General Information

Specifications

Fuel Delivery System

Items	Specification	
Fuel Tank	Capacity	53lit. (14.0 U.S.gal., 11.7 Imp.gal.)
Fuel Filter (built in Fuel Pump Assembly)	Type	High pressure type
Fuel Pressure Regulator (built in Fuel Pump assembly)	Regulated Fuel Pressure	338 ~ 348kpa (3.45 ~ 3.55kgf/㎠, 49.0 ~ 50.5psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor
Fuel Retrun System	Type	Returnless

Sensors

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

▷ Type: Piezo-resistive pressure sensor type

▷ Specification

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

INTAKE AIR TEMPERATURE SENSOR (IATS)

▷ Type: Thermistor type

▷ Specification

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

ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

▷ Type: Thermistor type

▷ Specification

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

THROTTLE POSITION SENSOR (TPS)

▷ Type: Variable resistor type

▷ Specification

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

Items	Specification
Sensor Resistance (kΩ)	1.6 ~ 2.4

HEATED OXYGEN SENSOR (HO2S)

▷ Type: Zirconia (ZrO2) type

▷ Specification

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

Item	Resistance (Ω)
Heater Resistance (Ω)	Approx. 9.0 (20℃)

CAMSHAFT POSITION SENSOR (CMPS)

▷ Type: Hall effect type

CRANKSHAFT POSITION SENSOR (CKPS)

▷ Type: Magnetic field sensitive Type

KNOCK SENSOR (KS)

▷ Type: Piezo-electricity type

▷ Specification

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

Actuators

INJECTOR

▷ Number: 4

▷ Specification

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

IDLE SPEED CONTROL ACTUATOR (ISCA)

▷ Type: Double coil type

▷ Specification

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

Duty (%)	Air Flow Rate (㎥/h)
15	0.5 ~ 1.5
35	5.5 ~ 9.3
70	28.5 ~ 36.5
96	39.0 ~ 48.0

PURGE CONTROL SOLENOID VALVE (PCSV)

▷ Specification

Item	Specification
Coil Resistance (Ω)	16.0 [20℃ (68°F)]

CVVT OIL CONTROL VALVE (OCV)

▷ Specification

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

IGNITION COIL

▷ Type: Stick type

▷ Specification

Item	Specification
Primary Coil Resistance (Ω)	0.75Ω±15%[20℃ (68°F)]
Secondary Coil Resistance (kΩ)	Measurement is impossible because a diode is inserted

Service Standard

Ignition Timing	BTDC 5° ± 10°		
Idle Speed	A/CON OFF	Neutral,N,P-range	660 ± 100 rpm
		D-range	
	A/CON ON	Neutral,N,P-range	
		D-range	

Tightening Torques

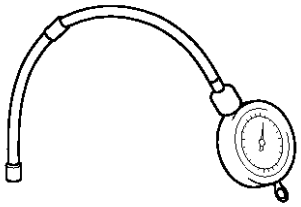
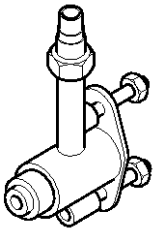
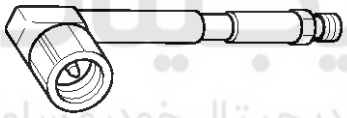
Engine Control System

Item	Kgf·m	N·m	lbf·ft
PCM/ECM installation bolts	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Manifold absolute pressure sensor installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Engine coolant temperature sensor installation	3.0 ~ 4.0	29.4 ~ 39.2	21.7 ~ 28.9
Throttle position sensor installation screws	0.15 ~ 0.25	1.5 ~ 2.5	1.1 ~ 1.8
Crankshaft position sensor installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Camshaft position sensor installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Knock sensor installation bolt	1.9 ~ 2.5	18.6 ~ 24.5	13.7 ~ 18.1
Heated oxygen sensor (Bank 1 / Sensor 1) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 1 / Sensor 2) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Idle speed control actuator installation screws	0.6 ~ 0.8	5.9 ~ 7.8	4.3 ~ 5.8
CVVT Oil control valve installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7

Fuel Delivery System

Item	Kgf·m	N·m	lbf·ft
Fuel pump installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Delivery pipe installation bolts	2.0 ~ 2.5	19.6 ~ 24.5	14.5 ~ 18.1
Delivery pipe stud bolts	1.37 ~ 1.67	13.4 ~ 16.4	9.9 ~ 12.1

Special Service Tools

Tool (Number and name)	Illustration	Application
09353-24100 Fuel Pressure Gauge		Measuring the fuel line pressure
09353-38000 Fuel Pressure Gauge Adapter		Connection between the delivery pipe and fuel feed line
09353-24000 Fuel Pressure Gauge Connector		Connection between Fuel Pressure Gauge (09353-24100) and Fuel Pressure Gauge 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 of the DTC**
	Try to recreate or simulate the symptoms and conditions of the malfunction as described by customer. If DTC(s) is/are displayed, simulate the condition according to troubleshooting procedure for the DTC.

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

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

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

11	**Perform troubleshooting procedure for DTC**

12	**Adjust or repair the vehicle**

13	**Confirm test**

14	**END**

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Customer Problem Analysis Sheet

1. VEHICLEINFORMAITON

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

2. SYMPTOMS

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

3. ENVIRONMENT

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

4. MIL/DTC

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

5. ECM/PCM INFORMATION

ECM/PCM Part No.	
ROM ID	

SCMFL6150L

Basic Inspection Procedure

Measuring Condition Of Electronic Parts' Resistance

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

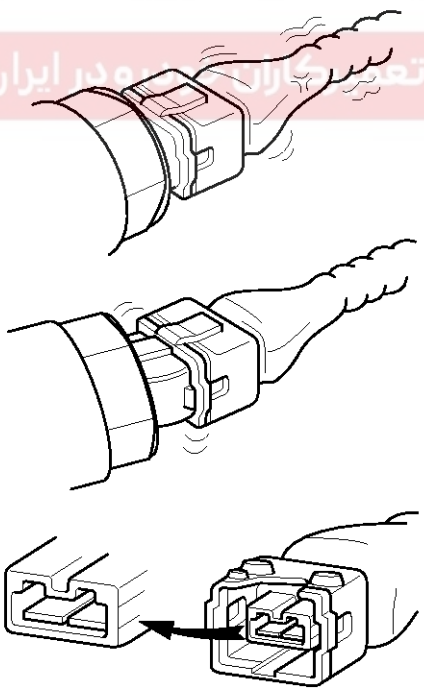
NOTICE

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

Intermittent Problem Inspection Procedure

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

1. Clear Diagnostic Trouble Code (DTC).
2. Inspect connector connection, and check terminal for poor connections, loose wires, bent, broken or corroded pins, and then verify that the connectors are always securely fastened.



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3. Slightly shake the connector and wiring harness vertically and horizontally.
4. Repair or replace the component that has a problem.
5. Verify that the problem has disappeared with the road test.

● SIMULATING VIBRATION

a. Sensors and Actuators

: Slightly vibrate sensors, actuators or relays with finger.

WARNING

Strong vibration may break sensors, actuators or relays

b. Connectors and Harness

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

● SIMULATING HEAT

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

WARNING

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

● SIMULATING WATER SPRINKLING

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

WARNING

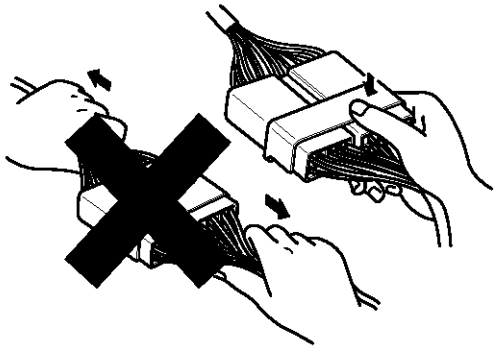
DO NOT sprinkle water directly into the engine compartment or electronic components.

● SIMULATING ELECTRICAL LOAD

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

Connector Inspection Procedure

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



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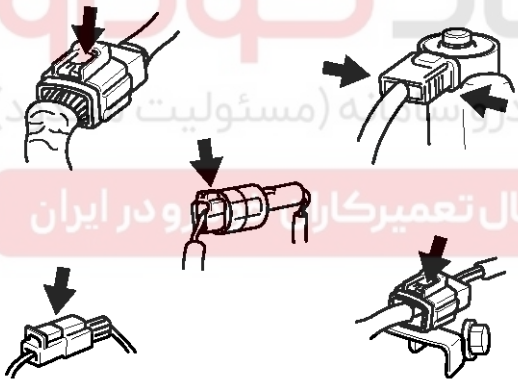
   b. When removing the connector with a lock, press or pull locking lever.



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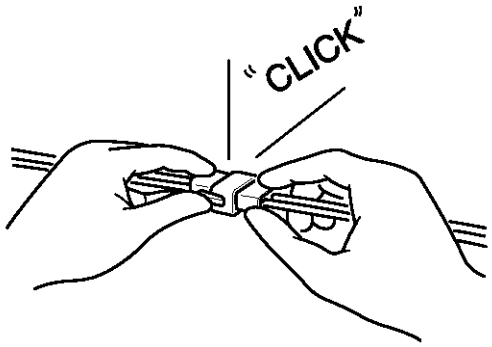
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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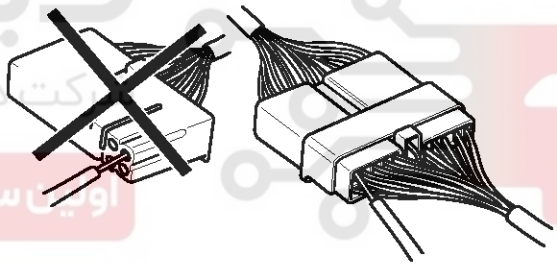
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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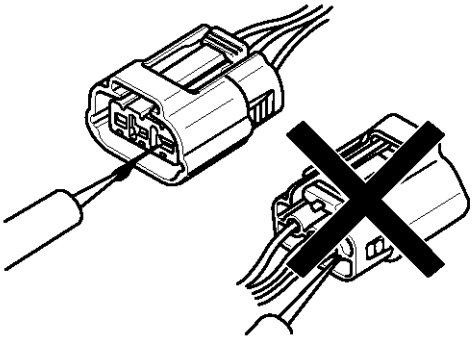
e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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NOTICE

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

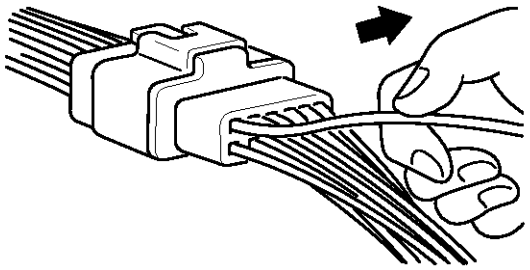
2. Checking Point for Connector

a. While the connector is connected:
Hold the connector, check connecting condition and locking efficiency.

b. When the connector is disconnected:
Check missed terminal, crimped terminal or broken core wire by slightly pulling the wire harness.
Visually check for rust, contamination, deformation and bend.

c. Check terminal tightening condition:
Insert a spare male terminal into a female terminal, and then check terminal tightening conditions.

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



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3. Repair Method of Connector Terminal

a. Clean the contact points using air gun and/or shop rag.

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

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

Wire Harness Inspection Procedure

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

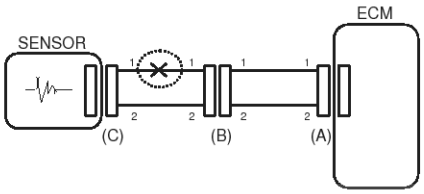
Electrical Circuit Inspection Procedure

● Check Open Circuit

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

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

FIG 1



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2. Continuity Check Method

NOTICE

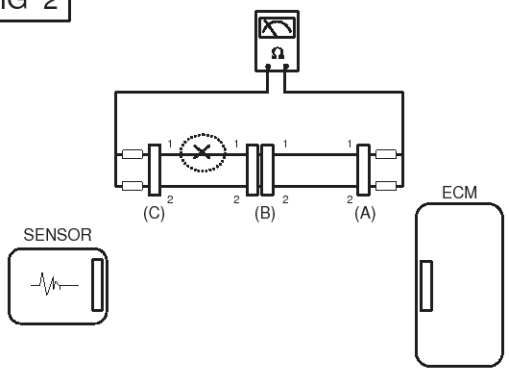
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

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

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

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

FIG 2



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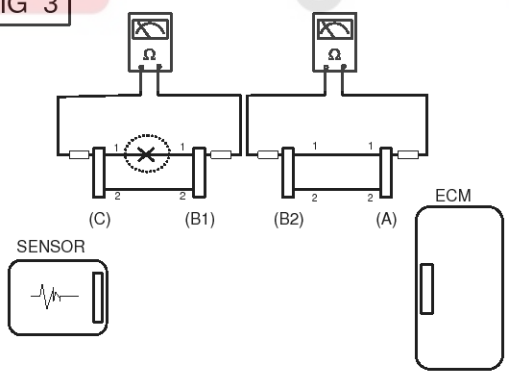
b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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

FIG 3



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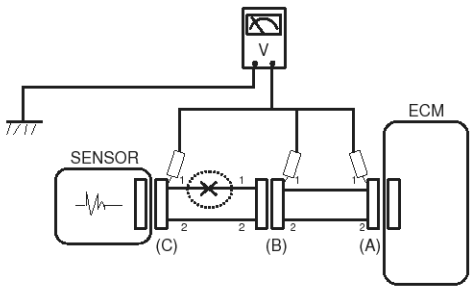
3. Voltage Check Method

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

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

FIG 4



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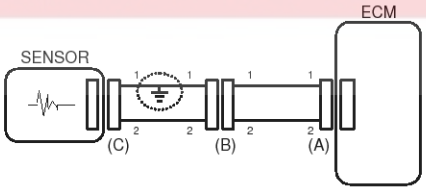
● Check Short Circuit

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

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

FIG 5



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2. Continuity Check Method (with Chassis Ground)

   NOTICE

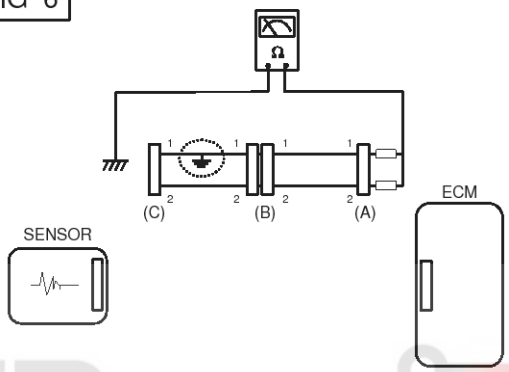
   Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

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

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

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

FIG 6



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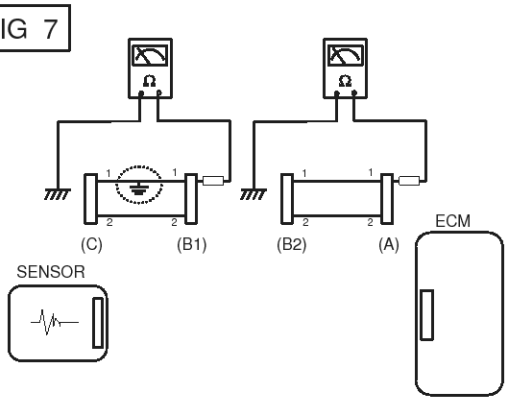
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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

FIG 7



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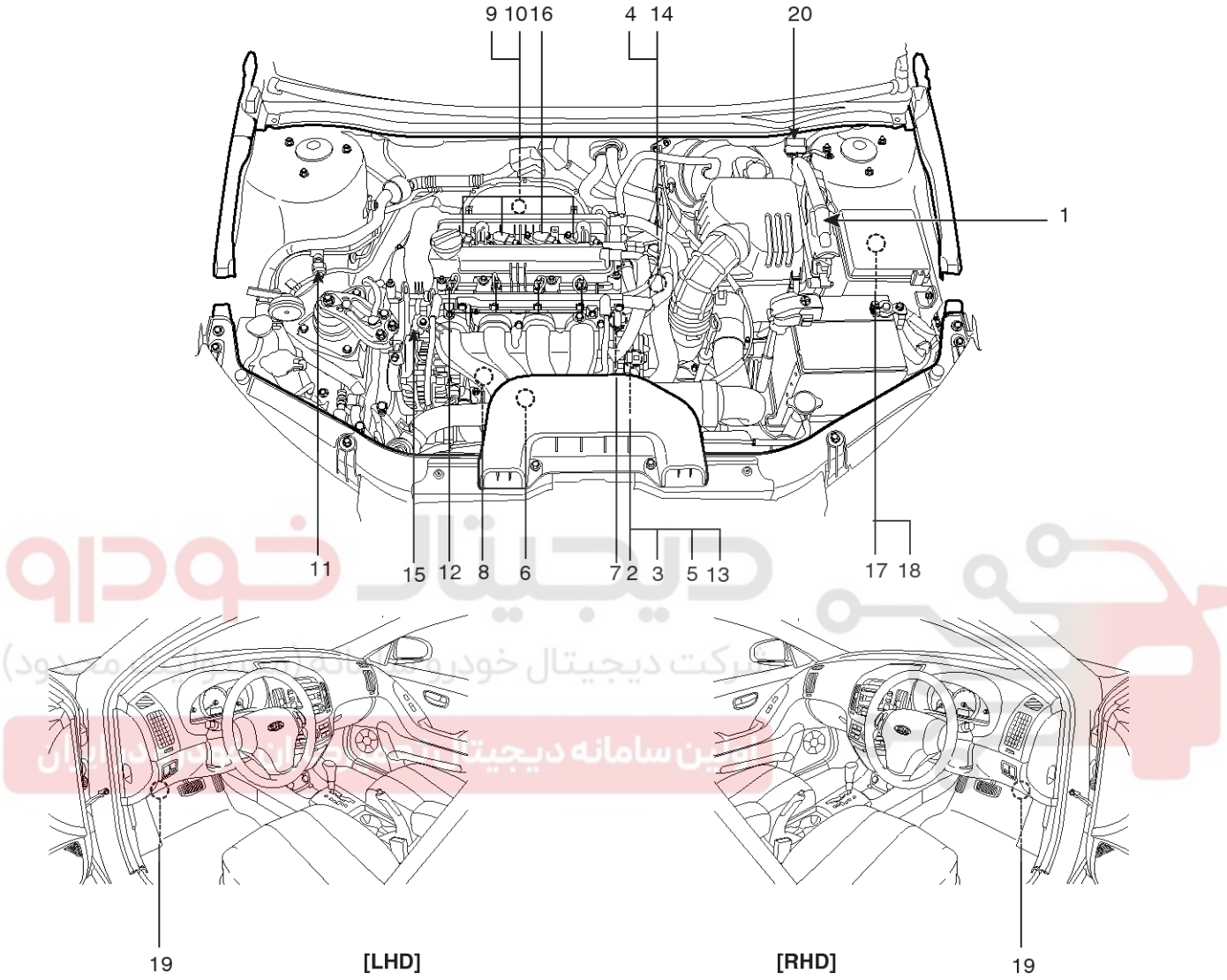
Symptom Troubleshooting Guide Chart

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

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

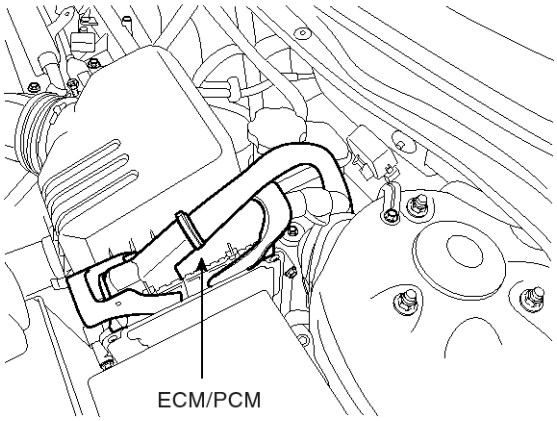
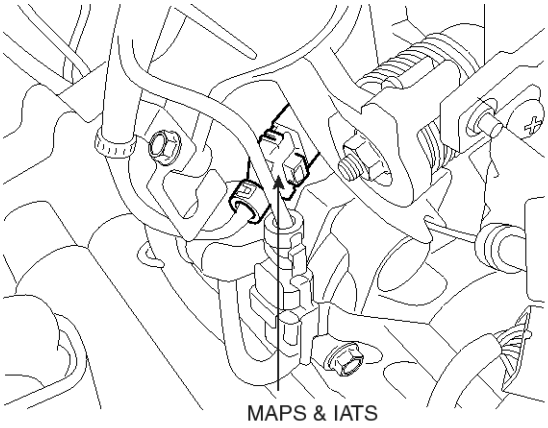
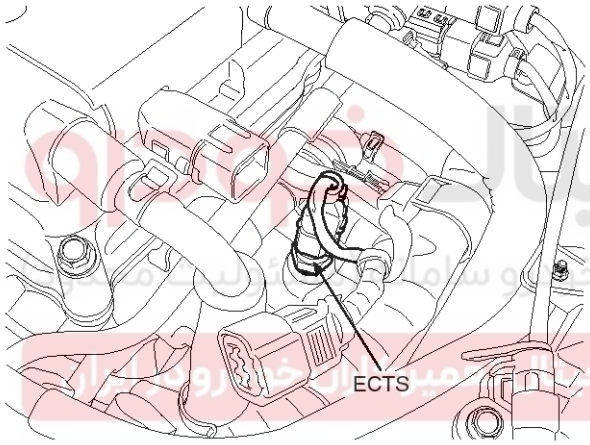
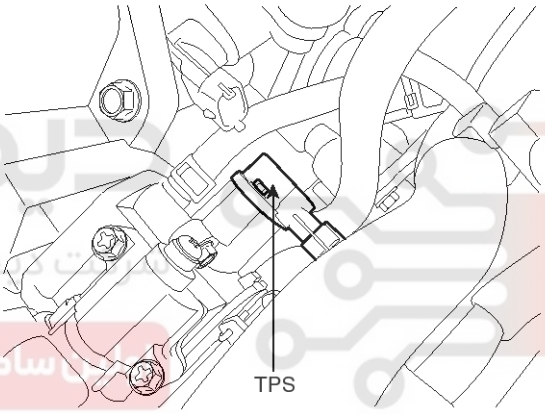
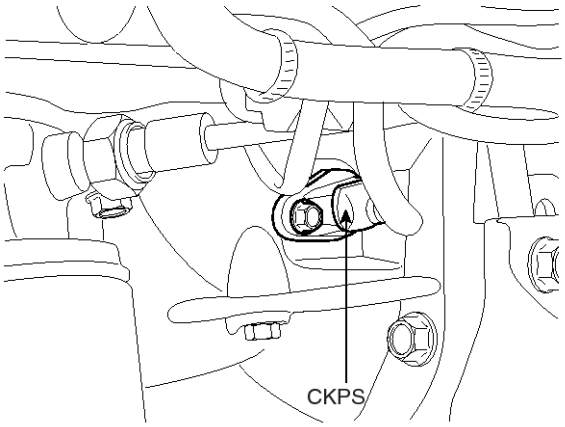
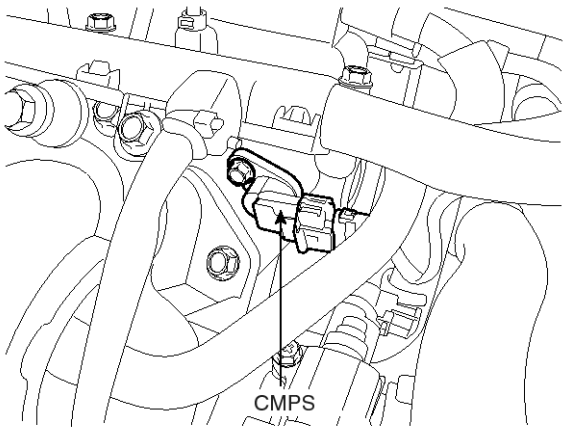
Engine Control System

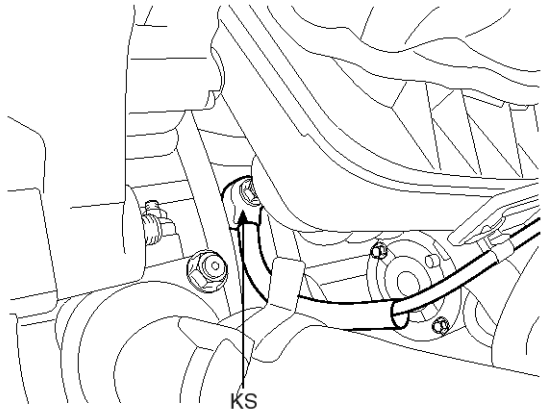
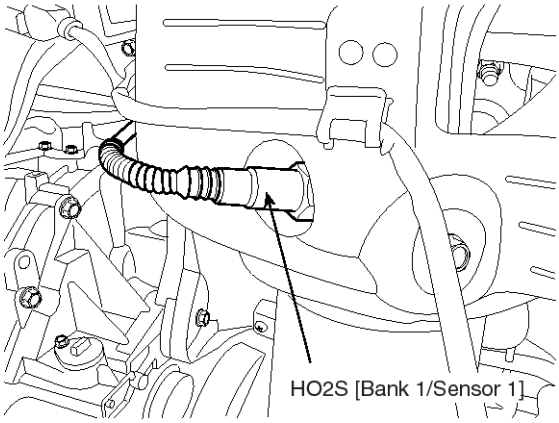
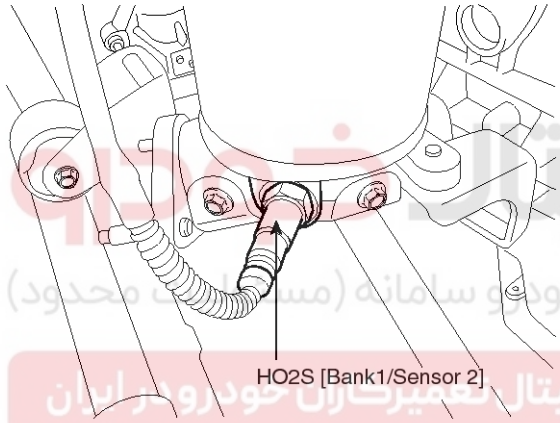
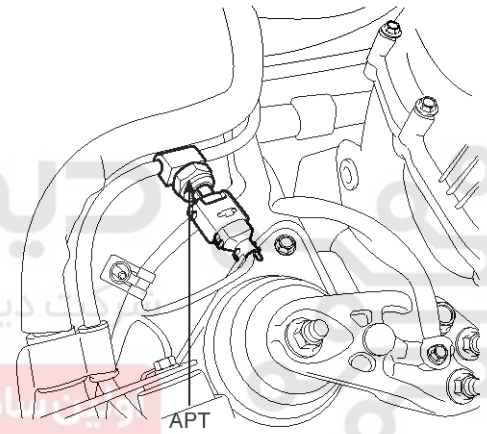
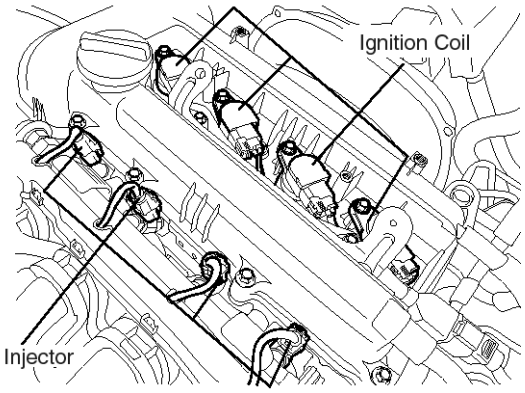
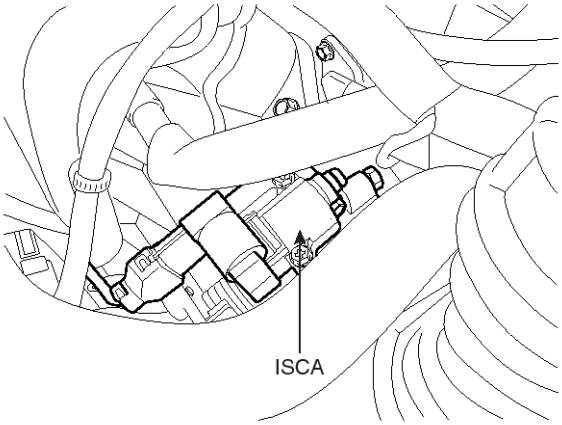
Components Location

