General Information

SPECIFICATIONS

FUEL DELIVERY SYSTEM

Items	Specification	
Fuel Tank	Capacity	58 lit. (12.75 Imp.gal., 15.32 U.S.gal.)
Fuel Return System	Type	Return Type
Fuel Filter	Type	High pressure type (Built in engine room)
High Pressure Fuel Pump	Type	Mechanical, Plunger Pumping Type
	Driven by	Camshaft
Fuel Pressure (Maximum)	Pressure	1,600 bar (160 MPa, 23,206 psi)

INPUT SENSORS

MASS AIR FLOW SENSOR (MAFS)

▷ Type: Hot-Film Type

▷ Specification

* At intake air temperature = 20℃(68˚F)

Air Flow (kg/h)	Frequency (kHz)
8	1.94 ~ 1.96
10	1.98 ~ 1.99
15	2.06 ~ 2.07
75	2.72 ~ 2.75
160	3.36 ~ 3.41
310	4.44 ~ 4.53
640	7.66 ~ 8.01
800	10.13 ~ 11.17

* At intake air temperature = -15℃(5˚F) or 80℃(176˚F)

Air Flow (kg/h)	Frequency (kHz)
10	1.97 ~ 1.99
75	2.71 ~ 2.76
160	3.34 ~ 3.43
310	4.39 ~ 4.58

INTAKE AIR TEMPERATURE SENSOR (IATS) #1 [BUILT IN MAFS]

▷ Type: Thermistor type

▷ Specification

Temperature [℃(˚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)
70	1.02 ~ 1.17
140	2.13 ~ 2.28
210	3.25 ~ 3.40
270	4.20 ~ 4.35

INTAKE AIR TEMPERATURE SENSOR (IATS) #2 [BUILT IN BPS]

▷ Type: Thermistor type

▷ Specification

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

CAMSHAFT POSITION SENSOR (CMPS)

▷ Type: Hall effect type

▷ Specification

Level	Output Pulse (V)
High	12V
Low	0V

Items	Specification
Air Gap	1.5 ± 0.1 mm

CRANKSHAFT POSITION SENSOR (CKPS)

▷ Type: Variable reluctance type

▷ Output Voltage (V): 0 ~ 5V

Items	Specification
Coil Resistance (Ω))	774 ~ 946Ω [20℃(68˚F)]

ACCELERATOR POSITION SENSOR (APS)

▷ Type: Potentiometer type

▷ Specification

Test Condition	Output Voltage(V)	
	APS 1	APS 2
Idle	0.7 ~ 0.8	0.275 ~ 0.475
Fully depressed	3.8 ~ 4.4	1.75 ~ 2.35

Items	Specification	
	APS 1	APS 2
Potentiometer Resistance (kΩ)	0.7 ~ 1.3	1.4 ~ 2.6

FUEL TEMPERATURE SENSOR (FTS)

▷ Type: Thermistor type

▷ Specification

Temperature [℃(˚F)]	Resistance(kΩ)
-30(-22)	27.00
-20(-4)	15.67
-10(14)	9.45
0(32)	5.89
20(68)	2.27 ~ 2.73
40(104)	1.17
50(122)	0.83
60(140)	0.60
70(158)	0.43
80(176)	0.30 ~ 0.32

RAIL PRESSURE SENSOR (RPS)

▷ Type: Piezo-electricity type

▷ Specification

Test Condition	Rail pressure (bar)	Output Voltage(V)
Idle	220 ~ 320	Below 1.7
Fully depressed	1800	Approx. 4.5

LAMBDA SENSOR

▷ Type: Zirconia (ZrO2) Type

▷ Specification

λ Value (A/F Ratio)	Pumping Current(A)
0.65	-2.22
0.70	-1.82
0.80	-1.11
0.90	-0.50
1.01	0.00
1.18	0.33
1.43	0.67
1.70	0.94
2.42	1.38
Air (Atmosphere)	2.54

Temperature [℃(˚F)]	Heater Resistance(Ω)
20(68)	9.2
100(212)	10.7
200(392)	13.1
300(572)	14.6
400(752)	17.7
500(932)	19.2
600(1,112)	20.7
700(1,292)	22.5

EXHAUST GAS TEMPERATURE SENSOR (EGTS) #1 FOR VGT

▷ Type: Thermistor type

▷ Specification

Temperature [℃(˚F)]	Resistance(kΩ)
100(212)	289.0 ~ 481.0
300(572)	5.30 ~ 6.61
600(1,112)	0.35 ~ 0.38
900(1,652)	0.08 ~ 0.09

DIFFERENTIAL PRESSURE SENSOR (DPS)

▷ Type: Piezo-electricity type

▷ Specification: Vout = (4.5 - 1.0) / 100 * △P + 1.0 (V)

Differential Pressure [△P] (kPa)	Output Voltage (V)
0	1.00
10	1.35
20	1.70
30	2.05
40	2.40
50	2.75
60	3.10
70	3.45
80	3.80
90	4.15
100	4.50

EXHAUST GAS TEMPERATURE SENSOR (EGTS) #2 FOR CPF

▷ Type: Thermistor type

▷ Specification

Temperature [℃(˚F)]	Resistance(kΩ)
100(212)	289.0 ~ 481.0
300(572)	5.30 ~ 6.61
600(1,112)	0.35 ~ 0.38
900(1,652)	0.08 ~ 0.09

VEHICLE SPEED SENSOR (VSS)

▷ Type: Inductive type

OUTPUT ACTUATORS

INJECTOR

▷ Number: 4

▷ Specification

Items	Specification
Coil Resistance (Ω)	0.33Ω [20℃(68˚F)]

FUEL PRESSURE REGULATOR VALVE

▷ Specification

Items	Specification
Coil Resistance (Ω)	2.9 ~ 3.15Ω [20℃(68˚F)]

RAIL PRESSURE REGULATOR VALVE

▷ Specification

Items	Specification
Coil Resistance (Ω)	3.42 ~ 3.78Ω [20℃(68˚F)]

THROTTLE CONTROL ACTUATOR

▷ Type : Duty control motor type

▷ Specification

Duty (%)	Throttle Valve Position
5	Open
5 ~ 94	Normal operation (Partially open in pr-oportion to duty value)
94	Closed
94 ~ 95	Maintaining the last valid position
95 ~ 97	Fully closed

ELECTRIC EGR CONTROL VALVE

▷ Type: Linear solenoid type

▷ Specification

Items	Specification
Coil Resistance (Ω)	7.3 ~ 8.3Ω [20℃(68˚F)]

VGT CONTROL SOLENOID VALVE

▷ Specification

Items	Specification
Coil Resistance (Ω)	14.7 ~ 16.1Ω [20℃(68˚F)]

VARIABLE SWIRL CONTROL ACTUATOR

▷ Type: Motor Driven (including Position Sensor)

▷ Specification

Motor

Items	Specification
Coil Resistance (Ω)	3.4 ~ 4.4Ω [20℃(68˚F)]

Position Sensor

Items	Specification
Coil Resistance (kΩ)	3.44 ~ 5.16kΩ [20℃(68˚F)]

SERVICE STANDARD

Basic Idle rpm(After warm u-p)	A/C OFF	Neutral,N,P-range	790 ± 100 rpm
		D-range	790 ± 100 rpm
	A/C ON	Neutral,N,P-range	790 ± 100 rpm
		D-range	790 ± 100 rpm

TIGHTENING TORQUES

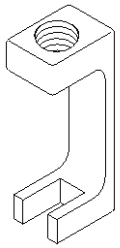
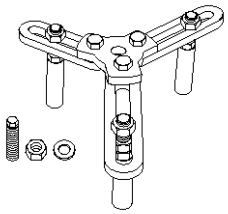
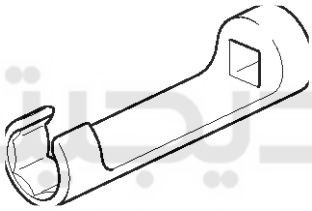
ENGINE CONTROL SYSTEM

Item	N·m	Kgf·m	lbf·ft
ECM bracket installation bolts/nuts	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Boost pressure sensor installation bolts	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Engine coolant temperature sensor installation	19.6 ~ 39.2	2.0 ~ 4.0	14.5 ~ 28.9
Crankshaft position sensor installation bolt	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Camshaft position sensor installation bolt	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Lambda sensor installation	40.2 ~ 59.8	4.1 ~ 6.1	29.7 ~ 44.1
Electric EGR control valve installation bolts	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Variable swirl control actuator installation bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Exhaust gas temperature sensor (For CPF) installation	39.2 ~ 49.1	4.0 ~ 5.0	28.9 ~ 36.2
Exhaust gas temperature sensor (For VGT) installation	39.2 ~ 49.1	4.0 ~ 5.0	28.9 ~ 36.2
DPS & VGT control solenoid valve bracket installation bolts	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Throttle body installation bolts	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pressure switch installation	14.7 ~ 21.6	1.5 ~ 2.2	10.9 ~ 15.9
Glow plug installation	9.8 ~ 13.7	1.0 ~ 1.4	7.2 ~ 10.1
Pipe (DPS ↔ CPF) installation (CPF side)	39.2 ~ 49.1	4.0 ~ 5.0	28.9 ~ 36.2

FUEL DELIVERY SYSTEM

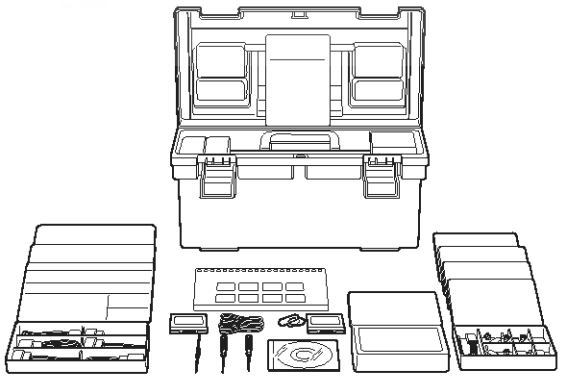
Item	N·m	Kgf·m	lbf·ft
Injector clamp installation bolt	24.5 ~ 28.4	2.5 ~ 2.9	18.1 ~ 21.0
Common rail installation bolts	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
High pressure fuel pump installation bolts	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
High pressure pipe (Injector ↔ Common Rail) installation nuts	24.5 ~ 28.4	2.5 ~ 2.9	18.1 ~ 21.0
High pressure pipe (Common Rail ↔ High Pressure Fuel Pump) installation nuts	24.5 ~ 28.4	2.5 ~ 2.9	18.1 ~ 21.0
Fuel tank band installation bolts	39.2 ~ 54.0	4.0 ~ 5.5	28.9 ~ 39.8
Fuel pump (Low Pressure) installation bolts	2.0 ~ 2.9	0.2 ~ 0.3	1.4 ~ 2.2
Sub fuel sender installation bolts	2.0 ~ 2.9	0.2 ~ 0.3	1.4 ~ 2.2
Accelerator pedal installation bolts	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7

SPECIAL SERVICE TOOLS

Tool (Number and name)	Illustration	Application
09351-27210 Injector Remover Adapter		Removing the injector
09351-4A200 Injector Remover		Removing the injector
09314-27110(14mm) 09314-27120(17mm) Torque Wrench Socket		Installing the high pressure pipe

Tool Number	Tool Name
0K000 003 AA0	Wire Harness Repair Kit II
0K000 003 A01 (001~028)	Connector Assembly Set
0K000 003 A02 (TS01~TS19)	Terminal & Seal Set
0K000 003 A03 (029~031)	Removal Tool Set
0K000 003 029	Removal Tool 1 (Flat Type)
0K000 003 030	Removal Tool 2 (Round Type)
0K000 003 031	Tweezers
0K000 003 A04 (032-1~032-9)	Inner Box Set
0K000 003 032-1~3	Inner Box A~C (Large)
0K000 003 032-4~7	Inner Box A~C (Samll)
0K000 003 032-8	Inner Box H (Empty Box for Storage of Terminals)
0K000 003 032-9	Inner Box H (Empty Box for Storage of Connectors)
0K000 003 033	Carrying Case
0K000 003 034	Shrink Tube (#Black, Ø4, 1M)
0K000 003 035	Shrink Tube (#Black, Ø5, 1M)
0K000 003 036	Wire (0.5SQ, 2M)
0K000 003 061	Inline Solder Connector 1 (Ø3.85 X 8mm)
0K000 003 062	Inline Solder Connector 1 (Ø5.25 X 8mm)

* For the wiring repair kit II, refer to the User's guide of the Wiring Repair Kit II(Pub. No. : 0K000 003 A05).



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BASIC TROUBLESHOOTING

BASIC TROUBLESHOOTING GUIDE

1	**Bring Vehicle to Workshop**

2	**Analyze Customer's Problem**

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

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

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

NOTE

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

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

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

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

WARNING

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

6	**Inspect Vehicle Visually**

Go to Step 11, if you recognize the problem.

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

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

8	**Confirm Symptoms of Problem**

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

9	**Recreate (Simulate) Symptom**

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

10	**Check the DTC**

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

11	**Perform troubleshooting procedure for DTC**

12	**Adjust or repair the vehicle**

13	**Confirm test**

14	**END**

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CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLE INFORMATION

(I) VIN:
(II) Production Date:
(III) Odometer Reading: _____km

2. SYMPTOMS

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

3. ENVIRONMENT

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

4. MIL/DTC

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

BASIC INSPECTION PROCEDURE

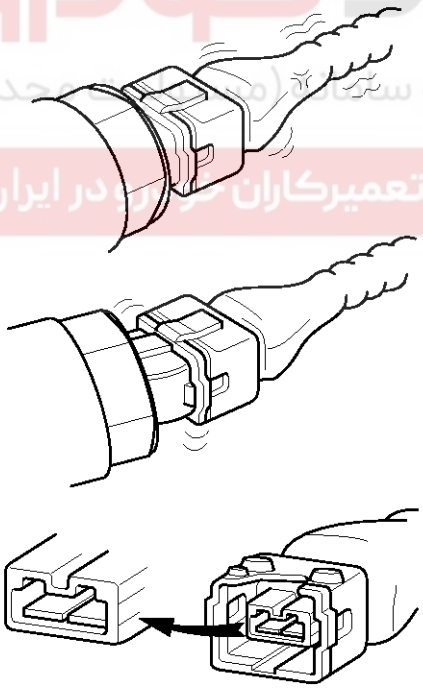
The measured resistance at high temperature after vehicle running may be high or low. So all resistance must be measured at ambient temperature (20℃, 68°F), unless stated otherwise.

NOTICE

The measured resistance in except for ambient temperature (20℃, 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.



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

● SIMULATING VIBRATION

a. Sensors and Actuators

: Slightly vibrate sensors, actuators or relays with finger.

WARNING

Strong vibration may break sensors, actuators or relays

b. Connectors and Harness

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

● SIMULATING HEAT

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

WARNING

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

● SIMULATING WATER SPRINKLING

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

WARNING

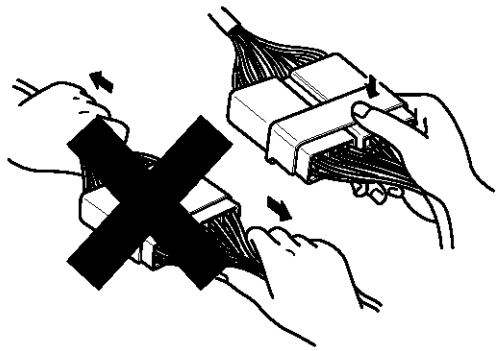
DO NOT sprinkle water directly into the engine compartment or electronic components.

● SIMULATING ELECTRICAL LOAD

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

CONNECTOR INSPECTION PROCEDURE

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



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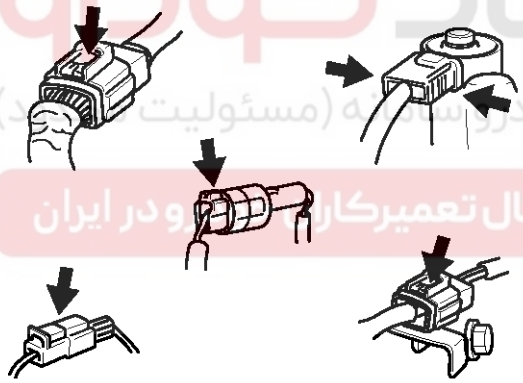
   b. When removing the connector with a lock, press or pull locking lever.



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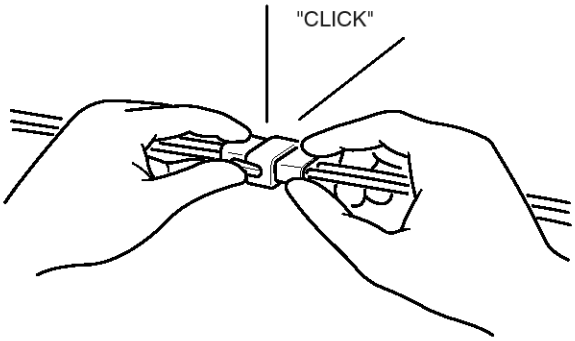
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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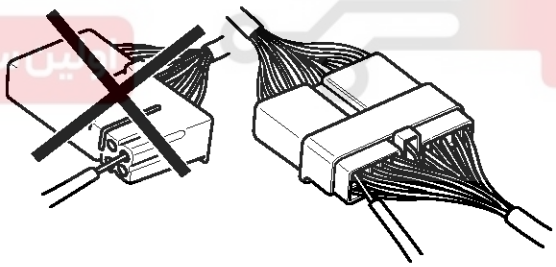
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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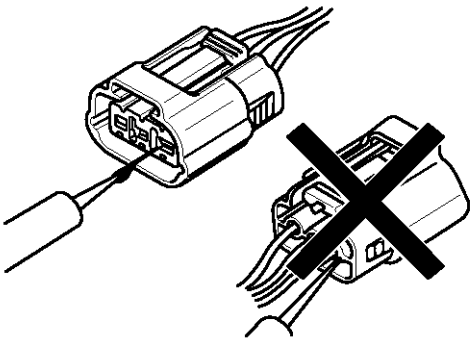
e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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NOTICE

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

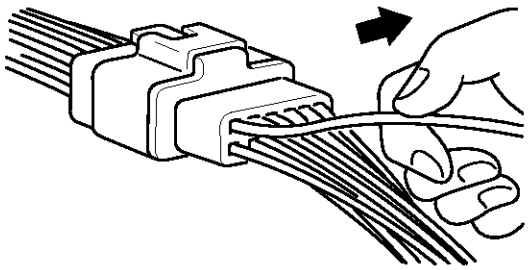
2. Checking Point for Connector

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

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

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

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



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3. Repair Method of Connector Terminal

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

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

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

WIRE HARNESS INSPECTION PROCEDURE

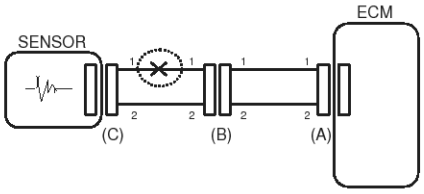
1. Before removing the wire harness, check the wire harness position and crimping in order to restore it correctly.
2. Check whether the wire harness is twisted, pulled or loosened.
3. Check whether the temperature of the wire harness is abnormally high.
4. Check whether the wire harness is rotating,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

ELECTRICAL CIRCUIT INSPECTION PROCEDURE

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

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

FIG 1



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2. Continuity Check Method

NOTICE

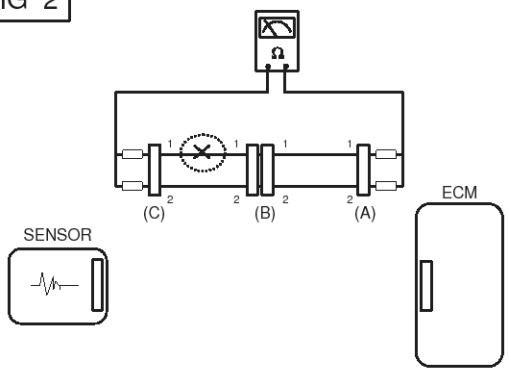
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

Specification (Resistance)
1Ω or less → Normal Circuit
1MΩ or Higher → Open Circuit

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

In [FIG.2.] the measured resistance of line 1 and 2 is higher than 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

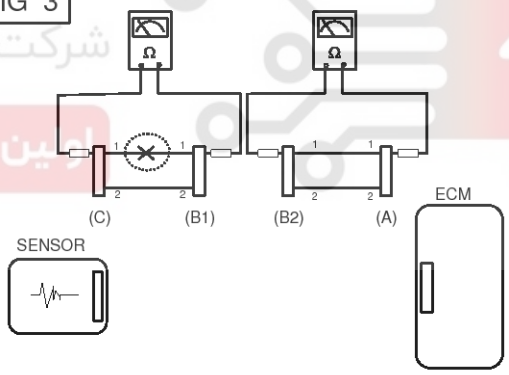


BFGE501B

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

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

FIG 3

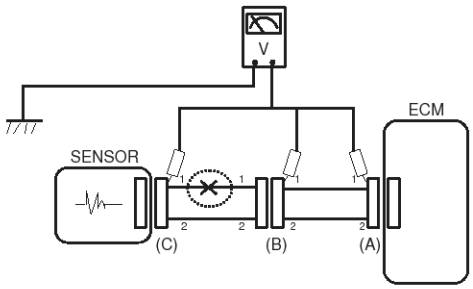


BFGE501C

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

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

FIG 4



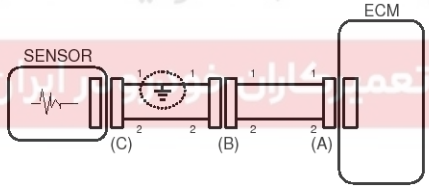
BFGE501D

● CHECK SHORT CIRCUIT

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

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

FIG 5



BFGE501E

2. Continuity Check Method (with Chassis Ground)

   NOTICE

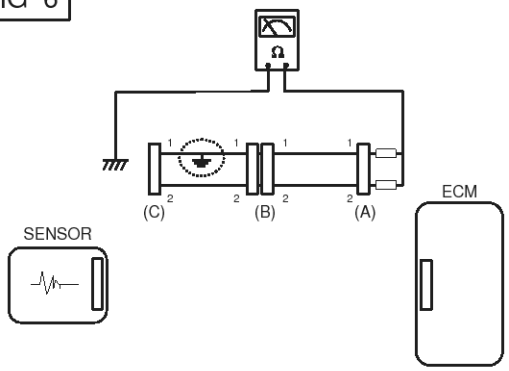
   Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

Specification (Resistance)
1Ω or less → Short to Ground Circuit
1MΩ or Higher → Normal Circuit

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

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

FIG 6

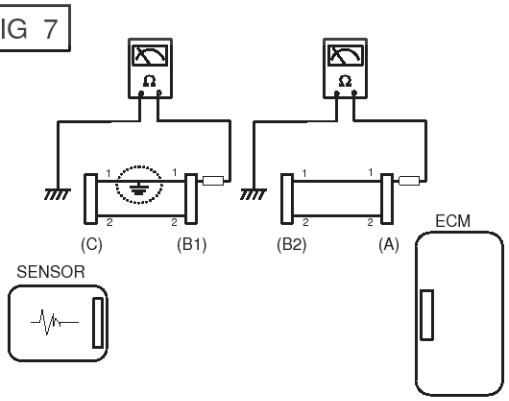


BFGE501F

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

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

FIG 7



BFGE501G

SYMPTOM TROUBLESHOOTING GUIDE TABLE

(SYMPTOM 1) ENGINE DOES NOT START

Possible Cause	
• Run out of fuel • Starter faulty • Fuel pump hose supply cut • High pressure leakage • Fuse out of order • Drift of the rail pressure sensor not detected • Cam and Crank signals missing simultaneously • Battery voltage too low • Faulty immobilizer • Electric EGR control valve blocked open • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Fuel quality / presence of water	• Inversion of low pressure fuel connections • Fuel filter not adapted • Low pressure fuel circuit sealed • Sealed fuel filter • Intermittent fault connection • Air ingress in the low pressure fuel circuit • Fuel return circuit of the pump sealed • Engine compression too low • Leakage at the injector • Low pressure fuel pump faulty • High pressure fuel pump faulty • Injector jammed open • Bug software or hardware fault not detected • Glow system faulty

(SYMPTOM 2) ENGIEN STARTS WITH DIFFICULTY OR STARTS AND STALLS

Possible Cause	
• Run out of fuel • Fuel return hose of injector cut • High pressure leakage • Fuse faulty • Air filter sealed • Alternator or voltage regulator faulty • The compensation of individual injector not adapted • Drift of the engine coolant temperature sensor not detected • Drift of the rail pressure sensor not detected • Battery voltage too low • Electric EGR control valve blocked open • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Fuel quality / presence of water	• Inversion of low pressure fuel connections • Low pressure fuel circuit sealed • Sealed fuel filter • Oil level too high/too low • Catalytic converter sealed or damaged • Intermittent fault connection • Air ingress in the low pressure fuel circuit • Fuel return circuit of the pump sealed • Glow system faulty • Engine compression too low • Fuel return hose of injector sealed • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Gasoline in fuel • Bug software or hardware fault not detected

(SYMPTOM 3) POOR STARTING WHEN HOT

Possible Cause	
• The compensation of individual injector not adapted • Drift of the rail pressure sensor not detected • Electric EGR control valve blocked open • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Air filter sealed • Air ingress in the low pressure fuel circuit • Fuel quality / presence of water	• Fuel return circuit of the pump sealed • Sealed fuel filter • Engine compression too low • Intermittent fault connection • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Gasoline in fuel • Bug software or hardware fault not detected

(SYMPTOM 4) UNSTABLE IDLING

Possible Cause	
• Fuel return hose of injector cut • The compensation of individual injector not adapted • Drift of the rail pressure sensor not detected • Harness resistance increased • Air ingress in the low pressure fuel circuit • Fuel quality / presence of water • Sealed fuel filter • Air filter sealed • Fuel return hose of injector sealed • High pressure leakage	• Glow system faulty • Engine compression too low • Bad flanging of the injector • High pressure pump out of order • Injector not adapted • Carbon deposit on the injector (sealed holes) • 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	
• Drift of the engine coolant temperature sensor not detected • Incorrect state of the electrical pack devices • Alternator or voltage regulator faulty	• Clutch not well set • Bug software or hardware fault not detected • Electric EGR control valve blocked open • Throttle control actuator faulty

(SYMPTOM 6) BLUE, WHITE, OR BLACK SMOKES

Possible Cause	
• The compensation of individual injector not adapted • Drift of the engine coolant temperature sensor not detected • Drift of the rail pressure sensor not detected • Electric EGR control valve blocked open • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Oil level too high/too low • Fuel quality / presence of water	• Catalytic converter sealed or damaged • Air filter sealed • Oil suction (engine racing) • Glow system faulty • Engine compression too low • Bad flanging of the injector • Injector washer not adapted, forgotten, doubled • Injector not adapted • Carbon deposit on the injector (sealed holes) • Injector jammed open • Gasoline in fuel

(SYMPTOM 7) ENGINE RATTLING, NOISY ENGINE

Possible Cause	
• The compensation of individual injector not adapted • Electric EGR control valve blocked closed (noisy engine) • Electric EGR control valve blocked open • Drift of the engine coolant temperature sensor not detected • Glow system faulty • Engine compression too low • Fuel return hose of injector sealed	• Drift of the rail pressure sensor not detected • Injector washer not adapted, forgotten, doubled • Injector not adapted • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Injector jammed open • Drift of engine coolant temperature sensor not detected

(SYMPTOM 8) BURST NOISE

Possible Cause	
• The compensation of individual injector not adapted • Intermittent fault connection • Exhaust system sealed • Drift of the rail pressure sensor not detected	• Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Bug software or hardware fault not detected

(SYMPTOM 9) UNTIMELY ACCELERATION/DECELERATION AND ENGINE RACING

Possible Cause	
• Accelerator position sensor blocked • Electric EGR valve blocked open • Intermittent fault connection	• Oil suction (engine racing) • Drift of the rail pressure sensor not detected • Bug software or hardware fault not detected

(SYMPTOM 10) GAP WHEN ACCELERATING AND AT RE-COUPLING (RESPONSE TIME)

Possible Cause	
• Air inlet circuit open • Incorrect state of the electrical pack devices • Accelerator position sensor blocked • Electric EGR valve blocked open • Turbo charger damaged, vacuum hose line leakage • Sealed fuel filter	• Engine compression too low • High pressure leakage • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Needle stuck (injection possible over a certain pressure) • Bug software or hardware fault not detected

(SYMPTOM 11) ENGINE STOP OR STALLING

Possible Cause	
• Run out of fuel • Fuel pump hose supply cut • High pressure leakage • Fuse faulty • Fuel quality / presence of water • Low pressure fuel circuit sealed • Sealed fuel filter • Crank signals missing simultaneously • Electric EGR valve blocked open • Fuel pressure regulator valve contaminated, stuck, jammed	• Rail pressure regulator valve contaminated, stuck, jammed • Alternator or voltage regulator faulty • Intermittent fault connection • Catalytic converter sealed or damaged • Oil suction (engine racing) • Low pressure fuel pump faulty • High pressure pump faulty • Faulty ignition key • Gasoline in fuel • Bug software or hardware fault not detected

(SYMPTOM 12) ENGINE JUDDER

Possible Cause	
• Run out of fuel • Fuel return hose of injector cut • Incorrect state of the electrical pack devices • The compensation of individual injector not adapted • Electric EGR valve blocked open • Fuel filter not adapted • Air ingress in the low pressure fuel circuit • Fuel quality / presence of water • Sealed fuel filter • Intermittent fault connection • Harness resistance increased	• Glow system faulty • Engine compression too low • Fuel return hose of injector sealed • Valve clearance • Low pressure fuel pump faulty • Injector washer not adapted, forgotten, doubled • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Injector jammed open • Gasoline in fuel • Bug software or hardware fault not detected

(SYMPTOM 13) LACK OF POWER

Possible Cause	
• The compensation of individual injector not adapted • Accelerator position sensor blocked • Incorrect state of the electrical pack devices • Electric EGR valve blocked open • Air inlet circuit open • Air filter sealed • Oil level too high/too low • Catalytic converter sealed or damaged • Turbo charger damaged, vacuum hose line leakage	• Sealed fuel filter • Leakage at the injector • Fuel return circuit of the pump sealed • Fuel return hose of injector sealed • Engine compression too low • Injector not adapted • Carbon deposit on the injector (sealed holes) • Valve clearance

(SYMPTOM 14) TOO MUCH POWER

Possible Cause	
• The compensation of individual injector not adapted • Oil suction (engine racing)	• Bug software or hardware fault not detected

(SYMPTOM 15) EXCESSIVE FUEL CONSUMPTION

Possible Cause	
• Fuel return hose of injector cut • Leakage at the Fuel pressure regulator valve • Leakage at fuel temperature sensor • Leakage at the spacers • High pressure leakage • Air inlet circuit open • Air filter sealed • The compensation of individual injector not adapted • Electric EGR valve blocked open	• Incorrect state of the electrical pack devices • Oil level too high/too low • Fuel quality / presence of water • Catalytic converter sealed or damaged • Turbo charger damaged • Engine compression too low • Injector not adapted • Bug software or hardware fault not detected

(SYMPTOM 16) OVER SPEED ENGINE WHEN CHANGING THE GEAR BOX RATIO

Possible Cause	
• Accelerator position sensor blocked • The compensation of individual injector not adapted • Intermittent fault connection • Clutch not well set	• Oil suction (engine racing) • Turbo charger damaged • Injector not adapted • Bug software or hardware fault not detected

(SYMPTOM 17) EXHAUST SMELLS

Possible Cause	
• Electric EGR control valve leakage • Oil suction (engine racing) • Turbo charger damaged • Oil level too high/too low • The compensation of individual injector not adapted • Catalytic converter sealed or damaged • Bad flanging of the injector	• Injector washer not adapted, forgotten, doubled • Injector not adapted • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Injector jammed open • Bug software or hardware fault not detected

(SYMPTOM 18) SMOKES (BLACK, WHITE, BLUE) WHEN ACCELERATING

Possible Cause	
• The compensation of individual injector not adapted • Electric EGR valve blocked open • Air filter sealed • Fuel quality / presence of water • Oil level too high/too low • Turbo charger damaged • Catalytic converter sealed or damaged • Oil suction (engine racing) • Air heaters out of order • Engine compression too low • High pressure leakage	• Intermittent fault connection • Bad flanging of the injector • Injector washer not adapted, forgotten, doubled • Injector not adapted • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Injector jammed open • Gasoline in fuel • Bug software or hardware fault not detected • Catalyzed Particulate Filter (CPF) fail

(SYMPTOM 19) FUEL SMELLS

Possible Cause	
• Fuel pump hose supply cut • Fuel return hose of injector cut • Leakage at the Fuel pressure regulator valve	• Leakage at fuel temperature sensor • Leakage at the spacers • High pressure leakage

(SYMPTOM 20) THE ENGINE COLLAPSES AT TAKE OFF

Possible Cause	
• Accelerator position sensor blocked • Incorrect state of the electrical pack devices • Air filter sealed • Inversion of low pressure fuel connections • Fuel filter not adapted • Fuel quality/presence of water • Air ingress in the low pressure fuel circuit • Sealed fuel filter	• Catalytic converter sealed or damaged • Clutch not well set • Intermittent fault connection • Drift of the rail pressure sensor not detected • Fuel pressure regulator valve contaminated, stuck, jammed • Rail pressure regulator valve contaminated, stuck, jammed • Gasoline in fuel • Bug software or hardware fault not detected

(SYMPTOM 21) THE ENGINE DOES NOT STOP

Possible Cause
• Faulty ignition key • Oil suction (engine racing) • Bug software or hardware fault not detected

(SYMPTOM 22) DIFFERENT MECHANICAL NOISES

Possible Cause	
• Buzzer noise (discharge by the injectors) • Clip broken (vibrations, resonance, noises) • Incorrect state of the electrical pack devices • Catalytic converter sealed or damaged • Air inlet circuit open	• Bad flanging of the injector • Clutch not well set • Turbo charger damagedValve clearance • Valve clearance

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 codesand 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 operationor while the ignition switch is ON could cause damage to the ECM.*
- *Wchecking the generator for the charging state, do not disconnect the battery '+' terminal to prevent the ECM from damage due to the voltage.*
- *Wcharging the battery with the external charger, disconnect the vehicleside 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 attery 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.*

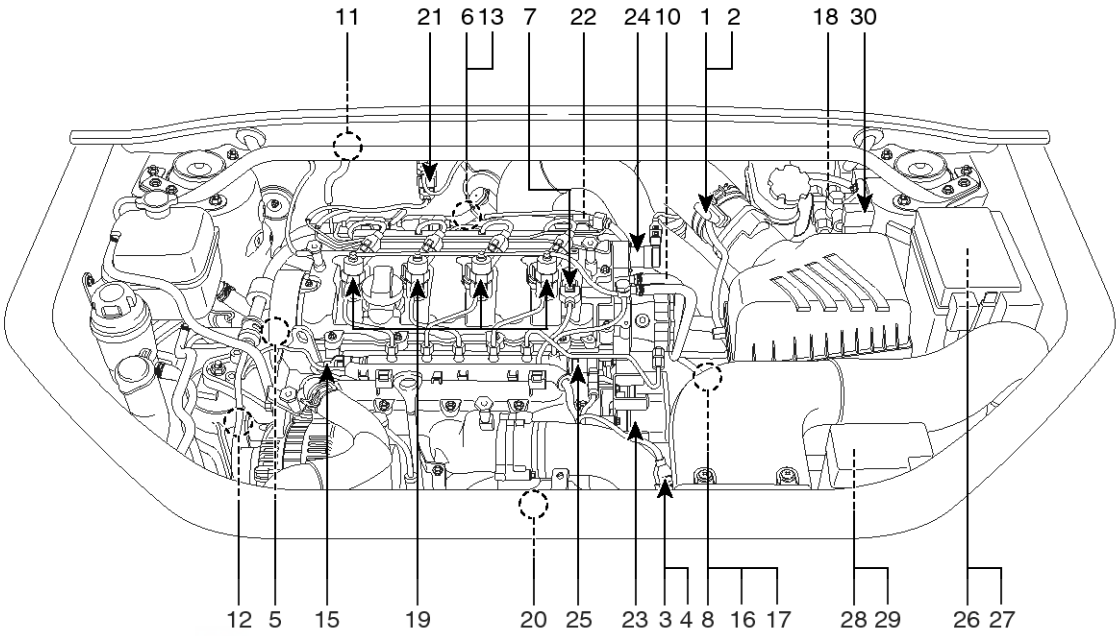
INSPECTION PROCEDURE (USING GENERIC SCAN TOOL)

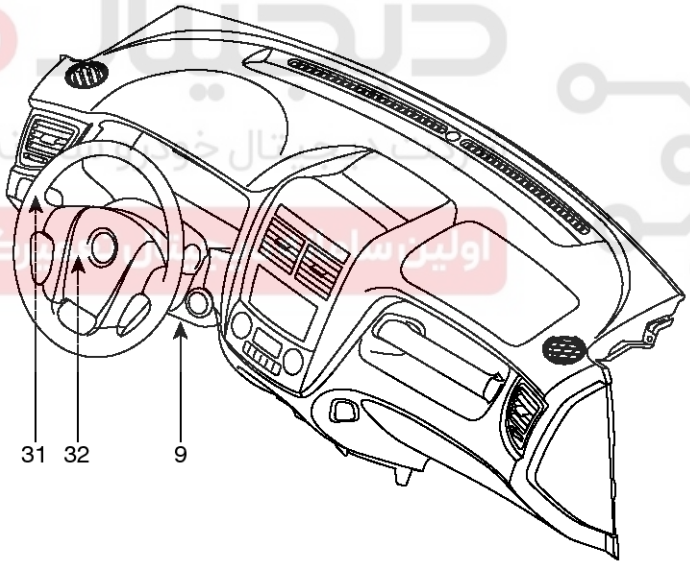
1. Turn OFF the ignition switch.
2. Connect the scan tool to the data link connector on the lower crash pad.
3. Turn ON the ignition switch.
4. Use the scan tool to check the diagnostic trouble code.
5. Repair the faulty part from the diagnosis chart.
6. Erase the diagnostic trouble code.
7. Disconnect the GST.

NOTICE

When deleting diagnostic trouble code, use scan tool as possible. When deleting diagnostic trouble code by disconnecting battery terminal(-), data for ECM control may delete simultaneously.

