

General Information

FL-3

General Information

Specification

Fuel Delivery System

Items	Specification	
Fuel Injection System	Type	Common Rail Direct Injection (CRDI)
Fuel Return System	Type	Return type
Fuel Pressure	Max. Pressure	1,600 bar
Fuel Tank	Capacity	82 lit. (21.6 U.S.gal., 86.6 U.S.qt., 72.1 Imp.qt.)
Fuel Filter	Type	High pressure type (Built in engine room)
High Pressure Fuel Pump	Type	Mechanical, Plunger Pumping Type
	Driven by	Timing chain
Low Pressure Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor

Sensors

Mass Air Flow Sensor (MAFS)

▷ Type: Hot-Film Type

▷ Specification

* At intake air temperature = 20°C (68°F)

Air Flow (kg/h)	Frequency (kHz)
10	1.93 ~ 1.94
15	2.00 ~ 2.01
20	2.06 ~ 2.07
90	2.67 ~ 2.69
220	3.43 ~ 3.47
440	4.65 ~ 4.76
850	7.87 ~ 8.25
1000	9.60 ~ 10.52

* At intake air temperature = -15°C (5°F) or 80°C (176°F)

Air Flow (kg/h)	Frequency (kHz)
10	1.93 ~ 1.94
75	2.65 ~ 2.70
160	3.40 ~ 3.49
310	4.60 ~ 4.81

Intake Air Temperature Sensor (IATS) #1 [Built In MAFS]

▷ Type: Thermistor type

▷ Specification

Temperature [°C (°F)]	Resistance (kΩ)
-40(-40)	35.14 ~ 43.76
-20(-4)	12.66 ~ 15.12
0(32)	5.12 ~ 5.89
20(68)	2.29 ~ 2.55
40(104)	1.10 ~ 1.24
60(140)	0.57 ~ 0.65
80(176)	0.31 ~ 0.37

Boost Pressure Sensor (BPS)

▷ Type: Piezo-resistive pressure sensor type

▷ Specification

Pressure (kPa)	Output Voltage (V)
32.5	0.5
70.0	1.02 ~ 1.17
140.0	2.13 ~ 2.28
210.0	3.25 ~ 3.40
270.0	4.20 ~ 4.35
284.0	4.5

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Fuel System

Intake Air Temperature Sensor (IATS) #2 [Built In BPS]

▷ Type: Thermistor type

▷ Specification

Temperature [$^{\circ}\text{C}$ ($^{\circ}\text{F}$)]	Resistance($\text{k}\Omega$)
-40(-40)	40.93 ~ 48.35
-20(-4)	13.89 ~ 16.03
0(32)	5.38 ~ 6.09
20(68)	2.31 ~ 2.57
40(104)	1.08 ~ 1.21
60(140)	0.54 ~ 0.62
80(176)	0.29 ~ 0.34

Engine Coolant Temperature Sensor (ECTS)

▷ Type: Thermistor type

▷ Specification

Temperature [$^{\circ}\text{C}$ ($^{\circ}\text{F}$)]	Resistance($\text{k}\Omega$)
-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

Camshaft Position Sensor (CMPS)

▷ Type: Hall effect type

▷ Specification

Level	Output Pulse (V)
High	5
Low	0

Item	Specification
Air Gap (mm)	0.5 ~ 1.5

Crankshaft Position Sensor (CKPS)

▷ Type: Magnetic field sensitive type

▷ Specification

Items	Specification
Coil Resistance (Ω)	774 ~ 946 [20°C (68°F)]
Air Gap (mm)	0.5 ~ 1.5

Rail Pressure Sensor (RPS)

▷ Type: Piezo-resistive pressure sensor type

▷ Specification

Condition	Rail pressure (bar)	Output Voltage (V)
Idle	200 ~ 300	Below 1.7
3,000 rpm	450 ~ 650	1.5 ~ 1.9
Accelerator pedal fully depressed	About 1600	About 4.5

Fuel Temperature Sensor (FTS)

▷ Type: Thermistor type

▷ Specification

Temperature [$^{\circ}\text{C}$ ($^{\circ}\text{F}$)]	Resistance($\text{k}\Omega$)
-10(14)	8.64 ~ 10.15
20(68)	2.35 ~ 2.65
80(176)	0.31 ~ 0.33
120(248)	0.11 ~ 0.12

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Lambda Sensor

▷ Type: Zirconia (ZrO₂) Type

▷ Specification

[Pumping Current]

λ Value (A/F Ratio)	Pumping Current (A)
0.65	-2.2
0.7	-1.8
0.8	-1.1
0.9	-0.5
1.01	0
1.18	0.33
1.43	0.67
1.7	0.94
2.42	1.38
Air (Atmosphere)	2.54

[Heater Resistance]

Temperature [°C (°F)]	Heater Resistance (Ω)
20(68)	2.4 ~ 4.0

Accelerator Position Sensor (APS)

▷ Type: Potentiometer type

▷ Specification

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2
Released	0.7 ~ 0.8	0.275 ~ 0.475
Fully depressed	3.8 ~ 4.4	1.75 ~ 2.35

Water Sensor

▷ Specification

Item	Specification
Warning Level (cc)	53 ~ 63

Actuators

Injector

▷ Number: 6

▷ Type: Piezo injector

▷ Specification

Items	Specification
Component Resistance($k\Omega$)	150 ~ 250 [20°C (68°F)]
Operating Voltage (V)	100 ~ 200

Fuel Pressure Regulator Valve

▷ Specification

Item	Specification
Coil Resistance (Ω)	2.6 ~ 3.15 [20°C (68°F)]
Operating Current (A)	0 ~ 1.8

Rail Pressure Regulator Valve

▷ Specification

Items	Specification
Coil Resistance (Ω)	3.42 ~ 4.4 [20°C (68°F)]
Operating Current (A)	0 ~ 1.7

Electric EGR Control Valve

▷ Type: Linear solenoid type

▷ Specification

Item	Specification
Coil Resistance (Ω)	7.3 ~ 8.3 [20°C (68°F)]

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Fuel System

Variable Swirl Control Actuator

- ▷ Type: Motor driven (including Position Sensor)
- ▷ Specification

[Motor]

Item	Specification
Coil Resistance (Ω)	3.4 ~ 4.4 [20°C (68°F)]

[Position Sensor]

Item	Specification
Coil Resistance ($k\Omega$)	3.01 ~ 5.59 [20°C (68°F)]

Electric VGT Control Actuator

- ▷ Type: DC motor driven

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



General Information

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Service Standard

Items	Specification		
Basic Idle rpm (After warm up)	A/CON OFF	Neutral,N,P-range	680 ± 100rpm
		D-range	680 ± 100rpm
	A/CON ON	Neutral,N,P-range	680 ± 100rpm
		D-range	680 ± 100rpm

Tightening Torques

Engine Control System

Item	Kgf.m	N.m	lb-ft
ECM installation bolts	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
ECM bracket installation bolts/nuts	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Mass air flow sensor clamp installation screw	0.3 ~ 0.5	2.9 ~ 4.9	2.2 ~ 3.6
Mass air flow sensor installation bolts	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Boost pressure sensor installation bolts	0.7 ~ 1.1	6.9 ~ 10.8	5.1 ~ 8.0
Engine coolant temperature sensor installation	4.0 ~ 5.5	39.2 ~ 54.0	28.9 ~ 39.8
Camshaft position sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Crankshaft position sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Lambda sensor installation	4.0 ~ 6.0	39.2 ~ 58.9	28.9 ~ 43.4
Electric EGR control valve installation bolts (Valve ↔ EGR Cooler)	2.0 ~ 2.7	19.6 ~ 26.5	14.5 ~ 19.5
Electric EGR control valve installation nuts (Valve ↔ EGR Pipe)	3.0 ~ 3.5	29.4 ~ 34.3	21.7 ~ 25.3
Variable swirl control actuator installation bolts	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Variable swirl control actuator bracket installation bolts	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Glow control module installation bolts	0.9 ~ 1.4	8.8 ~ 13.7	6.5 ~ 10.1
Glow plug installation	0.8 ~ 1.1	7.8 ~ 10.8	5.8 ~ 8.0

Fuel Delivery System

Item	Kgf.m	N.m	lb-ft
Fuel tank band installation nuts	5.0 ~ 6.0	49.1 ~ 58.9	36.2 ~ 43.4
Accelerator pedal module installation nuts	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Fuel pump installation bolts	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Injector clamp installation bolt	2.5 ~ 2.7	24.5 ~ 26.5	18.1 ~ 19.5
High pressure fuel pump installation bolts	2.5 ~ 3.5	24.5 ~ 34.3	18.1 ~ 25.3
Common rail [Bank 1] installation bolts	2.0 ~ 2.7	19.6 ~ 26.5	14.5 ~ 19.5
Common rail [Bank 2] installation bolts	2.0 ~ 2.7	19.6 ~ 26.5	14.5 ~ 19.5
High pressure fuel pipe installation nut (High pressure fuel pump ↔ Common Rail)	2.5 ~ 2.9	24.5 ~ 28.4	18.1 ~ 21.0
High pressure fuel pipe installation nut (Common Rail ↔ Injector)	2.5 ~ 2.9	24.5 ~ 28.4	18.1 ~ 21.0

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Fuel System

Item	Kgf.m	N.m	lb-ft
High pressure fuel pipe installation nut (Common Rail [Bank 1] ↔ Common Rail [Bank 2])	2.5 ~ 2.9	24.5 ~ 28.4	18.1 ~ 21.0
High pressure fuel pipe clamp installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

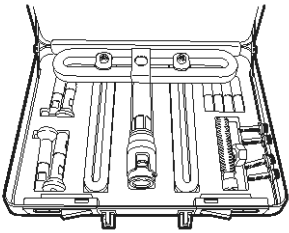
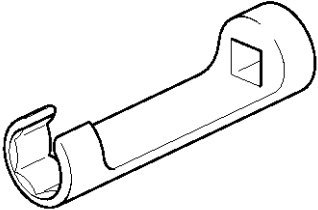
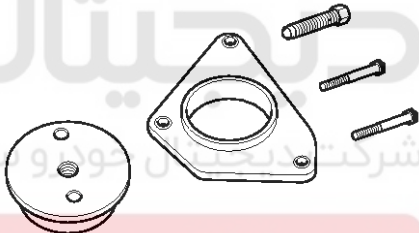
اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



General Information

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Special Service Tools



Tool (Number and name)	Illustration	Application
09351-4A300 Injector Remover	 SVQFL6499D	Removing the injector
09314-3A000 Torque Wrench Socket (17mm)	 AFAF201B	Installing the high pressure fuel pipe
09331-3A000 High Pressure Fuel Pump Remover	 SENFL7100D	Removing the high pressure fuel pump

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Fuel System

Basic Troubleshooting

Basic Troubleshooting Guide

1	Bring Vehicle to Workshop
2	Analyze Customer's Problem <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Connect Hi-Scan (Pro) to Diagnostic Link Connector (DLC). Record the DTC and freeze frame data. <p> NOTE To erase DTC and freeze frame data, refer to Step 5.</p>
4	Confirm the Inspection Procedure for the System or Part <ul style="list-style-type: none"> 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 <p> WARNING NEVER erase DTC and freeze frame data before completing Step 2 MIL/DTC in "CUSTOMER PROBLEM ANALYSIS SHEET".</p>
6	Inspect Vehicle Visually <ul style="list-style-type: none"> Go to Step 11, if you recognize the problem.
7	Recreate (Simulate) Symptoms of the DTC <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Try to recreate or simulate the condition of the malfunction as described by the customer.
10	Check the DTC <ul style="list-style-type: none"> If DTC(s) does(do) not occur, refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE. If DTC(s) occur(s), go to Step 11.
11	Perform troubleshooting procedure for DTC
12	Adjust or repair the vehicle
13	Confirmation test
14	END

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General Information

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Customer Problem Analysis Sheet

1. VEHICLE INFORMATION

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

2. SYMPTOMS

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

3. ENVIRONMENT

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

4. MIL/DTC

MIL (Malfunction Indicator Lamp)		<input type="checkbox"/> Remains ON <input type="checkbox"/> Sometimes lights up <input type="checkbox"/> Does not light
DTC	Normal check (Pre-check)	<input type="checkbox"/> Normal <input type="checkbox"/> DTC (_____) <input type="checkbox"/> Freeze Frame Data
	Check mode	<input type="checkbox"/> Normal <input type="checkbox"/> DTC (_____) <input type="checkbox"/> Freeze Frame Data

5. ECM/PCM INFORMATION

ECM/PCM Part No.	
ROM ID	

SFDF28233L

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Fuel System

Basic Inspection Procedure

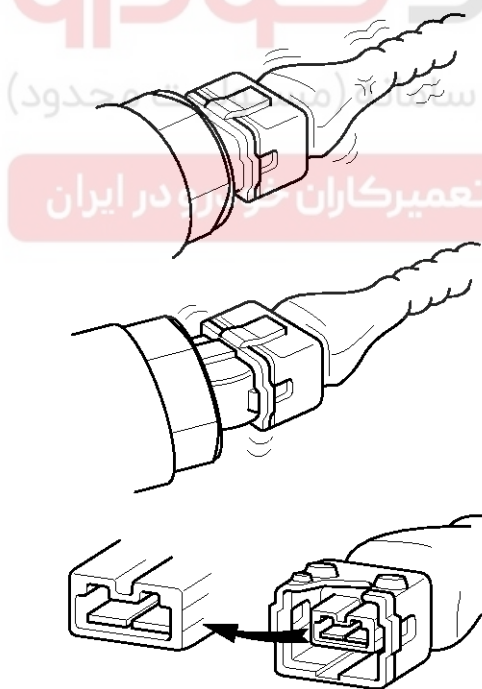
The measured resistance at high temperature after vehicle running may be high or low. So all resistance must be measured at ambient temperature (20°C, 68°F), unless stated otherwise.

NOTICE

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

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.



BFG321A

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.).

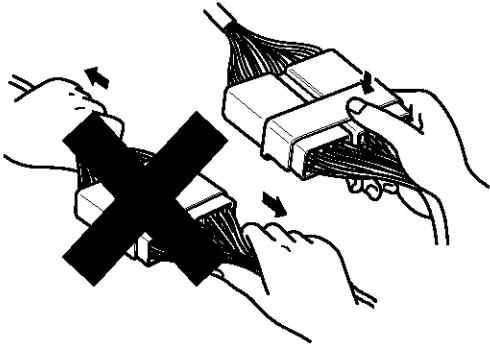
General Information

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Connector Inspection Procedure

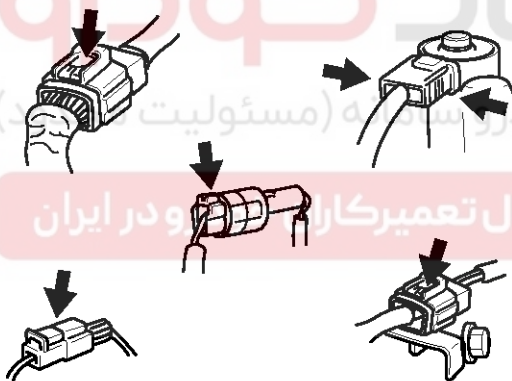
1. Handling of Connector

- a. Never pull on the wiring harness when disconnecting connectors.



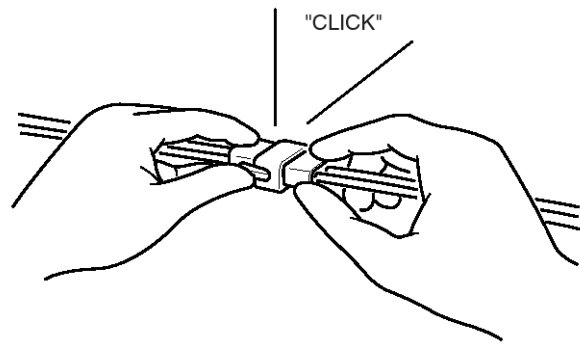
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- b. When removing the connector with a lock, press or pull locking lever.



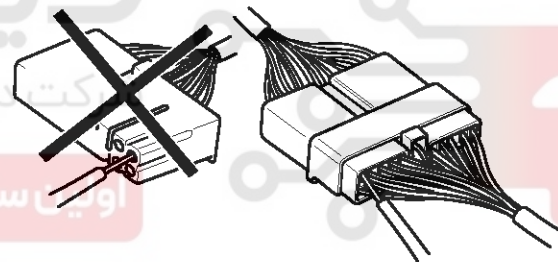
BFGE015G

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



BFGE015H

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

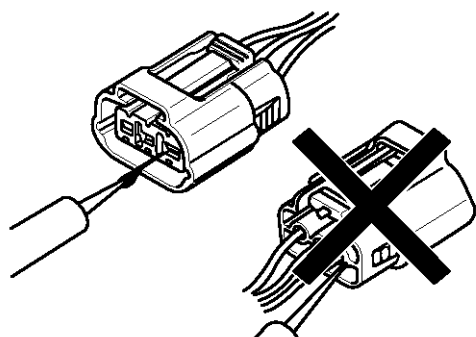


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Fuel System

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



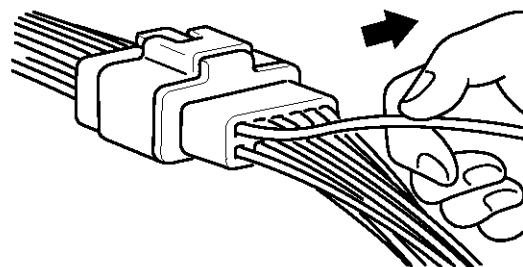
BFGE015J

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

- While the connector is connected:
Hold the connector, check connecting condition and locking efficiency.
- 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.
- Check terminal tightening condition:
Insert a spare male terminal into a female terminal, and then check terminal tightening conditions.
- Pull lightly on individual wires to ensure that each wire is secured in the terminal.



BFGE015K

3. Repair Method of Connector Terminal

- 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.

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

Wire Harness Inspection Procedure

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

General Information

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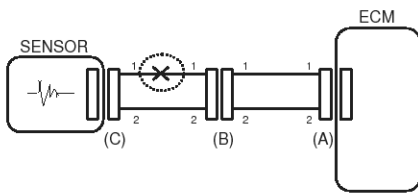
Electrical Circuit Inspection Procedure

1. Procedures for Open Circuit

- Continuity Check
- Voltage Check

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

FIG 1



BFGE501A

2. Continuity Check Method

NOTICE

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

Specification (Resistance)

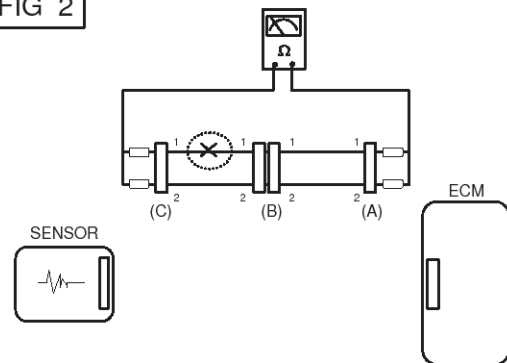
1Ω or less → Normal Circuit

1MΩ or Higher → Open Circuit

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

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

FIG 2

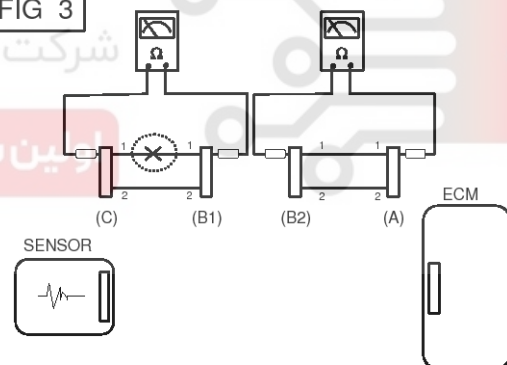


BFGE501B

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

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

FIG 3



BFGE501C

3. Voltage Check Method

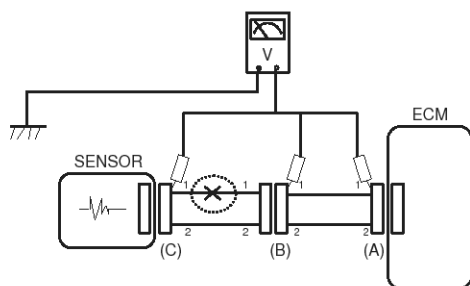
- With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

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

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Fuel System

FIG 4



BFGE501D

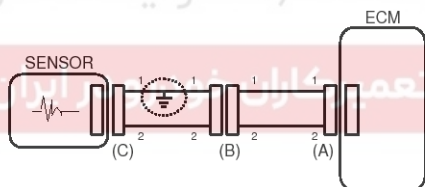
● Check Short Circuit

1. Test Method for Short to Ground Circuit

- Continuity Check with Chassis Ground

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

FIG 5



BFGE501E

2. Continuity Check Method (with Chassis Ground)

NOTICE

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

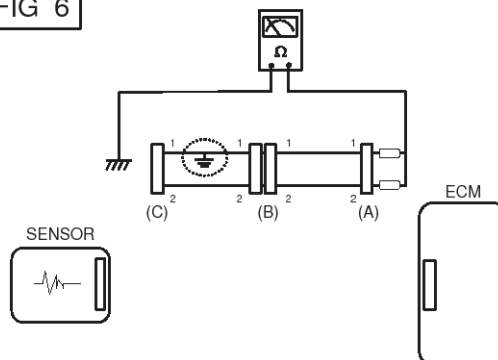
Specification (Resistance)

1Ω or less → Short to Ground Circuit

1MΩ or Higher → Normal Circuit

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

FIG 6

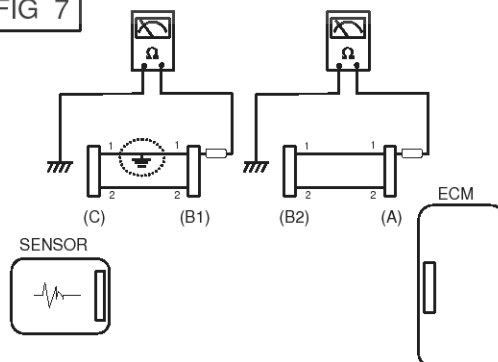


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- Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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

General Information

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Symptom Troubleshooting Guide Table

(Symptom 1) Engine Does Not Start

Possible Cause	
<ul style="list-style-type: none"> • Run out of fuel • Faulty starter • Not connected fuel feed line • Leakage in high pressure fuel circuit • Fuse out of order • Drift of the rail pressure sensor • Cam and crank signals missing simultaneously • Low battery voltage • Faulty immobilizer • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Bad fuel quality or water ingress in fuel 	<ul style="list-style-type: none"> • Inversion of fuel connections (feed & return) • Faulty fuel filter • Clogged low pressure fuel circuit • Clogged fuel filter • Intermittent faulty fuel line connection • Air ingress in the low pressure fuel circuit • Clogged return line of high pressure fuel pump • Low compression pressure • Leakage at the injector • Faulty low pressure fuel pump • Faulty high pressure fuel pump • Injector jammed open • ECM program error or hardware fault • Faulty glow system

(Symptom 2) Engine Starts With Difficulty Or Starts And Stalls

Possible Cause	
<ul style="list-style-type: none"> • Not connected fuel return line at injector • Leakage in high pressure fuel circuit • Fuse out of order • Clogged air filter • Faulty alternator or voltage regulator • Compensation of individual injector not adapted • No engine coolant temperature sensor signal • No rail pressure sensor signal • Low battery voltage • Electric EGR control valve blocked open • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Bad fuel quality or water ingress in fuel • Inversion of fuel connections (feed & return) 	<ul style="list-style-type: none"> • Clogged low pressure fuel circuit • Clogged fuel filter • Oil level too high or too low • Sealed or damaged catalytic converter • Intermittent faulty fuel line connection • Air ingress in the low pressure fuel circuit • Clogged return line of high pressure fuel pump • Faulty glow system • Low compression pressure • Clogged injector return line • Carbon deposit on the injector (sealed holes) • Injector needle stuck (injection possible over a certain pressure) • Gasoline in fuel • ECM program error or hardware fault

FL-18

Fuel System

(Symptom 3) Poor Starting When Hot

Possible Cause	
<ul style="list-style-type: none"> • Compensation of individual injector not adapted • No rail pressure sensor signal • Electric EGR control valve blocked open • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Clogged air filter • Air ingress in the low pressure fuel circuit • Bad fuel quality or water ingress in fuel 	<ul style="list-style-type: none"> • Clogged return line of high pressure fuel pump • Clogged fuel filter • Low compression pressure • Intermittent faulty fuel line connection • Carbon deposit on the injector (sealed holes) • Injector needle stuck (injection possible over a certain pressure) • Gasoline in fuel • ECM program error or hardware fault

(Symptom 4) Unstable Idling

Possible Cause	
<ul style="list-style-type: none"> • Not connected fuel return line at injector • Compensation of individual injector not adapted • No rail pressure sensor signal • Wiring harness open or poor connection • Air ingress in the low pressure fuel circuit • Bad fuel quality or water ingress in fuel • Clogged fuel filter • Clogged air filter • Clogged injector return line • Leakage in high pressure fuel circuit 	<ul style="list-style-type: none"> • Faulty glow system • Low compression pressure • Poor tightening of injector clamp • Faulty high pressure fuel pump • Injector not adapted • Carbon deposit on the injector (sealed holes) • Injector needle stuck (injection possible over a certain pressure) • Injector jammed open • Electric EGR control valve blocked open

(Symptom 5) Idle Speed Too High Or Too Low

Possible Cause	
<ul style="list-style-type: none"> • No engine coolant temperature sensor signal • Incorrect state of the electrical pack devices • Faulty alternator or voltage regulator • ECM program error or hardware fault 	<ul style="list-style-type: none"> • Electric EGR control valve blocked open • Faulty accelerator pedal (At this time, engine speed has been fixed at 1,250rpm)

General Information

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(Symptom 6) Blue, White, Or Black Smokes

Possible Cause	
<ul style="list-style-type: none"> • Compensation of individual injector not adapted • No engine coolant temperature sensor signal • No rail pressure sensor signal • Electric EGR control valve blocked open • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Oil level too high or too low • Bad fuel quality or water ingress in fuel • Sealed or damaged catalytic converter 	<ul style="list-style-type: none"> • Clogged air filter • Oil suction (engine racing) • Faulty glow system • Low compression pressure • Poor tightening of injector clamp • Poor injector O-ring, no O-ring or two O-ring installed • Injector not adapted • Carbon deposit on the injector (sealed holes) • Injector jammed open • Gasoline in fuel

(Symptom 7) Engine Rattling, Noisy Engine

Possible Cause	
<ul style="list-style-type: none"> • Compensation of individual injector not adapted • Electric EGR control valve blocked open • Electric EGR control valve blocked open • No engine coolant temperature sensor signal • Faulty glow system • Low compression pressure • Clogged injector return line • No rail pressure sensor signal 	<ul style="list-style-type: none"> • Poor injector O-ring, no O-ring or two O-ring installed • Injector not adapted • Carbon deposit on the injector (sealed holes) • Injector needle stuck (injection possible over a certain pressure) • Injector jammed open • No engine coolant temperature sensor signal

(Symptom 8) Nurst Noise

Possible Cause	
<ul style="list-style-type: none"> • Compensation of individual injector not adapted • Intermittent faulty fuel line connection • Clogged exhaust system • No rail pressure sensor signal 	<ul style="list-style-type: none"> • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • ECM program error or hardware fault

(Symptom 9) Untimely Acceleration/deceleration And Engine Racing

Possible Cause	
<ul style="list-style-type: none"> • Blocked accelerator pedal position sensor • Electric EGR control valve blocked open • Intermittent faulty fuel line connection 	<ul style="list-style-type: none"> • Oil suction (engine racing) • No rail pressure sensor signal • ECM program error or hardware fault

FL-20

Fuel System

(Symptom 10) Gap When Accelerating And At Re-coupling (Response Time)

Possible Cause	
<ul style="list-style-type: none"> Leakage in intake system Incorrect state of the electrical pack devices Blocked accelerator pedal position sensor Electric EGR control valve blocked open Damaged turbocharger or leakage in vacuum line Clogged fuel filter Low compression pressure Leakage in high pressure fuel circuit 	<ul style="list-style-type: none"> Fuel pressure regulator valve contaminated, stuck, jammed Rail pressure regulator valve contaminated, stuck, jammed Injector needle stuck (injection possible over a certain pressure) ECM program error or hardware fault

(Symptom 11) Engine Stop

Possible Cause	
<ul style="list-style-type: none"> Run out of fuel Not connected fuel feed line Leakage in high pressure fuel circuit Fuse out of order Bad fuel quality or water ingress in fuel Clogged low pressure fuel circuit Clogged fuel filter Crank signals missing Electric EGR control valve blocked open Fuel pressure regulator valve contaminated, stuck, jammed 	<ul style="list-style-type: none"> Rail pressure regulator valve contaminated, stuck, jammed Faulty alternator or voltage regulator Intermittent faulty fuel line connection Sealed or damaged catalytic converter Faulty low pressure fuel pump Faulty high pressure fuel pump Gasoline in fuel ECM program error or hardware fault

(Symptom 12) Engine Judder

Possible Cause	
<ul style="list-style-type: none"> Run out of fuel Not connected fuel return line at injector Incorrect state of the electrical pack devices Compensation of individual injector not adapted Electric EGR control valve blocked open Faulty fuel filter Air ingress in the low pressure fuel circuit Bad fuel quality or water ingress in fuel Clogged fuel filter Intermittent faulty fuel line connection Wiring harness open or poor connection Faulty glow system 	<ul style="list-style-type: none"> Low compression pressure Clogged injector return line Poor valve clearance Faulty low pressure fuel pump Poor injector O-ring, no O-ring or two O-ring installed Carbon deposit on the injector (sealed holes) Injector needle stuck (injection possible over a certain pressure) Injector jammed open Gasoline in fuel ECM program error or hardware fault

General Information

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(Symptom 13) Lack Of Power

Possible Cause	
<ul style="list-style-type: none"> • Compensation of individual injector not adapted • Blocked accelerator pedal position sensor • Incorrect state of the electrical pack devices • Electric EGR control valve blocked open • Leakage in intake system • Clogged air filter • Oil level too high or too low • Sealed or damaged catalytic converter • Damaged turbocharger or leakage in vacuum line • Damaged turbocharger 	<ul style="list-style-type: none"> • Clogged fuel filter • Leakage at the injector • Clogged return line of high pressure fuel pump • Clogged injector return line • Low compression pressure • Injector not adapted • Carbon deposit on the injector (sealed holes) • Poor valve clearance • Engine coolant temperature too high • Fuel temperature too high

(Symptom 14) Too Much Power

Possible Cause	
<ul style="list-style-type: none"> • Compensation of individual injector not adapted • Oil suction (engine racing) 	<ul style="list-style-type: none"> • ECM program error or hardware fault

(Symptom 15) Excessive Fuel Consumption

Possible Cause	
<ul style="list-style-type: none"> • Not connected fuel return line at injector • Leakage at the Fuel pressure regulator valve • Leakage at fuel temperature sensor • Leakage in high pressure fuel circuit • Leakage in intake system • Clogged air filter • Compensation of individual injector not adapted • Electric EGR control valve blocked open 	<ul style="list-style-type: none"> • Incorrect state of the electrical pack devices • Oil level too high or too low • Bad fuel quality or water ingress in fuel • Sealed or damaged catalytic converter • Damaged turbocharger • Low compression pressure • Injector not adapted • ECM program error or hardware fault

(Symptom 16) Over Speed Engine When Changing The Gear Box Ratio

Possible Cause	
<ul style="list-style-type: none"> • Blocked accelerator pedal position sensor • Compensation of individual injector not adapted • Intermittent faulty fuel line connection • Clutch not well set (optional) 	<ul style="list-style-type: none"> • Oil suction (engine racing) • Damaged turbocharger • Injector not adapted • ECM program error or hardware fault

FL-22

Fuel System

(Symptom 17) Exhaust Smells

Possible Cause	
<ul style="list-style-type: none"> Leakage at electric EGR control valve Oil suction (engine racing) Damaged turbocharger Oil level too high or too low Compensation of individual injector not adapted Sealed or damaged catalytic converter Poor tightening of injector clamp 	<ul style="list-style-type: none"> Poor injector O-ring, no O-ring or two O-ring installed Injector not adapted Carbon deposit on the injector (sealed holes) Injector needle stuck (injection possible over a certain pressure) Injector jammed open ECM program error or hardware fault

(Symptom 18) Smokes (Black, White, Blue) When Accelerating

Possible Cause	
<ul style="list-style-type: none"> Compensation of individual injector not adapted Electric EGR control valve blocked open Clogged air filter Bad fuel quality or water ingress in fuel Oil level too high or too low Damaged turbocharger Sealed or damaged catalytic converter Oil suction (engine racing) Faulty air heater Low compression pressure Leakage in high pressure fuel circuit 	<ul style="list-style-type: none"> Intermittent faulty fuel line connection Poor tightening of injector clamp Poor injector O-ring, no O-ring or two O-ring installed Injector not adapted Carbon deposit on the injector (sealed holes) Injector needle stuck (injection possible over a certain pressure) Injector jammed open Gasoline in fuel ECM program error or hardware fault

(Symptom 19) Fuel Smells

Possible Cause	
<ul style="list-style-type: none"> Not connected fuel feed line Not connected fuel return line at injector Leakage at the Fuel pressure regulator valve 	<ul style="list-style-type: none"> Leakage at fuel temperature sensor Leakage in high pressure fuel circuit

(Symptom 20) The Engine Collapses At Take Off

Possible Cause	
<ul style="list-style-type: none"> Blocked accelerator pedal position sensor Incorrect state of the electrical pack devices Clogged air filter Inversion of fuel connections (feed & return) Faulty fuel filter Bad fuel quality or water ingress in fuel Air ingress in the low pressure fuel circuit Clogged fuel filter Sealed or damaged catalytic converter 	<ul style="list-style-type: none"> Intermittent faulty fuel line connection No rail pressure sensor signal Fuel pressure regulator valve contaminated, stuck, jammed Rail pressure regulator valve contaminated, stuck, jammed Gasoline in fuel ECM program error or hardware fault Faulty accelerator pedal position sensor

General Information

FL-23

(Symptom 21) Engine Does Not Stop

Possible Cause	
<ul style="list-style-type: none">Stuck or worn lubrication circuit of turbochargerToo much engine oil	<ul style="list-style-type: none">Leakage at vacuum hoseECM program error or hardware fault

(Symptom 22) Different Mechanical Noises

Possible Cause	
<ul style="list-style-type: none">Buzzer noise (discharge by the injectors)Broken clip (vibrations, resonance, noises)Incorrect state of the electrical pack devicesSealed or damaged catalytic converter	<ul style="list-style-type: none">Leakage in intake systemPoor tightening of injector clampDamaged turbochargerPoor valve clearance

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



FL-24

Fuel System

Actuation Test

Items	Test Condition
A/C COMPRESSOR RELAY	ACTUATION TEST/IG ON/ENGINE RUN
MIL (ENGINE CHECK)	ACTUATION TEST/IG ON/ENGINE RUN
AUXILIARY HEATER RELAY	ACTUATION TEST/IG ON/ENGINE RUN
FUEL PUMP RELAY	ACTUATION TEST/IG ON/ENGINE STOP
FAN-HIGH SPEED	ACTUATION TEST/IG ON/ENGINE STOP
FAN-LOW SPEED	ACTUATION TEST/IG ON/ENGINE STOP
GLOW LAMP	ACTUATION TEST/IG ON/ENGINE RUN
IMMOBILIZER LAMP	ACTUATION TEST/IG ON/ENGINE RUN
ELECTRIC VGT CONTROL ACTUATOR	ACTUATION TEST/IG ON/ENGINE STOP
ELECTRIC EGR CONTROL VALVE	ACTUATION TEST/IG ON/ENGINE STOP
FUEL PRESSURE REGULATOR VALVE(HP PUMP SIDE)	ACTUATION TEST/IG ON/ENGINE STOP
RAIL PRESSURE REGULATOR VALVE(COMMON RAIL SIDE)	ACTUATION TEST/IG ON/ENGINE STOP

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



Engine Control System

FL-25

Engine Control System

Description

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

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.
- 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.

Self-diagnosis

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.

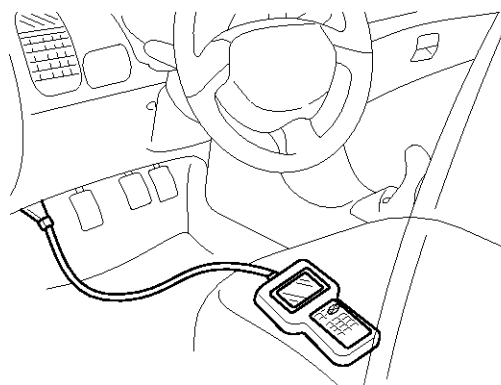
Checking Procedure (Self-diagnosis)

NOTICE

- When battery voltage is excessively low, diagnostic trouble codes can not be read. Be sure to check the battery for voltage and the charging system before starting the test
- Diagnosis memory is erased if the battery or the ECM connector is disconnected. Do not disconnect the battery before the diagnostic trouble codes are completely read and recorded.

Inspection Procedure (Using Generic Scan Tool)

1. Turn OFF the ignition switch.
2. Connect the scan tool to the data link connector on the lower crash pad.



AWJF300D

3. Turn ON the ignition switch.
4. Use the scan tool to check the diagnostic trouble code.
5. Repair the faulty part from the diagnosis chart.
6. Erase the diagnostic trouble code.
7. Disconnect the GST.

