Fuel System (G6DC - GSL 3.5)

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General Information

Specifications

Fuel Delivery System

Items	Specification	
Fuel Tank	Capacity	70 lit. (18.5 U.S.gal., 74.0 U.S.qt., 61.6 Imp.qt.)
Fuel Filter	Type	High pressure type
Fuel Pressure Regulator	Regulated Fuel Pressure	380 kPa (3.87kgf/㎠, 55.0psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor

Sensors

Barometric Pressure Sensor (BPS)

▷ Type: Piezo-resistive pressure sensor

▷ Specification

Pressure [kPa (kg/cm², psi)]	Output Voltage (V)
10.0 (0.10, 1.45)	0.50
55.0 (0.55, 7.9)	2.21
100.0 (1.01, 14.5)	3.93
115.0 (1.17, 16.7)	4.50

Intake Air Temperature Sensor (IATS)

▷ Type: Thermistor type

▷ Specification

Temperature		Resistance (kΩ)
℃	˚F	
-40	-40	40.93 ~ 48.35
-20	-4	13.89 ~ 16.03
0	32	5.38 ~ 6.09
10	50	3.48 ~ 3.90
20	68	2.31 ~ 2.57
40	104	1.08 ~ 1.21
60	140	0.54 ~ 0.66
80	176	0.29 ~ 0.34

Manifold Absolute Pressure Sensor (MAPS)

▷ Type: Piezo-resistive pressure sensor

▷ Specification

Pressure [kPa (kg/cm², psi)]	Output Voltage (V)
20.0 (0.20, 2.9)	0.79
46.66 (0.47, 6.76)	1.84
101.32 (1.03, 14.7)	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	1.6 ~ 2.4 [20℃(68˚F)]
TPS2	1.6 ~ 2.4 [20℃(68˚F)]

Crankshaft Position Sensor (CKPS)

▷ Type: Magnetic field sensitive sensor

▷ Specification

Item	Specification
Coil Resistance (Ω)	774 ~ 946 [20℃(68˚F)]
Air Gap [mm(in)]	0.5 ~ 1.5 (0.0196 ~ 0.0590)

Camshaft Position Sensor (CMPS)

▷ Type: Hall effect type

▷ Specification

Item	Specification
Output Voltage (V)	High: 5.0
	Low: 0.7
Air Gap [mm(in)]	0.5 ~ 1.5 (0.0196 ~ 0.0590)

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	Min. 0.8
LEAN	Max. 0.1

Item	Specification
Heater Resistance (Ω)	3.3 ~ 4.1[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

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)	22.0 ~ 26.0 [20℃(68˚F)]

CVVT Oil Control Valve (OCV)

▷ Specification

Item	Specification
Coil Resistance (Ω)	9.4 ~10.4 [20℃(68˚F)]

Variable Intake Solenoid (VIS) Valve

▷ Specification

Item	Specification
Coil Resistance (Ω)	30.0 ~ 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 8 ± 10	
Idle Speed (rpm)	A/C OFF	Neutral, N, P-range	550 ± 100
		D-range	550 ± 100
	A/C ON	Neutral, N, P-range	550 ± 100
		D-range	550 ± 100

Tightening Torques

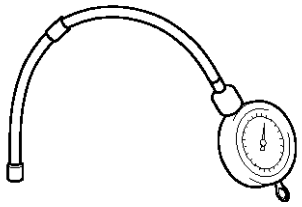
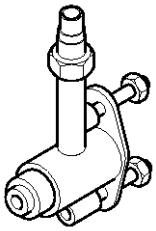
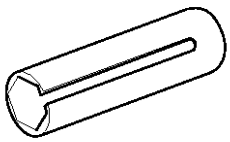
Engine Control System

Item	kgf.m	N.m	lb-ft
ECM installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
ECM bracket installation bolt/nut	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Barometric pressure sensor installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Manifold absoute pressure sensor installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Crankshaft position sensor installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 1/Intake) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 1/Exhaust) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 2/Intake) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 2/Exhaust) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Knock sensor (Bank 1) installation bolt	1.6 ~ 2.4	15.7 ~ 23.5	11.6 ~ 17.4
Knock sensor (Bank 2) installation bolt	1.6 ~ 2.4	15.7 ~ 23.5	11.6 ~ 17.4
Heated oxygen sensor (Bank 1/Sensor 1) installation	3.6 ~ 4.6	35.3 ~ 45.1	26.0 ~ 33.3
Heated oxygen sensor (Bank 1/Sensor 2) installation	3.6 ~ 4.6	35.3 ~ 45.1	26.0 ~ 33.3
Heated oxygen sensor (Bank 2/Sensor 1) installation	3.6 ~ 4.6	35.3 ~ 45.1	26.0 ~ 33.3
Heated oxygen sensor (Bank 2/Sensor 2) installation	3.6 ~ 4.6	35.3 ~ 45.1	26.0 ~ 33.3
CVVT oil temperature sensor installation	3.5 ~ 4.5	34.3 ~ 44.1	25.3 ~ 32.6
ETC module installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
ETC module stay installation bolt	1.6 ~ 2.6	15.7 ~ 25.5	11.6 ~ 18.8
Purge control solenoid valve bracket installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
CVVT oil control valve (Bank 1/Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1/Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 2/Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 2/Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Variable intake solenoid valve 1 installation nut	0.6 ~ 0.9	5.4 ~ 8.3	4.0 ~ 6.2
Variable intake solenoid valve 2 installation nut	0.6 ~ 0.9	5.4 ~ 8.3	4.0 ~ 6.2
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 installation nut	4.0 ~ 5.5	39.2 ~ 54.0	28.9 ~ 39.8
Fuel pump plate cover tightening	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Filler-neck assembly installation screw	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Filler-neck assembly bracket installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Accelerator pedal module installation bolt	0.9 ~ 1.4	8.8 ~ 13.7	6.5 ~ 10.1
Accelerator pedal module installation nut	1.3 ~ 1.6	12.8 ~ 15.7	9.4 ~ 11.6
Delivery pipe installation bolt	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7

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)
Heated Oxygen Sensor Socket Wrench (09392-2H100)	 SFDEM8050L	Removal and installation of the heated oxygen sensor

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 the GDS to Diagnostic Link Connector (DLC).
- Record the DTC and Freeze Frame Data.

NOTE

To erase DTC and Freeze Frame Data, refer to Step 5.

4	**Confirm the Inspection Procedure for the System or Part**

- Using the SYMPTOM TROUBLESHOOTING GUIDE CHART, choose the correct inspection procedure for the system or part to be checked.

5	**Erase the DTC and Freeze Frame Data**

WARNING

NEVER erase DTC and Freeze Frame Data before completing Step 2 : MIL/DTC in CUSTOMER PROBLEM ANALYSIS SHEET.

6	**Inspect Vehicle Visually**

- Go to Step 11, if you recognize the problem.

7	**Recreate (Simulate) Symptoms of the DTC**

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

8	**Confirm Symptoms of Problem**

- If DTC(s) is/are not displayed, go to Step 9.
- If DTC(s) is/are displayed, go to Step 11.

9	**Recreate (Simulate) Symptom**

- Try to recreate or simulate the condition of the malfunction as described by the customer.

10	**Check the DTC**

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

11	**Perform Troubleshooting Procedure for DTC**

12	**Adjust or repair the vehicle**

13	**Confirmation test**

14	**END**

STDFL0001N

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	DPF (Diesel Engine)	☐ With DPF ☐ Without DPF

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	

SCMF10001L

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.

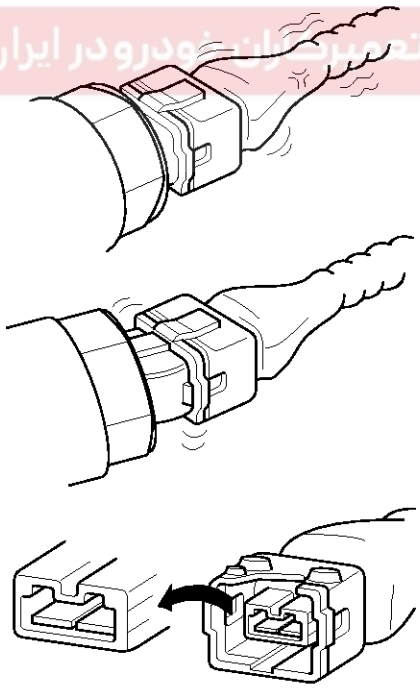
NOTICE

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

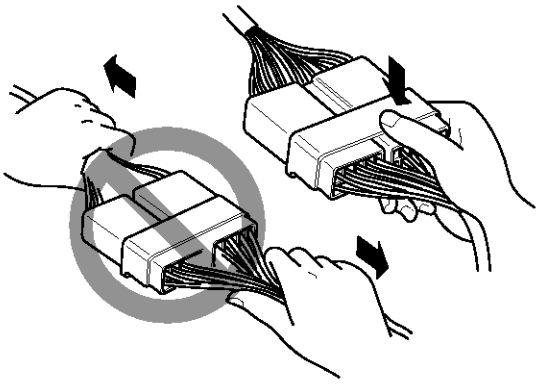
DO NOT sprinkle water directly into the engine compartment or electronic components.

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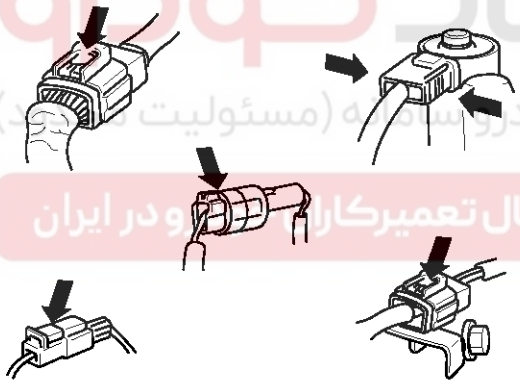
   b. When removing the connector with a lock, press or pull locking lever.



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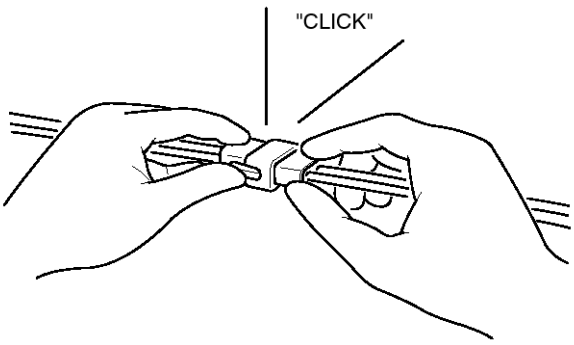
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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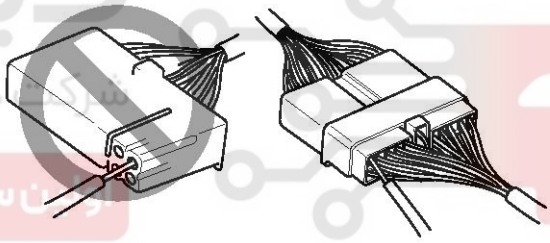
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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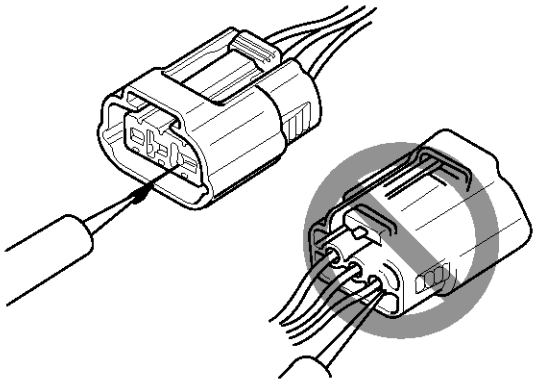
e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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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.*

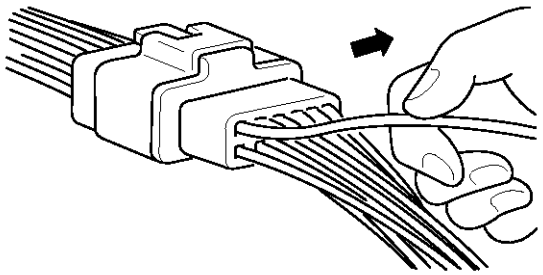
2. Checking Point for Connector

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.

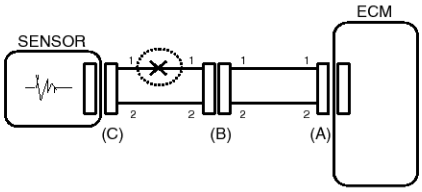
Electrical Circuit Inspection Procedure

● 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



BFGE501A

2. Continuity Check Method

NOTICE

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

Specification (Resistance)

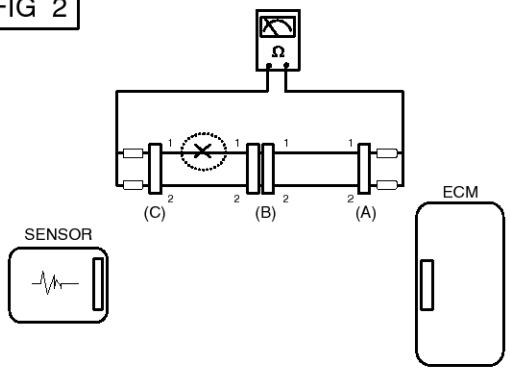
1Ω or less → Normal Circuit

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

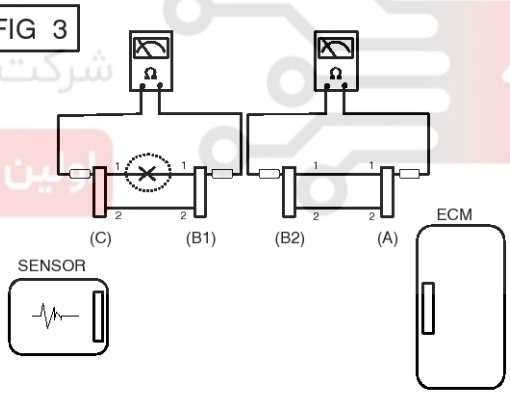


BFGE501B

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

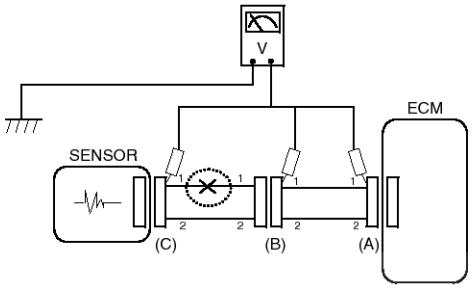


BFGE501C

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



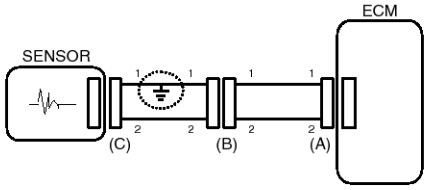
BFGE501D

● 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



BFGE501E

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.

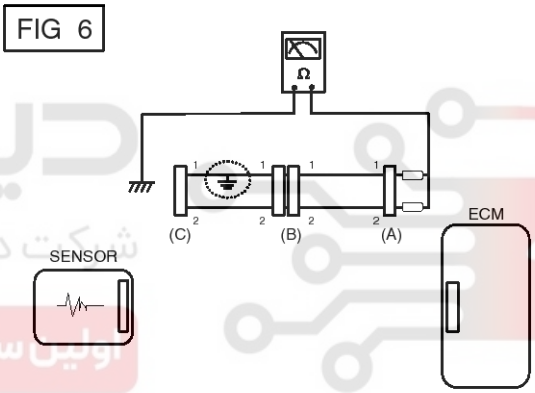
Specification (Resistance)

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

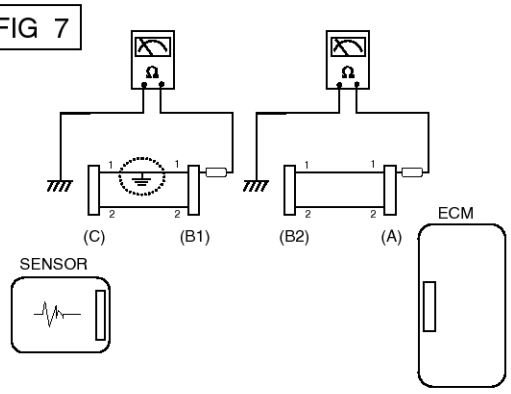


BFGE501F

   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



BFGE501G

● Testing For Voltage Drop

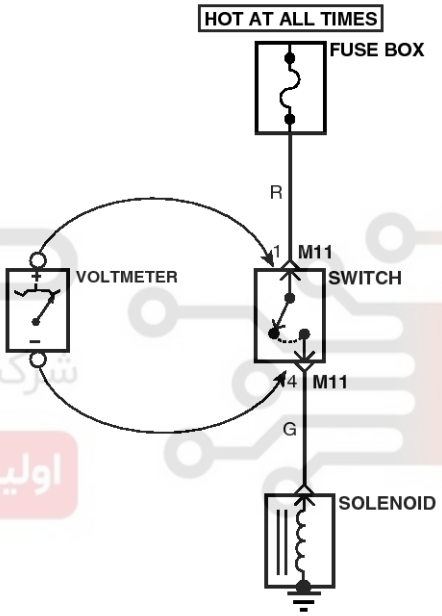
This test checks for voltage drop along a wire, or through a connection orswitch.

A. Connect the positive lead of a voltmeter to the end of the wire (or to the side of the connector or switch) closest to the battery.

B. Connect the negative lead to the other end of the wire. (or the other side of the connector or switch)

C. Operate the circuit.

D. The voltmeter will show the difference in voltage between the two points. A difference, or drop of more than 0.1 volts (50mV in 5V circuits), may indicate a problem. Check the circuit for loose or dirty connections.



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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 GDS.

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.

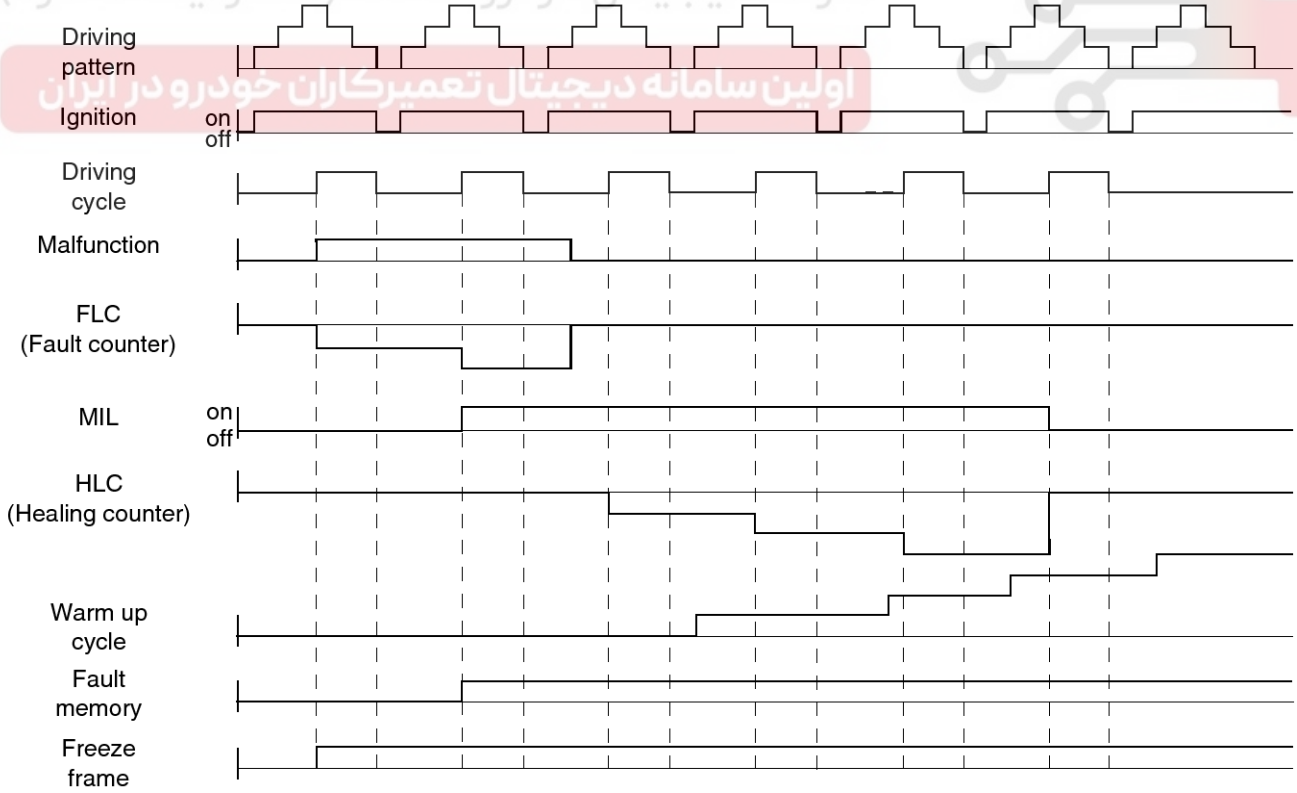
Self-Diagnosis

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 the GDS. 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 GDS.

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



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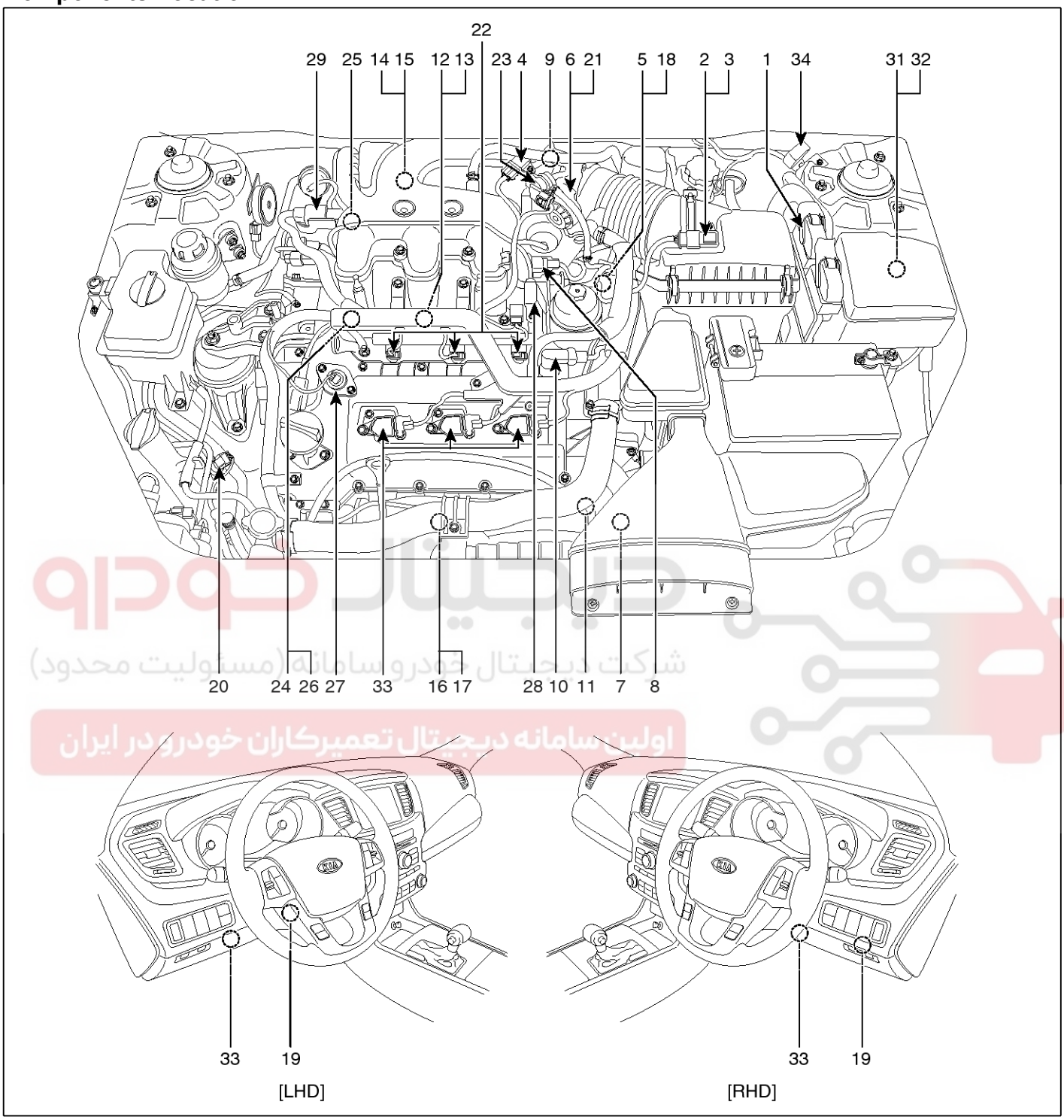
1. When the same malfunction is detected and maintained during two sequential driving cycles, the MIL will automatically illuminate.
2. The MIL will go off automatically if no fault is detected after 3 sequential driving cycles.
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction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

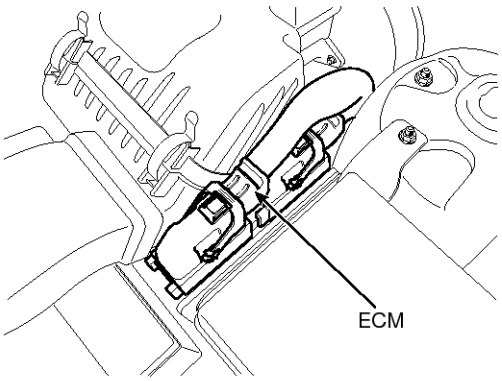
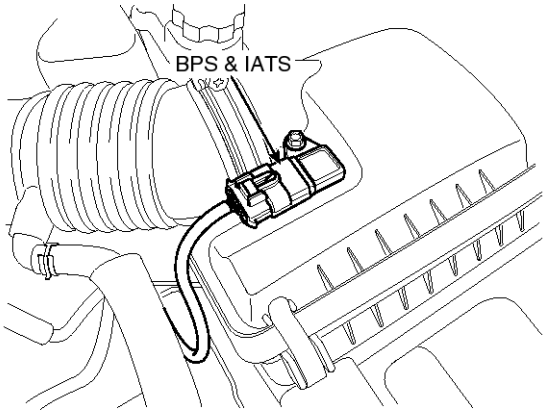
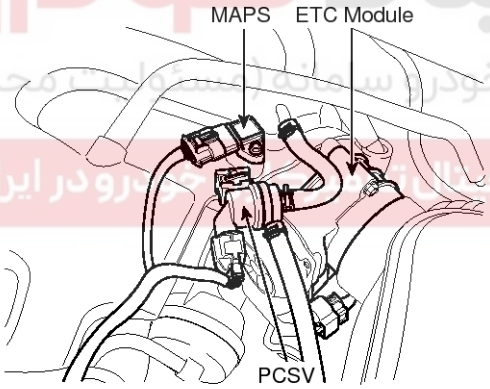
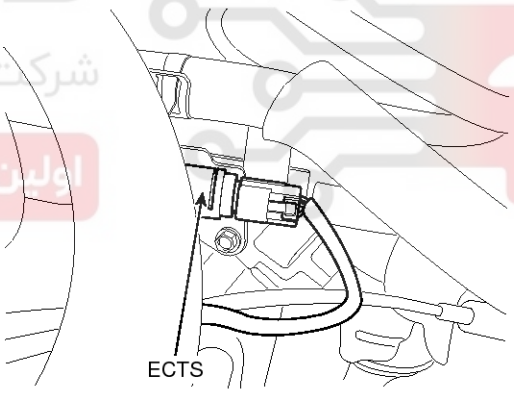
- *A "warm-up cycle" means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of 160 degress Fahrenheit.*
- *A "driving cycle" consists of engine startup, vehicle operation beyond the beginning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

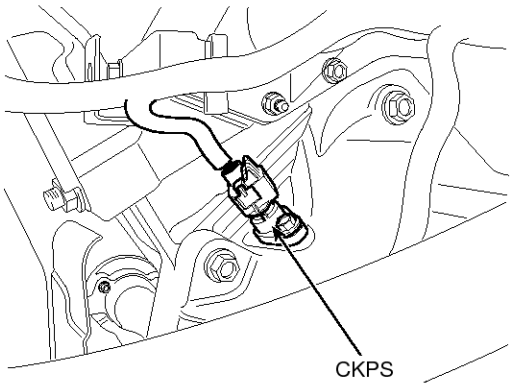
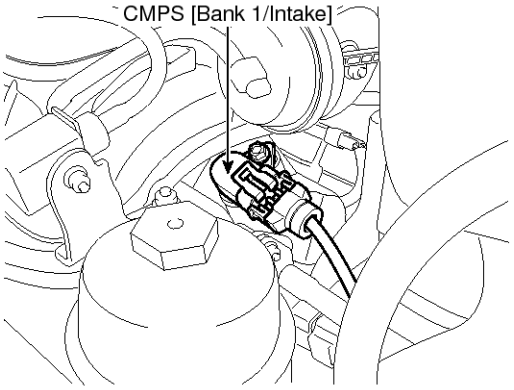
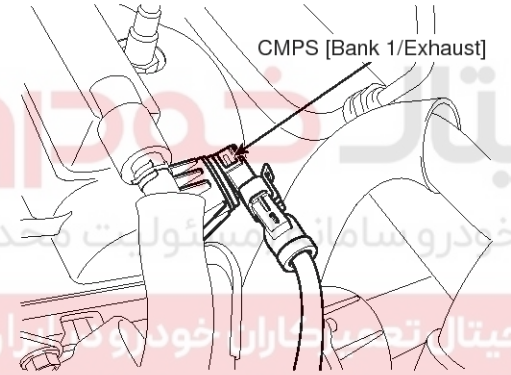
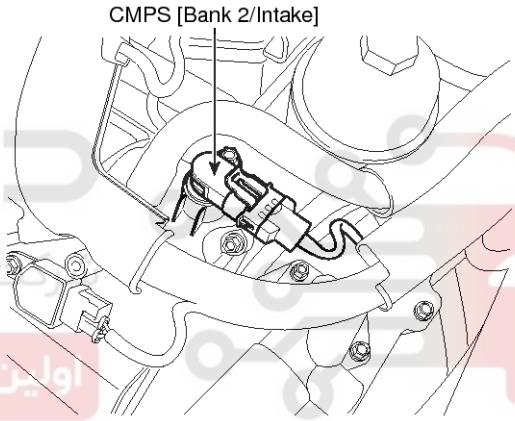
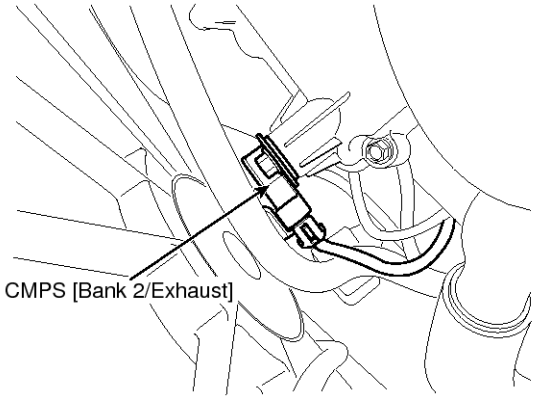
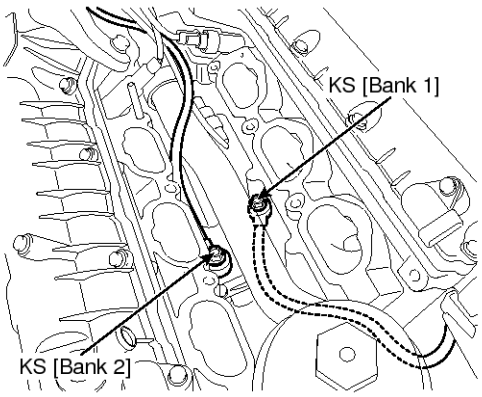
Components Location

