General Information

Specifications

Fuel delivery system

Items	Specification	
Fuel Tank	Capacity	62liter. (65.5 US.qt, 54.5 Imp.qt)
Fuel Filter (built in Fuel Pump Assembly)	Type	Paper type
Fuel Pressure Regulator (built in Fuel Pump Assembly)	Regulated Fuel Pressure	338 ~ 348kpa(3.45 ~ 3.55kgf/㎠, 49.0 ~ 50.5psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor
Fuel Retrun System	Pressure	Returnless

Sensors

Manifold Absolute Pressure Sensor (MAPS)

▷ Type: Piezo-resistive pressure sensor type

▷ Specification

Pressure (kPa)	Output voltage (V)
20	0.79
46.7	1.84
101.32	4

Intake Air Temperature Sensor (IATS)

▷ Type: Thermistor type

▷ Specification

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

Engine Coolant Temperature Sensor (ECTS)

▷ Type: Thermistor type

▷ Specification

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

Throttle Position Sensor (TPS) [2.0 DOHC]

▷ Type : Variable Resistor type

▷ Specification

Test Condition	Output voltage (V)
C.T	0.2 ~ 0.325
W.O.T	4.7

Item	Specification
Sensor Resistance (kΩ)	1.6 ~ 2.4

Throttle Position Sensor (TPS)

▷ Type: Variable resistor type

▷ Specification

Throttle angle (˚)	Output voltage (V) [Vref = 5.0V]	
	TPS1	TPS2
0	0	5.00
10	0.48	4.52
20	0.95	4.05
30	1.43	3.57
40	1.9	3.10
50	2.38	2.62
60	2.86	2.14
70	3.33	1.67
80	3.81	1.19
90	4.29	0.71
100	4.76	0.24
105	5	0
C.T (6~15˚)	0.3 ~ 0.7	4.3 ~ 4.7
W.O.T (93~102˚)	4.45 ~ 4.85	0.15 ~ 0.55

Items	Sensor resistance (kΩ)
TPS1	0.875 ~ 1.625
TPS2	0.875 ~ 1.625

Heated Oxygen Sensor (HO2S)

▷ Type: Zirconia (ZrO2) type

▷ Specification

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

Items	Specification
Heater Resistance (Ω)	3.1 ~ 4.1 [20℃(68˚F)]

Camshaft Position Sensor (CMPS) #1 [Intake]

▷ Type: Hall effect type

Camshaft Position Sensor (CMPS) #2 [Exhaust]

▷ Type: Hall effect type

Crankshaft Position Sensor (CKPS)

▷ Type: Magnetic field sensitive type

Knock Sensor (KS)

▷ Type: Piezo-electricity type

▷ Specification

Items	Specification
Capacitance (pF)	1,480 ~ 2,200
Resistance(MΩ)	1

Accelerator Position Sensor (APS)

▷ Type: Variable resistor type

▷ Specification

Pedal Position	Output voltage (V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

Items	Sensor resistance (kΩ)
APS1	0.7 ~ 1.3 [20℃(68˚F)]
APS2	1.4 ~ 2.6 [20℃(68˚F)]

Actuators

Injector

▷ Number: 4

▷ Specification

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

Purge Control Solenoid Valve (PCSV)

▷ Specification

Items	Specification
Coil Resistance (Ω)	19.0 ~ 22.0 [20℃(68˚F)]

CVVT Oil Control Valve (OCV) #1 [Intake]

▷ Specification

Items	Specification
Coil Resistance (Ω)	6.9 ~ 7.9 [20℃(68˚F)]

CVVT Oil Control Valve (OCV) #2 [Exhaust]

▷ Specification

Items	Specification
Coil Resistance (Ω)	6.9 ~ 7.9 [20℃(68˚F)]

Ignition Coil

▷ Type: Stick type

▷ Specification

Items	Specification
Primary Coil Resistance (Ω)	0.62 ± 10%[20℃(68˚F)]
Secondary Coil Resistance (kΩ)	7.0 ± 15%[20℃(68˚F)]

ETC Motor

▷ Specification

Item	Specification
Coil Resistance (Ω)	1.2 ~ 1.8 [20℃(68˚F)]

Variable Intake Solenoid (VIS) Valve

▷ Specification

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

Service standard

Ignition Timing	BTDC 8° ± 5°		
Idle Speed	A/CON OFF	Neutral,N,P-range	620 ± 100 rpm
		D-range	
	A/CON ON	Neutral,N,P-range	
		D-range	

Tightening torques

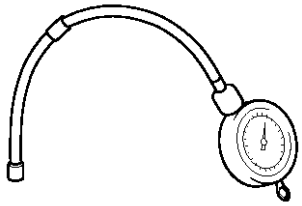
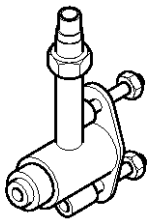
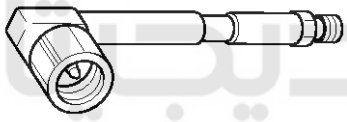
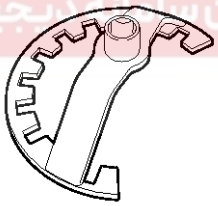
Engine control system

Item	Kgf.m	N.m	lb-ft
PCM bracket installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Manifold absolute pressure sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Engine coolant temperature sensor installation	3.0 ~ 4.0	29.4 ~ 39.2	21.7 ~ 28.9
Throttle position sensor installation screws	0.15 ~ 0.25	1.5 ~ 2.5	1.1 ~ 1.8
Crankshaft position sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Crankshaft position sensor - target wheel installaion screw	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Camshaft position sensor #1, #2 installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Knock sensor installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
Heated oxygen sensor (Bank 1 / Sensor 1) installation	3.5 ~ 4.5	34.3 ~ 44.1	25.3 ~ 32.6
Heated oxygen sensor (Bank 1 / Sensor 2) installation	3.5 ~ 4.5	34.3 ~ 44.1	25.3 ~ 32.6
CVVT Oil control valve #1, #2 installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Purge control solenoid valve installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
ETC (Electronic throttle control) module installation bolt	0.8 ~ 1.0	7.8 ~ 9.8	5.8 ~ 7.2
Ignition coil assembly installation bolts	0.4 ~0.6	3.9 ~ 5.9	2.9 ~ 4.3

Fuel delivery system

Items	kgf·m	N·m	lb-ft
Fuel tank band installation nuts	4.0 ~ 5.5	39.2 ~ 53.9	28.9 ~ 39.8
Fuel pump plate cover installation	6.0 ~ 7.0	58.8 ~ 68.6	43.4 ~ 50.6
Accelerator pedal installation nuts	1.3 ~ 1.6	12.8 ~ 15.7	9.4 ~ 11.6
Delivery pipe installation	2.0 ~ 2.5	19.6 ~ 24.5	14.5 ~ 18.1

Special service tools

Tool (Number and name)	Illustration	Application
09351-27210 Injector Remover Adapter	 EFDA003A	Removing the injector
09351-4A200 Injector Remover	 BF1A025D	Removing the injector
09314-27110(14mm) 09314-27120(17mm) Torque Wrench Socket	 EFDA003C	Installing the high pressure pipe
09310-2B100 Fuel Pump Plate Cover Wrench	 SCMFL6666D	Removing and Installing the fuel pump assembly

Basic Troubleshooting

Basic Troubleshooting Guide

1	**Bring Vehicle to Workshop**

2	**Analyze Customer's Problem**

- Ask the customer about the conditions and environment relative to the issue (Use CUSTOMER PROBLEM ANALYSIS SHEET).

3	**Verify Symptom, and then Check DTC and Freeze Frame Data**

- Connect Hi-Scan (Pro) to Diagnostic Link Connector (DLC).
- Record the DTC and freeze frame data.

NOTE

To erase DTC and freeze frame data, refer to Step 5.

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

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

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

WARNING

NEVER erase DTC and freeze frame data before completing Step 2 MIL/DTC in "CUSTOMER PROBLEM ANALYSIS SHEET".

6	**Inspect Vehicle Visually**

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

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

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

8	**Confirm Symptoms of Problem**

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

9	**Recreate (Simulate) Symptom**

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

10	**Check the DTC**

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

11	**Perform troubleshooting procedure for DTC**

12	**Adjust or repair the vehicle**

13	**Confirm test**

14	**END**

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Customer Problem Analysis Sheet

1. VEHICLE INFORMAITON

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

2. SYMPTOMS

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

3. ENVIRONMENT

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

4. MIL/DTC

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

5. ECM/PCM INFORMATION

ECM/PCM Part No.	
ROM ID	

SFDF28233L

Basic Inspection Procedure

Measuring Condition of Electronic Parts' Resistance

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

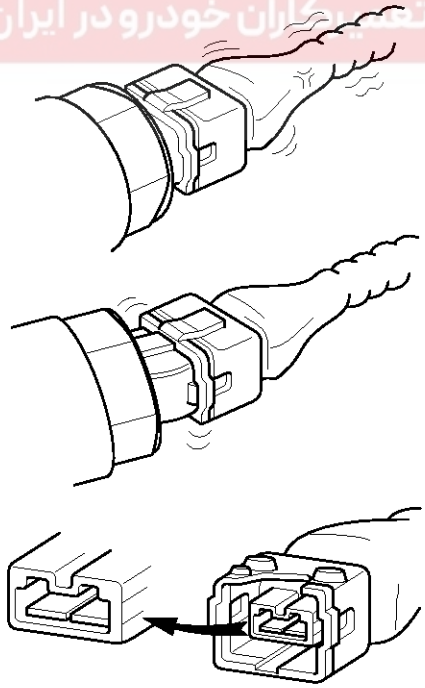
NOTICE

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

Intermittent Problem Inspection Procedure

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

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



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

● Simulating Vibration

a. Sensors and Actuators

: Slightly vibrate sensors, actuators or relays with finger.

WARNING

Strong vibration may break sensors, actuators or relays

b. Connectors and Harness

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

● Simulating Heat

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

WARNING

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

● Simulating Water Sprinkling

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

WARNING

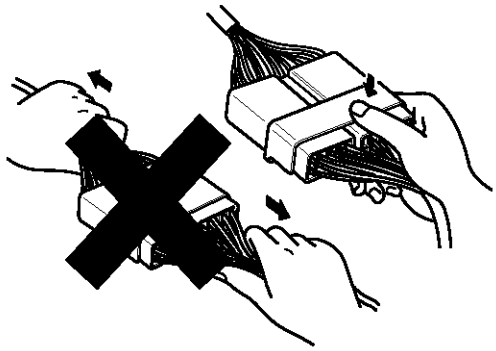
DO NOT sprinkle water directly into the engine compartment or electronic components.

● Simulating Electrical Load

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

Connector Inspection Procedure

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



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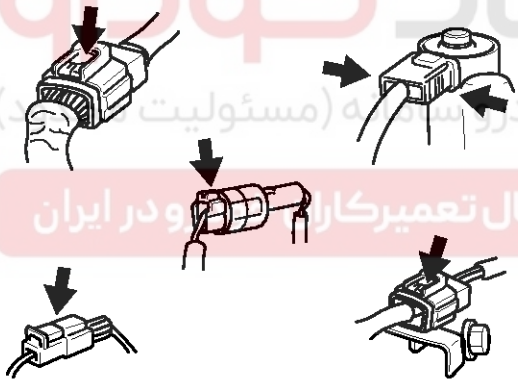
   b. When removing the connector with a lock, press or pull locking lever.



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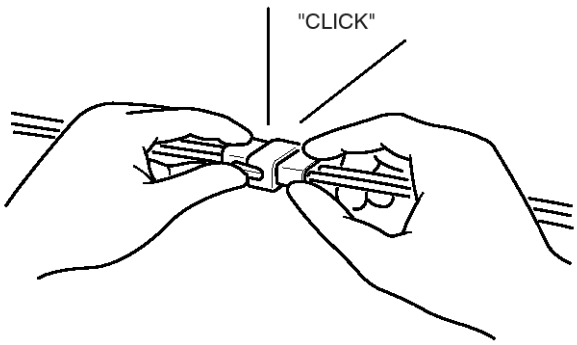
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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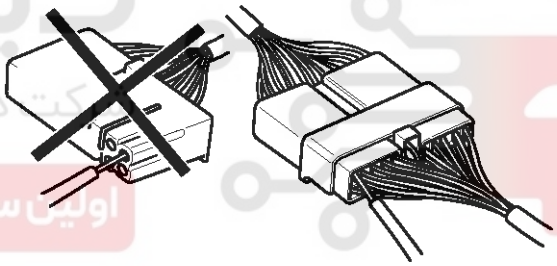
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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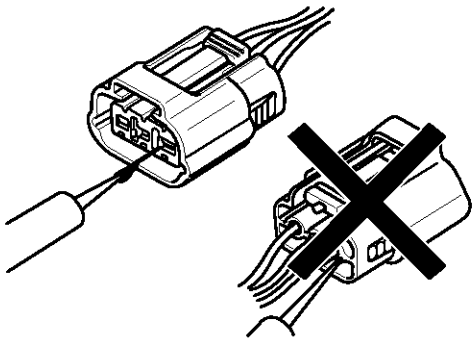
e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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NOTICE

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

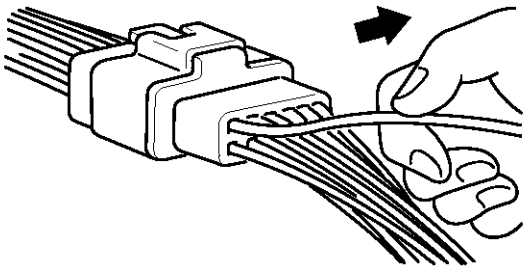
2. Checking Point for Connector

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

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

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

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



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3. Repair Method of Connector Terminal

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

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

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

Wire Harness Inspection Procedure

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

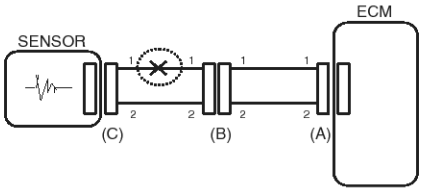
Electrical Circuit Inspection Procedure

● Check Open Circuit

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

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

FIG 1



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2. Continuity Check Method

NOTICE

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

Specification (Resistance)

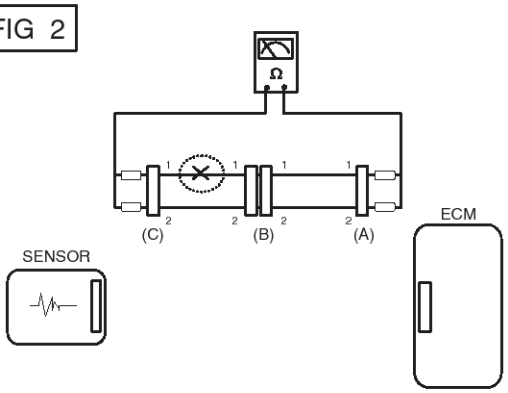
1Ω or less → Normal Circuit

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



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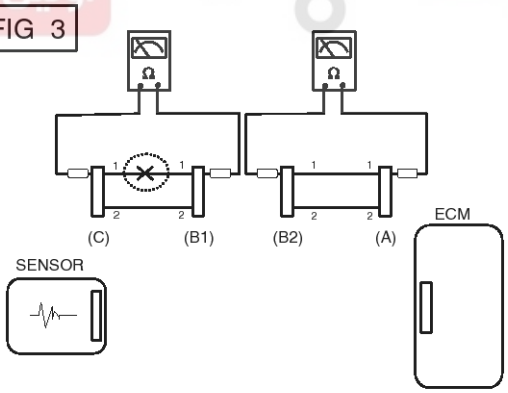
b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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

FIG 3



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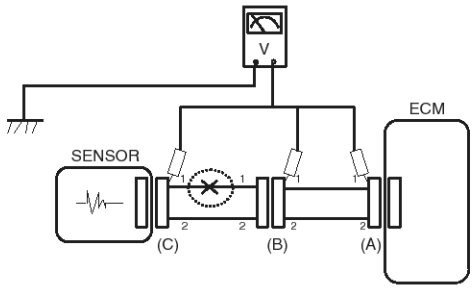
3. Voltage Check Method

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

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

FIG 4



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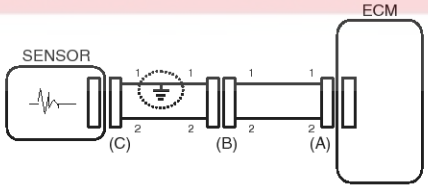
● Check Short Circuit

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

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

FIG 5



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2. Continuity Check Method (with Chassis Ground)

NOTICE

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

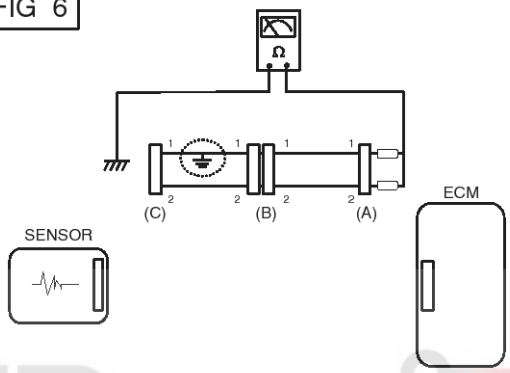
Specification (Resistance)

1Ω or less → Short to Ground Circuit
1MΩ or Higher → Normal Circuit

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

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

FIG 6



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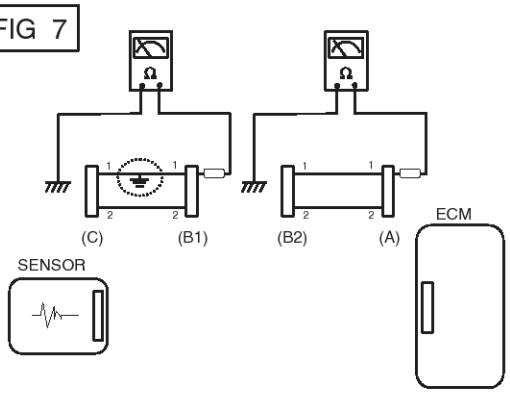
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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

FIG 7



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● Testing For Voltage Drop

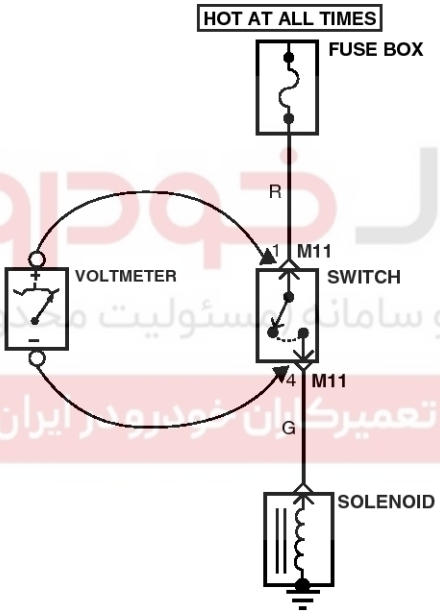
This test checks for voltage drop along a wire, or through a connection orswitch.

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.



SHMFL9331N

Symptom Troubleshooting Guide Chart

Main symptom	Diagnostic procedure	Also check for
Unable to start (Engine does not turn over)	1. Test the battery 2. Test the starter 3. Inhibitor switch (A/T) or clutch start switch (M/T)	
Unable to start (Incomplete combustion)	1. Test the battery 2. Check the fuel pressure 3. Check the ignition circuit 4. Troubleshooting the immobilizer system (In case of immobilizer lamp flashing)	• DTC • Low compression • Intake air leaks • Slipped or broken timing belt • Contaminated fuel
Difficult to start	1. Test the battery 2. Check the fuel pressure 3. Check the ECT sensor and circuit (Check DTC) 4. Check the ignition circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor idling (Rough, unstable or incorrect Idle)	1. Check the fuel pressure 2. Check the Injector 3. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM) 4. Check the idle speed control circuit (Check DTC) 5. Inspect and test the Throttle Body 6. Check the ECT sensor and circuit (Check DTC)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Engine stall	1. Test the Battery 2. Check the fuel pressure 3. Check the idle speed control circuit (Check DTC) 4. Check the ignition circuit 5. Check the CKPS Circuit (Check DTC)	• DTC • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor driving (Surge)	1. Check the fuel pressure 2. Inspect and test Throttle Body 3. Check the ignition circuit 4. Check the ECT Sensor and Circuit (Check DTC) 5. Test the exhaust system for a possible restriction 6. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Knocking	1. Check the fuel pressure 2. Inspect the engine coolant 3. Inspect the radiator and the electric cooling fan 4. Check the spark plugs	• DTC • Contaminated fuel
Poor fuel economy	1. Check customer's driving habitsIs · A/C on full time or the defroster mode on? · Are tires at correct pressure? · Is excessively heavy load being carried? · Is acceleration too much, too often? 2. Check the fuel pressure 3. Check the injector 4. Test the exhaust system for a possible restriction 5. Check the ECT sensor and circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark

Main symptom	Diagnostic procedure	Also check for
Hard to refuel (Overflow during refueling)	1. Test the canister close valve 2. Inspect the fuel filler hose/pipe · Pinched, kinked or blocked? · Filler hose is torn 3. Inspect the fuel tank vapor vent hose between the EVAP. canister and air filter 4. Check the EVAP. canister	• Malfunctioning gas station filling nozzle (If this problem occurs at a specific gas station during refueling)

Engine Control System

Description

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

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

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

NOTICE

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

Malfunction Indicator Lamp (MIL) [EOBD]

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

Faults with the following items will illuminate the MIL.

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

NOTICE

Refer to "Inspection Chart For Diagnostic Trouble Codes (DTC)" for more information.

[NON-EOBD]

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

Faults with the following items will illuminate the MIL

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

NOTICE

Refer to "Inspection Chart For Diagnostic Trouble Codes (DTC)" for more information.

[INSPECTION]

1. After turning ON the ignition key, ensure that the light illuminates for about 5 seconds and then goes out.
2. If the light does not illuminate, check for an open circuit in the harness, a blown fuse or a blown bulb.