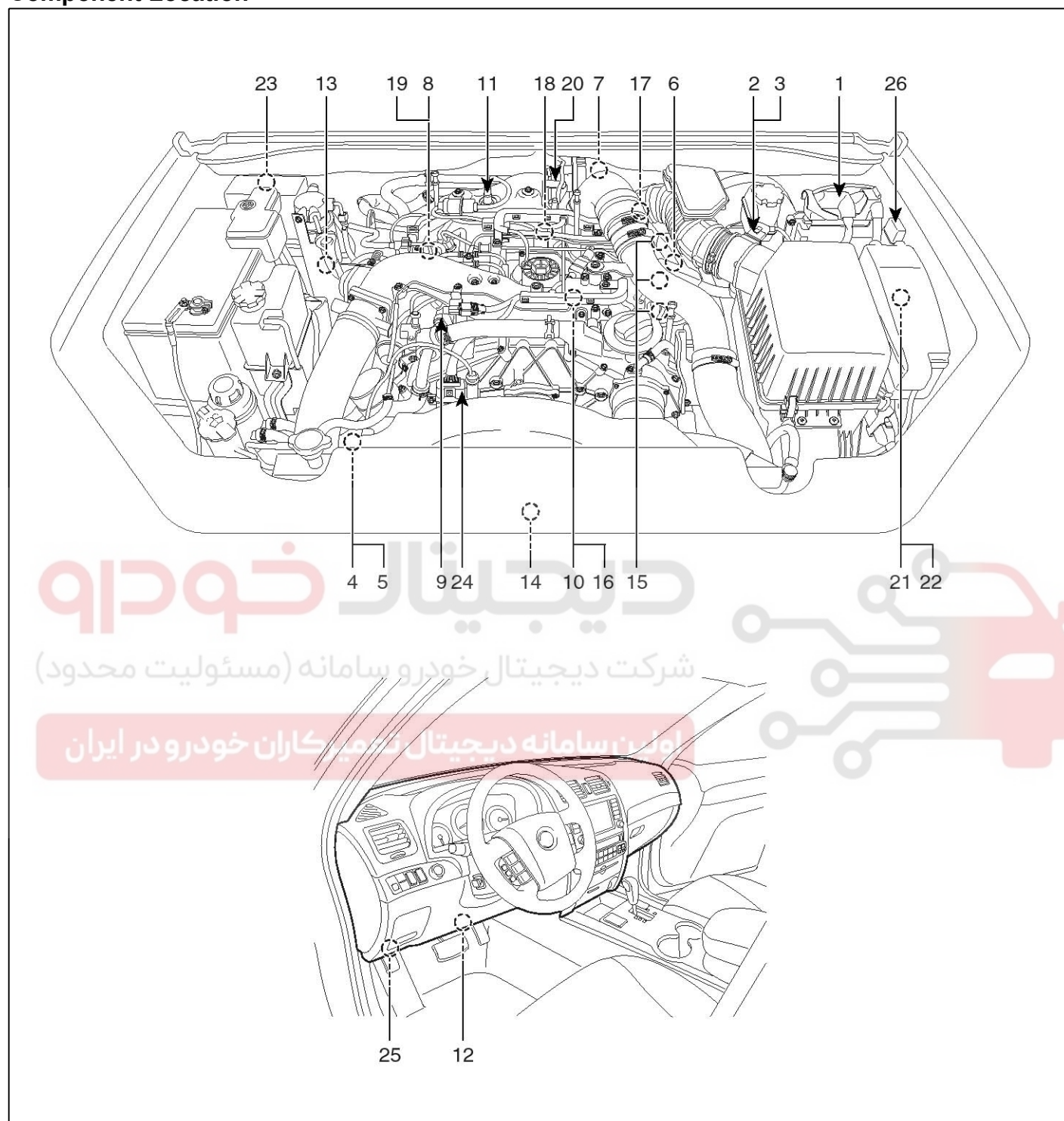
NOTICE

When deleting diagnostic trouble code, use scan tool as possible.

FL-26

Fuel System

Component Location



SHMFL8101D

Engine Control System

FL-27

- | | |
|---|--|
| 1. ECM (Engine Control Module) | 14. A/C Pressure Transducer (APT) |
| 2. Mass Air Flow Sensor (MAFS) | 15. Injector |
| 3. Intake Air Temperature Sensor (IATS) #1 | 16. Fuel Pressure Regulator Valve (FPRV) |
| 4. Boost Pressure Sensor (BPS) | 17. Rail Pressure Regulator Valve (RPRV) |
| 5. Intake Air Temperature Sensor (IATS) #2 | 18. Variable Swirl Actuator (VSA) |
| 6. Engine Coolant Temperature Sensor (ECTS) | 19. Electric EGR Control Valve (EEGR) |
| 7. Crankshaft Position Sensor (CKPS) | 20. Electric VGT Control Actuator |
| 8. Camshaft Position Sensor (CMPS) | 21. Main Relay |
| 9. Rail Pressure Sensor (RPS) | 22. Fuel Pump Relay |
| 10. Fuel Temperature Sensor (FTS) | 23. PTC Heater Relay |
| 11. Lambda Sensor | 24. Glow Control Module |
| 12. Accelerator Pedal Position Sensor (APS) | 25. Data Link Connector (DLC) |
| 13. Water Sensor | 26. Multi-Purpose Check Connector |

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

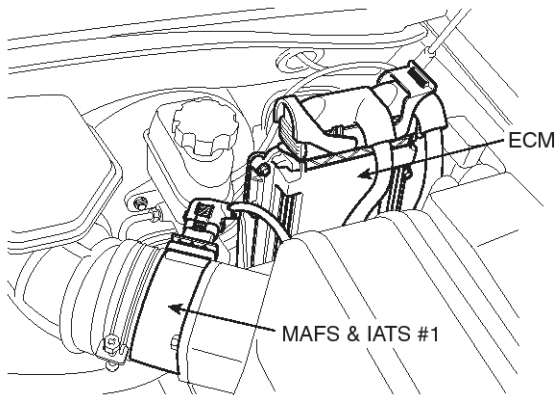
اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



FL-28

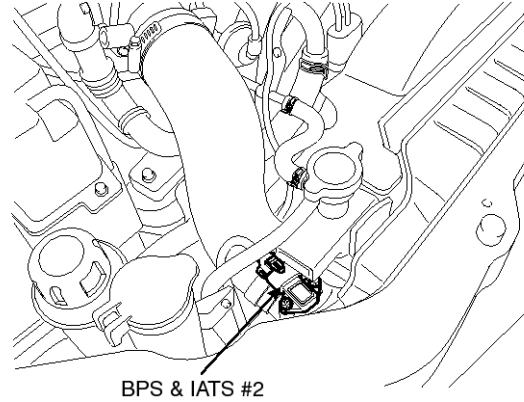
Fuel System

1. ECM (Engine Control Module)
2. Mass Air Flow Sensor (MAFS)
3. Intake Air Temperature Sensor (IATS) #1



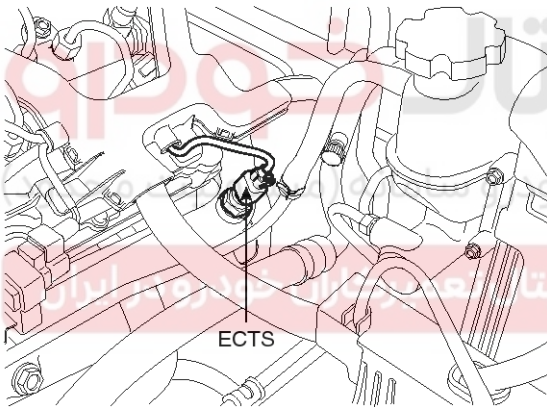
SHMFL8102D

4. Boost Pressure Sensor (BPS)
5. Intake Air Temperature Sensor (IATS) #2



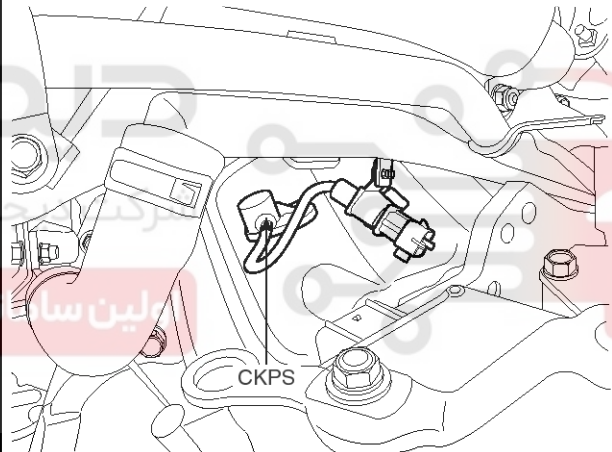
SHMF29157L

6. Engine Coolant Temperature Sensor (ECTS)



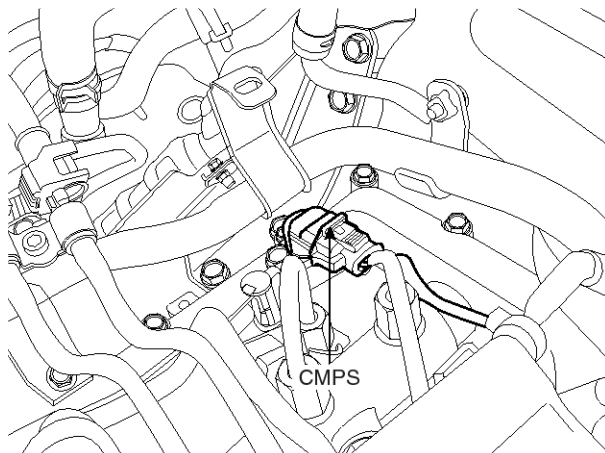
SHMFL8103D

7. Crankshaft Position Sensor (CKPS)



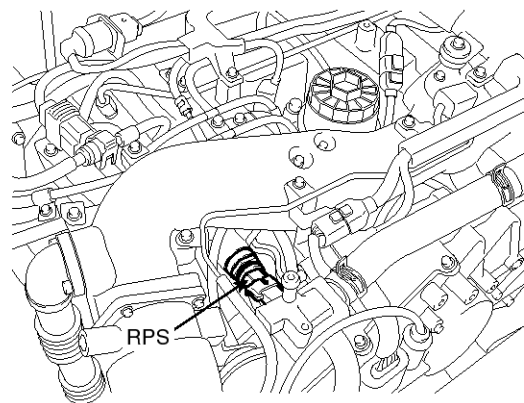
SENFL7106D

8. Camshaft Position Sensor (CMPS)



SENFL7107D

9. Rail Pressure Sensor (RPS)

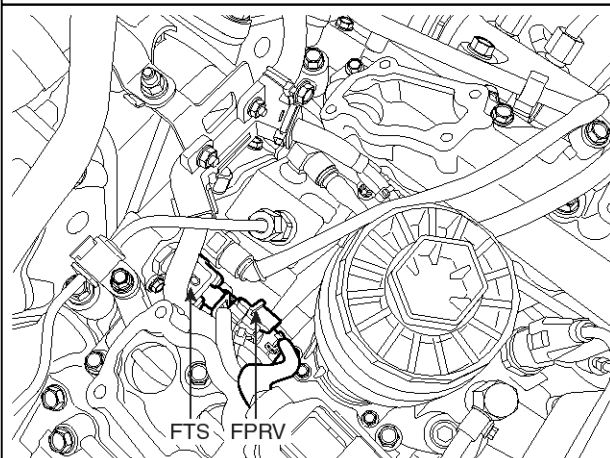


SHMFL8104D

Engine Control System

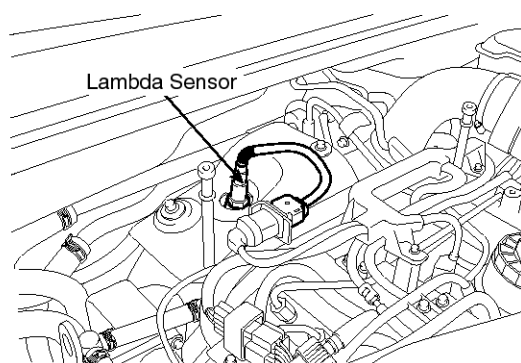
FL-29

10. Fuel Temperature Sensor (FTS)
16. Fuel Pressure Regulator Valve (FPRV)



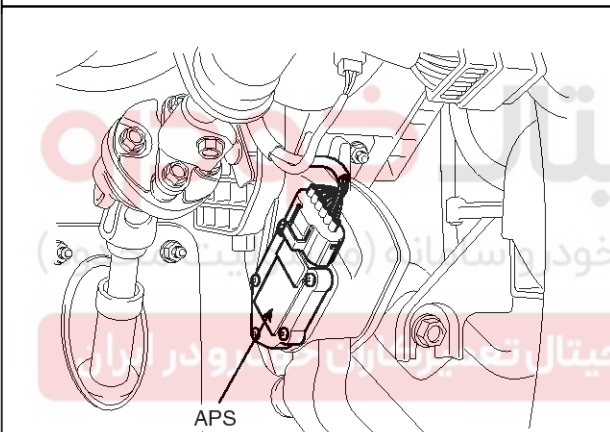
SHMF29100L

11. Lambda Sensor



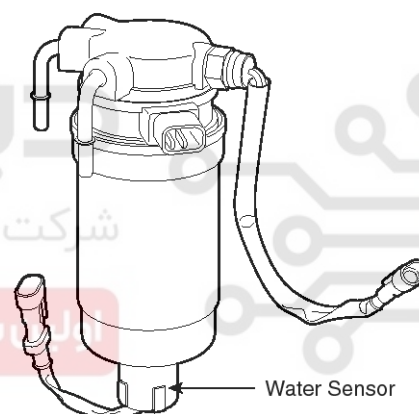
SHMF29101L

12. Accelerator Pedal Position Sensor (APS)



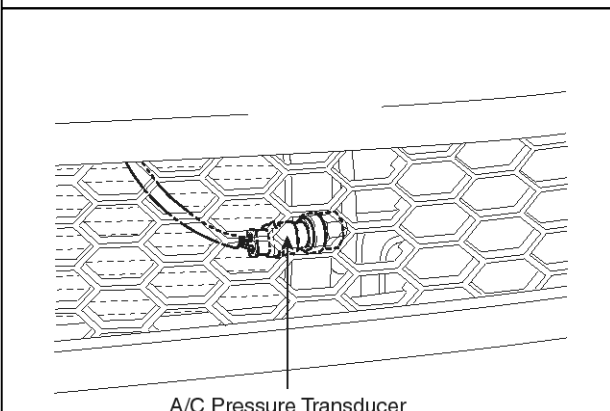
SHMFL8106D

13. Water Sensor



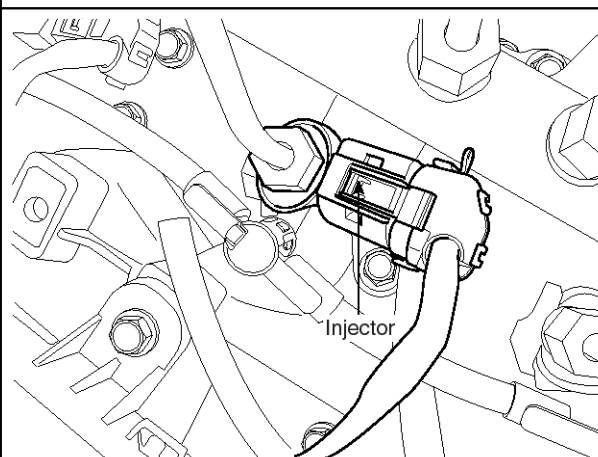
SHMF29102L

14. A/C Pressure Transducer (APT)



SHMF29103L

15. Injector

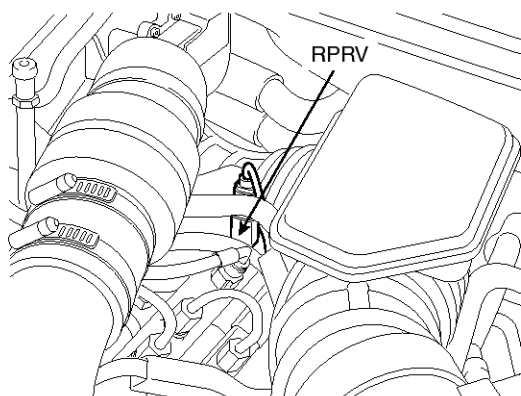


SHMF29104L

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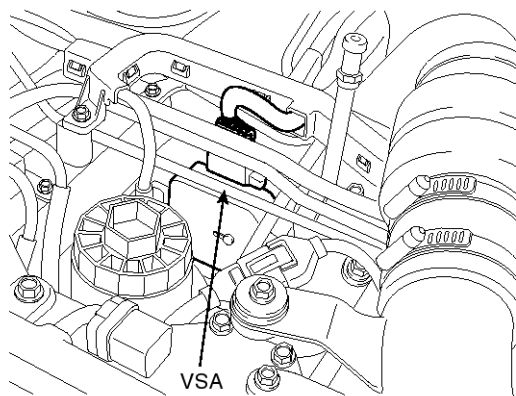
Fuel System

17. Rail Pressure Regulator Valve (RPRV)



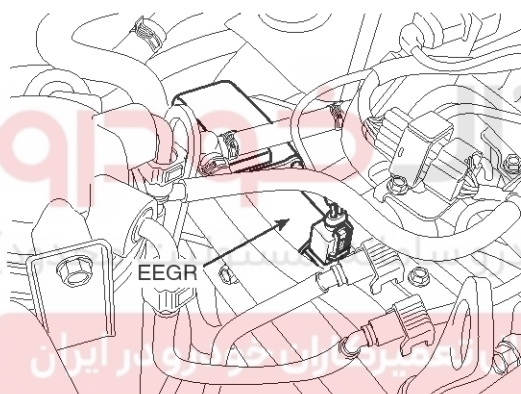
SHMF29105L

18. Variable Swirl Actuator (VSA)



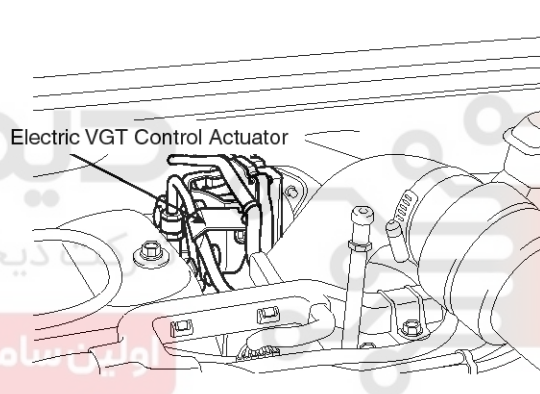
SHMF29106L

19. Electric EGR Control Valve (EEGR)



SHMFL8111D

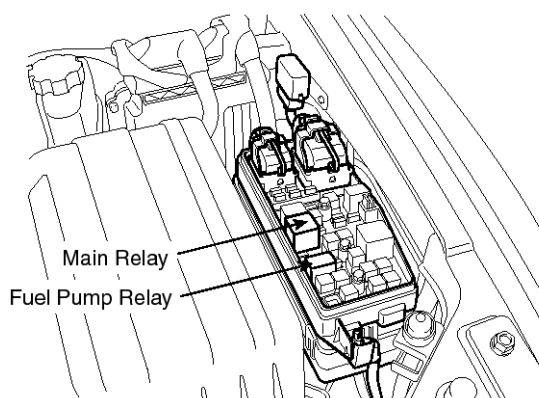
20. Electric VGT Control Actuator



SHMF29107L

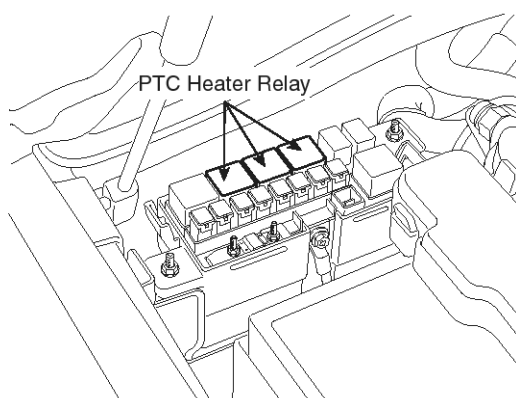
21. Main Relay

22. Fuel Pump Relay



SHMF29108L

23. PTC Heater Relay



SHMF29109L

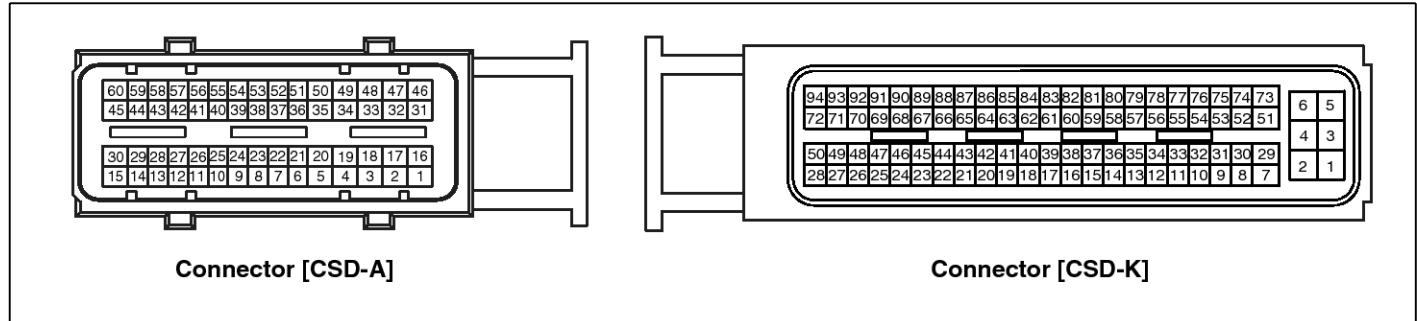
Engine Control System

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Engine Control Module (ECM)

Engine Control Module (ECM)

1. ECM Harness Connector



SHMF29110L

2. ECM Terminal Function

Connector [CSD-A]

Pin	Description	Connected to
1	Injector (Cylinder #2) [Low] control output	Injector (Cylinder #2)
2	Injector (Cylinder #4) [Low] control output	Injector (Cylinder #4)
3	Injector (Cylinder #6) [Low] control output	Injector (Cylinder #6)
4	Fuel Pressure Regulator Valve control output	Fuel Pressure Regulator Valve
5	Rail Pressure Regulator Valve control output	Fuel Pressure Regulator Valve
6	-	
7	Intake Air Temperature Sensor (IATS) #2 signal input	Boost Pressure Sensor (BPS)
8	-	
9	-	
10	Fuel Temperature Sensor (FTS) signal input	Fuel Temperature Sensor(FTS)
11	-	
12	-	
13	-	
14	-	
15	-	
16	Injector (Cylinder #2) [High] control output	Injector (Cylinder #2)
17	Injector (Cylinder #4) [High] control output	Injector (Cylinder #4)
18	Injector (Cylinder #6) [High] control output	Injector (Cylinder #6)
19	-	
20	Electric VGT Control Actuator control output	Electric VGT Control Actuator
21	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
22	Engine Coolant Temperature Sensor(ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)

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Fuel System

Pin	Description	Connected to
23	Sensor ground	Position Sensor (Variable Swirl Control Actuator)
24	-	
25	-	
26	Sensor power (+5V)	Boost Pressure Sensor (BPS)
27	Sensor power (+5V)	Rail Pressure Sensor (RPS)
28	Camshaft Position Sensor(CMPS) signal input	Camshaft Position Sensor (CMPS)
29	Sensor ground	Camshaft Position Sensor (CMPS)
30	-	
31	Injector (Cylinder #1) [High] control output	Injector (Cylinder #1)
32	Injector (Cylinder #3) [High] control output	Injector (Cylinder #3)
33	Injector (Cylinder #5) [High] control output	Injector (Cylinder #5)
34	-	
35	-	
36	-	
37	-	
38	-	
39	Sensor ground	Fuel Temperature Sensor(FTS)
40	Rail Pressure Sensor(RPS) signal input	Rail Pressure Sensor (RPS)
41	Boost Pressure Sensor(BPS) signal input	Boost Pressure Sensor (BPS)
42	-	
43	Crankshaft Position Sensor (CKPS) [-] signal input	Crankshaft Position Sensor (CKPS)
44	-	
45	-	
46	Injector (Cylinder #1) [Low] control output	Injector (Cylinder #1)
47	Injector (Cylinder #3) [Low] control output	Injector (Cylinder #3)
48	Injector (Cylinder #5) [Low] control output	Injector (Cylinder #5)
49	Motor [+] control output	Variable Swirl Control Actuator
50	Motor [-] control output	Variable Swirl Control Actuator
51	Sensor power (+5V)	Position Sensor (Variable Swirl Control Actuator)
52	Position Sensor signal input	Position Sensor (Variable Swirl Control Actuator)
53	-	
54	Sensor power (+5V)	Camshaft Position Sensor (CMPS)
55	Sensor ground	Rail Pressure Sensor (RPS)
56	Sensor ground	Boost Pressure Sensor (BPS)
57	Sensor shield	Crankshaft Position Sensor (CKPS)

Engine Control System

FL-33

Pin	Description	Connected to
58	Crankshaft Position Sensor (CKPS) [+] signal input	Crankshaft Position Sensor (CKPS)
59	-	
60	Electric EGR Control Valve control output	Electric EGR Control Valve

Connector [CSD-K]

Pin	Description	Connected to
1	Power ground	Chassis ground
2	Power ground	Chassis ground
3	Battery power	Main Relay
4	Power ground	Chassis ground
5	Battery power	Main Relay
6	Battery power	Main Relay
7	-	
8	ESP/ABS Auto Recognition signal input	ESP: Ground, ABS: Open
9	-	
10	VS-/IP- (Virtual Ground)	Lambda Sensor
11	VS+ (NERNST Cell Voltage)	Lambda Sensor
12	-	
13	-	
14	-	
15	Sensor power (+5V)	A/C Pressure Transducer (APT)
16	-	
17	-	
18	Battery power	Ignition Switch
19	-	
20	-	
21	-	
22	-	
23	-	
24	-	
25	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
26	-	
27	-	
28	-	
29	PTC Heater Relay control output	PTC Heater Relay
30	-	

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Fuel System

Pin	Description	Connected to
31	-	
32	Rc/Rp (Pumping Cell Voltage)	Lambda Sensor
33	Immobilizer Communication Line	Immobilizer Control Module
34	-	
35	CAN [Low]	Other Control Modules
36	CAN [High]	Other Control Modules
37	-	
38	Intake Air Temperature Sensor (IATS) #1 signal input	Mass Air Flow Sensor(MAFS)
39	-	
40	Sensor Power (+5V)	Cruise Control Switch
41	-	
42	Water Sensor signal input	Water Sensor (in Fuel Filter)
43	Brake Switch 2 signal input	Brake Switch
44	Brake Switch 1 signal input	Brake Switch
45	Ground	Immobilizer Control Module
46	-	
47	Engine speed signal output	Tachometer (Cluster)
48	A/C Compressor Relay control output	A/C Compressor Relay
49	Main Relay control output	Main Relay
50	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
51	Lambda Sensor Heater control output	Lambda Sensor
52	-	
53	-	
54	Rc (Compensative Resistance)	Lambda Sensor
55	-	
56	-	
57	Accelerator Position Sensor (APS) #1 signal input	Accelerator Position Sensor (APS) #1
58	Accelerator Position Sensor (APS) #2 signal input	Accelerator Position Sensor (APS) #2
59	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)
60	Sensor power (+5V)	Accelerator Position Sensor (APS) #2
61	-	
62	-	
63	-	
64	A/C Switch "ON" signal input	A/C Switch
65	A/C Pressure Switch signal input	A/C Pressure Switch

Engine Control System






FL-35

Pin	Description	Connected to
66	-	
67	-	
68	Fuel Pump Relay control output	Fuel Pump Relay
69	Immobilizer Lamp control output	Immobilizer Lamp (Cluster)
70	-	
71	Glow Time Lamp control output	Glow Time Lamp (Cluster)
72	Diagnosis Data Line (K-Line)	Data Link Connector (DLC), Multi-Purpose Connector
73	Accelerator Position Sensor signal output	EPS Control Module
74	Mass Air Flow Sensor(MAFS) signal input	Mass Air Flow Sensor(MAFS)
75	Reference Frequency	Mass Air Flow Sensor(MAFS)
76	-	
77	-	
78	-	
79	Sensor ground	Accelerator Position Sensor (APS) #1
80	Sensor ground	Accelerator Position Sensor (APS) #2
81	Sensor ground	Mass Air Flow Sensor(MAFS)
82	Sensor power (+5V)	Accelerator Position Sensor (APS) #1
83	-	
84	Sensor ground	A/C Pressure Transducer (APT)
85	Thermo Switch signal input	A/C Switch
86	-	
87	-	
88	-	
89	-	
90	Feedback signal input	Electric VGT Control Actuator
91	Malfunction Indicator Lamp (MIL) control output	Malfunction Indicator Lamp (MIL)
92	-	
93	Cruise Control "ACTIVATOR" signal input	Cruise Control Switch
94	Ground	Cruise Control Switch

FL-36

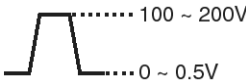
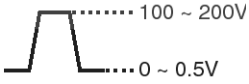

Fuel System

3. ECM Terminal Input/output Signal
Connector [CSD-A]

Pin	Description	Condition	Type	Level
1	Injector (Cylinder #2) [Low] control output	Engine Run	DC	 100 ~ 200V 0 ~ 0.5V
2	Injector (Cylinder #4) [Low] control output			
3	Injector (Cylinder #6) [Low] control output			
4	Fuel Pressure Regulator Valve control output	Engine Run	PWM (120~200 Hz)	 Vbat 0 ~ 0.5V
5	Rail Pressure Regulator Valve control output	Engine Run	PWM (1kHz)	 Vbat 0 ~ 0.5V
6	-			
7	Intake Air Temperature Sensor (IATS) #2 signal input	Idle	Analog	0.5 ~ 4.5V
8	-			
9	-			
10	Fuel Temperature Sensor (FTS) signal input	IG ON	Analog	0.5 ~ 4.5V
11	-			
12	-			
13	-			
14	-			
15	-			
16	Injector (Cylinder #2) [High] control output	Engine Run	DC	 100 ~ 200V 0 ~ 0.5V
17	Injector (Cylinder #4) [High] control output			
18	Injector (Cylinder #6) [High] control output			
19	-			
20	Electric VGT Control Actuator control output	IG ON	PWM (250Hz)	 Vbat 0 ~ 0.5V · Engine running duty: 20~80% · Idle duty: 80% · W.O.T duty: 50%
21	Sensor ground	Always	DC	0 ~ 0.5V
22	Engine Coolant Temperature Sensor(ECTS) signal input	Idle	Analog	0.5 ~ 4.5V
23	Sensor ground	Always	DC	0 ~ 0.5V
24	-			
25	-			
26	Sensor power (+5V)	IG ON	DC	4.9 ~ 5.1V


Engine Control System

FL-37

Pin	Description	Condition	Type	Level
27	Sensor power (+5V)	IG ON	DC	4.9 ~ 5.1V
28	Camshaft Position Sensor(CMPS) signal input	Engine Run	Pulse	High: 4.8 ~ 5.2V Low: Max. 1.0V
29	Sensor ground	Always	DC	0 ~ 0.5V
30	-			
31	Injector (Cylinder #1) [High] control output	Engine Run	DC	
32	Injector (Cylinder #3) [High] control output			
33	Injector (Cylinder #5) [High] control output			
34	-			
35	-			
36	-			
37	-			
38	-			
39	Sensor ground	Always	DC	0 ~ 0.5V
40	Rail Pressure Sensor(RPS) signal input	Engine Run	Analog	0.5 ~ 4.5V
41	Boost Pressure Sensor(BPS) signal input	Engine Run	Analog	1.0 ~ 4.4V
42	-			
43	Crankshaft Position Sensor (CKPS) [-] signal input	Engine Run	SINE Wave	Vp_p: Min. 1.0V
44	-			
45	-			
46	Injector (Cylinder #1) [Low] control output	Engine Run	DC	
47	Injector (Cylinder #3) [Low] control output			
48	Injector (Cylinder #5) [Low] control output			
49	Motor [+] control output	Engine Run	PWM	 · Engine running duty: below 50% · Offset learning duty: 0~100%
50	Motor [-] control output	Engine Run	PWM	
51	Sensor power (+5V)	IG ON	DC	4.9 ~ 5.1V
52	Position Sensor signal input	Idle	DC	0.5 ~ 4.5V
53	-			
54	Sensor power (+5V)	IG ON	DC	4.9 ~ 5.1V
55	Sensor ground	Always	DC	0 ~ 0.5V
56	Sensor ground	Always	DC	0 ~ 0.5V

FL-38

Fuel System

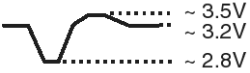

Pin	Description	Condition	Type	Level
57	Sensor shield			
58	Crankshaft Position Sensor (CKPS) [+] signal input	Engine Run	SINE Wave	Vp_p: Min.1.0V
59	-			
60	Electric EGR Control Valve control output	Engine Run	PWM	 <p>· Engine running duty: 5~80 % · Valve closing: 5% · Valve opening: 80%</p>

Connector [CSD-K]

Pin	Description	Condition	Type	Level
1	Power ground	Always	DC	0 ~ 0.5V
2	Power ground	Always	DC	0 ~ 0.5V
3	Battery power	IG ON	DC	Battery Voltage
4	Power ground	Always	DC	0 ~ 0.5V
5	Battery power	IG ON	DC	Battery Voltage
6	Battery power	IG ON	DC	Battery Voltage
7	شرکت دیجیتال خودرو (مسئولیت محدود)			
8	ESP/ABS Auto Recognition signal input			
9	اولین سامانه دیجیتال تعمیرکاران خودرو در ایران			
10	VS-/IP- (Virtual Ground)	Engine Run & Heater ON	DC	~ 3.0V
11	VS+ (NERNST Cell Voltage)	Engine Run & Heater ON	DC	~ 3.0V
12	-			
13	-			
14	-			
15	Sensor power (+5V)	IG ON	DC	4.9 ~ 5.1V
16	-			
17	-			
18	Battery power	IG ON	DC	Battery Voltage
19	-			
20	-			
21	-			
22	-			
23	-			

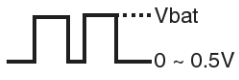
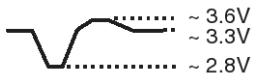
Engine Control System

FL-39

Pin	Description	Condition	Type	Level
24	-			
25	Cooling Fan Relay [High] control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
26	-			
27	-			
28	-			
29	PTC Heater Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
30	-			
31	-			
32	Rc/Rp (Pumping Cell Voltage)	Engine Run & Heater ON	DC	 ~ 3.5V ~ 3.2V ~ 2.8V
33	Immobilizer Communication Line			
34	-			
35	CAN [Low]	RECESSIVE	DC	2.0 ~ 3.0V
		DOMINANT		0.5 ~ 2.25V
36	CAN [High]	RECESSIVE	DC	2.0 ~ 3.0V
		DOMINANT		2.75 ~ 4.5V
37	-			
38	Intake Air Temperature Sensor (IATS) #1 signal input	Idle	Analog	0.5 ~ 4.5V
39	-			
40	Sensor Power (+5V)	IG ON	DC	4.9 ~ 5.1V
41	-			
42	Water Sensor signal input	IG ON	DC	
43	Brake Switch 2 signal input	Release	DC	Battery Voltage
		Push		Max. 0.5V
44	Brake Switch 1 signal input	Release	DC	Max. 0.5V
		Push		Battery Voltage
45	Ground	Always	DC	0 ~ 0.5V
46	-			
47	Engine speed signal output	Engine Run	Pulse (4Pulse/rev)	 Vbat 0 ~ 0.5V
48	A/C Compressor Relay control output	A/C OFF	DC	Battery Voltage
		A/C ON		Max. 1.0V



FL-40

Fuel System

Pin	Description	Condition	Type	Level
49	Main Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
50	Cooling Fan Relay [Low] control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
51	Lambda Sensor Heater control output	Engine Run & Heater ON	PWM (100 Hz)	
52	-			
53	-			
54	Rc (Compensative Resistance)	Engine Run & Heater ON	DC	
55	-			
56	-			
57	Accelerator Position Sensor (APS) #1 signal input	Released	DC	0.7 ~ 0.8V
		Fully depressed		3.8 ~ 4.4V
58	Accelerator Position Sensor (APS) #2 signal input	Released	DC	0.275 ~ 0.475V
		Fully depressed		1.75 ~ 2.35V
59	A/C Pressure Transducer (APT) signal input	A/C ON	DC	Max. 4.8V
60	Sensor power (+5V)	IG ON	DC	4.9 ~ 5.1V
61	-			
62	-			
63	-			
64	A/C Switch "ON" signal input	A/C S/W OFF	DC	Max. 1.0V
		A/C S/W ON		Battery Voltage
65	A/C Pressure Switch signal input	S/W OFF	DC	Max. 1.0V
		S/W ON		Battery Voltage
66	-			
67	-			
68	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
69	Immobilizer Lamp control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		Max. 1.0V
70	-			
71	Glow Time Lamp control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		Max. 1.0V