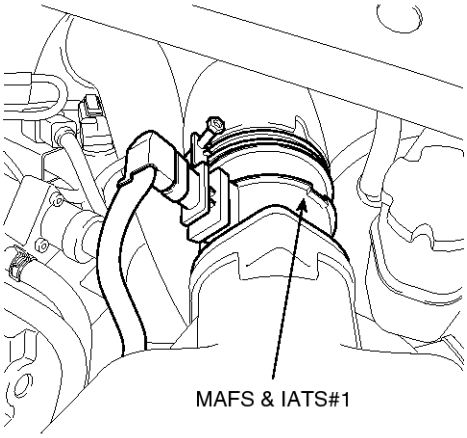
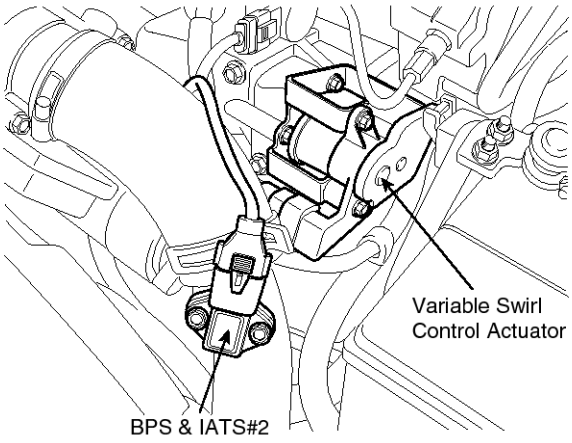
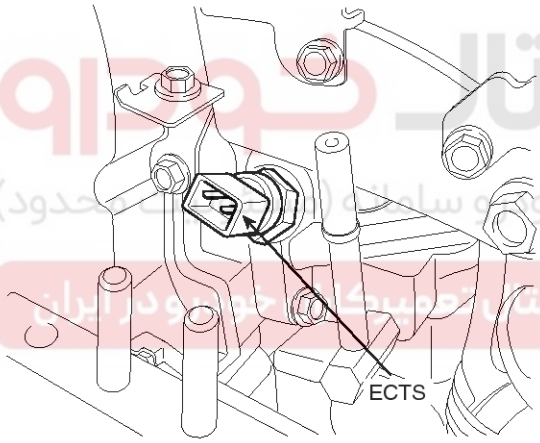
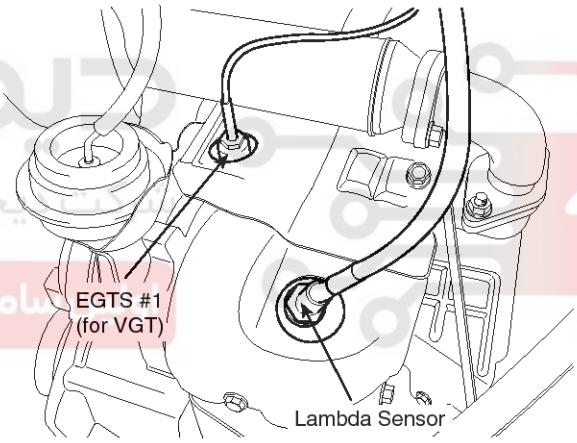
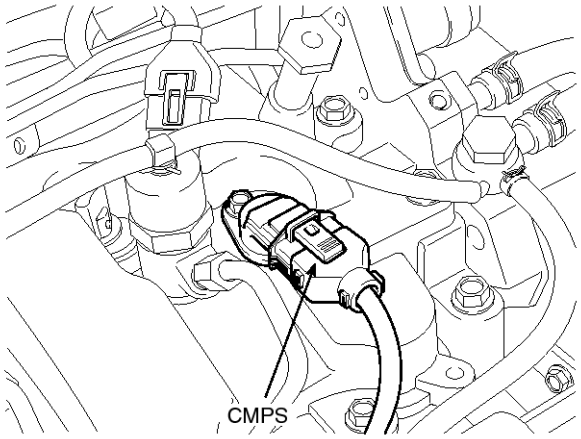
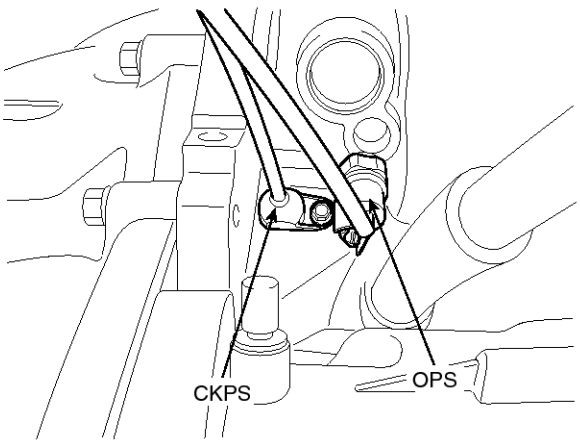
COMPONENT LOCATION



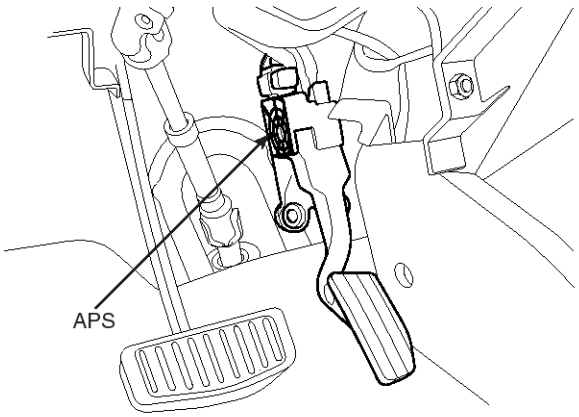


1. Mass Air Sensor (MAFS)
2. Intake Air Temperature Sensor (IATS) #1 built in MAFS
3. Boost Pressure Sensor (BPS)
4. Intake Air Temperature Sensor (IATS) #2 built in BPS
5. Engine Coolant Temperature Sensor (ECTS)
6. Lambda Sensor
7. Camshaft Position Sensor (CMPS)
8. Crankshaft Position Sensor (CKPS)
9. Accelerator Position Sensor (APS)
10. Fuel Temperature Sensor (FTS)
11. Differential Pressure Sensor (DPS)
12. A/C Pressure Transducer (APT)
13. Exhaust Gas Temperature Sensor (EGTS) #1 for VGT
14. Exhaust Gas Temperature Sensor (EGTS) #2 for CPF
15. Rail Pressure Sensor (RPS)
16. Vehicle Speed Sensor (VSS)
17. Oil Pressure Switch (OPS)
18. Water Sensor (included in Fuel Filter)
19. Injector
20. Throttle Control Actuator
21. VGT Control Solenoid Valve
22. Electric EGR Control Valve
23. Variable Swirl Control Actuator
24. Fuel Pressure Regulator Valve
25. Rail Pressure Regulator Valve
26. Main Relay
27. Fuel Pump Relay
28. Glow Relay
29. Auxiliary Heater Relay
30. Multi-Purpose Check Connector
31. Data Link Connector (DLC)
32. ECM (Engine Control Module)

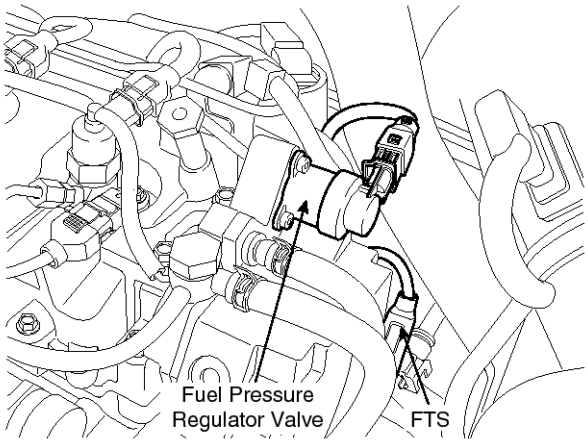
LFIG005A

1. Mass Air Flow Sensor (MAFS) 2. Intake Air Temperature Sensor (IATS) #1 built in MAFS	3. Boost Pressure Sensor (BPS) 4. Intake Air Temperature Sensor (IATS) #2 built in BPS 23. Variable Swirl Control Actuator
	
5. Engine Coolant Temperature Sensor (ECTS)	6. Lambda Sensor 13. Exhaust Gas Temperature Sensor (EGTS) #1 for VGT
	
7. Camshaft Position Sensor (CMPS)	8. Crankshaft Position Sensor (CKPS) 17. Oil Pressure Switch (OPS)
	

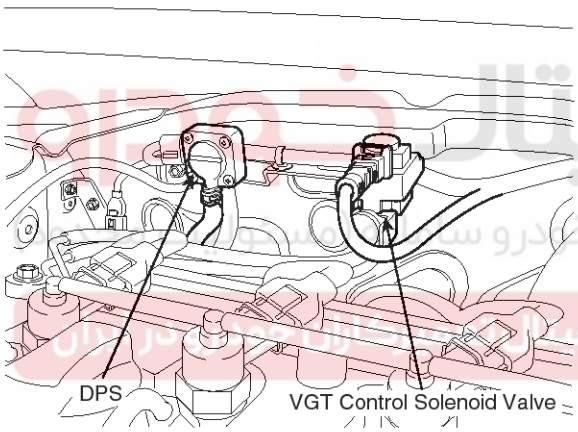
9. Accelerator Pedal Position Sensor (APS)



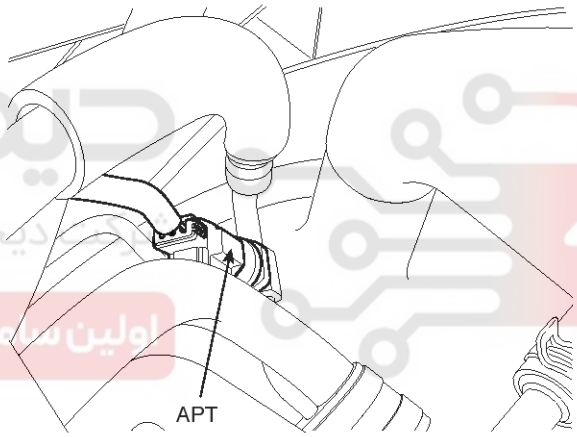
10. Fuel Temperature Sensor (FTS)
24. Fuel Pressure Regulator Valve



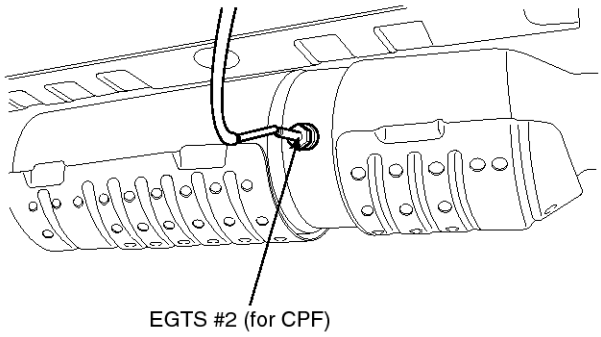
11. Differential Pressure Sensor (DPS)
21. VGT Control Solenoid Valve



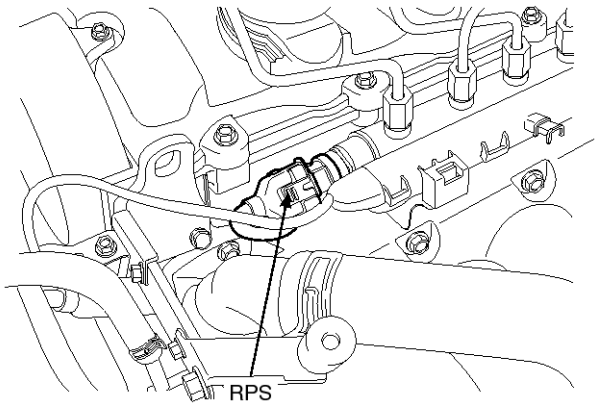
12. A/C Pressure Transducer (APT)



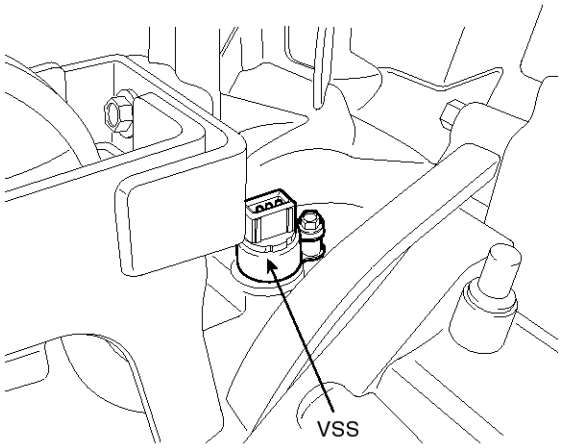
14. Exhaust Gas Temperature Sensor (EGTS) #2 for CPF



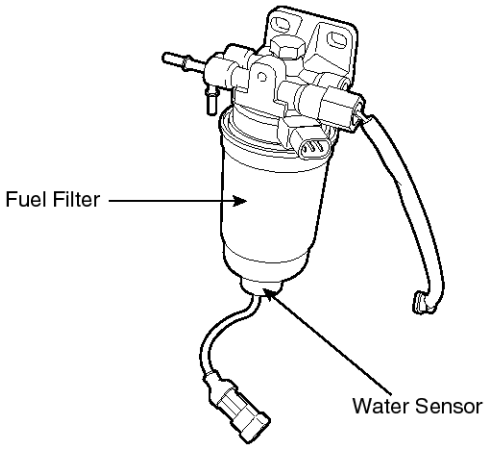
15. Rail Pressure Sensor (RPS)



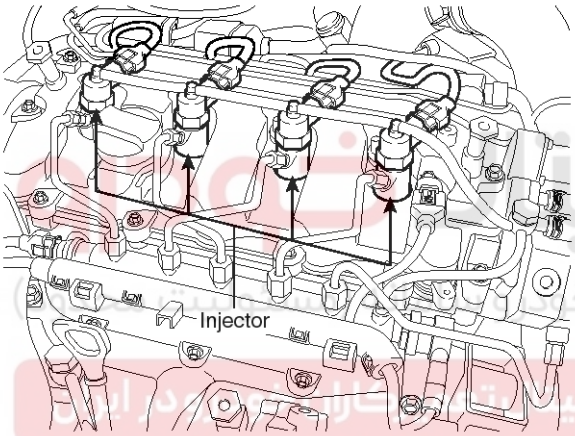
16. Vehicle Speed Sensor (VSS)



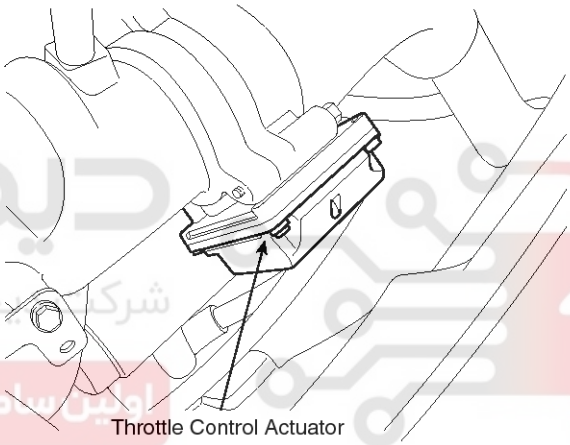
18. Water Sensor (included in Fuel Filter)



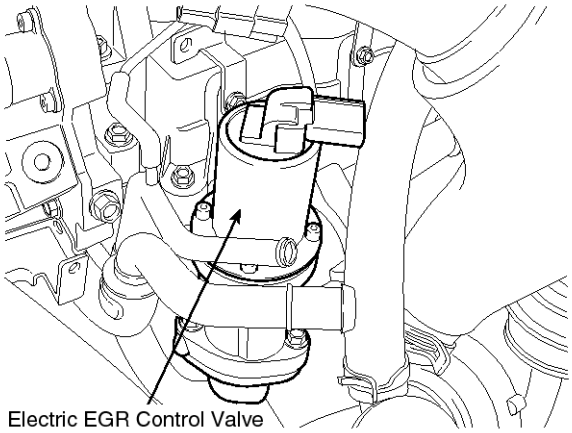
19. Injector



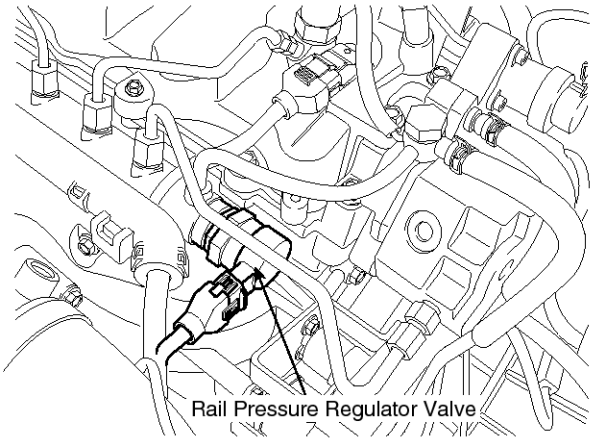
20. Throttle Control Actuator

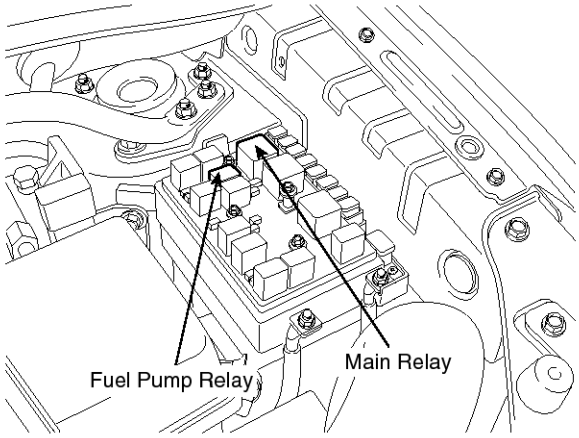
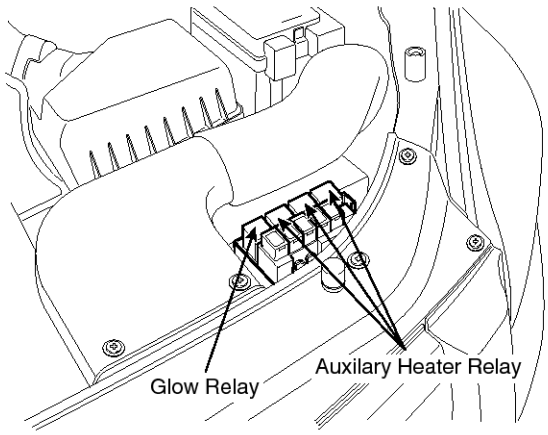
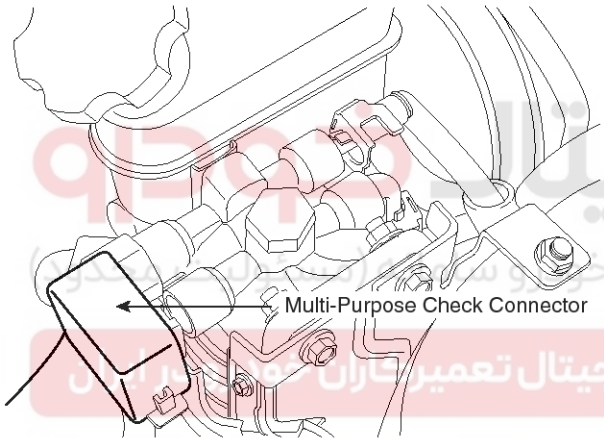


22. Electric EGR Control Valve



25. Rail Pressure Regulator Valve

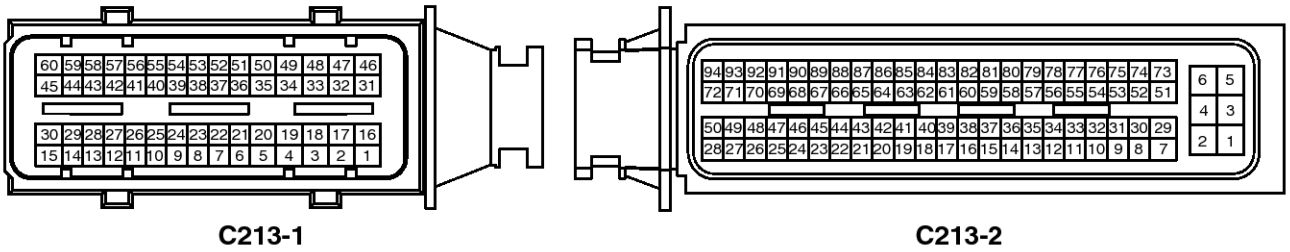


26. Main Relay 27. Fuel Pump Relay	28. Glow Relay 29. Auxiliary Heater Relay
	
30. Multi-Purpose Check Connector	
	

Engine Control Module (ECM)

ECM (ENGINE CONTROL MODULE)

1. ECM HARNESS CONNECTOR



LFIG027A

2. ECM TERMINAL FUNCTION

CONNECTOR [C213-1]

Pin	Description	Connected to
1	Injector (Cylinder #3) [HIGH] control output	Injector (Cylinder #3)
2	Injector (Cylinder #2) [HIGH] control output	Injector (Cylinder #2)
3	-	
4	Battery power	Rail Pressure Regulator Valve
5	-	
6	Sensor ground	Position Sensor in Variable Swirl Control Actuator
7	Sensor shield	Crankshaft Position Sensor (CKPS)
8	Sensor ground	Rail Pressure Sensor (RPS)
9	-	
10	-	
11	-	
12	Crankshaft Position Sensor (CKPS) [-] signal input	Crankshaft Position Sensor (CKPS)
13	Reference voltage (+5V)	Boost Pressure Sensor (BPS)
14	-	
15	-	
16	Injector (Cylinder #1) [HIGH] control output	Injector (Cylinder #1)
17	Injector (Cylinder #4) [HIGH] control output	Injector (Cylinder #4)
18	-	
19	Battery power	Fuel Pressure Regulator Valve
20	Sensor ground	Camshaft Position Sensor (CMPS)
21	-	
22	-	

Pin	Description	Connected to
23	Sensor ground	Boost Pressure Sensor (BPS)
24	-	
25	-	
26	Reference voltage (+5V)	Position Sensor in Variable Swirl Control Actuator
27	Crankshaft Position Sensor (CKPS) [+] signal input	Crankshaft Position Sensor (CKPS)
28	Reference voltage (+5V)	Rail Pressure Sensor (RPS)
29	-	
30	Motor [-] control output	Variable Swirl Control Actuator
31	Injector (Cylinder #2) [LOW] control output	Injector (Cylinder #2)
32	-	
33	Injector (Cylinder #4) [LOW] control output	Injector (Cylinder #4)
34	Rail Pressure Regulator Valve control output	Rail Pressure Regulator Valve
35	-	
36	-	
37	Reference frequency	Mass Air Flow Sensor (MAFS)
38	-	
39	-	
40	Boost Pressure Sensor (BPS) signal input	Boost Pressure Sensor (BPS)
41	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
42	Mass Air Flow Sensor (MAFS) signal input	Mass Air Flow Sensor (MAFS)
43	Rail Pressure Sensor (RPS) signal input	Rail Pressure Sensor (RPS)
44	Sensor ground	MAFS & IATS #1
45	Fuel Pump Relay output	Fuel Pump Relay
46	Injector (Cylinder #3) [LOW] control output	Injector (Cylinder #3)
47	Injector (Cylinder #1) [LOW] control output	Injector (Cylinder #1)
48	-	
49	Fuel Pressure Regulator Valve control output	Fuel Pressure Regulator Valve
50	Camshaft Position Sensor (CMPS) signal input	Camshaft Position Sensor (CMPS)
51	-	
52	-	
53	Intake Air Temperature Sensor (IATS) #2 signal input	Intake Air Temperature Sensor (IATS) #2 built in BPS
54	-	
55	-	
56	Position Sensor signal input	Position Sensor in Variable Swirl Control Actuator

Pin	Description	Connected to
57	-	
58	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
59	Electric EGR Control Valve control output	Electric EGR Control Valve
60	Motor [+] control output	Variable Swirl Control Actuator

CONNECTOR [C213-2]

Pin	Description	Connected to
1	Batter voltage supply after main relay	Main Relay
2	Power ground	Chassis Ground
3	Batter voltage supply after main relay	Main Relay
4	Power ground	Chassis Ground
5	Batter voltage supply after main relay	Main Relay
6	Power ground	Chassis Ground
7	Cooling Fan Relay [HIGH] control output	Cooling Fan Relay [HIGH]
8	Sensor ground	Accelerator Position Sensor (APS) #2
9	Accelerator Position Sensor (APS) #1 signal input	Accelerator Position Sensor (APS) #1
10	Sensor ground	Fuel Temperature Sensor (FTS)
11	Fuel Temperature Sensor (FTS) signal input	Fuel Temperature Sensor (FTS)
12	Ground	A/C Pressure Transducer
13	A/C Pressure Transducer signal input	A/C Pressure Transducer
14	Ground	Cruise Control Switch
15	Cruise Control "ACTIVATOR" signal input	Cruise Control Switch
16	Ground	Immobilizer Control Module
17	-	
18	-	
19	-	
20	-	
21	-	
22	Reference voltage (+5V)	A/C Pressure Transducer
23	-	
24	Reference voltage (+5V)	Cruise Control Switch
25	Diagnosis Data Line (K-Line)	Data Link Connector (DLC)
26	-	
27	Fuel consumption signal output	Trip computer

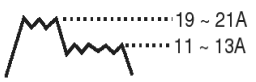
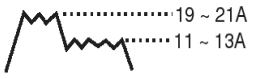
Pin	Description	Connected to
28	Ignition switch signal input	Ignition Switch
29	VGT Control Solenoid Valve control output	VGT Control Solenoid Valve
30	Sensor ground	Accelerator Position Sensor (APS) #1
31	Accelerator Position Sensor (APS) #2 signal input	Accelerator Position Sensor (APS) #2
32	Exhaust Gas Temperature Sensor (EGTS) #2 signal input	Exhaust Gas Temperature Sensor (EGTS) #2 for CPF
33	Sensor ground	Exhaust Gas Temperature Sensor (EGTS) #2 for CPF
34	Exhaust Gas Temperature Sensor (EGTS) #1 signal input	Exhaust Gas Temperature Sensor (EGTS) #1 for VGT
35	Sensor ground	Exhaust Gas Temperature Sensor (EGTS) #1 for VGT
36	Differential Pressure Sensor (DPS) signal input	Differential Pressure Sensor (DPS)
37	Sensor ground	Differential Pressure Sensor (DPS)
38	Brake Switch "Lamp" signal input	Brake Switch
39	-	
40	Water Sensor siganl input	Water Sensor in Fuel Filter
41	-	
42	Blower Switch Signal input	Blower Switch
43	-	
44	Reference voltage (+5V)	Differential Pressure Sensor (DPS)
45	Reference voltage (+5V)	Accelerator Position Sensor (APS) #1
46	Reference voltage (+5V)	Accelerator Position Sensor (APS) #2
47	Immobilizer Communication Line	Immobilizer Control Module
48	Engine speed signal output	Tachometer (Cluster)
49	Cruise Control "SET" Lamp control output	Cruise Control "SET" Lamp (Cluster)
50	-	
51	Lambda Sensor Heater control output	Lambda Sensor
52	A/C "MIDDLE" Switch signal input	A/C "MIDDLE" Switch
53	-	
54	A/C Switch "ON" signal input	A/C Switch
55	-	
56	Thermo Switch signal input	A/C Switch
57	Gear Neutral Switch signal input (MT Only)	Gear Neutral Switch
58	-	
59	-	
60	-	

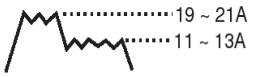
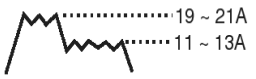
Pin	Description	Connected to
61	-	
62	-	
63	-	
64	Lambda Sensor Voltage "NERNST"	Lambda Sensor
65	Lambda Sensor Current Pump	Lambda Sensor
66	-	
67	-	
68	Malfunction Indicator Lamp (MIL) control output	Malfunction Indicator Lamp (MIL)
69	Glow Time Indicator Lamp contorl output	Glow Time Indicator Lamp (Cluster)
70	A/C Compressor Relay control output	A/C Compressor Relay
71	Cooling Fan Relay [LOW] control output	Cooling Fan Relay
72	Main Relay control output	Main Relay
73	-	
74	-	
75	Vehicle speed signal input	Vehicle Speed Sensor (VSS)
76	-	
77	Feedback signal input	Throttle Control Actuator
78	-	
79	Clutch Switch signal input	Clutch Switch
80	Brake Switch "Redundant" signal input	Brake Switch
81	MT/AT auto reconition signal input	M/T: Open, A/T: Ground
82	-	
83	CAN [LOW]	Other Control Modules
84	CAN [HIGH]	Other Control Modules
85	-	
86	Lambda Sensor Virtual Ground	Lambda Sensor
87	Lambda Sensor Current Adjust	Lambda Sensor
88	-	
89	Intake Air Temperature Sensor (IATS) #1 signal input	Intake Air Temperature Sensor (IATS) #1 in MAFS
90	Throttle Control Actuator control output	Throttle Control Actuator
91	Cruise Control "MAIN" Lamp control output	Cruise Control "MAIN" Lamp (Cluster)
92	Immobilizer Lamp control output	Immobilizer Lamp (Cluster)
93	Glow Relay control output	Glow Relay
94	PTC Heater Relay control output	PTC Heater Relay

3. ECM TERMINAL INPUT/OUTPUT SIGNAL

CONNECTOR [C213-1]

Pin	Description	Type	Vehicle State	Level
1	Injector (Cylinder #3) [HIGH] control output	Idle	Pulse	B+ ~ 80V
2	Injector (Cylinder #2) [HIGH] control output	Idle	Pulse	B+ ~ 80V
3	-	-	-	-
4	Battery power	Idle	DC	Vbatt
5	-	-	-	-
6	Sensor ground	Idle	DC	Max. 50mV
7	Sensor shield	Idle	DC	Max. 50mV
8	Sensor ground	Idle	DC	Max. 50mV
9	-	-	-	-
10	-	-	-	-
11	-	-	-	-
12	Crankshaft Position Sensor (CKPS) [-] signal i-nput	Idle	Sine Wave	Vp_p : Min.1.0V
13	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
14	-	-	-	-
15	-	-	-	-
16	Injector (Cylinder #1) [HIGH] control output	Idle	Pulse	Vbatt ~ 80V
17	Injector (Cylinder #4) [HIGH] control output	Idle	Pulse	Vbatt ~ 80V
18	-	-	-	-
19	Battery power	IG OFF	DC	Max. 0.5 V
		IG ON		Vbatt
20	Sensor ground	Idle	DC	Max. 50 mV
21	-	-	-	-
22	-	-	-	-
23	Sensor ground	Idle	DC	Max. 50 mV
24	-	-	-	-
25	-	-	-	-
26	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
27	Crankshaft Position Sensor (CKPS) [+] signal i nput	Idle	Sine Wave	Vp_p : Min.1.0V
28	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V

Pin	Description	Type	Vehicle State	Level
29	-	-	-	-
30	Motor [-] control output	Active	DC	Max.0.5V
31	Injector (Cylinder #2) [LOW] control output	Idle	Pulse	Peak Current : 19 ~ 21 A Hold Current : 11 ~ 13 A 
32	-	-	-	-
33	Injector (Cylinder #4) [LOW] control output	Idle	Pulse	Peak Current : 19 ~ 21 A Hold Current : 11 ~ 13 A 
34	Rail Pressure Regulator Valve control output	Idle	Pulse	Hi: Vbatt Lo: Max. 1.0V Frequency = 1kHz ± 2%
35	-	-	-	-
36	-	-	-	-
37	Reference frequency	Idle	Pulse	Hi: Vcc or Vbatt Lo: Max. 1.0V
38	-	-	-	-
39	-	-	-	-
40	Boost Pressure Sensor (BPS) signal input	IG ON	Analog	0.5 ~ 4.5V
41	Sensor ground	Idle	DC	Max. 50 mV
42	Mass Air Flow Sensor (MAFS) signal input	Idle	Pulse	Hi: Vcc or Vbatt Lo: Max. 1.0V
43	Rail Pressure Sensor (RPS) signal input	IG ON	Analog	Max. 1.0V
		Idle		1.0 ~ 1.5 V
		3000 RPM		1.5 ~ 3.0 V
44	Sensor ground	Idle	DC	Max. 50 mV
45	Fuel Pump Relay output	Relay OFF	DC	Vbatt
		Relay ON		Max. 1.0V

Pin	Description	Type	Vehicle State	Level
46	Injector (Cylinder #3) [LOW] control output	Idle	Pulse	Peak Current : 19 ~ 21 A Hold Current : 11 ~ 13 A 
47	Injector (Cylinder #1) [LOW] control output	Idle	Pulse	Peak Current : 19 ~ 21 A Hold Current : 11 ~ 13 A 
48	-	-	-	-
49	Fuel Pressure Regulator Valve control output	Idle	Pulse	Hi: Vbatt Lo: Max. 1.0V
50	Camshaft Position Sensor (CMPS) signal input	Idle	Pulse	Hi: Vcc or Vbatt Lo: Max. 1.0V
51	-	-	-	-
52	-	-	-	-
53	Intake Air Temperature Sensor (IATS) #2 signal input	Idle	Analog	0.5 ~ 4.5V
54	-	-	-	-
55	-	-	-	-
56	Position Sensor signal input	Idle	DC	0.5 ~ 4.5V
57	-	-	-	-
58	Engine Coolant Temperature Sensor (ECTS) signal input	Idle	Analog	0.5 ~ 4.5V
59	Electric EGR Control Valve control output	Idle	Pulse	Hi: Vbatt Lo: Max. 1.0V
60	Motor [+] control output	Active	Pulse	Hi: Vbatt Lo: Max. 1.0V

CONNECTOR [C213-2]

Pin	Description	Type	Vehicle State	Level
1	Batter voltage supply after main relay	IG OFF	DC	Max. 1.0 V
		IG ON		Vbatt
2	Power ground	Idle	DC	Max. 50 mV
3	Batter voltage supply after main relay	IG OFF	DC	Max. 1.0 V
		IG ON		Vbatt

Pin	Description	Type	Vehicle State	Level
4	Power ground	Idle	DC	Max. 50 mV
5	Batter voltage supply after main relay	IG OFF	DC	Max. 1.0 V
		IG ON		Vbatt
6	Power ground	Idle	DC	Max. 50 mV
7	Cooling Fan Relay [HIGH] control output	Relay OFF	DC	Vbatt
		Relay ON		Max. 1.0V
8	Sensor ground	Idle	DC	Max. 50 mV
9	Accelerator Position Sensor (APS) #1 signal input	C.T	Analog	0.3 ~ 0.9V
		W.O.T		4.0 ~ 4.8V
10	Sensor ground	Idle	DC	Max. 50 mV
11	Fuel Temperature Sensor (FTS) signal input	IG ON	Analog	0.5 ~ 4.5V
12	Ground	Idle	DC	Max. 50 mV
13	A/C Pressure Transducer signal input	A/C On	Analog	Max. 4.8V
14	Ground	Idle	DC	Max. 50mV
15	Cruise Control "ACTIVATOR" signal input	-	-	-
16	Ground	Idle	DC	Max. 50 mV
17	-	-	-	-
18	-	-	-	-
19	-	-	-	-
20	-	-	-	-
21	-	-	-	-
22	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
23	-	-	-	-
24	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
25	Diagnosis K-Line	When transmitting	Pulse	Hi: Min. Vbatt×80% Lo: Max. Vbatt×20%
		When receiving		Hi: Min. Vbatt×70% Lo: Max. Vbatt×30%
26	-	-	-	-
27	Fuel consumption signal output	Idle	Pulse	Hi: Vbatt or Vcc Lo: Max. 0.5V
28	Ignition switch signal input	IG OFF	DC	Max. 1.0V
		IG ON		Vbatt

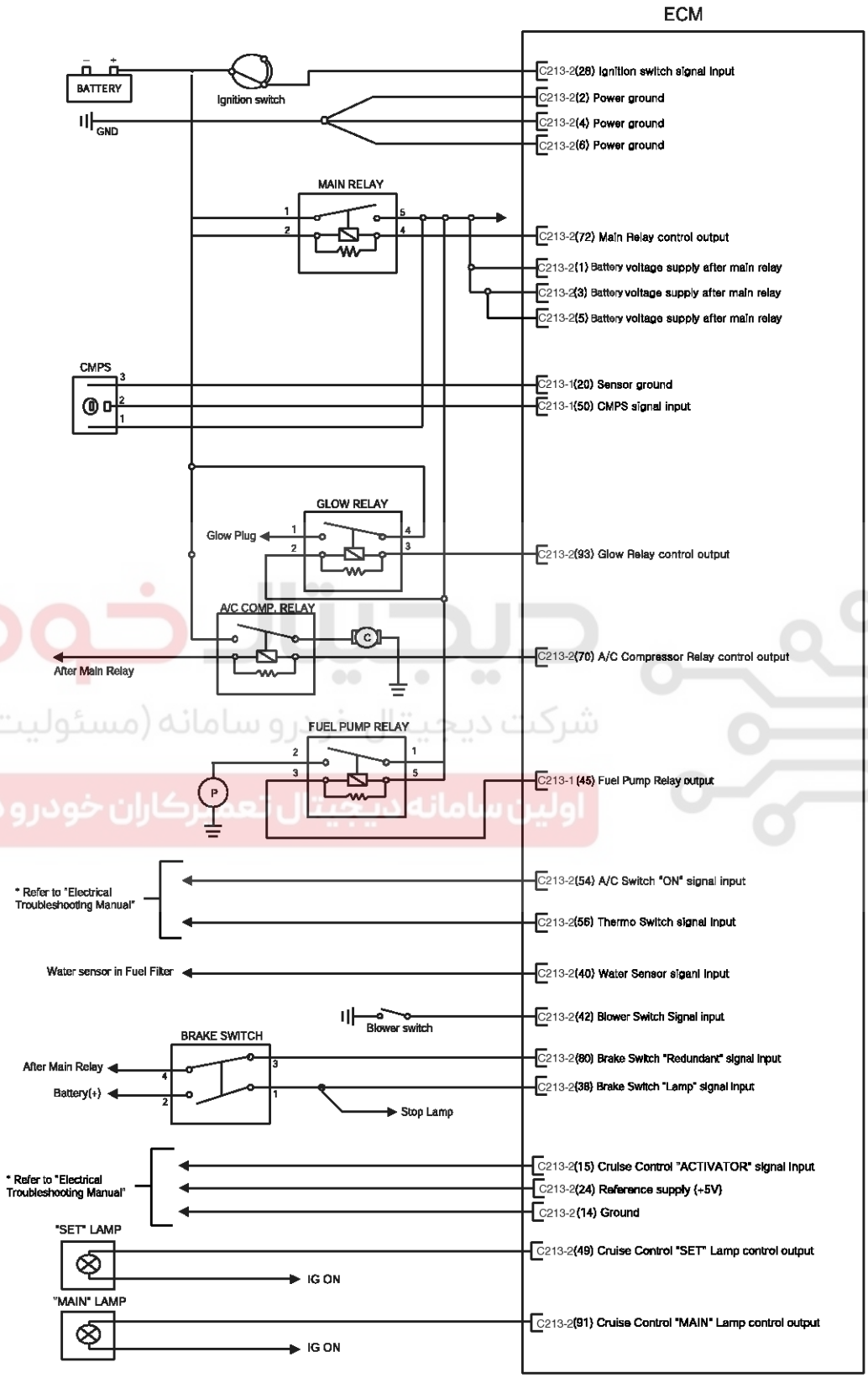
Pin	Description	Type	Vehicle State	Level
29	VGT Control Solenoid Valve control output	Idle	Pulse	Hi: Vbatt Lo: Max. 0.5V
30	Sensor ground	Idle	DC	Max. 50 mV
31	Accelerator Position Sensor (APS) #2 signal input	C.T	Analog	0.3 ~ 0.9V
		W.O.T		1.5 ~ 3.0V
32	Exhaust Gas Temperature Sensor (EGTS) #2 signal input	Idle	Analog	0.5 ~ 4.5V
33	Sensor ground	Idle	DC	Max. 50 mV
34	Exhaust Gas Temperature Sensor (EGTS) #1 signal input	Idle	Analog	0.5 ~ 4.5V
35	Sensor ground	Idle	DC	Max. 50 mV
36	Differential Pressure Sensor (DPS) signal input	Idle	Analog	0.5 ~ 4.5V
37	Sensor ground	Idle	DC	Max. 50 mV
38	Brake Switch "Lamp" signal input	Release	DC	Max. 0.5V
		Push		Vbatt
39	-	-	-	-
40	Water Sensor siganl input	Full of Water	Analog	Vbatt
		No Water		Max. 1V
41	-	-	-	-
42	Blower Switch Signal input	Blower Off	DC	Vbatt
		Blower On		Max. 2V
43	-	-	-	-
44	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
45	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
46	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
47	Immobilizer Communication Line	After IG ON when communicating	Pulse	Hi: Min. 8.5V
				Lo: Max. 3.5V
48	Engine speed signal output	Idle	Pulse	Hi: Vbatt Lo: Max. 5V Frequency : 50~60Hz
49	Cruise Control "SET" Lamp control output	-	-	-
50	-	-	-	-

Pin	Description	Type	Vehicle State	Level
51	Lambda Sensor Heater control output	Vehicle Run	Pulse	Hi: Vbatt Lo: Max. 1.0V
52	-	-	-	-
53	-	-	-	-
54	A/C Switch "ON" signal input	A/C SW OFF	DC	Max. 1.0V
		A/C SW ON		Vbatt
55	-	-	-	-
56	Thermo Switch signal input	A/C OFF	DC	Max. 0.5V
		A/C ON		Vbatt
57	Gear Neutral Switch signal input (MT Only)	SW OFF (Neutr-al)	DC	Vbatt
		SW ON (1st)		Max. 0.5V
58	-	-	-	-
59	-	-	-	-
60	-	-	-	-
61	-	-	-	-
62	-	-	-	-
63	-	-	-	-
64	Lambda Sensor Voltage "NERNST"	Engine Run	Analog	Normal : 450 ± 50 mV Rich : Max. Normal + 150mV Lean : Min. Normal - 150mV
65	Lambda Sensor Current Pump	Engine Run	Analog	Normal : 0 ± 500 mV Rich : Min. Normal - 1.5V Lean : Max. Normal + 1.5V
66	-	-	-	-
67	-	-	-	-
68	Malfunction Indicator Lamp (MIL) control outp-ut	Lamp OFF	DC	Vbatt
		Lamp ON		Max. 1.0V
69	Glow Time Indicator Lamp control output	Glow OFF	DC	Vbatt
		Glow ON		Max. 1.0V
70	A/C Compressor Relay control output	A/Con OFF	DC	Vbatt
		A/Con ON		Max. 1.0V
71	Cooling Fan Relay [LOW] control output	Relay OFF	DC	Vbatt
		Relay ON		Max. 1.0V

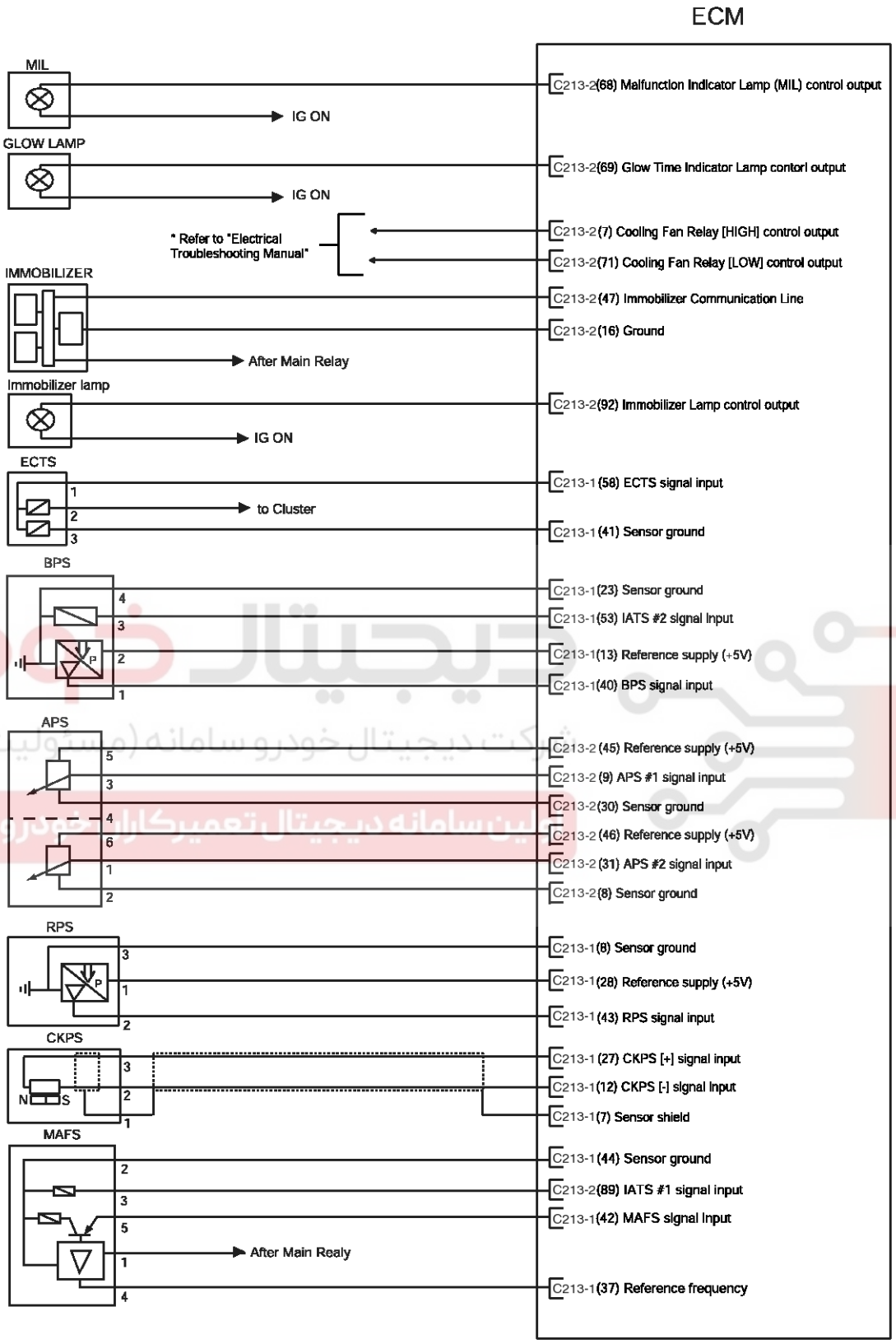
Pin	Description	Type	Vehicle State	Level
72	Main Relay control output	Relay OFF	DC	Vbatt
		Relay ON		Max. 1.0V
73	-			
74	-	-	-	-
75	Vehicle speed signal input	Vehicle Run	Pulse	Hi: Min. 5.0V Lo: Max. 1.0V
76	-	-	-	-
77	Feedback signal input	Normal	DC	Vbatt
		Abnormal		Max. 0.5V
78	-	-	-	-
79	Clutch Switch signal input	Release	DC	Max. 0.5V
		Push		Vbatt
80	Brake Switch "Redundant" signal input	Release	DC	Vbatt
		Push		Max. 0.5V
81	MT/AT auto reconition signal input	MT	DC	Vbatt
		AT		Max. 0.5V
82	-	-	-	-
83	CAN [LOW]	Recessive	Pulse	2.0 ~ 3.0 V
		Dominant		0.5 ~ 2.25 V
84	CAN [HIGH]	Recessive	Pulse	2.0 ~ 3.0 V
		Dominant		2.75 ~ 4.5 V
85	-	-	-	-
86	Lambda Sensor Virtual Ground	Engine Run	Analog	2.4 ~ 2.6V
87	Lambda Sensor Current Adjust	Engine Run	Analog	|Current Pump - Current Adjust| < 0.2V
88	-	-	-	-
89	Intake Air Temperature Sensor (IATS) #1 signal input	Idle	Analog	0.5V ~ 4.5V
90	Throttle Control Actuator control output	Key On/Key Off	Pulse	Hi: Vbatt Lo: Max. 1V
91	Cruise Control "MAIN" Lamp control output	-	-	-
92	Immobilizer Lamp control output	Lamp OFF	DC	Vbatt
		Lamp ON		Max. 1.0V
93	Glow Relay control output	Relay OFF	DC	Vbatt
		Relay ON		Max. 1.0V

