Fuel System

GENERAL

SPECIFICATIONS E1FBE479

FUEL DELIVERY SYSTEM

Items	Specification	
Fuel Tank	Capacity	55lit. (14.5 U.S.gal., 12.1 Imp.gal.)
Fuel Filter (built in Fuel Pump Assembly)	Type	High pressure type
Fuel Pressure Regulator (built in Fuel Pump Assembly)	Regulated Fuel Pressure	338 ~ 348kpa (3.45 ~ 3.55kgf/㎠, 49.0 ~ 50.5psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor
Fuel Retrun System	Pressure	Returnless

SENSORS

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

▷ Type: Piezo-resistive pressure sensor type
▷ Specification

Pressure (kPa)	Output Voltage (V)
20.0	0.79
46.7	1.84
101.32	4.0

INTAKE AIR TEMPERATURE SENSOR (IATS)

▷ Type: Thermistor type
▷ Specification

Temperature [°C(°F)]	Resistance(kΩ)
-40(-40)	40.93 ~ 48.35
-30(-22)	23.43 ~ 27.34
-20(-4)	13.89 ~ 16.03
-10(14)	8.50 ~ 9.71
0(32)	5.38 ~ 6.09
10(50)	3.48 ~ 3.90
20(68)	2.31 ~ 2.57
25(77)	1.90 ~ 2.10
30(86)	1.56 ~ 1.74
40(104)	1.08 ~ 1.21
60(140)	0.54 ~ 0.62
80(176)	0.29 ~ 0.34

ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

▷ Type: Thermistor type
▷ Specification

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

THROTTLE POSITION SENSOR (TPS)

▷ Type: Variable resistor type
▷ Specification

Throttle Angle	Output Voltage (V)
C.T	0.25 ~ 0.9V
W.O.T	Min. 4.0V

Items	Specification
Sensor Resistance (kΩ)	1.6 ~ 2.4

HEATED OXYGEN SENSOR (HO2S)
▷ Type: Zirconia (ZrO_2) Type
▷ Specification

A/F Ratio	Output Voltage (V)
Rich	0.6 ~ 1.0
Lean	0 ~ 0.4

Items	Specification
Heater Resistance (Ω)	Approx. 9.0 [20°C(68°F)]

CAMSHAFT POSITION SENSOR (CMPS)
▷ Type: Hall effect type

CRANKSHAFT POSITION SENSOR (CKPS)
▷ Type: Hall effect type

KNOCK SENSOR (KS)
▷ Type: Piezo-electricity type
▷ Specification

Items	Specification
Capacitance (pF)	950 ~ 1,350
Resistance(MΩ)	4.87

CVVT OIL TEMPERATURE SNESOR (OTS)
▷ Type: Thermistor type
▷ Specification

Temperature [°C(°F)]	Resistance (kΩ)
-40(-40)	52.15
-20(-4)	16.52
0(32)	6.0
20(68)	2.45
40(104)	1.11
60(140)	0.54
80(176)	0.29

ACTUATORS

INJECTOR
▷ Number: 4
▷ Specification

Items	Specification
Coil Resistance (Ω)	13.8 ~ 15.2 [20°C(68°F)]

IDLE SPEED CONTROL ACTUATOR (ISCA)
▷ Type: Double coil type
▷ Specification

Items	Specification
Closing Coil Resistance (Ω)	14.6 ~ 16.2 [20°C(68°F)]
Opening Coil Resistance (Ω)	11.1 ~ 12.7 [20°C(68°F)]

Duty (%)	Air Flow Rate (m^3/h)
15	1.0 ~ 2.3
35	7.5 ~ 12.7
70	43.0 ~ 55.0
96	63.0 ~ 71.0

PURGE CONTROL SOLENOID VALVE (PCSV)
▷ Specification

Items	Specification
Coil Resistance (Ω)	26.0 [20°C(68°F)]

CVVT OIL CONTROL VALVE (OCV)
▷ Specification

Items	Specification
Coil Resistance (Ω)	6.9 ~ 7.9 [20°C(68°F)]

IGNITION COIL
▷ Type: Stick type
▷ Specification

Items	Specification
Primary Coil Resistance (Ω)	0.58Ω ±10% [20°C(68°F)]
Secondary Coil Resistance (kΩ)	8.8kΩ±15% [20°C(68°F)]

SERVICE STANDARD E01C76E3

<table>
<tr><td>Ignition Timing</td><td colspan="3">BTDC 5° ± 10°</td></tr>
<tr><td rowspan="4">Idle Speed</td><td rowspan="2">A/CON OFF</td><td>Neutral,N,P-range</td><td rowspan="4">660 ± 100 rpm</td></tr>
<tr><td>D-range</td></tr>
<tr><td rowspan="2">A/CON ON</td><td>Neutral,N,P-range</td></tr>
<tr><td>D-range</td></tr>
</table>

TIGHTENING TORQUES E83EB6B6

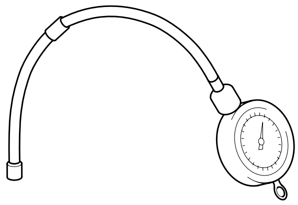
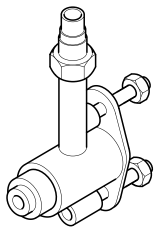
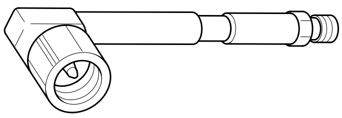
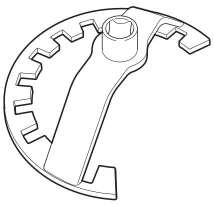
ENGINE CONTROL SYSTEM

Item	Kgf·m	N·m	lbf·ft
ECM installation bolts	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Manifold absolute pressure sensor installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Engine coolant temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Throttle position sensor installation screws	0.15 ~ 0.25	1.5 ~ 2.5	1.1 ~ 1.8
Crankshaft position sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Camshaft position sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Knock sensor installation bolt	1.7 ~ 2.7	16.7 ~ 26.5	12.3 ~ 19.5
Heated oxygen sensor (Bank 1 / Sensor 1) installation	3.5 ~ 4.5	34.3 ~ 44.1	25.3 ~ 32.5
Heated oxygen sensor (Bank 1 / Sensor 2) installation	5.0 ~ 6.0	49.1 ~ 58.9	36.2 ~ 43.4
CVVT Oil temperature sensor installation	0.2 ~ 0.4	2.0 ~ 3.9	1.4 ~ 2.9
Idle speed control actuator installation screws	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
CVVT Oil control valve installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil assembly installation bolts/nuts	1.9 ~ 2.7	18.6 ~ 26.5	13.7 ~ 19.5
Throttle body installation nuts	1.9 ~ 2.4	18.6 ~ 26.5	13.7 ~ 17.4

FUEL DELIVERY SYSTEM

Item	Kgf·m	N·m	lbf·ft
Fuel tank band mounting nuts	4.0 ~ 5.5	39.2 ~ 54.0	28.9 ~ 39.8
Fuel pump plate cover tightening	6.1 ~ 7.1	60.0 ~ 70.0	44.3 ~ 51.6
Delivery pipe installation bolts	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4

SPECIAL SERVICE TOOLS EF1F42DC

Tool (Number and name)	Illustration	Application
09353-24100 Fuel Pressure Gauge	 EFDA003A	Measuring the fuel line pressure
09353-38000 Fuel Pressure Gauge Adapter	 BF1A025D	Connection between the delivery pipe and fuel feed line
09353-24000 Fuel Pressure Gauge Connector	 EFDA003C	Connection between Fuel Pressure Gauge (09353-24100) and Fuel Pressure Gauge Adapter (09353-38000)
09310-2B100 Fuel Pump Plate Cover Wrench	 SCMFL6666D	Removeing and installation fuel low pressure fuel pump & sub fuel sender plate cover

BASIC TROUBLESHOOTING EF3ABC00

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**

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CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLEINFORMAITON

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

2. SYMPTOMS

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

3. ENVIRONMENT

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

4. MIL/DTC

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

5. ECM/PCM INFORMATION

ECM/PCM Part No.	
ROM ID	

SCMFL6150L

BASIC INSPECTION PROCEDURE

MEASURING CONDITION OF ELECTRONIC PARTS' RESISTANCE

The measured resistance at high temperature after vehicle running may be high or low. So all resistance must be measured at ambient temperature (20°C, 68°F), unless stated otherwise.

NOTE

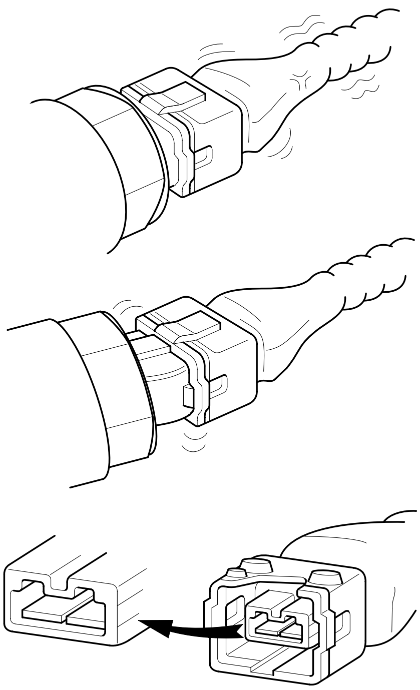
The measured resistance in except for ambient temperature (20°C, 68°F) is reference value.

INTERMITTENT PROBLEM INSPECTION PROCEDURE

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

1. Clear Diagnostic Trouble Code (DTC).

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



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

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

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

● SIMULATING VIBRATION

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

WARNING

Strong vibration may break sensors, actuators or relays

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

● SIMULATING HEAT

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

WARNING

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

● SIMULATING WATER SPRINKLING

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

WARNING

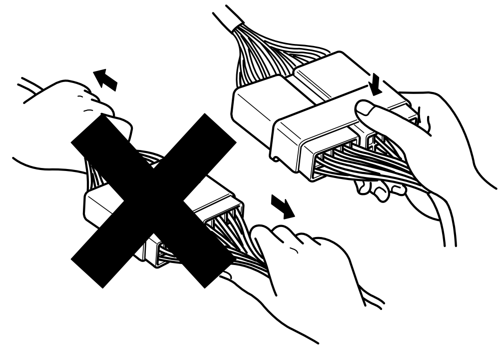
DO NOT sprinkle water directly into the engine compartment or electronic components.

● SIMULATING ELECTRICAL LOAD

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

CONNECTOR INSPECTION PROCEDURE

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



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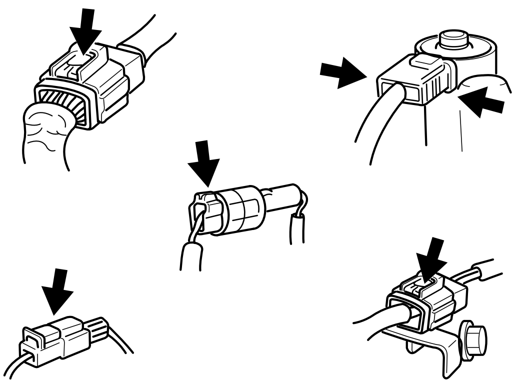
   b. When removing the connector with a lock, press or pull locking lever.



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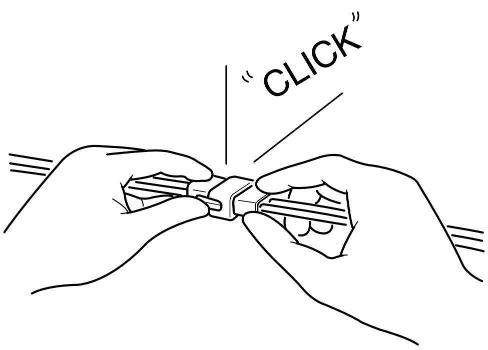
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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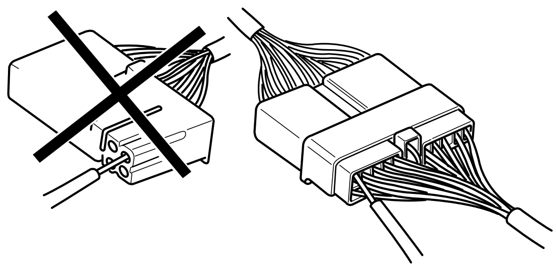
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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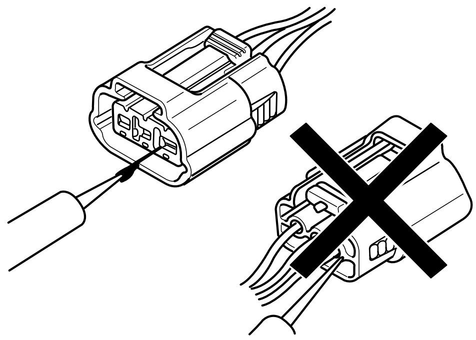
   e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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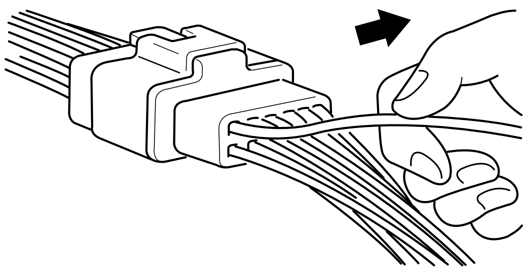
NOTE

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

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

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



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

NOTE

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

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

WIRE HARNESS INSPECTION PROCEDURE

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

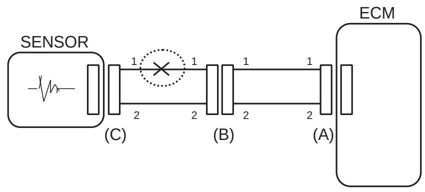
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

● CHECK OPEN CIRCUIT

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

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

FIG 1



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2. Continuity Check Method

NOTE

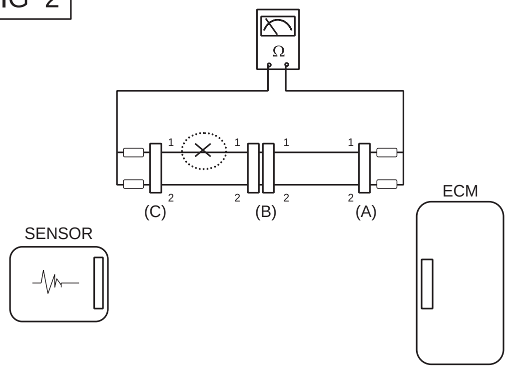
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

Specification (Resistance)
1Ω or less → Normal Circuit
$1M\Omega$ 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 $1M\Omega$ and below $1\ \Omega$ respectively. Specifically the open circuit is line 1 (Line 2 is normal). To find exact break point, check sub line of line 1 as described in next step.

FIG 2



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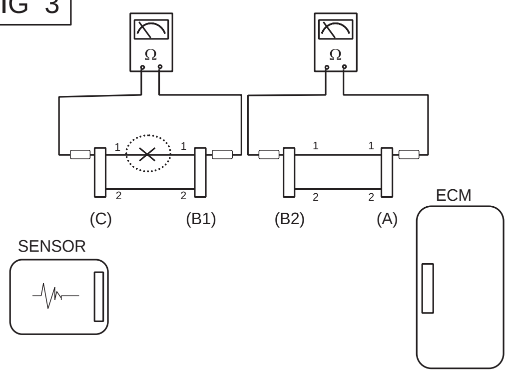
b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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

FIG 3



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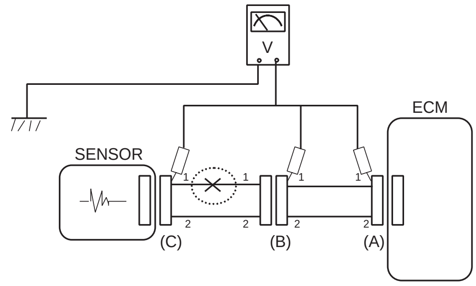
3. Voltage Check Method
   a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

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

FIG 4



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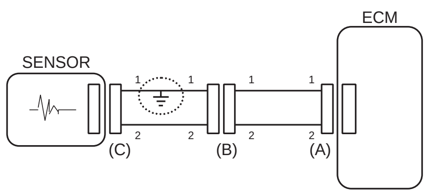
● **CHECK SHORT CIRCUIT**

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

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

FIG 5



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2. Continuity Check Method (with Chassis Ground)

   NOTE

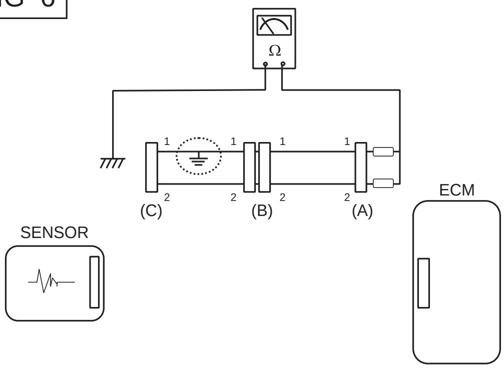
   Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

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

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

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

FIG 6



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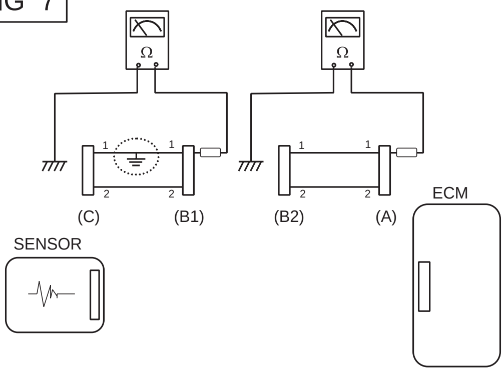
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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 flashing)	• DTC • Low compression • Intake air leaks • Slipped or broken timing belt • Contaminated fuel
Difficult to start	1. Test the battery 2. Check the fuel pressure 3. Check the ECT sensor and circuit (Check DTC) 4. Check the ignition circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor idling (Rough, unstable or incorrect Idle)	1. Check the fuel pressure 2. Check the Injector 3. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM) 4. Check the idle speed control circuit (Check DTC) 5. Inspect and test the Throttle Body 6. Check the ECT sensor and circuit (Check DTC)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Engine stall	1. Test the Battery 2. Check the fuel pressure 3. Check the idle speed control circuit (Check DTC) 4. Check the ignition circuit 5. Check the CKPS Circuit (Check DTC)	• DTC • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor driving (Surge)	1. Check the fuel pressure 2. Inspect and test Throttle Body 3. Check the ignition circuit 4. Check the ECT Sensor and Circuit (Check DTC) 5. Test the exhaust system for a possible restriction 6. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Knocking	1. Check the fuel pressure 2. Inspect the engine coolant 3. Inspect the radiator and the electric cooling fan 4. Check the spark plugs	• DTC • Contaminated fuel

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

GASOLINE ENGINE CONTROL SYSTEM

DESCRIPTION E7F2FC02

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

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

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

NOTE

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

MALFUNCTION INDICATOR LAMP (MIL)

[EOBD]

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

Faults with the following items will illuminate the MIL.

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

NOTE

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

[NON-EOBD]

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

Faults with the following items will illuminate the MIL

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

NOTE

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

[INSPECTION]

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

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

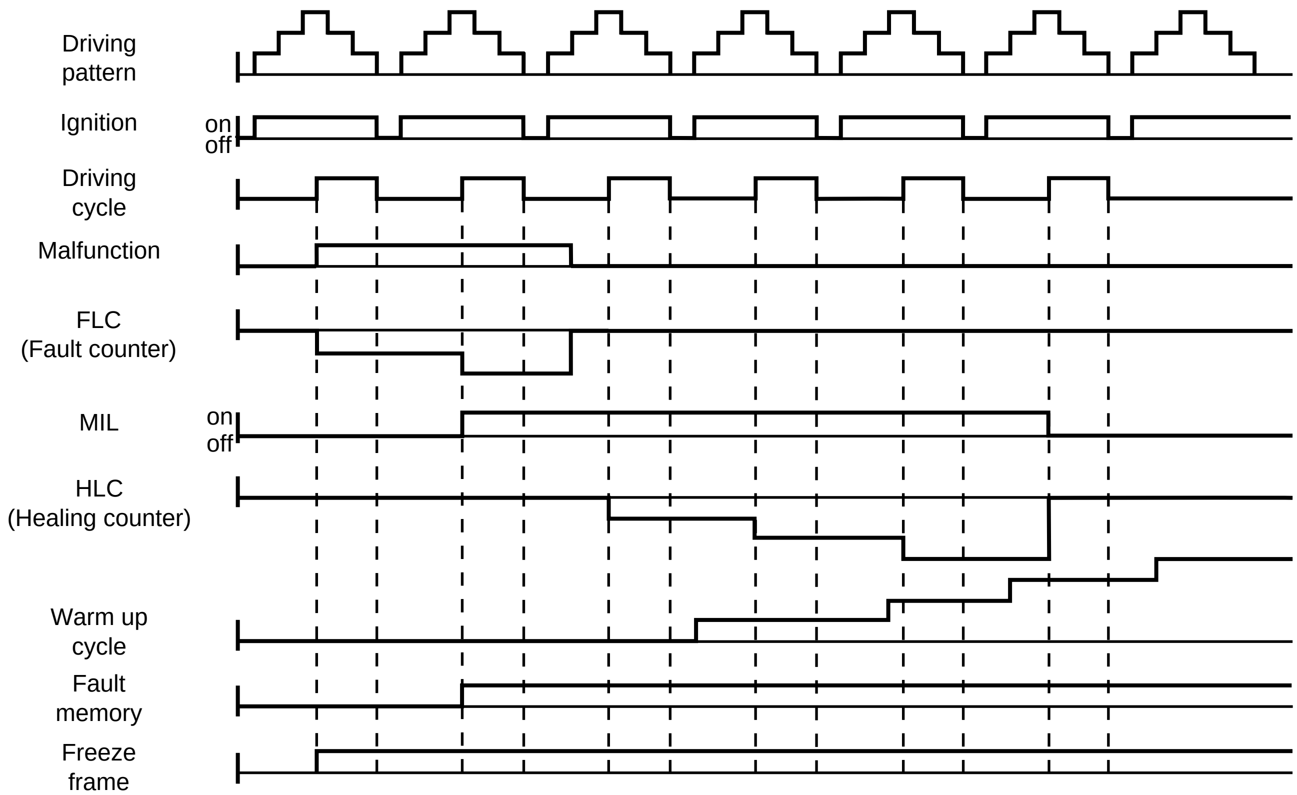
SELF-DIAGNOSIS

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

NOTE

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

THE RELATION BETWEEN DTC AND DRIVING PATTERN IN EOBD SYSTEM



LGIF601Q

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

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

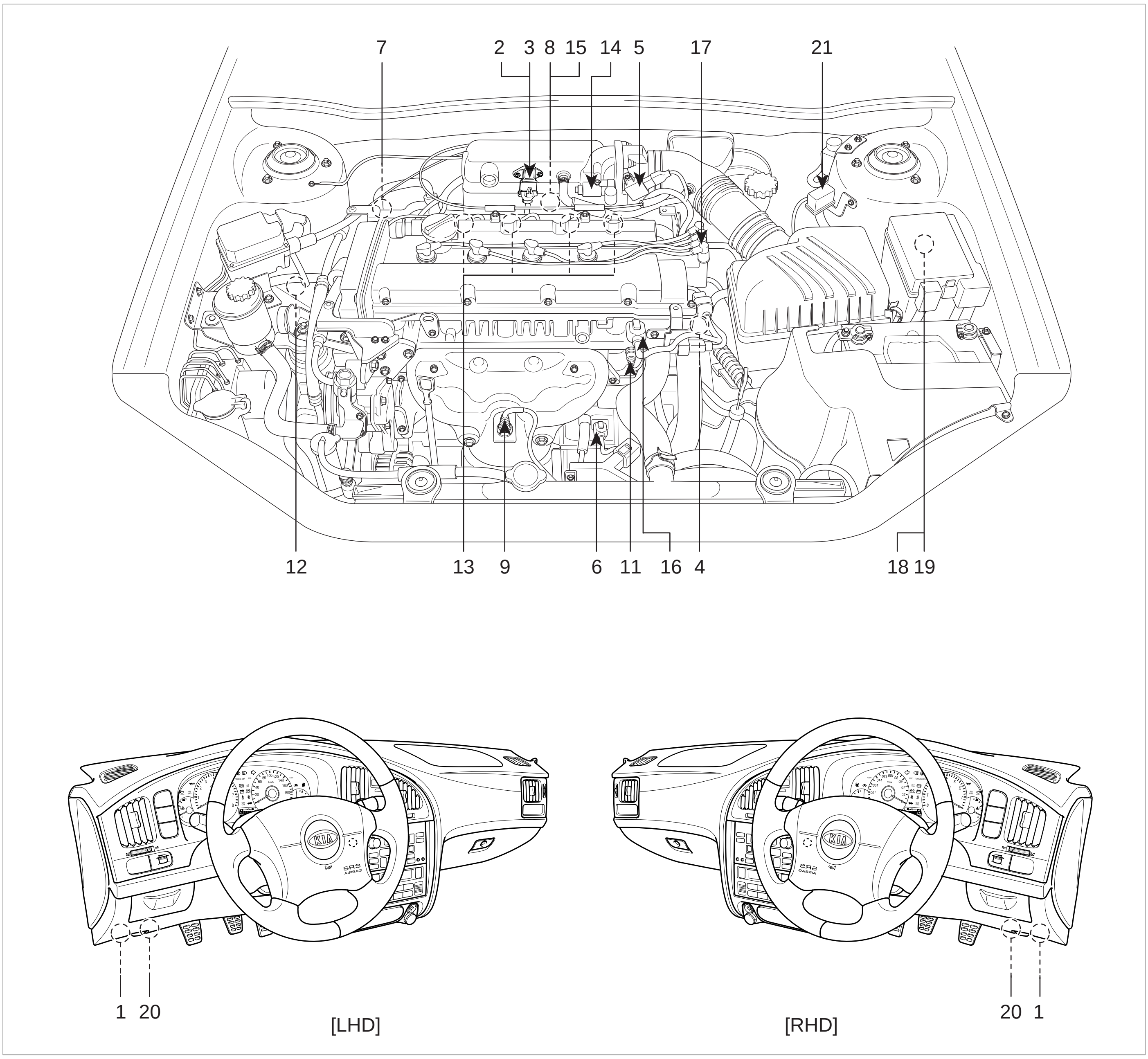
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction is detected after two sequential driving cycles. The MIL will illuminate when the malfunction is detected on the second driving cycle.
   If a misfire is detected, a DTC will be recorded, and the MIL will illuminate, immediately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

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

NOTE

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

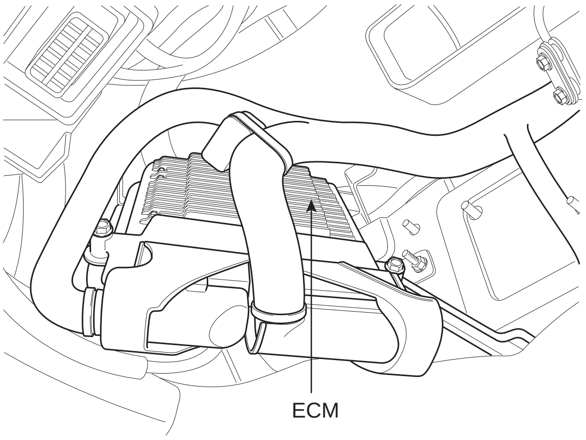
COMPONENTS LOCATION E8ABD4B4



1. ECM (Engine Control Module)
2. Manifold Absolute Pressure Sensor (MAPS)
3. Intake Air Temperature Sensor (IATS)
4. Engine Coolant Temperature Sensor (ECTS)
5. Throttle Position Sensor (TPS)
6. Crankshaft Position Sensor (CKPS)
7. Camshaft Position Sensor (CMPS)
8. Knock Sensor (KS)
9. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
10. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
11. CVVT Oil Temperature Sensor (OTS)
12. A/C Pressure Transducer (APT)
13. Injector
14. Idle Speed Control Actuator (ISCA)
15. Purge Control Solenoid Valve (PCSV)
16. CVVT Oil Control Valve (OCV)
17. Ignition Coil
18. Main Relay
19. Fuel Pump Relay
20. Data Link Connector (DLC)
21. Multi-Purpose Check Connector

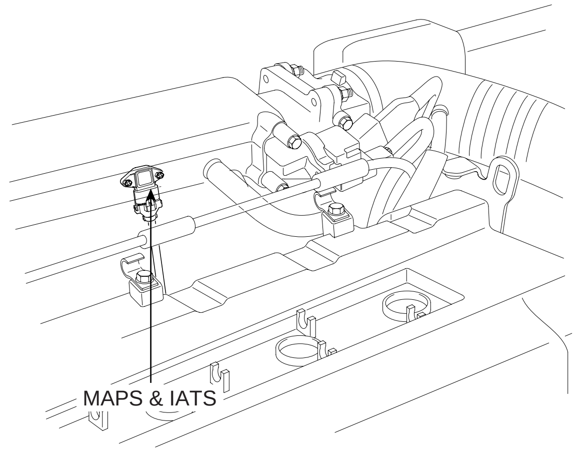
SLDF17101L

1. ECM (Engine Control Module)



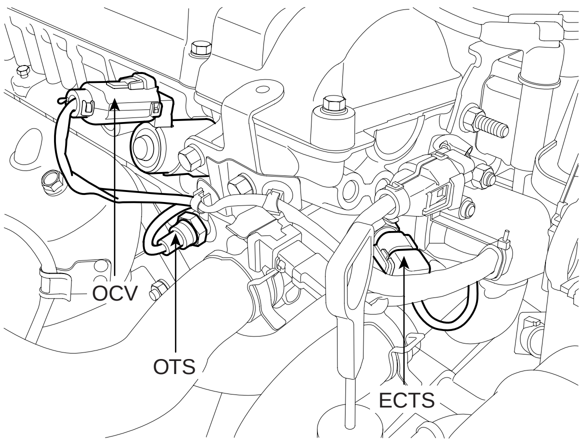
SLDF17102D

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



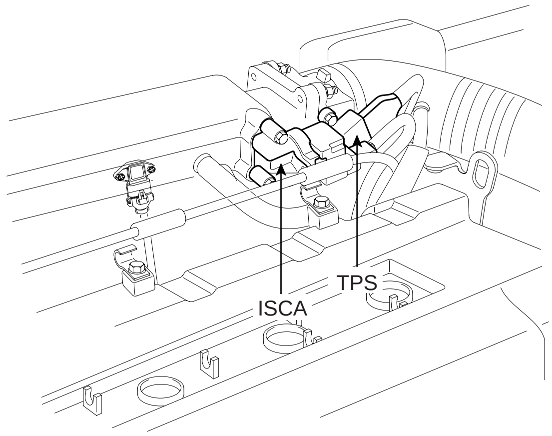
SLDF17104L

4. Engine Coolant Temperature Sensor (ECTS)
11. CVVT Oil Temperature Sensor (OTS)
16. CVVT Oil Control Valve (OCV)



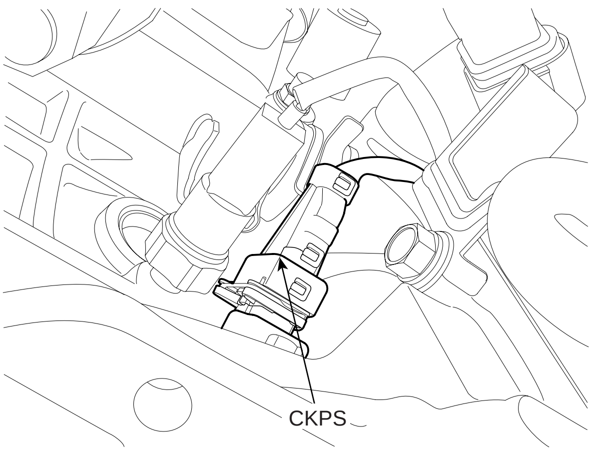
SHDF16104L

5. Throttle Position Sensor (TPS)
14. Idle Speed Control Actuator (ISCA)



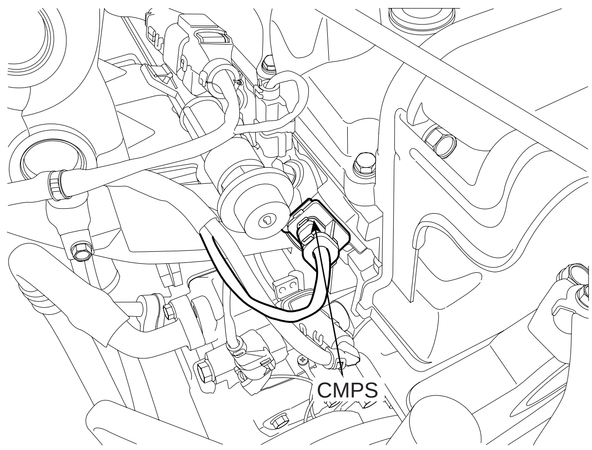
SLDF17124L

6. Crankshaft Position Sensor (CKPS)



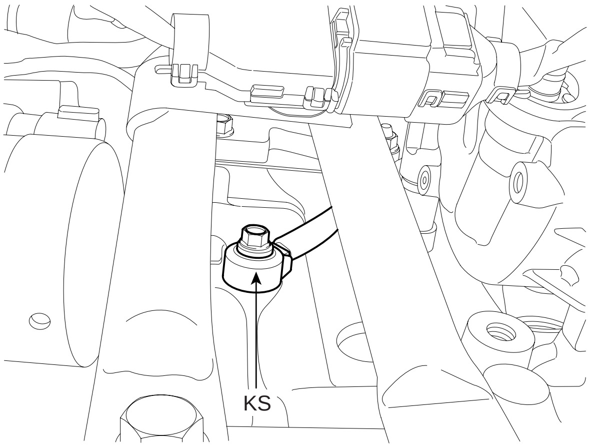
SHDF16106L

7. Camshaft Position Sensor (CMPS)



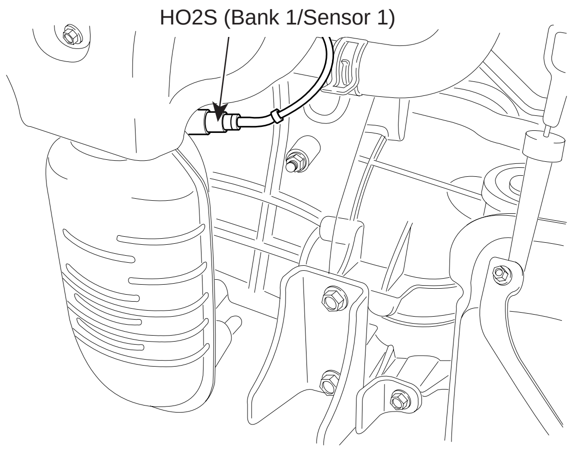
SHDF16107L

8. Knock Sensor (KS)



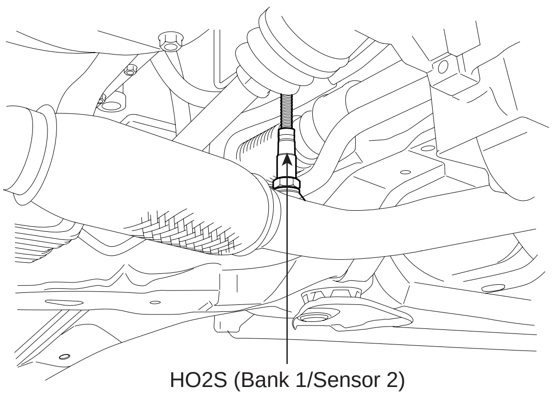
SHDF16108L

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



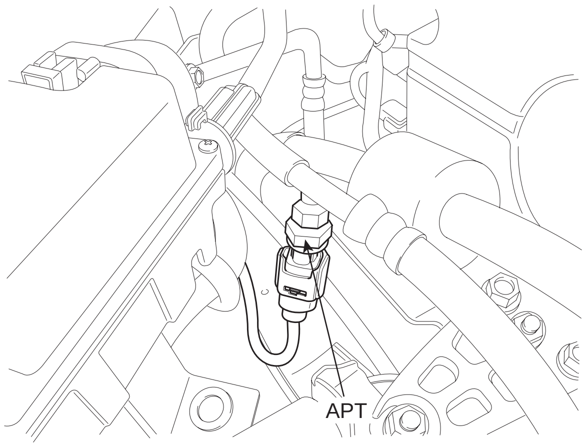
SLDF17109L

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



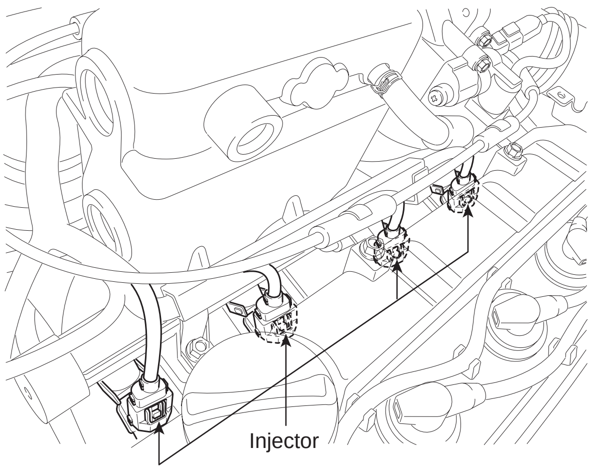
SLDF17108L

12. A/C Pressure Transducer (APT)



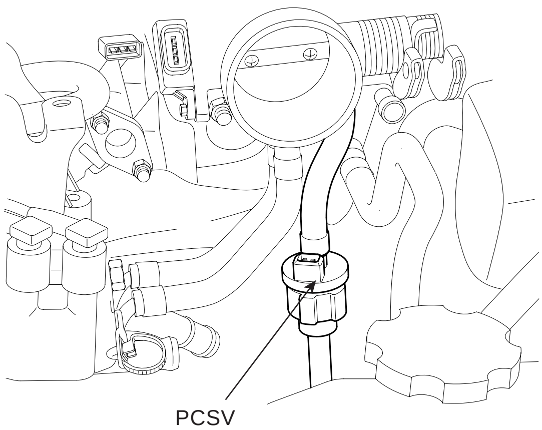
SLDF17109D

13. Injector

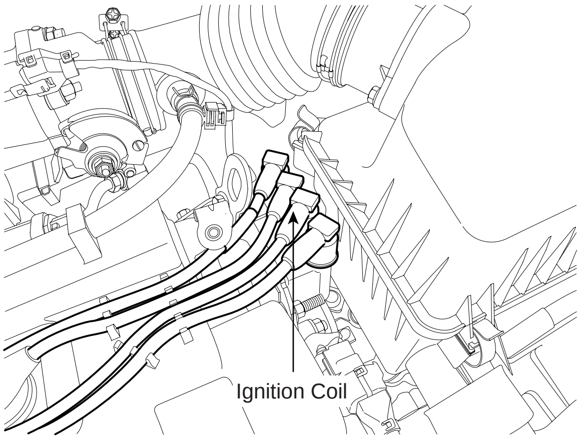
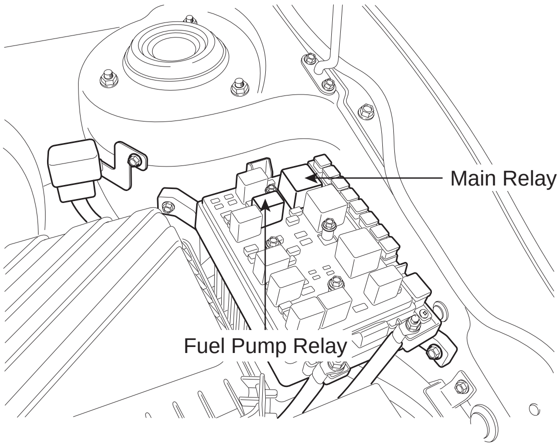


SLDF17114L

15. Purge Control Solenoin Valve (PCSV)



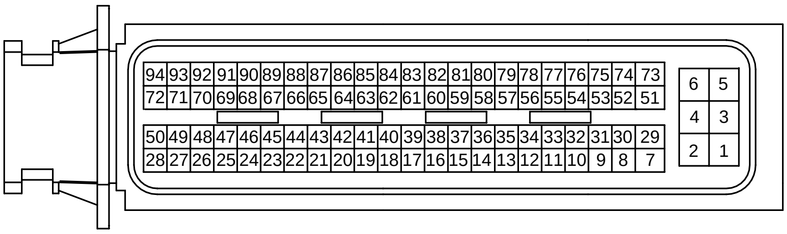
BFGE302B

17. Ignition Coil	18. Main Relay 19. Fuel Pump Relay
 SHDF16113L	 SLDFL7106L

ENGINE CONTROL MODULE (ECM)

ENGINE CONTROL MODULE (ECM) EE8DE8D2

1. HARNESS CONNECTOR



CONNECTOR [CBG-K]

SHDF16115L

2. TERMINAL FUNCTION

CONNECTOR [CBG-K]

PinNo.	Description	Connected to
1	Power Ground	Chassis Ground
2	Battery voltage supply after ignition switch	Ignition Switch
3	Power Ground	Chassis Ground
4	Battery voltage supply after main relay	Main Relay
5	ECM Ground	Chassis Ground
6	Battery Power	Battery
7	Ignition Coil (Cylinder #1,4) control output	Ignition Coil (Cylinder #1,4)
8	Shield	Ignition Coil
9	Sensor ground	Manifold Absolute Pressure Sensor (MAPS)
10	Manifold Absolute Pressure Sensor signal input	Manifold Absolute Pressure Sensor (MAPS)
11	-	
12	Ground	Immobilizer Control Module
13	A/C Pressure Transducer signal input	A/C Pressure Transducer (APT)
14	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
15	Engine Coolant Temperature Sensor signal input	Engine Coolant Temperature Sensor (ECTS)
16	Sensor ground	Heated Oxygen Sensor (Sensor 1) [Except LEADED]
17	Heated Oxygen Sensor (Sensor 1) signal input	Heated Oxygen Sensor (Sensor 1) [Except LEADED]
18	Intake Air Temperature Sensor signal input	Intake Air Temperature Sensor (IATS)
19	-	
20	-	
21	Sensor ground	Knock Sensor (KS)

PinNo.	Description	Connected to
22	Knock Sensor signal input	Knock Sensor (KS)
23	Sensor power (+5V)	Throttle Position Sensor (TPS)
24	-	
25	Injector (Cylinder #1) control output	Injector (Cylinder #1)
26	Injector (Cylinder #3) control output	Injector (Cylinder #3)
27	Injector (Cylinder #4) control output	Injector (Cylinder #4)
28	Injector (Cylinder #2) control output	Injector (Cylinder #2)
29	Ignition Coil (Cylinder #2,3) control output	Ignition Coil (Cylinder #2,3)
30	-	
31	-	
32	-	
33	-	
34	-	
35	-	
36	-	
37	Sensor ground	CVVT Oil Temperature Sensor (OTS)
38	Heated Oxygen Sensor (Sensor 2) signal input	Heated Oxygen Sensor (Sensor 2) [Euro-III/IV]
39	Sensor ground	Heated Oxygen Sensor (Sensor 2) [Euro-III/IV]
40	CVVT Oil Temperature Sensor signal input	CVVT Oil Temperature Sensor (OTS)
41	Throttle Position Sensor signal input	Throttle Position Sensor (TPS)
42	Sensor ground	Throttle Position Sensor (TPS)
43	-	
44	-	
45	-	
46	-	
47	Sensor power (+5V)	A/C Pressure Transducer (APT)
48	Sensor power (+5V)	Manifold Absolute Pressure Sensor (MAPS)
49	-	
50	-	
51	-	
52	-	
53	Vehicle speed signal input	ABS/ESP Control Module [With ABS/ESP (Euro-III/IV)]
		TCM [Except Euro-III/IV]
54	-	
55	Wheel Speed Sensor [A] signal input	Wheel Speed Sensor (WSS)[Without ABS/ESP (Euro-III/IV)]
56	Wheel Speed Sensor [B] signal input	Wheel Speed Sensor (WSS)[Without ABS/ESP (Euro-III/IV)]

PinNo.	Description	Connected to
57	Sensor ground	A/C Pressure Transducer (APT)
58	-	
59	-	
60	A/C switch "ON" signal input	A/C Switch
61	-	
62	A/C thermal switch signal input	A/C Thermal Switch
63	Fuel consumption signal output	Trip Computer
64	Main Relay control output	Main Relay
65	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
66	CVVT Oil Control Valve control output	CVVT Oil Control Valve (OCV)
67	Purge Control Solenoid Valve control output	Purge Control Solenoid Valve (PCSV)
68	-	
69	Immobilizer lamp control output	Immobilizer Lamp
70	Fuel Pump Relay control output	Fuel Pump Relay
71	-	
72	-	
73	Battery voltage supply after main relay	Main Relay
74	Alternator load signal input	Alternator
75	Immobilizer communication line	Immobilizer Control Module
76	-	
77	CAN [HIGH]	Other control module
78	CAN [LOW]	Other control module
79	Sensor ground	Camshaft Position Sensor (CMPS)
80	Camshaft Position Sensor signal input	Camshaft Position Sensor (CMPS)
81	Sensor ground	Crankshaft Position Sensor (CKPS)
82	Crankshaft Position Sensor signal input	Crankshaft Position Sensor (CKPS)
83	-	
84	Clutch Switch signal input	Clutch Switch
85	-	
86	Engine speed signal output	Cluster (Tachometer)
87	A/C Compressor Relay control output	A/C Compressor Relay
88	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
89	Idle Speed Control Actuator [OPEN] control output	Idle Speed Control Actuator (ISCA)
90	Idle Speed Control Actuator [CLOSE] control output	Idle Speed Control Actuator (ISCA)
91	-	
92	Malfunction Indicator Lamp (MIL) control output	Cluster (Malfunction Indicator Lamp)

PinNo.	Description	Connected to
93	Heated Oxygen Sensor (Sensor 1) Heater control output	Heated Oxygen Sensor (Sensor 1) [Except LEADED]
94	Heated Oxygen Sensor (Sensor 2) Heater control output	Heated Oxygen Sensor (Sensor 2) [Euro-III/IV]

3. TERMINAL INPUT/OUTPUT SIGNAL

CONNECTOR [CBG-K]

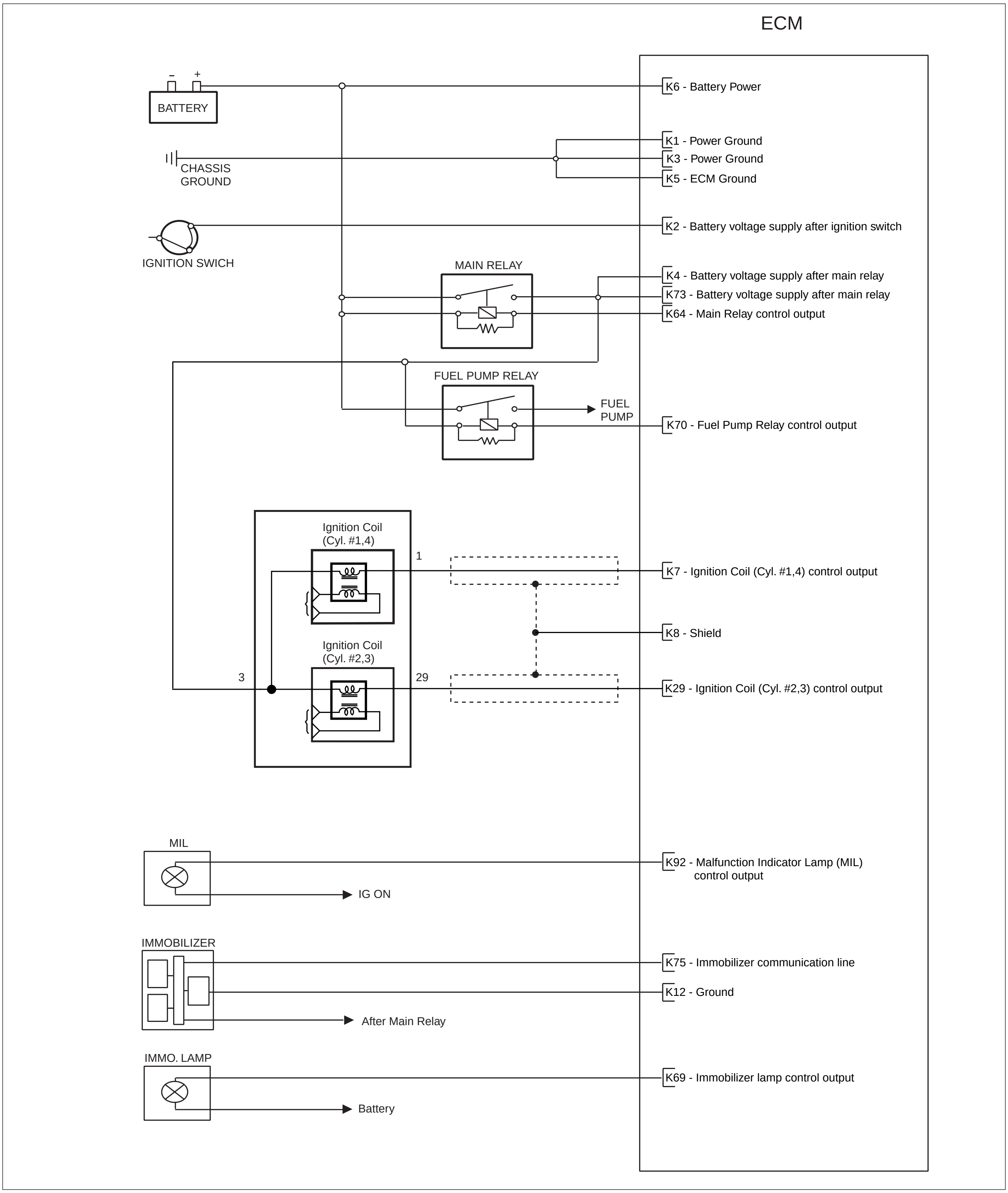
Pin No.	Description	Condition	Type	Level	Test Result
1	Power Ground	Idle	DC	Max. 50mV	
2	Battery voltage supply after ignition switch	IG OFF	DC	Max. 1.0V	1.18mV
		IG ON		Battery Voltage	12.7V
3	Power Ground	Idle	DC	Max. 50mV	-4.37mV
4	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0V	-5.1mV
		IG ON		Battery Voltage	12.3V
5	ECM Ground	Idle	DC	Max. 50mV	10.1mV
6	Battery Power	Always	DC	Battery Voltage	12.2V
7	Ignition Coil (Cylinder #1,4) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	372V
				ON Voltage: Max. 2.0V	1.6V
8	Shield	Idle	DC	Max. 50mV	18.3mV
9	Sensor ground	Idle	DC	Max. 50mV	18.7mV
10	Manifold Absolute Pressure Sensor signal input	IG ON	DC	3.9 ~ 4.1V	4.09V
		Idle		0.8 ~ 1.6V	1.44V
11	-				
12	Ground	Idle	DC	Max. 50mV	
13	A/C Pressure Transducer signal input	Idle	DC	0.4 ~ 4.6V	A/C OFF:1.18V A/C ON:1.48V
14	Sensor ground	Idle	DC	Max. 50mV	13.0mV
15	Engine Coolant Temperature Sensor signal input	Idle	DC	0.5 ~ 4.5V	1.84V
16	Sensor ground	Idle	DC	Max. 50mV	
17	Heated Oxygen Sensor (Sensor 1) signal input	Racing	Analog	Rich: 0.6 1.0V	
				Lean: Max. 0.4V	
18	Intake Air Temperature Sensor signal input	Idle	Analog	0 ~ 5.0V	3.63V
19	-				
20	-				
21	Sensor ground	Idle	DC	Max. 50mV	
22	Knock Sensor signal input	Knocking	Variable Frequency		
		Normal			
23	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.03V
24	-				
25	Injector (Cylinder #1) control output	Idle	DC	Hi: Battery Voltage	14.4V
				Lo: Max. 1.0V	280mV
				Vpeak: Max. 80V	48.8V

Pin No.	Description	Condition	Type	Level	Test Result
26	Injector (Cylinder #3) control output	Idle	DC	Hi: Battery Voltage	14.2V
				Lo: Max. 1.0V	240mV
				Vpeak: Max. 80V	49.0V
27	Injector (Cylinder #4) control output	Idle	DC	Hi: Battery Voltage	14.4V
				Lo: Max. 1.0V	280mV
				Vpeak: Max. 80V	48.8V
28	Injector (Cylinder #2) control output	Idle	DC	Hi: Battery Voltage	14.2V
				Lo: Max. 1.0V	240mV
				Vpeak: Max. 80V	49.0V
29	Ignition Coil (Cylinder #1,4) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	376V
				ON Voltage: Max. 2.0V	1.36V
30	-				
31	-				
32	-				
33	-				
34	-				
35	-				
36	-				
37	Sensor ground	Idle	DC	Max. 50mV	17.3mV
38	Heated Oxygen Sensor (Sensor 2) signal input	Racing	Analog	Rich: 0.6 1.0V	640mV
				Lean: Max. 0.4V	22mV
39	Sensor ground	Idle	DC	Max. 50mV	3.14mV
40	CVVT Oil Temperature Sensor signal input	Idle	Analog	0.5 ~ 4.5V	950mV
41	Throttle Position Sensor signal input	C.T	Analog	0.25 ~ 0.9V	307mV
		W.O.T		Min. 4.0V	4.28V
42	Sensor ground	Idle	DC	Max. 50mV	13.6mV
43	-				
44	-				
45	-				
46	-				
47	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	2.61mV
		IG ON		4.9 ~ 5.1V	5.04V
48	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	3.16mV
		IG ON		4.9 ~ 5.1V	5.06V
49	-				
50	-				
51	-				
52	-				

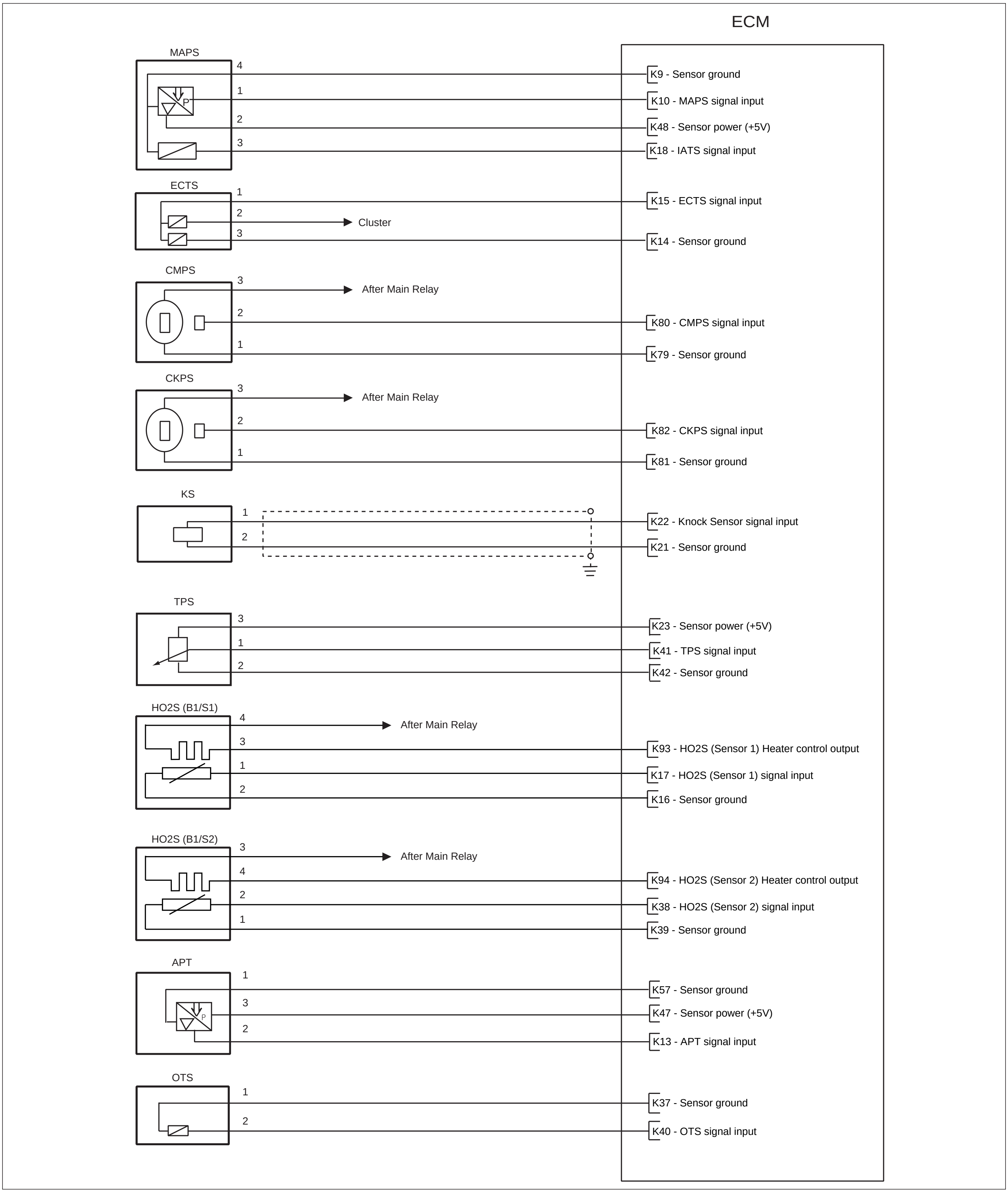
Pin No.	Description	Condition	Type	Level	Test Result
53	Vehicle speed signal input	Vehicle Run	Pulse	Hi: Min. 4.5V	13.0V
				Lo: Max. 0.5V	-200mV
54	-				
55	Wheel Speed Sensor [A] signal input	Vehicle Run (30km/h)	SINE Wave	15Hz: Min. 0.13Vpp	
				1,000Hz: Min 0.2Vpp	
				Overall: Max. 250Vpp	
56	Wheel Speed Sensor [B] signal input	Vehicle Run (30km/h)	SINE Wave	15Hz: Min. 0.13Vpp	
				1,000Hz: Min 0.2Vpp	
				Overall: Max. 250Vpp	
57	Sensor ground	Idle	DC	Max. 50mV	10mV
58	-				
59	-				
60	A/C switch "ON" signal input	A/C S/W OFF	DC	Max. 1.0V	0mV
		A/C S/W ON		Battery Voltage	12.8V
61	-				
62	A/C thermal switch signal input	A/C S/W OFF	DC	Max. 1.0V	0mV
		A/C S/W ON		Battery Voltage	12.8V
63	Fuel consumption signal output	Idle	Pulse	Hi: Battery Voltage	13.8V
				Lo: Max. 0.5V	0.1V
64	Main Relay control output	Relay OFF	DC	Battery Voltage	12.9V
		Relay ON		Max. 1.0V	0.88V
65	Cooling Fan Relay [Low] control output	Relay OFF	DC	Battery Voltage	12.9V
		Relay ON		Max. 1.0V	30mV
66	CVVT Oil Control Valve control output	Idle	Pulse	Battery Voltage	14.8V
				Max. 1.0V	100mV
67	Purge Control Solenoid Valve control output	Active Inactive	Pulse	Hi: Battery Voltage	14.2V
				Lo: Max. 1.0V	100mV
68	-				
69	Immobilizer lamp control output	Lamp OFF	DC	Battery Voltage	
		Lamp ON		Max. 2.0V	
70	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage	13V
		Relay ON		Max. 1.0V	100mV
71	-				
72	-				
73	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0V	-5.1mV
		IG ON		Battery Voltage	12.3V
74	Alternator load signal input	Idle	Pulse	Hi: Battery Voltage	14V
				Lo: Max. 1.5V	10mV

Pin No.	Description	Condition	Type	Level	Test Result
75	Immobilizer communication line	When communicating after IG ON	Pulse	Hi: Min. 8.5V	
				Lo: Max. 3.5V	
76	-				
77	CAN [HIGH]	RECESSIVE	Pulse	2.0 ~ 3.0V	2.55V
		DOMINANT		2.75 ~ 4.5V	3.57V
78	CAN [LOW]	RECESSIVE	Pulse	2.0 ~ 3.0V	2.55V
		DOMINANT		0.5 ~ 2.25V	1.44V
79	Sensor ground	Idle	DC	Max. 50mV	10mV
80	Camshaft Position Sensor signal input	Idle	Pulse	Hi: Vcc	5.0V
				Lo: Max. 0.5V	0.2V
81	Sensor ground	Idle	DC	Max. 50mV	10mV
82	Crankshaft Position Sensor signal input	Idle	Pulse	Hi: Vcc	5.0V
				Lo: Max. 0.5V	40mV
83	-				
84	Clutch Switch signal input	Release	DC	Max. 0.5V	
		Push		Battery Voltage	
85	-				
86	Engine aspeed signal output	Idle	Pulse	Hi: Battery Voltage	14.0V
				Lo: Max. 0.5V	100mV
				Freq.: 20 ~ 26Hz	21.8Hz
87	A/C Compressor Relay control output	Relay OFF	DC	Battery Voltage	14.1V
		Relay ON		Max. 1.0V	0.1V
88	Cooling Fan Relay [High] control output	Relay OFF	DC	Battery Voltage	14.1V
		Relay ON		Max. 1.0V	320mV
89	Idle Speed Control Actuator [OPEN] control output	Idle	Pulse	Hi: Battery Voltage	14.6V
				Lo: Max. 1.0V	192mV
90	Idle Speed Control Actuator [CLOSE] control output	Idle	Pulse	Hi: Battery Voltage	14.9V
				Lo: Max. 1.0V	248mV
91	-				
92	Malfunction Indicator Lamp (MIL) control output	Lamp OFF	DC	Battery Voltage	13V
		Lamp ON		Max. 1.0V	50mV
93	Heated Oxygen Sensor (Sensor 1) Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14V
				Lo: Max. 1.0V	0.3V
94	Heated Oxygen Sensor (Sensor 2) Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14V
				Lo: Max. 1.0V	0.3V