Engine Control System

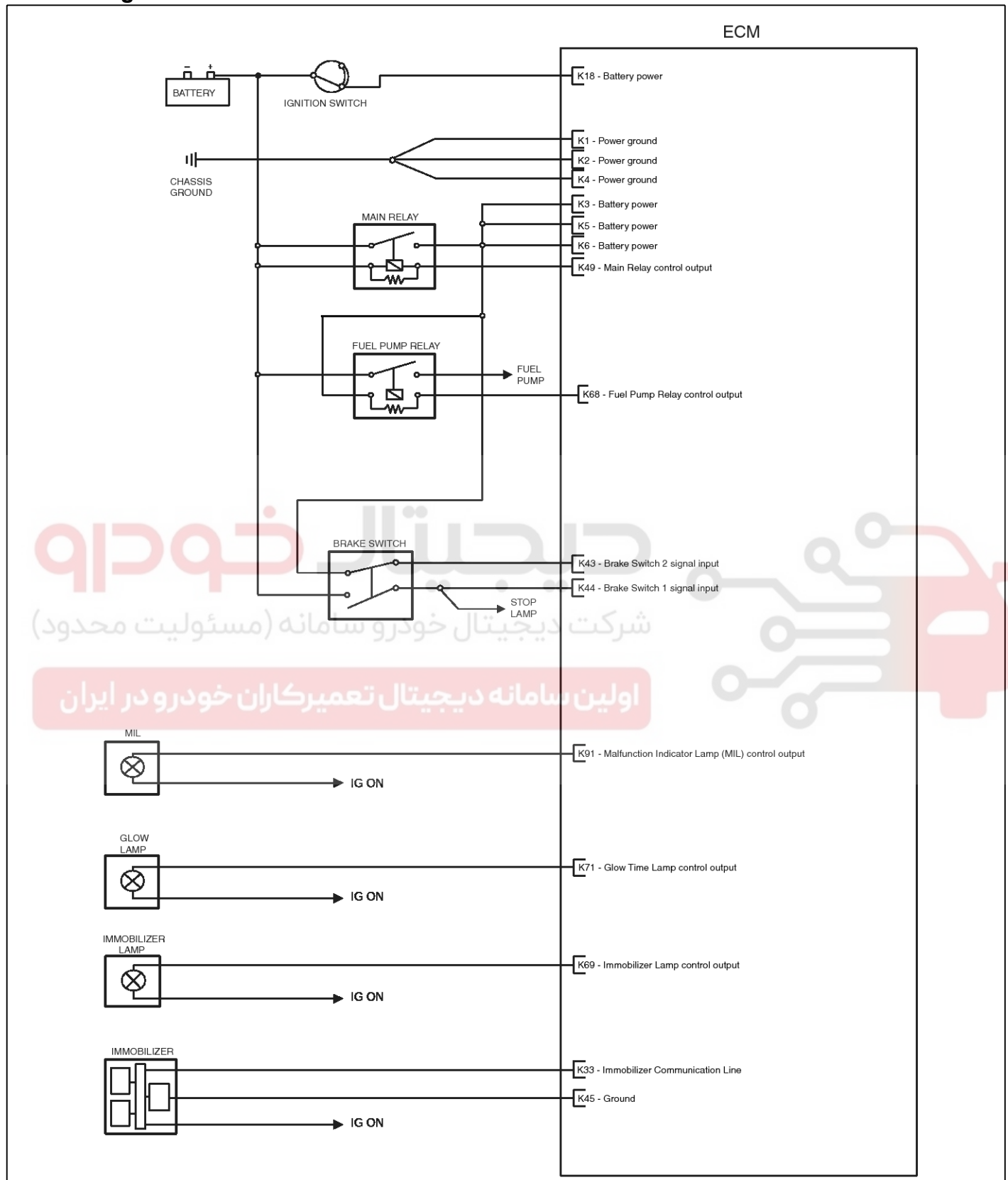
FL-41

Pin	Description	Condition	Type	Level
72	Diagnosis Data Line (K-Line)	When transmitti- ng	Pulse	High: Min. Vbatt×80%
		When receiving		Low: Max. Vbatt×20%
				High: Min. Vbatt×70%
				Low: Max. Vbatt×30%
73	Accelerator Position Sensor signal output			
74	Mass Air Flow Sensor(MAFS) signal input	Engine Run & Warmed-up	Pulse	
75	Reference Frequency	Idle	Pulse	High: Vcc or Vbat Low: Max. 1.0V
76	-			
77	-			
78	-			
79	Sensor ground	Always	DC	0 ~ 0.5V
80	Sensor ground	Always	DC	0 ~ 0.5V
81	Sensor ground	Always	DC	0 ~ 0.5V
82	Sensor power (+5V)	IG ON	DC	4.9 ~ 5.1V
83	-			
84	Sensor ground	Always	DC	0 ~ 0.5V
85	Thermo Switch signal input	A/C OFF	DC	Max. 0.5V
		A/C ON		Battery Voltage
86	-			
87	-			
88	-			
89	-			
90	Feedback signal input	IG ON	PWM	 · Engine running duty: 20~80% · Idle duty: 80% · W.O.T duty: 50
91	Malfunction Indicator Lamp (MIL) Control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		Max. 1.0V
92	-			
93	Cruise Control "ACTIVATOR" signal input	IG ON	DC	4.9 ~ 5.1V
94	Ground	Always	DC	0 ~ 0.5V

FL-42

Fuel System

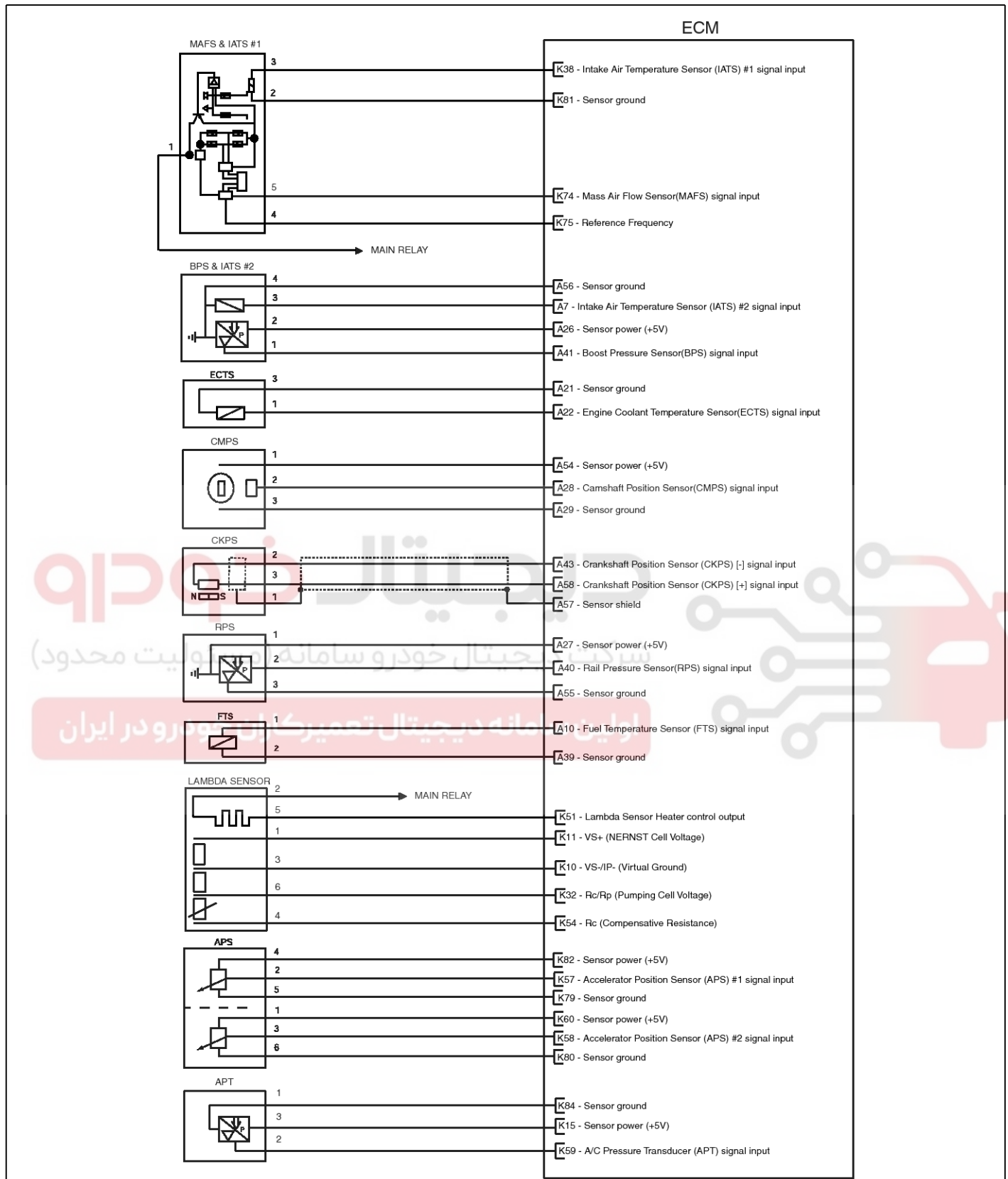
Circuit Diagram



SENFL7110L

Engine Control System

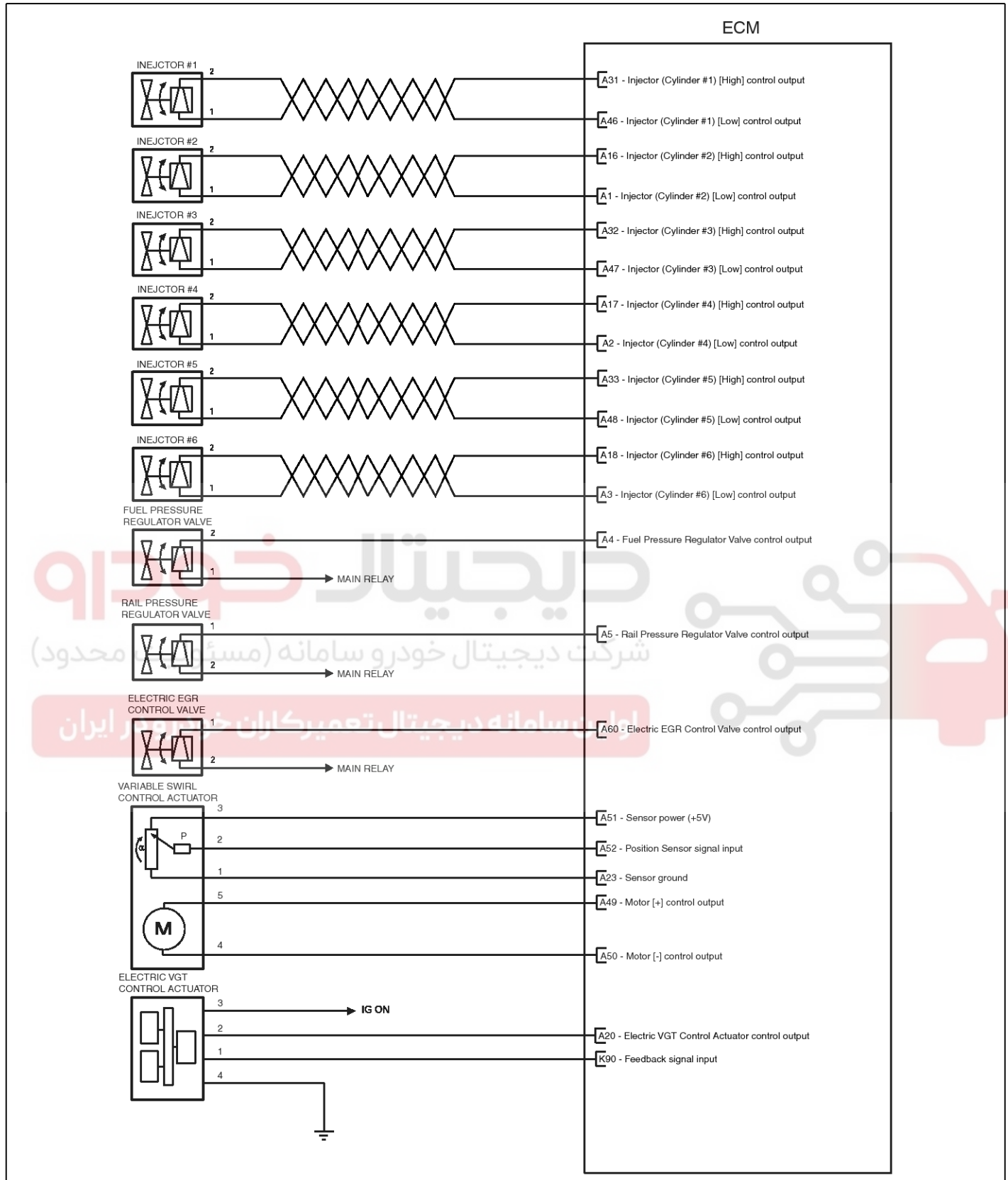
FL-43



SENFL7111L

FL-44

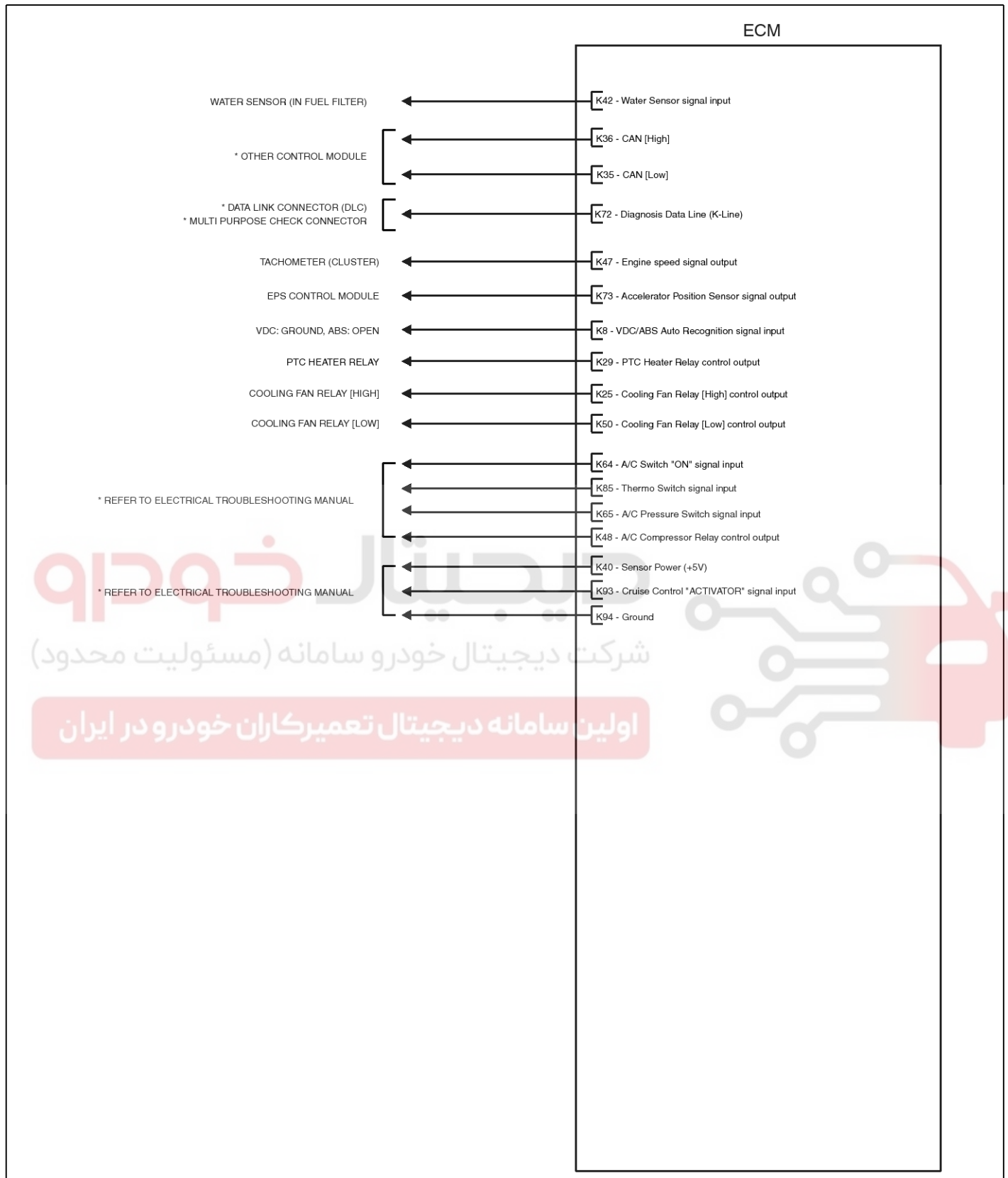
Fuel System



SENFL7112L

Engine Control System

FL-45



SENFL7113L

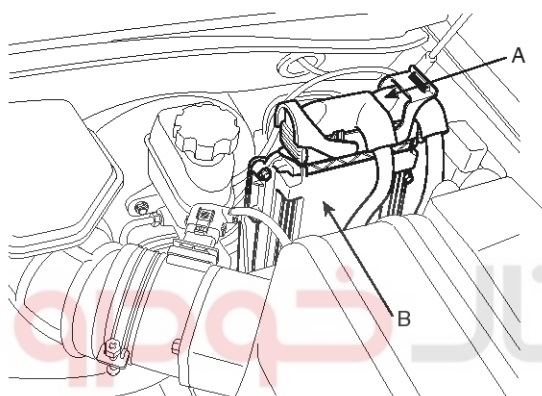
FL-46

Fuel System

Replacement

⚠ CAUTION

- After replacing ECM, **MUST** input the injector specific data (7 digits) of each cylinder into a new ECM with scan tool.
 - 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).



SHMFL8120D

3. Unscrew the ECM bracket mounting bolts and then remove the ECM (B).

4. Install a new ECM.

ECM installation bolts (on bracket):

7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)

ECM bracket installation bolts/nuts:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

5. Perform "Injector Specific Data Input" procedure (Refer to "INJECTOR" in this group).
6. Perform "Key Teaching" procedure (Refer to "IMMOBILIZER" in BE group).

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.
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 PROCEDURE in BASIC INSPECTION PROCEDURE)

Engine Control System

FL-47

Injector

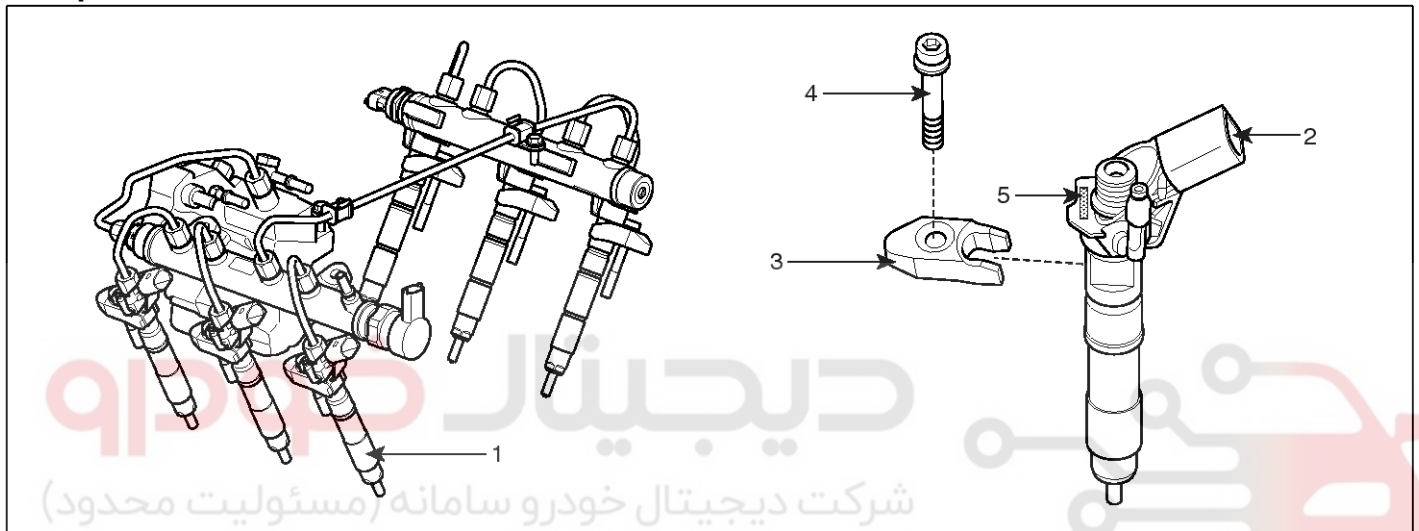
Description

⚠WARNING

As the Piezo-Injector operates under maximum DC 200V, there may be a risk of an electric shock caused by shorted control line etc. So when repairing the injector or its wiring, disconnect the battery negative (-) terminal from the battery and wait for about 30 seconds.

Components

The injectors are installed on the cylinder head and inject the compressed fuel stored in common rail into each cylinder by ECM control signal. This consists of the piezo actuator, the hydraulic coupler which amplifies output of the piezo actuator, the pressure control valve which moves the needle, the needle which opens or closes the injection hole of the injector, the fuel inlet nipple, and the fuel return nipple.



1. Injector
2. Connector
3. Clamp

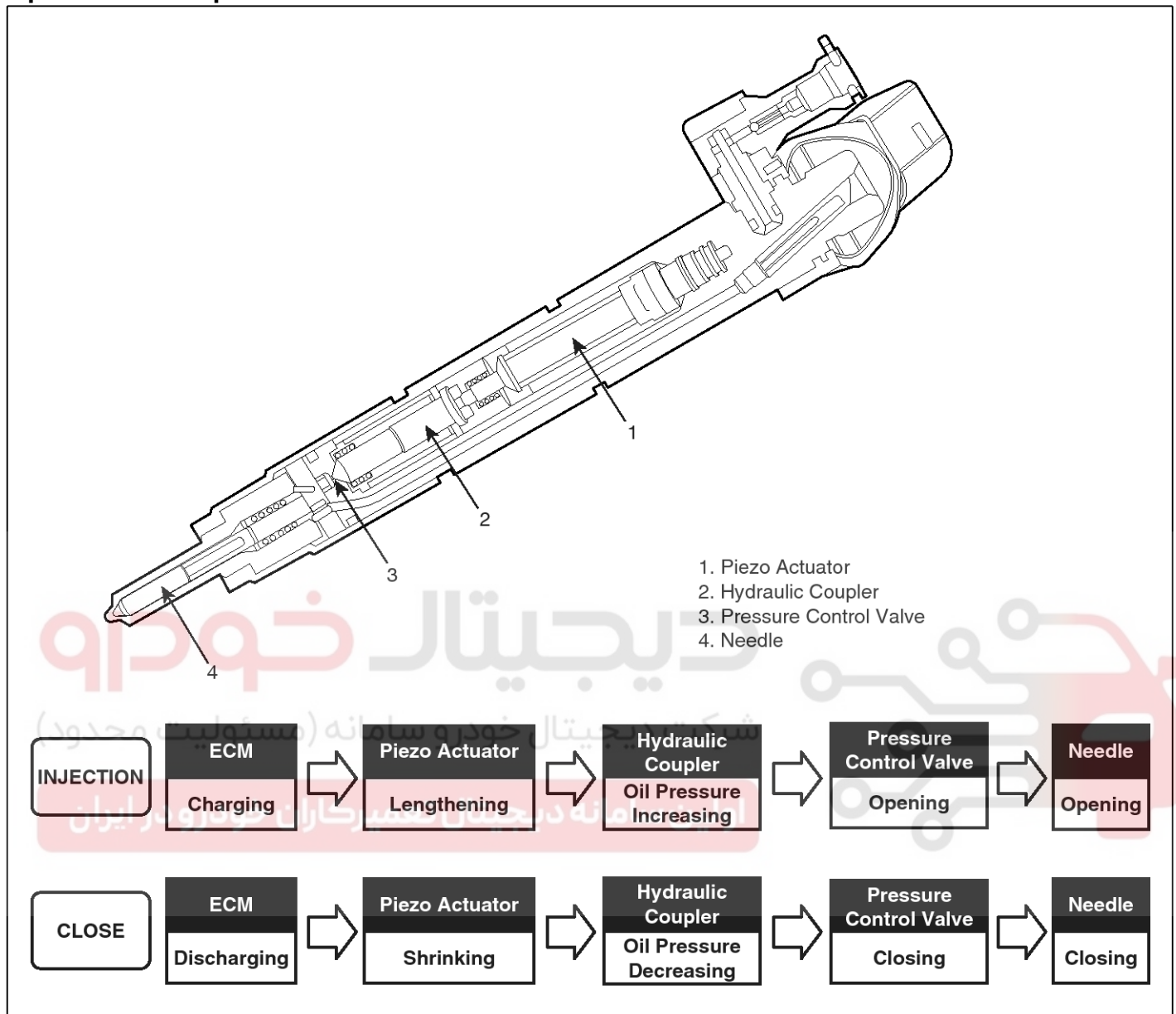
4. Clamp Mounting Bolt
5. Injector Specific Data (7 digits)

SHMF29111L

FL-48

Fuel System

Operation Principle



SENFL7114L

● Piezo Actuator

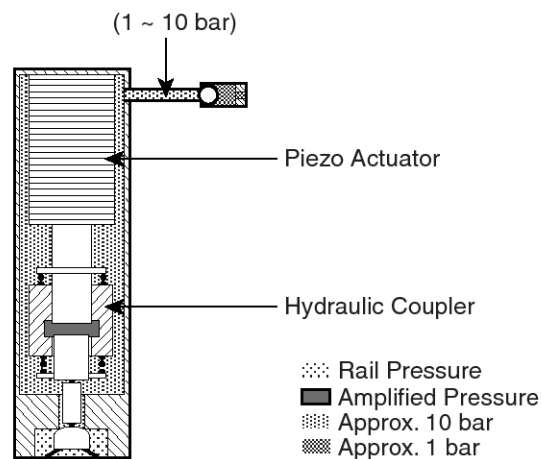
The Piezo Actuator is made up of several floors of cylindrical piezo-ceramic (height: approximately $90\mu\text{m}$). This lengthens by from 1.5% through 2.0% of its length if voltage is applied (Piezoelectric Converse Effect) and this length is "Stroke". The number and the cross section of the ceramic are proportional to the actuator's stroke and output respectively.

● Hydraulic Coupler

The hydraulic coupler is located under the piezo actuator and amplifies the actuator's output by the cross section ratio of the upper and the lower pistons. At this time, the actuator's stroke is lengthened. The hydraulic oil is the fuel and the oil pressure to operate the hydraulic coupler normally is from 1 through 10 bar.

Engine Control System

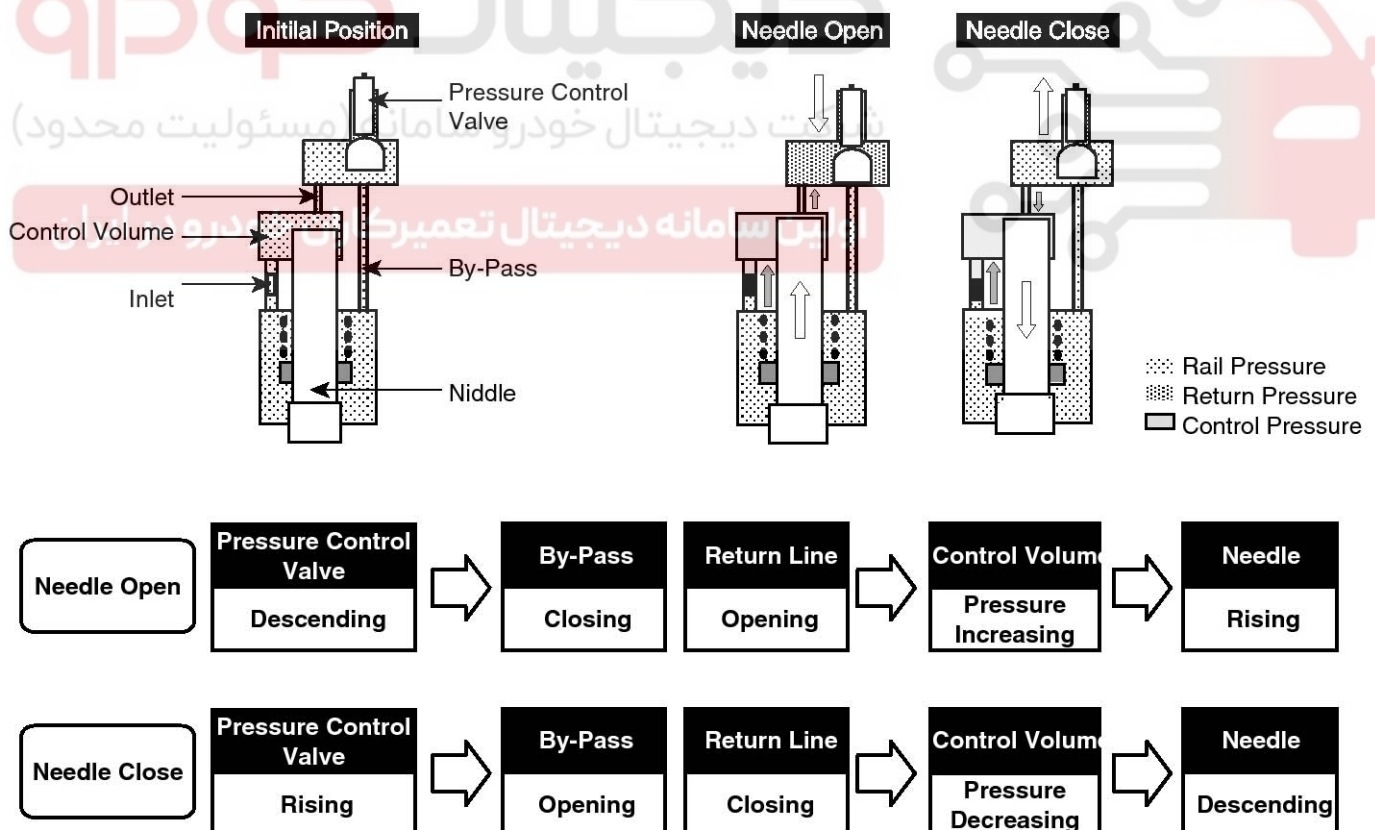
FL-49



SENFL7115L

● Pressure Control Valve

The Pressure Control Valve is located under the hydraulic coupler and controls the needle by amplified actuator's output.



SENFL7116L

● Needle

The needle is located under the pressure control valve

and finally opens or closes the injection hole.

FL-50

Fuel System

Specification

Items	Specification
Component Resistance (kΩ)	150 ~ 250 [20℃(68°F)]
Operation Voltage (V)	100 ~ 200

Circuit Diagram

[Circuit Diagram]

INJECTOR #1 (CSD24-1)

INJECTOR #2 (CSD24-2)

INJECTOR #3 (CSD24-3)

INJECTOR #4 (CSD24-4)

INJECTOR #5 (CSD24-5)

INJECTOR #6 (CSD24-6)

[Connection Information]

INJECTOR #1 (CSD24-1)

Terminal	Connected to	Function
1	ECM CSD-A (46)	Injector (cyl. #1) [LOW]
2	ECM CSD-A (31)	Injector (cyl. #1) [HIGH]

INJECTOR #2 (CSD24-2)

Terminal	Connected to	Function
1	ECM CSD-A (1)	Injector (cyl. #2) [LOW]
2	ECM CSD-A (16)	Injector (cyl. #2) [HIGH]

INJECTOR #3 (CSD24-3)

Terminal	Connected to	Function
1	ECM CSD-A (47)	Injector (cyl. #3) [LOW]
2	ECM CSD-A (32)	Injector (cyl. #3) [HIGH]

INJECTOR #4 (CSD24-4)

Terminal	Connected to	Function
1	ECM CSD-A (2)	Injector (cyl. #4) [LOW]
2	ECM CSD-A (17)	Injector (cyl. #4) [HIGH]

INJECTOR #5 (CSD24-5)

Terminal	Connected to	Function
1	ECM CSD-A (48)	Injector (cyl. #5) [LOW]
2	ECM CSD-A (33)	Injector (cyl. #5) [HIGH]

INJECTOR #6 (CSD24-6)

Terminal	Connected to	Function
1	ECM CSD-A (3)	Injector (cyl. #6) [LOW]
2	ECM CSD-A (18)	Injector (cyl. #6) [HIGH]

[Harness Connector]

CSD24-1,2,3,4,5,6
INJECTOR #1,2,3,4,5,6

CSD-A
ECM

Engine Control System

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Removal

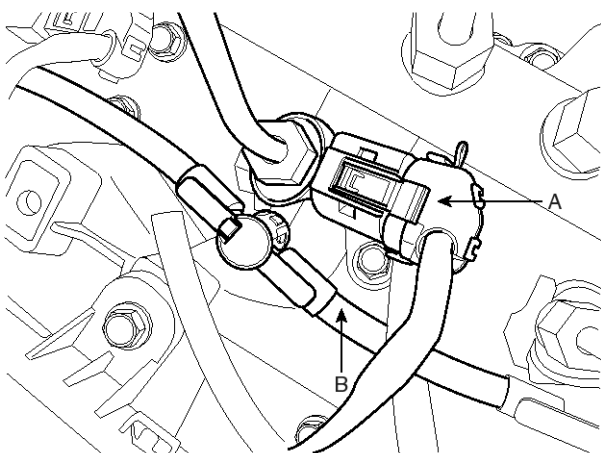
⚠WARNING

As the Piezo-Injector operates under maximum DC 200V, there may be a risk of an electric shock caused by shorted control line etc. So when repairing the injector or its wiring, disconnect the battery negative (-) terminal from the battery and wait for about 30 seconds.

⚠CAUTION

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep cleanly the parts and the working area.
- Pay attention to a foreign substance.
- Just before installing injector, tube or hose, remove the protect-cap attached on them.
- Do not remove injector except for special case.
- When installing Injector
 - Wash the contact area of the injector and replace the O-ring with a new one.
 - Spread oil on the injector O-ring.
 - To protect damage caused by shock, vertically insert the injector into the cylinder head.
- When installing High Pressure Fuel Pipe
 - Do not use again the used high pressure fuel pipe.
 - Install the flange nut correctly.

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

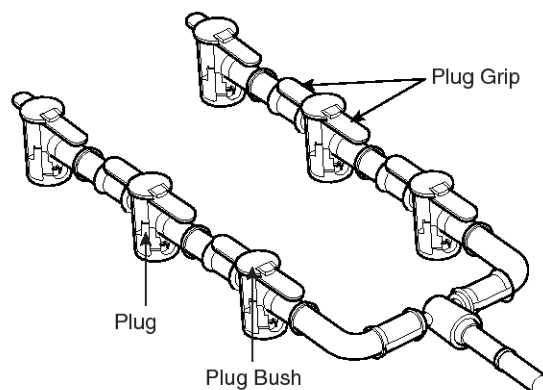


SENFL7129D

3. Disconnect the injector return line (B).

⚠NOTICE

Before connecting the injector return line or after disconnecting the injector return line, check that the plug bush was completely raised from the plug. Otherwise fuel will leak around the injector's nipple because of broken plug.

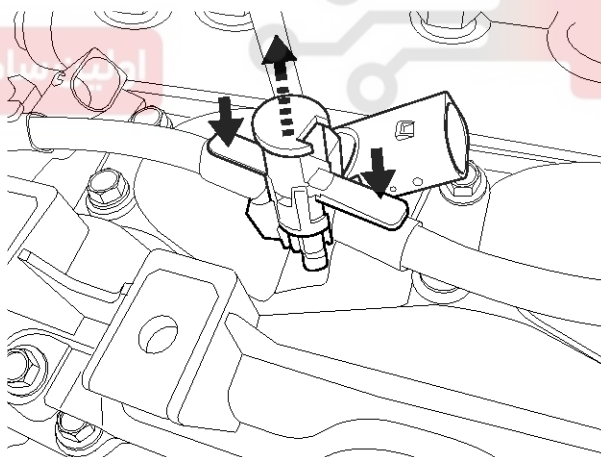


SENFL7118L

⚠NOTICE

[DISCONNECTION-INJECTOR RETURN LINE]

1. Pull the plug bush upward with the plug grip pressed.



SENFL7131D

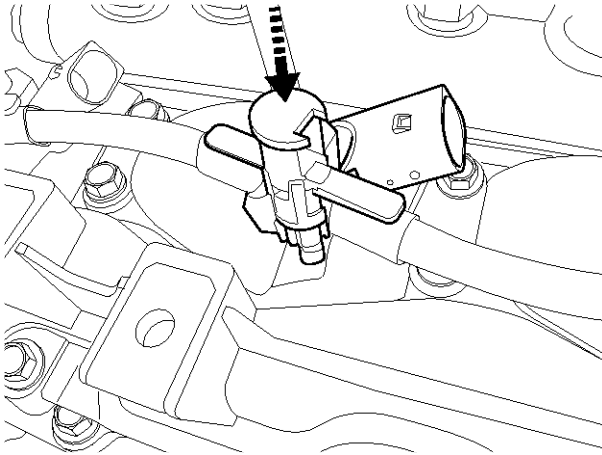
2. Seize the return line on both sides of the plug, and then disconnect the plug upward from the injector nipple.

FL-52

Fuel System

[CONNECTION-INJECTOR RETURN LINE]

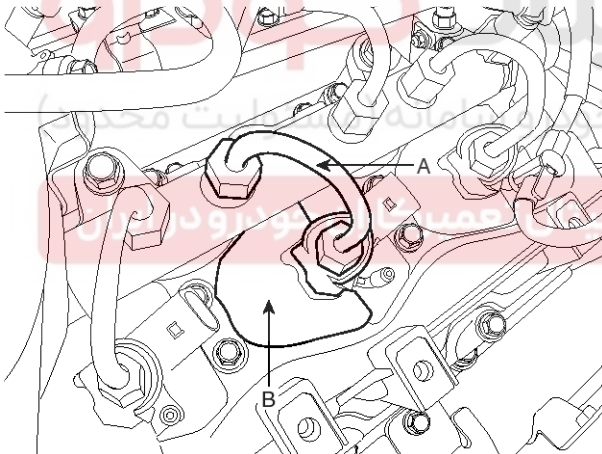
1. With the plug bush fully raised, vertically install the plug to the injector nipple until "Click" sound generates.



SENFL7132D

2. Press the plug bush downward until "Click" sound generates.

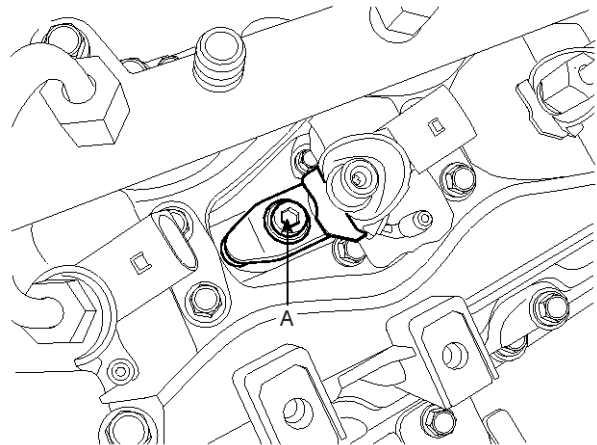
4. Disconnect the high pressure fuel pipe (A).



SENFL7133D

5. Remove the injector pad (B).

6. Unscrew the injector clamp bolt (A), and then remove the injector.



SENFL7134D

NOTICE

If the injector adheres to the cylinder head, use the Special Service Tool (SST No.: 09351-4A300).

Installation

1. Installation is reverse of removal.

NOTICE

1. When installing the high pressure fuel pipe, apply the specified tightening torques with the special service tool [SST No.: 09314-3A000].

2. When installing the high pressure fuel pipe connecting the common rail and injector, follow the below procedure.

1. Temporarily install the nuts on common rail and injector
2. Install the injector side and common rail side sequentially

Injector clamp installation bolt: 24.5 ~ 26.5 N·m (2.5 ~ 2.7 kgf·m, 18.1 ~ 19.5 lbf·ft)

High pressure fuel pipe installation nut: 24.5 ~ 28.4 N·m (2.5 ~ 2.9 kgf·m, 18.1 ~ 21.0 lbf·ft)

Engine Control System

FL-53

Replacement

⚠WARNING

As the Piezo-Injector operates under maximum DC 200V, there may be a risk of an electric shock caused by shorted control line etc. So when repairing the injector or its wiring, disconnect the battery negative (-) terminal from the battery and wait for about 30 seconds.