Pin	Description	Type	Vehicle State	Level
94	PTC Heater Relay control output	Relay OFF	DC	Vbatt
		Relay ON		Max. 1.0V

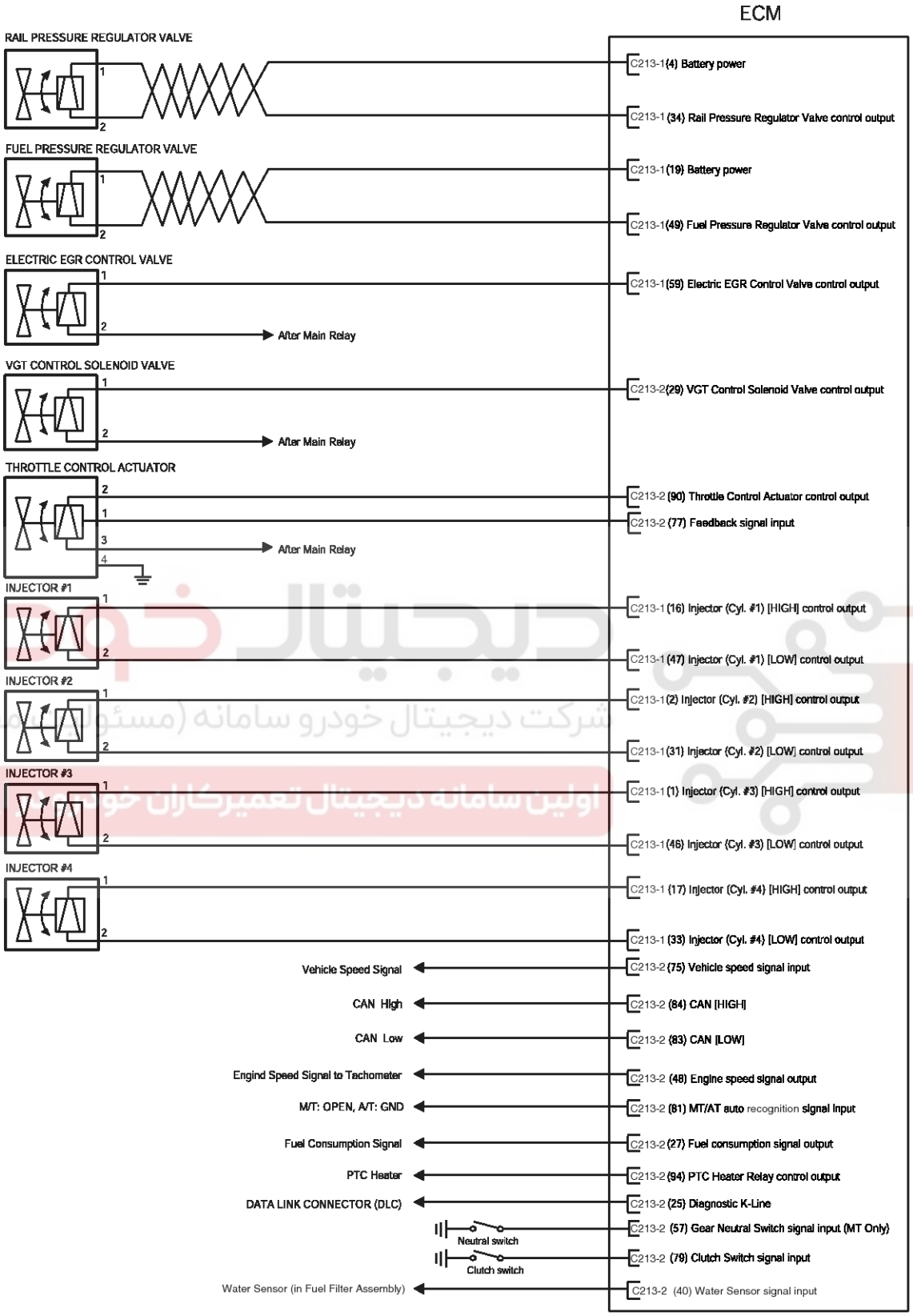
CIRCUIT DIAGRAM



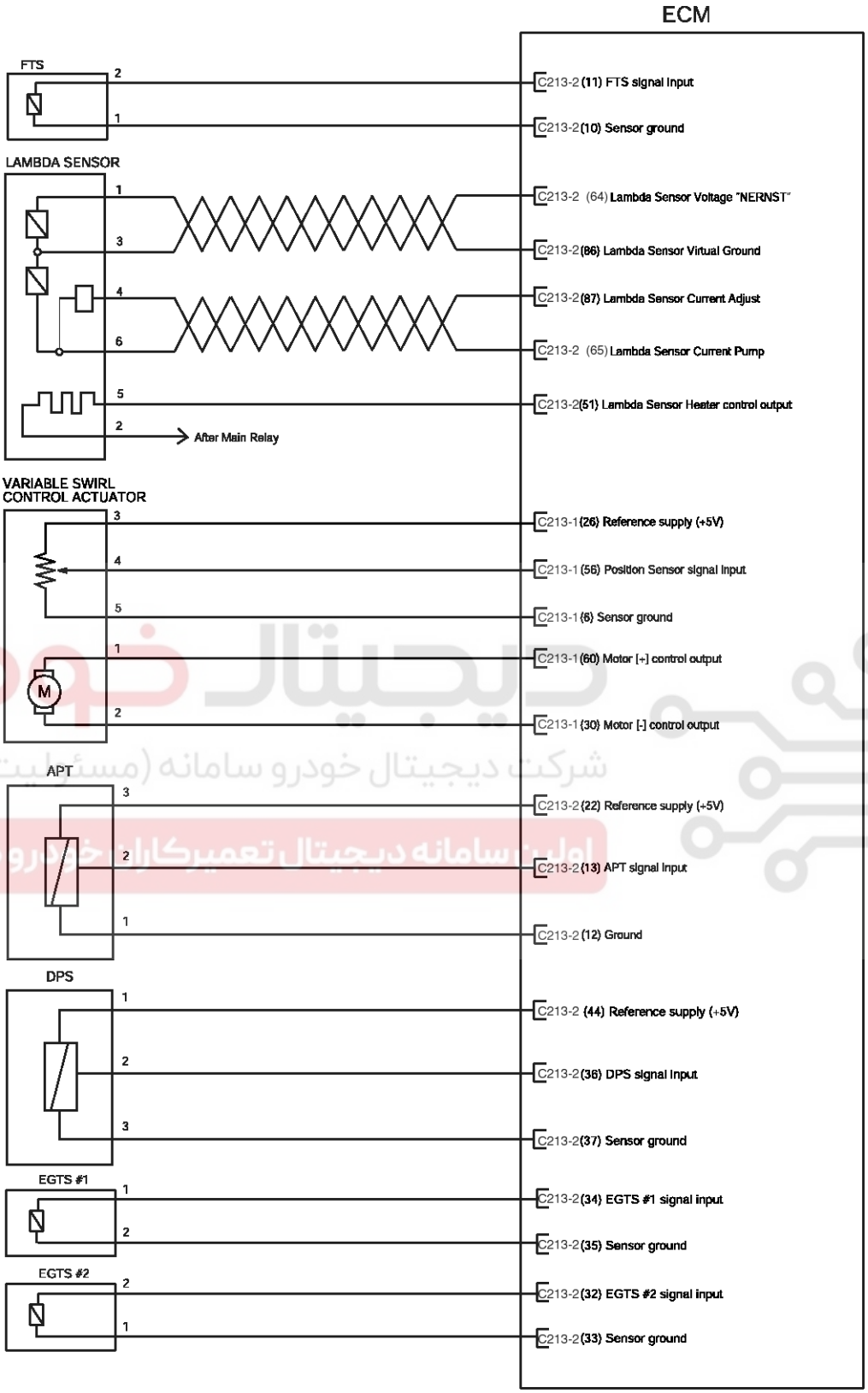
LFIG028A



LFIG029A



LFIG030A



LFIG031A

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 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)

REPLACEMENT

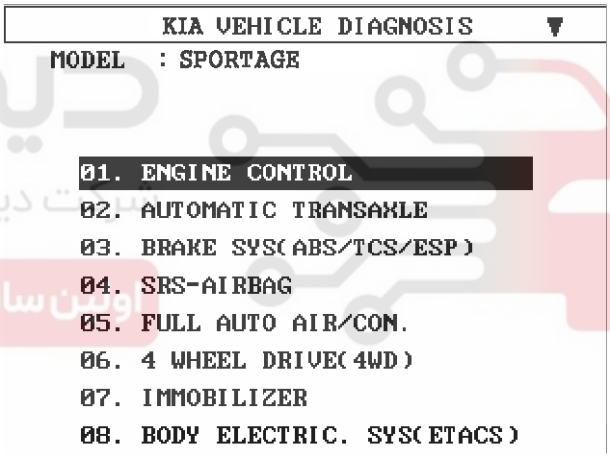
⚠CAUTION

After replacing an ECM, MUST input the vehicle mileage and the injector data (7 digit) of each cylinder into a new ECM.

1. Turn ignition switch OFF.
2. Remove the battery negative (-) cable from the battery.
3. Disconnect the ECM connector and unfasten the mounting bolts and nuts under the instrument panel.
4. Install a new ECM according to the reverse order of step 1, 2, and 3.

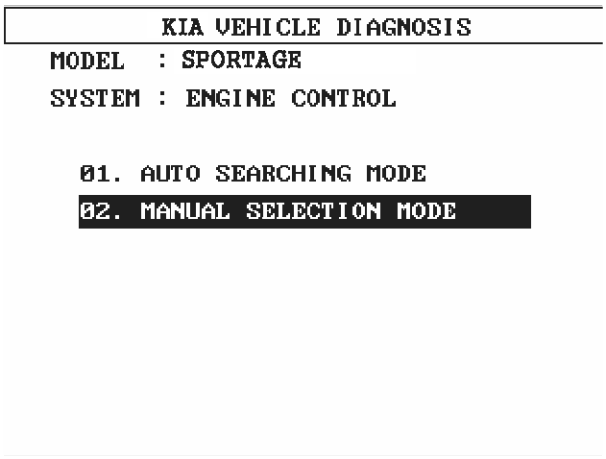
ECM mounting bolts/nuts : 0.4 ~ 0.6kgf·m (3.9 ~ 5.9 N·m, 2.9 ~ 4.3lbf·ft)

5. Connect a scan tool to Data Link Connector (DLC) and turn ignition switch on.
6. Proceed "ECM CHANGE" procedure.
   1) Select "ENGINE CONTROL".



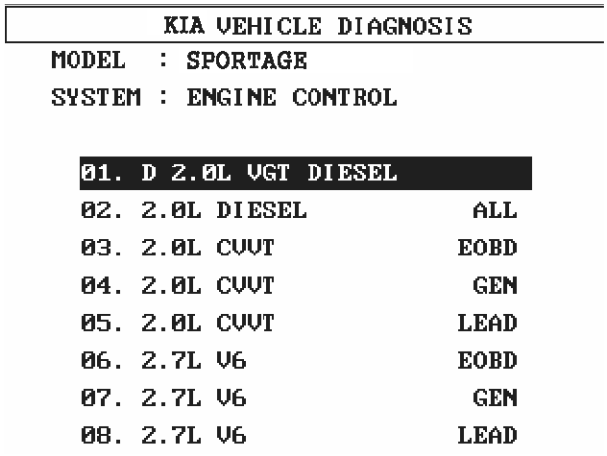
LFIG103A

   2) Select "MANUAL SELECTION MODE".



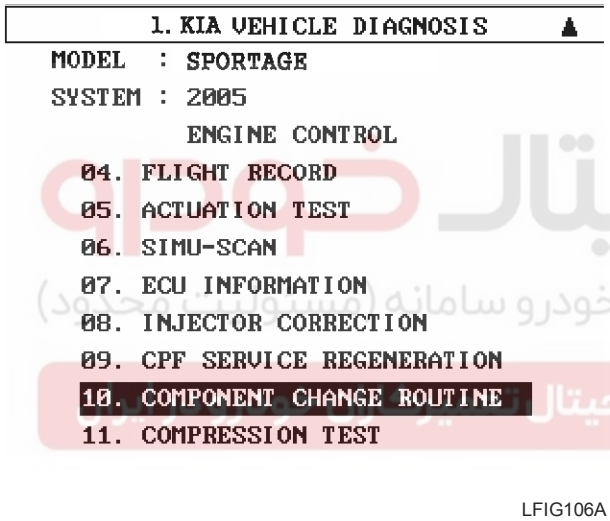
LFIG104A

3) Select "D 2.0L VGT DIESEL".



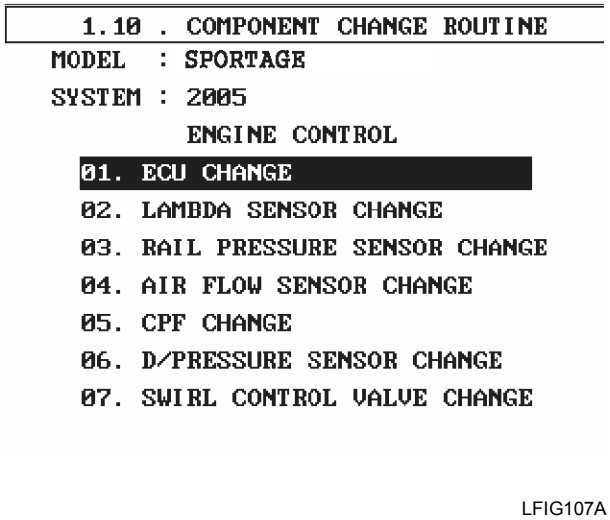
LFIG105A

4) Select "COMPONET CHANGE ROUTNE"



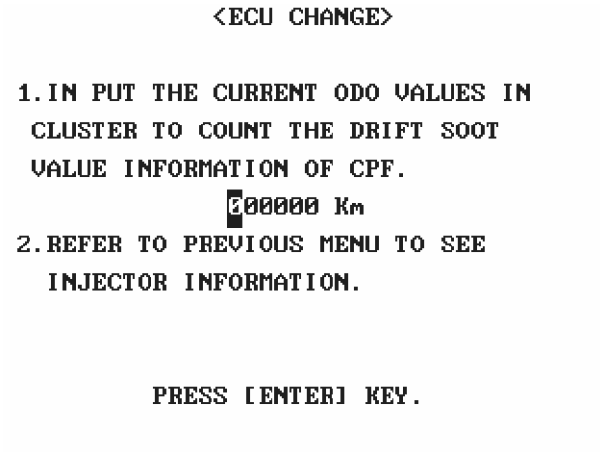
LFIG106A

5) Select "ECU CHANGE".



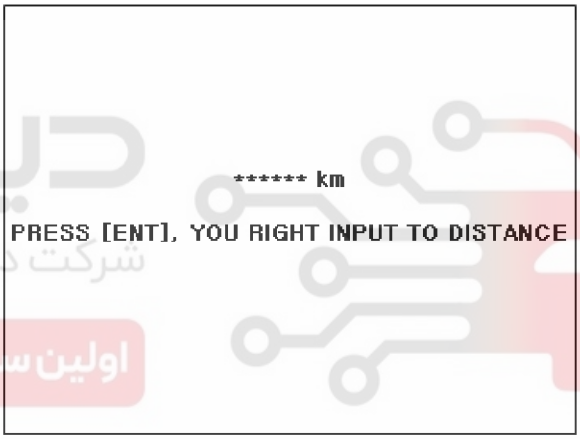
LFIG107A

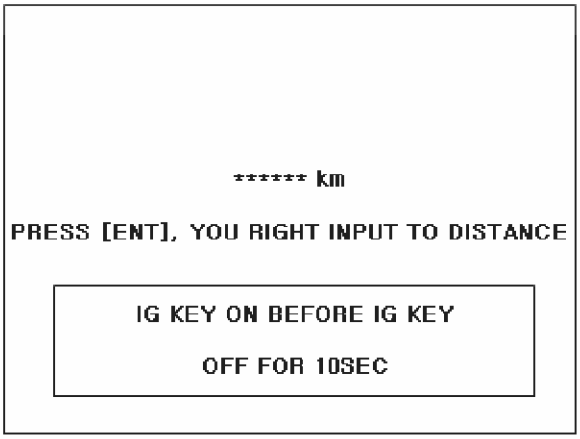
6) Press "ENTER" key.



LFIG108A

7) Input the vehicle mileage and press "ENTER" key.





LFIG109A

8) Wait 10 seconds with IG ON.

9) Turn ignition switch off.

7. Turn ignition switch on.
8. Proceed "INJECTOR CORRECTION" procedure.
   1) Select "ENGINE CONTROL".

```
          KIA VEHICLE DIAGNOSIS          ▼
MODEL   : SPORTAGE


   01. ENGINE CONTROL
   02. AUTOMATIC TRANSAXLE
   03. BRAKE SYS(ABS/TCS/ESP)
   04. SRS-AIRBAG
   05. FULL AUTO AIR/CON.
   06. 4 WHEEL DRIVE(4WD)
   07. IMMOBILIZER
   08. BODY ELECTRIC. SYS(ETACS)
```

LFIG103A

   2) Select "MANUAL SELECTION MODE".

```
          KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM  : ENGINE CONTROL

   01. AUTO SEARCHING MODE
   02. MANUAL SELECTION MODE
```

LFIG104A

   3) Select "D 2.0L VGT DIESEL".

```
          KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM  : ENGINE CONTROL

   01. D 2.0L VGT DIESEL
   02. 2.0L DIESEL                ALL
   03. 2.0L CVVT                  EOBD
   04. 2.0L CVVT                  GEN
   05. 2.0L CVVT                  LEAD
   06. 2.7L V6                    EOBD
   07. 2.7L V6                    GEN
   08. 2.7L V6                    LEAD
```

LFIG105A

   4) Select "INJECTOR CORRECTION".

```
          1. KIA VEHICLE DIAGNOSIS       ▲
MODEL   : SPORTAGE
SYSTEM  : 2005
            ENGINE CONTROL
     04. FLIGHT RECORD
     05. ACTUATION TEST
     06. SIMU-SCAN
     07. ECU INFORMATION
     08. INJECTOR CORRECTION
     09. CPF SERVICE REGENERATION
     10. COMPONENT CHANGE ROUTINE
     11. COMPRESSION TEST
```

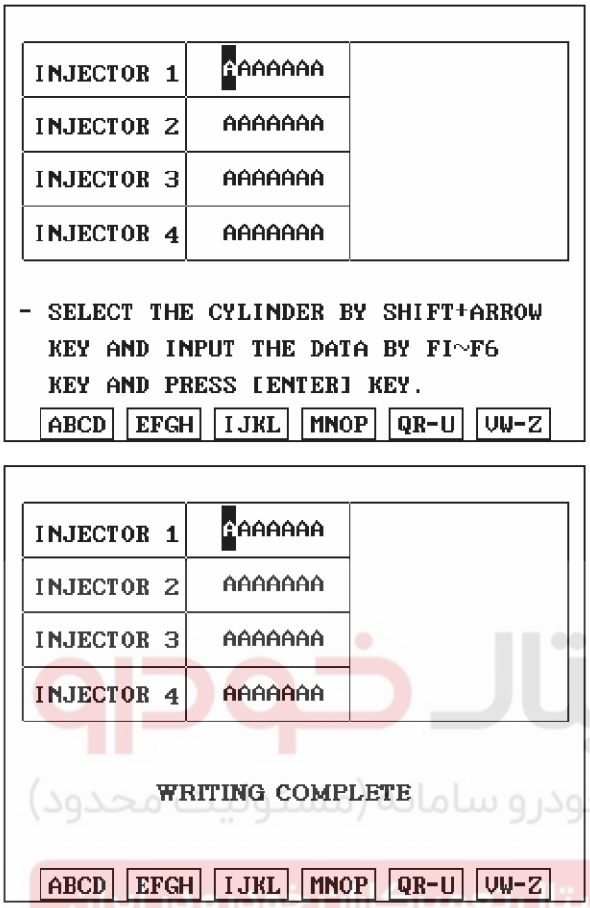
LFIG110A

   5) 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 NOR.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. PRESS [ENTER].

3. AFTER COMPLETE, TURN THE IG. KEY OFF
   AND CHECK THE SYSTEM AFTER 10 SEC.
```

LFIG111A

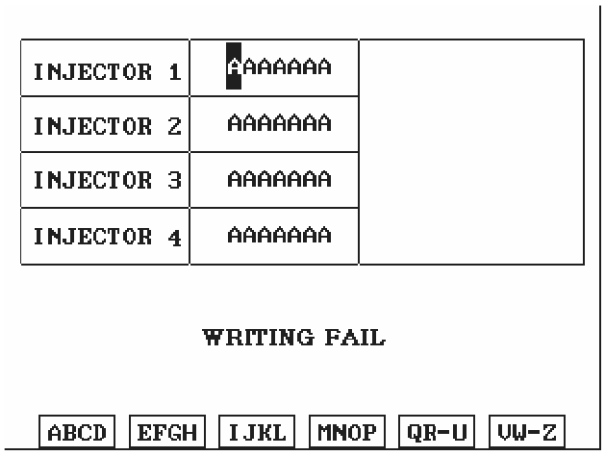
6) Input the injector data (7 digit) written on the top of each injector with function keys ([F1] ~ [F6]) and number keys.



LFIG112A

NOTICE

When "WRITING FAIL" is displayed on the scan tool, input injector data (7 digits) of each cylinder into a new ECM again as prior procedure.



LFIG113A

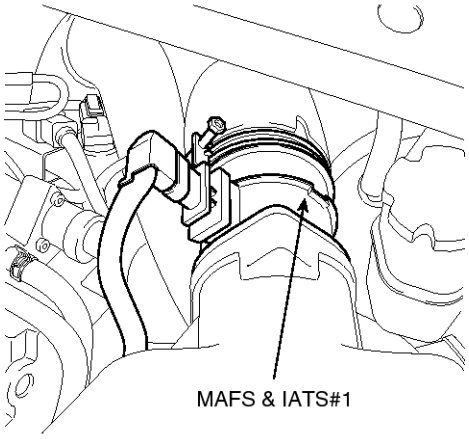
Mass Air Flow Sensor (MAFS)

INSPECTION

MAFS uses a hot-film type sensing element to measure the mass of intake air entering the engine, and send the signal to ECM.

A large amount of intake air represents acceleration or high load conditions while a small amount of intake air represents deceleration or idle.

The ECM uses this information to control the EGR solenoid valve and correct the fuel amount.



LFIG006A

SPECIFICATION

*At intake air temperature = 20℃(68˚F)

Air Flow (kg/h)	Frequency (kHz)
8	1.94 ~ 1.96
10	1.98 ~ 1.99
15	2.06 ~ 2.07
75	2.72 ~ 2.75
160	3.36 ~ 3.41
310	4.44 ~ 4.53
640	7.66 ~ 8.01
800	10.13 ~ 11.17

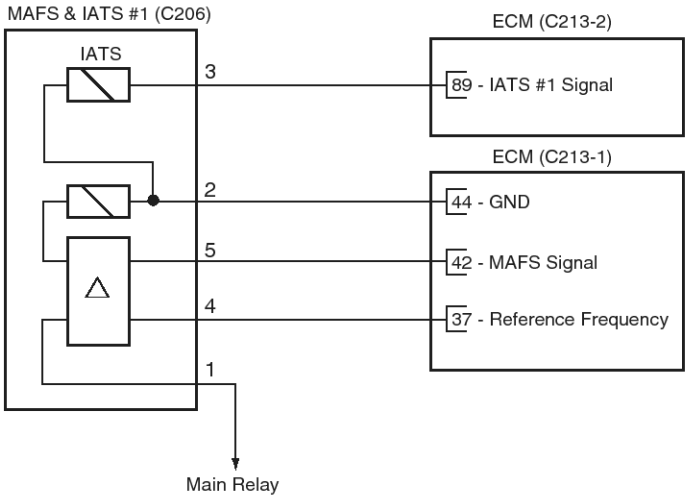
*At intake air temperature = -15℃(5˚F) or 80℃(176˚F)

Air Flow (kg/h)	Frequency (kHz)
10	1.97 ~ 1.99
75	2.71 ~ 2.76
160	3.34 ~ 3.43
310	4.39 ~ 4.58

LFIG034A

CIRCUIT DIAGRAM

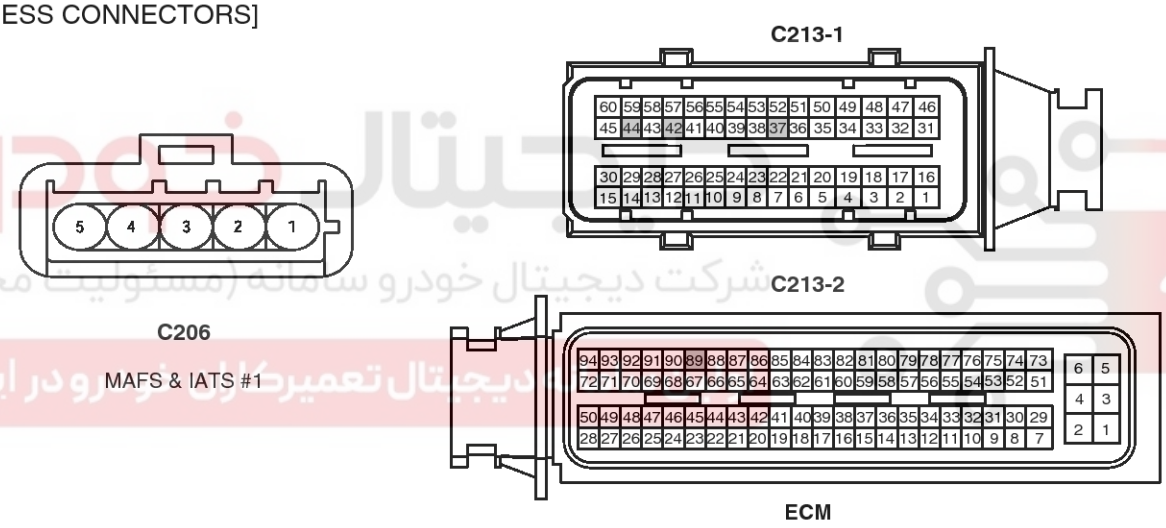
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	ECM C213-1 (44)	Sensor Ground
3	ECM C213-2 (89)	IATS #1 Signal
4	ECM C213-1 (37)	Reference Frequency
5	ECM C213-1 (42)	MAFS Signal

[HARNESS CONNECTORS]



LFIG035A

SIGNAL WAVEFORM

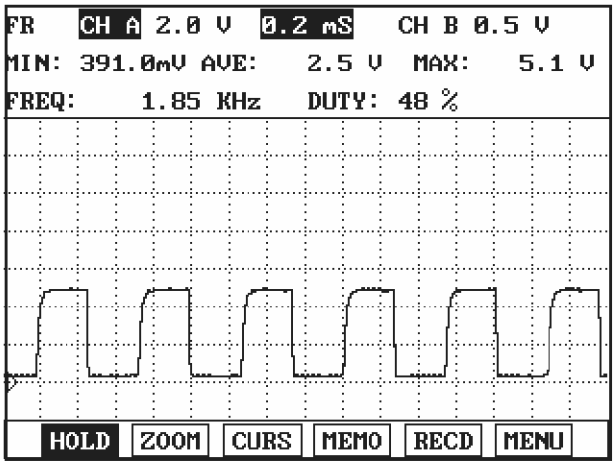


Fig.1

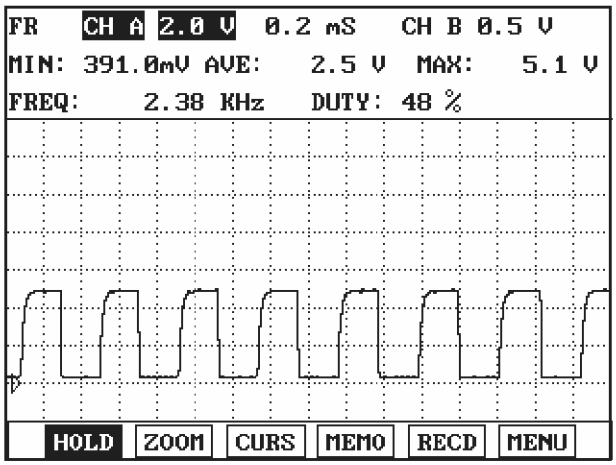


Fig.2

Fig.1) AFS signal waveform at IG KEY "ON". It shows digital signal of 50% duty, 1.8KHz.
Fig.2) AFS signal waveform at idle(790RPM, EGR actuator duty 5%, air flow for each cylinder 410mg/st).
It shows digital signal of 50% duty, 2.2~2.7KHz.

LFIG222A

COMPONENT INSPECTION

1. Check the MAFS visually.
   - Mounting direction correct.
   - Any contamination, corrosion or damage on connector.
   - Air cleaner's clogging or wet.
   - MAFS cylinder's deforming or blocking by any foreign material.
2. Check any leakage on intake system and intercooler system.

REPLACEMENT

NOTICE

After replacing a Mass Air Flow Sensor (MAFS) or Intake Air Temperature Sensor (IATS)#1, MUST proceed below procedure.

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

```
          KIA VEHICLE DIAGNOSIS          ▼
MODEL   : SPORTAGE


    01. ENGINE CONTROL
    02. AUTOMATIC TRANSAXLE
    03. BRAKE SYS(ABS/TCS/ESP)
    04. SRS-AIRBAG
    05. FULL AUTO AIR/CON.
    06. 4 WHEEL DRIVE(4WD)
    07. IMMOBILIZER
    08. BODY ELECTRIC. SYS(ETACS)
```

LFIG103A

5. Select "MANUAL SELECTION MODE".

```
          KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM  : ENGINE CONTROL

    01. AUTO SEARCHING MODE
    02. MANUAL SELECTION MODE
```

LFIG104A

6. Select "D 2.0L VGT DIESEL".

```
          KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM  : ENGINE CONTROL

    01. D 2.0L VGT DIESEL
    02. 2.0L DIESEL              ALL
    03. 2.0L CVVT                EOBD
    04. 2.0L CVVT                GEN
    05. 2.0L CVVT                LEAD
    06. 2.7L V6                  EOBD
    07. 2.7L V6                  GEN
    08. 2.7L V6                  LEAD
```

LFIG105A

7. Select "COMPONET CHANGE ROUTNE"

```
          1. KIA VEHICLE DIAGNOSIS          ▲
MODEL   : SPORTAGE
SYSTEM  : 2005
          ENGINE CONTROL
    04. FLIGHT RECORD
    05. ACTUATION TEST
    06. SIMU-SCAN
    07. ECU INFORMATION
    08. INJECTOR CORRECTION
    09. CPF SERVICE REGENERATION
    10. COMPONENT CHANGE ROUTINE
    11. COMPRESSION TEST
```

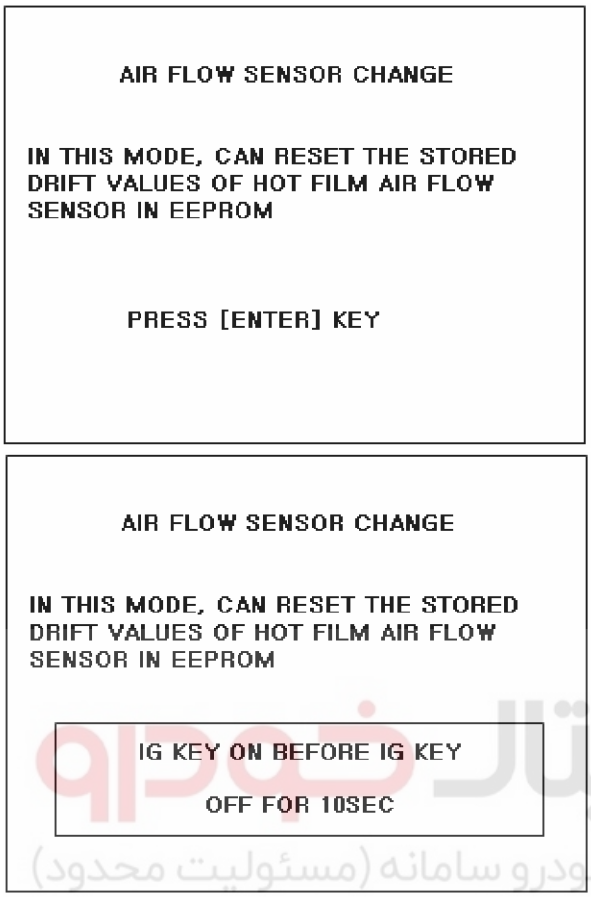
LFIG106A

8. Select "AIR FLOW SENSOR CHANGE".

```
      1.10 . COMPONENT CHANGE ROUTINE
MODEL   : SPORTAGE
SYSTEM  : 2005
          ENGINE CONTROL
    01. ECU CHANGE
    02. LAMBDA SENSOR CHANGE
    03. RAIL PRESSURE SENSOR CHANGE
    04. AIR FLOW SENSOR CHANGE
    05. CPF CHANGE
    06. D/PRESSURE SENSOR CHANGE
    07. SWIRL CONTROL VALVE CHANGE
```

LFIG128A

9. Press "ENTER" key.



LFIG129A

10. Wait 10 seconds with IG ON.
11. Turn ignition switch off.

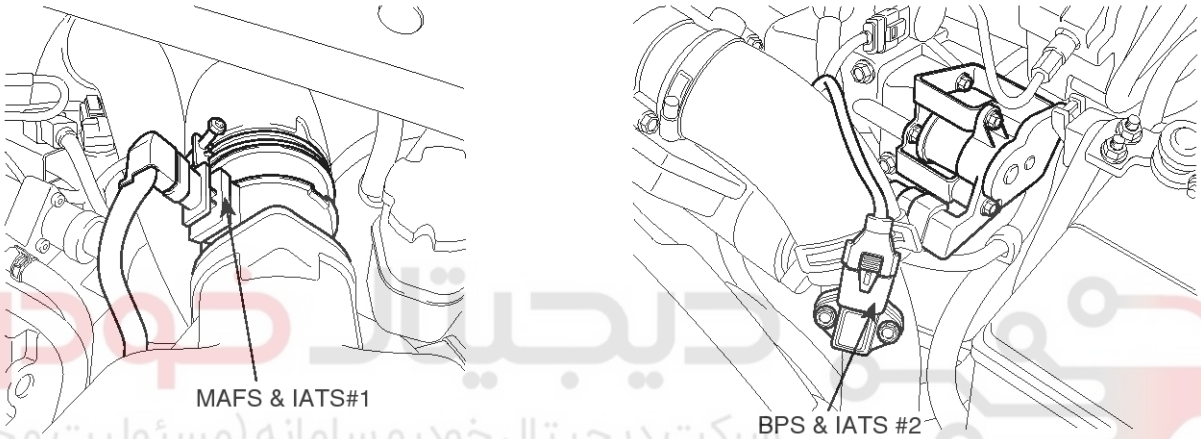
Intake Air Temperature Sensor (IATS)

INSPECTION

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.



LFIG041A

SPECIFICATION

IATS #1 in MAFS

Temperature [℃(°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

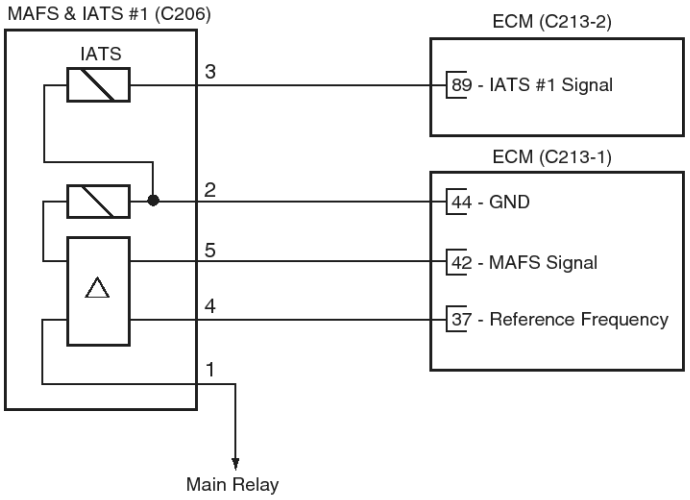
IATS #2 in BPS

Temperature [℃(°F)]	Resistance (kΩ)
-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

LFIG042A

CIRCUIT DIAGRAM

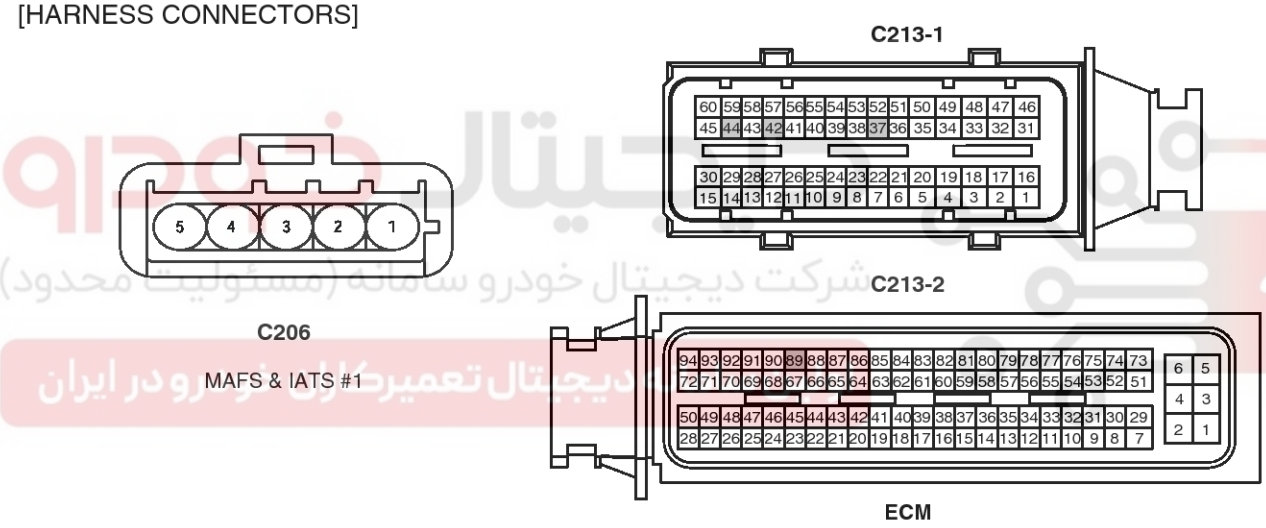
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

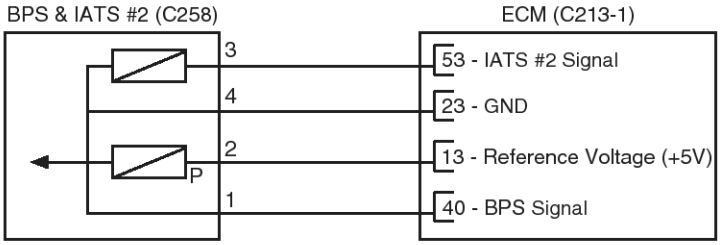
Terminal	Connected to	Function
1	Main Relay	Battery Voltage (B+)
2	ECM C213-1 (44)	Sensor Ground
3	ECM C213-2 (89)	IATS #1 Signal
4	ECM C213-1 (37)	Reference Frequency
5	ECM C213-1 (42)	MAFS Signal

[HARNESS CONNECTORS]



LFIG035A

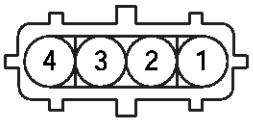
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

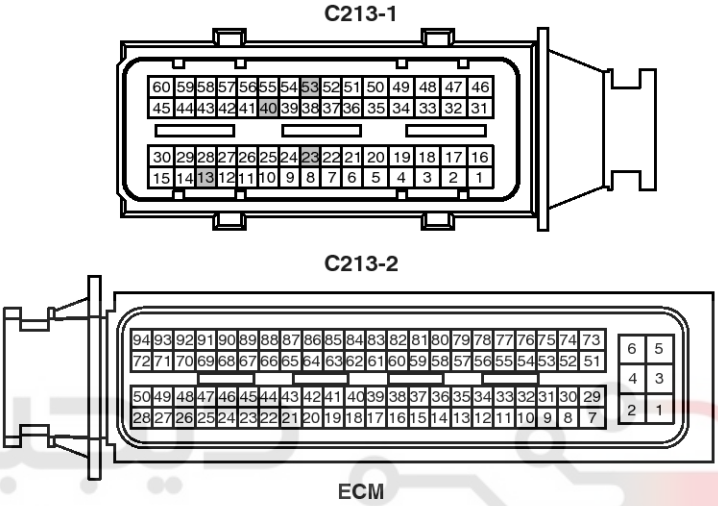
Terminal	Connected to	Function
1	ECM C213-1 (40)	BPS Signal
2	ECM C213-1 (13)	Reference Voltage (+5V)
3	ECM C213-1 (53)	IATS #2 Signal
4	ECM C213-1 (23)	Sensor ground

[HARNESS CONNECTORS]



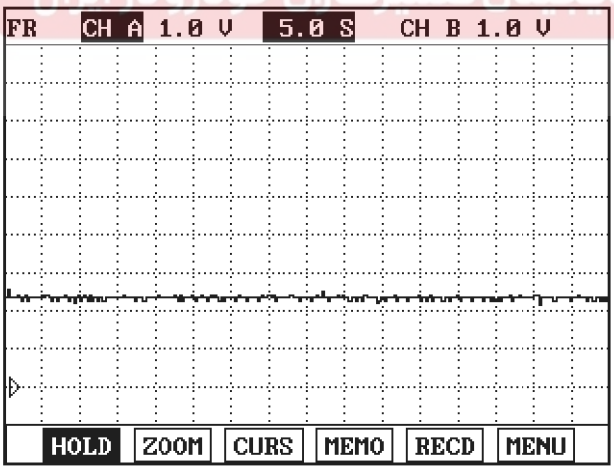
C258

BPS & IATS #2



LFIG039A

SIGNAL WAVEFORM



IATS signal should be smooth and continuous without any sudden changes.
After warmed-up, the IATS signal should not change significantly while ECTS signal drops.

LFIG043A

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".

REPLACEMENT

NOTICE

After replacing a Mass Air Flow Sensor (MAFS) or Intake Air Temperature Sensor (IATS)#1, MUST proceed below procedure.

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

```
          KIA VEHICLE DIAGNOSIS          ▼
MODEL   : SPORTAGE


    01. ENGINE CONTROL
    02. AUTOMATIC TRANSAXLE
    03. BRAKE SYS(ABS/TCS/ESP)
    04. SRS-AIRBAG
    05. FULL AUTO AIR/CON.
    06. 4 WHEEL DRIVE(4WD)
    07. IMMOBILIZER
    08. BODY ELECTRIC. SYS(ETACS)
```

LFIG103A

5. Select "MANUAL SELECTION MODE".