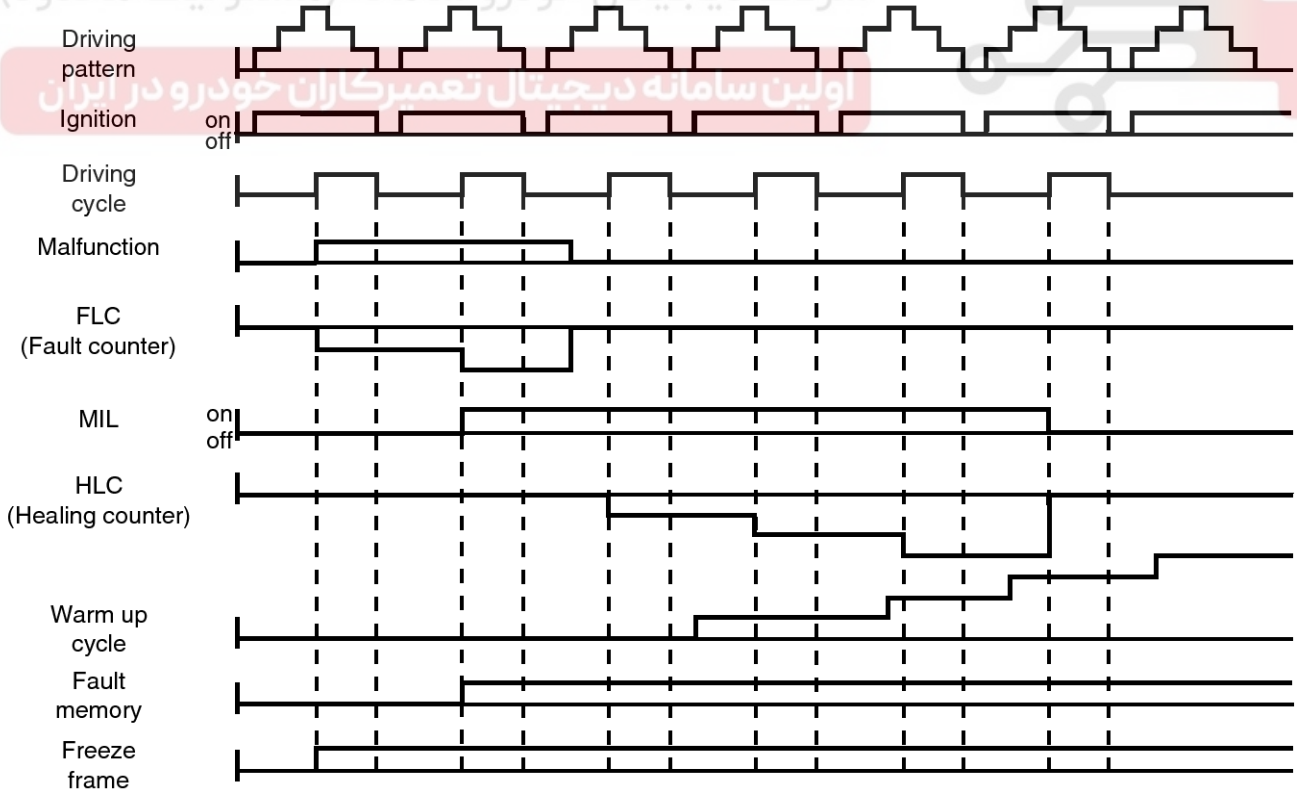
Self-Diagnosis

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

NOTICE

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

The relation between DTC and driving pattern in eobd system



LGIF601Q

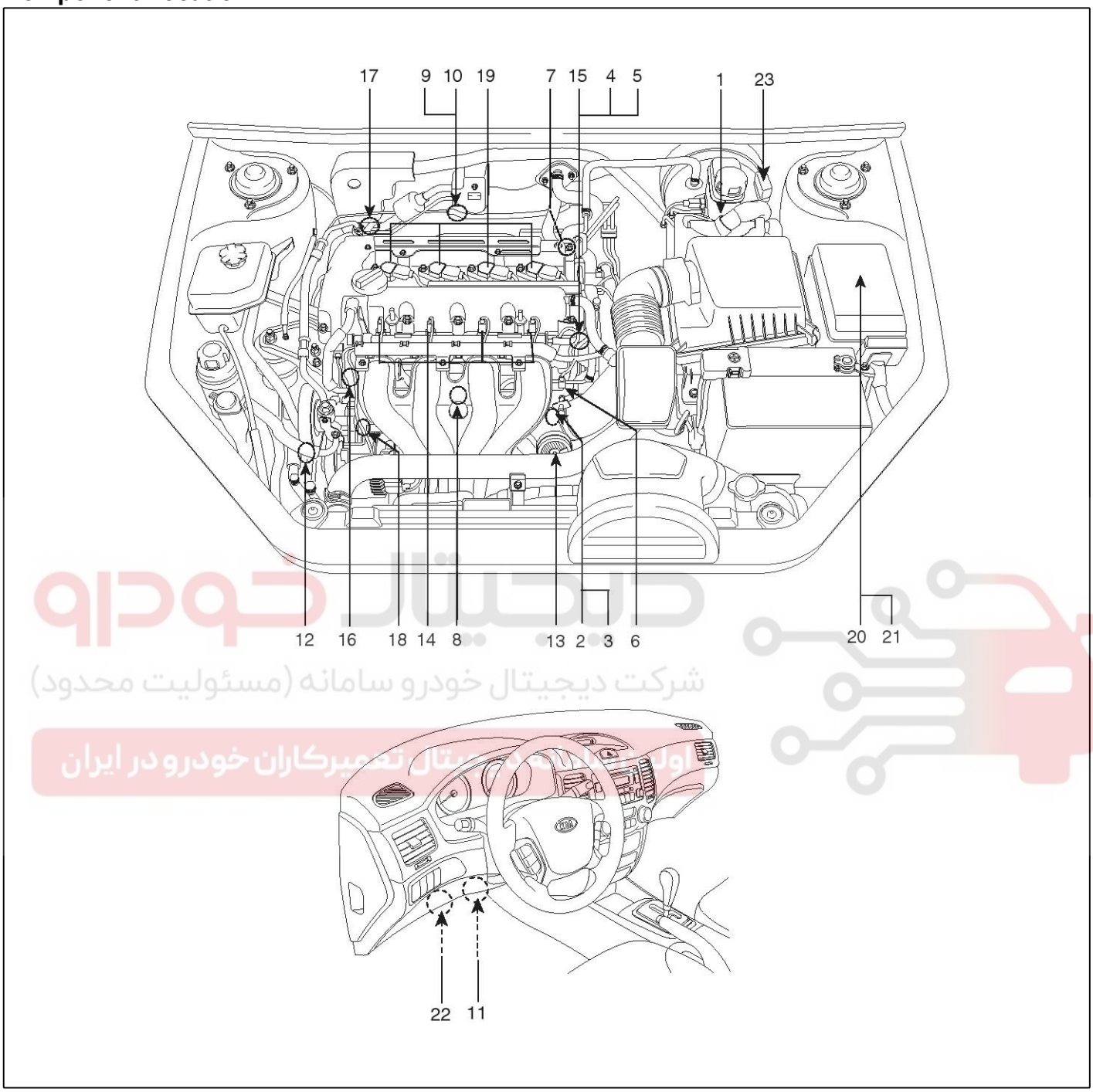
1. When the same malfunction is detected and maintained during two sequential driving cycles, the MIL will automatically illuminate.
2. The MIL will go off automatically if no fault is detected after 3 sequential driving cycles.
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction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

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

NOTICE

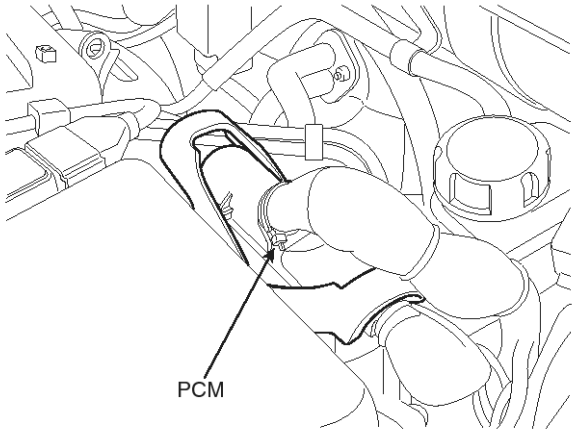
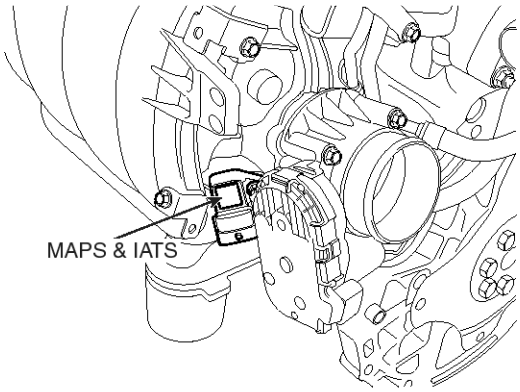
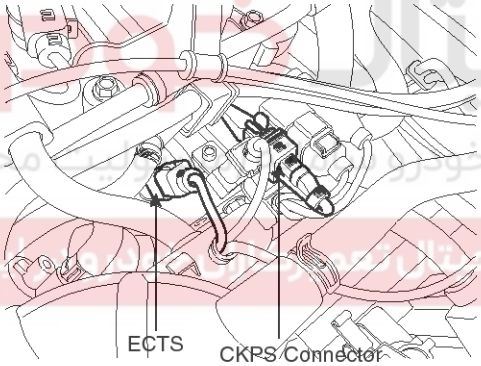
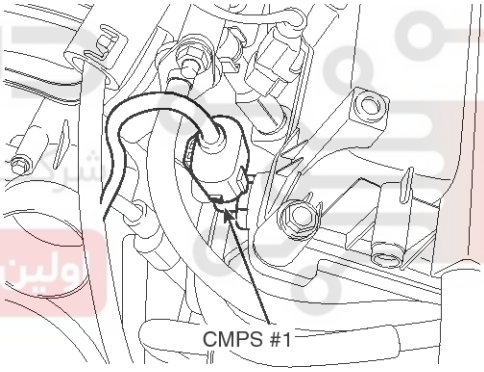
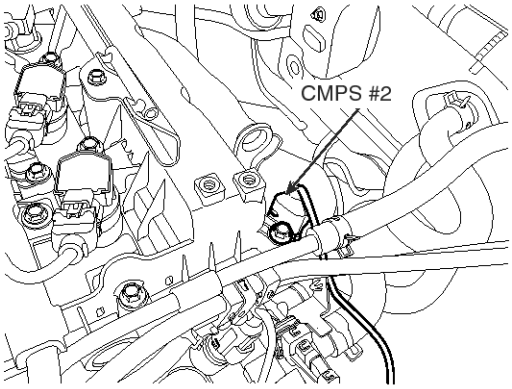
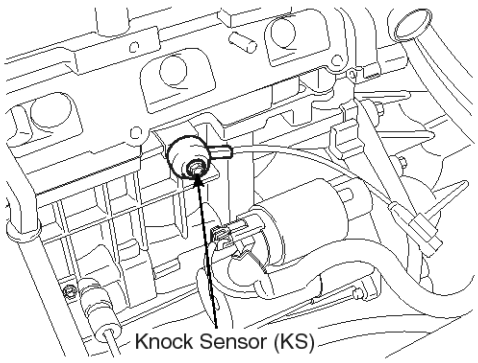
- *A "warm-up cycle" means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of 160 degress Fahrenheit.*
- *A "driving cycle" consists of engine startup, vehicle operation beyond the beginning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

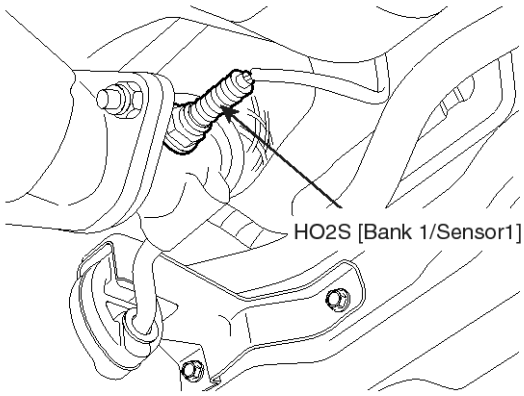
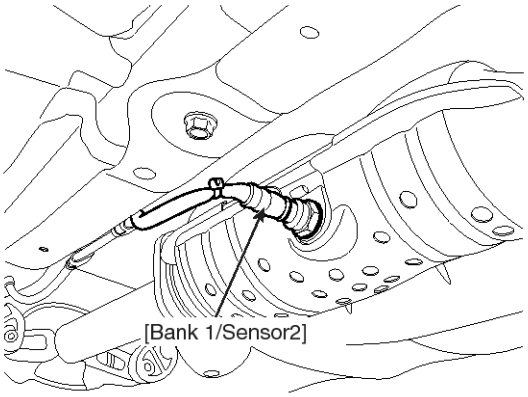
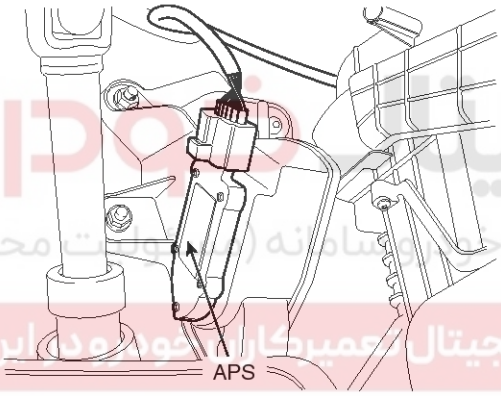
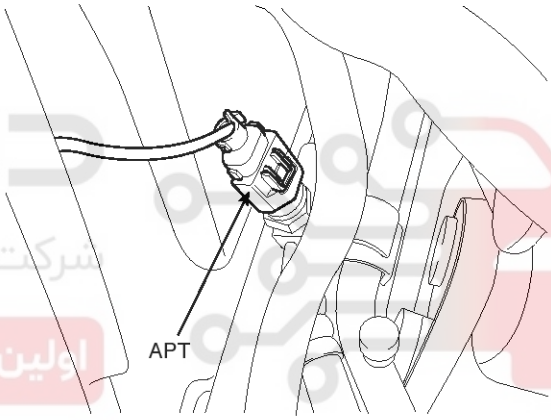
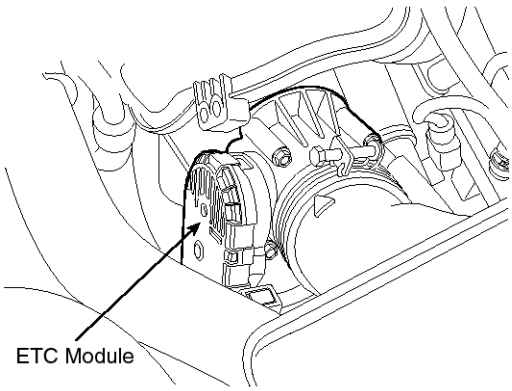
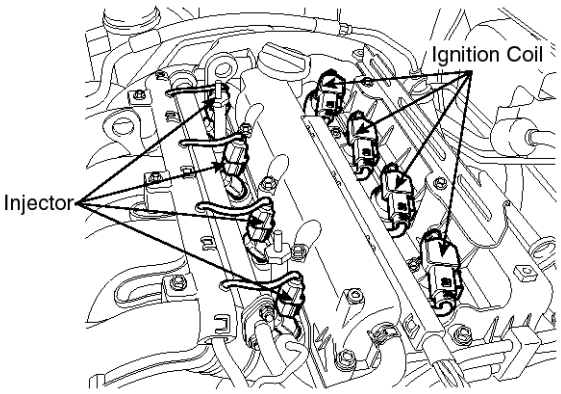
Component Location

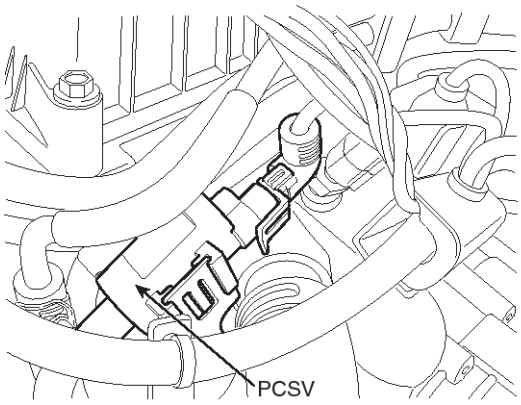
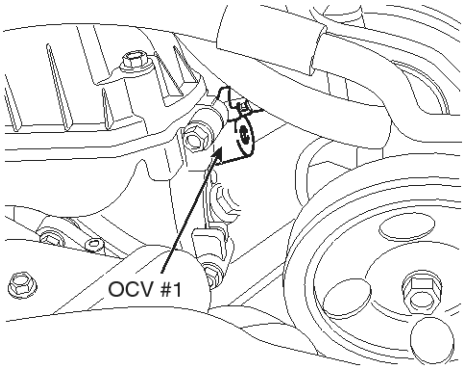
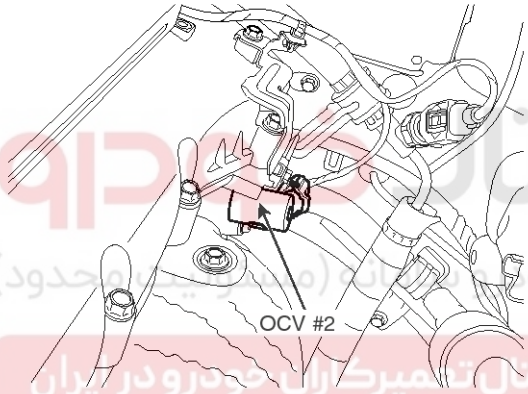
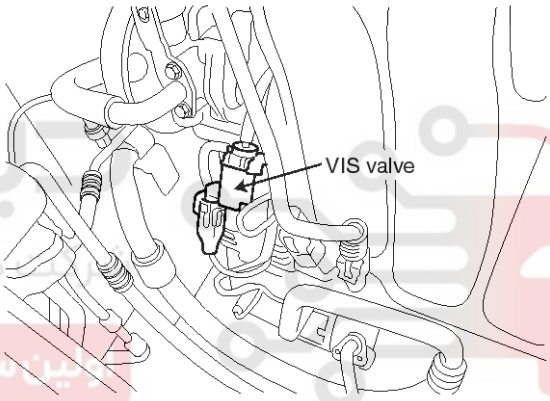
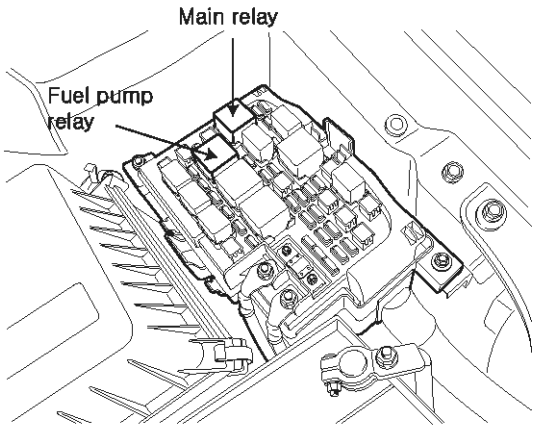


SMGFL9100L

1. PCM (Powertrain Control Module)
2. Manifold Absolute Pressure Sensor (MAPS)
3. Intake Air Temperature Sensor (IATS)
4. Engine Coolant Temperature Sensor (ECTS)
5. Crankshaft Position Sensor (CKPS)
6. Camshaft Position Sensor (CMPS) #1 [Intake]
7. Camshaft Position Sensor (CMPS) #2 [Exhaust]
8. Knock Sensor (KS)
9. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
10. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
11. Accelerator Position Sensor (APS)
12. A/C Pressure Transducer (APT)
13. ETC Module (Including TPS & ETC Motor)
14. Injector
15. Purge Control Solenoid Valve (PCSV)
16. CVVT Oil Control Valve (OCV) #1 [Intake]
17. CVVT Oil Control Valve (OCV) #2 [Exhaust]
18. Variable Intake Solenoid (VIS) Valve
19. Ignition coil
20. Main relay
21. Fuel pump relay
22. Data link connector (DLC)
23. Multi-purpose check connector

1. PCM (Powertrain Control Module)	2. Manifold Absolute Pressure Sensor (MAPS) 3. Intake Air Temperature Sensor (IATS)
 SMGFL9128L	 SNFFL9003D
4. Engine Coolant Temperature Sensor (ECTS) 5. Crankshaft Position Sensor (CKPS)	6. Camshaft Position Sensor (CMPS) #1 [Intake]
 SNFFL9002N	 SNFFL9000D
7. Camshaft Position Sensor (CMPS) #2 [Exhaust]	8. Knock Sensor (KS)
 SNFFL9004D	 SNFFL9003N

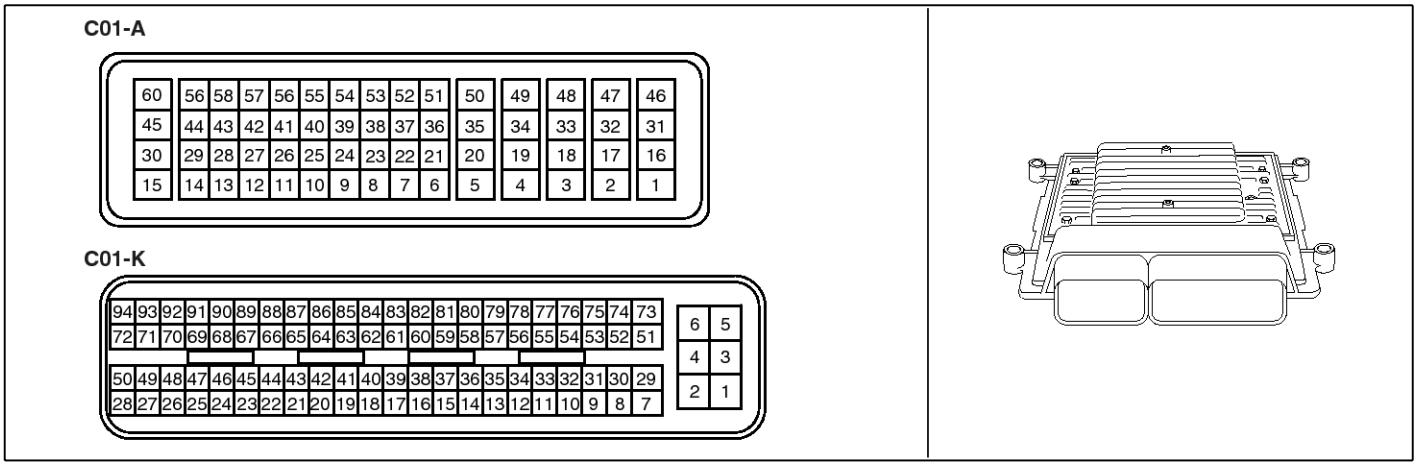
9. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]	10. Heated Oxygen Sensor(HO2S) [Bank 1/Sensor 2]
 SNFFL9004N	 SNFFL9005N
11. Accelerator Position Sensor (APS)	12. A/C Pressure Transducer (APT)
 AFLG001A	 AFLG001B
13. ETC Module (Including TPS & ETC Motor)	14. Injector 19. Ignition coil
 SNFFL9006N	 SNFFL9007N

