GENESIS COUPE(BK) > 2013 > G 3.8 GDI > Fuel System

Fuel System > General Information > Specifications

Specifications

Fuel Delivery System

Items	Specification	
Fuel Tank	Capacity	65 lit. (17.2 U.S.gal., 68.7 U.S.qt., 57.2 Imp.qt.)
Fuel Filter	Type	Paper type
Fuel Pressure	Low Pressure Fuel Line	480 ~ 520 kPa (4.9 ~ 5.3 kgf/cm², 69.6 ~ 75.4 psi)
	High Pressure Fuel Line	2.0 ~ 15.0 MPa (20.0 ~ 152.9 kgf/cm², 290.0 ~ 2175.0 psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor
High Pressure Fuel Pump	Type	Mechanical type
	Driven by	Camshaft

Sensors

Barometric Pressure Sensor (BPS)

Type: Piezo-resistive pressure sensor

Specification

Pressure (kPa)	Output Voltage (V)
10.0	0.50
55.0	2.21
100.0	3.93
115.0	4.50

Intake Air Temperature Sensor (IATS)

Type: Thermistor type

Specification

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

Manifold Absolute Pressure Sensor (MAPS)

Type: Piezo-resistive pressure sensor

Specification

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

Engine Coolant Temperature Sensor (ECTS)

Type: Thermistor type

Specification

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

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

Type: Hall IC Non-contact sensor type

Specification

Throttle angle(°)	Output Voltage (V)	
	TPS1	TPS2
0	0.5	4.5
10	0.96	4.05
20	1.41	3.59
30	1.87	3.14
40	2.32	2.68
50	2.78	2.23
60	3.23	1.77
70	3.69	1.32
80	4.14	0.86
90	4.6	0.41
98	4.65	0.35
C.T (0)	0.5	4.5
W.O.T (86)	4.41	0.59

Crankshaft Position Sensor (CKPS)

Type: Magnetic field sensitive sensor

Specification

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

Camshaft Position Sensor (CMPS)

Type: Hall effect type

Specification

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

Knock Sensor (KS)

Type: Piezo-electricity type

Specification

Item	Specification
Capacitance (pF)	950 ~ 1,350
Resistance (MΩ)	4.87

Heated Oxygen Sensor (HO2S)

Type: Zirconia (ZrO2) Type

Specification

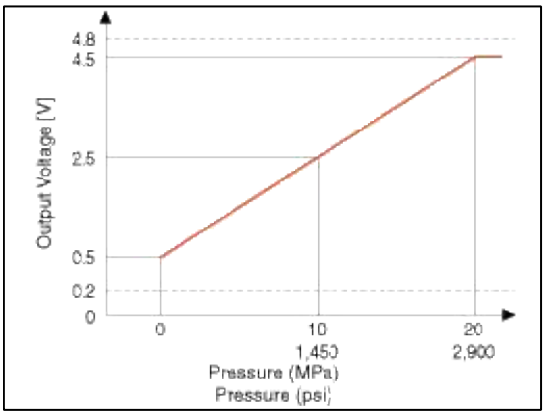
A/F Ratio (λ)	Output Voltage(V)
RICH	Min. 0.8
LEAN	Max. 0.1

Item	Specification
Heater Resistance (Ω)	3.3 ~ 4.1[20°C(68°F)]

Rail Pressure Sensor (RPS)

Type: Piezo-electricity type

Specification



CVVT Oil Temperature Sensor (OTS)

Type: Thermistor type

Specification

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

Accelerator Position Sensor (APS)

Type: Variable resistor type

Specification

Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.7 ~ 0.8	0.33 ~ 0.43
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

Fuel Tank Pressure Sensor (FTPS)
Type: Piezo - Resistivity type
Specification

Pressure (kPa)	Output Voltage (V)
-6.67	0.5
0	2.5
+6.67	4.5

Actuators

Injector
Specification

Item	Specification
Coil Resistance (Ω)	0.98 ~ 1.14 [20°C(68°F)]

ETC Motor [integrated into ETC Module]
Specification

Item	Specification
Coil Resistance (Ω)	0.3 ~ 100 [20°C(68°F)]

Purge Control Solenoid Valve (PCSV)
Specification

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

CVVT Oil Control Valve (OCV)
Specification

Item	Specification
Coil Resistance (Ω)	9.4 ~ 10.4 [20°C(68°F)]

Ignition Coil
Type: Stick type
Specification

Item	Specification
Primary Coil Resistance (Ω)	0.62 ± 10 [20°C(68°F)]
Secondary Coil Resistance (kΩ)	7.0 ± 15 [20°C(68°F)]

Fuel Pressure Control Valve (FPCV)

Specification

Item	Specification
Coil Resistance (Ω)	1.04 ~ 1.27 [23°C(73.4°F)]

Canister Close Valve (CCV)

Specification

Item	Specification
Coil Resistance (Ω)	23.0 ~ 26.0 [20°C(68°F)]

Service Standard

Item		Specification	
Ignition Timing (°)		BTDC 7° ± 10°	
Idle Speed (rpm)	A/C OFF	Neutral, N, P-range	600 ± 100
		D-range	600 ± 100
	A/C ON	Neutral, N, P-range	600 ± 100
		D-range	600 ± 100

Tightening Torques

Engine Control System

Item	kgf.m	N.m	lb-ft
ECM installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
ECM bracket installation bolt / nut	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
IDB installation bolt / nut	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
IDB bracket installation bolt / nut	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Barometric pressure sensor installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Engine coolant temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Manifold absolute pressure sensor installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Crankshaft position sensor installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2

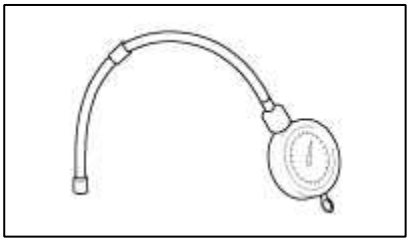
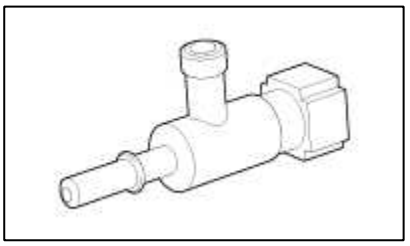
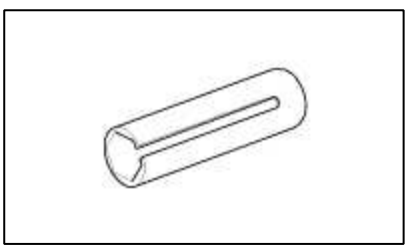
Camshaft position sensor (Bank 1/Intake) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 1/Exhaust) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 2/Intake) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 2/Exhaust) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Knock sensor #1 (Bank 1) installation bolt	1.6 ~ 2.4	15.7 ~ 23.5	11.6 ~ 17.4
Knock sensor #2 (Bank 2) installation bolt	1.6 ~ 2.4	15.7 ~ 23.5	11.6 ~ 17.4
Heated oxygen sensor (Bank 1 / sensor 1) installation	3.6 ~ 4.6	35.3 ~ 45.1	26.0 ~ 33.3
Heated oxygen sensor (Bank 1 / sensor 2) installation	3.6 ~ 4.6	35.3 ~ 45.1	26.0 ~ 33.3
Heated oxygen sensor (Bank 2 / sensor 1) installation	3.6 ~ 4.6	35.3 ~ 45.1	26.0 ~ 33.3
Heated oxygen sensor (Bank 2 / sensor 2) installation	3.6 ~ 4.6	35.3 ~ 45.1	26.0 ~ 33.3
Rail pressure sensor installation	3.0 ~ 3.5	29.4 ~ 34.3	21.7 ~ 25.3
CVVT oil temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Electronic throttle body installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Purge control solenoid valve bracket installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
CVVT oil control valve (Bank 1 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 2 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 2 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil condenser installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Fuel tank pressure snesor installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Canister close valve installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Fuel pump resister installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7

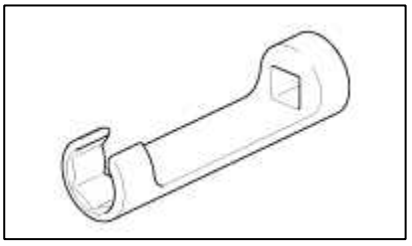
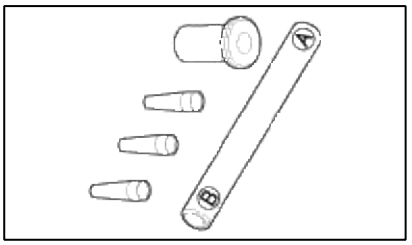
Fuel Delivery System

Item	kgf.m	N.m	lb-ft
Fuel tank band installation nut	4.0 ~ 5.5	39.2 ~ 54.0	28.9 ~ 39.8
Fuel pump installation bolt	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Sub fuel sender installation bolt	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Filler-neck assembly installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Filler-neck assembly installation nut	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Accelerator pedal module installation bolt	0.9 ~ 1.4	8.8 ~ 13.7	6.5 ~ 10.1
Delivery pipe installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
High pressure fuel pipe bracket installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
High pressure fuel pump installation bolt	1.3 ~ 1.5	12.8 ~ 14.7	9.4 ~ 10.9
High pressure fuel pipe installation nut	3.0 ~ 3.6	29.4 ~ 35.3	21.7 ~ 26.0

Fuel System > General Information > Special Service Tools

Special Service Tools

Item	Illustration	Application
Fuel Pressure Gauge (09353-24100)		Measuring the fuel line pressure
Fuel Pressure Gauge Adapter (09353-02100)		Connection between the high pressure fuel pump and the fuel feed line
Heated Oxygen Sensor Socket Wrench (09392-2H100)		Removal and installation of the heated oxygen sensor

Torque Wrench Socket (17mm) (09314-3V100)		Removal and installation of the high pressure fuel pipe
Injector Combustion Seal Guide & Sizing tool (09353-2B000)		Installation of the injector combustion seal

Fuel System > General Information > Troubleshooting

Basic Troubleshooting

Basic Troubleshooting Guide

1	**Bring Vehicle to Workshop**

2	**Analyze Customer's Problem**

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

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

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

NOTE

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

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

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

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

WARNING

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

6	**Inspect Vehicle Visually**

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

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

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

8	**Confirm Symptoms of Problem**

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

9	**Recreate (Simulate) Symptom**

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

10	**Check the DTC**

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

11	**Perform Troubleshooting Procedure for DTC**
12	**Adjust or repair the vehicle**
13	**Confirmation test**
14	**END**

Customer Problem Analysis Sheet

1. VEHICLE INFORMAITON

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

2. SYMPTOMS

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

3. ENVIRONMENT

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

4. MIL/DTC

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

5. ECM/PCM INFORMATION

ECM/PCM Part No.	
ROM ID	

Basic Inspection Procedure

Measuring Condition of Electronic Parts' Resistance

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

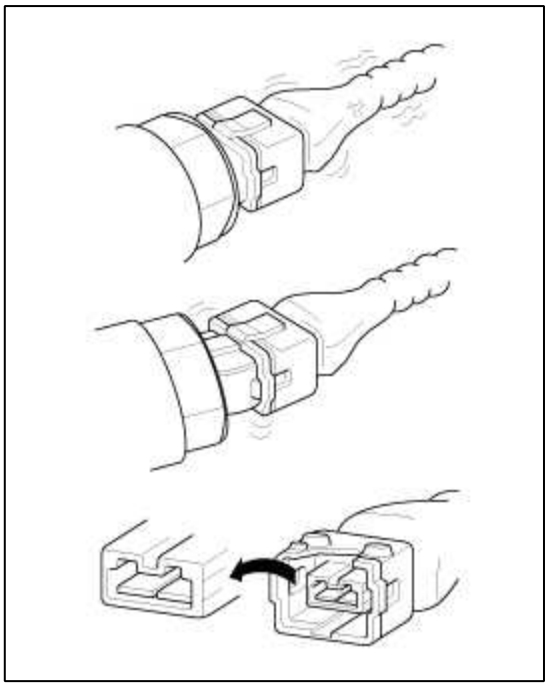
NOTE

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

Intermittent Problem Inspection Procedure

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

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



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

1) Sensors and Actuators
: Slightly vibrate sensors, actuators or relays with finger.

> WARNING
>
> Strong vibration may break sensors, actuators or relays

2) Connectors and Harness
: Lightly shake the connector and wiring harness vertically and then horizontally.

● Simulating Heat

1) 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

1) 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.

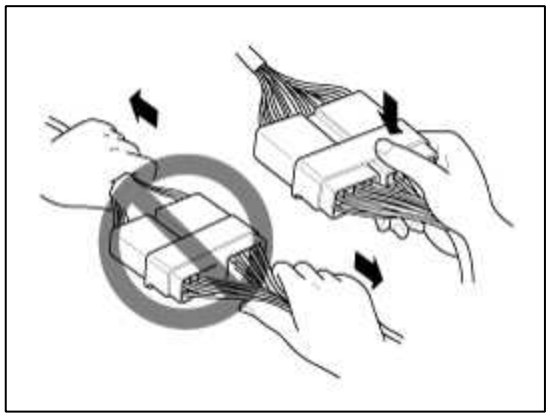
● Simulating Electrical Load

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

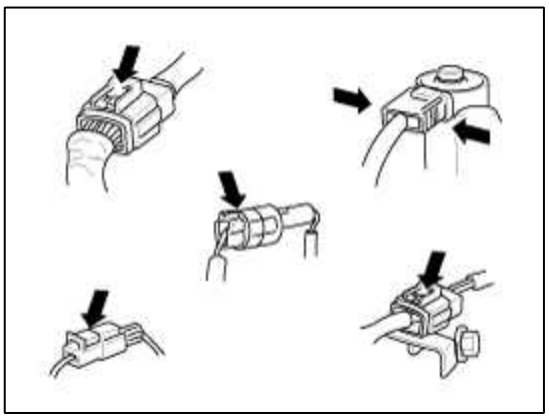
Connector Inspection Procedure

1. Handling of Connector

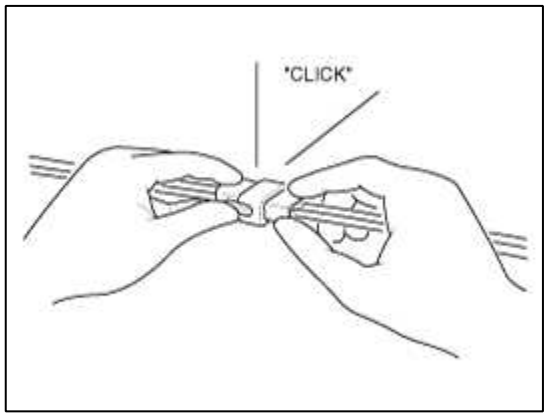
A. Never pull on the wiring harness when disconnecting connectors.



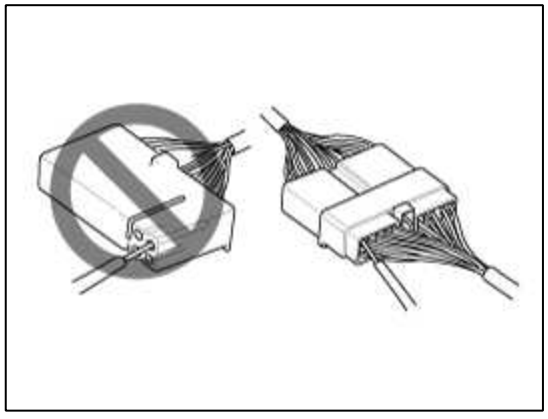
B. When removing the connector with a lock, press or pull locking lever.



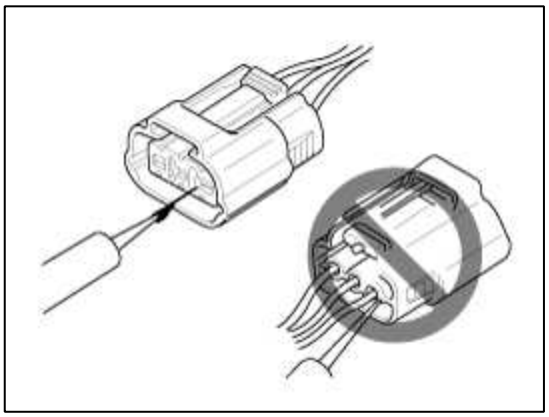
C. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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



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



NOTE

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

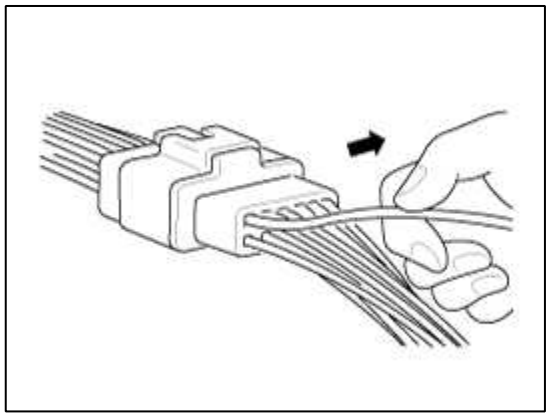
2. Checking Point for Connector

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.



3. Repair Method of Connector Terminal

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

NOTE

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

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

Wire Harness Inspection Procedure

1. Before removing the wire harness, check the wire harness position and crimping in order to restore it correctly.
2. Check whether the wire harness is twisted, pulled or loosened.
3. Check whether the temperature of the wire harness is abnormally high.
4. Check whether the wire harness is rotating, moving or vibrating against the sharp edge of a part.

5. Check the connection between the wire harness and any installed part.
6. If the covering of wire harness is damaged; secure, repair or replace the harness.

Electrical Circuit Inspection Procedure

● Check Open Circuit

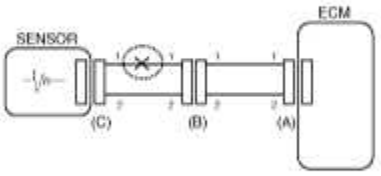
1. Procedures for Open Circuit

A. Continuity Check

B. 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



2. Continuity Check Method

NOTE

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

Specification (Resistance)

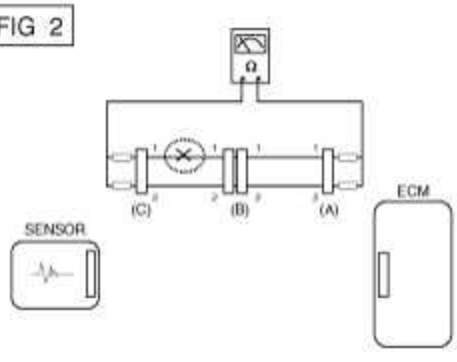
1Ω or less → Normal Circuit

1MΩ or Higher → Open Circuit

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

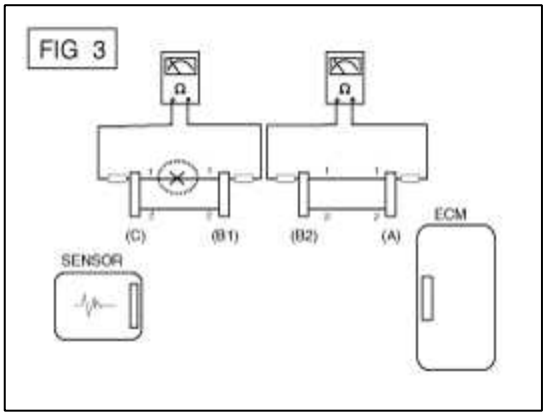
In [FIG.2.] the measured resistance of line 1 and 2 is higher than 1MΩ and below 1 Ω respectively. Specifically the open circuit is line 1 (Line 2 is normal). To find exact break point, check sub line of line 1 as described in next step.

FIG 2



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).

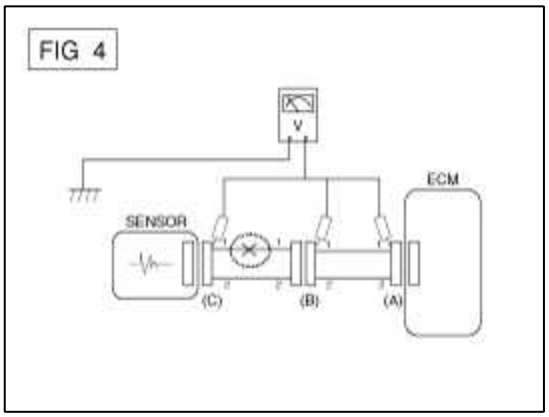
FIG 3



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



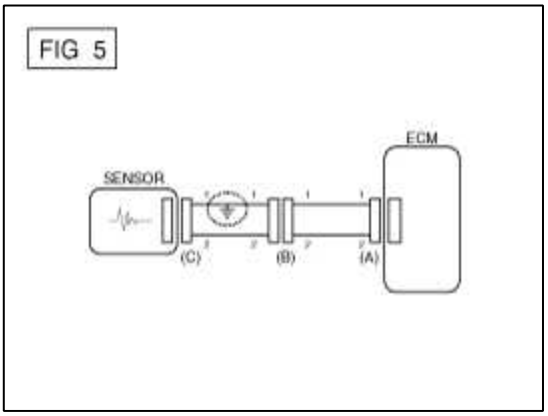
● Check Short Circuit

1. Test Method for Short to Ground Circuit

A. 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



2. Continuity Check Method (with Chassis Ground)

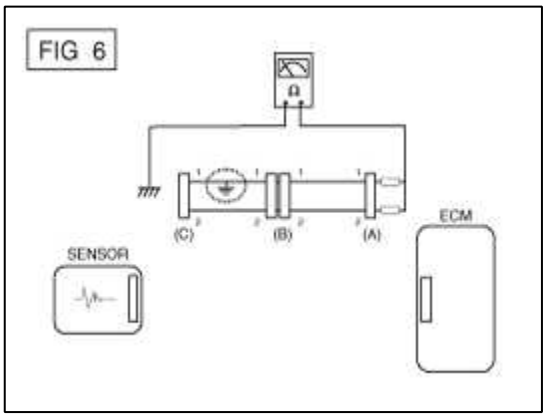
NOTE

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

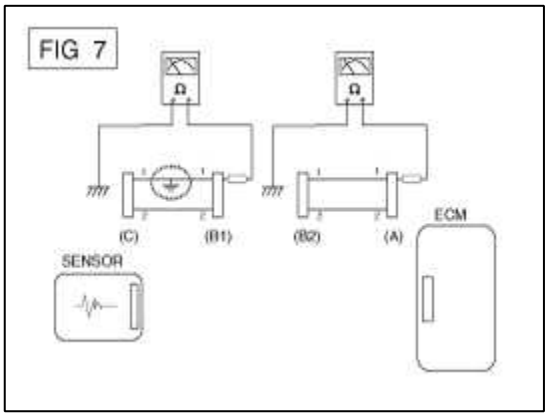
A. Disconnect connectors (A), (C) and measure for resistance between connector (A) and Chassis Ground as shown in [FIG. 6].
The measured resistance of line 1 and 2 in this example is below 1 Ω and higher than 1MΩ respectively. Specifically the short to ground circuit is line 1 (Line 2 is normal). To find exact broken point, check the sub line of line 1 as described in the following step.

FIG 6



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).

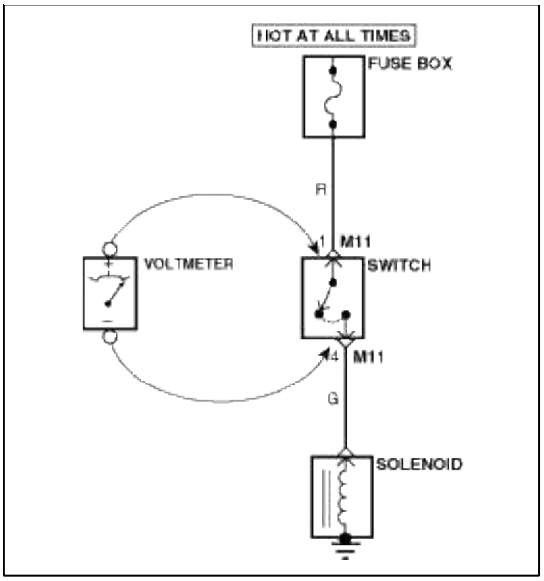
FIG 7



● Testing For Voltage Drop

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

1) Connect the positive lead of a voltmeter to the end of the wire (or to the side of the connector or switch) closest to the battery.
2) Connect the negative lead to the other end of the wire. (or the other side of the connector or switch)
3) Operate the circuit.
4) The voltmeter will show the difference in voltage between the two points. A difference, or drop of more than 0.1 volts (50mV in 5V circuits), may indicate a problem. Check the circuit for loose or dirty connections.



Symptom Troubleshooting Guide Chart

Main symptom	Diagnostic procedure	Also check for
Unable to start (Engine does not turn over)	1. Test the battery 2. Test the starter 3. Inhibitor switch (A/T) or clutch start switch (M/T)	
Unable to start (Incomplete combustion)	1. Test the battery 2. Check the fuel pressure 3. Check the ignition circuit 4. Troubleshooting the immobilizer system (In case of immobilizer lamp flashing)	• DTC • Low compression • Intake air leaks • Slipped or broken timing belt • Contaminated fuel
Difficult to start	1. Test the battery 2. Check the fuel pressure 3. Check the ECT sensor and circuit (Check DTC) 4. Check the ignition circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor idling (Rough, unstable or incorrect Idle)	1. Check the fuel pressure 2. Check the Injector 3. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM) 4. Check the idle speed control circuit (Check DTC) 5. Inspect and test the Throttle Body 6. Check the ECT sensor and circuit (Check DTC)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Engine stall	1. Test the Battery 2. Check the fuel pressure 3. Check the idle speed control circuit (Check DTC) 4. Check the ignition circuit 5. Check the CKPS Circuit (Check DTC)	• DTC • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor driving (Surge)	1. Check the fuel pressure 2. Inspect and test Throttle Body	• DTC

	3. Check the ignition circuit 4. Check the ECT Sensor and Circuit (Check DTC) 5. Test the exhaust system for a possible restriction 6. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM)	• Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Knocking	1. Check the fuel pressure 2. Inspect the engine coolant 3. Inspect the radiator and the electric cooling fan 4. Check the spark plugs	• DTC • Contaminated fuel
Poor fuel economy	1. Check customer's driving habitsIs · A/C on full time or the defroster mode on? · Are tires at correct pressure? · Is excessively heavy load being carried? · Is acceleration too much, too often? 2. Check the fuel pressure 3. Check the injector 4. Test the exhaust system for a possible restriction 5. Check the ECT sensor and circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Hard to refuel (Overflow during refueling)	1. Test the canister close valve 2. Inspect the fuel filler hose/pipe · Pinched, kinked or blocked? · Filler hose is torn 3. Inspect the fuel tank vapor vent hose between the EVAP. canister and air filter 4. Check the EVAP. canister	• Malfunctioning gas station filling nozzle (If this problem occurs at a specific gas station during refueling)

Fuel System > Engine Control System > Description and Operation

OBD-II review

1. Overview

The California Air Resources Board (CARB) began regulation of On Board Diagnostics (OBD) for vehicles sold in California beginning with the 1988 model year. The first phase, OBD-I, required monitoring of the fuel metering system, Exhaust Gas Recirculation (EGR) system and additional emission related components. The Malfunction Indicator Lamp (MIL) was required to light and alert the driver of the fault and the need for repair of the emission control system. Associated with the MIL was a fault code or Diagnostic Trouble Code (DTC) idenfying the specific area of the fault.

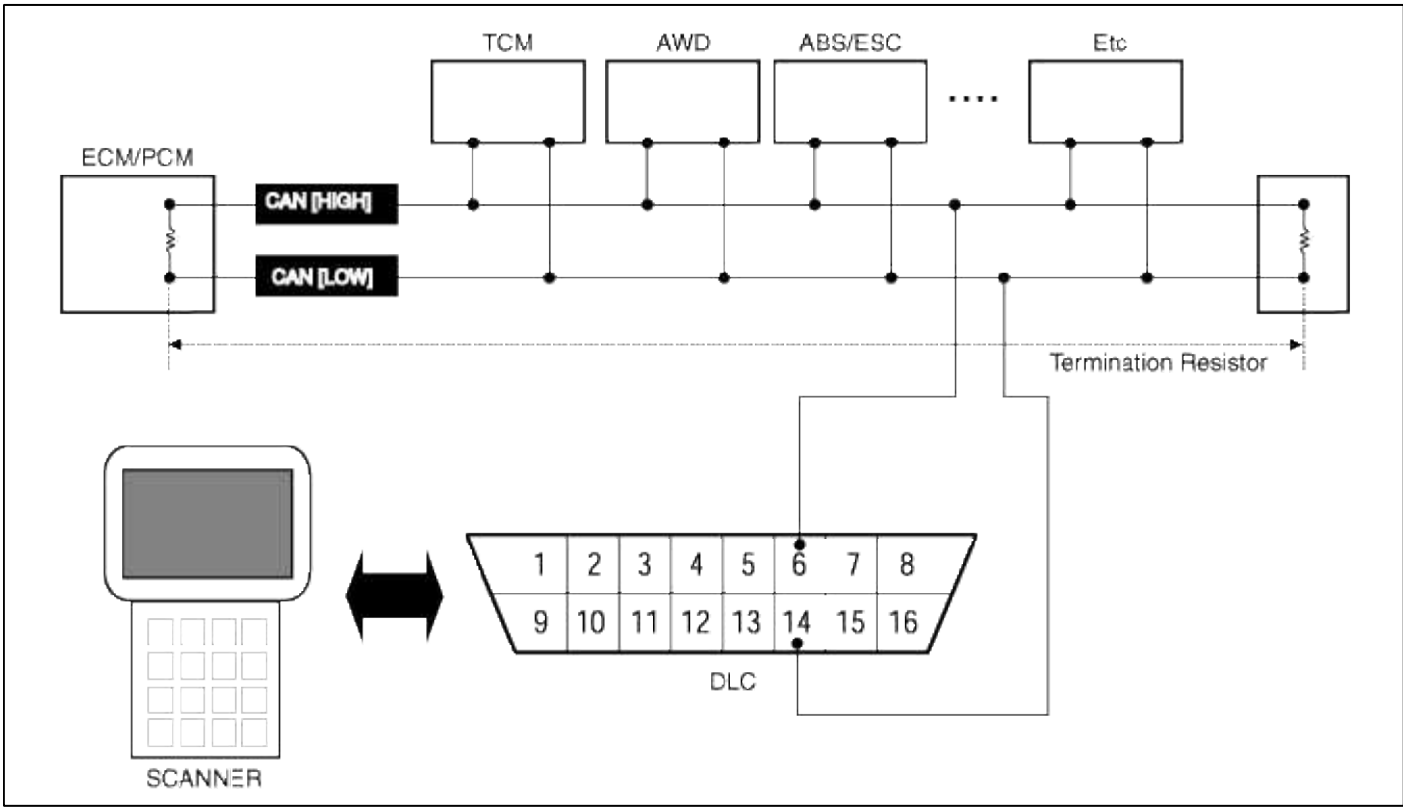
The OBD system was proposed by CARB to improve air quality by identifying vehicle exceeding emission standards. Passage of the Federal Clean Air Act Amendments in 1990 has also prompted the Environmental Protection Agency (EPA) to develop On Board Diagnostic requirements. CARB OBD-II regulations were followed until 1999 when the federal regulations were used.

The OBD-II system meets government regulations by monitoring the emission control system. When a system or component exceeds emission threshold or a component operates outside tolerance, a DTC will be stored and the MIL illuminated.

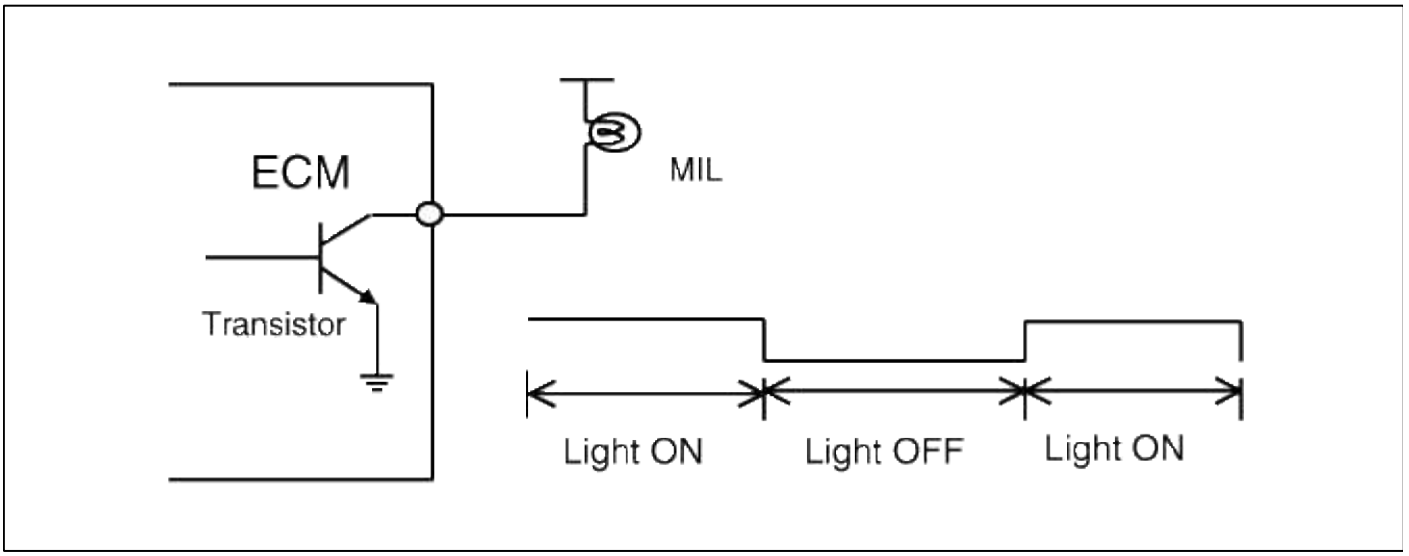
The diagnostic executive is a computer program in the Engine Control Module (ECM) or PowertrainControl Module (PCM) that coordinates the OBD-II self-monitoring system. This program controls all the monitors and interactions, DTC and MIL operation, freeze frame data and scan tool interface.

Freeze frame data describes stored engine conditions, such as state of the engine, state of fuel control, spark, RPM,

load and warm status at the point the first fault is detected. Previously stored conditions will be replaced only if a fuel or misfire fault is detected. This data is accessible with the scan tool to assist in repairing the vehicle.
The center of the OBD-II system is a microprocessor called the Engine Control Module (ECM) or Powertrain Control Module(PCM).
The ECM or PCM receives input from sensors and other electronic components (switches, relays, and others) based on information received and programmed into its memory (keep alive random access memory, and others), the ECM or PCM generates output signals to control various relays, solenoids and actuators.
2. Configuration of hardware and related terms
1) GST (Generic scan tool)



2) MIL (Malfunction indication lamp) - MIL activity by transistor



The Malfunction Indicator Lamp (MIL) is connected between ECM or PCM-terminal Malfunction Indicator Lamp and battery supply (open collector amplifier).
In most cars, the MIL will be installed in the instrument panel. The lamp amplifier can not be damaged by a short circuit.

Lamps with a power dissipation much greater than total dissipation of the MIL and lamp in the tester may cause a fault indication.

At ignition ON and engine revolution (RPM)< MIN. RPM, the MIL is switched ON for an optical check by the driver.

3) MIL illumination

When the ECM or PCM detects a malfunction related emission during the first driving cycle, the DTC and engine data are stored in the freeze frame memory. The MIL is illuminated only when the ECM or PCM detects the same malfunction related to the DTC in two consecutive driving cycles.

4) MIL elimination

● Misfire and Fuel System Malfunctions:

For misfire or fuel system malfunctions, the MIL may be eliminated if the same fault does not reoccur during monitoring in three subsequent sequential driving cycles in which conditions are similar to those under which the malfunction was first detected.

● All Other Malfunctions:

For all other faults, the MIL may be extinguished after three subsequent sequential driving cycles during which the monitoring system responsible for illuminating the MIL functions without detecting the malfunction and if no other malfunction has been identified that would independently illuminate the MIL according to the requirements outlined above.

5) Erasing a fault code

The diagnostic system may erase a fault code if the same fault is not re-registered in at least 40 engine warm-up cycles, and the MIL is not illuminated for that fault code.

6) Communication Line (CAN)

- Bus Topology : Line (bus) structure
- Wiring : Twisted pair wire
- Off Board DLC Cable Length : Max. 5m
- Data Transfer Rate
- Diagnostic : 500 kbps
- Service Mode (Upgrade, Writing VIN) : 500 or 1Mbps)

7) Driving cycle

A driving cycle consists of engine start up, and engine shut off.

8) Warm-up cycle

A warm-up cycle means sufficient vehicle operation such that the engine coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of at least 160 degrees Fahrenheit.

9) Trip cycle

A trip means vehicle operation (following an engine-off period) of duration and driving mode such that all components and systems are monitored at least once by the diagnostic system except catalyst efficiency or evaporative system monitoring when a steady-speed check is used, subject to the limitation that the manufacturer-defined trip monitoring conditions shall all be encountered at least once during the first engine start portion of the applicable FTP cycle.

10) DTC format

- Diagnostic Trouble Code (SAE J2012)
- DTCs used in OBD-II vehicles will begin with a letter and are followed by four numbers.

The letter of the beginning of the DTC identifies the function of the monitored device that has failed. A "P" indicates a powertrain device, "C" indicates a chassis device. "B" is for body device and "U" indicates a network or data link code. The first number indicates if the code is generic (common to all manufacturers) or if it is manufacturer specific. A "0" & "2" indicates generic, "1" indicates manufacturer-specific. The second number indicates the system that is affected with a number between 1 and 7.

The following is a list showing what numbers are assigned to each system.

1. Fuel and air metering
2. Fuel and air metering(injector circuit malfunction only)

3. Ignition system or misfire
4. Auxiliary emission controls
5. Vehicle speed controls and idle control system
6. Computer output circuits
7. Transmission

The last two numbers of the DTC indicates the component or section of the system where the fault is located.

11) Freeze frame data

When a freeze frame event is triggered by an emission related DTC, the ECM or PCM stores various vehicle information as it existed the moment the fault ocurred. The DTC number along with the engine data can be useful in aiding a technician in locating the cause of the fault. Once the data from the 1st driving cycle DTC ocurrence is stored in the freeze frame memory, it will remain there even when the fault ocurrs again (2nd driving cycle) and the MIL is illuminated.

- Freeze Frame List

1) Calculated Load Value
2) Engine RPM
3) Fuel Trim
4) Fuel Pressure (if available)
5) Vehicle Speed (if available)
6) Coolant Temperature
7) Intake Manifold Pressure (if available)
8) Closed-or Open-loop operation
9) Fault code

3. OBD-II system readiness tests

1) Catalyst monitoring

The catalyst efficiency monitor is a self-test strategy within the ECM or PCM that uses the downstream Heated Oxygen Sensor (HO2S) to determine when a catalyst has fallen below the minimum level of effectiveness in its ability to control exhaust emission.

2) Misfire monitoring

Misfire is defined as the lack of proper combustion in the cylinder due to the absence of spark, poor fuel metering, or poor compression. Any combustion that does not occur within the cylinder at the proper time is also a misfire. The misfire detection monitor detects fuel, ignition or mechanically induced misfires. The intent is to protect the catalyst from permanent damage and to alert the customer of an emission failure or an inspection maintenance failure by illuminating the MIL . When a misfire is detected, special software called freeze frame data is enabled. The freeze frame data captures the operational state of the vehicle when a fault is detected from misfire detection monitor strategy.

3) Fuel system monitoring

The fuel system monitor is a self-test strategy within the ECM or PCM that monitors the adaptive fuel table The fuel control system uses the adaptive fuel table to compensate for normal variability of the fuel system components caused by wear or aging. During normal vehicle operation, if the fuel system appears biased lean or rich, the adaptive value table will shift the fuel delivery calculations to remove bias.

4) Engine cooling system monitoring

The cooling system monitoring is a self-test strategy within the ECM or PCM that monitors ECTS (Engine Coolant Temperature Sensor) and thermostat about circuit continuity, output range, rationality faults.

5) O2 sensor monitoring

OBD-II regulations require monitoring of the upstream Heated O2 Sensor (H2OS) to detect if the deterioration of the sensor has exceeded thresholds. An additional HO2S is located downstream of the Warm-Up Three Way Catalytic Converter (WU-TWC) to determine the efficiency of the catalyst.

Although the downstream H2OS is similar to the type used for fuel control, it functions differently. The downstream HO2S is monitored to determine if a voltage is generated. That voltage is compared to a calibrated acceptable

range.

6) Evaporative emission system monitoring

The EVAP. monitoring is a self-test strategy within the ECM or PCM that tests the integrity of the EVAP. system. The complete evaporative system detects a leak or leaks that cumulatively are greater than or equal to a leak caused by a 0.040 inch and 0.020 inch diameter orifice.

7) Air conditioning system monitoring

The A/C system monitoring is a self-test strategy within the ECM or PCM that monitors malfunction of all A/C system components at A/C ON.

8) Comprehensive components monitoring

The comprehensive components monitoring is a self-test strategy within the ECM or PCM that detects fault of any electronic powertrain components or system that provides input to the ECM or PCM and is not exclusively an input to any other OBD-II monitor.

9) A/C system component monitoring

Requirement:

If a vehicle incorporates an engine control strategy that alters off idle fuel and/or spark control when the A/C system is on, the OBD II system shall monitor all electronic air conditioning system components for malfunctions that cause the system to fail to invoke the alternate control while the A/C system is on or cause the system to invoke the alternate control while the A/C system is off.

Additionally, the OBD II system shall monitor for malfunction all electronic air conditioning system components that are used as part of the diagnostic strategy for any other monitored system or component.