```
          KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM  : ENGINE CONTROL

    01. AUTO SEARCHING MODE
    02. MANUAL SELECTION MODE
```

LFIG104A

6. Select "D 2.0L VGT DIESEL".

```
          KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM  : ENGINE CONTROL

    01. D 2.0L VGT DIESEL
    02. 2.0L DIESEL              ALL
    03. 2.0L CVVT                EOBD
    04. 2.0L CVVT                GEN
    05. 2.0L CVVT                LEAD
    06. 2.7L V6                  EOBD
    07. 2.7L V6                  GEN
    08. 2.7L V6                  LEAD
```

LFIG105A

7. Select "COMPONET CHANGE ROUTNE"

```
          1. KIA VEHICLE DIAGNOSIS          ▲
MODEL   : SPORTAGE
SYSTEM  : 2005
          ENGINE CONTROL
    04. FLIGHT RECORD
    05. ACTUATION TEST
    06. SIMU-SCAN
    07. ECU INFORMATION
    08. INJECTOR CORRECTION
    09. CPF SERVICE REGENERATION
    10. COMPONENT CHANGE ROUTINE
    11. COMPRESSION TEST
```

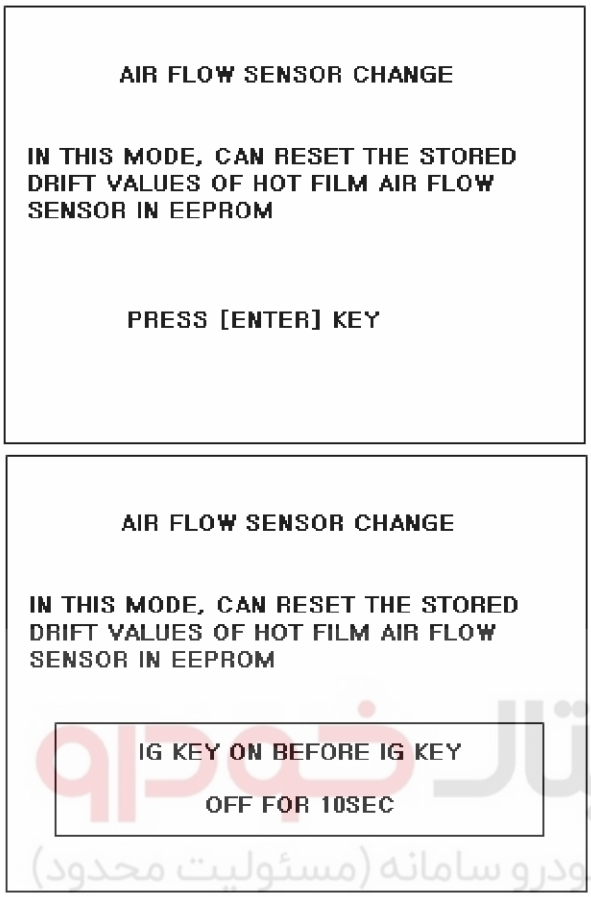
LFIG106A

8. Select "AIR FLOW SENSOR CHANGE".