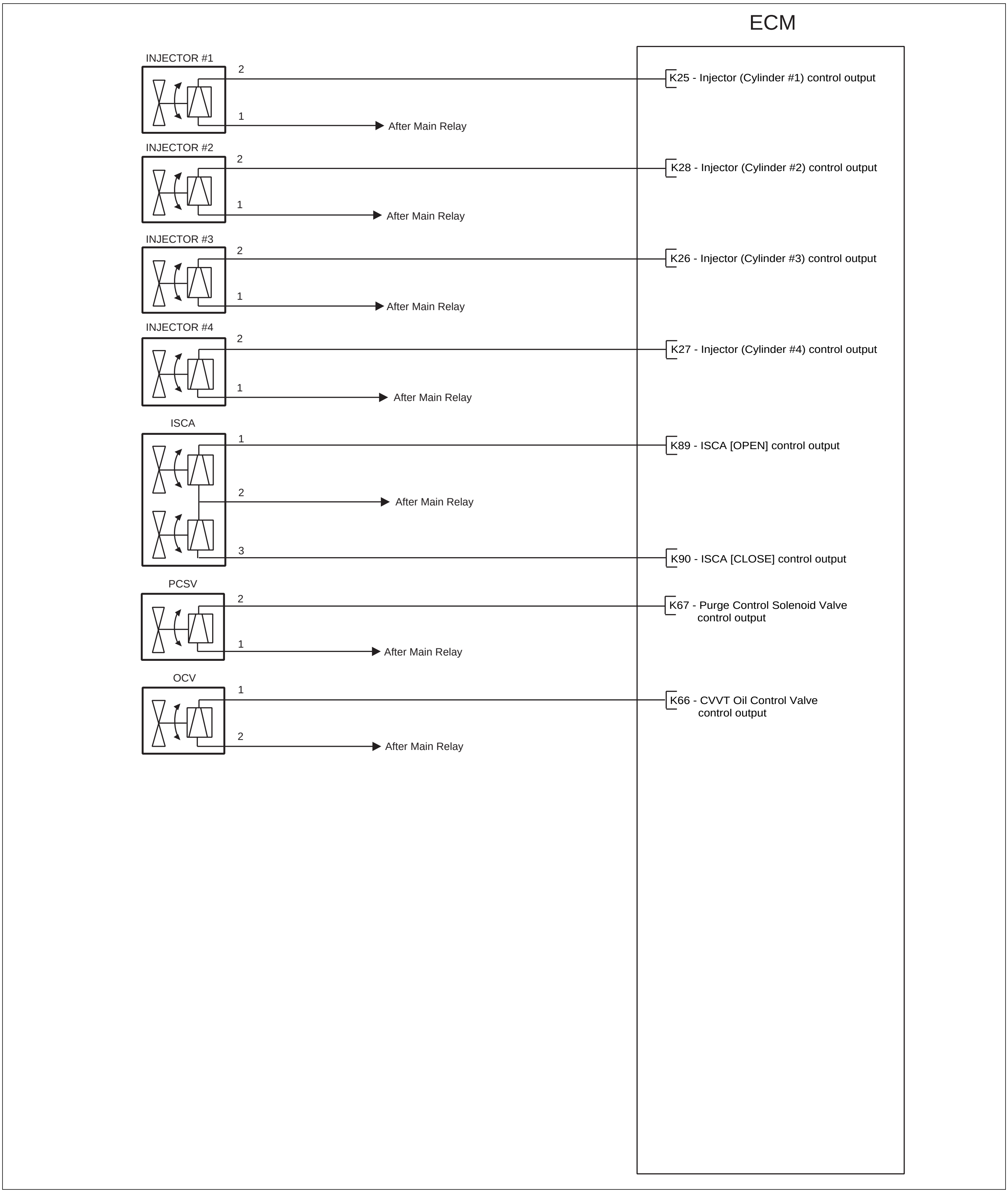
CIRCUIT DIAGRAM EA25CAB1



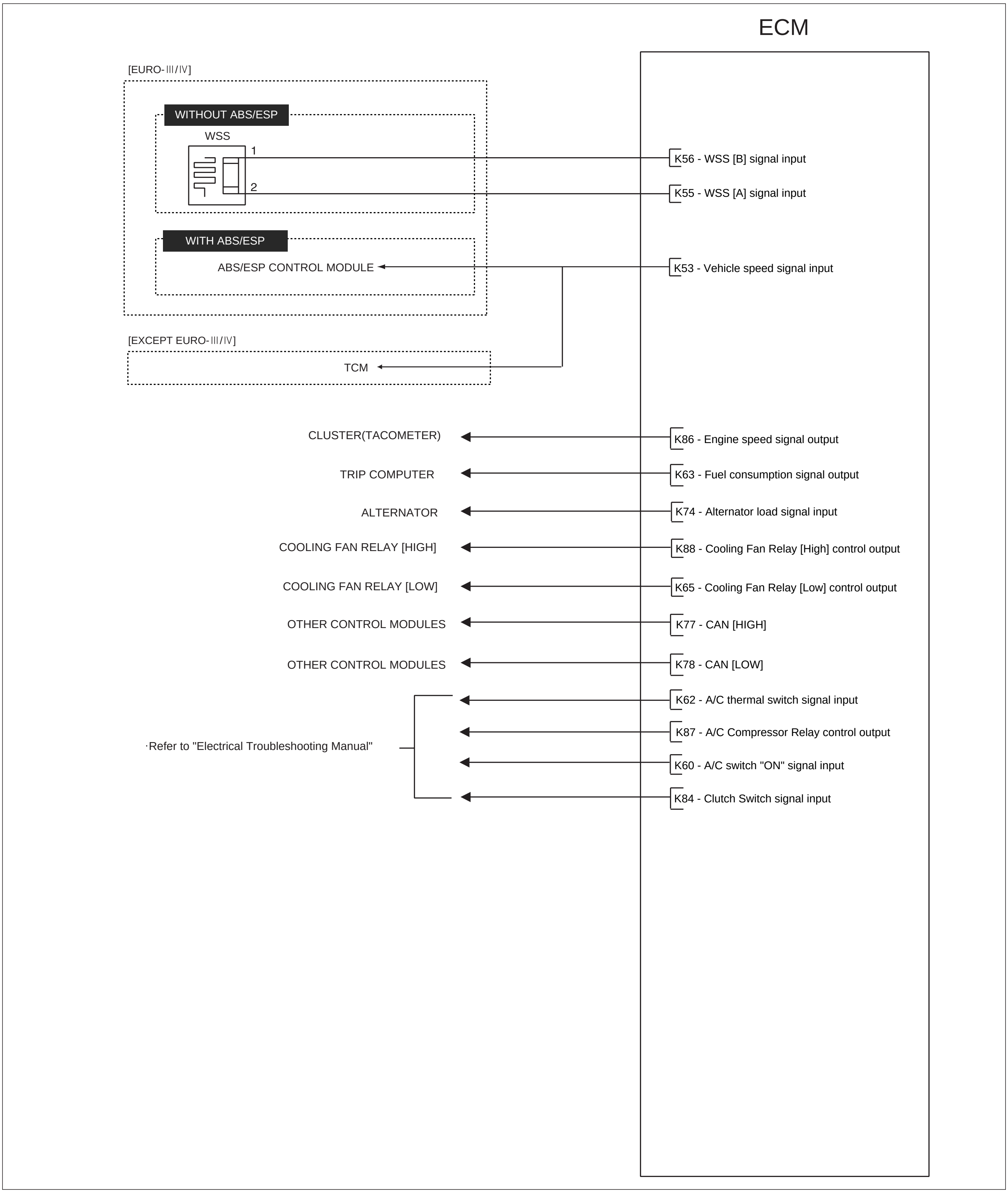
SHDF16116L


ECM
MAPS
4
1
2
3
K9 - Sensor ground
K10 - MAPS signal input
K48 - Sensor power (+5V)
K18 - IATS signal input
ECTS
1
2
3
Cluster
K15 - ECTS signal input
K14 - Sensor ground
CMPS
3
2
1
After Main Relay
K80 - CMPS signal input
K79 - Sensor ground
CKPS
3
2
1
After Main Relay
K82 - CKPS signal input
K81 - Sensor ground
KS
1
2
K22 - Knock Sensor signal input
K21 - Sensor ground
TPS
3
1
2
K23 - Sensor power (+5V)
K41 - TPS signal input
K42 - Sensor ground
HO2S (B1/S1)
4
3
1
2
After Main Relay
K93 - HO2S (Sensor 1) Heater control output
K17 - HO2S (Sensor 1) signal input
K16 - Sensor ground
HO2S (B1/S2)
3
4
2
1
After Main Relay
K94 - HO2S (Sensor 2) Heater control output
K38 - HO2S (Sensor 2) signal input
K39 - Sensor ground
APT
1
3
2
K57 - Sensor ground
K47 - Sensor power (+5V)
K13 - APT signal input
OTS
1
2
K37 - Sensor ground
K40 - OTS signal input

SLDF17117L


ECM
INJECTOR #1
2
1
K25 - Injector (Cylinder #1) control output
After Main Relay
INJECTOR #2
2
1
K28 - Injector (Cylinder #2) control output
After Main Relay
INJECTOR #3
2
1
K26 - Injector (Cylinder #3) control output
After Main Relay
INJECTOR #4
2
1
K27 - Injector (Cylinder #4) control output
After Main Relay
ISCA
1
2
3
K89 - ISCA [OPEN] control output
After Main Relay
K90 - ISCA [CLOSE] control output
PCSV
2
1
K67 - Purge Control Solenoid Valve control output
After Main Relay
OCV
1
2
K66 - CVVT Oil Control Valve control output
After Main Relay

SLDF17118L


ECM
[EURO-Ⅲ/Ⅳ]
WITHOUT ABS/ESP
WSS
1
2
K56 - WSS [B] signal input
K55 - WSS [A] signal input
WITH ABS/ESP
ABS/ESP CONTROL MODULE
K53 - Vehicle speed signal input
[EXCEPT EURO-Ⅲ/Ⅳ]
TCM
CLUSTER(TACOMETER)
K86 - Engine speed signal output
TRIP COMPUTER
K63 - Fuel consumption signal output
ALTERNATOR
K74 - Alternator load signal input
COOLING FAN RELAY [HIGH]
K88 - Cooling Fan Relay [High] control output
COOLING FAN RELAY [LOW]
K65 - Cooling Fan Relay [Low] control output
OTHER CONTROL MODULES
K77 - CAN [HIGH]
OTHER CONTROL MODULES
K78 - CAN [LOW]
K62 - A/C thermal switch signal input
·Refer to "Electrical Troubleshooting Manual"
K87 - A/C Compressor Relay control output
K60 - A/C switch "ON" signal input
K84 - Clutch Switch signal input

SLDF17119L

ECM PROBLEM INSPECTION PROCEDURE E33515CF

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

Specification (Resistance): 1Ω or less

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

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

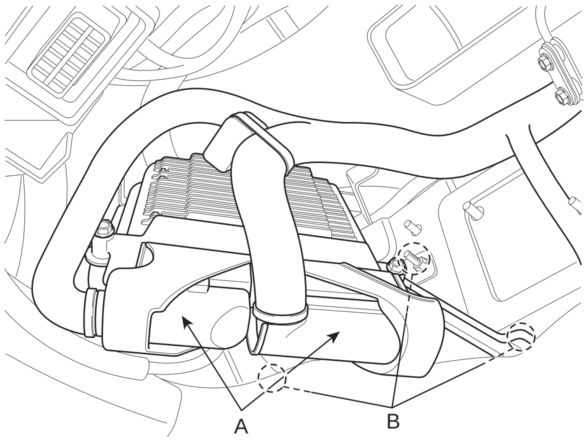
4. RE-TEST THE ORIGINAL ECM : Install the original ECM (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original ECM with a new one. If problem does not occur, this is intermittent problem (Refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION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

REPLACEMENT E9DE5C40

1. Turn ignition switch off.

2. Disconnect the battery (-) cable from the battery.

3. Disconnect the ECM connector(s) (A).



SLDF17152D

4. Unscrew the ECM mounting bolts/nuts (B) and remove the ECM from the air cleaner assembly.

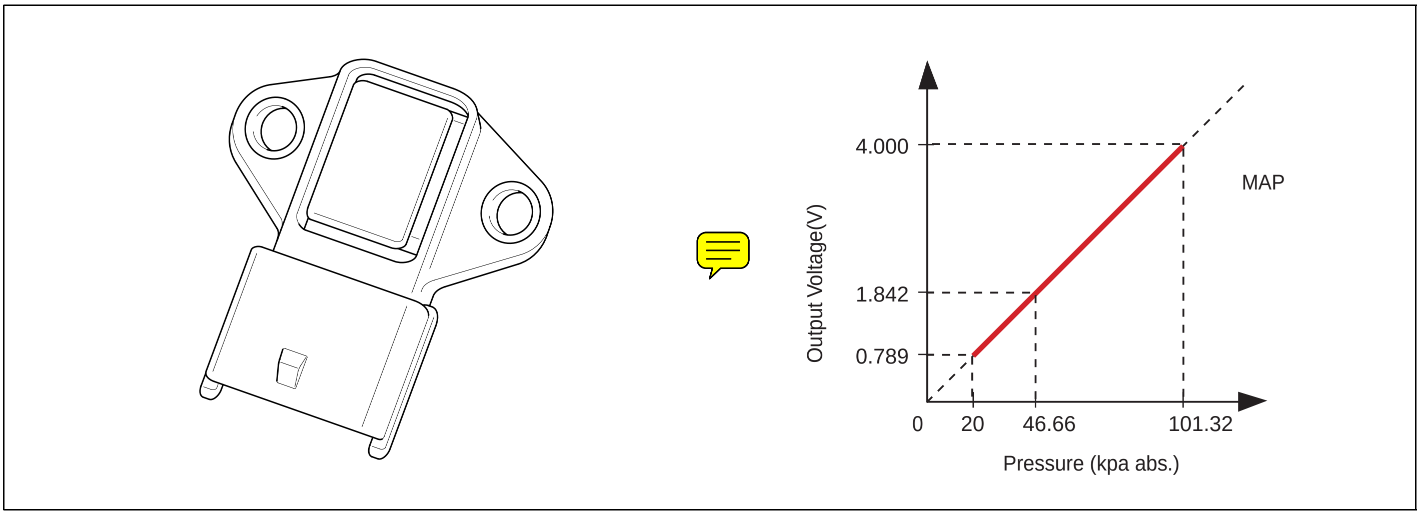
5. Install a new ECM.

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

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

INSPECTION EDBAD074

FUNCTION AND OPERATION PRICIPLE



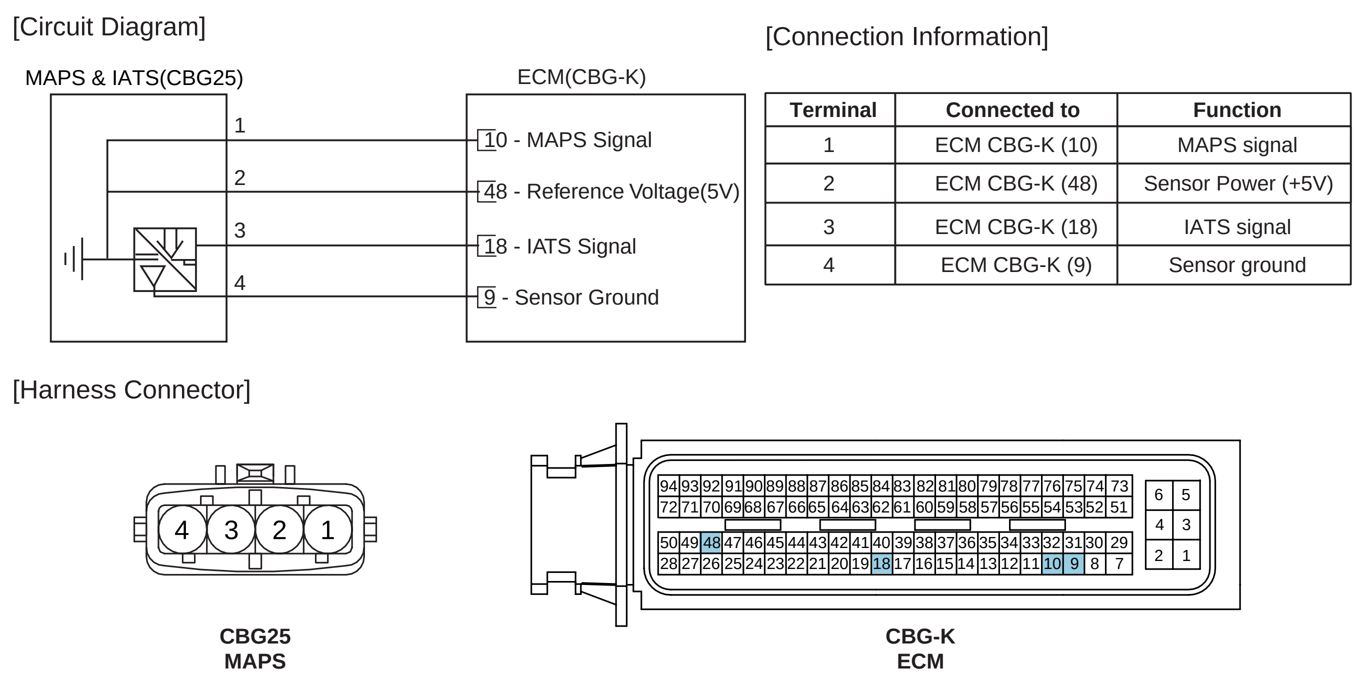
LGLG002A

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 ECM. The ECM 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)
20.0	0.79
46.66	1.84
101.32	4.0

CIRCUIT DIAGRAM



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (10)	MAPS signal
2	ECM CBG-K (48)	Sensor Power (+5V)
3	ECM CBG-K (18)	IATS signal
4	ECM CBG-K (9)	Sensor ground

SHDF16212L

COMPONENT INSPECTION

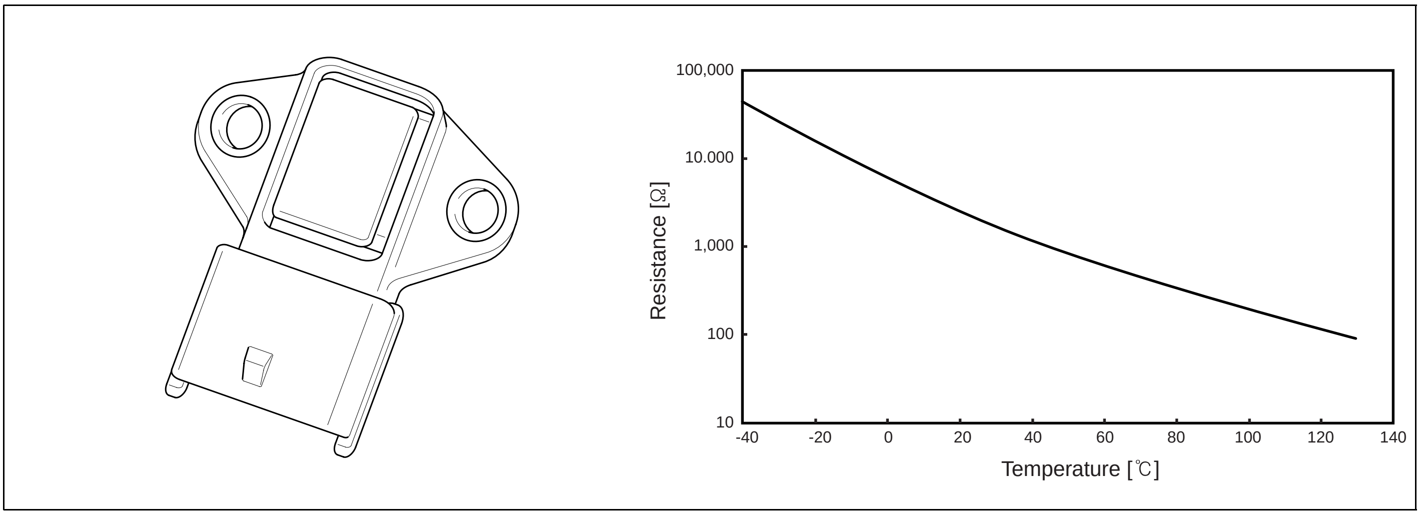
1. Connect a scantool on Diagnisis Link Connector (DLC).
2. Check MAPS output voltage at idle and IG ON.

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

INTAKE AIR TEMPERATURE SENSOR (IATS)

INSPECTION ECFBBEDE

FUNCTION AND OPERATION PRICIPLE



SHDF16121L

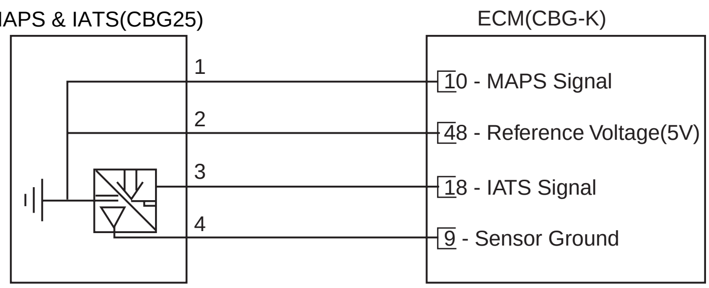
Intake Air Temperature Sensor (IATS) is installed inside the Manifold Absolute Pressure Sensor (MAPS) and detects the intake air temperature. To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the ECM uses not only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

SPECIFICATION

Temperature [°C(°F)]	Resistance(kΩ)
-40(-40)	40.93 ~ 48.35
-30(-22)	23.43 ~ 27.34
-20(-4)	13.89 ~ 16.03
-10(14)	8.50 ~ 9.71
0(32)	5.38 ~ 6.09
10(50)	3.48 ~ 3.90
20(68)	2.31 ~ 2.57
25(77)	1.90 ~ 2.10
30(86)	1.56 ~ 1.74
40(104)	1.08 ~ 1.21
60(140)	0.54 ~ 0.62
80(176)	0.29 ~ 0.34

CIRCUIT DIAGRAM

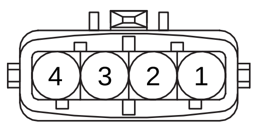
[Circuit Diagram]



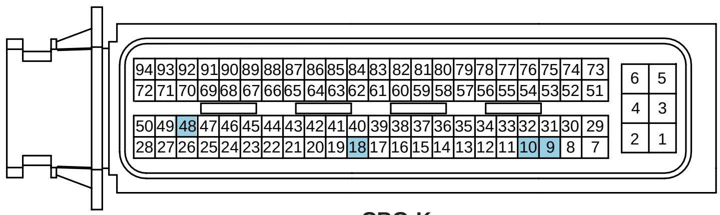
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (10)	MAPS signal
2	ECM CBG-K (48)	Sensor Power (+5V)
3	ECM CBG-K (18)	IATS signal
4	ECM CBG-K (9)	Sensor ground

[Harness Connector]



CBG25
MAPS



CBG-K
ECM

SHDF16212L

COMPONENT INSPECTION

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

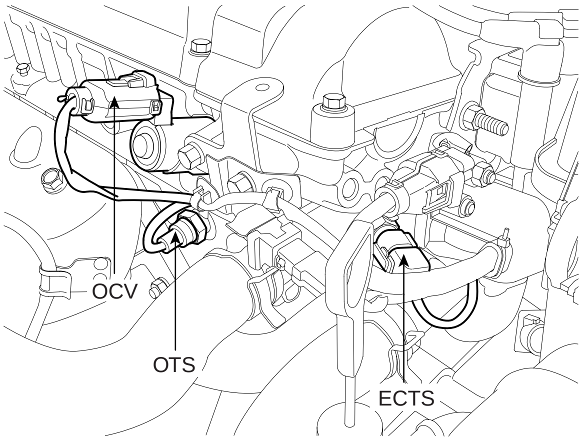
Specification: Refer to SPECIFICATION.

ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

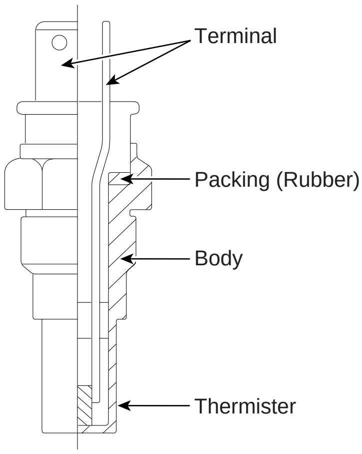
INSPECTION EB3DC7BD

FUNCTION AND OPERATION PRICIPLE

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.



SHDF16104L



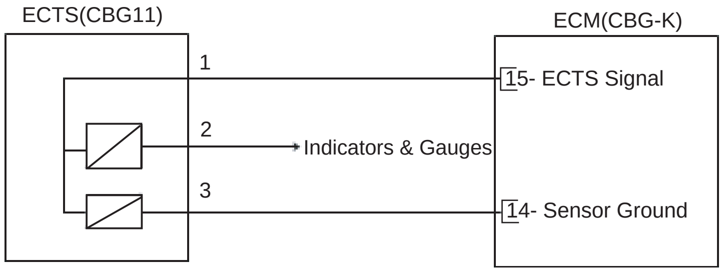
EGRF241A

SPECIFICATION

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

CIRCUIT DIAGRAM

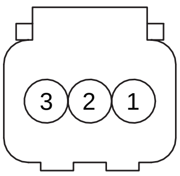
[Circuit Diagram]



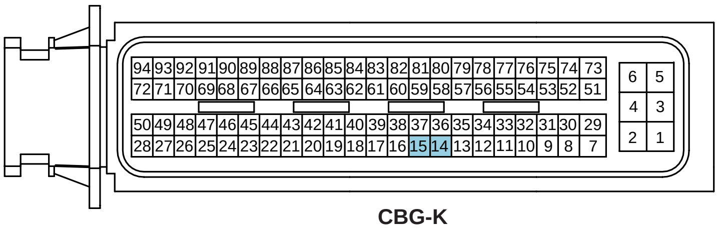
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (15)	ECTS Signal
2	Indicators & Gauges	-
3	ECM CBG-K (14)	Sensor Ground

[Harness Connector]



CBG11
ECTS



CBG-K
ECM

SHDF16224L

COMPONENT INSPECTION

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

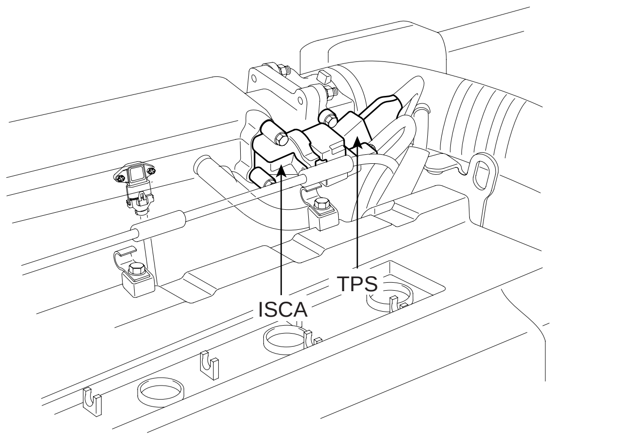
Specification: Refer to SPECIFICATION.

THROTTLE POSITION SENSOR (TPS)

INSPECTION E9DED5DF

FUNCTION AND OPERATION PRINCIPLE

The Throttle Position Sensor (TPS) is mounted on the throttle body and detects the opening angle of the throttle plate. The TPS has a variable resistor (potentiometer) whose characteristic is the resistance changing according to the throttle angle. During acceleration, the TPS resistance between the reference 5V and the signal terminal decreases and output voltage increases; during deceleration, the TPS resistance increases and TPS output voltage decreases. The ECM supplies a reference 5V to the TPS and the output voltage increases directly with the opening of the throttle valve. The TPS output voltage will vary from 0.2~0.8V at closed throttle to 4.3~4.8V at wide-open throttle. The ECM determines operating conditions such as idle (closed throttle), part load, acceleration/deceleration, and wide-open throttle from the TPS. Also The ECM uses the Manifold Absolute Pressure Sensor (MAPS) signal along with the TPS signal to adjust fuel injection duration and ignition timing.



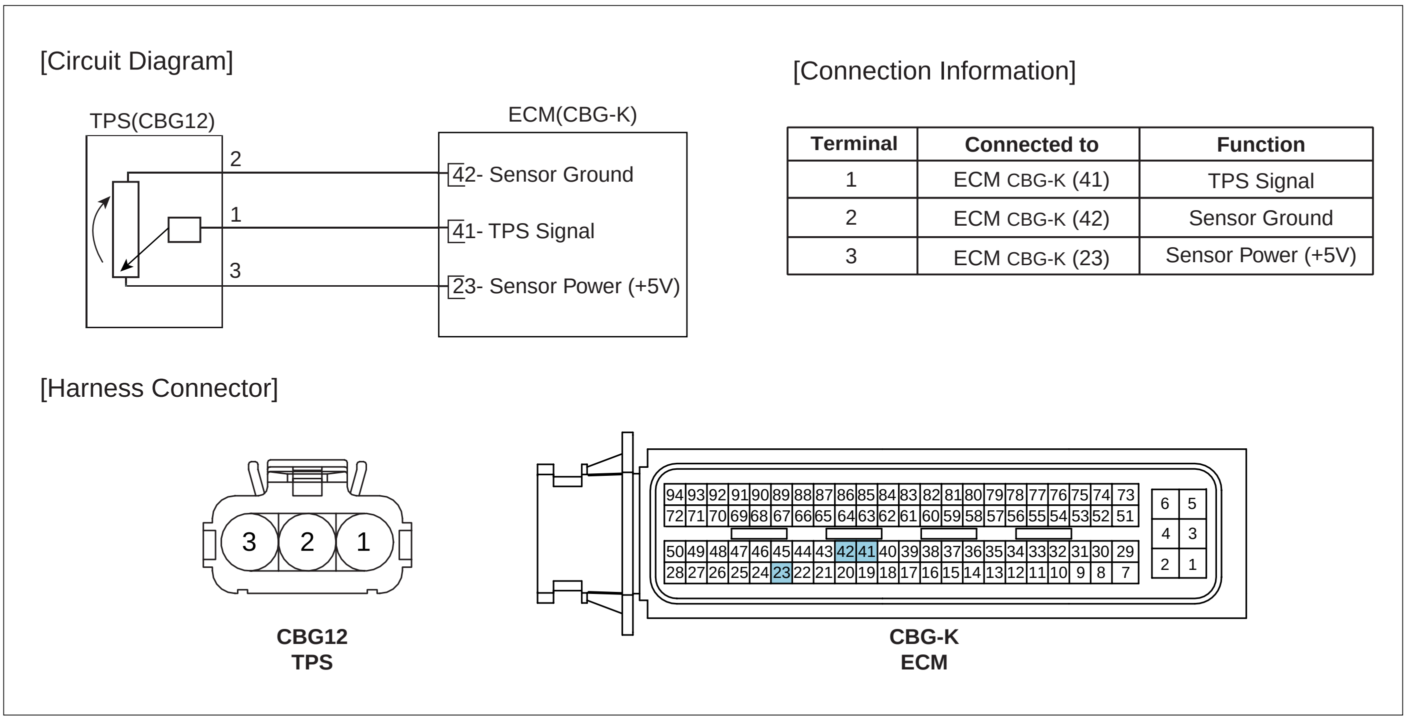
SLDF17124L

SPECIFICATION

Throttle Angle	Output Voltage (V)
C.T	0.25 ~ 0.9
W.O.T	Min. 4.0V

Items	Specification
Sensor Resistance (kΩ)	1.6 ~ 2.4kΩ at 20℃(68°F)

CIRCUIT DIAGRAM



SHDF16230L

COMPONENT INSPECTION

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

Specification: Refer to SPECIFICATION.

3. Turn ignition switch OFF and disconnect the scantool from the DLC.
4. Disconnect TPS connector and measure resistance between TPS terminals 2 and 3

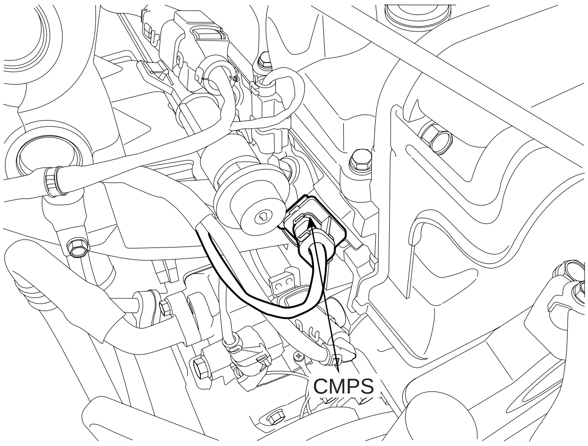
Specification: Refer to SPECIFICATION.

CAMSHAFT POSITION SENSOR (CMPS)

INSPECTION E452C770

FUNCTION AND OPERATION PRICIPLE

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 CMPS are installed on engine head cover 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.



SHDF16107L

WAVEFORM

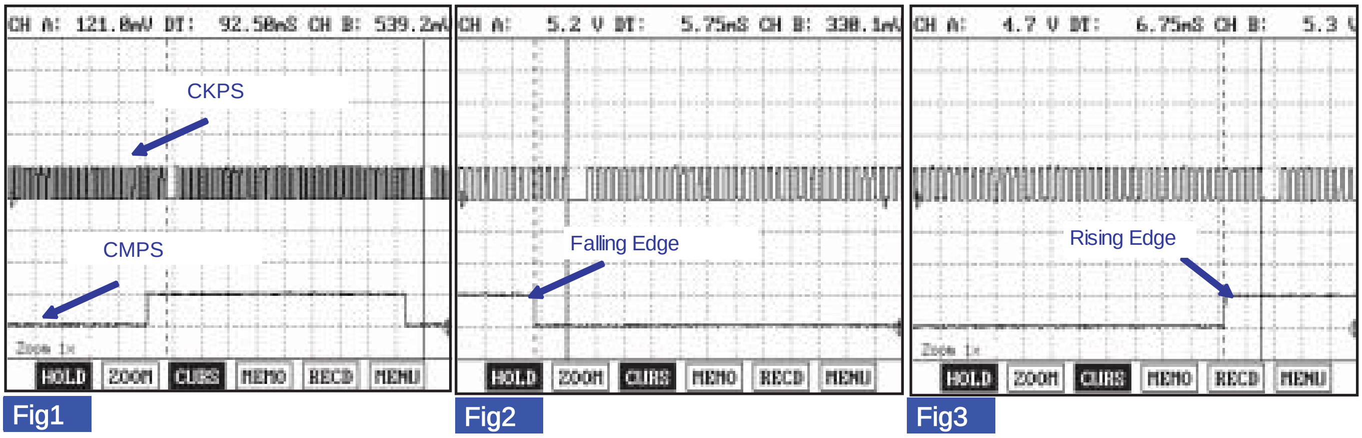
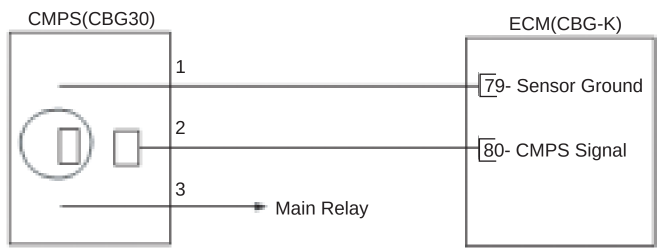


Fig.1) The square wave signal should be smooth and without any distortion.
Fig.2,3)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

LFLG156A

CIRCUIT DIAGRAM

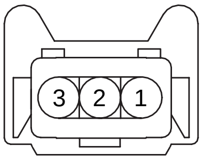
[Circuit Diagram]



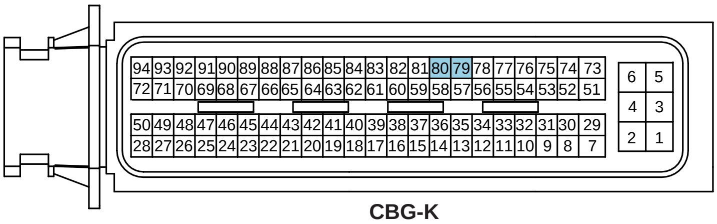
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (79)	Sensor Ground
2	ECM CBG-K (80)	CMPS Signal
3	Main Relay	Power Supply (B+)

[Connection Information]



CBG30
CMPS



CBG-K
ECM

SLDF17281L

COMPONENT INSPECTION

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

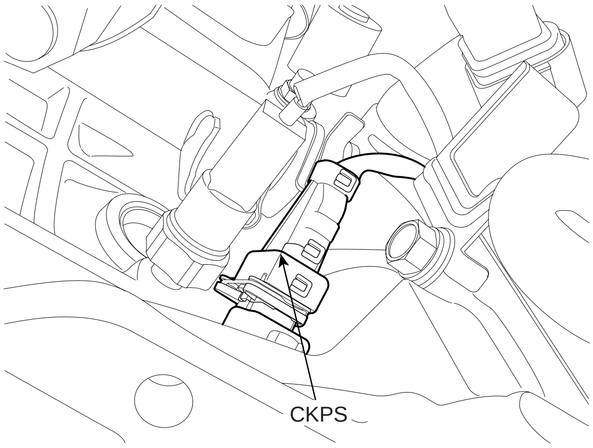
Specification : Refer to "WAVE FORM"

CRANKSHAFT POSITION SENSOR (CKPS)

INSPECTION E738C97B

FUNCTION AND OPERATION PRICIPLE

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



SHDF16106L

WAVEFORM

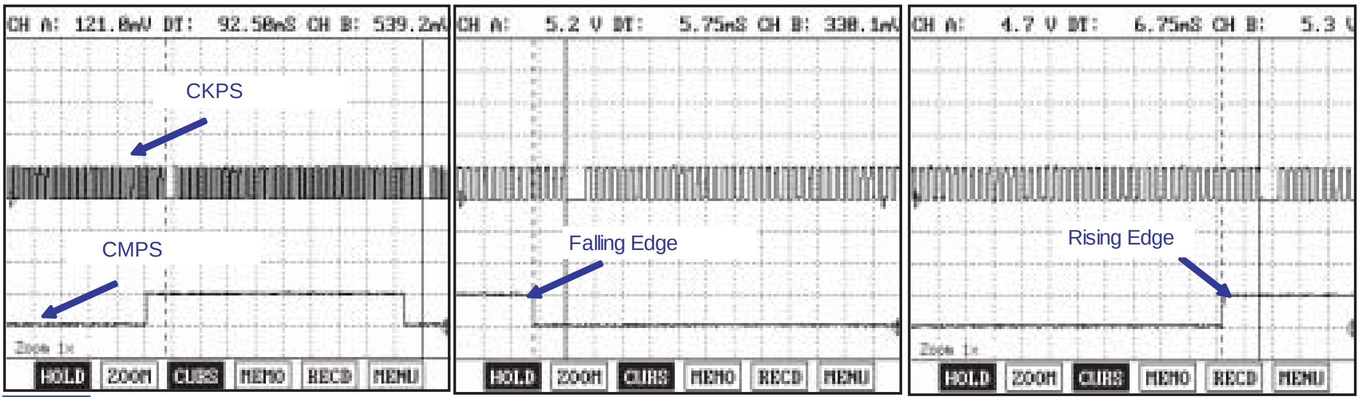


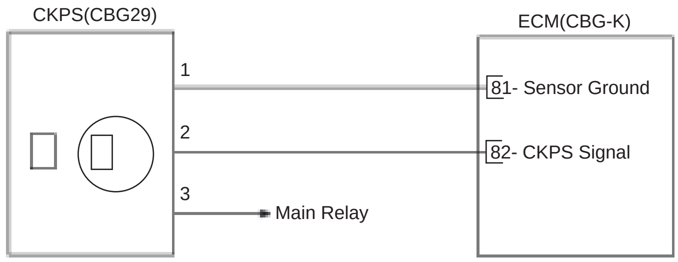
Fig1 Fig2 Fig3

Fig.1) The square wave signal should be smooth and without any distortion.
Fig.2,3)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

LFLG156A

CIRCUIT DIAGRAM

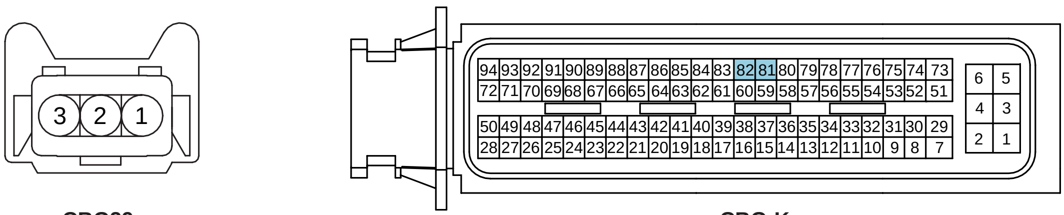
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (81)	Sensor Ground
2	ECM CBG-K (82)	CKPS Signal
3	Main Relay	Power Supply (B+)

[Harness Connector]



CBG29
CKPS

CBG-K
ECM

SLDF17272L

COMPONENT INSPECTION

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

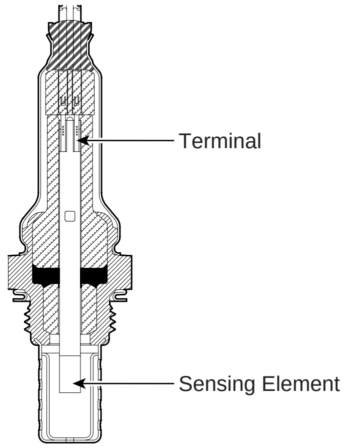
Specification : Refer to "WAVE FORM"

HEATED OXYGEN SENSOR (HO2S)

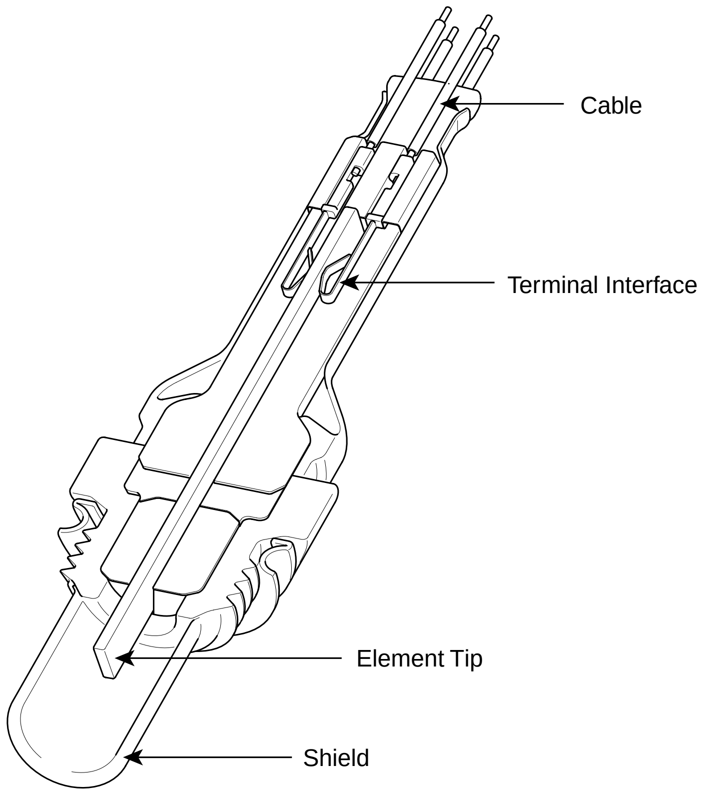
INSPECTION E32BF64A

FUNCTION AND OPERATION PRICIPLE

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 ECM. 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 ECM duty signal. When the exhaust gas temperature is lower than the specified value, the heater warms the sensor tip.



EGRF247A



EGRF248A

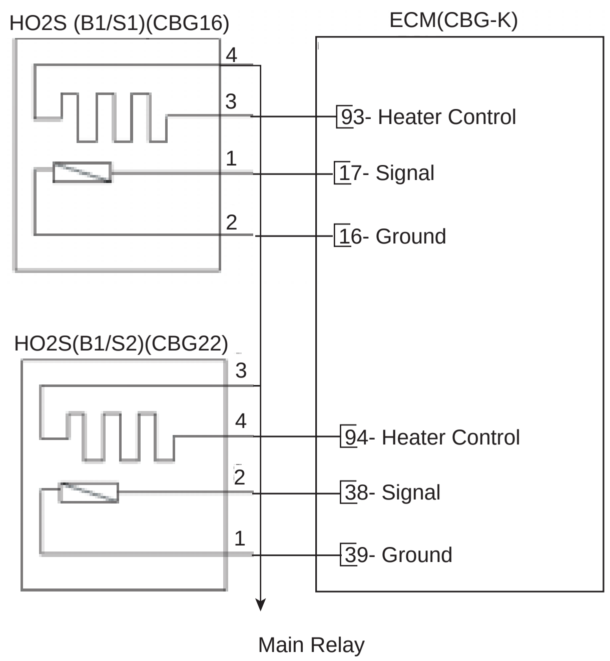
SPECIFICATION

A/F Ratio	Output Voltage (V)
RICH	0.6 ~ 1.0
LEAN	0.1 ~ 0.4

Item	Specification
Heater Resistance (Ω)	Approx. 9.0Ω at 20℃ (68°F)

CIRCUIT DIAGRAM

[Circuit Diagram]



[Connection Information]

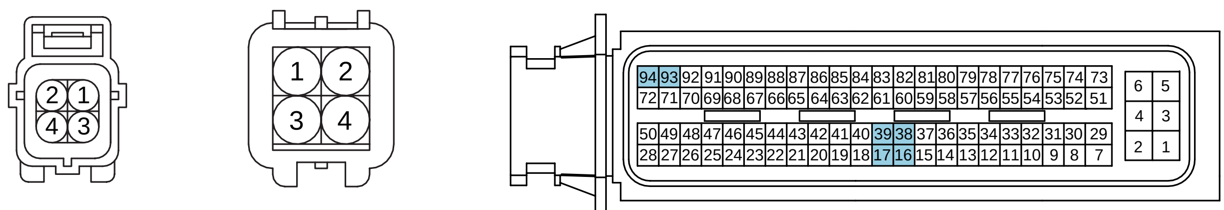
HO2S (B1/S1)

Terminal	Connected to	Function
1	ECM CBG-K (17)	HO2S (B1/S1) Signal
2	ECM CBG-K (16)	Sensor Ground
3	ECM CBG-K (93)	Heater Control
4	Main Relay	Power Supply (B+)

HO2S (B1/S2)

Terminal	Connected to	Function
1	ECM CBG-K (39)	Sensor Ground
2	ECM CBG-K (38)	HO2S (B1/S2) Signal
3	Main Relay	Power Supply (B+)
4	ECM CBG-K (94)	Heater Control

[Harness Connector]



CBG16
HO2S (B1/S1)

CBG22
HOS2 (B1/S2)

CBG-K
ECM

SHDF16600L

COMPONENT INSPECTION

1. Disconnet the HO2S connector.
2. Measure resistance between HO2S heater terminals 3 and 4.
3. Check that the resistance is within the specification.

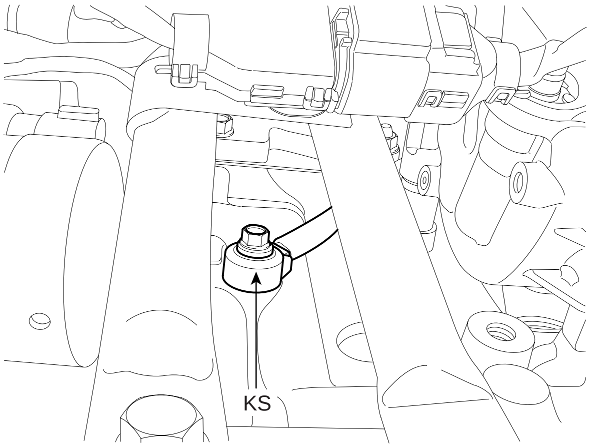
Specification: Refer to SPECIFICATION.

KNOCK SENSOR (KS)

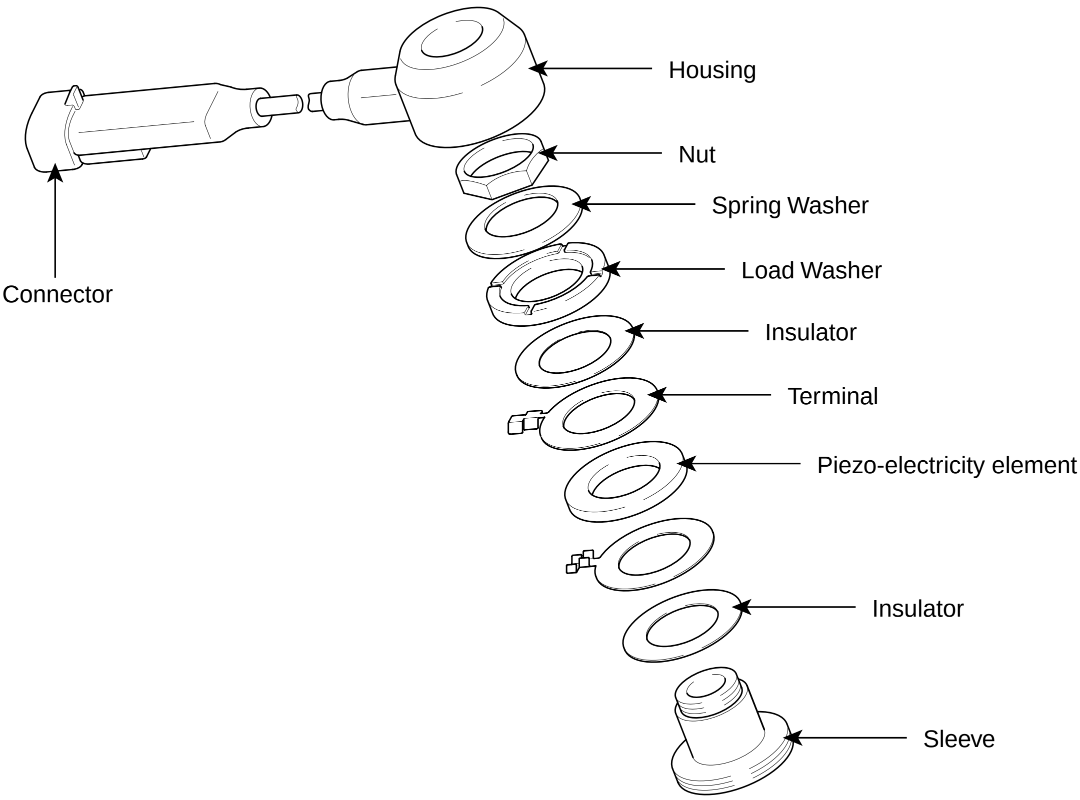
INSPECTION EA2F12E4

FUNCTION AND OPERATION PRICIPLE

Knocking is a phenomenon characterized by undesirable vibration and noise and can cause engine damage. Knock Sensor (KS) senses engine knocking and 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 ECM and the ECM retards the ignition timing. If the knocking disappears after retarding the ignition timing, the ECM will advance the ignition timing. This sequential control can improve engine power, torque and fuel economy.



SHDF16108L

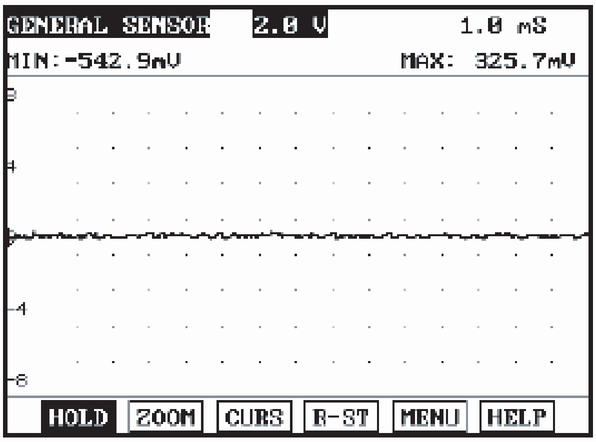


EGRF252A

SPECIFICATION

Item	Specification
Capacitance (pF)	950 ~ 1,350
Resistance (MΩ)	4.87

WAVEFORM

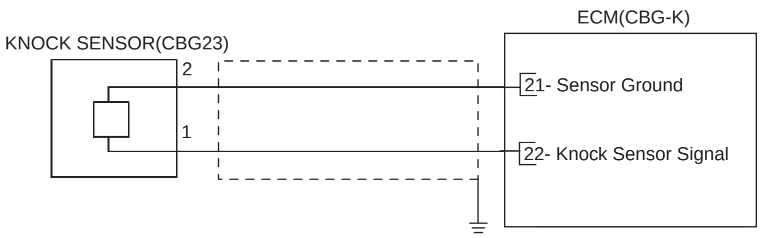


The knock sensor is installed at cycliner block to detect the vibration effectively during engine running.
The above waveform shows the signal waveform of knock sensor when knock dosen't happen. Generally, knock signal has more noise than other sensor.

EGRF610B

CIRCUIT DIAGRAM

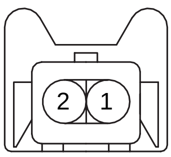
[Circuit Diagram]



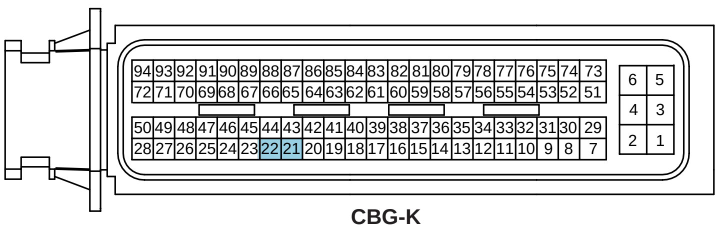
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (22)	Knock Sensor Signal
2	ECM CBG-K (21)	Sensor Ground

[Harness Connector]



CBG23
KNOCK SENSOR



CBG-K
ECM

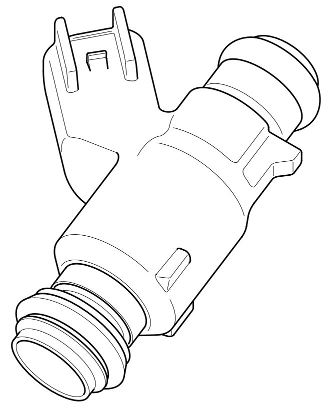
SHDF16273L

INJECTOR

INSPECTION EBDFCEA0

FUNCTION AND OPERATION PRICIPLE

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



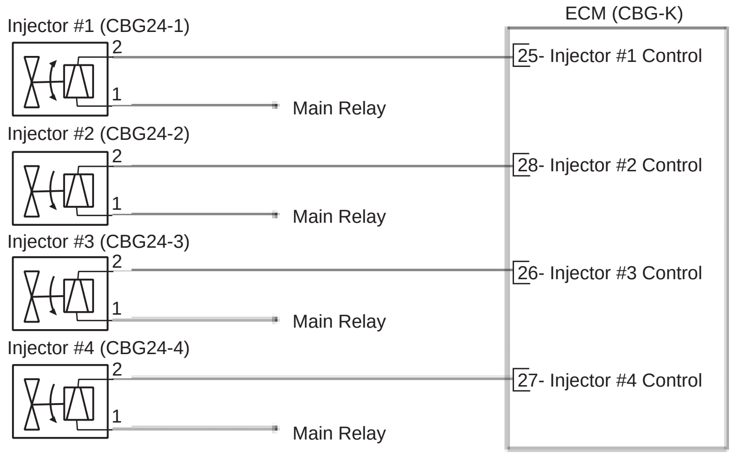
KFCF1026

SPECIFICATION

Item	Specification
Coil Resistance (Ω)	13.8 ~ 15.2Ω at 20℃ (68°F)

CIRCUIT DIAGRAM

[Circuit Diagram]



[Connection Information]

Injector #1 (CBG24-1)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (25)	Injector Control

Injector #2 (CBG24-2)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (28)	Injector Control

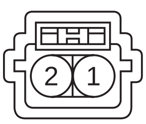
Injector #3 (CBG24-3)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (26)	Injector Control

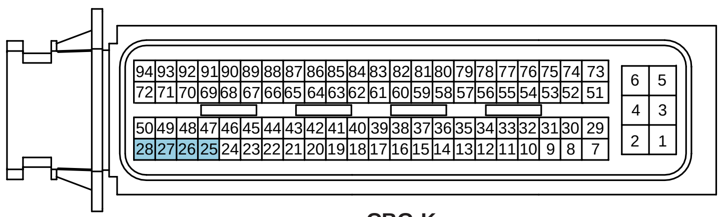
Injector #4 (CBG24-4)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (27)	Injector Control

[Harness Connector]



CBG24-1,2,3,4
INJECTOR #1,2,3,4



CBG-K
ECM

SLDF17254L

COMPONENT INSPECTION

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

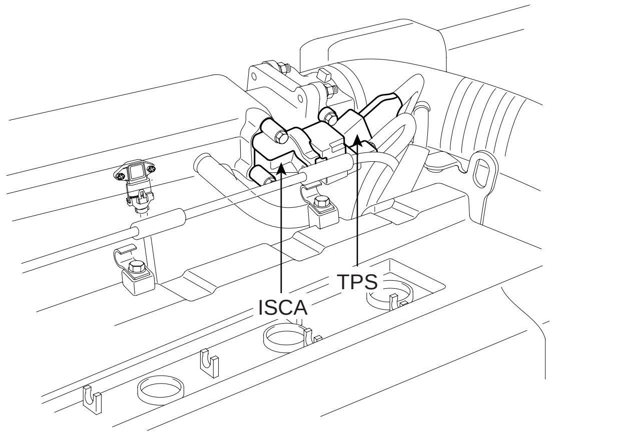
Specification: Refer to SPECIFICATION.

IDLE SPEED CONTROL ACTUATOR (ISCA)

INSPECTION EAF1ECF9

FUNCTION AND OPERATION PRINCIPLE

The Idle Speed Control Actuator (ISCA) is installed on the throttle body and controls the intake airflow that is by-passed around the throttle plate to keep constant engine speed when the throttle valve is closed. The function of the ISCA is to maintain idle speed according to various engine loads and conditions, and also to provide additional air during starting. The ISCA consists of an opening coil, a closing coil, and a permanent magnet. Based on information from various sensors, the ECM controls both coils by grounding their control circuits. According to the control signals from the ECM, the valve rotor rotates to control the by pass airflow into the engine.



SLDF17124L

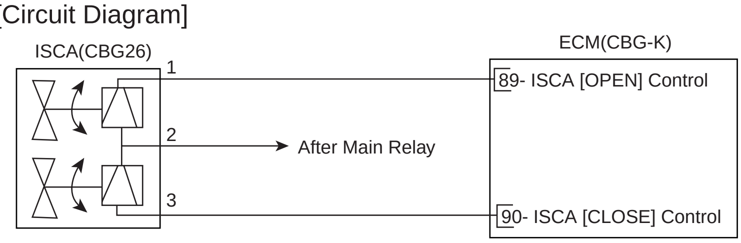
SPECIFICATION

ITems	Specification
Closing Coil Resistance (Ω)	14.6 ~ 16.2 at 20℃ (68°F)
Opening Coil Resistance (Ω)	11.1 ~ 12.7 at 20℃ (68°F)

Duty (%)	Air Flow Rate (m^3/h)
15	1.0 ~ 2.3
35	7.5 ~ 12.7
70	43.0 ~ 55.0
96	63.0 ~ 71.0

CIRCUIT DIAGRAM

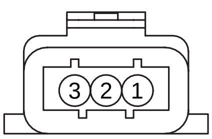
[Circuit Diagram]



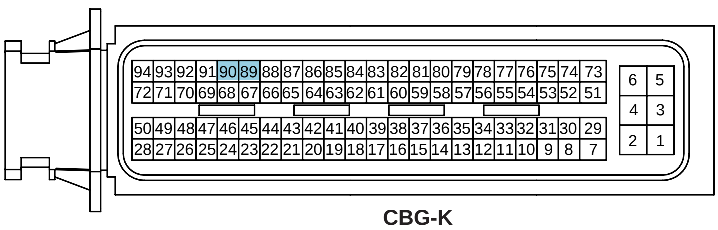
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (89)	ISCA (OPEN) Control
2	Main Relay	Power Supply (B+)
3	ECM CBG-K (90)	ISCA (CLOSE) Control

[Harness Connector]



CBG26
ISCA



CBG-K
ECM

SHDF16313L

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect ISCA connector.
3. Measure resistance between ISCA terminals 2 and 1 [Opening Coil].
4. Measure resistance between ISCA terminals 2 and 3 [Closing Coil].
5. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

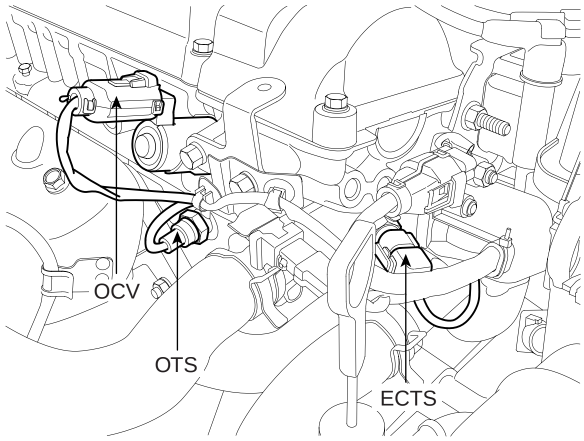
CVVT OIL CONTROL VALVE (OCV)

INSPECTION E20ADB81

FUNCTION AND OPERATION PRICIPLE

The Continuously Variable Valve Timing (CVVT) system controls the amount of valve overlap by varying the amount of oil flow into an assembly mounted on the intake camshaft through ECM control of an oil control valve. An Oil Temperature Sensor (OTS) is used to allow ECM monitoring of engine oil temperature. As oil is directed into the chambers of the CVVT assembly, the cam phase is changed to suit various performance and emissions requirements..

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



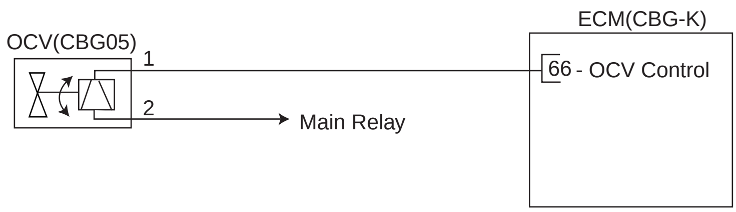
SHDF16104L

SPECIFICATION

Item	Specification
Coil Resistance (Ω)	6.9 ~ 7.9Ω at 20℃ (68°F)

CIRCUIT DIAGRAM

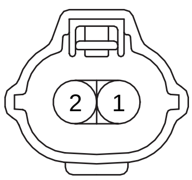
[Circuit Diagram]



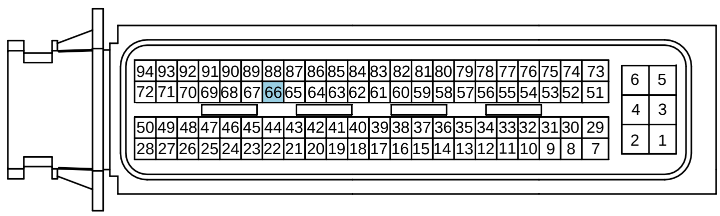
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (66)	OCV Control
2	Main Relay	Power Supply (B+)

[Harness Connector]



CBG05
OCV



CBG-K
ECM

SHDF16200L

COMPONENT INSPECTION

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

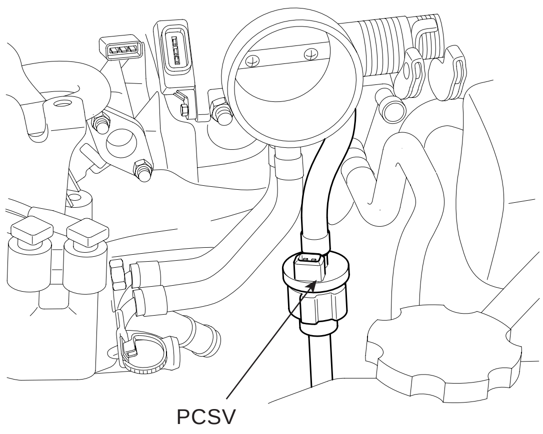
Specification: Refer to SPECIFICATION.

PURGE CONTROL SOLENOID VALVE (PCSV)

INSPECTION E0D72C99

FUNCTION AND OPERATION PRICIPLE

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 vapors stored in the canister is transferred to the intake manifold.



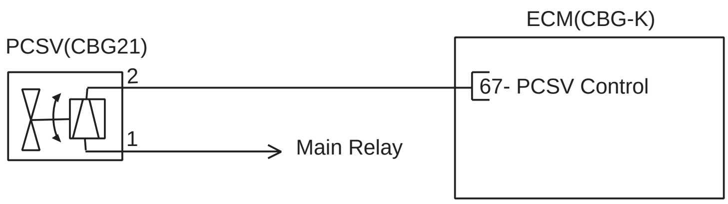
BFGE302B

SPECIFICATION

Item	Specification
Coil Resistance (Ω)	26.0Ω at 20℃ (68°F)

CIRCUIT DIAGRAM

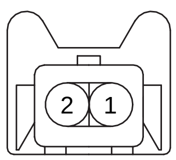
[Circuit Diagram]



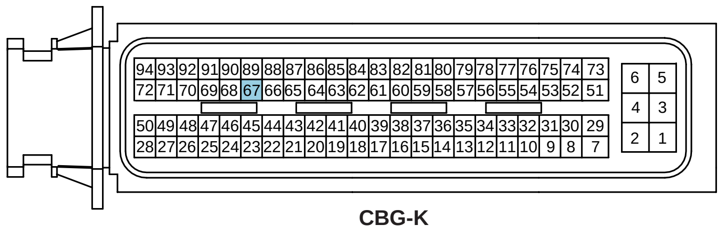
[Connection Information]

Terminal	Connected to	Connected to
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (67)	PCSV Control

[Harness Connector]



CBG21
PCSV



CBG-K
ECM

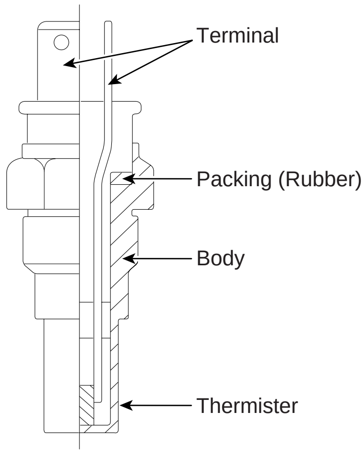
SLDF17287L

COMPONENT INSPECTION

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

Specification: Refer to SPECIFICATION.

CVVT OIL TEMPERATURE SENSOR(OTS)

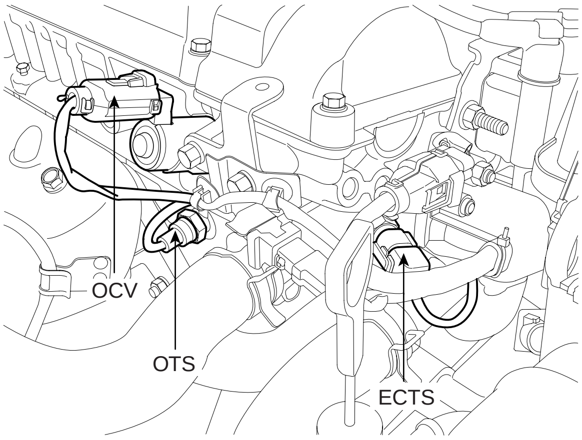


EGRF241A

INSPECTION EFEBE0C9

FUNCTION AND OPERATION PRICIPLE

The CVVT Oil Temperature Sensor (OTS) is a negative coefficient thermistor used by the PCM tl measure engine oil temperature for the purpose of adjusting CVVT calculations.



