General Information

Specifications

Fuel Delivery System

Items	Specification	
Fuel Tank	Capacity	62 lit. (65.5 U.S.qt., 54.6 Imp.qt.)
Fuel Filter	Type	Paper type
Fuel Pressure Regulator	Regulated Fuel Pressure	379.5kPa (3.87kgf/㎠, 55.0psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor

Sensors

Mass Air Flow Sensor (MAFS)

▷ Type: Hot-film type

▷ Specification

Air Flow (kg/h)	Frequency (Hz)
12.6	2,617
18.0	2,958
23.4	3,241
32.4	3,653
43.2	4,024
57.6	4,399
72.0	4,704
108.0	5,329
144.0	5,897
198.0	6,553
270.0	7,240
360.0	7,957
486.0	8,738
666.0	9,644
900.0	10,590

Intake Air Temperature Sensor (IATS)

▷ Type: Thermistor type

▷ Specification

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

Manifold Absolute Pressure Sensor (MAPS)

▷ Type: Piezo-resistive pressure sensor

▷ Specification

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

Engine Coolant Temperature Sensor (ECTS)

▷ Type: Thermistor type

▷ Specification

Temperature		Resistance (kΩ)
℃	˚F	
-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) [integrated into ETC Module]

▷ Type: Variable resistor type

▷ Specification

Throttle Angle(˚)	Output Voltage(V)	
	TPS1	TPS2
0	0.0	5.0
10	0.5	4.5
20	0.9	4.1
30	1.4	3.6
40	1.8	3.2
50	2.3	2.7
60	2.7	2.3
70	3.2	1.8
80	3.6	1.4
90	4.1	0.9
100	4.5	0.5
110	5.0	0.0

Item	Sensor Resistance(kΩ)
TPS1	4.0 ~ 6.0 [20℃(68˚F)]
TPS2	2.7 ~ 4.1 [20℃(68˚F)]

Crankshaft Position Sensor (CKPS)

▷ Type: Magnetic field sensitive sensor

▷ Specification

Item	Specification
Coil Resistance (Ω)	725 ~ 925Ω [20℃(68˚F)]
Air Gap (mm)	0.5 ~ 1.5

Camshaft Position Sensor (CMPS)

▷ Type: Hall effect type

▷ Specification

Item	Specification
Output Voltage (V)	High: 4.75 ~ 5.25V
	Low: 0 ~ 0.7V
Air Gap (mm)	0.5 ~ 1.5

Knock Sensor (KS)

▷ Type: Piezo-electricity type

▷ Specification

Item	Specification
Capacitance (pF)	950 ~ 1,350

Heated Oxygen Sensor (HO2S)

▷ Type: Zirconia (ZrO2) Type

▷ Specification

A/F Ratio (λ)	Output Voltage(V)
RICH	0.80 ~ 0.92
LEAN	0.1

Item	Specification
Heater Resistance (Ω)	3.0 ~ 4.0Ω[20℃(68˚F)]

CVVT Oil Temperature Sensor (OTS)

▷ Type: Thermistor type

▷ Specification

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

Accelerator Position Sensor (APS)

▷ Type: Variable resistor type

▷ Specification

Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.7 ~ 0.8	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

Item	Sensor Resistance (kΩ)
APS 1	0.7 ~ 1.3 [20℃(68˚F)]
APS 2	1.4 ~ 2.6 [20℃(68˚F)]

Actuators

Injector

▷ Specification

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

ETC Motor [integrated into ETC Module]

▷ Specification

Item	Specification
Coil Resistance (Ω)	1.275 ~ 1.725 [20℃(68˚F)]

Purge Control Solenoid Valve (PCSV)

▷ Specification

Item	Specification
Coil Resistance (Ω)	14.0 ~ 18.0 [20℃(68˚F)]

CVVT Oil Control Valve (OCV)

▷ Specification

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

Variable Intake Solenoid (VIS) Valve

▷ Specification

Item	Specification
Coil Resistance (Ω)	29.0 ~ 35.0 [20℃(68˚F)]

Ignition Coil

▷ Type: Stick type

▷ Specification

Item	Specification
1st Coil Resistance (Ω)	0.62 ± 10%[20℃(68˚F)]
2nd Coil Resistance (kΩ)	7.0 ± 15%[20℃(68˚F)]

Service Standard

Item		Specification	
Ignition Timing (˚)		BTDC 7 ± 10	
Idle Speed (rpm)	A/C OFF	Neutral, N, P-range	650 ± 100
		D-range	650 ± 100
	A/C ON	Neutral, N, P-range	650 ± 100
		D-range	650 ± 100

Tightening Torques

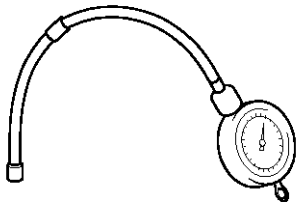
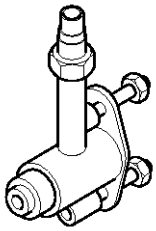
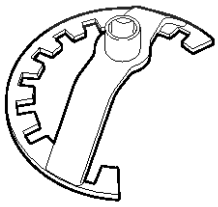
Engine Control System

Item	kgf.m	N.m	lb-ft
ECM installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Mass air flow sensor installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Manifold absolute pressure sensor installation bolt	0.28 ~ 0.35	2.7 ~ 3.4	2.0 ~ 2.5
Engine coolant temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Crankshaft position sensor installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 1) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 2) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Knock sensor #1 (Bank 1) installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
Knock sensor #2 (Bank 2) installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
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
Heated oxygen sensor (Bank 2 / sensor 1) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 2 / sensor 2) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
CVVT oil temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Electronic throttle body installation bolt	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7
CVVT oil control valve (Bank 1 / Intake) installation bolt	0.8 ~ 1.0	7.8 ~ 9.8	5.8 ~ 7.2
CVVT oil control valve (Bank 2 / Intake) installation bolt	0.8 ~ 1.0	7.8 ~ 9.8	5.8 ~ 7.2
Variable intake solenoid valve installation bolt	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 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	lb-ft
Fuel tank band installation nut	4.0 ~ 5.5	39.2 ~ 54.0	28.9 ~ 39.8
Fuel pump plate cover tightening	6.0 ~ 7.0	58.9 ~ 68.7	43.4 ~ 50.6
Filler-neck assembly installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Accelerator pedal module installation nut	1.3 ~ 1.6	8.8 ~ 13.7	6.5 ~ 10.1
Delivery Pipe installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4

Special Service Tools

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

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. VEHICLE INFORMAITON

VIN No.		Transmission	☐ M/T ☐ A/T ☐CVT ☐ etc.
Production date		Driving type	☐ 2WD (FF) ☐ 2WD (FR) ☐ 4WD
Odometer Reading	_____km/mile	CPF (Diesel Engine)	☐ With CPF ☐ Without CPF

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	

SFDF28233L

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.

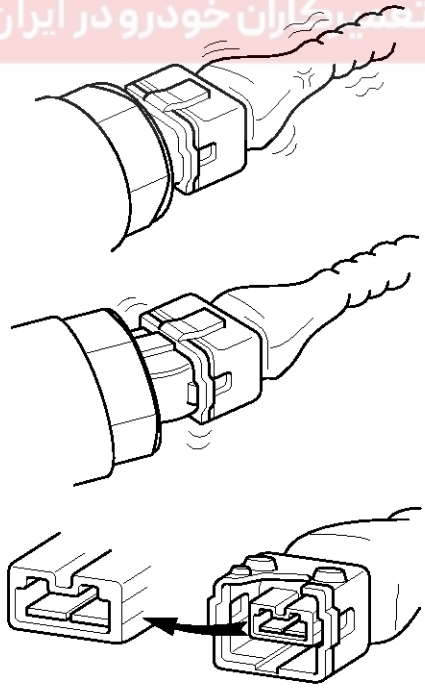
NOTICE

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

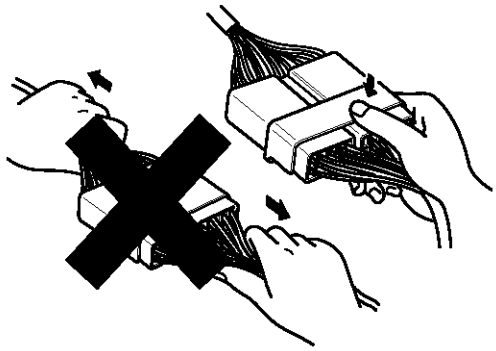
DO NOT sprinkle water directly into the engine compartment or electronic components.

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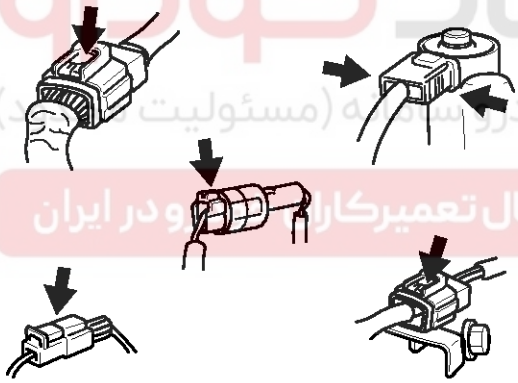
   b. When removing the connector with a lock, press or pull locking lever.



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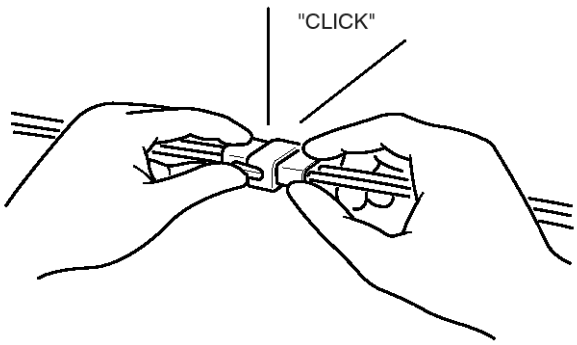
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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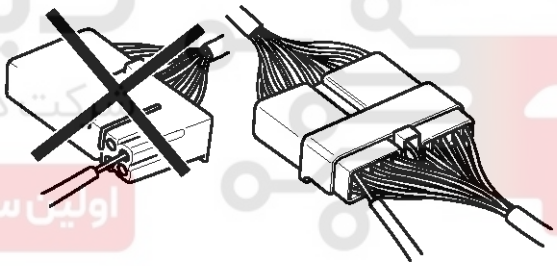
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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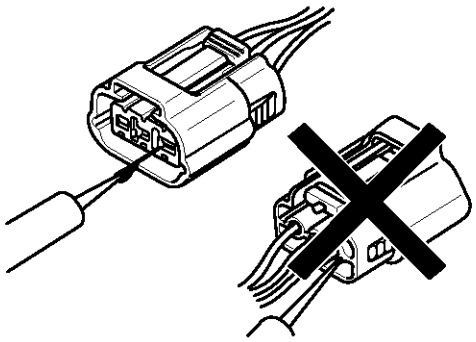
e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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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.*

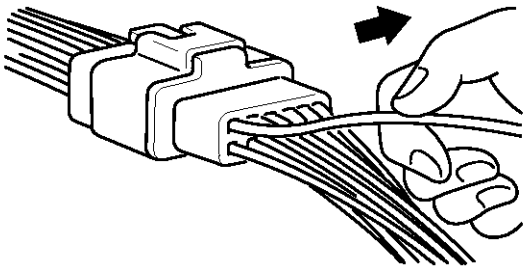
2. Checking Point for Connector

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.

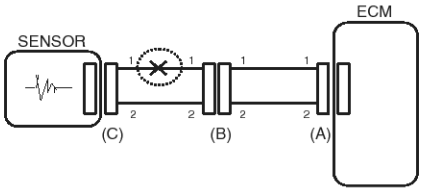
Electrical Circuit Inspection Procedure

● 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 side to side.

Specification (Resistance)

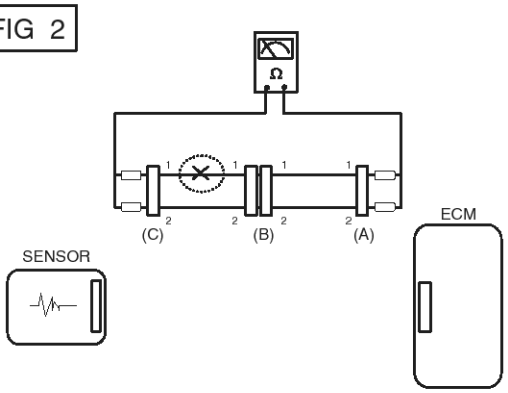
1Ω or less → Normal Circuit

1㏁ or Higher → Open Circuit

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

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

FIG 2



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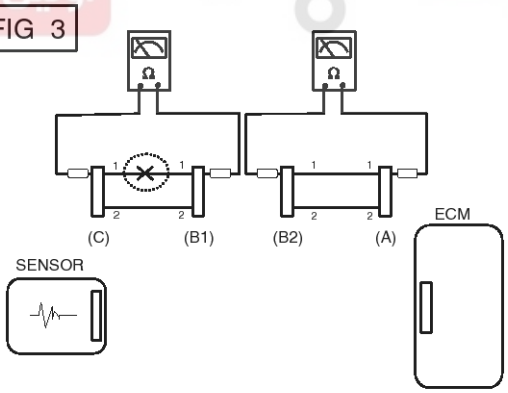
b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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

FIG 3



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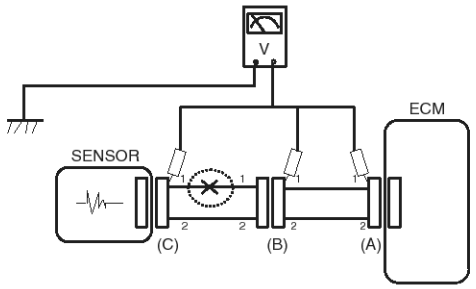
3. Voltage Check Method

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

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

FIG 4



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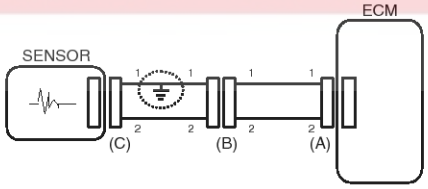
● Check Short Circuit

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.

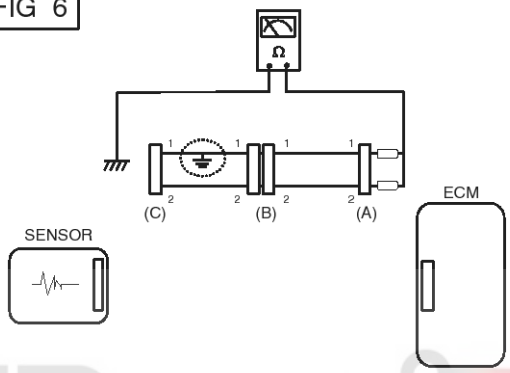
Specification (Resistance)

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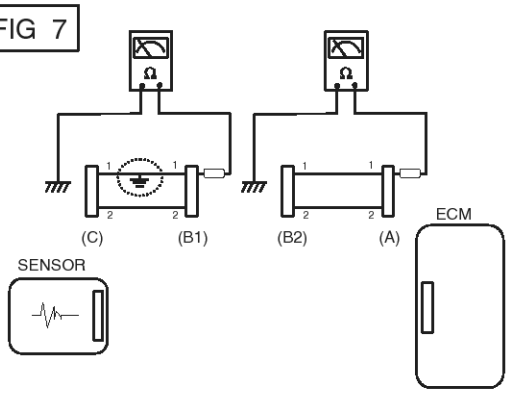
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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
Poor fuel economy	1. Check customer's driving habitsIs · 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

Main symptom	Diagnostic procedure	Also check for
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

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.

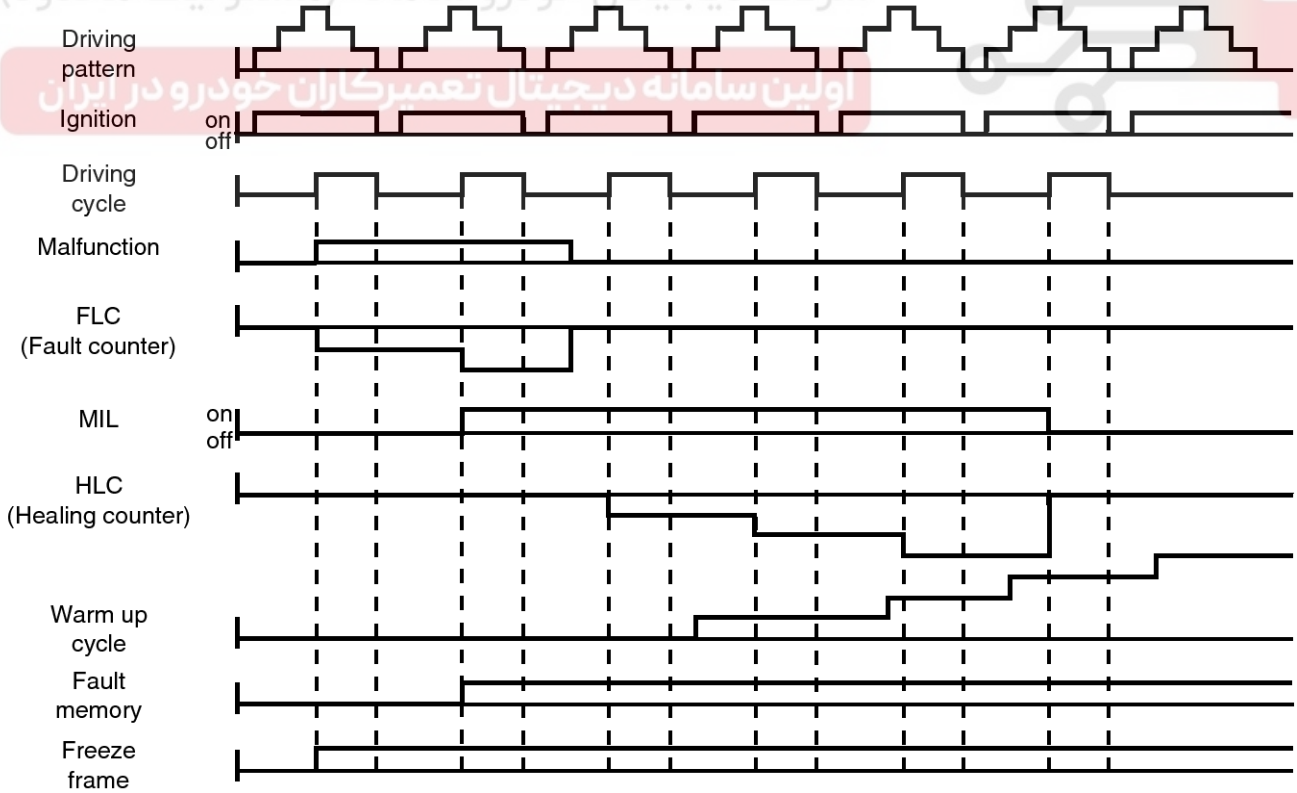
Self-Diagnosis

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

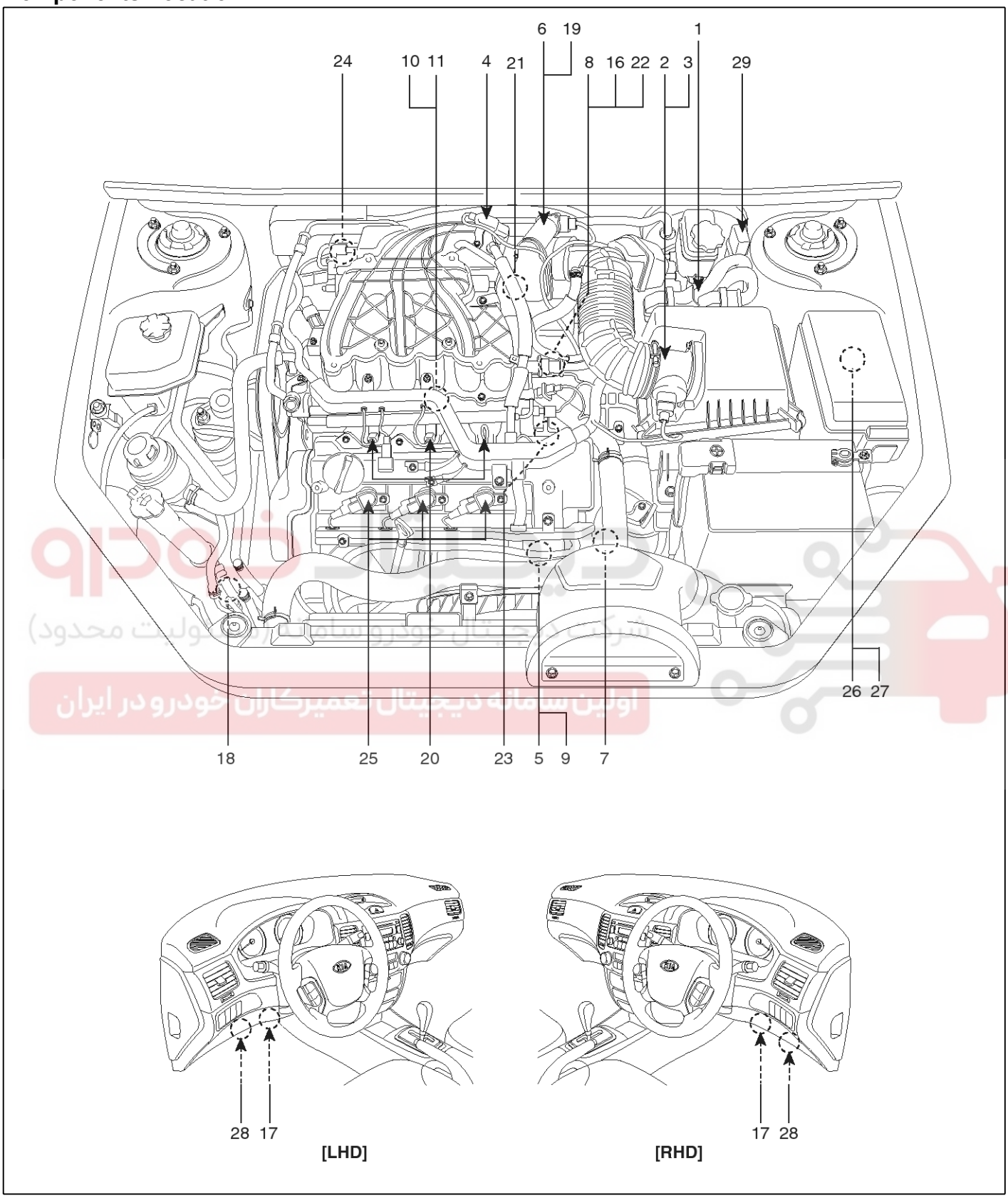
1. When the same malfunction is detected and maintained during two sequential driving cycles, the MIL will automatically illuminate.
2. The MIL will go off automatically if no fault is detected after 3 sequential driving cycles.
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction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