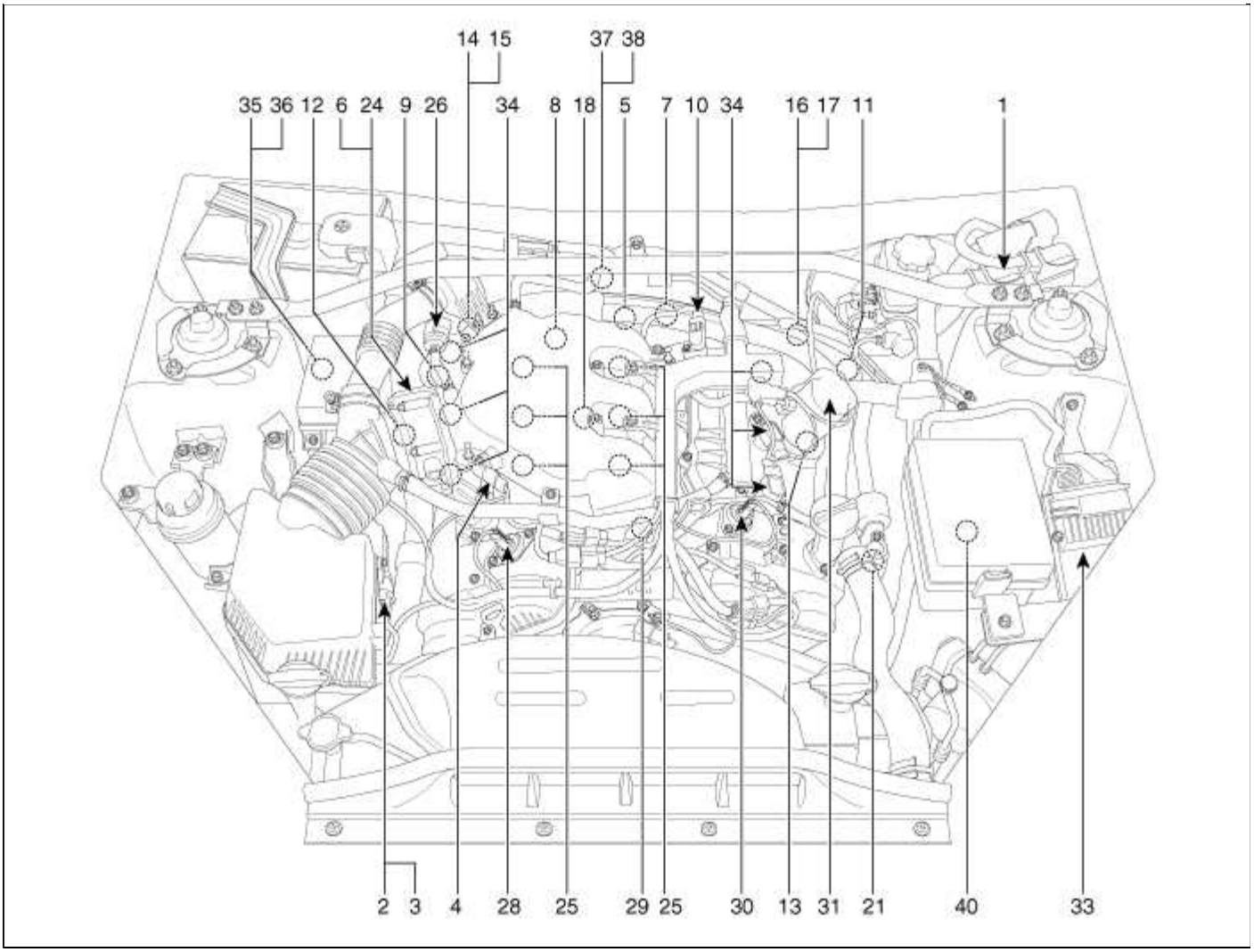
Implementation plan:

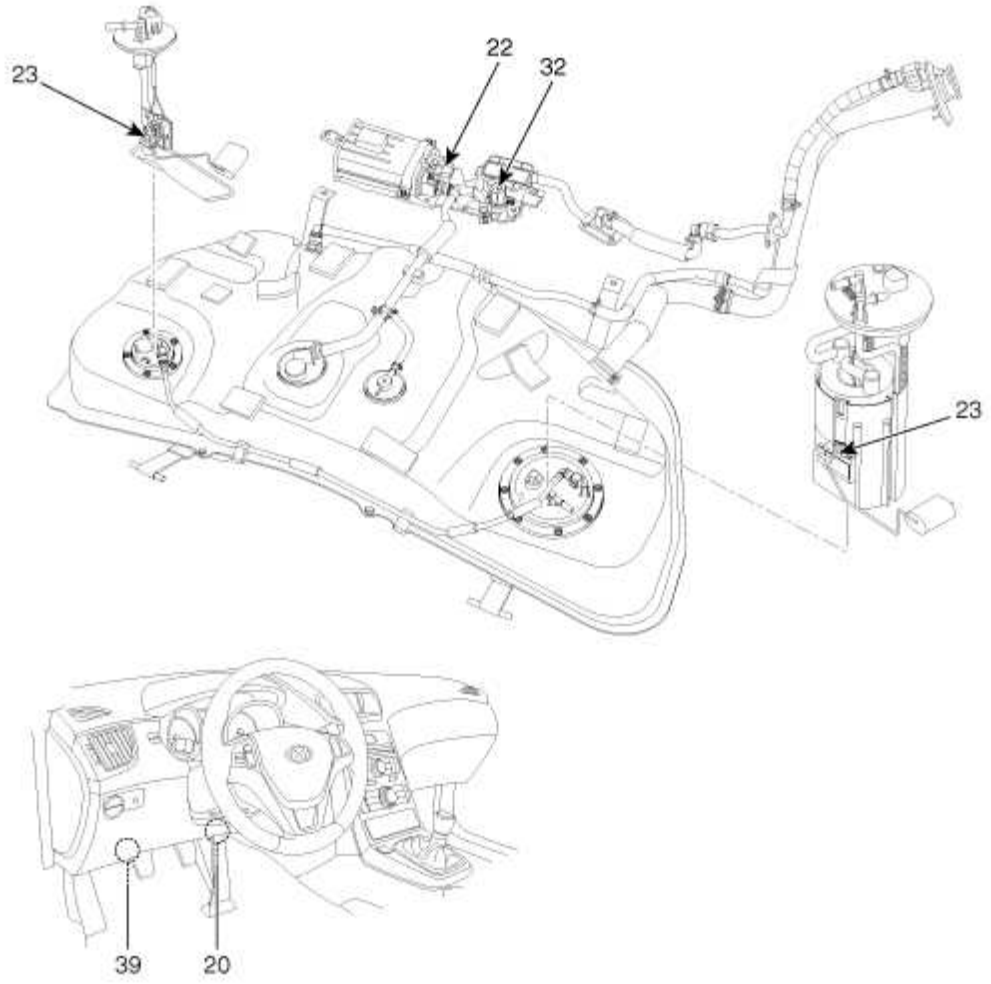
No engine control strategy incorporated that alters offidle fuel and/or spark control when A/C system is on.

Malfuction of A/C system components is not used as a part of the diagnostic strategy for other monitored system or component.

Fuel System > Engine Control System > Components and Components Location

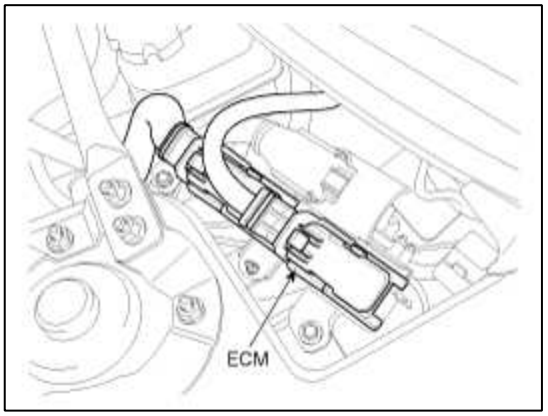
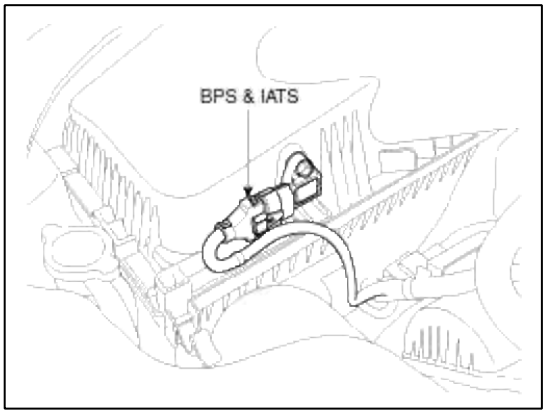
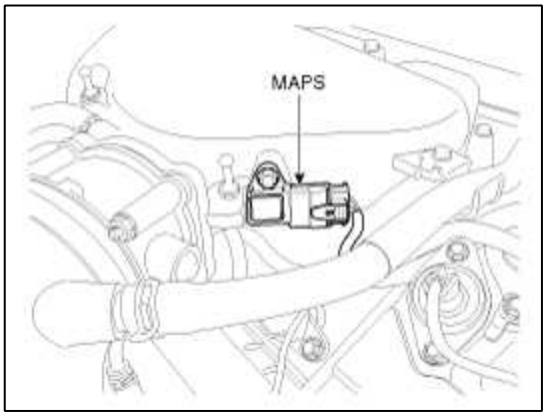
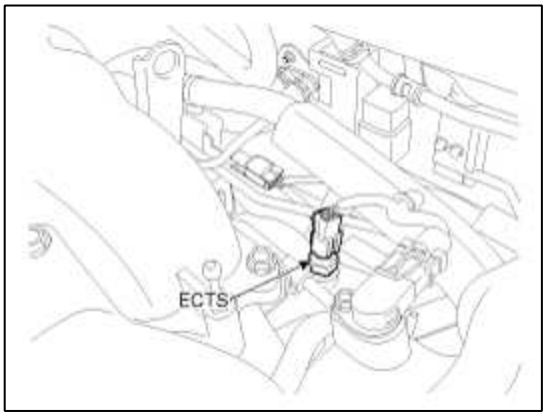
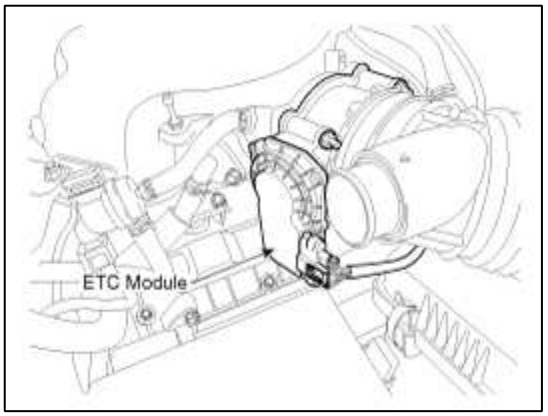
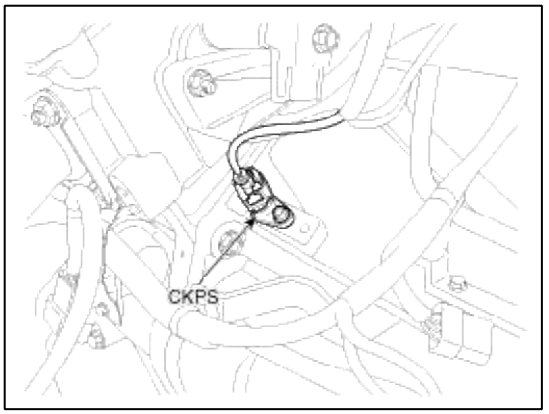
Components Location

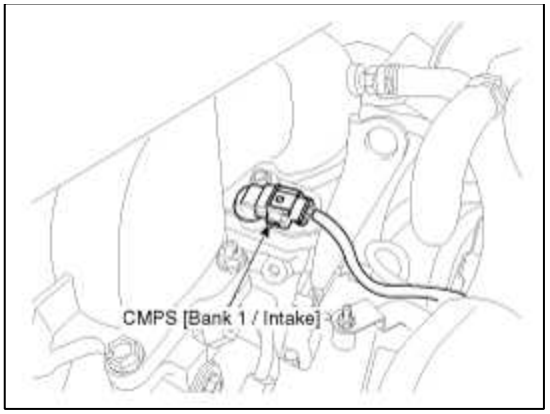

14 15
37 38
35 36 12 6 24 9 26 34 8 18 5 7 10 34 16 17 11 1
2 3 4 28 25 29 25 30 13 31 21 40 33



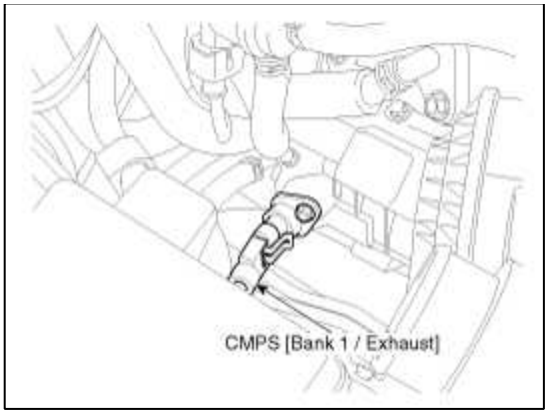
1. ECM (Engine Control Module) 2. Barometric Pressure Sensor (BPS) 3. Intake Air Temperature Sensor (IATS) 4. Manifold Absolute Pressure Sensor (MAPS) 5. Engine Coolant Temperature Sensor (ECTS) 6. Throttle Position Sensor (TPS) [integrated into ETC Module] 7. Crankshaft Position Sensor (CKPS) 8. Camshaft Position Sensor (CMPS) [Bank 1 / Intake] 9. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust] 10. Camshaft Position Sensor (CMPS) [Bank 2 / Intake] 11. Camshaft Position Sensor (CMPS) [Bank 2 / Exhaust] 12. Knock Sensor (KS) [Bank 1] 13. Knock Sensor (KS) [Bank 2] 14. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1] 15. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2] 16. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1] 17. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2] 18. Rail Pressure Sensor (RPS) 19. CVVT Oil Temperature Sensor (OTS) 20. Accelerator Position Sensor (APS)	21. A/C Pressure Transducer (APT) 22. Fuel Tank Pressure Sensor (FTPS) 23. Fuel Level Sender (FLS) 24. ETC Motor [integrated into ETC Module] 25. Injector 26. Purge Control Solenoid Valve (PCSV) 27. CVVT Oil Control Valve (OCV) [Bank 1 / Intake] 28. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust] 29. CVVT Oil Control Valve (OCV) [Bank 2 / Intake] 30. CVVT Oil Control Valve (OCV) [Bank 2 / Exhaust] 31. Fuel Pressure Control Valve (FPCV) 32. Canister Close Valve (CCV) 33. Injector Drive Box (IDB) 34. Ignition Coil 35. Main Relay 36. Fuel Pump Relay 37. Fuel Pump Resistor 38. Fuel Pump Resistor Relay 39. Data Link Connector (DLC) [16 Pin]

	40. Multi-Purpose Check Connector [20 Pin]

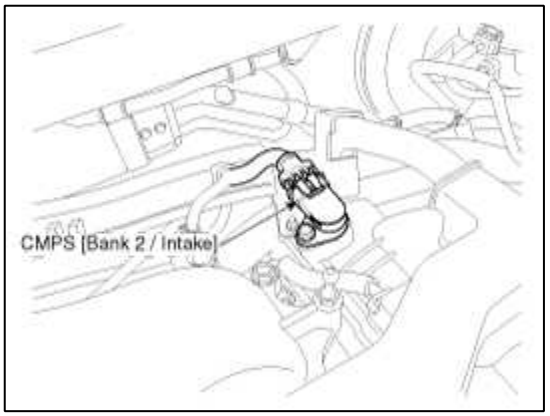
1. ECM (Engine Control Module)	2. Barometric Pressure Sensor (BPS) 3. Intake Air Temperature Sensor (IATS)
	
4. Manifold Absolute Pressure Sensor (MAPS)	5. Engine Coolant Temperature Sensor (ECTS)
	
6. Throttle Position Sensor (TPS) [integrated into ETC Module] 24. ETC Motor [integrated into ETC Module]	7. Crankshaft Position Sensor (CKPS)
	
8. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]	9. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]



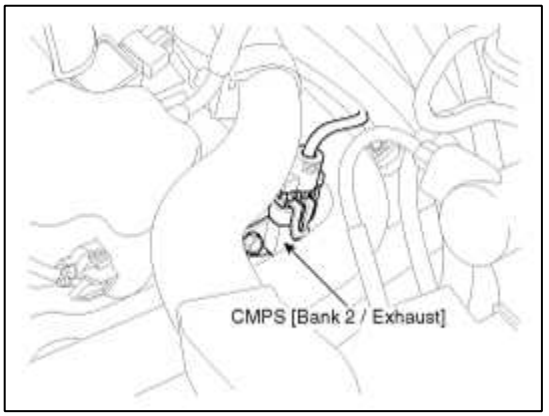
10. Camshaft Position Sensor (CMPS) [Bank 2 / Intake]



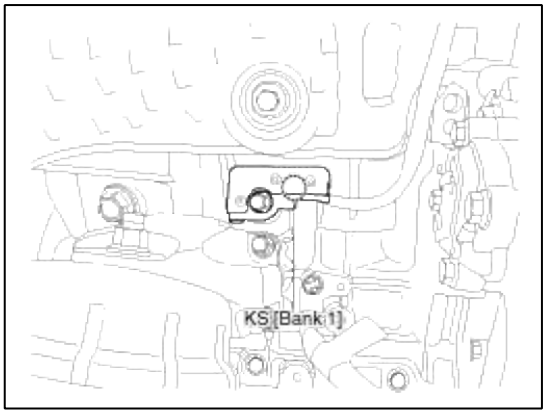
11. Camshaft Position Sensor (CMPS) [Bank 2 / Exhaust]



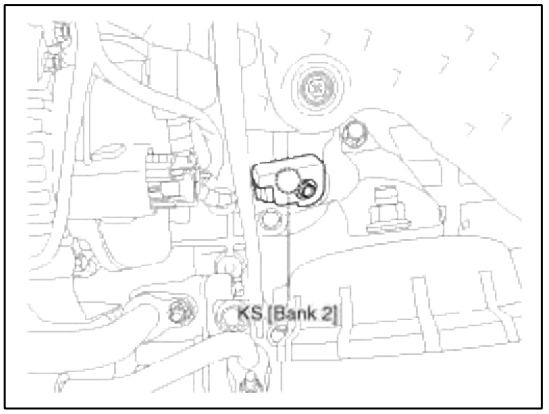
12. Knock Sensor (KS) [Bank 1]



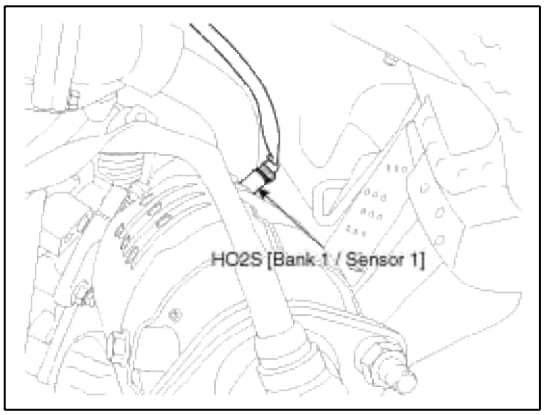
13. Knock Sensor (KS) [Bank 2]

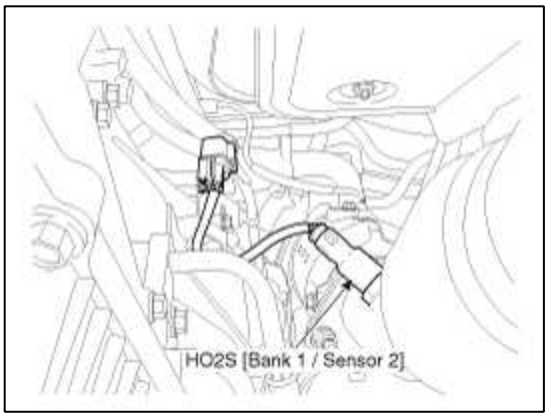


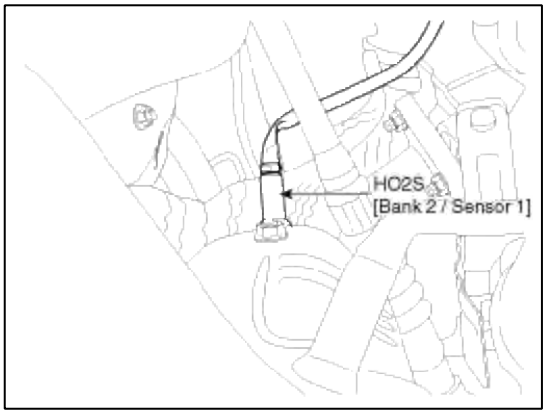
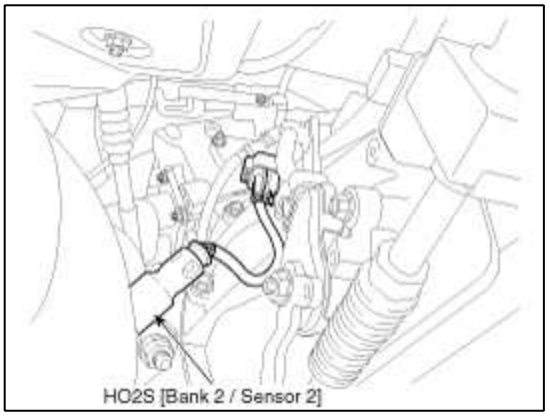
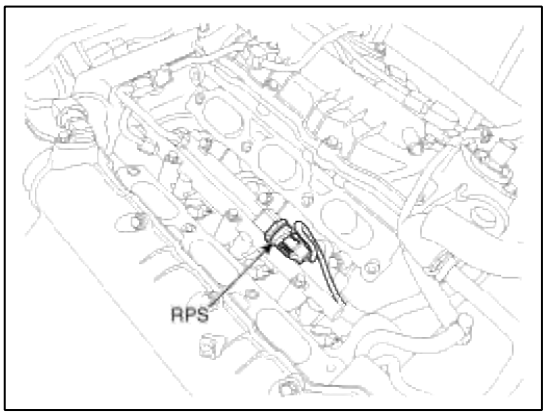
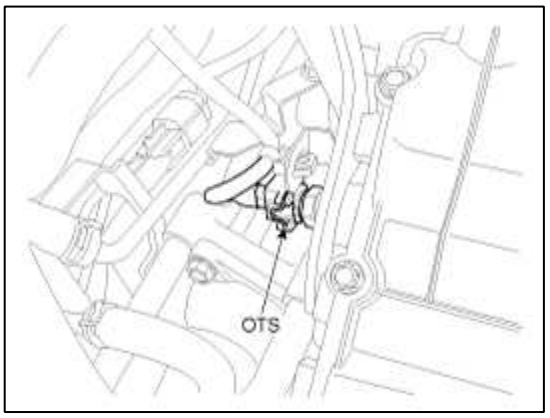
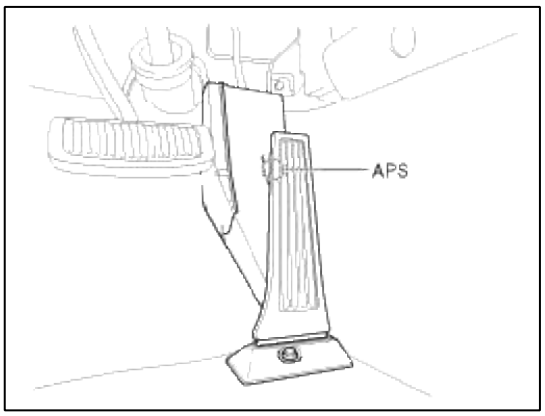
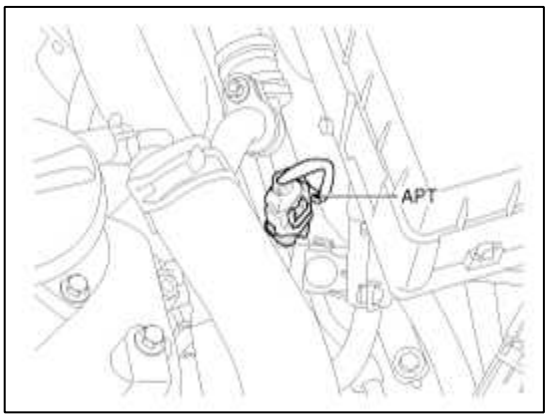
14. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]

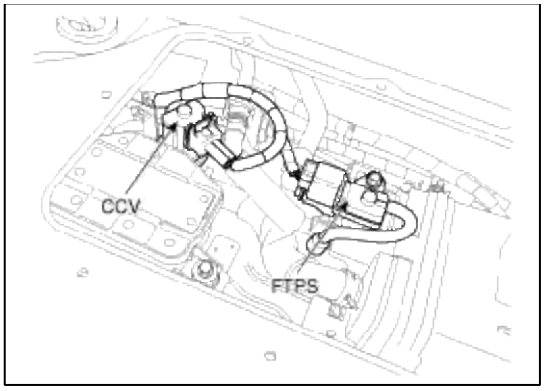


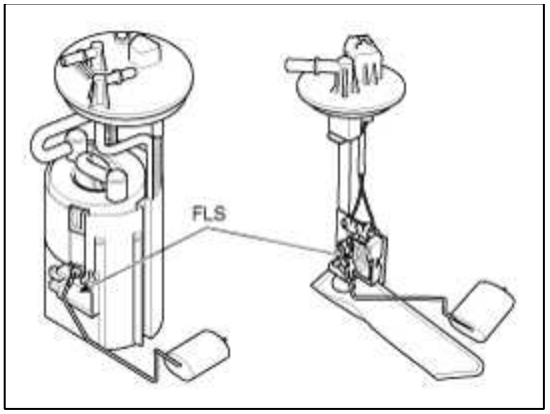
15. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]





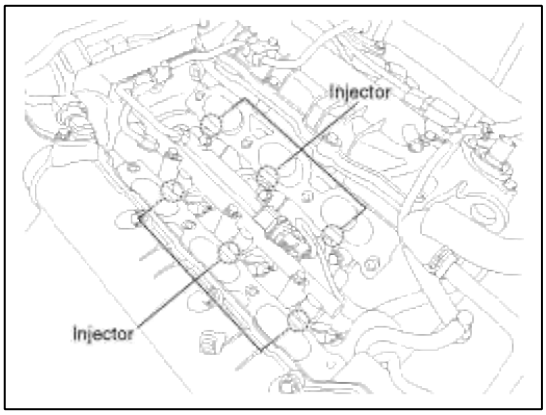
16. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]	17. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]
	
18. Rail Pressure Sensor (RPS)	19. CVVT Oil Temperature Sensor (OTS)
	
20. Accelerator Position Sensor (APS)	21. A/C Pressure Transducer (APT)
	
22. Fuel Tank Pressure Sensor (FTPS) 32. Canister Close Valve (CCV)	23. Fuel Level Sender (FLS)

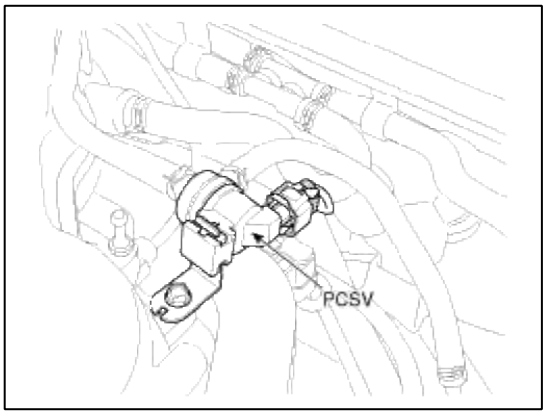




25. Injector

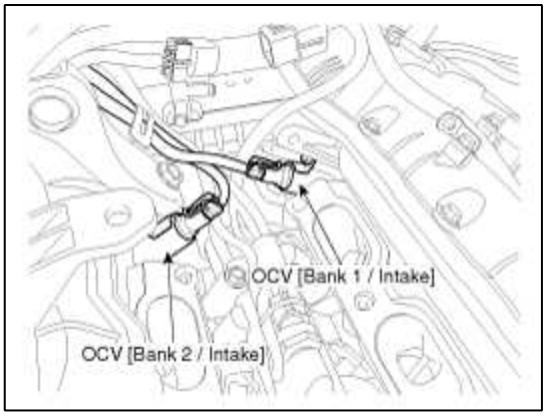
26. Purge Control Solenoid Valve (PCSV)

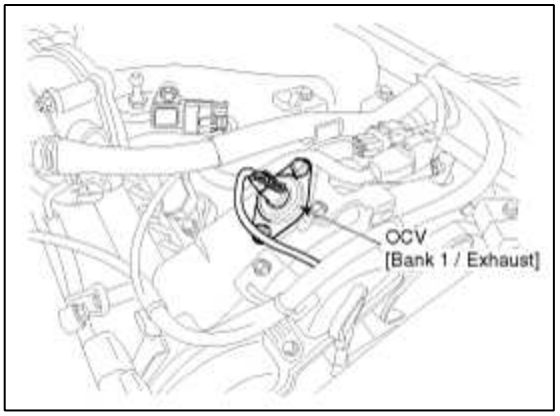




27. CVVT Oil Control Valve (OCV) [Bank 1 / Intake]
29. CVVT Oil Control Valve (OCV) [Bank 2 / Intake]

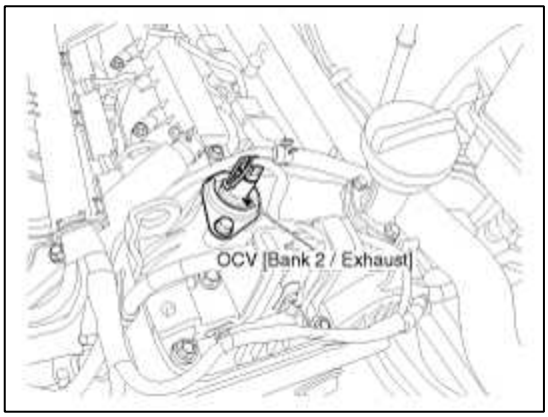
28. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]

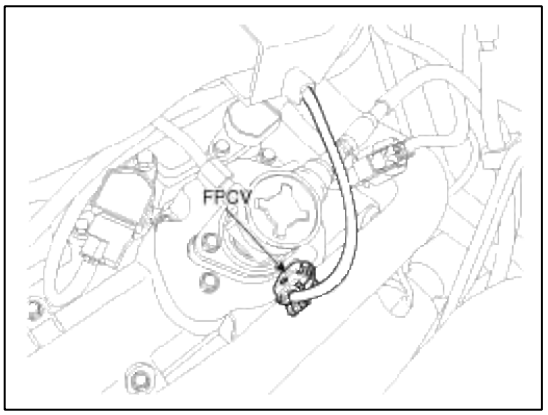


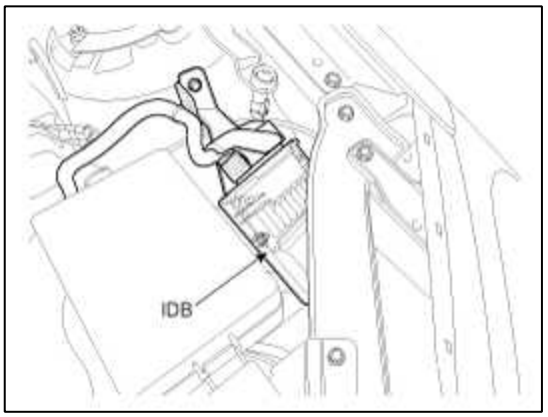
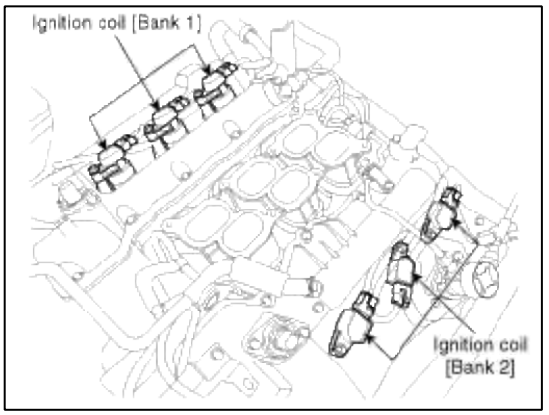
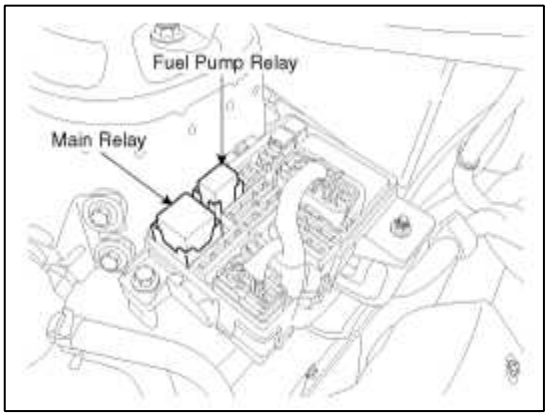
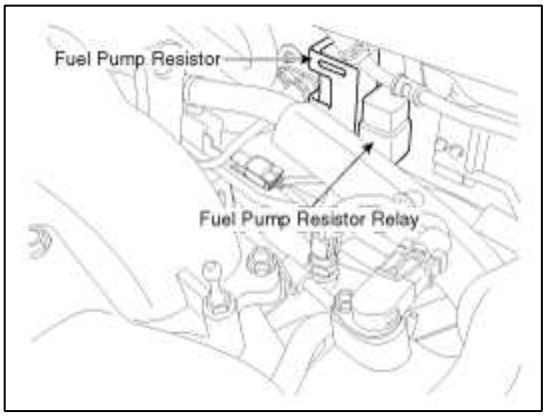
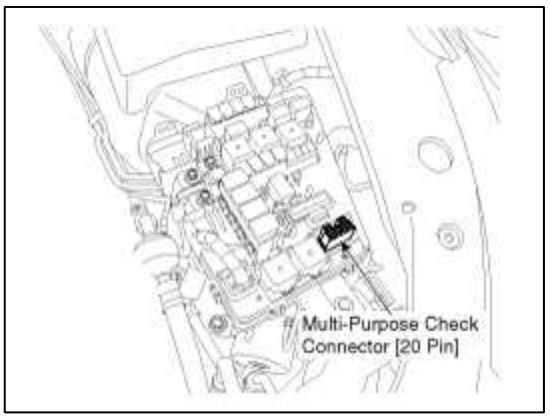


30. CVVT Oil Control Valve (OCV) [Bank 2 / Exhaust]

31. Fuel Pressure Control Valve (FPCV)

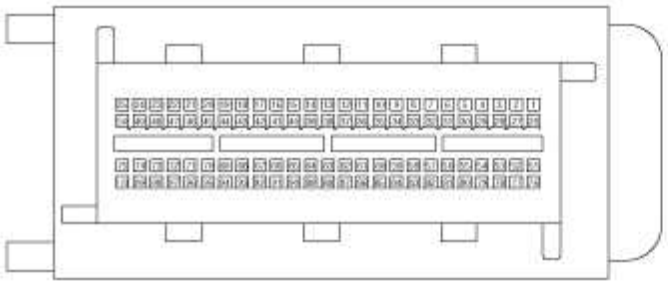




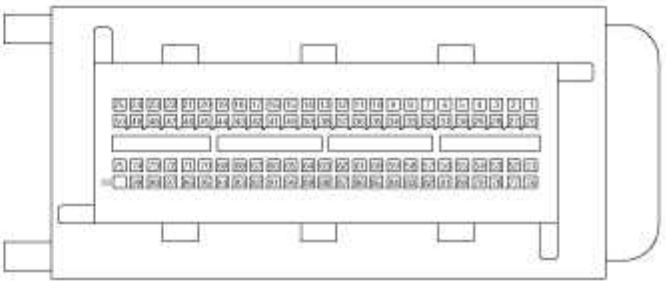
33. Injector Drive Box (IDB)	34. Ignition Coil
	
35. Main Relay 36. Fuel Pump Relay	37. Fuel Pump Resistor 38. Fuel Pump Resistor Relay
	
40. Multi-Purpose Check Connector [20 Pin]	
	

Fuel System > Engine Control System > Engine Control Module (ECM) > Schematic Diagrams

ECM Terminal And Input/Output signal



Connector [ELG-A]



Connector [CLG-B]

ECM Terminal Function

Connector [ELG-A]

Pin No.	Description	Connected to
1	-	
2	-	
3	-	
4	Immobilizer Lamp control output	Immobilizer Lamp [Without Button Engine Start System]
5	Power ground	Chassis Ground
6	Power ground	Chassis Ground
7	-	
8	-	
9	2nd CAN [High]	Multi-Purpose Check Connector
10	CAN [High]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
11	Fuel Tank Pressure Sensor (FTPS) signal input	Fuel Tank Pressure Sensor (FTPS)
12	-	
13	-	
14	Sensor power (+5V)	Accelerator Position Sensor (APS) 1
15	Sensor power (+5V)	A/C Pressure Transducer (APT)
		Rail Pressure Sensor (RPS)
16	Fuel Level Sensor (FLS) [TOTAL] signal input	Fuel Level Sensor (FLS)
17	Power Steering Pressure Switch signal input	Power Steering Pressure Switch
18	Clutch switch signal input	Clutch switch
19	-	
20	-	
21	Brake Switch 2 signal input	Brake Switch
22	-	

23	-	
24	Alternator (FR)	Alternator
25	-	
26	-	
27	Battery power (B+)	Ignition Switch
28	Rail Pressure Sensor (RPS) signal input	Rail Pressure Sensor (RPS)
29	-	
30	Power ground	Chassis Ground
31	-	
32	-	
33	-	
34	2nd CAN [Low]	Multi-Purpose Check Connector
35	CAN [Low]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
36	-	
37	Sensor ground	Rail Pressure Sensor (RPS)
38	Accelerator Position Sensor (APS) 1 signal input	Accelerator Position Sensor (APS) 1
39	-	
40	-	
41	Fuel Level Sensor (FLS) [MIDDLE] signal input	Fuel Level Sensor (FLS)
42	-	
43	Brake Switch 1 signal input	Brake Switch
44	-	
45	-	
46	-	
47	-	
48	-	
49	-	
50	-	
51	-	
52	Battery power (B+)	Battery
53	-	
54	-	
55	Power ground	Chassis Ground
56	-	

57	A/C Compressor Clutch Relay control output	A/C Control Module [With Immobilzer]
58	-	
59	Sensor ground	Accelerator Position Sensor (APS) 2
60	Sensor ground	Accelerator Position Sensor (APS) 1
61	Sensor ground	Fuel Tank Pressure Sensor (FTPS)
62	Ground	Cruise Control Switch
63	Sensor ground	A/C Pressure Transducer (APT)
64	-	
65	Sensor Power (+5V)	Fuel Tank Pressure Sensor (FTPS)
66	Cruise Control Switch signal input	Cruise Control Switch
67	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)
68	Accelerator Position Sensor (APS) 2 signal input	Accelerator Position Sensor (APS) 2
69	-	
70	Engine speed signal output	Power Distribution Module (PDM)
71	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
72	-	
73	-	
74	Immobilizer communication line	Smart Key Control Module [With Button Engine Start System]
		Immobilizer Control Unit [Without Button Engine Start System]
75	Battery power (B+)	Main Relay
76	-	
77	Battery power (B+)	Battery
78	Fuel pump resistor relay control output	Fuel pump resistor relay
79	-	
80	Power ground	Chassis Ground
81	-	
82	-	
83	-	
84	-	
85	-	
86	-	
87	-	
88	-	
89	-	

90	Sensor power (+5V)	Accelerator Position Sensor (APS) 2
91	Cooling fan relay [Low] control output	Cooling fan relay
92	-	
93	Starter Relay control output	Starter Relay
94	Main Relay control output	Main Relay
95	Fuel pump Relay control output	Fuel pump Relay
96	Canister Close Valve (CCV) control output	Canister Close Valve (CCV)
97	-	
98	-	
99	Battery power (B+)	Main Relay
100	Battery power (B+)	Main Relay

Connector [CLG-B]

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

15	Vehicle speed signal input	Power Distribution Module (PDM) [With Button Engine Start System]
		ABS/ESP Control Module [Without Button Engine Start System]
16	Knock Sensor (KS) [Bank 2] [High] signal input	Knock Sensor (KS) [Bank 2]
17	Knock Sensor (KS) [Bank 1] [High] signal input	Knock Sensor (KS) [Bank 1]
18	Crankshaft Position Sensor (CKPS) [High] signal input	Crankshaft Position Sensor (CKPS)
19	Sensor ground	CVVT Oil Temperature Sensor (OTS)
20	VCM Position Sensor signal input	VCM Position Sensor
21	Camshaft Position Sensor (CMPS) [Bank 2/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 2/Intake]
22	-	
23	-	
24	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1)
25	-	
26	-	
27	-	
28	-	
29	-	
30	-	
31	Sensor ground	Throttle Position Sensor (TPS) 1
32	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
		Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]
33	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
34	Throttle Position Sensor (TPS) 2 signal input	Throttle Position Sensor (TPS) 2
35	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
36	-	
37	-	
38	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
39	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
40	Sensor Shield	Crankshaft Position Sensor (CKPS)
		Knock Sensor (KS) #1 [Bank 1]
		Knock Sensor (KS) #2 [Bank 2]
41	Knock Sensor (KS) [Bank 2] [Low] signal input	Knock Sensor (KS) [Bank 2]
42	Knock Sensor (KS) [Bank 1] [Low] signal input	Knock Sensor (KS) [Bank 1]

43	Crankshaft Position Sensor (CKPS) [Low] signal input	Crankshaft Position Sensor (CKPS)
44	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
		Camshaft Position Sensor (CMPS) [Bank 2/Intake]
45	-	
46	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]
47	-	
48	Sensor power (+5V)	Barometric Pressure Sensor (BPS)
		Manifold Absolute Pressure Sensor (MAPS)
		VCM Position Sensor
49	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3)
50	-	
51	-	
52	-	
53	-	
54	-	
55	-	
56	Sensor ground	Barometric Pressure Sensor (BPS)
		Manifold Absolute Pressure Sensor (MAPS)
		Engine Coolant Temperature Sensor (ECTS)
		VCM Position Sensor
57	-	
58	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
59	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
60	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
61	-	
62	-	
63	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
64	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
65	-	
66	Purge Control Solenoid Valve (PCSV) control output	Purge Control Solenoid Valve (PCSV)
67	-	
68	-	
69	-	