SHDF16104L

SPECIFICATION

Temperature [°C(°F)]	Resistance (kΩ)
-40(-40)	52.15
-20(-4)	16.52
0(32)	6.0
20(68)	2.45
40(104)	1.11
60(140)	0.54
80(176)	0.29

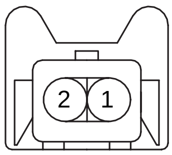
CIRCUIT DIAGRAM

[Circuit Diagram]

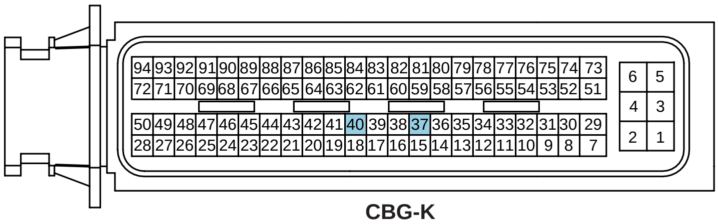
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (37)	Sensor Ground
2	ECM CBG-K (40)	OTS Signal

[Harness Connector]



CBG03
OTS



CBG-K
ECM

SHDF16245L

COMPONENT INSPECTION

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

Specification: Refer to SPECIFICATION.

DTC TROUBLESHOOTING PROCEDURES

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC) E1BFC251

DTC	Description	MIL			Page
		Euro-III/IV	Euro-II	Leaded	
P0011	A Camshaft Position-Timing Over-Advanced or System Performance (Bank 1)	●	▲	▲	FLA-62
P0016	Crankshaft Position-Camshaft Position Correlation (Bank 1 Sensor A)	●	▲	▲	FLA-71
P0030	HO2S Heater Control Circuit (Bank 1 / Sensor 1)	●	▲		FLA-77
P0031	HO2S Heater Circuit Low (Bank 1 / Sensor 1)	●	▲		FLA-82
P0032	HO2S Heater Circuit High (Bank 1 / Sensor 1)	●	▲		FLA-85
P0036	HO2S Heater Control Circuit (Bank 1 / Sensor 2)	●	▲		FLA-88
P0037	HO2S Heater Circuit Low (Bank 1 / Sensor 2)	●	▲		FLA-93
P0038	HO2S Heater Circuit High (Bank 1 / Sensor 2)	●	▲		FLA-96
P0076	Intake Valve Control Solenoid Circuit Low (Bank 1)	●	▲		FLA-99
P0077	Intake Valve Control Solenoid Circuit High (Bank 1)	●	▲		FLA-105
P0106	Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance	●	●	●	FLA-108
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input	●	●	●	FLA-113
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input	●	●	●	FLA-116
P0111	Intake Air Temperature Sensor1 Circuit Range/Performance	●	▲	▲	FLA-119
P0112	Intake Air Temperature Sensor1 Circuit Low Input	●	▲	▲	FLA-125
P0113	Intake Air Temperature Sensor1 Circuit High Input	●	▲	▲	FLA-128
P0116	Engine Coolant Temperature Circuit Range/Performance	●	●	●	FLA-131
P0117	Engine Coolant Temperature Circuit Low Input	●	●	●	FLA-138
P0118	Engine Coolant Temperature Circuit High Input	●	●	●	FLA-141
P0121	Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance	●			FLA-145
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input	●	●	●	FLA-151
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	●	●	●	FLA-154
P0130	HO2S Circuit (Bank 1/ Sensor 1)	●	▲		FLA-158
P0131	HO2S Circuit Low Voltage (Bank 1 / Sensor 1)	●	▲		FLA-163
P0132	HO2S Circuit High Voltage (Bank 1 / Sensor 1)	●	▲		FLA-166
P0133	HO2S Circuit Slow Response (Bank 1 / Sensor 1)	●	▲		FLA-169

DTC	Description	MIL			Page
		Euro-III/IV	Euro-II	Leaded	
P0134	HO2S Circuit No Activity Detected (Bank 1 / Sensor 1)	●	▲		FLA-172
P0136	HO2S Circuit (Bank 1/ Sensor 2)	●			FLA-175
P0137	HO2S Circuit Low Voltage (Bank 1 / Sensor 2)	●			FLA-180
P0138	HO2S Circuit High Voltage (Bank 1 / Sensor 2)	●			FLA-183
P0139	HO2S Circuit Slow Response (Bank 1 / Sensor 2)	●			FLA-185
P0140	HO2S Circuit No Activity Detected (Bank 1 / Sensor 2)	●			FLA-188
P0170	Fuel Trim (Bank 1)	●			FLA-191
P0171	System Too Lean (Bank 1)	●	▲		FLA-197
P0172	System Too Rich (Bank 1)	●	▲		FLA-202
P0196	Engine Oil Temperature Sensor Range / Performance	●	▲	▲	FLA-207
P0197	Engine Oil Temperature Sensor Low Input	●	▲	▲	FLA-214
P0198	Engine Oil Temperature Sensor High Input	●	▲	▲	FLA-217
P0230	Fuel Pump Primary Circuit	▲	▲	▲	FLA-220
P0261	Cylinder 1-Injector Circuit Low	●	●	●	FLA-225
P0262	Cylinder 1-Injector Circuit High	●	●	●	FLA-230
P0264	Cylinder 2-Injector Circuit Low	●	●	●	FLA-225
P0265	Cylinder 2-Injector Circuit High	●	●	●	FLA-230
P0267	Cylinder 3-Injector Circuit Low	●	●	●	FLA-225
P0268	Cylinder 3-Injector Circuit High	●	●	●	FLA-230
P0270	Cylinder 4-Injector Circuit Low	●	●	●	FLA-225
P0271	Cylinder 4-Injector Circuit High	●	●	●	FLA-230
P0300	Random/Multiple Cylinder Misfire Detected	●			FLA-233
P0301	Cylinder 1-Misfire Detected	●			FLA-240
P0302	Cylinder 2-Misfire Detected	●			FLA-233
P0303	Cylinder 3-Misfire Detected	●			FLA-233
P0304	Cylinder 4-Misfire Detected	●			FLA-233
P0315	Segment Time Acquisition Incorrect	▲			FLA-245
P0325	Knock Sensor 1 Circuit	▲	▲	▲	FLA-249
P0335	Crankshaft Position Sensor "A" Circuit	●	▲	▲	FLA-254
P0340	Camshaft Position Sensor "A" Circuit Malfunction (Bank 1 or Single Sensor)	●	▲	▲	FLA-260
P0420	Catalyst System Efficiency below Threshold (Bank 1)	●			FLA-266
P0444	Evap. Emission System-Purge Ctrl. Valve Circuit Open	●			FLA-270

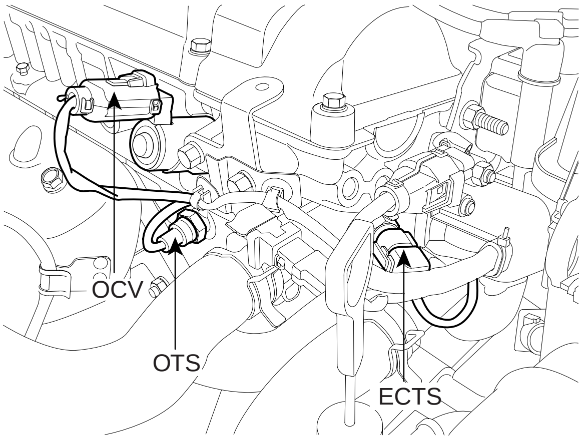
DTC	Description	MIL			Page
		Euro-III/IV	Euro-II	Leaded	
P0445	Evap. Emission System-Purge Ctrl. Valve Circuit Shorted	●			FLA-275
P0501	Vehicle Speed Sensor A Range/Performance	●	▲	▲	FLA-278
P0506	Idle Air Control System-RPM Lower Than Expected	●	▲	▲	FLA-286
P0507	Idle Air Control System-RPM Higher Than Expected	●	▲	▲	FLA-290
P0560	System Voltage	▲	▲	▲	FLA-293
P0562	System Voltage Low	●	▲	▲	FLA-299
P0563	System Voltage High	●	▲	▲	FLA-302
P0605	Internal Control Module Read Only Memory(ROM) Error	▲	▲	▲	FLA-305
P0625	Generator Field/F Terminal Circuit Low	▲	▲	▲	FLA-308
P0626	Generator Field/F Terminal Circuit High	▲	▲	▲	FLA-313
P0650	Malfunction Indicator Lamp(MIL) Control Circuit	▲			FLA-316
P0700	TCU Request for MIL ON	●			FLA-320
P1505	Idle Charge Actuator Signal Low of Coil #1	●	●	●	FLA-321
P1506	Idle Charge Actuator Signal High of Coil #1	●	●	●	FLA-326
P1507	Idle Charge Actuator Signal Low of Coil #2	●	●	●	FLA-329
P1508	Idle Charge Actuator Signal High of Coil #2	●	●	●	FLA-332
U0001	CAN Communication Malfunction	●	▲	▲	FLA-335
U0101	Serial Communication Problem with TCU (Timeout)	●	▲	▲	FLA-340

NOTE

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

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

COMPONENT LOCATION E77C4ACB



SHDF16324L

GENERAL DESCRIPTION E0496E79

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the exhaust camshaft. There is no variation in valve timing of the exhaust cam because the exhaust camshaft is driven by the timing belt. The timing of the intake cam is varied by the relative operation the CVVT vane to the housing. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV(Oil Control Valve). As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease by changing the valve open/close timing of the intake camshaft.

DTC DESCRIPTION E7487B8B

The deviation of the camshaft position from the target point is evaluated during stable driving condition. The ECM accumulates this deviation for a certain period and sets DTC P0011 when the accumulated deviation is too high. The target camshaft position is predetermined value depending on engine speed and throttle angle in the ECM.

DTC DETECTING CONDITION E61B1DB9

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitor deviation between camshaft position setpoint and actual value	• Faulty Oil leak • Faulty Oil pump • Faulty Intake valve control solenoid
Enable Conditions	• No relevant failure • 11V < Battery voltage < 16V • CVVT control : enabled • Camshaft setpoint moved more than 5 times for this Driving Cycle • Stable camshaft set-point moving by more than 1.125°CRK moving • Camshaft position setpoint-actual > 5°CRK • 600 ~ 1700rpm < Engine speed < 5000rpm • 20℃(68°F) < Engine oil temperature < 100℃(212°F)	
Threshold Value	• Integral of Camshaft position setpoint - Camshaft position actual value > 150°CRK/sec.	
Diagnostic Time	• Approx. 38~300 seconds depending on CAM deviation	
Mil On Condition	• 2 Driving Cycles	

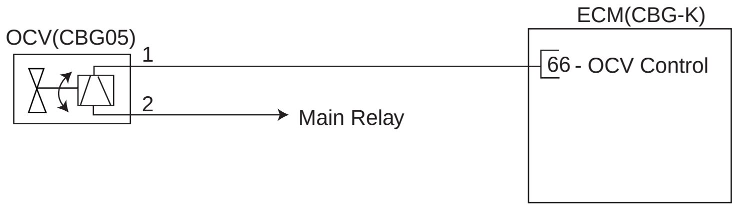
SPECIFICATION E023A7DF

Intake OCV	Normal Parameter
Insulation Resistance (Ω)	Above 50 MΩ

Temp.(℃)	Temp.(°F)	Resistance(Ω)
0	32	6.2 ~ 7.4
10	50	6.5 ~ 7.7
20	68	6.9 ~ 7.9
30	86	7.1 ~ 8.3
40	104	7.4 ~ 8.6
50	122	7.7 ~ 8.9
60	140	8.0 ~ 9.2
70	158	8.3 ~ 9.5
80	176	8.6 ~ 9.8
90	194	8.9 ~ 10.1
100	212	9.2 ~ 10.4

SCHEMATIC DIAGRAM EF65420A

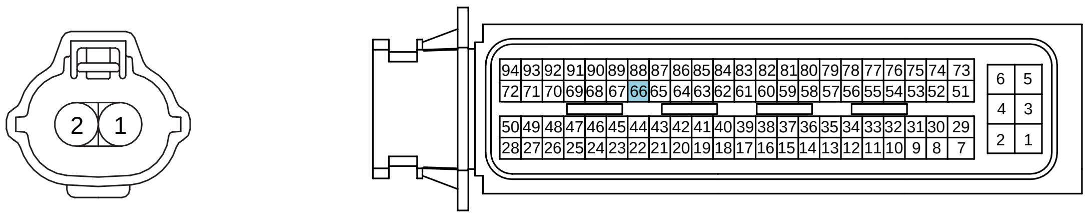
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (66)	OCV Control
2	Main Relay	Power Supply (B+)

[Harness Connector]



CBG05
OCV

CBG-K
ECM

SHDF16200L

SIGNAL WAVEFORM AND DATA EA02E8B1

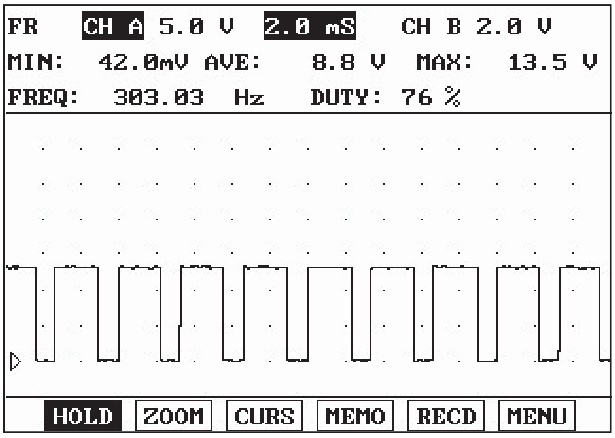


Fig1

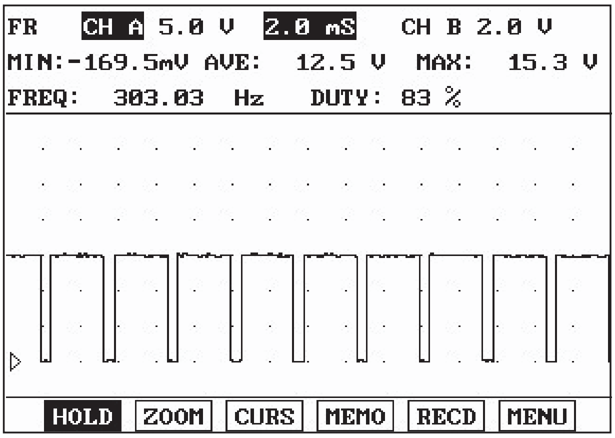


Fig2

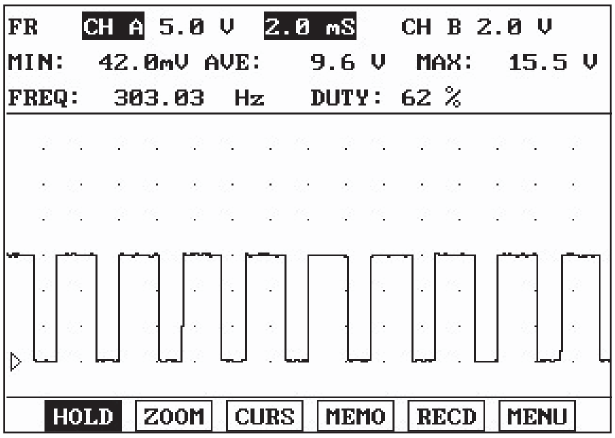


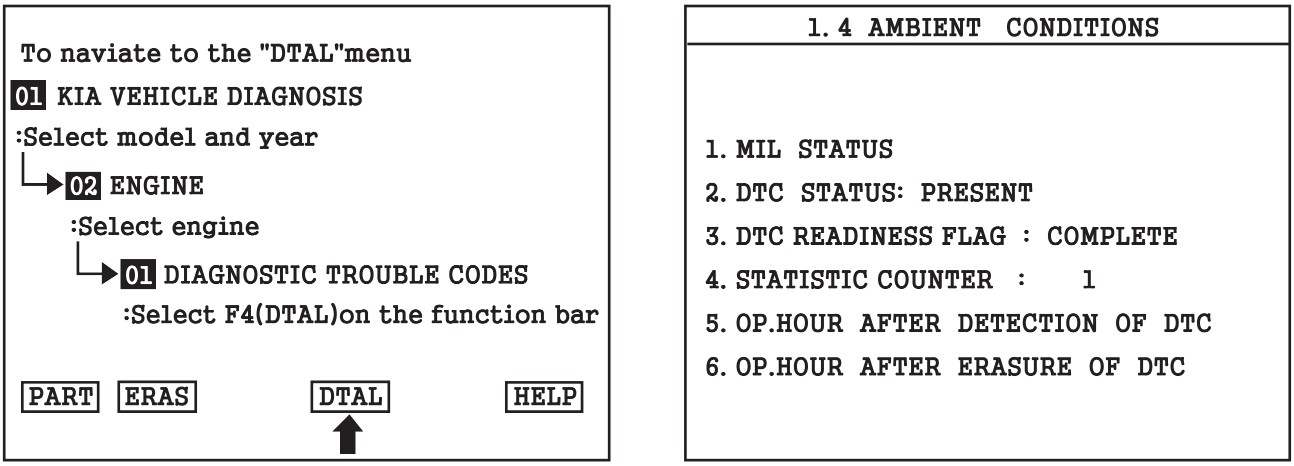
Fig3

Fig 1) Normal OCV (-) duty ratio with Ignition "ON"
Fig 2) Normal OCV (-) duty ratio with idle : Approx. 12~20%
Fig 3) Normal OCV (-) duty ratio with maintaining 2000RPM : Approx. 30~50%

SLDF17103L

MONITOR DTC STATUS E84D844D

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Press F4(DTAL) to select DTC information from the DTCs menu.
3. Confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
4. Read "DTC Status" parameter.



SLDF17102L

5. Is parameter displayed "History(Not Present) fault"?

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

COMPONENT INSPECTION E7E6CCE0

CHECK OCV AND FILTER

1. Check resistance of OCV.

   1) Ignition "OFF"

   2) Disconnect intake OCV connector.

   3) Measure resistance between terminals 1 and 2 of the intake OCV connector.(Component side)

Specification : Approx. 6.9~7.9Ω at 20℃(68°F)

   4) Is resistance within the specification?

   YES

   ▶ Go to next step as below.

   NO

▶ Replace OCV and then go to "Verification of Vehicle Repair" procedure.

2. Check operation of OCV

1) Start the engine and let it idle.

2) With OCV connector still disconnected, connect 12V and a ground to 2 and 1 of the OCV(Component side).

SPECIFICATION :

Test Condition	Disconnect OCV connector	Apply battery voltage
Normal Value	Normal engine speed	Rough idle or engine stall

3) Has a problem been found?

YES

▶ Go to next step as below.

NO

▶ Go to "Check CVVT(Continuously Variable Valve Timing) Assembly" procedure.

3. Check OCV and Filter.

1) Ignition"OFF"

2) Check OCV filter for sticking or contamination.

3) Remove the OCV and visually check the spool column of OCV for contamination.

4) Has a problem been found?

YES

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

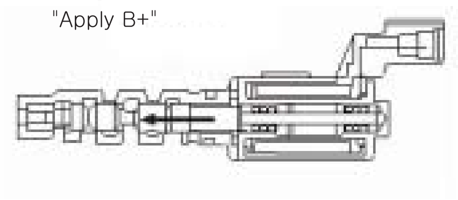
NO

▶ Go to next step as below.

5) Apply 12V and a ground to 2 and 1 terminals of the OCV(Component side).

6) Verify that a "clicking" sound is heard when applying the battery voltage.

7) Repeat this procedure 4 or 5 times to ensure intake OCV reliability.



LFLG103A

8) Is OCV working properly?

YES

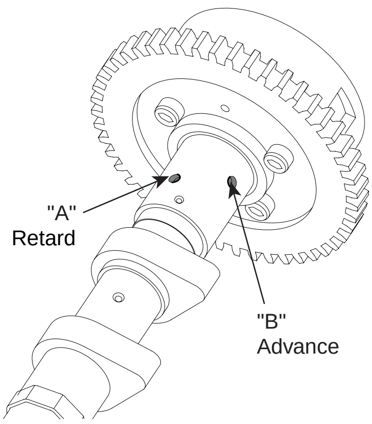
▶ Go to next step as below.

NO

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

CHECK CVVT(CONTINUOUSLY VARIABLE VALVE TIMING) ASSEMBLY

1. Remove the CVVT assembly. Refer to "Removal Procedure" in Workshop Manual.
2. Check that the CVVT assembly is locked.
3. The one of the 2 holes on the cam journal is for advances(upper) and the rest is for retards(lower). Apply masking tape to all oil path holes except the one advance hole("B") indicated by the arrow as shown in the figure.

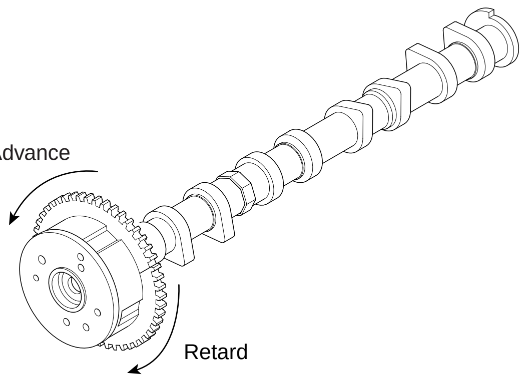


LFLG104A

4. To release the CVVT lock pin, wrap some tape around the tip of an air pressure adapter and apply low air pressure of approx. 150kPa(1.5kg/㎠, 21 psi) to the exposed camshaft port. Wrap a shop towel or rag around the CVVT because residual oil may leak out of the unit when applying air pressure.
5. With low air pressure applied, turn the CVVT to the ADVANCE direction as indicated in the figure.

NOTE

If too much air leaks when applying the low air pressure, the CVVT lock pin may not release and the CVVT may not turn.



LFLG105A

6. Allow the CVVT assembly to move in the ADVANCE and DELAY directions to ensure there is no binding and that it moves freely.(Movable smoothly in the range about 20˚)
7. Turn the CVVT by hand and make sure it locks in the maximum delay angle position.
8. Is CVVT assembly working properly?

YES

▶ Go to next step as below.

NO

▶ Replace the CVVT assembly and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EBA2D285

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check valve timing. Refer to "P0016: Crankshaft Position-Camshaft Position Correlation(Bank1)" procedure. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EB5B547D

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

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

YES

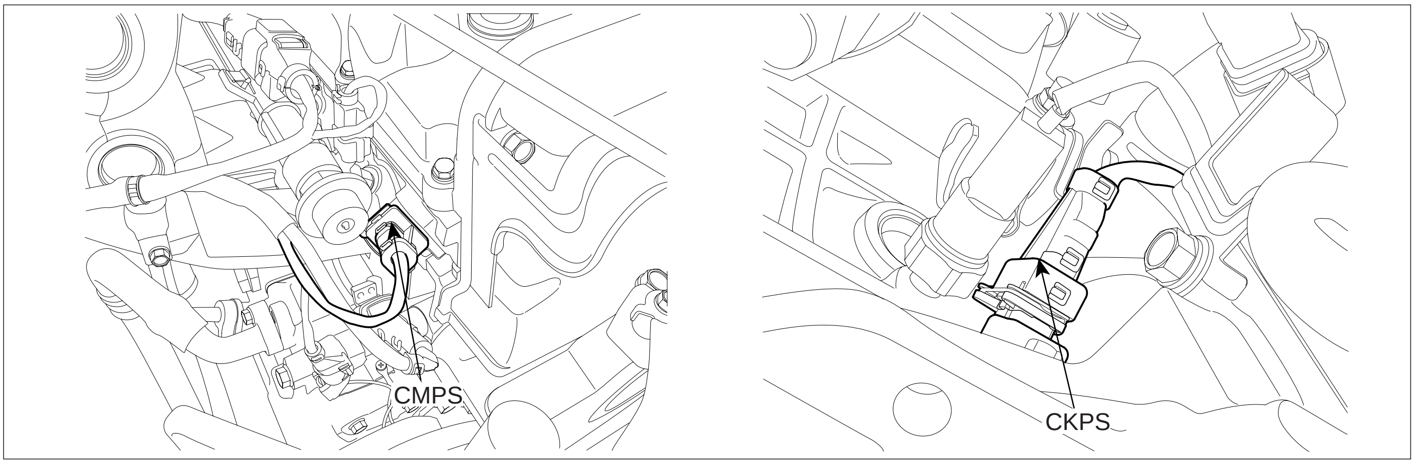
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E1ACBABF



SHDF16325L

GENERAL DESCRIPTION ECAB580B

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the exhaust camshaft. There is no variation in valve timing of the exhaust cam because the exhaust camshaft is driven by the timing belt. The timing of the intake cam is varied by the relative operation the CVVT vane to the housing. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV(Oil Control Valve). As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease by changing the valve open/close timing of the intake camshaft.

DTC DESCRIPTION E08A4ADD

This diagnosis checks the camshaft position plausibility whether the expected range plus some margin is not violated that might be caused by a wrong engine repair, or a chain/belt misalignment. DTC P0016 is set when actual camshaft position is too much retarded or advanced than full retard position or full advance position. To continue the adjustment in such case could lead to a damage of the engine by hitting the valves with the piston.

DTC DETECTING CONDITION E3EFD321

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check Camshaft Signal Switching	• Abnormal installation of camshaft • Abnormal installation of crankshaft • Abnormal installation of tone wheel
Enable Conditions	• 11V < Battery voltage < 16V • No relevant failure	
Threshold Value	• Camshaft switching out of 108 ~ 142° CRK in full retard position, 70° ~ 140° CRK during CVVT control	
Diagnostic Time	• 8 Sec.	
MIL On Condition	• 2 Driving Cycles	

SIGNAL WAVEFORM AND DATA E39C1FC9

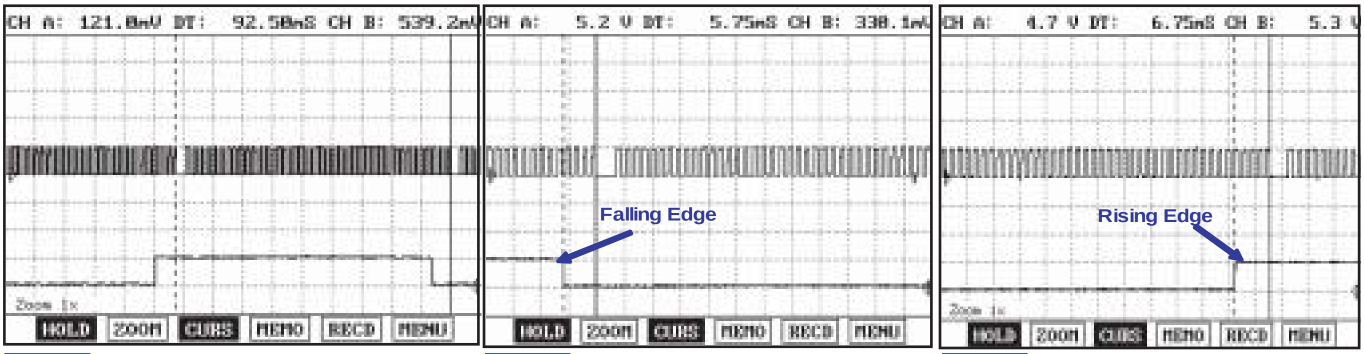


Fig 1 Fig 2 Fig 3

Fig.1) The square wave signal should be smooth and without any distortion.
Fig.2,3)The CMPS falling(rising) edge is coincided with 3rd~5th tooth of the CKP from one longer signal(missing tooth)

LFLG373A

MONITOR DTC STATUS EEBB705D

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

2. Press F4(DTAL) to select DTC information from the DTCs menu.

3. Confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

4. Read "DTC Status" parameter.

5. Is parameter displayed "History(Not Present) fault"?

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

TERMINAL AND CONNECTOR INSPECTION E32E6EF3

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below.

COMPONENT INSPECTION E0FA91F9

1. Timing Inspection

   1) With ignition "OFF", set up an oscilloscope as follows :
   Channel A (+): terminal 2 of the CKPS(back probe), (-): ground
   Channel B (+): terminal 2 of the CMPS(back probe), (-): ground

   2) Start the engine and check for signal waveform whether synchronize with camshaft sensor or not and tooth is missing refer to sample waveforms as below

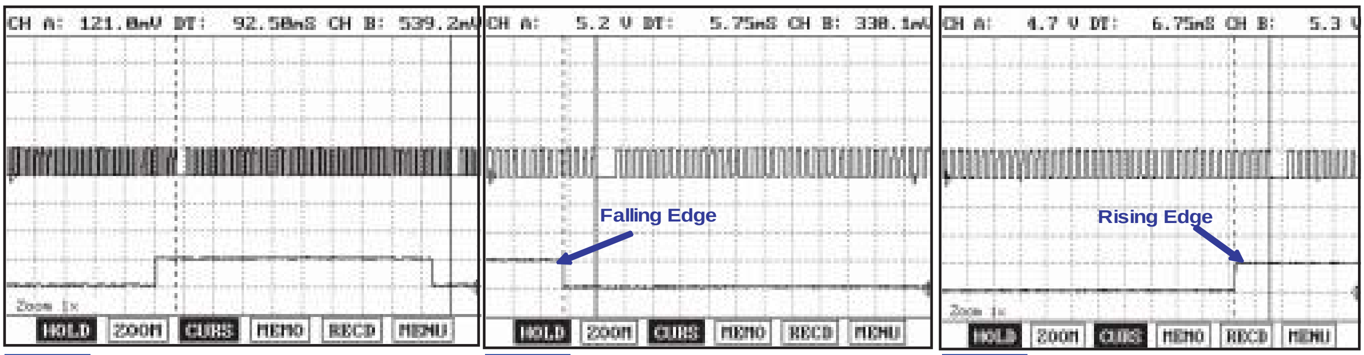


Fig 1 Fig 2 Fig 3

Fig.1) The square wave signal should be smooth and without any distortion.
Fig.2,3)The CMPS falling(rising) edge is coincided with 3rd~5th tooth of the CKP from one longer signal(missing tooth)

LFLG373A

   3) Is the signal waveform normal?

   YES

   ▶ Go to next step as below

   NO

   ▶ Check that the crankshaft and camshaft are correctly aligned the matching marks of the pulleys for the followings.
   - Alignment of the timing belt
   - Alignment of the camshaft timing chain

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

CHECK OCV AND FILTER

1. Check operation of OCV

   1) Ignition "OFF"

   2) Disconnect intake OCV connector.

3) Start the engine and let it idle.

4) With OCV connector still disconnected, connect 12V and a ground to 2 and 1 of the OCV(Component side).

SPECIFICATION :

Test Condition	Disconnect OCV connector	Apply battery voltage
Normal Value	Normal engine speed	Rough idle or engine stall

5) Has a problem been found?

YES

▶ Go to next step as below.

NO

▶ Go to "Check CVVT(Continuously Variable Valve Timing) Assembly" procedure.

2. Check OCV and Filter.

1) Ignition"OFF"

2) Check OCV filter for sticking or contamination.

3) Remove the OCV and visually check the spool column of OCV for contamination.

4) Has a problem been found?

YES

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

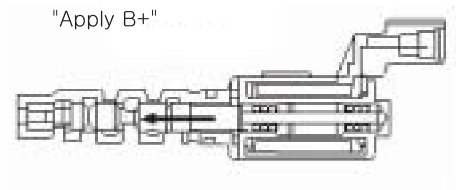
NO

▶ Go to next step as below.

5) Apply 12V and a ground to 2 and 1 terminals of the OCV(Component side).

6) Verify that a "clicking" sound is heard when applying the battery voltage.

7) Repeat this procedure 4 or 5 times to ensure intake OCV reliability.



LFLG103A

8) Is OCV working properly?

YES

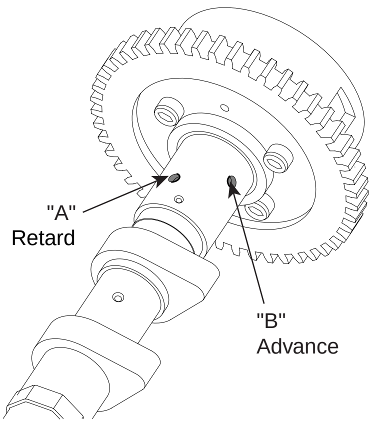
▶ Go to next step as below.

NO

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

CHECK CVVT(CONTINUOUSLY VARIABLE VALVE TIMING) ASSEMBLY

1. Remove the CVVT assembly. Refer to "Removal Procedure" in Workshop Manual.
2. Check that the CVVT assembly is locked.
3. The one of the 2 holes on the cam journal is for advances(upper) and the rest is for retards(lower). Apply masking tape to all oil path holes except the one advance hole("B") indicated by the arrow as shown in the figure.

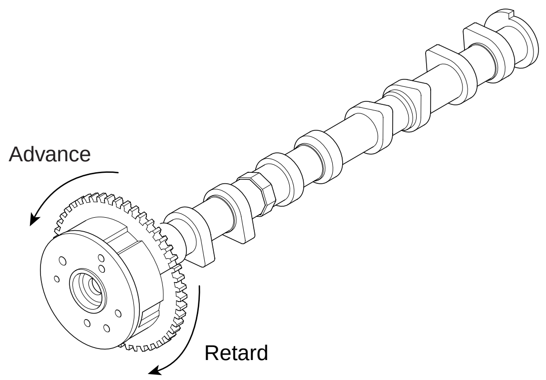


LFLG104A

4. To release the CVVT lock pin, wrap some tape around the tip of an air pressure adapter and apply low air pressure of approx. 150kPa(1.5kg/㎠, 21 psi) to the exposed camshaft port. Wrap a shop towel or rag around the CVVT because residual oil may leak out of the unit when applying air pressure.
5. With low air pressure applied, turn the CVVT to the ADVANCE direction as indicated in the figure.

NOTE

If too much air leaks when applying the low air pressure, the CVVT lock pin may not release and the CVVT may not turn.



LFLG105A

6. Allow the CVVT assembly to move in the ADVANCE and DELAY directions to ensure there is no binding and that it moves freely.(Movable smoothly in the range about 20˚)

7. Turn the CVVT by hand and make sure it locks in the maximum delay angle position.

8. Is CVVT assembly working properly?

YES

▶ Check valve timing. Refer to "P0016: Crankshaft Position-Camshaft Position Correlation(Bank1)" procedure. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the CVVT assembly and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E56FB378

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

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

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES

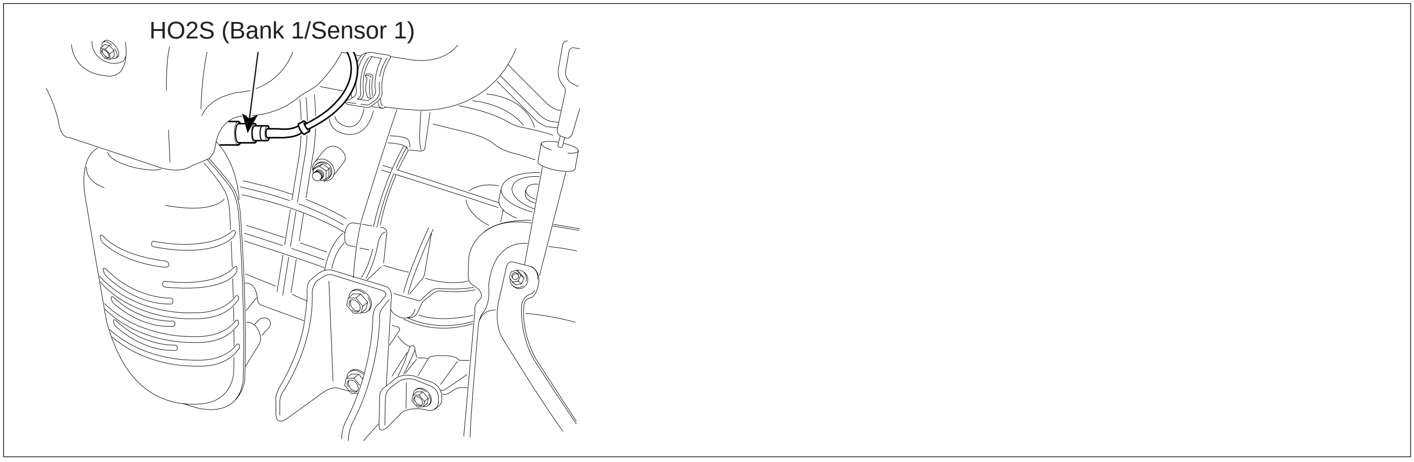
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E8FCAAA2



SLDF17326L

GENERAL DESCRIPTION E24D4BDA

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

DTC DESCRIPTION E1E1F69C

The ECM determines if a front HO2S heater fault has occurred and sets DTC P0030 if the front HO2S heater control driver inside the ECM fails, if HO2S is not operational (after an elapse of predetermined time) since engine start, or when the front HO2S tip temperature is out of normal working range.

DTC DETECTING CONDITION EF1D1B4C

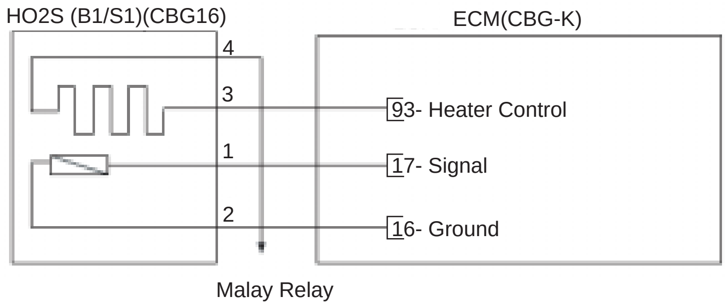
Item	Detecting Condition	Possible Cause
DTC Strategy	• Evalute O2 sensor element temperature via measuring element resistance	• Related fuse blown or missing • Heater control circuit open or short • Power supply circuit open or short • Contact resistance in connectors • Faulty HO2S
Enable Conditions	• 11V ＜ Battery voltage ＜ 16V • Dewpoint exceeded • No relevant failure • Time after start elapsed : 240sec. • 1% ＜ Heater power ＜ 99% • Exhaust gas Temp. model ＜ 650℃	
Threshold Value	• Element resistace ＞ 1100Ω (Element temperature ＜ 500℃)	
Diagnostic Time	• 5 min.	
Mil On Condition	• 2 Driving cycle	

SPECIFICATION E580D626

Temp.(℃)	Temp.(°F)	Heater Resistance (Ω)
18~20	64~82	Approx. 9

SCHEMATIC DIAGRAM EDE77830

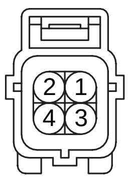
[Circuit Diagram]



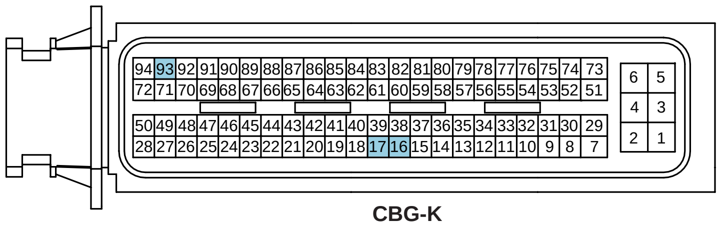
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (17)	HO2S (B1/S1) Signal
2	ECM CBG-K (16)	Sensor Ground
3	ECM CBG-K (93)	Heater Control
4	Main Relay	Power Supply (B+)

[Harness Connector]



CBG16
HO2S (B1/S1)



CBG-K
ECM

SHDF16201L

SIGNAL WAVEFORM AND DATA ECCE37FD

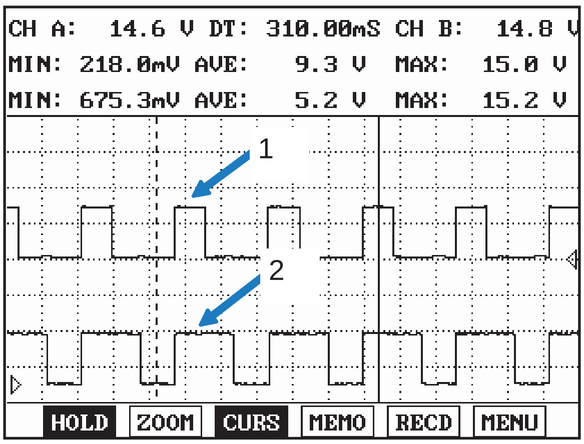


Fig1

Normal waveform of HO2S heater with idle :

1. Front HO2S heater 2. Rear HO2S heater

LFLG106A

MONITOR DTC STATUS EE13BC66

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

POWER CIRCUIT INSPECTION EC7FA698

1. Ignition "OFF"
2. Disconnect HO2S connector.
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between terminal 4 of the HO2S heater harness connector and chassis ground.

Specification : B+

5. Is voltage within the specification?

YES

▶ Go to "Control Circuit Inspection" procedure

NO

▶ Check for an open in the power supply circuit between the main relay and the HO2S.
▶ Especially check for "SNSR FUSE 10A" is installed and not blown.
▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

CONTROL CIRCUIT INSPECTION E9B20ADD

1. Measure voltage between terminal3 of the HO2S heater harness connector and chassis ground.

Specification : Approx. 4~5V

2. Is voltage within the specification?

YES

▶ Go to "Component Inspection" procedure

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION E2001AA7

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

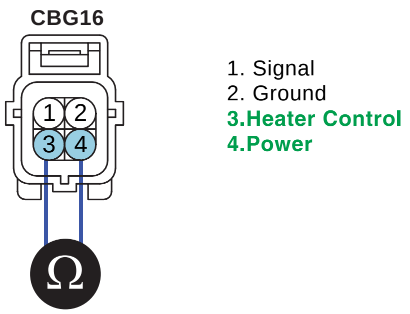
▶ Go to next step as below.

COMPONENT INSPECTION EA401A04

1. Ignition "OFF"
2. Measure resistance between terminals 3 and 4 of the sensor connector (Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Heater Resistance (Ω)
18~20	64~82	Approx. 9



SHDF16204L

3. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

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

VERIFICATION OF VEHICLE REPAIR E278EF38

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E0B46136

Refer to DTC P0030.

GENERAL DESCRIPTION EBE8BD70

Refer to DTC P0030.

DTC DESCRIPTION E79BA474

ECM sets DTC P0031 if the ECM detects that the front HO2S heater control circuit is short to ground.

DTC DETECTING CONDITION E11C19EF

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Related fuse blown or missing • Open or short to ground in power supply or control harness • Poor connection or damaged harness • Faulty HO2S
Enable Conditions	• 10V < Battery voltage < 16V • No relevant failure • 1.17% < Heater power < 98.83%	
Threshold Value	• Short to ground	
Diagnostic Time	• 10sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E8DEDD9C

Refer to DTC P0030.

SCHEMATIC DIAGRAM ED9AC62E

Refer to DTC P0030.

SIGNAL WAVEFORM AND DATA E7E76164

Refer to DTC P0030.

MONITOR DTC STATUS E2CBA945

Refer to DTC P0030.

POWER CIRCUIT INSPECTION EF53EC79

1. Ignition "OFF"
2. Disconnect HO2S connector.
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between terminal 4 of the HO2S heater harness connector and chassis ground.

Specification : B+

5. Is voltage within the specification?

YES

▶ Go to "Control Circuit Inspection" procedure

NO

▶ Check for an open in the power supply circuit between the main relay and the HO2S.
▶ Especially check for "SNSR FUSE 10A" is installed and not blown.
▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

CONTROL CIRCUIT INSPECTION E16F73E9

1. Measure voltage between terminal 3 of the HO2S heater harness connector and chassis ground.

Specification : Approx. 4~5V

2. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION EBDFBD73

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below

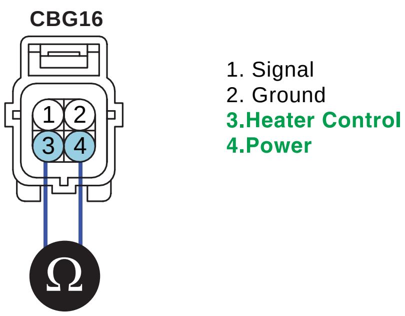
COMPONENT INSPECTION E596A63E

1. Ignition "OFF"

2. Measure resistance between terminals 3 and 4 of the sensor connector (Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Heater Resistance (Ω)
18~20	64~82	Approx. 9



SHDF16204L

3. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

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

VERIFICATION OF VEHICLE REPAIR EA17E2B4

Refer to DTC P0030.

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

COMPONENT LOCATION E545E23B

Refer to DTC P0030.

GENERAL DESCRIPTION E0459232

Refer to DTC P0030.

DTC DESCRIPTION E051C7ED

ECM sets DTC P0032 if the ECM detects that the front HO2S heater control line is open or short to battery circuit

DTC DETECTING CONDITION EC3195EB

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Open or short to battery in control harness • PoorS connection or damaged harness • Faulty HO2S
Enable Conditions	• 10V< Battery voltage <16V • 1.17% < Heater power < 98.93%	
Threshold Value	• Short to Battery or Line break	
Diagnostic Time	• 10sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E846FFA3

Refer to DTC P0030.

SCHEMATIC DIAGRAM EBC421C5

Refer to DTC P0030.

SIGNAL WAVEFORM AND DATA E535535F

Refer to DTC P0030.

MONITOR DTC STATUS E29F7A1C

Refer to DTC P0030.

CONTROL CIRCUIT INSPECTION EC2C875E

1. Ignition "OFF"
2. Disconnect HO2S sensor connector
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between terminal 3 of the HO2S heater harness connector and chassis ground.

https://autolibrary.ir

Specification : Approx. 4~5V

5. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION E0D9B67C

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

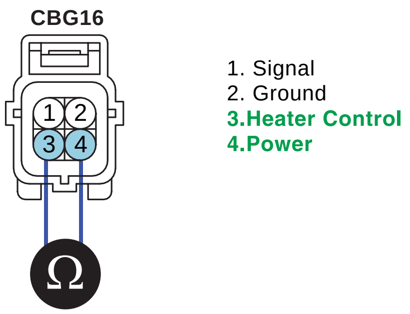
▶ Go to next step as below

COMPONENT INSPECTION EA9B7792

1. Ignition "OFF"
2. Measure resistance between terminals 3 and 4 of the sensor connector (Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Heater Resistance (Ω)
18~20	64~82	Approx. 9



SHDF16204L

3. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

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

VERIFICATION OF VEHICLE REPAIR ED11F90A

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

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

YES

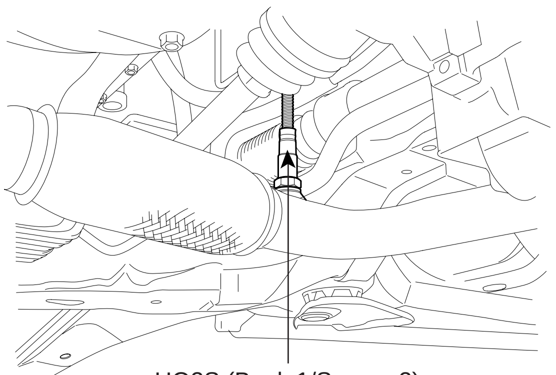
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E26DDE20



SLDF17327L

GENERAL DESCRIPTION E11F730F

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

DTC DESCRIPTION E3ACC7D0

The ECM determines when a rear HO2S heater fault occurs and sets DTC P0036 if measured rear HO2S resistance is lower than the predetermined threshold.

DTC DETECTING CONDITION E8689892

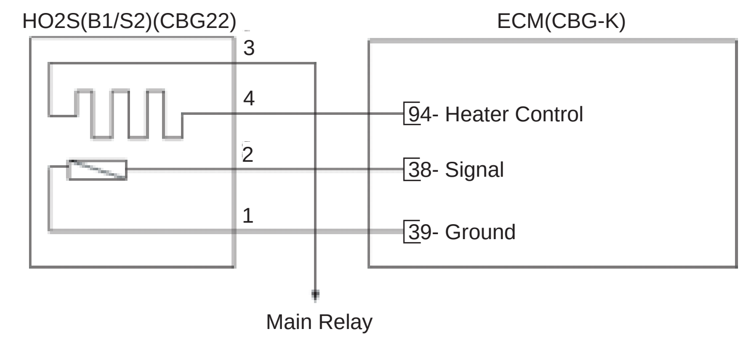
Item	Detecting Condition	Possible Cause
DTC Strategy	• Evaluate O2 sensor element temperature via measuring element resistance	• Related fuse blown or missing • Heater control circuit open or short • Power supply circuit open or short • Contact resistance in connectors • Faulty HO2S
Enable Conditions	• 1% < Heater power < 99% • Time after start elapsed:240 sec. • 11V < Battery voltage <16V • Exhaust gas temp.model < 650℃(1, 202°F) • Dewpoint exceeded • No relevant failure	
Threshold Value	• HO2S Element Resistance > 1100 Ohm (Catalyst Temperature < 500°C(932°F))	
Diagnostic Time	• 5 min.	
Mil On Condition	• 2 Driving Cycles	

SPECIFICATION E2EABB17

Temp.(℃)	Temp.(°F)	Heater Resistance (Ω)
18~20	64~82	Approx. 9

SCHEMATIC DIAGRAM EA692CF9

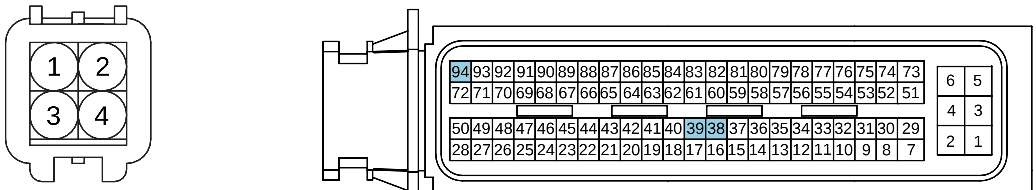
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (39)	Sensor Ground
2	ECM CBG-K (38)	HO2S (B1/S2) Signal
3	Main Relay	Power Supply (B+)
4	ECM CBG-K (94)	Heater Control

[Harness Connector]



CBG22
HOS2 (B1/S2)

CBG-K
ECM

SHDF16205L

SIGNAL WAVEFORM AND DATA E8EAAFB9

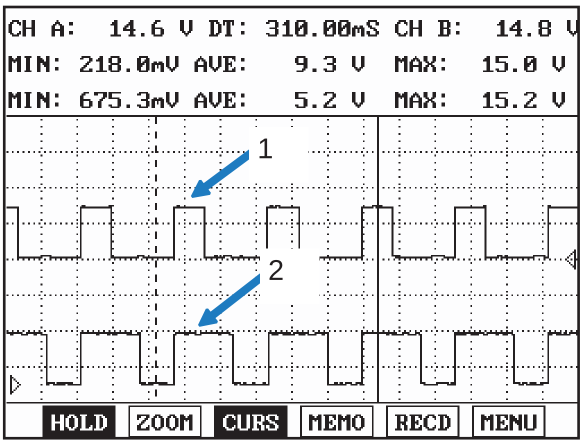


Fig1

Normal waveform of HO2S heater with idle :
1. Front HO2S heater 2. Rear HO2S heater

LFLG106A

MONITOR DTC STATUS E7C95C11

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

POWER CIRCUIT INSPECTION EBB1B346

1. Ignition "OFF"
2. Disconnect HO2S connector.
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between terminal 3 of the HO2S heater harness connector and chassis ground.

Specification : B+

5. Is voltage within the specification?

YES

▶ Go to "Control Circuit Inspection" procedure

NO

▶ Check for an open in the power supply circuit between the main relay and the HO2S.
▶ Especially check for "SNSR FUSE 10A" is installed and not blown.
▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

CONTROL CIRCUIT INSPECTION E1EF2330

1. Measure voltage between terminal 4 of the HO2S heater harness connector and chassis ground.

Specification : Approx. 4~5V

2. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION EC9ACD46

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

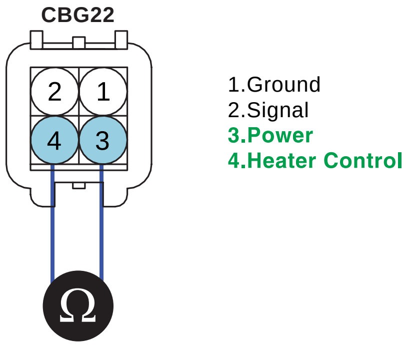
▶ Go to next step as below

COMPONENT INSPECTION E89A4476

1. Ignition "OFF"
2. Measure resistance between terminals 3 and 4 of the sensor connector (Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Heater Resistance (Ω)
18~20	64~82	Approx. 9



SHDF16208L

3. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

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

VERIFICATION OF VEHICLE REPAIR E4D45E84

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION EADCAB49

Refer to DTC P0036.

GENERAL DESCRIPTION E0B63B24

Refer to DTC P0036.

DTC DESCRIPTION E34684EA

ECM sets DTC P0037 if the ECM detects that the rear HO2S heater control line is short to ground.

DTC DETECTING CONDITION ED9C1983

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Related fuse blown or missing • Open or short to ground in power supply or control harness • Contact resistance in connectors • Faulty HO2S
Enable Conditions	• 10V＜ Battery voltage ＜16V • No relevant failure • 1.17% ＜ Heater power ＜ 98.83%	
Threshold Value	• Short to ground	
Diagnostic Time	• 10sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E541CF8E

Refer to DTC P0036.

SCHEMATIC DIAGRAM E73DBEE6

Refer to DTC P0036.

SIGNAL WAVEFORM AND DATA E6CDF232

Refer to DTC P0036.

MONITOR DTC STATUS EC0C84CD

Refer to DTC P0036.

POWER CIRCUIT INSPECTION EFE89337

1. Ignition "OFF"
2. Disconnect HO2S connector.
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between terminal 3 of the HO2S heater harness connector and chassis ground.

Specification : B+

5. Is voltage within the specification?

YES

▶ Go to "Control Circuit Inspection" procedure

NO

▶ Check for an open in the power supply circuit between the main relay and the HO2S.
▶ Especially check for "SNSR FUSE 10A" is installed and not blown.
▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

CONTROL CIRCUIT INSPECTION E338E499

1. Measure voltage between terminal 4 of the HO2S heater harness connector and chassis ground.

Specification : Approx. 4~5V

2. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION E85D0C91

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

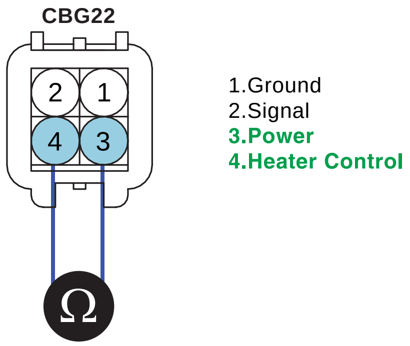
▶ Go to next step as below

COMPONENT INSPECTION EE221129

1. Ignition "OFF"
2. Measure resistance between terminals 3 and 4 of the sensor connector (Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Heater Resistance (Ω)
18~20	64~82	Approx. 9



SHDF16208L

3. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

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

VERIFICATION OF VEHICLE REPAIR E92C90A1

Refer to DTC P0036.

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

COMPONENT LOCATION ED4DACF4

Refer to DTC P0036.

GENERAL DESCRIPTION ED94714E

Refer to DTC P0036.

DTC DESCRIPTION E858447E

ECM sets DTC P0038 if the ECM detects that the rear HO2S heater control line is open or short to battery line.

DTC DETECTING CONDITION E03B2B60

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Open or short to battery in control harness • Contact resistance in connectors • Faulty HO2S
Enable Conditions	• 10V＜ Battery voltage ＜16V • 1.17% ＜ Heater power ＜ 98.83%	
Threshold Value	• Short to Battery or Line break	
Diagnostic Time	• 10sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E30AC64C

Refer to DTC P0036.

SCHEMATIC DIAGRAM EDE6B9CB

Refer to DTC P0036.

SIGNAL WAVEFORM AND DATA E4A5B41E

Refer to DTC P0036.

MONITOR DTC STATUS E5DE8044

Refer to DTC P0036.

CONTROL CIRCUIT INSPECTION E8605BA7

1. Ignition "OFF"
2. Disconnect HO2S connector.
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between terminal 4 of the HO2S heater harness connector and chassis ground.

Specification : Approx. 4~5V

5. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION EB23B1ED

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

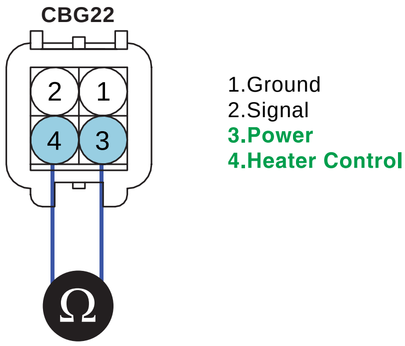
▶ Go to next step as below.

COMPONENT INSPECTION E434F4DA

1. Ignition "OFF"
2. Measure resistance between terminals 3 and 4 of the sensor connector (Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Heater Resistance (Ω)
18~20	64~82	Approx. 9



SHDF16208L

3. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

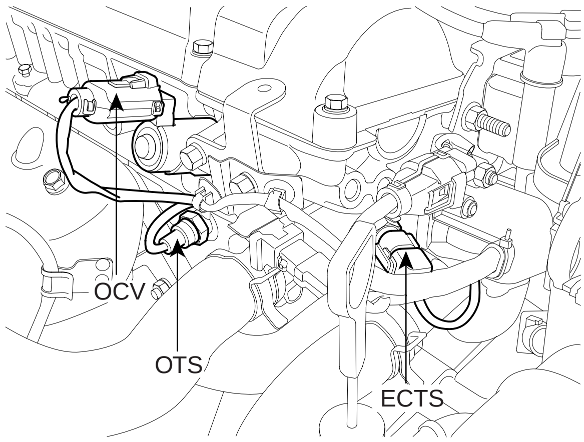
▶ Check HO2S for contamination, deterioration, or damage. Substitute with a known-good HO2S and check for proper operation. If the problem is corrected, replace HO2S and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E08EB917

Refer to DTC P0036.

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

COMPONENT LOCATION EFDB1A9F



SHDF16324L

GENERAL DESCRIPTION E069947E

The CVVT (Continuously Variable Valve Timing) system built on the camshaft helps the engine decrease the exhaust gas and increase engine power and fuel economy by changing the valve open/close timing of the intake camshaft continuously. The intake valve control solenoid, the main control part of the CVVT, changes the direction of the oil path through the CVVT by the duty control of the ECM and changes the open and close timing of the intake and exhaust valves.

DTC DESCRIPTION E29DA600

ECM sets DTC P0076 if the ECM detects that the intake valve control solenoid control circuit is short to ground.

DTC DETECTING CONDITION EAF6A038

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Short to ground in control circuit • Contact resistance in connectors • Faulty Intake Valve Control Solenoid
Enable Conditions	• 10 < Battery voltage < 16	
Threshold Value	• Short to ground	
Diagnostic Time	• 2 seconds	
MIL On Condition	• 2 Driving Cycles	

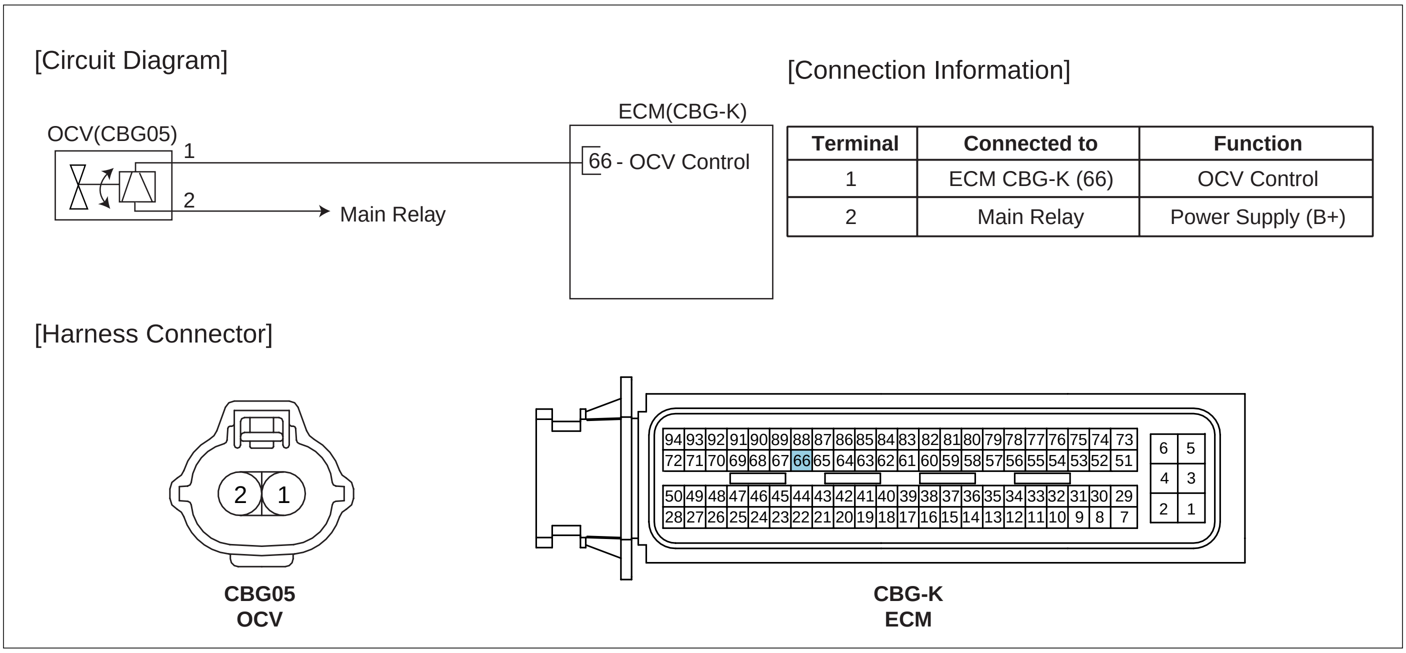
SPECIFICATION E8D33241

Intake OCV	Normal Parameter at 20℃ (68°F)
Insulation Resistance (Ω)	Above 50 MΩ

Temp.(℃)	Temp.(°F)	Resistance(Ω)
0	32	6.2 ~ 7.4
10	50	6.5 ~ 7.7
20	68	6.9 ~ 7.9

30	86	7.1 ~ 8.3
40	104	7.4 ~ 8.6
50	122	7.7 ~ 8.9
60	140	8.0 ~ 9.2
70	158	8.3 ~ 9.5
80	176	8.6 ~ 9.8
90	194	8.9 ~ 10.1
100	212	9.2 ~ 10.4

SCHEMATIC DIAGRAM EC6D085D



Terminal	Connected to	Function
1	ECM CBG-K (66)	OCV Control
2	Main Relay	Power Supply (B+)

SHDF16200L

SIGNAL WAVEFORM AND DATA E30F63DF

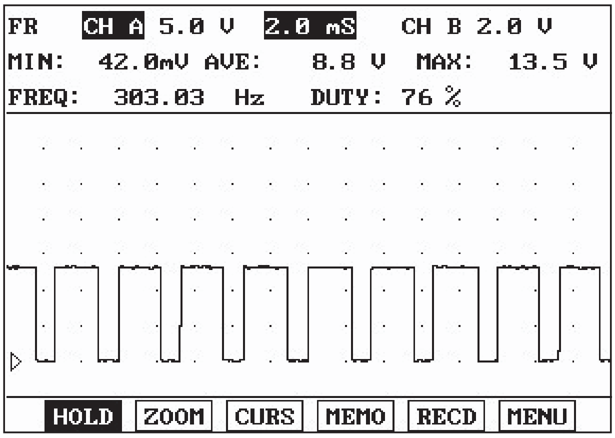


Fig1

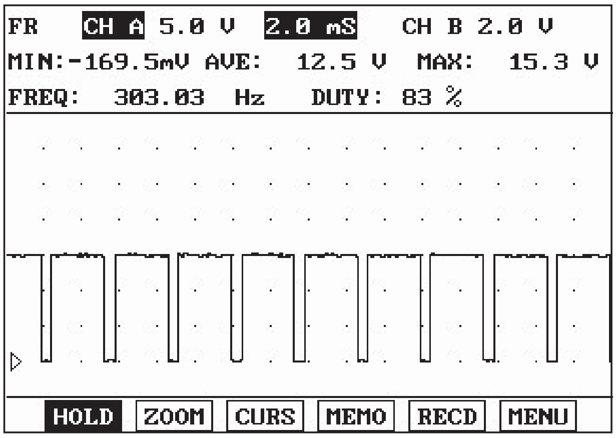


Fig2

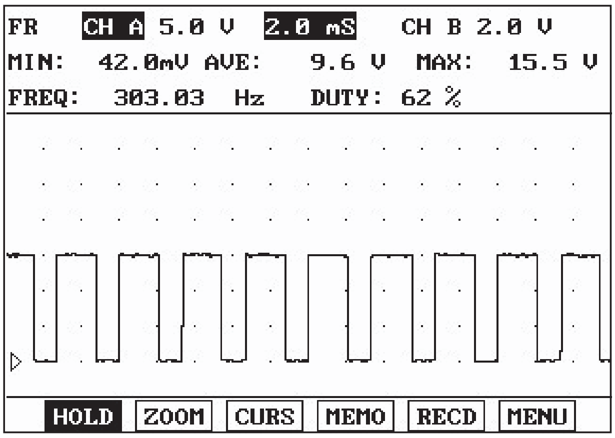


Fig3

Fig 1) Normal OCV (-) duty ratio with Ignition "ON"
Fig 2) Normal OCV (-) duty ratio with idle : Approx. 12~20%
Fig 3) Normal OCV (-) duty ratio with maintaining 2000RPM : Approx. 30~50%

SLDF17103L

MONITOR DTC STATUS ED5C0FDE

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

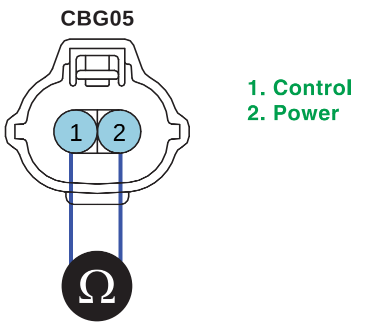
▶ Go to next step as below.

