Fuel System (1.1 SOHC)

GENERAL .....FL -2

GASOLINE ENGINE CONTROL SYSTEM .....FL -14

DIAGNOSIS.....FL -28

FUEL DELIVERY SYSTEM .....FL -232

GENERAL

SPECIFICATIONS

Items		Specification		
Fuel Tank		Capacity	35L	
Fuel Return System		Type	Returnless	
Fuel Filter		Type	High pressure type (built in Fuel Pump assembly)	
Fuel Pressure Regulator		Type	Built in Fuel Pump assembly	
		Regulated Fuel Pressure	350 kpa (3.5 kg/cm2, 49.8 psi)	
Fuel Pump		Type	Electrical, in tank type	
Sensors	Manifold Absolute Pressure Sensor (MAPS)	Type	Piezo-resistivity type	
	Intake Air Temperature Sensor (IATS)	Type	Thermister type (built in MAPS)	
		Resistance	- 40°C	40.93 ~ 48.35 kΩ
			- 20°C	13.89 ~ 16.03 kΩ
			0°C	5.38 ~ 6.09 kΩ
			20°C	2.31 ~ 2.57 kΩ
			40°C	1.08 ~ 1.21 kΩ
			60°C	0.54 ~ 0.62 kΩ
			80°C	0.29 ~ 0.34 kΩ
	Engine Coolant Temperature Sensor (ECTS)	Type	Thermister type	
		Resistance	- 40°C	48.14 kΩ
			- 20°C	14.13 ~ 16.83 kΩ
			0°C	5.79 kΩ
			20°C	2.31 ~ 2.59 kΩ
			40°C	1.15 kΩ
			60°C	0.59 kΩ
			80°C	0.32 kΩ
	Throttle Position Sensor (TPS)	Type	Variable Resistor Type	
		Resistance	1.6 ~ 2.4	
		Output Voltage	C.T	0.3 ~ 0.9V
			W.O.T	4.0 ~ 4.8V

Items		Specification		
Sensors	Heated Oxygen Sensor (HO2S)	Type	Zirconia Sensor (including Heater)	
		Output Voltage	0 ~ 1V	
		Heater Resistance	9.0 Ω (at 20°C)	
	Knock Sensor	Type	Piezo-electric type	
		Impedance	800 ~ 1,600 pF	
	Vehicle Speed Sensor (VSS)	Type	Hall IC type	
	Camshaft Position Sensor (CMPS)	Type	Hall Effect Sensor	
	Crankshaft Position Sensor (CKPS)	Type	Hall Effect Sensor	
Actuators	Injector	Type	Electromagnetic Type	
		Number	4	
		Coil Resistance	13.8 ~ 15.2 Ω (at 20°C)	
	Purge Control Solenoid Valve (PCSV)	Type	Duty Control Type	
		Coil Resistance	32.0 Ω ~ (at 20°C)	
	Idle Speed Control Actuator (ISCA)	Type	Double Coil Type	
		Coil Resistance	Close	16.6 ~ 18.6 Ω (at 20°C)
			Open	14.5 ~ 16.5 Ω (at 20°C)

SEALANT

Engine Coolant Temperature Sensor (ECTS) assembly	LOCTITE 962T or equivalent

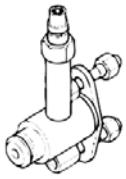
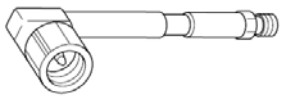
SERVICE STANDARD

Basic Idle rpm (After warm up)	A/C OFF	N,P	750 ± 100 rpm
		D	750 ± 100 rpm
	A/C ON	N,P	800 ± 100 rpm
		D	800 ± 100 rpm
Ignition Timing (After warm up, at idle)	BTDC 7° ± 5°		

TIGHTENING TORQUES

Items		kg·m	N·m	lb·ft
Engine Control System	ECM bracket installation bolts and nuts	0.4 ~ 0.6	3.92~ 5.88	2.89~ 4.34
	ECM installation bolts	0.8 ~ 1.0	7.85~ 9.81	5.79~ 7.23
	Knock sensor installation bolt	1.7 ~ 2.6	16.67~ 25.50	12.30~18.81
	Knock sensor connector bracket installation bolt	0.8 ~ 1.2	7.85~ 11.77	5.79~ 8.68
	Heated Oxygen Sensor (Sensor 1) installation	4.0 ~ 5.0	39.23~ 49.03	28.93~36.16
	Heated Oxygen Sensor (Sensor 2) installation	4.0 ~ 5.0	39.23~49.03	28.93~36.16
	Oil pressure switch installation	1.5 ~ 2.2	14.71~ 21.57	10.85~ 15.91
	Manifold absolute pressure sensor installation bolts	0.8 ~ 1.2	7.85~ 11.77	5.79~ 8.68
	Crankshaft position sensor installation bolt	0.9 ~ 1.0	8.83~ 9.81	6.51~ 7.23
	Camshaft position sensor installation bolt	0.8 ~ 1.0	7.85~ 9.81	5.79~ 7.23
	Purge control solenoid valve bracket installation bolts	1.2 ~ 1.5	11.77~ 14.71	8.68~ 10.85
	Purge control solenoid valve installation bolts	1.0 ~ 1.2	9.81~ 11.77	7.23~ 8.68
	Vehicle speed sensor installation	0.3 ~ 0.8	2.94~ 7.85	2.17~ 5.79
	Idle speed control actuator installation bolts	0.6 ~ 0.8	5.88~ 7.85	4.34~ 5.79
	Throttle position sensor installation bolts	0.15 ~ 0.25	1.47~ 2.45	1.08~ 1.81
	Acceleration sensor bracket installation nuts	1.0 ~ 1.2	9.81~ 11.77	7.23~ 8.68
Fuel Delivery System	Delivery pipe installation bolts	1.5 ~ 2.2	14.71~ 21.57	10.85~15.91
	Throttle body installation bolts	1.5 ~ 2.2	14.71~21.57	10.85~15.91
	Throttle body installation nuts	1.5 ~ 2.2	14.71~ 21.57	10.85~ 15.91
	Accelerator pedal installation bolts	0.8 ~ 1.2	7.85~ 11.77	5.79~ 8.68
	Fuel tank installation nuts	4.0 ~ 5.5	39.23~ 53.94	28.93~ 39.78

SPECIAL SERVICE TOOLS

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

BASIC TROUBLESHOOTING

BASIC TROUBLESHOOTING GUIDE

1	Bring Vehicle to Workshop

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

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

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

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

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

7	Recreate (Simulate) Symptoms the DTC
• Try to recreate or simulate the symptoms and conditions of the malfunction as described by customer. • If DTC(s) is/are displayed, simulate the condition according to troubleshooting procedure for the DTC.	

8	Confirm Symptoms of Problem
• If DTC(s) is/are not displayed, go to Step 9. • If DTC(s) is/are displayed, go to Step 11.	

9	Recreate (Simulate) Symptom
• Try to recreate or simulate the condition of the malfunction as described by the customer.	

10	Check the DTC
• If DTC(s) does(do) not occur, refer to BASIC INSPECTION in INTERMITTENT PROBLEM PROCEDURE. • If DTC(s) occur(s), go to Step 11.	

11	Perform troubleshooting procedure for DTC

12	Adjust or repair the vehicle

13	Confirmation test

14	END

CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLE INFORMATION

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

2. SYMPTOMS

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

3. ENVIRONMENT

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

4. MIL/DTC

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

BASIC INSPECTION PROCEDURE

MEASURING CONDITION OF ELECTRONIC PARTS' RESISTANCE

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

NOTE

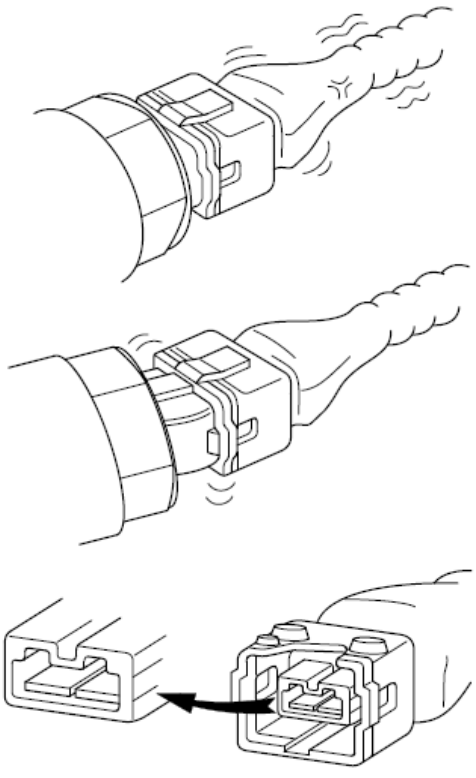
The measured resistance in except for ambient temperature (20°C, 68°F) is reference value.

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, 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.



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

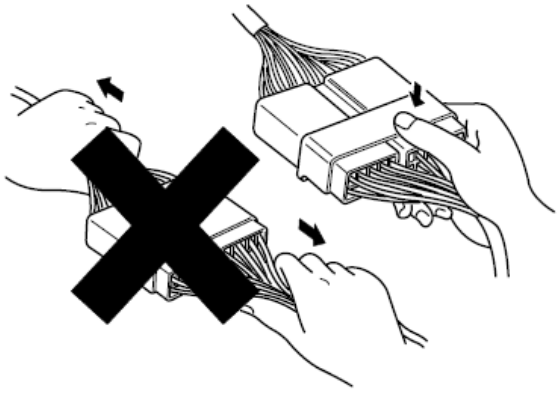
DO NOT sprinkle water directly into the engine compartment or electronic components.

- SIMULATING ELECTRICAL LOAD

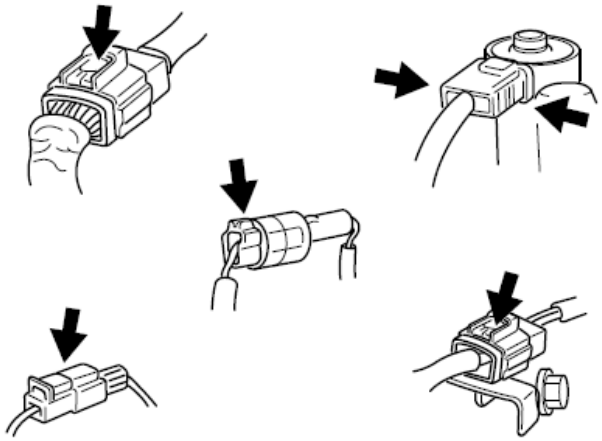
a. Turn on all electrical systems to simulate excessive electrical loads (Radios, fans, lights, etc.).

CONNECTOR INSPECTION PROCEDURE

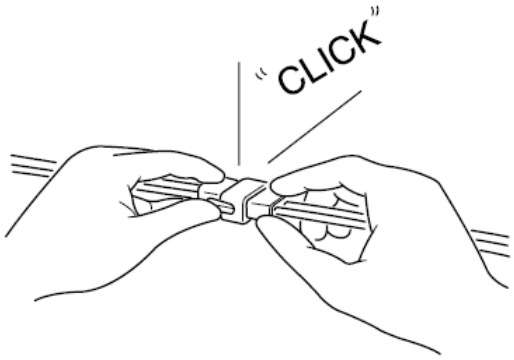
1. Handling of Connector
   a. Never pull on the wiring harness when disconnecting connectors.



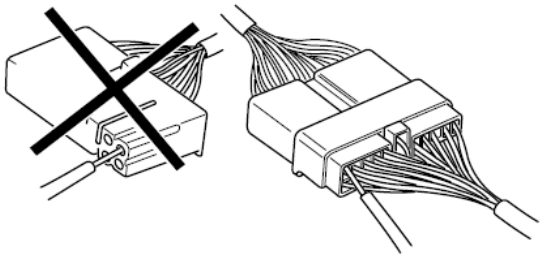
   b. When removing the connector with a lock, press or pull locking lever.



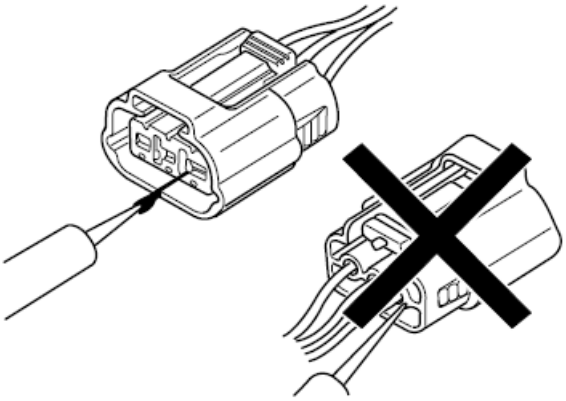
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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



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

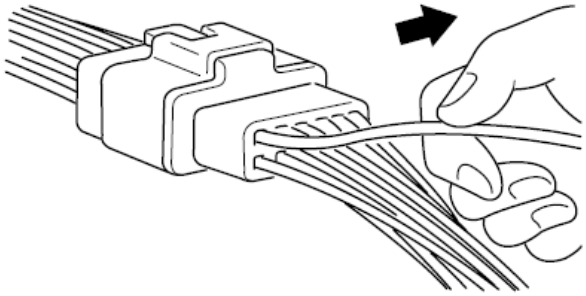


NOTE

- *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.



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.

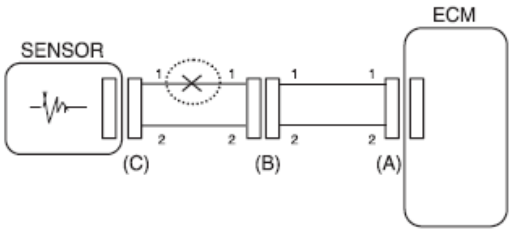
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

- 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



2. Continuity Check Method

NOTE

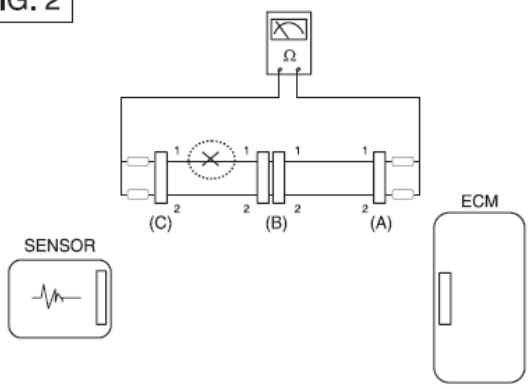
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

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

a. Disconnect connectors (A), (C) and measure resistance between connector (A) and (C) as shown in [FIG. 2].

In [FIG.2.] the measured resistance of line 1 and 2 is higher than 1MΩ and below 1 Ω respectively. Specifically the open circuit is line 1 (Line 2 is normal). To find exact break point, check sub line of line 1 as described in next step.

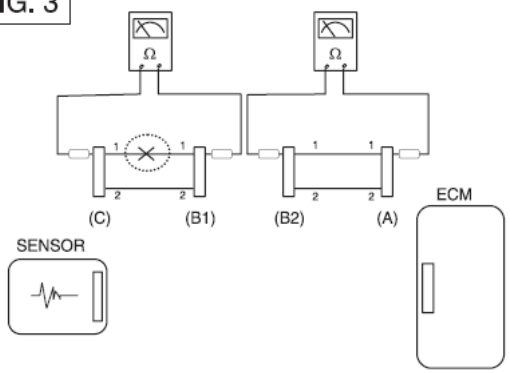
FIG. 2



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

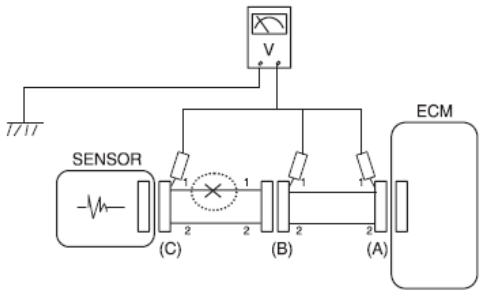


3. Voltage Check Method

a. With each connector still connected, measure the voltage between the chassis ground and terminal 1of 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

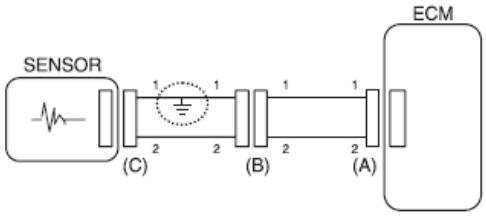


- CHECK SHORT CIRCUIT

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

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

FIG. 5



2. Continuity Check Method (with Chassis Ground)

NOTE

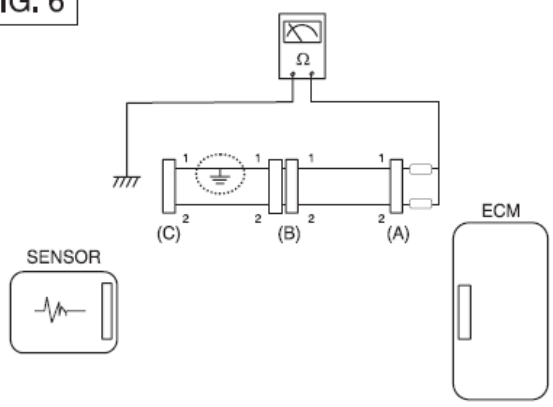
Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

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 1M Ω 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.

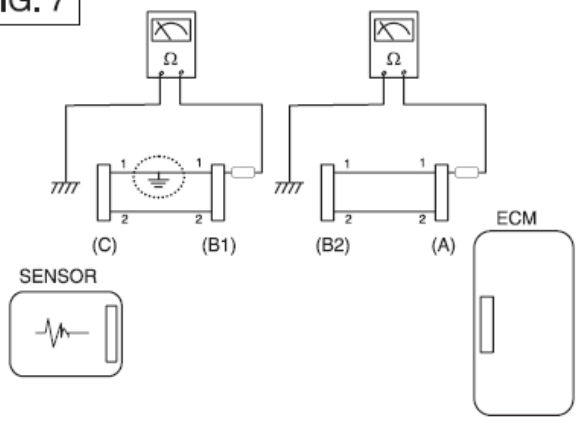
FIG. 6



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 1 Ω or less. The short to ground circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).

FIG. 7



ECM PROBLEM INSPECTION PROCEDURE

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

   Specification (Resistance): 1§Ùr 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).

SYMPTOM TROUBLESHOOTING GUIDE CHART

MAIN SYMPTOM	DIAGNOSTIC PROCEDURE	ALSO CHECK FOR
Unable to start (Engine does not turn over)	1. Test the battery 2. Test the starter 3. Inhibitor switch (A/T) or clutch start switch (M/T)	
Unable to start (Incomplete combustion)	1. Test the battery 2. Check the fuel pressure 3. Check the ignition circuit 4. Troubleshooting the immobilizer system (In case of immobilizer lamp ON)	• DTC • Low compression • Intake air leaks • Slipped or broken timing belt • Contaminated fuel
Difficult to start	1. Test the battery 2. Check the fuel pressure 3. Check the ECT sensor and circuit (Check DTC) 4. Check the ignition circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor idling (Rough, unstable or incorrect Idle)	1. Check the fuel pressure 2. Check the Injector 3. Check the long term fuel trim and short term fuel trim 4. Check the ISCA and ISCA 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 ISCA and ISCA 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	• 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
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 refueling (Overflow during refueling)	1. Inspect the fuel filler hose/pipe • Pinched, kinked or blocked? • Filler hose is torn 2. Inspect the fuel tank vapor vent hose between the EVAP. canister and air filter 3. Check the EVAP. canister	• Malfunctioning gas station filling nozzle (If this problem occurs at a specific gas station during refueling)

GASOLINE ENGINE CONTROL SYSTEM

DESCRIPTION

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 drivability.

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

NOTE

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

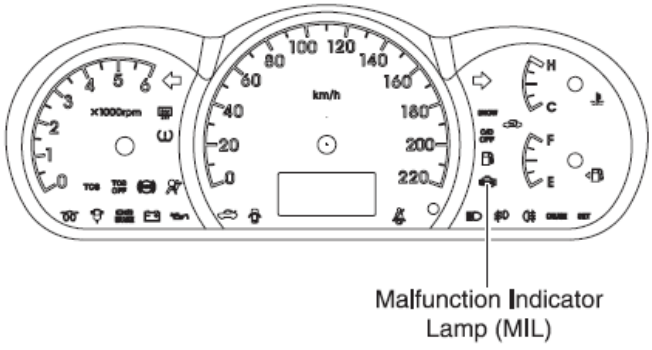
MALFUNCTION INDICATOR LAMP (MIL) [EOBD]

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

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

NOTE

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



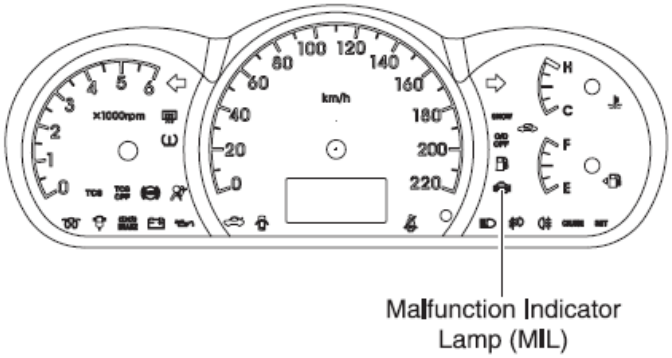
[NON-EOBD]

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

Faults with the following items will illuminate the MIL
- Heated oxygen sensor (HO2S)
- Mass Air Flow sensor (MAFS)
- Throttle position sensor (TPS)
- Engine coolant temperature sensor (ECTS) • Idle speed control actuator (ISCA)
- Injectors
- ECM

NOTE

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



[INSPECTION]

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

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

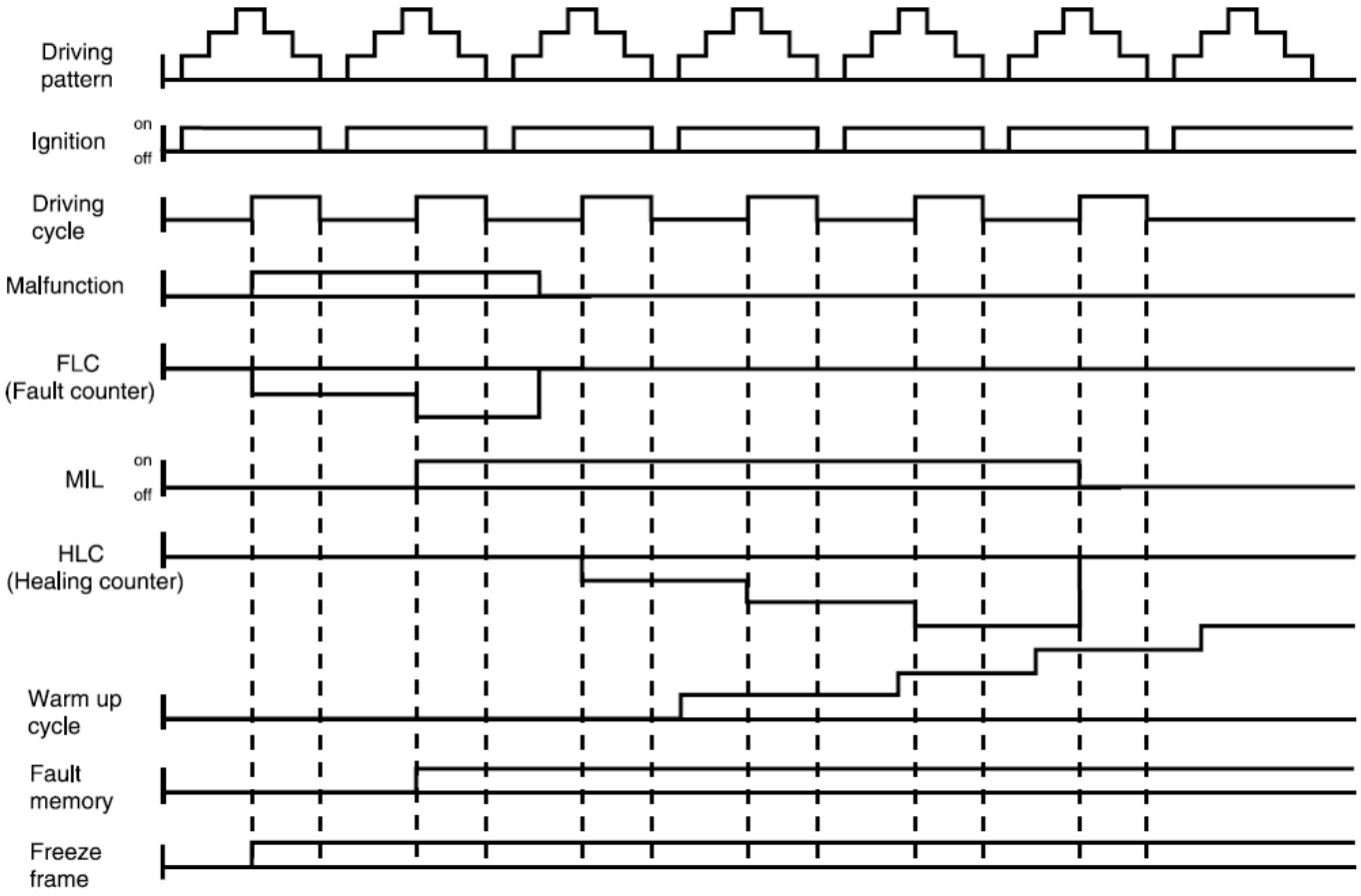
SELF-DIAGNOSIS

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

NOTE

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

THE RELATION BETWEEN DTC AND DRIVING PATTERN IN EOBD SYSTEM



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.

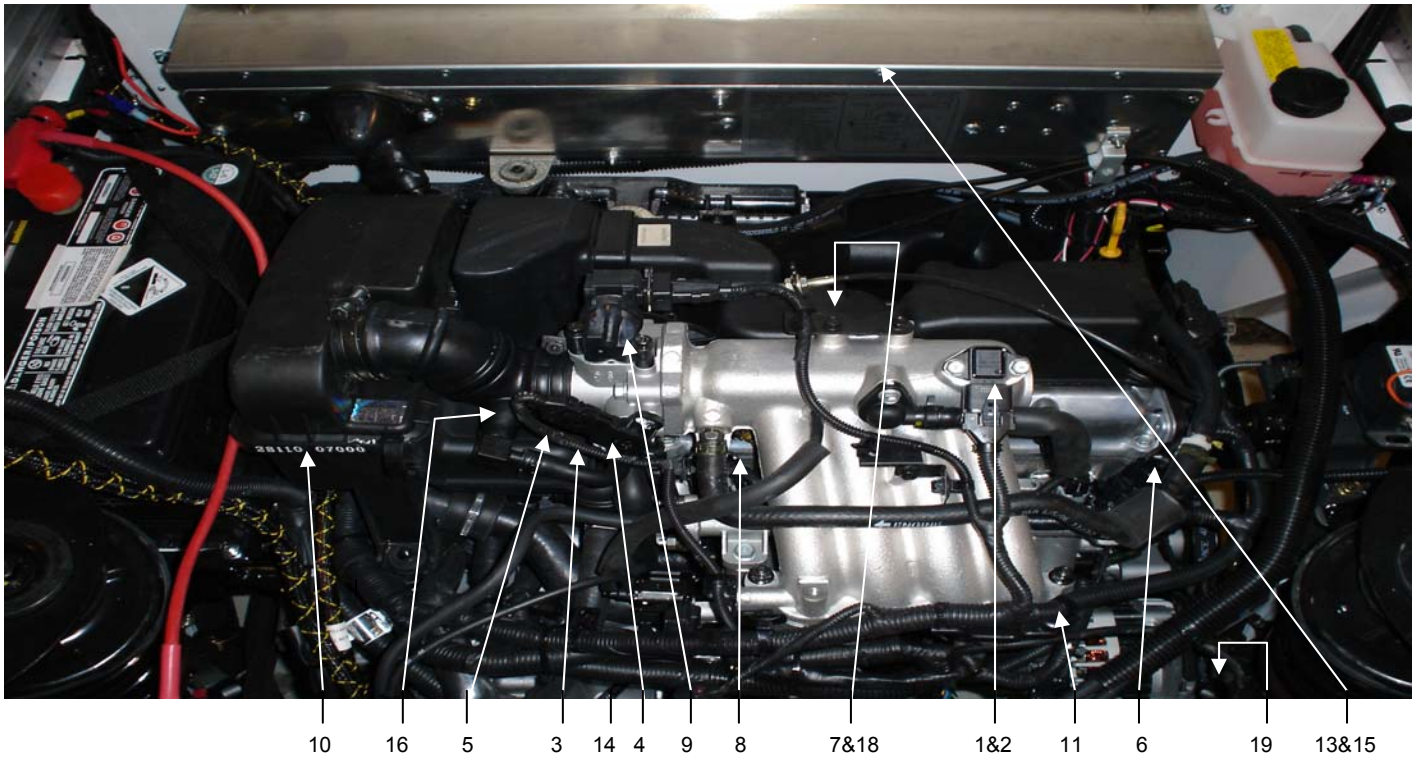
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction is detected after two sequential driving cycles. The MIL will illuminate when the malfunction is detected on the second driving cycle. If a misfire is detected, a DTC will be recorded, and the MIL will illuminate, immediately 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 degrees Fahrenheit.*
- *A "driving cycle" consists of engine startup, vehicle operation beyond the beginning of closed loop operation.*

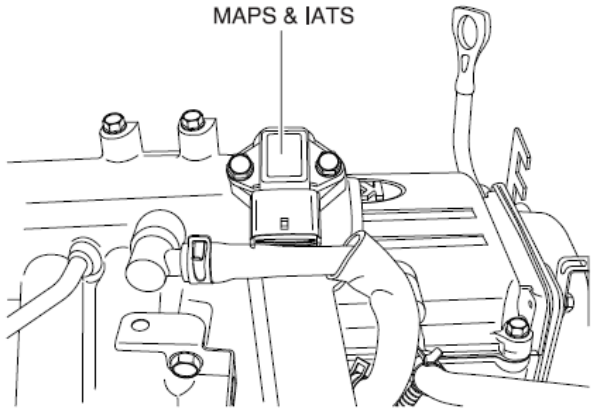
COMPONENTS LOCATION



1. Manifold Absolute Pressure Sensor (MAPS)
2. Intake Air Temperature Sensor (IATS)
3. Engine Coolant Temperature Sensor (ECTS)
4. Throttle Position Sensor (TPS)
5. Camshaft Position Sensor (CMPS)
6. Crankshaft Position Sensor (CKPS)
7. Heated Oxygen Sensor (HO2S, Sensor 1)
8. Injectors
9. Idle Speed Control Actuator (ISCA)
10. Vehicle Speed Sensor (VSS)
11. Knock Sensor
12. Ignition Switch (on steering column)
13. Engine Control Module (ECM)
14. Purge Control Solenoid Valve (PCSV)
15. Main Relay
16. Ignition Coils
17. Diagnostic Link Connector (under dash right side)
18. Heated Oxygen Sensor (HO2S, Sensor 2)
19. Acceleration Sensor (Lower trunk wall)

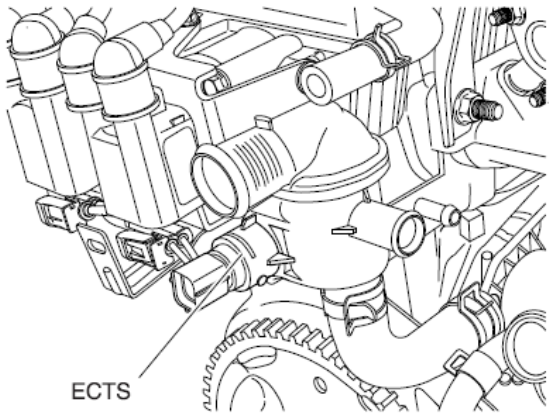
Electrical Box Components Location

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



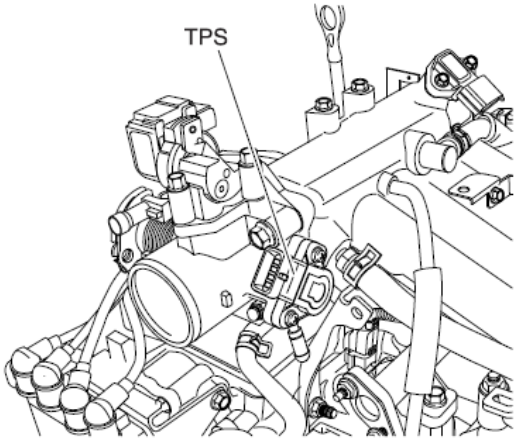
LFHE101A

3. Engine Coolant Temperature Sensor (ECTS)



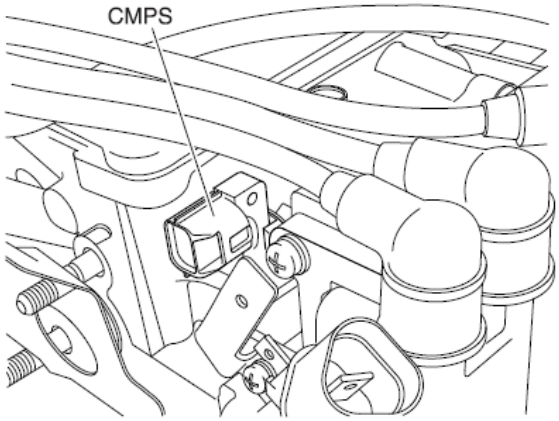
LFHE101B

4. Throttle Position Sensor (TPS)



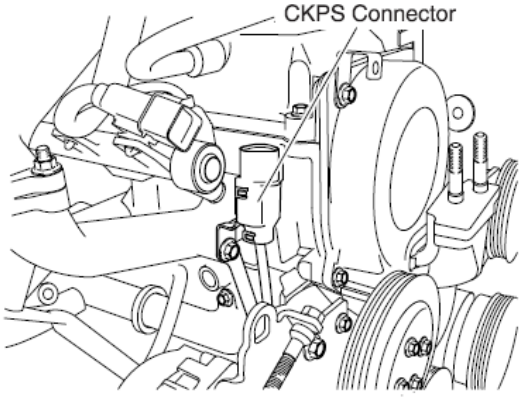
LFHE101C

5. Camshaft Position Sensor (CMPS)



LFHE101D

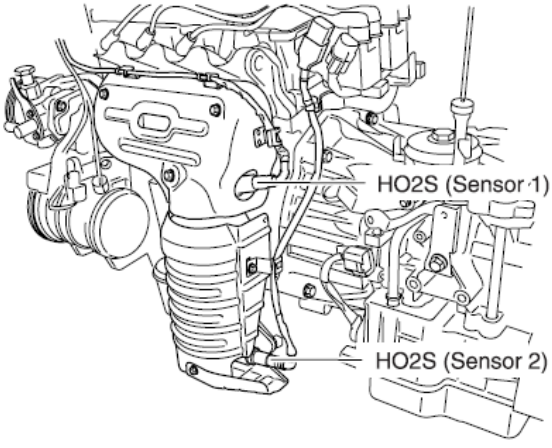
6. Crankshaft Position Sensor (CKPS)



* CKPS is on transaxle housing

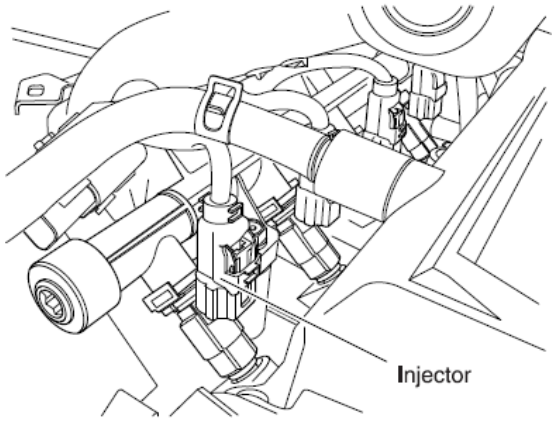
LFHE101E

7. Heated Oxygen Sensor (HO2S, Sensor 1)
18. Heated Oxygen Sensor (HO2S, Sensor 2)



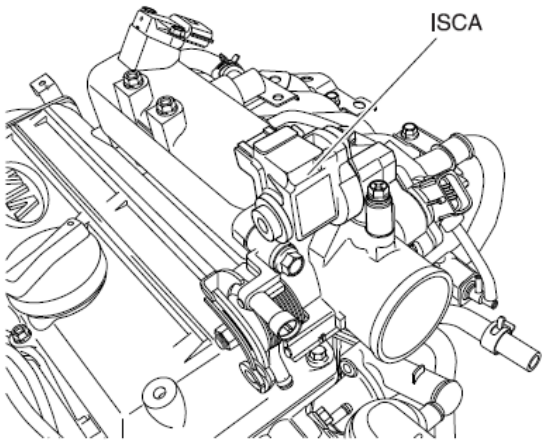
LFHE101F

8. Injector



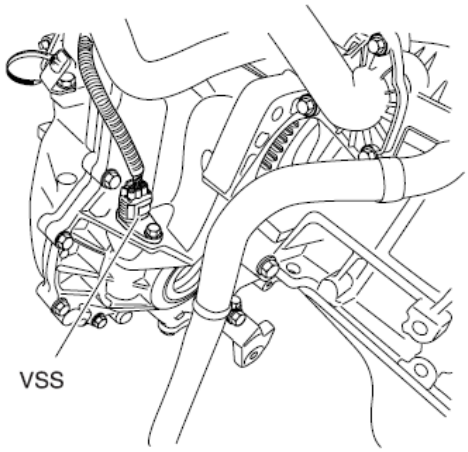
LFHE101G

9. Idle Speed Control Actuator (ISCA)



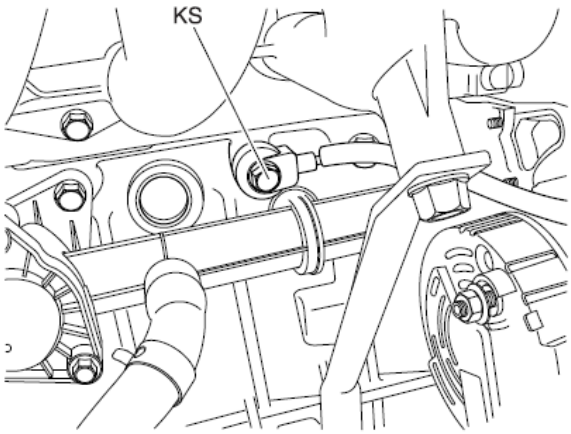
LFHE101H

10. Vehicle Speed Sensor (VSS)



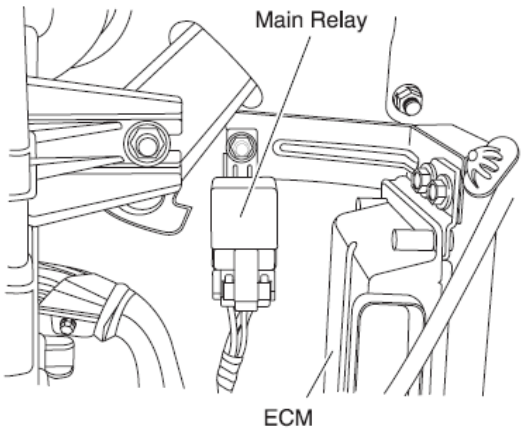
LFHE101I

11. Knock Sensor



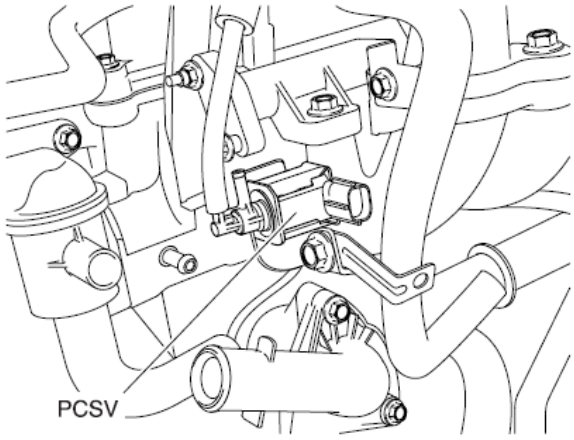
LFHE101J

13. ECM
15. Main Relay

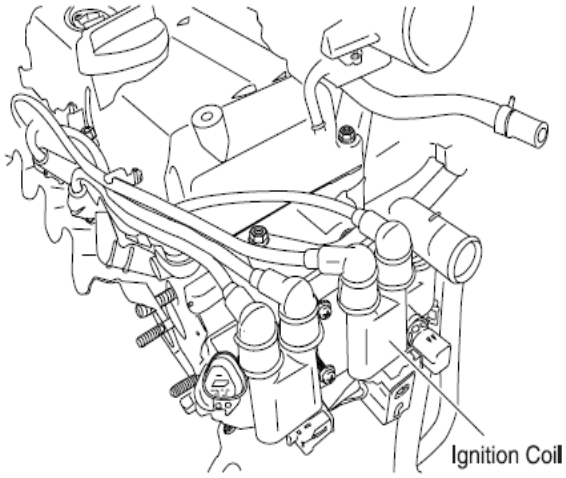
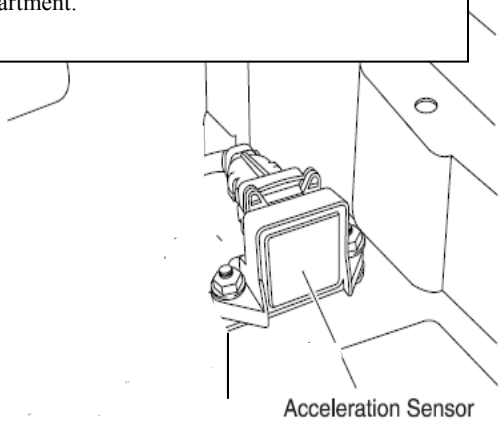


LFHE101K

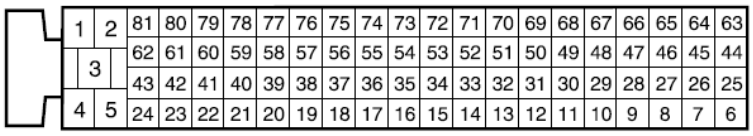
14. Purge Control Solenoid Valve (PCSV)



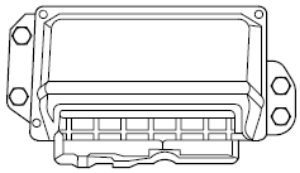
LFHE101L

16. Ignition Coil	19. Acceleration Sensor
 LFHE101M	Located on the front, trunk wall in the engine compartment.  LFHE101N

1. ECM HARNESS CONNECTOR



ECM Harness Side Connector



2. ECM TERMINAL FUNCTION

Pin No.	Description	Connected to	Remark
1	Not connected		
2	Ignition coil output 2,3	Ignition Coil #2, 3	
3	Ignition shield ground	Chassis ground	
4	Not connected		
5	Ignition coil output 1,4	Ignition Coil #1, 4	
6	Injector output (cyl.2)	Injector (cyl.2)	
7	Injector output (cyl.3)	Injector (cyl.3)	
8	Engine Speed signal output	Tachometer	
9	Not connected		
10	Not connected		
11	Fuel Consumption signal output	Trip Computer	
12	Battery Voltage Supply	Battery	
13	Ignition switch signal input	Ignition Switch	
14	Main Relay control output	Main Relay	
15	Crankshaft Position Sensor input	Crankshaft Position Sensor (CKPS)	
16	Throttle Position Sensor input	Throttle Position Sensor (TPS)	
17	Sensor ground	TPS, Acceleration Sensor	Except for LEAD
18	HO2S (B1/S1) input	HO2S (B1/S1)	
19	Knock Sensor Input	Knock Sensor	
20	Knock Sensor ground	Knock Sensor	
21	Not connected		
22	Not connected		
23	Not connected		
24	Air Conditioner Compressor Switch (MIDDLE) input	Triple Switch	
25	Not connected		
26	Idle Speed Control Actuator PWM output 2 (CLOSE)	Idle Speed Control Actuator	