15. Purge Control Solenoid Valve (PCSV)	16. CVVT Oil Control Valve (OCV) #1 [Intake]
 AFLG001M	 SNFFL9011D
17. CVVT Oil Control Valve (OCV) #2 [Exhaust]	18. Variable Intake Solenoid (VIS) valve
 SNFFL9005D	 SNFFL9030N
20. Main relay 21. Fuel pump relay	
 LFLG715A	

Powertrain Control Module (PCM)

Powertrain control module (PCM)

1. PCM harness connector



SMGFL9101L

2. PCM terminal function

Connector [C01-K]

Pin	Description	Connected to
1	Power ground	Chassis ground
2	Battery voltage supply after ignition switch	Ignition Switch
3	Power ground	Chassis ground
4	Battery voltage supply after main relay	Main Relay
5	Power ground	Chassis ground
6	Battery voltage supply	Battery
7	Wheel speed sensor (WSS) [+] signal input	Wheel speed sensor (WSS)
8	-	
9	-	
10	-	
11	-	
12	Knock sensor (KS) signal input	Knock sensor (KS)
13	Sensor ground	Accelerator position sensor #2
14	Sensor ground	Engine coolant temperature sensor (ECTS)
15	Camshaft position sensor (CMPS) #2 signal input	Camshaft position sensor (CMPS) #2
16	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
17	Crankshaft position sensor (CKPS) signal input	Crankshaft position sensor (CKPS)
18	-	
19	-	

Pin	Description	Connected to
20	-	
21	-	
22	-	
23	Fuel consumption signal output	Trip computer
24	-	
25	Injector (Cylinder #1) control output	Injector (Cylinder #1)
26	Injector (Cylinder #3) control output	Injector (Cylinder #3)
27	Injector (Cylinder #4) control output	Injector (Cylinder #4)
28	Injector (Cylinder #2) control output	Injector (Cylinder #2)
29	Wheel speed sensor (WSS) [-] signal input	Wheel speed sensor (WSS)
30	Sensor power (+5V)	Manifold absolute pressure sensor (MAPS)
31	Manifold absolute pressure sensor (MAPS) signal input	Manifold absolute pressure sensor (MAPS)
32	Throttle position sensor (TPS) #2 signal input	Throttle position sensor (TPS) #2 [ETC module]
33	Engine coolant temperature sensor (ECTS) signal input	Engine coolant temperature sensor (ECTS)
34	Sensor ground	Knock sensor (KS)
35	Accelerator Position Sensor (APS) #2 signal input	Accelerator Position Sensor (APS) #2
36	Sensor power (+5V)	Accelerator Position Sensor (APS) #2
37	Sensor ground	Camshaft position sensor (CMPS) #2
38	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
39	Sensor ground	Crankshaft position sensor (CKPS)
40	Vehicle speed signal input	ABS/VDC control module
41	-	
42	-	
43	Sensor power (+5V)	A/C pressure transducer (APT)
44	-	
45	Throttle position sensor (TPS) signal output	
46	-	
47	-	
48	-	
49	-	
50	Variable intake solenoid valve (VIS) control output	Variable intake solenoid valve (VIS)
51	Battery voltage supply after main relay	Main relay
52	-	

Pin	Description	Connected to
53	Intake Air temperature sensor (IATS) signal input	Intake Air temperature sensor (IATS)
54	A/C pressure transducer (APT) signal input	A/C pressure transducer (APT)
55	-	
56	-	
57	Sensor ground	A/C pressure transducer (APT)
58	-	
59	Sensor ground	Throttle position sensor (TPS) #1,2 [ETC module]
60	Sensor power (+5V)	Accelerator Position Sensor (APS) #1
61	Sensor ground	Accelerator Position Sensor (APS) #1
62	Camshaft position sensor (CMPS) #1 signal input	Camshaft position sensor (CMPS) #1
63	Sensor power (+5V)	Throttle position sensor (TPS) #1,2 [ETC module]
64	Main relay control output	Main relay
65	Fan relay control output [Low]	Fan relay [Low]
66	CVVT Oil control valve (OCV) #1 control output	CVVT Oil control valve (OCV) #1
67	Purge control solenoid valve (PCSV) control output	Purge control solenoid valve (PCSV)
68	CVVT Oil control valve (OCV) #2 control output	CVVT Oil control valve (OCV) #2
69	Immobilizer lamp control output	Immobilizer lamp (Cluster)
70	Fuel pump relay control output	Fuel pump relay
71	ETC motor [A] control output	ETC motor [ETC module]
72	ETC motor [B] control output	ETC motor [ETC module]
73	-	
74	Sensor ground	Manifold absolute pressure sensor (MAPS), Intake A-ir temperature sensor (IATS)
75	Immobilizer communication line	Immobilizer control module
76	-	
77	CAN [High]	ABS/VDC control module
78	CAN [Low]	ABS/VDC control module
79	-	
80	Throttle position sensor (TPS) #1 signal input	Throttle position sensor (TPS) #1 [ETC module]
81	-	
82	Accelerator Position Sensor (APS) #1 signal input	Accelerator Position Sensor (APS) #1
83	Sensor ground	Camshaft position sensor (CMPS) #1
84	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
85	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
86	Engine speed signal output	Tachometer (Cluster)

Pin	Description	Connected to
87	A/C compressor relay control output	A/C compressor relay
88	Fan realy control output [High]	Fan realy [High]
89	-	
90	-	
91	-	
92	Malfunction Indicator Lamp (MIL) control output	Malfunction Indicator Lamp (Cluster)
93	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
94	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]

Connector [C01-A]

Pin	Description	Connected to
1	Ignition coil (Cylinder #1) control output (Non-Immobilizer)	Ignition coil (Cylinder #1)
	Ignition coil (Cylinder #4) control output (With-Immobilizer)	Ignition coil (Cylinder #4)
2	Ignition coil shield ground	Ignition coil (Cylinder #1,2,3,4)
3	Transaxle control output	
4	Transaxle control output	
5	Transaxle control output	
6	-	
7	-	
8	-	
9	Transaxle control output	
10	Transaxle control output	
11	Transaxle control output	
12	Transaxle control output	
13	-	
14	Alternator signal	Alternator
15	-	
16	Ignition coil (Cylinder #3) control output (Non-Immobilizer)	Ignition coil (Cylinder #3)
	Ignition coil (Cylinder #2) control output (With-Immobilizer)	Ignition coil (Cylinder #2)
17	Transaxle control output	
18	Transaxle control output	
19	Transaxle control output	

Pin	Description	Connected to
20	Transaxle control output	
21	-	
22	-	
23	-	
24	Transaxle control output	
25	Transaxle control output	
26	Transaxle control output	
27	-	
28	-	
29	Brake lamp switch signal input	Brake switch
30	-	
31	Ignition coil (Cylinder #4) control output (Non-Immobilizer)	Ignition coil (Cylinder #4)
	Ignition coil (Cylinder #1) control output (With-Immobilizer)	Ignition coil (Cylinder #1)
32	Transaxle control output	
33	Transaxle control output	
34	Transaxle control output	
35	Transaxle control output	
36	Transaxle control output	
37	-	
38	Transaxle control output	
39	Transaxle control output	
40	Transaxle control output	
41	-	
42	Blower switch input	Blower switch
43	Clutch switchsignal	Clutch switch
44	Brake switch signal input	Brake switch
45	-	
46	Ignition coil (Cylinder #2) control output (Non-Immobilizer)	Ignition coil (Cylinder #2)
	Ignition coil (Cylinder #3) control output (With-Immobilizer)	Ignition coil (Cylinder #3)
47	Transaxle control output	
48	Transaxle control output	
49	Transaxle control output	

Pin	Description	Connected to
50	Transaxle control output	
51	Transaxle control output	
52	Transaxle control output	
53	Transaxle control output	
54	Transaxle control output	
55	Transaxle control output	
56	-	
57	A/C switch ON input	A/C switch
58	-	
59	-	
60	-	

3. In/output signal

Connector [C01-K]

Pin	Description	Condition	inoutput signal		Test result	Remark
			Type	Level		
1	Power ground	Idle	DC voltage	Max. 50 mV		
2	Ignition switch signal input	IG OFF	DC voltage	Max. 0.5 V	10.2 mV	
		IG ON		Battery voltage	12.02 V	
3	Power ground	Idle	DC voltage	Max. 50 mV	2.8 mV	
4	Battery voltage supply after main relay	IG OFF	DC voltage	Max. 1.0 V	3.1 mV	
		IG ON		Battery voltage	12.1 V	
5	ECU ground	Idle	DC voltage	Max. 50 mV	1.8 mV	
6	Battery voltage supply after main relay	Removing t he key	Current	Below 2.0 mA	0.38 mA	
		Always	DC voltage	Battery voltage	12.7 V	
7	Wheel speed sensor (WSS) [+] signal input	Engine run (30KPH)	SINE WAVE	15Hz :Min. 0.13Vpp 1000Hz :Min. 0.2Vpp Through :Max. 250V-pp		
8	-					
9	-					
10	-					
11	-					
12	Knock sensor (KS) signal input	Knocking	Irregula Frequency	0.3 ~ 0.3 V	Normal	
		Normal		0 V		
13	Sensor ground	Idle	DC voltage	Max. 50 mV	30 mV	

Pin	Description	Condition	inoutput signal		Test result	Remark
			Type	Level		
14	Sensor ground	Idle	DC voltage	Max. 50 mV	12.4 mV	
15	Camshaft position sensor (CMPS) #2 signal input	Idle	PULSE	High :Battery voltage	5.0 V	Frequency : 5.36 Hz (Idle)
				Low : Max . 0.5V	0.2 V	
16	Sensor ground	Idle	DC voltage	Max. 50 mV	29 mV	
17	Crankshaft position sensor (CMPS) signal input	Idle	PULSE	High :Battery voltage	5.00 V	Frequency : 600 Hz (Idle)
				Low : Max. 0.5V	40 mV	
18	-					
19	-					
20	-					
21	-					
22	-					
23	Fuel consumption signal out-put	Idle	PULSE	High :Battery voltage	13.7 V	Frequency :3.33 Hz
				Low : Max. 0.5V	0 V	PULSE Width : 500 µs
24	-					
25	Injector (Cylinder #1) control output	Idle	PULSE	High :Battery voltage	13.8 V	Frequency : 5.21 Hz (Idle)/Injection time : 2.74 ms
				Low : Max . 1.0V	200 mV	
				Vpeak : Max. 80V	54.1 V	
26	Injector (Cylinder #3) control output	Idle	PULSE	High :Battery voltage	13.9 V	Frequency : 5.18 Hz (Idle)/Injection time : 2.73 ms
				Low : Max . 1.0V	170 mV	
				Vpeak : Max. 80V	53.9 V	
27	Injector (Cylinder #4) control output	Idle	PULSE	High :Battery voltage	14 V	Frequency : 5.24 Hz (Idle)/Injection time : 2.70 ms
				Low : Max . 1.0V	160 mV	
				Vpeak : Max. 80V	54.3 V	
28	Injector (Cylinder #2) control output	Idle	PULSE	High :Battery voltage	14.1 V	Frequency : 5.21 Hz (Idle)/Injection time : 2.73 ms
				Low : Max . 1.0V	160 mV	
				Vpeak : Max. 80V	53.9 V	
29	Wheel speed sensor (WSS) [-] signal input [with ABS]	Engine run (30KPH)	SINE WAVE	15Hz :Min. 0.13Vpp 1000Hz :Min. 0.2Vpp Through :Max. 250V-pp		
30	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V	0 mV	
		IG ON		5±0.1V	4.98 V	
31	Manifold absolute pressure sensor (MAPS) signal input	Idle	Analog	0.8 V ~ 1.6 V	1.37 V	

Pin	Description	Condition	inoutput signal		Test result	Remark
			Type	Level		
32	Throttle position sensor (TP-S) #2 signal input	C.T	Analog	4.2 ~ 5.0V	4.52 V	
		W.O.T		3.3 ~ 3.8V	3.68 V	
33	Engine coolant temperature sensor (ECTS) signal input	Idle	Analog	0.5V ~ 4.5V	1.02 V	
34	Sensor ground	Idle	DC voltage	Max. 50 mV	8 mV	
35	Accelerator Position Sensor (APS) #2 signal input	C.T	Analog	0.3 ~ 0.9V	0.4 V	
		W.O.T		1.5 ~ 3.0V	1.9 V	
36	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V	5 mV	
		IG ON		5±0.1V	5.02 V	
37	Sensor ground	Idle	DC voltage	Max. 50 mV	11 mV	
38	Heated Oxygen Sensor (HO 2S) [Bank 1/Sensor 1] signal input	Idle	DC voltage	Rich : 0.6 ~ 1.0V	926 mV	
				Lean : Max. 0.4V	20 mV	
39	Sensor ground	Idle	DC voltage	Max. 50 mV	11 mV	
40	Vehicle speed signal input	Engine run	PULSE	High : Min. 4.5V	5 V	Frequency : 46.9 Hz (Idle)
				Low : Max. 0.5V	0 V	Duty(-) : 50.4% (Idle)
41	-					
42	-					
43	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V		N.A.
		IG ON		5±0.1V		
44	-					
45	Throttle position signal outp-ut	Idle	PULSE	High :Battery voltage	14.0 V	Frequency : 100 Hz
				Low : 0 ~ 0.5 V	60 mV	Duty(+) : 5.05% (Idl-e) : 8.93% (3000 rpm)z
46	-					
47	-					
48	-					
49	-					
50	Variable intake solenoid val-ve (VIS) control output	Active	DC voltage	Max. 1.0 V	316 mV	
		Inactive		Battery voltage	14 V	
51	Battery voltage supply after main relay	IG OFF	DC voltage	Max. 1.0 V	3.1 mV	
		IG ON		Battery voltage	12.3 V	
52	-					

Pin	Description	Condition	inoutput signal		Test result	Remark
			Type	Level		
53	Intake Air temperature sensor (IATS) signal input	Idle	Analog	0V ~ 5V	2.55 V	
54	A/C pressure transducer (A-PT) signal input	Idle	DC voltage	0.4 ~ 4.6V	A/C OFF : 1.29 V A/C ON : 2.01 V	
55	-					
56	-					
57	Sensor ground	Idle	DC voltage	Max. 50 mV	11 mV	
58	-					
59	Sensor ground	Idle	DC voltage	Max. 50 mV	6 mV	
60	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V	10 mV	
		IG ON		5±0.1V	5.02 V	
61	Sensor ground	Idle	DC voltage	Max. 50 mV	30 mV	
62	Camshaft position sensor (CMPS) #1 signal input	Idle	PULSE	High :Battery voltage	5.0 V	Frequency : 5.2 Hz (Idle)
				Low : Max. 0.5V	0.2 V	
63	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V	0 mV	
		IG ON		5±0.1V	4.98 V	
64	Main relay control output	relay OFF	DC voltage	Battery voltage	12.3 V	
		relay ON		Max. 1.0 V	730 mV	
				Vpeak : Max. 70V	52.1 V	
65	Fan relay control output [Low]					
66	CVVT Oil control valve (OCV) #1 control output	Idle	PULSE	High :Battery voltage	15.0 V	Frequency : 300 Hz Duty(+) : 84.7% (Idle)
				Low : Max. 1.0V	120 mV	
				Vpeak : Max. 70V	15.0 V	
67	Purge control solenoid valve (PCSV) control output	Inactive	PULSE	High :Battery voltage	14.3 V	Frequency : 16 Hz
		Active		Low : Max. 1.0V	80 mV	
				Vpeak : Max. 70V	57 V	
68	CVVT Oil control valve (OCV) #2 control output	Idle	PULSE	High :Battery voltage	13.5 V	Frequency : 300 Hz
				Low : Max. 1.0V	100 mV	
				Vpeak : Max. 70V	13.5 V	
69	Immobilizer lamp control output	lamp OFF	DC voltage	High :Battery voltage	13.2 V	
		lamp ON		Low : Max . 2.0V	40 mV	

Pin	Description	Condition	inoutput signal		Test result	Remark
			Type	Level		
70	Fuel pump relay control output	relay OFF	DC voltage	Battery voltage	12.8 V	
		relay ON		Max. 1.0V	40 mV	
				Vpeak : Max. 70V	47.3 V	
				Resistance : 680 Ω	680 Ω	
71	ETC motor [A] control output	Idle	PULSE	High :Battery voltage	13.4 V	
				Low : Max . 1.0V	0 V	
72	ETC motor [B] control output	Idle	PULSE	High :Battery voltage	13.3 V	
				Low : Max . 1.0V	0 V	
73	-					
74	Sensor ground	Idle	DC voltage	Max. 50 mV	7 mV	
75	Immobilizer communication line	After IG.ON	PULSE	High : Min. 8.5V	11.8 V	
		Communication		Low : Max . 3.5V	1.0 V	
76	-					
77	CAN [High]	RECESSIVE	PULSE	2.0 ~ 3.0 V	2.58 V	Communication speed : 500kbps
		DOMINANT		2.75~4.5 V	3.54 V	
78	CAN [Low]	RECESSIVE	PULSE	2.0 ~ 3.0 V	2.64 V	Communication speed : 500kbps
		DOMINANT		0.5~2.25 V	1.52 V	
79	-					
80	Throttle position sensor (TPS) #1 signal input	C.T	Analog	0.3 ~ 0.9V	0.65 V	
		W.O.T		1.5 ~ 3.0V	1.63 V	
81	-					
82	Accelerator Position Sensor (APS) #1 signal input	C.T	Analog	0.3 ~ 0.9V	0.8 V	
		W.O.T		1.5 ~ 3.0V	4 V	
83	Sensor ground	Idle	DC voltage	Max. 50 mV	12 mV	
84	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Idle	DC voltage	Rich : 0.6 ~ 1.0V	740 mV	
				Lean : Max. 0.4V	70 mV	
85	Sensor ground	Idle	DC voltage	Max. 50 mV	10 mV	
86	Engine speed signal output	Idle	PULSE	High :Battery voltage	14.0 V	Duty(+) : 50% (Idle)
				Low : Max. 0.5V	60 mV	
				Idle = 20~26Hz(Reference)	21 Hz	

Pin	Description	Condition	inoutput signal		Test result	Remark
			Type	Level		
87	A/C compressor relay control output	A/C OFF	DC voltage	Battery voltage	14.3 V	Resistance : 680 Ohm
		A/C ON		Max. 1.0V	102 mV	
88	Fan relay control output [High]					
89	-					
90	-					
91	-					
92	Malfunction Indicator Lamp (MIL) control output	lamp OFF	DC voltage	Battery voltage	13.8 V	
		lamp ON		Max. 1.0V	54 mV	
93	Heated Oxygen Sensor (HO 2S) [Bank 1/Sensor 1] heater control output	Engine run	PULSE	High :Battery voltage	14.4 V	Frequency : 10 Hz
				Low : Max. 1.0V	0.36 V	Duty(+) : 58.3%
94	Heated Oxygen Sensor (HO 2S) [Bank 1/Sensor 2] heater control output	Engine run	PULSE	High :Battery voltage	14V	Frequency : 7.68Hz
				Low : Max. 1.0V	0.31V	Duty(+) : 53.9%