COMPONENT INSPECTION E7E96DF5

1. Ignition "OFF"
2. Disconnect oil control valve connector
3. Measure resistance between terminals 1 and 2 of the solenoid connector(Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Resistance(Ω)
0	32	6.2 ~ 7.4
10	50	6.5 ~ 7.7
20	68	6.9 ~ 7.9
30	86	7.1 ~ 8.3
40	104	7.4 ~ 8.6
50	122	7.7 ~ 8.9
60	140	8.0 ~ 9.2
70	158	8.3 ~ 9.5
80	176	8.6 ~ 9.8
90	194	8.9 ~ 10.1
100	212	9.2 ~ 10.4



SHDF16209L

4. Is resistance within specification?

YES

▶ Go to next step as below.

NO

▶ Check oil control valve for contamination, deterioration, or damage. Substitute with a known-good solenoid and check for proper operation. If the problem is corrected, replace solenoid and then go to "Verification of Vehicle Repair" procedure.

POWER CIRCUIT INSPECTION EAE67D9D

1. Ignition "ON" & Engine "OFF"
2. Measure voltage between terminal 2 of the oil control valve harness connector and chassis ground.

Specification : Approx. B+

3. Is voltage within specification?

YES

▶ Go to "Control Circuit Inspection" procedure.

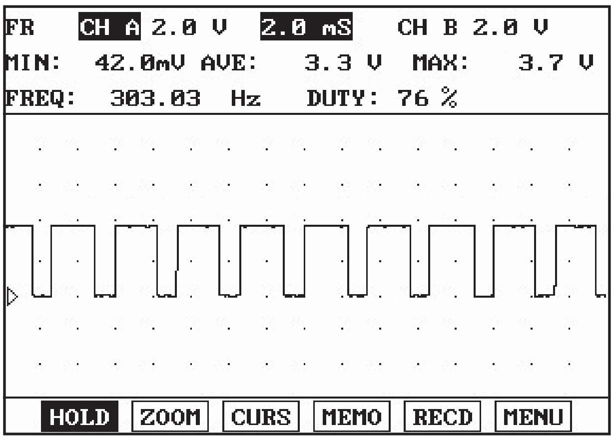
NO

▶ Repair open or short to ground in the power supply circuit and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E5414BE4

1. Measure voltage between terminal 1 of the oil control valve harness connector and chassis ground.

Specification : Approx. 3~4V



SLDF17115L

NOTE

Signal waveform in control circuit with ignition ON & Engine OFF

2. Is voltage within specification?

YES

▶ Go to "Terminal and Connector Inspection" procedure.

NO

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

TERMINAL AND CONNECTOR INSPECTION EA644D41

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between PCM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E1266BCA

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E2DFDADC

Refer to DTC P0076.

GENERAL DESCRIPTION E35C74BF

Refer to DTC P0076.

DTC DESCRIPTION E9EC74BD

ECM sets DTC P0077 if the ECM detects that the OCV control circuit is open or short to battery

DTC DETECTING CONDITION E7BEDCF7

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Open or short to battery in control circuit • Contact resistance in connectors • Faulty Intake Valve Control Solenoid
Enable Conditions	• 10 $<$ Battery voltage $<$ 16	
Threshold Value	• Short to battery or Line break	
Diagnostic Time	• 2 seconds	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E10A76B7

Refer to DTC P0076.

SCHEMATIC DIAGRAM E1D8FD71

Refer to DTC P0076.

SIGNAL WAVEFORM AND DATA E271A875

Refer to DTC P0076.

MONITOR DTC STATUS EFC7E518

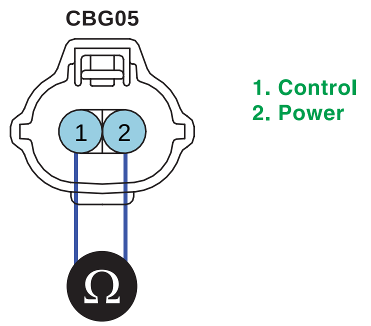
Refer to DTC P0076.

COMPONENT INSPECTION EF36588E

1. Ignition "OFF"
2. Disconnect oil control valve connector
3. Measure resistance between terminals 1 and 2 of the solenoid connector(Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Resistance(Ω)
0	32	6.2 ~ 7.4
10	50	6.5 ~ 7.7
20	68	6.9 ~ 7.9
30	86	7.1 ~ 8.3
40	104	7.4 ~ 8.6
50	122	7.7 ~ 8.9
60	140	8.0 ~ 9.2
70	158	8.3 ~ 9.5
80	176	8.6 ~ 9.8
90	194	8.9 ~ 10.1
100	212	9.2 ~ 10.4



SHDF16209L

4. Is resistance within specification?

YES

▶ Go to "W/Harness Inspection" procedure

NO

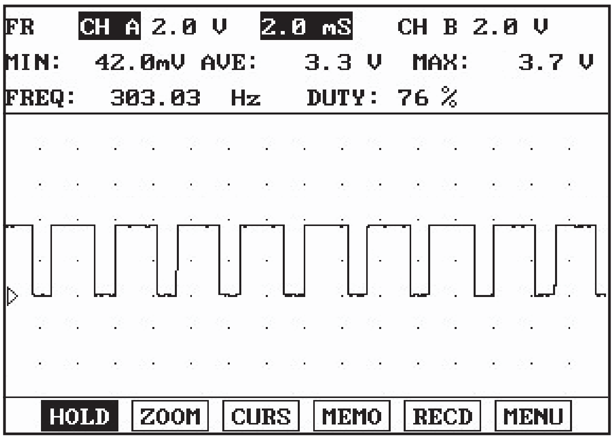
▶ Check oil control valve for contamination, deterioration, or damage. Substitute with a known-good solenoid and check for proper operation. If the problem is corrected, replace solenoid and then go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E81E5F83

1. Ignition "ON" & Engine "OFF"

2. Measure voltage between terminal 1 of the oil control valve harness connector and chassis ground.

Specification : Approx. 3~4V



SLDF17115L

NOTE

Signal waveform in control circuit with ignition ON & Engine OFF

3. Is voltage within specification?

YES

▶ Go to "Terminal and Connector Inspection" procedure.

NO

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

TERMINAL AND CONNECTOR INSPECTION E45D5FE2

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

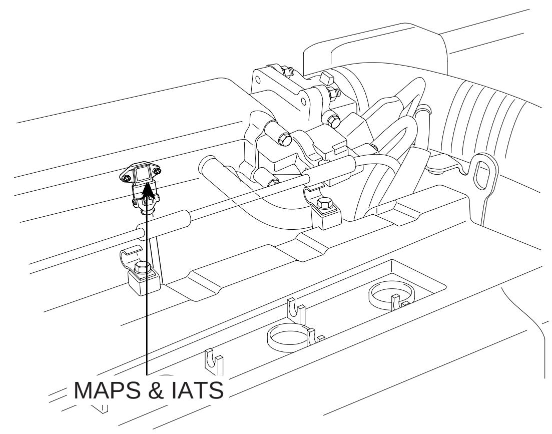
▶ Check for poor connection between PCM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E9735892

Refer to DTC P0076.

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

COMPONENT LOCATION E9B83CD9



SLDF17211L

GENERAL DESCRIPTION ED24E0A9

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

DTC DESCRIPTION E4D48B09

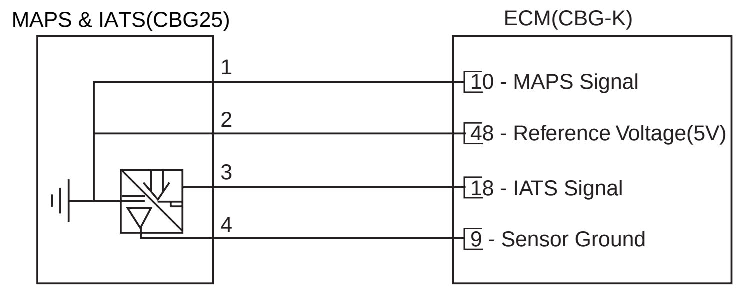
ECM compares the MAPS output and calculated MAPS value while enable condition is met. If the acutal MAP value is higher than Maximum threshold or lower than Minimum threshold for a pre-determined time, ECM determines that a fault exists and a DTC is stored.

DTC DETECTING CONDITION E6683487

Item	Detecting Condition	Possible Cause
DTC Strategy	• Plausability check	• Dirty air cleaner. • Oil Cap or Dipstick missing or not installed correctly. • Air leak in intake system • Contact resistance in connectors. • Faulty MAPS or TPS
Enable Conditions	• No relevant failure • 10 ≤ Battery voltage ≤ 16V • Lambda close loop control activated	
Threshold Value	• Difference between model pressure and measured pressure ＞ 280hpa • Deviation value of fuel trim control ＞ 20% or ＜ -20%	
Diagnostic Time	• 200 revolutions	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM EBC08C67

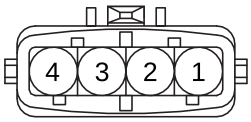
[Circuit Diagram]



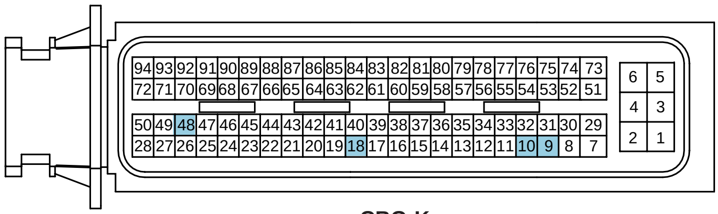
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (10)	MAPS signal
2	ECM CBG-K (48)	Sensor Power (+5V)
3	ECM CBG-K (18)	IATS signal
4	ECM CBG-K (9)	Sensor ground

[Harness Connector]



CBG25
MAPS



CBG-K
ECM

SHDF16212L

SIGNAL WAVEFORM AND DATA EA3A9F3C

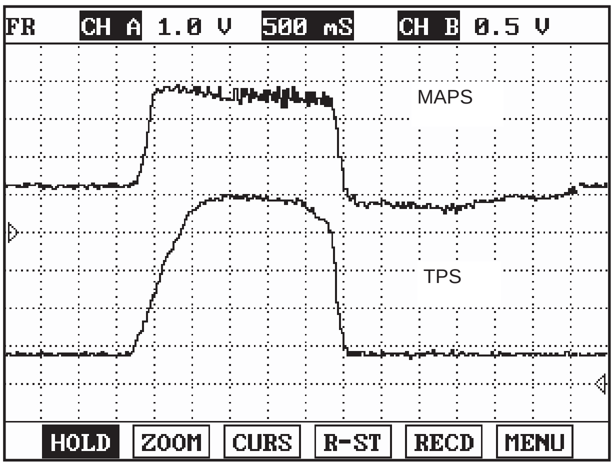


Fig1

As often as possible, the MAPS signal should be compared with the TPS signal. Check whether the MAPS and TPS signals increase at the same time when accelerating. During acceleration, the MAPS output voltage increases; during deceleration, the MAPS output voltage decreases.

SHDF16213L

MONITOR DTC STATUS E55E1482

NOTE

If any DTCs relating to TPS or MAFS are stored, do ALL REPAIRS associated with those codes before proceeding with further troubleshooting

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

2. Press F4(DTAL) to select DTC information from the DTCs menu.

3. Confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

4. Read "DTC Status" parameter.

5. Is parameter displayed "History(Not Present) fault"?

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

TERMINAL AND CONNECTOR INSPECTION E3D3C70C

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 next step as below

VOLTAGE INSPECTION ECCEA709

1. IG "OFF".

2. Disconnect MAPS connector.

3. IG "ON" & ENG "OFF".

4. Measure voltage between terminal 1, 2,4 of MAPS harness connector and chassis ground.

Specification : Terminal 1 : Approx. 5V
Terminal 2 : Approx. 5V
Terminal 4 : Below 0V

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 E7C86C0A

1. Check MAPS performance.

   1) IG "OFF".

   2) Connnect CH A probe to terminal 1 of MAPS and CH B probe to terminal 1 of TPS connector.

   3) Warm up the engine to normal operating temperature.

   4) Measure signal waveform of MAPS and TPS together by stepping on and off the accellerator pedal.

SPECIFICATION :

Pressure (kPa)	Approx. 20	Approx. 35	Approx. 60	Approx. 95	Approx. 101
Voltage(V)	Approx. 0.7~0.8	Approx. 1.3~1.4	Approx. 2.3~2.4	Approx. 3.7~3.8	Approx. 3.9~4.1

   5) Is the measured signal waveform(Comparison response of TPS with MAPS) O.K ?

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

VERIFICATION OF VEHICLE REPAIR E05E9712

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

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

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0107 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT LOW INPUT

COMPONENT LOCATION E0E0E301

Refer to DTC P0106.

GENERAL DESCRIPTION E3D2541A

Refer to DTC P0106.

DTC DESCRIPTION EAF8E004

If sensor signal input is lower than 0.25V during 5 sec, ECM sets DTC P0107.

DTC DETECTING CONDITION E90E5AB0

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical check	• Poor connection • Open or short to ground in power circuit • Short to ground in signal circuit • MAPS • ECM
Enable Conditions	• 10V < Battery voltage < 16V	
Threshold Value	• Sensor voltage < 0.1 V	
Diagnostic Time	• 0.4 sec	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM ECC318A6

Refer to DTC P0106.

SIGNAL WAVEFORM AND DATA E6991DF0

Refer to DTC P0106.

MONITOR DTC STATUS E17DDBF1

Refer to DTC P0106.

TERMINAL AND CONNECTOR INSPECTION E2FC97BD

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 next step as below

POWER CIRCUIT INSPECTION E2CE576B

1. IG "OFF".
2. Disconnect MAPS connector.
3. IG "ON" & ENG "OFF"
4. Measure voltage between terminal 2 of MAPS 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 E1E1DBC6

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

Specification : Approx. 5V

2. 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 E3B4510C

1. Check MAPS performance.
   1) IG "OFF".
   2) Connect CH A probe to terminal 1 of MAPS and CH B probe to terminal 1 of TPS connector.
   3) Warm up the engine to normal operating temperature.
   4) Measure signal waveform of MAPS and TPS together by stepping on and off the accellerator pedal.

SPECIFICATION :

Pressure (kPa)	Approx. 20	Approx. 35	Approx. 60	Approx. 95	Approx. 101
Voltage(V)	Approx. 0.7~0.8	Approx. 1.3~1.4	Approx. 2.3~2.4	Approx. 3.7~3.8	Approx. 3.9~4.1

5) Is the measured signal waveform(Comparison response of TPS with MAPS) O.K ?

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

VERIFICATION OF VEHICLE REPAIR E1EC2D1C

Refer to DTC P0106.

DTC P0108 MANIFOLD ABSOLUTE PRESSURE/BAROMETRIC PRESSURE CIRCUIT HIGH INPUT

COMPONENT LOCATION EBF0DC0C

Refer to DTC P0106.

GENERAL DESCRIPTION E9083605

Refer to DTC P0106.

DTC DESCRIPTION E1FC9754

If sensor signal input is higher than 4.88V during 5 sec, ECM sets DTC P0108.

DTC DETECTING CONDITION E232F435

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical check	• Poor connection • Open or short to power in signal circuit • Open in ground circuit • MAPS • ECM
Enable Conditions	• 10V < Battery voltage < 16V	
Threshold Value	• Sensor voltage > 4.9 V	
Diagnostic Time	• 0.4 sec	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E29E34F2

Refer to DTC P0106.

SIGNAL WAVEFORM AND DATA EA5920DE

Refer to DTC P0106.

MONITOR DTC STATUS EB3ECF55

Refer to DTC P0106.

TERMINAL AND CONNECTOR INSPECTION EB74B5E2

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 next step as below

SIGNAL CIRCUIT INSPECTION E5E3AA7F

1. Check short to battery in harness.
   1) IG "OFF".
   2) Disconnect MAPS and ECM connector.
   3) IG "ON" & Eng. "OFF"
   4) Measure voltage between terminal 1 of the MAPS harness connector and chassis ground.

Specification : 0V

   5) Is the measured voltage within specification ?

   YES

   ▶ Go to next step as below

   NO

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

GROUND CIRCUIT INSPECTION EFBC7FD8

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

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES

▶ Go to next step as below

NO

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

COMPONENT INSPECTION EC63385D

1. Check MAPS performance.
   1) IG "OFF".
   2) Connnect CH A probe to terminal 1 of MAPS and CH B probe to terminal 1 of TPS connector.
   3) Warm up the engine to normal operating temperature.

4) Measure signal waveform of MAPS and TPS together by stepping on and off the accellerator pedal.

SPECIFICATION :

Pressure (kPa)	Approx. 20	Approx. 35	Approx. 60	Approx. 95	Approx. 101
Voltage(V)	Approx. 0.7~0.8	Approx. 1.3~1.4	Approx. 2.3~2.4	Approx. 3.7~3.8	Approx. 3.9~4.1

5) Is the measured signal waveform(Comparison response of TPS with MAPS) O.K ?

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

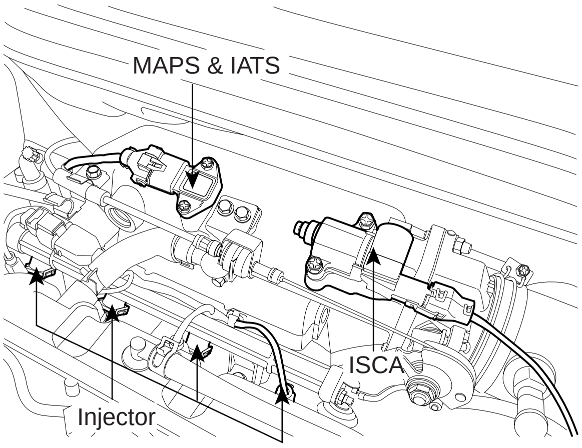
▶ Substitute with a known - good MAPS and check for proper operation. If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E63670E0

Refer to DTC P0106.

DTC P0111 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION EF234B3D



SHDF16328L

GENERAL DESCRIPTION E601647A

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

DTC DESCRIPTION E697ADD6

The purpose of this diagnosis is to detect a stuck intake air temperature signal. The diagnostic function checks whether after a variation of the calculated intake air temperature also a variation of the measured intake air temperature is detected.ECM sets DTC P0111 when the variation of measured intake air temperature from engine start is smaller than threshold while variation of calculated intake air temperature by ECM is greater than threshold.

DTC DETECTING CONDITION EAD93EBA

Item		Detecting Condition	Possible Cause
DTC Strategy	case 1)	• Check intake air temperature signal stuck.	• Contact resistance in connections. • Faulty IAT sensor
	case 2)	• Difference between maximum and minimum air temperature	
Enable Conditions		• Time after engine start > 400sec. • Coolant temp. > 74℃(165.2°F) > more than 0.5sec. • Coolant temp. increasing after start > 40℃(104°F) • Accumulated time for vehicle speed > 70kph (44mph) for more than 100sec. • No relevant failure • Battery Voltage > 6V	
Threshold Value	case 1)	• Variation of intake Air Temperature after starting < 5.25℃	
	case 2)	• Maximum intake air temp. - minimum intake air temp. < 1.5℃ at below 30℃ (or 3 at below 60℃)	
Diagnostic Time		• 5 sec	
MIL On Condition		• 2 Driving Cycles	

SPECIFICATION EC8AA295

Temp.(℃)	Temp.(°F)	Resistance(kΩ)
-10	14	8.5~9.7
0	32	5.4~6.1
10	50	3.5~3.9
20	68	2.3~2.5
30	86	1.6~1.7
80	176	Approx. 0.3

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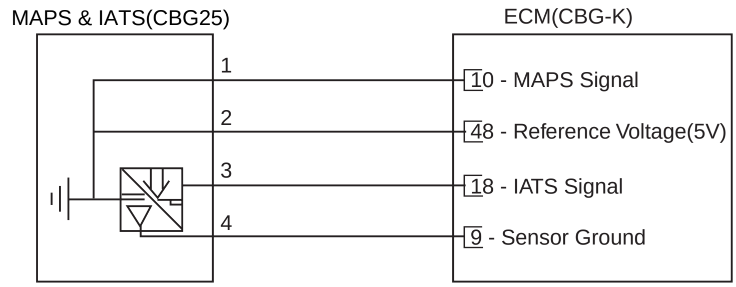
SCHEMATIC DIAGRAM E46334E2

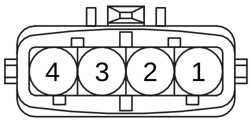
[Circuit Diagram]



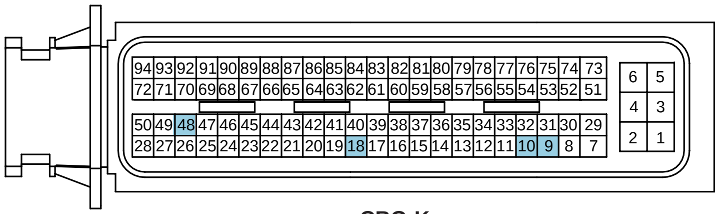
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (10)	MAPS signal
2	ECM CBG-K (48)	Sensor Power (+5V)
3	ECM CBG-K (18)	IATS signal
4	ECM CBG-K (9)	Sensor ground

[Harness Connector]



CBG25
MAPS



CBG-K
ECM

SHDF16212L

SIGNAL WAVEFORM AND DATA EF5396A8

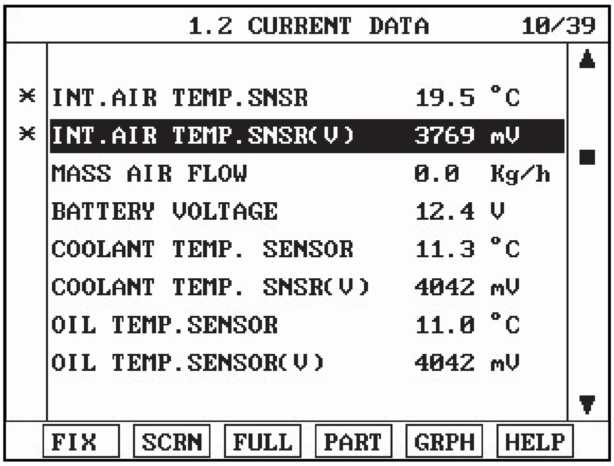


Fig1

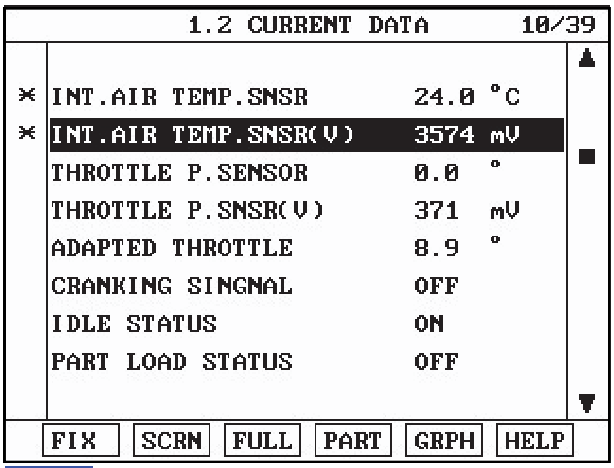


Fig2

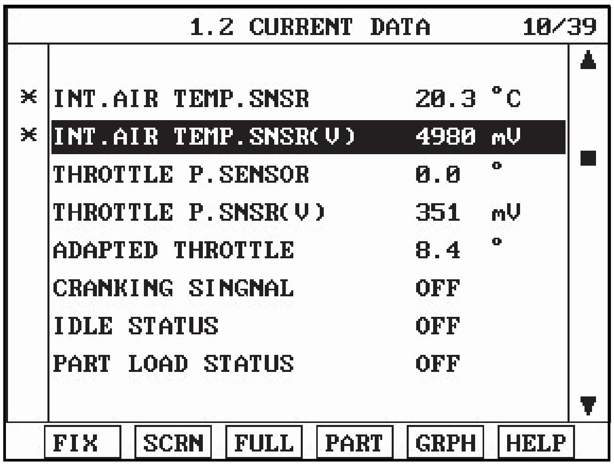


Fig3

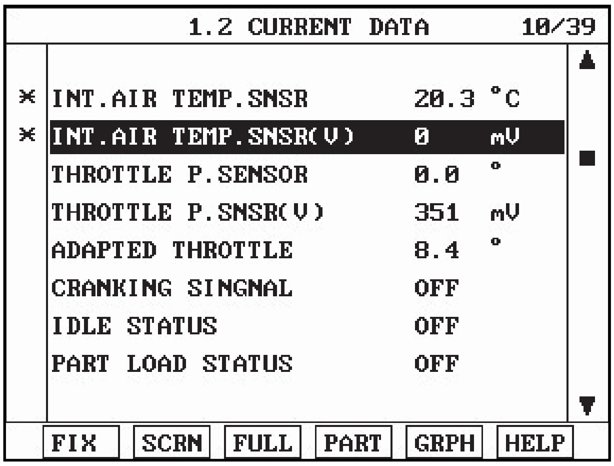


Fig4

Fig 1,2) Signal decreases with increasing sensor temperature and increases with decreasing sensor temperature : Approx. 3769mV at 19.5℃(at IG ON), Approx. 3574mV at 24.0℃(at Idle)
Fig 2) Open or short to battery in signal circuit/Open in ground circuit : Approx. 5V
Fig 3) Short to ground in signal circuit : Approx. 0V

SHDF16219L

MONITOR DTC STATUS E2472F74

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

TERMINAL AND CONNECTOR INSPECTION EE50BFE1

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

YES

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

NO

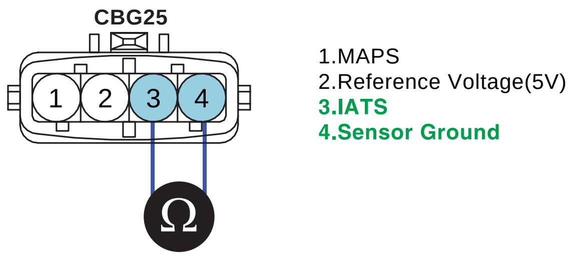
▶ Go to "Component Inspection" procedure

COMPONENT INSPECTION E4426718

1. Ignition "OFF"
2. Disconnect IATS connector
3. Measure resistance between terminals 3and 4 of the sensor connector(Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Resistance(kΩ)
-10	14	8.5~9.7
0	32	5.4~6.1
10	50	3.5~3.9
20	68	2.3~2.5
30	86	1.6~1.7
80	176	Approx. 0.3



4. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR EB779BFE

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0112 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT LOW INPUT

COMPONENT LOCATION EA8DDA72

Refer to DTC P0111.

GENERAL DESCRIPTION E1002812

Refer to DTC P0111.

DTC DESCRIPTION EB76FB27

ECM sets DTC P0112 if the ECM detects signal voltage lower than the possible range of a properly operating IATS.

DTC DETECTING CONDITION EC1CB43B

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Short to ground in signal harness • Contact resistance in connections • Faulty IAT sensor
Enable Conditions	• 6 < Battery voltage	
Threshold Value	• Measured intake air temperature > 142℃(287°F)	
Diagnostic Time	• 5 seconds	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E1415AF5

Refer to DTC P0111.

SCHEMATIC DIAGRAM E2D5E504

Refer to DTC P0111.

SIGNAL WAVEFORM AND DATA EFEABDDA

Refer to DTC P0111.

MONITOR DTC STATUS E008794B

Refer to DTC P0111.

SIGNAL CIRCUIT INSPECTION E02E21FB

1. Ignition "OFF"
2. Disconnect IAT sensor connector
3. Measure resistance between terminals 3 and chassis ground

Specification : Infinite

4. Is resistance within the specification?

YES

▶ Go to next step as below

NO

▶ Repair as necessary and go to "W/Harness Inspection" procedure.

TERMINAL AND CONNECTOR INSPECTION EB5BB978

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

YES

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

NO

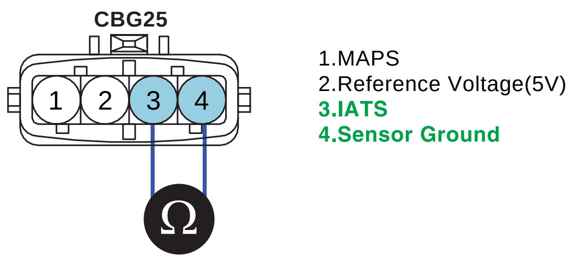
▶ Go to "Component Inspection" procedure

COMPONENT INSPECTION EA8E9992

1. Measure resistance between terminals 3 and 4 of the sensor connector(Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Resistance(kΩ)
-10	14	8.5~9.7
0	32	5.4~6.1
10	50	3.5~3.9
20	68	2.3~2.5
30	86	1.6~1.7
80	176	Approx. 0.3



SHDF16220L

2. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR E9142FFE

Refer to DTC P0111.

DTC P0113 INTAKE AIR TEMPERATURE SENSOR1 CIRCUIT HIGH INPUT

COMPONENT LOCATION E6C52BF9

Refer to DTC P0111.

GENERAL DESCRIPTION E1AFD185

Refer to DTC P0111.

DTC DESCRIPTION ECDD4DB8

ECM sets DTC P0113 if the ECM detects signal voltage higher than the possible range of a properly operating IATS.

DTC DETECTING CONDITION EE923130

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Short to battery in signal harness • Open in signal or ground circuit • Contact resistance in connections. • Faulty IAT sensor
Enable Conditions	• 6 ＜ Battery voltage • Time after start ＞ 110sec.	
Threshold Value	• Measured intake air temperature ＜ -46℃(-51°F)	
Diagnostic Time	• 5 seconds	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION ECAA2657

Refer to DTC P0111.

SCHEMATIC DIAGRAM E085E095

Refer to DTC P0111.

SIGNAL WAVEFORM AND DATA E12670C8

Refer to DTC P0111.

MONITOR DTC STATUS ECE0D681

Refer to DTC P0111.

TERMINAL AND CONNECTOR INSPECTION E86646E7

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below.

GROUND CIRCUIT INSPECTION EF8CF5C1

1. Ignition "OFF"
2. Disconnect IATS connector
3. Measure resistance between terminals 4 of the sensor harness connector and chassis ground

Specification : Approx. 0Ω

4. Is resistance within the specification?

YES

▶ Go to next step as below

NO

▶ Repair open circuit and go to "Verification of Vehicle Repair" procedure

SIGNAL CIRCUIT INSPECTION EFBB9768

1. Ignition "ON" & Engine "OFF"
2. Measure voltage between terminals 3 of the sensor harness connector and chassis ground

Specification : Approx. 5V

3. Is voltage within the specification?

YES

▶ Go to next step as below

NO

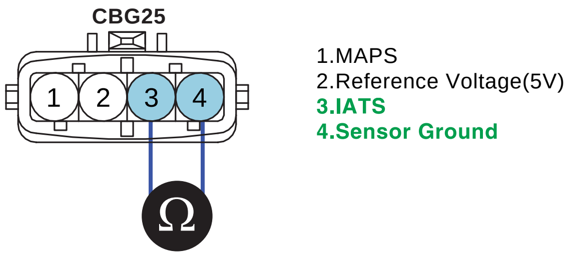
▶ Check for open or short to battery in signal harness. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EDFDFB03

1. Ignition "OFF"
2. Measure resistance between terminals 3 and 4 of the sensor connector(Component side).

SPECIFICATION

Temp.(℃)	Temp.(°F)	Resistance(kΩ)
-10	14	8.5~9.7
0	32	5.4~6.1
10	50	3.5~3.9
20	68	2.3~2.5
30	86	1.6~1.7
80	176	Approx. 0.3



SHDF16220L

3. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

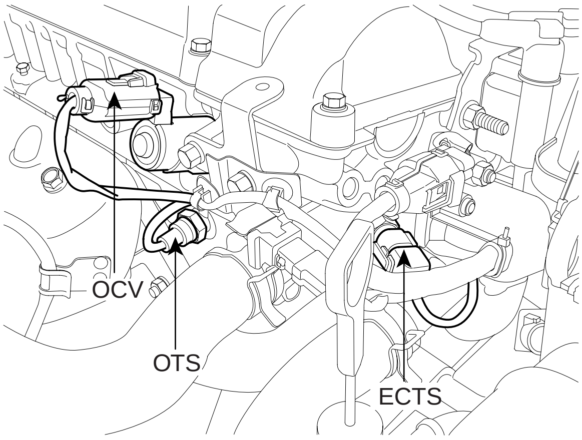
▶ Check IATS for contamination, deterioration, or damage. Substitute with a known-good IATS and check for proper operation. If the problem is corrected, replace IATS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR EB7BA2CC

Refer to DTC P0111.

DTC P0116 ENGINE COOLANT TEMPERATURE CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION E898215F



SHDF16329L

GENERAL DESCRIPTION E3DF7825

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

DTC DESCRIPTION E2382CAD

ECM sets DTC P0116 if the ECM detects stuck low, high or implausible high ECT signal

DTC DETECTING CONDITION E74527B4

Item		Detecting Condition & Fail Safe	Possible Cause
DTC Strategy	case 1)	• Signal stuck Low	• Contact resistance in connectors • Defective cooling system • Defective thermostat
	case 2)	• Signal stuck High	
Enable Conditions	case 1)	• No relevant failure • 6 ＜ Battery voltage ＜ 16V	
	case 2)	• No relevant failure • Engine oil temp. at engine stop of previous DC ＞ 70℃(158°F) • Coolant temp. at engine stop of previous driving cycle ＞ 70℃(158°F) • Engine oil temperature at Start ＜ 35℃(95°F) • Intake Air Temperature at Start ＜ 35℃(95°F)	
Threshold Value	case 1)	• Coolant temperature signal variation since engine start ＜ 2℃(4°F) when coolant temp. below 40℃(104°F) at start	
	case 2)	• Engine coolant temperature at start ＞ 53℃(127°F)	
Diagnostic Time	case 1)	• 10~30 minutes depends on coolant temp. at start	
	case 2)	• Immediate	
Mil On Condition		• 2 Driving Cycles	

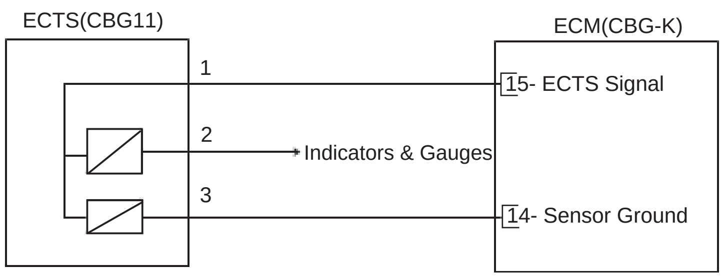
SPECIFICATION EDD9CEFC

Temp.(℃)	Temp.(°F)	Resistance(kΩ)
-20	-4	14.1 ~ 16.8
0	32	Approx. 5.8
20	68	2.3 ~ 2.6
40	104	Approx. 1.2
60	140	Approx. 0.6
80	176	Approx. 0.3

SCHEMATIC DIAGRAM

ED675464

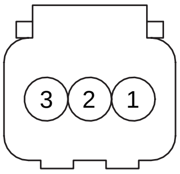
[Circuit Diagram]



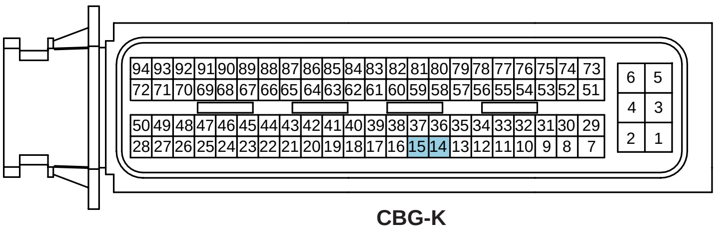
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (15)	ECTS Signal
2	Indicators & Gauges	-
3	ECM CBG-K (14)	Sensor Ground

[Harness Connector]



CBG11
ECTS



CBG-K
ECM

SHDF16224L

SIGNAL WAVEFORM AND DATA E5A000B6

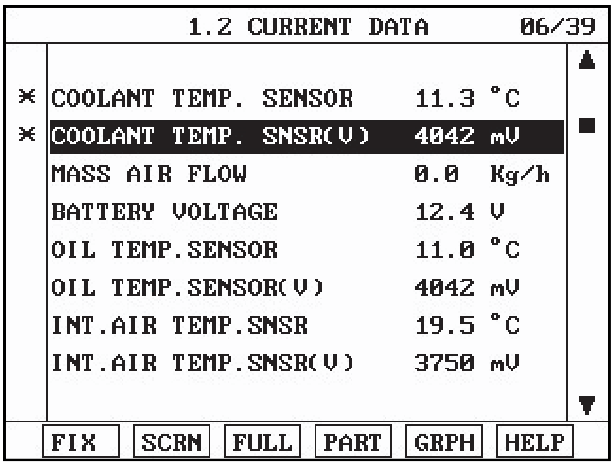


Fig1

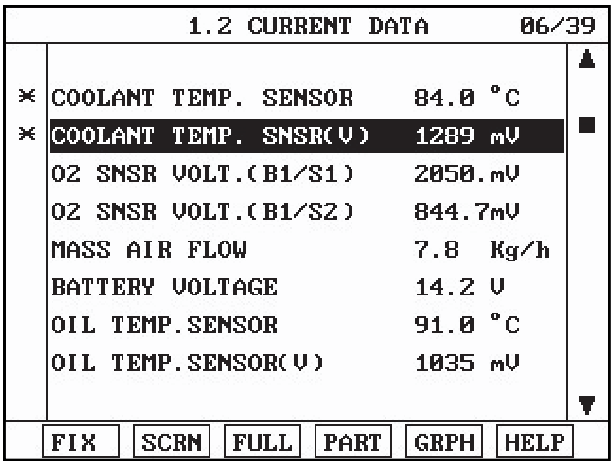


Fig2

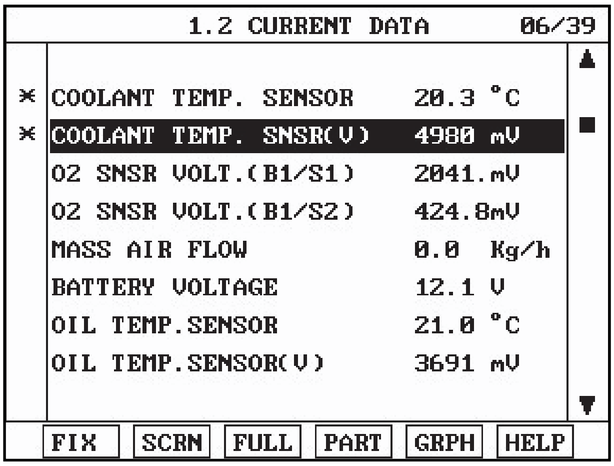


Fig3

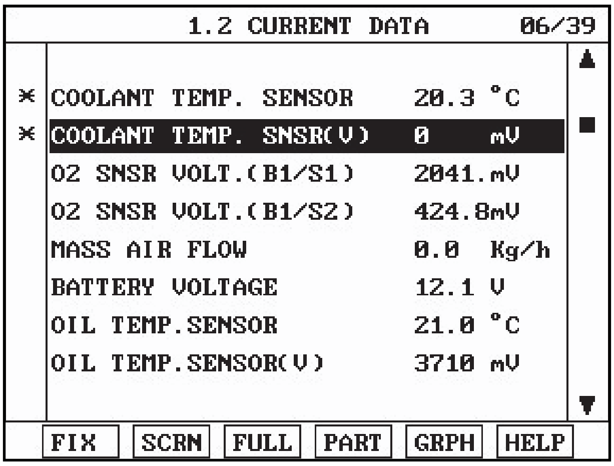


Fig4

Fig 1,2) Signal decreases with increasing sensor temperature and increases with decreasing sensor temperature : Approx. 4042mV at 11.3℃(at IG ON), Approx. 1289mV at 84.0℃(at Warm up)
Fig 2) Open or short to battery in signal circuit/Open in ground circuit : Approx. 5V
Fig 3) Short to ground in signal circuit : Approx. 0V

SHDF16225L

MONITOR DTC STATUS EE24D6C5

NOTE

If any DTCs relating to ECTS are stored, do ALL REPAIRS associated with those codes before proceeding with further troubleshooting

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

MONITOR SCANTOOL DATA EE8933FD

1. Allow the engine to cool completely
2. Run the cold engine at idle for 5 minutes and observe cooling fan status.

NOTE

Ensure that the A/C is OFF

3. Check the engine coolant temperature parameter at idle with the scantool.
4. Is the engine coolant temperature increase to above 50°C(122°F)

YES

▶ Go to "Terminal and Connector Inspection" procedure

NO

▶ Go to next step as below

5. ▶ Are the cooling fans running when engine coolant temperature is low(less than approximately 98°C(208°F)) with A/C OFF?

YES

▶ Check for short circuit in cooling fan harness or cooling fan relay. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

- With ignition "ON", Install scantool and select "COOLING FAN RELAY" on the Actuation Test mode.
- Activates "COOLING FAN RELAY" by pressing "STRT(F1)" key
- Repeat this procedure 4 or 5 times to ensure cooling fan reliability.
- If cooling fan works properly, go to next step as below
- If NG, check for intermittent fault caused by poor contact in the sensor's and/or ECM's connector. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

SYSTEM INSPECTION E4739423

1. Coolant Level Inspection

1) Check the cooling system coolant level.

2) Is the coolant in the reservoir at the proper level?

YES

▶ Go to next step as below

NO

▶ Repair or add engine coolant as necessary and go to "Verification of Vehicle Repair" procedure

2. Thermostat Inspection

1) Check if the thermostat bypass valve is stuck in the open position or if the correct type of thermostat was installed. Replace thermostat as necessary and go to "Verification of Vehicle Repair" procedure

2) Check the valve opening temperature of the thermostat

Specification(Valve opening temperature) : 80~84℃(176~183°F):

3) If the opening temperature is not as specified, Replace thermostat as necessary and go to "Verification of Vehicle Repair" procedure.
If OK, go to next step as below.

3. ECT Sensor Inspection

1) Ignition "OFF"

2) Disconnect ECTS connector

3) Measure resistance between terminals 1 and 3 of the sensor connector(Component side)

SPECIFICATION :

Temp.(℃)	Temp.(°F)	Resistance(kΩ)
-20	-4	14.1 ~ 16.8
0	32	Approx. 5.8
20	68	2.3 ~ 2.6
40	104	Approx. 1.2
60	140	Approx. 0.6
80	176	Approx. 0.3

4) Is resistance within the specification?

YES

▶ Go to next step as below.

NO

▶ Check ECTS for contamination, deterioration, or damage. Substitute with a known-good ECTS and check for proper operation. If the problem is corrected, replace ECTS and then go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EC6BCEE8

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR EBEAD1CF

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0117 ENGINE COOLANT TEMPERATURE CIRCUIT LOW INPUT

COMPONENT LOCATION EAC1CF95

Refer to DTC P0116.

GENERAL DESCRIPTION E726F916

Refer to DTC P0116.

DTC DESCRIPTION EFA74CE5

ECM sets DTC P0117 if the ECM detects signal voltage lower than the possible range of a properly operating ECTS.

DTC DETECTING CONDITION ED78B93C

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Short to ground in signal harness • Contact resistance in connections. • Faulty ECT sensor
Enable Conditions	• 6 < Battery voltage	
Threshold Value	• Measured coolant temperature > 138℃(280°F).	
Diagnostic Time	• 5 sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E245433F

Refer to DTC P0116.

SCHEMATIC DIAGRAM EE023865

Refer to DTC P0116.

SIGNAL WAVEFORM AND DATA E89764B8

Refer to DTC P0116.

MONITOR DTC STATUS E133BCE2

Refer to DTC P0116.

SIGNAL CIRCUIT INSPECTION E26FC331

1. Ignition "OFF"
2. Disconnect ECTS connector
3. Measure resistance between terminal 1 of the sensor harness connector and chassis ground

Specification : Infinite

4. Is resistance within the specification?

YES

▶ Go to "Terminal and Connector Inspection" procedure.

NO

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

TERMINAL AND CONNECTOR INSPECTION EB9F1A01

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

YES

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

NO

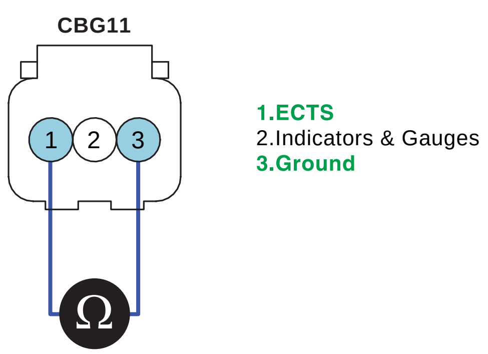
▶ Go to "Component Inspection" procedure.

COMPONENT INSPECTION EB648450

1. Measure resistance between terminals 1 and 3 of the sensor connector(Component side)

SPECIFICATION :

Temp.(℃)	Temp.(°F)	Resistance(kΩ)
-20	-4	14.1 ~ 16.8
0	32	Approx. 5.8
20	68	2.3 ~ 2.6
40	104	Approx. 1.2
60	140	Approx. 0.6
80	176	Approx. 0.3



SHDF16227L

2. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Check ECTS for contamination, deterioration, or damage. Substitute with a known-good ECTS and check for proper operation. If the problem is corrected, replace ECTS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E57DF976

Refer to DTC P0116.

DTC P0118 ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT

COMPONENT LOCATION E56F29C5

Refer to DTC P0116.

GENERAL DESCRIPTION ED57EB83

Refer to DTC P0116.

DTC DESCRIPTION E4FB70E3

ECM sets DTC P0118 if the ECM detects signal voltage higher than the possible range of a properly operating ECTS.

DTC DETECTING CONDITION E45D4B40

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Short to battery in signal harness • Open in signal or ground circuit • Contact resistance in connections. • Faulty ECT sensor
Enable Conditions	• 6 ＜ Battery voltage • Time after start ＞ 110sec. & intake air temperature ≥ -30℃(-22°F)	
Threshold Value	• Measured coolant temperature ＜ -46℃(-51°F)	
Diagnostic Time	• 5 sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E4E04D2C

Refer to DTC P0116.

SCHEMATIC DIAGRAM E0C3E11C

Refer to DTC P0116.

SIGNAL WAVEFORM AND DATA EC3EDBE1

Refer to DTC P0116.

MONITOR DTC STATUS E513ED45

Refer to DTC P0116.

GROUND CIRCUIT INSPECTION E2613114

1. Ignition "OFF"
2. Disconnect ECTS connector
3. Measure resistance between terminal 3 of the sensor harness connector and chassis ground

Specification : Approx. 0Ω

4. Is resistance within the specification?

YES

▶ Go to next step as below

NO

▶ Repair open circuit and go to "Verification of Vehicle Repair" procedure

SIGNAL CIRCUIT INSPECTION E93A6CF3

1. Check for short to battery in signal harness

   1) Disconnect ECM connector.

   2) Ignition "ON" & Engine "OFF"

   3) Measure voltage between terminal 1 of the sensor harness connector and chassis ground

Specification :	Approx. 0V

   4) Is voltage within the specification?

   YES

   ▶ Go to next step.

   NO

   ▶ Check for short to battery or open in signal harness. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

2. Check for open in signal harness

   1) Ignition "OFF"

   2) Measure resistance between terminal 1 of the sensor harness connector and 15 of the ECM harness connector

Specification :	Approx. 0Ω

   3) Is resistance within the specification?

   YES

   ▶ Go to next step as below

   NO

   ▶ Check for open in signal harness. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E3BD27DF

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

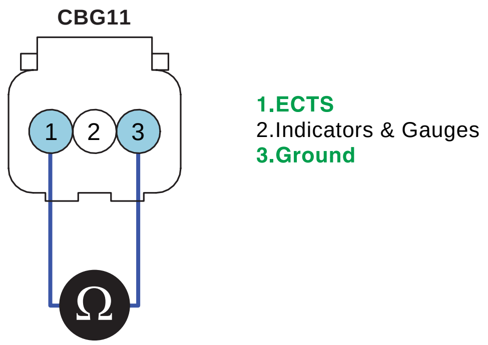
▶ Go to next step as below

COMPONENT INSPECTION E7187F9A

1. Measure resistance between terminals 1 and 3 of the sensor connector(Component side)

SPECIFICATION :

Temp.(℃)	Temp.(°F)	Resistance(kΩ)
-20	-4	14.1 ~ 16.8
0	32	Approx. 5.8
20	68	2.3 ~ 2.6
40	104	Approx. 1.2
60	140	Approx. 0.6
80	176	Approx. 0.3



SHDF16227L

2. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

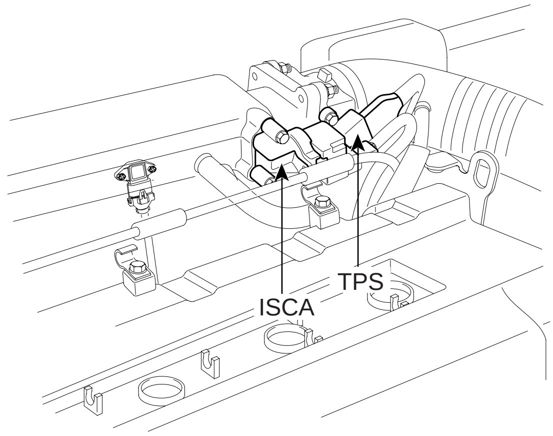
▶ Check ECTS for contamination, deterioration, or damage. Substitute with a known-good ECTS and check for proper operation. If the problem is corrected, replace ECTS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E7425AC9

Refer to DTC P0116.

DTC P0121 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT RANGE/PERFORMANCE

COMPONENT LOCATION EFC5446C



SLDF17236L

GENERAL DESCRIPTION E9769890

The Throttle Position Sensor (TPS) is mounted on the throttle body and detects the opening angle of the throttle plate. The TPS has a variable resistor (potentiometer) whose characteristic is the resistance changing according to the throttle angle. During acceleration, the TPS resistance between the reference 5V and the signal terminal decreases and output voltage increases; during deceleration, the TPS resistance increases and TPS output voltage decreases. The PCM supplies a reference 5V to the TPS and the output voltage increases directly with the opening of the throttle valve. The PCM determines operating conditions such as idle (closed throttle), part load, acceleration/deceleration, and wide-open throttle from the TPS. Also The PCM uses the Mass Air Flow Sensor (MAFS) signal along with the TPS signal to adjust fuel injection duration and ignition timing.

DTC DESCRIPTION EC746843

The DTC P0121 is set when the intake manifold model filtered reduced area controller is out of range in low or high load.

DTC DETECTING CONDITION E74C102C

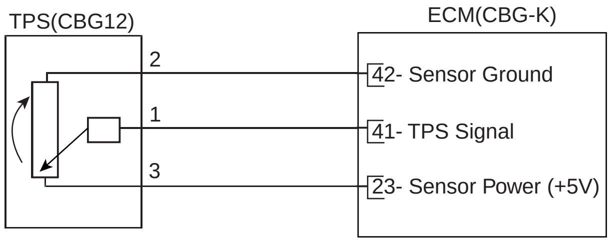
Item	Detecting Condition	Possible Cause
DTC Strategy	• Plausibility check	• Contact resistance in connectors • Faulty TP Sensor(TPS)
Enable Conditions	• No relevant failure • 10V ≤ Battery voltage ≤ 16V • Lambda control active	
Threshold Value	• Difference between modeled and measured pressure ＞ 280hpa • Deviation value of fuel trim control ＞ 20% or ＜ -20%	
Diagnostic Time	• 200 revolutions	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E9B2E08E

		Closed throttle status	Wide open throttle
Throttle opening angle(°)		0 ~ 0.5°	Approx. 86 °
Voltage (V)		0.25 ~ 0.9 V	Min. 4.0V
Resistance (kΩ)	Terminal 1 & 2	0.71 ~ 1.38kΩ	2.7kΩ
	Terminal 2 & 3	1.6 ~ 2.4kΩ	

SCHEMATIC DIAGRAM E4A9601F

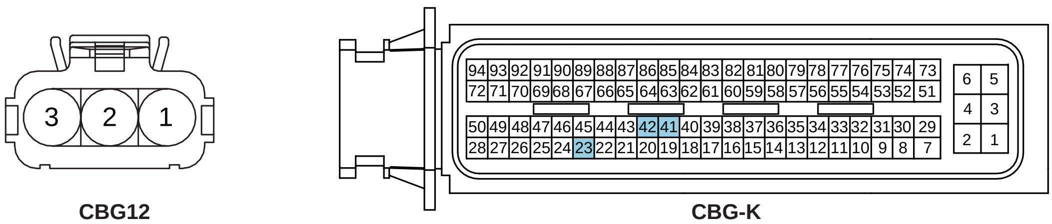
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (41)	TPS Signal
2	ECM CBG-K (42)	Sensor Ground
3	ECM CBG-K (23)	Sensor Power (+5V)

[Harness Connector]



CBG12
TPS

CBG-K
ECM

SHDF16230L

SIGNAL WAVEFORM AND DATA E4618690

Test Condition		Scan Tool Parameter TPS VOLTAGE	Scan Tool Screen
Normal value with ignition "ON" & engine "OFF"	Accelerator pedal released	0.25~0.9V	Fig.1
Normal value with engine ON & accelerator pedal fully depressed		Min. 4.0V	-
Abnormal value with ignition "ON" & engine "OFF"	Power circuit open	0.01V	Fig. 2
	Ground circuit open	4.99V	Fig. 3
	TPS signal circuit open	4.99V	Fig. 4
	TPS signal circuit short to ground	Approx. 0V	-
	TPS signal circuit short to battery	Above 4.99V	-

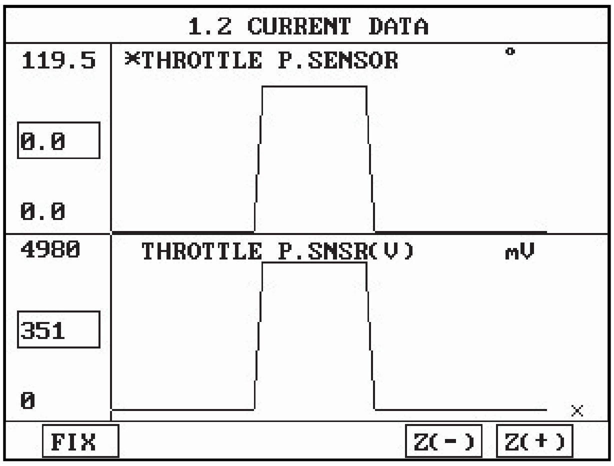


Fig1

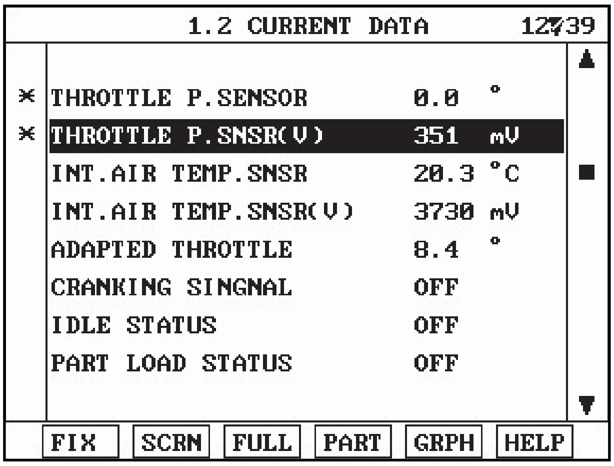


Fig2

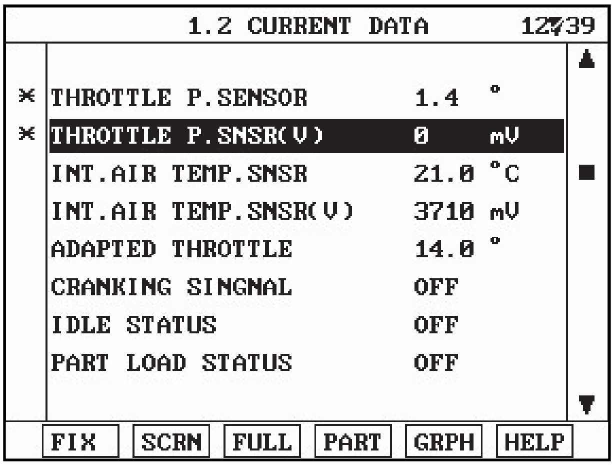


Fig3

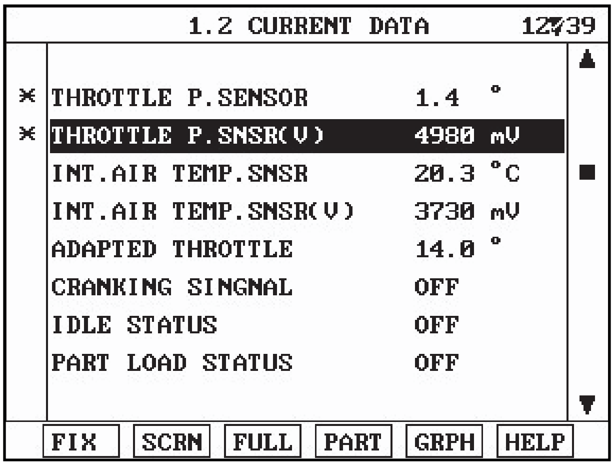


Fig4

Fig 1) Signal increases proportionally with throttle open and close angle
Fig 2) Normal value with IG "ON"
Fig 3) Short to ground in signal circuit/Open in power supply circuit : Approx. 0V
Fig 4) Open in signal or ground circuit : Approx. 5V

SHDF16231L

MONITOR DTC STATUS E4C47C43

NOTE

If any DTCs relating to TPS are stored, do ALL REPAIRS associated with those codes before proceeding with further troubleshooting

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

AIR LEAKAGE INSPECTIOM E555AEA4

1. Visually/physically inspect the following items:
   - Vacuum hoses for splits, kinks and improper connections
   - EVAP system for leakage
   - PCV hose for proper installation

2. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below.

TERMINAL AND CONNECTOR INSPECTION EE626AAA

NOTE

Check for open or short circuit in harness. Refer to "Signal Waveform & Data" in the "General Information" procedure

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

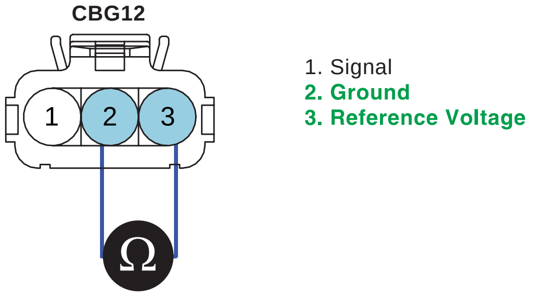
NO

▶ Go to next step as below

COMPONENT INSPECTION EA7B6848

1. Ignition "OFF"
2. Disconnect TPS connector
3. Measure resistance between terminals 2 and 3 of the TPS connector(Component side)

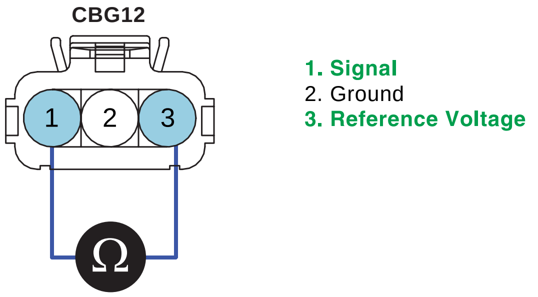
Specification : Approx. 1.6 ~ 2.4 kΩ at all throttle position



SHDF16232L

4. With still TPS connector disconnected, measure resistance between terminals 1 and 3 of the sensor connector(Component side)
5. Operate the throttle valve slowly from the idle position to the full open position and check the resistance changes smoothly in proportion with the throttle valve opening angle.

Specification : 0.71 ~ 1.38 kΩ at closed throttle valve, 2.7 kΩ at wide open throttle



SHDF16233L

6. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Check TPS for contamination, deterioration, or damage. 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

VERIFICATION OF VEHICLE REPAIR E3ECB0D9

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E9AAC90D

Refer to DTC P0121.

GENERAL DESCRIPTION EA309801

Refer to DTC P0121.

DTC DESCRIPTION E66A05D3

ECM sets DTC P0122 if the ECM detects signal voltage lower than the possible range of a properly operating TPS.

DTC DETECTING CONDITION E2029FC5

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Open in power supply harness • Short to ground in power supply or signal harness • Contact resistance in connectors • Faulty TP sensor
Enable Conditions	• 6 < Battery voltage < 16V	
Threshold Value	• Voltage < 0.14 V	
Diagnostic Time	• 1 sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION ED9C6929

Refer to DTC P0121.

SCHEMATIC DIAGRAM ED9E5C9D

Refer to DTC P0121.

SIGNAL WAVEFORM AND DATA E0AC837D

Refer to DTC P0121.

MONITOR DTC STATUS E3362C9E

Refer to DTC P0121.

POWER CIRCUIT INSPECTION EFA51740

NOTE

Check for open or short circuit in harness. Refer to "Signal Waveform & Data" in the "General Information" procedure

1. Ignition "OFF"
2. Disconnect TPS connector
3. Ignition "ON" & Engine "OFF"

4. Measure voltage between terminal 3 of the sensor harness connector and chassis ground

Specification :	Approx. 5V

5. Is voltage within the specification?

YES

▶ Go to next step as below

NO

▶ Possibility of open or short to ground in 5V reference circuit. Repair as necessary and go to "Verification of Vehicle Repair" procedure

SIGNAL CIRCUIT INSPECTION E12F9A9A

NOTE

Check for open or short circuit in harness. Refer to "Signal Waveform & Data" in the "General Information" procedure

1. Measure voltage between terminal 1 of the sensor harness connector and chassis ground

Specification :	Approx. 5V

2. Is voltage within the specification?

YES

▶ Go to next step as below

NO

▶ Check the short to ground in signal circuit.
▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

TERMINAL AND CONNECTOR INSPECTION E6C10CF2

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

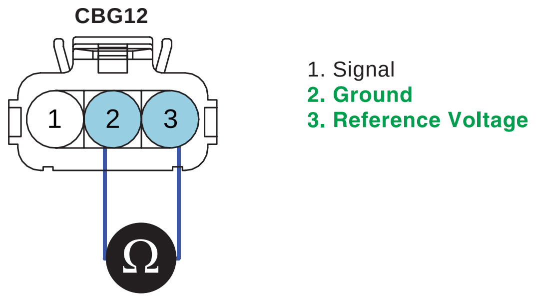
NO

▶ Go to next step as below

COMPONENT INSPECTION E60FE03A

1. Ignition "OFF"
2. Disconnect TPS connector
3. Measure resistance between terminals 2 and 3 of the TPS connector(Component side)

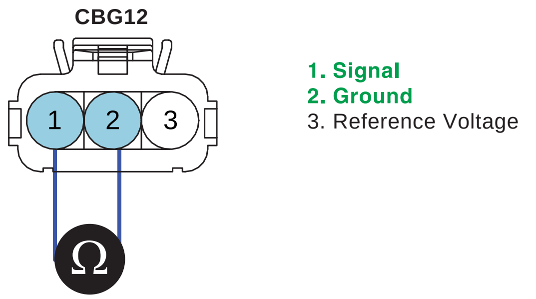
Specification : Approx. 1.6 ~ 2.4 kΩ at all throttle position



SHDF16232L

4. With still TPS connector disconnected, measure resistance between terminals 1 and 2 of the sensor connector(Component side)
5. Operate the throttle valve slowly from the idle position to the full open position and check the resistance changes smoothly in proportion with the throttle valve opening angle.

Specification : 0.71 ~ 1.38 kΩ at closed throttle valve, 2.7 kΩ at wide open throttle



SHDF16330L

6. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Check TPS for contamination, deterioration, or damage. 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

VERIFICATION OF VEHICLE REPAIR E0C93D3C

Refer to DTC P0121.

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

COMPONENT LOCATION EF0E6193

Refer to DTC P0121.

GENERAL DESCRIPTION E9C9E014

Refer to DTC P0121.

DTC DESCRIPTION E8F91613

ECM sets DTC P0123 if the ECM detects signal voltage higher than the possible range of a properly operating TPS

DTC DETECTING CONDITION EF7F584B

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Open in signal or ground circuit • Short to battery in signal circuit • Contact resistance in connectors • Faulty TP sensor
Enable Conditions	• 6 < Battery voltage < 16V	
Threshold Value	• Voltage > 4.86 V	
Diagnostic Time	• 1 sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EB6342F9

Refer to DTC P0121.