Pin No.	Description	Connected to	Remark
27	Injector output (cyl.1)	Injector (cyl.1)	
28	HO2S Heater (B1/S2)	HO2S (B1/S2)	E-OBD only
29	Idle Speed Control Actuator PWM output 1 (OPEN)	Idle Speed Control Actuator (ISCA)	
30	Not connected		
31	Malfunction Indicating Lamp (MIL) output	Malfunction Indicating Lamp (MIL)	
32	Sensor supply (+5V)	TPS, Acceleration Sensor	
33	Sensor supply (+5V)	MAPS, IATS	
34	Not connected		
35	Sensor ground	HO2S (Sensor 2), ECTS	
36	Sensor ground	HO2S (Sensor 1), MAPS, IATS	
37	Manifold Absolute Pressure Sensor signal input	Manifold Absolute Pressure Sensor (MAPS)	
38	Not connected		
39	Engine Coolant Temperature Sensor input	Engine Coolant Temperature Sensor (ECTS)	
40	Not connected		
41	Not connected		
42	Intake Air Temperature Sensor input	Intake Air Temperature Sensor (IATS)	
43	Electrical Load 3 (Head Lamp)		Active: Low
44	Battery Voltage Supply after Main Relay	Main Relay	
45	Battery Voltage Supply after Main Relay	Main Relay	
46	Purge Control Solenoid Valve (PCSV) PWM output	Purge Control Solenoid Valve (PCSV)	
47	Injector output (cyl.4)	Injector (cyl.4)	
48	HO2S Heater (B1/S1)	HO2S (B1/S1)	Except for LEAD
49	Not connected		
50	Cooling Fan Relay - High control output	Cooling Fan Relay	
51	Ground of electronic	Chassis ground	
52	Not connected		
53	Ground of electronic	Chassis ground	
54	Not connected		
55	HO2S (B1/S2) input	HO2S (B1/S2)	E-OBD only
56	Not connected		
57	Air Conditioner Compressor Switch (LOW/HIGH) input	Triple Switch	
58	Not connected		
59	Vehicle Speed Sensor input	Vehicle Speed Sensor	

Pin No.	Description	Connected to	Remark
60	Acceleration sensor input	Acceleration Sensor	E-OBD only
61	Immobilizer ground	Immobilizer	
62	CAN - HIGH	TCM	A/T only
63	Battery Voltage Supply after Main Relay	Main Relay	
64	Not connected		
65	Not connected		
66	Not connected		
67	Not connected		
68	Cooling Fan Relay - Low control output	Cooling Fan Relay	
69	Air Conditioner Compressor Relay control output	Air Conditioner Compressor Relay	
70	Electric Fuel Pump Relay control output	Electric Fuel Pump Relay	
71	Diagnostic Data Line (k-Line)	Data Link Connector (DLC)	
72	Not connected		
73	Not connected		
74	Not connected		
75	Air Conditioner Pressure switch input	Triple Switch	
76	Electrical Load 1 (Defroster)		Active: High
77	Electrical Load 2 (Power Steering Pump)		Active: Low
78	MT/AT Encoding line	MT: Open, AT: Ground	
79	Camshaft Position Sensor input	Camshaft Position Sensor (CMPS)	
80	Power stage ground	Chassis ground	
81	CAN - LOW	TCM	A/T only

3. ECM TERMINAL INPUT/OUTPUT SIGNAL

Pin No.	Description	State	Input/Output Value		Test Result	Remark
			Type	Level		
1	Not connected					
2	Ignition coil output 2,3	Idle	Pulse	1st voltage:		
				300~400V	370.69V	
				ON: Max. 2V	1.82V	
3	Ignition shield ground	Idle	DC	Max. 50 mV	0.133mV	
4	Not connected					
5	Ignition coil output 1,4	Idle	Pulse	1st voltage:		
				300~400V	382.55V	
				ON: Max. 2V	1.24V	
6	Injector output (cyl.2)	Idle	Pulse	High: Vbatt	13.57V	
				Low: Max. 2V	0.41V	
7	Injector output (cyl.3)	Idle	Pulse	High: Vbatt	13.81V	
				Low: Max. 2V	0.37V	
8	Engine Speed signal output	Idle	Pulse	High: Vbatt	13.9V	Idle: 20 ~ 26 Hz
				Low: Max. 0.5 V	0.037V	
9	Not connected					
10	Not connected					
11	Fuel Consumption signal output	Idle	Pulse	High: Vbatt or Vcc	4.23V	
				Low: Max. 0.5V	1.0mV	
12	Battery Voltage Supply	Always	Current	Max. 1.0 mA	0.40mA	
			DC	Vbatt	13.65V	
13	Ignition switch signal input	IG OFF	DC	Max. 0.5 V	0.01V	
		IG ON		Vbatt	12.85V	
14	Main Relay control output	Relay ON	DC	Max. 1.0 V	0.03V	
		Relay OFF		Vbatt	12.5V	
15	Crankshaft Position Sensor input	Idle	Pulse	High: Vcc or Vbatt	8.91V	
				Low: Max. 0.5V	0.13V	
16	Throttle Position Sensor input	C.T	Analog	0.3~ 0.9 V	0.502V	
		W.O.T		4.0~ 4.8 V	4.604V	
17	Sensor ground	Idle	DC	Max. 50 mV	1.045mV	
18	HO2S (B1/S1) input	1500rpm	Analog	RICH : 0.6 ¡1.0V	0.703V	
				LEAN : 0 ~ 0.4V	0.111V	
19	Knock Sensor Input	Knocking	Frequency			
		Normal				
20	Knock Sensor ground	Idle	DC	Max. 50 mV	1.57mV	
21	Not connected					

Pin No.	Description	State	Input/Output Value		Test Result	Remark
			Type	Level		
22	Not connected					
23	Not connected					
24	Air Conditioner Compressor Switch (MIDDLE) input	MID OFF	DC	Max. 0.5 V	0.01 V	
		MID ON		Vbatt	12.29 V	
25	Not connected					
26	Idle Speed Control Actuator PWM output 2 (CLOSE)	Idle	Pulse	High: Vbatt	14.97 V	100 Hz
				Low: Max. 1.0 V	0.25 V	
27	Injector output (cyl. 1)	Idle	Pulse	High: Vbatt	13.49 V	
				Low: Max. 1.0 V	0.33 V	
28	HO2S Heater (B1/S2)	Engine Run	Pulse	High: Vbatt	14.02 V	
				Low: Max. 1.0 V	0.31 V	
29	Idle Speed Control Actuator PWM output 1 (OPEN)	Idle	Pulse	High: Vbatt	14.82 V	100 Hz
				Low: Max. 1.0 V	0.16 V	
30	Not connected					
31	Malfunction Indicating Lamp (MIL) output	MIL OFF	DC	Vbatt	13.12 V	
		MIL ON		Max. 1.0 V	0.93 V	
32	Sensor supply (+5V)	IG OFF	DC	Max. 0.5 V	0.06 V	
		IG ON		4.9 ~ 5.1 V	4.97 V	
33	Sensor supply (+5V)	IG OFF	DC	Max 0.5 V	0.063 V	
		IG ON		4.9 ~ 5.1 V	4.943 V	
34	Not connected					
35	Sensor ground	Idle	DC	Max. 50 mV	1.84 mV	
36	Sensor ground	Idle	DC	Max. 50 mV	2.06 mV	
37	Manifold Absolute Pressure Sensor signal input	IG ON	Analog	3.9 ~ 4.1 V	4.012 V	
		Idle		0.8 ~ 1.6 V	1.253 V	
38	Not connected					
39	Engine Coolant Temperature Sensor input	Idle	Analog	0.5 ~ 4.5 V	0.988 V	89.3°C
40	Not connected					
41	Not connected					
42	Intake Air Temperature Sensor input	Idle	Analog	0 ~ 5 V	1.68 V	67.5°C
43	Electrical Load 3 (Head Lamp)	Idle	DC	Vbatt		
				Max. 0.5 V		
44	Battery Voltage Supply after Main Relay	IG OFF	DC	Max. 0.5 V	0.09 V	
		IG ON		Vbatt	12.85 V	
45	Battery Voltage Supply after Main Relay	IG OFF	DC	Max. 0.5 V	0.061 V	
		IG ON		Vbatt	12.90 V	

Pin No.	Description	State	Input/Output Value		Test Result	Remark
			Type	Level		
46	Purge Control Solenoid Valve (PCSV) PWM output	Inactive	Pulse	High: Vbatt	13.49 V	
		Active		Low: Max. 1.0 V	0.33 V	
47	Injector output (cyl. 4)	Idle	Pulse	High: Vbatt	13.93 V	
48	HO2S Heater (B1/S1)	Engine Run	Pulse	High: Vbatt	14.04 V	
				Low: Max. 0.5 V	0 V	
49	Not connected					
50	Cooling Fan Relay - High control output	Relay OFF	DC	Vbatt	14.3 V	
		Relay ON		Max 1.0 V	0 V	
51	Ground of electronic	Idle	DC	Max. 50 mV	0.041 mV	
52	Not connected					
53	Ground of electronic	Idle	DC	Max. 50 mV	0.86 mV	
54	Not connected					
55	HO2S (B1/S2) input	Engine Run	Analog	RICH: 0.6 ~ 1.0 V	0.87 V	
				LEAN: 0 ~ 0.4V	0.1 V	
56	Not connected					
57	Air Conditioner Compressor Switch (LOW/HIGH) input	A/C ON OFF	DC	Max. 0.5 V	0.225 V	
		A/C ON ON		Vbatt	13.9 V	
58	Not connected					
59	Vehicle Speed Sensor input	Vehicle Run	Pulse	High: Min. 5.0 V	10.63 V	
				Low: Max. 1.0 V	0 V	
60	Acceleration sensor input	Idle	Analog	2.4 ~ 2.6 V		
61	Not connected					
62	CAN - HIGH	Recessive	Pulse	2.7 ~ 3.0 V	2.47 V	
		Dominant		2.75 ~ 4.5 V	3.59 V	
63	Battery Voltage Supply after Main Relay	IG OFF	DC	Max. 0.5 V	0.095 V	
		IG ON		Vbatt	12.73 V	
64	Not connected					
65	Not connected					
66	Not connected					
67	Not connected					

Pin No.	Description	State	Input/Output Value		Test Result	Remark
			Type	Level		
68	Cooling Fan Relay - Low control output	Relay OFF	DC	Vbatt	14.21 V	
		Relay ON		Max. 1.0 V	0.012 V	
69	Air Conditioner Compressor Relay control output	A/C ON OFF	DC	Vbatt	14.15 V	
		A/C ON ON		Max. 1.0 V	0.022 V	
70	Electric Fuel Pump Relay control output	Relay OFF	DC	Vbatt	13.032 V	
		Relay ON		Max. 1.0 V	0 V	
71	Diagnostic Data Line (k-Line)	During communication	Pulse	[Transmitting] Hi:Min. Vbatt *80% Lo:Max. Vbatt *20% [Receiving] Hi:Min. Vbatt *70% Lo:Max. Vbatt *30%	High: 11.27 V Low: 0.074 V	
72	Not connected					
73	Not connected					
74	Not connected					
75	Air Conditioner Pressure switch input	A/C ON S/W OFF	DC	Max. 1.0 V	0 V	
		A/C ON S/W ON		Vbatt	14.22 V	
76	Electrical Load 1 (Defroster)	Idle	DC	Vbatt	14.01 V	
				Max. 0.5 V	0V	
77	Electrical Load 2 (Power Steering Pump)	IG ON	DC	Min. 4 V	12.02 V	
				Max. 0.5 V	-0.347 V	
78	MT/AT Encoding Line	IG ON	DC	A/T: Max 0.5 V	1.5 mV	
				M/T: Min. 4 V		
79	Camshaft Position Sensor input	Idle	Pulse	High: Vcc or Vbatt	12.91 V	
				Low: Max. 0.5 V	0.078 V	
80	Power stage ground	Idle	DC	Max. 50 mV	1.5 mV	
81	CAN - LOW	Recessive	Pulse	2.0 ~ 3.0 V	2.58 V	
		Dominant		0.5 ~ 2.25 V	1.45 V	

DIAGNOSIS

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC)

DTC	DESCRIPTION	E-OBD	OBD-1
			UNLEADED
P0030	O2 Sensor Heater - Heater Control Circuit (Bank 1 / Sensor 1)	●	-
P0031	O2 Sensor Heater Circuit Low (Bank 1 / Sensor 1)	●	▲
P0032	O2 Sensor Heater Circuit High (Bank 1 / Sensor 1)	●	▲
P0036	O2 Sensor Heater - Heater Control Circuit (Bank 1 / Sensor 2)	●	-
P0037	O2 Sensor Heater Circuit Low (Bank 1 / Sensor 2)	●	-
P0038	O2 Sensor Heater Circuit High (Bank 1 / Sensor 2)	●	-
P0106	Manifold Absolute Pressure Circuit - Rationality	●	●
P0107	Manifold Absolute Pressure Circuit - Range Check Low	●	●
P0108	Manifold Absolute Pressure Circuit - Range Check High	●	●
P0112	Intake Air Temperature Circuit Low Input	●	▲
P0113	Intake Air Temperature Circuit High Input	●	▲
P0117	Engine Coolant Temperature Circuit Low Input	●	●
P0118	Engine Coolant Temperature Circuit High Input	●	●
P0121	Throttle / Pedal Position Circuit Range/Performance Problem	●	●
P0122	Throttle / Pedal Position Circuit Low Input	●	●
P0123	Throttle / Pedal Position Circuit High Input	●	●
P0130	O2 Sensor Circuit (Bank 1/ Sensor 1)	●	▲
P0131	O2 Sensor Circuit Low Input (Bank 1 / Sensor 1)	●	▲
P0132	O2 Sensor Circuit High Input (Bank 1 / Sensor 1)	●	▲
P0133	O2-Sensor Circuit Slow Response (Bank 1 / Sensor 1)	●	▲
P0134	O2 Sensor Circuit No Activity Detected (Bank 1 / Sensor 1)	●	-
P0136	O2 Sensor Circuit Malfunction (Bank 1 / Sensor 2)	●	-
P0137	O2 Sensor Circuit Low Input (Bank 1 / Sensor 2)	●	-
P0138	O2 Sensor Circuit High Input (Bank 1 / Sensor 2)	●	-
P0140	O2 Sensor Circuit No Activity Detected (Bank 1 / Sensor 2)	●	-
P0230	Fuel Pump Circuit Malfunction	▲	▲
P0261	Cylinder 1 - Injector Circuit Low	●	●
P0262	Cylinder 1 - Injector Circuit High	●	●

DTC	DESCRIPTION	E-OBD	OBD-1
			UNLEADED
P0264	Cylinder 2 - Injector Circuit Low	●	●
P0265	Cylinder 2 - Injector Circuit High	●	●
P0267	Cylinder 3 - Injector Circuit Low	●	●
P0268	Cylinder 3 - Injector Circuit High	●	●
P0270	Cylinder 4 - Injector Circuit Low	●	●
P0271	Cylinder 4 - Injector Circuit High	●	●
P0300	Multiple Cylinder Misfire Detected	●	-
P0301	Cylinder 1 - Misfire detected	●	-
P0302	Cylinder 2 - Misfire detected	●	-
P0303	Cylinder 3 - Misfire detected	●	-
P0304	Cylinder 4 - Misfire detected	●	-
P0325	Knock Sensor 1 Circuit Malfunction	▲	▲
P0335	Crankshaft Position Sensor Circuit Malfunction	●	▲
P0336	Crankshaft Position Sensor Circuit Range/Performance	●	▲
P0340	Camshaft Position Sensor Circuit Malfunction(Bank1 or Single Sensor)	●	▲
P0420	Catalyst System Efficiency below Threshold (Bank 1)	●	-
P0444	Evap. Emission Ctrl. System - Purge Ctrl. Valve Circuit Open	●	-
P0445	Evap. Emission Ctrl. System - Purge Ctrl. Valve Circuit Shorted	●	-
P0501	Vehicle Speed Sensor Range / Performance	●	▲
P0506	Idle Control System - RPM lower than expected	●	▲
P0507	Idle Control System - RPM higher than expected	●	▲
P0562	System Voltage Low	●	▲
P0563	System Voltage High	●	▲
P0600	CAN Communication BUS	●	▲
P0605	Internal Control Module Read Only Memory (ROM) Error	●	▲
P0646	A/C Clutch Relay Control Circuit Low	▲	▲
P0647	A/C Clutch Relay Control Circuit High	▲	▲
P0650	Malfunction Indicator Lamp (MIL) Control Circuit Malfunction	▲	▲
P1307	Acceleration Sensor Circuit - Rationality	●	-
P1308	Acceleration Sensor Circuit - Signal Check Low	●	-
P1309	Acceleration Sensor Circuit - Signal Check High	●	-
P1505	Idle Charge Actuator Signal Low of Coil #1	●	●

DTC	DESCRIPTION	E-OBD	OBD-1
			UNLEADED
P1506	Idle Charge Actuator Signal High of Coil #1	●	●
P1507	Idle Charge Actuator Signal Low of Coil #2	●	●
P1508	Idle Charge Actuator Signal High of Coil #2	●	●
P1529	TCM Request for MIL ON / Freeze Frame to ECM via	●	-
P1586	MT/AT Encoding Error	●	▲
P1602	CAN Communication BUS with TCM (Timeout)	●	▲
P1674	Transponder Status Error	▲	▲
P1675	Transponder Programming Error	▲	▲
P1676	SMARTRA Message Error	▲	▲
P1690	SMARTRA No Response	▲	▲
P1691	Antenna Coil Error	▲	▲
P1692	Immobilizer Lamp Error	▲	▲
P1693	Transponder No Response Error / Invalid Response	▲	▲
P1694	EMS MESSAGE Error	▲	▲
P1695	EMS MEMORY Error	▲	▲
P1696	Authentication Fail	▲	▲
P1697	HI-SCAN Message Error	▲	▲
P1699	Twice Overtrial	▲	▲
P2096	Fuel Trim Malfunction - System Too Lean (Downstream)	●	-
P2097	Fuel Trim Malfunction - System Too Rich (Downstream)	●	-
P2187	Fuel Trim Malfunction - System Too Lean at Idle (Upstream)	●	▲
P2188	Fuel Trim Malfunction - System Too Rich at Idle (Upstream)	●	▲
P2191	Fuel Trim Malfunction - System Too Lean at Higher Load (Upstream)	●	▲
P2192	Fuel Trim Malfunction - System Too Rich at Higher Load (Upstream)	●	▲

NOTE

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

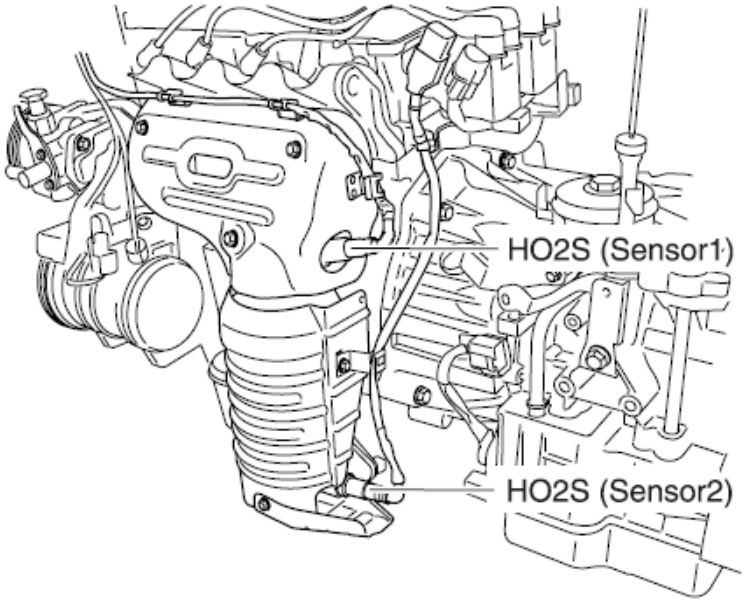
NOTE

Refer to the group "BE" for the troubleshooting Procedures of DTC P1674, P1675, P1676, P1690, P1691, P1692, P1693, P1694, P1695, P1696, P1697 and P1699.

TROUBLESHOOTING FOR DTC

DTC	P0030	O2 Sensor Heater - Heater Control Circuit (Bank1/Sensor1)

COMPONENT LOCATION



DESCRIPTION

In order to control the emission of the CO, HC and NOx components of the exhaust gas, a heated oxygen sensor (HO2S), mounted on the front side and rear side of the catalytic converter, detects the oxygen content in the exhaust gas. The front HO2S signal is used to control air/fuel ratio (closed loop fuel control) and the rear HO2S signal is used to monitor front HO2S and catalyst for proper operation. The HO2S requires a minimum temperature to operate properly and provide a closed loop fuel control system. So the HO2S contains a heater element to reduce warm-up time and ensure proper performance during all driving conditions, which allows for closed loop fuel control or catalyst monitoring immediately upon engine start-up. The ECM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the ECM provides a ground circuit for activating the heater.

DTC DETECTING CONDITION

1. DTC Description

The ECM determines front HO2S heater fault and sets DTC P0030 if the front HO2S heater control driver inside the ECM fails or HO2S is not operational after an elapse of predetermined time since engine start or front HO2S tip temperature is out of normal working range. The ECM illuminates the MIL on the second consecutive driving cycle that the diagnostic runs and fails.

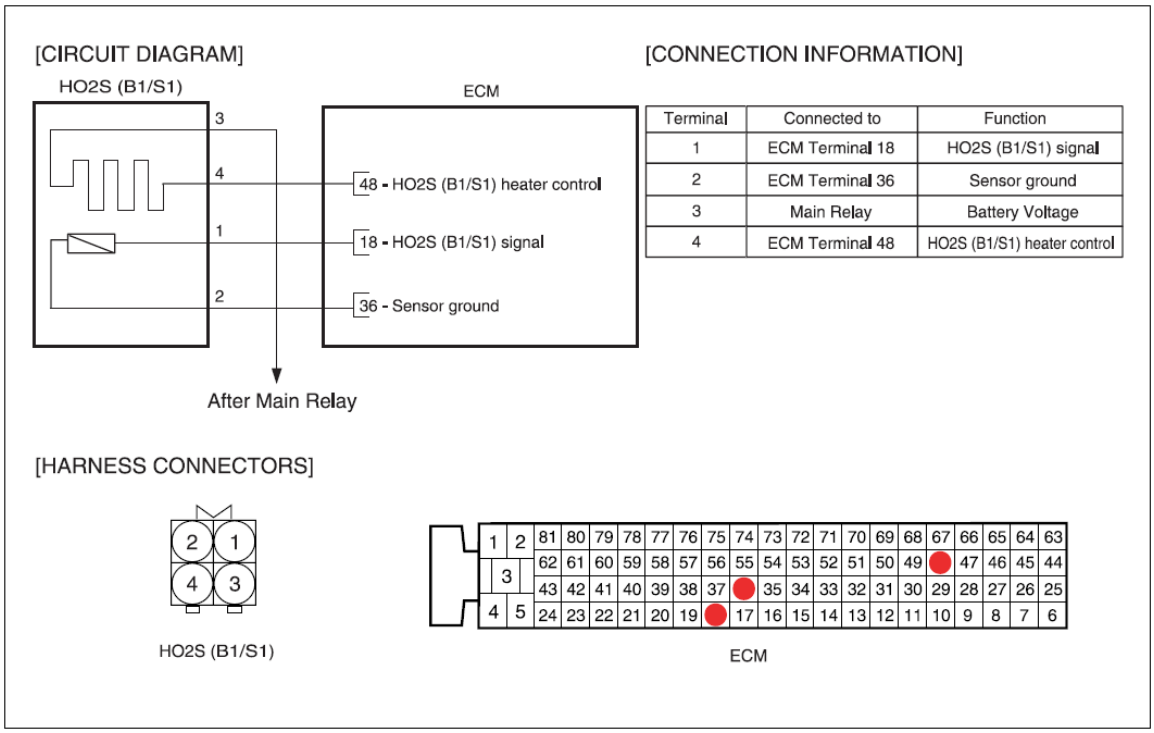
2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0030	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - Dew point end detected - Exhaust temperature : 450 ~ 510°C - Battery voltage : 10.7~ 15.6 V • Threshold Value - Internal resistance > 260Ω ~ 4.5 k Ω (exhaust temperature, heating power)	• Open or short in front HO2S heater circuit • Front HO2S heater

SPECIFICATION

Temperature	Front HO2S Heater Resistance
20°C	9.0 Ω

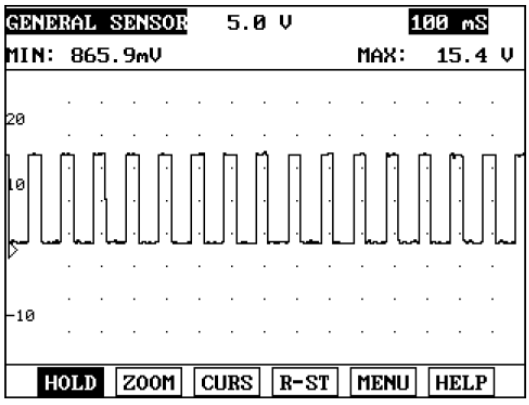
SCHEMATIC DIAGRAM



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM Terminal 18	HO2S (B1/S1) signal
2	ECM Terminal 36	Sensor ground
3	Main Relay	Battery Voltage
4	ECM Terminal 48	HO2S (B1/S1) heater control

SIGNAL WAVEFORM



The HO2S requires a minimum temperature to provide a closed loop fuel control system. So HO2S contains the heater element to reduce its warming-up time and ensure its performance during all driving conditions. The HO2S heater should be always ON after engine start. The ECM controls this heater element by duty cycle. The main relay supplies voltage to the heater and the ECM provides a ground circuit for activating the heater.
The illustration is the signal waveform at idle after HO2S heater completes warming-up.

INSPECTION PROCEDURE

1. CHECK HO2S AND ECM CONNECTORS

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

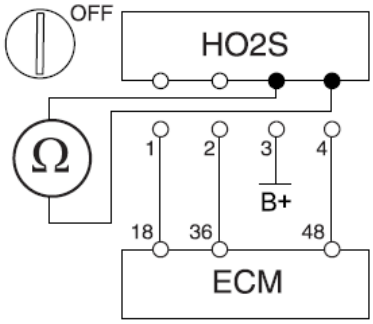
Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK HEATER RESISTANCE

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Measure resistance between terminals 3 and 4 of the HO2S connector.
   - **Specification (HO2S resistance):**

Temperature	Front HO2S Heater Resistance
20°C	9.0 Ω

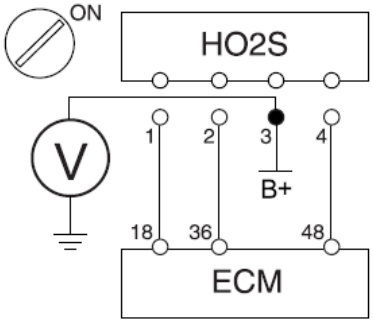


Is resistance within specification?

Yes	
No	Replace HO2S.

3. CHECK POWER TO HO2S HEATER

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): approximately B+**

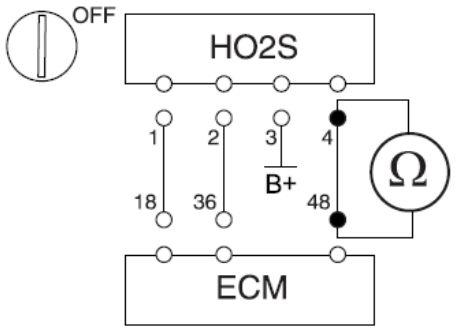


Is voltage within specification?

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

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 4 of the HO2S harness connector and 48 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**

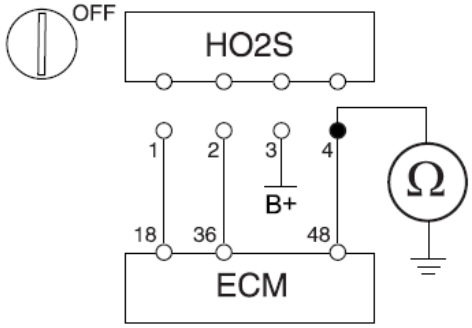


Does the resistance indicate continuity?

Yes		
	No	Repair open in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 4 of the HO2S harness connector and chassis ground.
   - **Specification (Resistance): infinite**

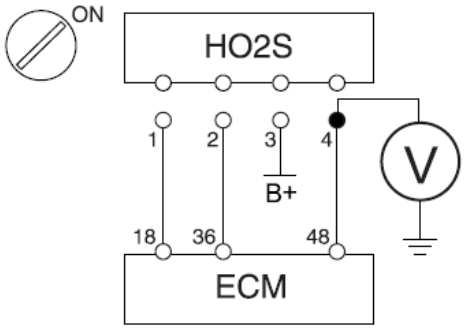


Is the resistance displayed correcfly?

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

6. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 4 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**



Is voltage within specification?

Yes		
	No	Repair short to power in harness.

Replace HO2S

TROUBLESHOOTING FOR DTC

DTC	P0031	O2 Sensor Heater - Heater Circuit Low (Bank1/Sensor1)

DESCRIPTION

Refer to DTC P0030

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0031 if the ECM detects that the front HO2S heater control is open 2.Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0031	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption - Rationality check • Threshold Value - Short circuit to ground - Wire disconnection	• Open in front HO2S heater circuit • Short to ground in front HO2S heater circuit • Front HO2S heater • ECM

SPECIFICATION

Refer to DTC P0030

SCHEMATIC DIAGRAM

Refer to DTC P0030

SIGNAL WAVEFORM

Refer to DTC P0030

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and warm up the vehicle until the cooling operates.

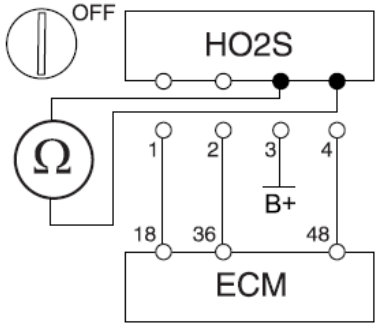
Does scan tool display DTC P0031?

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

2. CHECK HEATER RESISTANCE

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Measure resistance between terminals 3 and 4 of the HO2S connector.
   - **Specification (HO2S resistance):**

Temperature	Front HO2S Heater Resistance
20°C	9.0 Ω

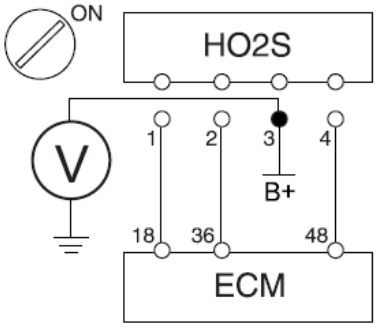


Is resistance within specification?

Yes	
No	Replace HO2S.

3. CHECK POWER TO HO2S HEATER

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): approximately B+**

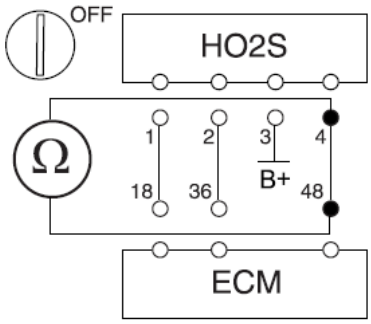


Is voltage within specification?

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

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 4 of the HO2S harness connector and 48 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**

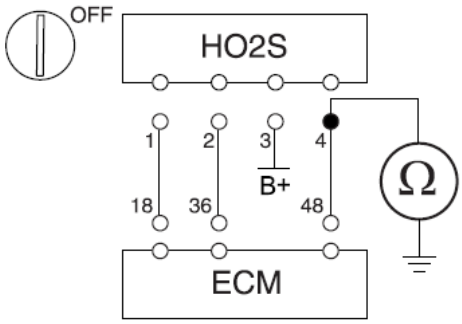


Does the resistance indicate continuity?

Yes	No	Repair open in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 4 of the HO2S harness connector and chassis ground.
   - **Specification (Resistance): infinite**



Is the resistance displayed correctly?

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

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

TROUBLESHOOTING FOR DTC

DTC	P0032	O2 Sensor Heater Circuit High (Bank1/Sensor1)

DESCRIPTION

Refer to DTC P0030

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0032 if the ECM detects that the front HO2S heater control is short to battery.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0032	Detecting Condition • DTC Strategy - Signal check, High - Signal interruption • Threshold Value - Short circuit to battery	• Short to battery in front HO2S heater circuit • Front HO2S heater • ECM

SPECIFICATION

Refer to DTC P0030

SCHEMATIC DIAGRAM

Refer to DTC P0030

SIGNAL WAVEFORM

Refer to DTC P0030

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and warm up the vehicle until the cooling fan operates.

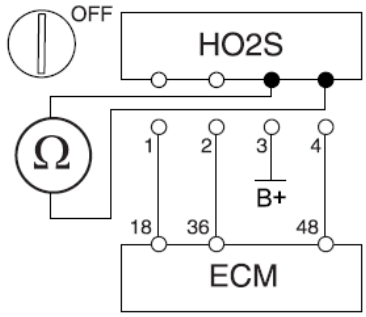
Does scan tool display DTC P0032?

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

2. CHECK HEATER RESISTANCE

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Measure resistance between terminals 3 and 4 of the HO2S connector.
   - **Specification (HO2S resistance):**

Temperature	Front HO2S Heater Resistance
20°C	9.0 Ω

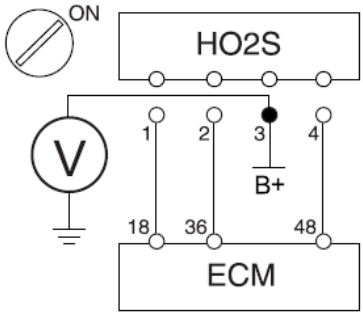


Is resistance within specification?

Yes	
No	Replace HO2S.

3. CHECK POWER TO HO2S HEATER

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): approximately B+**

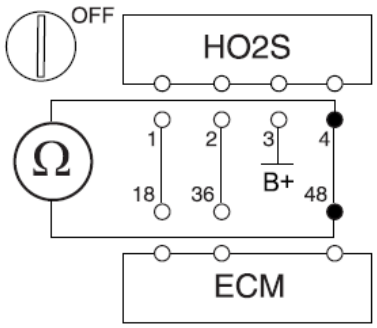


Is voltage within specification?

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

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 4 of the HO2S harness connector and 48 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**

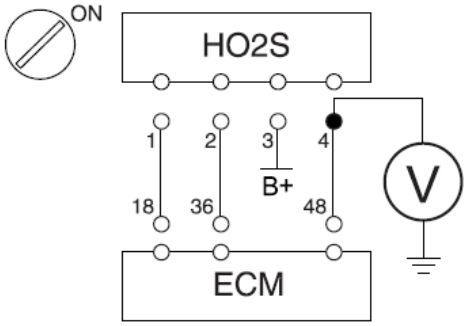


Does the resistance indicate continuity?

Yes	
No	Repair open in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 4 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**



Is voltage within specification?

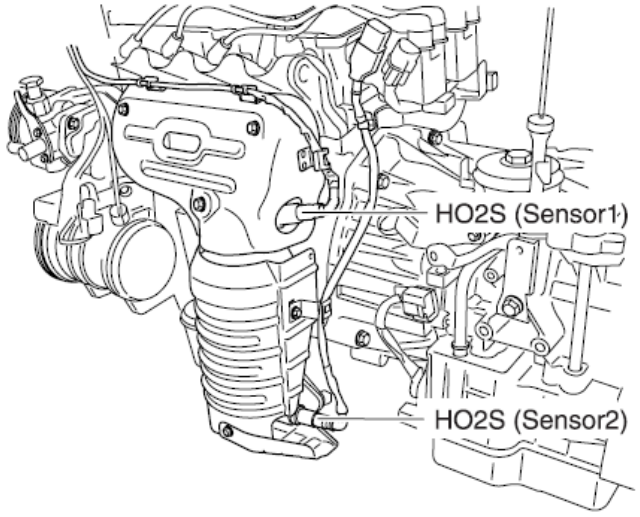
Yes	
No	Repair short to power in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0036	O2 Sensor Heater - Heater Control Circuit (Bank1/Sensor 2)

COMPONENT LOCATION



DESCRIPTION

Refer to DTC P0030

DTC DETECTING CONDITION

1. DTC Description

The ECM determines rear HO2S heater fault and sets DTC P0036 if measured rear HO2S resistance is lower than the predetermined threshold. The ECM illuminates the MIL on the second consecutive driving cycle that the diagnostic runs and fails.

2. Conditions for Setting the DTC

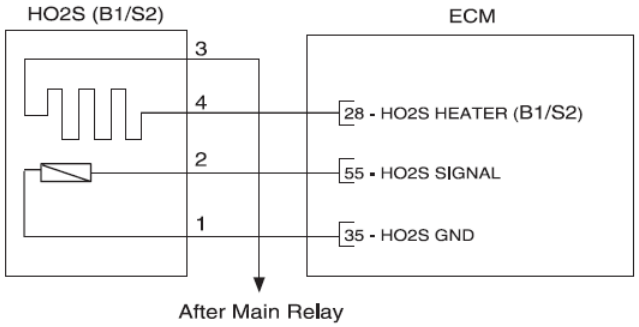
DTC	Detecting Condition	Possible Cause
P0036	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - Dew point end detected - 450°C < Exhaust temp. < 640°C - 10.7 V < Battery voltage < 15.6 V • Threshold Value - Internal resistance > (2.7 kΩ ~ 16 kΩ)	• Rear HO2S heater • Front HO2S heater

SPECIFICATION

Temperature	HO2S Heater Resistance
20°C	9.0 Ω

SCHEMATIC DIAGRAM

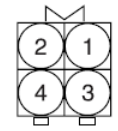
[CIRCUIT DIAGRAM]



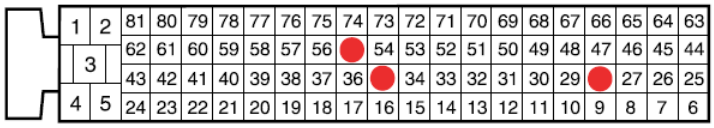
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM Terminal 35	Ground
2	ECM Terminal 55	HO2S Signal
3	Main Relay	Battery Voltage
4	ECM Terminal 28	HO2S Heater (B1/S2)

[HARNESS CONNECTORS]

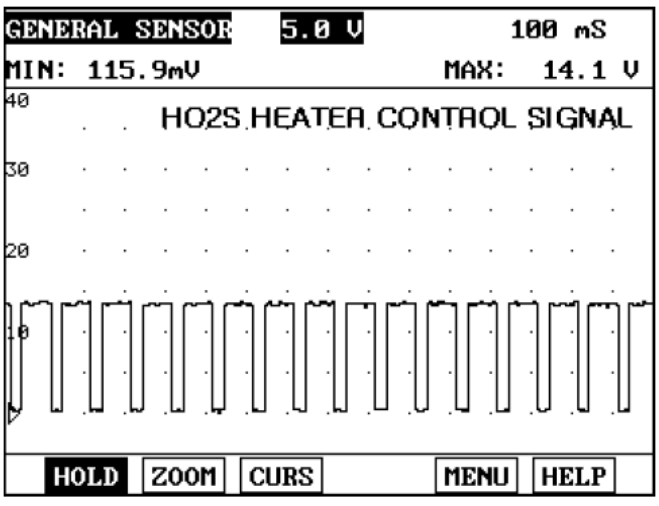


HO2S (B1/S2)



ECM

SIGNAL WAVEFORM



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

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and warm up the vehicle until cooling fan operates.

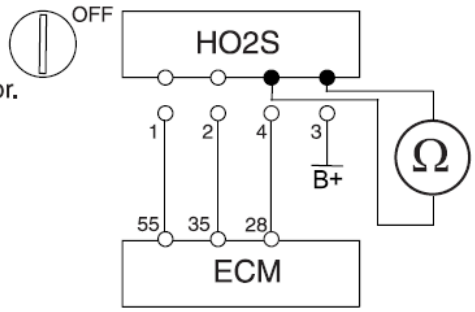
Does scan tool display DTC P0036?

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

2. CHECK HEATER RESISTANCE

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Measure resistance between terminals 3 and 4 of the HO2S connector.
   - **Specification (HO2S resistance):**

Temperature	Rear HO2S Heater Resistance
20°C	9.0 Ω

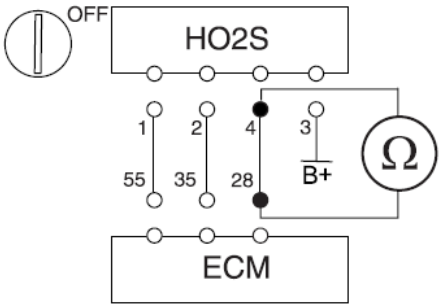


Is resistance within specification?

Yes	
No	Replace HO2S.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 4 of the HO2S harness connector and 28 of the ECM harness connector.
   - **Specification (Resistance): below** 1Ω

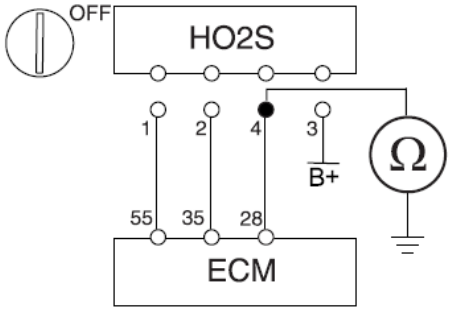


Does the resistance indicate continuity?

Yes	
No	Repair open in harness.

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 4 of the HO2S harness connector and chassis ground.
   - **Specification (Resistance): infinite**

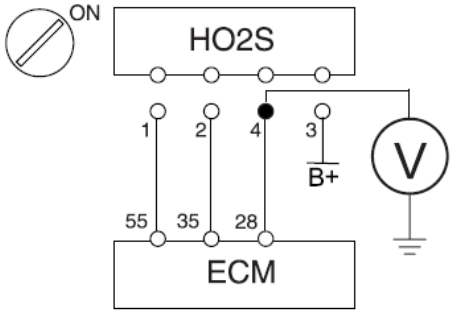


Is the resistance displayed correctly?

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

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 4 of the HO2S harness connector and chassis ground.
   - **Specification (Resistance): below 0.5V**



Is voltage within specification?

Yes		
	No	Repair short to power in harness.

6. VISUALLY CHECK HO2S FOR CONDITIONS

1. Remove HO2S.
2. Thoroughly check HO2S for contamination, deterioration or damage.

Is HO2S contaminated, deteriorated or damaged?

Yes		
	No	Clean or replace HO2S.

Replace HO2S

TROUBLESHOOTING FOR DTC

DTC	P0037	O2 Sensor Heater Circuit Low (Bank1/Sensor 2)

DESCRIPTION

Refer to DTC P0030

DTC DETECTING CONDITION

1. DTC Description

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

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0037	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption - Rationality check • Threshold Value - Short circuit to ground - Wire disconnection	• Open or short to ground in rear HO2S heater circuit • Front HO2S heater • ECM

SPECIFICATION

Refer to DTC P0036

SCHEMATIC DIAGRAM

Refer to DTC P0036

SIGNAL WAVEFORM

Refer to DTC P0036

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and warm up the vehicle until the cooling operates.

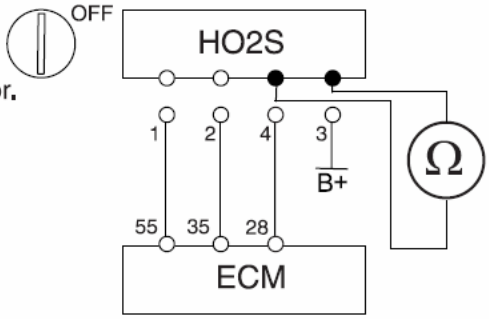
Does scan tool display DTC P0037?

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

2. CHECK HEATER RESISTANCE

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Measure resistance between terminals 3 and 4 of the HO2S connector.
   - **Specification (HO2S resistance):**

Temperature	Rear HO2S Heater Resistance
20 °C	9.0 Ω

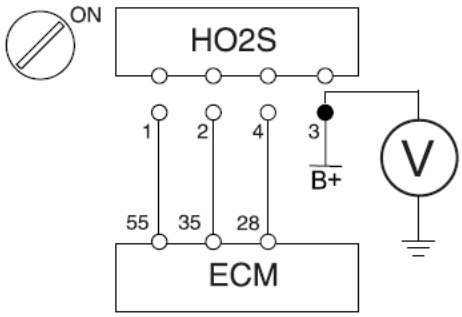


Is resistance within specification?

Yes	
No	Replace HO2S.