⚠CAUTION

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep cleanly the parts and the working area.
- Pay attention to a foreign substance.
- Just before installing injector, tube or hose, remove the protect-cap attached on them.
- Do not remove injector except for special case.
- When installing Injector
 - Wash the contact area of the injector and replace the O-ring with a new one.
 - Spread oil on the injector O-ring.
 - To protect damage caused by shock, vertically insert the injector into the cylinder head.
- When installing High Pressure Fuel Pipe
 - Do not use again the used high pressure fuel pipe.
 - Install the flange nut correctly.

⚠CAUTION

After replacing injector, MUST input the injector specific data (7 digits) of each cylinder into ECM with scan tool.

1. Remove the injector (Refer to "REMOVAL" procedure).
2. Install the injector (Refer to "INSTALLATION" procedure).
3. Perform "Injector Specific Data Input" procedure (Refer to "INJECTOR SPECIFIC DATA INPUT" procedure).



FL-54

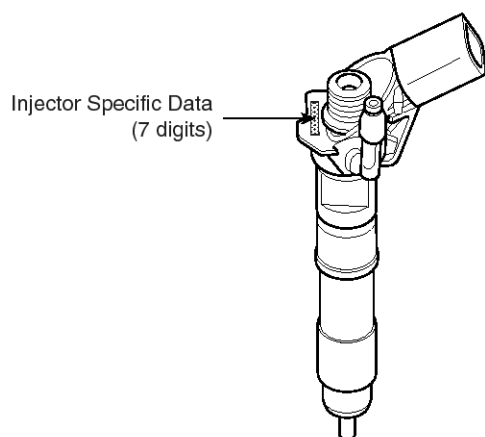
Fuel System

Injector Specific Data Input

⚠ CAUTION

After replacing injector, **MUST** input the injector specific data (7 digits) of each cylinder into ECM with scan tool.

📖 NOTICE



SENFL7119L

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".

MODEL :

- 01. ENGINE(GASOLINE)
- 02. ENGINE(DIESEL)**
- 03. AUTOMATIC TRANSAXLE
- 04. ABS/ESP
- 05. ELEC.POWER STEERING
- 06. FULL AUTO AIR/CON.
- 07. SRS-AIRBAG
- 08. 4WD CONTROL

SHMF29113L

5. Select "INJECTOR SPECIFIC DATA".

MODEL :

SYSTEM : ENGINE(DIESEL)
EURO-4 UGT(CAN)

- 03. FLIGHT RECORD
- 04. ACTUATION TEST
- 05. SIMU-SCAN
- 06. IDENTIFICATION CHECK
- 07. ENGINE TEST FUNCTION
- 08. COMPONENT CHANGE ROUTINE
- 09. INJECTOR SPECIFIC DATA**
- 10. DATA SETUP(UNIT CONV.)

SHMF29114L

6. Confirm the message, and then press "ENTER" key.

✖ CONDITION:IG.KEY ON(ENGINE STOP)

1. IF THE INJ IS CHANGED, THE INJ CORRECTION FUNC. SHOULD BE PERFORM TO CONTROL THE NORMAL FUEL INJ.
2. TO INPUT THE INJECTOR NUMBER, PRESS SHIFT KEY AND SELECT THE CYL. BY ARROW KEY AT THE SAME TIME. AND INPUT THE INJ DATA BY [F1]~[F6], DIGIT KEY. AND THEN PRESS [ENTER].
3. AFTER COMPLETE, TURN THE IG.KEY OFF AND RECHECK THE SYSTEM AFTER 10 SEC

SHMF29115L

7. Input the injector data (7 digit), and then press "ENTER" key.

1.9. INJECTOR SPECIFIC DATA

INJ. # 1	C6FPR4E	INPUT THE NUM OF ALL CYL. AT ONE TIME
INJ. # 2	MEIGY25	
INJ. # 3	3EIRWFP	
INJ. # 4	KQOM83V	
INJ. # 5	WQTOQVD	
INJ. # 6	A3EJKOW	

SELECT THE CYLINDER BY F1~F6 KEY AND INPUT THE DATA BY ARROW KEY AND PRESS [ENTER]KEY.

ABCD	EFGH	IJKL	MNOP	QR-U	VW-Z
------	------	------	------	------	------

SENFL7165L

Engine Control System

FL-55

8. After confirming the "Complete" message, turn ignition switch OFF.

1.9. INJECTOR SPECIFIC DATA					
INJ. # 1	C6FPR4E	INPUT THE NUM OF ALL CYL. AT ONE TIME			
INJ. # 2	MEIGY25				
INJ. # 3	3EIRWFP				
INJ. # 4	KQOM83V				
INJ. # 5	WQTOQVD				
INJ. # 6	A3EJKOW				
WRITING COMPLETE					
ABCD	EFGH	IJKL	MNOP	QR-U	VW-Z

SENFL7166L

9. In about 10 seconds, turn ignition switch ON and check the injector specific data memorized in the ECM.

NOTICE

In case of failure, input the injector specific data (7 digits) into the ECM again.

1.9. INJECTOR SPECIFIC DATA					
INJ. # 1	C6FPR4E	INPUT THE NUM OF ALL CYL. AT ONE TIME			
INJ. # 2	MEIGY25				
INJ. # 3	3EIRWFP				
INJ. # 4	KQOM83V				
INJ. # 5	WQTOQVD				
INJ. # 6	A3EJKOW				
WRITING FAIL					
ABCD	EFGH	IJKL	MNOP	QR-U	VW-Z

SENFL7167L



FL-56

Fuel System

Inspection

[Compression Test]

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".

MODEL :

- 01. ENGINE(GASOLINE)
- 02. ENGINE(DIESEL)**
- 03. AUTOMATIC TRANSAXLE
- 04. ABS/ESP
- 05. ELEC.POWER STEERING
- 06. FULL AUTO AIR/CON.
- 07. SRS-AIRBAG
- 08. 4WD CONTROL

SHMF29116L

5. Select "ENGINE TEST FUNCTION".

MODEL :

SYSTEM : ENGINE(DIESEL)

EURO-4 UGT(CAN)

- 03. FLIGHT RECORD
- 04. ACTUATION TEST
- 05. SIMU-SCAN
- 06. IDENTIFICATION CHECK
- 07. ENGINE TEST FUNCTION**
- 08. COMPONENT CHANGE ROUTINE
- 09. INJECTOR SPECIFIC DATA
- 10. DATA SETUP(UNIT CONV.)

SHMF29117L

6. Select "COMPRESSION TEST".

1.7. ENGINE TEST FUNCTION

- 01. COMPRESSION TEST**
- 02. IDLE SPEED COMPARISON
- 03. INJECT. QUANTITY COMPARISON

SENFL7170L

7. Perform the test in accordance with the message.

7.1 COMPRESSION TEST

This test is used for detecting cylinder specific engine speed without injection.

*Test condition

- Shift level : P or N
- Engine : Stop(IGN. ON)
- Electrical Load : OFF

If you ready, now cranking, and stop cranking when stop message appear on the screen. Press[ENTER].

SENFL7171L

7.1 COMPRESSION TEST

CYLINDER ENGINE SPEED(RPM)

#1	#2	#3	#4	#5	#6
228	229	228	227	228	228
228	229	228	227	227	227
227	227	228	227	227	227
227	227	226	226	225	227
226	227	226	226	225	226
226	226	225	226	225	226
226	226	225	225	224	226

ANALYZE THE TEST RESULT.

ANAL

SENFL7172L

Engine Control System

FL-57

7.1 COMPRESSION TEST					
CYLINDER ENGINE SPEED(RPM)					
#1	#2	#3	#4	#5	#6
228	229	228	227	228	228
228	229	228	227	227	227
227	227	228	227	227	227
227	227	226	226	225	227
226	227	226	226	225	226
226	226	225	226	225	226
226	226	225	225	224	226
ANALYZE THE TEST RESULT.					
<<		>>		AUG	HELP

SENFL7173L

CYLINDER ENGINE SPEED(RPM)					
SPEED(RPM)	200	250	300	350	AUG.
#1 CYL.					227
#2 CYL.					226
#3 CYL.					226
#4 CYL.					227
#5 CYL.					226
#6 CYL.					227
PREV					HELP

SENFL7174L

<p>*The higher cylinder engine speed: ->The low compression pressure.</p> <p>*It can help to identify the mechanical defects.</p>	PREV
--	------

SENFL7175L

NOTICE

If a cylinder's engine speed is higher than the other cylinders, the cylinder's compression pressure is low.



FL-58

Fuel System

[Idle Speed Comparison]

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".

MODEL :

- 01. ENGINE(GASOLINE)
- 02. ENGINE(DIESEL)**
- 03. AUTOMATIC TRANSAXLE
- 04. ABS/ESP
- 05. ELEC.POWER STEERING
- 06. FULL AUTO AIR/CON.
- 07. SRS-AIRBAG
- 08. 4WD CONTROL

SHMF29116L

5. Select "ENGINE TEST FUNCTION".

MODEL :

SYSTEM : ENGINE(DIESEL)

EURO-4 UGT(CAN)

- 03. FLIGHT RECORD
- 04. ACTUATION TEST
- 05. SIMU-SCAN
- 06. IDENTIFICATION CHECK
- 07. ENGINE TEST FUNCTION**
- 08. COMPONENT CHANGE ROUTINE
- 09. INJECTOR SPECIFIC DATA
- 10. DATA SETUP(UNIT CONV.)

SHMF29117L

6. Select "IDLE SPEED COMPARISON".

1.7. ENGINE TEST FUNCTION

- 01. COMPRESSION TEST
- 02. IDLE SPEED COMPARISON**
- 03. INJECT. QUANTITY COMPARISON

SENFL7176L

7. Perform the test in accordance with the message.

7.2 IDLE SPEED COMPARISON

This test is used for detecting cylinder specific engine speed with injector energizing.

(Cylinder balancing function is deactivated.)

***Test condition**

- Compression test : Normal
- Shift level : P or N
- Engine : Idle
- Electrical Load : OFF

IF you ready, Press[ENTER].

SENFL7177L

7.2 IDLE SPEED COMPARISON					
CYLINDER ENGINE SPEED(RPM)					
#1	#2	#3	#4	#5	#6
785	782	786	801	796	787
800	792	792	798	794	792
792	789	787	791	787	789
798	793	791	795	794	792
797	791	793	796	793	789
794	790	791	796	791	789
800	795	793	797	792	796
ANALYZE THE TEST RESULT.					
ANAL					

SENFL7178L

Engine Control System

FL-59

7.2 IDLE SPEED COMPARISON					
CYLINDER ENGINE SPEED(RPM)					
#1	#2	#3	#4	#5	#6
785	782	786	801	796	787
800	792	792	798	794	792
792	789	787	791	787	789
798	793	791	795	794	792
797	791	793	796	793	789
794	790	791	796	791	789
800	795	793	797	792	796
ANALYZE THE TEST RESULT.					
<<		>>		AUG	HELP

SENFL7179L

CYLINDER ENGINE SPEED(RPM)					
SPEED(RPM)	650	750	850	950	AUG.
#1 CYL.					795
#2 CYL.					792
#3 CYL.					792
#4 CYL.					797
#5 CYL.					794
#6 CYL.					790
PREV					HELP

SENFL7180L

<p>*The lower engine speed:</p> <p>->The injector injects less quantity than other injectors.</p> <p>*The higher engine speed:</p> <p>->The injector injects more quantity than other injectors.</p>	PREV
--	------

SENFL7181L

NOTICE

The injector in cylinder with significantly high (low) idle speed injects more (less) quantity than the other injectors.



FL-60

Fuel System

[Injection Quantity Comparison]

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".

MODEL :

- 01. ENGINE(GASOLINE)
- 02. ENGINE(DIESEL)
- 03. AUTOMATIC TRANSAXLE
- 04. ABS/ESP
- 05. ELEC.POWER STEERING
- 06. FULL AUTO AIR/CON.
- 07. SRS-AIRBAG
- 08. 4WD CONTROL

SHMF29116L

5. Select "ENGINE TEST FUNCTION".

MODEL :

SYSTEM : ENGINE(DIESEL)

EURO-4 UGT(CAN)

- 03. FLIGHT RECORD
- 04. ACTUATION TEST
- 05. SIMU-SCAN
- 06. IDENTIFICATION CHECK
- 07. ENGINE TEST FUNCTION
- 08. COMPONENT CHANGE ROUTINE
- 09. INJECTOR SPECIFIC DATA
- 10. DATA SETUP(UNIT CONV.)

SHMF29117L

6. Select "INJECTION QUANTITY COMPARISON".

1.7. ENGINE TEST FUNCTION

- 01. COMPRESSION TEST
- 02. IDLE SPEED COMPARISON
- 03. INJECT. QUANTITY COMPARISON

SENFL7182L

7. Perform the test in accordance with the message.

7.3 INJECT. QUANTITY COMPARISON

This test is used for detecting cylinder specific quantity with individual energizing of injector. (Cylinder balancing function is activated.)

*Test condition

- Compression test : Normal
- Shift level : P or N
- Engine : Idle
- Electrical Load : OFF

IF you ready, Press[ENTER].

SENFL7183L

7.3 INJECT. QUANTITY COMPARISON											
ENG. SPEED(RPM)						INJECTION QUANTITY(MM3)					
1	2	3	4	5	6	1	2	3	4	5	6
0	0	0	0	0	0	-0.380.67	-0.380.66	-0.660.55	0.17		
0	0	0	0	0	0	-0.370.66	-0.370.66	-0.660.56	0.19		
0	0	0	0	0	0	-0.380.65	-0.380.66	-0.660.56	0.19		
0	0	0	0	0	0	-0.390.64	-0.370.65	-0.650.56	0.20		
0	0	0	0	0	0	-0.390.64	-0.370.64	-0.640.57	0.20		
0	0	0	0	0	0	-0.390.63	-0.370.64	-0.640.57	0.21		
0	0	0	0	0	0	-0.390.63	-0.370.64	-0.640.56	0.21		
ANALYZE THE TEST RESULT.											
ANAL											

SENFL7184L

Engine Control System

FL-61

7.3 INJECT. QUANTITY COMPARISON												
ENG. SPEED(RPM)						INJECTION QUANTITY(MM3)						
1	2	3	4	5	6	1	2	3	4	5	6	
0	0	0	0	0	0	-0.38	0.67	-0.38	-0.66	0.55	0.17	
0	0	0	0	0	0	-0.37	0.66	-0.37	-0.66	0.56	0.19	
0	0	0	0	0	0	-0.38	0.65	-0.36	-0.66	0.56	0.19	
0	0	0	0	0	0	-0.39	0.64	-0.37	-0.65	0.56	0.20	
0	0	0	0	0	0	-0.39	0.64	-0.37	-0.64	0.57	0.20	
0	0	0	0	0	0	-0.39	0.63	-0.37	-0.64	0.57	0.21	
0	0	0	0	0	0	-0.39	0.63	-0.37	-0.64	0.56	0.21	
ANALYZE THE TEST RESULT.												
<<			>>			AUG			HELP			

SENFL7185L

CYLINDER ENGINE SPEED(RPM)												
SPEED(RPM)												
650	750	850	950	AUG.								
No.1 Cyl					0							
No.2 Cyl					0							
No.3 Cyl					0							
No.4 Cyl					0							
No.5 Cyl					0							
No.6 Cyl					0							
QUANT.(MM3)						-4	-2	0	2	4	AUG.	
No.1 Cyl											-0.37	
No.2 Cyl											0.67	
No.3 Cyl											-0.36	
No.4 Cyl											-0.65	
No.5 Cyl											0.56	
No.6 Cyl											0.15	
												PREV
												HELP

SENFL7186L

*The positive correction value:												
->The fuel injection of the cylinder is less than that of other cylinder.												
*The negative correction value:												
->The fuel injection of the cylinder is more than that of other cylinder.												
*Extreme correction value identifies a problematic injector.												
After replacing a injector with new one , retest & confirm the engine condition												
												PREV

SENFL7187L

NOTICE

* (+) correction value: Injection quantity is less than the others.

* (-) correction value: Injection quantity is more than the others.

* Very high correction value: The injector may have any fault. At this time, replace the injector with a new one and perform these tests again.



FL-62

Fuel System

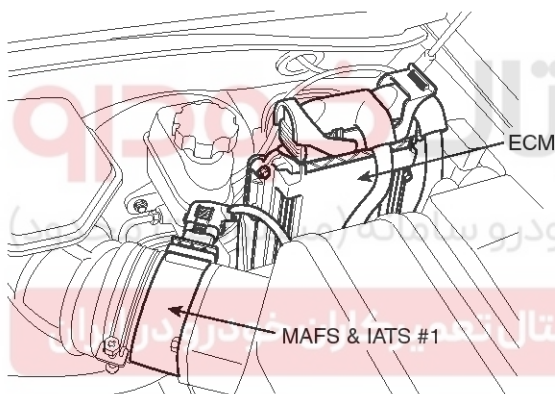
Mass Air Flow Sensor (MAFS)

Function And Operation Principle

The Mass Air Flow Sensor (MAFS) is installed in air intake line and is a hot-film type sensor. This sensor detects mass of air flow and sends the amount to the ECM by frequency signal. A large amount of intake air represents acceleration or high load conditions while a small amount of intake air represents deceleration or idle. By using this signal, the ECM can control EGR amount and fuel injection amount more correctly.

⚠CAUTION

After replacing the Mass Air Flow Sensor (MAFS), **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure (Refer to "REPLACEMENT" procedure). Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.



SHMFL8102D

Specification

At intake air temperature = 20°C (68°F)

Air Flow (kg/h)	Frequency (kHz)
10	1.93 ~ 1.94
15	2.00 ~ 2.01
20	2.06 ~ 2.07
90	2.67 ~ 2.69
220	3.43 ~ 3.47
440	4.65 ~ 4.76
850	7.87 ~ 8.25
1000	9.60 ~ 10.52

At intake air temperature = -15°C (5°F)

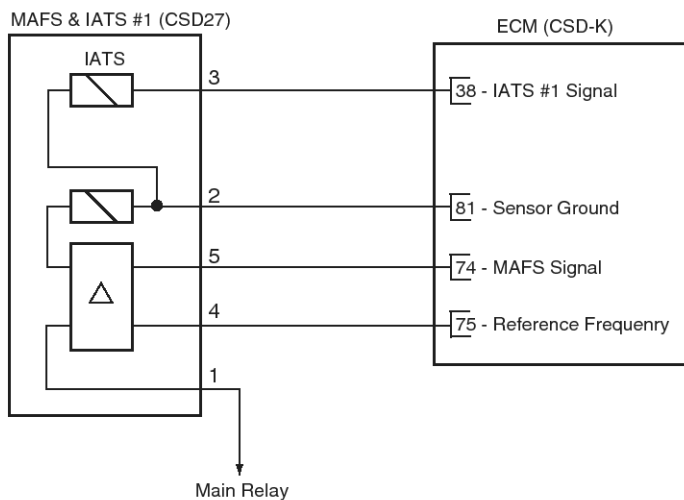
Air Flow (kg/h)	Frequency (kHz)
10	1.93 ~ 1.94
75	2.65 ~ 2.70
160	3.40 ~ 3.49
310	4.60 ~ 4.81

Engine Control System

FL-63

Circuit Diagram

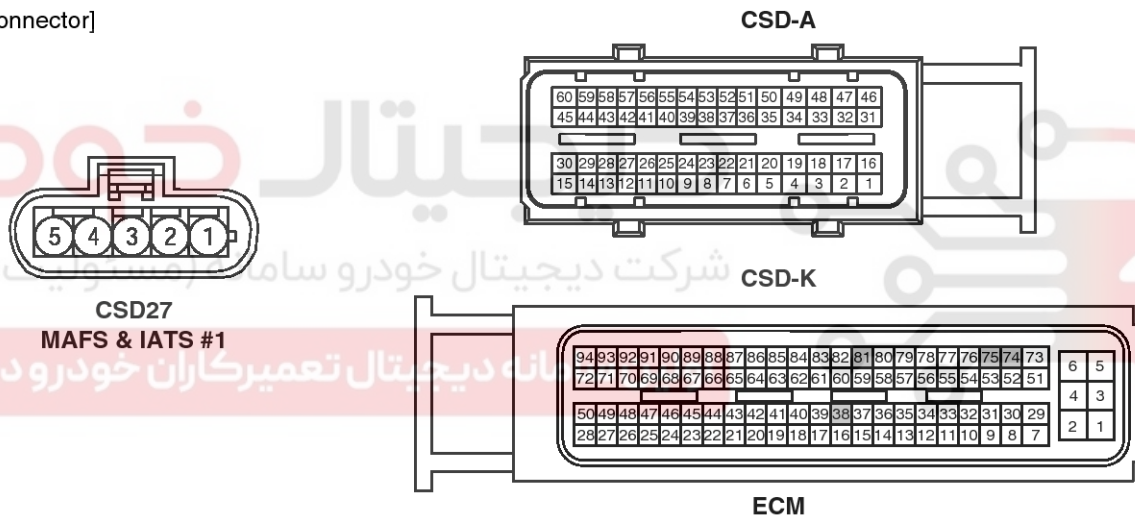
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CSD-K (81)	Sensor Ground
3	ECM CSD-K (38)	IATS #1 Signal
4	ECM CSD-K (75)	Reference Frequency
5	ECM CSD-K (74)	MAFS Signal

[Harness Connector]

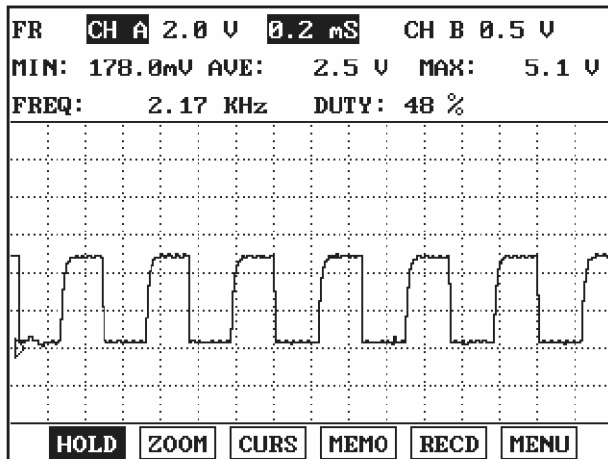


SHMF29118L

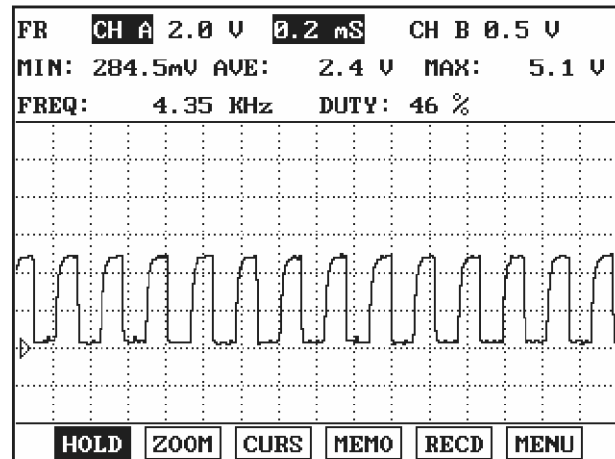
FL-64

Fuel System

Signal Waveform



Idle



At 3,000 rpm

SENFL7121L

Component Inspection

1. Check the MAFS visually.
 - Mounting direction
 - Any contamination, corrosion or damage on connector
 - Clogged or wet air cleaner
 - Deformed or blocked by any foreign material on MAFS' cylinder
2. Check any leakage on intake system and intercooler system.



Engine Control System

FL-65

Replacement

⚠CAUTION

After replacing the Mass Air Flow Sensor (MAFS), **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure. Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".

MODEL :	
01. ENGINE(GASOLINE)	
02. ENGINE(DIESEL)	
03. AUTOMATIC TRANSAXLE	
04. ABS/ESP	
05. ELEC.POWER STEERING	
06. FULL AUTO AIR/CON.	
07. SRS-AIRBAG	
08. 4WD CONTROL	

SHMF29119L

5. Select "COMPONENT CHANGE ROUTINE".

MODEL :	
SYSTEM : ENGINE(DIESEL)	
EURO-4 UGT(CAN)	
03. FLIGHT RECORD	
04. ACTUATION TEST	
05. SIMU-SCAN	
06. IDENTIFICATION CHECK	
07. ENGINE TEST FUNCTION	
08. COMPONENT CHANGE ROUTINE	
09. INJECTOR SPECIFIC DATA	
10. DATA SETUP(UNIT CONV.)	

SHMF29120L

6. Select "AIR FLOW SENSOR CHANGE".

1.8 . COMPONENT CHANGE ROUTINE	
MODEL :	
SYSTEM : ENGINE(DIESEL)	
EURO-4 UGT(CAN)	
01. LAMBDA SENSOR CHANGE	
02. RAIL PRESSURE SENSOR CHANGE	
03. AIR FLOW SENSOR CHANGE	
04. SWIRL CONTROL VALVE CHANGE	
05. PRESSURE REGULATING VALVE CHANGE	
06. ELECTRIC UGT ACTUATOR CHANGE	

SHMF29121L

7. Confirm the message, and then press "ENTER" key.

1.8 . COMPONENT CHANGE ROUTINE	
AIR FLOW SENSOR CHANGE	
IN THIS MODE, CAN RESET THE STORED DRIFT VALUES OF HOT FILM AIR FLOW SENSOR IN EEPROM.	
PRESS [ENTER] KEY.	

SENFL7191L

8. Confirm the "Complete" message, and then turn ignition switch OFF.

1.8 . COMPONENT CHANGE ROUTINE	
AIR FLOW SENSOR CHANGE	
IN THIS MODE CAN RESET THE STORED D COMPLETED! AFTER 10 SEC. OR MORE S SINCE IG.KEY OFF, TURN IG.KEY ON	
PRESS [ENTER] KEY.	

SENFL7192L

9. Wait for more than 10 seconds, and then turn ignition switch ON.

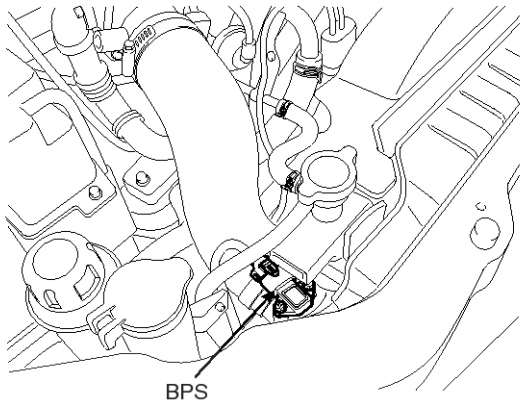
FL-66

Fuel System

Boost Pressure Sensor (BPS)

Function And Operation Principle

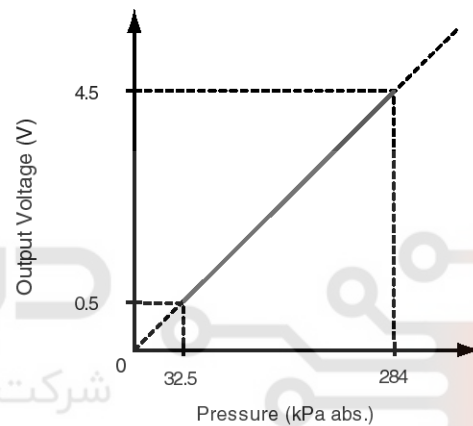
The Boost Pressure Sensor (BPS) is installed on the intercooler assembly and measures the pressure of the compressed air in turbocharger. By using this signal, the ECM controls the Variable Geometry Turbocharger (VGT).



SHMFL8100D

Specification

Pressure (Kpa)	Output Voltage (V)
32.5	0.5
70	1.02 ~ 1.17
140	2.13 ~ 2.28
210	3.25 ~ 3.40
270	4.20 ~ 4.35
284	4.5



EFQG038A

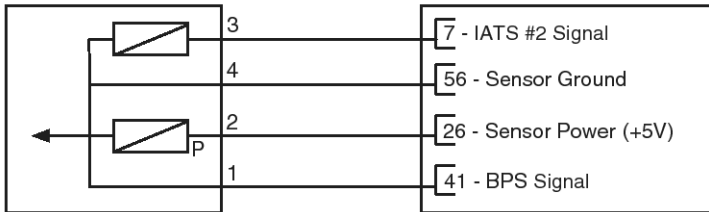
Engine Control System

FL-67

Circuit Diagram

[Circuit Diagram]

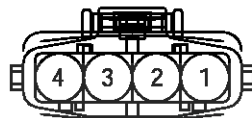
BPS & IATS #2 (E34)



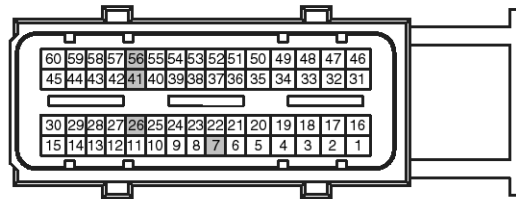
[Connection Information]

Terminal	Connected to	Function
1	ECM CSD-A (41)	BPS Signal
2	ECM CSD-A (26)	Sensor Power (+5V)
3	ECM CSD-A (7)	IATS #2 Signal
4	ECM CSD-A (56)	Sensor Ground

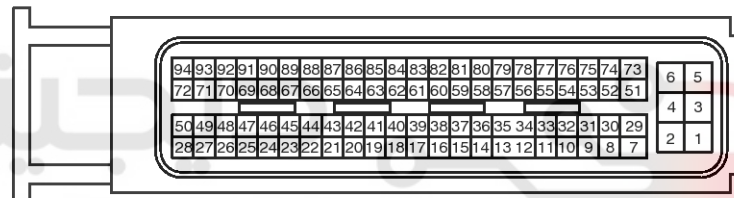
[Harness Connector]

E34
BPS & IATS #2

CSD-A



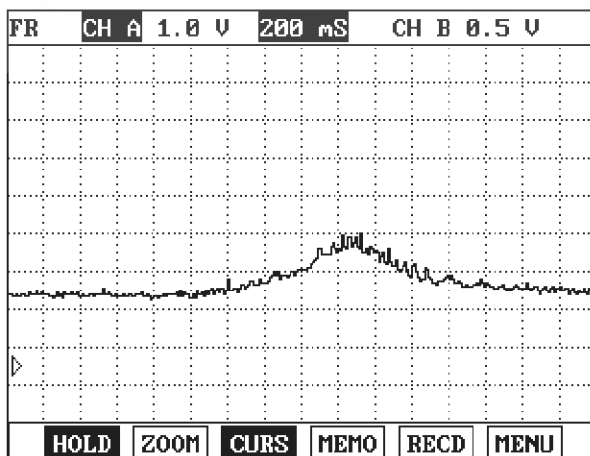
CSD-K



ECM

SHMF29122L

Signal Waveform



During Acceleration

SENFL7123L

FL-68

Fuel System

Intake Air Temperature Sensor (IATS)

Function And Operation Principle

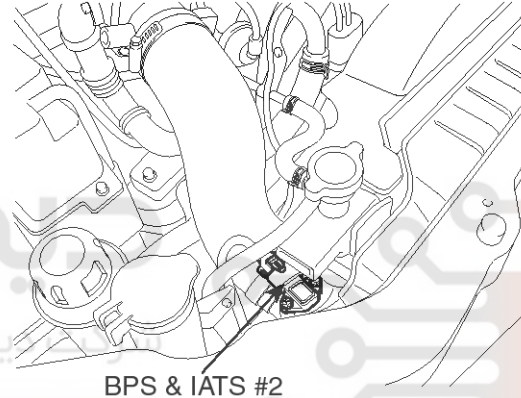
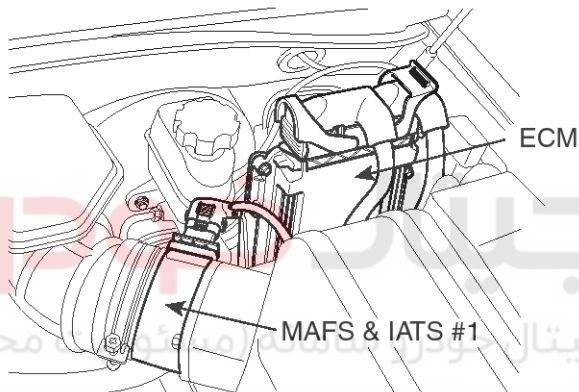
Intake Air Temperature Sensor (IATS) uses a Negative Temperature Characteristics (NTC) thermistor and senses intake air temperature. Two intake air temperature sensors are installed in this engine.

IATS #1 in Mass Air Flow Sensor (MAFS) and IATS #2 in Boost Pressure Sensor (BPS) are located in front of and behind turbo-charger respectively. IATS #1 senses air temperature entering turbo-charger and the other (IATS #2) does air temperature coming out from the turbo-charger.

Comparing these air temperature values from both sensors, more accurate sensing of intake air temperature is possible. ECM uses these air temperature signals to perform EGR control correction and fuel injection quantity correction.

CAUTION

After replacing the Intake Air Temperature Sensor (IATS) #1, MUST perform the "COMPONENT CHANGE ROUTINE" procedure (Refer to "REPLACEMENT" procedure). Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.



SHMF29158L

Specification

IATS #1 (MAFS)

Temperature [$^{\circ}\text{C}$ ($^{\circ}\text{F}$)]	Resistance ($\text{k}\Omega$)
-40(-40)	35.14 ~ 43.76
-20(-4)	12.66 ~ 15.12
0(32)	5.12 ~ 5.89
20(68)	2.29 ~ 2.55
40(104)	1.10 ~ 1.24
60(140)	0.57 ~ 0.65
80(176)	0.31 ~ 0.37

IATS #2 (BPS)

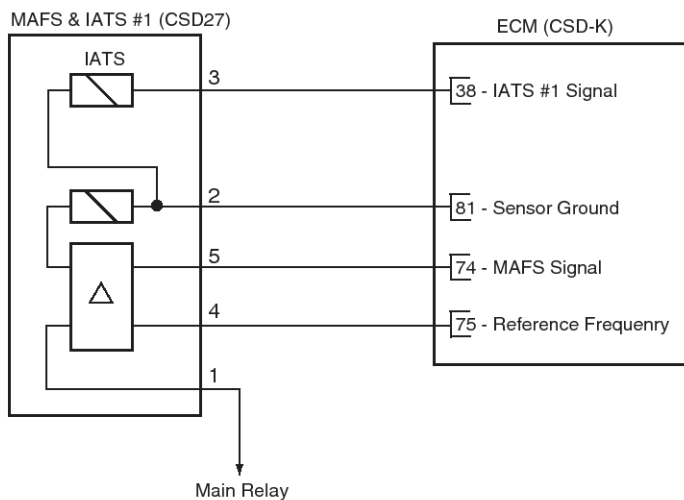
Temperature [$^{\circ}\text{C}$ ($^{\circ}\text{F}$)]	Resistance ($\text{k}\Omega$)
-40(-40)	40.93 ~ 48.35
-20(-4)	13.89 ~ 16.03
0(32)	5.38 ~ 6.09
20(68)	2.31 ~ 2.57
40(104)	1.08 ~ 1.21
60(140)	0.54 ~ 0.62
80(176)	0.29 ~ 0.34

Engine Control System

FL-69

Circuit Diagram

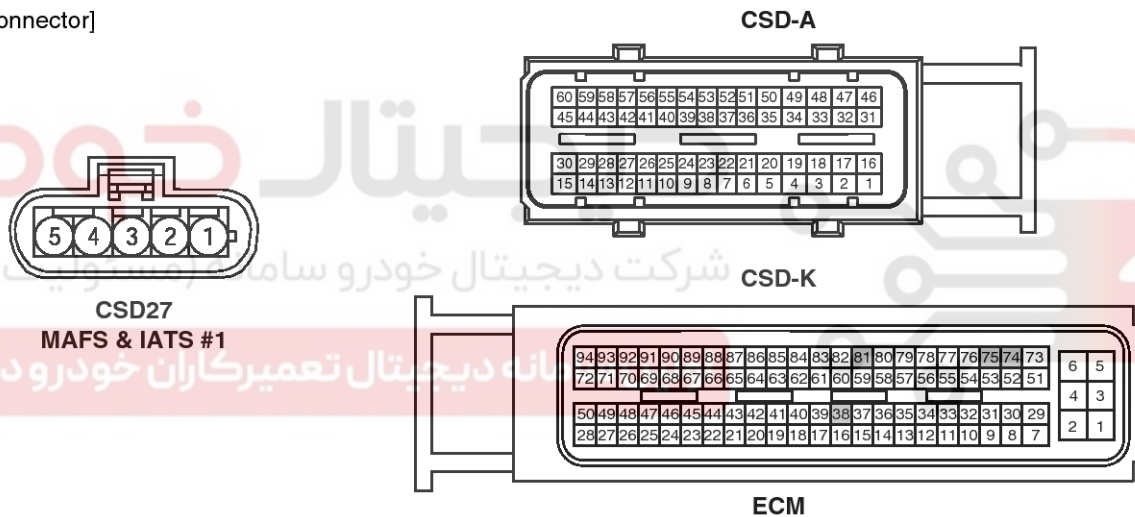
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CSD-K (81)	Sensor Ground
3	ECM CSD-K (38)	IATS #1 Signal
4	ECM CSD-K (75)	Reference Frequency
5	ECM CSD-K (74)	MAFS Signal

[Harness Connector]



SHMF29118L

FL-70

Fuel System

[Circuit Diagram]

BPS & IATS #2 (E34)

ECM (CSD-A)

[Connection Information]

Terminal	Connected to	Function
1	ECM CSD-A (41)	BPS Signal
2	ECM CSD-A (26)	Sensor Power (+5V)
3	ECM CSD-A (7)	IATS #2 Signal
4	ECM CSD-A (56)	Sensor Ground

[Harness Connector]

E34
BPS & IATS #2

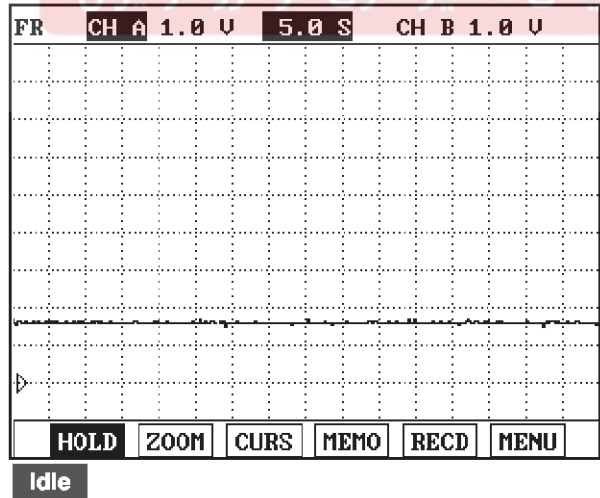
CSD-A

CSD-K

ECM

SHMF29122L

Signal Waveform



SENFL7125L

Component Inspection

1. Turn ignition switch OFF.
2. Disconnect the MAFS (for IATS #1) or BPS (for IATS #2) connector.
3. Measure resistance between IATS signal terminal and sensor ground terminal.
4. Check that the resistance is within the specification.