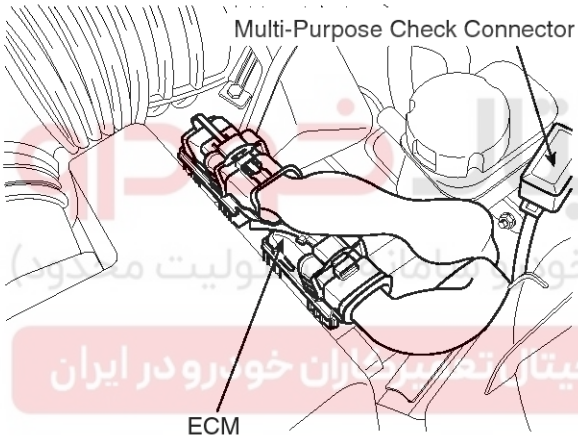
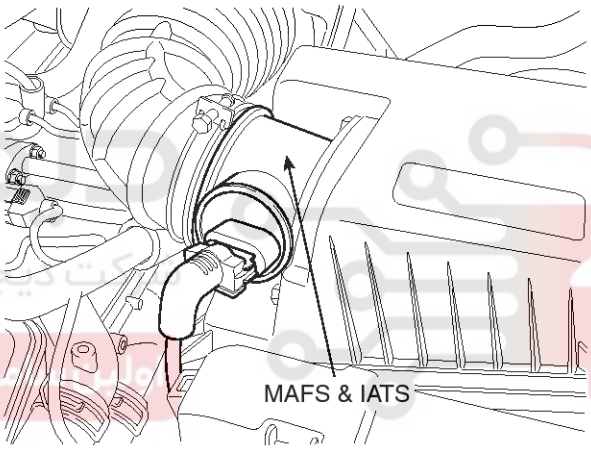
- *A "warm-up cycle" means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of 160 degress Fahrenheit.*
- *A "driving cycle" consists of engine startup, vehicle operation beyond the beginning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

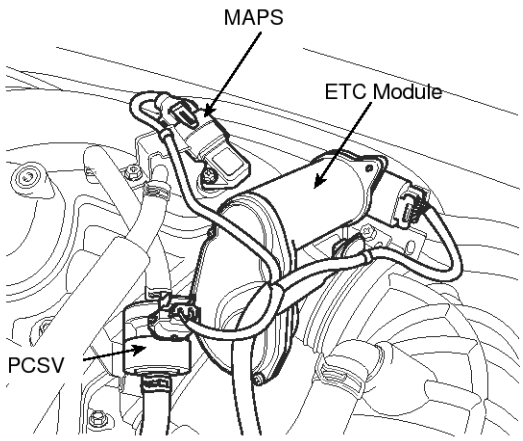
Components Location



SMGF19100L

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

1. ECM (Engine Control Module) 29. Multi-Purpose Check Connector [20 Pin]	2. Mass Air Flow Sensor (MAFS) 3. Intake Air Temperature Sensor (IATS)
 SMGF19101L	 LGLG001B
4. Manifold Absolute Pressure Sensor (MAPS) 6. Throttle Position Sensor (TPS) [integrated into ETC Module] 19. ETC Motor [integrated into ETC Module] 21. Purge Control Solenoid Valve (PCSV)	5. Engine Coolant Temperature Sensor (ECTS) 9. Camshaft Position Sensor (CMPS) [Bank 2]



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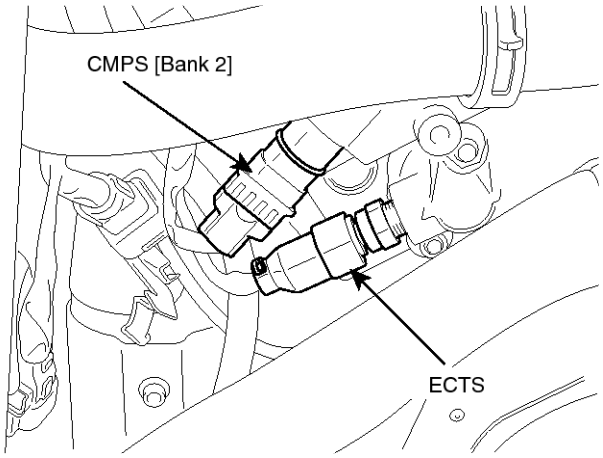
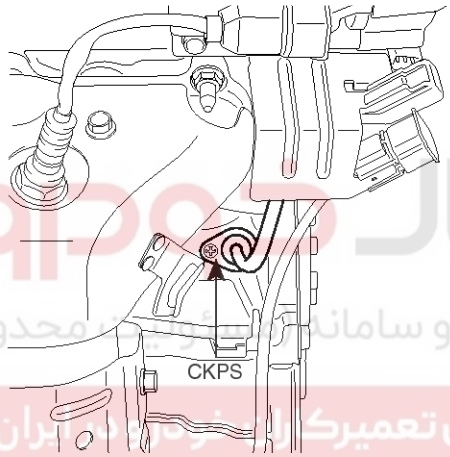
7. Crankshaft Position Sensor (CKPS)



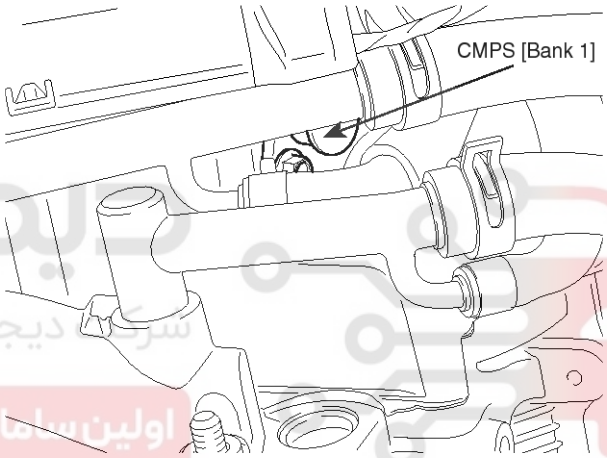
LGLG001R

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



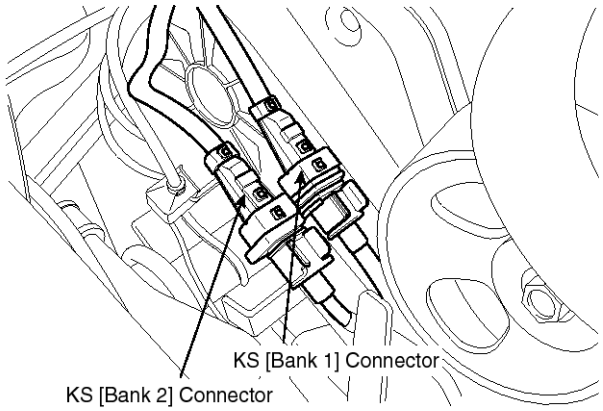
LGLG001T

10. Knock Sensor (KS) [Bank 1]
11. Knock Sensor (KS) [Bank 2]



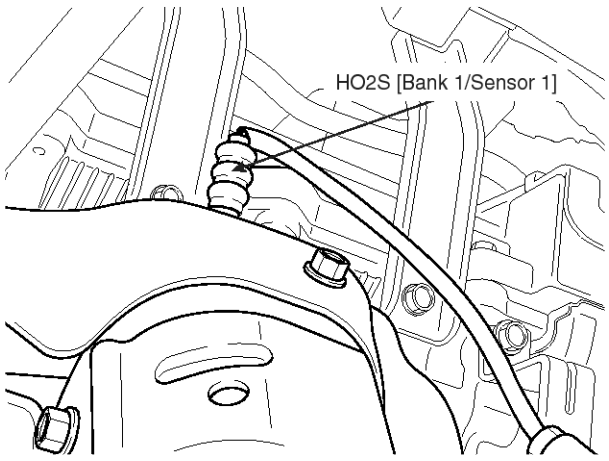
LGLG001S

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



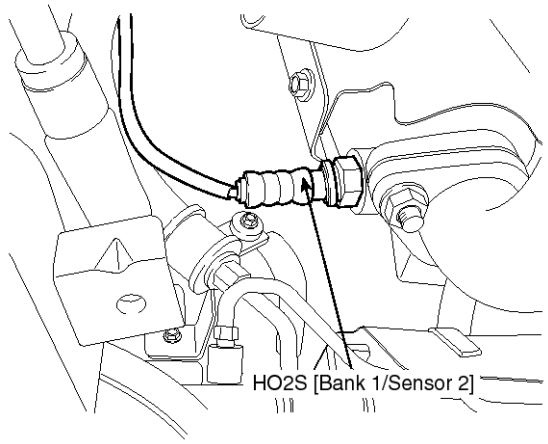
LGLG001J

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



LGLG001U

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



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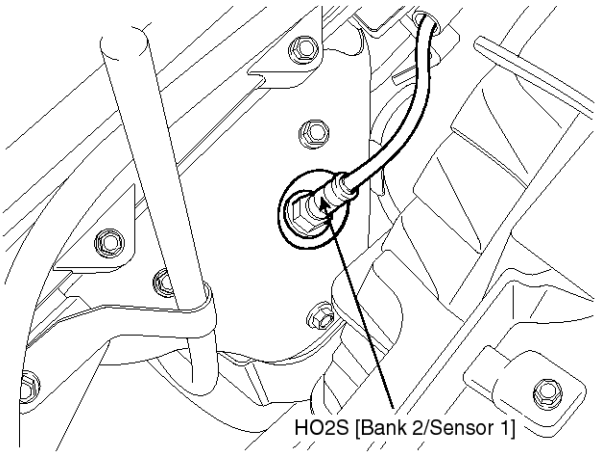
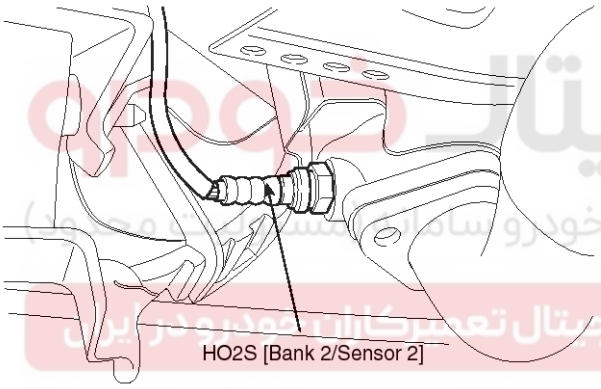


LGLG001G

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

16. CVVT Oil Temperature Sensor (OTS)
22. CVVT Oil Control Valve (OCV) [Bank 1 / Intake]
23. CVVT Oil Control Valve (OCV) [Bank 2 / Intake]



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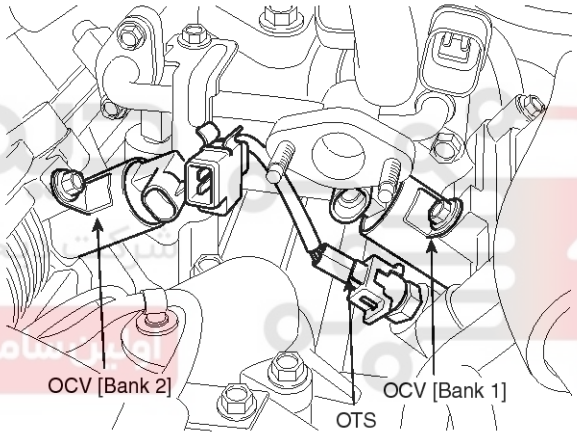
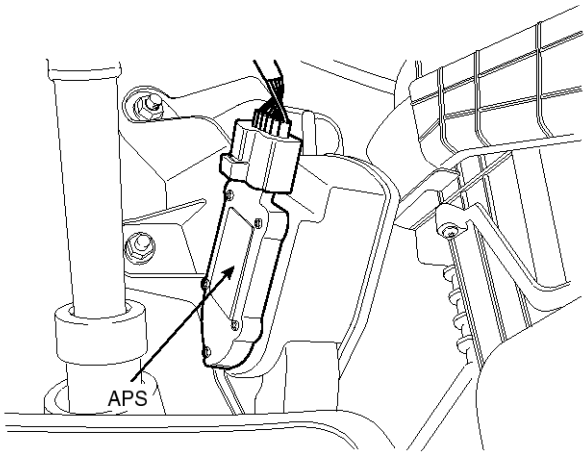


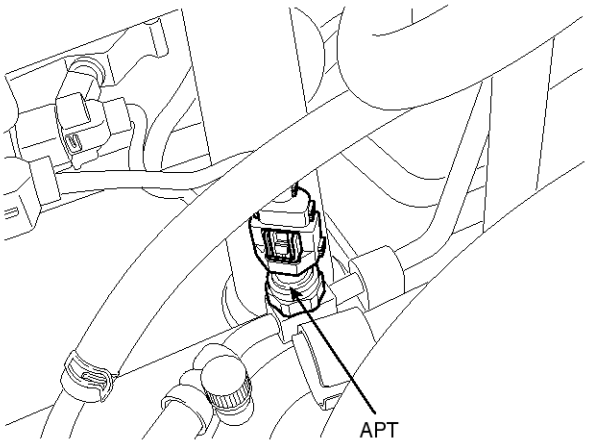
LGLG001K

17. Accelerator Position Sensor (APS)

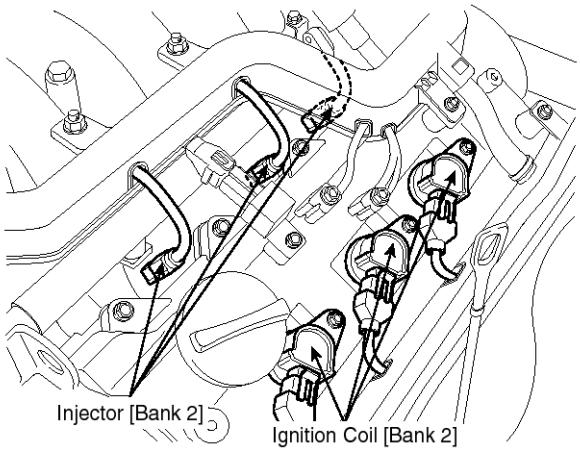
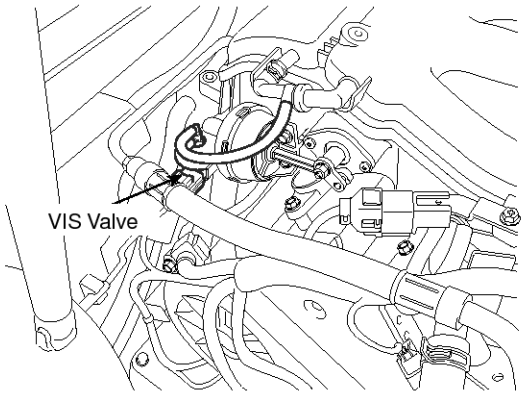
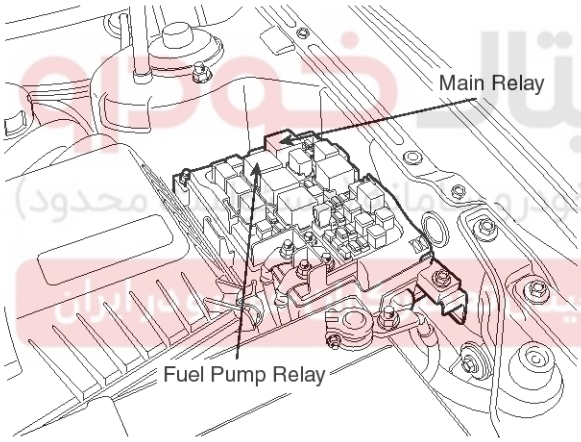
18. A/C Pressure Transducer (APT)



LGLG001P



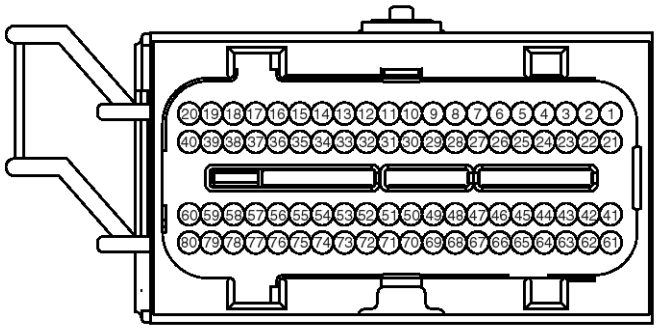
LGLG001Q

20. Injector 25. Ignition Coil	24. Variable Intake Solenoid (VIS) Valve
 LGLG001I	 SMGF19103L
26. Main Relay 27. Fuel Pump Relay	
 LGLG001M	

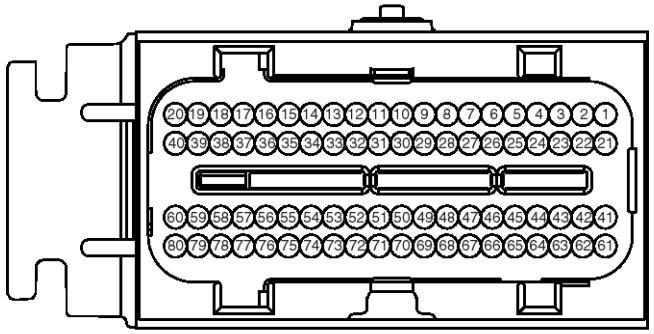
Engine Control Module (ECM)

ECM Terminal And Input/Output signal

ECM Harness Connector



Connector [C201-A]



Connector [C201-B]

SMGF19104L

ECM Terminal Function

Connector [C201-A]

Pin No.	Description	Connected to
1	2nd CAN [High]	Multi-Purpose Check Connector
2	2nd CAN [Low]	Multi-Purpose Check Connector
3	-	
4	-	
5	-	
6	-	
7	-	
8	-	
9	-	
10	Power Steering Switch signal input	Power Steering Switch
11	-	
12	-	
13	-	
14	-	
15	Alternator load signal input	Alternator
16	Ground	Cruise Control Switch
17	-	
18	A/C Switch "ON" signal input	A/C Control Module
19	-	
20	-	

Pin No.	Description	Connected to
21	Brake Switch 2 signal input	Brake Switch
22	-	
23	Brake Switch 1 signal input	Brake Switch
24	-	
25	Cruise Control Switch signal input	Cruise Control Switch
26	A/C Thermal Switch signal input	A/C Thermal Switch
27	Diagnostic Data Line (K-Line)	Data Link Connector (DLC), Multi-Purpose Check Connector
28	-	
29	-	
30	-	
31	-	
32	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)
33	Sensor ground	A/C Pressure Transducer (APT)
34	-	
35	-	
36	-	
37	-	
38	Battery power (B+)	Main Relay
39	Battery power (B+)	Main Relay
40	Battery power (B+)	Main Relay
41	CAN [High]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
42	CAN [Low]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
43	Main Relay control output	Main Relay
44	Intake Air Temperature Sensor (IATS) signal input	Intake Air Temperature Sensor (IATS)
45	Immobilizer Communication Line	Immobilizer Control Module
46	-	
47	Mass Air Flow Sensor (MAFS) signal input	Mass Air Flow Sensor (MAFS)
48	Sensor ground	Accelerator Position Sensor (APS) 2
49	Accelerator Position Sensor (APS) 2 signal input	Accelerator Position Sensor (APS) 2
50	-	
51	Cruise "SET" Lamp control output	Cruise "SET" Lamp

Pin No.	Description	Connected to
52	Vehicle speed signal input	ABS/ESP Control Module [With ABS/ESP (Euro-III/IV)]
		Vehicle Speed Sensor (VSS) [Except Euro-III/IV]
53	Sensor ground	Intake Air Temperature Sensor (IATS)
54	Accelerator Position Sensor (APS) 1 signal input	Accelerator Position Sensor (APS) 1
55	Sensor ground	Accelerator Position Sensor (APS) 1
56	-	
57	Sensor power (+5V)	Accelerator Position Sensor (APS) 2
58	Sensor power (+5V)	A/C Pressure Transducer (APT)
59	Sensor power (+5V)	Accelerator Position Sensor (APS) 1
60	-	
61	-	
62	-	
63	Malfunction Indicator Lamp (MIL) control output	Malfunction Indicator Lamp (MIL)
64	A/C Compressor Relay control putput	A/C Compressor Relay
65	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
66	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
67	Variable Intake Solenoid (VIS) Valve control output	Variable Intake Solenoid (VIS) Valve
68	-	
69	Cruise "MAIN" Lamp control output	Cruise "MAIN" Lamp
70	Fuel Pump Relay control output	Fuel Pump Relay
71	-	
72	Immobilizer Lamp control output	Immobilizer Lamp
73	-	
74	-	
75	-	
76	-	
77	-	
78	Purge Control Solenoid Valve (PCSV) control output	Purge Control Solenoid Valve (PCSV)
79	Wheel Speed Sensor [Low] signal input	Wheel Speed Sensor (WSS) [With ABS/ESP (Euro-III/IV)]
80	Wheel Speed Sensor [High] signal input	Wheel Speed Sensor (WSS) [With ABS/ESP (Euro-III/IV)]