3. CHECK POWER TO HO2S HEATER

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): approximately B+**

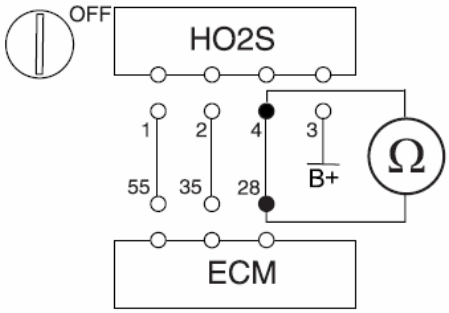


Is voltage within specification?

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

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 4 of the HO2S harness connector and 28 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**

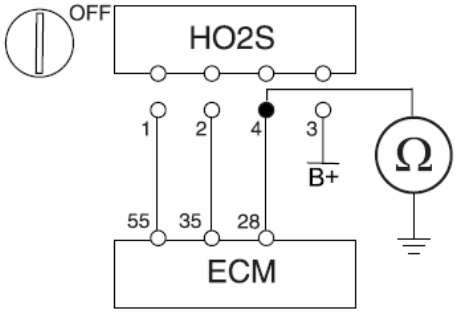


Does the resistance indicate continuity?

Yes		
	No	Repair open in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 4 of the HO2S harness connector and chassis ground.
   - **Specification (Resistance): infinite**



Is the resistance displayed correctly?

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

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

TROUBLESHOOTING FOR DTC

DTC	P0038	O2 Sensor Heater Circuit Low (Bank1/Sensor 2)

DESCRIPTION

Refer to DTC P0030

DTC DETECTING CONDITION

1. DTC Description

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

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0038	Detecting Condition • DTC Strategy - Signal check, High • Threshold Value - Short circuit to battery	• Short to battery in front HO2S heater circuit • Rear HO2S heater • ECM

SPECIFICATION

Refer to DTC P0036

SCHEMATIC DIAGRAM

Refer to DTC P0036

SIGNAL WAVEFORM

Refer to DTC P0036

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and warm up the vehicle until the cooling operates.

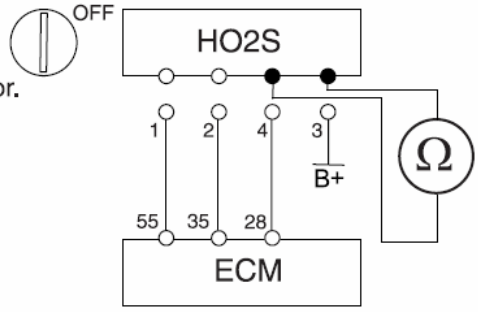
Does scan tool display DTC P0038?

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

2. CHECK HEATER RESISTANCE

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Measure resistance between terminals 3 and 4 of the HO2S connector.
   - **Specification (HO2S resistance):**

Temperature	Rear HO2S Heater Resistance
20°C	9.0 Ω

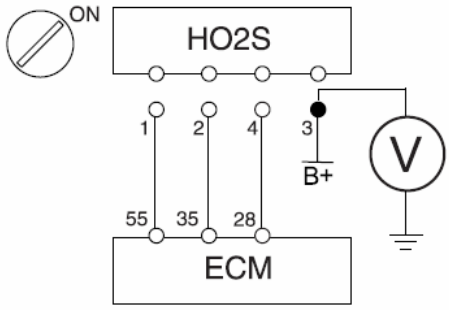


Is resistance within specification?

Yes	
No	Replace HO2S.

3. CHECK POWER TO HO2S HEATER

1. Turn ignition switch to OFF position and disconnect HO2S connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 3 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): approximately B+**

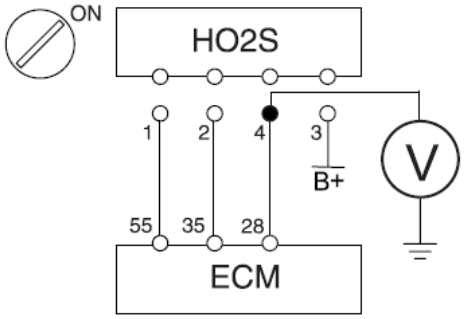


Is voltage within specification?

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

4. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 4 of the HO2S harness connector and chassis ground.
   - **Specification (Resistance): below 0.5V**



Is voltage within specification?

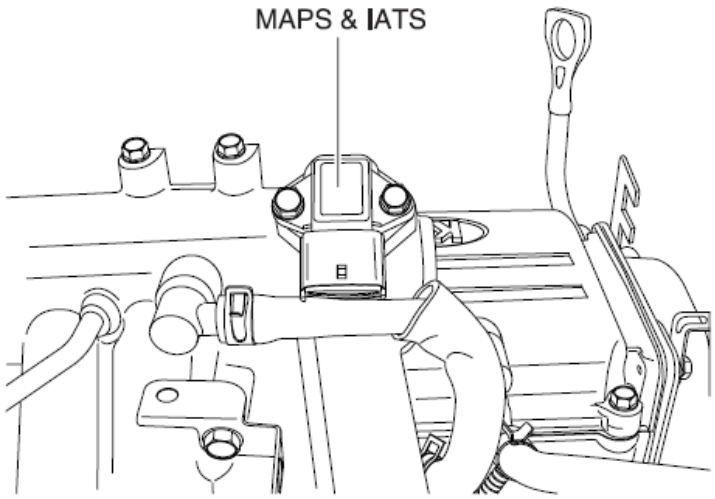
Yes	No	Repair short to power in harness.

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

TROUBLESHOOTING FOR DTC

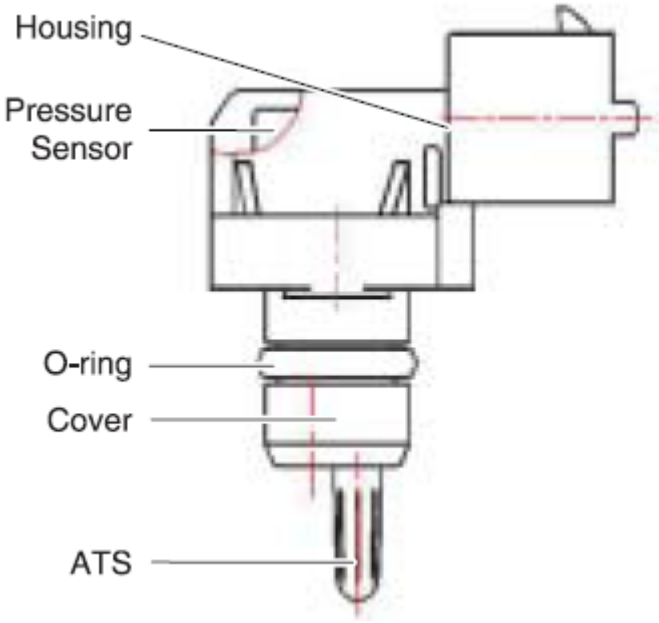
DTC	P0106	Manifold Absolute Pressure Circuit - Rationality

COMPONENT LOCATION



DTC DETECTING CONDITION

The Manifold Absolute Pressure (MAP) sensor measures the change of pressure in the intake manifold. The pressure of intake manifold is changed as variable engine running condition and converted into voltage and then it is monitored by the ECM.



DTC DETECTING CONDITION

1. DTC Description

The ECM sets the DTC P0106 When the intake manifold pressure is not of threshold of the possible range of properly operating. The ECM illuminates the MIL on the second consecutive driving cycle that the diagnostic runs and fails.

2. Conditions for Setting the DTC

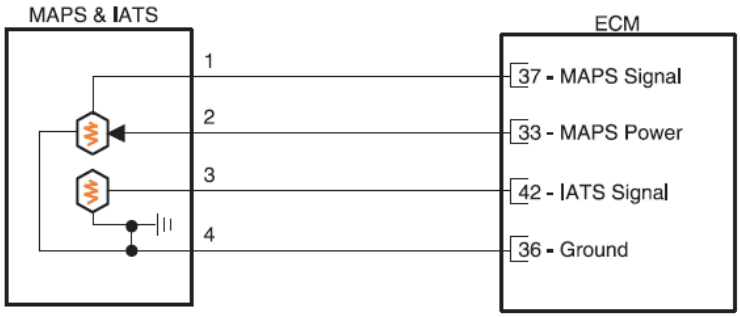
DTC	Detecting Condition	Possible Cause
P0106	Detecting Condition • DTC Strategy - Rationality check • Enable condition - No TPS error - Time elapse after start > 5.0 s • Threshold Value - Intake manifold pressure > maximum threshold : (engine speed, throttle opening degree) - Intake manifold pressure < minimum threshold : (engine speed, throttle opening degree)	• MAPS • TPS • Air cleaner • ECM

SPECIFICATION

TPS		MAPS
Resistance	**Output voltage**	**Output voltage**
1.6 ~ 2.4 k (20°C)	0.2 ~ 4.8 V	1.2 ~ 4.1 V

SCHEMATIC DIAGRAM

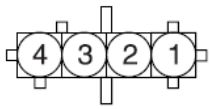
[CIRCUIT DIAGRAM]



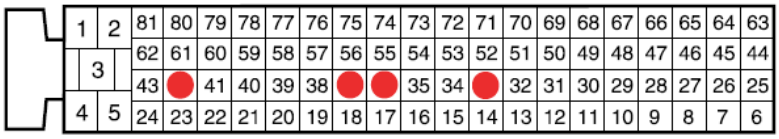
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM terminal 37	MAPS signal
2	ECM terminal 33	MAPS power
3	ECM terminal 42	IATS signal
4	ECM terminal 36	Ground

[HARNESS CONNECTORS]

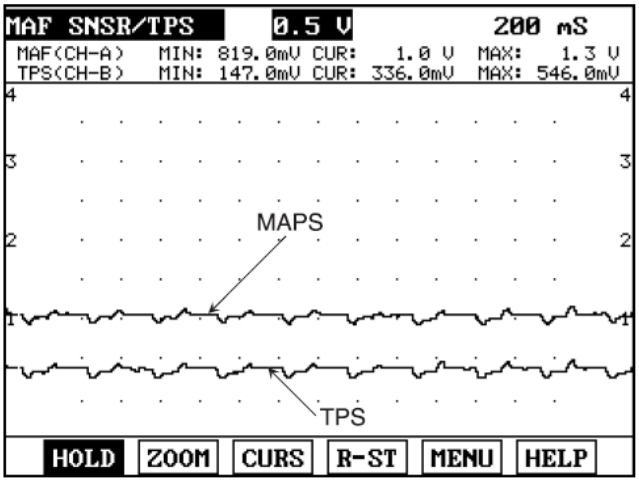


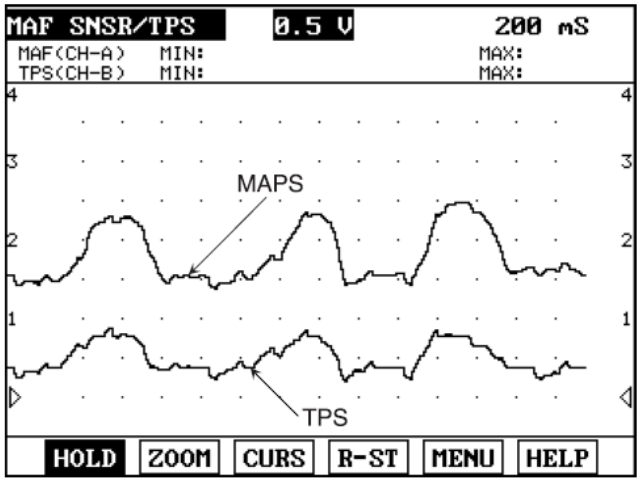
MAPS & IATS



ECM

SIGNAL WAVEFORM





As much as possible, MAPS signal should be compared with the TPS signal. And check whether MAPS and TPS signals are increased at the same time when accelerated. During acceleration, the MAPS output voltage increases; during deceleration, the MAPS output voltage decreases. The left illustration is signal waveform at idle and the right illustration during acceleration and deceleration.

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO MAPS/TPS

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

Is any DTC relating to MAPS or TPS set?

No

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

2. PROBLEM VERIFICATION

1. Warm up engine to normal operating temperature.
2. Using Hi-Scan (Pro), monitor MAFS signals while changing throttle position.
   - **Specification (MAPS signal voltage): 1.2 ~ 4.1 V**

Does signal change normally according to TPS signal?

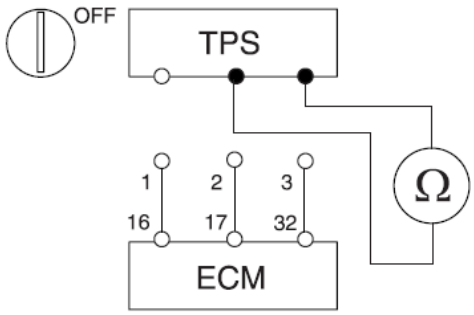
No

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

3. CHECK TPS RESISTANCE

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

TPS	
Resistance	Output Voltage
1.6 ~ 2.4 kΩ (20℃)	0.2 ~ 4.8 V



Is resistance within specification?

Yes

No	Replace TPS.

4. CHECK MAPS, TPS, AND ECM CONNECTORS

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

Are all connectors good?

Yes

No	Repair or replace it.

5. CHECK AIR CLEANER

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

Is air cleaner good?

Yes

No	Clean or replace it.

6. CHECK INTAKE SYSTEM FOR LEAKAGE

1. Check entire air intake system for leaks or blockages such as:
   - Throttle body
   - PCV valve
   - Intake manifold
   - Gasket between intake manifold and surge tank
   - Seals between intake manifold and fuel injectors
   - Seal between surge tank and PCV pipe

Is entire air intake system good?

Yes

No	Repair or replace it.

7. CHECK MAPS SIGNAL AGAIN

1. Reconnect the ECM and MAPS connectors.
2. Connect a Hi-Scan (Pro) to the data link connector.
3. Start the engine and monitor the MAPS signals.
   - **Specification (MAPS signal voltage):**
     0.6 ~ 1.0 V at idle
     1.7 ~ 2.0 V at 3000 rpm

Is signal within specification?

Yes

No	Replace MAPS.

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

TROUBLESHOOTING FOR DTC

DTC	P0107	Manifold Absolute Pressure Circuit - Range Check Low

DESCRIPTION

Refer to DTC P0106

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0107 if the ECM detects signal voltage lower than threshold of the possible range of a properly operating MAP sensor.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0107	Detecting Condition • DTC Strategy - Signal check, Low • Enable condition - Engine speed < 75 rpm or time elapse after start > 5.0 s • Threshold Value - Sensor output voltage < 0.195 V	• Open or short in MAPS circuit • ECM • MAPS

SPECIFICATION

Refer to DTC P0106

SCHEMATIC DIAGRAM

Refer to DTC P0106

SIGNAL WAVEFORM

Refer to DTC P0106

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start the engine and monitor the MAPS signals.
   - **Specification (MAPS signal voltage): 1.2 ~ 4.1 V**

Is signal within specification?

No

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

2. CHECK MAPS AND ECM CONNECTORS

1. Check the MAPS and ECM for poor connection, misplaced, bent, loose or corroded terminals.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

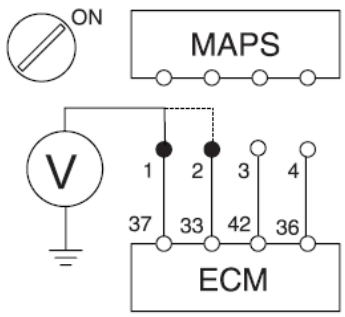
Are both connectors good?

Yes

No	Repair or replace it.

3. CHECK POWER TO MAPS

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



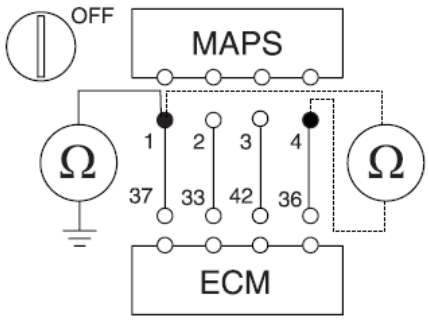
Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

4. CHECK FOR SHORT TO GROUND IN HARNESS

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



Is resistance displayed correctly?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK MAPS SIGNAL

1. Connect the ECM and MAPS connectors.
2. Connect a Hi-Scan (Pro) to the data link connector.
3. Start the engine and monitor the MAPS signals.
   - **Specification (MAPS signal voltage): 1.2 ~ 4.1 V**

Is signal within specification?

Yes

No	Replace MAPS.

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

TROUBLESHOOTING FOR DTC

DTC	P0108	Manifold Absolute Pressure Circuit - Range Check High

DESCRIPTION

Refer to DTC P0106

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0108 if the ECM detects signal voltage higher than threshold of the possible range of a properly operating MAP sensor.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0108	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - Engine speed < 75 rpm or time elapse after start > 5.0 s • Threshold Value - Sensor output voltage > 4.88	• Short to battery in MAPS circuit • ECM • MAPS

SPECIFICATION

Refer to DTC P0106

SCHEMATIC DIAGRAM

Refer to DTC P0106

SIGNAL WAVEFORM

Refer to DTC P0106

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start the engine and monitor the MAPS signals.
   - **Specification (MAPS signal voltage): 1.2 ~ 4.1 V**

Is signal within specification?

No

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

2. CHECK MAPS AND ECM CONNECTORS

1. Check the MAPS and ECM for poor connection, misplaced, bent, loose or corroded terminals.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

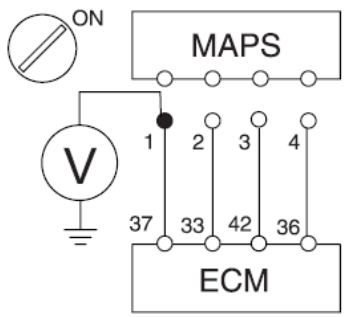
Are both connectors good?

Yes

No	Repair or replace it.

3. CHECK FOR SHORT TO POWER IN HARNESS

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



Is voltage within specification?

Yes

No	Repair short to power in harness.

4. CHECK MAPS SIGNAL

1. Reconnect the ECM and MAPS connectors.
2. Connect a Hi-Scan (Pro) to the data link connector.
3. Start the engine and monitor the MAPS signals.
   - **Specification (MAPS signal voltage): 1.2 ~ 4.1V**

Is signal within specification?

Yes

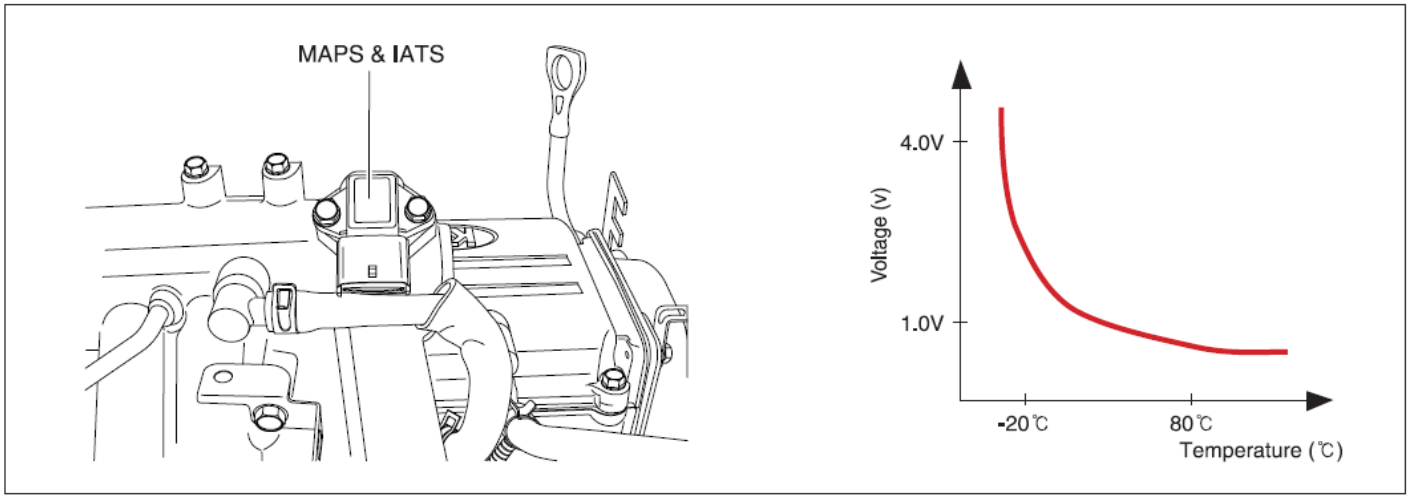
No	Replace MAPS.

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

TROUBLESHOOTING FOR DTC

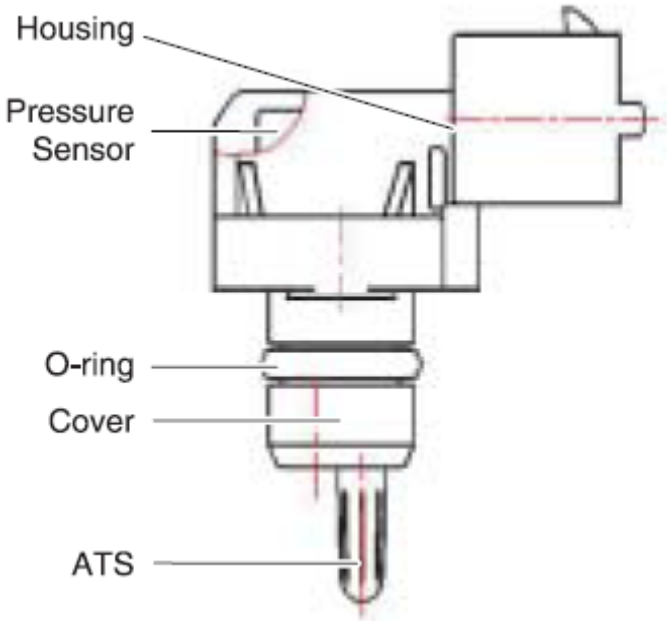
DTC	P0112	Intake Air Temperature Circuit Low Input

COMPONENT LOCATION



DESCRIPTION

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



DTC DETECTING CONDITION

1. DTC Description

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

2. Conditions for Setting the DTC

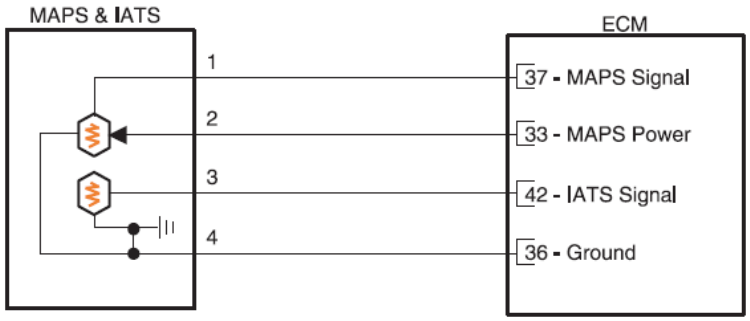
DTC	Detecting Condition	Possible Cause
P0112	Detecting Condition • DTC Strategy - Signal check, Low • Enable condition - Idle - No fuel cut - Time elapse after start > 240 s • Threshold Value - Intake air temperature < -38.5°C	• Short to battery or open in IATS circuit • IATS • ECM

SPECIFICATION

Temperature	IATS Resistance	Temperature	IATS Resistance
-40°C	40.93 ~ 48.35 kΩ	40°C	1.08 ~ 1.21 kΩ
-20°C	13.89 ~ 16.03 kΩ	60°C	0.54 ~ 0.62 kΩ
0°C	5.38 ~ 6.09 kΩ	80°C	0.29 ~ 0.34 kΩ
20°C	2.31 ~ 2.57 kΩ		

SCHEMATIC DIAGRAM

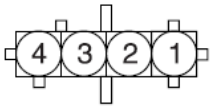
[CIRCUIT DIAGRAM]



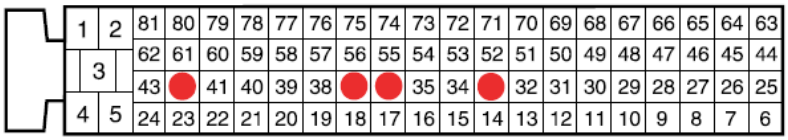
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM terminal 37	MAPS signal
2	ECM terminal 33	MAPS power
3	ECM terminal 42	IATS signal
4	ECM terminal 36	Ground

[HARNESS CONNECTORS]

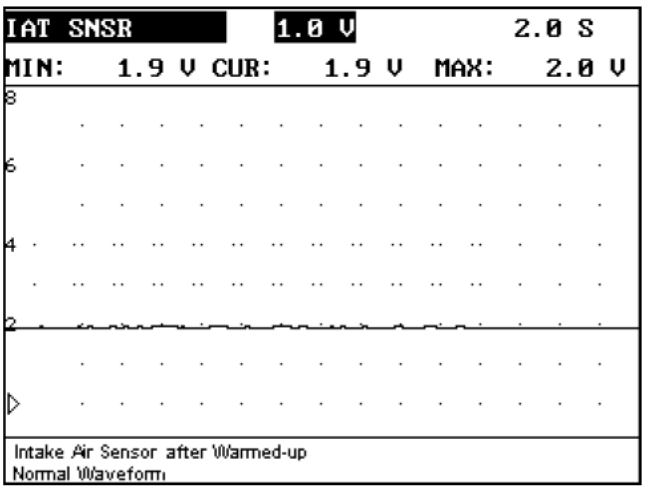


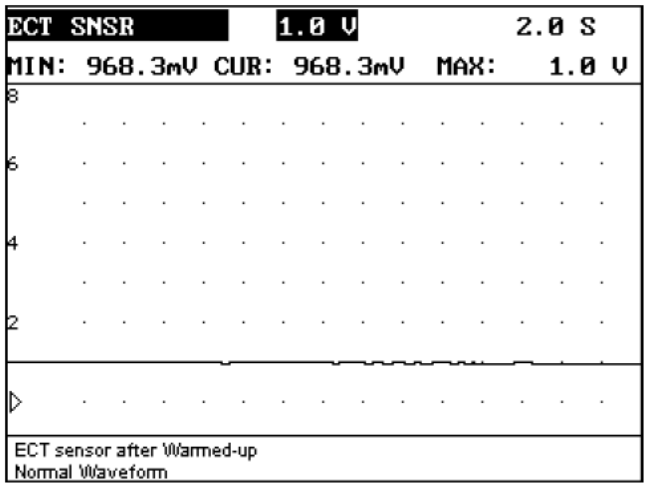
MAPS & IATS



ECM

SIGNAL WAVEFORM





IATS and ECTS signals should be smooth and continuous without any sudden changes. When the engine is cold, IATS and ECTS signals should look similar, depending on the ambient air temperature. After warmed-up the IATS signal should not have changed less significantly while ECTS signal should have dropped. This indicates the normal increase of the engine coolant temperature is larger than the normal increase of the intake air temperature as the engine warms up.

INSPECTION PROCEDURE

1. CHECK IATS AND ECM CONNECTORS

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

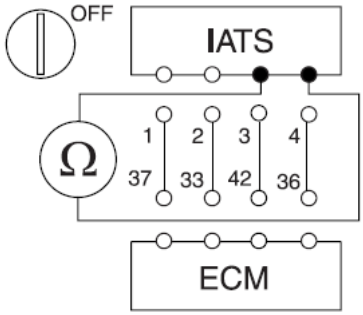
Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK IATS RESISTANCE

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

Temperature	Resistance	Temperature	Resistance
-40 °C	40.93 ~ 48.35 kΩ	40 °C	1.08 ~ 1.21 kΩ
-20 °C	13.89 ~ 16.03 kΩ	60 °C	0.54 ~ 0.62 kΩ
0 °C	5.38 ~ 6.09 kΩ	80 °C	0.29 ~ 0.34 kΩ
20 °C	2.31 ~ 2.57 kΩ		

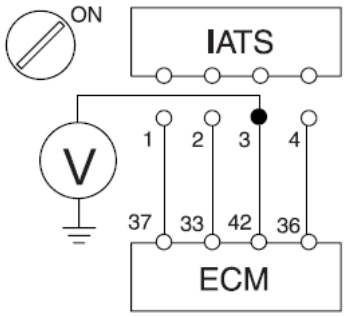


Is resistance within specification?

Yes	
No	Replace IATS.

3. CHECK REFERENCE VOLTAGE TO IATS

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



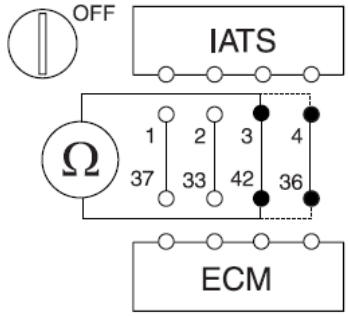
Is voltage within specification?

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

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect IATS and ECM connector.
2. Measure resistance between terminal 3 of the IATS harness connector and 42 of the ECM harness connector.
3. Measure resistance between terminal 4 of the IATS harness connector and 36 of the ECM harness connector.
   - **Specification (Resistance): approximately below 1Ω**

Is the resistance displayed correctly?



Yes

No	Repair open in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0113	Intake Air Temperature Circuit High Input

DESCRIPTION

Refer to DTC P0112

DTC DETECTING CONDITION

1. DTC Description

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

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0113	Detecting Condition • DTC Strategy - Signal check, High • Threshold Value - Intake air temperature > 128.25°C	• Short to ground in IATS circuit • IATS • ECM

SPECIFICATION

Refer to DTC P0112

SCHEMATIC DIAGRAM

Refer to DTC P0112

SIGNAL WAVEFORM

Refer to DTC P0112

INSPECTION PROCEDURE

1. CHECK IATS AND ECM CONNECTORS

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

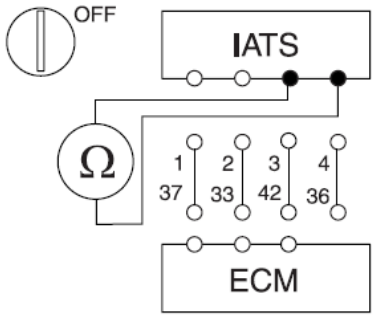
Are all connectors good?

Yes	No	Repair or replace it.

2. CHECK IATS RESISTANCE

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

Temperature	Resistance	Temperature	Resistance
-40 °C	40,93 – 48,35 kΩ	40 °C	1,08 – 1,21 kΩ
-20 °C	13,89 – 16,03 kΩ	60 °C	0,54 – 0,62 kΩ
0 °C	5,38 – 6,09 kΩ	80 °C	0,29 – 0,34 kΩ
20 °C	2,31 – 2,57 kΩ		

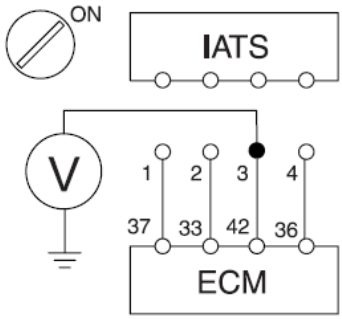


Is resistance within specification?

Yes	No	Replace IATS.

3. CHECK REFERENCE VOLTAGE TO IATS

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



Is voltage within specification?

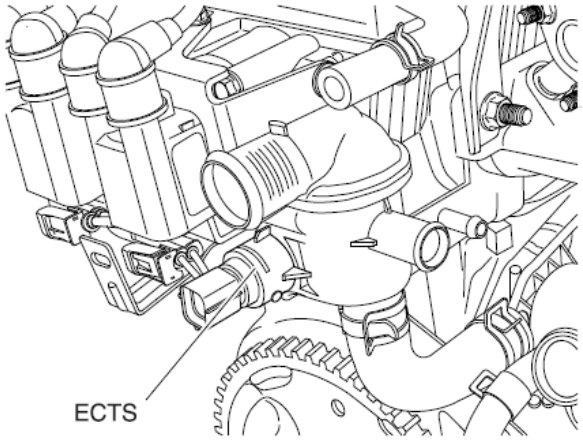
Yes	No	Repair short to chassis ground in harness.

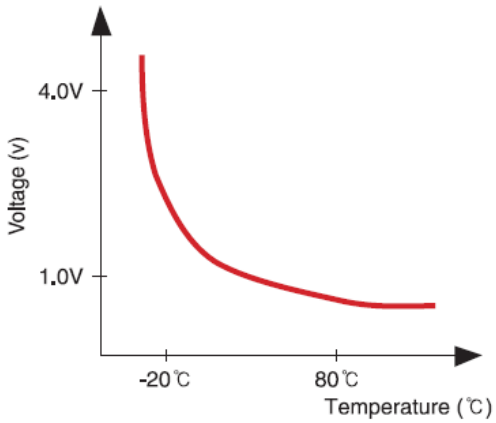
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TROUBLESHOOTING FOR DTC

DTC	P0117	Engine Coolant Temperature Circuit Low Input

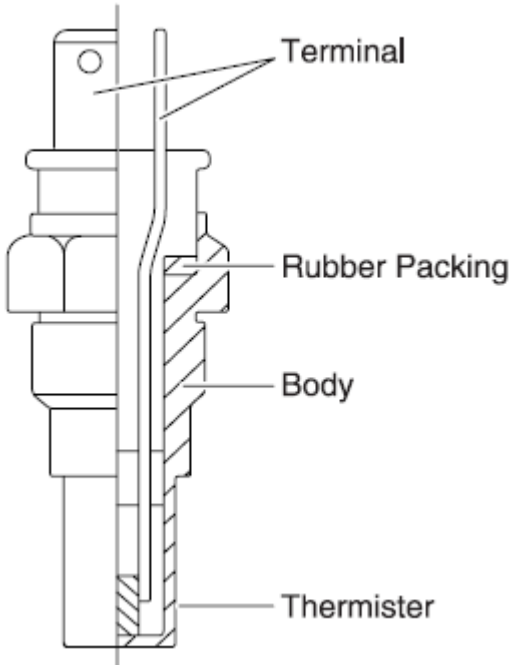
COMPONENT LOCATION





DESCRIPTION

The Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage near 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 DETECTING CONDITION

1. DTC Description

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

2. Conditions for Setting the DTC

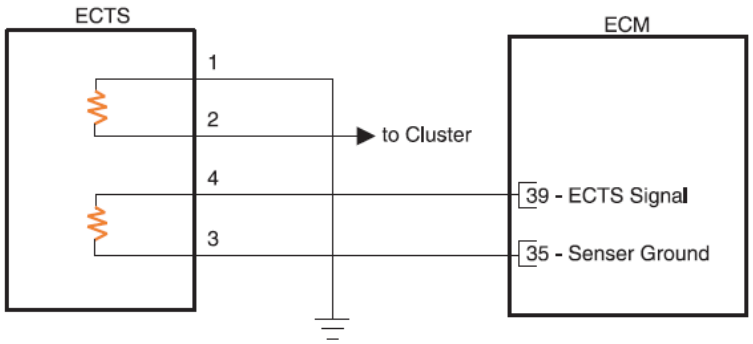
DTC	Detecting Condition	Possible Cause
P0117	Detecting Condition • DTC Strategy - Signal check, Low • Threshold Value - Engine coolant temperature < -38.25°C	• Open or short to battery in ECTS circuit • ECTS • ECM

SPECIFICATION

Temperature	Resistance	Temperature	Resistance
-40°C	48.14 kΩ	40°C	1.15 kΩ
-20°C	14.13 ~ 16.82 kΩ	60°C	0.59 kΩ
0°C	5.79 kΩ	80°C	0.32 kΩ
20°C	2.31 ~ 2.59 kΩ		

SCHEMATIC DIAGRAM

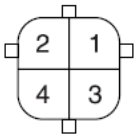
[CIRCUIT DIAGRAM]



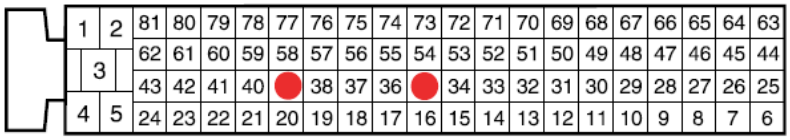
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Ground	Sensor Ground
2	Cluster	Gauge Signal
3	ECM terminal 73	Sensor Ground
4	ECM terminal 39	ECTS Signal

[HARNESS CONNECTORS]

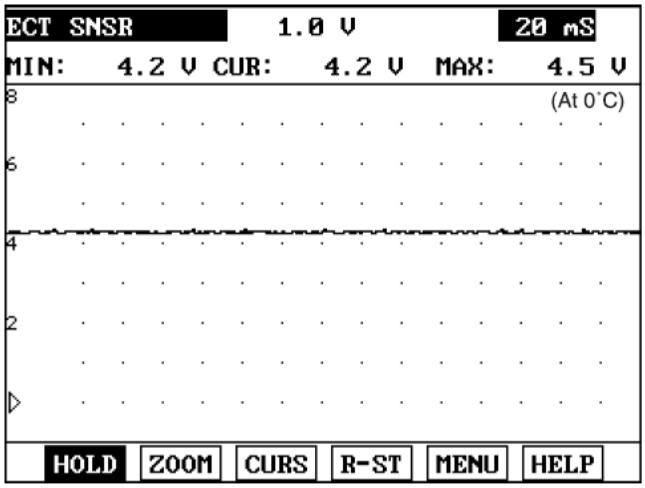


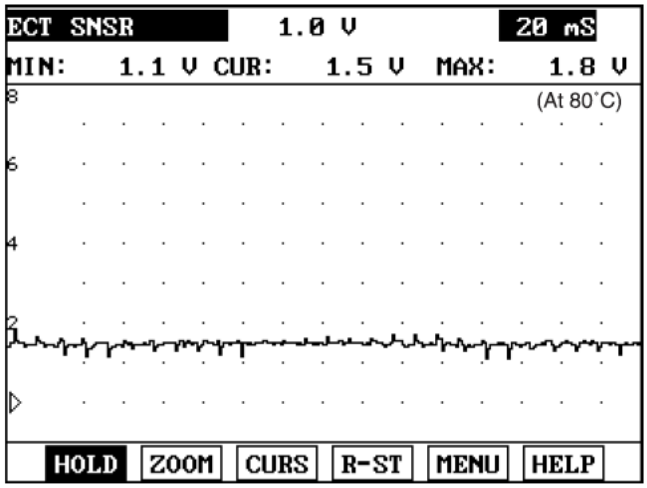
ECTS



ECM

SIGNAL WAVEFORM





ECTS and IATS signals should be smooth and continuous without any sudden changes. When the engine is cold, ECTS and IATS signals should look similar, depending on the ambient air temperature. After warmed-up the IATS signal should not have changed less significantly while ECTS signal should have dropped. This indicates the normal increase of the engine coolant temperature is larger than the normal increase of the intake air temperature as the engine warms up.

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

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

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

No

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

2. CHECK ECTS AND ECM CONNECTORS

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

Are all connectors good?

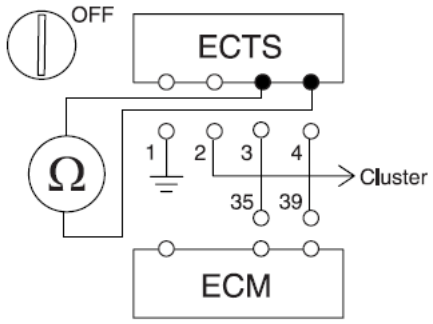
Yes

No	Repair or replace it.

3. CHECK ECTS RESISTANCE

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

Temperature	Resistance	Temperature	Resistance
-40 °C	48,14 kΩ	40 °C	1,15 kΩ
-20 °C	14,13 ~ 16,82 kΩ	60 °C	0,59 kΩ
0 °C	5,79 kΩ	80 °C	0,32 kΩ
20 °C	2,31 ~ 2,59 kΩ		



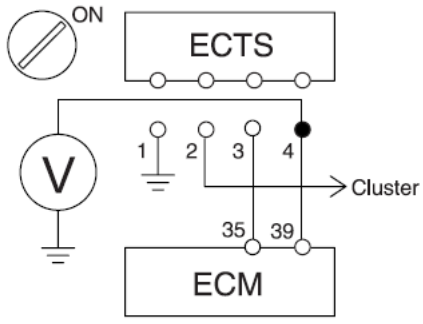
Is resistance within specification?

Yes

No	Replace ECTS.

4. CHECK REFERENCE VOLTAGE TO ECTS

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

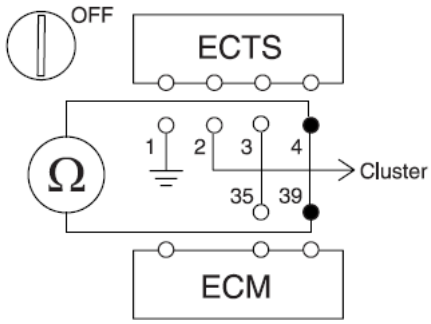


Is voltage within specification?

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

5. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect ECTS and ECM connectors.
2. Measure resistance between terminal 4 of the ECTS harness connector and 39 of the ECM harness connector.
   - **Specification (Resistance): Approximately below 1Ω**



Is the resistance displayed correctly?

Yes	No	Repair open in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0118	Engine Coolant Temperature Circuit High Input

DESCRIPTION

Refer to DTC P0117

DTC DETECTING CONDITION

1. DTC Description

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

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0118	Detecting Condition • DTC Strategy - Signal check, High • Threshold Value - Engine coolant temperature > 138.75°C	• Short to ground in ECTS circuit • ECTS • ECM

SPECIFICATION

Refer to DTC P0117

SCHEMATIC DIAGRAM

Refer to DTC P0117

SIGNAL WAVE FORM

Refer to DTC P0117

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

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

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

No

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

2. CHECK ECTS AND ECM CONNECTORS

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

Are all connectors good?

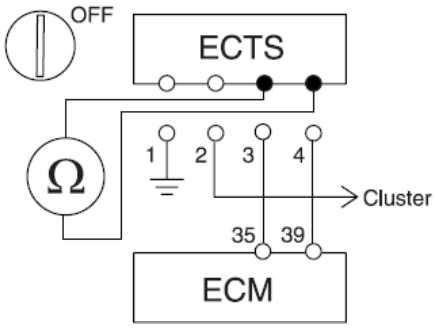
Yes

No	Repair or replace it.

3. CHECK ECTS RESISTANCE

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

Temperature	Resistance	Temperature	Resistance
-40 °C	48.14 kΩ	40 °C	1.15 kΩ
-20 °C	14.13 ~ 16.82 kΩ	60 °C	0.59 kΩ
0 °C	5.79 kΩ	80 °C	0.32 kΩ
20 °C	2.31 ~ 2.59 kΩ		



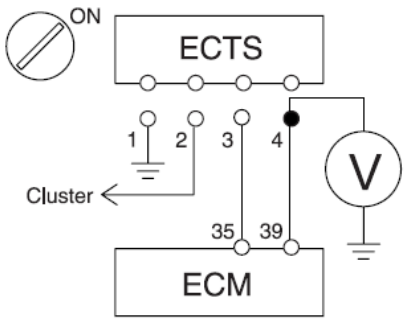
Is resistance within specification?

Yes

No	Replace ECTS.

4. CHECK REFERENCE VOLTAGE TO ECTS

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

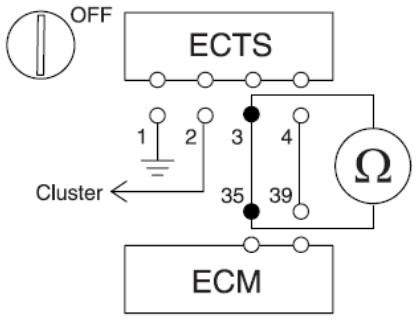


Is voltage within specification?

Yes		
	No	Repair short to chassis ground in harness.

5. CHECK FOR OPEN IN HARNESS

1. Turn ignition to OFF position, and then disconnect ECTS and ECM connector.
2. Measure resistance between terminal 3 of the ECTS harness connector and 35 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**



Does the resistance indicate continuity?

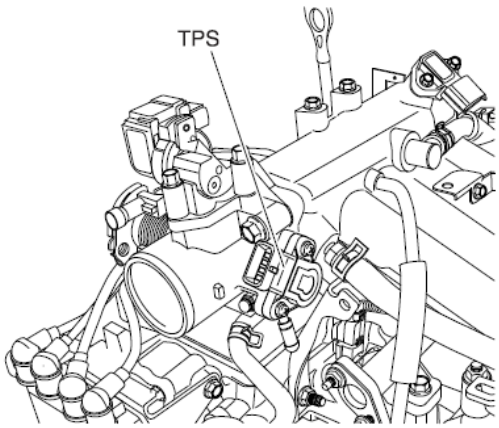
Yes		
	No	Repair open in harness.

