General Information

Specifications

Fuel Delivery System

Items	Specification	
Fuel Tank	Capacity	82 lit. (86.6 U.S.qt., 72.1 Imp.qt.)
Fuel Filter	Type	High pressure type
Fuel Pressure Regulator	Regulated Fuel Pressure	380 kPa (3.87 kgf/㎠, 55.0 psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor

Sensors

Mass Air Flow Sensor (MAFS)

▷ Type: Hot-film type

▷ Specification

Air Flow (kg/h)	Frequency (Hz)
12.6	2,320
18	2,645
23.4	2,903
32.4	3,263
43.2	3,622
57.6	3,986
72	4,288
108	4,876
144	5,380
198	5,983
270	6,636
360	7,286
486	8,002
666	8,843
900	9,699

Intake Air Temperature Sensor (IATS)

▷ Type: Thermistor type

▷ Specification

Temperature		Resistance (kΩ)
℃	˚F	
-40	-40	100.87
-20	-4	28.58
0	32	9.4
10	50	5.66
20	68	3.51
40	104	1.47
60	140	0.67
80	176	0.33

Engine Coolant Temperature Sensor (ECTS)

▷ Type: Thermistor type

▷ Specification

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

Throttle Position Sensor (TPS) [integrated into ETC Module]

▷ Type: Variable resistor type

▷ Specification

Throttle angle (˚)	Output Voltage (V) [Vref = 3.3V]	
	TPS1	TPS2
0	0.00	3.30
10	0.32	2.98
20	0.63	2.67
30	0.94	2.36
40	1.25	2.05
50	1.57	1.73
60	1.89	1.41
70	2.20	1.10
80	2.51	0.79
90	2.83	0.47
100	3.14	0.16
105	3.30	0.00
C.T (6~15˚)	0.20 ~ 0.46	2.84 ~ 3.10
W.O.T (93~102˚)	2.94 ~ 3.20	0.10 ~ 0.36

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

Crankshaft Position Sensor (CKPS)

▷ Type: Magnetic field sensitive sensor

▷ Specification

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

Camshaft Position Sensor (CMPS)

▷ Type: Hall effect type

▷ Specification

Item	Specification
Output Voltage (V)	High: 5.0V
	Low: 0.7V
Air Gap (mm)	0.5 ~ 1.5

Knock Sensor (KS)

▷ Type: Piezo-electricity type

▷ Specification

Item	Specification
Capacitance (pF)	950 ~ 1,350

Heated Oxygen Sensor (HO2S)

▷ Type: Zirconia (ZrO2) Type

▷ Specification

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

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

Accelerator Position Sensor (APS) [Non-adjust type]

▷ Type: Potentiometer type

▷ Specification (When reference voltage = 5.0V)

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8	0.275 ~ 0.475
W.O.T	3.8 ~ 4.4	1.75 ~ 2.35

Accelerator Position Sensor (APS) [Adjust type]

▷ Type: Variable resistor type

▷ Specification (When reference voltage = 5.0V)

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

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

Actuators

Injector

▷ Specification

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

ETC Motor [integrated into ETC Module]

▷ Specification

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

Purge Control Solenoid Valve (PCSV)

▷ Specification

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

CVVT Oil Control Valve (OCV)

▷ Specification

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

Variable Intake Solenoid (VIS) Valve

▷ Specification

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

Ignition Coil

▷ Type: Stick type

▷ Specification

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

Service Standard

Item		Specification	
Ignition Timing (˚)		Neutral, N, P-range	BTDC 0 ± 10
		D-range	BTDC 10 ± 10
Idle Speed (rpm)	A/C OFF	Neutral, N, P-range	600±100rpm
		D-range	600±100rpm
	A/C ON	Neutral, N, P-range	600±100rpm
		D-range	600±100rpm

Tightening Torques

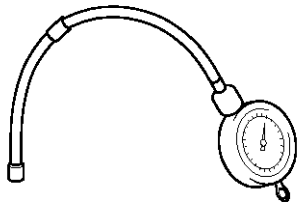
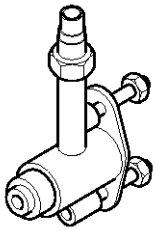
Engine Control System

Item	kgf.m	N.m	lb-ft
ECM installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Mass air flow sensor installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Engine coolant temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Crankshaft position sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Camshaft position sensor (Bank 1/Intake) installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Camshaft position sensor (Bank 1/Exhaust) installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Camshaft position sensor (Bank 2/Intake) installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Camshaft position sensor (Bank 2/Exhaust) installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Knock sensor (Bank 1/Front) installation bolt	1.5 ~ 2.5	14.7 ~ 24.5	10.9 ~ 18.1
Knock sensor (Bank 1/Rear) installation bolt	1.5 ~ 2.5	14.7 ~ 24.5	10.9 ~ 18.1
Knock sensor (Bank 2/Front) installation bolt	1.5 ~ 2.5	14.7 ~ 24.5	10.9 ~ 18.1
Knock sensor (Bank 2/Rear) installation bolt	1.5 ~ 2.5	14.7 ~ 24.5	10.9 ~ 18.1
Heated oxygen sensor (Bank 1 / sensor 1) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 1 / sensor 2) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 2 / sensor 1) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 2 / sensor 2) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Oil pressure switch installation	1.5 ~ 2.2	14.7 ~ 21.6	10.9 ~ 15.9
ETC (Electronic throttle control) module installation bolt	0.8 ~ 1.0	7.8 ~ 9.8	5.8 ~ 7.2
Purge control solenoid valve bracket installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 2 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 2 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Variable intake solenoid valve installation nut	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7

Fuel Delivery System

Item	kgf.m	N.m	lb-ft
Fuel rail assembly installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Fuel tank band installation nut/bolt	5.0 ~ 6.0	49.1 ~ 58.9	36.2 ~ 43.4
Fuel tank protector installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Fuel tank protector installation nut	0.7 ~ 1.1	6.9 ~ 10.8	5.1 ~ 8.0
Fuel pump installation bolt	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Filler-neck assembly installation nut	0.7 ~ 1.1	6.9 ~ 10.8	5.1 ~ 8.0
Accelerator pedal assembly installation nut	1.3 ~ 1.6	12.8 ~ 15.7	9.4 ~ 11.6
Accelerator pedal module installation nut	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7

Special Service Tools

Tool (Number and Name)	Illustration	Application
Fuel Pressure Gauge (09353-24100)	 EFDA003A	Measuring the fuel line pressure
Fuel Pressure Gauge Adapter (09353-38000)	 BF1A025D	Connection between the delivery pipe and the fuel feed line
Fuel Pressure Gauge Connector (09353-24000)	 EFDA003C	Connection between the Fuel Pressure Gauge (09353-24100) and the Fuel Pressure Gauge Adapter (09353-38000)

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.

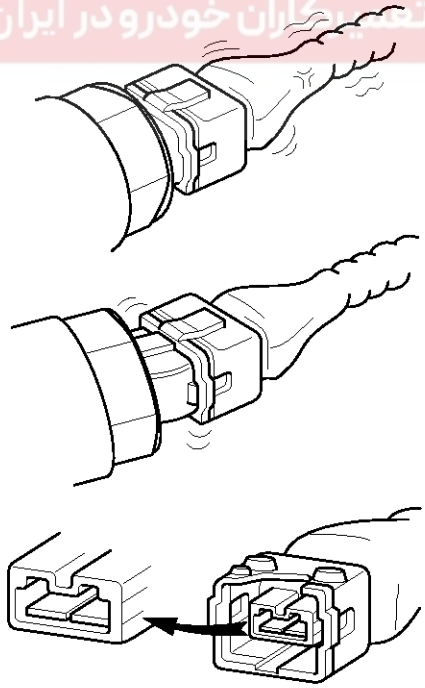
NOTICE

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

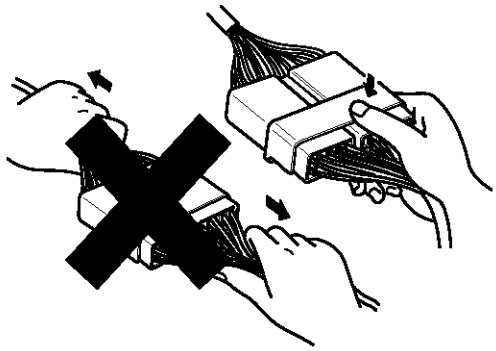
DO NOT sprinkle water directly into the engine compartment or electronic components.

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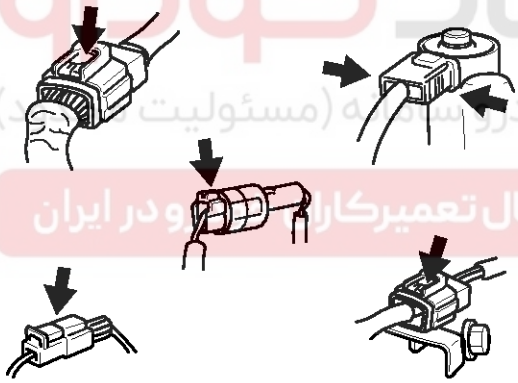
   b. When removing the connector with a lock, press or pull locking lever.



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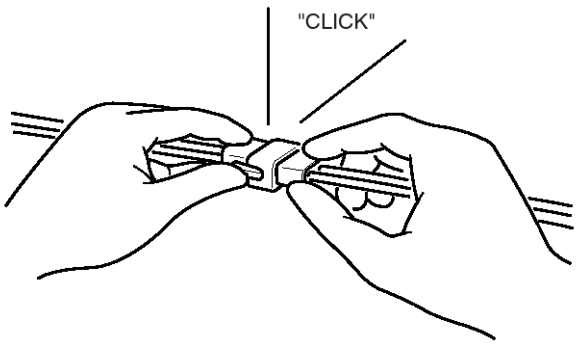
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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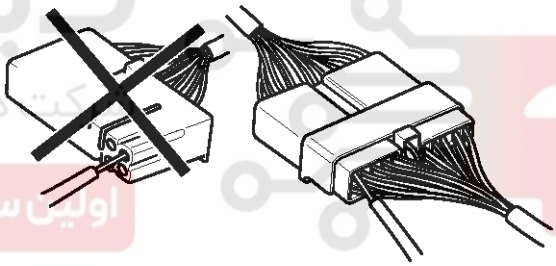
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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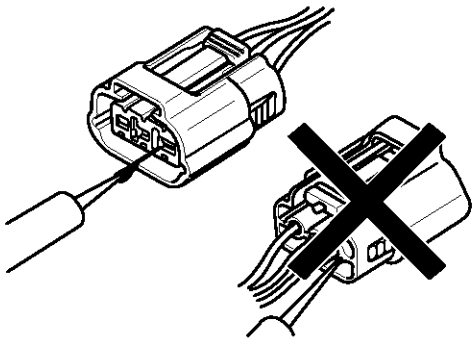
e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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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:

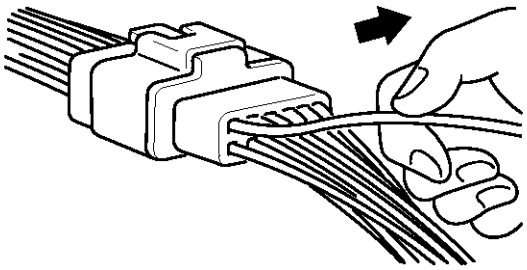
Check missed terminal, crimped terminal or broken core wire by slightly pulling the wire harness.

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.

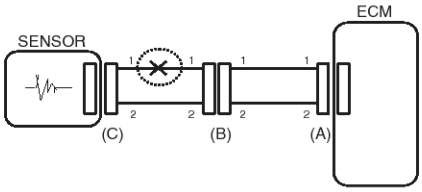
Electrical Circuit Inspection Procedure

● 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)

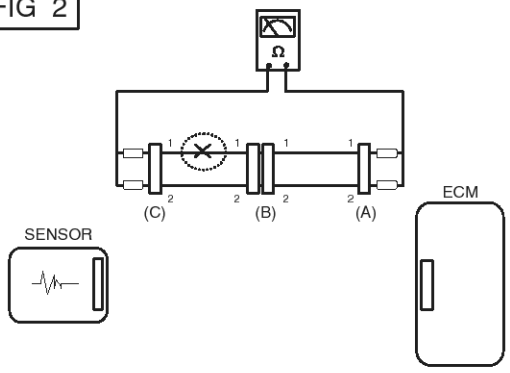
1Ω or less → Normal Circuit

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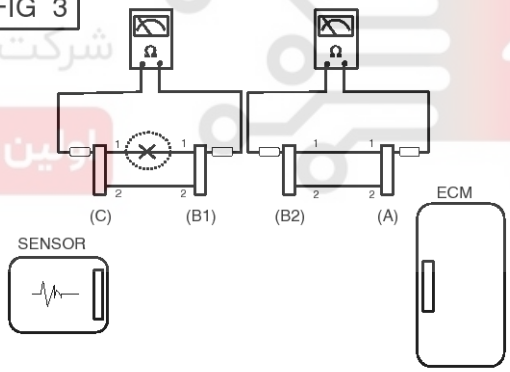
b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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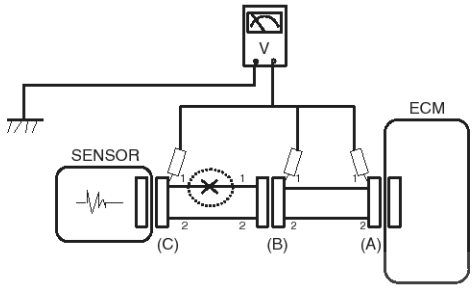
3. Voltage Check Method
   a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

      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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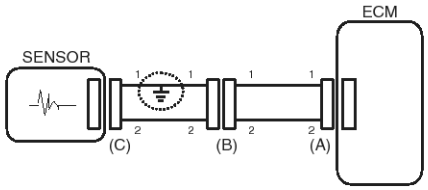
● Check Short Circuit

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.

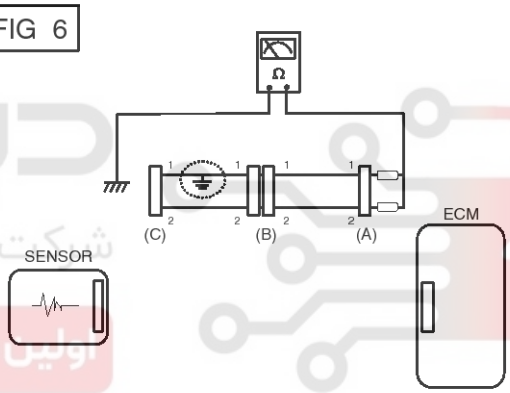
Specification (Resistance)

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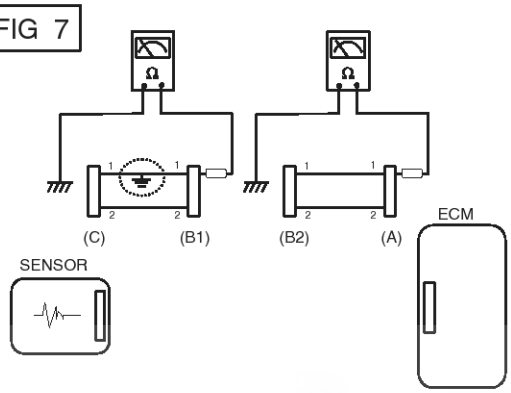
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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



BFGE501G

● Testing For Voltage Drop

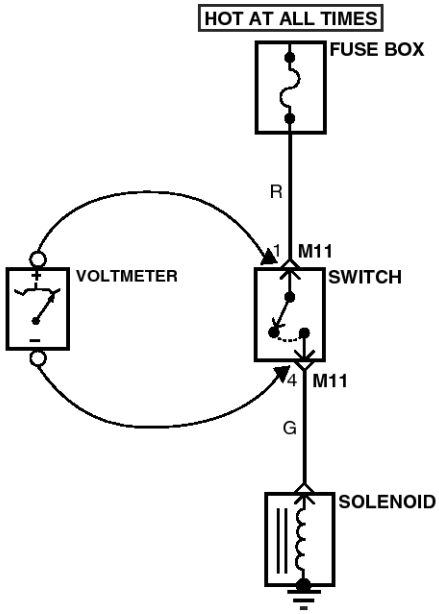
This test checks for voltage drop along a wire, or through a connection orswitch.

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

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

C. Operate the circuit.

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



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.

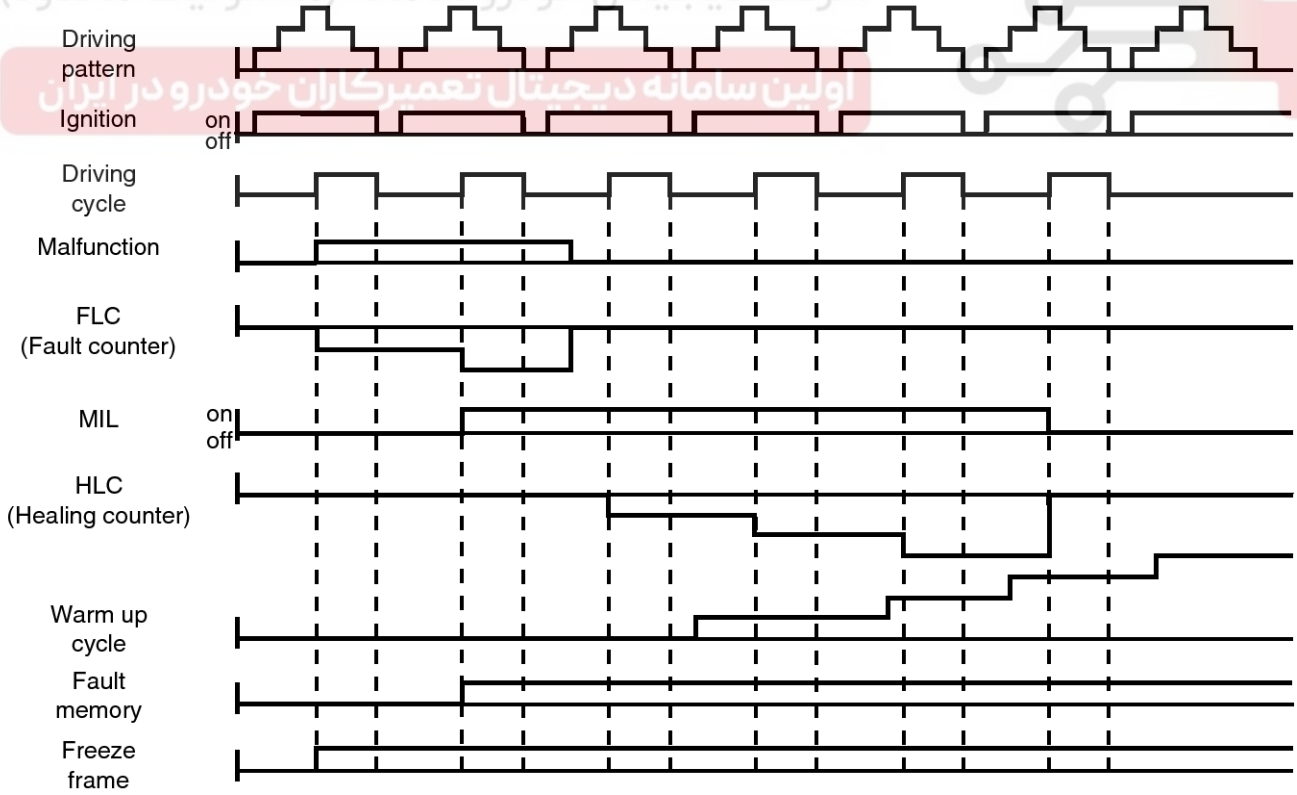
Self-Diagnosis

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

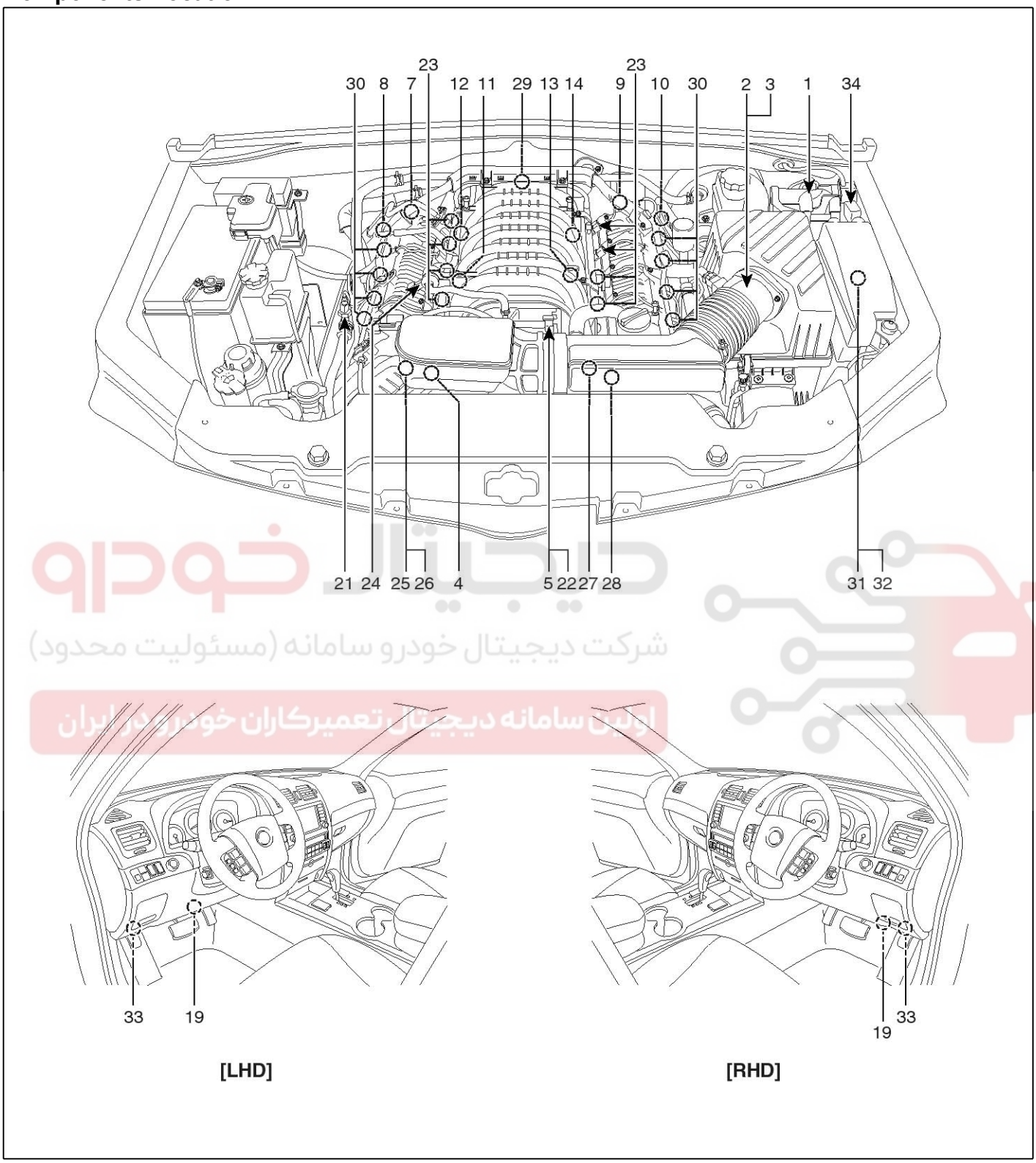
1. When the same malfunction is detected and maintained during two sequential driving cycles, the MIL will automatically illuminate.
2. The MIL will go off automatically if no fault is detected after 3 sequential driving cycles.
3. A Diagnostic Trouble Code(DTC) is recorded in ECM memory when a malfunction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

