196 ENGINE OIL TEMP. SENSOR RANGE / PERFORMANCE

COMPONENT LOCATION E34D2226



EGRF606X

GENERAL DESCRIPTION EDDEDC05

In CVVT system, the working fluid is engine oil. But its density varies according to temperature, PCM performs oil quantity correction based on the signal from engine oil temperature sensor over the various range of temperature. Main function of Oil Pressure Sensor is as follows.

1. intake air valve control solenoid(oil control valve) duty correction : As coil resistance varies according to oil temperature, excessive current flows at low temperture and low current at high temperature without duty correction. Therefore, PCM performs duty correction properly according to output signal from oil temperature sensor to supply constant current which is free from the change of oil temperature.

2. CVVT system operation starting temperature determination : As CVVT response gets weaker due to the friction of engine components such as valve at low temperature, PCM operates CVVT at above specific temperture based on output signal from oil temperture sensor.

3. improved CVVT controllability : CVVT response speed varies as oil temperature, PCM improves controllability throughout estimating response speed with oil temperture sensor output signal.

DTC DESCRIPTION EE5C1941

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(Malfuction Indication Lamp) turns on when the malfuction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E5997883

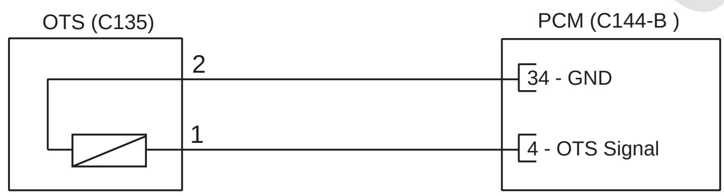
Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if the oil temperature value is rational, compared to coolant and intake air temperature.	• Poor connection • Open or short in harness • Faulty OTS • PCM
Enable Conditions	• Engine run time after startup 〈 30 sec • Minimum soak period required 〉 270 min	
Threshold value	• The difference in temperature between oil and coolant temperatures at startup. 〉 35℃(63°F) • The difference in temperature between oil temperature and intake air temperature at startup 〉 35℃(63°F)	
Diagnosis Time	• Continuous (More than 12.5 sec.failure for every 25 sec.test)	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E4E57767

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

SCHEMATIC DIAGRAM E6CBB1C4

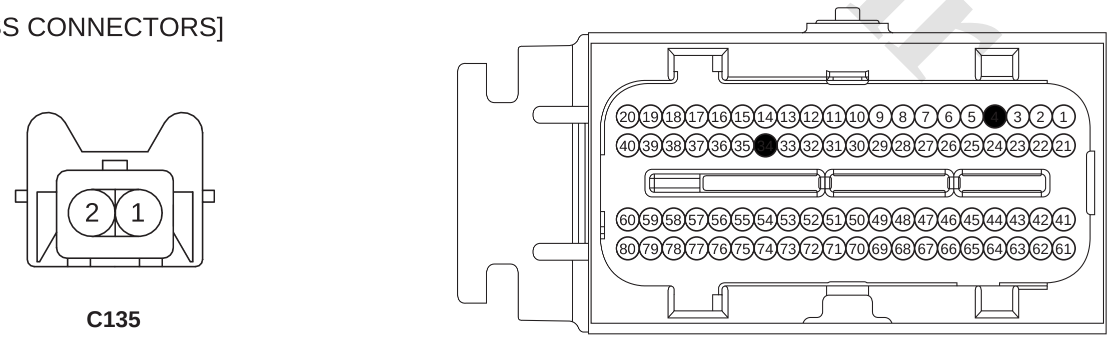
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

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

[HARNESS CONNECTORS]



C135

OTS

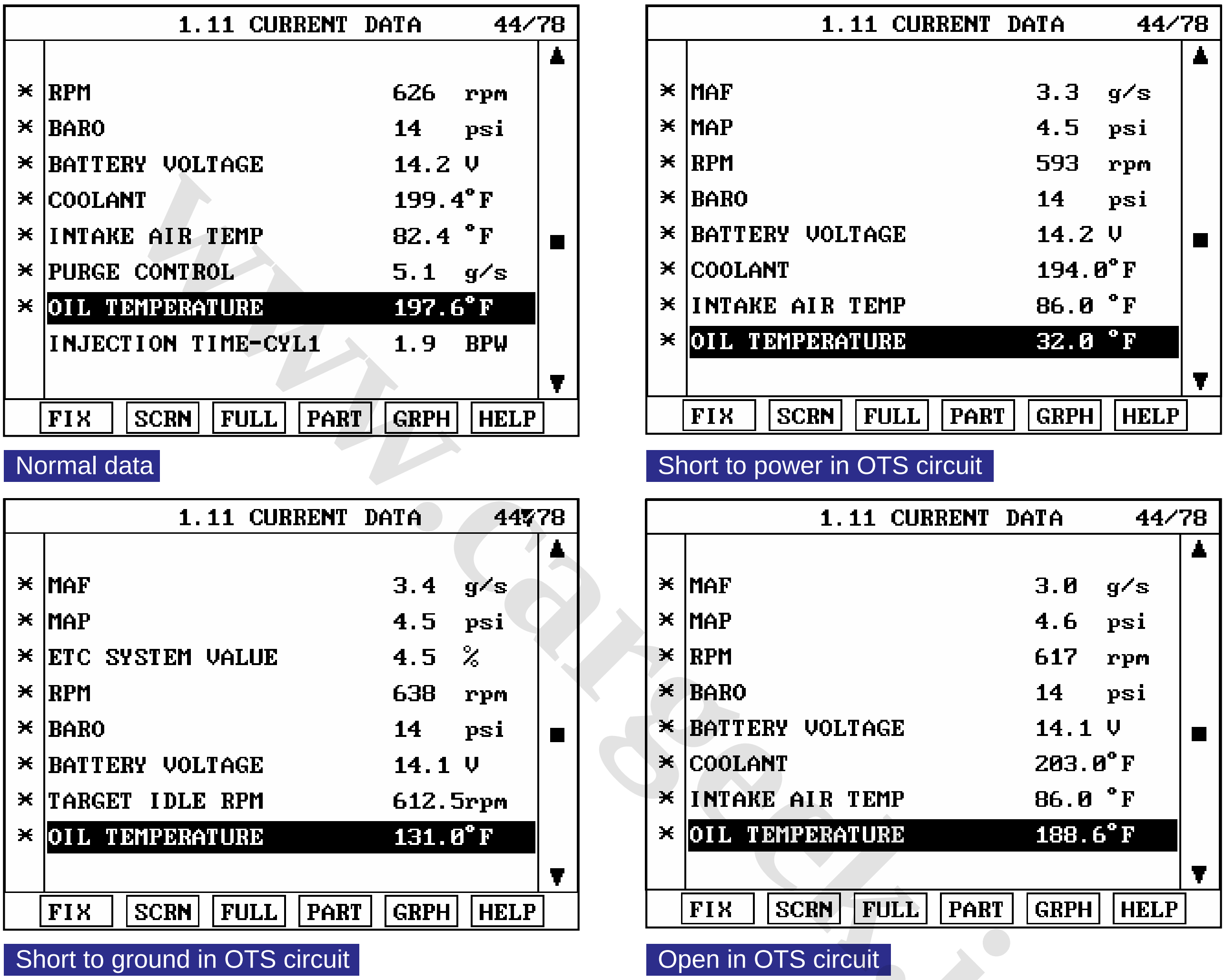
C144-B

PCM

EFBF256A

MONITOR SCANTOOL DATA E55C5E5A

1. Connect scantool to Data Link Connector (DLC)
2. Warm up engine to normal operating temperature
3. Monitor "Oil Temperature" parameter on the scantool.



EGRF606Y

4. Is the current data displayed correctly ?

YES

▶ Fault is intermittently caused by poor contact in the sensor and/or PCM connector or non cleared PCM memory after repair. 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" .

NO

▶ Go to "Terminal and connector inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E12E6705

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to "signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION ECDDF054

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 follow.

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.

Specification : Approx. below 1Ω

   4) 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 E8F5913D

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

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

5. Is the measured voltage within specification ?

YES

▶ Go to "Component Inspection" procedure

NO

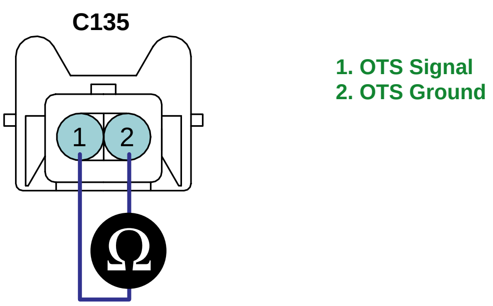
▶ Repair or replace contact resistance or open in harness and then, go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E1A42E44

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



EFBF607A

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.

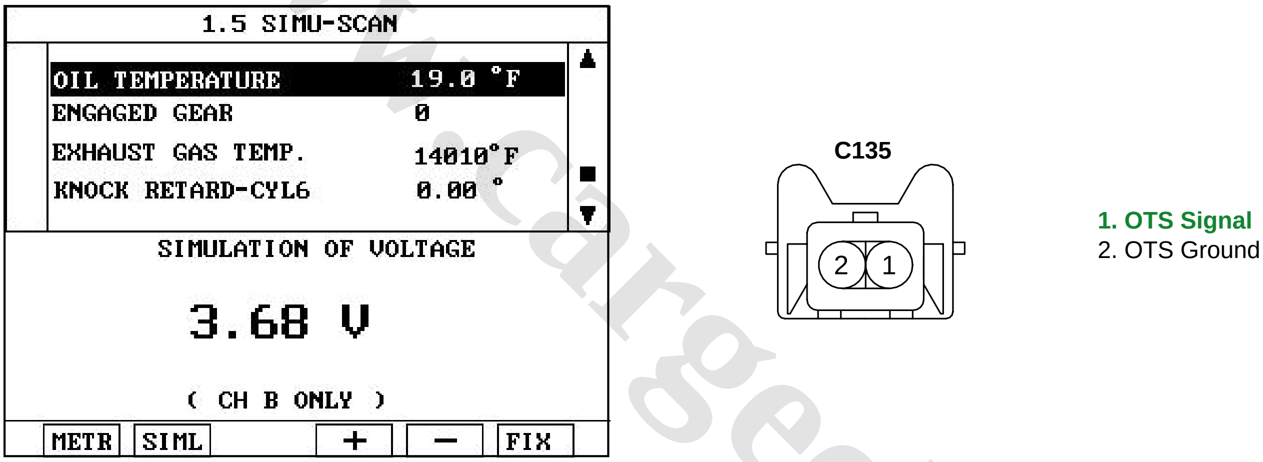
2. Check PCM

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.



EGRF607B

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E8373A58

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.

2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0197 ENGINE OIL TEMP. SENSOR LOW INPUT

COMPONENT LOCATION E19AC54A

Refer to DTC P0196.

GENERAL DESCRIPTION E4C73F2D

Refer to DTC P0196.

DTC DESCRIPTION E903EAB3

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 E6600347

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• Signal low</td><td rowspan="6">• Poor connection
• Short to ground in harness
• Oil temp.sensor
• PCM</td></tr>
<tr><td rowspan="2">Enable Condi-tions</td><td>Case 1</td><td>• Engine running state 〉 60 sec
• Coolant temperature 〈 110 ℃(230˚F)</td></tr>
<tr><td>Case 2</td><td>• Engine running state 〉 90 sec.</td></tr>
<tr><td colspan="2">Thresh old value</td><td>• Oil temperature sensor's signal 〈 0.1V</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(More than 12.5 sec.failure for every 15 sec.test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• 2 Driving Cycles</td></tr>
</table>

SPECIFICATION EB03835E

Refer to DTC P0196.

SCHEMATIC DIAGRAM E7B32EE5

Refer to DTC P0196.

MONITOR SCANTOOL DATA EB742712

Refer to DTC P0196.

TERMINAL AND CONNECTOR INSPECTION EE3AF085

Refer to DTC P0196.

SIGNAL CIRCUIT INSPECTION E7136917

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 E84A90D0

1. Check resistance of OTS

1) IG "ON" & ENG "OFF"

2) Monitor Oil Temperature parameter on the scantool

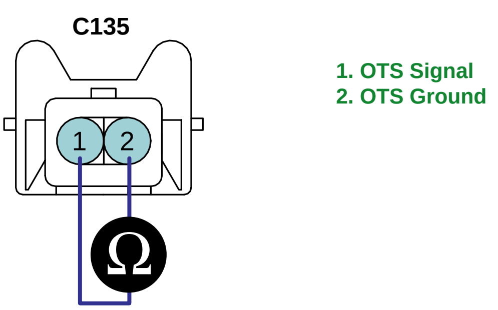
3) IG "OFF" & ENG "OFF"

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



EFBF607A

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.

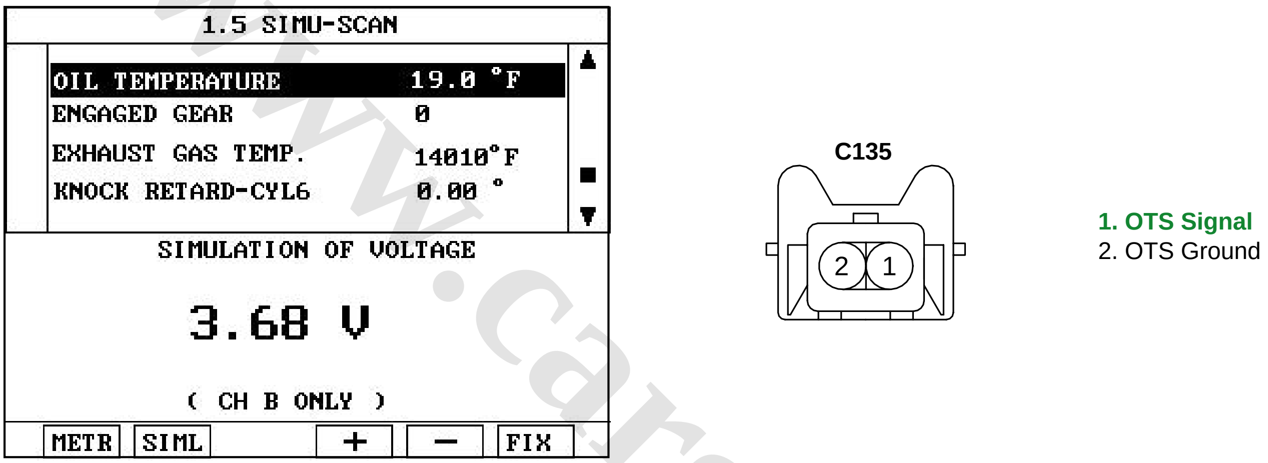
2. Check PCM

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.



EGRF607B

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E840FC74

Refer to DTC P0196.

DTC P0198 ENGINE OIL TEMP. SENSOR HIGH INPUT

COMPONENT LOCATION E907A8E7

Refer to DTC P0196.

GENERAL DESCRIPTION E77653C5

Refer to DTC P0196.

DTC DESCRIPTION ED757E90

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 E4071448

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• Signal low</td><td rowspan="6">• Poor connection
• Open or short to battery in signal harness
• Open in ground harness
• Oil temp.sensor
• PCM</td></tr>
<tr><td rowspan="2">Enable Condi-tions</td><td>Case 1</td><td>• Engine running state 〉 60 sec
• Coolant temperature 〈 110 ℃(230°F)</td></tr>
<tr><td>Case 2</td><td>• Engine running state 〉 90 sec.</td></tr>
<tr><td colspan="2">Thresh old value</td><td>• Oil temperature sensor's signal 〉 4.9V</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(More than 12.5 sec.failure for every 15 sec.test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• 2 Driving Cycles</td></tr>
</table>

SPECIFICATION E439F7AF

Refer to DTC P0196.

SCHEMATIC DIAGRAM EA2CDF08

Refer to DTC P0196.

MONITOR SCANTOOL DATA E40DEB9C

Refer to DTC P0196.

TERMINAL AND CONNECTOR INSPECTION EE71CE15

Refer to DTC P0196.

SIGNAL CIRCUIT INSPECTION EDF7B992

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 follow.

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.

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 ED73C6F8

1. IG "OFF" & ENG "OFF"

2. Disconnect OTS connector

3. Measure voltage between terminal 1 of OTS harness connector and chassis ground.

4. Measure voltage between terminals 1 and 2 of OTS harness connector.

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

5. Is the measured voltage within specification ?

YES

▶ Go to "Component Inspection" procedure

NO

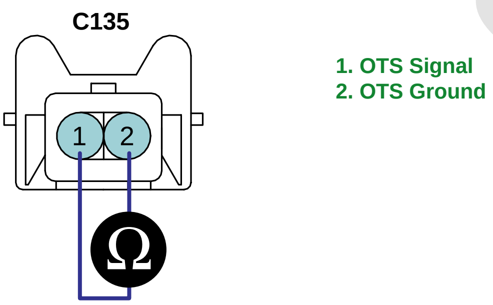
▶ Repair or replace contact resistance or open in harness and then, go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EFE46765

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



EFBF607A

   6) Is the measured resistance within specification ?

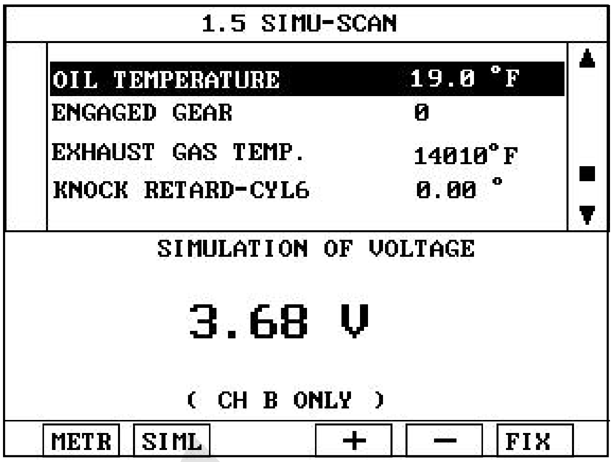
YES

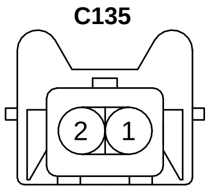
▶ Go to "Check PCM" as follows.

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.





EGRF607B

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

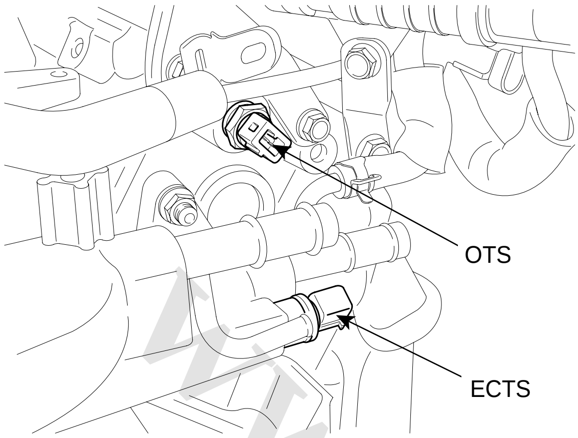
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EE348C47

Refer to DTC P0196.

DTC P0217 ENGINE COOLANT OVER TEMPERATURE CONDITION

COMPONENT LOCATION E8FB21DD



EGRF700A

GENERAL DESCRIPTION EC40146C

The Engine Coolant Temperature(ECT) Sensor measures the temperature of engine coolant. The Engine Coolant Temperature (ECT) Sensor is located near the thermostat housing of the cylinder head. ECT Sensor is a thermistor (A Variable Resistor that Changes Along with ECT) in series with a fixed resistor in the Engine Control Module (PCM). The PCM applies 5 volts to the ECT sensor. The PCM monitors the voltage across the ECT sensor and converts it into a temperature reading. When the engine is cold the ECT sensor resistance is high, and when the engine is warm the ECT sensor resistance is low. Therefore, when the engine is cold the PCM will receive a high voltage input, and when the engine is warm the PCM will receive a low voltage input. The signal from ECT sensor is used for Injection, ignition timing, idle speed and cooling fan control.

DTC DESCRIPTION E5EB9897

The Engine Coolant Temperature High Rationality Diagnostic checks for unusually high engine coolant temperatures under normal operating loads.
PCM monitors difference between the startup and current coolant temperature and compares agaist the threshold while enable condition is met. If the PCM detects that the coolant temperature exceeds the limit under normal operating condition, PCM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E4968CF2

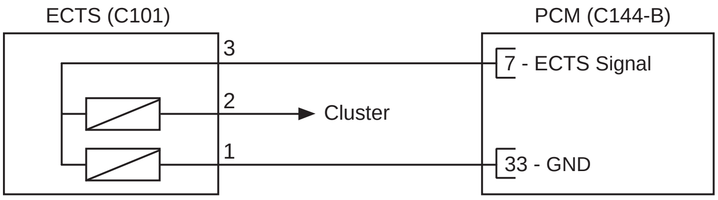
Item	Detecting Condition	Possible cause
DTC Strategy	• This diagnostic introduces a calibratable delay and simultaneously looks out for excessive engine loads. Once the delay period passes and excessive loads have not been experienced, the diagnostic checks whether the undefaulted coolant temperature has exceeded a maximum threshold in order to make a PASS/FAIL determination.	• Poor connection • Lack of engine coolant • Water pump • ECTS • PCM
Enable Conditions	• Engine Running status • No disabling faults present • Coolant Sensor within range • Undefaulted Coolant Temp ≥ 50℃(122 °F) • Undefaulted IAT ≥ 35℃(95 °F) • Soak time ≥ 360min or Undefaulted Coolant temp ≤ 45℃(113 °F)	
Thresh old value	• Coolant temperature ≥ 110℃ (230 °F) • Average airflow 〈 30 g/s and filtered airflow 〈 50 g/s.	
Diagnosis Time	• Continuous (More than 12.5 sec.failure for every 15 sec.test)	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E09D88A1

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 EF7CE0BB

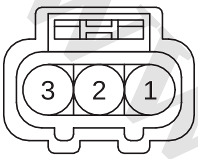
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

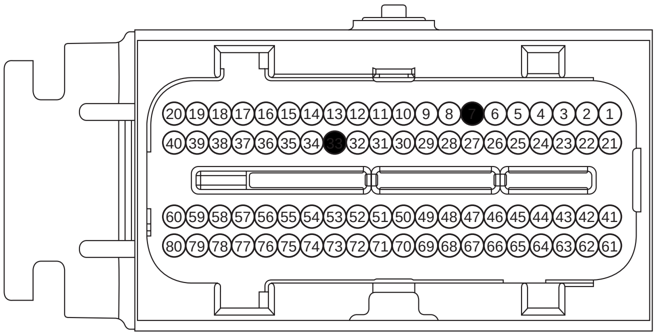
Terminal	Connected to	Funtion
1	PCM C144-B (33)	Sensor ground
2	Cluster	-
3	PCM C144-B (7)	ECTS Signal

[HARNESS CONNECTORS]



C101

ECTS

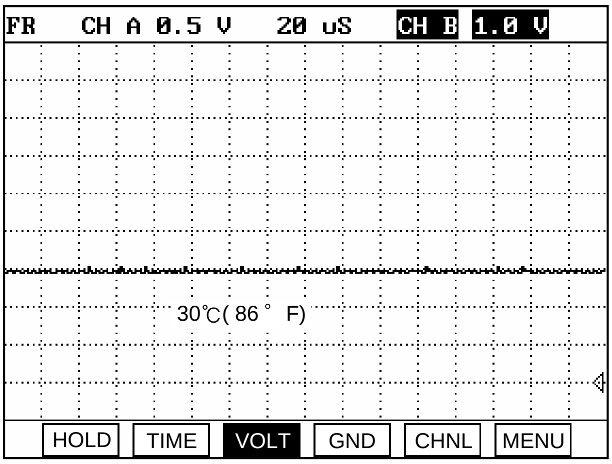


C144-B

PCM

EFBF242A

SIGNAL WAVEFORM AND DATA E7DAAA18



EGRF700B

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 SCANTOOL DATA EE3410D2

1. IG "OFF" ＆ connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "ECTS" item on the service data.

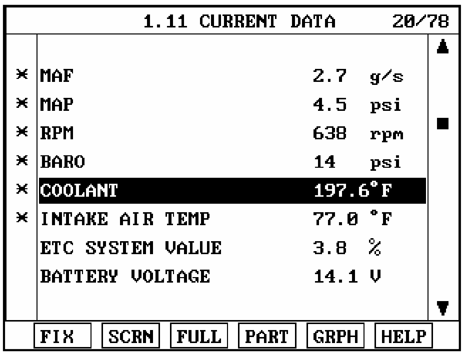


Fig. 1

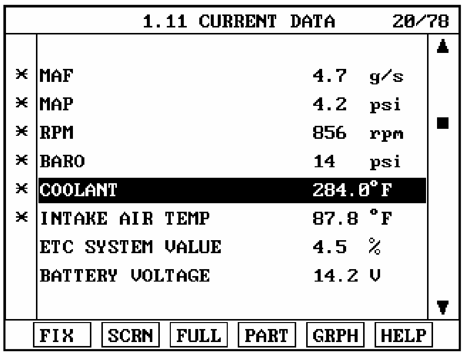


Fig. 2

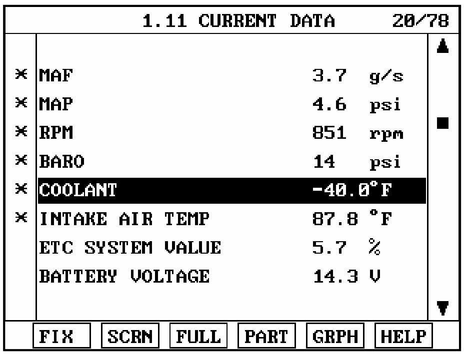


Fig. 3

Fig. 1 : Normal at Idle
Fig. 2 : Short to ground at idle
Fig. 3 : Open or short to battery at idle

EGRF700C

4. Is the "ECTS" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION ED1EB664

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

YES

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

NO

▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION EDF5538C

1. IG "OFF" and disconnect ECTS connector.
2. IG "ON" & 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 "System Inspection" procedure.

NO

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

5. 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 "System Inspection" procedure.

    NO

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

SYSTEM INSPECTION E12BA21E

1. Check if Engine coolant level is O.K

2. Check if that water pump is operating correctly.

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 E4844F72

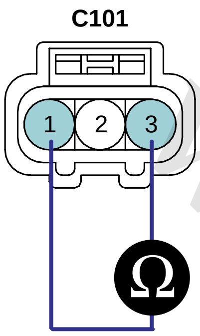
1. Check resistance of ECTS

    1) IG "OFF" and disconnect ECTS connector.

    2) Measure resistance between terminal 1 and 3 of ECTS connector. (Component Side)

SPECIFICATION :

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

EFBF700F

3) Is the measured resistance within specification ?

YES

▶ Go to "Check PCM" procedure.

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.

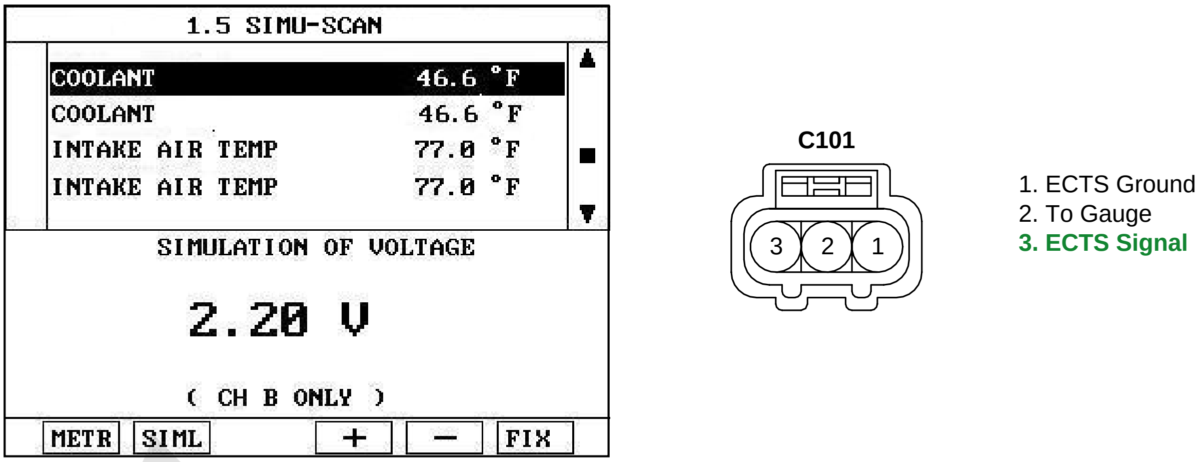
2. Check PCM

1) IG "OFF" and connect scantool.

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

3) IG "ON" and ENG "OFF" and simulation Function on scantool.

4) Simulate voltage at terminal 3 of ECTS harness connector.



EGRF700G

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. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E740B77A

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

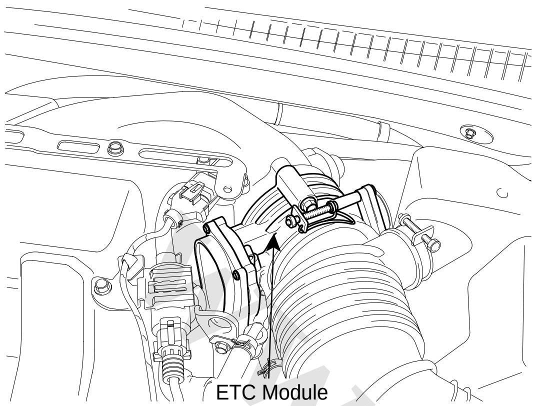
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E4D66B77



EFBF604Y

GENERAL DESCRIPTION EC5EE3BD

ETC(Electronic Throttle Control Valve) is the device controlling amount of air to engine acccording to driver's intension. Different from the existing mechanical throttle valve which is composed of accelerator pecal and connecting wire cable, ETC consists of a motor, a throttle body and a throttle position sensor. Receiving input signals from electronic accelerator pedal module, PCM lets ETC motor control throttle valve. With ETC, cruise control system works without any additional device.

DTC DESCRIPTION E1AB31AA

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 E695622E

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	

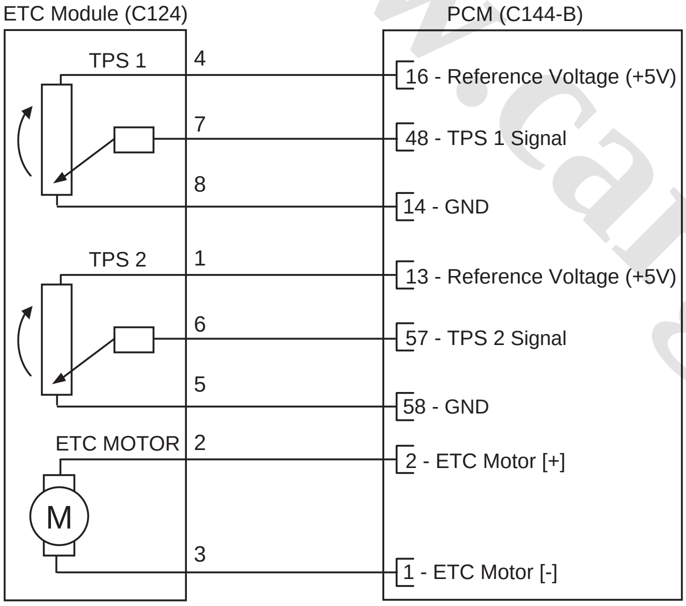
SPECIFICATION EE33DD17

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 E02CD1B1

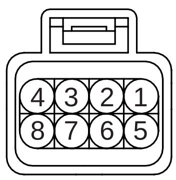
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

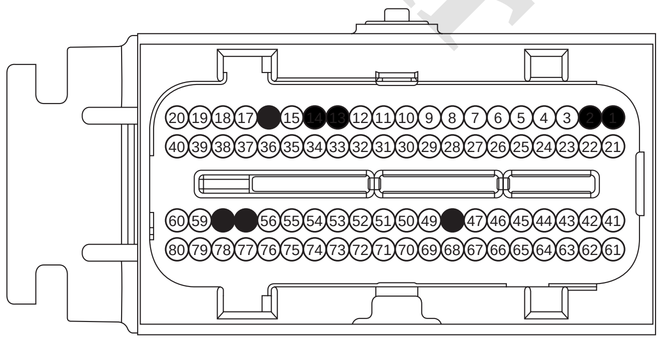
Terminal	Connected to	Funtion
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144- B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM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

[HARNESS CONNECTORS]



C124

ETC MODULE

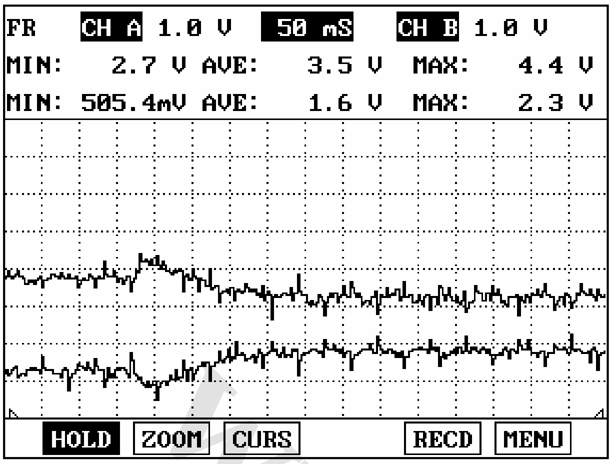


C144-B

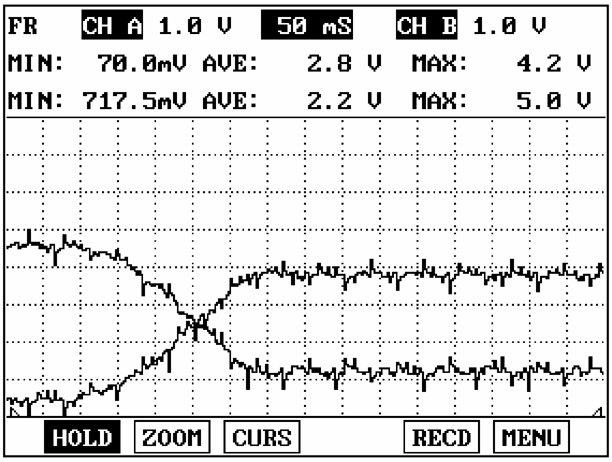
PCM

EFBF236A

SIGNAL WAVEFORM AND DATA ED371B66



Hit the accelerator at IG ON

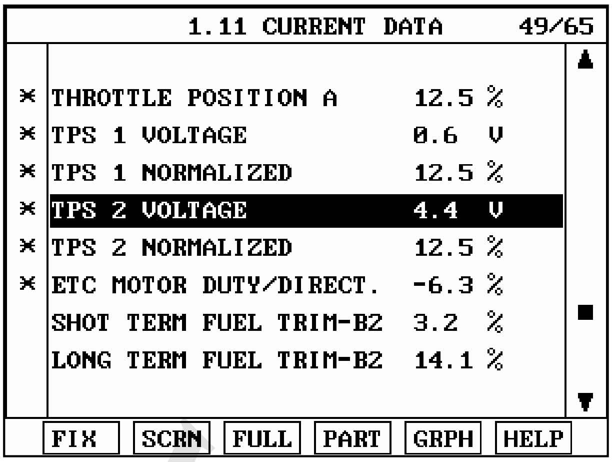


Open the throttle valve by force at IG ON

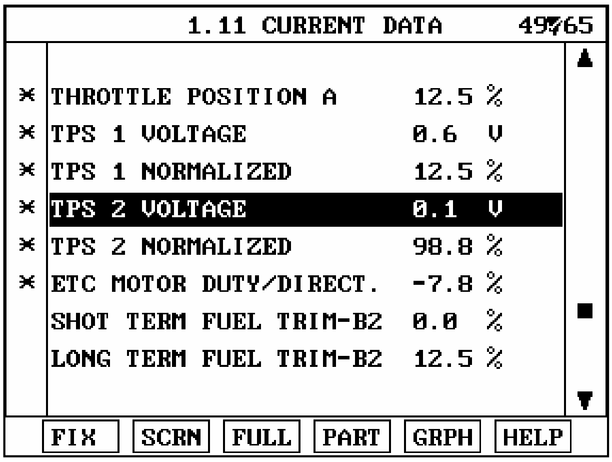
EGRF604Z

MONITOR SCANTOOL DATA E0A141E1

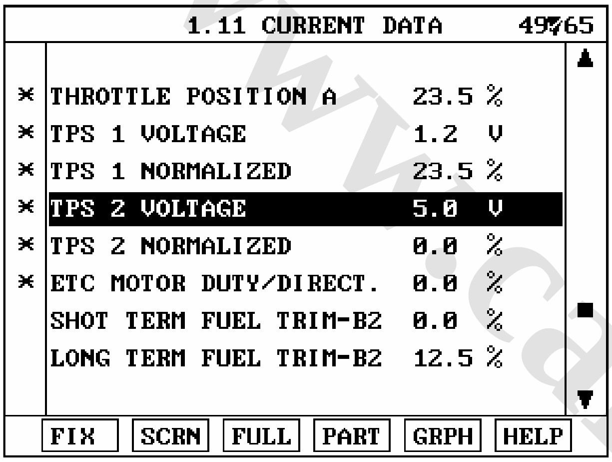
1. IG "OFF" ＆ connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "TPS" item on the service data.



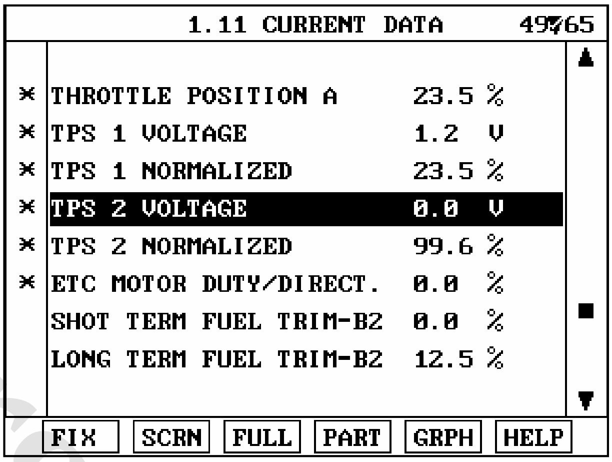
Normal data at Idle



Open circuit at Idle



High signal at Idle



Short to ground at Idle

EGRF607F

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E681DAE0

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 EBDDE855

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 E71DE041

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.

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.

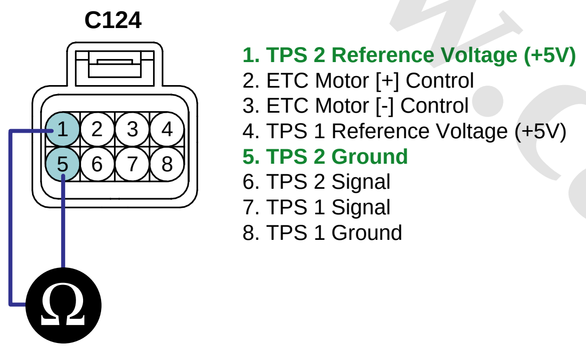
COMPONENT INSPECTION E5AC6C24

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



EFBF607J

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 to reuse the PCM on the others

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.(It will takes 10sec.)***
3. ***Turn ignition key on more than 1second to record the throttle motor position on the EEPROM***

VERIFICATION OF VEHICLE REPAIR E09640F5

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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

COMPONENT LOCATION E3DCA7B8

Refer to DTC P0222.

GENERAL DESCRIPTION EC13AD42

Refer to DTC P0222.

DTC DESCRIPTION EA5D980B

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 ECCB4225

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 EBD15B06

Refer to DTC P0222.

SCHEMATIC DIAGRAM EF8581E1

Refer to DTC P0222.

SIGNAL WAVEFORM AND DATA E1FABB90

Refer to DTC P0222.

MONITOR SCANTOOL DATA E0DC330C

Refer to DTC P0222.

TERMINAL AND CONNECTOR INSPECTION E1C5C058

Refer to DTC P0222.

SIGNAL CIRCUIT INSPECTION EC580FCF

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 EF9DD7ED

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 E866A944

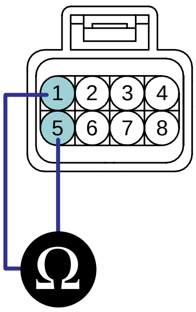
1. Check TPS

   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

C124



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

EFBF607J

   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 to reuse the PCM on the others

CAUTION

Procedure of ETS Initialization

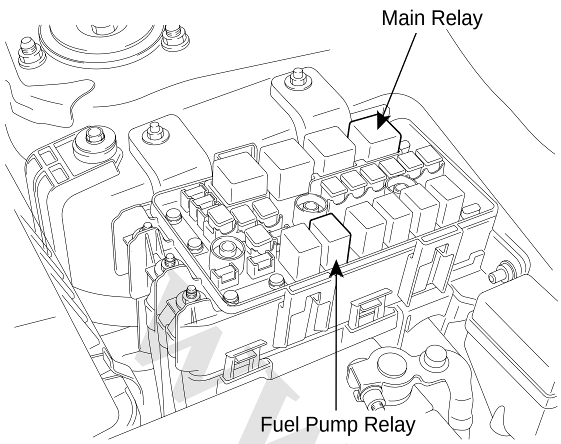
1. ***Erase the trouble codes on PCM***
2. ***Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)***
3. ***Turn ignition key on more than 1second to record the throttle motor position on the EEPROM***

VERIFICATION OF VEHICLE REPAIR E75F343C

Refer to DTC P0222.

DTC P0230 FUEL PUMP PRIMARY CIRCUIT

COMPONENT LOCATION E5FEE0C0



EFBF607N

GENERAL DESCRIPTION E9875072

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 fuel pump 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 ED90339D

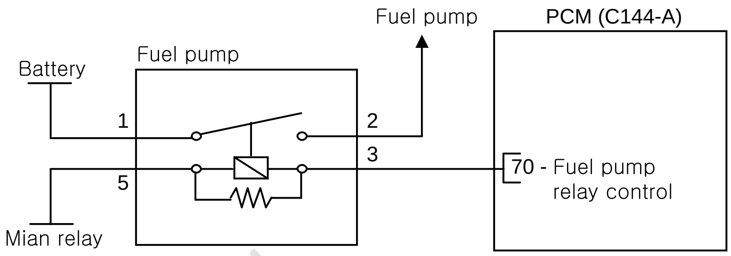
Checking fuel pump relay circuit continuously under detecting condition, if open or short in the circuit is detected, PCM sets P0230.In addition, Take note that open circuit in Main Relay may cause this P0230 code.
※ In addition, Take note that open circuit in Main Relay may cause this P0230 code.

DTC DETECTING CONDITION E1FEAACD

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 EDB23D42

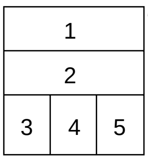
[CIRCUIT DIAGRAM]

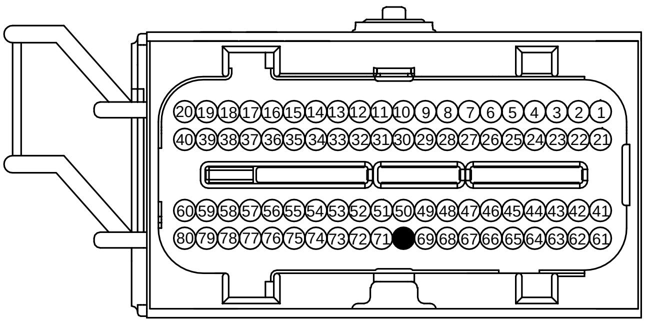


[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Battery	Battery power (B+)
2	Fuel pump	Power Supply to fuel pump (B+)
3	PCM C144-A (70)	Relay control
5	Mian relay	Battery power (B+)

[HARNESS CONNECTOR]



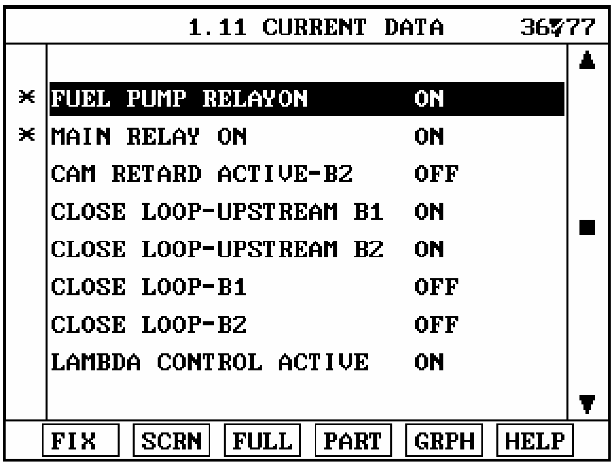


C144-A
PCM

EFBF987Z

MONITOR SCANTOOL DATA E924DB16

1. Connect Scantool to Data Link Connector(DLC).
2. ENG "ON"
3. Monitor "Fuel Pump Relay" item on the scantool.



EGRF607O

4. Is the service data displayed correctly ?

YES

▶ Fault is intermittently caused by poor contact in the sensor and/or PCM connector or non cleared PCM memory after repair. 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" .

NO

▶ Go to "Terminal and connector inspection" procedure.
▶ In case of open in Main Relay, this DTC can be set. so, check it for open before going next procedure.(Refer to DTC relating to Main relay)

TERMINAL AND CONNECTOR INSPECTION E7247408

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

YES

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

NO

▶ Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION E35260A9

1. IG "OFF" & ENG "OFF"
2. Disconnect fuel pump relay.
3. IG "ON" & ENG "OFF"
4. Measure voltage between harness terminal 1(5) 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 5 is not detected, replace the Main Relay.
▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EBAD11F0

1. IG "OFF"

2. Disconnect fuel pump relay.

3. IG "ON" & ENG "OFF"

4. Measure voltage between harness terminal 3 and chassis ground.

Specification : Approx. 2.5V

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 EF4C91B0

1. Check fuel pump relay

1) IG "OFF"

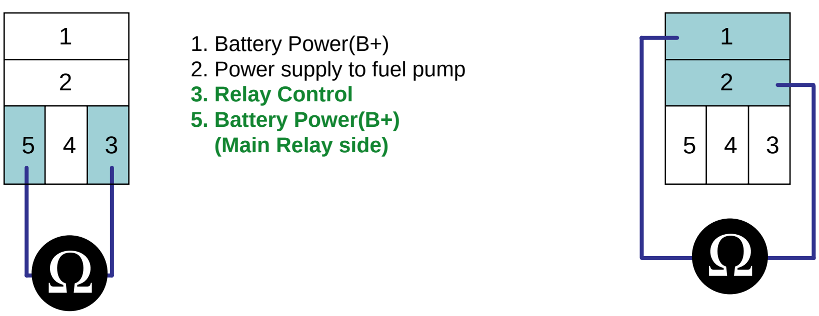
2) Disconnect Fuel Pump Relay

3) Measure resistance between terminal 1 and 2 of Fuel Pump Relay

4) Measure resistance between terminal 3 and 5 of Fuel Pump Relay

SPECIFICATION :

Terminal	continuity
1~2	NO
3~5	YES (Approx. 70Ω ~ 120Ω)



EFBF607R

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 to reuse the PCM on the others

NO

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

VERIFICATION OF VEHICLE REPAIR E9BFDD52

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

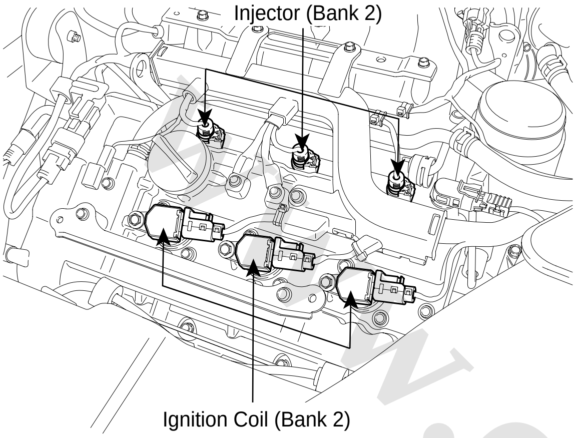
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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 E2EE36F5



EGRF607C

GENERAL DESCRIPTION E3FDC26C

Electronically controlled fuel injector is a solenoid valve which supplies exactly calculated amount of fuel to engine for optimum conbustion under various engine load and speed. To meat air-fuel ratio required in system, PCM regulates fuel injection quantity as controlling injector solenoid operating duration referring air flow to cylinders and output signals from HO2S. For this precise control, quick response of solenoid is required and for perfect combustion, injection characteristic is important.

DTC DESCRIPTION EF2615A1

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 E86720A0

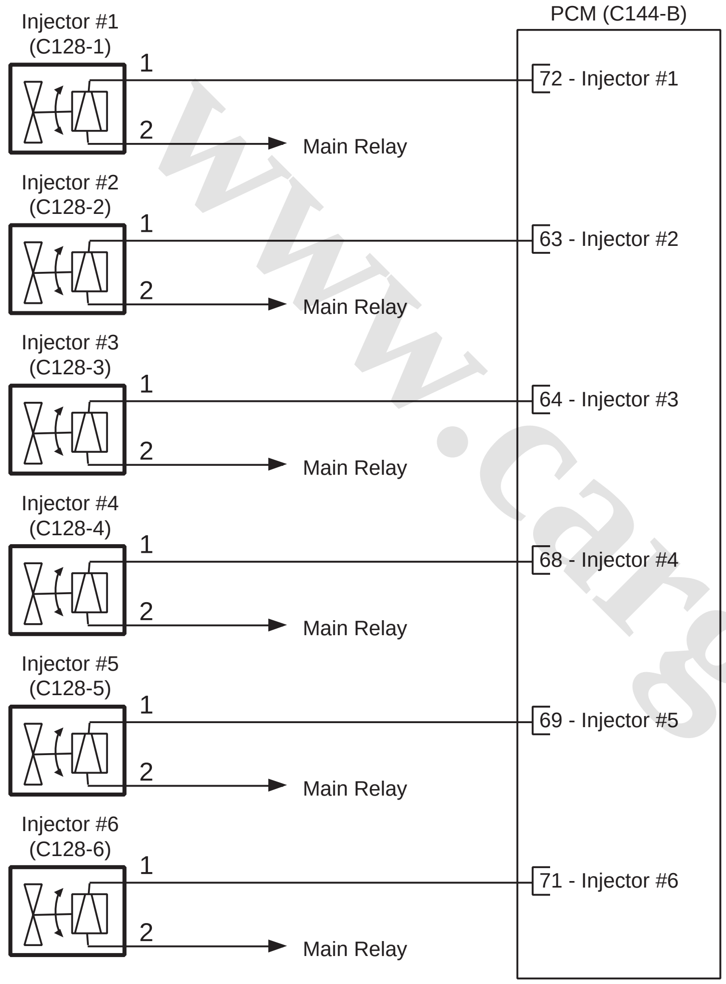
Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal Low	• Poor connection • Open or short to ground in power harness • Open or short to ground in control harness • Injector • PCM
Enable condition	• Engine running state • 11V ≤ Battery voltage ≤ 16V • Above conditions are met 〉 0.5sec. • No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

SPECIFICATION E03CB14D

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

SCHEMATIC DIAGRAM E8AA9471

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1

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

Injector #2

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

Injector #3

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

Injector #4

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

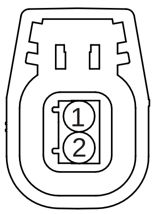
Injector #5

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

Injector #6

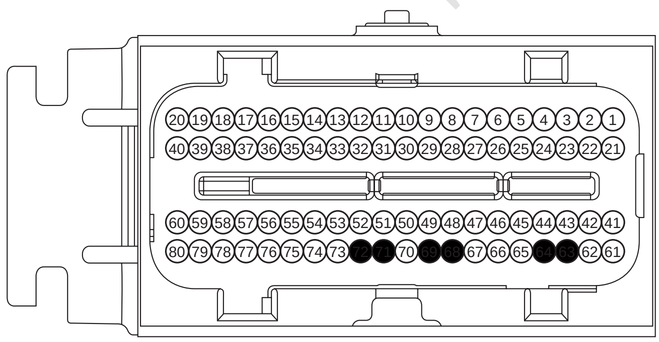
Terminal	Connected to	Funtion
1	PCM C144-B (71)	Injector #6 control
2	Main Relay	Battery Voltage (B+)

[HARNESS CONNECTORS]



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

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

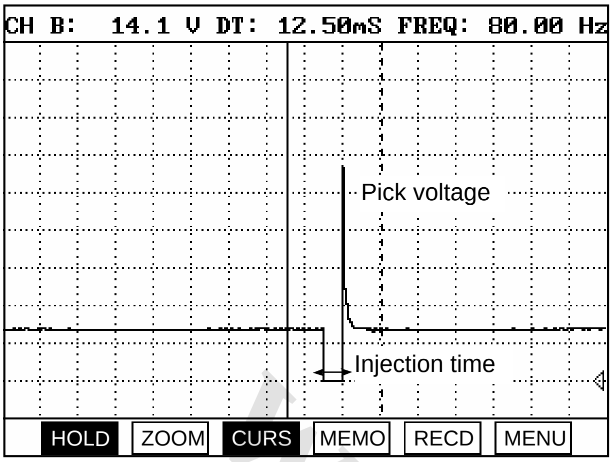


C144-B

PCM

EFBF254A

SIGNAL WAVEFROM AND DATA E094E58E



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 be peak at a moment.

MONITOR SCANTOOL DATA E3E34F37

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "fuel injection time" item on the service data.

	1.11 CURRENT DATA	23/78
×	INJECTION TIME-CYL1	2.2 BPW
×	INJECTION TIME-CYL2	2.5 BPW
×	INJECTION TIME-CYL3	2.4 BPW
×	INJECTION TIME-CYL4	2.6 BPW
×	INJECTION TIME-CYL5	2.5 BPW
×	INJECTION TIME-CYL6	2.6 BPW
	INDICATE ACTUAL TORQUE	51.1 Nm
	TORQUE REQUEST	736.6Nm

FIX SCRN FULL PART GRPH HELP

EGRF607T

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E50AF365

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 E78D8F73

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 EFFF3DAE

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.
[P0264] Measure resistance between terminal 1 of injector harness connector and 63 of PCM harness connector.
[P0267] Measure resistance between terminal 1 of injector harness connector and 64 of PCM harness connector.
[P0270] Measure resistance between terminal 1 of injector harness connector and 68 of PCM harness connector.
[P0273] Measure resistance between terminal 1 of injector harness connector and 69 of PCM harness connector.
[P0276] Measure resistance between terminal 1 of injector harness connector and 71 of PCM harness connector.

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 EB566662

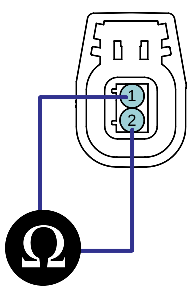
1. Check injector

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℃/ 68˚F)



1. Injector control
2. Battery voltage

EFBF991D

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E7C5DC1D

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

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 E8492B5D

Refer to DTC P0261.

GENERAL DESCRIPTION ED5C157E

Refer to DTC P0261.

DTC DESCRIPTION E3764D51

Checking output signals from injectors. Under detecting condition, if an output signal is high, PCM sets P0262/P0265/P0268/P0271/P0274/P0277. MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF26F103

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

SPECIFICATION E27C26E4

Refer to DTC P0261.

SCHEMATIC DIAGRAM ED739366

Refer to DTC P0261.

SIGNAL WAVEFROM AND DATA E2EF8FB2

Refer to DTC P0261.

MONITOR SCANTOOL DATA E565E8A1

Refer to DTC P0261.

TERMINAL AND CONNECTOR INSPECTION EB5D3D34

Refer to DTC P0261.

CONTROL CIRCUIT INSPECTION E0223C4B

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

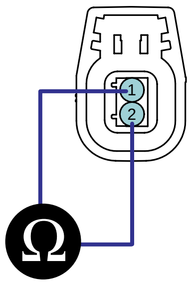
▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E17D12C0

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℃/ 68˚F)



1. Injector control
2. Battery voltage

EFBF991D

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

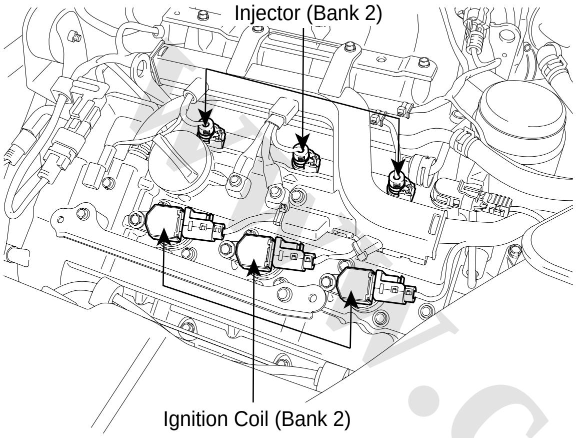
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E85075EE

Refer to DTC P0261.

DTC P0300 RANDOM/MULTIPLE CYLINDER MISFIRE DETECTED
DTC P0301 CYLINDER 1 - MISFIRE DETECTED
DTC P0302 CYLINDER 2 - MISFIRE DETECTED
DTC P0303 CYLINDER 3 - MISFIRE DETECTED
DTC P0304 CYLINDER 4 - MISFIRE DETECTED
DTC P0305 CYLINDER 5 - MISFIRE DETECTED
DTC P0306 CYLINDER 6 - MISFIRE DETECTED

COMPONENT LOCATION EC98135B



EGRF609P

GENERAL DESCRIPTION E96B98C9

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 E4EB395F

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. PCM sets this DTC. In case that misfire affects Catalyst damage, MIL(Malfunction Indication 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 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 EA226C57

Item		Detecting Condition	Possible Cause
DTC Strategy		• Determine if a multiple cylinder misfire or a cylinder specific misfire is occurring by monitoring crankshaft acceleration.	• Faulty Spark plugs • Faulty Spark plug cables • Air Leakage • Belt deflection and Air gap of CKPS • Incorrect timing • Faulty injector • Improper fuel pressure • Improper engine compression • Faulty PCM
Enable condition		• No sudden change in throttle opening • Torque management control is not functioning • Not deceleration fuel cut off • Not fuel cut off during high speed operation • Not negative torque driving conditions • Not fuel level low • TEC is learned • Coolant temperature is outside the window • 500 〈 Engine speed 〈 6600 • 11 〈 Battery vlotage 〈 16 • TPS/MAP sensor/CAMS/CKPS/ECT sensor are normal	
Threshold value	Case 1	• Individual event misfire detection 〉 Threshold	
	Case 2	• Emissions damaging 〉 Threshold	
	Case 3	• Catalyst damaging 〉 Threshold	
Diagnosis time		• Continuous	
MIL ON condition		• 2 driving cycles	

MONITOR SCANTOOL DATA EA20A178

1. Is the power balance test done?

YES

▶ If injector connector for power balance test is disconnect for over 46 sec., this can cause DTC relating to misfire. Stop the test and connect it and delete DTC and then go to "Verification of Vehicle repair" procedure.
▶ If power balance test is finished within 46 sec., go to next procedure.

NO

▶ Go to "Monitor scantool data" as follows.

2. Monitor scantool data

   1) Ignition "OFF"

   2) Connect Scantool and Engine "ON"

   3) Monitor parameters related to "Random Misfire Detected" on CURRENT DATA

SPECIFICATION :

Ignition	BTDC 10° ± 5°	
Idle speed	N-range	720 ± 100 rpm
	D-range	650 ± 100 rpm

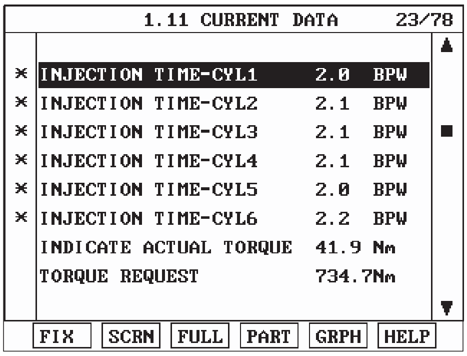


Fig. 1

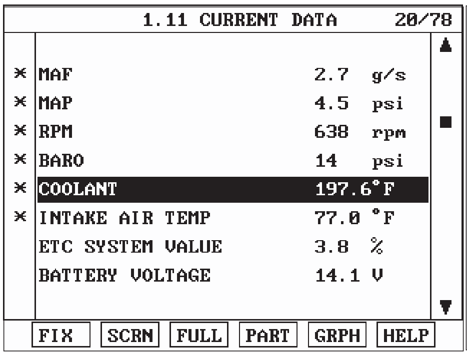


Fig. 2

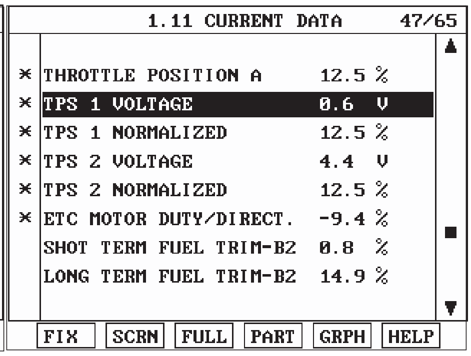


Fig. 3

EGRF609Q

4) Are the parameters related to "Random/Multi Misfire Detected" displayed correctly on Current Data ?

YES

▶ 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, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Go to "System Inspection " procedure

SYSTEM INSPECTION E399CC28

1. Check Spark Pulg

1) Remove cylinder's spark plugs

2) Visually/physically inspect the following items:
- Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
- Check for plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)
- Check if the spark plug for the relevant cylinder is lighter in color than the other plugs.

3) Has a problem been found in any of the above areas?

YES

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

NO

▶ Go to "Check Air Leakage " as below

2. Check Air Leakage

1) Visually/physically inspect the air leakage in intake/exhaust system as following items,
- Vacuum hoses for splits, kinks and improper connections.
- Throttle body gasket
- Gasket between intake manifold and cylinder head
- Seals between intake manifold and fuel injectors
- Exhaust system between HO2S and Three way catalyst for air leakage

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

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

YES

▶ Go to "Check Timing " as below

NO

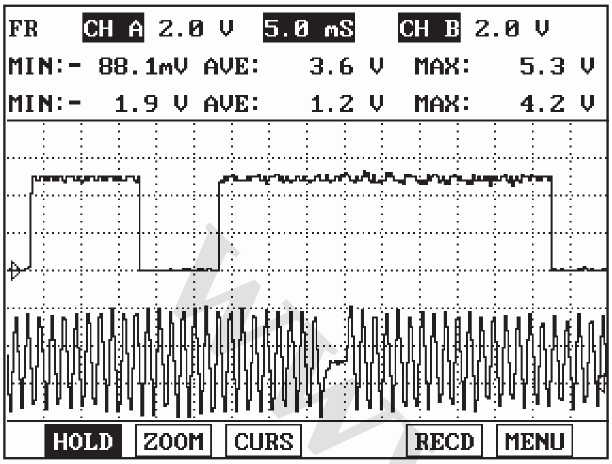
▶ Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.
▶ If the compression remains the same, the cause is a burnt or defective valve seat, or pressure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

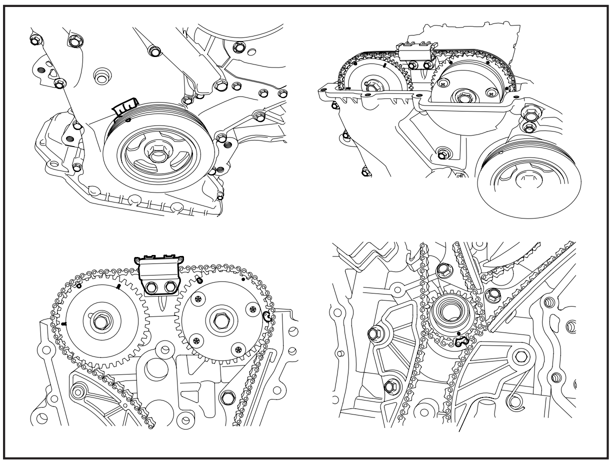
5. Check Timing

1) Ignition "OFF"

2) Check that Cam, Crank and Oil pump sprocket timing marks are correctly in alignment

3) Monitor these signal waveforms from CAM and Crank shaft position Sensor are correctly in alignment





EGRF609R

4) Are all timing marks alligned correctly ?

YES

▶ Go to "Check Fuel Pressure Test" as below

NO

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

6. Check Fuel Pressure Test

1) Refer to "Fuel pressure test" in "Fuel delivery system"

2) Are 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.

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

NO

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

VERIFICATION OF VEHICLE REPAIR EE6FAA08

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.

2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0315 SEGMENT TIME ACQUISITION INCORRECT

GENERAL DESCRIPTION EDDFAB7E

It is impossible to forge or machine a perfectly proportioned crankshaft wheel. Therefore, each crankshaft wheel produced will have minor variations in the spacing and/or width of its gear teeth.These variations (tooth error), if not compensated for, can cause false misfire detection. The Tooth Error Correction (TEC) Learn Algorithm determines engine-specific variation in crankshaft position sensing. Once TEC is learned, compensation factors are then calculated and used by the Misfire Diagnostic algorithm to improve the accuracy of engine positiondeterminations.Tooth error correction factors are normally learned only once during the life of a vehicle. However, if a vehicle controller, engine crankshaft, target wheel, or crank sensor is replaced or serviced, tooth error correction factors must be re-learned. This can be performed in a service environment with serial data commands.

DTC DESCRIPTION E16F135A

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

DTC DETECTING CONDITION E1169B67

Item	Detecting Condition	Possible cause
DTC Strategy	• This DTC indicates that crankwheel tooth error has not been learned.	
Enable Conditions	• 12 ≤ Ignition Voltage ≤ 16 (V) • 10 ≤ Engine load 〈 90 (%) • 1500 ≤ engine speed ≤ 4000 (rpm) • Vehicle speed 〈 5kph(3.106856 mph) • Tec RPM stability timer 〉 10sec • 0℃(32°F) 〈 coolant temp 〈 110℃(230°F) • Not active disabling faults • Not key on disabling faults	• CKPS • Target wheel • PCM
Threshold value	• Distance driven without learning tooth error ≥ 4000km(2485.484769 mile) or • Maximum allowed number of tooth error correction samples taken in the On The Road(OTR)learning mode 〈 250 or • Sum of tooth error factors variation outside calibratable range ≥ 250	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycles	

COMPONENT INSPECTION E982A241

1. Visually check CKPS and target wheel

   1) IG "OFF"

   2) Check CKPS and target wheel for deformation or damage visually

   3) Is the above items normal ?