SCHEMATIC DIAGRAM EB51CB83

Refer to DTC P0121.

SIGNAL WAVEFORM AND DATA EE819667

Refer to DTC P0121.

MONITOR DTC STATUS E4E5592C

Refer to DTC P0121.

TERMINAL AND CONNECTOR INSPECTION EED4D48F

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below

GROUND CIRCUIT INSPECTION E69C4DBB

NOTE

Check for open or short circuit in harness. Refer to "Signal Waveform & Data" in the "General Information" procedure

1. Ignition "OFF"
2. Disconnect TPS connector
3. Measure resistance between terminal 2 of the sensor harness connector and chassis ground

Specification : Approx. 0Ω

4. Is resistance within the specification?

YES

▶ Go to next step as below

NO

▶ Check the ground circuit for an open.
▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

SIGNAL CIRCUIT INSPECTION ECF37142

NOTE

Check for open or short circuit in harness. Refer to "Signal Waveform & Data" in the "General Information" procedure

1. Check for short to battery in signal circuit
   1) Disconnect ECM connector
   2) Ignition "ON" & Engine "OFF"
   3) Measure voltage between terminal 1 of the sensor harness connector and chassis ground

Specification : Approx. 0V

   4) Is voltage within the specification?

   YES

   ▶ Go to next step as below

   NO

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

2. Check for open in signal circuit

   1) Ignition "OFF"

   2) Measure resistance between terminals 1 of the sensor harness connector and 41 of the ECM harness connector

Specification : Approx. 0Ω

   3) Is resistance within the specification?

YES

▶ Go to next step as below

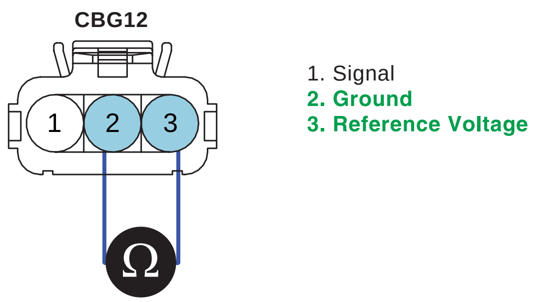
NO

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

COMPONENT INSPECTION E9544B6D

1. Ignition "OFF"
2. Disconnect TPS connector
3. Measure resistance between terminals 2 and 3 of the TPS connector(Component side)

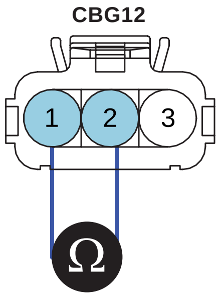
Specification : Approx. 1.6 ~ 2.4 kΩ at all throttle position



SHDF16232L

4. With still TPS connector disconnected, measure resistance between terminals 1 and 2 of the sensor connector(Component side)
5. Operate the throttle valve slowly from the idle position to the full open position and check the resistance changes smoothly in proportion with the throttle valve opening angle.

Specification : 0.71 ~ 1.38 kΩ at closed throttle valve, 2.7 kΩ at wide open throttle



1. Signal
2. Ground
3. Reference Voltage

SHDF16330L

6. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

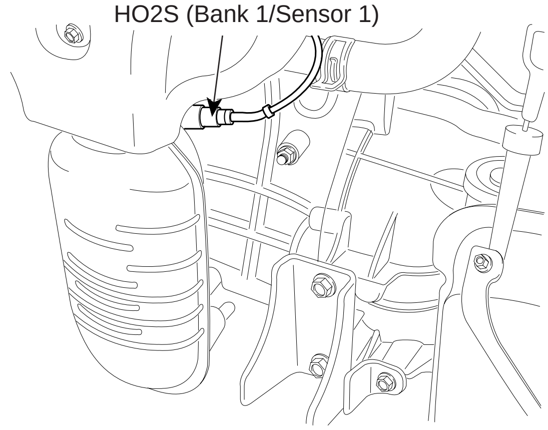
▶ Check TPS for contamination, deterioration, or damage. Substitute with a known-good TPS and check for proper operation. If the problem is corrected, replace TPS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR EF2D5D6F

Refer to DTC P0121.

DTC P0130 HO2S CIRCUIT (BANK 1/ SENSOR 1)

COMPONENT LOCATION E2803053



SLDF17326L

GENERAL DESCRIPTION EDBF53CE

The HO2S(Heated Oxygen Sensor) is used to supply the ECM 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. Since this is supplied through the wiring, the lead must not be clamped or damaged in any other way. The HO2S produces a voltage that varies between 0.1V and 0.9V under normal operating conditions. The Engine Control Module (ECM) monitors this voltage and determines if the exhaust gas is lean or rich. If the voltage input at the ECM is under approx. 0.45V the exhaust is lean, and if the voltage input is over approx. 0.45V the exhaust is rich. The ECM 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 EE06632B

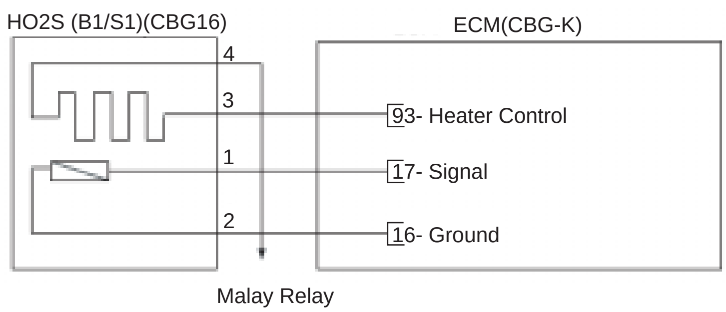
ECM sets DTC P0130 if the ECM detects that the front HO2S signal circuit is open.

DTC DETECTING CONDITION E4E79AA0

Item	Detecting Condition	Detecting Condition
DTC Strategy	• Voltage range check	• Open in signal harness • Open in ground harness • Poor connection or damaged harness • Faulty Heated O2 Sensor(HO2S)
Enable Conditions	• 10V＜ Battery voltage ＜16V • O2 sensor pre-heating phase finished • Exhaust gas temperature ＞ 600℃(1112°F) in case of O2 sensor heater failure • Lambda close loop control activated	
Enable Conditions	• 0.37V＜ HO2S ＜ 0.49V	
Diagnostic Time	• 10sec.	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E2AF1BDE

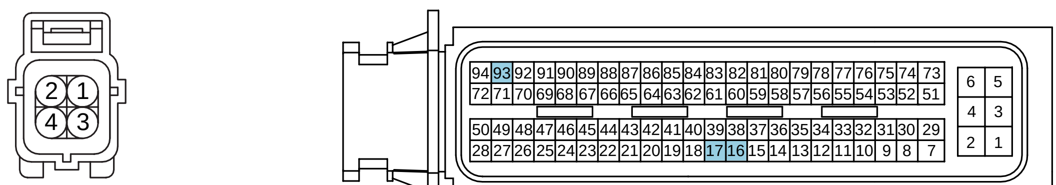
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (17)	HO2S (B1/S1) Signal
2	ECM CBG-K (16)	Sensor Ground
3	ECM CBG-K (93)	Heater Control
4	Main Relay	Power Supply (B+)

[Harness Connector]



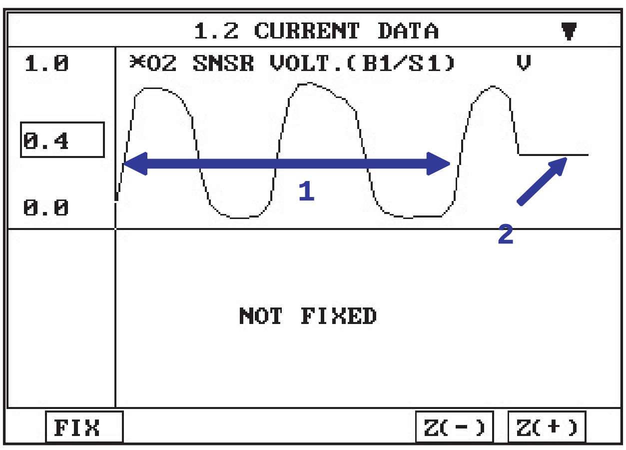
CBG16
HO2S (B1/S1)

CBG-K
ECM

SHDF16201L

SIGNAL WAVEFORM AND DATA E768EBBF

Test Condition		Scan Tool Parameter	
		O2 SNSR VOL.-B1/S1	O2 SNSR VOL.-B1/S2
Normal Value when circuit is normal	Idle after warm up	Signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds.	above 0.7V
HO2S(B1S1) signal circuit open		Approx. 0.43~0.45V	-
HO2S(B1S2) signal circuit open		-	Approx. 0.43~0.45V



LFLG137A

1. Normal value with idle after warm up : Signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds.

2. Scan tool display with open in signal circuit : Approx. 0.43~0.45V

MONITOR DTC STATUS E50F5226

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

2. Press F4(DTAL) to select DTC information from the DTCs menu.

3. Confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

4. Read "DTC Status" parameter.

5. Is parameter displayed "History(Not Present) fault"?

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

GROUND CIRCUIT INSPECTION EFF6DBBA

1. Ignition "OFF"

2. Disconnect HO2S connector.

3. Measure resistance between terminals 2 of the sensor harness connector and chassis ground

Specification : Approx. 0Ω

4. Is resistance within the specification?

YES

▶ Go to "Signal circuit inspection" procedure

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

SIGNAL CIRCUIT INSPECTION E29062AB

1. Ignition "ON" & Engine "OFF"

2. Measure voltage between terminals 1 of the sensor harness connector and chassis ground

Specification : Approx. 0.4 ~ 0.5V

3. Is voltage within the specification?

YES

▶ Go to next step as below

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION E4042EF3

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below

COMPONENT INSPECTION E7997CF1

1. Visually/physically inspect the following items:
   - Inspect the front HO2S for any silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
   - If contamination is evident on the HO2S, fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.

2. Warm up the engine to normal operating temperature and let it idle.

3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S1 parameter on the Scantool data list

Specification : Verify signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds (voltage will vary between 0.1 and 0.9V) at idle.

4. Is sensor switching properly?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR E19713B9

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION ED4F38C7

Refer to DTC P0130.

GENERAL DESCRIPTION EE336098

Refer to DTC P0130.

DTC DESCRIPTION EE989C64

ECM sets DTC P0131 if the HO2S(B1S1) voltage remains excessively low for a predetermined time

DTC DETECTING CONDITION E866A944

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Short to ground in signal harness • Contact resistance in connectors • Faulty Heated O2 Sensor(HO2S)
Enable Conditions	• 10V < Battery voltage < 16V • No relevant failure • Canister Purge Valve is Closed • Lambda control fixed at upper threshold value for 10sec. • Lambda close loop control activated	
Threshold Value	• O2 sensor Voltage < 0.02V (Sensor resister < 30Ω)	
Diagnostic Time	• 60 Seconds	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM EE242181

Refer to DTC P0130.

SIGNAL WAVEFORM AND DATA E79C1A62

Refer to DTC P0130.

MONITOR DTC STATUS E2BD65D4

Refer to DTC P0130.

SIGNAL CIRCUIT INSPECTION E55B4796

1. Ignition "OFF"
2. Disconnect ECM and HO2S connector
3. Measure resistance between terminal 1 of the sensor harness connector and chassis ground

Specification : Infinite

4. Is resistance within the specification?

YES

▶ Go to next step as below

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION E403ADB7

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below.

COMPONENT INSPECTION ECDFCB51

1. Visually/physically inspect the following items:
   - Inspect the front HO2S for any silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
   - If contamination is evident on the HO2S, fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.
2. Warm up the engine to normal operating temperature and let it idle.
3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S1 parameter on the Scantool data list

Specification : Verify signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds (voltage will vary between 0.1 and 0.9V) at idle.

4. Is sensor switching properly?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR E58666BC

Refer to DTC P0130.

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

COMPONENT LOCATION E75ECBE7

Refer to DTC P0130.

GENERAL DESCRIPTION E7C74964

Refer to DTC P0130.

DTC DESCRIPTION E1690A25

ECM sets DTC P0132 if the HO2S(B1S1) voltage remains excessively high for a predetermined time

DTC DETECTING CONDITION E5AAAC32

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Short to Battery in signal harness • Contact resistance in connectors • Faulty Heated O2 Sensor(HO2S)
Enable Conditions	• 10V < Battery voltage < 16V	
Threshold Value	• Sensor Voltage > 1.3V	
Diagnostic Time	• 1 Second	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E51886F8

Refer to DTC P0130.

SIGNAL WAVEFORM AND DATA E8B7C1D1

Refer to DTC P0130.

MONITOR DTC STATUS EE9371D1

Refer to DTC P0130.

SIGNAL CIRCUIT INSPECTION EEC5ECEA

1. Ignition "OFF"
2. Disconnect HO2S connector
3. Ignition "ON" & Engine "OFF".
4. Measure voltage between terminal 1 of the sensor harness connector and chassis ground.

Specification : Approx. 0.4~0.5V

5. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION E0AF8AD2

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below.

COMPONENT INSPECTION E3EC6ABF

1. Visually/physically inspect the following items:
   - Inspect the front HO2S for any silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
   - If contamination is evident on the HO2S, fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.

2. Warm up the engine to normal operating temperature and let it idle.

3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S1 parameter on the Scantool data list

Specification : Verify signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds (voltage will vary between 0.1 and 0.9V) at idle.

4. Is sensor switching properly?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR E0D7743B

Refer to DTC P0130.

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

COMPONENT LOCATION E51835EF

Refer to DTC P0130.

GENERAL DESCRIPTION EB0EE202

Refer to DTC P0130.

DTC DESCRIPTION ECEC30F3

The ECM monitors the HO2S(B1/S1) transition frequency for predetermined time. During the monitoring period, the ECM calculates transition times that the front HO2S switches from rich to lean and from lean to rich. With this information, an average frequency for all switches can be determined. The ECM sets DTC P0133 when the average frequency is too slow.

DTC DETECTING CONDITION E7B370DA

Item	Detecting Condition	Possible Cause
DTC Strategy	• HO2S signal ampliture check	• Leak in intake or exhaust system • Faulty fuel system. • Front and rear HO2S connections reversed. • Contact resistance in connectors • HO2S contamination
Enable Conditions	• 400℃ < Modeled catalyst temp. < 902℃ • Lambda regulation active • Stable driving condition • Canister closed < 0.5 • Canister purge closed • Engine speed(rpm) < 3400 • Coolant temperature > 74℃ • 5 <Vehicle speed(km/h) < 180 • No relevant failure • 11V < Battery voltage	
Threshold Value	• Time ration between rich to lean or lean to rich exceeds threshold value	
Diagnostic Time	• 50 lambda controller cycles	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E5AB95D4

Refer to DTC P0130.

SIGNAL WAVEFORM AND DATA EABD8D35

Refer to DTC P0130.

MONITOR DTC STATUS EDB3134D

Refer to DTC P0130.

AIR LEAKAGE INSPECTION EA63B688

1. Visually/physically inspect the following items:
   - Vacuum hoses for splits, kinks and improper connections.
   - Exhaust system between HO2S and Three way catalyst for air leakage
   - EVAP system for leakage
   - PCV hose for proper installation

2. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

VISUAL / PHYSICAL INSPECTION E0BF115C

1. Visually/physically inspect the following items:
   - Check for corrosion on terminals
   - Check for terminal tension (at the HO2S and at the ECM)
   - Check for damaged wiring
   - Check the HO2S ground circuit for a good connection
   - Check front and rear HO2S for connections being reversed.

2. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

COMPONENT INSPECTION E40D34C8

1. Visually/physically inspect the following conditions:
   - Ensure that the HO2S is securely installed.
   - Silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
   - Fuel, engine coolant or oil contamination
   - Use of improper sealant
   - If contamination is evident on the HO2S, Fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.

2. Warm up the engine to normal operating temperature and let it idle.

3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S1 parameter on the Scantool data list.

Specification : Refer to "Signal Waveform & Data" in the "General Information" procedure. Verify signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds (voltage will vary between 0.1 and 0.9V) at idle.

4. Is sensor switching properly?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR E5CBCB6D

Refer to DTC P0130.

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

COMPONENT LOCATION EADC45BF

Refer to DTC P0130.

GENERAL DESCRIPTION E780765C

Refer to DTC P0130.

DTC DESCRIPTION E6631DAA

1. Signal amplitude plausibility error : In order to determine the signal amplitude plausibility, the ECM monitors front HO2S signal level from rich to lean and from lean to rich. The ECM sets DTC P0134, If the difference of the signal transition level is too small.
2. Signal plausibility error during fuel cut-off : ECM sets DTC P0134, if the HO2S(B1S1) signal is too high during fuel cut-off period for a predetermined time

DTC DETECTING CONDITION E8460AC3

Item		Detecting Condition	Possible Cause
DTC Strategy	Case1	• Signal plausibility during fuel cut-off	• Poor connection or damaged harness • HO2S contamination
	Case2	• Signal amplitude plausibility	
Enable Conditions	Case1	• O2 sensor operative readiness detected • O2 sensor pre-heating phase finished • 16g< Integrated Mass Air Flow since Fuel Cut-Off begin <360g • No relevant failure • 10V< Battery voltage <16V	
	Case2	• O2 sensor pre-heating phase finished • Closed loop lambda controller output not limited to min./max. limit • O2 sensor signal lean half period <2.5sec. • O2 sensor signal rich half period <2.5sec. • No relevant failure • 10V< Battery voltage <16V	
Threshold Value	Case1	• HO2S voltage at fuel-cut mode > 0.1V	
	Case2	• Upstream O2 sensor signal amplitude < 0.25 V	
Diagnostic Time	Case1	• 5 sec.	
	Case2	• 120 sec.	
MIL On Condition		• 2 Driving Cycles	

SCHEMATIC DIAGRAM E9ED62E5

Refer to DTC P0130.

SIGNAL WAVEFORM AND DATA ED2CE845

Refer to DTC P0130.

MONITOR DTC STATUS E0667E61

Refer to DTC P0130.

TERMINAL AND CONNECTOR INSPECTION E69E90C4

1. Ignition "ON" & Engine "OFF"
2. Monitor the O2 SNSR VOL.-B1/S1 parameter on the Scantool data list while wiggling the wiring harness and related connectors.
3. The value should remain more or less unchanged. If not, check for the following conditions:
   - Check for corrosion on terminals
   - Check for terminal tension (at the HO2S and at the ECM)
   - Check for damaged wiring
   - Check the HO2S ground circuit for a good connection
   - Check the 10A SNSR FUSE
   - Check front and rear HO2S for connections being reversed.
4. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below.

COMPONENT INSPECTION EB80B6AD

1. Visually/physically inspect the following conditions:
   - Ensure that the HO2S is securely installed.
   - Silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
   - Fuel, engine coolant or oil contamination
   - Use of improper sealant
   - If contamination is evident on the HO2S, Fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.
2. Warm up the engine to normal operating temperature and let it idle.
3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S1 parameter on the Scantool data list.

Specification : Refer to "Signal Waveform & Data" in the "General Information" procedure. Verify signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds (voltage will vary between 0.1 and 0.9V) at idle.

---

4. Is sensor switching properly?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

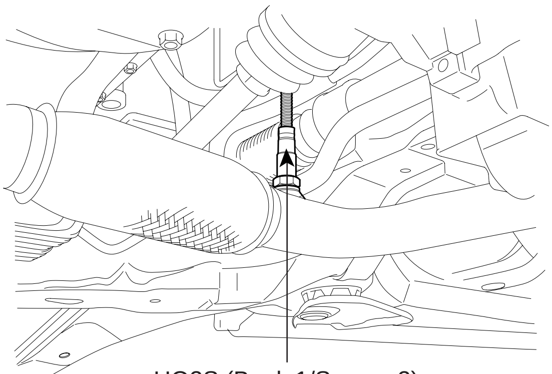
▶ Check HO2S for contamination, deterioration, or damage. Substitute with a known-good HO2S and check for proper operation. If the problem is corrected, replace HO2S and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E94B2444

Refer to DTC P0130.

DTC P0136 HO2S CIRCUIT (BANK 1/ SENSOR 2)

COMPONENT LOCATION E70D2C20



SLDF17327L

GENERAL DESCRIPTION E488A54C

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter (warm-up catalytic converter) or in the rear exhaust pipe, which is able to detect catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC DESCRIPTION E3AD8A16

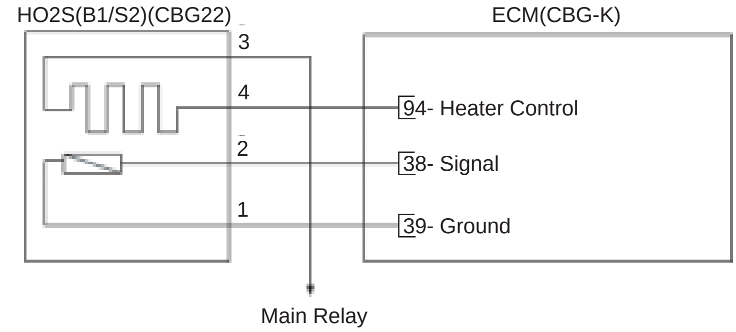
ECM sets DTC P0136 if the ECM detects that the rear HO2S signal circuit is open.

DTC DETECTING CONDITION E1B12F71

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Open in signal harness • Open in ground harness • Contact resistance in connectors • Faulty Heated O2 Sensor(HO2S)
Enable Conditions	• O2 Sensor operative readiness • O2 Sensor preheating and full heating phases finished • No relevant failure • 10V < Battery voltage <16V	
Threshold Value	• 0.37 < Downstream O2 Sensor voltage < 0.49V & sensor element resistance > 60kΩ	
Diagnostic Time	• 30sec.	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM ED7DD2B3

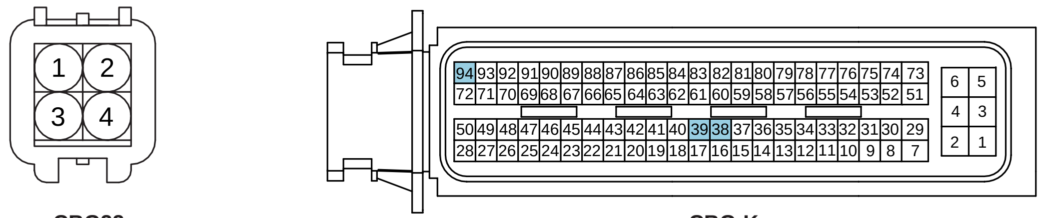
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (39)	Sensor Ground
2	ECM CBG-K (38)	HO2S (B1/S2) Signal
3	Main Relay	Power Supply (B+)
4	ECM CBG-K (94)	Heater Control

[Harness Connector]



CBG22
HOS2 (B1/S2)

CBG-K
ECM

SHDF16205L

SIGNAL WAVEFORM AND DATA E922F8C5

Test Condition		Scan Tool Parameter	
		O2 SNSR VOL.-B1/S1	**O2 SNSR VOL.-B1/S2**
Normal Value when circuit is normal	Idle after warm up	Signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds.	above 0.7V
HO2S(B1S1) signal circuit open		Approx. 0.43~0.45V	-
HO2S(B1S2) signal circuit open		-	Approx. 0.43~0.45V

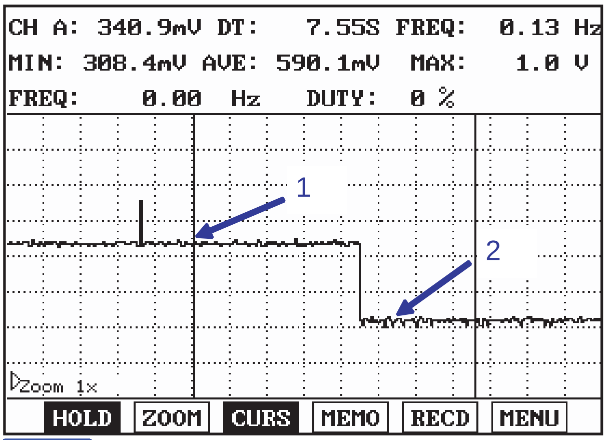


Fig1

Fig.1) HO2S signal waveform with idle after warm up :
1: Normal status(Approx. above 0.7V), 2: Open in signal circuit(Approx. 0.4~0.5V)

SHDF16332L

MONITOR DTC STATUS E418EDE8

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

GROUND CIRCUIT INSPECTION ED7D6285

1. Ignition "OFF".
2. Disconnect HO2S connectors.
3. Measure resistance between terminals 1 of the sensor harness connector and chassis ground.

Specification : Approx. 0Ω

4. Is resistance within the specification?

YES

▶ Go to "Signal circuit inspection" procedure.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

SIGNAL CIRCUIT INSPECTION E16FE208

1. Ignition "ON" & Engine "OFF"

2. Measure voltage between terminal 2 of the sensor harness connector and chassis ground

Specification : Approx. 0.4~0.5V

3. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION E158F043

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below.

COMPONENT INSPECTION E20CF932

1. With ignition "OFF", reconnect the HO2S connector
2. Warm up the engine to normal operating temperature and let it idle.
3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S2 parameter on the Scantool data list.

Specification : Above 0.7V at idle

4. Is sensor data near the specified value?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR EDCD859D

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

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

COMPONENT LOCATION E174143A

Refer to DTC P0136.

GENERAL DESCRIPTION E2CB1148

Refer to DTC P0136.

DTC DESCRIPTION E48A1845

ECM sets DTC P0137 if the HO2S(B1S2) voltage remains excessively low for a predetermined time

DTC DETECTING CONDITION EB0273DB

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Short to ground in signal harness • Contact resistance in connectors • Faulty Heated O2 Sensor(HO2S)
Enable Conditions	• Catalyst temperature model ＞ 500℃(932°F) • Lambda regulation active • Catalyst purge after fuel cut off is not active • No relevant failure • 10V ＜ Battery voltage ＜ 16V	
Threshold Value	• Downstream O2 Sensor voltage ＜ 0.02V & sensor element resistance ＜ 30Ω	
Diagnostic Time	• 20 sec.	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E6148C0F

Refer to DTC P0136.

SIGNAL WAVEFORM AND DATA E029A284

Refer to DTC P0136.

MONITOR DTC STATUS EB8D7824

Refer to DTC P0136.

SIGNAL CIRCUIT INSPECTION EB08B2B4

1. Ignition "OFF".
2. Disconnect ECM and HO2S connector.
3. Measure resistance between terminal 2 of the sensor harness connector and chassis ground.

Specification : Infinite

4. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION EBB334C0

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below.

COMPONENT INSPECTION E0475103

1. With ignition "OFF", reconnect the HO2S connector.
2. Warm up the engine to normal operating temperature and let it idle.
3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S2 parameter on the Scantool data list.

Specification : Above 0.7V at idle

4. Is sensor data near the specified value?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR E68742ED

Refer to DTC P0136.

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

COMPONENT LOCATION EB5DC00E

Refer to DTC P0136.

GENERAL DESCRIPTION E5600A4F

Refer to DTC P0136.

DTC DESCRIPTION EA84784A

ECM sets DTC P0138 if the HO2S(B1S2) voltage remains excessively high for a predetermined time

DTC DETECTING CONDITION EB40777D

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range check	• Short to Battery in signal harness • Contact resistance in connectors • Faulty Heated O2 Sensor(HO2S)
Enable Conditions	• 10V＜ Battery voltage ＜16V	
Threshold Value	• Sensor voltage ＞1.3V	
Diagnostic Time	• 1sec.	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM EB29970E

Refer to DTC P0136.

SIGNAL WAVEFORM AND DATA E7B791B0

Refer to DTC P0136.

MONITOR DTC STATUS E96FC931

Refer to DTC P0136.

SIGNAL CIRCUIT INSPECTION E4DFE0C1

1. Ignition "OFF".
2. Disconnect HO2S connector.
3. Ignition "ON" & Engine"OFF".
4. Measure voltage between terminal 2 of the sensor harness connector and chassis ground.

Specification : Approx. 0.4~0.5V

5. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

NOTE

HO2S must have a clean air reference to function properly. The air is obtained by way of the sensor wire(s). Do not attempt to repair the wire(s), connector, or the terminals.

TERMINAL AND CONNECTOR INSPECTION EC71DB08

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below.

COMPONENT INSPECTION E7B651D6

1. With ignition "OFF", reconnect the HO2S connector.
2. Warm up the engine to normal operating temperature and let it idle.
3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S2 parameter on the Scantool data list.

Specification : Above 0.7V at idle

4. Is sensor data near the specified value?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR ED41D309

Refer to DTC P0136.

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

COMPONENT LOCATION EDED7F17

Refer to DTC P0136.

GENERAL DESCRIPTION EB13C63E

Refer to DTC P0136.

DTC DESCRIPTION E358EF5A

The ECM monitors rich-lean switching time of rear heated oxygen sensor (HO2S) after fuel cut-off to validate dynamic behavior of rear heated oxygen sensor (HO2S). After detection of fuel cut-off engine operating state, the ECM measures rich-lean switching time of the rear heated oxygen sensor (HO2S) signal and compares it to the predetermined limit value. DTC P0139 is set when the switching time is bigger than the limit value.

DTC DETECTING CONDITION E3EAF859

Item	Detecting Condition	Possible Cause
DTC Strategy	• Slow response(Switching time check at entry in fuel cut off)	• Leak in intake or exhaust system • Faulty fuel system. • Front and rear HO2S connections reversed. • Contact resistance in connectors • HO2S contamination
Enable Conditions	• Coolant temp ＞74.25℃(165.65°F) • Sensor preheating and full phase finished • Catalyst temp.model ＞348℃(658.4°F) • No relevant failure • 11V＜ Battery voltage ＜16V • Downstream O2 sensor signal at entry in fuel cut off ＞ 0.55V • O2 Sensor operative readiness detected	
Threshold Value	• Average ratio(between measured and maximum allowed switching time at entry in fuel cut-off) ＞ 1	
Diagnostic Time	• 5 fuel cut-off phases	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E4B76BBC

Refer to DTC P0136.

SIGNAL WAVEFORM AND DATA EC9FD613

Refer to DTC P0136.

MONITOR DTC STATUS E8D81F9E

Refer to DTC P0136.

EXHAUST SYSTEM INSPECTION EA6A441F

1. Check the exhaust system for an exhaust leak near the engine.

2. Was an exhaust leak found?

YES

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

NO

▶ Go to next step as below

AIR LEAKAGE INSPECTION E6788820

1. Visually/physically inspect the following items:
   - Vacuum hoses for splits, kinks and improper connections.
   - Exhaust system between HO2S and Three way catalyst for air leakage
   - EVAP system for leakage
   - PCV hose for proper installation

2. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

VISUAL/PHYSICAL INSPECTION E89CA2D0

1. Visually/physically inspect the following items:
   - Check for corrosion on terminals
   - Check for terminal tension (at the HO2S and at the ECM)
   - Check for damaged wiring
   - Check the HO2S ground circuit for a good connection
   - Check front and rear HO2S for connections being reversed.

2. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

COMPONENT INSPECTION ED04E341

1. Visually/physically inspect the following conditions:
   - Ensure that the sensor is securely installed
   - Check for corrosion on terminals
   - Check for damaged wiring
   - Repair as necessary and go to next step

2. Warm up the engine to normal operating temperature and let it idle.

3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S2 parameter on the Scantool data list.

Specification : Above 0.7V at idle

4. Is sensor data near the specified value?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR EF476601

Refer to DTC P0136.

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

COMPONENT LOCATION E3FBD9CD

Refer to DTC P0136.

GENERAL DESCRIPTION EFBADD41

Refer to DTC P0136.

DTC DESCRIPTION E22D1435

Due to possible oxygen sensor defects (e.g. reference air poisoning) or faults in the injection system (e.g. leaking fuel injector), the rear oxygen sensor may not provide the expected lean or rich signal level during fuel cut-off or full load condition. Hence, the oxygen sensor signal is checked for plausibility during this engine operating states.There are 2 cases which DTC P0140 sets.

1. Signal monitoring during fuel cut-off: The ECM monitors rear O2 sensor signal level during fuel cut-off which normally shows near 0V and sets DTC P0140 when signal level is too high.

2. Signal monitoring after fuel cut-off: The ECM monitors rear O2 sensor signal level after leaving fuel cut-off and sets DTC P0140 when signal remains at or below 0.6V.

DTC DETECTING CONDITION E66E826C

Item		Detecting Condition	Possible Cause
DTC trategy	Case1)	• Voltage range check	• Related fuse blown or missing • Contact resistance in connectors • HO2S contamination
	Case2)	• Voltage range check	
Enable Conditions	Case1)	• O2 sensor operative readiness detected • Integrated mass air flow in lask fuel cut off ＞ 4g • Integrated mass air flow in part load ＞ 250g • Coolant temperature ＞ 74.25℃ • Downstream O2 sensor signal at end of last fuel cut off ＜ 0.25V • Sensor preheating and fuel heating phases finished • Catalyst temperature ＞ 348℃ (658°F) • No relevant failure • 11V ＜ Battery voltage ＜ 16V	
	Case2)	• O2 sensor operative readiness detected • 20 ＜ Integrated mass air flow in lask fuel cut off ＜ 360g • Sensor preheating and fuel heating phases finished • No relevant failure • 10V ＜ Battery voltage ＜ 16V	
Threshold Value	Case1)	• Voltage ＜ 0.55V	
	Case2)	• Voltage with fuel cut ＞ 0.1V	
Diagnostic Time	Case1)	• 3 vaild fuel cut-off phases	
	Case2)	• 2 sec.	
Mil On Condition		• 2 Driving Cycles	

SCHEMATIC DIAGRAM E9F0D107

Refer to DTC P0136.

SIGNAL WAVEFORM AND DATA E2CAAC42

Refer to DTC P0136.

MONITOR DTC STATUS EEEB5893

Refer to DTC P0136.

TERMINAL AND CONNECTOR INSPECTION E979B20C

1. Ignition "ON" & Engine "OFF"

2. Monitor the O2 SNSR VOL.-B1/S2 parameter on the Scantool data list while wiggling the wiring harness and related connectors.

3. The value should remain more or less unchanged. If not, check for the following conditions:
   - Check for corrosion on terminals
   - Check for terminal tension (at the HO2S and at the ECM)
   - Check for damaged wiring
   - Check the HO2S ground circuit for a good connection
   - Check the 10A SNSR FUSE
   - Check front and rear HO2S for connections being reversed.

4. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as belowTerminal and Connector Inspection

COMPONENT INSPECTION EE72C06C

1. Visually/physically inspect the following conditions:
   - Ensure that the sensor is securely installed
   - Check for corrosion on terminals
   - Check for damaged wiring
   - Repair as necessary and go to next step

2. Warm up the engine to normal operating temperature and let it idle.

3. Connect Scantool and monitor the O2 SNSR VOL.-B1/S2 parameter on the Scantool data list.

Specification : Above 0.7V at idle

4. Is sensor switching properly?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR E0763D0E

Refer to DTC P0136.

DTC P0170 FUEL TRIM (BANK 1)

GENERAL DESCRIPTION ED20A575

In order to provide the best possible combination of drivability, fuel economy and emission control, the ECM uses a closed loop air/fuel metering system. The ECM monitors the HO2S signal voltage and adjusts fuel delivery based it in closed loop fuel control. Changes in fuel delivery will be indicated by the long-term and the short-term fuel trim values. The ideal fuel trim value is around 0%. The ECM will add fuel when the HO2S signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are above 0%. The ECM will reduce fuel when the HO2S signal is indicating a rich condition. Reduction in fuel is indicated by fuel trim values that are below 0%. The DTC relevant to fuel trim will be set when the amount reaches excessive levels because of a lean or rich condition.

DTC DESCRIPTION EB50AEC5

If the fuel trim values reaches the maximum or minimum threshold, then feedback control is no longer possible and emissions will be increased. The ECM sets DTC P0170 if no proportional fuel adaptation occurs for a defined time after the short term fuel trim has reached its minimum or maximum threshold.

DTC DETECTING CONDITION EA3909C5

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitoring deviation of lambda controller	• Air leakage or restriction in intake or exhaust system • Dirty engine oil or oil level too high • Front HO2S or MAFS contamination • Fuel system • EVAP system • Faulty sensor signals
Enable Conditions	• Lambda control active • Coolant temperature > 70℃(158°F) • No relevant failure	
Threshold Value	• Lambda controller < -30% or > +50%	
Diagnostic Time	• 30 seconds	
MIL On Condition	• 2 Driving Cycles	

SIGNAL WAVEFORM AND DATA EDE6505A

1. Scan Tool Display for HO2S

Signal Waveform & Data		Scan Tool Parameter	
		O2 SNSR VOL.-B1/S1	O2 SNSR VOL.-B1/S2
Normal Value when circuit is normal	Idle after warm up	Signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds.	above 0.7V
HO2S(B1S1) signal circuit open		Approx. 0.43~0.45V	-
HO2S(B1S2) signal circuit open		-	Approx. 0.43~0.45V

2. MAPS Terminal voltage with pressure

Pressure (kPa)	Approx. 20	Approx. 35	Approx. 60	Approx. 95	Approx. 101
Voltage (V)	Approx. 0.7 ~ 0.8	Approx. 1.3 ~ 1.4	Approx. 2.3 ~ 2.4	Approx. 3.7 ~ 3.8	Approx. 3.9 ~ 4.1

3. Scan Tool Display for TPS

Test Condition		Scan Tool Parameter
		TPS VOLTAGE 1
Normal value with ignition "ON" & engine "OFF"	Accelerator pedal released	0.25~0.9V
Normal value with engine ON & accelerator pedal fully depressed		Min. 4.0V
Abnormal value with ignition "ON" & engine "OFF"	Power circuit open	0.01V
	Ground cicuit open	4.99V
	TPS1 signal circuit open	4.99V
	TPS1 signal circuit short to ground	Approx. 0V
	TPS1 signal circuit short to battery	Above 4.99V

MONITOR DTC STATUS E686C144

NOTE

If any DTCs relating to INJECTOR,HO2S,ECTS, or MAFS are stored, do ALL REPAIRS associated with those codes before proceeding with further troubleshooting

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

MONITOR ACTUATION TEST EA36CD07

NOTE

The main purpose of this test is to identify potential engine mechanical condition problems and fuel and ignition systems problems that are not common to all cylinders. For best results, perform this test while maintaining as steady an rpm reading as possible.

WARNING

Before beginning tests; set the parking brake, place gear selector in P or N and block drive wheels for safety.

1. Warm up the engine to normal operating temperature and let it idle.
2. Install Scan Tool and select INJECTOR #1 parameter on the Actuation Test mode
3. Monitor engine rpm and shut off the injector #1 by pressing "STRT(F1)" key
4. Repeat procedure on all injectors and record the engine rpm.

Specification :	All cylinders should show an even RPM drop.

5. Was each cylinder's rpm drop within the same value?

YES

▶ Go to next step as below

NO

▶ Cylinders with the least amount of RPM drop are not contributing their share of power.
▶ Go to "Fuel Injector Inspection" procedure and check the suspect cylinders

NOTE

If the RPM loss between cylinders is quite large(200RPM or more) and engine has high mileage, there is possibility of engine wear. Perform compression test with pressure gauge to check the engine wear

SYSTEM INSPECTION E0577B0A

CHECK INTAKE/EXHAUST SYSTEM FOR RESTRICTION OR LEAKAGE

1. Visually/physically inspect the air leakage in intake/exhaust system for the following areas:
   - 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. Visually/physically inspect the restriction in intake/exhaust system for the following areas:
   - Air cleaner filter element for excessive dirt or for any foreign objects
   - Throttle body inlet for damage or for any foreign objects
   - Throttle bore and throttle plate for chocking and for any foreign objects
   - Restricted exhaust system

3. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

4. Inspect the leakage in EVAP. system for the following conditions:

1) Check the EVAP canister for fuel saturation. If the EVAP canister is full of fuel, visually and physically inspect the EVAP and fuel system.Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure. If OK, go to next step.

2) Remove the manifold side vacuum hose from the EVAP canister purge valve.

3) Using a hand vacuum pump apply specified vacuum(Approx. 15 in, Hg) to the manifold side of the valve

4) Does the valve hold vacuum?

YES

▶ Go to next step as below

NO

▶ Repair air leakage and go to "Verification of Vehicle Repair" procedure

SENSOR INSPECTION

NOTE

Refer to "Signal Waveform & Data" in the "General Information" procedure

1. Visually/physically inspect the HO2S for the following conditions:
   - Ensure that the HO2S is securely installed.
   - Silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
   - Fuel, engine coolant or oil contamination
   - Use of improper sealant
   - If contamination is evident on the HO2S, Fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.

2. Visually/physically inspect the MAFS for the following conditions:
   - Contamination or deterioration
   - Poor connection or damaged harness

3. Check for an intermittent TPS false signal. TPS signal displayed on a scantool should increase steadily when depressing accelerator pedal after starting.

4. Verify that the ECM ground connections are clean and properly tightened.

5. If test result is NG, repair or replace as necessary and go to "Verification of Vehicle Repair" procedure. If OK, go to next step as below.

NOTE

If the contamination is evident on the HO2S or MAFS. Fix the source of the sensor contamination before replacing the sensor to prevent future contamination.

POSITIVE CRANKCASE VENTILATION SYSTEM INSPECTION

1. Check the engine oil level. The oil level should be between the min. and max. marking. Fill to the correct oil level

2. Check crankcase ventilation valve for improper installation, damaged o-rings and malfunctioning .

3. Warm up the engine to normal operating temperature

4. Connect Scantool and note the "SHORT TERM FUEL-B1" parameter on the Scantool data list.

5. Disconnect and plug the positive crankcase ventilation at the intake manifold side

6. Monitor the "SHORT TERM FUEL-B1" parameter on the Scantool data list once again.

Specification : The value should remain more or less unchanged

7. Is the displayed value within the specified value?

YES

▶ Go to next step as below

NO

▶ Check the PCV(Positive Crankcase Ventilation) valve for operation properly. Refer to "EM" group in Workshop Manual. If OK, check that engine oil is diluted with fuel. Change the oil or filter as necessary and go to "Verification of Vehicle Repair" procedure

FUEL SYSTEM INSPECTION EDF6F470

1. Fuel Line Pressure Inspection

   1) Check the fuel for excessive water, alcohol, or other contaminants. Replace contaminated fuel as necessary.

   2) Install a fuel pressure gage

   3) Inspect fuel pressure with normal idle status

Specification : 338~348kPa(3.45~3.55kg/㎠)

   4) Is fuel pressure within the specified value?

   YES

   ▶ Go to next step as below

   NO

   ▶ Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause	SuspectedArea
Fuel Pressure too low	Clogged fuel filter	Fuel filter
	Fuel leak on the fuel-pressure regulator that is assembled on fuel pump	Fuel Pump(Fuel Pressure Regulator)
Fuel Pressure too High	Sticking fuel pressure regulator	Fuel Pump(Fuel Pressure Regulator)

2. Fuel Pressure Hold Inspection

   1) Stop the engine and check for a change in the fuel pressure gauge reading.

Specification : After engine stops, the gauge reading should hold for minimum 5 minutes

   2) Is fuel pressure within the specified value?

YES

Visually/physically inspect the engine mechanical problem for the following:
- Worn cylinder
- Worn valve
- Worn piston or piston ring

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

NO

Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause	Suspected Area
Fuel pressure drops slowly	Injector leak	Injector
Fuel pressure drops immediately	Stuck open in check valve of the fuel pump	Fuel pump

VERIFICATION OF VEHICLE REPAIR E827CBCC

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0171 SYSTEM TOO LEAN (BANK 1)

GENERAL DESCRIPTION EBF103AB

Refer to DTC P0170.

DTC DESCRIPTION E05B2D2A

If the lambda controller reaches the maximum or minimum threshold, then feedback control is no longer possible and emissions will be increased. The ECM sets DTC P0171 if no proportional post catalyst fuel trim adaptation occurs for a defined time after the lambda controller has reached its maximum threshold.

DTC DETECTING CONDITION ECFF0DF1

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td rowspan="2">DTC Strategy</td><td>Case1)</td><td>• Monitoring deviation of fuel trim control (Long term)</td><td rowspan="7">• Three Way Catalytic Converter(TWC)
• Rear HO2S</td></tr>
<tr><td>Case2)</td><td>• Monitoring deviation of fuel trim control (Short term)</td></tr>
<tr><td rowspan="2">Enable Conditions</td><td>Case1)</td><td>• No relevant failure
• Long term fuel trim active</td></tr>
<tr><td>Case2)</td><td>• No relevant failure
• Short term fuel trim active
• Canister load < 1
• Engine Coolant temperature > 70℃</td></tr>
<tr><td colspan="2">Threshold Value</td><td>• Short or Long term fuel trim > +25% or < -25%</td></tr>
<tr><td colspan="2">Diagnostic Time</td><td>• 60 sec.</td></tr>
<tr><td colspan="2">Mil On Condition</td><td>• 2 Driving Cycles</td></tr>
</table>

SIGNAL WAVEFORM AND DATA E25EDBC6

Refer to DTC P0170.

MONITOR DTC STATUS E03BC6B7

Refer to DTC P0170.

MONITOR ACTUATION TEST E184BD20

NOTE

The main purpose of this test is to identify potential engine mechanical condition problems and fuel and ignition systems problems that are not common to all cylinders. For best results, perform this test while maintaining as steady an rpm reading as possible.

WARNING

Before beginning tests; set the parking brake, place gear selector in P or N and block drive wheels for safety.

1. Warm up the engine to normal operating temperature and let it idle.
2. Install Scan Tool and select INJECTOR #1 parameter on the Actuation Test mode
3. Monitor engine rpm and shut off the injector #1 by pressing "STRT(F1)" key

4. Repeat procedure on all injectors and record the engine rpm.

Specification : All cylinders should show an even RPM drop.

5. Was each cylinder's rpm drop within the same value?

YES

▶ Go to next step as below

NO

▶ Cylinders with the least amount of RPM drop are not contributing their share of power.
▶ Go to "Fuel Injector Inspection" procedure and check the suspect cylinders

NOTE

If the RPM loss between cylinders is quite large(200RPM or more) and engine has high mileage, there is possibility of engine wear. Perform compression test with pressure gauge to check the engine wear

SYSTEM INSPECTION EBE038DE

CHECK INTAKE/EXHAUST SYSTEM FOR RESTRICTION OR LEAKAGE

1. Visually/physically inspect the air leakage in intake/exhaust system for the following areas:
   - 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. Visually/physically inspect the restriction in intake/exhaust system for the following areas:
   - Air cleaner filter element for excessive dirt or for any foreign objects
   - Throttle body inlet for damage or for any foreign objects
   - Throttle bore and throttle plate for chocking and for any foreign objects
   - Restricted exhaust system

3. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

4. Inspect the leakage in EVAP. system for the following conditions:

   1) Check the EVAP canister for fuel saturation. If the EVAP canister is full of fuel, visually and physically inspect the EVAP and fuel system.Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure. If OK, go to next step.

   2) Remove the manifold side vacuum hose from the EVAP canister purge valve.

   3) Using a hand vacuum pump apply specified vacuum(Approx. 15 in, Hg) to the manifold side of the valve

   4) Does the valve hold vacuum?

YES

▶ Go to next step as below

NO

▶ Repair air leakage and go to "Verification of Vehicle Repair" procedure

SENSOR INSPECTION

NOTE

Refer to "Signal Waveform & Data" in the "General Information" procedure

1. Visually/physically inspect the HO2S for the following conditions:
   - Ensure that the HO2S is securely installed.
   - Silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
   - Fuel, engine coolant or oil contamination
   - Use of improper sealant
   - If contamination is evident on the HO2S, Fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.

2. Visually/physically inspect the MAFS for the following conditions:
   - Contamination or deterioration
   - Poor connection or damaged harness

3. Check for an intermittent TPS false signal. TPS signal displayed on a scantool should increase steadily when depressing accelerator pedal after starting.

4. Verify that the ECM ground connections are clean and properly tightened.

5. If test result is NG, repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.
   If OK, go to next step as below.

NOTE

If the contamination is evident on the HO2S or MAFS. Fix the source of the sensor contamination before replacing the sensor to prevent future contamination.

POSITIVE CRANKCASE VENTILATION SYSTEM INSPECTION

1. Check the engine oil level. The oil level should be between the min. and max. marking. Fill to the correct oil level

2. Check crankcase ventilation valve for improper installation, damaged o-rings and malfunctioning .

3. Warm up the engine to normal operating temperature

4. Connect Scantool and note the "SHORT TERM FUEL-B1" parameter on the Scantool data list.

5. Disconnect and plug the positive crankcase ventilation at the intake manifold side

6. Monitor the "SHORT TERM FUEL-B1" parameter on the Scantool data list once again.

Specification : The value should remain more or less unchanged

7. Is the displayed value within the specified value?

YES

▶ Go to next step as below

NO

▶ Check the PCV(Positive Crankcase Ventilation) valve for operation properly. Refer to "EM" group in Workshop Manual. If OK, check that engine oil is diluted with fuel. Change the oil or filter as necessary and go to "Verification of Vehicle Repair" procedure

FUEL SYSTEM INSPECTION EB92B9D3

1. Fuel Line Pressure Inspection
   1) Check the fuel for excessive water, alcohol, or other contaminants. Replace contaminated fuel as necessary.
   2) Install a fuel pressure gage
   3) Inspect fuel pressure with normal idle status

Specification : 338~348kPa(3.45~3.55kg/㎠)

   4) Is fuel pressure within the specified value?

YES

▶ Go to next step as below

NO

▶ Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause	SuspectedArea
Fuel Pressure too low	Clogged fuel filter	Fuel filter
	Fuel leak on the fuel-pressure regulator that is assembled on fuel pump	Fuel Pump(Fuel Pressure Regulator)
Fuel Pressure too High	Sticking fuel pressure regulator	Fuel Pump(Fuel Pressure Regulator)

2. Fuel Pressure Hold Inspection
   1) Stop the engine and check for a change in the fuel pressure gauge reading.

Specification : After engine stops, the gauge reading should hold for minimum 5 minutes

   2) Is fuel pressure within the specified value?

YES

Visually/physically inspect the engine mechanical problem for the following:
- Worn cylinder
- Worn valve
- Worn piston or piston ring

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

NO

Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause	Suspected Area
Fuel pressure drops slowly	Injector leak	Injector
Fuel pressure drops immediately	Stuck open in check valve of the fuel pump	Fuel pump

VERIFICATION OF VEHICLE REPAIR E30C6324

Refer to DTC P0170.

DTC P0172 SYSTEM TOO RICH (BANK 1)

GENERAL DESCRIPTION E5BDD424

Refer to DTC P0170.

DTC DESCRIPTION E3FD0651

If the lambda controller reaches the maximum or minimum threshold, then feedback control is no longer possible and emissions will be increased. The ECM sets DTC P0172 if no proportional post catalyst fuel trim adaptation occurs for a defined time after the lambda controller has reached its minimum threshold.

DTC DETECTING CONDITION E5F2BE0C

Item		Detecting Condition	Possible Cause
DTC Strategy	Case1)	• Monitoring deviation of fuel trim control (Long term)	• Three Way Catalytic Converter(TWC) • Rear HO2S
	Case2)	• Monitoring deviation of fuel trim control (Short term)	
Enable Conditions	Case1)	• No relevant failure • Long term fuel trim active	
	Case2)	• No relevant failure • Short term fuel trim active • Canister load ＜ 1 • Engine coolant temperature ＞ 70℃	
Threshold Value		• Deviation value of fuel trim (Short/Long trim) ＞ +25% or ＜ -25%	
Diagnostic Time		• 60 sec.	
Mil On Condition		• 2 Driving Cycles	

SIGNAL WAVEFORM AND DATA EBDC00E1

Refer to DTC P0170.

MONITOR DTC STATUS EB3FCCF6

Refer to DTC P0170.

MONITOR ACTUATION TEST E62E759C

NOTE

The main purpose of this test is to identify potential engine mechanical condition problems and fuel and ignition systems problems that are not common to all cylinders. For best results, perform this test while maintaining as steady an rpm reading as possible.

WARNING

Before beginning tests; set the parking brake, place gear selector in P or N and block drive wheels for safety.

1. Warm up the engine to normal operating temperature and let it idle.

2. Install Scan Tool and select INJECTOR #1 parameter on the Actuation Test mode

3. Monitor engine rpm and shut off the injector #1 by pressing "STRT(F1)" key

4. Repeat procedure on all injectors and record the engine rpm.

Specification : All cylinders should show an even RPM drop.

5. Was each cylinder's rpm drop within the same value?

YES

▶ Go to next step as below

NO

▶ Cylinders with the least amount of RPM drop are not contributing their share of power.
▶ Go to "Fuel Injector Inspection" procedure and check the suspect cylinders

NOTE

If the RPM loss between cylinders is quite large(200RPM or more) and engine has high mileage, there is possibility of engine wear. Perform compression test with pressure gauge to check the engine wear

SYSTEM INSPECTION E0686634

CHECK INTAKE/EXHAUST SYSTEM FOR RESTRICTION OR LEAKAGE

1. Visually/physically inspect the air leakage in intake/exhaust system for the following areas:
   - 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. Visually/physically inspect the restriction in intake/exhaust system for the following areas:
   - Air cleaner filter element for excessive dirt or for any foreign objects
   - Throttle body inlet for damage or for any foreign objects
   - Throttle bore and throttle plate for chocking and for any foreign objects
   - Restricted exhaust system

3. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

4. Inspect the leakage in EVAP. system for the following conditions:

   1) Check the EVAP canister for fuel saturation. If the EVAP canister is full of fuel, visually and physically inspect the EVAP and fuel system.Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure. If OK, go to next step.

   2) Remove the manifold side vacuum hose from the EVAP canister purge valve.

   3) Using a hand vacuum pump apply specified vacuum(Approx. 15 in, Hg) to the manifold side of the valve

4) Does the valve hold vacuum?

YES

▶ Go to next step as below

NO

▶ Repair air leakage and go to "Verification of Vehicle Repair" procedure

SENSOR INSPECTION

NOTE

Refer to "Signal Waveform & Data" in the "General Information" procedure

1. Visually/physically inspect the HO2S for the following conditions:
   - Ensure that the HO2S is securely installed.
   - Silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
   - Fuel, engine coolant or oil contamination
   - Use of improper sealant
   - If contamination is evident on the HO2S, Fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.

2. Visually/physically inspect the MAFS for the following conditions:
   - Contamination or deterioration
   - Poor connection or damaged harness

3. Check for an intermittent TPS false signal. TPS signal displayed on a scantool should increase steadily when depressing accelerator pedal after starting.

4. Verify that the ECM ground connections are clean and properly tightened.

5. If test result is NG, repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.
   If OK, go to next step as below.

NOTE

If the contamination is evident on the HO2S or MAFS. Fix the source of the sensor contamination before replacing the sensor to prevent future contamination.

POSITIVE CRANKCASE VENTILATION SYSTEM INSPECTION

1. Check the engine oil level. The oil level should be between the min. and max. marking. Fill to the correct oil level

2. Check crankcase ventilation valve for improper installation, damaged o-rings and malfunctioning .

3. Warm up the engine to normal operating temperature

4. Connect Scantool and note the "SHORT TERM FUEL-B1" parameter on the Scantool data list.

5. Disconnect and plug the positive crankcase ventilation at the intake manifold side

6. Monitor the "SHORT TERM FUEL-B1" parameter on the Scantool data list once again.

Specification : The value should remain more or less unchanged

7. Is the displayed value within the specified value?

YES

▶ Go to next step as below

NO

▶ Check the PCV(Positive Crankcase Ventilation) valve for operation properly. Refer to "EM" group in Workshop Manual. If OK, check that engine oil is diluted with fuel. Change the oil or filter as necessary and go to "Verification of Vehicle Repair" procedure

FUEL SYSTEM INSPECTION EF001EAB

1. Fuel Line Pressure Inspection

   1) Check the fuel for excessive water, alcohol, or other contaminants. Replace contaminated fuel as necessary.

   2) Install a fuel pressure gage

   3) Inspect fuel pressure with normal idle status

Specification : 338~348kPa(3.45~3.55kg/㎠)

   4) Is fuel pressure within the specified value?

   YES

   ▶ Go to next step as below

   NO

   ▶ Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause	SuspectedArea
Fuel Pressure too low	Clogged fuel filter	Fuel filter
	Fuel leak on the fuel-pressure regulator that is assembled on fuel pump	Fuel Pump(Fuel Pressure Regulator)
Fuel Pressure too High	Sticking fuel pressure regulator	Fuel Pump(Fuel Pressure Regulator)

2. Fuel Pressure Hold Inspection

   1) Stop the engine and check for a change in the fuel pressure gauge reading.

Specification : After engine stops, the gauge reading should hold for minimum 5 minutes

   2) Is fuel pressure within the specified value?

   YES

   Visually/physically inspect the engine mechanical problem for the following:
   - Worn cylinder
   - Worn valve
   - Worn piston or piston ring

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

NO

Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

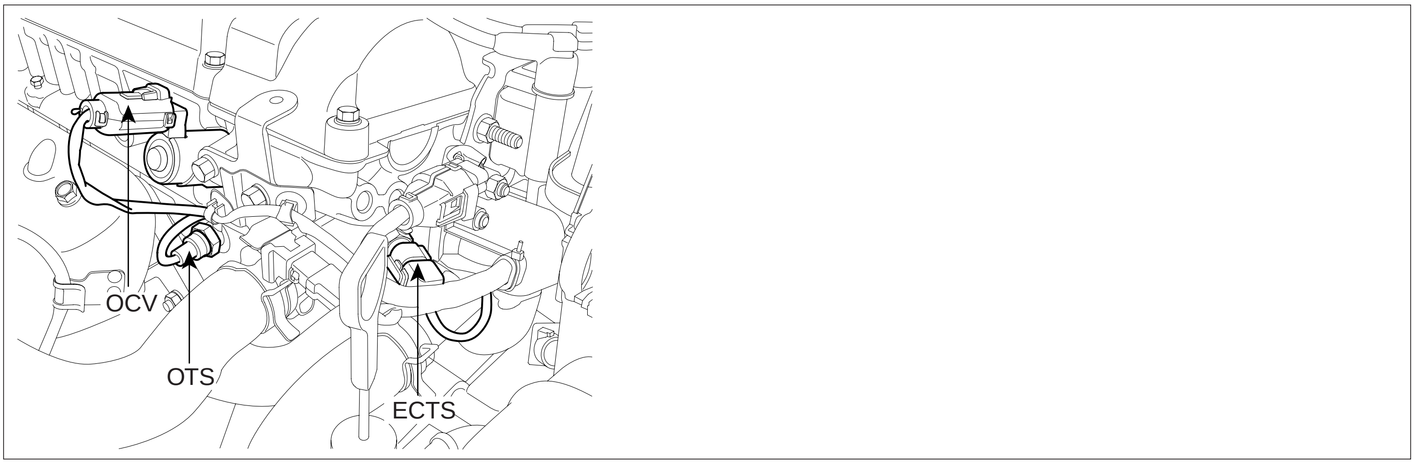
Condition	Possible Cause	Suspected Area
Fuel pressure drops slowly	Injector leak	Injector
Fuel pressure drops immediately	Stuck open in check valve of the fuel pump	Fuel pump

VERIFICATION OF VEHICLE REPAIR E1CCB26D

Refer to DTC P0170.

DTC P0196 ENGINE OIL TEMP. SENSOR RANGE / PERFORMANCE

COMPONENT LOCATION ECEE578F



SHDF16333L

GENERAL DESCRIPTION E9750A1F

The fluid of the CVVT is the engine oil and its density changes according to the engine oil temperature. At this time the Oil Temperature Sensor (OTS) helps compensation against the temperature differences. The Oil Temperature Sensor measures the engine oil temperature before the engine oil comes into the Oil-flow Control Valve (OCV).According to the measured temperature, the Engine Control Module (ECM) compensates the oil-flow control valve operation time.

DTC DESCRIPTION EEDD8070

The purpose of this diagnosis is to detect a stuck oil temperature signal or implausibly low ,high signal. For the stuck signal detection, the ECM checks whether after a variation of the calculated oil temperature also a variation of the measured oil temperature is detected and sets DTC P0196 if the variation of the measured oil temperature is lower than the threshold.For the implausibly high, low signal detection, the ECM compares measured engine oil temperature with calculated oil temperature or coolant temperature and sets DTC P0196 when one of following conditions is met.

1. Measured oil temperature is implausibly low when calculated oil temperature is high.
2. Measured oil temperature is implausibly high when coolant is low without any relevant failure.
3. Measured oil temp. ＜ threshold but calculated oil temp. ＞ threshold

DTC DETECTING CONDITION E1AFEAAC

Item		Detecting Condition	Possible Cause
DTC Strategy	Case1)	• Sensor signal implausible Low	• Contact resistance in connectors • Faulty OTS
	Case2)	• Sensor signal implausible High	
	Case 3)	• Sensor signal stuck	
Enable Conditions	Case1)	• Engine Oil temp. model > 70℃(158°F) • Engine coolant temperature at start < 53℃(127.4°F) • No relevant failure • 6 < Battery voltage	
	Case2)	• Engine coolant temperature < 70℃(158°F) • No relevant failure • 6 < Battery voltage	
	Case 3)	• Minimum Oil Temperature model increase > 50~100℃(122~212°F) depending on ECT at engine start • Modeled coolant temp. or measured coolant temp. > 85℃(185°F) • Engine coolant temperature at start < 40℃(104°F) • No relevant failure • 6 < Battery voltage	
Threshold Value	Case1)	• Measured oil temperature < 20℃(68°F)	
	Case2)	• Measured oil temperature > 100℃(212°F)	
	Case 3)	• Measured oil temperature increase < 17~35℃(30~63°F)(Threshold depends on Coolant temperature at start)	
Diagnostic Time	Case1)	• 15 seconds	
	Case2)	• 15 seconds	
	Case 3)	• 10~30 min. (depends on Engine Coolant Temp. and driving condition at start)	
Mil On Condition		• 2 Driving Cycles	

SPECIFICATION E0C4AB3E

Temp.(℃)	Temp.(°F)	OTS Resistance(kΩ)
-20	-4	Approx. 14.1 ~ 16.9
0	32	Approx. 6
20	68	Approx. 2.3 ~ 2.6
40	104	Approx. 1.1 ~ 1.2
60	140	Approx. 0.5
80	176	Approx. 0.3

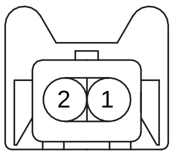
SCHEMATIC DIAGRAM EB39D89B

[Circuit Diagram]

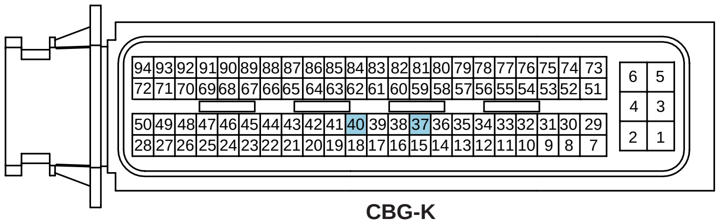
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (37)	Sensor Ground
2	ECM CBG-K (40)	OTS Signal

[Harness Connector]



CBG03
OTS



CBG-K
ECM

SHDF16245L

SIGNAL WAVEFORM AND DATA EB53FAC6

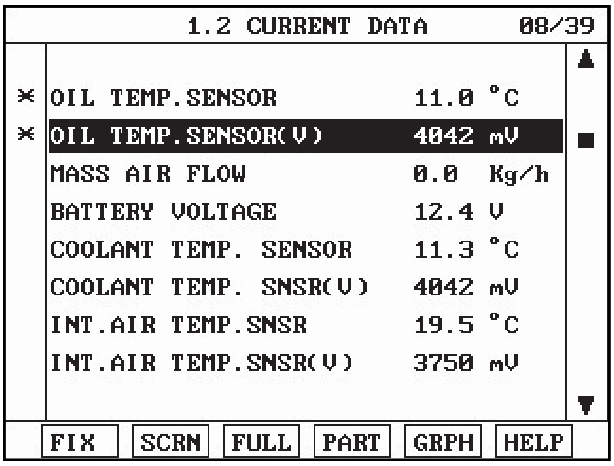


Fig1

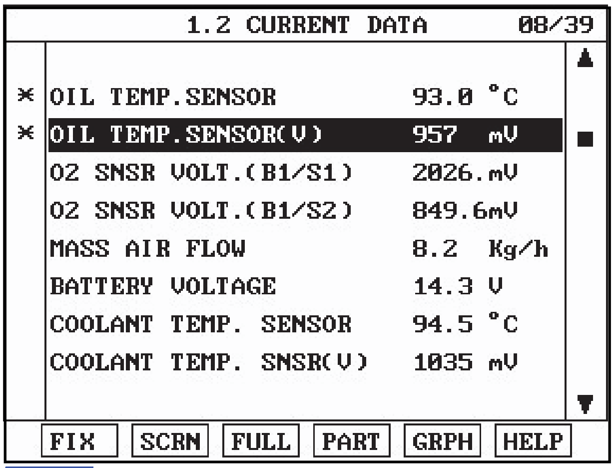


Fig2

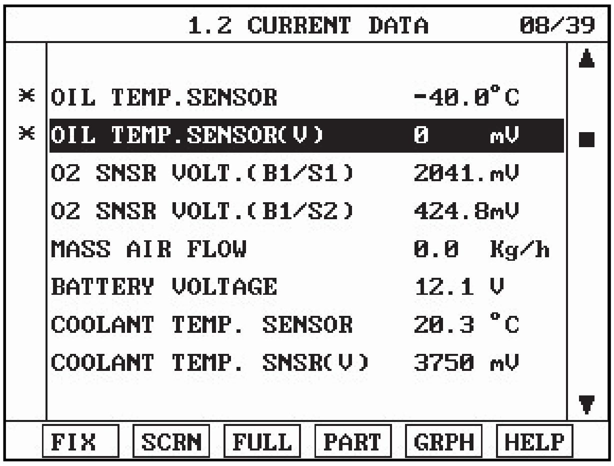


Fig3

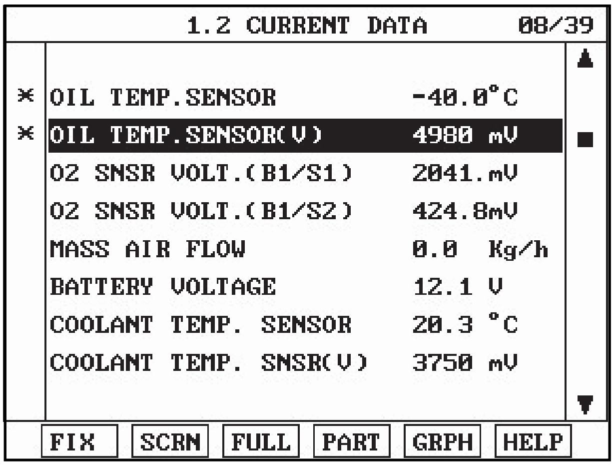


Fig4

Fig 1) Normal value with IG "ON"
Fig 2) Normal value with warm up
Fig 3) Short to ground in signal circuit : Approx. 0V
Fig 4) Open or short to battery in signal circuit/Open in ground circuit : Approx. 5V

SHDF16246L

MONITOR DTC STATUS E83B2A87

NOTE

If any DTCs relating to OTS(Oil Temperature Sensor) or ECT(Engine Coolant Temperature)Sensor are stored, do ALL REPAIRS associated with those codes before proceeding with this troubleshooting tree.