Specification: Refer to "SPECIFICATION"

Engine Control System

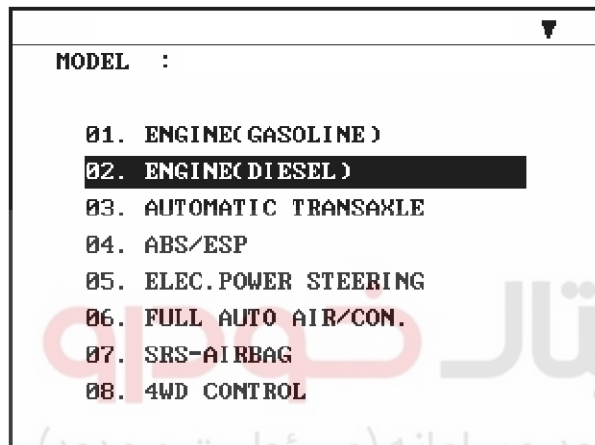
FL-71

Replacement

⚠CAUTION

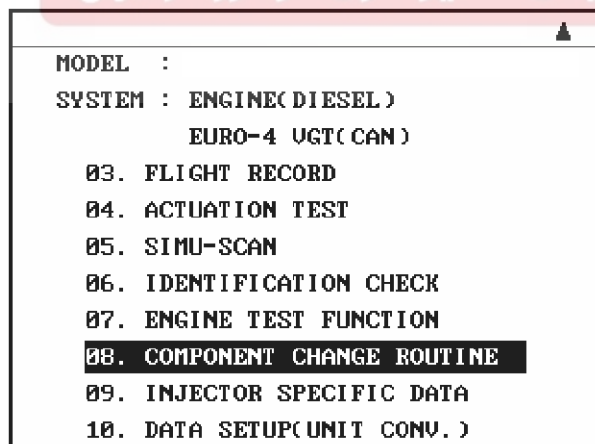
After replacing the Intake Air Temperature Sensor (IATS) #1, MUST perform the "COMPONENT CHANGE ROUTINE" procedure. Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".



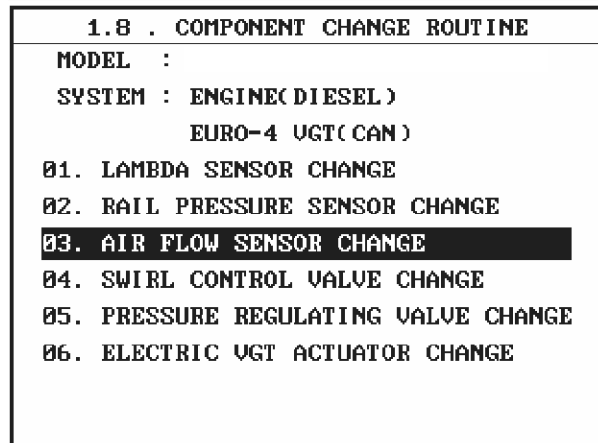
SHMF29123L

5. Select "COMPONENT CHANGE ROUTINE".



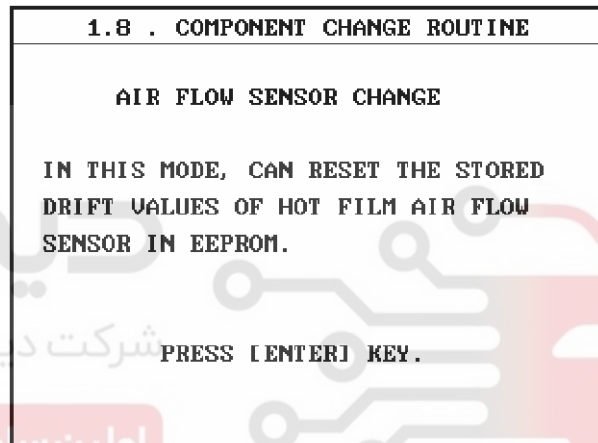
SHMF29124L

6. Select "AIR FLOW SENSOR CHANGE".



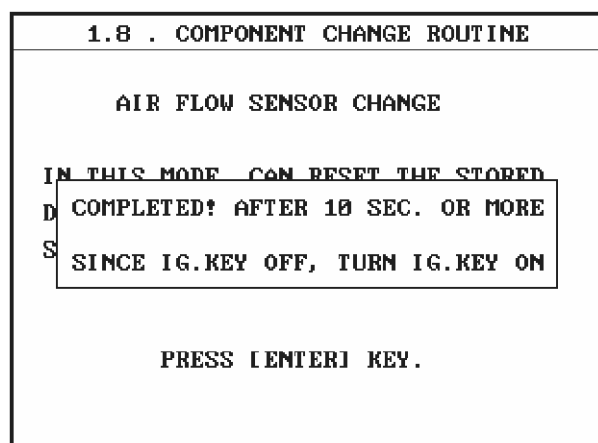
SHMF29125L

7. Confirm the message, and then press "ENTER" key.



SENFL7196L

8. Confirm the "Complete" message, and then turn ignition switch OFF.



SENFL7197L

9. Wait for more than 10 seconds, and then turn ignition switch ON.

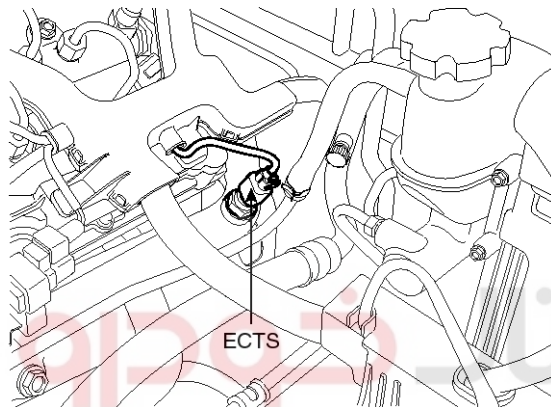
FL-72

Fuel System

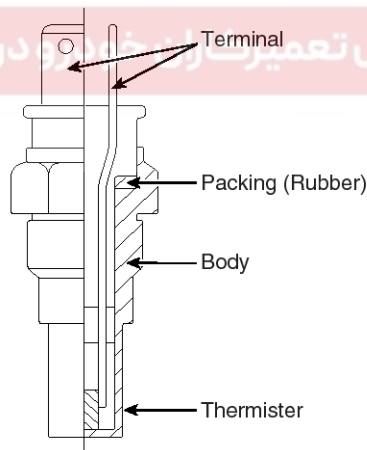
Engine Coolant Temperature Sensor (ECTS)

Function And Operation Principle

The Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage of the cylinder for detecting the engine coolant temperature. The ECTS uses a thermistor which resistance is in inverse proportion to the temperature (NTC: Negative Temperature Coefficient). During cold engine operation, the ECM adjusts the injection amount and the timing by using this ECTS output signal to avoid engine stalling and improve drivability.



SHMFL8103D



EGRF241A

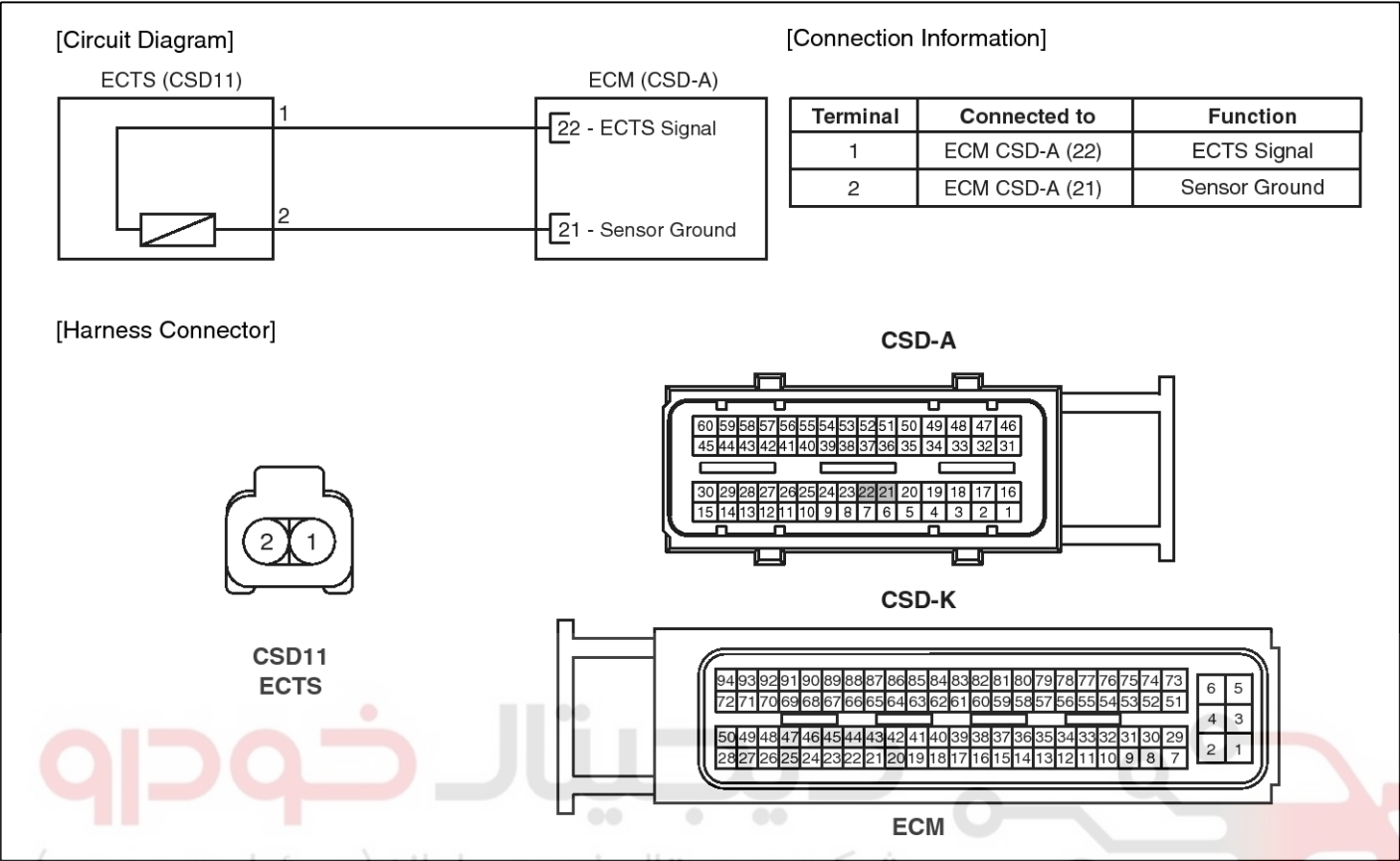
Specification

Temperature [$^{\circ}\text{C}$ ($^{\circ}\text{F}$)]	Resistance ($\text{k}\Omega$)
-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

Engine Control System

FL-73

Circuit Diagram



Component Inspection

1. Turn ignition switch OFF.

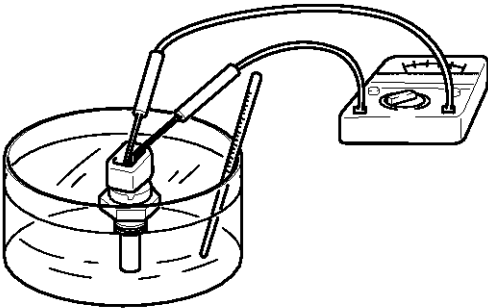
2. Disconnect the engine coolant temperature sensor connector.

3. Remove the sensor.

4. After immersing the thermistor of the sensor into engine coolant, measure resistance between ECTS signal terminal and ground terminal.

5. Check that the resistance is within the specification.

Specification: Refer to "SPECIFICATION"



EFNF541A

SHMF29126L

FL-74

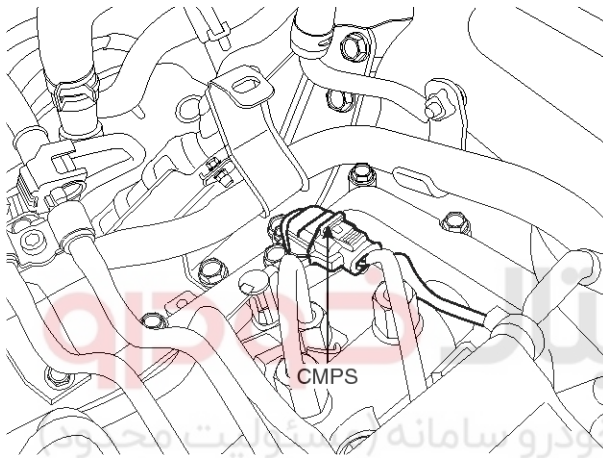
Fuel System

Camshaft Position Sensor (CMPS)

Function And Operation Principle

The Camshaft Position Sensor (CMPS) is installed on the cylinder head cover and detects the camshaft position. This is a hall sensor and has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow.

It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of the each cylinder which the CKPS can't detect. By using this signal, the ECM perceives the position of each cylinder and controls sequential injection.



SENFL7107D

Specification

Level	Output Voltage (V)
High	5
Low	0

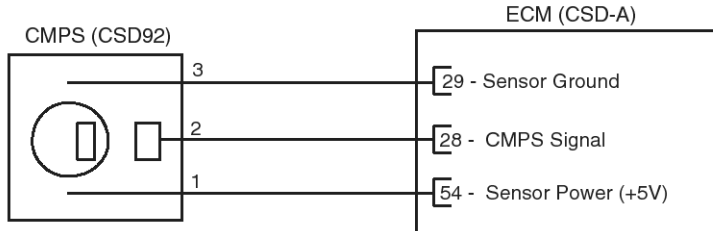
Item	Specification
Air gap (mm)	0.5 ~ 1.5

Engine Control System

FL-75

Circuit Diagram

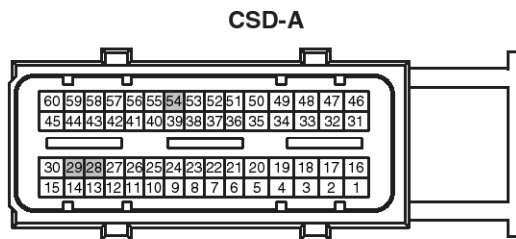
[Circuit Diagram]



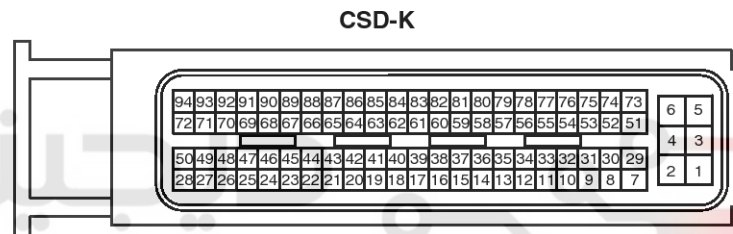
[Connection Information]

Terminal	Connected to	Function
1	ECM CSD-A (54)	Sensor Power (+5V)
2	ECM CSD-A (28)	CMPS Signal
3	ECM CSD-A (29)	Sensor Ground

[Harness Connector]

CSD92
CMPS

CSD-A

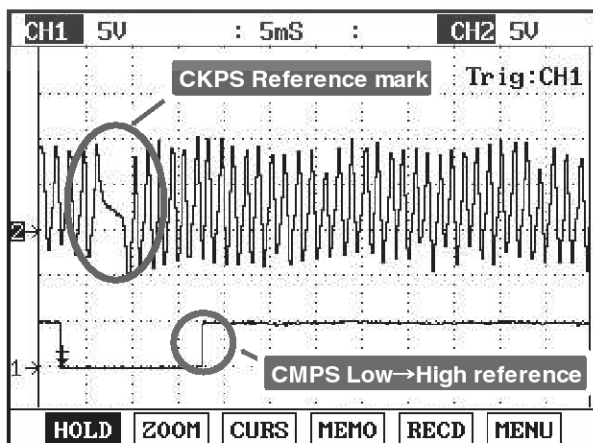


CSD-K

ECM

SHMF29127L

Signal Waveform



SENFL7128L

Component Inspection

1. Check signal waveform of CMPS and CKPS using a scan tool.

Specification: Refer to "SIGNAL WAVE FORM"

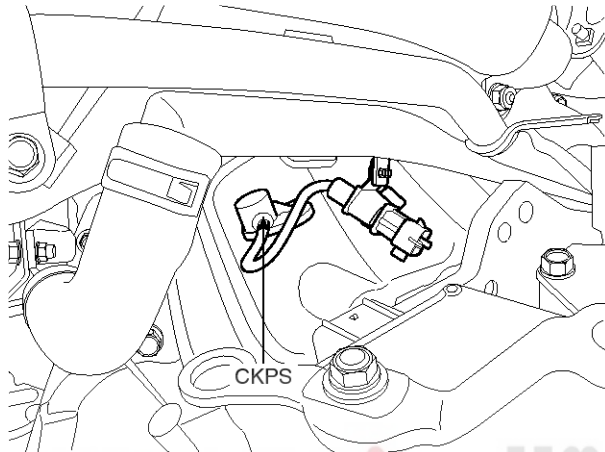
FL-76

Fuel System

Crankshaft Position Sensor (CKPS)

Function And Operation Principle

The Crankshaft Position Sensor (CKPS) is installed on the transaxle housing and detects the crankshaft position. By using this signal, the ECM can calculate the piston position of each cylinder and the engine speed for sequential injection.



SENFL7106D

Specification

Items	Specification
Coil Resistance (Ω)	774 ~ 946 [20°C (68°F)]
Air Gap (mm)	0.5 ~ 1.5

دیجیتال خودرو
شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

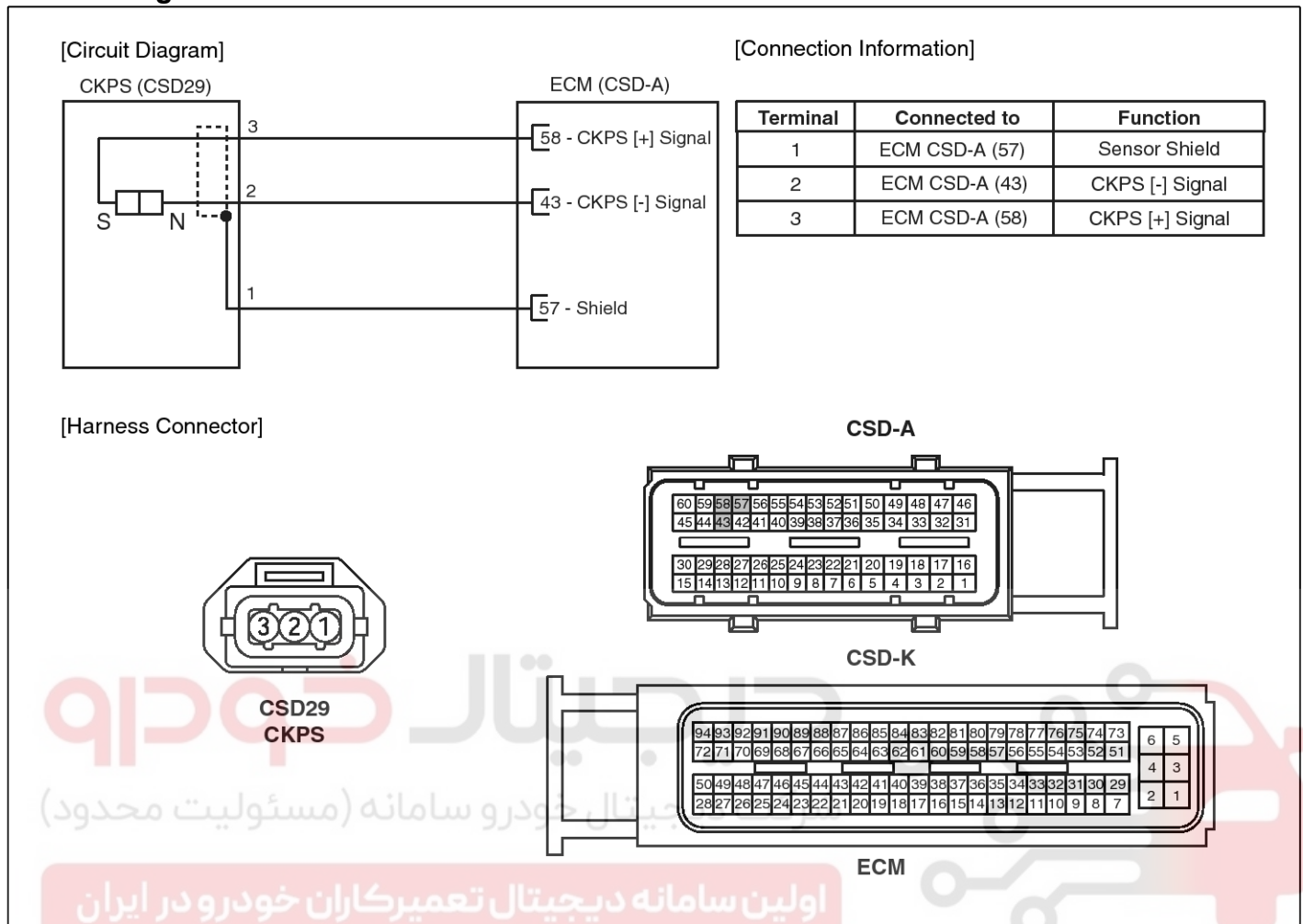
اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



Engine Control System

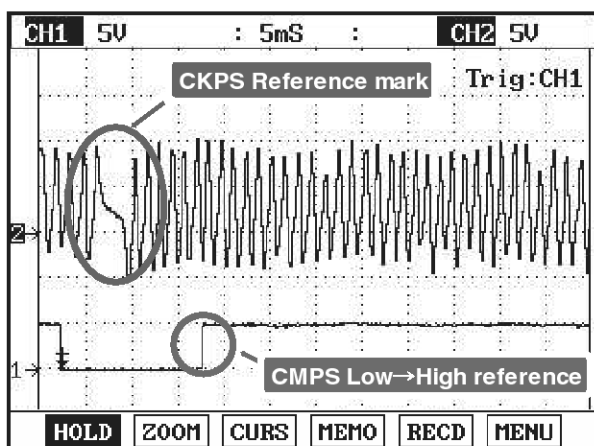
FL-77

Circuit Diagram



SHMF29128L

Signal Waveform



SENFL7128L

Component Inspection

1. Check signal waveform of CMPS and CKPS using a scan tool.

Specification: Refer to "SIGNAL WAVE FORM"

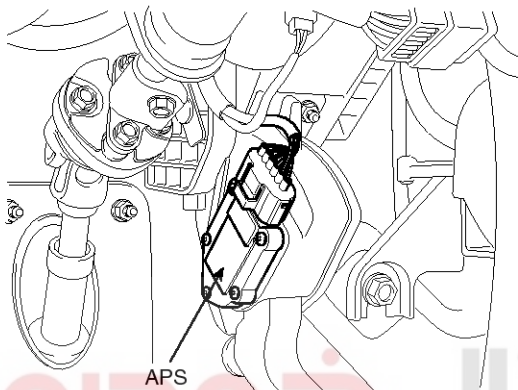
FL-78

Fuel System

Accelerator Position Sensor (APS)

Function And Operation Principle

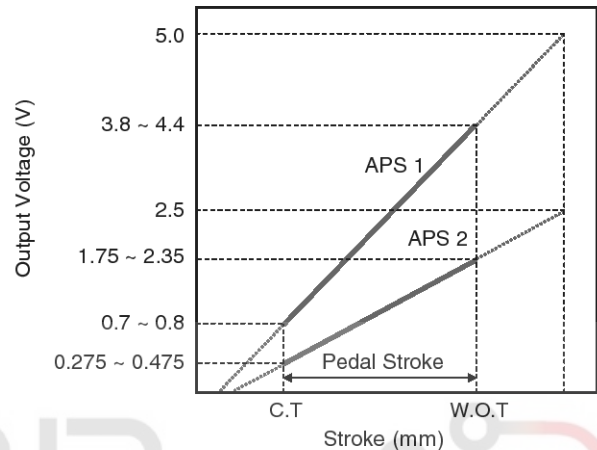
The Accelerator Pedal Position Sensor (APS) is installed on the accelerator pedal assembly and consists of the two potentiometers which have independent circuit (power, signal output, and ground) individually. This system makes the ECM recognize the driver's intention even if one sensor is broken. Also the ECM can diagnose the sensor by comparing the two sensor's signal.



SHMFL8106D

Specification

Pedal Position	Output Voltage(V) [Vref = 5.0V]	
	APS1	APS2
Released	0.7 ~ 0.8	0.275 ~ 0.475
Fully depressed	3.8 ~ 4.4	1.75 ~ 2.35



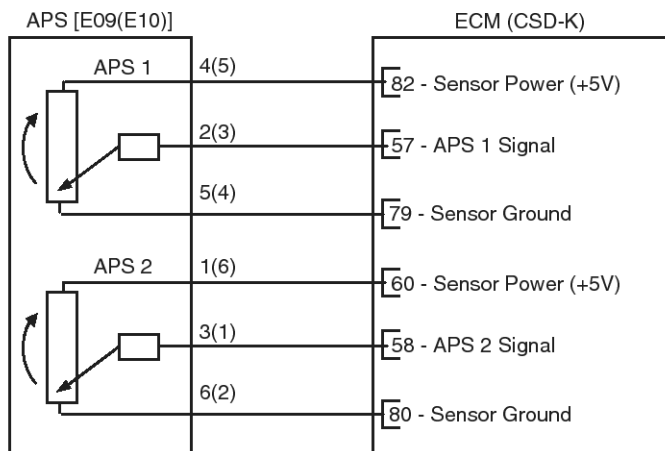
SENFL7130L

Engine Control System

FL-79

Circuit Diagram

[Circuit Diagram]



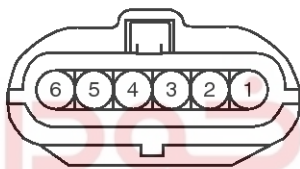
* () : Non-Adjustable pedal

[Connection Information]

Terminal	Connected to	Function
1(6)	ECM CSD-K (60)	APS 2 Sensor Power (+5V)
2(3)	ECM CSD-K (57)	APS 1 Signal
3(1)	ECM CSD-K (58)	APS 2 Signal
4(5)	ECM CSD-K (82)	APS 1 Sensor Power (+5V)
5(4)	ECM CSD-K (79)	APS 1 Sensor Ground
6(2)	ECM CSD-K (80)	APS 2 Sensor Ground

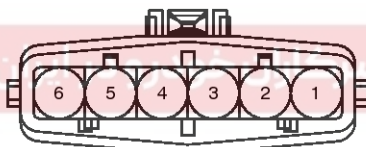
* () : Non-Adjustable pedal

[Harness Connector]



E09

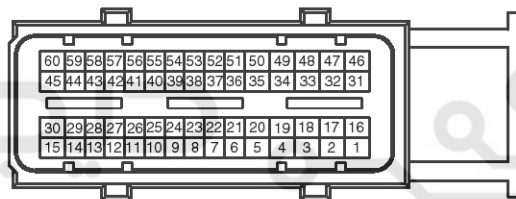
Adjustable pedal



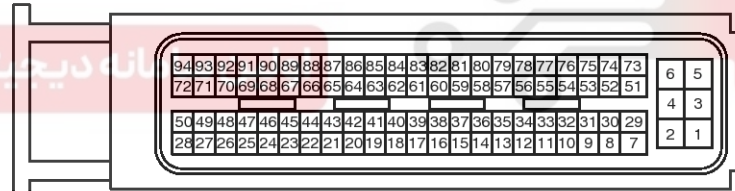
E10

Non-Adjustable pedal

CSD-A

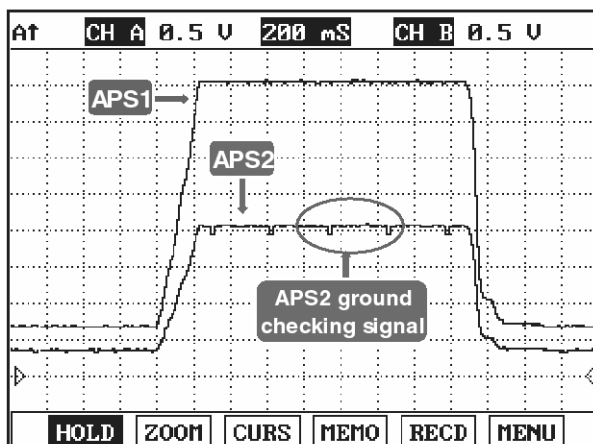


CSD-K



ECM

Signal Waveform



SHMF29129L

SENFL7132L

FL-80

Fuel System

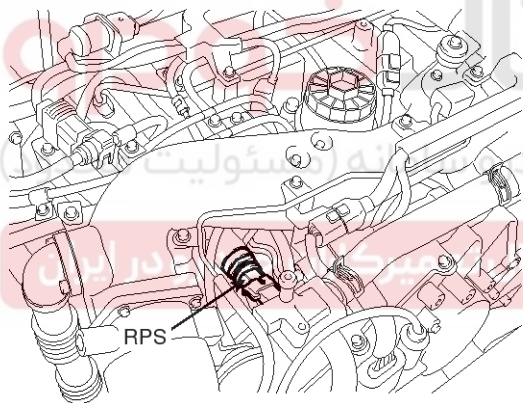
Rail Pressure Sensor (RPS)

Function And Operation Principle

The Rail Pressure Sensor (RPS) is installed at the end of the common rail (bank 1) and measures the instantaneous fuel pressure in the common rail. The sensing element (semiconductor device) built in the sensor converts the pressure to voltage signal. By using this signal, the ECM can control correct injection amount and timing. And it adjusts the rail pressure with the rail pressure regulator valve if the target pressure and the actual pressure calculated by the RPS output signal are different.

⚠CAUTION

After replacing the Rail Pressure Sensor (RPS), **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure (Refer to "REPLACEMENT" procedure). Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.



SHMFL8104D

Specification

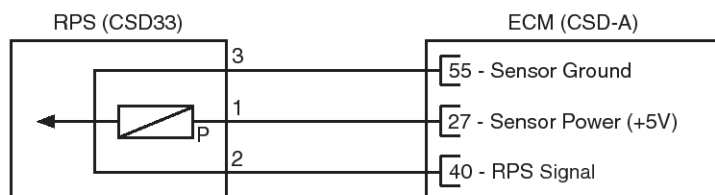
Condition	Rail pressure (bar)	Output Voltage (V)
Idle	200 ~ 300	Below 1.7
3,000 rpm	450 ~ 650	1.5 ~ 1.9
Accelerator pedal fully depressed	About 1600	About 4.5

Engine Control System

FL-81

Circuit Diagram

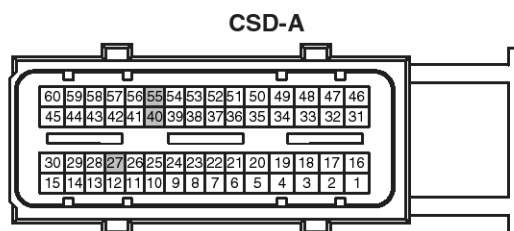
[Circuit Diagram]



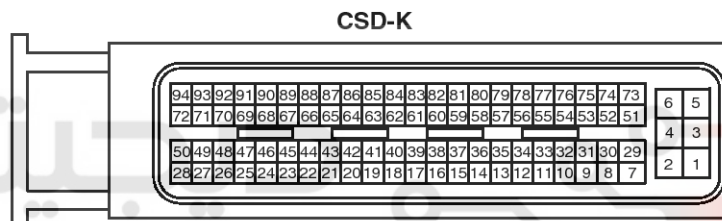
[Connection Information]

Terminal	Connected to	Function
1	ECM CSD-A (27)	Sensor Power (+5V)
2	ECM CSD-A (40)	RPS Signal
3	ECM CSD-A (55)	Sensor Ground

[Harness Connector]

CSD33
RPS

CSD-A

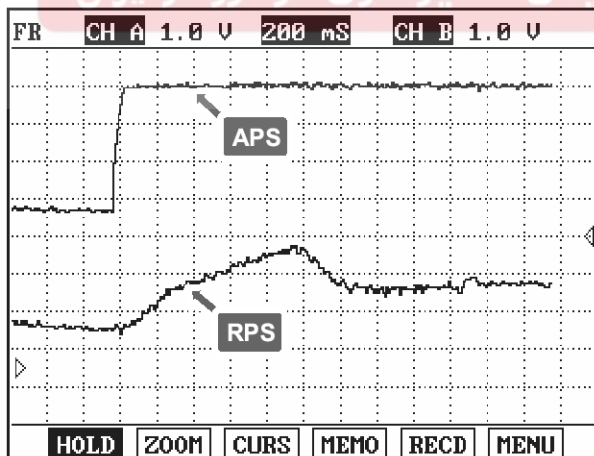


CSD-K

ECM

SHMF29130L

Signal Waveform



During Acceleration

SENFL7134L

FL-82

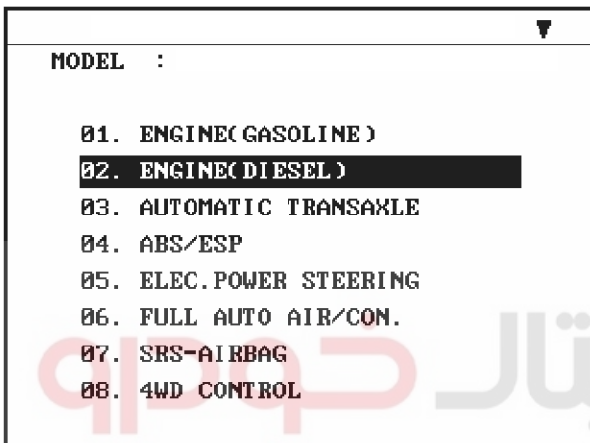
Fuel System

Replacement

⚠CAUTION

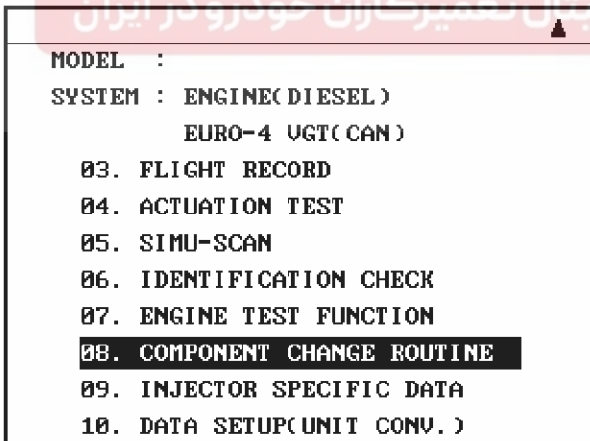
After replacing the Rail Pressure Sensor (RPS), **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure. Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".



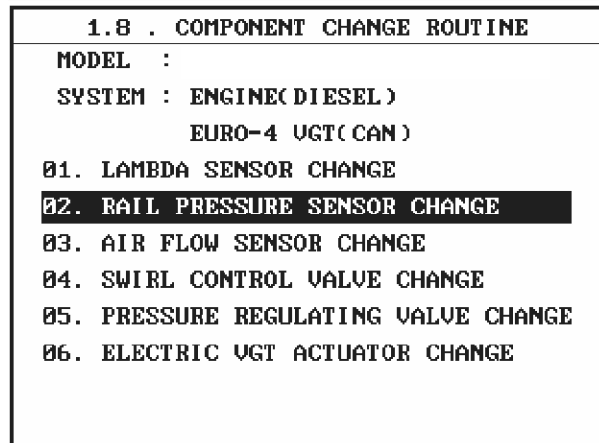
SHMF29131L

5. Select "COMPONENT CHANGE ROUTINE".



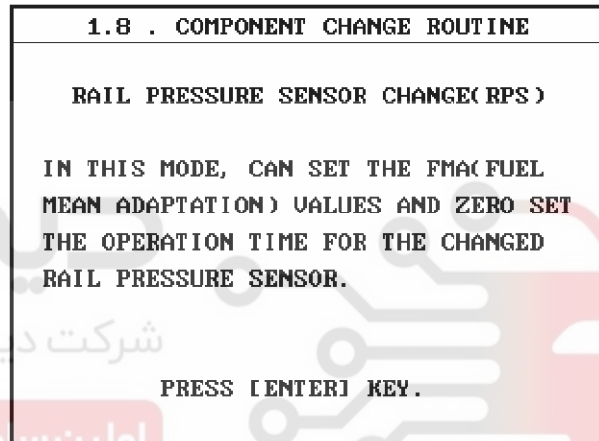
SHMF29132L

6. Select "RAIL PRESSURE SENSOR CHANGE".



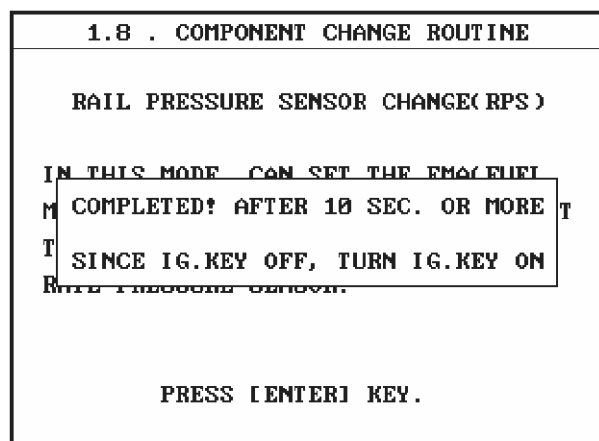
SHMF29133L

7. Confirm the message, and then press "ENTER" key.



SENFL7601L

8. Confirm the "Complete" message, and then turn ignition switch OFF.



SENFL7602L

9. Wait for more than 10 seconds, and then turn ignition switch ON.

Engine Control System

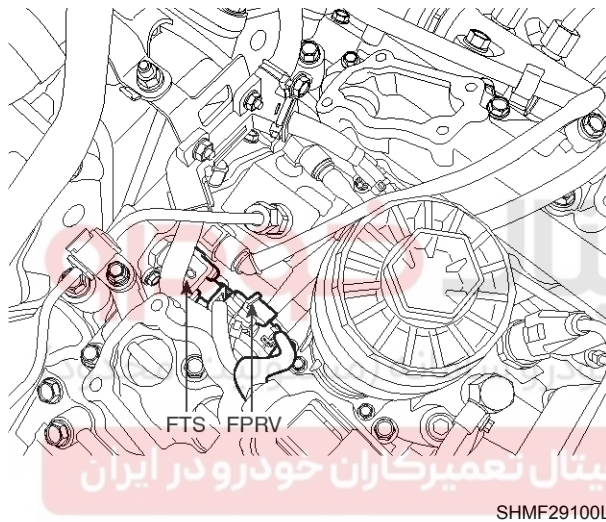
FL-83

Fuel Temperature Sensor (FTS)

Function And Operation Principle

The Fuel Temperature Sensor (FTS) is installed on the high pressure fuel pump and measures the temperature of the fuel supplied from the fuel tank (via fuel filter). The FTS uses a thermistor which resistance is in inverse proportion to the temperature (NTC: Negative Temperature Coefficient). With this signal, the ECM can adjust the injection amount.