   YES

   ▶ Go to "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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E6980C61

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

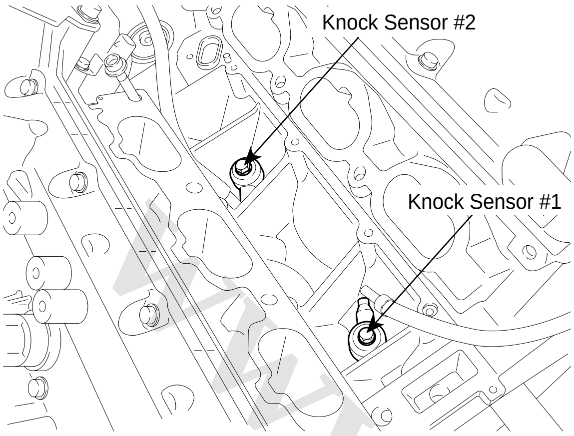
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0325 KNOCK SENSOR 1 CIRCUIT
DTC P0330 KNOCK SENSOR 2 CIRCUIT

COMPONENT LOCATION EA55241F



EGRF610A

GENERAL DESCRIPTION ED7F1298

Knocking is a phenomenon characterized by undesirable vibration and noise that can cause engine damage. A knock sensor (KS) is mounted on the cylinder block and senses engine knocking. A knocking vibration from the cylinder block is applied as pressure to the piezoelectric element. A knock sensor (KS) detects vibration when RPM rises or drops and generates voltages based on this vibration. The PCM controls the ignition timing based on the amplitude and frequency of the knock sensor signal. For example, if engine knocking occurs, the ignition timing is retarded to prevent it.

DTC DESCRIPTION E693E489

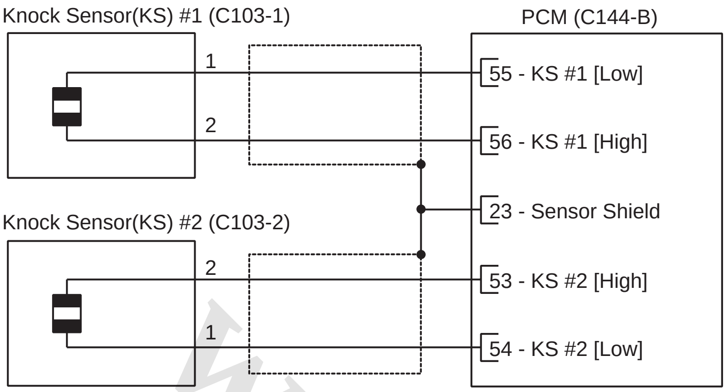
Checking the range of input signal with a knock sensor under detecting condition, PCM senses open in knock sensor circuit or malfunction of sensor. If a knock signal or noise level is inputted without the specified value during standard duration, PCM sets P0325/P0330.

DTC DETECTING CONDITION E54BE481

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 ≥ 2200 rpm	
Threshold value	• Filter coefficient 〈 1.0	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM E6452883

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

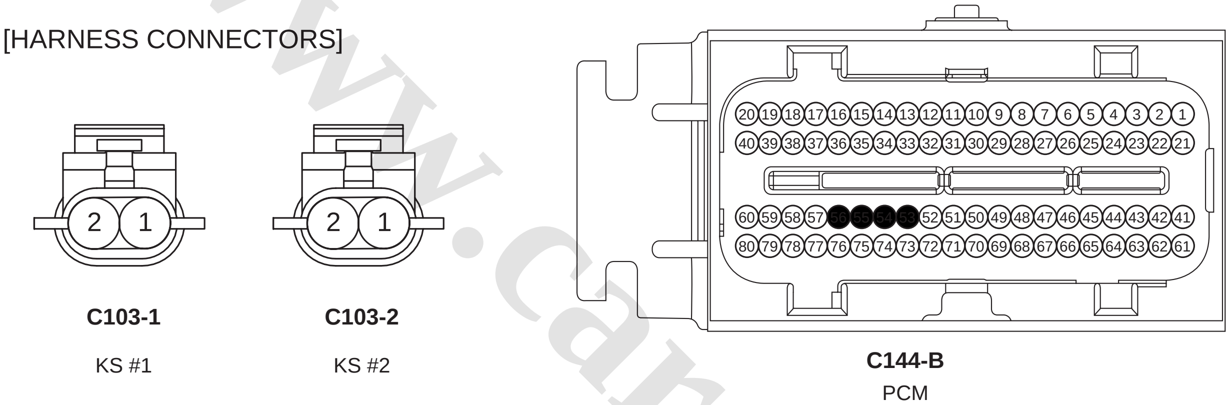
KS #1 (Cyl. #4,5,6)

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

KS #2 (Cyl. #1,2,3)

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

[HARNESS CONNECTORS]



EFBF253A

SIGNAL WAVEFROM AND DATA E935AD50

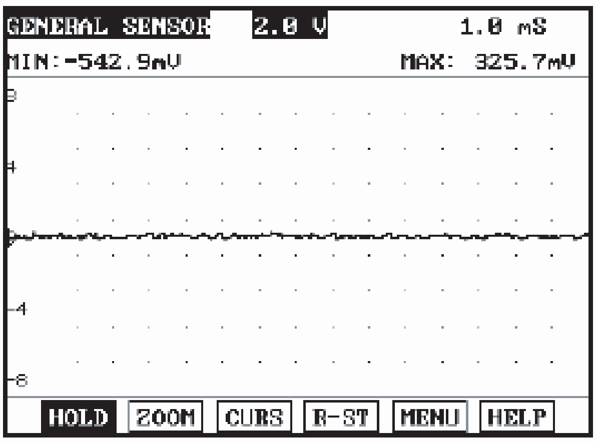


Fig. 1

The knock sensor is installed at cycliner block to detect the vibration effectively during engine running.
The above waveform shows the signal waveform of knock sensor when knock dosen't happen. Generally, knock signal has more noise than other sensor.

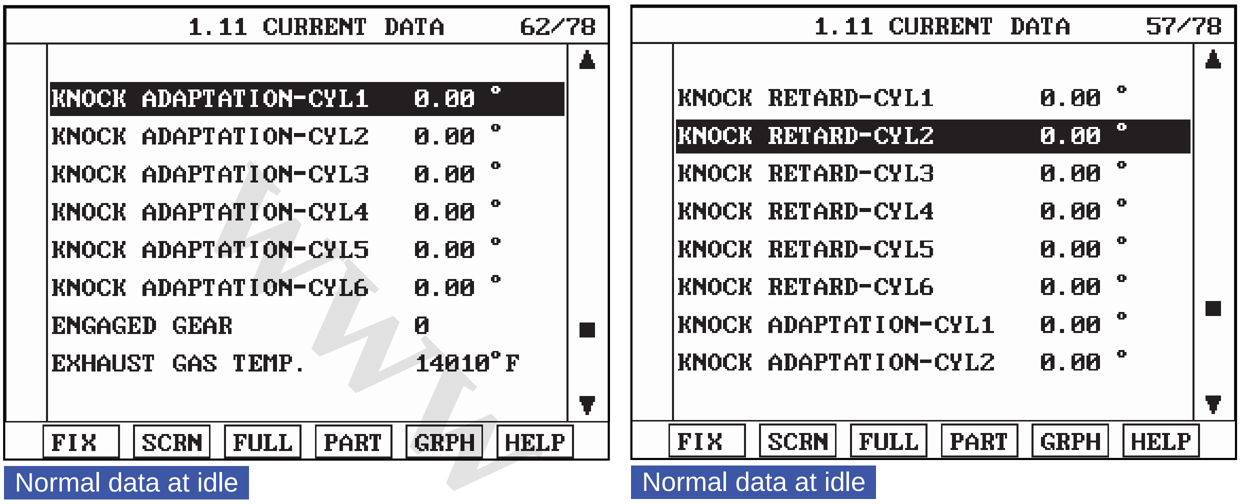
EGRF610B

MONITOR SCANTOOL DATA EB61F757

1. IG "OFF" & connect scantool.

2. ENG "ON" and warm -up the engine to normal operating temperature.

3. Monitor item related to knock sensor on the service data.



EFBF990A

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and connector inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E9478C55

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E604E0BA

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.

   3) Measure resistance between terminal 2 of knock sensor harness connector and terminal 56 of PCM harness connector.

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E4C5EB2B

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0326 KNOCK SENSOR 1 CIRCUIT RANGE/PERFORMANCE (BANK 1)
DTC P0331 KNOCK SENSOR 2 CIRCUIT RANGE/PERFORMANCE (BANK 2)

COMPONENT LOCATION EFEA5A4B

Refer to DTC P0325.

GENERAL DESCRIPTION E51D2E4E

Refer to DTC P0325.

DTC DESCRIPTION EDF127D0

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 average value of the knok signals is out of the threshold value during standard duration, PCM sets P0326/P0331. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E8433FDE

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	• 2 driving cycles	

SCHEMATIC DIAGRAM E6598878

Refer to DTC P0325.

SIGNAL WAVEFROM AND DATA E1F58BA2

Refer to DTC P0325.

MONITOR SCANTOOL DATA E6B9027F

Refer to DTC P0325.

TERMINAL AND CONNECTOR INSPECTION EA9F4313

Refer to DTC P0325.

SIGNAL CIRCUIT INSPECTION E833C09A

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

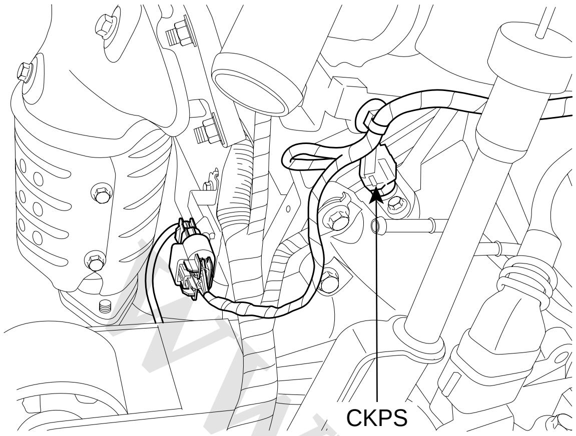
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E874A544

Refer to DTC P0325.

DTC P0335 CRANKSHAFT POSITION SENSOR A CIRCUIT

COMPONENT LOCATION E1F92D97



EGRF610J

GENERAL DESCRIPTION E614B363

Crankshaft Position Sensor (58X) derives its name from the fact that current systems utilize a Crankshaft Position Sensor, coupled with a 58-tooth crankshaft wheel, to determine crankshaft angular position. Each edge of the wheel corresponds to a change in crank sensor output voltage as a tooth edge passes the sensor. The sensor will produce 58 pulses with one rotation of the crankshaft.

DTC DESCRIPTION EDA86D30

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.

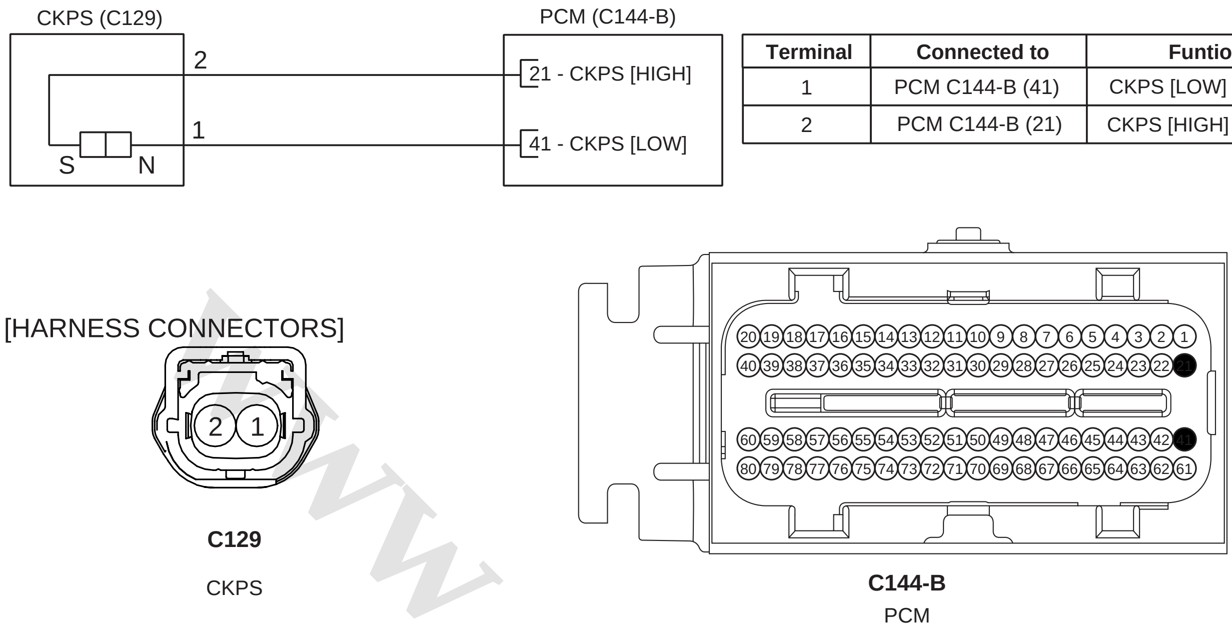
DTC DETECTING CONDITION E81EB88C

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 position sensor state change	
Threshold value	• No reference signal over 0.15 sec.	
Diagnosis Time	• 0.15 sec.	
MIL On Condition	• 2 driving cycles	

SPECIFICATION EDDA6271

Resistance	700 ± 70Ω

SCHEMATIC DIAGRAM E4F5F1A6

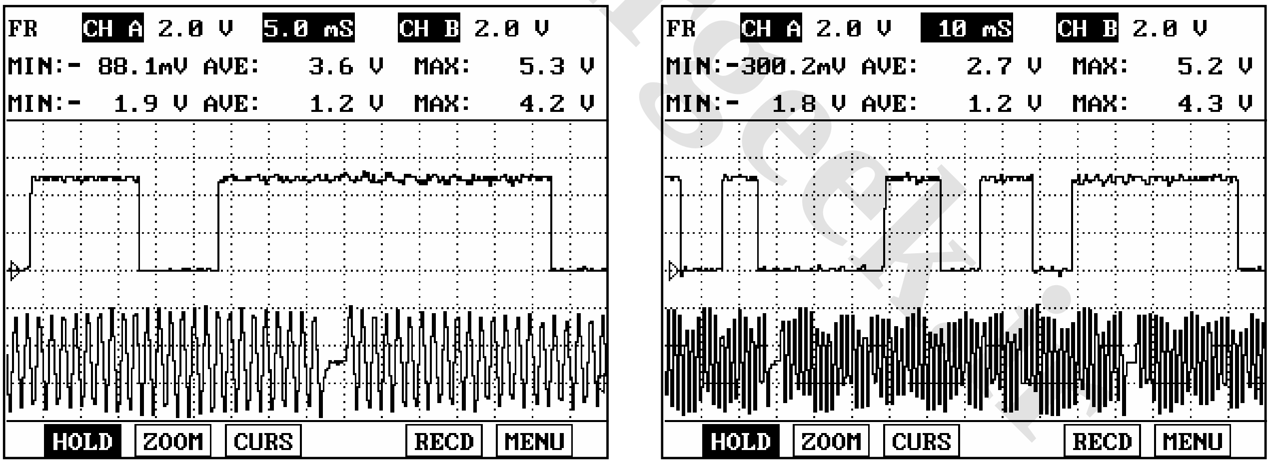


[CONNECTION INFORMATION]

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

EFBF246A

SIGNAL WAVEFROM AND DATA EED03D4A

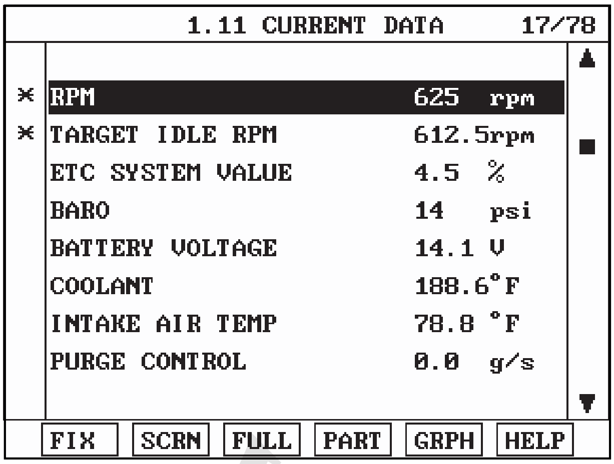


EGRF610K

MONITOR SCANTOOL DATA EF7E9BAA

1. IG "OFF" ＆ connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor engine speed item on the service data.

Specification :
650 ± 100 rpm (D-range)
720 ± 100 rpm (N-range)



EGRF610L

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EB18AE3A

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION EB6ED86A

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.

3) Measure resistance between terminal 2 of CKPS harness connector and terminal 21 of PCM harness connector.

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 E4CB36BF

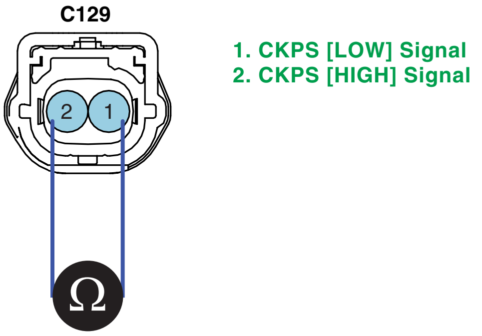
1. Check CKPS

1) IG "OFF" and disconnect CKPS connector.

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

SPECIFIATION :

Resistance	700 ± 70Ω



EGRF610O

3) Is the measured resistance within specification?

YES

▶ Go to "Check signal waveform of CKPS" as follows.

NO

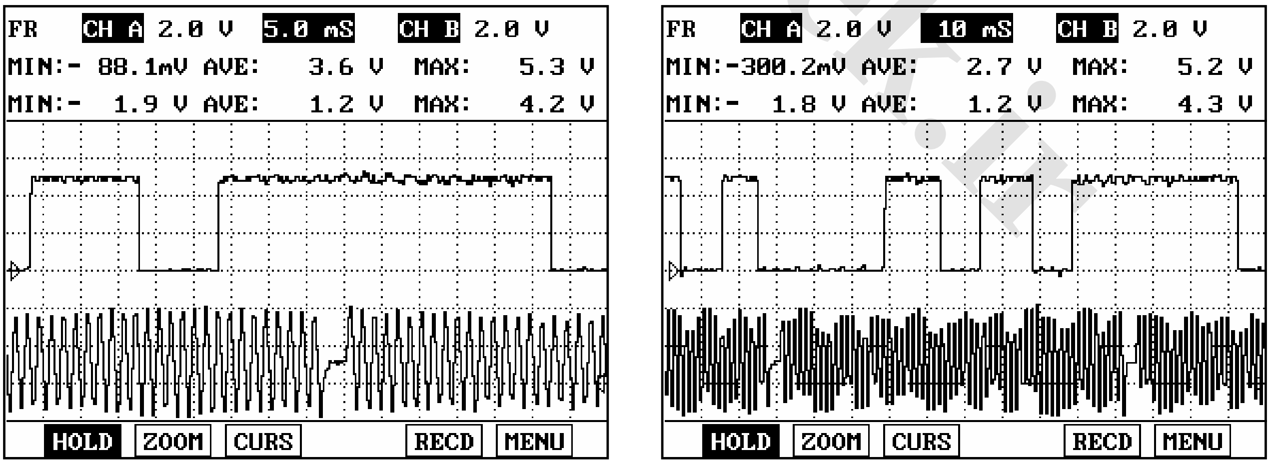
▶ Substitute with a known - good CKPS and check for proper operation. If the problem is corrected, replace CKPS and go to "Verification of Vehicle Repair" procedure.

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 siganl 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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E7656CAC

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0336 CRANKSHAFT POSITION SENSOR A CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION EED1E315

Refer to DTC P0335.

GENERAL DESCRIPTION EF87BAE7

Refer to DTC P0335.

DTC DESCRIPTION ED7FC304

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 E92F378A

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 state	
Threshold value	• Extra/ missing pulses 〉 2 pulse	
Diagnosis Time	• Continuous (More than 1.56 sec.failure for every 7.8 sec.test)	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E9CD19A1

Refer to DTC P0335.

SCHEMATIC DIAGRAM E8648AB1

Refer to DTC P0335.

SIGNAL WAVEFROM AND DATA E4787479

Refer to DTC P0335.

MONITOR SCANTOOL DATA E509C12D

Refer to DTC P0335.

TERMINAL AND CONNECTOR INSPECTION EDEC9A6D

Refer to DTC P0335.

SIGNAL CIRCUIT INSPECTION EA0FE168

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 E736E177

1. Visually check CKPS and Target wheel
   1) IG "OFF"
   2) Check CKPS and target wheel for deformation or damage visually
   3) Is the above items normal ?

YES

▶ Go to "Check CKPS resistance" as follows.

NO

▶ Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

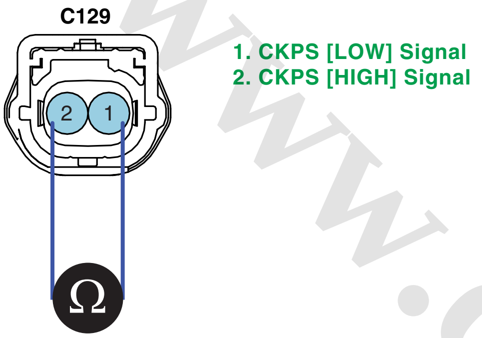
2. Check CKPS resistance

   1) IG "OFF" and disconnect CKPS connector.

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

SPECIFIATION :

Resistance	700 ± 70Ω



EGRF610O

   3) Is the measured resistance within specification?

YES

▶ Go to "Check signal waveform of CKPS" as follows.

NO

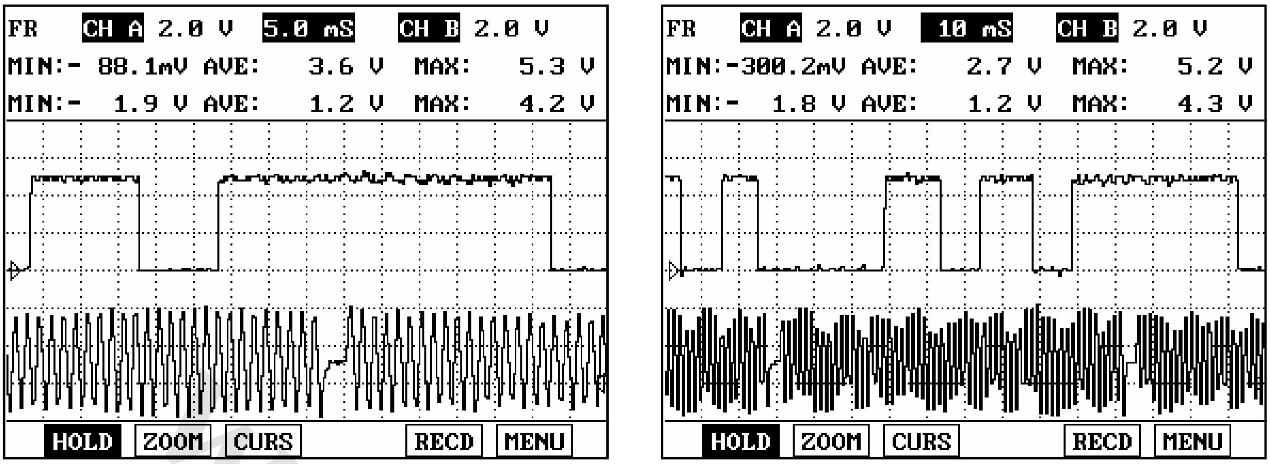
▶ Substitute with a known - good CKPS and check for proper operation. If the problem is corrected, replace CKPS and go to "Verification of Vehicle Repair" procedure.

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 siganl 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

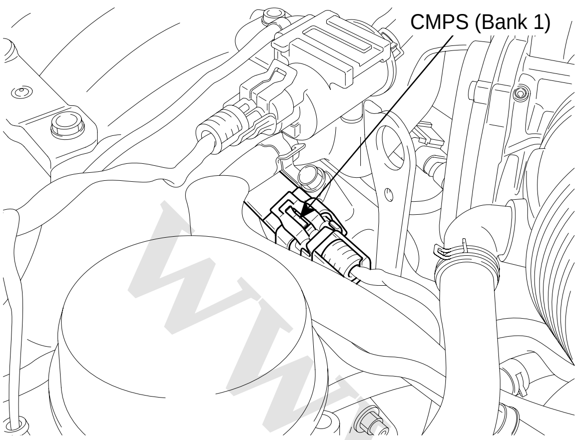
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EE547C6A

Refer to DTC P0335.

DTC P0340 CAMSHAFT POSITION SENSOR A CIRCUIT MALFUNCTION (BANK 1 OR SINGLE SENSOR)

COMPONENT LOCATION E61163EB



EGRF610Q

GENERAL DESCRIPTION EBDF73AE

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 the 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. When teeth on the target wheel trigger the sensor, output voltage is 5V. If not, it is 0V. These CMPS signal is sent to the PCM and it uses CMPS signals for determining the ignition timing with CKPS signals. CMPS makes Sequential Injection possible.

DTC DESCRIPTION E9C80C7B

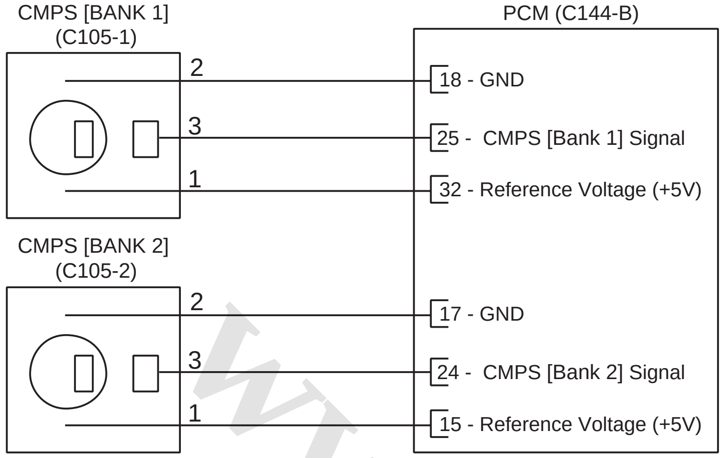
If PCM detects that cam event signal count is over 3 under detecting condition, PCM sets P0340. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION ECD17624

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 state	
Threshold value	• Cam evnt signal count ≥ 3	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM EAC6E655

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

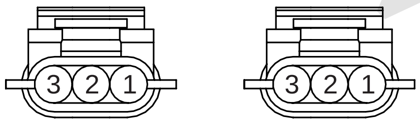
CMPS [BANK 1]

Terminal	Connected to	Funtion
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]

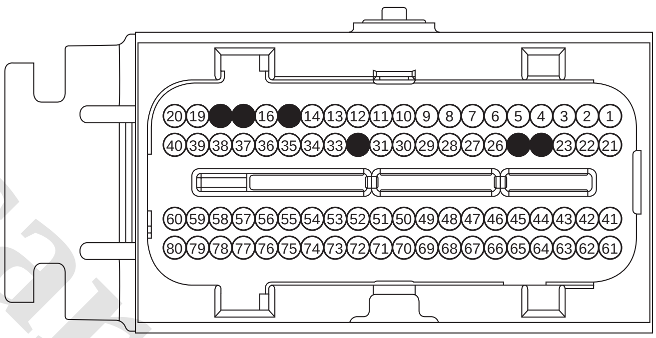
Terminal	Connected to	Funtion
1	PCM C144-B (15)	Reference Voltage (+5V)
2	PCM C144-B (17)	Sensor ground
3	PCM C144-B (24)	CMPS [Bank 2] signal

[HARNESS CONNECTORS]



C105-1 CMPS [BANK 1]

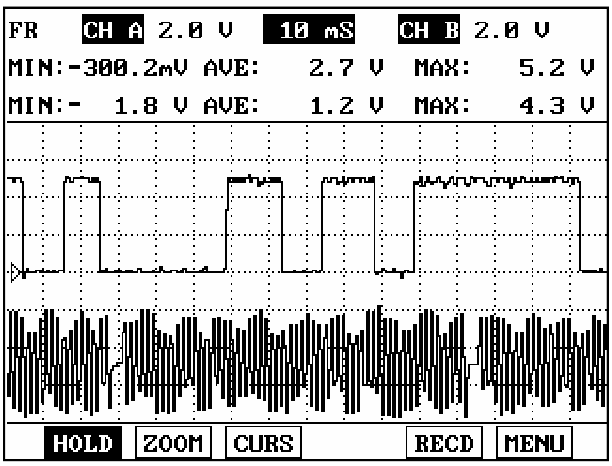
C105-2 CMPS [BANK 2]

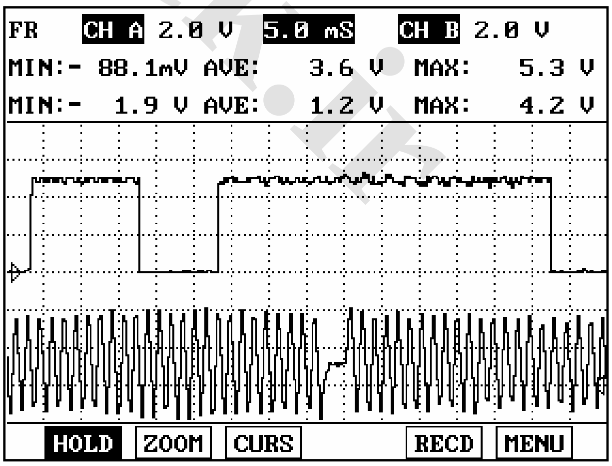


C144-B
PCM

EFBF244A

SIGNAL WAVEFROM AND DATA EB415486



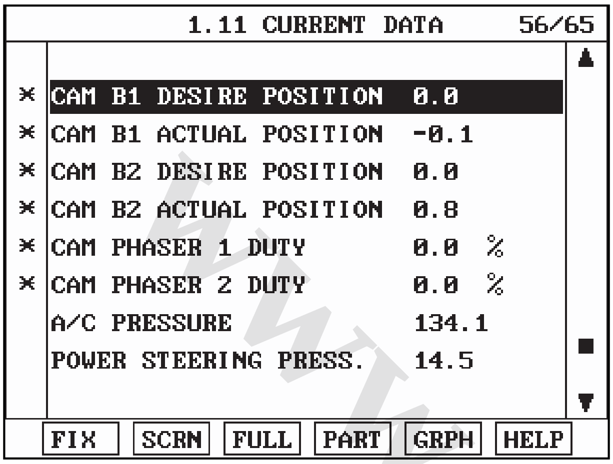


This example shows a typical Crankshaft Position Sensor(CKPS) and Camshaft Position Sensor(CMPS) waveform at idle. The PCM controls the injection and ignition timing by using these signals. Generally CKPS signal is used to detect the piston's position and CMPS signal is used to detect the Top Dead Center of each cylinder.

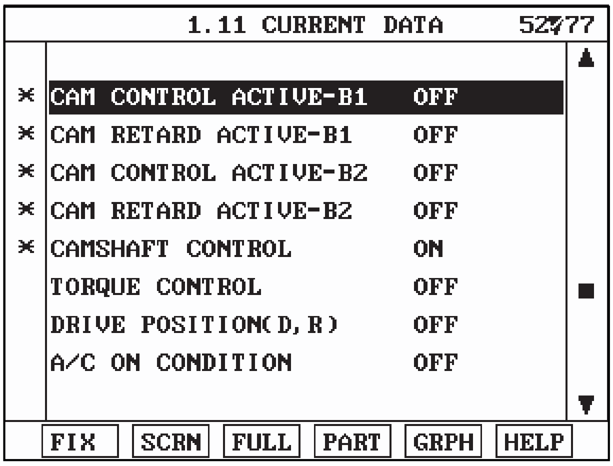
EGRF610R

MONITOR SCANTOOL DATA ECBCBA3E

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor items related to CMPS on the service data.



Normal data at idle



Normal data at idle

EGRF610S

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EA5AE0B5

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 ECF09031

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 E7C5B6EF

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.

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 EAB65CBF

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

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

4. Is the measured voltage within specification?

YES

▶ Go to "Component Inspection" procedure.

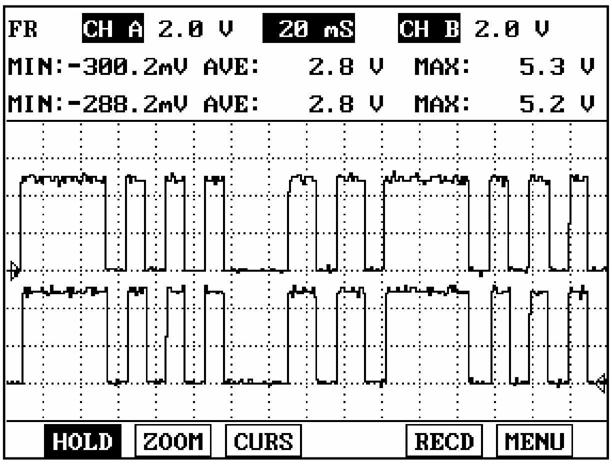
NO

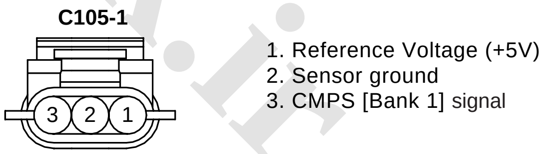
▶ Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EE4F77FD

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

REFERENCE SIGNAL WAVEFORM :





EFBF610Z

   3) Is the measured siganl 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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E27A2A0B

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0341 CAMSHAFT POSITION SENSOR A CIRCUIT RANGE/PERFORMANCE (BANK 1 OR SINGLE SENSOR)

COMPONENT LOCATION E30E1870

Refer to DTC P0340.

GENERAL DESCRIPTION E80C9E48

Refer to DTC P0340.

DTC DESCRIPTION E7A60056

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 EE714FF3

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 state	
Threshold value	• Cam tooth count ≠ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM E24F56DF

Refer to DTC P0340.

SIGNAL WAVEFROM AND DATA EC4E3A77

Refer to DTC P0340.

MONITOR SCANTOOL DATA EBFCF1B9

Refer to DTC P0340.

TERMINAL AND CONNECTOR INSPECTION E1C49F5C

Refer to DTC P0340.

POWER CIRCUIT INSPECTION EC8F7E3C

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 EB8B7197

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 resitance 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.

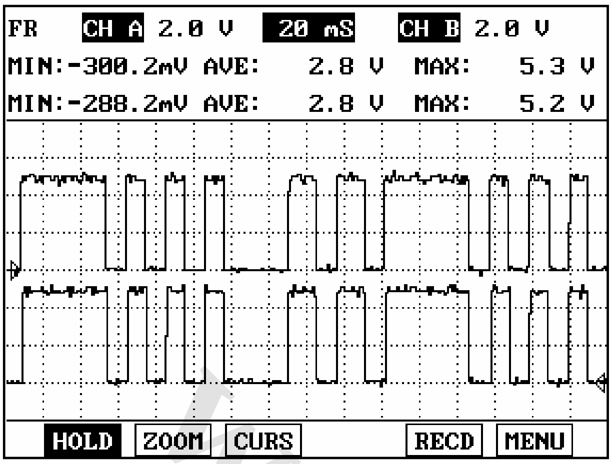
COMPONENT INSPECTION EB261D6B

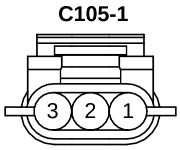
1. Check CMPS

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

EFBF610Z

3) Is the measured siganl 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

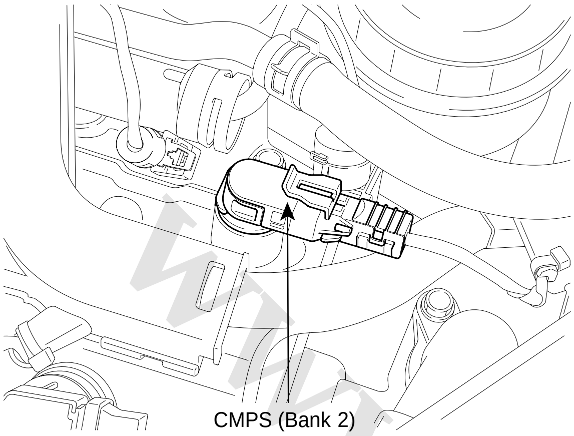
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E8D5A3F0

Refer to DTC P0340.

DTC P0346 CAMSHAFT POSITION SENSOR "A" CIRCUIT RANGE/PERFORMANCE (BANK 2)

COMPONENT LOCATION E182B20A



EGRF990H

GENERAL DESCRIPTION E0491C3C

Refer to DTC P0340.

DTC DESCRIPTION EE5E4BF2

Checking oputput signals from CMP during engine running, if the expected number of cam tooth count is not observer. PCM sets P0346. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E792B2A5

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 state	
Threshold value	• Cam tooth count ≠ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM E447AD08

Refer to DTC P0340.

SIGNAL WAVEFROM AND DATA EC6B5B20

Refer to DTC P0340.

MONITOR SCANTOOL DATA E6C9972B

Refer to DTC P0340.

TERMINAL AND CONNECTOR INSPECTION EB901E7C

Refer to DTC P0340.

POWER CIRCUIT INSPECTION E9449280

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 E8150A41

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.

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 EF390EBA

1. IG "OFF" and disconnect CMPS connector.

2. Measure voltage between terminal 3 of CMPS harness connector and chassis ground.

3. Measure voltage between terminals 2 and 3 of CMPS harness connector.

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

4. Is the measured voltage within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

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

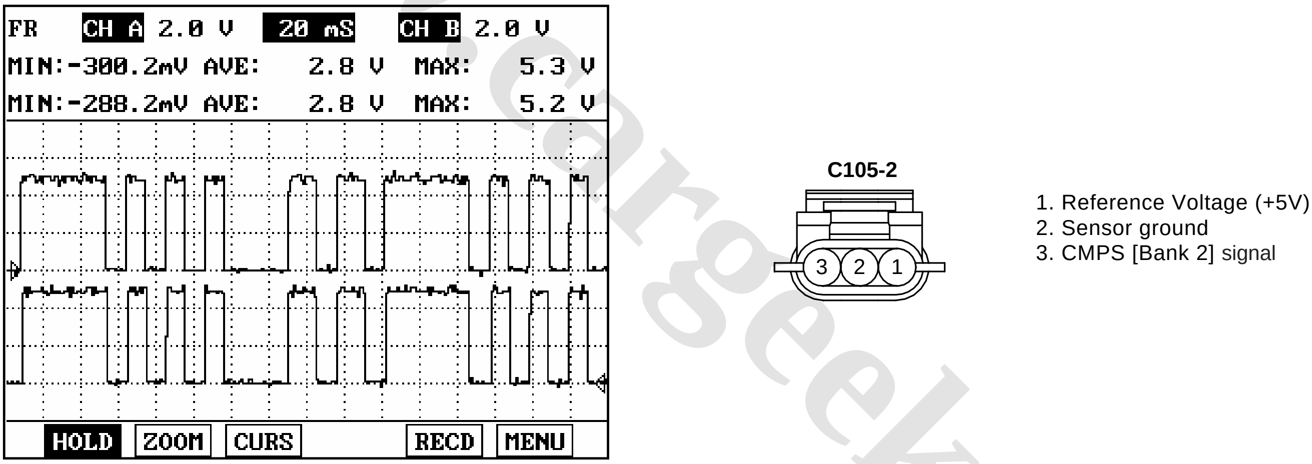
COMPONENT INSPECTION EDDFC03F

1. Check CMPS

   1) IG "OFF" and connect scantool.

   2) ENG "ON" and Measure signal waveform at terminal 3 of CMPS.

REFERENCE SIGNAL WAVEFORM :



EFBF611H

   3) Is the measured siganl 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 siganl waveform, and go to "Check target wheel of CAM shaft" as follows.

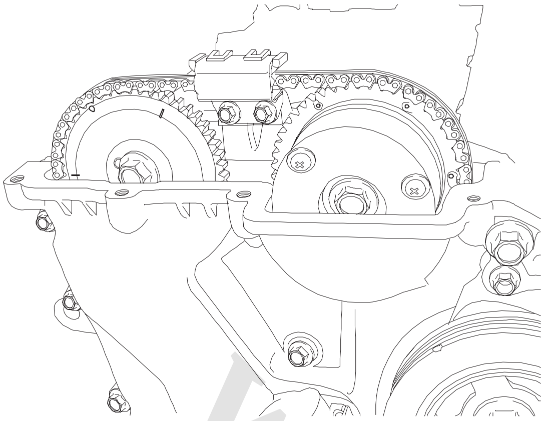
NOTE

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 to reuse the PCM on the others

2. Check target wheel of CAM shaft

   1) IG "OFF"

2) Remove the cover of cylinder head and check target wheel state of bank 2.



EGRF611I

3) Is the target wheel state normal?

YES

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

NO

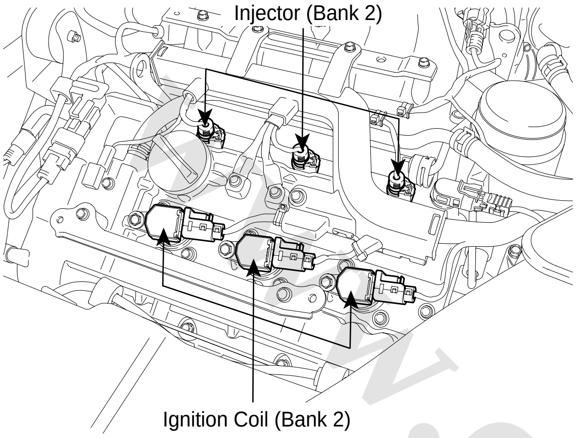
▶ Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EDE5D6B4

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 E0E0832C



EGRF811A

GENERAL DESCRIPTION ED414611

When the ignition switch is 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 ignition coils. Ignition coils fire two spark plugs on every power stroke (the cylinder under compression and the one on the exhaust stroke). PCM provides ground to a switching circuit for energizing the primary ignition coils. PCM uses the crankshaft position sensor and camshaft position sensor signals to meet the timing of energizing coil. When a primary ignition coil is energized or de-energized, the secondary coil produces a high voltage spike to the attached spark plugs.

DTC DESCRIPTION E7B0C792

Checking output signals from ignition coils every 10 sec. under detecting condition, if signals indicating open of short in the circuit are detected for more than 5 sec., PCM sets P0351/P0352/P0353/P0354/P0355/P0356. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EF597853

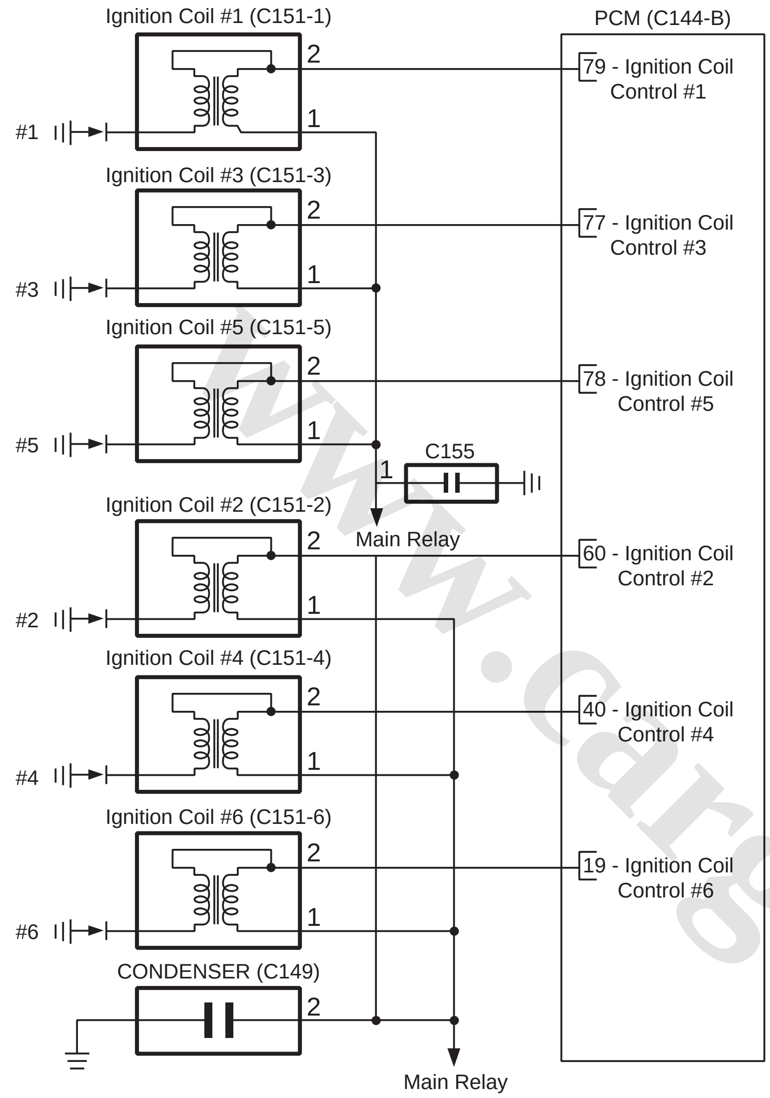
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground, to battery or open circuit	• Poor connection • Open or short in harness • Ignition Coil • PCM
EnableConditions	• NO DTC related to this item • Engine running state • 11V ≤ Battery voltage ≤ 16V • The above conditions are 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 EFDA05E8

Resistance (Ω)	Primary Coil	Secondary Coil
	0.62 ± 10%	7.0k ± 15%

SCHEMATIC DIAGRAM E88D6AC8

[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 #3

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (77)	Ignition Coil #3

Ignition Coil #5

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (78)	Ignition Coil #5

Ignition Coil #2

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (60)	Ignition Coil #2

Ignition Coil #4

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (40)	Ignition Coil #4

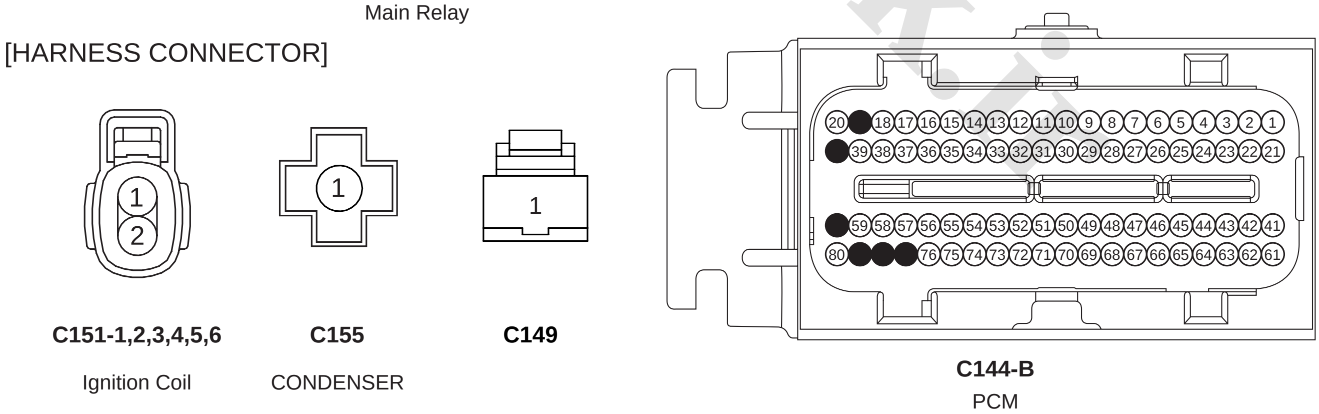
Ignition Coil #6

Terminal	Connected to	Function
1	Main Relay	Battery (B+)
2	PCM C144-B (19)	Ignition Coil #6

CONDENSER

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	Main Relay	Power Supply (B+)

[HARNESS CONNECTOR]



EFBF800A

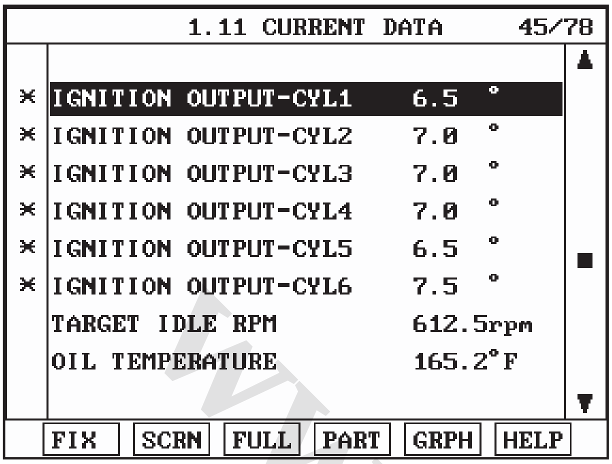
MONITOR SCANTOOL DATA E9045E51

1. IG "OFF" & connect scantool.

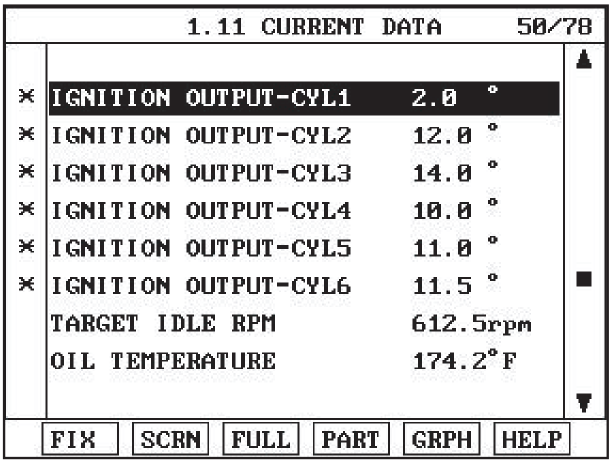
2. ENG "ON" and warm -up the engine to normal operating temperature.

3. Monitor items related to Ignition on the service data.

Specification :	BTDC 10° ± 5°



Normal at idle



Open at idle

EGRF812A

4. Is the service data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E1E9C68E

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSEPCTION EDE7A8E2

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 ED8A6A5C

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.
[P0352] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 77 of PCM harness connector.
[P0353] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 78 of PCM harness connector.
[P0354] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 60 of PCM harness connector.
[P0355] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 40 of PCM harness connector.
[P0356] Measure resistance between terminal 2 of Ignition Coil harness connector and terminal 19 of PCM harness connector.

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 E3BE11DA

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	Secondary Coil
	0.62 ± 10%	7.0k ± 15%

EFBF991B

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E4AC89DF

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

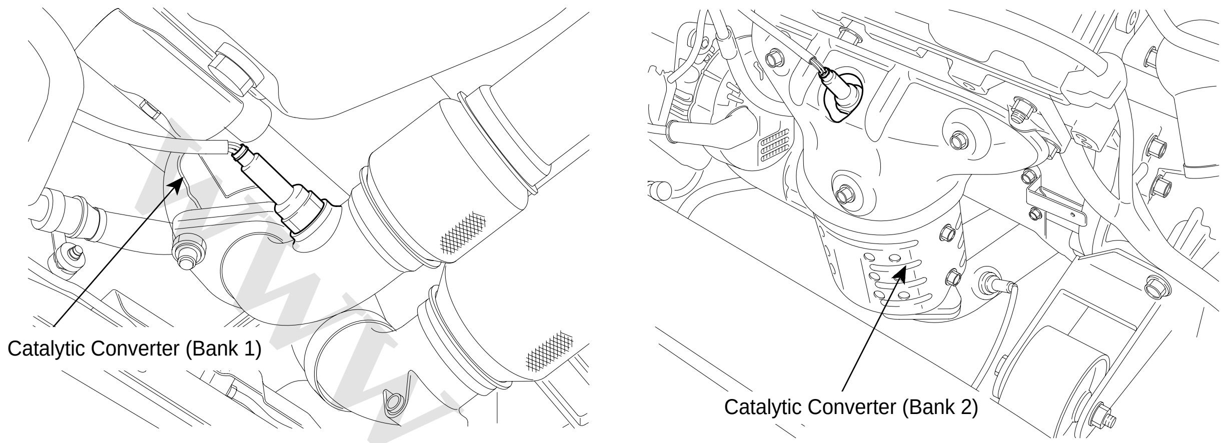
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0420 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1) DTC P0430 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 2)

COMPONENT LOCATION EC12690F



EGRF999E

GENERAL DESCRIPTION E4EEE761

The catalyst's efficiency is demonstrated by its ability to oxidize CO and hydrocarbon emissions. The Powertrain Control Module (PCM) compares the output signals of the front and rear oxygen sensors to determine whether the output of the rear sensor is beginning to match the output of the front oxygen sensor. Air/fuel mixture compensation keeps the frequency of the front oxygen sensor high due to the changes from rich-to-lean combusition. The catalyst causes the rear oxygen sensor to have a lower frequency. As the catalyst wears, the rear oxygen sensor's signal trace begins to match the front oxygen sensor's signal trace. That is because the catalyst becomes saturated with oxygen and cannot use the oxygen to convert hydrocarbon and CO into H_2O and CO_2 with the same efficiency as when it was new. A completely worn catalyst shows a 100% match between the frequency of the front and rear sensors.

DTC DESCRIPTION E07303EB

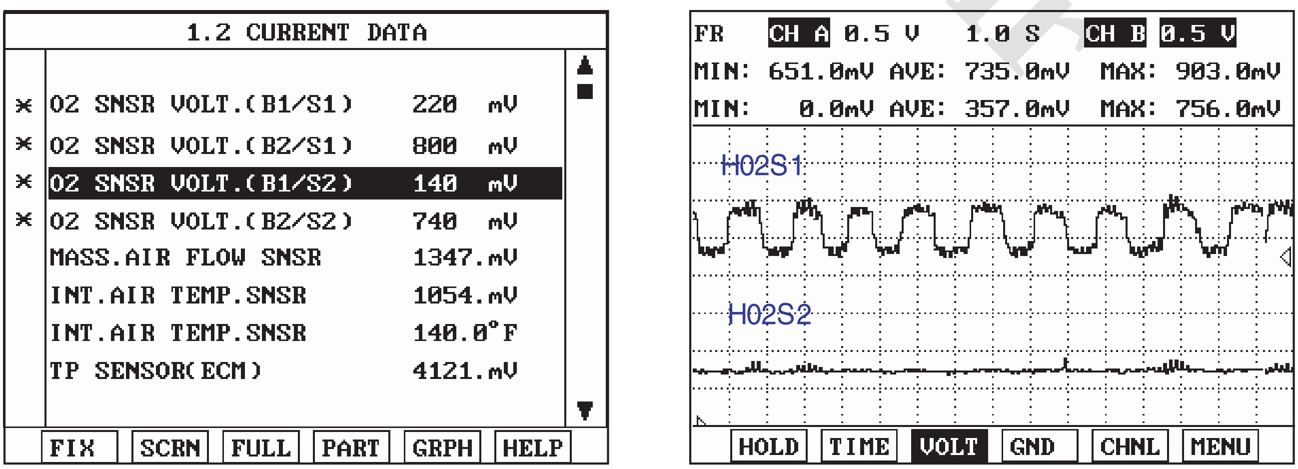
If the oxygen storage time for bank 1/2 is lower than threshold , the PCM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION E1F215A1

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.	• Leakage in the exhaust system • Faulty Catalyst Converter • Faulty HO2S • Faulty PCM
EnableConditions	• Engine runtime ≥ 580sec • Purge concentration learned • Airflow in range (3 ~ 10 g/s) • Closed throttle • Coolant temp in range • Intake air temp in range • Barometer above 72 kPa • Max number of test attempts not exceeded • Closed loop fueling • Catalyst temperature in range • Fuel learning in range • Vehicle speed below 3 kph (2 mph) • Auto trans in gear • Long term fuel correction learnded at idle • Airflow timer reached limit • Max idle time not exceeded • Max number tests not complete • Disabling faults not present	
Threshold value	• Oxygen Storage Time 〈 1.5 sec for Bank 1 (2 sec for Bank 2)	
DiagnosisTime	• -	
MIL On Condition	• 1 Driving cycle	

MONITOR SCANTOOL DATA EDA6B724

1. Ignition "OFF"
2. Connect Scantool and Ignition "ON".
3. Monitor the HO2S parameters and signal waveform on scantool.



EGRF844A

4. Are the signal of rear HO2S and waveform the same as that of the front HO2S?

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 repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poor connection,bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and goto "Verification vehicle Repair" procedure.

SYSTEM INSPECTION E453D4A4

1. Check Exhaust sytem.

   1) Visually/physically inspect the following conditions:
      - Exhaust system between HO2S and Three way catalyst for air leakage
      - Damage, and for loose or missing hardware:

   2) Has a problem been found in any of the above areas?

      YES

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

      NO

      ▶ Go to "Component Inspection" procedure.

COMPONENT INSPECTION ED7EFC25

1. Check Rear HO2S.

   1) Visually/physically inspect the rear HO2S for the following conditions:
      - Ensure that the HO2S is securely installed.
        (Pigtail and wiring harness not making contact with the exhaust pipe)
      - Check for corrosion on terminals.
      - Check for terminal tension (at the HO2S and at the PCM).
      - Any damage.

   2) Has a problem been found in any of the above areas?

      YES

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

      NO

      ▶ Go to "Check TWC" as below.

2. Check TWC

   1) Visually/physically inspect the three-way catalyst(TWC) converter for the following damage:
      - Severe discoloration caused by excessive temperature
      - Dents and holes
      - Internal rattle caused by a damaged catalyst

   2) Also, ensure that the TWC is a proper original equipment manufacturer part.

3) Has a problem been found?

YES

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

VERIFICATION OF VEHICLE REPAIR E6681B93

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

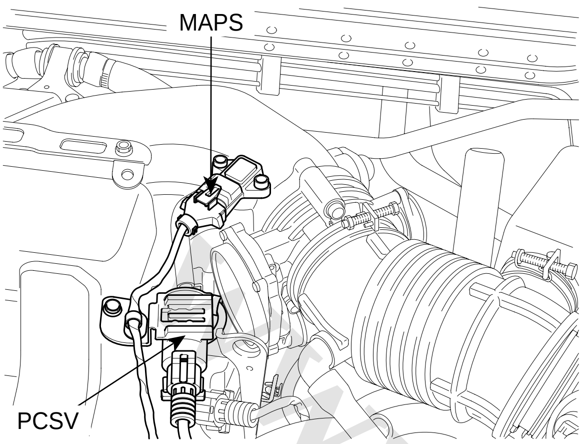
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0444 EVAP. EMISSION SYSTEM-PURGE CTRL. VALVE CIRCUIT OPEN

COMPONENT LOCATION EAE3FEDC



EGRF845A

GENERAL DESCRIPTION E1962FEA

The purge solenoid is a pneumatic device that meters the air and fuel (purge) vapor flow to thepurge port. In a sense, the purge solenoid is comparable to a fuel injector, because the meteredpurge flow follows the same slope and offset characteristics. However, the purge solenoidnormally runs with a duty cycle at a fixed frequency because the opening response is significantly slower than a fuel injector. It would not practical to run the solenoid synchronouslywith engine events except perhaps at very low RPM. The normal frequencies for the purgesolenoid are between 8 and 20 Hz.

DTC DESCRIPTION ECF568D5

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 E279F116

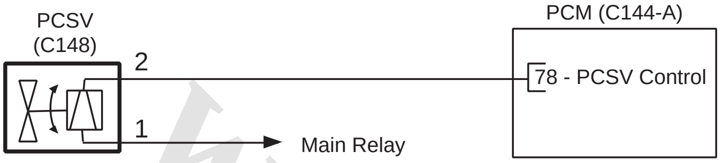
Item	Detecting Condition	Possible cause
DTC Strategy	• Open, short to ground	• Poor connection • Open or short to ground in harness • PCSV • PCM
EnableConditions	• Engine running state • 11V ≤ Battery voltage ≤ 16V • Above enable conditions are met > 0.5 sec.	
Threshold value	• Open or short to ground	
DiagnosisTime	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E7E24ACD

Item	Coil resistance(Ω)
PCSV	19.0 ~ 22.0Ω (at 20℃ / 68˚F)

SCHEMATIC DIAGRAM E38E268E

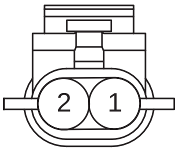
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

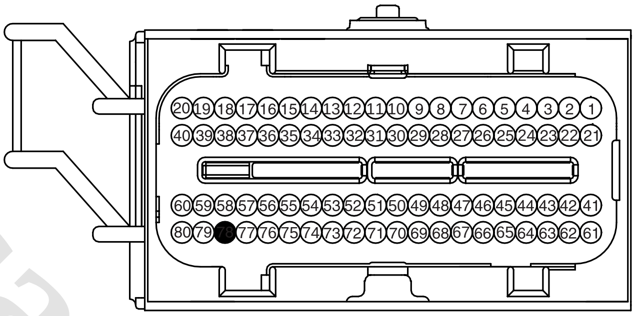
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-A (78)	PCSV Control

[HARNESS CONNECTORS]



C148

PCSV



C144-A

PCM

EFBF257A

SIGNAL WAVEFORM EF71D13F

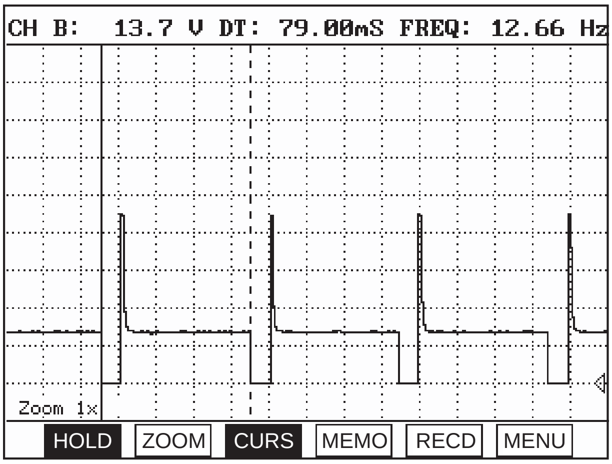


Fig. 1

The Purge Control Solenoid Valve(PCSV) is open or closed by PCM and vacuum of intake manifold.
At opening, fuel vapor from canister enters into intake manifold. To prevent vacuum from forming inside canister, PCM controls to open it. This photo shows the signal waveform of PCSV operating normally.

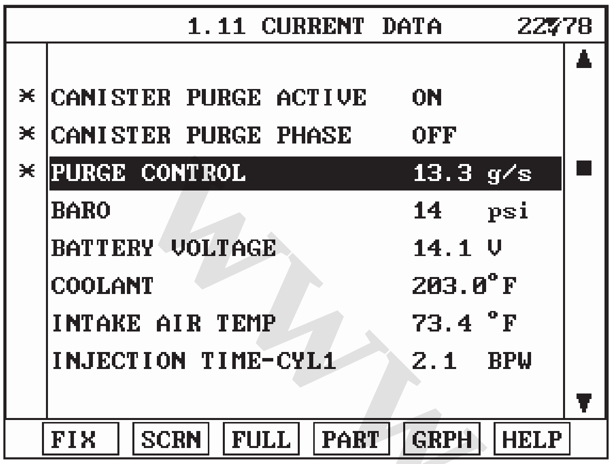
EGRF848A

MONITOR SCANTOOL DATA EC22A0CA

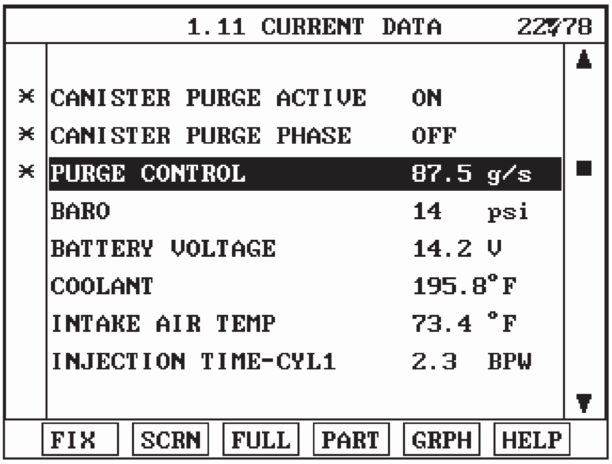
1. Connect scantool to Data Link Connector (DLC)

2. Warm up engine to normal operating temperature.

3. Monitor "PCSV" parameter on the scantool.



Normal data at idle



Normal data at accel.

EGRF849A

4. Is the current data displayed correctly?

YES

▶ Fault is intermittently caused by poor contact in the sensor and/or PCM connector or non cleared PCM memory after repair. 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".

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EC938A59

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSEPCTION E19A8768

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 EAC6CE3B

1. Check short to ground in harness.
   1) IG "OFF" and disconnect PCSV connector.
   2) IG "ON"
   3) Measure voltage between terminal 2 of PCSV harness connector and chassis ground.

Specification : Approx. 0.5V

   4) Is the measured voltage within specification?

   YES

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

   NO

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

2. Check open in harness.
   1) IG "OFF" and disconnect PCSV connector and PCM connector.
   2) Measure resistance between terminal 2 of PCSV harness connector and terminal 78 of PCM harness connector.

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 EAAD3636

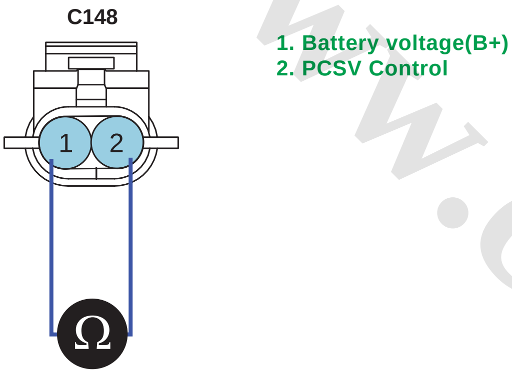
1. Check PCSV

   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)



EFBF853A

   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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E17EB935

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.