Connector [C201-B]

Pin No.	Description	Connected to
1	ETC Motor [-] control output	ETC Motor
2	ETC Motor [+] control output	ETC Motor
3	-	
4	CVVT Oil Temperature Sensor (OTS) signal input	CVVT Oil Temperature Sensor (OTS)
5	-	
6	-	
7	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
8	Manifold Absolute Pressure Sensor (MAPS) signal input	Manifold Absolute Pressure Sensor (MAPS)
9	-	
10	-	
11	Sensor power (+5V)	Manifold Absolute Pressure Sensor (MAPS)
12	Battery power (B+)	Ignition Switch
13	Sensor power (+5V)	Throttle Position Sensor (TPS) 2
14	Sensor ground	Throttle Position Sensor (TPS) 1
15	Sensor power (+5V)	Camshaft Position Sensor (CMPS) [Bank 2]
16	Sensor power (+5V)	Throttle Position Sensor (TPS) 1
17	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 2]
18	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1]
19	Ignition Coil (Cylinder #6) control output	Ignition Coil (Cylinder #6)
20	-	
21	Crankshaft Position Sensor (CKPS) [High] signal input	Crankshaft Position Sensor (CKPS)
22	-	
23	Sensor Shield	Knock Sensor (KS) #1 [Bank 1]
		Knock Sensor (KS) #2 [Bank 2]
24	Camshaft Position Sensor (CMPS)[Bank 2] signal input	Camshaft Position Sensor (CMPS) [Bank 2]
25	Camshaft Position Sensor (CMPS)[Bank 1] signal input	Camshaft Position Sensor (CMPS) [Bank 1]
26	-	
27	-	
28	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
29	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
30	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]

Pin No.	Description	Connected to
31	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
32	Sensor power (+5V)	Camshaft Position Sensor (CMPS) [Bank 1]
33	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
34	Sensor ground	Manifold Absolute Pressure Sensor (MAPS)
		CVVT Oil Temperature Sensor (OTS)
35	Power ground	Chassis Ground
36	Power ground	Chassis Ground
37	Power ground	Chassis Ground
38	Power ground	Chassis Ground
39	Power ground	Chassis Ground
40	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4)
41	Crankshaft Position Sensor (CKPS) [Low] signal input	Crankshaft Position Sensor (CKPS)
42	-	
43	-	
44	-	
45	-	
46	-	
47	-	
48	Throttle Position Sensor (TPS) 1 signal input	Throttle Position Sensor (TPS) 1
49	Heated Oxygen Sensor (HO2S)[Bank 1/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
50	Heated Oxygen Sensor (HO2S)[Bank 1/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
51	Heated Oxygen Sensor (HO2S)[Bank 2/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
52	Heated Oxygen Sensor (HO2S)[Bank 2/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
53	Knock Sensor (KS) [Bank 2] [High] signal input	Knock Sensor (KS) [Bank 2]
54	Knock Sensor (KS) [Bank 2] [Low] signal input	Knock Sensor (KS) [Bank 2]
55	Knock Sensor (KS) [Bank 1] [Low] signal input	Knock Sensor (KS) [Bank 1]
56	Knock Sensor (KS) [Bank 1] [High] signal input	Knock Sensor (KS) [Bank 1]
57	Throttle Position Sensor (TPS) 2 signal input	Throttle Position Sensor (TPS) 2
58	Sensor ground	Throttle Position Sensor (TPS) 2
59	-	
60	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2)

Pin No.	Description	Connected to
61	CVVT Oil Control Valve (OCV)[Bank 2/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 2/Intake]
62	CVVT Oil Control Valve (OCV)[Bank 1/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 1/Intake]
63	Injector (Cylinder #2) control output	Injector (Cylinder #2)
64	Injector (Cylinder #3) control output	Injector (Cylinder #3)
65	-	
66	-	
67	Heated Oxygen Sensor (HO2S)[Bank 2/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
68	Injector (Cylinder #4) control output	Injector (Cylinder #4)
69	Injector (Cylinder #5) control output	Injector (Cylinder #5)
70	Heated Oxygen Sensor (HO2S)[Bank 1/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
71	Injector (Cylinder #6) control output	Injector (Cylinder #6)
72	Injector (Cylinder #1) control output	Injector (Cylinder #1)
73	Heated Oxygen Sensor (HO2S)[Bank 2/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
74	Heated Oxygen Sensor (HO2S)[Bank 1/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
75	-	
76	Battery power (B+)	Battery
77	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3)
78	Ignition Coil (Cylinder #5) control output	Ignition Coil (Cylinder #5)
79	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1)
80	-	

ECM Terminal Input/Output Signal

Connector [C201-A]

Pin No.	Description	Condition	Type	Level	Test Result
1	2nd CAN [High]	Idle	DC	2.0 ~ 3.0V	2.5V
2	2nd CAN [Low]	Idle	DC	2.0 ~ 3.0V	2.5V
3	-				
4	-				
5	-				
6	-				
7	-				
8	-				
9	-				
10	Power Steering Switch signal input	S/W ON	DC	Max. 0.5V	-0.125V
		S/W OFF		Battery Voltage	13.47V
11	-				
12	-				
13	-				
14	-				
15	Alternator load signal input	Idle	Pulse	Hi: Battery Voltage	13.67V
				Lo: Max 1.5 V	-0.125mV
16	Ground	Idle	DC	Max. 50 mV	22.44mV
17	-				
18	A/C switch "ON" signal input	A/C Relay OFF	DC	Battery Voltage	12.37V
		A/C Relay ON		Max. 1.0V	-25mV
19	-				
20	-				
21	Brake Switch 2 signal input	Pedal Release	DC	Battery Voltage	13.97V
		Pedal Push		Max. 0.5V	-25mV
22	-				
23	Brake Switch 1 signal input	Pedal Release	DC	Max. 0.5V	-225mV
		Pedal Push		Battery Voltage	12.97V
24	-				

Pin No.	Description	Condition	Type	Level	Test Result
25	Cruise Control Switch signal input	All Release	DC	4.3 ~ 4.7V	4.39V
		Main SW		Battery Voltage	13.37V
		Set SW		1.3 ~ 1.7V	1.38V
		Resume SW		2.8 ~ 3.2V	2.82V
		Cancel SW		-0.2 ~ 0.2V	-37.54mV
26	A/C Thermal Switch signal input	A/C OFF	DC	Max. 1.0V	-25mV
		A/C ON		Battery Voltage	12.57V
27	Diagnostic Data Line (K-Line)	When transmitting	Pulse	Hi: Min. Vbatt × 80%	11.57V
				Lo: Max. Vbatt × 20%	175mV
		When receiving		Hi: Min. Vbatt × 70%	
				Lo: Max. Vbatt × 30%	
28	-				
29	-				
30	-				
31	-				
32	A/C Pressure Transducer (APT) signal input	A/C OFF	DC	0 ~ 5V	1.36V
		A/C ON			1.83V
33	Sensor ground	Idle	DC	Max. 50 mV	22.66mV
34	-				
35	-				
36	-				
37	-				
38	Battery Power (B+)	IG OFF	DC	Max. 1.0 V	-25mV
		IG ON		Battery Voltage	12.77V
39	Battery Power (B+)	IG OFF	DC	Max. 1.0 V	-25mV
		IG ON		Battery Voltage	12.77V
40	Battery Power (B+)	IG OFF	DC	Max. 1.0 V	-25mV
		IG ON		Battery Voltage	12.37V
41	CAN [High]	Recessive	Pulse	2.0 ~ 3.0 V	2.4V
		Dominant		2.75~4.5 V	3.56V
42	CAN [Low]	Recessive	Pulse	2.0 ~ 3.0 V	2.42V
		Dominant		0.5~2.25 V	1.62V
43	Main Relay control output	Relay ON	DC	Battery Voltage	0.875V
		Relay OFF		Max. 1.0V	12.47V

FLA-34 Fuel System

Pin No.	Description	Condition	Type	Level	Test Result
44	Intake Air Temperature Sensor (IATS) signal input	Idle	Analog	0 ~ 5V	2.05V
45	Immobilizer Communication Line	When communi-cating after IG ON	Pulse	Hi: Min. 8.5V	11.87V
				Lo: Max. 3.5V	875mV
46	-				
47	Mass Air Flow Sensor (MAFS) signal input	Idle	Pulse	Hi: Vcc	4.97V
				Lo: Max. 0.5V	70mV
48	Sensor ground	Idle	DC	Max. 50 mV	22.52mV
49	Accelerator Position Sensor (APS) 2 signal input	C.T	Analog	0.3 ~ 0.9V	0.38V
		W.O.T		1.5 ~ 3.0V	2V
50	-				
51	Cruise "SET" Lamp control output	Cruise OFF	DC	Battery Voltage	12.57V
		Cruise ON		Max. 1.0V	-25mV
52	Vehicle speed signal input	Vehicle Run	Pulse	Hi: Min. 5.0V	11.07V
				Lo: Max. 1.0V	-125mV
53	Sensor ground	Idle	DC	Max. 50 mV	22.37mV
54	Accelerator Position Sensor (APS) 1 signal input	C.T	Analog	0.3 ~ 0.9V	819mV
		W.O.T		4.0 ~ 4.8V	4.01V
55	Sensor ground	Idle	DC	Max. 50mV	22.6mV
56	-				
57	S ensor Power (+5V)	IG OFF	DC	Max. 0.5V	4.95V
		IG ON		4.9 ~ 5.1V	-10mV
58	S ensor Power (+5V)	IG OFF	DC	Max. 0.5V	4.95V
		IG ON		4.9 ~ 5.1V	-10mV
59	S ensor Power (+5V)	IG OFF	DC	Max. 0.5V	4.95V
		IG ON		4.9 ~ 5.1V	-10mV
60	-				
61	-				
62	Fuel consumption signal output	Idle	Pulse	Hi: Battery Voltage	13.57V
				Lo: Max. 0.5V	-25mV
63	Malfunction Indicator Lamp (MIL) control output	Lamp OFF	DC	Hi: Battery Voltage	13.37V
		Lamp ON		Lo: Max. 2.0V	-25mV
64	A/C Compressor Relay control output	A/C OFF	DC	Battery Voltage	13.97V
		A/C ON		Max. 1.0V	175mV

Pin No.	Description	Condition	Type	Level	Test Result
65	Cooling Fan Relay [Low] control output	Fan OFF	DC	Battery Voltage	13.77V
		Fan ON		Max. 1.0V	175mV
66	Cooling Fan Relay [High] control output	Fan OFF	DC	Battery Voltage	13.57V
		Fan ON		Max. 1.0V	-25mV
67	Variable Intake Solenoid (VIS) Valve control output	Active	DC	Max. 1.0 V	13.77
		Inactive		Battery Voltage	-25mV
68	-				
69	Cruise "MAIN" Lamp control output	Cruise OFF	DC	Battery Voltage	12.37V
		Cruise ON		Max. 1.0V	-25mV
70	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage	12.57V
		Relay ON		Max. 1.0V	-25mV
71	-				
72	Immobilizer lamp control output	Lamp OFF	DC	Battery Voltage	12.77V
		Lamp ON		Max. 1.0V	-25mV
73	-				
74	-				
75	-				
76	-				
77	-				
78	Purge Control Solenoid Valve (PCSV) control output	Inactive	Pulse	Hi: Battery Voltage	13.83V
		Active		Lo: Max. 1.0V	31.54mV
79	Wheel Speed Sensor [Low] signal input				
80	Wheel Speed Sensor [High] signal input				

FLA-36 Fuel System

Connector [C201-B]

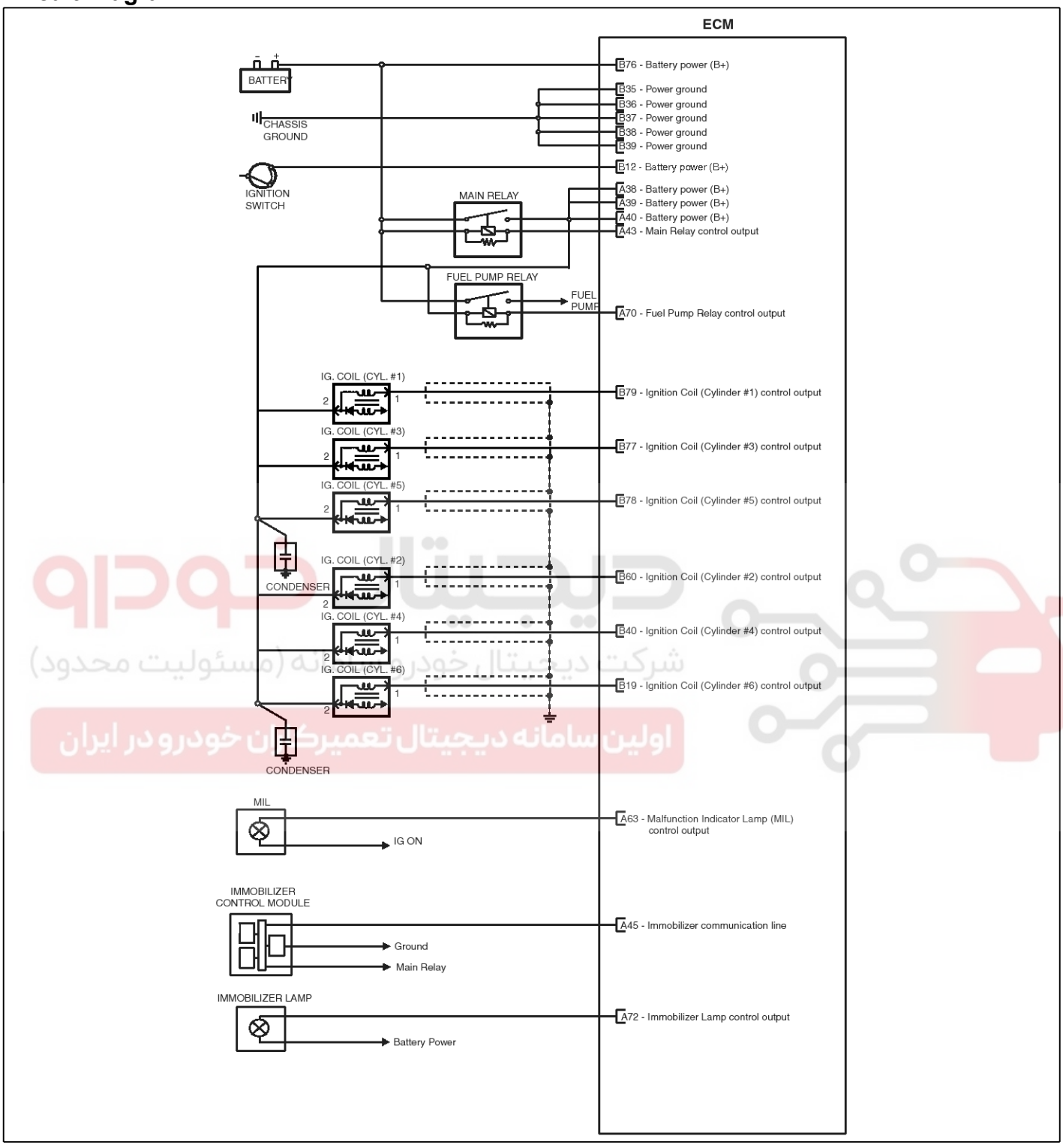
Pin No.	Description	Condition	Type	Level	Test Result
1	ETC Motor [-] control output	Idle	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max . 1.0V	-125mV
2	ETC Motor [+] control output	Idle	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max . 1.0V	-325mV
3	-				
4	CVVT Oil Temperature Sensor (OTS) signal input	Idle	Analog	0 ~ 5.0V	282mV at 96℃
5	-				
6	-				
7	Engine Coolant Temperature Sensor (ECTS) signal input	Idle	Analog	0 ~ 5.0V	1.88V
8	Manifold Absolute Pressure Sensor (MAPS) signal input	IG ON	Analog	3.9 ~ 4.1V	3.96V
		Idle		0.8 ~ 1.6V	1.31V
9	-				
10	-				
11	Sensor Power (+5V)	IG OFF	DC	Max. 0.5V	4.91V
		IG ON		4.9 ~ 5.1V	-50mV
12	Battery Power (+5V)	IG OFF	DC	Max. 0.5 V	13.87V
		IG ON		Battery Voltage	-125mV
13	Sensor Power (+5V)	IG OFF	DC	Max. 0.5V	4.89V
		IG ON		4.9 ~ 5.1V	-70mV
14	Sensor ground	Idle	DC	Max. 50 mV	19.77mV
15	Sensor Power (+5V)	IG OFF	DC	Max. 0.5V	4.91V
		IG ON		4.9 ~ 5.1V	-50mV
16	Sensor Power (+5V)	IG OFF	DC	Max. 0.5V	4.91V
		IG ON		4.9 ~ 5.1V	-50mV
17	Sensor ground	Idle	DC	Max. 50 mV	21.1mV
18	Sensor ground	Idle	DC	Max. 50 mV	20.87mV
19	Ignition Coil (Cylinder #6) control output	Idle	Pulse	1st Voltage: 200~400V	278V
				ON Voltage: Max. 2V	1.97V
20	-				
21	Crankshaft Position Sensor [High] signal input	Idle	SINE WAVE	Vp_p : Min.1.0V	41.6V
22	-				

Pin No.	Description	Condition	Type	Level	Test Result
23	Sensor Shield	Idle	DC	Max. 50 mV	21.41mV
24	Camshaft Position Sensor [Bank 2] signal input	Idle	Pulse	Hi: Vcc	4.95V
				Lo: Max . 0.5V	-10mV
25	Camshaft Position Sensor [Bank 1] signal input	Idle	Pulse	Hi: Vcc	4.95V
				Lo: Max . 0.5V	-10mV
26	-				
27	-				
28	Sensor ground	Idle	DC	Max. 50 mV	20.73mV
29	Sensor ground	Idle	DC	Max. 50 mV	21.9mV
30	Sensor ground	Idle	DC	Max. 50 mV	20.16mV
31	Sensor ground	Idle	DC	Max. 50 mV	20.63mV
32	Sensor Power (+5V)	IG OFF	DC	Max. 0.5V	4.91V
		IG ON		4.9 ~ 5.1V	-50mV
33	Sensor ground	Idle	DC	Max. 50 mV	22.52mV
34	Sensor ground	Idle	DC	Max. 50 mV	20.99mV
35	Power ground	Idle	DC	Max. 50 mV	
36	Power ground	Idle	DC	Max. 50 mV	
37	Power ground	Idle	DC	Max. 50 mV	
38	Power ground	Idle	DC	Max. 50 mV	
39	Power ground	Idle	DC	Max. 50 mV	
40	Ignition Coil (Cylinder #4) control output	Idle	Pulse	1st Voltage: 2300~400V	294V
				ON Voltage: Max. 2V	1.93V
41	Crankshaft Position Sensor [Low] signal input	Idle	SINE WAVE	Vp_p: Min.1.0V	8.24V
42	-				
43	-				
44	-				
45	-				
46	-				
47	-				
48	Throttle Position Sensor (TPS) 1 signal input	C.T	Analog	0.25 ~ 0.9V	0.68V
		W.O.T		Min. 4.0V	4.27V
49	Heated Oxygen Sensor [Bank 1 / Sensor 1] signal input	Racing	DC	Rich: 0.6 ~ 1.0V	774mV
				Lean: 0 ~ 0.4V	137mV

Pin No.	Description	Condition	Type	Level	Test Result
50	Heated Oxygen Sensor [Bank 1 / Sensor 2] signal input	Racing	DC	Rich: 0.6 ~ 1.0V	
				Lean: 0 ~ 0.4V	
51	Heated Oxygen Sensor [Bank 2 / Sensor 1] signal input	Racing	DC	Rich: 0.6 ~ 1.0V	705.2mV
				Lean: 0 ~ 0.4V	82mV
52	Heated Oxygen Sensor [Bank 2 / Sensor 2] signal input	Racing	DC	Rich: 0.6 ~ 1.0V	
				Lean: 0 ~ 0.4V	
53	Knock Sensor (KS) [Bank 2] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
54	Knock Sensor (KS) [Bank 2] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
55	Knock Sensor (KS) [Bank 1] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
56	Knock Sensor (KS) [Bank 1] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
57	Throttle Position Sensor (TPS) 2 signal input	C.T	Analog	Min. 4.0V	4.23V
		W.O.T		0.25 ~ 0.9V	703mV
58	Sensor ground	Idle	DC	Max. 50 mV	21.64mV
59	-				
60	Ignition Coil (Cylinder #2) control output	Idle	Pulse	1st Voltage: 200~400V	305V
				ON Voltage: Max. 2V	1.85V
61	CVVT Oil Control Valve [Bank 2/Intake] control output	Idle	Pulse	Battery Voltage	14.45V
				Max. 1.0V	50mV
62	CVVT Oil Control Valve [Bank 1/Intake] control output	Idle	Pulse	Battery Voltage	14.47V
				Max. 1.0V	75mV
63	Injector (Cylinder #2) control output	Idle	Pulse	Battery Voltage	14.06V
				Max. 1.0V	44.2mV
64	Injector (Cylinder #3) control output	Idle	Pulse	Battery Voltage	14V
				Max. 1.0V	38.31mV
65	-				
66	-				
67	Heated Oxygen Sensor [Bank 2 / Sensor 1] Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max. 1.0V	275mV