At high temperature, vapor-lock in fuel line or oil membrane destruction may appear. Especially oil membrane destruction deteriorates fuel's lubrication performance and it may damage the high pressure fuel pump and the injector.



Specification

Temperature [$^{\circ}\text{C}$ ($^{\circ}\text{F}$)]	Resistance($\text{k}\Omega$)
-10(14)	8.64 ~ 10.15
20(68)	2.35 ~ 2.65
80(176)	0.31 ~ 0.33
120(248)	0.11 ~ 0.12

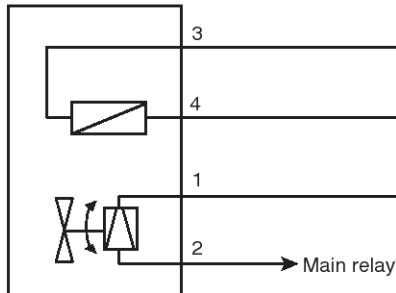
FL-84

Fuel System

Circuit Diagram

[Circuit Diagram]

FTS & FPRV (CSD32)

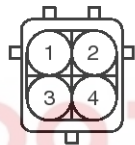
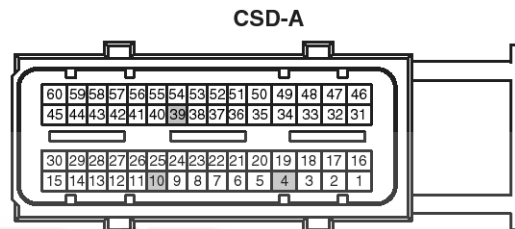


ECM (CSD-A)

[Connection Information]

Terminal	Connected to	Function
1	ECM CSD-A (4)	Valve control
2	Main relay	Power supply (B+)
3	ECM CSD-A (39)	Sensor ground
4	ECM CSD-A (10)	FTS signal

[Harness Connector]

CSD32
FTS & FPRV

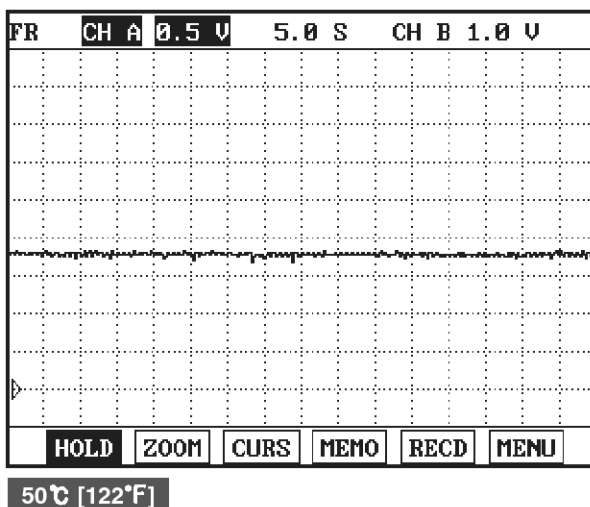
CSD-K



ECM

SHMF29134L

Signal Waveform



SENFL7136L

Component Inspection

1. Turn ignition switch OFF.
2. Disconnect the fuel temperature sensor connector.
3. Measure resistance between sensor signal terminal and ground terminal.
4. Check that the resistance is within the specification.

Specification: Refer to "SPECIFICATION"

Engine Control System

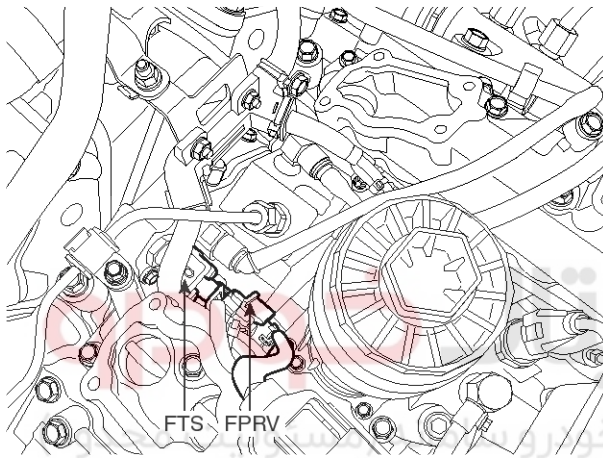
FL-85

Fuel Pressure Control Valve

Function And Operation Principle

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail (bank 2) respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.



SHMF29100L

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

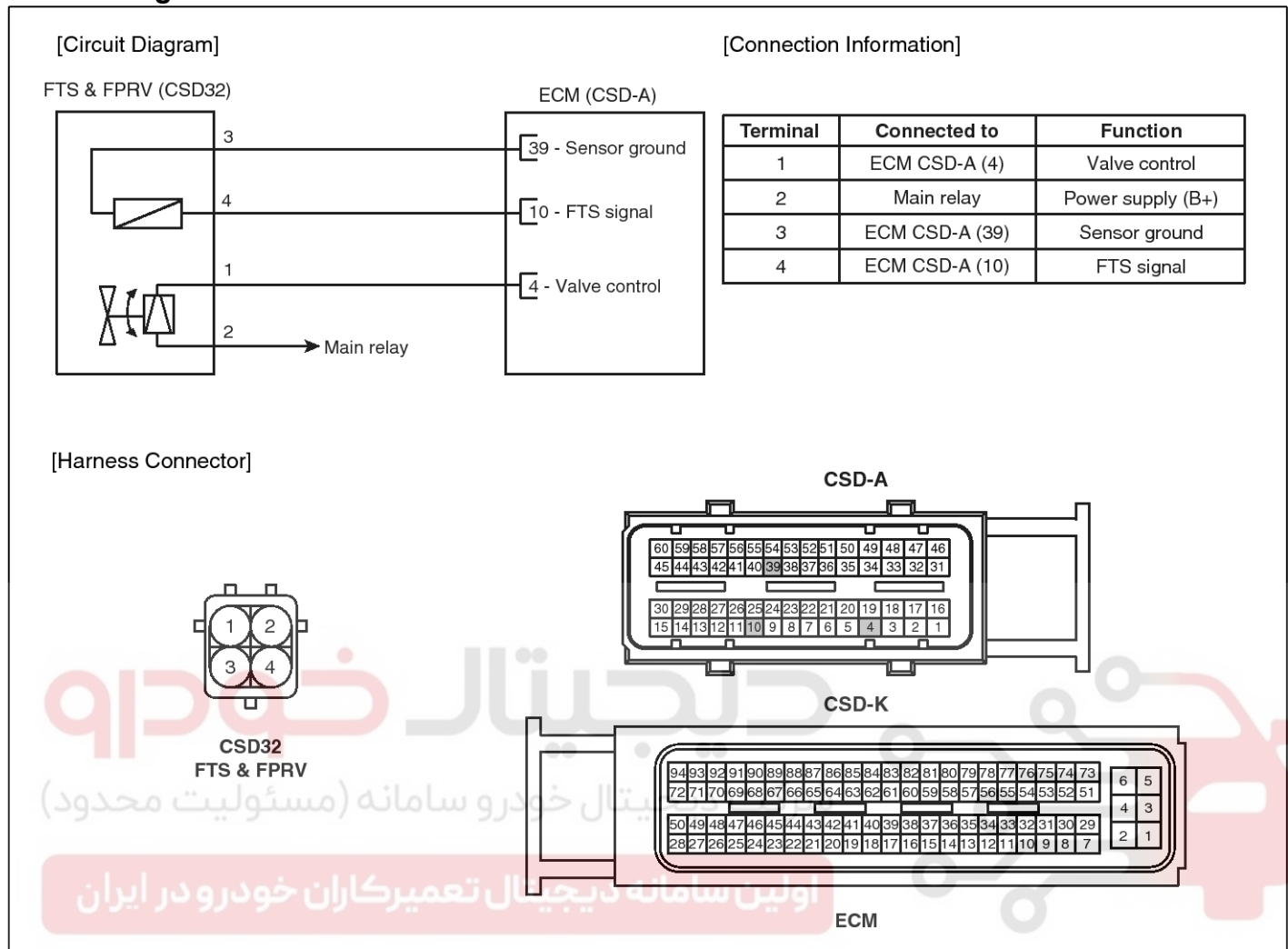
Specification

Item	Specification
Coil Resistance (Ω)	2.9 ~ 3.15 [20°C (68°F)]

FL-86

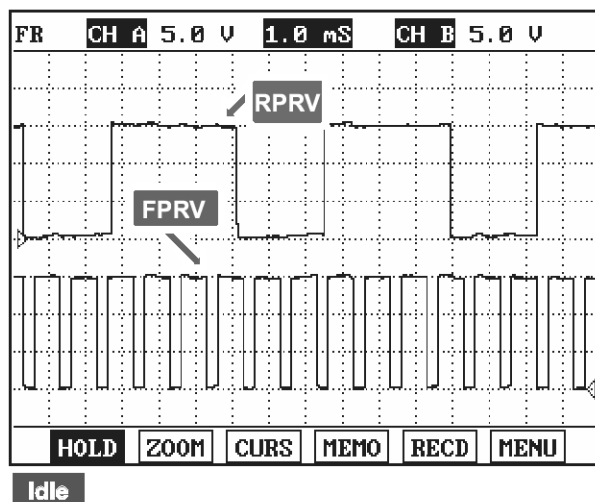
Fuel System

Circuit Diagram



SHMF29134L

Signal Waveform



SENFL7138L

Component Inspection

1. Turn ignition switch OFF.
2. Disconnect the fuel pressure regulator valve connector.
3. Measure resistance between terminal 1 and 2 of the valve.
4. Check that the resistance is within the specification.

Specification: Refer to "SPECIFICATION"

Engine Control System

FL-87

Rail Pressure Regulator Valve

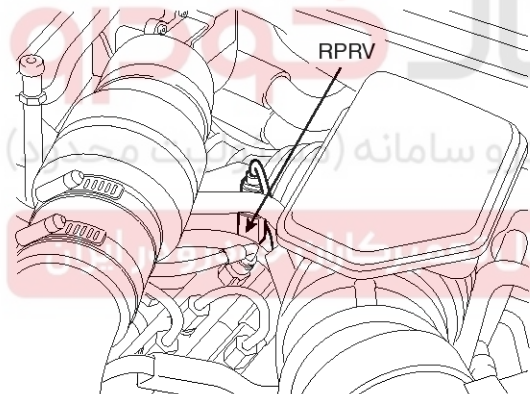
Function And Operation Principle

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail (bank 2) respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

⚠ CAUTION

After replacing the Rail Pressure Regulator Valve, **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure (Refer to "REPLACEMENT" procedure). Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.



SHMF29105L

Specification

Items	Specification
Coil Resistance (Ω)	3.42 ~ 3.78 [20°C (68°F)]
Operating Current (A)	0 ~ 1.7

FL-88

Fuel System

Circuit Diagram

[Circuit Diagram]

[Connection Information]

Terminal	Connected to	Function
1	ECM CSD-A (5)	Valve Control
2	Main Relay	Power Supply (B+)

[Harness Connector]

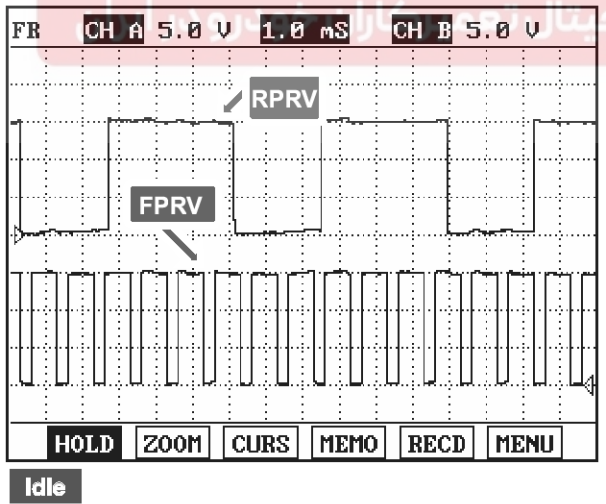
CSD34 RPRV

CSD-A

CSD-K

ECM

Signal Waveform



SENFL7140L

Component Inspection

1. Turn ignition switch OFF.
2. Disconnect the rail pressure regulator valve connector.
3. Measure resistance between terminal 1 and 2 of the valve.
4. Check that the resistance is within the specification.

Specification: Refer to "SPECIFICATION"

SHMF29135L

Engine Control System

FL-89

Replacement

⚠CAUTION

After replacing the Rail Pressure Regulator Valve, **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure. Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".

MODEL :

- 01. ENGINE (GASOLINE)
- 02. ENGINE (DIESEL)**
- 03. AUTOMATIC TRANSAXLE
- 04. ABS/ESP
- 05. ELEC. POWER STEERING
- 06. FULL AUTO AIR/CON.
- 07. SRS-AIRBAG
- 08. 4WD CONTROL

SHMF29136L

5. Select "COMPONENT CHANGE ROUTINE".

MODEL

SYSTEM : ENGINE (DIESEL)

EURO-4 UGT (CAN)

- 03. FLIGHT RECORD
- 04. ACTUATION TEST
- 05. SIMU-SCAN
- 06. IDENTIFICATION CHECK
- 07. ENGINE TEST FUNCTION
- 08. COMPONENT CHANGE ROUTINE**
- 09. INJECTOR SPECIFIC DATA
- 10. DATA SETUP (UNIT CONV.)

SHMF29137L

6. Select "PRESSURE REGULATING VALVE CHANGE".

1.8 . COMPONENT CHANGE ROUTINE

MODEL :

SYSTEM : ENGINE (DIESEL)

EURO-4 UGT (CAN)

- 01. LAMBDA SENSOR CHANGE
- 02. RAIL PRESSURE SENSOR CHANGE
- 03. AIR FLOW SENSOR CHANGE
- 04. SWIRL CONTROL VALVE CHANGE
- 05. PRESSURE REGULATING VALVE CHANGE**
- 06. ELECTRIC UGT ACTUATOR CHANGE

SHMF29138L

7. Confirm the message, and then press "ENTER" key.

1.8 . COMPONENT CHANGE ROUTINE

PRESSURE REGULATING VALVE CHANGE

IN THIS MODE, CAN RESET THE STORED LEARNING VALUES IN ECU.

PRESS [ENTER] KEY.

SENFL7606L

8. Confirm the "Complete" message, and then turn ignition switch OFF.

1.8 . COMPONENT CHANGE ROUTINE

PRESSURE REGULATING VALVE CHANGE

IN THIS MODE CAN RESET THE STORED COMPLETED! AFTER 10 SEC. OR MORE SINCE IG.KEY OFF, TURN IG.KEY ON

SENFL7607L

9. Wait for more than 10 seconds, and then turn ignition switch ON.

FL-90

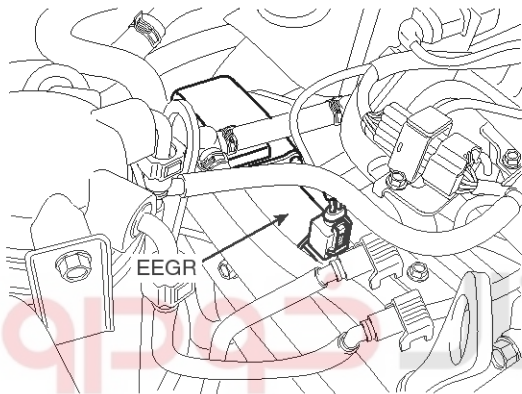
Fuel System

Electric EGR Control Valve

Function And Operation Principle

The Electric EGR Control Valve is installed in between the EGR cooler and the exhaust line and is a solenoid valve. This valve controls EGR (Exhaust Gas Recirculation) amount by the ECM's duty control signal depending on engine load and the need of intake air.

The Exhaust Gas Recirculation (EGR) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.



SHMFL8111D

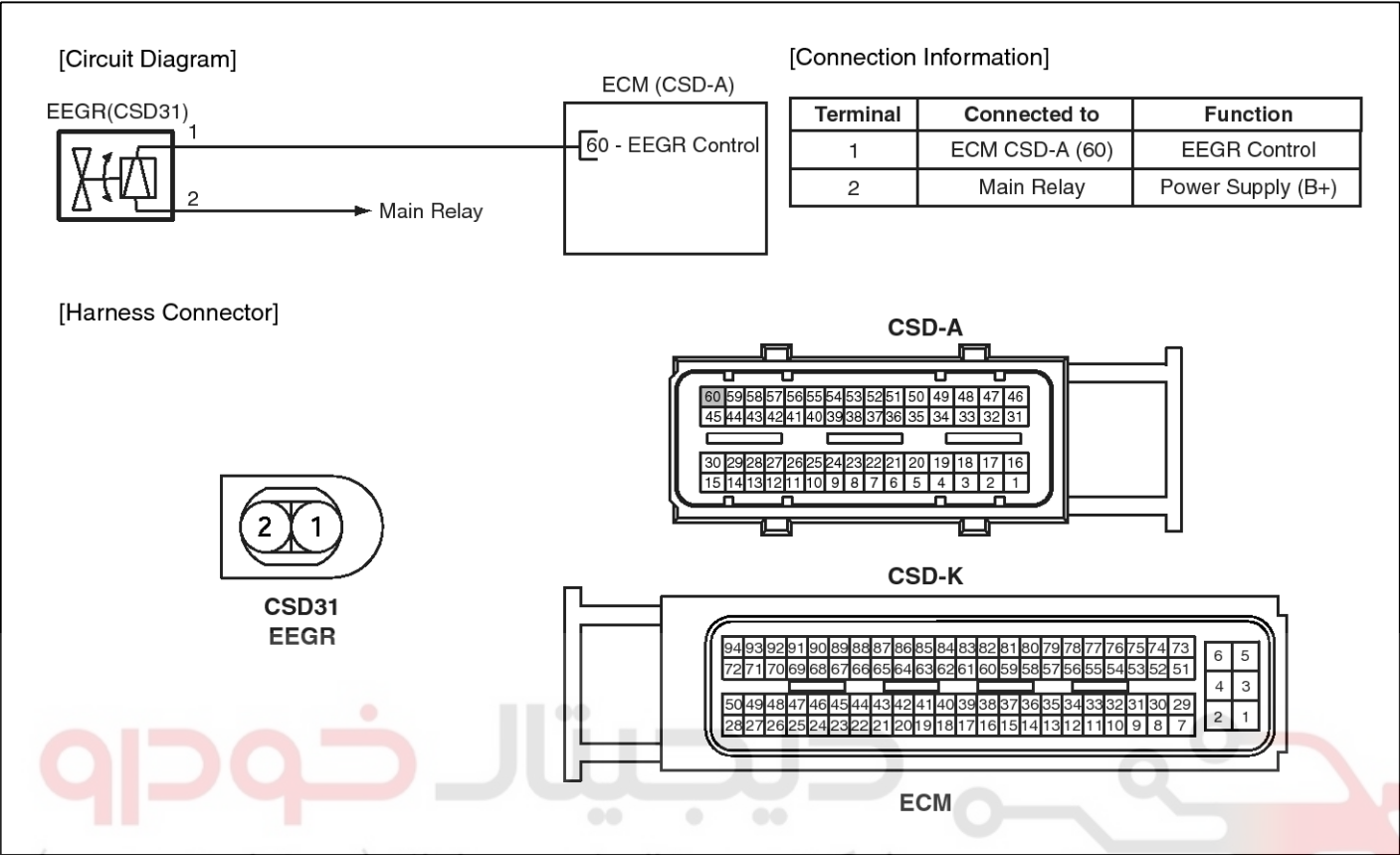
Specification

Item	Specification
Coil Resistance (Ω)	7.3 ~ 8.3 [20°C (68°F)]

Engine Control System

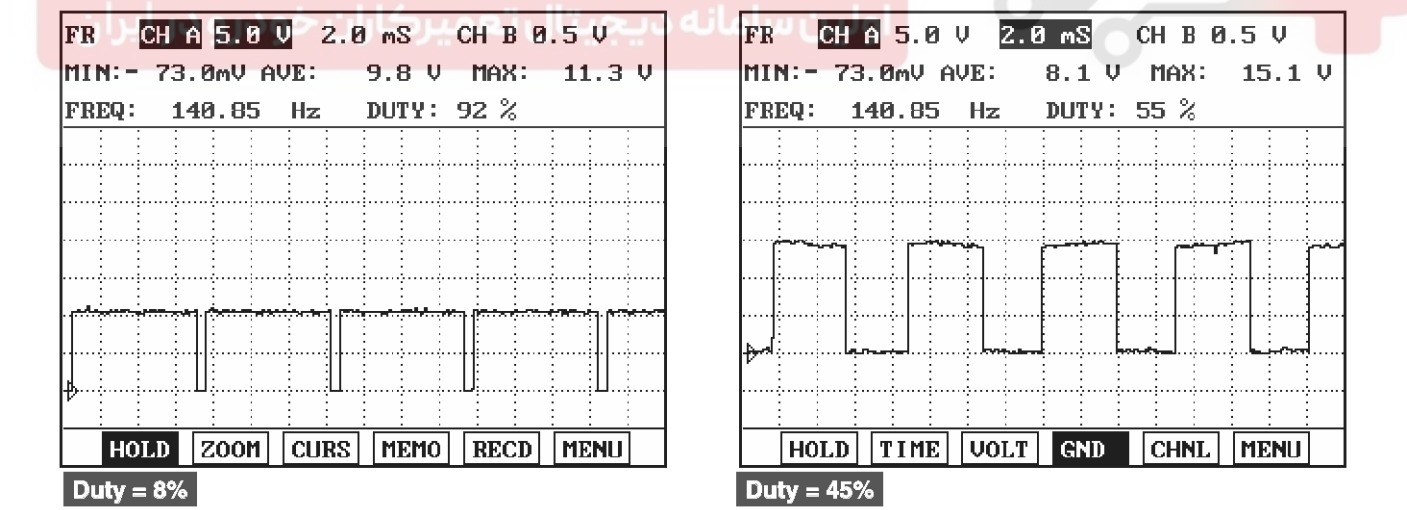
FL-91

Circuit Diagram



SHMF29139L

Signal Waveform



SENFL7142L

Component Inspection

1. Turn ignition switch OFF.

2. Disconnect the electric EGR control valve connector.

3. Measure resistance between terminal 1 and 2 of the valve.

4. Check that the resistance is within the specification.

Specification: Refer to "SPECIFICATION"

FL-92

Fuel System

Variable Swirl Actuator

Function And Operation Principle

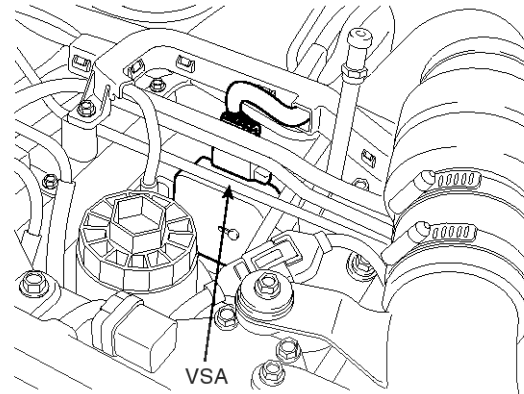
The Variable Swirl Actuator is installed in between the two intake manifolds (bank 1 and 2) and consists of a DC motor which actuates the swirl valve and a position sensor which detects the position of the swirl valve. This swirl system optimizes air flow entering into combustion chamber of each cylinder in accordance with the various engine conditions.

[At High Speed or High Load] Swirl valve opening → Swirl amount decreasing → Swirl effect increasing → Pumping loss decreasing → Engine power increasing


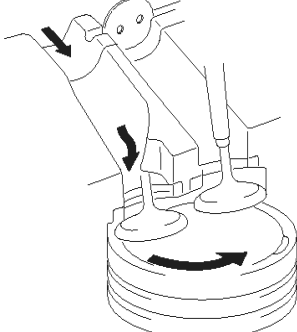
[At Low/Middle Speed or Low Load] Swirl valve closing → Swirl amount increasing → Air/fuel mixture increasing → EGR amount enlarging → Emission reducing

⚠ CAUTION

After replacing the Variable Swirl Actuator, **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure (Refer to "REPLACEMENT" procedure). Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.



SHMF29106L

Items	High Speed or High Load	Low/Middle Speed or Low Load
Engine Speed	More than 3,000rpm	Less than 3,000rpm
Swirl Valve	Opening	Closing
Swirl Quantity	Little	Much
Effect	Swirl effect increasing → Pumping loss decreasing → Engine power increasing	Air/Fuel mixture increasing → EGR amount enlarging → Emission reducing
Description illustration		
Fail-safe	Fully opened	

ⓘ NOTICE

To prevent the swirl valve and its shaft from being stuck by foreign material and to learn maximum opening and closing position of the valve, the ECM fully opens and closes the valve twice when engine is being stopped.

Engine Control System

FL-93

Specification

Motor

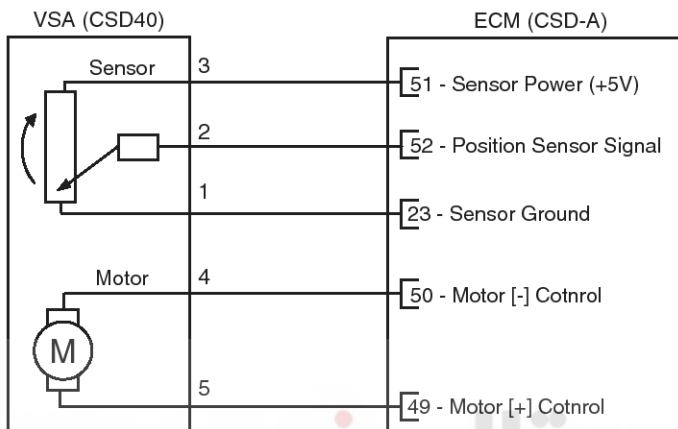
Item	Specification
Coil Resistance (Ω)	3.4 ~ 4.4 [20°C (68°F)]

Position Sensor

Item	Specification
Coil Resistance ($k\Omega$)	3.44 ~ 5.16 [20°C (68°F)]

Circuit Diagram

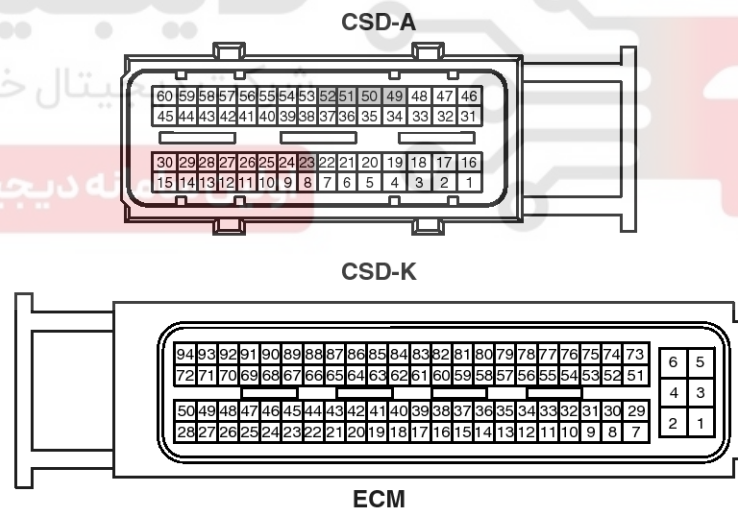
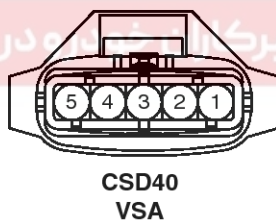
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CSD-A (23)	Sensor Ground
2	ECM CSD-A (52)	Position Sensor Signal
3	ECM CSD-A (51)	Sensor Power (+5V)
4	ECM CSD-A (50)	Motor [-] Control
5	ECM CSD-A (49)	Motor [+] Control

[Harness Connector]

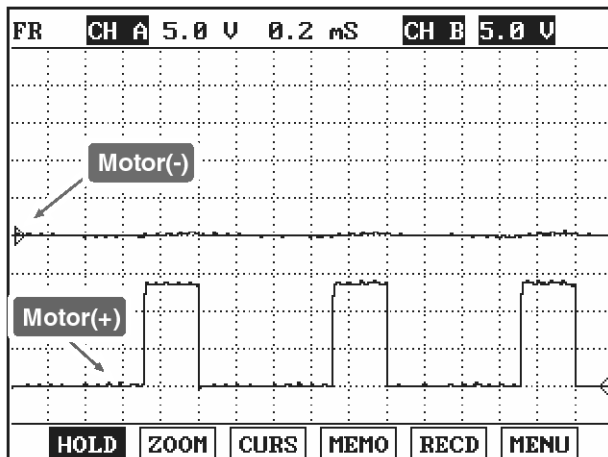


SHMF29140L

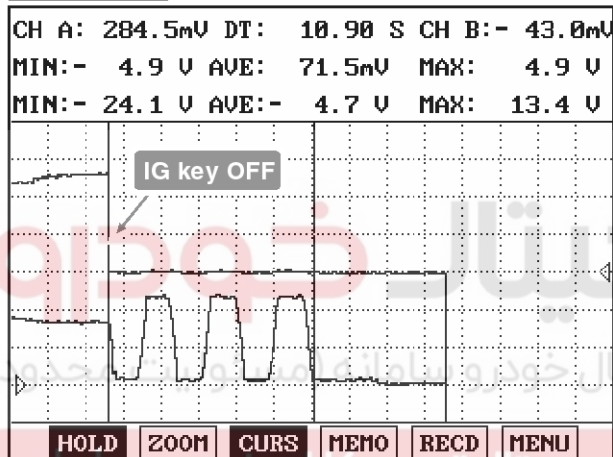
FL-94

Fuel System

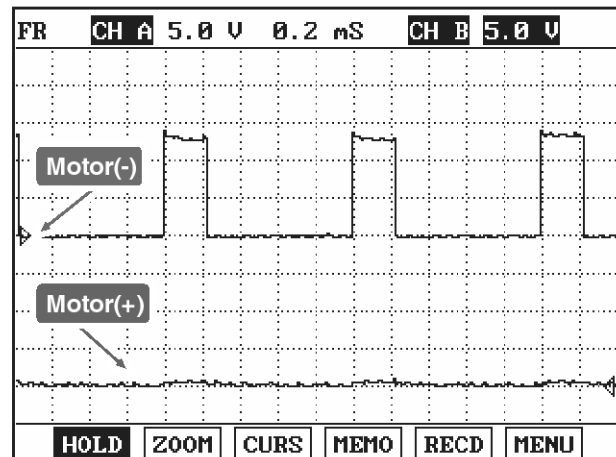
Signal Waveform



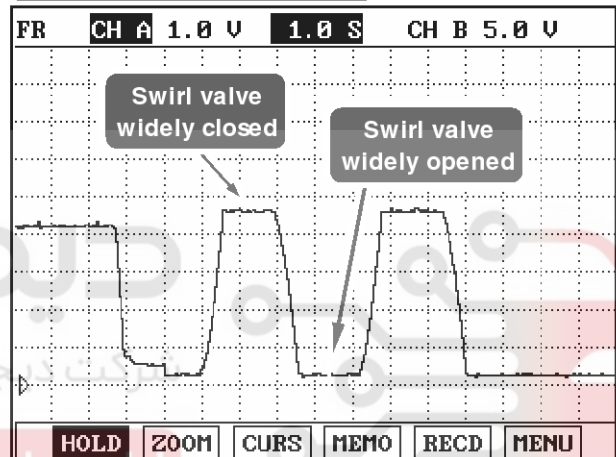
Idle - Closed



Position sensor signal at IG OFF



During Acceleration - Opened



During learning of valve position

SENFL7144L

Component Inspection

1. Turn ignition switch OFF.
2. Disconnect the electric variable swirl control actuator connector.
3. Check that swirl valve is stuck by foreign material.
4. Measure resistance between motor (+) and (-) control terminals of the motor.
5. Check that the resistance is within the specification.

Specification: Refer to "SPECIFICATION"

6. Measure resistance between voltage supply terminal and ground terminal of the position sensor.
7. Check that the resistance is within the specification.

Specification: Refer to "SPECIFICATION"

Engine Control System

FL-95

Replacement

⚠CAUTION

After replacing the Variable Swirl Control Actuator, **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure. Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".

MODEL :

- 01. ENGINE (GASOLINE)
- 02. ENGINE (DIESEL)**
- 03. AUTOMATIC TRANSAXLE
- 04. ABS/ESP
- 05. ELEC. POWER STEERING
- 06. FULL AUTO AIR/CON.
- 07. SRS-AIRBAG
- 08. 4WD CONTROL

SHMF29141L

5. Select "COMPONENT CHANGE ROUTINE".

MODEL :

SYSTEM : ENGINE (DIESEL)

EURO-4 UGT (CAN)

- 03. FLIGHT RECORD
- 04. ACTUATION TEST
- 05. SIMU-SCAN
- 06. IDENTIFICATION CHECK
- 07. ENGINE TEST FUNCTION
- 08. COMPONENT CHANGE ROUTINE**
- 09. INJECTOR SPECIFIC DATA
- 10. DATA SETUP (UNIT CONV.)

SHMF29142L

6. Select "SWIRL CONTROL VALVE CHANGE".

1.8 . COMPONENT CHANGE ROUTINE

MODEL :

SYSTEM : ENGINE (DIESEL)

EURO-4 UGT (CAN)

- 01. LAMBDA SENSOR CHANGE
- 02. RAIL PRESSURE SENSOR CHANGE
- 03. AIR FLOW SENSOR CHANGE
- 04. SWIRL CONTROL VALVE CHANGE**
- 05. PRESSURE REGULATING VALVE CHANGE
- 06. ELECTRIC UGT ACTUATOR CHANGE

SHMF29143L

7. Confirm the message, and then press "ENTER" key.

1.8 . COMPONENT CHANGE ROUTINE

SWIRL CONTROL VALVE CHANGE

IN THIS MODE, CAN INITIATE OFFSET LEARNING FOR NEW VARIABLE SWIRL ACTUATOR.

PRESS [ENTER] KEY.

SENFL7611L

8. Confirm the "Complete" message, and then turn ignition switch OFF.

1.8 . COMPONENT CHANGE ROUTINE

SWIRL CONTROL VALVE CHANGE

IN THIS MODE, CAN INITIATE OFFSET LEARNING FOR NEW VARIABLE SWIRL COMPLETED! AFTER 10 SEC. OR MORE SINCE IG.KEY OFF, TURN IG.KEY ON

SENFL7612L

9. Wait for more than 10 seconds, and then turn ignition switch ON.

FL-96

Fuel System

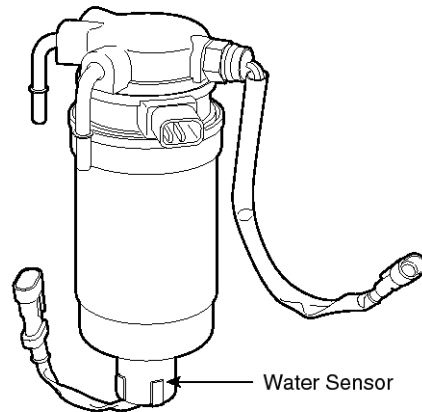
Water Sensor

Function And Operation Principle

The Water Sensor is installed on bottom end of fuel filter and detects presence of water in fuel. When the water amount reaches the predetermined level, the sensor sends the warning signal to the ECM.

NOTICE

Without presence of water, the lamp should flash for 2 seconds and turn off afterward in order that this system has normal condition.



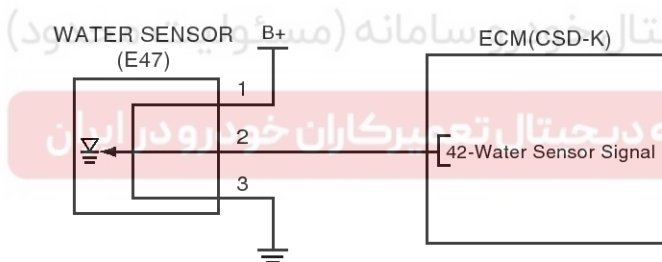
SHMF29102L

Specification

Item	Specification
Warning Level (cc)	40 ~ 60

Circuit Diagram

[Circuit Diagram]



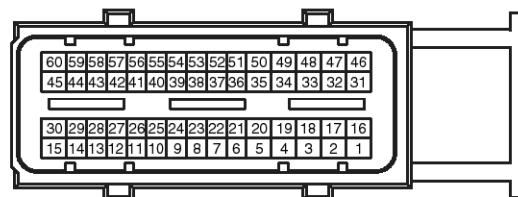
[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Power Supply (B+)
2	ECM CSD-K (42)	Sensor Signal
3	Chassis Ground	Sensor Ground

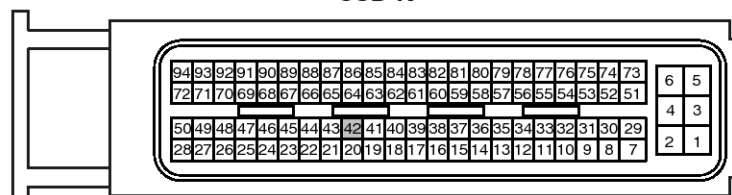
[Harness Connector]

E47
Water Sensor

CSD-A



CSD-K



ECM

SHMF29144L

Engine Control System

FL-97

Lambda Sensor

Function And Operation Principle

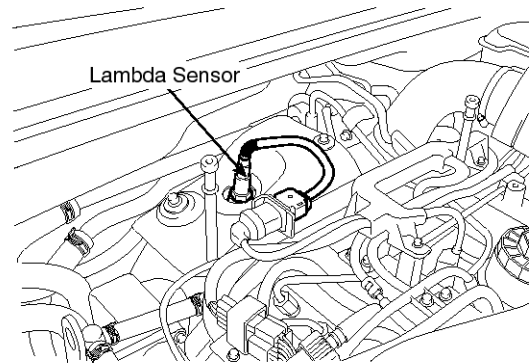
Lambda Sensor is installed on exhaust manifold and is a linear oxygen sensor. It senses oxygen density of exhaust gas in order to control EGR accurately through fuel correction and also limits smoke which is generated by rich air-fuel mixture at high engine load condition. ECM controls pumping current in order to fit λ -value from linear lambda sensor to 1.0.