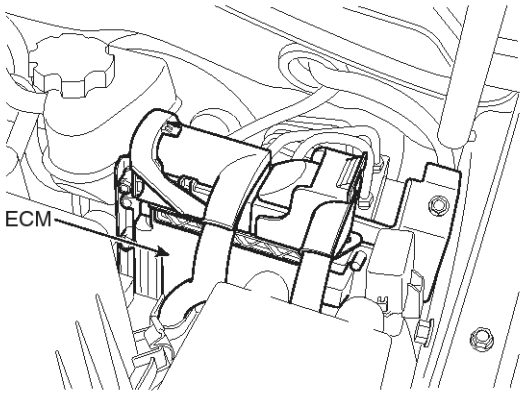
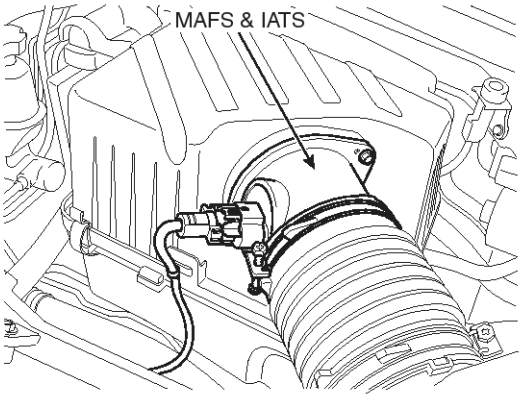
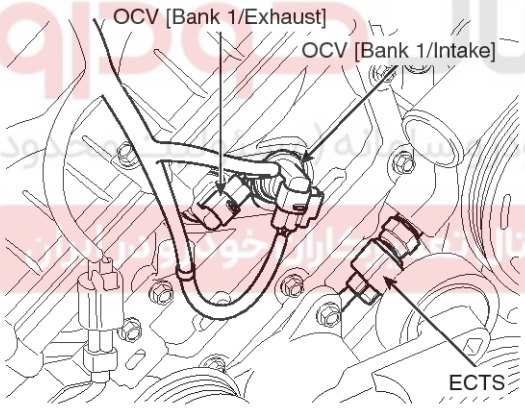
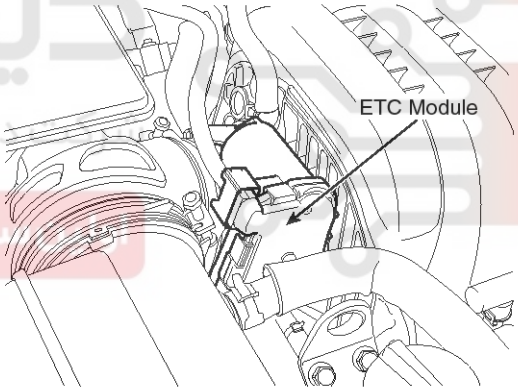
- *A "warm-up cycle" means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of 160 degress Fahrenheit.*
- *A "driving cycle" consists of engine startup, vehicle operation beyond the beginning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

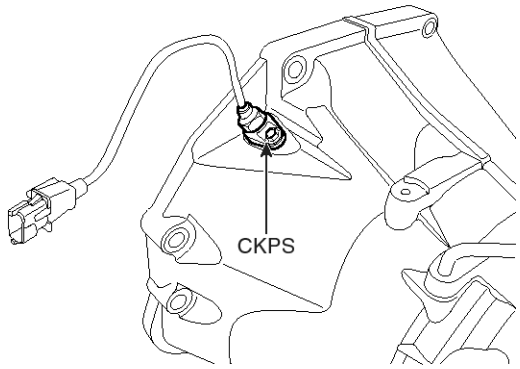
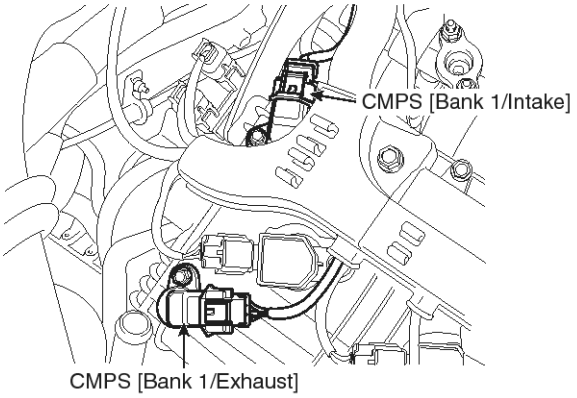
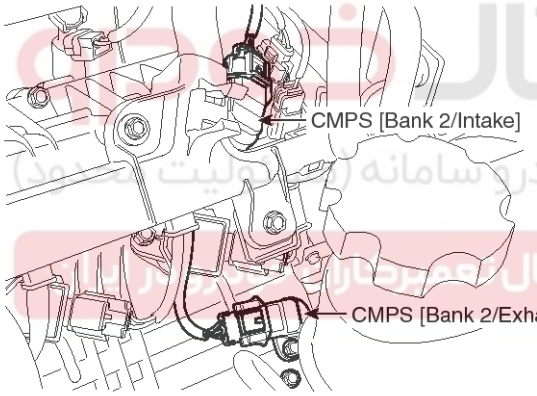
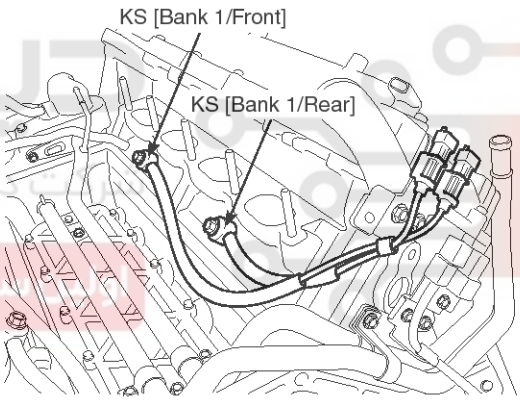
Components Location

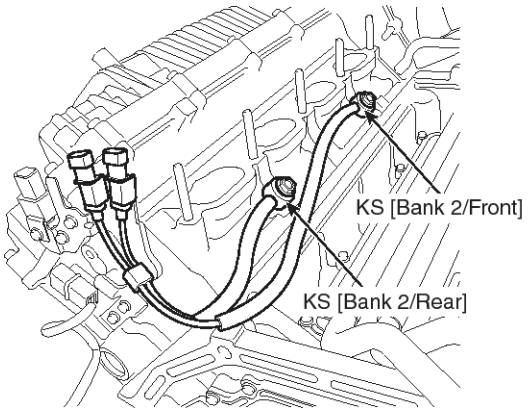
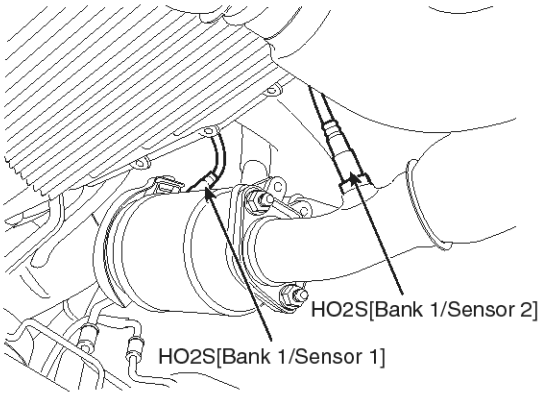
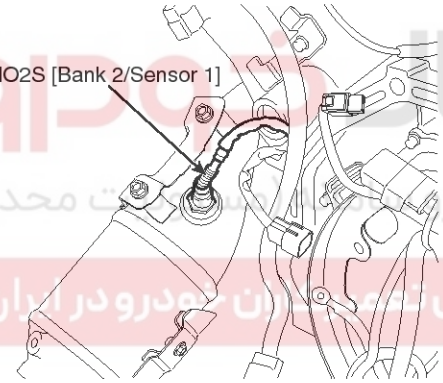
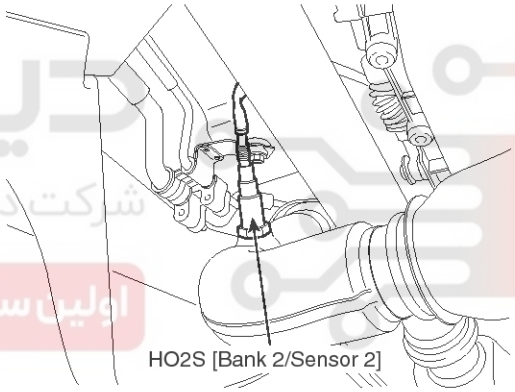
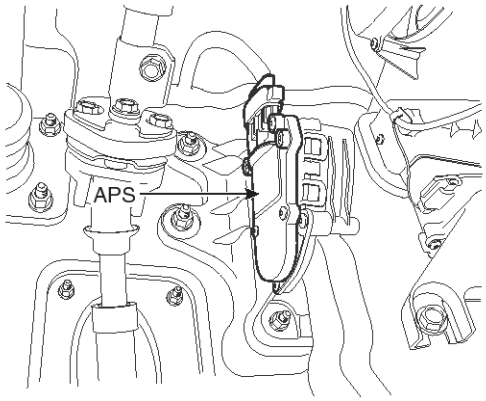
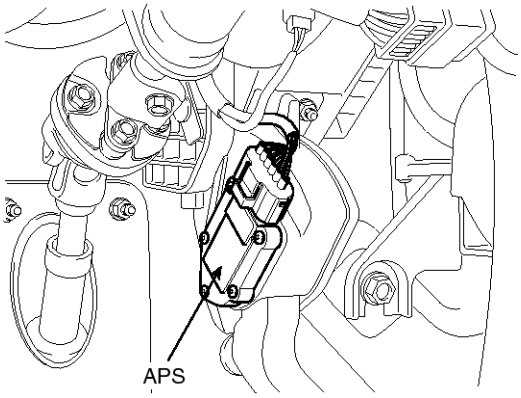


SHMF19100L

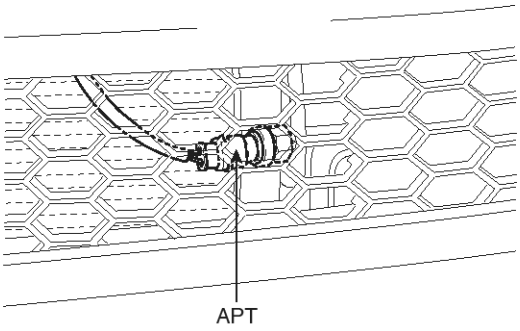
1. ECM (Engine Control Module)
2. Mass Air Flow Sensor (MAFS)
3. Intake Air Temperature Sensor (IATS)
4. Engine Coolant Temperature Sensor (ECTS)
5. Throttle Position Sensor (TPS) [integrated into ETC Module]
6. Crankshaft Position Sensor (CKPS)
7. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]
8.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

1. ECM (Engine Control Module)	2. Mass Air Flow Sensor (MAFS) 3. Intake Air Temperature Sensor (IATS)
 SHMF19101N	 SHMF19102N
4. Engine Coolant Temperature Sensor (ECTS) 25. CVVT Oil Control Valve (OCV) [Bank 1 / Intake] 26. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]	5. Throttle Position Sensor (TPS) [integrated into ETC Module] 22. ETC Motor [integrated into ETC Module]
 SHMF19103N	 SHMF19104N

6. Crankshaft Position Sensor (CKPS)	7. Camshaft Position Sensor (CMPS) [Bank 1 / Intake] 8. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]
 SHMF19105N	 SHMF19106N
9. Camshaft Position Sensor (CMPS) [Bank 2 / Intake] 10. Camshaft Position Sensor (CMPS) [Bank 2 / Exhaust]	11. Knock Sensor (KS) [Bank 1/ Front] 12. Knock Sensor (KS) [Bank 1/ Rear]
 SHMF19107N	 SHMF19108N

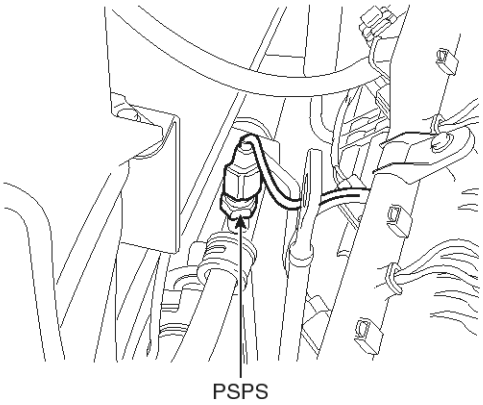
13. Knock Sensor (KS) [Bank 2/ Front] 14. Knock Sensor (KS) [Bank 2/ Rear]	15. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1] 16. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]
 SHMF19109N	 SHMF19110N
17. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]	18. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]
 SHMF19111N	 SHMF19112N
19. Accelerator Position Sensor (APS) [Non-Adjust type]	19. Accelerator Position Sensor (APS) [Adjust type]
 SHMF19113N	 SHMFL8106D

20. A/C Pressure Transducer (APT)



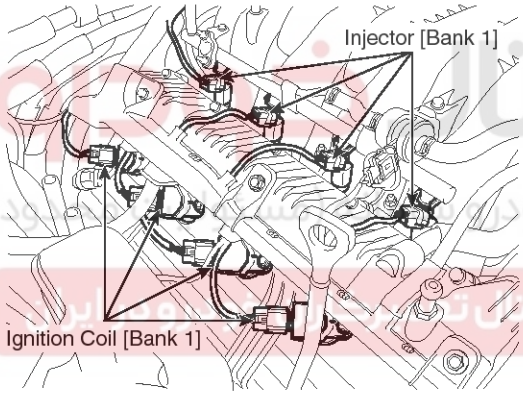
SHMF19115N

21. Power Steering Pressure Sensor (PSPS)

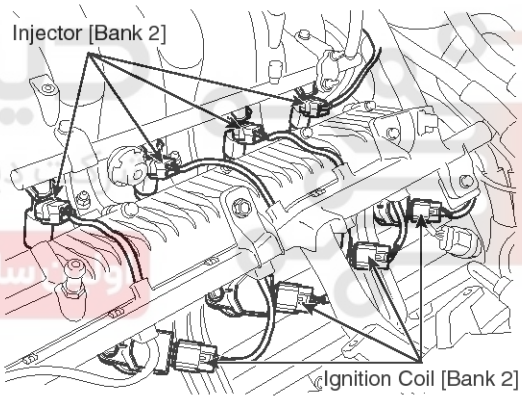


SHMF19116N

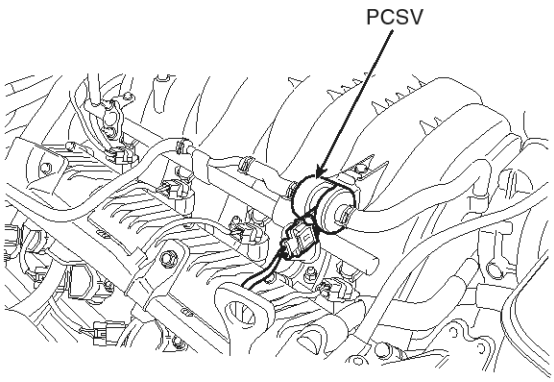
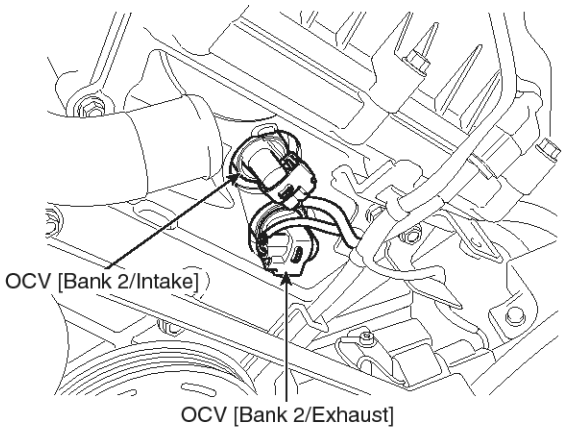
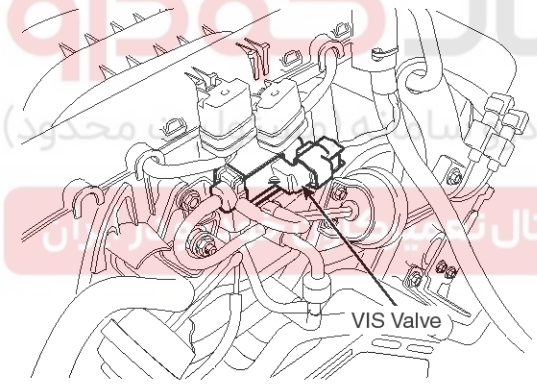
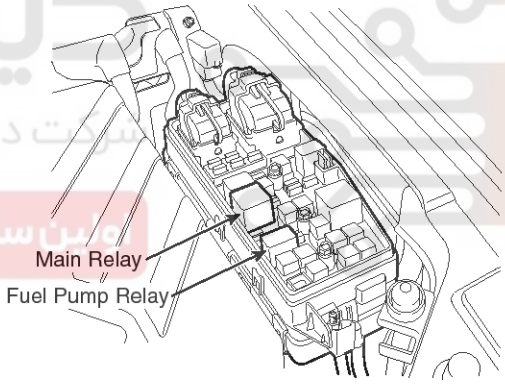
23. Injector
30. Ignition Coil



SHMF19119N



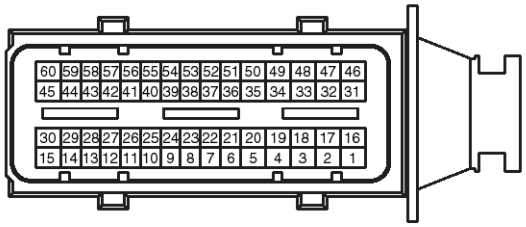
SHMF19120N

23. Purge Control Solenoid Valve (PCSV)	26. CVVT Oil Control Valve (OCV) [Bank 2 / Intake] 27. CVVT Oil Control Valve (OCV) [Bank 2 / Exhaust]
 SHMF19121N	 SHMF19122N
29. Variable Intake Solenoid (VIS) Valve	31. Main Relay 32. Fuel Pump Relay 34. Multi-Purpose Check Connector [20 Pin]
 SHMF19123N	 SHMF19125N

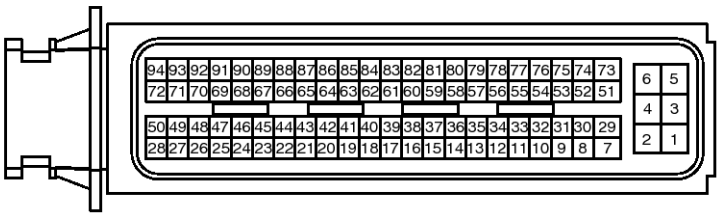
Engine Control Module (ECM)

ECM Terminal And Input / Output signal

ECM Harness Connector



Connector [CTG-A]



Connector [CTG-K]

SHMF19126N

ECM Terminal Function

Connector [CTG-A]

Pin No.	Description	Connected to
1	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3)
2	Ignition Coil (Cylinder #6) control output	Ignition Coil (Cylinder #6)
3	Engine speed signal output	Power Distribution Module (PDM)
4	Injector (Cylinder #2) control output	Injector (Cylinder #2)
5	Injector (Cylinder #1) control output	Injector (Cylinder #1)
6	-	
7	-	
8	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)
9	Ground	Cruise Control Switch
10	Sensor ground	A/C Pressure Transducer (APT)
11	Sensor ground	Power Steering Pressure Sensor (PSPS)
12	Crankshaft Position Sensor (CKPS) [High] signal input	Crankshaft Position Sensor (CKPS)
13	-	
14	Main Relay control output	Main Relay
15	Injector (Cylinder #6) control output	Injector (Cylinder #6)
16	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2)
17	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4)
18	-	
19	Injector (Cylinder #7) control output	Injector (Cylinder #7)
20	Purge Control Solenoid Valve (PCSV) control output	Purge Control Solenoid Valve (PCSV)
21	-	

Pin No.	Description	Connected to
22	Power Steering Pressure Sensor (PSPS) signal input	Power Steering Pressure Sensor (PSPS)
23	-	
24	-	
25	-	
26	Cruise Control Switch signal input	Cruise Control Switch
27	Crankshaft Position Sensor (CKPS) [Low] signal input	Crankshaft Position Sensor (CKPS)
28	-	
29	-	
30	Injector (Cylinder #4) control output	Injector (Cylinder #4)
31	Ignition Coil (Cylinder #5) control output	Ignition Coil (Cylinder #5)
32	Ignition Coil (Cylinder #8) control output	Ignition Coil (Cylinder #8)
33	Injector (Cylinder #8) control output	Injector (Cylinder #8)
34	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust]
35	CVVT Oil Control Valve (OCV) [Bank 1/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 1/Intake]
36	Immobilizer Lamp control output	Immobilizer Lamp
37	-	
38	Fuel Pump Relay control output	Fuel Pump Relay
39	-	
40	-	
41	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
42	-	
43	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
44	2nd CAN [Low]	Multi-Purpose Check Connector
45	Injector (Cylinder #3) control output	Injector (Cylinder #3)
46	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1)
47	Ignition Coil (Cylinder #7) control output	Ignition Coil (Cylinder #7)
48	ETC Motor [+] control output	ETC Motor
49	-	
50	ETC Motor [-] control output	ETC Motor
51	Malfunction Indicator Lamp (MIL) control output	Malfunction Indicator Lamp (MIL)
52	Variable Intake Solenoid (VIS) Valve control output	Variable Intake Solenoid (VIS) Valve
53	-	
54	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]

Pin No.	Description	Connected to
55	-	
56	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
57	-	
58	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
59	2nd CAN [High]	Multi-Purpose Check Connector
60	Injector (Cylinder #5) control output	Injector (Cylinder #5)

Connector [CTG-K]

Pin No.	Description	Connected to
1	Ignition Coil ground	Chassis Ground
2	Electronic power ground	Chassis Ground
3	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
4	ECM ground	Chassis Ground
5	Battery power (B^+)	Main Relay #1
6	Battery power (B^+)	Main Relay #2
7	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
8	-	
9	Knock Sensor (KS) [Bank 1/Front] [High] signal input	Knock Sensor (KS) [Bank 1/Front]
10	Knock Sensor (KS) [Bank 1/Rear] [High] signal input	Knock Sensor (KS) [Bank 1/Rear]
11	Sensor ground	Throttle Position Sensor (TPS)
12	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
13	-	
14	Throttle Position Sensor (TPS) 1 signal input	Throttle Position Sensor (TPS) 1
15	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
16	Accelerator Position Sensor (APS) 1 signal input	Accelerator Position Sensor (APS) 1
17	-	
18	Mass Air Flow Sensor (MAFS) signal input	Mass Air Flow Sensor (MAFS)
19	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
20	-	
21	Start Relay signal input	Power Distribution Module (PDM)