Pin No.	Description	Condition	Type	Level	Test Result
68	Injector (Cylinder #4) control output	Idle	Pulse	Hi: Battery Voltage	13.96V
				Lo: Max. 1.0V	55.71mV
69	Injector (Cylinder #5) control output	Idle	Pulse	Hi: Battery Voltage	14V
				Lo: Max. 1.0V	40.82mV
70	Heated Oxygen Sensor [Bank 1 / Sensor 1] Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max. 1.0V	275mV
71	Injector (Cylinder #6) control output	Idle	Pulse	Hi: Battery Voltage	13.95mV
				Lo: Max. 1.0V	55.77mV
72	Injector (Cylinder #1) control output	Idle	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max. 1.0V	56.7mV
73	Heated Oxygen Sensor [Bank 2 / Sensor 2] Heater control output	Engine Run	Pulse	Hi: Battery Voltage	13.87V
				Lo: Max. 1.0V	275mV
74	Heated Oxygen Sensor [Bank 1 / Sensor 2] Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max. 1.0V	275mV
75	-				
76	Battery Power (B+)	Always	DC	Battery Voltage	12.39V
				1.0 mA or below 1.5 mA	0.34mA
77	Ignition Coil (Cylinder #3) control output	Idle	Pulse	1st Voltage: 200~400V	289V
				ON Voltage: Max. 2V	1.87V
78	Ignition Coil (Cylinder #5) control output	Idle	Pulse	1st Voltage: 200~400V	279V
				ON Voltage: Max. 2V	1.93V
79	Ignition Coil (Cylinder #1) control output	Idle	Pulse	1st Voltage: 200~400V	269V
				ON Voltage: Max. 2V	1.91V
80	-				

Circuit Diagram



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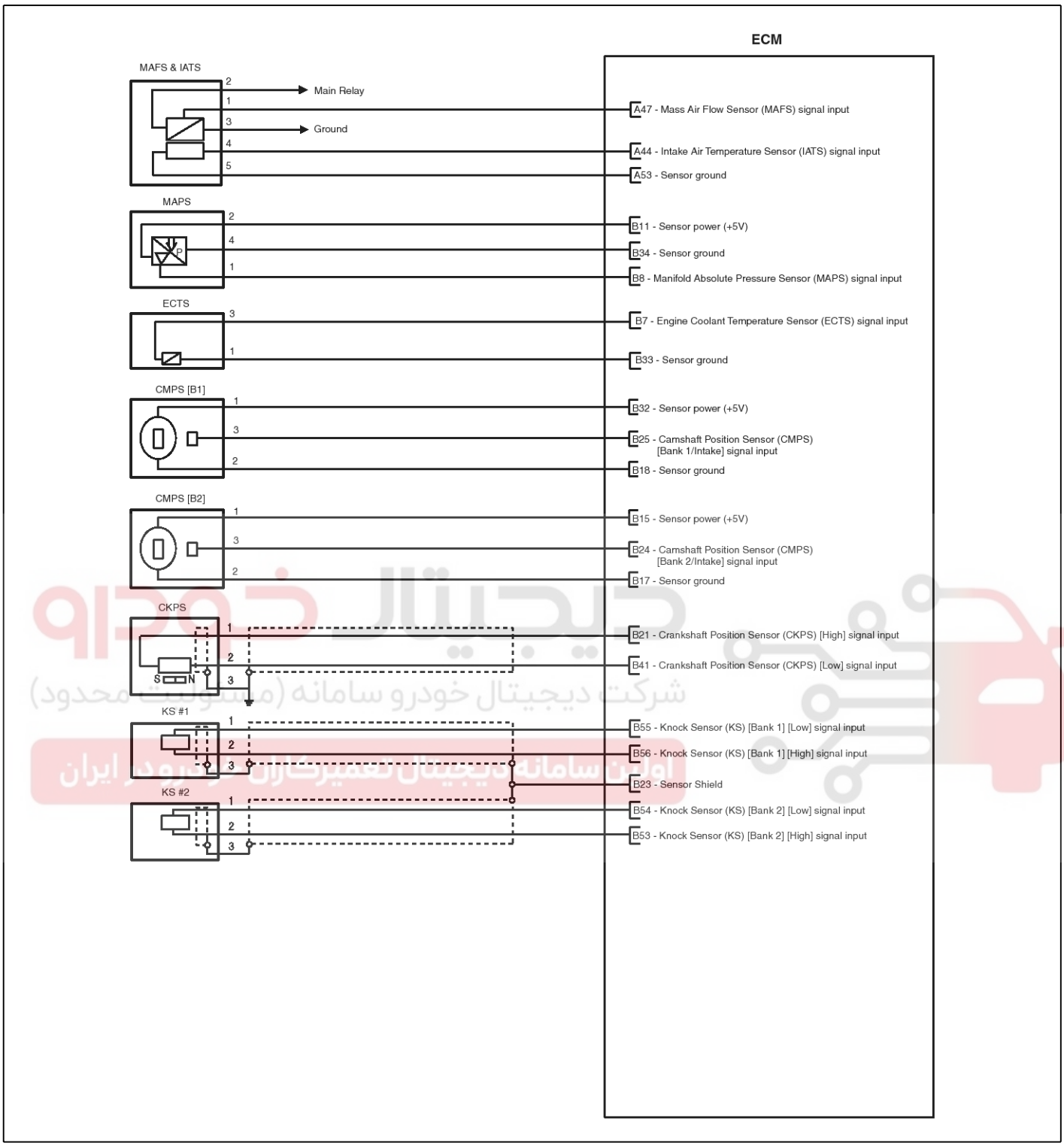

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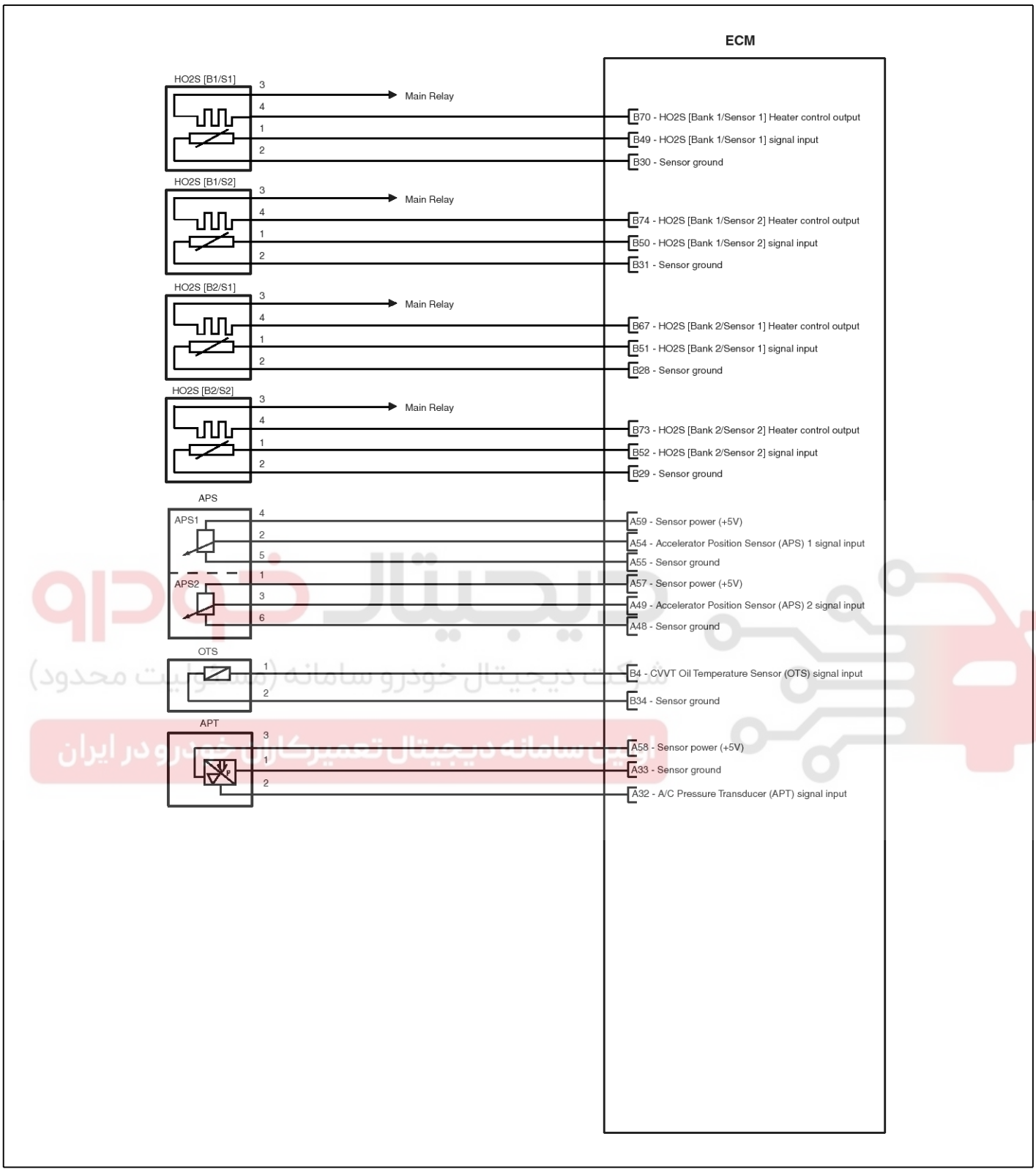

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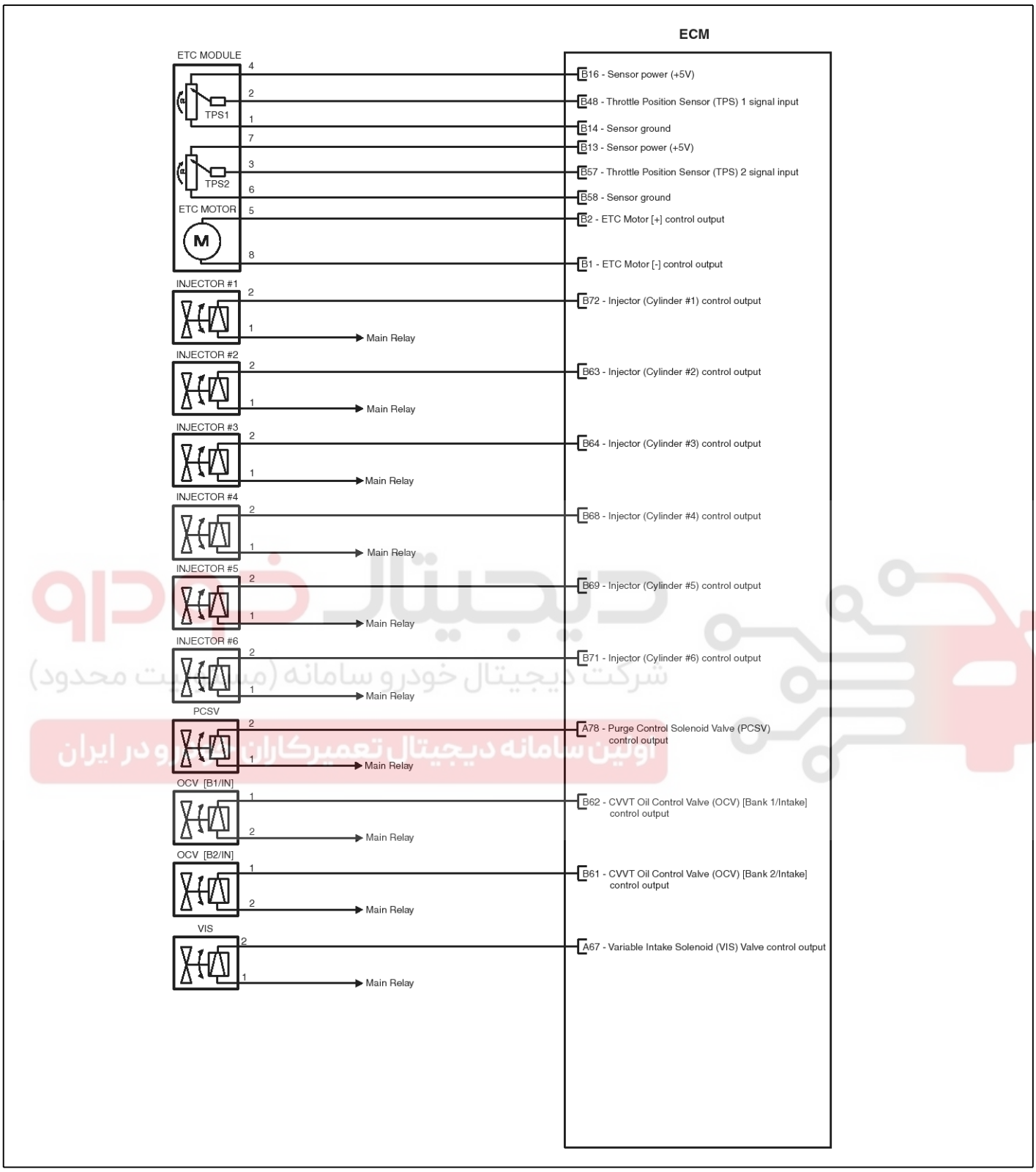

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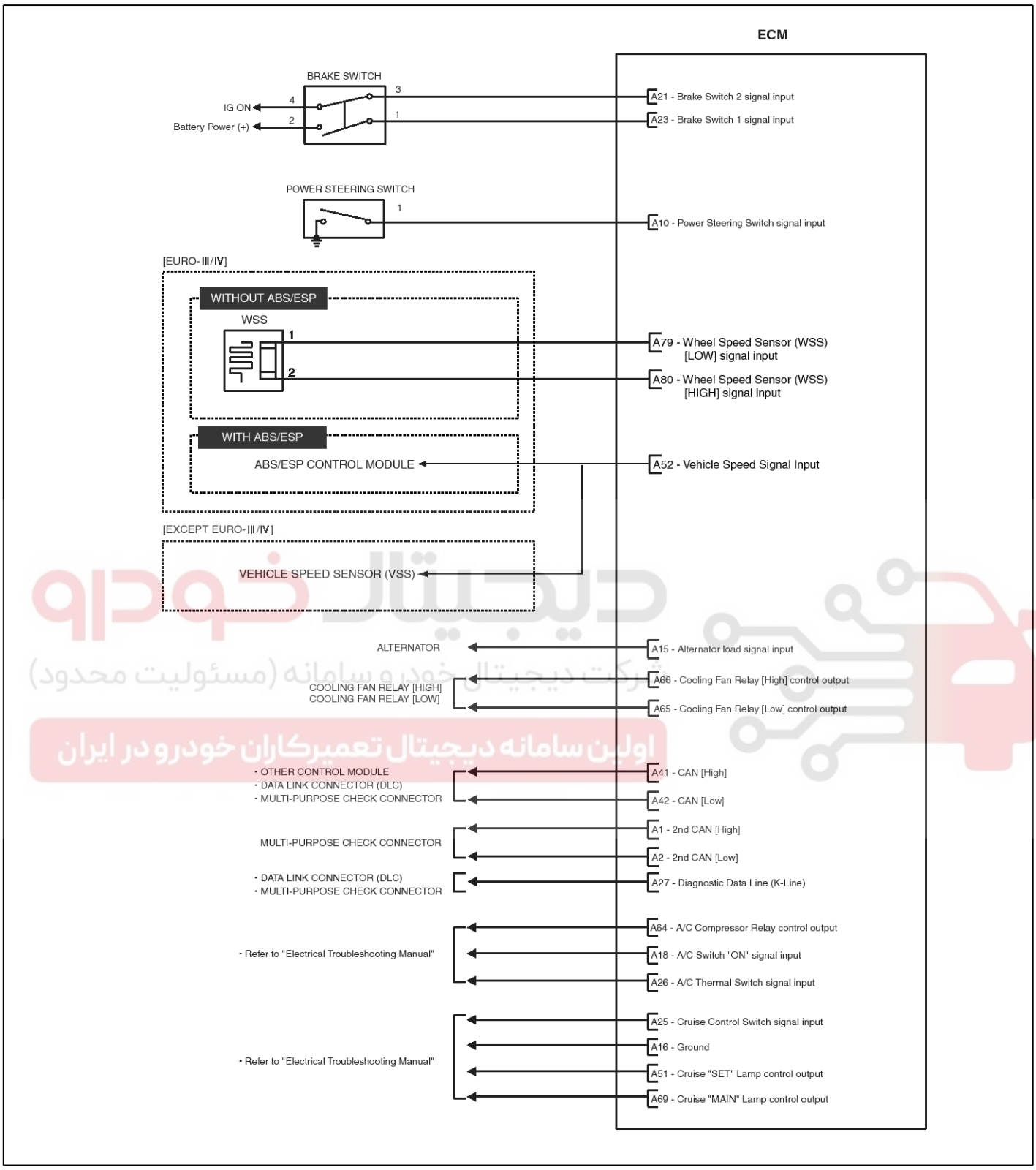


SMGF19109L

ECM Problem Inspection Procedure

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

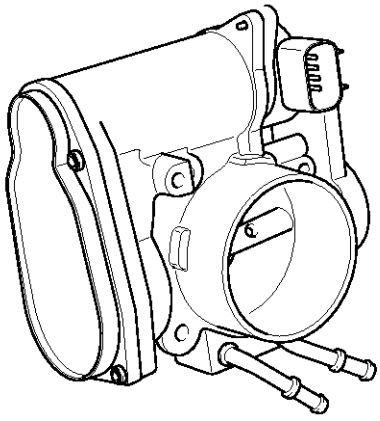
Specification: Below 1Ω

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

ETC (Electronic Throttle Control) System

Description

The Electronic Throttle Control (ETC) System consists of a throttle body with an integrated control motor and throttle position sensor (TPS). Instead of the traditional throttle cable, an Accelerator Position Sensor (APS) is used to receive driver input. The ECM uses the APS signal to calculate the target throttle angle; the position of the throttle is then adjusted via ECM control of the ETC motor. The TPS signal is used to provide feedback regarding throttle position to the ECM. Using ETC, precise control over throttle position is possible; the need for external cruise control modules/cables is eliminated.



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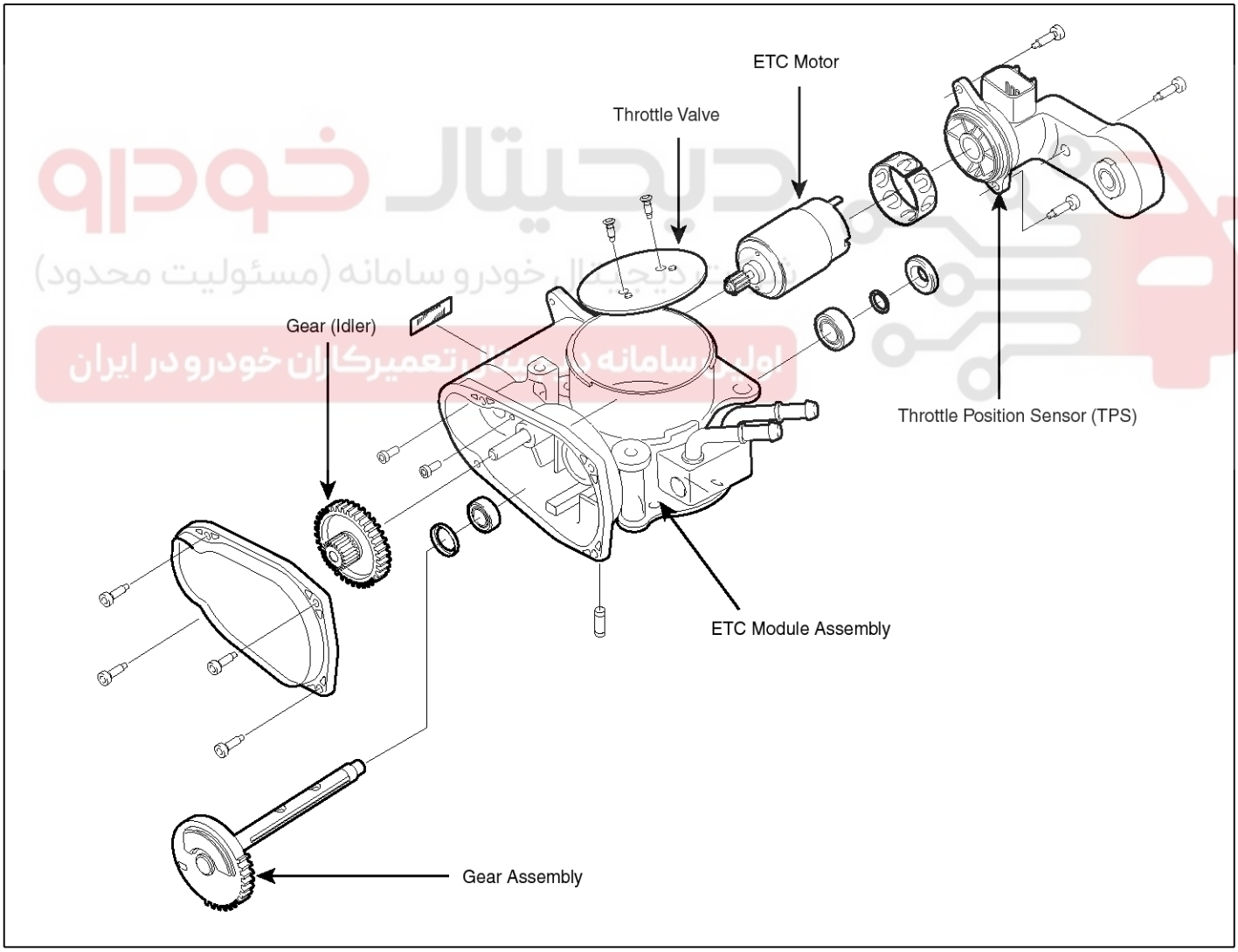