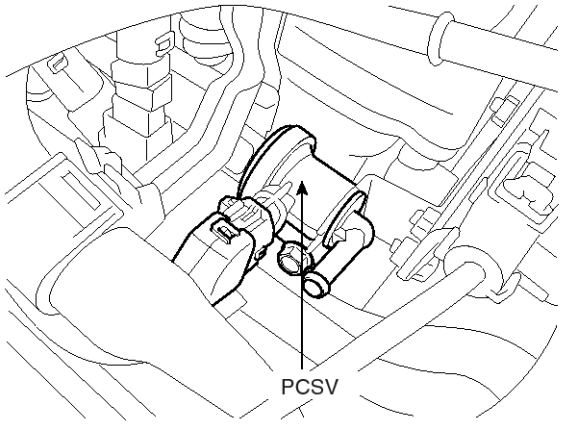
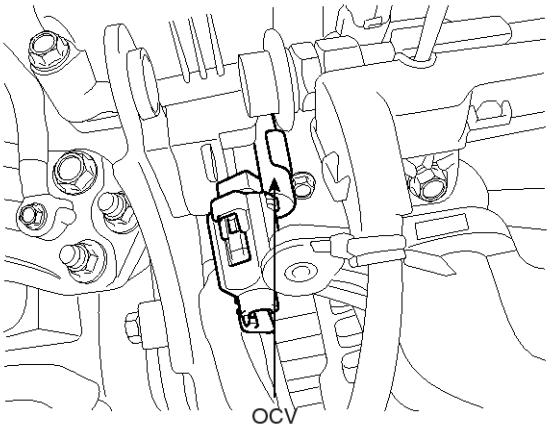
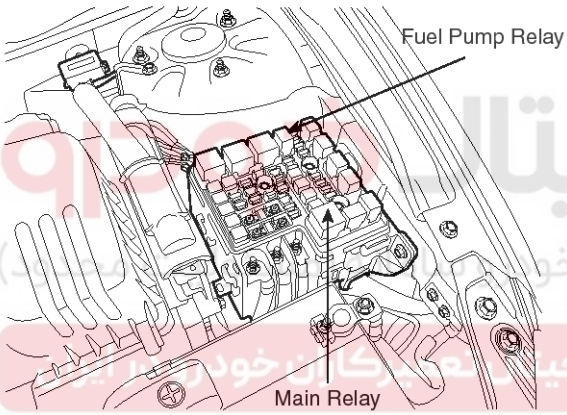


1. ECM (Engine Control Module) [M/T]
   PCM (Powertrain Control Module) [A/T]
2. Manifold Absolute Pressure Sensor (MAPS)
3. Intake Air Temperature Sensor (IATS)
4. Engine Coolant Temperature Sensor (ECTS)
5. Throttle Position Sensor (TPS)
6. Crankshaft Position Sensor (CKPS)
7. Camshaft Position Sensor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

SFDFL8001L

1. ECM (Engine Control Module) [M/T] PCM (Powertrain Control Module) [A/T]	2. Manifold Absolute Pressure Sensor (MAPS) 3. Intake Air Temperature Sensor (IATS)
	
4. Engine Coolant Temperature Sensor (ECTS)	5. Throttle Position Sensor (TPS)
	
6. Crankshaft Position Sensor (CKPS)	7. Camshaft Position Sensor (CMPS)
	

8. Knock Sensor (KS)	9. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
	
10. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]	11. A/C Pressure Transducer (APT)
	
12. Injector 16. Ignition Coil	13. Idle Speed Control Actuator (ISCA)
	

14. Purge Control Solenoid Valve (PCSV)	15. CVVT Oil Control Valve (OCV)
	
17. Main Relay 18. Fuel Pump Relay	
	

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 driveability

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

NOTICE

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

Malfunction Indicator Lamp (MIL) [EOBD]

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

Faults with the following items will illuminate the MIL.

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

NOTICE

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

NOTICE

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.

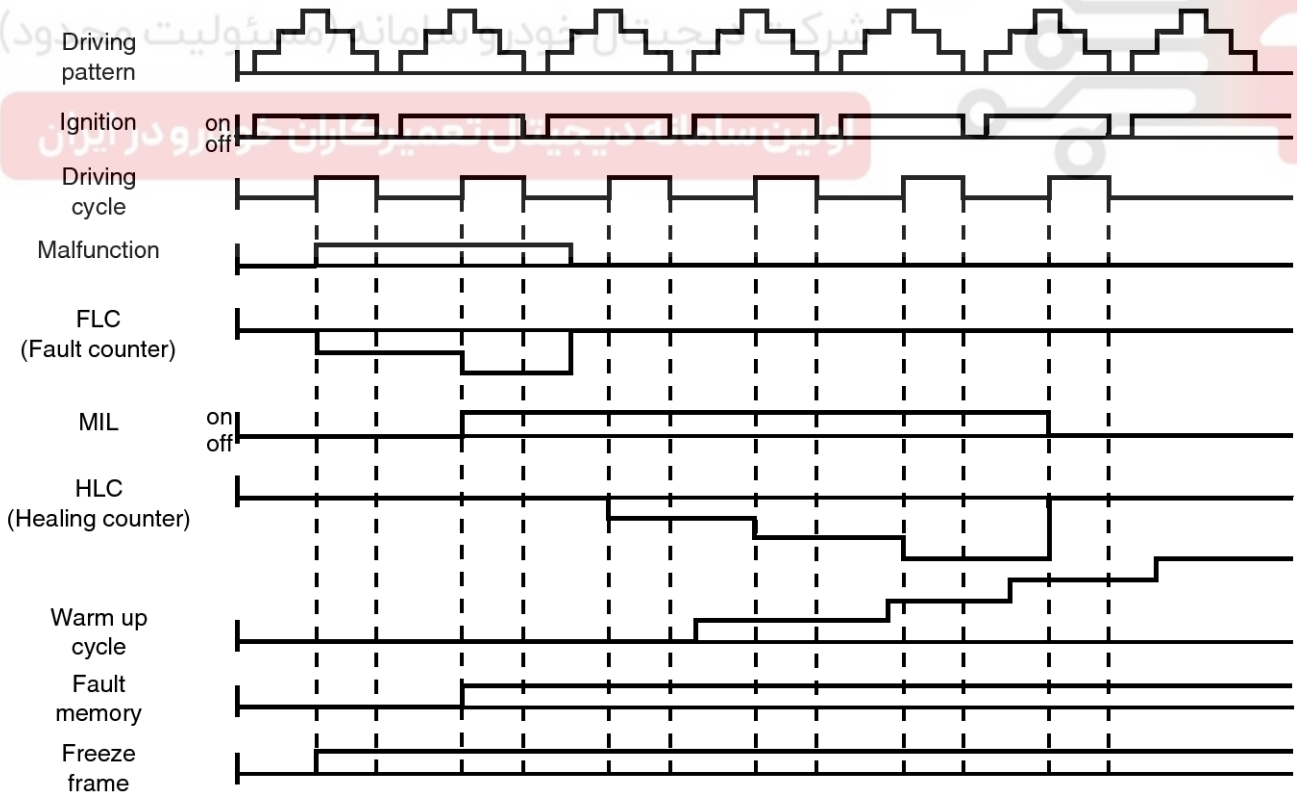
Self-Diagnosis

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).

NOTICE

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

The Relation Between DTC And Driving Pattern In Eobd System



LGIF601Q

1. When the same malfunction is detected and maintained during two sequential driving cycles, the MIL will automatically illuminate.
2. The MIL will go off automatically if no fault is detected after 3 sequential driving cycles.
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction is detected after two sequential driving cycles. The MIL will illuminate when the malfunction is detected on the second driving cycle.

   If a misfire is detected, a DTC will be recorded, and the MIL will illuminate, immediately after a fault is first detected.
4. A Diagnostic Trouble Code(DTC) will automatically erase from ECM memory if the same malfunction is not detected for 40 driving cycles.

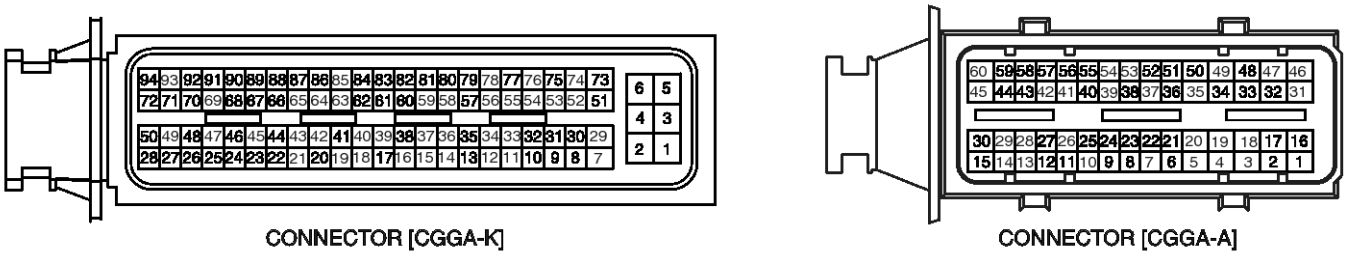
NOTICE

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

Powertrain Control Module (PCM)

Powertrain Control Module (PCM)

1. HARNESS CONNECTOR (A/T)



SHDFL6117L

2. TERMINAL FUNCTION (A/T)

Connector [CGGA-K]

Pin No.	Description	Connected to
1	Power Ground	Chassis Ground
2	Power Ground	Chassis Ground
3	Power Ground	Chassis Ground
4	For Autotransaxle Control	
5	For Autotransaxle Control	
6	Battery voltage supply after main relay	Main Relay
7	-	
8	Sensor ground	Manifold Absolute Pressure Sensor (MAPS)
9	Sensor ground	Heated Oxygen Sensor (Sensor 2)
10	Manifold Absolute Pressure Sensor signal input	Manifold Absolute Pressure Sensor (MAPS)
11	-	
12	-	
13	Heated Oxygen Sensor (Sensor 2) signal input	Heated Oxygen Sensor (Sensor 2)
14	-	
15	-	
16	-	
17	Alternator load signal input	Alternator
18	-	
19	-	
20	Vehicle speed signal input	ABS/ESP Control Module [With ABS/ESP]
21		
22	Electric Load signal input (Defrost)	

Pin No.	Description	Connected to
23	A/C switch "ON" signal input	A/C Switch
24	For Autotransaxle Control	
25	For Autotransaxle Control	
26	For Autotransaxle Control	
27	For Autotransaxle Control	
28	For Autotransaxle Control	
29		
30	Sensor ground	A/C Pressure Transducer (APT)
31	Sensor ground	Heated Oxygen Sensor (Sensor 1)
32	Intake Air Temperature Sensor signal input	Intake Air Temperature Sensor (IATS)
33	-	
34	-	
35	Heated Oxygen Sensor (Sensor 1) signal input	Heated Oxygen Sensor (Sensor 1)
36	-	
37	-	
38	Sensor ground	Camshaft Position Sensor (CMPS)
39	-	
40	-	
41	Camshaft Position Sensor signal input	Camshaft Position Sensor (CMPS)
42	-	
43	-	
44	-	
45	-	
46	A/C thermal switch signal input	A/C Thermal Switch
47	For Autotransaxle Control	
48	For Autotransaxle Control	
49	For Autotransaxle Control	
50	For Autotransaxle Control	
51	Sensor ground	Throttle Position Sensor (TPS)
52	-	
53	-	
54	-	
55	-	
56	-	

Pin No.	Description	Connected to
57	For Autotransaxle Control	
58	-	
59	-	
60	For Autotransaxle Control	
61	For Autotransaxle Control	
62	For Autotransaxle Control	
63	-	
64	For Autotransaxle Control	
65	For Autotransaxle Control	
66	For Autotransaxle Control	
67	For Autotransaxle Control	
68	For Autotransaxle Control	
69	-	
70	For Autotransaxle Control	
71	For Autotransaxle Control	
72	For Autotransaxle Control	
73	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
74	-	
75	Throttle Position Sensor signal input	Throttle Position Sensor (TPS)
76	-	
77	Engine Coolant Temperature Sensor signal input	Engine Coolant Temperature Sensor (ECTS)
78	-	
79	A/C Pressure Transducer signal input	A/C Pressure Transducer (APT)
80	For Autotransaxle Control	
81	For Autotransaxle Control	
82	For Autotransaxle Control	
83	For Autotransaxle Control	
84	For Autotransaxle Control	
85	-	
86	For Autotransaxle Control	
87	For Autotransaxle Control	
88	For Autotransaxle Control	
89	For Autotransaxle Control	
90	For Autotransaxle Control	

Pin No.	Description	Connected to
91	For Autotransaxle Control	
92	For Autotransaxle Control	
93	For Autotransaxle Control	
94	For Autotransaxle Control	

Connector [CGGA-A]

Pin No.	Description	Connected to
1	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2)
2	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4)
3	-	
4	-	
5	-	
6	Idle Speed Control Actuator [OPEN] control output	Idle Speed Control Actuator (ISCA)
7	-	
8	Purge Control Solenoid Valve control output	Purge Control Solenoid Valve (PCSV)
9	Main Relay control output	Main Relay
10	-	
11	Battery voltage supply after ignition switch	Ignition Switch
12	CAN [HIGH]	Other control module
13	-	
14	-	
15	Knock Sensor signal input	Knock Sensor (KS)
16	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3)
17	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1)
18	-	
19	-	
20	-	
21	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
22	Idle Speed Control Actuator [CLOSE] control output	Idle Speed Control Actuator (ISCA)
23	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
24	Fuel consumption signal output	Trip Computer
25	Engine speed signal output	Cluster (Tachometer)
26	-	
27	CAN [LOW]	Other control module

Pin No.	Description	Connected to
28	-	
29	-	
30	Sensor ground	Knock Sensor (KS)
31	-	
32	Immobilizer lamp control output	Immobilizer Lamp
33	Heated Oxygen Sensor (Sensor 2) Heater control output	Heated Oxygen Sensor (Sensor 2)
34	Heated Oxygen Sensor (Sensor 1) Heater control output	Heated Oxygen Sensor (Sensor 1)
35	-	
36	Injector (Cylinder #3) control output	Injector (Cylinder #3)
37	Fuel Pump Relay control output	Fuel Pump Relay
38	A/C Compressor Relay control output	A/C Compressor Relay
39	-	
40	Crankshaft Position Sensor [A] signal input	Crankshaft Position Sensor (CKPS)
41	-	
42	-	
43	Sensor power (+5V)	Manifold Absolute Pressure Sensor (MAPS)
44	Immobilizer communication line	Immobilizer Control Module
45	Wheel Speed Sensor [A] signal input	Wheel Speed Sensor (WSS) [Without ABS/ESP]
46	-	
47	-	
48	Injector (Cylinder #4) control output	Injector (Cylinder #4)
49	CVVT Oil Control Valve control output	CVVT Oil Control Valve (OCV)
50	Injector (Cylinder #1) control output	Injector (Cylinder #1)
51	Malfunction Indicator Lamp (MIL) control output	Cluster (Malfunction Indicator Lamp)
52	Injector (Cylinder #2) control output	Injector (Cylinder #2)
53	-	
54	-	
55	Crankshaft Position Sensor [B] signal input	Crankshaft Position Sensor (CKPS)
56	Battery Power	Battery
57	Sensor power (+5V)	A/C Pressure Transducer (APT)
58	Sensor power (+5V)	Throttle Position Sensor (TPS)
59	-	
60	Wheel Speed Sensor [B] signal input	Wheel Speed Sensor (WSS)[Without ABS/ESP]

3. TERMINAL INPUT/OUTPUT SIGNAL (A/T)

Connector [CGGA-K]

PinNo	Description	Condition	Type	Level	Test Result
1	Power Ground	Idle	DC	Max. 50mV	0mV
2	Power Ground	Idle	DC	Max. 50mV	3.6mV
3	Power Ground	Idle	DC	Max. 50mV	3.6mV
4	For Autotransaxle Control				
5	For Autotransaxle Control				
6	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0V	200mV
		IG ON		Battery Voltage	12.9V
7	-				
8	Sensor ground	Idle	DC	Max. 50mV	16mV
9	Sensor ground	Idle	DC	Max. 50mV	6.2mV
10	Manifold Absolute Pressure Sensor signal input	IG ON	DC	3.9 ~ 4.1V	4.09V
		Idle		0.8 ~ 1.6V	1.44V
11	-				
12	-				
13	Heated Oxygen Sensor (Sensor 2) signal input	Racing	Analog	Rich: 0.6 ~ 1.0V	860mV
				Lean: Max. 0.4V	10mV
14	-				
15	-				
16	-				
17	Alternator load signal input	Idle	Pulse	Hi: Battery Voltage	13.2V
				Lo: Max. 1.5V	1.34V
18	-				
19	-				
20	Vehicle speed signal input	Idle	Pulse	Hi: Min. 4.5V	12.2V
				Lo: Max. 1.0V	0V
					Freq.: 72.2Hz
		Vehicle Run (30km/h)		Hi: Min. 4.5V	12.2V
				Lo: Max. 1.0V	0V
					Freq.: 212Hz
21	-				
22	Electric Load signal input (Defrost)				
23	A/C switch "ON" signal input	A/C S/W OFF	DC	Max. 1.0V	20mV
		A/C S/W ON		Battery Voltage	12.48V

PinNo	Description	Condition	Type	Level	Test Result
24	For Autotransaxle Control				
25	For Autotransaxle Control				
26	For Autotransaxle Control				
27	For Autotransaxle Control				
28	For Autotransaxle Control				
29	-				
30	Sensor ground	Idle	DC	Max. 50mV	6.2mV
31	Sensor ground	Idle	DC	Max. 50mV	6.8mV
32	Intake Air Temperature Sensor signal input	Idle	DC	0.2 ~ 4.8V	1.89V
33	-				
34	-				
35	Heated Oxygen Sensor (Sensor 1) signal input	Racing	Analog	Rich: 0.6 ~ 1.0V	884mV
				Lean: Max. 0.4V	8mV
36	-				
37	-				
38	Sensor ground	Idle	DC	Max. 50mV	12mV
39	-				
40	-				
41	Camshaft Position Sensor signal input	Idle	Pulse	Hi: Battery Voltage	13.72V
				Lo: Max. 0.5V	200mV
42	-				
43	-				
44	-				
45	-				
46	A/C thermal switch signal input	A/C S/W OFF	DC	Max.0.5V	200mV
		A/C S/W ON		Battery Voltage	12.6V
47	For Autotransaxle Control				
48	For Autotransaxle Control				
49	For Autotransaxle Control				
50	For Autotransaxle Control				
51	Sensor ground	Idle	DC	Max. 50mV	11.2mV
52	-				
53	-				
54	-				

PinNo	Description	Condition	Type	Level	Test Result
55	-				
56	-				
57	For Autotransaxle Control				
58	-				
59	-				
60	For Autotransaxle Control				
61	For Autotransaxle Control				
62	For Autotransaxle Control				
63	-				
64	For Autotransaxle Control				
65	For Autotransaxle Control				
66	For Autotransaxle Control				
67	For Autotransaxle Control				
68	For Autotransaxle Control				
69	-				
70	For Autotransaxle Control				
71	For Autotransaxle Control				
72	For Autotransaxle Control				
73	Sensor ground	Idle	DC	Max. 50mV	16.8mV
74	-				
75	Throttle Position Sensor signal input	C.T	Analog	0.25 ~ 0.9V	0.34V
		W.O.T		Min. 4.0V	4.43V
76	-				
77	Engine Coolant Temperature Sensor signal input	Idle	Analog	0.5 ~ 4.5V	1.43V
78	-				
79	A/C Pressure Transducer signal input	A/C ON	Analog	Max. 4.8V	1.88V
80	For Autotransaxle Control				
81	For Autotransaxle Control				
82	For Autotransaxle Control				
83	For Autotransaxle Control				
84	For Autotransaxle Control				
85	-				
86	For Autotransaxle Control				
87	For Autotransaxle Control				

PinNo	Description	Condition	Type	Level	Test Result
88	For Autotransaxle Control				
89	For Autotransaxle Control				
90	For Autotransaxle Control				
91	For Autotransaxle Control				
92	For Autotransaxle Control				
93	For Autotransaxle Control				
94	For Autotransaxle Control				

Connector [CGGA-A]

Pin No.	Description	Condition	Type	Level	Test Result
1	Ignition Coil (Cylinder #2) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	372V
				ON Voltage: Max. 2.0V	1.1V
2	Ignition Coil (Cylinder #4) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	372V
				ON Voltage: Max. 2.0V	1.1V
3	-				
4	-				
5	-				
6	Idle Speed Control Actuator [OPEN] control output	Idle	Pulse	Hi: Battery Voltage	13.8V
				Lo: Max. 1.0V	20mV
7	-				
8	Purge Control Solenoid Valve control output	Active	Pulse	Hi: Battery Voltage	14.2V
		Inactive		Lo: Max. 1.0V	120mV
9	Main Relay control output	Relay OFF	DC	Battery Voltage	12.78V
		Relay ON		Max. 1.0V	860mV
10	-				
11	Battery voltage supply after ignition switch	IG OFF	DC	Max. 1.0V	3.2mV
		IG ON		Battery Voltage	12.68V
12	CAN [HIGH]	RECESSIVE	Pulse	2.0 ~ 3.0V	2.5V
		DOMINANT		2.75 ~ 4.5V	3.58V
13	-				
14	-				

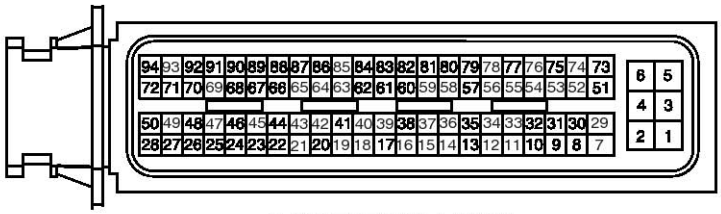
Pin No.	Description	Condition	Type	Level	Test Result
15	Knock Sensor signal input	Knocking	Variable Frequency		
		Normal			
16	Ignition Coil (Cylinder #3) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	366V
				ON Voltage: Max. 2.0 V	1.1V
17	Ignition Coil (Cylinder #1) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	352V
				ON Voltage: Max. 2.0 V	1.1V
18	-				
19	-				
20	-				
21	Cooling Fan Relay [Low] control output	Relay OFF	DC	Battery Voltage	14.12V
		Relay ON		Max. 1.0V	61.6mV
22	Idle Speed Control Actuator [CLOSE] control output	Idle	Pulse	Hi: Battery Voltage	13.8V
				Lo: Max. 1.0V	200mV
23	Cooling Fan Relay [High] control output	Relay OFF	DC	Battery Voltage	14.01V
		Relay ON		Max. 1.0V	52.6mV
24	Fuel consumption signal output	Idle	Pulse	Hi: Battery Voltage	13.8V
				Lo: Max. 0.5V	20mV
25	Engine speed signal output	Idle	Pulse	Hi: Battery Voltage	14.0V
				Lo: Max. 0.5V	20mV
				Freq.: 20 ~ 26Hz	22Hz
26	-				
27	CAN [LOW]	RECESSIVE	Pulse	2.0 ~ 3.0V	2.5V
		DOMINANT		0.5 ~ 2.25V	1.5V
28	-				
29	-				
30	Sensor ground	Idle	DC	Max. 50mV	
31	-				
32	Immobilizer lamp control output	Lamp OFF	DC	Battery Voltage	12.6V
		Lamp ON		Max. 1.0V	20mV
33	Heated Oxygen Sensor (Sensor 2) Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.2V
				Lo: Max. 1.0V	220mV