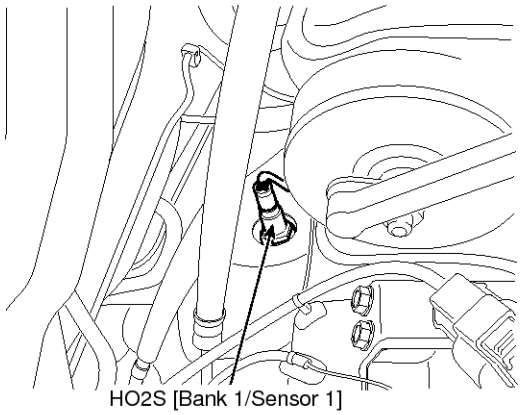
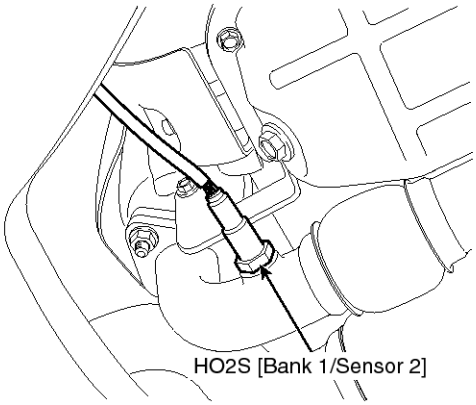
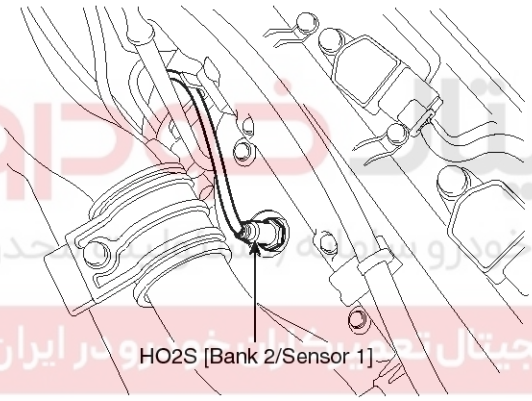
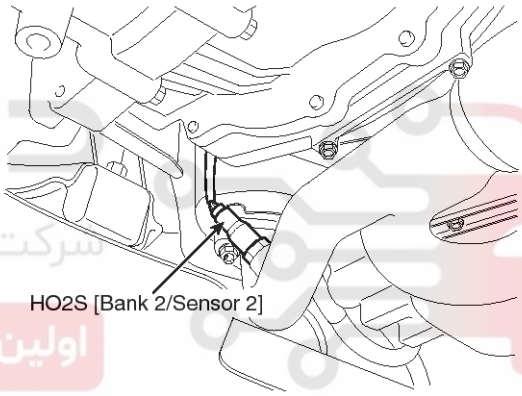
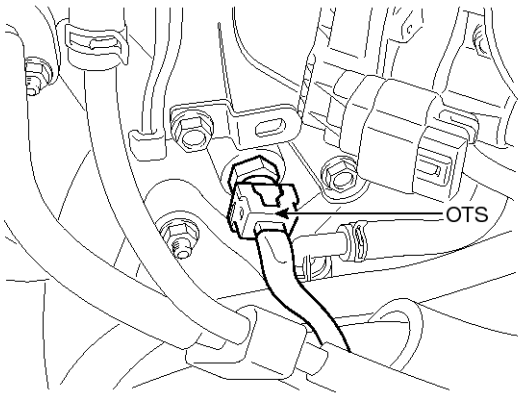
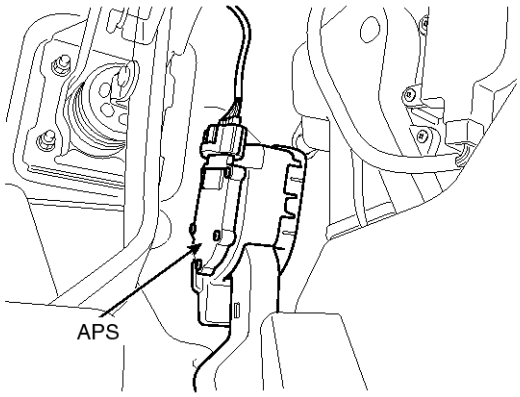


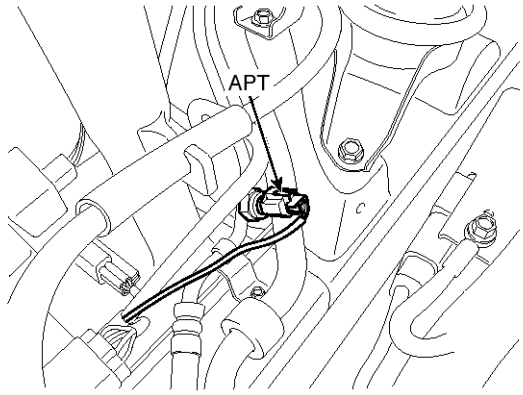
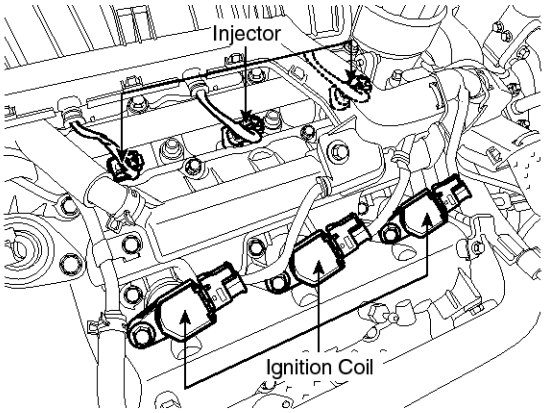
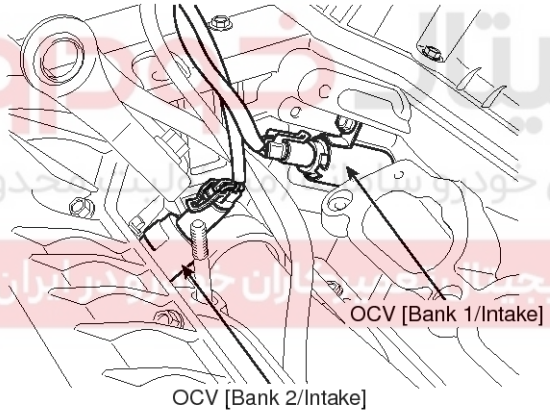
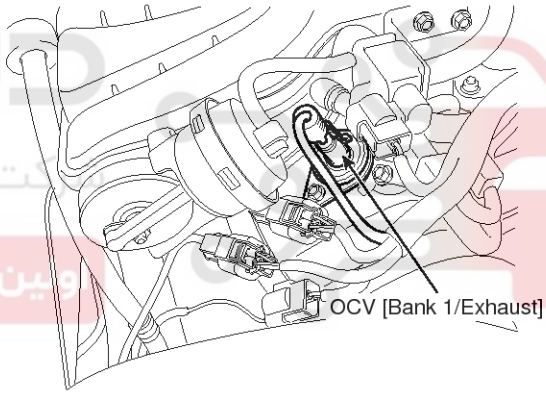
SVGFL0010L

1. ECM (Engine Control Module)
2. Barometric Pressure Sensor (BPS)
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 / Intake]
9. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]
10. Camshaft Position Sensor (CMPS) [Bank 2 / Intake]
11. Camshaft Position Sensor (CMPS) [Bank 2 / Exhaust]
12. Knock Sensor (KS) [Bank 1]
13. Knock Sensor (KS) [Bank 2]
14. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]
15. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]
16. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]
17. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]
18. CVVT Oil Temperature Sensor (OTS)
19. Accelerator Position Sensor (APS)
20. A/C Pressure Transducer (APT)
21. ETC Motor [integrated into ETC Module]
22. Injector
23. Purge Control Solenoid Valve (PCSV)
24. CVVT Oil Control Valve (OCV) [Bank 1 / Intake]
25. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]
26. CVVT Oil Control Valve (OCV) [Bank 2 / Intake]
27. CVVT Oil Control Valve (OCV) [Bank 2 / Exhaust]
28. Variable Intake Solenoid (VIS) Valve 1
29. Variable Intake Solenoid (VIS) Valve 2
30 Ignition Coil
31. Main Relay
32. Fuel Pump Relay
33. Data Link Connector (DLC) [16 Pin]
34. Multi-Purpose Check Connector [20 Pin]

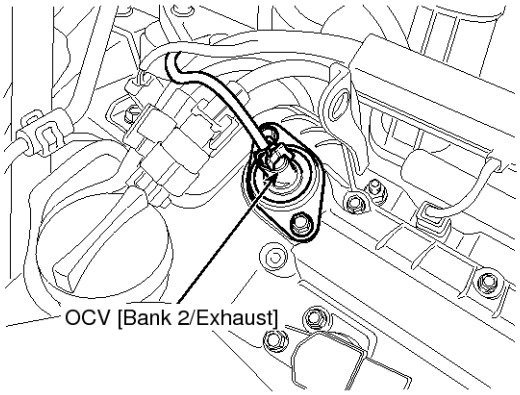
1. ECM (Engine Control Module)	2. Barometric Pressure Sensor (BPS) 3. Intake Air Temperature Sensor (IATS)
 SCMF20020L	 SVGF20110D
4. Manifold Absolute Pressure Sensor (MAPS) 6. Throttle Position Sensor (TPS) [integrated into ETC Module] 21. ETC Motor [integrated into ETC Module] 23. Purge Control Solenoid Valve (PCSV)	5. Engine Coolant Temperature Sensor (ECTS)
 SCMF20050L	 SCMF20060L

7. Crankshaft Position Sensor (CKPS)	8. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]
 SCMF20070L	 SCMF20080L
9. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]	**10. Camshaft Position Sensor (CMPS) [Bank 2 / Intake]**
 SCMF20090L	 SCMF20100L
11. Camshaft Position Sensor (CMPS) [Bank 2 / Exhaust]	**12. Knock Sensor (KS) [Bank 1]** **13. Knock Sensor (KS) [Bank 2]**
 SCMF20110L	 SCMF20120L

14. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]	15. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]
 SCMF20150L	 SVGFL0120L
16. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]	17. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]
 SVGFL0130L	 SVGFL0140L
18. CVVT Oil Temperature Sensor (OTS)	19. Accelerator Position Sensor (APS)
 SCMF20220L	 SLMFL0160D

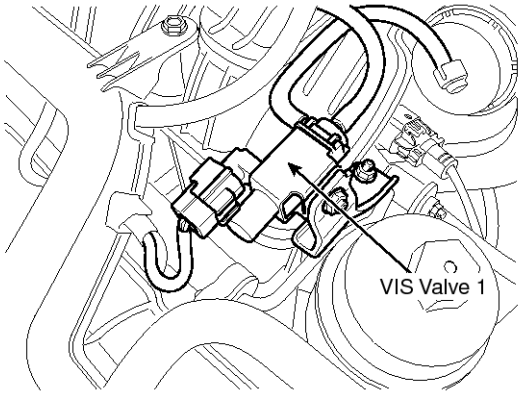
20. A/C Pressure Transducer (APT)	22. Injector 30. Ignition Coil
 SVGF20150D	 SBHFL9112L
24. CVVT Oil Control Valve (OCV) [Bank 1 / Intake] 26. CVVT Oil Control Valve (OCV) [Bank 2 / Intake]	25. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]
 SCMF20250L	 SCMF20190L

27. CVVT Oil Control Valve (OCV) [Bank 2 / Exhaust]



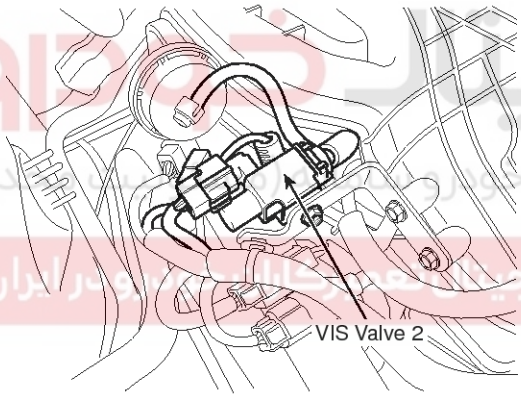
SCMF20260L

28. Variable Intake Solenoid (VIS) Valve 1



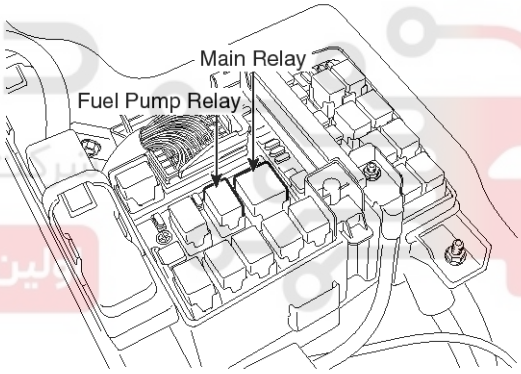
SCMF20270L

29. Variable Intake Solenoid (VIS) Valve 2



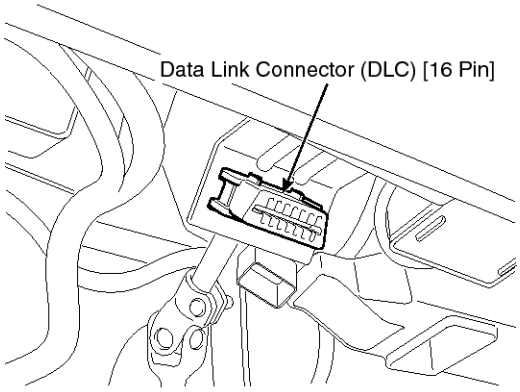
SCMF20280L

31. Main Relay
32. Fuel Pump Relay



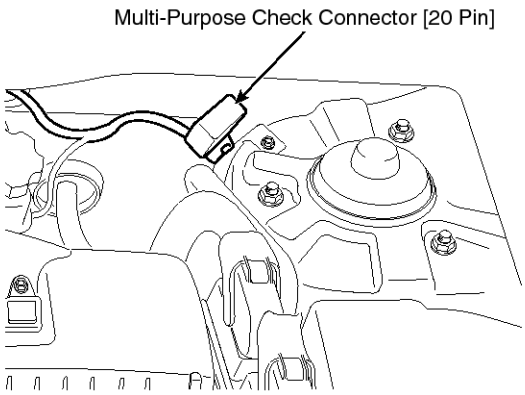
SVGFL0160L

33. Data Link Connector (DLC) [16 Pin]



SVGFL0170L

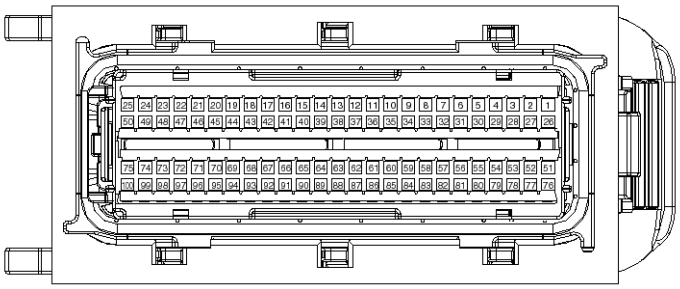
34. Multi-Purpose Check Connector [20 Pin]



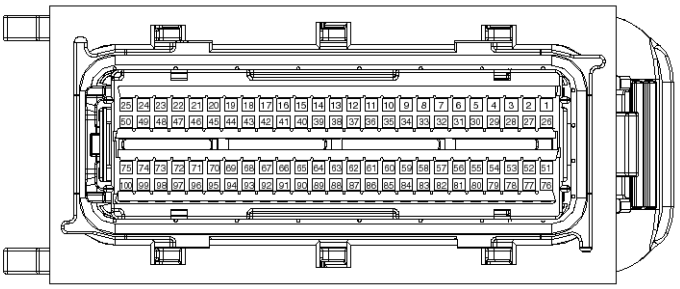
SVGFL0100L

Engine Control Module (ECM)

ECM Terminal And Input/Output signal



Connector [ELG-A]



Connector [CLG-B]

SVGFL0400L

ECM Terminal Function

Connector [ELG-A]

Pin No.	Description	Connected to
1	-	
2	-	
3	-	
4	Immobilizer Lamp control output	Immobilizer Lamp [Without Button Engine Start System]
5	Power ground	Chassis Ground
6	Power ground	Chassis Ground
7	-	
8	-	
9	2nd CAN [High]	Multi-Purpose Check Connector
10	CAN [High]	Other control module, Data Link Connector (DLC), Multi -Purpose Check Connector
11	-	
12	-	
13	-	
14	Sensor power (+5V)	Accelerator Position Sensor (APS) 1
15	Sensor power (+5V)	A/C Pressure Transducer (APT)
		Power Steering Pressure Sensor (PSPS)
16	-	
17	-	
18	-	
19	-	

Pin No.	Description	Connected to
20	-	
21	Brake Switch 2 signal input	Brake Switch
22	-	
23	-	
24	Alternator (FR)	Alternator
25	Malfunction Indicator Lamp (MIL) control output	Malfunction Indicator Lamp (MIL)
26	-	
27	Battery power (B+)	Ignition Switch
28	-	
29	-	
30	Power ground	Chassis Ground
31	-	
32	-	
33	-	
34	2nd CAN [Low]	Multi-Purpose Check Connector
35	CAN [Low]	Other control module, Data Link Connector (DLC), Multi -Purpose Check Connector
36	-	
37	Sensor ground	Power Steering Pressure Sensor (PSPS)
38	Accelerator Position Sensor (APS) 1 signal input	Accelerator Position Sensor (APS) 1
39	-	
40	-	
41	-	
42	-	
43	Brake Switch 1 signal input	Brake Switch
44	-	
45	-	
46	-	
47	-	
48	-	
49	-	
50	-	
51	-	
52	Battery power (B+)	Battery
53	-	

Pin No.	Description	Connected to
54	-	
55	Power ground	Chassis Ground
56	-	
57	Fuel Pump Relay control output	Fuel Pump Relay
58	-	
59	Sensor ground	Accelerator Position Sensor (APS) 2
60	Sensor ground	Accelerator Position Sensor (APS) 1
61	-	
62	Ground	Cruise Control Switch
63	Sensor ground	A/C Pressure Transducer (APT)
64	-	
65	-	
66	Cruise Control Switch signal input	Cruise Control Switch
67	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)
68	Accelerator Position Sensor (APS) 2 signal input	Accelerator Position Sensor (APS) 2
69	Power Steering Pressure Sensor (PSPS) signal input	Power Steering Pressure Sensor (PSPS)
70	Engine speed signal output	Power Distribution Module (PDM)
71	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
72	-	
73	-	
74	Immobilizer communication line	Smart Key Control Module [With Button Engine Start System] Immobilizer Control Unit [Without Button Engine Start System]
75	Battery power (B+)	Main Relay
76	-	
77	Battery power (B+)	Battery
78	-	
79	-	
80	Power ground	Chassis Ground
81	-	
82	-	
83	-	
84	-	
85	-	

Pin No.	Description	Connected to
86	-	
87	LIN (Local Interconnect Network) Serial Bus Line	Battery Sensor
88	-	
89	-	
90	Sensor power (+5V)	Accelerator Position Sensor (APS) 2
91	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
92	-	
93	Starter Relay control output	Starter Relay
94	Main Relay control output	Main Relay
95	-	
96	-	
97	-	
98	-	
99	Battery power (B+)	Main Relay
100	Battery power (B+)	Main Relay

Connector [CLG-B]

Pin No.	Description	Connected to
1	-	
2	-	
3	-	
4	-	
5	Sensor power (+5V)	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
		Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]
6	Sensor power (+5V)	Throttle Position Sensor (TPS)
7	Throttle Position Sensor PWM signal output	ABS Control Module, ESP Control Module
8	Crank request signal output	Power Distribution Module (PDM) [With Button Engine Start System]
		Ignition Switch [Without Button Engine Start System]
9	Barometric Pressure Sensor (BPS) signal input	Barometric Pressure Sensor (BPS)
10	CVVT Oil Temperature Sensor (OTS) signal input	CVVT Oil Temperature Sensor (OTS)
11	-	
12	Throttle Position Sensor (TPS) 1 signal input	Throttle Position Sensor (TPS) 1
13	Manifold Absolute Pressure Sensor (MAPS) signal input	Manifold Absolute Pressure Sensor (MAPS)
14	Intake Air Temperature Sensor (IATS) signal input	Intake Air Temperature Sensor (IATS)

Pin No.	Description	Connected to
15	Vehicle speed signal input	Power Distribution Module (PDM) [With Button Engine Start System]
		ABS/ESP Control Module [Without Button Engine Start System]
16	Knock Sensor (KS) [Bank 2] [High] signal input	Knock Sensor (KS) [Bank 2]
17	Knock Sensor (KS) [Bank 1] [High] signal input	Knock Sensor (KS) [Bank 1]
18	Crankshaft Position Sensor (CKPS) [High] signal input	Crankshaft Position Sensor (CKPS)
19	Sensor ground	CVVT Oil Temperature Sensor (OTS)
20	-	
21	Camshaft Position Sensor (CMPS) [Bank 2/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 2/Intake]
22	Electrical Load signal input	Wiper [Low] Relay
23	-	
24	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1)
25	-	
26	-	
27	-	
28	-	
29	-	
30	-	
31	Sensor ground	Throttle Position Sensor (TPS)
32	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
		Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]
33	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
34	Throttle Position Sensor (TPS) 2 signal input	Throttle Position Sensor (TPS) 2
35	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
36	-	
37	-	
38	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
39	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
40	Sensor Shield	Crankshaft Position Sensor (CKPS)
		Knock Sensor (KS) #1 [Bank 1]
		Knock Sensor (KS) #2 [Bank 2]
41	Knock Sensor (KS) [Bank 2] [Low] signal input	Knock Sensor (KS) [Bank 2]

Pin No.	Description	Connected to
42	Knock Sensor (KS) [Bank 1] [Low] signal input	Knock Sensor (KS) [Bank 1]
43	Crankshaft Position Sensor (CKPS) [Low] signal input	Crankshaft Position Sensor (CKPS)
44	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
		Camshaft Position Sensor (CMPS) [Bank 2/Intake]
45	-	
46	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]
47	-	
48	Sensor power (+5V)	Barometric Pressure Sensor (BPS)
		Manifold Absolute Pressure Sensor (MAPS)
49	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3)
50	-	
51	-	
52	-	
53	-	
54	-	
55	-	
56	Sensor ground	Barometric Pressure Sensor (BPS)
		Manifold Absolute Pressure Sensor (MAPS)
		Engine Coolant Temperature Sensor (ECTS)
57	-	
58	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
59	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
60	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
61	-	
62	-	
63	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
64	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
65	Variable Intake Solenoid (VIS) Valve 1 control output	Variable Intake Solenoid (VIS) Valve 1
66	Purge Control Solenoid Valve (PCSV) control output	Purge Control Solenoid Valve (PCSV)
67	-	
68	-	
69	Variable Intake Solenoid (VIS) Valve 2 control output	Variable Intake Solenoid (VIS) Valve 2

Pin No.	Description	Connected to
70	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
71	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
72	-	
73	Sensor Power (+5V)	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
		Camshaft Position Sensor (CMPS) [Bank 2/Intake]
74	Ignition Coil (Cylinder #5) control output	Ignition Coil (Cylinder #5)
75	-	
76	-	
77	-	
78	-	
79	-	
80	ETC Motor [+] control output	ETC Motor
81	ETC Motor [-] control output	ETC Motor
82	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
83	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
84	-	
85	Injector (Cylinder #2) control output	Injector (Cylinder #2)
86	Injector (Cylinder #5) control output	Injector (Cylinder #5)
87	Injector (Cylinder #3) control output	Injector (Cylinder #3)
88	Injector (Cylinder #6) control output	Injector (Cylinder #6)
89	Injector (Cylinder #4) control output	Injector (Cylinder #4)
90	Injector (Cylinder #1) control output	Injector (Cylinder #1)
91	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
92	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
93	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust]
94	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust]
95	CVVT Oil Control Valve (OCV) [Bank 2/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 2/Intake]

Pin No.	Description	Connected to
96	CVVT Oil Control Valve (OCV) [Bank 1/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 1/Intake]
97	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2)
98	Ignition Coil (Cylinder #6) control output	Ignition Coil (Cylinder #6)
99	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4)
100	-	

ECM Terminal Input/Output Signal

Connector [ELG-A]

Pin No.	Description	Condition	Type	Level
1	-			
2	-			
3	-			
4	Immobilizer Lamp control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		Max. 1.1V
5	Power ground	Idle	DC	Max. 0.1V
6	Power ground	Idle	DC	Max. 0.1V
7	-			
8	-			
9	2nd CAN [High]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		2.75 ~ 4.5V
10	CAN [High]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		2.75 ~ 4.5V
11	-			
12	-			
13	-			
14	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
15	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
16	-			
17	-			
18	-			
19	-			
20	-			
21	Brake Switch 2 signal input	Brake OFF	DC	Battery Voltage
		Brake ON		Max. 0.5V
22	-			
23	-			
24	Alternator (FR)	Idle	PWM	High: Battery Voltage
				Low: Max. 2.0V
				133<Frequency<200Hz
				5<Duty<95%

Pin No.	Description	Condition	Type	Level
25	Malfunction Indicator Lamp (MIL) control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		Max. 0.5V
26	-			
27	Battery power (B+)	IG OFF	DC	Battery Voltage
		IG ON		Max. 1.0V
28	-			
29	-			
30	Power ground	Idle	DC	Max. 0.1V
31	-			
32	-			
33	-			
34	2nd CAN [Low]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		0.5 ~ 2.25V
35	CAN [Low]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		0.5 ~ 2.25V
36	-			
37	Sensor ground	Idle	DC	Max. 0.1V
38	Accelerator Position Sensor (APS) 1 signal input	C.T	Analog	0.7 ~ 0.8V
		W.O.T		3.85 ~ 4.35V
39	-			
40	-			
41	-			
42	-			
43	Brake Switch 1 signal input	Brake OFF	DC	Max. 0.5V
		Brake ON		Battery Voltage
44	-			
45	-			
46	-			
47	-			
48	-			
49	-			
50	-			
51	-			
52	Battery power (B+)	Always (Without Ignition key)	DC	Battery Voltage

Pin No.	Description	Condition	Type	Level
53	-			
54	-			
55	Power ground	Idle	DC	Max. 0.1V
56	-			
57	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max 1.1V
58	-			
59	Sensor ground	Idle	DC	Max. 0.1V
60	Sensor ground	Idle	DC	Max. 0.1V
61	-			
62	Ground	Idle	DC	Max. 0.1V
63	Sensor ground	Idle	DC	Max. 0.1V
64	-			
65	-			
66	Cruise Control Switch signal input	“MAIN”	Analog	11.1 ~ 12.1V
		“SET”		1.0 ~ 1.8V
		“CANCEL”		-0.5 ~ 0.5V
		“RESUME”		2.5 ~ 3.5V
67	A/C Pressure Transducer (APT) signal input	A/C ON	Analog	0.5 ~ 4.5V
68	Accelerator Position Sensor (APS) 2 signal input	C.T	Analog	0.29 ~ 0.46V
		W.O.T		1.93 ~ 2.18V
69	Power Steering Pressure Sensor (PSPS) signal input	Handling	Analog	0.3 ~ 4.53V
70	Engine speed signal output	Engine Running	Pulse	High: Battery Voltage
				Low: Max. 1.1V
				0<Frequency<350Hz
				47.5<Duty<52.5%
71	Cooling Fan Relay [High] control output	A/C ON	Pulse	High: Battery Voltage
				Low: Max. 1.1V
72	-			
73	-			
74	Immobilizer communication line	Transmitting	DC	High: Min. Vbatt X 80%
				Low: Max. Vbatt X 20%
		Receiving		High: Min. Vbatt X 70%
				Low: Max. Vbatt X 30%

Pin No.	Description	Condition	Type	Level
75	Battery power (B+)	IG OFF	DC	Battery Voltage
		IG ON		Max. 1.0V
76	-			
77	Battery power (B+)	Always (Without Ignition key)	DC	Battery Voltage
78	-			
79	-			
80	Power ground	Idle	DC	Max. 0.1V
81	-			
82	-			
83	-			
84	-			
85	-			
86	-			
87	LIN (Local Interconnect Network) Serial Bus Line	Transmitting	DC	High: Min. Vbatt X 80%
				Low: Max. Vbatt X 20%
		Receiving		High: Min. Vbatt X 70%
				Low: Max. Vbatt X 30%
88	-			
89	-			
90	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
91	Cooling Fan Relay [Low] control output	A/C ON	Pulse	High: Battery Voltage
				Low: Max. 1.1V
92	-			
93	Starter Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max 1.1V
94	Main Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max 1.7V
95	-			
96	-			
97	-			
98	-			
99	Battery power (B+)	IG OFF	DC	Battery Voltage
		IG ON		Max. 1.0V