- Lean air-fuel mixture ($1.0 < \lambda < 1.1$): ECM supplies pumping current to lambda sensor (+pumping current) and activates it for lambda sensor to have the characteristic at $\lambda = 1.0$ (0.0 pumping current). With the value of pumping current supplied to lambda sensor, ECM detects lambda density of exhaust gas.
- Rich air-fuel mixture ($0.9 < \lambda < 1.0$): ECM takes away pumping current from lambda sensor (-pumping current) and deactivates it for lambda sensor to have the characteristic at $\lambda = 1.0$ (0.0 pumping current). With the value of pumping current taken away from lambda sensor, ECM detects lambda density of exhaust gas.

This performance is the most active and fast at normal operating temperature ($450^{\circ}\text{C} \sim 600^{\circ}\text{C}$) thus, in order to reach normal operating temp. and last at that temperature, a heater (heating coil) is integrated with lambda sensor. The heater coil is controlled by ECM as Pulse With Modulator (PWM). The resistance of heater coil is low when coil is cold thus, current through it increases while resistance is high when coil is hot thus, current decreases. With this principle, temperature of lambda sensor is measured and lambda sensor heater operation varies based on the data.

⚠CAUTION

After replacing the Lambda Sensor, **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure (Refer to "REPLACEMENT" procedure). Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.



SHMF29101L

Specification Sensor

λ Value (A/F Ratio)	Pumping Current (A)
0.65	-2.2
0.7	-1.8
0.8	-1.1
0.9	-0.5
1.01	0
1.18	0.33
1.43	0.67
1.7	0.94
2.42	1.38
Air (Atmosphere)	2.54

Heater

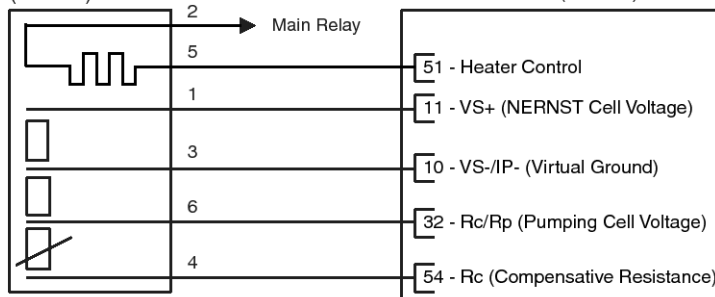
Temperature [$^{\circ}\text{C}$ ($^{\circ}\text{F}$)]	Heater Resistance (Ω)
20(68)	2.4 ~ 4.0

FL-98

Fuel System

Circuit Diagram

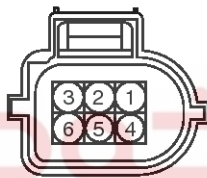
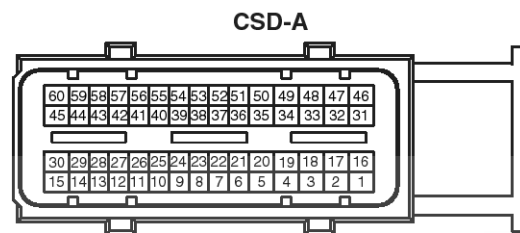
[Circuit Diagram]

Lambda Sensor
(CSD36)

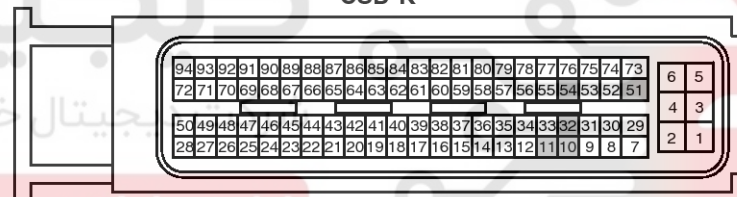
[Connection Information]

Terminal	Connected to	Function
1	ECM CSD-K (11)	VS+ (NERNST Cell Voltage)
2	Main Relay	Power Supply (B+)
3	ECM CSD-K (10)	VS-/IP- (Virtual Ground)
4	ECM CSD-K (54)	Rc (Compensative Resistance)
5	ECM CSD-K (51)	Heater Control
6	ECM CSD-K (32)	Rc/Rp (Pumping Cell Voltage)

[Harness Connector]

CSD36
Lambda Sensor

CSD-K



ECM

SHMF29145L

Engine Control System

FL-99

Replacement

⚠CAUTION

After replacing the Lambda Sensor, MUST perform the "COMPONENT CHANGE ROUTINE" procedure. Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".

MODEL :

- 01. ENGINE(GASOLINE)
- 02. ENGINE(DIESEL)**
- 03. AUTOMATIC TRANSAXLE
- 04. ABS/ESP
- 05. ELEC.POWER STEERING
- 06. FULL AUTO AIR/CON.
- 07. SRS-AIRBAG
- 08. 4WD CONTROL

SHMF29146L

5. Select "COMPONENT CHANGE ROUTINE".

MODEL :

SYSTEM : ENGINE(DIESEL)

EURO-4 UGT(CAN)

- 03. FLIGHT RECORD
- 04. ACTUATION TEST
- 05. SIMU-SCAN
- 06. IDENTIFICATION CHECK
- 07. ENGINE TEST FUNCTION
- 08. COMPONENT CHANGE ROUTINE**
- 09. INJECTOR SPECIFIC DATA
- 10. DATA SETUP(UNIT CONV.)

SHMF29147L

6. Select "LAMBDA SENSOR CHANGE".

1.8 . COMPONENT CHANGE ROUTINE

MODEL :

SYSTEM : ENGINE(DIESEL)

EURO-4 UGT(CAN)

- 01. LAMBDA SENSOR CHANGE**
- 02. RAIL PRESSURE SENSOR CHANGE
- 03. AIR FLOW SENSOR CHANGE
- 04. SWIRL CONTROL VALVE CHANGE
- 05. PRESSURE REGULATING VALVE CHANGE
- 06. ELECTRIC UGT ACTUATOR CHANGE

SHMF29148L

7. Confirm the message, and then press "ENTER" key.

1.8 . COMPONENT CHANGE ROUTINE

LAMBDA SENSOR CHANGE(LSU)

IN THIS MODE, CAN SET ZERO THE LAMBDA SENSOR PARAMETERS FOR THE CHANGED SENSOR.

PRESS [ENTER] KEY.

SENFL7616L

8. Confirm the "Complete" message, and then turn ignition switch OFF.

1.8 . COMPONENT CHANGE ROUTINE

LAMBDA SENSOR CHANGE(LSU)

IN THIS MODE CAN SET ZERO THE LAM-
COMPLETED! AFTER 10 SEC. OR MORE
SINCE IG.KEY OFF, TURN IG.KEY ON

PRESS [ENTER] KEY.

SENFL7617L

9. Wait for more than 10 seconds, and then turn ignition switch ON.

FL-100

Fuel System

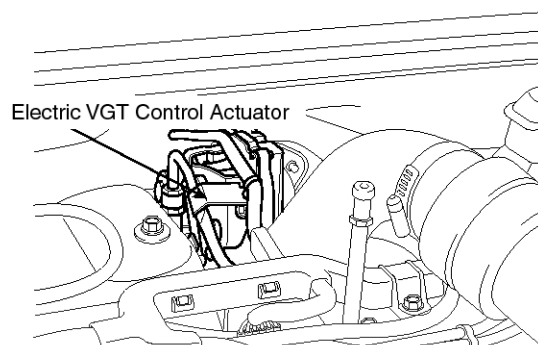
Electric VGT Control Actuator

Function And Operation Principle

The Electric VGT Control Actuator is installed on the turbocharger. It operates the vane in the Variable Geometry Turbocharger (VGT) and regulates the compressed air amount by the ECM's PWM signal. This valve consists of a DC motor which actuates the vane, a 2-step gear which increases torque of the DC motor, a position sensor which detects status of the vane, an electric control unit which drives the DC motor, and a reset spring which resets the de-energized vane to its open position.

⚠ CAUTION

After replacing the Electric VGT Control Actuator, **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure (Refer to "REPLACEMENT" procedure). Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.



SHMF29107L

دیجیتال خودرو

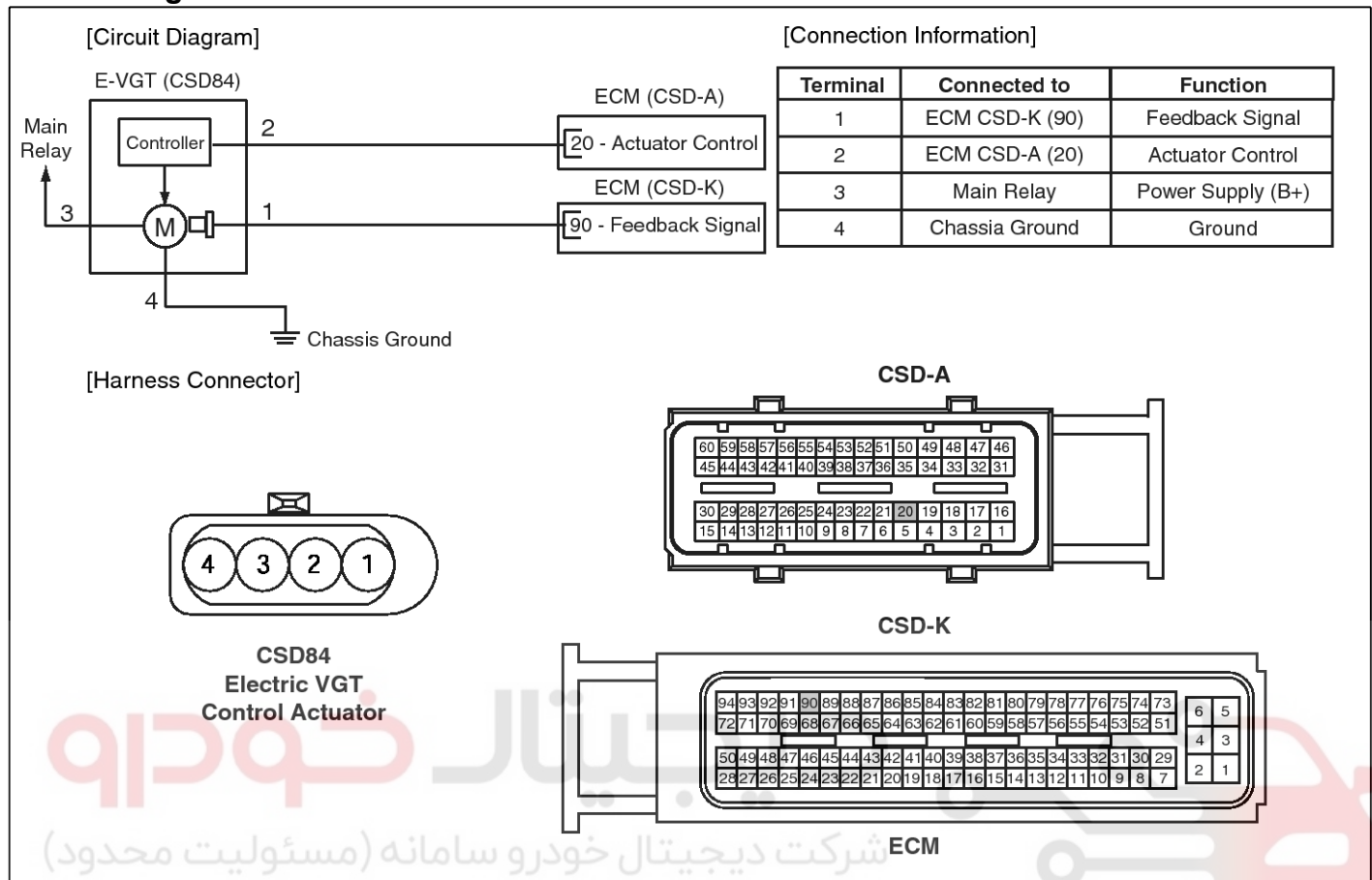
شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

Engine Control System

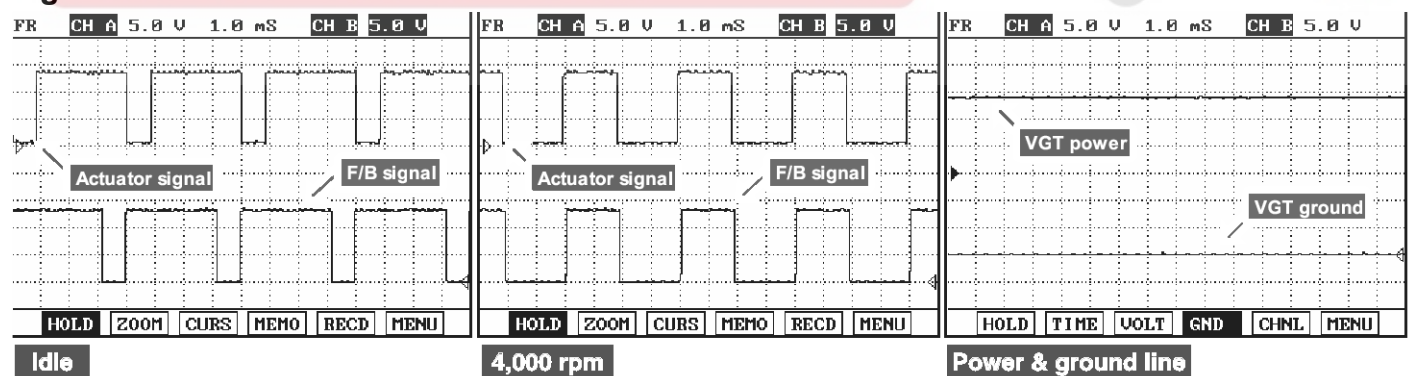
FL-101

Circuit Diagram



SHMF29149L

Signal Waveform



SENFL7149L

FL-102

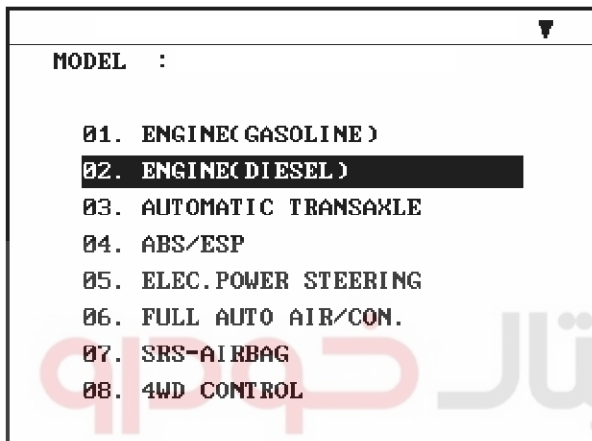
Fuel System

Replacement

⚠CAUTION

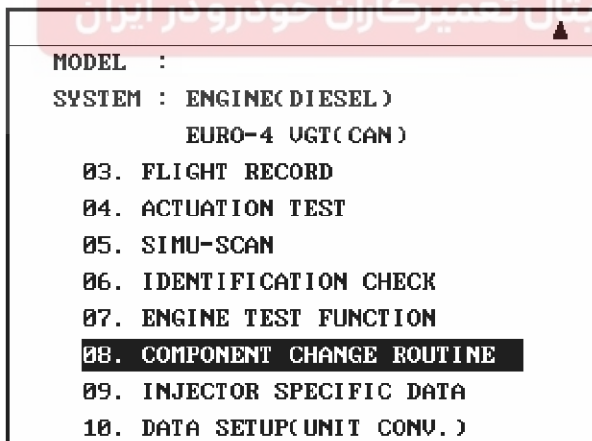
After replacing the Electric VGT Control Actuator, **MUST** perform the "COMPONENT CHANGE ROUTINE" procedure. Otherwise trouble related with engine performance or emission control may occur until ECM learning about the component is over.

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "ENGINE (DIESEL)".



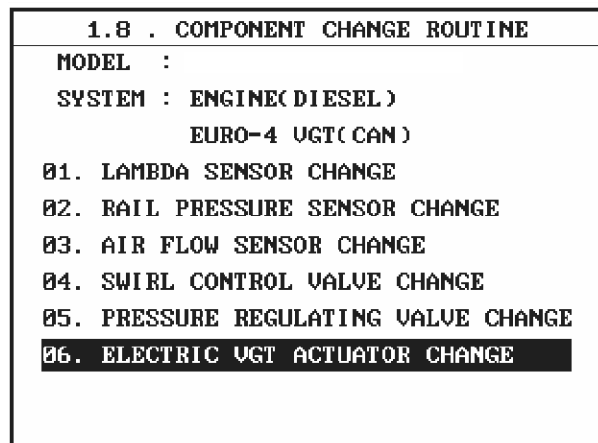
SHMF29150L

5. Select "COMPONENT CHANGE ROUTINE".



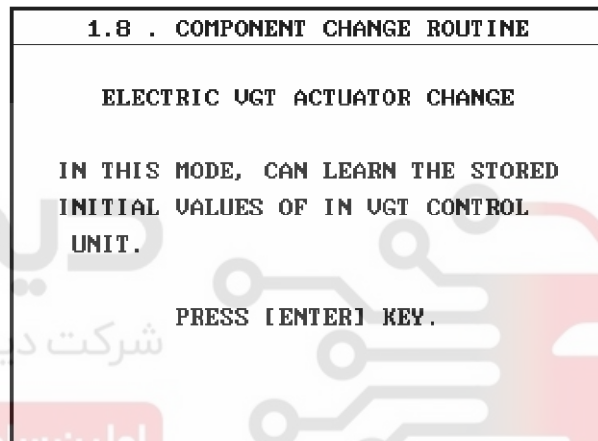
SHMF29151L

6. Select "ELECTRIC VGT ACTUATOR CHANGE".



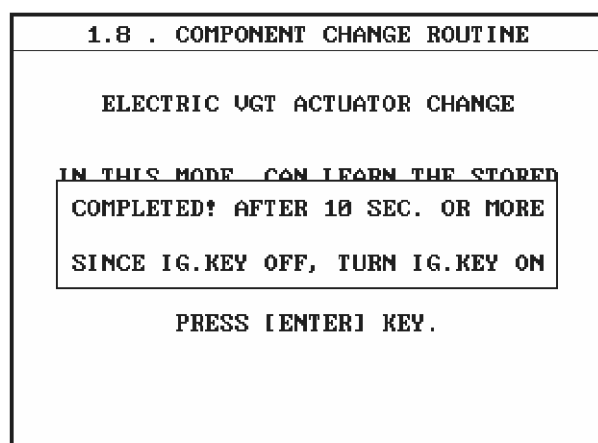
SHMF29152L

7. Confirm the message, and then press "ENTER" key.



SENFL7621L

8. Confirm the "Complete" message, and then turn ignition switch OFF.



SENFL7622L

9. Wait for more than 10 seconds, and then turn ignition switch ON.

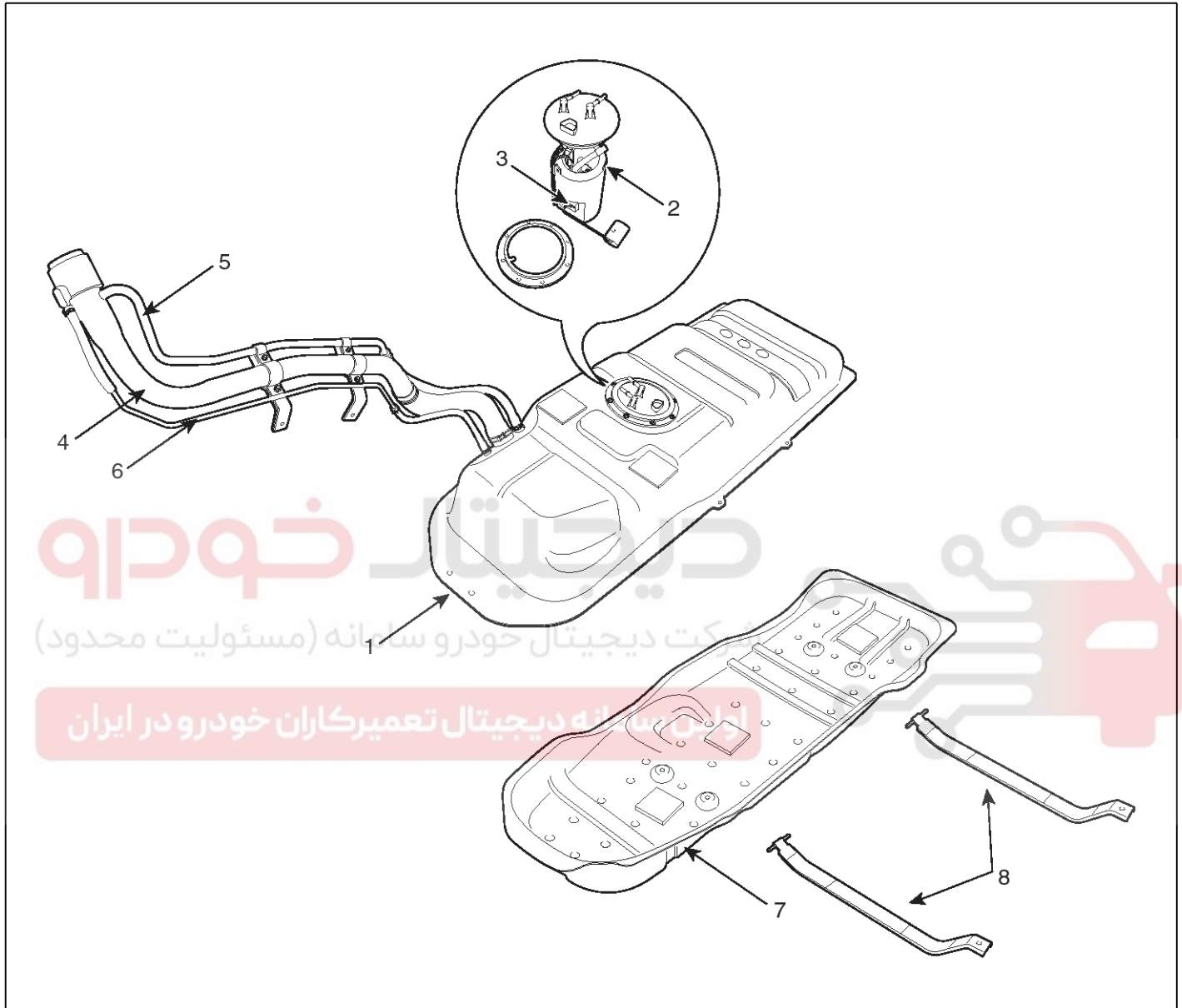
Fuel Delivery System

FL-103

Fuel Delivery System

Component Location

● Section (I) - Fuel Tank



SHMFL8158D

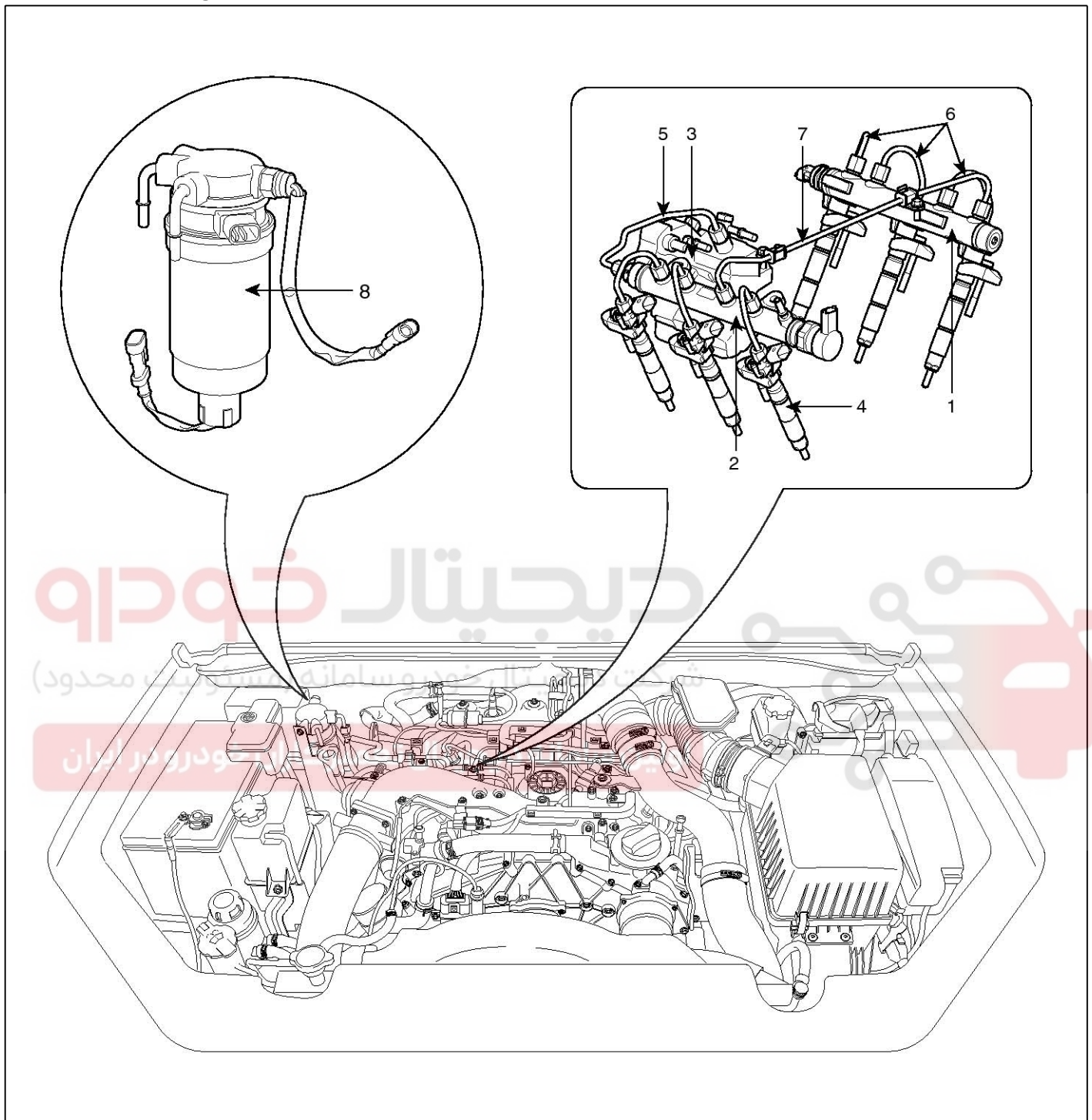
1. Fuel Tank
2. Fuel Pump (Low Pressure)
3. Fuel Sender
4. Fuel Filler Pipe

5. Leveling Pipe
6. Ventilation Pipe
7. Fuel Tank Protector
8. Fuel Tank Band

FL-104

Fuel System

● Section (II) - Engine Room



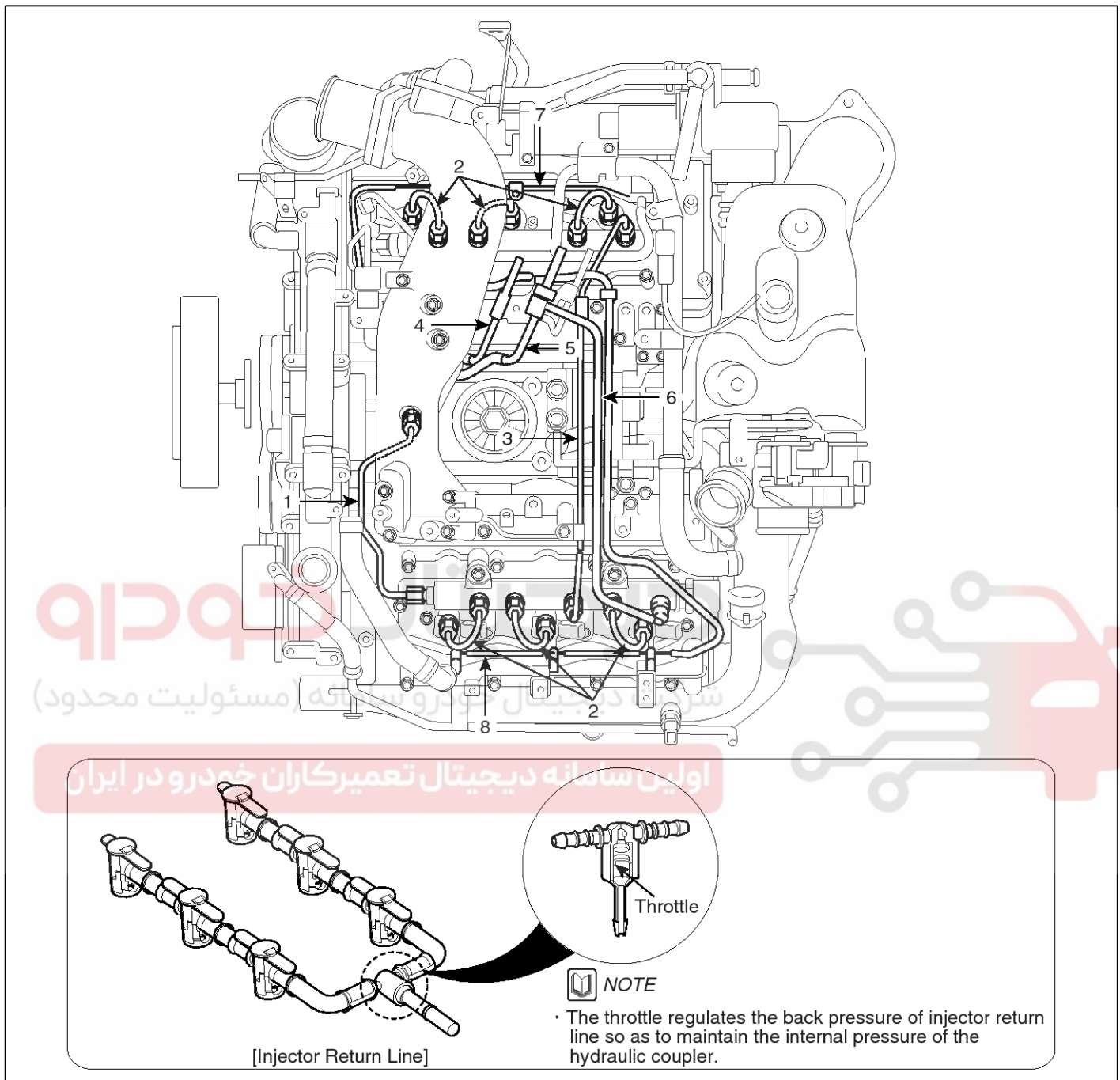
SHMFL8159D

- | | |
|----------------------------|--|
| 1. Common Rail (Bank 1) | 5. High Pressure Fuel Pipe (High Pressure Fuel Pump ↔ Common Rail) |
| 2. Common Rail (Bank 2) | 6. High Pressure Fuel Pipe (Common Rail ↔ Injector) |
| 3. High Pressure Fuel Pump | 7. High Pressure Fuel Pipe (Common Rail ↔ Common Rail) |
| 4. Injector | 8. Fuel Filter |

Fuel Delivery System

FL-105

● Section (III) - Fuel Line



SHMF29153L

- | | |
|---|--|
| 1. High Pressure Fuel Pipe
(High Pressure Fuel Pump ↔ Common Rail) | 5. Fuel Return Tube
(High Pressure Fuel Pump ↔ Fuel Tank) |
| 2. High Pressure Fuel Pipe
(Common Rail ↔ Injector) | 6. Fuel Return Tube
(Common Rail ↔ Fuel Tank) |
| 3. High Pressure Fuel Pipe
(Common Rail ↔ Common Rail) | 7. Fuel Return Tube
(Injector [Bank 1] ↔ Fuel Filter) |
| 4. Fuel Feed Tube
(Fuel Filter ↔ High Pressure Fuel Pump) | 8. Fuel Return Tube
(Injector [Bank 2] ↔ Fuel Filter) |

FL-106

Fuel System

⚠WARNING

As the Piezo-Injector operates under maximum DC 200V, there may be a risk of an electric shock caused by shorted control line etc. So when repairing the injector or its wiring, disconnect the battery negative (-) terminal from the battery and wait for about 30 seconds.

⚠CAUTION

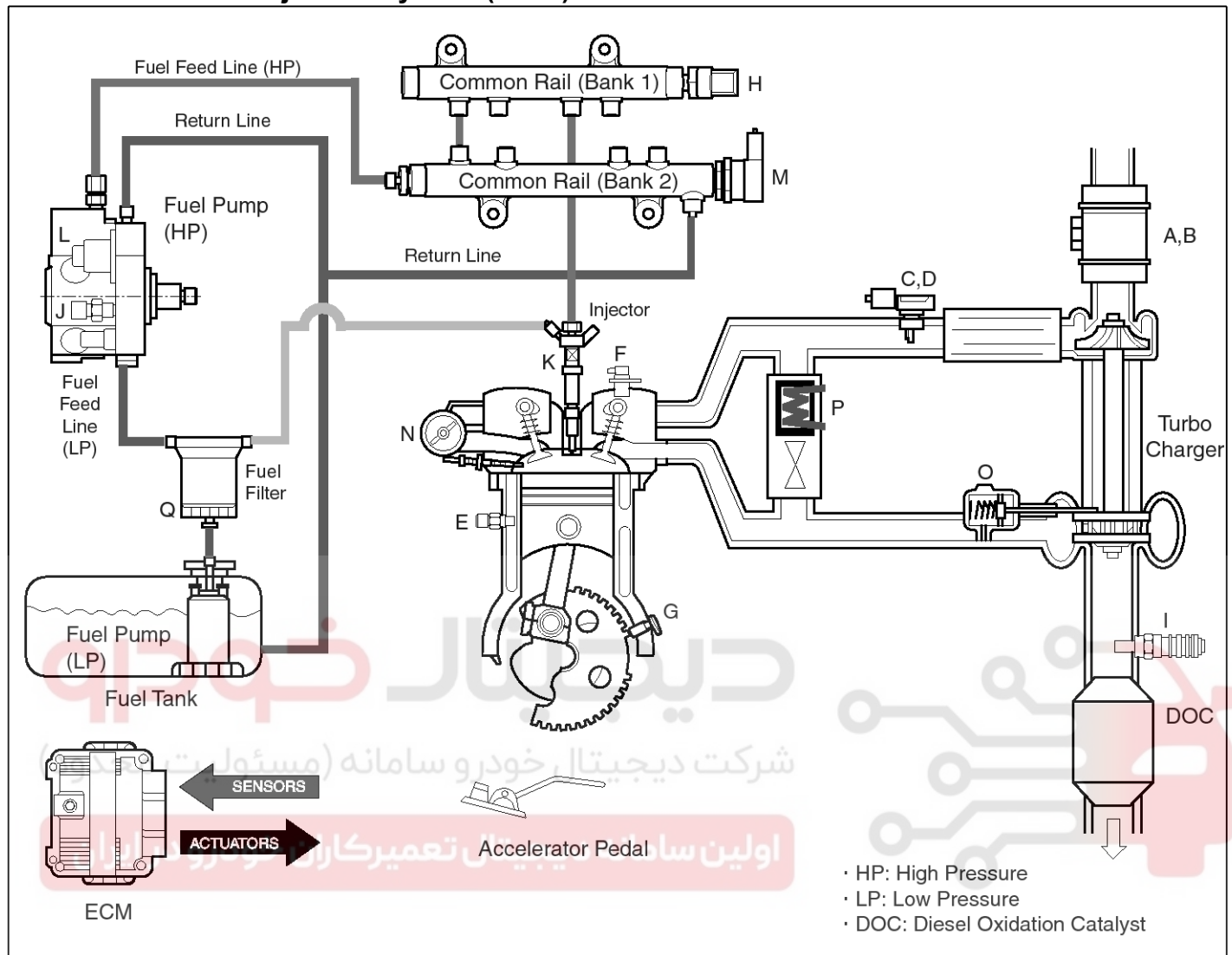
- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep cleanly the parts and the working area.
- Pay attention to a foreign substance.
- Just before installing injector, tube or hose, remove the protect-cap attached on them.
- Do not remove injector except for special case.
- When installing Injector
 - Wash the contact area of the injector and replace the O-ring with a new one.
 - Spread oil on the injector O-ring.
 - To protect damage caused by shock, vertically insert the injector into the cylinder head.
- When installing High Pressure Fuel Pipe
 - Do not use again the used high pressure fuel pipe.
 - Install the flange nut correctly.



Fuel Delivery System

FL-107

Common Rail Fuel Injection System (CRDI)



SHMF29154L

- | | |
|---|------------------------------------|
| A. Mass Air Flow Sensor (MAFS) | I. Lambda Sensor |
| B. Intake Air Temperature Sensor (IATS) #1 | J. Fuel Temperature Sensor (FTS) |
| C. Boost Pressure Sensor (BPS) | K. Injector |
| D. Intake Air Temperature Sensor (IATS) #2 | L. Fuel Pressure Regulator Valve |
| E. Engine Coolant Temperature Sensor (ECTS) | M. Rail Pressure Regulator Valve |
| F. Camshaft Position Sensor (CMPS) | N. Variable Swirl Control Actuator |
| G. Crankshaft Position Sensor (CKPS) | O. Electric VGT Control Actuator |
| H. Rail Pressure Sensor (RPS) | P. Electric EGR Control Valve |
| | Q. Water Sensor |

FL-108

Fuel System

● Low Pressure Fuel Circuit

Low Pressure Fuel Pump

The low pressure fuel pump is either an electric fuel pump with pre-filter, or a gear-type fuel pump. The pump draws the fuel from the fuel tank and continually delivers the required quantity of fuel in the direction of the high pressure fuel pump (via fuel filter).