Pin No.	Description	Condition	Type	Level	Test Result
34	Heated Oxygen Sensor (Sensor 1) Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.2V
				Lo: Max. 1.0V	200mV
35	-				
36	Injector (Cylinder #3) control output	Idle	Pulse	Hi: Battery Voltage	14.2V
				Lo: Max. 1.0V	40mV
				Vpeak: Max. 80V	73.6V
37	Fuel Pump Relay control outtput	Relay OFF	DC	Battery Voltage	12.8V
		Relay ON		Max. 1.0V	400mV
38	A/C Compressor Relay control output	Relay OFF	DC	Battery Voltage	14.1V
		Relay ON		Max. 1.0V	400mV
39	-				
40	Crankshaft Position Sensor [A] signal input	Idle		Vp_p: Min. 1.0V	6.48V
41	-				
42	-				
43	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	3.6mV
		IG ON		4.8 ~ 5.2V	5.02V
44	Immobilizer communication line	When communicating after IG ON	Pulse	Hi: Min. 8.5V	12.51V
				Lo: Max. 3.5V	1.17V
45	Wheel Speed Sensor [A] signal input	Vehicle Run	SINE Wave	Vp_p: Min. 0.2V	
46	-				
47	-				
48	Injector (Cylinder #4) control output	Idle	Pulse	Hi: Battery Voltage	13.6V
				Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
49	CVVT Oil Control Valve control output	Idle	Pulse	Hi: Battery Voltage	14.9V
				Lo: Max. 1.0V	36.2mV
50	Injector (Cylinder #1) control output	Idle	Pulse	Hi: Battery Voltage	13.6V
				Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
51	Malfunction Indicator Lamp (MIL) control output	Lamp OFF	DC	Battery Voltage	11.51V
		Lamp ON		Max. 1.0V	663mV

Pin No.	Description	Condition	Type	Level	Test Result
52	Injector (Cylinder #2) control output	Idle	Pulse	Hi: Battery Voltage	13.6V
				Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
53	-				
54	-				
55	Crankshaft Position Sensor [B] signal input	Idle	SINE Wave	Vp_p: Min. 1.0V	6.48V
56	Battery Power	Always	DC	Battery Voltage	12.23V
57	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	3.6mV
		IG ON		4.9 ~ 5.1V	5.02V
58	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	3.6mV
		IG ON		4.9 ~ 5.1V	5.02V
59	-				
60	Wheel Speed Sensor [B] signal input	Vehicle Run	SINE Wave	Vp_p: Min. 0.2V	

Engine Control Module (ECM)

1. HARNESS CONNECTOR (M/T)



SHDFL6118L

2. TERMINAL FUNCTION (M/T)

Connector [CGGM-K]

PinNo.	Description	Connectedto
1	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1)
2	Power Ground	Chassis Ground
3	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3)
4	-	
5	-	
6	Battery voltage supply after main relay	Main Relay
7	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4)
8	A/C thermal switch signal input	A/C Thermal Switch
9	-	
10	-	
11	Knock Sensor signal input	Knock Sensor (KS)
12	Sensor ground	Throttle Position Sensor (TPS)
13	-	
14	-	
15	Sensor ground	Manifold Absolute Pressure Sensor (MAPS)
16	Sensor ground	Heated Oxygen Sensor (Sensor 2)
17	Sensor ground	Camshaft Position Sensor (CMPS)
18	Immobilizer communication line	Immobilizer Control Module
19	Manifold Absolute Pressure Sensor signal input	Manifold Absolute Pressure Sensor (MAPS)
20	-	
21	-	
22	Main Relay control output	Main Relay
23	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
24	Injector (Cylinder #3) control output	Injector (Cylinder #3)

PinNo.	Description	Connectedto
25	Idle Speed Control Actuator [CLOSE] control outp-ut	Idle Speed Control Actuator (ISCA)
26	-	
27	-	
28	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
29	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2)
30	A/C switch "ON" signal input	A/C Switch
31	Electric Load signal input (Defrost)	
32	Sensor ground	Knock Sensor (KS)
33	Sensor ground	A/C Pressure Transducer (APT)
34	-	
35	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
36	Heated Oxygen Sensor (Sensor 2) signal input	Heated Oxygen Sensor (Sensor 2)
37	-	
38	Sensor ground	Heated Oxygen Sensor (Sensor 1)
39	Throttle Position Sensor signal input	Throttle Position Sensor (TPS)
40	A/C Pressure Transducer signal input	A/C Pressure Transducer (APT)
41	-	
42	-	
43	Intake Air Temperature Sensor signal input	Intake Air Temperature Sensor (IATS)
44	-	
45	A/C Compressor Relay control output	A/C Compressor Relay
46	Fuel Pump Relay control output	Fuel Pump Relay
47	Injector (Cylinder #2) control output	Injector (Cylinder #2)
48	Immobilizer lamp control output	Immobilizer Lamp
49	-	
50	-	
51	Power Ground	Chassis Ground
52	-	
53	-	
54	Heated Oxygen Sensor (Sensor 1) signal input	Heated Oxygen Sensor (Sensor 1)
55	-	
56	-	
57	-	
58	Wheel Speed Sensor [A] signal input	Wheel Speed Sensor (WSS)[Without ABS/ESP]

PinNo.	Description	Connectedto
59	Sensor power (+5V)	A/C Pressure Transducer (APT)
60	Sensor power (+5V)	Throttle Position Sensor (TPS)
61	-	
62	CAN [LOW]	Other control module
63	Camshaft Position Sensor signal input	Camshaft Position Sensor (CMPS)
64	Vehicle speed signal input	ABS/ESP Control Module [With ABS/ESP]
65	-	
66	Alternator load signal input	Alternator
67	Engine speed signal output	Cluster (Tachometer)
68	Injector (Cylinder #4) control output	Injector (Cylinder #4)
69	Purge Control Solenoid Valve control output	Purge Control Solenoid Valve (PCSV)
70	Malfunction Indicator Lamp (MIL) control output	Cluster (Malfunction Indicator Lamp)
71	Heated Oxygen Sensor (Sensor 2) Heater control output	Heated Oxygen Sensor (Sensor 2)
72	Heated Oxygen Sensor (Sensor 1) Heater control output	Heated Oxygen Sensor (Sensor 1)
73	Power Ground	Chassis Ground
74	-	
75	-	
76	-	
77	Engine Coolant Temperature Sensor signal input	Engine Coolant Temperature Sensor (ECTS)
78	-	
79	Wheel Speed Sensor [B] signal input	Wheel Speed Sensor (WSS)[Without ABS/ESP]
80	-	
81	Sensor power (+5V)	Manifold Absolute Pressure Sensor (MAPS)
82	Battery Power	Battery
83	Battery voltage supply after ignition switch	Ignition Switch
84	CAN [HIGH]	Other control module
85	-	
86	Crankshaft Position Sensor [B] signal input	Crankshaft Position Sensor (CKPS)
87	Crankshaft Position Sensor [A] signal input	Crankshaft Position Sensor (CKPS)
88	Fuel consumption signal output	Trip Computer
89	-	
90	Idle Speed Control Actuator [OPEN] control output	Idle Speed Control Actuator (ISCA)
91	Injector (Cylinder #1) control output	Injector (Cylinder #1)
92	CVVT Oil Control Valve control output	CVVT Oil Control Valve (OCV)

PinNo.	Description	Connectedto
93	-	
94	-	

3. TERMINAL INPUT/OUTPUT SIGNAL (M/T)

Connector [CGGM-K]

Pin No.	Description	Condition	Type	Level	Test Result
1	Ignition Coil (Cylinder #1) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	352V
				ON Voltage: Max. 2.0V	1.1V
2	Power Ground	Idle	DC	Max. 50mV	0mV
3	Ignition Coil (Cylinder #3) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	366V
				ON Voltage: Max. 2.0V	1.1V
4	-				
5	-				
6	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0V	200mV
		IG ON		Battery Voltage	12.9V
7	Ignition Coil (Cylinder #4) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	372V
				ON Voltage: Max. 2.0V	1.1V
8	A/C thermal switch signal input	A/C S/W OFF	DC	Max.0.5V	200mV
		A/C S/W ON		Battery Voltage	12.6V
9	-				
10	-				
11	Knock Sensor signal input	Knocking	Variable Frequency		
		Normal			
12	Sensor ground	Idle	DC	Max. 50mV	11.2mV
13	-				
14	-				
15	Sensor ground	Idle	DC	Max. 50mV	16mV
16	Sensor ground	Idle	DC	Max. 50mV	6.2mV
17	Sensor ground	Idle	DC	Max. 50mV	12mV
18	Immobilizer communication line	When communicating after IG ON	Pulse	Hi: Min. 8.5V	12.51V
				Lo: Max. 3.5V	1.17V
19	Manifold Absolute Pressure Sensor signal input	IG ON	DC	3.9 ~ 4.1V	4.09V
		Idle		0.8 ~ 1.6V	1.44V
20	-				

Pin No.	Description	Condition	Type	Level	Test Result
21	-				
22	Main Relay control output	Relay OFF	DC	Battery Voltage	12.78V
		Relay ON		Max. 1.0V	860mV
23	Cooling Fan Relay [High] control output	Relay OFF	DC	Battery Voltage	14.01V
		Relay ON		Max. 1.0V	52.6mV
24	Injector (Cylinder #3) control output	Idle	Pulse	Hi: Battery Voltage	14.2V
				Lo: Max. 1.0V	40mV
				Vpeak: Max. 80V	73.6V
25	Idle Speed Control Actuator [CLOSE] control output	Idle	Pulse	Hi: Battery Voltage	13.8V
				Lo: Max. 1.0V	200mV
26	-				
27	-				
28	Cooling Fan Relay [Low] control output	Relay OFF	DC	Battery Voltage	14.12V
		Relay ON		Max. 1.0V	61.6mV
29	Ignition Coil (Cylinder #2) control output	Idle	Pulse	1st Voltage: 300 ~ 400V	372V
				ON Voltage: Max. 2.0V	1.1V
30	A/C switch "ON" signal input	A/C S/W OFF	DC	Max. 1.0V	20mV
		A/C S/W ON		Battery Voltage	12.48V
31	Electric Load signal input (Defrost)				
32	Sensor ground	Idle	DC	Max. 50mV	
33	Sensor ground	Idle	DC	Max. 50mV	6.2mV
34	-				
35	Sensor ground	Idle	DC	Max. 50mV	16.8mV
36	Heated Oxygen Sensor (Sensor 2) signal input	Racing	Analog	Rich: 0.6 ~ 1.0V	860mV
				Lean: Max. 0.4V	10mV
37	-				
38	Sensor ground	Idle	DC	Max. 50mV	6.8mV
39	Throttle Position Sensor signal input	C.T	Analog	0.25 ~ 0.9V	0.34V
		W.O.T		Min. 4.0V	4.43V
40	A/C Pressure Transducer signal input	A/C ON	Analog	Max. 4.8V	1.88V
41	-				
42	-				

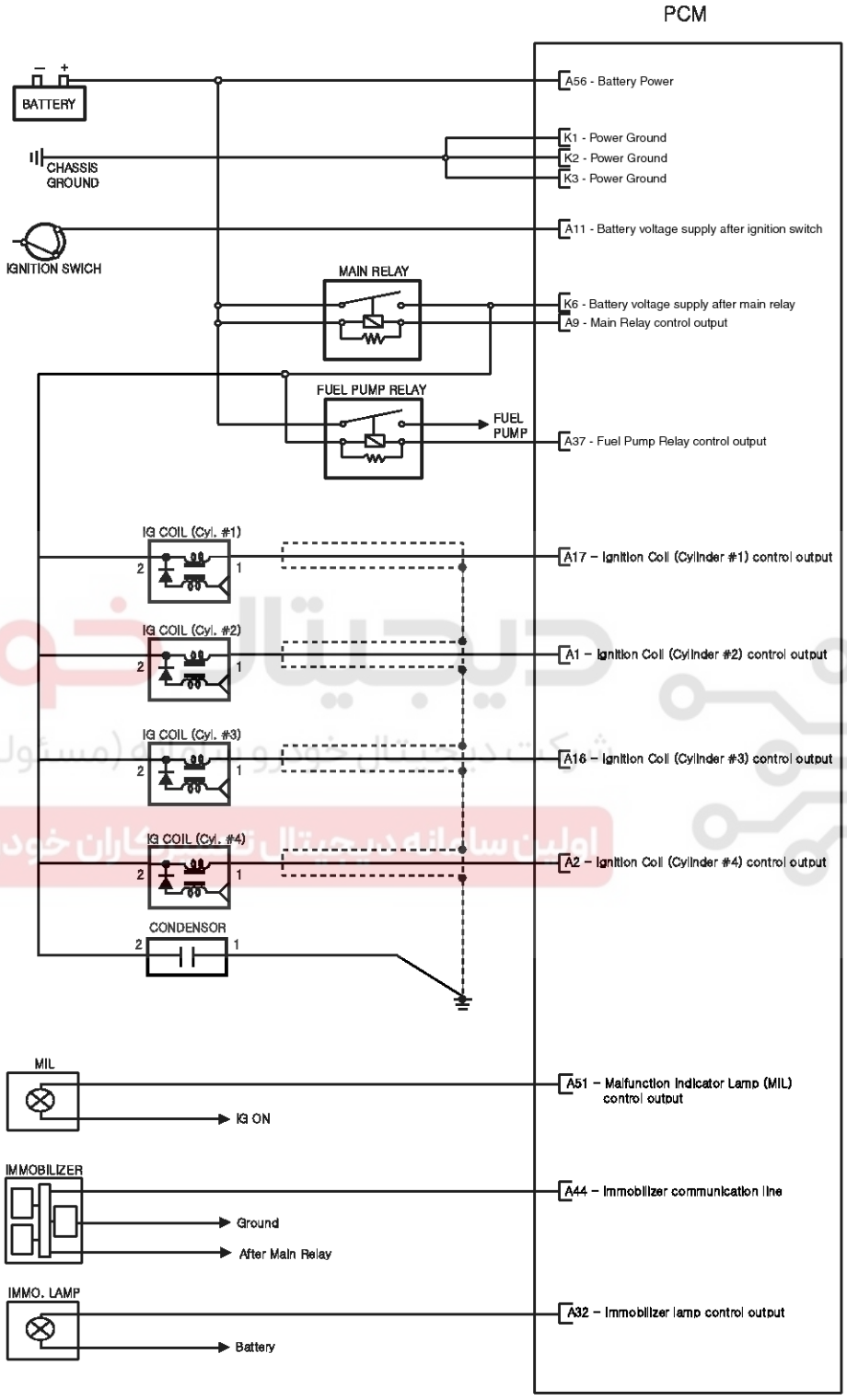
Pin No.	Description	Condition	Type	Level	Test Result
43	Intake Air Temperature Sensor signal input	Idle	DC	0.2 ~ 4.8V	1.89V
44	-				
45	A/C Compressor Relay control output	Relay OFF	DC	Battery Voltage	14.1V
		Relay ON		Max. 1.0V	400mV
46	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage	12.8V
		Relay ON		Max. 1.0V	400mV
47	Injector (Cylinder #2) control output	Idle	Pulse	Hi: Battery Voltage	13.6V
				Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
48	Immobilizer lamp control output	Lamp OFF	DC	Battery Voltage	12.6V
		Lamp ON		Max. 1.0V	20mV
49	-				
50	-				
51	Power Ground	Idle	DC	Max. 50mV	3.6mV
52	-				
53	-				
54	Heated Oxygen Sensor (Sensor 1) signal input	Racing	Analog	Rich: 0.6 ~ 1.0V	884mV
				Lean: Max. 0.4V	8mV
55	-				
56	-				
57	-				
58	Wheel Speed Sensor [A] signal input	Vehicle Run	SINE Wave	Vp_p: Min. 0.2V	
59	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	3.6mV
		IG ON		4.9 ~ 5.1V	5.02V
60	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	3.6mV
		IG ON		4.9 ~ 5.1V	5.02V
61	-				
62	CAN [LOW]	RECESSIVE	Pulse	2.0 ~ 3.0V	2.5V
		DOMINANT		0.5 ~ 2.25V	1.5V
63	Camshaft Position Sensor signal input	Idle	Pulse	Hi: Battery Voltage	13.72V
				Lo: Max. 0.5V	200mV

FL-42 Fuel System

Pin No.	Description	Condition	Type	Level	Test Result
64	Vehicle speed signal input	Idle	Pulse	Hi: Min. 4.5V	12.2V
				Lo: Max. 1.0V	0V
					Freq.: 72.2Hz
		Vehicle Run (30km)		Hi: Min. 4.5V	12.2V
				Lo: Max. 1.0V	0V
					Freq.: 212Hz
65	-				
66	Alternator load signal input	Idle	Pulse	Hi: Battery Voltage	13.2V
				Lo: Max. 1.5V	1.34V
67	Engine speed signal output	Idle	Pulse	Hi: Battery Voltage	14.0V
				Lo: Max. 0.5V	20mV
				Freq.: 20 ~ 26Hz	22Hz
68	Injector (Cylinder #4) control output	Idle	Pulse	Hi: Battery Voltage	13.6V
				Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
69	Purge Control Solenoid Valve control output	Active	Pulse	Hi: Battery Voltage	14.2V
		Inactive		Lo: Max. 1.0V	120mV
70	Malfunction Indicator Lamp (MIL) control output	Lamp OFF	DC	Battery Voltage	11.51V
		Lamp ON		Max. 1.0V	663mV
71	Heated Oxygen Sensor (Sensor 2) Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.2V
				Lo: Max. 1.0V	220mV
72	Heated Oxygen Sensor (Sensor 1) Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.2V
				Lo: Max. 1.0V	200mV
73	Power Ground	Idle	DC	Max. 50mV	3.6mV
74	-				
75	-				
76	-				
77	Engine Coolant Temperature Sensor signal input	Idle	Analog	0.5 ~ 4.5V	1.43V
78	-				
79	Wheel Speed Sensor [B] signal input	Vehicle Run	SINEWave	Vp_p: Min. 0.2V	
80	-				
81	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	3.6mV
		IG ON		4.8 ~ 5.2V	5.02V
82	Battery Power	Always	DC	Battery Voltage	12.23V

Pin No.	Description	Condition	Type	Level	Test Result
83	Battery voltage supply after ignition switch	IG OFF	DC	Max. 1.0V	3.2mV
		IG ON		Battery Voltage	12.68V
84	CAN [HIGH]	RECESSIVE	Pulse	2.0 ~ 3.0V	2.5V
		DOMINANT		2.75 ~ 4.5V	3.58V
85	-				
86	Crankshaft Position Sensor [B] signal input	Idle	SINE Wave	Vp_p: Min. 1.0V	6.48V
87	Crankshaft Position Sensor [A] signal input	Idle	SINE Wave	Vp_p: Min. 1.0V	6.48V
88	Fuel consumption signal output	Idle	Pulse	Hi: Battery Voltage	13.8V
				Lo: Max. 0.5V	20mV
89	-				
90	Idle Speed Control Actuator [OPEN] control output	Idle	Pulse	Hi: Battery Voltage	13.8V
				Lo: Max. 1.0V	20mV
91	Injector (Cylinder #1) control output	Idle	Pulse	Hi: Battery Voltage	13.6V
				Lo: Max. 1.0V	336mV
				Vpeak: Max. 80V	69.7V
92	CVVT Oil Control Valve control output	Idle	Pulse	Hi: Battery Voltage	14.9V
				Lo: Max. 1.0V	36.2mV
93	-				
94	-				

Circuit Diagram
[A/T]



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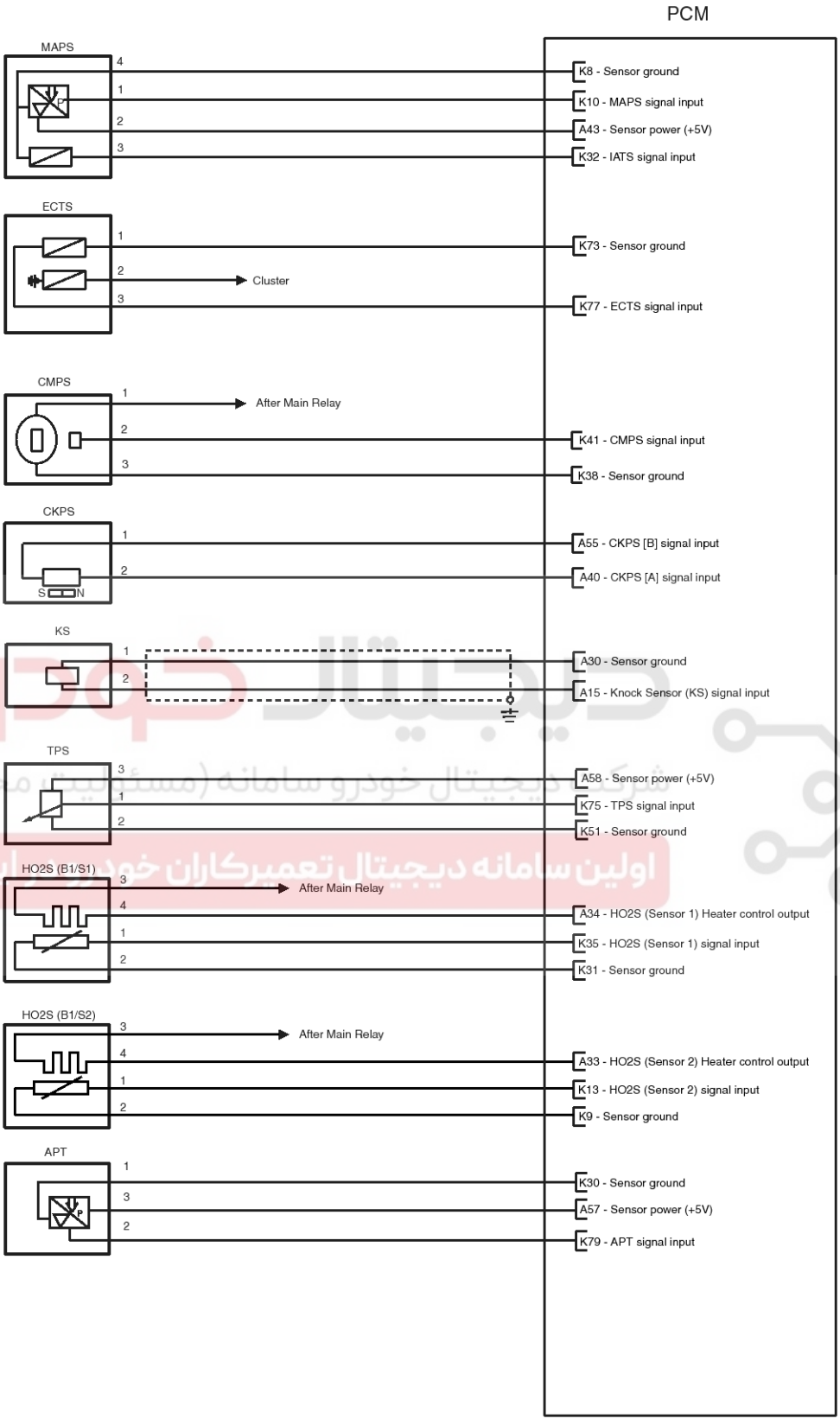

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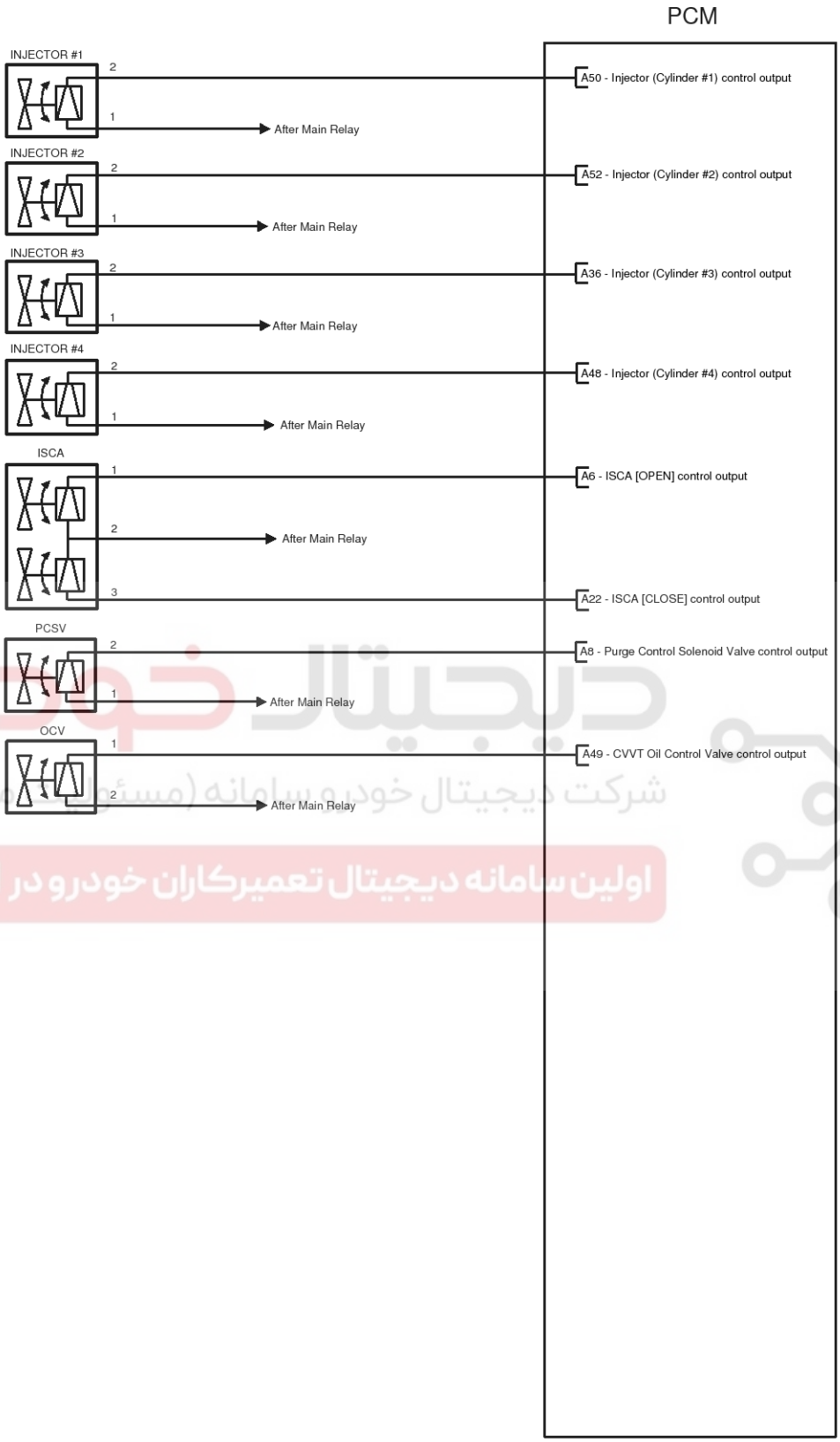