Pin No.	Description	Condition	Type	Level
100	Battery power (B+)	IG OFF	DC	Battery Voltage
		IG ON		Max. 1.0V

Connector [CLG-B]

Pin No.	Description	Condition	Type	Level
1	-			
2	-			
3	-			
4	-			
5	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
6	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
7	Throttle Position Sensor PWM signal output			
8	Crank request signal output	S/W OFF	DC	Max. 1.0V
		S/W ON		Battery Voltage
9	Barometric Pressure Sensor (BPS) signal input	IG ON	Analog	Approx. 4.0V
10	CVVT Oil Temperature Sensor (OTS) signal input	IG ON	Analog	3.2V at -40℃(-40˚F)
				0.1V at 150℃(302˚F)
11	-			
12	Throttle Position Sensor (TPS) 1 signal input	C.T	Analog	0.25 ~ 0.9V
		W.O.T		Min. 4.0V
13	Manifold Absolute Pressure Sensor (MAPS) signal input	IG ON	Analog	Approx. 4.44V
		Idle		Approx. 0.75V
14	Intake Air Temperature Sensor (IATS) signal input	IG ON	Analog	3.2V at -40℃(-40˚F)
				0.05V at 125℃(257˚F)
15	Vehicle speed signal input	Vehicle Running	Pulse	High: Battery Voltage
				Low: Max. 0.5V
				0.7(1kph)<Frequency<200Hz (240kph)
				44<Duty<56%
16	Knock Sensor (KS) [Bank 2] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3V
		Normal		0V
17	Knock Sensor (KS) [Bank 1] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3V
		Normal		0V

Pin No.	Description	Condition	Type	Level
18	Crankshaft Position Sensor (CKPS) [High] signal input	Idle	SINE Wave	0.4<Vp_p<200V 55<Frequency<7,000Hz
19	Sensor ground	Idle	DC	Max. 0.1V
20	-			
21	Camshaft Position Sensor (CMPS) [Bank 2/Intake] signal input	Idle	Pulse	High: 3.2 ~ Vcc Low: Max. 0.7V 0<Frequency< 350Hz
22	Electrical Load signal input			
23	-			
24	Ignition Coil (Cylinder #1) control output	Engine Running	Pulse	Vpeak = 400V 0<Frequency< 58.3Hz
25	-			
26	-			
27	-			
28	-			
29	-			
30	-			
31	Sensor ground	Idle	DC	Max. 0.1V
32	Sensor ground	Idle	DC	Max. 0.1V
33	Sensor ground	Idle	DC	Max. 0.1V
34	Throttle Position Sensor (TPS) 2 signal input	C.T	Analog	Min. 4.0V
		W.O.T		0.25 ~ 0.9V
35	Engine Coolant Temperature Sensor (ECTS) signal input	IG ON	Analog	3.22V at -40℃(-40˚F) 0.29V at 125℃(257˚F)
36	-			
37	-			
38	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] signal input	RICH	Analog	Min. 0.8V
		LEAN		Max. 0.1V
39	Sensor ground	Idle	DC	Max. 0.1V
40	Sensor Shield	Idle	DC	Max. 0.1V
41	Knock Sensor (KS) [Bank 2] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3V
		Normal		0V
42	Knock Sensor (KS) [Bank 1] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3V
		Normal		0V

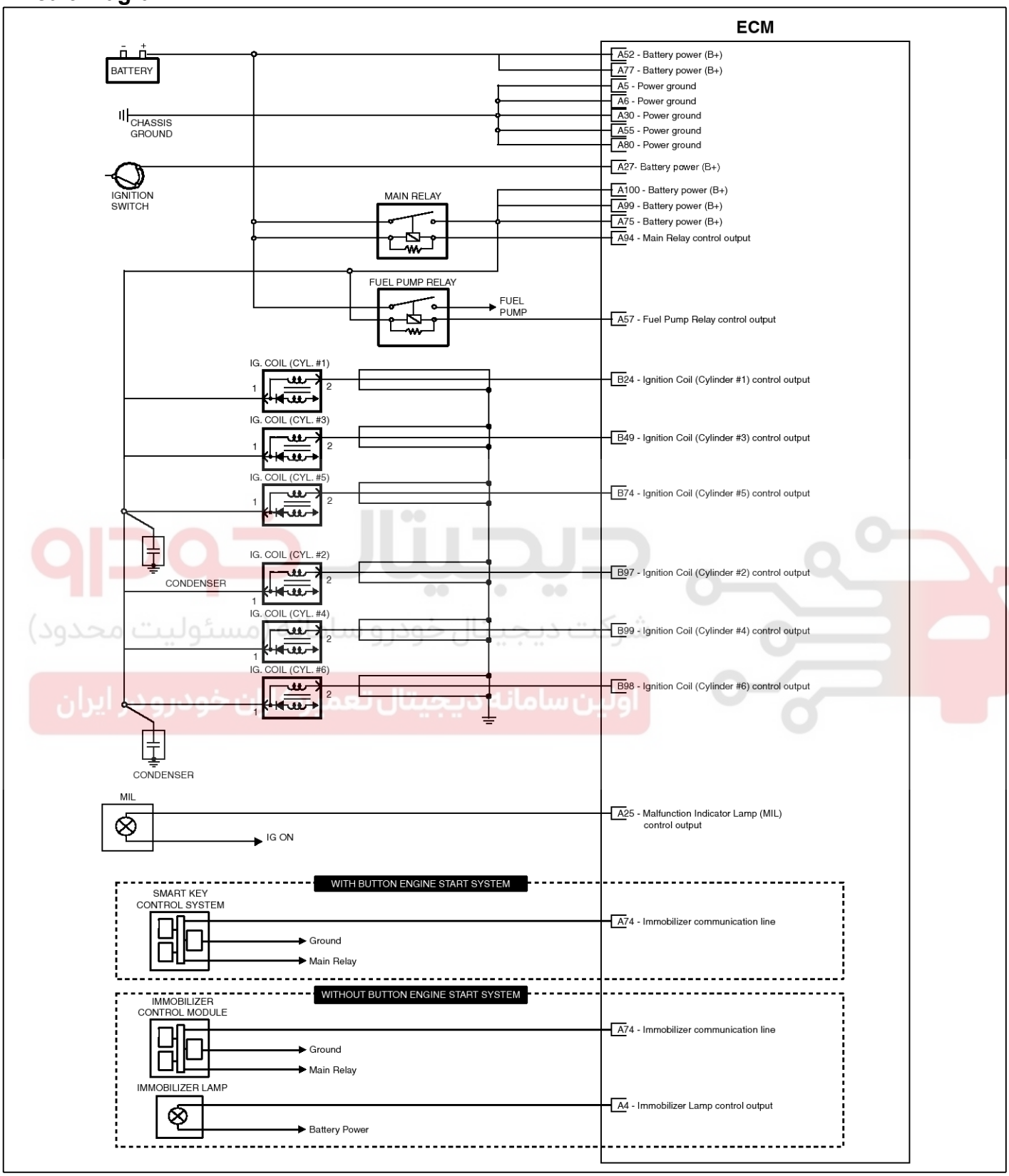
Pin No.	Description	Condition	Type	Level
43	Crankshaft Position Sensor (CKPS) [Low] signal input	Idle	SINE Wave	0.4<Vp_p<200V 55<Frequency<7,000Hz
44	Sensor ground	Idle	DC	Max. 0.1V
45	-			
46	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust] signal input	Idle	Pulse	High: 3.2 ~ Vcc Low: Max. 0.7V 0<Frequency< 350Hz
47	-			
48	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
49	Ignition Coil (Cylinder #3) control output	Engine Running	Pulse	Vpeak = 400V 0<Frequency< 58.3Hz
50	-			
51	-			
52	-			
53	-			
54	-			
55	-			
56	Sensor ground	Idle	DC	Max. 0.1V
57	-			
58	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] signal input	RICH	Analog	Min. 0.8V
		LEAN		Max. 0.1V
59	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	RICH	Analog	Min. 0.8V
		LEAN		Max. 0.1V
60	Sensor ground	Idle	DC	Max. 0.1V
61	-			
62	-			
63	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] signal input	RICH	Analog	Min. 0.8V
		LEAN		Max. 0.1V
64	Sensor ground	Idle	DC	Max. 0.1V
65	Variable Intake Solenoid (VIS) Valve 1 control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.1V
66	Purge Control Solenoid Valve (PCSV) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V

Pin No.	Description	Condition	Type	Level
67	-			
68	-			
69	Variable Intake Solenoid (VIS) Valve 2 control output	Engine Running	PWM	High: Battery Voltage
				Low: Max. 1.1V
70	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Idle	Pulse	High: 3.2 ~ Vcc
				Low: Max. 0.7V
				0<Frequency< 350Hz
71	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Idle	Pulse	High: 3.2 ~ Vcc
				Low: Max. 0.7V
				0<Frequency< 350Hz
72	-			
73	Sensor Power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
74	Ignition Coil (Cylinder #5) control output	Engine Running	Pulse	Vpeak = 400V
				0<Frequency< 58.3Hz
75	-			
76	-			
77	-			
78	-			
79	-			
80	ETC Motor [+] control output	Engine Running	PWM	High: Battery Voltage
				Low: Max.1.0V
				1,500<Frequency<2,400Hz
				0<Duty< 98%
81	ETC Motor [-] control output	Engine Running	PWM	High: Battery Voltage
				Low: Max.1.0V
				1,500<Frequency<2,400Hz
				0<Duty< 98%
82	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Engine Running	PWM	High: Battery Voltage
				Low: Max. 1.15V
				0<Duty<100%

Pin No.	Description	Condition	Type	Level
83	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] Heater control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.15V 0<Duty<100%
84	-			
85	Injector (Cylinder #2) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<Frequency< 58.3Hz 47<Vpeak<64V
86	Injector (Cylinder #5) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<Frequency< 58.3Hz 47<Vpeak<64V
87	Injector (Cylinder #3) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<Frequency< 58.3Hz 47<Vpeak<64V
88	Injector (Cylinder #6) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<Frequency< 58.3Hz 47<Vpeak<64V
89	Injector (Cylinder #4) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<Frequency< 58.3Hz 47<Vpeak<64V
90	Injector (Cylinder #1) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<Frequency< 58.3Hz 47<Vpeak<64V
91	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.15V 0<Duty<100%
92	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] Heater control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.15V 0<Duty<100%

Pin No.	Description	Condition	Type	Level
93	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust] control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V Frequency = 128Hz 0<Duty<100%
94	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust] control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V Frequency = 128Hz 0<Duty<100%
95	CVVT Oil Control Valve (OCV) [Bank 2/Intake] control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V Frequency = 128Hz 0<Duty<100%
96	CVVT Oil Control Valve (OCV) [Bank 1/Intake] control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V Frequency = 128Hz 0<Duty<100%
97	Ignition Coil (Cylinder #2) control output	Engine Running	Pulse	Vpeak = 400V 0<Frequency< 58.3Hz
98	Ignition Coil (Cylinder #6) control output	Engine Running	Pulse	Vpeak = 400V 0<Frequency< 58.3Hz
99	Ignition Coil (Cylinder #4) control output	Engine Running	Pulse	Vpeak = 400V 0<Frequency< 58.3Hz
100	-			

Circuit Diagram



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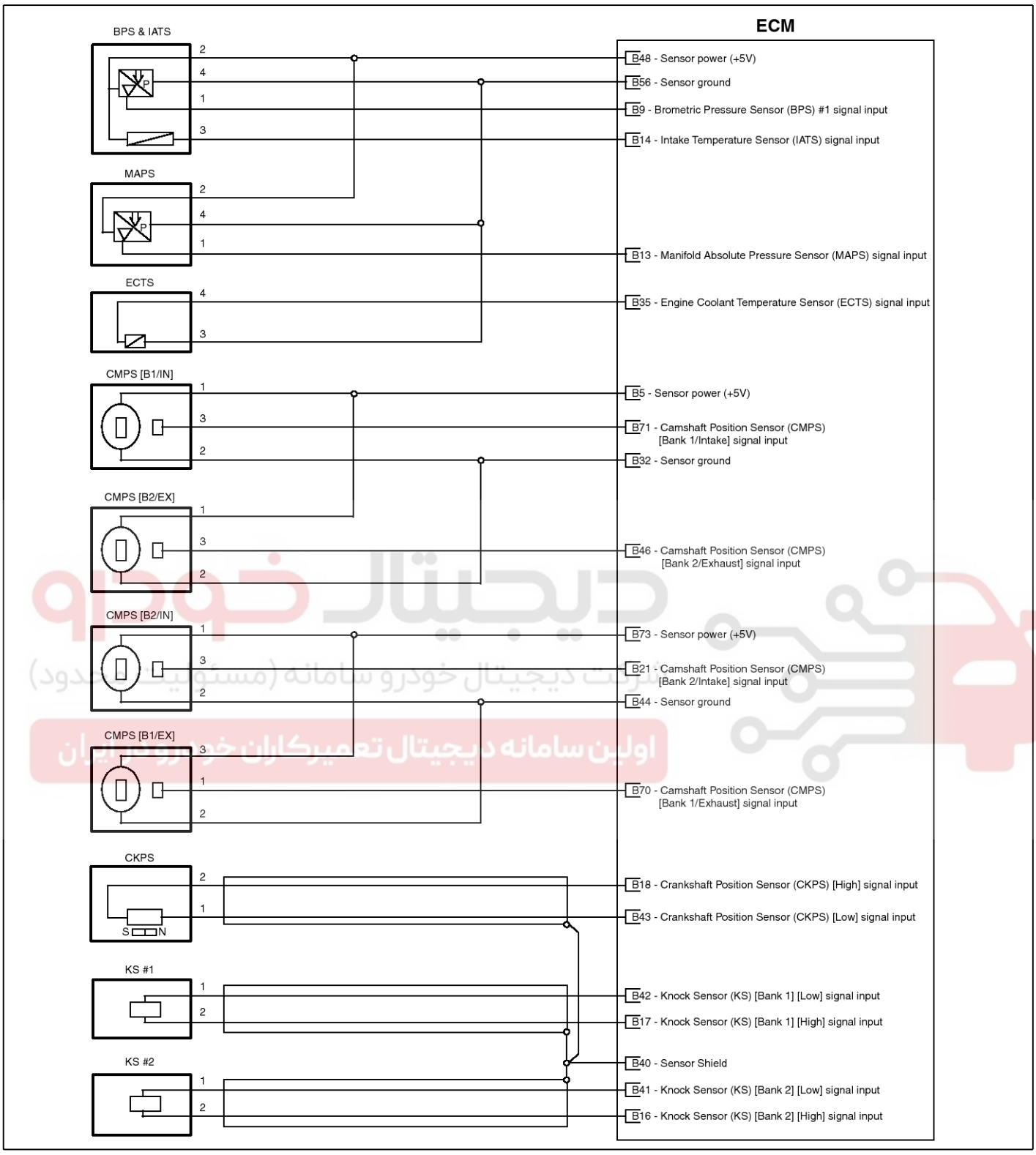
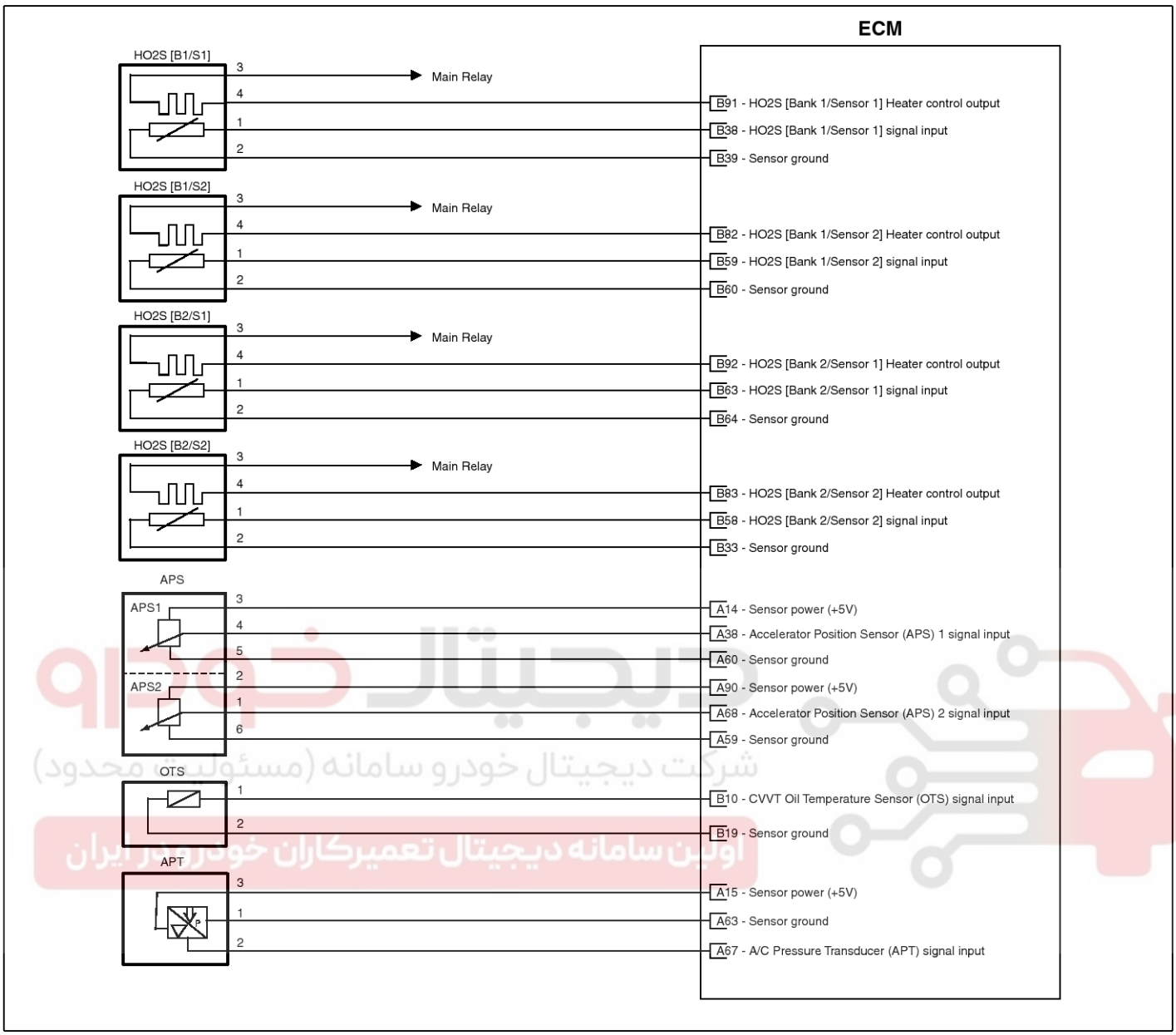


SCMF20401L



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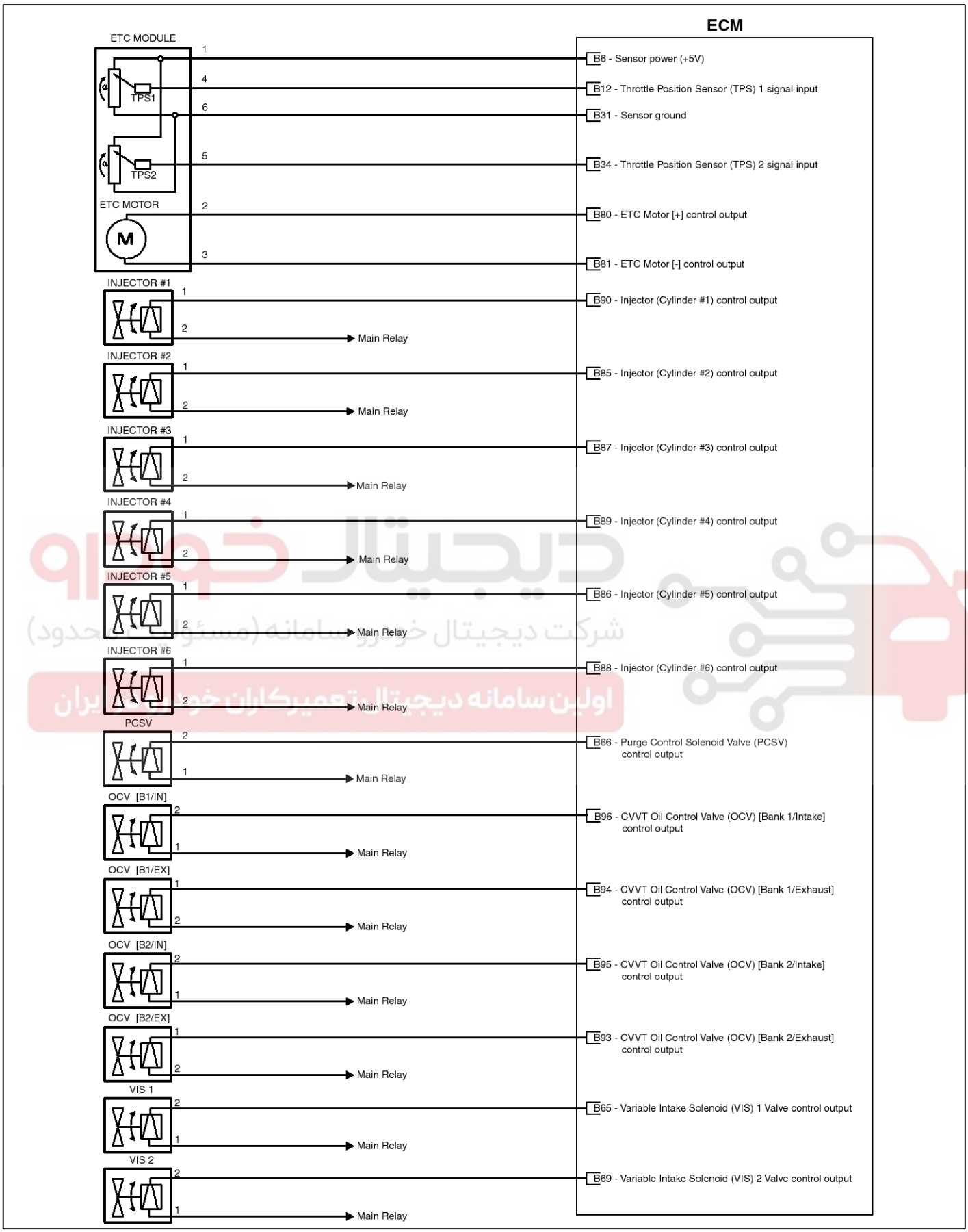

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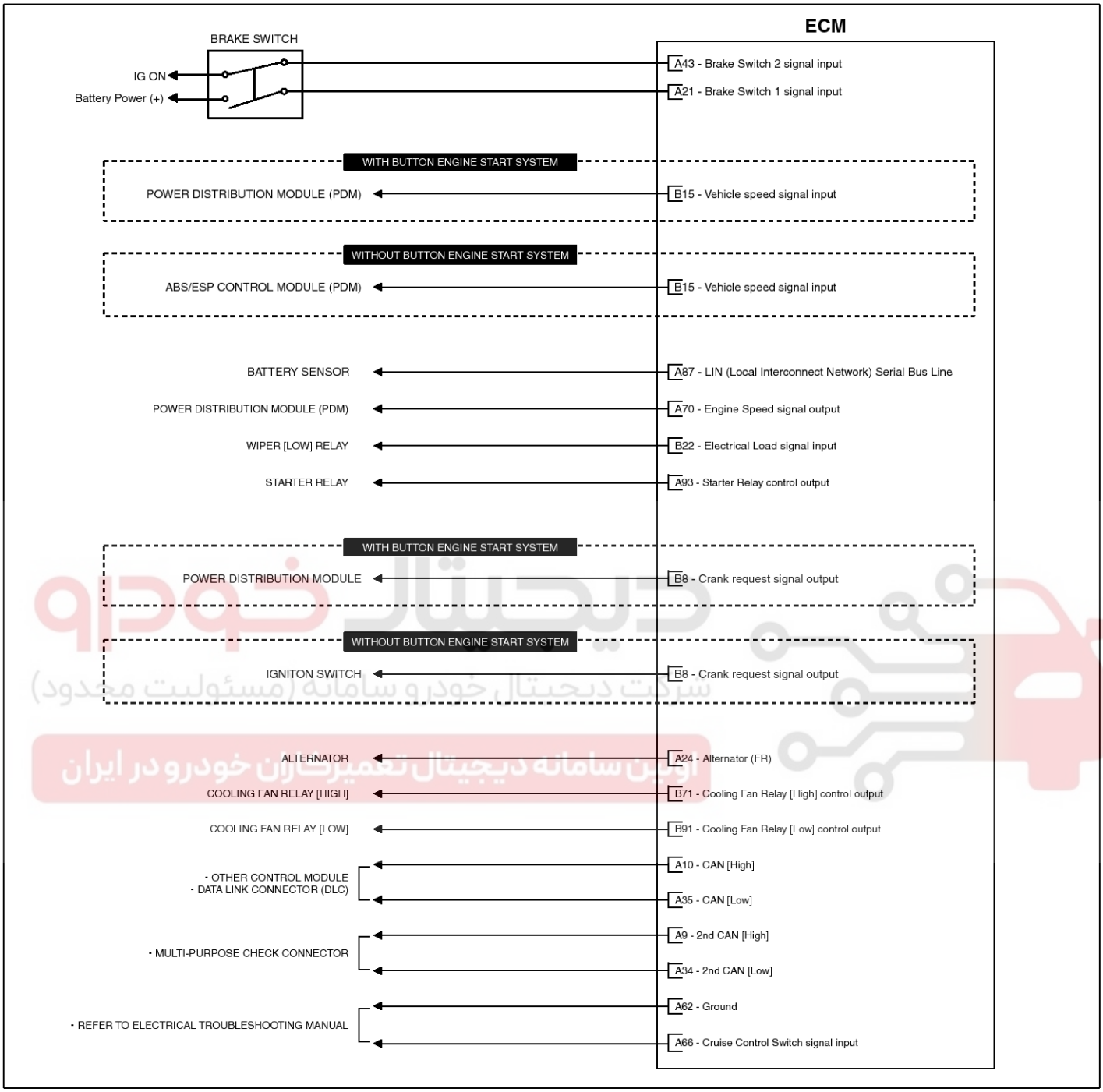


SVGFL0404L

Removal

NOTICE

When replacing the ECM, the vehicle equipped with immobilizer(Button engine start) must be performed the procedure as below.

[In the case of installing used ECM]

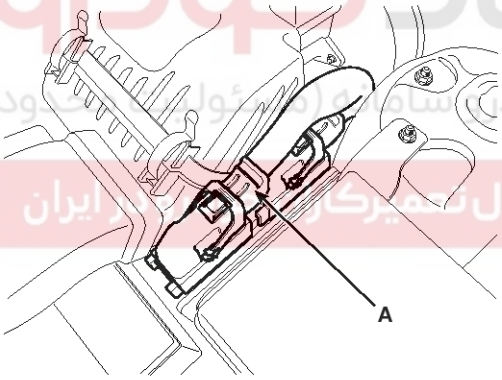
1) Perform "Neutral mode" procedure with GDS. (Refer to "Immobilizer system" or "Button engine start system" in BE group)

2) Insert the key and turn it to the IGN ON and OFF position. Then the ECM key register process is completed automatically.

[In the case of installing new ECM]

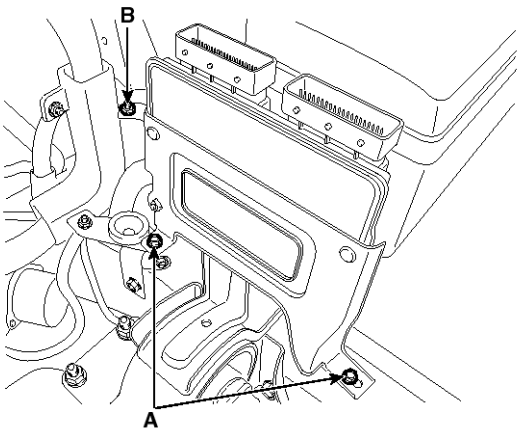
1) Insert the key and turn it to the IGN ON and OFF position. Then the ECM key register process is completed automatically.

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the ECM connector (A).



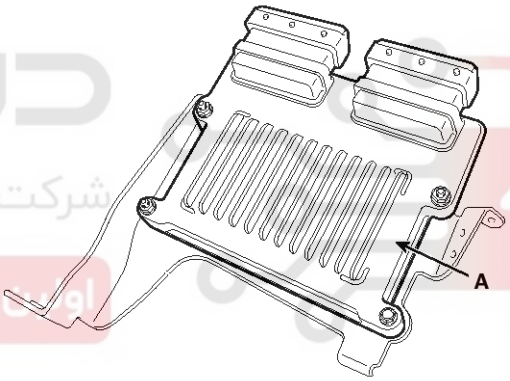
SCMF20021L

3. Remove the air cleaner assembly (Refer to "Intake And Exhaust System" in EM group).
4. Remove the ECM bracket installation bolts (A), and a nut (B).



SVGF20180D

5. Remove the ECM (A) from the bracket after installation bolt/nuts.



SVGF20190D

Installation

NOTICE

When replacing the ECM, the vehicle equipped with immobilizer(Button engine start) must be performed the procedure as below.

[In the case of installing used ECM]

1) Perform "Neutral mode" procedure with GDS. (Refer to "Immobilizer system" or "Button engine start system" in BE group)

2) Insert the key and turn it to the IGN ON and OFF position. Then the ECM key register process is completed automatically.

[In the case of installing new ECM]

1) Insert the key and turn it to the IGN ON and OFF position. Then the ECM key register process is completed automatically.

1. Installation is reverse of removal.

ECM installation bolt/nut:
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)
ECM bracket installation bolt/nut:
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

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.