Pin No.	Description	Connected to
22	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
23	Sensor power (+5V)	Power Steering Pressure Sensor (PSPS)
24	Sensor power (+5V)	Accelerator Position Sensor (APS) 1
25	Batterypower (B+)	Ignition Switch
26	-	
27	Accelerator Position Sensor (APS) 2 signal input	Accelerator Position Sensor (APS) 2
28	-	
29	-	
30	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
31	Knock Sensor (KS) [Bank 1/Front] [Low] signal input	Knock Sensor (KS) [Bank 1/Front]
32	Knock Sensor (KS) [Bank 1/Rear] [Low] signal input	Knock Sensor (KS) [Bank 1/Rear]
33	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
34	-	
35	Intake Air Temperature Sensor (IATS) signal input	Intake Air Temperature Sensor (IATS)
36	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
37	-	
38	Throttle Position Sensor (TPS) 2 signal input	Throttle Position Sensor (TPS) 2
39	-	
40	Brake Switch 2 signal input	Brake Switch
41	Brake Switch 1 signal input	Brake Switch
42	-	
43	-	
44	A/C Request Switch signal input	A/C Control Module
45	Sensor power (+5V)	Accelerator Position Sensor (APS) 2
		A/C Pressure Transducer (APT)
46	-	
47	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
48	Start Relay control output	Start Relay
49	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 2/Intake]
50	-	
51	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
52	Knock Sensor (KS) [Bank 2/Front] [Low] signal input	Knock Sensor (KS) [Bank 2/Front]
53	Knock Sensor (KS) [Bank 2/Rear] [Low] signal input	Knock Sensor (KS) [Bank 2/Rear]

Pin No.	Description	Connected to
54	Sensor ground	Accelerator Position Sensor (APS) 1
55	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
56	-	
57	-	
58	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
59	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]
60	-	
61	A/C Thermal Switch signal input	A/C Thermal Switch
62	Camshaft Position Sensor (CMPS) [Bank 2/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 2/Intake]
63	-	
64	Vehicle speed signal input	ABS/ESP Control Module
65	Sensor power (+5V)	Throttle Position Sensor (TPS)
66	CAN [Low]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
67	Immobilizer communication line	Immobilizer Control Module
68	-	
69	-	
70	-	
71	-	
72	-	
73	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
74	Knock Sensor (KS) [Bank 2/Front] [High] signal input	Knock Sensor (KS) [Bank 2/Front]
75	Knock Sensor (KS) [Bank 2/Rear] [High] signal input	Knock Sensor (KS) [Bank 2/Rear]
76	Sensor ground	Accelerator Position Sensor (APS) 2
77	-	
78	Sensor ground	Intake Air Temperature Sensor (IATS)
79	-	
80	-	
81	-	
82	-	
83	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
84	Alternator "FR" signal input	Alternator

Pin No.	Description	Connected to
85	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]
86	Battery Power (B+)	Battery
87	-	
88	CAN [High]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
89	-	
90	CVVT Oil Control Valve (OCV) [Bank 2/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 2/Intake]
91	-	
92	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust]
93	A/C Compressor Relay control output	A/C Compressor Relay
94	-	

ECM Terminal Input/ Output signal

Connector [CTG-A]

Pin No.	Description	Condition	Type	Level	Test Result
1	Ignition Coil (Cylinder #3) control output	Idle	Pulse	1st Voltage : 300~400V	375V
				ON Voltage : Max. 2V	1.23V
2	Ignition Coil (Cylinder #6) control output	Idle	Pulse	1st Voltage : 300~400V	391V
				ON Voltage : Max. 2V	1.26V
3	Engine speed signal output	Idle	Pulse	HI : Battery Voltage	11.25V
				LO : Max. 0.5V	0V
				Idle = 20~26Hz	31Hz
4	Injector (Cylinder #2) control output	Idle	Pulse	HI : Battery Voltage	13.54V
				LO : Max . 1.0V	170mV
				Vpeak : Max.80V	73V
5	Injector (Cylinder #1) control output	Idle	Pulse	HI : Battery Voltage	13.55V
				LO : Max . 1.0V	158mV
				Vpeak : Max.80V	73V
6	-				
7	-				
8	A/C Pressure Transducer (APT) signal input	Idle	DC	0.5 ~ 4.5 V	A/C OFF:3.27V A/C ON:2.4V
9	Ground	Idle	DC	Max. 50 mV	23.09mV

Pin No.	Description	Condition	Type	Level	Test Result
10	Sensor ground	Idle	DC	Max. 50 mV	23.74mV
11	Sensor ground	Idle	DC	Max. 50 mV	23.23mV
12	Crankshaft Position Sensor (CKPS) [High] signal input	Idle	SINE WAVE	Vp_p : Min.1.0V	17.88V
13	-	-	-	-	-
14	Main Relay control output	Relay OFF	DC	Battery Voltage	12.92V
		Relay ON		Max. 1.0V	833mV
15	Injector (Cylinder #6) control output	Idle	Pulse	HI : Battery Voltage	13.55V
				LO : Max . 1.0V	214mV
				Vpeak : Max.80V	73.45V
16	Ignition Coil (Cylinder #2) control output	Idle	Pulse	1st Voltage : 300~400V	391V
				ON Voltage : Max. 2V	1.25V
17	Ignition Coil (Cylinder #4) control output	Idle	Pulse	1st Voltage : 300~400V	387V
				ON Voltage : Max. 2V	1.25V
18	-	-	-	-	-
19	Injector (Cylinder #7) control output	Idle	Pulse	HI : Battery Voltage	13.53V
				LO : Max . 1.0V	166mV
				Vpeak : Max.80V	73V
20	Purge control Solenoid Valve (PCSV) control output	Close	Pulse	Battery Voltage	13.49V
		Open		Max. 1.0V	156mV
21	-				
22	Power Steering Pressure Sensor (PSPS) signal input	Steering	DC	0.4 ~ 4.6V	741mV~3.79V
23	-	-	-	-	-
24	-				
25	-	-	-	-	-
26	Cruise control Switch signal input	ALL SW OFF	DC	4.25 ~ 5.25 V	4.56V
		MAIN SW		6.5 ~ 14.0 V	6.83V
		SET / COAST		0.5 ~ 1.3 V	666mV
		RES / ACCEL		1.5 ~ 2.5 V	1.89V
		CANCEL		Below 0.2 V	41mV
27	Crankshaft Position Sensor (CKPS) [Low] signal input	Idle	SINE WAVE	Vp_p : Min.1.0V	17.4V
28	-	-	-	-	-
29	-	-	-	-	-

Pin No.	Description	Condition	Type	Level	Test Result
30	Injector (Cylinder #4) control output	Idle	Pulse	HI : Battery Voltage	13.53V
				LO : Max . 1.0V	227mV
				Vpeak : Max.80V	73.45V
31	Ignition Coil (Cylinder #5) control output	Idle	Pulse	1st Voltage : 300~400V	387V
				ON Voltage : Max. 2V	1.26V
32	Ignition Coil (Cylinder #8) control output	Idle	Pulse	1st Voltage : 300~400V	387mV
				ON Voltage : Max. 2V	1.29V
33	Injector (Cylinder #8) control output	Idle	Pulse	HI : Battery Voltage	13.56V
				LO : Max . 1.0V	166mV
				Vpeak : Max.80V	73V
34	CVVT Oil control Valve (OCV) [Bank 1/Exhaust] control output	Idle	Pulse	Battery Voltage	13.96V
				Max. 1.0V	0V
35	CVVT Oil control Valve (OCV) [Bank 1/Intake] control output	Idle	Pulse	Battery Voltage	13.96V
				Max. 1.0V	0V
36	Immobilizer Lamp control output	Lamp OFF	DC	Battery Voltage	9.17V
		Lamp ON		Max. 1.0V	-12.5mV
37	-	-	-	-	-
38	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage	12.5V
		Relay ON		Max. 1.0V	
39	-	-	-	-	-
40	-	-	-	-	-
41	Sensor ground	Idle	DC	Max. 50 mV	18mV
42	-	-	-	-	-
43	Sensor ground	Idle	DC	Max. 50 mV	23mV
44	2nd CAN [Low]	Recessive	Pulse	2.0 ~ 3.0 V	-
		Dominant		0.5~2.25 V	
45	Injector (Cylinder #3) control output	Idle	Pulse	HI : Battery Voltage	13.54V
				LO : Max . 1.0V	186mV
				Vpeak : Max.80V	73V
46	Ignition Coil (Cylinder #1) control output	Idle	Pulse	1st Voltage : 300~400V	391V
				ON Voltage : Max. 2V	1.28V
47	Ignition Coil (Cylinder #7) control output	Idle	Pulse	1st Voltage : 300~400V	391V
				ON Voltage : Max. 2V	1.28V

Pin No.	Description	Condition	Type	Level	Test Result
48	ETC Motor [+] control output	Idle	Pulse	HI : Battery Voltage	13.75V
				LO: Max .0.5V	208mV
49	-	-	-	-	-
50	ETC Motor [-] control output	Idle	Pulse	HI : Battery Voltage	13.33V
				LO: Max .0.5V	208mV
51	Malfunction Indicator Lamp (MIL) control output	Lamp OFF	DC	Battery Voltage	12.7V
		Lamp ON		Max. 1.0V	625mV
52	Variable Intake Solenoid (VIS) Valve control output	Valve Open	DC	Max. 1.0 V	208mV
		Valve Close		Battery Voltage	13.54V
53	-		-	-	-
54	Cooling Fan Relay [High] control output	FAN OFF	DC	Battery Voltage	13.33V
		FAN ON		Max.0.5V	208mV
55	-	-	-	-	-
56	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] signal input	Racing	DC	Rich : 0.6～1.0V	728mV
				Lean : 0 ～ 0.4V	124mV
57	-	-	-	-	-
58	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] signal input	Racing	DC	Rich : 0.6～1.0V	731mV
				Lean : 0 ～ 0.4V	136mV
59	2nd CAN [High]	Recessive	Pulse	2.0 ～ 3.0 V	-
		Dominant		2.75～4.5 V	
60	Injector (Cylinder #5) control output	Idle	Pulse	HI : Battery Voltage	13.57V
				LO : Max . 1.0V	186mV
				Vpeak : Max.80V	73V

Connector [CTG-K]

Pin No.	Description	condition	Type	Level	Test Result
1	Ignition Coil ground	Idle	DC	Max. 50 mV	
2	Electronic power ground	Idle	DC	Max. 50 mV	
3	Heated Oxygen Sensor (HO2S) [Bank 2/ Sensor 1] Heater control output	Engine Run	Pulse	HI : Battery Voltage	13.96V
				LO : Max. 1.0V	208mV
4	ECM ground	Idle	DC	Max. 50 mV	
5	Battery power (B+)	Relay ON	DC	Battery Voltage	13.96V
		Relay OFF		Max. 1.0V	0mV
6	Battery power (B+)	Relay ON	DC	Battery Voltage	13.96V
		Relay OFF		Max. 1.0V	0mV
7	Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] Heater control output	Engine Run	Pulse	HI : Battery Voltage	13.83V
				LO : Max. 1.0V	495mV
8	-	-	-	-	-
9	Knock Sensor (KS) [Bank 1/Front] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
10	Knock Sensor (KS) [Bank 1/Rear] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
11	Sensor ground	Idle	DC	Max. 50 mV	16.76mV
12	Sensor ground	Idle	DC	Max. 50 mV	18.7mV
13	-	-	-	-	-
14	Throttle Position Sensor (TPS) 1 signal input	Release	Analog	0.3 ~ 0.9V	0.42V
		Push		1.5 ~ 3.0V	1.88V
15	Heated Oxygen Sensor (HO2S) [Bank 2/ Sensor 2] signal input	Racing	DC	Rich : 0.6 ~ 1.0V	859mV
				Lean : 0 ~ 0.4V	124mV
16	Accelerator Position Sensor (APS) 1 signal input	Release	Analog	0.3 ~ 0.9V	755mV
		Push		3.8 ~ 4.8V	3.86V
17	-	-	-	-	-
18	Mass Air Flow Sensor (MAFS) signal input	Idle	Pulse	HI : Vcc	5.04V
				LO : Max . 0.5V	292mV
19	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Idle	Pulse	HI : Vcc or Battery Voltage	4.8V
				LO : Max . 0.5V	41mV
20	-	-	-	-	-
21	Start Relay signal input	Cranking	DC	Battery Voltage	13.75V
		Otherwise		Max. 3.5V	1.04V

Pin No.	Description	condition	Type	Level	Test Result
22	Sensor ground	Idle	DC	Max. 50 mV	15.7mV
23	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		5±0.2V	5.04V
24	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		5±0.2V	5.04V
25	Battery power (B+)	IG OFF	DC	Max. 0.5 V	0V
		IG ON		Battery Voltage	13.54V
26	-	-	-	-	-
27	Accelerator Position Sensor (APS) 2 signal input	Release	Analog	0.3 ~ 0.9V	386mV
		Push		1.5V ~ 3.0V	1.98V
28	-	-	-	-	-
29	-	-	-	-	-
30	Sensor ground	Idle	DC	Max. 50 mV	9.86mV
31	Knock Sensor (KS) [Bank 1/Front] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
32	Knock Sensor (KS) [Bank 1/Rear] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
33	Sensor ground	Idle	DC	Max. 50 mV	17.55mV
34	-	-	-	-	-
35	Intake Air Temperature Sensor (IATS) signal input	Idle	Analog	0.5V ~ 4.5V	994mV
36	Engine Coolant Temperature Sensor (ECTS) signal input	Idle	DC	0.5V ~ 4.5V	713mV
37	-	-	-	-	-
38	Throttle Position Sensor (TPS) 2 signal input	Release	Analog	Min. 2.8V	2.96V
		Push		Max. 1.8V	1.63V
39	-	-	-	-	-
40	Brake Switch 2 signal input	Release	DC	Battery Voltage	13.54V
		Push		Max. 0.5V	0V
41	Brake Switch 1 signal input	Release	DC	Max. 0.5V	0V
		Push		Battery Voltage	13.54V
42	-	-	-	-	-
43	-	-	-	-	-
44	A/C Request Switch signal input	A/C SW OFF	DC	Max. 1.0V	0V
		A/C SW ON		Battery Voltage	12.29V

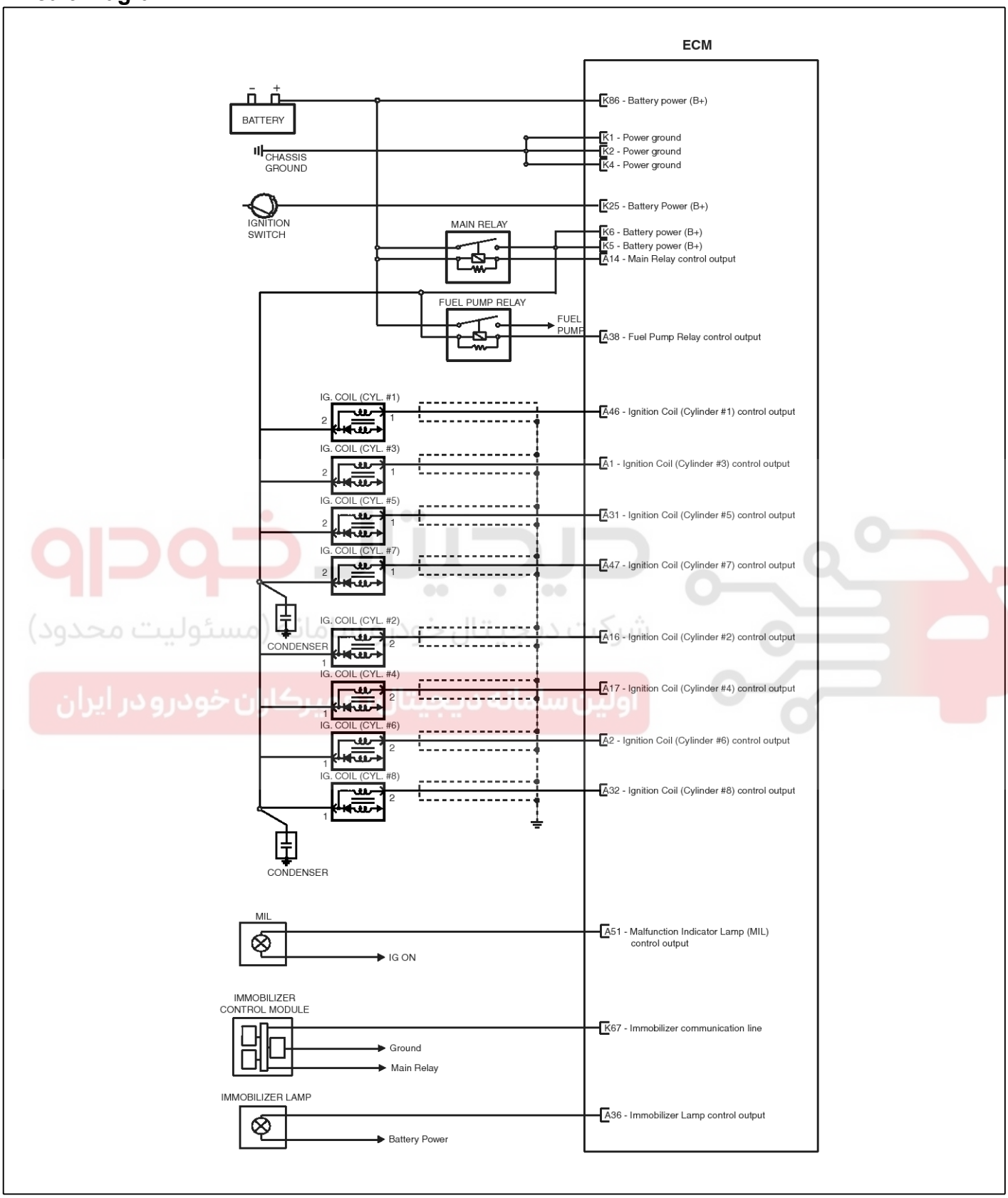
FLA-40 Fuel System

Pin No.	Description	condition	Type	Level	Test Result
45	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		5±0.2V	5.04V
46	-	-	-	-	-
47	Cooling Fan Relay [Low] control output	FAN OFF	DC	Battery Voltage	13.54V
		FAN ON		Max.0.5V	0mV
48	Start Relay control output	IG ON	DC	Battery Voltage	12.7V
		Cranking		Max. 0.5V	0mV
49	Sensor ground	Idle	DC	Max. 50 mV	18.41mV
50	-	-	-	-	-
51	Heated Oxygen Sensor (HO2S) [Bank 2/ Sensor 2] Heater control output	Engine Run	Pulse	HI : Battery Voltage	13.54V
				LO : Max. 1.0V	208mV
52	Knock Sensor (KS) [Bank 2/Front] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
53	Knock Sensor (KS) [Bank 2/Rear] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
54	Sensor ground	Idle	DC	Max. 50 mV	17.67mV
55	Sensor ground	Idle	DC	Max. 50 mV	17.56mV
56	-	-	-	-	-
57	-	-	-	-	-
58	Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] signal input	Racing	DC	Rich : 0.6~1.0V	745mV
				Lean : 0 ~ 0.4V	44mV
59	Sensor ground	Idle	DC	Max. 50 mV	17.7mV
60	-	-	-	-	-
61	A/C Thermal Switch signal input	Idle	DC	HI : Battery Voltage	11.88V
				LO : Max. 1.0V	0V
62	Camshaft Position Sensor (CMPS) [Bank 2/Intake] signal input	Idle	Pulse	HI : Vcc or Battery Voltage	4.75V
				LO : Max . 0.5V	41.67mV
63	-	-	-	-	-
64	Vehicle speed signal input	Vehicle Run	Pulse	HI : Min. 5.0V	10.83V
				LO : Max. 0.5V	0V
65	Sensor power (+5V)	IG OFF	DC	Max. 0.5V	0V
		IG ON		3.3±0.2V	3.33V
66	CAN [Low]	Recessive	Pulse	2.0 ~ 3.0 V	2.5V
		Dominant		0.5~2.25 V	1.38V

Pin No.	Description	condition	Type	Level	Test Result
67	Immobilizer communication line	When transmitting	Pulse	HI : Min. Battery Voltage X80%	10.99V
				LO : Max. Battery Voltage X 20%	787.5mV
		When receiving		HI : Min. Battery Voltage X 70%	10.99V
				LO : Max. Battery Voltage X 30%	587.5mV
68	-	-	-	-	-
69	-	-	-	-	-
70	-	-	-	-	-
71	-	-	-	-	-
72	-	-	-	-	-
73	Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 1] Heater control output	Engine Run	Pulse	HI : Battery Voltage	13.54V
				LO : Max. 1.0V	208mV
74	Knock Sensor (KS) [Bank 2/Front] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
75	Knock Sensor (KS) [Bank 2/Rear] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
76	Sensor ground	Idle	DC	Max. 50 mV	21.28mV
77	-	-	-	-	-
78	Sensor ground	Idle	DC	Max. 50 mV	17.7mV
79	-	-	-	-	-
80	-	-	-	-	-
81	-	-	-	-	-
82	-	-	-	-	-
83	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Idle	Pulse	HI : Vcc or Battery Voltage	4.7V
				LO : Max . 0.5V	0V
84	Alternator "FR" signal input	Idle	Pulse	HI : Battery Voltage	11.46V
				LO : Max 1.5 V	416mV
85	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust] signal input	Idle	Pulse	HI : Vcc or Battery Voltage	4.8V
				LO : Max . 0.5V	41.67mV
86	Battery Power (B+)	Always	DC	Battery Voltage	11.46V
87	-	-	-	-	-
88	CAN 1 [HIGH]	Recessive	Pulse	2.0 ~ 3.0 V	2.46V
		Dominant		2.75~4.5 V	3.58V
89	-	-	-	-	-

Pin No.	Description	condition	Type	Level	Test Result
90	CVVT Oil control Valve (OCV) [Bank 2/I-ntake] control output	Idle	Pulse	Battery Voltage	13.96V
				Max. 1.0V	0mV
91	-	-	-	-	-
92	CVVT Oil control Valve (OCV) [Bank 2/ Exhaust] control output	Idle	Pulse	Battery Voltage	13.96V
				Max. 1.0V	0mV
93	A/C Compressor Relay control output	A/C OFF	DC	Battery Voltage	13.33V
		A/C ON		Max. 1.0V	208mV
94	-	-	-	-	-