2. Using a Scantool, Clear the DTCs

3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions

4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0445 EVAP. EMISSION SYSTEM-PURGE CTRL. VALVE CIRCUIT SHORTED

COMPONENT LOCATION E495C8A7

Refer to DTC P0444.

GENERAL DESCRIPTION E4A99CBC

Refer to DTC P0444.

DTC DESCRIPTION E82F5E98

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 EB951EE9

Item	Detecting Condition	Possible cause
DTC Strategy	• Short to battery	• Poor connection • Short to battery in harness • PCSV • PCM
EnableConditions	• Engine running state • 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 E928D1A5

Refer to DTC P0444.

SCHEMATIC DIAGRAM E8C13133

Refer to DTC P0444.

SIGNAL WAVEFORM E6C0629F

Refer to DTC P0444.

MONITOR SCANTOOL DATA ECFD5898

Refer to DTC P0444.

TERMINAL AND CONNECTOR INSPECTION E4498C67

Refer to DTC P0444.

CONTROL CIRCUIT INSPECTION E1CCA95B

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

Specification : Approx. 0.5V

4. Is the measured voltage within specification?

YES

▶ Go to "Component Insepction" procedure.

NO

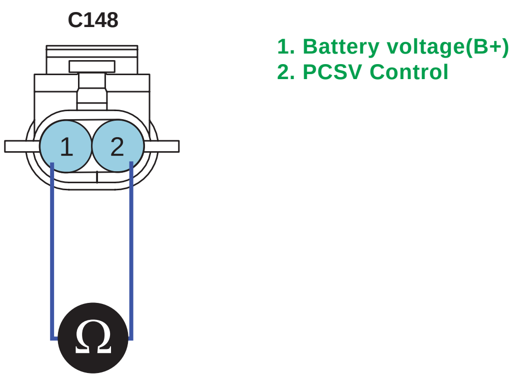
▶ Repair short to battery in harness, and go to " Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E7218082

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)



EFBF853A

   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

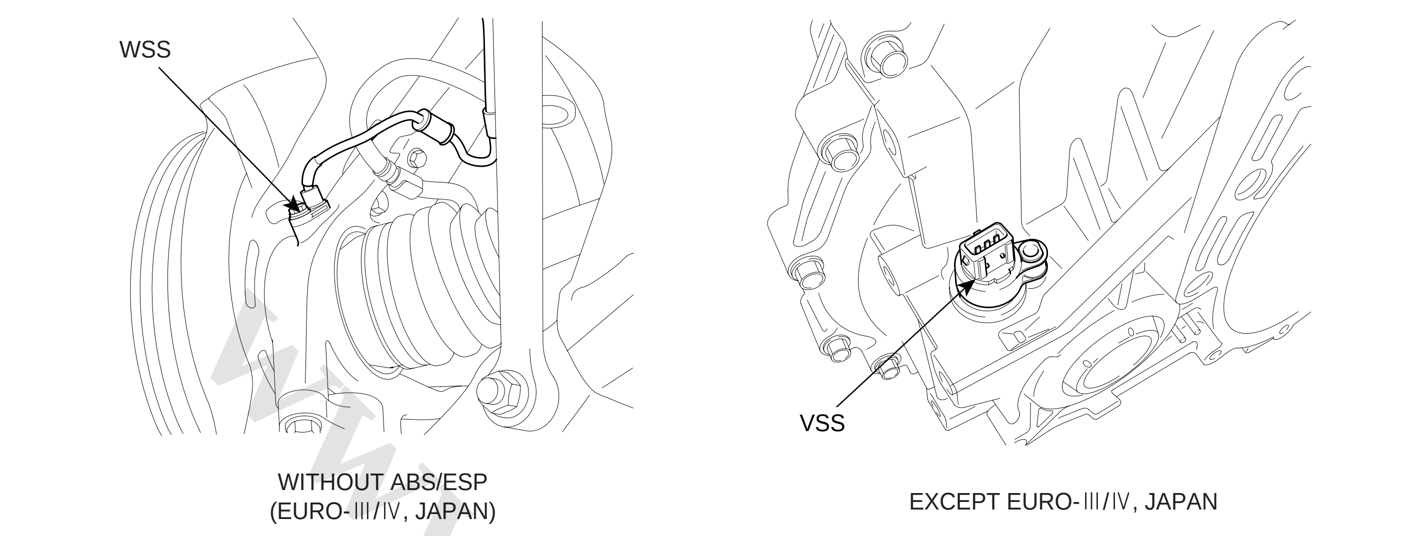
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E824C5B4

Refer to DTC P0444.

DTC P0501 VEHICLE SPEED SENSOR A RANGE/PERFORMANCE

COMPONENT LOCATION E3164CB4



EGRF311N

GENERAL DESCRIPTION E546B88F

The wheel speed sensor or vehicle speed sensor is the essential component that the PCM uses to calculate vehicle speed. Digital wave is produced as tone-wheel rotates according to hall sensor principle. Frequency of duty wave is changed in proportion to rotation of tone wheel and PCM gets vehicle speed through ABS control unit or ESP control unit or wheel speed sensor or vehicle speed sensor. The PCM uses this signal to control fuel injection, ignition timing, transmission/transaxle shift scheduling and torque converter clutch scheduling.

DTC DESCRIPTION E487DD06

Checking output signals from wheel speed sensor or ABS control unit or VSS 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 cosecutive 2 driving cycle.

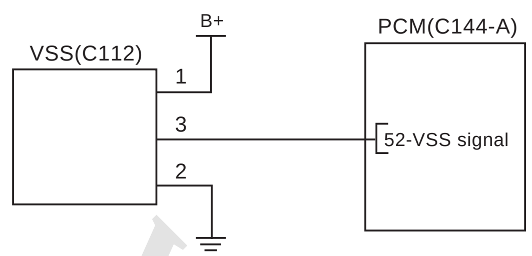
DTC DETECTING CONDITION E0CC6FD8

Item		Detecting Condition	Possible cause
DTC Strategy		• Detects the lack of vehicle speed signal	• Poor connection • Open or short in harness • Wheel speed sensor(FR) • Vehicle speed sensor • 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℃ (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℃ (140˚F) • MAP 〈 32kPa • TPS 〈 1% • 1800rpm ≤ Engine Speed ≤ 6000rpm • Transmission in gear	
Thresh old value	Case 1(Power)	• VSS Fault 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 E53A01DF

[EXCEPT EURO-Ⅲ/Ⅳ, JAPAN]

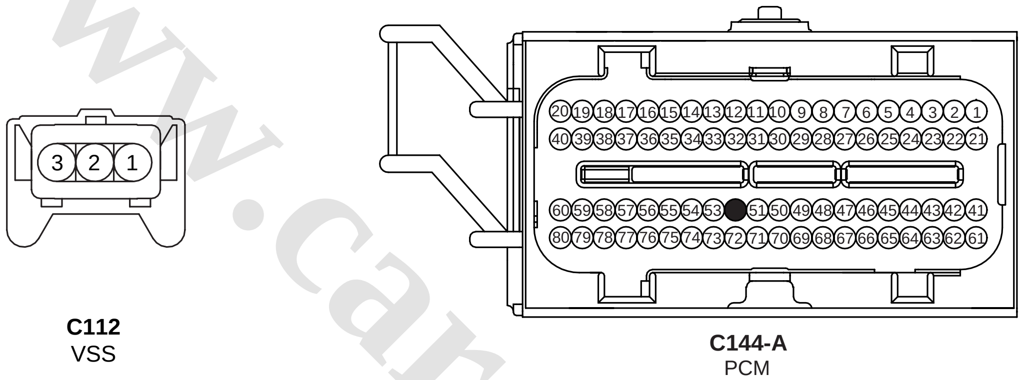
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Engine compartment junction block	Battery voltage(B+)
2	Chassis ground	Sensor ground
3	PCM C144-A (52)	VSS signal

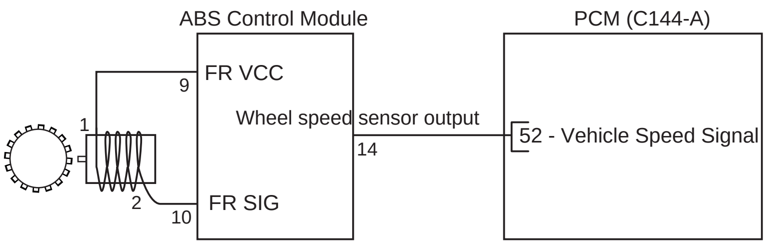
[HARNESS CONNECTOR]



EFBF311G

[EURO-Ⅲ/Ⅳ, JAPAN WITH ABS (OR ESP)]

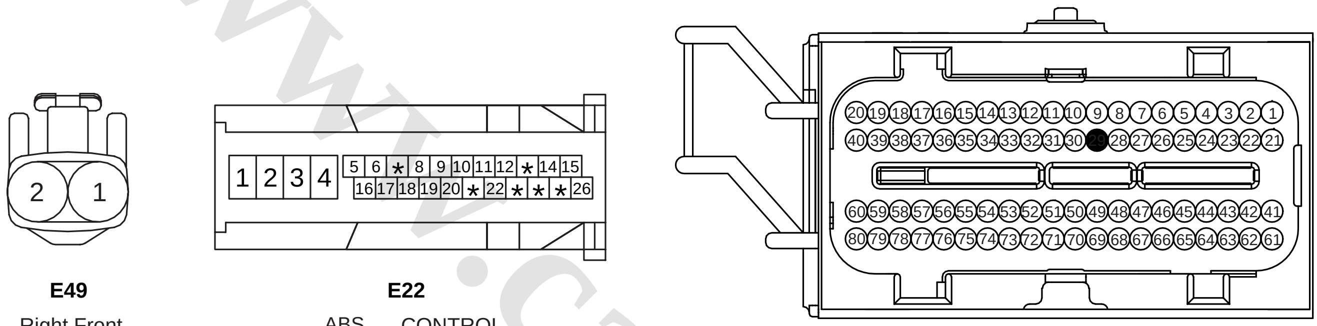
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
14	PCM C144-A (52)	Vehicle Speed Signal

[HARNESS CONNECTOR]



E49
Right Front Wheel Sensor

E22
ABS CONTROL MODULE

C144-A
PCM

EFBF810A

SIGNAL WAVEFROM AND DATA E4ED43D8

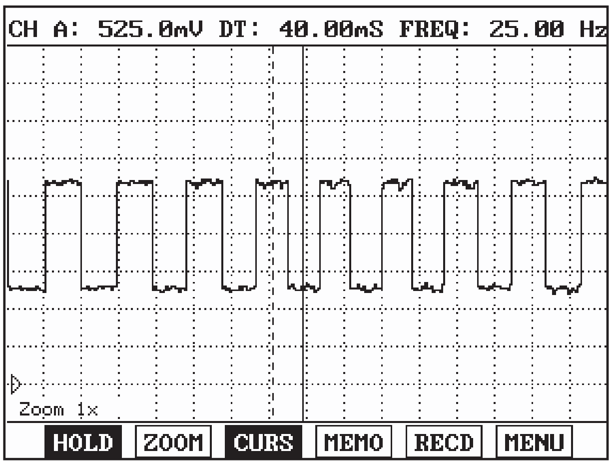


Fig. 1

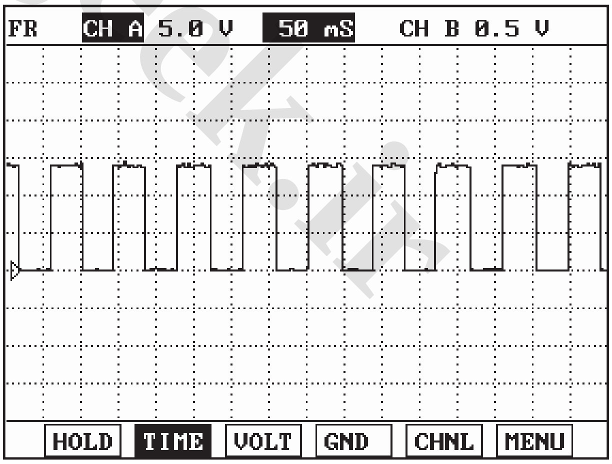


Fig. 2

Fig.1 : Signal waveform [EURO-Ⅲ/Ⅳ,JAPAN]
Fig.2 : Signal waveform [Except EURO-Ⅲ/Ⅳ,JAPAN]

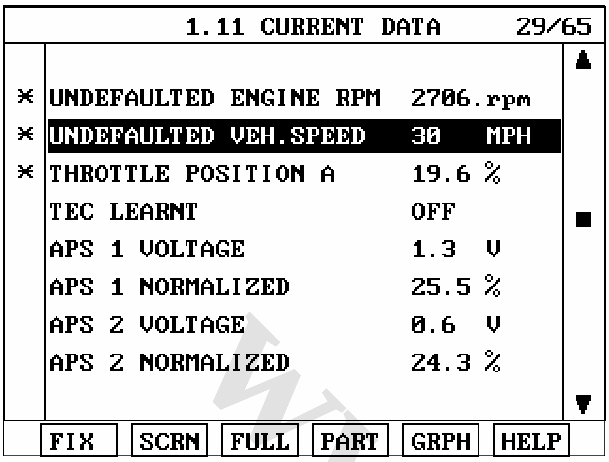
EGRF311H

MONITOR SCANTOOL DATA E78EDDAC

1. Ignition "OFF"

2. Connect Scantool and Engine "ON"

3. Drive vehicle in gear and monitor "vehicle speed" item on the scantool.



EGRF874A

4. Are thsoe "VSS" parameters displayed correctly ?

YES

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

NO

▶ Go to "Terminal and Connector Inspection" procedure.

[EURO-Ⅲ/Ⅳ, JAPAN] E0C8F27B

TERMINAL AND CONNECTOR INSPECTION

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to " Signal Circuit Inspection " procedure.

SIGNAL CIRCUIT INSPECTION E5891900

WARNING

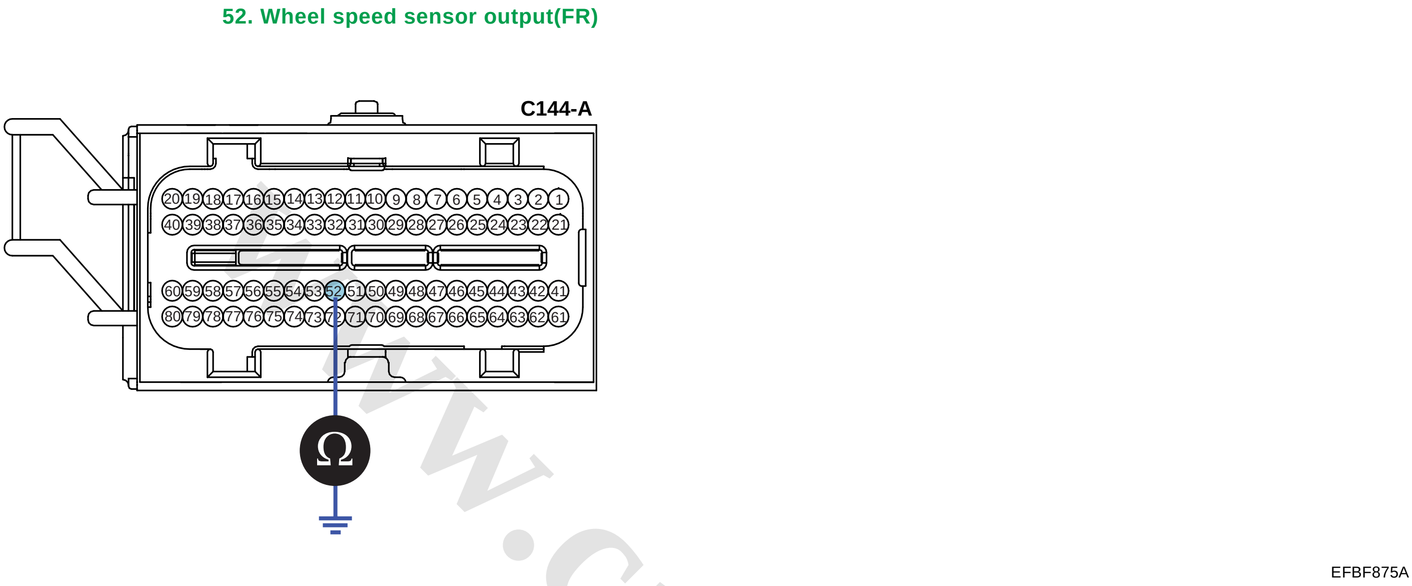
This procedure is applied to vehicle with ABS (or ESP). In case of no ABS(or ESP), refer to "C1203 Wheel speed sensor front-RH open/short".

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 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

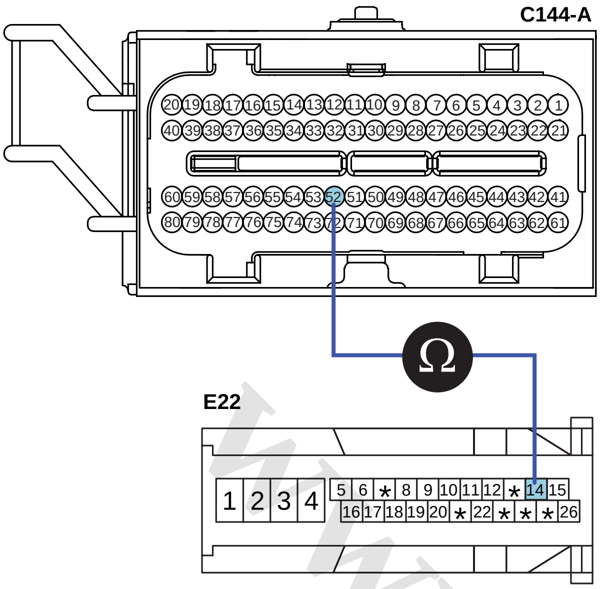
   1) Ignition "OFF"

   2) Disconnect PCM connector and ABS or ESP control module connector.

   3) Measure resistance between terminal "52" of PCM harness connector and terminal "14(With ESP: terminal 40)" of ABS control module harness connector.

Specification : Approx. below 1Ω

52. Wheel speed sensor output(FR)



NOTE

Note: This picture is only applied to vehicle with ABS

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/ ABS or 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,JAPAN]

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

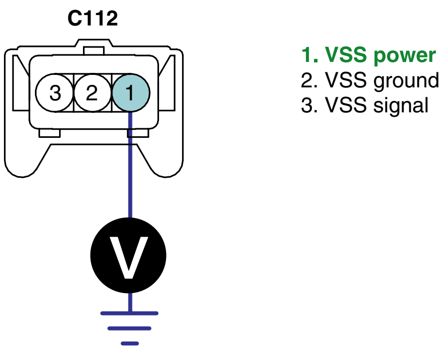
NO

▶ 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



EGRF311J

   5) Is the measured voltage within specifications?

YES

▶ Go to "Signal circuit inspection" procedure.

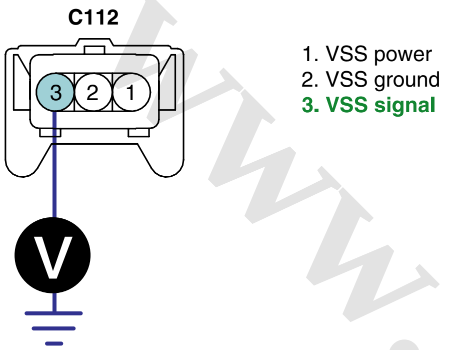
NO

▶ 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

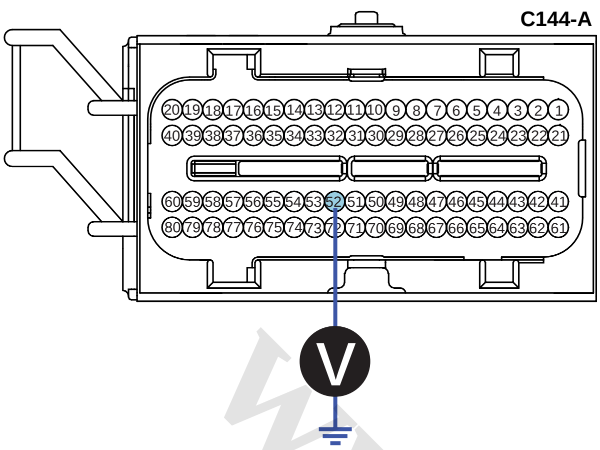
▶ Go to "Check voltage from PCM side" as follows.

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.

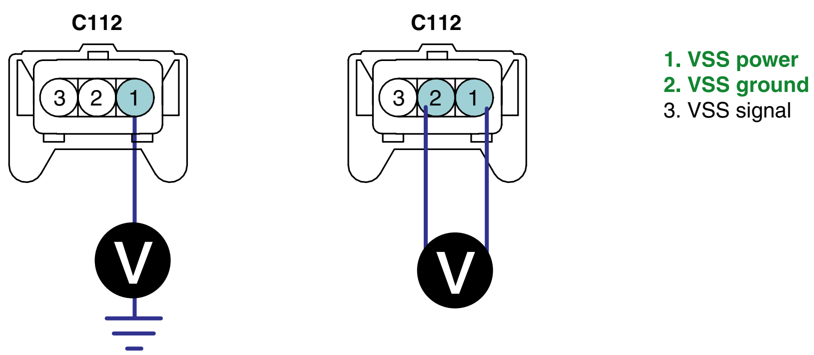
NO

▶ 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 corrected, 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 E195A61A

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

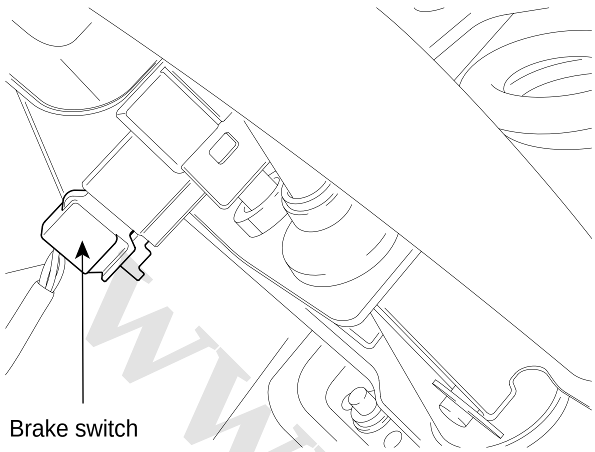
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0504 BRAKE SWITCH "A"/"B" CORRELATION

COMPONENT LOCATION EB83B543



EGRF872A

GENERAL DESCRIPTION E4BAB7A6

Brake switch connected to brake pedal transfers brake operating state to PCM. For diagnosis of abnormal operation of Brake switch, two types of signals(one from Brake warning lamp switch, the other from Brake checking switch) are used and those two types output different signals at both condition, depressing or releasing brake pedal. When brake pedal is depressed, brake checking switch outputs B+ voltage while brake warning lamp switch emits 0V. Conversly, when brake pedal is released, the output signals of each switch are opposite.

DTC DESCRIPTION E03D85F3

Checking output signals from both brake switch. when all of them are On or OFF simultaneously, if abnormal signal is detected for more than 0.5 sec., an error is recognized. And if this condition lasts for certain period, PCM sets P0504. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC DETECTING CONDITION E748B342

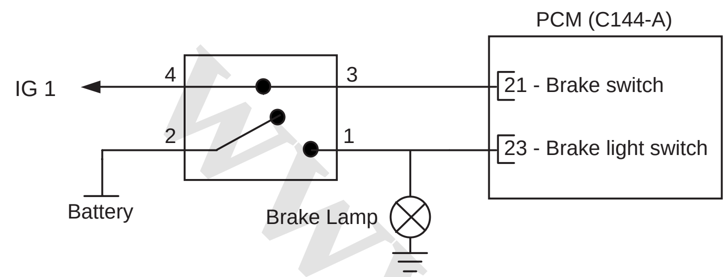
Item		Detecting Condition	Possible cause
DTC Strategy		• Comparing 2 brake signals during driving	• Poor connection • Open or Short • Faulty PCM
Enable Conditions	Case 1	• Engine works • Vehicle Speed Sensor is abnormal.	
	Case 2	• Engine works • Vehicle Speed Sensor is normal and Vehicle Speed is over 20kph during 1sec or more.	
Threshold value		• The one brake signal's change duration when another signal has been changed 〉 0.5 sec	
Diagnosis Time		• Continuous	
MIL On Condition		• 2 driving cycles	

SPECIFICATION EB9A0E77

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	0V	Battery voltage
Brake Switch	Battery voltage	0V

SCHEMATIC DIAGRAM EA296797

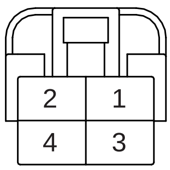
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

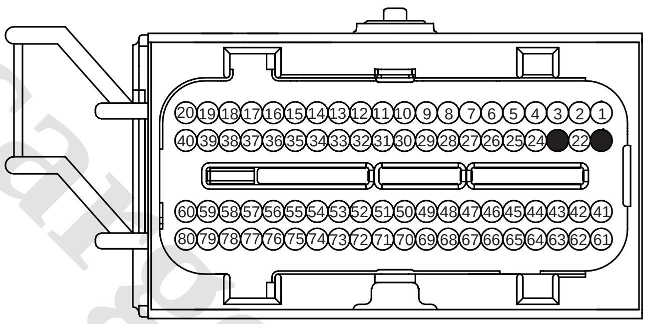
Terminal	Connected to	Function
1	PCM C144-A (23)	Brake light switch
2	Battery	Power Supply (12V)
3	PCM C144-A (21)	Brake switch
4	Battery	Power Supply (12V)

[HARNESS CONNECTOR]



E62

STOP LAMP SWITCH



C144-A

PCM

EFBF802A

MONITOR SCANTOOL DATA E0B30238

1. Ignition "OFF"
2. Connect Scantool and Engine "ON"
3. Monitor "Brake Switch" parameter on Current Data

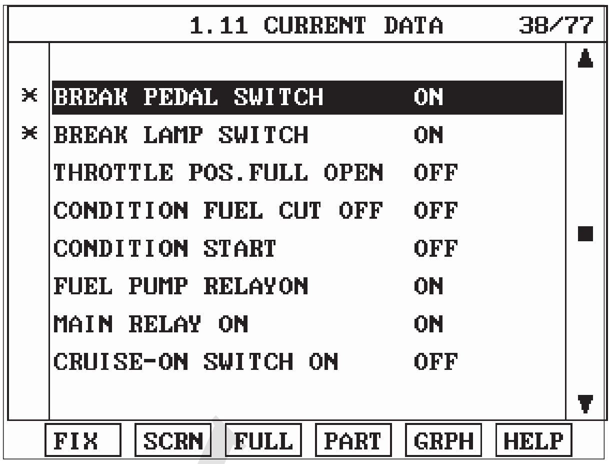


Fig. 1

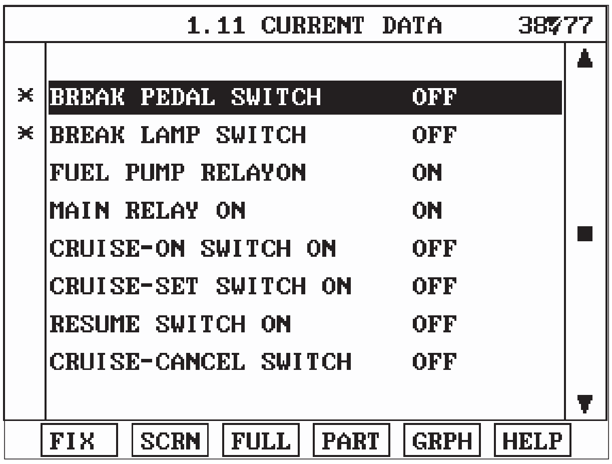


Fig. 2

Fig1) Data during stepping on the brake
Fig2) Data during taking off the brake

EGRF877A

4. Are those "Brake Switch" parameters displayed correctly ?

YES

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

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E87ADA53

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 EBAD3CDA

1. Check voltage

   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 connector and chassis ground.

5) Measure the voltage between terminal 23 of PCM connector and chassis ground .

6) Keep the brake stepping on.

7) Measure the voltage between terminal 21 of PCM connector and chassis ground.

8) Measure the voltage between terminal 23 of PCM connector and chassis ground .

SPECIFICATION :

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	0V	Battery voltage
Brake Switch	Battery voltage	0V

9) Is the measured voltage within specification ?

YES

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

NO

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

2. Check open in harness

1) IG Key "OFF".

2) Disconnect the brake switch and PCM connector.

3) Measure the resistance between terminal 21 of PCM harness connector and terminal 3 of Brake switch harness side.

4) Measure the resistance between terminal 23 of PCM harness connector and terminal 1 of Brake switch harness side.

Specification : Approx. below 1Ω

5) Is the measured resistance within specification ?

YES

▶ Go to "Check voltagen" procedure.

NO

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

3. Check voltage

1) IG Key "OFF".

2) Disconnect the brake switch connector.

3) Measure the voltage between brake lamp switch terminal and chassis ground.

4) Measure the voltage between brake switch terminal and chassis ground.

5) IG Key "ON".

6) Measure the voltage between brake lamp switch terminal and chassis ground.

7) Measure the voltage between brake switch terminal and chassis ground.

SPECIFICATION :

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	0V	Battery voltage
Brake Switch	Battery voltage	0V

8) Is the measured voltage within specification ?

YES

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

NO

▶ Check the fuse between battery and brake switch.
▶ Repair open or short in power circuit of brake switch and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EA1ECE71

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0506 IDLE AIR CONTROL SYSTEM-RPM LOWER THAN EXPECTED

GENERAL DESCRIPTION E7A591A9

The IAC System is designed to maintain a steady desired idle speed. Idle airflow is adjustedthrough the idle air actuator, which may be ETC throttle body, in order to maintain the desired idle speed under various load conditions. Load conditions vary due to numerous factors, such as engine temperature, air conditioning, electrical load and power steering load.

DTC DESCRIPTION E726B1AA

Checking idle RPM under detecting condition, if if the idle speed is 100RPM below desired idle speed, PCM sets P0506. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC DETECTING CONDITION E80E7FA0

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if a low idle condition exists.	• Poor connection • Intake/Exhaust system for blockage • Throttle plate for carbon deposits • Faulty ETS motor • Faulty TPS • Faulty ETS system • Faulty PCM
Enable Conditions	• Normal Idle conditions • Canister Purge Fuel Flow ≤ 100 • Barometric Pressure 〉 72kPa • Engine running ≥ 2 sec • Air Intake Temperature ≥ -20℃ (-4°F) • Coolant Temperature ≥ 0℃ (32°F) • 11V ≤ Ignition Voltage ≤ 16V • Above conditions met period 〉 3 sec	
Thresh old value	• Real engine speed - Target engine speed 〈 -100rpm	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

MONITOR SCANTOOL DATA EE18C6B5

1. Ignition "OFF"
2. Connect Scantool and Engine "ON"
3. Monitor items which affect idle rpm on scantool.

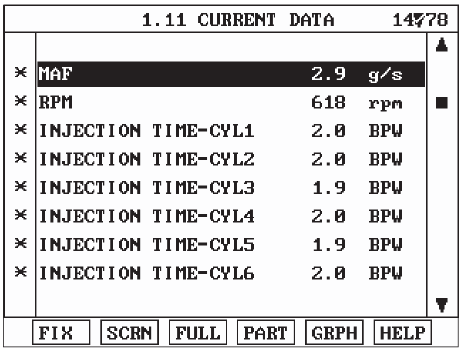


Fig. 1

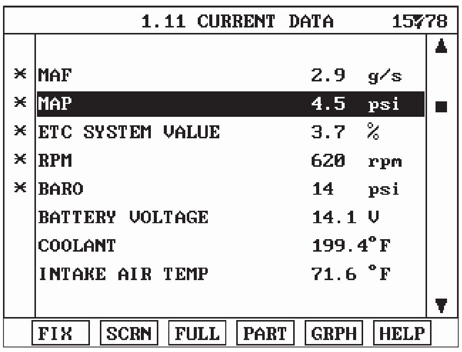


Fig. 2

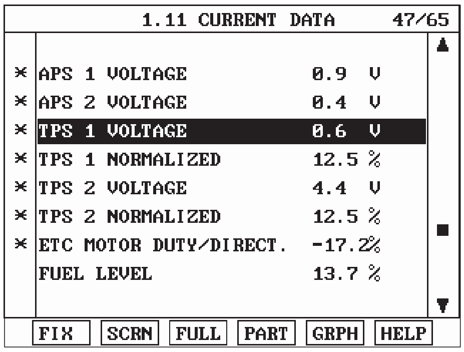


Fig. 3

EGRF881A

4. Are those items on scantool displayed correctly ?

YES

▶ Go to "Terminal and Connector Inspection" procedure.

NO

▶ Check DTCs related to Mass airflow sensor(MAF),Injectors,Throttle position sensor(TPS), Purge control solenoid valve(PCSV), Acceleration position sensor(APS), Heated oxygen sensors(HO2S), ETS system
▶ Perform all repairs associated with those codes and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E175ED16

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 " System Inspection " procedure

SYSTEM INSPECTION EC59908E

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
   - Restricted exhaust system

   2) Has a problem been found in any of the above areas?

   YES

   ▶ Replace or repair as necessary and go to "Verification of Vehicle Repair" procedure

   NO

   ▶ Go to "Visually check ETS System" as below

2. Visually check ETS System

   1) Ignition "OFF"

   2) Remove the air hose between MAF sensor and Throttle body.

   3) Visually check the overall ETS system(Throttle valve,ETS motor,APS and TPS).

   4) Has a problem been found?

YES

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

NO

▶ Go to " Component Inspection" procedure.

COMPONENT INSPECTION E515F6C4

1. Check ETS motor
    1) Ignition "OFF"
    2) Disconnect ETS motor connector
    3) Measure resistance between terminals "1" and "2" of the ETS motor connector.

Specification: Approx. 1.275 ~ 1.725Ω at 20℃(68 °F)

4) Is the measured resistance within specifications?

YES

▶ Go to "Check TPS" as below

NO

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

2. Check TPS
    1) Disconnect TPS connector and measure resistance between terminals 4 and 8 of the TPS connector.

Specification : Approx. 4.0~6.0kΩ (with throttle valve fully closed) at 20°C(68°F)

2) Disconnect TPS connector and measure resistance between terminals 1 and 5 of the TPS connector.

SPECIFICATION:

Item	Sensor Resistance at 20℃ (68℉)
TPS 1	4.0 ~ 6.0 kΩ
TPS 2	2.72 ~ 4.08 kΩ

3) Are the TPS resistance within specifications?

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. If PCM needs to be replaced, do "ETS Initialization" after it is replaced.

NO

▶ Substitute with a known-good TPS and check for proper operation.If the problem is corrected, replace TPS and then do "ETS Initialization". 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.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E580A938

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0507 IDLE AIR CONTROL SYSTEM-RPM HIGHER THAN EXPECTED

GENERAL DESCRIPTION EC5E74EE

Refer to DTC P0506.

DTC DESCRIPTION EEDEB58A

Checking idle RPM from under detecting condition, if the idle speed is more than 200 RPM above desired idle speed, PCM sets P0507. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC DETECTING CONDITION E3548732

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if a high idle condition exists.	• Poor connection • Intake system/Vapor hoses for air leakage or disconnection • Faulty Accelerator cable • Faulty ETS motor • Faulty TPS • Faulty ETS system • Faulty PCM
Enable Conditions	• Normal Idle conditions • Canister Purge Fuel Flow ≤ 100 • Barometric Pressure 〉 72kPa • Engine running ≥ 2 sec • Air Intake Temperature ≥ -20℃ (-4℉) • Coolant Temperature ≥ 0℃ (32℉) • 11V ≤ Ignition Voltage ≤ 16V • Above conditions met period 〉 3 sec	
Thresh old value	• Real engine speed - Target engine speed 〉 200rpm	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

MONITOR SCANTOOL DATA ED1002EA

Refer to DTC P0506.

TERMINAL AND CONNECTOR INSPECTION EA071374

Refer to DTC P0506.

SYSTEM INSPECTION EE4B32CB

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

   ▶ Replace or repair as necessary and go to "Verification of Vehicle Repair" procedure

   NO

   ▶ Go to "Visually check ETS System" as below

2. Visually check ETS System

    1) Ignition "OFF"

    2) Remove the air hose between MAF sensor and Throttle body.

    3) Visually check the overall ETS system(Throttle valve,ETS motor,APS and TPS).

    4) Has a problem been found?

YES

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

NO

▶ Go to " Component Inspection" procedure.

COMPONENT INSPECTION E7272432

1. Check Accelerator Cable

    1) Ignition "OFF" & Engine "OFF"

    2) Check free play of accelerator Cable

Specification 1.0 ~ 3.0mm(0.04 ~ 0.12 in)

    3) Is the measured resistance within specifications?

YES

▶ Go to "Check TPS" as below

NO

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

2. Check ETS motor

    1) Ignition "OFF"

    2) Disconnect ETS motor connector

    3) Measure resistance between terminals "1" and "2" of the ETS motor connector.

Specification: Approx. 1.275 ~ 1.725Ω at 20℃(68 °F)

Item	Sensor Resistance at 20℃ (68°F)
Coll Resistance (Ω)	1.275 ~ 1.725Ω

    4) Are the TPS resistance within specifications?

YES

▶ Go to "Check TPS" as below

NO

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

3. Check TPS

1) Disconnect TPS connector and measure resistance between terminals 4 and 8 of the TPS connector.

Specification : Approx. 4.0~6.0kΩ (with throttle valve fully closed) at 20°C(68°F)

2) Disconnect TPS connector and measure resistance between terminals 1 and 5 of the TPS connector.

SPECIFICATION:

Item	Sensor Resistance at 20℃ (68°F)
TPS 1	4.0 ~ 6.0 kΩ
TPS 2	2.72 ~ 4.08 kΩ

3) Are the TPS resistance within specifications?

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. If PCM needs to be replaced, do "ETS Initialization" after it is replaced.

NO

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

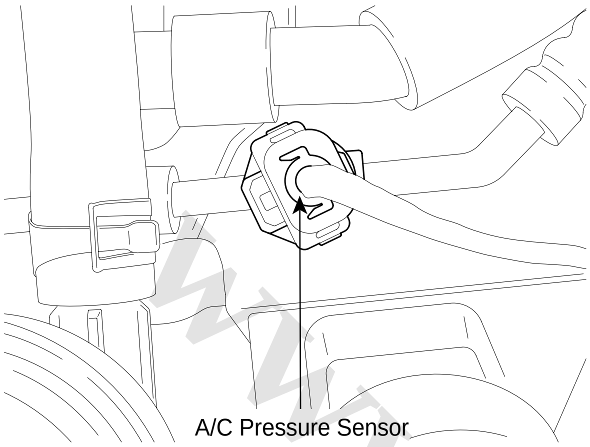
※ Procedure of ETS Initialization
1. Erase the trouble codes on PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR EC163944

Refer to DTC P0506.

DTC P0532 A/C REFRIGERANT PRESSURE SENSOR "A" CIRCUIT LOW INPUT

COMMPONENT LOCATION E85D9ADB



EGRF883A

GENERAL DESCRIPTION E2F30A13

A/C pressure sensor is installed betweem receiver driver and expansion valve. Sensing refrigerants pressure, this sensor converts pressure into voltage to input the value to PCM. With this signal, PCM performs idle control, cooling fan control, aircon compresser control.

DTC DESCRIPTION EE6AA4BA

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.

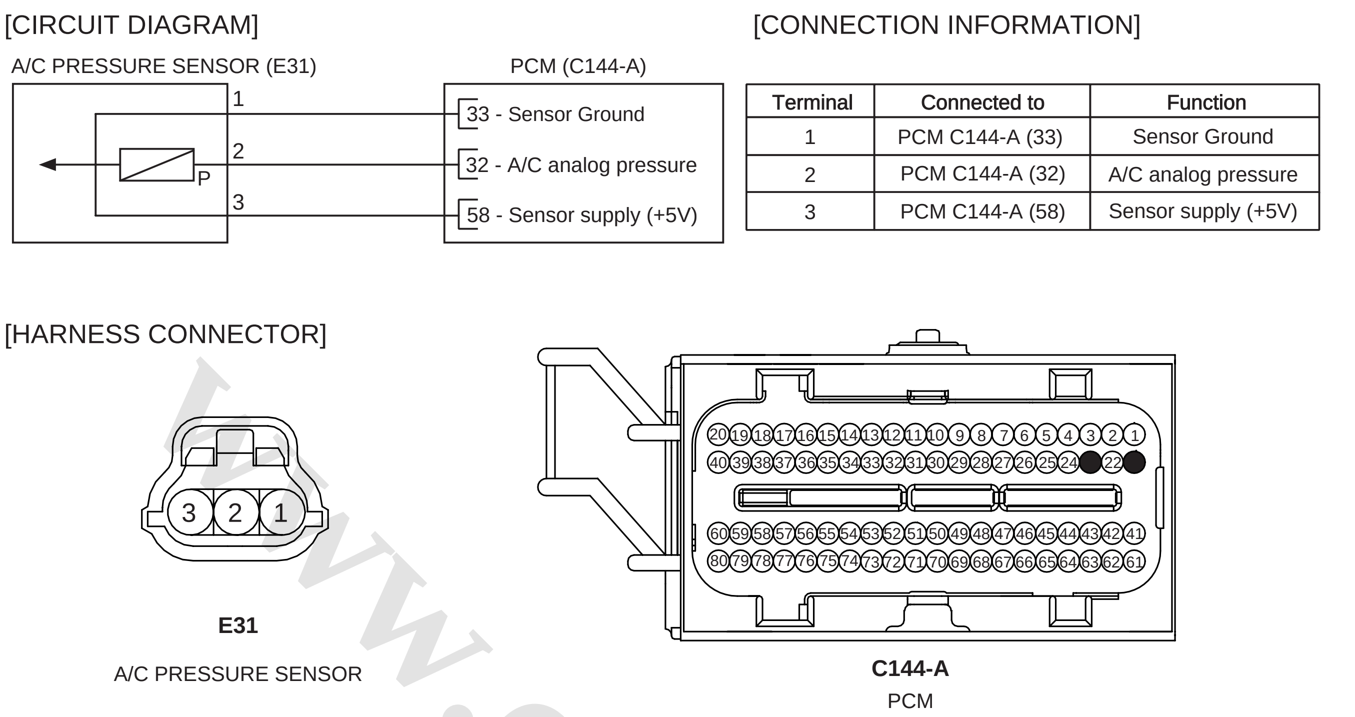
DTC DETECTING CONDITION EA180D2F

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 works	
Thresh old value	• Sensor output voltage 〈 0.25V	
Diagnosis Time	• Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION EBE3C373

Pressure(psi)	14.7	56.7	250	439.7	465
Voltage(V)	0.203	0.629	2.633	4.649	4.8

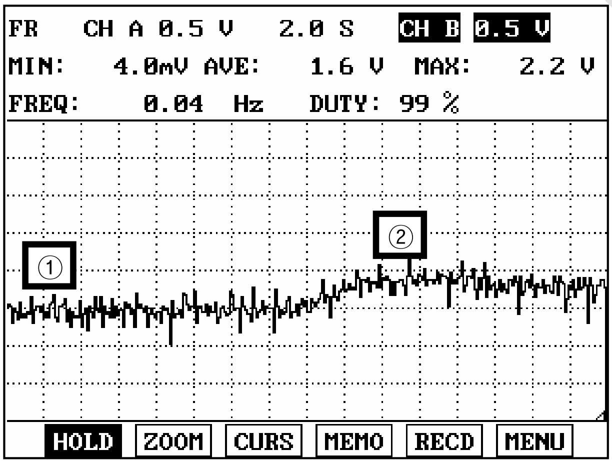
SCHEMATIC DIAGRAM E1E8CFF6



Terminal	Connected to	Function
1	PCM C144-A (33)	Sensor Ground
2	PCM C144-A (32)	A/C analog pressure
3	PCM C144-A (58)	Sensor supply (+5V)

EFBF803A

SIGNAL WAVEFORM AND DATA E5292D85



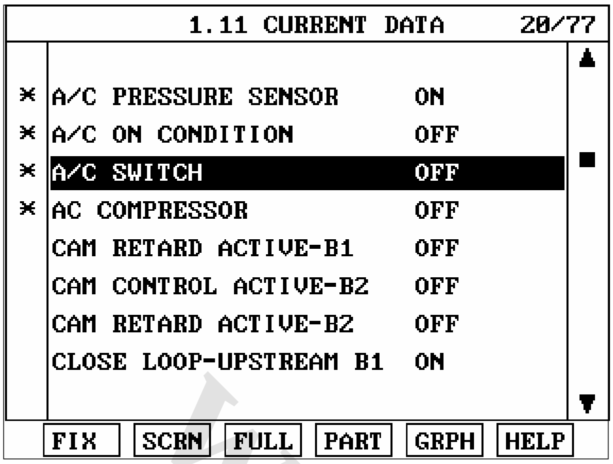
① - A/C OFF & idle state
② - A/C ON & idle state

EGRF884A

MONITOR SCANTOOL DATA E3605460

1. Ignition "OFF"
2. Connect Scantool and Engine "ON"
3. Check whether Air-Con pressure is rising during acceclerating.

Fig : A/C - OFF



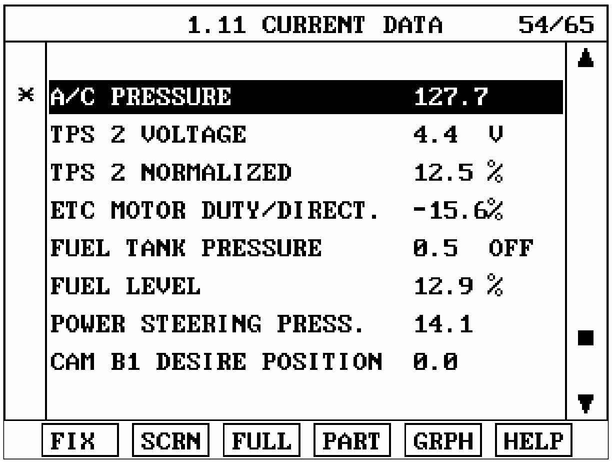
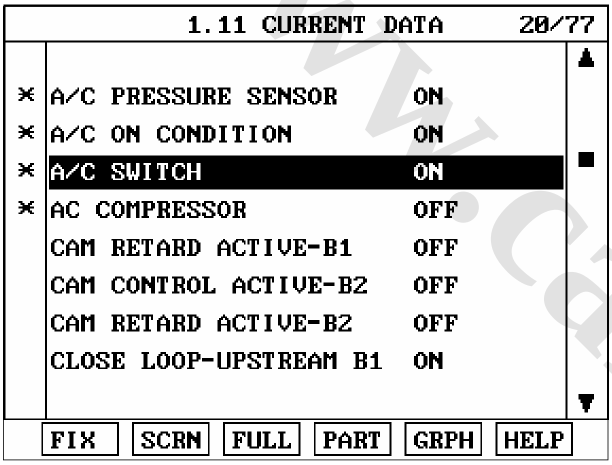


Fig : A/C Switch - ON



EGRF885A

4. Are those items on scantool displayed correctly ?

YES

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

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EB336E24

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 EC7131B3

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 "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 EA4BA061

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 ED7CA87F

1. A/C pressure sensor inspection

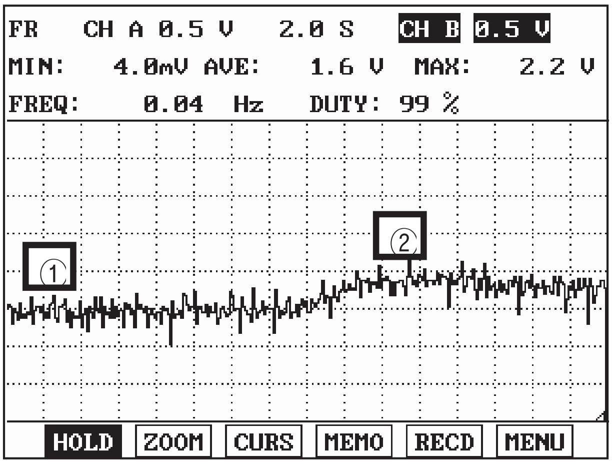
1) IG Key "OFF" and connect the scantool.

2) Connect the probe to A/C pressure sensor signal and select the oscilloscope in the menu.

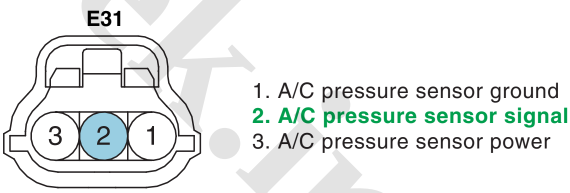
3) Check the waveform with acceleration and deceleration after engine start.

SPECIFICATION :

Pressure(psi)	14.7	56.7	250	439.7	465
Voltage(V)	0.203	0.629	2.633	4.649	4.8



① - A/C OFF & Idle
② - A/C ON & Idle



EGRF889A

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E893EB05

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0533 A/C REFRIGERANT PRESSURE SENSOR "A" CIRCUIT HIGH INPUT

COMMPONENT LOCATION EA3F816B

Refer to DTC P0532.

GENERAL DESCRIPTION E58F43A8

Refer to DTC P0532.

DTC DESCRIPTION E95B8C29

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 EE803B13

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects sensor signal short to high voltage	• Poor connection • Short to battery in signal circuit • Open in ground circuit • Faulty A/C pressure sensor • Faulty PCM
Enable Conditions	• Engine works	
Thresh old value	• Sensor output voltage 〉 4.65V	
Diagnosis Time	• Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION E996D149

Refer to DTC P0532.

SCHEMATIC DIAGRAM E3220A60

Refer to DTC P0532.

SIGNAL WAVEFORM AND DATA E45A3D1F

Refer to DTC P0532.

MONITOR SCANTOOL DATA E3193E45

Refer to DTC P0532.

TERMINAL AND CONNECTOR INSPECTION EFE407DA

Refer to DTC P0532.

POWER CIRCUIT INSPECTION E51152C1

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 E87EE5FF

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 E70DBEA7

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 EEB8C22E

1. A/C pressure sensor inspection

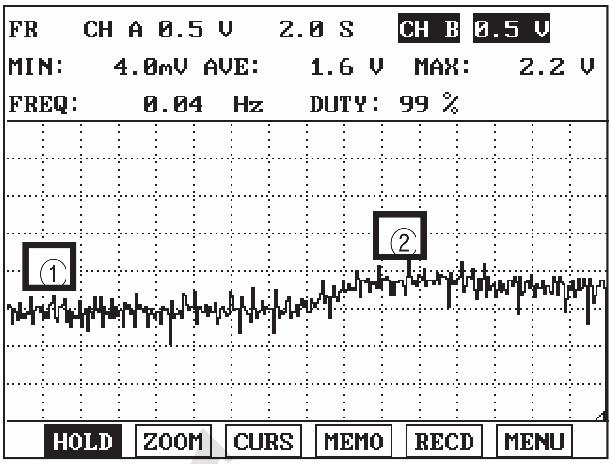
1) IG Key "OFF" and connect the scantool.

2) Connect the probe to A/C pressure sensor signal and select the oscilloscope in the menu.

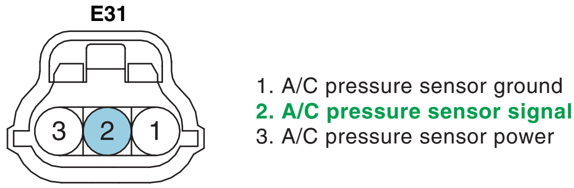
3) Check the waveform with acceleration and deceleration after engine start.

SPECIFICATION :

Pressure(psi)	14.7	56.7	250	439.7	465
Voltage(V)	0.203	0.629	2.633	4.649	4.8



① - A/C OFF & Idle
② - A/C ON & Idle



EGRF889A

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

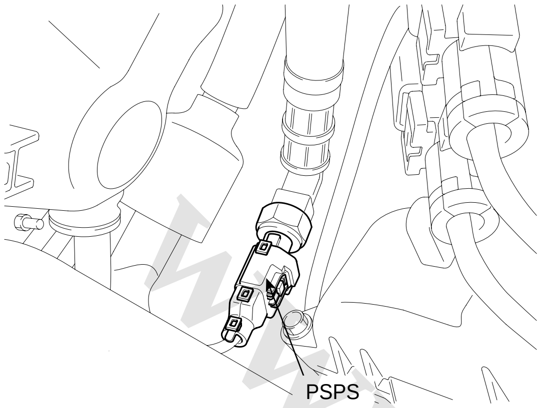
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EAAECDF0

Refer to DTC P0532.

DTC P0552 POWER STEERING PRESSURE SENSOR/SWITCH CIRCUIT LOW INPUT

COMMPONENT LOCATION EB356FDB



EFBF894A

GENERAL DESCRIPTION EAEB78B3

To reduce the required power to manipulate steering wheel, hydraulic pressure is used in power steering system. A load is sensed at steering oil pressure sensor then inputted to PCM as vlotage signal. Controlling idle speed valve, PCM performs appropriate load correction with this signal.

DTC DESCRIPTION EDB2941A

Checking output signals from P/S PS(power steering pressure sensor) under detecting condition, if an signal below 0.1V lasts for over failure limit. PCM sets P0552. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC DETECTING CONDITION E408D0D2

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 P/S pressure sensor • Faulty PCM
Enable Conditions	• Engine works • 11V ≤ Battery voltage ≤ 16V	
Thresh old value	• Sensor output voltage 〈 0.1V	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E2E76025

Pressure(Kgf/㎠)	37.9	41.3	68.8	96.4
Voltage(V)	1	2	3	4

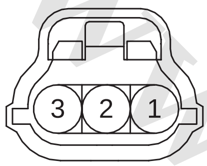
SCHEMATIC DIAGRAM EEA97EAB

[CIRCUIT DIAGRAM]

[CONNECTION INFORMATION]

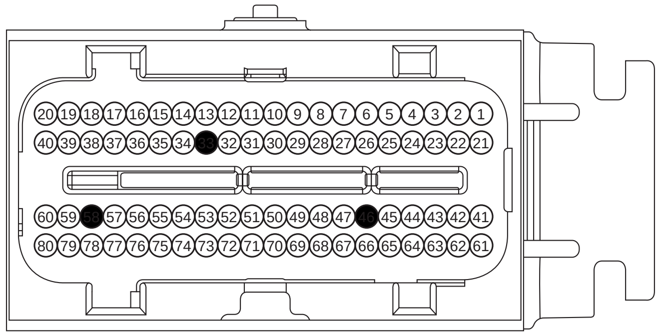
Terminal	Connected to	Function
1	PCM C144-A (33)	Sensor Ground
2	PCM C144-A (46)	PSPS Signal
3	PCM C144-A (58)	Sensor supply (+5V)

[HARNESS CONNECTOR]



C122

PSPS



C144-A

PCM

EFBF801A

MONITOR SCANTOOL DATA E9BA05C7

1. Ignition "OFF"
2. Connect Scantool and Engine "ON"
3. Check whether steering pressure is rising during operating. (Keep the idling status)

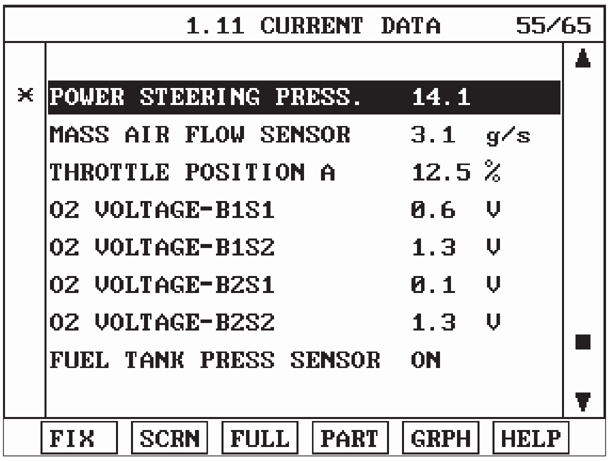


Fig.1

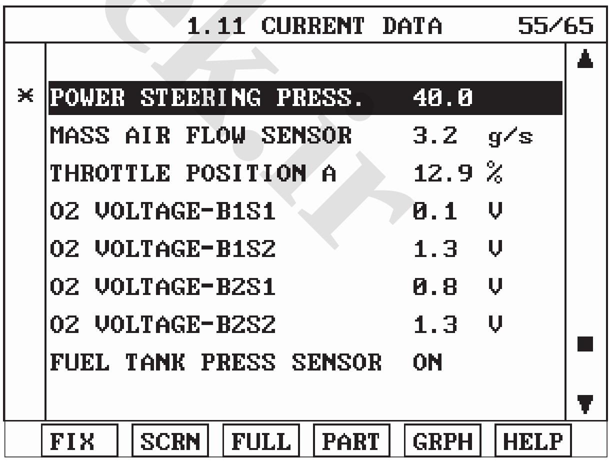


Fig.2

Fig1) Data with not turning steering wheel at idle
Fig2) Data with turning steering wheel at idle

EGRF895A

4. Is the current data displayed correctly ?

YES

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

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E57DE1A0

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 E88125CE

1. IG Key "OFF".
2. Disconnect the P/S pressure sensor connector.
3. IG Key "ON".
4. Measure the voltage between terminal 3 of P/S 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 in power circuit and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION EA47ACFE

1. Check short to ground inspection
   1) IG Key "OFF".
   2) Disconnect P/S pressure sensor connector and PCM connector.
   3) Measure the resistance between terminal 2 of P/S 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 signal circuit and go to "Verification of Vehicle Repair" procedure.

2. Check open in harness

1) IG Key "OFF".

2) Disconnect P/S pressure sensor connector and PCM connector.

3) Measure the resistance between terminal 2 of P/S pressure sensor harness connector and terminal 46 of PCM connector.

Specification : Approx. below 1Ω

4) Is the measured resistance within specification ?

YES

▶ Go to "Component inspection" procedure.

NO

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

COMPONENT INSPECTION E55F1090

1. P/S pressure sensor inspection

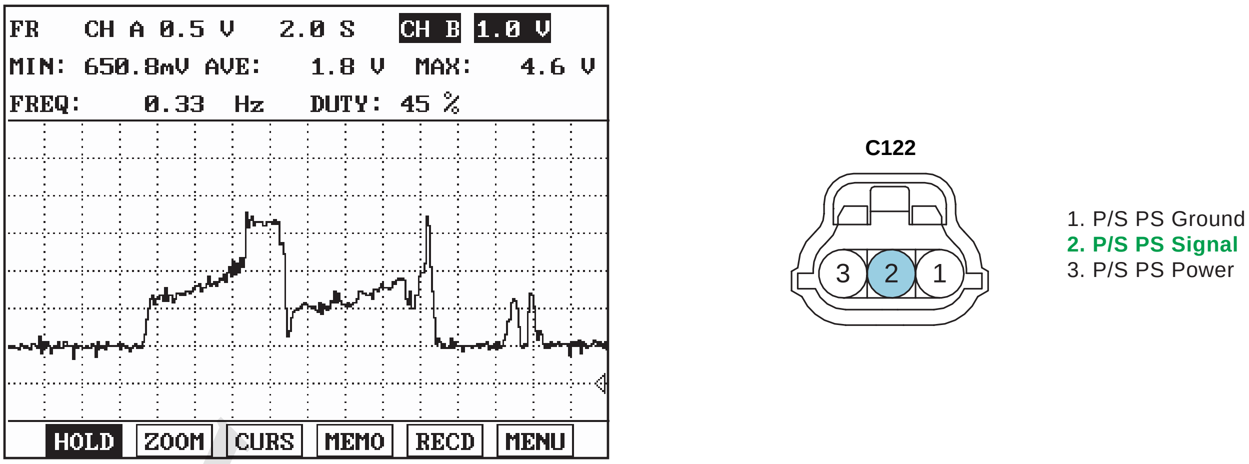
1) IG Key "OFF" and connect the scantool.

2) Connect the probe to signal line of P/S pressure sensor and select the oscilloscope in menu.

3) Check the waveform with steering handle movement after engine start.

SPECIFICATION :

Pressure(Kgf/㎠)	37.9	41.3	68.8	96.4
Voltage(V)	1	2	3	4



EFBF899A

4) Is the measured waveform of P/S 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 P/S pressure sensor and check for proper operation. If the problem is corrected, replace P/S 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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EA762F99

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0553 POWER STEERING PRESSURE SENSOR/SWITCH CIRCUIT HIGH INPUT

COMMPONENT LOCATION E8D3E9B1

Refer to DTC P0552.

GENERAL DESCRIPTION E7B634AF

Refer to DTC P0552.

DTC DESCRIPTION E88D843E

Checking output signals from P/S PS(power steering pressure sensor) under detecting condition, if an signal above 4.95V lasts for over failure limit. PCM sets P0552. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC DETECTING CONDITION E0BDF25F

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects sensor signal short to high voltage	• Poor connection • Short to battery in signal circuit • Open in ground circuit • Faulty P/S pressure sensor • Faulty PCM
Enable Conditions	• Engine works • 11V ≤ Battery voltage ≤ 16V	
Thresh old value	• Sensor output voltage 〉 4.65V	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E2FE9C67

Refer to DTC P0552.

SCHEMATIC DIAGRAM E9566D1A

Refer to DTC P0552.

MONITOR SCANTOOL DATA E4D46783

Refer to DTC P0552.

TERMINAL AND CONNECTOR INSPECTION ED4E0EFB

Refer to DTC P0552.

POWER CIRCUIT INSPECTION E1FBBEB9

1. IG Key "OFF".
2. Disconnect the P/S pressure sensor connector.
3. IG Key "ON".

4. Measure the voltage between terminal 3 of P/S 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 Short in power circuit and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EC26A80A

1. IG Key "OFF".
2. Disconnect the P/S pressure sensor connector.
3. IG Key "ON"
4. Measure the voltage between terminal 3 of P/S pressure sensor harness connector and chassis ground. (Fig A)
5. Measure the voltage between terminal 3 and terminal 1 of P/S 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 E35D8F43

1. Check short in harness
   1) IG Key "OFF".
   2) Disconnect P/S pressure sensor connector and PCM connector.
   3) Measure the resistance between terminal 2 and terminal 3 of P/S 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 E03728BD

1. P/S pressure sensor inspection

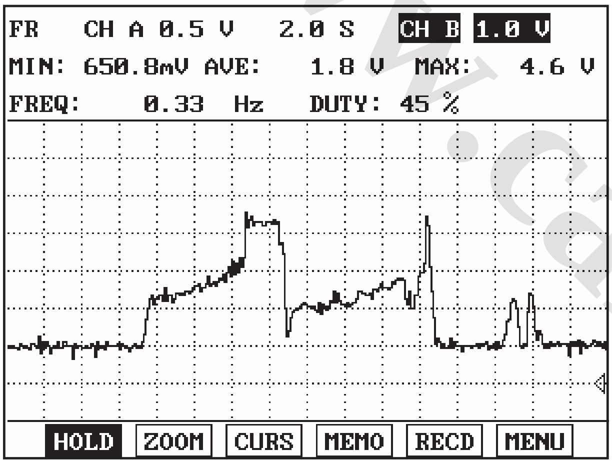
   1) IG Key "OFF" and connect the scantool.

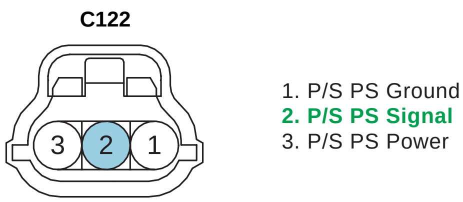
   2) Connect the probe to signal line of P/S pressure sensor and select the oscilloscope in menu.

   3) Check the waveform with steering handle movement after engine start.

SPECIFICATION :

Pressure(Kgf/㎠)	37.9	41.3	68.8	96.4
Voltage(V)	1	2	3	4





EFBF899A

   4) Is the measured waveform of P/S 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 P/S pressure sensor and check for proper operation. If the problem is corrected, replace P/S pressure sensor and go to "Verification of Vehicle Repair" procedure.

NOTE

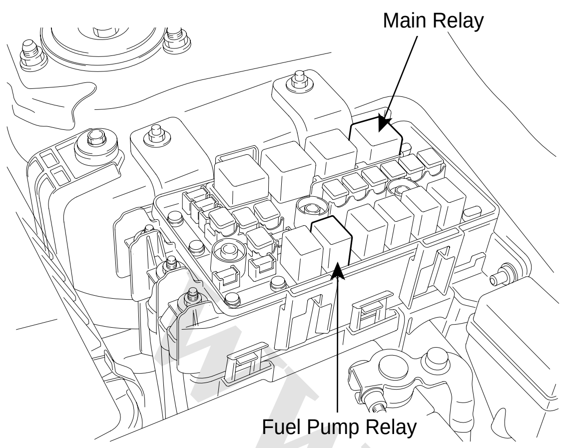
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E0FCCF6E

Refer to DTC P0552.

DTC P0562 SYSTEM VOLTAGE LOW

COMMPONENT LOCATION EC5FA106



EFBF903A

GENERAL DESCRIPTION E5EB9DAB

The purpose of the System Voltage is to detect an excessively low or high system voltage that may be caused by a malfunctioning charging system.