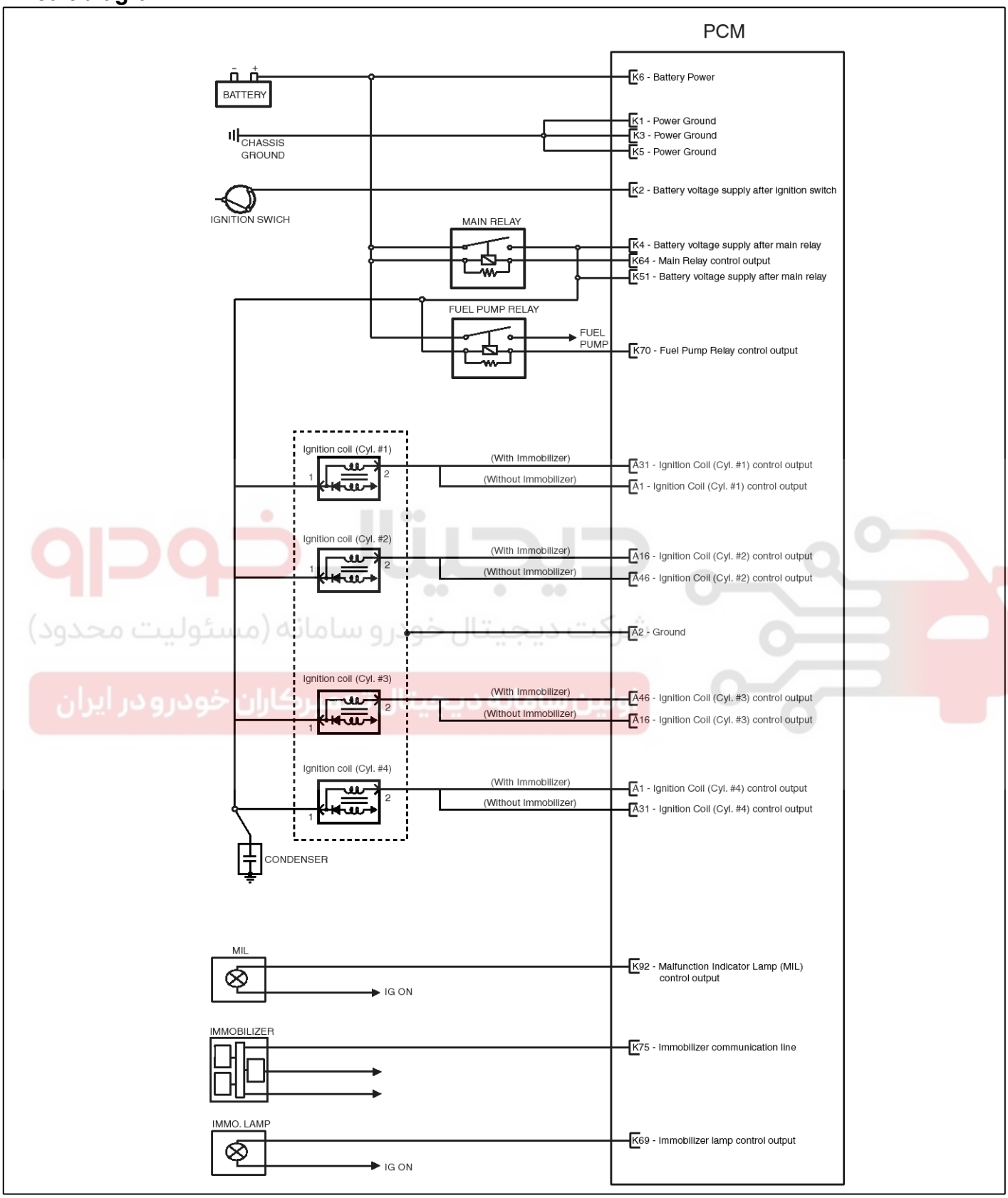
Connector [C01-A]

Pin	Description	Condition	inoutput signal		Test result	Remark
			Type	Level		
1	Ignition coil (Cylinder #1) control output (Non-Immobilizer)	Idle	PULSE	1st voltage : 300~400V	416 V	Frequency : 5.2 Hz (Idle)Injection time : 2.78 ms
	Ignition coil (Cylinder #4) control output (With-Immobilizer)			ON voltage : Max. 2V	1.4 V	
2	Ignition coil shield ground	Idle	DC voltage	Max. 50 mV	16.8 mV	
3	Transaxle control output					
4	Transaxle control output					
5	Transaxle control output					
6	-					
7	-					
8	-					
9	Transaxle control output					
10	Transaxle control output					
11	Transaxle control output					
12	Transaxle control output					
13	-					

Pin	Description	Condition	inoutput signal		Test result	Remark
			Type	Level		
14	Alternator signal	Idle	PULSE	High :Battery voltage	13.4 V	
				Low : Max 1.5 V	40 mV	
15	-	Idle	DC voltage	Max. 50 mV		
16	Ignition coil (Cylinder #3) control output (Non-Immobilizer)	Idle	PULSE	1st voltage : 300~400V	416 V	Frequency : 5.2 Hz (Idle)
	Ignition coil (Cylinder #2) control output (With-Immobilizer)			ON voltage : Max. 2V	1.3 V	Injection time : 2.73 ms
17	Transaxle control output					
18	Transaxle control output					
19	Transaxle control output					
20	Transaxle control output					
21	-					
22	-					
23	-					
24	Transaxle control output					
25	Transaxle control output					
26	Transaxle control output					
27	-					
28	-					
29	Brake lamp switch signal input	Brake ON	DC voltage	Battery voltage		
		Brake OFF		Max. 0.5 V		
30	-					
31	Ignition coil (Cylinder #4) control output (Non-Immobilizer)	Idle	PULSE	1st voltage : 300~400V	408 V	Frequency : 5.2 Hz (Idle)Injection time : 2.74 ms
	Ignition coil (Cylinder #1) control output (With-Immobilizer)			ON voltage : Max. 2V	1.6 V	
32	Transaxle control output					
33	Transaxle control output					
34	Transaxle control output					
35	Transaxle control output					
36	Transaxle control output					
37	-					

Pin	Description	Condition	inoutput signal		Test result	Remark
			Type	Level		
38	Transaxle control output					
39	Transaxle control output					
40	Transaxle control output					
41	-					
42	Blower switch input	A/C OFF	DC voltage	Max. 0.5V	20 mV	
		A/C ON		Battery voltage	11.8 V	
43	Clutch switchsignal	RELEASE	DC voltage	Max. 0.5V		
		PUSH		Battery voltage		
44	Brake switch signal input	PUSH	DC voltage	Max. 0.5 V		
		Normal		Battery voltage		
45	-					
46	Ignition coil (Cylinder #2) control output (Non-Immobilizer)	Idle	PULSE	1st voltage : 300~400V	410 V	Frequency : 5.2 Hz (Idle)
	Ignition coil (Cylinder #3) control output (With-Immobilizer)			ON voltage : Max. 2V	1.5 V	Injection time : 2.78 ms
47	Transaxle control output					
48	Transaxle control output					
49	Transaxle control output					
50	Transaxle control output					
51	Transaxle control output					
52	Transaxle control output					
53	Transaxle control output					
54	Transaxle control output					
55	Transaxle control output					
56	-					
57	A/C switch ON input	A/C OFF	DC voltage	Max. 0.5V	0 V	
		A/C ON		Battery voltage	14 V	
58	-					
59	-					
60	-					

Circuit diagram



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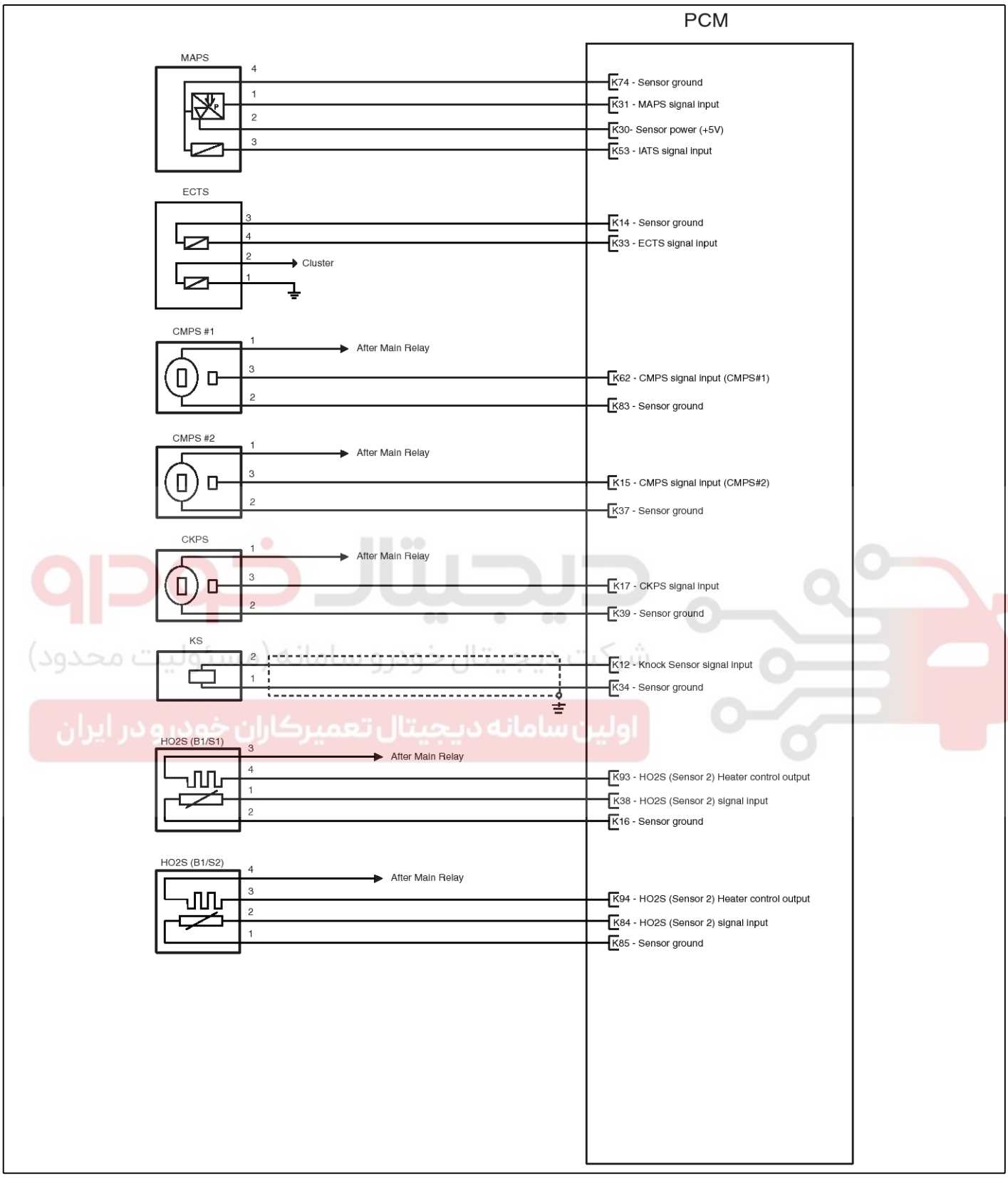

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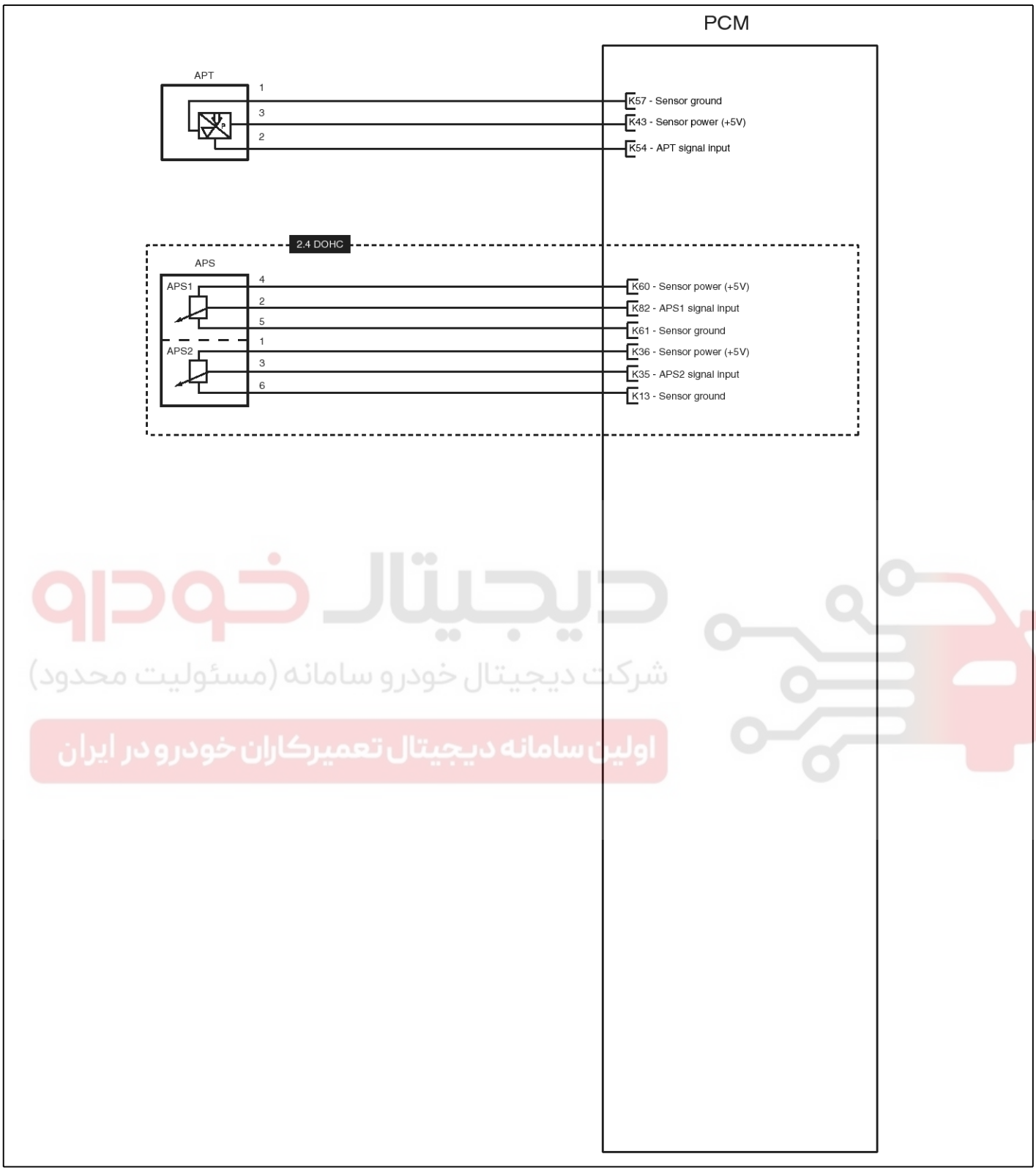

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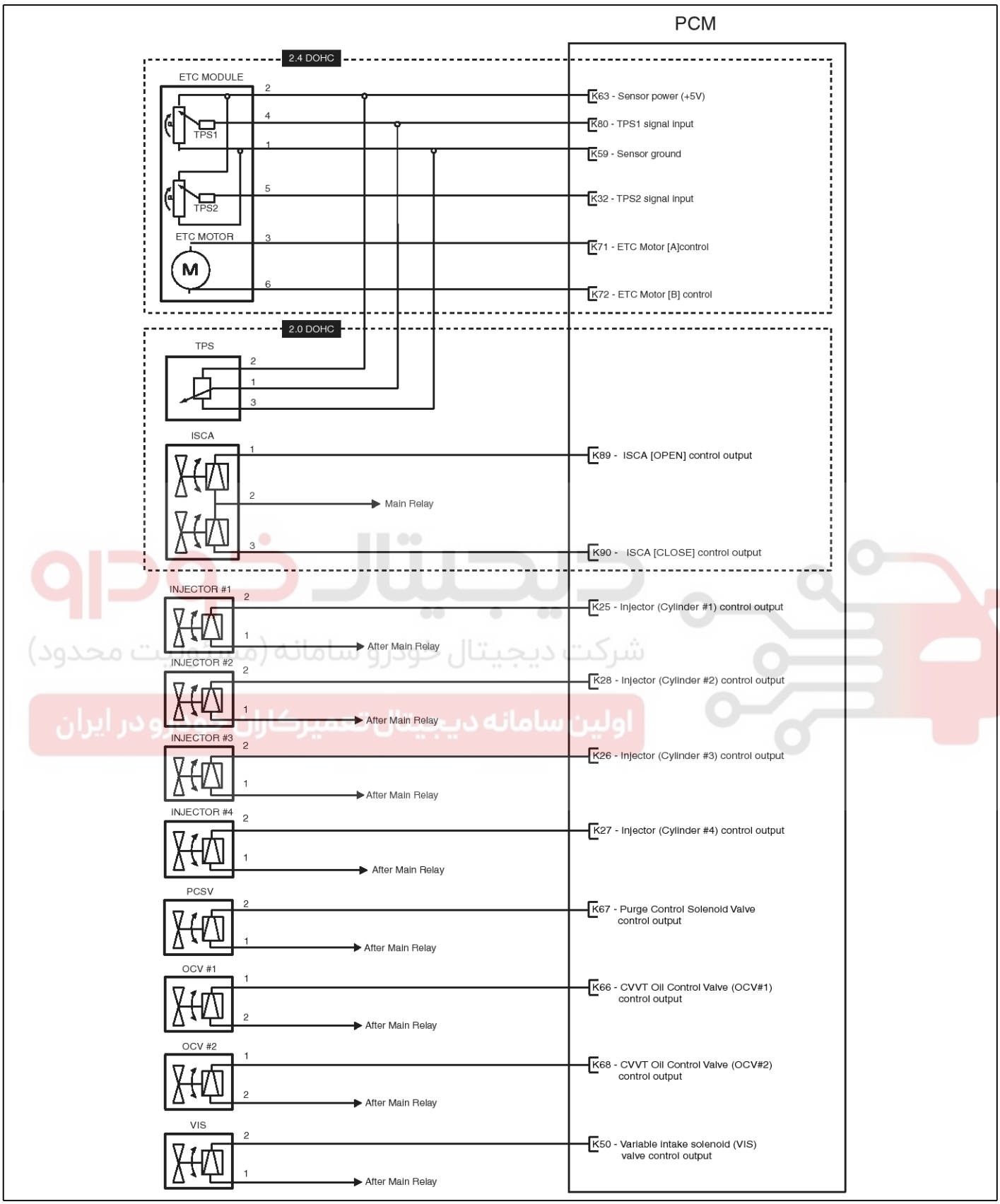

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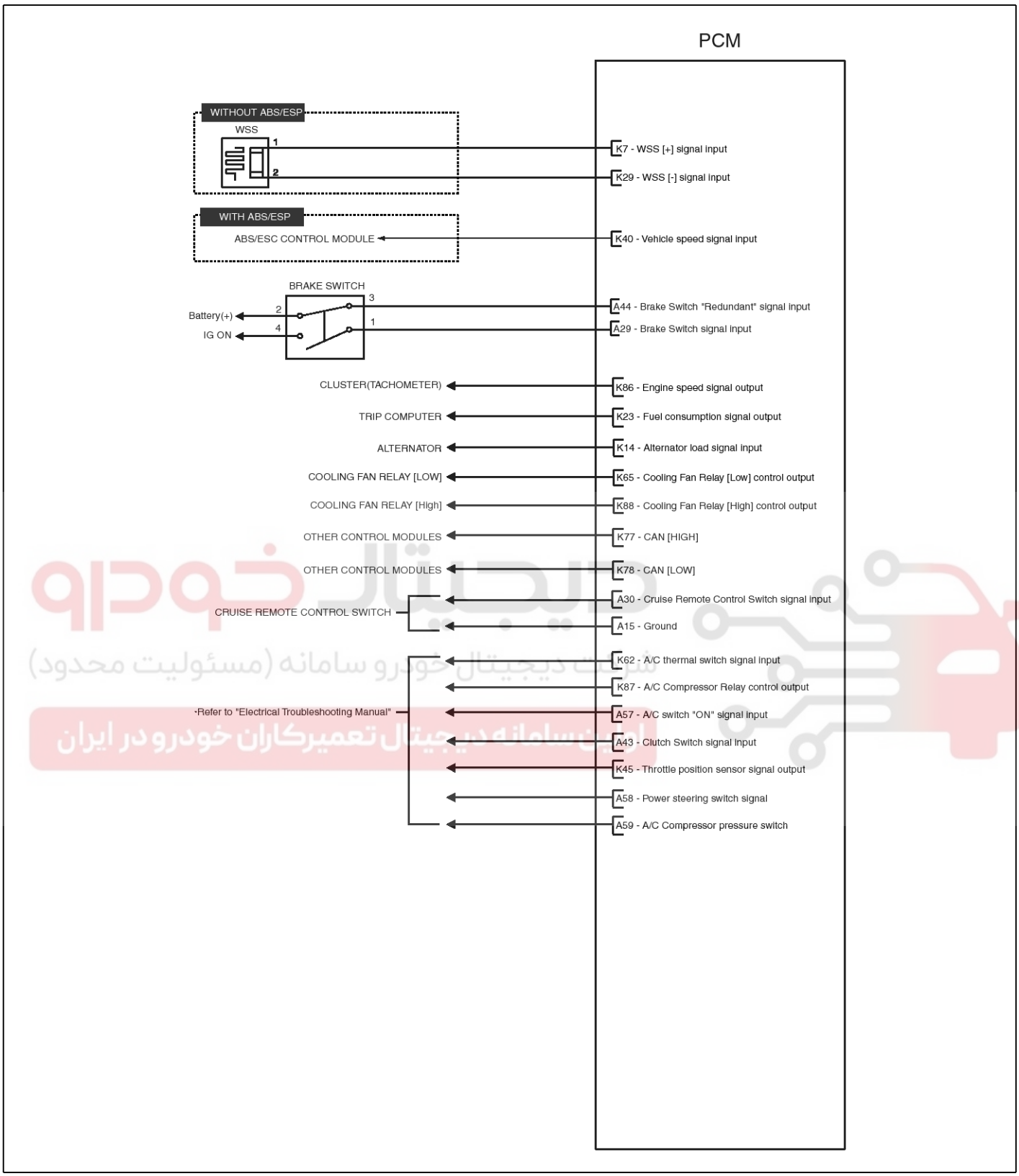

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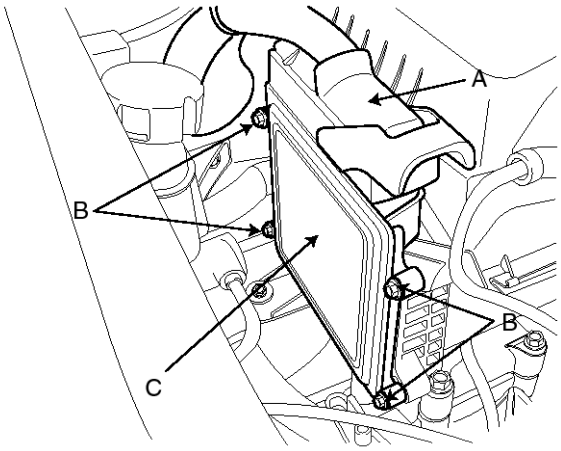
Removal

1. Turn the ignition switch off and disconnect the battery (-) terminal.
2. Disconnect the PCM connector (A).
3. Unscrew 4 mounting bolts behind the air cleaner.
4. Remove the PCM.



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Installation

Installation is the reverse of removal.