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

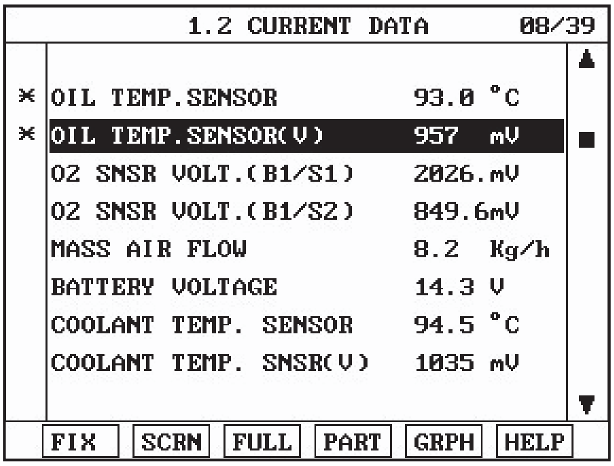
▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to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

NO

▶ Go to next step as below.

MONITOR SCANTOOL DATA EF1DDF81

1. Allow the engine to cool.
2. Run the cold engine at idle for 5 minutes.
3. Check the engine coolant temperature parameter at idle with the scantool.
4. Is the engine coolant temperature increase to above 50℃(122°F)



SHDF16247L

YES

▶ Go to next step as below

NO

▶ Check ECTS for contamination, deterioration, poor connection or damaged harness. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure

TERMINAL AND CONNECTOR INSPECTION E9ABA3A8

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

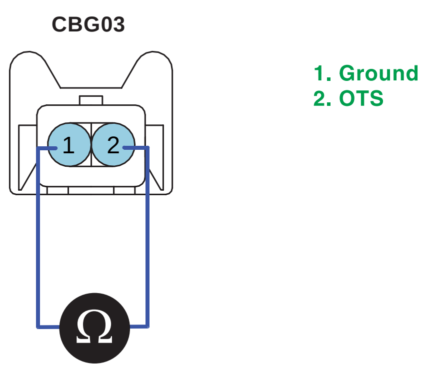
▶ Go to next step as below

COMPONENT INSPECTION ECF68BA3

1. Ignition "OFF"
2. Disconnect OTS connector.
3. Measure resistance between terminals 1 and 2 of OTS connector.(Component side)

SPECIFICATION

Temp.(℃)	Temp.(°F)	OTS Resistance(kΩ)
-20	-4	Approx. 14.1 ~ 16.9
0	32	Approx. 6
20	68	Approx. 2.3 ~ 2.6
40	104	Approx. 1.1 ~ 1.2
60	140	Approx. 0.5
80	176	Approx. 0.3



SHDF16248L

4. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Check OTS for contamination, deterioration, or damage. Substitute with a known-good OTS and check for proper operation. If the problem is corrected, replace OTS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E7F3F949

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0197 ENGINE OIL TEMP. SENSOR LOW INPUT

COMPONENT LOCATION E02BB4B0

Refer to DTC P0196.

GENERAL DESCRIPTION E0D5BC80

Refer to DTC P0196.

DTC DESCRIPTION ECC59B53

ECM sets DTC P0197 if the ECM detects signal voltage lower than the possible range of a properly operating OTS.

DTC DETECTING CONDITION E812A59B

Item	Detecting Condition	Possible Cause
DTC Strategy	• Engine Coolant temperature	• Short circuit to ground • Contact resistance in connectors • Faulty OTS
Enable Conditions	• Engine coolant temperature < 100℃(212°F) • No relevant failure • 6V < Battery Voltage	
Threshold Value	• Oil temperature > 154℃(309°F)	
Diagnostic Time	• 5 seconds	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E09D0EB1

Refer to DTC P0196.

SCHEMATIC DIAGRAM E5241292

Refer to DTC P0196.

MONITOR DTC STATUS E530076F

Refer to DTC P0196.

SIGNAL CIRCUIT INSPECTION E8AEEF77

1. Ignition "OFF"
2. Disconnect OTS connector
3. Measure resistance between terminal 2 of the sensor harness connector and chassis ground

Specification : Infinite

4. Is resistance within the specification?

YES

▶ Go to next step.

NO

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

TERMINAL AND CONNECTOR INSPECTION E1E18FC3

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

YES

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

NO

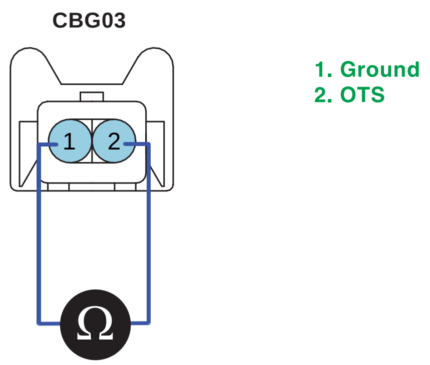
▶ Go to "Component Inspection" procedure

COMPONENT INSPECTION EE291B61

1. Ignition "OFF"
2. Disconnect OTS connector.
3. Measure resistance between terminals 1 and 2 of OTS connector.(Component side)

SPECIFICATION

Temp.(℃)	Temp.(°F)	OTS Resistance(kΩ)
-20	-4	Approx. 14.1 ~ 16.9
0	32	Approx. 6
20	68	Approx. 2.3 ~ 2.6
40	104	Approx. 1.1 ~ 1.2
60	140	Approx. 0.5
80	176	Approx. 0.3



SHDF16248L

4. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Check OTS for contamination, deterioration, or damage. Substitute with a known-good OTS and check for proper operation. If the problem is corrected, replace OTS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR EC1EC242

Refer to DTC P0196.

DTC P0198 ENGINE OIL TEMP. SENSOR HIGH INPUT

COMPONENT LOCATION E0EA6CC8

Refer to DTC P0196.

GENERAL DESCRIPTION EE755076

Refer to DTC P0196.

DTC DESCRIPTION E32D0E12

ECM sets DTC P0198 if the ECM detects signal voltage higher than the possible range of a properly operating OTS.

DTC DETECTING CONDITION EF43BE79

Item	Detecting Condition	Possible Cause
DTC Strategy	• Engine coolant temperature	• Open or short circuit to battery • Contact resistance in connectors • Faulty OTS
Enable Conditions	• Engine coolant temperature ＞ -10℃(14°F) • No relevant failure • 6V ＜ Battery Voltage	
Threshold Value	• Oil temperature ＜ -36℃(-33°F)	
Diagnostic Time	• 5 seconds	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E112FE9B

Refer to DTC P0196.

SCHEMATIC DIAGRAM E9550B92

Refer to DTC P0196.

MONITOR DTC STATUS E279C419

Refer to DTC P0196.

GROUND CIRCUIT INSPECTION EDCF94E4

1. Ignition "OFF"
2. Disconnect OTS connector
3. Measure resistance between terminals 1 of the OTS harness connector and chassis ground

Specification : Approx. 0Ω

4. Is resistance within specification?

YES

▶ Go to next step as below

NO

▶ Repair open circuit and go to "Verification of Vehicle Repair" procedure

SIGNAL CIRCUIT INSPECTION EB4FF15E

1. Check the signal circuit for short to battery
   1) Disconnect ECM harness connector
   2) Ignition "ON" & Engine "OFF"
   3) Measure voltage between terminal 2 of the OTS harness connector and chassis ground

Specification : Approx. 0V

   4) Is voltage within specification?

   YES

   ▶ Go to next step as below.

   NO

   ▶ Check for short to battery in signal circuit. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

2. Check the signal circuit for open
   1) Ignition "OFF"
   2) Measure resistance between terminals 2 of the OTS harness connector and 40 of the ECM harness connector.

Specification : Approx. 0Ω

   3) Is voltage within the specification?

   YES

   ▶ Go to next step as below

   NO

   ▶ Check for open in signal circuit. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EE59215A

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

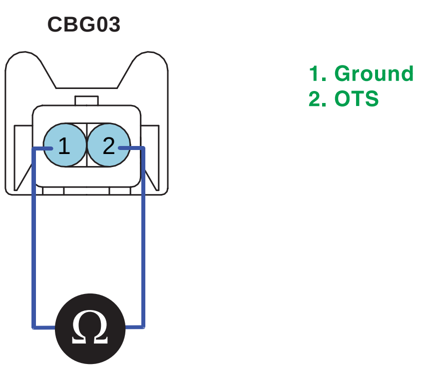
▶ Go to next step as below.

COMPONENT INSPECTION E23C29A0

1. Ignition "OFF"
2. Disconnect OTS connector.
3. Measure resistance between terminals 1 and 2 of OTS connector.(Component side)

SPECIFICATION

Temp.(℃)	Temp.(°F)	OTS Resistance(kΩ)
-20	-4	Approx. 14.1 ~ 16.9
0	32	Approx. 6
20	68	Approx. 2.3 ~ 2.6
40	104	Approx. 1.1 ~ 1.2
60	140	Approx. 0.5
80	176	Approx. 0.3



SHDF16248L

4. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

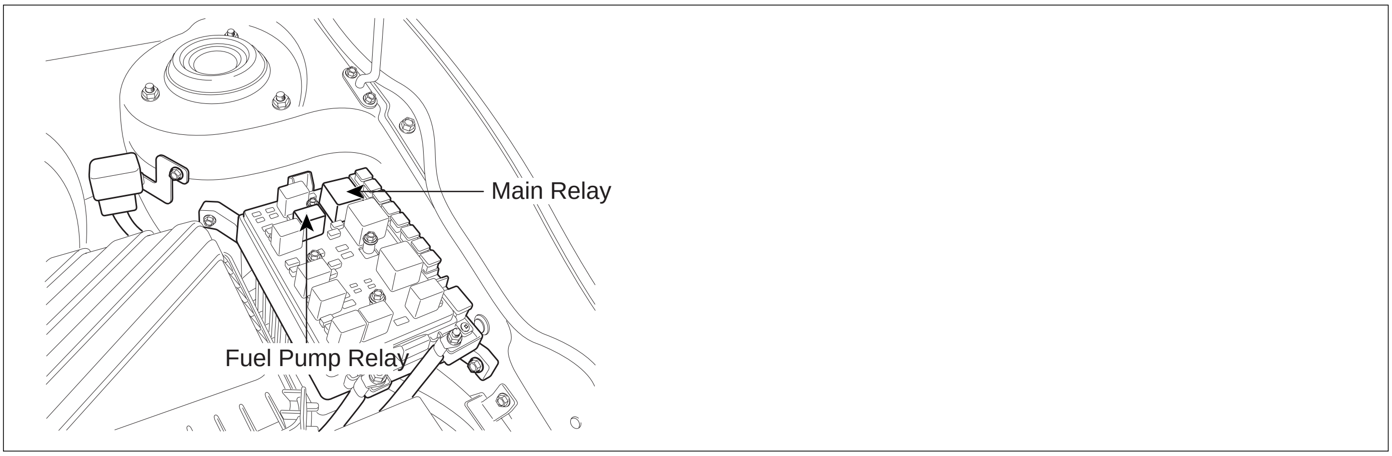
▶ Check OTS for contamination, deterioration, or damage. Substitute with a known-good OTS and check for proper operation. If the problem is corrected, replace OTS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E3598931

Refer to DTC P0196.

DTC P0230 FUEL PUMP PRIMARY CIRCUIT

COMPONENT LOCATION E6AAFBFC



SLDF17334L

GENERAL DESCRIPTION E422A5C0

The ECM provides ground to one side of the coil in the fuel pump relay to control the fuel pump relay. The other side of the fuel pump relay coil is connected to fuel pump relay, which activates when the ignition switch is ON. The ECM monitors the control circuit between the fuel pump relay and the ECM. When the ignition switch is turned ON, the ECM energizes the fuel pump relay, which sends power to the fuel pump.

DTC DESCRIPTION E7A5E6F7

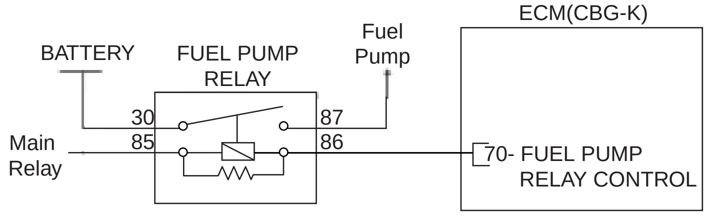
ECM sets DTC P0230 if the ECM detects the fuel pump relay control circuit is open, short to ground or battery.

DTC DETECTING CONDITION EEB4F247

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage Check	• Open or short in harness • Contact resistance in connectors • Faulty fuel pump relay
Enable Conditions	• 10V ＜ Battery voltage ＜ 16V	
Threshold Value	• Open, short to battery or short to ground,	
Diagnostic Time	• 3 seconds	
MIL On Condition	• -	

SCHEMATIC DIAGRAM ECFD8947

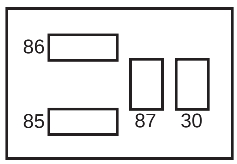
[Circuit Diagram]



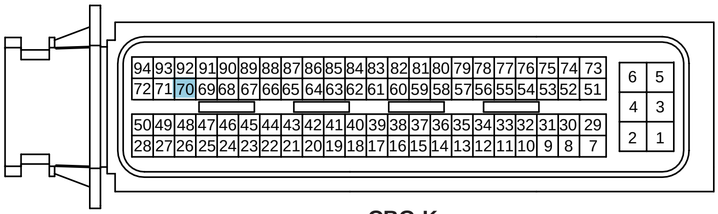
[Connection Information]

Terminal	Connected to	Function
30	Battery	Power Supply (B+)
85	Main Relay	Power Supply (B+)
86	ECM CBG-K (70)	Relay Control
87	Fuel Pump	Pump Power (B+)

[Harness Connector]



FUEL PUMP RELAY



CBG-K
ECM

SHDF16253L

MONITOR DTC STATUS EFF2B136

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

2. Press F4(DTAL) to select DTC information from the DTCs menu.

3. Confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

4. Read "DTC Status" parameter.

5. Is parameter displayed "History(Not Present) fault"?

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

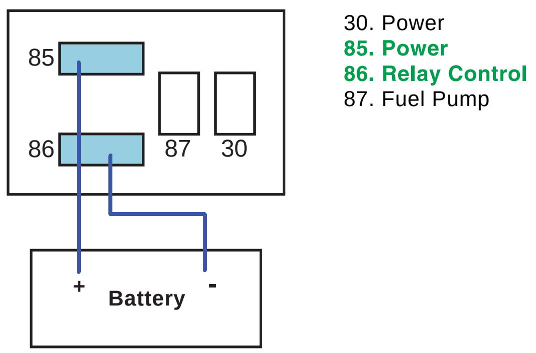
COMPONENT INSPECTION EF1EEEFE

1. With Ignition OFF, remove the fuel pump relay.

2. Measure resistance between terminals 85 and 86 of the fuel pump relay(Component side).

Specification : Approx. 70~120Ω at 20℃(68°F)

3. Apply 12V and a ground to 85 and 86 terminals of the fuel pump relay(Components side).



SHDF16335L

4. Check if the main relay works well when it is energized. (If the fuel pump relay works normally, a clicking sound can be heard.)

5. Does the fuel pump relay operate normally?

YES

▶ Go to next step as below.

NO

▶ Check fuel pump relay for contamination, deterioration, or damage. Substitute with a known-good fuel pump relay and check for proper operation. If the problem is corrected, replace fuel pump relay and then go to "Verification of Vehicle Repair" procedure.

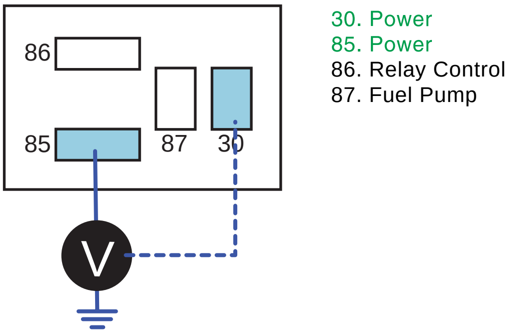
POWER CIRCUIT INSPECTION E6850420

1. Ignition "ON" & Engine "OFF".

2. Measure the voltage between terminal 30 of the fuel pump relay connector and chassis ground.

3. Measure the voltage between terminal 85 of the fuel pump relay connector and chassis ground.

Specification : Approx. B+



LFLG147A

4. Is voltage within the specification?

YES

▶ Go to "Control Circuit Inspection" procedure.

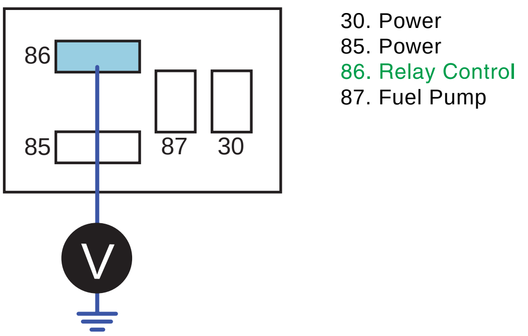
NO

▶ Check for an open or short to ground in the power supply circuit. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EA90EB93

1. Measure the voltage between terminal 86 of the fuel pump relay harness connector and chassis ground.

Specification : 4~5V



LFLG148A

2. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

▶ Check for open or short in control circuit. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION EFED2F4A

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Thoroughly check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure .

VERIFICATION OF VEHICLE REPAIR EF453E91

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

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

YES

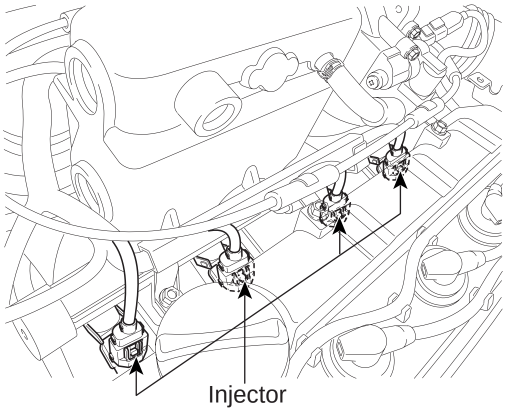
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC 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

COMPONENT LOCATION E670A6DF



SLDF17336L

GENERAL DESCRIPTION E2B38EEA

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

DTC DESCRIPTION ECCCEC15

ECM sets DTC P0261/P0264/P0267/P0270 if the ECM detects that injector (Cylinder #1/#2/#3/#4) control circuit is shorted to ground

DTC DETECTING CONDITION E2FF6D48

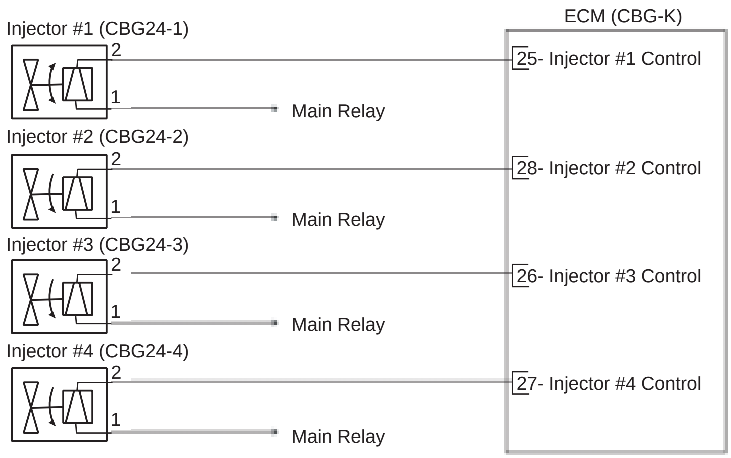
Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Open in power supply harness • Short to ground in control harness • Contact resistance in connectors • Faulty injector
Enable Conditions	• 10V < Battery voltage <16V • Engine speed(rpm) >32	
Threshold Value	• Short to ground	
Diagnostic Time	• 1.5sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E2547256

Temp.(℃)	Temp.(°F)	Resistance (Ω)
20	68	13.8~15.2

SCHEMATIC DIAGRAM E38CFE03

[Circuit Diagram]



[Connection Information]

Injector #1 (CBG24-1)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (25)	Injector Control

Injector #2 (CBG24-2)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (28)	Injector Control

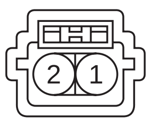
Injector #3 (CBG24-3)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (26)	Injector Control

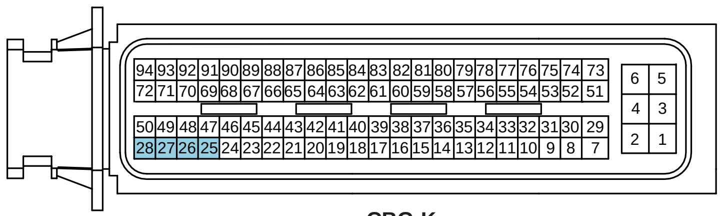
Injector #4 (CBG24-4)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (27)	Injector Control

[Harness Connector]



CBG24-1,2,3,4
INJECTOR #1,2,3,4



CBG-K
ECM

SLDF17254L

MONITOR DTC STATUS E23FA7D0

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

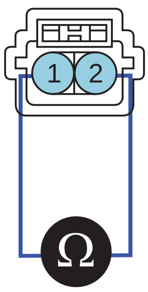
▶ Go to next step as below.

COMPONENT INSPECTION EFA9EF8E

1. Ignition "OFF".
2. Disconnect injector connector.
3. Measure resistance between terminals 1 and 2 of the injector connector(Component side).

SPECIFICATION :

Temp.(℃)	Temp.(°F)	Resistance (Ω)
20	68	13.8~15.2



SHDF16255L

4. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

▶ Check injector for contamination, deterioration, or damage. 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.

POWER CIRCUIT INSPECTION ED6165C6

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between terminal 1 of the injector harness connector and chassis ground.

Specification : Approx. B+

3. Is voltage within the specification?

YES

▶ Go to "Control Circuit Inspection" procedure.

NO

▶ Check for a open in the power supply circuit between the main relay and the Injector.
▶ Check for open or blown 10A injector fuse.
▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E3EC9312

1. Check for short to ground in control circuit.

    1) Ignition "OFF".

    2) Measure resistance between terminal 2 of the injector harness connector and chassis ground.

Specification :	Infinite

    3) Is resistance within the specification?

    YES

    ▶ Go to next step as below.

    NO

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

TERMINAL AND CONNECTOR INSPECTION E466A2E9

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure .

VERIFICATION OF VEHICLE REPAIR E2E4971D

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

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

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0262 CYLINDER 1-INJECTOR CIRCUIT HIGH
DTC P0265 CYLINDER 2-INJECTOR CIRCUIT HIGH
DTC P0268 CYLINDER 3-INJECTOR CIRCUIT HIGH
DTC P0271 CYLINDER 4-INJECTOR CIRCUIT HIGH

COMPONENT LOCATION E1A20B0C

Refer to DTC P0261.

GENERAL DESCRIPTION E7F043E2

Refer to DTC P0261.

DTC DESCRIPTION E22D3A41

ECM sets DTC P0262/P0265/P0268/P0271 if the ECM detects that injector (Cylinder #1/#2/#3/#4) control circuit is open or shorted to battery voltage.

DTC DETECTING CONDITION EDA8B04A

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Open or short to battery in control harness. • Contact resistance in connectors • Faulty injector
Enable Conditions	• 10V < Battery voltage <16V • Engine speed(rpm) >32	
Threshold Value	• Short to battery or Line break	
Diagnostic Time	• 1.5sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E43AD112

Refer to DTC P0261.

SCHEMATIC DIAGRAM E56108C7

Refer to DTC P0261.

MONITOR DTC STATUS E5FABBBE

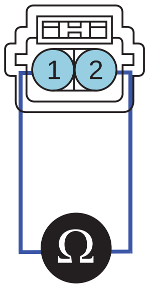
Refer to DTC P0261.

COMPONENT INSPECTION EB211088

1. Ignition "OFF".
2. Disconnect injector connector.
3. Measure resistance between terminals 1 and 2 of the injector connector(Component side).

SPECIFICATION :

Temp.(℃)	Temp.(°F)	Resistance (Ω)
20	68	13.8~15.2



SHDF16255L

4. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

▶ Check injector for contamination, deterioration, or damage. 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.

POWER CIRCUIT INSPECTION E0F2C789

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between terminal 1 of the injector harness connector and chassis ground.

Specification : Approx. B+

3. Is voltage within the specification?

YES

▶ Go to "Control Circuit Inspection" procedure.

NO

▶ Check for a open in the power supply circuit between the main relay and the Injector.
▶ Check for open or blown 10A injector fuse.
▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E57B0073

1. Measure voltage between terminal 2 of the injector harness connector and chassis ground.

Specification : Approx. 4~5V

2. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

▶ Check control circuit for open or short. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E24842F0

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

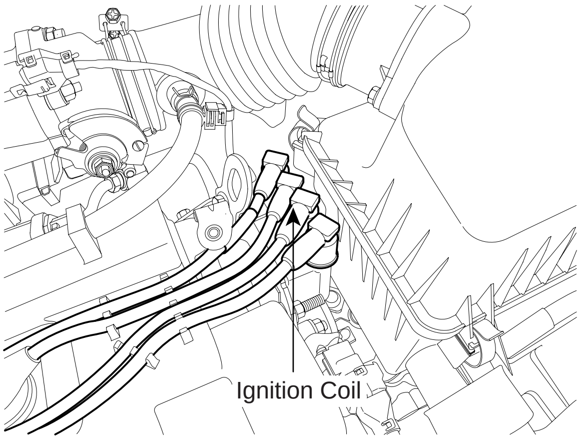
▶ heck for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E08E3E50

Refer to DTC P0261.

DTC P0300 RANDOM/MULTIPLE CYLINDER MISFIRE DETECTED

COMPONENT LOCATION EF1FA6F6



SHDF16337L

GENERAL DESCRIPTION E81FD852

The Misfire monitor diagnostic is based on crankshaft rotation velocity variation. The ECM determines crankshaft rotational velocity using the crankshaft position sensor and camshaft position sensor. When a cylinder misfires the crankshaft slows down momentarily. By monitoring the crankshaft and camshaft position sensor signals, the ECM can calculate when a misfire occurs. For a non-catalyst damaging misfire, the diagnostic will be required to report a misfire present within 1000-3200 engine revolutions. For catalyst damaging misfire, the diagnostic will respond to monitor 200 engine revolutions. Rough roads may cause false misfire detection. The rough road(acceleration)sensor consists of a piezoelectric vibration pick up which detects vertical acceleration of the vehicle. The sensor signal is used by the ECM to determine the degree of vertical movement of the car, for example, on a bumpy road. Since this may also cause uneven engine running, the ECM uses the signal to distinguish the phenomenon from actual misfiring.

DTC DESCRIPTION E754049F

If the ECM detects that engine speed variation indicates a misfire sufficient to cause three-way catalyst converter damage or emissions level to exceed standard value, the ECM sets misfire DTC. If the misfire rate is high enough to damage the catalyst, the MIL will flash to alert the vehicle operator. With a more than two cylinder misfire detection, the ECM sets P0300

DTC DETECTING CONDITION E8AD0B8F

Item	Detecting Condition	Possible Cause
DTC Strategy	• Calculation of engine roughness	• Faulty spark plugs, high-tension lead, or Ignition coil • Incorrect valve timing • Uneven compression • Air leakage • Improper Fuel pressure or dirty fuel. • Blocked/Leaking injectors • Leakage between cooling system and cylinder
Enable Conditions	• 170 < Mass air flow (mg/rev.) < 726 • 512 < Engine speed(RPM) < 4500 • 40 < MAF gradient (mg/rev/Seg.) < 400 • 141 < Throttle gradient (°TPS/sec.) < 199 • Coolant temperature > 20℃ (-4°F) if Start temperature < -7℃ (19.4°F) • No rough road • No relevant failure • 11V < Battery voltage < 16V • Fuel cut off not active	
Threshold Value	• Misfire detected on 2 or more cylinders	
MIL On Condition	• When misfire rate is high enough to damage the catalyst : Immediate • When emissions level to excees standard value : 2 Driving Cycle	

SPECIFICATION E4743333

Temp.(℃)	Temp.(°F)	Primary ignition coil (Ω)	Secondary ignition coil(kΩ)
20	68	0.5 ~ 0.6	7.5 ~ 10.2

MONITOR DTC STATUS E4A128BB

NOTE

If any codes relating to injectors, HO2S, ECT(Engine Coolant Temperature)Sensor, Throttle Position sensor or Mass Air Flow Sensor are stored, do ALL REPAIRS associated with those codes before proceeding with this troubleshooting tree.

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ If any misfire DTCs related to companion cylinders{P0301(Cylinder1) & P0304(Cylinder4), P0302(Cylinder2)) & P0303(Cylinder3)} are also stored, go to "Ignition System Inspection" procedure.If not, go to next step as below

SYSTEM INSPECTION E46A3A5D

VISUAL INSPECTION

1. Visually/physically inspect for the following conditions
   - Vacuum hoses in engine room for splits, kinks and improper installation
   - Positive crankcase ventilation valve for improper installation, damaged o-rings and malfunctioning .
   - Verify that the ECM ground connections are clean and properly tightened.

2. Check MAFS and ECTS for the following conditions:
   - Check MAFS and ECTS for the following conditions:
   - The MAF signal displayed on the scantool should increase as engine speed increases
   - The engine coolant temperature displayed on the scantool should close to the actual coolant temperature.

3. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

TIMING INSPECTION

1. With ignition "OFF", set up an oscilloscope as follows :
   Channel A (+): terminal 2 of the Crankshaft Position Sensor(CKPS), (-): ground
   Channel B (+): terminal 2 of the Camshaft Position Sensor(CMPS), (-): ground

2. Start the engine and check for signal waveform whether synchronize with camshaft sensor or not.

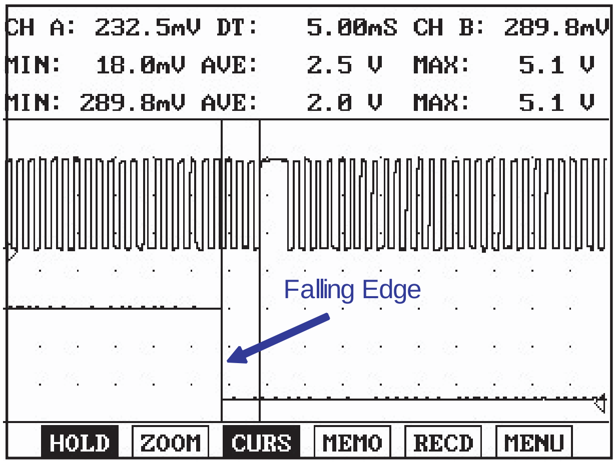


Fig 1

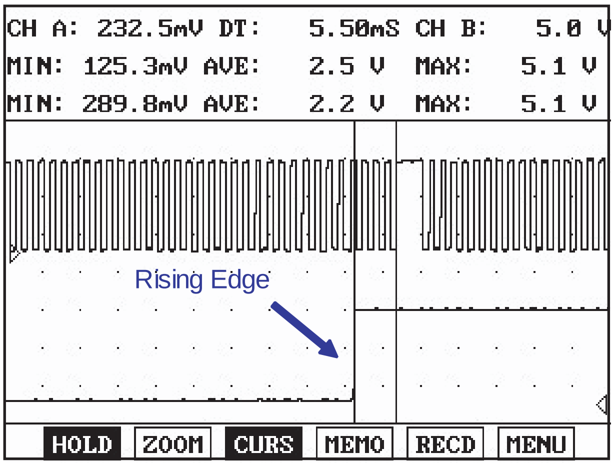


Fig 2

Fig.1,2)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

SLDF17271L

3. Is the signal waveform normal?

YES

▶ Go to next step as below.

NO

▶ Repair or readjust as necessary, if air gap of the CKPS is exceeds specification[0.3~1.7 mm(0.012~0.067 in)]. If OK, check that the crankshaft and camshaft are correctly aligned the matching marks of the pulleys. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure.

IGINITION SYSTEM INSPECTION

1. Spark Plug Cable & Ignition Coil Inspection

   1) Visually/physically inspect the spark plug cable and ignition coil related to the misfiring cylinder(s) for the following conditions
      - Damage, cracks, carbon and flashover
      - Poor connection or damaged harness
      - Connected to the incorrect cylinders at the ignition coil and spark plug

   2) Measure the resistance of the spark plug cable related to the misfiring cylinder(s)

Specification : 5.6kΩ/m ± 20%

   3) Measure the resistance of the primary and secondary ignition coil related to the misfiring cylinder(s)

Specification : Primary Ignition Coil Resistance : Approx. 0.5~0.6Ω at 20℃(68°F) Secondary Ignition Coil Resistance : Approx. 7.5~10.2kΩ at 20℃(68°F)

   4) Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

2. Spark Plug Inspection

1) Visually/physically inspect the spark plug related to the misfiring cylinder(s) for the following conditions
- Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
- Check for electrode 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.

2) Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

FUEL SYSTEM INSPECTION

1. Fuel Line Pressure Inspection

1) Check the fuel for excessive water, alcohol, or other contaminants. Replace contaminated fuel as necessary.

2) Install a fuel pressure gage

3) Inspect fuel pressure with normal idle status

Specification : 338~348kPa(3.45~3.55kg/㎠)

4) Is fuel pressure within the specified value?

YES

▶ Go to next step as below

NO

▶ Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Condition	Possible 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	Fuel Pump(Fuel Pressure Regulator)
Fuel Pressure too High	Sticking fuel pressure regulator	Fuel Pump(Fuel Pressure Regulator)

2. Fuel Pressure Hold Inspection

1) Stop the engine and check for a change in the fuel pressure gauge reading.

Specification : After engine stops, the gauge reading should hold for minimum 5 minutes

2) Is fuel pressure within the specified value?

YES

▶ Go to next step as below

NO

▶ Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause	Suspected Area
Fuel pressure drops slowly	Injector leak	Injector
Fuel pressure drops immediately	Stuck open in check valve of the fuel pump	Fuel pump

ENGINE COMPRESSION TEST

1. Warm up the engine to normal operating temperature. Verify the battery must be at or near full charge.
2. With ignition "OFF", disconnect the ignition coil connectors and the spark plug cables
3. Install compression pressure gauge to the spark plug hole.
4. With wide open throttle by hand, cranking the engine and record the compression readings from all of the cylinders

Specification :
Compression pressure : 1,283kPa (13.0kgf/cm², 185psi)
Minimum pressure : 1,135kPa (11.5kgf/cm², 164psi)
Difference between each cylinder : 100kPa (1.0kgf/cm², 15psi) or less

5. Is compression pressure within the specified value?

YES

▶ Verify if the engine has excessive coolant consumption. If yes, check for damaged inlet water passage, engine block, cylinder head or head gasket. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat compression test for cylinders with low compression pressure.
- If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
- If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.

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

VERIFICATION OF VEHICLE REPAIR E1F4F2DD

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0301 CYLINDER 1-MISFIRE DETECTED
DTC P0302 CYLINDER 2-MISFIRE DETECTED
DTC P0303 CYLINDER 3-MISFIRE DETECTED
DTC P0304 CYLINDER 4-MISFIRE DETECTED

COMPONENT LOCATION EAA6E580

Refer to DTC P0300.

GENERAL DESCRIPTION EC4E2C92

Refer to DTC P0300.

DTC DESCRIPTION ECDEA054

If the ECM detects that engine speed variation indicates a misfire sufficient to cause three-way catalyst converter damage or emissions level to exceed standard value, the ECM sets DTC P0301/P0302/P0303/P0304. If the misfire rate is high enough to damage the catalyst, the MIL will flash to alert the vehicle operator.

DTC DETECTING CONDITION EB4277E3

Item		Detecting Condition	Possible Cause
DTC Strategy		• Calculation of engine roughness	• Faulty spark plugs, high-tension lead, or Ignition coil • Incorrect valve timing • Uneven compression • Air leakage • Improper Fuel pressure or dirty fuel. • Blocked/Leaking injectors • Leakage between cooling system and cylinder
Enable Conditions		• 170 < Mass air flow (mg/rev.) < 726 • 512 < Engine speed(RPM) < 4500 • 40 < MAF gradient (mg/rev/Seg.) < 400 • 141 < Throttle gradient (°TPS/sec.) < 199 • Coolant temperature > 20℃ (-4°F) if Start temperature < -7℃ (19.4°F) • No rough road • No relevant failure • 11V < Battery voltage < 16V • Fuel cut off not active	
Threshold Value	Case1)	• Misfire = 12~54% within 200 rev. (Catalyst temperature > 1000℃ (1832°F))	
	Case2)	• Misfire = 1.3% within 1000 rev.	
Diagnosis Time	Case1)	• 200 revolution or 3*200 revolution	
	Case2)	• 1000 revolution or 4*1000 revolution	
Mil On Condition	Case1)	• Immediate	
	Case2)	• 2 Driving Cycles	

SPECIFICATION EB205C07

Refer to DTC P0300.

MONITOR DTC STATUS EEB60EB9

Refer to DTC P0300.

SYSTEM INSPECTION E3C9EF07

VISUAL INSPECTION

1. Visually/physically inspect for the following conditions
   - Vacuum hoses in engine room for splits, kinks and improper installation
   - Positive crankcase ventilation valve for improper installation, damaged o-rings and malfunctioning .
   - Verify that the ECM ground connections are clean and properly tightened.

2. Check MAFS and ECTS for the following conditions:
   - Check MAFS and ECTS for the following conditions:
   - The MAF signal displayed on the scantool should increase as engine speed increases
   - The engine coolant temperature displayed on the scantool should close to the actual coolant temperature.

3. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

TIMING INSPECTION

1. With ignition "OFF", set up an oscilloscope as follows :
   Channel A (+): terminal 2 of the Crankshaft Position Sensor(CKPS), (-): ground
   Channel B (+): terminal 2 of the Camshaft Position Sensor(CMPS), (-): ground

2. Start the engine and check for signal waveform whether synchronize with camshaft sensor or not.

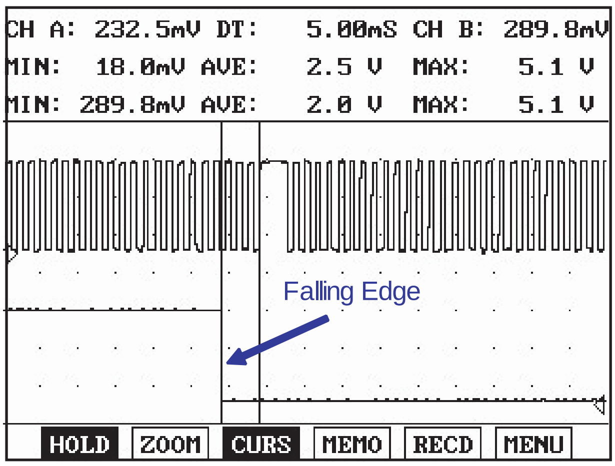


Fig 1

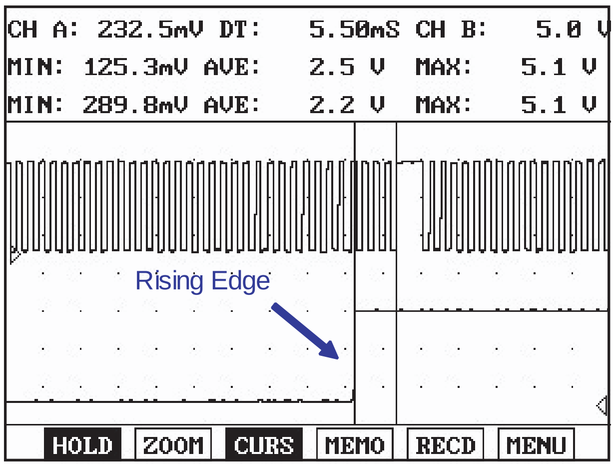


Fig 2

Fig.1,2)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

SLDF17271L

3. Is the signal waveform normal?

YES

▶ Go to next step as below.

NO

▶ Repair or readjust as necessary, if air gap of the CKPS is exceeds specification[0.3~1.7 mm(0.012~0.067 in)]. If OK, check that the crankshaft and camshaft are correctly aligned the matching marks of the pulleys. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure.

IGINITION SYSTEM INSPECTION

1. Spark Plug Cable & Ignition Coil Inspection

   1) Visually/physically inspect the spark plug cable and ignition coil related to the misfiring cylinder(s) for the following conditions
      - Damage, cracks, carbon and flashover
      - Poor connection or damaged harness
      - Connected to the incorrect cylinders at the ignition coil and spark plug

   2) Measure the resistance of the spark plug cable related to the misfiring cylinder(s)

Specification : 5.6kΩ/m ± 20%

   3) Measure the resistance of the primary and secondary ignition coil related to the misfiring cylinder(s)

Specification :
Primary Ignition Coil Resistance : Approx. 0.5~0.6Ω at 20℃(68°F)
Secondary Ignition Coil Resistance : Approx. 7.5~10.2kΩ at 20℃(68°F)

   4) Was a problem found in any of the above areas?

      YES

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

      NO

      ▶ Go to next step as below

2. Spark Plug Inspection

   1) Visually/physically inspect the spark plug related to the misfiring cylinder(s) for the following conditions
      - Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
      - Check for electrode 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.

   2) Was a problem found in any of the above areas?

      YES

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

      NO

      ▶ Go to next step as below

FUEL SYSTEM INSPECTION

1. Fuel Line Pressure Inspection

   1) Check the fuel for excessive water, alcohol, or other contaminants. Replace contaminated fuel as necessary.

   2) Install a fuel pressure gage

3) Inspect fuel pressure with normal idle status

Specification : 338~348kPa(3.45~3.55kg/㎠)

4) Is fuel pressure within the specified value?

YES

▶ Go to next step as below

NO

▶ Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Condition	Possible 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	Fuel Pump(Fuel Pressure Regulator)
Fuel Pressure too High	Sticking fuel pressure regulator	Fuel Pump(Fuel Pressure Regulator)

2. Fuel Pressure Hold Inspection

1) Stop the engine and check for a change in the fuel pressure gauge reading.

Specification : After engine stops, the gauge reading should hold for minimum 5 minutes

2) Is fuel pressure within the specified value?

YES

▶ Go to next step as below

NO

▶ Inspect the suspected area. Refer to table as below. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause	Suspected Area
Fuel pressure drops slowly	Injector leak	Injector
Fuel pressure drops immediately	Stuck open in check valve of the fuel pump	Fuel pump

ENGINE COMPRESSION TEST

1. Warm up the engine to normal operating temperature. Verify the battery must be at or near full charge.
2. With ignition "OFF", disconnect the ignition coil connectors and the spark plug cables
3. Install compression pressure gauge to the spark plug hole.
4. With wide open throttle by hand, cranking the engine and record the compression readings from all of the cylinders

Specification :
Compression pressure : 1,283kPa (13.0kgf/cm², 185psi)
Minimum pressure : 1,135kPa (11.5kgf/cm², 164psi)
Difference between each cylinder : 100kPa (1.0kgf/cm², 15psi) or less

5. Is compression pressure within the specified value?

YES

▶ Verify if the engine has excessive coolant consumption. If yes, check for damaged inlet water passage, engine block, cylinder head or head gasket. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat compression test for cylinders with low compression pressure.

- If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
- If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.

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

VERIFICATION OF VEHICLE REPAIR EA34F145

Refer to DTC P0300.

DTC P0315 SEGMENT TIME ACQUISITION INCORRECT

COMPONENT LOCATION E1F49C3D

SHDF16338L

GENERAL DESCRIPTION EF248B93

The Crankshaft Position Sensor (CKPS) is a hall effect type sensor that generates voltage using a sensor and a target wheel mounted on the crankshaft; there are 58 slots in the target wheel where one is longer than the others. When the slot in the wheel aligns with the sensor, the sensor voltage outputs low. When the metal (tooth) in the wheel aligns with the sensor, the sensor voltage outputs high. During one crankshaft rotation there are 58 rectangular signals and one longer signal. The ECM calculates engine RPM by using the sensor' s signal and controls the injection duration and the ignition timing. Using the signal differences caused by the longer slot, the ECM identifies which cylinder is at top dead center.

DTC DESCRIPTION E5D67398

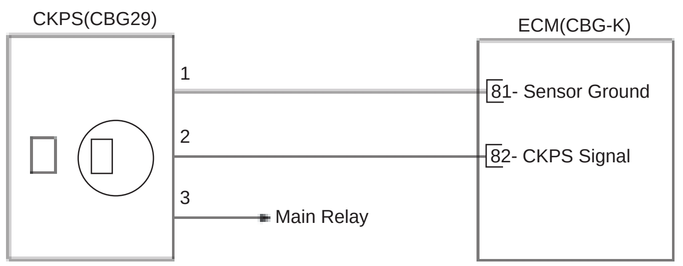
The ECM sets DTC P0315 when the number of crankshaft teeth during one revolution is incorrect or crankshaft signal is missing while camshaft signal is detected.

DTC DETECTING CONDITION E16BE7C3

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitor segment time adaptation	• Improperly installed target wheel • Contact resistance in connectors
Enable Conditions	• 2000 ＜ Engine speed(RPM) ＜ 3000 • No relevant failure	
Threshold Value	• Segment adaptation value ＞ 5/1000	
Diagnostic Time	•	
MIL On Condition	• 2 driving cycles	

SCHEMATIC DIAGRAM EBDE7C29

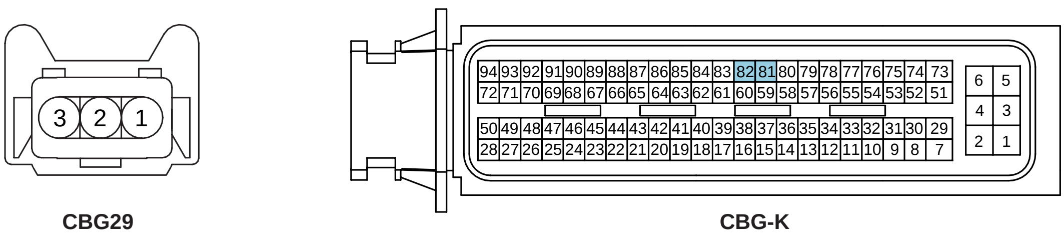
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (81)	Sensor Ground
2	ECM CBG-K (82)	CKPS Signal
3	Main Relay	Power Supply (B+)

[Harness Connector]



CBG29
CKPS

CBG-K
ECM

SLDF17272L

SIGNAL WAVEFORM AND DATA EC089C2F

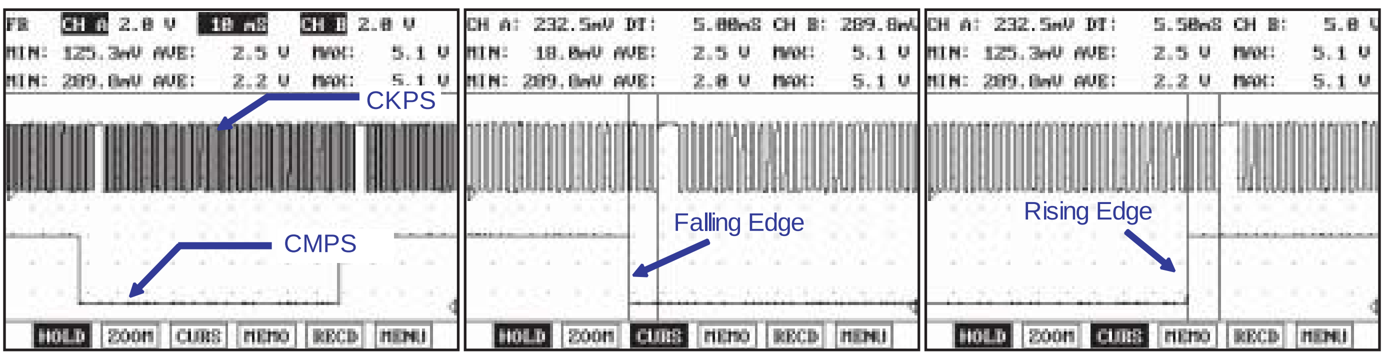


Fig 1 Fig 2 Fig 3

Fig.1) The square wave signal should be smooth and without any distortion.
Fig.2,3)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

SLDF17156L

MONITOR DTC STATUS E6CA72C1

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

2. Press F4(DTAL) to select DTC information from the DTCs menu.

3. Confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

4. Read "DTC Status" parameter.

5. Is parameter displayed "History(Not Present) fault"?

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

COMPONENT INSPECTION E8FBFED1

1. Set up an oscilloscope as follows :
   Channel A (+): terminal 2 of the CKPS(back probe), (-): ground.
   Channel B (+): terminal 2 of the CMPS(back probe), (-): ground.

2. Start the engine and check for signal waveform compared with reference waveform as below.

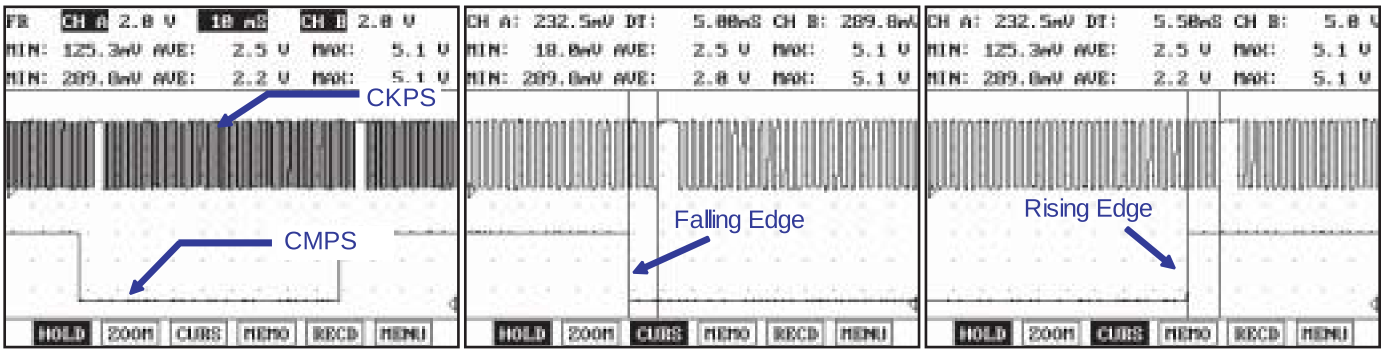


Fig 1 Fig 2 Fig 3

Fig.1) The square wave signal should be smooth and without any distortion.
Fig.2,3)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

SLDF17156L

3. Is the signal waveform normal?

YES

▶ Go to next step as below.

NO

▶ Remove CKP and calculate air gap between sensor and flywheel/torque converter. Readjust as necessary and go to "Verification of Vehicle Repair" procedure

NOTE

Air gap [0.3~1.7 mm [0.012~0.067 in] = measure distance from housing to teeth on flywheel/torque converter (measurement "A") and from mounting surface on sensor to sensor tip (measurement "B") subtract "B" from "A"

- If fail to synchronize with CMP sensor, check that the crankshaft and camshaft are correctly aligned the matching marks of the pulleys. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure
- Check CKPS for contamination, deterioration, or damage. Substitute with a known-good CKPS and check for proper operation. If the problem is corrected, replace CKPS and then go to "Verification of Vehicle Repair" procedure

TERMINAL AND CONNECTOR INSPECTION EF59C6EA

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E3C823DD

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

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

YES

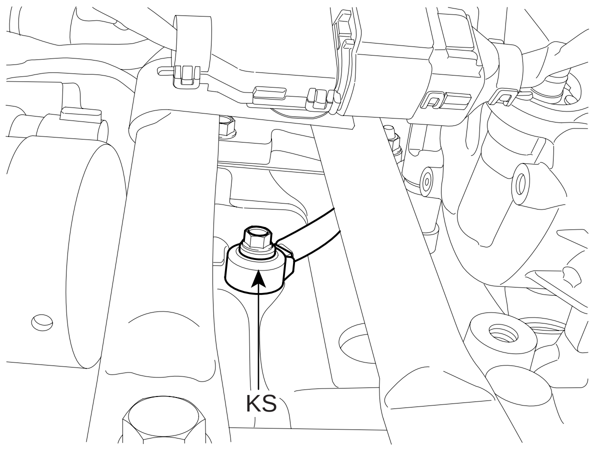
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0325 KNOCK SENSOR 1 CIRCUIT

COMPONENT LOCATION EF880DF1



SHDF16339L

GENERAL DESCRIPTION E78D58BD

The knock sensor is attached to the cylinder block and senses engine knocking. The sensor contains a piezoelectric element that converts vibration (or noise) into voltage signal and sends this signal to ECM. With input signals from camshaft position and crankshaft position sensor, ECM can identify which cylinder is knocking. ECM filters vibrations and determines if the vibrations are knocking signal. The Engine Control Module (ECM) uses this signal to suppress knocking by retarding ignition timing. The ECM will set a code (Malfunction Indicator Lamp will Not turn on) if during two driving cycles the Knock sensor’s output voltage falls below minimum threshold. This code indicates an unexpected vibration is being read by the Knock sensor or ECM under normal engine operation.

DTC DESCRIPTION E2235751

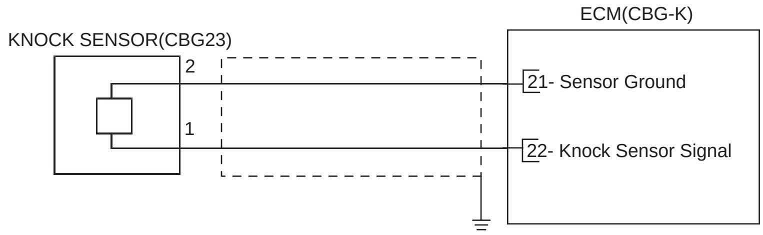
The ECM monitors the range of the analog input signal from knock sensor to check sensor failure that is short circuit or open circuit. If the difference between knock signal and noise level is smaller than the threshold during defined time period, the DTC P0325 is set. In case the noise level is higher than the upper threshold or lower than the lower threshold, the DTC P0325 is set too.

DTC DETECTING CONDITION E5750F6B

Item	Detecting Condition	Possible Cause
DTC Strategy	• Plausability check	• Open/short in signal or ground circuit • Contact resistance in connectors • Faulty knock sensor
Enable Conditions	• Engine speed > 2200 rpm • Engine load > 0.4g/rev (220mg/tdc) • No relevant failure	
Threshold Value	• Difference between sensor signal and noise level < 0.08V	
Diagnostic Time	• 200 revolutions	
MIL On Condition	• -	

SCHEMATIC DIAGRAM EC70C303

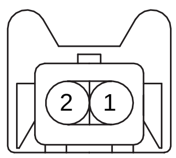
[Circuit Diagram]



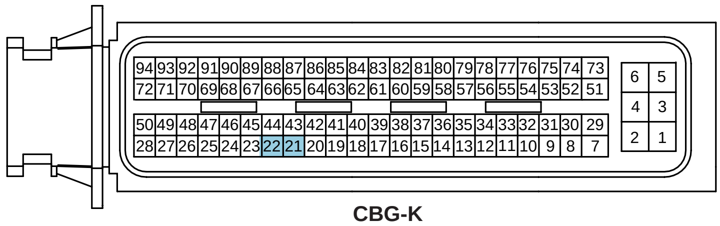
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (22)	Knock Sensor Signal
2	ECM CBG-K (21)	Sensor Ground

[Harness Connector]



CBG23
KNOCK SENSOR



CBG-K
ECM

SHDF16273L

MONITOR DTC STATUS E2CAC069

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

GROUND CIRCUIT INSPECTION E558A8DD

1. Ignition "OFF"

2. Disconnect Knock sensor and ECM connectors

3. Measure resistance between terminals 2 of the sensor harness connector and 21 of the ECM harness connector

Specification : Approx. 0Ω

4. Is resistance within the specification?

YES

▶ Go to "Signal Circuit Inspection" procedure

NO

▶ Check for an open in ground circuit. Repair as necessary and go to "Verification of Vehicle Repair" procedure

SIGNAL CIRCUIT INSPECTION E4855618

1. Check for short to ground in signal circuit

   1) Measure resistance between terminal 1 of sensor harness connector and chassis ground

Specification : Infinite

   2) Is resistance within the specification?

   YES

   ▶ Go to next step as below

   NO

   ▶ Check signal circuit for short to ground. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

2. Check for short to power in signal circuit

   1) Disconnect ECM connector

   2) Ignition "ON" & Engine "OFF"

   3) Measure voltage between terminals 2 of sensor harness connector and chassis ground

Specification : Approx. 0V

   4) Is voltage within the specification?

   YES

   ▶ Go to next step as below

   NO

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

3. Check for open in signal harness

1) Ignition "OFF"

2) Measure resistance between terminals 1 of sensor harness connector and 22 of the ECM harness connector

Specification : Approx. 0Ω

3) Is resistance within the specification?

YES

▶ Go to next step as below

NO

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

TERMINAL AND CONNECTOR INSPECTION E12CC61D

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below.

COMPONENT INSPECTION E4D131EF

1. Component resistance inspection

1) Measure resistance between terminals 1 and 2 of the sensor connector(Component side)

Specification : Approx. 5MΩ at 20°C(68°F)

2. Output signal inspection

1) Remove knock sensor from vehicle and secure (across mounting boss) in a shop vise.

2) Set up an oscilloscope as follows :
Channel A (+): terminal 1 (-): terminal 2

3) Rap on vise with a ball peen hammer while monitoring oscilloscope screen (there should be a spike of less than 1 volt with each hammer strike).

Specification : knock sensor send a voltage spike with hammer strikes

3. Installation torque inspection

1) Check the installation torque of the knock sensor.

Specification : Approx. 16 ~ 28N·m(160~250 kg·cm,11.8~18.4 lb·ft)

4. Has a problem been found?

YES

▶ Check knock sensor for contamination, deterioration, or damage. Substitute with a known-good sensor and check for proper operation. If the problem is corrected, replace sensor and then go to "Verification of Vehicle Repair" procedure

NO

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR EC06BF4E

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

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

YES

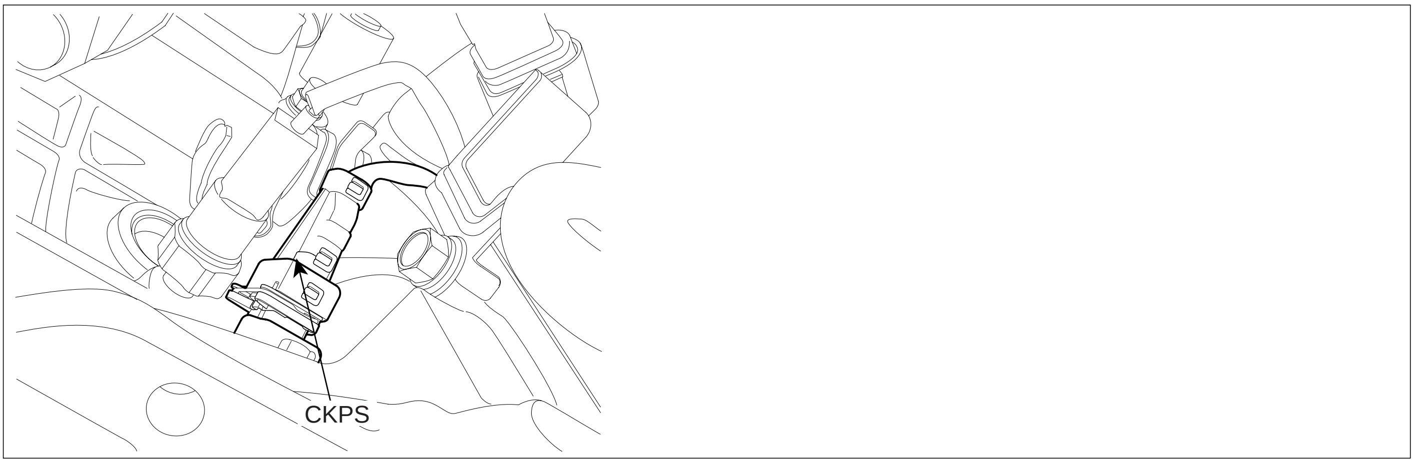
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0335 CRANKSHAFT POSITION SENSOR A CIRCUIT

COMPONENT LOCATION E9B20FAB



SHDF16338L

GENERAL DESCRIPTION E12AF6E3

The Crankshaft Position Sensor (CKPS) is a hall effect type sensor that generates voltage using a sensor and a target wheel mounted on the crankshaft; there are 58 slots in the target wheel where one is longer than the others. When the slot in the wheel aligns with the sensor, the sensor voltage outputs low. When the metal (tooth) in the wheel aligns with the sensor, the sensor voltage outputs high. During one crankshaft rotation there are 58 rectangular signals and one longer signal. The ECM calculates engine RPM by using the sensor' s signal and controls the injection duration and the ignition timing. Using the signal differences caused by the longer slot, the ECM identifies which cylinder is at top dead center.

DTC DESCRIPTION EA53C8CA

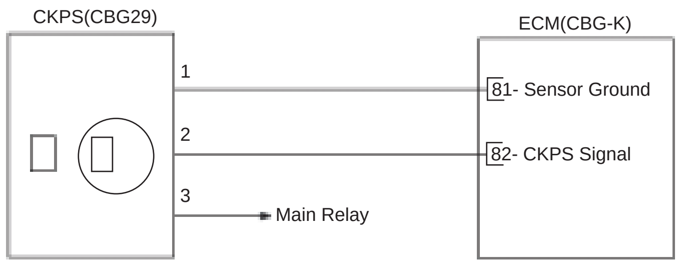
The ECM sets DTC P0335 when the number of crankshaft teeth during one revolution is incorrect or crankshaft signal is missing while camshaft signal is detected.