70	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
71	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
72	-	
73	Sensor Power (+5V)	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
		Camshaft Position Sensor (CMPS) [Bank 2/Intake]
74	Ignition Coil (Cylinder #5) control output	Ignition Coil (Cylinder #5)
75	-	
76	-	
77	-	
78	-	
79	-	
80	ETC Motor [+] control output	ETC Motor
81	ETC Motor [-] control output	ETC Motor
82	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
83	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
84	Fuel Pressure Control Valve (FPCV) control output	Injector Drive Box (IDB)
85	Injector (Cylinder #2) control output	Injector Drive Box (IDB)
86	Injector (Cylinder #5) control output	Injector Drive Box (IDB)
87	Injector (Cylinder #3) control output	Injector Drive Box (IDB)
88	Injector (Cylinder #6) control output	Injector Drive Box (IDB)
89	Injector (Cylinder #4) control output	Injector Drive Box (IDB)
90	Injector (Cylinder #1) control output	Injector Drive Box (IDB)
91	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
92	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
93	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust]
94	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust]
95	CVVT Oil Control Valve (OCV) [Bank 2/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 2/Intake]
96	CVVT Oil Control Valve (OCV) [Bank 1/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 1/Intake]

97	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2)
98	Ignition Coil (Cylinder #6) control output	Ignition Coil (Cylinder #6)
99	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4)
100	-	

ECM Terminal Input/Output Signal

Connector [CGL-A]

Pin No.	Description	Condition	Type	Level
1	-			
2	-			
3	-			
4	Immobilizer Lamp control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		Max. 1.1V
5	Power ground	Idle	DC	Max. 0.1V
6	Power ground	Idle	DC	Max. 0.1V
7	-			
8	-			
9	2nd CAN [High]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		2.75 ~ 4.5V
10	CAN [High]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		2.75 ~ 4.5V
11	Fuel Tank Pressure Sensor (FTPS) signal input	Idle	Analog	0.4 ~ 4.6V
12	-			
13	-			
14	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
15	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
16	Fuel Level Sensor (FLS) [TOTAL] signal input	IG ON	Analog	0.88 ~ 8.45V
17	Power Steering Pressure Switch signal input			
18	Clutch switch signal input			
19	-			
20	-			

21	Brake Switch 2 signal input	Brake OFF	DC	Battery Voltage
		Brake ON		Max. 0.5V
22	-			
23	-			
24	Alternator (FR)	Idle	PWM	High: Battery Voltage
				Low: Max. 2.0V
				133<FREQUENCY<200HZ< span>
				5<DUTY<95%< span>
25	-			
26	-			
27	Battery power (B+)	IG OFF	DC	Battery Voltage
		IG ON		Max. 1.0V
28	Rail Pressure Sensor (RPS) signal input	Idle	DC	1.0 ~ 2.0V
29	-			
30	Power ground	Idle	DC	Max. 0.1V
31	-			
32	-			
33	-			
34	2nd CAN [Low]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		0.5 ~ 2.25V
35	CAN [Low]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		0.5 ~ 2.25V
36	-			
37	Sensor ground	Idle	DC	Max. 0.1V
38	Accelerator Position Sensor (APS) 1 signal input	C.T	Analog	0.7 ~ 0.8V
		W.O.T		3.85 ~ 4.35V
39	-			
40	-			
41	Fuel Level Sensor (FLS) [MIDDLE] signal input	IG ON	Analog	0.88 ~ 8.45V
42	-			
43	Brake Switch 1 signal input	Brake OFF	DC	Max. 0.5V
		Brake ON		Battery Voltage
44	-			
45	-			
46	-			

47	-			
48	-			
49	-			
50	-			
51	-			
52	Battery power (B+)	Always (Without Ignition key)	DC	Battery Voltage
53	-			
54	-			
55	Power ground	Idle	DC	Max. 0.1V
56	-			
57	Fuel Pump Relay control output [Without Immobilzer]	Relay OFF	DC	Battery Voltage
	A/C Compressor Clutch Relay control output [With Immobilzer]	Relay ON		Max 1.1V
58	-			
59	Sensor ground	Idle	DC	Max. 0.1V
60	Sensor ground	Idle	DC	Max. 0.1V
61	Sensor ground	Idle	DC	Max. 0.1V
62	Ground	Idle	DC	Max. 0.1V
63	Sensor ground	Idle	DC	Max. 0.1V
64	-			
65	Sensor Power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
66	Cruise Control Switch signal input	“MAIN”	Analog	11.1 ~ 12.1V
		“SET”		1.0 ~ 1.8V
		“CANCEL”		-0.5 ~ 0.5V
		“RESUME”		2.5 ~ 3.5V
67	A/C Pressure Transducer (APT) signal input	A/C ON	Analog	0.5 ~ 4.5V
68	Accelerator Position Sensor (APS) 2 signal input	C.T	Analog	0.29 ~ 0.46V
		W.O.T		1.93 ~ 2.18V
69	-			
70	Engine speed signal output	Engine Running	Pulse	High: Battery Voltage
				Low: Max. 1.1V
				0<FREQUENCY<350HZ< span>
				47.5<DUTY<52.5%< span>

71	Cooling Fan Relay [High] control output	A/C ON	Pulse	High: Battery Voltage
				Low: Max. 1.1V
72	-			
73	-			
74	Immobilizer communication line	Transmitting	DC	High: Min. Vbatt X 80%
				Low: Max. Vbatt X 20%
		Receiving		High: Min. Vbatt X 70%
				Low: Max. Vbatt X 30%
75	Battery power (B+)	IG OFF	DC	Battery Voltage
		IG ON		Max. 1.0V
76	-			
77	Battery power (B+)	Always (Without Ignition key)	DC	Battery Voltage
78	Fuel pump resistor relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max.1.1V
79	-			
80	Power ground	Idle	DC	Max. 0.1V
81	-			
82	-			
83	-			
84	-			
85	-			
86	-			
87	-			
88	-			
89	-			
90	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
91	Cooling Fan Relay [Low] control output	A/C ON	Pulse	High: Battery Voltage
				Low: Max. 1.1V
92	-			
93	Starter Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max 1.1V
94	Main Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max 1.7V

95	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max 1.1V
96	Canister Close Valve (CCV) control output	Active	Pulse	High: Battery Voltage
		Inactive		Low: Max. 1.0V
				Vpeak: Max. 70V
97	-			
98	-			
99	Battery power (B+)	IG OFF	DC	Battery Voltage
		IG ON		Max. 1.0V
100	Battery power (B+)	IG OFF	DC	Battery Voltage
		IG ON		Max. 1.0V

Connector [CLG-B]

Pin No.	Description	Condition	Type	Level
1	-			
2	-			
3	-			
4	-			
5	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
6	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
7	Throttle Position Sensor PWM signal output			
8	Crank request signal output	S/W OFF	DC	Max. 1.0V
		S/W ON		Battery Voltage
9	Barometric Pressure Sensor (BPS) signal input	IG ON	Analog	Approx. 4.0V
10	CVVT Oil Temperature Sensor (OTS) signal input	IG ON	Analog	3.2V at -40°C(-40°F)
				0.1V at 150°C(302°F)
11	-			
12	Throttle Position Sensor (TPS) 1 signal input	C.T	Analog	0.25 ~ 0.9V
		W.O.T		Min. 4.0V
13	Manifold Absolute Pressure Sensor (MAPS) signal input	IG ON	Analog	Approx. 4.44V
		Idle		Approx. 0.75V
14	Intake Air Temperature Sensor (IATS) signal input	IG ON	Analog	3.2V at -40°C(-40°F)
				0.05V at 125°C(257°F)

15	Vehicle speed signal input	Vehicle Running	Pulse	High: Battery Voltage
				Low: Max. 0.5V
				0.7(1kph)<FREQUENCY<>
				44<DUTY<56%< span>
16	Knock Sensor (KS) [Bank 2] [High] signal input	Knocking	Variable	-0.3 ~ 0.3V
		Normal	Frequency	0V
17	Knock Sensor (KS) [Bank 1] [High] signal input	Knocking	Variable	-0.3 ~ 0.3V
		Normal	Frequency	0V
18	Crankshaft Position Sensor (CKPS) [High] signal input	Idle	SINE	0.4<VP_P<200V< span>
			Wave	55<FREQUENCY<7,000HZ< span>
19	Sensor ground	Idle	DC	Max. 0.1V
20	VCM Position Sensor signal input	Engine Running	Analog	0.4 ~ 0.6V
21	Camshaft Position Sensor (CMPS) [Bank 2/Intake] signal input	Idle	Pulse	High: 3.2 ~ Vcc
				Low: Max. 0.7V
				0<FREQUENCY< span 350Hz<>
22	Electrical Load signal input			
23	-			
24	Ignition Coil (Cylinder #1) control output	Engine Running	Pulse	Vpeak = 400V
				0<FREQUENCY< span 58.3Hz<>
25	-			
26	-			
27	-			
28	-			
29	-			
30	-			
31	Sensor ground	Idle	DC	Max. 0.1V
32	Sensor ground	Idle	DC	Max. 0.1V
33	Sensor ground	Idle	DC	Max. 0.1V
34	Throttle Position Sensor (TPS) 2 signal input	C.T	Analog	Min. 4.0V
		W.O.T		0.25 ~ 0.9V
35	Engine Coolant Temperature Sensor (ECTS) signal input	IG ON	Analog	3.22V at -40°C(-40°F)
				0.29V at 125°C(257°F)
36	-			
37	-			

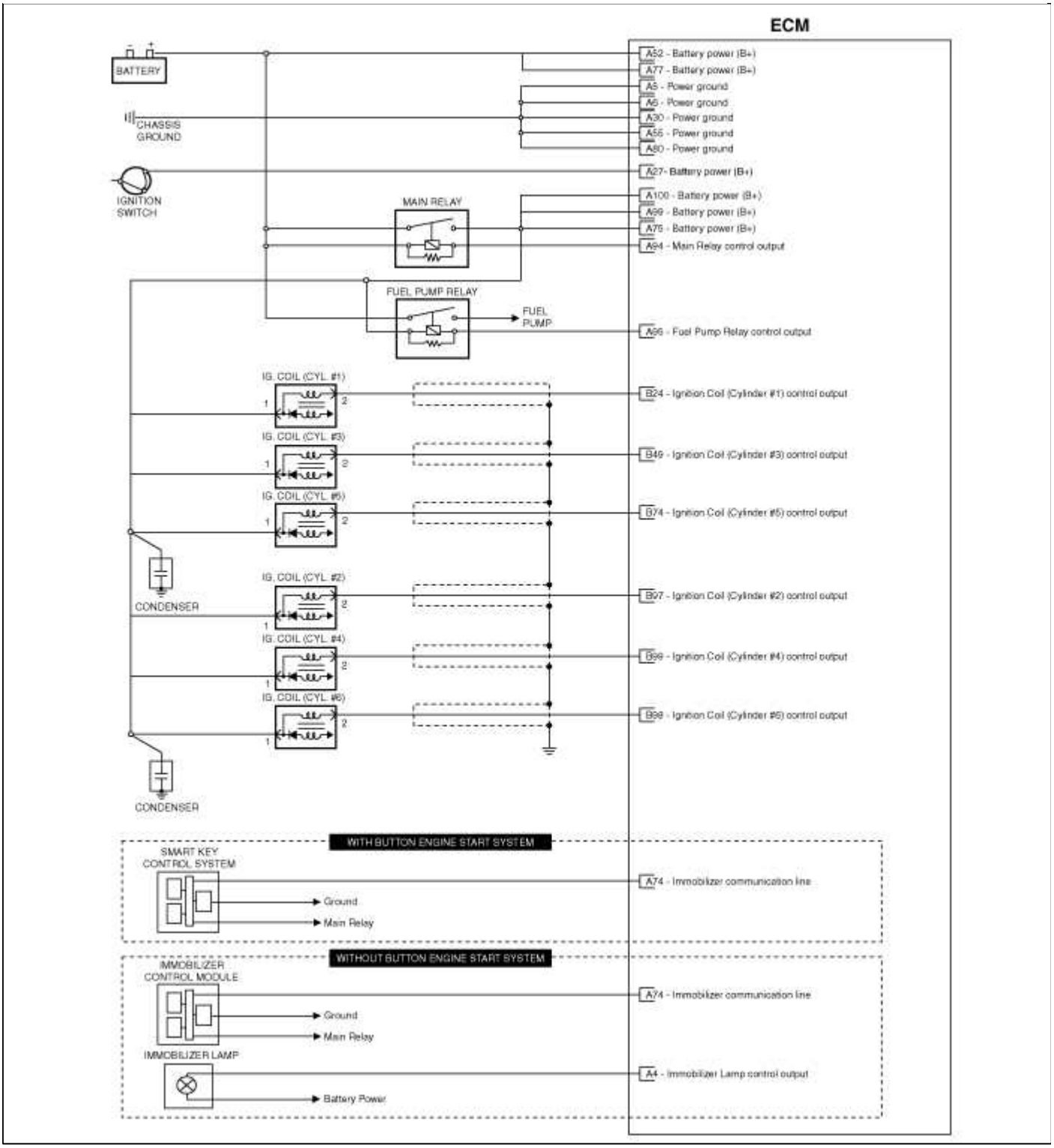
38	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] signal input	RICH	Analog	Min. 0.8V
		LEAN		Max. 0.1V
39	Sensor ground	Idle	DC	Max. 0.1V
40	Sensor Shield	Idle	DC	Max. 0.1V
41	Knock Sensor (KS) [Bank 2] [Low] signal input	Knocking	Variable	-0.3 ~ 0.3V
		Normal	Frequency	0V
42	Knock Sensor (KS) [Bank 1] [Low] signal input	Knocking	Variable	-0.3 ~ 0.3V
		Normal	Frequency	0V
43	Crankshaft Position Sensor (CKPS) [Low] signal input	Idle	SINE	0.4<VP_P<200V< span>
			Wave	55<FREQUENCY<7,000HZ< span>
44	Sensor ground	Idle	DC	Max. 0.1V
45	-			
46	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust] signal input	Idle	Pulse	High: 3.2 ~ Vcc
				Low: Max. 0.7V
				0<FREQUENCY< span 350Hz<>
47	-			
48	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
49	Ignition Coil (Cylinder #3) control output	Engine Running	Pulse	Vpeak = 400V
				0<FREQUENCY< span 58.3Hz<>
50	-			
51	-			
52	-			
53	-			
54	-			
55	-			
56	Sensor ground	Idle	DC	Max. 0.1V
57	-			
58	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] signal input	RICH	Analog	Min. 0.8V
		LEAN		Max. 0.1V
59	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	RICH	Analog	Min. 0.8V
		LEAN		Max. 0.1V
60	Sensor ground	Idle	DC	Max. 0.1V
61	-			
62	-			

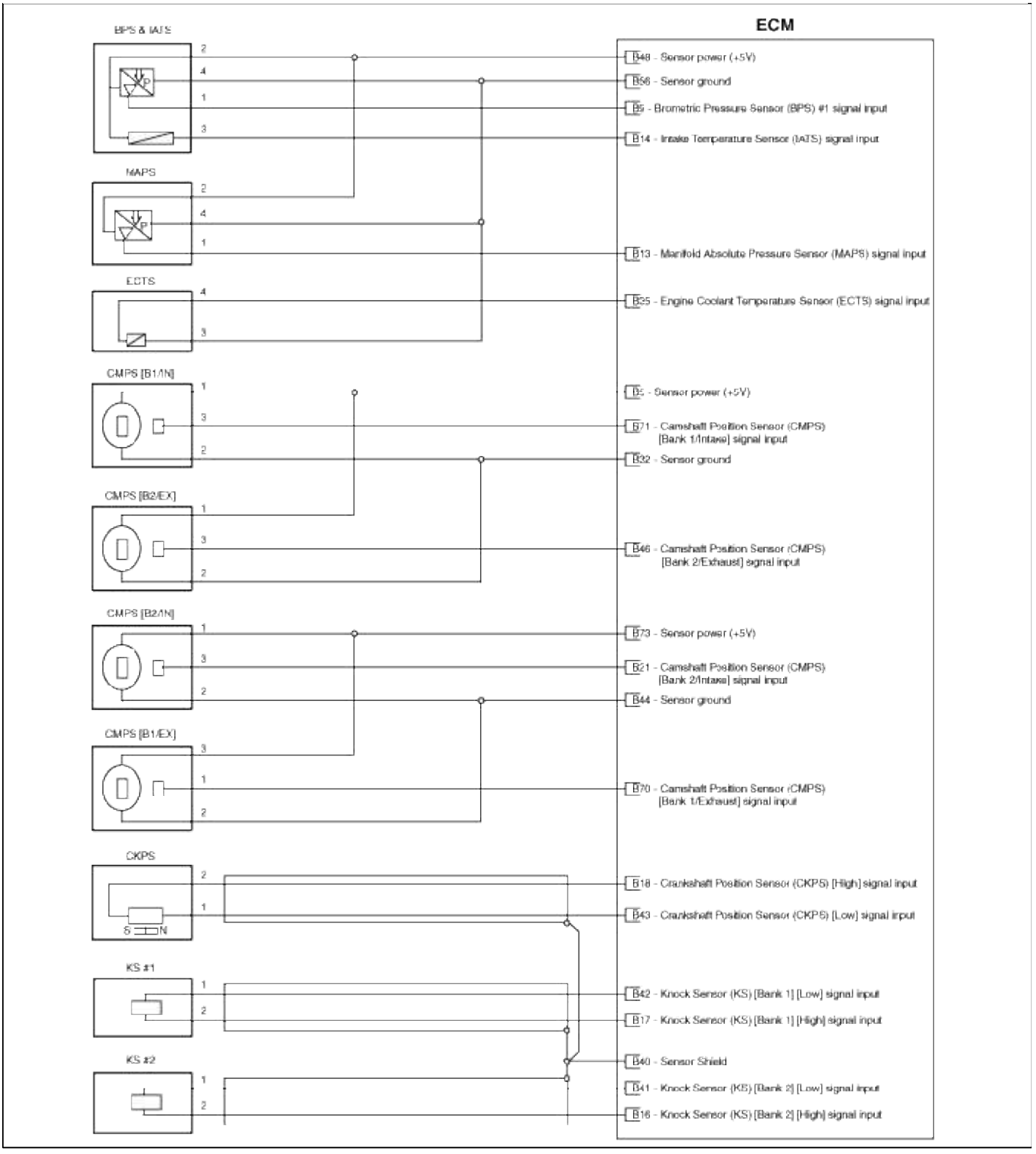
63	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] signal input	RICH	Analog	Min. 0.8V
		LEAN		Max. 0.1V
64	Sensor ground	Idle	DC	Max. 0.1V
65	-			
66	Purge Control Solenoid Valve (PCSV) control output	Engine Running	PWM	High: Battery Voltage
				Low: Max. 1.0V
67	-			
68	-			
69	-			
70	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Idle	Pulse	High: 3.2 ~ Vcc
				Low: Max. 0.7V
				0<FREQUENCY< span 350Hz<>
71	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Idle	Pulse	High: 3.2 ~ Vcc
				Low: Max. 0.7V
				0<FREQUENCY< span 350Hz<>
72	-			
73	Sensor Power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
74	Ignition Coil (Cylinder #5) control output	Engine Running	Pulse	Vpeak = 400V
				0<FREQUENCY< span 58.3Hz<>
75	-			
76	-			
77	-			
78	-			
79	-			
80	ETC Motor [+] control output	Engine Running	PWM	High: Battery Voltage
				Low: Max.1.0V
				1,500<FREQUENCY<2,400HZ< span>
				0<DUTY< span 98%<>
81	ETC Motor [-] control output	Engine Running	PWM	High: Battery Voltage
				Low: Max.1.0V
				1,500<FREQUENCY<2,400HZ< span>
				0<DUTY< span 98%<>

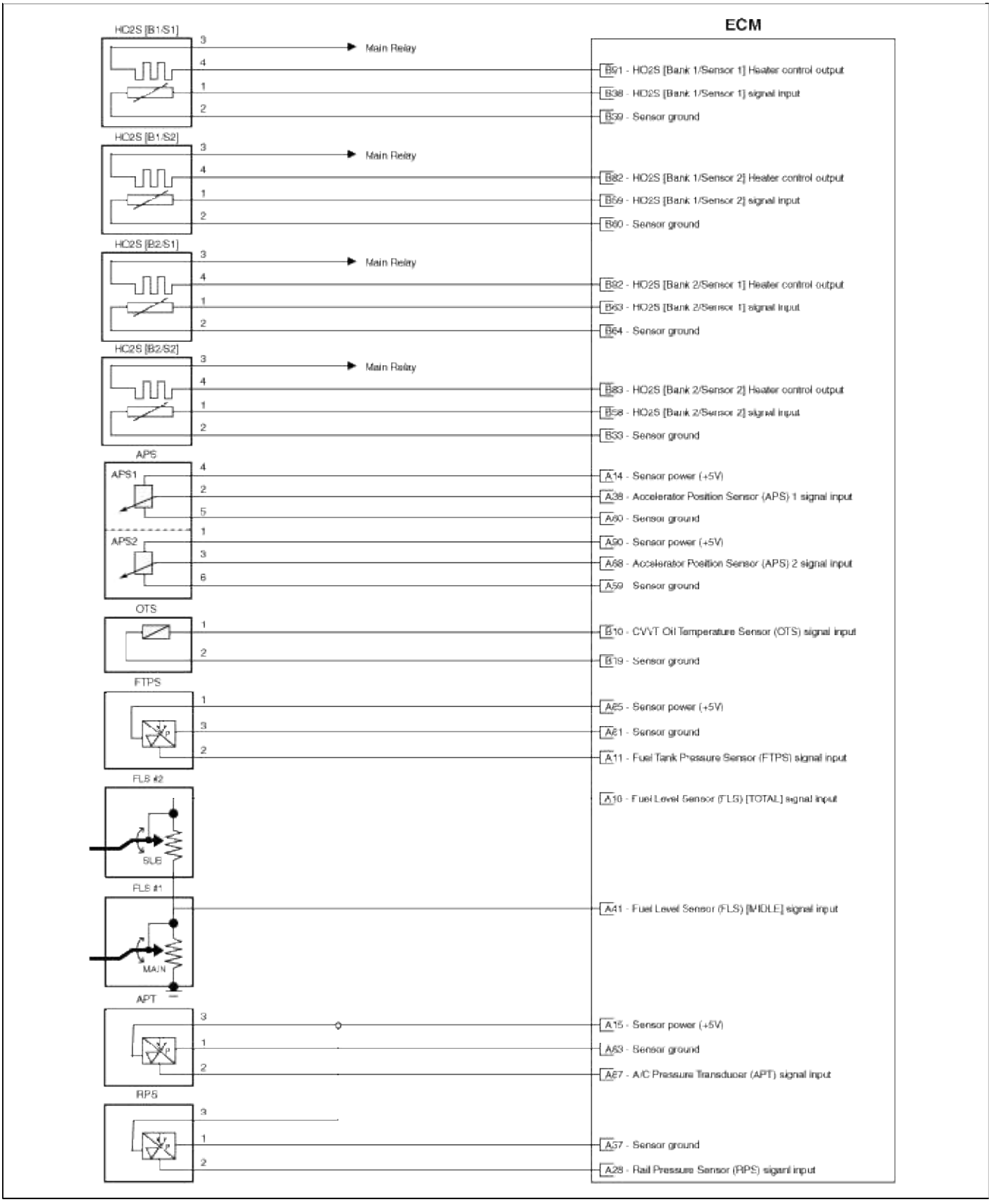
82	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.15V 0<DUTY<100%< span>
83	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] Heater control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.15V 0<DUTY<100%< span>
84	Fuel Pressure Control Valve (FPCV) control output			
85	Injector (Cylinder #2) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<FREQUENCY< span 58.3Hz<> 47<VPEAK<64V< span>
86	Injector (Cylinder #5) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<FREQUENCY< span 58.3Hz<> 47<VPEAK<64V< span>
87	Injector (Cylinder #3) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<FREQUENCY< span 58.3Hz<> 47<VPEAK<64V< span>
88	Injector (Cylinder #6) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<FREQUENCY< span 58.3Hz<> 47<VPEAK<64V< span>
89	Injector (Cylinder #4) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<FREQUENCY< span 58.3Hz<> 47<VPEAK<64V< span>
90	Injector (Cylinder #1) control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V 0<FREQUENCY< span 58.3Hz<> 47<VPEAK<64V< span>
91	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.15V 0<DUTY<100%< span>

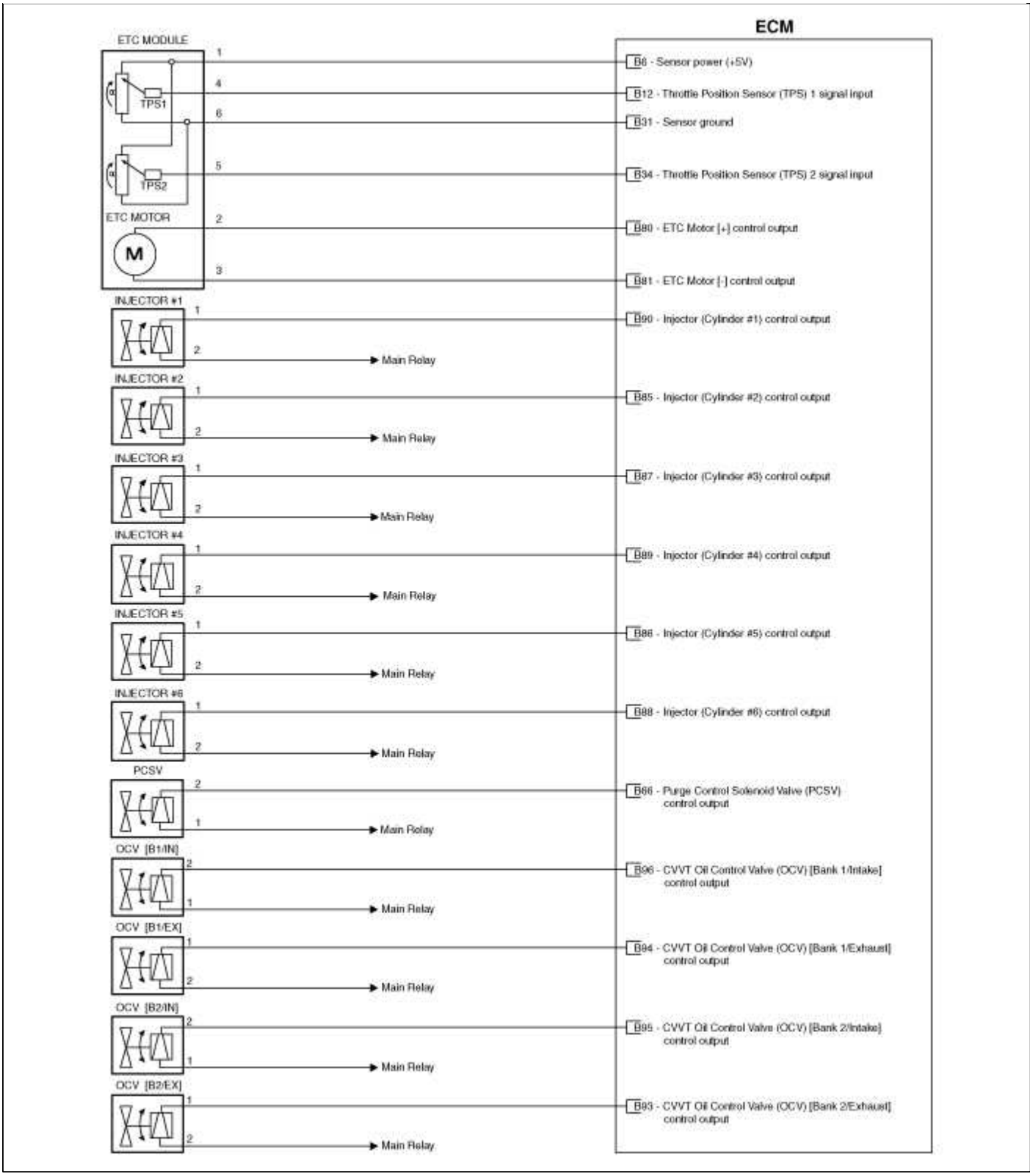
92	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] Heater control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.15V 0<DUTY<100%< span>
93	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust] control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V Frequency = 128Hz 0<DUTY<100%< span>
94	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust] control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V Frequency = 128Hz 0<DUTY<100%< span>
95	CVVT Oil Control Valve (OCV) [Bank 2/Intake] control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V Frequency = 128Hz 0<DUTY<100%< span>
96	CVVT Oil Control Valve (OCV) [Bank 1/Intake] control output	Engine Running	PWM	High: Battery Voltage Low: Max. 1.0V Frequency = 128Hz 0<DUTY<100%< span>
97	Ignition Coil (Cylinder #2) control output	Engine Running	Pulse	Vpeak = 400V 0<FREQUENCY< span 58.3Hz<>
98	Ignition Coil (Cylinder #6) control output	Engine Running	Pulse	Vpeak = 400V 0<FREQUENCY< span 58.3Hz<>
99	Ignition Coil (Cylinder #4) control output	Engine Running	Pulse	Vpeak = 400V 0<FREQUENCY< span 58.3Hz<>
100	-			

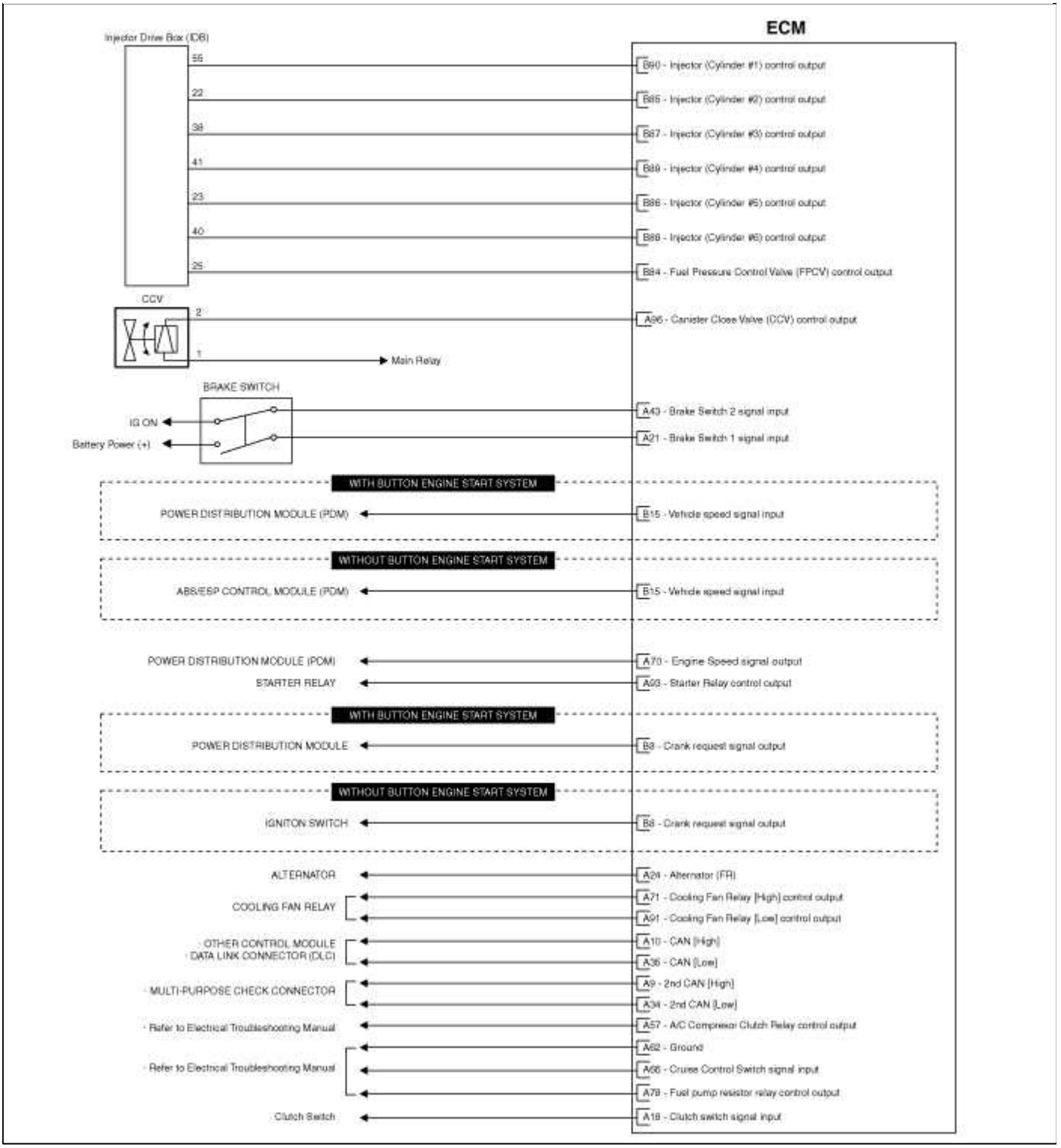
Circuit Diagram


ECM
BATTERY
CHASSIS GROUND
IGNITION SWITCH
MAIN RELAY
FUEL PUMP RELAY
FUEL PUMP
IG. COIL (CYL. #1)
IG. COIL (CYL. #3)
IG. COIL (CYL. #5)
IG. COIL (CYL. #2)
IG. COIL (CYL. #4)
IG. COIL (CYL. #6)
CONDENSER
CONDENSER
A52 - Battery power (B+)
A77 - Battery power (B+)
A5 - Power ground
A6 - Power ground
A30 - Power ground
A56 - Power ground
A80 - Power ground
A27 - Battery power (B+)
A100 - Battery power (B+)
A99 - Battery power (B+)
A75 - Battery power (B+)
A94 - Main Relay control output
A96 - Fuel Pump Relay control output
B24 - Ignition Coil (Cylinder #1) control output
B49 - Ignition Coil (Cylinder #3) control output
B74 - Ignition Coil (Cylinder #5) control output
B97 - Ignition Coil (Cylinder #2) control output
B99 - Ignition Coil (Cylinder #4) control output
B98 - Ignition Coil (Cylinder #6) control output
WITH BUTTON ENGINE START SYSTEM
SMART KEY CONTROL SYSTEM
Ground
Main Relay
A74 - Immobilizer communication line
WITHOUT BUTTON ENGINE START SYSTEM
IMMOBILIZER CONTROL MODULE
Ground
Main Relay
A74 - Immobilizer communication line
IMMOBILIZER LAMP
Battery Power
A4 - Immobilizer Lamp control output


ECM
BPS & IATS
MAPS
ECTS
CMPS [B1/IN]
CMPS [B2/EX]
CMPS [B2/IN]
CMPS [B1/EX]
CKPS
KS #1
KS #2
B48 - Sensor power (+5V)
B56 - Sensor ground
B5 - Barometric Pressure Sensor (BPS) #1 signal input
B14 - Intake Temperature Sensor (IATS) signal input
B13 - Manifold Absolute Pressure Sensor (MAPS) signal input
B25 - Engine Coolant Temperature Sensor (ECTS) signal input
B5 - Sensor power (+5V)
B71 - Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input
B32 - Sensor ground
B46 - Camshaft Position Sensor (CMPS) [Bank 2/Exhaust] signal input
B73 - Sensor power (+5V)
B21 - Camshaft Position Sensor (CMPS) [Bank 2/Intake] signal input
B44 - Sensor ground
B70 - Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input
B18 - Crankshaft Position Sensor (CKPS) [High] signal input
B43 - Crankshaft Position Sensor (CKPS) [Low] signal input
B42 - Knock Sensor (KS) [Bank 1] [Low] signal input
B17 - Knock Sensor (KS) [Bank 1] [High] signal input
B40 - Sensor Shield
B41 - Knock Sensor (KS) [Bank 2] [Low] signal input
B16 - Knock Sensor (KS) [Bank 2] [High] signal input


ECM
HO2S [B1/S1]
3
4
1
2
Main Relay
B91 - HO2S [Bank 1/Sensor 1] Heater control output
B38 - HO2S [Bank 1/Sensor 1] signal input
B39 - Sensor ground
HO2S [B1/S2]
3
4
1
2
Main Relay
B82 - HO2S [Bank 1/Sensor 2] Heater control output
B59 - HO2S [Bank 1/Sensor 2] signal input
B60 - Sensor ground
HO2S [B2/S1]
3
4
1
2
Main Relay
B92 - HO2S [Bank 2/Sensor 1] Heater control output
B63 - HO2S [Bank 2/Sensor 1] signal input
B64 - Sensor ground
HO2S [B2/S2]
3
4
1
2
Main Relay
B83 - HO2S [Bank 2/Sensor 2] Heater control output
B58 - HO2S [Bank 2/Sensor 2] signal input
B33 - Sensor ground
APS
APS1
APS2
4
2
5
1
3
6
A14 - Sensor power (+5V)
A38 - Accelerator Position Sensor (APS) 1 signal input
A60 - Sensor ground
A90 - Sensor power (+5V)
A68 - Accelerator Position Sensor (APS) 2 signal input
A59 - Sensor ground
OTS
1
2
B10 - CVVT Oil Temperature Sensor (OTS) signal input
B19 - Sensor ground
FTPS
1
3
2
A25 - Sensor power (+5V)
A61 - Sensor ground
A11 - Fuel Tank Pressure Sensor (FTPS) signal input
FLS #2
SUB
A10 - Fuel Level Sensor (FLS) [TOTAL] signal input
FLS #1
MAIN
A41 - Fuel Level Sensor (FLS) [MIDLE] signal input
APT
3
1
2
A15 - Sensor power (+5V)
A53 - Sensor ground
A27 - A/C Pressure Transducer (APT) signal input
RPS
3
1
2
A37 - Sensor ground
A28 - Rail Pressure Sensor (RPS) signal input


ECM
ETC MODULE
TPS1
TPS2
ETC MOTOR
M
INJECTOR #1
INJECTOR #2
INJECTOR #3
INJECTOR #4
INJECTOR #5
INJECTOR #6
PCSV
OCV [B1/IN]
OCV [B1/EX]
OCV [B2/IN]
OCV [B2/EX]
Main Relay
B6 - Sensor power (+5V)
B12 - Throttle Position Sensor (TPS) 1 signal input
B31 - Sensor ground
B34 - Throttle Position Sensor (TPS) 2 signal input
B80 - ETC Motor [+] control output
B81 - ETC Motor [-] control output
B90 - Injector (Cylinder #1) control output
B85 - Injector (Cylinder #2) control output
B87 - Injector (Cylinder #3) control output
B89 - Injector (Cylinder #4) control output
B86 - Injector (Cylinder #5) control output
B88 - Injector (Cylinder #6) control output
B86 - Purge Control Solenoid Valve (PCSV) control output
B96 - CVVT Oil Control Valve (OCV) [Bank 1/Intake] control output
B94 - CVVT Oil Control Valve (OCV) [Bank 1/Exhaust] control output
B95 - CVVT Oil Control Valve (OCV) [Bank 2/Intake] control output
B93 - CVVT Oil Control Valve (OCV) [Bank 2/Exhaust] control output



Fuel System > Engine Control System > Engine Control Module (ECM) > Repair procedures

Removal

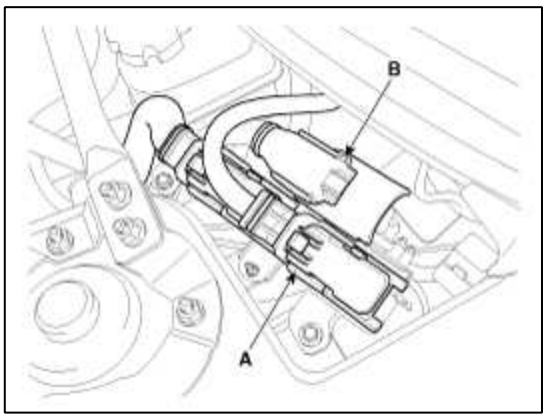
CAUTION

When replacing the ECM, the vehicle equipped with the immobilizer must be performed procedure as below.
[In the case of installing used ECM]
1) Perform "ECM Neutral mode" procedure with GDS. (Refer to "Immobilizer" in BE group)
2) After finishing "ECM Neutral mode", perform "Key teaching" procedure with GDS. (Refer to "Immobilizer" in BE group)
[In the case of installing new ECM]
Perform "Key teaching" procedure with GDS. (Refer to "Immobilizer" in BE group)

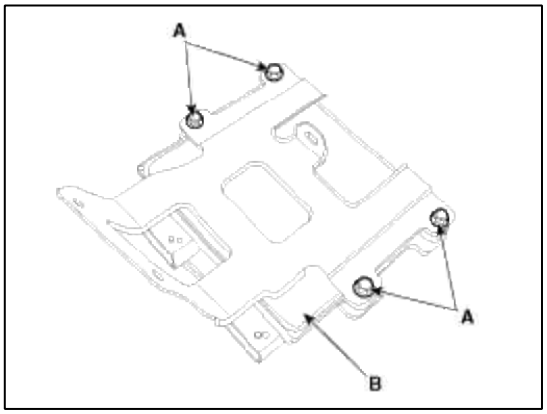
CAUTION

When replacing the ECM, the vehicle equipped with the smart key system (Button start) must be performed procedure as below.
[In the case of installing used ECM]
1) Perform "ECM Neutral mode" procedure with GDS. (Refer to "Smart key" in BE group)
2) After finishing "ECM Neutral mode", insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.
[In the case of installing new ECM]
Insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.

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



4. Remove the ECM & TCM bracket installation bolts (C) and nut (D).
5. After removing the installation bolts (A), remove the ECM (B) from the bracket.



Installation

NOTE

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

1. Installation is reverse of removal.

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

ECM Problem Inspection Procedure

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

Specification: Below 1Ω

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

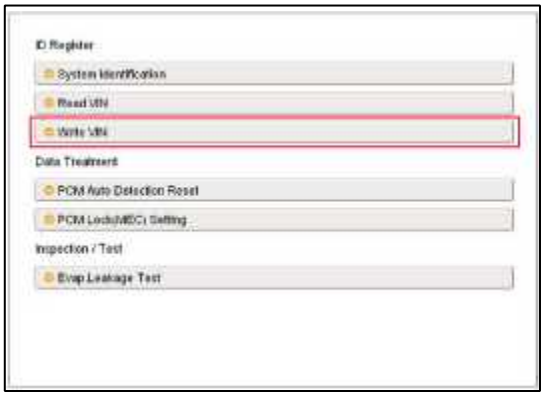
VIN Programming Procedure

VIN (Vehicle Identification Number) is a number that has the vehicle's information (Maker, Vehicle Type, Vehicle Line/Series, Body Type, Engine Type, Transmission Type, Model Year, Plant Location and so forth. For more information, please refer to the group "GI" in this SERVICE MANUAL). When replacing an ECM, the VIN must be programmed in the ECM. If there is no VIN in ECM memory, the fault code (DTC P0630) is set.