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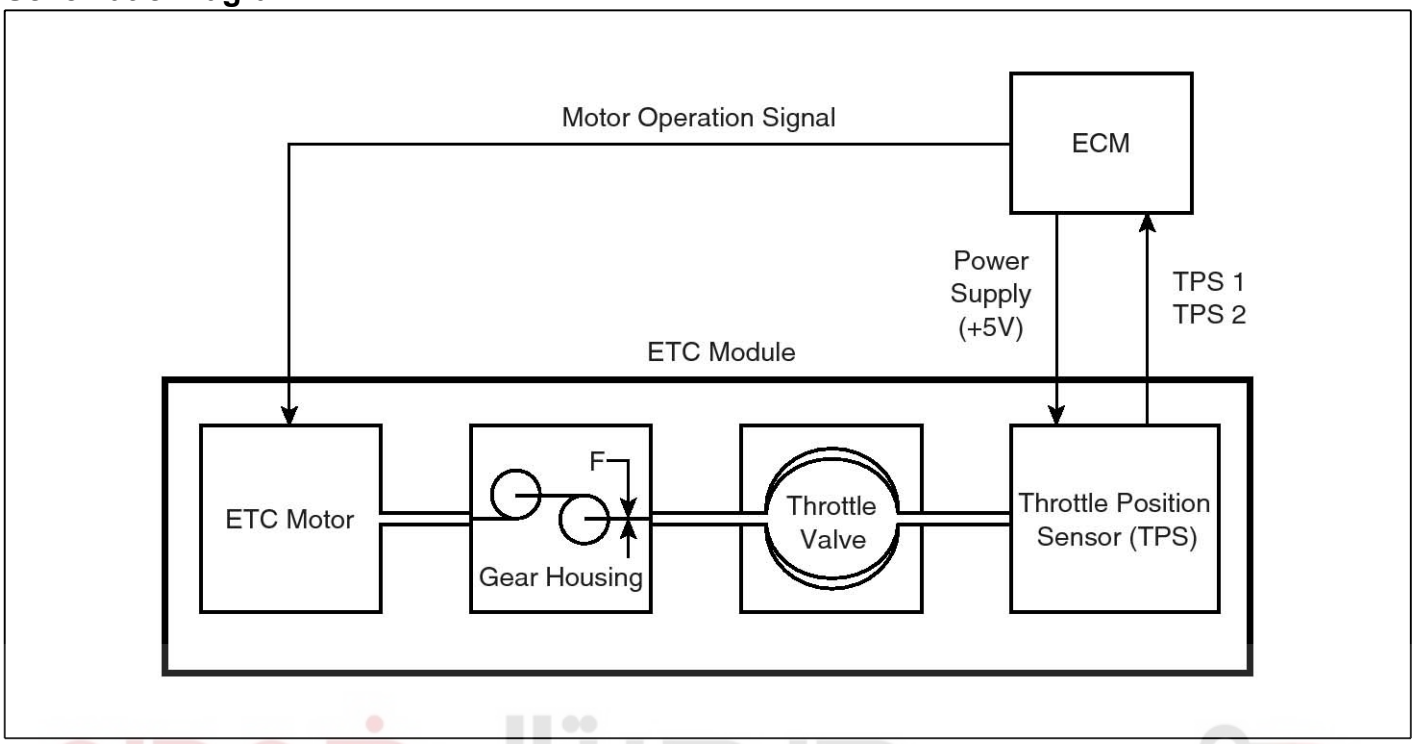
Schematic Diagram



EGRF234A

Fail-Safe Mode

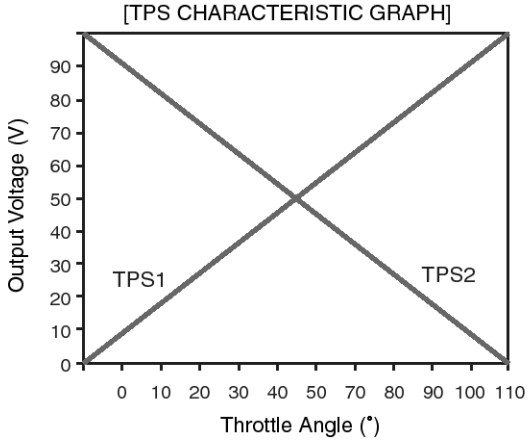
Mode	Symptom	Possible Cause
[MODE 1] FORCED ENGINE SHUTDOWN	• Engine stop	• ETC system can't proceed reliable algorithm procedure - Fatal ECM internal programming error - Faulty intake system or throttle body
[MODE 2] FORCED IDLE & POWER MANAGEMENT	• Forced idle state controlled by fuel quantity regulation and ignition timing adjustment	• ETC system can't control engine power via throttle device • Disabled throttle control or broken throttle position information
[MODE 3] FORCED IDLE	• No response for accelerator activation • Forced idle state	• No information about the accelerator position - Broken APS 1 and 2, faulty A/D converter or internal controller
[MODE 4] LIMIT PERFORMANCE & POWER MANAGEMENT	• Engine power is determined by accelerator position and idle power requirement (Limited vehicle running)	• ETC system can't securely control engine power
[MODE 5] LIMIT PERFORMANCE	• Engine power varies with accelerator position • Driver perceives lack of engine power. • MIL ON (Normalvehicle running)	• Not reliable accelerator position signal or bad maximum power generation - Faulty APS, ignition voltage or internal controller
[MODE 6] NORMAL	• Normal	

Specification

[Throttle Position Sensor (TPS)]

Throttle Angle(°)	Output Voltage(V)	
	TPS1	TPS2
0	0.0	5.0
10	0.5	4.5
20	0.9	4.1
30	1.4	3.6
40	1.8	3.2
50	2.3	2.7
60	2.7	2.3
70	3.2	1.8
80	3.6	1.4
90	4.1	0.9
100	4.5	0.5
110	5.0	0.0

[TPS CHARACTERISTIC GRAPH]



EGRF235A

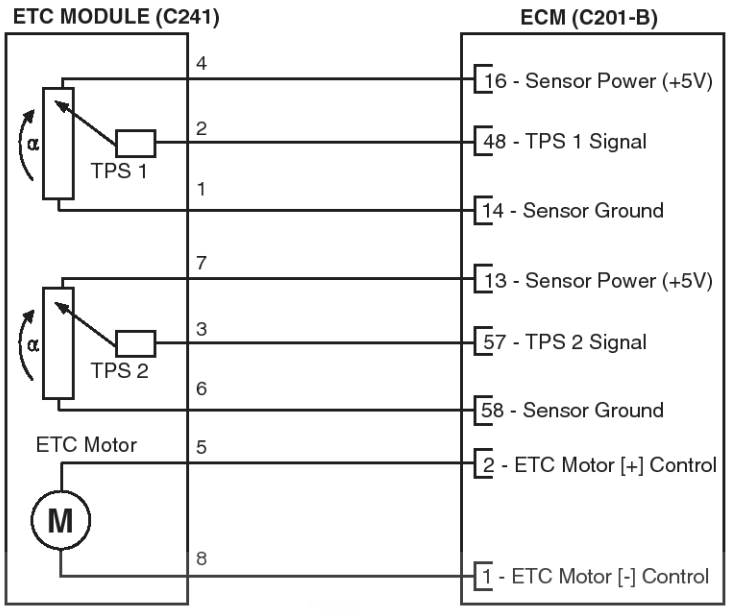
Item	Sensor Resistance(kΩ)
TPS1	4.0 ~ 6.0 [20℃(68°F)]
TPS2	2.7 ~ 4.1 [20℃(68°F)]

[ETC Motor]

Item	Specification
Coil Resistance (Ω)	1.275 ~ 1.725 [20℃(68°F)]

Circuit Diagram

[Circuit Diagram]

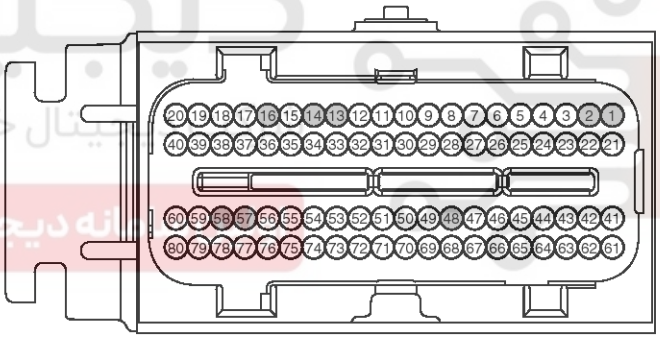


[Connection Information]

Terminal	Connected to	Function
1	ECM C201-B (14)	TPS 1 Sensor Ground
2	ECM C201-B (48)	TPS 1 Signal
3	ECM C201-B (57)	TPS 2 Signal
4	ECM C201-B (16)	TPS 1 Sensor Power (+5V)
5	ECM C201-B (2)	ETC Motor [+] Control
6	ECM C201-B (58)	TPS 2 Sensor Ground
7	ECM C201-B (13)	TPS 2 Sensor Power (+5V)
8	ECM C201-B (1)	ETC Motor [-] Control

[Harness Connector]

C241
ETC MODULE



C201-B
ECM

SMGF19200L

Inspection

Throttle Position Sensor (TPS)

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

Throttle Angle	Output Voltage (V)	
	TPS 1	TPS 2
C.T	0.25 ~ 0.9	Min.4.0
W.O.T	Min.4.0	0.25 ~ 0.9

3. Turn the ignition switch OFF and disconnect the scantool from the DLC.
4. Disconnect the ETC module connector and measure the resistance between the ETC module terminals 4 and 1 (TPS 1).

Specification: Refer to “Specification”

5. Measure resistance between the ETC module terminals 7 and 6 (TPS 2).

Specification: Refer to “Specification”

ETC Motor

1. Turn the ignition switch OFF.
2. Disconnect the ETC module connector.
3. Measure resistance between the ETC module terminals 5 and 8.
4. Check that the resistance is within the specification.

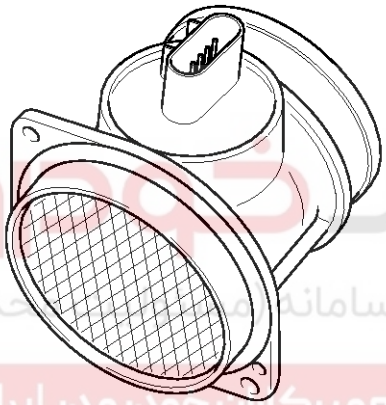
Specification: Refer to “Specification”

Mass Air Flow Sensor (MAFS)

Description

Mass Air Flow Sensor (MAFS) is a hot-film type sensor and is located in between the air cleaner and the throttle body. It consists of a tube, a sensor assembly and a honey cell and detects the intake air quantity flowing into the intake manifold.

While the intake air coming out of the air cleaner flows by the honey cell, it becomes laminar flow, and then it passes the hot-film. At this time, heat transfer is generated by convection and this sensor loses its energy. This sensor detects the mass air flow by using the energy loss and transfers the information to the ECM by frequency. By using this signal, the ECM can calculate fuel quantity and ignition timing.



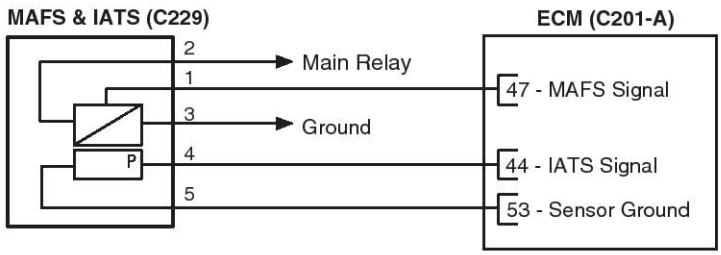
KFCF1021

Specification

Air Flow (kg/h)	Frequency (Hz)
12.6	2,617
18.0	2,958
23.4	3,241
32.4	3,653
43.2	4,024
57.6	4,399
72.0	4,704
108.0	5,329
144.0	5,897
198.0	6,553
270.0	7,240
360.0	7,957
486.0	8,738
666.0	9,644
900.0	10,590

Circuit Diagram

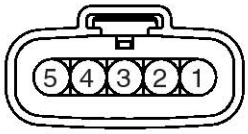
[Circuit Diagram]



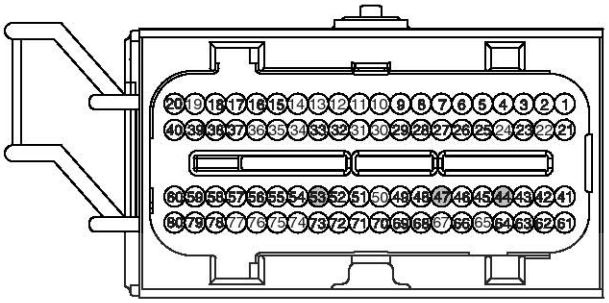
[Connection Information]

Terminal	Connected to	Function
1	ECM C201-A (47)	MAFS Signal
2	Main Relay	Sersor Power (B+)
3	Chassis Ground	Power Ground
4	ECM C201-A (44)	IATS Signal
5	ECM C201-A (53)	Sensor Ground

[Harness Connector]



C229
MAFS & IATS



C201-A
ECM

SMGF19201L

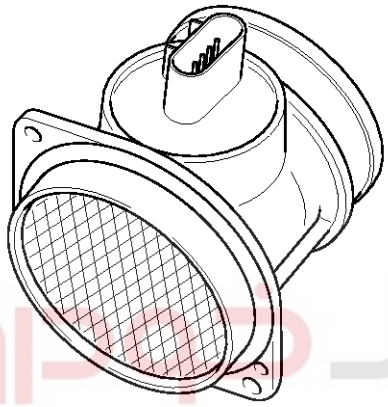
Inspection

1. Check the mass air flow sensor visually.
   - Mounting direction of the sensor
   - Any contamination, corrosion or damage of connector
   - Air cleaner's clogging or wet
   - Sensor cylinder's deforming or blocking by any foreign material
2. Check any leakage on intake system.

Intake Air Temperature Sensor (IATS)

Description

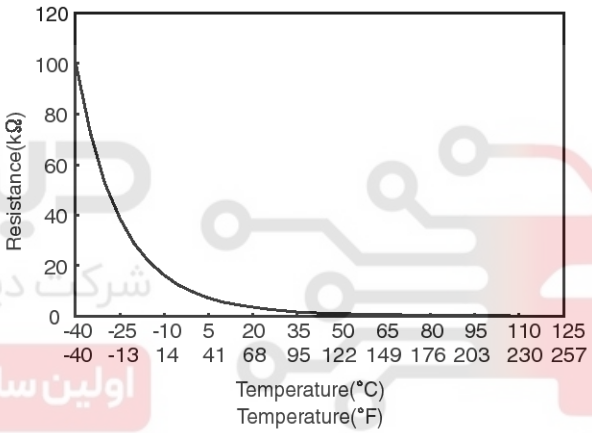
Intake Air Temperature Sensor (IATS) is installed inside the Mass Air Flow Sensor (MAFS) and detects the intake air temperature. To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the ECM uses not only MAFS signal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



KFCF1021

Specification

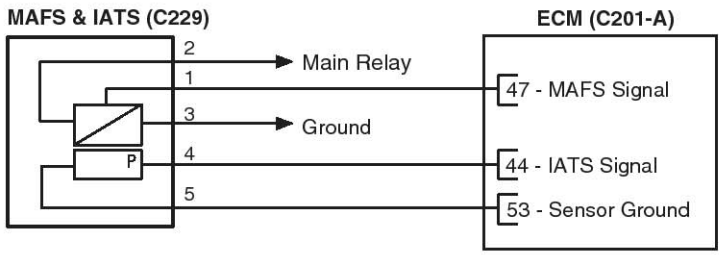
Temperature		Resistance (kΩ)
℃	˚F	
-40	-40	100.87
-20	-4	28.58
0	32	9.40
10	50	5.66
20	68	3.51
40	104	1.47
60	140	0.67
80	176	0.33



SBHFL9135N

Circuit Diagram

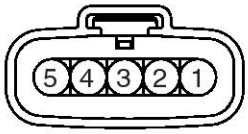
[Circuit Diagram]



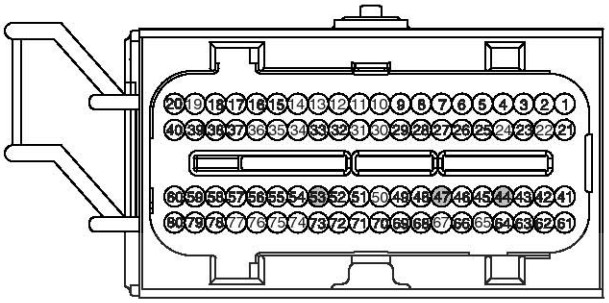
[Connection Information]

Terminal	Connected to	Function
1	ECM C201-A (47)	MAFS Signal
2	Main Relay	Sersor Power (B+)
3	Chassis Ground	Power Ground
4	ECM C201-A (44)	IATS Signal
5	ECM C201-A (53)	Sensor Ground

[Harness Connector]



C229
MAFS & IATS



C201-A
ECM

SMGF19201L

Inspection

1. Turn the ignition switch OFF.
2. Disconnect the IATS connector.
3. Measure resistance between the IATS terminals 4 and 5.
4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

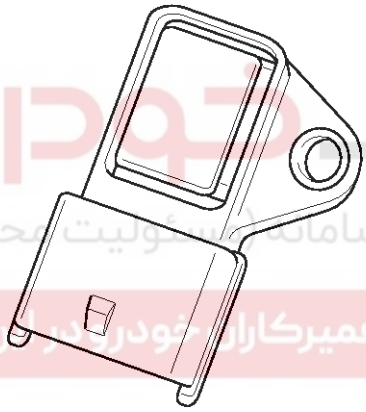
Manifold Absolute Pressure Sensor (MAPS)

Description

Manifold Absolute Pressure Sensor (MAPS) is a speed-density type sensor and is installed on the surge tank.

The MAPS senses absolute pressure in surge tank and transfers this analog signal proportional to the pressure to the ECM. The ECM calculates the intake air quantity and engine speed based on this signal.

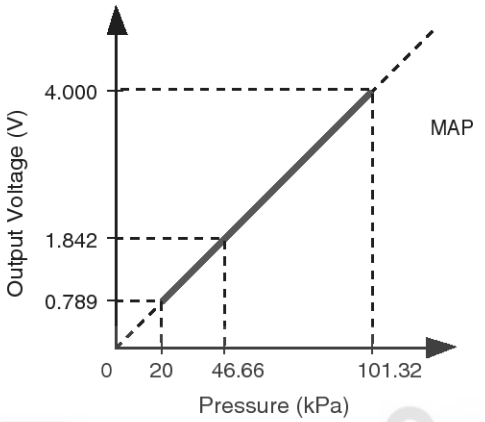
This MAPS consists of a piezo-electric element and a hybrid IC that amplifies the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor.100% vacuum and the manifold pressure apply to the both sides of it respectively. That is, this sensor outputs the silicon variation proportional to pressure change by voltage.



SMGF19111L

Specification

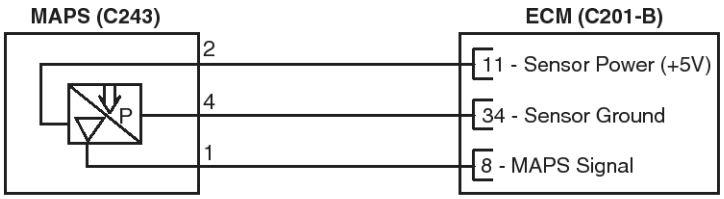
Pressure (kPa)	Output Voltage (V)
20.0	0.79
46.66	1.84
101.32	4.0



SBHFL9136L

Circuit Diagram

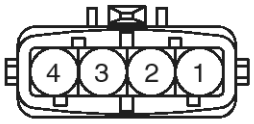
[Circuit Diagram]



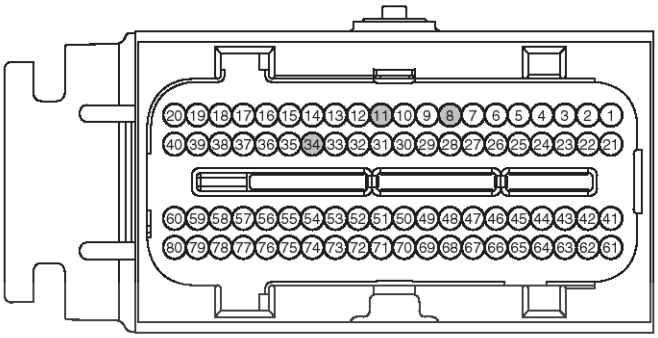
[Connection Information]

Terminal	Connected to	Function
1	ECM C201-B (8)	MAPS Signal
2	ECM C201-B (11)	Sensor Power (+5V)
3	-	-
4	ECM C201-B (34)	Sensor Ground

[Harness Connector]



C243
MAPS



C201-B
ECM

SMGF19202L

Inspection

1. Connect a scantool on the Data Link Connector (DLC).
2. Measure the output voltage of the MAPS at idle and IG ON.

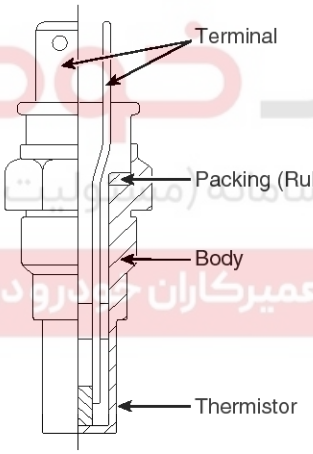
Condition	Output Voltage (V)
IG ON	3.9 ~ 4.1
Idle	0.8 ~ 1.6

Engine Coolant Temperature Sensor (ECTS)

Description

Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature.The ECTS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases. The reference 5 V in the ECM is supplied to the ECTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in the ECTS changes according to the engine coolant temperature, the output voltage also changes.

During cold engine operation the ECM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.