```
      1.10 . COMPONENT CHANGE ROUTINE
MODEL   : SPORTAGE
SYSTEM  : 2005
          ENGINE CONTROL
    01. ECU CHANGE
    02. LAMBDA SENSOR CHANGE
    03. RAIL PRESSURE SENSOR CHANGE
    04. AIR FLOW SENSOR CHANGE
    05. CPF CHANGE
    06. D/PRESSURE SENSOR CHANGE
    07. SWIRL CONTROL VALVE CHANGE
```

LFIG128A

9. Press "ENTER" key.



LFIG129A

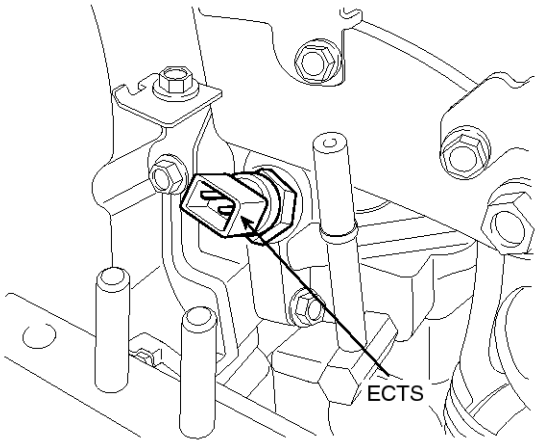
10. Wait 10 seconds with IG ON.
11. Turn ignition switch off.

Engine Coolant Temperature Sensor (ECTS)

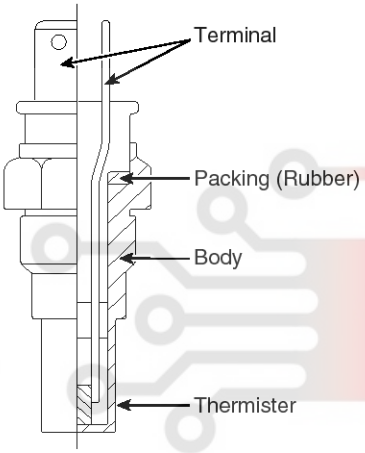
INSPECTION

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

That is, the resistor in the ECM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in the ECTS changes according to the engine coolant temperature, the output voltage also changes. During cold engine operation the ECM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.



LFIG008A



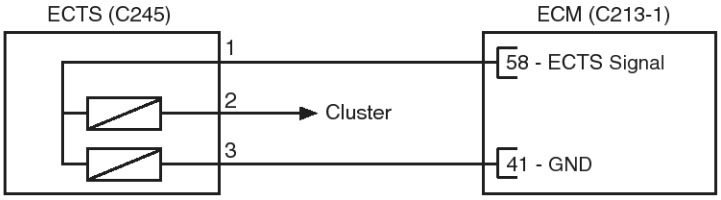
EGRF241A

SPECIFICATION

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

CIRCUIT DIAGRAM

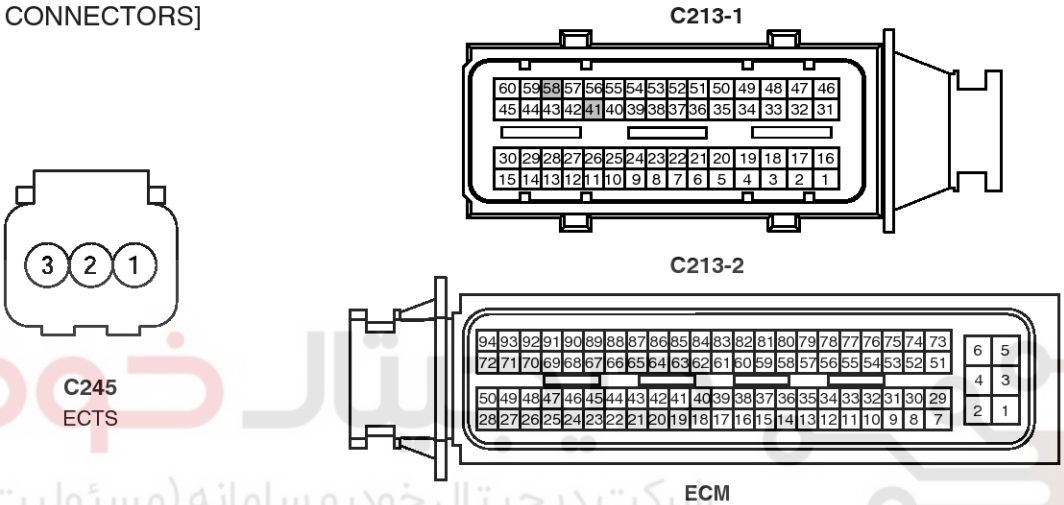
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C213-1 (58)	ECTS Signal
2	Cluster	-
3	ECM C213-1 (41)	Sensor ground

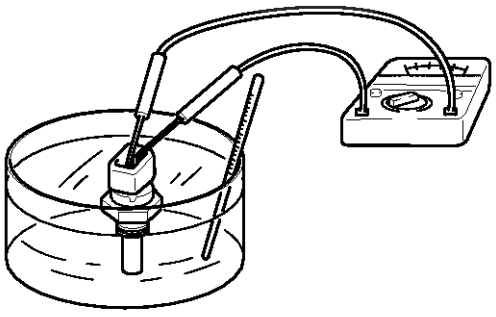
[HARNESS CONNECTORS]



LFIG037A

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.



EFNF541A

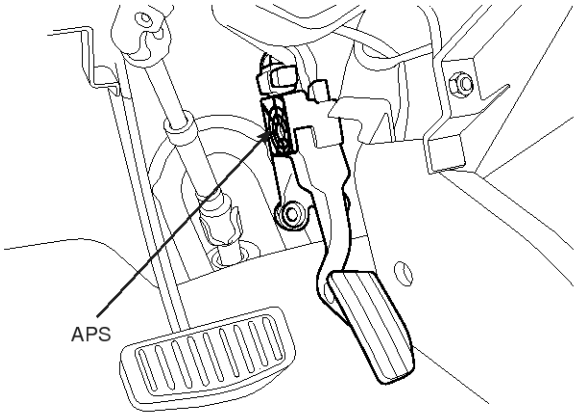
5. Check that the resistance is within the specification.

Specification: Refer to "SPECIFICATION".

Accelerator Position Sensor (APS)

INSPECTION

On electronic injection systems, there is no longer a load lever that mechanically controls the fuelling. The flow is caculated by the ECM depending on a number of parameters, including pedal position, which is measured using a potentiometer. The pedal sensor has two potentio-meters whoses slides are mechanically solid. The two potentiometers are supplied from distinct and different power sources so there is built in redundancy of information giving reliable driver's request information. A voltage is generated across the potentiometer in the acceleration position sensor as a function of the accelerator-pedal setting. Using a peogrammed characteristic curve, the pedal's position is then calculated from this voltage.

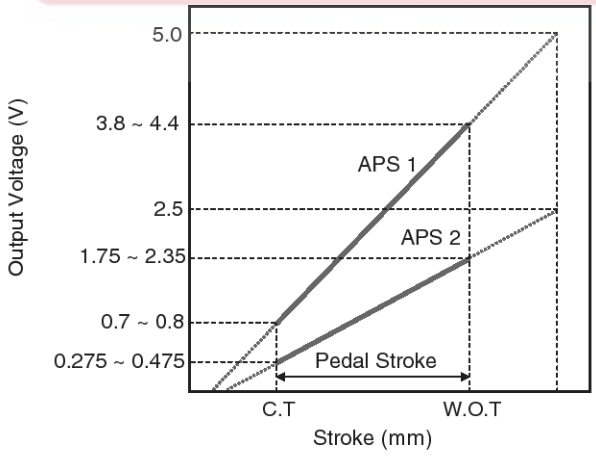


LFIG048A

SPECIFICATION

Test Condition	Output Voltage(V)	
	APS 1	APS 2
Idle	0.7 ~ 0.8	0.275 ~ 0.475
Fully depressed	3.8 ~ 4.4	1.75 ~ 2.35

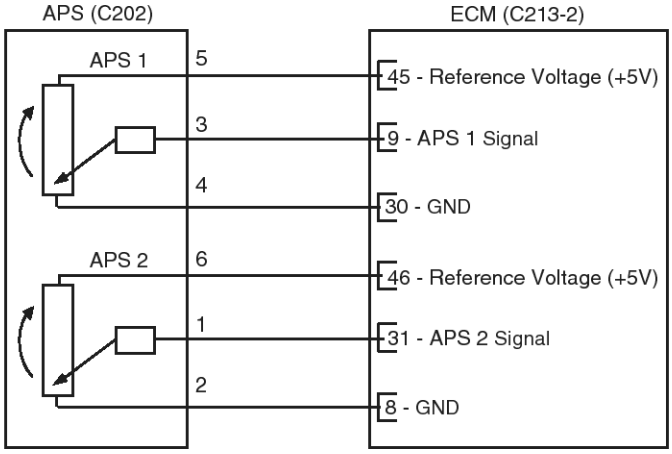
Items	Specification	
	APS 1	APS 2
Potentiometer Resistance (kΩ)	0.7 ~ 1.3	1.4 ~ 2.6



LFIG092A

CIRCUIT DIAGRAM

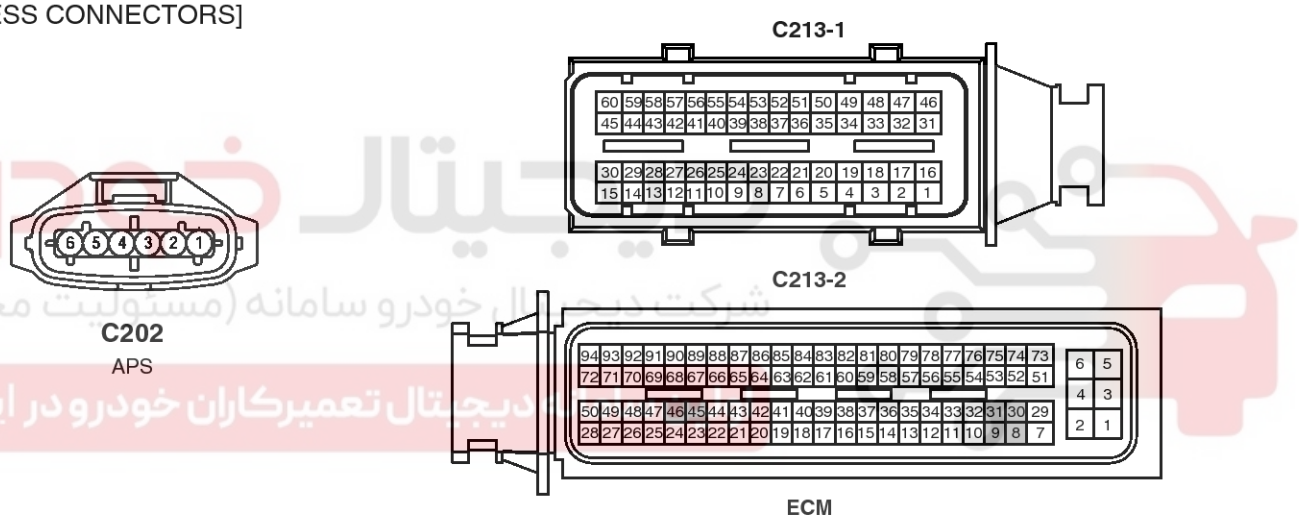
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C213-2 (31)	APS 2 Signal
2	ECM C213-2 (8)	APS 2 Ground
3	ECM C213-2 (9)	APS 1 Signal
4	ECM C213-2 (30)	APS 1 Ground
5	ECM C213-2 (45)	APS 1 Reference Voltage (+5V)
6	ECM C213-2 (46)	APS 2 Reference Voltage (+5V)

[HARNESS CONNECTORS]



LFIG049A

SIGNAL WAVEFORM

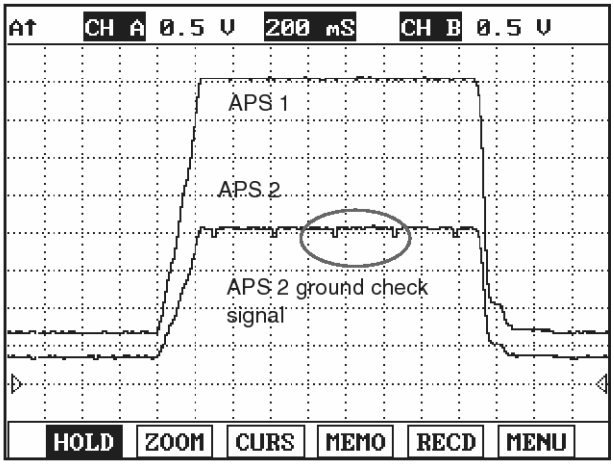


Fig.1

Fig.1) APS 1 and APS 2 signals are measured simultaneously, Check if output value is rising and APS 2 is 1/2 of APS 1 signal.

LFIG541A

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect the accelerator position sensor connector.
3. Measure resistance between voltage supply terminal and ground terminal of APS1.
4. Measure resistance between voltage supply terminal and ground terminal of APS2.

Specification: Refer to "SPECIFICATION".

Heated Oxygen Sensor (HO2S)

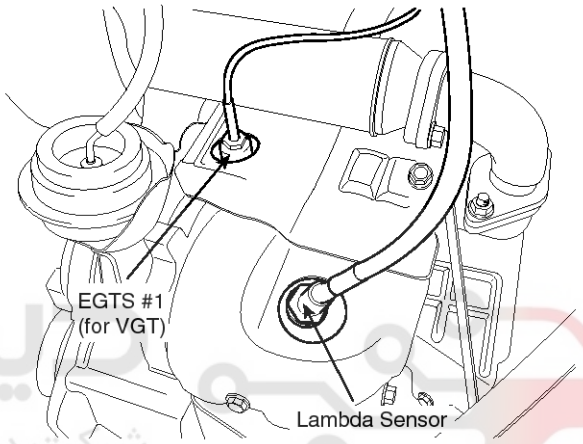
INSPECTION

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 acculately through fuel correction and also limits smoke which is generated by reach 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℃ ~ 600℃) 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.



LFIG009A

SPECIFICATION

Sensor

λ Value (A/F Ratio)	Pumping Current (A)
0.65	-2.22
0.70	-1.82
0.80	-1.11
0.90	-0.50
1.01	0.00
1.18	0.33
1.43	0.67
1.70	0.94
2.42	1.38
Air (Atmosphere)	2.54

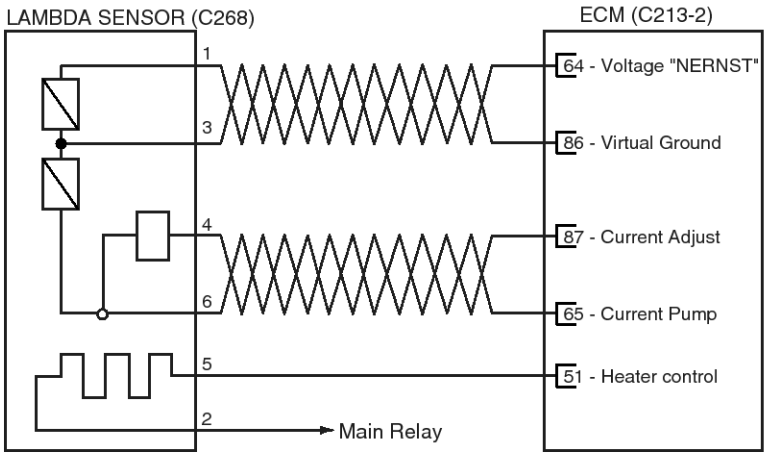
Heater

Temperature [℃(°F)]	Heater Resistance(Ω)
20 (68)	9.2
100 (212)	10.7
200 (392)	13.1
300 (572)	14.6
400 (752)	17.7
500 (932)	19.2
600 (1,112)	20.7
700 (1,292)	22.5

LFIG062A

CIRCUIT DIAGRAM

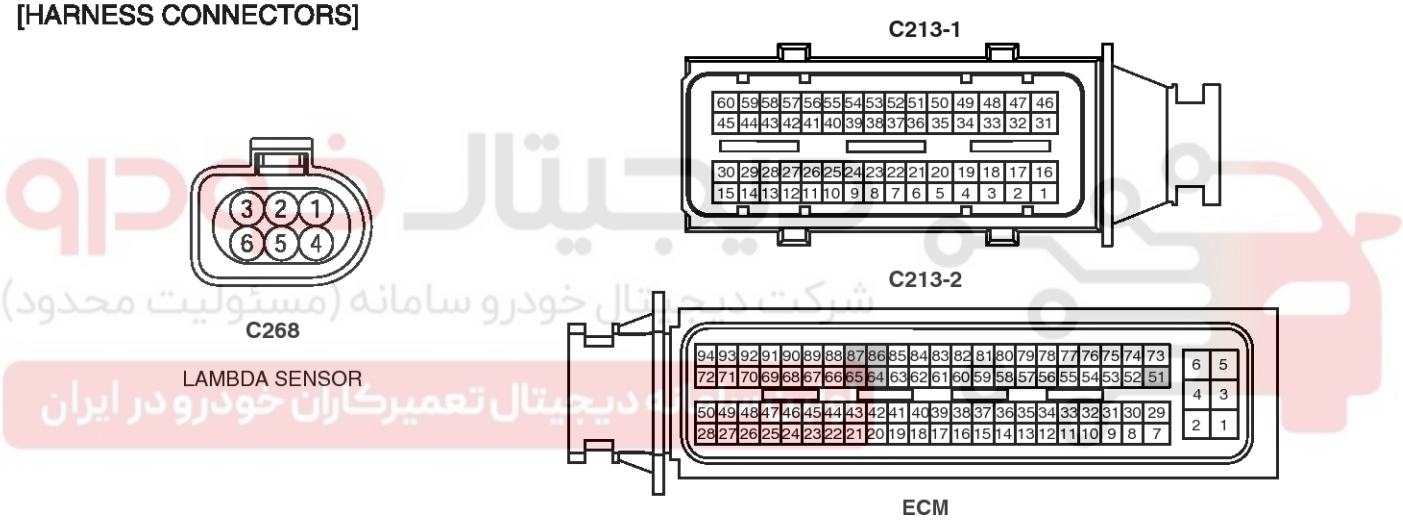
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C213-2 (64)	Voltage "NERNST"
2	Main Relay	Battery Voltage (B+)
3	ECM C213-2 (86)	Virtual Ground
4	ECM C213-2 (87)	Current Adjust
5	ECM C213-2 (51)	Heater control
6	ECM C213-2 (65)	Current Pump

[HARNESS CONNECTORS]



LFIG063A

SIGNAL WAVEFORM

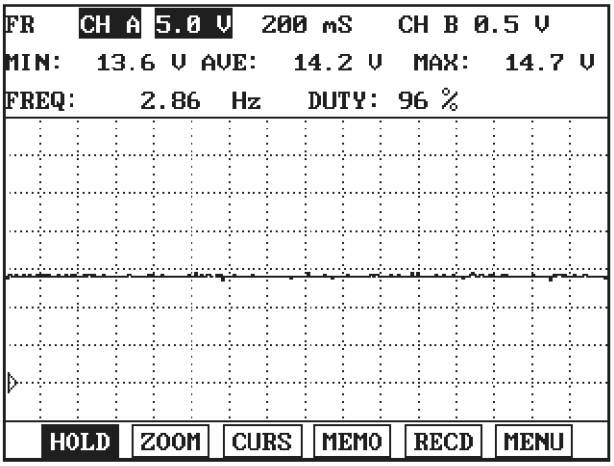


Fig.1

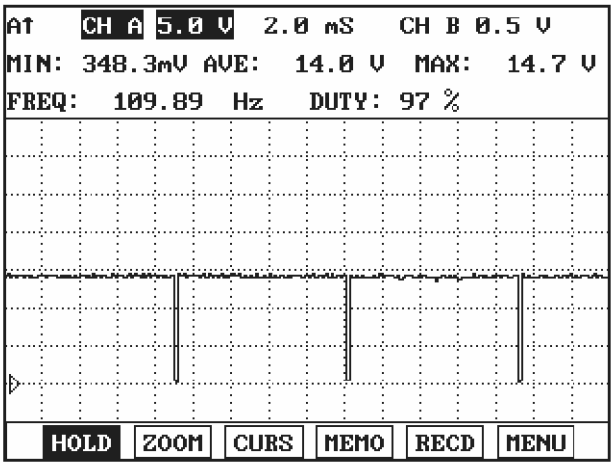


Fig.2

Fig.1) Waveform of Lambda sensor heater power. It is battery voltage.
Fig.2) Waveform of Lambda sensor heater control at cold idle.(duty increases to approx. 40% at heater operation.)

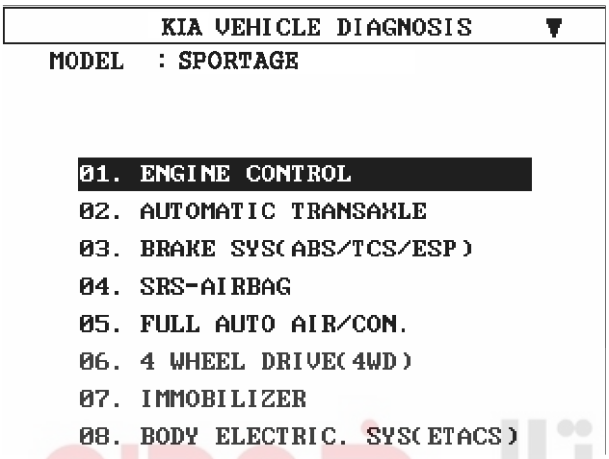
LFIG200A

REPLACEMENT

NOTICE

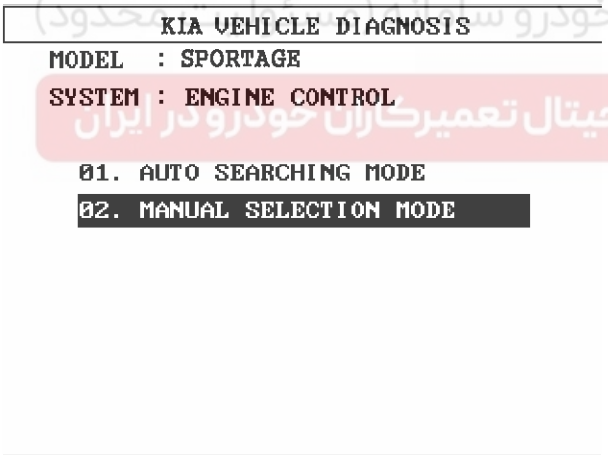
After replacing a Lambda Sensor, MUST proceed below procedure.

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



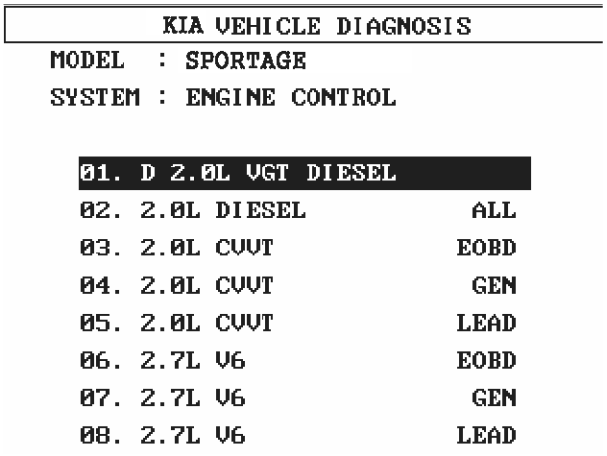
LFIG103A

5. Select "MANUAL SELECTION MODE".



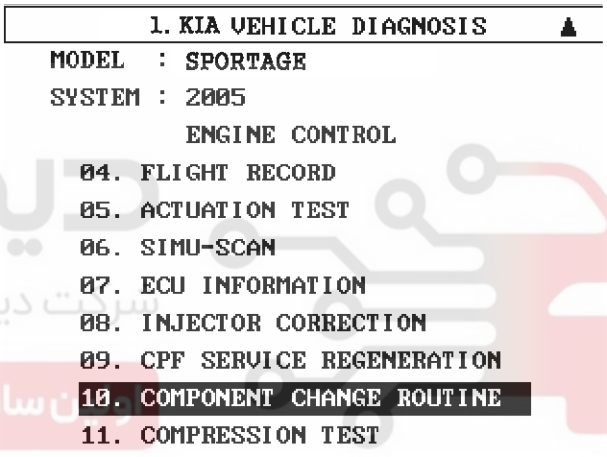
LFIG104A

6. Select "D 2.0L VGT DIESEL".



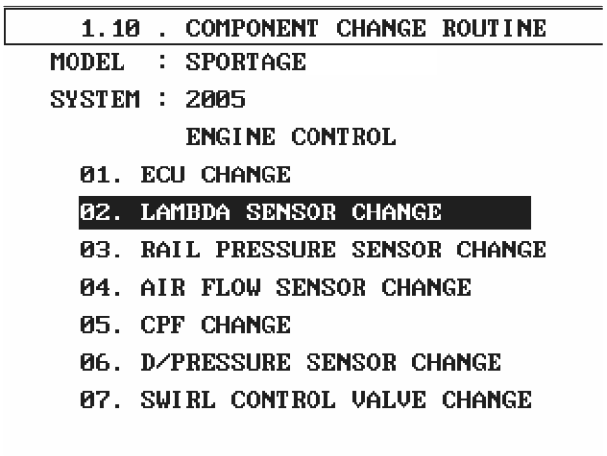
LFIG105A

7. Select "COMPONET CHANGE ROUTNE"



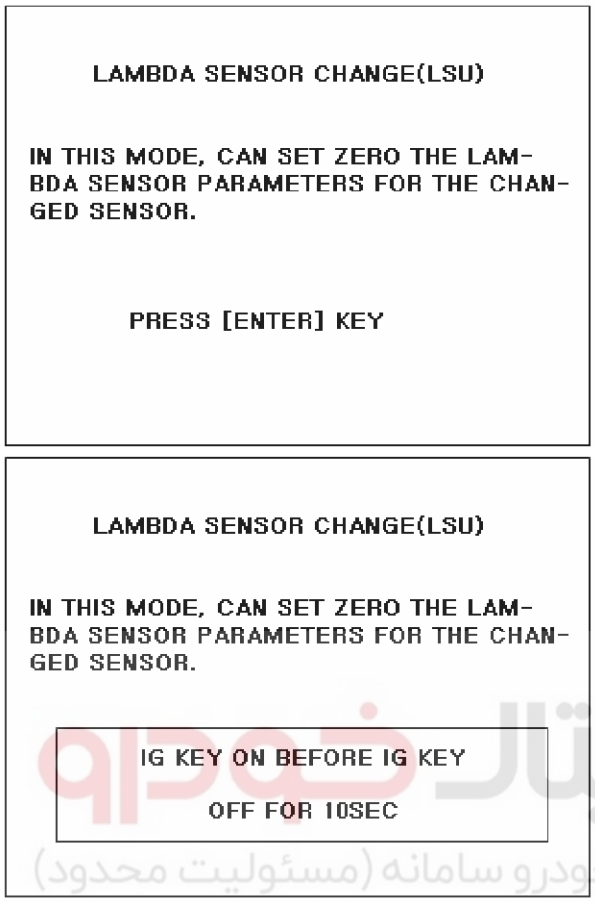
LFIG106A

8. Select "LAMBDA SENSOR CHANGE".



LFIG124A

9. Press "ENTER" key.



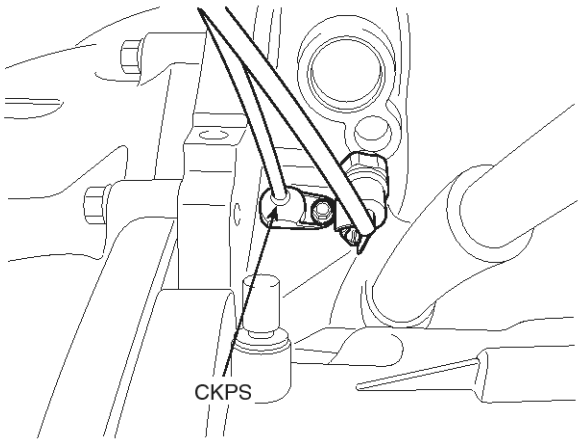
LFIG125A

10. Wait 10 seconds with IG ON.
11. Turn ignition switch off.

Crankshaft Position Sensor (CKPS)

INSPECTION

Piston position on combustion chamber is the substantial to define the starting of injection timing. All engine pistons are connected to crankshaft by connecting rod. Sensor on crankshaft can supply the informations concerning all piston positions, revolution speed is defined by revolution perminute of crankshaft. Prior input variable is determined at ECM by using signal induced from crankshaft position sensor.



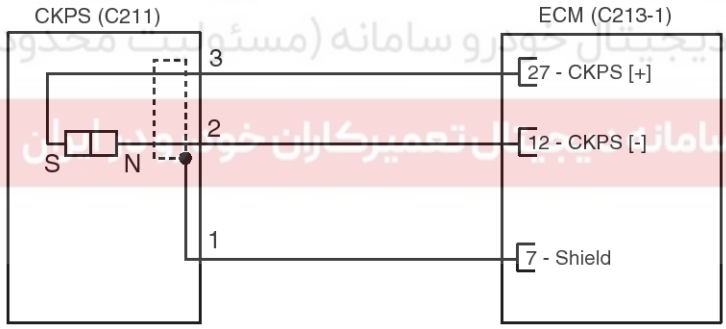
LFIG046A

SPECIFICATION

Items	Specification
Coil Resistance (Ω)	774 ~ 946Ω [20℃(68˚F)]

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

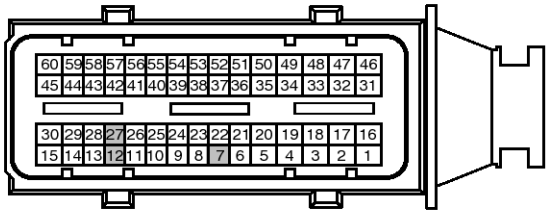
Terminal	Connected to	Function
1	ECM C213-1 (7)	Sensor Shield
2	ECM C213-1 (12)	CKPS [-] Signal
3	ECM C213-1 (27)	CKPS [+] Signal

[HARNESS CONNECTORS]

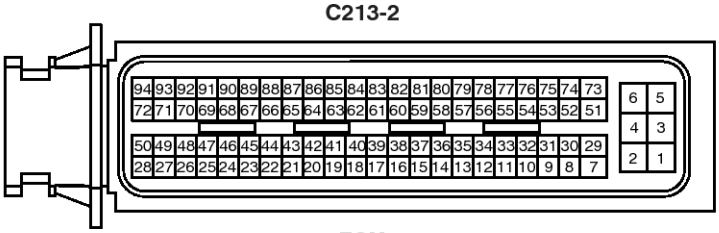
C211

CKPS

C213-1



C213-2



ECM

LFIG047A

SIGNAL WAVEFORM

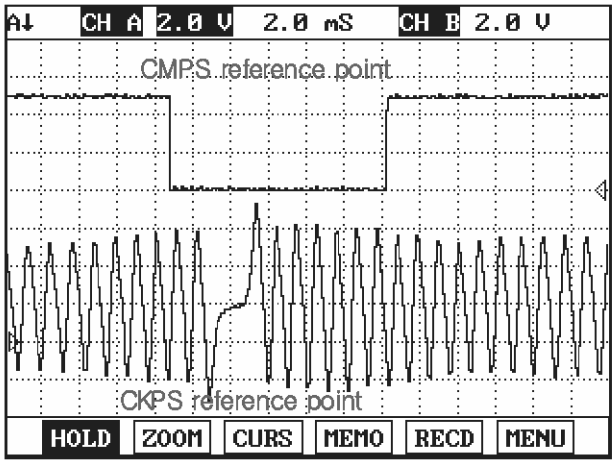


Fig.1

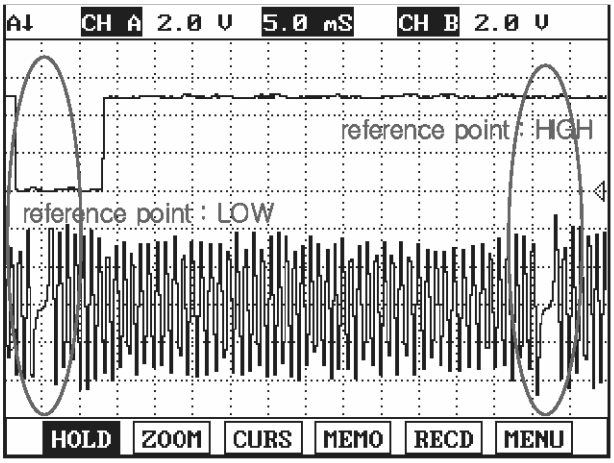


Fig.2

Fig.1) This shows waveform of Crank Shaft Position Sensor and Cam Shaft Position Sensor simulatneously. The middle area indicates reference points of Crank Shaft Position Sensor and Cam Shaft Position Sensor.

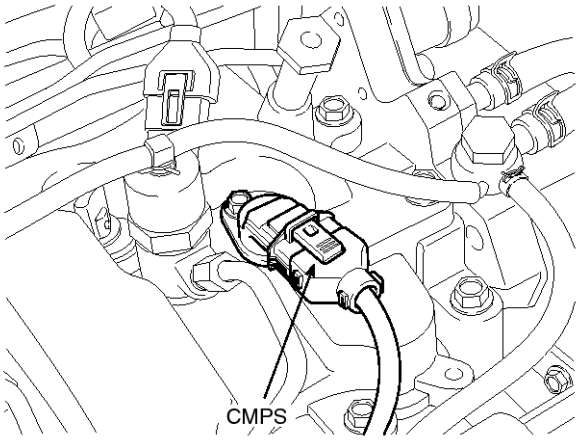
Fig.2) Crank Shaft Position Sensor and Cam Shaft Position Sensor signal are measured simultaneously.
Cam Shaft Position Sensor
signal is outputted once when Crank Shaft Position sensor signal is outputted twice. LOW and HIGH output of Cam Shaft Position sensor reference point is detected at Crank Shaft Position sensor reference point.
(Injection sequence is determined based on LOW and HIGH signal of Cam Shaft Position Sensor reference point as detecting cylinder position.)

LFIG299A

Camshaft Position Sensor (CMPS)

INSPECTION

Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element. It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of the each cylinder which the CKPS can't detect. The two CMPS are installed on engine head cover and uses a target wheel installed on the camshaft. This sensor has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow. So the sequential injection of the 4 cylinders is impossible without CMPS signal.



LFIG010A

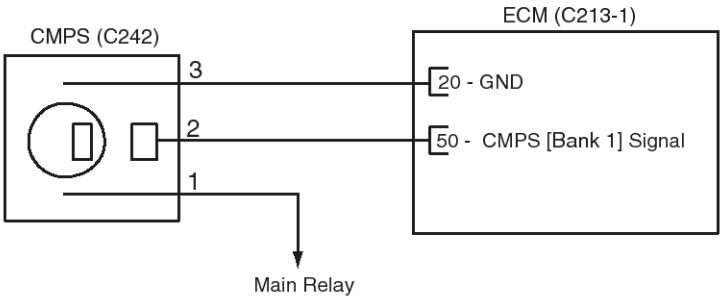
SPECIFICATION

Level	Output Pulse (V)
High	12V
Low	0V

Items	Specification
Air Gap	1.5 ± 0.1 mm

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

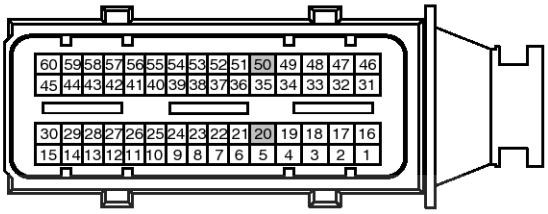
Terminal	Connected to	Function
1	Main Relay	Battery Voltage
2	ECM C213-1 (50)	CMPS Signal
3	ECM C213-1 (20)	GND

[HARNESS CONNECTORS]

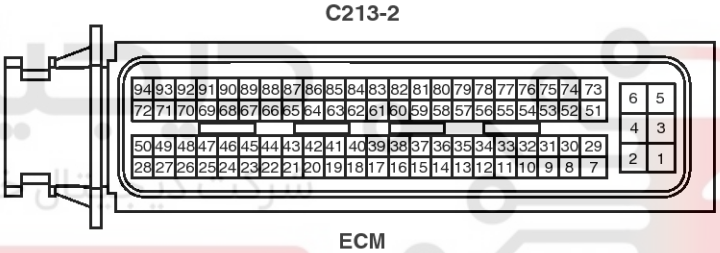
C242

CMPS

C213-1



C213-2



ECM

LFIG045A

SIGNAL WAVEFORM

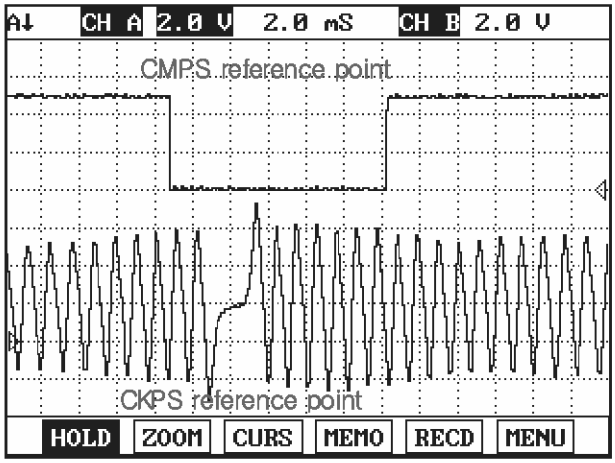


Fig.1

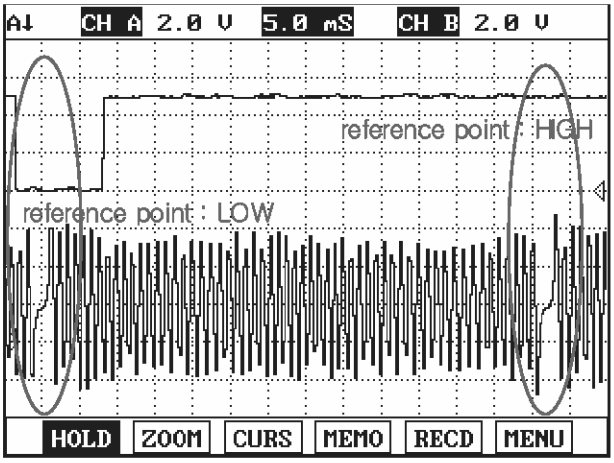


Fig.2

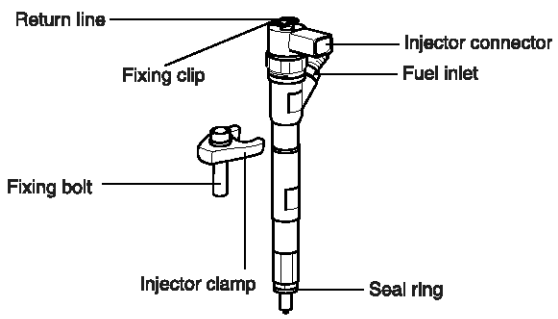
Fig.1) This shows waveform of Crank Shaft Position Sensor and Cam Shaft Position Sensor simulatneously. The middle area indicates reference points of Crank Shaft Position Sensor and Cam Shaft Position Sensor.

Fig.2) Crank Shaft Position Sensor and Cam Shaft Position Sensor signal are measured simultaneously.
Cam Shaft Position Sensor
signal is outputted once when Crank Shaft Position sensor signal is outputted twice. LOW and HIGH output of Cam Shaft Position sensor reference point is detected at Crank Shaft Position sensor reference point.
(Injection sequence is determined based on LOW and HIGH signal of Cam Shaft Position Sensor reference point as detecting cylinder position.)

LFIG299A

Injector

DESCRIPTION



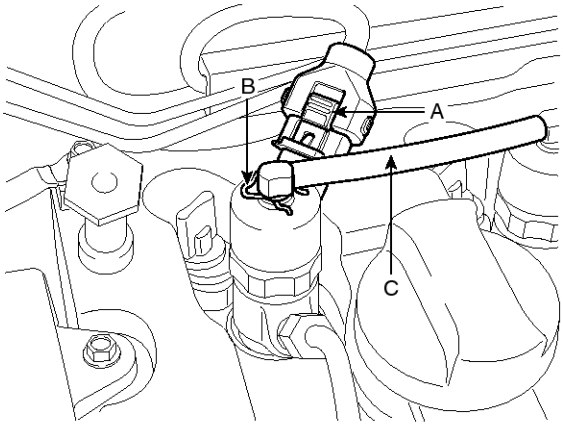
LFIG101A

REMOVAL

WARNING

- **Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)**
- **Never perform any work on injection system with engine running or within 30 seconds after the engine stops.**
- **Always pay attention to safety precaution.**
- **Ensure the absolute cleanliness.**
- **It is not recommended to remove the injectors without any notice.**

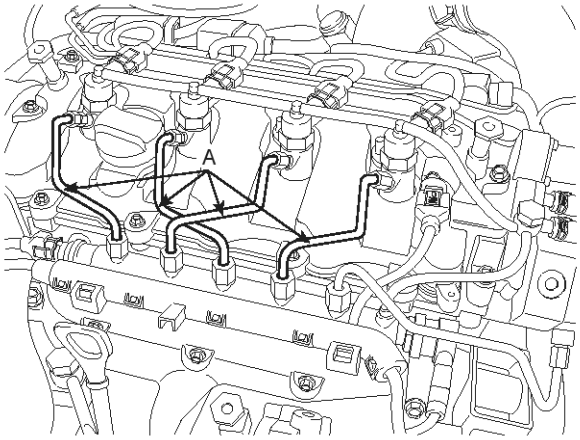
1. Disconnect the injector connector (A).



LFIG084A

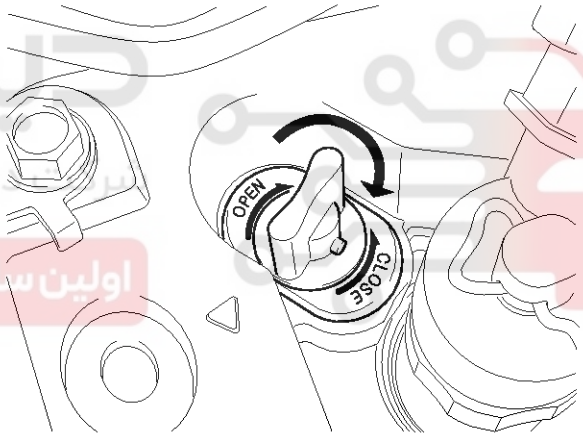
2. After removing the clip (B), disconnect the retun hose (C) from the injectors

3. Disconnect the high pressure pipe (A) connecting the injectors with the common rail.



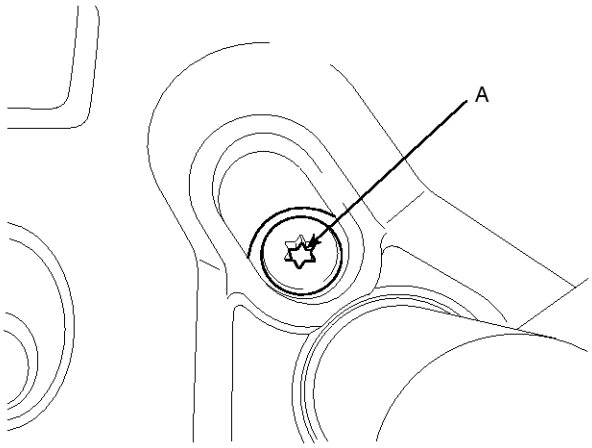
LFIG085A

4. Rotate the lever (A) clockwise and pull it upward.

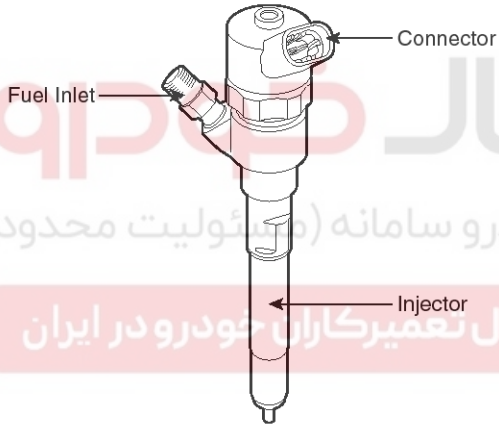


LFIG086A

5. Unscrew the clamp tightening bolt (A) and pull the injector upward with the "Injector Remover" and the "Injector Remover Adapter" (Refer to "SPECIAL SERVICE TOOL" section).



LFIG087A



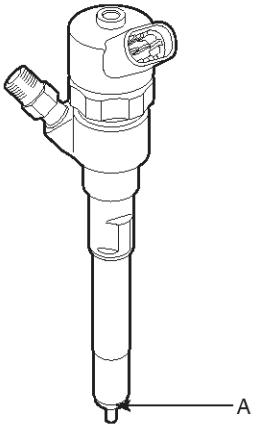
LFIG088A

INSTALLATION

1. Install the injector according to the reverse order of "REMOVAL" procedure.

NOTICE

When installing the injector, MUST REPLACE the O-ring (A) and apply a grease to that.



LFIG089A

NOTICE

When installing the high pressure pipe, apply the specified tightening torques to the flange nuts of the injectors and the common rail side with SST (Refer to below table).

Item	Dimension	SST No.
Flange Nut (Injector Side)	14 mm (0.551 in)	09314-27110
Flange Nut (Common Rail Side)	17 mm (0.669 in)	09314-27120

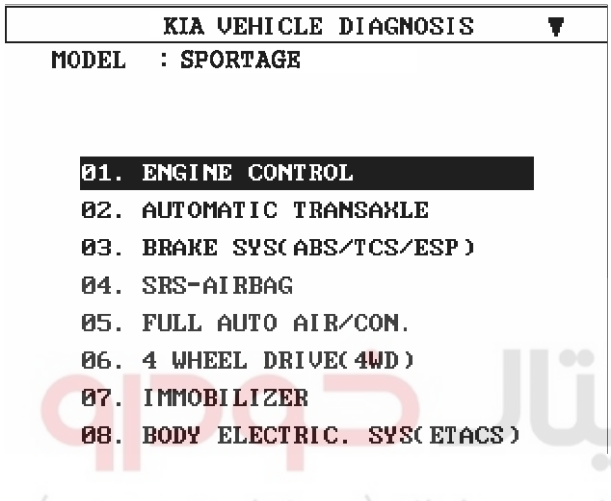
· Injector clamp mounting bolts: 24.5 ~ 28.4 N·m (2.5 ~ 2.9 kgf·m, 18.1 ~ 20.1 lbf·ft)
· High pressure pipe flange nuts (Injectors ↔ Common Rail): 24.5 ~ 28.4 N·m (2.5 ~ 2.9 kgf·m, 18.1 ~ 20.1 lbf·ft)

REPLACEMENT

⚠CAUTION

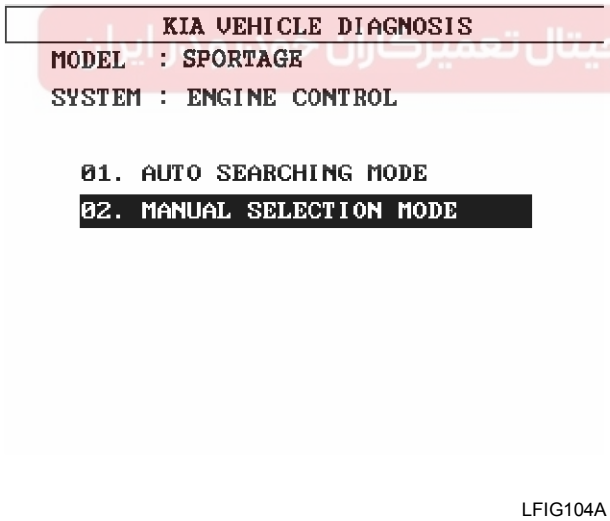
After replacing (an) injector(s), MUST input the injector data (7 digit) into the ECM.

1. Turn ignition switch OFF.
2. Replace the injector with a new one according to the "REMOVAL" and "INSTALLATION" procedures.
3. Connect a scan tool to Data Link Connector (DLC) and turn ignition switch on.
4. Select "ENGINE CONTROL".



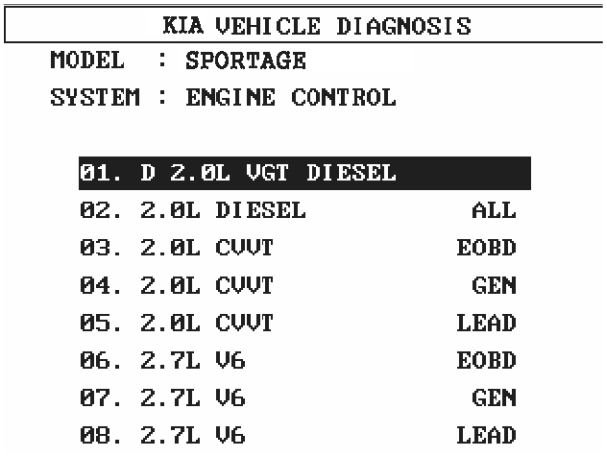
LFIG103A

5. Select "MANUAL SELECTION MODE".



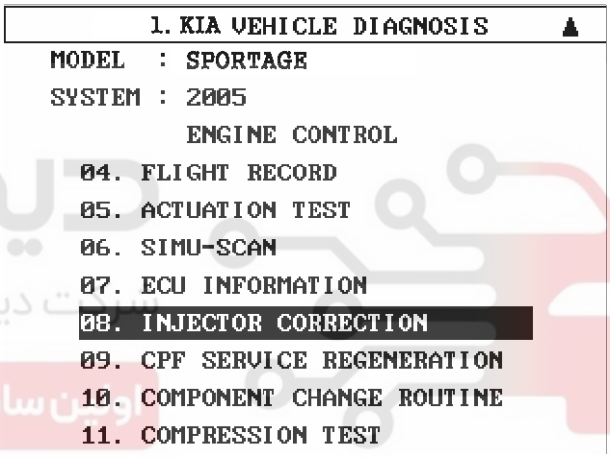
LFIG104A

6. Select "D 2.0L VGT DIESEL".



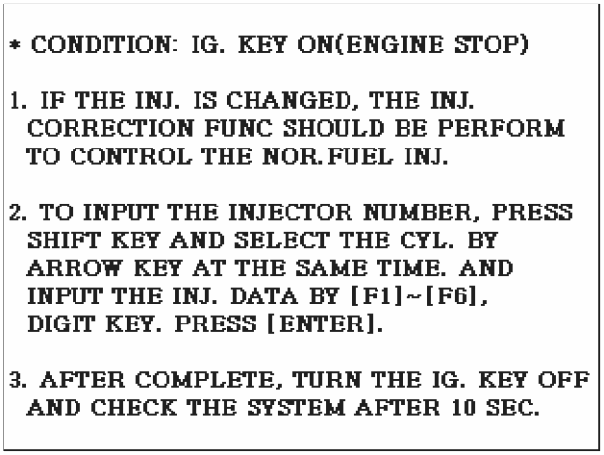
LFIG105A

7. Select "INJECTOR CORRECTION".



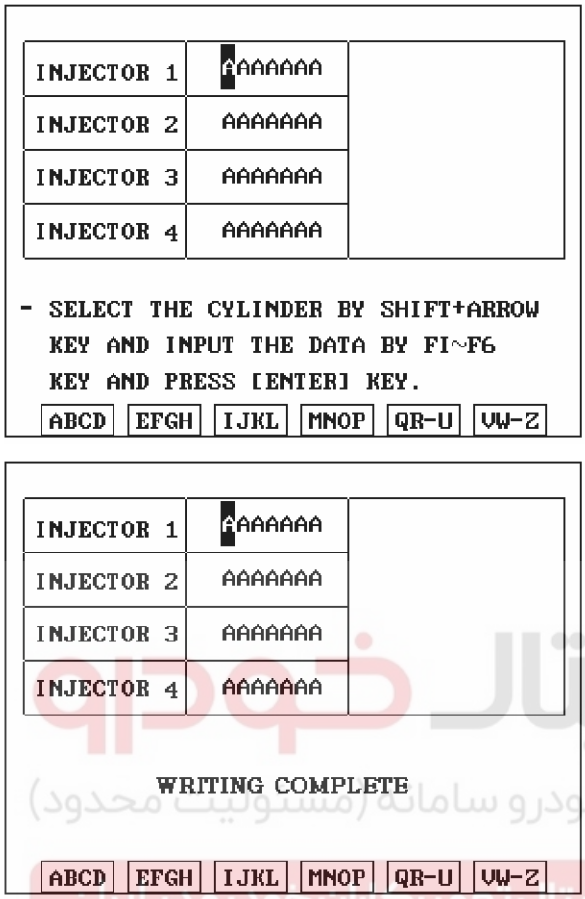
LFIG134A

8. Press "ENTER" key.



LFIG135A

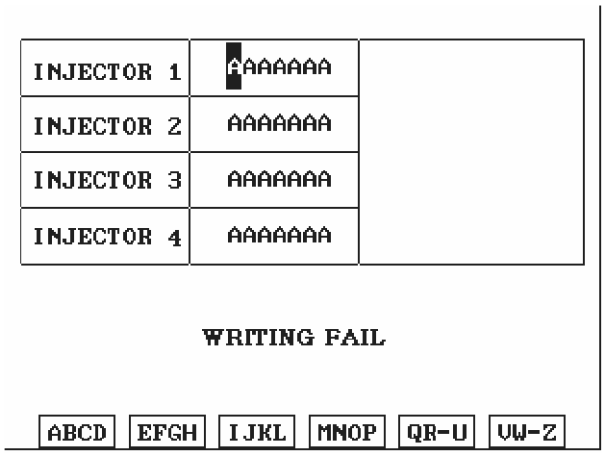
9. Input the injector data (7 digit) written on the top of each injector with function keys ([F1] ~ [F6]) and number keys.



LFIG136A

NOTICE

When "WRITING FAIL" is displayed on the scan tool, input injector data (7 digits) of each cylinder into a new ECM again as prior procedure.



LFIG137A

INSPECTION

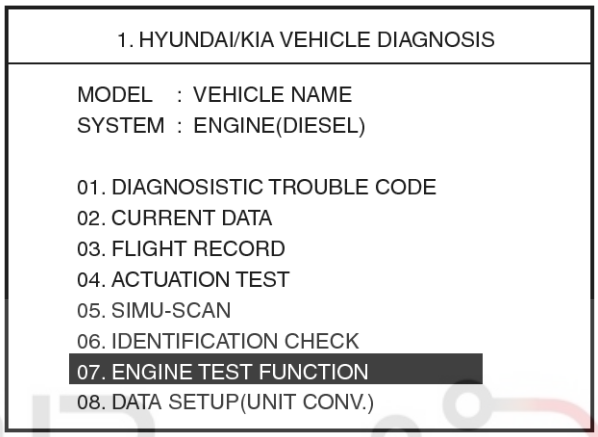
USING HI-SCAN(PRO)

Test mode

- COMPRESSION TEST
- IDLE SPEED COMPARISON
- INJECT QUANTITY COMPARISON

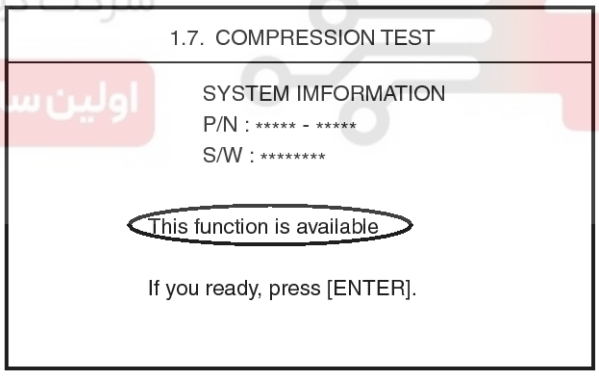
TEST PROCEDURE

1. Connect Scan tool to the DLC and select "Vehicle" and "Engine Test Function".

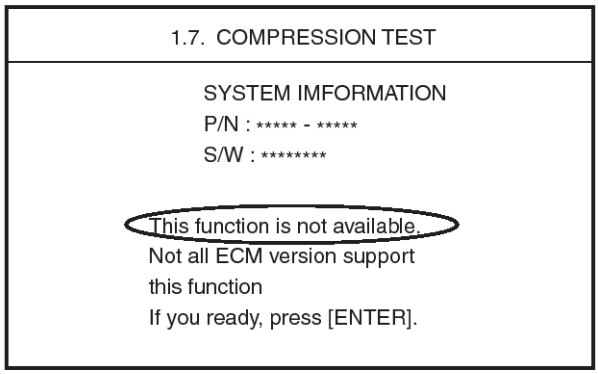


LFIG090A

2. Information for ECM version is displayed as below.



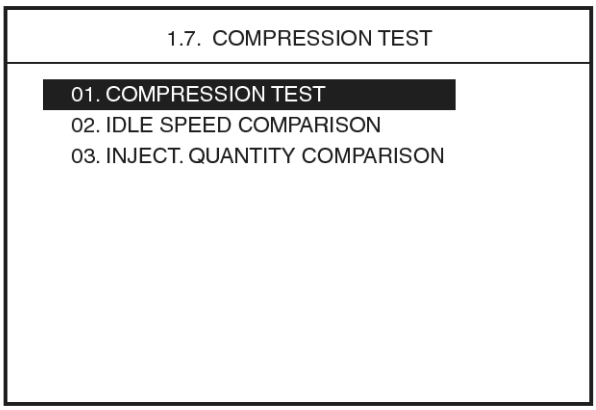
<Available system>



<Not available system>

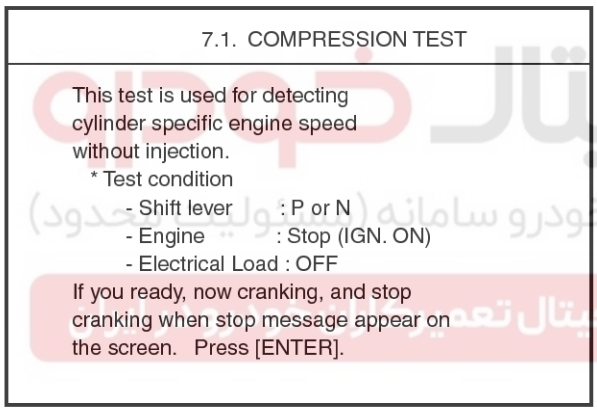
LFIF660B

3. After pressing "[ENTER]" select "COMPRESSION TEST" mode and press "[ENTER]".



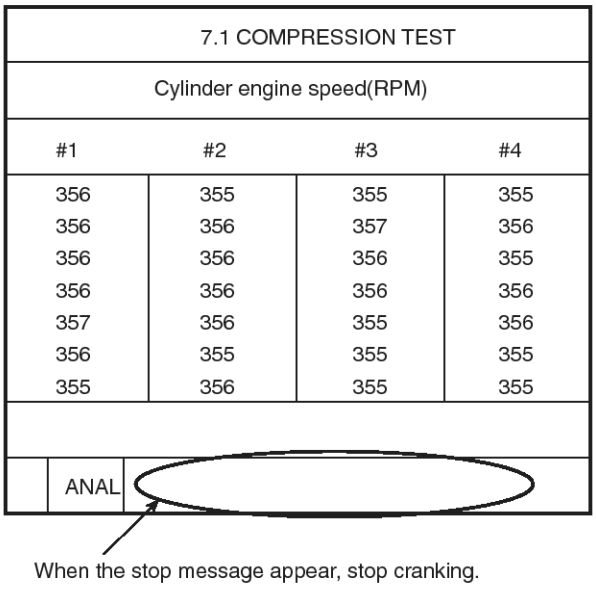
LFIF660D

4. Set the test condition described as below screen and then, crank engine. When engine stop message being appeared, stop cranking.



LFIF660E

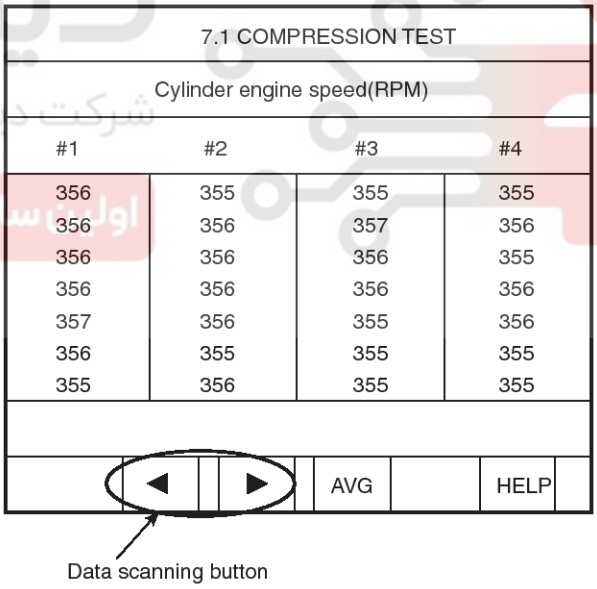
5. Press "ANAL" and the test result is appeared.



LFIF660F

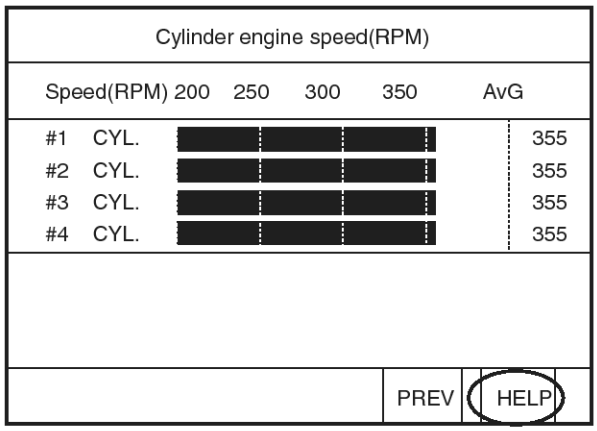
NOTICE

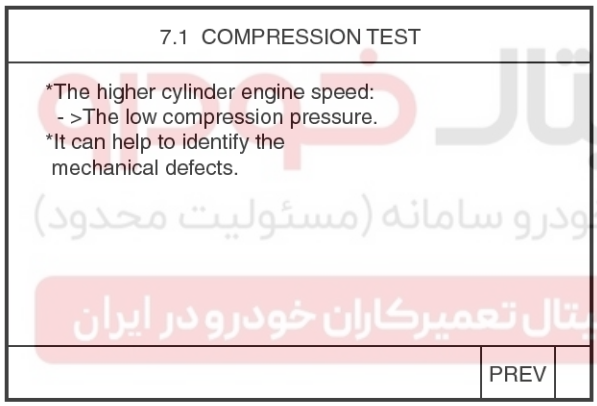
During cranking engine does not start.



LFIF660G

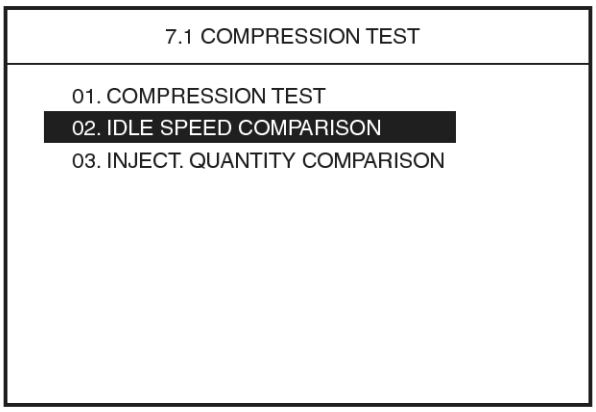
6. Press "AVG" and the data average of each cylinder is appeared.
   Press "HELP" and description of the data is appeared.





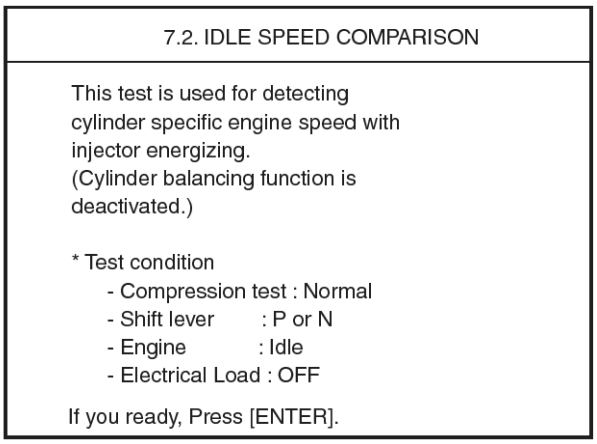
LFIF660H

7. After pressing "ESC", select "IDLE SPEED COMPARISON" and press "[ENTER]".



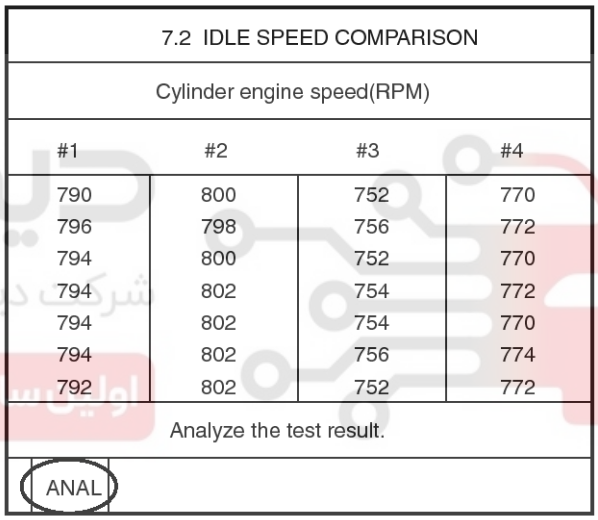
LFIF002A

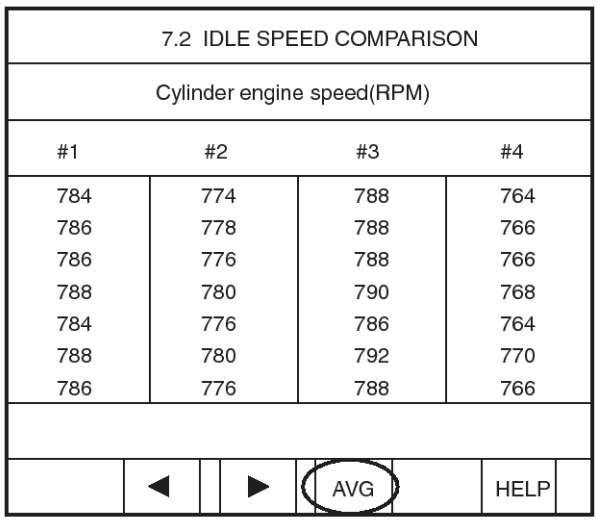
8. Set the test condition described as below screen and press "[ENTER]".



LFIF660J

9. The rpm data of each cylinder is appeared.

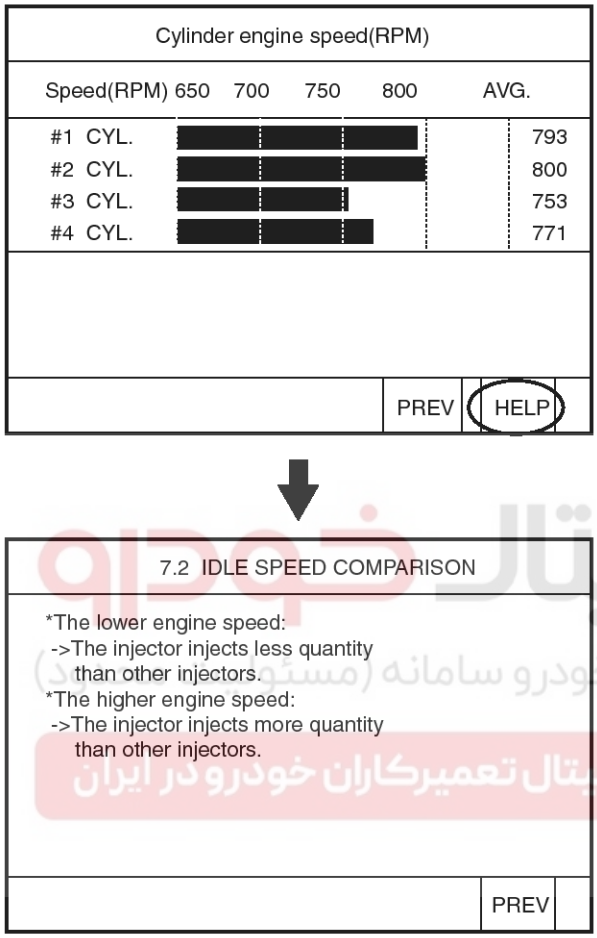




LFIF660K

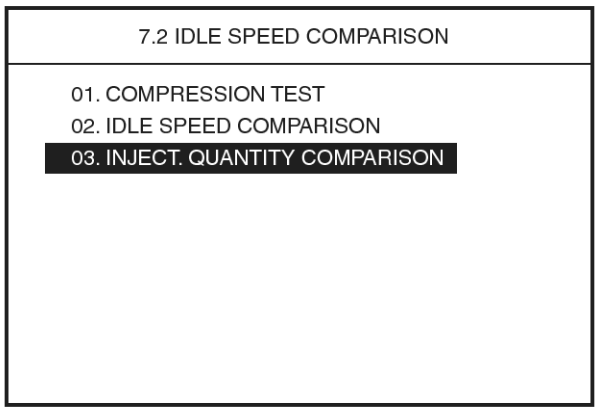
10. Press "AVG" and teh data average of each cylinder is appeared.

    Press "HELP" and description of the data is appeared.



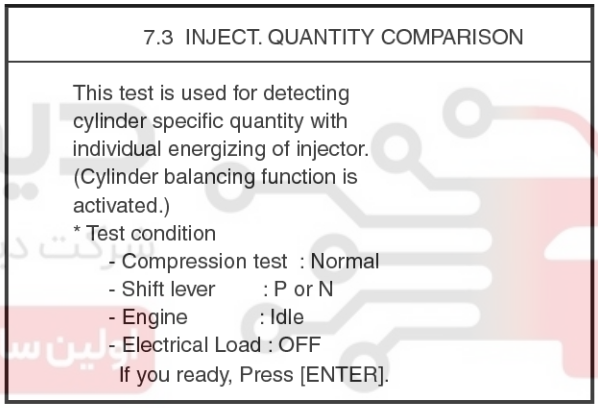
LFIF660M

11. After pressing "ESC", select "INJECT QUANTITY COMPARISON" and press "[ENTER]".



LFIF700A

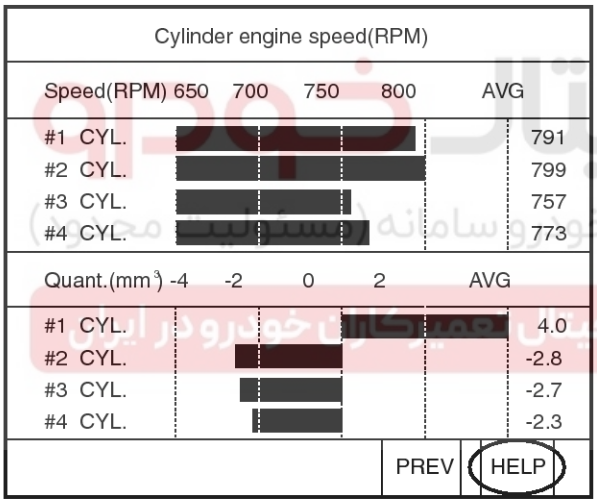
12. Set the test condition described as below screen and press "[ENTER]".



LFIF660O

13. The data of each cylinder about RPM and compensating injection quantity is appeared.

7.3 INJECT. QUANTITY COMPARISON							
Eng. Speed(RPM)				Injection quantity(mm3)			
#1	#2	#3	#4	#1	#2	#3	#4
792	800	758	774	4.0	-2.9	-2.8	-2.4
788	798	760	774	4.0	-2.9	-2.7	-2.4
794	802	758	776	4.0	-2.9	-2.7	-2.4
792	798	758	774	4.0	-2.8	-2.7	-2.4
788	798	758	772	4.0	-2.8	-2.6	-2.4
794	802	758	772	4.0	-2.8	-2.8	-2.5
790	798	754	770	4.0	-2.9	-2.8	-2.5
Analyze the test result.							
ANAL							



<Abnormal state>

LFIF660P

14. Press "HELP" and description of the data is displayed as below.

7.3 INJECT. QUANTITY COMPARISON
*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 replacinga injector with new one, reset & confirm the engine condition.

LFIF660R

15. Replace the default injector, and then repeat previous test modes to check if the injector is normal.

COMPONENT INSPECTION

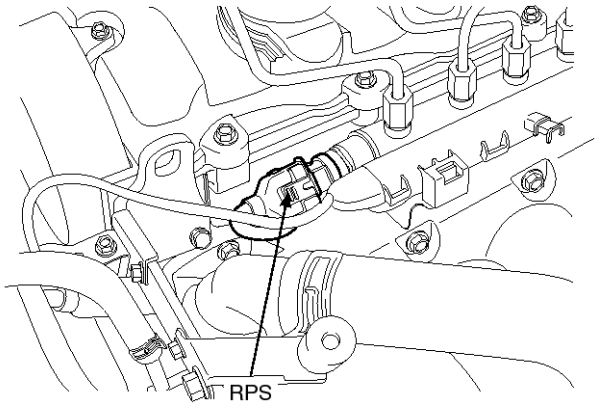
1. Turn ignition switch OFF.
2. Disconnect the injector connector.
3. Measure resistance between terminal 1 and 2.

Specification : 0.33Ω at 20℃(68˚F)

Rail Pressure Sensor (RPS)

INSPECTION

Rail Pressure Sensor (RPS) is installed at the end of the common rail and measures the instantaneous fuel pressure in the common rail by using its diaphragm. Its sensing element (semiconductor device) mounted on the diaphragm converts the fuel pressure to an electric signal.



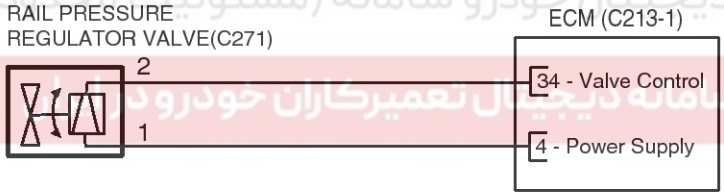
LFIG017A

SPECIFICATION

Test Condition	Rail pressure (bar)	Output Voltage (V)
Idle	220 ~ 320	Below 1.7
Fully depressed	1,800	Approx. 4.5

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

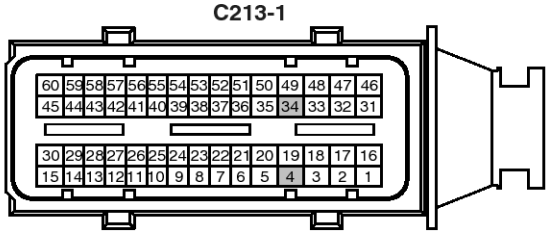
Terminal	Connected to	Function
1	ECM C213-1 (4)	Battery Voltage (B+)
2	ECM C213-1 (34)	Valve Control

[HARNESS CONNECTORS]

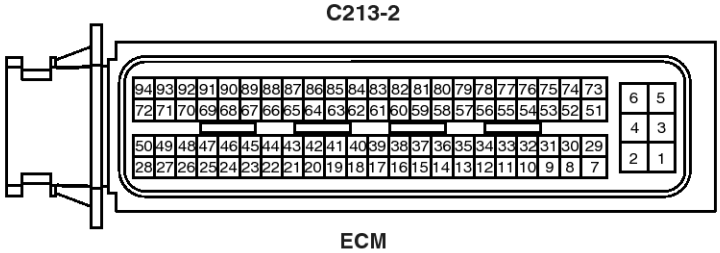
C271

RAIL PRESSURE REGULATOR VALVE

C213-1



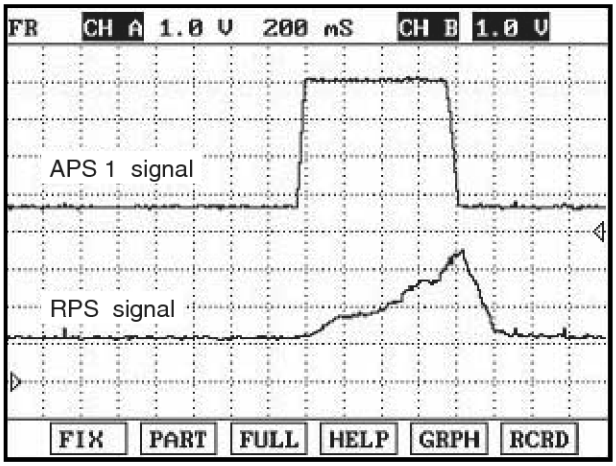
C213-2



ECM

LFIG094A

SIGNAL WAVEFORM



Rail Pressure Sensor (RPS) is to provide to the ECM the voltage signal corresponding to rail pressure.
The change in resistance is preportional to the rail pressure acting upon the diaphragm and rail pressure increases as load increases.

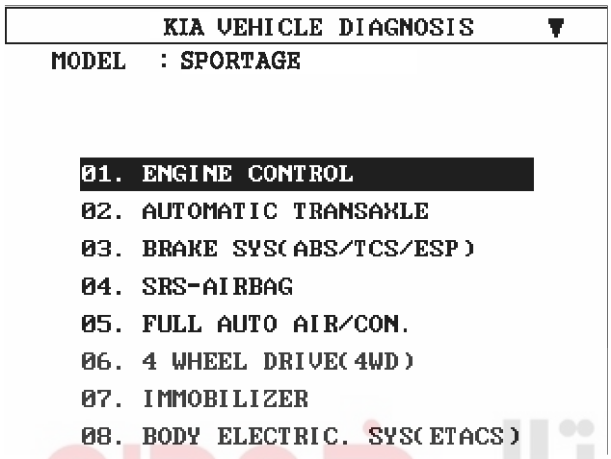
EFNF550A

REPLACEMENT

NOTICE

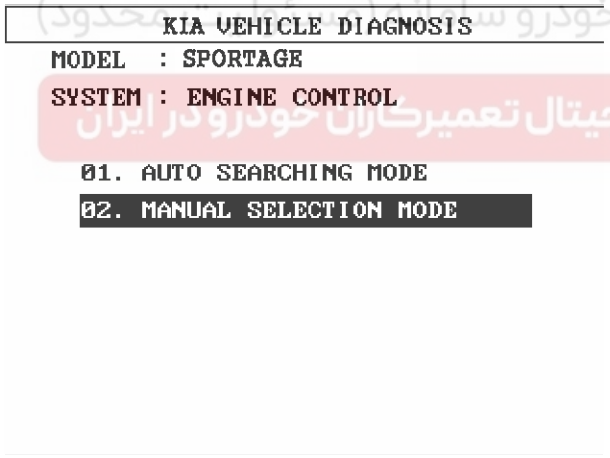
After replacing a Rail Pressure Sensor (RPS), MUST proceed below procedure.

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



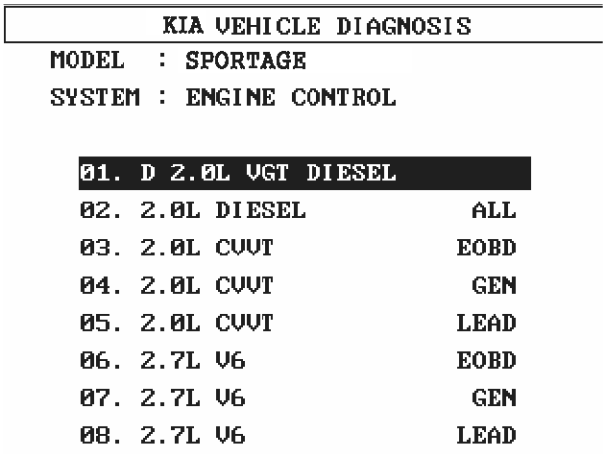
LFIG103A

5. Select "MANUAL SELECTION MODE".



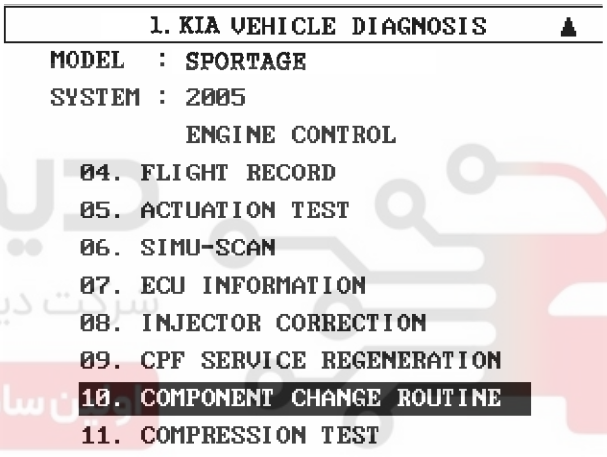
LFIG104A

6. Select "D 2.0L VGT DIESEL".



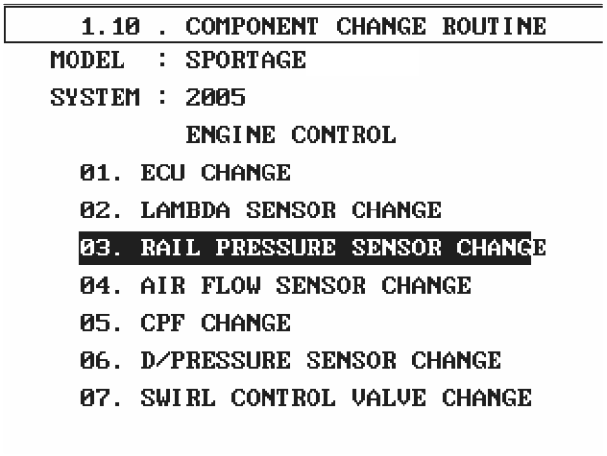
LFIG105A

7. Select "COMPONET CHANGE ROUTNE"



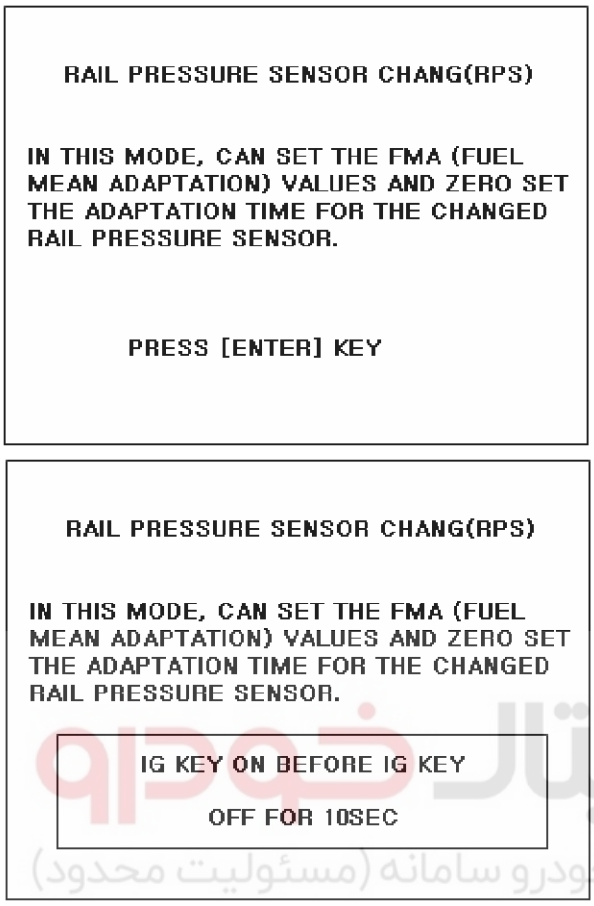
LFIG106A

8. Select "RAIL PRESSURE SENSOR CHANGE".



LFIG126A

9. Press "ENTER" key.



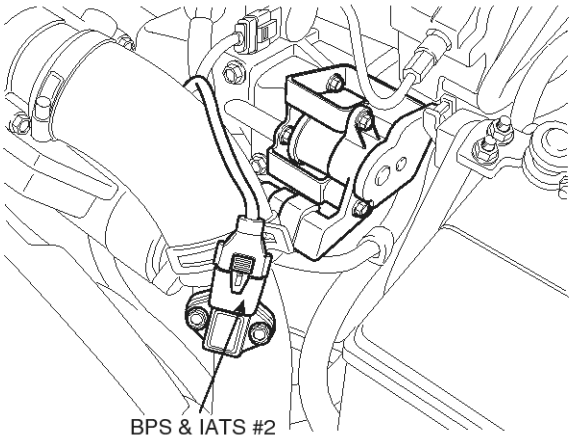
LFIG127A

10. Wait 10 seconds with IG ON.
11. Turn ignition switch off.

Boost Pressure Sensor (BPS)

INSPECTION

Boost pressure sensor (BPS) is installed on surge tank to measure the absolute intake manifold pressure. BPS input voltage is changed in proportion with absolute pressure in manifold. This information is used to control Variable Geometery Turbocharger (VGT) by ECM.



LFIG044A

SPECIFICATION

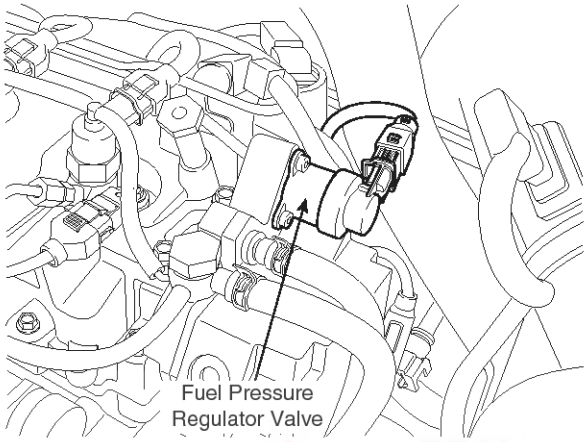
Pressure (kPa)	Output Voltage (V)
70	1.02 ~ 1.17
140	2.13 ~ 2.28
210	3.25 ~ 3.40
270	4.20 ~ 4.35

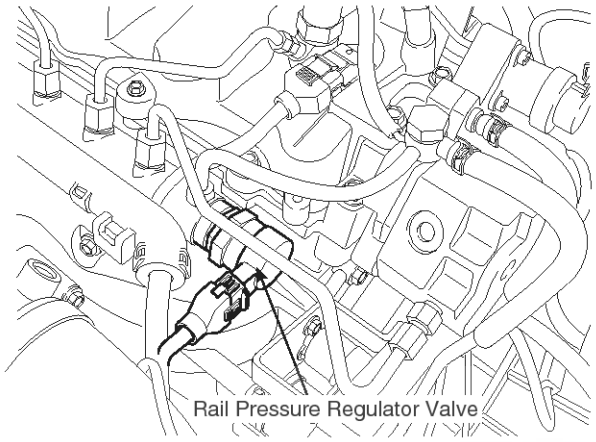
Rail Pressure Regulator Valve

INSPECTION

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail 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.





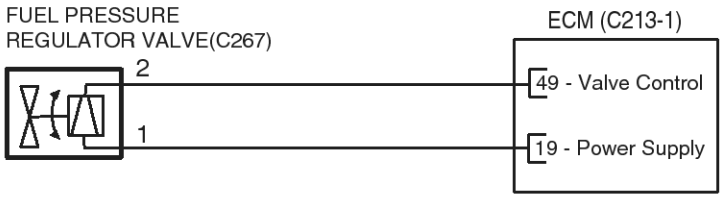
LFIG114A

SPECIFICATION

Items	Specification
Coil Resistance (Ω)	3.42 ~ 3.78Ω [20℃(68°F)]

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



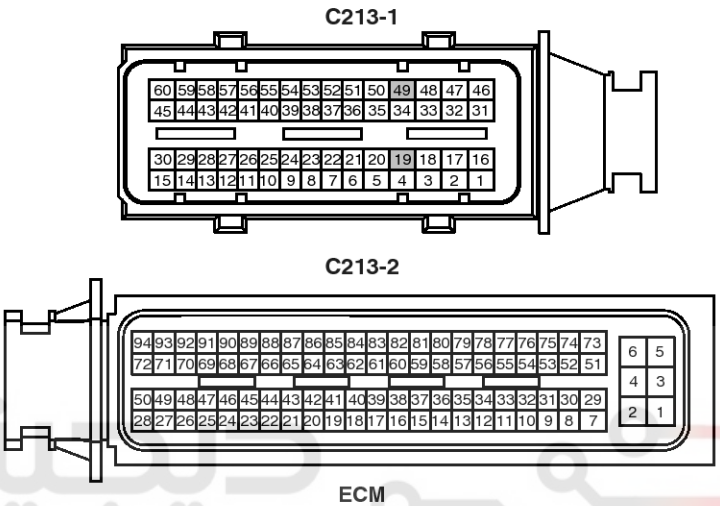
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C213-1 (19)	Battery Voltage (B+)
2	ECM C213-1 (49)	Valve Control

[HARNESS CONNECTORS]

C267

FUEL PRESSURE REGULATOR VALVE



LFIG055A

SIGNAL WAVEFORM

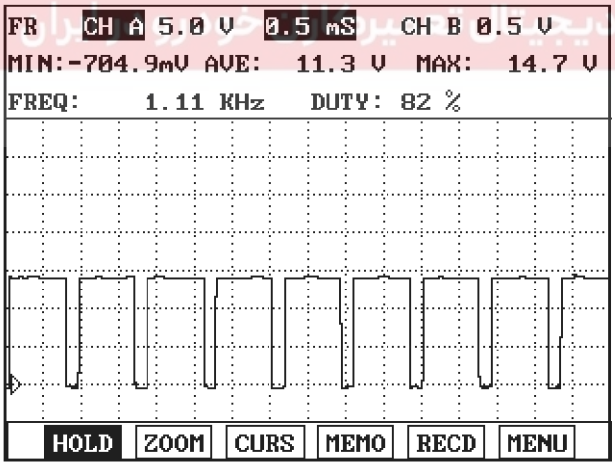


Fig.1

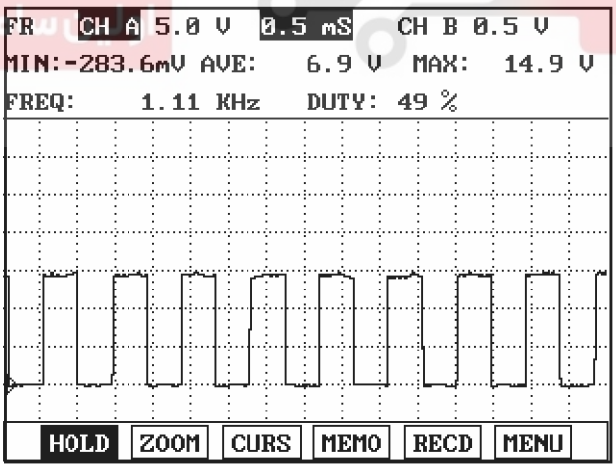


Fig.2

Fig.1) Waveform of rail pressure regulator valve at idle. It shows approx. 17% duty((-) duty).
Fig.2) Waveform of rail pressure regulator valve as accelerating. Approx. 50% duty is outputted as engine load increases.
(When rail pressure increases as accelerating, rail pressure regulator valve duty(current) rises.)

LFIG377A

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.

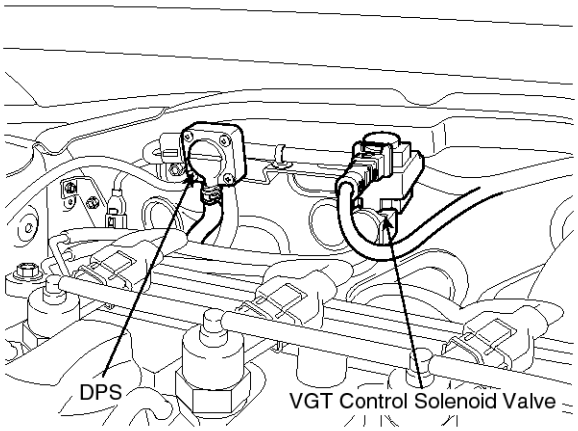
Specification: Refer to "SPECIFICATION".

VGT Control Solenoid Valve

INSPECTION

Variable Geometry Turbo-charger (VGT) is used to charge additional air into combustion chamber for improvement of combustion efficiency.

ECM controls the VGT with controlling duty of the VGT control solenoid valve according to engine load.



LFIG014A

SPECIFICATION

Items	Specification
Coil Resistance (Ω)	14.7 ~ 16.1Ω [20℃(68°F)]

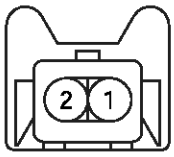
CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]

[CONNECTION INFORMATION]

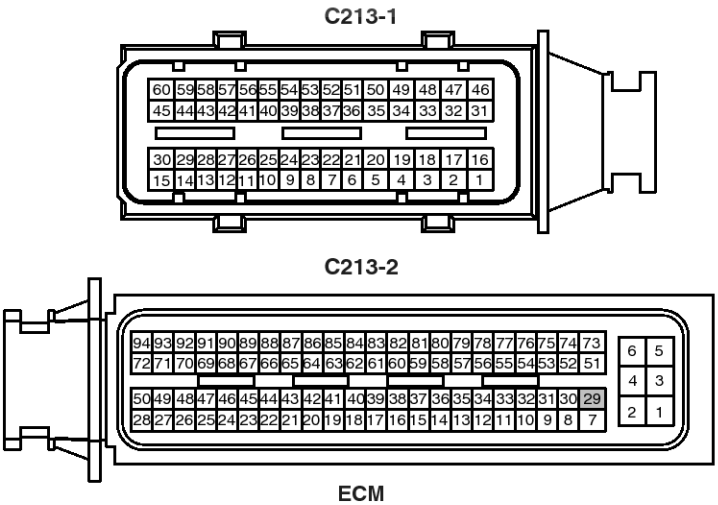
Terminal	Connected to	Function
1	ECM C213-2 (29)	Valve Control
2	Main Relay	Battery Voltage (B+)

[HARNESS CONNECTORS]



C265

VGT CONTROL SOLENOID VALVE



ECM

LFIG061A

SIGNAL WAVEFORM

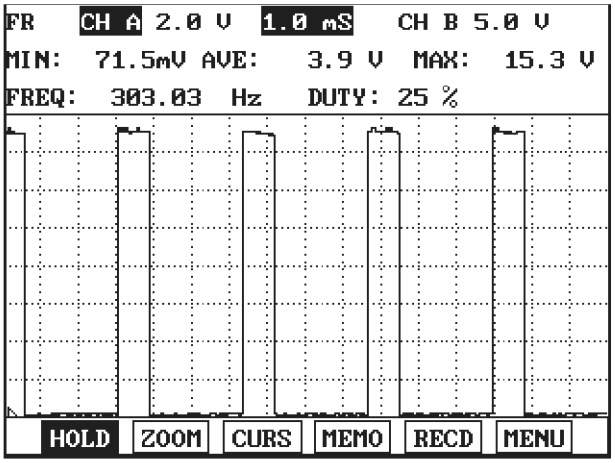


Fig.1

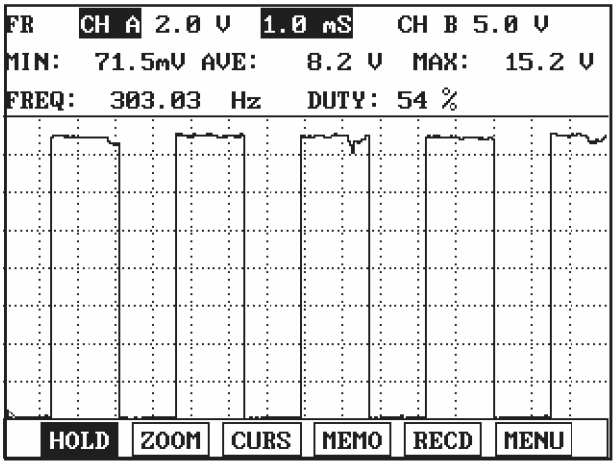


Fig.2

Fig.1) VGT actuator output waveform at 76% duty((-)duty). Duty decreases as boost pressure increases.
Fig.2) VGT actuator duty((-)duty) decreases as accelerating.

LFIG369A

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect the VGT control solenoid valve connector.
3. Measure resistance between terminal 1 and 2 of the valve.

Specification: Refer to "SPECIFICATION".

Throttle Flap Control Solenoid Valve

INSPECTION

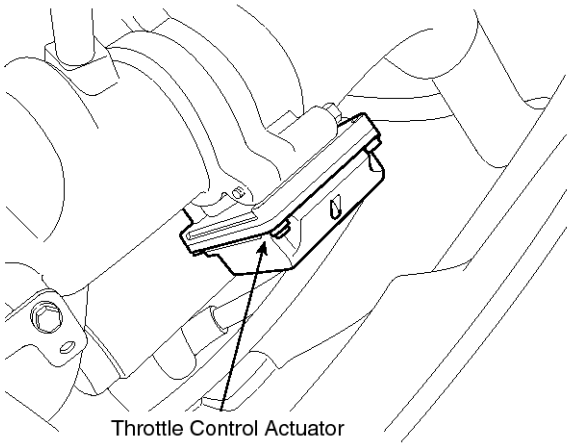
The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve,
- a 2-step gear (transmission ratio = 1:40) which is located in between the DC motor and the throttle valve and increases torque of the DC motor,
- a position sensor which is a hall-effect sensor and detects status of the throttle valve,
- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM,
- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1. Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve for 1.5 seconds (95% < Duty < 97%) to reduce engine vibration.
2. Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve (5% < Duty < 94%) to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.
3. Exhaust gas temperature control for CPF regeneration: When the Catalyzed Particulate Filter (CPF) is need to regenerate, the ECM partially closes the throttle valve (5% < Duty < 94%) to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the CPF.



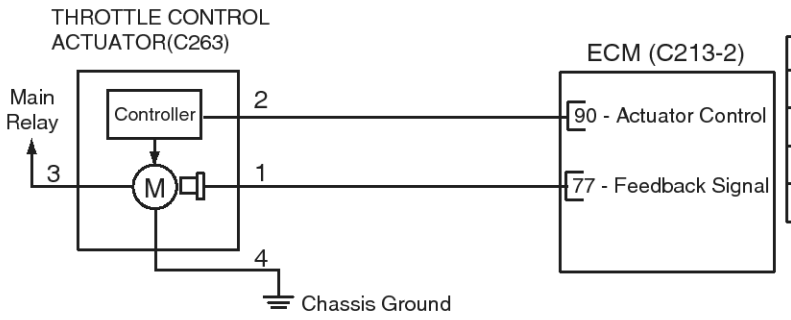
LFIG021A

SPECIFICATION

Duty (%)	Throttle Valve Position
5	Open
5 ~ 94	Normal operation (Partially open in proportion to duty value)
94	Closed
94 ~ 95	Maintaining the last valid position
95 ~ 97	Fully closed

CIRCUIT DIAGRAM

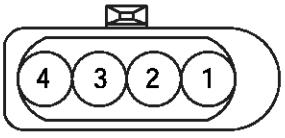
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

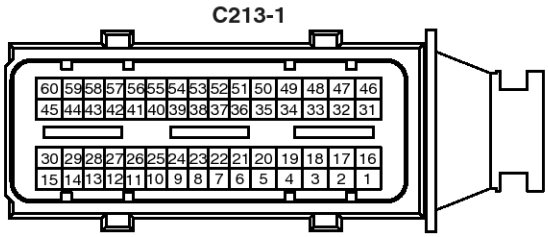
Terminal	Connected to	Function
1	ECM C213-2 (77)	Feedback Signal
2	ECM C213-2 (90)	Actuator Control
3	Main Relay	Battery Voltage
4	Chassis Ground	Ground

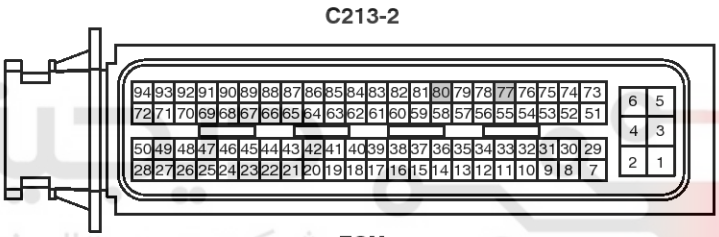
[HARNESS CONNECTORS]



C263

THROTTLE CONTROL ACTUATOR





ECM

LFIG097A

SIGNAL WAVEFORM

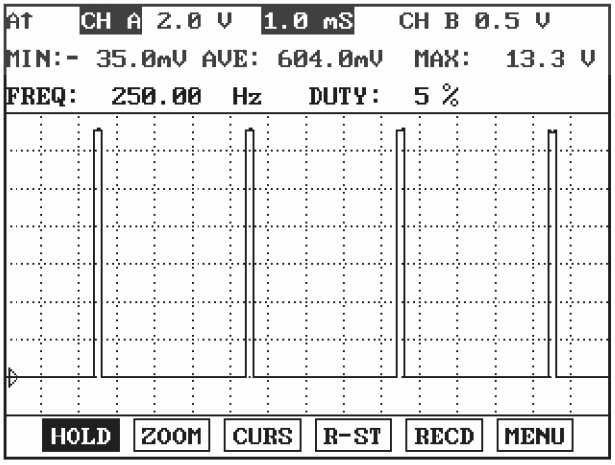


Fig.1

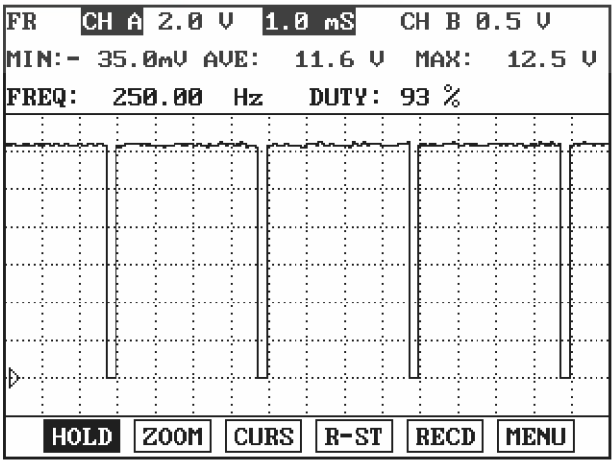


Fig.2

Fig.1) Waveform of Throttle control actuator at wide open(at idle) : At IG KEY "ON", ENGINE "ON", 5% duty is outputted continuously.

Fig.2) Waveform of Throttle control actuator at closed position : At IG KEY "OFF", 93% duty is outputted for about 1 sec.

LFIG529A

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect the electric throttle control actuator connector.
3. Measure resistance between terminal 1 and 2 of the valve.

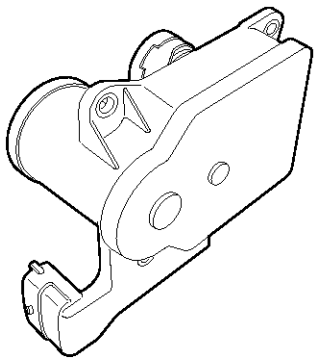
Specification: Refer to "SPECIFICATION".

Variable Swirl Actuator

DESCRIPTION

Variable Swirl Control Actuator consists of DC motor and position sensor which detects the position of the swirl valve.

At idle or below 3000rpm, the swirl valve is closed. This swirl effect increases air flow rate.



SZZF19100D

	Low and Middle Load	High Load
Engine speed	Below 3000rpm	Above 3000rpm
Valve operation	CLOSE	OPEN
Description illustration		
Fail-safe	Fully opened	

NOTICE

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

SPECIFICATION

Motor

Items	Specification
Coil Resistance (Ω)	3.4 ~ 4.4Ω [20℃(68°F)]

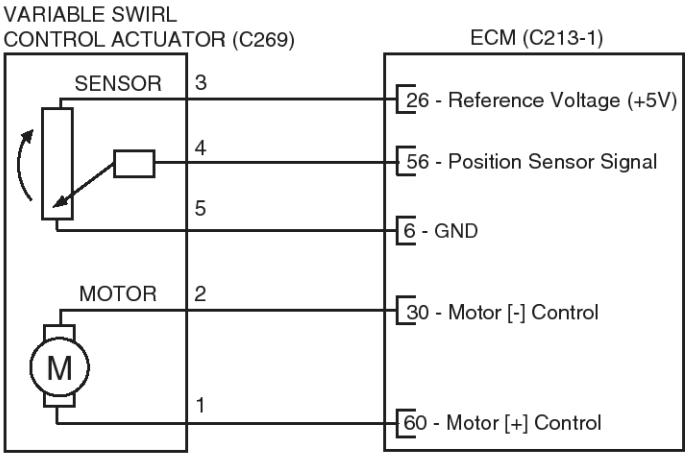
Position Sensor

Items	Specification
Coil Resistance (Ω)	3.44 ~ 5.16Ω [20℃(68°F)]

LFIG058A

CIRCUIT DIAGRAM

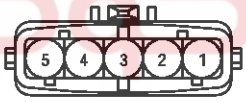
[CIRCUIT DIAGRAM]



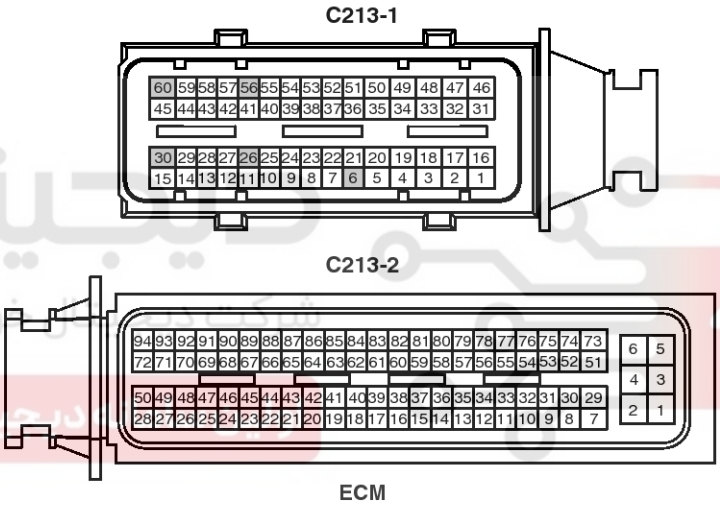
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C213-1 (60)	Motor [+] Control
2	ECM C213-1 (30)	Motor [-] Control
3	ECM C213-1 (26)	Reference Voltage (+5V)
4	ECM C213-1 (56)	Position Signal
5	ECM C213-1 (6)	Sensor Ground

[HARNESS CONNECTORS]



C269
VARIABLE SWIRL CONTROL ACTUATOR



LFIG059A

SIGNAL WAVEFORM

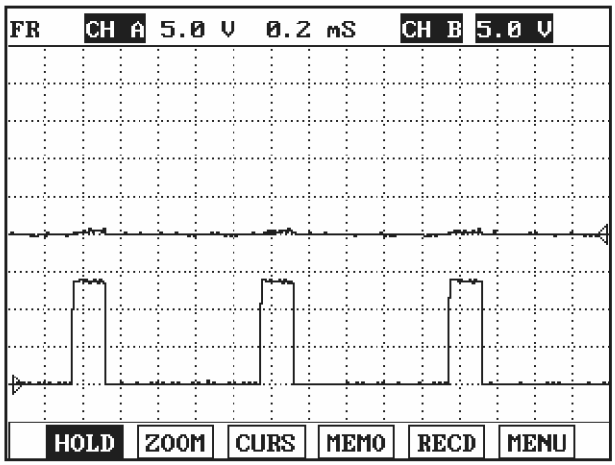


Fig.1

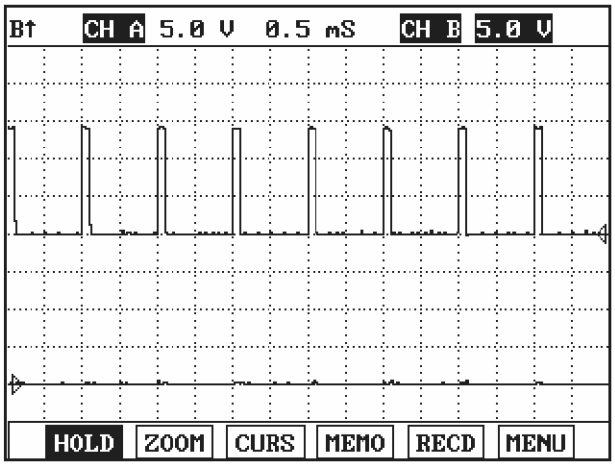


Fig.2

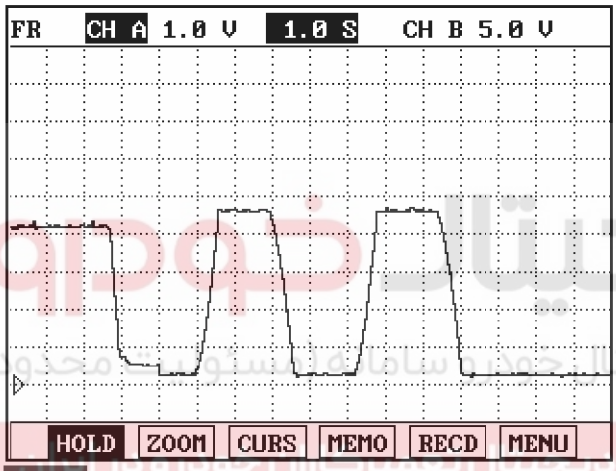


Fig.3

Fig.1) Waveform when variable swirl valve closed at idle. Terminal 1 is (+) and 2 is (-).
Fig. 2) Waveform when variable swirl valve opened at above 3000RPM. Terminal 1 is (-) and 2 is (+).
Fig. 3) Waveform of variable swirl control actuator motor position sensor at the point of turning engine OFF.
4.3V at swirl valve closed and 0.3V at swirl valve opened. Swirl valve is opened and closed twice at engine "OFF".

LFIG512A

COMPONENT INSPECTION

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

Specification: Refer to "SPECIFICATION".

5. Measure resistance between voltage supply terminal and ground terminal of position sensor.

Specification: Refer to "SPECIFICATION".

REPLACEMENT

NOTICE

After replacing a Variable Swirl Actuator, MUST proceed below procedure.

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