DTC DETECTING CONDITION E770CC62

Item		Detecting Condition	Possible Cause
DTC Strategy		• Check camshaft signal switching	• Open or short in signal, ground or power supply circuit • Contact resistance in connectors • Damage to the connecting flange/flywheel • Misadjust crankshaft and camshaft pulley position • Faulty CKP sensor
Enable Conditions		• 10V < Battery voltage < 16V • No relevant failure	
Threshold Value	Case1)	• No crankshaft teeth during 4 camshaft signal transition	
	Case2)	• Crankshaft Teeth detected but synchronisation not successful	
	Case 3)	• No signal or Number of Crankshaft Teeth within one revolution is abnormal.)	
Diagnosis Time	Case1)	• 2 revolutions	
	Case2)	• 2 revolutions	
	Case 3)	• 2.5 revolutions	
Mil On Condition		• 2 Driving Cycles	

SCHEMATIC DIAGRAM E6F525DC

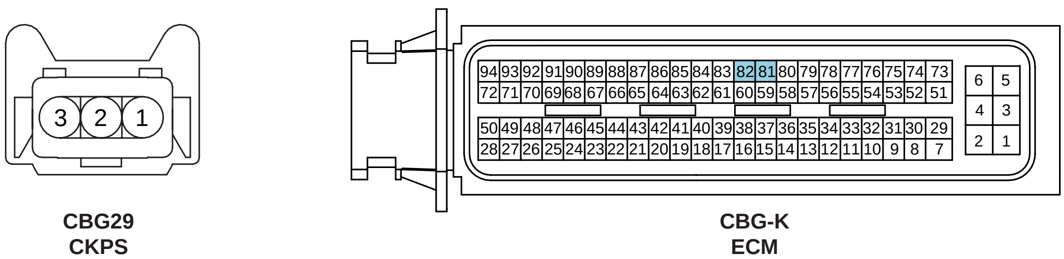
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (81)	Sensor Ground
2	ECM CBG-K (82)	CKPS Signal
3	Main Relay	Power Supply (B+)

[Harness Connector]



SLDF17272L

SIGNAL WAVEFORM AND DATA E237594D

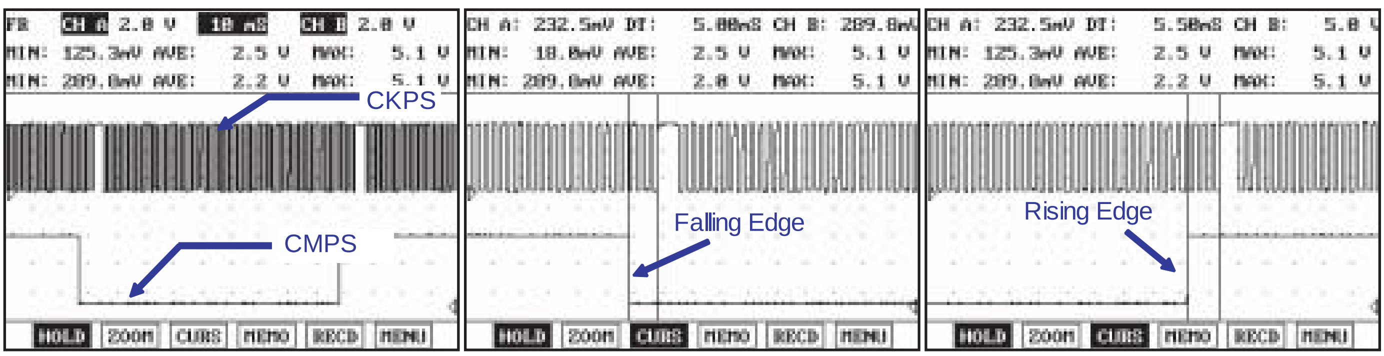


Fig 1 Fig 2 Fig 3

Fig.1) The square wave signal should be smooth and without any distortion.
Fig.2,3)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

SLDF17156L

MONITOR DTC STATUS E3530715

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

POWER CIRCUIT INSPECTION E6071A37

1. Ignition "OFF"
2. Disconnect CKP sensor connector
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between terminal 3 of the sensor harness connector and chassis ground

Specification : Approx. B+

5. Is voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection" procedure

NO

▶ Check for a open in the power supply circuit between the main relay and the CKPS
▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

GROUND CIRCUIT INSPECTION E1BCC9BB

1. Ignition "OFF"
2. Measure resistance between terminal 1 of the sensor harness connector and chassis ground

Specification : Approx. 0Ω

3. Is resistance within the specification?

YES

▶ Go to "Signal Circuit Inspection" procedure

NO

▶ Check for an open or short to battery in the ground circuit.

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

SIGNAL CIRCUIT INSPECTION E8B97ED6

1. Check for open or short to ground in signal circuit
   1) Ignition "ON" & Engine "OFF"
   2) Measure voltage between terminal 2 of the sensor harness connector and chassis ground

Specification : Approx. 5V

   3) Is voltage within the specification?

   YES

   ▶ Go to next step as below

   NO

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

2. Check for short to power in signal circuit
   1) Ignition "OFF"
   2) Disconnect ECM connector
   3) Ignition "ON" & Engine "OFF"
   4) Measure voltage between terminal 2of sensor harness connector and chassis ground

Specification : Approx. 0V

   5) Is voltage within the specification?

   YES

   ▶ Go to next step as below

   NO

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

TERMINAL AND CONNECTOR INSPECTION EBB85017

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step.

COMPONENT INSPECTION E74F4D8E

1. Reconnect the CKPS and ECM connectors

2. Set up an oscilloscope as follows :
   Channel A (+): terminal 2 of the CKPS(back probe), (-): ground
   Channel B (+): terminal 2 of the CMPS(back probe), (-): ground

3. Start the engine and check for signal waveform compared with reference waveform as below.

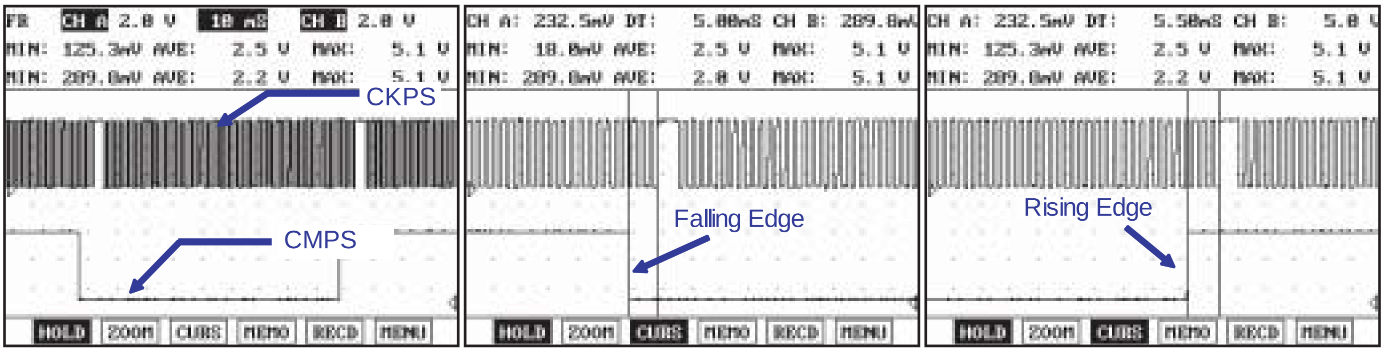


Fig 1 Fig 2 Fig 3

Fig.1) The square wave signal should be smooth and without any distortion.
Fig.2,3)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

SLDF17156L

4. Is the signal waveform normal?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Remove CKP and calculate air gap between sensor and flywheel/torque converter. Readjust as necessary and go to "Verification of Vehicle Repair" procedure

NOTE

Air gap [0.3~1.7 mm [0.012~0.067 in] = measure distance from housing to teeth on flywheel/torque converter (measurement "A") and from mounting surface on sensor to sensor tip (measurement "B") subtract "B" from "A"

- If air gap is OK, check CKPS for contamination, deterioration, or damage. Substitute with a known-good CKPS and check for proper operation. If the problem is corrected, replace CKPS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E72C3B23

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

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

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES

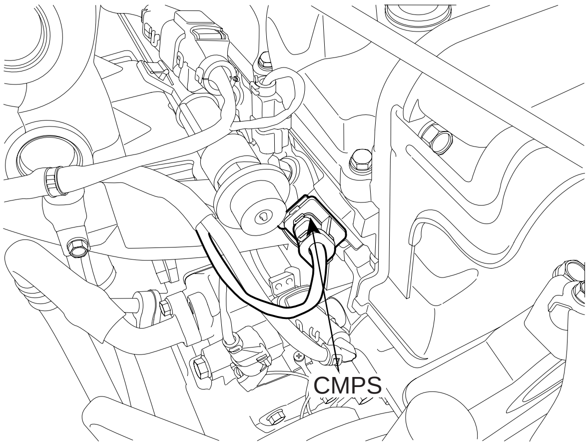
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0340 CAMSHAFT POSITION SENSOR A CIRCUIT MALFUNCTION (BANK 1 OR SINGLE SENSOR)

COMPONENT LOCATION E691CEB1



SHDF16340L

GENERAL DESCRIPTION E4F36E1F

The Camshaft Position Sensor (CMPS) is a sensor that detects the compression TDC of the NO. 1 cylinder. The CMPS consists of a hall type sensor and a target on the end of the intake camshaft. When the target triggers the sensor, the sensor voltage is 5V. If not, the sensor voltage is 0V. These CMPS signal is sent to the ECM and the ECM uses the CMPS signal for synchronizing the firing of sequential fuel injectors.

DTC DESCRIPTION E5510C79

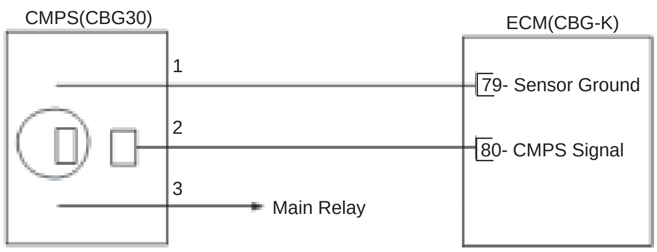
The ECM monitors the camshaft sensor signal transition position which must change only once per crankshaft revolution. If no camshaft signal is detected while crankshaft signal is detected, the ECM sets DTC P0340.

DTC DETECTING CONDITION EC3DAF9C

Item		Detecting Condition	Possible Cause
DTC Strategy		• Check camshaft signal switching	• Open or short in signal, ground or power supply circuit • Contact resistance in connectors • Misadjust crankshaft and camshaft pulley position • Faulty CMP sensor
Enable Conditions		• 10V＜ Battery voltage ＜ 16V • No relevant failure	
Threshold Value	Case 1)	• No camshaft edge detected	
	Case 2)	• Camshaft segment duration gradient not valid	
Diagnostic Time		• 40 revolutions	
MIL On Condition		• 2 Driving Cycles	

SCHEMATIC DIAGRAM EA565F17

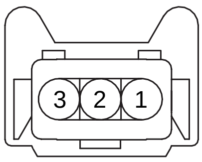
[Circuit Diagram]



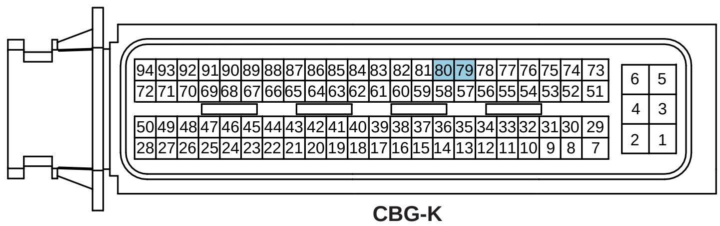
[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (79)	Sensor Ground
2	ECM CBG-K (80)	CMPS Signal
3	Main Relay	Power Supply (B+)

[Connection Information]



CBG30
CMPS



CBG-K
ECM

SLDF17281L

MONITOR DTC STATUS EFC67DC9

1. Clear the DTC with scan tool.

2. Operate the vehicle within the following conditions:
   - Engine run time at idle over 10 minutes
   - Engine Oil Temp. is between 20℃(68°F) and 110℃(230°F)

3. Ignition"ON" & Engine"OFF"

4. Using a scan tool, monitor DTC

5. Go to applicable troubleshooting procedure for the following conditions
   - If any DTCs related to OCV(P0011) are stored, do ALL REPAIRS associated with those codes before proceeding with this troubleshooting procedure.
   - If DTC P0340 is set again, go to next step as below
   - If other DTCs are stored, go to the applicable troubleshooting procedure.
   - If no DTC output, go to "Verification of Vehicle Repair" procedure.

6. Press F4(DTAL) to select DTC information from the DTCs menu

7. Confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions

8. Read "DTC Status" parameter

9. Is parameter displayed "History(Not Present) fault"?

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

POWER CIRCUIT INSPECTION E7450C47

1. Ignition "OFF"
2. Disconnect CMP sensor connector
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between terminal 3 of the sensor harness connector and chassis ground

Specification : Approx. B+

5. Is voltage within the specification?

YES

▶ Go to "Ground Circuit Inspection" procedure

NO

▶ Check for a open in the power supply circuit between the main relay and the CMPS
▶ Especially check for open or blown 10A sensor fuse
▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

GROUND CIRCUIT INSPECTION E5F08C14

1. Ignition "OFF"
2. Measure resistance between terminal 1 of the sensor harness connector and chassis ground

Specification : Approx. 0Ω

3. Is resistance within the specification?

YES

▶ Go to "Signal Circuit Inspection" procedure

NO

▶ Check for an open or short to battery in the ground circuit.
▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

SIGNAL CIRCUIT INSPECTION E189D635

1. Check for short to ground in signal harness

   1) Measure resistance between terminal 2 of sensor harness connector and chassis ground

Specification : Infinite

   2) Is resistance within the specification?

YES

▶ Go to next step as below

NO

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

2. Check for short to battery in signal harness

   1) Disconnect ECM connector

   2) Ignition "ON" & Engine "OFF"

   3) Measure voltage between terminal 2 of sensor harness connector and chassis ground

Specification : Approx. 0V

   4) Is voltage within the specification?

YES

▶ Go to next step as below

NO

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

3. Check for open in signal harness

   1) Ignition "OFF"

   2) Measure resistance between terminals 2 of sensor harness connector and 80 of the ECM connector

Specification : Approx. 0Ω

   3) Is resistance within the specification?

YES

▶ Go to next step as below

NO

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

TERMINAL AND CONNECTOR INSPECTION E1F0D529

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step.

COMPONENT INSPECTION EA44257F

1. Reconnect the CMPS and ECM connectors

2. Set up an oscilloscope as follows :
   Channel A (+): terminal 2 of the CKPS(back probe), (-): ground
   Channel B (+): terminal 2 of the CMPS(back probe), (-): ground

3. Start the engine and check for signal waveform compared with reference waveform as below.

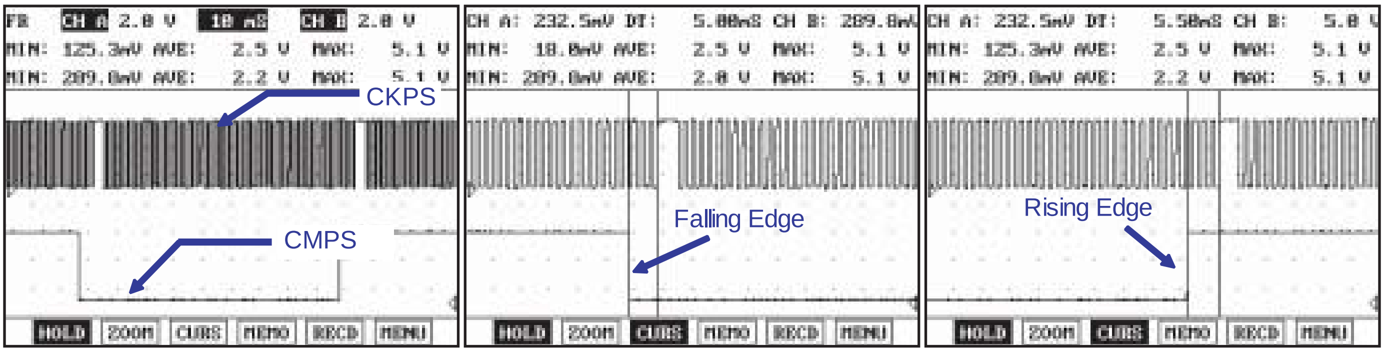


Fig 1 Fig 2 Fig 3

Fig.1) The square wave signal should be smooth and without any distortion.
Fig.2,3)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

SLDF17156L

4. Is the signal waveform normal?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Remove CMPS and check for air gap. Readjust as necessary and go to "Verification of Vehicle Repair" procedure
- If fail to synchronize with CKP sensor, check that the crankshaft and camshaft are correctly aligned the matching marks of the pulleys. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure

- Check CMPS for contamination, deterioration, or damage. Substitute with a known-good CMPS and check for proper operation. If the problem is corrected, replace CMPS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR EDCD1626

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

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

YES

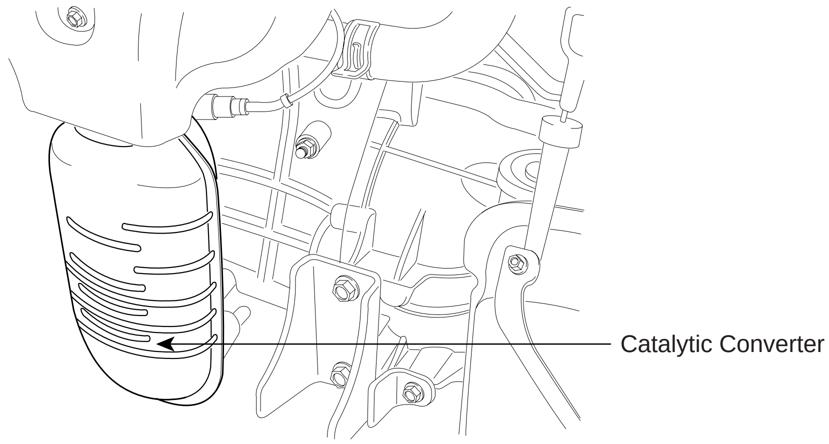
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0420 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1)

COMPONENT LOCATION E0AB288B



SHDF16341L

GENERAL DESCRIPTION E3D5AC99

The ECM uses dual oxygen sensors to monitor the efficiency of the manifold catalytic converter (warm-up catalytic converter). By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream (front) HO2S is used to detect the amount of oxygen in the exhaust gas before it enters the catalytic converter. A low voltage indicates high oxygen contents (lean air mixture). A high voltage indicates low oxygen contents (rich air mixture). When the catalyst efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same at the rear as it is at the front. The output voltage of the rear HO2S copies the voltage of the front HO2S.To monitor the system, the lean-to-rich switches of the front HO2S to the rear HO2S is counted. The ratio of rear switches to front switches is used to determine whether the catalyst is operating properly. An effective catalyst will have fewer rear switches than front switches, that is, a ratio closer to zero.

DTC DESCRIPTION E77D4E43

The ECM calculates oscillation size of rear HO2S signal which represents catalyst conversion properties. This oscillation size will determine if catalyst conversion is low due to aging or poisoning from leaded fuel or misfiring. The ECM sets P0420 if the average of calculated oscillation size of rear HO2S signal during predetermined duration is higher than the predetermined threshold.

DTC DETECTING CONDITION E3BEA04C

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check catalyst oxygen storage capacity by evaluation downstream O2 sensor fluctuations	• Exhaust gas leaks • Faulty rear HO2S • Faulty three way catalyst converter
Enable Conditions	• Coolant temperature ＞74°C(165°F) • 5 ＜ Vehicle speed(km/h) ＜ 180 • Engine speed ＜ 3400rpm • 200 ＜ Mass air flow(mg/rev.) ＜700 • Canister load = 0.5 • 400°C(752°F) ≤ Catalyst temp. model ≤ 900°C(1652°F) • Lambda control active & Stable driving condition • Downstream O2 sensor operative readiness • No opening / closing of Canister Purge Valve • No relevant failure • 11V ＜ Battery voltage ＜ 16V	
Threshold Value	• Average malfunction index ＞ 0.3	
Diagnostic Time	• 50 Lambda controller Cycles	
MIL On Condition	• 2 Driving Cycles	

SIGNAL WAVEFROM AND DATA E81FB272

Test Condition		Scan Tool Parameter	
		O2 SNSR VOL.-B1/S1	Scan Tool Parameter
Normal Value when circuit is normal	Idle after warm up	Signal is switching from rich(above 0.45V) to lean(below 0.45V) a minimum of 3 times in 10 seconds.	above 0.7V
HO2S(B1S1) signal circuit open		Approx. 0.43~0.45V	-
HO2S(B1S2) signal circuit open		-	Approx. 0.43~0.45V

NOTE

If any codes relating to injectors, HO2S, ECT(Engine Coolant Temperature)Sensor, Throttle Position sensor or Mass Air Flow Sensor are stored, do ALL REPAIRS associated with those codes before proceeding with this troubleshooting tree.

MONITOR DTC STATUS EFA80EF5

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

EXHAUST SYSTEM INSPECTION EDDE1DE2

1. Visually/physically inspect the following conditions:
   - Exhaust system between HO2S and Three way catalyst for air leakage, restriction and damage.
   - Damage, and for loose or missing hardware:

2. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to "Rear HO2S Inspection " procedure

REAR HO2S INSPECTION

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 ECM)
   - Any road damage

2. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to "TWC Inspection " procedure

TWC INSPECTION

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. Was a problem found?

YES

▶ Replace TWC and go to "Verification of Vehicle Repair" procedure

NO

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR EFD1A691

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

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

YES

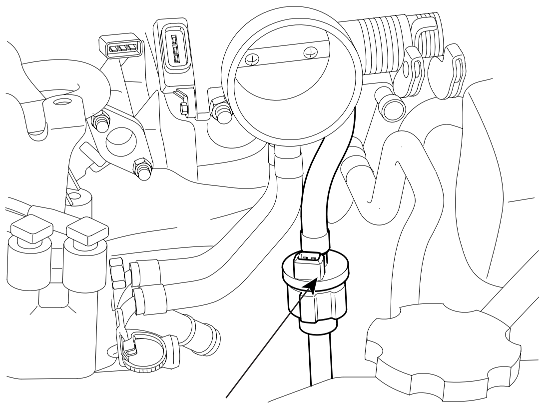
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0444 EVAP. EMISSION SYSTEM-PURGE CTRL. VALVE CIRCUIT OPEN

COMPONENT LOCATION E89D15E0



SLDF17342L

GENERAL DESCRIPTION E1321AEB

The evaporative emission control system prevents hydrocarbon (HC) vapors from the fuel tank from escaping into the atmosphere where they could form photochemical smog. Gasoline vapors are collected in the charcoal canister. The ECM controls the Purge Control Solenoid Valve (PCSV) to purge any collected vapors from the canister back to the engine for combustion. This valve is actuated by the purge control signal from the ECM and controls fuel vapor flow from the canister to the intake manifold.

DTC DESCRIPTION E129875C

ECM sets DTC P0444 if the ECM detects that the PCSV control circuit is open.

DTC DETECTING CONDITION E163F7FA

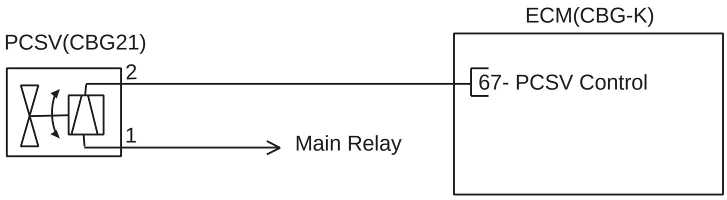
Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Open in PCSV harness • Contact resistance in connectors • Faulty PCSV
Enable Conditions	• 10 < Battery voltage(V) < 16	
Threshold Value	• Line break	
Diagnostic Time	• 3 sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E13BF9DC

Temp.(℃)	Temp.(°F)	PCSV Resistance(Ω)
20	68	Approx. 16

SCHEMATIC DIAGRAM EDC83A6D

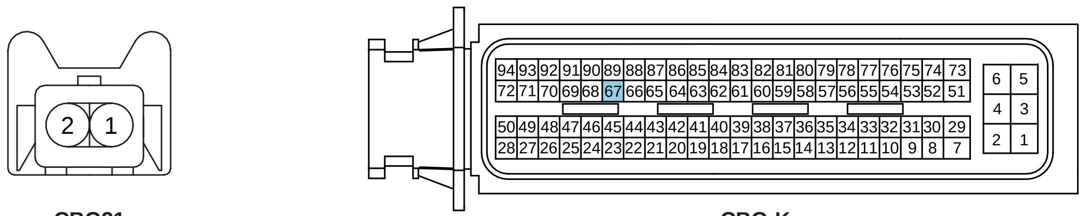
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Connected to
1	Main Relay	Power Supply (B+)
2	ECM CBG-K (67)	PCSV Control

[Harness Connector]



CBG21
PCSV

CBG-K
ECM

SLDF17287L

SIGNAL WAVEFROM AND DATA E9E928DC

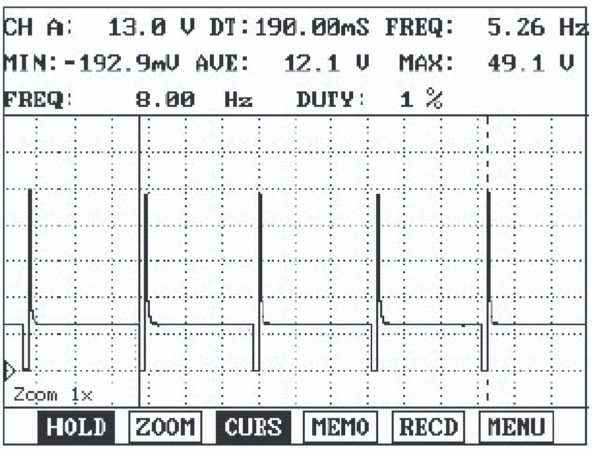


Fig 1

Fig.1) Normal waveform with idle

LFLG173A

MONITOR DTC STATUS E9A8A2E3

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

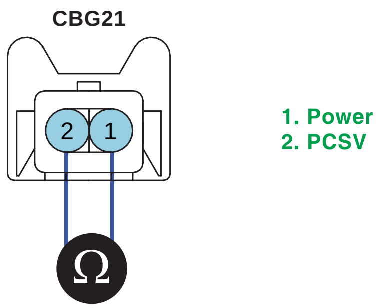
NO

▶ Go to next step as below.

COMPONENT INSPECTION E65C513B

1. Ignition "OFF"
2. Disconnect PCSV connector
3. Measure resistance between terminals 1 and 2 of the PCSV connector(Component side)

Temp.(℃)	Temp.(°F)	PCSV Resistance(Ω)
20	68	Approx. 16



SLDF17288L

4. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

▶ Check PCSV for contamination, deterioration, or damage. 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

POWER CIRCUIT INSPECTION E7688F43

1. Ignition "ON" & Engine "OFF"
2. Measure voltage between terminal 1 of the PCSV harness connector and chassis ground

Specification : Approx. B+

3. Is voltage within the specification?

YES

▶ Go to "Control Circuit Inspection" procedure

NO

▶ Check for a open in the power supply circuit. Repair as necessary and go to "Verification of Vehicle Repair" procedure

CONTROL CIRCUIT INSPECTION E0773E56

1. Measure voltage between terminal 2 of the PCSV harness connector and chassis ground

Specification : Approx. 4~5V

2. Is voltage within the specification?

YES

▶ Go to next step as below

NO

▶ Check control circuit for open or short. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION ED13834F

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EE5C769B

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0445 EVAP. EMISSION SYSTEM-PURGE CTRL. VALVE CIRCUIT SHORTED

COMPONENT LOCATION EC2DA220

Refer to DTC P0444.

GENERAL DESCRIPTION E66E29DE

Refer to DTC P0444.

DTC DESCRIPTION E9B6E445

ECM sets DTC P0445 if the ECM detects that the PCSV control circuit is shorted to ground or shorted to battery voltage.

DTC DETECTING CONDITION E05D7EA7

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Short in PCSV harness • Contact resistance in connectors • Faulty PCSV
Enable Conditions	• 10 < Battery voltage(V) < 16	
Threshold Value	• Short to ground or Short to Battery	
Diagnostic Time	• 3 sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EB9D40B6

Refer to DTC P0444.

SCHEMATIC DIAGRAM E32C989D

Refer to DTC P0444.

SIGNAL WAVEFROM AND DATA E2D54BFC

Refer to DTC P0444.

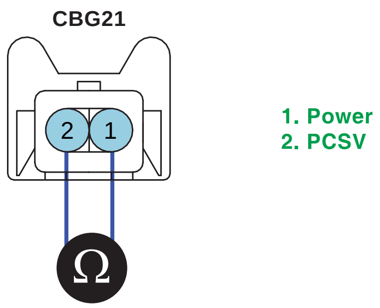
MONITOR DTC STATUS E992BE84

Refer to DTC P0444.

COMPONENT INSPECTION EB6BBF0C

1. Ignition "OFF"
2. Disconnect PCSV connector
3. Measure resistance between terminals 1 and 2 of the PCSV connector(Component side)

Temp.(℃)	Temp.(°F)	PCSV Resistance(Ω)
20	68	Approx. 16



SLDF17288L

4. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

▶ Check PCSV for contamination, deterioration, or damage. 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.

POWER SUPPLY CIRCUIT INSPECTION E2D1E550

1. Ignition "ON" & Engine "OFF"
2. Measure voltage between terminal 1 of the PCSV harness connector and chassis ground

Specification : Approx. B+

3. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

▶ Check for a open in the power supply circuit. Repair as necessary and go to "Verification of Vehicle Repair" procedure

CONTROL CIRCUIT INSPECTION E8308D36

1. Measure voltage between terminal 2 of the PCSV harness connector and chassis ground

Specification : Approx. 4~5V

2. Is voltage within the specification?

YES

▶ Go to next step as below

NO

▶ Check control circuit for open or short. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E4D3BE83

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ECEF54BC

Refer to DTC P0444.

DTC P0501 VEHICLE SPEED SENSOR A RANGE/PERFORMANCE

GENERAL DESCRIPTION EFDB7D3C

The Wheel Speed Sensor (WSS) generates a waveform with a frequency proportional to the speed of the vehicle. The signal generated by the WSS informs the ECM not only if the vehicle speed is low or high but also if the vehicle is or is not moving. The ECM uses this signal to control the fuel injection, ignition timing, transaxle shift scheduling and torque converter clutch scheduling. The WSS signal is also used to detect rough road conditions.

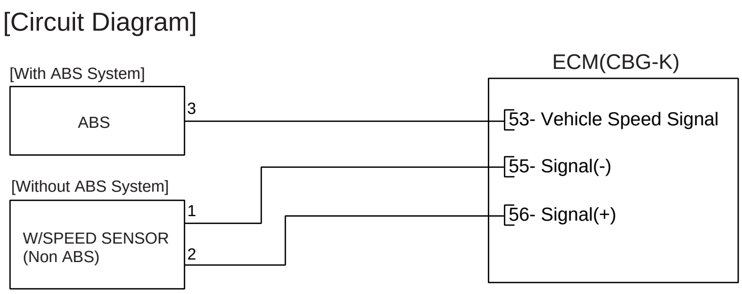
DTC DESCRIPTION E292BB2F

The ECM evaluates engine speed and mass air flow if there is no vehicle speed signal. This evaluation of both values will detect open circuit or short circuit errors on the wheel speed sensor. The ECM sets DTC P2159 if there is no vehicle speed signal from wheel speed sensor while both engine speed and mass air flow are higher than predetermined threshold during the predetermined time

DTC DETECTING CONDITION E8FAFCDD

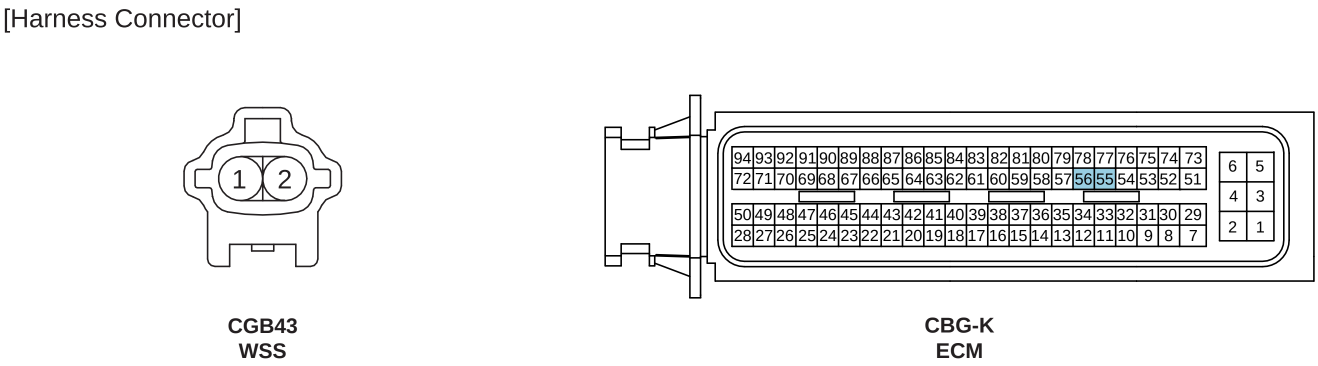
Item	Detecting Condition	Possible Cause
DTC Strategy	• Plausibility check	• Open or short in harness • Poor connection or damaged harness • VSS
Enable Conditions	• Engine speed ＞2112rpm • Air mass flow ＞0.44g/rev. (220mg/tdc) • No fuel injection shut off • Coolant Temp. ＞ 60℃(140°F)	
Threshold Value	• VSS = 0 with high engine speed and load	
Diagnostic Time	• 60 seconds	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E75F7FEC



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (55)	Signal(-)
2	ECM CBG-K (56)	Signal(+)



SLDF17291L

MONITOR DTC STATUS E9A3EE91

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ [With ABS] Go to "Monitor Scan tool Data" procedure
▶ [Without ABS system] Go to "Signal Circuit Inspection[Without ABS]" procedure

MONITOR SCANTOOL DATA EBB9E4AE

1. With vehicle raised on a lift , start the engine and place transaxle in Drive. Let vehicle idle and verify speedometer indicates approx. 10km/h or more(6mph or more) on the instrument cluster.

2. Connect Scantool and select ABS system.

3. Monitor the "WHEEL SPD SENSOR-FR" parameter on the current data list.

Specification : 10km/h or more(6mph or more)

4. Is value within the specification?

YES

▶ Wheel speed sensor is OK. Go to Go to "Signal Circuit Inspection[With ABS]" procedure

NO

▶ Check for open or short circuit between wheel speed sensor(FR) and ABS control module
If problems are found, repair as necessary and go to "Verification of Vehicle Repair" procedure
If OK, Check wheel speed sensor(FR) as follow:
- Gap between ABS sensor and trigger wheel (Air gap : 0.3~1.1 mm(0.011 ~ 0.043 in))
- Trigger wheel condition
- Sensor resistance : Approx. 1,300~1,500Ω at 20℃(68°F)

Replace wheel speed sensor as necessary and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E2793660

[WITH ABS]

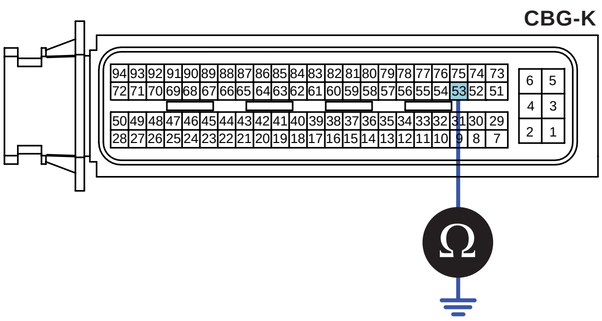
1. Check for short to ground in signal circuit

   1) Ignition "OFF"

   2) Disconnect ECM and ABS Control Module connectors

   3) Measure resistance between terminal 53 of the ECM harness connector and chassis ground

Specification : Infinite



SHDF16292L

   4) Is resistance within the specification?

YES

▶ Go to next step as below

NO

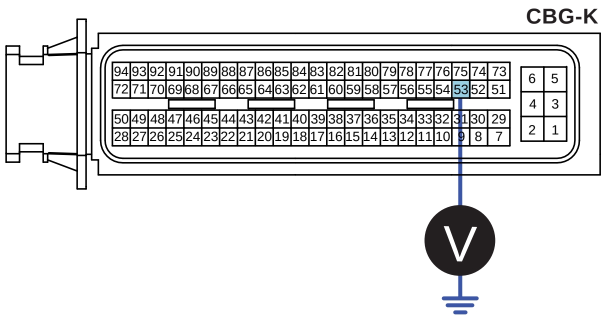
▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

2. Check for short to battery in signal circuit

   1) Ignition "ON" & Engine"OFF"

   2) Measure voltage between terminal 53 of the ECM harness connector and chassis ground

Specification : Approx. 0V



SHDF16293L

   3) Is voltage within the specification?

YES

▶ Go to next step as below

NO

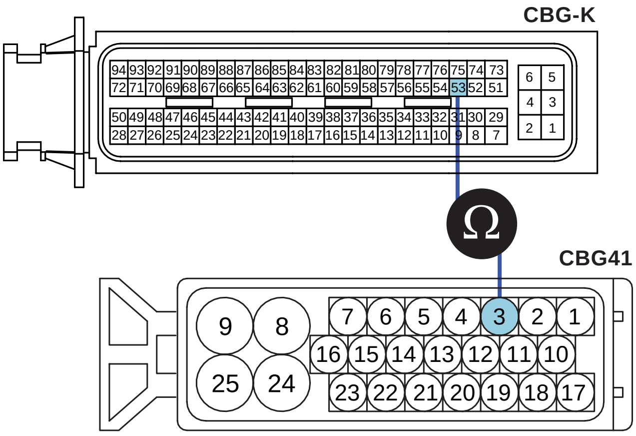
▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

3. Check for open in signal circuit

   1) Ignition "OFF"

   2) Measure resistance between terminals 53 of the ECM harness connector and 3 of the ABS Control Module harness connector

Specification : Approx. 0Ω



SLDF17294L

3) Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

[WITHOUT ABS SYSTEM]

1. Check for short to ground in Signal circuit

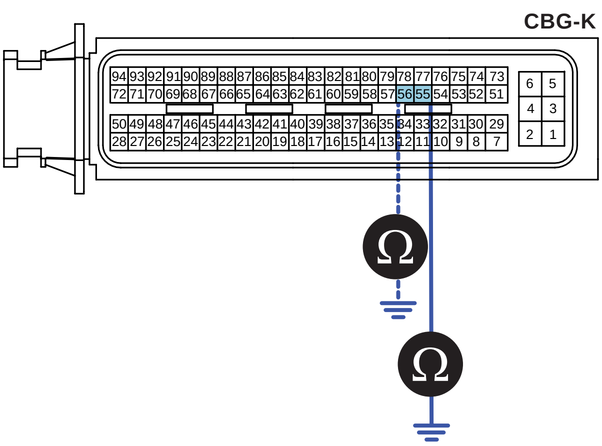
   1) Ignition "OFF"

   2) Disconnect ECM and wheel speed sensor(front right) harness connector

   3) Measure resistance between terminal 55 of the ECM harness connector and chassis ground

   4) Measure resistance between terminal 56 of the ECM harness connector and chassis ground

Specification :	Infinite



SHDF16295L

5) Is resistance within the specification?

YES

▶ Go to next step as below

NO

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

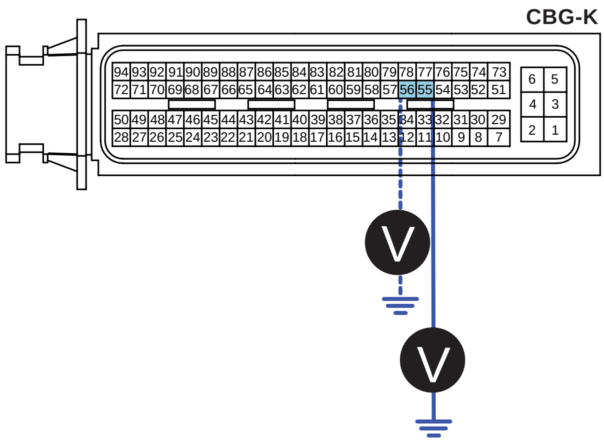
2. Check for short to battery in signal circuit

   1) Ignition "ON" & Engine"OFF"

   2) Measure voltage between terminal 55 of the ECM harness connector and chassis ground

   3) Measure voltage between terminal 56 of the ECM harness connector and chassis ground

Specification :	Approx. 0V



SHDF16296L

   4) Is voltage within the specification?

YES

▶ Go to next step as below

NO

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

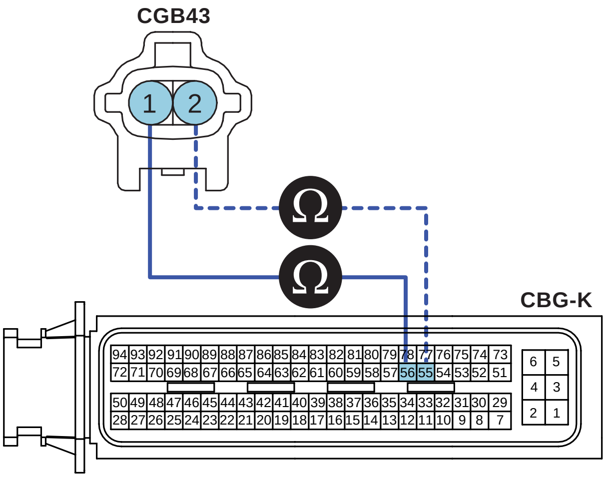
3. Check for open in signal circuit

   1) Ignition "OFF"

   2) Measure resistance between terminals 1 of the wheel speed sensor harness connector and 55 of the ECM harness connector.

   3) Measure resistance between terminals 2 of the wheel speed sensor harness connector and 56 of the ECM harness connector.

Specification :	Approx. 0Ω



SLDF17297L

4) Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

COMPONENT INSPECTION EC1E7D00

1. Reconnect VSS and ECM connectors
2. With vehicle raised on a lift , start the engine and place transaxle in Drive. Let vehicle idle and verify speedometer indicates approx. 10km/h or more on the instrument cluster.
3. Connect scan tool and Monitor the "VEHICLE SPEED SENSOR" parameter on the scan tool data list.

Specification : 10km/h or more(6mph or more)

4. Is value within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Check VSS for contamination, deterioration, or damage. Substitute with a known-good VSS and check for proper operation. If the problem is corrected, replace VSS and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E09F5922

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

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

2. Press F4(DTAL) and confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES

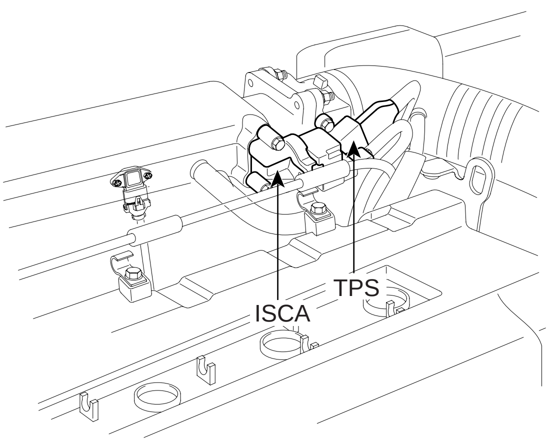
▶ System performing to specification at this time. Clear the DTC

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0506 IDLE AIR CONTROL SYSTEM-RPM LOWER THAN EXPECTED

COMPONENT LOCATION E16C8F41



SLDF17236L

GENERAL DESCRIPTION EB301D49

When the TP sensor’ s signal indicates closed throttle position and the engine is idling, the ECM adjusts the idle speed control actuator so that the engine runs at the correct idling speed, regardless of coolant temperature, load and etc. When the additional load applied in the engine, the air flow through the idle speed control actuator is increased momentarily to raise the idling speed.

DTC DESCRIPTION EC60E8E5

The ECM monitors engine speed deviation from the target idle engine speed when the vehicle is stopped and the throttle valve opening is stable. The ECM sets DTC P0506 if the difference to the target idle engine speed is lower than the predetermined threshold.

DTC DETECTING CONDITION E7A616A2

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitor deviation between target idle speed and actual engine speed	• Restriction in intake or exhaust system • Carbonustment of the accelerator cable • Contact resistance in connectors • Faulty ICA valve
Enable Conditions	• Coolant temperature ＞73℃(163.4°F) • Throttle angle: closed • Vehicle speed = 0 • 10seconds after engine start. • 10V＜ Battery voltage ＜16 • No relevant failure	
Threshold Value	• Engine speed-Target idle speed ＜ -100rpm (Engine speed too low)	
Diagnostic Time	• 16 seconds	
MIL On Condition	• 2 Driving Cycles	

SIGNAL WAVEFORM AND DATA E13C10DC

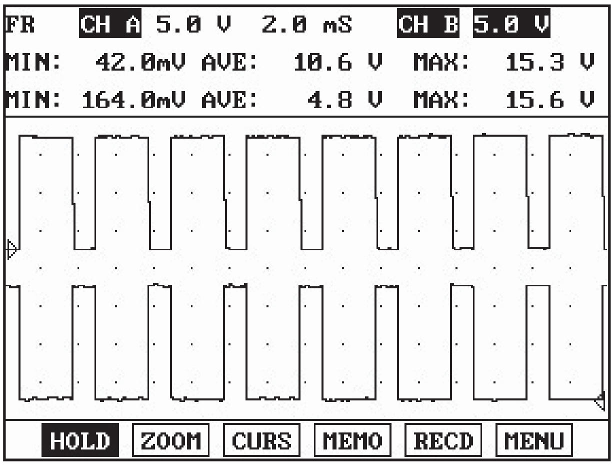


Fig1

Fig 1) The above waveforms are the voltage signals generated when the ISCA operates. This ISCA is a duty type and the time opened determines the duty amount. The left side is the waveform of the ISCA Opening coil during idle.
The right side is the waveform of the ISCA Closing coil during idle.

SHDF16299L

MONITOR DTC STATUS E4711B13

NOTE

If any MAFS or ISCA codes are present, do ALL REPAIRS associated with them before proceeding with this troubleshooting tree.

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below

CHECK FOR RESTRICTED INTAKE OR EXHAUST SYSTEM E2A464BF

1. Visually/physically inspect the following items:
   - Air cleaner filter element for excessive dirt or for any foreign objects
   - Throttle body inlet for damage or for any foreign objects
   - Restricted exhaust system
2. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below

TERMINAL AND CONNECTOR INSPECTION EB817131

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below

COMPONENT INSPECTION E1C6328D

ISCA INSPECTION

1. Ignition "OFF".
2. Remove ISCA from Throttle body and Check for throttle bore, throttle plate and the ISCA passages for chocking and for any foreign objects. Repair or clean as necessary.
3. Ignition "ON" & Engine "OFF".
4. Connect scan tool and select "IDLE SPEED ACTUATOR" parameter on the "ACTUATION TEST" mode.
5. Activates ISCA by pressing "STAT" key.
6. Check the ISCA for clicking sound and visually verifying valve closes and opens.

NOTE

Repeat numerous times to ensure valve reliability.

7. Is ISCA Valve moving freely and not carbon fouled?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Check ISCA valve for contamination, deterioration, or damage. Substitute with a known-good ISCA valve and check for proper operation. If the problem is corrected, replace ISCA valve and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E521DDA9

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0507 IDLE AIR CONTROL SYSTEM-RPM HIGHER THAN EXPECTED

COMPONENT LOCATION ED8F798B

Refer to DTC P0506.

GENERAL DESCRIPTION E30C3BA8

Refer to DTC P0506.

DTC DESCRIPTION EC0A8C34

The ECM monitors engine speed deviation from the target idle engine speed when the vehicle is stopped and the throttle valve opening is stable. The ECM sets DTC P0507 if the difference to the target idle engine speed is higher than the predetermined threshold.

DTC DETECTING CONDITION EBD9B792

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitor deviation between target idle speed and actual engine speed	• A stuck or binding throttle plate • Maladjustment of the accelerator cable • Contact resistance in connectors • Faulty ICA valve
Enable Conditions	• Coolant temperature ＞73℃(163.4°F) • Throttle angle: closed • Vehicle speed = 0 • 10seconds after engine start. • 10V＜ Battery voltage ＜16 • No relevant failure	
Threshold Value	• Engine speed-Target idle speed ＞ 200rpm (Engine speed too high)	
Diagnostic Time	• 16 seconds	
MIL On Condition	• 2 Driving Cycles	

SIGNAL WAVEFORM AND DATA E8696A30

Refer to DTC P0506.

MONITOR DTC STATUS EA464D44

Refer to DTC P0506.

SYSTEM INSPECTION EC84883A

ACCELERATOR CABLE & THROTTLE PLATE INSPECTION

1. Visually/physically inspect the following items. Repair or adjust as necessary and go to next step.
   - Check that the Accelerator Cable is not sticking or moving sluggishly.
   - Check Accelerator Cable free play [0.040~0.120 in. (1.0~3.0 mm)].

2. Remove Intake Hose and inspect Throttle Plate for excessive carbon deposits.

3. Is Throttle Plate being held open with excessive carbon deposits?

YES

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

NO

▶ Go to next step as below.

AIR LEAKAGE INSPECTION

1. Visually/physically inspect the air leakage in intake/exhaust system as following items,
   - Check for throttle Plate being held open with excessive carbon deposits
   - Vacuum hoses for splits, kinks and improper connections.
   - Throttle body gasket
   - Positive crankcase ventilation valve for improper installation, damaged o-rings and malfunctioning .
   - 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. Was a problem found in any of the above areas?

YES

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

NO

▶ Go to next step as below.

TERMINAL AND CONNECTOR INSPECTION E3188395

1. Many malfunctions in the electrical system are caused by poor harness(es) 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 next step as below

COMPONENT INSPECTION E425D557

ISCA INSPECTION

1. Ignition "OFF".

2. Remove ISCA from Throttle body and Check for throttle bore, throttle plate and the ISCA passages for chocking and for any foreign objects. Repair or clean as necessary.

3. Ignition "ON" & Engine "OFF".

4. Connect scan tool and select "IDLE SPEED ACTUATOR" parameter on the "ACTUATION TEST" mode.

5. Activates ISCA by pressing "STAT" key.

6. Check the ISCA for clicking sound and visually verifying valve closes and opens.

NOTE

Repeat numerous times to ensure valve reliability.

7. Is ISCA Valve moving freely and not carbon fouled?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

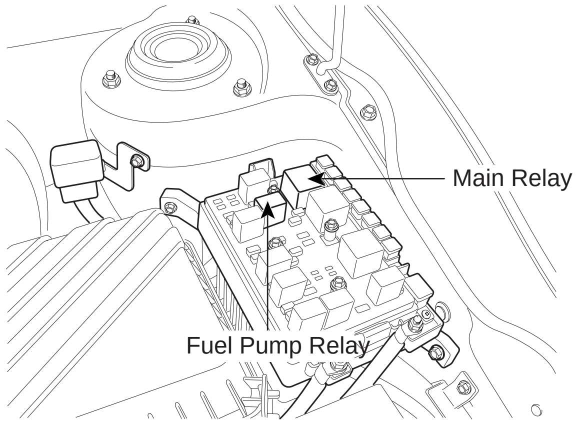
▶ Check ISCA valve for contamination, deterioration, or damage. Substitute with a known-good ISCA valve and check for proper operation. If the problem is corrected, replace ISCA valve and then go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E6445C02

Refer to DTC P0506.

DTC P0560 SYSTEM VOLTAGE

COMPONENT LOCATION E0B4CDFE



SLDF17334L

GENERAL DESCRIPTION E21BA96F

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

DTC DESCRIPTION EF1EC8E6

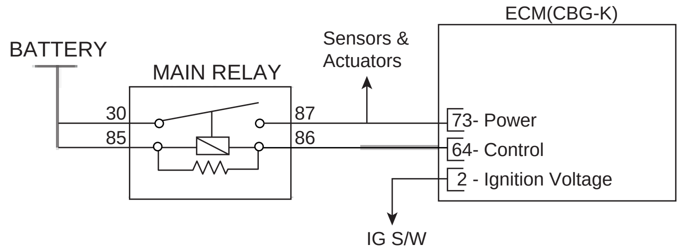
The ECM measures the voltage from ignition key and from main relay respectively and compares two voltages. This comparison will watch if the Main Relay has switched and remains on after ignition Key-On and if it has switched off after the ignition Key-Off. The ECM sets DTC P0560 if the voltage after Main Relay is lower than a predetermined threshold after ignition key-on or higher than a predetermined threshold after ignition key-off.

DTC DETECTING CONDITION E7C2F202

Item		Detecting Condition	Possible Cause
DTC Strategy		• Monitor battery voltage	• Open or short circuit • Poor connection or damaged harness
Enable Conditions	Case1	• Ignition "ON" • Battery voltage ＞10V	
	Case2	• Ignition "OFF"	
Threshold Value	Case1	• Voltage after Main Relay ＜6 V	
	Case2	• Voltage after Main Relay ＞6 V	
Diagnostic Time	Case1	• 0.2 sec.	
	Case2	• 0.2 sec.	
MIL On Condition		• -	

SCHEMATIC DIAGRAM E961D4D6

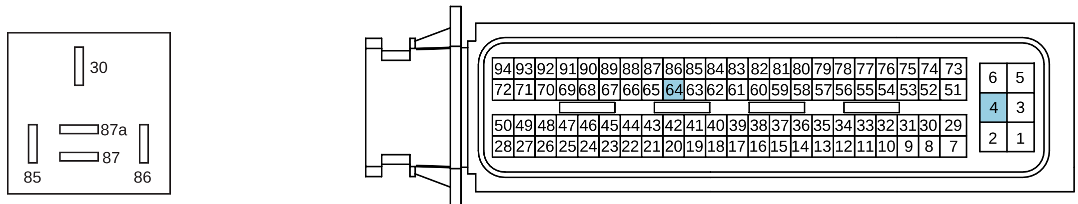
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
30	Battery	Power
85	Battery	Power
86	ECM CBG-K (64)	Control
87	-	Power Supply
	ECM CBG-K (73)	Power

[Harness Connector]

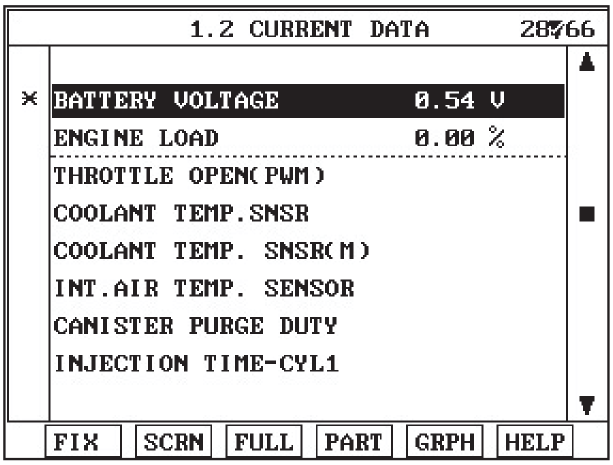


MAIN RELAY(RELAY SIDE)

CBG-K
ECM

SLDF17309L

SIGNAL WAVEFORM AND DATA E2C8DF2F



Open circuit in 64(Main relay control) of the ECM harness terminal : Approx. 0.54(Battery voltage parameter)

SHDF16343L

MONITOR DTC STATUS E7B32AC2

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

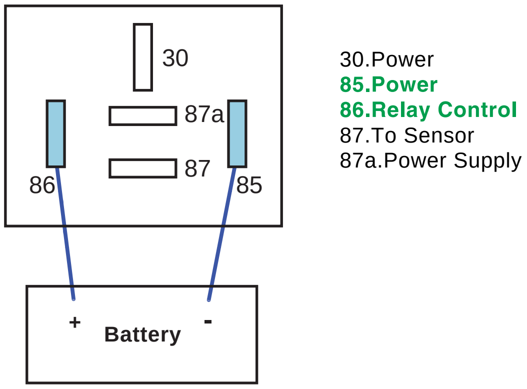
▶ Go to next step as below.

COMPONENT INSPECTION EAF547F8

1. With Ignition OFF, remove the main relay.
2. Measure resistance between terminals 85 and 86 of the main relay(Component side).

Specification : Approx. 70~120Ω at 20℃(68°F)

3. Apply 12V and a ground to 85 and 86 terminals of the main relay(Components side).
4. Check if the main relay works well when it is energized. (If the main relay works normally, a clicking sound can be heard.)



SHDF16344L

5. Does the main relay operate normally?

YES

▶ Go to next step as below.

NO

▶ Check main relay for contamination, deterioration, or damage. Substitute with a known-good main relay and check for proper operation. If the problem is corrected, replace main relay and then go to "Verification of Vehicle Repair" procedure.

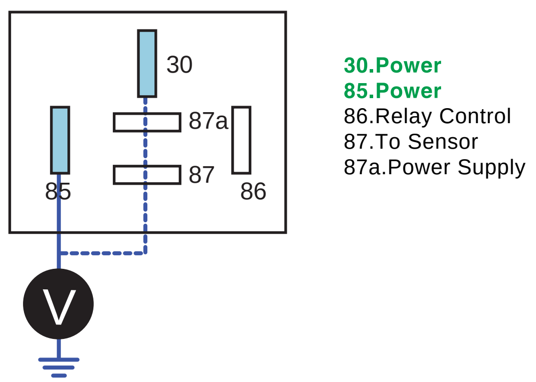
POWER CIRCUIT INSPECTION EDB381D6

1. Ignition "ON" & Engine "OFF".

2. Measure the voltage between terminal 30 of the main relay harness connector and chassis ground.

3. Measure the voltage between terminal 85 of the main relay harness connector and chassis ground.

Specification : Approx. B+



SLDF17345L

4. Is voltage within the specification?

YES

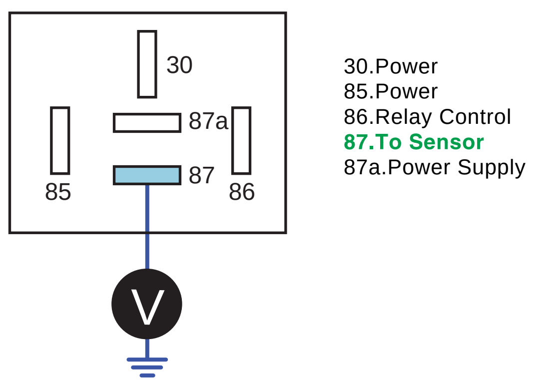
▶ Go to next step as below.

NO

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

5. Measure the voltage between terminal 87 of the main relay harness connector and chassis ground.

Specification : Approx. 1.5V



SHDF16346L

6. Is value within the specification?

YES

▶ Go to next step as below.

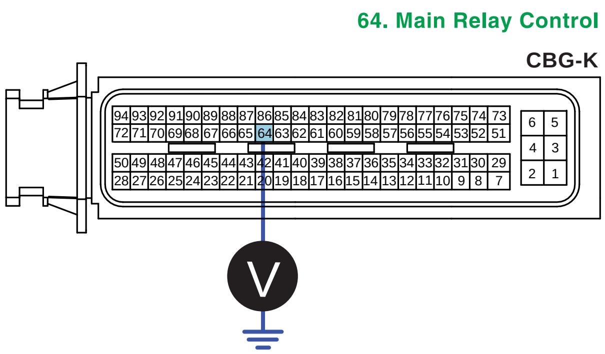
NO

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

CONTROL CIRCUIT INSPECTION EF6641EC

1. Ignition "OFF"
2. With ECM connector still disconnected, measure voltage between terminal 64 of the ECM harness connector and chassis ground

Specification :	Approx. B+



SHDF16347L

3. Is voltage within the specification?

YES

▶ Go to next step as below.

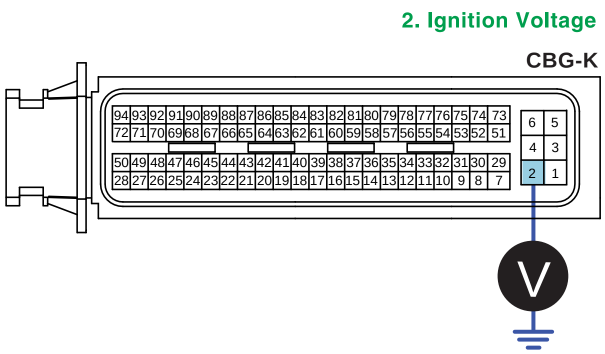
NO

▶ Check control circuit for open or short circuit between main relay and ECM. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

IGNITION SWITCH CIRCUIT INSPECTION

1. Ignition "ON" & Engine "OFF".
2. Measure the voltage between terminal 2 of the ECM harness connector and chassis ground.

Specification :	Approx. B+



SHDF16348L

3. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

TERMINAL AND CONNECTOR INSPECTION ED8F8AF8

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ECE75EAD

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0562 SYSTEM VOLTAGE LOW

COMPONENT LOCATION ECCBB995

Refer to DTC P0560.

GENERAL DESCRIPTION E6370542

Refer to DTC P0560.

DTC DESCRIPTION E785023A

ECM sets DTC P0562 if the ECM detects system voltage lower than the possible range of battery voltage.

DTC DETECTING CONDITION E5F1156F

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical check	• Contact resistance in connectors • Faulty charging system
Enable Conditions	• No relevant failure • Vehicle speed ＞ 10kph(6mph)	
Threshold Value	• Voltage after main relay when ON ＜ 10V	
Diagnostic Time	• 30 sec.	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM EEEF8902

Refer to DTC P0560.

SIGNAL WAVEFORM AND DATA EC53A4E9

Refer to DTC P0560.

MONITOR DTC STATUS E8FFCA3E

NOTE

If any codes relating to system voltage(P0562) is stored, do ALL REPAIRS associated with those codes before proceeding with troubleshooting

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*

- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

SYSTEM INSPECTION EE5353C4

1. Start the engine and raise the engine speed to 2,500~3,000 RPM
2. Turn ON all electrical loads by turning on the headlamps, and by turning on the high blower motor, etc
3. Monitor the battery(ignition) voltage parameter on the Scantool data list

SPECIFICATION :

Ambient temperature ℃(℉)	Reference Voltage(V)
-20(-4)	Approx. 14.2~15.4
20(68)	Approx. 14.0~15.0
60(140)	Approx. 13.7~14.9
80(176)	Approx. 13.5~14.7

4. Is the battery voltage within the specification?

YES

▶ Go to next step as below.

NO

▶ Possibility of charging system malfunction. Repair or replace alternator and battery. Refer to Charging System group in Workshop manual. And then go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E41DDE9B

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E04DDE79

Refer to DTC P0560.

DTC P0563 SYSTEM VOLTAGE HIGH

COMPONENT LOCATION EA349D6B

Refer to DTC P0560.

GENERAL DESCRIPTION E9435F91

Refer to DTC P0560.

DTC DESCRIPTION EB4E6AE1

ECM sets DTC P0563 if the ECM detects system voltage higher than the possible range of battery voltage.

DTC DETECTING CONDITION E0CF2C67

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical check	• Contact resistance in connectors • Faulty charging system
Enable Conditions	• No relevant failure • Vehicle speed ＞ 10kph(6mph)	
Threshold Value	• Voltage after main relay when ON ＞ 16V	
Diagnostic Time	• 30 sec.	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM EA1B7FA4

Refer to DTC P0560.

SIGNAL WAVEFORM AND DATA E85D208B

Refer to DTC P0560.

MONITOR DTC STATUS EE035BB0

NOTE

If any codes relating to system voltage(P0563) is stored, do ALL REPAIRS associated with those codes before proceeding with troubleshooting

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*

- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

SYSTEM INSPECTION E4411D4C

1. Start the engine and raise the engine speed to 2,500~3,000 RPM
2. Turn ON all electrical loads by turning on the headlamps, and by turning on the high blower motor, etc
3. Monitor the battery(ignition) voltage parameter on the Scantool data list

SPECIFICATION :

Ambient temperature ℃(℉)	Reference Voltage(V)
-20(-4)	Approx. 14.2~15.4
20(68)	Approx. 14.0~15.0
60(140)	Approx. 13.7~14.9
80(176)	Approx. 13.5~14.7

4. Is the battery voltage within the specification?

YES

▶ Go to next step as below.

NO

▶ Possibility of charging system malfunction. Repair or replace alternator and battery. Refer to Charging System group in Workshop manual. And then go to "Verification of Vehicle Repair" procedure.

TERMINAL AND CONNECTOR INSPECTION E98C8C2A

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

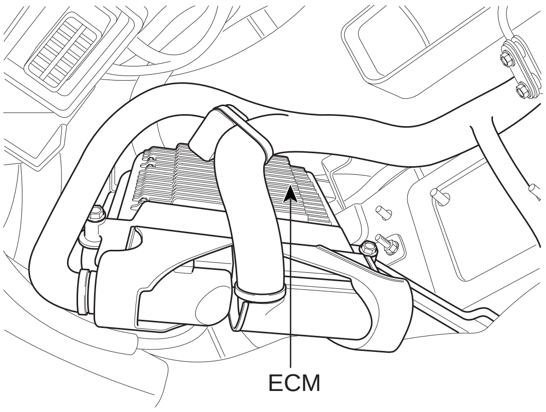
▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR ECFBBED2

Refer to DTC P0560.

DTC P0605 INTERNAL CONTROL MODULE READ ONLY MEMORY(ROM) ERROR

COMPONENT LOCATION E44595A8



SLDF17349L

GENERAL DESCRIPTION E5D8DF67

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

DTC DESCRIPTION EC1D1A00

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

DTC DETECTING CONDITION EEE994A4

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check RAM Area / Communication connections	• Contact resistance in connectors • Faulty PCM
Enable Conditions	• Ignition ON	
Threshold Value	• RAM test/Checksum/SPI communication : Failure	
Diagnostic Time	• 0.1 second	
MIL On Condition	• Immediate	

MONITOR DTC STATUS EE8EBCE9

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

2. Press F4(DTAL) to select DTC information from the DTCs menu.

3. Confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

4. Read "DTC Status" parameter.

5. Is parameter displayed "History(Not Present) fault"?

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

BACK UP VOLTAGE INSPECTION E8F76498

1. Ignition "OFF"
2. Disconnect ECM connector
3. Ignition "ON"
4. Measure voltage between terminal 6 of the ECM harness connector and chassis ground

Specification : Remain stable at battery voltage

5. Are circuits remaining stable at battery voltage?

YES

▶ Using a scan tool, check ECM software version and upgrade as necessary. If version is the newest one, check ECM for contamination, deterioration, or damage. Substitute with a known-good ECM and check for proper operation. If the problem is corrected, replace ECM and then go to "Verification of Vehicle Repair" procedure.