Tightening torque : 9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

PCM problem inspection procedure

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

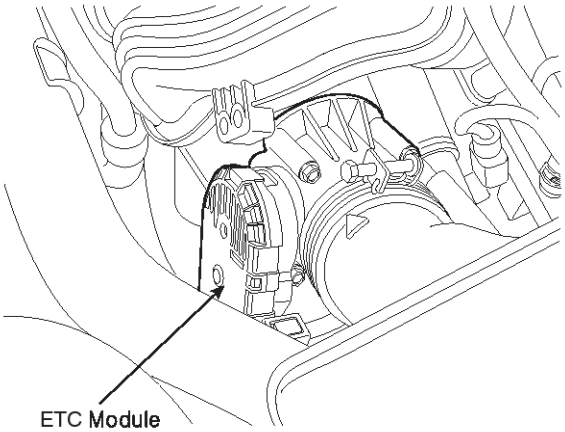
Specification (Resistance): 1Ω or less

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

ETC (Electronic Throttle control) System

Function and opertion principle

ETC (Electronic Throttle Control) system is electronically controlled throttle device which controls the throttle valve. It consists of ETC motor, throttle body and throttle position sensor (TPS). A mechanical throttle control system receives a driver's intention via a wire cable between the accelerator and the throttle valve, while this ETC system does the signal from the Accelerator Position Sensor (APS) installed on the accelerator pedal. After the PCM receives the APS signal and calculates the throttle opening angle, it activates the throttle valve by using the ETC motor. Additionally, it can materialize cruise control function without any special devices.



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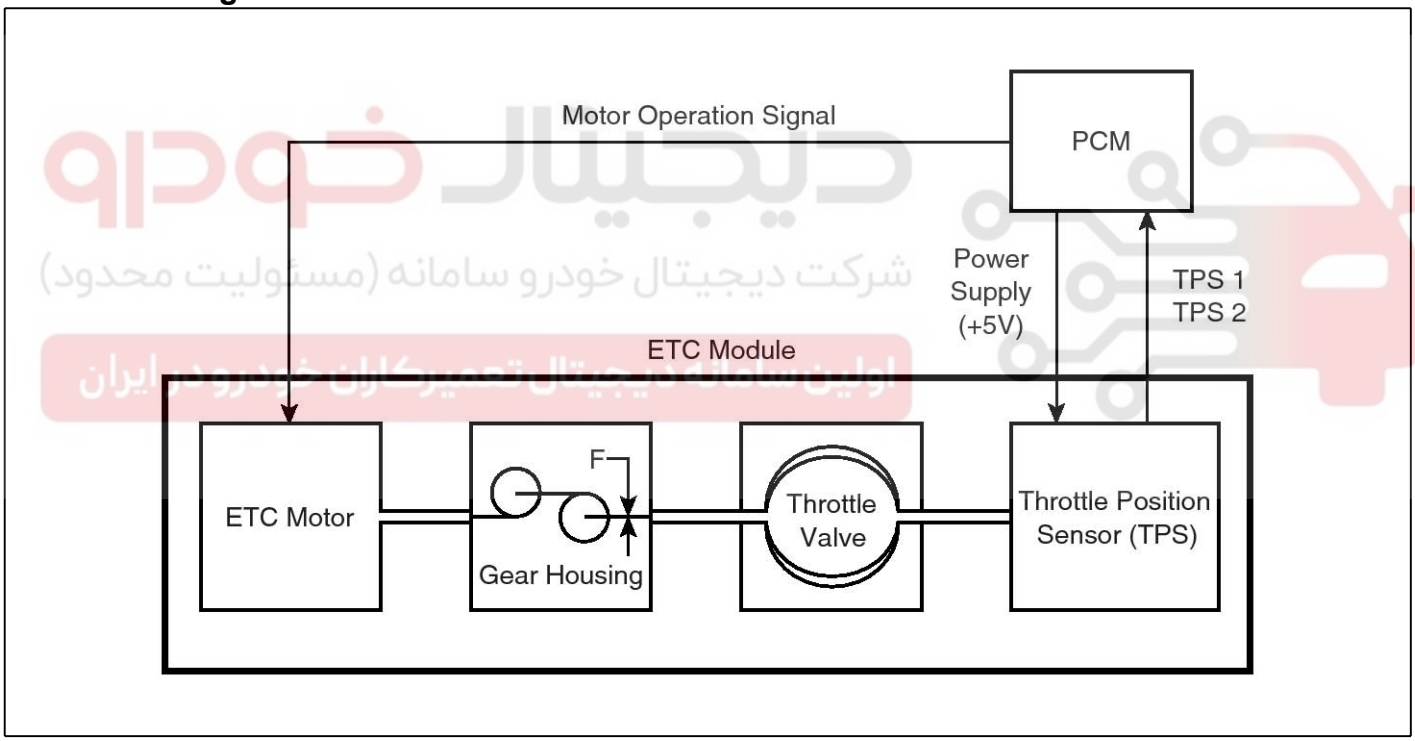
Schematic diagram



EGRF234A

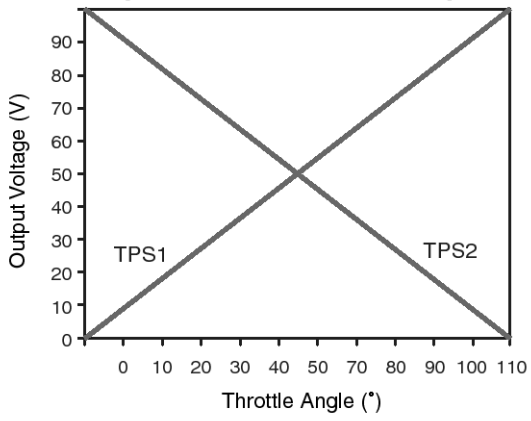
Specification

[Throttle position sensor]

Throttle Angle (°)	Output Voltage (V)[Vref = 5.0V]	
	TPS1	TPS2
0	0	5.00
10	0.48	4.52
20	0.95	4.05
30	1.43	3.57
40	1.90	3.10
50	2.38	2.62
60	2.86	2.14
70	3.33	1.67
80	3.81	1.19
90	4.29	0.71
100	4.76	0.24
105	5.00	0
C.T (6 ~ 15°)	0.3 ~ 0.7	4.3 ~ 4.7
W.O.T (93 ~ 102 °)	4.45 ~ 4.85	0.15 ~ 0.55

Item	Sensor Resistance (kΩ)
TPS1	0.875 ~ 1.625
TPS2	0.875 ~ 1.625

[TPS CHARACTERISTIC GRAPH]



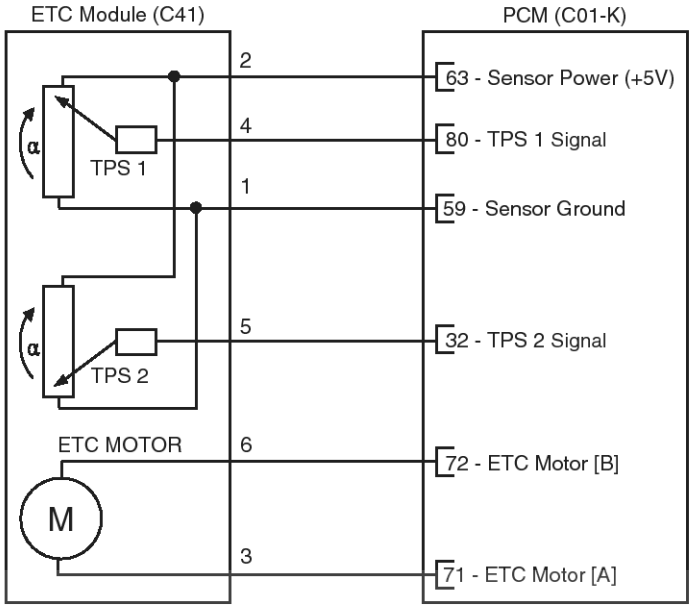
EGRF235A

[ETC motor]

Item	Sensor Resistance
Coil Resistance (Ω)	1.2 ~ 1.8 [20℃ (68°F)]

Circuit diagram

[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	PCM C01-K (59)	Sensor Ground
2	PCM C01-K (63)	Sensor Power (+5V)
3	PCM C01-K (71)	ETC Motor [A] Control
4	PCM C01-K (80)	TPS 1 Signal
5	PCM C01-K (32)	TPS 2 Signal
6	PCM C01-K (72)	ETC Motor [B] Control

[Harness Connector]

SMGFL9107L

Fail-safe mode

ITEMS	FAIL-SAFE	
ETC Motor	Throttle valve stuck at 5°	
TPS	TPS 1 fault	Replace it with TPS2
	TPS 2 fault	Replace it with TPS1
	TPS 1,2 fault	Throttle valve stuck at 5°
APS	APS 1 fault	Replace it with APS2
	APS 2 fault	Replace it with APS1
	APS 1,2 fault	Throttle valve stuck at 5°

NOTICE

When throttle value is stuck at 5°, engine speed is limited at below 1,500rpm and vehicle speed at maximum 40 ~ 50 km/h (25 ~ 31mph).

Component inspection

Throttle position sensor (TPS)

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

Specification: Refer to Specification Section.

3. Turn ignition switch OFF and disconnect the scantool from the DLC.
4. Disconnect ETC module connector and measure resistance between ETC module terminals 1 and 2.

Specification: Refer to Specification Section.

ETC motor

1. Disconnect ETC module connector and measure resistance between ETC module terminals 3 and 6.

Specification: Refer to Specification Section.

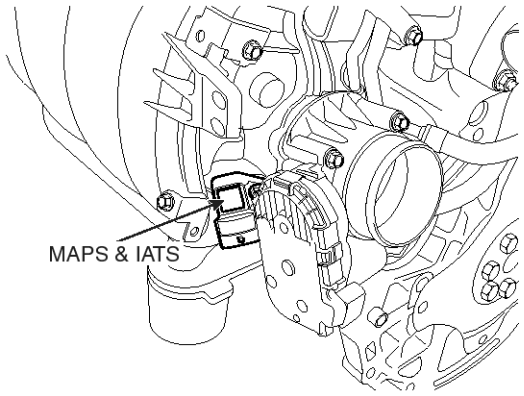
ETC system initialization

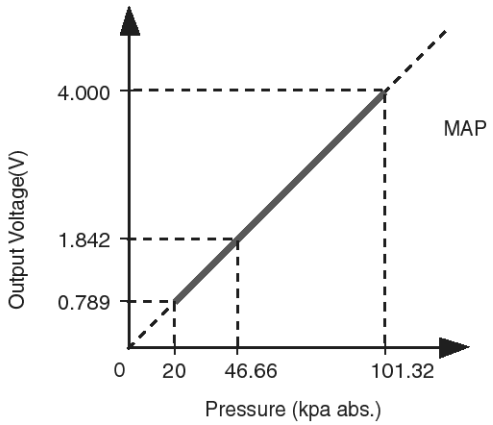
When ignition switch is turned from OFF to ON, ETC system learns the throttle angle in 1 sec.

1. Throttle valve moves from limp-home position to close position.
2. And then, it opens to about 15° and moves to limp-home position.

Manifold Absolute Pressure Sensor (MAPS)

Function and opertion principle





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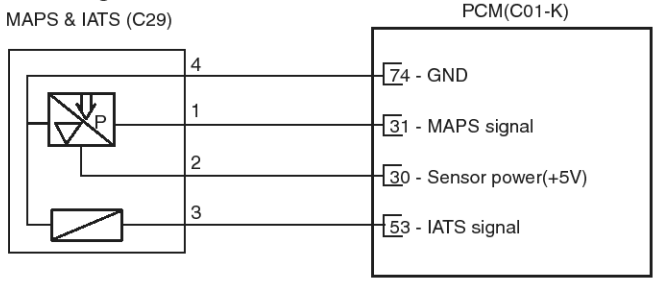
Manifold Absolute Pressure Sensor (MAPS) is speed-density type sensor and is installed on the surge tank. This MAPS senses absolute pressure in surge tank and transfers this analog signal proportional to the pressure to the PCM. The PCM calculates the intake air quantity and engine speed based on this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

Specification

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

Circuit diagram

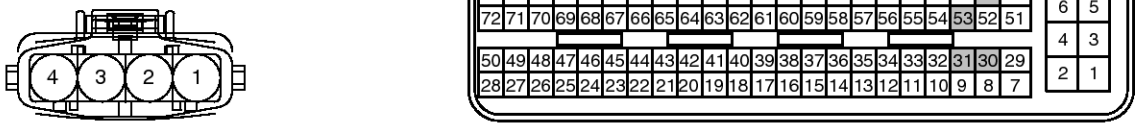
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	PCM C01-K (31)	MAPS signal
2	PCM C01-K (30)	Sensor power(+5V)
3	PCM C01-K (53)	IATS signal
4	PCM C01-K (74)	Sensor signal

[Harness Connector]



C29
MAPS

C01-K
PCM

SMGFL9108L

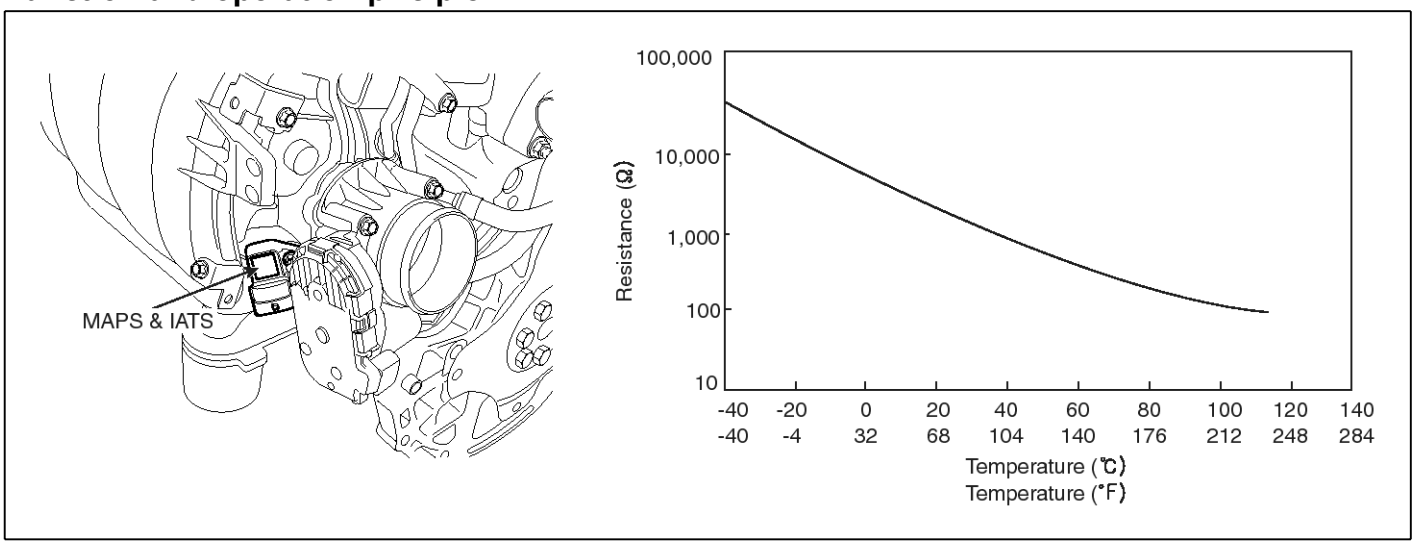
Component inspection

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

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

Intake Air Temperature Sensor (IATS)

Function and operation priciple



SMGFL9109L

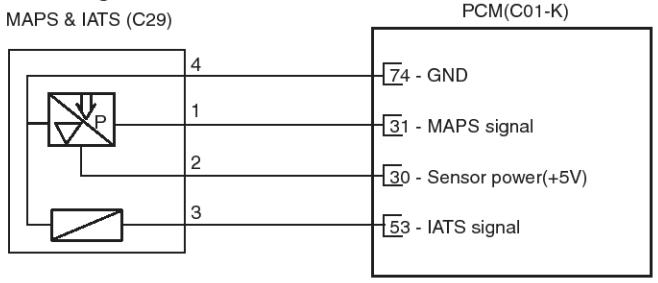
Intake Air Temperature Sensor (IATS) is installed inside the Manifold Absolute Pressure Sensor (MAPS) and detects the intake air temperature. To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the PCM uses not only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

Specification

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

Circuit diagram

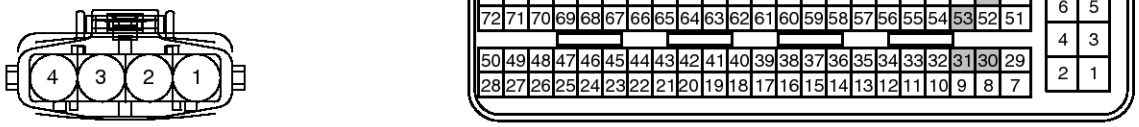
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	PCM C01-K (31)	MAPS signal
2	PCM C01-K (30)	Sensor power(+5V)
3	PCM C01-K (53)	IATS signal
4	PCM C01-K (74)	Sensor signal

[Harness Connector]



C29
MAPS

C01-K
PCM

SMGFL9108L

Component inspection

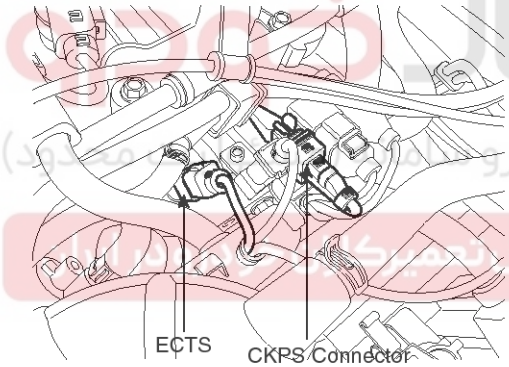
1. Turn ignition switch OFF.
2. Disconnect IATS connector.
3. Measure resistance between IATS terminals 3 and 4.
4. Check that the resistance is within the specification.

Specification: Refer to Specification Section.

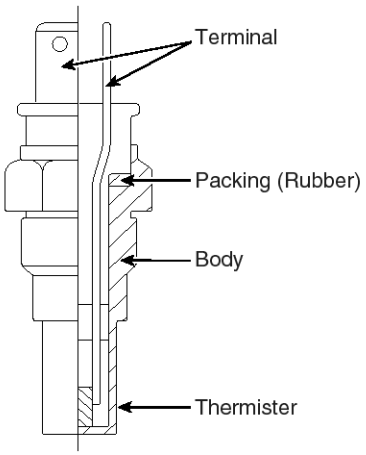
Engine Coolant Temperature Sensor (ECTS)

Function and operation priciple

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



SNFFL9002N



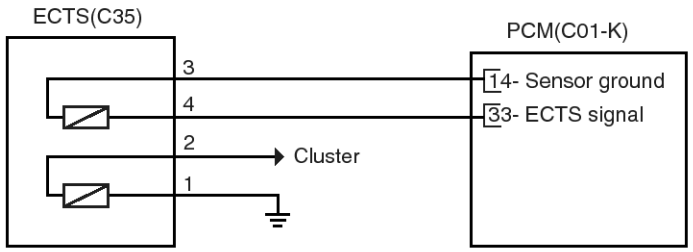
EGRF241A

Specification

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

Circuit diagram

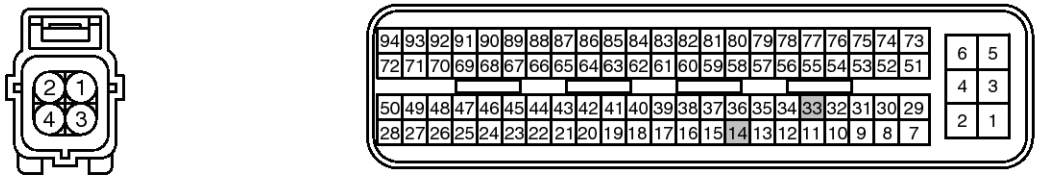
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	Chassis ground	-
2	Cluster	-
3	PCM C01-K (14)	ECTS signal
4	PCM C01-K (33)	Sensor ground

[Harness Connector]



C35
ECTS

C01-K
PCM

SMGFL9110L

Component inspection

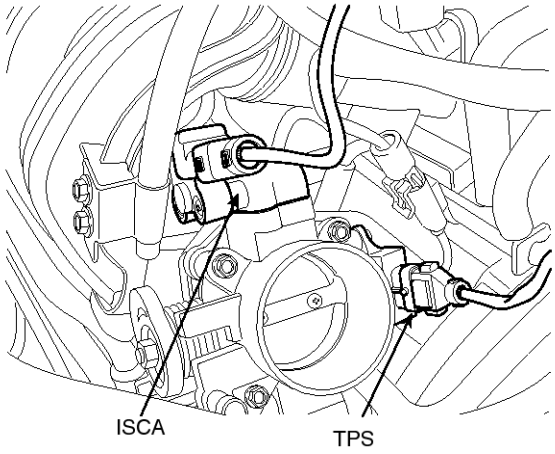
1. Turn ignition switch OFF.
2. Disconnect ECTS connector.
3. Remove the ECTS.
4. After immersing the thermistor of the sensor into engine coolant, measure resistance between ECTS terminals 3 and 4.
5. Check that the resistance is within the specification.

Specification: Refer to Specification Section.

Throttle Position Sensor (TPS)

Function and operation priciple

The Throttle Position Sensor (TPS) is mounted on the throttle body and detects the opening angle of the throttle plate. The TPS has a variable resistor (potentiometer) whose characteristic is the resistance changing according to the throttle angle. During acceleration, the TPS resistance between the reference 5V and the signal terminal decreases and output voltage increases; during deceleration, the TPS resistance increases and TPS output voltage decreases. The PCM supplies a reference 5V to the TPS and the output voltage increases directly with the opening of the throttle valve. The TPS output voltage will vary from about 2.5 V at closed throttle to about 4.5 V at wide-open throttle. The PCM determines operating conditions such as idle (closed throttle), part load, acceleration/deceleration, and wide-open throttle from the TPS. Also The PCM uses the Manifold Absolute Pressure Sensor (MAPS) signal along with the TPS signal to adjust fuel injection duration and ignition timing.