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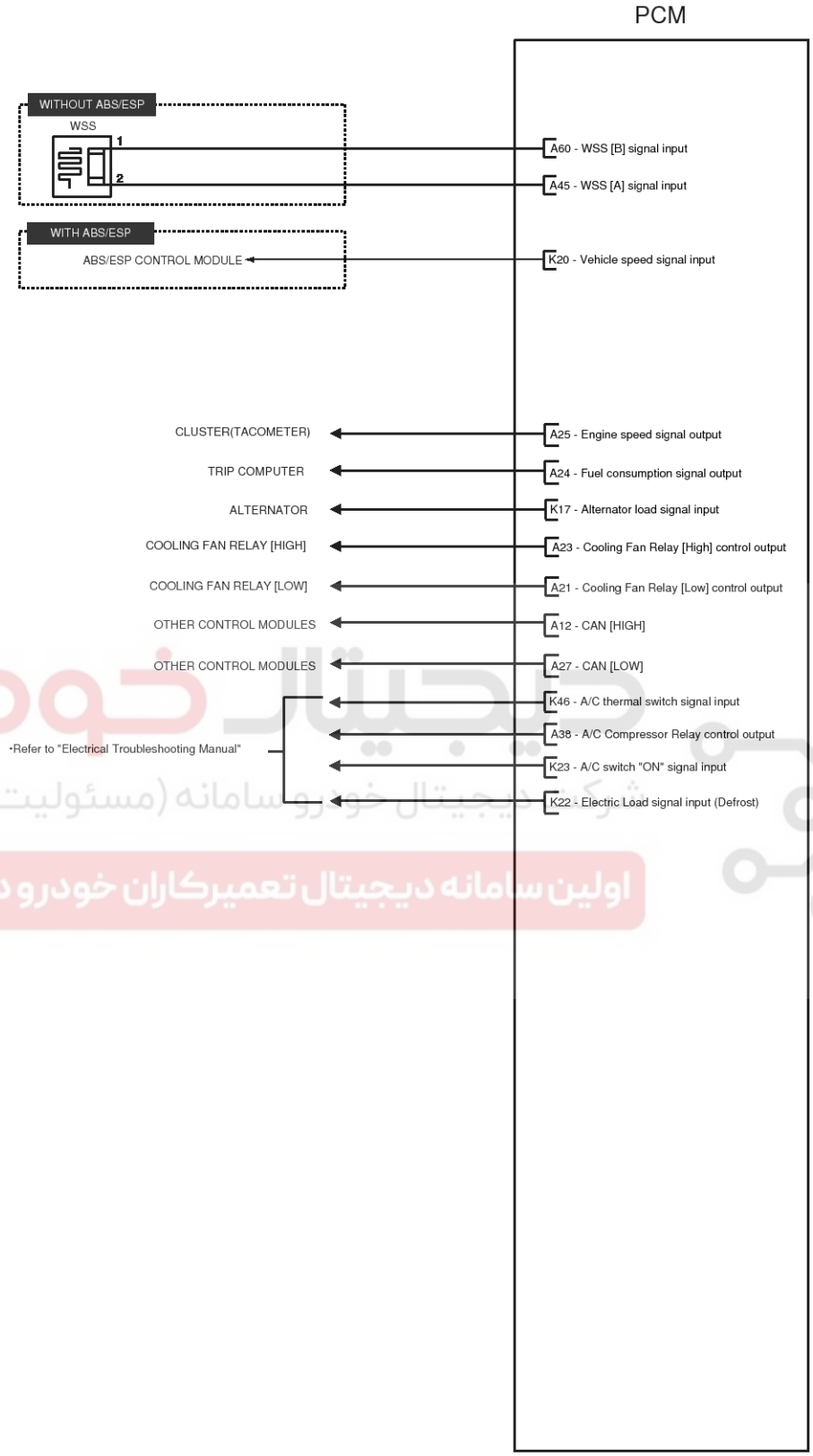

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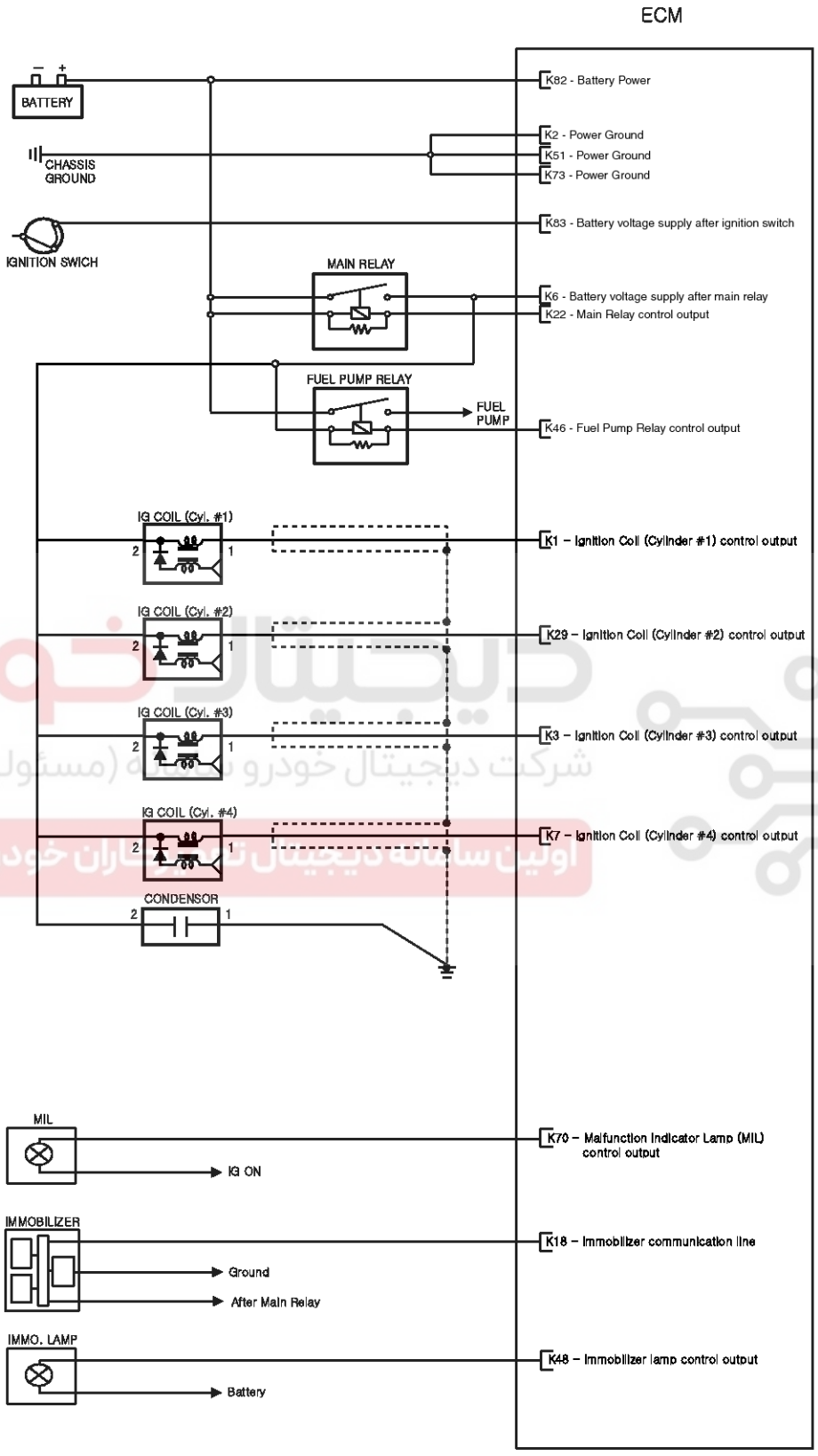
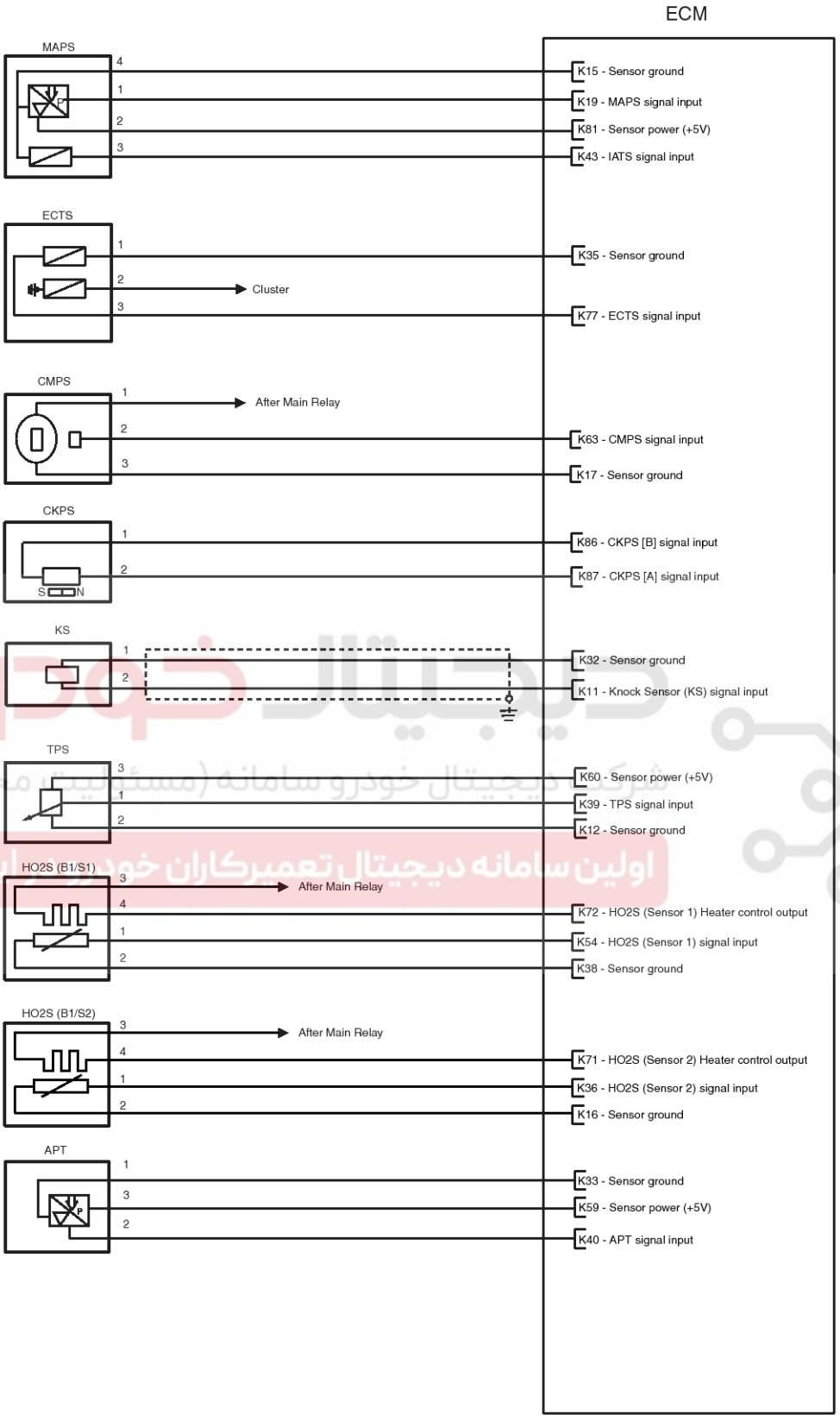
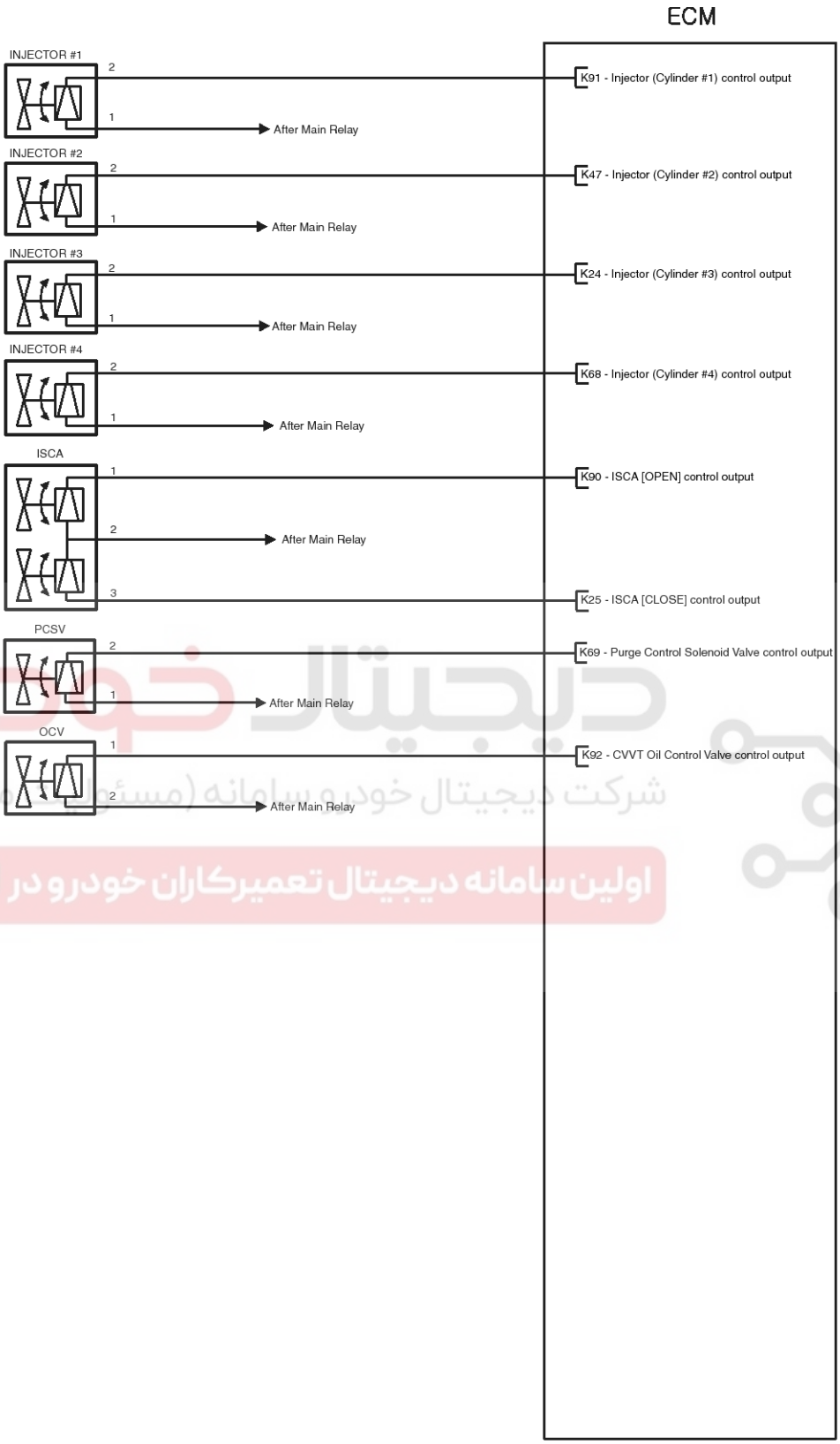
[M/T]



SHDFL6123L



SFDFL8004L



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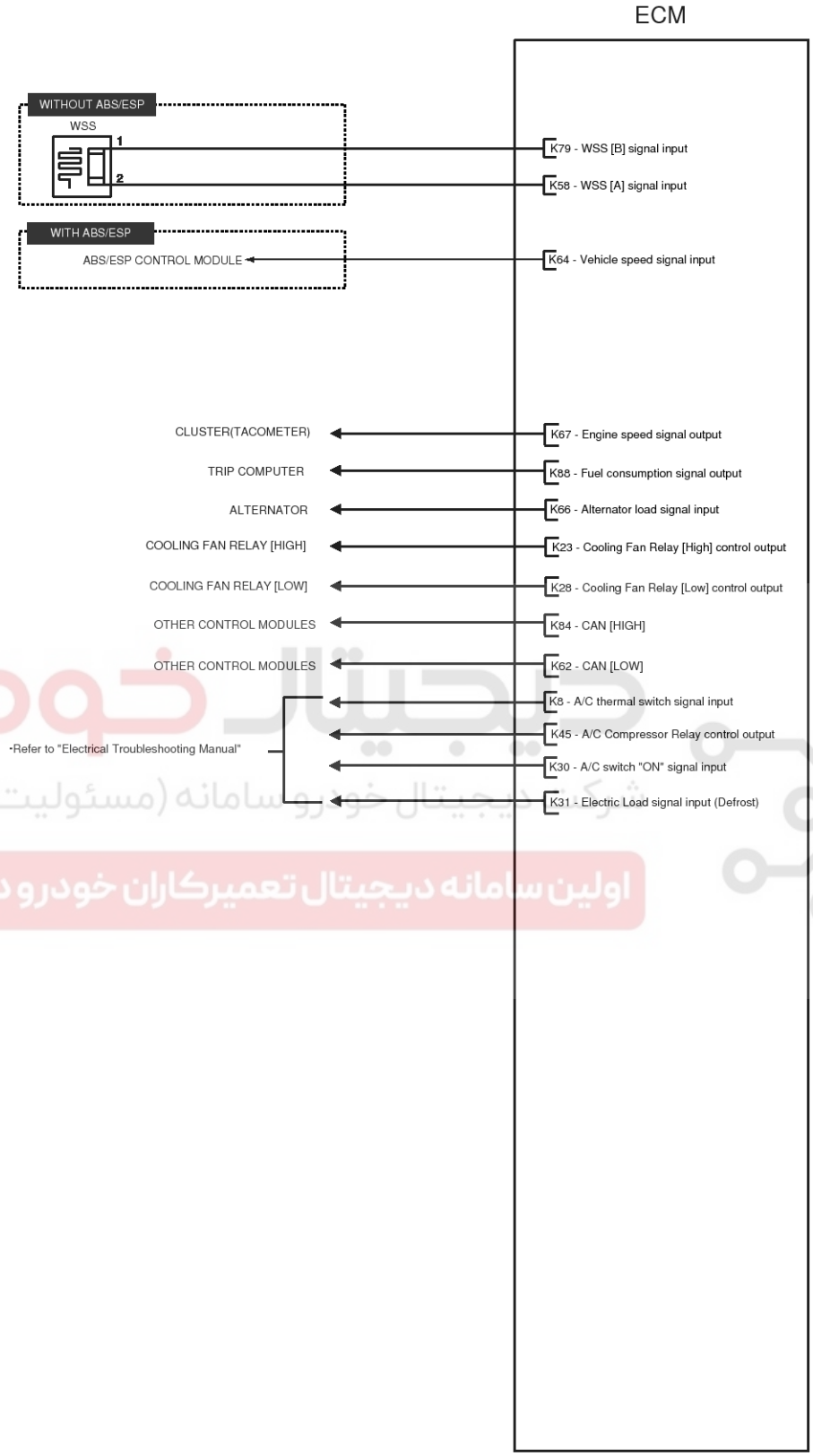


SEDFL7005L

PCM Problem Inspection Procedure

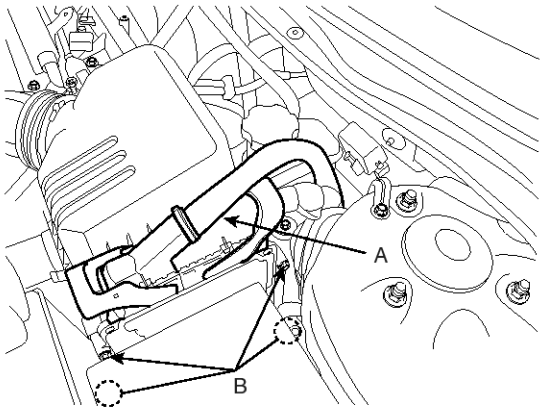
1. TEST PCM GROUND CIRCUIT: Measure resistance between PCM and chassis ground using the backside of PCM harness connector as PCM side check point. If the problem is found, repair it.

Specification (Resistance): 1Ω or less

2. TEST PCM CONNECTOR: Disconnect the PCM connector and visually check the ground terminals on PCM side and harness side for bent pins or poor contact pressure. If the problem is found, repair it.
3. If problem is not found in Step 1 and 2, the PCM could be faulty. If so, replace the PCM with a new one, and then check the vehicle again. If the vehicle operates normally then the problem was likely with the PCM.
4. RE-TEST THE ORIGINAL PCM : Install the original PCM (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original PCM with a new one. If problem does not occur, this is intermittent problem (Refer to INTERMITTENT PROBLEM PROCEDURE in BASIC Inspection PROCEDURE).

Replacement

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



SHDFL6134L

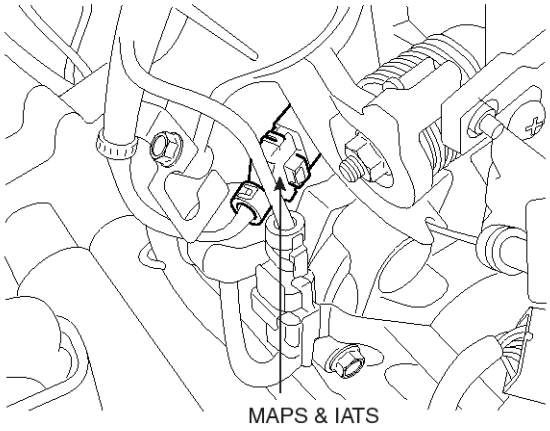
4. Unscrew the PCM mounting bolts (B) and remove the PCM from the air cleaner assembly.
5. Install a new PCM.

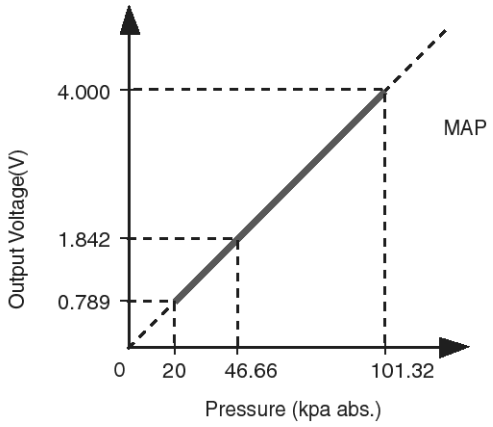
PCM mounting bolts: 3.9~ 5.9 N·m (0.4 ~ 0.6 kgf·m, 2.9 ~ 4.3 lbf·ft)

Manifold Absolute Pressure Sensor (MAPS)

Inspection

Function And Operation Priciple


MAPS & IATS



SHDFL6127L

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

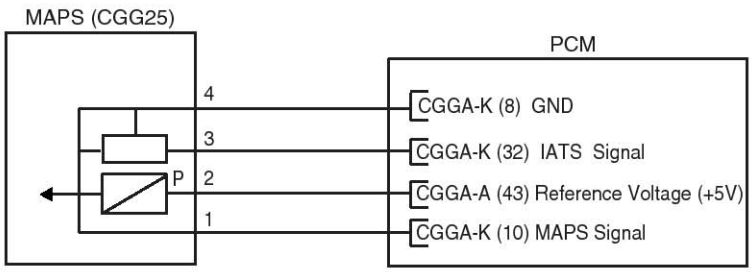
Specification

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

Circuit Diagram

(A/T)

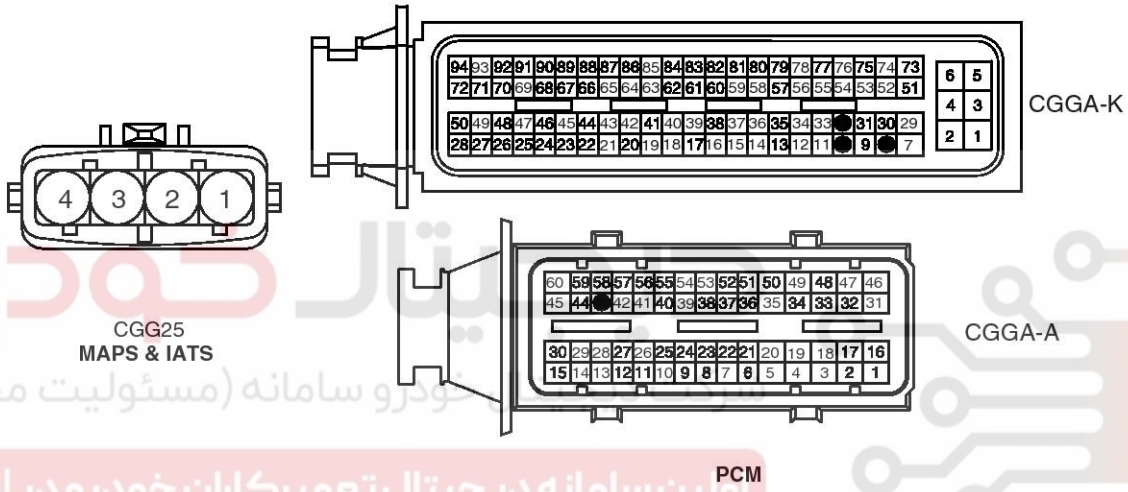
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM CGGA-K (10)	MAPS Signal
2	PCM CGGA-A (43)	Reference Voltage (+5V)
3	PCM CGGA-K (32)	IATS Signal
4	PCM CGGA-K (8)	Sensor Ground

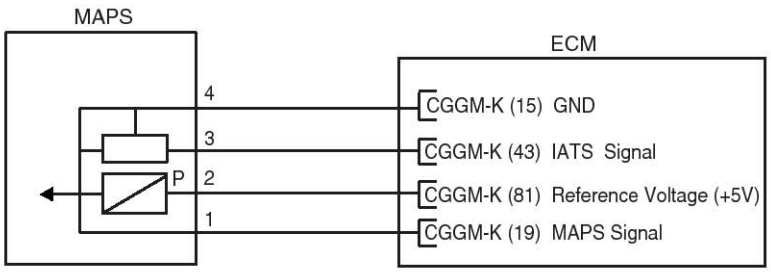
[HARNESS CONNECTORS]



SHDFL6581L

(M/T)

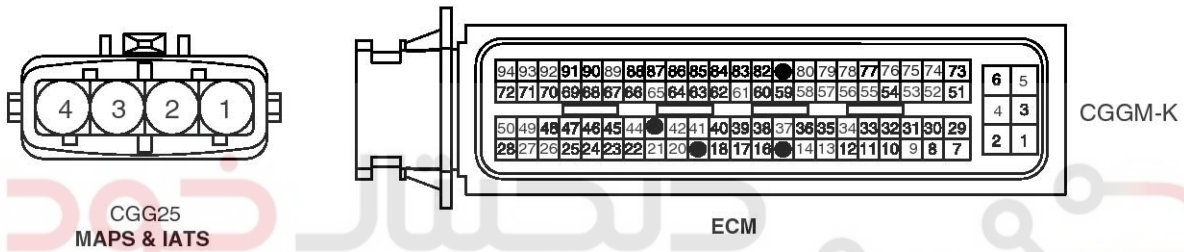
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM CGGM-K (19)	MAPS Signal
2	ECM CGGM-K (81)	Reference Voltage (+5V)
3	ECM CGGM-K (43)	IATS Signal
4	ECM CGGM-K (15)	Sensor Ground

[HARNESS CONNECTORS]



SHDFL6582L

Component Inspection

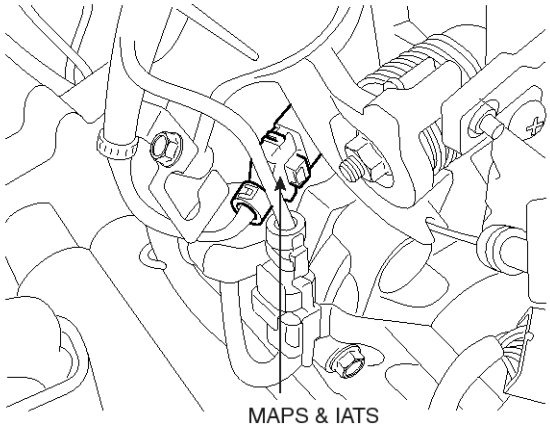
1. Connect a scantool on Diagnisis Link Connector (DLC).
2. Check MAPS output voltage at idle and IG ON.