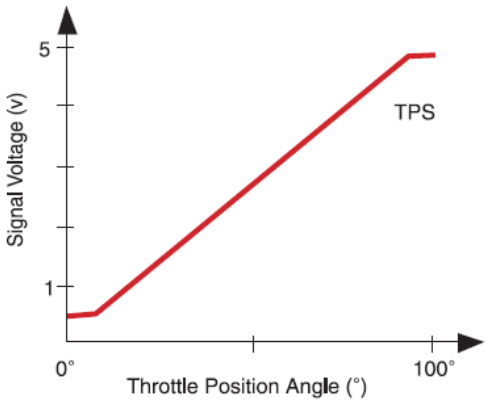
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TROUBLESHOOTING FOR DTC

DTC	P0121	Throttle/Pedal Position Circuit Range / Performance Problem

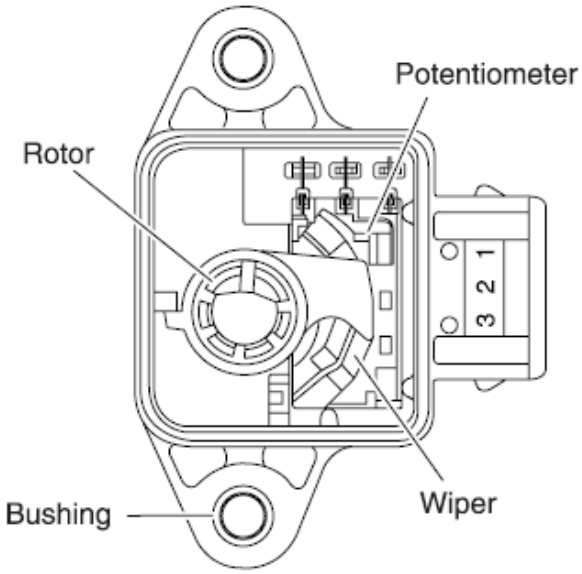
COMPONENT LOCATION





DESCRIPTION

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) who's 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 Mass Air Flow Sensor (MAFS) or Manifold Absolute Pressure Sensor (MAPS) signal along with the TPS signal to adjust fuel injection duration and ignition timing.



DTC DETECTING CONDITION

1. DTC Description

The ECM compares the actual measured Manifold Absolute Pressure signal with the modeled Manifold Absolute Pressure value to detect implausible TPS signal. Because throttle position is one of key parameters in determining the modeled MAP.
The DTC P0121 is set when the difference between these two values is too high or too low with lambda deviation in same direction for a certain time.

2. Conditions for Setting the DTC

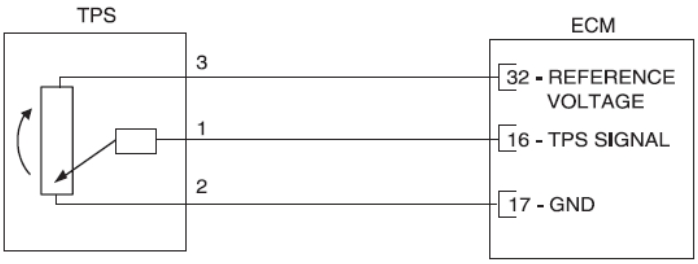
DTC	Detecting Condition	Possible Cause
P0121	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - Engine speed ≥ target engine speed - Time elapse after start > 20 s or time elapse after ambient pressure adaptation active (in case after power fail) > 120 s • Threshold Value - (modeled relative load / real relative load) > 1.25 or < 0.75	• TPS • Intake system • ECM

SPECIFICATION

TPS		MAPS
Resistance	**Output voltage**	**Output voltage**
1.6 ~ 2.4 k (20°C)	0.2 ~ 4.8 V	1.2 ~ 4.1 V

SCHEMATIC DIAGRAM

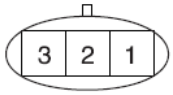
[CIRCUIT DIAGRAM]



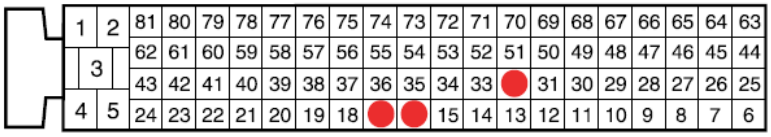
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM terminal 16	TPS signal
2	ECM terminal 17	Sensor ground
3	ECM terminal 32	Reference Voltage

[HARNESS CONNECTORS]

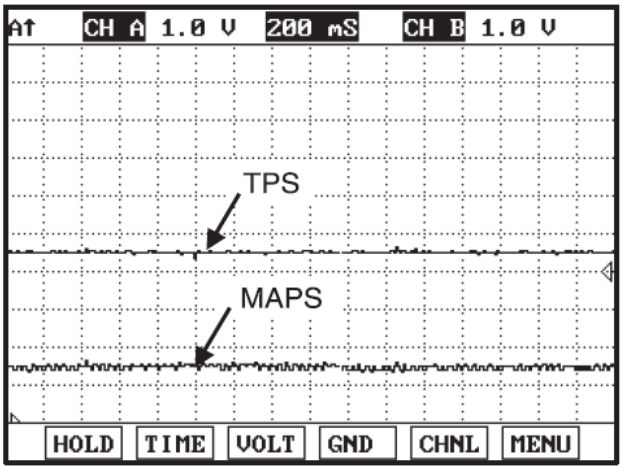


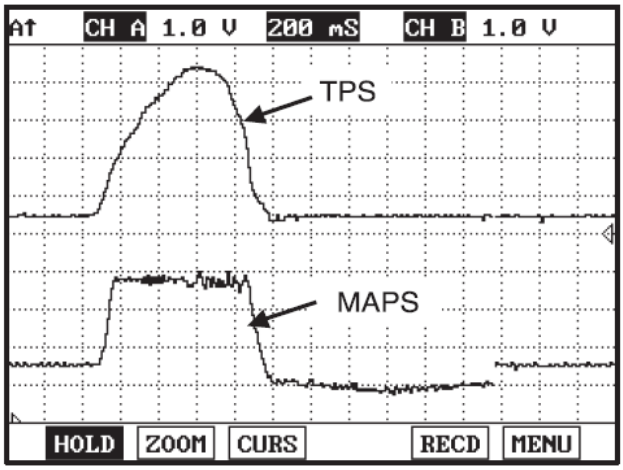
TPS



ECM

SIGNAL WAVEFORM





During acceleration, the TPS output voltage increases; during deceleration, the TPS output voltage decreases. As much as possible, TPS signal should be compared with the MAPS signal. And check whether TPS and MAPS signals are increase at the same time when accelerated.

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO TPS

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

Is any DTC relating to TPS set?

No

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

2. CHECK INTAKE SYSTEM

1. Inspect the intake system for the following items:
   - Air leakage
   - Connection of each components

Are the items okay?

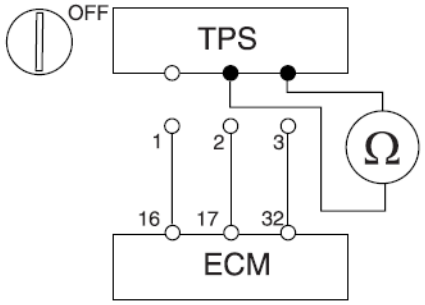
Yes

No	Repair or replace it.

3. CHECK TPS RESISTANCE

1. Turn ignition switch to OFF and disconnect TPS connector.
2. Measure resistance between the terminal 2 and 3 of TPS connector.
   - **Specification:**

TPS	
Resistance	Signal Voltage
1.6 ~ 2.4 kΩ (20℃)	0.2 ~ 4.8 V



Is each resistance within specification?

Yes

No	Replace TPS.

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

TROUBLESHOOTING FOR DTC

DTC	P0122	Throttle/Pedal Position Sensor Circuit Low Input

DESCRIPTION

Refer to DTC P0121

DTC DETECTING CONDITION

1. DTC Description

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

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0122	Detecting Condition • DTC Strategy - Signal check, Low • Enable condition - Engine speed > 600 rpm • Threshold Value - Throttle opening degree < 3.14% (0.157 V)	• Short to ground in TPS circuit • TPS • ECM

SPECIFICATION

Refer to DTC P0121

SCHEMATIC DIAGRAM

Refer to DTC P0121

SIGNAL WAVEFORM

Refer to DTC P0121

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Turn ignition switch to ON position.
2. Using a Hi-Scan (Pro), monitor the TPS signals while slowly opening the throttle.
   - **Specification (TPS signal):**
     0.2 ~ 0.8 V at Closed Throttle
     4.3 ~ 4.8 V at Wide Open Throttle
   - **Refer to CHARACTERISTIC CURVE in P0121 about any other throttle angle.**

Is signal within specification and consistent with the normal curve?

No

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

2. CHECK TPS AND ECM CONNECTORS

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

Are all connectors good?

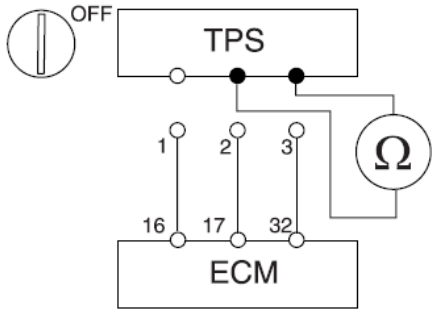
Yes

No	Repair or replace it.

3. CHECK TPS RESISTANCE

1. Turn ignition switch to OFF and disconnect TPS connector.
2. Measure resistance between the terminal 2 and 3 of TPS connector.
   - **Specification :**

TPS	
Resistance	Signal Voltage
1.6 ~ 2.4 kΩ (20℃)	0.2 ~ 4.8 V



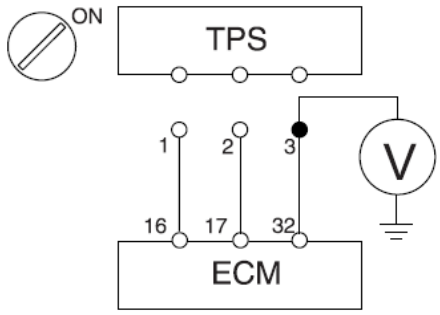
Is each resistance within specification?

Yes

No	Replace TPS.

4. CHECK REFERENCE VOLTAGE TO TPS

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

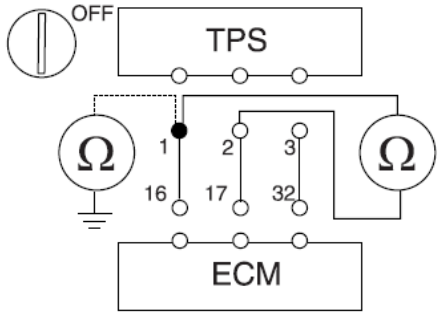


Is voltage within specification?

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

5. CHECK FOR SHORT TO GROUND IN HARNESS

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



Is resistance displayed correctly?

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

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

TROUBLESHOOTING FOR DTC

DTC	P0123	Throttle/Pedal Position Sensor Circuit High Input

DESCRIPTION

Refer to DTC P0121

DTC DETECTING CONDITION

1. DTC Description

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

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0123	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - Engine speed > 600 rpm • Threshold Value - Throttle opening degree > 95.7% (4.78 V)	• Open or short to battery in TPS circuit • TPS • ECM

SPECIFICATION

Refer to DTC P0121

SCHEMATIC DIAGRAM

Refer to DTC P0121

SIGNAL WAVEFORM

Refer to DTC P0121

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Turn ignition switch to ON position.
2. Using a Hi-Scan (Pro), monitor the TPS signals while slowly opening the throttle.
   - **Specification (TPS signal):**
     0.2 ~ 0.8 V at Closed Throttle
     4.3 ~ 4.8 V at Wide Open Throttle
   - **Refer to CHARACTERISTIC CURVE in P0121 about any other throttle angle.**

Is signal within specification and consistent with the normal curve?

No

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

2. CHECK TPS AND ECM CONNECTORS

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

Are all connectors good?

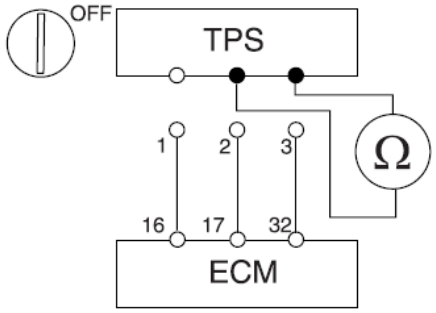
Yes

No	Repair or replace it.

3. CHECK TPS RESISTANCE

1. Turn ignition switch to OFF and disconnect TPS connector.
2. Measure resistance between the terminal 2 and 3 of TPS connector.
   - **Specification :**

TPS	
Resistance	Signal Voltage
1.6 ~ 2.4 kΩ (20℃)	0.2 ~ 4.8 V



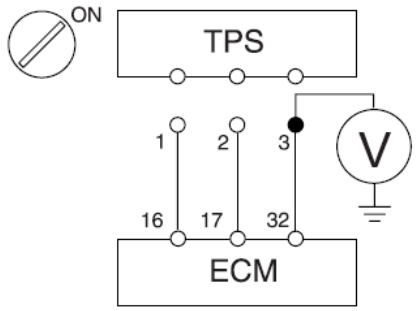
Is each resistance within specification?

Yes

No	Replace TPS.

4. CHECK REFERENCE VOLTAGE TO TPS

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

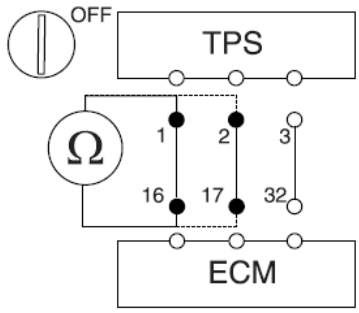


Is voltage within specification?

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

5. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect TPS and ECM connector.
2. Measure resistance between terminal 1 of the TPS harness connector and 16 of the ECM harness connector.
3. Measure resistance between terminal 2 of the TPS harness connector and 17 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**

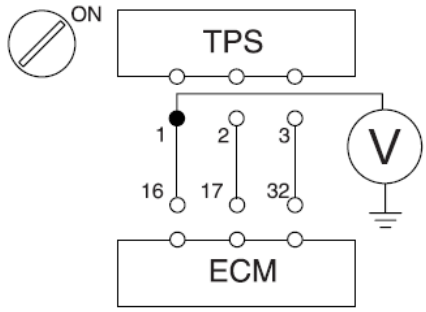


Does each resistance indicate continuity?

Yes	No	Repair open in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

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



Is voltage within specification?

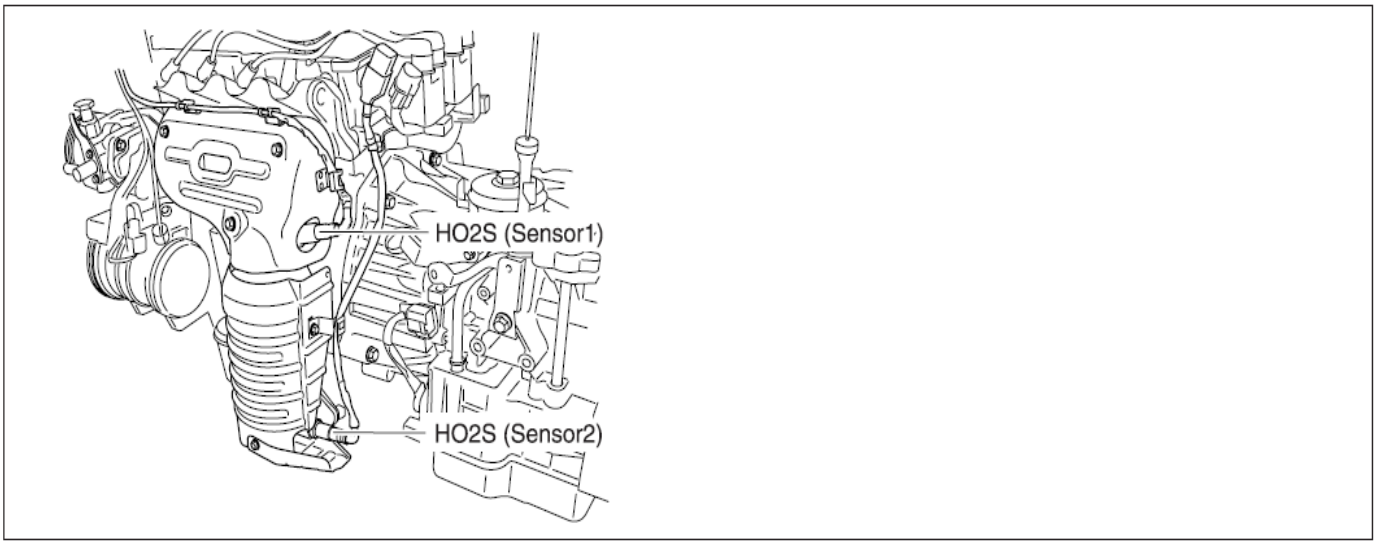
Yes	No	Repair short to power in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0130	O2 Sensor Circuit (Bank 1 / Sensor 1)

COMPONENT LOCATION



DESCRIPTION

The heated oxygen sensor is mounted or the front side of Catalytic Converter (warm-up catalytic converter) or in the front exhaust pipe, which detects the oxygen concentration in the exhaust gas. The heated oxygen sensor (HO2S) produces a voltage that varies between 0V and 1V. When the air/fuel ratio is lean, the oxygen concentration in the exhaust gas increases and the front HO2S outputs a low voltage (approximately 0 ~ 0.1 V). When the air/fuel ratio is rich, the oxygen concentration in the exhaust gas decreases and the front HO2S output a high voltage (approximately 0.8 ~ 1 V). The ECM constantly monitors the HO2S and increases or decreases the fuel injection duration by using the HO2S signal, which is called closed-loop fuel control operation.

DTC DETECTING CONDITION

1. DTC Description

The ECM sets DTC P0130 if ECM detects HO2S (B1/S1) circuit malfunction.

2. Conditions for Setting the DTC

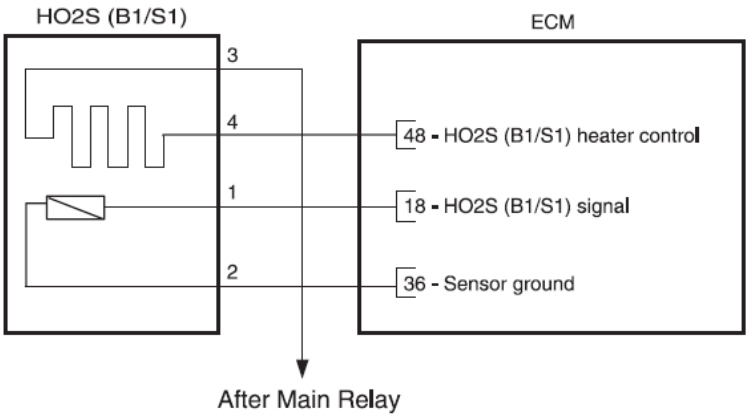
DTC	Detecting Condition	Possible Cause
P0130	Detecting Condition • DTC Strategy - Rationality check • Enable condition - Battery voltage > 10.7 V - Target lambda = 1.0 (600°C < exhaust gas temp. < 800°C) or target lambda > 0.8 (heating power dew point end detected downstream O2 sensor readiness) - Time after dew - point end > 10 s • Threshold Value - (heater coupling > 5 times) or (0.06 V < signal output upstream O2 sensor < 0.4V, signal output downstream O2 sensor > 0.5V) or (signal output downstream O2 sensor < 0.099V, 0.6V < signal output upstream O2 sensor < 1.5V)	• Short to battery or ground in HO2S circuit • HO2S (Bank 1 / Sensor 1) • ECM

SPECIFICATION

Temperature	Heater Resistance
0 ~ 1.0 V	9.0 Ω (20°C)

SCHEMATIC DIAGRAM

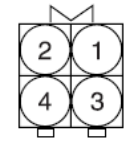
[CIRCUIT DIAGRAM]



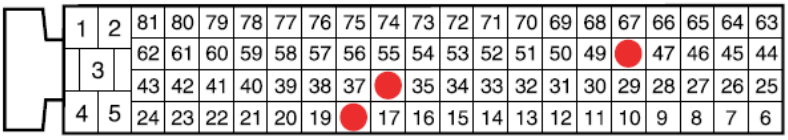
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM Terminal 18	HO2S (B1/S1) signal
2	ECM Terminal 36	Sensor ground
3	Main Relay	Battery Voltage
4	ECM Terminal 48	HO2S (B1/S1) heater control

[HARNESS CONNECTORS]

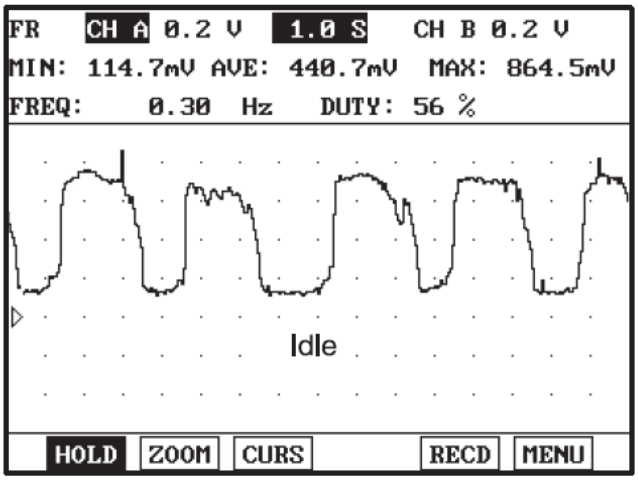


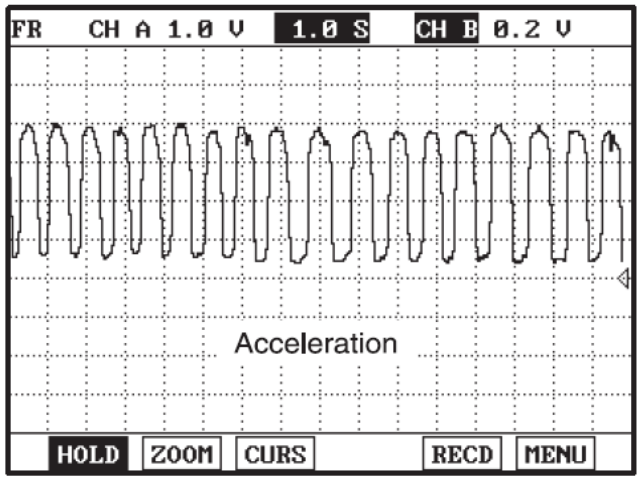
HO2S (B1/S1)



ECM

SIGNAL WAVEFORM





If you release the accelerator pedal suddenly after engine running about 4000 rpm, fuel supply will stop for short period and the O2 sensor service data in the Hi-Scan (Pro) will disply values 200mV or lower.
When you suddenly press on the accelerator pedal down, the voltage will reach 0.6 ~ 1.0 V.
When you let the engine idle again, the voltage will fluctuate between 200 mV or lower and 0.6 ~ 1.0 V in this case, the O2 snesor can be determined as good.

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and warm up the vehicle, and then monitor that HO2S (B1/S1) signal value is fluctuating from lean to rich condition or conversely.

Is current data displayed correctly?

No

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

2. CHECK HO2S (B1/S1) AND ECM CONNECTORS

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

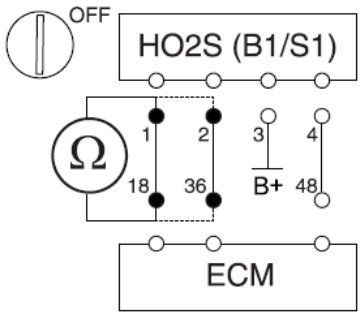
Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 1 of the HO2S (B1/S1) harness connector and 18 of the ECM harness connector.
3. Measure resistance between terminal 2 of the HO2S (B1/S1) harness connector and 36 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**



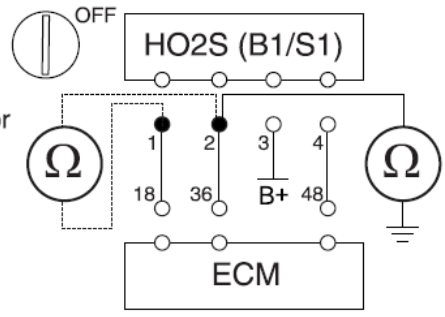
Does each resistance indicate continuity?

Yes

No	Repair open in harness.

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 2 of the HO2S harness connector and chassis ground.
3. Measure resistance between terminal 1 and 2 of the HO2S harness connector.
   - **Specification (Resistance): infinite**



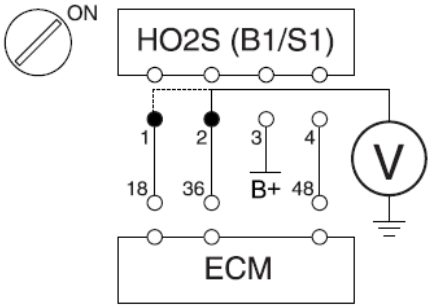
Is resistance displayed correctly?

Yes

No	Repair short or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 2 of the HO2S harness connector and chassis ground.
4. Measure voltage between terminal 1 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**



Is voltage within specification?

Yes

No	Repair short to power in harness.

6. CHECK HO2S

1. Turn ignition switch to OFF position and then disconnect HO2S connector.
2. Remove the HO2S.
3. Visually check HO2S (B1/S1) is contaminated or damaged.

Is HO2S O.K?

Yes

No	Replace HO2S (B1/S1).

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

TROUBLESHOOTING FOR DTC

DTC	P0131	O2 Sensor Circuit Low Input (Bank 1 / Sensor 1)

DESCRIPTION

Refer to DTC P0130

DTC DETECTING CONDITION

1. DTC Description

The ECM sets DTC P0131 if ECM detects open or short to ground in HO2S circuit.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0131	Detecting Condition • DTC Strategy - Signal check, Low • Enable condition - Battery voltage > 10.7 V - Target lambda = 1.0 (600°C < exhaust gas temp. < 800°C) or target lambda > 0.8 (heating power dew point end detected downstream O2 sensor readiness) - Engine coolant temperature < 40°C - Engine coolant temperature after 1 driving cycle > 60°C - Time after dew - point end > 0.1 s • Threshold Value - Signal output upstream O2 sensor < 0.04V	• Short to ground or open in HO2S circuit • Front HO2S • ECM

SPECIFICATION

Refer to DTC P0130

SCHEMATIC DIAGRAM

Refer to DTC P0130

SIGNAL WAVEFORM

Refer to DTC P0130

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and warm up the vehicle until the cooling operates.

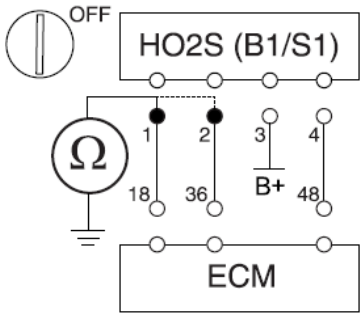
Does scan tool display DTC P0131?

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

2. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 1 of the HO2S harness connector and chassis ground.
3. Measure resistance between terminal 2 of the HO2S harness connector and chassis ground.
   - **Specification (Resistance): infinite**

Is each resistance within specification?



Yes	
No	Repair short to chassis ground in harness.

3. VISUALLY CHECK HO2S

1. Remove HO2S.
2. Thoroughly check HO2S for contamination, deterioration or damage.

Is HO2S contaminated, deteriorated or damaged?

No	
Yes	Clean or replace HO2S.

4. CHECK HO2S

1. Install a well-known good HO2S.
2. Connect a Hi-Scan (Pro) to the data link connector.
3. Start engine and warm up the vehicle until the cooling operates.

Does scan tool display DTC P0131?

Yes	
No	Replace HO2S.

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

TROUBLESHOOTING FOR DTC

DTC	P0132	O2 Sensor Circuit High Input (Bank 1 / Sensor 1)

DESCRIPTION

Refer to DTC P0130

DTC DETECTING CONDITION

1. DTC Description

The ECM sets DTC P0132 if ECM detects signal voltage is higher than threshold.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0132	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - Battery voltage > 10.7 V - Target lambda = 1.0 (600°C < exhaust gas temp. < 800°C) or target lambda > 0.8 (heating power dew point end detected downstream O2 sensor readiness) - Time elapse > 80 s • Threshold Value - Signal output upstream O2 sensor > 1.5 V	• Short to battery in HO2S circuit • Front HO2S • ECM

SPECIFICATION

Refer to DTC P0130

SCHEMATIC DIAGRAM

Refer to DTC P0130

SIGNAL WAVEFORM

Refer to DTC P0130

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

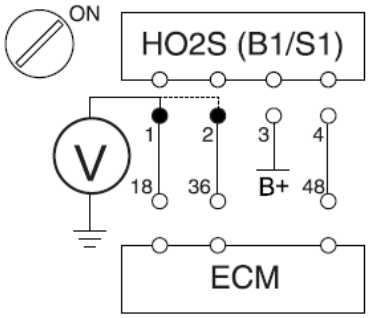
1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and warm up the vehicle until the cooling operates.

Does scan tool display DTC P0132?

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

2. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 1 of the HO2S harness connector and chassis ground.
4. Measure voltage between terminal 2 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**



Is each resistance within specification?

Yes	No	Repair short to battery in harness.

3. VISUALLY CHECK HO2S

1. Remove HO2S.
2. Thoroughly check HO2S for contamination, deterioration or damage.

Is HO2S contaminated, deteriorated or damaged?

No	Yes	Clean or replace HO2S.

4. CHECK HO2S

1. Install a well-known good HO2S.
2. Connect a Hi-Scan (Pro) to the data link connector.
3. Start engine and warm up the vehicle until the cooling operates.

Does scan tool display DTC P0132?

Yes	No	Replace HO2S.

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

TROUBLESHOOTING FOR DTC

DTC	P0133	O2 Sensor Circuit Slow Response (Bank 1 / Sensor 1)

DESCRIPTION

Refer to DTC P0130

DTC DETECTING CONDITION

1. DTC Description

The ECM monitors front oxygen sensor amplitude level and compares it to predetermined minimum amplitude value which could increase emission or disturb lambda control by the effectof ageing on the oxygen sensor. The ECM sets DTC P0133 when the signal of oxygen sensor is out of threshold. If same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0133	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - 1420 rpm < Engine speed < 3000 rpm - 20% < Engine load < 50% - Exhaust temperature > 450C - Lambda control active • Threshold Value - Signal check, High : Average of 20 period > 2.9 s - Signal check, Low : Average of 20 period < 0 s	• Exhaust system • Front HO2S

SCHEMATIC DIAGRAM

Refer to DTC P0130

SIGNAL WAVEFORM

Refer to DTC P0130

INSPECTION PROCEDURE

1. CHECK OTHER DTCS

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

Are any other DTCs also set?

No

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

2. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Erase the DTC(s).
3. Start engine and wait for cooling fan comes on.
4. Drive the vehicle under following condition.
   - Steady speed of 30 mph through 50 mph (48 kph trough 80 kph)
   - D-range in A/T vehicle (5th gear in M/T vehicle)
   - Drive until O2 monitor readiness code is set to complete or temporary DTC P0133 comes on.

Is DTC P0133 indicated?

Yes

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

3. CHECK EXHAUST SYSTEM FOR LEAKAGE

1. Visually check exhaust system for leakage (especially between TWC converter and head) and HO2S installation status.

Is all system ok?

Yes

No	Repair the abnormal system.

4. VISUALLY CHECK HO2S

1. Remove HO2S.
2. Thoroughly check HO2S for contamination, deterioration or damage.

Is HO2S contaminated, deteriorated or damaged?

No

Yes	Clean or replace HO2S.

5. CHECK HO2S

1. Install a well-known good HO2S.
2. Connect a Hi-Scan (Pro) to the data link connector.
3. Erase the DTC(s).
4. Start engine and wait for cooling fan comes on.
5. Drive the vehicle under following condition.
   - Steady speed of 30 mph through 50 mph (48 kph trough 80 kph)
   - D-range in A/T vehicle (5th gear in M/T vehicle)
   - Drive until O2 monitor readiness code is set to complete or temporary DTC P0133 comes on.

Does scan tool display DTC P0133?

Yes

No	Replace HO2S.

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

TROUBLESHOOTING FOR DTC

DTC	P0134	O2 Sensor Circuit No Activity Detected (Bank 1 / Sensor 1)

DESCRIPTION

Refer to DTC P0130

DTC DETECTING CONDITION

DTC	Detecting Condition	Possible Cause
P0134	Detecting Condition • DTC Strategy - Rationality check • Enable condition - Battery voltage > 10.7 V - Target lambda = 1.0 (600°C < exhaust gas temp. < 800°C) or target lambda > 0.8 (heating power dew point end detected downstream O2 sensor readiness) - Time elapse after fuel cut-off > 3 s • Threshold Value - (Signal output upstream O2 sensor > 0.2V, Signal output downstream O2 sensor > 0.2V) or (0.4V < Signal output upstream O2 sensor < 0.6V) or (internal resistance > 20,000 Ω, exhaust gas temp. > 600C)	• Injector • Front HO2S • Vacuum leakage • Open or short in front HO2S circuit • Improper fuel pressure • ECM

SCHEMATIC DIAGRAM

Refer to DTC P0130

SIGNAL WAVEFORM

Refer to DTC P0130

INSPECTION PROCEDURE

1. CHECK OTHER DTC

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

Are any other DTCs also set?

No

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

2. CHECK HO2S AND ECM CONNECTORS

1. Thoroughly check connectors for loose, poor connection, bent, corrosion, contamination, deterioration, or damage.

Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK INTAKE SYSTEM FOR VACUUM LEAKGE

1. Check intake system for vacuum leakage.

Is any leakage present?

Yes

No	Repair it.

4. CHECK HO2S SIGNAL WAVEFORM

1. Warm up engine to normal operating temperature.
2. Using Hi-Scan (Pro), monitor HO2S signal waveform.

• Refer to " Signal waveform" for more information.

Does the HO2S signal switch from lean to rich or from rich to lean?

Yes

No	Replace HO2S.

5. CHECK INJECTOR

1. Check the injector for the following items:

• Injector error
• Open or short in injector circuit

• Refer to "DTC P0261~P0271 (Injector Circuit High/Low)" for a detailed inspection procedure.

Is the injector okay?

Yes

No	Replace it.

6. CHECK FUEL LINE PRESSURE

1. Reduce the fuel pressure to install the fuel pressure gauge.
2. After installing tightly the fuel pressure gauge to fuel delivery pipe, start the engine and let it idle.
3. Check fuel line pressure.

• Refer to " Fuel Pressure Test " of Fuel System for more information.

Is fuel line pressure normal?

No

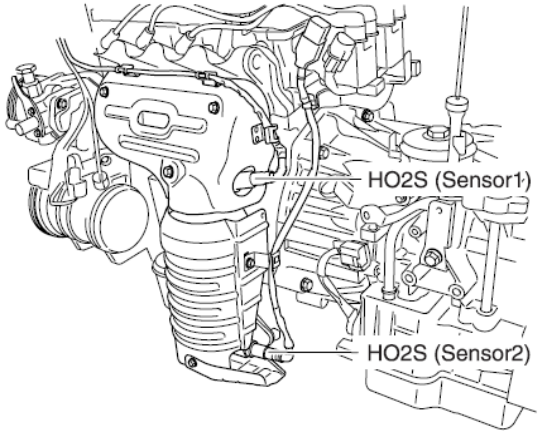
Yes	Repair it.

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

TROUBLESHOOTING FOR DTC

DTC	P0136	O2 Sensor Circuit Malfunction (Bank 1 / Sensor 2)

COMPONENT LOCATION



DESCRIPTION

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 detects the catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC DETECTING CONDITION

1. DTC Description

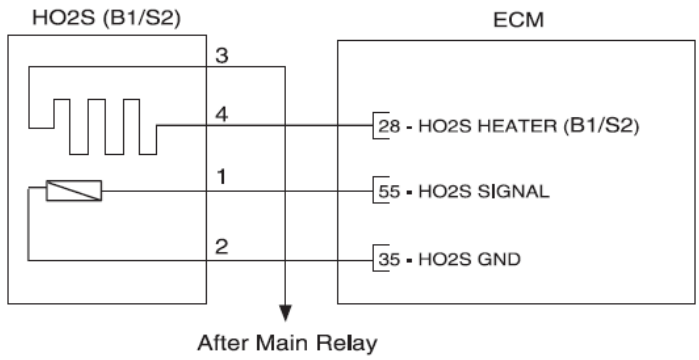
ECM sets DTC P0136 if the ECM detects that the rear HO2S signal is short to battery.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0136	Detecting Condition • DTC Strategy - Rationality check • Enable condition - Battery voltage > 10.7V - Target lambda = 1.0 - 370C < catalyst temp. < 900C - Enough heated - Time after dew - point end > 10 s • Threshold Value - Heater coupling > 5 times	• Short to battery in HO2S circuit • Rear HO2S • ECM

SCHEMATIC DIAGRAM

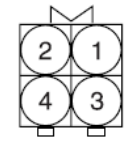
[CIRCUIT DIAGRAM]



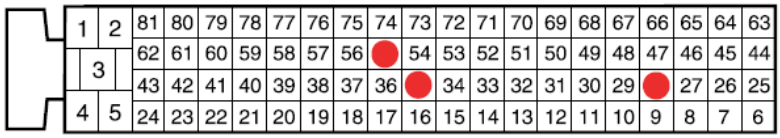
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM Terminal 55	HO2S Signal
2	ECM Terminal 35	Ground
3	Main Relay	Battery Voltage
4	ECM Terminal 28	HO2S Heater (B1/S2)

[HARNESS CONNECTORS]

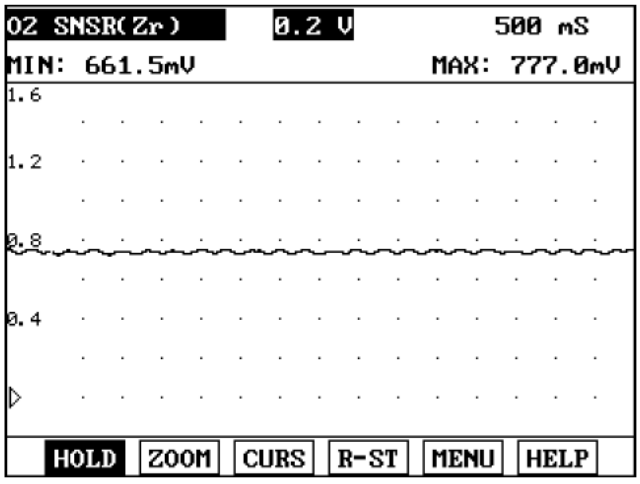


HO2S (B1/S2)



ECM

SIGNAL WAVEFORM



The amplitude of the signal output of the rear HO2S is small compared to the front HO2S because the rear HO2S detects emission gas purified by the catalytic converter.
This illustration is the normal signal waveform of the rear HO2S at idle.

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and hold the engine at 3000 rpm with no load (in P or N) until the cooling fan comes on.

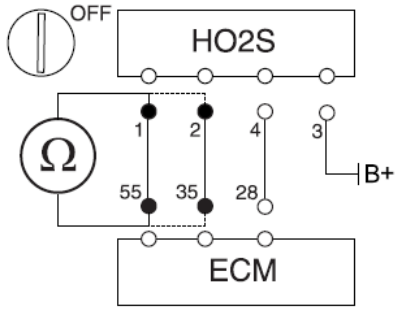
Does scan tool display DTC P0136?

Yes

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

2. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 1 of the HO2S harness connector and terminal 55 of the ECM harness connector.
3. Measure resistance between terminal 2 of the HO2S harness connector and terminal 35 of the ECM harness connector.
   - **Specification (HO2S resistance): below 1Ω**



Does each resistance indicate continuity?

Yes

No	Repair open in harness.

3. VISUALLY CHECK HO2S

1. Remove HO2S.
2. Throughly check HO2S for contamination, deterioration or damage.

Is HO2S contaminated, deteriorated or damaged?

No

Yes	Replace HO2S.

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

TROUBLESHOOTING FOR DTC

DTC	P0137	O2 Sensor Circuit Low Input (Bank 1 / Sensor 2)

DESCRIPTION

Refer to DTC P0136

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0137 if the ECM detects signal voltage lower than the possible range of a properly operating rear heated oxygen sensor (HO2S).

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0137	Detecting Condition • DTC Strategy - Signal check, Low • Enable condition - Battery voltage > 10.7V - Target lambda = 1.0 - 370°C < catalyst temp. < 900°C - Enough heated - Time elapse > 25 s • Threshold Value - Signal output downstream O2 sensor < 0.04V	• Short to ground in HO2S circuit • Rear HO2S • ECM

SPECIFICATION

Refer to DTC P0136

SCHEMATIC DIAGRAM

Refer to DTC P0136

SIGNAL WAVEFORM

Refer to DTC P0136

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and wait 1 minute.

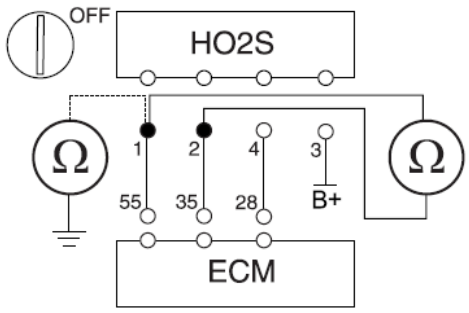
Does scan tool display DTC P0137?

Yes

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

2. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connector.
2. Measure resistance between terminal 1 and 2 of the HO2S harness connector.
3. Measure resistance between terminal 1 of the HO2S harness connector and chassis ground.
   - **Specification (Resistance): infinite**



Is the resistance displayed correctly?

Yes

No	Repair open in harness.

3. VISUALLY CHECK HO2S

1. Remove HO2S.
2. Throughly check HO2S for contamination, deterioration or damage.

Is HO2S contaminated, deteriorated or damaged?

No

Yes	Replace HO2S.

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

TROUBLESHOOTING FOR DTC

DTC	P0138	O2 Sensor Circuit High Input (Bank 1 / Sensor 2)

DESCRIPTION

Refer to DTC P0136

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0138 if the ECM detects signal voltage higher than the possible range of a properly operating rear heated oxygen sensor (HO2S).

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0138	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - Battery voltage > 10.7V - Target lambda = 1.0 - 370°C < catalyst temp. < 900°C - Enough heated - Time elapse > 80 s • Threshold Value - Signal output downstream O2 sensor > 1.5V	• Short to battery in HO2S circuit • Rear HO2S • ECM

SPECIFICATION

Refer to DTC P0136

SCHEMATIC DIAGRAM

Refer to DTC P0136

SIGNAL WAVEFORM

Refer to DTC P0136

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

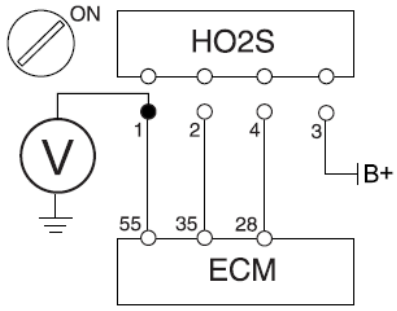
1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start engine and wait 1 minute.

Does scan tool display DTC P0138?

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

2. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect HO2S and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 1 of the HO2S harness connector and chassis ground.
   - **Specification (Voltage): below 0.45V**



Is voltage within specification?

Yes	
No	Repair short to power in harness.

3. VISUALLY CHECK HO2S

1. Remove HO2S.
2. Throughly check HO2S for contamination, deterioration or damage.

Is HO2S contaminated, deteriorated or damaged?

No	
Yes	Replace HO2S.

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

TROUBLESHOOTING FOR DTC

DTC	P0140	O2 Sensor Circuit No Activity Detected (Bank 1 / Sensor 2)

DESCRIPTION

Refer to DTC P0136

DTC DETECTING CONDITION

1. DTC Description

If there is no signal or activity, the ECM judges this as a fault and DTC is set.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0140	Detecting Condition • DTC Strategy - Signal interruption • Enable condition - Battery voltage > 10.7V - Target lambda = 1.0 - 370°C < catalyst temp. < 900°C - Enough heated - Time elapse > 80 s • Threshold Value - 0.4V < Signal output downstream O2 sensor < 0.519V or internal resistance > 40,000 Ω (catalyst temp. > 600°C)	• Leakage • Injector • Rear HO2S • ECM

SCHEMATIC DIAGRAM

Refer to DTC P0136

SIGNAL WAVEFORM

Refer to DTC P0136

INSPECTION PROCEDURE

1. CHECK OTHER DTCS

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

Are any other DTCs also set?