Circuit Diagram



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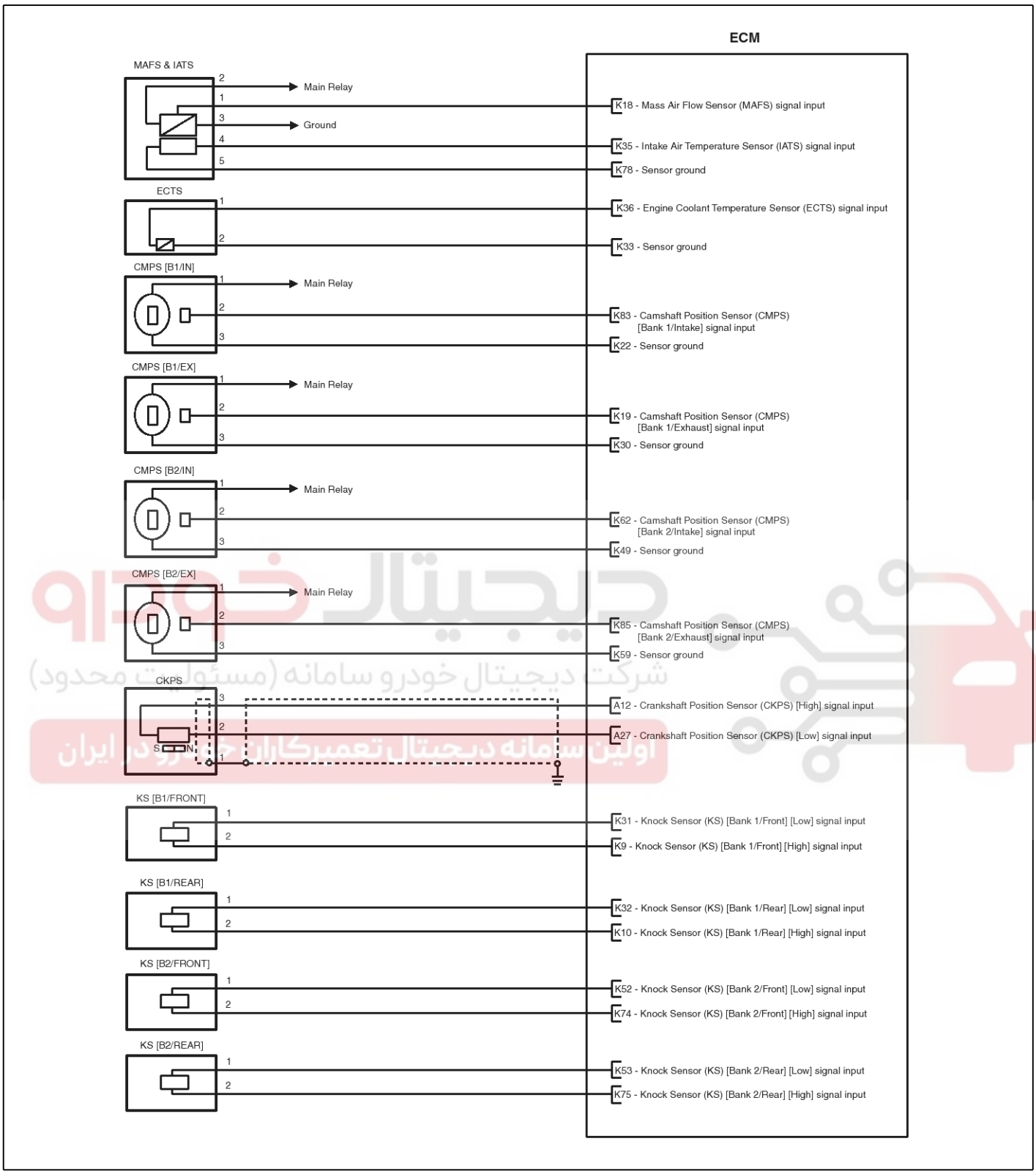

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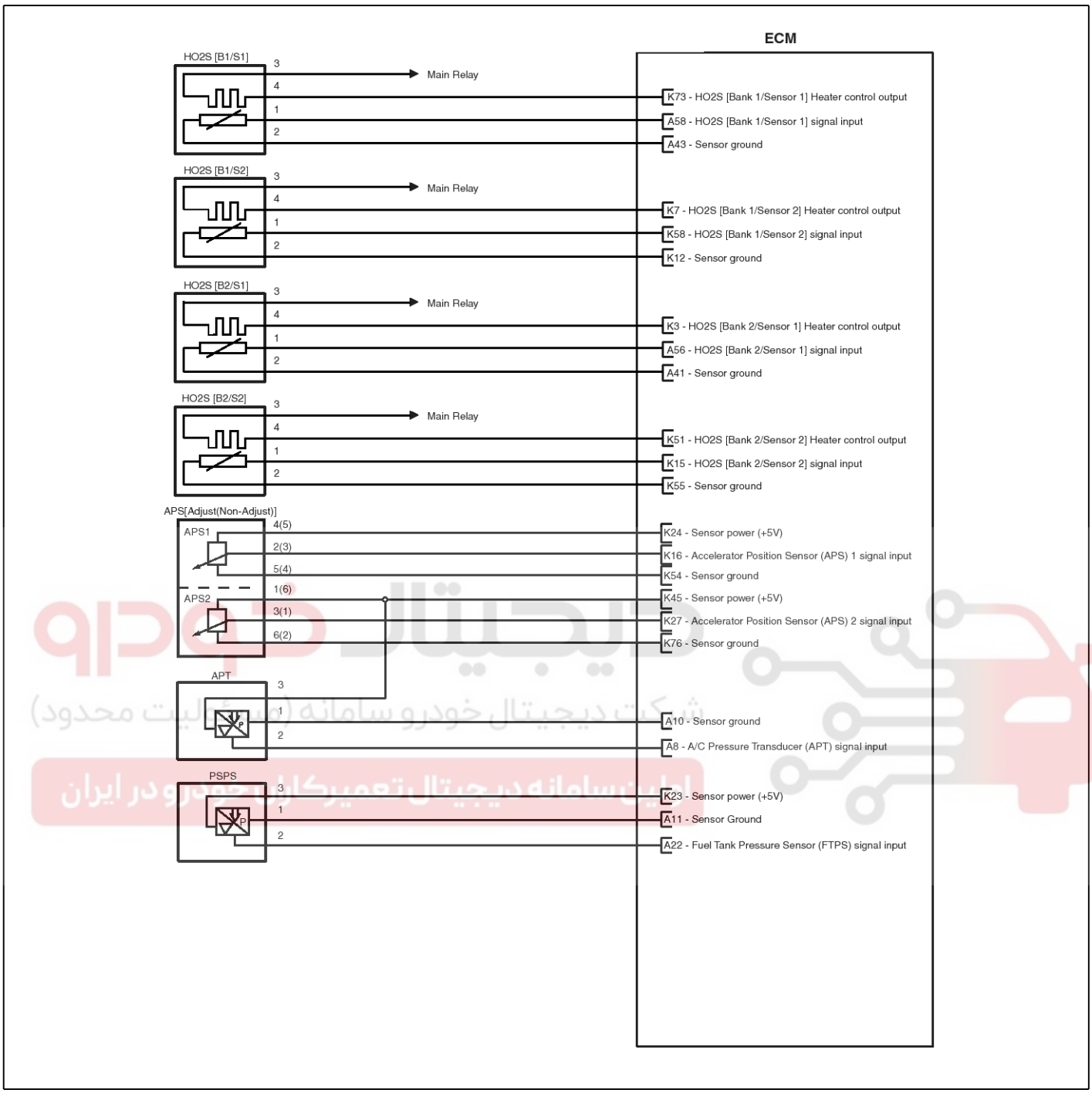
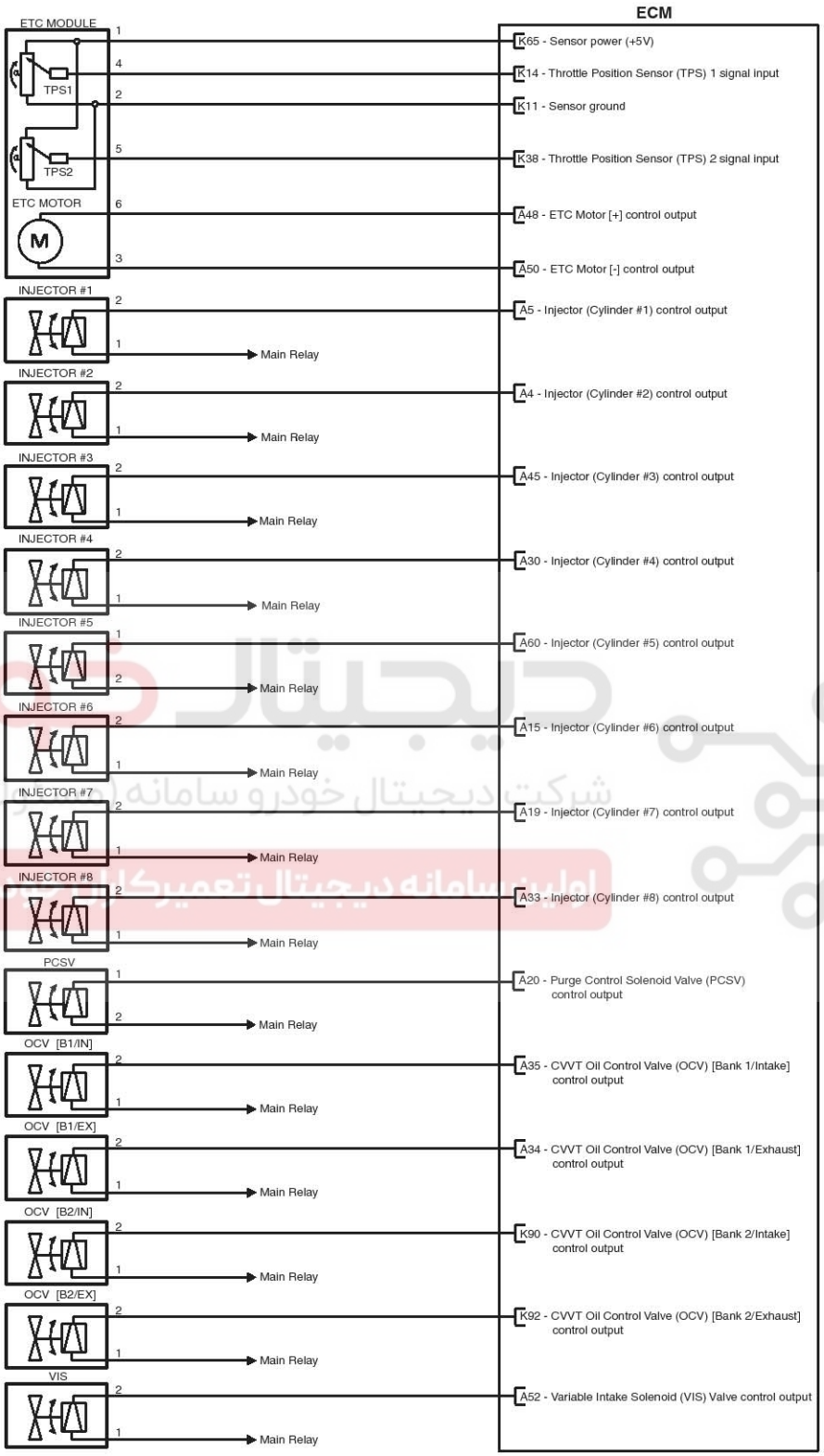
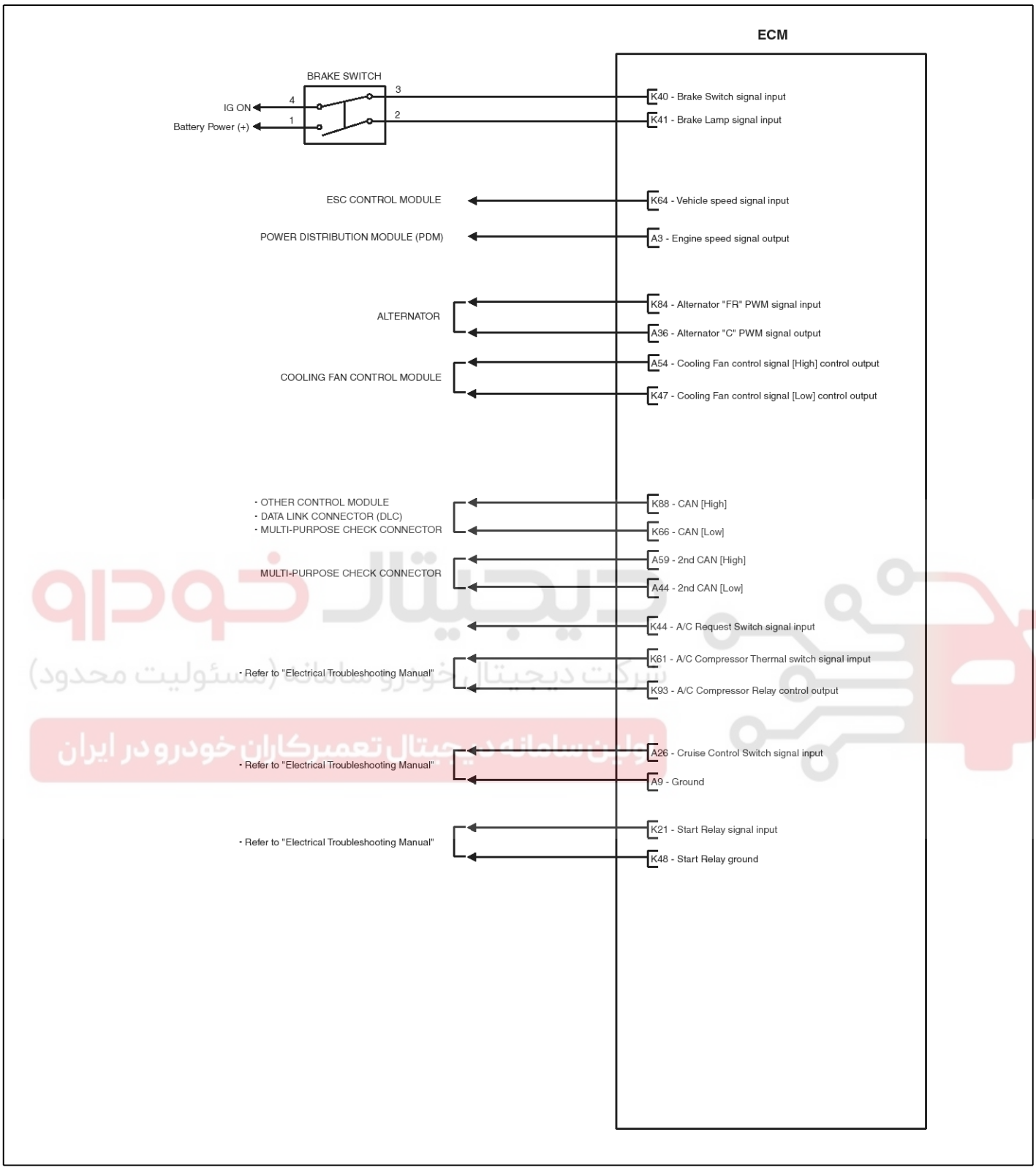


SHMF19130L



SHMF19131L



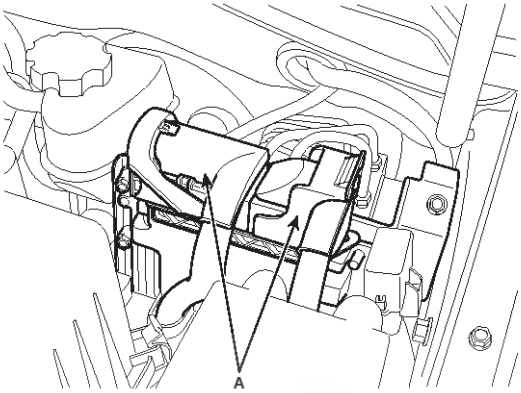
SHMF19132N

Removal

NOTICE

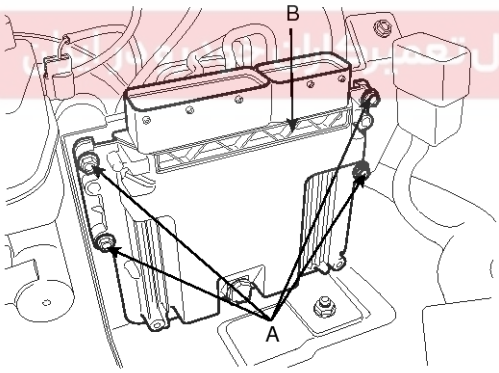
In the case of the vehicle equipped with immobilizer, perform "Key Teaching" procedure together (Refer to "Immobilizer" in BE group).

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



SHMF19127N

3. After removing the installation bolts (A), remove the ECM (B) from the bracket.



SHMFL9113L

Installation

NOTICE

In the case of the vehicle equipped with immobilizer, perform "Key Teaching" procedure together (Refer to "Immobilizer" in BE group).

1. Installation is reverse of removal.

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

ECM Problem Inspection Procedure

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

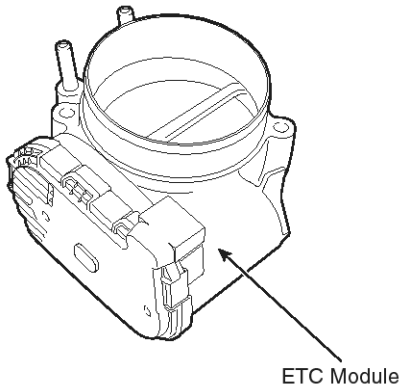
Specification: Below 1Ω

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

ETC (Electronic Throttle control) System

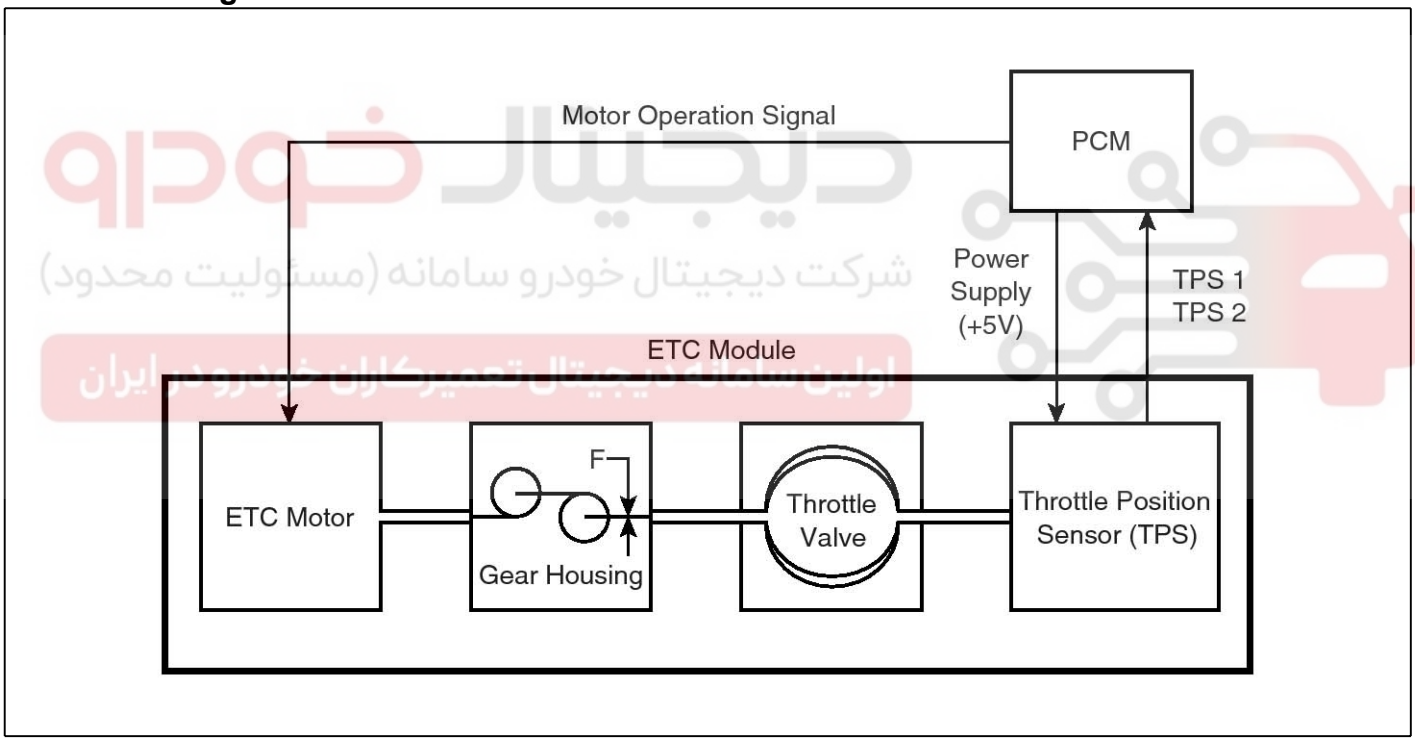
Function and operation principle

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, when the ETC system receives 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. The ETC can have the cruise control function without any special devices.



SHMF19133N

Schematic diagram



EGRF234A

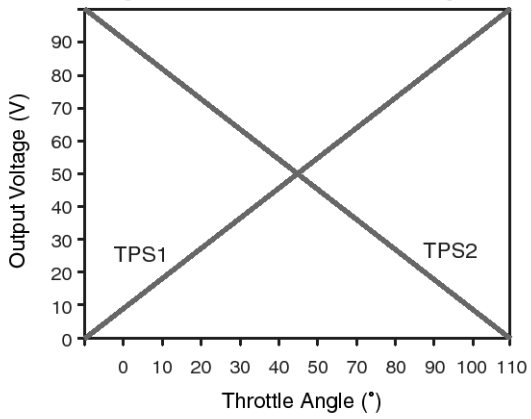
Specification

[Throttle position sensor]

Throttle angle (˚)	Output Voltage (V) [Vref = 3.3V]	
	TPS1	TPS2
0	0.00	3.30
10	0.32	2.98
20	0.63	2.67
30	0.94	2.36
40	1.25	2.05
50	1.57	1.73
60	1.89	1.41
70	2.20	1.10
80	2.51	0.79
90	2.83	0.47
100	3.14	0.16
105	3.30	0.00
C.T (6~15˚)	0.20 ~ 0.46	2.84 ~ 3.10
W.O.T (93~102˚)	2.94 ~ 3.20	0.10 ~ 0.36

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

[TPS CHARACTERISTIC GRAPH]



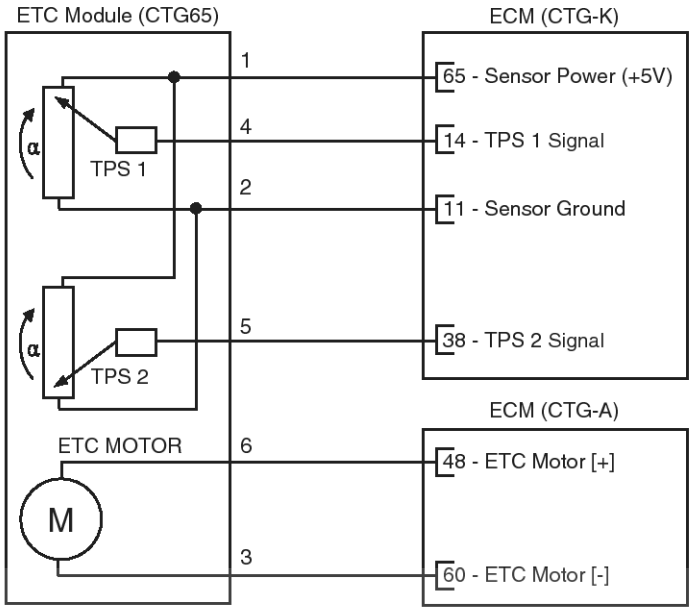
EGRF235A

[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	ECM CTG-K (65)	Sensor Power (+5V)
2	ECM CTG-K (11)	Sensor Ground
3	ECM CTG-A (60)	ETC Motor [-] Control
4	ECM CTG-K (14)	TPS 1 Signal
5	ECM CTG-K (38)	TPS 2 Signal
6	ECM CTG-A (48)	ETC Motor [+] Control

[Harness Connector]

CTG65
ETC MODULE

CTG-K
ECM

SHMF19134N

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.

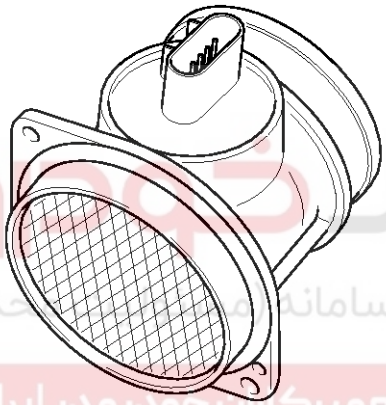
1. Throttle valve moves from limp-home position to close position.
2. And then, it opens to about 15° and moves to limp-home position.