Sub Fuel Sender

The sub fuel sender is installed on the fuel tank which has separated fuel storeroom (LH & RH) and detects the fuel quantity of RH's one.

The fuel stored in RH is flown into the LH by the assist pump involved in the fuel pump in LH (The sub fuel sender doesn't have an independent pump).

Fuel Filter

The fuel filter is located in between the low pressure fuel pump and the high pressure fuel pump and filters the fuel delivered from the fuel tank.

● High Pressure Fuel Circuit

High Pressure Fuel Pump

The high pressure fuel pump compresses fuel up to 1,600 bar and delivers the compressed fuel to the common rail.

Common Rail

The two common rails are installed on bank 1 and 2 and are connected with the high pressure fuel pump and the injectors by the high pressure fuel pipes. This rail stores the fuel compressed in the high pressure fuel pump. So that the two rails have same fuel pressure, the high pressure fuel pipe connects the two rails. The ECM controls the fuel pressure of the common rail by using the rail pressure sensor and the rail pressure regulator valve installed on the common rail (Bank 1) and (Bank 2) respectively.

Injector

The injector injects the high pressure fuel stored in the common rail into the cylinder by the ECM control signal.

High Pressure Fuel Pipe

The high pressure fuel pipe is a channel in high pressure fuel circuit consisting of the high pressure fuel pump, common rails, and injectors. It is a steel tube which can withstand high frequency generated when the fuel pressure reaches the maximum pressure or fuel injection stops.

The differences in length between the common rail and the individual injectors are compensated for by using slight or pronounced bends in the individual lengths of tubing. Nevertheless, the injection lines should be kept as short as possible.

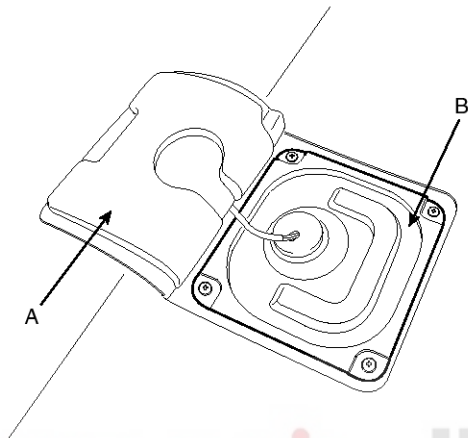
Fuel Delivery System

FL-109

Fuel Tank

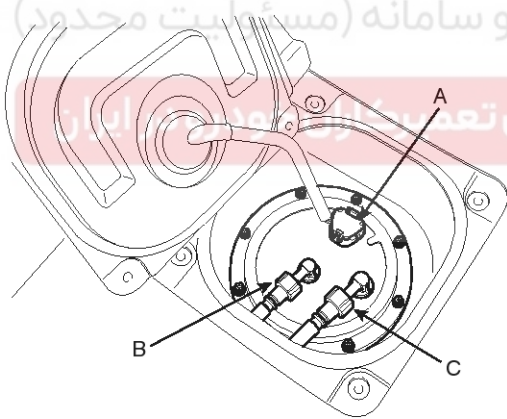
Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the 2nd seat (Refer to "SEAT" in BD group).
3. Remove the fuel pump carpet and the service cover (A).



SHMFL8163D

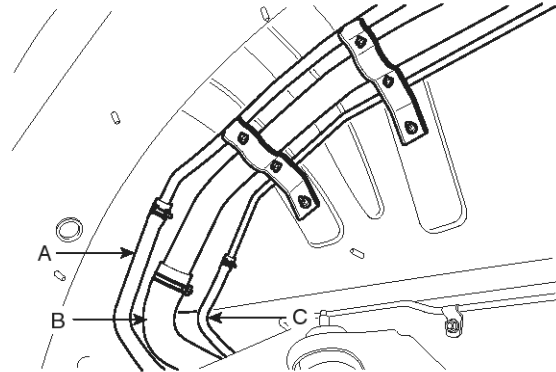
4. Disconnect the fuel pump connector (A).



SHMF29159L

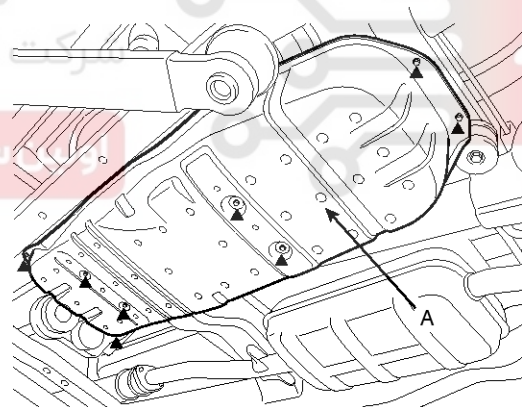
5. Disconnect the fuel feed tube quick-connector (B) and the fuel return tube quick-connector (C).
6. Remove the left - rear wheel & tire and the wheel house.

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



SHMFL8165D

8. Lift the vehicle.
9. Support the fuel tank with a jack.
10. Remove the fuel tank protector (A) after removing the installation nuts/bolts.

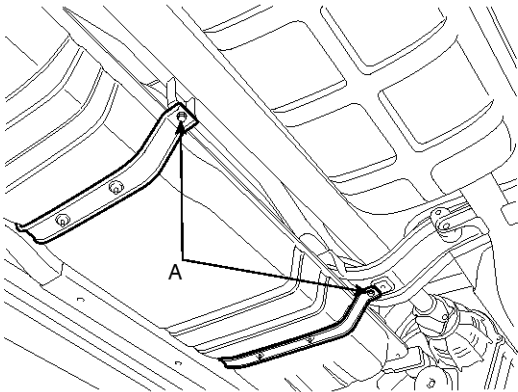


SHMFL8166D

FL-110

Fuel System

11. Unscrew the fuel tank band installation bolts (A), and then remove the fuel tank from the vehicle.



SHMFL8167D

Installation

1. Installation is reverse of removal.

Fuel tank band installation nuts:

49.1 ~ 58.9 N.m (5.0 ~ 6.0 kgf.m, 36.2 ~ 43.4 lb-ft)

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



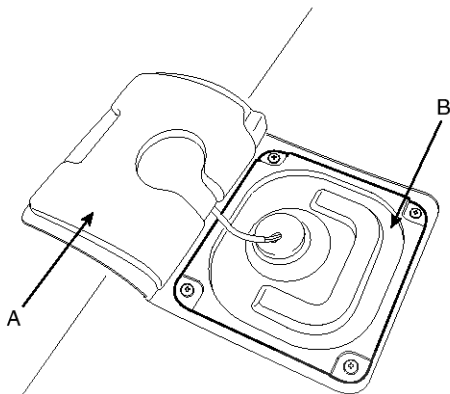
Fuel Delivery System

FL-111

Fuel Pump

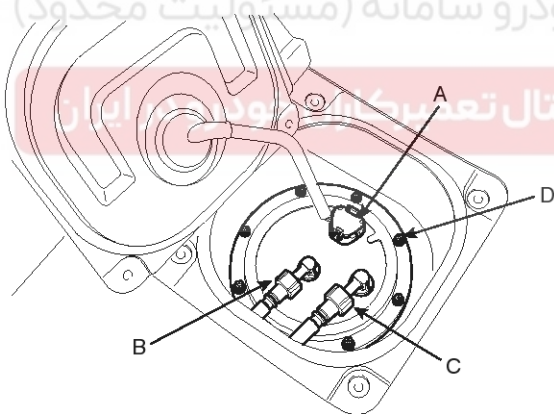
Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the 2nd seat (Refer to "SEAT" in BD group).
3. Open the carpet (A) for the fuel pump.
4. Remove the fuel pump service cover (B).



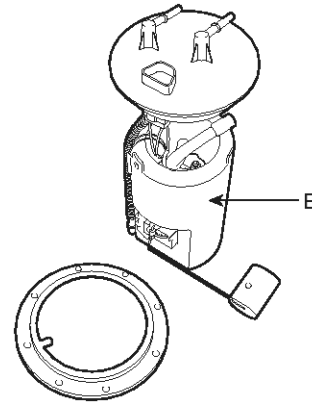
SHMFL8163D

5. Disconnect the fuel pump connector (A).



SHMFL8164D

6. Disconnect the fuel feed tube quick-connector (B), the fuel return tube quick-connector (C).
7. Unscrew the fuel pump installation bolts (D), and then remove the fuel pump (E) from the fuel tank.



SHMFL8168D

Installation

1. Installation is reverse of removal.

Fuel pump installation bolts:

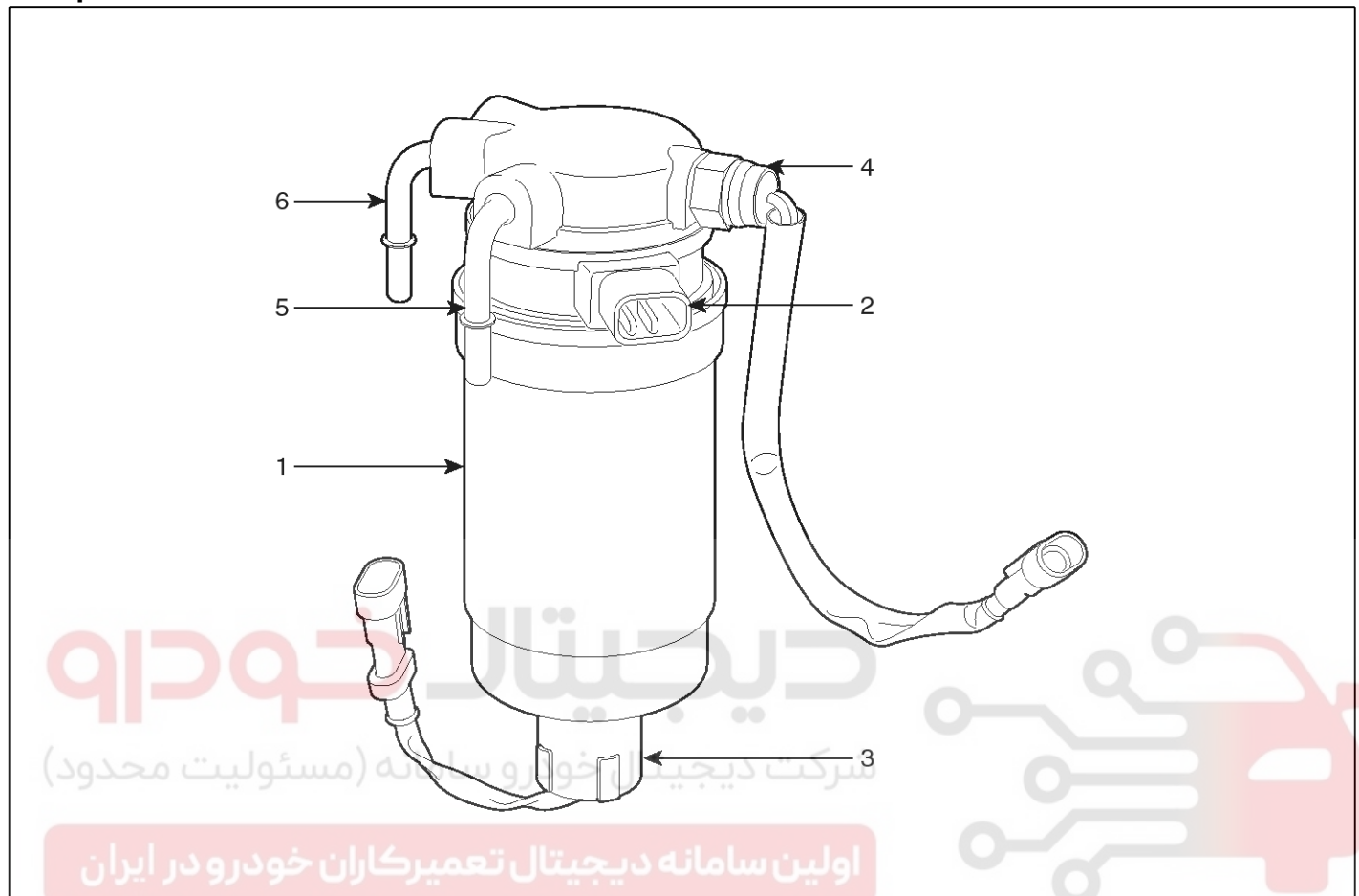
2.0 ~ 2.9 N.m (0.2 ~ 0.3 kgf.m, 1.4 ~ 2.2 lb-ft)

FL-112

Fuel System

Fuel Filter

Component Location



SHMFL8170D

- 1. Fuel Filter
- 2. Heater
- 3. Water Sensor

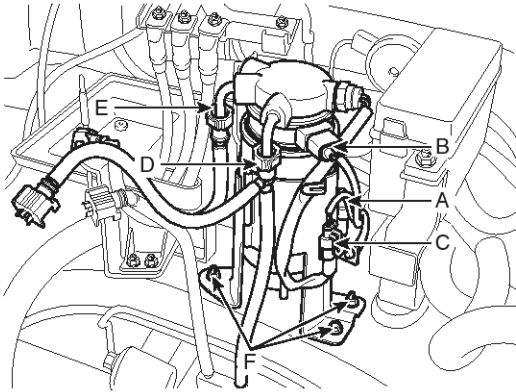
- 4. Thermostat
- 5. Nipple (↔ Fuel Tank, Injector Return Line)
- 6. Nipple (↔ High Pressure Fuel Pump)

Fuel Delivery System

FL-113

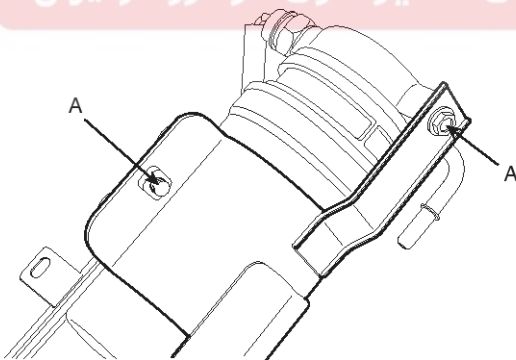
Replacement

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the water sensor connector (A), the heater connector (B), and the thermostat connector (C).



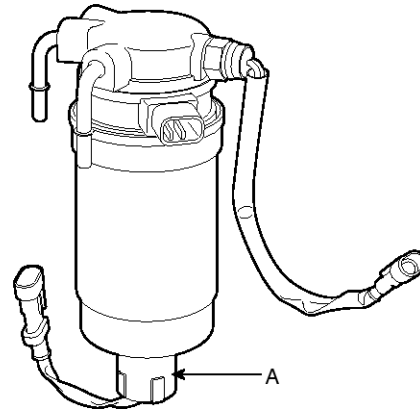
SHMFL8171D

3. Disconnect the fuel inlet tube quick-connector (D) and the fuel outlet tube quick-connector (E).
4. Unscrew the fuel filter bracket installation bolt/nuts (F) and then remove the fuel filter from the vehicle.
5. Remove the fuel filter assembly from the bracket after removing the bolt (A).



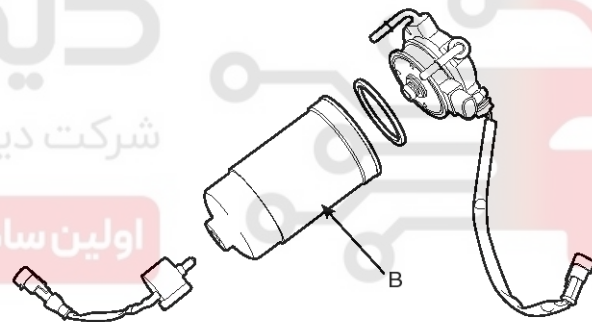
SHMFL8172D

6. Remove the water sensor (A).



SHMFL8173D

7. Remove the fuel filter (A) with a wrench from the fuel filter assembly, after then replace it with a new one, and then install the fuel filter assembly in accordance with reverse of above steps.



SHMFL8174D

⚠ CAUTION

When replacing the fuel filter, must replace the O-ring.

8. Start the engine and check that there is any leak on the low pressure fuel circuit including the fuel filter.

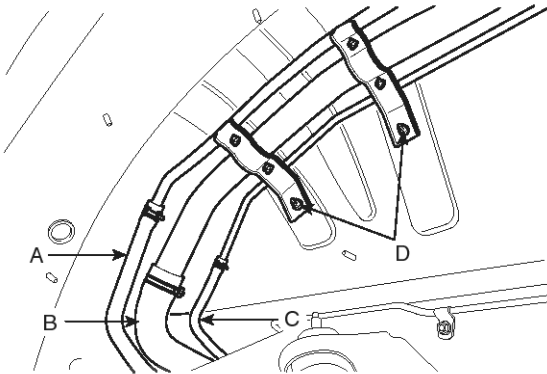
FL-114

Fuel System

Filler-Neck Assembly

Removal

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



SHMFL8169D

3. Remove the filler-neck assembly after unscrewing the bracket mounting nuts (D).

Installation

1. Installation is reverse of removal.



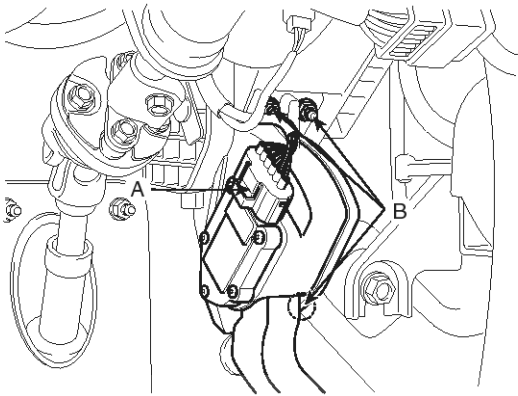
Fuel Delivery System

FL-115

Accelerator Pedal and Cable

Removal

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



SHMFL8186D

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

Installation

1. Installation is reverse of removal.

Fuel pump installation bolts:

7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)

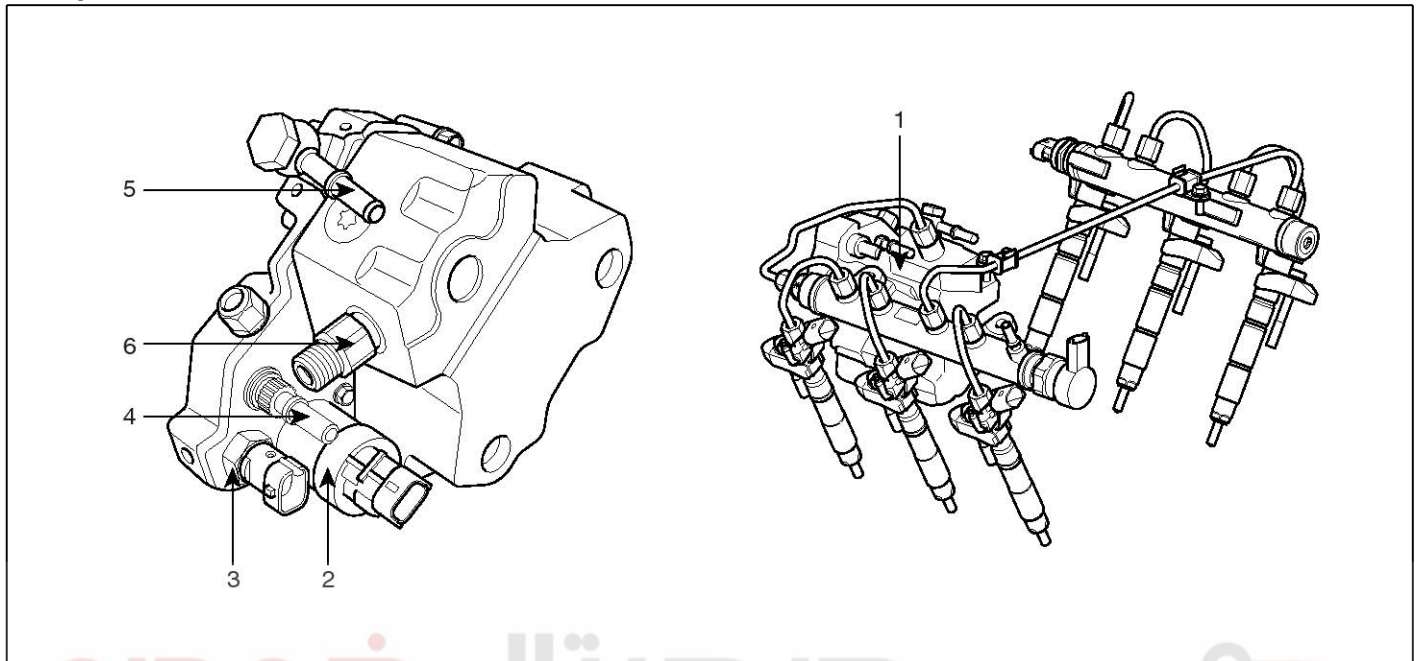


FL-116

Fuel System

High Pressure Pump

Component Location



SHMF29155L

- | | |
|----------------------------------|---|
| 1. High Pressure Fuel Pump | 4. Nipple - Fuel Inlet (↔ Fuel Filter) |
| 2. Fuel Pressure Regulator Valve | 5. Nipple - Fuel Return (↔ Fuel Tank) |
| 3. Fuel Temperature Sensor (FTS) | 6. Nipple - Fuel Outlet (↔ Common Rail) |

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

Fuel Delivery System

FL-117

Removal

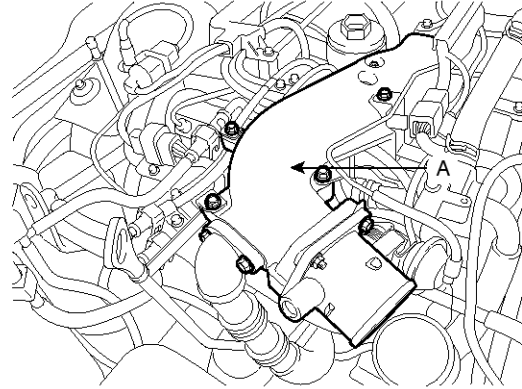
⚠WARNING

As the Piezo-Injector operates under maximum DC 200V, there may be a risk of an electric shock caused by shorted control line etc. So when repairing the injector or its wiring, disconnect the battery negative (-) terminal from the battery and wait for about 30 seconds.

⚠CAUTION

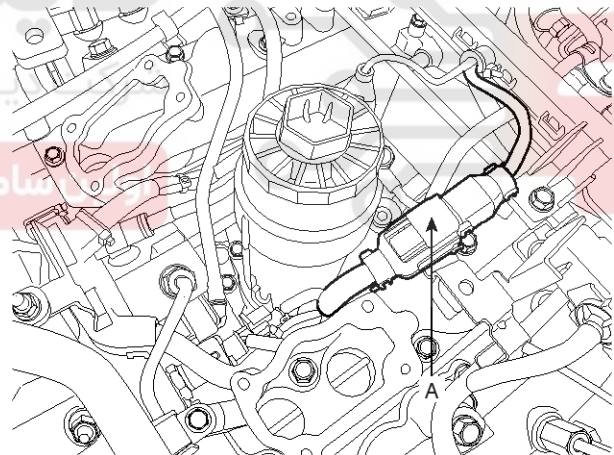
- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep cleanly the parts and the working area.
- Pay attention to a foreign substance.
- Just before installing injector, tube or hose, remove the protect-cap attached on them.
- Do not remove injector except for special case.
- When installing Injector
 - Wash the contact area of the injector and replace the O-ring with a new one.
 - Spread oil on the injector O-ring.
 - To protect damage caused by shock, vertically insert the injector into the cylinder head.
- When installing High Pressure Fuel Pipe
 - Do not use again the used high pressure fuel pipe.
 - Install the flange nut correctly.

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the radiator upper shroud and the cooling fan (Remove the "Cooling system" in EM group).
3. Remove the inlet upper manifold assembly (A) (Refer to "Intake and Exhaust system" in EM group).



SHMFL8176D

4. Disconnect the fuel pressure regulator valve & fuel temperature sensor connector (A).

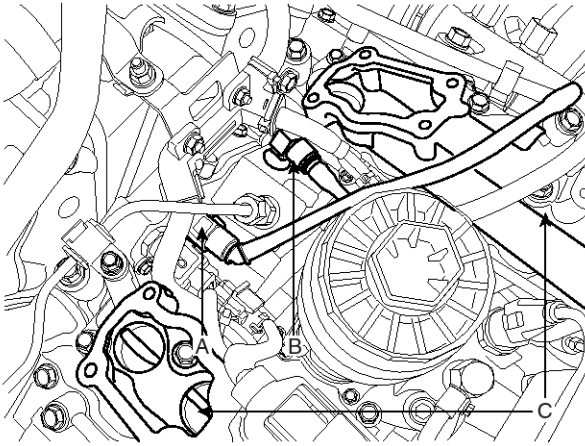


SENFL7201D

FL-118

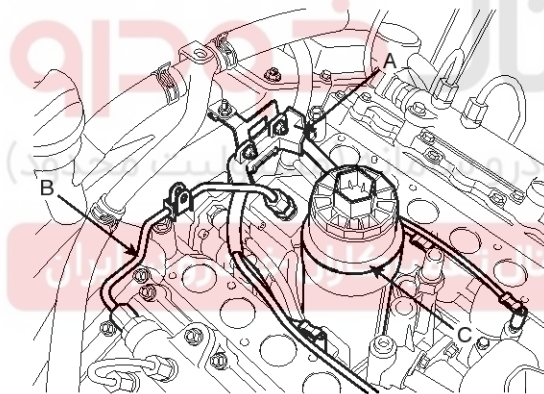
Fuel System

5. Disconnect the fuel inlet tube quick-connector (A) and the fuel return tube quick-connector (B).
6. Remove the inlet lower manifold assembly (C).



SHMFL8177D

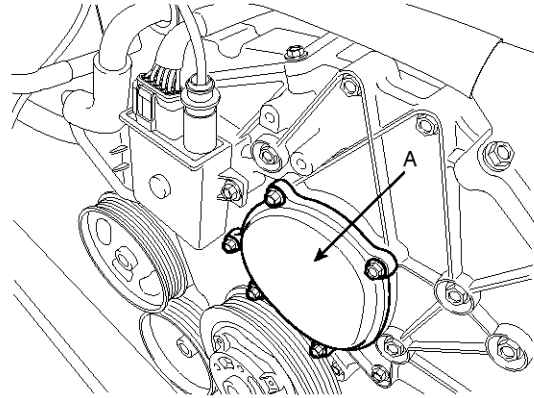
7. Remove the glow plug wiring (A) and the high pressure fuel pipe (B).



SHMFL8178D

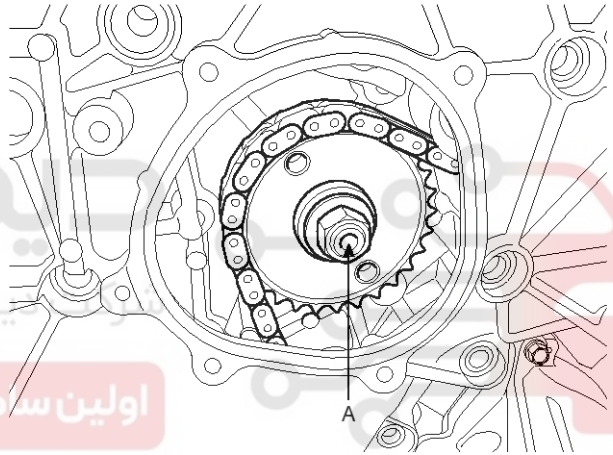
8. Remove the engine oil filter (C) (Refer to "LUBRICATION SYSTEM" in EM group).
9. Unscrew the three high pressure fuel pump mounting bolts.

10. Remove the service cover (A).



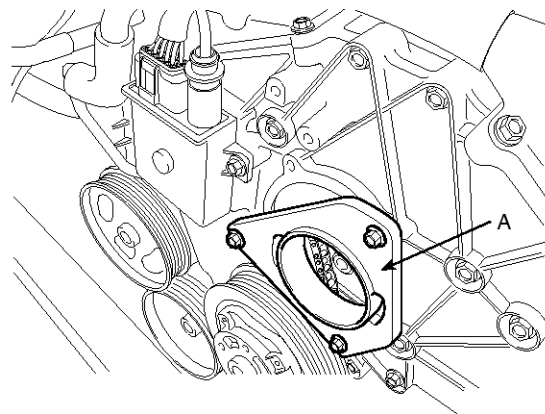
SHMFL8179D

11. Remove the sprocket tightening nut (A).



SENFL7204D

12. Install the fixing plate (A) [SST No.: 09331-3A000] on the timing case.

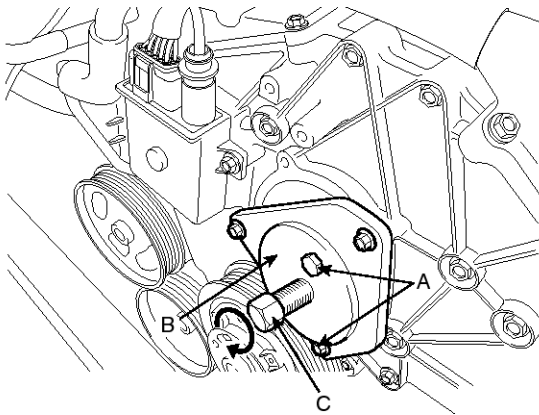


SHMFL8180D

Fuel Delivery System

FL-119

13. Install the supporter (B) [SST No.: 09331-3A000] on the sprocket with the bolts (A) [SST No.: 09331-3A000].



SHMF29160L

14. Push the pump shaft from the sprocket with rotating the main bolt (C) [SST No.: 09331-3A000] clockwise, and then remove the high pressure fuel pump from the engine.

Installation

1. Installation is reverse of removal.

NOTICE

When installing the high pressure fuel pipe, apply the specified tightening torques with the special service tool [SST No.: 09314-3A000].

High pressure fuel pump installation bolts:

19.6 ~ 26.5 N.m (2.0 ~ 2.7 kgf.m, 14.5 ~ 19.5 lb-ft)

High pressure fuel pipe installation nut:

24.5 ~ 28.4 N.m (2.5 ~ 2.9 kgf.m, 18.1 ~ 21.0 lb-ft)

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

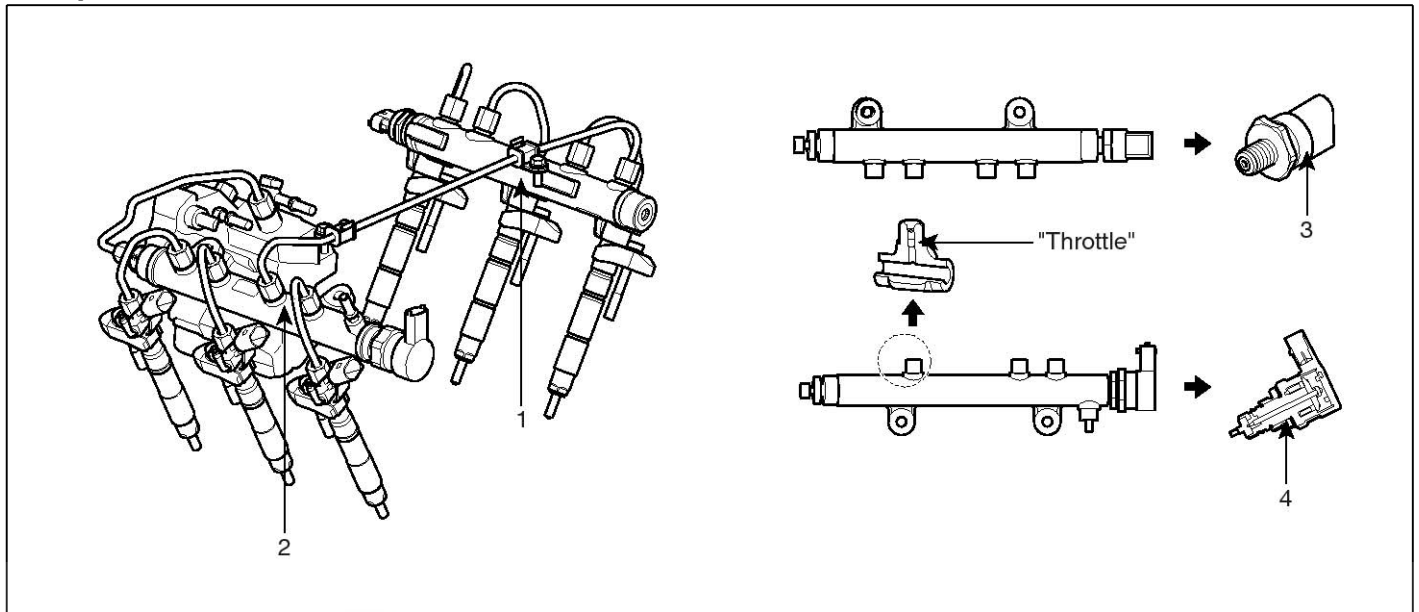


FL-120

Fuel System

Common Rail

Component Location



SHMF29156L

1. Common Rail (Bank 1)
2. Common Rail (Bank 2)

3. Rail Pressure Sensor (RPS)
4. Rail Pressure Regulator Valve

شرکت دیجیتال خودرو (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

Fuel Delivery System

FL-121

Removal

⚠ WARNING

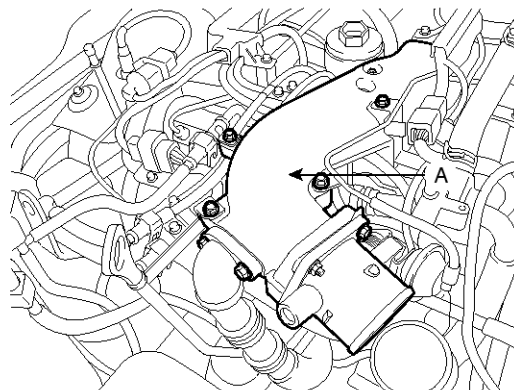
As the Piezo-Injector operates under maximum DC 200V, there may be a risk of an electric shock caused by shorted control line etc. So when repairing the injector or its wiring, disconnect the battery negative (-) terminal from the battery and wait for about 30 seconds.

⚠ CAUTION

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep cleanly the parts and the working area.
- Pay attention to a foreign substance.
- Just before installing injector, tube or hose, remove the protect-cap attached on them.
- Do not remove injector except for special case.
- When installing Injector
 - Wash the contact area of the injector and replace the O-ring with a new one.
 - Spread oil on the injector O-ring.
 - To protect damage caused by shock, vertically insert the injector into the cylinder head.
- When installing High Pressure Fuel Pipe
 - Do not use again the used high pressure fuel pipe.
 - Install the flange nut correctly.

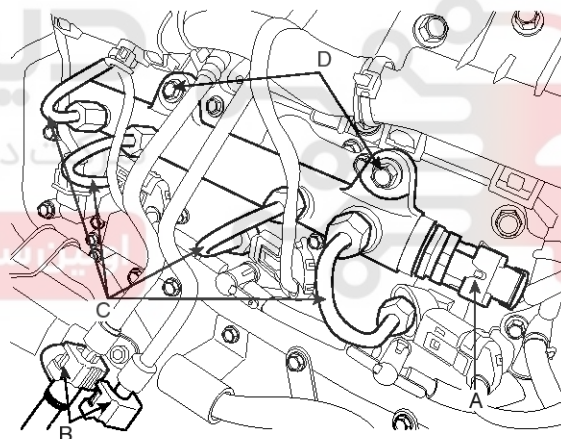
[Common Rail (Bank 1)]

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the inlet upper manifold assembly (A) (Refer to "Intake and Exhaust system" in EM group).



SHMFL8176D

3. Disconnect the rail pressure sensor connector (A).



SHMFL8183D

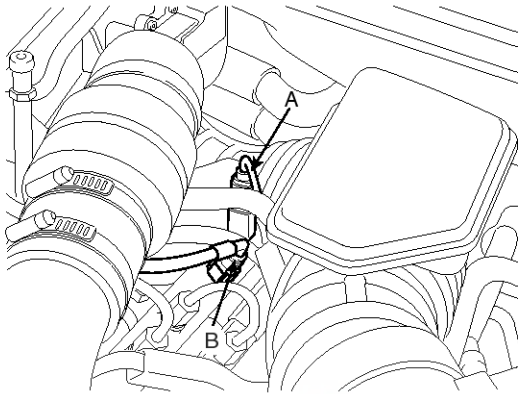
4. Disconnect the fuel feed and the return tube quick-connector (B).
5. Remove the high pressure fuel pipes (C).
6. Unscrew the mounting bolts (D), and then remove the common rail from the engine.

FL-122

Fuel System

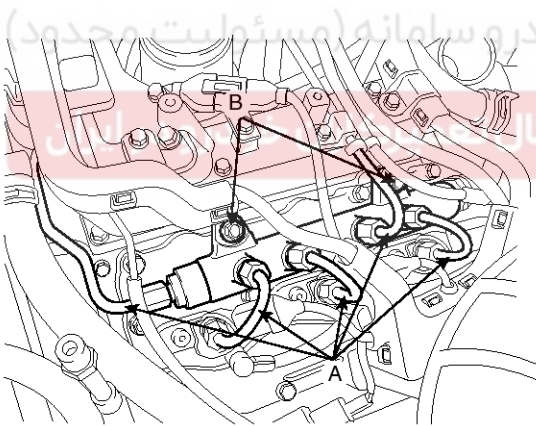
[Common Rail (Bank 2)]

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the intercooler pipe and the hose (Refer to "Intake and Exhaust system" in EM group).
3. Disconnect the rail pressure regulator valve connector (A).
4. Disconnect the fuel return tube quick-connector (B).



SHMFL8184D

5. Remove the high pressure fuel pipes (A).



SHMFL8185D

6. Unscrew the mounting bolts (B), and then remove the common rail from the engine.

Installation

1. Installation is reverse of removal.

NOTICE

- A. When installing the high pressure fuel pipe, apply the specified tightening torques with the special service tool [SST No.: 09314-3A000].
- B. When installing the high pressure fuel pipe connecting the common rail and injector, follow the below procedure.
- a. Temporarily install the nut on common rail.
 - b. Temporarily install the nut on injector.
 - c. Install the injector side nut.
 - d. Install the common rail side nut.

Common rail installation bolts:

19.6 ~ 26.5 N.m (2.0 ~ 2.7 kgf.m, 14.5 ~ 19.5 lb-ft)

High pressure fuel pipe installation nut:

24.5 ~ 28.4 N.m (2.5 ~ 2.9 kgf.m, 18.1 ~ 21.0 lb-ft)