No

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

2. CHECK HO2S AND ECM CONNECTORS

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

Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK INJECTOR

1. Check the injector for the following items :
   - Injector damage
   - Injector leakage

   - **Refer to "INJECTOR INSPECTION" in FUEL DELIVERY SYSTEM.**

Is the injector okay?

Yes

No	Replace it.

4. CHECK FUEL LINE PRESSURE

1. Release the fuel pressure to install the fuel pressure gauge.
2. After tightly installing the fuel pressure gauge to the fuel delivery pipe, start the engine and let it idle.
3. Check fuel line pressure.
   - **Refer to "FUEL PRESSURE TEST" in FUEL DELIVERY SYSTEM.**

Is fuel line pressure normal?

Yes

No	Repair it.

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

TROUBLESHOOTING FOR DTC

DTC	P0230	Fuel Pump Circuit Malfunction

DESCRIPTION

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 DETECTING CONDITION

1. DTC Description

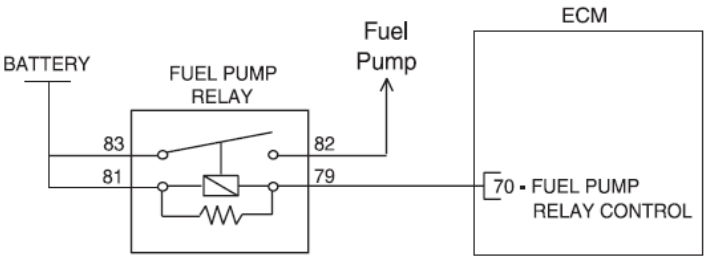
ECM sets DTC P0230 if the ECM detects that fuel pump relay control circuit is open or short to ground or battery.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0230	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - Engine speed > 40 rpm - 6.34V < Battery voltage < 15.49V - Counter test pulse trigger > 0 • Threshold Value - Signal check to Battery - Signal check to Ground - Wire disconnection	• Open or short in fuel pump relay circuit • Fuel pump relay • ECM

SCHEMATIC DIAGRAM

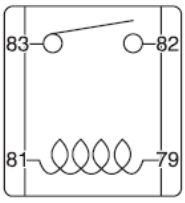
[CIRCUIT DIAGRAM]



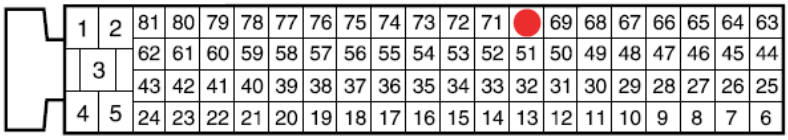
[CONNECTION INFORMATION]

Terminal	Connected to	Function
81	Battery	Battery Voltage
83	Battery	Battery Voltage
79	ECM terminal 70	Fuel Pump Relay Control
82	-	Supply B+

[HARNESS CONNECTORS]



Fuel Pump Relay



ECM

INSPECTION PROCEDURE

1. CHECK FUEL PUMP RELAY AND ECM CONNECTORS

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

Are all connectors good?

Yes	No	Repair or replace it.

2. CHECK FUEL PUMP RELAY

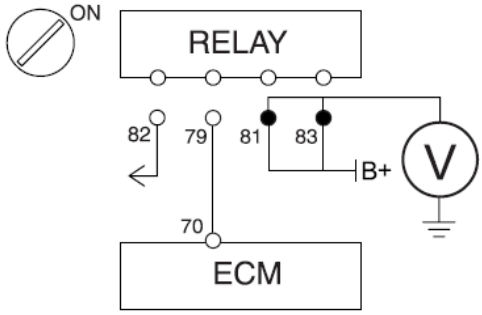
1. Remove the fuel pump relay.
2. Apply power to the fuel pump relay terminal 81 and ground terminal 79.
3. Check if the fuel pump relay works well when it is energized.
   (If the fuel pump relay works normally, a clicking sound can be heard.)

Does the fuel pump relay operate normally?

Yes	No	Replace fuel pump relay.

3. CHECK POWER TO FUEL PUMP RELAY

1. Remove the fuel pump relay.
2. Turn ignition switch to ON position.
3. Measure the voltage between terminal 81 of the fuel pump relay harness connector and chassis ground.
4. Measure the voltage between terminal 83 of the fuel pump relay harness connector and chassis ground.
   - **Specification : approximately B+**

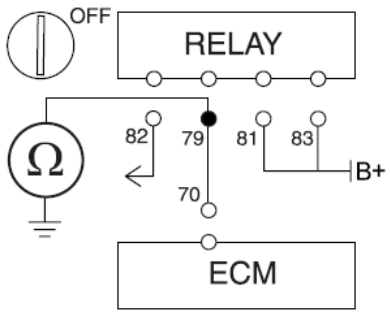


Is voltage within specification?

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

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect fuel pump relay and ECM connectors.
2. Measure resistance between terminal 79 of the fuel pump relay harness connector and chassis ground.
   - **Specification (Resistance): infinite**

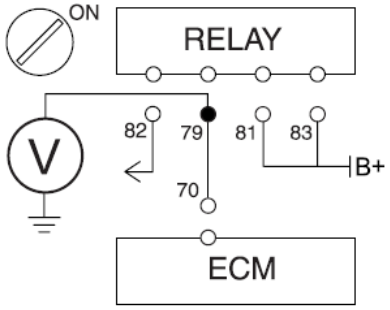


Is the resistance displayed correctly?

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

5. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect fuel pump relay and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 79 of the fuel pump relay harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**

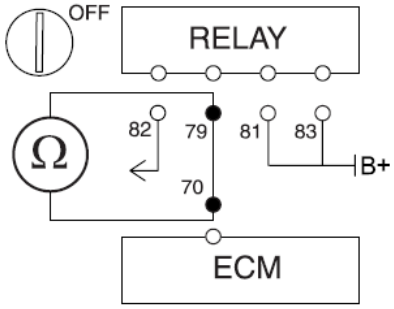


Is voltage within specification?

Yes	No	Repair short to power in harness.

6. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect fuel pump relay and ECM connectors.
2. Measure resistance between terminal 79 of the injector harness connector and terminal 70 of ECM harness connector.
   - **Specification (Resistance): below 1Ω**



Does resistance indicate continuity?

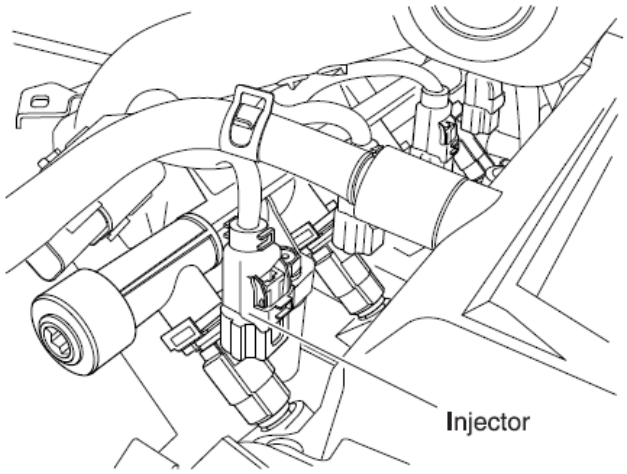
Yes	No	Repair open in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0261	Cylinder 1 - Injector Circuit Low
	P0264	Cylinder 2 - Injector Circuit Low
	P0267	Cylinder 3 - Injector Circuit Low
	P0270	Cylinder 4 - Injector Circuit Low

COMPONENT LOCATION



DESCRIPTION

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 control circuit, the fuel injector is closed and circuit voltage should be peak for a moment.

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0261, P0264, P0267 or P0270 respectively if the ECM detects that injector (Cylinder #1, 2, 3 or 4) control circuit is open or short to ground.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0261 P0264 P0267 P0270	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption - Rationality check • Threshold Value - Signal check to Ground - Wire disconnection	• Short to ground or open in injector circuit • Injector • ECM

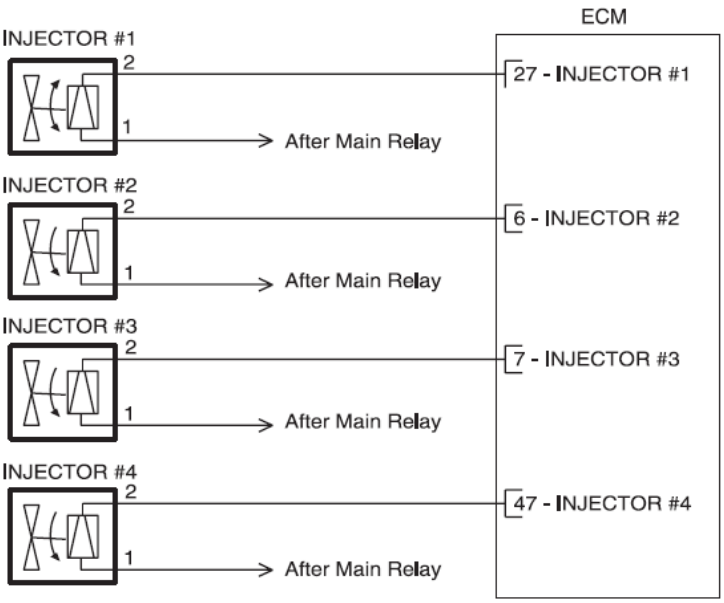
SPECIFICATION

INJECTOR

Temperature	Injector Resistance
20°C	13.8 ~ 15.2 Ω

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

INJECTOR #1

Terminal	Connected to	Function
1	Main relay	Battery Voltage
2	ECM terminal 27	Injector operation

INJECTOR #2

Terminal	Connected to	Function
1	Main relay	Battery Voltage
2	ECM terminal 6	Injector operation

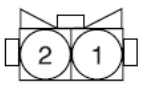
INJECTOR #3

Terminal	Connected to	Function
1	Main relay	Battery Voltage
2	ECM terminal 7	Injector operation

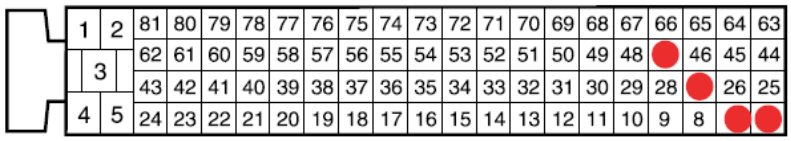
INJECTOR #4

Terminal	Connected to	Function
1	Main relay	Battery Voltage
2	ECM terminal 47	Injector operation

[HARNESS CONNECTORS]

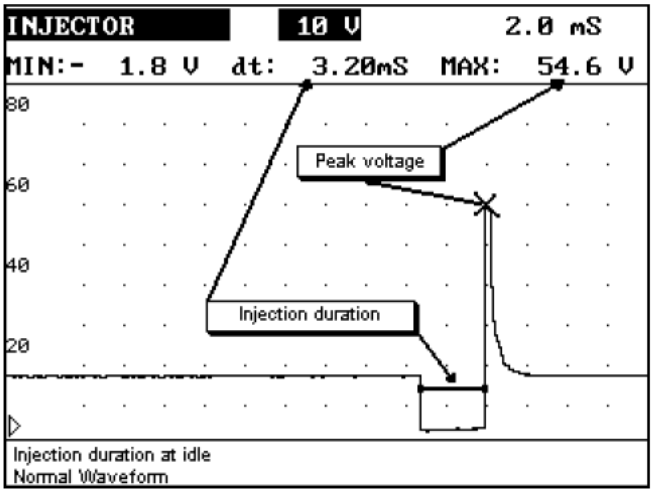


INJECTOR



ECM

SIGNAL WAVEFROM



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 be peak for a moment.

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-scan (Pro) to the data link connector.
2. Start the engine.
3. Using the Hi-Scan (Pro), monitor the signal waveform of the injector.

Is the signal waveform normal?

No

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

2. CHECK INJECTOR AND ECM CONNECTORS

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

Are all connectors good?

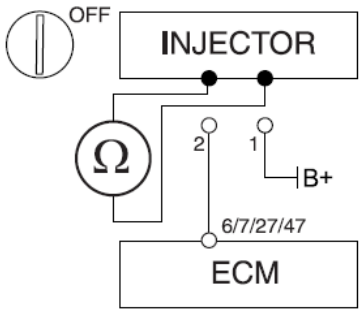
Yes

No	Repair or replace it.

3. CHECK INJECTOR RESISTANCE

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

Temperature	Resistance
20°C	13.8 ~ 15.2 Ω



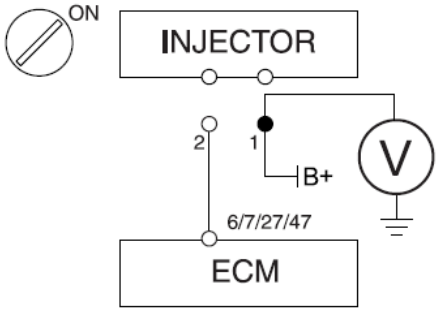
Is resistance within specification?

Yes

No	Replace Injector.

4. CHECK POWER TO INJECTOR

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

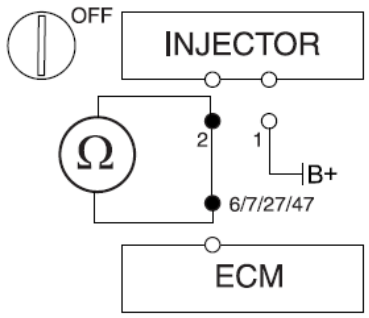


Is voltage within specification?

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

5. CHECK FOR OPEN IN HARNESS

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



Is the resistance displayed correctly?

Yes	No	Repair open in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0262	Cylinder 1 - Injector Circuit High
	P0265	Cylinder 2 - Injector Circuit High
	P0268	Cylinder 3 - Injector Circuit High
	P0271	Cylinder 4 - Injector Circuit High

DESCRIPTION

Refer to DTC P0261

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0262, P0265, P0268 or P0271 respectively if the ECM detects that injector (Cylinder #1, 2, 3 or 4) control line is short to battery.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0262 P0265 P0268 P0271	Detecting Condition • DTC Strategy - Signal check, High • Threshold Value - Short circuit to Battery	• Short to battery in injector circuit • Injector • ECM

SPECIFICATION

Refer to DTC P0261

SCHEMATIC DIAGRAM

Refer to DTC P0261

SIGNAL WAVEFORM

Refer to DTC P0261

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-scan (Pro) to the data link connector.
2. Start the engine.
3. Using the Hi-Scan (Pro), monitor the signal waveform of the injector.

Is the signal waveform normal?

No

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

2. CHECK INJECTOR AND ECM CONNECTORS

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

Are all connectors good?

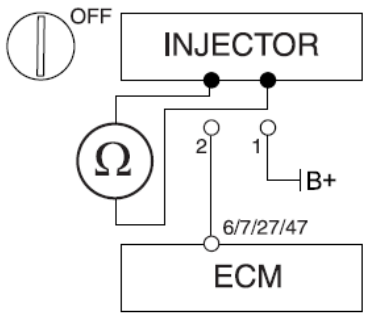
Yes

No	Repair or replace it.

3. CHECK INJECTOR RESISTANCE

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

Temperature	Resistance
20°C	13.8 ~ 15.2 Ω



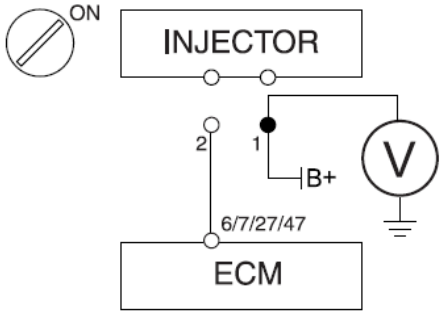
Is resistance within specification?

Yes

No	Replace Injector.

4. CHECK POWER TO INJECTOR

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



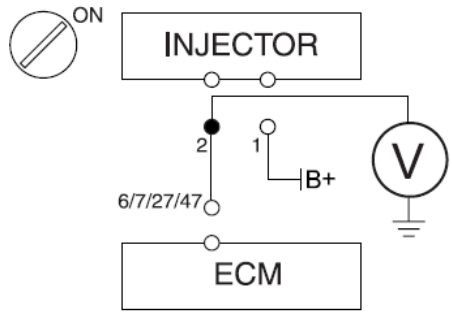
Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

5. CHECK FOR SHORT TO POWER IN HARNESS

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



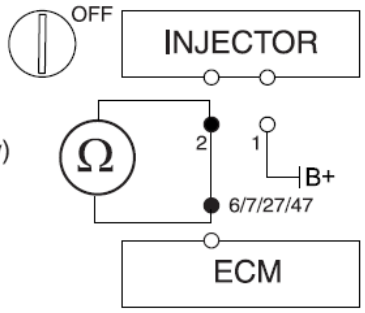
Is voltage within specification?

Yes

No	Repair short to power in harness.

6. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect injector and ECM connectors.
2. Measure resistance between terminal 2 of the injector harness connector and terminal 6, 7, 27 or 47 (for cylinder #1, 2, 3 or 4 respectively) of ECM harness connector.
   - **Specification (Resistance): below 1Ω**



Does resistance indicate continuity?

Yes

No	Repair open in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0300	Multiple Cylinder Misfire Detected
	P0301	Cylinder 1 - Misfire Detected
	P0302	Cylinder 2 - Misfire Detected
	P0303	Cylinder 3 - Misfire Detected
	P0304	Cylinder 4 - Misfire Detected

DESCRIPTION

Misfires can be caused by lack of combustion in a cylinder due to absence of spark, poor fuel metering, poor compression, or many other causes. Even a small number of misfires may result in excessive exhaust emissions due to the unburned mixture. Increased misfire rates cause damage to the catalytic converter. The ECM monitors the crankshaft speed variation to determine if any misfiring generated. The ECM identifies the specific cylinder in which the misfire has occurred and counts individual misfire events by monitoring changes in the crankshaft rotation for each cylinder. A random misfire indicates two or more cylinders are misfiring.

DTC DETECTING CONDITION

1. DTC Description

The ECM must monitor the engine for misfiring possibly caused by ignition coil defects or injector fails. If misfiring is detected, the ECM identify the cylinder(s) that has (have) misfired and calculate misfiring rate for a given duration. The DTC for Misfire (P0301 to 0304) is set as soon as misfiring rate exceed the limit which result in damage to the catalyst or increase emissions. The ECM stores individual DTC for the cylinder which has more than 4% of total misfire rate. With more than two cylinders misfire detection, the ECM sets P0300.
If the misfire rate is not extremely high, the MIL will be illuminated in the next driving cycle that diagnostic runs and fails. With extremely high misfire rate which has a danger of burning up the catalyst, the MIL blinks immediately.

2. Conditions for Setting the DTC

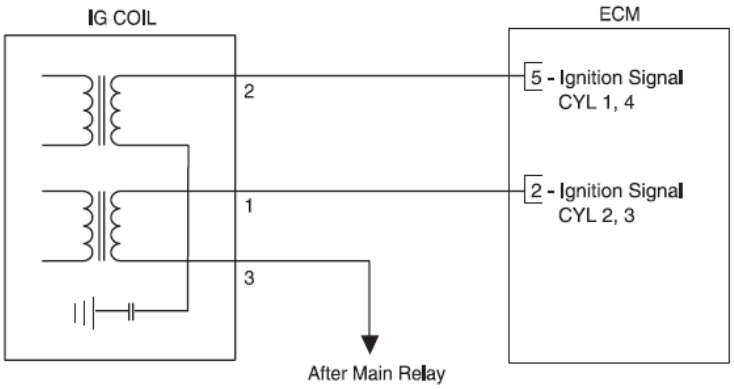
DTC	Detecting Condition	Possible Cause
P0300 P0301 P0302 P0303 P0304	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - Engine speed < 4500 rpm - Engine load > zero torq. - Engine load change < (60 ~ 380 % / seg - Engine speed change < (2800 ~ 5200 rpm/s) - Wheel acceleration < 0.2 g - Time after engine start > 4.5 s - Intake air temperature > -7C • Threshold Value - Misfire rate > catalyst damage misfire rate - Misfire rate > 4%	• Open or short in engine wire • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Compression pressure • Valve clearance and timing • PCV hose • PCV hose connection • CKPS • ECM

SPECIFICATION

Ignition Coil Resistance	
Primary Coil	**Secondary Coil**
0.87 ± 10% Ω	13.0 ± 15% kΩ

SCHEMATIC DIAGRAM

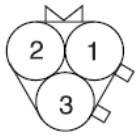
[CIRCUIT DIAGRAM]



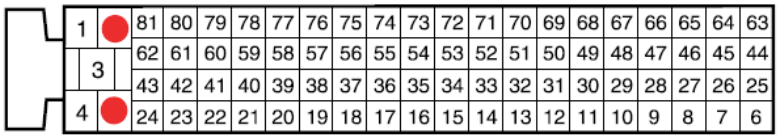
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM terminal 2	IG Coil control (1,4)
2	ECM terminal 5	IG Coil control (2,3)
3	Main Relay	Battery voltage

[HARNESS CONNECTORS]



IGNITION COIL



ECM

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO INJECTOR/CKPS/MAPS/TPS

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

Is any DTC relating to injectors, CKPS, MAPS or TPS set?

No

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

2. CHECK INTAKE SYSTEM FOR VACUUM LEAK AND PCV VALVE

1. Check intake system for any split, disconnected, worn, or perforated vacuum hoses.
2. Check Positive Crankcase Ventilation (PCV) valve for proper operation and for leak.

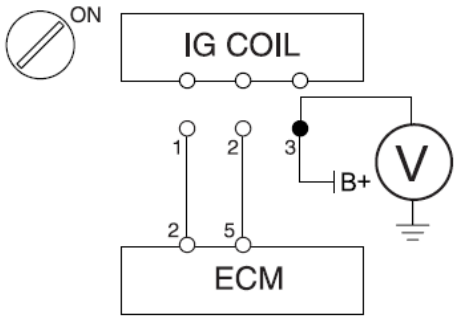
Are vacuum hoses and PCV valve okay?

Yes

No	Replace faulty vacuum hoses or PCV valve.

3. CHECK POWER TO IGNITION COIL

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



Is resistance within specification?

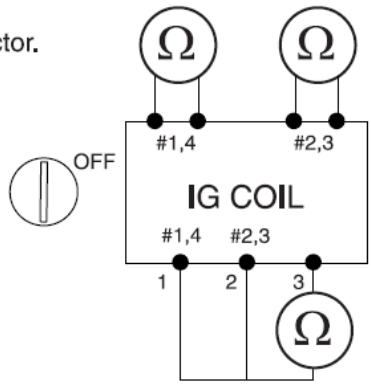
Yes

No	Repair open or short to chassis ground in harness.

4. CHECK IGNITION COILS AND SPARK PLUG WIRES

1. Turn ignition switch to OFF position and disconnect the ignition coil connector.
2. Measure resistance of the primary coils and the secondary iginition coils.
   - **Specification (Resistance):**

Temperature (°C)	Ignition Coil	
	Primary Coil	Secondary Coil
20°C	0.8 ± 10% Ω	13.0 ± 15% kΩ



3. Disconnect plug wires and check spark plug wires for cracks, corroded terminal, or carbon tracking.

Are ignition coils and spark plug wires okay?

Yes	No	Repair or replace it.

5. CHECK SPARK PLUG FOR PROPER OPERATION

1. Remove the spark plug.
2. Visually check the spark plug for carbon tracking, foreign materials (oil or fuel), damage, or cracking.
3. Measure the spark plug gap and check the spark plug for proper operation.
   - **Specification (Air Gap): 1.0~1.1 mm (0.039~0.043 in)**

Is spark plug okay?

Yes	No	Repair or replace it.

6. CHECK CKPS, TONE-WHEEL AND AIR GAP

1. Turn ignition switch to OFF position.
2. Disconnect the CKPS connector.
3. Visually check the tone-wheel for damaged teeth, foreign materials and improper installation and measure the air gap between the CKPS and the rotor.
   - **Specification (Air Gap): 0.3~1.7 mm (0.012~0.067 in)**

Are CKPS and tone-wheel okay?

Yes	No	Repair or replace it.

7. CHECK COMPRESSION

1. Do a compression test (no more than 10% between highest and lowest cylinder).
   - **Refer to "EM" group.**

Is compression okay?

Yes	No	Repair or replace it.

8. CHECK FUEL LINE PRESSURE

1. Reconnect the ignition coils and spark plug connectors.
2. Release the fuel pressure and attach the fuel pressure gage to the delivery pipe.
   - **To release the fuel presure, refer to "FUEL DELIVERY SYSTEM" section.**
3. Start the engine and warm it up to normal operating temperature.
4. Check fuel line pressure at idle.
   - **Specification (Fuel Pressure): 350 kpa (3.5 kg/cm², 49.8 psi)**

Is fuel line pressure within specification?

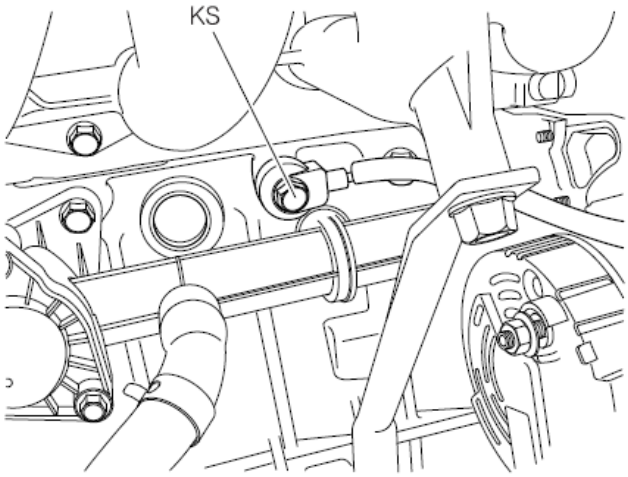
Yes	No	Check fuel delivery system. (Refer to "FUEL DELIVERY SYSTEM" section)

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

TROUBLESHOOTING FOR DTC

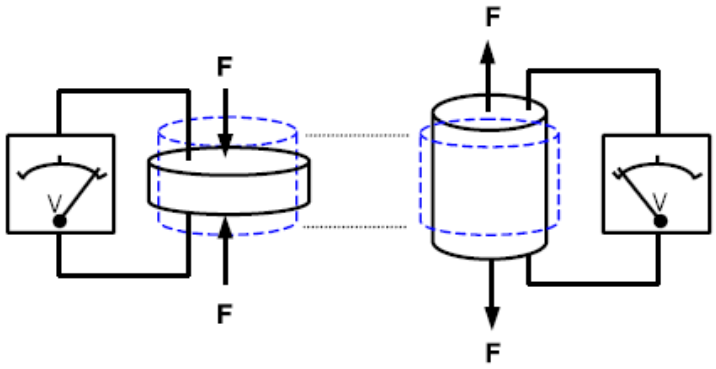
DTC	P0325	Knock Sensor 1 Circuit Malfunction

COMPONENT LOCATION



DESCRIPTION

Knocking is a phenomenon characterized by undesirable vibration and noise and can cause engine damage. The knock sensor (KS) is attached to the cylinder block and senses engine knocking. A knocking vibration from the cylinder block is applied as pressure to the piezoelectric element. The knock sensor (KS) detects vibration upon increase and decrease in engine RPM and generates a voltage based on this vibration. The ECM controls the ignition timing based on the amplitude and frequency of the knock sensor signal. For example, if engine knocking occurs, the ignition timing is retarded to suppress it. This DTC is set when the frequency goes outside a calibrated level.



DTC DETECTING CONDITION

1. DTC Description

The ECM monitors the range of the analog input signal from knock sensor to check sensor failure that is short circuit or open circuit. In case the normalized reference level of knock control is out of the threshold value, the DTC P0325 is set. If same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0325	Detecting Condition • DTC Strategy - Signal check - Signal interruption - Rationality check • Enable condition - Signal check : Engine speed > 2600 rpm, No dynamic condition, Knock control active - Rationality check : function active, engine speed > 1200 rpm or ≤ 5200 rpm • Threshold Value - Signal check : the normalized reference level of knock control is out of the threshold valve - Rationality check : integrator gradient ≤ f(measuring window length) or integrated difference between integrator value at start of measuring window and 715 > 0.2344V, (integrator value at the end of measuring window - integrator value at start of measuring window) < 3.7V	• Knock sensor • Open or Short in knock sensor circuit • ECM

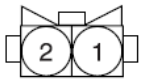
SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]

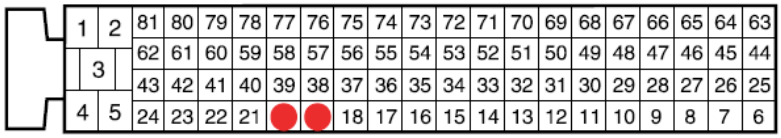
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM terminal 19	Knock Sensor signal
2	ECM terminal 20	Sensor Ground

[HARNESS CONNECTORS]

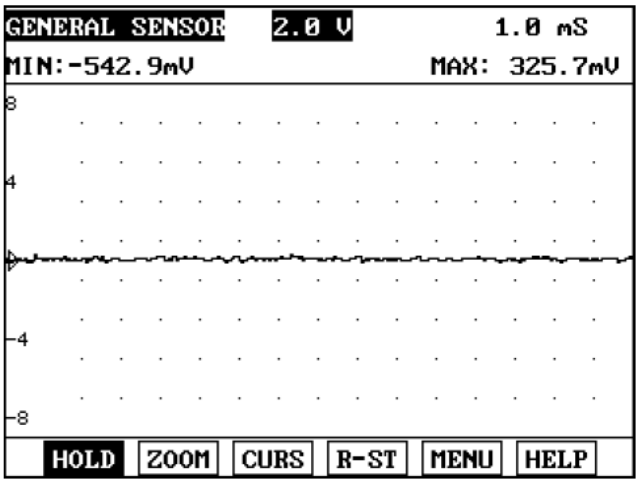


KNOCK SENSOR



ECM

SIGNAL WAVEFORM



The knock sensor is fitted to the cylinder block to successfully sense vibration when the engine operates.
The waveform shown is the knock sensor signal characteristic and indicates that no knocking has taken place.
The knocking signal generally appears as a noise that is higher than other signals.

INSPECTION PROCEDURE

1. CHECK KNOCK SENSOR AND ECM CONNECTORS

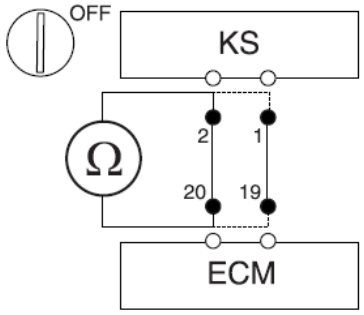
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect KS and ECM connector.
2. Measure resistance between terminal 2 of the KS harness connector and 20 of the ECM harness connector.
3. Measure resistance between terminal 1 of the KS harness connector and 19 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**

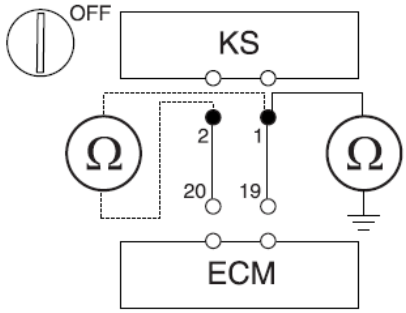


Does each resistance indicate continuity?

Yes	
No	Repair open in harness.

3. CHECK FOR SHORT TO GROUND IN HARNESS

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

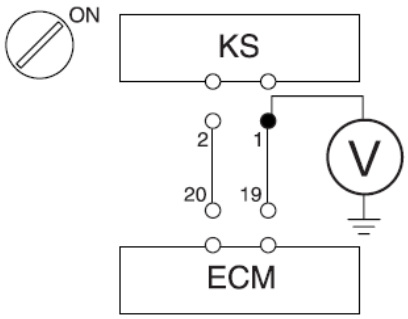


Is the resistance displayed correctly?

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

4. CHECK FOR SHORT TO POWER IN HARNESS

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



Is voltage within specification?

Yes	
No	Repair short to power in harness.

5. CHECK KNOCK SENSOR SIGNAL

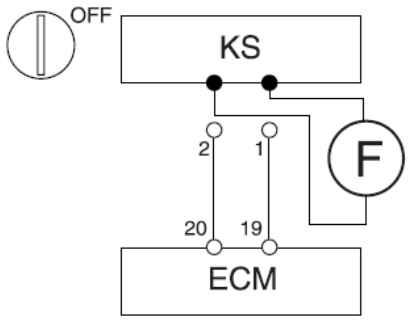
1. Reconnect the ECM and KS connectors.
2. Connect a Hi-Scan (Pro) to the knock sensor.
3. Start the engine and monitor the KS signal at idle.
   - **Refer to "SIGNAL WAVEFORM" for more information.**

Is KS signal normal?

Yes	
No	Replace KS.

6. CHECK KNOCK SENSOR

1. Turn ignition switch to OFF position and disconnect KS connectors.
2. Measure capacitance between terminal 1 and 2 of the KS connector.
   - **Specification (capacitance): 0.8 ~ 1.6 nF (800 ~ 1,600 pF)**



Is the measured capacitance within specification?

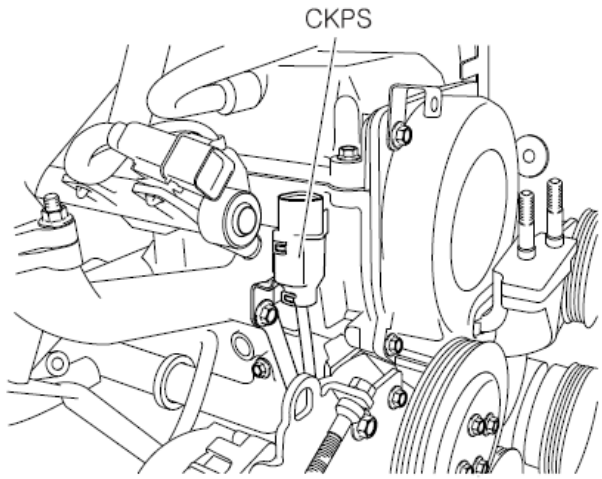
Yes	
No	Replace KS.

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

TROUBLESHOOTING FOR DTC

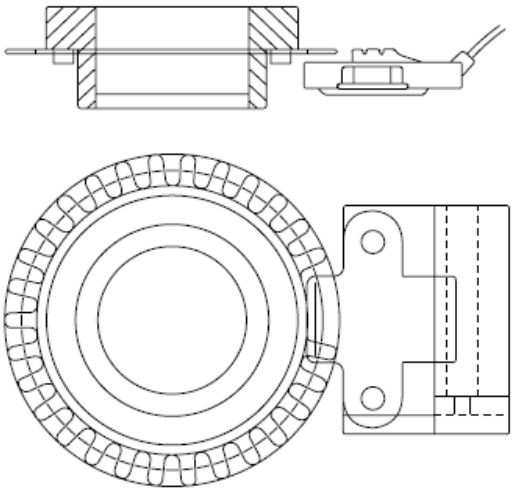
DTC	P0335	Crankshaft Position Sensor Circuit Malfunction

COMPONENT LOCATION



DESCRIPTION

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 28 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 output is high. During one crankshaft rotation there are 28 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 DETECTING CONDITION

1. DTC Description

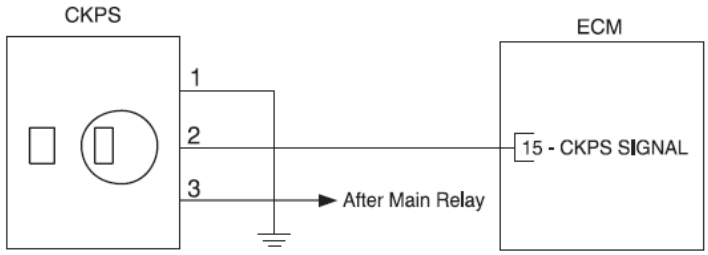
The ECM sets DTC P0335 When the signal is out of threshold value or the counter of level change of phase sensor output signal is over 8 times. If same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0335	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption • Enable condition - Signal interruption : no engine speed signal • Threshold Value - Counter of level of phase sensor output signal > 8 times	• Short to ground • Open or short to battery in CKPS • Poor connection of CKPS connector • Air gap out of specification • CKPS interfered with electrical noise at cranking • CKPS • ECM

SCHEMATIC DIAGRAM

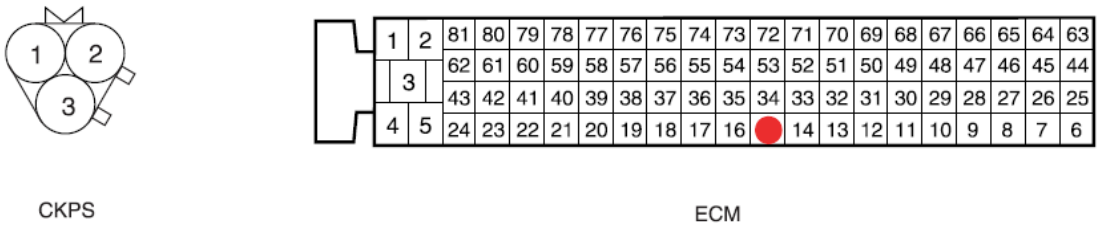
[CIRCUIT DIAGRAM]



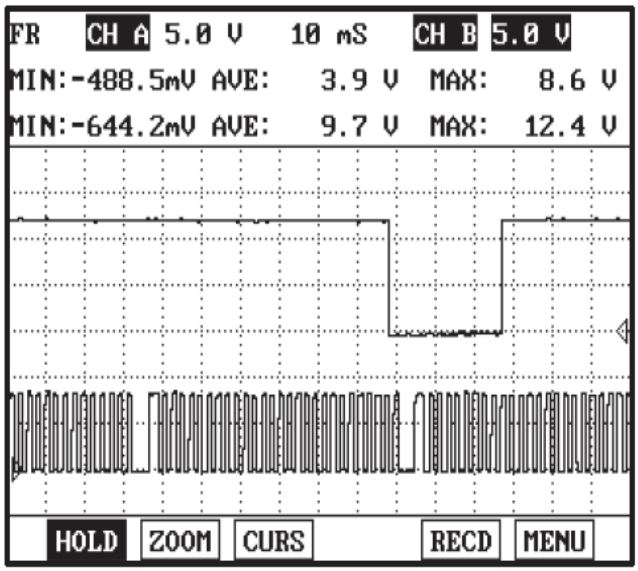
[CONNECTION INFORMATION]

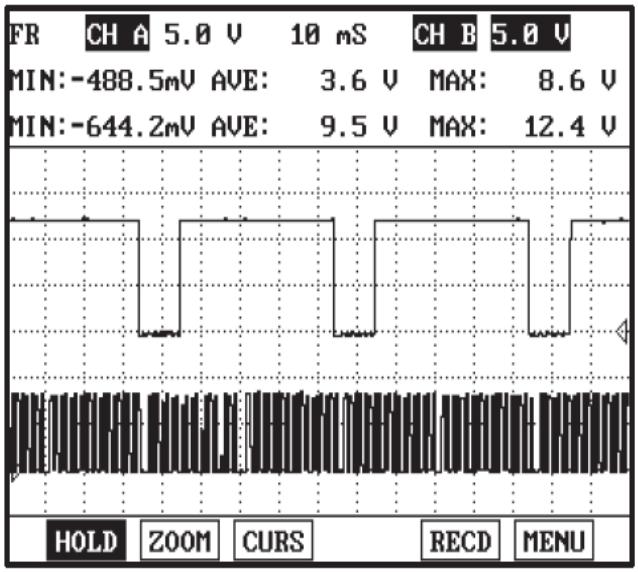
Terminal	Connected to	Function
1	Chassis ground	Sensor ground
2	ECM Terminal 15	CKPS signal
3	Main Relay	Battery Voltage

[HARNESS CONNECTORS]



SIGNAL WAVEFORM





The given data is the normal waveform of the Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS). The left picture is at idle and the right picture is at accelleration. The ECM controls the injection timing and the ignition timing by using these signals. The CKPS signal is used to detect the piston's position and the CMPS signal is used to detect the compression Top Dead Center of each cylinder.

INSPECTION PROCEDURE

1. CHECK CKPS AND ECM CONNECTORS

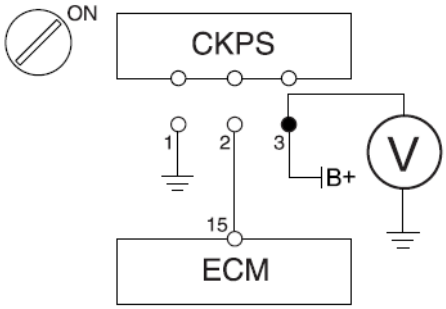
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK POWER TO CKPS

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

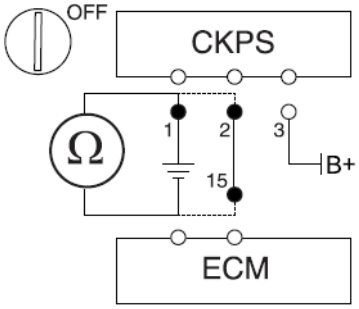


Is voltage within specification?

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

3. CHECK FOR OPEN IN HARNESS

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

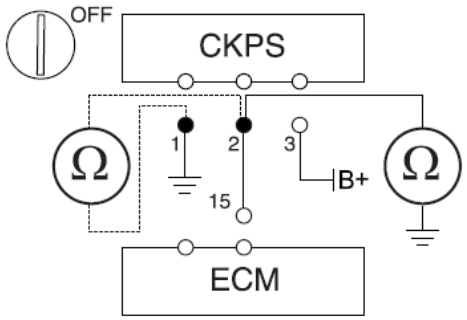


Does each resistance indicate continuity?

Yes	
No	Repair open in harness.

4. CHECK FOR SHORT TO GROUND IN HARNESS

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

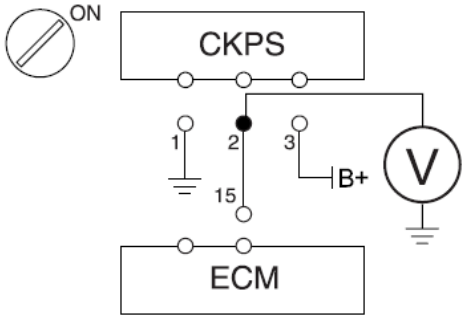


Is the resistance displayed correctly?

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

5. CHECK FOR SHORT TO POWER IN HARNESS

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



Is voltage within specification?

Yes	No	Repair short to power in harness.

6. CHECK CKPS SIGNAL

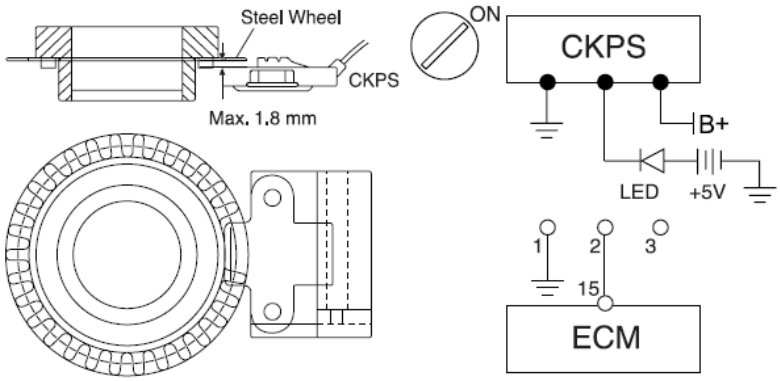
1. Reconnect the ECM and CKPS connectors.
2. Connect a Hi-Scan (Pro) to the CKPS.
3. Start the engine and monitor the CKPS signal at normal operating temperature.
   - **Refer to "SIGNAL WAVEFORM" for more information.**

Is CKPS signal normal?

Yes	No	Replace CKPS.