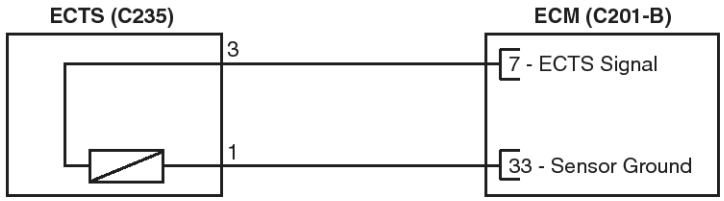
SBHFL9140L

Specification

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

Circuit Diagram

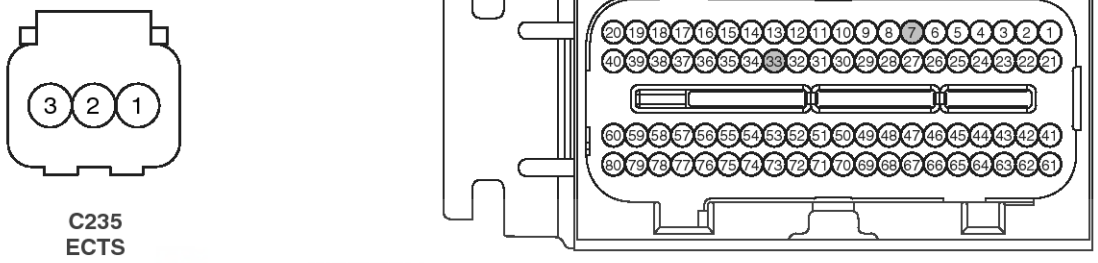
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM C201-B (33)	Sensor Ground
2	-	-
3	ECM C201-B (7)	ECTS Signal

[Harness Connector]



SMGF19203L

Inspection

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

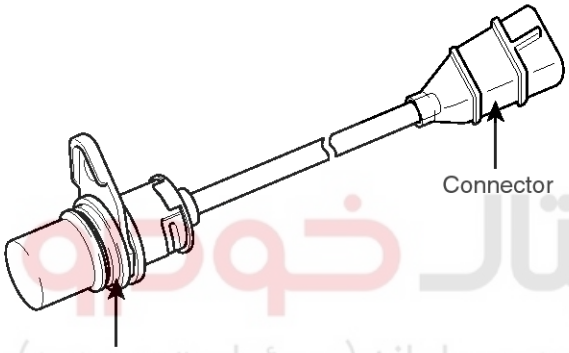
Specification: Refer to “Specification”

Crankshaft Position Sensor (CKPS)

Description

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, the engine may stop because of CKPS signal missing.

This sensor is installed on transaxle housing or the cylinder block and generates alternating current by magnetic flux field which is made by the sensor and the target wheel when the engine rotates. The target wheel consists of 58 slots and 2 missing slots on 360 CA (Crank Angle).

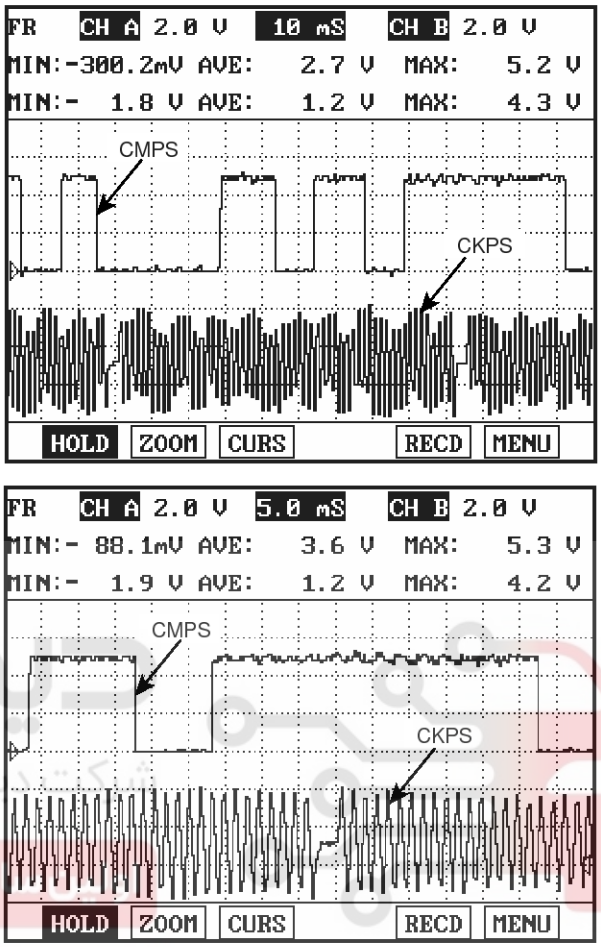


EGRF245A

Specification

Item	Specification
Coil Resistance (Ω)	725 ~ 925Ω [20℃(68°F)]
Air Gap (mm)	0.5 ~ 1.5

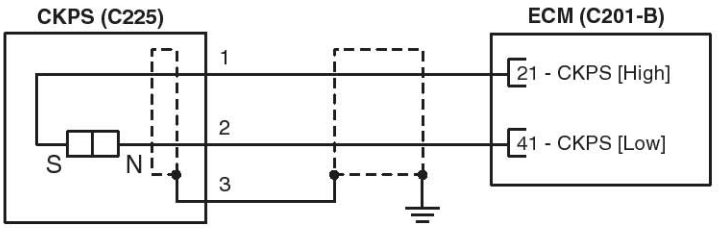
Wave Form



SBHFL9214L

Circuit Diagram

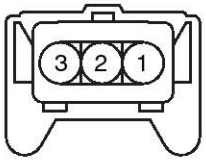
[Circuit Diagram]



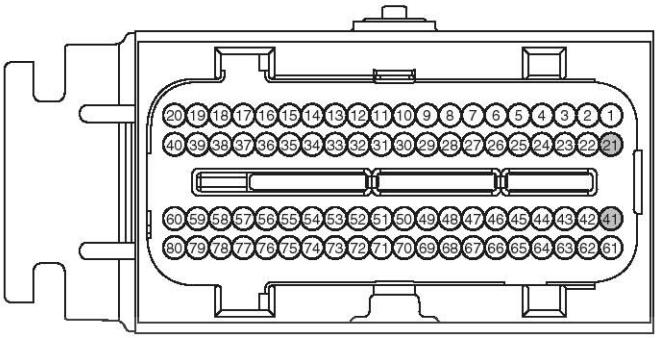
[Connection Information]

Terminal	Connected to	Function
1	ECM C201-B (21)	CKPS [HIGH] Signal
2	ECM C201-B (41)	CKPS [LOW] Signal
3	Chassis Ground	Sensor Shield

[Harness Connector]



C225
CKPS



C201-B
ECM

SMGF19204L

Inspection

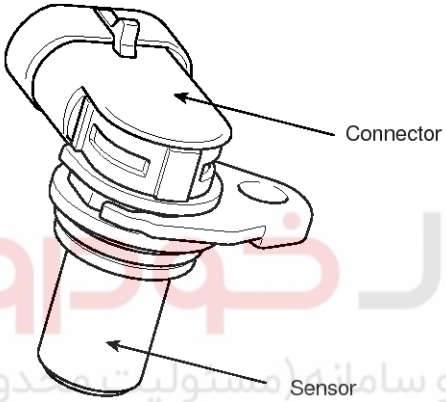
1. Check the signal waveform of the CMPS and CKPS using a scantool.

Specification: Refer to “Wave Form”

Camshaft Position Sensor (CMPS)

Description

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

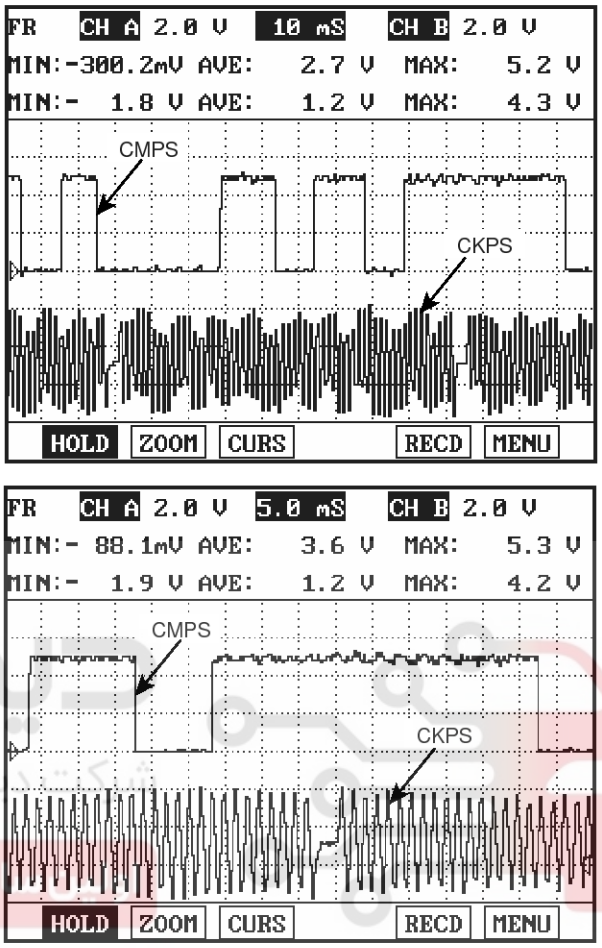


SBHFL9138L

Specification

Item	Specification
Output Voltage (V)	High: 4.75 ~ 5.25V
	Low: 0 ~ 0.7V
Air Gap (mm)	0.5 ~ 1.5

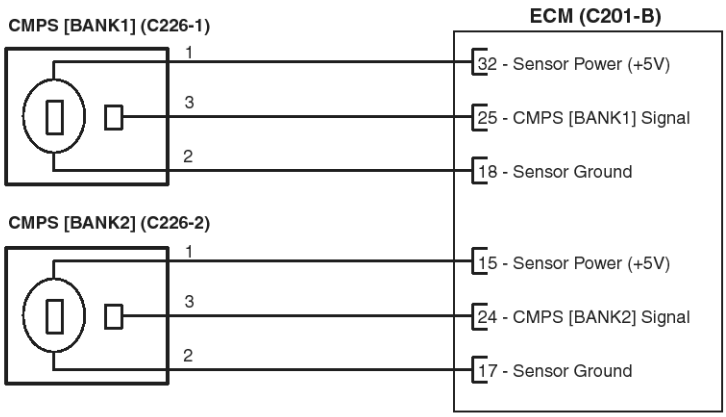
Wave Form



SBHFL9214L

Circuit Diagram

[Circuit Diagram]



[Connection Information]

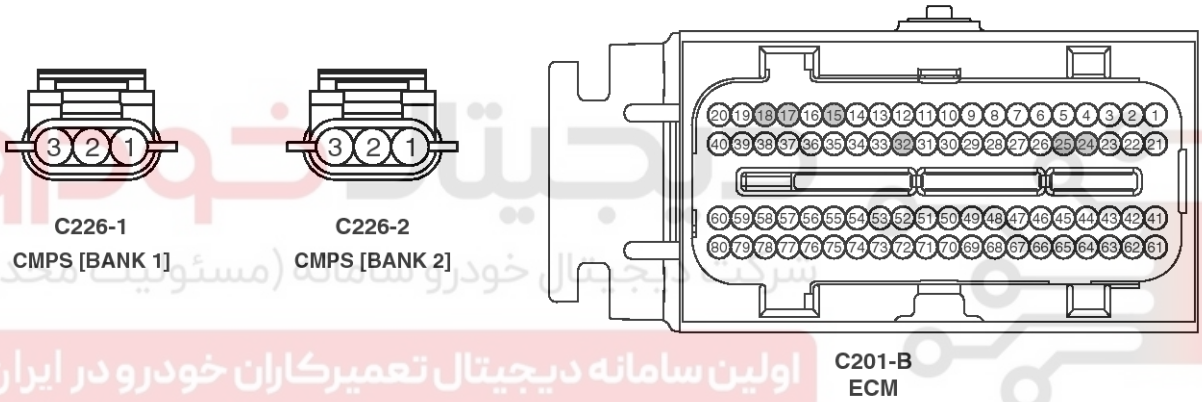
CMPS [BANK 1] (C226-1)

Terminal	Connected to	Function
1	ECM C201-B (32)	Sensor Power (+5V)
2	ECM C201-B (18)	Sensor Ground
3	ECM C201-B (25)	CMPS [BANK1] Signal

CMPS [BANK 2] (C226-2)

Terminal	Connected to	Function
1	ECM C201-B (15)	Sensor Power (+5V)
2	ECM C201-B (17)	Sensor Ground
3	ECM C201-B (24)	CMPS [BANK2] Signal

[Harness Connector]



SMGF19205L

Inspection

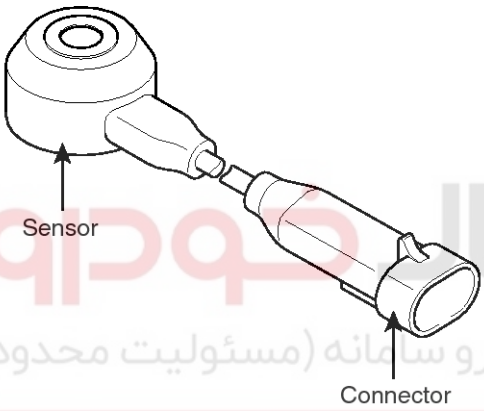
1. Check the signal waveform of the CMPS and CKPS using a scantool.

Specification: Refer to “Wave Form”

Knock Sensor (KS)

Description

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



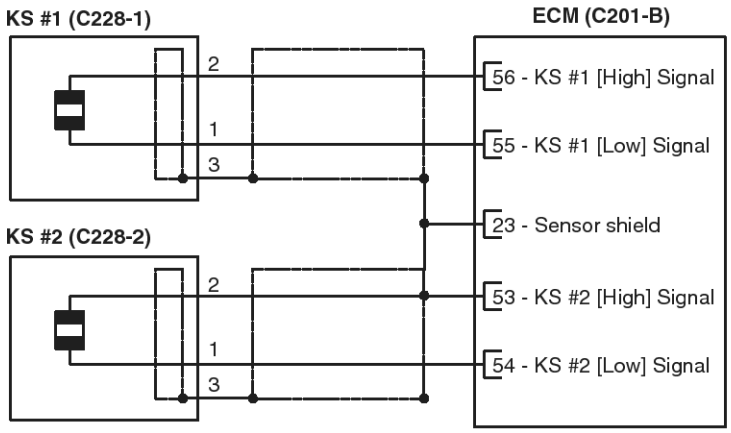
EGRF251A

Specification

Item	Specification
Capacitance (pF)	950 ~ 1,350

Circuit Diagram

[Circuit Diagram]



[Connection Information]

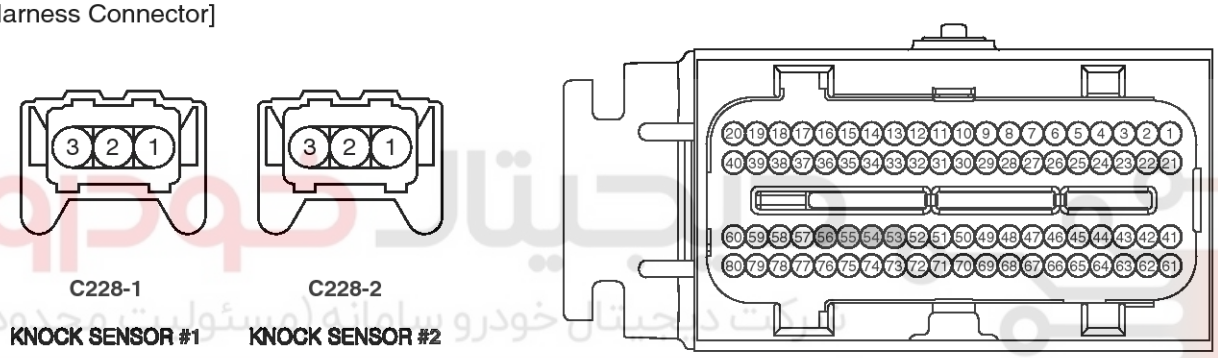
KNOCK SENSOR #1 (C228-1)

Terminal	Connected to	Function
1	ECM C201-B (55)	KS #1 [Low] Signal
2	ECM C201-B (56)	KS #1 [High] Signal
3	Chassis Ground	Shield ground

KNOCK SENSOR #2 (C228-2)

Terminal	Connected to	Function
1	ECM CLG-B (54)	KS #2 [Low] Signal
2	ECM CLG-B (53)	KS #2 [High] Signal
3	Chassis Ground	Shield ground

[Harness Connector]



SMGF19206L

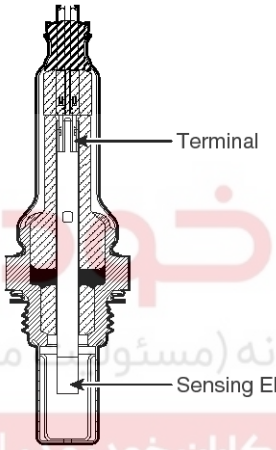
Heated Oxygen Sensor (HO2S)

Description

Heated Oxygen Sensor (HO2S) consists of the zirconium and the alumina and is installed on upstream and downstream of the Manifold Catalyst Converter (MCC).

After it compares oxygen consistency of the atmosphere with the exhaust gas, it transfers the oxygen consistency of the exhaust gas to the ECM. When A/F ratio is rich or lean, it generates approximately 1V or 0V respectively. In order that this sensor normally operates, the temperature of the sensor tip is higher than 370℃ (698˚F). So it has a heater which is controlled by the ECM duty signal.

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



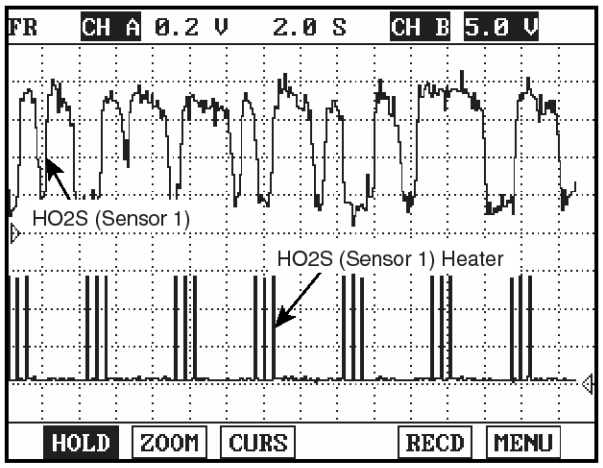
EGRF247A

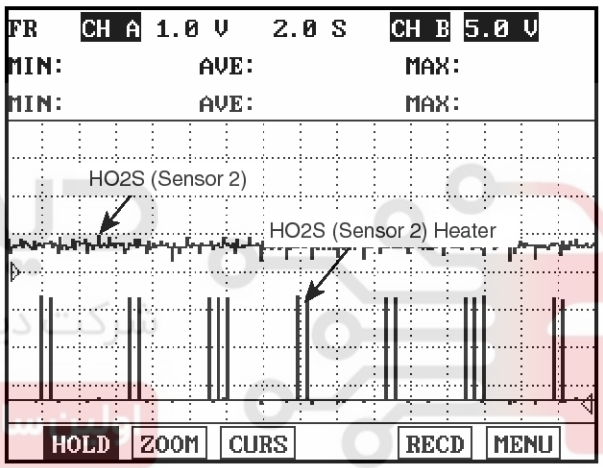
Specification

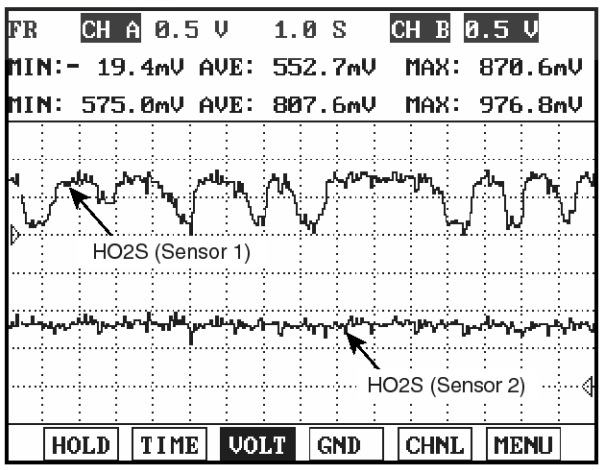
A/F Ratio (λ)	Output Voltage(V)
RICH	0.80 ~ 0.92
LEAN	0.1

Item	Specification
Heater Resistance (Ω)	3.0 ~ 4.0Ω [20℃(68˚F)]

Wave Form



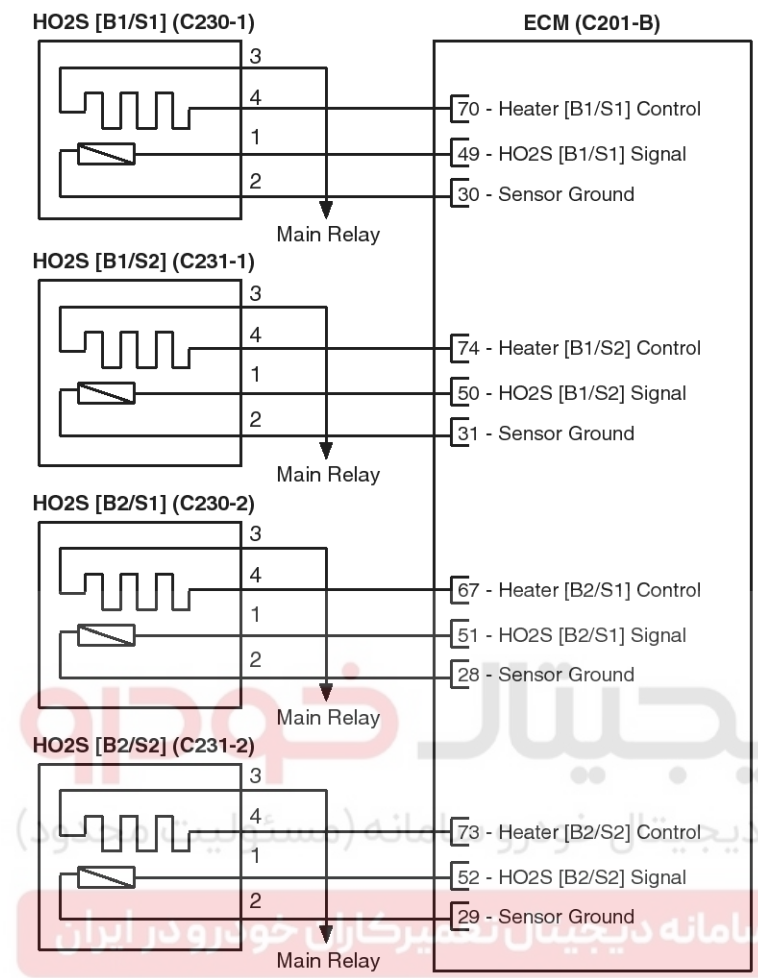




SBHFL9139L

Circuit Diagram

[Circuit Diagram]



[Connection Information]

HO2S [BANK 1/SENSOR 1] (C230-1)

Terminal	Connected to	Function
1	ECM C201-B (49)	HO2S [B1/S1] Signal
2	ECM C201-B (30)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM C201-B (70)	Heater [B1/S1] Control

HO2S [BANK 1/SENSOR 2] (C231-1)

Terminal	Connected to	Function
1	ECM C201-B (50)	HO2S [B1/S2] Signal
2	ECM C201-B (31)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM C201-B (74)	Heater [B1/S2] Control

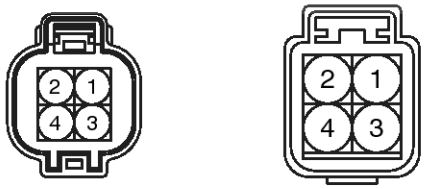
HO2S [BANK 2/SENSOR 1] (C230-2)

Terminal	Connected to	Function
1	ECM C201-B (51)	HO2S [B2/S1] Signal
2	ECM C201-B (28)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM C201-B (67)	Heater [B2/S1] Control

HO2S [BANK 2/SENSOR 2] (C231-2)

Terminal	Connected to	Function
1	ECM C201-B (52)	HO2S [B2/S2] Signal
2	ECM C201-B (29)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM C201-B (73)	Heater [B2/S2] Control

[Harness Connector]

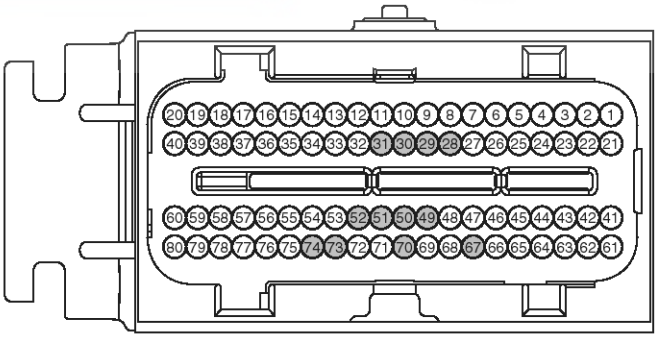


C230-1,2

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

C231-1,2

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



C201-B
ECM

SMGF19207L

Inspection

1. Turn the ignition switch OFF.
2. Disconnect the HO2S connector.
3. Measure resistance between the HO2S terminals 3 and 4.
4. Check that the resistance is within the specification.