DTC DESCRIPTION E2B16E68

System Voltage is the ignition voltage potential at the Powertrain Control Module (PCM).PCM measures and compares voltage from ignition key and each relay. With this mechanism, PCM knows if the main relay switch turns on after IG on or if turns OFF after IG off.
During engine running, if battery voltage is below 11V, PCM sets P0562. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC DETECTING CONDITION EC928EFE

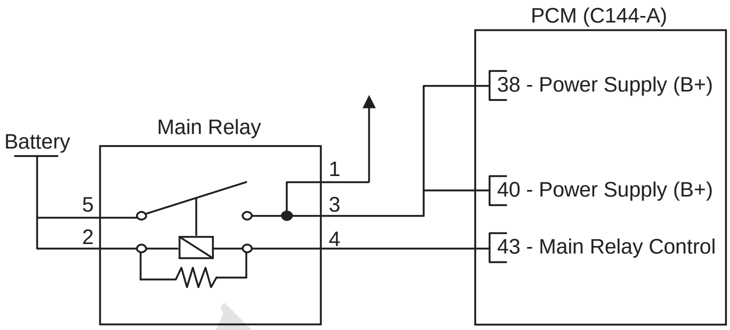
Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage too low	• Poor connection • Open in power circuit • Faulty charging system • Faulty main relay • Faulty PCM
Enable Conditions	• Engine works • 11V ≤ Battery voltage ≤ 16V	
Thresh old value	• System voltage 〈 11V	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E6B79FA1

Coil Resistance	70Ω ~ 120Ω

SCHEMATIC DIAGRAM EA8F7E8E

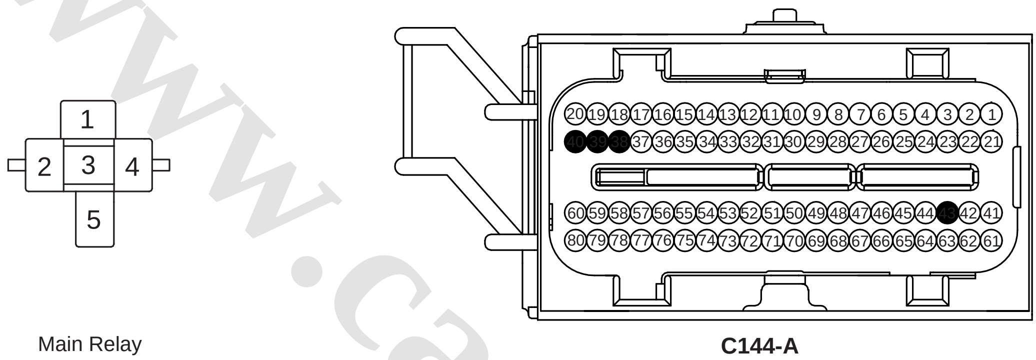
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	-	Power Supply (B+)
2	Battery	Battery Power (B+)
3	PCM C144-A (38)	Power Supply (B+)
	PCM C144-A (40)	
4	PCM C144-A (43)	Main Relay Control
5	Battery	Battery Power (B+)

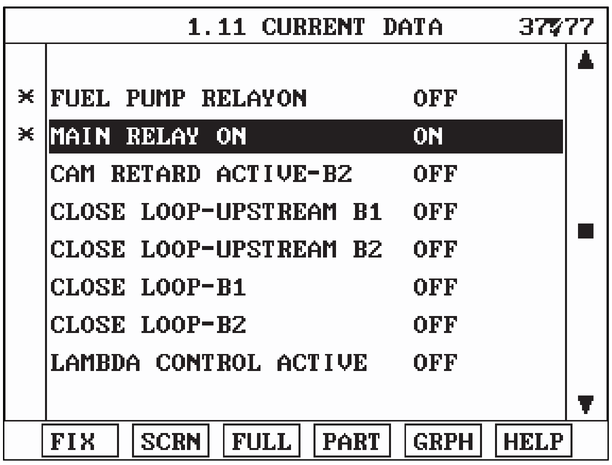
[HARNESS CONNECTOR]



EFBF807A

MONITOR SCANTOOL DATA E2597CF8

1. Ignition "OFF"
2. Connect Scantool and Engine "ON"
3. Monitor "Main Relay" parameter on Current Data



EGRF904A

4. Is the "Main Relay" parameter displayed correctly ?

YES

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

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EB56B021

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 EA66EE73

1. Power circuit inspection
   1) Key "OFF".
   2) Disconnect the main relay connector.
   3) Key "ON".
   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) Key "OFF".
   2) Disconnect main relay and PCM connector.

3) Measure the resistance between terminal 3 of main relay harness connector and terminals 38,40 of PCM 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) Key "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 E9AF6DAF

1. Check short in harness

1) Key "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) Key "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 connector.

Specification : Approx. below 1Ω

   4) Is the measured resistance within specification ?

YES

▶ Go to "Ground circuit inspection" procedure.

NO

▶ Repair Open in control harness and go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E818273C

1. Open in circuit inspection
   1) Key "OFF".
   2) Disconnect PCM connector.
   3) Measure the resistance between terminals 35,36 of PCM(C144-B) connector and chassis ground.
   4) Measure the resistance between terminals 37,38,39 of PCM(C144-B) connector and chassis ground.

Specification : Approx. blow 1Ω

   5) 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 E1BBAB97

1. Check Alternator circuit
   1) Key "OFF".
   2) Disconnect alternator connector.
   3) Key "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+

6) Is the measured voltage within specification?

YES

▶ Go to "Component inspection" procedure.

NO

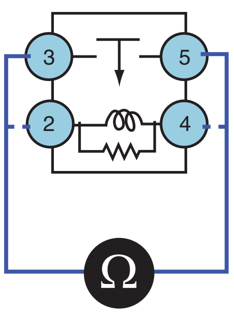
▶ In case terminal 2 : Repair MIL circuit, MIL resistor or Open in circuit and go to "Verification of Vehicle Repair" procedure.
▶ In case terminal 3 : Repair the fuse(30A IG2) between battery and Ignition switch, the fuse(10A IG3) between Ignition switch and alternator or Open in circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E6126A46

1. Main relay inspection
   1) Key "OFF".
   2) Disconnect the main relay.
   3) Measure the resistance between terminal 3 and 5 of main relay.
   4) Measure the resistance between terminal 2 and 4 of main relay.

Specification : 70 ~ 120Ω

Terminal	Power approval
3 ~ 5	NO
2 ~ 4	YES (Approx. 70Ω ~ 120Ω)



EGRF912A

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EAF92E71

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0563 SYSTEM VOLTAGE HIGH

COMMPONENT LOCATION E8D50A5F

Refer to DTC P0562.

GENERAL DESCRIPTION E5A1BBD3

Refer to DTC P0562.

DTC DESCRIPTION E7D97FE8

System Voltage is the ignition voltage potential at the Powertrain Control Module (PCM).PCM measures and compares voltage from ignition key and each relay. With this mechanism, PCM knows if the main relay switch turns on after IG on or if turns OFF after IG off.
During engine running, if battery voltage is above 16V, PCM sets P0563. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC DETECTING CONDITION EB60B9B7

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 works	
Thresh old value	• System voltage 〉 16V	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SPECIFICATION E983D2B9

Refer to DTC P0562.

SCHEMATIC DIAGRAM EEF5110D

Refer to DTC P0562.

MONITOR SCANTOOL DATA E00F6C83

Refer to DTC P0562.

TERMINAL AND CONNECTOR INSPECTION EF506338

Refer to DTC P0562.

POWER CIRCUIT INSPECTION EC2C8D60

1. Power circuit inspection

    1) Key "OFF".

    2) Disconnect the main relay connector.

3) Key "ON".

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 short in harness" procedure.

NO

▶ Repair Short in power harness and go to "Verification of Vehicle Repair" procedure.

2. Check short in harness

1) Key "ON".

2) Measure the voltage between terminal 38, 40 of PCM harness terminal 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 E8569E1E

1. Check Alternator circuit

1) Key "OFF".

2) Disconnect alternator connector.

3) Key "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+

6) Is the measured voltage within specification?

YES

▶ Go to "Component inspection" procedure.

NO

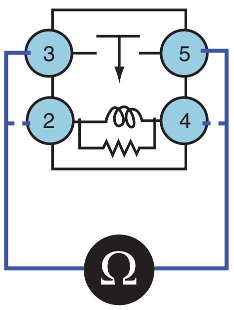
▶ Repair short in Sensing circuit or MIL circuit and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E9A67393

1. Main relay inspection
   1) Key "OFF".
   2) Disconnect the main relay.
   3) Measure the resistance between terminal 3 and 5 of main relay.
   4) Measure the resistance between terminal 2 and 4 of main relay.

Specification : 70 ~ 120Ω

Terminal	Power approval
3 ~ 5	NO
2 ~ 4	YES (Approx. 70Ω ~ 120Ω)



EGRF912A

   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) Key "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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EDC03401

Refer to DTC P0562.

DTC P0564 CRUISE CONTROL MULTI-FUNCTION INPUT "A" CIRCUIT

GENERAL DESCRIPTION E3DDD69B

The cruise control system makes the vehicle drive at a fixed speed until a signal canceling this fixed speed is received. When the main switch is turned on, the battery voltage is applied to the PCM. When a signal from the control switch like Set or Resume switch while driving is input to the PCM, it controls the ETS motor to make a car go at a steady speed you want. Also, while the system is operating, "CRUISE" indicator lamp on cluster lights up.

DTC DESCRIPTION EEEEE06B

If the swich signal's voltage is not within the calibrated ranges when PCM checks the switch signal under detecting condition, PCM sets P0564.

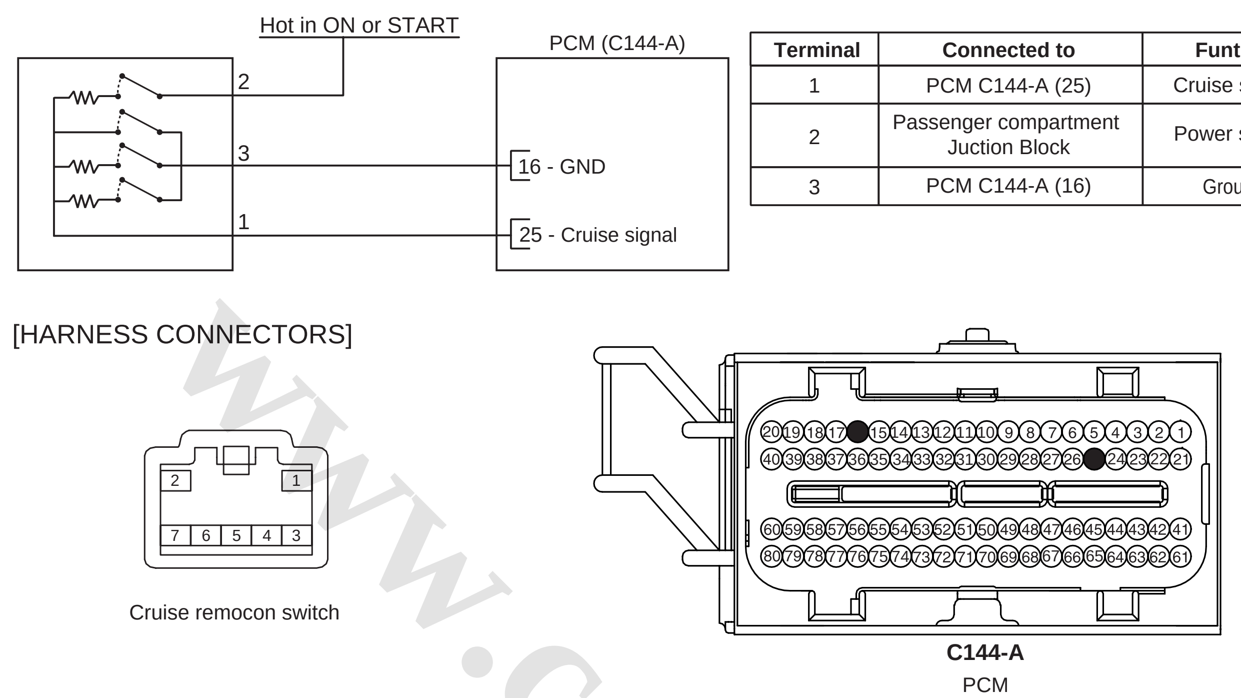
DTC DETECTING CONDITION E11E11DB

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitors the switch is switching too frequently or stuck for too long.	• Poor connection • Faulty cruise switch • Faulty PCM
Enable Conditions	• Engine is running • Ignition voltage ≥ 9V • Cruise control system type is learned	
Threshold value	• Input switch signal is switching too frequently or stuck	
Diagnosis Time	• Switching: more than 1 second failure for 300 seconds test • Stuck: more than 75 seconds failure for 300 seconds test	
MIL On Condition	• NO MIL ON(DTC only)	

SPECIFICATION E4FB4162

Item	Resistance(Ω)
ON/OFF switch	3.9 kΩ ± 5%
SET switch	220 Ω ± 5%
RESUME switch	910 Ω ± 5%
CANCEL switch	0 Ω ± 5%

SCHEMATIC DIAGRAM E0BDDB3C



[CONNECTION INFORMATION]

Terminal	Connected to	Funtion
1	PCM C144-A (25)	Cruise signal
2	Passenger compartment Juction Block	Power supply
3	PCM C144-A (16)	Ground

EFBF262A

TERMINAL AND CONNECTOR INSPECTION EF1A36D2

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to " Component Inspection " procedure.

POWER CIRCUIT INSPECTION EABD9DDA

1. IG "OFF" and disconnect Auto cruise switch connector.

2. IG "ON" and ENG "OFF"

3. Measure voltage between terminal 2 of auto cruise switch harness connector and chassis ground.

Specification :	Approx. B+

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 EDBEECDC

1. Check voltage

   1) IG "OFF" and disconnect auto cruise switch connector.

   2) IG "ON" and ENG "OFF"

   3) Measure voltage between terminal 1 of auto cruise switch 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 in harness" as follows.

2. Check short in harness

   1) IG "OFF" and disconnect auto cruise switch connector and PCM connector.

   2) Measure resistance between terminals 1 and 2 of auto cruise switch harness connector.

   3) Measure resistance between terminals 1 and 3 of auto cruise switch 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 auto cruise switch connector and PCM connector.

   2) Measure resistance between terminal 1 of auto cruise switch harness connector and terminal 25 of PCM harness connector.

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 EFDFC8FC

1. Check auto cruise switch

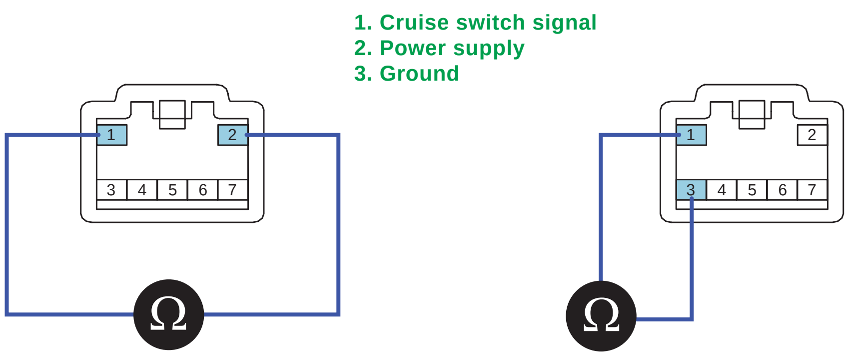
1) IG "OFF" and disconnect auto cruise switch connector.

2) Measure resistance between terminals 1 and 2 of auto cruise switch connector with each switch depressed.(Component side)

3) Measure resistance between terminals 1 and 3 of auto cruise switch connector with each switch depressed.(Component side)

SPECIFICATION :

Item	Resistance(Ω)
ON/OFF switch	3.9 kΩ ± 5% between terminals 1 and 2
SET switch	220 Ω ± 5% between terminals 1 and 3
RESUME switch	910 Ω ± 5% between terminals 1 and 3
CANCEL switch	0 Ω ± 5% between terminals 1 and 3



EFBF410E

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 auto cruise switch and check for proper operation.
If the problem is corrected, replace auto cruise switch 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 EAD4CAC8

1. After a repair, it is essential to verify that the fault has been corrected.
   1) Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
   2) Using a Scantool, Clear the DTCs
   3) Operate the vehicle within conditions noted in the freeze frame data or enable conditions
   4) Monitor that all rediness test have been verified as " Complete "
   5) Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0565 CRUISE CONTROL "ON" SIGNAL

GENERAL DESCRIPTION E9BAEFDC

Refer to DTC P0564.

DTC DESCRIPTION EE811FFB

If the main swich signal is switching too frequently or stuck for too long, PCM sets P0565.

DTC DETECTING CONDITION E88F7EB6

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitors the switch is switching too frequently or stuck for too long.	• Poor connection • Faulty cruise switch • Faulty PCM
Enable Conditions	• Engine is running • Ignition voltage ≥ 9V • Cruise control system type is learned	
Threshold value	• Input switch signal is switching too frequently or stuck	
Diagnosis Time	• Switching: more than 1 second failure for 300 seconds test • Stuck: more than 75 seconds failure for 300 seconds test	
MIL On Condition	• NO MIL ON(DTC only)	

SPECIFICATION EE50AA1A

Refer to DTC P0564.

SCHEMATIC DIAGRAM E21A081A

Refer to DTC P0564.

TERMINAL AND CONNECTOR INSPECTION ECEE80BB

Refer to DTC P0564.

COMPONENT INSPECTION EE4FCBAC

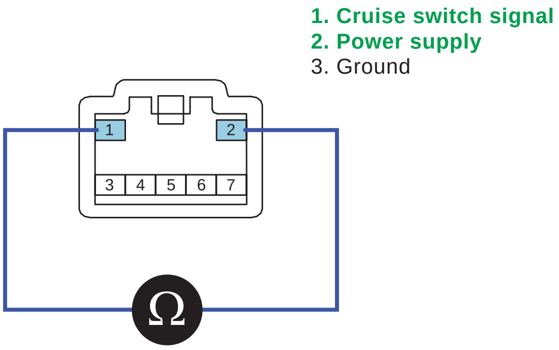
1. Check auto cruise switch

   1) IG "OFF" and disconnect auto cruise switch connector.

   2) Measure resistance between terminals 1 and 2 of auto cruise switch connector with "ON" switch depressed.(Component side)

SPECIFICATION :

Item	Resistance(Ω)
ON/OFF switch	3.9 kΩ ± 5% between terminals 1 and 2



EFBF411A

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 auto cruise switch and check for proper operation. If the problem is corrected, replace auto cruise switch 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 E94457EF

Refer to DTC P0564.

DTC P0566 CRUISE CONTROL "CANCEL" SIGNAL

GENERAL DESCRIPTION ECDC91F1

Refer to DTC P0564.

DTC DESCRIPTION ED3FF7DD

If the cancel swich signal is switching too frequently or stuck for too long, PCM sets P0566.

DTC DETECTING CONDITION EDD86735

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitors the switch is switching too frequently or stuck for too long.	• Poor connection • Faulty cruise switch • Faulty PCM
Enable Conditions	• Engine is running • Ignition voltage ≥ 9V • Cruise control system type is learned	
Threshold value	• Input switch signal is switching too frequently or stuck	
Diagnosis Time	• Switching: more than 1 second failure for 300 seconds test • Stuck: more than 75 seconds failure for 300 seconds test	
MIL On Condition	• NO MIL ON(DTC only)	

SPECIFICATION EDA46DB7

Refer to DTC P0564.

SCHEMATIC DIAGRAM EDBEE0E1

Refer to DTC P0564.

TERMINAL AND CONNECTOR INSPECTION EDFC1B62

Refer to DTC P0564.

COMPONENT INSPECTION ED5BD7FB

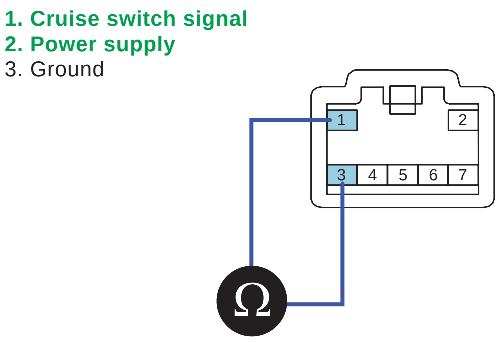
1. Check auto cruise switch

   1) IG "OFF" and disconnect auto cruise switch connector.

   2) Measure resistance between terminals 1 and 3 of auto cruise switch connector with "CANCLE" switch depressed.(Component side)

SPECIFICATION :

Item	Resistance(Ω)
CANCLE switch	0 Ω ± 5% between terminals 1 and 3



EFBF412A

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 auto cruise switch and check for proper operation. If the problem is corrected, replace auto cruise switch 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 EDDE753D

Refer to DTC P0564.

DTC P0567 CRUISE CONTROL "RESUME" SIGNAL

GENERAL DESCRIPTION ECCF9C40

Refer to DTC P0564.

DTC DESCRIPTION E030CF49

If the RESUME swich signal is switching too frequently or stuck for too long, PCM sets P0567.

DTC DETECTING CONDITION EB96B6FB

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitors the switch is switching too frequently or stuck for too long.	• Poor connection • Faulty cruise switch • Faulty PCM
Enable Conditions	• Engine is running • Ignition voltage ≥ 9V • Cruise control system type is learned	
Threshold value	• Input switch signal is switching too frequently or stuck	
Diagnosis Time	• Switching: more than 1 second failure for 300 seconds test • Stuck: more than 75 seconds failure for 300 seconds test	
MIL On Condition	• NO MIL ON(DTC only)	

SPECIFICATION E3BCD32C

Refer to DTC P0564.

SCHEMATIC DIAGRAM EF2DE0EB

Refer to DTC P0564.

TERMINAL AND CONNECTOR INSPECTION EC73218D

Refer to DTC P0564.

COMPONENT INSPECTION E79764F0

1. Check auto cruise switch

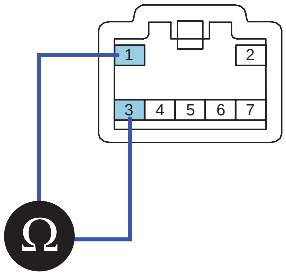
   1) IG "OFF" and disconnect auto cruise switch connector.

   2) Measure resistance between terminals 1 and 3 of auto cruise switch connector with "RESUME" switch depressed.(Component side)

SPECIFICATION :

Item	Resistance(Ω)
RESUME switch	910 Ω ± 5% between terminals 1 and 3

1. Cruise switch signal
2. Power supply
3. Ground



EFBF412A

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 auto cruise switch and check for proper operation. If the problem is corrected, replace auto cruise switch 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 E8EDEDED

Refer to DTC P0564.

DTC P0568 CRUISE CONTROL "SET" SIGNAL

GENERAL DESCRIPTION E12CB5A3

Refer to DTC P0564.

DTC DESCRIPTION E048378A

If the SET swich signal is switching too frequently or stuck for too long, PCM sets P0568.

DTC DETECTING CONDITION E9D91E3B

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitors the switch is switching too frequently or stuck for too long.	• Poor connection • Faulty cruise switch • Faulty PCM
Enable Conditions	• Engine is running • Ignition voltage ≥ 9V • Cruise control system type is learned	
Threshold value	• Input switch signal is switching too frequently or stuck	
Diagnosis Time	• Switching: more than 1 second failure for 300 seconds test • Stuck: more than 75 seconds failure for 300 seconds test	
MIL On Condition	• NO MIL ON(DTC only)	

SPECIFICATION EF985A28

Refer to DTC P0564.

SCHEMATIC DIAGRAM E92E6FA8

Refer to DTC P0564.

TERMINAL AND CONNECTOR INSPECTION EC7ABBC1

Refer to DTC P0564.

COMPONENT INSPECTION EEBBADCF

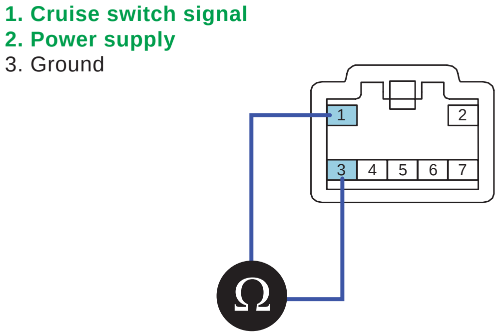
1. Check auto cruise switch

   1) IG "OFF" and disconnect auto cruise switch connector.

   2) Measure resistance between terminals 1 and 3 of auto cruise switch connector with "SET" switch depressed.(Component side)

SPECIFICATION :

Item	Resistance(Ω)
SET switch	220 Ω ± 5% between terminals 1 and 3



EFBF412A

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

NOTE

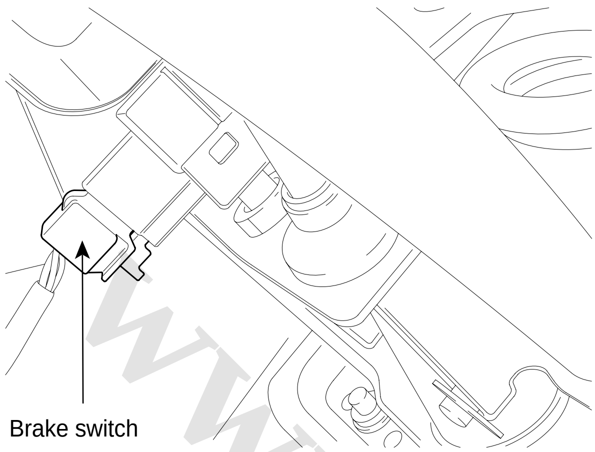
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM. After testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E5F7A8B8

Refer to DTC P0564.

DTC P0571 BRAKE SWITCH "A" CIRCUIT

COMPONENT LOCATION E94AAED7



EGRF872A

GENERAL DESCRIPTION E2CD5CBB

Brake switch connected to brake pedal transfers brake operating state to PCM. For diagnosis of abnormal operation of Brake switch, two types of signals(one from Brake warning lamp switch, the other from Brake checking switch) are used and those two types output different signals at both condition, depressing or releasing brake pedal. When brake pedal is depressed brake checking switch outputs B+ voltage while brake warning lamp switch emits 0V. Conversly, when brake pedal is released, the output signals of each switch are opposite.

DTC DESCRIPTION ED929009

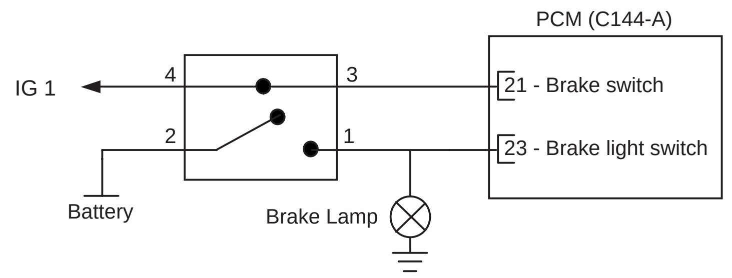
Checking input signals from brake lamp switch under detecting condition, if the operation state of brake lamp switch does not change for more than 3 sec., PCM sets P0571. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC DETECTING CONDITION E74FEA11

Item	Detecting Condition	Possible cause
DTC Strategy	• PCM detects brake lamp input signal when vehicle stops.	• Poor connection • Open or short to ground in signal circuit • Faulty PCM
Enable onditions	• Engine works • Vehicle speed signal is normal. • Vehicle speed 〉 20kph (during 1sec or more)	
Threshold value	• Vehicle speed 〈 3kph • Vehicle acceleration 〈 -6kph/s • Brake lamp "OFF" and not changing of brake lamp signal for more 3 sec.	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM EDBAE8DD

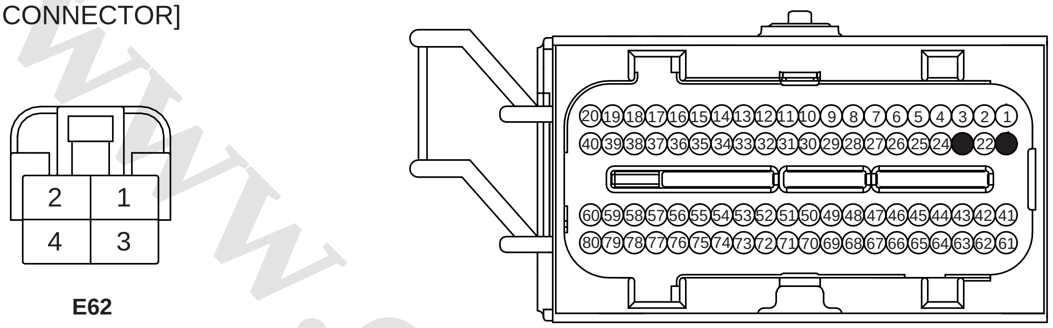
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C144-A (23)	Brake light switch
2	Battery	Power Supply (12V)
3	PCM C144-A (21)	Brake switch
4	Battery	Power Supply (12V)

[HARNESS CONNECTOR]



E62

STOP LAMP SWITCH

C144-A

PCM

EFBF802A

MONITOR SCANTOOL DATA E1B47863

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "Brake Switch" parameter on the service data with stepping on and off the brake.

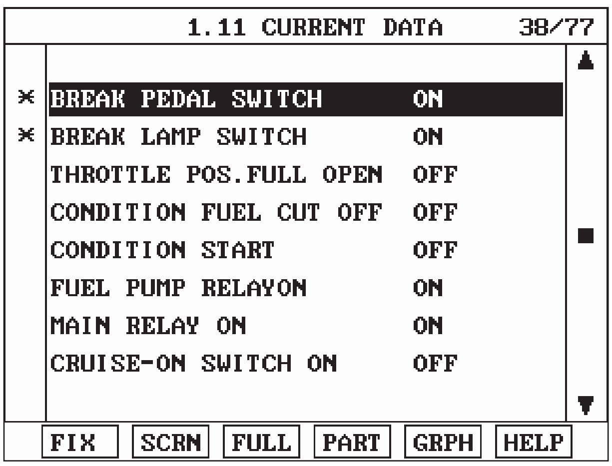


Fig. 1

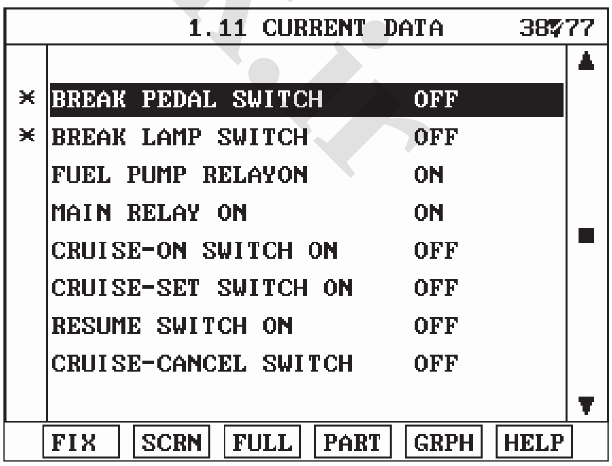


Fig. 2

Fig1) Data during stepping on the brake
Fig2) Data during taking off the brake

EGRF915A

4. Are those related current data displayed correctly ?

YES

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

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E9630B90

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 E62377C2

1. Check voltage
   1) IG "OFF".
   2) Disconnect the PCM connector.
   3) IG "ON" and ENG "OFF"
   4) During taking off the brake : Measure the voltage between terminal 23 of PCM harness connector and chassis ground.
   5) During stepping on the brake : Measure the voltage between terminal 23 of PCM harness connector and chassis ground.

SPECIFICATION :

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	0V	Battery voltage
Brake Switch	Battery voltage	0V

   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 1 of Brake switch harness side.

Specification : Approx. below 1Ω

---

    4) Is the measured resistance within specification ?

YES

▶ Go to "Check voltage" as follows.

NO

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

3. Check voltage

    1) IG "OFF".

    2) Disconnect the brake switch connector.

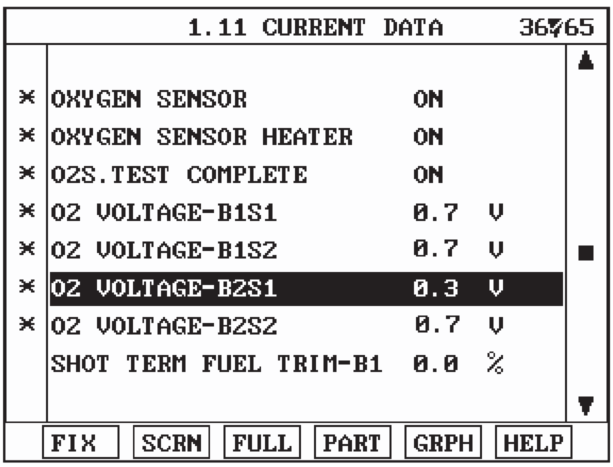
    3) Measure the voltage between brake lamp switch terminal and chassis ground.

    4) IG "ON" and ENG "OFF"

    5) Measure the voltage between brake lamp switch terminal and chassis ground.

SPECIFICATION :

Item	During taking off the brake	During stepping on the brake
Brake Lamp Switch	Battery voltage	Battery voltage
Brake Switch	0V	Battery voltage



EGRF988P

6) Is the measured voltage within specification ?

YES

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

NO

▶ Check the fuse between battery and brake switch.
▶ Repair open or short in power circuit of brake switch and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E859CF4C

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

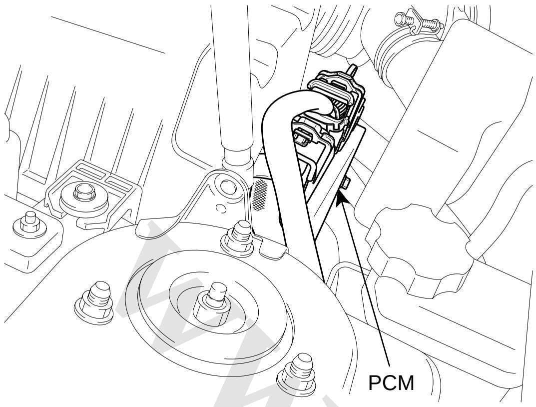
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0601 EEPROM-CHECK SUM ERROR

COMPONENT LOCATION E632661D



EFBF919A

GENERAL DESCRIPTION E91AD09F

PCM monitors errors through checksum. Every information consists of the combination of 0 and 1, checksum means summing up all values in a row. Thus, errors are recognized comparing checksum value and the memory value at PCM.

DTC DESCRIPTION EDD94869

If real checksum does not accord with memory checksum, PCM sets P0601 and MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EBFDFB3D

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	

TERMINAL AND CONNECTOR INSPECTION EBA509CE

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Substitute with a known-good 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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E6D2E783

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0602 EEPROM-PROGRAMING ERROR

COMPONENT LOCATION E748E8E8

Refer to DTC P0601.

GENERAL DESCRIPTION E7ED97A9

Refer to DTC P0601.

DTC DESCRIPTION E92E8E9C

If CPU software version dose not accord with main CPU, PCM sets P0602.

DTC DETECTING CONDITION E68D7938

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	

TERMINAL AND CONNECTOR INSPECTION EF24D648

Refer to DTC P0601.

VERIFICATION OF VEHICLE REPAIR E1C65F7B

Refer to DTC P0601.

DTC P0604 INTERNAL CONTROL MODULE RANDOM ACCESS MEMORY (RAM) ERROR

COMPONENT LOCATION E0E8FC25

Refer to DTC P0601.

GENERAL DESCRIPTION E41EC784

Refer to DTC P0601.

DTC DESCRIPTION EB79A260

If the RAM in PCM has errors, PCM sets P0604 and MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION E5626375

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	

TERMINAL AND CONNECTOR INSPECTION E62B8E13

Refer to DTC P0601.

VERIFICATION OF VEHICLE REPAIR E72EC453

Refer to DTC P0601.

DTC P0606 ECM/PCM PROCESSOR(ECM-SELF TEST FAILED)

COMPONENT LOCATION EEC2EC8B

Refer to DTC P0601.

GENERAL DESCRIPTION ED991308

The Controller Diagnostic receives data from several self-diagnosing devices onboard the powertrain control module. Conditions which are detected include supply voltage out of limits, acceptable temperature exceeded, low-power counter clock failure, and general device fault.

DTC DESCRIPTION E5C62EC4

Checking PCM under detecting condition, if internal error is detected, PCM sets P0606. And MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EEDB4B86

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	

TERMINAL AND CONNECTOR INSPECTION EA8E1D7D

Refer to DTC P0601.

VERIFICATION OF VEHICLE REPAIR EE508291

Refer to DTC P0601.

DTC P061B INTERNAL CONTROL MODULE TORQUE CALCULATION PERFORMANCE

COMPONENT LOCATION E12291B2

Refer to DTC P0601.

GENERAL DESCRIPTION E2ABED49

Checking torque control state and torque, PCM provides protection against RAM, ROM or ALU corruption causing the desired torque to be erroneously higher than actually desired. This type of malfunction is very difficult to find, however if it happens, it influences safety a lot. Therefore, detecting and decreasing torque is strongly required.

DTC DESCRIPTION EB37ACEF

If the calculated torque is much higher than the desired torque, PCM sets P061B. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION ED246291

Item	Detecting Condition	Possible cause
DTC Strategy	• Desired torque error	• Faulty PCM
Enable onditions	• Engine works	
Threshold value	• Calculated torque is much higher than desired torque.	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycle	

TERMINAL AND CONNECTOR INSPECTION E3CFE6DE

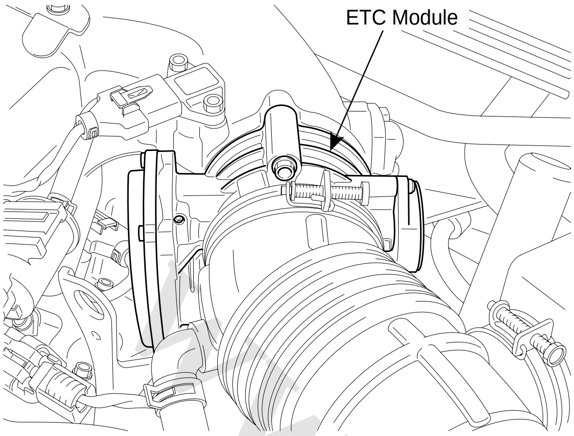
Refer to DTC P0601.

VERIFICATION OF VEHICLE REPAIR EA0FF986

Refer to DTC P0601.

DTC P0638 THROTTLE ACTUATOR CONTROL RANGE/PERFORMANCE

COMPONENT LOCATION EB83AEA2



EGRF604Y

GENERAL DESCRIPTION E1CE8E44

ETC(Electronic Throttle Control Valve) is the device controlling amount of air to engine acccording to driver's intension. Different from the existing mechanical throttle valve which is composed of accelerator pecal and connecting wire cable, ETC consists of a motor, a throttle body and a throttle position sensor. Receiving input signals from electronic accelerator pedal module, PCM lets ETC motor control throttle valve. With ETC, cruise control system works without any additional device.

DTC DESCRIPTION EFD415BB

Checking output signals from TPS every 8.5 sec. under detecting condition, if the difference between real and target throttle position is above the specified value, PCM sets P0638. MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION E1851759

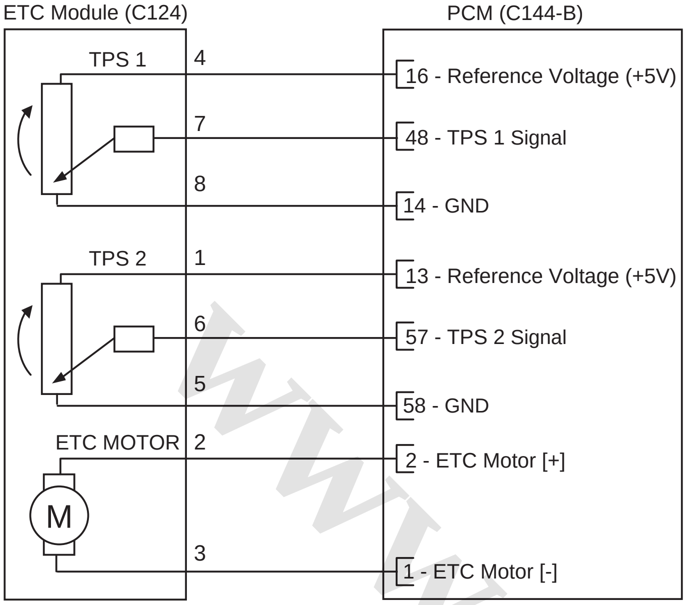
<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• ETS position control malfunction</td><td rowspan="7">• Throttle stuck
• Open in motor circuit
• Faulty motor
• Faulty PCM</td></tr>
<tr><td colspan="2">Enable Conditions</td><td>• Engine works
• Battery voltage 〉 5V</td></tr>
<tr><td rowspan="3">Thresh old value</td><td>Case1</td><td>• | real ETS motor ＆ TPS value - target ETS motor ＆ TPS value | 〉 4.5°</td></tr>
<tr><td>Case2</td><td>• When real Throttle position 〈36°, real throttle position - target throttle position 〈 - 4.5°</td></tr>
<tr><td>Case3</td><td>• real throttle position - target throttle position 〈 - 18°</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(More than 0.6 seconds failure for every 15.6 seconds test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• 1 driving cycle</td></tr>
</table>

SPECIFICATION E2A370FD

Throttle opening (°)	Output voltage (V) [Verf = 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 EDE7C9EE

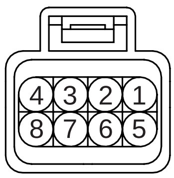
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

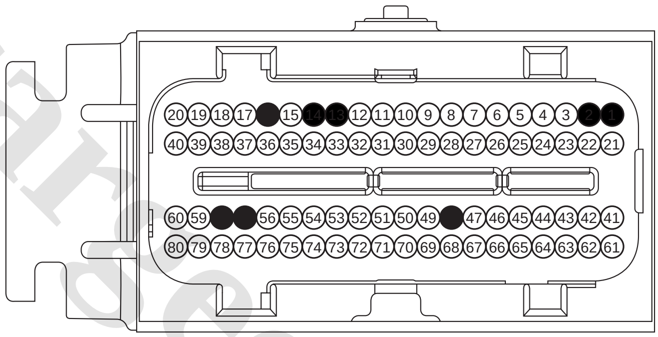
Terminal	Connected to	Funtion
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144- B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM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

[HARNESS CONNECTORS]



C124

ETC MODULE



C144-B

PCM

EFBF236A

SIGNAL WAVEFORM EE8727CF

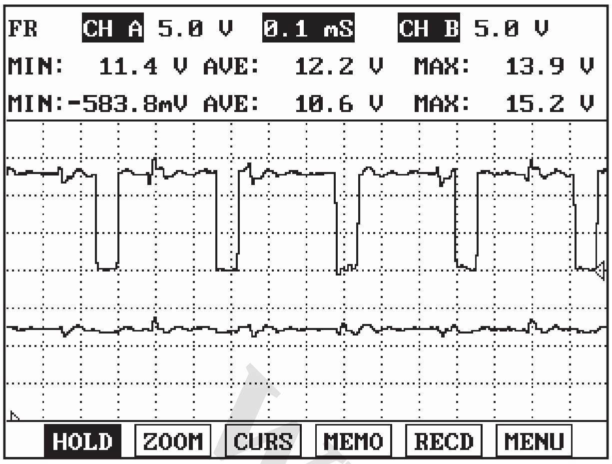


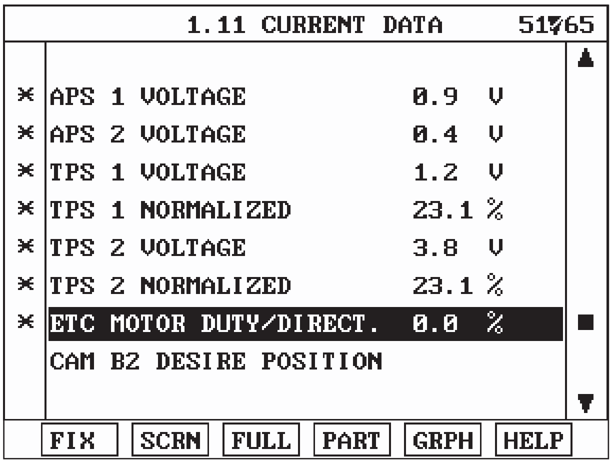
Fig. 1

Fig1) Signal waveform(+/-) instantly with accelerating

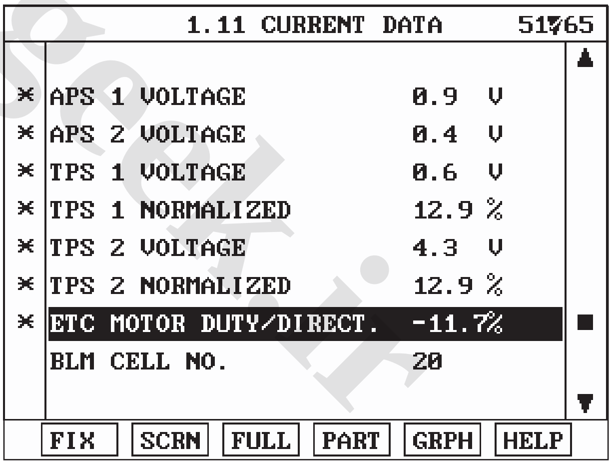
EGRF921A

MONITOR SCANTOOL DATA EA819AD4

1. Ignition "OFF"
2. Connect Scantool and Engine "ON"
3. Monitor "ETS Motor" items on Current Data



Data at opening circuit



Normal data at idle

EGRF922A

4. Are those related current data displayed correctly ?

YES

▶ Fault is intermittent caused by poor contact in Sensor's and/or PCM's connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poor connection,bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and goto "Verification of Vehicle Repair" procedure

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EA45C56A

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

YES

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

NO

▶ Go to " Control Circuit Inspection " procedure.

CONTROL CIRCUIT INSPECTION EEC61DFF

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. Open in control circuit inspection
   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.
   4) Measure the resistance between terminal 3 of ETS motor ＆ TPS harness connector and terminal 1 of PCM harness connector.

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 E584C73D

1. Check throttle valve for stuck
   1) IG "OFF".
   2) Disconnect the air hose between throttle body and air mass flow sensor.
   3) Check stuck on throttle valve.
   4) Is the throttle valve normal?

YES

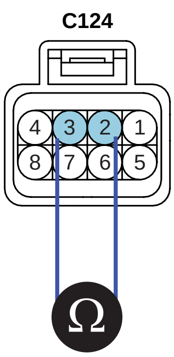
▶ Go to check "ETS motor resistance" as follows.

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

EFBF925A

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.

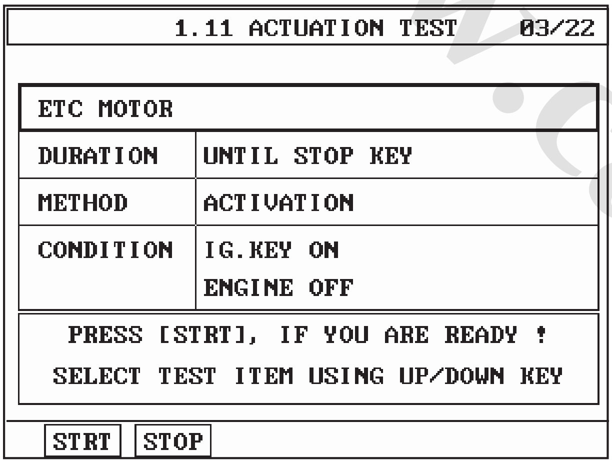
※ Procedure of ETS Initialization
1. Erase the trouble codes on PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

3. ETC motor actuation test

1) IG "OFF".

2) Connect ETS motor & TPS connector.

3) After IG "ON", execute the "ETC motor actuation test" by Scantool.



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.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR EABB5E0C

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0641 SENSOR REFERENCE VOLTAGE "A" CIRCUIT OPEN

GENERAL DESCRIPTION EAF3262E

ETC(Electronic Throttle Control Valve) is the device controlling amount of air to engine acccording to driver's intension. Different from the existing mechanical throttle valve which is composed of accelerator pecal and connecting wire cable, ETC consists of a motor, a throttle body and a throttle position sensor. Receiving input signals from electronic accelerator pedal module, PCM lets ETC motor control throttle valve. With ETC, cruise control system works without any additional device.

DTC DESCRIPTION E301A54F

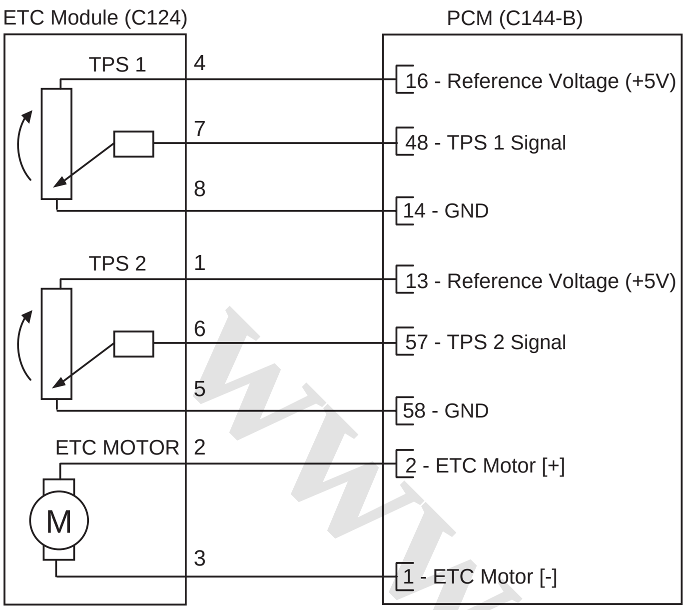
Checking the voltage from sensor power supply every 1.87 sec. under detecting condition, if the value within detecting condition lasts for more than 0.2 sec., PCM sets P0641. MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2A058D0

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 E499CA44

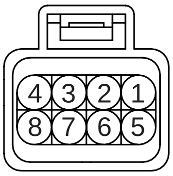
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

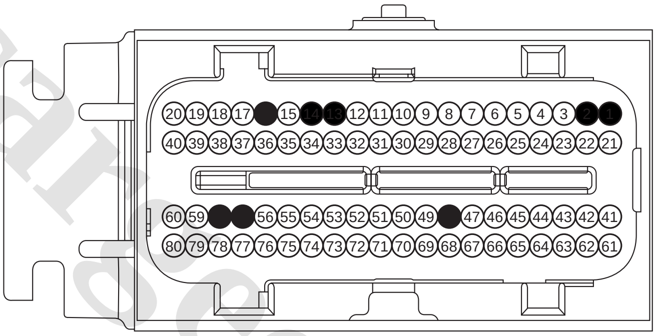
Terminal	Connected to	Funtion
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144- B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM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

[HARNESS CONNECTORS]



C124

ETC MODULE



C144-B

PCM

EFBF236A

MONITOR SCANTOOL DATA E712261A

1. Ignition "OFF".
2. Connect Scantool and Engine "ON".
3. Monitor "TPS1, TPS2" items on Current Data

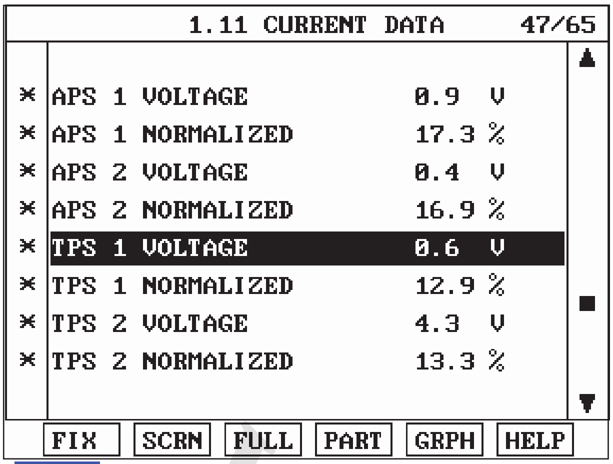


Fig. 1

Fig1)TPS1/2 at idle

EGRF927A

4. Are those related current data displayed correctly ?

YES

▶ Fault is intermittent caused by poor contact in Sensor’s and/or PCM’s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poor connection,bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and goto "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EE26794C

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 E8B120F3

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.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR EE9D5D7F

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.

2. Using a Scantool, Clear the DTCs

3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions

4. Monitor that all rediness test have been verified as " Complete "

5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0646 A/C CLUTCH RELAY CONTROL CIRCUIT LOW

GENERAL DESCRIPTION E6203C8F

A/C compressor raises pressure to condense the evaporated refrigerant at evaporator in A/C system more easily. Without A/C signal, A/C compressor does not operate but with ON signal, PCU activates A/C compressor relay. With the relay activation, A/C compressor turns on using the power of the engine.

DTC DESCRIPTION EAF504F0

PCM monitors inputted voltage through A/C compressor relay. Checking voltage every 10 sec. under detecting condition, if the voltage lower than the specified value is detected for more than 5 sec., PCM sets P0646.

DTC DETECTING CONDITION EAAF1515

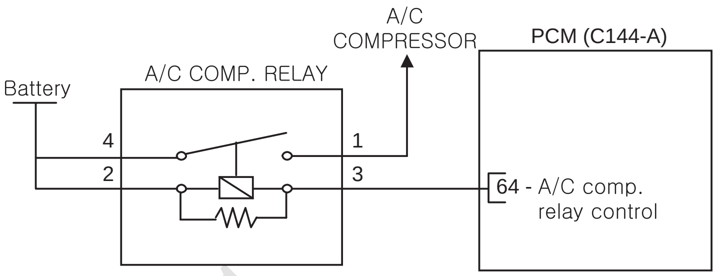
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects circuit short to low voltage	• Poor connection • Open or short to ground in A/C relay circuit • Faulty A/C relay • Faulty PCM
Enable Conditions	• After 0.5 sec under conditions below • No DTC exists • Engine works • 11V ≤ Battery voltage ≤ 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 E5C14C05

Coil Resistance
70Ω ~ 120Ω

SCHEMATIC DIAGRAM E8E9586A

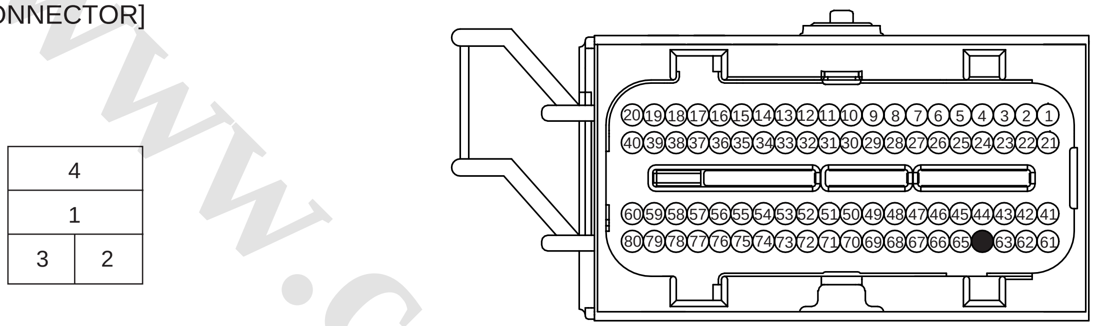
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	A/C COMPRESSOR	COMPRESSOR Supply
2	Battery	Power Supply (B+)
3	PCM C144-A (64)	A/C comp. relay control
4	Battery	Power Supply (B+)

[HARNESS CONNECTOR]



C144-A
PCM

EFBF804A

MONITOR SCANTOOL DATA E9DA8FE1

1. Ignition "OFF"
2. Connect Scantool and Engine "ON"
3. Monitor items related to "A/C" on Current Data

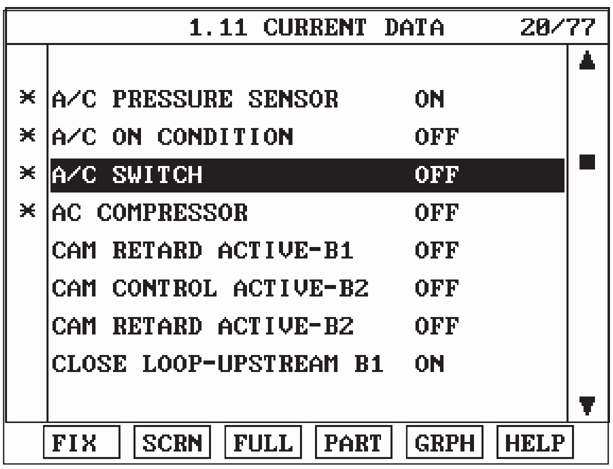


Fig. 1

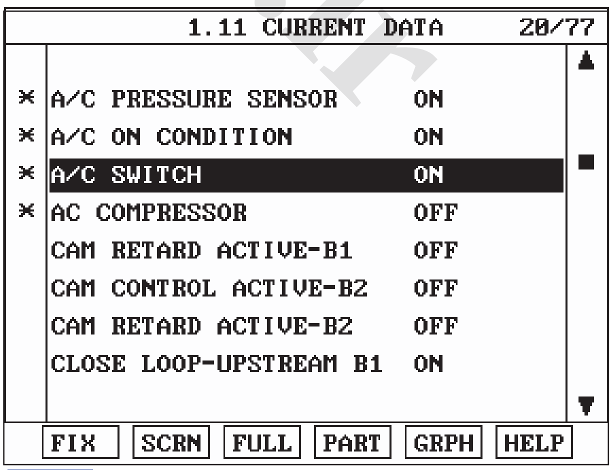


Fig. 2

Fig1) IG ON & A/C OFF
Fig2) Idle & A/C ON

EGRF932A

4. Are those related current data displayed correctly ?

YES

▶ Fault is intermittent caused by poor contact in Sensor' s and/or PCM' s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poor connection,bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and goto "Verification of Vehicle Repair" procedure

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E6202EAD

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 E9CACB45

1. Check voltage
   1) IG "OFF".
   2) Disconnect A/C relay connector.
   3) IG "ON" and ENG "OFF"
   4) Measure the voltage between terminal 2 of A/C relay harness connector and chassis ground.
   5) Measure the voltage between terminal 4 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 1 and 2 for looseness.
▶ Repair Open or Short to ground in power circuit and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E2120BF5

1. Check short in harness

   1) IG "OFF".

   2) Disconnect A/C relay and PCM connector.

   3) Measure the resistance between terminal 3 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 3 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 ECFBF187

1. Check A/C relay

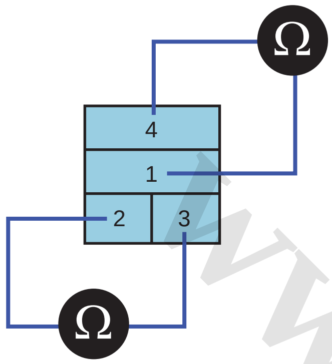
   1) IG "OFF".

   2) Disconnect A/C relay.

   3) Measure the resistance between terminal 2 and 3 of A/C relay.

   4) Measure the resistance between terminal 1 and 4 of A/C relay.

Terminal	Power approval
1~4	NO
2~3	YES (약 70Ω ~ 120Ω)



EFBF936A

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E188D2D7

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0647 A/C CLUTCH RELAY CONTROL CIRCUIT HIGH

GENERAL DESCRIPTION E293AC02

Refer to DTC P0646.

DTC DESCRIPTION E7395F2A

PCM monitors inputted voltage through A/C compressor relay. Checking voltage every 10 sec. under detecting condition, if the voltage higher than the specified value is detected for more than 5 sec., PCM sets P0647.

DTC DETECTING CONDITION E87210A2

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 works • 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 E1830ED9

Refer to DTC P0646.

SCHEMATIC DIAGRAM EAB2CE4D

Refer to DTC P0646.

MONITOR SCANTOOL DATA ECDFC50E

Refer to DTC P0646.

TERMINAL AND CONNECTOR INSPECTION E8D0E0CB

Refer to DTC P0646.

POWER CIRCUIT INSPECTION EDC25711

1. Check voltage

    1) IG "OFF".

    2) Disconnect A/C relay connector.

    3) IG "ON" and ENG "OFF"

    4) Measure the voltage between terminal 2 of A/C relay harness connector and chassis ground.

5) Measure the voltage between terminal 4 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 1 and 2 for looseness.
▶ Repair Open or Short to ground in power circuit and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EB686C3F

1. Check short in harness

1) IG "ON".

2) Disconnect A/C relay.

3) Measure the voltage between terminal 3 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 EF6AA6E4

1. Check A/C relay

1) IG "OFF".

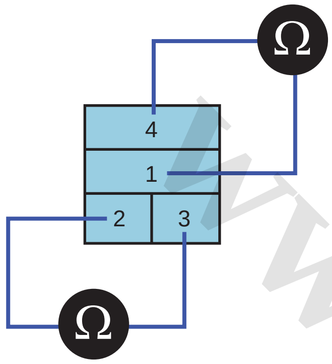
2) Disconnect A/C relay.

3) Measure the resistance between terminal 2 and 3 of A/C relay.

4) Measure the resistance between terminal 1 and 4 of A/C relay.

SPECIFICATION

Terminal	Power approval
1~4	NO
2~3	YES (APPROX. 70Ω ~ 120Ω)



1. Power supply to A/C compressor
2. A/C relay control power
3. A/C relay control
4. A/C relay switch power

EFBF936A

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E2957396

Refer to DTC P0646.

DTC P0650 MALFUNCTION INDICATOR LAMP(MIL) CONTROL CIRCUIT

GENERAL DESCRIPTION EDB2A676

As monitoring the errors of several sensors and actuators circuit,if any problem occurs, PCM turns engine check lamp ON at cluster to notify driver occurence of a problem.Generally, engine check lamp turns ON at Ignition ON and turns OFF within couple of seconds after turning engine ON. If engine check lamp turns on during driving, perform diagnosis of engine system and auto-transaxle system.

DTC DESCRIPTION ED4BE74A

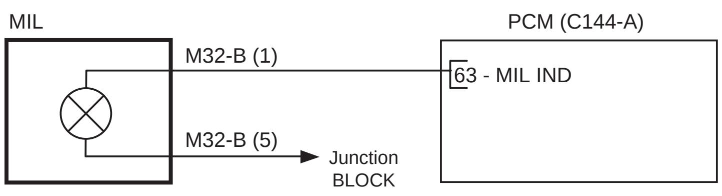
Checking input signal of engine check lamp every 10 sec. under detecting condition, if open, or short to battery or ground is detected for more than 5 sec., PCM sets P0650.

DTC DETECTING CONDITION E68821E1

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal low, high	• Poor connection • Open or short in MIL circuit • Faulty MIL • Faulty PCM
Enable Conditions	• After 0.5 sec under conditions below • Engine works • 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	• DTC only (NO MIL ON)	

SCHEMATIC DIAGRAM E45D6EE1

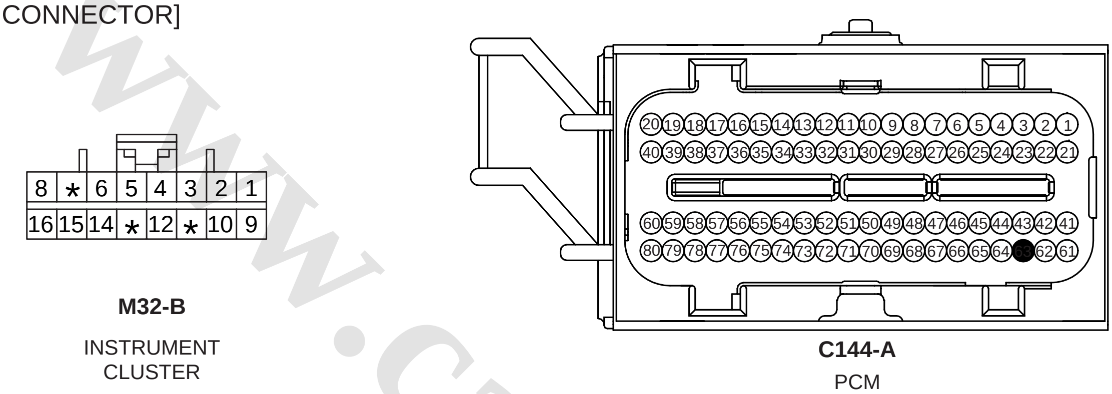
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
M08-3 (5)	Junction BLOCK	Power Supply (B+)
M08-3 (1)	PCM C144-A (63)	MIL IND

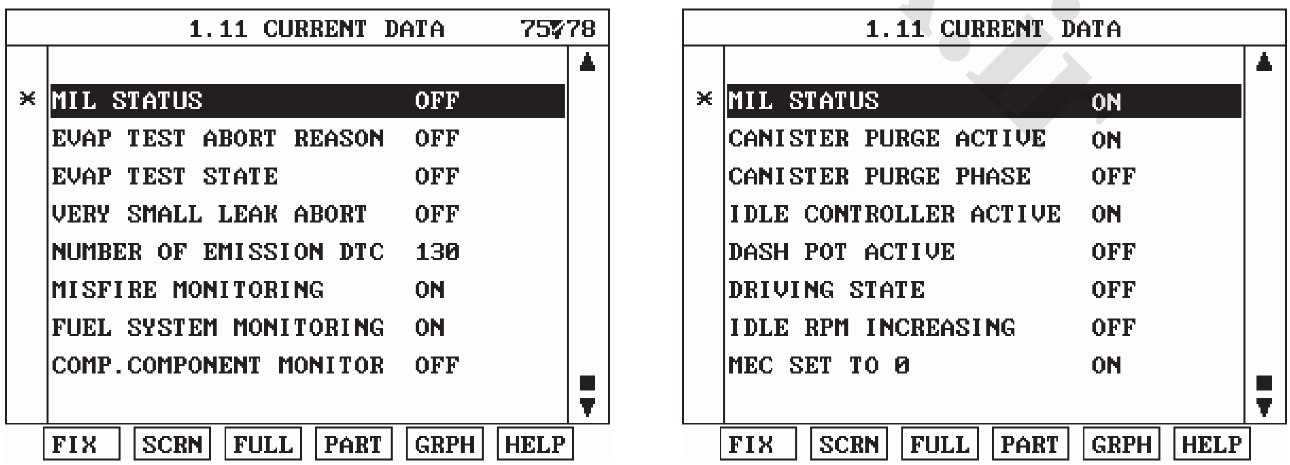
[HARNESS CONNECTOR]



EFBF805A

MONITOR SCANTOOL DATA E06DBB3E

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Compare "Current data" on scantool with "Engine Warning Lamp" on cluster.



EGRF939A

4. Is the current data displayed correctly ?

YES

▶ Fault is intermittent caused by poor contact in Sensor's and/or PCM's connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poor connection,bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and goto "Verification of Vehicle Repair" procedure

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EB38FE0B

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 E77BE09E

1. IG "OFF" and disconnect Instrument cluster connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between terminal 5 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 for open or blown-off.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EE297164

1. IG "OFF" and disconnect PCM connector.
2. IG "ON" and ENG "OFF"
3. Measure voltage between 63 of PCM harness connector 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 E5914C71

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E70CB7B6

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.