```
KIA VEHICLE DIAGNOSIS                    ▼
MODEL   : SPORTAGE

  01. ENGINE CONTROL
  02. AUTOMATIC TRANSAXLE
  03. BRAKE SYS(ABS/TCS/ESP)
  04. SRS-AIRBAG
  05. FULL AUTO AIR/CON.
  06. 4 WHEEL DRIVE(4WD)
  07. IMMOBILIZER
  08. BODY ELECTRIC. SYS(ETACS)
```

LFIG103A

5. Select "MANUAL SELECTION MODE".

```
KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM : ENGINE CONTROL

  01. AUTO SEARCHING MODE
  02. MANUAL SELECTION MODE
```

LFIG104A

6. Select "D 2.0L VGT DIESEL".

```
KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM : ENGINE CONTROL

  01. D 2.0L VGT DIESEL
  02. 2.0L DIESEL              ALL
  03. 2.0L CVVT                EOBD
  04. 2.0L CVVT                GEN
  05. 2.0L CVVT                LEAD
  06. 2.7L V6                  EOBD
  07. 2.7L V6                  GEN
  08. 2.7L V6                  LEAD
```

LFIG105A

7. Select "COMPONET CHANGE ROUTNE"

```
1.KIA VEHICLE DIAGNOSIS                  ▲
MODEL   : SPORTAGE
SYSTEM : 2005
         ENGINE CONTROL
  04. FLIGHT RECORD
  05. ACTUATION TEST
  06. SIMU-SCAN
  07. ECU INFORMATION
  08. INJECTOR CORRECTION
  09. CPF SERVICE REGENERATION
  10. COMPONENT CHANGE ROUTINE
  11. COMPRESSION TEST
```

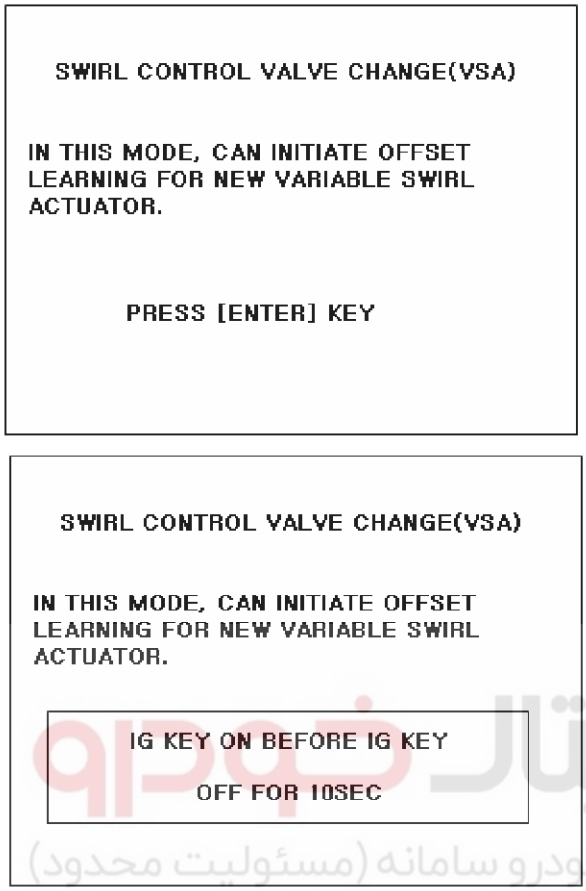
LFIG106A

8. Select "SWIRL CONTROL VALVE CHANGE".

```
1.10 . COMPONENT CHANGE ROUTINE
MODEL   : SPORTAGE
SYSTEM : 2005
         ENGINE CONTROL
  01. ECU CHANGE
  02. LAMBDA SENSOR CHANGE
  03. RAIL PRESSURE SENSOR CHANGE
  04. AIR FLOW SENSOR CHANGE
  05. CPF CHANGE
  06. D/PRESSURE SENSOR CHANGE
  07. SWIRL CONTROL VALVE CHANGE
```

LFIG132A

9. Press "ENTER" key.

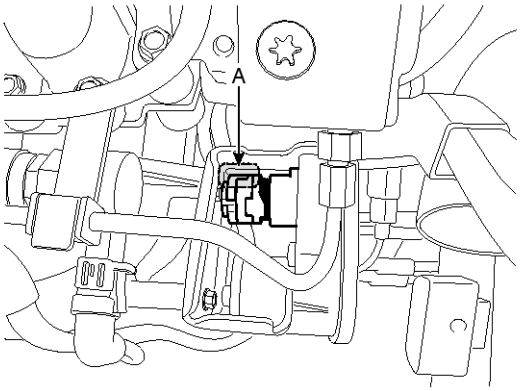


LFIG133A

10. Wait 10 seconds with IG ON.
11. Turn ignition switch off.

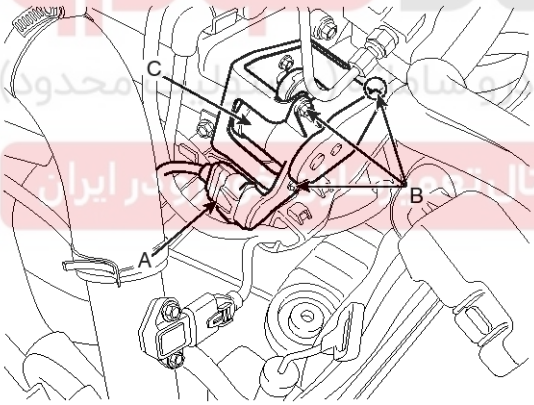
REMOVAL

1. Disconnect the battery (-) terminal.
2. Mark painting on the top (A) of the variable swirl actuator coupling of the intake manifold side.



SZZF19101D

3. Disconnect the variable swirl actuator connector (A).
4. Remove the variable swirl actuator (C) after removing the installation bolt (B).



SZZF19102D

INSTALLATION

1. Installation is the reverse order of removal.

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

⚠CAUTION

If the coupling of the intake manifold side is rotated a 180-degree turn, a real gap between the port and the flap in the intake manifold may be different from measuring it.

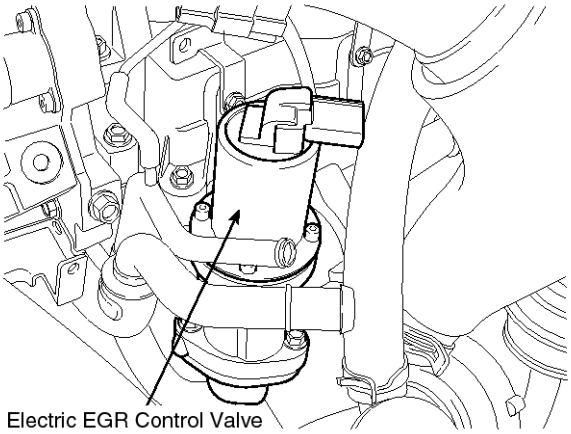
Install the actuator after confirming the mark on the top of the coupling.

2. Confirm normal operation of the actuator more than 3 times when the ignition switch OFF after full warm up (Engine Coolant Temperature > 70 ˚C).

EGR (Exhaust Gas Recirculation) Valve

INSPECTION

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. The Electric EGR valve is controlled by ECM's duty control signal depending on engine load and the need of intake air and is operated by solenoid valve not vacuum valve.



LFIG022A

SPECIFICATION

Items	Specification
Coil Resistance (Ω)	7.3 ~ 8.3Ω [20℃(68˚F)]

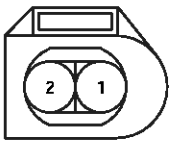
CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]

[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C213-1 (59)	EEGR Control
2	Main Relay	Battery Voltage (B+)

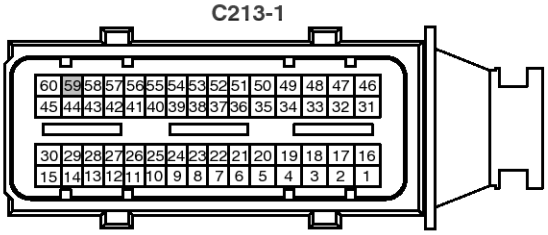
[HARNESS CONNECTORS]



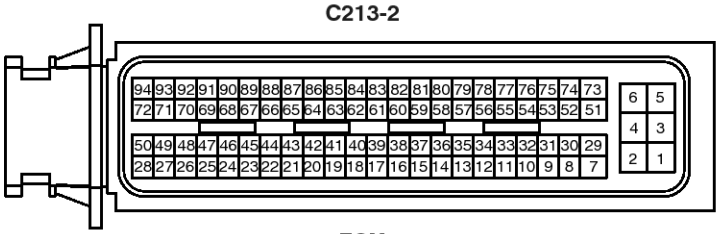
C215

EEGR

C213-1



C213-2



ECM

LFIG095A

SIGNAL WAVEFORM

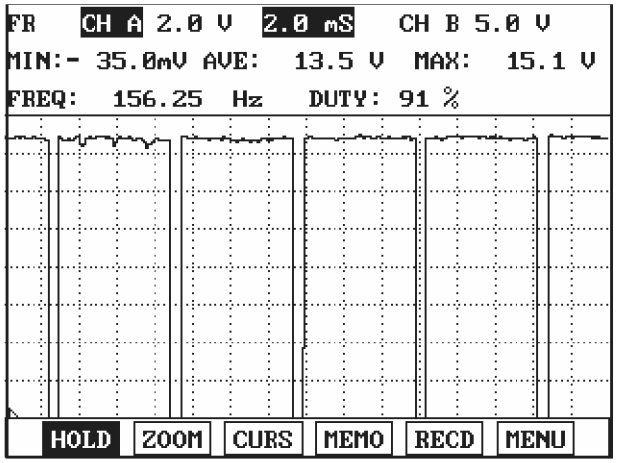


Fig.1

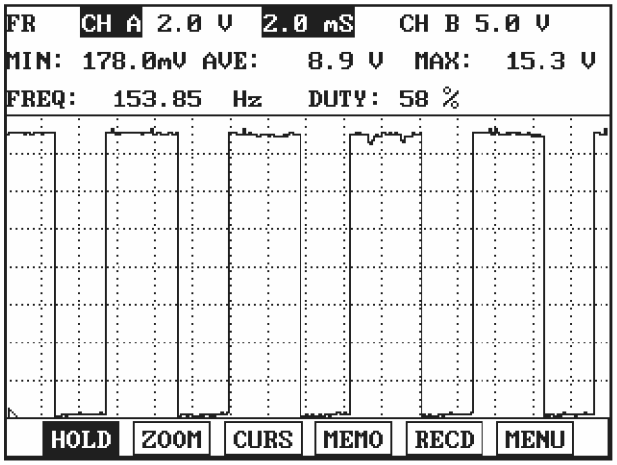


Fig.2

Fig.1) Approx. 10% duty((-)duty) signal waveform of EEGR actuator (with EEGR valve closed)
Fig.2) Approx. 40% duty((-)duty) signal waveform of EEGR actuator(with EEGR valve opened)

LFIG414A

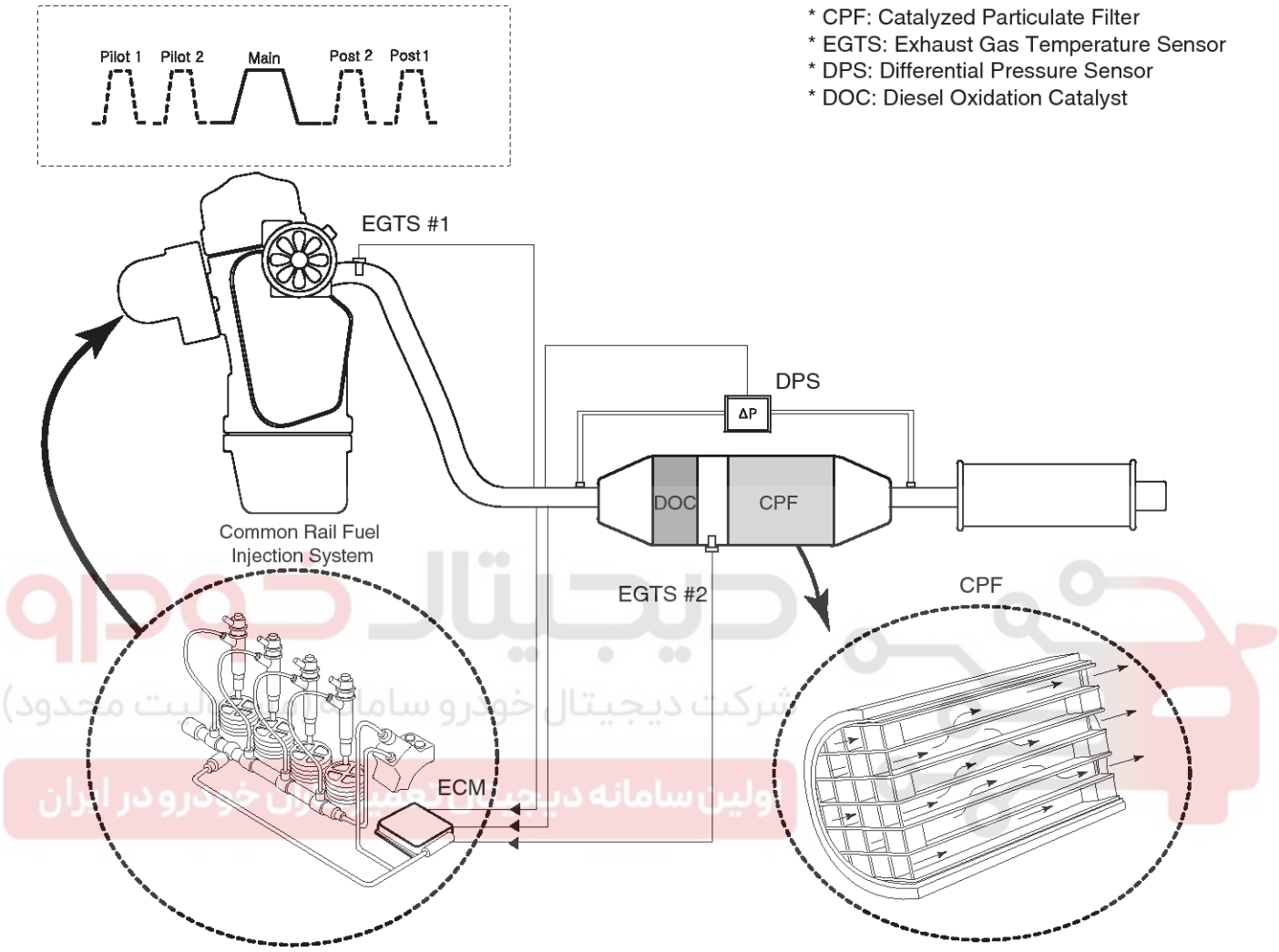
COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect the electric EGR control valve connector.
3. Measure resistance between terminal 1 and 2 of the valve.

Specification: Refer to "SPECIFICATION".

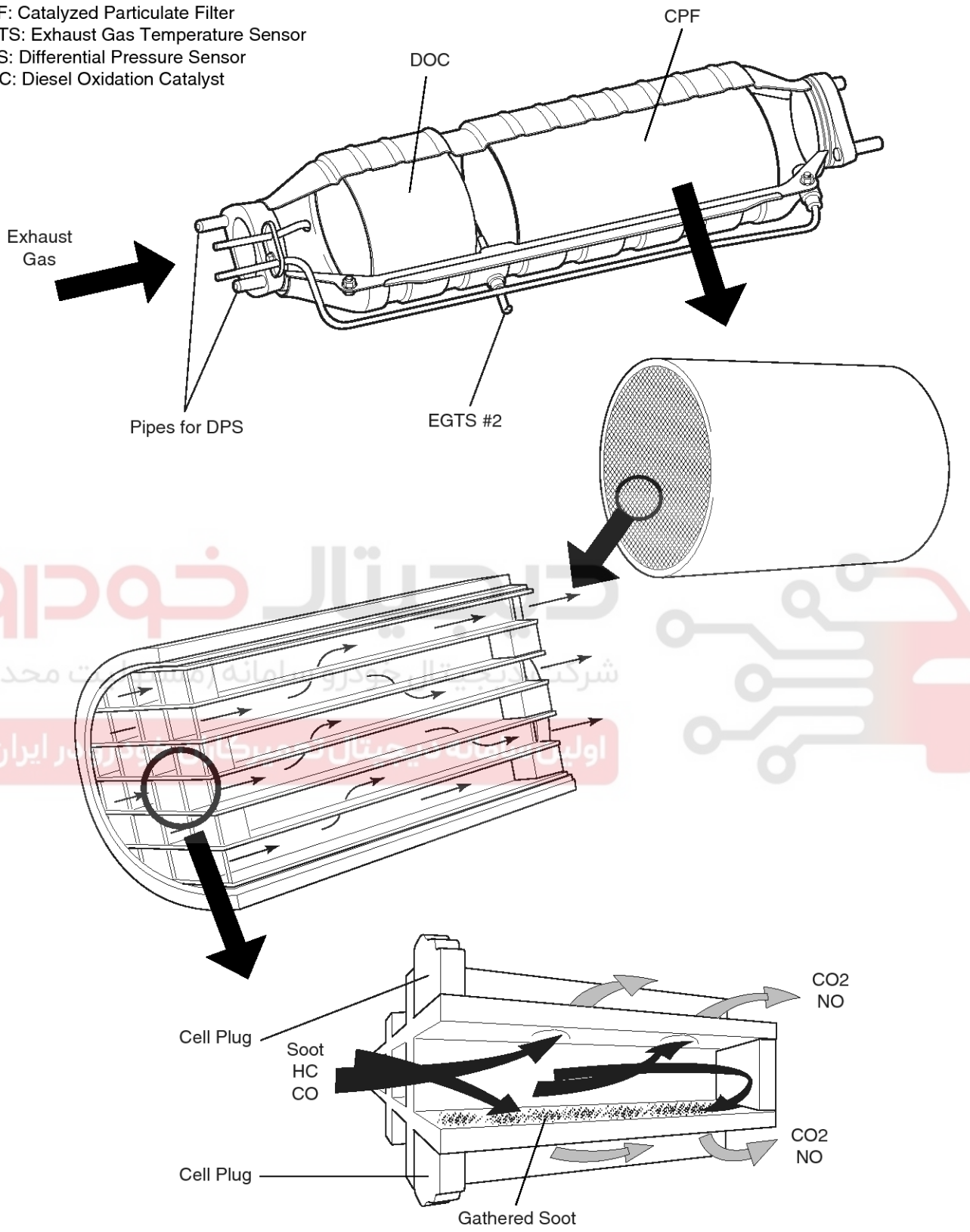
CPF (Catalyzed Particulate Filter)

SCHEMATIC DIAGRAM



LFIG116A

* CPF: Catalyzed Particulate Filter
* EGTS: Exhaust Gas Temperature Sensor
* DPS: Differential Pressure Sensor
* DOC: Diesel Oxidation Catalyst



LFIG117A

DESCRIPTION

The Catalyzed Particulate Filter (CPF) system prevents Particulate Matter (PM) from being discharged to the atmosphere and consists of a filter assembly, two Exhaust Gas Temperature Sensor (EGTS) and a Differential Pressure Sensor (DPS).The filter is integrated in the catalytic converter assembly and has honeycomb cell structure which can filter the PM in the exhaust gas. While the exhaust gas passes the CPF, the PM is gathered in the CPF and the others (CO2, NO, etc.) are discharged to the atmosphere via muffler. This gathered PM in CPF is called "soot".

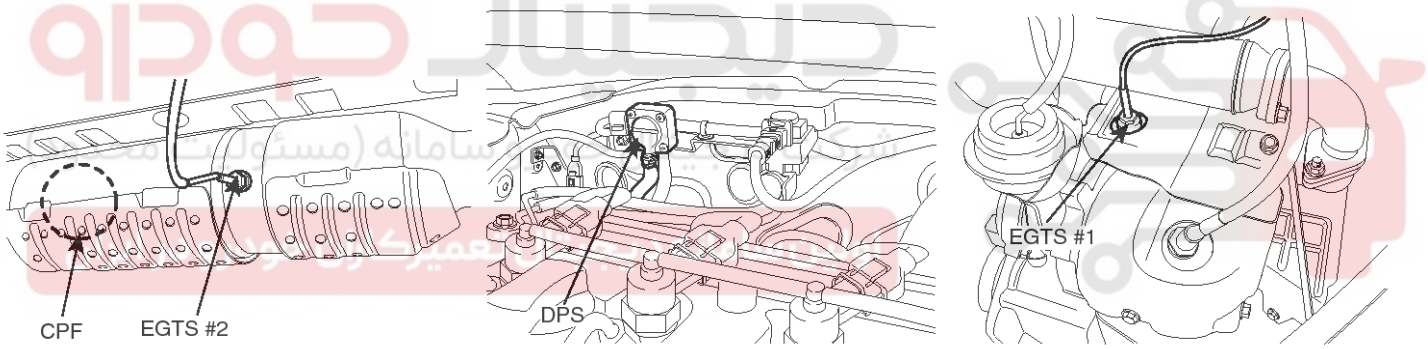
[CPF Regeneration]

If there are much soot in the CPF, the CPF must be regenerated. ECM can calculate amount of the soot by using the DPS signal, vehicle mileage or simulation data. If the ECM determines the CPF is need to regenerate, it will perform "Regeneration Procedure" when the vehicle condition is corresponded with the predetermined one (Regeneration Mode).

To burn the soot, the ECM injects additional fuel in the cylinders during exhaust stroke (two Post Injection) and increases the exhaust gas temperature to burning temperature of the soot (above 600℃). At this time, the soot are burn and its ash remains in the CPF as a result of the combustion.

[Regeneration Mode]

1. Mileage > 1,000km
2. Engine Speed: 1,000 ~ 4,000rpm
3. Engine Load = About 0.7bar [8mg/st]
4. Vehicle Speed > 5km/h
5. Engine Coolant Temperature > 40℃



LFIG115A

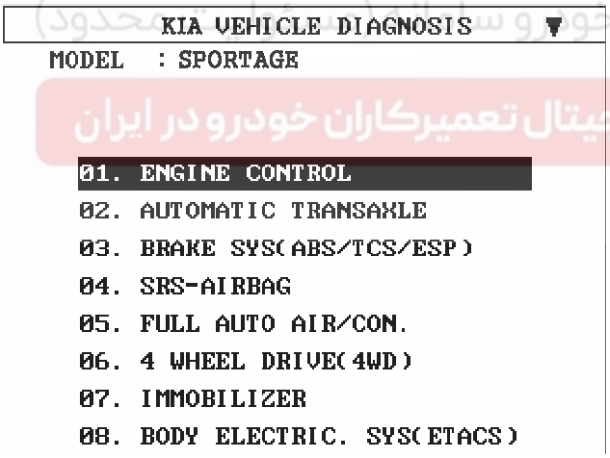
CPF REGENERATION

This procedures is to forcibly regenerate the CPF with scan tool when the CPF doesn't have been regenerated during driving. For example, if the vehicle has repeated "Low speed driving" or "Short distance driving", the CPF regeneration procedure cannot be proceeded because "Regeneration Mode" doesn't made.

FORCIBLY REGENERATION CONDITION

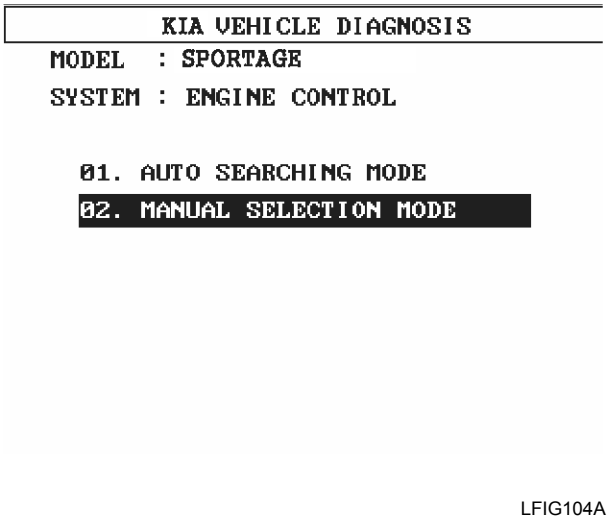
- Engine coolant temperature: about 70℃
- Engine at idle
- P-range (A/T) or Neutral (M/T)
- Normal battery voltage
- Electrical fully load (A/C ON if equipped, Blower ON with maximum speed, Head Lamp ON, Wiper ON, Other Lamps ON, etc.)

1. Turn ignition switch OFF.
2. Connect a scan tool to Data Link Connector (DLC).
3. Start engine at idle and P-range (A/T) or neutral (M/T).
4. Apply electrical fully load to the vehicle (A/C ON, Blower ON with maximum speed, Head Lamp ON, Wiper ON, and Other Lamps ON, etc.)
5. Select "ENGINE CONTROL".



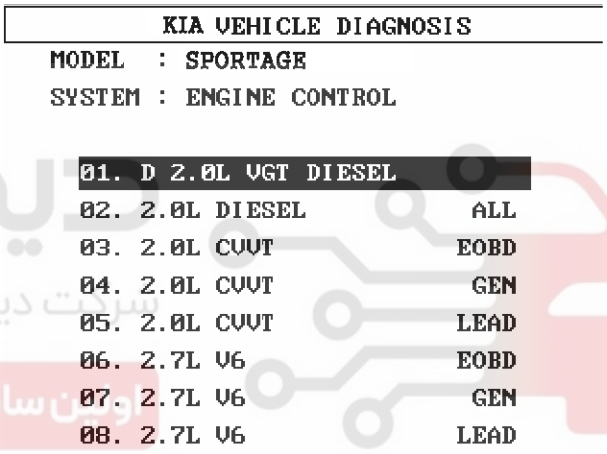
LFIG103A

6. Select "MANUAL SELECTION MODE".



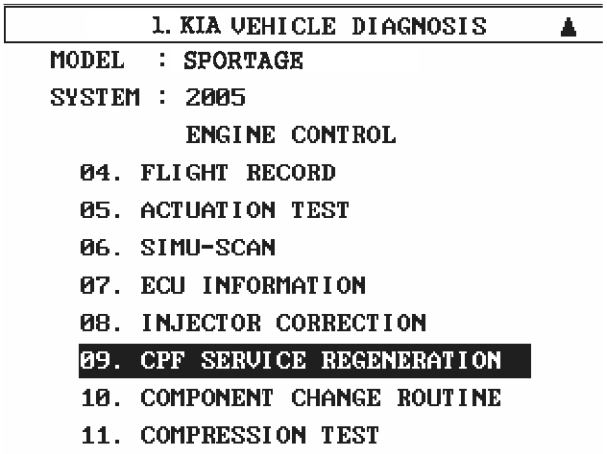
LFIG104A

7. Select "D 2.0L VGT DIESEL".



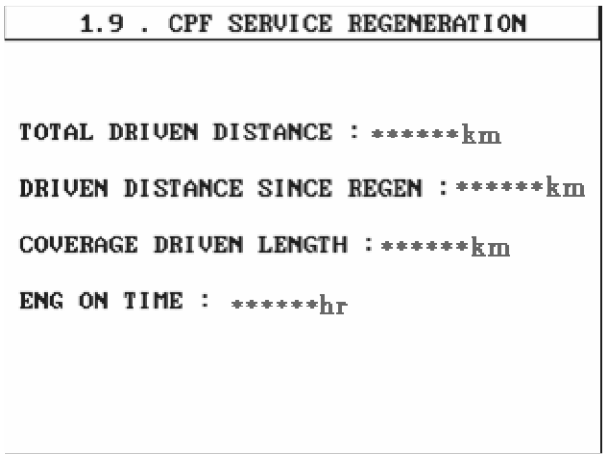
LFIG105A

8. Select "CPF SERVICE REGENERATION".



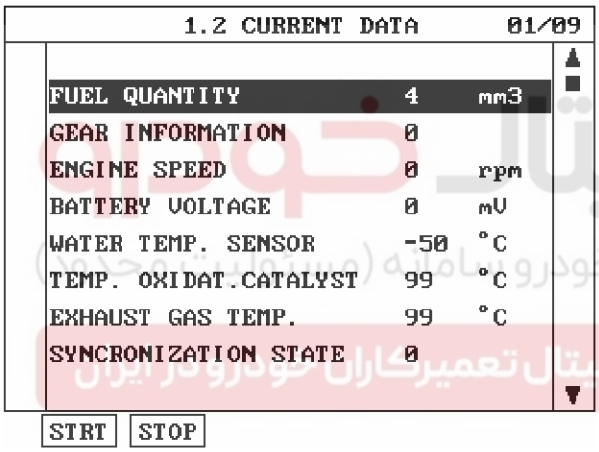
LFIG118A

9. Press "ENTER" key after looking around data memorized in ECM.



LFIG119A

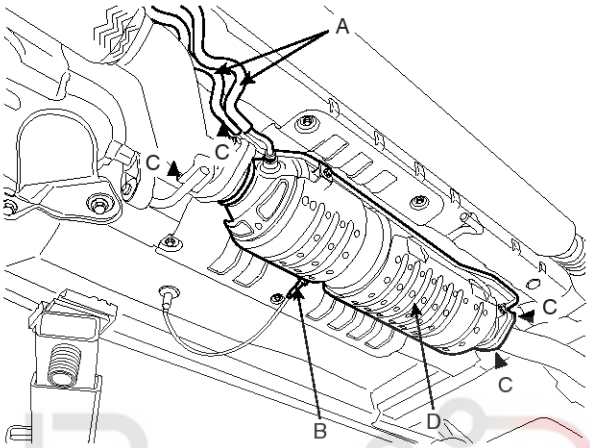
10. Press "STRT" key.



LFIG120A

REMOVAL

1. Turn ignition switch off.
2. Lift the vehicle and support it with a jack.
3. Disconnect the hoses (A) connected with Differential Pressure Sensor (DPS) from the CPF assembly.
4. Disconnect the Exhaust Gas Temperature Sensor (EGTS) #2 connector (B).
5. Unfasten the mounting nuts (C) and remove the CPF (D) from the vehicle.



LFIG121A

INSTALLATION

1. Install the CPF according to the reverse order of "REMOVAL" procedure.

CPF Mounting Nuts: 39.2 ~ 58.9N·m (4.0 ~ 6.0 kgf·m, 28.9 ~ 43.4lbf·ft)

REPLACEMENT

NOTICE

After replacing a CPF, MUST proceed below procedure.

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