CAUTION

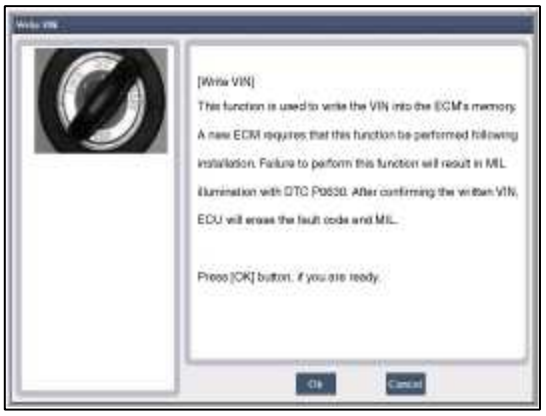
The programmed VIN cannot be changed. When writing the VIN, confirm the VIN carefully

1. Select "VIN Writing" function in "Vehicle S/W Management".
2. Select "Write VIN" in "ID Register".



3. Input the VIN.

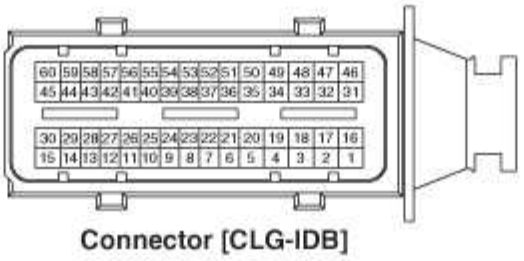
> WARNING
>
> Before inputing the VIN, confirm the VIN again because the programmed VIN cannot be changed.



4. Turn the ignition switch OFF, then back ON.

Fuel System > Engine Control System > Injector Drive Box (IDB) > Schematic Diagrams

IDB terminal and Inoutput



Connector [CLG-IDB]

IDB terminal function

Connector [CLG-IDB]

Pin No.	Description	Connected to
1	-	
2	-	
3	-	
4	-	
5	-	
6	-	
7	-	
8	-	
9	-	
10	-	
11	-	

12	-	
13	-	
14	-	
15	-	
16	Injector (Cylinder #3) [Low] control output	Injector (Cylinder #3)
17	Injector (Cylinder #6) [Low] control output	Injector (Cylinder #6)
18	Injector (Cylinder #6) [High] control output	Injector (Cylinder #6)
19	Injector (Cylinder #2) [Low] control output	Injector (Cylinder #2)
20	Injector (Cylinder #5) [Low] control output	Injector (Cylinder #5)
21	-	
22	Injector (Cylinder #2) signal input	Engine Control Module (ECM)
23	Injector (Cylinder #5) signal input	Engine Control Module (ECM)
24	-	
25	Fuel Pressure Control Valve (FPRV) logic input	Engine Control Module (ECM)
26	CCP-CAN [Low]	Other control module, Data Link Connector (DLC), Multi-purpose check connector
27	CCP-CAN [High]	Other control module, Data Link Connector (DLC), Multi-purpose check connector
28	Battery power (B+)	Ignition switch
29	Battery power (B+)	Main relay
30	Battery power (B+)	Main relay
31	Injector (Cylinder #4) [High] control output	Injector (Cylinder #4)
32	Injector (Cylinder #1) [High] control output	Injector (Cylinder #1)
33	Injector (Cylinder #3) [High] control output	Injector (Cylinder #3)
34	Injector (Cylinder #2) [High] control output	Injector (Cylinder #2)
35	Injector (Cylinder #5) [High] control output	Injector (Cylinder #5)
36	-	
37	-	
38	Injector (Cylinder #3) signal input	Engine Control Module (ECM)
39	-	
40	Injector (Cylinder #6) signal input	Engine Control Module (ECM)
41	Injector (Cylinder #4) signal input	Engine Control Module (ECM)
42	Battery power (B+)	Ignition switch
43	Battery power (B+)	Main relay
44	Battery power (B+)	Main relay
45	Fuel Pressure Control Valve (FPRV) [High] control output	Fuel Pressure Control Valve (FPRV)

46	Injector (Cylinder #4) [Low] control output	Injector (Cylinder #4)
47	Injector (Cylinder #1) [Low] control output	Injector (Cylinder #1)
48	ECM ground	Chassis ground
49	ECM ground	Chassis ground
50	ECM ground	Chassis ground
51	-	
52	-	
53	-	
54	-	
55	Injector (Cylinder #1) signal input	Engine Control Module (ECM)
56	-	
57	-	
58	-	
59	Battery power (B+)	Main relay
60	Fuel Pressure Control Valve (FPRV) [Low] control output	Fuel Pressure Control Valve (FPRV)

IDB Terminal input/output signal

Connector [CLG-IDB]

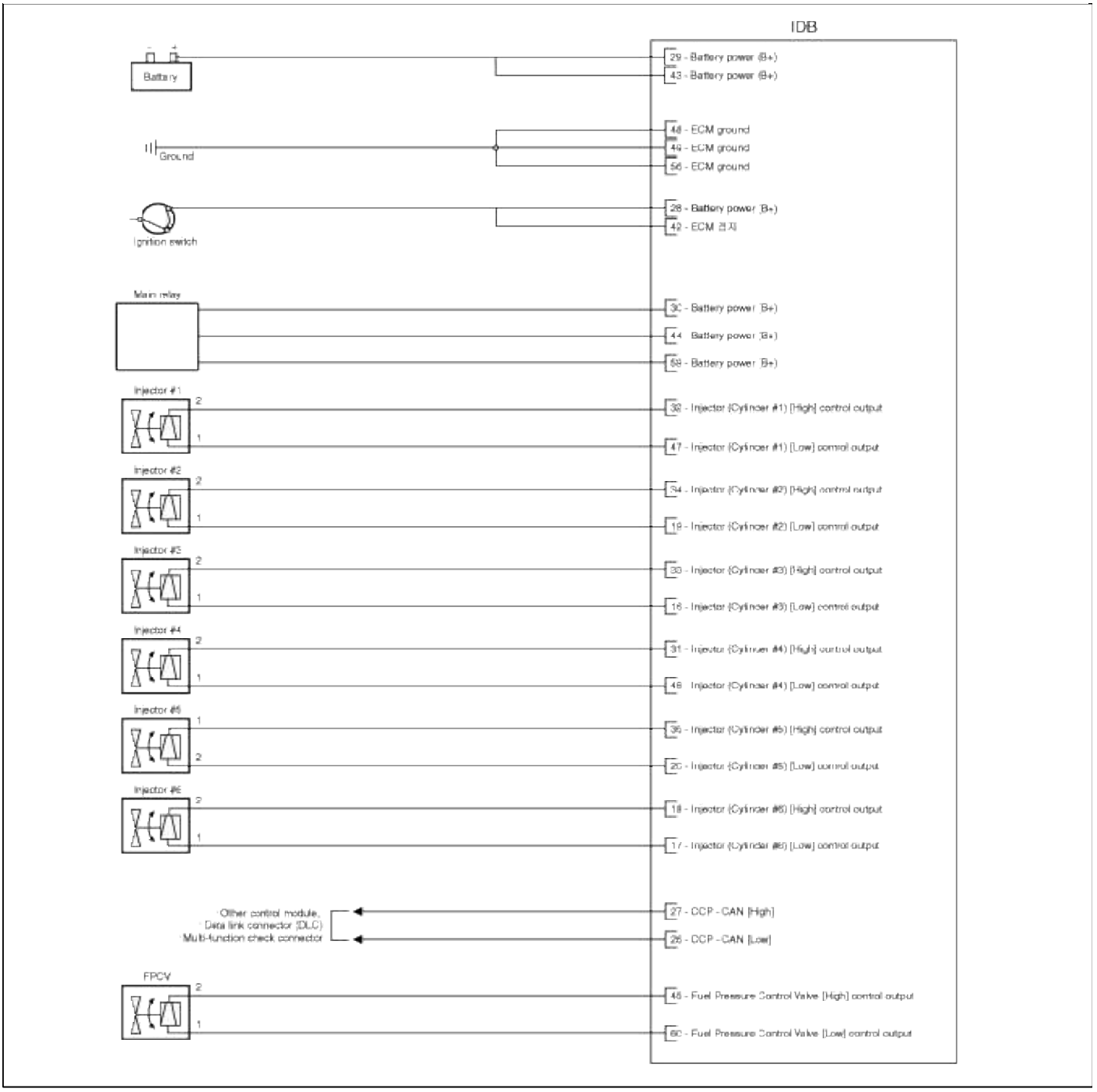
Pin No.	Description	Condition	Type	Level
1	-			
2	-			
3	-			
4	-			
5	-			
6	-			
7	-			
8	-			
9	-			
10	-			
11	-			
12	-			
13	-			
14	-			
15	-			

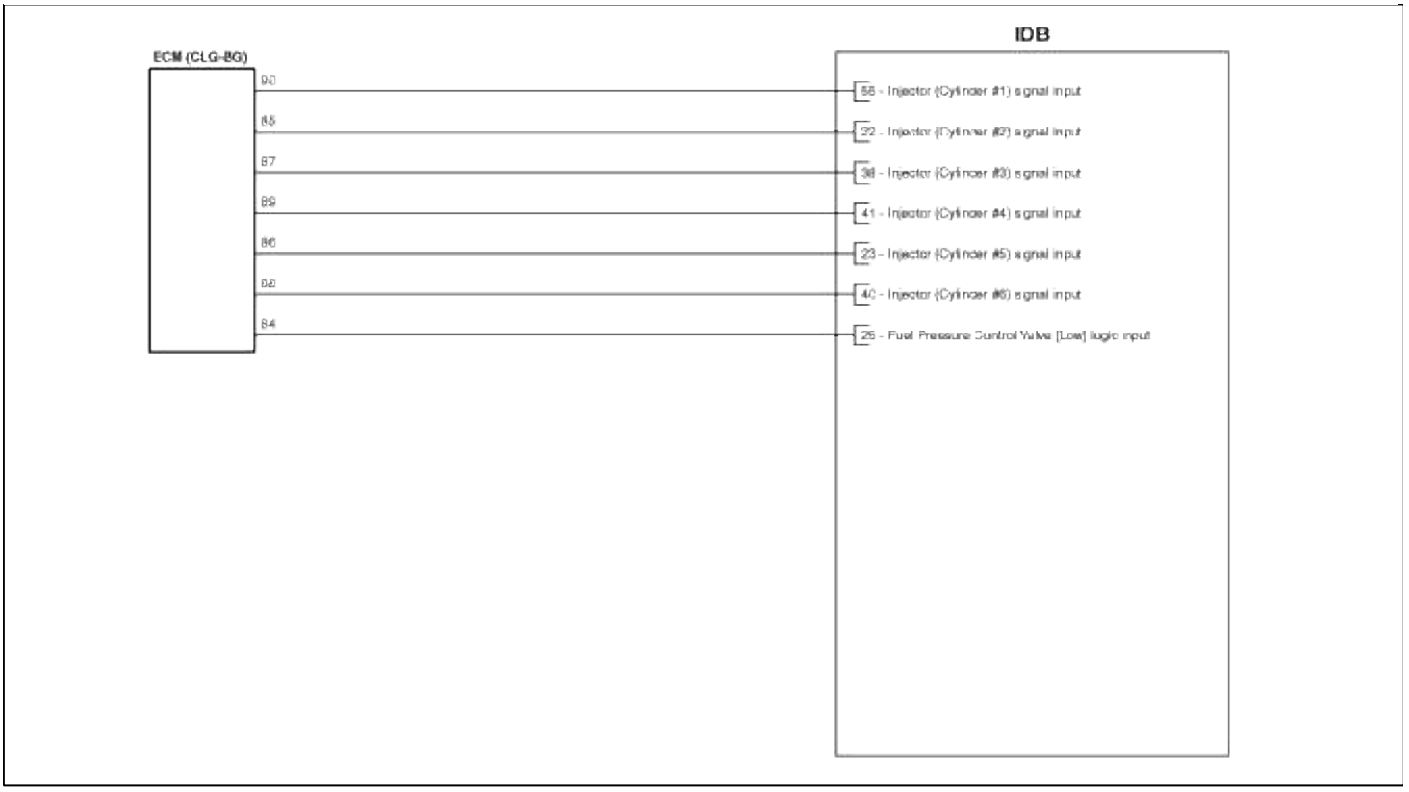
16	Injector (Cylinder #3) [Low] control output	Idle	Pulse	High: Battery voltage
		Relay ON		Low: Max. 1.0V
17	Injector (Cylinder #6) [Low] control output	Idle	Pulse	High: Battery voltage
		Relay ON		Low: Max. 1.0V
18	Injector (Cylinder #6) [High] control output	Idle	Pulse	High: Battery voltage ~ 80V
		Relay ON		Low: Battery voltage
19	Injector (Cylinder #2) [Low] control output	Idle	Pulse	High: Battery voltage
		Relay ON		Low: Max. 1.0V
20	Injector (Cylinder #5) [Low] control output	Idle	Pulse	High: Battery voltage
		Relay ON		Low: Max. 1.0V
21	-			
22	Injector (Cylinder #2) signal input	Idle	Pulse	High: Battery voltage
				Low: Max. 1.0V
23	Injector (Cylinder #5) signal input	Idle	Pulse	High: Battery voltage
				Low: Max. 1.0V
24	-			
25	Fuel Pressure Control Valve (FPRV) logic input			
26	CCP-CAN [Low]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		2.75 ~ 4.5V
27	CCP-CAN [High]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		2.75 ~ 4.5V
28	Battery power (B+)	IG OFF	DC voltage	Max. 0.5V
		IG ON		Battery voltage
29	Battery power (B+)	IG OFF	DC voltage	Max. 0.5V
		IG ON		Battery voltage
30	Battery power (B+)	IG OFF	DC voltage	Max. 0.5V
		IG ON		Battery voltage
31	Injector (Cylinder #4) [High] control output	Idle	Pulse	High: Battery voltage ~ 80V
		Relay ON		Low: Battery voltage
32	Injector (Cylinder #1) [High] control output	Idle	Pulse	High: Battery voltage ~ 80V
		Relay ON		Low: Battery voltage

33	Injector (Cylinder #3) [High] control output	Idle	Pulse	High: Battery voltage ~ 80V
		Relay ON		Low: Battery voltage
34	Injector (Cylinder #2) [High] control output	Idle	Pulse	High: Battery voltage ~ 80V
		Relay ON		Low: Battery voltage
35	Injector (Cylinder #5) [High] control output	Idle	Pulse	High: Battery voltage ~ 80V
		Relay ON		Low: Battery voltage
36	-			
37	-			
38	Injector (Cylinder #3) signal input	Idle	Pulse	High: Battery voltage
				Low: Max. 1.0V
39	-			
40	Injector (Cylinder #6) signal input	Idle	Pulse	High: Battery voltage
				Low: Max. 1.0V
41	Injector (Cylinder #4) signal input	Idle	Pulse	High: Battery voltage
				Low: Max. 1.0V
42	Battery power (B+)	IG OFF	DC voltage	Max. 0.5V
		IG ON		Battery voltage
43	Battery power (B+)	IG OFF	DC voltage	Max. 0.5V
		IG ON		Battery voltage
44	Battery power (B+)	IG OFF	DC voltage	Max. 0.5V
		IG ON		Battery voltage
45	Fuel Pressure Control Valve (FPRV) [High] control output	Idle	DC voltage	Battery voltage
				Max. 1.0V
46	Injector (Cylinder #4) [Low] control output	Idle	Pulse	High: Battery voltage
		Relay ON		Low: Max. 1.0V
47	Injector (Cylinder #1) [Low] control output	Idle	Pulse	High: Battery voltage
		Relay ON		Low: Max. 1.0V
48	ECM ground	Idle	DC voltage	Max. 50mV
49	ECM ground	Idle	DC voltage	Max. 50mV
50	ECM ground	Idle	DC voltage	Max. 50mV
51	-			
52	-			

53	-			
54	-			
55	Injector (Cylinder #1) signal input	Idle	Pulse	High: Battery voltage
				Low: Max. 1.0V
56	-			
57	-			
58	-			
59	Battery power (B+)	IG OFF	DC voltage	Max. 0.5V
		IG ON		Battery voltage
60	Fuel Pressure Control Valve (FPRV) [Low] control output	Idle	DC voltage	Battery voltage
				Max. 1.0V

Circuit Diagram

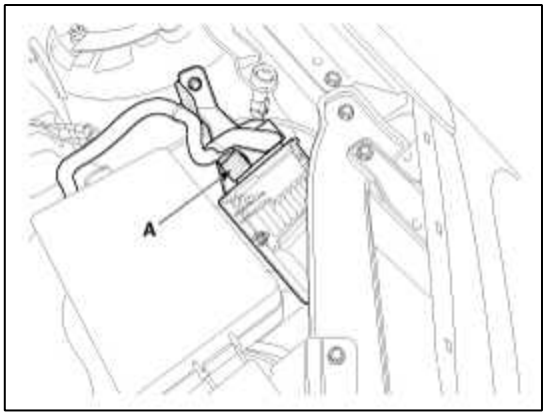

IDB
Battery
29 - Battery power (B+)
43 - Battery power (B+)
Ground
48 - ECM ground
49 - ECM ground
56 - ECM ground
Ignition switch
28 - Battery power (B+)
42 - ECM 점지
Main relay
30 - Battery power (B+)
44 - Battery power (B+)
58 - Battery power (B+)
Injector #1
2
1
32 - Injector (Cylinder #1) [High] control output
47 - Injector (Cylinder #1) [Low] control output
Injector #2
2
1
34 - Injector (Cylinder #2) [High] control output
19 - Injector (Cylinder #2) [Low] control output
Injector #3
2
1
33 - Injector (Cylinder #3) [High] control output
18 - Injector (Cylinder #3) [Low] control output
Injector #4
2
1
31 - Injector (Cylinder #4) [High] control output
46 - Injector (Cylinder #4) [Low] control output
Injector #5
1
2
35 - Injector (Cylinder #5) [High] control output
20 - Injector (Cylinder #5) [Low] control output
Injector #6
2
1
16 - Injector (Cylinder #6) [High] control output
17 - Injector (Cylinder #6) [Low] control output
Other control module,
Data link connector (DLC)
Multi-function check connector
27 - CCP - CAN [High]
26 - CCP - CAN [Low]
FPCV
2
1
45 - Fuel Pressure Control Valve [High] control output
60 - Fuel Pressure Control Valve [Low] control output



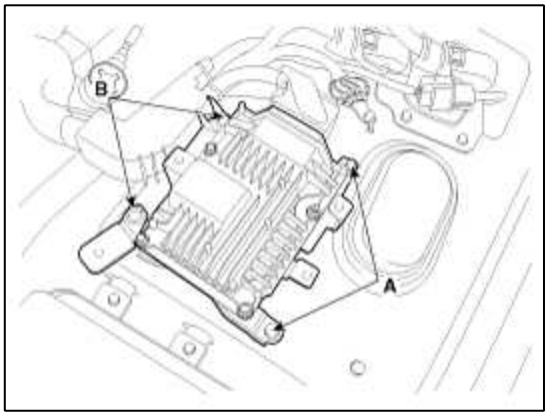
Fuel System > Engine Control System > Injector Drive Box (IDB) > Repair procedures

Removal

1. Turn the ignition switch off and disconnect the battery negative (-) cable.
2. Disconnect the injector drive box (IDB) connector (A).



3. Remove the left side head lamp. (Refer to Head lamp in BE group)
4. Remove the IDB assembly after removing the bolts (A) and the nuts (B).



Installation

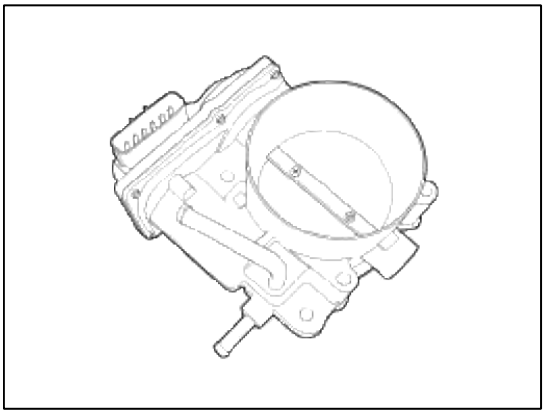
1. Installation is the reverse of removal.

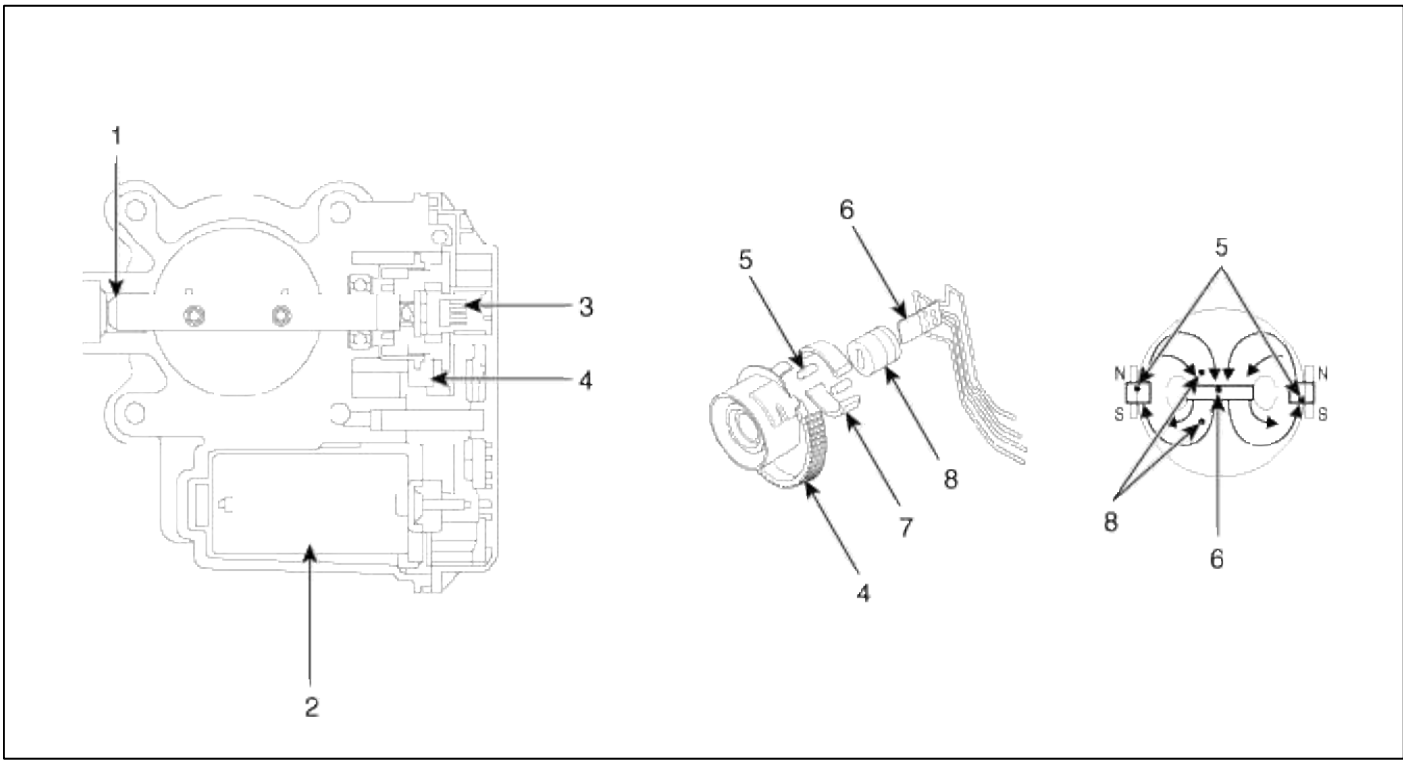
IDB installation bolt/nut:
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)
IDB bracket installation bolt/nut (on vehicle):
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Description and Operation

Description

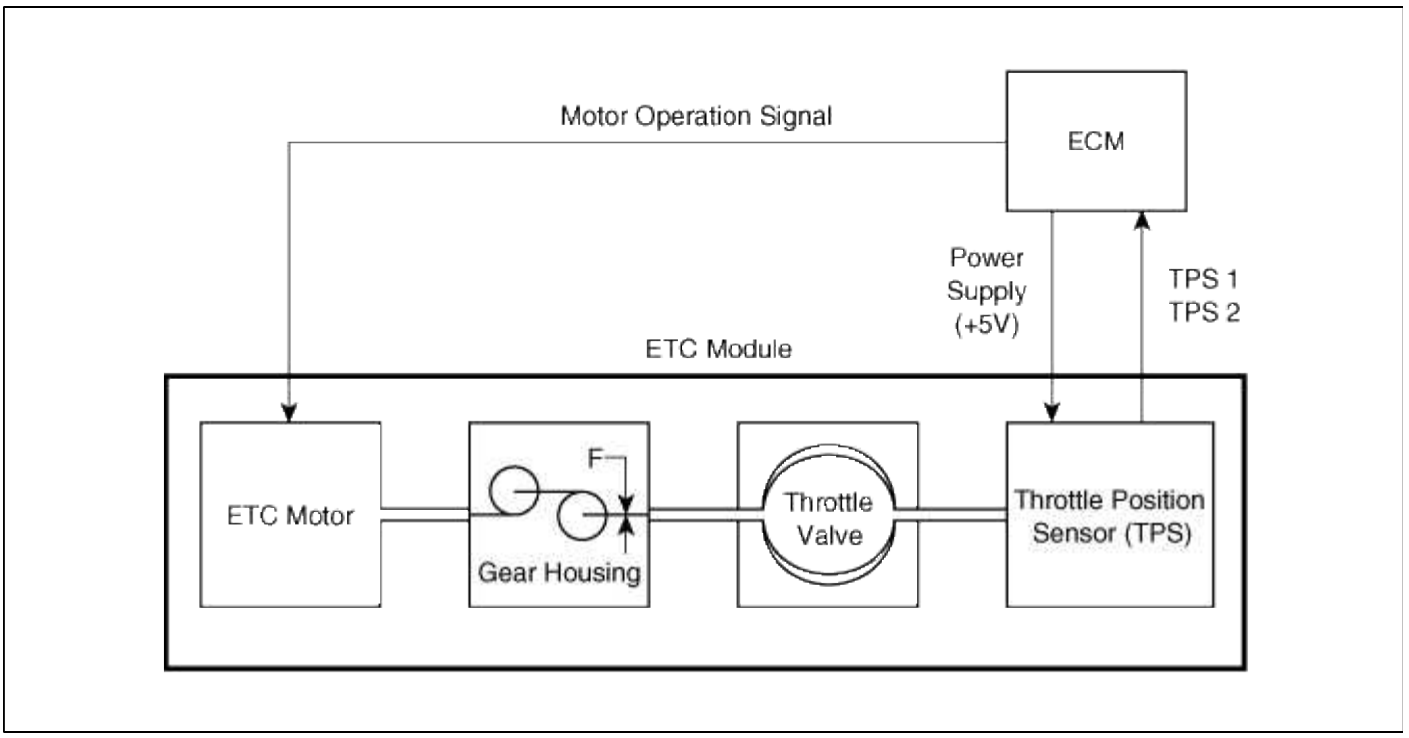
The Electronic Throttle Control (ETC) System consists of a throttle body with an integrated control motor and throttle position sensor (TPS). Instead of the traditional throttle cable, an Accelerator Position Sensor (APS) is used to receive driver input. The ECM uses the APS signal to calculate the target throttle angle; the position of the throttle is then adjusted via ECM control of the ETC motor. The TPS signal is used to provide feedback regarding throttle position to the ECM. Using ETC, precise control over throttle position is possible; the need for external cruise control modules/cables is eliminated.





1. Dry bearing 2. DC motor 3. Non-contact hall sensor 4. Gear	5. Magnet 6. Hall IC 7. Yoke 8. Stator

Schematic Diagram



Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Troubleshooting

Fail-Safe Mode

Item	Fail-Safe	
ETC Motor	Throttle valve stuck at 7°	
TPS	TPS 1 fault	ECM looks at TPS2
	TPS 2 fault	ECM looks at TPS1
	TPS 1,2 fault	Throttle valve stuck at 7°
APS	APS 1 fault	ECM looks at APS 2
	APS 2 fault	ECM looks at APS 1
	APS 1,2 fault	Engine idle state

NOTE

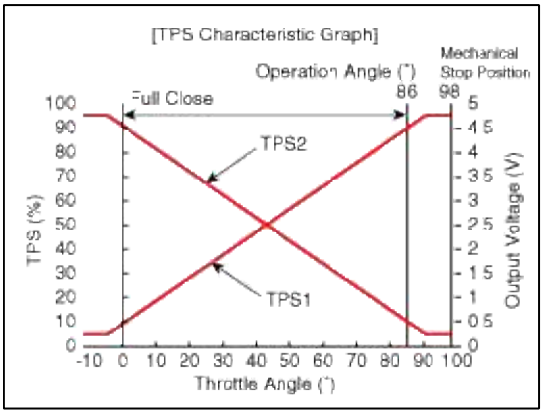
When throttle value is stuck at 7°, engine speed is limited at below 1,500rpm and vehicle speed at maximum 40 ~ 50 km/h (25 ~ 31 mph)

Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Specifications

Specification

[Throttle Position Sensor (TPS)]

Throttle angle(°)	Output Voltage (V)	
	TPS1	TPS2
0	0.5	4.5
10	0.96	4.05
20	1.41	3.59
30	1.87	3.14
40	2.32	2.68
50	2.78	2.23
60	3.23	1.77
70	3.69	1.32
80	4.14	0.86
90	4.6	0.41
98	4.65	0.35
C.T (0)	0.5	4.5
W.O.T (86)	4.41	0.59



[ETC Motor]

Item	Specification
Coil Resistance (Ω)	0.3 ~100 [20°C(68°F)]

Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Schematic Diagrams

Circuit Diagram

Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Repair procedures

Inspection

Throttle Position Sensor (TPS)

1. Connect the GDS on the Data Link Connector (DLC).
2. Start the engine and measure the output voltage of TPS 1 and 2 at C.T. and W.O.T.

Throttle angle(°)	Output Voltage (V)	
	TPS1	TPS2
C.T	0.5	4.5
W.O.T	4.41	0.59

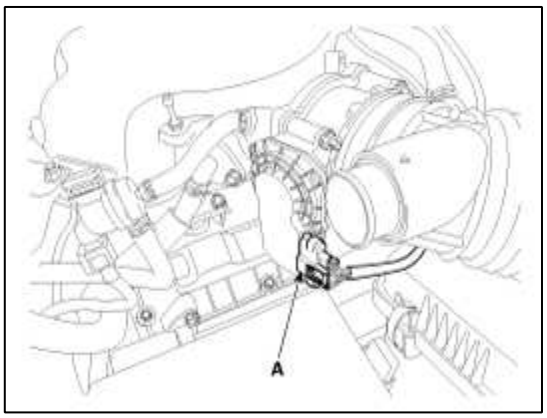
ETC Motor

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

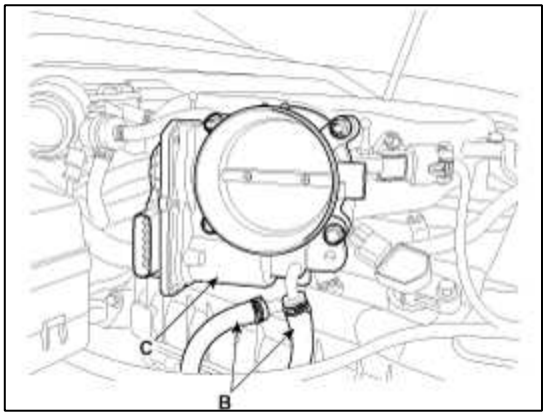
Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the air intake hose (Refer to “Intake And Exhaust System” in EM group).
3. Disconnect the ETC module connector (A).



4. Disconnect the coolant hoses (B).
5. Remove the installation bolts, and then remove the ETC module (C) from the engine.



Installation

CAUTION

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

1. Installation is reverse of removal.

Electronic throttle body Installation bolt:
7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)

Adjustment

ETC module learning procedure

When installing new ETC module or re-installing it, ETC module learning procedure must be performed.
1. Hold the ignition key or the start button at th IG ON position during 5 seconds.
2. Turn ignition swich OFF and then start the engine.

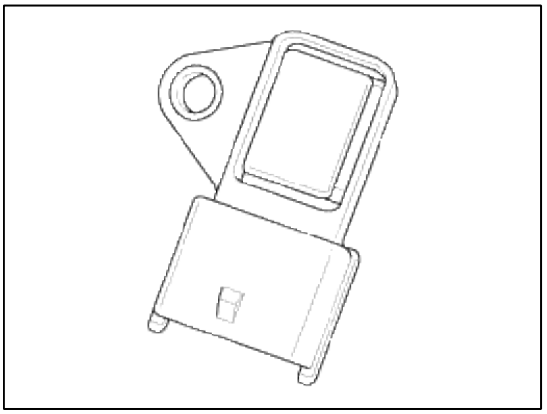
CAUTION

DTC codes (P0638, P2110) might be displayed if ETC module learning procedure does not performed after replacing ETC module.

Fuel System > Engine Control System > Barometric Pressure Sensor (BPS) > Description and Operation

Description

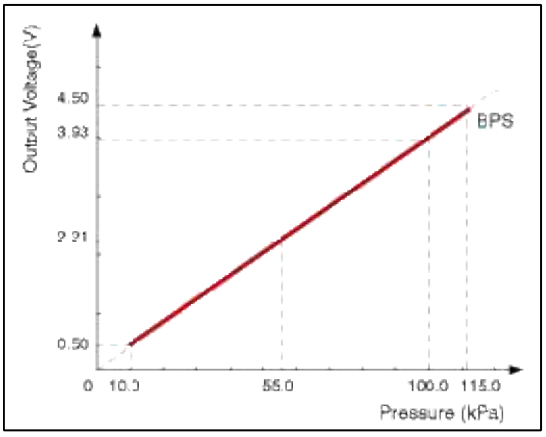
Barometric Pressure Sensor (BPS) is a speed-density type sensor and is installed on the air cleaner assemby. It senses absolute pressure of the air cleaner assemby and transfers the analog signal proportional to the pressure to the ECM. By using this signal, the ECM calculates the intake air quantity and engine speed.
The BPS consists of a piezo-electric element and a hybrid IC amplifying the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor. Because 100% vacuum and the manifold pressure apply to both sides of the sensor respectively, this sensor can output analog signal by using the silicon variation proportional to pressure change.



Fuel System > Engine Control System > Barometric Pressure Sensor (BPS) > Specifications

Specification

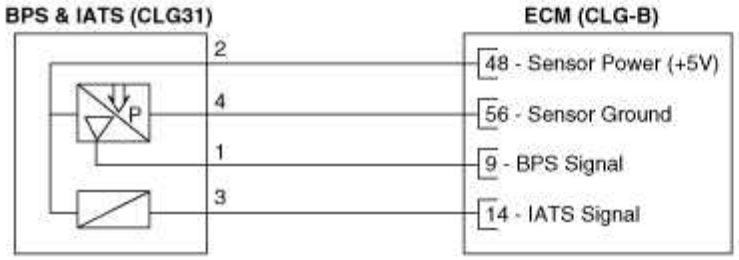
Pressure (kPa)	Output Voltage (V)
10.0	0.50
55.0	2.21
100.0	3.93
115.0	4.50



Fuel System > Engine Control System > Barometric Pressure Sensor (BPS) > Schematic Diagrams

Circuit Diagram

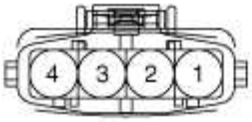
[Circuit Diagram]



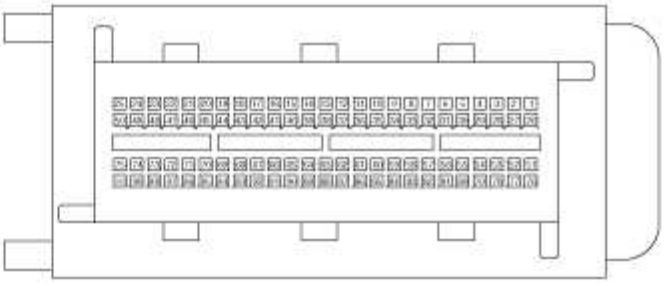
[Connection Information]

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

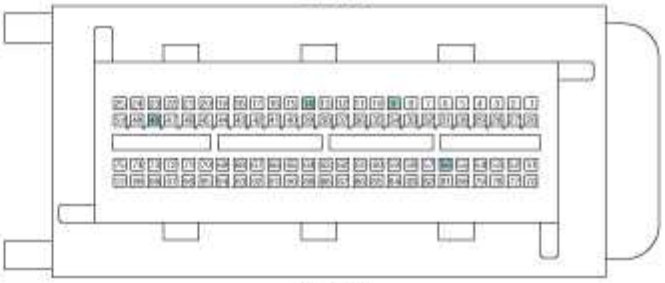
[Harness Connector]



CLG31
BPS & IATS



ELG-A



CLG-B
ECM

Fuel System > Engine Control System > Barometric Pressure Sensor (BPS) > Repair procedures

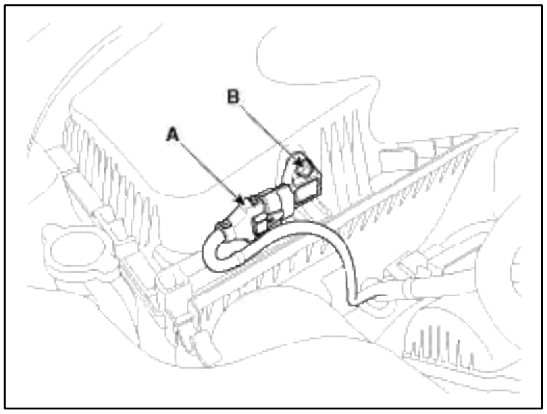
Inspection

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

Specification: Refer to "Specification"

Removal

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



Installation

CAUTION

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

CAUTION

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

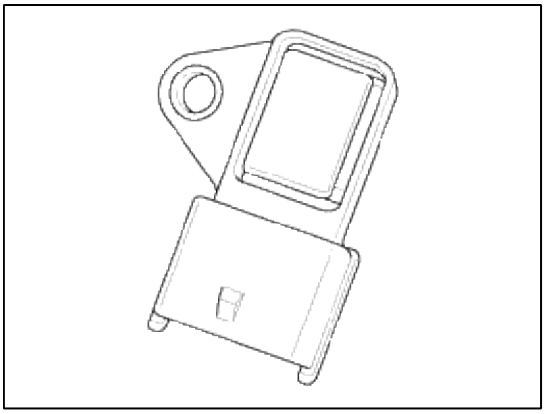
1. Installation is reverse of removal.

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

Fuel System > Engine Control System > Intake Air Temperature Sensor (IATS) > Description and Operation

Description

Intake Air Temperature Sensor (IATS) is included inside Barometric Pressure Sensor and detects the intake air temperature.
To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the ECM uses not only BPS signal but also IATS signal. This sensor has a Negative Temperature Coefficient (NTC) thermistor and it's resistance changes in reverse proportion to the temperature.



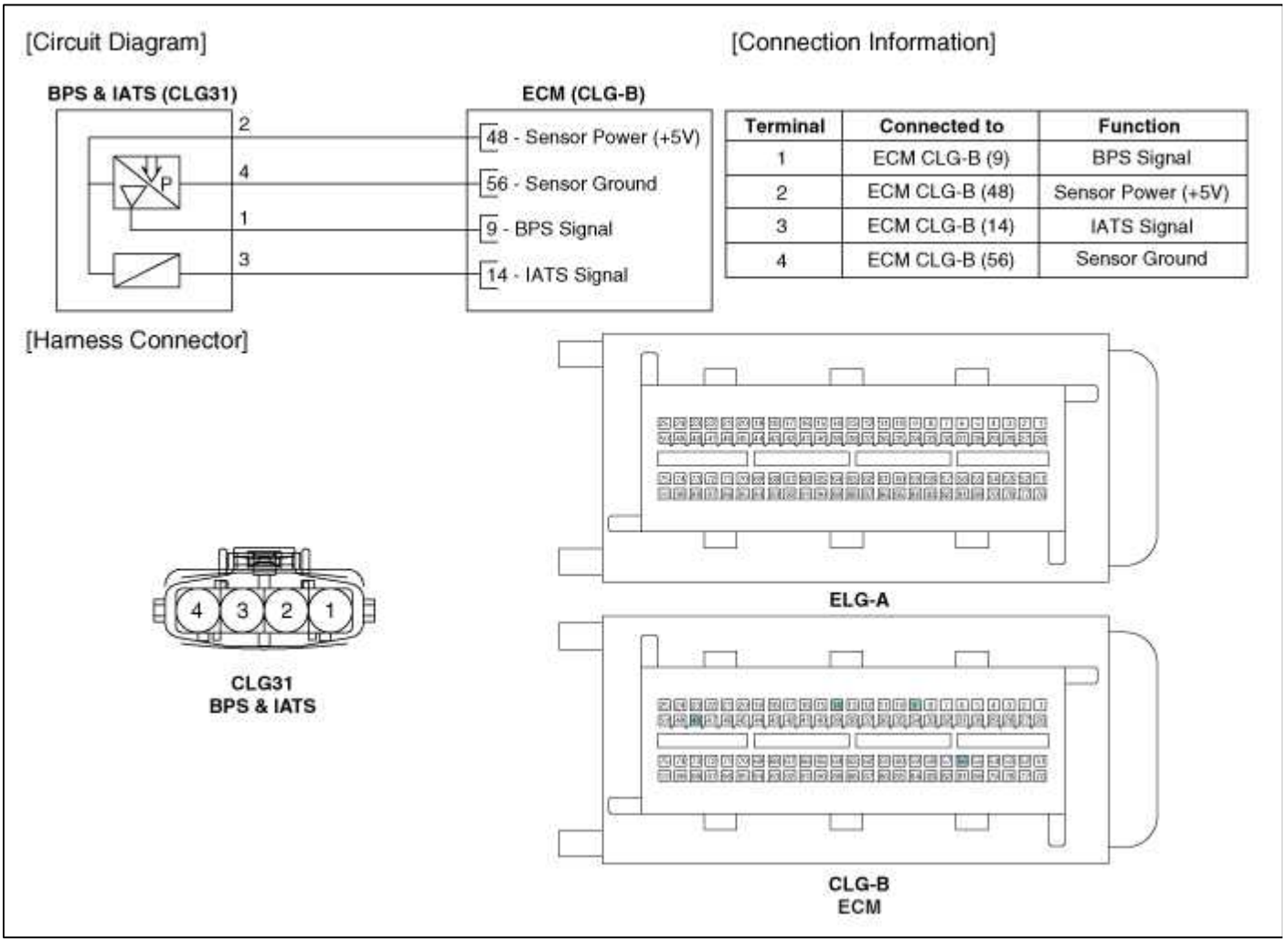
Fuel System > Engine Control System > Intake Air Temperature Sensor (IATS) > Specifications

Specification

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

Fuel System > Engine Control System > Intake Air Temperature Sensor (IATS) > Schematic Diagrams

Circuit Diagram



Fuel System > Engine Control System > Intake Air Temperature Sensor (IATS) > Repair procedures

Inspection

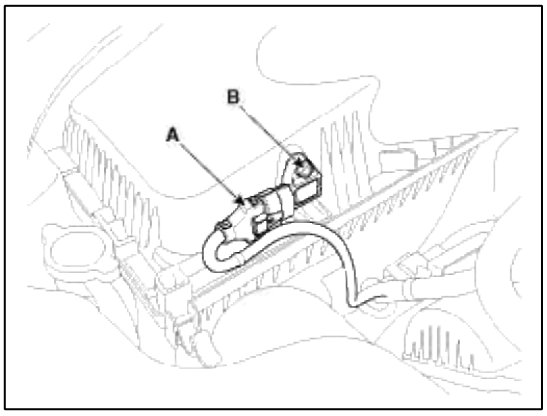
1. Turn the ignition switch OFF.