2. Using a Scantool, Clear the DTCs

3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions

4. Monitor that all rediness test have been verified as " Complete "

5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0651 SENSOR REFERENCE VOLTAGE "B" CIRCUIT OPEN

GENERAL DESCRIPTION EDFDE557

ETC(Electronic Throttle Control Valve) is the device controlling amount of air to engine acccording to driver's intension. Different from the existing mechanical throttle valve which is composed of accelerator pecal and connecting wire cable, ETC consists of a motor, a throttle body and a throttle position sensor. Receiving input signals from electronic accelerator pedal module, PCM lets ETC motor control throttle valve. With ETC, cruise control system works without any additional device.

DTC DESCRIPTION EAD5EFEE

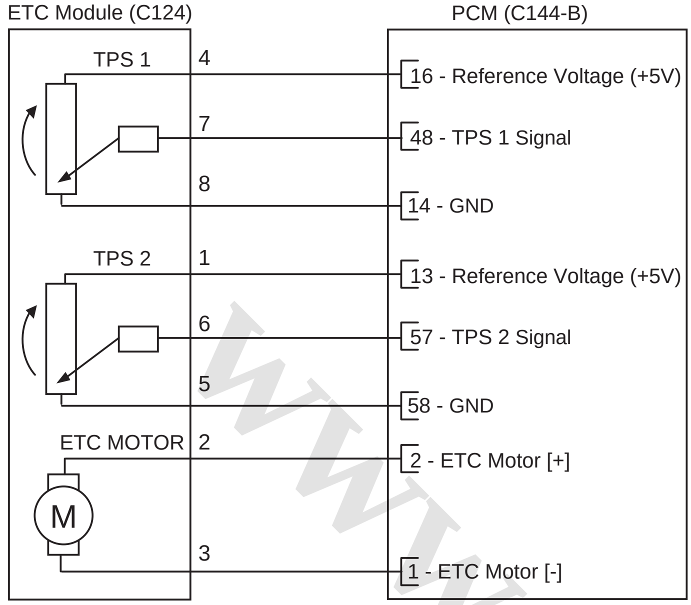
Checking the voltage from sensor power supply every 1.87 sec. under detecting condition, if the value within detecting condition lasts for more than 0.2 sec., PCM sets P0651. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EA2350F2

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 EFA19452

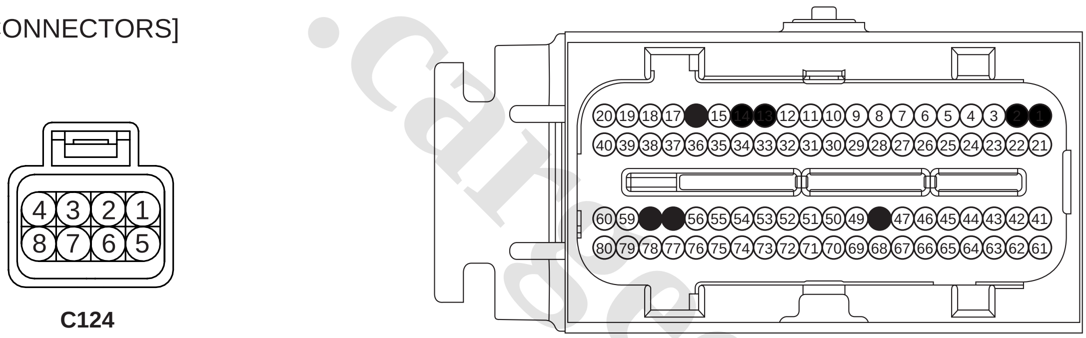
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Funtion
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

EFBF236A

MONITOR SCANTOOL DATA EAC0F3E3

1. Ignition "OFF"
2. Connect Scantool and Engine "ON"
3. Monitor "TPS1, TPS2" items on Current Data

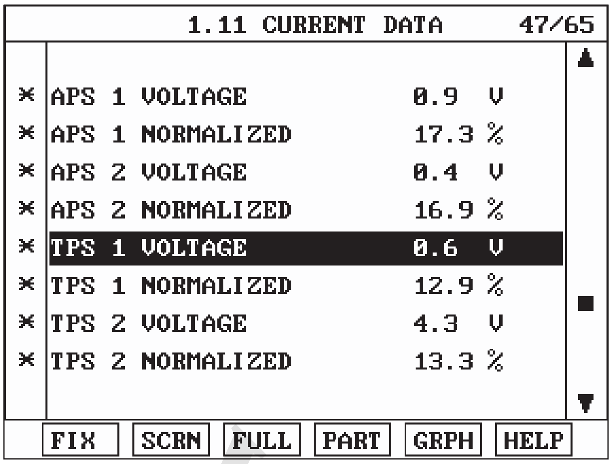


Fig. 1

Fig1)TPS1/2 at idle

EGRF942A

4. Are those related current data displayed correctly ?

YES

▶ Fault is intermittent caused by poor contact in Sensor' s and/or PCM' s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poor connection,bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and goto "Verification of Vehicle Repair" procedure

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E8897E88

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 E1E6680B

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.(It will takes 10 second)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR EF5444F8

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "

5. Are any DTCs present ?

YES

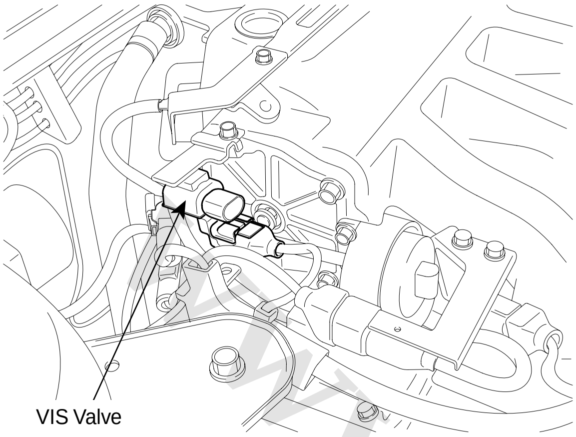
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0660 INTAKE MANIFOLD TUNING VALVE CONTROL CIRCUIT/OPEN (BANK 1)

COMPONENT LOCATION E3F279C9



EGRF945A

GENERAL DESCRIPTION E531F3F8

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 hign. PCU controlls VIS using RPM signal.

DTC DESCRIPTION E776DF00

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.

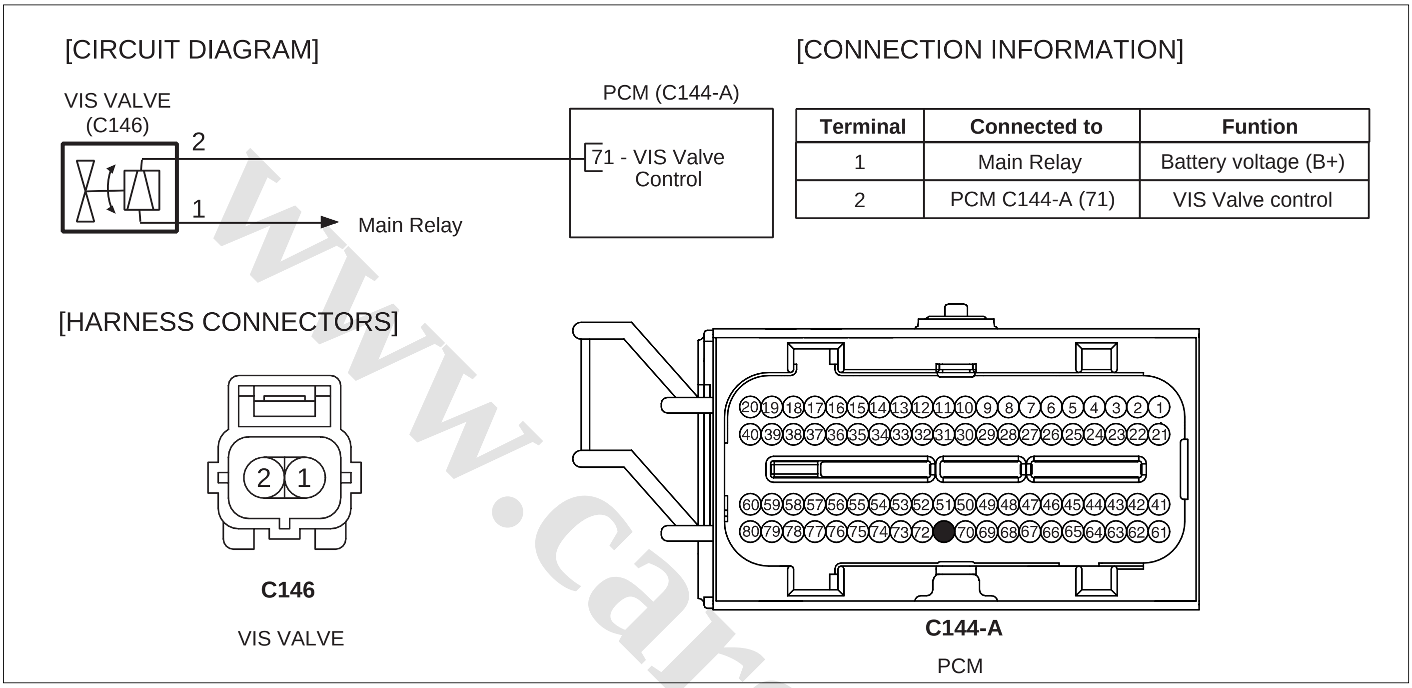
DTC DETECTING CONDITION ECDC74A7

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal low, high	• Poor connection • Open or short in VIS circuit • Faulty VIS • Faulty PCM
Enable condition	• After 0.5 sec under conditions below • Engine works • 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 EA034D47

Item	Specification
Coil Resistance (Ω)	21.8 ~ 28.5Ω [22℃ (71.6˚F)]

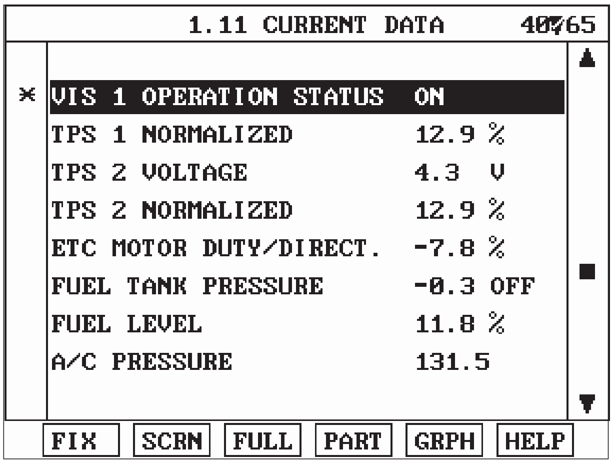
SCHEMATIC DIAGRAM E628C186



EFBF259A

MONITOR SCANTOOL DATA E8668FB3

1. IG "OFF" & connect scantool.
2. ENG "ON" and warm -up the engine to normal operating temperature.
3. Monitor "VIS 1" item on the service data.



VIS ON at idle

EGRF946A

4. Is the related current data displayed correctly ?

YES

▶ Fault is intermittent caused by poor contact in Sensor's and/or PCM's connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poor connection,bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and goto "Verification of Vehicle Repair" procedure

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E0DC3297

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 E32701E6

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

Specification :	Approx. B+

4. Is the measured voltage within specification?

YES

▶ Go to "Control Circuit Inspection" procedure.

NO

▶ Check fuse connected to power of VIS for open or blown-off.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E0A57A22

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.

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.

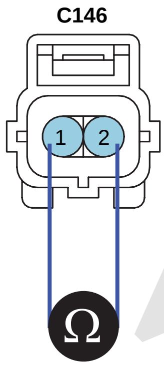
COMPONENT INSPECTION EF30463B

1. Check VIS

1) IG "OFF" and disconnect VIS connector.

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

Specification : 21.8 ~ 28.5 Ω [22℃(71.6˚F)]



EFBF951A

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E904FC92

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

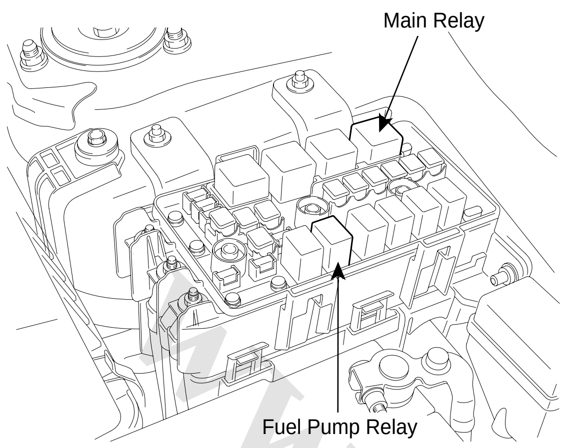
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P0685 ECM/PCM POWER RELAY CONTROL CIRCUIT /OPEN

COMPONENT LOCATION E6BFA784



EFBF903A

GENERAL DESCRIPTION ECB26D71

One terminal of main relay is connected to battery and the other terminal which is ground point is conneted to PCM. PCM monitors the voltages flowing into main relay and going through it.

DTC DESCRIPTION EEC59B96

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 E19FDEEC

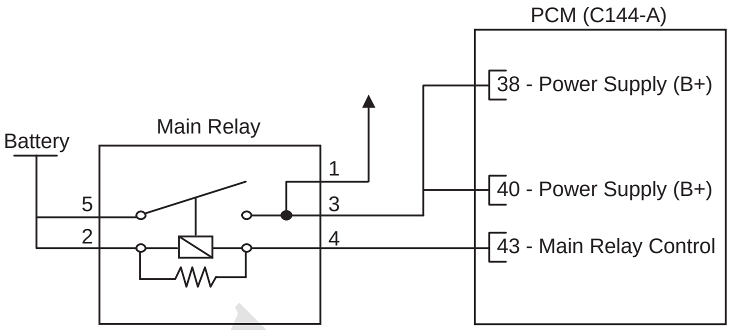
Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground, to battery or open circuit on Main Relay output Fault information provided by an output driver chip.	• Poor Connection • Open or short in control circuit. • Main Relay • PCM
EnableConditions	• Engine Running • 11V ≤ Ignition Voltage ≤ 16V • Enable Time delay ≥ 0.5sec.	
Threshold value	• Open or Short	
DiagnosisTime	• Contineous (More than 5sec. Failure for every 10 sec. test)	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION E183E3CE

Coil Resistance
70Ω ~ 120Ω

SCHEMATIC DIAGRAM E7C0A680

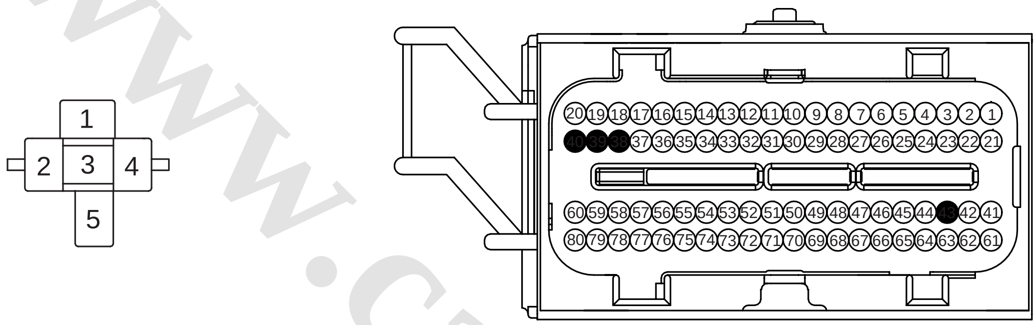
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	-	Power Supply (B+)
2	Battery	Battery Power (B+)
3	PCM C144-A (38)	Power Supply (B+)
	PCM C144-A (40)	
4	PCM C144-A (43)	Main Relay Control
5	Battery	Battery Power (B+)

[HARNESS CONNECTOR]



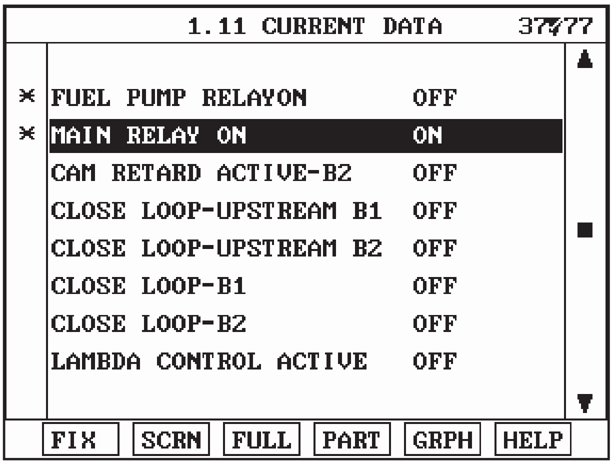
Main Relay

C144-A
PCM

EFBF807A

MONITOR SCANTOOL DATA E969CC94

1. Connect scantool to DLC(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "Main Relay" parameter on scantool.



EGRF953A

4. Is the "Main Relay" parameter displayed correctly ?

YES

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

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EAF21FD7

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

YES

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

NO

▶ Go to " Power Circuit Inspection " procedure.

POWER CIRCUIT INSEPCTION EF2541E0

1. IG "OFF"
2. Disconnect Main Relay
3. IG "ON" & ENG "OFF".
4. Measure voltage between harness terminal 2 of Main Relay and chassis ground.
5. Measure voltage between harness terminal 5 of Main Relay 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 E35EF859

1. Check short in coil control

1) IG "OFF".

2) Disconnect Main Relay and PCM connector.

3) Measure resistance between harness terminal 4 and chassis ground.

4) Measure resistance between harness terminal 4 and 5 of Main Relay.

Specification : Infinite

5) Is the measured resistance within specification ?

YES

▶ Go to "Check open in coil control" as follows.

NO

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

2. Check open in coil control

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 E3F2A279

1. Check Main Relay

1) IG "OFF"

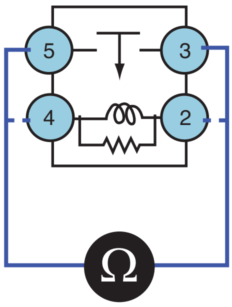
2) Disconnect Main Relay

3) Measure resistance between terminal 5 and 3 of Main Relay

4) Measure resistance between terminal 4 and 2 of Main Relay.

SPECIFICATION :

Terminal	continuity
3 ~ 5	NO
2 ~ 4	YES (Approx. 70Ω ~ 120Ω)



EGRF957A

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 E53E9D30

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

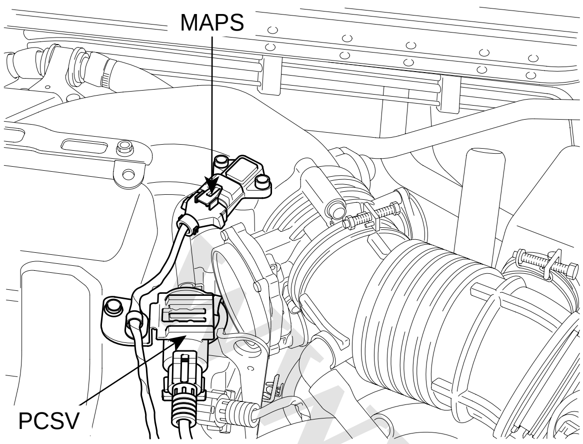
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P1106 MANIFOLD ABSOLUTE PRESSURE SENSOR CIRCUIT SHORT - INTERMITTENT HIGH INPUT

COMPONENT LOCATION E8B83352



EGRF603N

GENERAL DESCRIPTION E69F4F3F

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 output by the transformation of diagphragm according to the change of pressure inside of intake manifold.

DTC DESCRIPTION E4B86AB4

Checking output signals of MAPS every 60 sec. under detecting condition, if an output signal is above 4.5V for more than 2 sec., PCM sets P1106.

DTC DETECTING CONDITION EB5E90C1

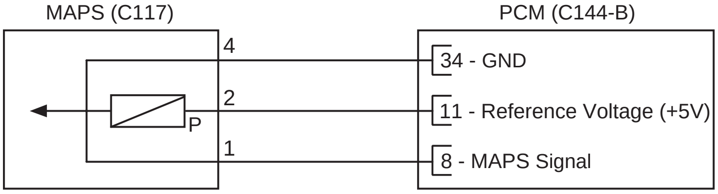
Item		Detecting Condition	Possible Cause
DTC Strategy		• This code detects a intermittent short to high in either the signal circuit or the MAP sensor	• Poor connection • Short to battery in signal circuit • Open in ground circuit • Faulty MAPS • Faulty PCM
Enable-Condi-tions	Case 1	• No TPS Active Fault Present • No TPS Short Fail Criteria Met • Engine Speed 〈 2500rpm • Throttle Position ≤ 30%	
	Case 2	• No TPS Active Fault Present • No TPS Short Fail Criteria Met • Engine Speed 〉 2500rpm • Throttle Position 〉 40%	
Threshold value		• MAP signal 〉 4.5V	
Diagnosis Time		• Continuous (More than 2 sec. failure for every 60 sec. test)	
MIL On Condition		• DTC only (NO MIL ON)	

SPECIFICATION E952C32D

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 E1DCB1A1

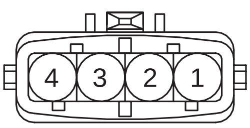
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

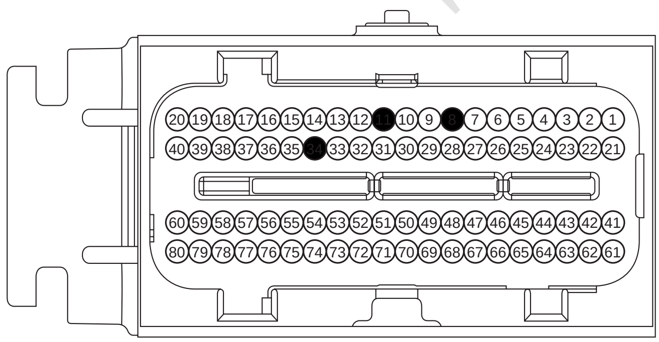
Terminal	Connected to	Funtion
1	PCM C144-B (8)	MAPS Signal
2	PCM C144-B (11)	Reference Voltage (+5V)
3	-	-
4	PCM C144-B (34)	Sensor ground

[HARNESS CONNECTORS]



C117

MAPS

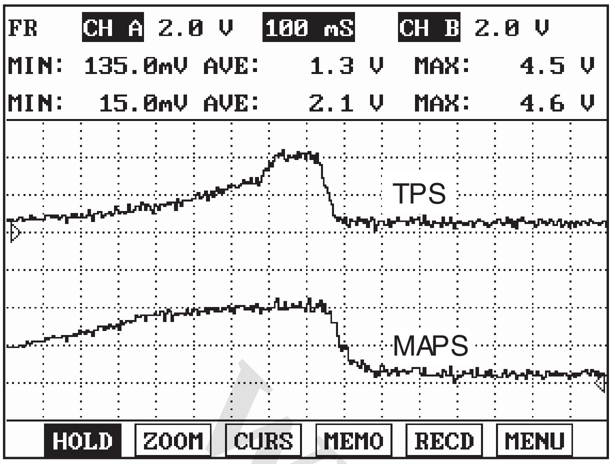


C144-B

PCM

EFBF240A

SIGNAL WAVEFROM AND DATA E53A0822

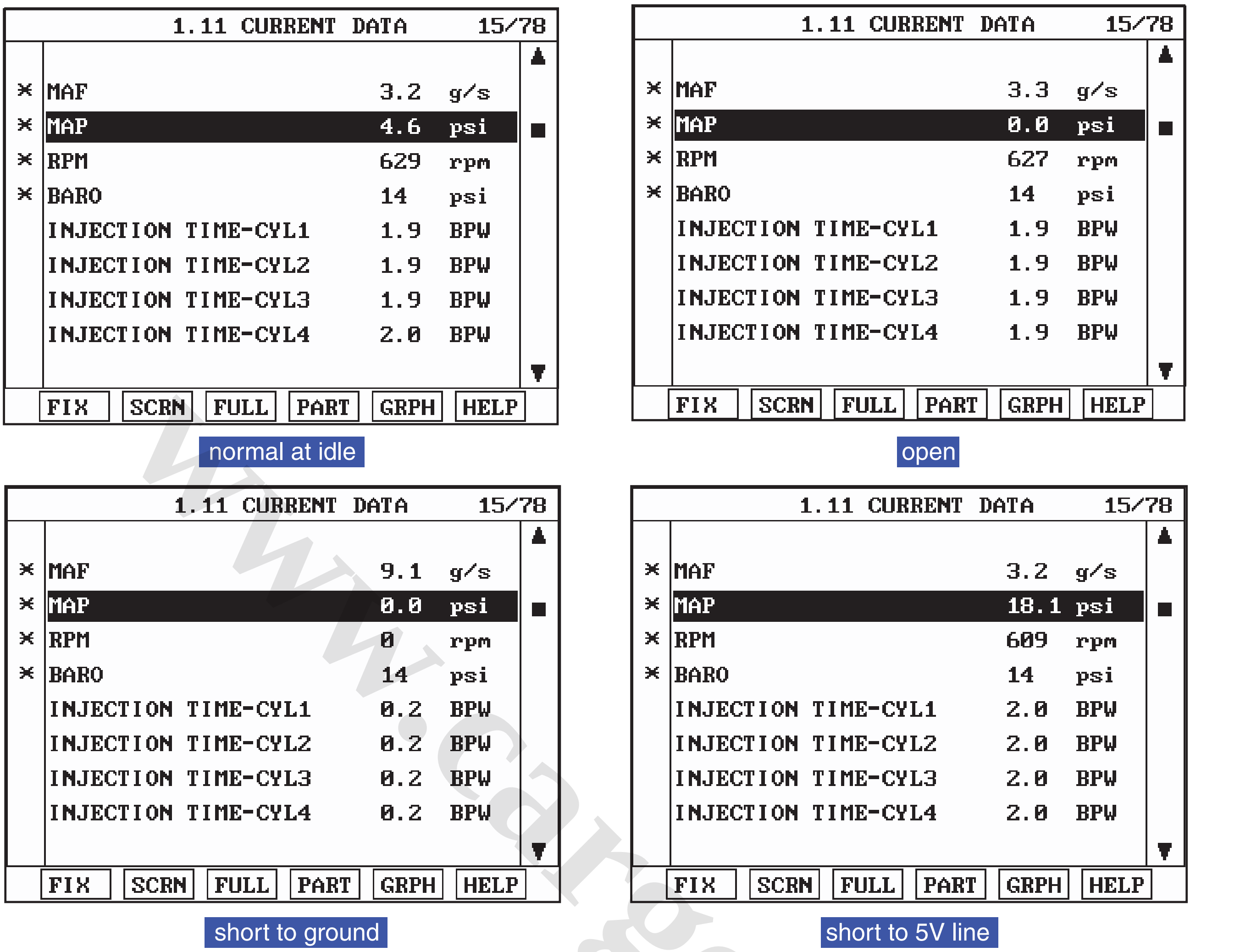


Comparing MAPS and TPS, The signals of MAPS and TPS increasess and decrease simultaneously.

EGRF958A

MONITOR SCANTOOL DATA E4E76F0A

1. Connect scantool to Data Link Connector (DLC)
2. Warm up engine to normal operating temperature
3. Monitor "MAPS" parameter on the scantool.



EGRF959A

4. Is the current data displayed correctly ?

YES

▶Fault is intermittently caused by poor contact in the sensor and/or PCM connector or non cleared PCM memory after repair. 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" .

NO

▶Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E3D97B1F

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found ?

YES

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

NO

▶ Go to "Power Circuit Inspection" procedure.

POWER CIRCUIT INSPECTION E693A024

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 E8C8AF81

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 EEDC0666

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

EC6C50C1

1. MAPS performance test

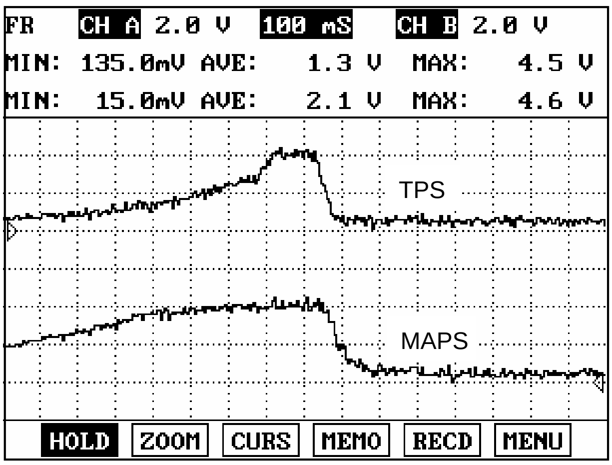
   1) IG "OFF"

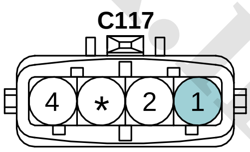
   2) Connect scantool to Data Link Connector(DLC) and select "Oscilloscope" then, connect probes to output signal lines of MAPS and TPS.Turn engine "ON" and monitor the waveforms accelerating or decelerating

   3) Start engine and monitor signal waveform during accelleration and decelleration.

SPECIFICATON :

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





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

EFBF603U

   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".

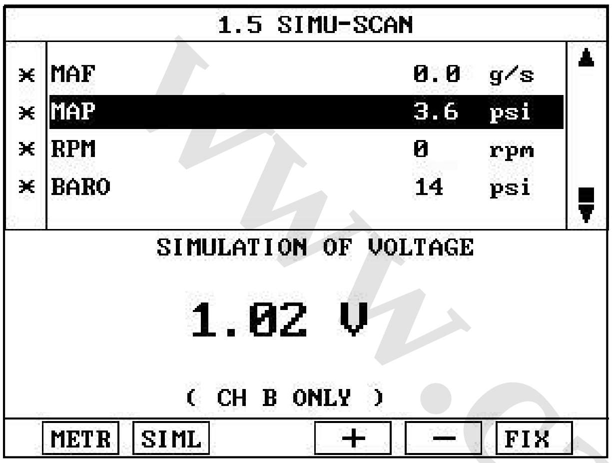
2. Check PCM

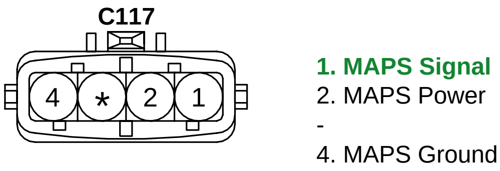
1) IG "OFF" and disconnect MAPS connector.

2) Connect scantool and IG "ON" ＆ ENG "OFF"

3) Select simulation function on scantool.

4) Simulate voltage at terminal 1 of MAPS harness connector.





EFBF604D

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 to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR EF1E9A92

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P1107 MANIFOLD ABSOLUTE PRESSURE SENSOR CIRCUIT SHORT - INTERMITTENT LOW INPUT

COMPONENT LOCATION ECD4A159

Refer to DTC P1106.

GENERAL DESCRIPTION E28BA843

Refer to DTC P1106.

DTC DESCRIPTION E88704B3

Checking output signals of MAPS every 60 sec. under detecting condition, if an output signal is below 0.25V for more than 2 sec., PCM sets P1107.

DTC DETECTING CONDITION EE8288E4

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• This code detects a intermittent short to low or open in either the signal circuit or the MAP</td><td rowspan="7">• Poor Connection
• Open or Short to ground in Power Circuit
• Open or short to ground in Signal Circuit.
• Faulty MAPS
• Faulty PCM</td></tr>
<tr><td rowspan="2">Enable Condi-tions</td><td>Case 1</td><td>• No TPS Active Fault Present
• No TPS Short Fail Criteria Met
• Ignition Voltage ≥ 11V
• Engine Speed 〈 1000rpm
• Throttle Position ≤ 0%</td></tr>
<tr><td>Case 2</td><td>• No TPS Active Fault Present
• Ignition Voltage ≥ 11V
• Engine Speed 〉 1000rpm
• Throttle Position 〉 30%</td></tr>
<tr><td colspan="2">Threshold value</td><td>• MAP signal 〈 0.25V</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(More than 2 sec. failure for every 60 sec. test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• DTC only (NO MIL ON)</td></tr>
</table>

SPECIFICATION E5EBE44E

Refer to DTC P1106.

SCHEMATIC DIAGRAM E08418DF

Refer to DTC P1106.

SIGNAL WAVEFORM AND DATA E57CBB19

Refer to DTC P1106.

MONITOR SCANTOOL DATA E69C7FF7

Refer to DTC P1106.

TERMINAL AND CONNECTOR INSPECTION E389F7B6

Refer to DTC P1106.

POWER CIRCUIT INSPECTION ECE6E6BA

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 E50496EB

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 open in the harness" of MAPS.

   NO

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

2. Check open in the harness
   1) IG "OFF"
   2) Disconnect MAPS and PCM connector.
   3) Measure the resistance between terminal 1 of MAPS harness connector and terminal 8 of PCM harness connector

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 EE6ABE7E

1. MAPS performance test

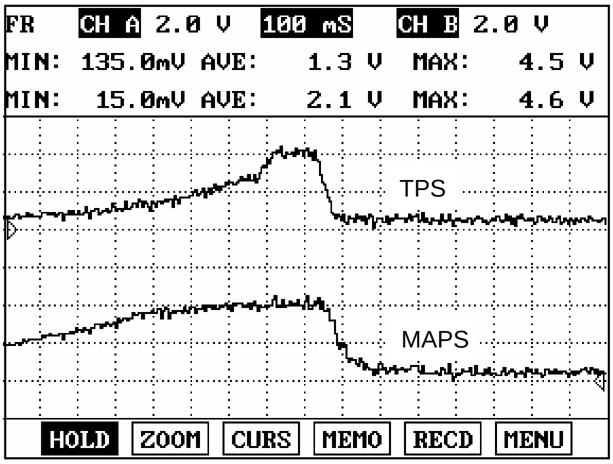
1) IG "OFF"

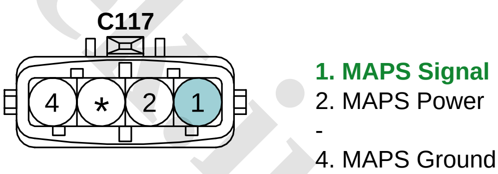
2) Connect scantool to Data Link Connector(DLC) and select "Oscilloscope" then, connect probes to output signal lines of MAPS and TPS.Turn engine "ON" and monitor the waveforms accelerating or decelerating

3) ENG "ON" and monitor signal waveform during accelleration and decelleration.

SPECIFICATON :

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





EFBF603U

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".

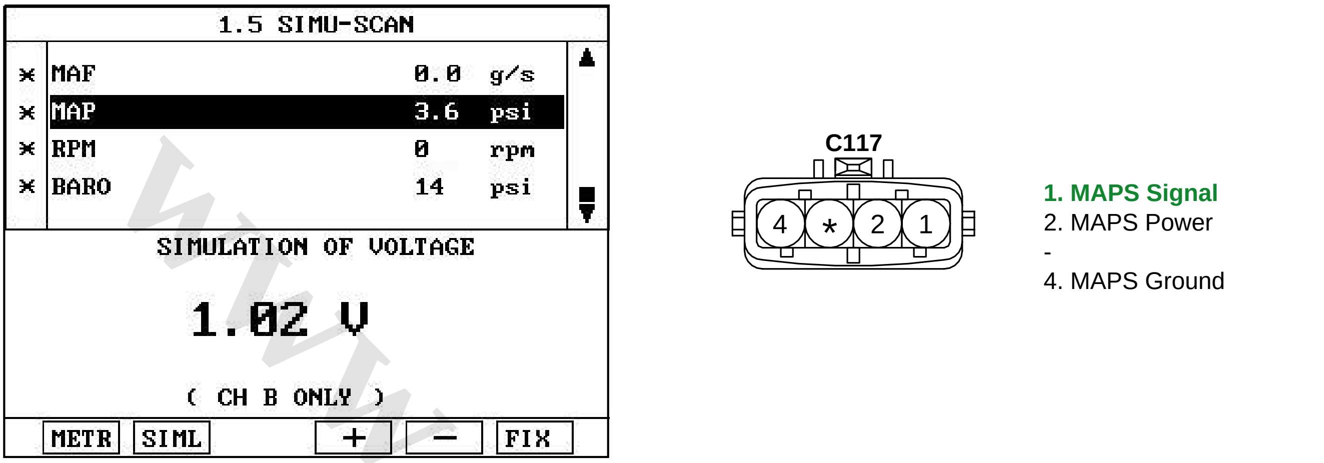
2. Check PCM

   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.



EFBF604D

   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

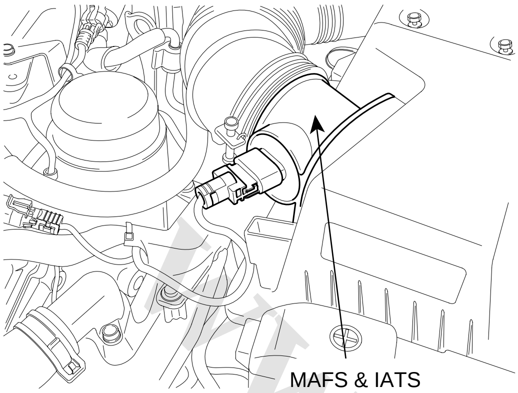
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM.Before or after testing PCM on the vehicle, use this function to reuse the PCM on the others

VERIFICATION OF VEHICLE REPAIR E063F0D4

Refer to DTC P1106.

DTC P1111 INTAKE AIR TEMPERATURE SENSOR CIRCUIT SHORT - INTERMITTENT HIGH INPUT

COMPONENT LOCATION EA7FF9A8



EFBF602Y

GENERAL DESCRIPTION EDC27789

The Intake Air Temperature (IAT) sensor measures the temperature of engine intake air. The Intake Air Temperature (IAT) sensor is a thermistor (a variable resistor that changes along with outside air temperature) in series with a fixed resistor in the PCM. The PCM applies 5V to the IAT sensor. The PCM monitors the voltage across the IAT sensor and converts it into a temperature reading. When the outside air temperature is cold the IAT sensor resistance is high, and when the outside air temperature is warm the IAT sensor resistance is low. Therefore, when the air temperature is cold the PCM will receive a high voltage input, and when the air temperature is warm the PCM will receive a low voltage input. The signal from IAT sensor is used for injection time correction, ignition timing correction and idle speed correction(Air-density correction).

DTC DESCRIPTION E387A8EC

Checking output signals of IATS every 120 sec. under detecting condition, if an ouput signal is over 4.9V for more than 4 sec., PCM sets P1111.

DTC DETECTING CONDITION EF257873

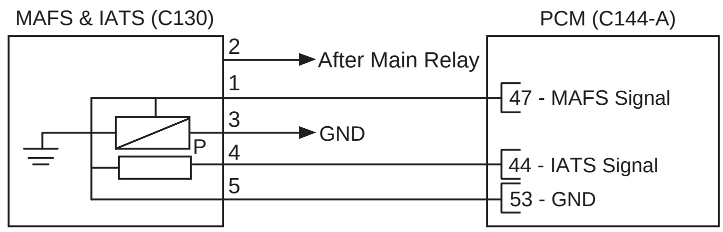
Item		Detecting Condition	Possible Cause
DTC Strategy		• This code detects a continuous short to high in either the signal circuit or the sensor	• Poor Connection • Open or short in signal circuit • Open in ground circuit • Faulty IATS • Faulty PCM
Enable Condi-tions	Case 1	• No VSS Fault Active (No P0501) • No Coolant Short Active Fault Present • No MAF Active Fault Present • Engine Air Flow 〈 15 g/s • Vehicle Speed 〈 25kph • Engine Coolant Temperature 〉 50℃(122 °F) • Engine Running Time 〉 120 sec.	
	Case 2	• No VSS Fault Active (No P0501) • No Coolant Short Active Fault Present • No MAF Active Fault Present • Engine Air Flow 〈 15 g/s • Vehicle Speed 〈 25kph • Ignition off time 〉 360 min. • Engine Coolant Temperature 〉 -10℃(14 °F) • Engine Running	
Threshold value		• IATS signal 〉 4.9V	
Diagnosis Time		• Continuous (More than 4 sec. failure for every 120 sec. test)	
MIL On Condition		• DTC only (NO MIL ON)	

SPECIFICATION E82F03A7

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

SCHEMATIC DIAGRAM ECA4145A

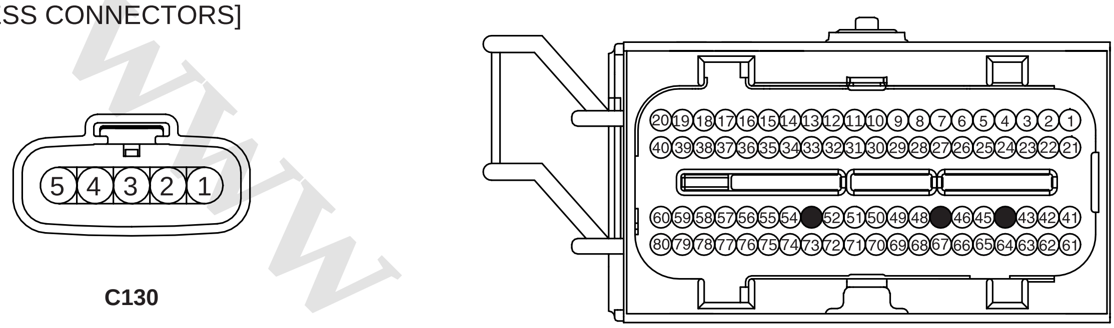
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Funtion
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

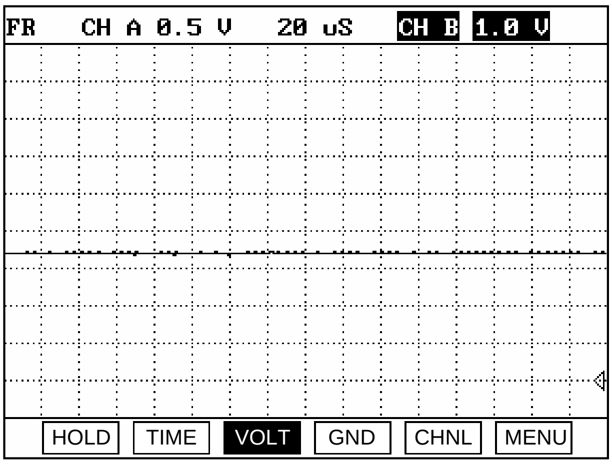
MAFS & IATS

C144-A

PCM

EFBF237A

SIGNAL WAVEFORM AND DATA E929B9A5



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 SCANTOOL DATA E12AC67F

1. IG "OFF" ＆ connect scantool.

2. ENG "ON" and warm -up the engine to normal operating temperature.

3. Monitor "IATS" item on the service data.

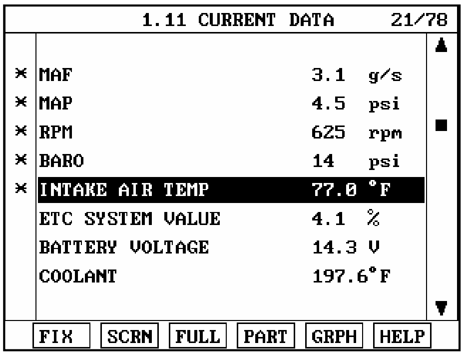


Fig. 1

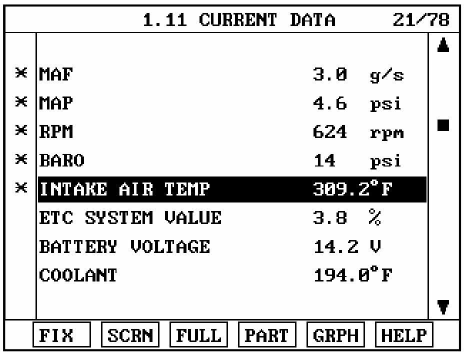


Fig. 2

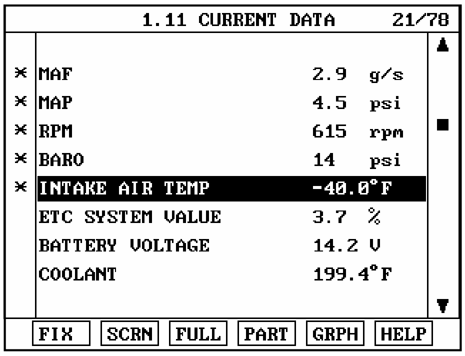


Fig. 3

Fig. 1 : Open at idle
Fig. 2 : Short to ground
Fig. 3 : Short to battery

EGRF604F

4. Is the "IATS" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E6670772

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E3B997F9

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.

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 E6DF45C4

1. IG "OFF" and disconnect IATS connector.

2. Measure voltage between terminal 4 of IATS harness connector and chassis ground.

3. Measure voltage between terminals 4 and 5 of IATS harness connector.

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

4. Is the measured voltage within specification ?

YES

▶ Go to "Component Inspection" procedure.

NO

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

COMPONENT INSPECTION EF0E24A1

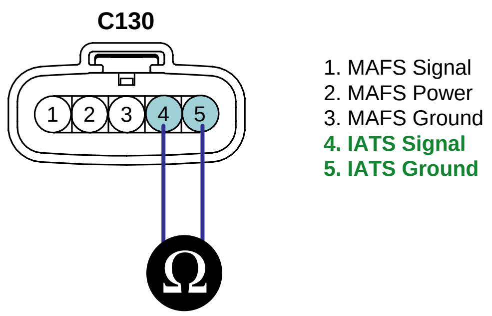
1. Check IATS

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



EFBF604I

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.

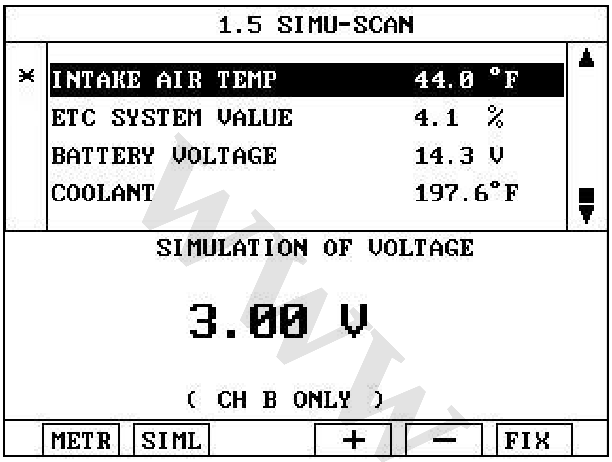
2. Check PCM

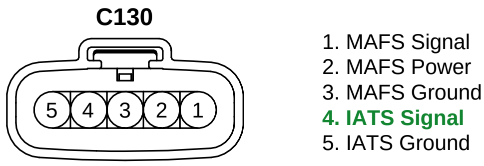
   1) IG "OFF" and connect scantool.

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

   3) IG "ON" and ENG "OFF" and simulation Function on scantool.

   4) Simulate voltage at terminal 4 of IATS harness connector.





EGRF604J

   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 to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR E4257603

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P1112 INTAKE AIR TEMPERATURE SENSOR CIRCUIT SHORT - INTERMITTENT LOW INPUT

COMPONENT LOCATION E2D66158

Refer to DTC P1111.

GENERAL DESCRIPTION EF0CEE2C

Refer to DTC P1111.

DTC DESCRIPTION E66FEA8F

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 P1112.

DTC DETECTING CONDITION E7829464

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 signal circuit. • Faulty IATS • Faulty PCM
Enable Conditions	Case 1	• Engine Run State • No VSS Fault Active • Vehicle Speed 〉 50kph(31mph) • IAT Short Low Enable Criteria Met	
	Case 2	• Engine Running Time 〉 120sec. • IG "OFF" time 〉 360min. • IAT Short Low Enable Criteria Met	
Threshold value		• IATS signal 〈 0.1V	
Diagnosis Time		• Continuous (More than 10 sec. failure for every 20 sec. test)	
MIL On Condition		• DTC only	

SPECIFICATION EBDB6F6A

Refer to DTC P1111.

SCHEMATIC DIAGRAM E1F5C6AD

Refer to DTC P1111.

SIGNAL WAVEFORM AND DATA E6D232C9

Refer to DTC P1111.

MONITOR SCANTOOL DATA E49CED71

Refer to DTC P1111.

TERMINAL AND CONNECTOR INSPECTION E84DE33F

Refer to DTC P1111.

SIGNAL CIRCUIT INSPECTION EE5A37D7

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 EB45C356

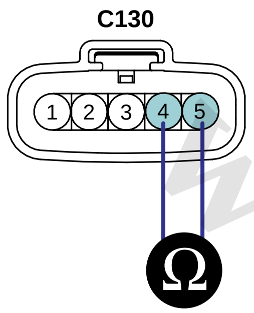
1. Check IATS

    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**

EFBF604I

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.

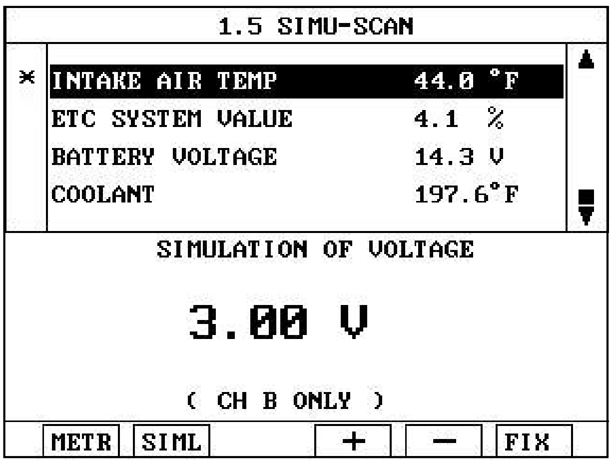
2. Check PCM

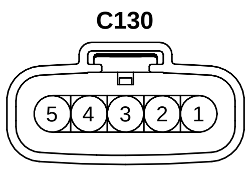
1) IG "OFF" and connect scantool.

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

3) IG "ON" and ENG "OFF" and 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

EGRF604J

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

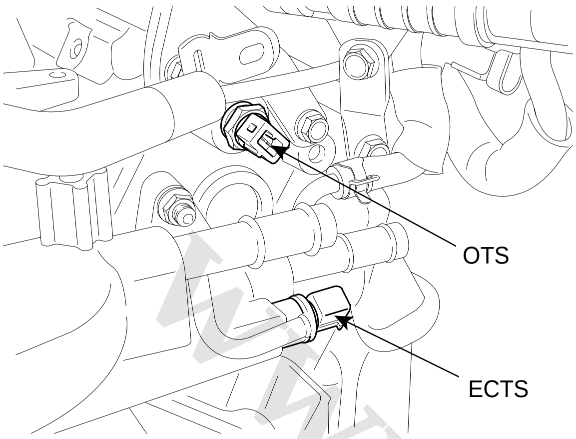
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM.
Before or after testing PCM on the vehicle, use this function to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR EE674A80

Refer to DTC P1111.

DTC P1114 ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT INTERMITTENT LOW INPUT

COMPONENT LOCATION EDF4C9FD



EGRF604O

GENERAL DESCRIPTION E87BC6E8

The Engine Coolant Temperature(ECT) Sensor measures the temperature of engine coolant. The Engine Coolant Temperature (ECT) Sensor is located near the thermostat housing of the cylinder head. ECT Sensor is a thermistor (A Variable Resistor that Changes Along with ECT) in series with a fixed resistor in the Engine Control Module (PCM). The PCM applies 5 volts to the ECT sensor. The PCM monitors the voltage across the ECT sensor and converts it into a temperature reading. When the engine is cold the ECT sensor resistance is high, and when the engine is warm the ECT sensor resistance is low. Therefore, when the engine is cold the PCM will receive a high voltage input, and when the engine is warm the PCM will receive a low voltage input. The signal from ECT sensor is used for Injection, ignition timing, idle speed and cooling fan control.

DTC DESCRIPTION E575FA6B

Checking output signals from ECTS every 120 sec. under detecting condition, if an output signal is below 0.1V for more than 4 sec., PCM sets P1114.

DTC DETECTING CONDITION EC901ED1

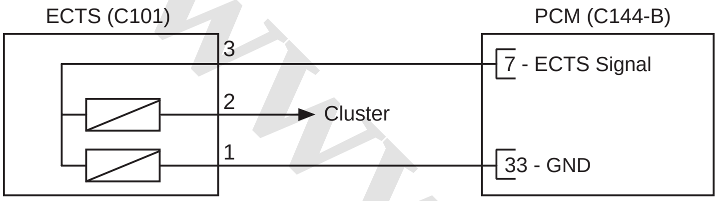
Item		Detecting Condition	Possible Cause
DTC Strategy		• This code detects a intermittent short to ground in the signal circuit or the sensor	• Poor Connection • Short to ground in signal Circuit • Faulty ECTS • Faulty PCM
Enable Conditions	Case 1	• Engine Running Time 〉 120sec.	
	Case 2	• Soak Time 〉 360min. • Engine Running	
Threshold value		• Coolant signal 〈 0.1V	
Diagnosis Time		• Continuous (More than 4 sec. failure for every 120 sec. test)	
MIL On Condition		• DTC only (NO MIL ON)	

SPECIFICATION E912CC79

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 E5DE565E

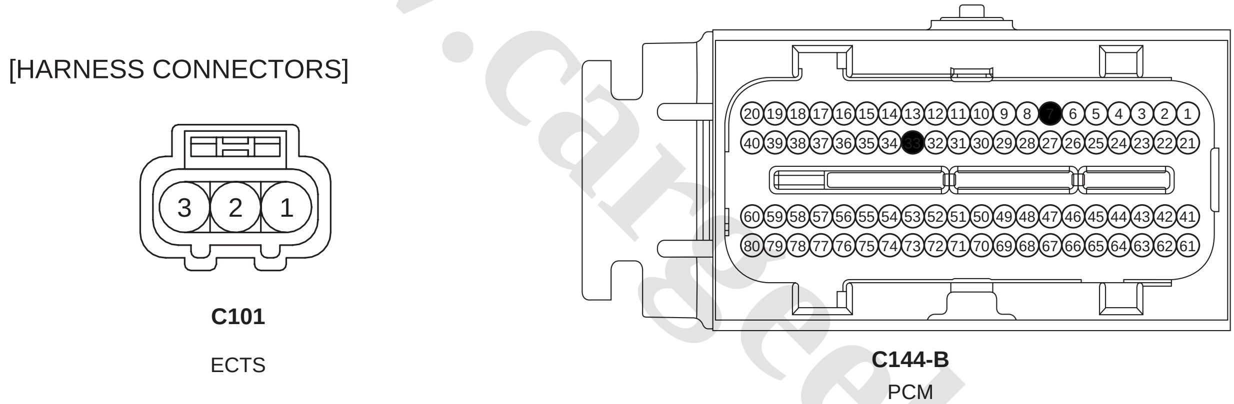
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

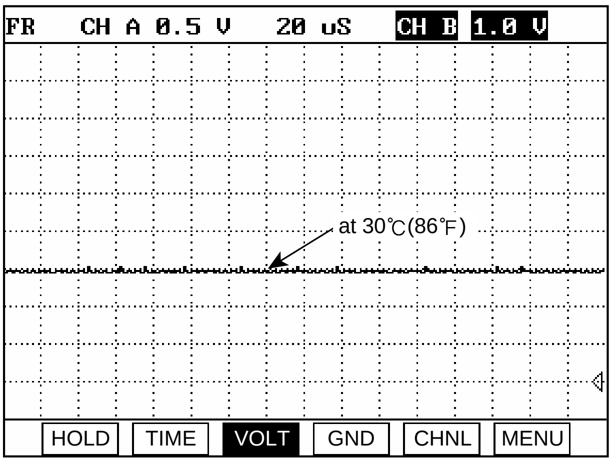
Terminal	Connected to	Funtion
1	PCM C144-B (33)	Sensor ground
2	Cluster	-
3	PCM C144-B (7)	ECTS Signal

[HARNESS CONNECTORS]



EFBF242A

SIGNAL WAVEFORM AND DATA E5EDC4D9



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 SCANTOOL DATA E2AC3164

1. IG "OFF" & connect scantool.

2. ENG "ON" and warm -up the engine to normal operating temperature.

3. Monitor "Monitor "ECTS" status on the service data." item on the service data.

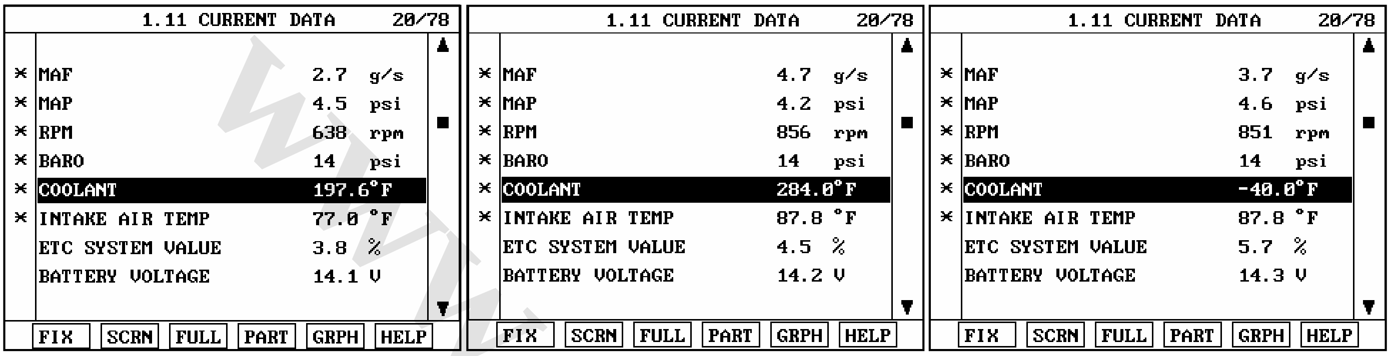


Fig. 1 Fig. 2 Fig. 3

Fig. 1 : Normal at Idle
Fig. 2 : Short to ground at idle
Fig. 3 : Open or short to battery at idle

EGRF604Q

4. Is the "ECTS" data displayed correctly ?

YES

▶ 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

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION E63BD28F

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION EDB2ECC4

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 E1E97041

1. Check ECTS

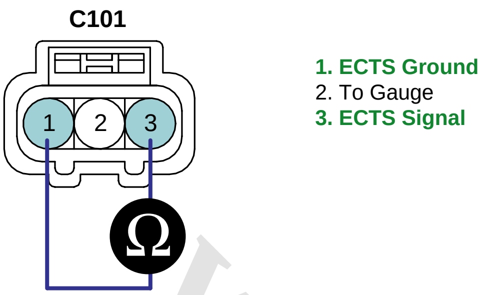
   1) IG "OFF" and disconnect ECTS connector.

   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		



EFBF604T

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.

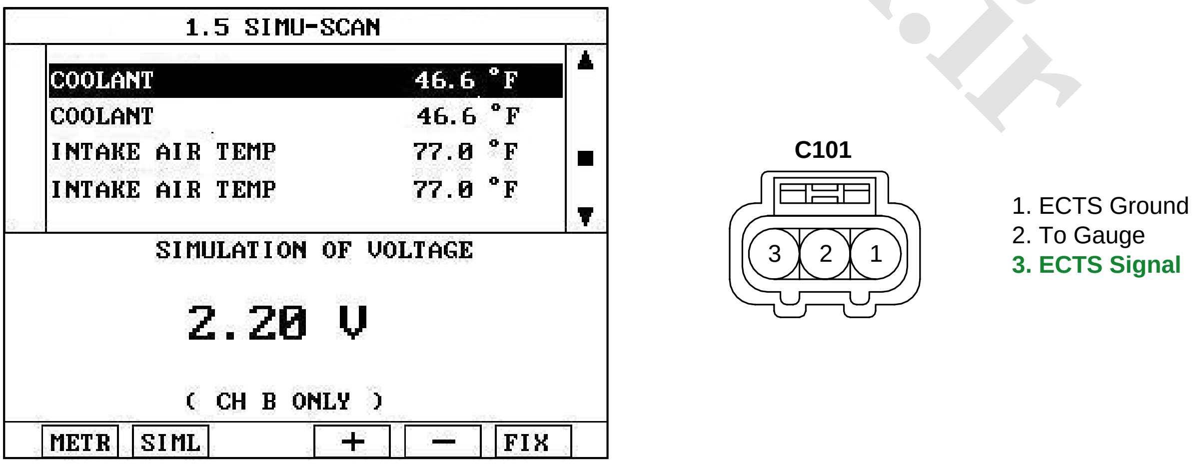
2. Check PCM

1) IG "OFF" and connect scantool.

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

3) IG "ON" and ENG "OFF" and simulation Function on scantool.

4) Simulate voltage at terminal 3 of ECTS harness connector.



EGRF604U

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 to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR EBFFA33F

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P1115 ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT - INTERMITTENT HIGH INPUT

COMPONENT LOCATION EC35DFAD

Refer to DTC P1114.

GENERAL DESCRIPTION EAC505DA

Refer to DTC P1114.

DTC DESCRIPTION EA763978

Checking output signals from ECTS every 120 sec. under detecting condition, if an output signal is above 4.9V for more than 4 sec., PCM sets P1115.

DTC DETECTING CONDITION E3A7157F

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• This code detects a intermittent open or short to battey in the signal circuit or the sensor</td><td rowspan="6">• Poor Connection
• Open or short to battery in signal Circuit
• Open in Ground Circuit.
• Faulty ECTS
• Faulty PCM</td></tr>
<tr><td rowspan="2">Enable Condi-tions</td><td>Case 1</td><td>• Engine Running Time > 120sec.</td></tr>
<tr><td>Case 2</td><td>• Soak Time > 360min.
• Engine Running</td></tr>
<tr><td colspan="2">Threshold value</td><td>• Coolant signal > 4.9V</td></tr>
<tr><td colspan="2">Diagnosis Time</td><td>• Continuous
(More than 4 sec. failure for every 120 sec. test)</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• DTC only (NO MIL ON)</td></tr>
</table>

SPECIFICATION E38DCF2F

Refer to DTC P1114.

SCHEMATIC DIAGRAM EA60115F

Refer to DTC P1114.

SIGNAL WAVEFORM AND DATA EDAE426C

Refer to DTC P1114.

MONITOR SCANTOOL DATA EFCD816D

Refer to DTC P1114.

TERMINAL AND CONNECTOR INSPECTION EEDF6866

Refer to DTC P1114.

SIGNAL CIRCUIT INSPECTION E3621080

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.

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 EA16DBD8

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

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

4. Is the measured voltage within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

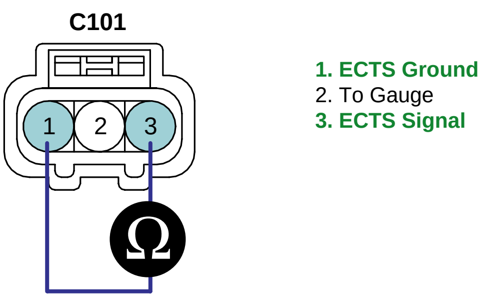
▶ Repair open or contact resistance in harness, and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EDD9D5CC

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		



EFBF604T

   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.

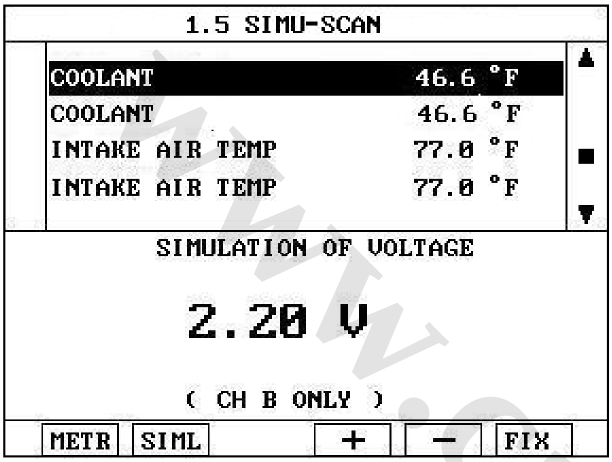
2. Check PCM

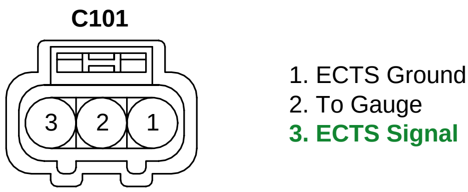
1) IG "OFF" and connect scantool.

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

3) IG "ON" and ENG "OFF" and simulation Function on scantool.

4) Simulate voltage at terminal 3 of ECTS harness connector.





EGRF604U

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

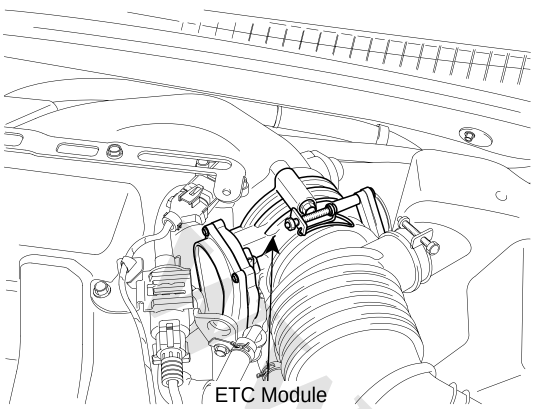
There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by PCM.
Before or after testing PCM on the vehicle, use this function to reuse the PCM on the others.

VERIFICATION OF VEHICLE REPAIR E4955236

Refer to DTC P1114.

DTC P1295 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - POWER MANAGEMENT

COMPONENT LOCATION E5286AF9



EFBF961A

GENERAL DESCRIPTION E1200EDE

ETC(Electronic Throttle Control Valve) is the device controlling amount of air to engine acccording to driver's intension. Different from the existing mechanical throttle valve which is composed of accelerator pecal and connecting wire cable, ETC consists of a motor, a throttle body and a throttle position sensor. Receiving input signals from electronic accelerator pedal module, PCM lets ETC motor control throttle valve. With ETC, cruise control system works without any additional device.