```
KIA VEHICLE DIAGNOSIS
MODEL  : SPORTAGE

01. ENGINE CONTROL
02. AUTOMATIC TRANSAXLE
03. BRAKE SYS(ABS/TCS/ESP)
04. SRS-AIRBAG
05. FULL AUTO AIR/CON.
06. 4 WHEEL DRIVE(4WD)
07. IMMOBILIZER
08. BODY ELECTRIC. SYS(ETACS)
```

LFIG103A

5. Select "MANUAL SELECTION MODE".

```
KIA VEHICLE DIAGNOSIS
MODEL  : SPORTAGE
SYSTEM : ENGINE CONTROL

01. AUTO SEARCHING MODE
02. MANUAL SELECTION MODE
```

LFIG104A

6. Select "D 2.0L VGT DIESEL".

```
KIA VEHICLE DIAGNOSIS
MODEL  : SPORTAGE
SYSTEM : ENGINE CONTROL

01. D 2.0L VGT DIESEL
02. 2.0L DIESEL          ALL
03. 2.0L CVVT            EOBD
04. 2.0L CVVT            GEN
05. 2.0L CVVT            LEAD
06. 2.7L V6              EOBD
07. 2.7L V6              GEN
08. 2.7L V6              LEAD
```

LFIG105A

7. Select "COMPONET CHANGE ROUTNE"

```
1.KIA VEHICLE DIAGNOSIS
MODEL  : SPORTAGE
SYSTEM : 2005
         ENGINE CONTROL
04. FLIGHT RECORD
05. ACTUATION TEST
06. SIMU-SCAN
07. ECU INFORMATION
08. INJECTOR CORRECTION
09. CPF SERVICE REGENERATION
10. COMPONENT CHANGE ROUTINE
11. COMPRESSION TEST
```

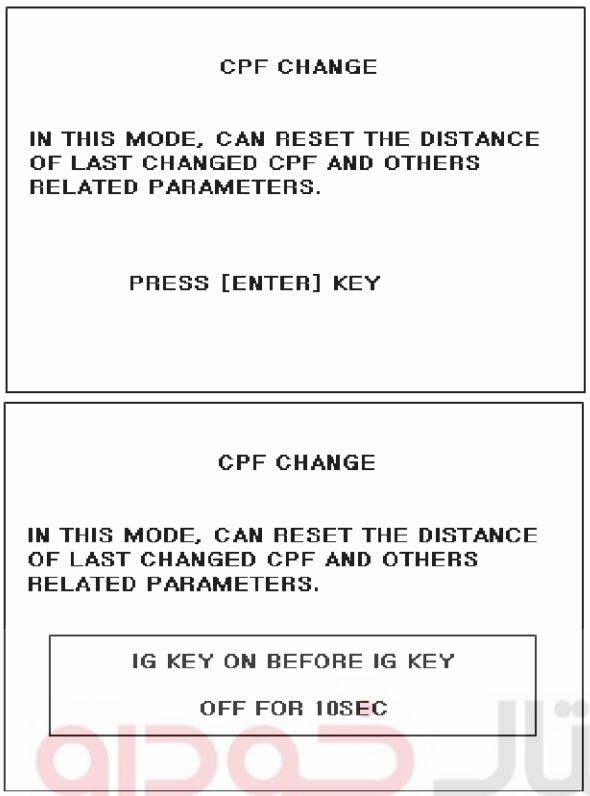
LFIG106A

8. Select "CPF CHANGE".

```
1.10 . COMPONENT CHANGE ROUTINE
MODEL  : SPORTAGE
SYSTEM : 2005
         ENGINE CONTROL
01. ECU CHANGE
02. LAMBDA SENSOR CHANGE
03. RAIL PRESSURE SENSOR CHANGE
04. AIR FLOW SENSOR CHANGE
05. CPF CHANGE
06. D/PRESSURE SENSOR CHANGE
07. SWIRL CONTROL VALVE CHANGE
```

LFIG123A

9. Press "ENTER" key.



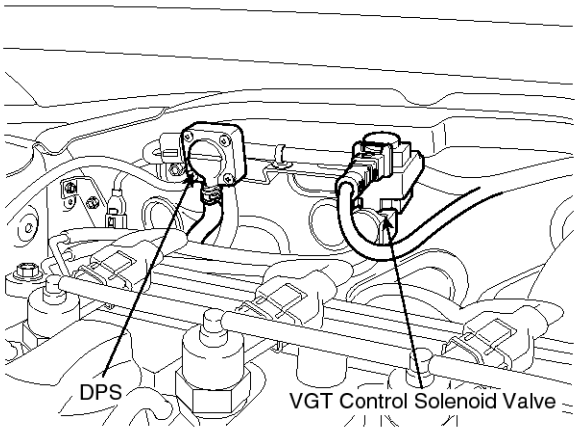
LFIG122A

10. Wait 10 seconds with IG ON.
11. Turn ignition switch off.

CPF Differential Pressure Sensor

INSPECTION

Differential Pressure Sensor (DPS) measures difference pressure between upstream and downstream exhaust gas of CPF. The ECM can calculate quantity of soot deposited in CPF with value from this sensor.



LFIG014A

SPECIFICATION

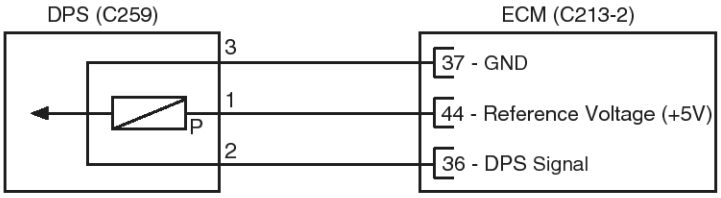
Differential Pressure[ΔP] (kPa)	Output Voltage (V)
0	1.00
10	1.35
20	1.70
30	2.05
40	2.40
50	2.75

Differential Pressure[ΔP] (kPa)	Output Voltage (V)
60	3.10
70	3.45
80	3.80
90	4.15
100	4.50

LFIG068A

CIRCUIT DIAGRAM

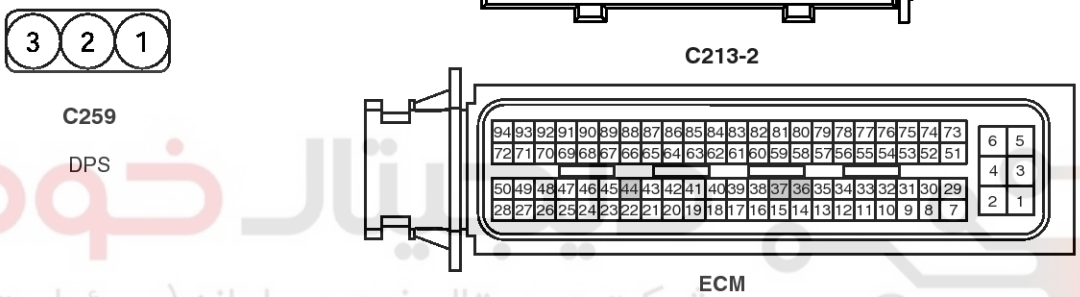
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C213-2 (44)	Reference Voltage (+5V)
2	ECM C213-2 (36)	DPS Signal
3	ECM C213-2 (37)	Sensor ground

[HARNESS CONNECTORS]



LFIG069A

SIGNAL WAVEFORM

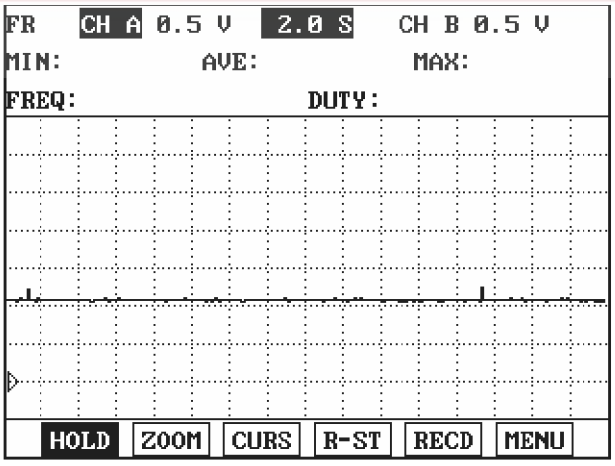


Fig.1

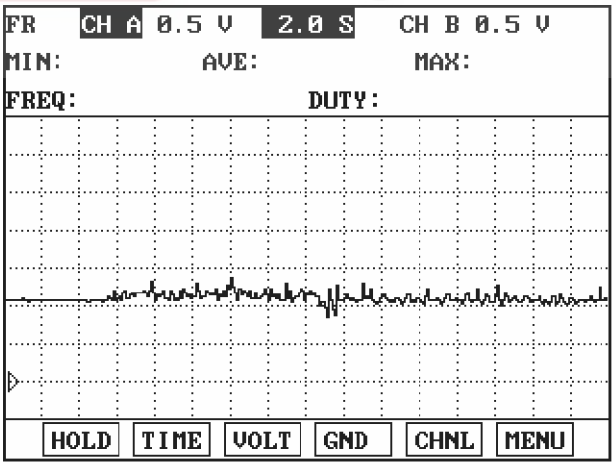


Fig.2

Fig1). This is the signal waveform of DPS at idle state. When CPF is new, 1.0~1.2V is outputted normally.
Fig2). This is the waveform of DPS as accelerating.

LFIG423A

REPLACEMENT

NOTICE

After replacing a Differential Pressure Sensor (DPS), MUST proceed below procedure.

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

```
KIA VEHICLE DIAGNOSIS                    ▼
MODEL   : SPORTAGE

  01. ENGINE CONTROL
  02. AUTOMATIC TRANSAXLE
  03. BRAKE SYS(ABS/TCS/ESP)
  04. SRS-AIRBAG
  05. FULL AUTO AIR/CON.
  06. 4 WHEEL DRIVE(4WD)
  07. IMMOBILIZER
  08. BODY ELECTRIC. SYS(ETACS)
```

LFIG103A

5. Select "MANUAL SELECTION MODE".

```
KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM : ENGINE CONTROL

  01. AUTO SEARCHING MODE
  02. MANUAL SELECTION MODE
```

LFIG104A

6. Select "D 2.0L VGT DIESEL".

```
KIA VEHICLE DIAGNOSIS
MODEL   : SPORTAGE
SYSTEM : ENGINE CONTROL

  01. D 2.0L VGT DIESEL
  02. 2.0L DIESEL              ALL
  03. 2.0L CVVT                EOBD
  04. 2.0L CVVT                GEN
  05. 2.0L CVVT                LEAD
  06. 2.7L V6                  EOBD
  07. 2.7L V6                  GEN
  08. 2.7L V6                  LEAD
```

LFIG105A

7. Select "COMPONET CHANGE ROUTNE"

```
1.KIA VEHICLE DIAGNOSIS                  ▲
MODEL   : SPORTAGE
SYSTEM : 2005
         ENGINE CONTROL
  04. FLIGHT RECORD
  05. ACTUATION TEST
  06. SIMU-SCAN
  07. ECU INFORMATION
  08. INJECTOR CORRECTION
  09. CPF SERVICE REGENERATION
  10. COMPONENT CHANGE ROUTINE
  11. COMPRESSION TEST
```

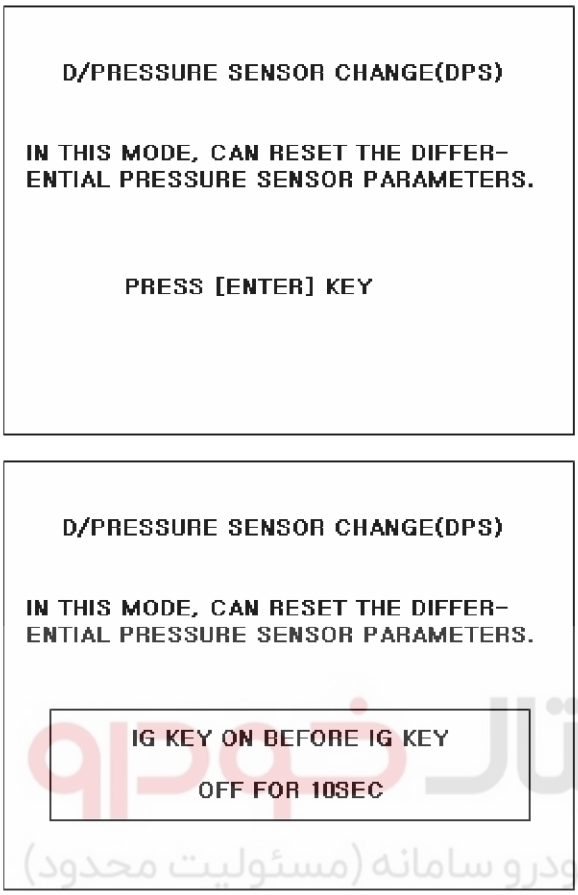
LFIG106A

8. Select "D/PRESSURE SENSOR CHANGE".