2. Disconnect the IATS connector.
3. Measure resistance between the IATS terminals 3 and 4.
4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

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



Installation

CAUTION

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

CAUTION

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

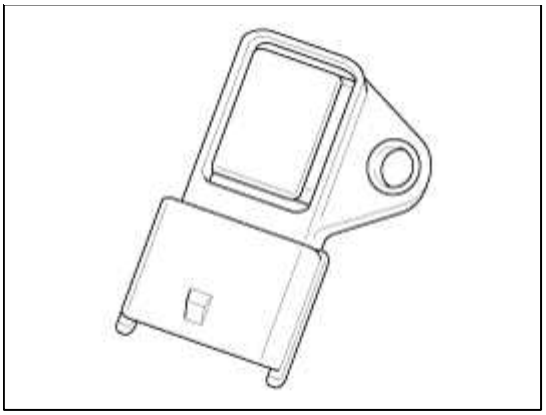
1. Installation is reverse of removal.

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

Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Description and Operation

Description

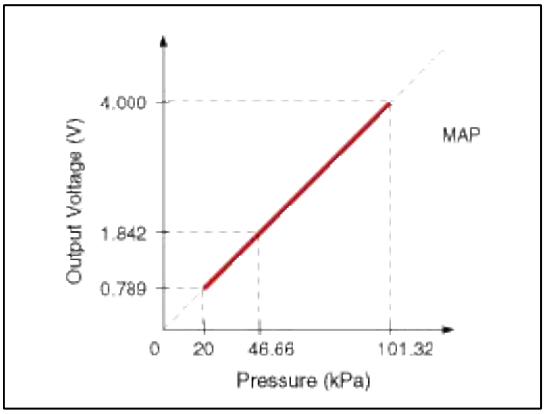
Manifold Absolute Pressure Sensor (MAPS) is a speed-density type sensor and is installed on the surge tank. It senses absolute pressure of the surge tank and transfers the analog signal proportional to the pressure to the ECM. By using this signal, the ECM calculates the intake air quantity and engine speed.
The MAPS consists of a piezo-electric element and a hybrid IC amplifying the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor.
Because 100% vacuum and the manifold pressure apply to both sides of the sensor respectively, this sensor can output analog signal by using the silicon variation proportional to pressure change.



Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Specifications

Specification

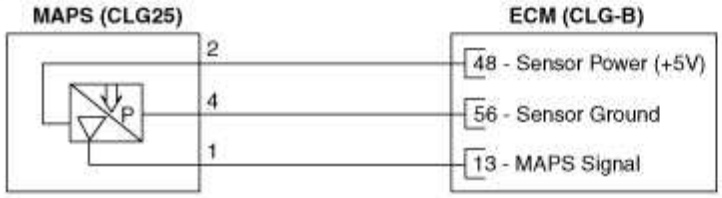
Pressure (kPa)	Output Voltage (V)
20.0	0.79
46.66	1.84
101.32	4.0



Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Schematic Diagrams

Circuit Diagram

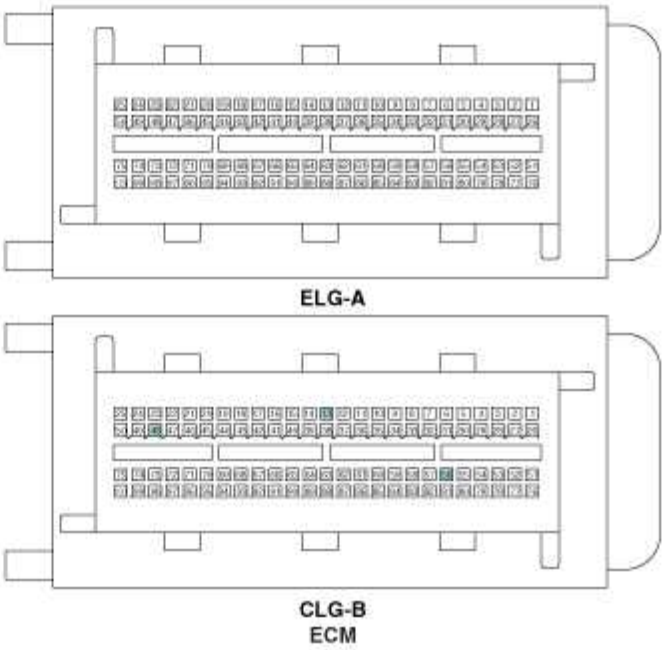
[Circuit Diagram]



[Connection Information]

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

[Harness Connector]



Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Repair procedures

Inspection

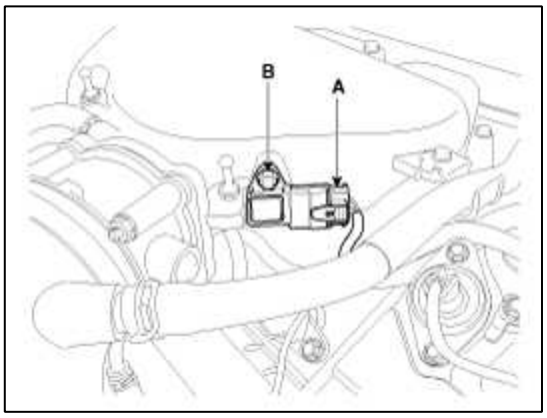
1. Connect the GDS on the Data Link Connector (DLC).
2. Measure the output voltage of the MAPS at idle and IG ON.

Condition	Output Voltage (V)
IG ON	Approx. 4.44V
Idle	Approx. 0.75V

Removal

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

3. Remove the installation bolts (B), and then vertically remove the sensor from the surge tank.



Installation

CAUTION

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

CAUTION

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

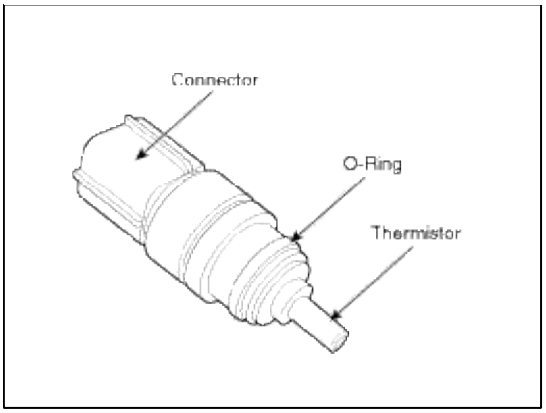
1. Installation is reverse of removal.

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

Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Description and Operation

Description

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



Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Specifications

Specification

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

Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Schematic Diagrams

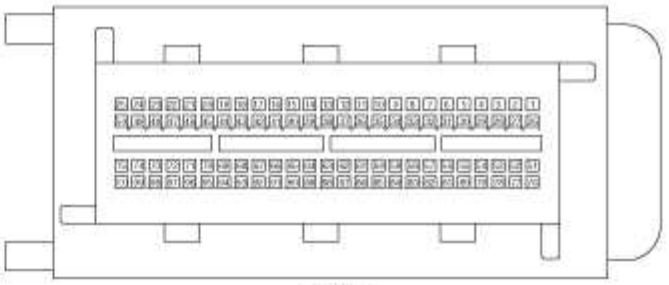
Circuit Diagram

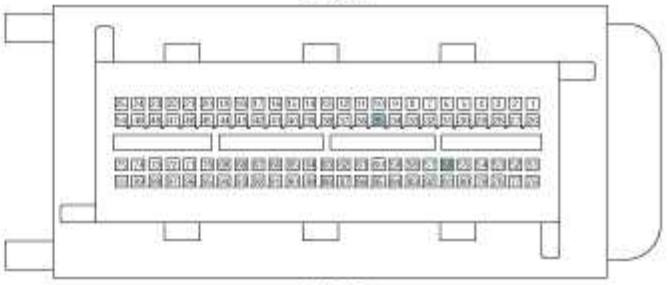
[Circuit Diagram]

[Connection Information]

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

[Harness Connector]





Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Repair procedures

Inspection

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

Specification: Refer to “Specification”

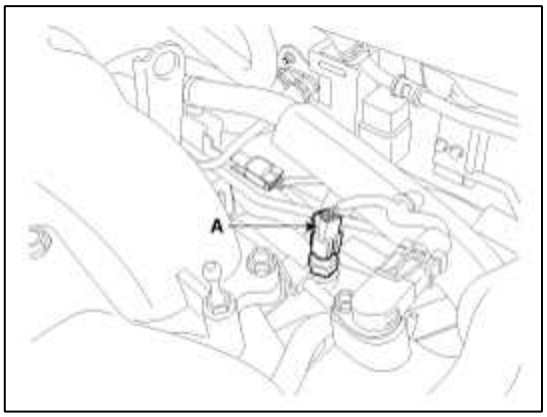
Removal

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

4. Remove the sensor from the water temperature control assembly.

CAUTION

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



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

Installation

CAUTION

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

CAUTION

- Apply the engine coolant to the O-ring.

CAUTION

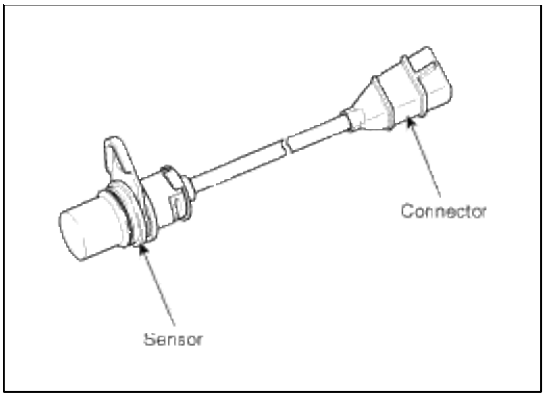
- Insert the sensor in the installation hole and be careful not to damage when installation.

1. Installation is reverse of removal.

Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Description and Operation

Description

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



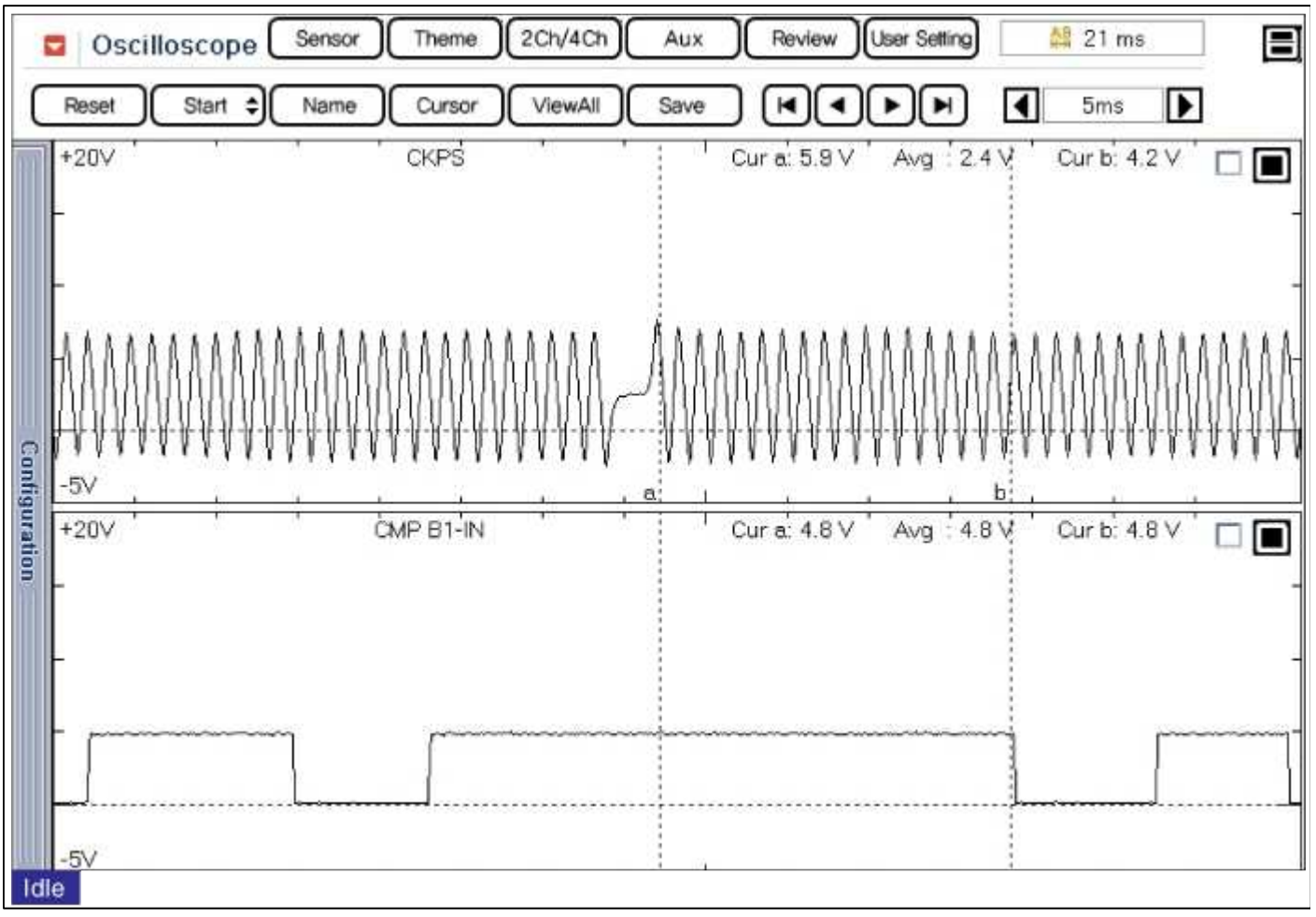
Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Specifications

Specification

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

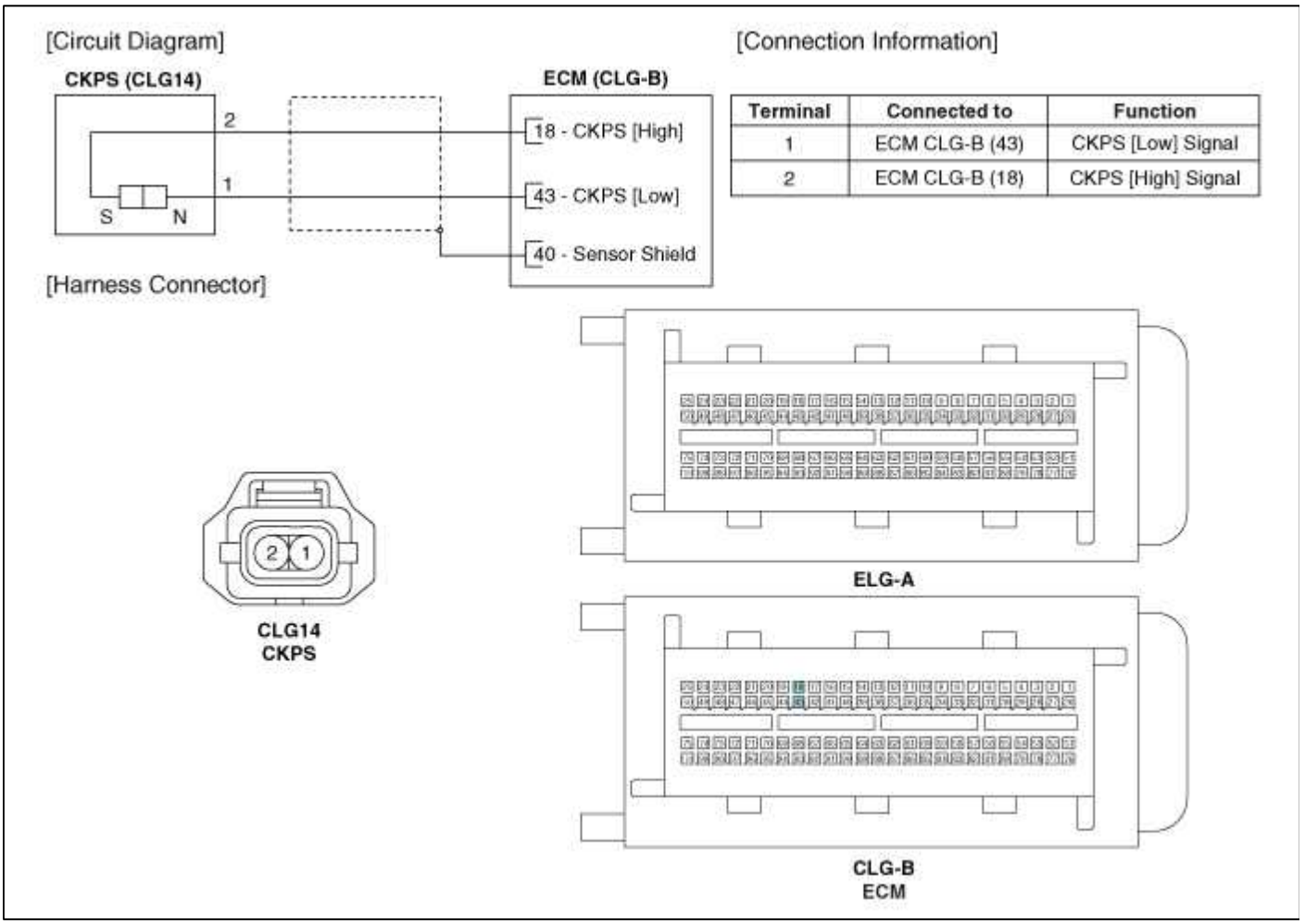
Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Troubleshooting

Wave Form



Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Schematic Diagrams

Circuit Diagram



Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Repair procedures

Inspection

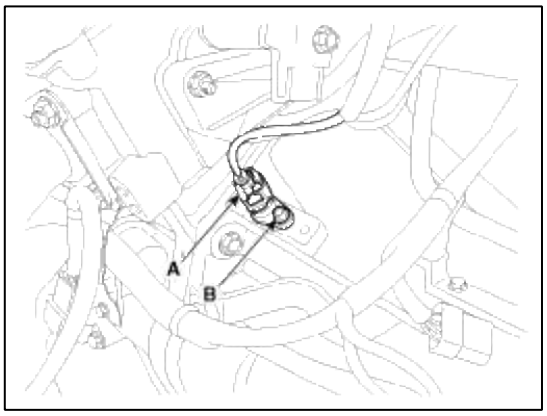
1. Check the signal waveform of the CMPS and CKPS using the GDS.

Specification: Refer to “Wave Form”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the air cleaner assembly (Refer to "Intake And Exhaust System" in EM group).
3. Disconnect the crankshaft position sensor connector (A).

4. Remove the installation bolt (B), and then vertically remove the sensor from the transaxle housing.



Installation

CAUTION

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

CAUTION

- Apply the engine oil to the O-ring.

CAUTION

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

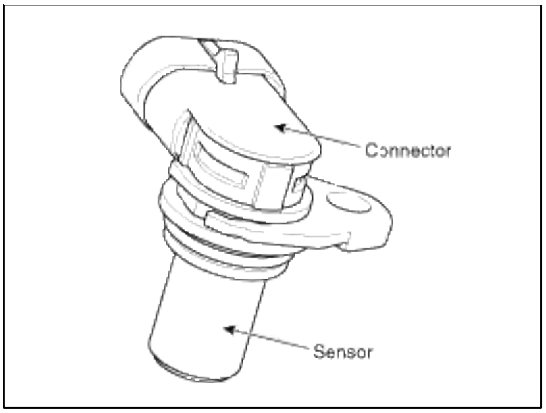
1. Installation is reverse of removal.

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

Fuel System > Engine Control System > Camshaft Position Sensor (CMPS) > Description and Operation

Description

Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element.
It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect.
The two CMPS are installed on engine head cover of bank 1 and 2 respectively and uses a target wheel installed on the camshaft. The Cam Position sensor is a hall-effect type sensor. As the target wheel passes the Hall sensor, the magnetic field changes in the sensor. The sensor then switches a signal which creates a square wave.



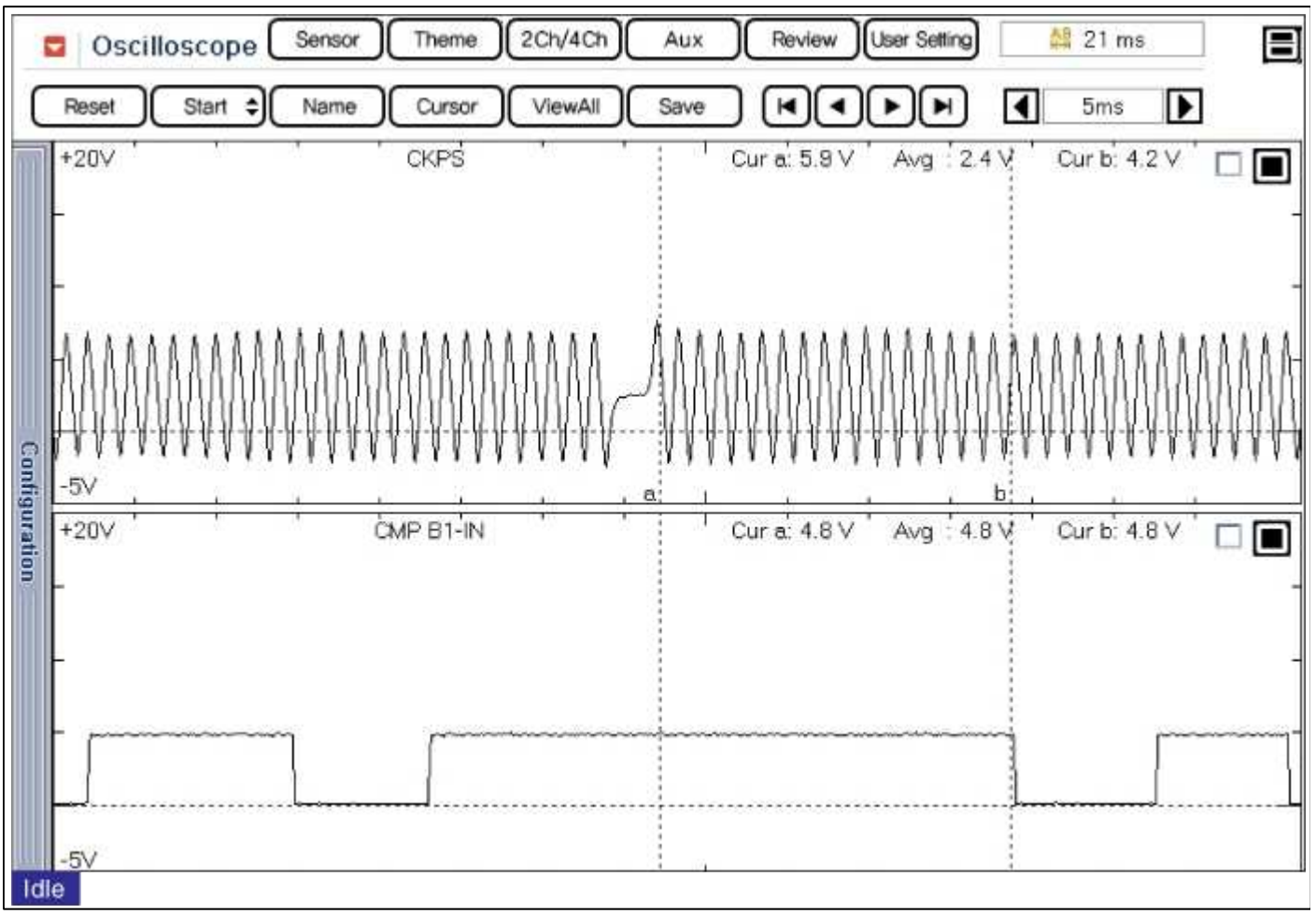
Fuel System > Engine Control System > Camshaft Position Sensor (CMPS) > Specifications

Specification

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

Fuel System > Engine Control System > Camshaft Position Sensor (CMPS) > Troubleshooting

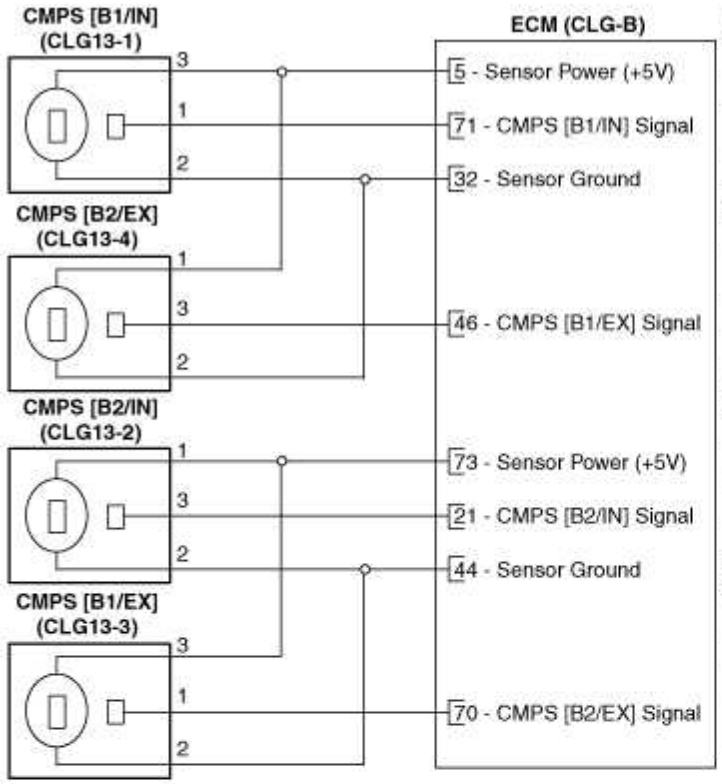
Wave Form



Fuel System > Engine Control System > Camshaft Position Sensor (CMPS) > Schematic Diagrams

Circuit Diagram

[Circuit Diagram]



[Connection Information]

CMPS [BANK 1/INTAKE] (CLG13-1)

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

CMPS [BANK 2/EXHAUST] (CLG13-4)

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

CMPS [BANK 2/INTAKE] (CLG13-2)

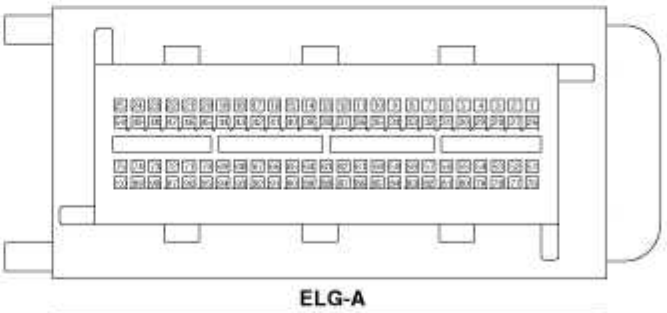
Terminal	Connected to	Function
1	ECM CLG-B (73)	Sensor Power (+5V)
2	ECM CLG-B (44)	Sensor Ground
3	ECM CLG-B (21)	CMPS [B2/IN] Signal

CMPS [BANK 1/EXHAUST] (CLG13-3)

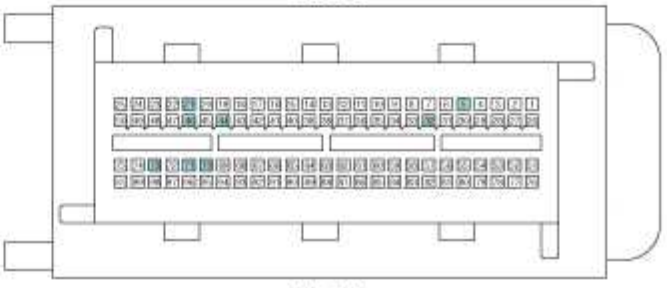
Terminal	Connected to	Function
1	ECM CLG-B (70)	CMPS [B1/EX] Signal
2	ECM CLG-B (44)	Sensor Ground
3	ECM CLG-B (73)	Sensor Power (+5V)

[Harness Connector]

CLG13-1
CLG13-2
CLG13-3
CLG13-4
CMPS [BANK 1/INTAKE]
CMPS [BANK 1/EXHAUST]
CMPS [BANK 2/INTAKE]
CMPS [BANK 2/EXHAUST]



ELG-A



CLG-B
ECM

Fuel System > Engine Control System > Camshaft Position Sensor (CMPS) > Repair procedures

Inspection

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

Specification: Refer to “Wave Form”

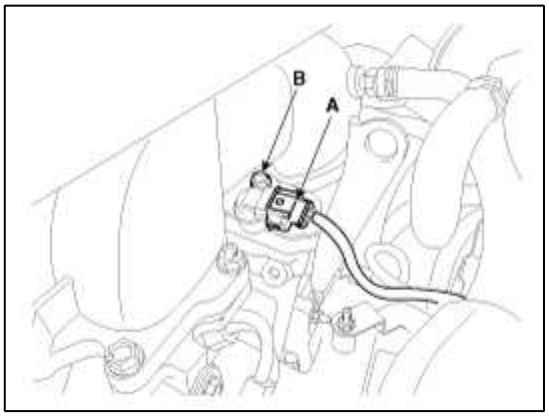
Removal

WARNING

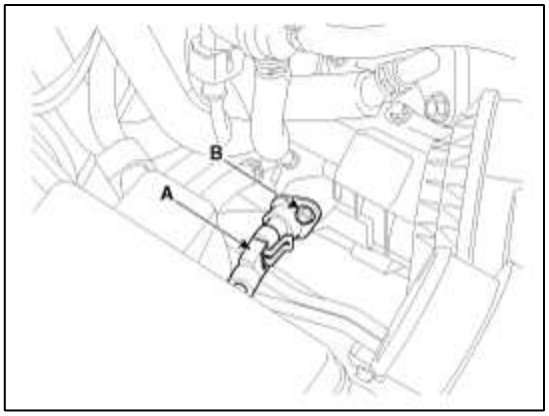
- DON'T remove the camshaft position sensor while the engine is running or right after engine is turned off. The part and engine oil is hot and can cause burns.

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

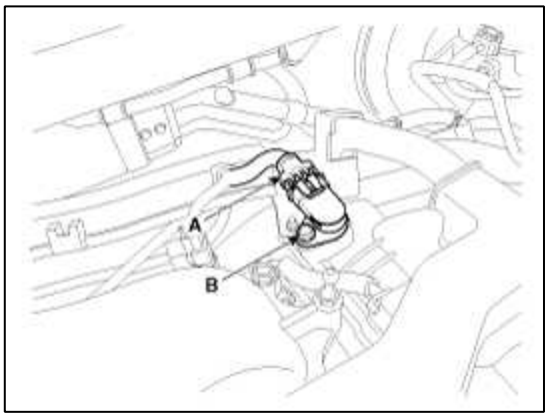
[Bank 1/Intake]



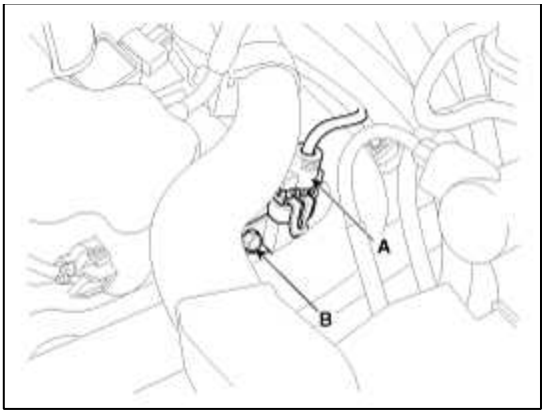
[Bank 1/Exhaust]



[Bank 2/Intake]



[Bank 2/Exhaust]



Installation

CAUTION

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

CAUTION

- Apply the engine oil to the O-ring.

CAUTION

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

CAUTION

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

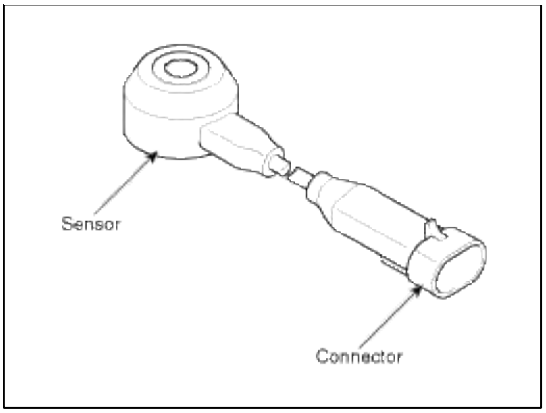
1. Installation is reverse of removal.

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

Fuel System > Engine Control System > Knock Sensor (KS) > Description and Operation

Description

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



Fuel System > Engine Control System > Knock Sensor (KS) > Specifications

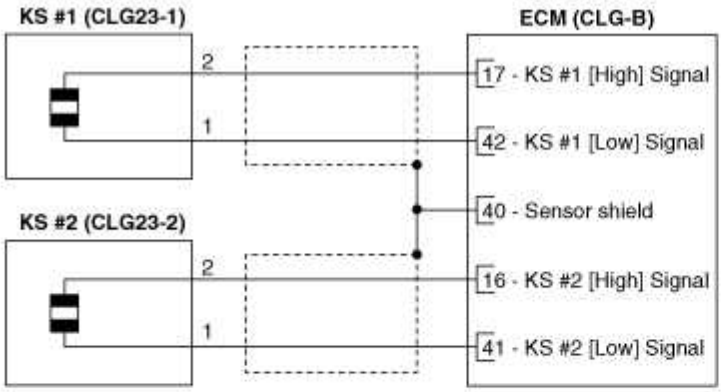
Specification

Item	Specification
Capacitance (pF)	950 ~ 1,350

Fuel System > Engine Control System > Knock Sensor (KS) > Schematic Diagrams

Circuit Diagram

[Circuit Diagram]



[Connection Information]

Knock Sensor #1 (CLG23-1)

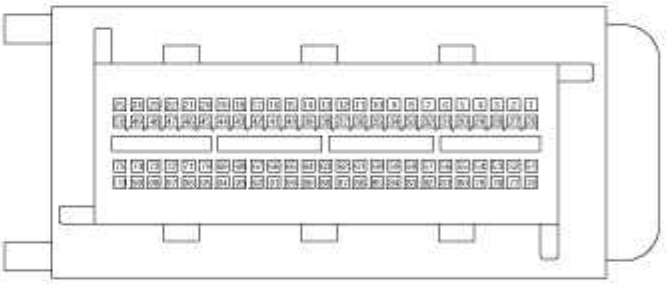
Terminal	Connected to	Function
1	ECM CLG-B (42)	KS #1 [Low] Signal
2	ECM CLG-B (17)	KS #1 [High] Signal

Knock Sensor #2 (CLG23-2)

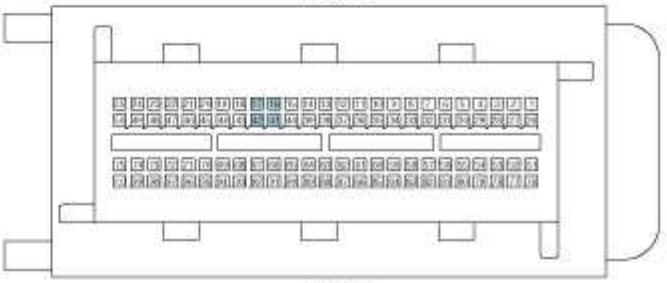
Terminal	Connected to	Function
1	ECM CLG-B (41)	KS #2 [Low] Signal
2	ECM CLG-B (16)	KS #2 [High] Signal

[Harness Connector]

CLG23-1
CLG23-2
KS #1
KS #2



ELG-A



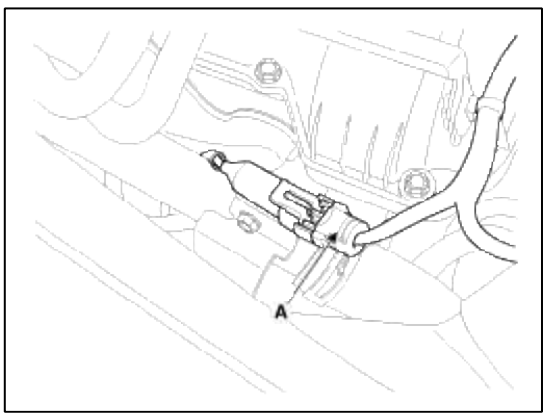
CLG-B
ECM

Fuel System > Engine Control System > Knock Sensor (KS) > Repair procedures

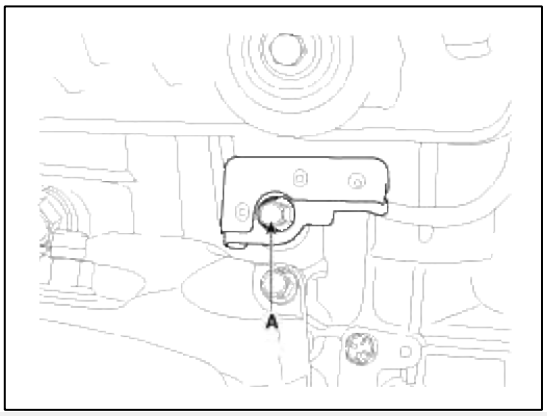
Removal

[Knock Sensor #1 (Bank 1)]

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

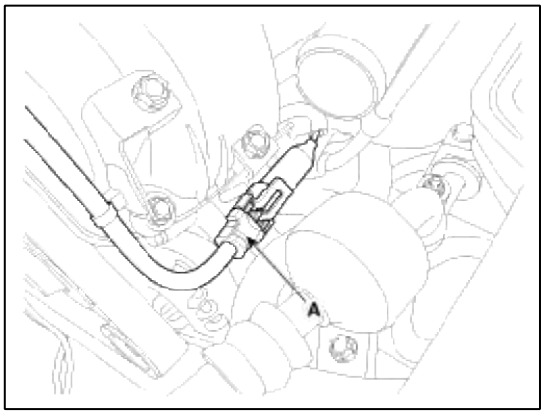


3. Remove the installation bolt (A), and then remove the sensor from the cylinder block.

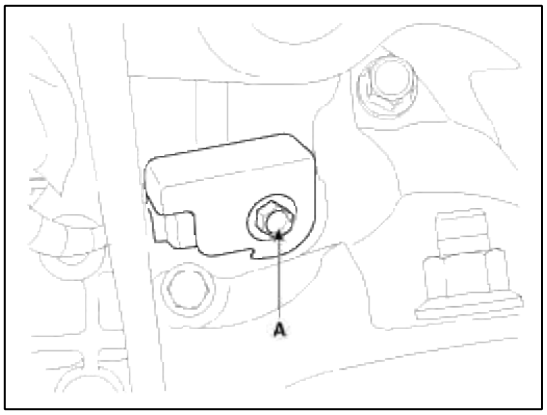


[Knock Sensor #2 (Bank 2)]

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



3. Drain the engine coolant (Refer to “Cooling System” in EM group).
4. Remove the radiator upper hose (Refer to “Cooling System” in EM group).
5. Remove the coolant pipe [Bank 2] (Refer to “Cooling System” in EM group).
6. Remove the oil level gauge (Refer to “Cooling System” in EM group).
7. Remove the installation bolt (A), and then remove the sensor from the cylinder block.



Installation

CAUTION

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

CAUTION

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

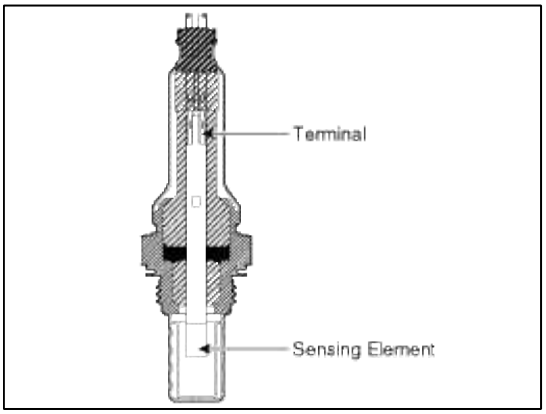
1. Installation is reverse of removal.