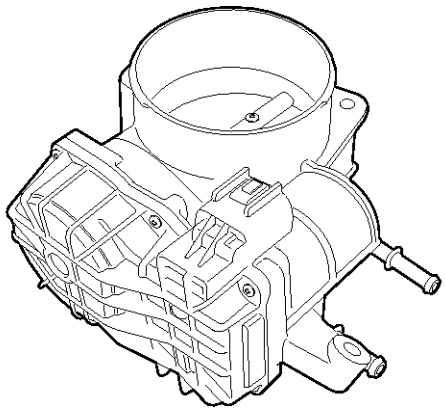
Specification: Below 1Ω

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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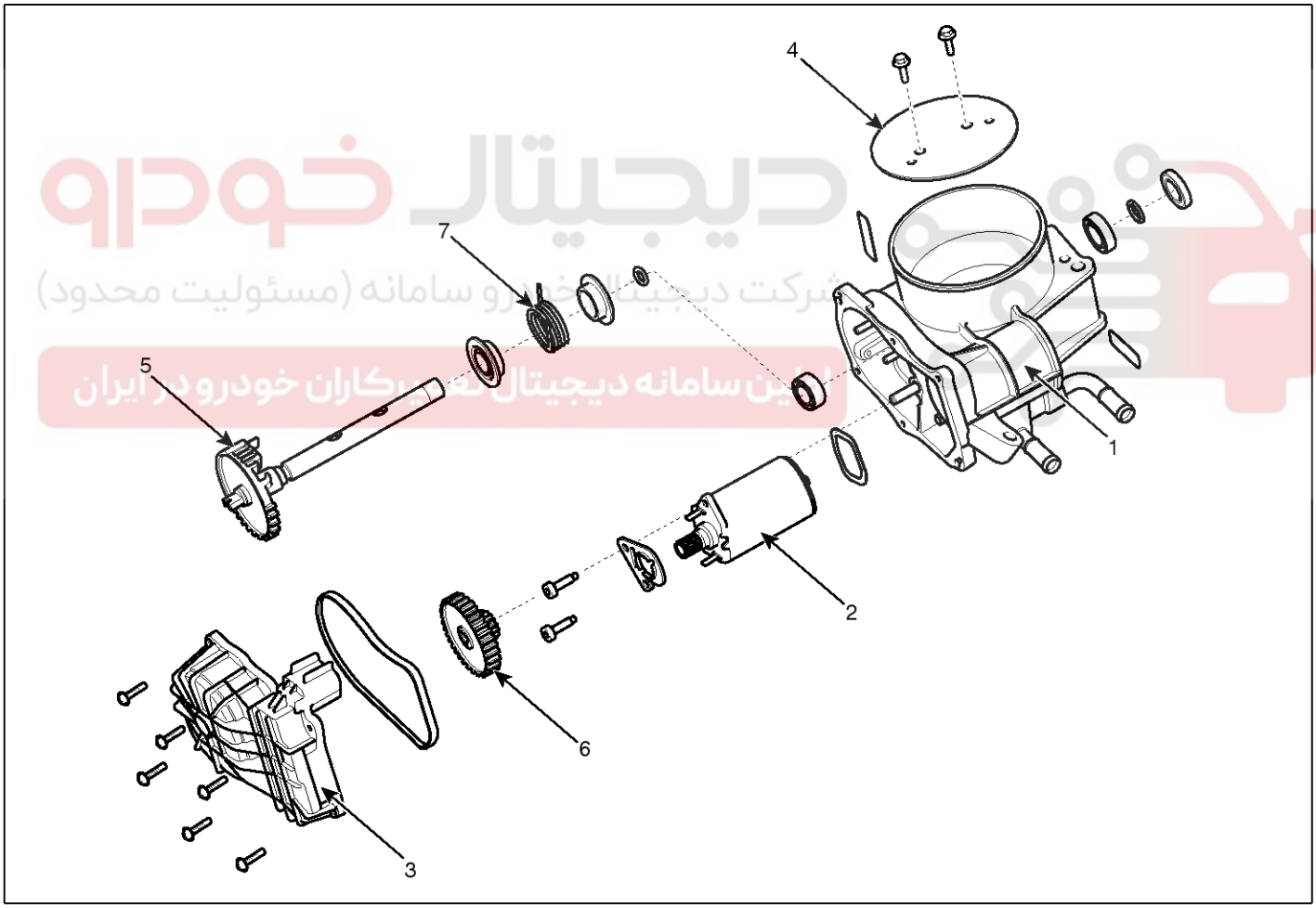
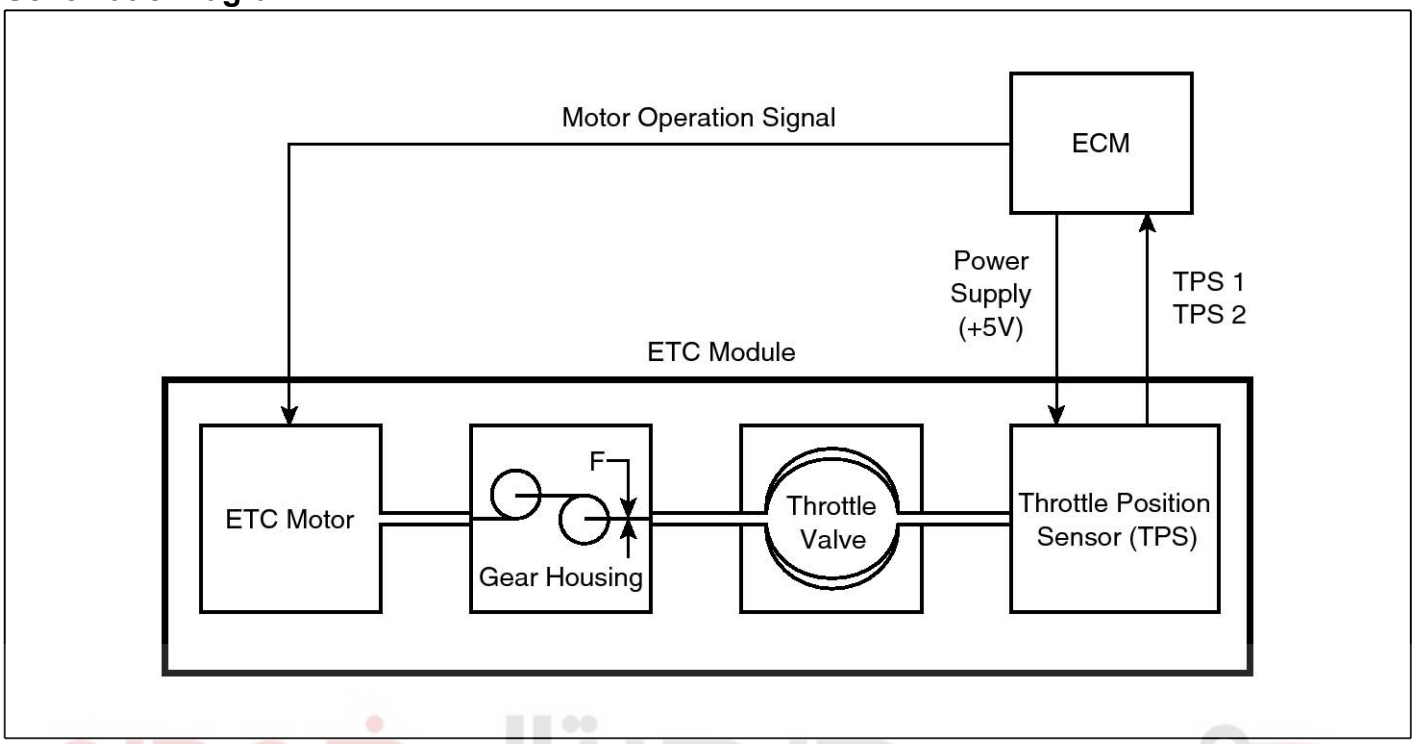


SCMF20300L

1. ETC Module Body
2. ETC Motor
3. Throttle Position Sensor (TPS)
4. Throttle Valve
5. Gear
6. Idle Gear
7. Return Spring

Schematic Diagram



EGRF234A

Fail-Safe Mode

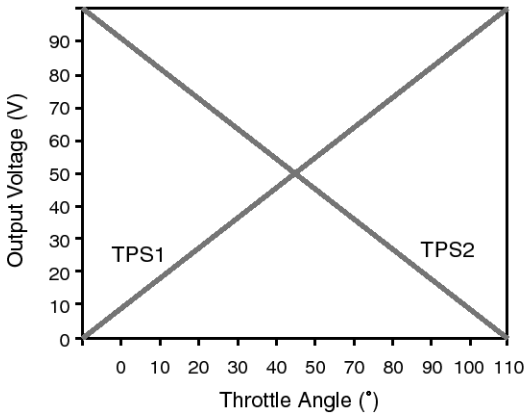
Mode	Symptom	Possible Cause
[Mode 1] Forced Engine Shutdown	• Engine stop	• ETC system can't proceed reliable algorithm procedure - Fatal ECM internal programming error - Faulty intake system or throttle body
[Mode 2] Forced Idle & power Management	• Forced idle state controlled by fuel quantity regulation 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

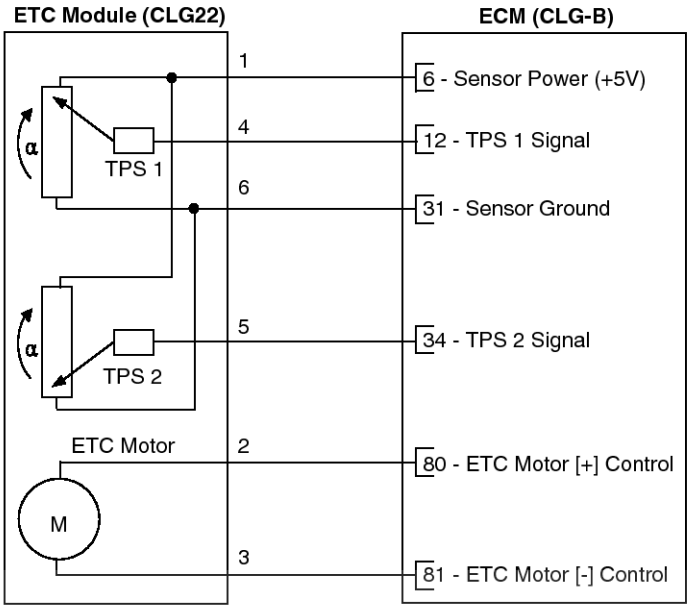
Item	Sensor Resistance(kΩ)
TPS1	1.6 ~ 2.4 [20℃(68°F)]
TPS2	1.6 ~ 2.4 [20℃(68°F)]

[ETC Motor]

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

Circuit Diagram

[Circuit Diagram]

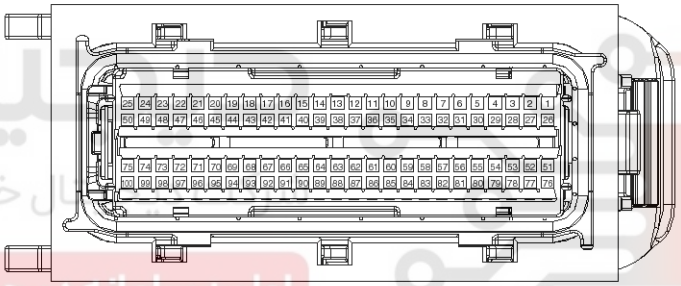


[Connection Information]

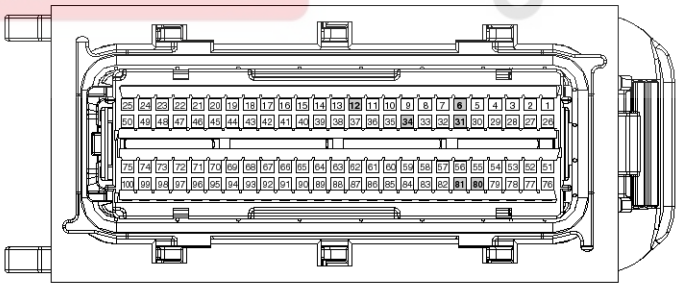
Terminal	Connected to	Function
1	ECM CLG-B (6)	Sensor Power (+5V)
2	ECM CLG-B (80)	ETC Motor [+] Control
3	ECM CLG-B (81)	ETC Motor [-] Control
4	ECM CLG-B (12)	TPS 1 Signal
5	ECM CLG-B (34)	TPS 2 Signal
6	ECM CLG-B (31)	Sensor Ground

[Harness Connector]

CLG22
ETC Module



ELG-A



CLG-B
ECM

SVGFL0405L

Inspection

Throttle Position Sensor (TPS)

1. Connect GDS 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 GDS from the DLC.
4. Disconnect the ETC module connector and measure the resistance between the ETC module terminals 1 and 6.

Specification: Refer to “Specification”

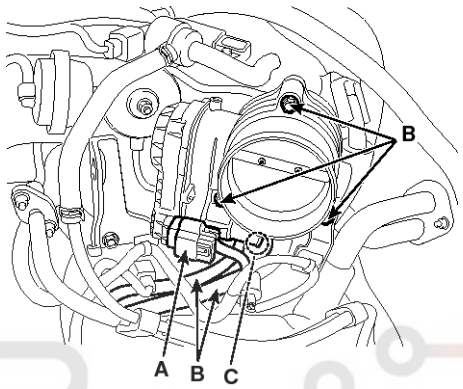
ETC Motor

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

Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the air cleaner assembly (Refer to "Intake And Exhaust System" in EM group).
3. Disconnect the ETC module connector (A).
4. Disconnect the coolant hoses (B).
5. Remove the stay installation bolt (C) and the ETC module installation bolts (D), and then remove the ETC module from the engine.



SCMF20230L

Installation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

1. Installation is reverse of removal.

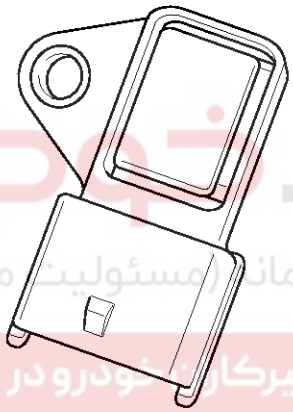
ETC Module installation bolt:
7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)
ETC Module Stay installation bolt:
15.7 ~ 25.5 N.m (1.6 ~ 2.6 kgf.m, 11.6 ~18.8 lb-ft)

Barometric Pressure Sensor (BPS)

Description

Barometric Pressure Sensor (BPS) is a speed-density type sensor and is installed on the air cleaner assemby. It senses absolute pressure of the air cleaner assemby and transfers the analog signal proportional to the pressure to the ECM. By using this signal, the ECM calculates the intake air quantity and engine speed.

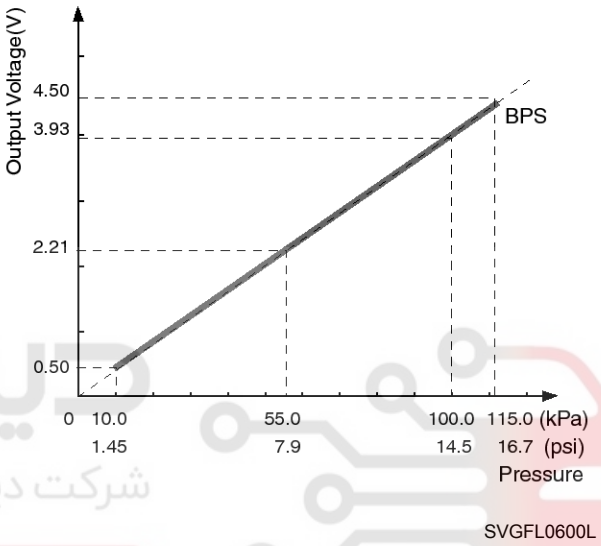
The BPS consists of a piezo-electric element and a hybrid IC amplifying the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor. Because 100% vacuum and the manifold pressure apply to both sides of the sensor respectively, this sensor can output analog signal by using the silicon variation proportional to pressure change.



SCMF20002L

Specification

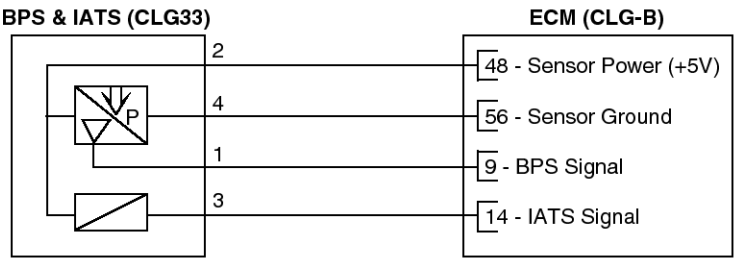
Pressure [kPa (kg/cm², p - si)]	Output Voltage (V)
10.0 (0.10, 1.45)	0.50
55.0 (0.55, 7.9)	2.21
100.0 (1.01, 14.5)	3.93
115.0 (1.17, 16.7)	4.50



SVGFL0600L

Circuit Diagram

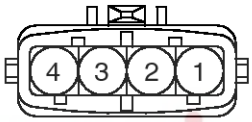
[Circuit Diagram]



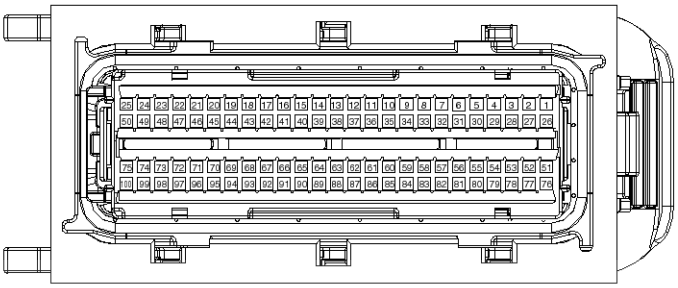
[Connection Information]

Terminal	Connected to	Function
1	ECM CLG-B (9)	BPS Signal
2	ECM CLG-B (48)	Sensor Power (+5V)
3	ECM CLG-B (14)	IATS Signal
4	ECM CLG-B (56)	Sensor Ground

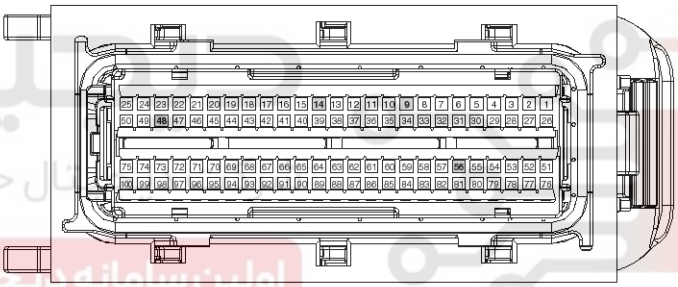
[Harness Connector]



CLG33
BPS & IATS



ELG-A



CLG-B
ECM

SVGFL0406L

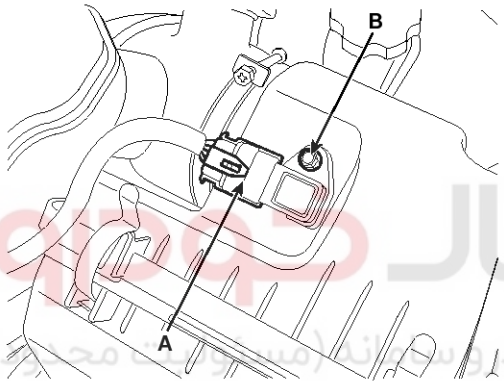
Inspection

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

Specification: Refer to "Specification"

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the barometric pressure sensor connector (A).
3. Remove the installation bolt (B), and then remove the sensor from the air cleaner assembly.



SCMF20041L

Installation

CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

CAUTION

- **Insert the sensor in the installation hole and be careful not to damage when installation.**

1. Installation is reverse of removal.

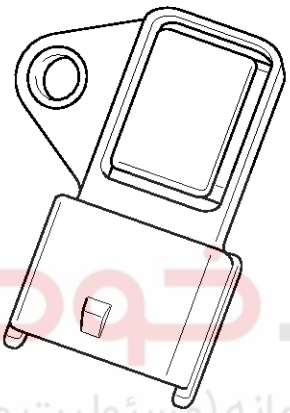
Barometric pressure sensor installation bolt:
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Intake Air Temperature Sensor (IATS)

Description

Intake Air Temperature Sensor (IATS) is included inside Barometric Pressure Sensor 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 BPS signal but also IATS signal. This sensor has a Negative Temperature Coefficient (NTC) thermistor and it's resistance changes in reverse proportion to the temperature.



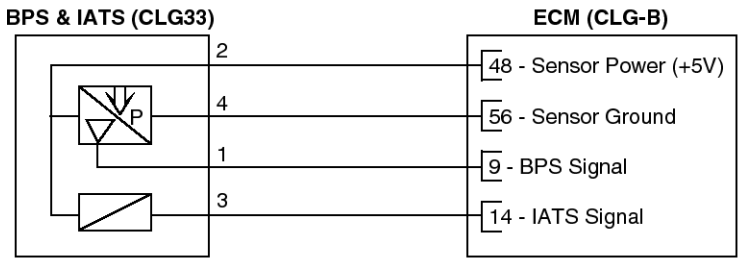
SCMF20002L

Specification

Temperature		Resistance (kΩ)
℃	℉	
-40	-40	40.93 ~ 48.35
-20	-4	13.89 ~ 16.03
0	32	5.38 ~ 6.09
10	50	3.48 ~ 3.90
20	68	2.31 ~ 2.57
40	104	1.08 ~ 1.21
60	140	0.54 ~ 0.66
80	176	0.29 ~ 0.34

Circuit Diagram

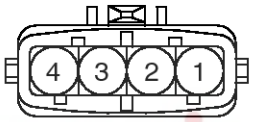
[Circuit Diagram]



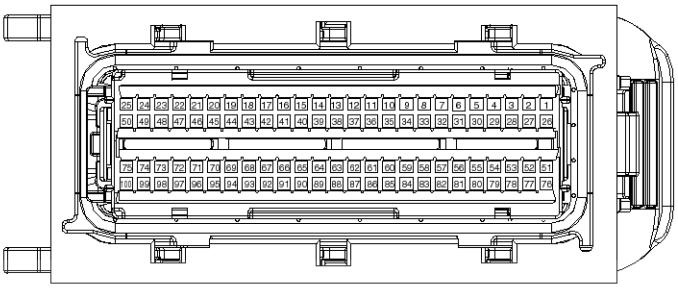
[Connection Information]

Terminal	Connected to	Function
1	ECM CLG-B (9)	BPS Signal
2	ECM CLG-B (48)	Sensor Power (+5V)
3	ECM CLG-B (14)	IATS Signal
4	ECM CLG-B (56)	Sensor Ground

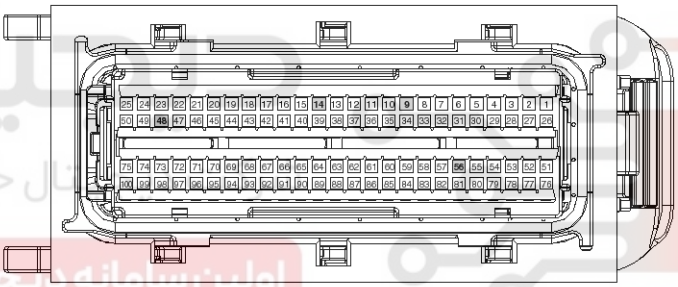
[Harness Connector]



CLG33
BPS & IATS



ELG-A



CLG-B
ECM

SVGFL0406L

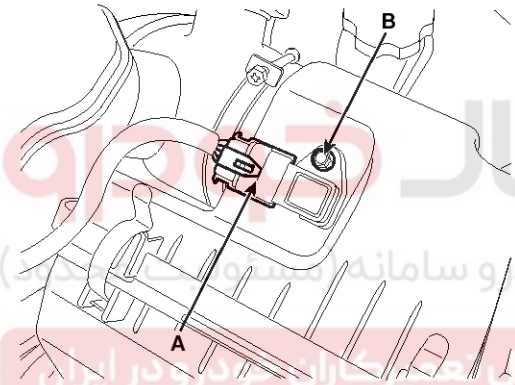
Inspection

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

Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the barometric pressure sensor connector (A).
3. Remove the installation bolt (B), and then remove the sensor from the air cleaner assembly.



SCMF20041L

Installation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

⚠CAUTION

- **Insert the sensor in the installation hole and be careful not to damage when installation.**

1. Installation is reverse of removal.

Barometric pressure sensor installation bolt:
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Manifold Absolute Pressure Sensor (MAPS)

Description

Manifold Absolute Pressure Sensor (MAPS) is a speed-density type sensor and is installed on the surge tank. It senses absolute pressure of the surge tank and transfers the analog signal proportional to the pressure to the ECM.

By using this signal, the ECM calculates the intake air quantity and engine speed.

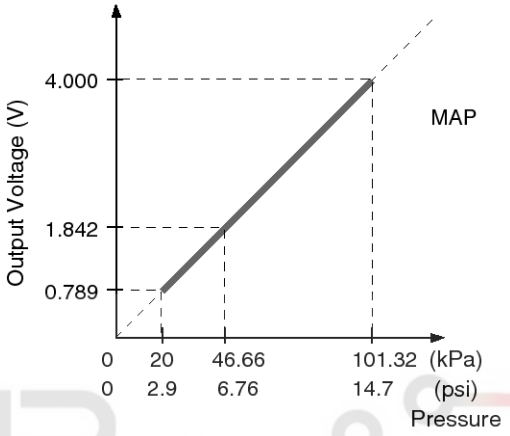
The MAPS consists of a piezo-electric element and a hybrid IC amplifying the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor.

Because 100% vacuum and the manifold pressure apply to both sides of the sensor respectively, this sensor can output analog signal by using the silicon variation proportional to pressure change.

SMGF19111L

Specification

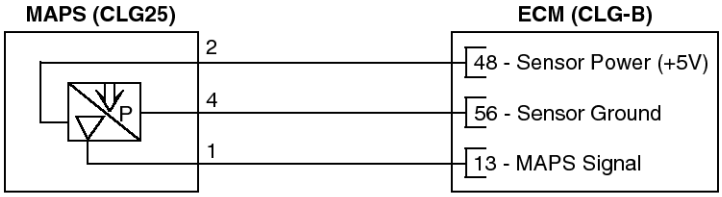
Pressure [kPa (kg/cm², psi)]	Output Voltage (V)
20.0 (0.20, 2.9)	0.79
46.66 (0.47, 6.76)	1.84
101.32 (1.03, 14.7)	4.0



SVGFL0601L

Circuit Diagram

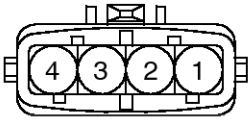
[Circuit Diagram]



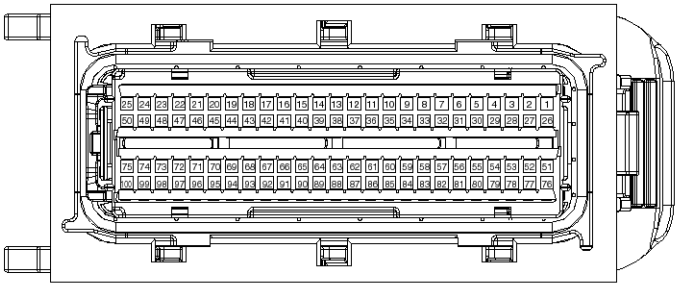
[Connection Information]

Terminal	Connected to	Function
1	ECM CLG-B (13)	MAPS Signal
2	ECM CLG-B (48)	Sensor Power (+5V)
3	-	-
4	ECM CLG-B (56)	Sensor Ground

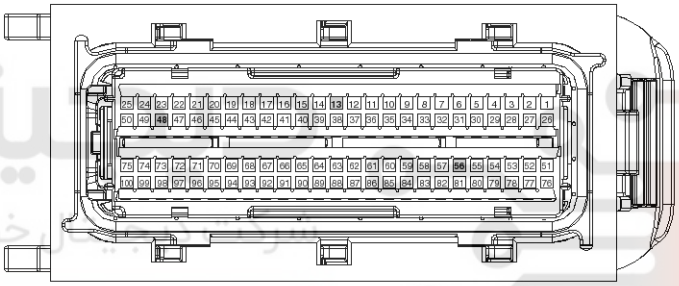
[Harness Connector]



CLG25
MAPS



ELG-A



CLG-B
ECM

SVGFL0407L

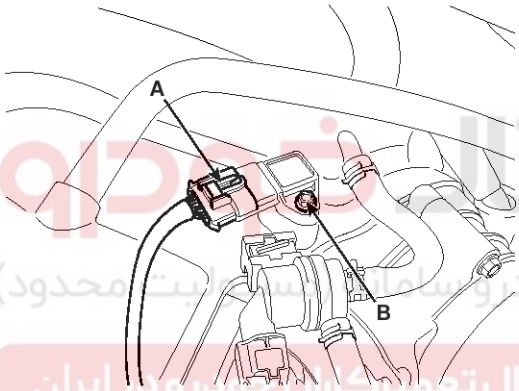
Inspection

1. Connect the GDS 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	Approx. 4.44V
Idle	Approx. 0.75V

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the manifold absolute pressure sensor connector (A).
3. Remove the installation bolts (B), and then vertically remove the sensor from the surge tank.



SCMF20051L

Installation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

⚠CAUTION

- **Insert the sensor in the installation hole and be careful not to damage when installation.**

1. Installation is reverse of removal.

Manifold absolute pressure sensor Installation bolt:
7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)

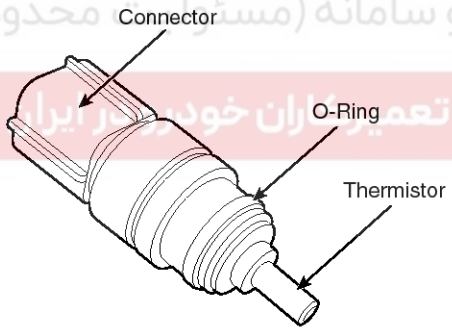
Engine Coolant Temperature Sensor (ECTS)

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 +5V 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.ion duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.

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.