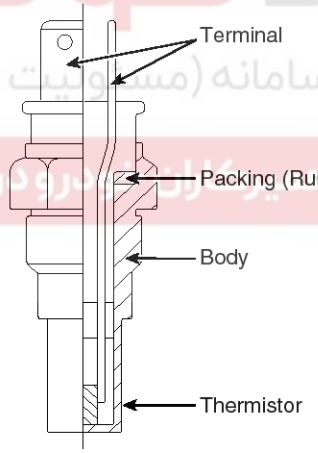
Specification: Refer to “Specification”

CVVT Oil Temperature Sensor (OTS)

Description

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

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



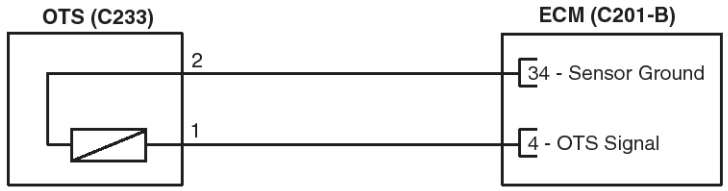
SBHFL9140L

Specification

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

Circuit Diagram

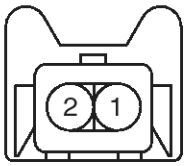
[Circuit Diagram]



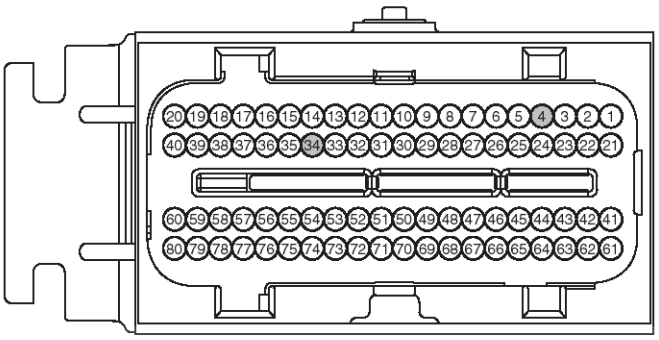
[Connection Information]

Terminal	Connected to	Function
1	ECM C201-B (4)	OTS Signal
2	ECM C201-B (34)	Sensor Ground

[Harness Connector]



C233
OTS



C201-B
ECM

SMGF19208L

Inspection

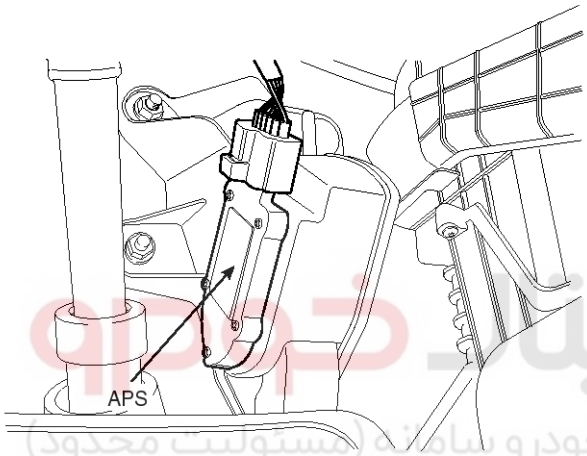
1. Turn the ignition switch OFF.
2. Disconnect the OTS connector.
3. Remove the OTS.
4. After immersing the thermistor of the sensor into engine coolant, measure resistance between the OTS terminals 1 and 2.
5. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Accelerator Position Sensor (APS)

Description

Accelerator Position Sensor (APS) is installed on the accelerator pedal module and detects the rotation angle of the accelerator pedal. The APS is one of the most important sensors in engine control system, so it consists of the two sensors which adapt individual sensor power and ground line. The second sensor monitors the first sensor and its output voltage is half of the first one. If the ratio of the sensor 1 and 2 is out of the range (approximately 1/2), the diagnostic system judges that it is abnormal.

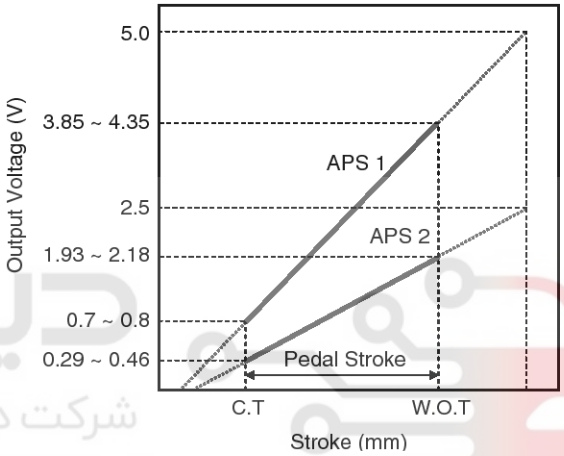


LGLG001P

Specification

Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.7 ~ 0.8	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

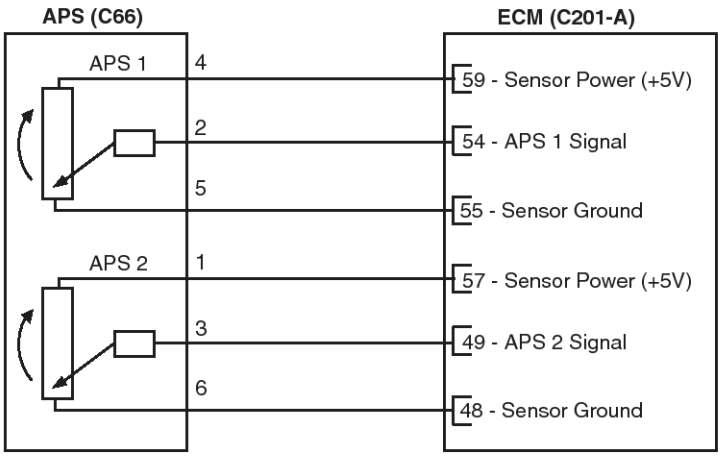
Item	Sensor Resistance (kΩ)
APS 1	0.7 ~ 1.3 [20℃(68°F)]
APS 2	1.4 ~ 2.6 [20℃(68°F)]



SMGF19112L

Circuit Diagram

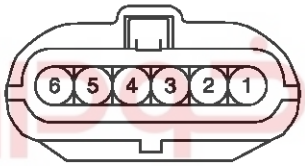
[Circuit Diagram]



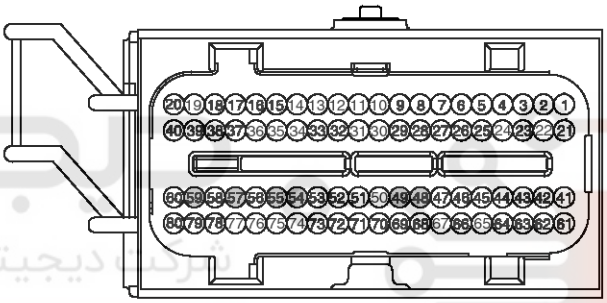
[Connection Information]

Terminal	Connected to	Function
1	ECM C201-A (57)	APS 2 Sensor Power (+5V)
2	ECM C201-A (54)	APS 1 Signal
3	ECM C201-A (49)	APS 2 Signal
4	ECM C201-A (59)	APS 1 Sensor Power (+5V)
5	ECM C201-A (55)	APS 1 Sensor Ground
6	ECM C201-A (48)	APS 2 Sensor Ground

[Harness Connector]



C66
APS



C201-A
ECM

SMGF19209L

Inspection

1. Connect a scantool on the Data Link Connector (DLC).
2. Turn the ignition switch ON.
3. Measure the output voltage of the APS 1 and 2 at C.T and W.O.T.

Specification: Refer to “Specification”

4. Turn ignition switch OFF and disconnect the scantool from the DLC.
5. Disconnect APS connector.
6. Measure resistance between the APS terminals 4 and 5 (APS 1).

Specification: Refer to “Specification”

7. Measure resistance between the APS terminals 1 and 6 (APS 2).

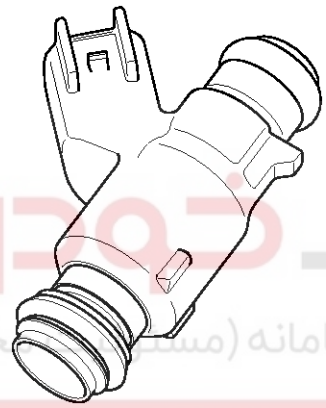
Specification: Refer to “Specification”

Injector

Description

Based on information from various sensors, the ECM determines the fuel injection amount. The fuel injector is a solenoid-operated valve and the fuel injection amount is controlled by length of time that the fuel injector is held open.

The ECM controls each injector by grounding the control circuit. When the ECM energizes the injector by grounding the control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the ECM de-energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should be peak for a moment.



KFCF1026

⚠CAUTION

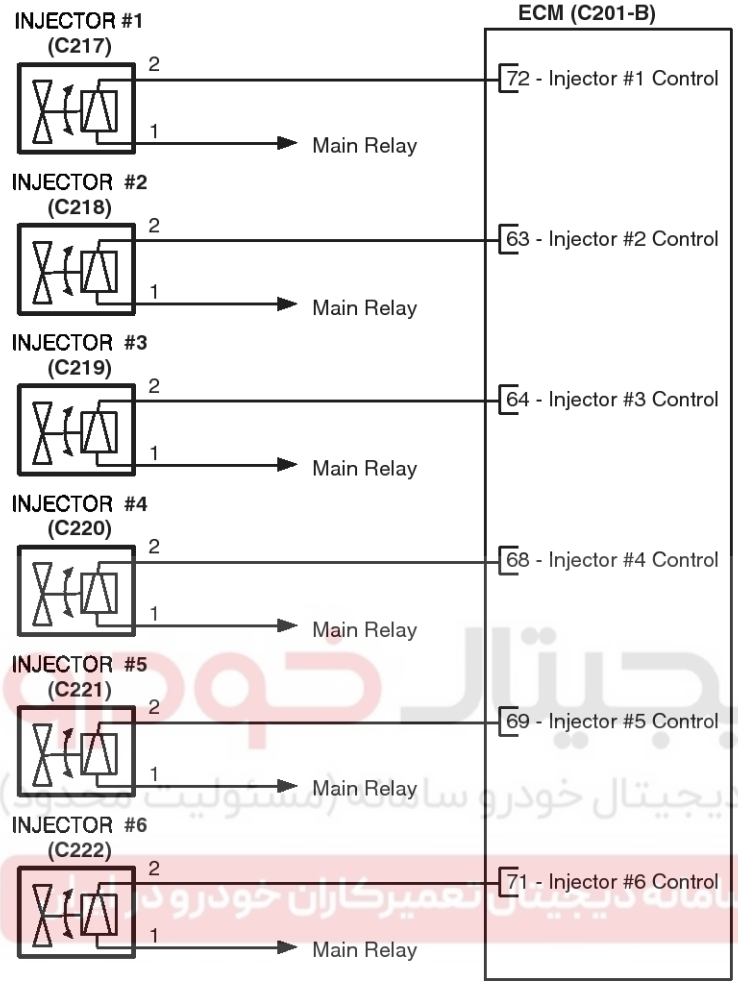
- **If an injector connector is disconnected for more than 46 seconds while the engine runs, the ECM will determine that the cylinder is misfiring and cut fuel supply. So be careful not to exceed 46 seconds.**
- **But the engine runs normally in 10 seconds after turning the ignition key off.**

Specification

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

Circuit Diagram

[Circuit Diagram]



[Connection Information]

INJECTOR #1 (C217)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM C201-B (72)	Injector #1 Control

INJECTOR #2 (C218)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM C201-B (63)	Injector #2 Control

INJECTOR #3 (C219)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM C201-B (64)	Injector #3 Control

INJECTOR #4 (C220)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM C201-B (68)	Injector #4 Control

INJECTOR #5 (C221)

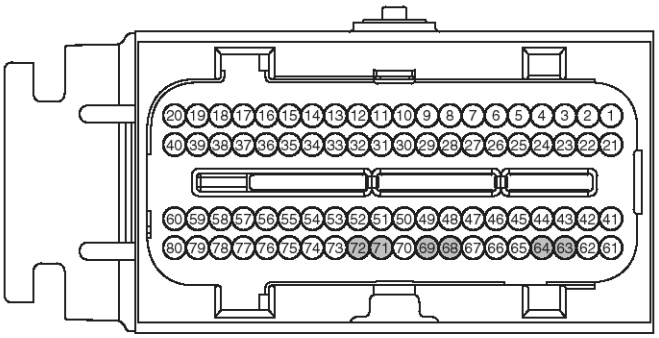
Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM C201-B (69)	Injector #5 Control

INJECTOR #6 (C222)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM C201-B (71)	Injector #6 Control

[Harness Connector]

C217/C218/C219/C220/C221/C222
INJECTOR #1,2,3,4,5,6



C201-B
ECM

SMGF19210L

Inspection

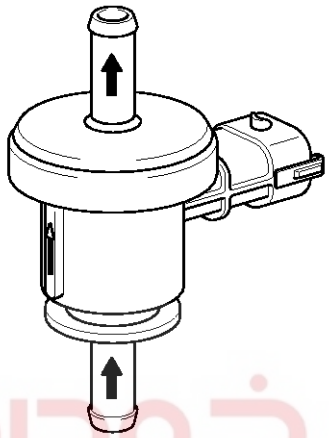
1. Turn the ignition switch OFF.
2. Disconnect the injector connector.
3. Measure resistance between the injector terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Purge Control Solenoid Valve (PCSV)

Description

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 ECM grounds the valve control line. When the passage is open (PCSV ON), fuel vapor stored in the canister is transferred to the intake manifold.



KGBF004W

Specification

Item	Specification
Coil Resistance (Ω)	14.0 ~ 18.0 [20℃(68°F)]

Circuit Diagram

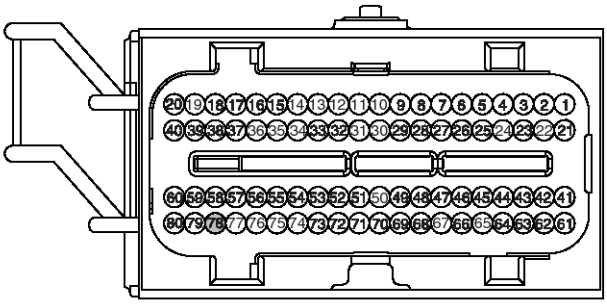
[Circuit Diagram]

[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Battery Power(B+)
2	ECM C201-A (78)	PCSV Control

[Harness Connector]

C210
PCSV



C201-A
ECM

SMGF19211L

Inspection

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

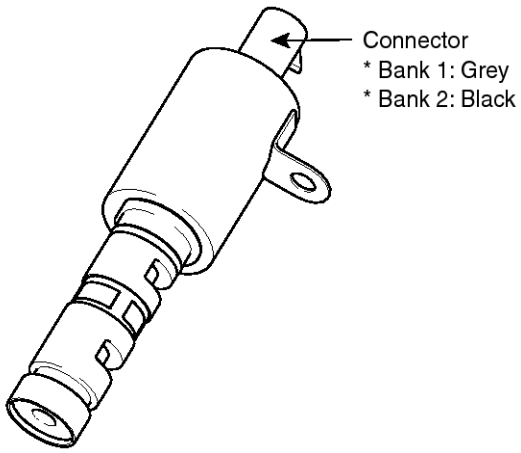
Specification: Refer to “Specification”

CVVT Oil Control Valve (OCV)

Description

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

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



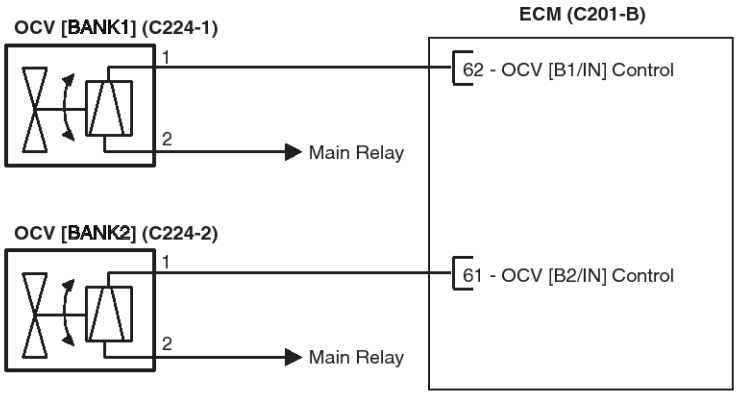
SBHFL9143L

Specification

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

Circuit Diagram

[Circuit Diagram]



[Connection Information]

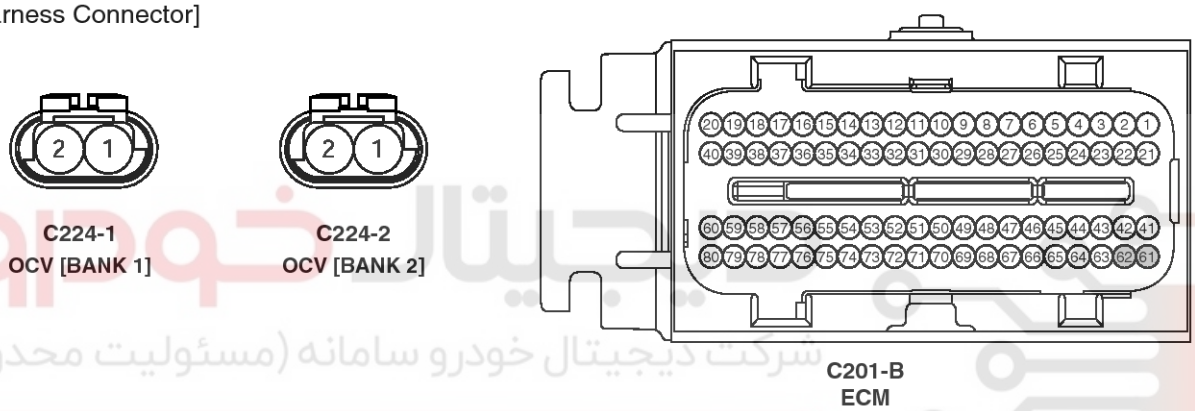
OCV [BANK 1/INTAKE] (C224-1)

Terminal	Connected to	Function
1	ECM C201-B (62)	OCV [B1/IN] Control
2	Main Relay	Battery Power (B+)

OCV [BANK 2/INTAKE] (C224-2)

Terminal	Connected to	Function
1	ECM C201-B (61)	OCV [B2/IN] Control
2	Main Relay	Battery Power (B+)

[Harness Connector]



SMGF19212L

Inspection

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

Specification: Refer to “Specification”

Installation

⚠CAUTION

Pay attention to color of valve connector (Component and harness side) when installing. If an OCV is installed on opposite bank, the engine may be damaged.