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

Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Description and Operation

Description

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



Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Specifications

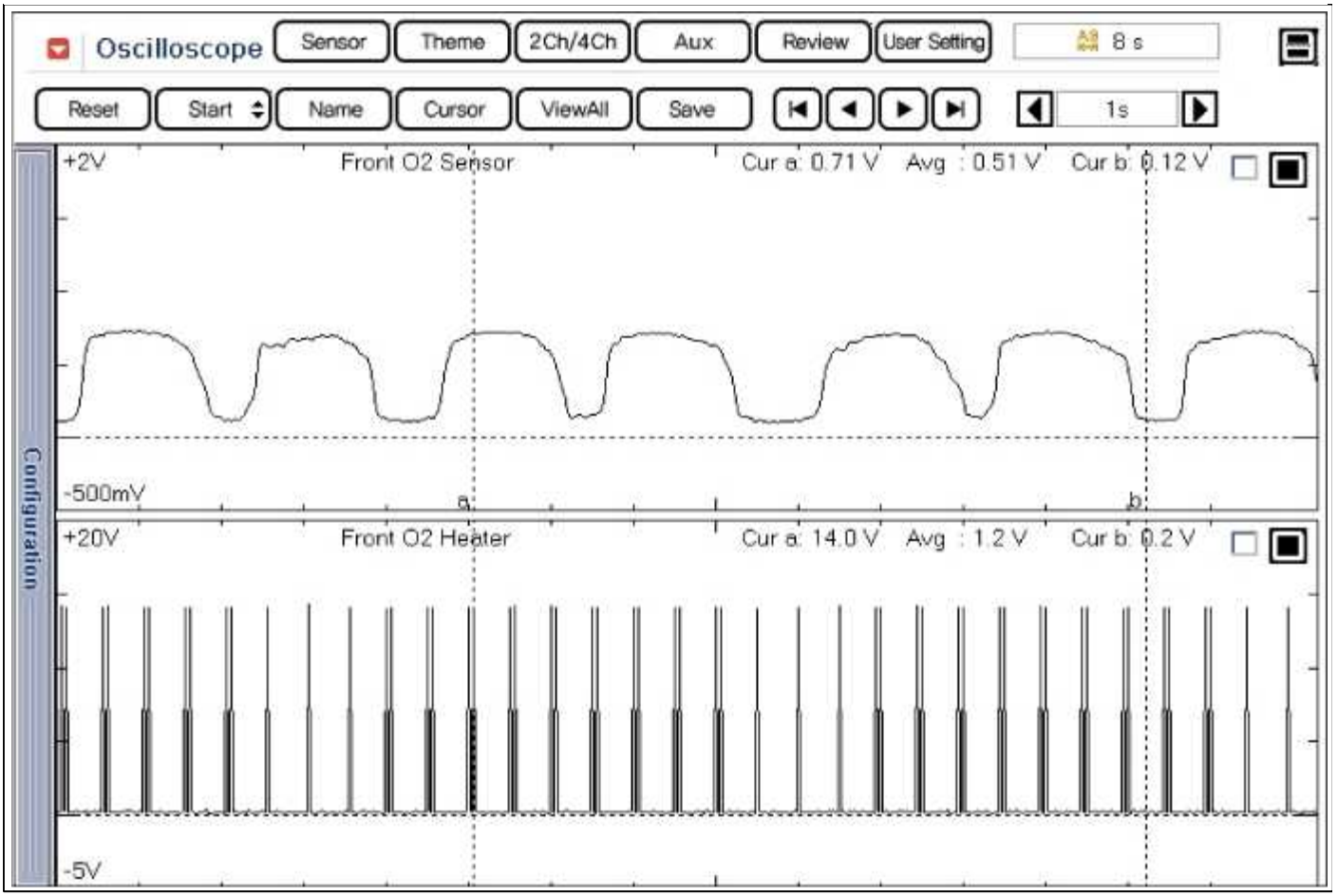
Specification

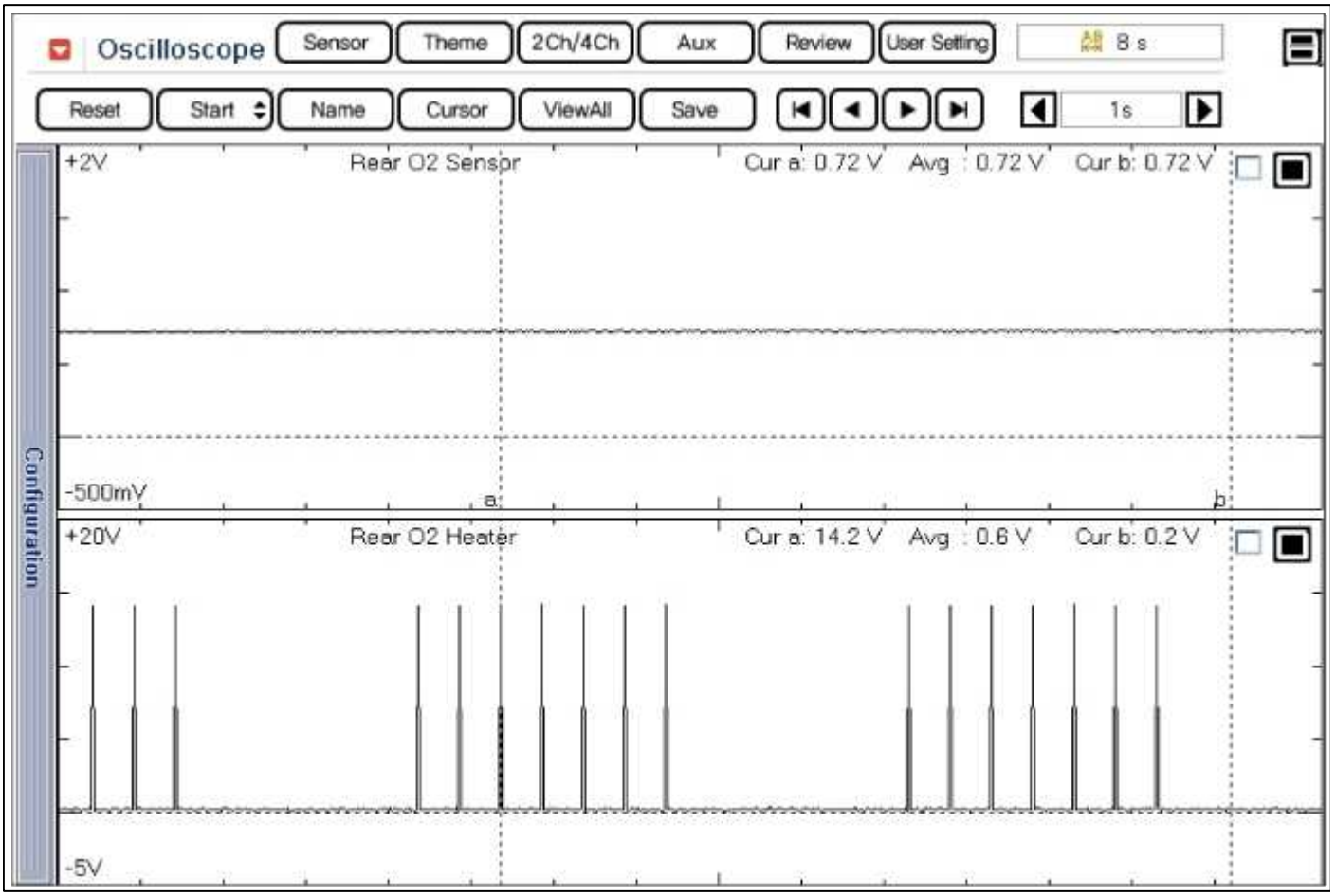
A/F Ratio (λ)	Output Voltage(V)
RICH	Min. 0.8
LEAN	Max. 0.1

Item	Specification
Heater Resistance (Ω)	3.3 ~ 4.1[20°C(68°F)]

Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Troubleshooting

Wave Form

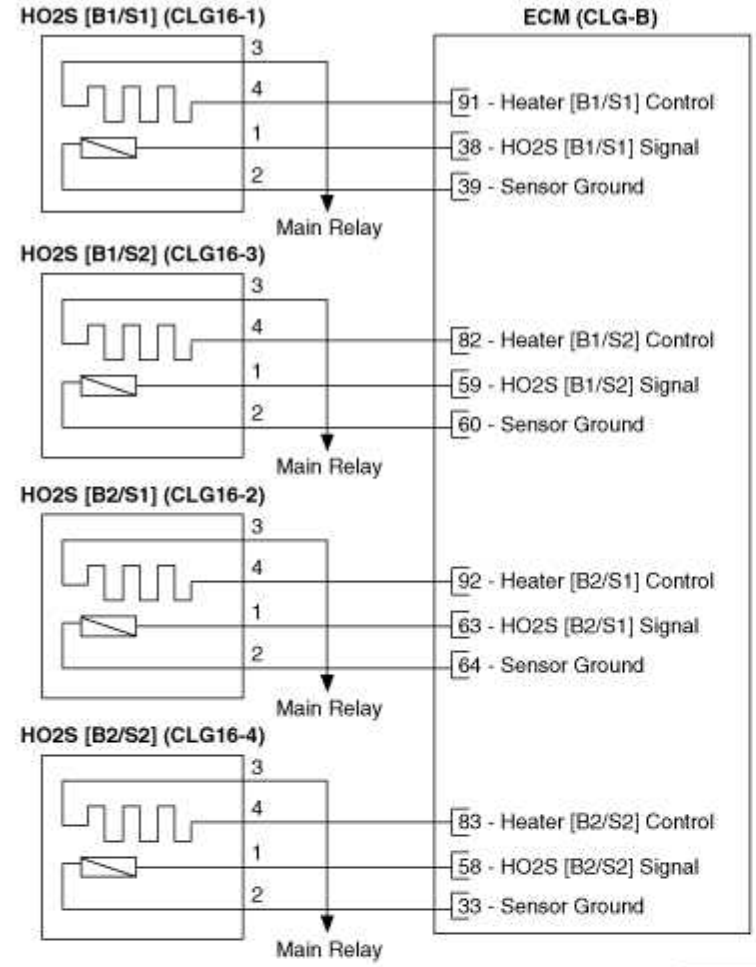




Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Schematic Diagrams

Circuit Diagram

[Circuit Diagram]



[Connection Information]

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

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

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

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

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

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

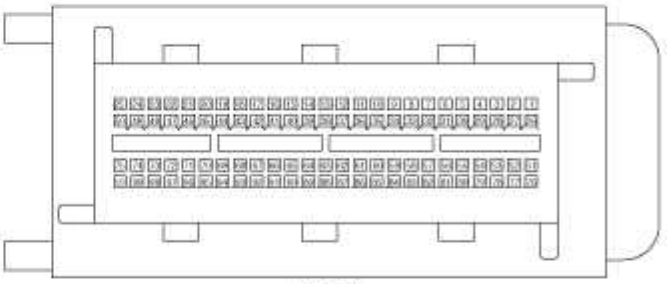
HO2S [Bank 2/Sensor 2] (CLG16-4)

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

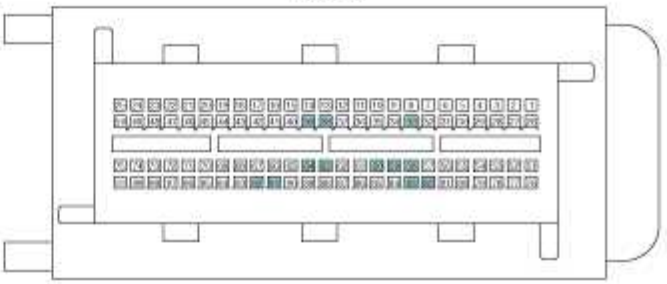
[Harness Connector]

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

CLG16-3
CLG16-4
HO2S [Bank 1/Sensor 2]
HO2S [Bank 2/Sensor 2]



ELG-A



CLG-B
ECM

Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Repair procedures

Inspection

1. Turn the ignition switch OFF.
2. Disconnect the HO2S connector.

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

Specification: Refer to “Specification”

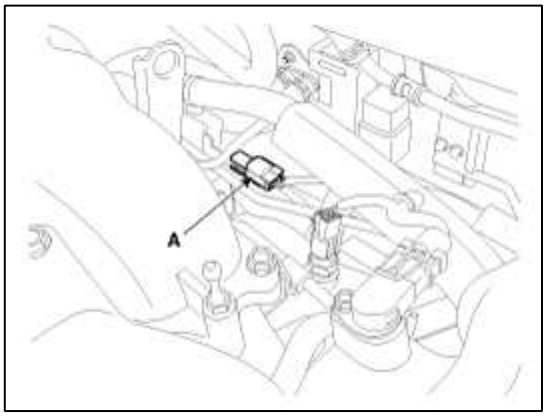
Removal

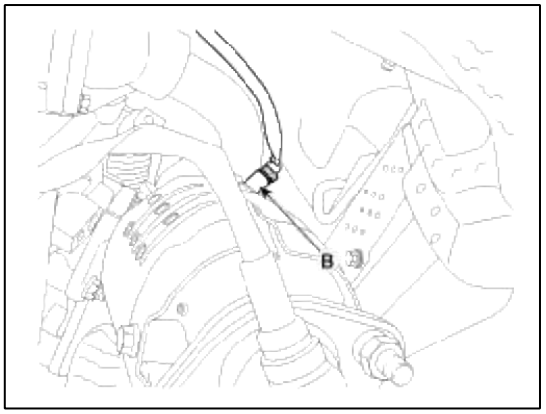
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the connector (A), and then remove the sensor (B).

NOTE

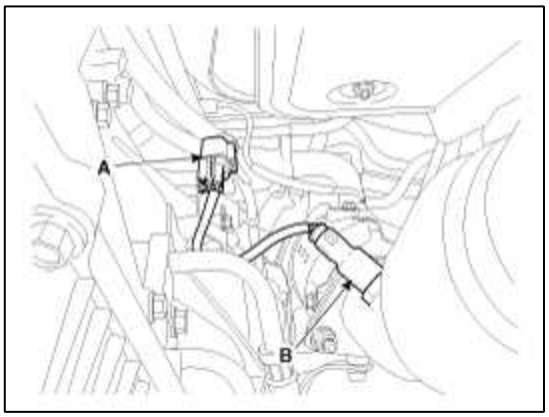
Note that the SST (Part No.: 09392-2H100) is useful when removing the heated oxygen sensor.

[Bank 1/Sensor 1]

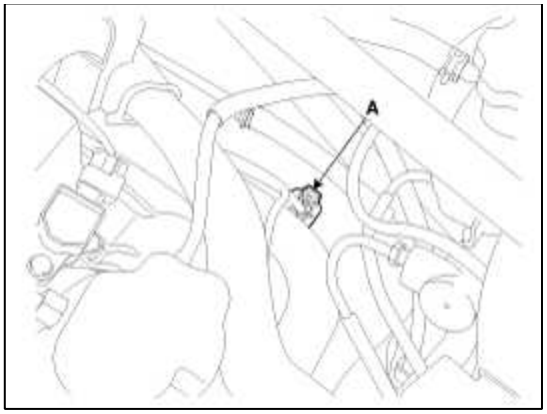


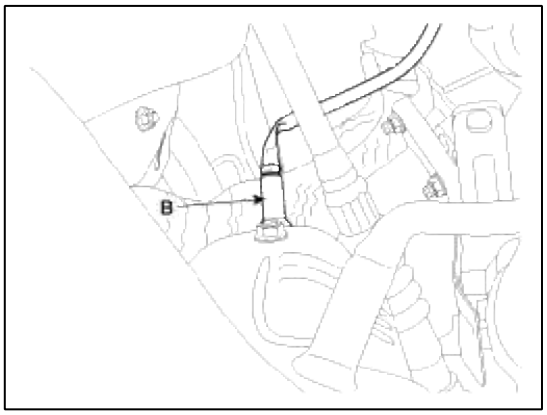


[Bank 1/Sensor 2]

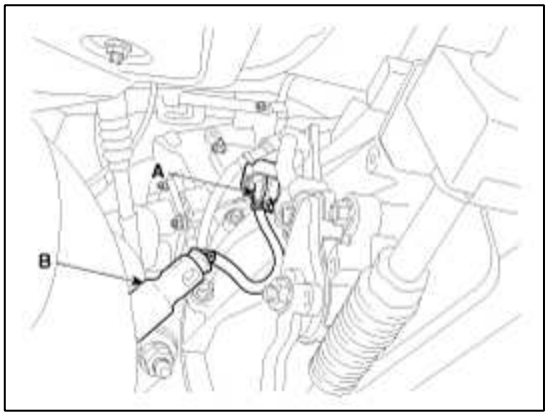


[Bank 2/Sensor 1]





[Bank 2/Sensor 2]



Installation

CAUTION

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

CAUTION

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

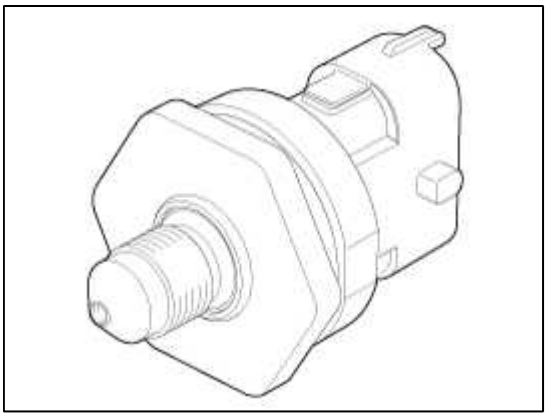
1. Installation is reverse of removal.

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

Fuel System > Engine Control System > Rail Pressure Sensor (RPS) > Description and Operation

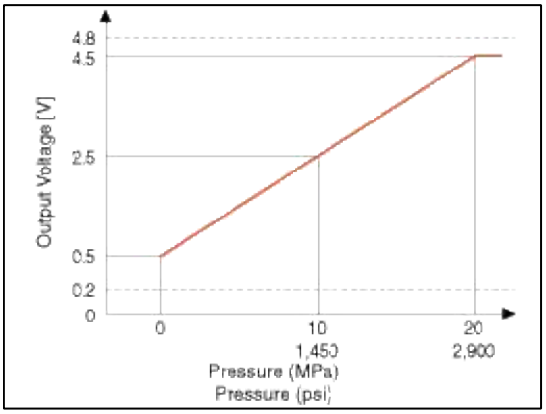
Description

Rail Pressure Sensor (RPS) is installed on the delivery pipe and measures the instantaneous fuel pressure in the delivery pipe. The sensing element (Semiconductor element) built in the sensor converts the pressure to voltage signal. By using this signal, the ECM can control correct injection amount and timing and adjusts the fuel pressure with the fuel pressure regulator valve if the target pressure and the actual pressure calculated by the RPS output signal are different.



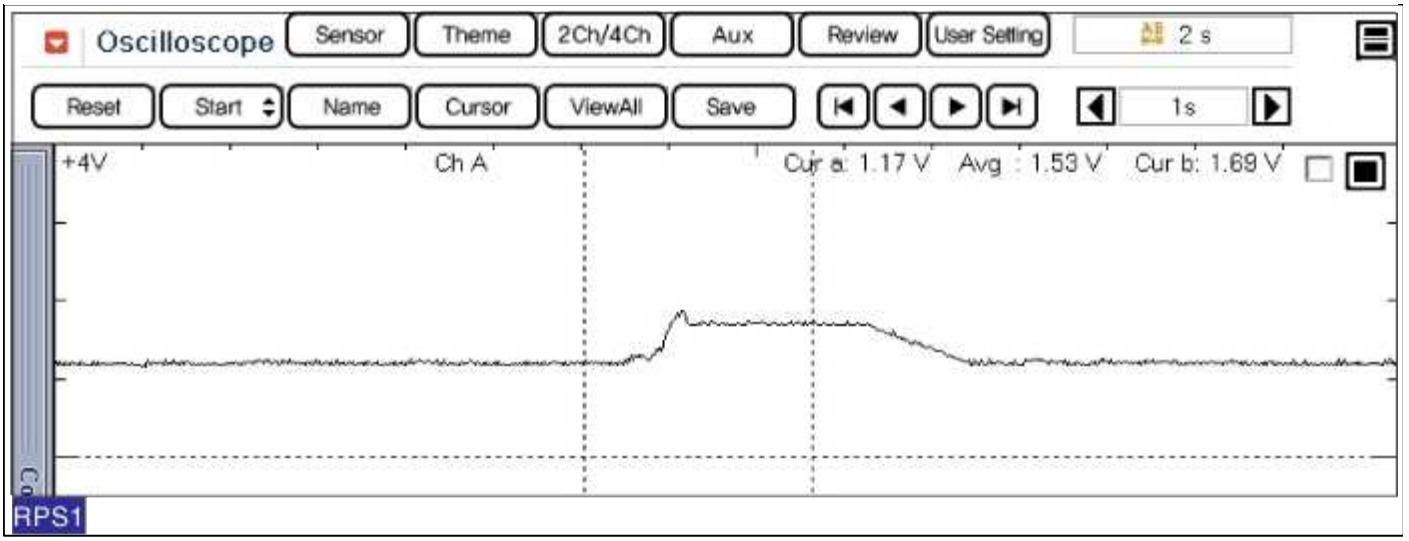
Fuel System > Engine Control System > Rail Pressure Sensor (RPS) > Specifications

Specification



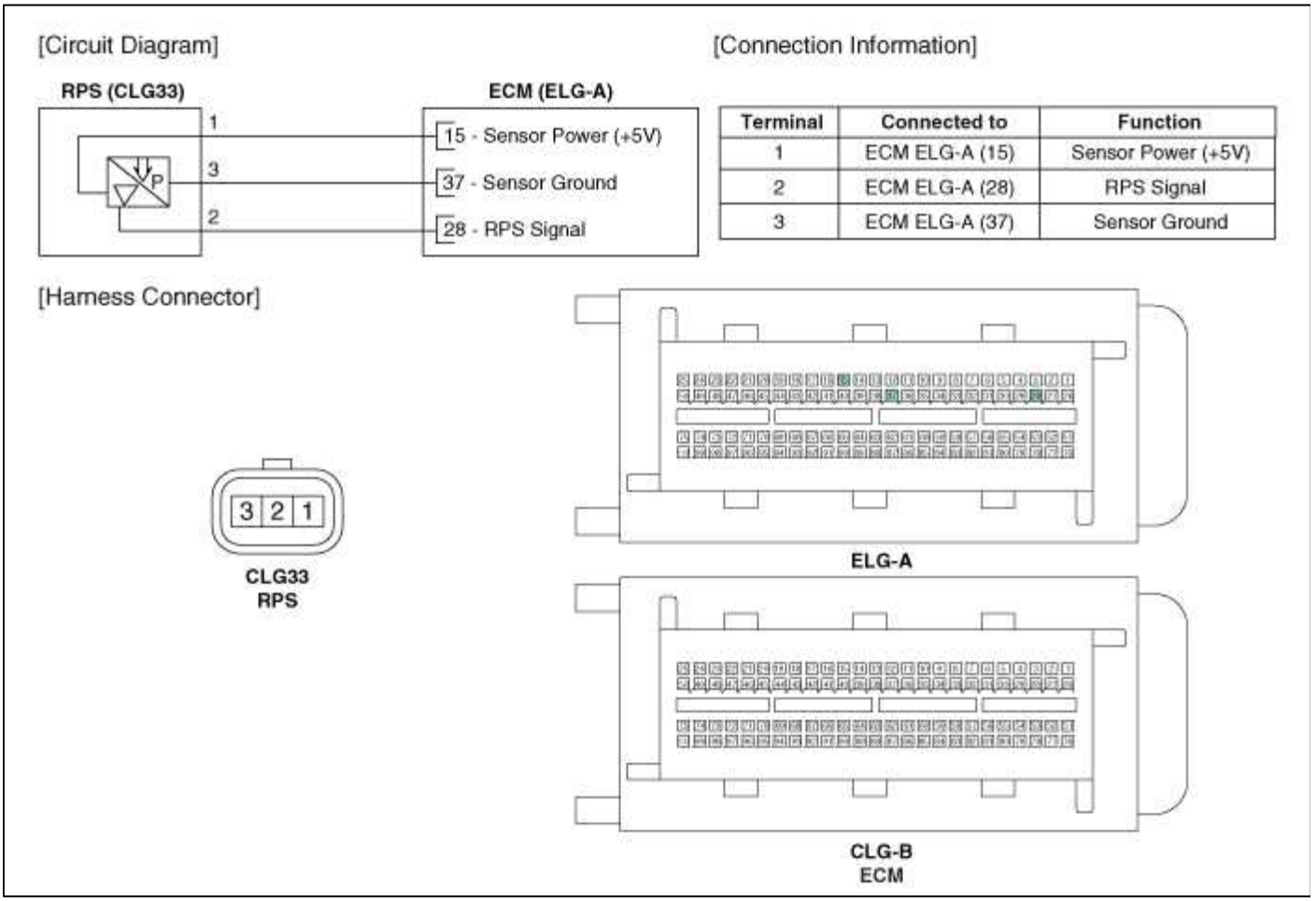
Fuel System > Engine Control System > Rail Pressure Sensor (RPS) > Troubleshooting

Signal Waveform



Fuel System > Engine Control System > Rail Pressure Sensor (RPS) > Schematic Diagrams

Circuit Diagram



Terminal	Connected to	Function
1	ECM ELG-A (15)	Sensor Power (+5V)
2	ECM ELG-A (28)	RPS Signal
3	ECM ELG-A (37)	Sensor Ground

Fuel System > Engine Control System > Rail Pressure Sensor (RPS) > Repair procedures

Inspection

1. Connect the GDS on the Data Link Connector (DLC).

2. Measure the output voltage of the RPS at idle and various engine speed.

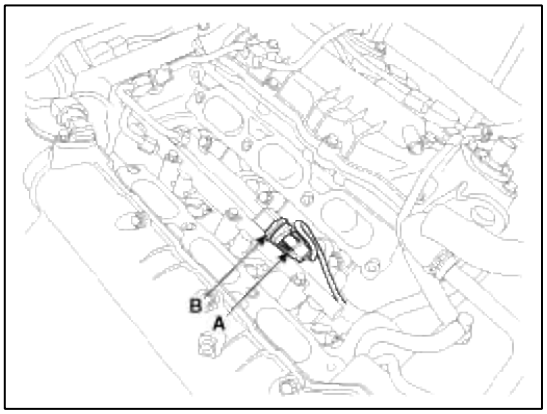
Condition	Output Voltage (V)
Idle	Approx. 1.2
1,500 rpm	2.0 ~ 2.2
6,300 rpm	Approx. 2.8

Removal

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

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

3. Remove the intake manifold (Refer to “Intake And Exhaust System” in EM group).
4. Disconnect the rail pressure sensor connector (A), and then remove the sensor (B) from the delivery pipe.



Installation

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

1. Installation is reverse of removal.

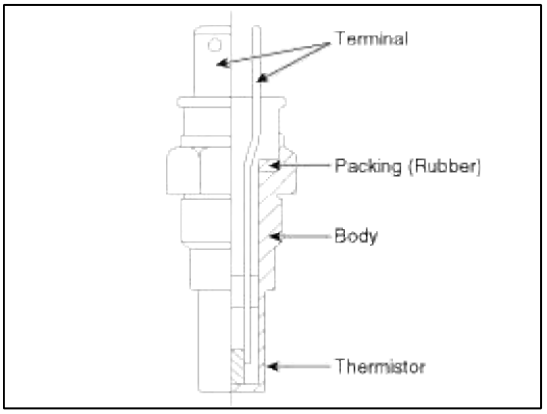
Rail Pressure Sensor Installation:
29.4 ~ 34.3 N.m (3.0 ~ 3.5 kgf.m, 21.7 ~ 25.3 lb-ft)

Fuel System > Engine Control System > CVVT Oil Temperature Sensor (OTS) > Description and Operation

Description

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.
By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect,

improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.
This system consist of
- the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or cuts the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,
- the CVVT Oil Temperature Sensor (OTS) which measures the engine oil temperature,
- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.
The engine oil getting out of the CVVT oil control valve varies the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.



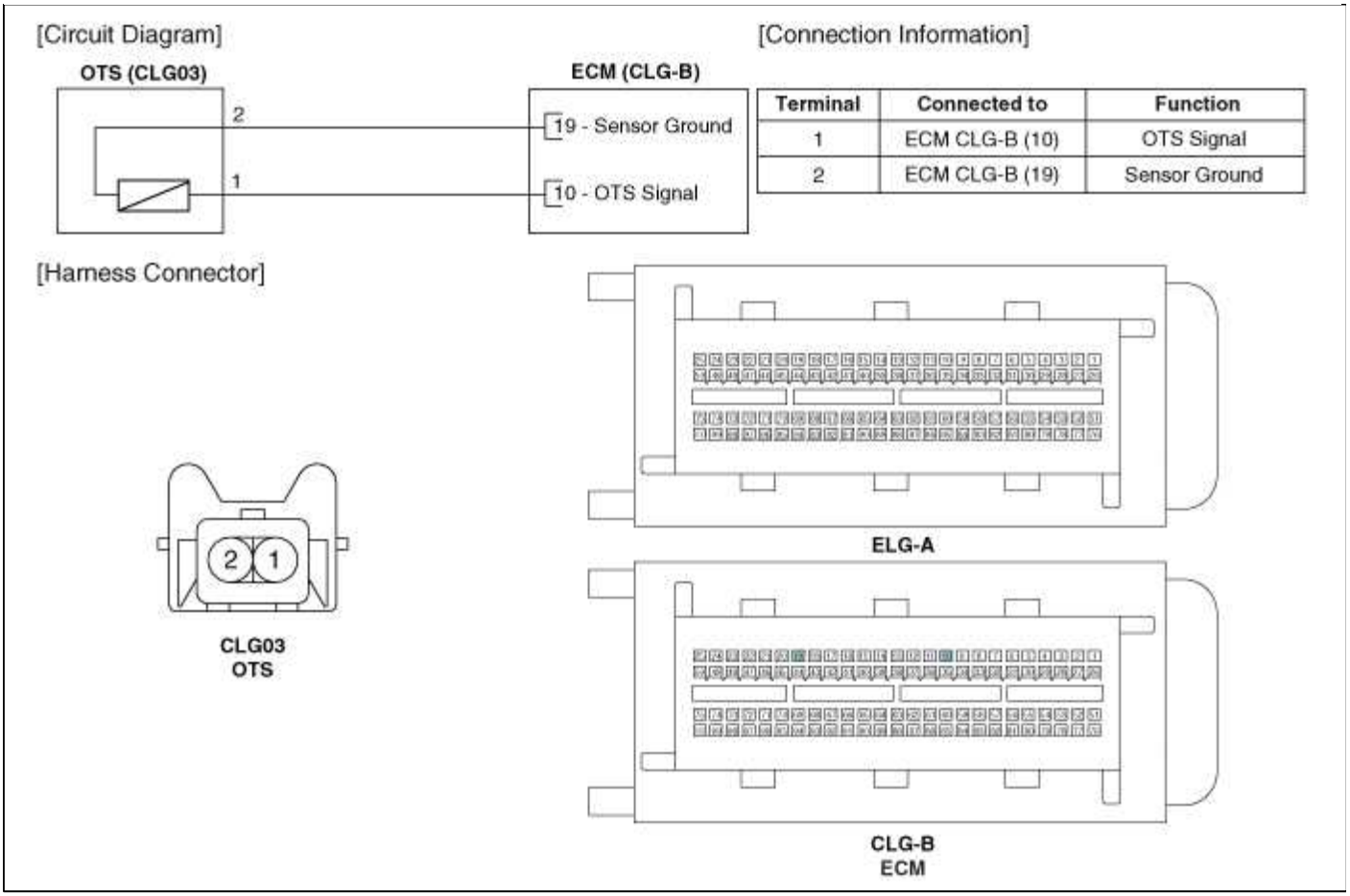
Fuel System > Engine Control System > CVVT Oil Temperature Sensor (OTS) > Specifications

Specification

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

Fuel System > Engine Control System > CVVT Oil Temperature Sensor (OTS) > Schematic Diagrams

Circuit Diagram



Fuel System > Engine Control System > CVVT Oil Temperature Sensor (OTS) > Repair procedures

Inspection

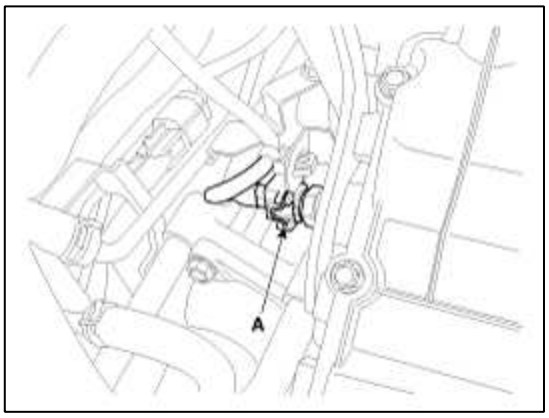
1. Turn the ignition switch OFF.
2. Disconnect the OTS connector.
3. Remove the OTS (Refer to "Removal").
4. After immersing the thermistor of the sensor into engine coolant, measure resistance between the OTS terminals 1 and 2.
5. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the air cleaner assembly (Refer to "Intake And Exhaust System" in EM group).

3. Disconnect the connector (A), and then remove the CVVT oil temperature sensor (B).



Installation

CAUTION

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

CAUTION

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

CAUTION

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

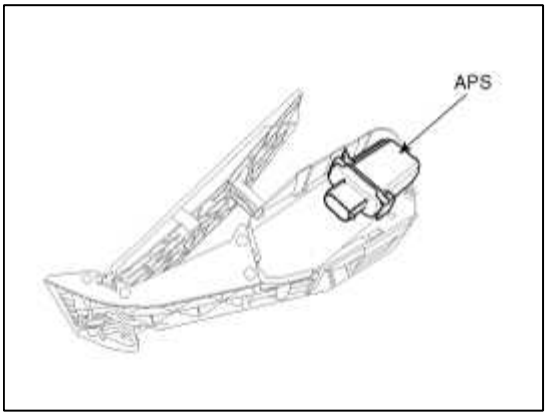
1. Installation is reverse of removal.

CVVT oil temperature sensor installation:
19.6 ~ 39.2 N.m (2.0 ~ 4.0 kgf.m, 14.5 ~ 28.9 lb-ft)

Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Description and Operation

Description

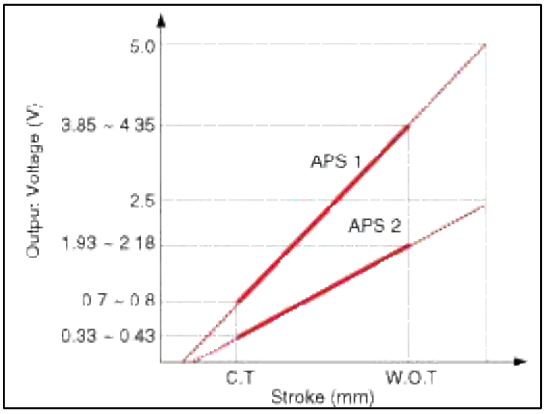
Accelerator Position Sensor (APS) is installed on the accelerator pedal module and detects the rotation angle of the accelerator pedal. The APS is one of the most important sensors in engine control system, so it consists of the two sensors which adapt individual sensor power and ground line. The second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



Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Specifications

Specification

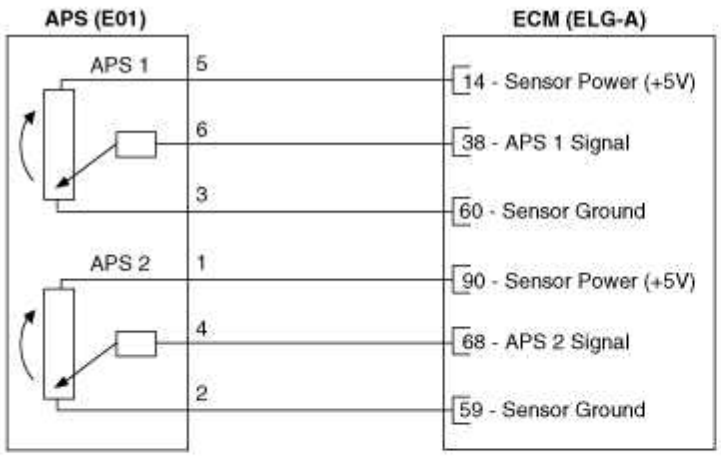
Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.7 ~ 0.8	0.33 ~ 0.43
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18



Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Schematic Diagrams

Circuit Diagram

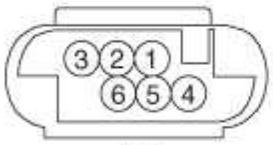
[Circuit Diagram]



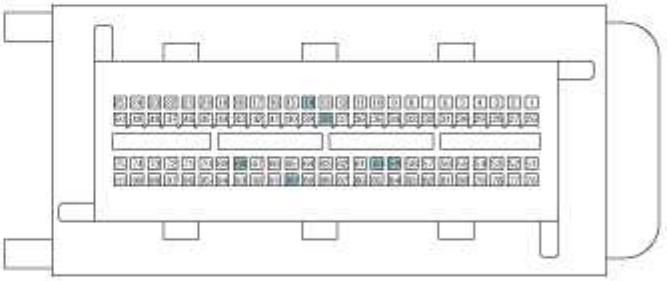
[Connection Information]

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

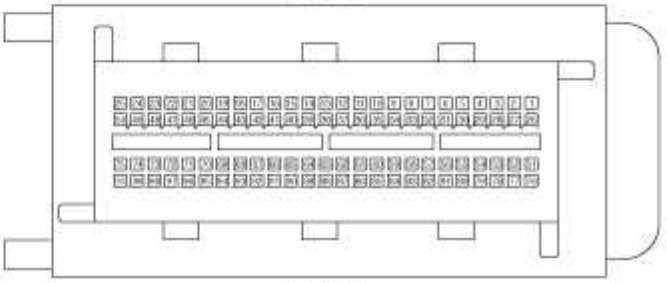
[Harness Connector]



E01
APS



ELG-A



CLG-B
ECM

Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Repair procedures

Inspection

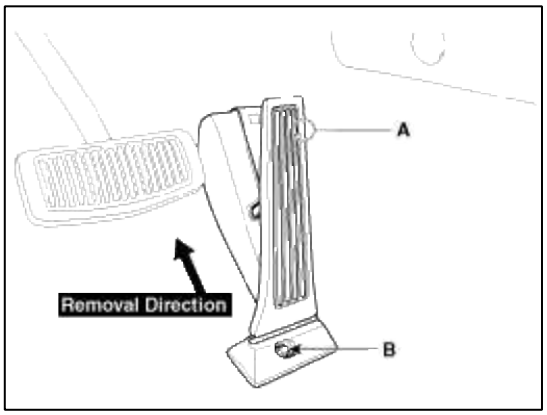
1. Connect the GDS on the Data Link Connector (DLC).
2. Turn the ignition switch ON.
3. Measure the output voltage of the APS 1 and 2 at C.T and W.O.T.

Specification: Refer to “Specification”

Removal

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

3. Remove the accelerator pedal in the direction of "Removal direction" in the figure after removing the installation bolt (B).



Installation

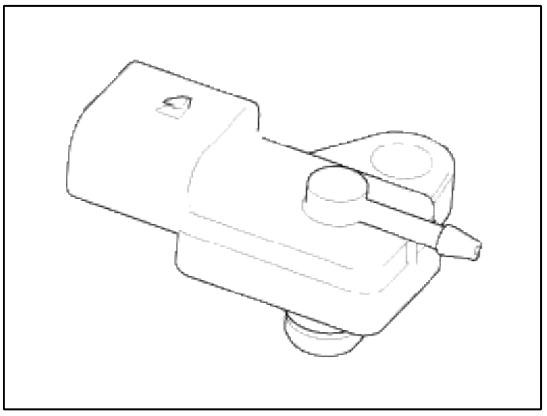
1. Installation is reverse of removal.

Accelerator pedal module installation bolt:
8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)

Fuel System > Engine Control System > Fuel Tank Pressure Sensor (FTPS) > Description and Operation

Description

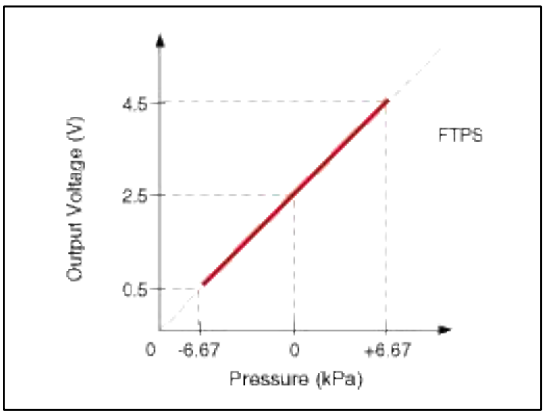
Fuel Tank Pressure Sensor (FTPS) is a component of the evaporative emission control system and is installed on the fuel tank, the fuel pump, or the canister. It checks the purge control solenoid valve operation and detects a leakage of the system.