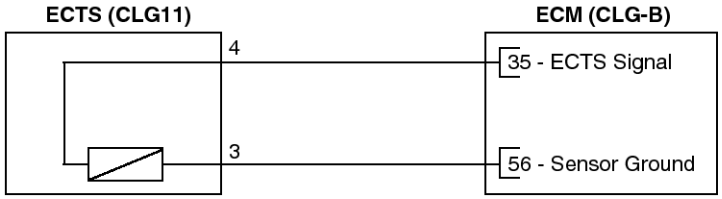
STDFL0127N

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

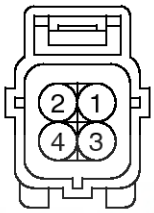
[Circuit Diagram]



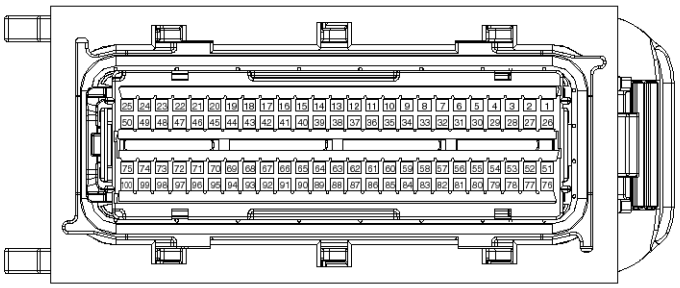
[Connection Information]

Terminal	Connected to	Function
1	-	-
2	-	-
3	ECM CLG-B (56)	Sensor Ground
4	ECM CLG-B (35)	ECTS Signal

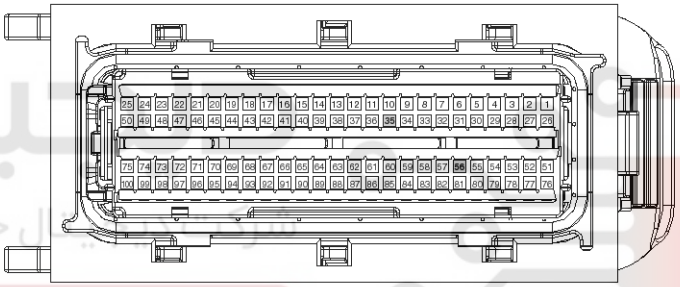
[Harness Connector]



CLG11
ECTS



ELG-A



CLG-B
ECM

SVGFL0408L

Inspection

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

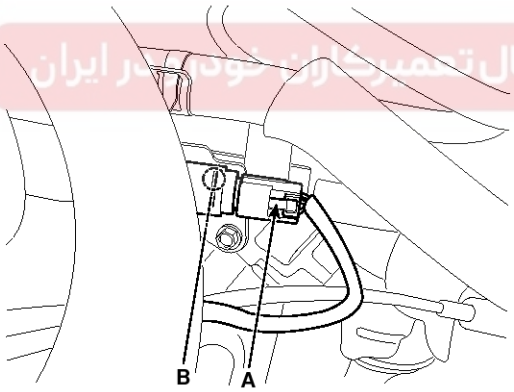
Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the air cleaner assembly (Refer to "Intake And Exhaust System" in EM group).
3. Disconnect the engine coolant temperature sensor connector (A).
4. Remove the fixing clip (B), and then pull the sensor from the water temperature control assembly.

⚠CAUTION

- **Note that engine coolant may be flowed out from the water temperature control assembly when removing the sensor.**



SCMF20061L

5. Supplement the engine coolant (Refer to “Cooling System” in EM group).

Installation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

⚠CAUTION

- **Apply the engine coolant to the O-ring.**

⚠CAUTION

- **Insert the sensor in the installation hole and be careful not to damage when installation.**

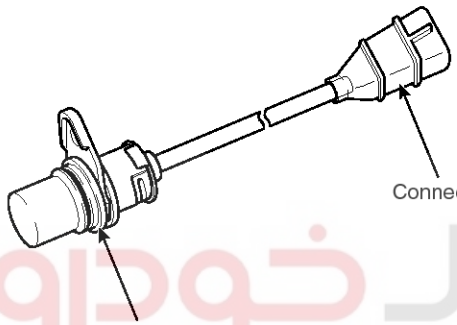
1. Installation is reverse of removal.

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 the cylinder block or the transaxle housing and generates alternating current by magnetic flux field which is made by the sensor and the target wheel when engine runs.

The target wheel consists of 58 slots and 2 missing slots on 360 degrees CA (Crank Angle).

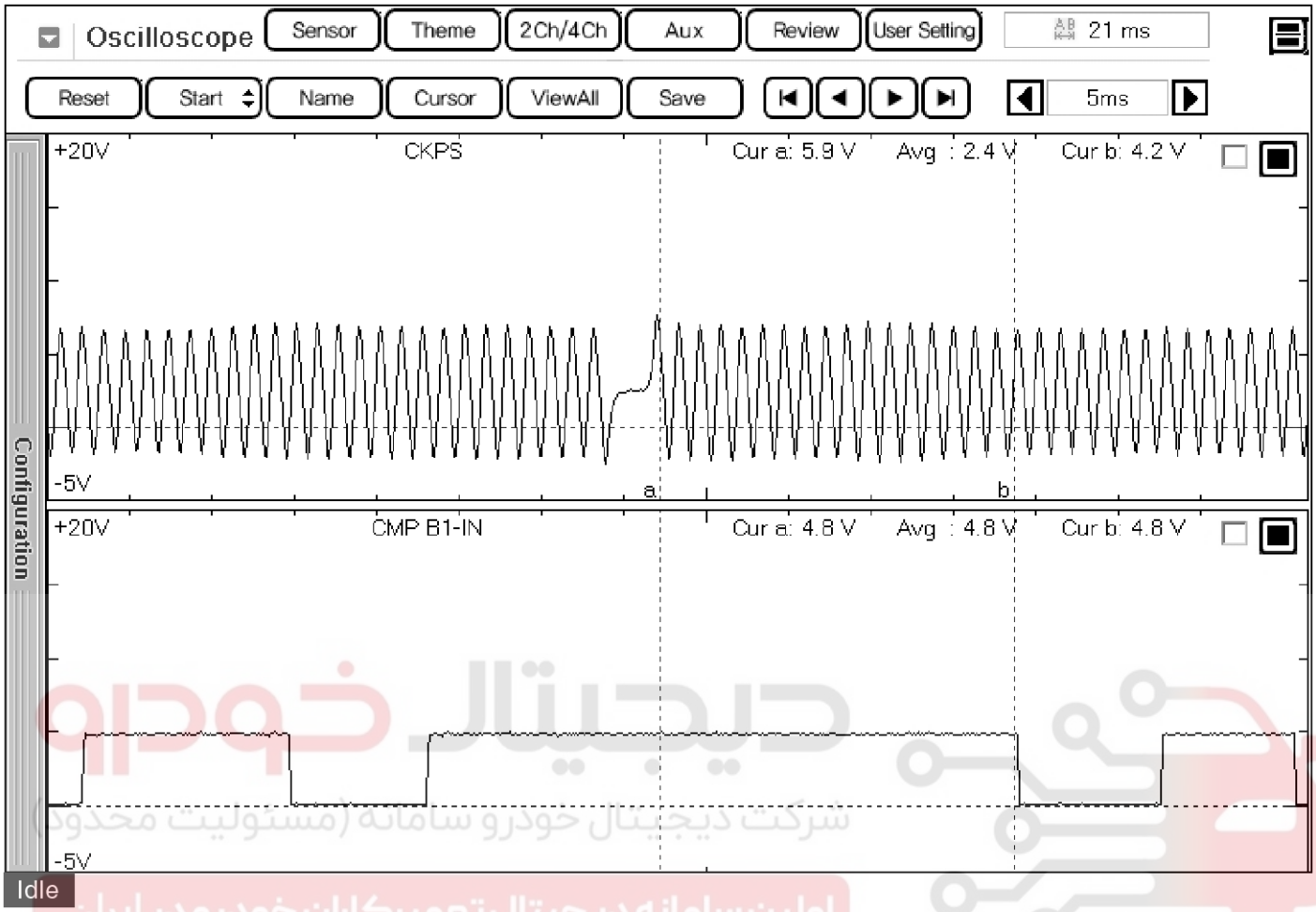


EGRF245A

Specification

Item	Specification
Coil Resistance (Ω)	774 ~ 946 [20℃(68°F)]
Air Gap [mm(in)]	0.5 ~ 1.5 (0.0196 ~ 0.0590)

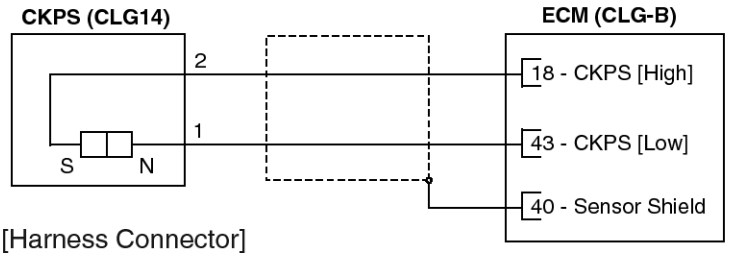
Wave Form



SVIFL9200L

Circuit Diagram

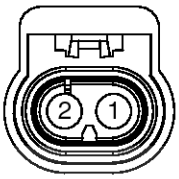
[Circuit Diagram]



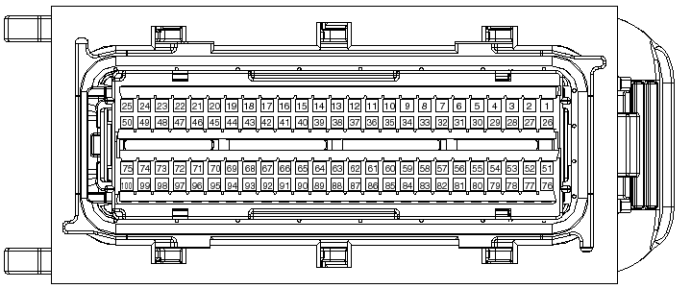
[Connection Information]

Terminal	Connected to	Function
1	ECM CLG-B (43)	CKPS [Low] Signal
2	ECM CLG-B (18)	CKPS [High] Signal

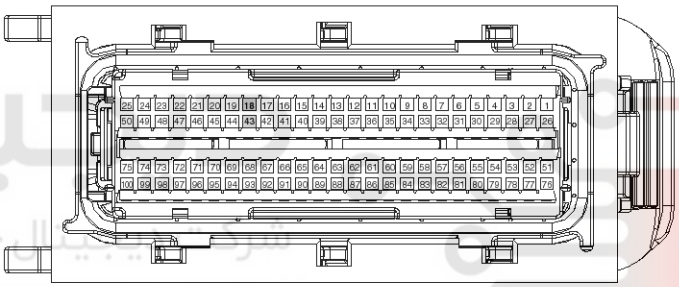
[Harness Connector]



CLG14
CKPS



ELG-A



CLG-B
ECM

SVGFL0409L

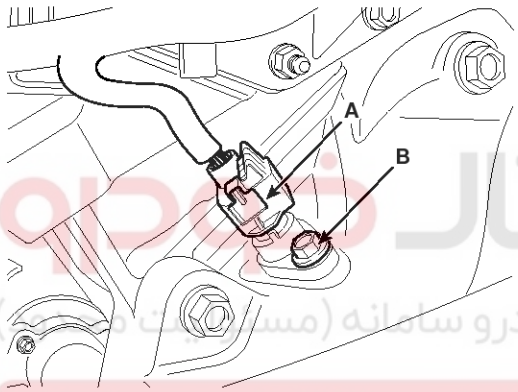
Inspection

1. Check the signal waveform of the CMPS and CKPS using the GDS.

Specification: Refer to “Wave Form”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the air cleaner assembly (Refer to "Intake And Exhaust System" in EM group).
3. Disconnect the crankshaft position sensor connector (A).
4. Remove the installation bolt (B), and then vertically remove the sensor from the transaxle housing.



SCMF20071L

Installation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

⚠CAUTION

- **Apply the engine oil to the O-ring.**

⚠CAUTION

- **Insert the sensor in the installation hole and be careful not to damage when installation.**

1. Installation is reverse of removal.

Crankshaft position sensor installation bolt:
6.9 ~ 9.8 N.m (0.7 ~ 1.0 kgf.m, 5.1 ~ 7.2 lb-ft)

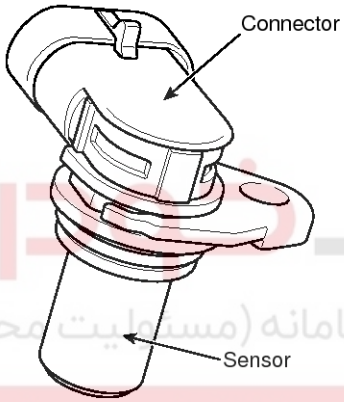
Camshaft Position Sensor (CMPS)

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 uses a target wheel installed on the camshaft. The Cam Position sensor is a hall-effect type sensor. As the target wheel passes the Hall sensor, the magnetic field changes in the sensor. The sensor then switches a signal which creates a square wave.

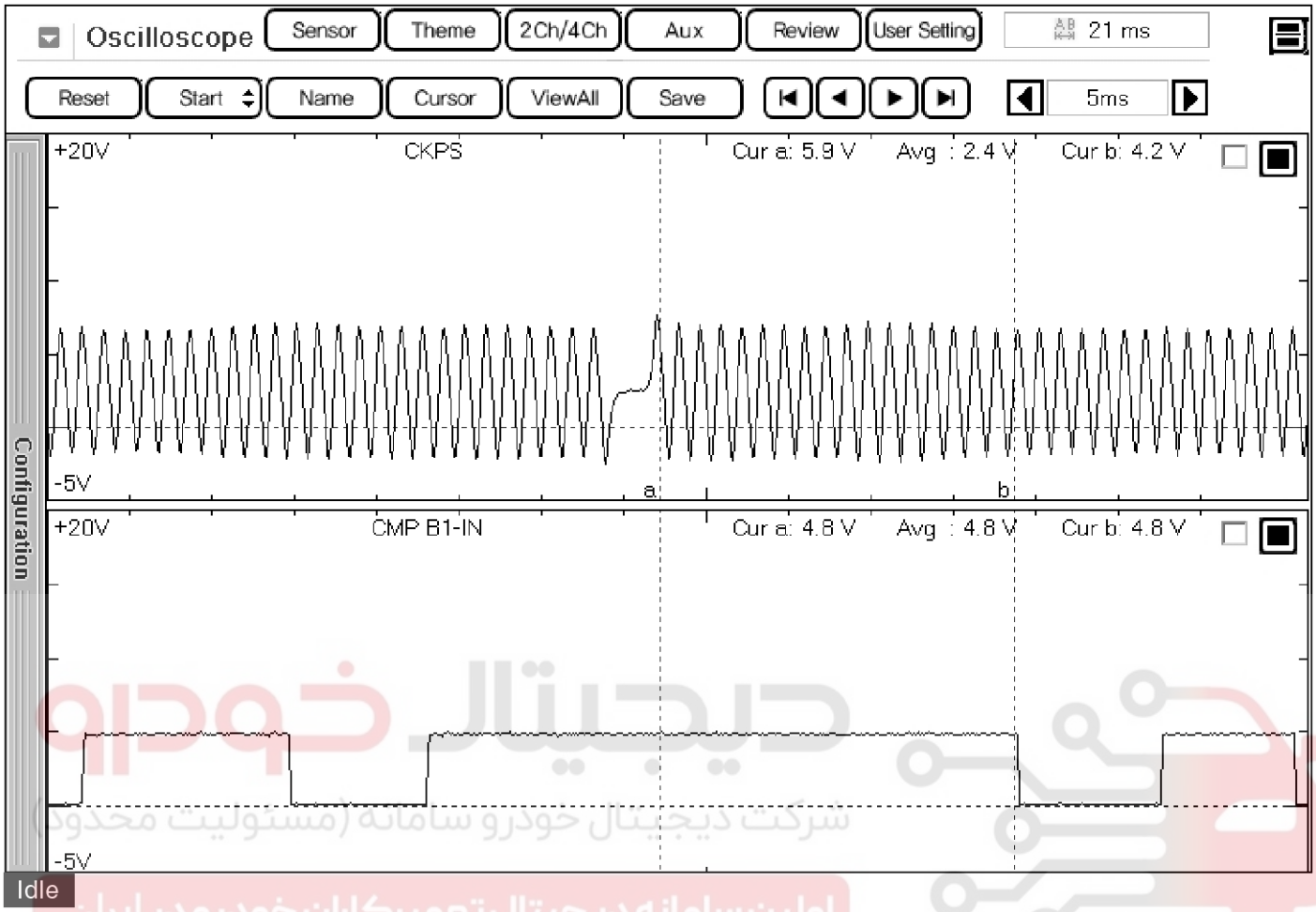


SBHFL9138L

Specification

Item	Specification
Output Voltage (V)	High: 5.0V
	Low: 0.7V
Air Gap [mm(in)]	0.5 ~ 1.5 (0.0196 ~ 0.0590)

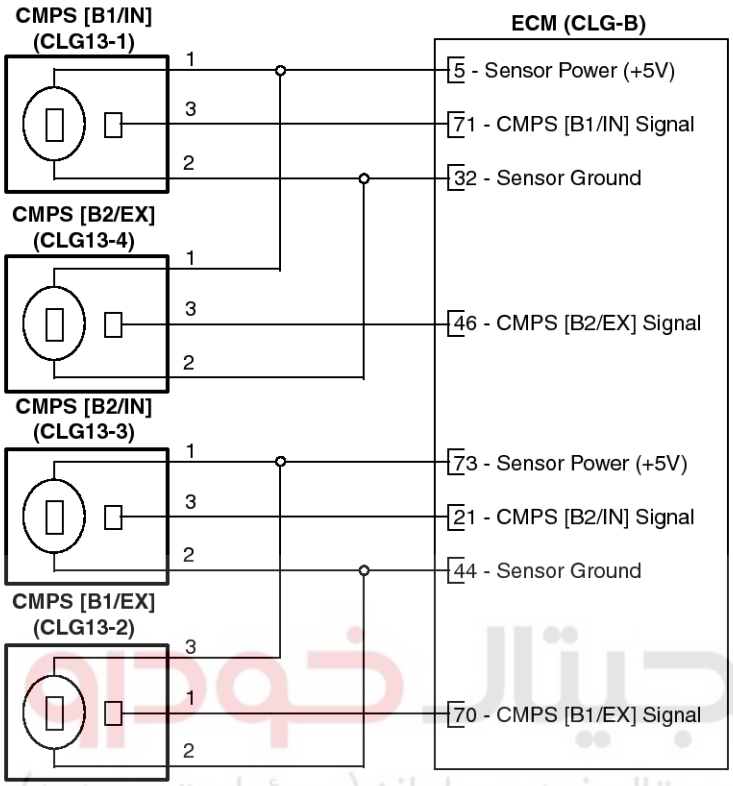
Wave Form



SVIFL9200L

Circuit Diagram

[Circuit Diagram]



[Connection Information]

CMPS [Bank 1/Intake] (CLG13-1)

Terminal	Connected to	Function
1	ECM CLG-B (5)	Sensor Power (+5V)
2	ECM CLG-B (32)	Sensor Ground
3	ECM CLG-B (71)	CMPS [B1/IN] Signal

CMPS [Bank 2/Exhaust] (CLG13-4)

Terminal	Connected to	Function
1	ECM CLG-B (5)	Sensor Power (+5V)
2	ECM CLG-B (32)	Sensor Ground
3	ECM CLG-B (46)	CMPS [B2/EX] Signal

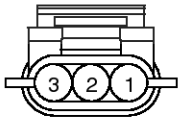
CMPS [Bank 2/Intake] (CLG13-3)

Terminal	Connected to	Function
1	ECM CLG-B (73)	Sensor Power (+5V)
2	ECM CLG-B (44)	Sensor Ground
3	ECM CLG-B (21)	CMPS [B2/IN] Signal

CMPS [Bank 1/Exhaust] (CLG13-2)

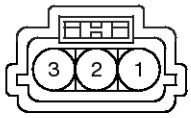
Terminal	Connected to	Function
1	ECM CLG-B (70)	CMPS [B1/EX] Signal
2	ECM CLG-B (44)	Sensor Ground
3	ECM CLG-B (73)	Sensor Power (+5V)

[Harness Connector]



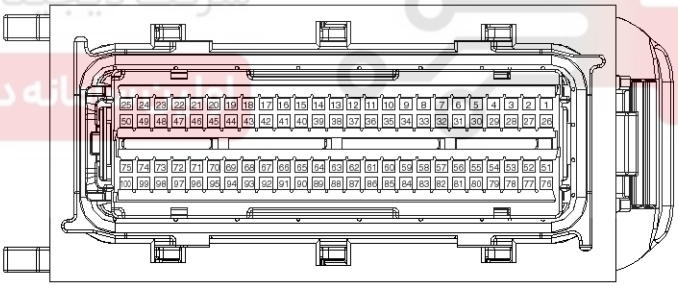
CLG13-1
CLG13-2
CLG13-4

CMPS [Bank 1/Intake]
CMPS [Bank 1/Exhaust]
CMPS [Bank 2/Exhaust]

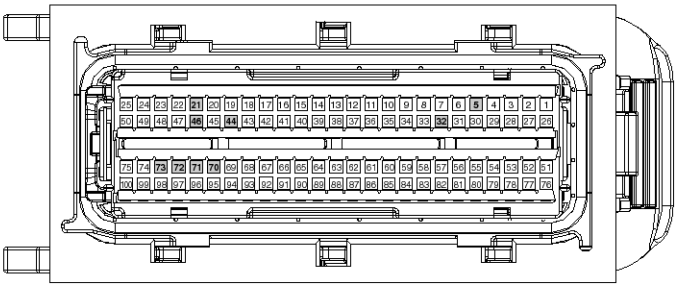


CLG13-3

CMPS [Bank 2/Intake]



ELG-A



CLG-B
ECM

SVGFL0410L

Inspection

1. Check the signal waveform of the CMPS and CKPS using the GDS.

Specification: Refer to “Wave Form”

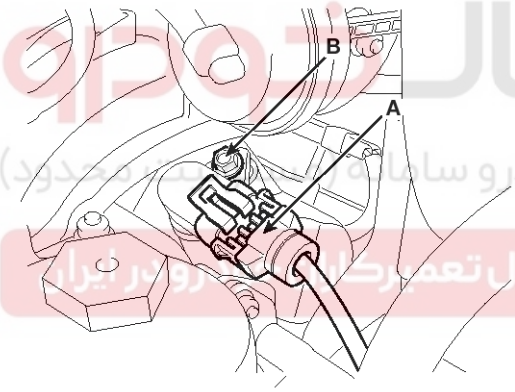
Removal

WARNING

- **DON’T remove the camshaft position sensor during engine running or right after engine stops, or a scald by the flowed out engine oil may occur.**

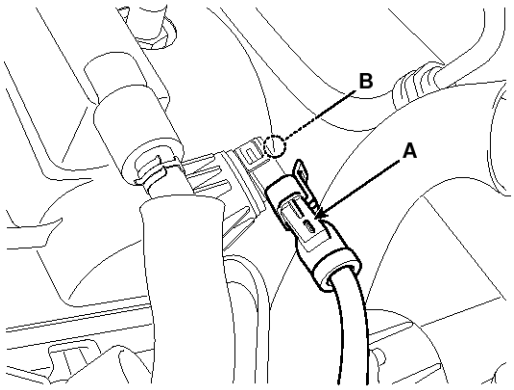
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the camshaft position sensor connector (A).
3. Remove the installation bolt (B), and then vertically remove the sensor from the cylinder head.

[Bank 1/Intake]



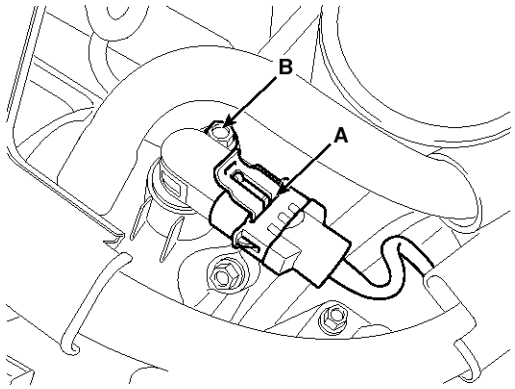
SCMF20081L

[Bank 1/Exhaust]



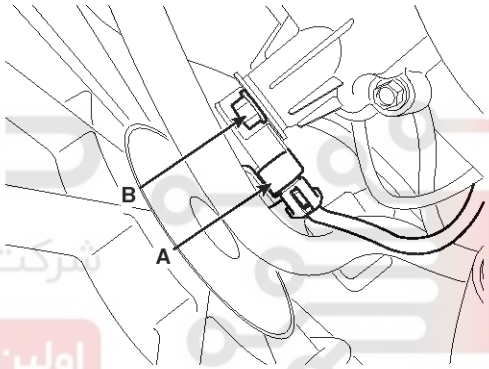
SCMF20091L

[Bank 2/Intake]



SCMF20101L

[Bank 2/Exhaust]



SCMF20111L

Installation

CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

CAUTION

- **Apply the engine oil to the O-ring.**

CAUTION

- **Insert the sensor in the installation hole and be careful not to damage when installation.**

CAUTION

- **Be careful not to damage the sensor housing and the connector.**
- **Be careful not to damage the O-ring.**

1. Installation is reverse of removal.

Camshaft position sensor installation bolt:
6.9 ~ 9.8N.m (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)

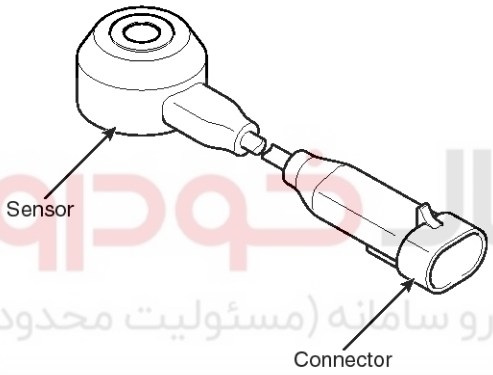
Knock Sensor (KS)

Description

Knocking is a phenomenon characterized by undesirable vibration and noise and can cause engine damage. The two Knock Sensor (KS) are installed inside the V-valley of the cylinder block and senses engine knocking.

When knocking occurs, the vibration from the cylinder block is applied as pressure to the piezoelectric element.

When a knock occurs, the sensor produces voltage signal. The ECM retards the ignition timing when knocking occurs. 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.



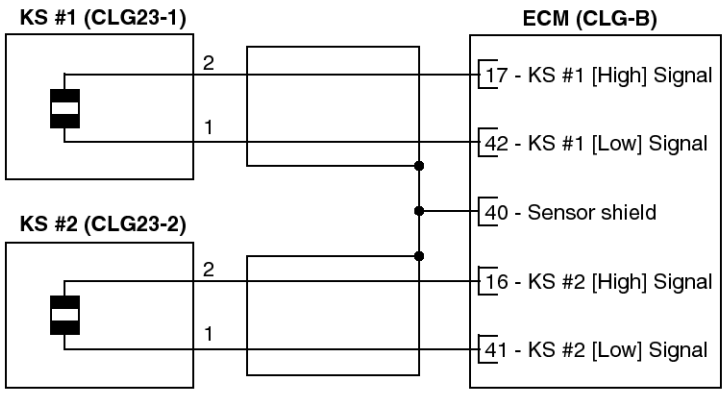
EGRF251A

Specification

Item	Specification
Capacitance (pF)	950 ~ 1,350

Circuit Diagram

[Circuit Diagram]



[Connection Information]

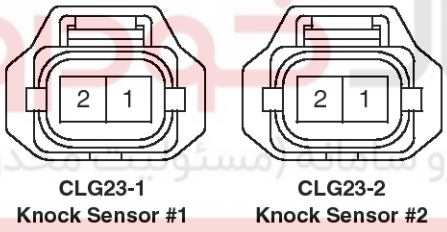
Knock Sensor #1 (CLG23-1)

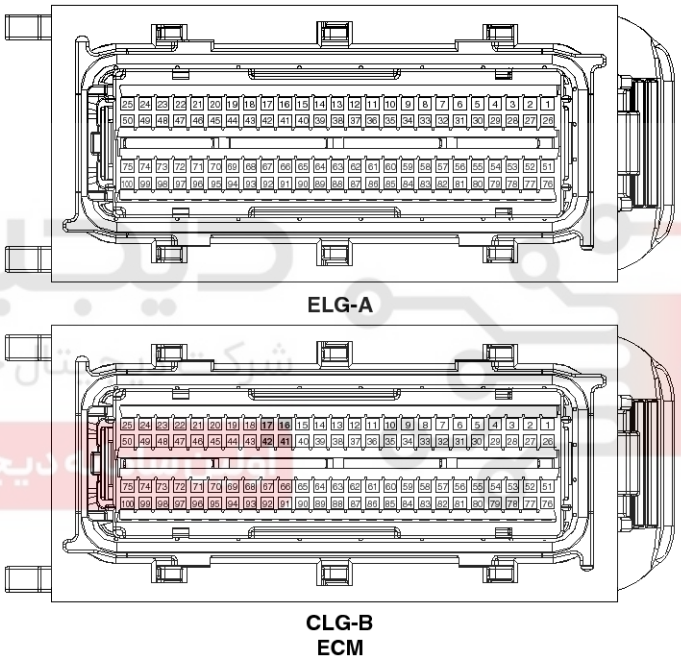
Terminal	Connected to	Function
1	ECM CLG-B (42)	KS #1 [Low] Signal
2	ECM CLG-B (17)	KS #1 [High] Signal

Knock Sensor #2 (CLG23-2)

Terminal	Connected to	Function
1	ECM CLG-B (41)	KS #2 [Low] Signal
2	ECM CLG-B (16)	KS #2 [High] Signal

[Harness Connector]



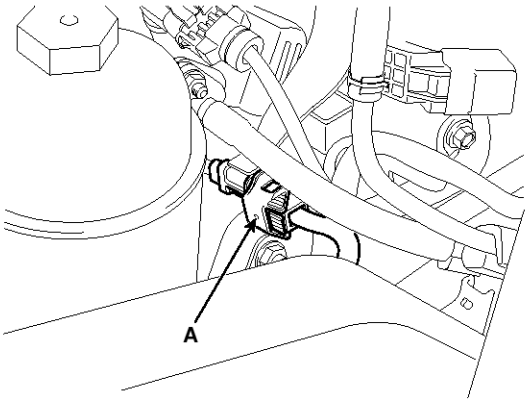


SVGFL0411L

Removal

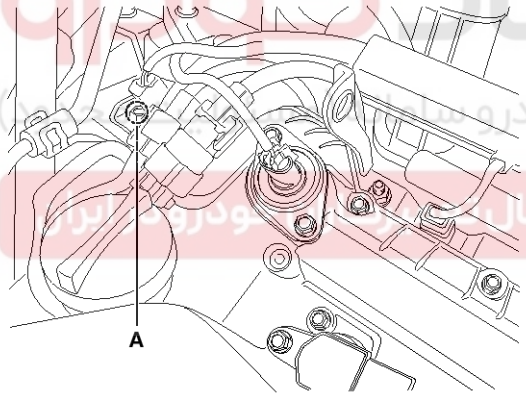
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the knock sensor connector (A).