Mass Air Flow Sensor (MAFS)

Description

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

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



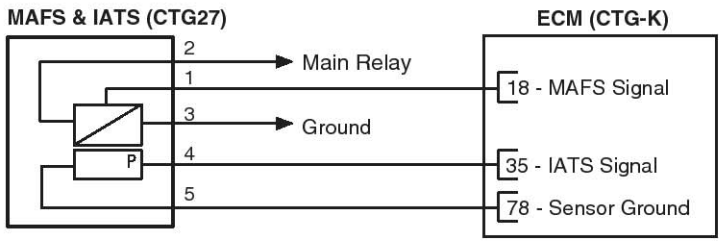
KFCF1021

Specification

Air Flow (kg/h)	Frequency (Hz)
12.6	2,320
18	2,645
23.4	2,903
32.4	3,263
43.2	3,622
57.6	3,986
72	4,288
108	4,876
144	5,380
198	5,983
270	6,636
360	7,286
486	8,002
666	8,843
900	9,699

Circuit Diagram

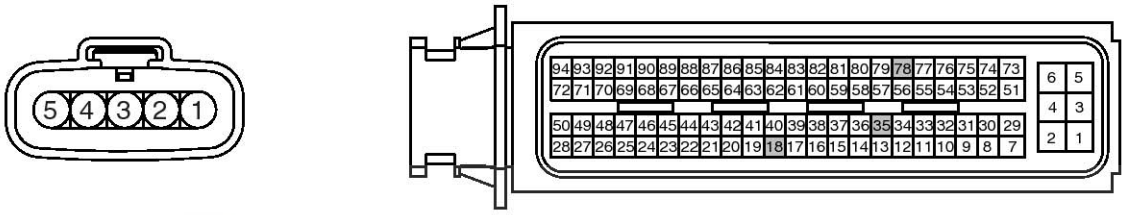
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CTG-K (18)	MAFS Signal
2	Main Relay	Sensor Power (B+)
3	Chassis Ground	Power Ground
4	ECM CTG-K (35)	IATS Signal
5	ECM CTG-K (78)	Sensor Ground

[Harness Connector]



CTG27
MAFS & IATS

CTG-K
ECM

SHMF19135N

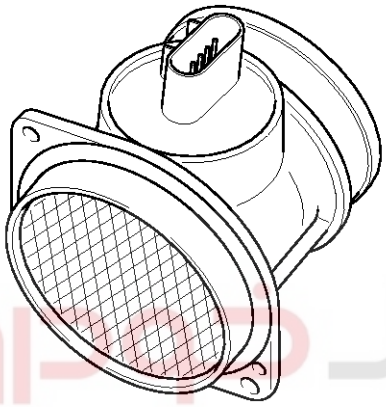
Inspection

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

Intake Air Temperature Sensor (IATS)

Description

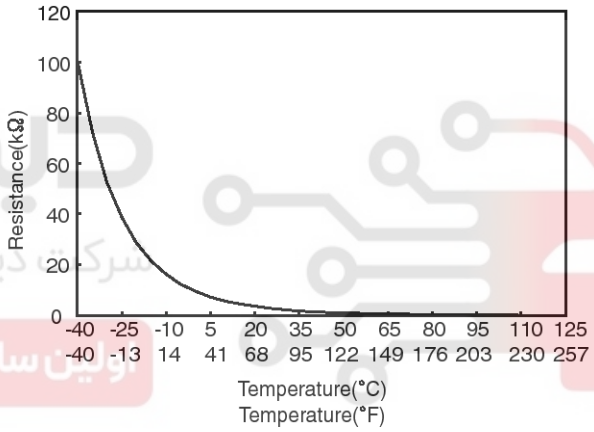
Intake Air Temperature Sensor (IATS) is installed inside the Mass Air Flow Sensor (MAFS) and detects the intake air temperature. To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the ECM uses not only MAFS signal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



KFCF1021

Specification

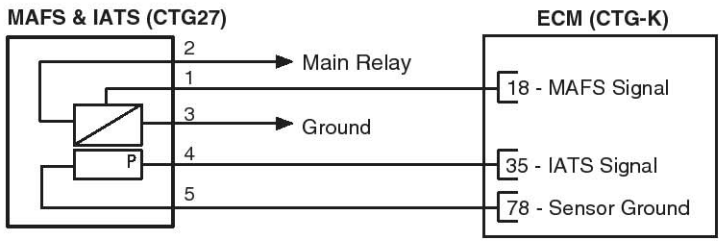
Temperature		Resistance (kΩ)
℃	˚F	
-40	-40	100.87
-20	-4	28.58
0	32	9.40
10	50	5.66
20	68	3.51
40	104	1.47
60	140	0.67
80	176	0.33



SHMFL9116L

Circuit Diagram

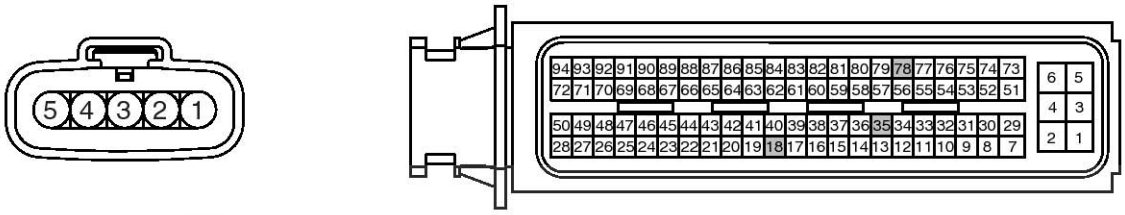
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CTG-K (18)	MAFS Signal
2	Main Relay	Sensor Power (B+)
3	Chassis Ground	Power Ground
4	ECM CTG-K (35)	IATS Signal
5	ECM CTG-K (78)	Sensor Ground

[Harness Connector]



CTG27
MAFS & IATS

CTG-K
ECM

SHMF19135N

Inspection

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

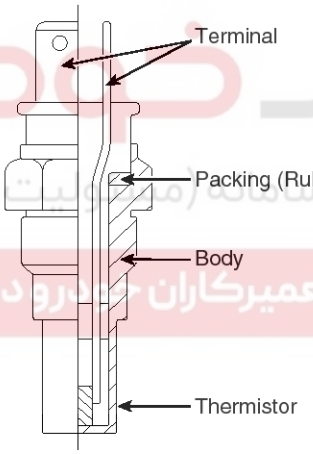
Specification: Refer to Specification Section.

Engine Coolant Temperature Sensor (ECTS)

Description

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

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



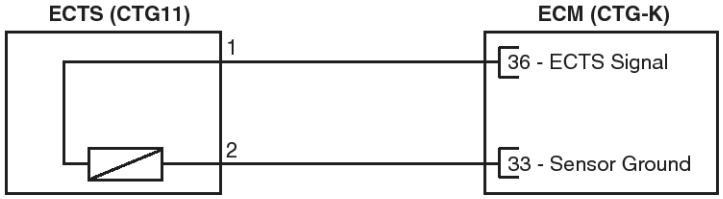
SBHFL9140L

Specification

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

Circuit Diagram

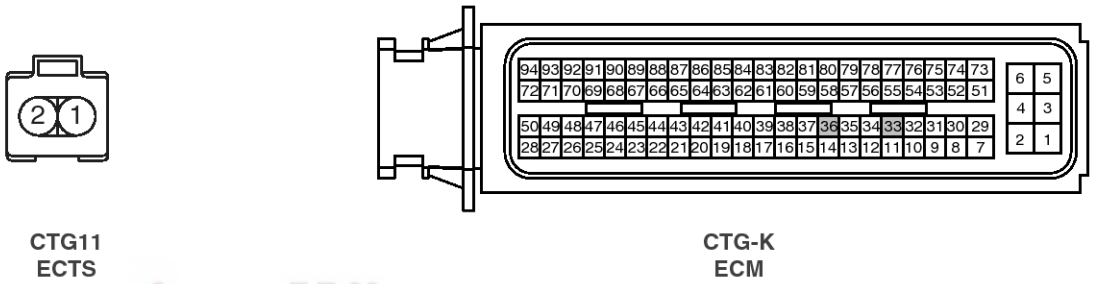
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CTG-K (36)	ECTS Signal
2	ECM CTG-K (33)	Sensor Ground

[Harness Connector]



CTG11
ECTS

CTG-K
ECM

SHMF19136N

Inspection

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

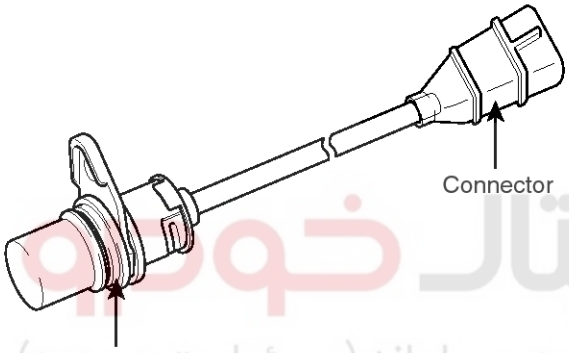
Specification: Refer to Specification Section.

Crankshaft Position Sensor (CKPS)

Description

Crankshaft Position Sensor (CKPS) detects the crankshaft position and is one of the most important sensors of the engine control system. If there is no CKPS signal input, the engine may stop because of CKPS signal missing.

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



EGRF245A

Specification

Item	Specification
Coil Resistance (Ω)	774 ~ 946 [25℃(77°F)]
Air Gap (mm)	1.8

Wave Form

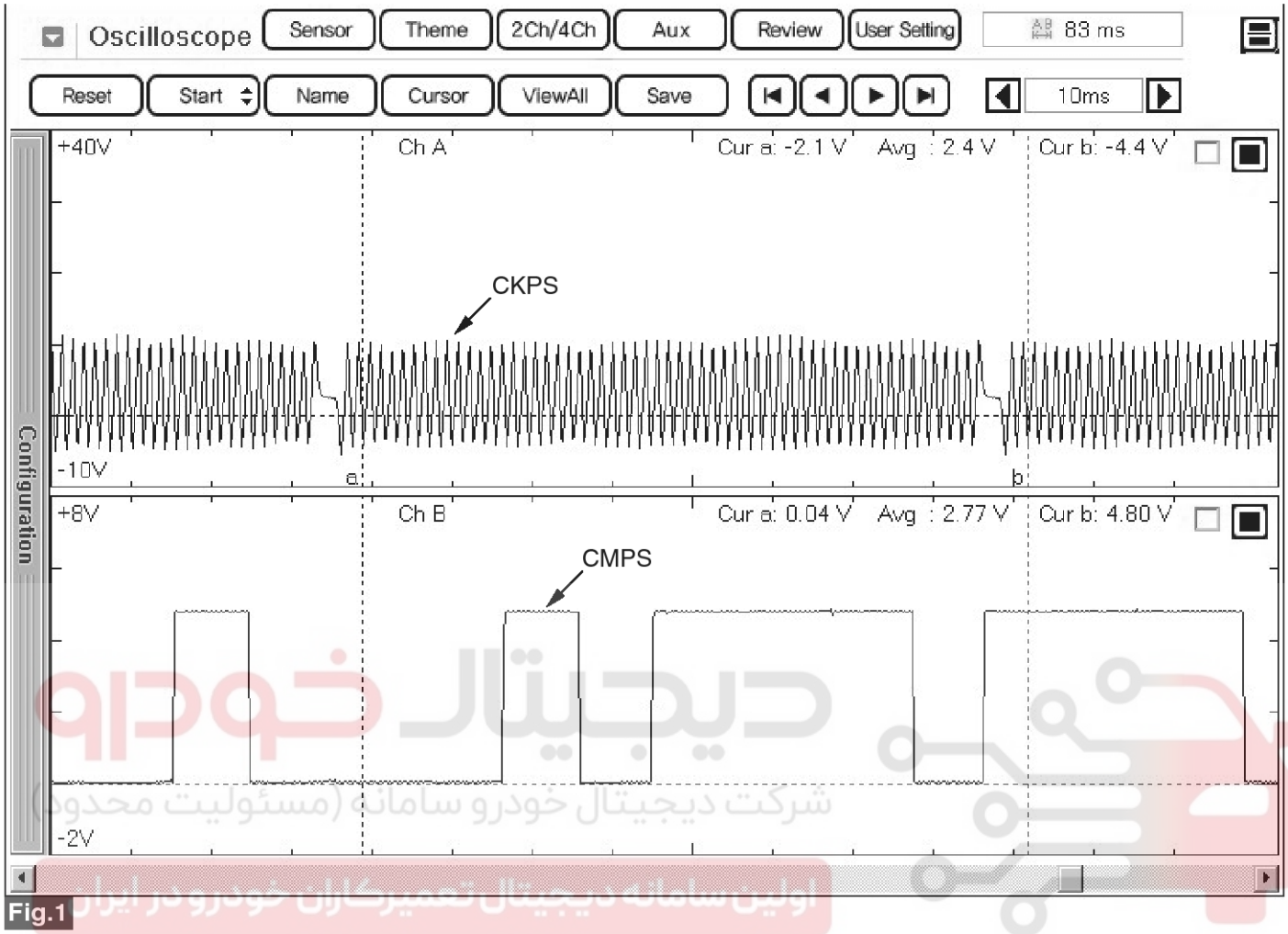


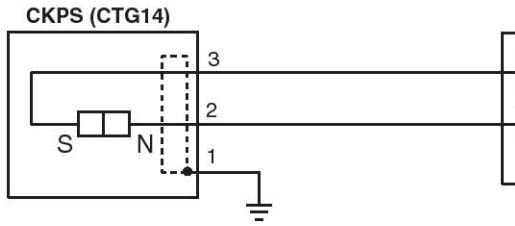
Fig.1

SHMF19137N

This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle.

Circuit Diagram

[Circuit Diagram]

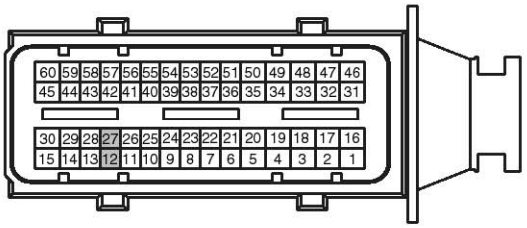


[Harness Connector]

[Connection Information]

Terminal	Connected to	Function
1	Chassis Ground	Ground
2	ECM CTG-A (27)	CKPS [Low] Signal
3	ECM CTG-A (12)	CKPS [High] Signal

CTG14
CKPS



CTG-A
ECM

SHMF19138L

Inspection

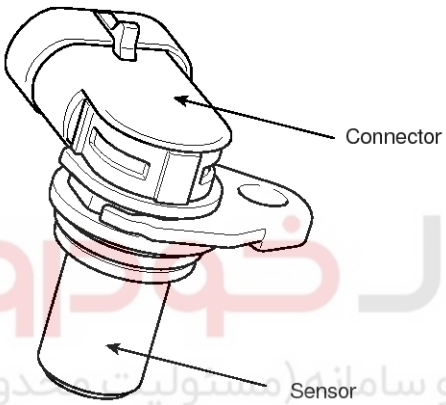
1. Check the signal waveform of the CMPS and CKPS using a scantool.

Specification: Refer to “Wave Form”

Camshaft Position Sensor (CMPS)

Description

Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element. It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect. The two CMPS are installed on engine head cover of bank 1 and 2 respectively and use a target wheel installed on the camshaft. This sensor has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow. So the sequential injection of the 8 cylinders is impossible without CMPS signal.



SBHFL9138L

Specification

Item	Specification
Output Voltage (V)	High: 5.0V
	Low: 0.7V
Air Gap (mm)	0.5 ~ 1.5

Wave Form

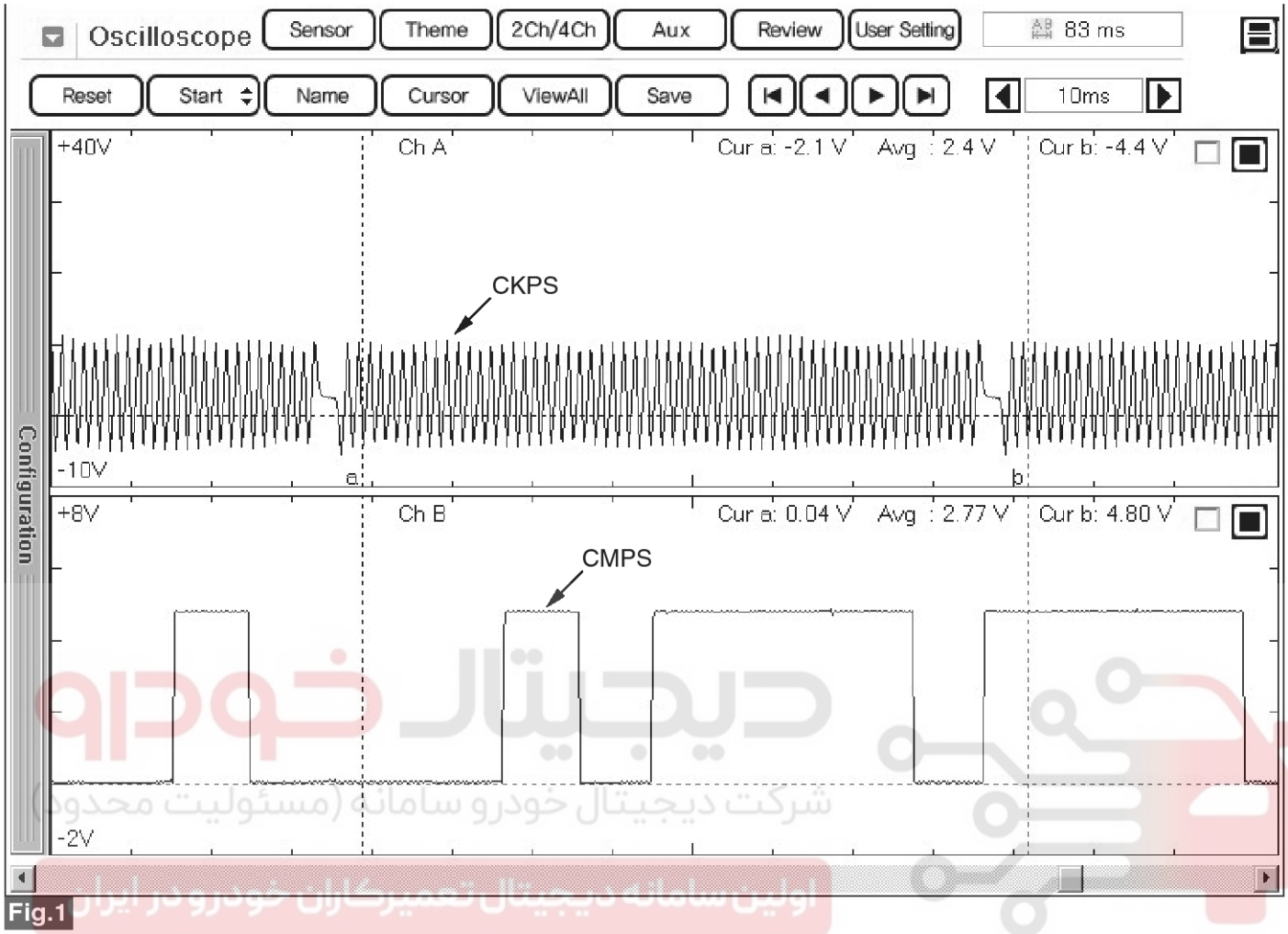


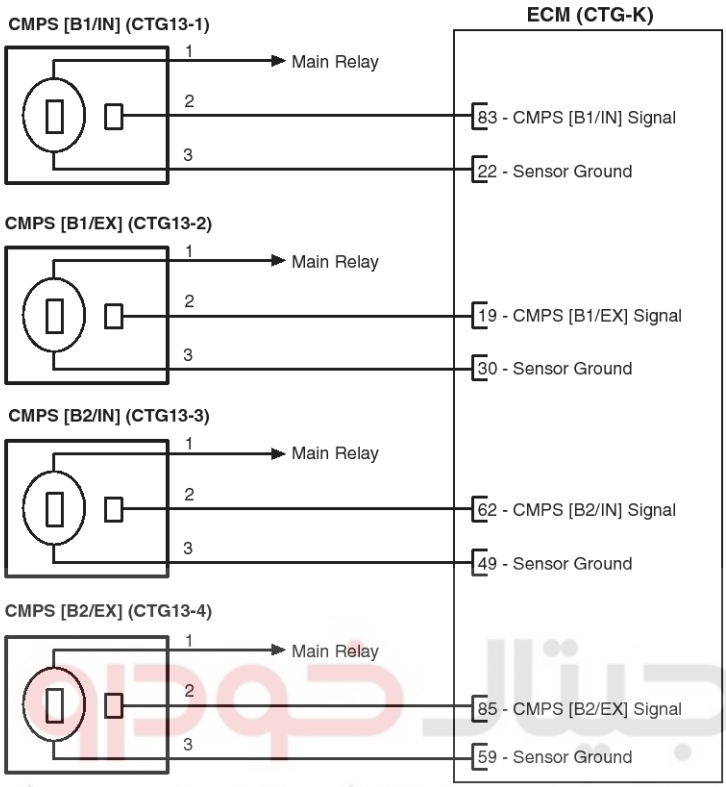
Fig.1

SHMF19137N

This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle.

Circuit Diagram

[Circuit Diagram]



[Connection Information]

CMPS [BANK 1/INTAKE] (CTG13-1)

Terminal	Connected to	Function
1	Main Relay	Sensor Power (+5V)
2	ECM CTG-K (83)	CMPS [B1/IN] Signal
3	ECM CTG-K (22)	Sensor Ground

CMPS [BANK 1/EXHAUST] (CTG13-2)

Terminal	Connected to	Function
1	Main Relay	Sensor Power (+5V)
2	ECM CTG-K (19)	CMPS [B1/EX] Signal
3	ECM CTG-K (30)	Sensor Ground

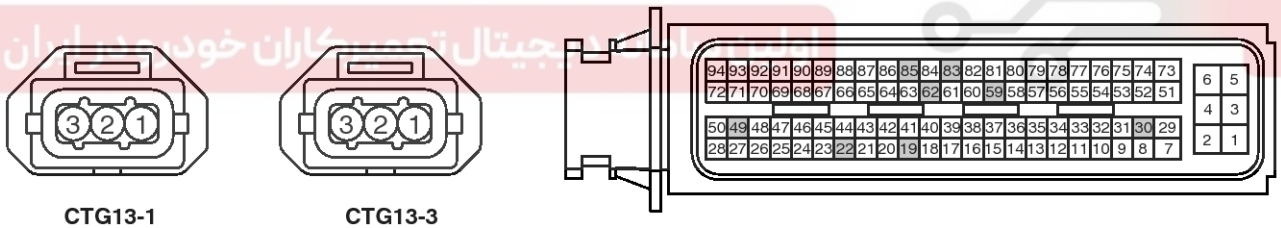
CMPS [BANK 2/INTAKE] (CTG13-3)

Terminal	Connected to	Function
1	Main Relay	Sensor Power (+5V)
2	ECM CTG-K (62)	CMPS [B2/IN] Signal
3	ECM CTG-K (49)	Sensor Ground

CMPS [BANK 2/EXHAUST] (CTG13-4)

Terminal	Connected to	Function
1	Main Relay	Sensor Power (+5V)
2	ECM CTG-K (85)	CMPS [B2/EX] Signal
3	ECM CTG-K (59)	Sensor Ground

[Harness Connector]



CTG13-1
CTG13-2

CMPS [BANK 1/INTAKE]
CMPS [BANK 1/EXHAUST]

CTG13-3
CTG13-4

CMPS [BANK 2/INTAKE]
CMPS [BANK 2/EXHAUST]

CTG-K
ECM

SHMF19139N

Inspection

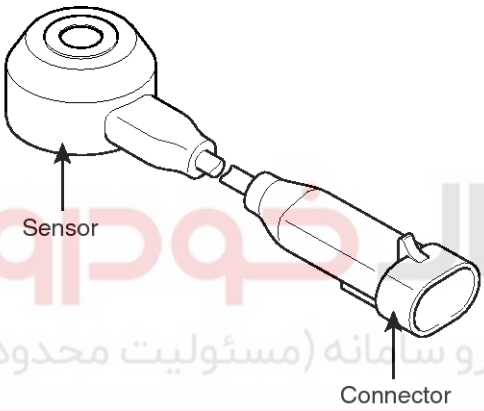
1. Check the signal waveform of the CMPS and CKPS using a scantool.