7. CHECK CKPS

1. Turn ignition switch to OFF position and then disconnect CKPS connector.
2. Remove the CKPS from the engine.
3. Turn ignition switch to ON position.
4. Apply battery voltage to the terminal 1 and 5V to the terminal 2 and ground terminal 3 of CKPS as shown in the figure.
5. Install as LED between +5V power and CKPS terminal 2 and a steel wheel-tooth wheel (or anything made of steel; hammer, wrench, bolt and nut etc.) at the CKPS's tip.
6. Rotate the steel wheel slowly and check if the LED flashes light.
   - **If the LED blinks, the CKPS works normally.**



Does flash the LED when rotating the steel wheel?

Yes	No	Replace CKPS.

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

TROUBLESHOOTING FOR DTC

DTC	P0336	Crankshaft Position Sensor Circuit Range / Performance

COMPONENT LOCATION

Refer to DTC P0335

DESCRIPTION

Refer to DTC P0335

DTC DETECTING CONDITION

1. DTC Description

The ECM sets DTC P0336 if ECM detects the number of tooth on crank shaft is not correct or can not detect missing tooth.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0336	Detecting Condition • DTC Strategy - Rationality check • Enable condition - No vehicle speed sensor error - 1.0 km/h < Engine speed < 25 km/h - Engine speed + 50 < stationary reference speed • Threshold Value - Counter of failure in searching reference gap or + / - 1 tooth	• Air gap • CKPS • Tone wheel • ECM

SCHEMATIC DIAGRAM

Refer to DTC P0335

SIGNAL WAVEFORM

Refer to DTC P0335

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start the engine.
3. Using the Hi-Scan (Pro), monitor the current data of engine RPM.

Is the resistance displayed correctly?

No

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

2. CHECK ECTS AND ECM CONNECTORS

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

Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK CKPS

1. Connect CKPS connector and ECM connector.
2. Connect a Hi-Scan (Pro) and monitor the signal wavefrom.
   - **Refer to "SIGNAL WAVEFROM"**
3. **Remove CKPS**
4. **Visually inspect CKPS.**

Are all items good?

Yes

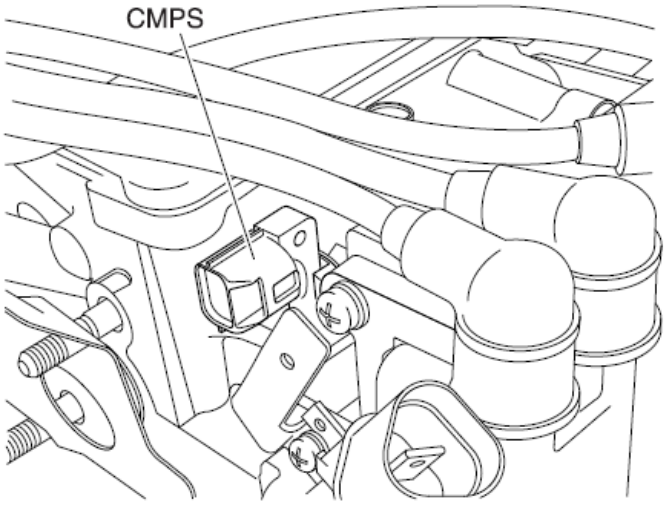
No	Replace CKPS.

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

TROUBLESHOOTING FOR DTC

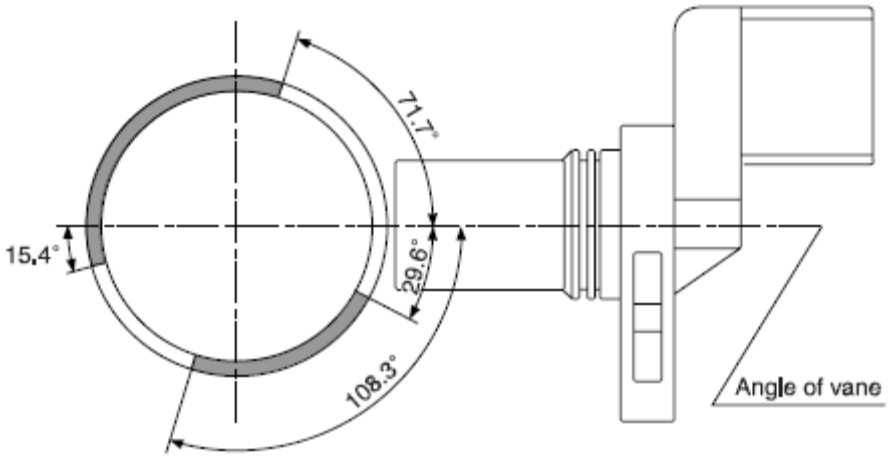
DTC	P0340	Camshaft Position Sensor Circuit Malfunction (Bank1 or Single Sensor)

COMPONENT LOCATION



DESCRIPTION

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 approximately 12V. 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 DETECTING CONDITION

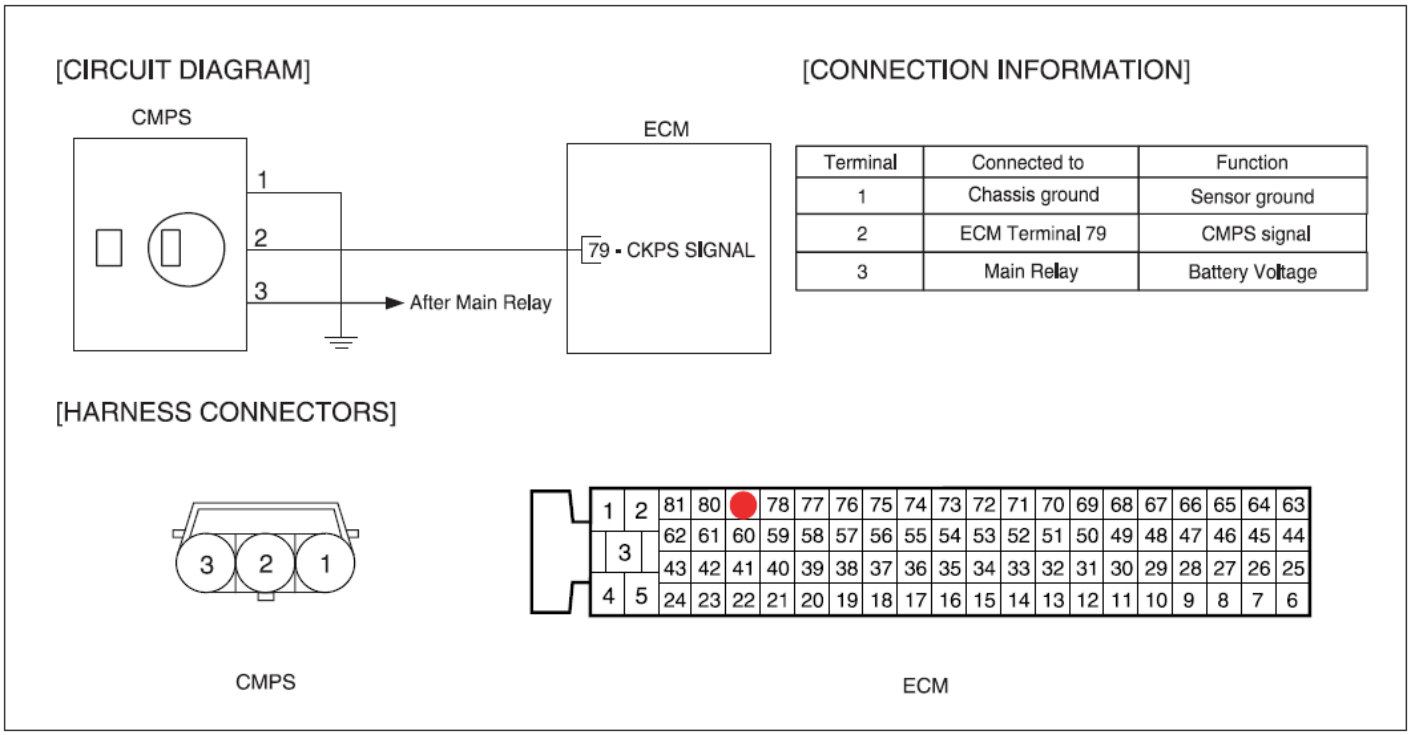
1. DTC Description

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. If same error code is set in the next driving cycle, the ECM illuminates the MIL.

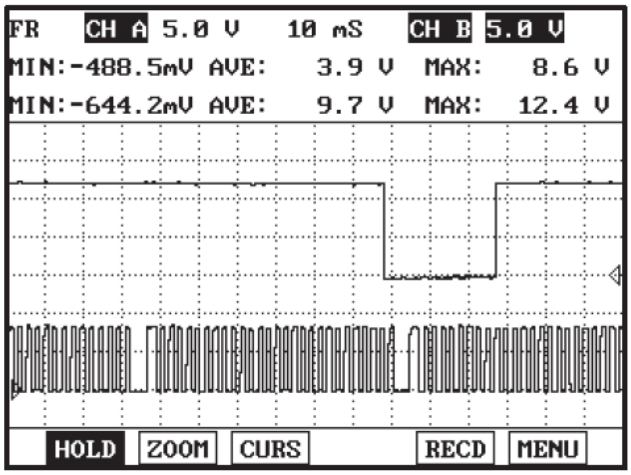
2. Conditions for Setting the DTC

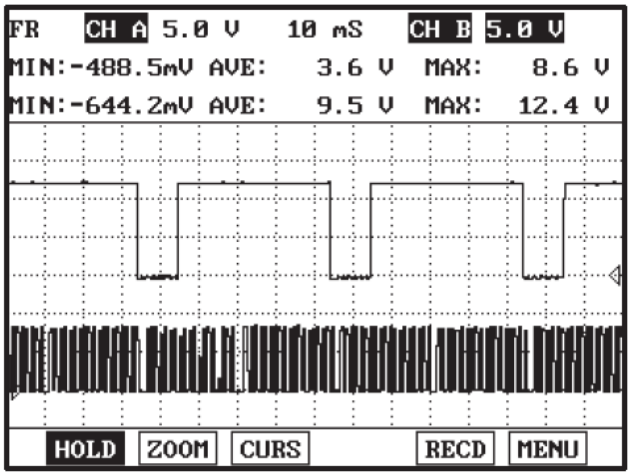
DTC	Detecting Condition	Possible Cause
P0340	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Threshold Value - Slope of phase signal (=255) > 12 times - Slope of phase signal (=0) > 12 times - Slope of phase signal (=255) > 12 times or Slope of phase signal (=0) > 12 times and Edge detected - (Slope of phase signal < 255 & slope of phase signal > 0 & Slope of phase signal ≠ 85 & Slope of phase signal ≠ 170) > 12 times	• Short to ground • Open or short to battery • Poor connection of CMPS connector • CMPS • ECM

SCHEMATIC DIAGRAM



SIGNAL WAVEFORM





The given data is the normal waveform of the Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS). The ECM controls the injection timing and the ignition timing by using these signals. The CKPS signal is used to detect the piston's position and the CMPS signal is used to detect the Top Dead Center of each cylinder.

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Start the engine and monitor the CMPS signal at normal operating temperature without electrical loads.

Is signal continuously fluctuating between 0V and 12V?

No

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

2. CHECK CMPS AND ECM CONNECTORS

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

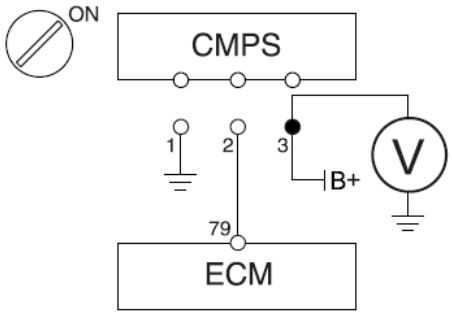
Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK POWER TO CMPS

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



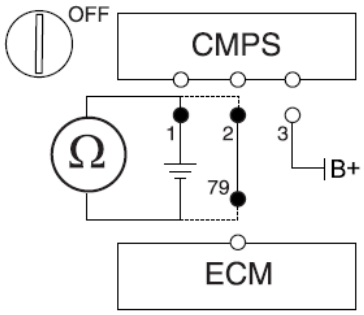
Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect CMPS and ECM connector.
2. Measure resistance between terminal 1 of the CMPS harness connector and chassis ground.
3. Measure resistance between terminal 2 of the CMPS harness connector and 79 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**

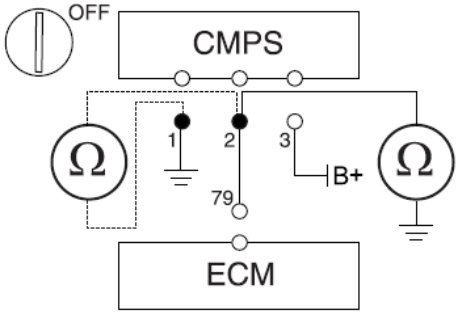


Does each resistance indicate continuity?

Yes	No	Repair open in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

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

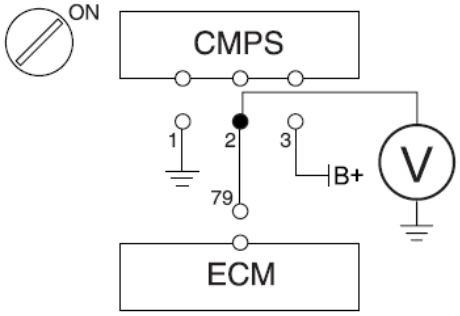


Is the resistance displayed correctly?

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

6. CHECK FOR SHORT TO POWER IN HARNESS

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

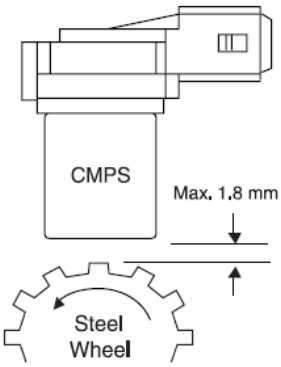


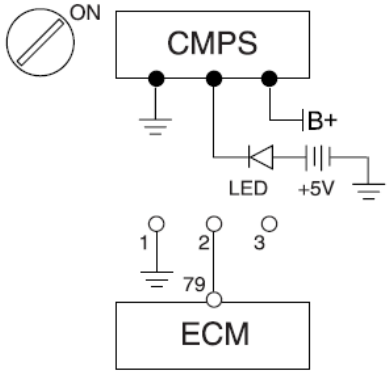
Is voltage within specification?

Yes	No	Repair short to power in harness.

7. CHECK CMPS

1. Turn ignition switch to OFF position and then disconnect CMPS connector.
2. Remove the CMPS from the engine.
3. Turn ignition switch to ON position.
4. Apply battery voltage to the terminal 1 and 5V to the terminal 2, and then ground terminal 3 of CMPS as shown in the figure.
5. Install as LED between +5V power and CMPS terminal 2 and a steel wheel-tooth wheel (or anything made of steel; hammer, wrench, bolt and nut etc.) at the CMPS's tip.
6. Rotate the steel wheel slowly and check if the LED flashes light.
   - **If the LED blinks, the CMPS works normally.**





Does flash the LED when rotating the steel wheel?

Yes	No	Replace CMPS.

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

TROUBLESHOOTING FOR DTC

DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

DESCRIPTION

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 DETECTING CONDITION

1. DTC Description

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. If same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0420	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - 1760 rpm < Engine speed < 2840 rpm - 22% < Engine load < 51% - 540°C < Catalyst temp. (model) < 800°C - Canister load factor < 10 - Closed loop control : Active • Threshold Value - Canister aging factor > 0.65	• Gas leakage in exhaust system • HO2S • Catalytic converter • ECM

INSPECTION PROCEDURE

1. CHECK DTC RELEVANT TO HO2S/FUEL TRIM /MISFIRE

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Turn the ignition switch ON and monitor any other DTCs relating to HO2S, fuel trim, or misfire.

Are any other DTCs also set?

No	Yes	Do all repairs associated with those codes before proceeding with this procedure.

2. MONITOR THE MANIFOLD CATALYTIC CONVERTER

1. Turn ignition switch to OFF position, and then reset the ECM with pulling the ECM fuse for about 10 seconds.
2. Start engine and hold the engine at 3,000 rpm with no load (in "Park" or "Neutral" position) until the radiator fan comes on.
3. Drive for about 10 minutes without stopping on highway or freeway (Your speed can vary).
4. In D-range for A/T or 5th gear for M/T, drive at steady speed between 80 and 100 kph for 30 seconds.
5. Repeat Step 5 three times. Between each repetition, close the throttle completely for 1 or 2 seconds. If the engine is stopped during this part of the procedure, repeat process 4, 5 and 6 in this step.
6. Check for a temporary DTC with the Hi-Scan (Pro).

Does the scan tool indicate temporary DTC P0420?

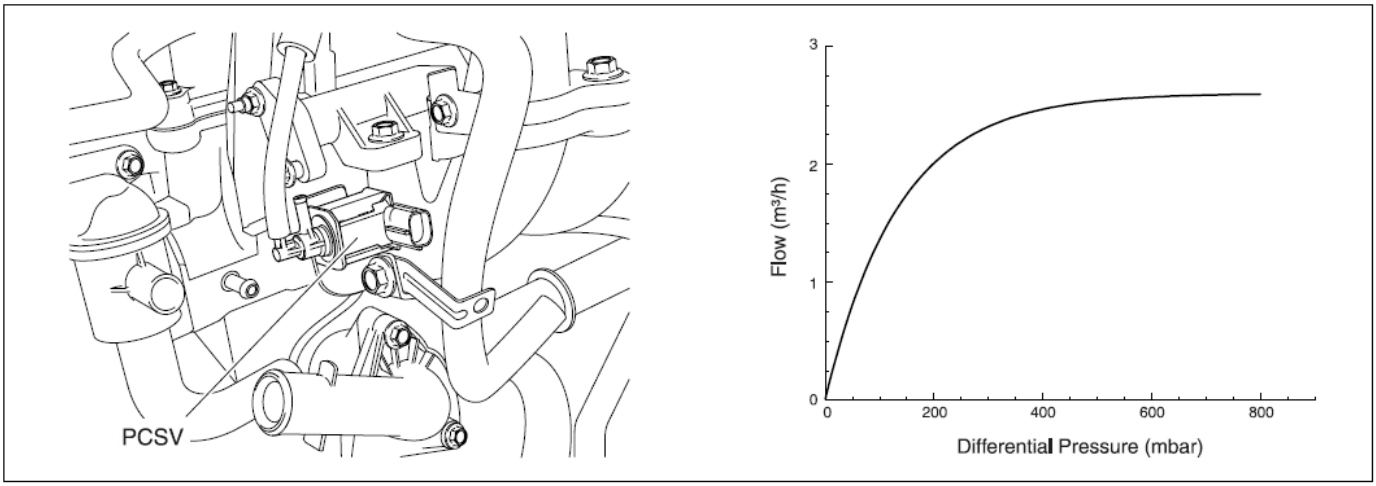
No	Yes	Check the catalytic converter. If necessary, replace the catalytic converter.

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

TROUBLESHOOTING FOR DTC

DTC	P0444	EVAP Emission Control System Purge Control Valve Circuit Open

COMPONENT LOCATION



DESCRIPTION

The evaporative emission control system prevents hydrocarbon (HC) vapors from the fuel tank from escaping into the atmosphere where they could form photochemical smog. Gasoline vapors are collected in the charcoal canister. The ECM controls the Purge Control Solenoid Valve (PCSV) to purge any collected vapors from the canister back to the engine for combustion. This valve is actuated by the purge control signal from the ECM and controls fuel vapor from the canister to the intake manifold.

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0444 if the ECM detects that the PCSV control line is open or short to ground.

2. Conditions for Setting the DTC

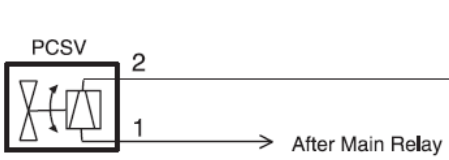
DTC	Detecting Condition	Possible Cause
P0444	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption - Rationality check • Threshold Value - Short circuit to ground - Wire disconnection	• Open or short to ground in PCSV circuit • PCSV • ECM

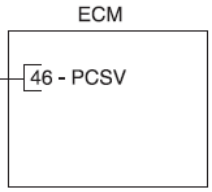
SPECIFICATION

Temperature	PCSV Resistance
20°C	32 Ω

SCHEMATIC DIAGRAM

[CIRCUIT DIAGRAM]

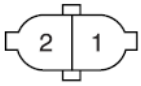




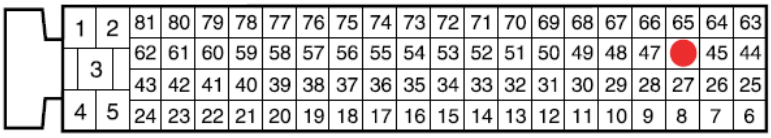
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage
2	ECM Terminal 46	PCSV operation

[HARNESS CONNECTORS]

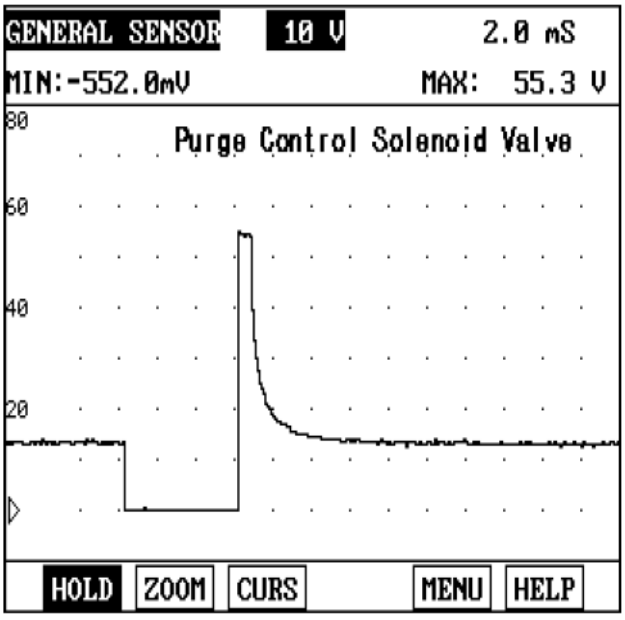


PCSV



ECM

SIGNAL WAVEFROM



During normal operation, the PCSV opens and closes, depending on throttle angle and intake manifold vacuum. When it opens, fuel vapors are flushed from the canister and drawn into the intake manifold. To avoid a vacuum build-up in the canister, the canister close valve is normally held open to allow fresh air to replace the vapors drawn into the intake manifold.

The given data is the signal waveform when the PCSV operates normally. Note that the PCSV will not operate until the engine has reached normal operating temperature.

INSPECTION PROCEDURE

1. CHECK PCSV AND ECM CONNECTORS

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

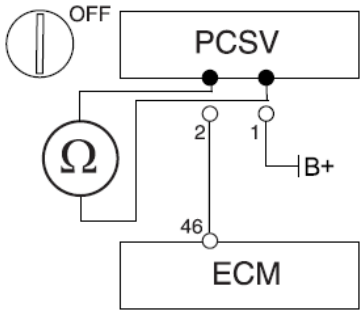
Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK PCSV RESISTANCE

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

Temperature	PCSV Resistance
20°C	32 Ω

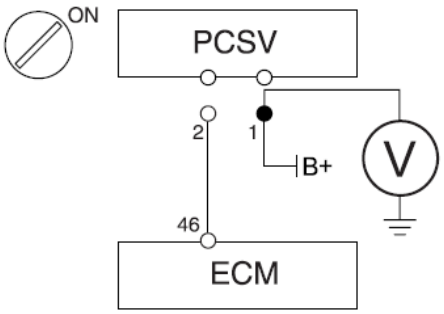


Is resistance within specification?

Yes	
No	Replace PCSV.

3. CHECK POWER TO PCSV

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

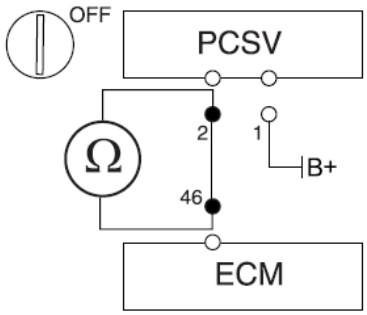


Is voltage within specification?

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

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition to OFF position, and then disconnect PCSV and ECM connector.
2. Measure resistance between terminal 2 of the PCSV harness connector and 46 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**



Does each resistance indicate continuity?

Yes	No	Repair open in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0445	EVAP Emission Control System Purge Control Valve Circuit Shorted

DESCRIPTION

Refer to DTC P0444

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0445 if the ECM detects that the PCSV control is short battery.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0445	Detecting Condition • DTC Strategy - Signal check, High • Threshold Value - Short circuit to ground	• Short to battery in PCSV circuit • PCSV • ECM

SPECIFICATION

Refer to DTC P0444

SCHEMATIC DIAGRAM

Refer to DTC P0444

SIGNAL WAVEFORM

Refer to DTC P0444

INSPECTION PROCEDURE

1. CHECK PCSV AND ECM CONNECTORS

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

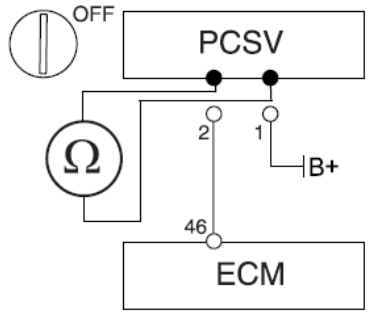
Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK PCSV RESISTANCE

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

Temperature	PCSV Resistance
20°C	32 Ω

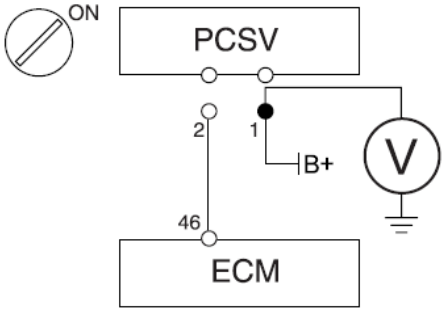


Is resistance within specification?

Yes	
No	Replace PCSV.

3. CHECK POWER TO PCSV

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

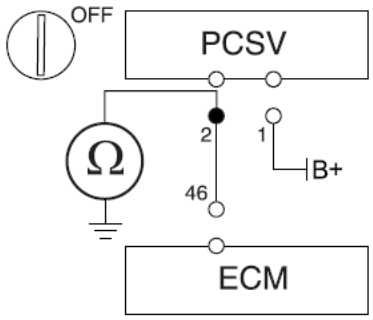


Is voltage within specification?

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

4. CHECK FOR SHORT TO GROUND IN HARNESS

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

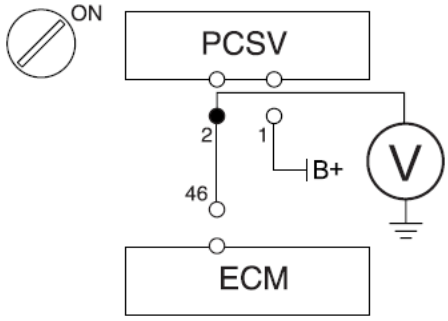


Is the resistance displayed correctly?

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

5. CHECK FOR SHORT TO POWER IN HARNESS

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



Is voltage within specification?

Yes	No	Repair short to power in harness.

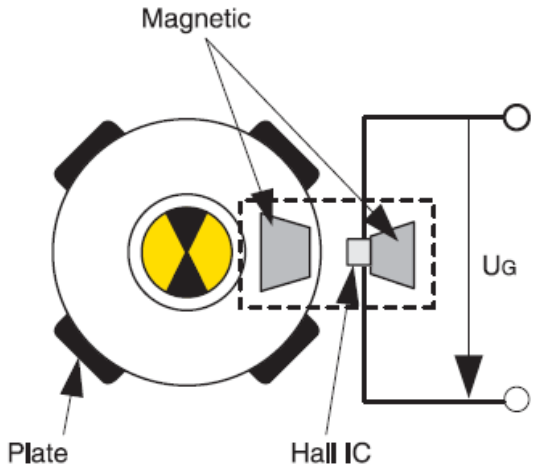
Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TROUBLESHOOTING FOR DTC

DTC	P0501	Vehicle Speed Sensor Range / Performance

DESCRIPTION

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



DTC DETECTING CONDITION

1. DTC Description

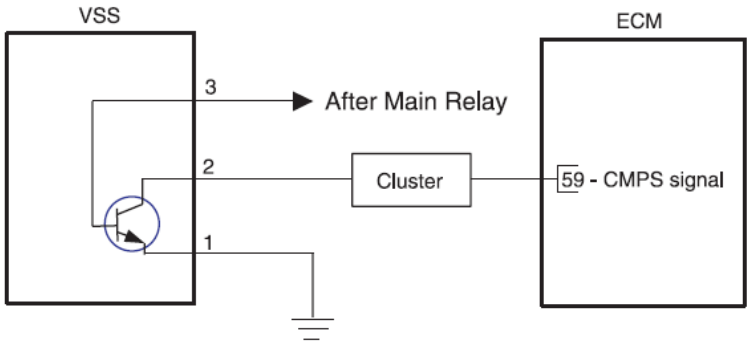
The ECM evaluates engine speed and mass air flow if there is no vehicle speed signal. This evaluation of both values will detect open circuit or short circuit error on wheel speed sensor. The ECM sets DTC P0501 if there is no vehicle speed signal from wheel speed sensor while both engine speed and mass air flow are higher than predetermined threshold during predetermined time.
If the same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0501	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - Signal interruption - Engine coolant temperature > 64.5°C - 3000 rpm < Engine speed < 4000 rpm - Fuel cut - off - Rationality check - Relative charge of cylinder > 49.5% - Engine speed > 3000 rpm • Threshold Value - Signal interruption : Vehicle speed < 5.0 km/h - Rationality check : Vehicle speed < 3.75 km/h	• Open or short in VSS circuit • VSS • ECM

SCHEMATIC DIAGRAM

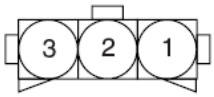
[CIRCUIT DIAGRAM]



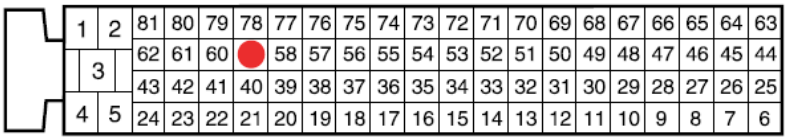
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Chassis ground	Sensor ground
2	ECM Terminal 59	VSS signal
3	Main Relay	Battery Voltage

[HARNESS CONNECTORS]



VSS



ECM

INSPECTION PROCEDURE

1. CHECK VSS IN CURRENT DATA

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Lift up the vehicle and start engine.
3. Drive the vehicle and monitor vehicle speed in current data

Is vehicle speed in current data displayed correctly?

No

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

2. CHECK VSS AND ECM CONNECTOR

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

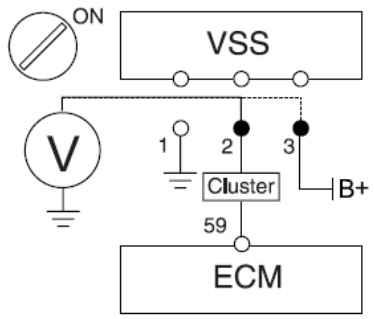
Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK FOR OPEN OR SHORT IN POWER AND SIGNAL HARNESS

1. Turn ignition switch to OFF position, and then disconnect VSS connector.
2. Turn ignition switch to ON.
3. Measure voltage between the terminal 2 of VSS harness connector and chassis ground.
   - **Specification: 7 ~ 11 V**
4. Measure voltage between the terminal 3 of VSS harness connector and chassis ground.
   - **Specification: B+**



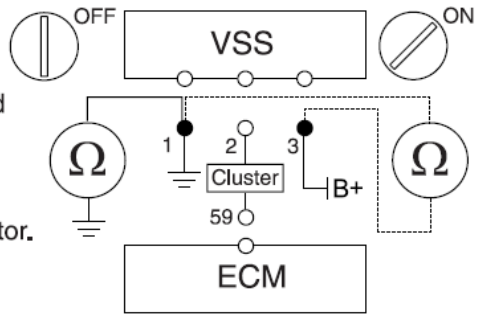
Is voltage displayed correctly?

Yes

No	Repair open or short in harness.

4. CHECK FOR OPEN OR SHORT IN GROUND HARNESS

1. Turn ignition switch to OFF position, and disconnect VSS and ECM connector.
2. Measure voltage between the terminal 1 of VSS harness connector and chassis ground.
   - **Specification: Approximately below 1Ω**
3. Measure voltage between the terminal 1 and 3 of VSS harness connector.
   - **Specification: Infinite**



Is voltage displayed correctly?

Yes	
No	Repair open or short in harness.

5. CHECK VSS

1. Connect VSS connector.
2. Start the vehicle and use a Hi-Scan (Pro) to monitor signal waveform after lifting the vehicle up.
   - **Refer to signal waveform**

Is signal waveform displayed correctly?

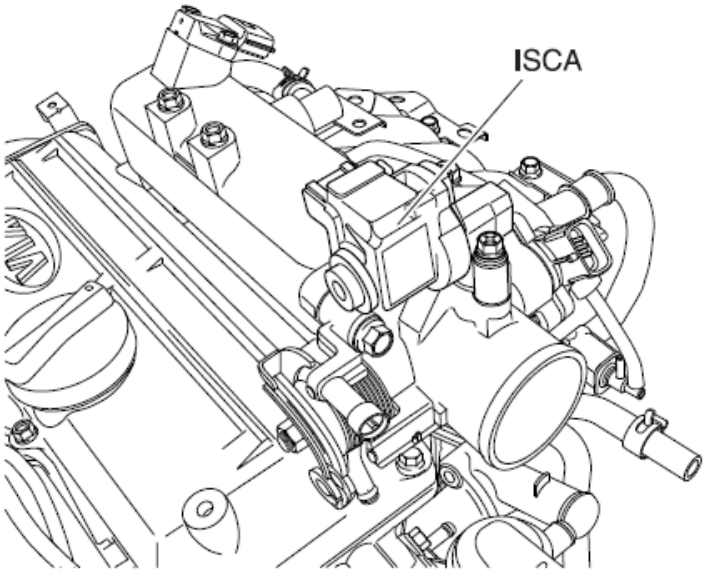
Yes	
No	Replace VSS.

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

TROUBLESHOOTING FOR DTC

DTC	P0506	Idle Control System - RPM Lower Than Expected

COMPONENT LOCATION



DESCRIPTION

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 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.

DTC DETECTING CONDITION

1. DTC Description

The ECM monitors engine speed deviation from the target idle engine speed when the vehicle is stopped and the idle speed valve opening is stable.
The ECM sets DTC P0506 if the difference to the target idle engine speed is lower than the predetermined threshold. If the same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0506	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption - Rationality check • Enable condition - Vehicle speed = 0 - Engine coolant temperature > 75°C - Intake air temperature > 9.75°C - Altitude adaptation factor > 0.7 - Idle ON - No error in vehicle speed sensor, engine coolant temperature sensor, intake air temperature sensor, purge valve drive stage, purge system, ISA drive stage • Threshold Value - Relative engine load < 50% - (Target engine speed - real engine speed) > 150 rpm	• ISCA • TPS • Intake hose • Carbon fouled throttle plate • Accelerator cable adjusted properly • ECM

SPECIFICATION

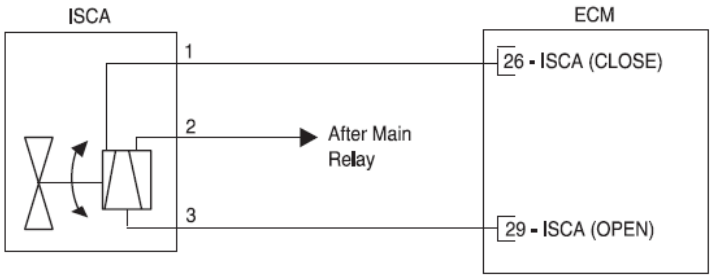
Throttle Position	Output Voltage
C.T (IDLE)	0.2 ~ 0.8 V
W.O.T.	4.3 ~ 4.8 V

ISCA COIL

Temperature	ISCA COIL Resistance	
20°C	CLOSE COIL	16.6 ~ 18.6 Ω
	OPEN COIL	14.5 ~ 16.5 Ω

SCHEMATIC DIAGRAM

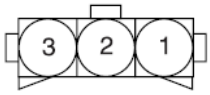
[CIRCUIT DIAGRAM]



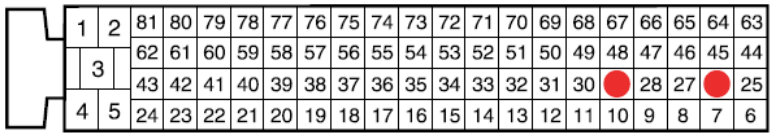
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM terminal 26	ISCA (CLOSE)
2	Main Relay	Battery voltage
3	ECM terminal 29	ISCA (OPEN)

[HARNESS CONNECTORS]

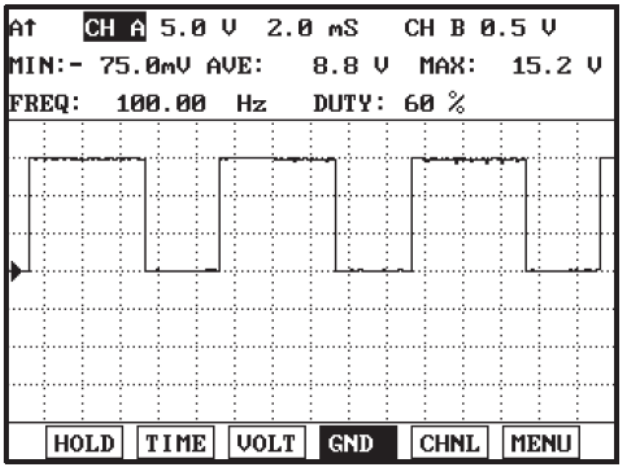


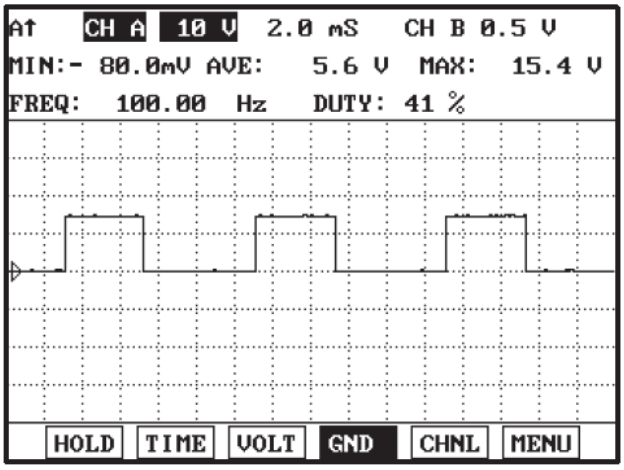
ISA



ECM

SIGNAL WAVEFORM





The above waveforms are the voltage signals generated when the 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.

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO TPS, MAPS, INJECTOR, PCSV, OR ISCA

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

Are any other DTC relating to TPS, MAPS, injector, PCSV, or ISCA also set?

No

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

2. CHECK FREE PLAY OF ACCELERATOR CABLE

1. Turn ignition switch to OFF position.
2. Check the free play of the accelerator cable.
   - **Specifications: 1.0~2.0 mm**

Is free play within specification?

Yes

No	Adjust cable.

3. CHECK TPS SIGNAL

1. Turn ignition switch to ON position.
2. Using the Hi-Scan (Pro), monitor the TPS signals while slowly opening the throttle.
   - **Specification (Voltage):**
     0.2 ~ 0.8 V at C.T (IDLE)
     4.3 ~ 4.8 V at W.O.T

Is signal within specification?

Yes

No	Replace the TPS.

4. VISUALLY CHECK ISCA FOR CONNECTOR CONDITION

1. Turn ignition switch to OFF position and disconnect the ISCA connector.
2. Thoroughly check the ISCA for loose, bent, corroded, contaminated, deteriorated or damaged connectors.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Is any problem present?

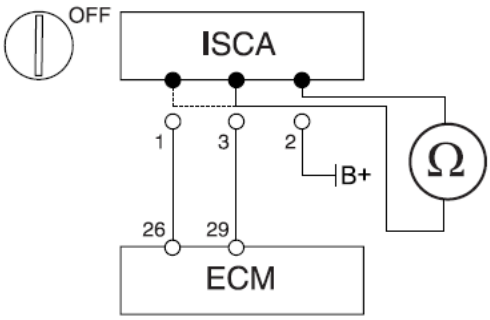
Yes

No	Repair or replace it.

5. CHECK ISCA RESISTANCE

1. Turn ignition switch to OFF position and then disconnect ISCA connector.
2. Measure resistance between terminals 2 and 3 of the ISCA opening coil.
3. Measure resistance between terminals 1 and 2 of the ISCA closing coil.
   - **Specification (ISCA resistance):**

Temperature (°C)	ISCA COIL Resistance	
20	CLOSE COIL	16.6 ~ 18.6 Ω
	OPEN COIL	14.5 ~ 16.5 Ω



Is each resistance within specification?

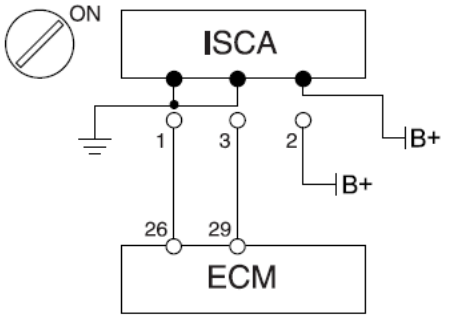
Yes		
	No	Replace ISCA.

6. CHECK ISCA FOR NORMAL OPERATION

1. Remove ISCA from throttle body and check for blockage and sticking.
2. Connect terminal 2 of the ISCA connector to a 12V power supply. One at a time, momentarily ground terminal 1 of the closing coil and terminal 3 of the opening coil while verifying that the valve closes when the closing coil is grounded and that the valve opens when opening coil is grounded.
3. Repeat several times to ensure reliability.

NOTE

While ISCA is removed, inspect the throttle body for obstructions in the idle circuit ports. Repair or replace it.



Is ISCA working properly?

Yes		
	No	Replace ISCA.

7. CHECK INTAKE HOSE AND THROTTLE PLATE FOR BLOCKAGE

1. Visually check the intake hose and throttle plate for blockage or carbon deposits.

Is the passage of the intake hose or the throttle plate blocked?

Yes		
	No	Clean or replace it.

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

TROUBLESHOOTING FOR DTC

DTC	P0507	Idle Control System - RPM Higher Than Expected

DESCRIPTION

Refer to DTC P0506

DTC DETECTING CONDITION

1. DTC Description

The ECM monitors engine speed deviation from the target idle engine speed when the vehicle is stopped and the idle speed valve opening is stable.
The ECM sets DTC P0507 if the difference to the target idle engine speed is higher than the predetermined threshold.
If same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0507	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - Engine speed > 40 rpm - Vehicle speed = 0 - Engine coolant temperature > 75°C - Intake air temperature > 9.75°C - Altitude adaptation factor > 0.7 - Idle ON - No error in vehicle speed sensor, engine coolant temperature sensor, intake air temperature sensor, purge valve drive stage, purge system, ISA drive stage • Threshold Value - Fuel cut - off occurrence > 3 times - Or (Target engine speed - real engine speed) < -150 rpm	• ISCA • TPS • Air leakage intake system • Vacuum hose and PCV • PCSV • Accelerator cable adjusted improperly • ECM

SPECIFICATION

Refer to DTC P0506

SCHEMATIC DIAGRAM

Refer to DTC P0506

SIGNAL WAVEFORM

Refer to DTC P0506

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO TPS, MAPS, INJECTOR, PCSV, OR ISCA

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

Are any other DTC relating to TPS, MAPS, injector, PCSV, or ISCA also set?

No

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

2. CHECK FREE PLAY OF ACCELERATOR CABLE

1. Turn ignition switch to OFF position.
2. Check the free play of the accelerator cable.
   - **Specifications: 1.0~2.0 mm**

Is free play within specification?

Yes

No	Adjust cable.

3. CHECK TPS SIGNAL

1. Turn ignition switch to ON position.
2. Using the Hi-Scan (Pro), monitor the TPS signals while slowly opening the throttle.
   - **Specification (Voltage):**
     0.2 ~ 0.8 V at C.T (IDLE)
     4.3 ~ 4.8 V at W.O.T

Is signal within specification?

Yes

No	Replace the TPS.