DTC DESCRIPTION E19184D4

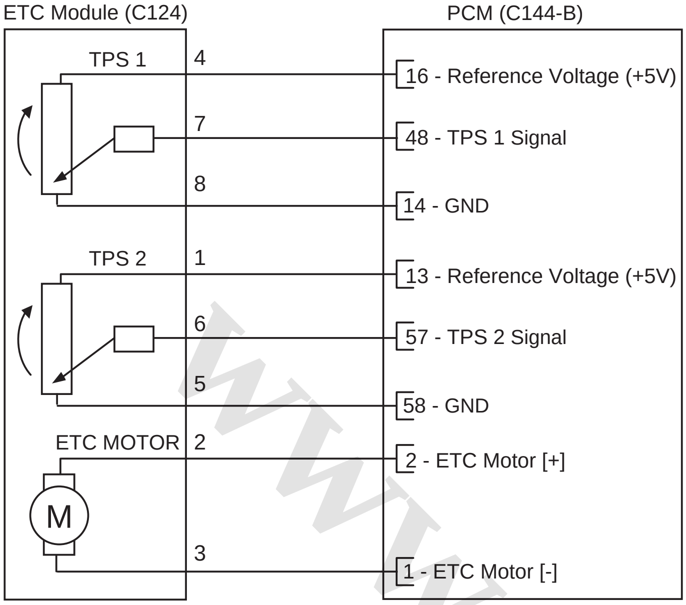
If power management mode is recognized under detecting condition, PCM sets P1295. And MIL(Malfunction Indication Lamp) turns on.

DTC DETECTING CONDITION EEB7C279

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	

SCHEMATIC DIAGRAM E3417A14

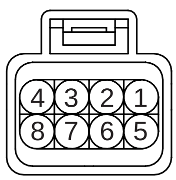
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

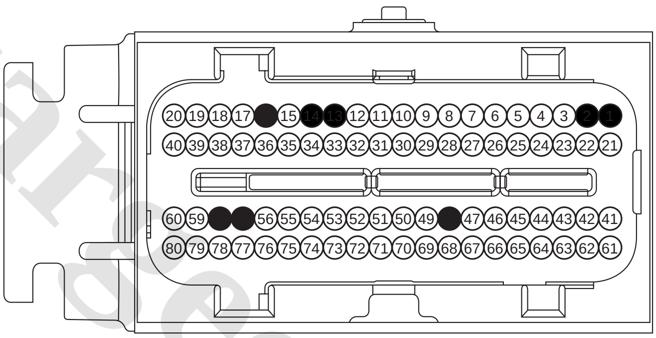
Terminal	Connected to	Funtion
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144- B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM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

[HARNESS CONNECTORS]



C124

ETC MODULE



C144-B

PCM

EFBF236A

MONITOR SCANTOOL DATA E42BFF87

1. Connect scantool to DLC(Data Link Connector)

2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
(There will be at least one more DTC which causes this DTC P1295 to retrieve)

3. Repair the DTCs cause DTC P1295 first according to the designated trouble shooting guide.
(After repairing the DTCs cause DTC P1295, don't forget to do "ETC Initialization" as follows.

4. Is the same DTC occurred ?

YES

▶Substitute with a known-good 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 to reuse the PCM on the others

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.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E983186F

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P1523 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - THROTTLE VALVE STUCK

COMPONENT LOCATION EFCEE1A8

Refer to DTC P1295.

GENERAL DESCRIPTION EC33BE0E

Refer to DTC P1295.

DTC DESCRIPTION E90728C8

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 E70ABE9A

Item	Detecting Condition	Possible cause
DTC Strategy	• This code detects when throttle fails to return to the unpowered default position when power to the ETC motor is turned off.	• Carbon in throttle • Broken Throttle return spring • throttle sticky • throttle icy • PCM
EnableConditions	• Throttle Actuation Mode Previous NOT Off • Throttle Actuation Mode is Off • ETC Power Control Mode = Normal • TPS 1 & 2 = normal • Sensor Supply voltage = Normal	
Threshold value	• If throttle did not return to default range within calculated seconds of turning off, increment fail count.	
DiagnosisTime	• Continuous	
MIL On Condition	• DTC only (NO MIL ON)	

SPECIFICATION E05CEC78

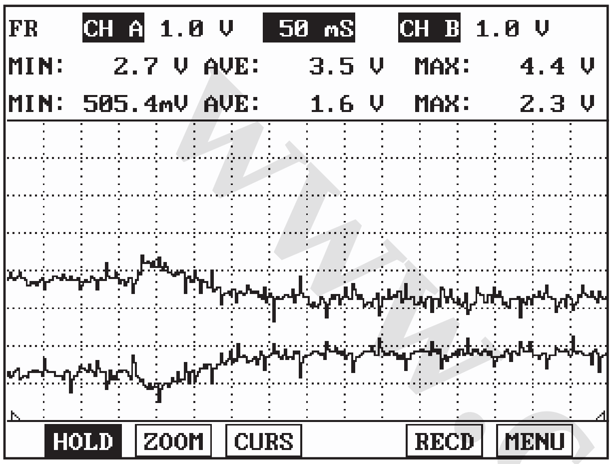
Throttle opening (°)	Output voltage (V) [Vref = 5.0V]	
	TPS1	TPS2
0°	0.0V	5.0V
10°	0.5V	4.5V
20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V

100°	4.5V	0.5V
110°	5.0V	0.0V

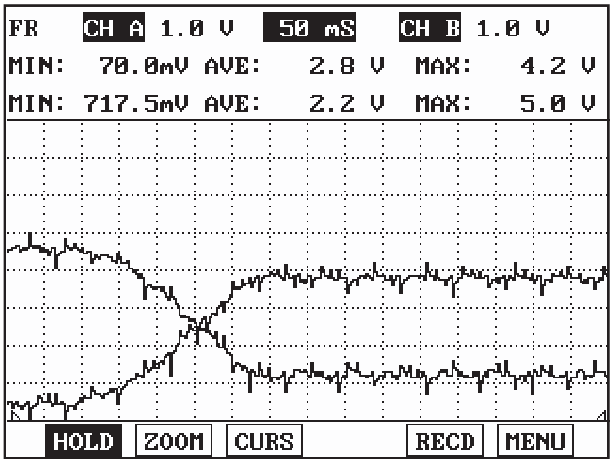
SCHEMATIC DIAGRAM E1DAE546

Refer to DTC P1295.

SIGNAL WAVEFROM AND DATA E950E387



Stepping on accelleraton pedal.



Pulling out accelleration cable with hand.

EGRF963A

MONITOR SCANTOOL DATA EFB36EDF

1. Connect scantool to DLC.(Data Link Connector)
2. IG "ON" & ENG "OFF"
3. Monitor "Throttle Position Sensor" by stepping on and off the accellerator pedal on scantool

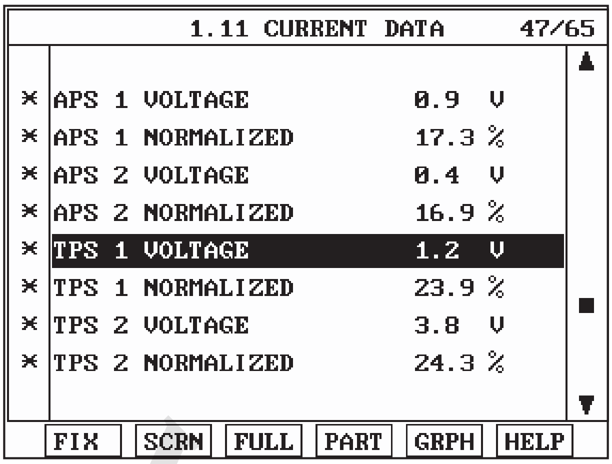


Fig. 1

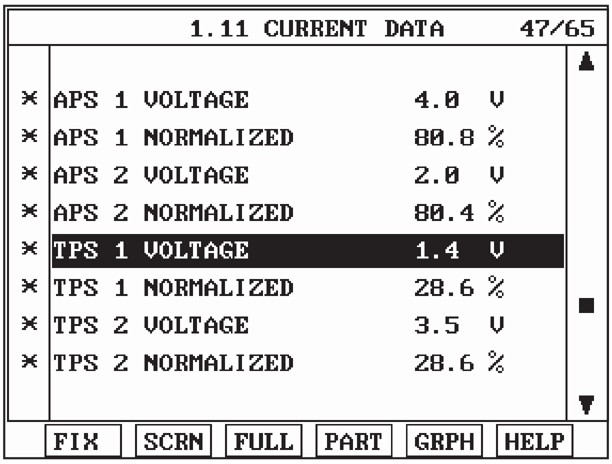


Fig. 2

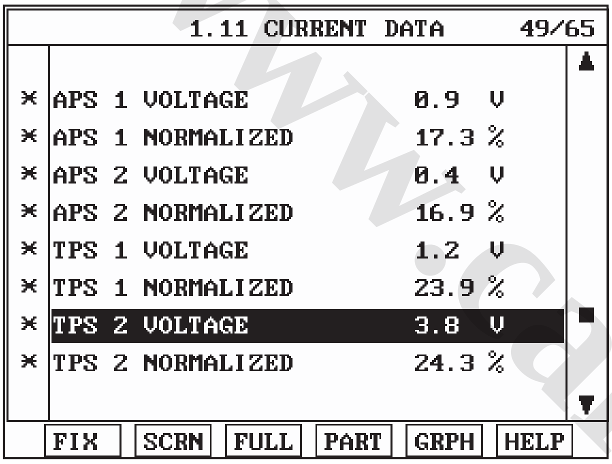


Fig. 3

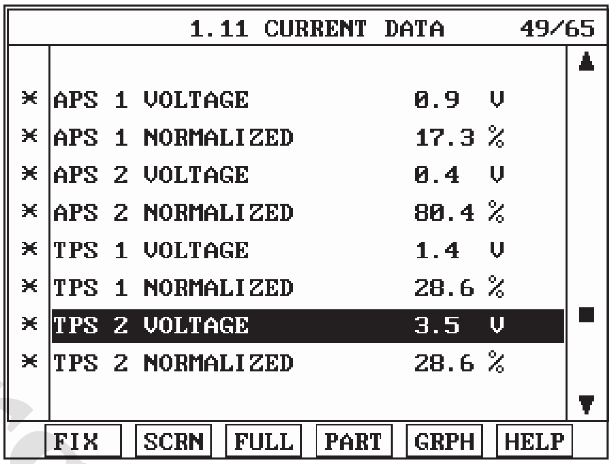


Fig. 4

Fig 1) Service data of TPS1 with IG ON and stepping off the pedal.
Fig 2) Service data of TPS1 with IG ON and stepping on the pedal.
Fig 3) Service data of TPS2 with IG ON and stepping off the pedal.
Fig 4) Service data of TPS2 with IG ON and stepping on the pedal.

EGRF964A

4. Are those parameters related to "TPS" operating correctly ?

YES

▶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

NO

▶Go to "System Inspection" procedure.

SYSTEM INSPECTION E73F80AA

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

▶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 to reuse the PCM on the others

NO

▶ Repair or replace as necessary and then, do ETS Initialization" as follows. then, go to "Verification of Vehicle Repair" procedure.

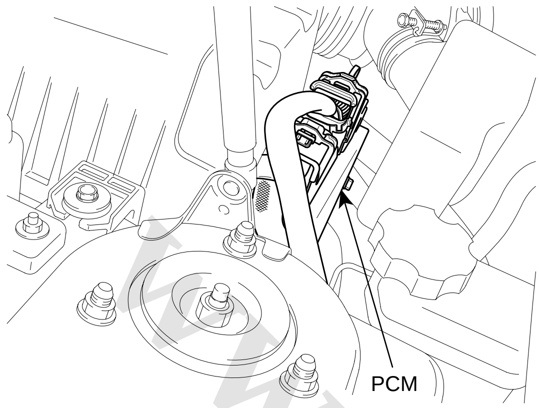
※ Procedure of ETS Initialization
1. Erase the trouble codes on PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E841B9B1

Refer to DTC P1295.

DTC P161B ECM/PCM INTERNAL ERROR - TORQUE CALCULATION

COMPONENT LOCATION E20B4E89



EFBF966A

GENERAL DESCRIPTION EFEF8FE8

Comparing actual torque and desired torque, PCM diagnoses calculated torque state. Actual torque keeps lower than desired torque, PCM checks if actual torque is higher than desired torque. deviding condition into two state, dynamic and steady states, PCM applies different diagnosis logic. Because the responses due to this code is similar to that of MAF control error, checking MAF at first.

DTC DESCRIPTION EAA10EE2

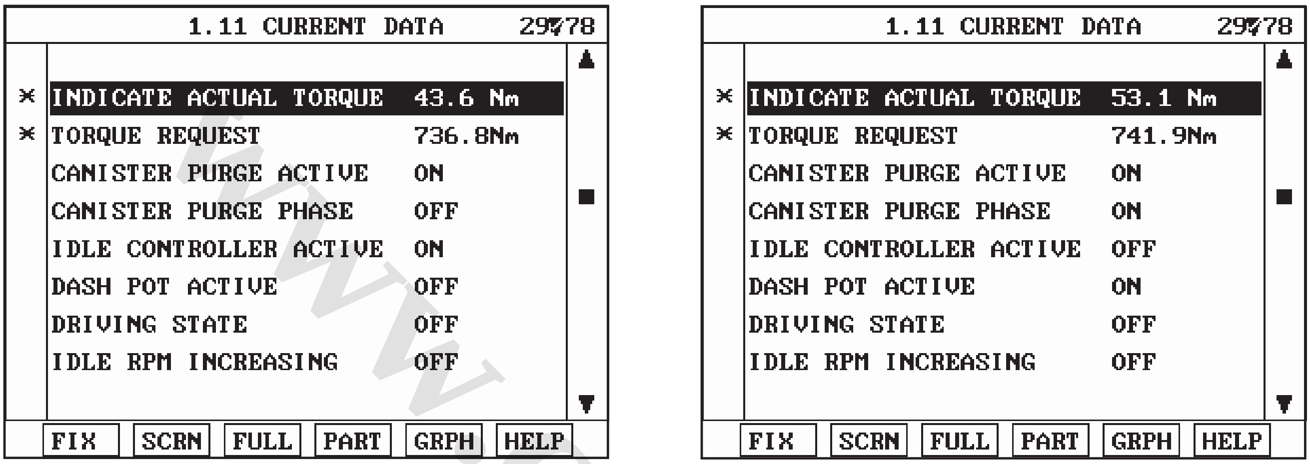
If the difference between actual torque and desired torque is higher than the threshold value, PCM sets P161B and MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION E821AB5F

ITEM		Detecting Condition	Possible Cause
DTC Strategy		• Determines if Delivered Torque Is Grossly Different fromDesired Torque	• Intake air leakage • Faulty ETS System • Clogged exhaust system • Faulty PCM
Enable Conditions	Case 1	• Engine Running state • Engine Speed 〉 600rpm • Desired Flywheel Torque Within 20Nm 〉 1sec.	
	Case 2	• Pedal Position 〈 0.8% • Torque Command Source = Accel pedal • Engine Speed 〉 desired torque engine speed • All injectors enabled	
Threshold value	Case 1	• Actual net torque-desired torque 〉 threshold	
	Case 2	• Normalized fuel flow 〉 threshold	
Diagnosis Time		• Continuous	
MIL On Condition		• 1 Driving Cycle	

MONITOR SCANTOOL DATA E3A2FEBC

1. Conect scantool to DLC(Data Link Connector)
2. Warm-up the engine to normal operating temperature.
3. Monitor "Actual Torque ＆ Torque Request" parameters on scantool
4. Monitor DTC related to "ETS or CAM" on scantool



Torque at Idle Torque at accelleration

EGRF967A

5. Are there any DTC related to "ETS" or "CAM" on the scantool ?

YES

▶ Repair "ETS" or "CAM" system first, then, go to "Terminal and Connector Inspection" procedure.

NO

▶ Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EDF53BAD

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 " System Inspection " procedure.

SYSTEM INSPECTION EEB52B25

1. Check air leakage

   1) Check contamination or installation of Gasket
      ▶ Check throttle body gasket
      ▶ Check gasket between intake manifold and surge tank.
      ▶ Check contamination or clog by foreign material of gasket between intake manifold and injector.
      ▶ Check contamination or open stuck resulting from foreign material between surge tank and PCSV.

   2) Is there any air leakage ?

      YES

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

      NO

      ▶ Go to "Check exhaust system for clogging" as follows.

2. Check exhaust system for clogging

   1) Check exhaust system.
      ▶ Clogged or broken muffler
      ▶ Broken catalyst

   2) Is the exhaust system colgged ?

      YES

      ▶ Go to "Check throttle valve for stuck" as follows.

      NO

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

3. Check throttle valve for stuck

   1) IG "OFF".

   2) Remove air hose between throttle body and airflow sensor.

   3) Check if throttle valve is sutck by foreign material.

   4) Is the throttle valve normal ?

      YES

      ▶ Go to "Component Inspection" procedure.

      NO

      ▶ After getting rid of foreign material, check that throttle valve is normal and check for proper operation. If the problem is corrected,replace ETC and 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.(It will takes 10sec.)

3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

COMPONENT INSPECTION EB58F7F0

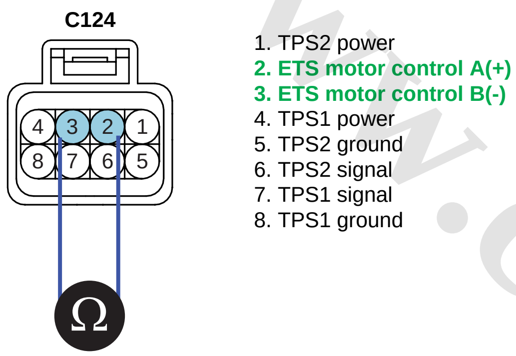
1. Check resistance of ETS Motor

   1) IG "OFF"

   2) Disconnect ETS motor ＆ TPS connector.

   3) Measure resistance between terminal 2 and 3 of ETS motor ＆ TPS connector.(Component Side)

Specification : Approx. 1.275 ~ 1.725Ω @ 23℃(73.4 °F)



EFBF925A

   4) Is the measured resistance within specifications ?

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 to reuse the PCM on the others

NO

▶ Substitute with a known-good ETC and check for proper operation. If the problem is corrected,replace ETC and 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.(It will takes 10sec.)

3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E83A8D5B

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

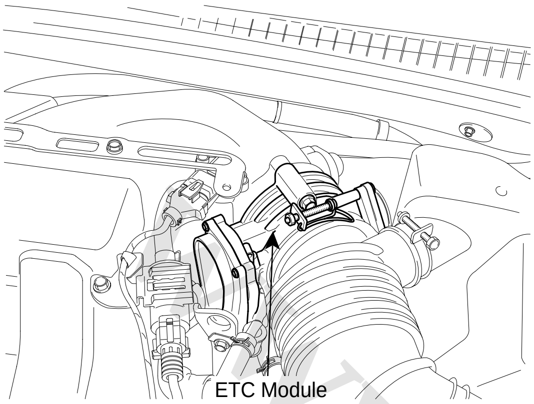
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2104 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - FORCED IDLE

COMPONENT LOCATION EF62B667



EFBF968A

GENERAL DESCRIPTION E06993CB

ETC(Electronic Throttle Control Valve) is the device controlling amount of air to engine acccording to driver's intension. Different from the existing mechanical throttle valve which is composed of accelerator pecal and connecting wire cable, ETC consists of a motor, a throttle body and a throttle position sensor. Receiving input signals from electronic accelerator pedal module, PCM lets ETC motor control throttle valve. With ETC, cruise control system works without any additional device.

DTC DESCRIPTION E6D09969

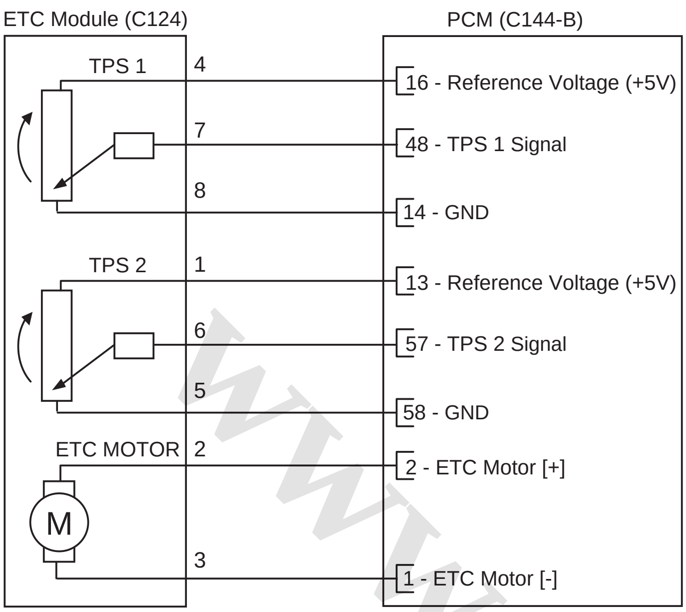
PCM recognizes vehicle state as forced idle under detecting condition, and sets P2104. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION E70182B1

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 E7807685

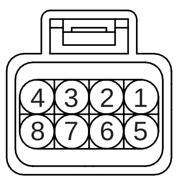
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

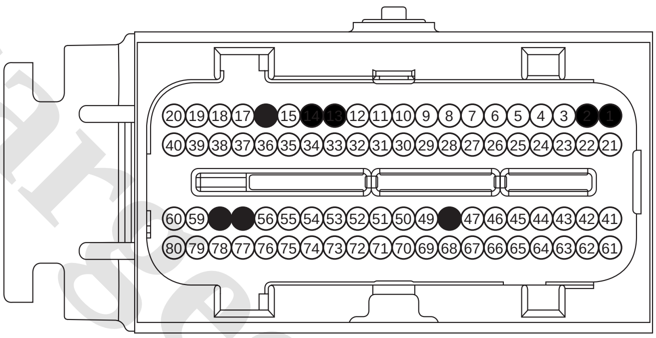
Terminal	Connected to	Funtion
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144- B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM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

[HARNESS CONNECTORS]



C124

ETC MODULE



C144-B

PCM

EFBF236A

MONITOR SCANTOOL DATA E03A6518

1. Connect scantool to DLC(Data Link Connector)

2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
   (There will be at least one more DTC which causes this DTC P2104 to retrieve)

3. Repair the DTCs cause DTC P2104 first according to the designated trouble shooting guide.
   (After repairing the DTCs cause DTC P2104 , don't forget to do "ETC Initialization" as follows.

4. Is the same DTC occurred ?

YES

▶Substitute with a known-good 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 to reuse the PCM on the others

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.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR EDD5A31F

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2105 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - FORCED ENGINE SHUTDOWN

COMPONENT LOCATION E5DE4515

Refer to DTC P2104.

GENERAL DESCRIPTION ED299B88

Refer to DTC P2104.

DTC DESCRIPTION E3B10A7D

PCM recognizes vehicle state as forced engine stop under detecting condition, and sets P2105. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION E62B2359

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 Cycles	

SCHEMATIC DIAGRAM E3D367B4

Refer to DTC P2104.

MONITOR SCANTOOL DATA EC8C245D

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" ＆ Monitor that any different DTC(Diagnostic Trouble Code) is existed.
   (There will be at least one more DTC which causes this DTC P2105 to retrieve)
3. Repair the DTCs cause DTC P2105 first according to the designated trouble shooting guide.
   (After repairing the DTCs cause DTC P2105 , don’t forget to do "ETC Initialization" as follows.
4. Is the same DTC occurred ?

YES

▶Substitute with a known-good 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 to reuse the PCM on the others

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.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E05B63AD

Refer to DTC P2104.

DTC P2106 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - FORCED LIMITED POWER

COMPONENT LOCATION E656290A

Refer to DTC P2104.

GENERAL DESCRIPTION ED905851

Refer to DTC P2104.

DTC DESCRIPTION E24BB287

PCM recognizes vehicle state as forced limited power mode under detecting condition, and sets P2106. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION E04DF978

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	

SCHEMATIC DIAGRAM E6A9DB77

Refer to DTC P2104.

MONITOR SCANTOOL DATA EA3E40E9

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
   (There will be at least one more DTC which causes this DTC P2106 to retrieve)
3. Repair the DTCs cause DTC P2106 first according to the designated trouble shooting guide.
   (After repairing the DTCs cause DTC P2106 , don't forget to do "ETC Initialization" as follows.
4. Is the same DTC occurred ?

YES

▶Substitute with a known-good 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 to reuse the PCM on the others

NO

▶ Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

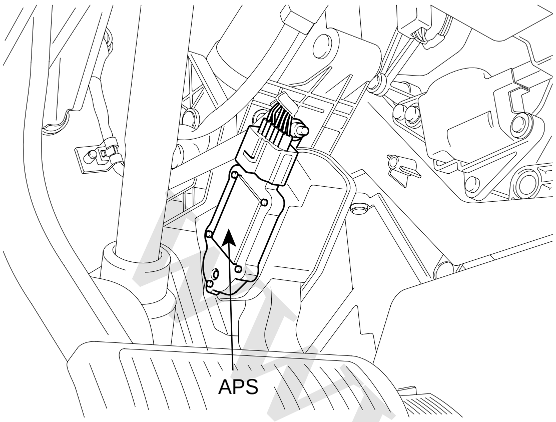
1. Erase the trouble codes on PCM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will takes 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR E333F466

Refer to DTC P2104.

DTC P2122 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT LOW INPUT

COMPONENT LOCATION E9AB3CF5



EFBF969A

GENERAL DESCRIPTION E6D9BBE7

APS(Acceleration Position Sensor) measures driver's accelerating intension using a potentiometer and APS signal is transmitted to the PCM. The pedal's position is converted as voltages of potentiometer in the APS.The absence of a mechanical link between the accelerator pedal and throttle valve presents a risk of loss of control of the engine in the event of a failure of the component. Therefore, APS has the two potentiometers whose slides are mechanically solid. APS 2 decides whether or not APS 1 ＆ 2 is faulty.

DTC DESCRIPTION E68065AA

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 when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION EF072A97

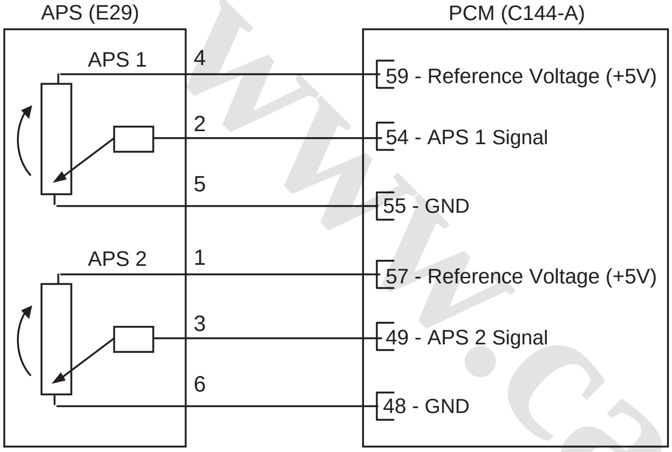
Item	Detecting Condition	Possible Cause
DTC Strategy	• This code detects a continuous short to ground or open in either the circuit or the sensor (0-100%)	• Poor connection • Open or short to ground in Power circuit • Open or short to ground in Signal Circuit • Faulty APS • Faulty PCM
EnableConditions	• Ignition "ON"	
Threshold	• APS1 〈 0.125V	
Diagnosis Time	• Contineous (More than 0.18sec. Failure for every 7.8sec. Test)	
MIL On Condition	• 1 Driving Cycle	

SPECIFICATION E13FB938

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 EFBAA96E

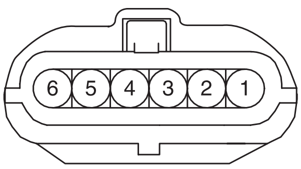
[CIRCUIT DIAGRAM]



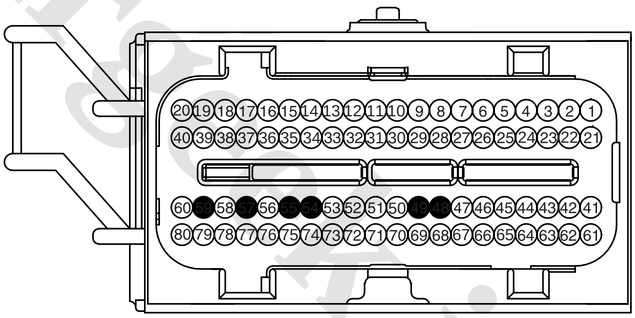
[CONNECTION INFORMATION]

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

[HARNESS CONNECTORS]



E29
APS



C144-A
PCM

EFBF261A

SIGNAL WAVEFROM AND DATA E5D99C09

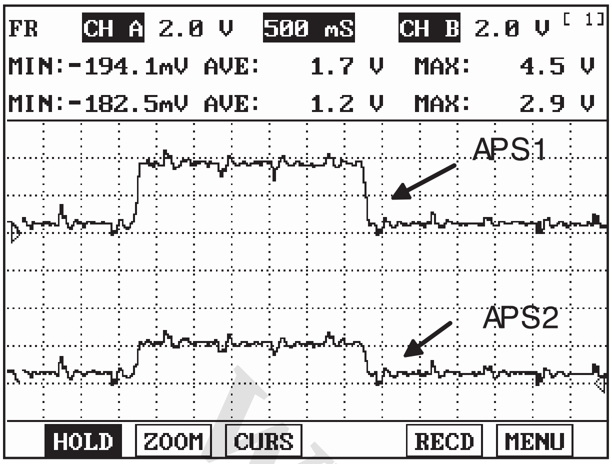


Fig. 1

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 SCANTOOL DATA E7D1C01F

1. Connect scantool to DLC.(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "APS1 ＆ APS2" parameters on the scantool.

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

1.11 CURRENT DATA 43/65

APS 1 VOLTAGE	0.9	V
APS 1 NORMALIZED	17.6	%
APS 2 VOLTAGE	0.4	V
APS 2 NORMALIZED	16.9	%
TPS 1 VOLTAGE	0.9	V
TPS 1 NORMALIZED	17.3	%
TPS 2 VOLTAGE	4.1	V
TPS 2 NORMALIZED	17.3	%

FIX SCRN FULL PART GRPH HELP

Normal at idle

1.11 CURRENT DATA 43/65

APS 1 VOLTAGE	0.0	V
APS 1 NORMALIZED	0.0	%
APS 2 VOLTAGE	0.4	V
APS 2 NORMALIZED	16.9	%
TPS 1 VOLTAGE	1.2	V
TPS 1 NORMALIZED	23.9	%
TPS 2 VOLTAGE	3.8	V
TPS 2 NORMALIZED	24.3	%

FIX SCRN FULL PART GRPH HELP

Ground Short at IG ON

1.11 CURRENT DATA 43/65

APS 1 VOLTAGE	5.0	V
APS 1 NORMALIZED	99.6	%
APS 2 VOLTAGE	0.4	V
APS 2 NORMALIZED	16.9	%
TPS 1 VOLTAGE	1.2	V
TPS 1 NORMALIZED	23.9	%
TPS 2 VOLTAGE	3.8	V
TPS 2 NORMALIZED	24.3	%

FIX SCRN FULL PART GRPH HELP

Short to 5V at IG ON

1.11 CURRENT DATA 43/65

APS 1 VOLTAGE	0.1	V
APS 1 NORMALIZED	2.0	%
APS 2 VOLTAGE	0.4	V
APS 2 NORMALIZED	16.9	%
TPS 1 VOLTAGE	1.2	V
TPS 1 NORMALIZED	23.9	%
TPS 2 VOLTAGE	3.8	V
TPS 2 NORMALIZED	24.3	%

FIX SCRN FULL PART GRPH HELP

Open at IG ON

EGRF971A

4. Are those "APS1 & APS2" parameters displayed correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor's and/or PCM's connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EC8EC81F

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 E41C1D96

1. IG "OFF" and disconnect APS connector.
2. IG "ON" ＆ ENG "OFF"
3. Measure voltage between harness terminal 4 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 EB029E0E

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 5 of APS harness connector.
   5) Measure resistance between terminal 2 and 6 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/C144-A of PCM harness connector.

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 E5B4C393

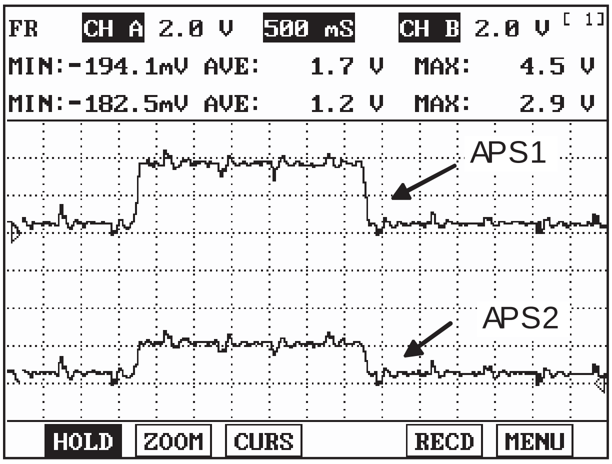
1. Check APS

1) IG "ON" & ENG "OFF".

2) Measure signal waveform of APS by pressing and depressing accellerator pedal.

SPECIFICATION :

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



EGRF975A

3) Is the measured signal waveform O.K ?

YES

▶ Substitute with a known-good 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 to reuse the PCM on the others

NO

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

VERIFICATION OF VEHICLE REPAIR ECF672DD

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2123 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT HIGH INPUT

COMPONENT LOCATION E46B834F

Refer to DTC P2122.

GENERAL DESCRIPTION E7F889BD

Refer to DTC P2122.

DTC DESCRIPTION E37D724D

Checking output signals from APS 1, under detecting condition, if output signals are above the threshol, PCM sets P2123. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION EB119007

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 (More than 0.18sec. Failure for every 7.8sec. Test)	
MIL On Condition	• 1 Driving Cycle	

SPECIFICATION ECC74037

Refer to DTC P2122.

SCHEMATIC DIAGRAM E465D4DE

Refer to DTC P2122.

SIGNAL WAVEFROM AND DATA EE853295

Refer to DTC P2122.

MONITOR SCANTOOL DATA EA90CD08

Refer to DTC P2122.

TERMINAL AND CONNECTOR INSPECTION EDD803C3

Refer to DTC P2122.

SIGNAL CIRCUIT INSPECTION ED156825

1. Check short to battery in harness
   1) IG "OFF".
   2) Disconnect APS and PCM connector.
   3) Measure resistance between terminal 1 and 2 of APS harness connector.
   4) Measure resistance between terminal 2 and 4 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 E057622C

1. Check open in harness
   1) IG "OFF".
   2) Disconnect APS connector.
   3) Measure voltage between terminal 4 of APS harness connector and chassis ground.(Fig. A)
   4) Measure voltage between terminal 4 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

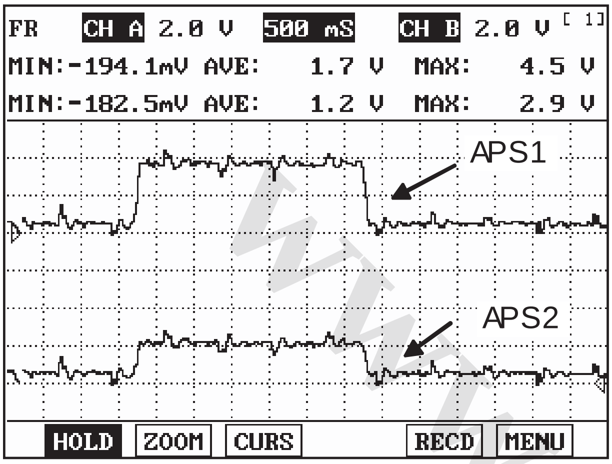
▶ Repair or replace contact resistance or open in harness and then, go to "Verification of VehicleRepair" procedure.

COMPONENT INSPECTION E3C8D204

1. Check APS
   1) Ignition "ON" ＆ ENG "OFF".
   2) Measure waveform of APS by pressing and depressing accellerator pedal with scantool.

SPECIFICATION :

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



EGRF975A

3) Is the measured signal waveform O.K ?

YES

▶ Substitute with a known-good 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 to reuse the PCM on the others

NO

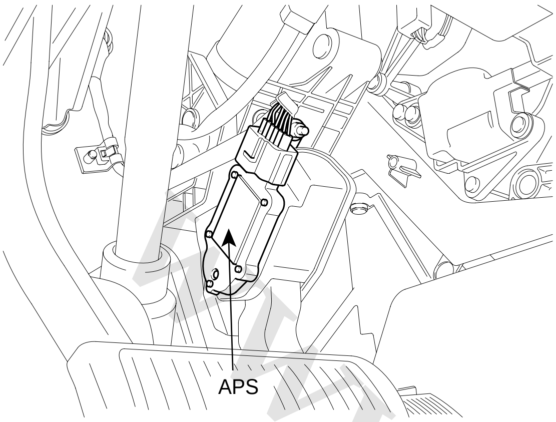
▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected,replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E6794A5C

Refer to DTC P2122.

DTC P2127 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT LOW INPUT

COMPONENT LOCATION E7F425C3



EFBF969A

GENERAL DESCRIPTION EEAC50D8

APS(Acceleration Position Sensor) measures driver's accelerating intension using a potentiometer and APS signal is transmitted to the PCM. The pedal's position is converted as voltages of potentiometer in the APS.The absence of a mechanical link between the accelerator pedal and throttle valve presents a risk of loss of control of the engine in the event of a failure of the component. Therefore, APS has the two potentiometers whose slides are mechanically solid. APS 2 decides whether or not APS 1 ＆ 2 is faulty.

DTC DESCRIPTION E5008521

Checking output signals from APS 2, under detecting condition, if output signals are below the threshold, PCM sets P2127. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION EAC56B88

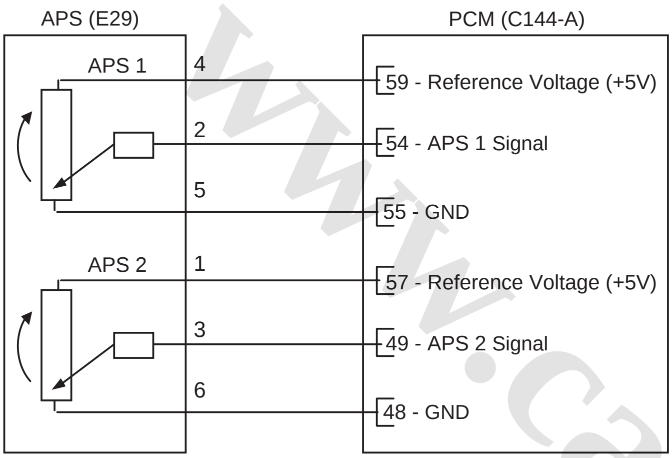
Item	Detecting Condition	Possible Cause
DTC Strategy	• This code detects a continuous short to ground or open in either the circuit or the sensor	• Poor connection • Open or short to ground in Power Circuit • Open or short to ground in Signal Circuit • Faulty APS • Faulty PCM
EnableConditions	• Ignition "ON"	
Threshold	• APS1 〈 0.125V	
Diagnosis Time	• Contineous (More than 0.18sec. Failure for every 7.8sec. Test)	
MIL On Condition	• 1 Driving Cycle	

SPECIFICATION E1D817FB

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 E9CED949

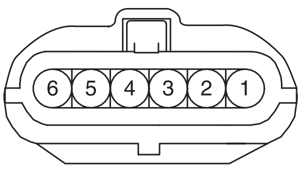
[CIRCUIT DIAGRAM]



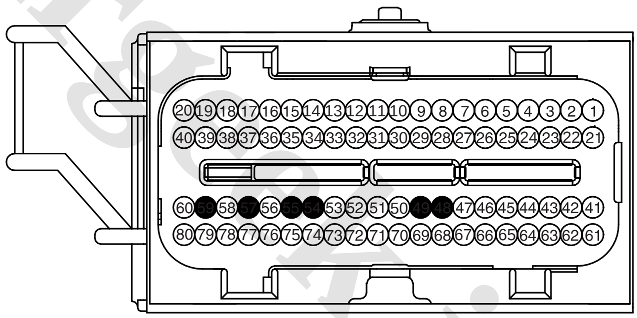
[CONNECTION INFORMATION]

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

[HARNESS CONNECTORS]



E29
APS



C144-A
PCM

EFBF261A

SIGNAL WAVEFROM AND DATA E1B73C69

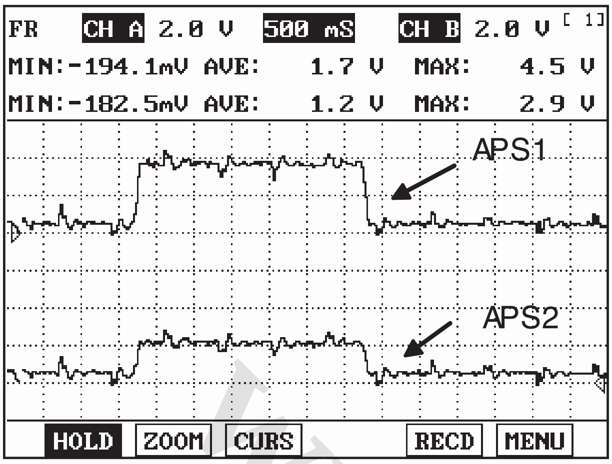


Fig. 1

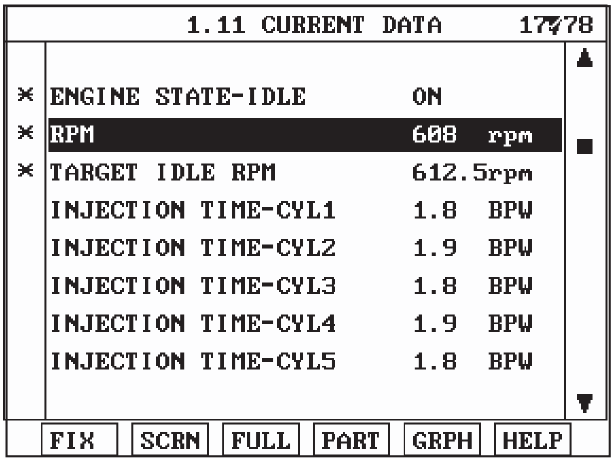
Fig. 1 : This is a signal waveform of APS 1 & 2 which shows that APS 2 increases voltage just half of APS 1 voltage increase when accelleration.

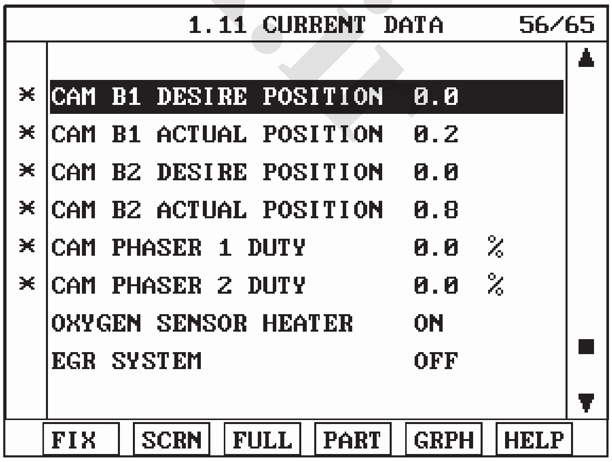
EGRF970A

MONITOR SCANTOOL DATA E0769D1D

1. Connect scantool to DLC.(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "APS1 & APS2" parameters on the scantool.

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





EGRF987O

4. Are those "APS1 & APS2" parameters displayed correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor' s and/or PCM' s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Terminal and Connector Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EAB0B265

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 EACEC12A

1. IG "OFF".
2. Disconnect APS connector.
3. IG "ON" & ENG "OFF".
4. Measure voltage between termial 1 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 ECEF8593

1. Check short to ground in harness
   1) IG "OFF".
   2) Disconnect APS and PCM connector.
   3) Measure resistance between terminal 3 of APS harness connector and chassis ground.

4) Measure resistance between terminal 3 and 5 of APS harness connector.

5) Measure resistance between terminal 3 and 6 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.

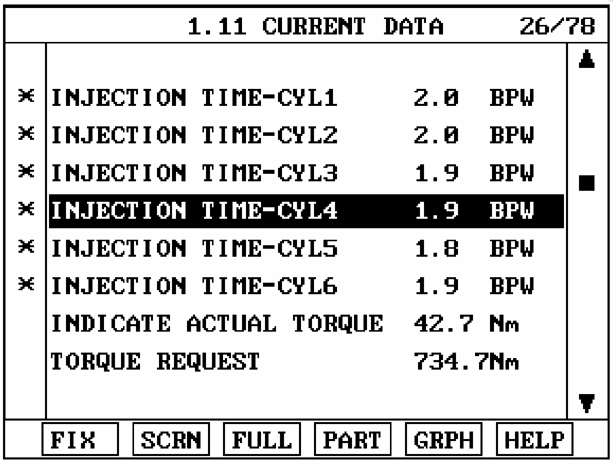
2. Check open in harness

1) IG "OFF".

2) Disconnect APS and PCM connector.

3) Measure resistance between terminal 3 of APS harness connector and terminal 49/C144-A of PCM harness connector.

Specification : Approx. below 1Ω



EGRF980A

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 E65EB8F5

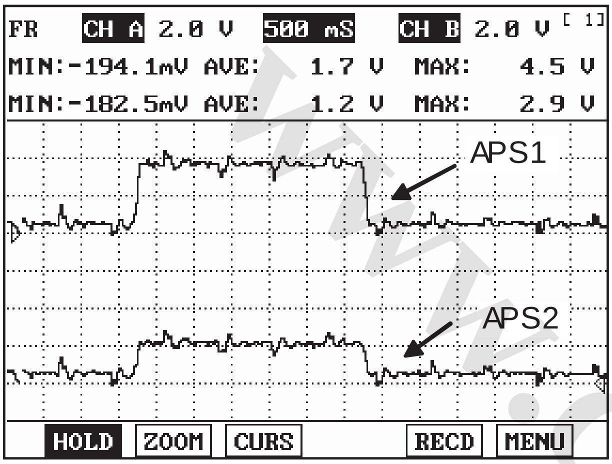
1. Check APS

1) Ignition "ON" & ENG "OFF".

2) Measure waveform of APS by pressing and depressing accellerator pedal with scantool.

SPECIFICATION :

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



EGRF975A

3) Is the measured signal waveform O.K ?

YES

▶ Substitute with a known-good 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 to reuse the PCM on the others

NO

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

VERIFICATION OF VEHICLE REPAIR E7831890

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2128 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT HIGH INPUT

COMPONENT LOCATION E5B7AC16

Refer to DTC P2127.

GENERAL DESCRIPTION EA3C7D8E

Refer to DTC P2127.

DTC DESCRIPTION E4A9C67B

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 when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION E178AD69

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 • Short to battery in Signal Circuit • Open in Ground Circuit • Faulty APS • Faulty PCM
EnableConditions	• Ignition "ON"	
Threshold	• APS2 〉 3V	
Diagnosis Time	• Continuous (More than 0.18sec. Failure for every 7.8sec. Test)	
MIL On Condition	• 1 Driving Cycle	

SPECIFICATION E582BCC2

Refer to DTC P2127.

SCHEMATIC DIAGRAM E1B22BA9

Refer to DTC P2127.

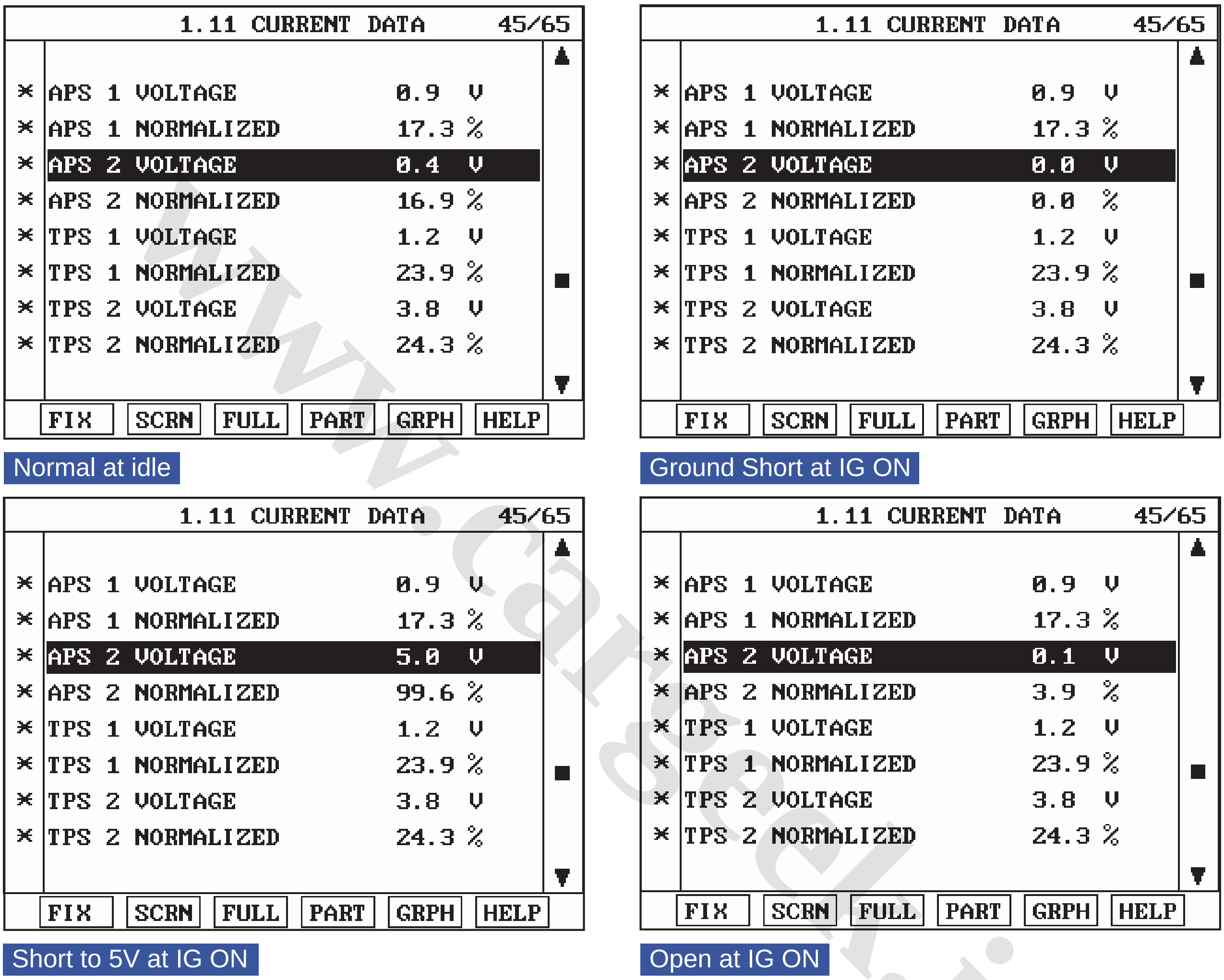
SIGNAL WAVEFROM AND DATA E664B151

Refer to DTC P2127.

MONITOR SCANTOOL DATA E748C486

1. Connect scantool to DLC(Data Link Connector).
2. Warm up the engine to normal operating temperature.
3. Monitor "APS1 ＆ APS2" parameters on the scantool.

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



Normal at idle

Ground Short at IG ON

Short to 5V at IG ON

Open at IG ON

EGRF988W

4. Are those "APS1 & APS2" parameters displayed correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor' s and/or PCM' s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Terminal and connector inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION ECD72093

Refer to DTC P2127.

SIGNAL CIRCUIT INSPECTION E950F489

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 3 and 4 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 E3E47932

1. Check open in harness

    1) IG "OFF"

    2) Disconnect APS connector.

    3) Measure voltage between terminal 1 of APS harness connector and chassis ground.(Fig. A)

    4) Measure voltage between terminal 1 and 6 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 E878B9D8

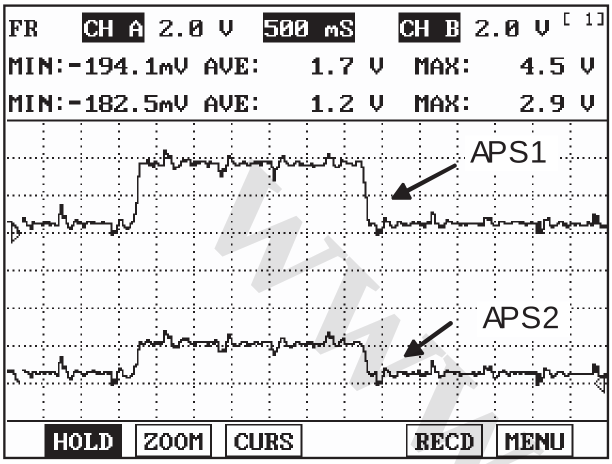
1. Check APS

    1) Ignition "ON" & ENG "OFF".

    2) Measure waveform of APS by pressing and depressing accellerator pedal with scantool.

SPECIFICATION :

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



EGRF975A

3) Is the measured signal waveform O.K ?

YES

▶ Substitute with a known-good 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 to reuse the PCM on the others

NO

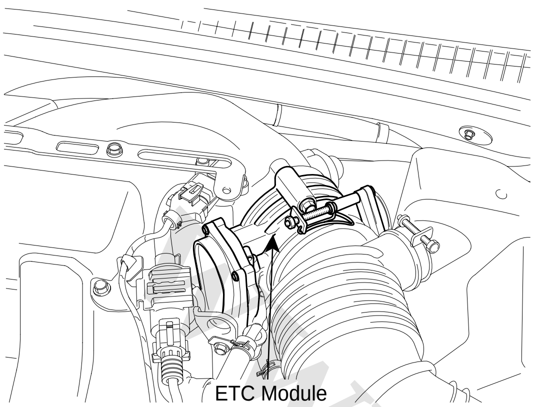
▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected,replace APS and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EEDB3FB7

Refer to DTC P2127.

DTC P2135 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" / "B" VOLTAGE CORRELATION

COMPONENT LOCATION E5C7E3CD



EFBF604Y

GENERAL DESCRIPTION E444AC58

ETC(Electronic Throttle Control Valve) is the device controlling amount of air to engine acccording to driver's intension. Different from the existing mechanical throttle valve which is composed of accelerator pecal and connecting wire cable, ETC consists of a motor, a throttle body and a throttle position sensor. Receiving input signals from electronic accelerator pedal module, PCM lets ETC motor control throttle valve. With ETC, cruise control system works without any additional device.

DTC DESCRIPTION E2C171E2

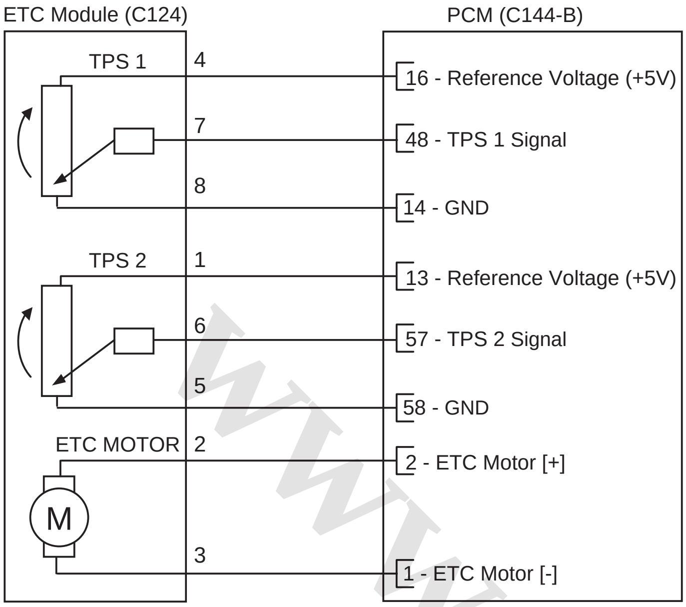
Checking output signals from TPS 1 and 2, under detecting condition, if output signals difference between TPS1 and TPS2 are detected more than 4.5% for the specified number of times., PCM sets P2135. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E63D95AD

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 (More than 0.34sec failure for every 10.92sec. Test)	
MIL ON condition	• 2 driving cycles	

SCHEMATIC DIAGRAM E103E004

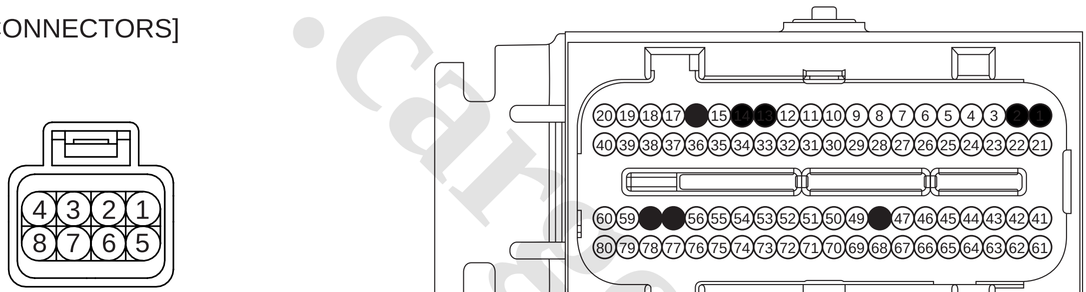
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Funtion
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

EFBF236A

SPECIFICATION EBACB3B0

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

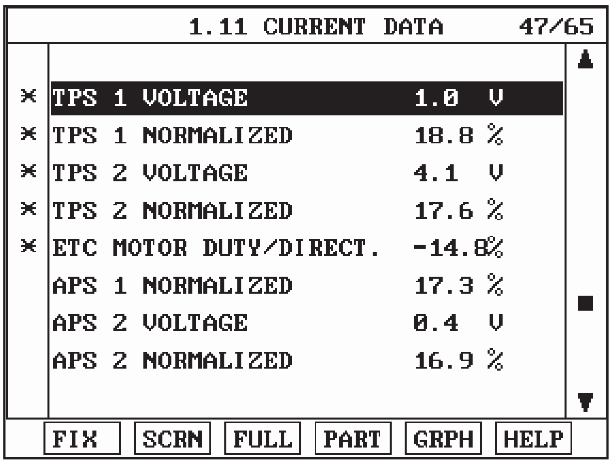
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V

MONITOR SCANTOOL DATA EC53B8B7

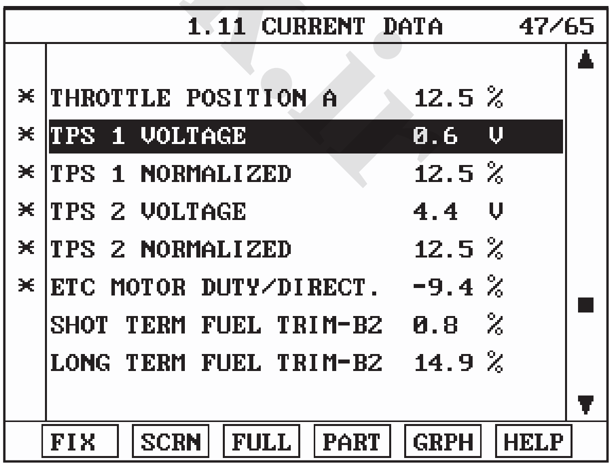
1. Connect scantool to DLC.(Data Link Connector)
2. IG "ON" & ENG "OFF"
3. Monitor "TPS1 & TPS2" items by pressing and depressing accellerator pedal.

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



IG ON



at idle

EGRF983A

4. Are those "TPS1 & TPS2" parameters displayed correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor’s and/or PCM’s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Terminal and connector inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E3F6E7EF

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 EFA40353

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 E5FFF9BA

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 EC19D4BD

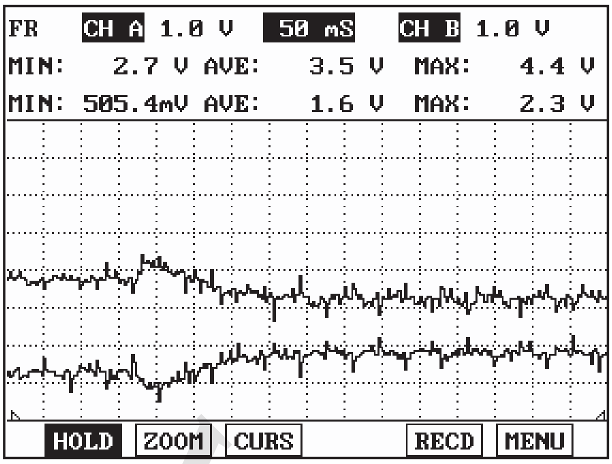
1. Check TPS

   1) Ignition "ON" & ENG "OFF".

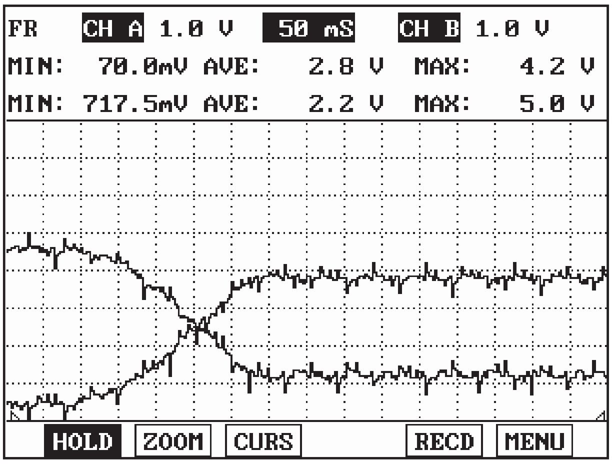
   2) Monitor signal waveform of TPS by stepping on and off the accellerator padel on scantool

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 to reuse the PCM on the others

NO

▶ Substitute with a known-good TPS and check for proper operation. If the problem is corrected,replace TPS and then go to "Verification of Vehicle Repair" procedure.
(After replacing ETC, do initialization of ETC as follows)

※ **PROCEDURE OF ETS INITIALIZATION**

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

VERIFICATION OF VEHICLE REPAIR E8784AA6

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

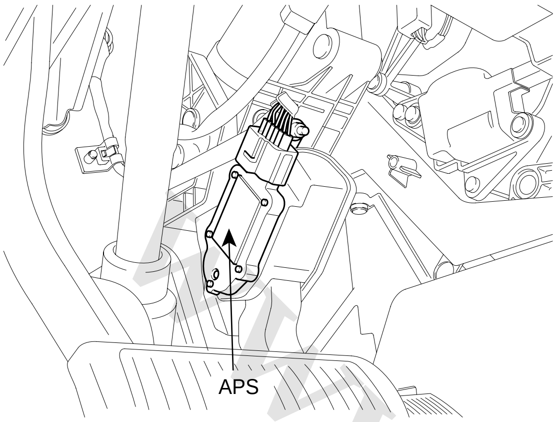
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2138 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" / "E" VOLTAGE CORRELATION

COMPONENT LOCATION E7E05FBF



EFBF969A

GENERAL DESCRIPTION EE40D993

APS(Acceleration Position Sensor) measures driver's accelerating intension using a potentiometer and APS signal is transmitted to the PCM. The pedal's position is converted as voltages of potentiometer in the APS.The absence of a mechanical link between the accelerator pedal and throttle valve presents a risk of loss of control of the engine in the event of a failure of the component. Therefore, APS has the two potentiometers whose slides are mechanically solid. APS 2 decides whether or not APS 1 ＆ 2 is faulty.

DTC DESCRIPTION E7304490

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 when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION E8D384D3

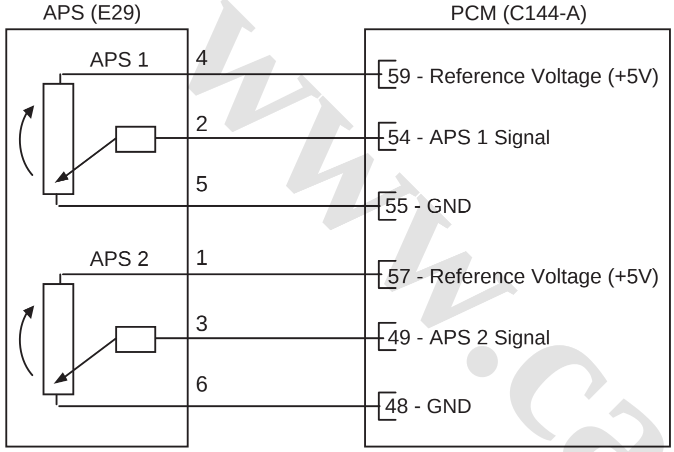
Item	Detecting Condition	Possible Cause
DTC Strategy	• This code detects a correlation error between APS 1 and APS 2	• Poor connection • Open or short in APS Circuit • Faulty APS • Faulty PCM
Enable condition	• Ignition "ON"	
threshold value	• Difference between APS1 and APS2 Normalized values 〉 4.5%	
diagnosis time	• Contineous (More than 0.32sec. Failure for every 9.36sec. Test)	
MIL ON condition	• 1 Driving Cycle	

SPECIFICATION E217DF0F

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 E3DCCE94

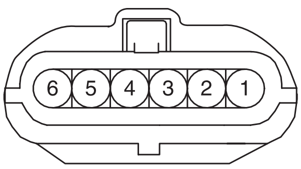
[CIRCUIT DIAGRAM]



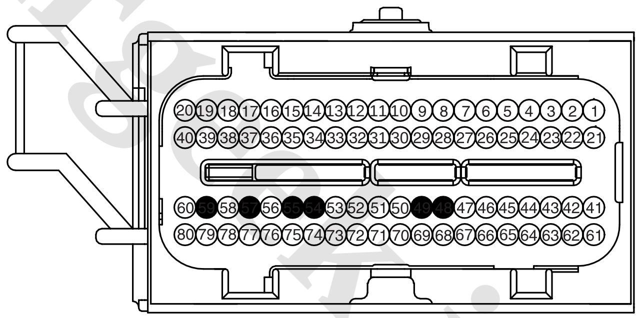
[CONNECTION INFORMATION]

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

[HARNESS CONNECTORS]



E29
APS



C144-A
PCM

EFBF261A

SIGNAL WAVEFROM AND DATA EFAF7C04

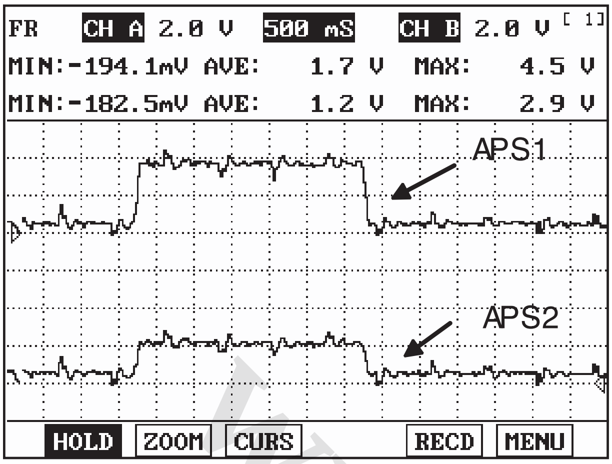


Fig. 1

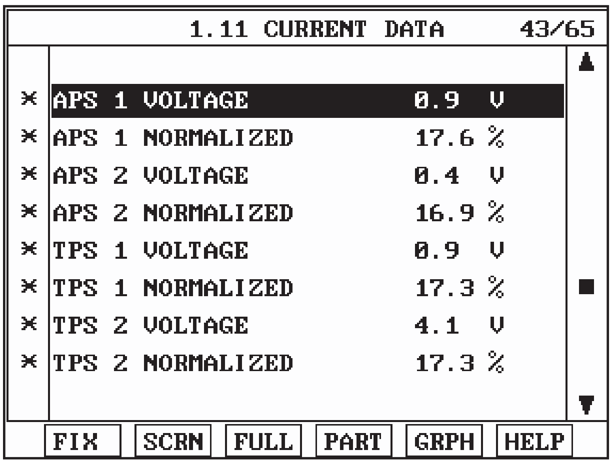
Fig. 1 : This is a signal waveform of APS 1 & 2 which shows that APS 2 increases voltage just half of APS 1 voltage increase when accelleration.