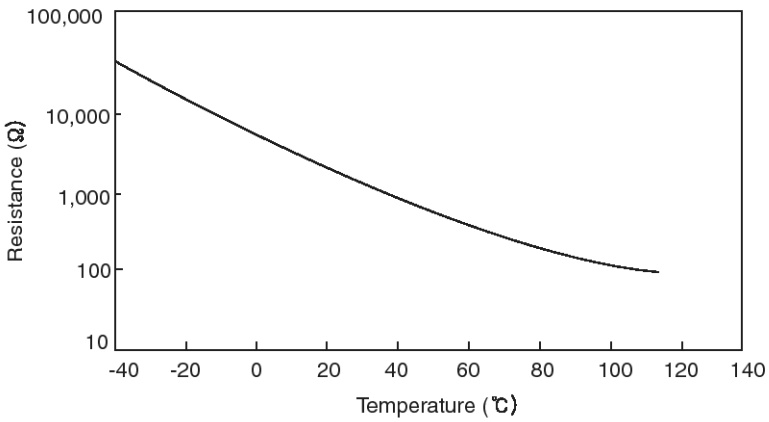
Condition	Output Voltage (V)
Idle	0.8V ~ 1.6V
IG ON	3.9V ~ 4.1V

Intake Air Temperature Sensor (IATS)

Inspection

Function And Operation Priciple


MAPS & IATS



SHDFL6128L

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

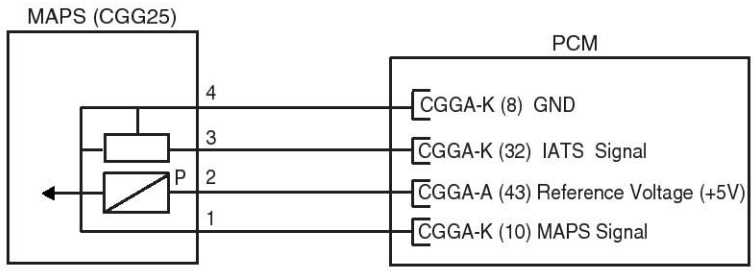
Specification

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

Circuit Diagram

(A/T)

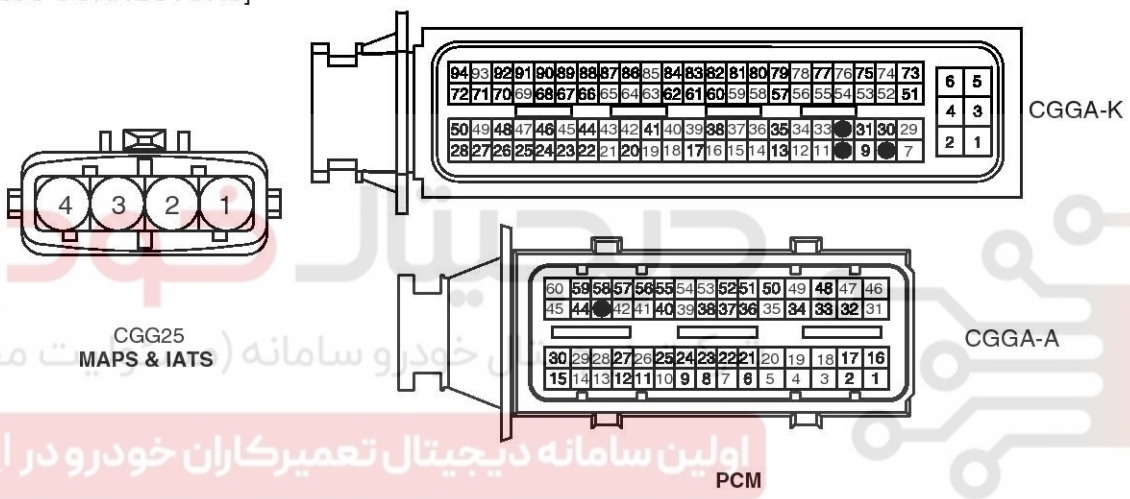
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM CGGA-K (10)	MAPS Signal
2	PCM CGGA-A (43)	Reference Voltage (+5V)
3	PCM CGGA-K (32)	IATS Signal
4	PCM CGGA-K (8)	Sensor Ground

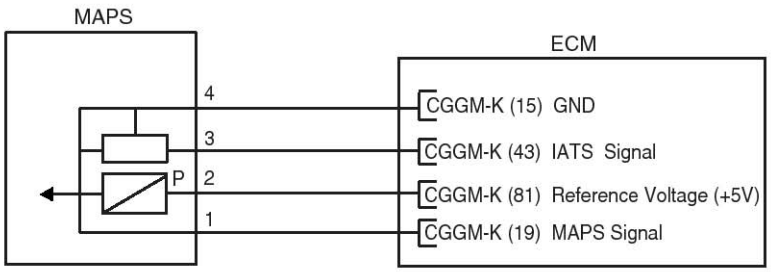
[HARNESS CONNECTORS]



SHDFL6581L

(M/T)

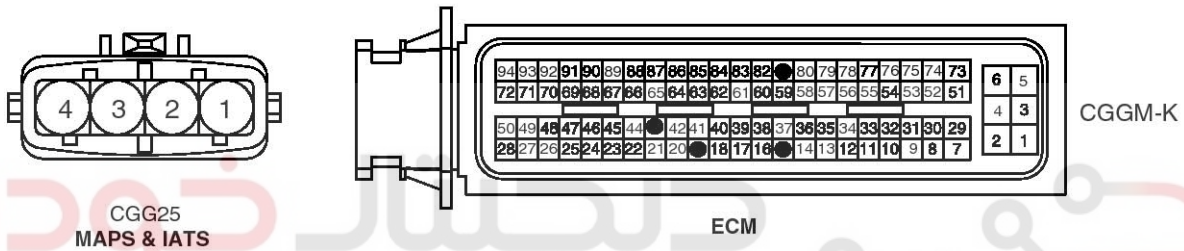
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM CGGM-K (19)	MAPS Signal
2	ECM CGGM-K (81)	Reference Voltage (+5V)
3	ECM CGGM-K (43)	IATS Signal
4	ECM CGGM-K (15)	Sensor Ground

[HARNESS CONNECTORS]



SHDFL6582L

Component Inspection

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

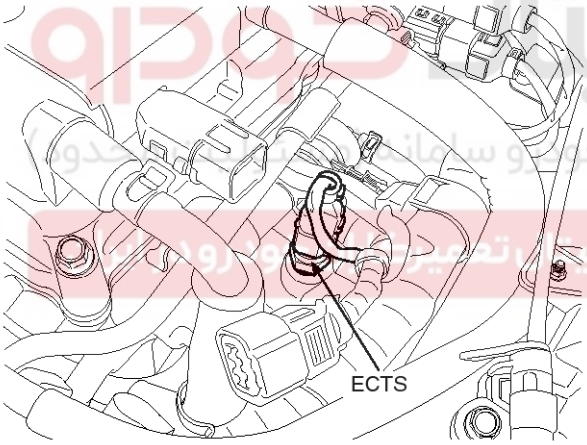
Specification: Refer to SPECIFICATION.

Engine Coolant Temperature Sensor (ECTS)

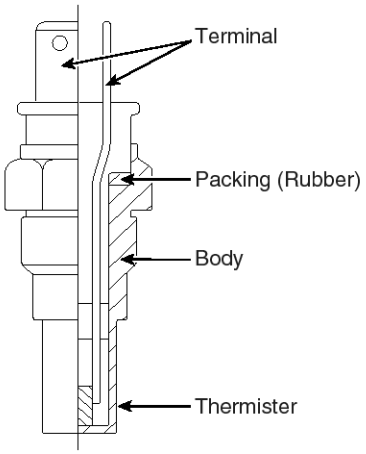
Inspection

Function And Operation Priciple

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



SFDFL8002L



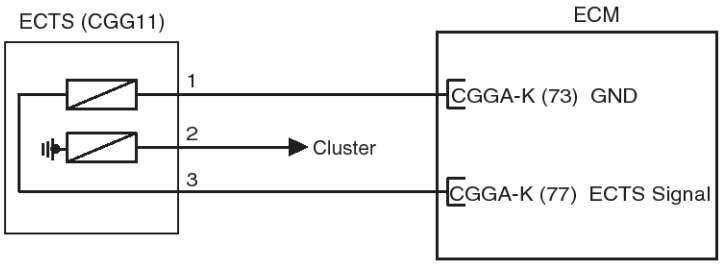
EGRF241A

Specification

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

Circuit Diagram
(A/T)

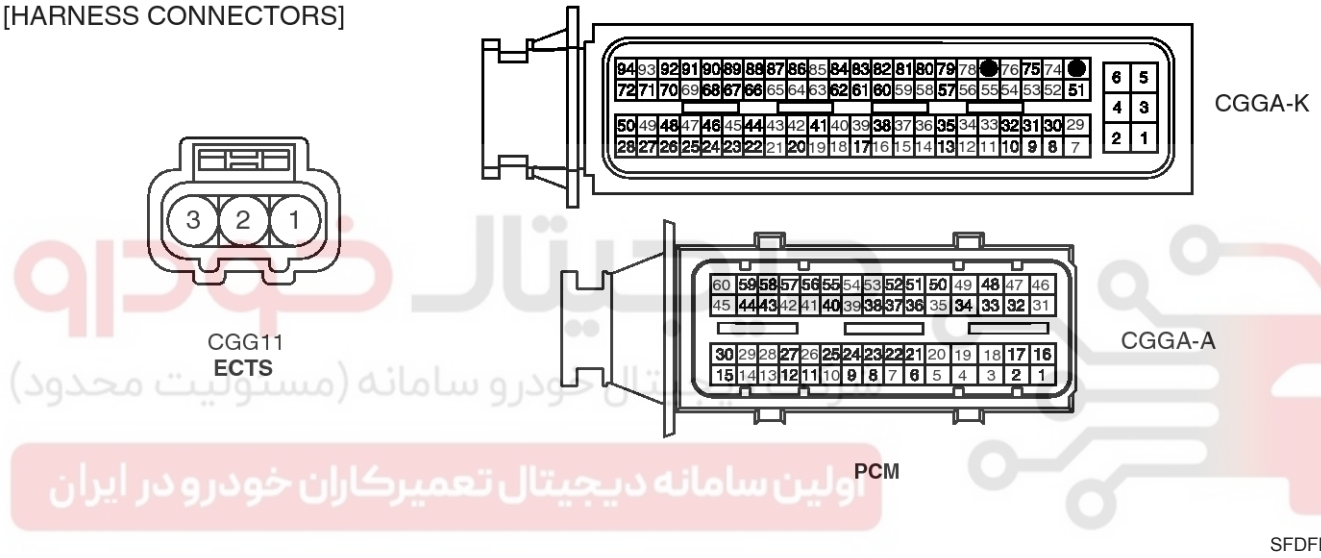
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM CGGA-K (73)	Sensor Ground
2	Cluster	-
3	PCM CGGA-K (77)	ECTS Signal

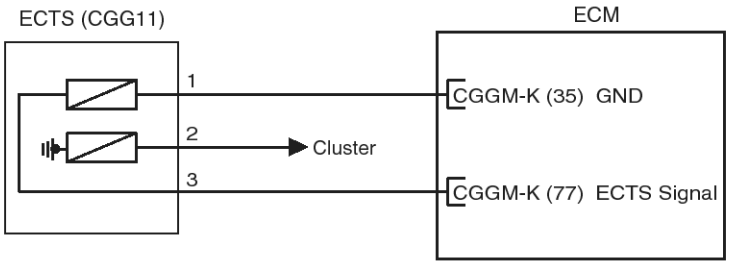
[HARNESS CONNECTORS]



SFDFL8005L

(M/T)

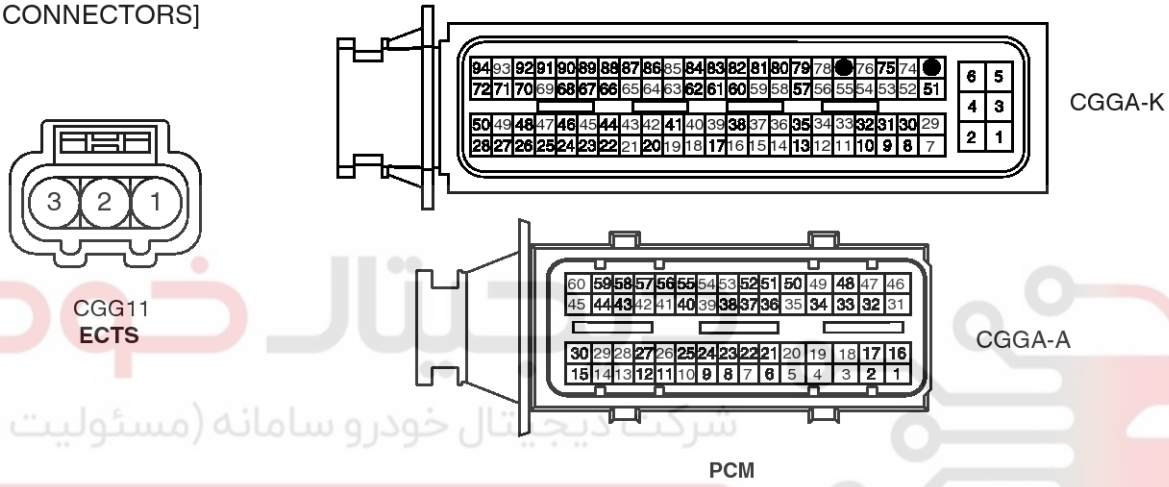
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM CGGM-K (35)	Sensor Ground
2	Cluster	-
3	ECM CGGM-K (77)	ECTS Signal

[HARNESS CONNECTORS]



SFDFL8006L

Component Inspection

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

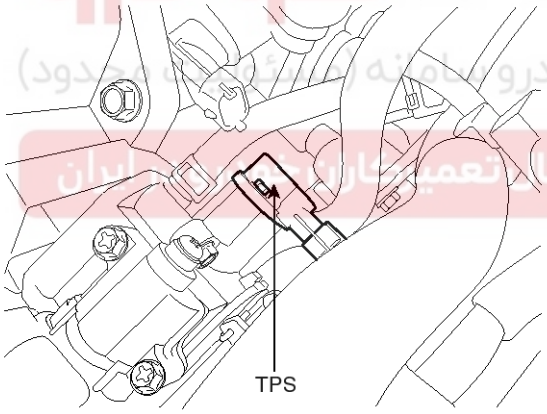
Specification: Refer to SPECIFICATION.

Throttle Position Sensor (TPS)

Inspection

Function And Operation Principle

The Throttle Position Sensor (TPS) is mounted on the throttle body and detects the opening angle of the throttle plate. The TPS has a variable resistor (potentiometer) whose characteristic is the resistance changing according to the throttle angle. During acceleration, the TPS resistance between the reference 5V and the signal terminal decreases and output voltage increases; during deceleration, the TPS resistance increases and TPS output voltage decreases. The PCM 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 0.25~0.9V at closed throttle to minimum 4.0V at wide-open throttle. The PCM determines operating conditions such as idle (closed throttle), part load, acceleration/deceleration, and wide-open throttle from the TPS. Also The PCM uses the Manifold Absolute Pressure Sensor (MAPS) signal along with the TPS signal to adjust fuel injection duration and ignition timing.



SHDFL6105L

Specification

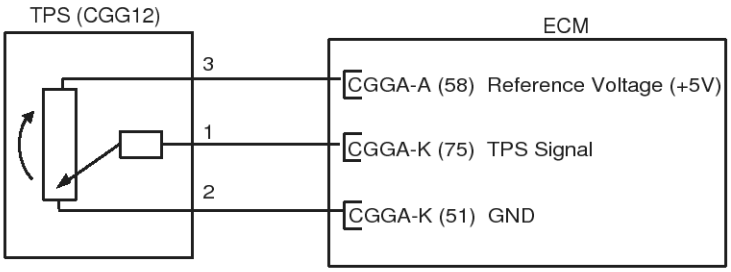
Throttle Angle	Output Voltage (V)
C.T	0.25 ~ 0.9
W.O.T	Min. 4.0V

Items	Specification
Sensor Resistance (kΩ)	1.6 ~ 2.4

Circuit Diagram

(A/T)

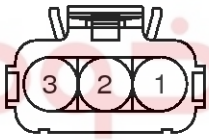
[CIRCUIT DIAGRAM]



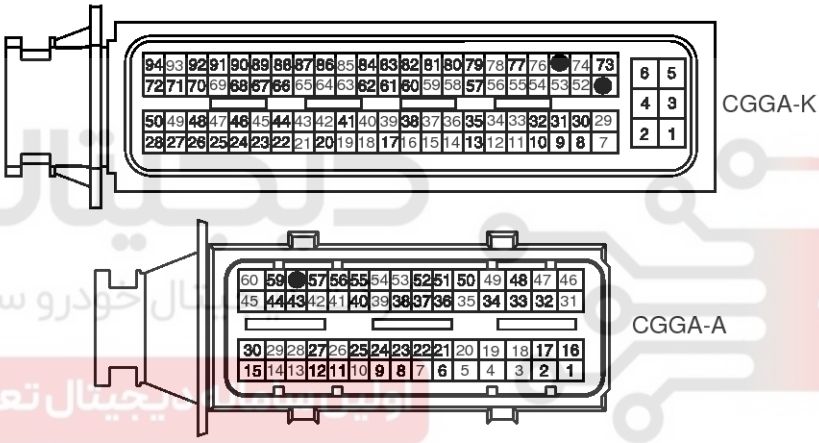
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM CGGA-K (75)	TPS Signal
2	PCM CGGA-K (51)	Sensor Ground
3	PCM CGGA-A (58)	Reference Voltage (+5V)

[HARNESS CONNECTORS]



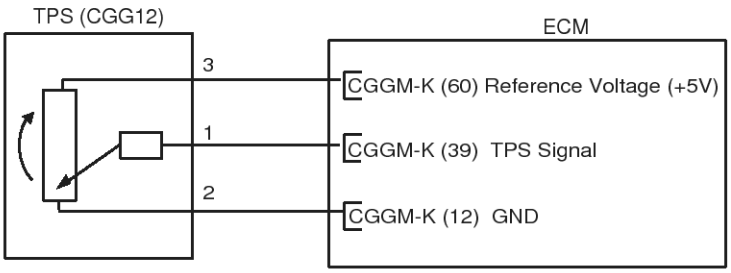
CGG12
TPS



SHDFL6579L

(M/T)

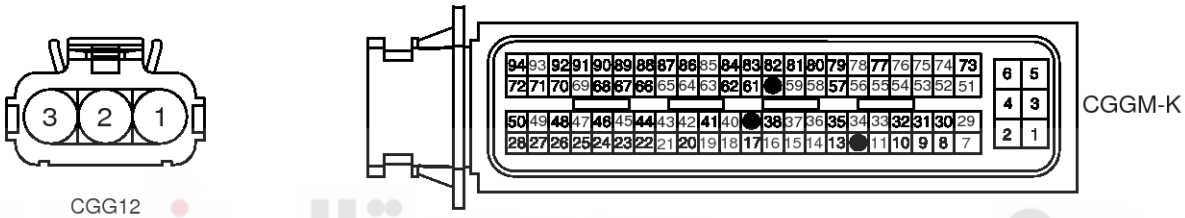
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM CGGM-K (39)	TPS Signal
2	ECM CGGM-K (12)	Sensor Ground
3	ECM CGGM-K (60)	Reference Voltage (+5V)

[HARNESS CONNECTORS]



SHDFL6580L

Component Inspection

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

Specification: Refer to SPECIFICATION.

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

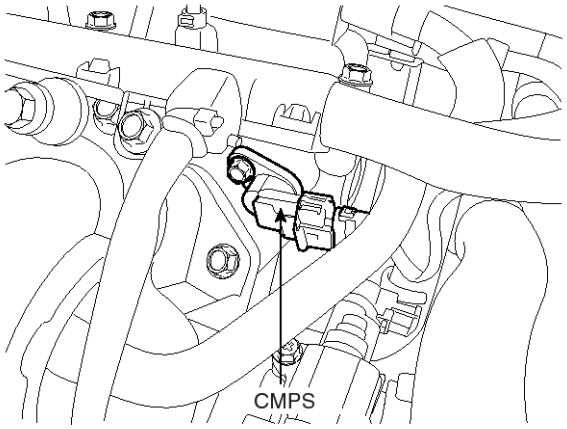
Specification: Refer to SPECIFICATION.

Camshaft Position Sensor (CMPS)

Inspection

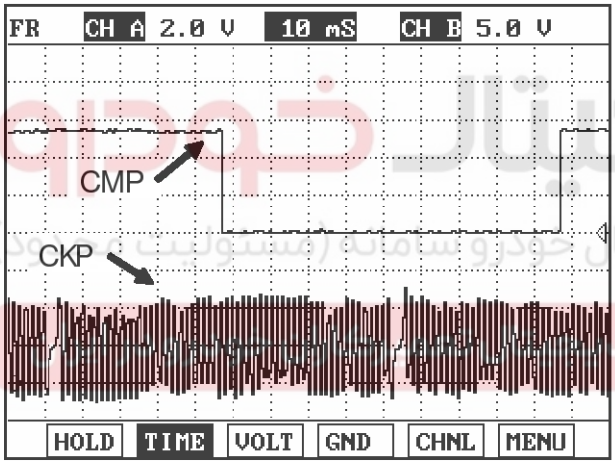
Function And Operation Priciple

Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element. It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect. The CMPS are installed on engine head cover and uses a target wheel installed on the camshaft. This sensor has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow.

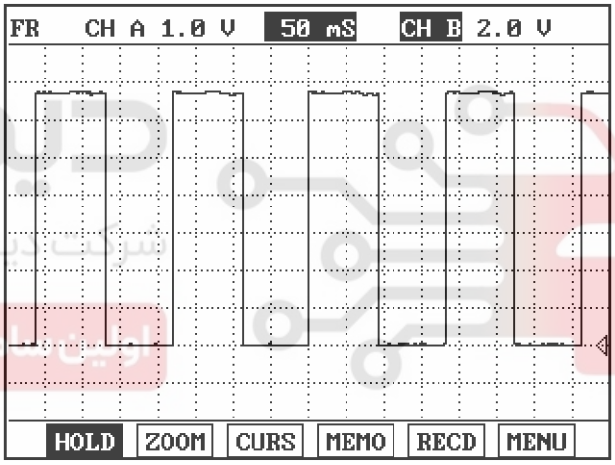


SHDFL6107L

Waveform



CKP-CMP



CMP

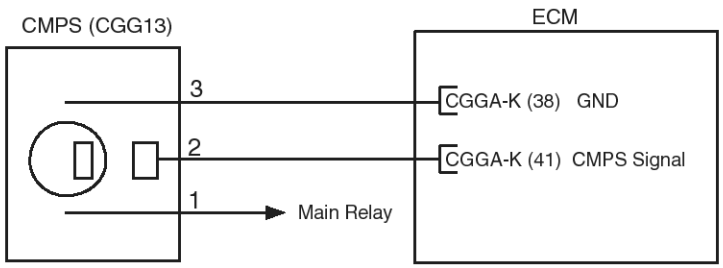
This example shows a typical Crankshaft Position Sensor(CkPS) and Camshaft Position Sensor(CMPS) waveform at idle. The PCM controls the injection and ignition timing by using these signals. Generally CkPS signal is used to detect the piston's position and CMPS signal is used to detect the Top Dead Center of each cylinder.