4. VISUALLY CHECK ISCA FOR CONNECTOR CONDITION

1. Turn ignition switch to OFF position and disconnect the ISCA connector.
2. Thoroughly check the ISCA for loose, bent, corroded, contaminated, deteriorated or damaged connectors.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

Is any problem present?

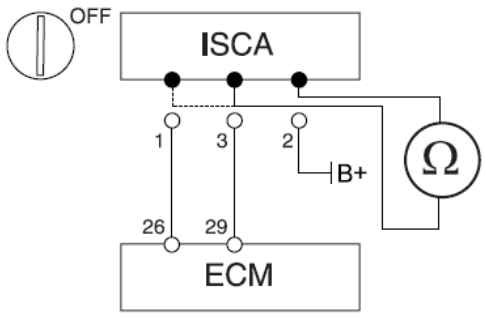
Yes

No	Repair or replace it.

5. CHECK ISCA RESISTANCE

1. Turn ignition switch to OFF position and then disconnect ISCA connector.
2. Measure resistance between terminals 2 and 3 of the ISCA opening coil.
3. Measure resistance between terminals 1 and 2 of the ISCA closing coil.
   - **Specification (ISCA resistance):**

Temperature (°C)	ISCA COIL Resistance	
20°C	CLOSE COIL	16.6 ~ 18.6 Ω
	OPEN COIL	14.5 ~ 16.5 Ω



Is each resistance within specification?

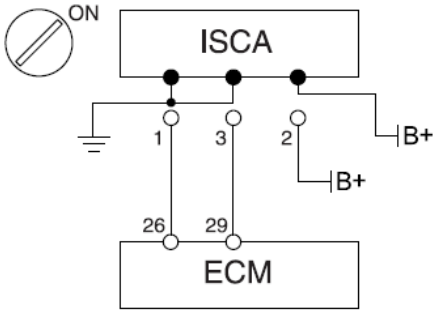
Yes	No	Replace ISCA.

6. CHECK ISCA FOR NORMAL OPERATION

1. Remove ISCA from throttle body and check for blockage and sticking.
2. Connect terminal 2 of the ISCA connector to a 12V power supply. One at a time, momentarily ground terminal 1 of the closing coil and terminal 3 of the opening coil while verifying that the valve closes when the closing coil is grounded and that the valve opens when opening coil is grounded.
3. Repeat several times to ensure reliability.

NOTE

While ISCA is removed, inspect the throttle body for obstructions in the idle circuit ports. Repair or replace it.



Is ISCA working properly?

Yes	No	Replace ISCA.

7. CHECK VACUUM HOSE AND PCV

1. Visually check for any split, disconnected or perforated vacuum hose.
2. Also, check PCV valve for proper operation.

Are vacuum hose and PCV okay?

Yes	No	Repair or replace it.

8. CHECK PCSV FOR NORMAL OPERATION

1. Turn ignition switch to OFF position and disconnect the hose leading from the PCSV to the intake manifold at PCSV.
2. Draw a vacuum at the nipple and verify that the PCSV holds vacuum.
3. Turn ignition switch to ON position and ground the PCSV connector terminal 2 (should hear a faint "click" from PCSV).
4. The Vacuum should bleed off.
5. Repeat this procedure 4 or 5 times to ensure PCSV reliability.

Is PCSV working properly?

Yes	No	Repair or replace it.

9. CHECK GASKETS, SEALS, AND VALVE FOR CRACKS OR LEAKS

1. Visually inspect the following items:
   - Gasket between the intake manifold and the surge tank
   - Gasket between the intake manifold and the cylinder head
   - Seals between the intake manifold and the fuel injectors
   - Seals between the surge tank and the PCV valves
   - Crankcase ventilation valve and/or system for leaks

Are the above items okay?

Yes	No	Repair or replace it.

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

TROUBLESHOOTING FOR DTC

DTC	P0562	System Voltage Low

DESCRIPTION

The system voltage has to be high enough to guarantee in order to perform diagnosis functions. The ECM monitors battery voltage.

DTC DETECTING CONDITION

1. DTC Description

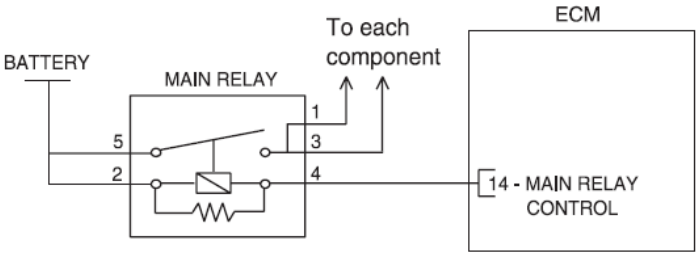
ECM sets DTC P0562 if the ECM detects system voltage is out of the threshold value.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0562	Detecting Condition • DTC Strategy - Signal check, Low • Enable condition - Time elapse after start > 120 s • Threshold Value - 2.5V < Battery voltage < 10V - Battery < 2.5V	• Charging system • ECM

SCHEMATIC DIAGRAM

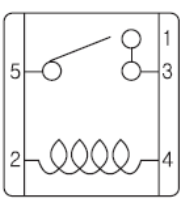
[CIRCUIT DIAGRAM]

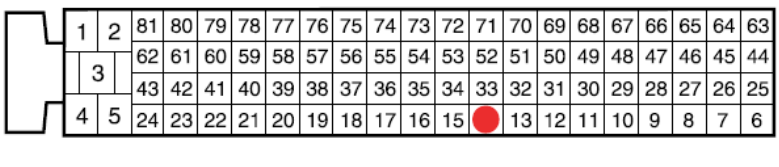


[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	-	Supply B+
2	Battery	Battery Voltage
3	-	Supply B+
4	ECM terminal 14	Main Relay Control
5	Battery	Battery Voltage

[HARNESS CONNECTORS]





ECM

INSPECTION PROCEDURE

1. CHECK CHARGING SYSTEM

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

Is charging system okay?

Yes	No	Repair or replace it.

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

TROUBLESHOOTING FOR DTC

DTC	P0563	System Voltage High

DESCRIPTION

Refer to DTC P0562

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0563 if the ECM detects system voltage higher than the possible range of battery voltage.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0563	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - No engine RPM failure - Vehicle speed > 25 km/h - Time elapse after start > 120 s • Threshold Value - Battery voltage > 17 V	• Charging system • ECM

SCHEMATIC DIAGRAM

Refer to DTC P0562

INSPECTION PROCEDURE

1. CHECK CHARGING SYSTEM

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

Is charging system okay

Yes

No	Repair or replace it.

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

TROUBLESHOOTING FOR DTC

DTC	P0600	CAN Communication BUS

DESCRIPTION

A communication line exists between the ECM and the other control module(s). The purpose of this DTC is for the ECM to activate the Malfunction Indicator Lamp (MIL) when a communication failure has occurred.

DTC DETECTING CONDITION

1. DTC Description

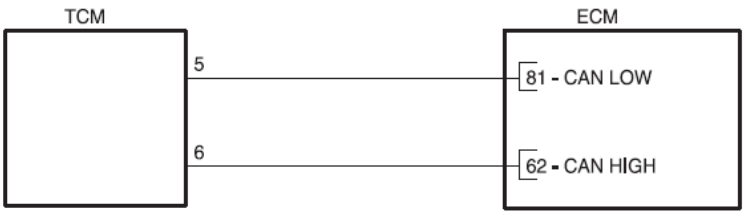
The ECM determines CAN communication error and sets DTC P0600 if communication with other engine control devices (e.g. TCM, ABS) via CAN is impossible.
If same error code is set in the next driving cycle, the ECM will illuminate the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0600	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Threshold Value - Short circuit to Ground - Short circuit to Battery	• CAN communication disabled • CAN line disconnected • TCM • ECM

SCHEMATIC DIAGRAM

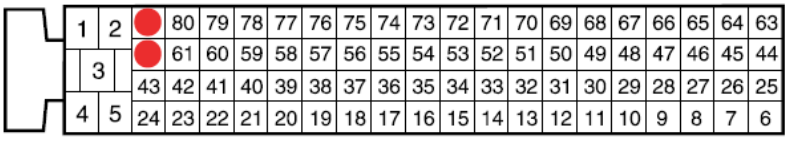
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

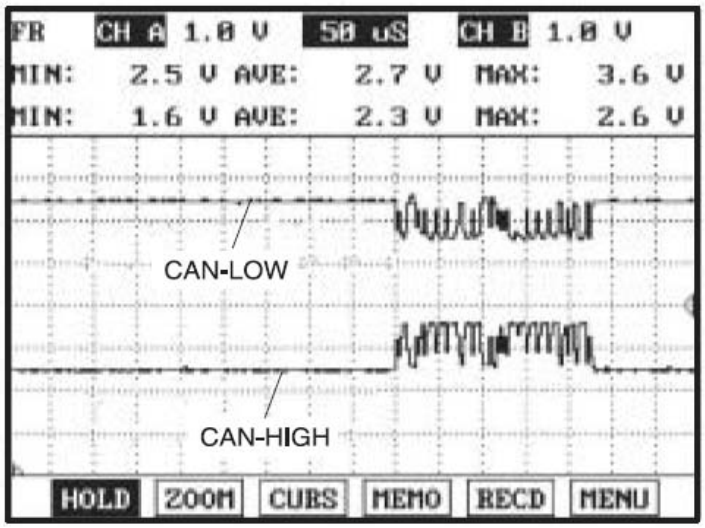
Terminal	Connected to	Function
5	ECM terminal 62	CAN LOW
6	ECM terminal 81	CAN HIGH

[HARNESS CONNECTORS]



ECM

SIGNAL WAVEFORM



INSPECTION PROCEDURE

- This is internal fault. There is no troubleshooting procedure for it.
- Temporarily install a good TCM/ECM Control Unit and check for proper operation. If problem is corrected, replace TCM/ ECM Control Unit.

TROUBLESHOOTING FOR DTC

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

COMPONENT LOCATION

DESCRIPTION

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

DTC DETECTING CONDITION

1. DTC Description

The ECM monitors RAM areas and communication connections between microcontroller and output drivers and sets DTC P0605 if failure is detected.
If same error code is set in the next driving cycle, the ECM will illuminate the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0605	Detecting Condition • DTC Strategy - Rationality check • Enable condition - None • Threshold Value - Each check sum of several blocks (Actual check sum check sum data)	• ECM internal fault • ECM hardware or software error

INSPECTION PROCEDURE

1. CHECK ECM SOFTWARE VERSION

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

Is the version newest one?

Yes	No	Upgrade the ECM software.

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

TROUBLESHOOTING FOR DTC

DTC	P0646	A/C Clutch Relay Control Circuit Low

DESCRIPTION

The A/C relay is activated if the A/C switch is ON while the blower is running and system operation is enabled the ECM. Power is then supplied to the A/C compressor electromagnetic clutch and A/C system is operated. The A/C compressor is switched out to prevent it running when full engine output is required or there is a risk of overheating. The ECM also inhibits compressor operation on starting to permit running conditions to stabilize.

DTC DETECTING CONDITION

1. DTC Description

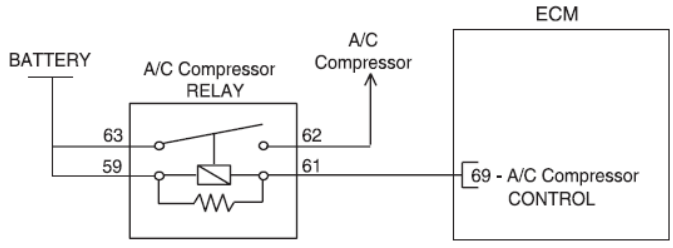
ECM sets DTC P0646 if the ECM detects that Air conditioner switch is open or short to ground.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0646	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Rationality check • Threshold Value - Short circuit to Ground - Wire disconnection	• Open or short to ground circuit • A/C clutch Relay • ECM

SCHEMATIC DIAGRAM

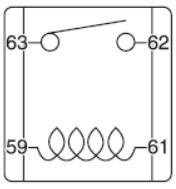
[CIRCUIT DIAGRAM]



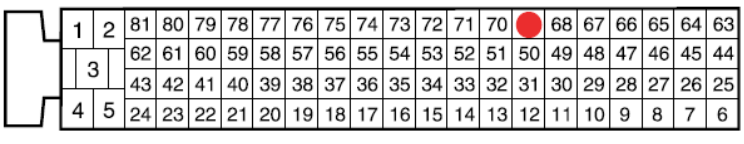
[CONNECTION INFORMATION]

Terminal	Connected to	Function
59	Main Relay	Battery Voltage
61	ECM terminal 69	A/C Compressor relay control
62	A/C Compressor	A/C Compressor power relay supply
63	Battery	Battery Voltage

[HARNESS CONNECTORS]



A/C Conditioner Compressor Relay



ECM

INSPECTION PROCEDURE

1. CHECK A/C COMPRESSOR RELAY AND ECM CONNECTORS

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

Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK A/C COMPRESSOR RELAY

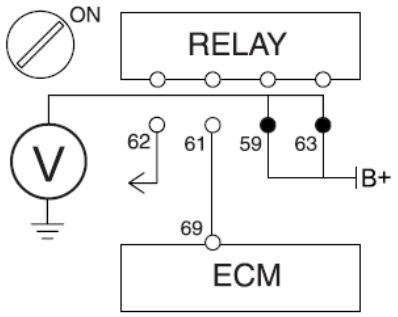
1. Remove the A/C compressor relay.
2. Apply power to the A/C compressor relay terminal 59 and ground terminal 61.
3. Check if the fuel pump relay works well when it is energized.
   (If the fuel pump relay works normally, a clicking sound can be heard.)

Does the fuel pump relay operate normally?

Yes	
No	Replace A/C compressor relay.

3. CHECK POWER TO A/C COMPRESSOR RELAY

1. Remove the A/C compressor relay.
2. Turn ignition switch to ON position.
3. Measure the voltage between terminal 63 of the A/C comp. relay harness connector and chassis ground.
4. Measure the voltage between terminal 59 of the A/C comp. relay harness connector and chassis ground.
   - **Specification : approximately B+**

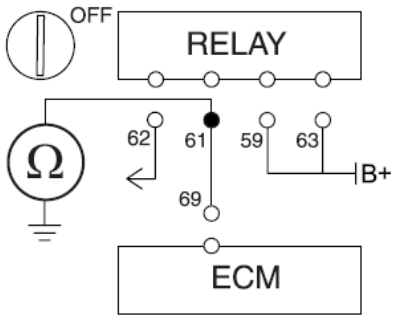


Is voltage within specification?

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

4. CHECK FOR SHORT TO GROUND IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect A/C comp. relay and ECM connectors.
2. Measure resistance between terminal 61 of the fuel pump relay harness connector and chassis ground.
   - **Specification (Resistance): infinite**

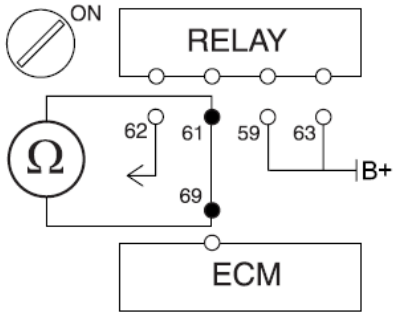


Is the resistance displayed correcfly?

Yes		
	No	Repair short to chassis ground in harness.

5. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect A/C comp. relay and ECM connectors.
2. Measure resistance between terminal 61 of the A/C comp. harness connector and terminal 69 of ECM harness connector.
   - **Specification (Resistance): below 1Ω**



Does resistance indicate continuity?

Yes		
	No	Repair open in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0647	A/C Clutch Relay Control Circuit High

DESCRIPTION

Refer to DTC P0646

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P0647 if the ECM detects that Air conditioner switch is short to battery.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0647	Detecting Condition • DTC Strategy - Signal check, High • Threshold Value - Short circuit to battery	• Short to battery circuit • A/C Clutch Relay • ECM

SCHEMATIC DIAGRAM

Refer to DTC P0646

INSPECTION PROCEDURE

1. CHECK A/C COMPRESSOR RELAY AND ECM CONNECTORS

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

Are all connectors good?

Yes	No	Repair or replace it.

2. CHECK A/C COMPRESSOR RELAY

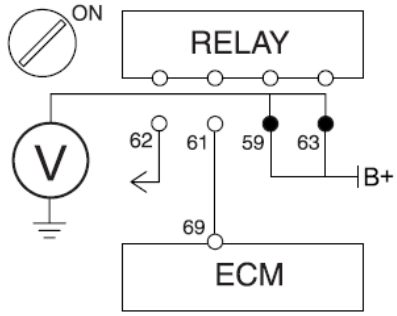
1. Remove the A/C compressor relay.
2. Apply power to the A/C compressor relay terminal 59 and ground terminal 61.
3. Check if the fuel pump relay works well when it is energized.
   (If the fuel pump relay works normally, a clicking sound can be heard.)

Does the fuel pump relay operate normally?

Yes	No	Replace A/C compressor relay.

3. CHECK POWER TO A/C COMPRESSOR RELAY

1. Remove the A/C compressor relay.
2. Turn ignition switch to ON position.
3. Measure the voltage between terminal 63 of the A/C comp. relay harness connector and chassis ground.
4. Measure the voltage between terminal 59 of the A/C comp. relay harness connector and chassis ground.
   - **Specification : approximately B+**

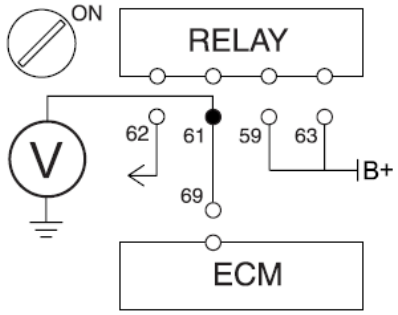


Is voltage within specification?

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

4. CHECK FOR SHORT TO POWER IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect A/C comp. relay and ECM connectors.
2. Turn ignition switch to ON position.
3. Measure voltage between terminal 61 of the A/C comp. relay harness connector and chassis ground.
   - **Specification (Voltage): below 0.5V**



Is voltage within specification?

Yes	No	Repair short to power in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P0650	Malfunction Indicator Lamp (MIL) Control Circuit Malfunction

DESCRIPTION

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 for 5 seconds to indicate that the MIL operates normally.

DTC DETECTING CONDITION

1. DTC Description

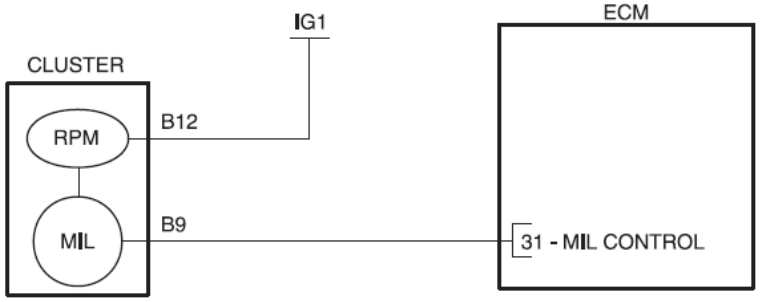
ECM sets DTC P0650 if the ECM detects that the MIL control line is open or short circuit to ground or battery line.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P0650	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Threshold Value - Short circuit to Ground - Short circuit to Battery - Wire disconnection	• Open circuit in MIL circuit • Short to ground or battery in MIL circuit • MIL • ECM

SCHEMATIC DIAGRAM

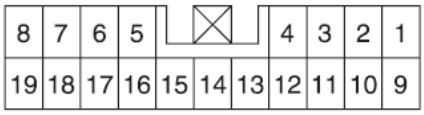
[CIRCUIT DIAGRAM]



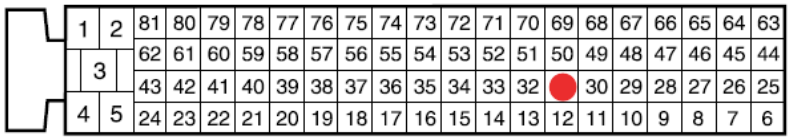
[CONNECTION INFORMATION]

Terminal	Connected to	Function
B12	IG 1	MIL control
B9	ECM terminal 31	Battery voltage

[HARNESS CONNECTORS]



CLUSTER (B) Connector



ECM

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Start the engine.
2. Check that the MIL illuminates for several seconds and then goes out.

Does the MIL illuminate for several seconds and then go out?

Yes	
No	Upgrade the ECM software.

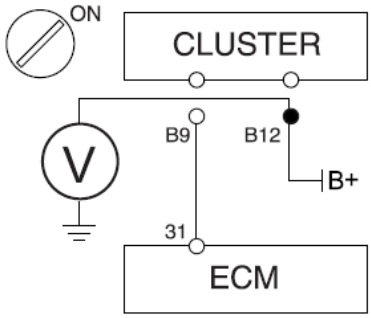
2. CHECK POWER TO MIL

1. Turn ignition switch to OFF position and disconnect MIL connector.

   NOTE

   MIL connector is a part of instrument panel connector.
   For more information about terminal B9, B12 refer to "BE" group.

2. Turn ignition switch to ON position.
3. Measure voltage between terminal B12 of the MIL harness connector and chassis ground.
   - **Specification (Voltage): approximately B+**

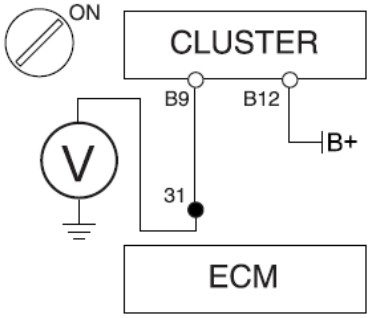


Is voltage within specification?

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

3. CHECK FOR OPEN OR SHORT IN HARNESS

1. Turn ignition switch to OFF position and disconnect the ECM connector.
2. Turn ignition switch to ON position.
3. Measure the voltage between terminal 31 of the ECM harness connector and chassis ground.
   - **Specification (Voltage): approximately B+**

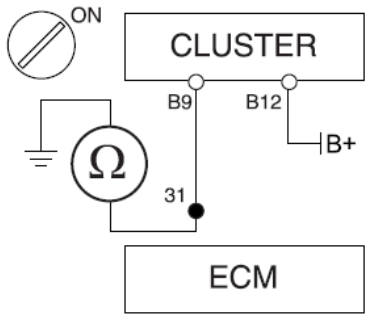


Is voltage within specification?

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

4. CHECK FOR OPEN OR SHORT IN HARNESS

1. Turn ignition switch to OFF position and disconnect the ECM connector.
2. Turn ignition switch to ON position.
3. Ground terminal 31 of ECM harness connector.
4. Check for MIL operation.



Does MIL operate normally?

Yes

No	Replace MIL.

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

TROUBLESHOOTING FOR DTC

DTC	P1307	Acceleration Sensor Circuit Rationality

DESCRIPTION

The Chassis Acceleration Sensor (CAS) 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 DETECTING CONDITION

1. DTC Description
If the value exceeds threshold value, the ECM judges this as a fault and DTC P1307 is set.

2. Conditions for Setting the DTC

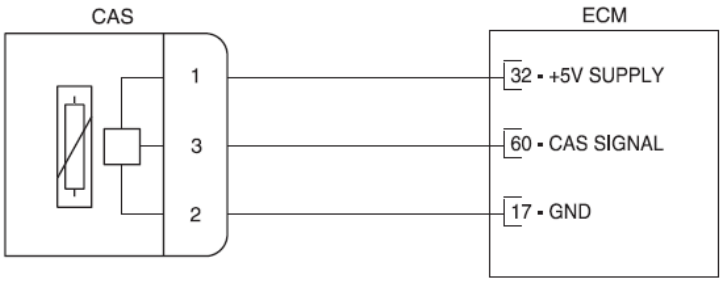
DTC	Detecting Condition	Possible Cause
P1307	Detecting Condition • DTC Strategy - Rationality check • Enable condition - No vehicle speed sensor error - Vehicle speed = 0.0 km/h • Threshold Value - Storage value of acceleration sensor signal > f(vehicle speed)	• CAS • ECM

SPECIFICATION

Acceleration Sensor	
IG ON	Approx. 2.5V

SCHEMATIC DIAGRAM

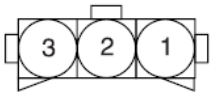
[CIRCUIT DIAGRAM]



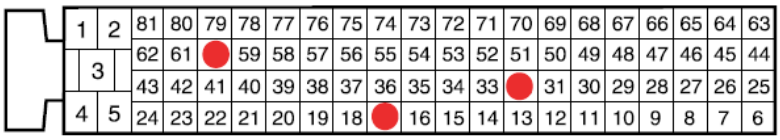
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM terminal 32	+5V SUPPLY
2	ECM terminal 17	Sensor Ground
3	ECM terminal 60	CAS Signal

[HARNESS CONNECTORS]



CAS



ECM

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Turn ignition switch to ON position.
2. Using a Hi-Scan (Pro), monitor the Acceleration Sensor in current data.

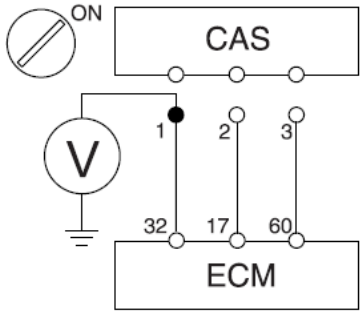
Is the TPS signal displayed correctly?

No

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

2. CHECK FOR OPEN OR SHORT IN POWER HARNESS

1. Turn ignition switch to OFF and disconnect Acceleration Sensor.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of Acceleration Sensor harness connector and chassis ground.
   - **Specification: Approximately 5V**



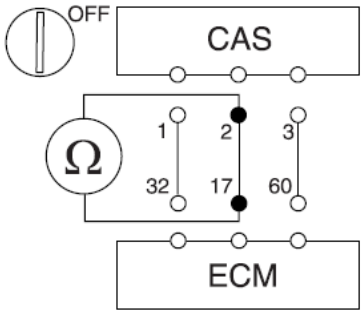
Is voltage displayed within specification?

Yes

No	Repair open or short in harness.

3. CHECK FOR OPEN IN GROUND HARNESS

1. Turn ignition switch to OFF and disconnect Acceleration Sensor and ECM connector.
2. Measure resistance between the terminal 2 of Acceleration Sensor harness connector and the terminal 17 of ECM connector.
   - **Specification: Approximately below 1Ω**



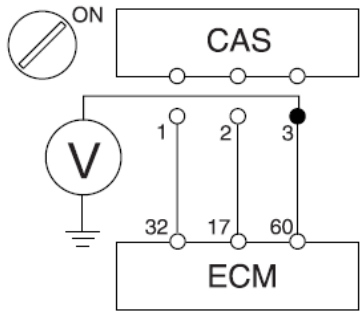
Is voltage displayed within specification?

Yes

No	Repair open in harness.

4. CHECK FOR OPEN OR SHORT IN SIGNAL HARNESS

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



Is voltage displayed within specification?

Yes	
No	Repair open or short in harness.

5. CHECK ACCELERATION SENSOR

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Using the Hi-Scan (Pro), monitor the Acceleration Sensor output voltage during idling.
   - **Specification: Approximately 2.5 V at idle**

Is voltage displayed within specification?

Yes	
No	Replace Acceleration Sensor.

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

TROUBLESHOOTING FOR DTC

DTC	P1308	Acceleration Sensor Circuit Signal Check Low

DESCRIPTION

Refer to DTC P1307

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P1308 if the ECM detects signal voltage lower than the possible range of a properly operating CAS.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P1308	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption • Threshold Value - Filtered acceleration sensor signal < 1.5V	• Short to ground in CAS circuit • CAS • ECM

SPECIFICATION

Refer to DTC P1307

SCHEMATIC DIAGRAM

Refer to DTC P1307

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Turn ignition switch to ON position.
2. Using a Hi-Scan (Pro), monitor the Acceleration Sensor signals.

Is current data displayed correcfly?

No

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

2. CHECK CAS AND ECM CONNECTORS

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

Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK ACCELERATION SENSOR

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Using the Hi-Scan (Pro), monitor the Acceleration Sensor output voltage during idling.
   - **Specification: Approximately 2.5 V at idle**

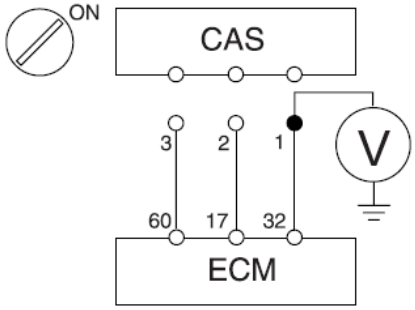
Is voltage displayed within specification?

Yes

No	Replace CAS.

4. CHECK REFERENCE VOLTAGE TO ACCELERATION SENSOR

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



Is voltage within specification?

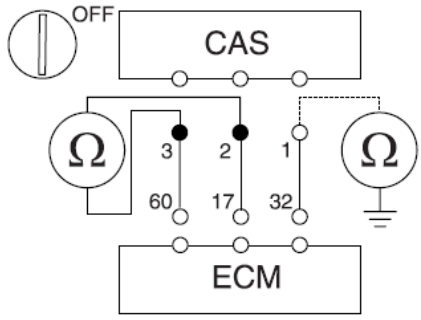
Yes

No	Repair open or short to chassis ground in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

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

Is the resistance displayed correcfly?



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

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

TROUBLESHOOTING FOR DTC

DTC	P1309	Acceleration Sensor Circuit Signal Check High

DESCRIPTION

Refer to DTC P1307

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P1309 if the ECM detects signal voltage higher than the possible range of a properly operating CAS.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P1309	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - No plausibility fault • Threshold Value - CAS signal > 3.5V	• Open or short to battery in CAS circuit • CAS • ECM

SPECIFICATION

Refer to DTC P1307

SCHEMATIC DIAGRAM

Refer to DTC P1307

INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Turn ignition switch to ON position.
2. Using a Hi-Scan (Pro), monitor the Acceleration Sensor signals.

Is current data displayed correcfly?

No

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

2. CHECK CAS AND ECM CONNECTORS

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

Are all connectors good?

Yes

No	Repair or replace it.

3. CHECK ACCELERATION SENSOR

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Using the Hi-Scan (Pro), monitor the Acceleration Sensor output voltage during idling.
   - **Specification: Approximately 2.5 V at idle**

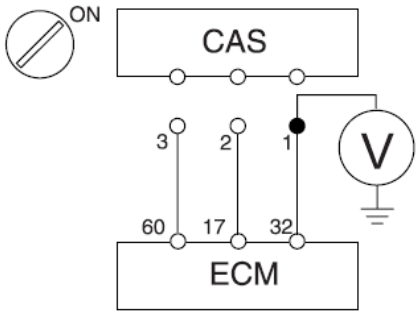
Is voltage displayed within specification?

Yes

No	Replace CAS.

4. CHECK REFERENCE VOLTAGE TO ACCELERATION SENSOR

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



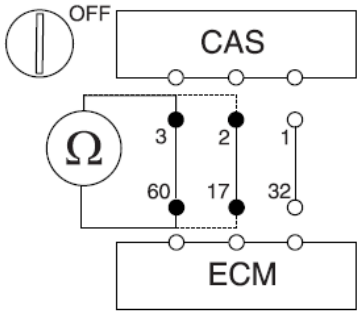
Is voltage within specification?

Yes

No	Repair open or short to chassis ground in harness.

5. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF position, and then disconnect Acceleration Sensor and ECM connector.
2. Measure resistance between terminal 3 of the Acceleration Sensor harness connector and 60 of the ECM harness connector.
3. Measure resistance between terminal 2 of the Acceleration Sensor harness connector and 17 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**

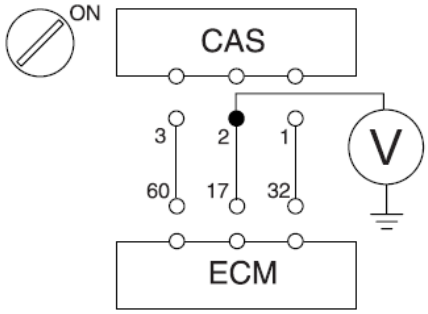


Does each resistance indicate continuity?

Yes	No	Repair open in harness.

6. CHECK FOR SHORT TO POWER IN HARNESS

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



Is voltage within specification?

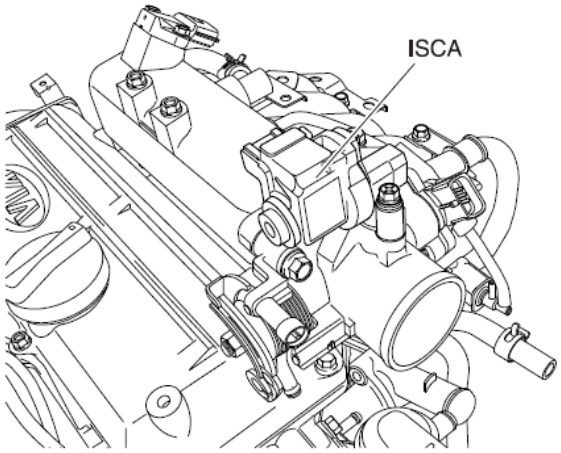
Yes	No	Repair short to power in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P1505	Idle Charge Actuator Signal Low of Coil #1

COMPONENT LOCATION



DESCRIPTION

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 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.

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P1505 if the ECM detects that the ISCA (CLOSE) control is open or short to ground.

2. Conditions for Setting the DTC

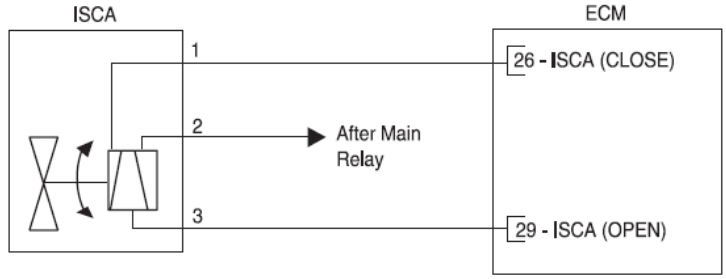
DTC	Detecting Condition	Possible Cause
P1505	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption - Rationality check • Threshold Value - Short circuit to Ground - Wire disconnection	• Open or short to ground in ISCA circuit • ISCA • ECM

SPECIFICATION

Temperature	ISCA COIL Resistance	
20°C	CLOSE COIL	16.6 ~ 18.6 Ω
	OPEN COIL	14.5 ~ 16.5 Ω

SCHEMATIC DIAGRAM

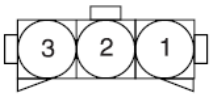
[CIRCUIT DIAGRAM]



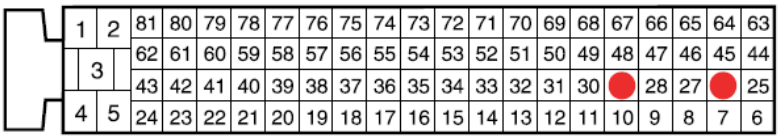
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM terminal 26	ISCA (CLOSE)
2	Main Relay	Battery voltage
3	ECM terminal 29	ISCA (OPEN)

[HARNESS CONNECTORS]

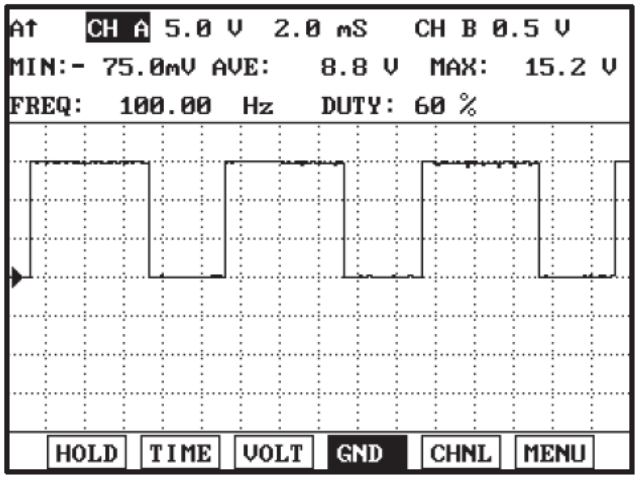


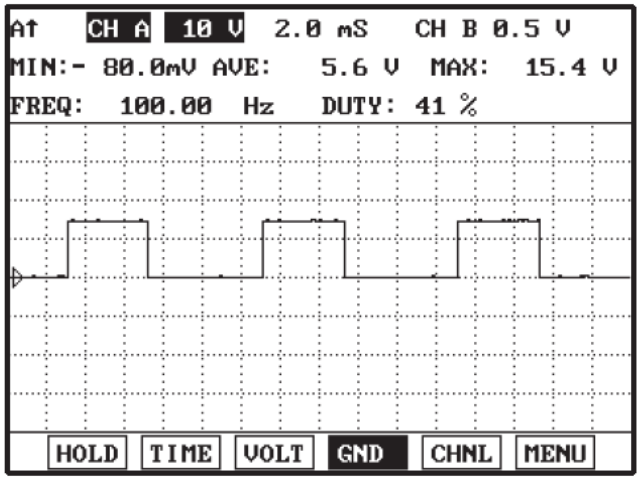
ISA



ECM

SIGNAL WAVEFORM





The above waveforms are the voltage signals generated when the 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.

INSPECTION PROCEDURE

1. CHECK ISCA AND ECM CONNECTORS

1. Thoroughly check the connectors for loose, bent, corroded, contaminated, deteriorated or damaged connectors.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

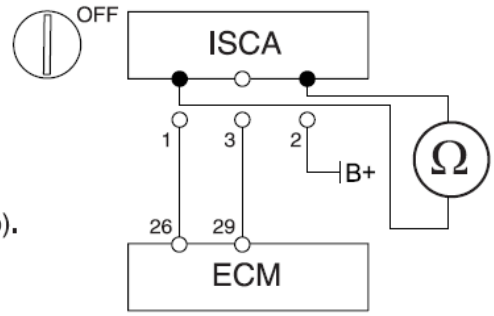
Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK ISCA RESISTANCE

1. Turn ignition switch to OFF position and then disconnect ISCA connector.
2. Measure resistance between terminals 1 and 2 of the ISCA closing coil.
   - **Specification (ISCA resistance):**

Temperature (°C)	ISCA COIL Resistance	
20°C	CLOSE COIL	16.6 ~ 18.6 Ω
	OPEN COIL	14.5 ~ 16.5 Ω



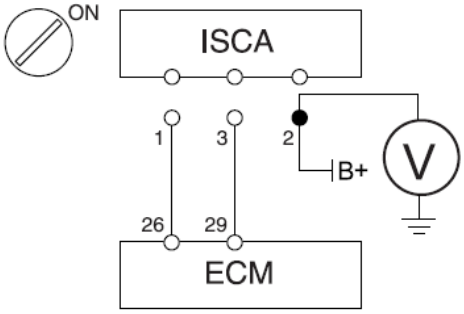
3. Inspect the signal waveform of the ISCA closing coil using a Hi-Scan (Pro).
   - **Refer to "SIGNAL WAVEFORM" for more information.**

Is the resistance within specification?

Yes	
No	Replace ISCA.

3. CHECK POWER TO ISCA

1. Turn ignition switch to ON position and disconnect ISCA connector.
2. Measure the voltage between terminal 2 of the ISCA harness connector and chassis ground.
   - **Specification: approximately B+**

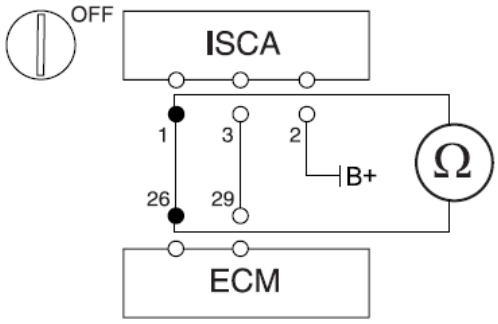


Is voltage within specification?

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

4. CHECK FOR OPEN IN HARNESSS

1. Turn ignition to OFF position, and then disconnect ISCA and ECM connector.
2. Measure resistance between terminal 1 of the ISCA harness connector and 26 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**

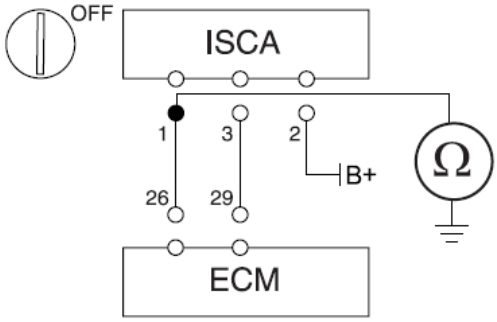


Does the resistance indicate continuity?

Yes	No	Repair open in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

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



Is the resistance displayed correcfly?

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

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

TROUBLESHOOTING FOR DTC

DTC	P1506	Idle Charge Actuator Signal High of Coil #1

DESCRIPTION

Refer to DTC P1505

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P1506 if the ECM detects that the ISCA (CLOSE) control is short to battery.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P1506	Detecting Condition • DTC Strategy - Signal check, High • Threshold Value - Short circuit to battery	• Short to battery in ISCA circuit • ISCA • ECM

SPECIFICATION

Refer to DTC P1505

SCHEMATIC DIAGRAM

Refer to DTC P1505

SIGNAL WAVEFORM

Refer to DTC P1505

INSPECTION PROCEDURE

1. CHECK ISCA AND ECM CONNECTORS

1. Thoroughly check the connectors for loose, bent, corroded, contaminated, deteriorated or damaged connectors.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

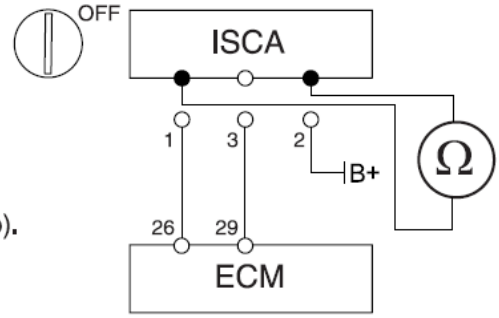
Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK ISCA RESISTANCE

1. Turn ignition switch to OFF position and then disconnect ISCA connector.
2. Measure resistance between terminals 1 and 2 of the ISCA closing coil.
   - **Specification (ISCA resistance):**

Temperature (°C)	ISCA COIL Resistance	
20°C	CLOSE COIL	16.6 ~ 18.6 Ω
	OPEN COIL	14.5 ~ 16.5 Ω



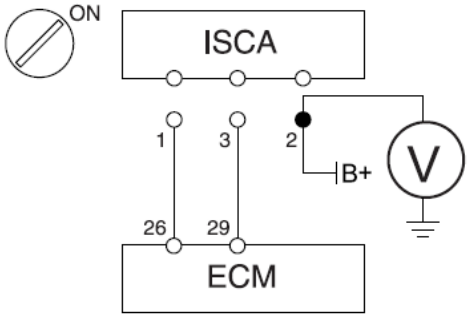
3. Inspect the signal waveform of the ISCA closing coil using a Hi-Scan (Pro).
   - **Refer to "SIGNAL WAVEFORM" for more information.**

Is the resistance within specification?

Yes	
No	Replace ISCA.

3. CHECK POWER TO ISCA

1. Turn ignition switch to ON position and disconnect ISCA connector.
2. Measure the voltage between terminal 2 of the ISCA harness connector and chassis ground.
   - **Specification: approximately B+**

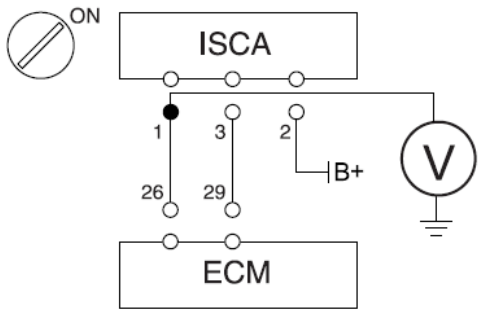


Is voltage within specification?

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

4. CHECK FOR SHORT TO POWER IN HARNESS

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



Is voltage within specification?