[Bank 1]



SCMF20130L

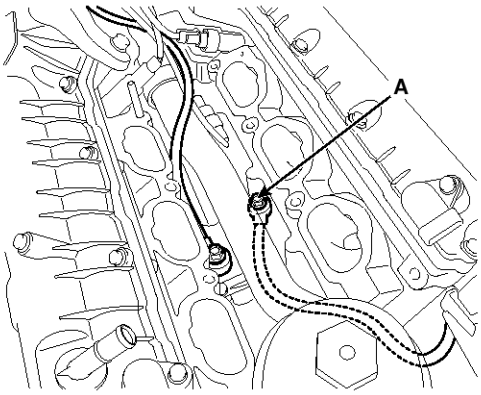
[Bank 2]



SCMF20261L

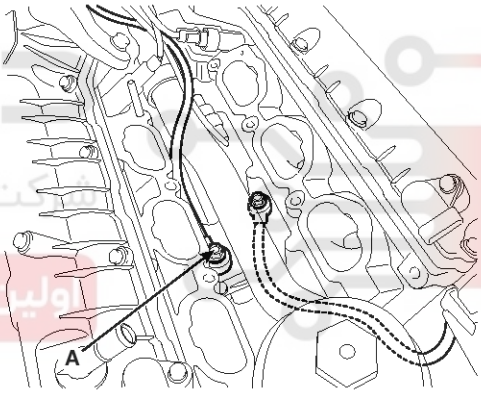
3. Remove the intake manifold (Refer to "Intake And Exhaust System" in EM group).
4. Remove the installation bolt (A), and then remove the sensor from the cylinder block.

[Bank 1]



SCMF20121L

[Bank 2]



SCMF20122L

Installation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

⚠CAUTION

- **The sensor connector must be installed parallel to the direction of the engine.**

1. Installation is reverse of removal.

Knock sensor installation bolt:
15.7 ~ 23.5 N.m (1.6 ~ 2.4 kgf.m, 11.6 ~ 17.4 lb-ft)

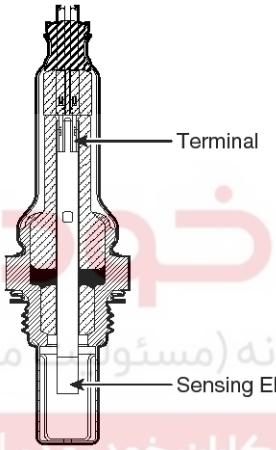
Heated Oxygen Sensor (HO2S)

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.



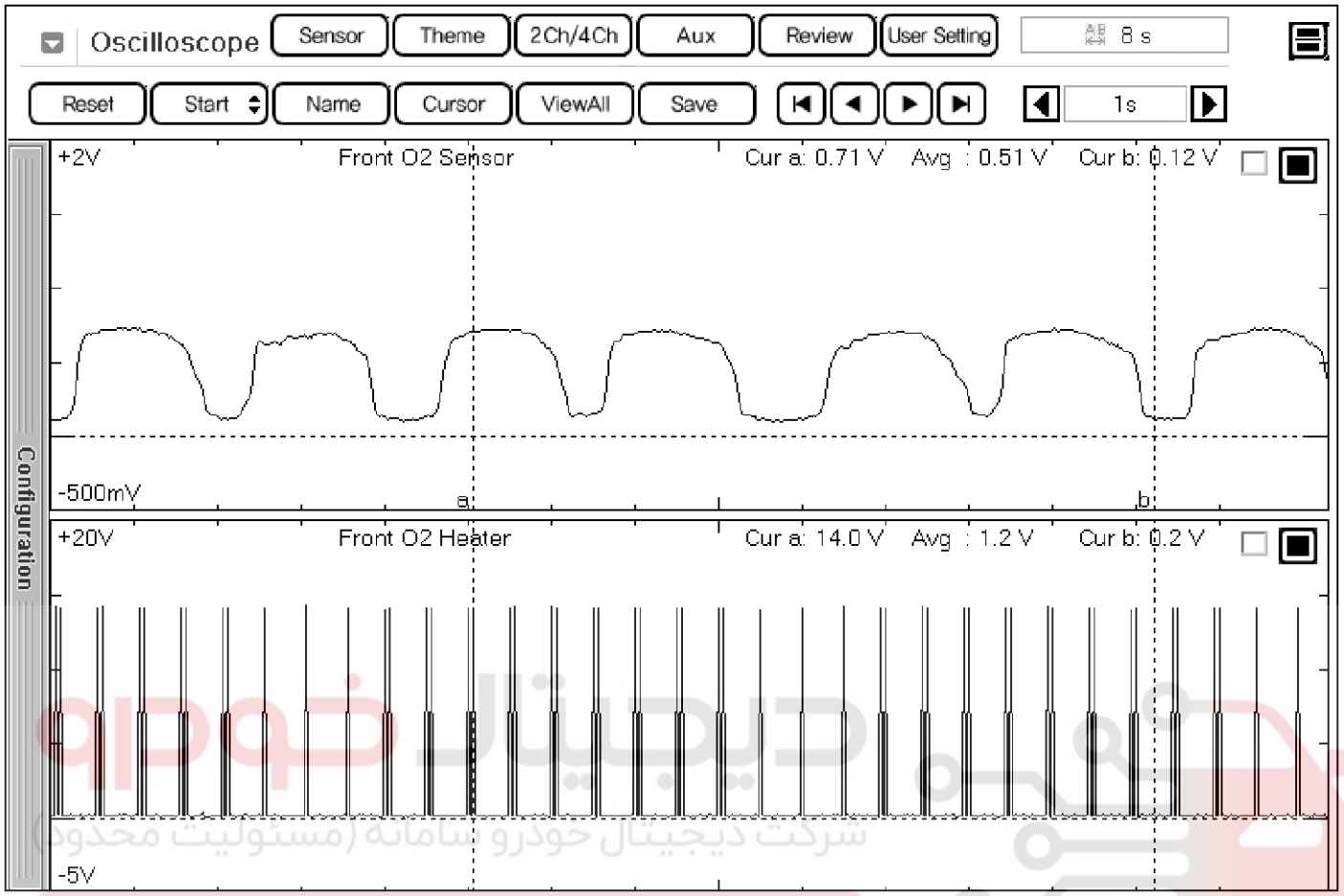
EGRF247A

Specification

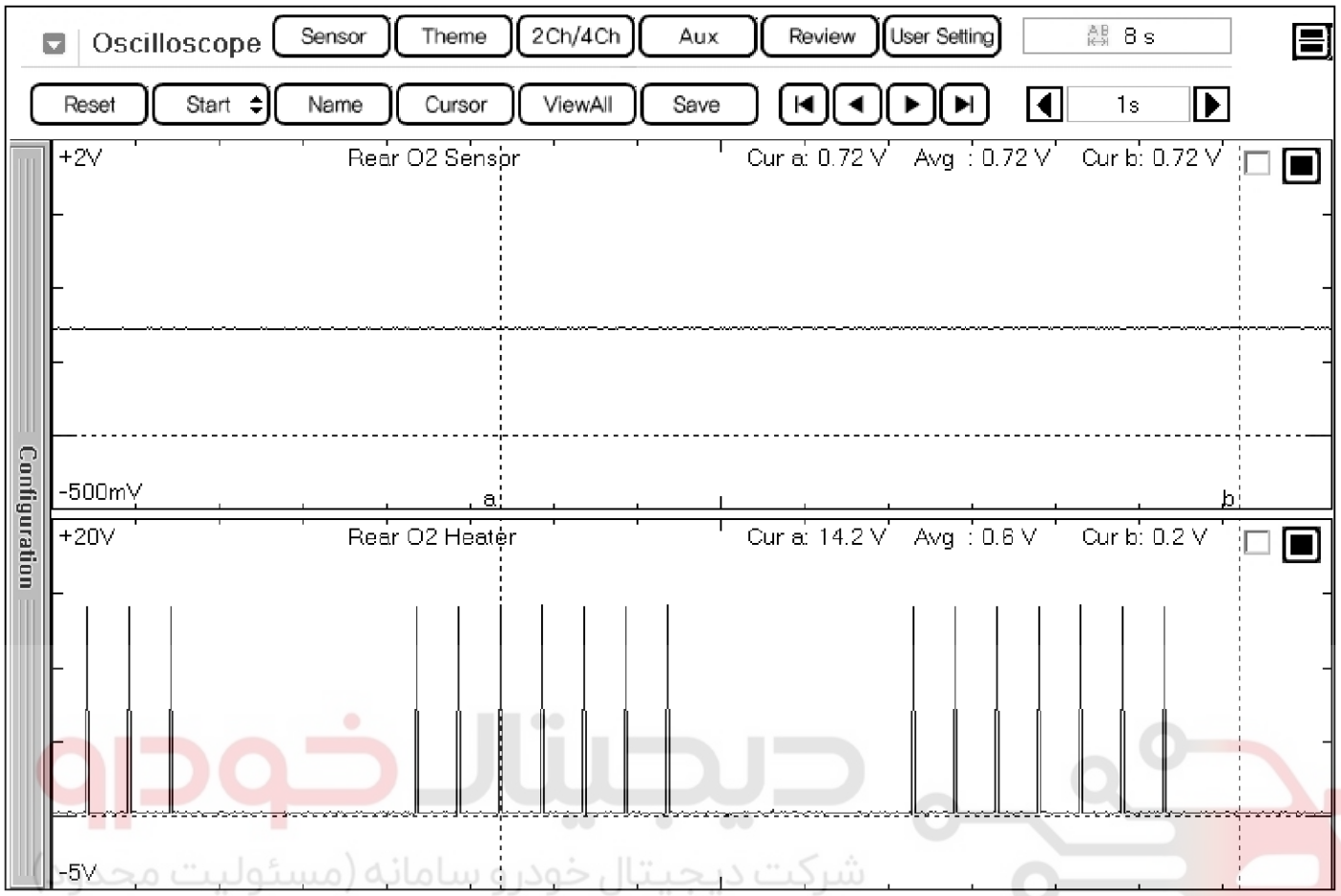
A/F Ratio (λ)	Output Voltage(V)
RICH	Min. 0.8
LEAN	Max. 0.1

Item	Specification
Heater Resistance (Ω)	3.3 ~ 4.1[20℃(68˚F)]

Wave Form



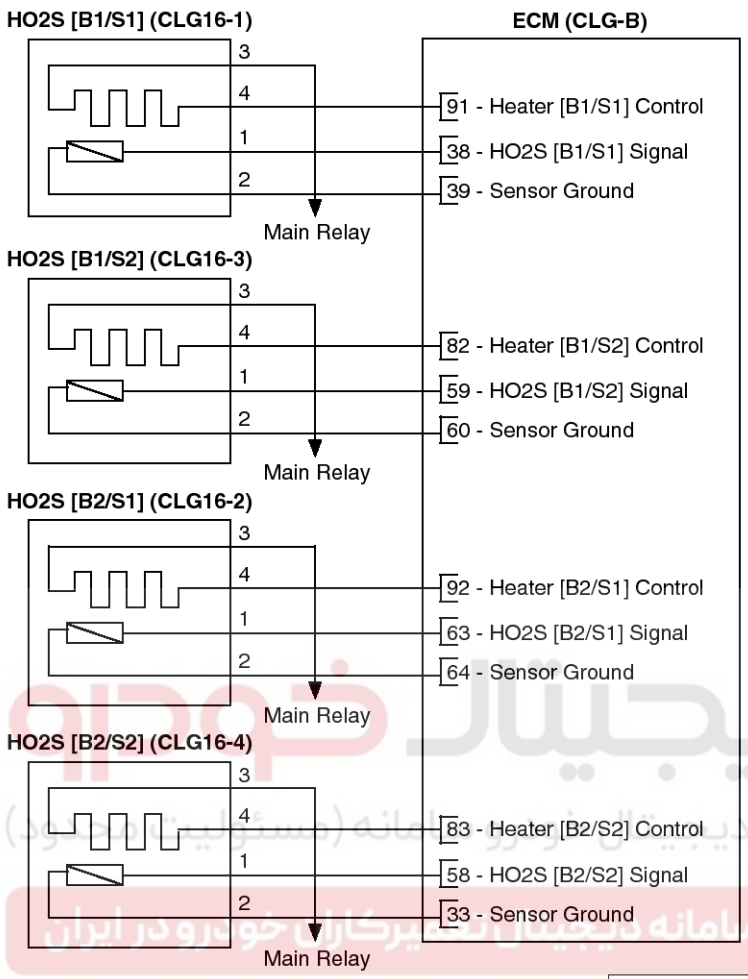
SVIFL9201L



SVIFL9202L

Circuit Diagram

[Circuit Diagram]



[Connection Information]

HO2S [Bank 1/Sensor 1] (CLG16-1)

Terminal	Connected to	Function
1	ECM CLG-B (38)	HO2S [B1/S1] Signal
2	ECM CLG-B (39)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM CLG-B (91)	Heater [B1/S1] Control

HO2S [Bank 1/Sensor 2] (CLG16-3)

Terminal	Connected to	Function
1	ECM CLG-B (59)	HO2S [B1/S2] Signal
2	ECM CLG-B (60)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM CLG-B (82)	Heater [B1/S2] Control

HO2S [Bank 2/Sensor 1] (CLG16-2)

Terminal	Connected to	Function
1	ECM CLG-B (63)	HO2S [B2/S1] Signal
2	ECM CLG-B (64)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM CLG-B (92)	Heater [B2/S1] Control

HO2S [Bank 2/Sensor 2] (CLG16-4)

Terminal	Connected to	Function
1	ECM CLG-B (58)	HO2S [B2/S2] Signal
2	ECM CLG-B (33)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM CLG-B (83)	Heater [B2/S2] Control

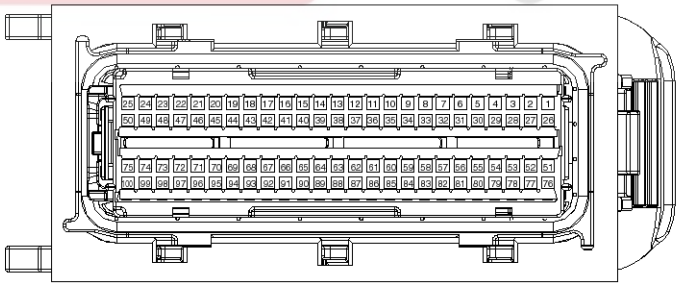
[Harness Connector]

CLG16-1
CLG16-2

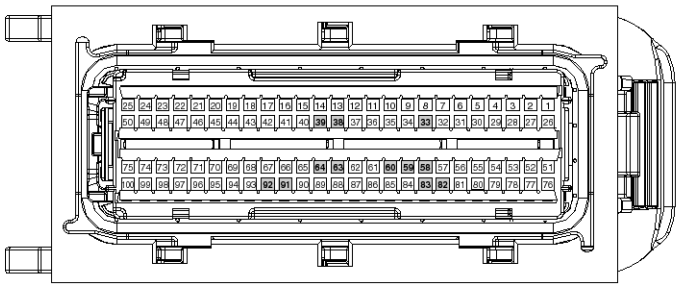
HO2S [Bank 1/Sensor 1]
HO2S [Bank 2/Sensor 1]

CLG16-3
CLG16-4

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



ELG-A



CLG-B
ECM

SVGFL0412L

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”

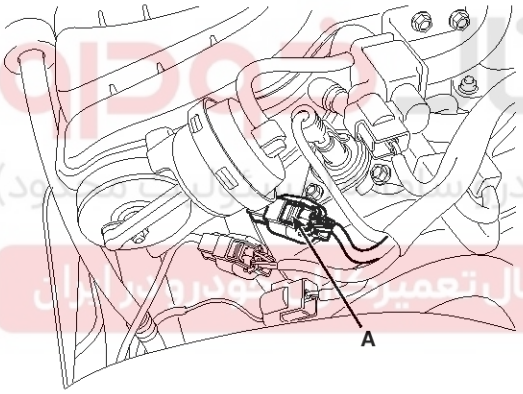
Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the connector (A), and then remove the sensor (B).

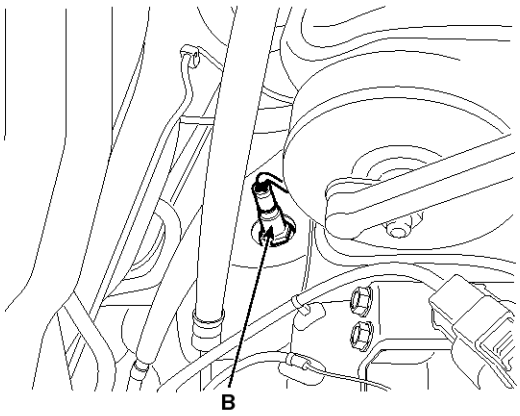
NOTICE

Note that the SST (Part No.: 09392-2H100) is useful when removing the heated oxygen sensor.

[Bank 1/Sensor 1]

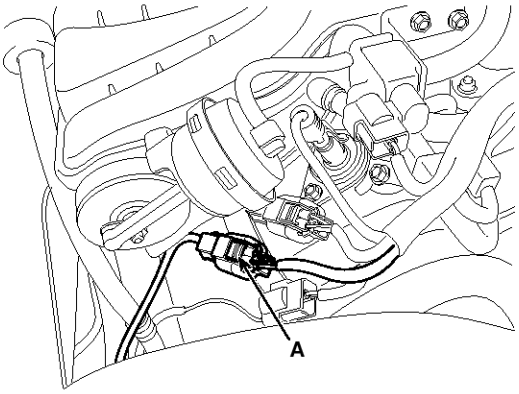


SCMF20191L

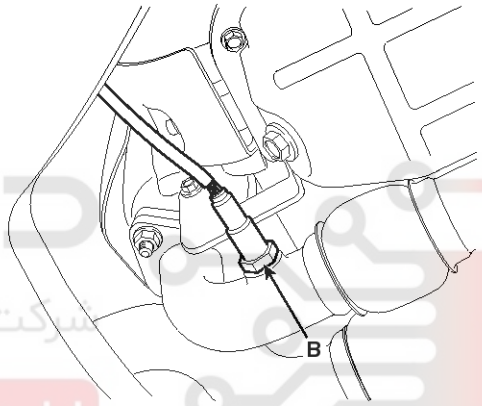


SCMF20151L

[Bank 1/Sensor 2]

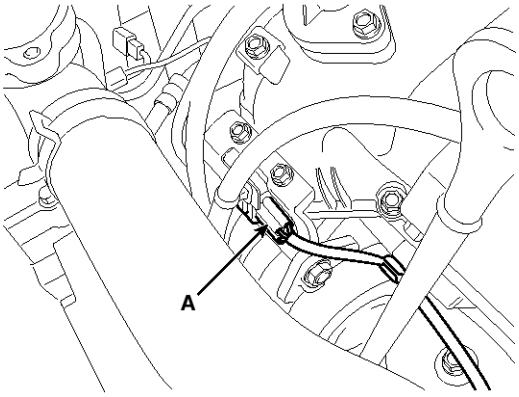


SCMF20192L

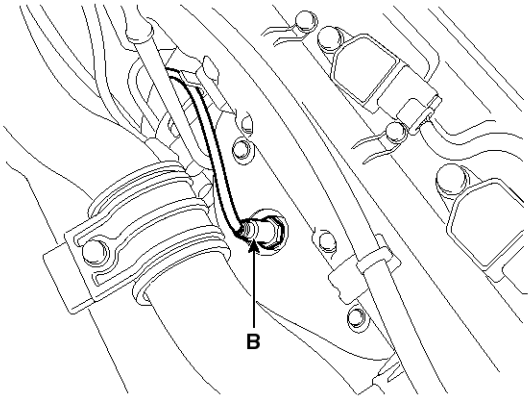


SVGF20121D

[Bank 2/Sensor 1]

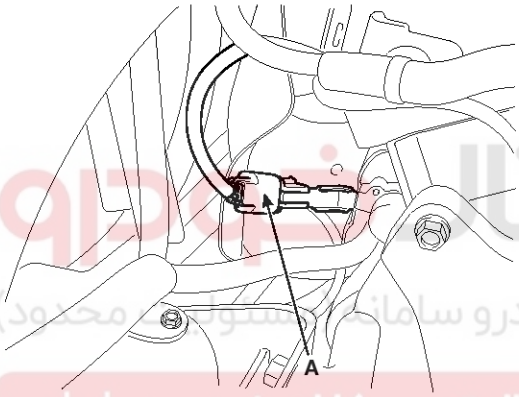


SVGF20200D

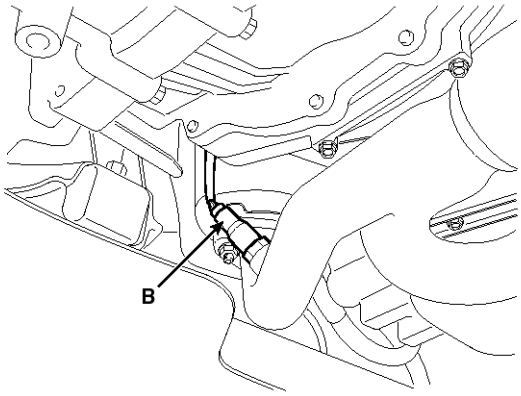


SVGF20131D

[Bank 2/Sensor 2]



SCMF20210L



SVGF20141D

Installation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

⚠CAUTION

- **DON'T use a cleaner, spray, or grease to sensing element and connector of the sensor because oil component in them may malfunction the sensor performance.**
- **Sensor and its wiring may be damaged in case of contacting with the exhaust system (Exhaust Manifold, Catalytic Converter, and so on).**

1. Installation is reverse of removal.

Heated oxygen sensor installation:
35.3 ~ 45.1 N.m (3.6 ~ 4.6 kgf.m, 26.0 ~ 33.3 lb-ft)

CVVT Oil Temperature Sensor (OTS)

Description

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

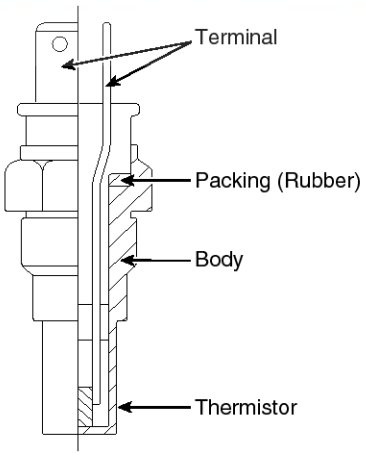
This system consist of

- the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or runs out the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,

- the CVVT Oil Temperature Sensor (OTS) which measures the engine oil temperature,

- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

The engine oil getting out of the CVVT oil control valve varies the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.



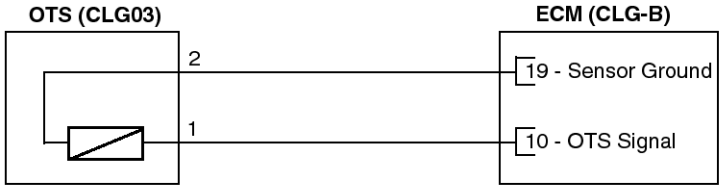
SBHFL9140L

Specification

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

Circuit Diagram

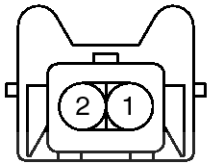
[Circuit Diagram]



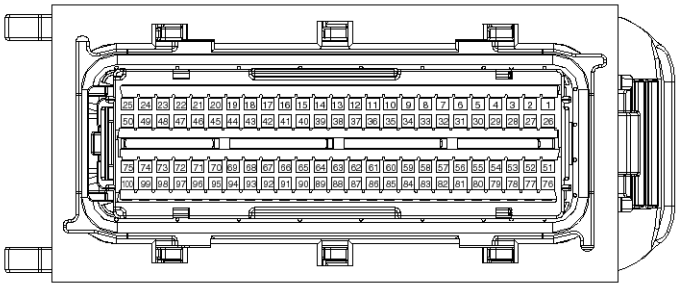
[Connection Information]

Terminal	Connected to	Function
1	ECM CLG-B (10)	OTS Signal
2	ECM CLG-B (19)	Sensor Ground

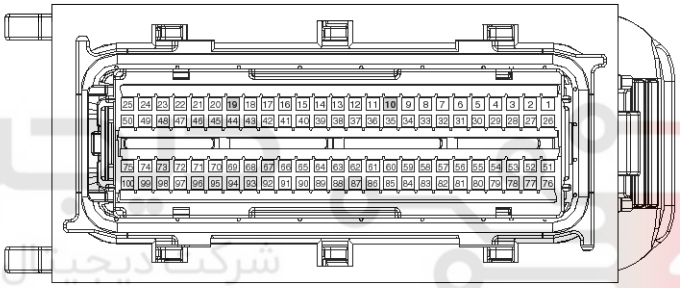
[Harness Connector]



CLG03
OTS



ELG-A



CLG-B
ECM

SVGFL0413L

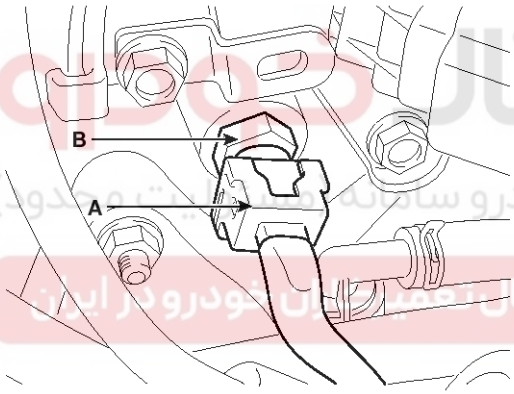
Inspection

1. Turn the ignition switch OFF.
2. Disconnect the OTS connector.
3. Remove the OTS (Refer to "Removal").
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”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the air cleaner assembly (Refer to "Intake And Exhaust System" in EM group).
3. Disconnect the connector (A), and then remove the CVVT oil temperature sensor (B).



SCMF20221L

Installation

CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

CAUTION

- **Apply the sealant (LOCTITE FED546 or equivalent) to the sensor.**

CAUTION

- **Insert the sensor in the installation hole and be careful not to damage when installation.**

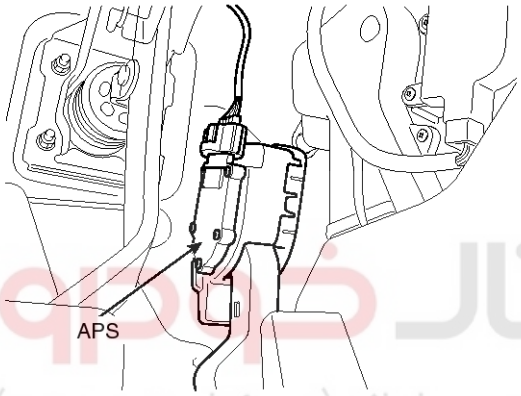
1. Installation is reverse of removal.

CVVT oil temperature sensor installation:
34.3 ~ 44.1 N.m (3.5 ~ 4.5 kgf.m, 25.3 ~ 32.6 lb-ft)

Accelerator Position Sensor (APS)

Description

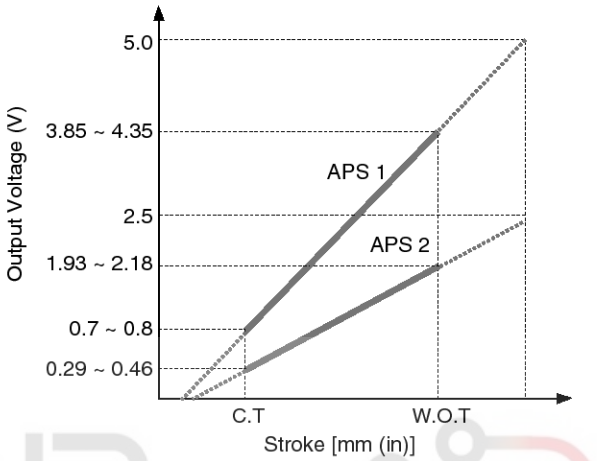
Accelerator Position Sensor (APS) is installed on the accelerator pedal module and detects the rotation angle of the accelerator pedal. The APS is one of the most important sensors in engine control system, so it consists of the two sensors which adapt individual sensor power and ground line. The second 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.