SHDFL6810L

Circuit Diagram

(A/T)

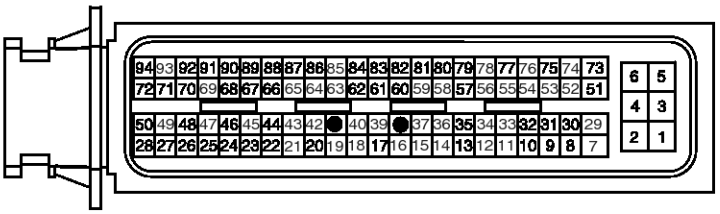
[CIRCUIT DIAGRAM]

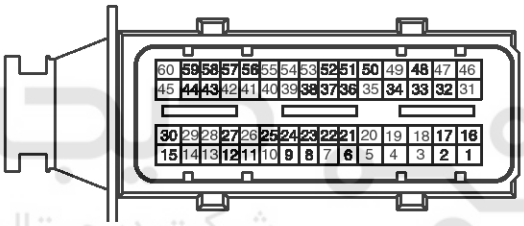


[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	PCM CGGA-K (41)	CMPS Signal
3	PCM CGGA-K (38)	Sensor Ground

[HARNESS CONNECTOR]

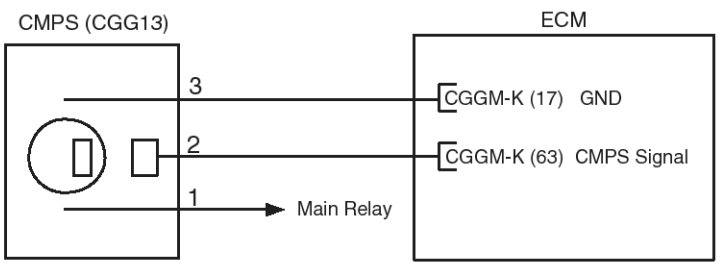




SHDFL6900L

(M/T)

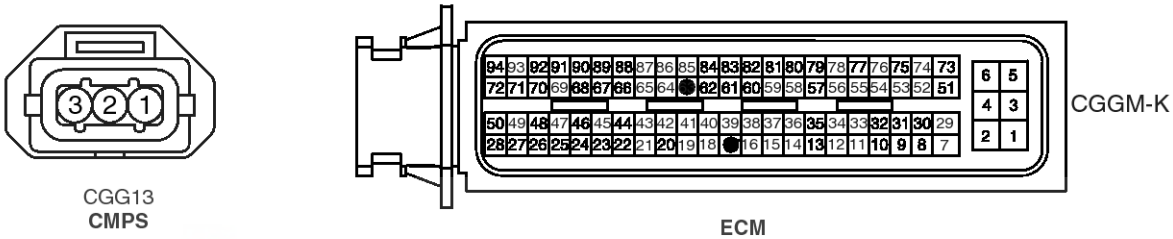
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	ECM CGGM-K (63)	CMPS Signal
3	ECM CGGM-K (17)	Sensor Ground

[HARNESS CONNECTOR]



SHDFL6901L

Component Inspection

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

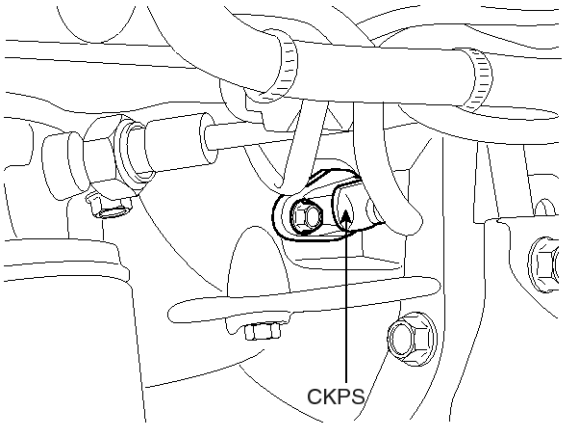
Specification : Refer to "WAVE FORM"

Crankshaft Position Sensor (CKPS)

Inspection

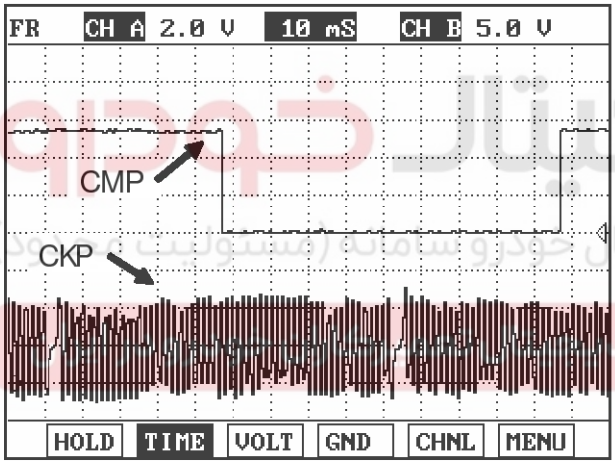
Function And Operation Priciple

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

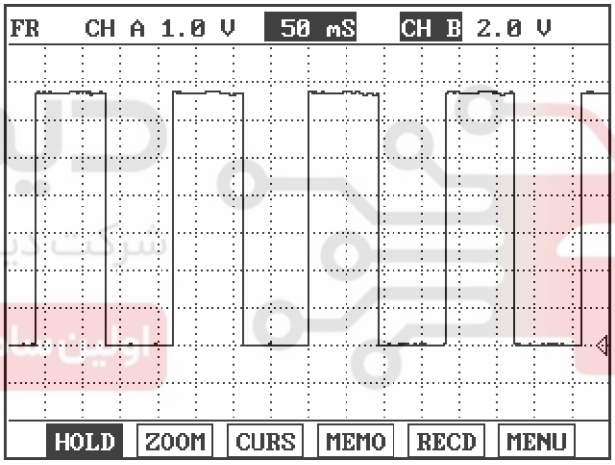


SHDFL6106L

Waveform



CKP-CMP



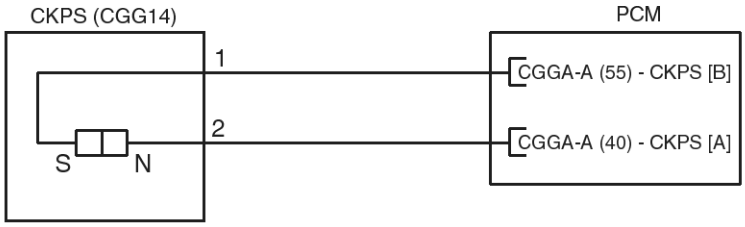
CMP

This example shows a typical Crankshaft Position Sensor(CkPS) and Camshaft Position Sensor(CMPS) waveform at idle. The PCM controls the injection and ignition timing by using these signals. Generally CkPS signal is used to detect the piston's position and CMPS signal is used to detect the Top Dead Center of each cylinder.

SHDFL6810L

Circuit Diagram
(A/T)

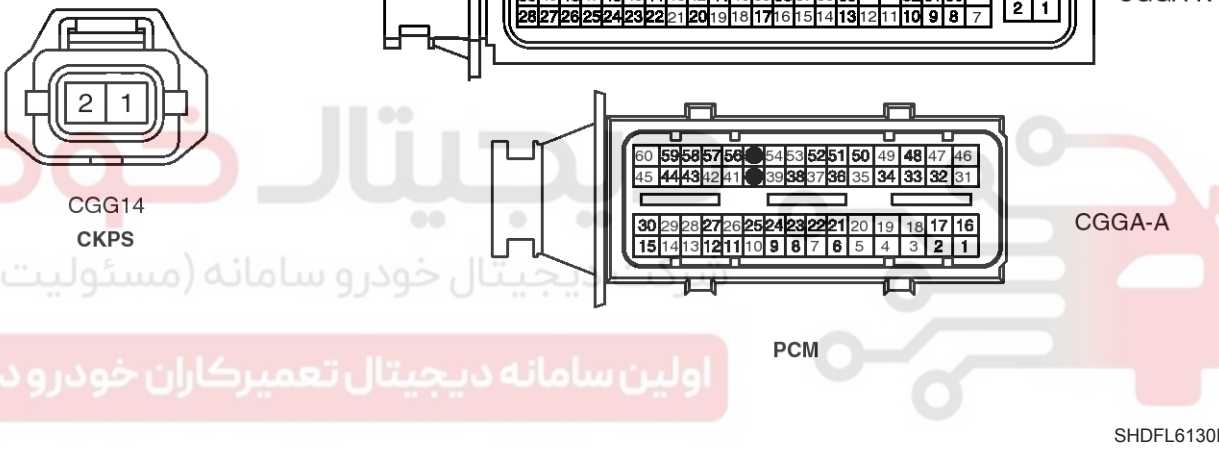
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM CGGA-A (55)	CKPS [B] Signal
2	PCM CGGA-A (40)	CKPS [A] Signal

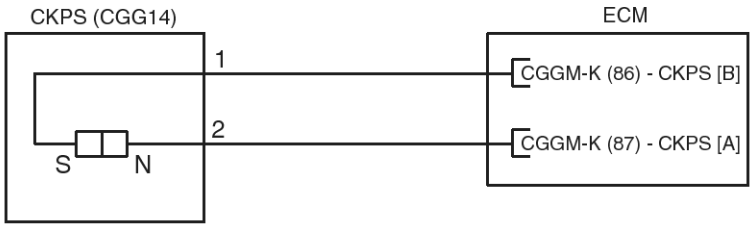
[HARNESS CONNECTORS]



SHDFL6130L

(M/T)

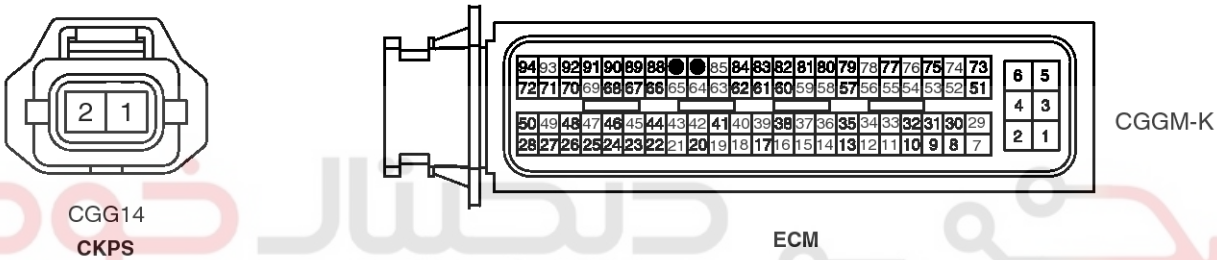
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM CGGM-K (86)	CKPS [B] Signal
2	ECM CGGM-K (87)	CKPS [A] Signal

[HARNESS CONNECTORS]



SHDFL6133L

Component Inspection

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

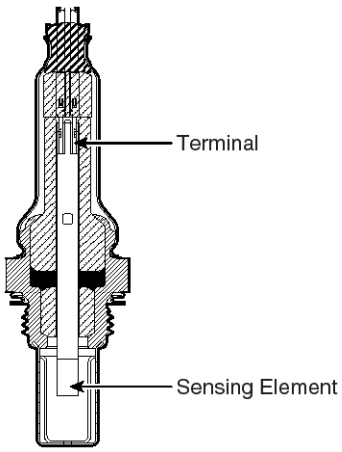
Specification : Refer to "WAVE FORM"

Heated Oxygen Sensor (HO2S)

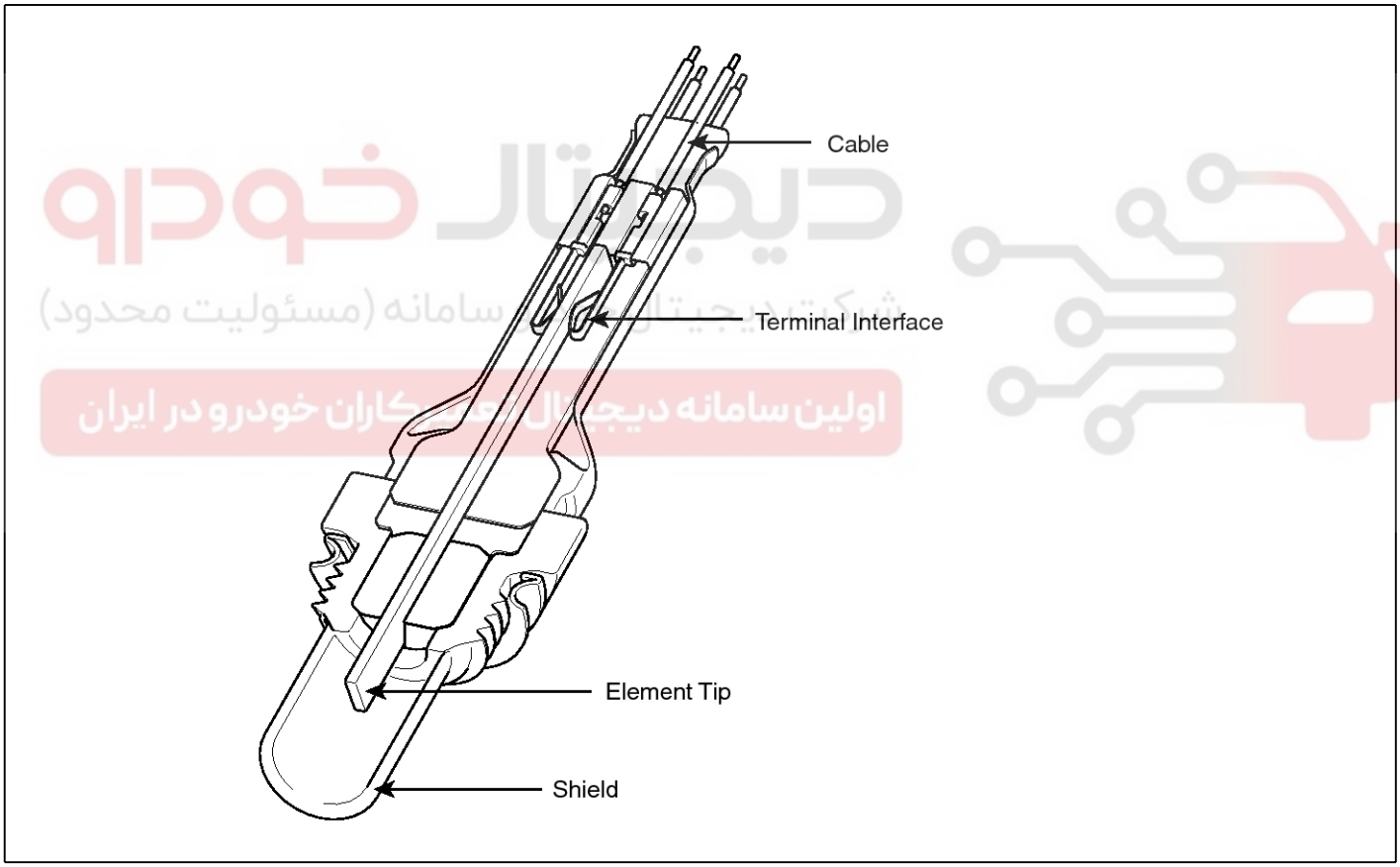
Inspection

Function And Operation Priciple

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



EGRF247A



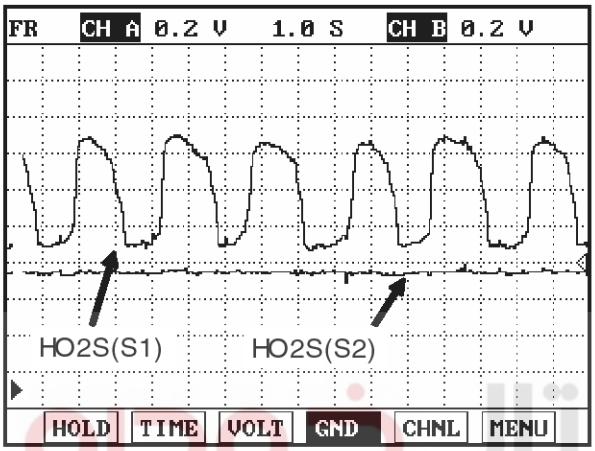
EGRF248A

Specification

A/F Ratio	Output Voltage (V)
RICH	0.6 ~ 1.0
LEAN	0 ~ 0.4

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

Waveform

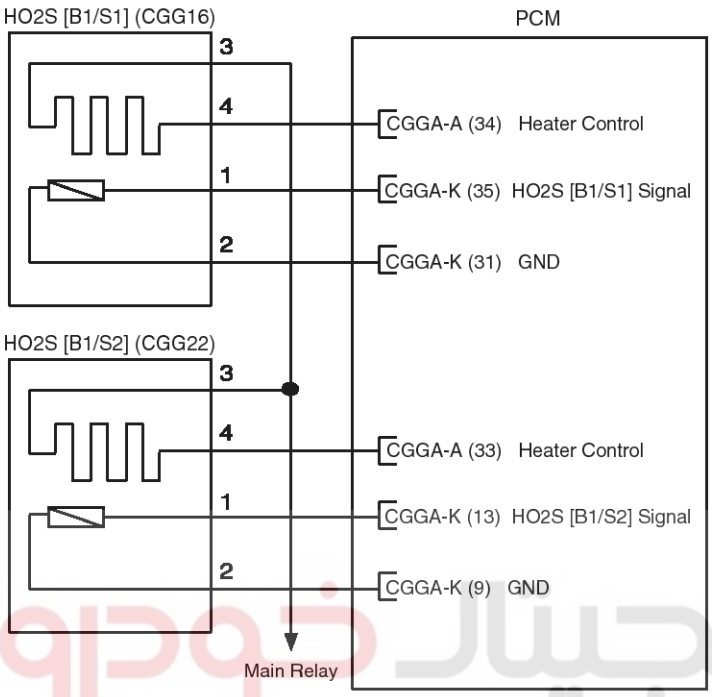


If you release the accelerator pedal suddenly after engine running about 4000 rpm, fuel supply will stop for short period and the O2 sensor service data in the Hi-Scan (Pro) will display values 200mV or lower.
When you suddenly press on the accelerator pedal down, the voltage will reach 0.6 ~ 1.0 V.
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 O2sensor can be determined as good.

LFJF421A

Circuit Diagram
(A/T)

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [Bank 1/ Sensor 1]

Terminal	Connected to	Function
1	PCM CGGA-K (35)	HO2S [B1/S1] Signal
2	PCM CGGA-K (31)	Sensor Ground
3	Main Relay	Power Supply (B+)
4	PCM CGGA-A (34)	Heater Control

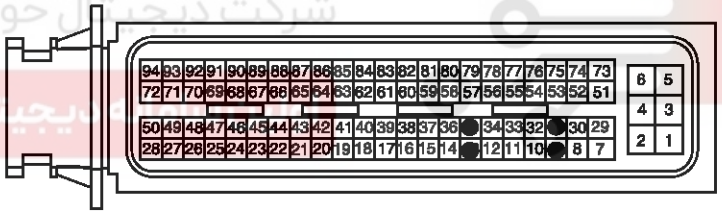
HO2S [Bank 1/ Sensor 2]

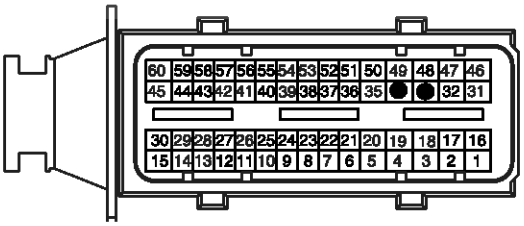
Terminal	Connected to	Function
1	PCM CGGA-K (13)	HO2S [B1/S2] Signal
2	PCM CGGA-K (9)	Sensor Ground
3	Main Relay	Power Supply (B+)
4	PCM CGGA-A (33)	Heater Control

[HARNESS CONNECTOR]

CGG16
HO2S [B1/S1]

CGG22
HO2S [B1/S2]



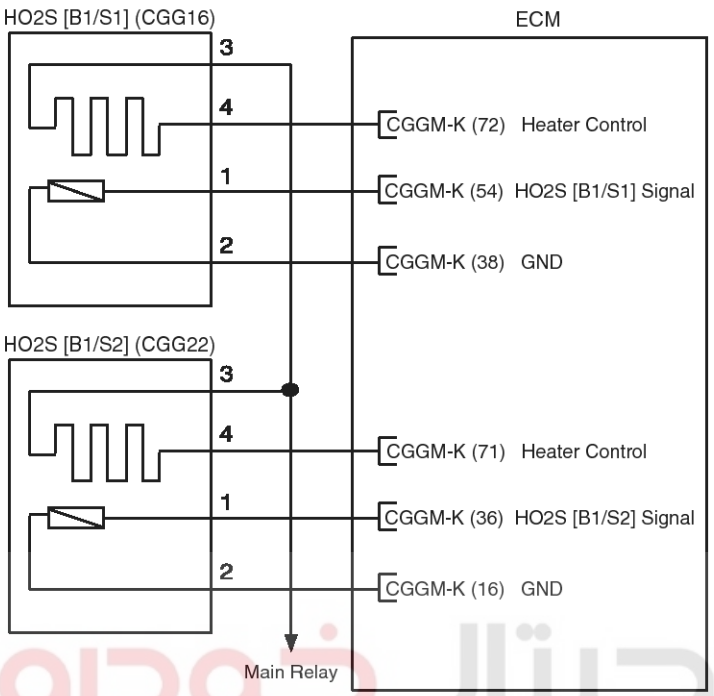


PCM

SFDFL8020L

(M/T)

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

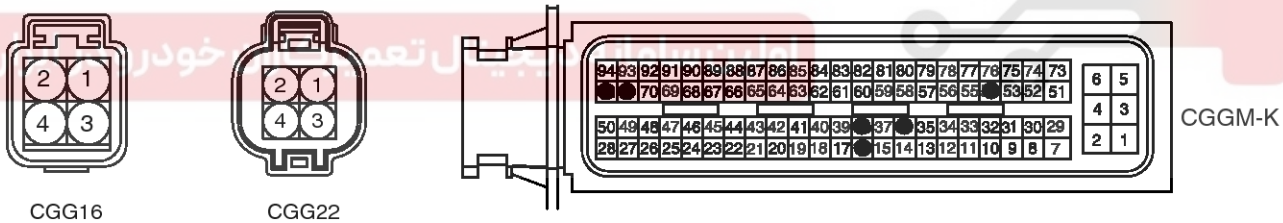
HO2S [Bank 1/ Sensor 1]

Terminal	Connected to	Function
1	ECM CGGM-K (54)	HO2S [B1/S1] Signal
2	ECM CGGM-K (38)	Sensor Ground
3	Main Relay	Power Supply (B+)
4	ECM CGGM-K (72)	Heater Control

HO2S [Bank 1/ Sensor 2]

Terminal	Connected to	Function
1	ECM CGGM-K (36)	HO2S [B1/S2] Signal
2	ECM CGGM-K (16)	Sensor Ground
3	Main Relay	Power Supply (B+)
4	ECM CGGM-K (71)	Heater Control

[HARNESS CONNECTOR]



SFDFL8021L

Component Inspection

1. Check signal waveform of HO2S using a scantool.

Specification: Refer to "waveform".

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

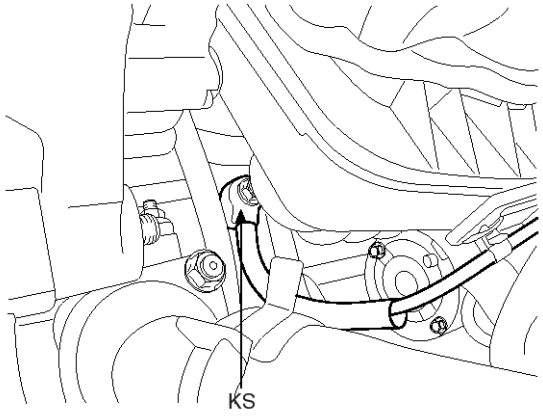
Specification: Refer to SPECIFICATION.