```
1.10 . COMPONENT CHANGE ROUTINE
MODEL   : SPORTAGE
SYSTEM : 2005
         ENGINE CONTROL
  01. ECU CHANGE
  02. LAMBDA SENSOR CHANGE
  03. RAIL PRESSURE SENSOR CHANGE
  04. AIR FLOW SENSOR CHANGE
  05. CPF CHANGE
  06. D/PRESSURE SENSOR CHANGE
  07. SWIRL CONTROL VALVE CHANGE
```

LFIG130A

9. Press "ENTER" key.



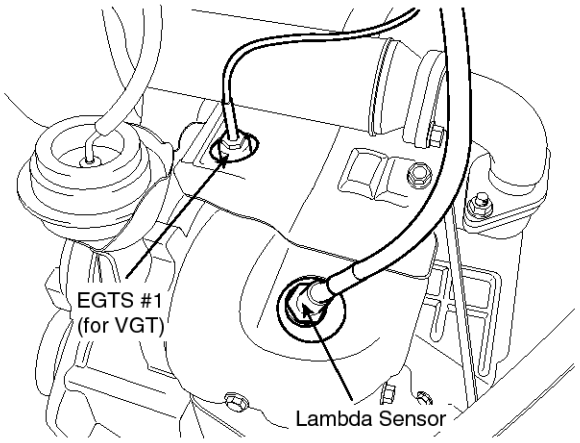
LFIG131A

10. Wait 10 seconds with IG ON.
11. Turn ignition switch off.

Exhaust Gas Temperature Sensor

INSPECTION

Exhaust Gas Temperature Sensor (EGTS) #1 for VGT is installed on exhaust manifold and senses the termperature of exhaust gas flowing into the VGT.



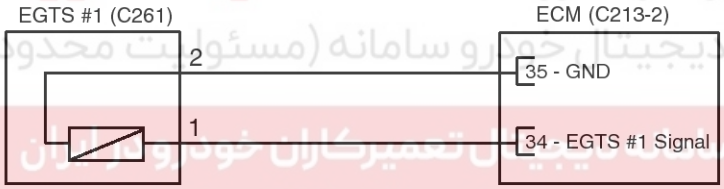
LFIG009A

SPECIFICATION

Temperature [℃(°F)]	Resistance(kΩ)
100(212)	289.0 ~ 481.0
300(572)	5.30 ~ 6.61
600(1,112)	0.35 ~ 0.38
900(1,652)	0.08 ~ 0.09

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

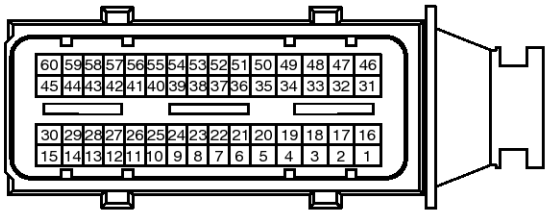
Terminal	Connected to	Function
1	ECM C213-2 (34)	EGTS #1 Signal
2	ECM C213-2 (35)	Sensor ground

[HARNESS CONNECTORS]

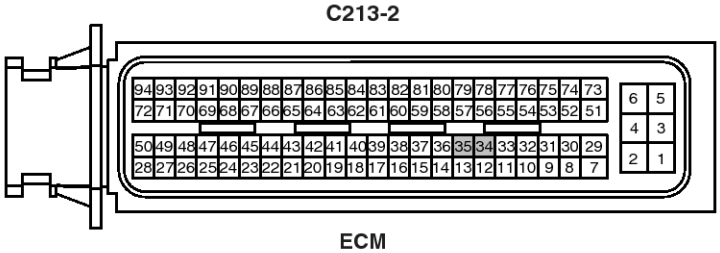
C261

EGTS #1

C213-1



C213-2



ECM

LFIG064A

SIGNAL WAVEFORM

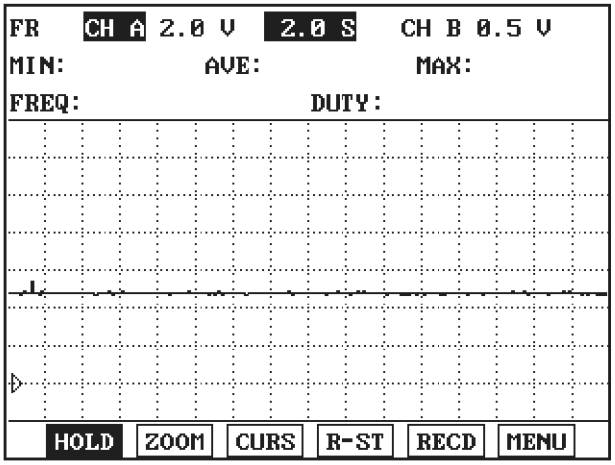


Fig.1

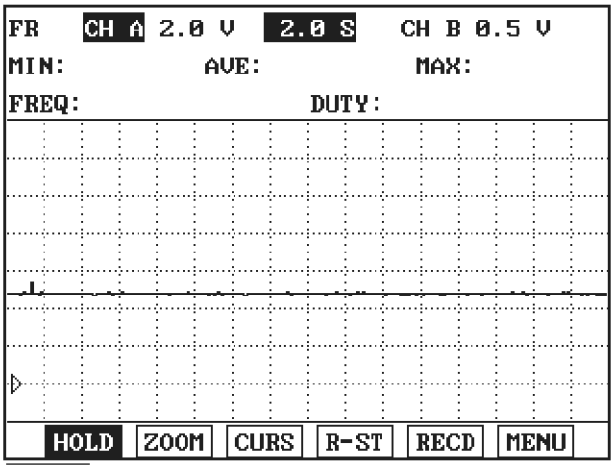


Fig.2

Fig.1) 4.8V is outputted at EGTS(T3-VGT) output signal circuit at IG KEY ON.
Fig.1) 4.8V is outputted at EGTS(T5-CPF) output signal circuit at IG KEY ON.

LFIG448A

COMPONENT INSPECTION

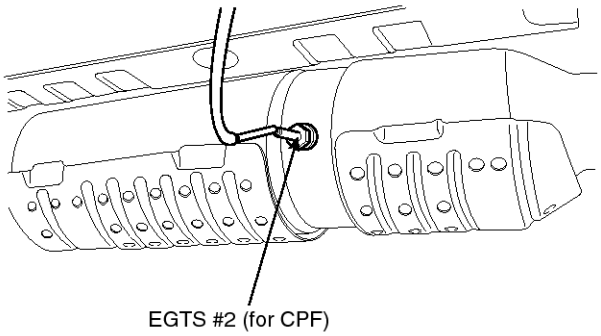
1. Turn ignition switch OFF.
2. Disconnect the exhaust gas temperature sensor #1 connector.
3. Measure resistance between sensor signal terminal and ground terminal.

Specification: Refer to "SPECIFICATION".

INSPECTION

Exhaust Gas Temperature Sensor (EGTS) #2 for CPF is installed on Catalyzed Particulate Filter (CPF) assembly and senses the temperature of exhaust gas flowing into the CPF.

When pre-determined engine condition is set, ECM burns soot gathered in CPF with exhaust gas. At this time, the exhaust gas temperature is an important factor of engine condition.



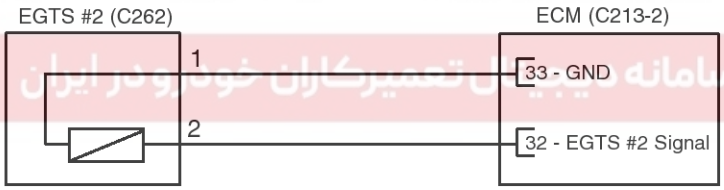
LFIG016A

SPECIFICATION

Temperature [℃(℉)]	Resistance(kΩ)
100(212)	289.0 ~ 481.0
300(572)	5.30 ~ 6.61
600(1,112)	0.35 ~ 0.38
900(1,652)	0.08 ~ 0.09

CIRCUIT DIAGRAM

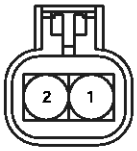
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

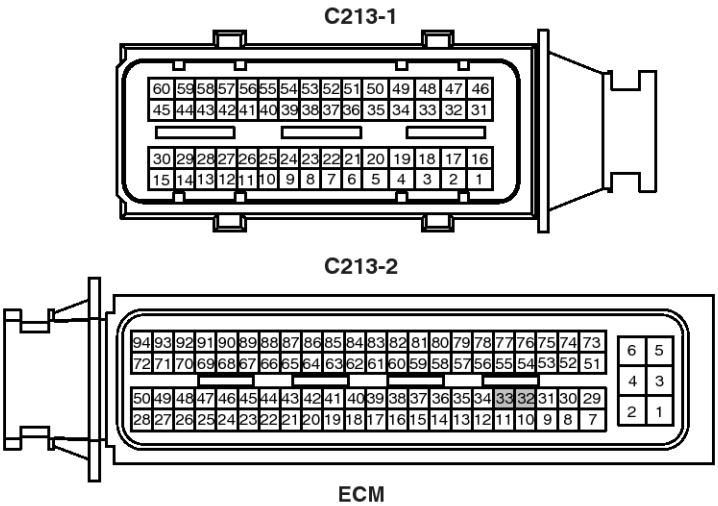
Terminal	Connected to	Function
1	ECM C213-2 (33)	Sensor ground
2	ECM C213-2 (32)	EGTS #2 Signal

[HARNESS CONNECTORS]



C262

EGTS #2



ECM

LFIG066A

SIGNAL WAVEFORM

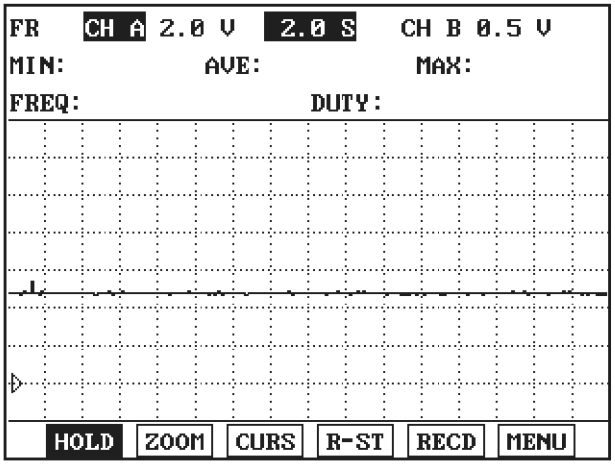


Fig.1

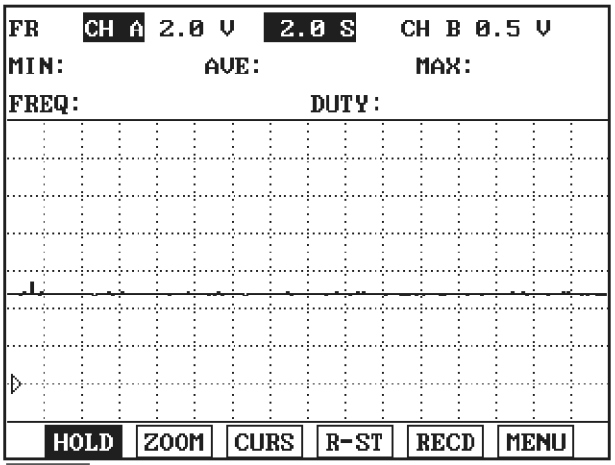


Fig.2

Fig.1) 4.8V is outputted at EGTS(T3-VGT) output signal circuit at IG KEY ON.
Fig.1) 4.8V is outputted at EGTS(T5-CPF) output signal circuit at IG KEY ON.

LFIG448A

COMPONENT INSPECTION

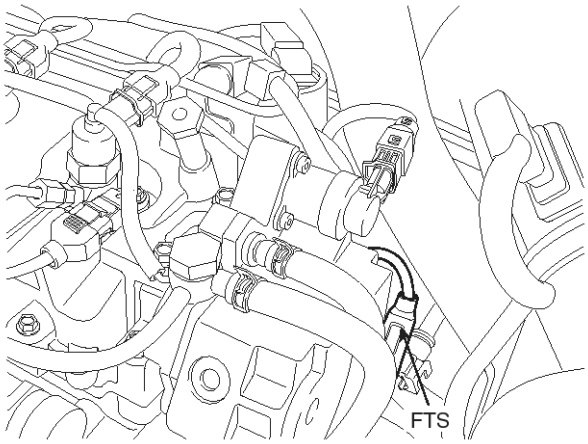
1. Turn ignition switch OFF.
2. Disconnect the exhaust gas temperature sensor #2 connector.
3. Measure resistance between sensor signal terminal and ground terminal.

Specification: Refer to "SPECIFICATION".

Fuel Temperature Sensor (FTS)

INSPECTION

Fuel Temperature Sensor(FTS) is installed in fuel supplying line and senses the termperature of fuel supplied to high pressure pump. Fuel temperature is limmited to protect fuel such as high pressure pump and injectors from damages due to rapid deterioration by vapor-lock which can occur at high temperature or destruction of oil membrance.



LFIG051A

SPECIFICATION

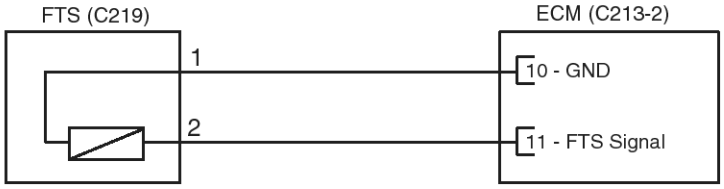
Temperature [℃(°F)]	Resistance (kΩ)
-30 (-22)	27.00
-20 (-4)	15.67
-10 (14)	9.45
0 (32)	5.89
20 (68)	2.27 ~ 2.73

Temperature [℃(°F)]	Resistance (kΩ)
40 (104)	1.17
50 (122)	0.83
60 (140)	0.60
70 (158)	0.43
80 (176)	0.30 ~ 0.32

LFIG052A

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



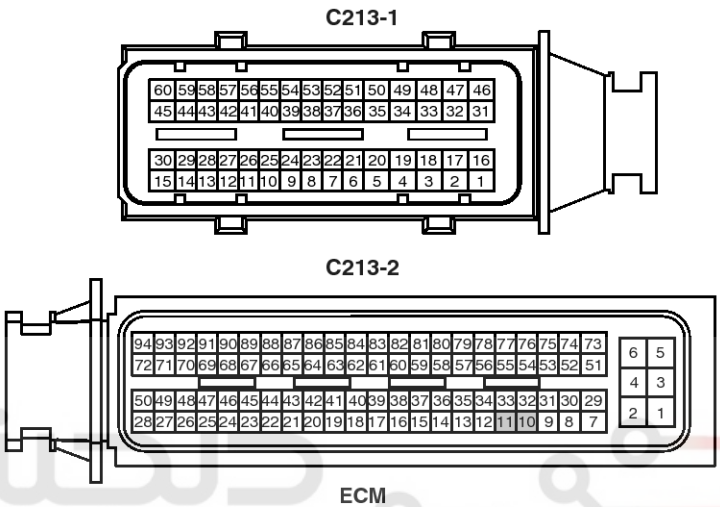
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C213-2 (10)	Sensor ground
2	ECM C213-2 (11)	FTS Signal

[HARNESS CONNECTORS]

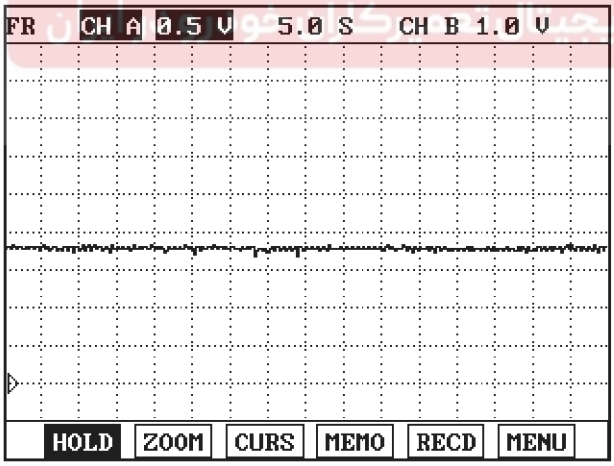
C219

FTS



LFIG053A

SIGNAL WAVEFORM



This illustration shows the waveform of fuel temperature sensor at 50℃.
The higher fuel temperature rises, the lower signal voltage becomes.

LGJF502I

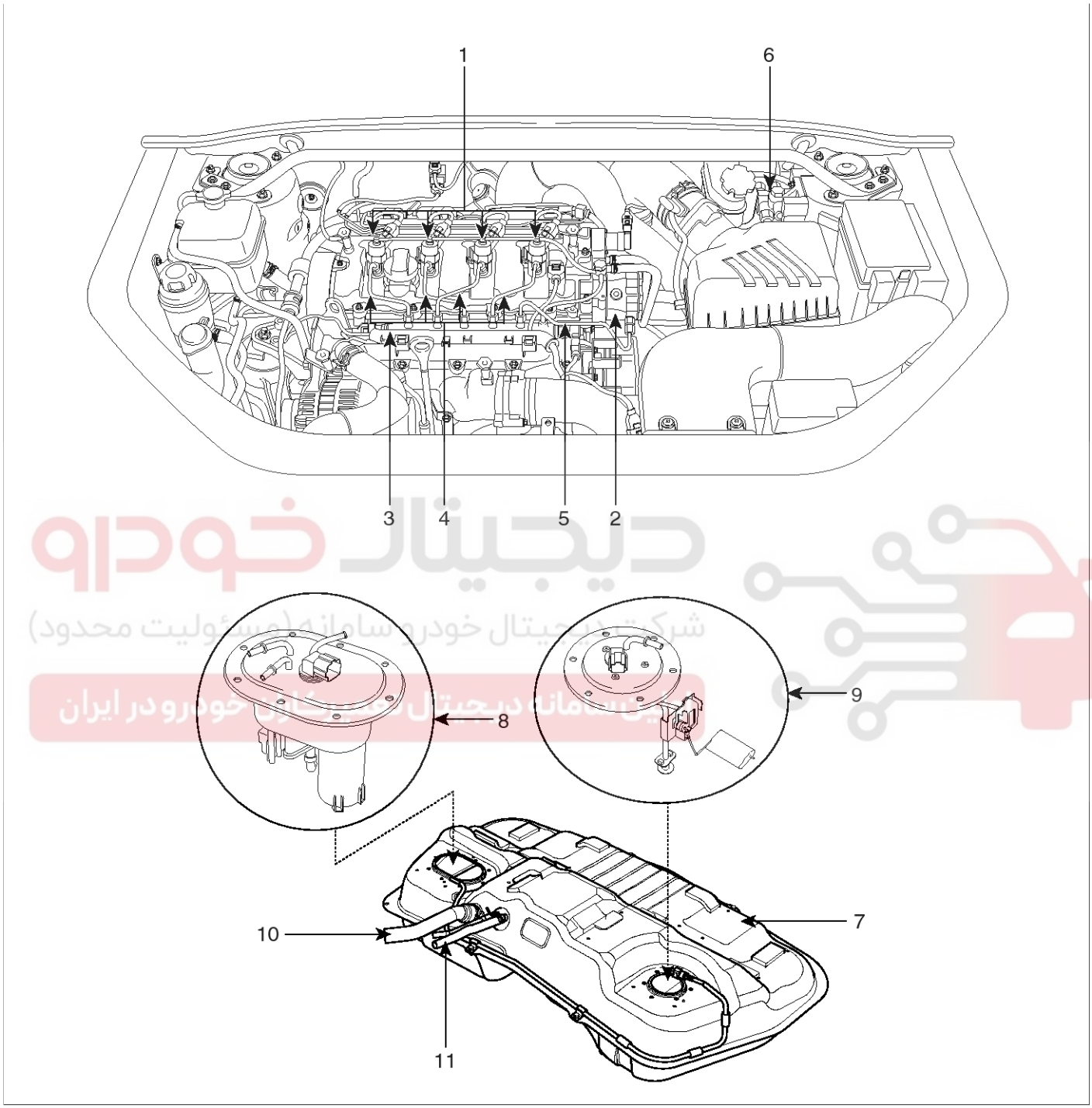
COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect the fuel temperature sensor connector.
3. Measure resistance between sensor signal terminal and ground terminal.

Specification: Refer to "SPECIFICATION".

Fuel Delivery System

COMPONENT LOCATION



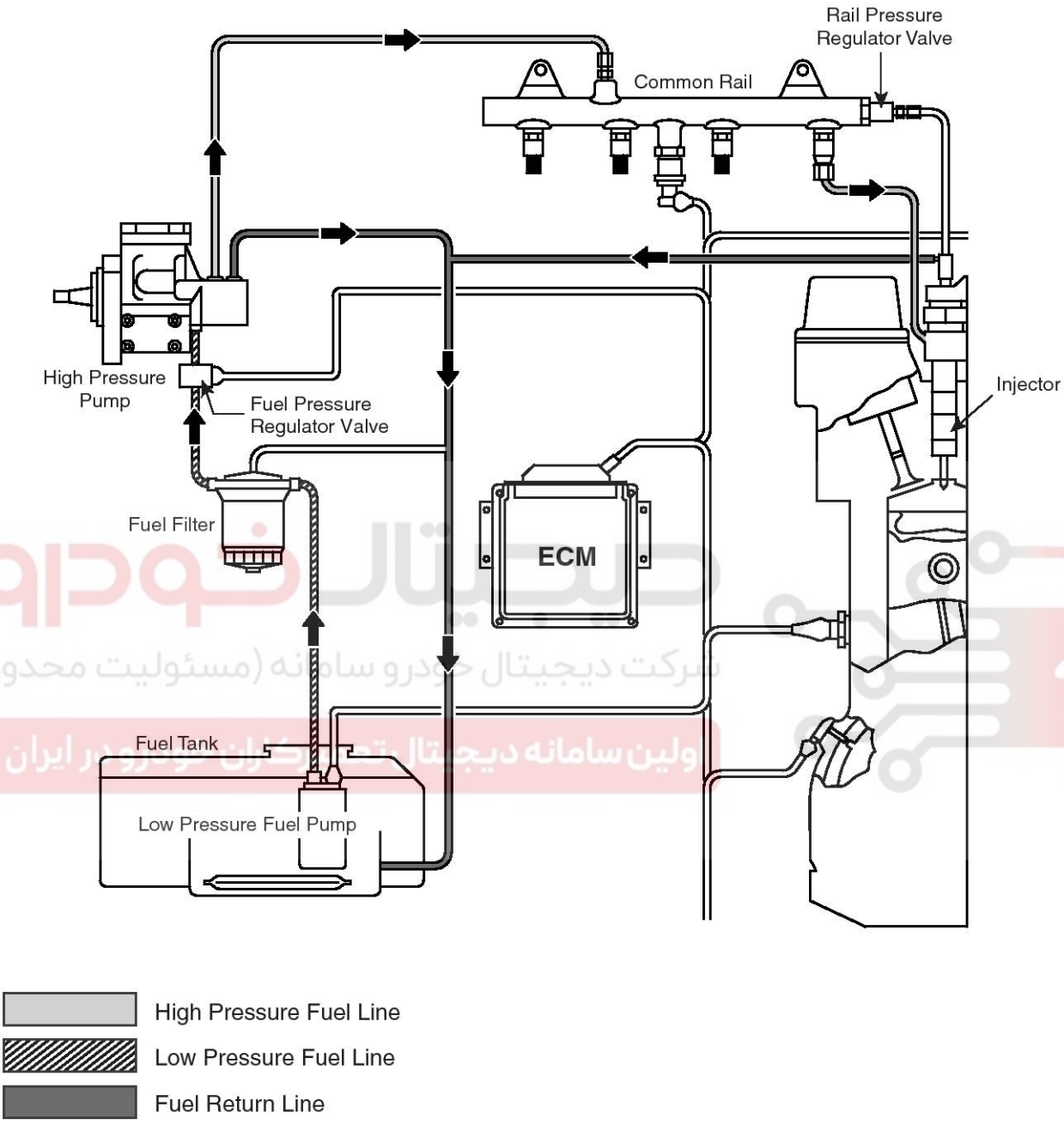
1. Injector
2. High Pressure Fuel Pump
3. Common Rail
4. High Pressure Pipe (Injector → Common Rail)
5. High Pressure Pipe (Common Rail → High Pressure Fuel Pump)
6. Fuel Filter
7. Fuel Tank
8. Fuel Pump (Low Pressure)
9. Sub Fuel Sender
10. Fuel Filler Hose
11. Leveling Hose

LFIG071A

⚠CAUTION

- **Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)**
- **Never perform any work on injection system with engine running or within 30 seconds after the engine stops.**
- **Always pay attention to safety precaution.**
- **Ensure the absolute cleanliness.**
- **It is not recommended to remove the injectors without any notice.**

SCHEMATIC DIAGRAM



LFIG701A

COMPONENTS

The 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 pump.

Inadequate filtering can lead to damage at the pump components, delivery valves, and injector nozzles. The fuel filter cleans the fuel before it reaches the high-pressure pump, and thereby prevents premature wear at the pump's sensitive components.

● HIGH PRESSURE FUEL SYSTEM COMPONENTS

The high-pressure pump pressurizes the fuel to a system pressure of up to 1,600bar. This pressurized fuel then passes through a high-pressure line and into the tubular common rail.

Even after an injector has taken fuel from the rail in order to inject it, the fuel pressure inside the rail remains practically constant. This is due to the accumulator effect arising from the fuel's inherent elasticity. Fuel pressure is measured by the rail pressure sensor and maintained at the desired level by the pressure-control valve.

The nozzles of these injectors open when the solenoid valve is triggered and permit the flow of fuel. They inject the fuel directly into the engine's combustion chamber. The excess fuel which was needed for opening the injector nozzles flows back to the tank through a collector line. The return fuel from the fuel pressure control valve and from the low-pressure stage is also led into this collector line together with the fuel used to lubricate the high-pressure pump.

These High Pressure Pipes carry the high-pressure fuel. They must therefore be able to permanently withstand the maximum system pressure and, during the pauses in injection, the sometimes high-frequency pressure fluctuations which occur. They are therefore manufactured from steel tubing.

Normally, they have an outside diameter of about 6.35mm and an internal diameter of about 3.0mm. The injection lines between the common rail and the injectors must all be of the same length. 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.

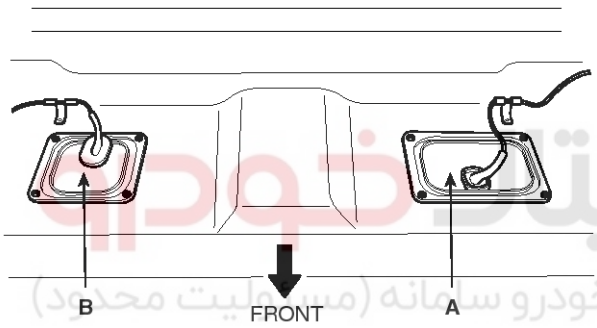
Fuel Tank

REMOVAL

WARNING

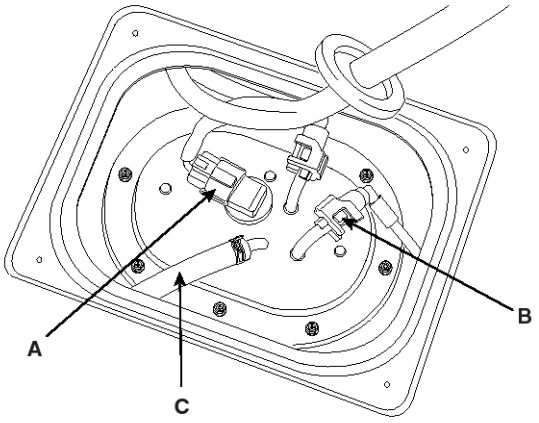
When lifting up or downing the vehicle, be sure to place blocks between the vehicle and lifter to prevent fuel tank from being damaged.

1. Remove the mufflers and the Catalyzed Particulate Filter (CPF) assembly passing under the fuel tank (Refer to group "EM" in this Shop Manual).
2. Remove the propeller-shaft (For 4WD only).
3. Remove the rear seat (Refer to group "BD" in this Shop Manual).
4. Open the service covers (A,B).



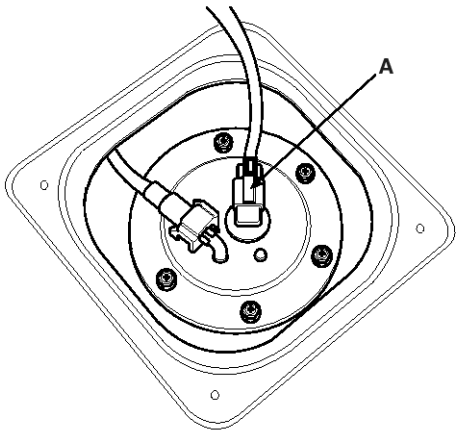
LFIF011L

5. Disconnet the fuel pump connector (A), the fuel feed quick-connector (B) and the return hose (C).



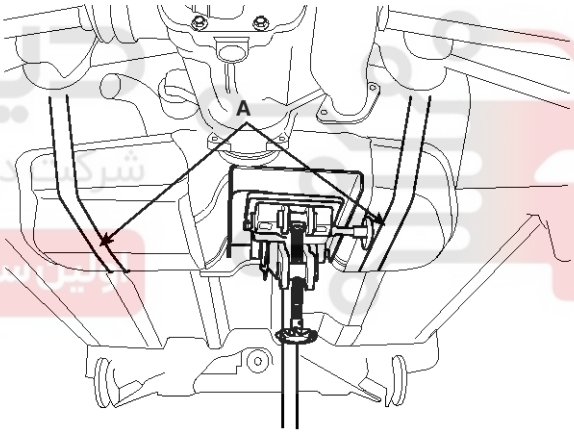
LFIG099A

6. Disconnect the sub fuel sender connector (A).



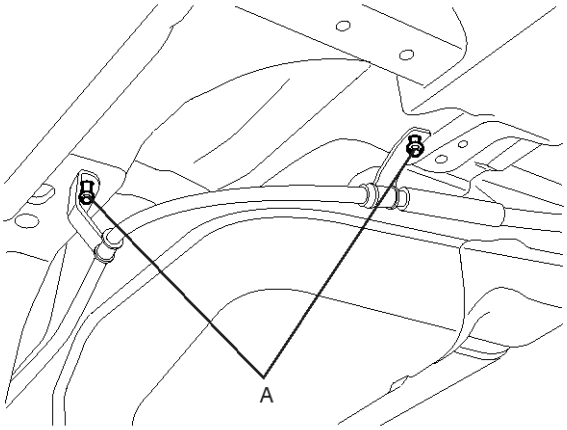
AFIE011K

7. Lift the vehicle and support the fuel tank with a jack, and then remove the two fuel tank band (A).



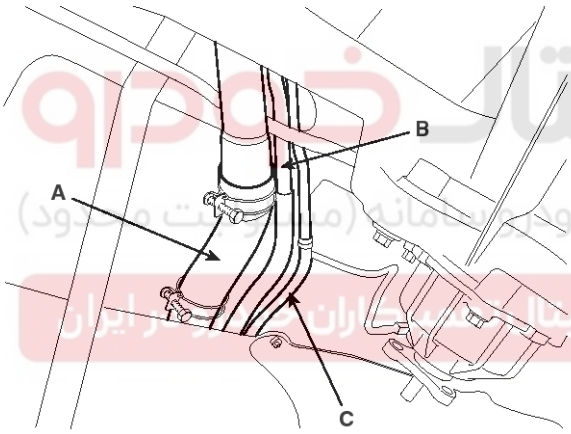
LFIG100A

8. Remove the four parking brake line mounting bolts (A) in LH and RH side.



LFIF011I

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



AFIE011G

10. Remove the fuel tank from the vehicle with setting down the jack.

INSTALLATION

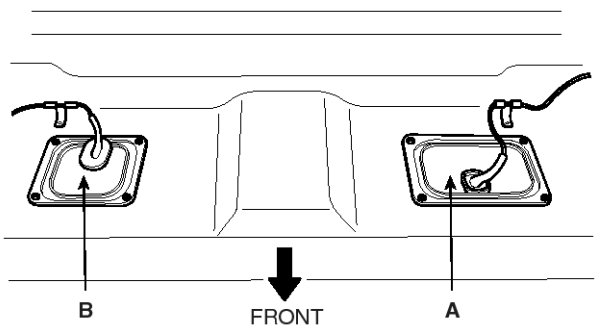
1. Install the fuel tank according to the reverse order of "REMOVAL" procedure.

Fuel tank band mounting bolts: 39.2 ~ 53.9 N·m (4.0 ~ 5.5 kgf·m, 28.9 ~ 39.8 lbf·ft)

Fuel Pump

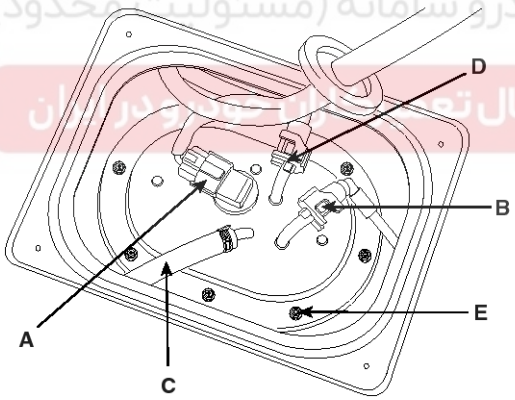
REMOVAL

1. Remove the rear seat (Refer to group "BD" in this Shop Manual).
2. Open the service cover (A).



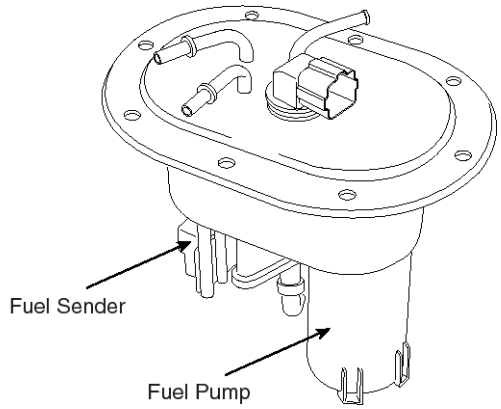
LFIF011L

3. Disconnet the fuel pump connector (A), the fuel feed hose quick-connector (B), the return hose (C) and the suction hose quick-connector (D).



AFIE011M

4. Unscrewing the mounting bolts (E) and remove the fuel pump assembly.



LFIF011N

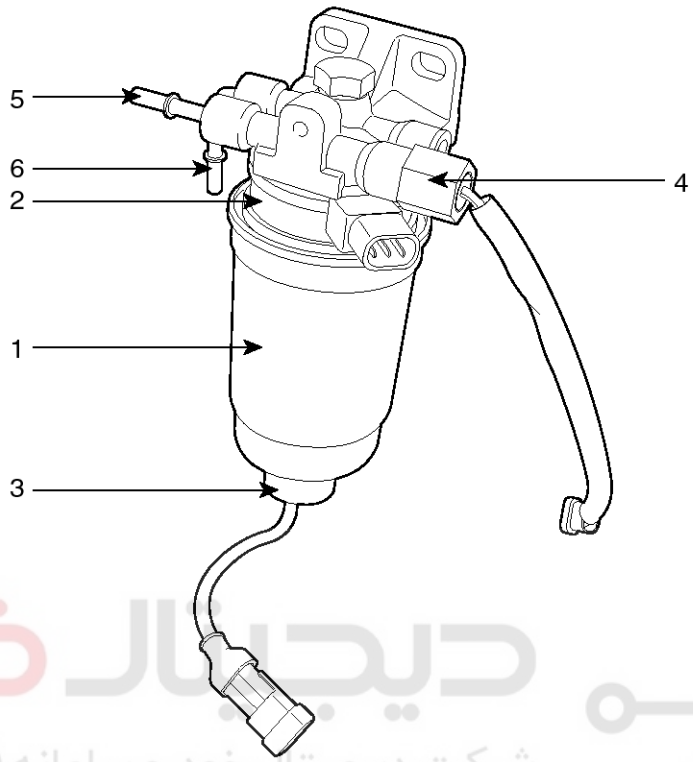
INSTALLATION

1. Install the fuel pump assembly according to the reverse order of "REMOVAL" procedure.

Fuel pump mounting bolts: 2.0 ~ 2.9 N·m (0.2 ~ 0.3 kgf·m, 1.4 ~ 2.2 lbf·ft)

Fuel Filter

COMPONENTS

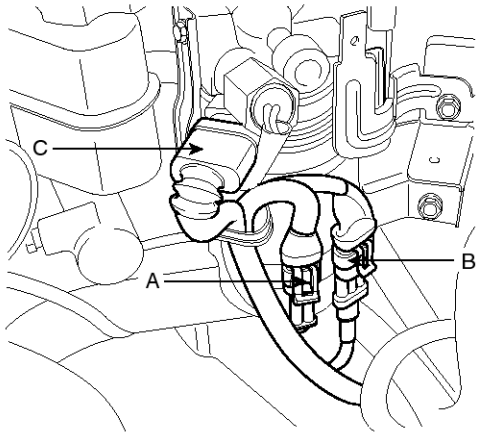


1. Fuel Filter
2. Heater
3. Water Sensor
4. Thermostat
5. Nipple (From Fuel Tank)
6. Nipple (To High Pressure Pump)

LFIG072A

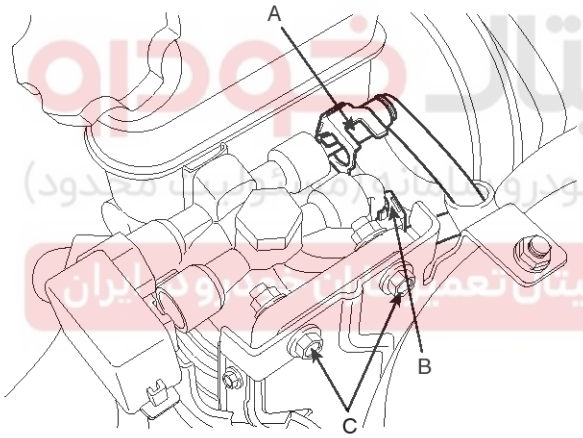
REMOVAL

1. Disconnect the thermostat connector (A), the water sensor connector (B) and the heater connector (C).



LFIG073A

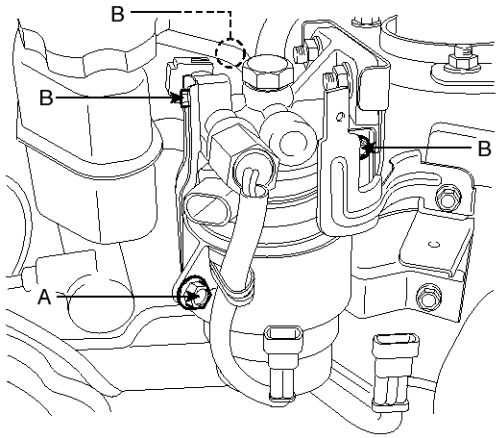
2. Disconnet the fuel input quick-connector (A) and the output connector (B).



LFIG074A

3. Unscrew the mounting bolts (C).

4. After loosening the fastening bolt (A), remove the fuel filter with unscrewing the three bolts (B) in fuel filter assembly.



LFIG075A

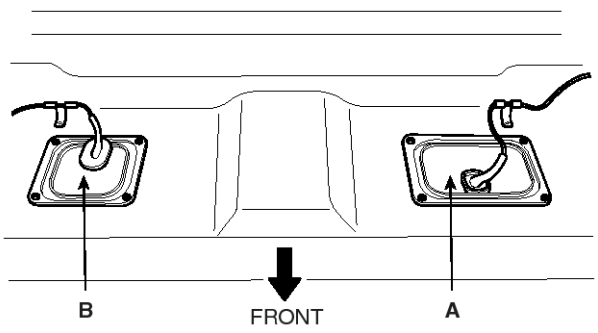
INSTALLATION

1. Install the fuel filter according to the reverse order of "REMOVAL" procedure.

Sub Fuel Sender

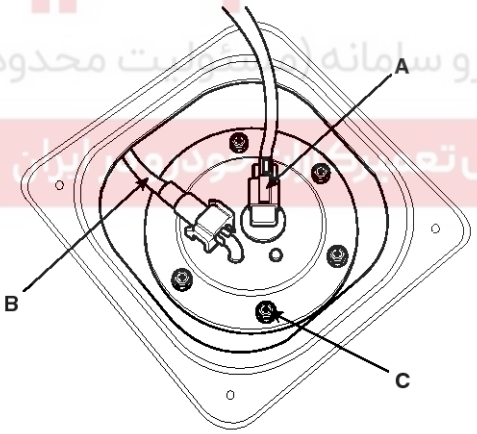
REMOVAL

1. Remove the rear seat (Refer to group "BD" in this Shop Manual).
2. Open the service covers (B).



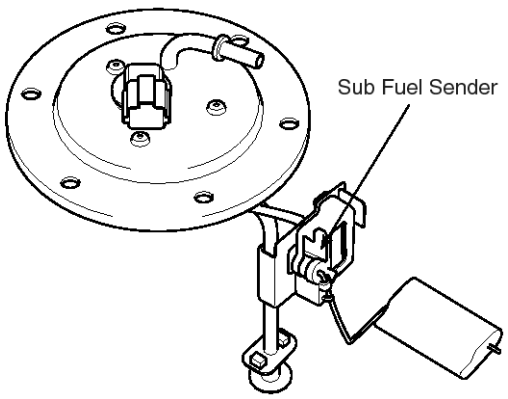
LFIF011L

3. Disconnet the sub fuel sender connector (A) and the suction hose quick-connector (B).



AFIE011O

4. Unscrewing the mounting bolts (C) and remove the sub fuel sender.



LFIF011P

INSTALLATION

1. Install the sub fuel sender according to the reverse order of "REMOVAL" procedure.

Sub fuel sender mounting bolts: 2.0 ~ 2.9 N·m (0.2 ~ 0.3 kgf·m, 1.4 ~ 2.2 lbf·ft)

Common Rail

DESCRIPTION

In order to comply with the wide variety of engine installation conditions, the common rail with its flow limiters and the provistions for attaching rail pressure sensor, fuel pressure control valve, and pressure limiter valve is available in a number of different designs.

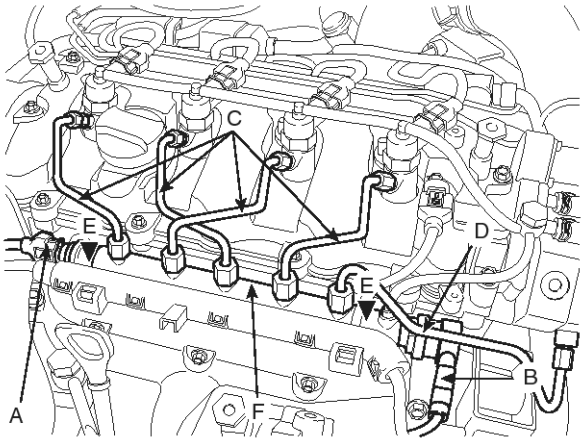
The available common rail volume is permanently filled with pressurized fuel. The compressibility of the fuel resulting from the high pressure is utilized to achieve the accumulator effect. When fuel leaves the rail for injection, the pressure variations resulting from the pulsating fuel supply from the high-pressure pump are compensated for.

REMOVAL

WARNING

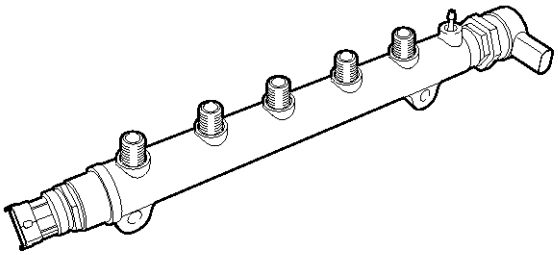
- **Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)**
- **Never perform any work on injection system with engine running or within 30 seconds after the engine stops.**
- **Always pay attention to safety precaution.**
- **Ensure the absolute cleanliness.**
- **It is not recommended to remove the injectors without any notice.**

1. Disconnect the rail pressure sensor connector (A) and rail pressure regulator valve connector (B).



LFIG082A

2. Disconnect the high pressure pipe (C) connecting the injectors with the common rail.
3. Disconnect the high pressure pipe (D) connecting the common rail with the high pressure fuel pump.
4. Unscrew the two mounting bolts (E) and remove the common rail (F).



LFIG083A

INSTALLATION

1. Install the common rail according to the reverse order of "REMOVAL" procedure.

NOTICE

When installing the high pressure pipe, apply the specified tightening torques to the flange nuts of the injectors, the high pressure pipe, and the common rail side with SST (Refer to below table).

Item	Dimension	SST No.
Flange Nut (Injector Side)	14 mm (0.551 in)	09314-27110
Flange Nut (HP Pump Side)		
Flange Nut (Common Rail Side)	17 mm (0.669 in)	09314-27120

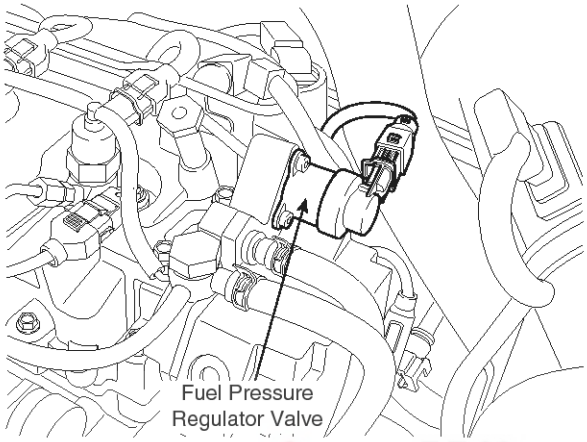
· Common rail mounting bolts: 19.6 ~ 26.5 N·m (2.0 ~ 2.7 kgf·m, 14.5 ~ 19.5 lbf·ft)
· High pressure pipe flange nuts (Injectors ↔ Common Rail): 24.5 ~ 28.4 N·m (2.5 ~ 2.9 kgf·m, 18.1 ~ 20.1 lbf·ft)
· High pressure pipe flange nuts (Common Rail ↔ HP Pump): 24.5 ~ 28.4 N·m (2.5 ~ 2.9 kgf·m, 18.1 ~ 20.1 lbf·ft)

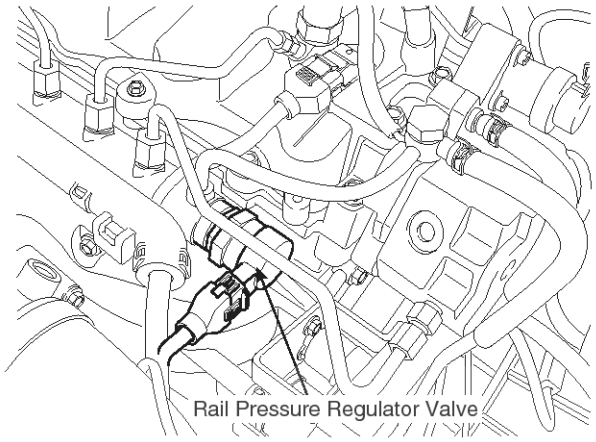
Fuel Pressure Control Valve

INSPECTION

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail 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.





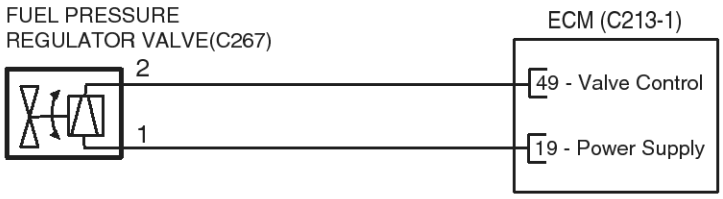
LFIG114A

SPECIFICATION

Items	Specification
Coil Resistance (Ω)	2.9 ~ 3.15Ω [20℃(68°F)]

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



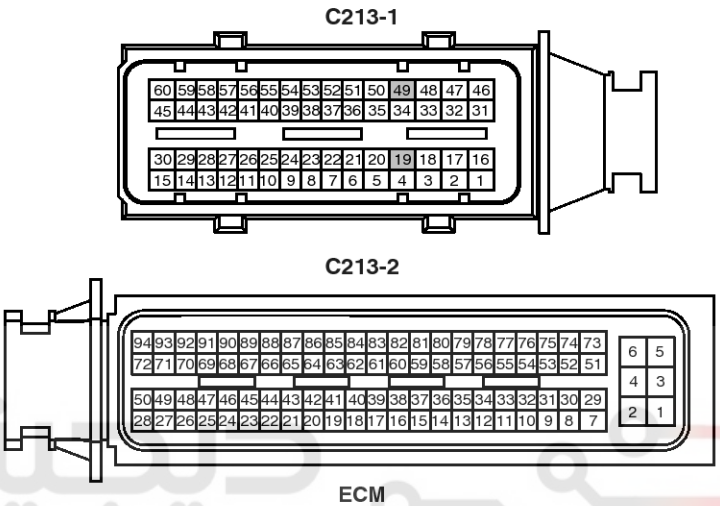
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM C213-1 (19)	Battery Voltage (B+)
2	ECM C213-1 (49)	Valve Control

[HARNESS CONNECTORS]

C267

FUEL PRESSURE REGULATOR VALVE



LFIG055A

SIGNAL WAVEFORM

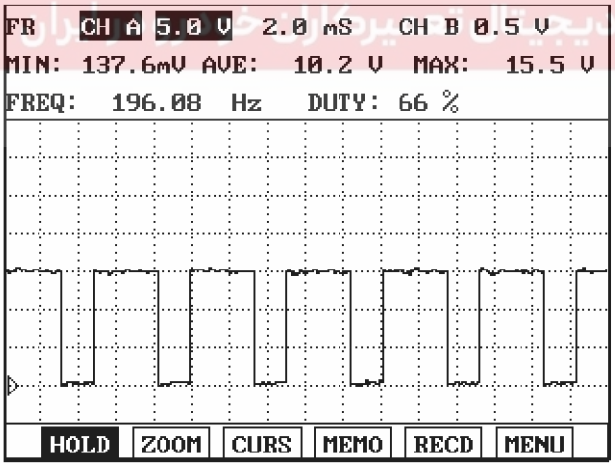


Fig.1

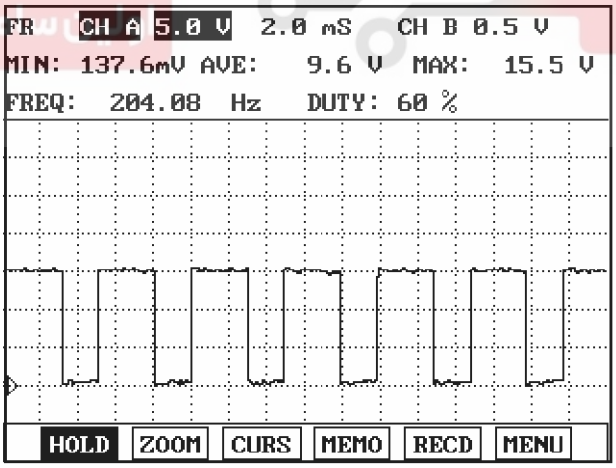


Fig.2

Fig.1) Waveform of fuel pressure regulator valve at idle. It shows approx. 34% duty((-)duty).
Fig.2) Waveform of fuel pressure regulator valve as accelerating. approx. 38% duty((-)duty) is outputted as engine load increases.

LFIG396A

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.

Specification: Refer to "SPECIFICATION".

High Pressure Pump

DESCRIPTION

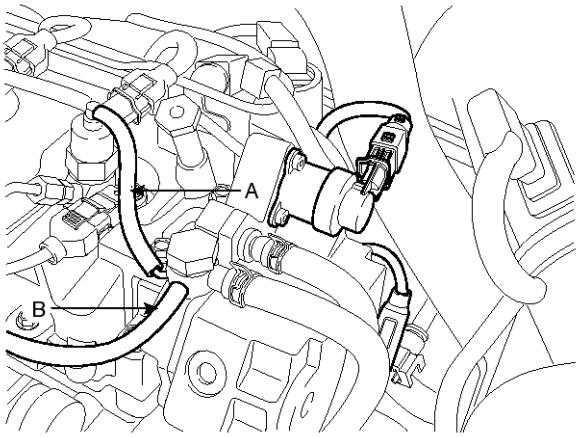
The high-pressure pump is the interface between the low pressure and the high-pressure stages. Under all operating conditions, it is responsible for providing adequate high-pressure fuel through out the vehicle's complete service life. This also includes the provision of extra as needed for rapid starting and for rapid build-up of pressure in the rail. The high pressure pump continually generates the system pressure as needed in the high-pressure accumulator (common rail). This means therefore, that in contrast to conventional systems, the fuel does not have to be specially compressed for each individual injection process.

REMOVAL

WARNING

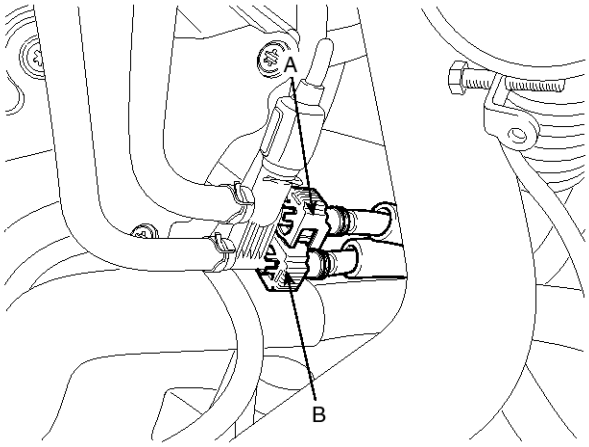
- **Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)**
- **Never perform any work on injection system with engine running or within 30 seconds after the engine stops.**
- **Always pay attention to safety precaution.**
- **Ensure the absolute cleanliness.**
- **It is not recommended to remove the injectors without any notice.**

1. Remove the air cleaner assembly (Refer to group "EM" in this Shop Manual).
2. Disconnect the return hoses (A,B) connected with the injectors and the common rail.



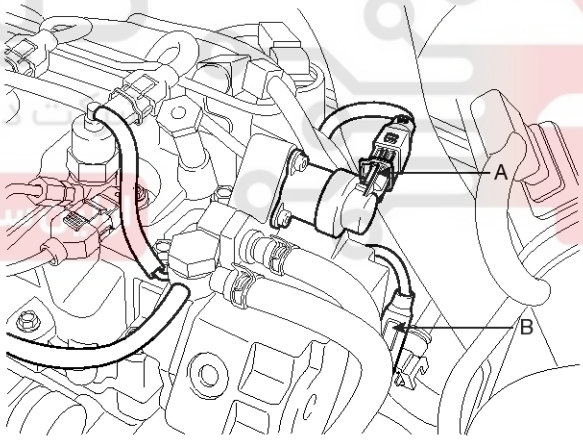
LFIG076A

3. Disconnet the fuel feed hose quick-connector (A) and the return hose quick-connector (B).



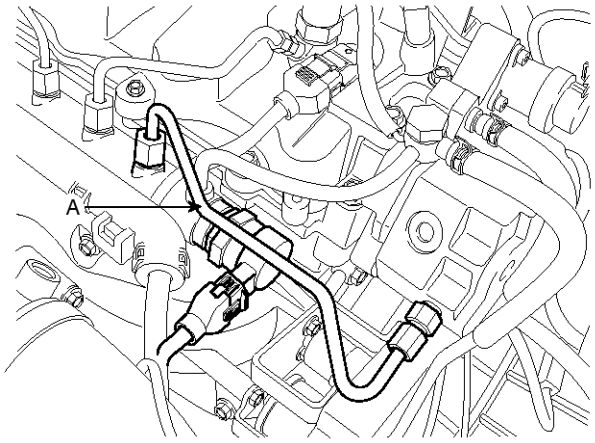
LFIG077A

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



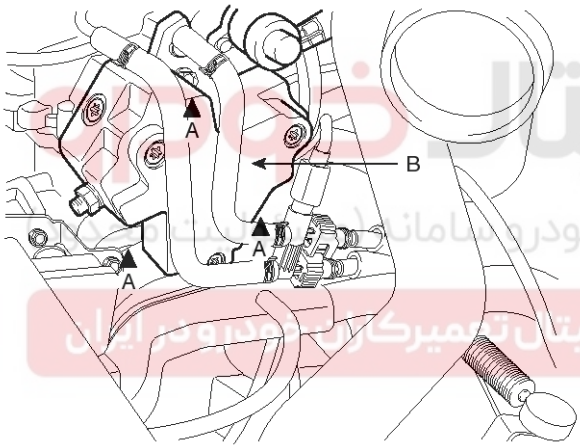
LFIG078A

5. Disconenct the high pressure pipe (A) connecting the common rail with the high pressure pump.

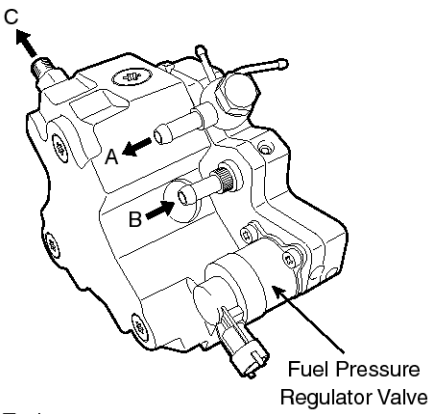


LFIG079A

6. Unscrew the mounting bolts (A) and remove the high pressure fuel pump (B) from the engine.



LFIG080A



A : To Fuel Tank (Return Line)
B : From Fuel Tank
C : To High Pressure Fuel Pump

LFIG081A

INSTALLATION

1. Install the high pressure fuel pump according to the reverse order of "REMOVAL" procedure.

NOTICE

When installing the high pressure pipe, apply the specified tightening torques to the flange nuts of the high pressure pipe side and the common rail side with SST (Refer to below table).

Item	Dimension	SST No.
Flange Nut (HP Pump Side)	14 mm (0.551 in)	09314-27110
Flange Nut (Common Rail Side)	17 mm (0.669 in)	09314-27120

High pressure fuel pump mounting bolts: 19.6 ~ 26.5 N·m (2.0 ~ 2.7 kgf·m, 14.5 ~ 19.5 lbf·ft)
High pressure pipe flange nuts (Common Rail ↔ HP Pump): 24.5 ~ 28.4 N·m (2.5 ~ 2.9 kgf·m, 18.1 ~ 20.1 lbf·ft)

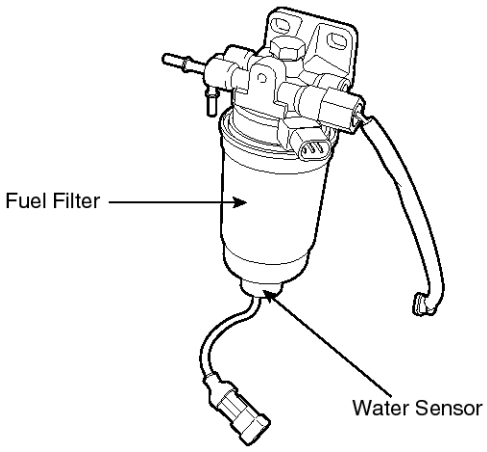
Water Sensor

INSPECTION

Water Sensor is installed on bottom end of fuel filter and detects presence of water in fuel. When the water level reaches the lower level of the upper electrode, the "WATER" lamp in cluster should flash. If the water level decreases below the lower electrode, the lamp should turn off.

NOTICE

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



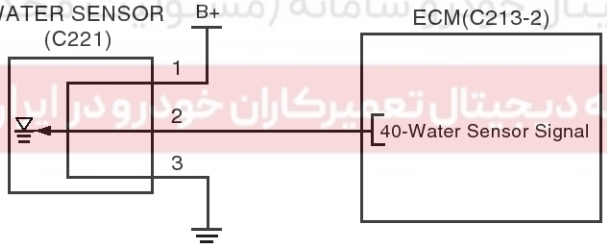
LFIG019A

SPECIFICATION

Items	Specification
Warning Level of Water Presence (cc)	40 ~ 60

CIRCUIT DIAGRAM

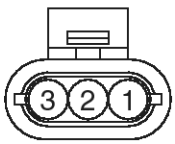
[CIRCUIT DIAGRAM]



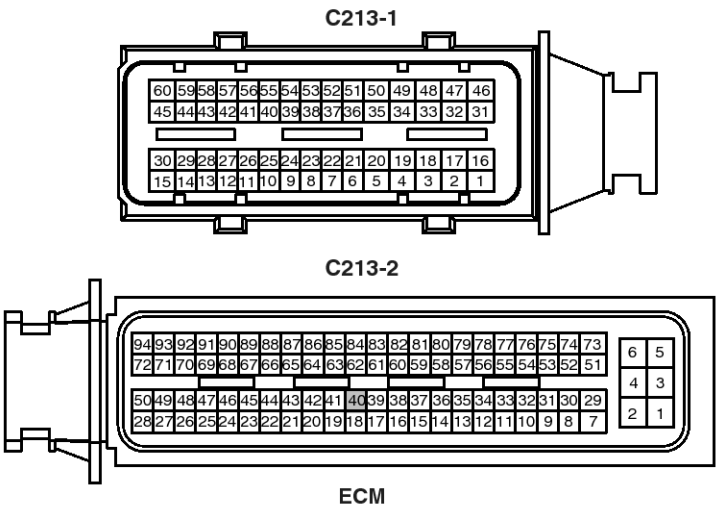
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Main Relay	Battery voltage(B+)
2	ECM C213-2 (40)	Sensor Signal
3	Chassis ground	Sensor ground

[HARNESS CONNECTOR]



C221
WATER SENSOR



ECM

LFIG060A