Yes	No	Repair short to power in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P1506	Idle Charge Actuator Signal Low of Coil #2

DESCRIPTION

Refer to DTC P1505

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P1507 if the ECM detects that the ISCA (OPEN) control line is open or short to ground.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P1507	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption - Rationality check • Threshold Value - Short circuit to Ground - Wire disconnection	• Open or short to ground in ISCA circuit • ISCA • ECM

SPECIFICATION

Refer to DTC P1505

SCHEMATIC DIAGRAM

Refer to DTC P1505

SIGNAL WAVEFORM

Refer to DTC P1505

INSPECTION PROCEDURE

1. CHECK ISCA AND ECM CONNECTORS

1. Thoroughly check the connectors for loose, bent, corroded, contaminated, deteriorated or damaged connectors.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

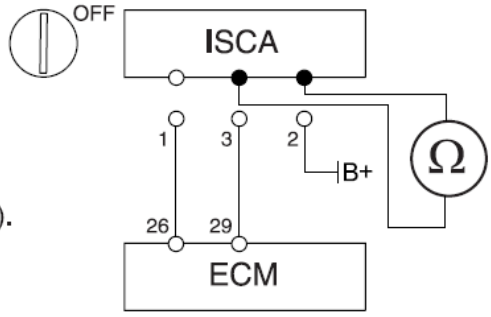
Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK ISCA RESISTANCE

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

Temperature (°C)	ISCA COIL Resistance	
20°C	CLOSE COIL	16.6 ~ 18.6 Ω
	OPEN COIL	14.5 ~ 16.5 Ω



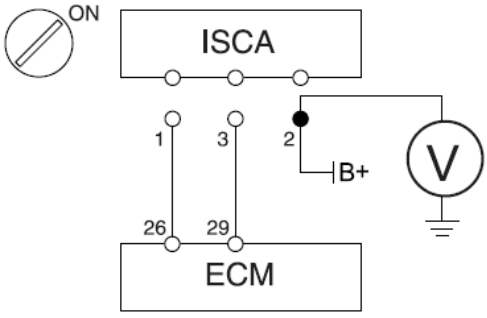
3. Inspect the signal waveform of the ISCA closing coil using a Hi-Scan (Pro).
   - **Refer to "SIGNAL WAVEFORM" for more information.**

Is the resistance within specification?

Yes	
No	Replace ISCA.

3. CHECK POWER TO ISCA

1. Turn ignition switch to ON position and disconnect ISCA connector.
2. Measure the voltage between terminal 2 of the ISCA harness connector and chassis ground.
   - **Specification: approximately B+**

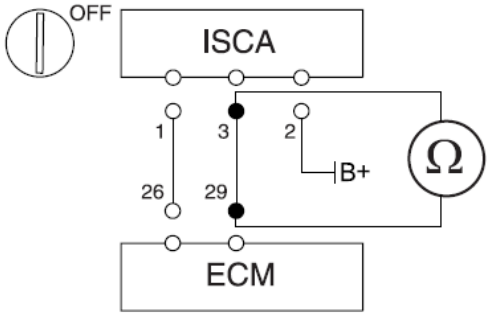


Is voltage within specification?

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

4. CHECK FOR OPEN IN HARNESS

1. Turn ignition to OFF position, and then disconnect ISCA and ECM connector.
2. Measure resistance between terminal 3 of the ISCA harness connector and 29 of the ECM harness connector.
   - **Specification (Resistance): below 1Ω**



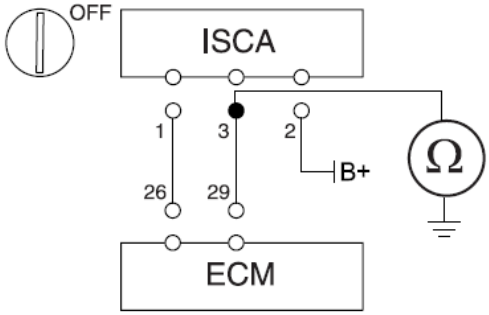
Does the resistance indicate continuity?

Yes

No	Repair open in harness.

5. CHECK FOR SHORT TO GROUND IN HARNESS

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



Is the resistance displayed correcfly?

Yes

No	Repair short or short to chassis ground in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P1508	Idle Charge Actuator Signal High of Coil #2

DESCRIPTION

Refer to DTC P1505

DTC DETECTING CONDITION

1. DTC Description

ECM sets DTC P1506 if the ECM detects that the ISCA (OPEN) control is short to battery line.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P1508	Detecting Condition • DTC Strategy - Signal check, High • Threshold Value - Short circuit to battery	• Short to battery in ISCA circuit • ISCA • ECM

SPECIFICATION

Refer to DTC P1505

SCHEMATIC DIAGRAM

Refer to DTC P1505

SIGNAL WAVEFORM

Refer to DTC P1505

INSPECTION PROCEDURE

1. CHECK ISCA AND ECM CONNECTORS

1. Thoroughly check the connectors for loose, bent, corroded, contaminated, deteriorated or damaged connectors.
   - **Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.**

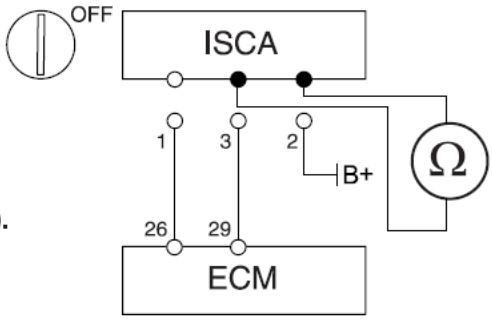
Are all connectors good?

Yes	
No	Repair or replace it.

2. CHECK ISCA RESISTANCE

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

Temperature (°C)	ISCA COIL Resistance	
20°C	CLOSE COIL	16.6 ~ 18.6 Ω
	OPEN COIL	14.5 ~ 16.5 Ω



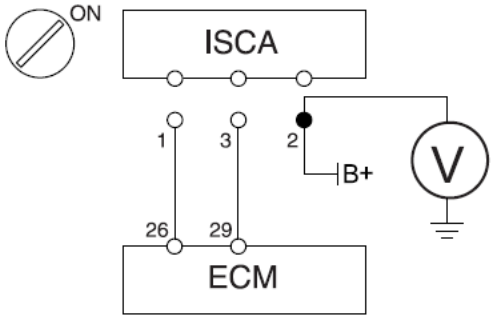
3. Inspect the signal waveform of the ISCA closing coil using a Hi-Scan (Pro).
   - **Refer to "SIGNAL WAVEFORM" for more information.**

Is the resistance within specification?

Yes	
No	Replace ISCA.

3. CHECK POWER TO ISCA

1. Turn ignition switch to ON position and disconnect ISCA connector.
2. Measure the voltage between terminal 2 of the ISCA harness connector and chassis ground.
   - **Specification: approximately B+**

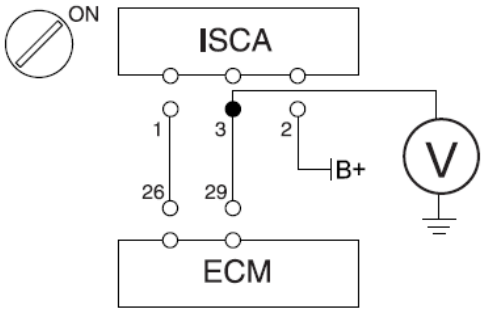


Is voltage within specification?

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

4. CHECK FOR SHORT TO POWER IN HARNESS

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



Is voltage within specification?

Yes	No	Repair short to power in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P1529	TCM Request for MIL ON / Freeze to ECM via CAN

DESCRIPTION

A communication line exists between the Engine Control Module (ECM) and the Transaxle Control Module (TCM). The sole purpose of this communication line is for the TCM to notify the ECM to activate the Malfunction Indicator Lamp (MIL) when a serious transaxle failure has occurred.

DTC DETECTING CONDITION

1. DTC Description

The ECM illuminates the MIL and sets DTC P1529 if TCM requests "MIL ON" via CAN. This error code determines diagnostic failure at TCM side.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P1529	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - Time after start : 4 s • Threshold Value - Request from TCU via CAN communication	• Transaxle system

INSPECTION PROCEDURE

- This is only a request from the TCM to turn the MIL ON. The fault code is stored in the TCM.
- Check the transaxle system.

TROUBLESHOOTING FOR DTC

DTC	P1586	MT / AT Encoding Error

DTC DETECTING CONDITION

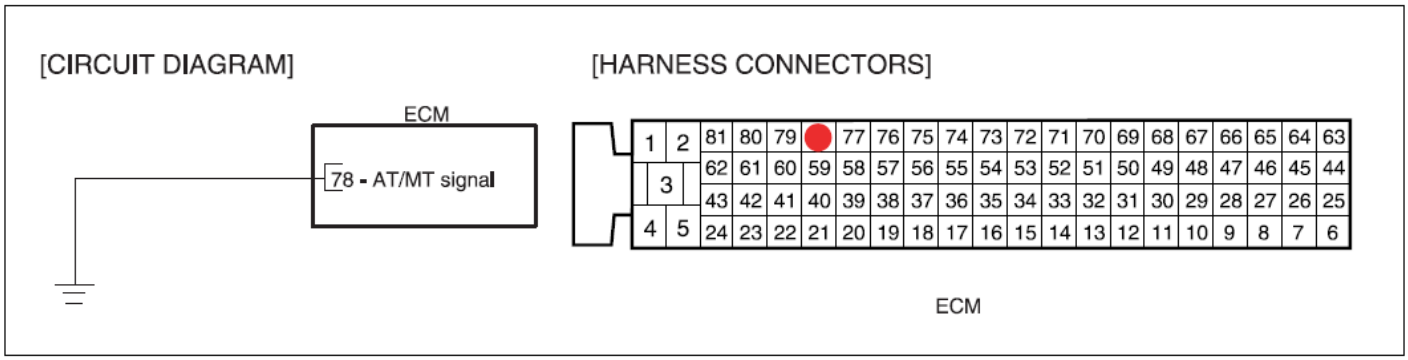
1. DTC Description

The ECM sets DTC P1586 if ECM detects that the circuit related AT-MT encoding is open circuit.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P1586	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - 2000 rpm < Engine speed < 5000 rpm - Relative engine load > 40.5% - Exhaust coolant temperature > 60°C • Threshold Value - Condition of driving position is detected at MT vehicle or condition of driving position is not detected at AT vehicle.	• Open in circuit • ECM

SCHEMATIC DIAGRAM



INSPECTION PROCEDURE

1. PROBLEM VERIFICATION

1. Turn ignition switch to ON position.
2. Using a Hi-Scan (Pro), monitor DTC status again after erasing DTC.

Is DTC status OK?

No

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

2. CHECK TPS AND ECM CONNECTORS

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

Are all connectors good?

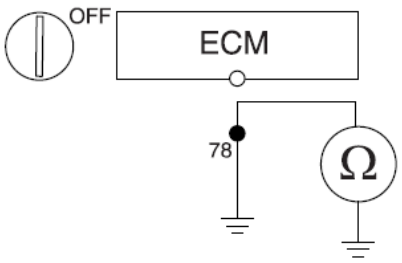
Yes

No	Repair or replace it.

3. CHECK FOR OPEN IN HARNESS

1. Turn ignition switch to OFF and disconnect ECM connector.
2. Measure resistance between the terminal 78 of ECM harness connector and chassis ground.
   - **Specification: Approximately below 1Ω**

Is each resistance within specification?



Yes

No	Replace open in harness.

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

TROUBLESHOOTING FOR DTC

DTC	P1602	CAN Communication Problem with TCM (Time out)

DESCRIPTION

A communication line exists between the Engine Control Module (ECM) and the Transmission Control Module (TCM). The communication is through a Control Area Network (CAN).

DTC DETECTING CONDITION

1. DTC Description

The ECM monitors CAN message transferred from TCM and sets DTC P1602 if ECM does not get any message during predetermined period.
If the same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P1602	Detecting Condition • DTC Strategy - Signal check, Low - Signal check, High - Signal interruption - Rationality check • Enable condition - Battery voltage > 10.8 V - After start : 500 ms • Threshold Value - No message from TCM > 500 ms - Signal interruption	• TCM • ECM

INSPECTION PROCEDURE

1. CHECK ECM SOFTWARE VERSION

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

Is the version newest one?

Yes

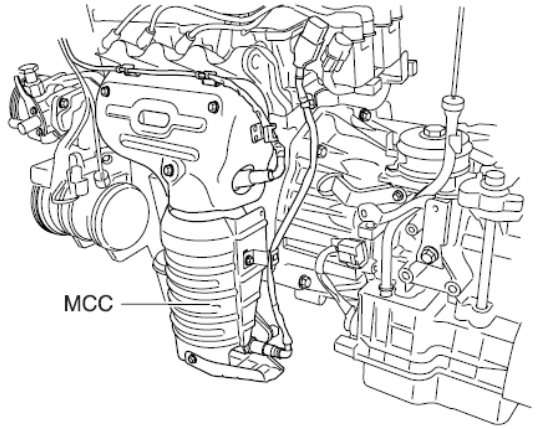
No	Upgrade the ECM software.

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

TROUBLESHOOTING FOR DTC

DTC	P2096	Fuel Trim Malfunction - System Too Lean (Downstream)

COMPONENT LOCATION



DESCRIPTION

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 the fuel delivery based on the HO2S signal voltage in closed loop fuel control. Changes in fuel delivery will be indicated by the short-term and the long-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 value reaches excessive levels because of a lean or rich condition.

DTC DETECTING CONDITION

1. DTC Description

The ECM monitors the trim of lambda control by the rear HO2S signal in addition to the HO2S monitoring. The trim value calculation is based on the difference of rear HO2S signal from desired value. The ECM sets DTC P2096 if either trim value or the difference of rear HO2S from desired value is reached to the maximum threshold. If the same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P2096	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - 1800 rpm < Engine speed < 3400 rpm - Engine load > 25% - Catalyst temp. < 60°C or > 300°C • Threshold Value - Second lambda controller from downstream lambda control> 1.2 s	• Catalytic converter • Rear HO2S • ECM

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO CATALYST AND REAR HO2S

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Turn the ignition switch ON and monitor any other DTCs relating to catalyst or rear HO2S.

Is there any DTC relevant to catalyst or rear HO2S?

No

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

2. VISUALLY CHECK CATALYST AND REAR HO2S CONDITIONS

1. Thoroughly check the catalyst and rear HO2S for contamination, deterioration or damage.

Is HO2S contaminated, deteriorated or damaged?

No

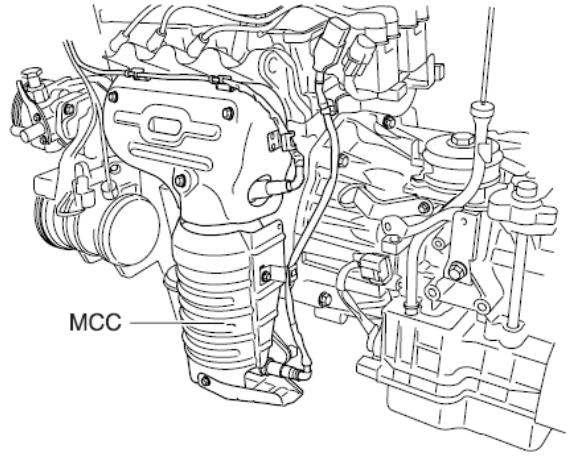
Yes	Repair or replace it.

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

TROUBLESHOOTING FOR DTC

DTC	P2097	Fuel Trim Malfunction - System Too Rich (Downstream)

COMPONENT LOCATION



DESCRIPTION

Refer to DTC P2096

DTC DETECTING CONDITION

1. DTC Description

The ECM monitors the trim of lambda control by the rear HO2S signal in addition to the HO2S monitoring. The trim value calculation is based on the difference of rear HO2S signal from desired value. The ECM sets DTC P2096 if either trim value or the difference of rear HO2S from desired value is reached to the maximum threshold. If the same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P2097	Detecting Condition • DTC Strategy - Signal check, Low • Enable condition - 1800 rpm < Engine speed < 3400 rpm - 25% < Engine load < 60% - Catalyst temp. > 300°C • Threshold Value - Second lambda controller from downstream lambda control < -1.2 s	• Catalytic converter • Rear HO2S • ECM

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO CATALYST AND REAR HO2S

1. Connect a Hi-Scan (Pro) to the data link connector.
2. Turn the ignition switch ON and monitor any other DTCs relating to catalyst or rear HO2S.

Is there any DTC relevant to catalyst or rear HO2S?

No	
Yes	Do all repairs associated with those codes before proceeding with this procedure.

2. VISUALLY CHECK CATALYST AND REAR HO2S CONDITIONS

1. Thoroughly check the catalyst and rear HO2S for contamination, deterioration or damage.

Is HO2S contaminated, deteriorated or damaged?

No	
Yes	Repair or replace it.

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

TROUBLESHOOTING FOR DTC

DTC	P2187	Fuel Trim Malfunction - System Too Lean at Idle (Upstream)

DESCRIPTION

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 DETECTING CONDITION

1. DTC Description

Breaking the lambda adaptation and lambda controller limits for a long time, which may have been caused by failures in the fuel or intake system will involve emission rise and therefore shall be diagnosed by fuel system monitoring. The lambda controller deviations, including adaptive terms, are used for fuel system monitoring. The time counter is increased if lambda controller exceeds the threshold and the ECM sets DTC P2187 or P2188 respectively depending on direction of lambda controller deviation. P2187 is set with positive deviation and P2188 is set with negative deviation. If same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P2187	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - Engine coolant temperature > 70C - Intake air temperature < 80C - Throttle angle not full load - Integrated air mass > 10 grams - No transient control phase - Purge control : inactive - Lambda control : active - Lambda adaptation : active - Low air mass : 1120 rpm < Engine rpm < 4000 rpm, 22 kg/h < air mass < 90 kg/h, 30% < relative load < 70% High air mass : Relative load > 60%, air mass > 170 kg/h • Threshold Value - Additive lambda adaptation factor > 7.5%	• PCSV • Intake system • Exhaust system • Fuel delivery system • MAPS • Front HO2S • TPS • ECM

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO INJECTOR, HO2S, ECTS, OR MAPS

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

Are DTCs relating to injector, HO2S, ECTS, or MAPS also set?

No

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

2. CHECK FUEL/SEALS/GASKETS FOR CONTAMINATION AND/OR LEAK

1. Visually/physically inspect the following items :
   - Throttle body gasket
   - Gasket between intake manifold and cylinder head
   - Seals between intake manifold and fuel injectors
   - Seals between surge tank and PCV valves
   - Crankcase ventilation valve and/or system for leaks
   - Contaminated fuel
   - Oil filler cap
   - Oil level gage

Are all items okay?

Yes

No	Repair or replace it.

3. CHECK AIR CLEANER/MAFS/EXHAUST SYSTEM

1. Visually/physically inspect the following items :
   - Air cleaner element for being restricted.
   - Inspect Manifold Absolute Pressure Sensor (MAPS)
   - Check for exhaust gas leakage
   - Check for main relay circuit (Open or short circuit)

Are all items okay?

Yes

No	Repair or replace it.

4. CHECK CONNECTIONS

1. Check vacuum hoses for splits and proper connections.
   (Especially PCSV, throttle body, intake manifold, and brake booster).

Are all connections okay?

Yes

No	Repair or replace it.

5. CHECK VACUUM AT PCSV

1. Disconnect PCSV connector and EVAP. hose (PCSV side) between PCSV and canister.
2. Start engine and check vacuum at PCSV at idle.

NOTE

In 40 seconds after starting the engine (the engine is already warmed up), PCSV operates. So this test must be terminated for 40 seconds.

Is vacuum present?

No

Yes	PCSV or circuit failure. Repair according to DTC P0444 and P0445 repair procedures.

6. CHECK FUEL LINE PRESSURE

1. Reconnect the ignition coils and spark plug connectors.
2. Release the fuel pressure and attach the fuel pressure gauge.
3. Start the engine and warm it up to operating temperature.
4. Check fuel line pressure at idle.
   - **Refer to "FUEL PREESURE TEST" in FUEL DELIVERY SYSTEM.**

Is fuel line pressure correct with ignition switch ON?

Yes

No	Check fuel delivery system. (Refer to "FUEL PREESURE TEST" in FUEL DELIVERY SYSTEM)

7. CHECK INJECTOR FOR NORMAL OPERATION

1. Start engine and check engine RPM decrease when disconnecting each injector connector in sequence.
2. Measure the decreasing engine RPM of all cylinders.

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

No

Yes	Repair or replace it.

8. CHECK ECM INPUT SIGNALS

1. Check for ECM input signal from MAPS, HO2S, TPS and other input signals.

Are input signals within specification?

Yes

No	Replace all failed parts.

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

TROUBLESHOOTING FOR DTC

DTC	P2188	Fuel Trim Malfunction - System Too Rich at Idle (Upstream)

DESCRIPTION

Refer to DTC P2187

DTC DETECTING CONDITION

1. DTC Description

Breaking the lambda adaptation and lambda controller limits for a long time, which may have been caused by failures in the fuel or intake system will involve emission rise and therefore shall be diagnosed by fuel system monitoring. The lambda controller deviations, including adaptive terms, are used for fuel system monitoring. The time counter is increased if lambda controller exceeds the threshold and the ECM sets DTC P2187 or P2188 respectively depending on direction of lambda controller deviation. P2187 is set with positive deviation and P2188 is set with negative deviation. If same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P2188	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption - Rationality check • Enable condition - Engine coolant temperature > 70C - Intake air temperature < 80C - Throttle angle not full load - Integrated air mass > 10 grams - No transient control phase - Purge control : inactive - Lambda control : active - Lambda adaptation : active - Low air mass : 1120 rpm < Engine rpm < 4000 rpm, 22 kg/h < air mass < 90 kg/h, 30% < relative load < 70% High air mass : Relative load > 60%, air mass > 170 kg/h • Threshold Value - Additive lambda adaptation factor > 7.5%	• PCSV • Intake system • Exhaust system • Fuel delivery system • MAPS • Front HO2S • TPS • ECM

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO INJECTOR, HO2S, ECTS, OR MAPS

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

Are DTCs relating to injector, HO2S, ECTS, or MAPS also set?

No

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

2. CHECK AIR CLEANER/MAFS

1. Visually/physically inspect the following items :
   - **Air cleaner element for restrictions.**
   - **MAPS for proper installation and foreign objects**

Are all items okay?

Yes

No	Repair or replace it.

3. CHECK FUEL LINE PRESSURE

1. Reconnect the ignition coils and spark plug connectors.
2. Release the fuel pressure and attach the fuel pressure gauge to the service port on the fuel rail.
3. Start the engine and warm it up to operating temperature.
4. Check fuel line pressure at idle.
   - **Refer to "FUEL PREESURE TEST" in FUEL DELIVERY SYSTEM.**

Is fuel line pressure correct with ignition switch ON?

Yes

No	Check fuel delivery system. (Refer to "FUEL PREESURE TEST" in FUEL DELIVERY SYSTEM)

4. CHECK INJECTOR FOR NORMAL OPERATION

1. Start engine and check engine RPM decrease when disconnecting each injector connector in sequence.
2. Measure the decreasing engine RPM of all cylinders.

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

No

Yes	Repair or replace it.

5. CHECK ECM INPUT SIGNALS

1. Check for ECM input signal from MAPS, HO2S, TPS and other input signals.

Are input signals within specification?

Yes	No	Replace all failed parts.

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

TROUBLESHOOTING FOR DTC

DTC	P2191	Fuel Trim Malfunction - System Too Lean at Higher Load (Upstream)

DESCRIPTION

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 DETECTING CONDITION

1. DTC Description

Breaking the lambda adaptation and lambda controller limits for a long time, which may have been caused by failures in the fuel or intake system will involve emission rise and therefore shall be diagnosed by fuel system monitoring. The lambda controller deviations including adaptive terms are used for fuel system monitoring. The time counter is increased if lambda controller exceeds the threshold and the ECM sets DTC P2191or P2192 respectively depending on direction of lambda controller deviation. P2191 is set with positive deviation and P2192 is set with negative deviation. If same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P2191	Detecting Condition • DTC Strategy - Signal check, High • Enable condition - Engine coolant temperature > 70C - Intake air temperature < 80C - Throttle angle not full load - Integrated air mass > 10 grams - No transient control phase - Purge control : inactive - Lambda control : active - Lambda adaptation : active - Low air mass : 1120 rpm < Engine rpm < 4000 rpm, 22 kg/h < air mass < 90 kg/h, 30% < relative load < 70% High air mass : Relative load > 60%, air mass > 170 kg/h • Threshold Value - Multiplicative lambda adaptation factor (low air mass) > 1.25	• PCSV • Intake system • Exhaust system • Fuel delivery system • MAPS • Front HO2S • TPS • ECM

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO INJECTOR, HO2S, ECTS, OR MAPS

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

Are DTCs relating to injector, HO2S, ECTS, or MAPS also set?

No

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

2. CHECK FUEL/SEALS/GASKETS FOR CONTAMINATION AND/OR LEAK

1. Visually/physically inspect the following items :
   - Throttle body gasket
   - Gasket between intake manifold and cylinder head
   - Seals between intake manifold and fuel injectors
   - Seals between surge tank and PCV valves
   - Crankcase ventilation valve and/or system for leaks
   - Contaminated fuel
   - Oil filler cap
   - Oil level gage

Are all items okay?

Yes

No	Repair or replace it.

3. CHECK AIR CLEANER/MAFS/EXHAUST SYSTEM

1. Visually/physically inspect the following items :
   - Air cleaner element for being restricted.
   - Inspect Manifold Absolute Pressure Sensor (MAPS)
   - Check for exhaust gas leakage
   - Check for main relay circuit (Open or short circuit)

Are all items okay?

Yes

No	Repair or replace it.

4. CHECK CONNECTIONS

1. Check vacuum hoses for splits and proper connections.
   (Especially PCSV, throttle body, intake manifold, and brake booster).

Are all connections okay?

Yes

No	Repair or replace it.

5. CHECK VACUUM AT PCSV

1. Disconnect PCSV connector and EVAP. hose (PCSV side) between PCSV and canister.
2. Start engine and check vacuum at PCSV at idle.

NOTE

In 40 seconds after starting the engine (the engine is already warmed up), PCSV operates. So this test must be terminated for 40 seconds.

Is vacuum present?

No

Yes	PCSV or circuit failure. Repair according to DTC P0444 and P0445 repair procedures.

6. CHECK FUEL LINE PRESSURE

1. Reconnect the ignition coils and spark plug connectors.
2. Release the fuel pressure and attach the fuel pressure gauge.
3. Start the engine and warm it up to operating temperature.
4. Check fuel line pressure at idle.
   - **Refer to "FUEL PREESURE TEST" in FUEL DELIVERY SYSTEM.**

Is fuel line pressure correct with ignition switch ON?

Yes

No	Check fuel delivery system. (Refer to "FUEL PREESURE TEST" in FUEL DELIVERY SYSTEM)

7. CHECK INJECTOR FOR NORMAL OPERATION

1. Start engine and check engine RPM decrease when disconnecting each injector connector in sequence.
2. Measure the decreasing engine RPM of all cylinders.

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

No

Yes	Repair or replace it.

8. CHECK ECM INPUT SIGNALS

1. Check for ECM input signal from MAPS, HO2S, TPS and other input signals.

Are input signals within specification?

Yes

No	Replace all failed parts.

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

TROUBLESHOOTING FOR DTC

DTC	P2192	Fuel Trim Malfunction - System Too Rich at Higher Load (Upstream)

DESCRIPTION

Refer to DTC P2191

DTC DETECTING CONDITION

1. DTC Description

Breaking the lambda adaptation and lambda controller limits for a long time, which may have been caused by failures in the fuel or intake system will involve emission rise and therefore shall be diagnosed by fuel system monitoring. The lambda controller deviations including adaptive terms are used for fuel system monitoring. The time counter is increased if lambda controller exceeds the threshold and the ECM sets DTC P2191 or P2192 respectively depending on direction of lambda controller deviation. P2191 is set with positive deviation and P2192 is set with negative deviation. If same error code is set in the next driving cycle, the ECM illuminates the MIL.

2. Conditions for Setting the DTC

DTC	Detecting Condition	Possible Cause
P2192	Detecting Condition • DTC Strategy - Signal check, Low - Signal interruption - Rationality check • Enable condition - Engine coolant temperature > 70C - Intake air temperature < 80C - Throttle angle not full load - Integrated air mass > 10 grams - No transient control phase - Purge control : inactive - Lambda control : active - Lambda adaptation : active - Low air mass : 1120 rpm < Engine rpm < 4000 rpm, 22 kg/h < air mass < 90 kg/h, 30% < relative load < 70% High air mass : Relative load > 60%, air mass > 170 kg/h • Threshold Value - Multiplicative lambda adaptation factor (low air mass) < 0.75	• PCSV • Intake system • Exhaust system • Fuel delivery system • MAPS • Front HO2S • TPS • ECM

INSPECTION PROCEDURE

1. CHECK DTC RELATING TO INJECTOR, HO2S, ECTS, OR MAPS

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

Are DTCs relating to injector, HO2S, ECTS, or MAPS also set?

No

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

2. CHECK AIR CLEANER/MAFS

1. Visually/physically inspect the following items :
   - **Air cleaner element for restrictions.**
   - **MAPS for proper installation and foreign objects**

Are all items okay?

Yes

No	Repair or replace it.

3. CHECK FUEL LINE PRESSURE

1. Reconnect the ignition coils and spark plug connectors.
2. Release the fuel pressure and attach the fuel pressure gauge to the service port on the fuel rail.
3. Start the engine and warm it up to operating temperature.
4. Check fuel line pressure at idle.
   - **Refer to "FUEL PREESURE TEST" in FUEL DELIVERY SYSTEM.**

Is fuel line pressure correct with ignition switch ON?

Yes

No	Check fuel delivery system. (Refer to "FUEL PREESURE TEST" in FUEL DELIVERY SYSTEM)

4. CHECK INJECTOR FOR NORMAL OPERATION

1. Start engine and check engine RPM decrease when disconnecting each injector connector in sequence.
2. Measure the decreasing engine RPM of all cylinders.

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

No

Yes	Repair or replace it.

5. CHECK ECM INPUT SIGNALS

1. Check for ECM input signal from MAPS, HO2S, TPS and other input signals.

Are input signals within specification?

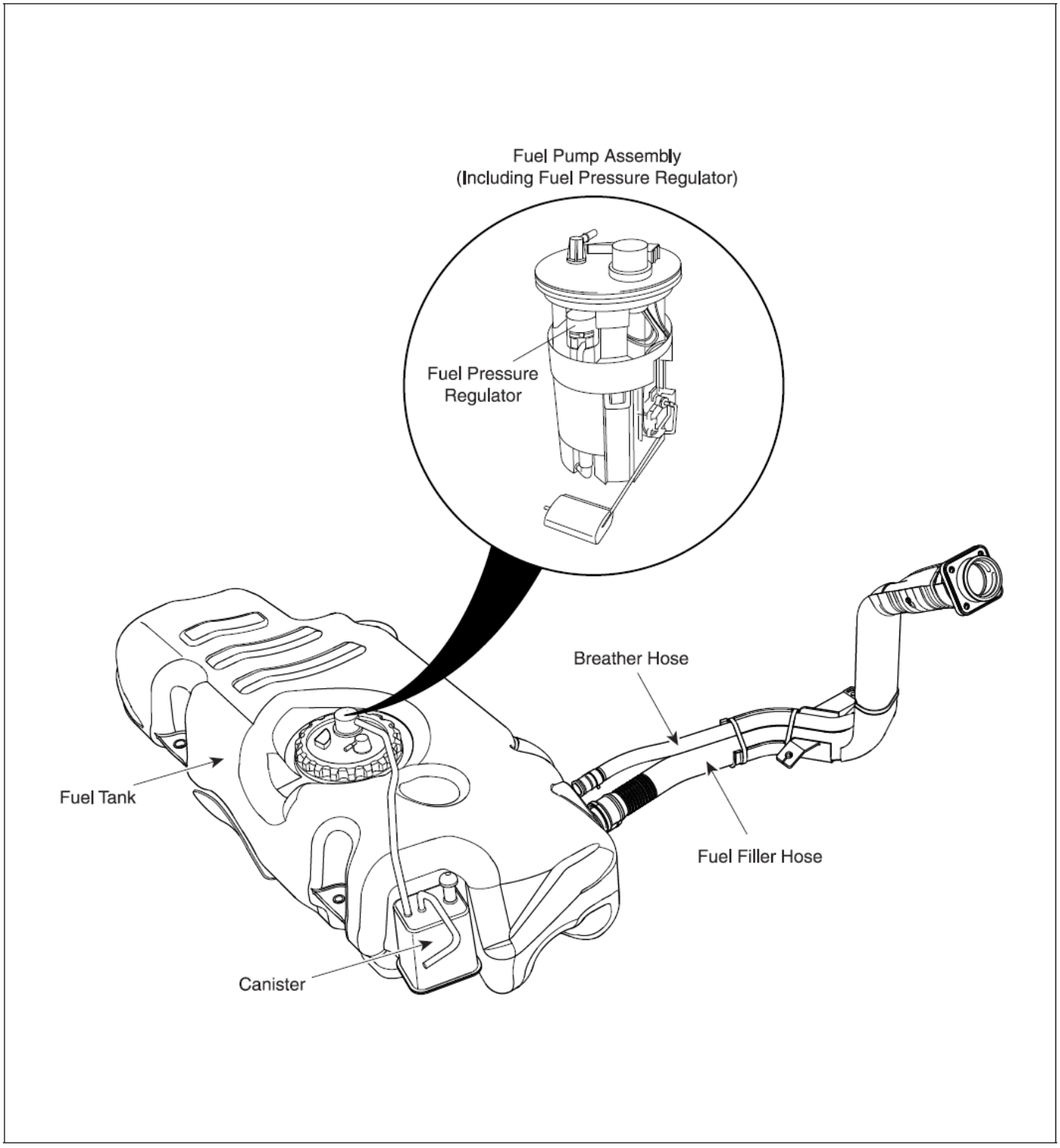
Yes

No	Replace all failed parts.

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

FUEL DELIVERY SYSTEM

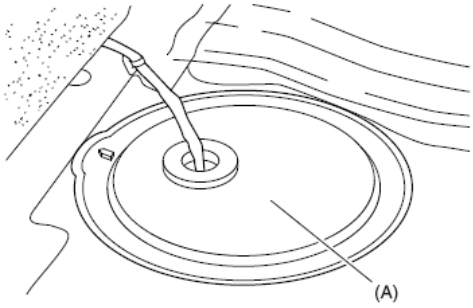
COMPONENTS



FUEL PRESSURE TEST

1. PREPARING

1. Disconnect the fuel pump electrical connection.

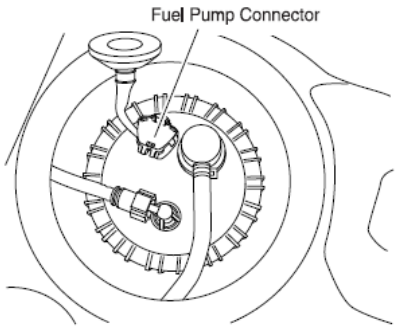


2. RELEASE THE INTERNAL PRESSURE

1. Disconnect the fuel pump connector.
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.



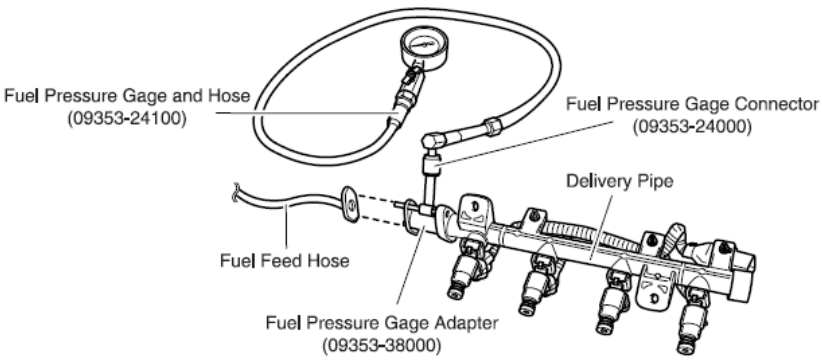
3. INSTALL THE SPECIAL SERVICE TOOL (SST) FOR MEASURING THE FUEL PRESSURE

1. Disconnect the fuel feed hose from the delivery pipe.

CAUTION

Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

2. Install the Fuel Pressure Gage Adapter (09353-38000) between the delivery pipe and the fuel feed hose.
3. Connect the Fuel Pressure Gage Connector (09353-24000) to the Fuel Pressure Gage Adapter (09353-38000).
4. Connect the Fuel Pressure Gage and Hose (09353-24100) to Fuel Pressure Gage Connector (09353-24000).
5. Connect the fuel feed hose to the Fuel Pressure Gage Adapter (09353-38000).



4. INSPECT FUEL LEAKAGE ON CONNECTION

1. Connect the battery negative (-) terminal.
2. Apply battery voltage to the fuel pump terminal and activate the fuel pump. With fuel pressure applied, check that there is no fuel leakage from the fuel pressure gauge or connection part.

5. FUEL PRESURE TEST

1. 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: 350 kpa (3.5 kg/㎠, 49.8 psi)

- If the measured fuel pressure differs from the standard value, perform the necessary repairs using the table below.

Condition	Probable Cause	Supected 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

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

After engine stops, the gage reading should hold for about 5 minutes

- Observing the declination of the fuel pressure when the gage reading drops and perform the necessary repairs using the table below.

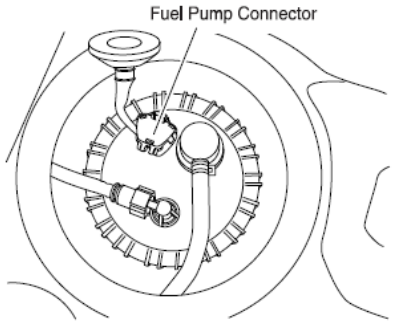
Condition	Probable Cause	Supected Area
Fuel pressure drops slowly after engine is stopped	Injector leak	Injector
Fuel pressure drops immediately after engine is stopped	The check valve within the fuel pump is open	Fuel Pump

6. RELEASE THE INTERNAL PRESSURE

1. Disconnect the fuel pump connector.
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.

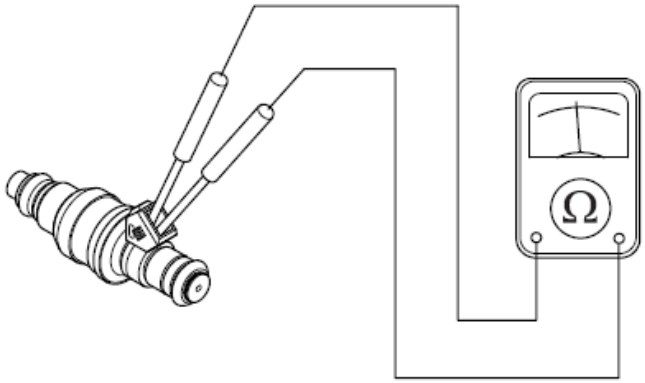
8. INSPECT FUEL LEAKAGE ON CONNECTION

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.

FUEL INJECTOR

INSPECTION

1. Measure resistance between the terminal 1 and 2 of the injector.



Specification (resistance): 13.8 ~ 15.2 Ω (at 20°C)

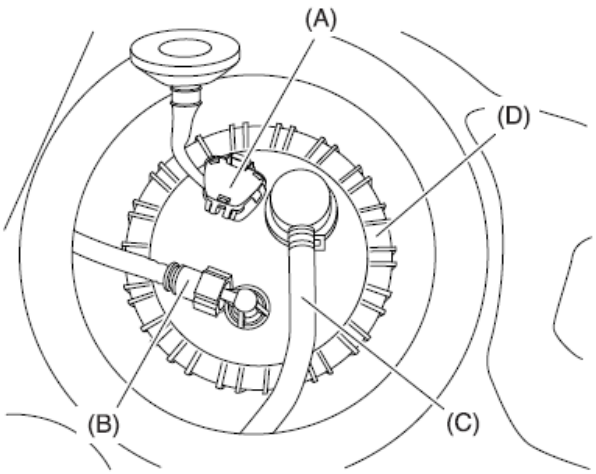
2. If the resistance is not within specification, replace the injector.

FUEL PUMP (FP)

REMOVAL (INCLUDING FUEL FILTER AND FUEL PRESSURE REGULATOR)

1. Refer to "BODY" group in this WORKSHOP MANUAL.

2. Release the internal pressure of the fuel lines and hoses as following:
   a. Disconnect the fuel pump assembly harness connector (A).
   b. Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, turn the ignition switch to OFF position.
   c. Disconnect the negative (-) terminal from the battery.



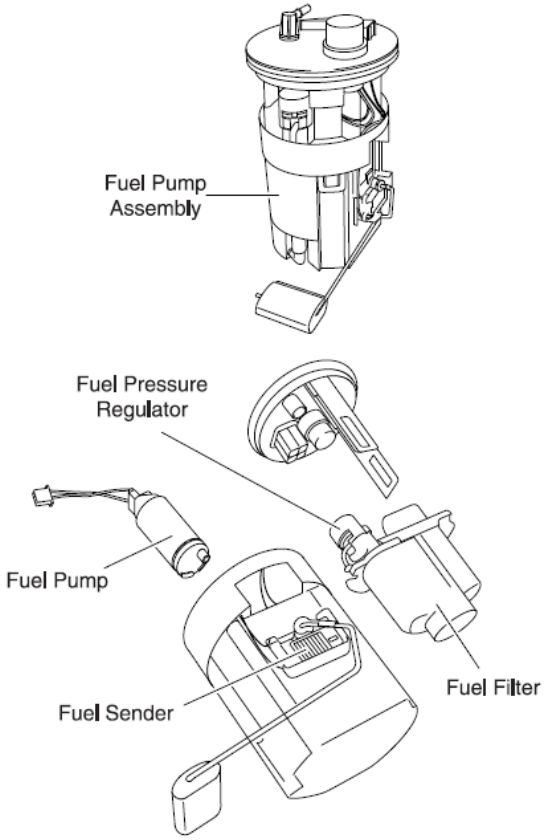
3. Disconnect the fuel feed line (B) and canister purge line quick-connector (C).

CAUTION

Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

4. Unfasten the fuel pump opening nut (D) with SST (Refer to “SPECIAL SERVICE TOOLS” section in this SERVICE MANUAL.)

5. Remove the fuel pump assembly.



FUEL TANK

REMOVAL

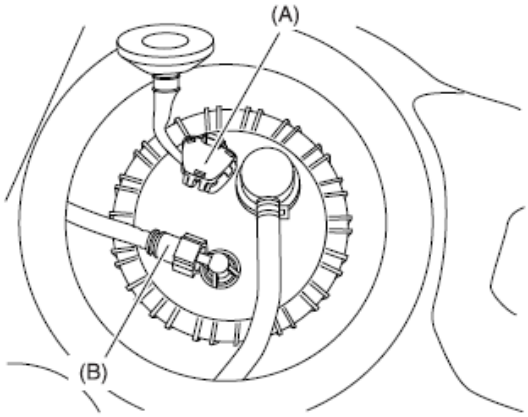
1. Refer to “BODY” group in this WORKSHOP MANUAL.

2. Release the internal pressure of the fuel lines and hoses as following:

a. Disconnect the fuel pump assembly harness connector (A).

b. Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, turn the ignition switch to OFF position.

c. Disconnect the negative (-) terminal from the battery.



3. Disconnect the fuel feed line (B).

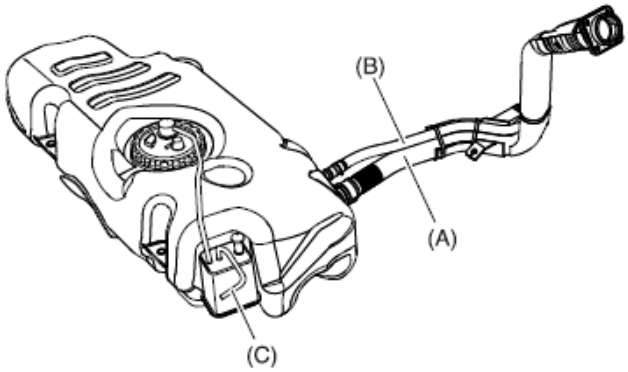
CAUTION

Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line

5. Lift the vehicle.

6. Remove the front muffler; center muffler and main muffler (Refer to "ENGINE MANUAL" group in this WORKSHOP MANUAL).

7. Disconnect the fuel filler hose (A), the breather hose (B) and the canister purge line quick-connector (C).



8. Unfasten the two fuel tank band mounting bolts, and then remove the fuel tank from the vehicle.