Knock Sensor (KS)

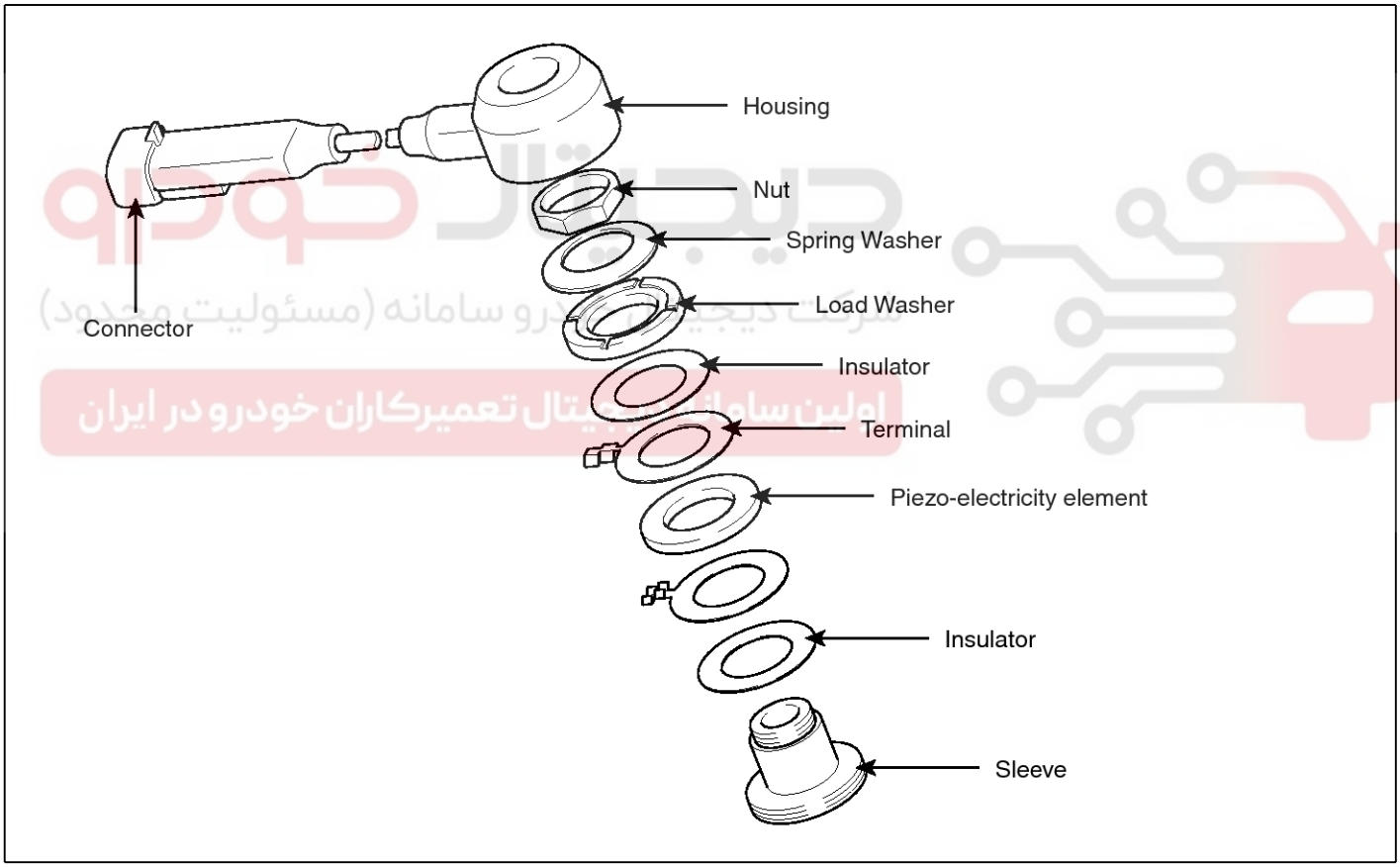
Inspection

Function And Operation Priciple

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



SHDFL6108L

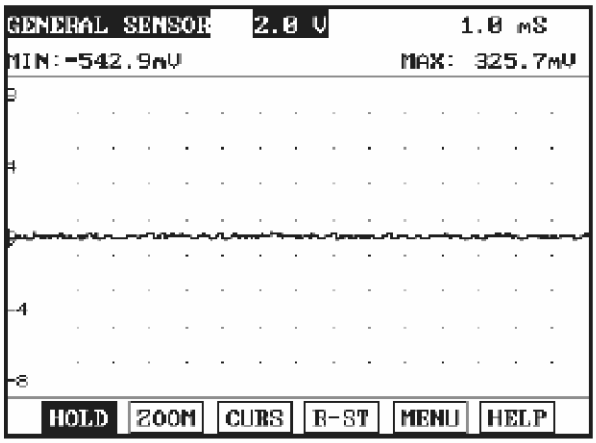


EGRF252A

Specification

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

Waveform

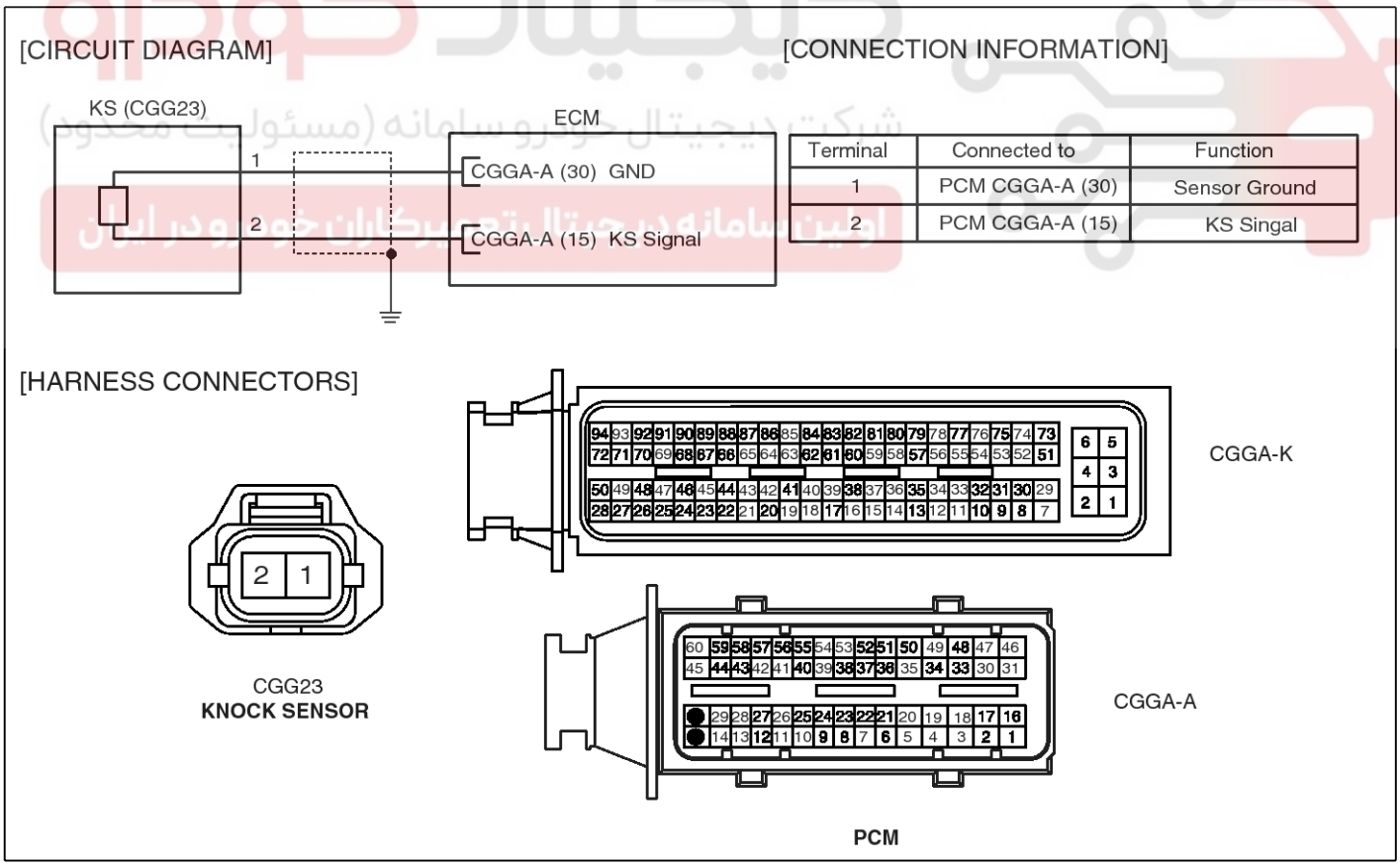


The knock sensor is installed at cycliner block to detect the vibration effectively during engine running.
The above waveform shows the signal waveform of knock sensor when knock dosen't happen. Generally, knock signal has more noise than other sensor.

EGRF610B

Circuit Diagram

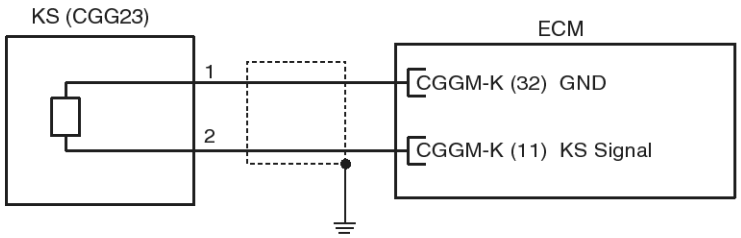
(A/T)



SHDFL6590L

(M/T)

[CIRCUIT DIAGRAM]

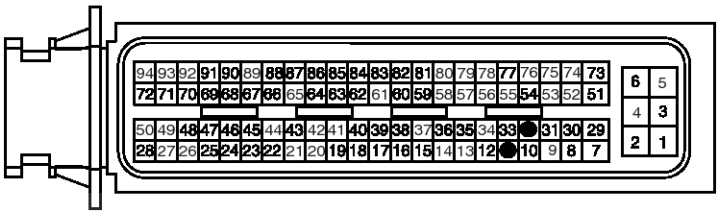


[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM CGGM-K (32)	Sensor Ground
2	ECM CGGM-K (11)	KS Signal

[HARNESS CONNECTORS]

CGG23
KNOCK SENSOR



ECM

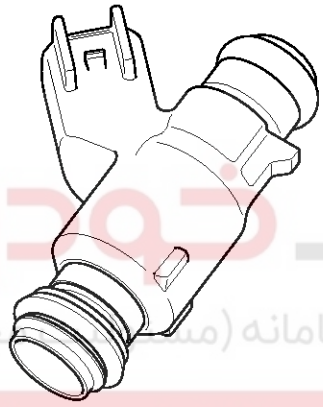
SHDFL6591L

Injector

Inspection

Function And Operation Priciple

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



KFCF1026

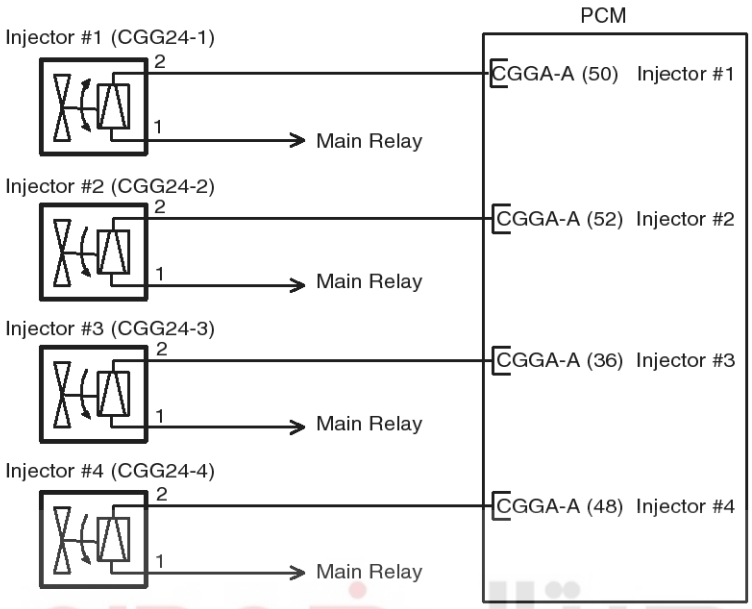
Specification

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

Circuit Diagram

(A/T)

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1

Terminal	Connected to	Function
1	Main Relay	Power supply (B+)
2	PCM CGGA-A (50)	Injector #1 Control

Injector #2

Terminal	Connected to	Function
1	Main Relay	Power supply (B+)
2	PCM CGGA-A (52)	Injector #2 Control

Injector #3

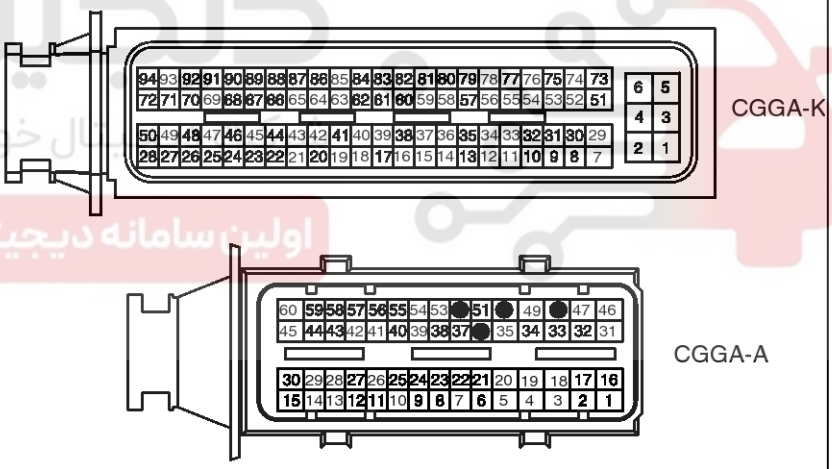
Terminal	Connected to	Function
1	Main Relay	Power supply (B+)
2	PCM CGGA-A(36)	Injector #3 Control

Injector #4

Terminal	Connected to	Function
1	Main Relay	Power supply (B+)
2	PCM CGGA-A (48)	Injector #4 Control

[HARNESS CONNECTORS]

CGG24-1,2,3,4
INJECTOR 1,2,3,4

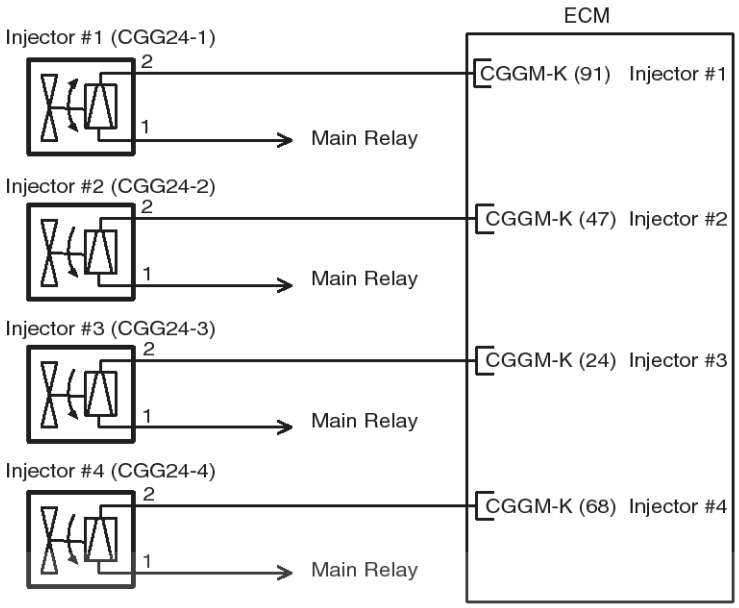


PCM

SHDFL6586L

(M/T)

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CGGM-K (91)	INjector #1 Control

Injector #2

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CGGM-K (47)	INjector #2 Control

Injector #3

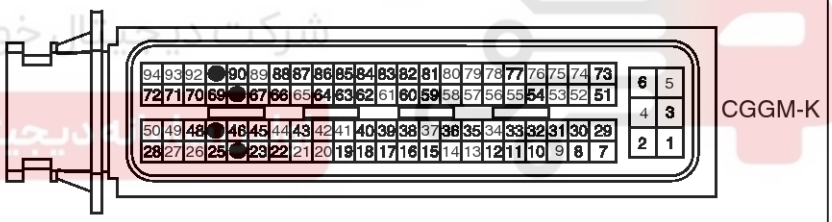
Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CGGM-K (24)	INjector #3 Control

Injector #4

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CGGM-K (68)	INjector #4 Control

[HARNESS CONNECTORS]

CGG24-1,2,3,4
INJECTOR 1,2,3,4



ECM

SHDFL6587L

Component Inspection

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

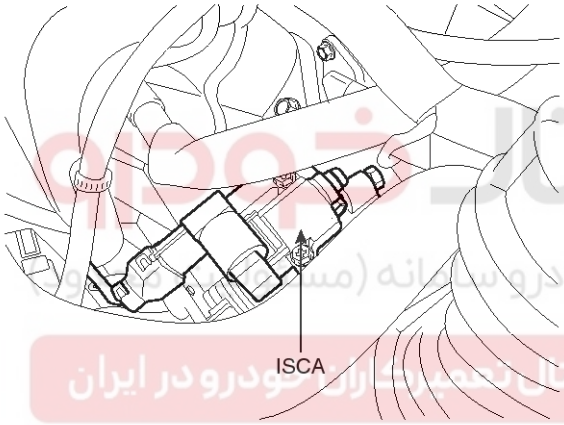
Specification: Refer to SPECIFICATION.

Idle Speed Control Actuator (ISCA)

Inspection

Function And Operation Principle

The Idle Speed Control Actuator (ISCA) is installed on the throttle body 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 PCM controls both coils by grounding their control circuits. According to the control signals from the PCM, the valve rotor rotates to control the by pass airflow into the engine.



SHDFL6113L

Specification

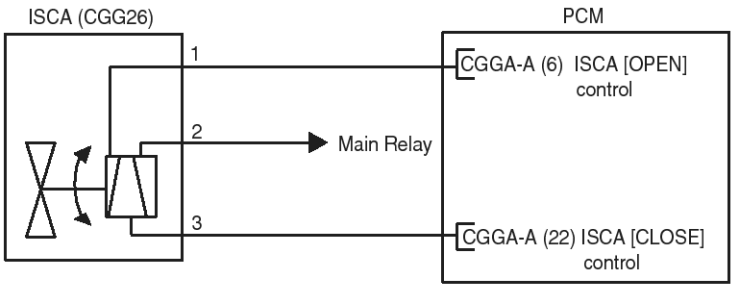
Items	Specification
Closing Coil Resistance (Ω)	14.6 ~ 16.2 [20℃ (68°F)]
Opening Coil Resistance (Ω)	11.1 ~ 12.7 [20℃ (68°F)]

Duty (%)	Air Flow Rate (㎥/h)
15	0.5 ~ 1.5
35	5.5 ~ 9.3
70	28.5 ~ 36.5
96	39.0 ~ 48.0

Circuit Diagram

(A/T)

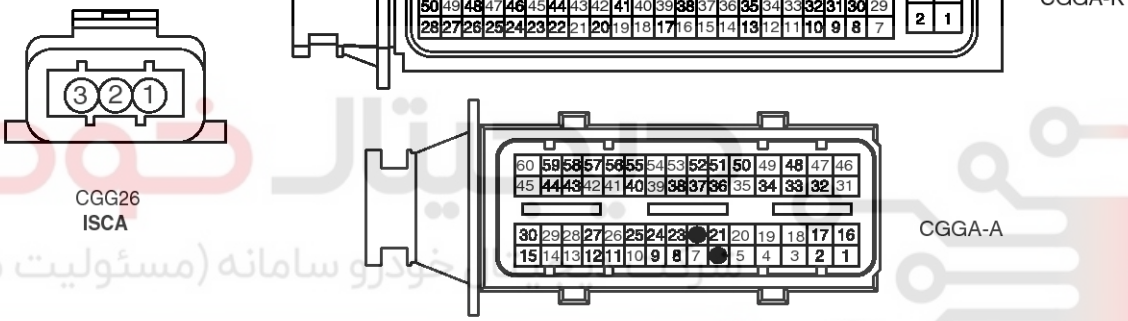
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM CGGA-A (6)	ISCA [OPEN] control
2	Main Relay	Power supply (B+)
3	PCM CGGA-A (22)	ISCA [CLOSE] control

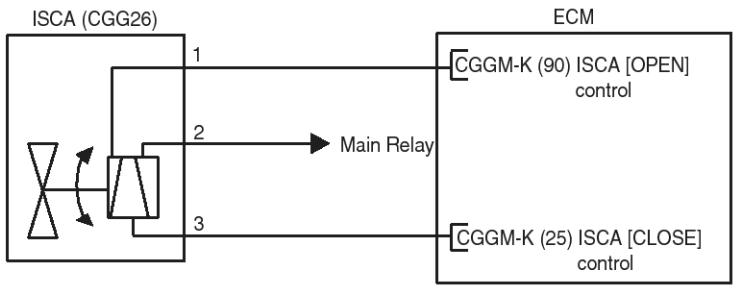
[HARNESS CONNECTORS]



SHDFL6596L

(M/T)

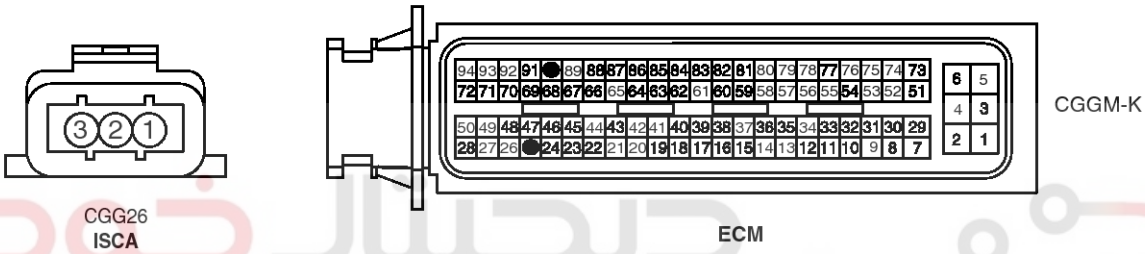
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM CGGM-K (90)	ISCA [OPEN] control
2	Main Relay	Power supply (B+)
3	ECM CGGM-K (25)	ISCA [CLOSE] control

[HARNESS CONNECTORS]



SHDFL6597L

Component Inspection

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

Check that the resistance is within the specification.

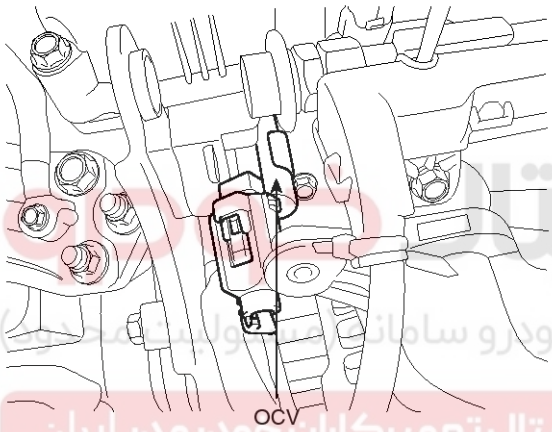
CVVT Oil Control Valve (OCV)

Inspection

Function And Operation Priciple

The Continuously Variable Valve Timing (CVVT) system controls the amount of valve overlap by varying the amount of oil flow into an assembly mounted on the intake camshaft through PCM control of an oil control valve. As oil is directed into the chambers of the CVVT assembly, the cam phase is changed to suit various performance and emissions requirements..

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



SHDFL6115L

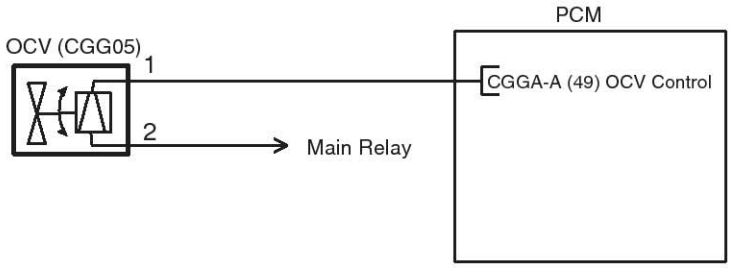
Specification

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

Circuit Diagram

(A/T)

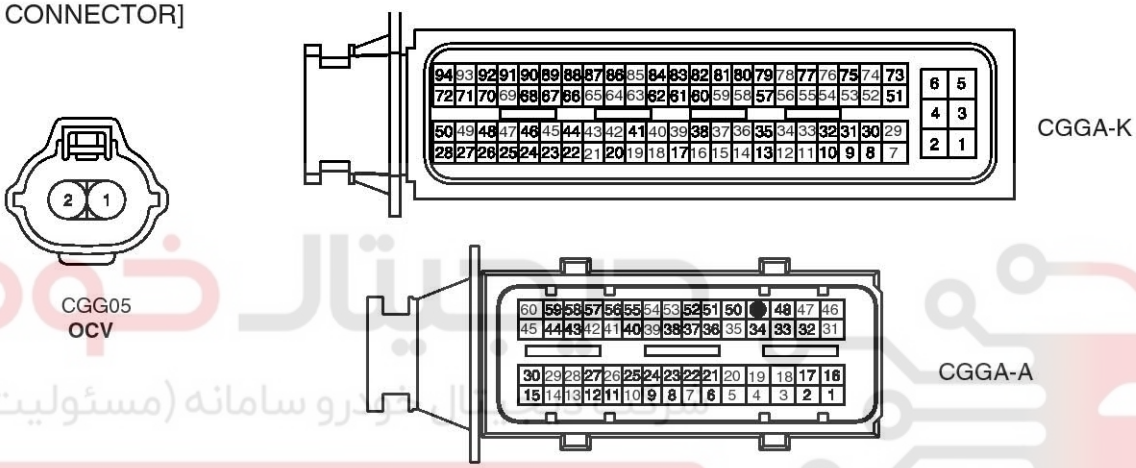
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM CGGA-A (49)	OCV Control
2	Main Relay	Power supply (B+)

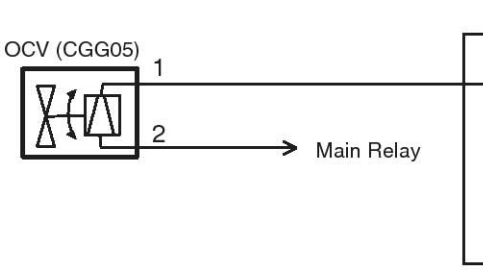
[HARNESS CONNECTOR]



SHDFL6572L

(M/T)

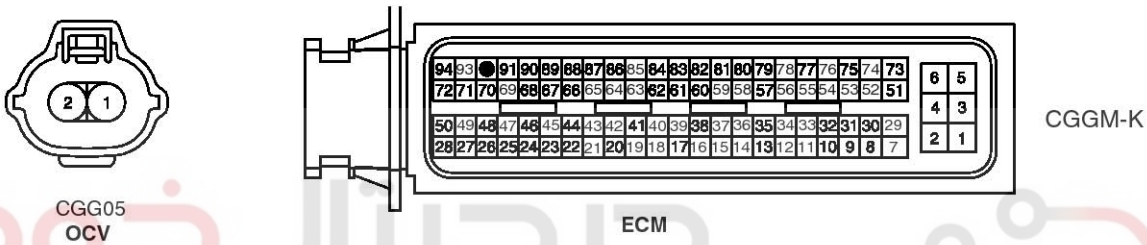
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM CGGM-K (92)	OCV Control
2	Main Relay	Power supply (B+)

[HARNESS CONNECTOR]



SHDFL6902L

Component Inspection

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

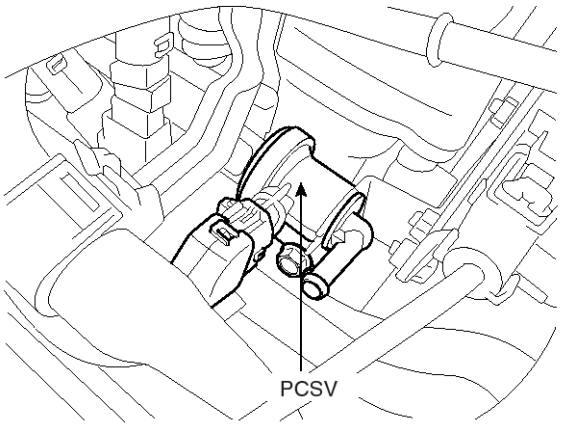
Specification: Refer to SPECIFICATION.