EGRF970A

MONITOR SCANTOOL DATA EE59FF4D

1. Connect scantool to DLC.(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "APS1 & APS2" parameters on the scantool.

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



Normal at IG ON

EGRF986B

4. Are those "APS1 & APS2" parameters displayed correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor' s and/or PCM' s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Terminal and connector inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E9AE7989

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 EB115122

1. IG "OFF"
2. Disconnect APS connector.
3. IG "ON" ＆ ENG "OFF".
4. Measure voltage between terminal 1 of APS harness connector and chassis ground.
5. Measure voltage between terminal 4 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 EF7E0FE8

1. IG "OFF".
2. Disconnect APS and PCM connector.

3. Measure resistance between terminal 2 and 3 of APS harness connector.

Specification : Infinite

4. Is the measured resistance within specification ?

YES

▶ Go to "Component Inspection" procedure.

NO

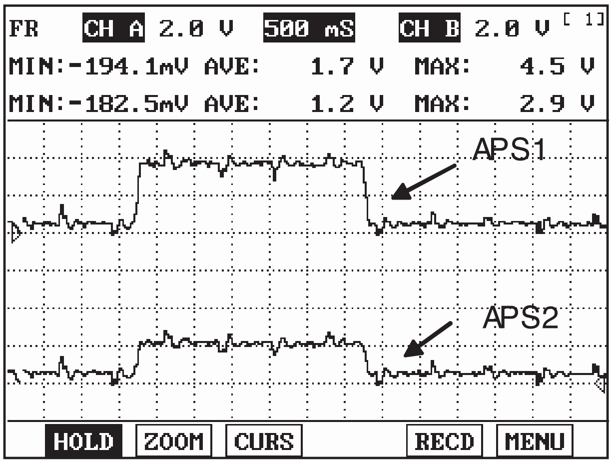
▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION ECAC5043

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 to reuse the PCM on the others

NO

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

VERIFICATION OF VEHICLE REPAIR EA12A1ED

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

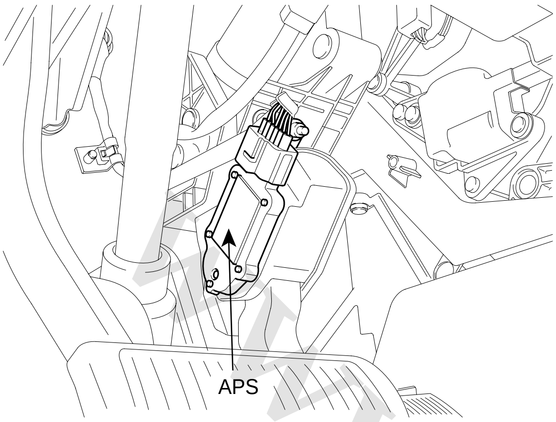
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2173 ETC (ELECTRONIC THROTTLE CONTROL) SYSTEM MALFUNCTION - HIGH AIR FLOW DETECTED

COMPONENT LOCATION E6F68EDF



EFBF969A

GENERAL DESCRIPTION ED9C7C35

ETC(Electronic Throttle Control Valve) is the device controlling amount of air to engine acccording to driver's intension. Different from the existing mechanical throttle valve which is composed of accelerator pecal and connecting wire cable, ETC consists of a motor, a throttle body and a throttle position sensor. Receiving input signals from electronic accelerator pedal module, PCM lets ETC motor control throttle valve. With ETC, cruise control system works without any additional device.

DTC DESCRIPTION EFB7B8DA

Comparing real intake air flow and the intake air flow calculated by ETS, under detecting condition, if the difference of air flow more than threshold is detected for more than 3.9 sec., PCM sets P2173. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till 1 driving cycle.

DTC DETECTING CONDITION E2AA2821

Item		Detecting Condition	Possible Cause
DTC Strategy		• The engine airflow measurements not based on throttle position are compared with throttle position based estimated airflow.	• Air Leakage between TPS and MAFS • Faulty throttle body • Faulty PCM
EnableConditions		• Engine running • Throttle Actuation Mode is not OFF • MAP Sensor is not failed • MAF Sensor is not failed • IAT sensor is not failed	
Thresh-old	Case 1	• Speed-Density Airflow - ETC estimated airflow 〉 9 g/s	
	Case 2	• MAF reading - ETC estimated airflow 〉 7g/s	
Diagnosis Time		• Contineous (More than 3.9sec. Failure for every 15.6sec. Test)	
MIL On Condition		• 1 Driving Cycle	

SPECIFICATION EAB0CA94

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

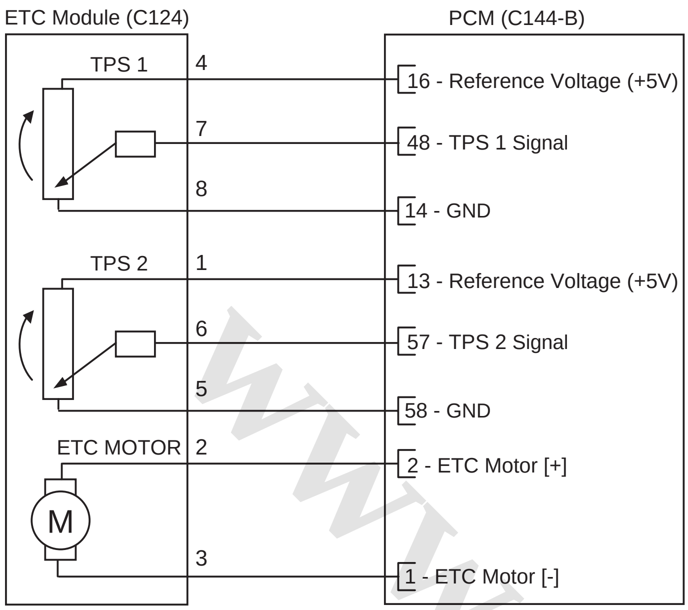
V20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0.0V

MAPS

Pressure(kPa)(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 ECFF8A27

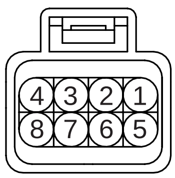
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

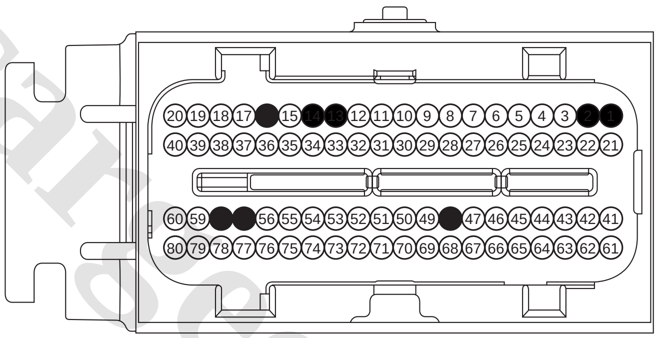
Terminal	Connected to	Funtion
1	PCM C144-B (13)	TPS 2 Reference Voltage (+5V)
2	PCM C144-B (2)	ETC Motor [+] Control
3	PCM C144- B (1)	ETC Motor [-] Control
4	PCM C144-B (16)	TPS 1 Reference Voltage (+5V)
5	PCM C144-B (58)	TPS 2 Ground
6	PCM C144-B (57)	TPS 2 Signal
7	PCM C144-B (48)	TPS 1 Signal
8	PCM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

[HARNESS CONNECTORS]



C124

ETC MODULE



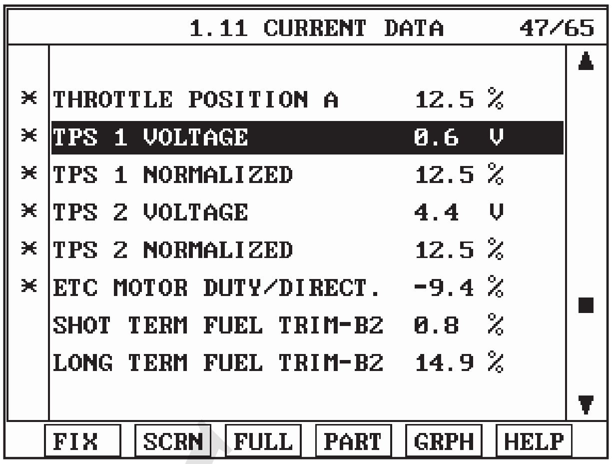
C144-B

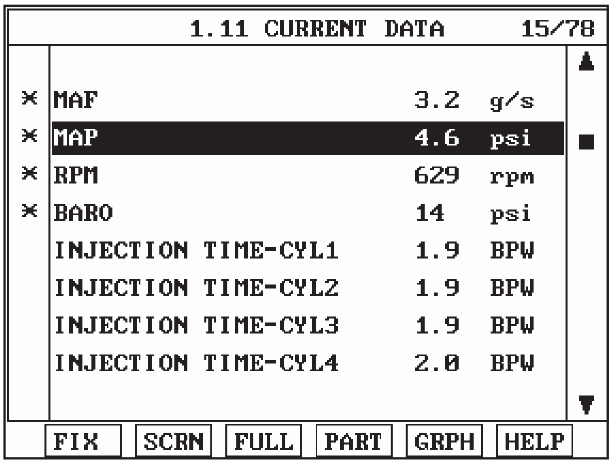
PCM

EFBF236A

MONITOR SCANTOOL DATA E429F156

1. Connect scantool to DLC.(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "TPS1 & 2, MAPS,MAFS" parameters on scantool





EGRF986F

YES

▶Fault is intermittent caused by poor contact in Sensor' s and/or PCM' s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "System Inspection" procedure.

SYSTEM INSPECTION E53BE638

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 to reuse the PCM on the others

※ 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.(It will takes 10sec.)

3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

VERIFICATION OF VEHICLE REPAIR EEC00EA2

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2187 SYSTEM TOO LEAN AT IDLE (←ADDITIVE) (BANK 1)
DTC P2189 SYSTEM TOO LEAN AT IDLE (←ADDITIVE) (BANK 2)

GENERAL DESCRIPTION E2F6D9AB

ideal air-fuel ratioto so as to raise the efficiency of catalytic convertor. Generally, NOx increases at lean combustion while CO, HC increases in rich combustion. Thus, in order to purge all of these gases with catalytic convertor, air-fuel ratio should be nearly at the ideal ratio. However the range in which all gases purified successfully is too narrow, it is impossible to meet ideal range with open loop control, therefore feed back control using HO2S is required. HO2S output signal changes rapidly near ideal air-fuel ratio and this characteristic is used at feed back control. comparing HO2S output signal and reference value, PCM increases fuel injection quantity at lean condition and decreases at rich condition. As deterioration of engine, due to the characteristic changes of many components of intake and fuel line or inevitable tolerance of components at production process, achieving ideal air-fuel ratio is almost impossible with the fixed fuel injectionduration. Regarding the change of cross section by clogged injector, feed back correction is performed yet, it cannot cover all the ranges. It means if the correction range is massively seperated from the ideal value or if the mean of feed back control range too inclines to lean or rich condition, feed back correction does not work efficiently. Therefore processing correction value throughout long time statistically during driving, PCM controlls fuel injection duration as fitting the mean to be the ideal air-fuel ratio value. Through adaptive control, accuracy of the control could be improved and the value of adaptive control varies countiuously during driving and is always up-dated.

DTC DESCRIPTION E82AEDDA

Checking air-fuel ratio correction value every 0.75 sec. at idle, if the value within the detecting condition for more than 0.3 sec., PCM sets P2187/P2189. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EBF6C1C8

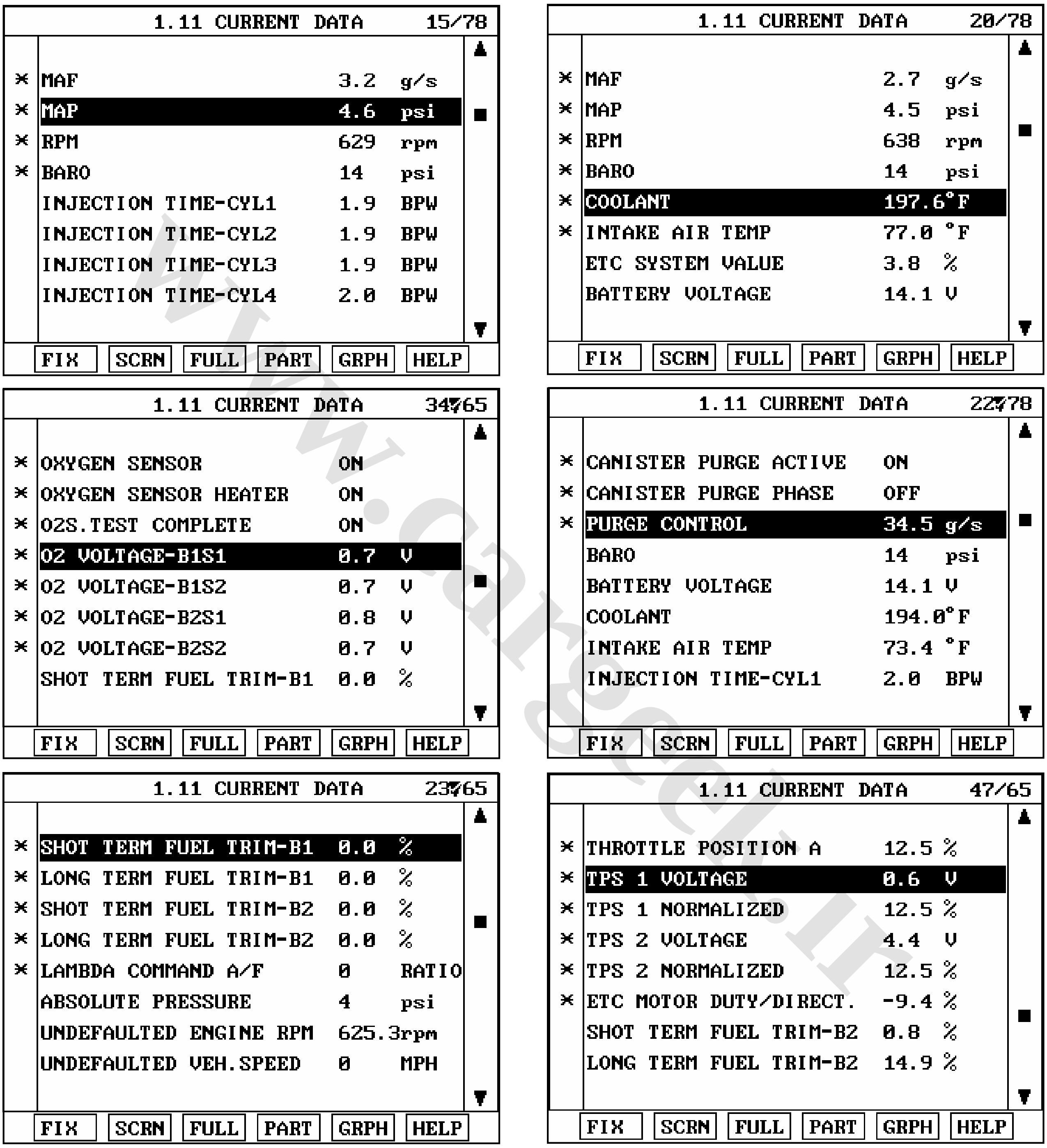
Item	Detecting Condition	Possible cause
DTC Strategy	• Fuel Trim Idle Condition Option Limits Exceeded	
EnableConditions	• 550rpm ≤ Engine Speed ≤ 4000rpm • 60℃ (140˚F) ≤ Engine coolant temperature ≤ 114.992℃ (239˚F) • -10℃ (14˚F) ≤ Intake Air Temperature ≤ 60℃ (140˚F) • 0° ≤ Throttle Position ≤ 72° • 25kPa ≤ Engine Load ≤ 90kPa • 1.5g/s ≤ Intake Air Flow ≤ 80g/s • Barometric Pressure ≥ 72kPa • Vehicle Speed ≤ 130km/h • System Voltage ≥ 11V • Closed Loop Active • Other diagnostic fault not active	• Sensors related to Fuel Trim • Intake system • Fuel Pressure • Faulty PCM
Threshold value	• Average of short term fuel trim 〉 1.5 • Average of long term fuel trim 〉 0.76	
DiagnosisTime	• Contineous (More than 0.375sec. Failure for every 0.75sec. Test)	
MIL On Condition	• 2 Driving Cycles	

MONITOR SCANTOOL DATA E80DB19A

1. Connect scantool to DLC(Data Link Connector)

2. Warm up the engine to normal operating temperature.

3. Monitor sensors related to fuel trim(Ex. HO2S,MAFS,MAPS,TPS,MAPS,TPS,ECTS,PCSV,Injectors etc.) with scant-ool



EGRF988X

4. Are those parameters displayed correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor' s and/or PCM' s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Terminal and connector inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION ECEB96D3

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 "System Inspection " procedure.

SYSTEM INSPECTION EBE14B03

1. Check Air leakage

   1) Check gasket is contaminated or misinstalled.
      ▶ Installation or any damage of Throttle body gasket
      ▶ Installation or any damage of the gasket between intake manifold and surge tank.
      ▶ Clogging of intake manifold or injectors resulting from foreign materials.
      ▶ Open stuck of PCSV caused by foreign materials between surge tank and PCSV.

   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 Fuel Line Inspection" as follows.

2. Check Fuel Line Inspection

   1) Check clog, contamination and installation of each hose as follows.
      ▶ Check connection of each fuel line.
      ▶ Check damage, interference and installation of vaccum hose connected to fuel line.
      ▶ Check that fuel pipe in the fuel line is bent and sqeezed.
      ▶ Check any fuel leakage from fuel pipe in the fuel line.

   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 fuel pressure" as follows.

3. Check Fuel Pressure

   1) Refer to "Fuel pressure test" in "Fuel delivery system"

   2) Is the measured fuel pressure within specification ?

   YES

   ▶ Go to "Component Inspection" procedure.

   YES

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

COMPONENT INSPECTION EE58CDD7

1. Check PCV

   1) IG "OFF".

   2) Remove PCV valve and then, check that plunger in the PCV is moving.

   3) Is the PCV normal ?

   YES

   ▶ Go to "Check PCSV" as follows.

   NO

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

2. Check PCSV

   1) IG "OFF".

   2) Remove PCSV and Vaccum Hose

   3) Check that PCSV is just one way solenoid valve

   4) Is the PCSV normal ?

   YES

   ▶ Go to "Check injector" as follows.

   NO

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

3. Check injector

   1) IG "OFF"

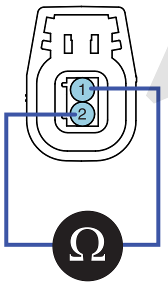
   2) Remove injector.

3) Check that injector hole is clogged by foreign materials.

4) Measure resistance between terminal 1 an 2 of injector connector.(Component Side)

SPECIFICATION :

Temp.	Resistance
20℃ (68°F)	11.4 ~ 12.6Ω



EFBF311N

5) Is the measured resistance within specification ?

YES

▶ Go to "Check component related to fuel trim" as follows.

NO

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

4. Check component related to fuel trim

1) Check component related to fuel trim such as HO2S, MAFS,MAPS, TPS, ECTS, PCSV and Injectores) - Refer to each designated trouble shooting guide.

2) Are those component related to fuel trim 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.

NO

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

VERIFICATION OF VEHICLE REPAIR ED10C11B

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2188 SYSTEM TOO RICH AT IDLE (BANK 1)
DTC P2190 SYSTEM TOO RICH AT IDLE (BANK 2)

GENERAL DESCRIPTION E6256CA3

Refer to DTC P2187.

DTC DESCRIPTION E4DC85ED

Checking air-fuel ratio correction value every 0.75 sec. at idle, if the value within the detecting condition for more than 0.3 sec., PCM sets P2188/P2190. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E25D54C6

Item	Detecting Condition	Possible cause
DTC Strategy	• Fuel Trim Idle Condition Option Limits Exceeded	• Sensors related to Fuel Trim • Intake system • Fuel Pressure • Faulty PCM
EnableConditions	• 550rpm ≤ Engine Speed ≤ 4000rpm • 60℃ (140˚F) ≤ Engine coolant temperature ≤ 114.992℃ (239˚F) • -10℃ (14˚F) ≤ Intake Air Temperature ≤ 60℃ (140˚F) • 0° ≤ Throttle Position ≤ 72° • 25kPa ≤ Engine Load ≤ 90kPa • 1.5g/s ≤ Intake Air Flow ≤ 80g/s • Barometric Pressure ≥ 72kPa • Vehicle Speed ≤ 130km/h • System Voltage ≥ 11V • Closed Loop Active • Other diagnostic fault not active	
Threshold value	• Average of short term fuel trim 〈 0.8 • Average of long term fuel trim 〈 1.24	
DiagnosisTime	• Contineous (More than 0.375sec. Failure for every 0.75sec. Test)	
MIL On Condition	• 2 Driving Cycles	

MONITOR SCANTOOL DATA E0EF2723

Refer to DTC P2187.

TERMINAL AND CONNECTOR INSPECTION E868EF9A

Refer to DTC P2187.

SYSTEM INSPECTION E99249FA

1. Check air clog.

    1) Check Contamination ,Gasket installation as follows
    ▶ Damage or installation of throttle body gasket.
    ▶ Check clog of air cleaner

- ▶ Clog or contamination of intake manifold or injectors caused by foreign materials
- ▶ Check vaccum hose connected to surge tank is normal.

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 Fuel Pressure" as follows

2. Check Fuel Pressure.

1) Refer to "Fuel pressure test" in "Fuel delivery system"

2) Is the measured fuel pressure 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 EEBE2C22

1. Check PCV

1) IG "OFF".

2) Remove PCV valve and then, check that plunger in the PCV is moving.

3) Is the PCV normal ?

YES

▶ Go to "Check PCSV" as follows.

NO

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

2. Check PCSV

1) IG "OFF".

2) Remove PCSV and Vaccum Hose

3) Check that PCSV is just one way solenoid valve

4) Is the PCSV normal ?

YES

▶ Go to "Check injector" as follows.

NO

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

3. Check injector

1) IG "OFF"

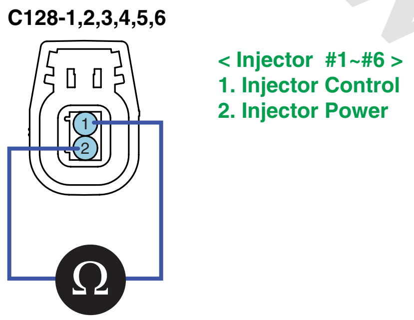
2) Remove injector.

3) Check that injector hole is clogged by foreign materials.

4) Measure resistance between terminal 1 an 2 of injector connector.(Component Side)

SPECIFICATION :

Temp.	Resistance
20℃ (68°F)	11.4 ~ 12.6Ω



EFBF311N

5) Is the measured resistance within specification ?

YES

▶ Go to "Check component related to fuel trim" as follows.

NO

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

4. Check component related to fuel trim

1) Check component related to fuel trim such as HO2S, MAFS,MAPS, TPS, ECTS, PCSV and Injectores) - Refer to each designated trouble shooting guide.

2) Are those component related to fuel trim 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.

NO

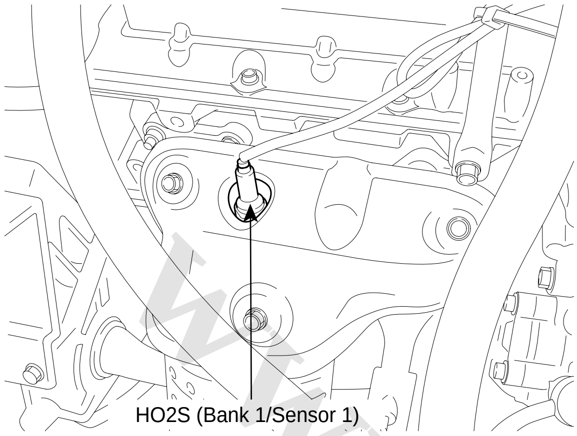
▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E3070DBC

Refer to DTC P2187.

DTC P2195 HO2S SIGNAL STUCK LEAN (BANK 1 / SENSOR 1)

COMPONENT LOCATION ED9385D7



EGRF986K

GENERAL DESCRIPTION E9A7FC08

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 E5D2F155

Checking output signals from HO2S under detecting condition, if an output signal within the detecting condition lasts continuously, PCM sets P2195. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E0C71461

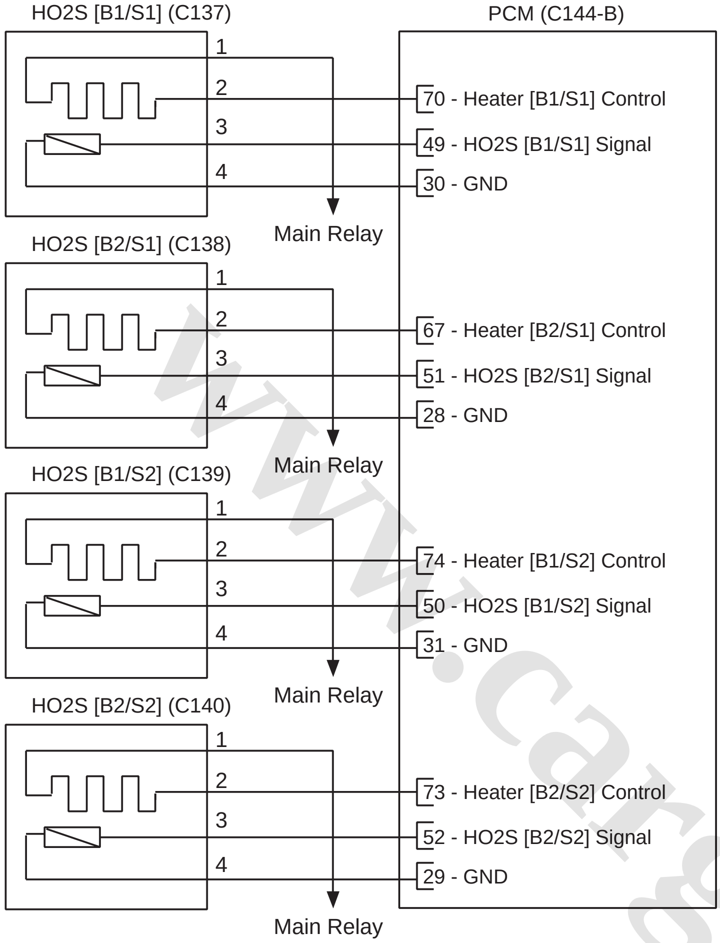
<table>
<tr><th>Item</th><th>Detecting Condition</th><th>Possible cause</th></tr>
<tr><td>DTC Strategy</td><td>• Determines if O2 sensor indicates lean exhaust while in Power Enrichment</td><td rowspan="6">• Poor Connection
• Faulty HO2S
• Faulty PCM</td></tr>
<tr><td>EnableConditions</td><td>• Sensor not in cooled status
• Not in Transient Conditions status
• Airflow present ≥ 2 g/s
• Ignition voltage ≥ 10V
• Fuel reduction not active
• Engine running
• Engine running ≥ 60sec.
• Power Enrichment conditions present
• Engine coolant warm enough ≥ 60℃(140 °F)
• Above conditions met long enough ≥ 1.5sec.</td></tr>
<tr><td>Threshold value</td><td>• O2 sensor voltage 〈 0.54V and Air Fuel Ratio ≤ 13.5</td></tr>
<tr><td>DiagnosisTime</td><td>• Contineous
(More than 11.25sec. failure for every 12.5sec. Test)</td></tr>
<tr><td>MIL On Condition</td><td>• 2 Driving Cycles</td></tr>
</table>

SPECIFICATION ED3BDA63

A/F Ratio	Output Voltage(V)
Rich	0.75 ~ 1.00V
Lean	0 ~ 0.12V

SCHEMATIC DIAGRAM EBD8DFD5

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

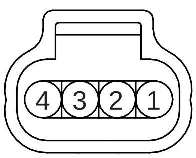
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

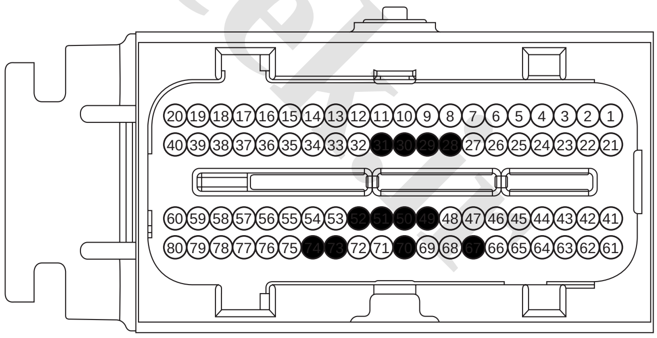
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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

EFBF250A

SIGNAL WAVEFROM AND DATA E560EC3F

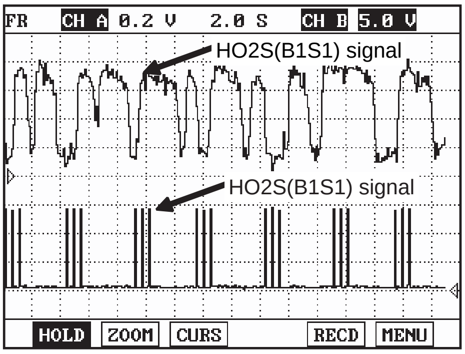


Fig.1:B1S1 & Heater

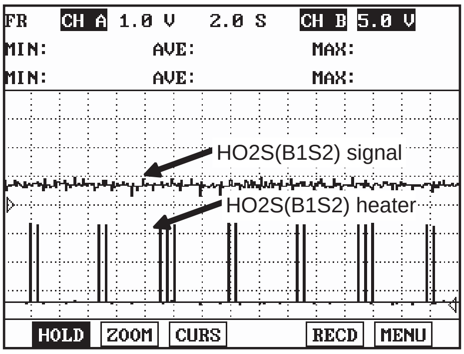


Fig.2 : HO2S(B1S2) & Heater

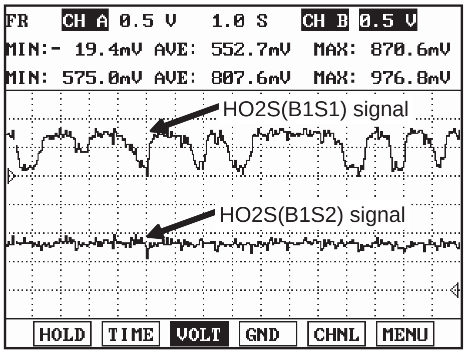


Fig3 : HO2S(B1S1) & (B1S2)

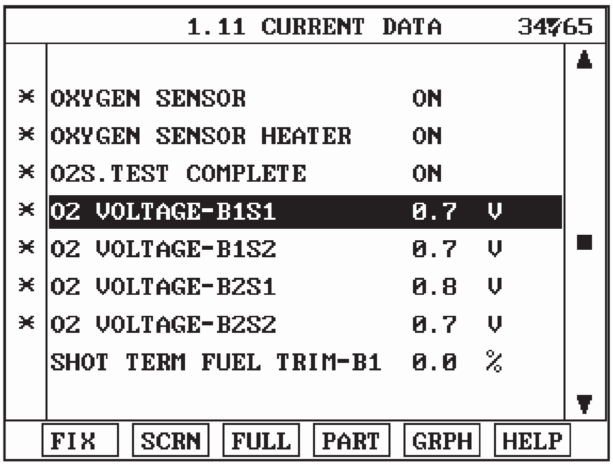
EGRF986L

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, HO2S signal will switch from lean to rich normally.

MONITOR SCANTOOL DATA E106D9B4

1. Connect scantool to DLC(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "HO2S(B1S1)" parameter on scantool

Specification : 0.1 ~ 0.9V



EGRF986M

4. Does the "HO2S(B1S1)" parameter operates correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor's and/or PCM's connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Component Inspection" procedure.

COMPONENT INSPECTION E09BC46C

1. Visual Inspection

   1) Visually check HO2S as follow.
      - Contamination, deformation or age of HO2S(B1/S1)

   2) Is the HO2S(B1/S1) normal ?

   YES

   ▶ Go to "Check performance of HO2S" as follows.

   NO

   ▶ Substitute with a known-good HO2S(B1S1) and check for proper operation. If the problem is corrected,replace HO2S(B1S1) and then go to "Verification of Vehicle Repair" procedure.

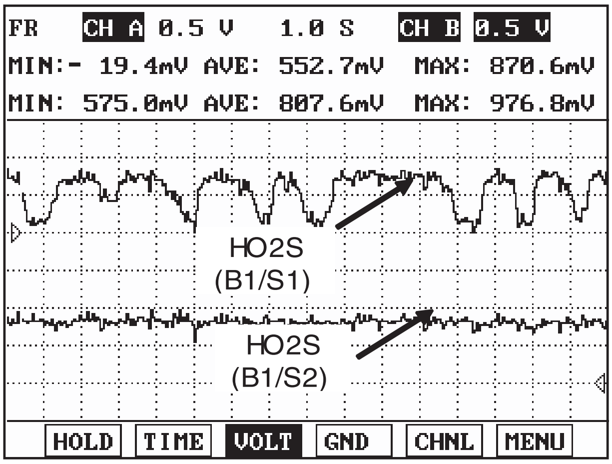
2. Check performance of HO2S

   1) Connect scantool to DLC(Data Link Connector)

   2) Warm up the engine to normal operating temperature.

   3) Monitor signal waveform of HO2S with scantool.

Specification : 0.1 ~ 0.9V.



EGRF986N

   4) Is the HO2S(B1S1) working properly ?

   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.

   NO

▶ Substitute with a known-good HO2S(B1S1) and check for proper operation. If the problem is corrected,replace HO2S(B1S1) and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ED3F4EA8

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2196 HO2S SIGNAL STUCK RICH (BANK 1 / SENSOR 1)

COMPONENT LOCATION E37E97A1

Refer to DTC P2195.

GENERAL DESCRIPTION E884E46D

Refer to DTC P2195.

DTC DESCRIPTION E5709C14

Checking output signals from HO2S under detecting condition, if an output signal within the detecting condition lasts continuously, PCM sets P2196. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E520CE03

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if O2 sensor indicates rich exhaust while in decel fuel cut-off	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Sensor not in cooled status • Not in Transient Conditions status • Airflow present ≥ 2 g/s • Ignition voltage ≥ 10V • Fuel reduction not active • Engine running • Engine running long enough ≥ 60sec. • Deceleration Fuel cut off conditions present • Engine coolant warm enough ≥ 60℃(140 °F) • Above conditions met long enough ≥ 1.5sec.	
Threshold value	• O2 sensor voltage 〉 0.2V	
DiagnosisTime	• Contineous (More than 11.25sec. failure for every 12.5sec. Test)	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E0A508EC

Refer to DTC P2195.

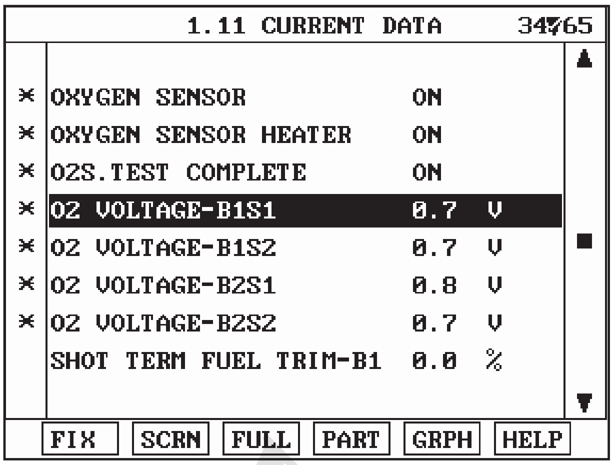
MONITOR SCANTOOL DATA E6DF00E9

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

2. Warm up the engine to normal operating temperature.

3. Monitor "HO2S(B1S1)" parameter on scantool

Specification : 0.1 ~ 0.9V



EGRF986O

4. Does the "HO2S(B1S1)" parameter operates correctly ?

YES

▶ Fault is intermittent caused by poor contact in Sensor's and/or PCM's connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Go to "Terminal and connector inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E6D6131D

Refer to DTC P2195.

COMPONENT INSPECTION E0980E30

1. Visual Inspection
   1) Visually check HO2S as follow.
      - Contamination, deformation or age of HO2S(B1/S1)
   2) Is the HO2S(B1/S1) normal ?

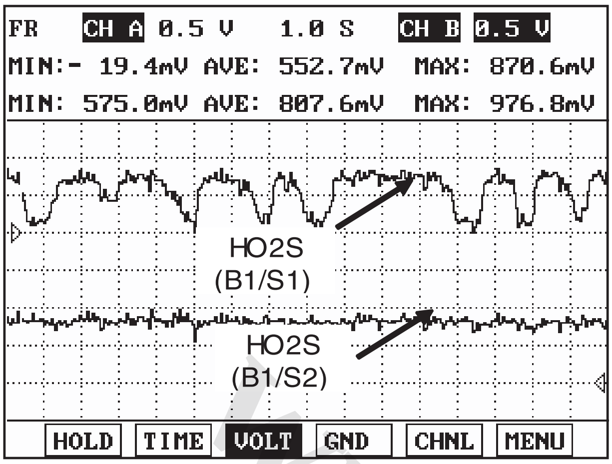
      YES

      ▶ Go to "Check performance of HO2S" as follows.

      NO

      ▶ Substitute with a known-good HO2S(B1S1) and check for proper operation. If the problem is corrected,replace HO2S(B1S1) and then go to "Verification of Vehicle Repair" procedure.
2. Check performance of HO2S
   1) Connect scantool to DLC(Data Link Connector)
   2) Warm up the engine to normal operating temperature.
   3) Monitor signal waveform of HO2S with scantool.

Specification : 0.1 ~ 0.9V.



EGRF986N

4) Is the HO2S(B1S1) working properly ?

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.

NO

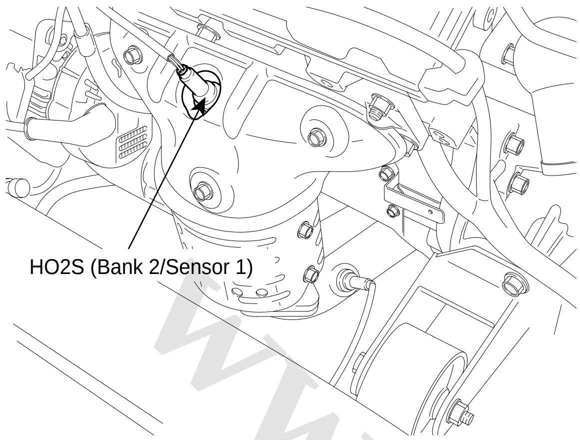
▶ Substitute with a known-good HO2S(B1S1) and check for proper operation. If the problem is corrected,replace HO2S(B1S1) and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E1F03FB5

Refer to DTC P2195.

DTC P2197 HO2S SIGNAL STUCK LEAN (BANK 2 / SENSOR 1)

COMPONENT LOCATION E851EB0C



EGRF986P

GENERAL DESCRIPTION E87A51C6

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 E0F17557

Checking output signals from HO2S under detecting condition, if an output signal within the detecting condition lasts continuously, PCM sets P2197. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E4F25EFC

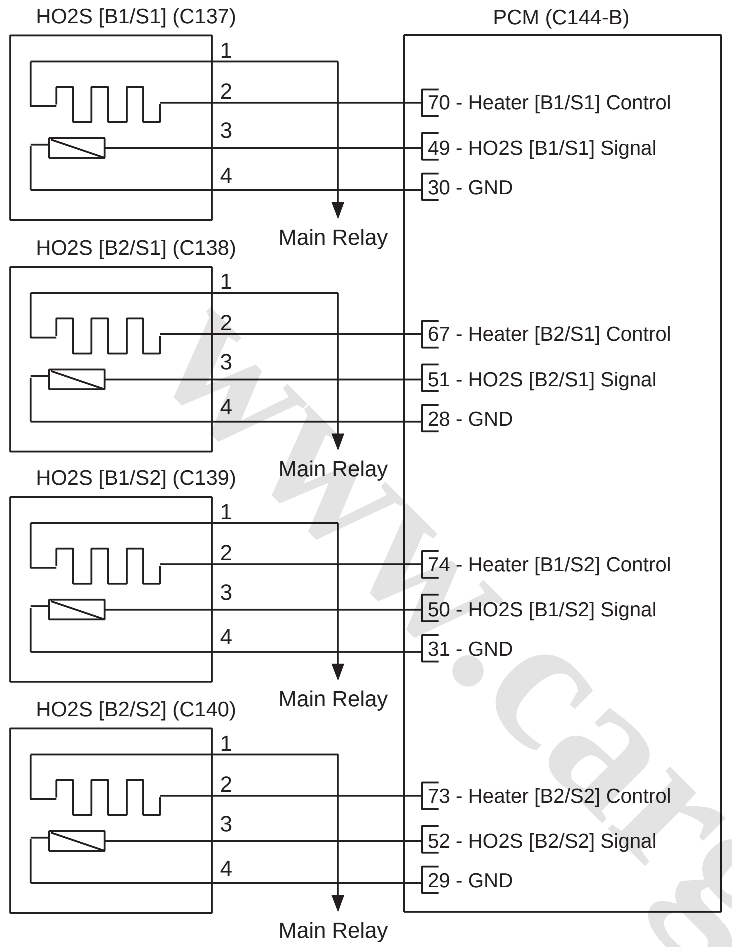
Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if O2 sensor indicates lean exhaust while in Power Enrichment	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Sensor not in cooled status • Not in Transient Conditions status • Airflow present ≥ 2 g/s • Ignition voltage ≥ 10V • Fuel reduction not active • Engine running • Engine running long enough ≥ 60sec. • Power Enrichment conditions present • Engine coolant warm enough ≥ 60℃(140 °F) • Above conditions met long enough ≥ 1.5sec.	
Threshold value	• O2 sensor voltage 〈 0.54V and, Air Fuel Ratio ≤ 13.5	
DiagnosisTime	• Contineous (More than 11.25sec. failure for every 12.5sec. Test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EF394DEF

A/F Ratio	Output Voltage(V)
Rich	0.75 ~ 1.00V
Lean	0 ~ 0.12V

SCHEMATIC DIAGRAM E18E0051

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

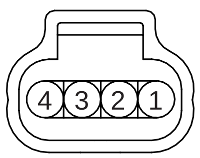
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

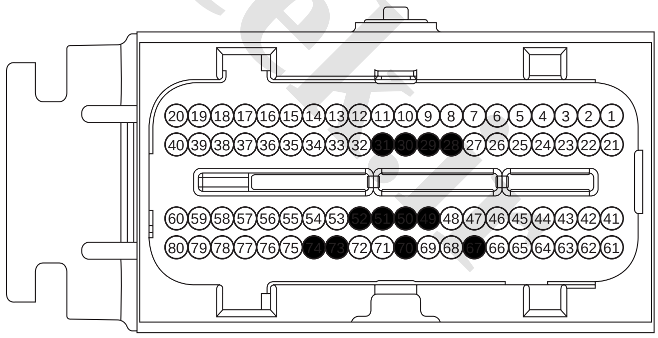
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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

EFBF250A

SIGNAL WAVEFROM AND DATA E45EFBBF

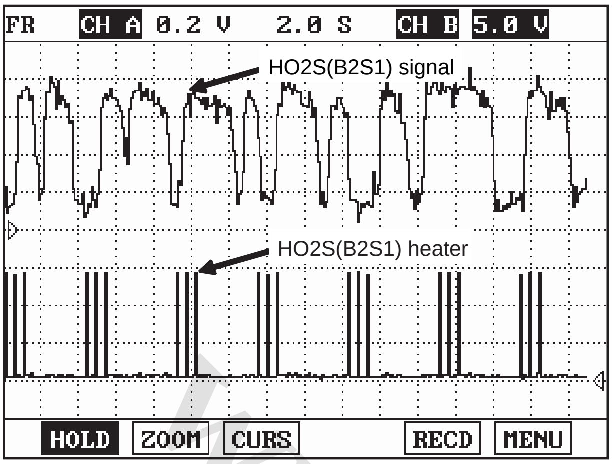


Fig.1: HO2S(B2S1) & Heater

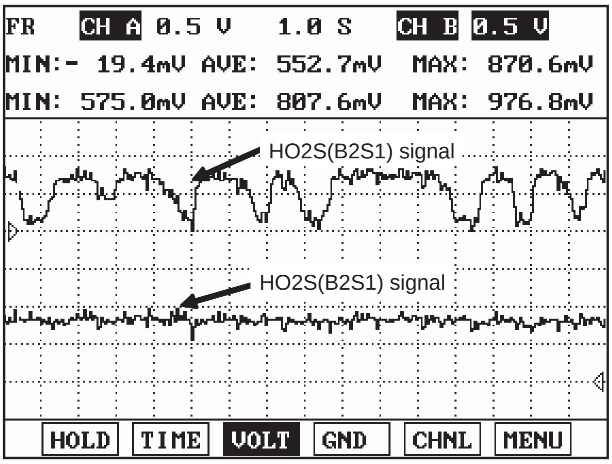


Fig.2: HO2S(B2S1) & (B2S2)

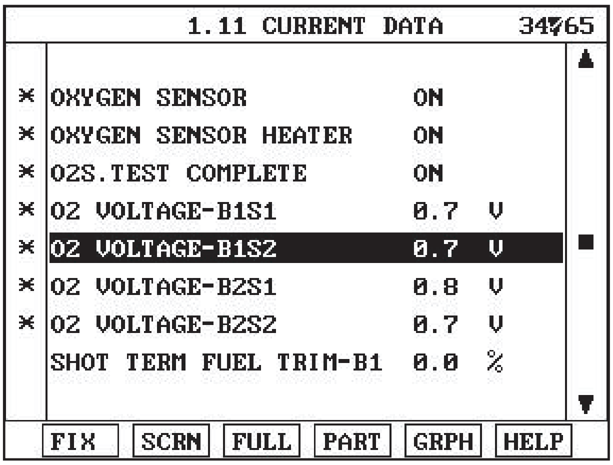
EGRF986Q

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, HO2S signal will switch from lean to rich normally.

MONITOR SCANTOOL DATA EE3D41F2

1. Connect scantool to DLC(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "HO2S(B2S1)" parameter on scantool

Specification : 0.1 ~ 0.9V



EGRF986R

4. Does the "HO2S(B2S1)" parameter operates correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor's and/or PCM's connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Go to "Component Inspection" procedure.

COMPONENT INSPECTION E7054CD7

1. Visual Inspection

   1) Visually check HO2S as follow.
      - Contamination, deformation or age of HO2S(B2/S1)

   2) Is the HO2S(B2/S1) normal ?

YES

▶ Go to "Check performance of HO2S" as follows.

NO

▶ Substitute with a known-good HO2S(B2S1) and check for proper operation. If the problem is corrected,replace HO2S(B2S1) and then go to "Verification of Vehicle Repair" procedure.

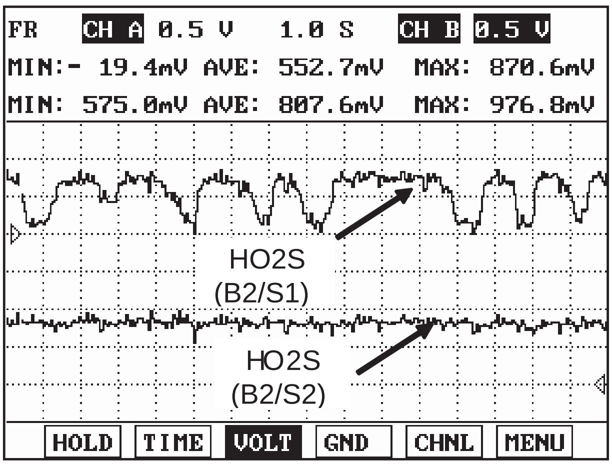
2. Check performance of HO2S

   1) Connect scantool to DLC(Data Link Connector)

   2) Warm up the engine to normal operating temperature.

   3) Monitor signal waveform of HO2S with scantool.

Specification : 0.1 ~ 0.9V.



EFBF986S

   4) Is the HO2S(B2S1) working properly ?

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.

NO

▶ Substitute with a known-good HO2S(B2S1) and check for proper operation. If the problem is corrected,replace HO2S(B2S1) and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EDE08B9E

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2198 HO2S SIGNAL STUCK RICH (BANK 2 / SENSOR 1)

COMPONENT LOCATION EE40B6B0

Refer to DTC P2197.

GENERAL DESCRIPTION ECA528DC

Refer to DTC P2197.

DTC DESCRIPTION E3DF6043

Checking output signals from HO2S under detecting condition, if an output signal within the detecting condition lasts continuously, PCM sets P2198. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EEF63AB1

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if O2 sensor indicates rich exhaust while in decel fuel cut-off	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Sensor not in cooled status • Not in Transient Conditions status • Airflow present ≥ 2 g/s • Ignition voltage ≥ 10V • Fuel reduction not active • Engine running • Engine running long enough ≥ 60sec. • Deceleration fuel cut off conditions present • Engine coolant warm enough ≥ 60℃(140 °F) • Above conditions met long enough ≥ 1sec.	
Threshold value	• O2 sensor voltage 〉 0.2V	
DiagnosisTime	• Contineous (More than 11.25sec. failure for every 12.5sec. Test)	
MIL On Condition	• 2 Driving Cycles	

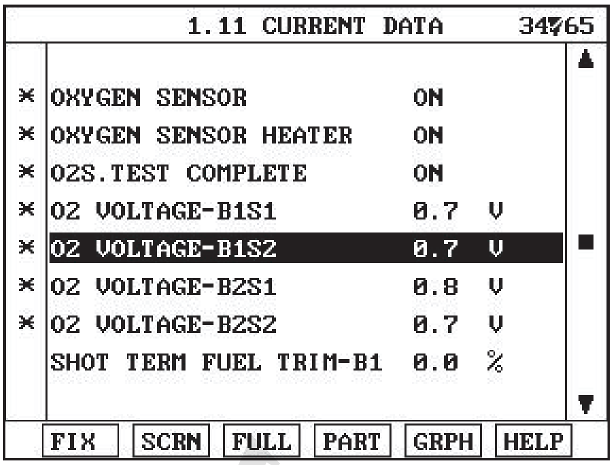
SCHEMATIC DIAGRAM EB63BCA0

Refer to DTC P2197.

MONITOR SCANTOOL DATA E9DF31B2

1. Connect scantool to DLC(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "HO2S(B2S1)" parameter on scantool

Specification : 0.1 ~ 0.9V



EGRF986R

4. Does the "HO2S(B2S1)" parameter operates correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor's and/or PCM's connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Terminal and connector inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E50704A8

Refer to DTC P2197.

COMPONENT INSPECTION E7B3CFD5

1. Visual Inspection

   1) Visually check HO2S as follow.
      - Contamination, deformation or age of HO2S(B2/S1)

   2) Is the HO2S(B2/S1) normal ?

      YES

      ▶ Go to "Check performance of HO2S" as follows.

      NO

      ▶ Substitute with a known-good HO2S(B2S1) and check for proper operation. If the problem is corrected,replace HO2S(B2S1) and then go to "Verification of Vehicle Repair" procedure.

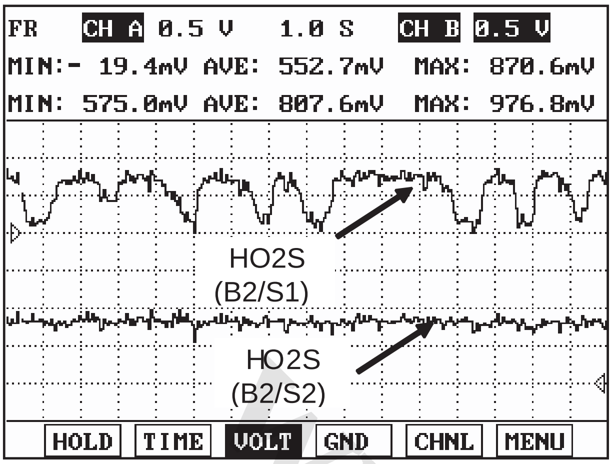
2. Check performance of HO2S

   1) Connect scantool to DLC(Data Link Connector)

   2) Warm up the engine to normal operating temperature.

   3) Monitor signal waveform of HO2S with scantool.

Specification : 0.1 ~ 0.9V.



EFBF986S

4) Is the HO2S(B2S1) working properly ?

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.

NO

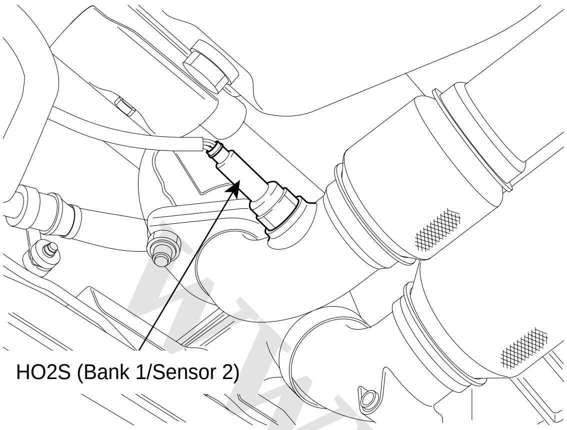
▶ Substitute with a known-good HO2S(B2S1) and check for proper operation. If the problem is corrected,replace HO2S(B2S1) and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ED0AD5D5

Refer to DTC P2197.

DTC P2270 HO2S SIGNAL STUCK LEAN (BANK 1 / SENSOR 2)

COMPONENT LOCATION EBC4AF05



EGRF986T

GENERAL DESCRIPTION E7A07683

Rear HO2S behind the catalytic conveter checks if purifying process performs well. purifying process is already done, the oxygen density of exhaust gas through catalytic converter is in the specified value.

DTC DESCRIPTION E24AD5B4

Checking output signals from HO2S under detecting condition, if an output signal within the threshold lasts continuously, PCM sets P2270. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E2A31843

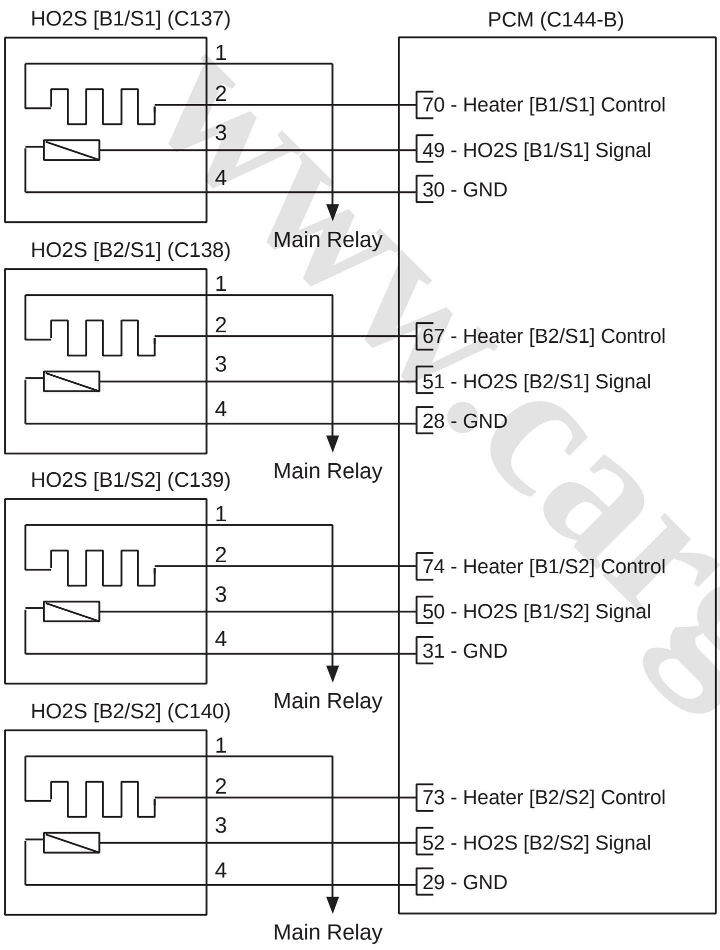
Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if O2 sensor indicates lean exhaust while in Power Enrichment	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Sensor not in cooled status • Not in Transient Conditions status • Airflow present ≥ 2 g/s • Ignition voltage ≥ 10V • Fuel reduction not active • Engine running • Engine running long enough ≥ 60sec. • Power Enrichment conditions present • Engine coolant warm enough ≥ 60℃(140 °F) • Above conditions met long enough ≥ 2.5sec.	
Threshold value	• O2 sensor voltage 〈 0.54V and, Air Fuel Ratio ≤ 13.5	
DiagnosisTime	• Contineous (More than 11.25sec. failure for every 12.5sec. Test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E32B96DC

A/F Ratio	Output Voltage(V)
Rich	0.75 ~ 1.00V
Lean	0 ~ 0.12V

SCHEMATIC DIAGRAM ED65B57F

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

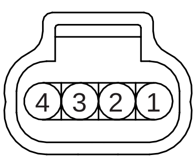
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

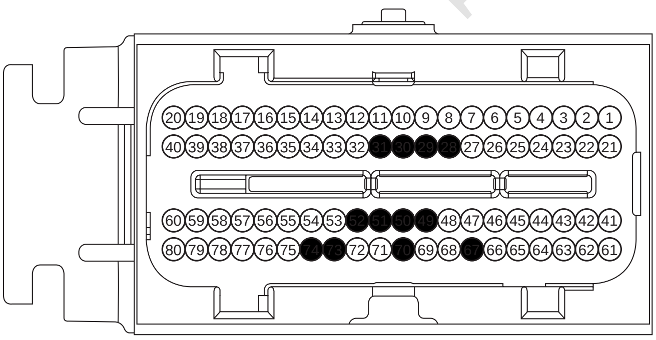
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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]

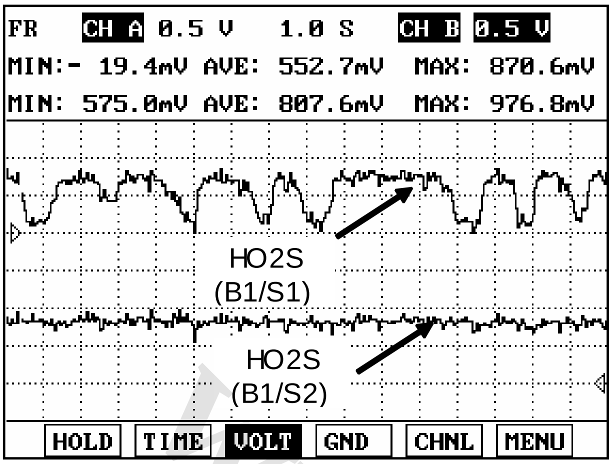


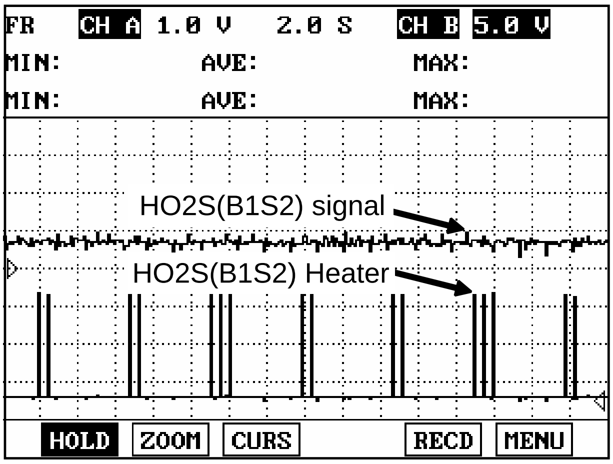
C144-B

PCM

EFBF250A

SIGNAL WAVEFROM AND DATA EB097780





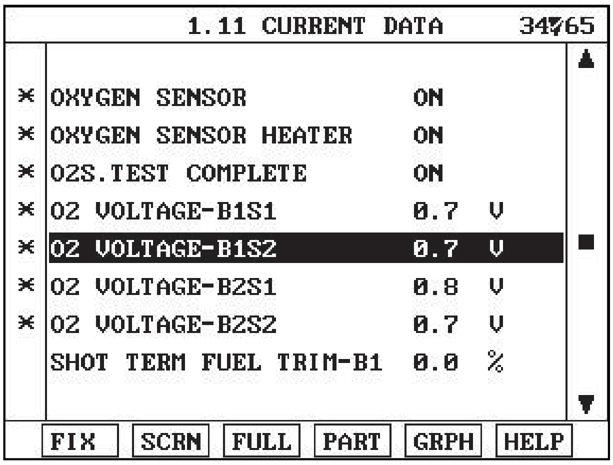
EGRF986U

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, HO2S signal will switch from lean to rich normally.

MONITOR SCANTOOL DATA E747B44B

1. Connect scantool to DLC(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "HO2S(B1S2)" parameter on scantool

Specification : 0.1 ~ 0.9V



Normal data

EGRF986V

4. Does the "HO2S(B1S2)" parameter operates correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor' s and/or PCM' s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Go to "Component Inspection" procedure.

COMPONENT INSPECTION E0C02A25

1. Visual Inspection

   1) Visually check HO2S as follow.
      - Contamination, deformation or age of HO2S(B1/S2)

   2) Is the HO2S(B1/S2) normal ?

   YES

   ▶ Go to "Check performance of HO2S" as follows.

   NO

   ▶ Substitute with a known-good HO2S(B1S2) and check for proper operation. If the problem is corrected,replace HO2S(B1S2) and then go to "Verification of Vehicle Repair" procedure.

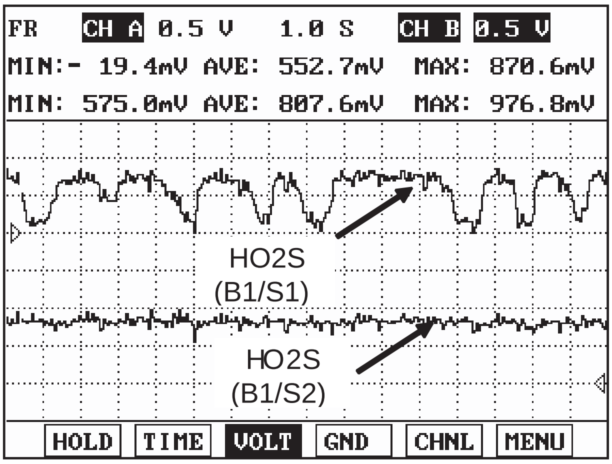
2. Check performance of HO2S

   1) Connect scantool to DLC(Data Link Connector)

   2) Warm up the engine to normal operating temperature.

   3) Monitor signal waveform of HO2S with scantool.

Specification : 0.1 ~ 0.9V.



EGRF986S

   4) Is the HO2S(B1S2) working properly ?

   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.

NO

▶ Substitute with a known-good HO2S(B1S2) and check for proper operation. If the problem is corrected,replace HO2S(B1S2) and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EE95DDEE

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2271 HO2S SIGNAL STUCK RICH (BANK 1 / SENSOR 2)

COMPONENT LOCATION ED8D1910

Refer to DTC P2270.

GENERAL DESCRIPTION EDE00AC6

Refer to DTC P2270.

DTC DESCRIPTION E82FFBC7

Checking output signals from HO2S under detecting condition, if an output signal within the detecting condition lasts continuously, PCM sets P2271. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E44F7965

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if O2 sensor indicates rich exhaust while in decel fuel cut-off	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Sensor not in cooled status • Not in Transient Conditions status • Airflow present ≥ 2 g/s • Ignition voltage ≥ 10V • Fuel reduction not active • Engine running • Engine running long enough ≥ 60sec. • Deceleration fuel cut off conditions present • Engine coolant warm enough ≥ 60℃(140 °F) • Above conditions met long enough ≥ 2sec.	
Threshold value	• O2 sensor voltage 〉 0.2V	
DiagnosisTime	• Contineous (More than 11.25sec. failure for every 12.5sec. Test)	
MIL On Condition	• 2 Driving Cycles	

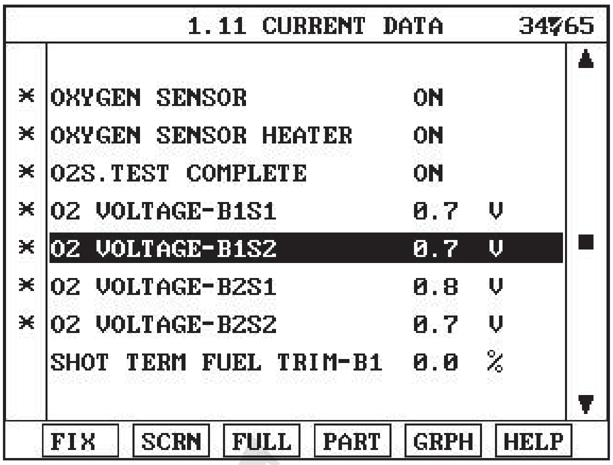
SCHEMATIC DIAGRAM E4FA9490

Refer to DTC P2270.