SLMFL0160D

Specification

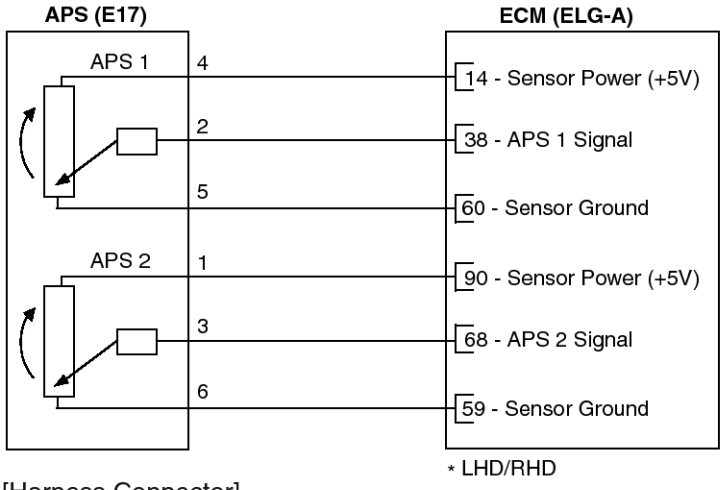
Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.7 ~ 0.8	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18



SCMF20004L

Circuit Diagram

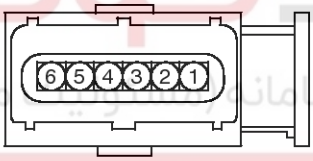
[Circuit Diagram]



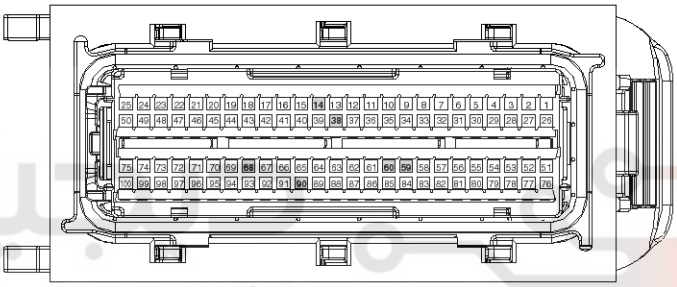
[Connection Information]

Terminal	Connected to	Function
1	ECM ELG-A (90)	APS 2 Sensor Power (+5V)
2	ECM ELG-A (38)	APS 1 Signal
3	ECM ELG-A (68)	APS 2 Signal
4	ECM ELG-A (14)	APS 1 Sensor Power (+5V)
5	ECM ELG-A (60)	APS 1 Sensor Ground
6	ECM ELG-A (59)	APS 2 Sensor Ground

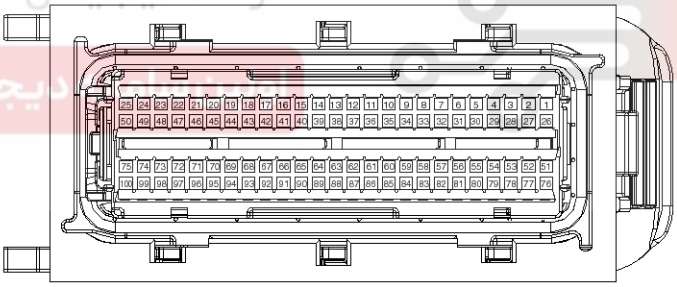
[Harness Connector]



E17
APS



ELG-A



CLG-B
ECM

SVGFL0414L

Inspection

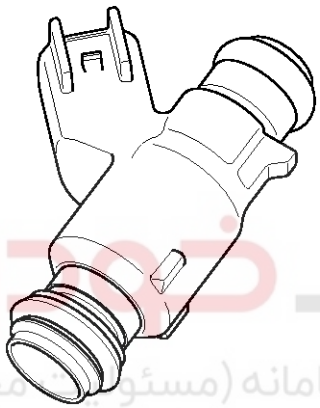
1. Connect the GDS on the Data Link Connector (DLC).
2. Turn the ignition switch ON.
3. Measure the output voltage of the APS 1 and 2 at C.T and W.O.T.

Specification: Refer to “Specification”

Injector

Description

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



KFCF1026

Specification

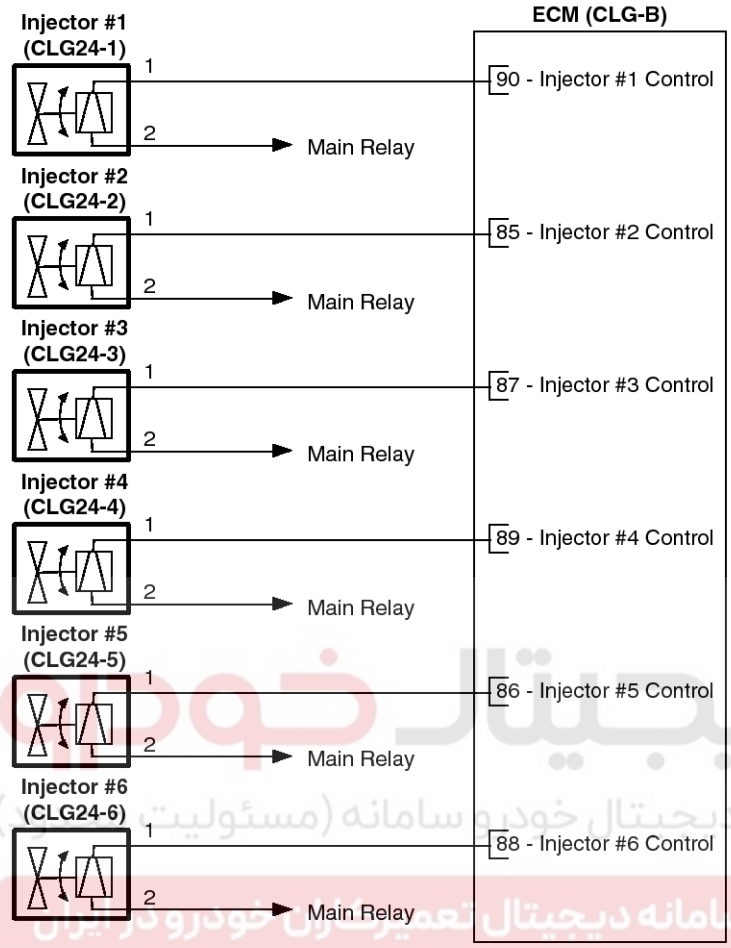
CAUTION

- 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.

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

Circuit Diagram

[Circuit Diagram]



[Connection Information]

Injector #1 (CLG24-1)

Terminal	Connected to	Function
1	ECM CLG-B (90)	Injector #1 Control
2	Main Relay	Battery Power (B+)

Injector #2 (CLG24-2)

Terminal	Connected to	Function
1	ECM CLG-B (85)	Injector #2 Control
2	Main Relay	Battery Power (B+)

Injector #3 (CLG24-3)

Terminal	Connected to	Function
1	ECM CLG-B (87)	Injector #3 Control
2	Main Relay	Battery Power (B+)

Injector #4 (CLG24-4)

Terminal	Connected to	Function
1	ECM CLG-B (89)	Injector #4 Control
2	Main Relay	Battery Power (B+)

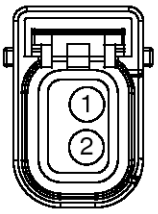
Injector #5 (CLG24-5)

Terminal	Connected to	Function
1	ECM CLG-B (86)	Injector #5 Control
2	Main Relay	Battery Power (B+)

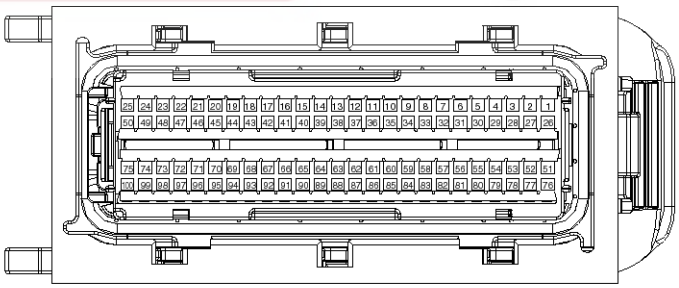
Injector #6 (CLG24-6)

Terminal	Connected to	Function
1	ECM CLG-B (88)	Injector #6 Control
2	Main Relay	Battery Power (B+)

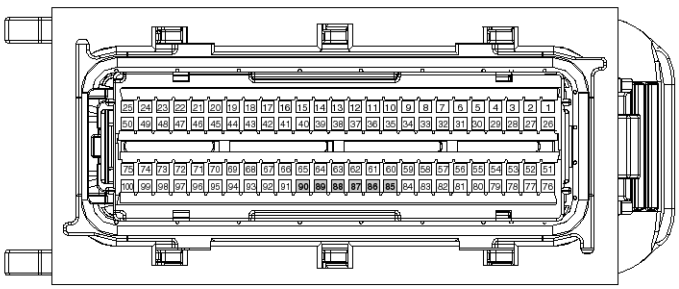
[Harness Connector]



CLG24-1,2,3,4,5,6
Injector #1,2,3,4,5,6



ELG-A



CLG-B
ECM

SVGFL0415L

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.

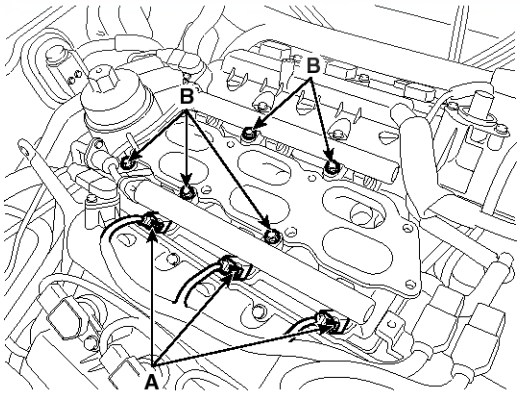
Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).

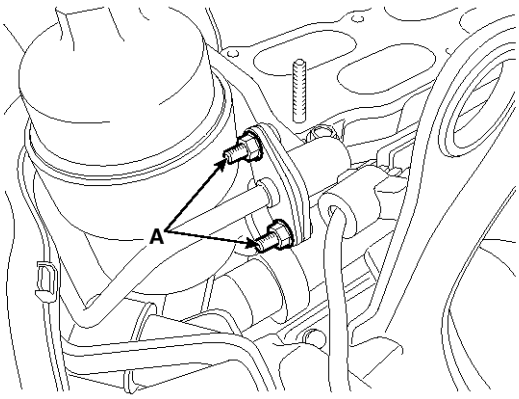
   CAUTION
   When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of “Release Residual Pressure in Fuel Line” work.
3. Remove the surge tank (Refer to “Intake And Exhaust System” in EM group).
4. Disconnect the injector [Bank 1] connector (A).

   NOTICE
   - *The injector [Bank 2] connector was disconnected when removing the surge tank.*
5. Remove the delivery pipe installation bolts (B).



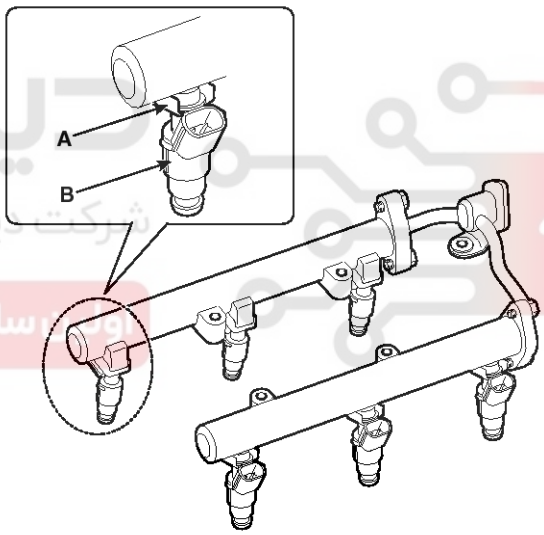
SVIFL9144D

6. Remove the installation nuts (A), and then remove the delivery pipe & injector assembly from the engine.



SVIFL9145D

7. Remove the fixing clip (A), and then separate the injector (B) from the delivery pipe.



SVIFL9146D

Installation

⚠CAUTION
- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

⚠CAUTION
- **Apply the engine oil to the injector O-ring.**

⚠CAUTION
- **Inspect the injector O-ring when installing.**

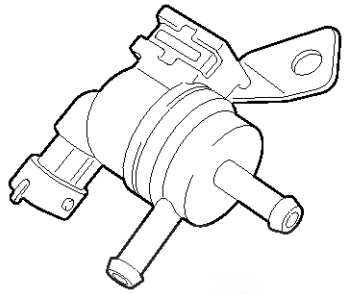
1. Installation is reverse of removal.

Delivery pipe installation bolt:
8.8 ~ 11.8 N.m (0.9 ~ 1.2 kgf.m, 6.5 ~ 8.7 lb-ft)

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.



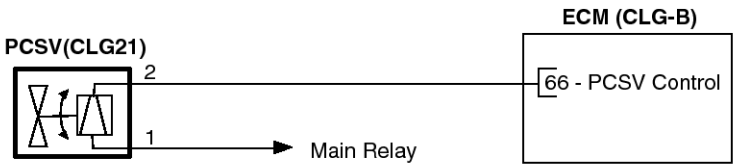
SCMF20241L

Specification

Item	Specification
Coil Resistance (Ω)	22.0 ~ 26.0 [20℃(68°F)]

Circuit Diagram

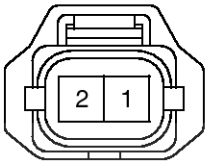
[Circuit Diagram]



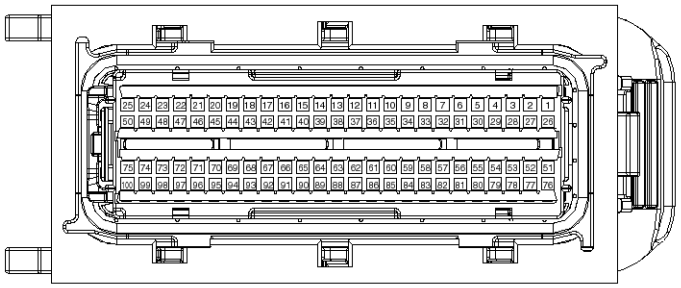
[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Battery Power(B+)
2	ECM CLG-B (66)	PCSV Control

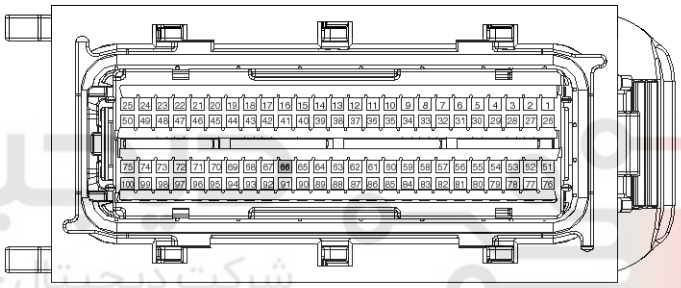
[Harness Connector]



CLG21
PCSV



ELG-A



CLG-B
ECM

SVGFL0416L

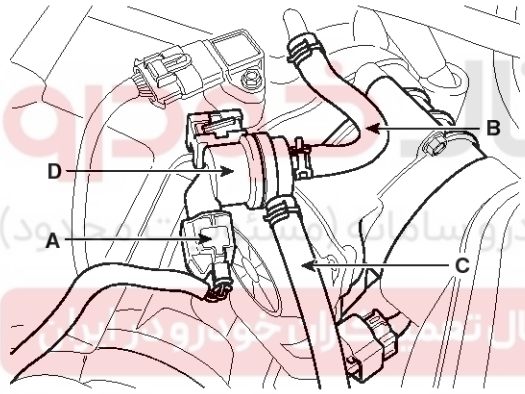
Inspection

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”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the purge control solenoid valve connector (A).
3. Disconnect the vapor hoses (B, C) from the purge control solenoid valve.
4. Remove the valve (B) from the bracket.



SCMF20052L

Installation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

⚠CAUTION

- **Be careful of foreign material not to flow into the valve.**

1. Installation is reverse of removal.

Purge control solenoid valve bracket installation bolt: 7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m 5.8 ~ 8.7 lb-ft)

CVVT Oil Control Valve (OCV)

Description

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

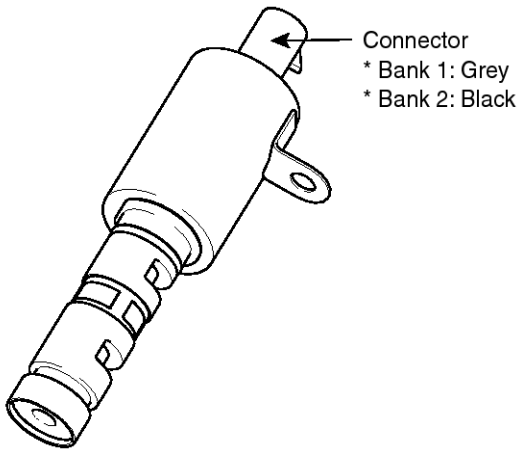
This system consist of

- the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or runs out the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,

- the CVVT Oil Temperature Sensor (OTS) which measures the engine oil temperature,

- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

The engine oil getting out of the CVVT oil control valve varies the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.



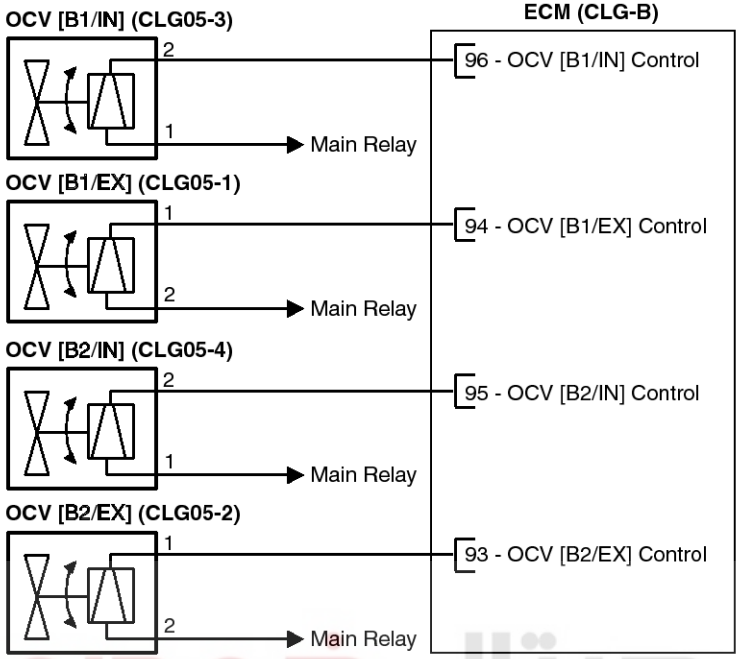
SBHFL9143L

Specification

Item	Specification
Coil Resistance (Ω)	9.4 ~ 10.4 [20℃(68˚F)]

Circuit Diagram

[Circuit Diagram]



[Connection Information]

OCV [Bank 1/Intake] (CLG05-3)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CLG-B (96)	OCV [B1/IN] Control

OCV [Bank 1/Exhaust] (CLG05-1)

Terminal	Connected to	Function
1	ECM CLG-B (94)	OCV [B1/EX] Control
2	Main Relay	Battery Power (B+)

OCV [Bank 2/Intake] (CLG05-4)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CLG-B (95)	OCV [B2/IN] Control

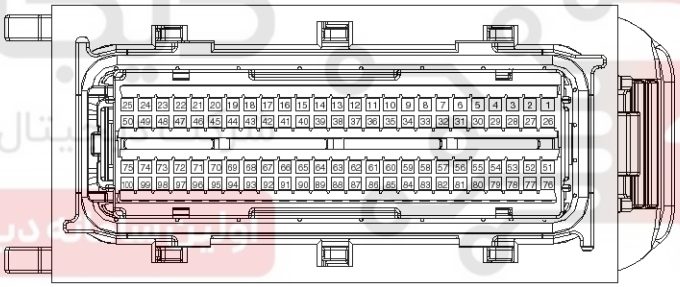
OCV [Bank 2/Exhaust] (CLG05-2)

Terminal	Connected to	Function
1	ECM CLG-B (93)	OCV [B2/EX] Control
2	Main Relay	Battery Power (B+)

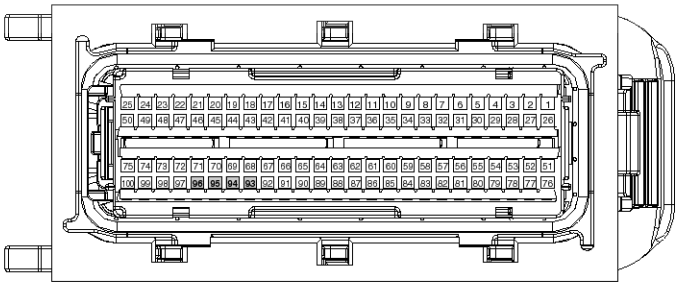
[Harness Connector]

CLG05-3
CLG05-4
OCV [Bank 1/Intake]
OCV [Bank 2/Intake]

CLG05-1
CLG05-2
OCV [Bank 1/Exhaust]
OCV [Bank 2/Exhaust]



ELG-A



CLG-B
ECM

SVGFL0417L

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.

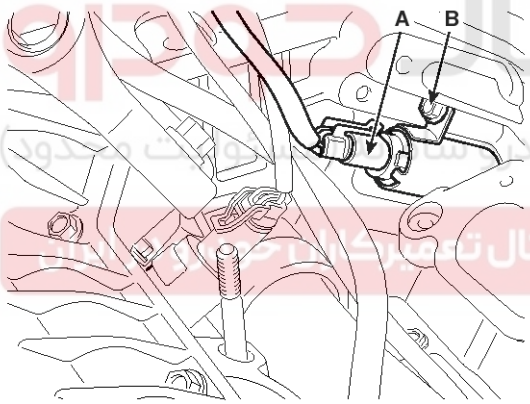
Specification: Refer to “Specification”

Removal

[CVVT Oil Control Valve (Intake)]

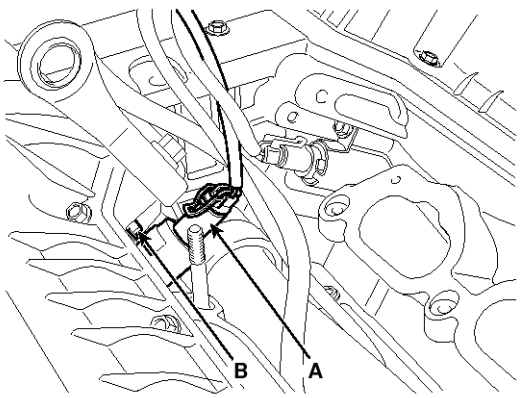
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the intake manifold (Refer to “Intake And Exhaust System” in EM group).
3. Disconnect the CVVT oil control valve connector (A).
4. Remove the installation bolt (B), and then remove the valve from the engine.

[Bank 1]



SCMF20251L

[Bank 2]

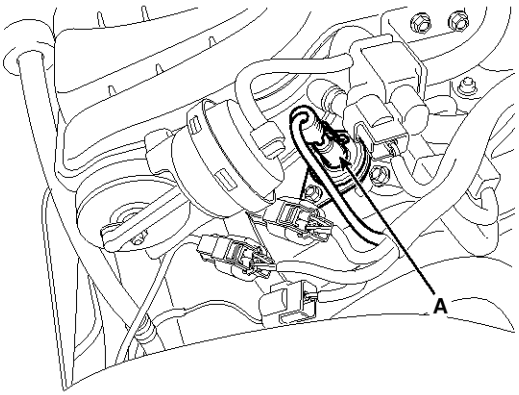


SCMF20252L

[CVVT Oil Control Valve (Exhaust)]

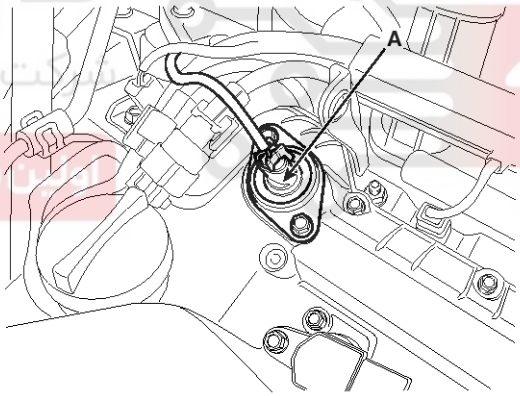
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the CVVT oil control valve connector (A).

[Bank 1]



SCMF20193L

[Bank 2]

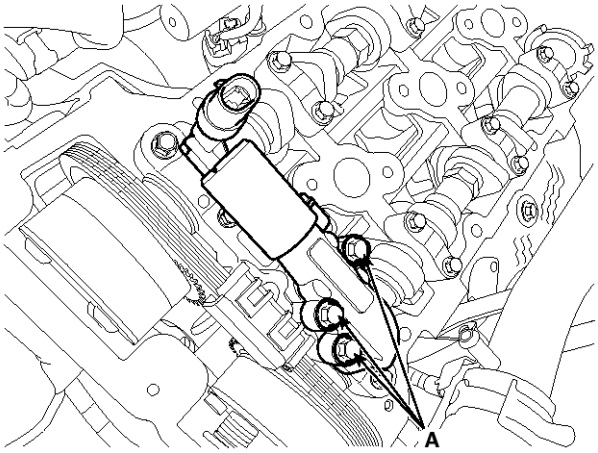


SCMF20262L

3. Remove the cylinder head cover (Refer to “Cylinder Head Assembly” in EM group).

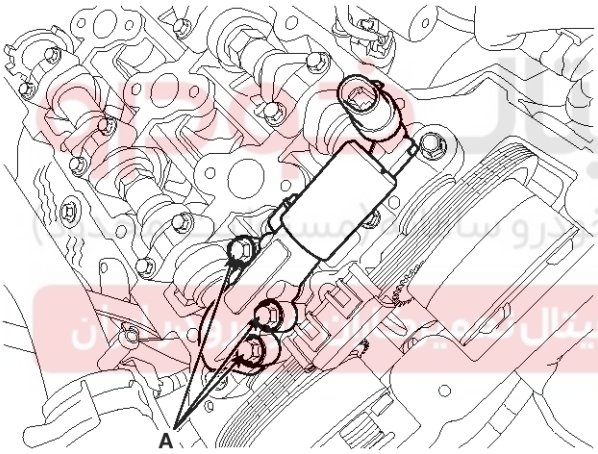
4. Remove the installation bolt (A), and then remove the valve from the engine.

[Bank 1]



SBHFL8159D

[Bank 2]



SCMF20005L

Inatallation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.**

⚠CAUTION

- **Apply the engine oil to the valve O-ring.**

⚠CAUTION

- **Exactly distinguish the color of the valve and harness connectors in bank 1 and 2 when installing, or the engine will operate abnormally (Refer to the table below).**

Items	Component Side	Harness Side
Bank 1 (RH)	Grey	
Bank 2 (LH)	Black	

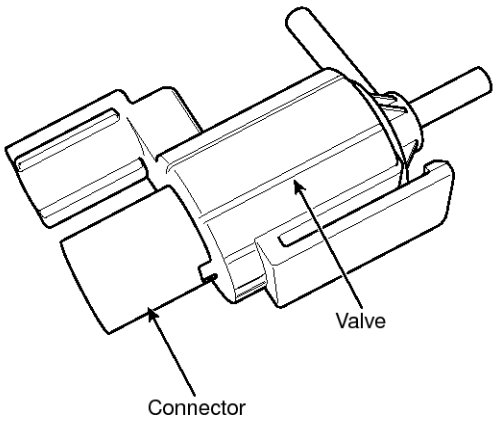
1. Installation is reverse of removal.

CVVT oil control valve installation bolt:
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Variable Intake Solenoid (VIS) Valve

Description

Variable Intake manifold Solenoid (VIS) valves are installed on the intake manifold (VIS Valve 1) and the surge tank (VIS Valve 2). These VIS valve 1 and 2 control vacuum modulators which activate valves in the intake manifold and the surge tank. These valves are opened or closed by ECM according to engine condition (Refer to below table).



SBHFL9215L

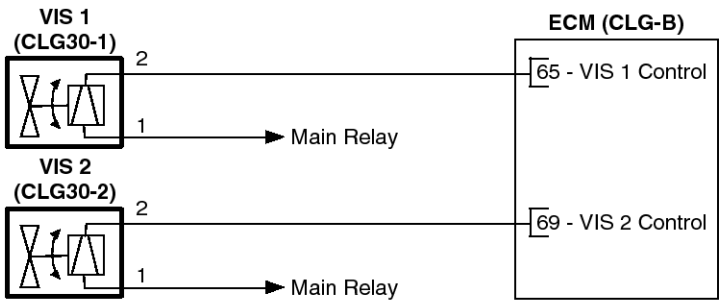
Engine Condition	VIS Valve #1 (In-manifold)	VIS Valve #2 (Surge Tank)
Low Speed	Open	Open
Medium Speed	Close	Close
High Speed	Close	Open
High End Speed	Open	Open

Specification

Item	Specification
Coil Resistance (Ω)	30.0 ~ 35.0 [20℃(68˚F)]

Circuit Diagram

[Circuit Diagram]



[Connection Information]

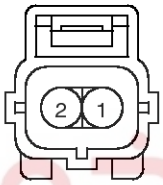
VIS Valve 1 (CLG 30-1)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CLG-B (65)	VIS Valve 1 Conrtol

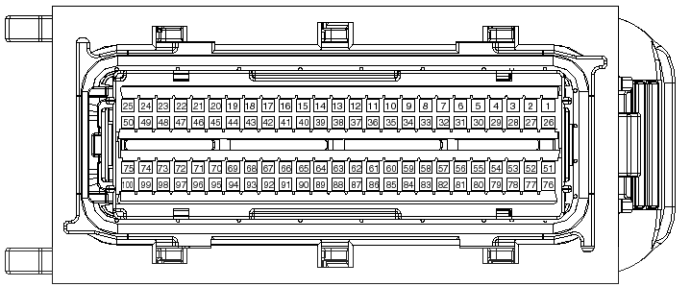
VIS Valve 1 (CLG 30-2)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CLG-B (69)	VIS Valve 2 Conrtol

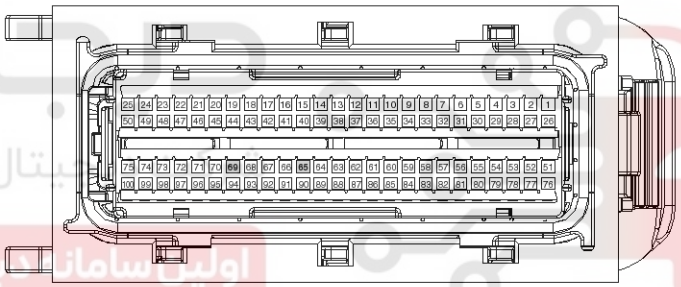
[Harness Connector]



CLG30-1
CLG30-2
VIS Valve 1
VIS Valve 2



ELG-A



CLG-B
ECM

SVGFL0418L

Inspection

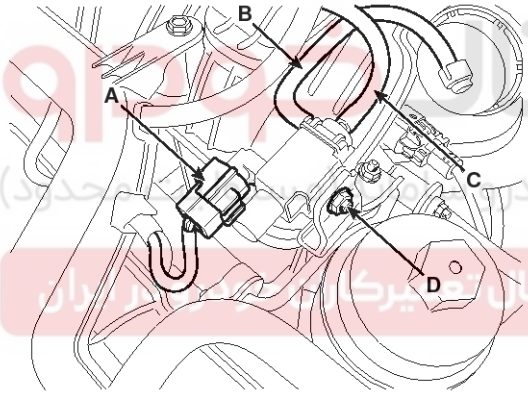
1. Turn the ignition switch OFF.
2. Disconnect the VIS valve connector.
3. Measure resistance between the VIS valve terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

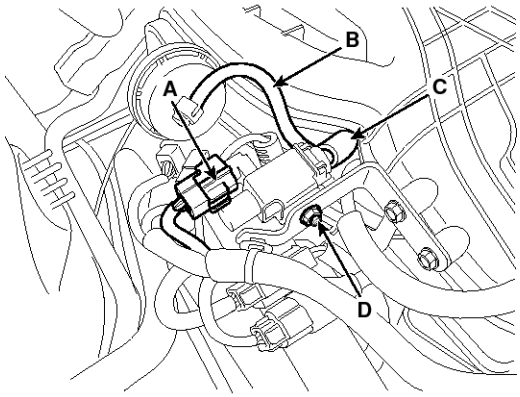
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the variable intake solenoid valve connector (A).
3. Disconnect the vacuum hoses (B, C) from the valve.
4. Remove the installation nut (D), and then remove the valve from the surge tank.