AFLG001O

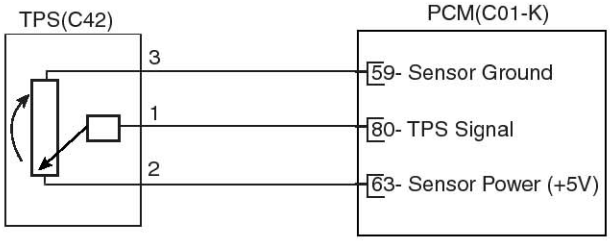
Specification

Throttle Angle	Output Voltage (V)
C.T	0.2 ~ 0.325
W.O.T	Approx. 4.7

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

Circuit Diagram

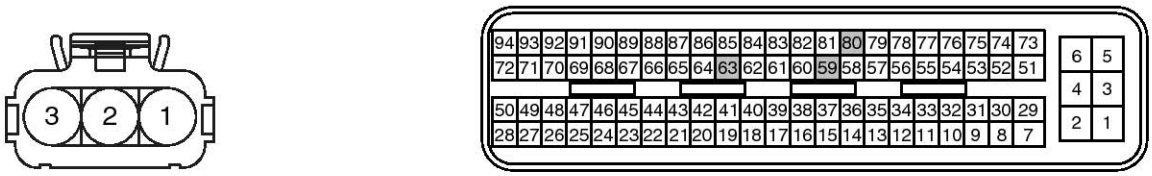
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	PCM C01-K (80)	TPS Signal
2	PCM C01-K (63)	Sensor Power (+5V)
3	PCM C01-K (59)	Sensor Ground

[Harness Connector]



C42
TPS

C01-K
PCM

SMGFL9111L

Component Inspection

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

Specification: Refer to Specification Section.

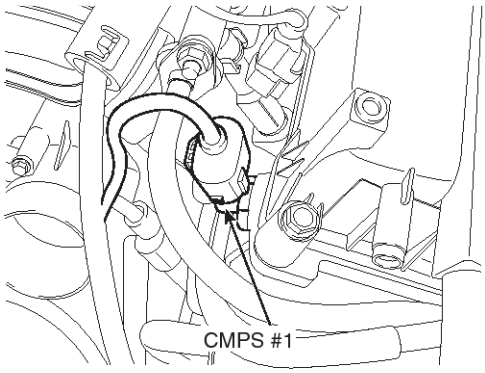
3. Turn ignition switch OFF and disconnect the scantool from the DLC.
4. Disconnect TPS connector and measure resistance between TPS terminals 2 and 3

Specification: Refer to Specification Section.

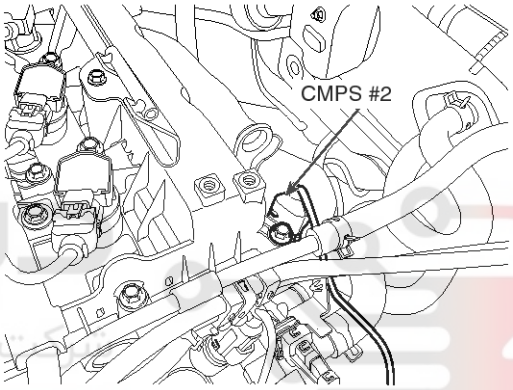
Camshaft Position Sensor (CMPS)

Function and operation principle

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

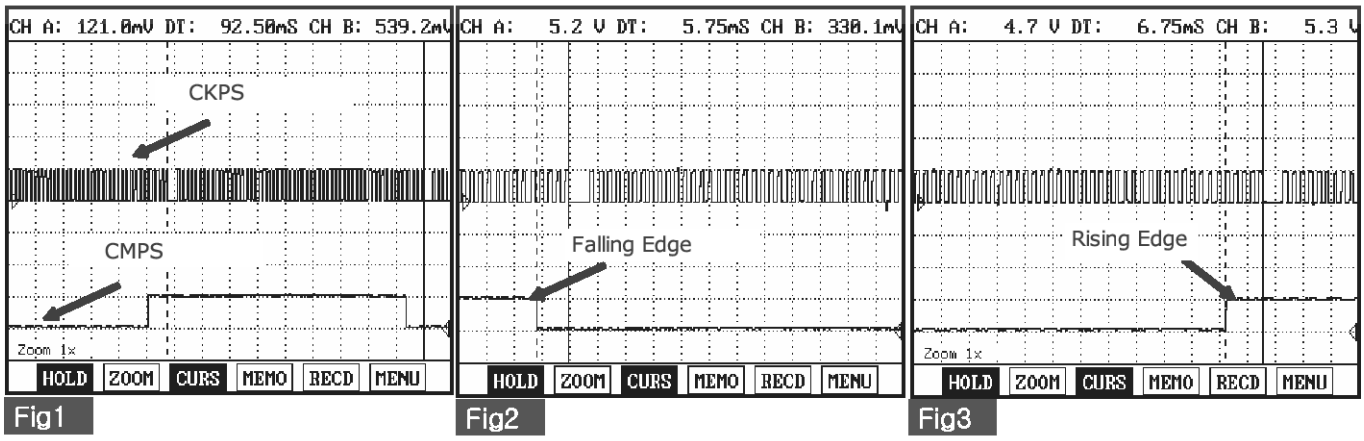


SNFFL9000D



SNFFL9004D

Waveform



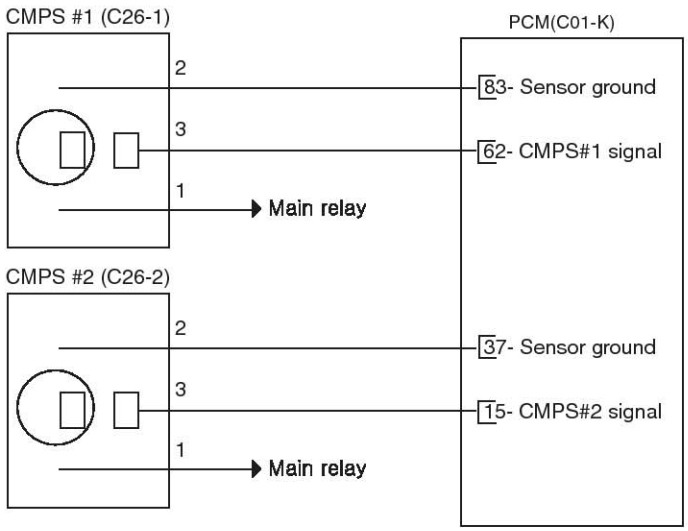
SNFFL9018N

Fig.1) The square wave signal should be smooth and without any distortion.

Fig.2,3)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

Circuit diagram

[Circuit Diagram]



[Connection Information]

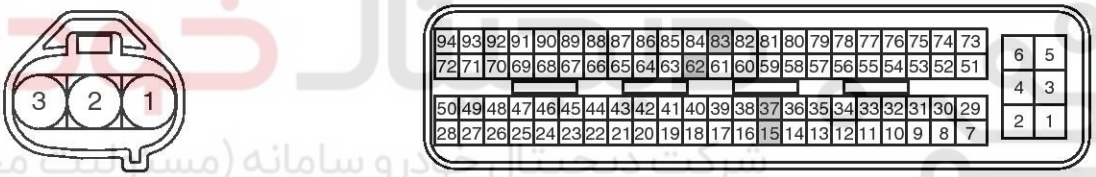
CMPS#1

Terminal	Connected to	Function
1	Main relay	Power supply (B+)
2	PCM C01-K (83)	Sensor ground
3	PCM C01-K (62)	CMPS#1 signal

CMPS#2

Terminal	Connected to	Function
1	Main relay	Power supply (B+)
2	PCM C01-K (37)	Sensor ground
3	PCM C01-K (15)	CMPS#2 signal

[Harness Connector]



C26-1,2
CMPS

C01-K
PCM

SMGFL9112L

Component inspection

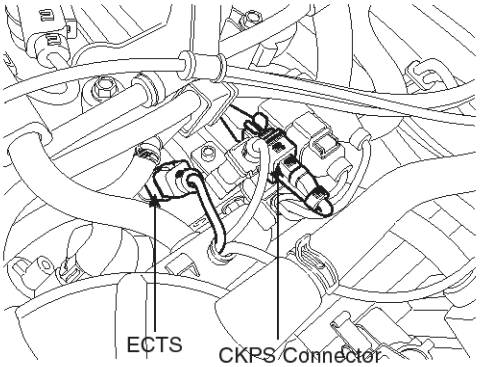
1. Check signal waveform of CMPS and CKPS using a scantool.

Specification : Refer to "WAVE FORM"

Crankshaft Position Sensor (CKPS)

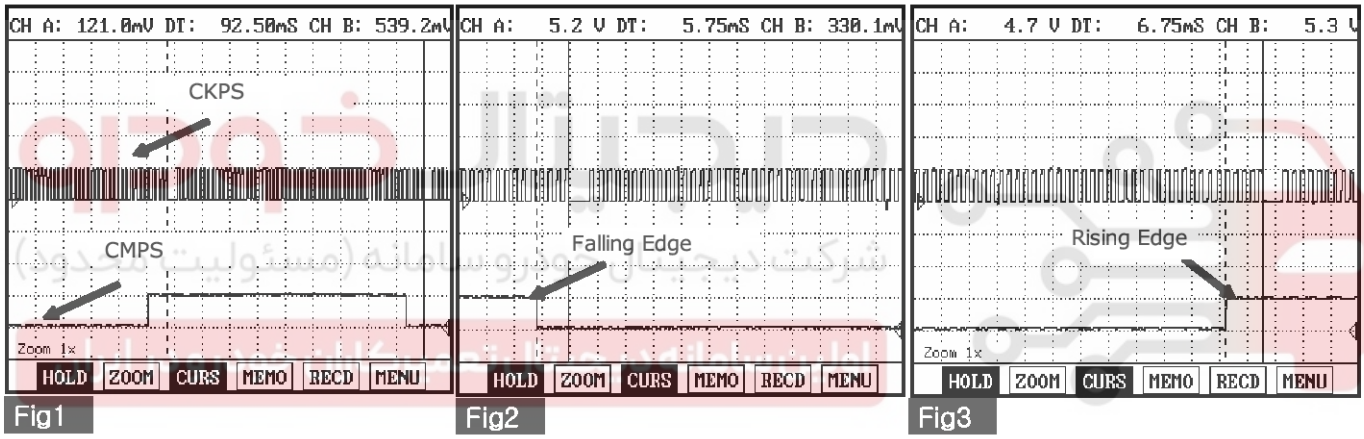
Function and operation priciple

Crankshaft Position Sensor (CKPS) detects the crankshaft position and is one of the most important sensors of the engine control system. If there is no CKPS signal input, the engine may stop because of CKPS signal missing. This sensor is installed on transaxle housing and generates alternating current by magnetic flux field which is made by the sensor and the target wheel when engine runs. The target wheel consists of 58 slots and 2 missing slots on 360 degrees CA (Crank Angle).



SNFFL9002N

Waveform



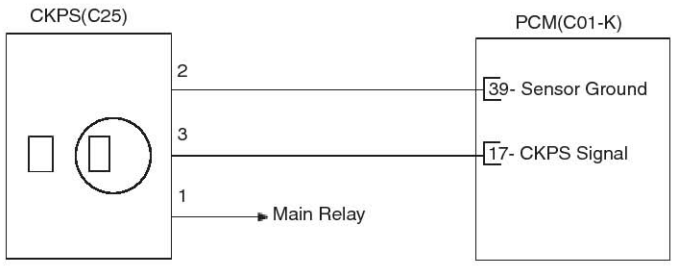
SNFFL9018N

Fig.1) The square wave signal should be smooth and without any distortion.

Fig.2,3)The CMPS falling(rising) edge is coincided with 3~5 tooth of the CKP from one longer signal(missing tooth)

Circuit diagram

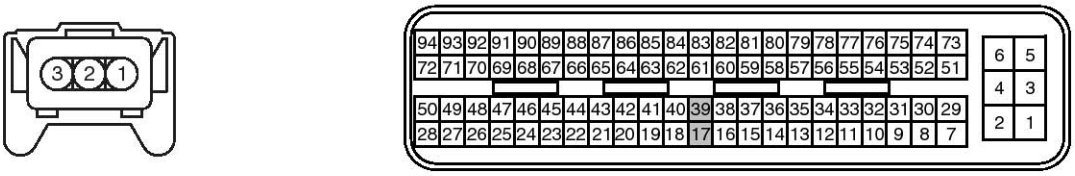
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	PCM C01-K (39)	Sensor Ground
3	PCM C01-K (17)	CKPS Signal

[Harness Connector]



C25
CKPS

C01-K
PCM

SMGFL9113L

Component inspection

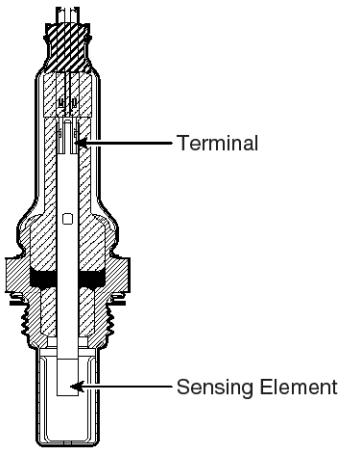
1. Check signal waveform of CKPS and CMPS using a scantool.

Specification : Refer to "WAVE FORM"

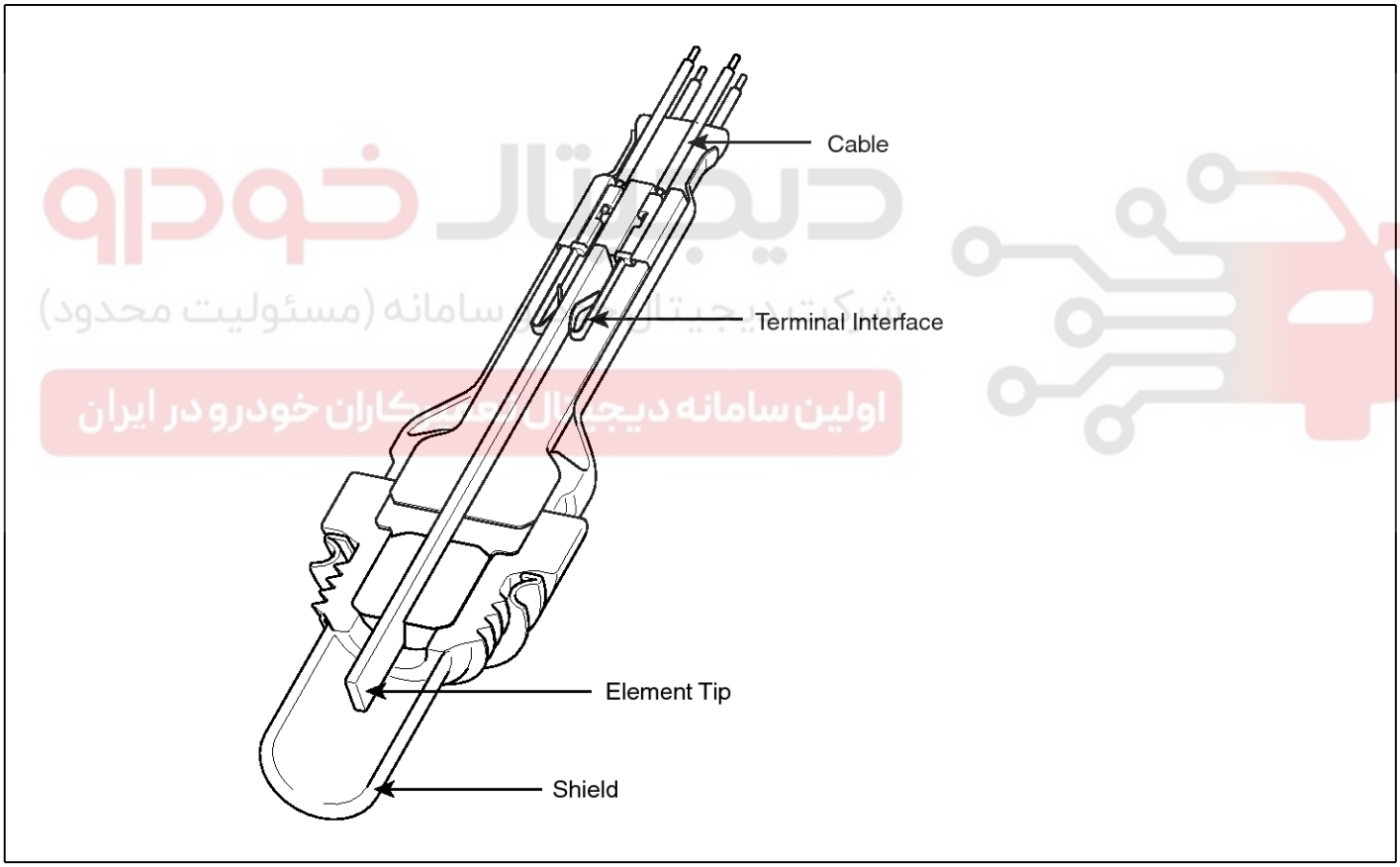
Heated Oxygen Sensor (HO2S)

Function and operation priciple

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



EGRF247A



EGRF248A

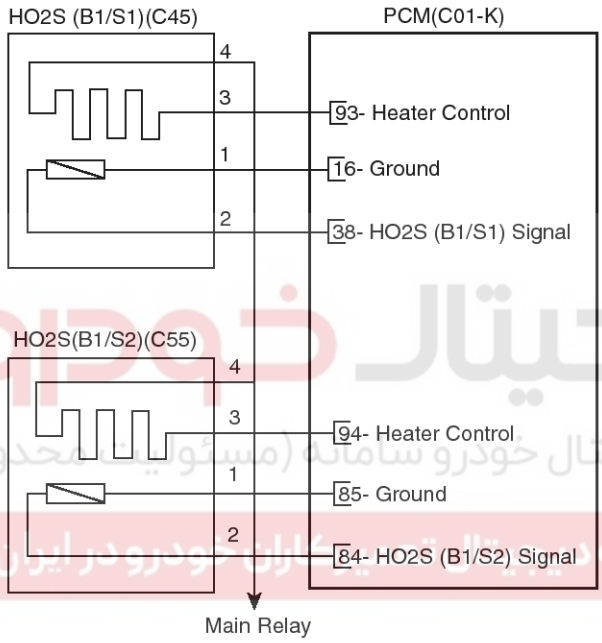
Specification

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

Item	Specification
Heater Resistance (Ω)	3.1 ~ 4.1 Ω [20℃ (68˚F)]

Circuit Diagram

[Circuit Diagram]



[Connection Information]

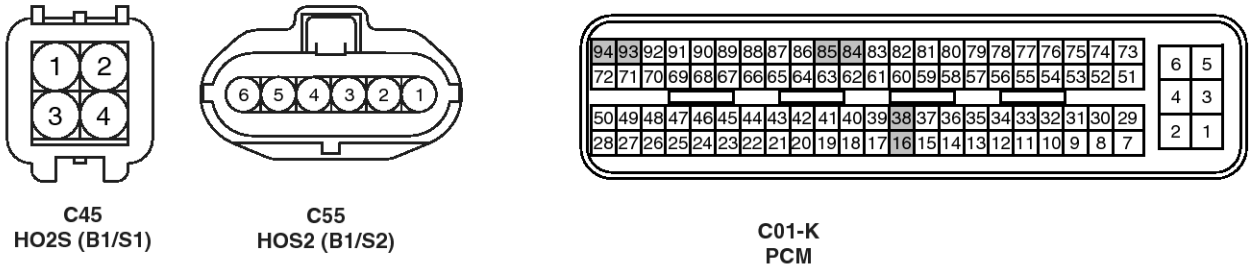
HO2S (B1/S1)

Terminal	Connected to	Function
1	PCM C01-K (16)	Sensor Ground
2	PCM C01-K (38)	HO2S (B1/S1) Signal
3	PCM C01-K (93)	Heater Control
4	Main Relay	Power Supply (B+)

HO2S (B1/S2)

Terminal	Connected to	Function
1	PCM C01-K (85)	Sensor Ground
2	PCM C01-K (84)	HO2S (B1/S2) Signal
3	PCM C01-K (94)	Heater Control
4	Main Relay	Power Supply (B+)

[Harness Connector]



C45
HO2S (B1/S1)

C55
HOS2 (B1/S2)

C01-K
PCM

SMGFL9114L

Component Inspection

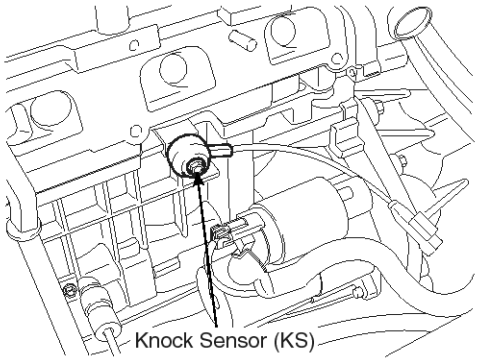
1. Disconnet the HO2S connector.
2. Measure resistance between HO2S heater terminals 3 and 4.
3. Check that the resistance is within the specification.

Specification: Refer to Specification Section.