Purge Control Solenoid Valve (PCSV)

Inspection

Function And Operation Priciple

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



SHDFL6114L

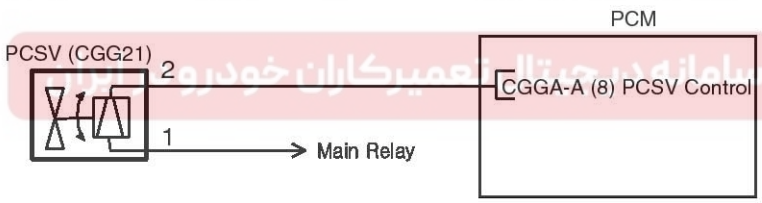
Specification

Item	Specification
Coil Resistance (Ω)	16.0Ω at 20℃ (68˚F)

Circuit Diagram

(A/T)

[CIRCUIT DIAGRAM]

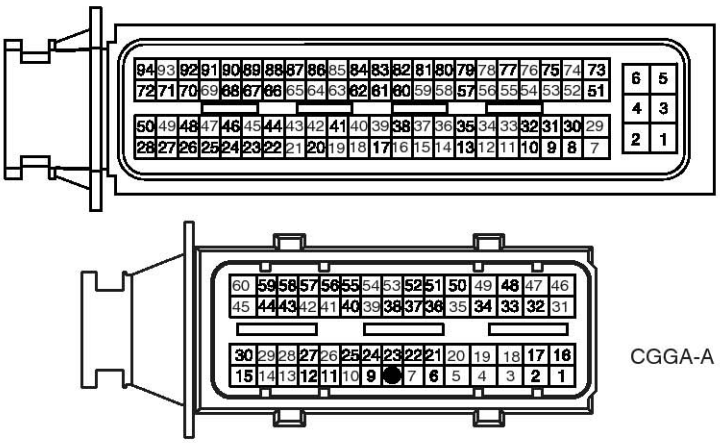


[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Main Relay	Power supply (B+)
2	ECM CGGA-A (8)	PCSV Control

[HARNESS CONNECTORS]

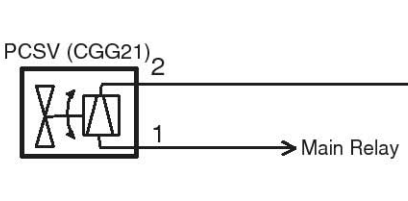
CGG21
PCSV



SHDFL6592L

(M/T)

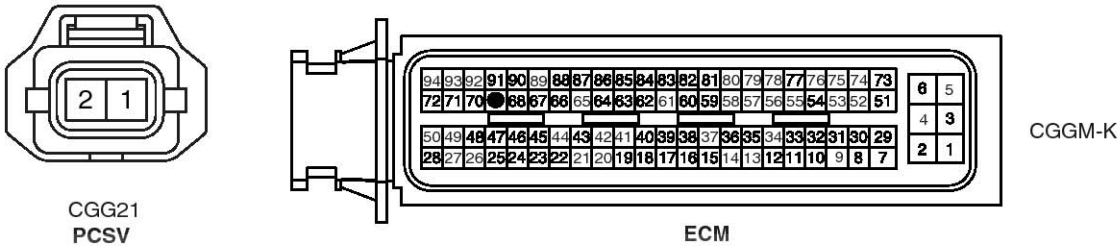
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CGGM-K (69)	PCSV Control

[HARNESS CONNECTORS]



SHDFL6593L

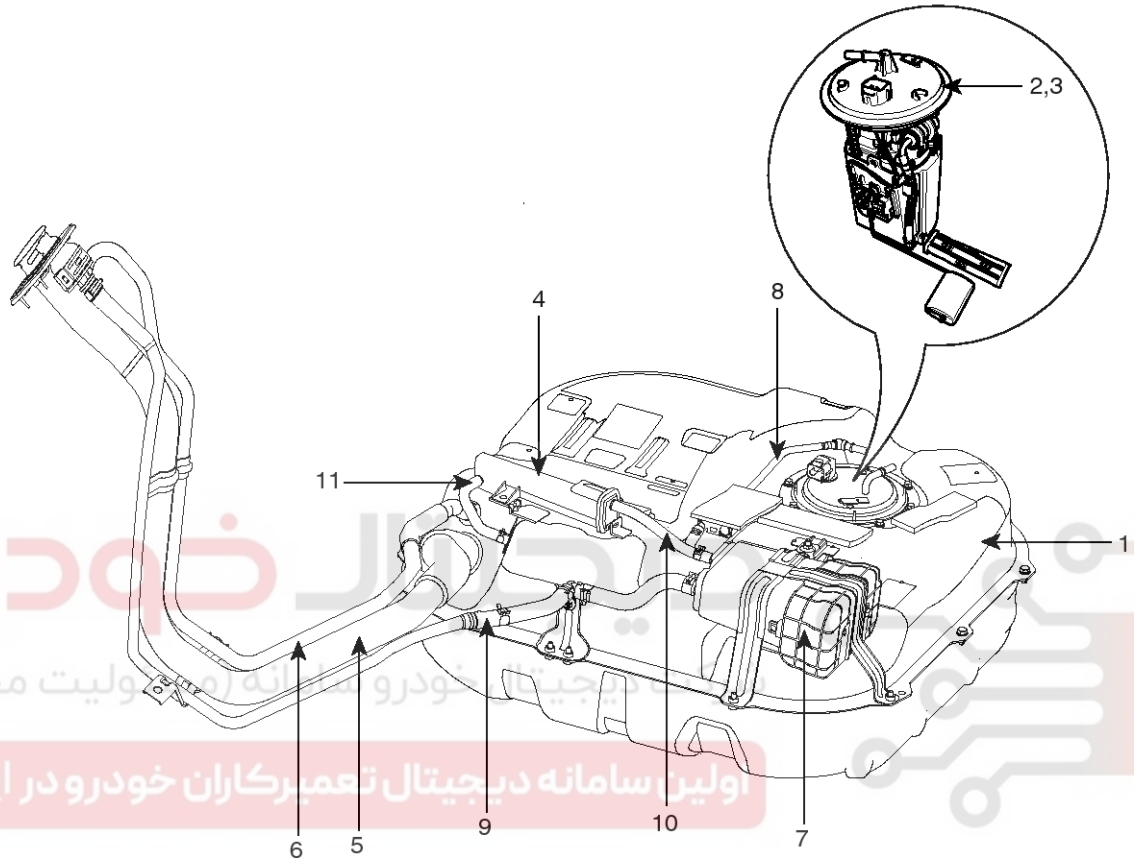
Component Inspection

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

Specification: Refer to SPECIFICATION.

Fuel Delivery System

Component Location



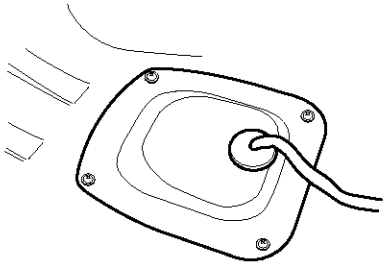
1. Fuel Tank
2. Fuel Pump (Including Fuel Filter)
3. Fuel Pressure Regulator
4. Separator
5. Fuel Filler Pipe
6. Leveling Pipe
7. Canister
8. Tube (Canister ↔ Intake Manifold)
9. Hose (Canister ↔ Fuel Tank Air Filter)
10. Hose (Canister ↔ Separator)
11. Hose (Separator ↔ Fuel Tank)

SFDFL8007L

Fuel Pressure Test

1. PREPARING

1. Remove the rear seat cushion (Refer to "SEAT" in BD group).
2. Open the service cover (A).

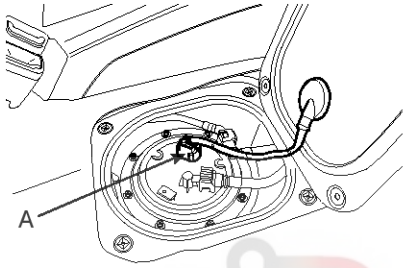


2. RELEASE THE INTERNAL PRESSURE

1. Disconnect the fuel pump connector (A).
2. Start the engine and wait until fuel in fuel line is exhausted.
3. After the engine stalls, turn the ignition switch to OFF position and disconnect the negative (-) terminal from the battery.

NOTE

Be sure to reduce the fuel pressure before disconnecting the fuel feed hose, otherwise fuel will spill out.



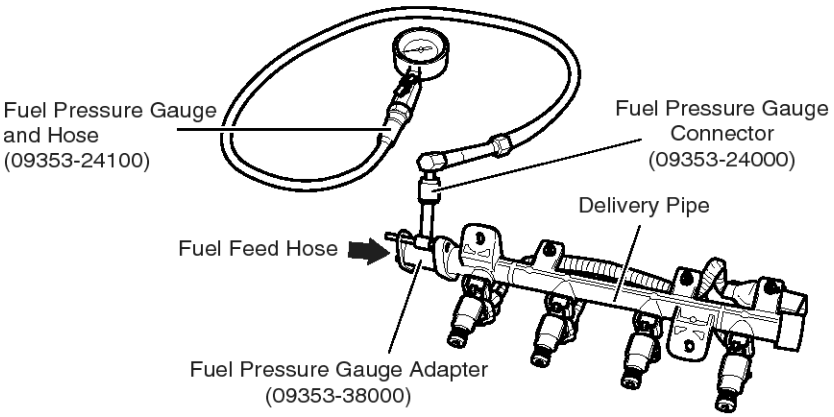
3. INSTALL THE SPECIAL SERVICE TOOL (SST) FOR MEASURING THE FUEL PRESSURE

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

CAUTION

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

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



SFDFL8008L

4. INSPECT FUEL LEAKAGE ON CONNECTION

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

5. FUEL PRESURE TEST

1. Diconnect the negative (-) terminal from the battery.
2. Connect the fuel pump connector.
3. Connect the battery negative (-) terminal.
4. Start the engine and measure the fuel pressure at idle.

Standard Value: 338 ~ 348 kpa (3.45 ~ 3.55 kgf/㎠, 49.0 ~ 50.5 psi)

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

Condition	Probable Cause	Suspected Area
Fuel Pressure too low	Clogged fuel filter	Fuel filter
	Fuel leak on the fuel-pressure regulator that is assembled on fuel pump because of poor seating of the fuel-pressure regulator.	Fuel Pressure Regulator
Fuel Pressure too High	Sticking fuel pressure regulator	Fuel Pressure Regulator

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

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

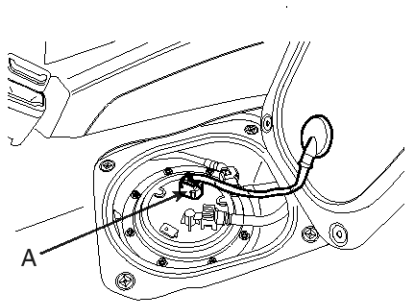
- Observing the declination of the fuel pressure when the gage reading drops and perform the necessary repairs using the table below.

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

SMGFL6906N

6. RELEASE THE INTERNAL PRESSURE

1. Disconnect the fuel pump connector (A).
2. Start the engine and wait until fuel in fuel line is exhausted.
3. After the engine stalls, turn the ignition switch to OFF position and diconnect the negative (-) terminal from the battery.



NOTE

Be sure to reduce the fuel pressure before disconnecting the fuel feed hose, otherwise fuel will spill out.

7. REMOVE THE SPECIAL SERVICE TOOL (SST) AND CONNECT THE FUEL LINE

1. Disconnect the Fuel Pressure Gage and Hose (09353-24100) from the Fuel Pressure Gage Connector (09353-24000).
2. Disconnect the Fuel Pressure Gage Connector (09353-24000) from the Fuel Pressure Gage Adapter (09353-38000).
3. Disconnect the fuel feed hose from the Fuel Pressure Gage Adapter (09353-38000).
4. Disconnect the Fuel Pressure Gage Adapter (09353-38000) from the delivery pipe.

CAUTION

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

5. Conenct the fuel feed hose to the delivery pipe.

8. INSPECT FUEL LEAKAGE ON CONNECTION

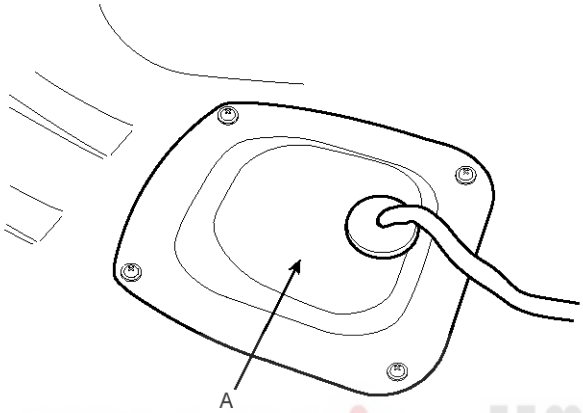
1. Connect the battery negative (-) terminal.
2. Apply battery voltage to the fuel pump terminal and activate the fuel pump. With fuel pressure applied, check that there is no fuel leakage from the fuel pressure gauge or connection part.
3. If the vehicle is normal, connect the fuel pump connector.

SFDFL8009L

Fuel Pump

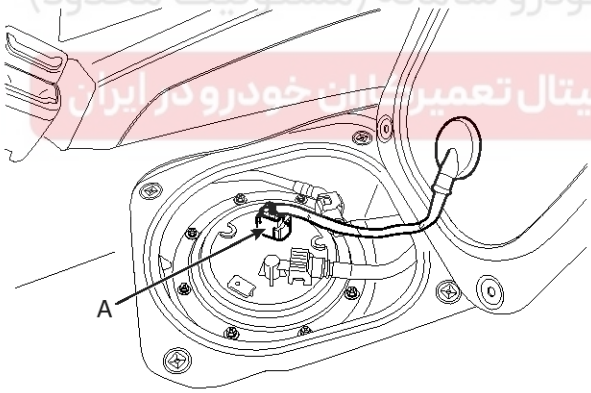
Removal (Including Fuel Filter And Fuel Pressure Regulator)

1. Preparation
   1) Fold or remove the rear seat cushion (Refer to "SEAT" in BD group).
   2) Open the service cover (A).



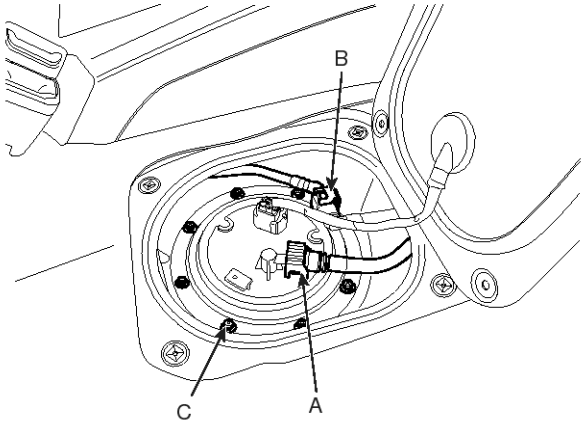
SHDF16125L

   3) Disconnect the fuel pump connector (A).



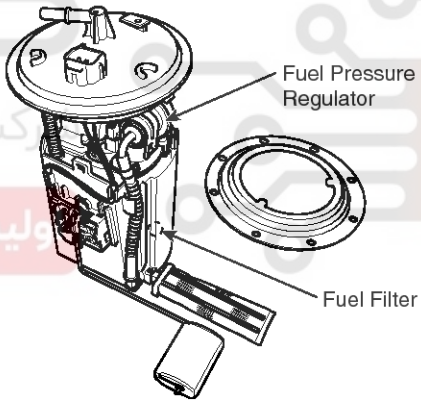
SFDFL8010L

   4) Start the engine and wait until fuel in fuel line is exhausted.
   5) After engine stalls, turn the ignition switch to OFF position.
2. Disconnect the fuel feed tube quick-connector (A) and the vapor tube quick-connector (B).



SFDFL8011L

3. Unscrew the fuel pump installation bolts (C) and remove the fuel pump assembly.



SFDFL8012L

Installation

Installation is reverse of removal.

Fuel Pump installation bolts : 3.9 ~ 5.9 N·m (0.4 ~ 0.6 kgf·m, 2.9 ~ 4.3 lbf·ft)

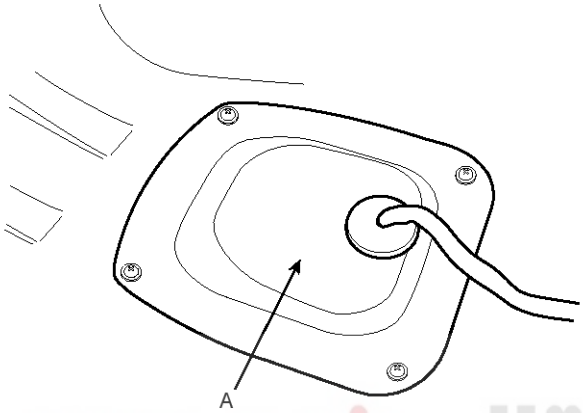
⚠CAUTION

When installing a pump module, be careful not to get the seal-ring entangled.

Fuel Tank

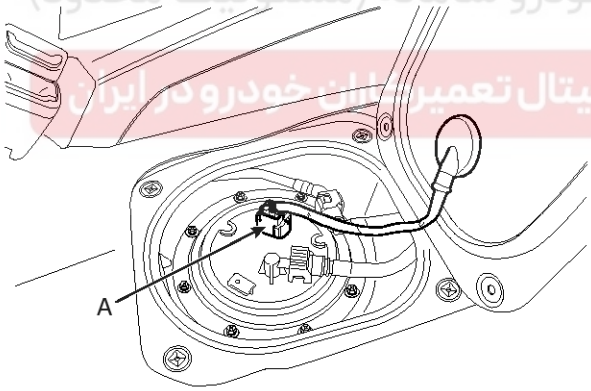
Removal (Including Fuel Filter And Fuel Pressure Regulator)

1. Preparation
   1) Remove the rear seat cushion (Refer to "SEAT" in BD group).
   2) Open the service cover (A).



SHDF16125L

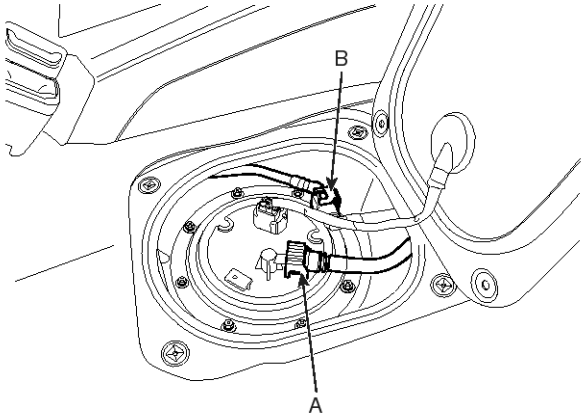
   3) Disconnect the fuel pump connector (A).



SFDFL8010L

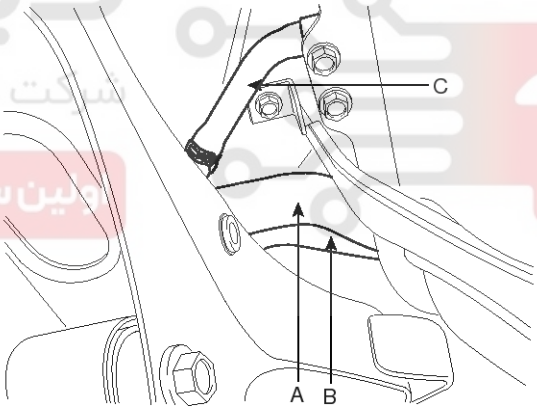
   4) Start the engine and wait until fuel in fuel line is exhausted.
   5) After engine stalls, turn the ignition switch to OFF position.

2. Disconnect the fuel feed quick-connector (A) and vapor tube quick-connector (B).



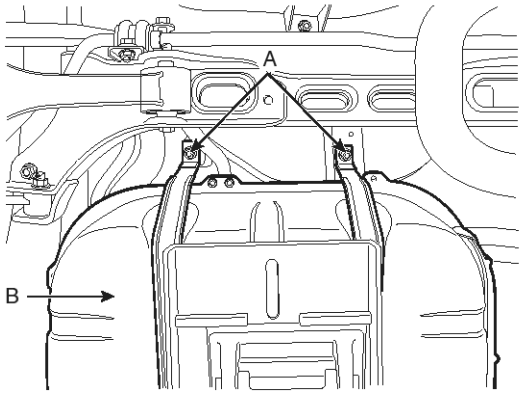
SFDFL8013L

3. Lift the vehicle and support the fuel tank with a jack.
4. Disconnect the fuel filler hose (A), the leveling hose (B) and the vapor hose (C).



SEDFL7007L

5. Unscrew the fuel tank band mounting nuts(A) and remove the fuel tank(B).



SEDF37009L

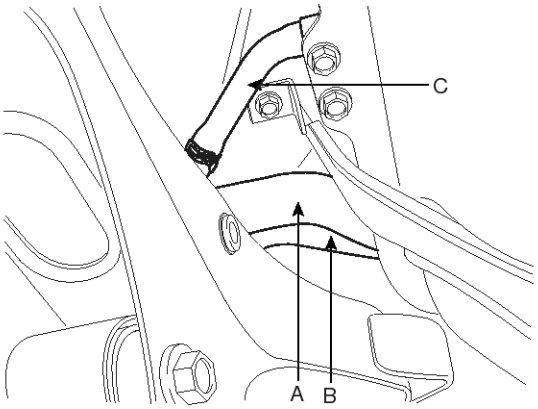
Installation

Installation is reverse of removal.

Filler-Neck Assembly

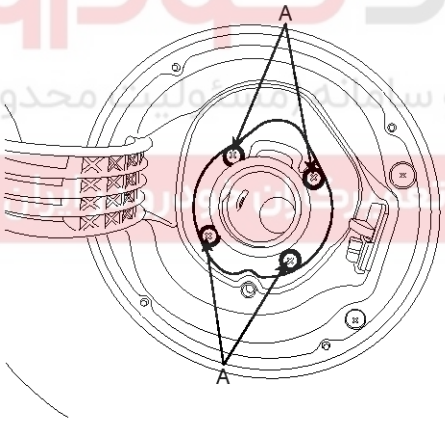
Removal

1. Disconnect the fuel filler hose (A), the leveling hose (B) and the vapor hose (C).



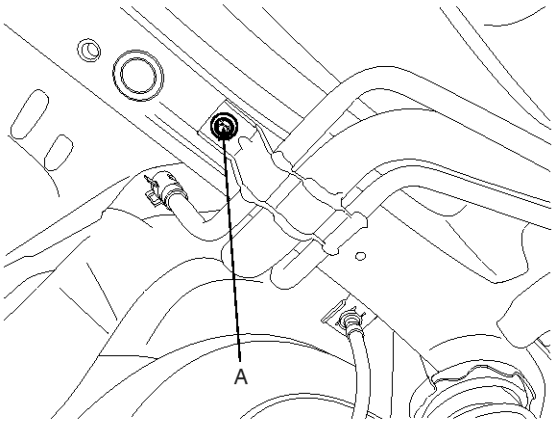
SEDFL7007L

2. Open the fuel filler door and unfasten the filler-neck assembly mounting screws (A).



SFDFL8019L

3. Remove the rear-LH wheel, tire, and the inner wheel house.
4. Remove the bracket mounting bolt (A) and remove the filler-neck assembly.



SFDFL8014L

NOTICE

If the filler neck assembly can't be removed easily, remove it again after loosening the rear cross member mounting bolt partly (Refer to "REAR LOWER ARM" in SS group).

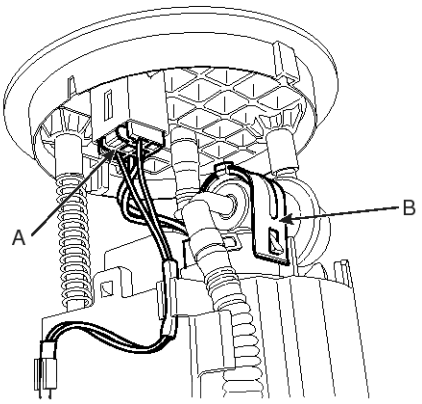
Installation

1. Installation is reverse of removal.

Fuel Filter

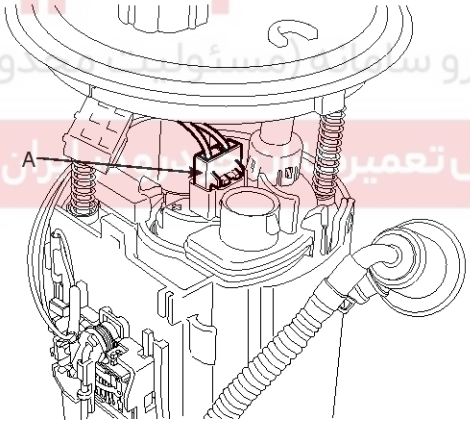
Replacement

1. Remove the fuel pump (Refer to “FUEL PUMP” in this group).
2. Disconnect the fuel pump & sender wiring connector (A) and remove the regulator cap (B).



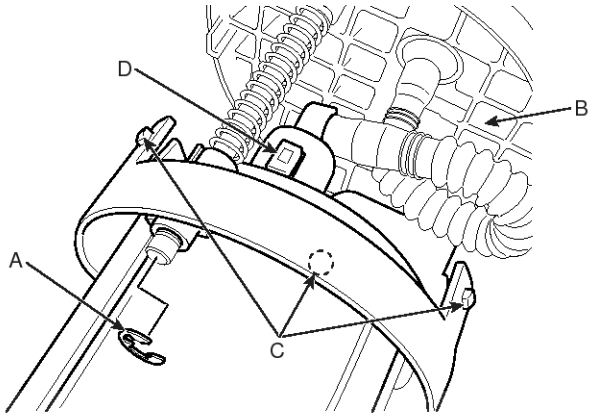
SFDFL8015L

3. Disconnect the electric pump wiring connector (A).



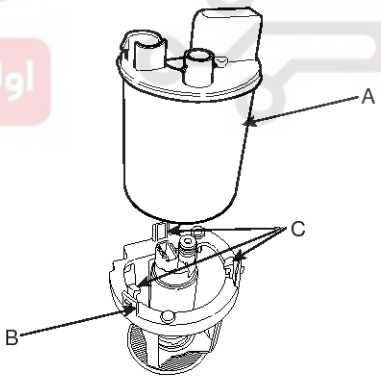
SFDFL8016L

4. Remove the cushion pipe fixing clip (A) after pressing the flange assembly (B).
5. Separate the flange assembly (B) from the fuel pump & filter assembly after disengaging three fixing hooks (C) and the feed hose connector (D).



SFDFL8017L

6. Separate the fuel filter assembly (A) from the fuel pump assembly (B) after disengaging three hooks (C).



SFDFL8018L