NOTE

It is necessary to perform the TPS adaptation procedure with Scan tool when the throttle body assembly or ECM is replaced.

■ TPS adaptation procedure
1. Erase previous TPS adaptation value using Scan tool.
2. Ignition "OFF" and then "ON" without cranking. Wait for 10 seconds under enable conditions

Enable conditions : Battery ＞10V & Intake Air Temp.＞5.3°C(41.5°F) & 5.3°C(41.5°F) ＜ Engine CoolantTemp. ＜99.8°C(211.6°F)

3. After TPS adaptation, the system normality should be confirmed by reading out "FMY" on the Scan Tool

NO

▶ If voltage fluctuates, check circuit for loose, bent or corroded terminals, Repair as necessary and go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E86A3237

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0625 GENERATOR FIELD/F TERMINAL CIRCUIT LOW

GENERAL DESCRIPTION E416EE71

Alternator output and power demand of all electrical loads and systems must be matched to each other as ideally as possible so that the entire system is reliable and trouble-free in operation. The ECM monitors alternator output deviation from the signal of the FR terminal of the alternator when the engine is running

DTC DESCRIPTION E17C7853

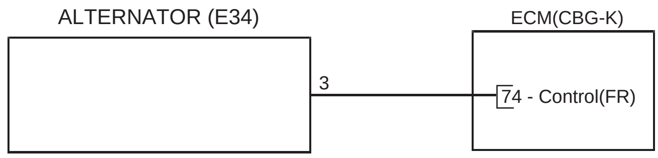
ECM sets DTC P0625 if the ECM detects output duty signal lower than the possible range of a properly operating alternator

DTC DETECTING CONDITION E1D0FA6D

<table>
<tr><th colspan="2">Item</th><th>Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td colspan="2">DTC Strategy</td><td>• Electrical Check</td><td rowspan="8">• Short to battery in harness
• Poor connection or damaged harness</td></tr>
<tr><td rowspan="2">Enable Conditions</td><td>Case 1</td><td>• Time after ignition ON ＞ 0.1sec.
• Engine speed=0
• No relevant failure</td></tr>
<tr><td>Case 2</td><td>• No relevant failure
• Battery voltage ＜16V
• 600＜ Engine speed(rpm) ＜4000
• Coolant temp. ＞74℃(165°F)</td></tr>
<tr><td rowspan="2">Threshold Value</td><td>Case 1</td><td>• Alternator load ＜15%</td></tr>
<tr><td>Case 2</td><td>• Alternator load ＜ 2%</td></tr>
<tr><td rowspan="2">Diagnostic Time</td><td>Case 1</td><td>• 1 sec.</td></tr>
<tr><td>Case 2</td><td>• 20sec.</td></tr>
<tr><td colspan="2">MIL On Condition</td><td>• -</td></tr>
</table>

SCHEMATIC DIAGRAM E29A9C93

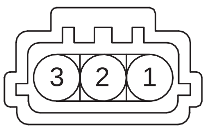
[Circuit Diagram]



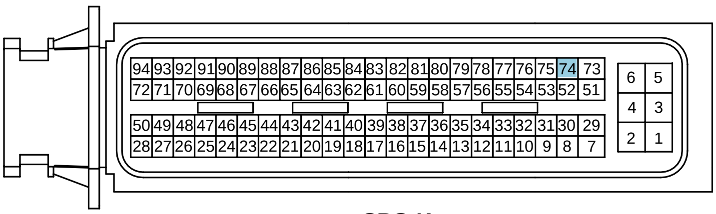
[Connection Information]

Terminal	Connected to	Function
3	ECM CBG-K (74)	Control(FR)

[Harness Connector]



E34
ALTERNATOR



CBG-K
ECM

SLDF17310L

SIGNAL WAVEFORM AND DATA EDDD549B

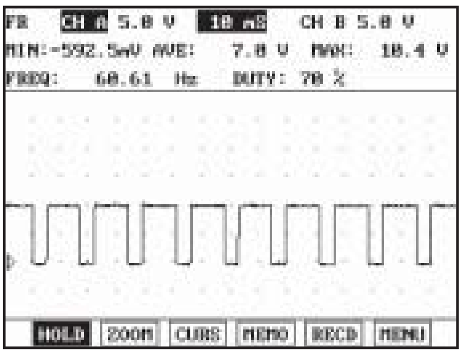


Fig1

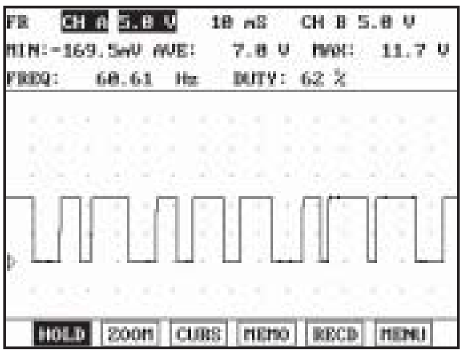


Fig2

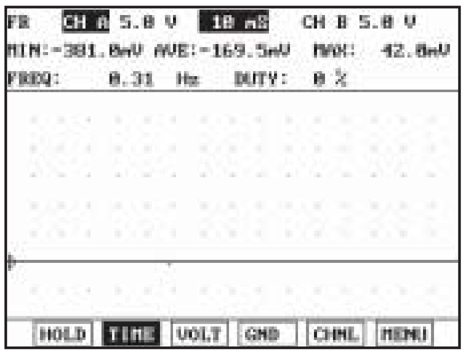


Fig3

Signal waveform at alternator #3 terminal
Fig. 1) Normal waveform with ignition "ON"
Fig. 2) All electrical load "OFF" with idle
Fig. 3) A/C, Rear defrost, Head lamp "ON" with idle

SLDF17407L

MONITOR DTC STATUS E538569A

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

SYSTEM INSPECTION E0666ED8

1. Start the engine and raise the engine speed to 2,500~3,000 RPM
2. Turn ON all electrical loads by turning on the headlamps, and by turning on the high blower motor, etc
3. Monitor the battery(ignition) voltage parameter on the Scantool data list

SPECIFICATION :

Ambient temperature ℃(°F)	Reference Voltage(V)
-20(-4)	Approx. 14.2 ~ 15.4
20 (68)	Approx. 14.0~15.0
60 (140)	Approx. 13.7~14.9
80 (176)	Approx. 13.5~14.7

4. Is the battery voltage within the specification?

YES

▶ Go to next step as below

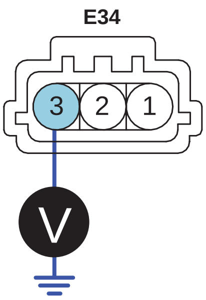
NO

▶ Possibility of charging system malfunction. Repair or replace alternator and battery. Refer to Charging System group in Workshop manual. And then go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION E789E6C8

1. With ignition OFF, disconnect alternator connector
2. Ignition "ON" & Engine "OFF"
3. Measure voltage between terminals 3 of the alternator harness connector and chassis ground

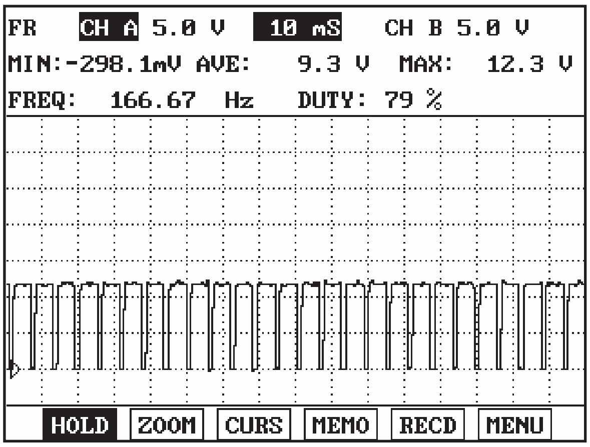
Specification : Approx. 9~10V



SLDF17311L

NOTE

Normal waveform with ignition "ON"



LFLG409A

4. Is voltage within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

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

TERMINAL AND CONNECTOR INSPECTION EADE3B67

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EBFD5C8D

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0626 GENERATOR FIELD/F TERMINAL CIRCUIT HIGH

GENERAL DESCRIPTION E5B6022A

Refer to DTC P0625.

DTC DESCRIPTION E7329BD5

ECM sets DTC P0626 if the ECM detects output duty signal higher than the possible range of a properly operating alternator.

DTC DETECTING CONDITION EA20DFFC

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical check	• Open or short to ground in harness • Faulty charging system
Enable Conditions	• Time after ignition ON ＞ 0.1sec. • Engine speed=0 • No relevant failure	
Threshold Value	• Alternator load ＞ 35%	
Diagnostic Time	• 1sec.	
MIL On Condition	• -	

SCHEMATIC DIAGRAM EA14B336

Refer to DTC P0625.

SIGNAL WAVEFORM AND DATA EC6E9E86

Refer to DTC P0625.

MONITOR DTC STATUS ECDA7F3B

Refer to DTC P0625.

SYSTEM INSPECTION E3F622F6

1. Start the engine and raise the engine speed to 2,500~3,000 RPM.
2. Turn ON all electrical loads by turning on the headlamps, and by turning on the high blower motor, etc.
3. Monitor the battery(ignition) voltage parameter on the Scantool data list.

SPECIFICATION :

Ambient temperature ℃(°F)	Reference Voltage(V)
-20(-4)	Approx. 14.2 ~ 15.4
20 (68)	Approx. 14.0~15.0
60 (140)	Approx. 13.7~14.9
80 (176)	Approx. 13.5~14.7

4. Is the battery voltage within the specification?

YES

▶ Go to next step as below.

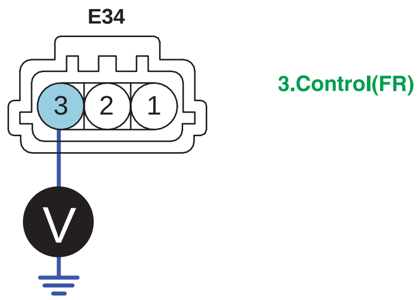
NO

▶ Possibility of charging system malfunction. Repair or replace alternator and battery. Refer to Charging System group in Workshop manual. And then go to "Verification of Vehicle Repair" procedure.

CONTROL CIRCUIT INSPECTION EA7A9E4A

1. With ignition OFF, disconnect alternator connector.
2. Ignition "ON" & Engine "OFF".
3. Measure voltage between terminals 3 of the alternator harness connector and chassis ground.

Specification : Approx. 9~10V



SLDF17311L

4. Is voltage within the specification?

YES

▶ Go to next step as below.

NO

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

TERMINAL AND CONNECTOR INSPECTION EF7DCB7A

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E05A837B

Refer to DTC P0625.

DTC P0650 MALFUNCTION INDICATOR LAMP(MIL) CONTROL CIRCUIT

GENERAL DESCRIPTION ECA0454A

The Malfunction Indicator Lamp (MIL), which is located in the instrument cluster, comes on to notify the driver that there may be a problem with the vehicle and that service is needed. Immediately after the ignition switch turns on, the malfunction indicator lamp is lit to indicate that the MIL operates normally and goes off after starting

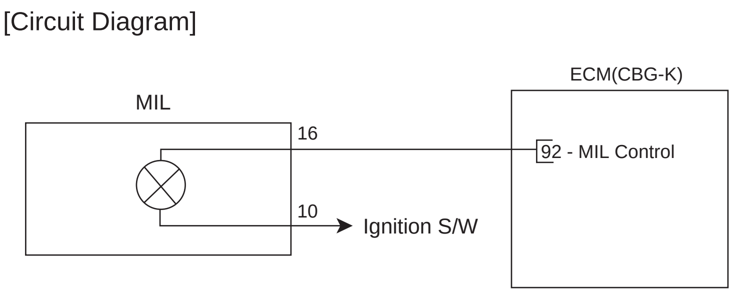
DTC DESCRIPTION E03C4F3F

ECM sets DTC P0650 if the ECM detects that the MIL control line is open or short circuit to ground or battery line.

DTC DETECTING CONDITION E8F65B54

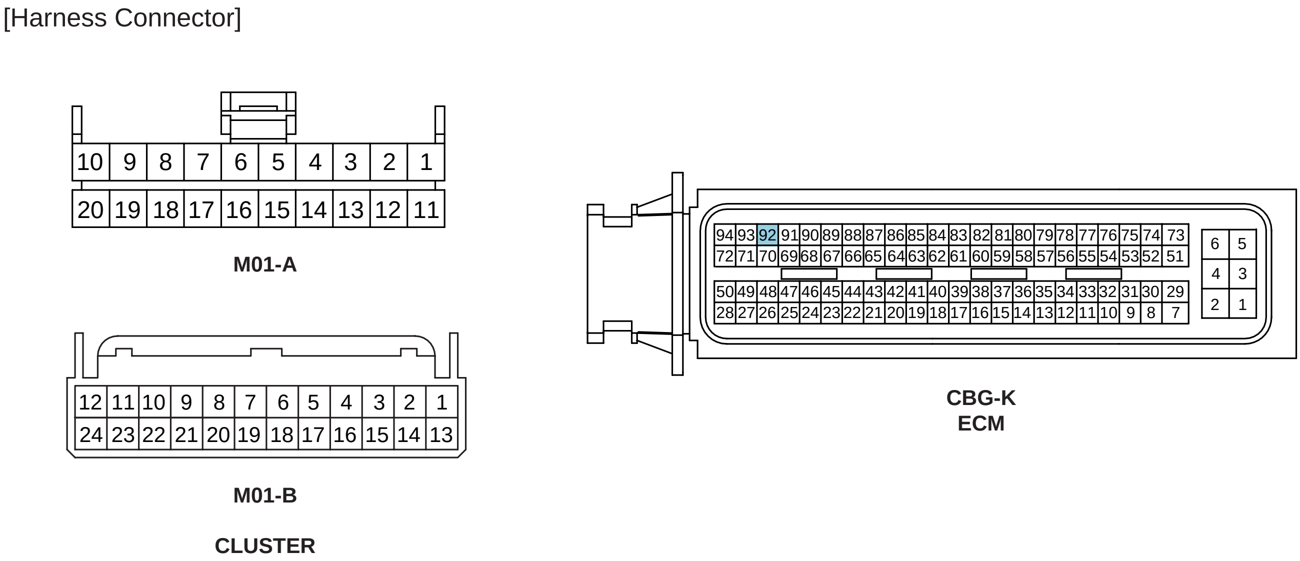
Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Open or short between MIL and ECM • Short to ground or battery or line break • Burned out MIL bulb
Enable Conditions	• 6V＜ Battery voltage ＜16V	
Threshold Value	• Short to ground or battery or line break	
Diagnostic Time	• 10 sec.	
MIL On Condition	• -	

SCHEMATIC DIAGRAM EC05C48C



[Connection Information]

Terminal	Connected to	Function
16	ECM CBG-K (92)	MIL Control
10	IG S/W	Power



SLDF17312L

MONITOR DTC STATUS EE48C1FF

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

CONTROL CIRCUIT INSPECTION E2A45607

1. Ignition "OFF"
2. Disconnect ECM connector
3. Ignition "ON" & Engine "OFF"
4. Using a suitable wire, jumper the terminal 92 of the ECM harness connector to chassis ground.
5. Is MIL bulb illuminated?

YES

▶ Go to next step as below

NO

▶ Remove instrument cluster and inspect MIL bulb. If it is burned out, replace bulb. If bulb is okay, locate source of open between bulb and Meter Fuse. Repair as necessary and go to "Verification of Vehicle Repair" procedure

6. Remove wire from ECM harness connector
7. Does MIL bulb go out?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

▶ Check for source of short to GND between bulb and ECM. Repair as necessary and go to "Verification of Vehicle Repair" procedure

VERIFICATION OF VEHICLE REPAIR E1CC4BF6

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P0700 TCU REQUEST FOR MIL ON

GENERAL DESCRIPTION E03A9115

The TCM can request activation of the MIL lamp Via a communication line to the ECM. This is only a request from TCM to ECM to turn the MIL on. The fault code is stored in the TCM. Select Transaxle system on the Scantool and monitor DTC related automatic transaxle system.DO ALL REPAIRS associated malfunction with A/T.

DTC DETECTING CONDITION E52D3DF8

Item	Detecting Condition	Possible Cause
DTC Strategy	• TCU request via CAN	• Transaxle system
Enable Conditions	• Battery voltage ＞ 10V • Engine speed ＞32 rpm • Time after ignition ON ＞ 0.5sec.	
Threshold Value	• Failure from TCU	
Diagnostic Time	• 10 ms	
MIL On Condition	• Controlled by TCM	

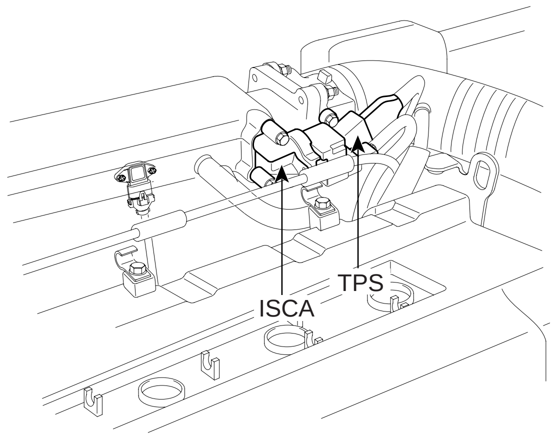
MONITOR DTC STATUS E151862C

1. This is only a request from TCM to ECM to turn the MIL on. The fault code is stored in the TCM. The Freeze Frame Data is stored in the ECM under the P0700 request code. Be sure to retrieve freeze frame data before clearing code P0700 from ECM.

2. Check the transaxle system.

DTC P1505 IDLE CHARGE ACTUATOR SIGNAL LOW OF COIL #1

COMPONENT LOCATION E10E2BF0



SLDF17236L

GENERAL DESCRIPTION ED7C2AEA

The Idle Speed Control Actuator(ISCA) is installed on the intake manifold and controls the intake airflow that is bypassed around the throttle plate to keep constant engine speed when the throttle valve is closed. The function of the ISCA valve is to maintain idle speed according to various engine loads and conditions, and also to provide additional air during starting. The ISCA valve consists of an opening coil, a closing coil, and a permanent magnet. Based on information from various sensors, the ECM controls both coils by grounding their control circuits. According to the control signals from the ECM, the valve rotor rotates to control the by pass airflow into the engine.

DTC DESCRIPTION E21BFEC2

ECM sets DTC P1505 if the ECM detects that the ISCA(OPEN) control circuit is open or short to ground.

DTC DETECTING CONDITION E56BBA4E

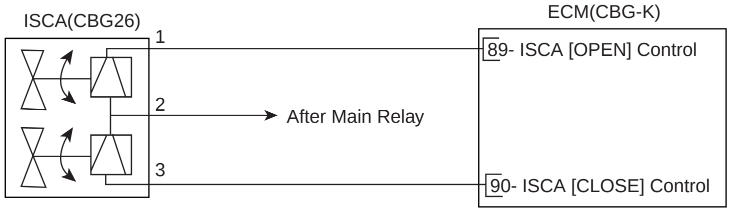
Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Open or short to ground in harness • Contact resistance in connectors • Faulty ISCA valve
Enable Conditions	• 10V < Battery voltage < 16V • 20% < PWM output < 80%	
Threshold Value	• Short to ground or line break	
Diagnostic Time	• 2 sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E34B4CF6

Temperature	Opening Coil(Ω)	Closing Coil(Ω)
20°C(68°F)	11.1~12.7	14.6~16.2

SCHEMATIC DIAGRAM E0B56C74

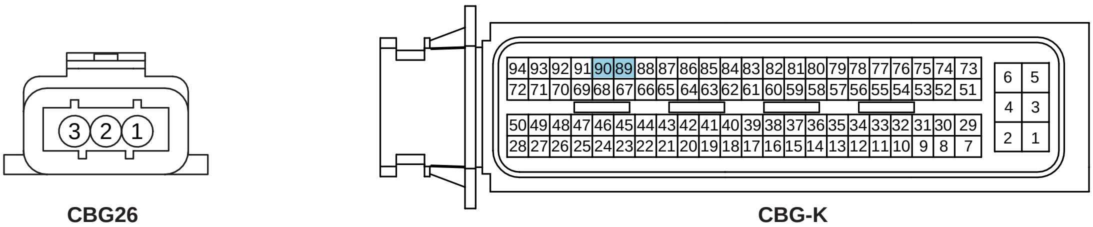
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CBG-K (89)	ISCA (OPEN) Control
2	Main Relay	Power Supply (B+)
3	ECM CBG-K (90)	ISCA (CLOSE) Control

[Harness Connector]



CBG26
ISCA

CBG-K
ECM

SHDF16313L

SIGNAL WAVEFORM AND DATA EF4BC466

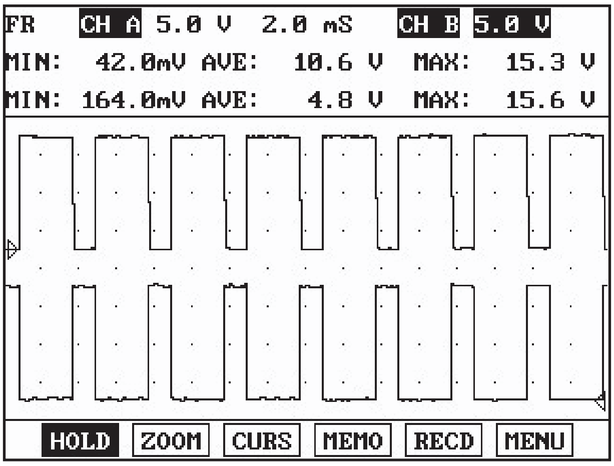


Fig1

Fig 1) The above waveforms are the voltage signals generated when the ISCA operates. This ISCA is a duty type and the time opened determines the duty amount. The left side is the waveform of the ISCA Opening coil during idle.
The right side is the waveform of the ISCA Closing coil during idle.

SHDF16299L

MONITOR DTC STATUS EBD4F290

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Press F4(DTAL) to select DTC information from the DTCs menu.
3. Confirm that "DTC Readiness Flag" indicates "Complete". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

4. Read "DTC Status" parameter.

5. Is parameter displayed "History(Not Present) fault"?

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

▶ Go to next step as below.

COMPONENT INSPECTION E1EB2CAD

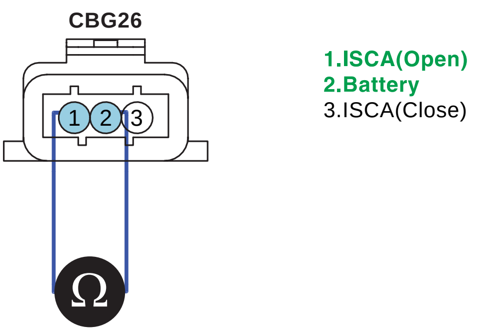
1. Ignition "OFF".

2. Disconnect ISCA valve connector.

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

SPECIFICATION

Temperature	Opening Coil(Ω)
20℃(68°F)	11.1~12.7



SHDF16314L

4. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

▶ Check ISCA for contamination, deterioration, or damage. Substitute with a known-good ISCA and check for proper operation. If the problem is corrected, replace ISCA and then go to "Verification of Vehicle Repair" procedure.

POWER CIRCUIT INSPECTION E8818D08

1. Ignition "ON" & Engine "OFF".

2. Measure voltage between terminal 2 of the valve harness connector and chassis ground.

Specification : Approx. B+

3. Is voltage within the Specification?

YES

▶ Go to next step as below.

NO

▶ Check for an open or short to ground in the power supply circuit between the ISCA valve and main relay. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION ED522129

1. Measure voltage between terminal 1 of the valve harness connector and chassis ground.

Specification : Approx. 2~4V

2. Is voltage within the Specification?

YES

▶ Go to next step as below.

NO

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

TERMINAL AND CONNECTOR INSPECTION EB6FD8DB

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Thoroughly check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E2928BA8

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC P1506 IDLE CHARGE ACTUATOR SIGNAL HIGH OF COIL #1

COMPONENT LOCATION E0B39F1D

Refer to DTC P1505.

GENERAL DESCRIPTION E2B7C6C2

Refer to DTC P1505.

DTC DESCRIPTION ED17AC5D

ECM sets DTC P1506 if the ECM detects that the ISCA(OPEN) control circuit is short to battery.

DTC DETECTING CONDITION E51FC7A0

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Short to battery in harness • Contact resistance in connectors • Faulty ISCA valve
Enable Conditions	• 10V < Battery voltage < 16V • 20% < PWM output < 80%	
Threshold Value	• Short to battery	
Diagnostic Time	• 2 sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E1149860

Refer to DTC P1505.

SCHEMATIC DIAGRAM E810451D

Refer to DTC P1505.

SIGNAL WAVEFORM AND DATA EB891137

Refer to DTC P1505.

MONITOR DTC STATUS EE95D529

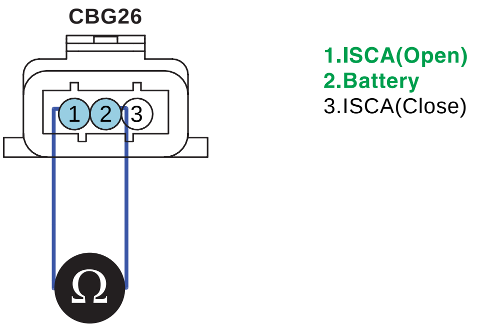
Refer to DTC P1505.

COMPONENT INSPECTION E5CB008D

1. Ignition "OFF".
2. Disconnect ISCA valve connector.
3. Measure resistance between terminals 1 and 2 of the valve connector(Component side).

SPECIFICATION

Temperature	Opening Coil(Ω)
20℃(68°F)	11.1 ~ 12.7



SHDF16314L

4. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

▶ Check ISCA for contamination, deterioration, or damage. Substitute with a known-good ISCA and check for proper operation. If the problem is corrected, replace ISCA and then go to "Verification of Vehicle Repair" procedure.

POWER CIRCUIT INSPECTION E0D9CC2C

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between terminal 2 of the valve harness connector and chassis ground.

Specification : Approx. B+

3. Is voltage within the Specification?

YES

▶ Go to next step as below.

NO

▶ Check for an open or short to ground in the power supply circuit between the ISCA valve and main relay. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E7C3A3BE

1. Measure voltage between terminal 1 of the valve harness connector and chassis ground.

Specification : Approx. 2~4V

2. Is voltage within the Specification?

YES

▶ Go to next step as below.

NO

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

TERMINAL AND CONNECTOR INSPECTION EA2ABD97

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Thoroughly check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EBB67138

Refer to DTC P1505.

DTC P1507 IDLE CHARGE ACTUATOR SIGNAL LOW OF COIL #2

COMPONENT LOCATION E600B5B9

Refer to DTC P1505.

GENERAL DESCRIPTION E5849C08

Refer to DTC P1505.

DTC DESCRIPTION E0F22CCF

ECM sets DTC P1507 if the ECM detects that the ISCAV(CLOSE) control line is open or short to ground.

DTC DETECTING CONDITION E09DE18D

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Open or short to ground in harness • Contact resistance in connectors • Faulty ISCA valve
Enable Conditions	• 10V < Battery voltage < 16V • 20% < PWM output < 80%	
Threshold Value	• Short to ground or line break	
Diagnostic Time	• 2 sec.	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION EB6DFFE8

Refer to DTC P1505.

SCHEMATIC DIAGRAM E2AFE9F3

Refer to DTC P1505.

SIGNAL WAVEFORM AND DATA E19E18AF

Refer to DTC P1505.

MONITOR DTC STATUS E78F546C

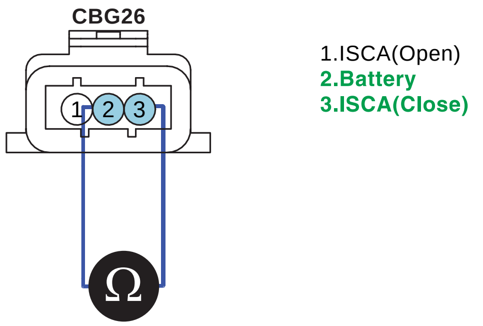
Refer to DTC P1505.

COMPONENT INSPECTION ECA73BC9

1. Ignition "OFF".
2. Disconnect ISCA valve connector.
3. Measure resistance between terminals 2 and 3 of the valve connector(Component side).

SPECIFICATION

Temperature	Opening Coil(Ω)
20℃(68°F)	14.6 ~ 16.2



SHDF16318L

4. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

▶ Check ISCA for contamination, deterioration, or damage. Substitute with a known-good ISCA and check for proper operation. If the problem is corrected, replace ISCA and then go to "Verification of Vehicle Repair" procedure.

POWER CIRCUIT INSPECTION EEEF6C48

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between terminal 2 of the valve harness connector and chassis ground.

Specification : Approx. B+

3. Is voltage within the Specification?

YES

▶ Go to next step as below.

NO

▶ Check for an open or short to ground in the power supply circuit between the ISCA valve and main relay. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION EDD738FC

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

Specification : Approx. 1~2V

2. Is voltage within the Specification?

YES

▶ Go to next step as below.

NO

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

TERMINAL AND CONNECTOR INSPECTION EFEB6699

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Thoroughly check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure .

VERIFICATION OF VEHICLE REPAIR E30EADC6

Refer to DTC P1505.

DTC P1508 IDLE CHARGE ACTUATOR SIGNAL HIGH OF COIL #2

COMPONENT LOCATION EEE4BDDE

Refer to DTC P1505.

GENERAL DESCRIPTION E9B383E8

Refer to DTC P1505.

DTC DESCRIPTION E7D5FB64

ECM sets DTC P1508 if the ECM detects that the ISCA(CLOSE) control circuit is short to battery.

DTC DETECTING CONDITION E389DDB1

Item	Detecting Condition	Possible Cause
DTC Strategy	• Electrical Check	• Short to battery in harness • Poor connection or damaged harness • Faulty ISCA valve
Enable Conditions	• 10V < Battery voltage < 16V • 20% < PWM output < 80%	
Threshold Value	• Short to battery	
Diagnostic Time	• 2 sec.	
Fail Safe	• PCM controls idle speed with predetermined value	
MIL On Condition	• 2 Driving Cycles	

SPECIFICATION E67D41E4

Refer to DTC P1505.

SCHEMATIC DIAGRAM E70914E8

Refer to DTC P1505.

SIGNAL WAVEFORM AND DATA E5BAFE95

Refer to DTC P1505.

MONITOR DTC STATUS E8EE9B20

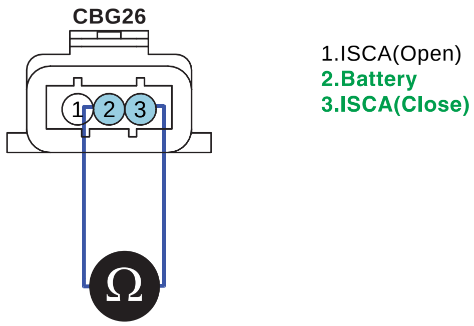
Refer to DTC P1505.

COMPONENT INSPECTION EB5D005F

1. Ignition "OFF"
2. Disconnect ISCA valve connector
3. Measure resistance between terminals 2 and 3 of the valve connector(Component side)

SPECIFICATION

Temperature	Opening Coil(Ω)
20℃(68°F)	14.6 ~ 16.2



SHDF16318L

4. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

▶ Check ISCA for contamination, deterioration, or damage. Substitute with a known-good ISCA and check for proper operation. If the problem is corrected, replace ISCA and then go to "Verification of Vehicle Repair" procedure

POWER CIRCUIT INSPECTION E3D5E657

1. Ignition "ON" & Engine "OFF"
2. Measure voltage between terminal 2 of the valve harness connector and chassis ground

Specification : Approx. B+

3. Is voltage within the Specification?

YES

▶ Go to next step as below

NO

▶ Check for an open or short to ground in the power supply circuit between the ISCA valve and main relay. Repair as necessary and go to "Verification of Vehicle Repair" procedure

SIGNAL CIRCUIT INSPECTION E80FA849

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

Specification : Approx. 1~2V

2. Is voltage within the Specification?

YES

▶ Go to next step as below

NO

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

TERMINAL AND CONNECTOR INSPECTION E64F2B3D

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

▶ Thoroughly check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E7722810

Refer to DTC P1505.

DTC U0001 CAN COMMUNICATION MALFUNCTION

GENERAL DESCRIPTION ED3EE921

A communication line exists between the Engine Control Module(ECM) and the Transaxle Control Module(TCM). The communication is through a Control Area Network(CAN). Without CAN communication, an independent pin and wiring is needed to receive a sensor information from a ECM. The more information to be communicated, the more wirings is required. In case of CAN communication type, all the information need to be communicated among control modules such as ECM and ABS control module use CAN lines.

DTC DESCRIPTION E25EC5C4

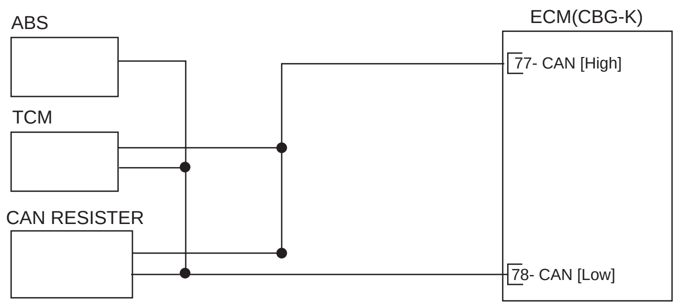
The ECM determines CAN communication error and sets DTC U0001 if communication with other control devices (e.g. ABS) via CAN is impossible or ECM detects that communication time via CAN exceeds threshold value.

DTC DETECTING CONDITION E10F9FBE

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check CAN message transfer status	• Open or short in CAN line • Poor connection or damaged harness • Faulty ECM
Enable Conditions	• Battery voltage ＞10V • Delay time ＞0.5 sec.	
Threshold Value	• 20 wrong messages received by ECM	
Diagnostic Time	• 20 wrong messages received by ECM	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM E1620A9F

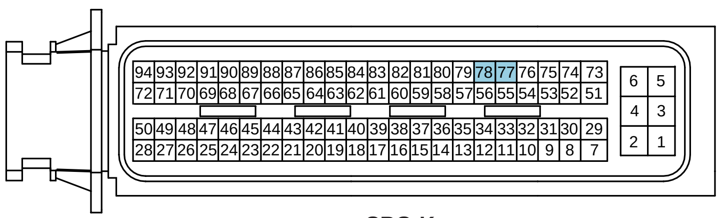
[Circuit Diagram]



[Connection Information]

Terminal	Terminal	Function
3	ECM CBG-K (77)	CAN(HIGH)
6	ECM CBG-K (78)	CAN(LOW)

[Harness Connector]



CBG-K
ECM

SLDF17320L

SIGNAL WAVEFORM AND DATA EBAF1DAC

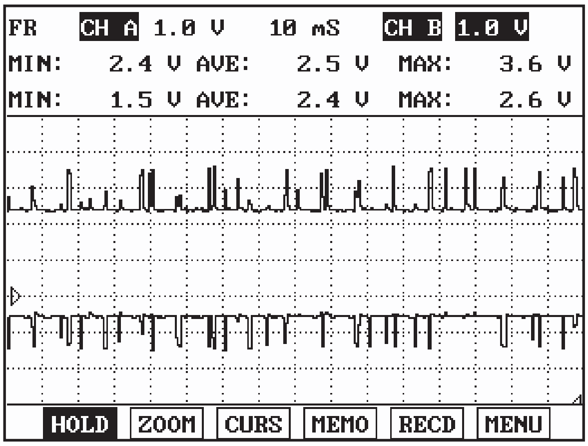


Fig1

Fig.1) Normal waveform with ignition ON

LFLG401A

MONITOR DTC STATUS EEFEE752

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

NOTE

- *History (Not Present) fault : DTC occurred but has been cleared.*
- *Present fault : DTC is occurring at present time.*

YES

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

NO

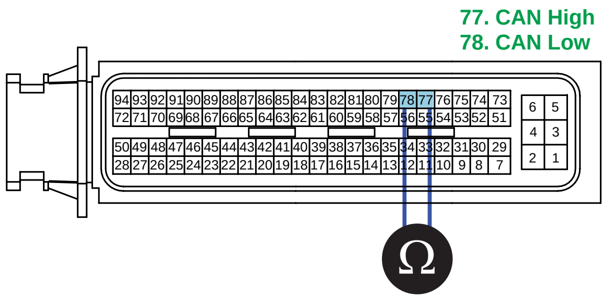
▶ Go to next step as below.

SIGNAL CIRCUIT INSPECTION EB8B3734

CHECK CAN COMMUNICATION LINE FOR OPEN

1. Ignition "OFF"
2. Disconnect ECM harness connector
3. Measure resistance between terminals 77 and 78 of the ECM harness connector.

Specification :	Approx. 110 ~ 130 Ω



SHDF16321L

4. Is resistance within the specification?

YES

▶ Go to next step as below

NO

▶ Check for open in wiring related to the CAN communication(ECM, EPS, MTS and vertical resistor at the junction box.). Repair as necessary and then go to "Verification of Vehicle Repair" procedure

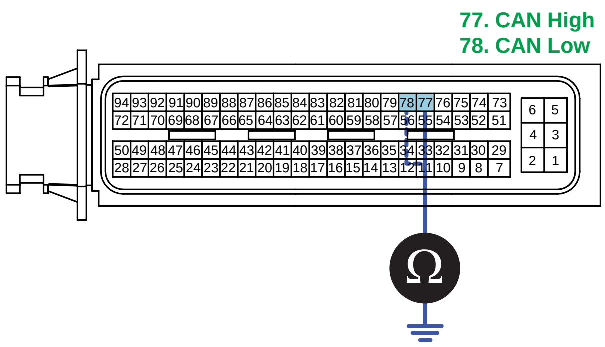
NOTE

Vertical Resistor Resistance : Approx. 110~130Ω

CHECK CAN COMMUNICATION LINE FOR SHORT TO GROUND

1. Measure resistance between terminal 77 of the ECM harness connector and chassis ground.
2. Measure resistance between terminal 78 of the ECM harness connector and chassis ground.

Specification :	Infinite(above 10kΩ)



SHDF16322L

3. Is resistance within the specification?

YES

▶ Go to next step as below

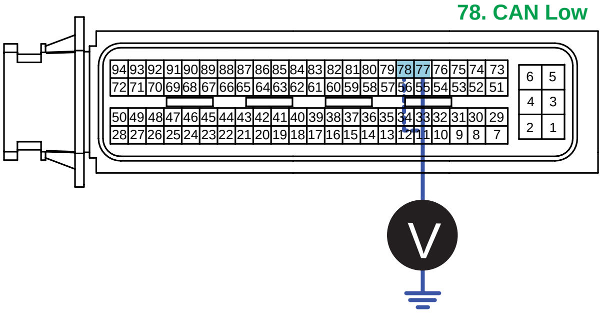
NO

▶ Repair CAN communication line for a short to ground. And then go to "Verification of Vehicle Repair" procedure

CHECK CAN COMMUNICATION LINE FOR SHORT TO BATTERY

1. Disconnect the connectors related to the CAN communication
2. Ignition "ON" & Engine "OFF"
3. Measure voltage between terminal 77 of the ECM harness connector and chassis ground.
4. Measure voltage between terminal 78 of the ECM harness connector and chassis ground.

Specification : Approx. 0V



SHDF16323L

5. Is voltage within the specification?

YES

▶ Go to next step as below

NO

▶ Repair CAN communication line for a short to battery. And then go to "Verification of Vehicle Repair" procedure

TERMINAL AND CONNECTOR INSPECTION EDDC1B56

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

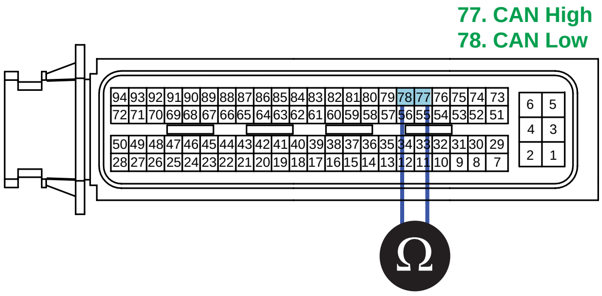
▶ Go to next step as below.

COMPONENT INSPECTION E4FE768E

1. Ignition "OFF"

2. Measure resistance between terminals 77 and 78 of the ECM connector(ECM side)

Specification : Approx. 110~130Ω



SHDF16321L

3. Is resistance within the specification?

YES

▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO

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

VERIFICATION OF VEHICLE REPAIR EC993EDE

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

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

YES

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

NO

▶ Go to the applicable troubleshooting procedure.

DTC U0101 CAN COMMUNICATION MALFUNCTION (ECM/PCM - TCM)

GENERAL DESCRIPTION EAA5A1CA

Refer to DTC U0001.

DTC DESCRIPTION E929692A

The ECM determines CAN communication error and sets DTC U0101 if no message received from TCM

DTC DETECTING CONDITION E8EDFFE3

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check CAN message transfer status	• Poor connection or damaged harness • Faulty ECM
Enable Conditions	• Battery voltage ＞10V • Engine speed >32rpm • Delay time ＞0.5 sec.	
Threshold Value	• No message from TCM	
Diagnostic Time	• 0.1 sec.	
MIL On Condition	• 2 Driving Cycles	

SCHEMATIC DIAGRAM EA7FE61F

Refer to DTC U0001.

SIGNAL WAVEFORM AND DATA E85496EE

Refer to DTC U0001.

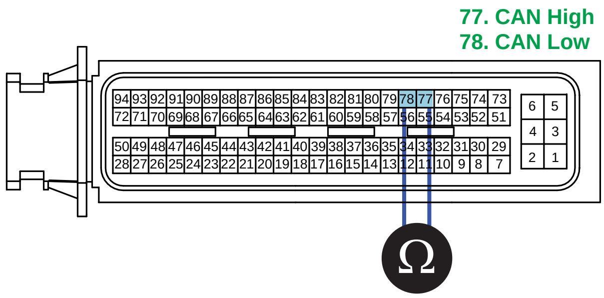
MONITOR DTC STATUS E3CC1742

Refer to DTC U0001.

COMPONENT INSPECTION ECD32C02

1. Ignition "OFF".
2. Measure resistance between terminals 77 and 78 of the ECM connector(ECM side).

Specification :	Approx. 110~130Ω



SHDF16321L

3. Is resistance within the specification?

YES

▶ Go to next step as below.

NO

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

TERMINAL AND CONNECTOR INSPECTION ED23CD93

1. Many malfunctions in the electrical system are caused by poor harness(es) 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

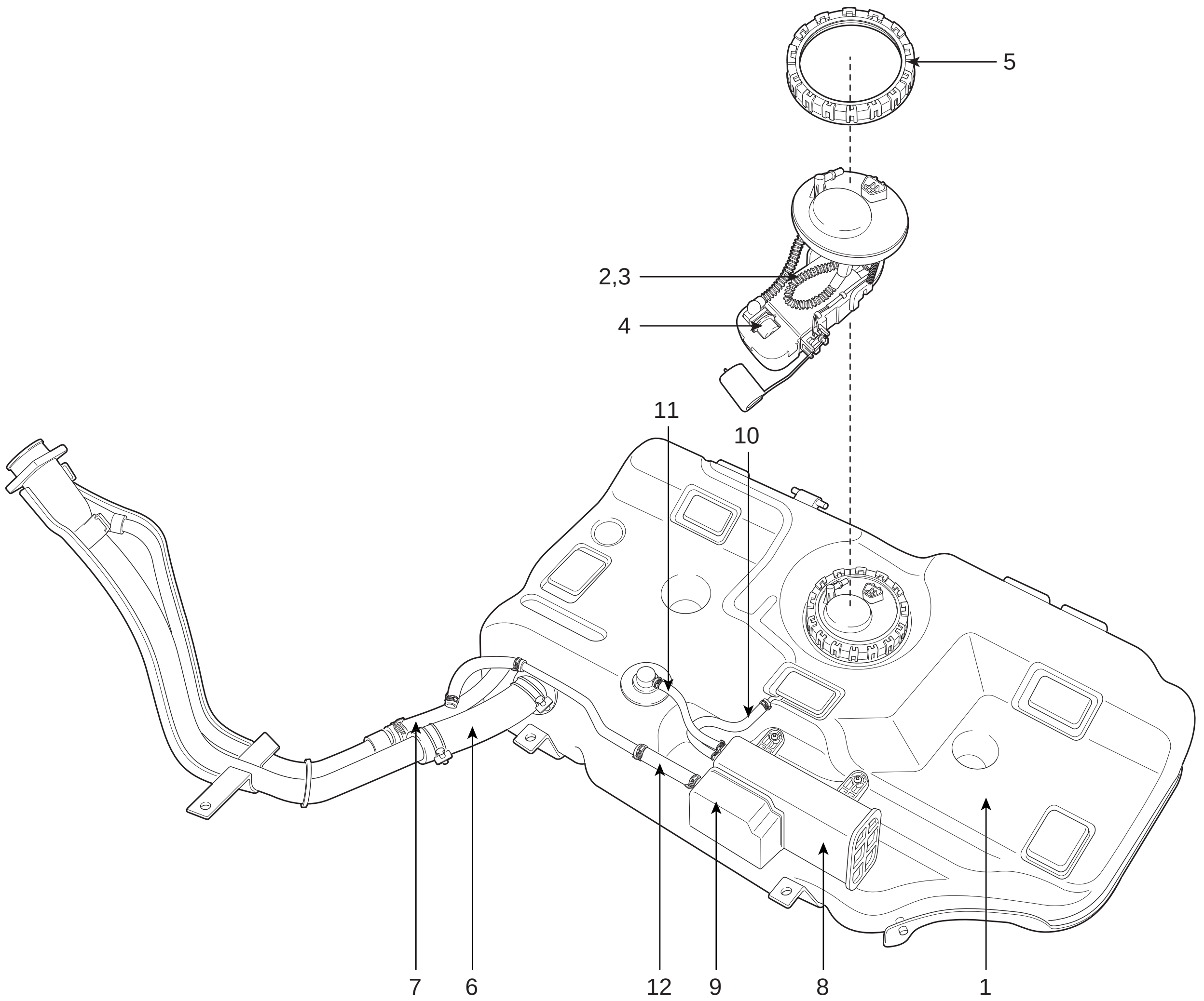
▶ Check for continuity in wiring related to the CAN communication line(ECM, EPS, MTS and vertical resistor at the junction box.). Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EB297C55

Refer to DTC U0001.

FUEL DELIVERY SYSTEM

COMPONENT LOCATION EC8301F8



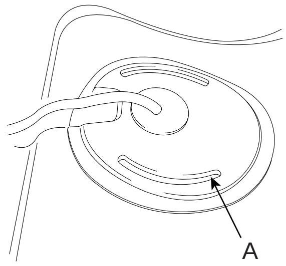
1. Fuel Tank
2. Fuel Pump
3. Fuel Filler
4. Fuel Pressure Regulator
5. Fuel Pump Plate Cover
6. Fuel Filler Hose
7. Leveling Hose
8. Canister
9. Fuel Tank Air Filter
10. Hose (Canister ↔ Intake Manifold)
11. Hose (Canister ↔ Fuel Tank)
12. Hose (Canister ↔ Atmosphere)

SLDFL7122L

FUEL PRESSURE TEST EAAB7481

1. PREPARING

1. Remove the rear seat cushion (Refer to "SEAT" in BD group).
2. Open the service cover (A).

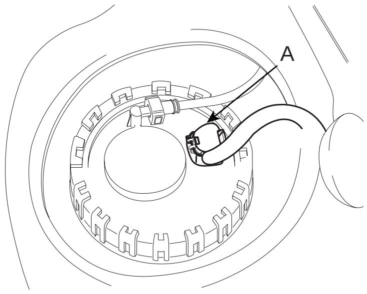


2. RELEASE THE INTERNAL PRESSURE

1. Disconnect the fuel pump connector (A).
2. Start the engine and wait until fuel in fuel line is exhausted.
3. After the engine stalls, turn the ignition switch to OFF position and disconnect the negative (-) terminal from the battery.

NOTE

Be sure to reduce the fuel pressure before disconnecting the fuel feed hose, otherwise fuel will spill out.



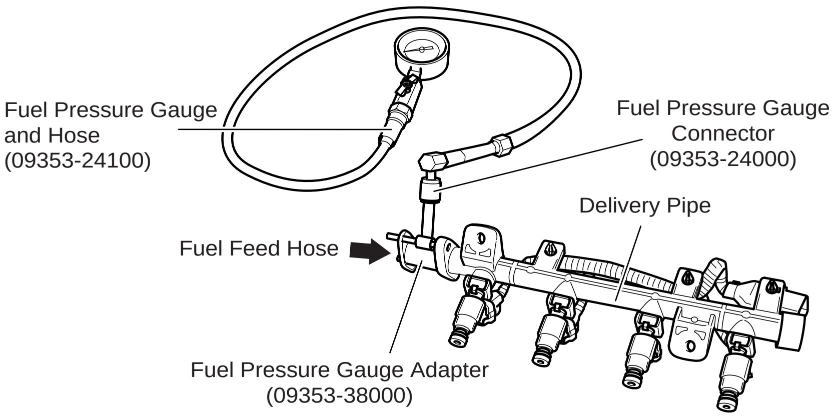
3. INSTALL THE SPECIAL SERVICE TOOL (SST) FOR MEASURING THE FUEL PRESSURE

1. Disconnect the fuel feed hose from the delivery pipe.

CAUTION

Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

2. Install the Fuel Pressure Gage Adapter (09353-38000) between the delivery pipe and the fuel feed hose.
3. Connect the Fuel Pressure Gage Connector (09353-24000) to the Fuel Pressure Gage Adapter (09353-38000).
4. Connect the Fuel Pressure Gage and Hose (09353-24100) to Fuel Pressure Gage Connector (09353-24000).
5. Connect the fuel feed hose to the Fuel Pressure Gage Adapter (09353-38000).



SLDFL7123L

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. Diconnect 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: 338 ~ 348 kpa (3.45 ~ 3.55 kgf/㎠, 49.0 ~ 50.5 psi)

- If the measured fuel pressure differs from the standard value, perform the necessary repairs using the table below.

Condition	Probable Cause	Suspected Area
Fuel Pressure too low	Clogged fuel filter	Fuel filter
	Fuel leak on the fuel-pressure regulator that is assembled on fuel pump because of poor seating of the fuel-pressure regulator.	Fuel Pressure Regulator
Fuel Pressure too High	Sticking fuel pressure regulator	Fuel Pressure Regulator

5. Stop the engine and check for a change in the fuel pressure gauge reading.

After engine stops, the gage reading should hold for about 5 minutes

- Observing the declination of the fuel pressure when the gage reading drops and perform the necessary repairs using the table below.

Condition	Probable Cause	Supected Area
Fuel pressure drops slowly after engine is stopped	Injector leak	Injector
Fuel pressure drops immediately after engine is stopped	The check valve within the fuel pump is open	Fuel Pump

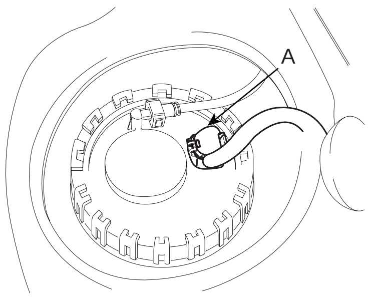
SMGFL6906N

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 diconnect 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 Gage and Hose (09353-24100) from the Fuel Pressure Gage Connector (09353-24000).
2. Disconnect the Fuel Pressure Gage Connector (09353-24000) from the Fuel Pressure Gage Adapter (09353-38000).
3. Disconnect the fuel feed hose from the Fuel Pressure Gage Adapter (09353-38000).
4. Disconnect the Fuel Pressure Gage 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.

SLDFL7124L

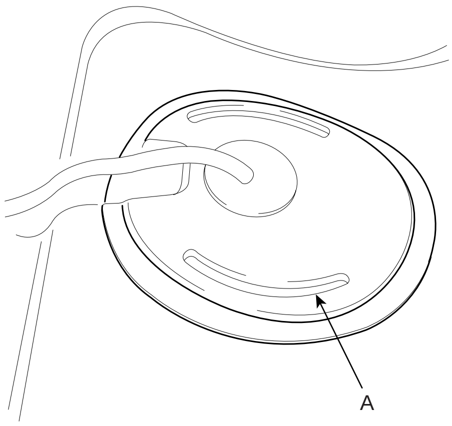
FUEL PUMP

REMOVAL (INCLUDING FUEL FILTER AND FUEL PRESSURE REGULATOR) EF311C37

1. Preparation

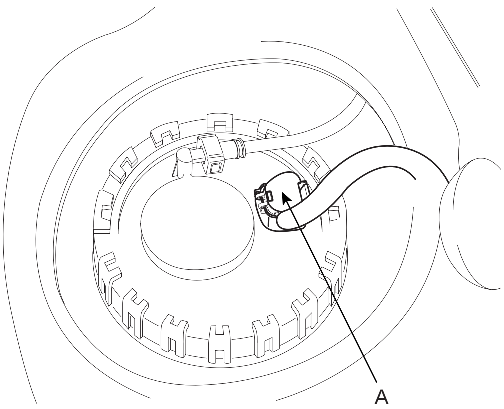
   1) Remove the rear seat cushion (Refer to "SEAT" in BD group).

   2) Open the service cover (A).



SLDF17137D

   3) Disconnect the fuel pump connector (A).

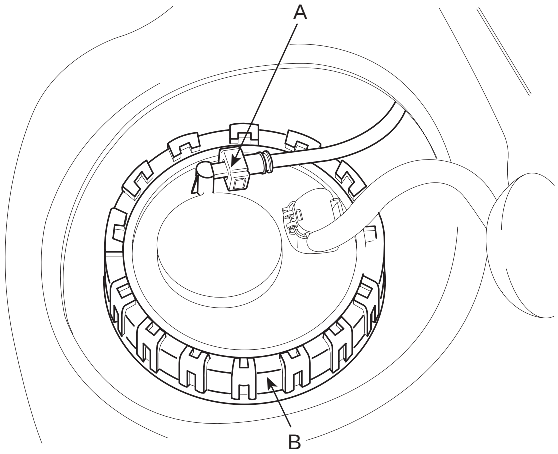


SLDFL7141L

   4) Start the engine and wait until fuel in fuel line is exhausted.

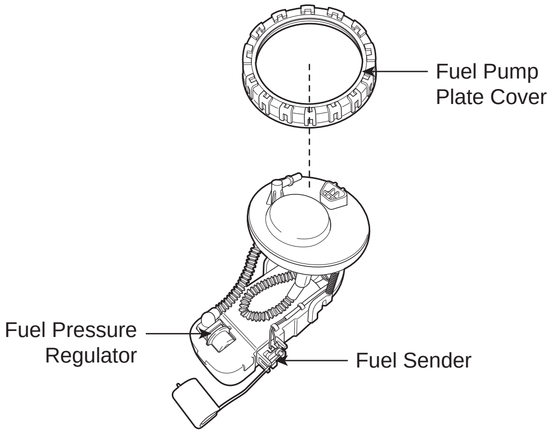
   5) After engine stalls, turn the ignition switch to OFF position.

2. Disconnect the fuel feed tube quick-connector (A).



SLDFL7142L

3. Unscrew the fuel pump plate cover (B) with the special service tool (SST No.: 09310-2B100) and remove the fuel pump assembly.



SLDFL7143L

INSTALLATION EFA1B080

Installation is reverse of removal.

Fuel Pump Plate Cover Tightening : 60.0 ~ 70.0 N·m (6.1 ~ 7.1 kgf·m, 44.3 ~ 51.6 lbf·ft)

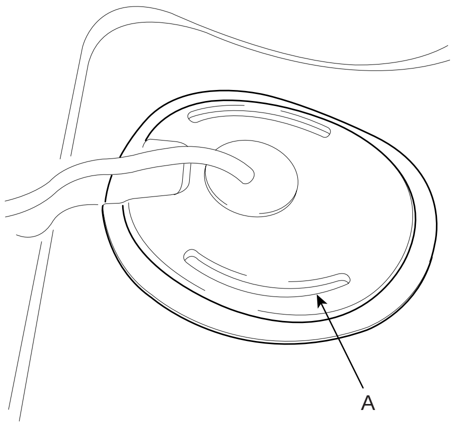
FUEL TANK

REMOVAL (INCLUDING FUEL FILTER AND FUEL PRESSURE REGULATOR) E0AC70A1

1. Preparation

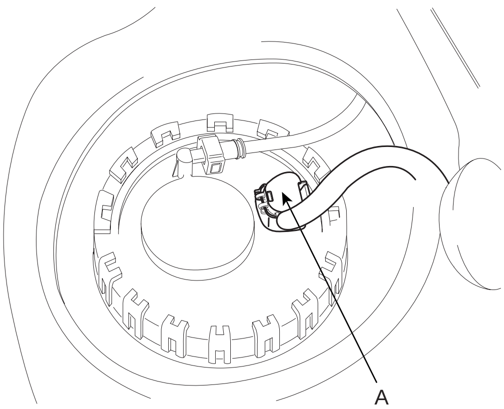
   1) Remove the rear seat cushion (Refer to "SEAT" in BD group).

   2) Open the service cover (A).



SLDF17137D

   3) Disconnect the fuel pump connector (A).

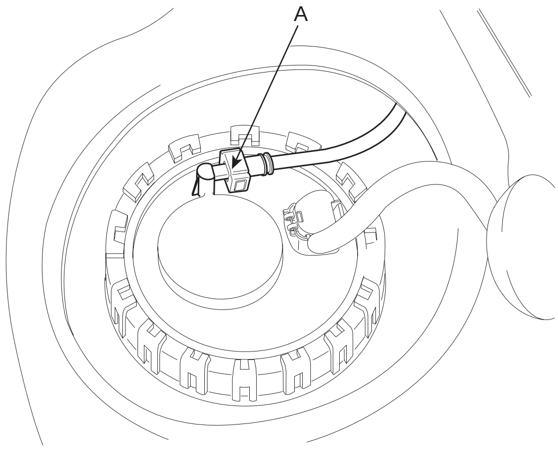


SLDFL7141L

   4) Start the engine and wait until fuel in fuel line is exhausted.

   5) After engine stalls, turn the ignition switch to OFF position.

2. Disconnect the fuel feed quick-connector (A).



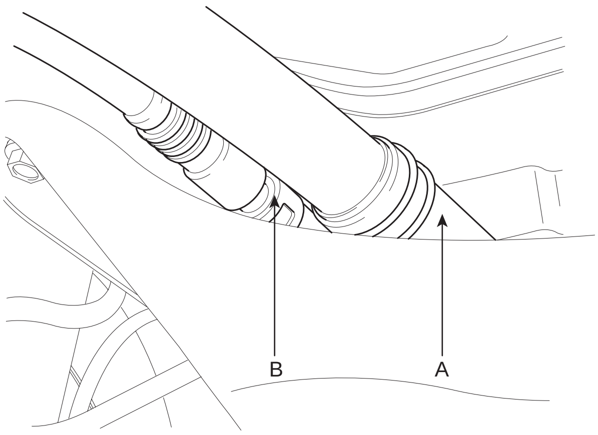
SLDFL7144L

3. Lift the vehicle.

4. Remove the muffler assembly (Refer "INTAKE ANS EXHUAUST SYSTEM" in EM group).

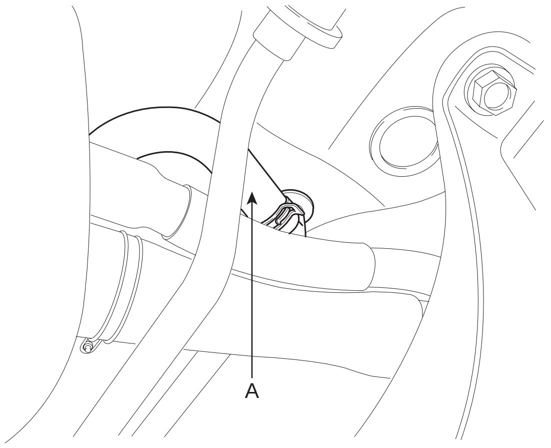
5. Support the fuel tank with a jack.

6. Disconnect the fuel filler hose (A) and the leveling hose (B).



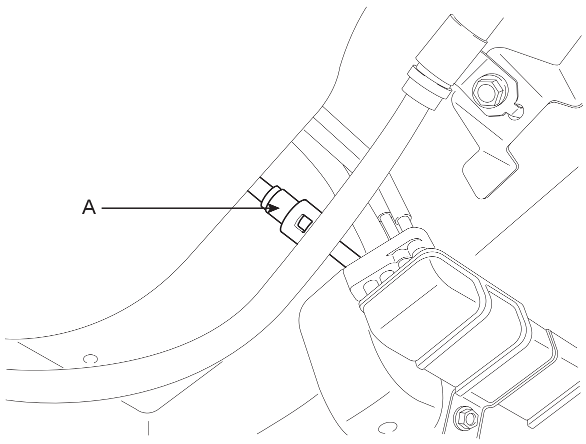
SLDF17146D

7. Disconnect the vacuum hose (A).



SLDF17147D

8. Disconnect the vacuum tube (A).



SLDF17148D

9. Unscrew the fuel tank band mounting nuts and remove the fuel tank.

INSTALLATION EE133990

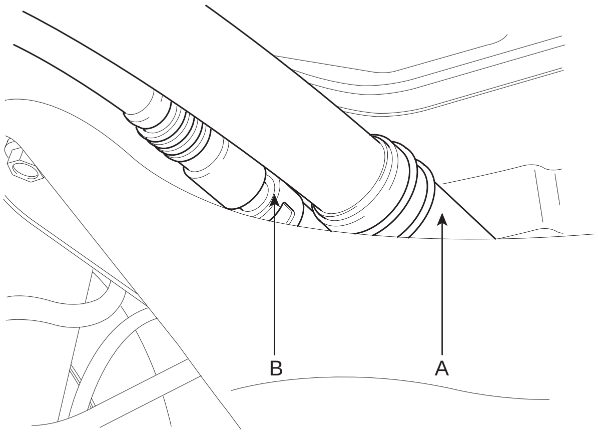
Installation is reverse of removal.

Fuel Tank Band Mounting Nuts : 39.2 ~ 54.0 N·m (4.0 ~ 5.5 kgf·m, 28.9 ~ 39.8 lbf·ft)

FILLER-NECK ASSEMBLY

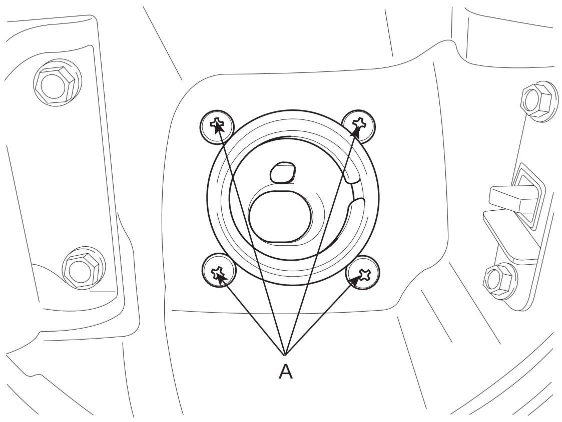
REMOVAL EA32CE5A

1. Disconnect the fuel filler hose (A) and the leveling hose (B).



SLDF17146D

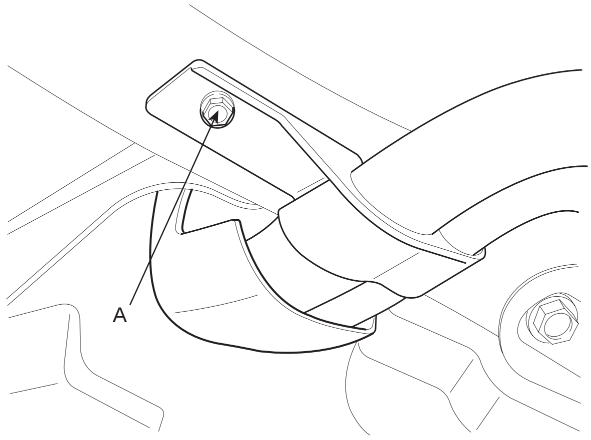
2. Open the fuel filler door and unfasten the filler-neck assembly mounting screws (A).



SCMFL6655D

3. Remove the rear-LH wheel, tire, and the inner wheel house.

4. Remove the bracket mounting bolts (A) and remove the filler-neck assembly.



SLDF17150D

INSTALLATION ED140CE1

1. Installation is reverse of removal.