Specification: Refer to “Wave Form”

Knock Sensor (KS)

Description

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



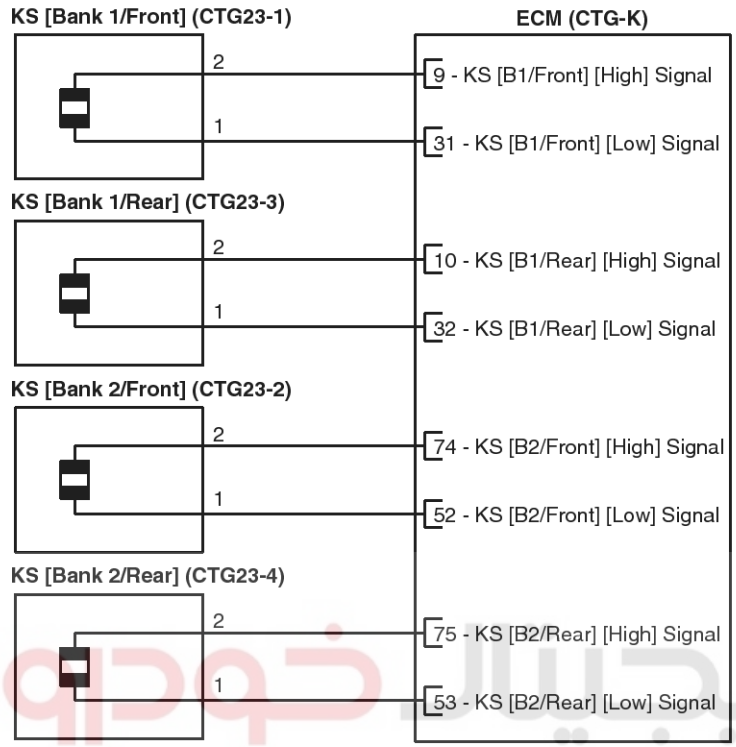
EGRF251A

Specification

Item	Specification
Capacitance (pF)	950 ~ 1,350

Circuit Diagram

[Circuit Diagram]



[Connection Information]

KNOCK SENSOR [Bank 1/Front] (CTG23-1)

Terminal	Connected to	Function
1	ECM CTG-K (31)	KS [B1/F] [Low] Signal
2	ECM CTG-K (9)	KS [B1/F] [High] Signal

KNOCK SENSOR [Bank 1/Rear] (CTG23-3)

Terminal	Connected to	Function
1	ECM CTG-K (32)	KS [B1/R] [Low] Signal
2	ECM CTG-K (10)	KS [B1/R] [High] Signal

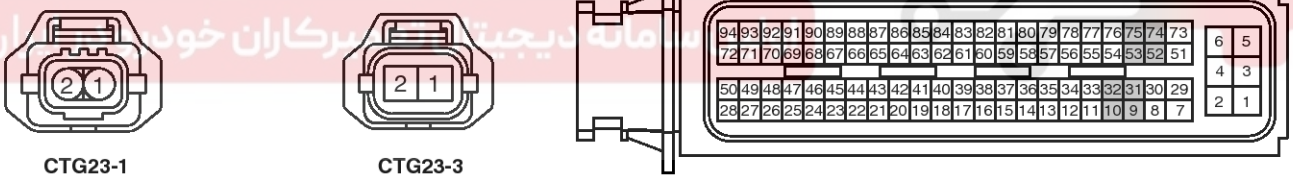
KNOCK SENSOR [Bank 2/Front] (CTG23-2)

Terminal	Connected to	Function
1	ECM CTG-K (52)	KS [B2/F] [Low] Signal
2	ECM CTG-K (74)	KS [B2/F] [High] Signal

KNOCK SENSOR [Bank 2/Rear] (CTG23-4)

Terminal	Connected to	Function
1	ECM CTG-K (53)	KS [B2/R] [Low] Signal
2	ECM CTG-K (75)	KS [B2/R] [High] Signal

[Harness Connector]



CTG23-1
CTG23-2
KNOCK SENSOR [Bank 1/Front]
KNOCK SENSOR [Bank 2/Front]

CTG23-3
CTG23-4
KNOCK SENSOR [Bank 1/Rear]
KNOCK SENSOR [Bank 2/Rear]

CTG-K
ECM

SHMF19140N

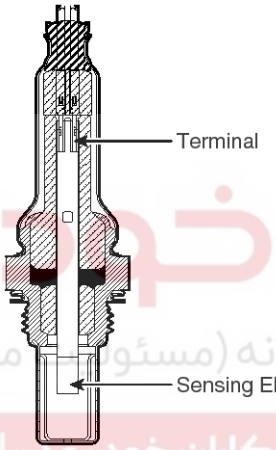
Heated Oxygen Sensor (HO2S)

Description

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

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

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



EGRF247A

Specification

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

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

Wave Form

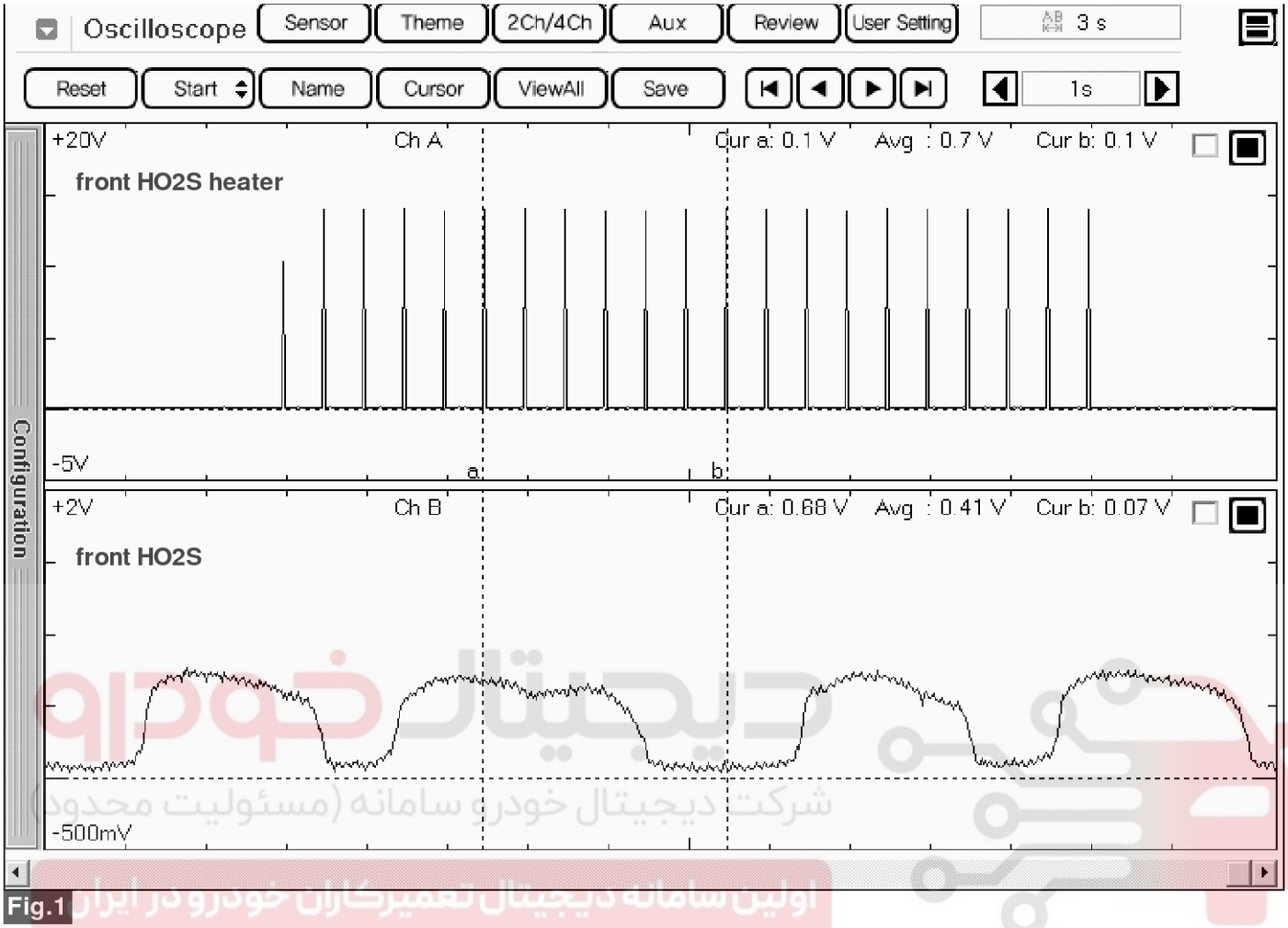


Fig.1

SBHFL9617L

Fig.2

SBHFL9618L

Fig.3

SHMF19141N

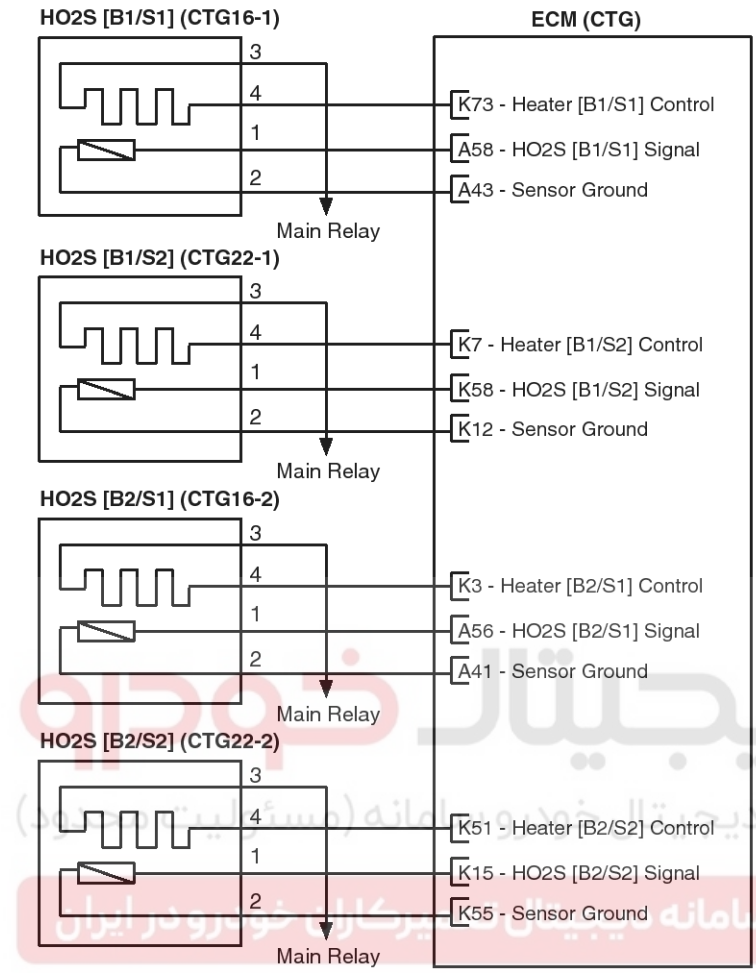
Fig.1) The signal waveforms of front HO2S(the upper) and heater(the lower) at idle

Fig.2) The signal waveforms of rear HO2S(the upper) and heater(the lower) at idle

Fig.3) Typical waveforms of front HO2S(the upper) and rear HO2S(the lower).

Circuit Diagram

[Circuit Diagram]



[Connection Information]

HO2S [BANK 1/SENSOR 1] (CTG16-1)

Terminal	Connected to	Function
1	ECM CTG-A (58)	HO2S [B1/S1] Signal
2	ECM CTG-A (43)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM CTG-K (73)	Heater [B1/S1] Control

HO2S [BANK 1/SENSOR 2] (CTG22-1)

Terminal	Connected to	Function
1	ECM CTG-K (58)	HO2S [B1/S2] Signal
2	ECM CTG-K (12)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM CTG-K (7)	Heater [B1/S2] Control

HO2S [BANK 2/SENSOR 1] (CTG16-2)

Terminal	Connected to	Function
1	ECM CTG-A (56)	HO2S [B2/S1] Signal
2	ECM CTG-A (41)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM CTG-K (3)	Heater [B2/S1] Control

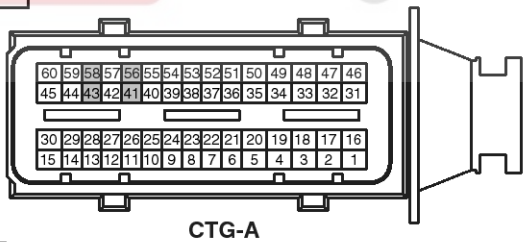
HO2S [BANK 2/SENSOR 2] (CTG22-2)

Terminal	Connected to	Function
1	ECM CTG-K (15)	HO2S [B2/S2] Signal
2	ECM CTG-K (55)	Sensor Ground
3	Main Relay	Battery Power (B+)
4	ECM CTG-K (51)	Heater [B2/S2] Control

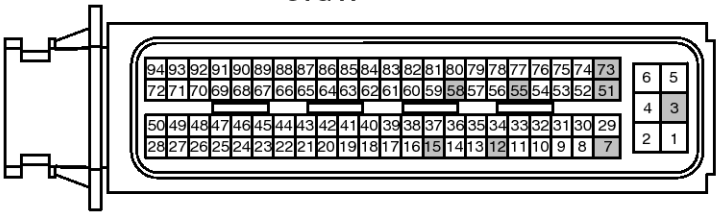
[Harness Connector]

CTG16-1,2
HO2S [BANK 1/SENSOR 1]
HO2S [BANK 2/SENSOR 1]

CTG22-1,2
HO2S [BANK 1/SENSOR 2]
HO2S [BANK 2/SENSOR 2]



CTG-A



CTG-K
ECM

SHMF19142N

Inspection

1. Check signal waveform of HO2S using a scantool.

Specification: Refer to “Waveform”

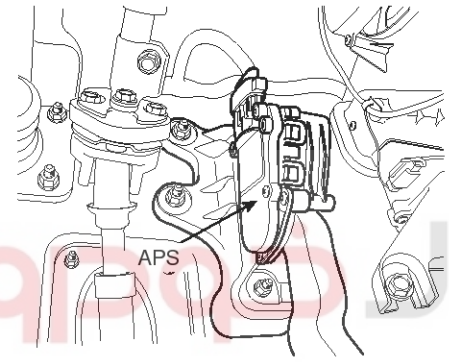
2. Turn the ignition switch OFF.
3. Disconnect the HO2S connector.
4. Measure resistance between the HO2S heater terminals 3 and 4.
5. Check that the resistance is within the specification.

Specification: Refer to Specification Section.

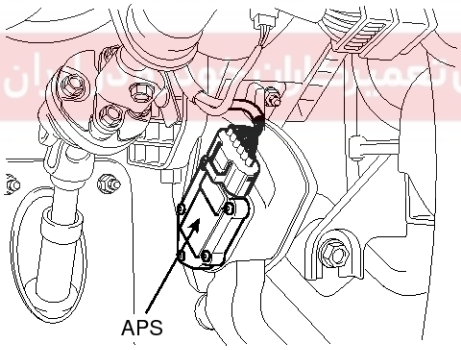
Accelerator Position Sensor (APS)

Description

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



[Non - Adjust type]



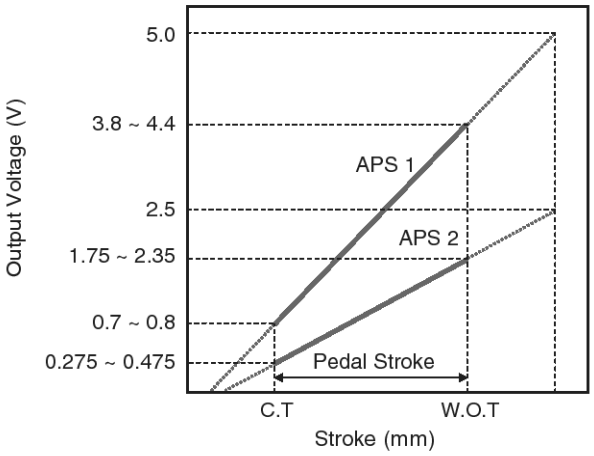
[Adjust type]

SHMFL9153L

Specification

[Non-Adjust type]

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.7 ~ 0.8	0.275 ~ 0.475
W.O.T	3.8 ~ 4.4	1.75 ~ 2.35

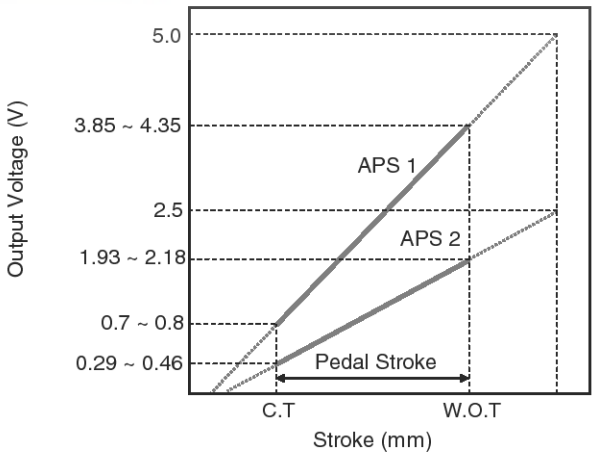


SENFL7130L

[Adjust type]

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

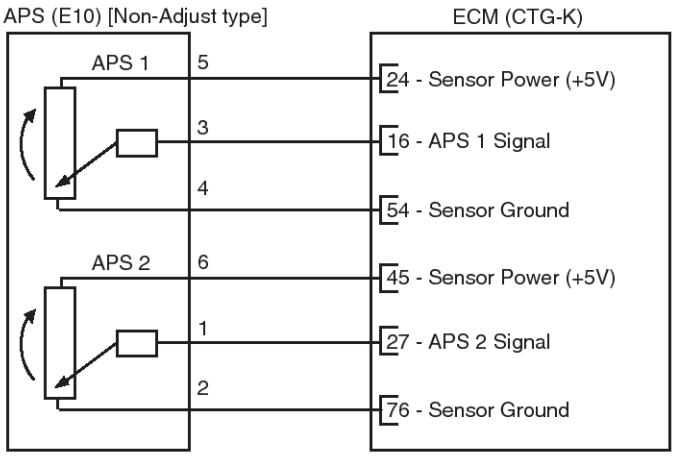
Item	Sensor Resistance (kΩ)
APS1	0.7 ~ 1.3 [20℃ (68°F)]
APS2	1.4 ~ 2.6 [20℃ (68°F)]



SHMFL9124L

Circuit Diagram

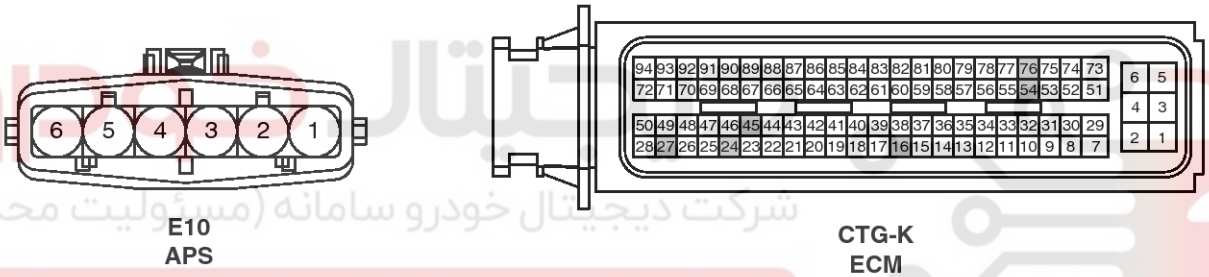
[Circuit Diagram]



[Connection Information]

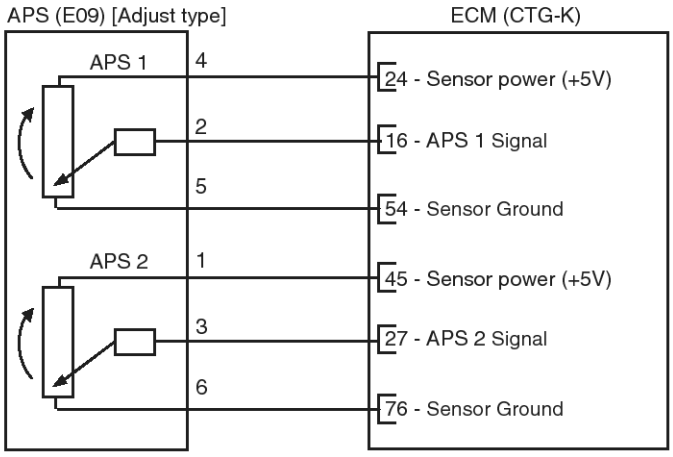
Terminal	Connected to	Function
1	ECM CTG-K (27)	APS 2 Signal
2	ECM CTG-K (76)	APS 2 Sensor Ground
3	ECM CTG-K (16)	APS 1 Signal
4	ECM CTG-K (54)	APS 1 Sensor Ground
5	ECM CTG-K (24)	APS 1 Sensor Power (+5V)
6	ECM CTG-K (45)	APS 2 Sensor Power (+5V)

[Harness Connector]



SHMF19169N

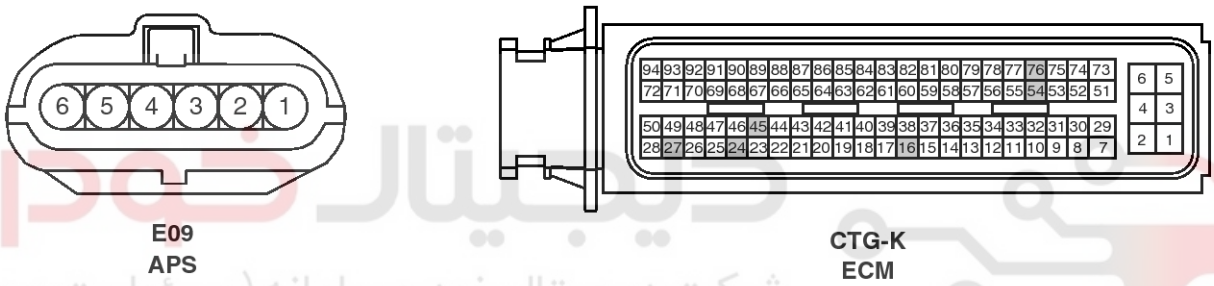
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CTG-K (45)	APS 2 Sensor power (+5V)
2	ECM CTG-K (16)	APS 1 Signal
3	ECM CTG-K (27)	APS 2 Signal
4	ECM CTG-K (24)	APS 1 Sensor power (+5V)
5	ECM CTG-K (54)	APS 1 Ground
6	ECM CTG-K (76)	APS 2 Ground

[Harness Connectors]



SHMF19170N

Inspection

[Non-Adjust type]

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

Specification: Refer to Specification Section.