Fuel System > Engine Control System > Fuel Tank Pressure Sensor (FTPS) > Specifications

Specification

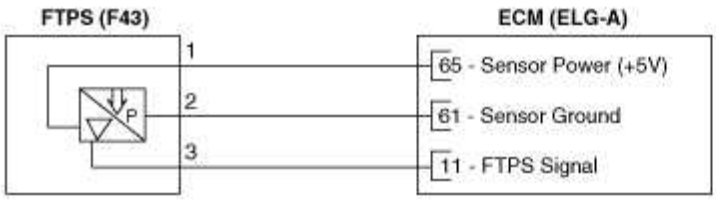
Pressure (kPa)	Output Voltage (V)
-6.67	0.5
0	2.5
+6.67	4.5



Fuel System > Engine Control System > Fuel Tank Pressure Sensor (FTPS) > Schematic Diagrams

Circuit Diagram

[Circuit Diagram]

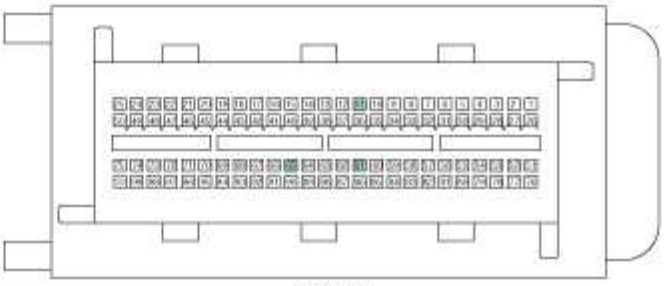


[Connection Information]

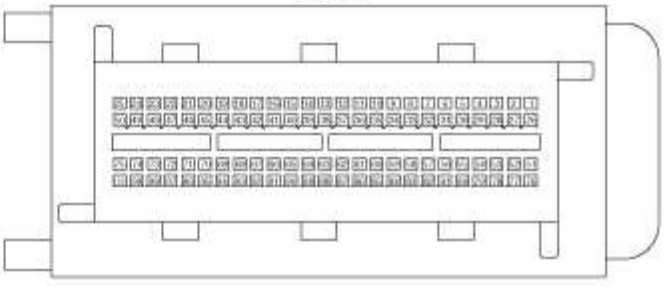
Terminal	Connected to	Function
1	ECM ELG-A (65)	Sensor Power (+5V)
2	ECM ELG-A (61)	Sensor Ground
3	ECM ELG-A (11)	FTPS Signal

[Harness Connector]

F43
FTPS



ELG-A



CLG-B
ECM

Fuel System > Engine Control System > Fuel Tank Pressure Sensor (FTPS) > Repair procedures

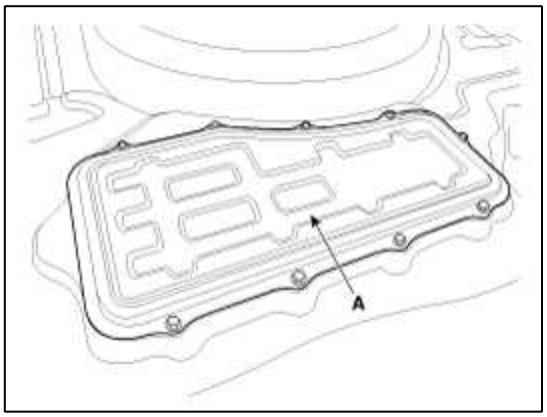
Inspection

1. Connect the GDS on the Data Link Connector (DLC).
2. Measure the output voltage of the FTPS.

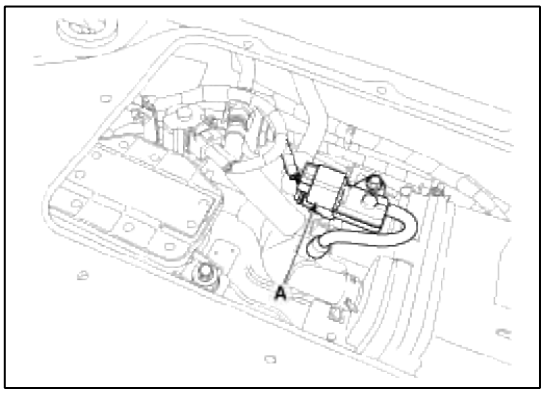
Specification: Refer to "Specification"

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the floor mat in the trunk (Refer to "Seat" in BD group).
3. Remove the service cover (A).



4. Disconnect the fuel tank pressure sensor connector (A).
5. Remove the fuel tank pressure sensor after removing the installation bolt.



Installation

CAUTION

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

CAUTION

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

1. Installation is reverse of removal.

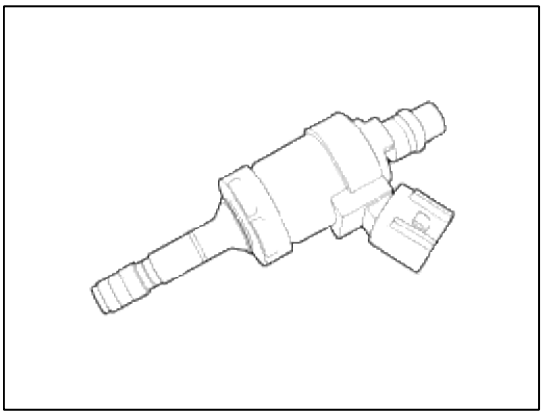
Fuel tank pressure installation bolt:
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Fuel System > Engine Control System > Injector > Description and Operation

Description

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

energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should momentarily peak, and then settle at system voltage.



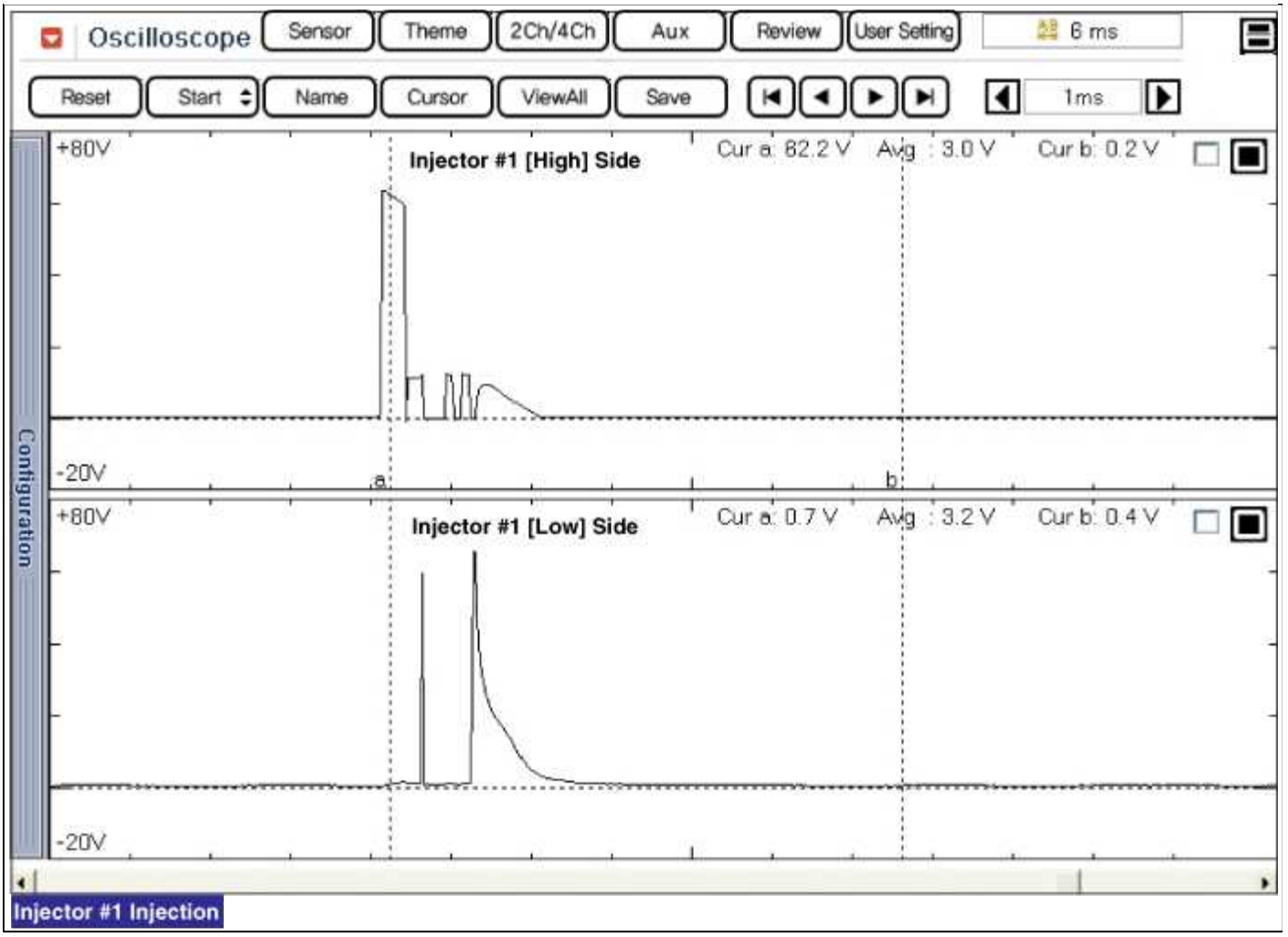
Fuel System > Engine Control System > Injector > Specifications

Specification

Item	Specification
Coil Resistance (Ω)	0.98 ~ 1.14 [20°C(68°F)]

Fuel System > Engine Control System > Injector > Troubleshooting

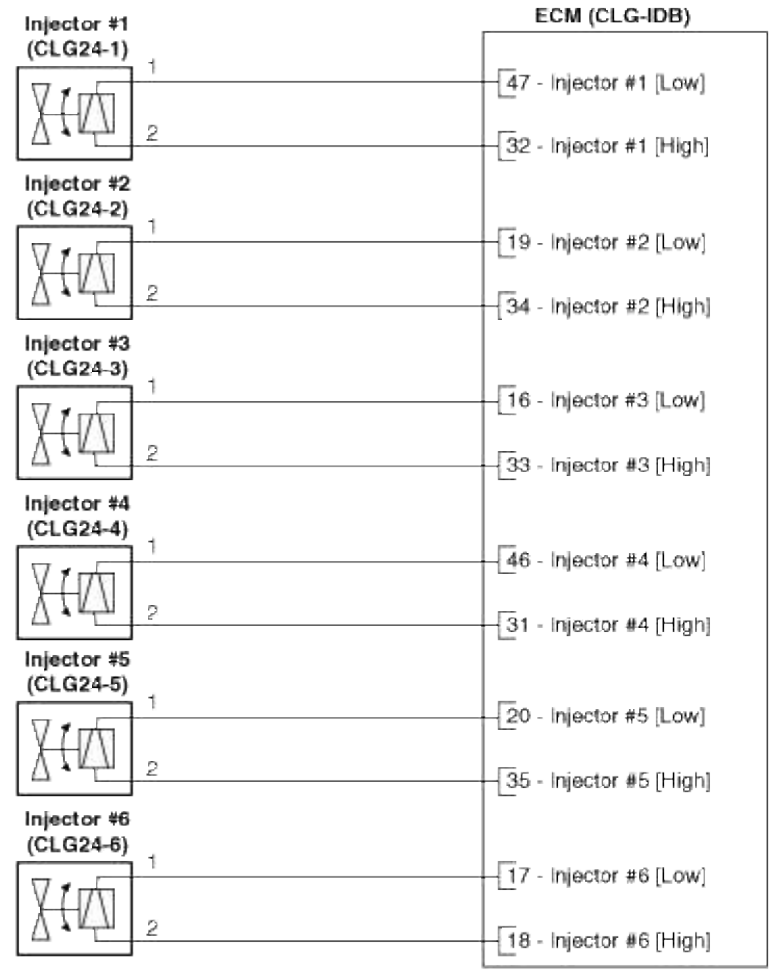
Signal Waveform



Fuel System > Engine Control System > Injector > Schematic Diagrams

Circuit Diagram

[Circuit Diagram]



[Connection Information]

Injector #1 (CLG24-1)

Terminal	Connected to	Function
1	ECM CLG-IDB (47)	Injector #1 [Low] Control
2	ECM CLG-IDB (32)	Injector #1 [High] Control

Injector #2 (CLG24-2)

Terminal	Connected to	Function
1	ECM CLG-IDB (19)	Injector #2 [Low] Control
2	ECM CLG-IDB (34)	Injector #2 [High] Control

Injector #3 (CLG24-3)

Terminal	Connected to	Function
1	ECM CLG-IDB (16)	Injector #3 [Low] Control
2	ECM CLG-IDB (33)	Injector #3 [High] Control

Injector #4 (CLG24-4)

Terminal	Connected to	Function
1	ECM CLG-IDB (46)	Injector #4 [Low] Control
2	ECM CLG-IDB (31)	Injector #4 [High] Control

Injector #5 (CLG24-5)

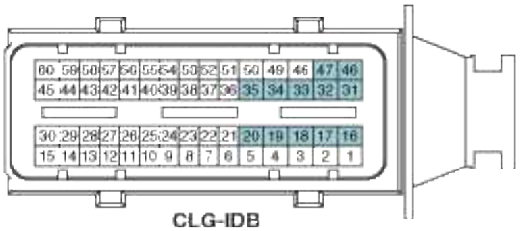
Terminal	Connected to	Function
1	ECM CLG-IDB (20)	Injector #5 [Low] Control
2	ECM CLG-IDB (35)	Injector #5 [High] Control

Injector #6 (CLG24-6)

Terminal	Connected to	Function
1	ECM CLG-IDB (17)	Injector #6 [Low] Control
2	ECM CLG-IDB (18)	Injector #6 [High] Control

[Harness Connector]

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



CLG-IDB
IDB

Fuel System > Engine Control System > Injector > Repair procedures

Inspection

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

Specification: Refer to “Specification”

Removal

WARNING

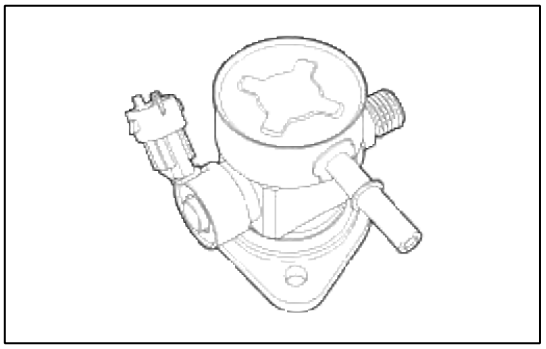
In case of removing the high pressure fuel pump, high pressure fuel pipe, delivery pipe, and injector, there may be injury caused by leakage of the high pressure fuel. So don't do any repair work right after engine stops.

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

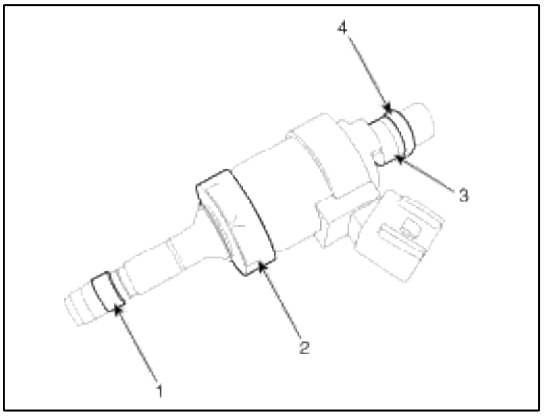
CAUTION

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

3. Remove the delivery pipe & injector assembly (Refer to "Delivery Pipe" in this group).
4. Remove the connector (A) and the fixing clip (B), and then separate the injector from the delivery pipe.



Installation



1. Combustion seal
2. Rubber washer
3. Support disc
4. O-ring

CAUTION

- Do not reuse the used injector fixing clip.

CAUTION

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

CAUTION

- Apply engine oil to the injector O-ring.
- Do not reuse the used injector O-ring.

CAUTION

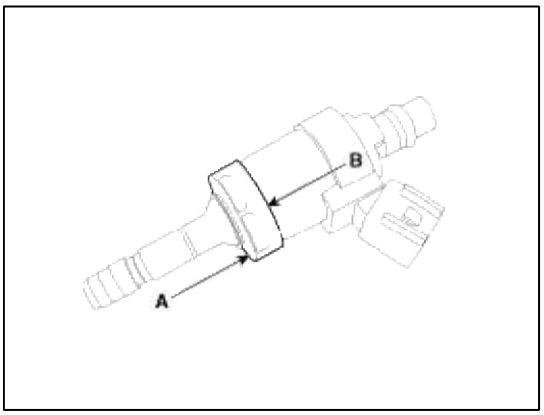
- Do not reuse the used bolt.

CAUTION

- When inserting the injector, be careful not to damage the injector tip.

CAUTION

- Do not reuse the support disc.
- Do not reuse the injector rubber washer.
- When replacing the rubber washer, the rounded edge (A) part should be faced the cylinder installation part and the angulated edge (B) part should be faced the injector body part.



CAUTION

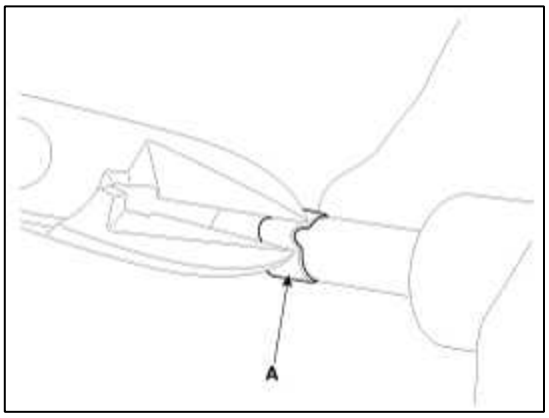
- Do not reuse the combustion seal.

1. Installation is reverse of removal.

Replacement

The injector combustion seal should be replaced new one to prevent leakage after removing the injector.

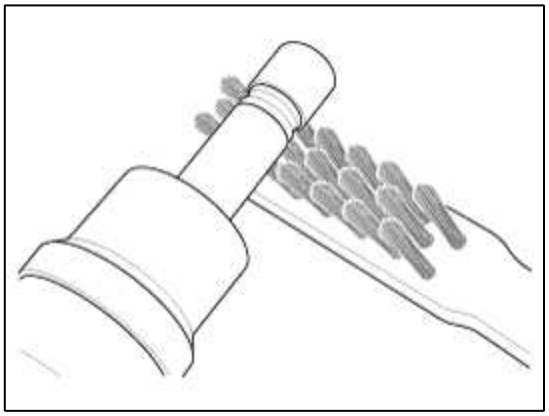
1. Remove the combustion seal (A) with a wire cutter.



CAUTION

Grip the sealing ring carefully, pull it to form a small loop and then cut it. Be careful not to damage the surface of the valve sleeve with the wire cutter.

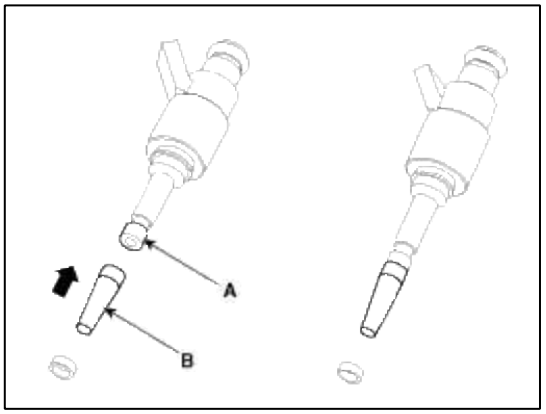
2. Before the assembly of the sealing ring the groove must be cleaned using a clean cloth.
   Any coking of the injector sealing surface must be carefully removed with a brass-wire brush.

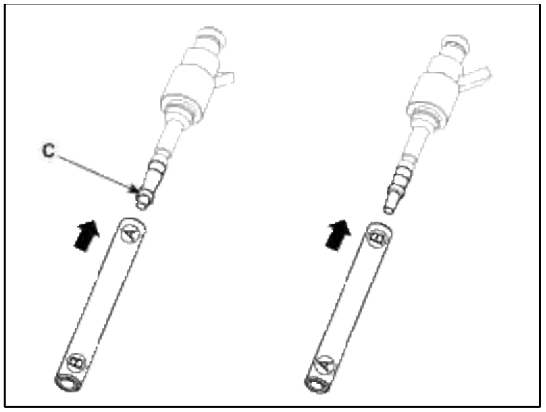


CAUTION

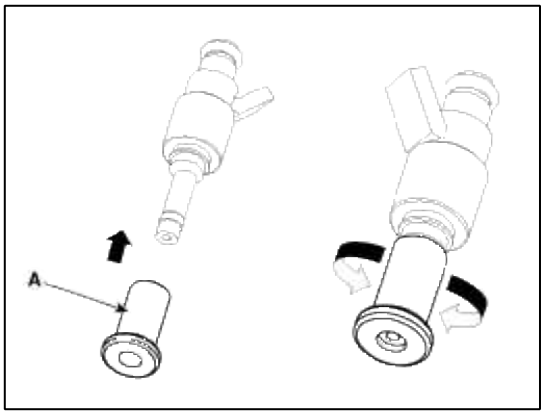
The surfaces of the new sealing ring must be clean and free of grease.

3. Place the seal installing guide (B) (SST No.: 09353-2B000) on the tip of the injector not to damage the injector tip (A).
   Push the sealing ring (C) with thumb and index finger over the conical assembly tool until it snaps into the groove.
   The complete assembly must not take longer than 2 to 3 seconds.





4. To size the sealing ring the injector is first introduced into the sizing tool (A) (SST No.: 09353-2B000) and then pressed and at the same time rotated 180° into the sizing tool.

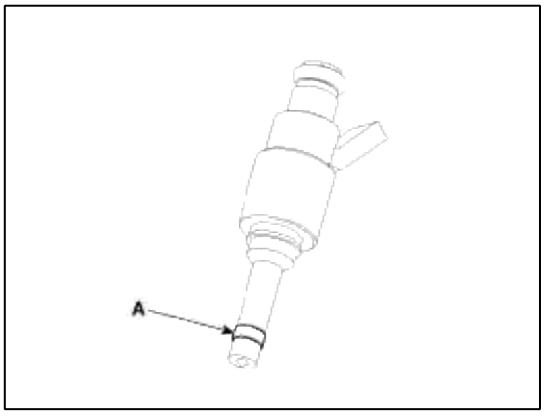


5. Pull the injector out of the sizing tool by turning it in the reverse direction to that used for the press-in process.

CAUTION

Check that the seal ring has not been damaged during assembly to the injector and that no circumferential scratches are present.
Do not reuse the combustion seal.
The seal must be completely free of grease and oil.

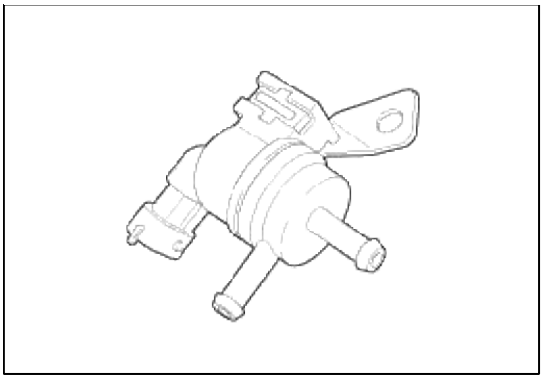
6. Check the combustion seal (A) installation.



Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Description and Operation

Description

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



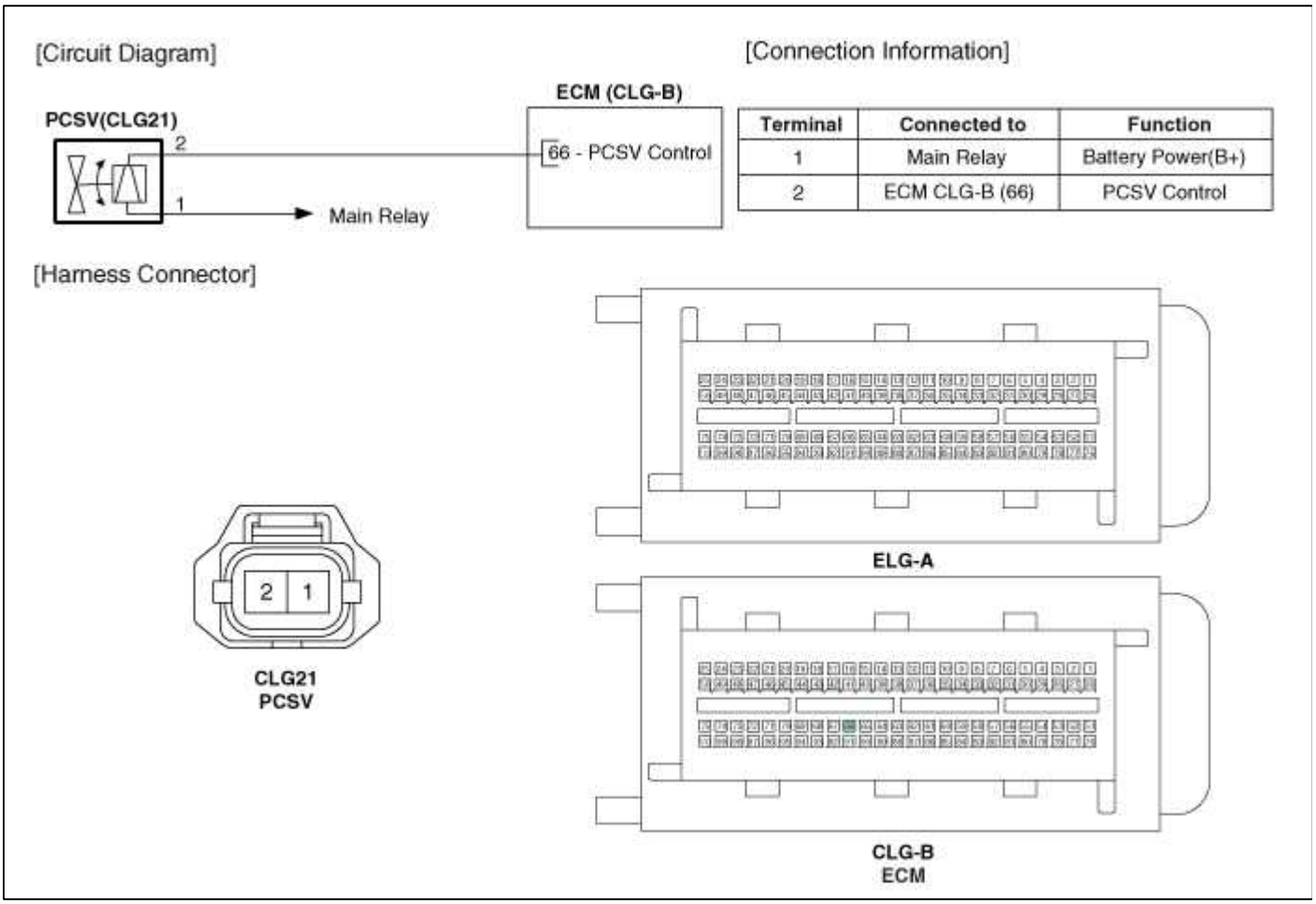
Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Specifications

Specification

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

Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Schematic Diagrams

Circuit Diagram



Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Repair procedures

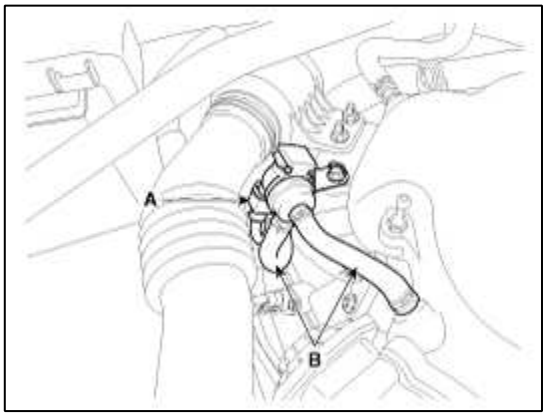
Inspection

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

Specification: Refer to “Specification”

Removal

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



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. If the component has been dropped, inspect before installing.
- Be sure not to apply oil or lubricant to the end of the hoses when connecting the PCSV hose.

CAUTION

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

1. Installation is reverse of removal.

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

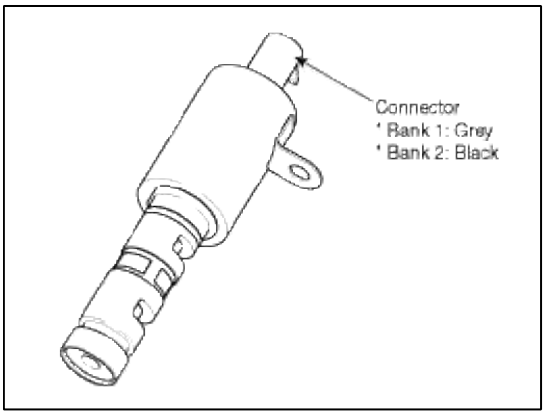
Fuel System > Engine Control System > CVVT Oil Control Valve (OCV) > Description and Operation

Description

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.
By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

This system consist of
- the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or runs out the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,
- the CVVT Oil Temperature Sensor (OTS) which measures the engine oil temperature,
- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

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



Fuel System > Engine Control System > CVVT Oil Control Valve (OCV) > Specifications

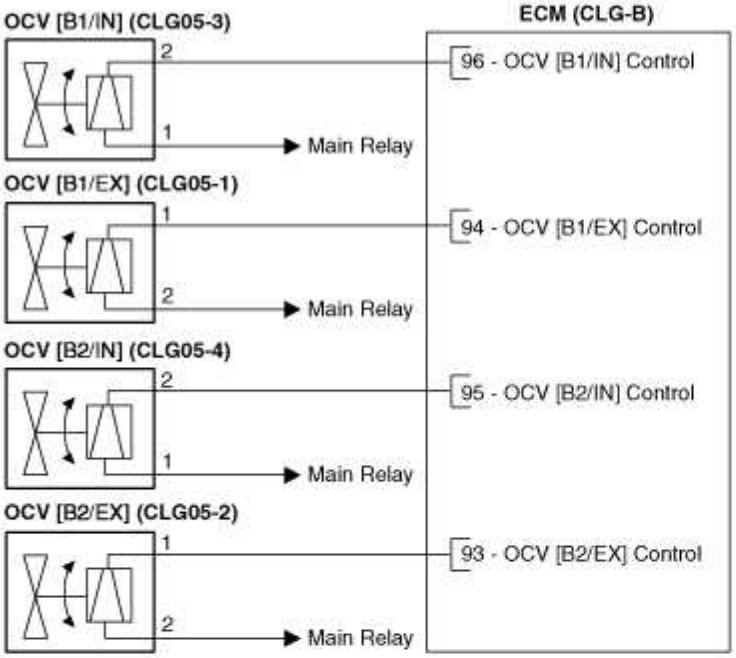
Specification

Item	Specification
Coil Resistance (Ω)	9.4 ~ 10.4 [20°C(68°F)]

Fuel System > Engine Control System > CVVT Oil Control Valve (OCV) > Schematic Diagrams

Circuit Diagram

[Circuit Diagram]



[Connection Information]

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

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

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

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

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

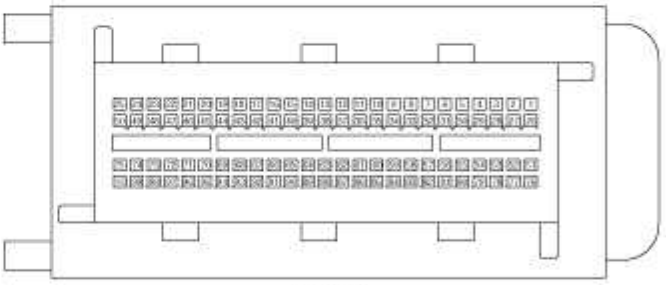
Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CLG-B (95)	OCV [B2/IN] Control

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

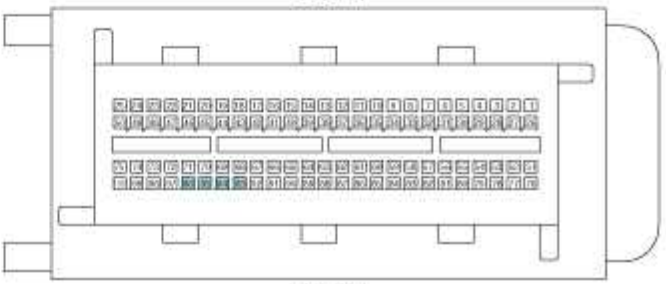
Terminal	Connected to	Function
1	ECM CLG-B (93)	OCV [B2/EX] Control
2	Main Relay	Battery Power (B+)

[Harness Connector]

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



ELG-A



CLG-B
ECM

Fuel System > Engine Control System > CVVT Oil Control Valve (OCV) > Repair procedures

Inspection

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

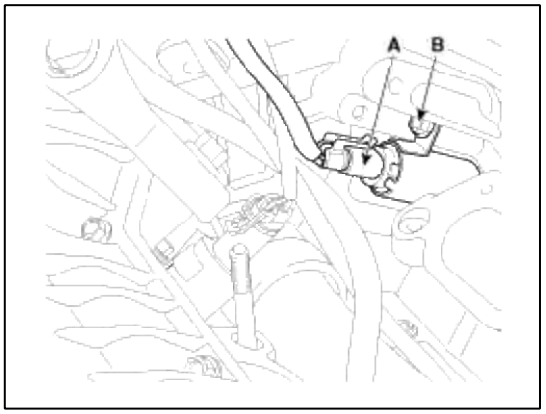
Specification: Refer to “Specification”

Removal

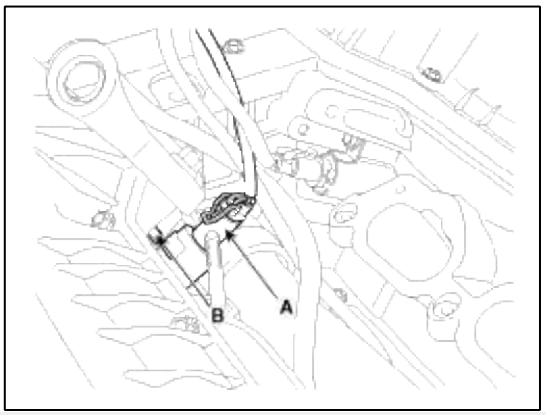
[CVVT Oil Control Valve (Intake)]

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

[Bank 1]



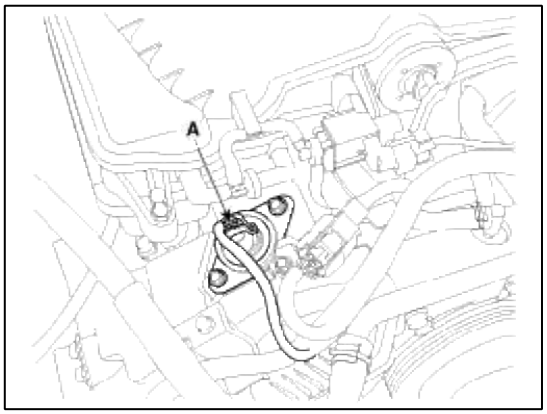
[Bank 2]



[CVVT Oil Control Valve (Exhaust)]

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

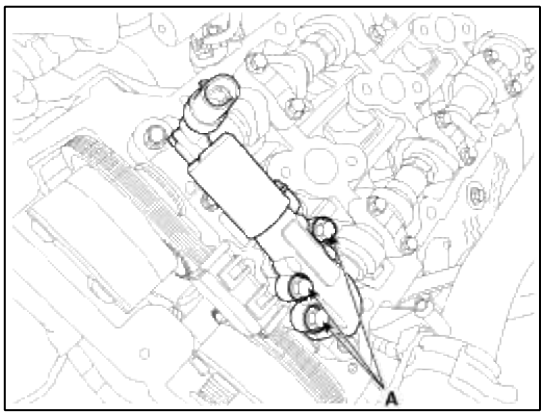
[Bank 1]



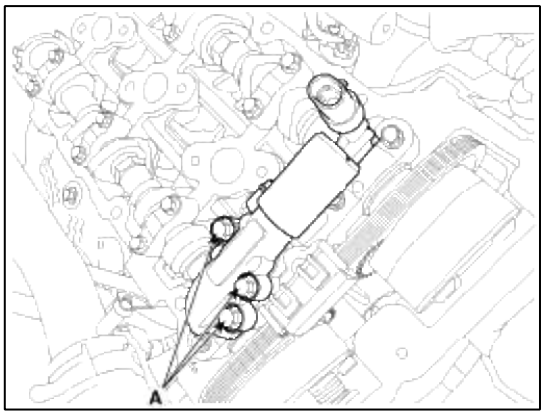
[Bank 2]

3. Remove the cylinder head cover (Refer to “Cylinder Head Assembly” in EM group).
4. Remove the installation bolt (A), and then remove the valve from the engine.

[Bank 1]



[Bank 2]



Inatallation

CAUTION

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

CAUTION

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

CAUTION

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

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

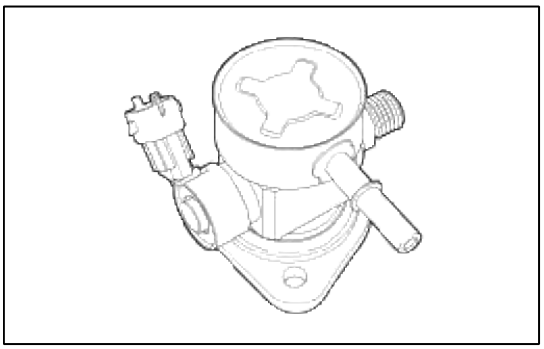
1. Installation is reverse of removal.

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

Fuel System > Engine Control System > Fuel Pressure Control Valve > Description and Operation

Description

Fuel Pressure Regulator Valve is installed on the high pressure fuel pump and controls fuel flow flowing into the injectors in accordance with the ECM signal calculated based on various engine condition.



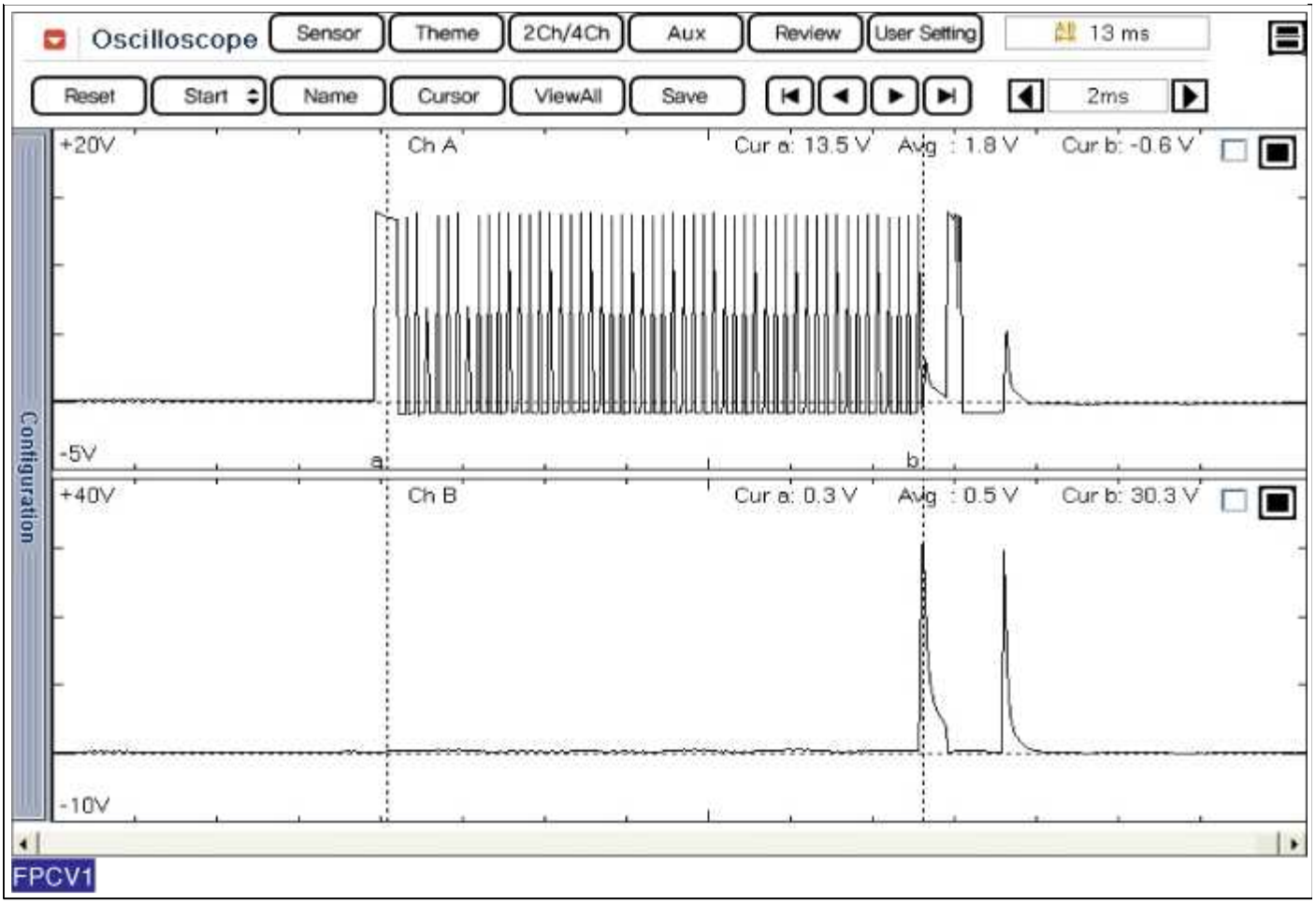
Fuel System > Engine Control System > Fuel Pressure Control Valve > Specifications

Specification

Item	Specification
Coil Resistance (Ω)	1.04 ~ 1.27 [23°C(73.4°F)]

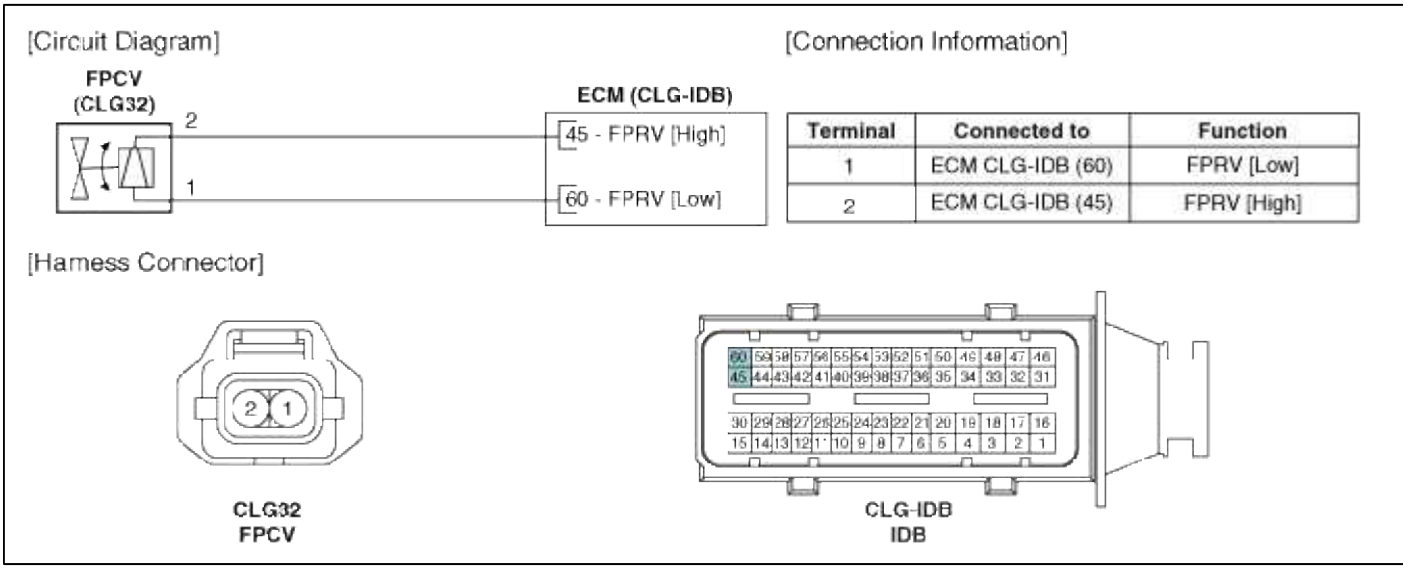
Fuel System > Engine Control System > Fuel Pressure Control Valve > Troubleshooting

Signal Waveform



Fuel System > Engine Control System > Fuel Pressure Control Valve > Schematic Diagrams

Circuit Diagram



Terminal	Connected to	Function
1	ECM CLG-IDB (60)	FPRV [Low]
2	ECM CLG-IDB (45)	FPRV [High]

Fuel System > Engine Control System > Fuel Pressure Control Valve > Repair procedures

Inspection

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the fuel pressure regulator valve connector.
3. Measure resistance between the fuel pressure regulator valve terminals 1 and 2.