[Valve 1 (Inatake Manifold)]



SCMF20271L

[Valve 2 (Surge Tank)]



SCMF20281L

Installation

⚠CAUTION

- **Install the component with the specified torques.**
- **Note that internal damage may occur when the component is dropped. If the component has been dropped, inspect before installing.**

⚠CAUTION

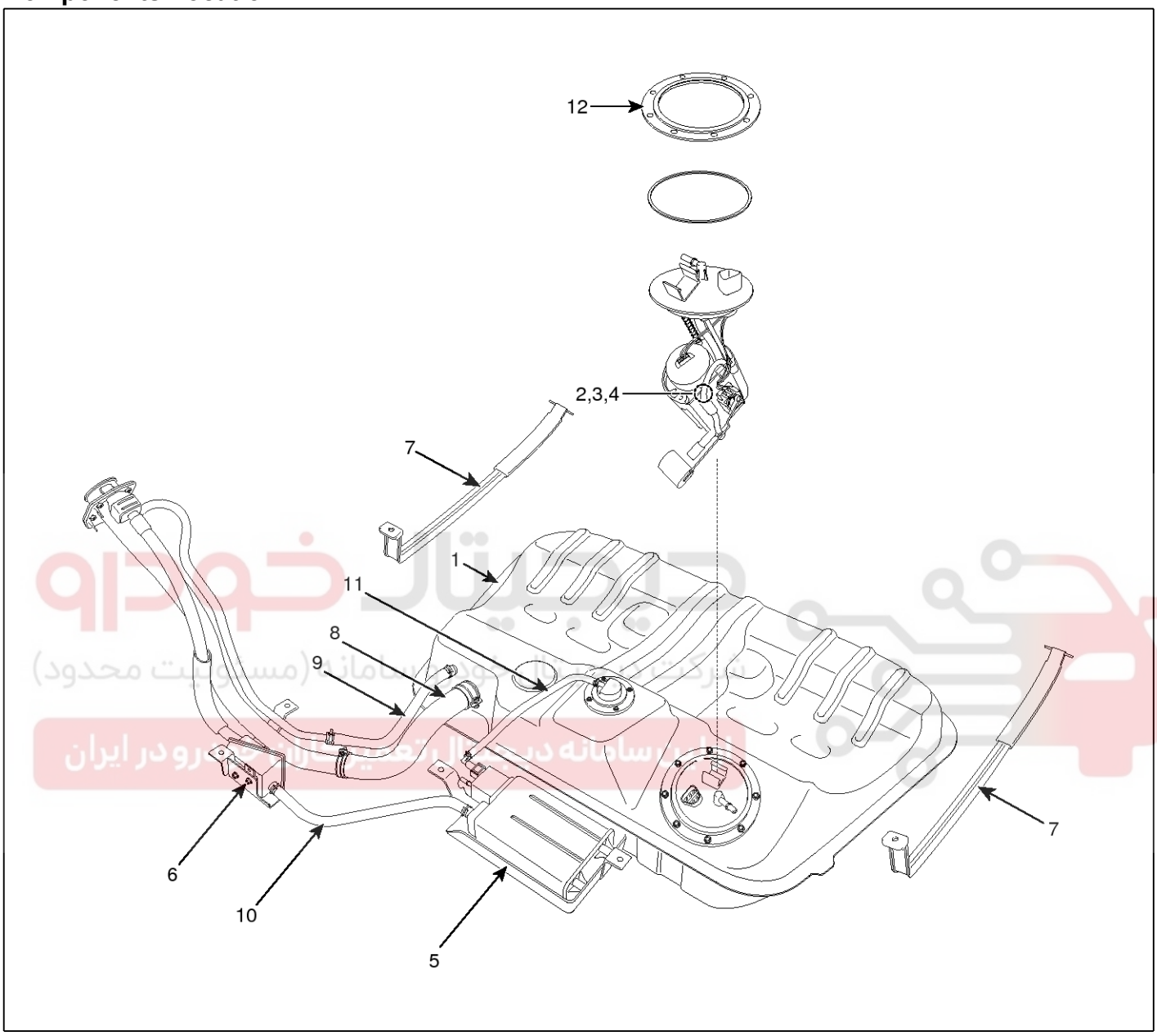
- **Be careful of foreign material not to flow into the valve.**

1. Installation is reverse of removal.

Variable intake solenoid valve installation nut:
5.4 ~ 8.3 N.m (0.6 ~ 0.9 kgf.m, 4.0 ~ 6.2 lb-ft)

Fuel Delivery System

Components Location



SYFFL0122L

1. Fuel Tank
2. Fuel Pump
3. Fuel Filter
4. Fuel Pressure Regulator
5. Canister
6. Fuel Tank Air Filter
7. Fuel Tank Band
8. Fuel Filler Hose
9. Leveling Hose
10. Ventilation Hose
11. Vapor Tube
12. Fuel Pump Plate Cover

Fuel Pressure Test

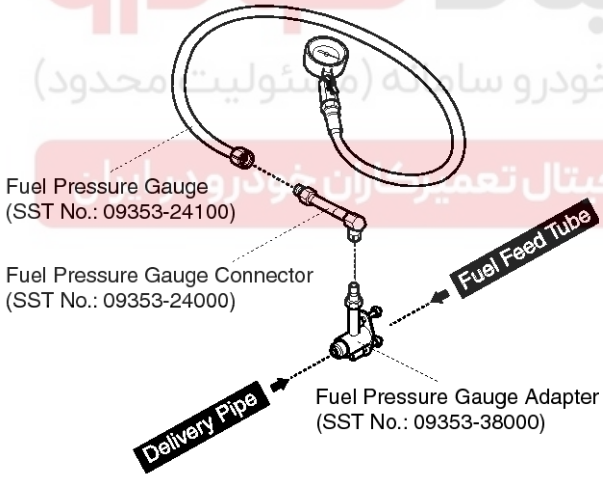
1. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).

   ⚠CAUTION
   When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of “Release Residual Pressure in Fuel Line” work.

2. Install the Special Service Tool (SST).
   1) Disconnect the fuel feed tube from the delivery pipe.

      ⚠CAUTION
      There may be some residual pressure even after “Release Residual Pressure in Fuel Line” work, so cover the hose connection with a shop towel to prevent residual fuel from spilling out before disconnecting any fuel connection.

   2) Install the special service tool for measuring the fuel pressure in between the fuel feed tube and the fuel delivery pipe (Refer to the figure below).



STDFL0144N

3. Inspect fuel leakage on connections among the fuel feed tube, the delivery pipe, and the SST components with IG ON.
4. Measure Fuel Pressure.
   1) Start the engine and measure the fuel pressure at idle.

Fuel Pressure: 380 kPa (3.87 kgf/㎠, 55.0 psi)

NOTICE
If the fuel pressure differs from the standard value, repair or replace the related part (Refer to the table below).

Fuel Pressure	Cause	Related Part
Too Low	Fuel filter clogged	Fuel Filter
	Fuel leakage	Fuel Pressure Regulator
Too High	Fuel pressure regulator valve stuck	Fuel Pressure Regulator

   2) Stop the engine, and then check for the change in the fuel pressure gauge reading.

Standard Value: The gauge reading should hold for about 5 minutes after the engine stops

NOTICE
If the gauge reading should not be held, repair or replace the related part (Refer to the table below).

Fuel Pressure (After Engine Stops)	Cause	Related Part
Fuel Pressure Drops Slowly	Leakage on injector	Injector
Fuel Pressure Drops Immediately	Check valve of fuel pump stuck open	Fuel Pump

   3) Turn the ignition switch OFF.
5. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line”).

   ⚠CAUTION
   When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of “Release Residual Pressure in Fuel Line” work.

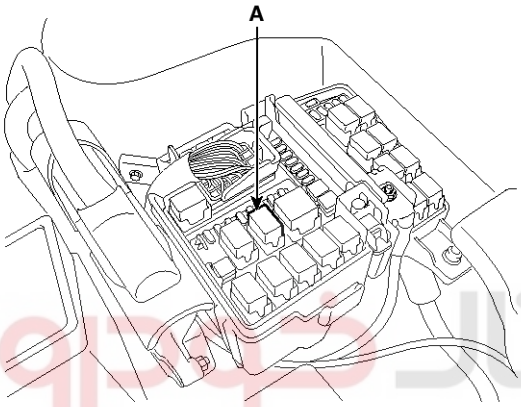
6. Test End
   1) Remove the Special Service Tool (SST) from the fuel feed tube and the delivery pipe.
   2) Connect the fuel feed tube and the delivery pipe.

Release Residual Pressure in Fuel Line

⚠CAUTION

There may be some residual pressure even after "Release Residual Pressure in Fuel Line" work, so cover the hose connection with a shop towel to prevent residual fuel from spilling out before disconnecting any fuel connection.

1. Turn the ignition switch OFF and disconnect the battery (-) cable.
2. Remove the fuel pump relay (A).



SYFFL0181D

⚠CAUTION

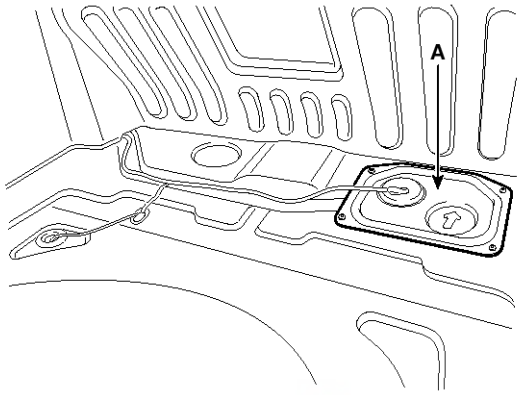
When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of "Release Residual Pressure in Fuel Line" work.

3. Connect the battery (-) cable.
4. Start the engine and let idle, and then turn the ignition switch OFF after the engine has stopped on its own.
5. Disconnect the battery (-) cable, and then install the fuel pump relay (A).
6. Connect the battery (-) cable.
7. Delete the Diagnostic Trouble Code (DTC) related the fuel pump relay with the GDS.

Fuel Tank

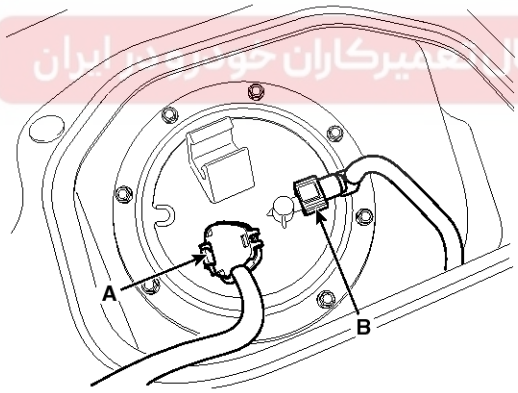
Removal

1. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).
2. Open the trunk and remove the floor mat.
3. Remove the fuel pump service cover (A).



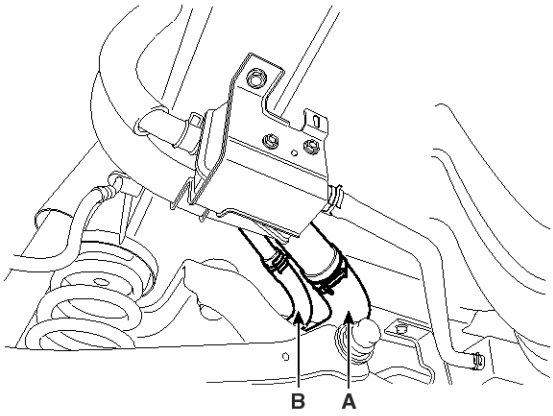
SYFFL0220D

4. Disconnect the fuel pump connector (A).
5. Disconnect the fuel feed tube quick connector (B).



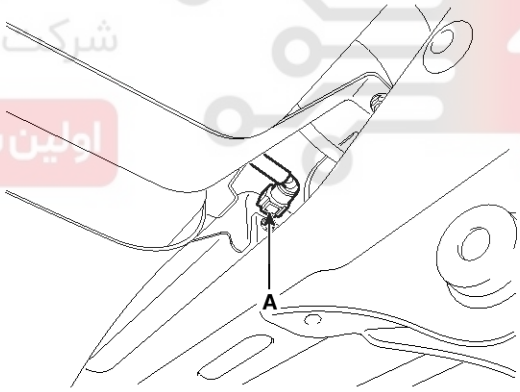
SYFFL0100L

6. Lift the vehicle and support the fuel tank with a jack.
7. Remove the center muffler assembly (Refer to “Intake And Exhaust System” in EM group).
8. Disconnect the fuel filler hose (A) and leveling hose (B).



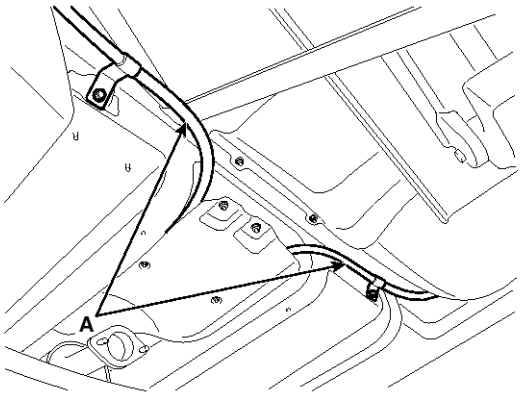
SYFFL0142L

9. Disconnect the vapor hose quick-connector (A).



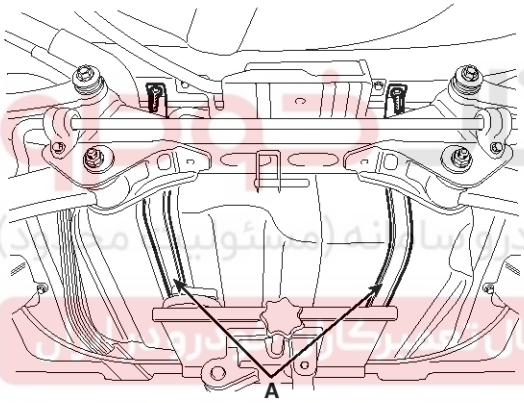
SYFFL0110L

10. Remove the brake line bracket (A).



SYFFL0120L

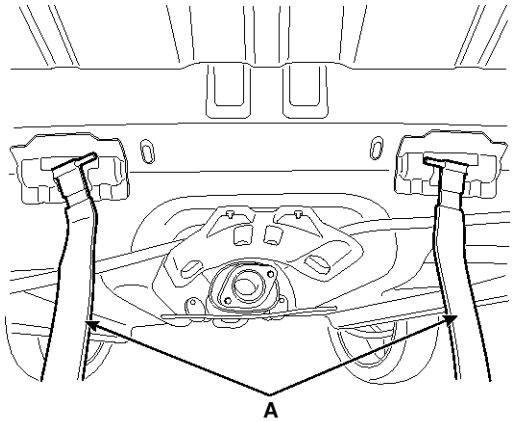
11. Remove the fuel tank from the vehicle after removing the fuel tank band (A).



SYFFL0130L

NOTICE

Remove the fuel tank band as below.



SYFFL0260D

Installation

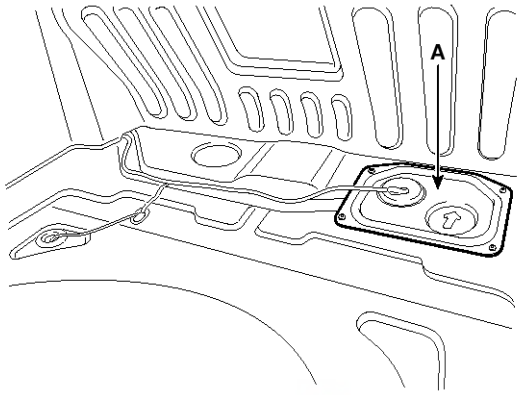
1. Installation is reverse of removal.

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

Fuel Pump

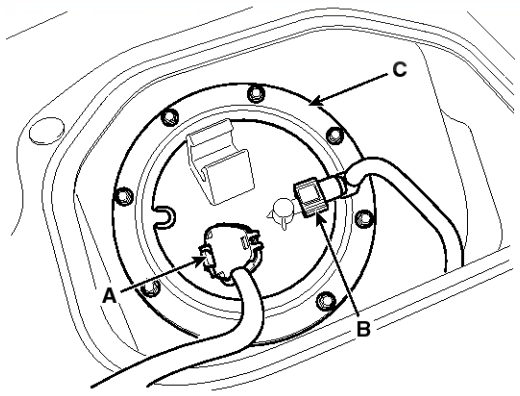
Removal

1. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).
2. Open the trunk and remove the floor mat.
3. Remove the fuel pump service cover (A).

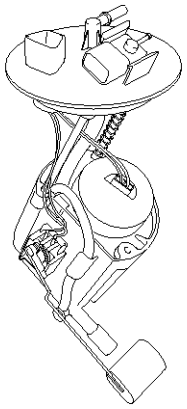


SYFFL0220D

4. Disconnect the fuel pump connector (A).
5. Disconnect the fuel feed tube quick connector (B).
6. Remove the plate cover (C) after removing the installation bolt, and then remove the fuel pump from the fuel tank.



SYFFL0101L



SYFFL0123D

Installation

1. Installation is reverse of removal.

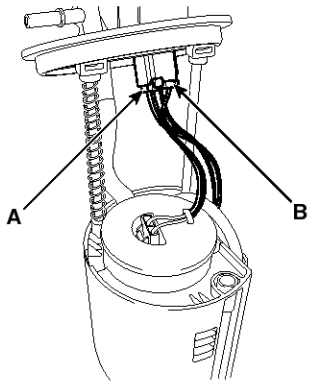
Fuel pump plate cover installation bolt:
2.0 ~ 2.9 N.m (0.2 ~ 0.3 kgf.m, 1.4 ~ 2.2 lb-ft)

⚠CAUTION
Be careful of fuel pump direction when installing (Refer to the groove in the fuel tank).

Fuel Filter

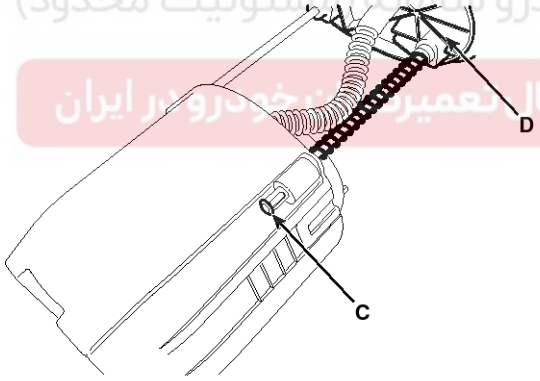
Replacement

1. Remove the fuel pump (Refer to “Fuel Pump” in this group).
2. Disconnect the electric pump wiring connector (A) and the fuel sender connector (B).



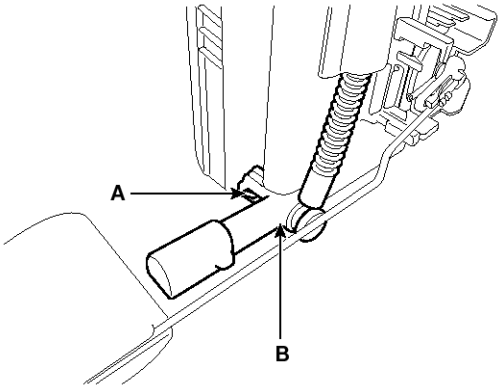
SYFFL0280D

3. Remove the cushion pipe fixing clip (C), and then separate the head assembly (D).



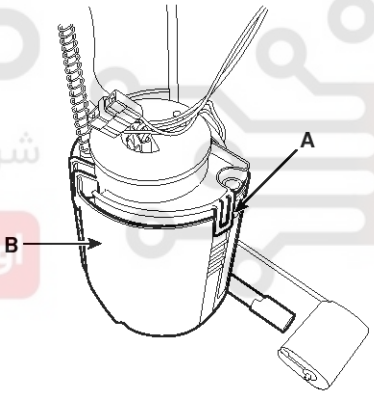
SYFFL0290D

4. Remove the return nozzle (B) after releasing the fixing hook (A).



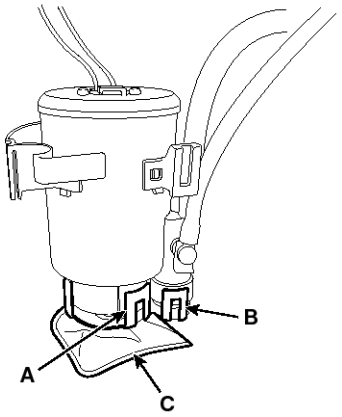
SYFFL0310D

5. Remove the reservoir-cup (B) after releasing the fixing hooks (A).



SYFFL0300D

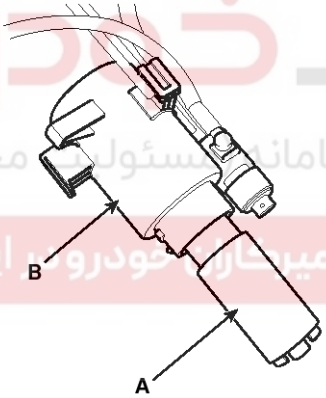
6. Remove the pre-filter (C) after releasing the fixing hooks (A,B).



SYFFL0320D

⚠CAUTION
Be careful of O-ring.

7. Separate the electric pump motor (A) from the fuel filter (B).



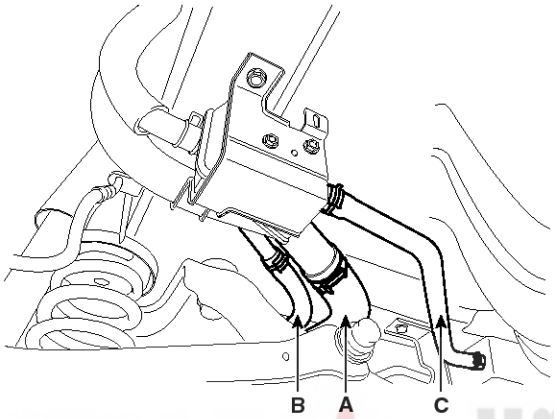
SYFFL0330D

8. Replace new fuel filter.

Filler-Neck Assembly

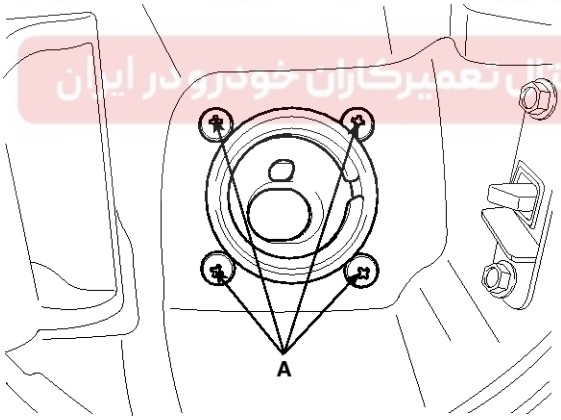
Removal

1. Lift the vehicle.
2. Disconnect the fuel filler hose (A) and the leveling hose (B).
3. Disconnect the ventilation hose (C) from the fuel tank air filter.



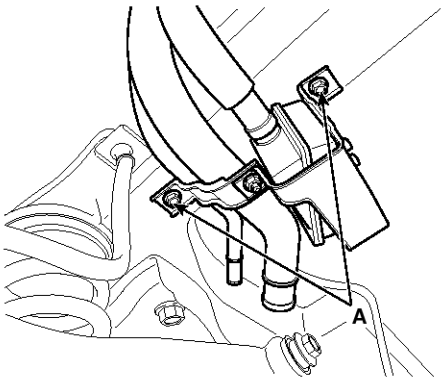
SYFFL0141L

4. Open the fuel filler door and then remove the filler-neck installation screw (A).



SYFFL0024D

5. Remove the rear-LH wheel, tire, and the inner wheel house.
6. Remove the filler-neck assembly from the vehicle after removing the bracket installation bolt (A).



SYFFL0270D

Installation

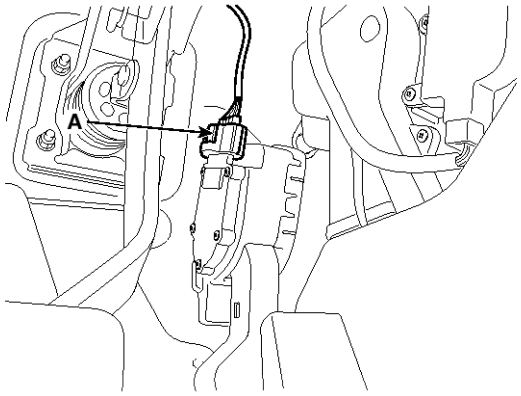
1. Installation is reverse of removal.

Filler-neck assembly bracket installation bolt :
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Accelerator Pedal

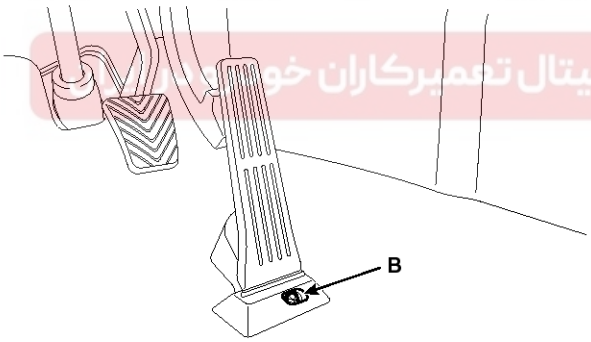
Removal

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

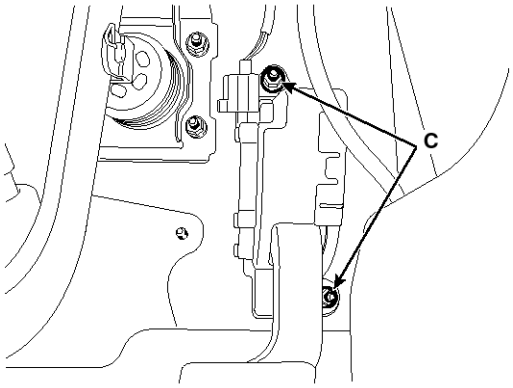


SLMF10409D

3. Remove the installation bolt (B) and nuts (C), and then remove the accelerator pedal module.



SXMF19192D



SLMF10240D

Installation

1. Installation is reverse of removal.

Accelerator pedal module installation bolt:
8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)
Accelerator pedal module installation nut:
12.8 ~ 15.7 N.m (1.3 ~ 1.6 kgf.m, 9.4 ~ 11.6 lb-ft)

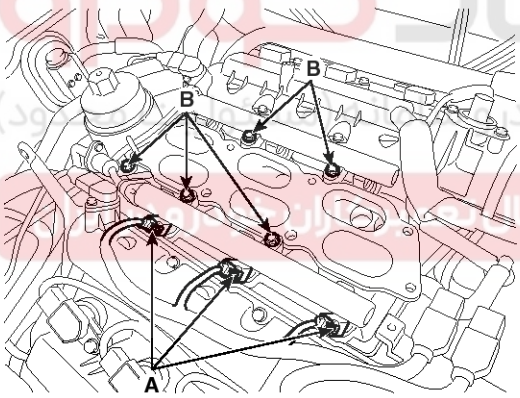
Delivery Pipe

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).

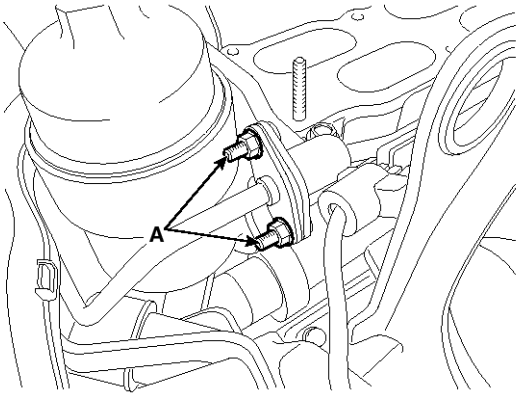
   CAUTION
   When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of “Release Residual Pressure in Fuel Line” work.
3. Remove the surge tank (Refer to “Intake And Exhaust System” in EM group).
4. Disconnect the injector [Bank 1] connector (A).

   NOTICE
   The injector [Bank 2] connector was disconnected when removing the surge tank.
5. Remove the delivery pipe installation bolts (B).

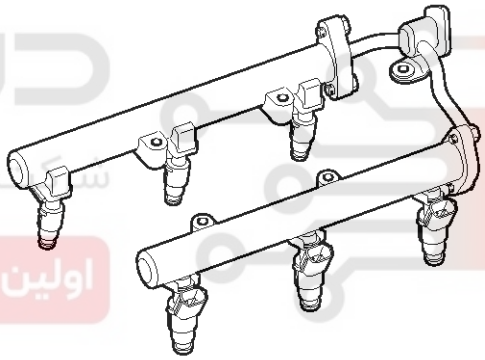


SVIFL9144D

6. Remove the installation nuts (A), and then remove the delivery pipe & injector assembly from the engine.



SVIFL9145D



SVIFL9161D

Installation

1. Installation is reverse of removal.

Delivery pipe installation bolt:
8.8 ~ 11.8 N.m (0.9 ~ 1.2 kgf.m, 6.5 ~ 8.7 lb-ft)