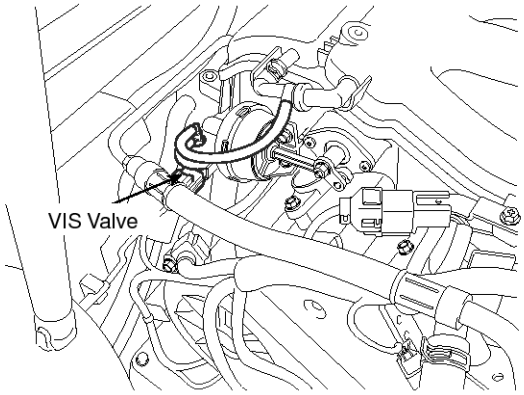
[Connector Color]

Item	Component Side	Harness Side
Bank1 (RH)	Grey	
Bank 2(LH)	Black	

Variable Intake Solenoid (VIS) Valve

Description

Variable Intake Solenoid (VIS) Valve is installed on the surge tank. It controls intake air passages to improve intake efficiency in accordance with the ECM control signal calculated by engine operating condition.



SMGF19113L

Specification

Item	Specification
Coil Resistance (Ω)	29.0 ~ 35.0 [20℃(68°F)]

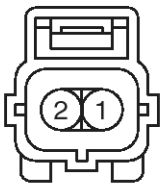
Circuit Diagram

[Circuit Diagram]

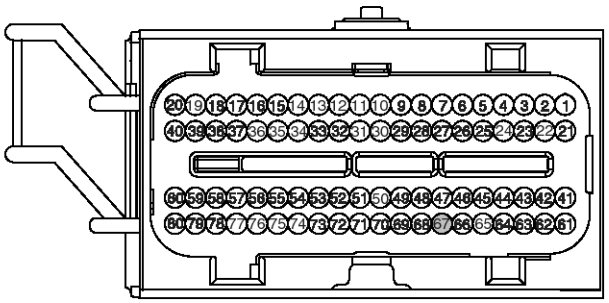
[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM C201-A (67)	VIS Valve Conrtol

[Harness Connector]



C242-2
VIS



C201-A
ECM

SMGF19213L

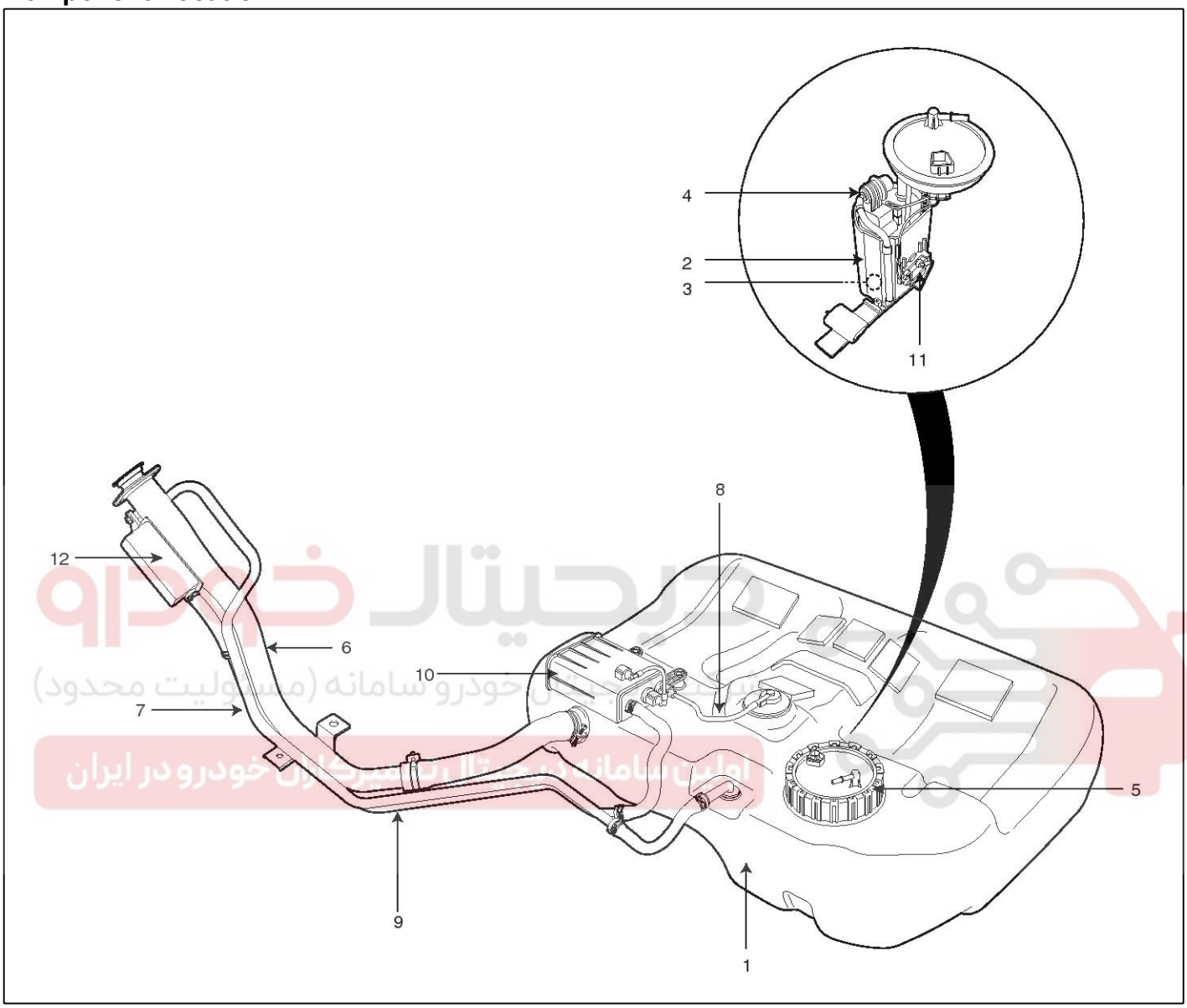
Inspection

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

Specification: Refer to “Specification”

Fuel Delivery System

Component Location



SMGFL9122L

1. Fuel tank
2. Fuel pump
3. Fuel filter
4. Fuel pressure regulator
5. Fuel pump plate cover
6. Fuel filler pipe
7. Leveling pipe
8. Tube (Fuel tank ↔ Canister)
9. Tube (Canister ↔ Fuel tank air filter)
10. Canister
11. Fuel sender
12. Fuel tank air filter

Fuel Pressure Test

1. PREPARING

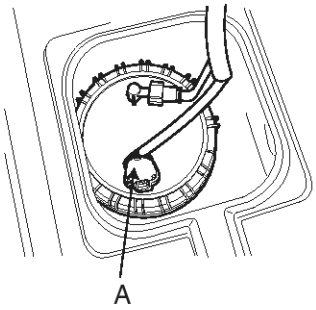
1. Open service cover in trunk.

2. RELEASE THE INTERNAL PRESSURE

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

NOTE

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



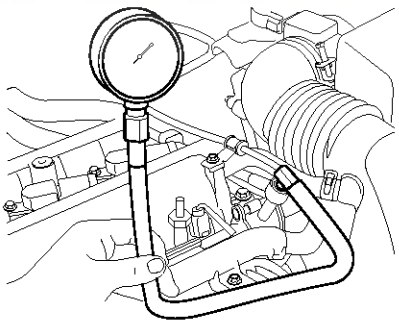
3. INSTALL THE SPECIAL SERVICE TOOL (SST) FOR MEASURING THE FUEL PRESSURE

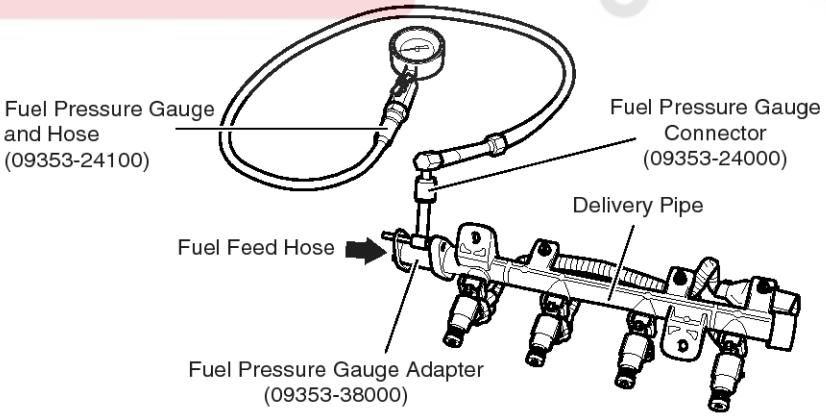
1. Disconnect the fuel feed hose from the delivery pipe.

CAUTION

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

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





SMGFL9123L

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 PRESSURE TEST

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

Standard Value: 379.5 kpa (3.87 kgf/㎠, 55.0 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

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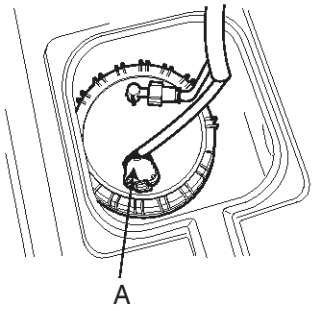
6. RELEASE THE INTERNAL PRESSURE

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.

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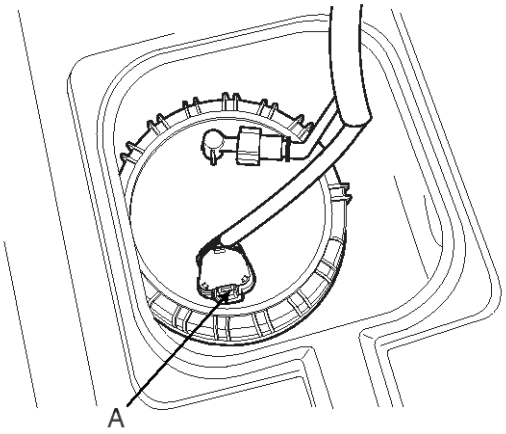
Fuel Pump

Removal

1. Preparation
   1) Remove service cover in trunk.
   2) Disconnect the fuel pump connector (A).



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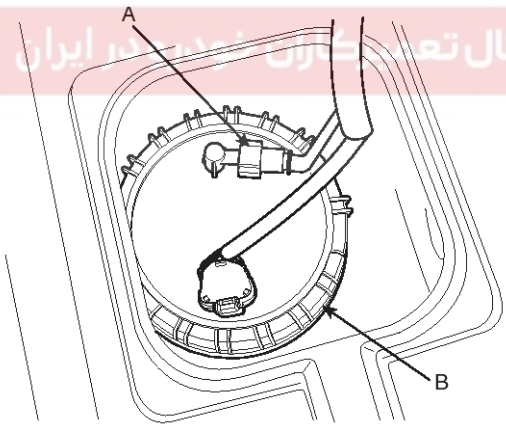
   3) Start the engine and wait until fuel in fuel line is exhausted.
   4) After engine stalls, turn the ignition switch to OFF position.
2. Disconnect fuel feed line (A).



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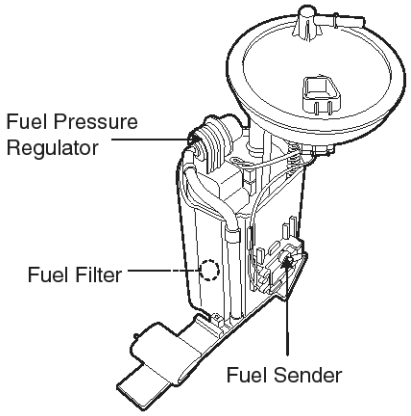
3. Unscrew the fuel pump plate cover (B) with SST(No : 09310 - 2B100) and remove the fuel pump assembly.



LGLG003E

Installation

1. Installation is the reverse of removal.

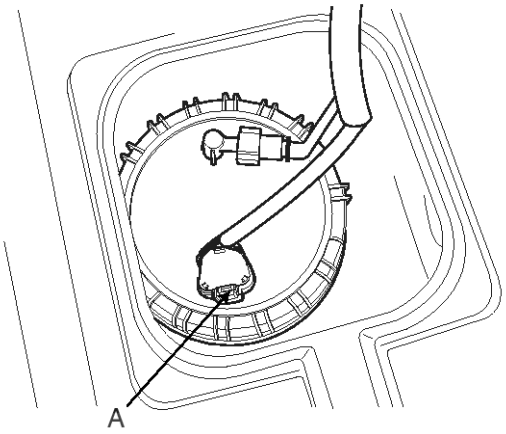
Fuel pump plate cover installation :
58.8 ~ 68.6 N.m (6.0 ~ 7.0 kgf.m, 43.4 ~ 50.6 lb-ft)

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

Fuel Tank

Removal

1. Preparation
   1) Remove service cover in trunk.
   2) Disconnect the fuel pump connector (A).



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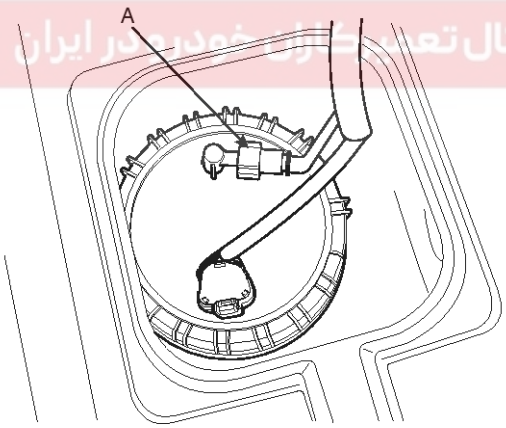
   3) Start the engine and wait until fuel in fuel line is exhausted.
   4) After engine stalls, turn the ignition switch to OFF position.
2. Disconnect fuel feed line (A).



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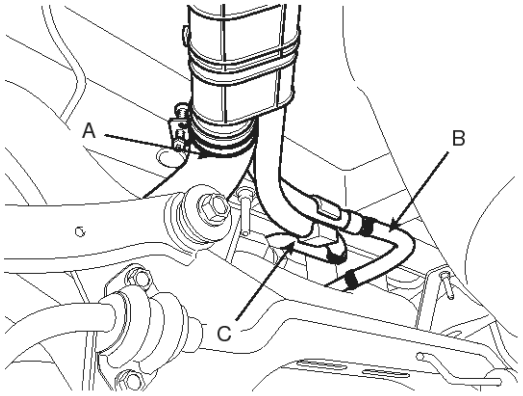
3. Lift the vehicle.
4. Remove the main muffler (Refer to "EM" group in this WORKSHOP MANUAL).
5. Disconnect fuel filler hose (A), leveling hose (B) and vacuum hose (C).



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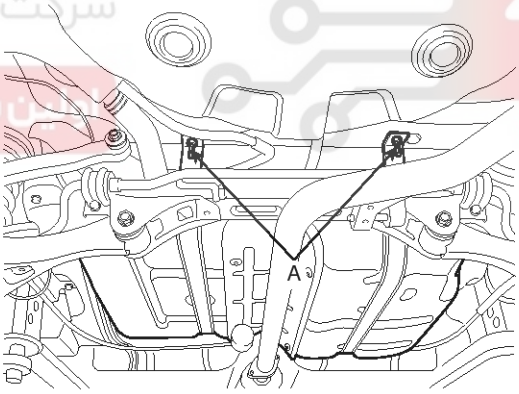
6. Support the fuel tank with a jack and unscrew fuel tank band mounting nuts (A).



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7. Remove the fuel tank from the vehicle with coming down the jack slowly.

Installation

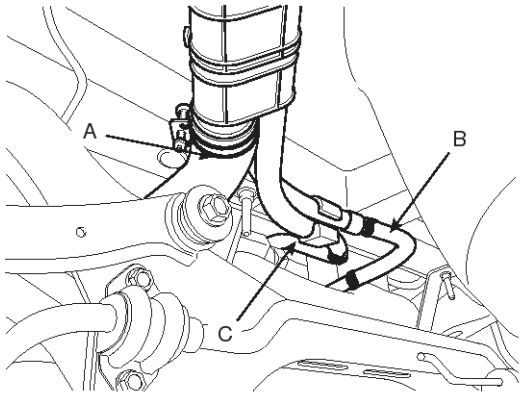
Installation is the reverse of removal.

Fuel tank installation nuts:
39.2 ~ 54.0 N.m (4.0 ~ 5.5 kgf.m, 28.9 ~ 39.8 lb-ft)

Filler-Neck Assembly

Replacement

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



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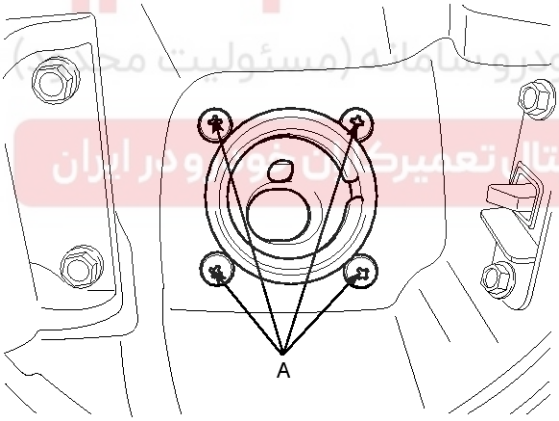
2. Open the fuel filler door and unfasten the filler-neck assembly mounting screws (A).



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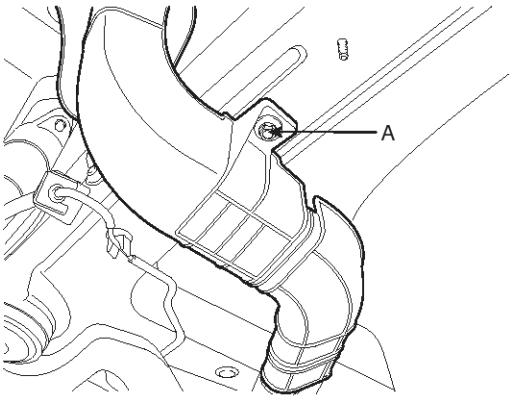
3. Remove the rear-LH wheel, tire, and the inner wheel house.
4. Remove the bracket mounting bolts (A) and remove the filler-neck assembly.



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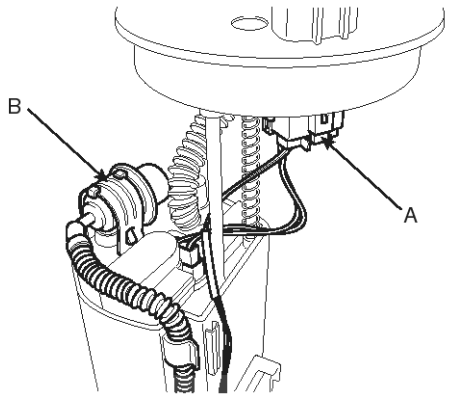
Installation

1. Installation is the 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).



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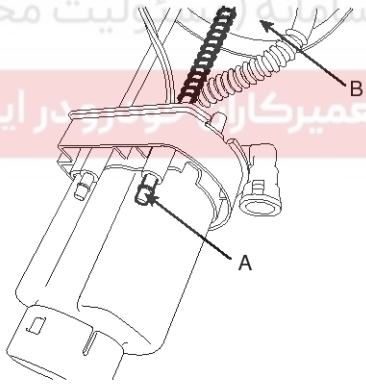
3. Remove the cushion pipe fixing clip (A) after pressing the flange assembly (B).



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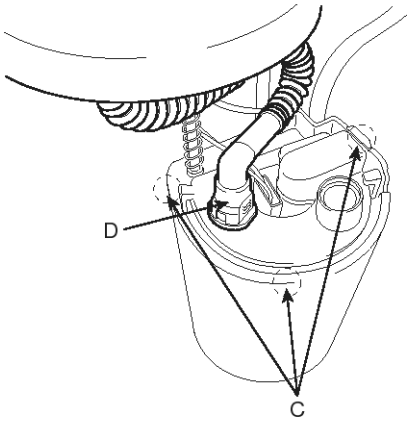
4. Separate the flange assembly from the fuel pump & filter assembly after disengaging three fixing hooks (C) and the feed hose connector (D).



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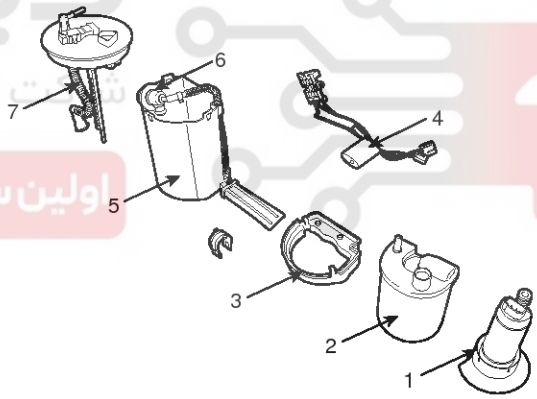
5. Separate the fuel filter assembly from the fuel pump assembly after disengaging two hooks.



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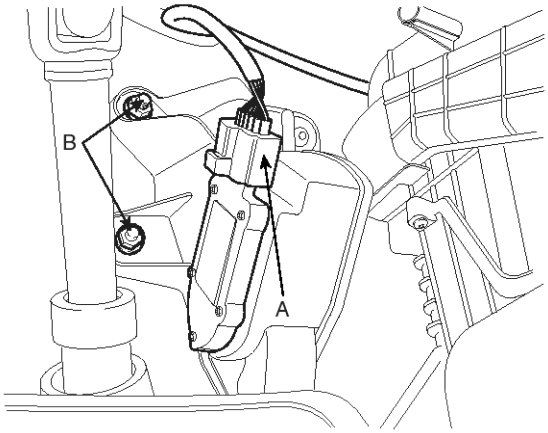
1. Electric Pump
2. Fuel Filter
3. Filter Bracket
4. Fuel Sender
5. Reservoir Cup
6. Fuel Pressure Regulator
7. Plate Assembly

Accelerator Pedal

Removal

1. Turn ignition switch off and disconnect the battery (-) cable from the battery.
2. Disconnect the accelerator position sensor connector (A).



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3. Unfasten the three mounting nuts(B) and remove the accelerator pedal from the vehicle.

Installation

1. Installation is reverse of removal.

Accelerator pedal mounting nuts :
7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)