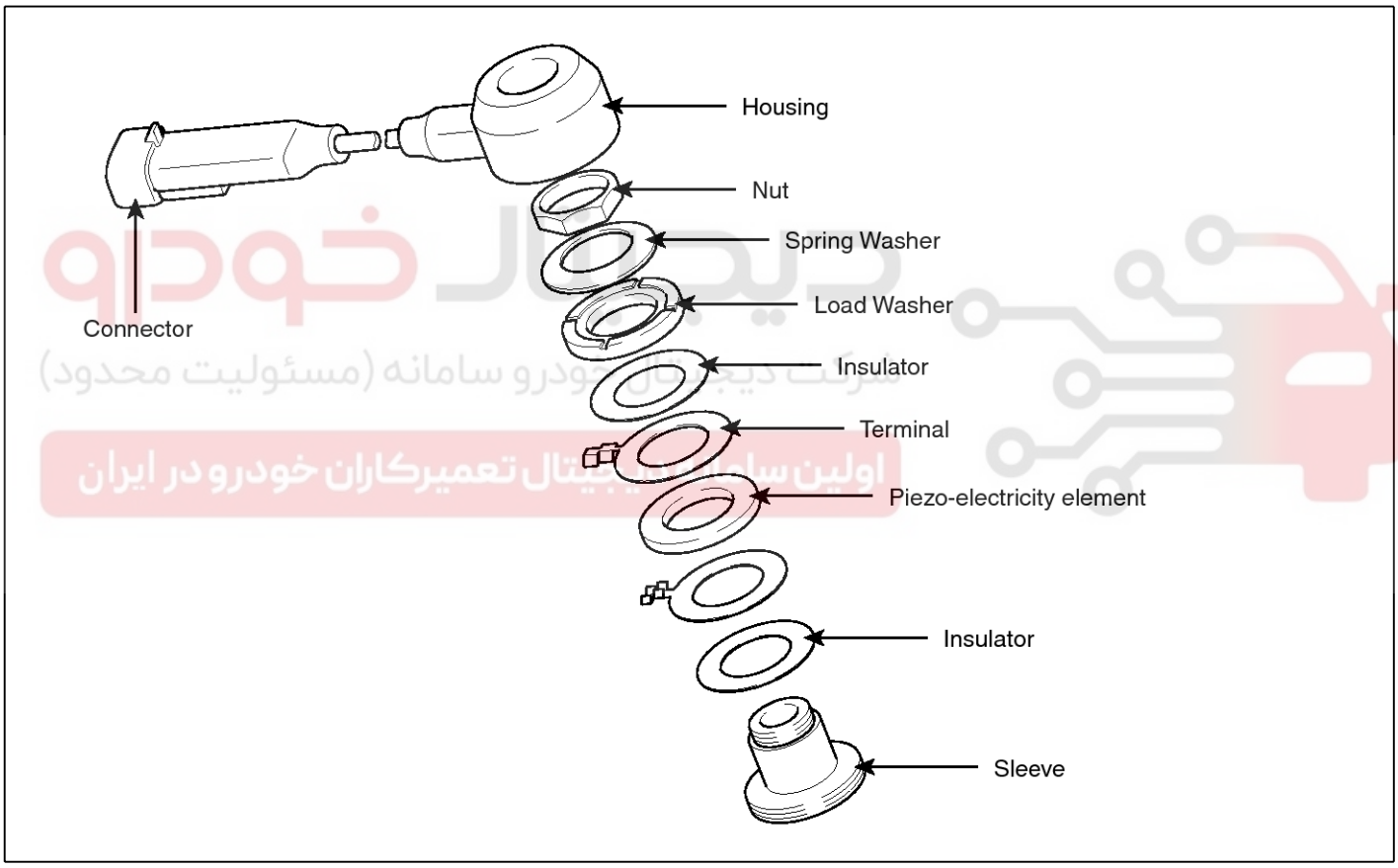
Knock Sensor (KS)

Function and operation priciple

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



SNFFL9003N

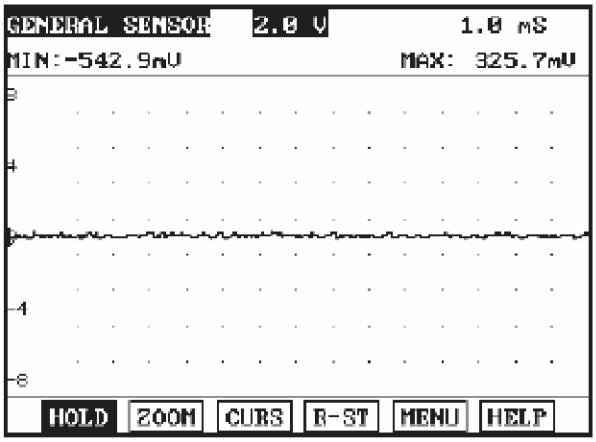


EGRF252A

Specification

Item	Specification
Capacitance (pF)	1,480 ~ 2,220
Resistance (MΩ)	1.0

Waveform



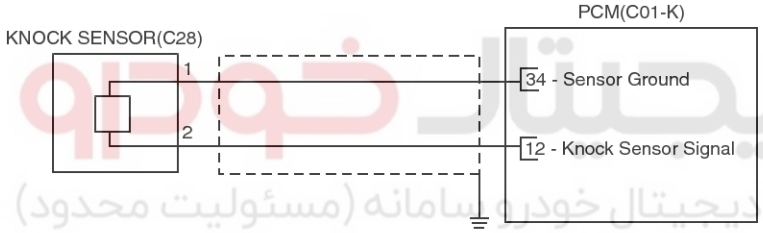
SNFFL9021N

The knock sensor is installed at cylinder block to detect the vibration effectively during engine running.

The above waveform shows the signal waveform of knock sensor when knock dosen't happen. Generally, knock signal has more noise than other sensor.

Circuit Diagram

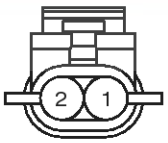
[Circuit Diagram]



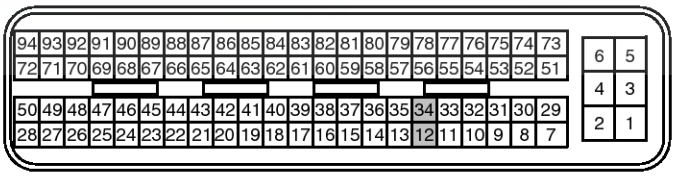
[Connection Information]

Terminal	Connected to	Function
1	PCM C01-K (34)	Sensor Ground
2	PCM C01-K (12)	Knock Sensor Signal

[Harness Connector]



C28
KNOCK SENSOR



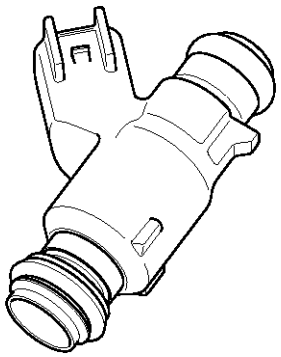
C01-K
PCM

SMGFL9115L

Injector

Function and operation principle

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



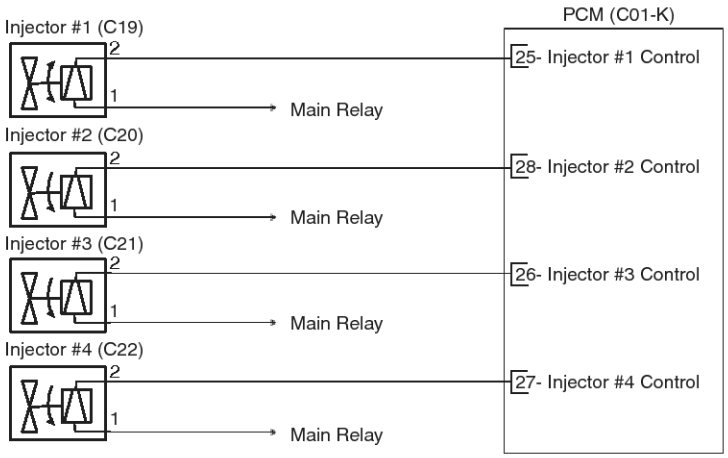
KFCF1026

Specification

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

Circuit diagram

[Circuit Diagram]



[Connection Information]

Injector #1 (C19)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	PCM C01-K (25)	Injector Control

Injector #2 (C20)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	PCM C01-K (28)	Injector Control

Injector #3 (C21)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	PCM C01-K (26)	Injector Control

Injector #4 (C22)

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	PCM C01-K (27)	Injector Control

[Harness Connector]

C19,C20,C21,C22
INJECTOR #1,2,3,4

C01-K
PCM

SMGFL9116L

Component inspection

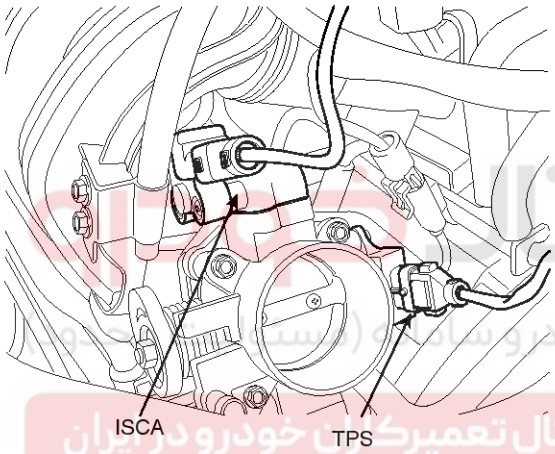
1. Turn ignition switch OFF.
2. Disconnect injector connector.
3. Measure resistance between injector terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to Specification Section.

Idle Speed Control Actuator (ISCA)

Function and operation priciple

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



AFLG001O

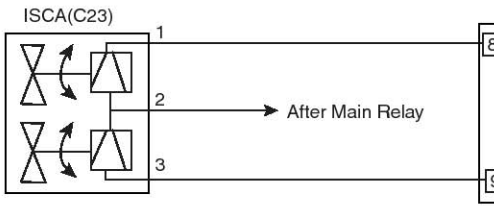
Specification

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

Duty (%)	Air flow rate (㎥/h)
15	1.0 ~ 2.3
35	7.5 ~ 12.7
70	43.0 ~ 55.0
96	63.0 ~ 71.0

Circuit Diagram

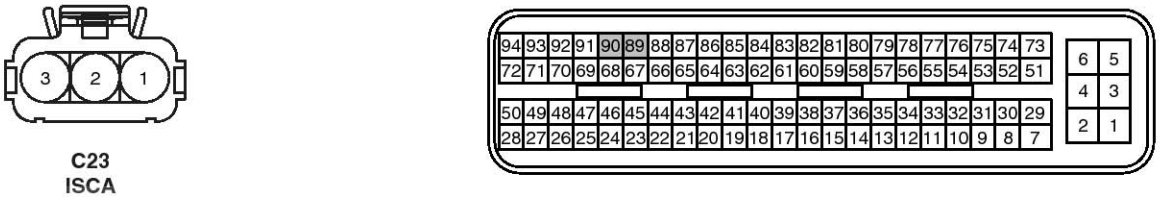
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	PCM C01-K (89)	ISCA (OPEN) Control
2	Main Relay	Power Supply (B+)
3	PCM C01-K (90)	ISCA (CLOSE) Control

[Harness Connector]



C23
ISCA

C01-K
PCM

SMGFL9117L

Component Inspection

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

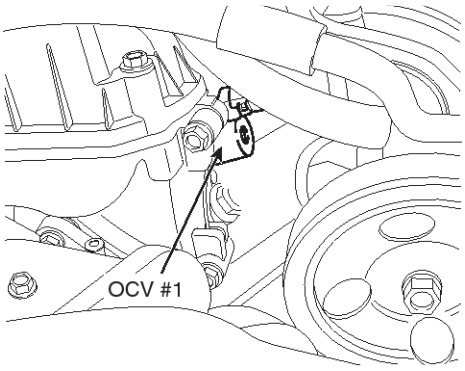
Specification: Refer to Specification Section.

CVVT Oil Control Valve (OCV)

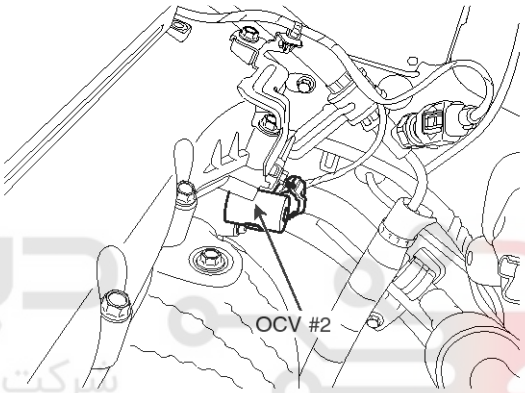
Function and operation principle

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

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



SNFFL9011D



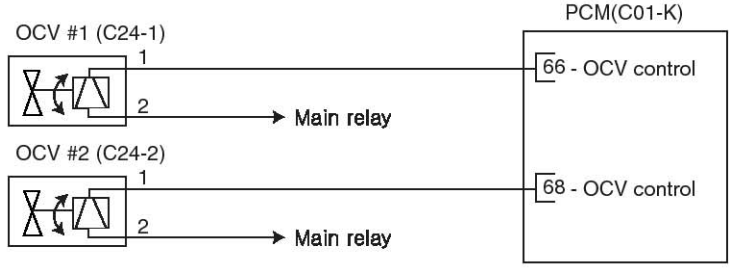
SNFFL9005D

Specification

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

Circuit Diagram

[Circuit Diagram]



[Connection Information]

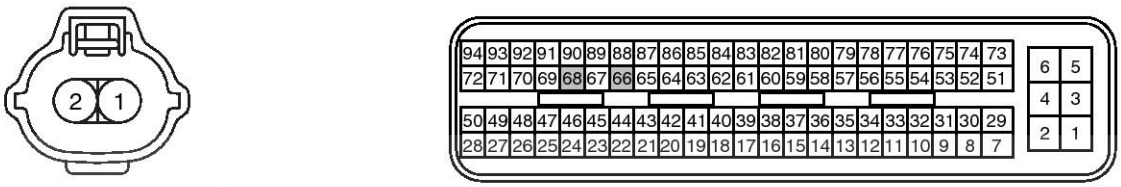
OCV #1 [Intake]

Terminal	Connected to	Function
1	PCM C01-K (66)	OCV control
2	Main relay	Power supply (B+)

OCV #2 [Exhaust]

Terminal	Connected to	Function
1	PCM C01-K (68)	OCV control
2	Main relay	Power supply (B+)

[Harness Connector]



C24-1,2
OCV

C01-K
PCM

SMGFL9118L

Component inspection

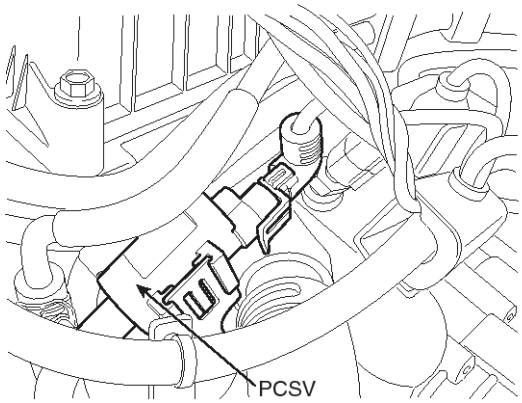
1. Turn ignition switch OFF.
2. Disconnect OCV connector.
3. Measure resistance between OCV terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to Specification Section.

Purge Control Solenoid Valve (PCSV)

Function and operation priciple

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

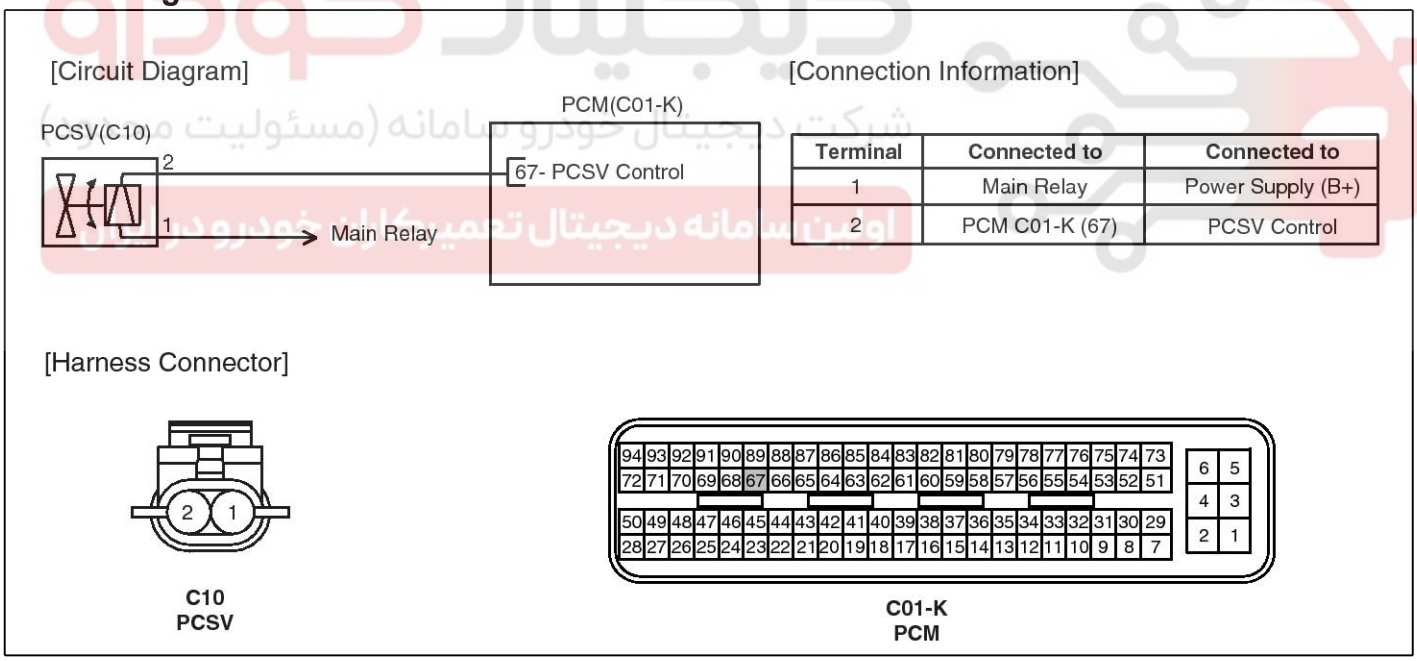


AFLG001M

Specification

Item	Specification
Coil Resistance (Ω)	19.0 ~ 22.0 [20℃ (68°F)]

Circuit diagram



SMGFL9119L

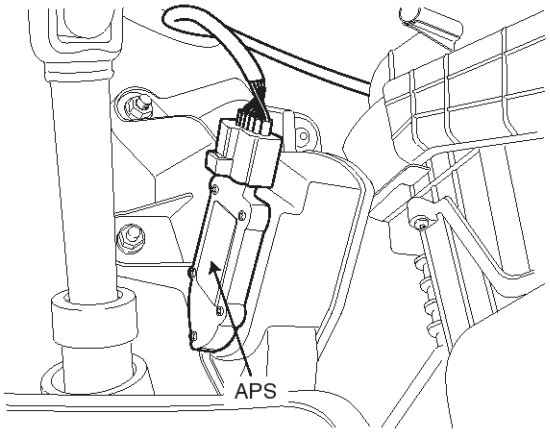
Component inspection

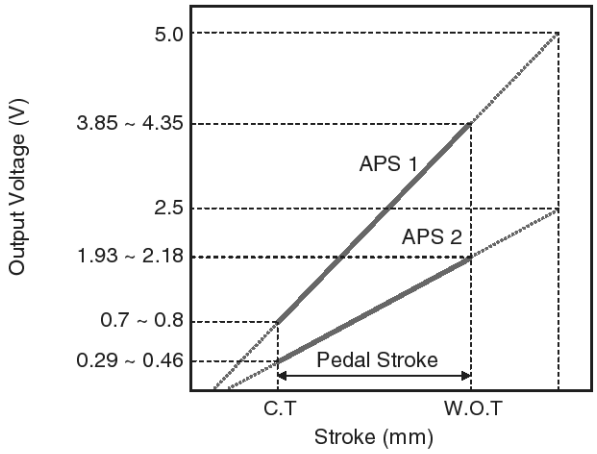
1. Turn ignition switch OFF.
2. Disconnect PCSV connector.
3. Measure resistance between PCSV terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to Specification Section.

Accelerator Position Sensor (APS)

Function and operation principle





SUNFL7108N

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.

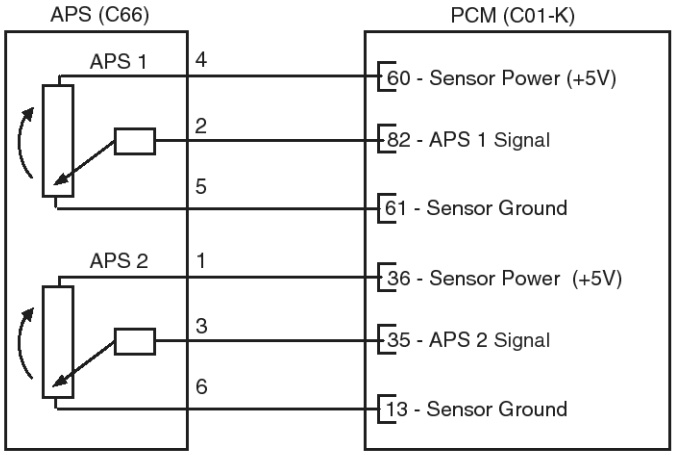
Specification

Pedal Position	Output Voltage (V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

Items	Sensor Resistance (kΩ)
APS1	0.7 ~ 1.3 [20℃ (68°F)]
APS2	1.4 ~ 2.6 [20℃ (68°F)]

Circuit diagram

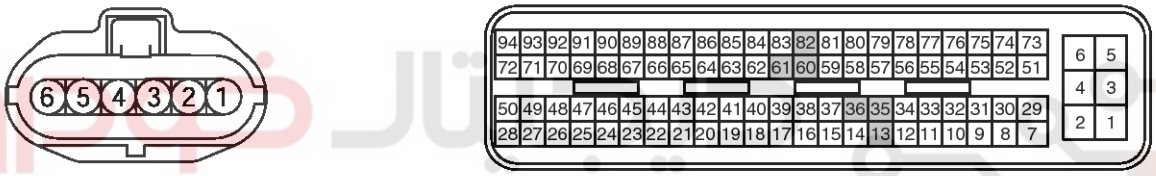
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	PCM C01-K (36)	Sensor power (+5V)
2	PCM C01-K (82)	APS 1 Signal
3	PCM C01-K (35)	APS 2 Signal
4	PCM C01-K (60)	Sensor power (+5V)
5	PCM C01-K (61)	Sensor ground
6	PCM C01-K (13)	Sensor ground

[Harness Connector]



C66
APS

C01-K
PCM

SMGFL9120L

Component inspection

1. Connect a scan tool to the Diagnosis Link Connector (DLC).
2. Start engine and check output voltages of APS 1 and 2 at C.T and W.O.T.

Specification: Refer to Specification Section.

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

Specification: Refer to Specification Section.