MONITOR SCANTOOL DATA EB2D0C50

1. Connect scantool to DLC(Data Link Connector).
2. Warm up the engine to normal operating temperature.
3. Monitor "HO2S(B1S2)" parameter on scantool

Specification : 0.1 ~ 0.9V



EGRF986R

4. Does the "HO2S(B1S2)" parameter operates correctly ?

YES

▶Fault is intermittent caused by poor contact in Sensor' s and/or PCM' s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Terminal and connector inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EF4E2A2A

Refer to DTC P2270.

COMPONENT INSPECTION EC33AD6D

1. Visual Inspection

    1) Visually check HO2S as follow.
        - Contamination, deformation or age of HO2S(B1/S2)

    2) Is the HO2S(B1/S2) normal ?

    YES

    ▶ Go to "Check performance of HO2S" as follows.

    NO

    ▶ Substitute with a known-good HO2S(B1S2) and check for proper operation. If the problem is corrected,replace HO2S(B1S2) and then go to "Verification of Vehicle Repair" procedure.

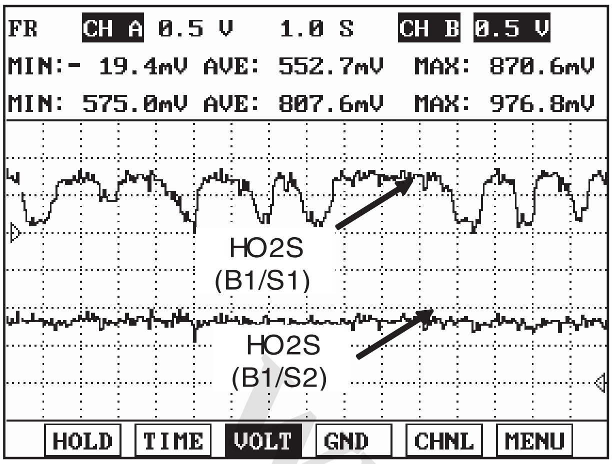
2. Check performance of HO2S

    1) Connect scantool to DLC(Data Link Connector)

    2) Warm up the engine to normal operating temperature.

    3) Monitor signal waveform of HO2S with scantool.

Specification : 0.1 ~ 0.9V.



EGRF986N

4) Is the HO2S(B1S2) working properly ?

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.

NO

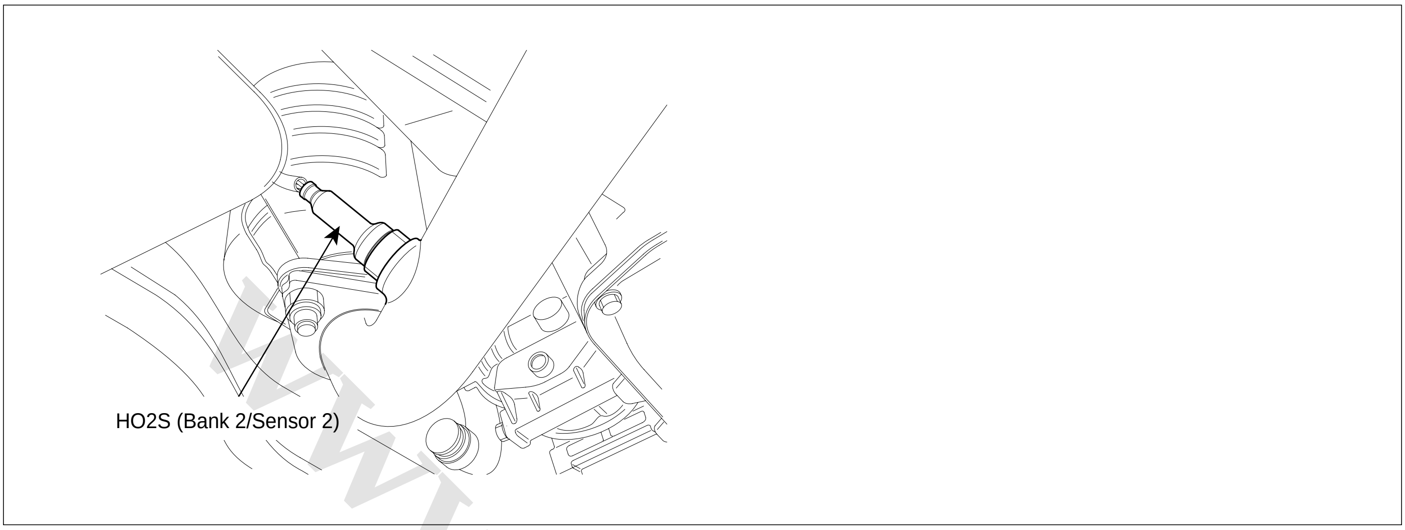
▶ Substitute with a known-good HO2S(B1S2) and check for proper operation. If the problem is corrected,replace HO2S(B1S2) and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E6537E23

Refer to DTC P2270.

DTC P2272 HO2S SIGNAL STUCK LEAN (BANK 2 / SENSOR 2)

COMPONENT LOCATION EC591DEC



EGRF986W

GENERAL DESCRIPTION E8E69730

Rear HO2S behind the catalytic conveter checks if purifying process performs well. purifying process is already done, the oxygen density of exhaust gas through catalytic converter is in the specified value.

DTC DESCRIPTION E5F5666E

Checking output signals from HO2S under detecting condition, if an output signal within the detecting condition lasts continuously, PCM sets P2272. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION EC0E515C

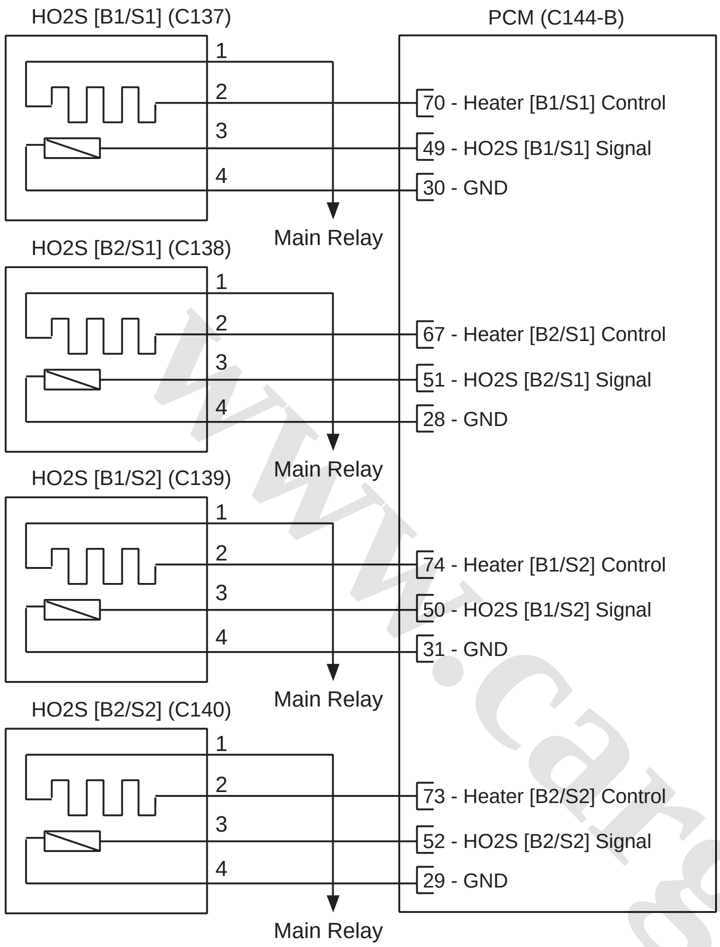
Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if O2 sensor indicates lean exhaust while in Power Enrichment	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Sensor not in cooled status • Not in Transient Conditions status • Airflow present ≥ 2 g/s • Ignition voltage ≥ 10V • Fuel reduction not active • Engine running • Engine running long enough ≥ 60sec. • Power Enrichment conditions present • Engine coolant warm enough ≥ 60℃(140 °F) • Above conditions met long enough ≥ 2.5sec.	
Threshold value	• O2 sensor voltage 〈 0.54V and, Air Fuel Ratio ≤ 13.5	
DiagnosisTime	• Contineous (More than 11.25sec. failure for every 12.5sec. Test)	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E9FEDFB7

A/F Ratio	Output Voltage(V)
Rich	0.75 ~ 1.00V
Lean	0 ~ 0.12V

SCHEMATIC DIAGRAM E9E682A7

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Funtion
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	Funtion
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

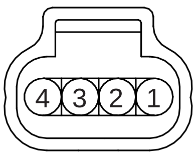
HO2S [B1/S2]

Terminal	Connected to	Funtion
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]

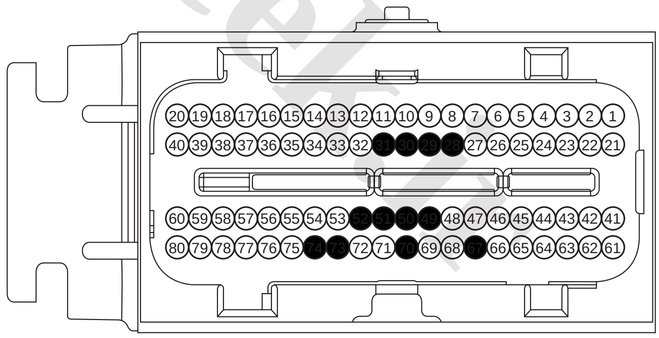
Terminal	Connected to	Funtion
1	Main Relay	Battery Voltage (B+)
2	PCM C144-B (73)	Heater [B2/S2] Control
3	PCM C144-B (52)	HO2S [B2/S2] Signal
4	PCM C144-B (29)	Sensor ground

[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]

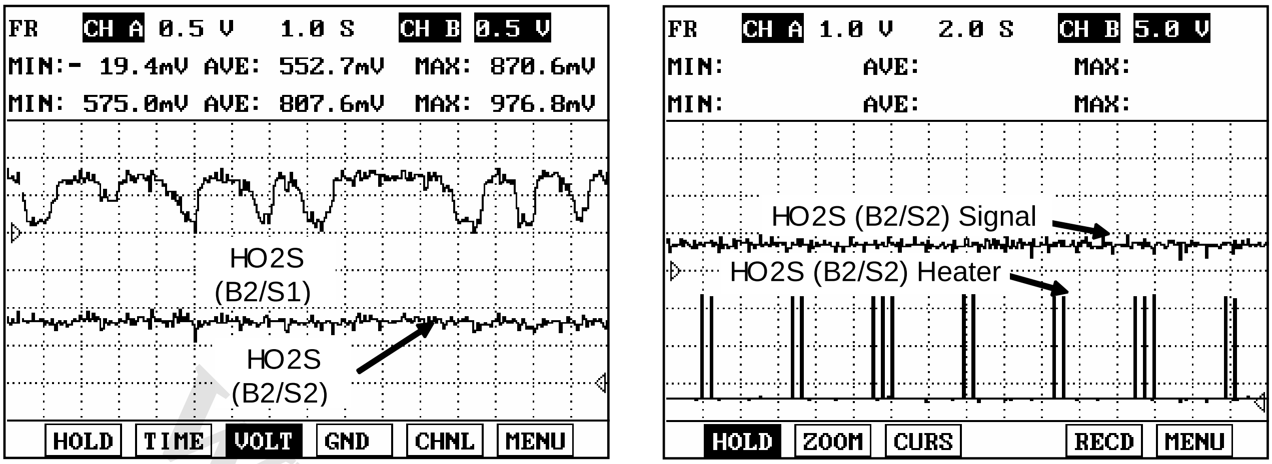


C144-B

PCM

EFBF250A

SIGNAL WAVEFROM AND DATA EB395E08



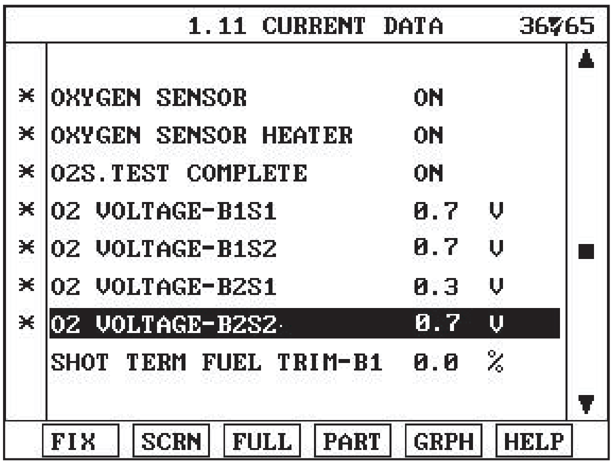
EGRF986X

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, HO2S signal will switch from lean to rich normally.

MONITOR SCANTOOL DATA EA343635

1. Connect scantool to DLC(Data Link Connector)
2. Warm up the engine to normal operating temperature.
3. Monitor "HO2S(B2S2)" parameter on scantool

Specification : 0.1 ~ 0.9V



EGRF986Y

4. Does the "HO2S(B2S2)" parameter operates correctly ?

YES

▶ Fault is intermittent caused by poor contact in Sensor's and/or PCM's connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶Go to "Component Inspection" procedure.

COMPONENT INSPECTION E695F758

1. Visual Inspection

1) Visually check HO2S as follow.
- Contamination, deformation or age of HO2S(B2/S2)

2) Is the HO2S(B2/S2) normal ?

YES

▶ Go to "Check performance of HO2S" as follows.

NO

▶ Substitute with a known-good HO2S(B2S2) and check for proper operation. If the problem is corrected,replace HO2S(B2S2) and then go to "Verification of Vehicle Repair" procedure.

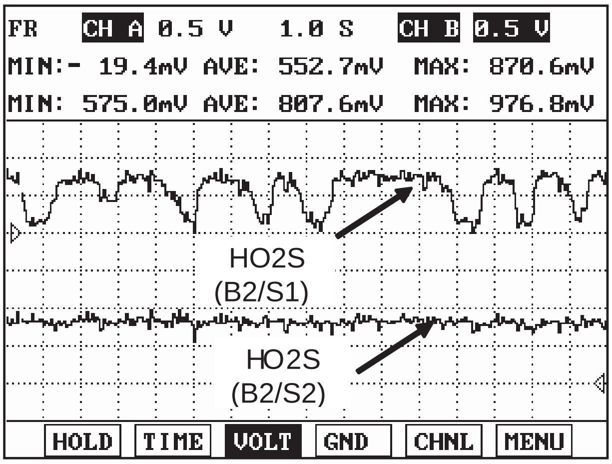
2. Check performance of HO2S

1) Connect scantool to DLC(Data Link Connector)

2) Warm up the engine to normal operating temperature.

3) Monitor signal waveform of HO2S with scantool.

Specification : 0.1 ~ 0.9V.



EFBF986S

4) Is the HO2S(B2S2) working properly ?

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.

NO

▶ Substitute with a known-good HO2S(B2S2) and check for proper operation. If the problem is corrected,replace HO2S(B2S2) and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EAE8ED45

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC P2273 HO2S SIGNAL STUCK RICH (BANK 2 / SENSOR 2)

COMPONENT LOCATION E7F4AEDF

Refer to DTC P2272.

GENERAL DESCRIPTION E49AA121

Refer to DTC P2272.

DTC DESCRIPTION E489F15B

Checking output signals from HO2S under detecting condition, if an output signal within the detecting condition lasts continuously, PCM sets P2273. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC DETECTING CONDITION E11348ED

Item	Detecting Condition	Possible cause
DTC Strategy	• Determines if O2 sensor indicates rich exhaust while in decel fuel cut-off	• Poor Connection • Faulty HO2S • Faulty PCM
EnableConditions	• Sensor not in cooled status • Not in Transient Conditions status • Airflow present ≥ 2 g/s • Ignition voltage ≥ 10V • Fuel reduction not active • Engine running • Engine running long enough ≥ 60sec. • Deceleration fuel cut off conditions present • Engine coolant warm enough ≥ 60℃(140 °F) • Above conditions met long enough ≥ 2sec.	
Threshold value	• O2 sensor voltage 〉 0.42V	
DiagnosisTime	• Contineous (More than 11.25sec. failure for every 12.5sec. Test)	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E0255991

Refer to DTC P2272.

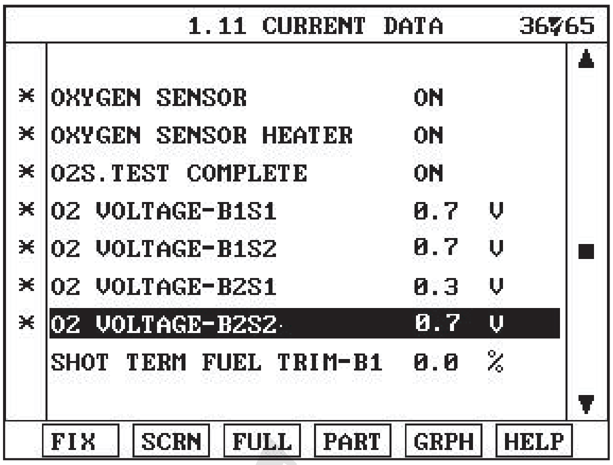
MONITOR SCANTOOL DATA E5CD9A6A

1. Connect scantool to DLC(Data Link Connector)

2. Warm up the engine to normal operating temperature.

3. Monitor "HO2S(B2S2)" parameter on scantool

Specification : 0.1 ~ 0.9V



EGRF986Y

4. Does the "HO2S(B2S2)" parameter operates correctly ?

YES

▶ Fault is intermittent caused by poor contact in Sensor’ s and/or PCM’ s connector or was repairedand PCM memory was not cleared. Thoroughly check connectors for looseness, poorconnection, bending, corrosion, contamination, deterioration, or damage. Repair or replaceas necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Go to "Terminal and connector inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION E5CC486D

Refer to DTC P2272.

COMPONENT INSPECTION E0B35C31

1. Visual Inspection

   1) Visually check HO2S as follow.
      - Contamination, deformation or age of HO2S(B2/S2)

   2) Is the HO2S(B2/S2) normal ?

      YES

      ▶ Go to "Check performance of HO2S" as follows.

      NO

      ▶ Substitute with a known-good HO2S(B2S2) and check for proper operation. If the problem is corrected,replace HO2S(B2S2) and then go to "Verification of Vehicle Repair" procedure.

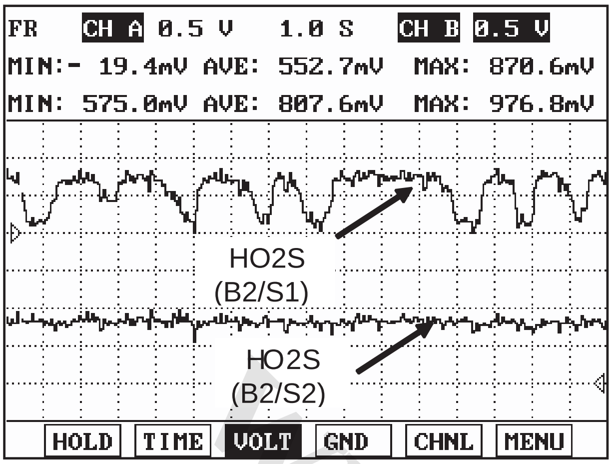
2. Check performance of HO2S

   1) Connect scantool to DLC(Data Link Connector)

   2) Warm up the engine to normal operating temperature.

   3) Monitor signal waveform of HO2S with scantool.

Specification : 0.1 ~ 0.9V.



EFBF986S

4) Is the HO2S(B2S2) working properly ?

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.

NO

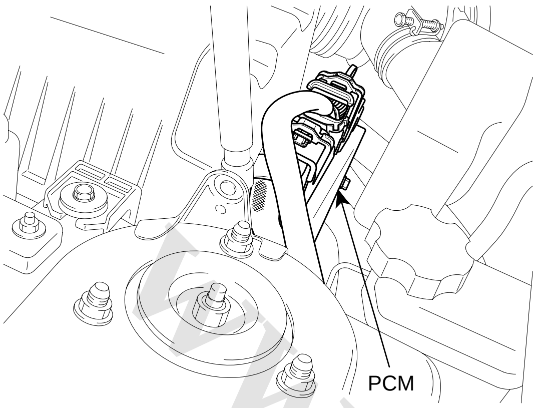
▶ Substitute with a known-good HO2S(B2S2) and check for proper operation. If the problem is corrected,replace HO2S(B2S2) and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EC12B39C

Refer to DTC P2272.

DTC P2610 ECM/PCM INTERNAL ENGINE OFF TIMER PERFORMANCE

COMPONENT LOCATION E594DE60



EFBF986Z

GENERAL DESCRIPTION EF3E37F0

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 E642F822

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 EF408D7B

ITEM		Detecting Condition	Possible Cause
DTC Strategy	Case 1	• Compares the time elapsed recorded by the LPC 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 by the low power counter and the calibration the test timer clocks up 〉 2sec.	
	Case 2	• The LPC is reset to zero abnormally	
Diagnosis Time		• -	
MIL On Condition		• 2 Driving Cycle	

TERMINAL AND CONNECTOR INSPECTION E1AD10F8

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Substitute with a known-good 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.

VERIFICATION OF VEHICLE REPAIR E5A6A870

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.

2. Using a Scantool, Clear the DTCs

3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions

4. Monitor that all rediness test have been verified as " Complete "

5. Are any DTCs present ?

YES

▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

DTC U0001 CAN COMMUNICATION MALFUNCTION

GENERAL DESCRIPTION E2660921

As vehicles electronically controlled, various control unit is applied to vehicle and several units are controlled based on the signals from the sensors. Therefore sharing signals of sensors and information is required. To meet this requirement, CAN communication type, which is insensible to external noises and whose communication speed is fast, is applied to power train control.Sharing signals from RPM, APS, gear shifting, torque reduction in ESP, ABS and various modules, active control is performed.

DTC DESCRIPTION EFF85B43

Checking CAN communication, under detecting condition, if an output signal 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.

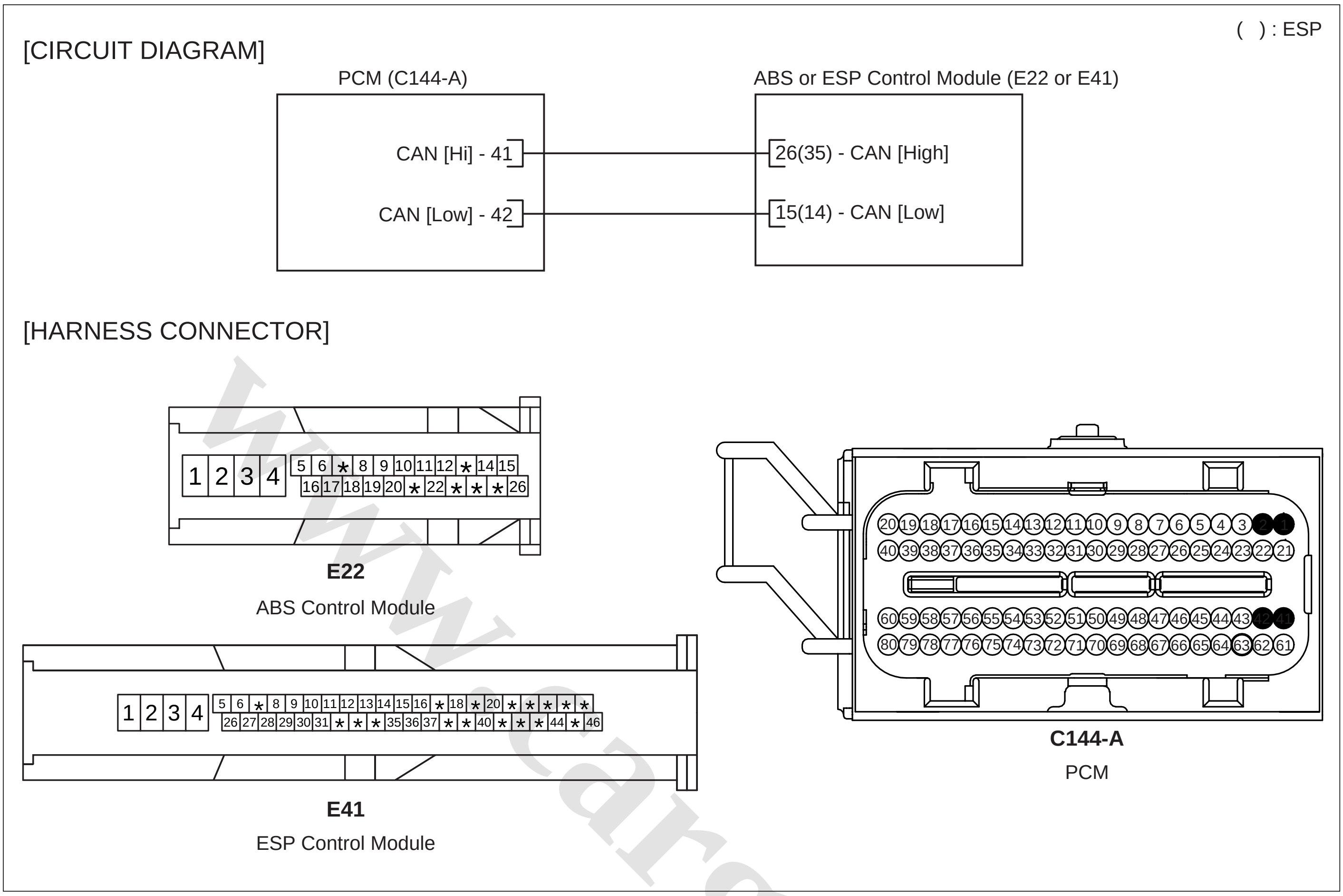
DTC DETECTING CONDITION EA2B4A46

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 Communicatio line • CAN Communication Module
EnableConditions	• Engine Run Time ≥ 2sec. • Ignition Voltage ≥ 11V	
Threshold value	• CAN communicatin error	
DiagnosisTime	• Continuous	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EB57EDF2

For-mat	DIGITAL "0"		DIGITAL "1"(BUS IDLE)		CAN Resistance	
	HIGH	LOW	HIGH	LOW	PCM	ESP
CAN 2.0B	3.5V	1.5V	2.5V	2.5V	120Ω (20℃)	120Ω (20℃)

SCHEMATIC DIAGRAM E4632EA7



EFBF806A

SIGNAL WAVEFROM AND DATA E10DB645

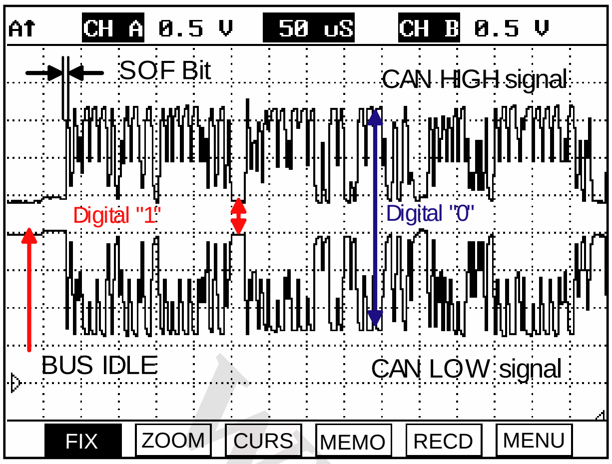


Fig.1

Fig. 1 : Waveform of CAN communication

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 is 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.

EGRF987F

MONITOR SCANTOOL DATA E35ADCC4

1. Connect scantool to Data Link Connector (DLC).
2. Warm engine up to normal operating temperature.
3. Turn "OFF" electrical devices and A/C.
4. Monitor the data from PCM through CAN communication among ABSCM or ESP data

If CAN is normal, vehicle speed data is showed through CAN communication line from ABS or ESP control module.

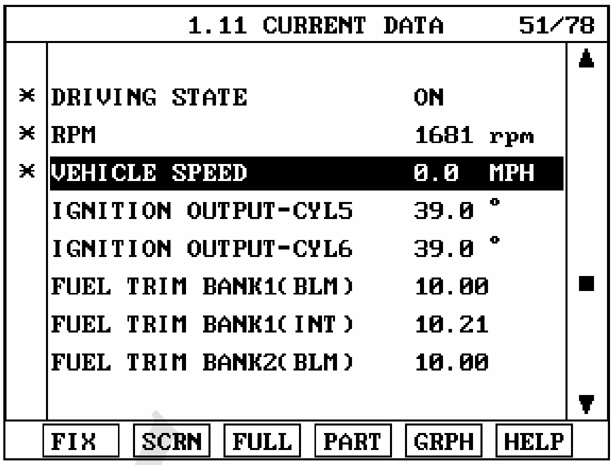


Fig. 1

Fig1 : Vehicle speed data on current data during driving state.

EGRF988V

5. Is the data displayed correctly?

YES

▶ 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, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Go to "Terminal and Connector Inspection" procedure

TERMINAL AND CONNECTOR INSPECTION EFBF0394

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

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

3. Has a problem been found?

YES

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

NO

▶ Go to "Signal Circuit Inspection" procedure.

SIGNAL CIRCUIT INSPECTION E44C5E09

1. Check CAN communication bus resistance

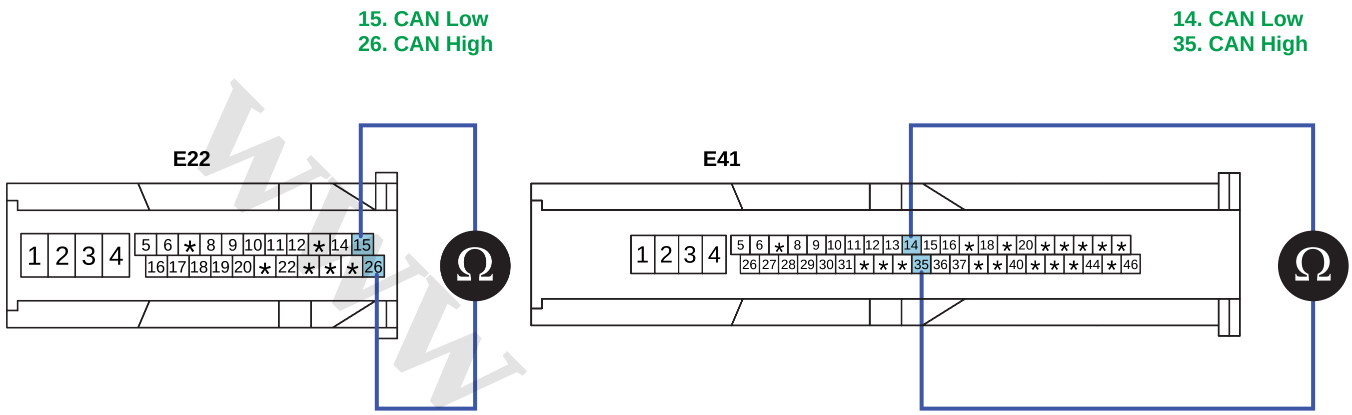
   1) Ignition "OFF".

   2) Check connection state of PCM connector and ESP or ABS connector.

3) Measure the resistance between ABS connector 15 and 26 refering to the checking condition of specification as follows.

4) Measure the resistance between ESP connector 14 and 35 refering to the checking condition of specification as follows.

Specification : ※ PCM connector, ESP or ABS connector connected : 60Ω ± 5Ω
※ PCM connecotor disconnected, ESP or ABS connector connected : 120Ω ± 10Ω
※ PCM connector connected, ESP or ABS connector disconnected : 120Ω ± 10Ω



EFBF987H

5) Is CAN BUS resistance within the specification?

YES

▶ Go to "Check short to ground in CAN BUS" as follows.

NO

▶ When resistance is about 1.0Ω : Go to "3. Check short between CAN communication lines" as follows
▶ When resistance is infinite Ω : Go to "4. Check open in CAN communication line" as follows

2. Check short to ground in CAN communication bus

1) Ignition "OFF"

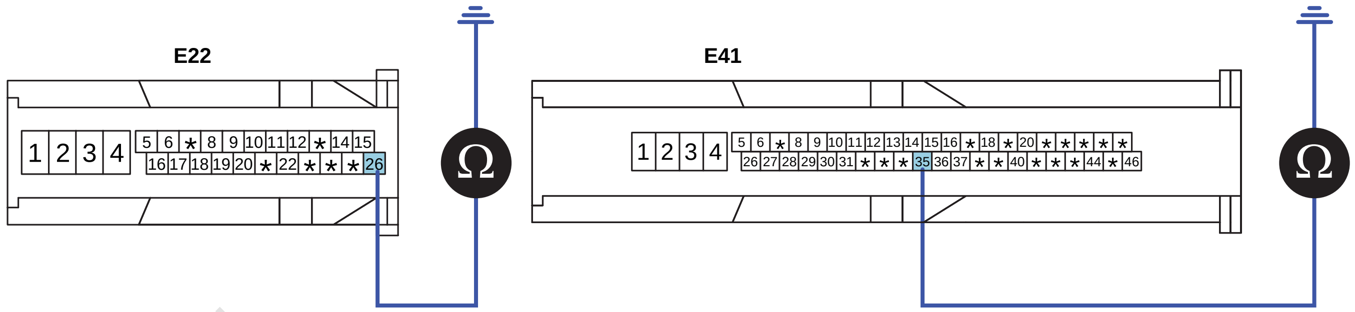
2) Disconnect ESP or ABS connector.

3) Measure resistance between terminal 26 of ABS harness connector and chassis ground.

4) Measure resistance between terminal 35 of ESP harness connector and chassis ground.

---

specification : Infinite



EFBF987I

5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection" procedure

NO

▶ Below 1.0Ω is detected : Repair short to ground in CAN High circuit and go to "Verification of Vehicle Repair" procedure.
▶ Above 120Ω is detected : Repair short to ground in CAN Low circuit and go to "Verification of Vehicle Repair" procedure.

3. Check short between CAN communication lines(LOW and HIGH)

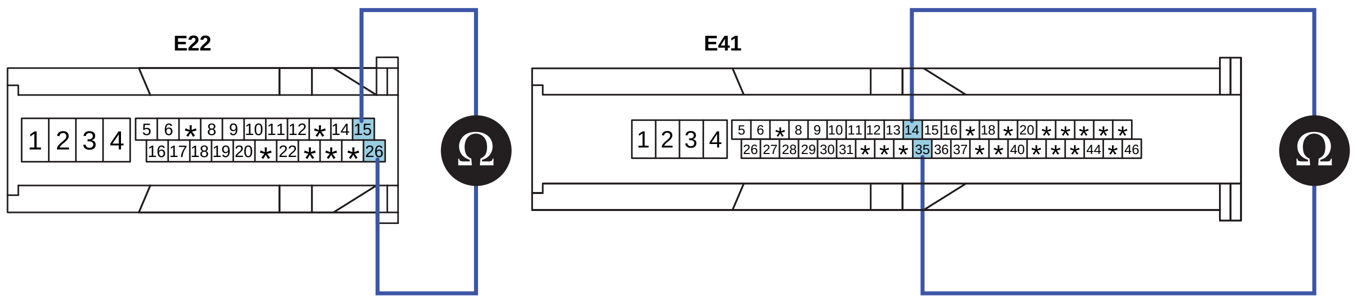
1) Ignition "OFF"

2) Disconnect PCM connector and ESP or ABS connector.

3) Measure resistance between terminal 15 and 26 of ABS harness connector.

4) Measure resistance between terminal 14 and 35 of ESP harness connector.

specification : Infinite



EFBF987H

5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Below 1.0Ω is detected : Repair short between CAN LOW and HIGH signal line and go to "Verification of Vehicle Repair" procedure.

4. Check open in CAN communication line

1) Ignition "OFF".

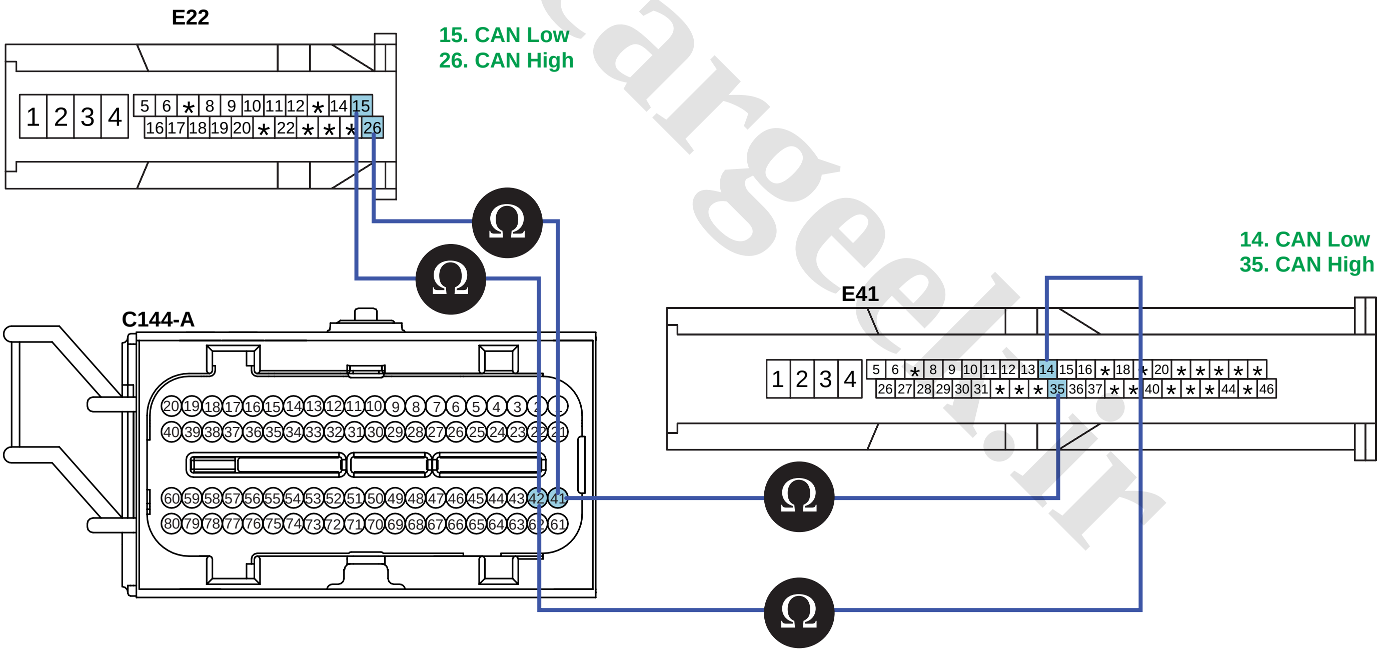
2) Disconnect PCM connector and ESP or ABS connector.

3) Measure resistance between terminal 42/C144-A of PCM harness connector and terminal 15 of ABS or 14 of ESP harness connector.(CAN Low)

4) Measure resistance between terminal 41/C144-A of PCM harness connector and terminal 26 of ABS or 35 of ESP harness connector (CAN high)

---

specification : Below 1.0Ω



EFBF987J

5) Is the measured resistance within the specification?

YES

▶ Go to "Component Inspection" procedure.

NO

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

COMPONENT INSPECTION E7972E5B

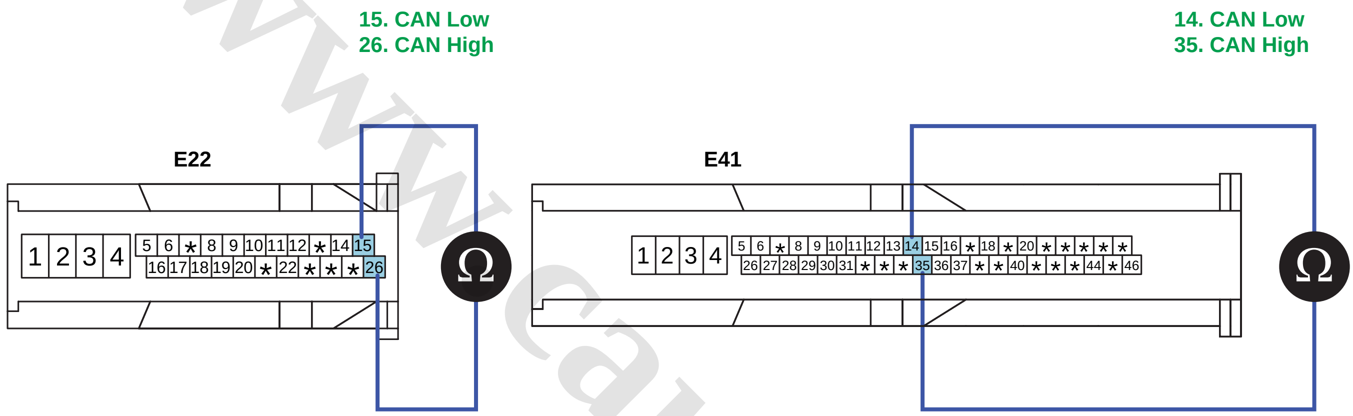
1. Check the resistance of CAN BUS inside of module

    1) Ignition "OFF"

    2) Measure the resistance between ABS connector 15 and 26 refering to the checking condition of specification as follows.

    3) Measure the resistance between ESP connector 14 and 35 refering to the checking condition of specification as follows.

Specification : ※ PCM connector disconnected, ESP or ABS connector connected. (TEST "A") : 120Ω ± 10Ω
※ PCM connector connected, ESP or ABS connector disconnected (TEST "B") : 120Ω ± 10Ω



EFBF987H

    4) Is the measured resistance within the specification?

YES

▶ Go to "2. Check CAN communication waveform" as follows

NO

▶ TEST "A" problem : the resistance of CAN BUS inside of ABS or ESP is without specification. Replace ABS or ESP and go to "Verification of Vehicle Repair"
▶ TEST "B" problem : the resistance of CAN BUS inside of PCM is without specification. Replace PCM and go to "Verification of Vehicle Repair"

2. Check CAN communication waveform output

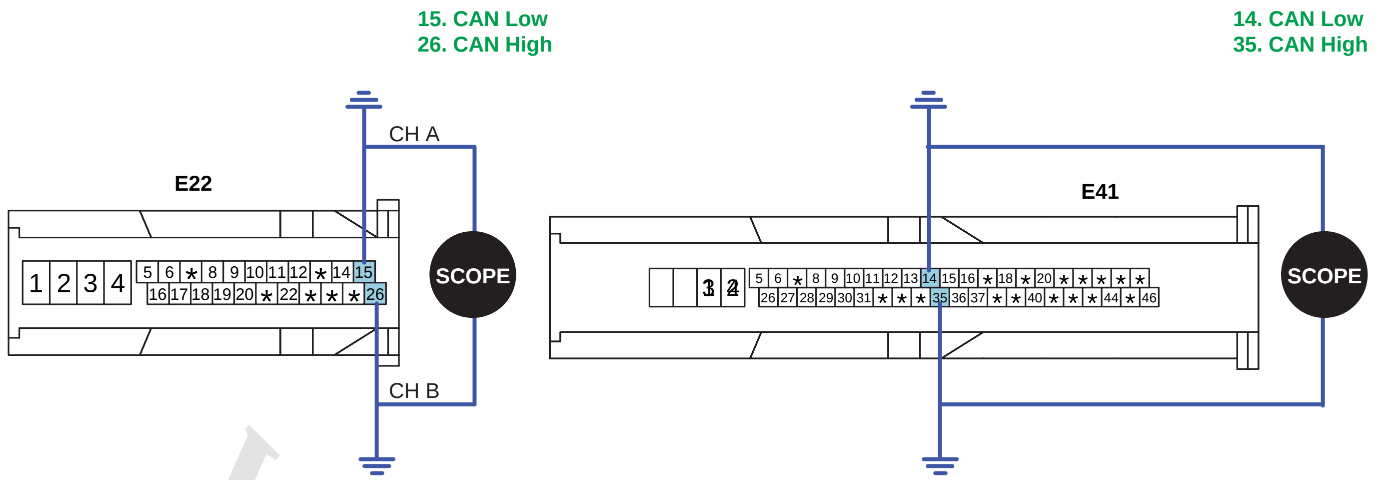
    1) Ignition "OFF"

    2) Connect 2 channel scope to ABS connector terminal 15 and 26.(ESP connector terminal 14 and 35)

    3) Disconnect ABS or ESP connector and check CAN communication waveform after Ignition "ON". (TEST "A")

    4) Disconnect PCM connector and check CAN communication waveform after Ignition "ON". (TEST "B")

Sspecification : Communication waveform similar to the waveform of "Signal Waveform & Data" is displayed when Ignition "ON"
※ It means communication error of connected module when, being different from reference waveform, 1) CAN HIGH and LOW signals are fixed at 2.5V or 2)HIGH and LOW signals are fixed at 3.5V and 1.5V,respectively



EFBF987K

5) Does correct waveform generate from PCM and ABS(ESP) module?

YES

▶ Go to "Verification of Vehicle Repair"

NO

▶ TEST "A" waveform is abnormal : Repalce PCM due to the communication error with PCM and go to "Verification of Vehicle Repair"
▶ TEST "B" waveform is abnormal : Repalce ABS or ESP due to the communication error with ABS or ESP and go to "Verification of Vehicle Repair"

※ Repeat this process 2~3 times.

VERIFICATION OF VEHICLE REPAIR EEC12FE3

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

1. Monitor and record the Freeze Frame Data for the Diagnostic Trouble Code(DTC) which has been diagnosed.
2. Using a Scantool, Clear the DTCs
3. Operate the vehicle within conditions noted in the freeze frame data or enable conditions
4. Monitor that all rediness test have been verified as " Complete "
5. Are any DTCs present ?

YES

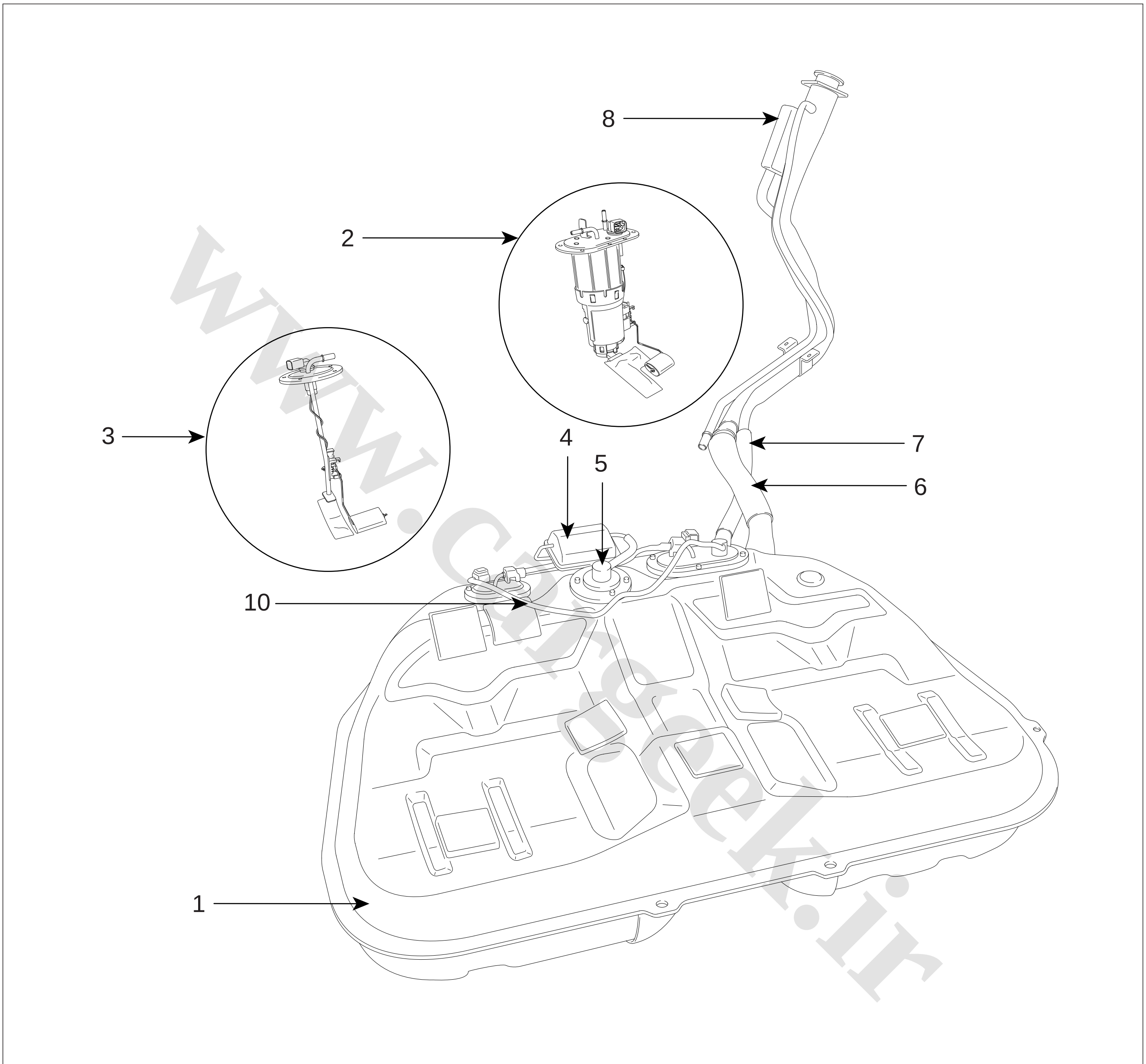
▶ Go to the applicable troubleshoooting procedure.

NO

▶ System is performing to specification at this time.

FUEL DELIVERY SYSTEM

COMPONENTS E19357F7



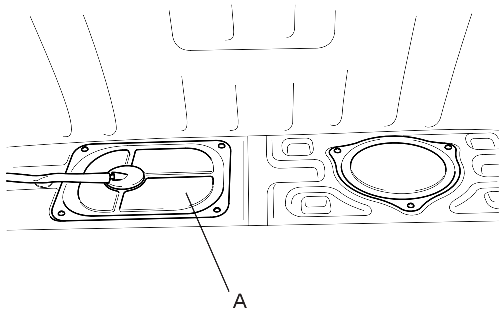
1. Fuel Tank
2. Fuel Pump
   (including Fuel Filter and Fuel Pressure Regulator)
3. Sub Fuel Sender
4. Separator
5. Fuel-Cut Valve
6. Fuel Filler Hose
7. Leveling Hose
8. Suction Tube
9. Tube (Canister ↔ Fuel Tank Air Filter)
10. Fuel Tank Air Filter

EFBF300B

FUEL PRESSURE TEST EDA97A92

1. PREPARING

1. Open the service cover (A) in trunk.

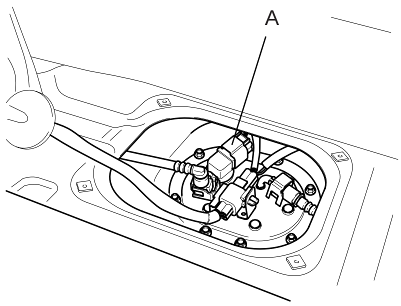


2. RELEASE THE INTERNAL PRESSURE

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.



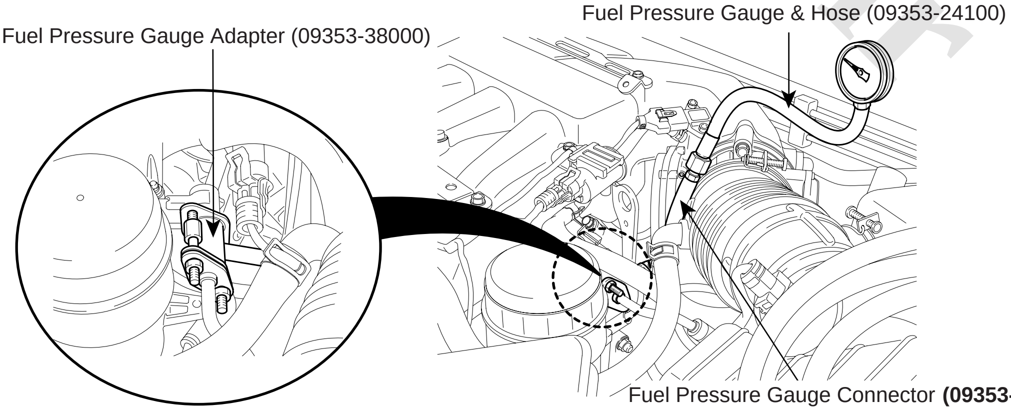
3. INSTALL THE SPECIAL SERVICE TOOL (SST) FOR MEASURING THE FUEL PRESSURE

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).



EFBF300C

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

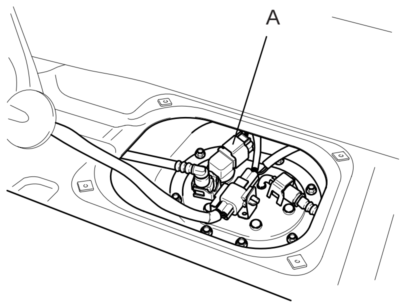
- Observing the declination of the fuel pressure when the gauge reading drops and perform the necessary repairs using the table below.

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. Conenct 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.

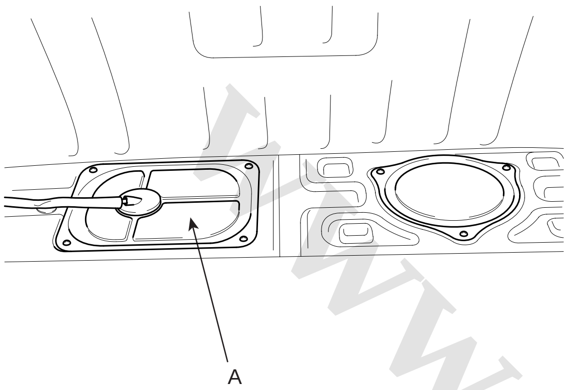
EFBF300D

FUEL PUMP (FP)

REMOVAL(INCLUDING FUEL FILTER AND FUEL PRESSURE REGULATOR) E5A2E301

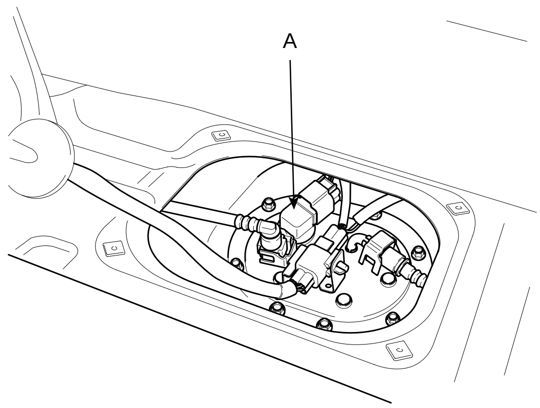
1. Preparation

   1) Remove the Service Cover (A) in the trunk.



KFBF261A

   2) Disconnect the Fuel Pump Connector (A).

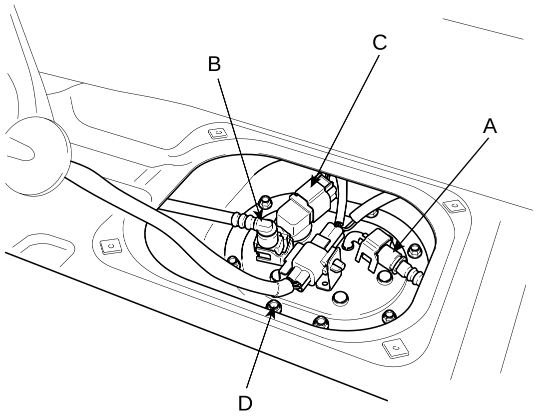


KFBF262A

   3) Start the engine and wait until fuel in fuel line is exhausted.

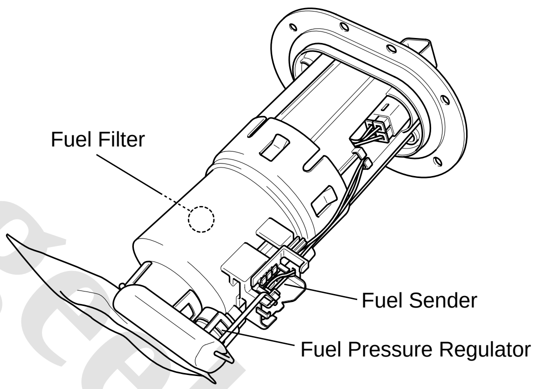
   4) After the engine stalls, turn the ignition switch OFF.

2. Disconnect Suction Tube Quick-Connector (A), Fuel Feed Quick-Connector (B) and Fuel Pump Connector (C).



EFBF263A

3. Unfasten the Fuel Pump mounting bolts (B) and remove the fuel pump assembly.



EFBF264A

INSTALLATION E818FF9F

1. Install the Fuel Pump assembly according to the reverse order of "REMOVAL" procedure.

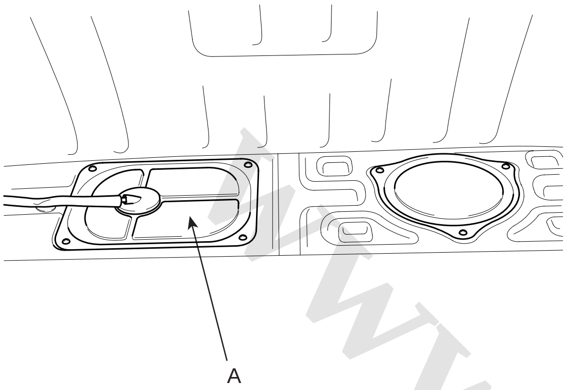
Tightening Torque 2.0 ~ 2.9 N·m (0.2 ~ 0.3 kgf·m, 1.4 ~ 2.2 lbf·ft)

FUEL TANK

REMOVAL ED5313CE

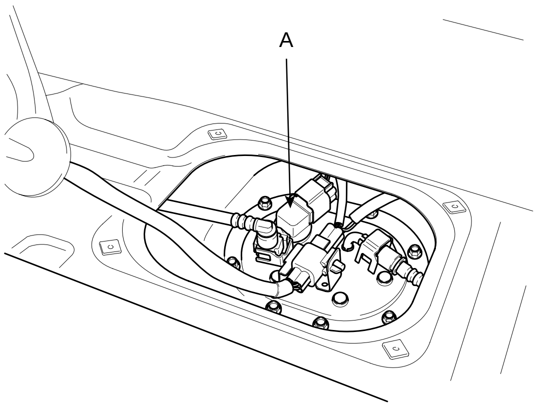
1. Preparation

   1) Remove the Service Cover (A) in the trunk.



KFBF261A

   2) Disconnect the Fuel Pump Connector (A).

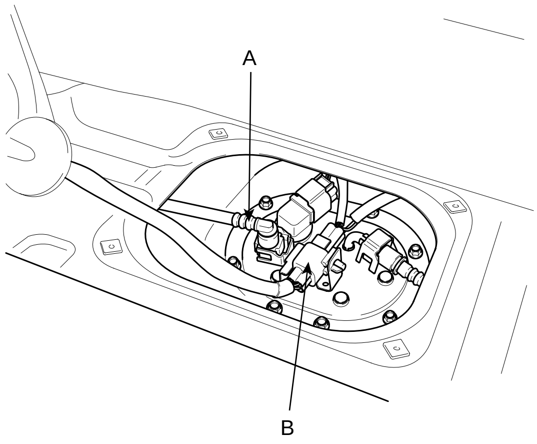


KFBF262A

   3) Start the engine and wait until fuel in fuel line is exhausted.

   4) After the engine stalls, turn the ignition switch OFF.

2. Disconnect the Fuel Feed Quick-Connector (A) and Electric Connector (B).

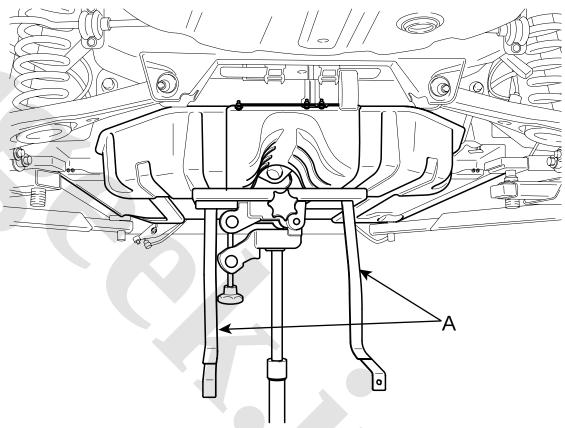


KFBF265A

3. Lift the vehicle.

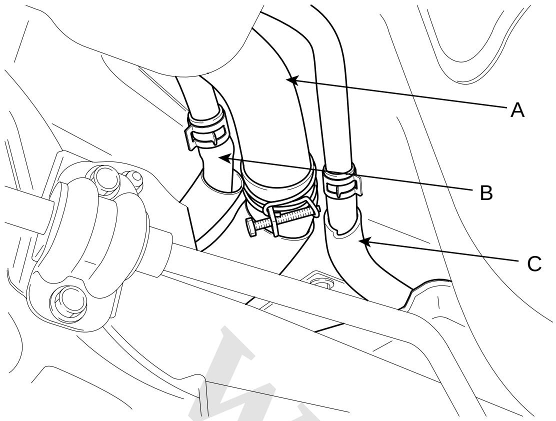
4. Remove the center and main mufflers (Refer to the group "EM").

5. Support the fuel tank with a jack and remove the Fuel Tank band (A).



KFBF266A

6. Disconnect the Fuel Feed Hose (A), Leveling Hose (B) and Canister Ventilation Hose (C).



KFBF267A

7. With moving the jack down slowly, remove the Fuel Tank from the vehicle.

INSTALLATION ECD61C3C

1. Install the Fuel Tank according to the reverse order of "REMOVAL" procedure.

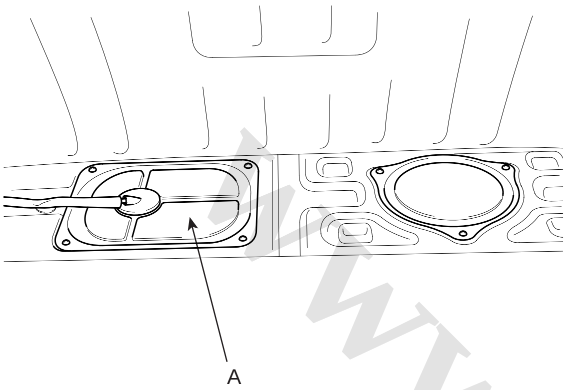
Tightening Torque
39.2 ~ 53.9 N·m (40. ~ 5.5 kgf·m, 28.9 ~ 39.8 lbf·ft)

SUB FUEL SENDER

REMOVAL EDE9D610

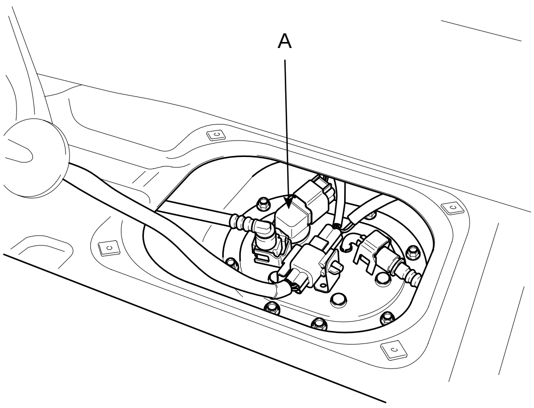
1. Preparation

   1) Remove the Service Cover (A) in the trunk.



KFBF261A

   2) Disconnect the Fuel Pump Connector (A).

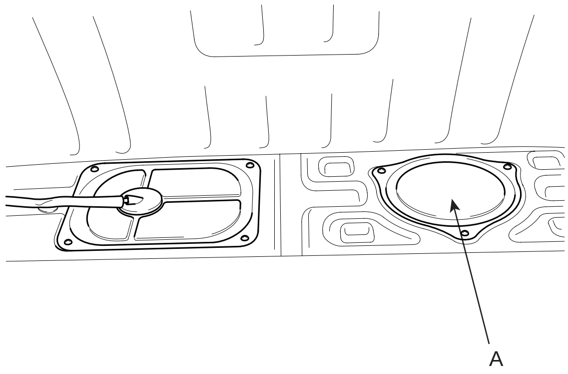


KFBF262A

   3) Start the engine and wait until fuel in fuel line is exhausted.

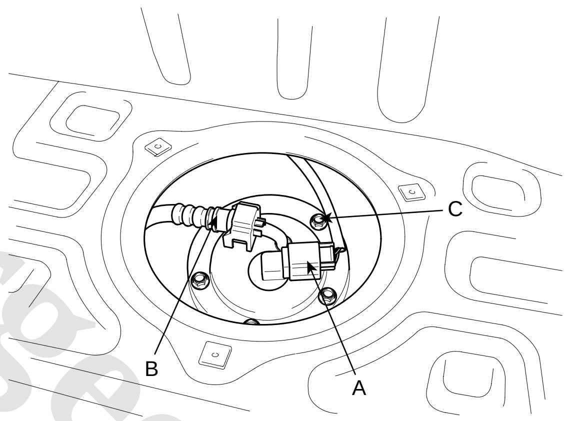
   4) After the engine stalls, turn the ignition switch OFF.

2. Remove the Service Cover (A) in the tank.



EFBF261B

3. Disconnect Sub Fuel Sender Connector (A) and Suction Tube Quick-Connector (B).



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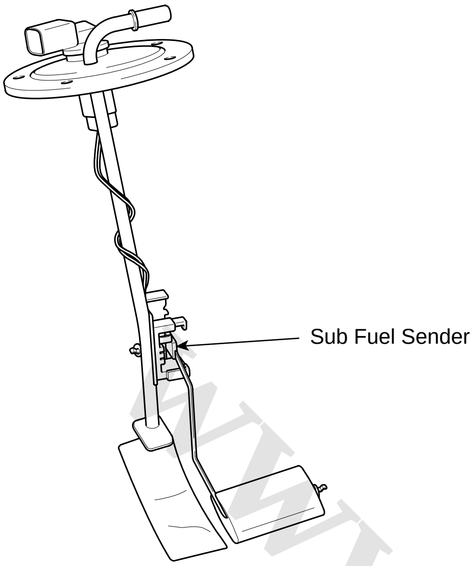
4. Unfasten the Sub Fuel Sender mounting bolts (C) and remove the Sub Fuel Sender.



INSTALLATION E07B50A1

1. Install the Sub Fuel Sener according to the reverse order of "REMOVAL" procedure.

Tightening Torque 2.0 ~ 2.9 N·m (0.2 ~ 0.3 kgf·m, 1.4 ~ 2.2 lbf·ft)