[Adjust type]

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

Specification

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

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).

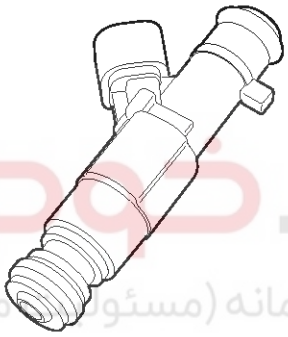
Specification: Refer to Specification Section.

Injector

Description

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

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



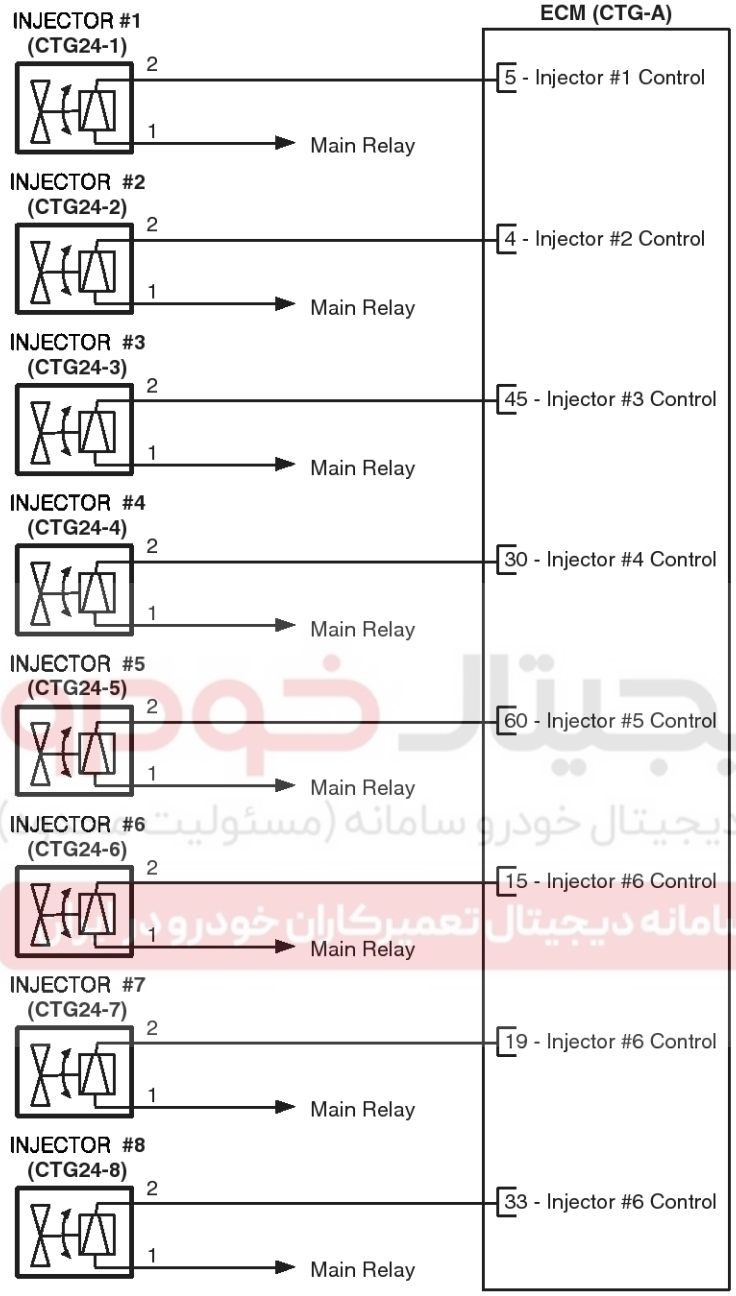
SHMF19144N

Specification

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

Circuit Diagram

[Circuit Diagram]



[Connection Information]

INJECTOR #1 (CTG24-1)

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

INJECTOR #2 (CTG24-2)

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

INJECTOR #3 (CTG24-3)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-A (45)	Injector #3 Control

INJECTOR #4 (CTG24-4)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-A (30)	Injector #4 Control

INJECTOR #5 (CTG24-5)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-A (60)	Injector #5 Control

INJECTOR #6 (CTG24-6)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-A (15)	Injector #6 Control

INJECTOR #7 (CTG24-7)

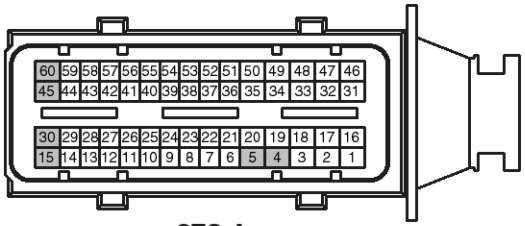
Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-A (19)	Injector #7 Control

INJECTOR #8 (CTG24-8)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-A (33)	Injector #8 Control

[Harness Connector]

CLG24-1,2,3,4,5,6,7,8
INJECTOR #1,2,3,4,5,6,7,8



CTG-A
ECM

SHMF19145N

Inspection

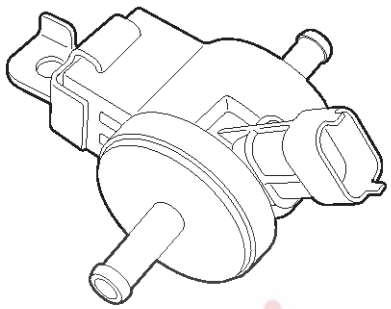
1. Turn the ignition switch OFF.
2. Disconnect the injector connector.
3. Measure resistance between the injector terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to Specification Section.

Purge Control Solenoid Valve (PCSV)

Description

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

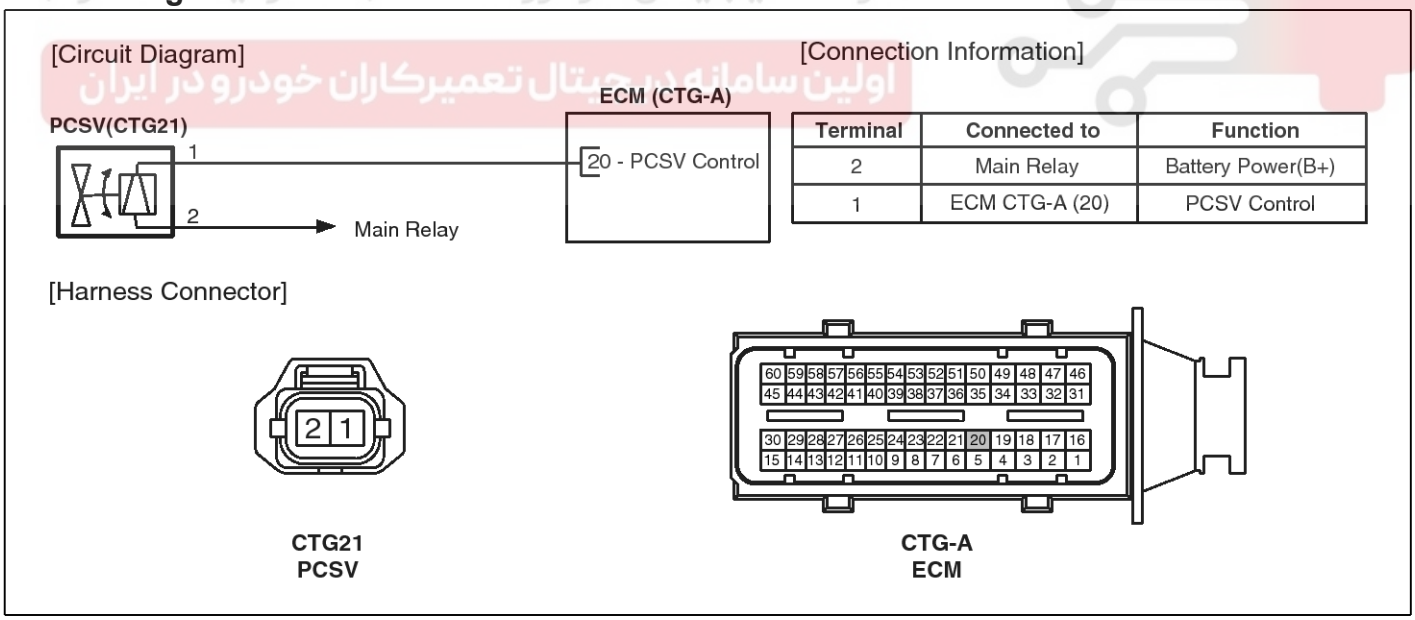


SHMF19146N

Specification

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

Circuit Diagram



SHMF19147N

Inspection

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

Specification: Refer to Specification Section.

CVVT Oil Control Valve (OCV)

Description

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

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

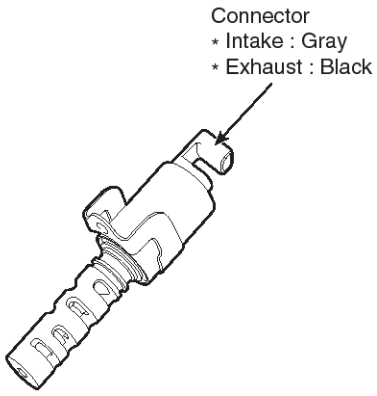
This system consist of

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

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

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

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

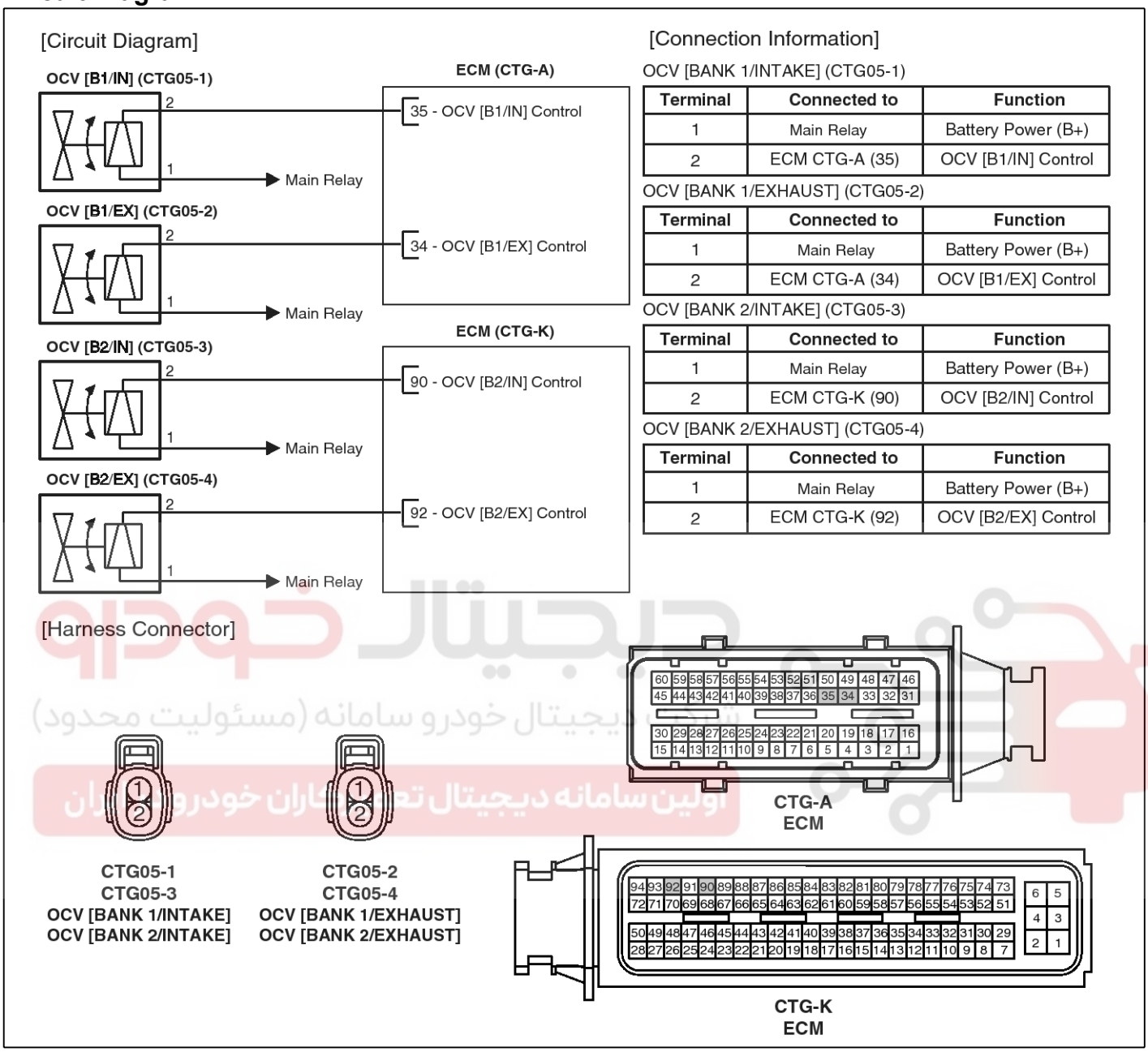


SHMF19148N

Specification

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

Circuit Diagram



[Connection Information]

OCV [BANK 1/INTAKE] (CTG05-1)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-A (35)	OCV [B1/IN] Control

OCV [BANK 1/EXHAUST] (CTG05-2)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-A (34)	OCV [B1/EX] Control

OCV [BANK 2/INTAKE] (CTG05-3)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-K (90)	OCV [B2/IN] Control

OCV [BANK 2/EXHAUST] (CTG05-4)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-K (92)	OCV [B2/EX] Control

SHMF19149N

Inspection

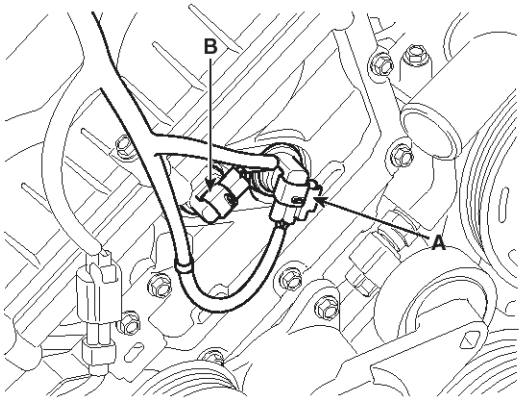
1. Turn the ignition switch OFF.
2. Disconnect the OCV connector.
3. Measure resistance between the OCV terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to Specification Section.

Removal

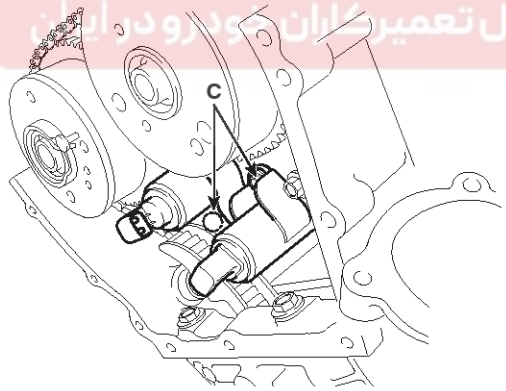
[CVVT Oil Control Valve (Bank 1)]

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



SHMF19150N

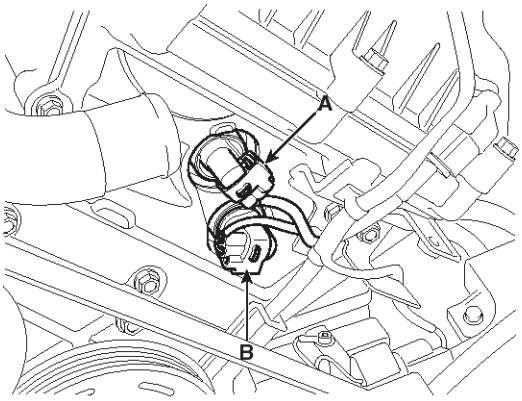
3. Remove the cylinder head cover and the timing chain upper cover. [Bank 1]
   (Refer to "Cylinder Head Assembly" in EM group)
4. Remove the mounting bolt (C), and then remove the valve from the engine.



SHMF19151N

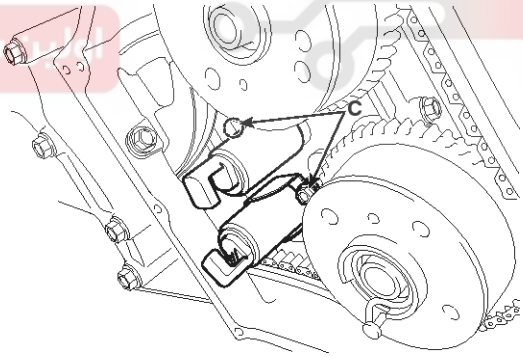
[CVVT Oil Control Valve (Bank 2)]

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



SHMF19152N

3. Remove the cylinder head cover and the timing chain upper cover. [Bank 2]
   (Refer to "Cylinder Head Assembly" in EM group)
4. Remove the mounting bolt (C), and then remove the valve from the engine.



SHMF19153N

Installation

1. Installation is the reverse of removal.

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

CAUTION

Pay attention to color of valve connector (Harness side) when installing.

If an OCV is installed on opposite manifold, the engine may be damaged.

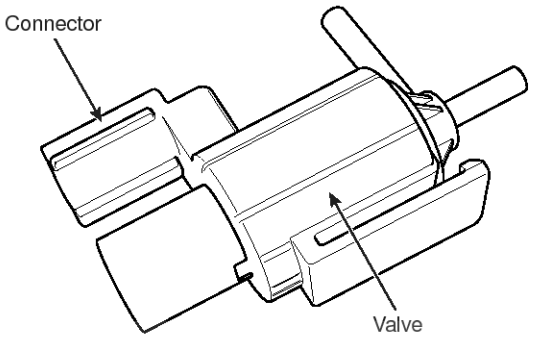
[Connector Color]

Item	Component Side	Harness Side
Intake	Black	Gray
Exhaust	Black	Black

Variable Intake Solenoid (VIS) Valve

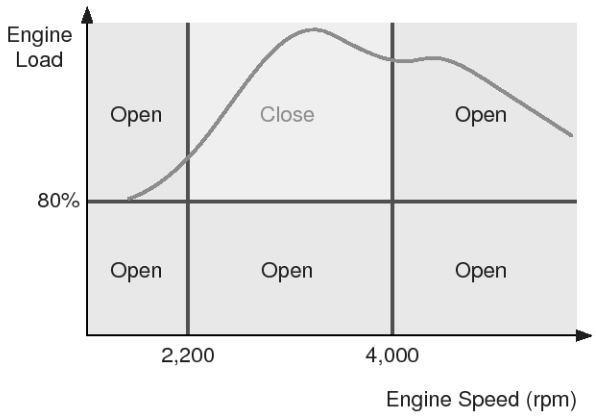
Description

Variable Intake Manifold (VIS) Valve is installed on the intake manifold. It combines or divides the two banks' intake air passages to improve intake efficiency in accordance with the ECM control signal calculated by engine operating condition.



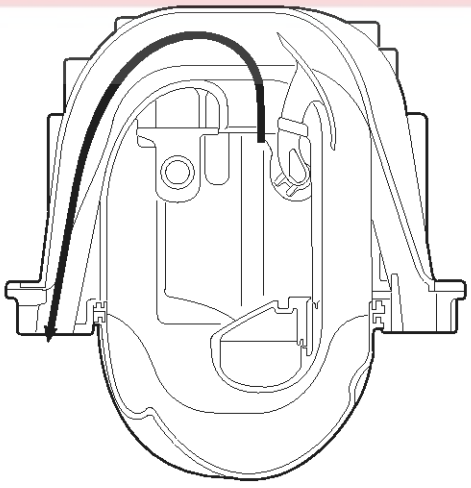
SHMF19154N

[The operation section of VIS valve]

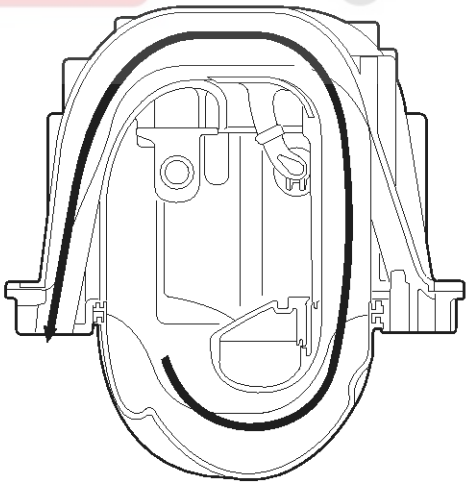


SHMF19155N

VIS Valve	Air Passage	Effect
Open	Short Runner	Improvement in power
Close	Long Runner	Improvement in Low/Middle speed torque



[Short Runner]



[Long Runner]

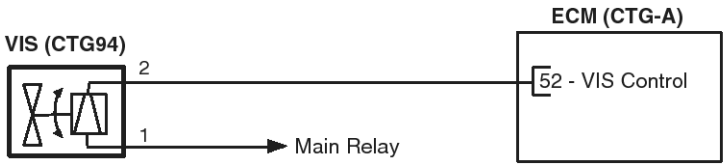
SHMF19156N

Specification

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

Circuit Diagram

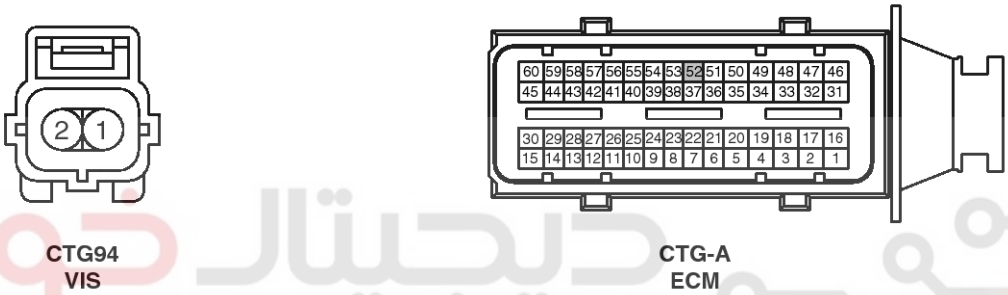
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CTG-A (52)	VIS Valve Conrtol

[Harness Connector]



CTG94
VIS

CTG-A
ECM

SHMF19157N

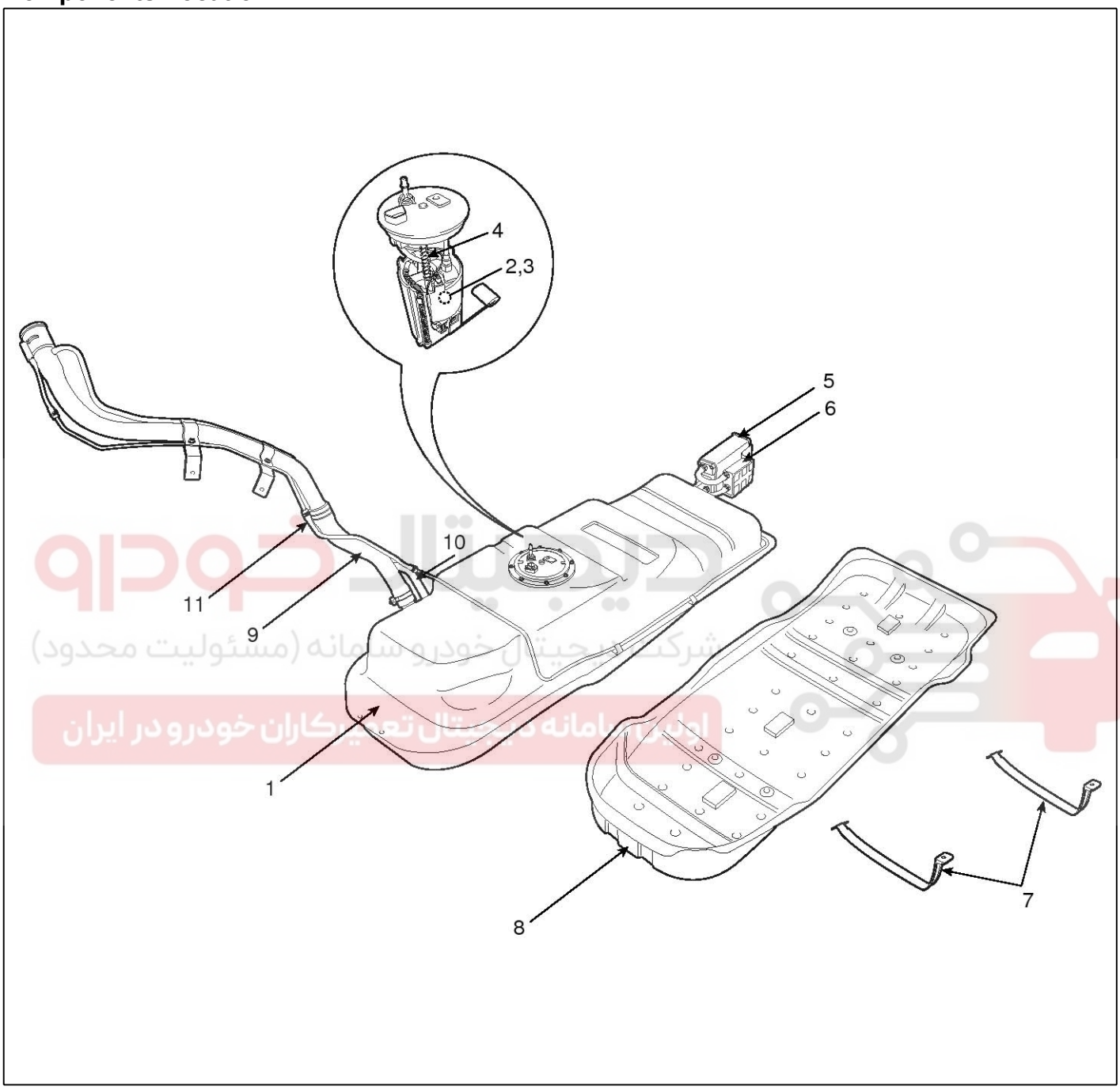
Inspection

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

Specification: Refer to Specification Section.