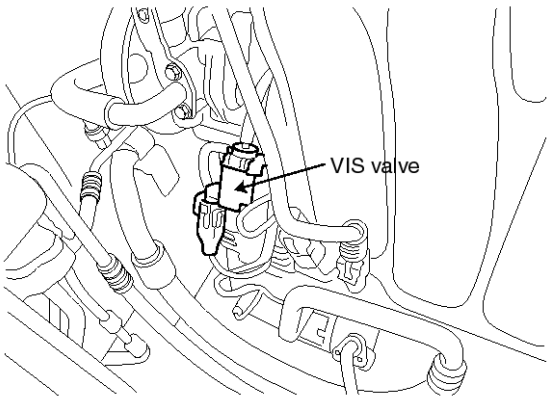
5. Disconnect APS connector and measure resistance between APS terminals 1 and 6 (APS 2).

Specification: Refer to Specification Section.

Variable Intake Solenoid (VIS) Valve

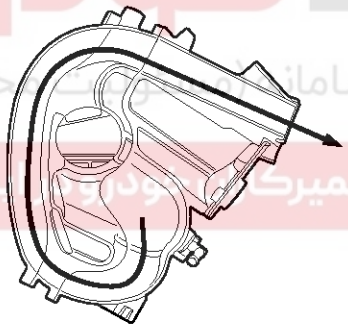
Function and operation principle

Variable Intake manifold Solenoid (VIS) valve is installed on intake manifold. These VIS valve controls vacuum modulator which activates valve in intake manifold. The PCM opens or closes this valve according to engine condition (Refer to below table).

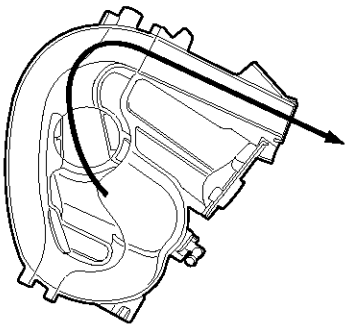


SNFFL9053N

Engine condition	VIS valve	Operation
Medium speed	Closed	Increasing engine performance in low engine speed by reducing intake interference among cylinders
Low / High speed	Open	Minimizing intake resistance by shortening intake manifold length and increasing area of air entrance



Medium speed



Low / High speed

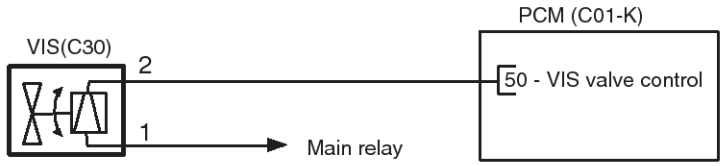
SNFFL9036N

Specification

Item	Specification
Coil resistance (Ω)	30.0 ~ 35.0 [20℃(68°F)]

Circuit Diagram

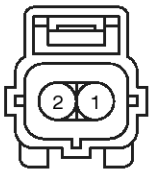
[Circuit Diagram]



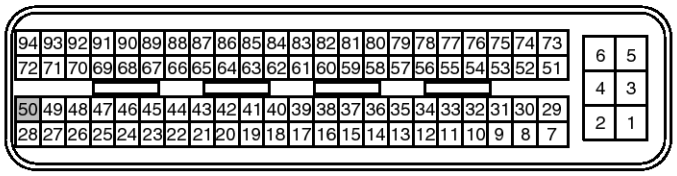
[Connection Information]

Terminal	Connected to	Function
1	Main relay	Power supply (B+)
2	PCM C01-K (50)	VIS valve control

[Harness Connector]



C30
VIS valve



C01-K
PCM

SMGFL9121L

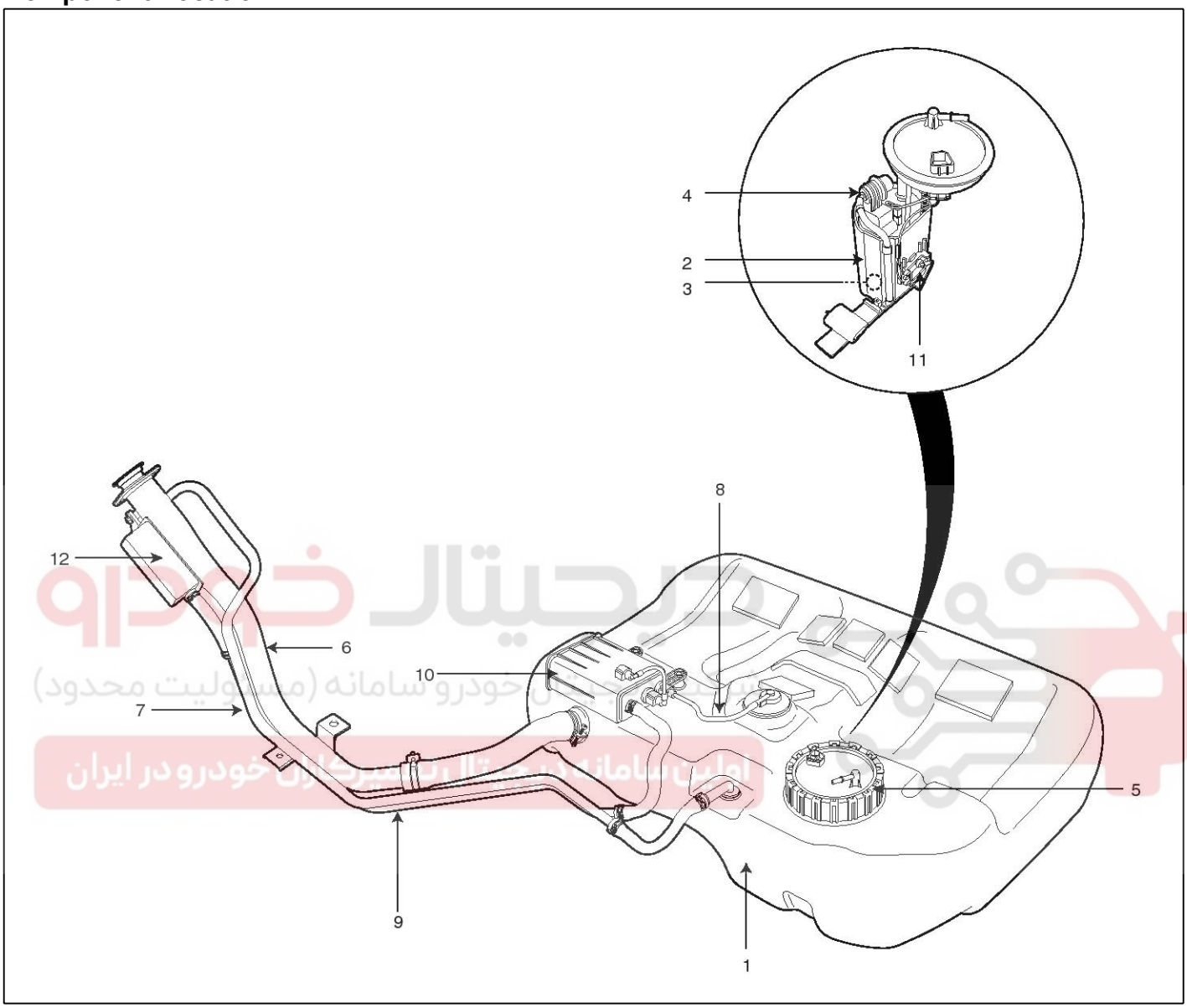
Component inspection

1. Turn ignition switch OFF.
2. Disconnect the electric variable swirl control actuator connector.
3. Measure resistance between VIS valve terminals 1 and 2.

Specification: Refer to Specification Section.

Fuel Delivery System

Component Location



SMGFL9122L

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

Fuel Pressure Test

1. PREPARING

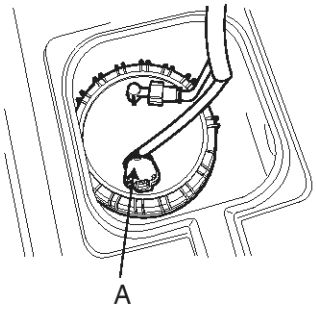
1. Open service cover in trunk.

2. RELEASE THE INTERNAL PRESSURE

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

NOTE

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



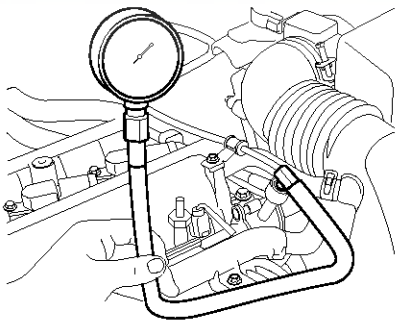
3. INSTALL THE SPECIAL SERVICE TOOL (SST) FOR MEASURING THE FUEL PRESSURE

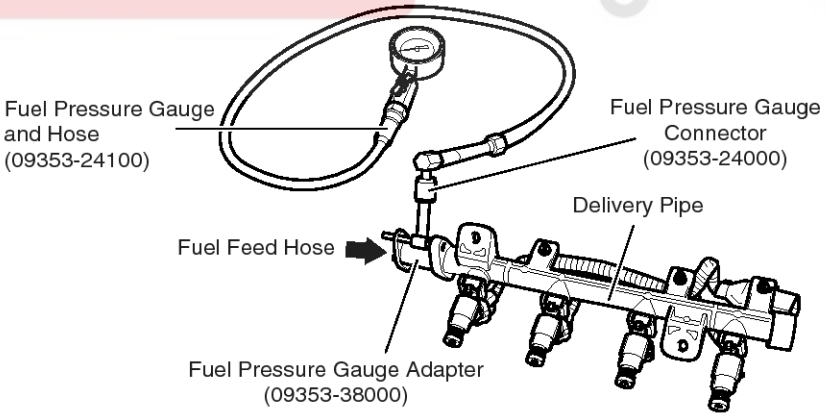
1. Disconnect the fuel feed hose from the delivery pipe.

CAUTION

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

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





SMGFL9123L

4. INSPECT FUEL LEAKAGE ON CONNECTION

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

5. FUEL PRESSURE TEST

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

Standard Value: 343 kpa (3.5 kgf/㎠, 49.8 psi)

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

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

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

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

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

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

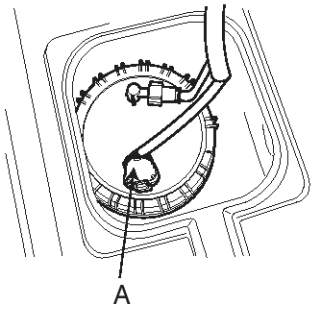
LFLG716A

6. RELEASE THE INTERNAL PRESSURE

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

NOTE

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



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

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

CAUTION

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

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

8. INSPECT FUEL LEAKAGE ON CONNECTION

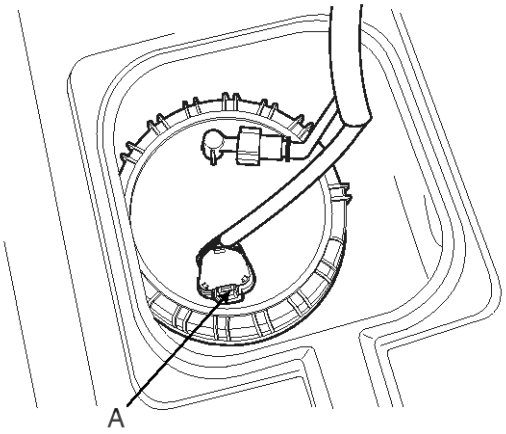
1. Connect the battery negative (-) terminal.
2. Apply battery voltage to the fuel pump terminal and activate the fuel pump. With fuel pressure applied, check that there is no fuel leakage from the fuel pressure gauge or connection part.
3. If the vehicle is normal, connect the fuel pump connector.

SMGFL9124L

Fuel Pump

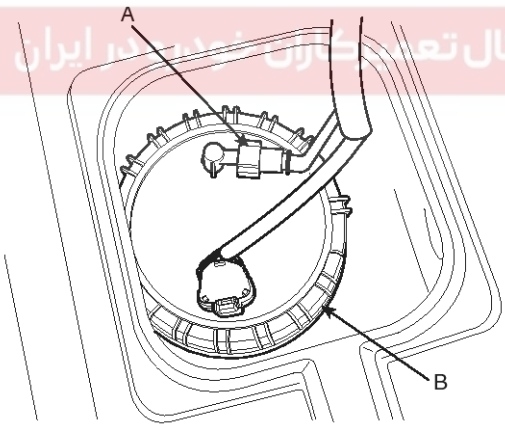
Removal

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



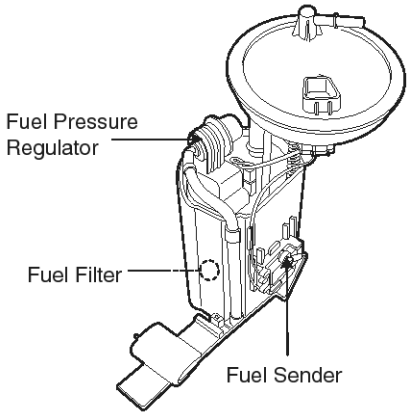
SMGFL9125L

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



SMGFL9126L

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



LGLG003E

Installation

1. Installation is the reverse of removal.

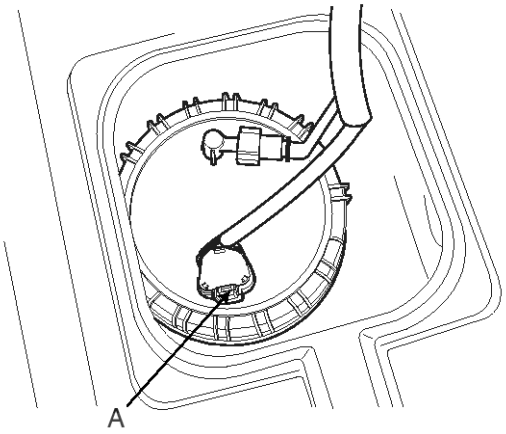
Fuel pump plate cover installation :
58.8 ~ 68.6 N.m (6.0 ~ 7.0 kgf.m, 43.4 ~ 50.6 lb-ft)

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

Fuel Tank

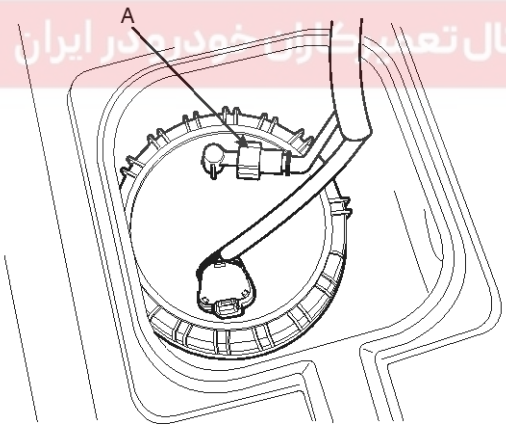
Removal

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



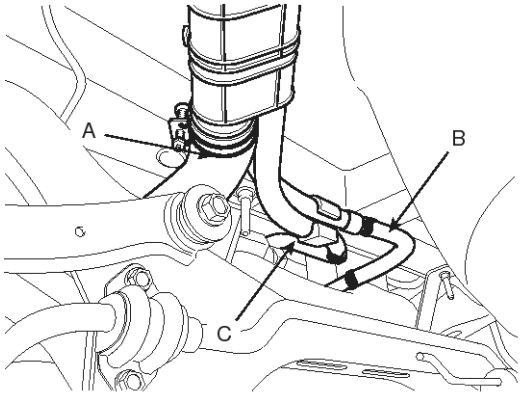
SMGFL9125L

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



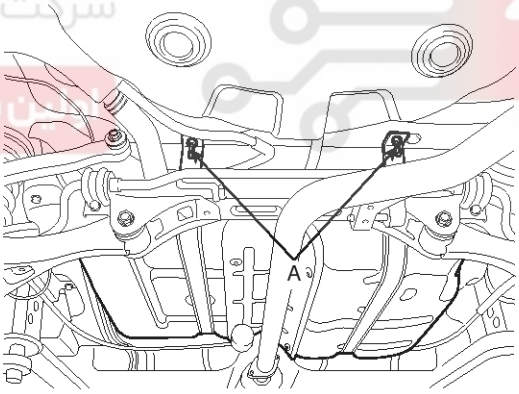
SMGFL9127L

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



SMGFL9201L

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



SMGFL9202L

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

Installation

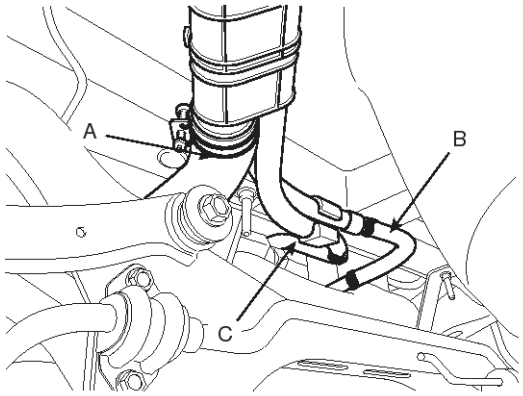
Installation is the reverse of removal.

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

Filler-Neck Assembly

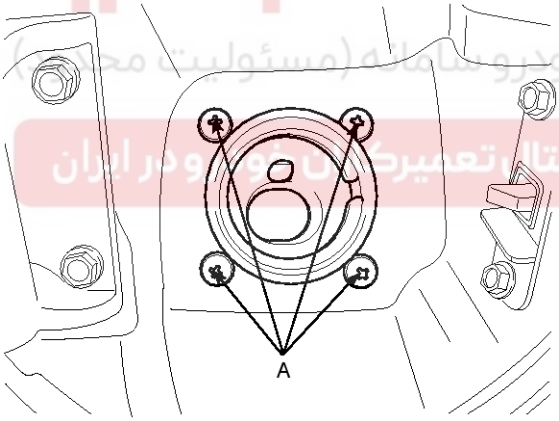
Removal

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



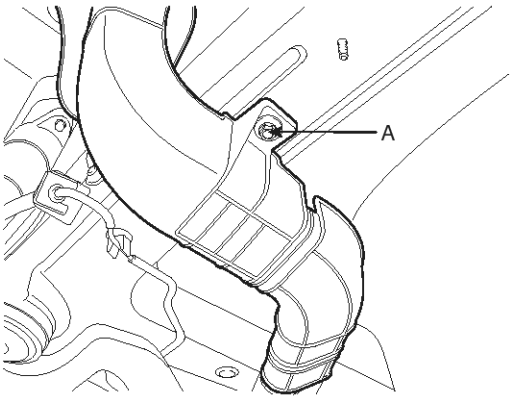
SMGFL9201L

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



SCMFL6655D

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



SMGFL9203L

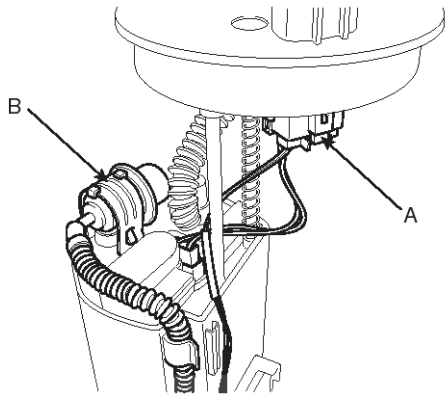
Installation

1. Installation is the reverse of removal.

Fuel Filter

Replacement

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



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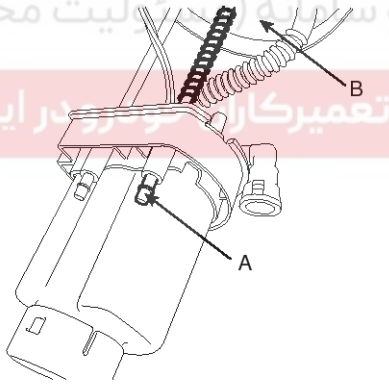
3. Remove the cushion pipe fixing clip (A) after pressing the flange assembly (B).



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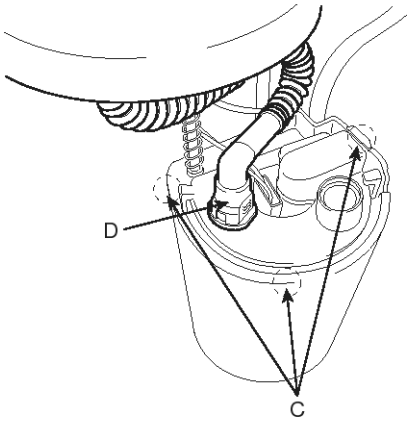
4. Separate the flange assembly from the fuel pump & filter assembly after disengaging three fixing hooks (C) and the feed hose connector (D).



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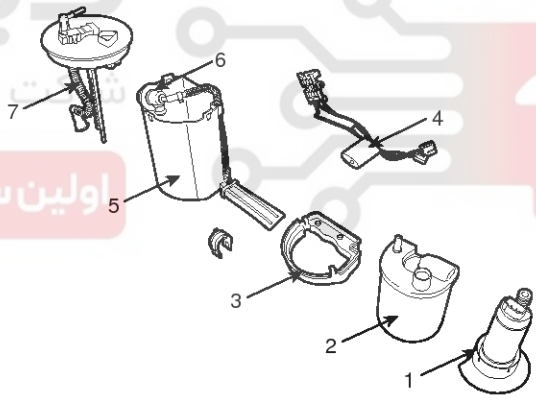
5. Separate the fuel filter assembly from the fuel pump assembly after disengaging two hooks.



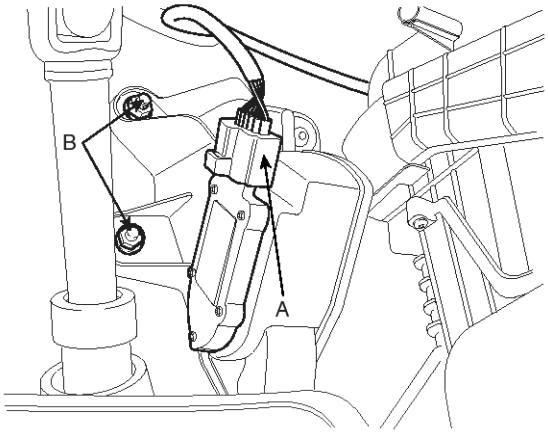
SMGFL9207L

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

Accelerator Pedal

Removal

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



SNFFL7144D

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

Installation

1. Installation is reverse of removal.

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