Fuel Delivery System

Components Location



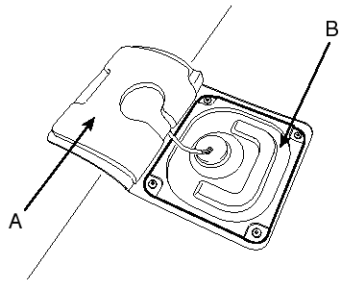
SHMFL9131L

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

Fuel Pressure Test

1. PREPARING

1. Remove the 2nd left seat (Refer to "Seat" in BD group).
2. Open the carpet (A) for fuel pump and remove the service cover (B) for fuel pump.

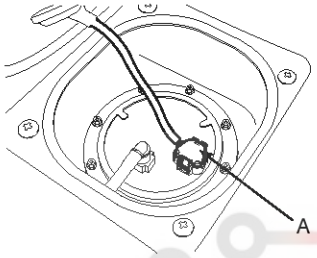


2. RELEASE THE INTERNAL PRESSURE

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

NOTE

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



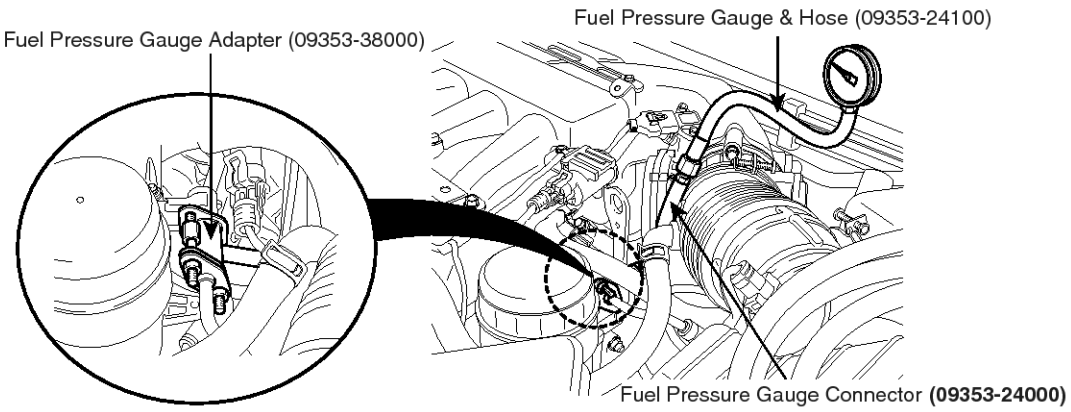
3. INSTALL THE SPECIAL SERVICE TOOL (SST) FOR MEASURING THE FUEL PRESSURE

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

CAUTION

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

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



SHMFL9132L

4. INSPECT FUEL LEAKAGE ON CONNECTION

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

5. FUEL PRESURE TEST

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

Standard Value: 379.5kPa (3.87kgf/cm², 55.0psi)

- 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

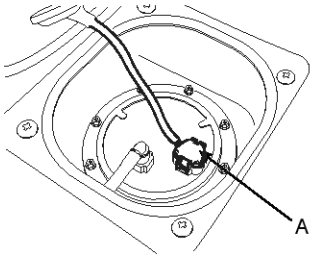
SBHFL9126L

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

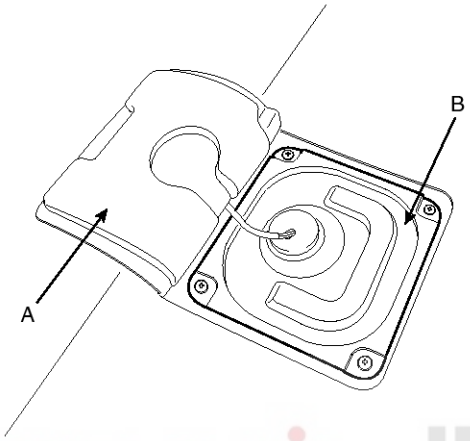
1. Connect the battery negative (-) terminal.
2. Apply battery voltage to the fuel pump terminal and activate the fuel pump. With fuel pressure applied, check that there is no fuel leakage from the fuel pressure gauge or connection part.
3. If the vehicle is normal, connect the fuel pump connector.

SHMFL9133L

Fuel Tank

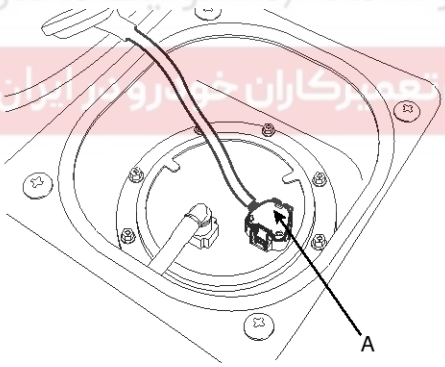
Removal

1. Preparation
   1) Remove the 2nd left seat (Refer to "Seat" in BD group).
   2) Open the carpet (A) for fuel pump and remove the service cover (B) for fuel pump.



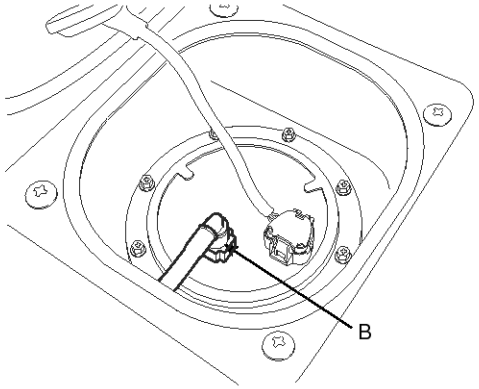
SHMFL8163D

   3) Disconnect the fuel pump connector (A).



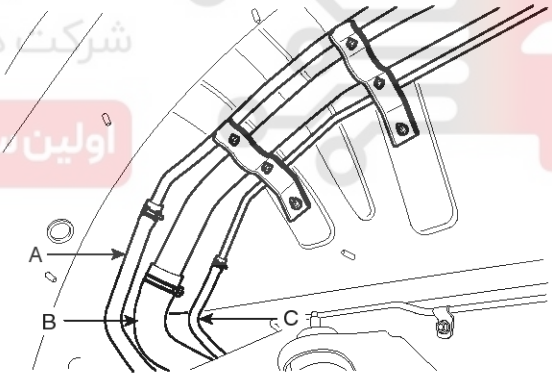
SHMFL9134L

   4) Idle the engine and wait until fuel in fuel line is exhausted.
   5) After engine stops, turn the ignition switch off.
2. Disconnect the fuel tube feed quick-connector (B).



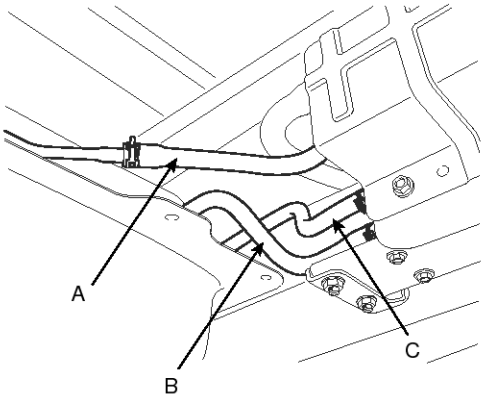
SHMFL9135L

3. Remove the rear-LH wheel & tire, and the inner wheel house (Refer to "DS" group in this SERVICE MANUAL).
4. Disconnect the leveling hose (A), the fuel filler hose (B) and the ventilation hose (C).



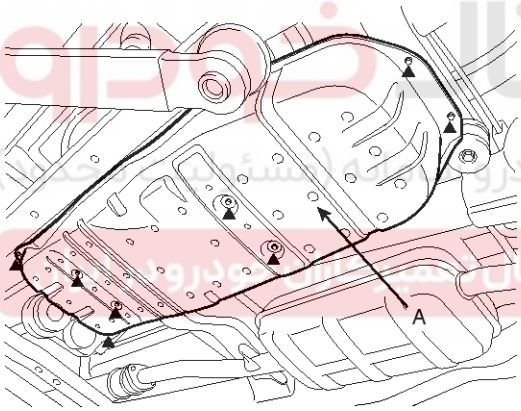
SHMFL8165D

5. Lift the vehicle and support the fuel tank with a jack.
6. Disconnect the vapor hose (A, B, C) connected to the canister.



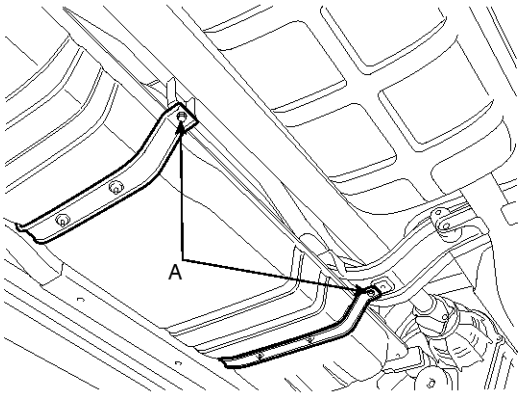
SHMFL9136L

7. Remove the protector (A) after removing 4 bolts / 4 nuts for installation.



SHMFL8166D

8. Remove the fuel tank from the vehicle after removing the fuel tank band mounting nuts (A).



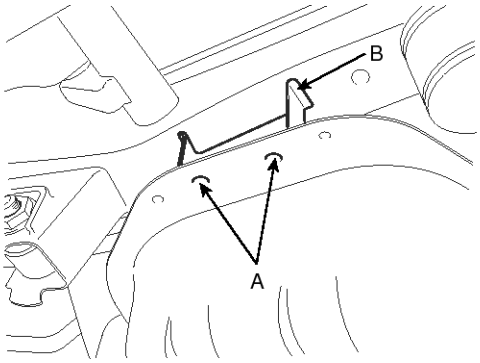
SHMFL8167D

Installation

1. Installation is the reverse of removal.

Fuel tank band mounting nut:
48.1 ~ 58.9 N·m (5.0 ~ 6.0 kgf·m, 36.2 ~ 43.4 lb-ft)
Fuel tank protector installation bolt :
3.9 ~ 5.9 N·m (0.4 ~ 0.6 kgf·m, 2.9 ~ 4.3 lb-ft)
Fuel tank protector installation nut :
6.9 ~ 10.8 N·m (0.7 ~ 1.1 kgf·m, 5.1 ~ 8.0 lb-ft)

⚠CAUTION
Check the fuel tank installation position (A) with the postion adjusting guide pin before reaching to the surface (B) of the frame when installing the fuel tank.

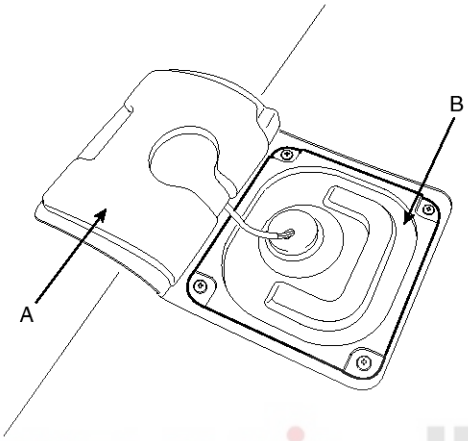


SHMFL9137L

Fuel Pump

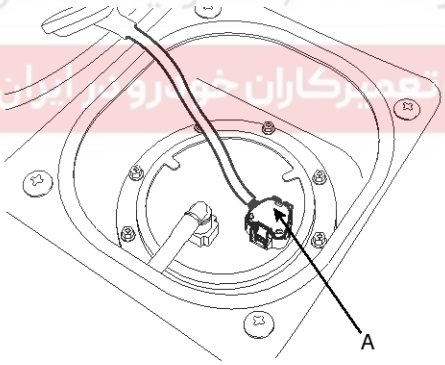
Removal

1. Preparation
   1) Remove the 2nd left seat (Refer to "Seat" in BD group).
   2) Open the carpet (A) for fuel pump and remove the service cover (B) for fuel pump.



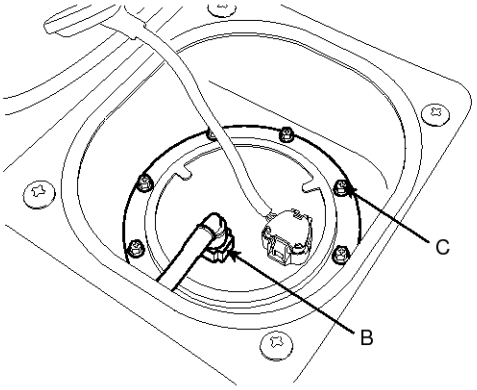
SHMFL8163D

   3) Disconnect the fuel pump connector (A).



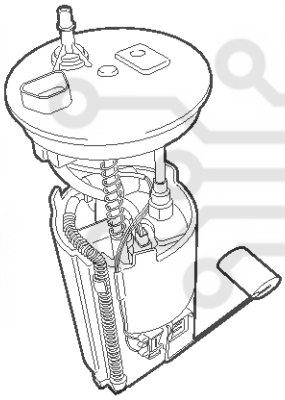
SHMFL9134L

   4) Idle the engine and wait until fuel in fuel line is exhausted.
   5) After engine stops, turn the ignition switch off.
2. Disconnect the fuel tube feed quick-connector (B).



SHMFL9154L

3. Remove the fuel pump from the fuel tank after removing the installation bolts (C).



SHMFL9138L

Installation

1. Installation is the reverse of removal.

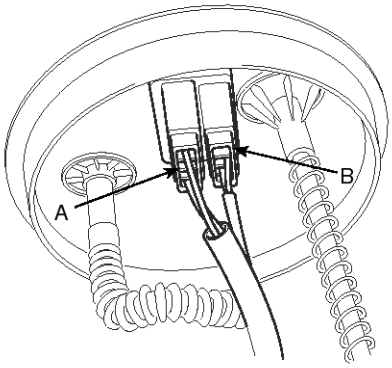
Fuel pump installation bolt :
2.0 ~ 2.7 N.m (0.2 ~ 0.3 kgf.m, 1.4 ~ 2.2 lb-ft)

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

Fuel Filter

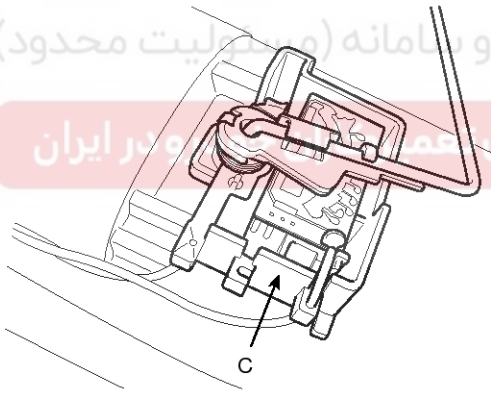
Replacement

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



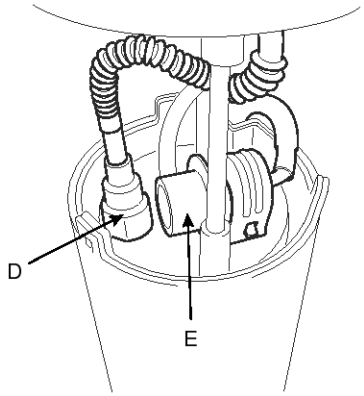
SHMFL9139L

3. Remove the fuel sender (C).



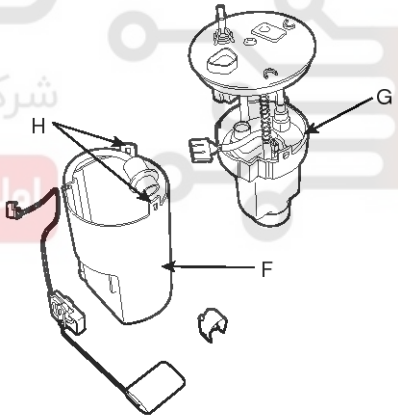
SHMFL9140L

4. Disconnect the fuel feed hose quick- connecter (D).
5. Remove the fuel pressure regulator (E).



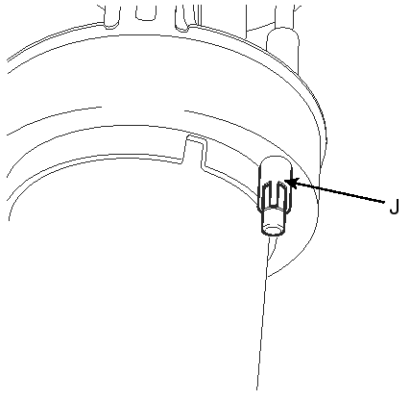
SHMFL9141L

6. Separate the reservoir cup assembly (F) from the electric pump & filter assembly (G) after disengaging two fixing hooks (H).



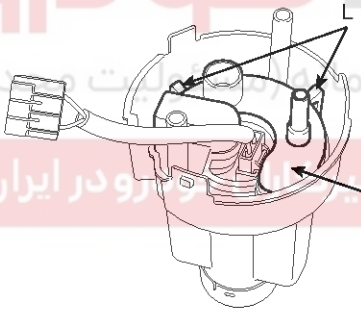
SHMFL9142L

7. Remove the plate assembly
   after widening the space of cushion pipe fixing part (J).

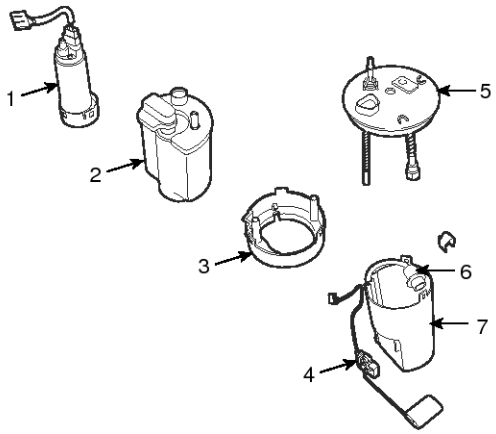


SHMFL9143L

8. Remove the fuel filter assembly (K) from the electric pump & pre-filter assembly after disengaging fixing hooks (L).



SHMFL9144L



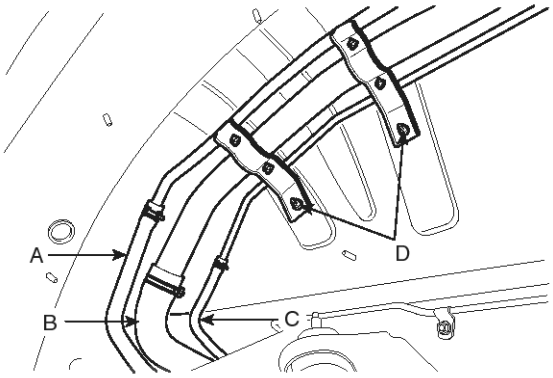
SHMFL9145L

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

Filler-Neck Assembly

Removal

1. Remove the rear-LH wheel, tire, and the inner wheel house.
2. Disconnect the leveling hose (A), the fuel filler hose (B) and the ventilation hose (C).



SHMFL8169D

3. Remove the bracket mounting nuts (D) and remove the filler-neck assembly.

Installation

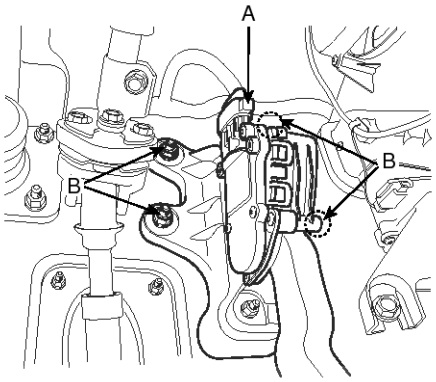
1. Installation is the reverse of removal.

Filler-neck assembly installation nut :
6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)

Accelerator Pedal

Removal

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



SHMFL9146L

3. Remove the accelerator pedal assembly from the vehicle after removing mounting nuts (B).

NOTICE

The accelerator pedal module is installed by both-sides nuts. It is possible to remove the accelerator pedal module. But, installation is very difficult. We recommend you to remove the accelerator pedal assembly when servicing the accelerator pedal.

Installation

1. Installation is the reverse of removal.

Accelerator pedal assembly installation nut :
12.8 ~ 15.7 N.m (1.3 ~ 1.6 kgf.m, 9.4 ~ 11.6 lb-ft)
Accelerator pedal module installation nut :
7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)