4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

Refer to "High pressure fuel pump" in this group.

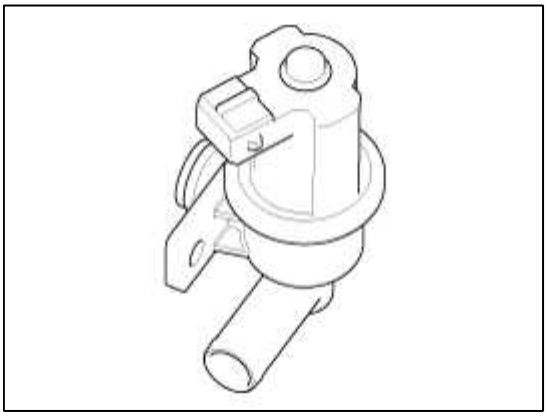
Installation

Refer to "High pressure fuel pump" in this group.

Fuel System > Engine Control System > Canister Close Valve (CCV) > Description and Operation

Description

Canister Close Valve (CCV) is installed on the canister ventilation line. It seals evaporative emission control system by shutting the canister from the atmosphere when leakage detecting system operates.



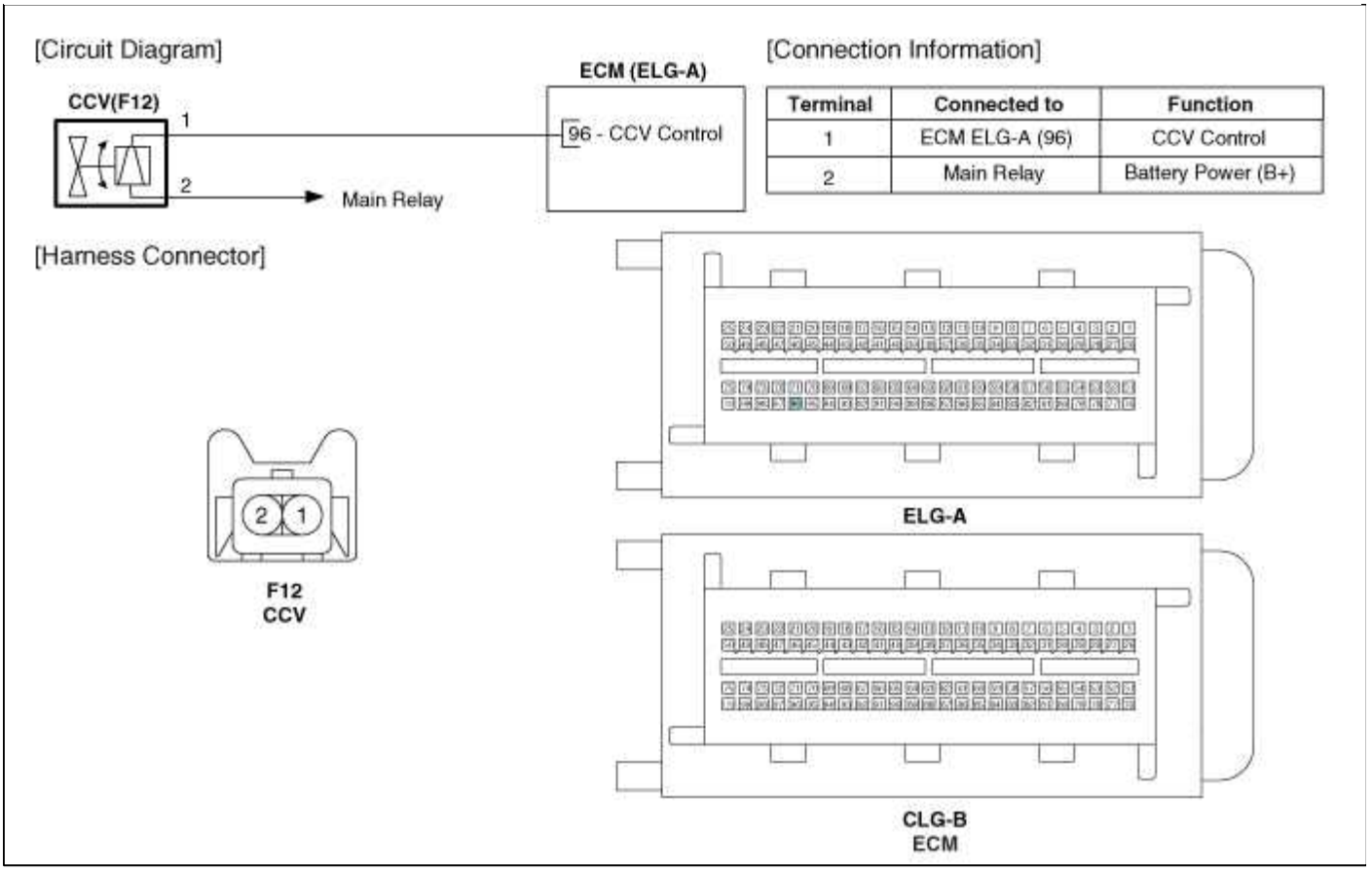
Fuel System > Engine Control System > Canister Close Valve (CCV) > Specifications

Specification

Item	Specification
Coil Resistance (Ω)	23.0 ~ 26.0 (20°C)

Fuel System > Engine Control System > Canister Close Valve (CCV) > Schematic Diagrams

Circuit Diagram



Fuel System > Engine Control System > Canister Close Valve (CCV) > Repair procedures

Inspection

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

Specification: Refer to "Specification"

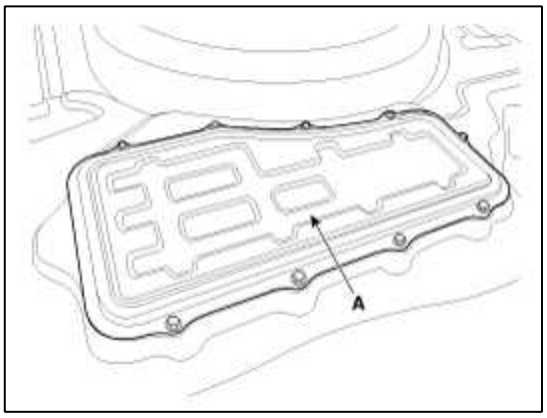
5. Disconnect the vapor hose connected with the canister from the CCV.
6. Connect a vacuum pump to the nipple.
7. Ground the CCV control line and apply battery voltage to the CCV power supply line.
8. Apply vacuum and check the valve operation.

Specification: Vacuum maintained

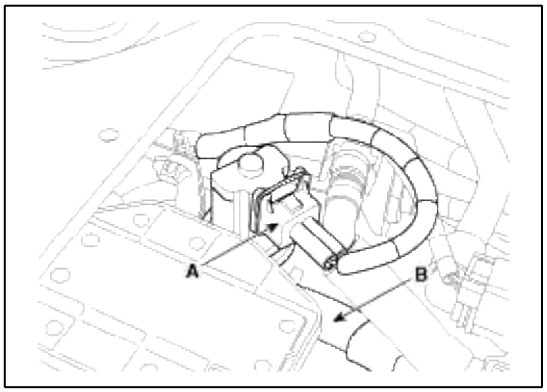
Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.

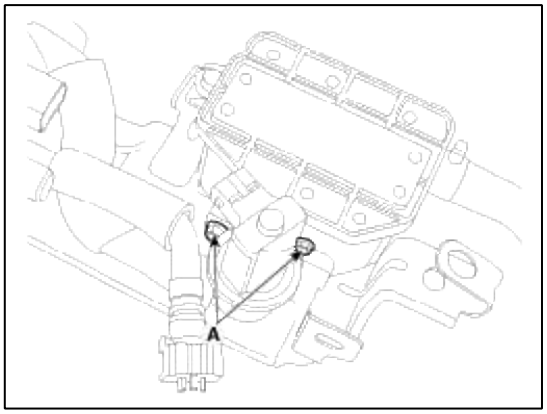
2. Remove the service cover (A) in the trunk.



3. Disconnect the canister close valve connector (A).
4. Disconnect the ventilation hose (B) from the canister close valve.



5. Remove the CCV from the fuel tank air filter assembly after removing 2 bolts (A).



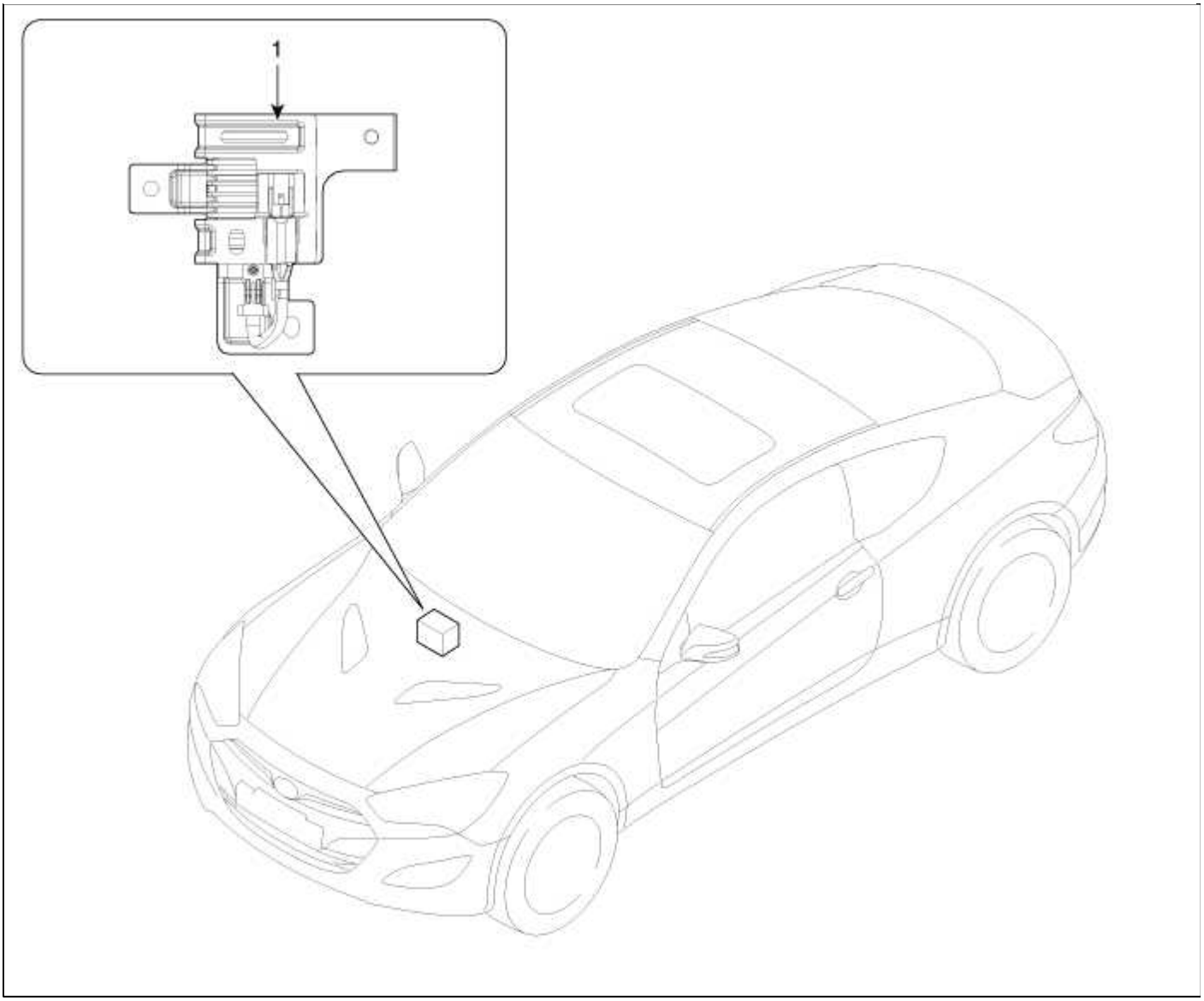
Installation

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

Canister close valve installation bolt:
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Fuel System > Engine Control System > Fuel Pump Resister > Components and Components Location

Component Location



1. Fuel Pump Resister	

Fuel System > Engine Control System > Fuel Pump Resister > Description and Operation

Description

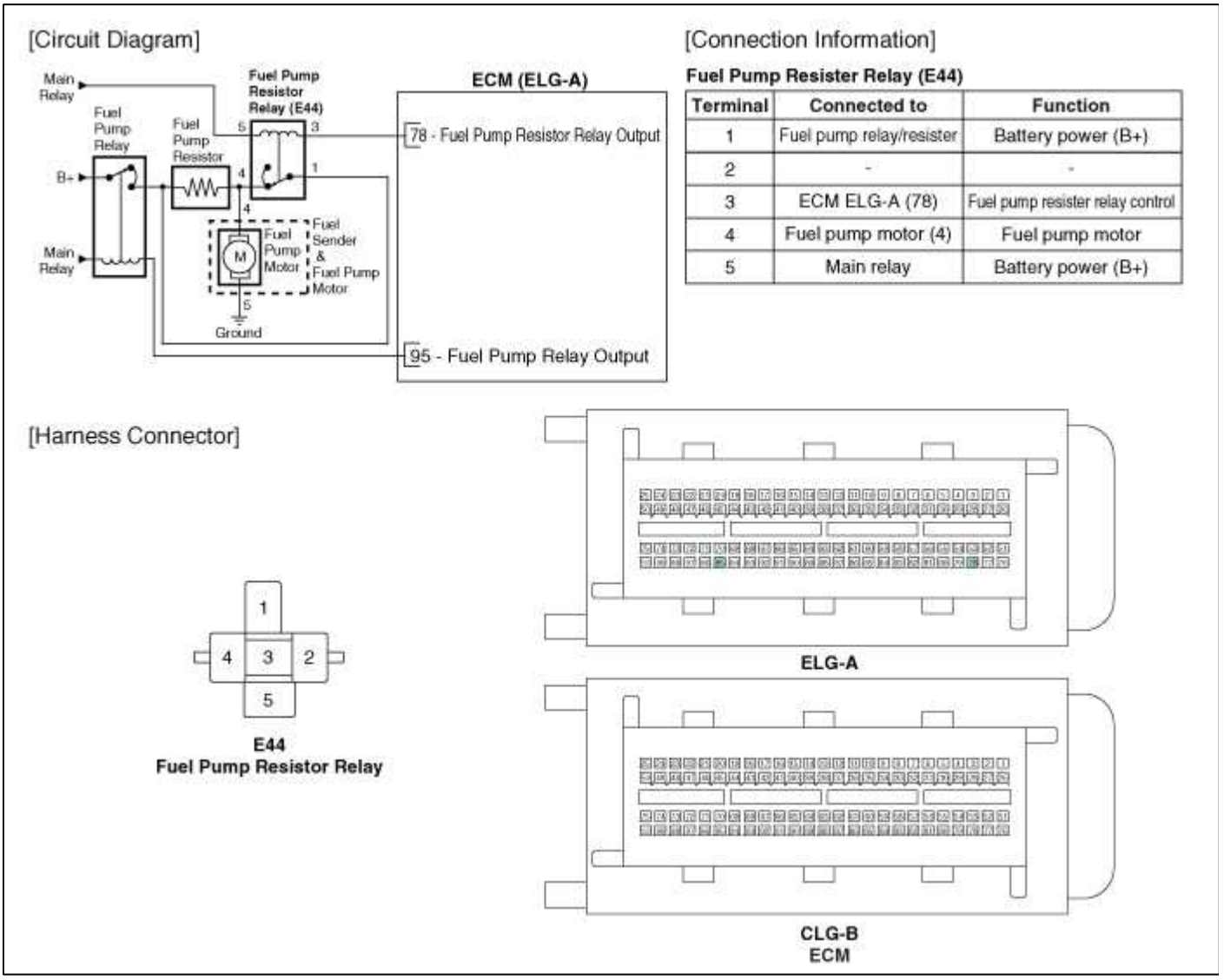
Fuel pump resistor controls supply voltage for the fuel pump motor.
This resistor reduces noise and increases durability of the fuel pump motor through reducing rpm and flow quantity at specific range.

Fuel pump motor operation

Engine state	Resistor	Mode	Supply voltage (V)
Engine start	Not operated	Hi mode	Battery voltage
Idle ~ Specific range	Operated	Lo mode	About 9.5
W.O.T or Rapid acceleration	Not operated	Hi mode	Battery voltage

Fuel System > Engine Control System > Fuel Pump Resister > Schematic Diagrams

Circuit Diagram

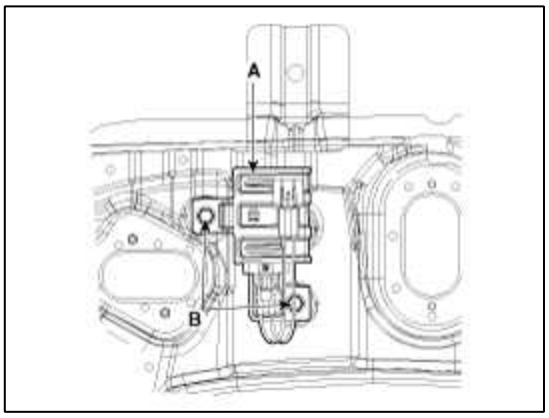


Fuel System > Engine Control System > Fuel Pump Resister > Repair procedures

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the fuel pump resister connector.

3. Remove the fuel pump resister (A) after removing the installation bolts (B).



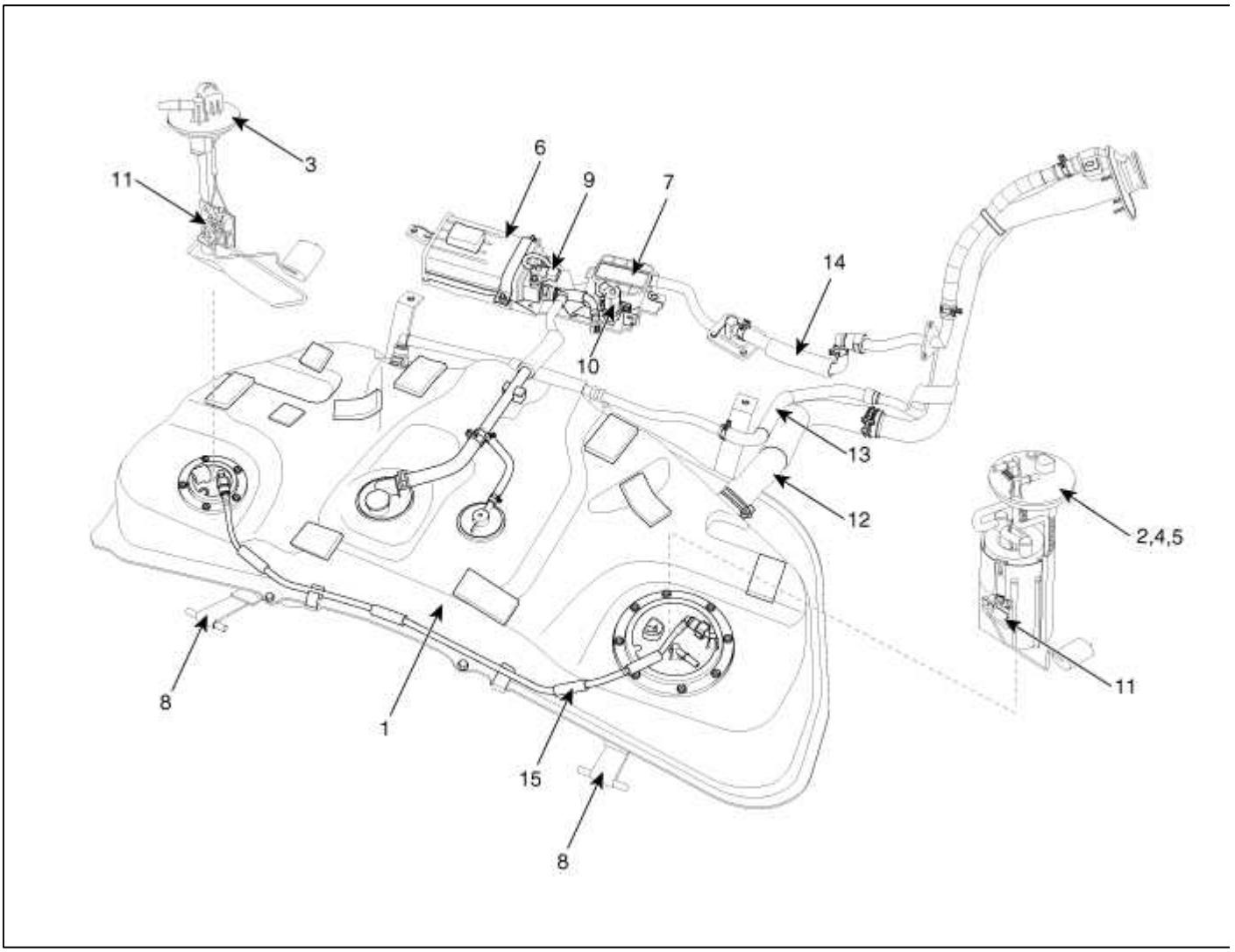
Installation

1. Installation is reverse of removal.

Fuel pump resister installation bolt :
6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)

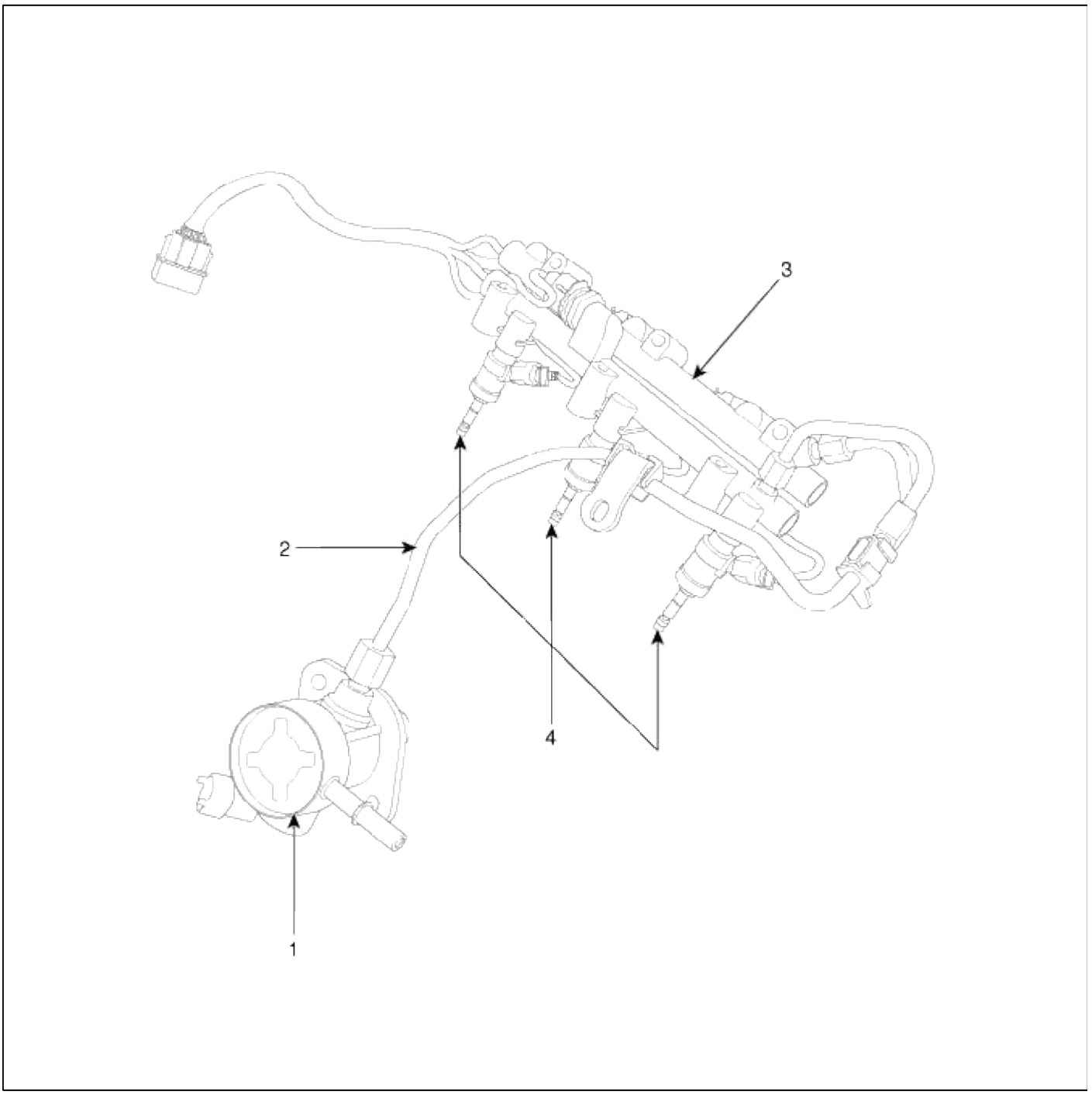
Fuel System > Fuel Delivery System > Components and Components Location

Components Location



1. Fuel tank 2. Fuel pump 3. Sub fuel sender 4. Fuel filter 5. Fuel pressure regulator 6. Canister 7. Fuel tank air filter 8. Fuel tank band	9. Fuel Tank Pressure Sensor (FTPS) 10. Canister Close Valve (CCV) 11. Fuel Level Sensor (FLS) 12. Fuel filler hose 13. Leveling tube 14. Ventilation tube 15. Suction hose

[High Pressure Fuel Line]



1. High Pressure Fuel Pump 2. High Pressure Fuel Pipe	3. Delivery Pipe 4. Injector

WARNING

In case of removing the high pressure fuel pump, high pressure fuel pipe, delivery pipe, and injector, there may be injury caused by leakage of the high pressure fuel. So don't do any repair work right after engine stops.

Fuel System > Fuel Delivery System > Repair procedures

Fuel Pressure Test

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

CAUTION

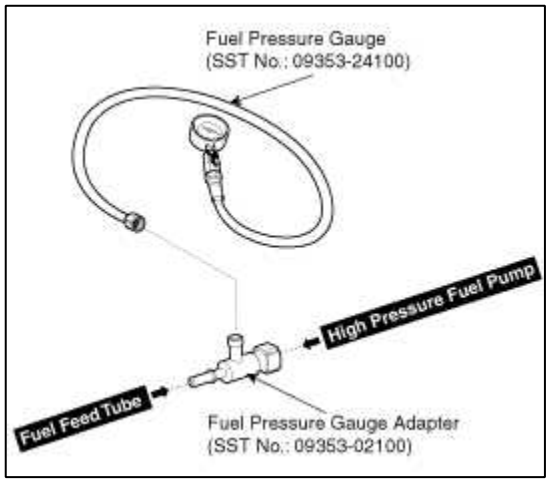
When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of "Release Residual Pressure in Fuel Line" work.

2. Install the Special Service Tool (SST).
   (1) Disconnect the fuel feed tube from the high pressure fuel pump.

CAUTION

There may be some residual high pressure even after "Release Residual Pressure in Fuel Line" work, so must cover the high pressure line connection part with a shop towel or a cloth to prevent residual fuel from spilling out before removing any high pressure fuel part. Then release pressure by carefully removing connection part. If not, it may result in the injury by high temperature and pressure fuel.

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



3. Inspect fuel leakage on connections among the fuel feed tube, the high pressure fuel pump, and the SST components with IG ON.

4. Measure Fuel Pressure.
   (1) Start the engine and measure the fuel pressure at idle.

Fuel Pressure: 480 ~ 519 kPa (4.9 ~ 5.3 kgf/cm², 69.6 ~ 75.3 psi)

NOTE

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

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

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

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

NOTE

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

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

   (3) Turn the ignition switch OFF.

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

CAUTION

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

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

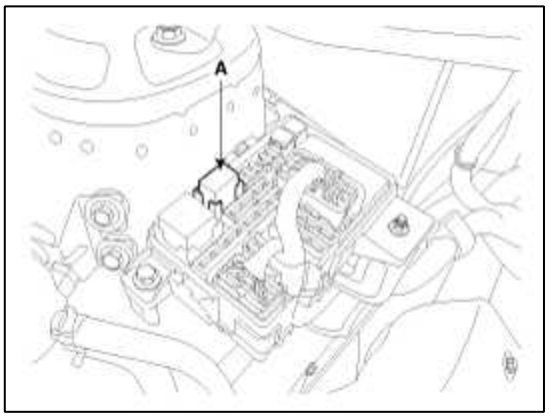
Release Residual Pressure in Fuel Line

CAUTION

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

1. Turn the ignition switch OFF and disconnect the battery (-) cable.

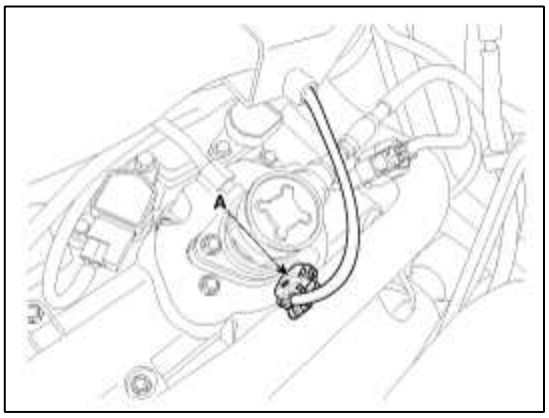
2. Remove the fuel pump relay (A).



CAUTION

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

3. Disconnect the high pressure fuel pump connector (A).

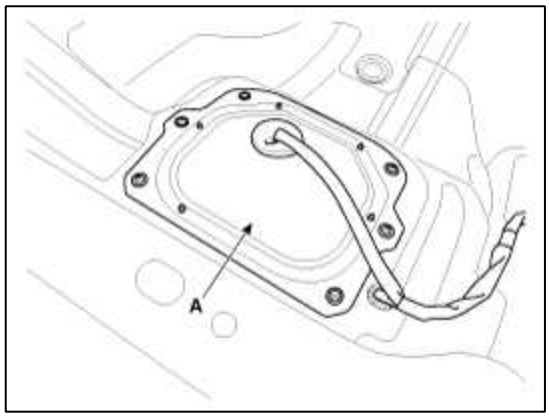


4. Connect the battery (-) cable.
5. Start the engine and let idle, and then turn the ignition switch OFF after the engine has stopped on its own.
6. Disconnect the battery (-) cable, and then install the fuel pump relay and the high pressure fuel pump connector.
7. Connect the battery (-) cable.
8.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

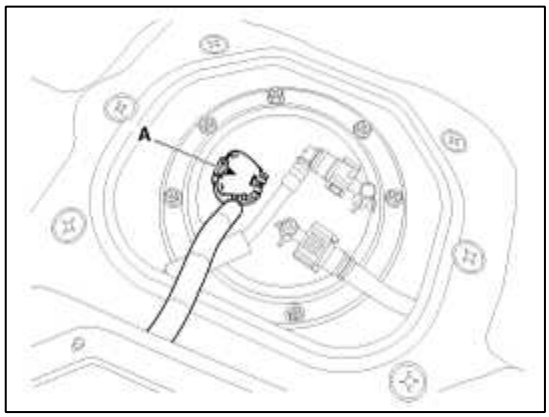
Fuel System > Fuel Delivery System > Fuel Tank > Repair procedures

Removal

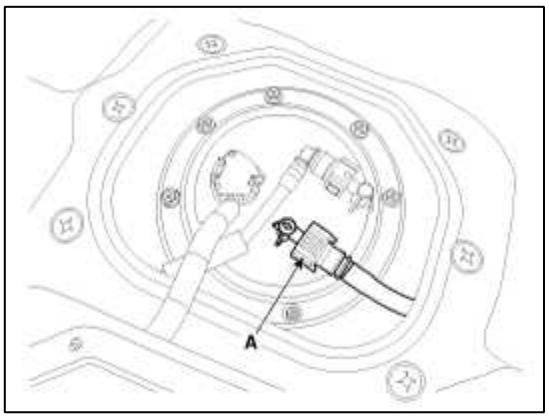
1. Preparation
   (1) Remove the rear seat cushion (Refer to “Seat” in BD group).
   (2) Remove the service cover of the fuel pump (A).



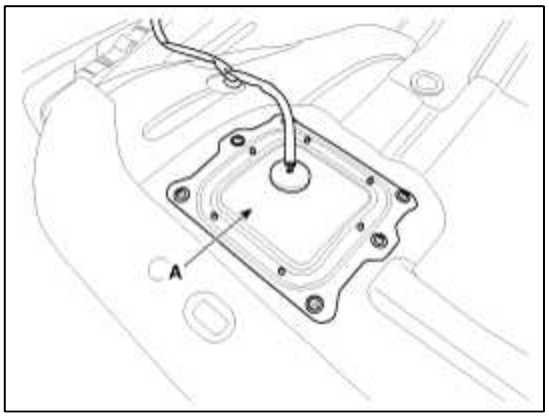
   (3) Disconnect the fuel pump connector (A).



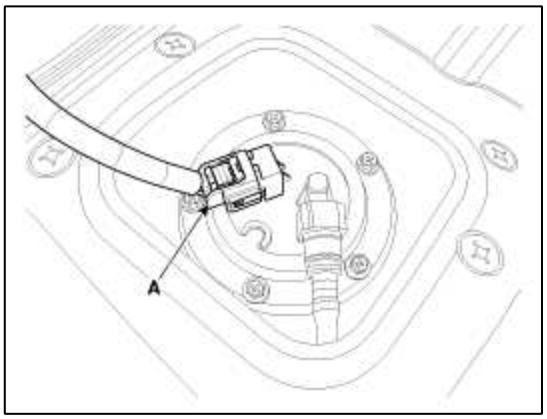
   (4) Idle the engine and wait until fuel in feed line is exhausted.
   (5) After engine stops, turn the ignition switch OFF.
2. Disconnect the fuel feed tube quick-connector (A).



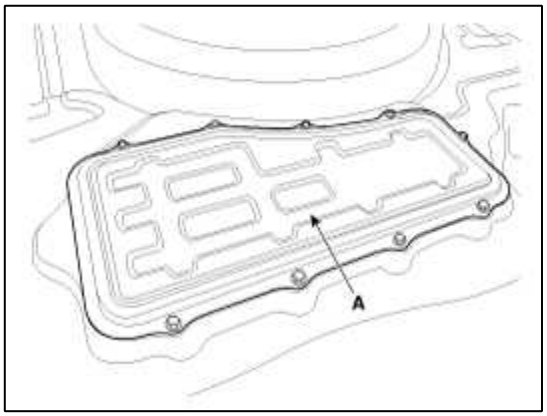
3. Remove the service cover of the sub fuel sender (A).



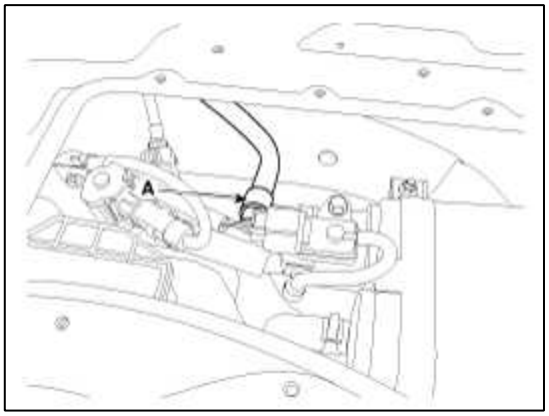
4. Disconnect the sub fuel sender connector (A).



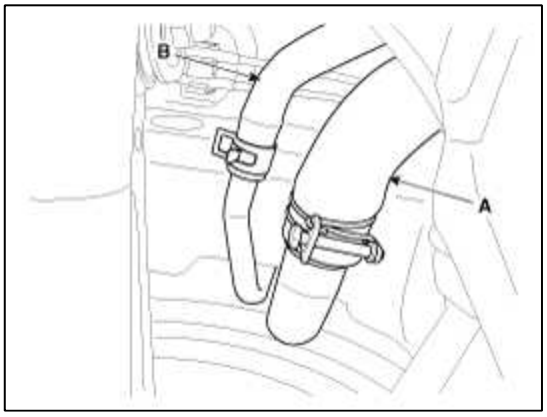
5. Remove the service cover of the canister (A) in trunk room.



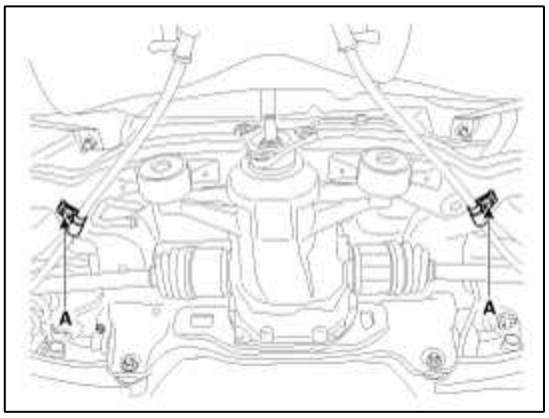
6. Disconnect the vapor tube quick-connector (A).



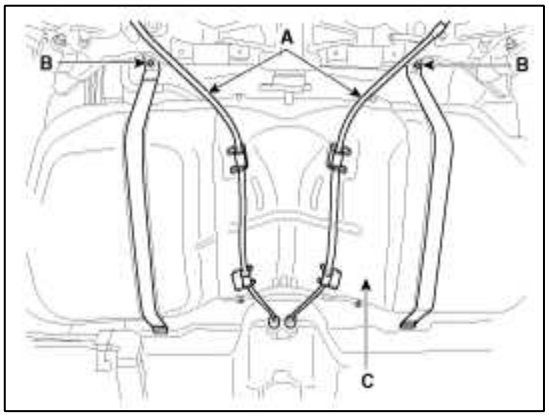
7. Lift the vehicle.
8. Remove the center muffler assembly (Refer to “Intake And Exhaust System” in EM group).
9. Remove the propeller shaft (Refer to “Propeller Shaft Assembly” in DS group).
10. Disconnect the fuel filler hose (A) and the leveling hose (B).



11. Remove the brake line bracket installation bolt (A).



12. Detach the parking brake cable (A) from the fuel tank.
13. Remove the fuel tank (C) from the vehicle after removing the mounting nuts (B).



Installation

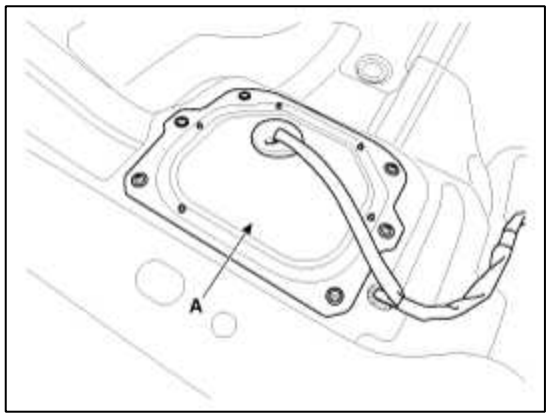
1. Installation is reverse of removal.

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

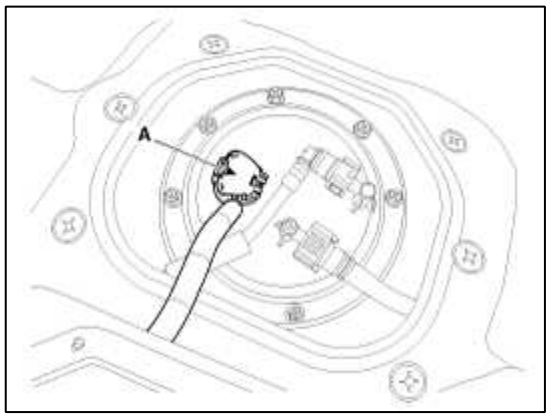
Fuel System > Fuel Delivery System > Fuel Pump > Repair procedures

Removal

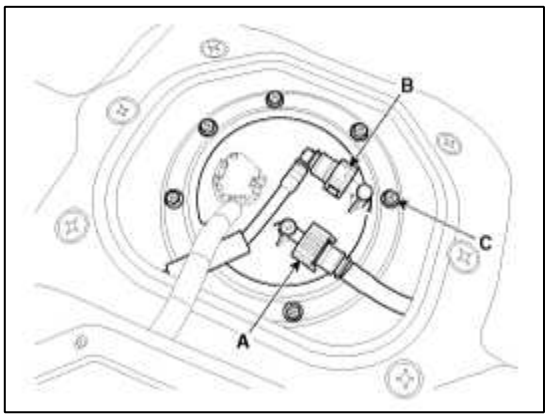
1. Preparation
   (1) Remove the rear seat cushion (Refer to “Seat” in BD group).
   (2) Remove the service cover of the fuel pump (A).



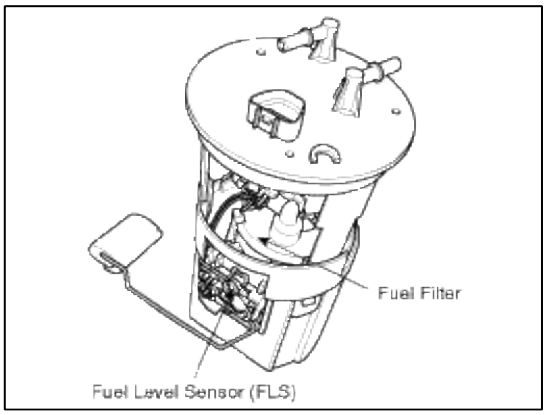
   (3) Disconnect the fuel pump connector (A).



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



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



Installation

1. Installation is reverse of removal.

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

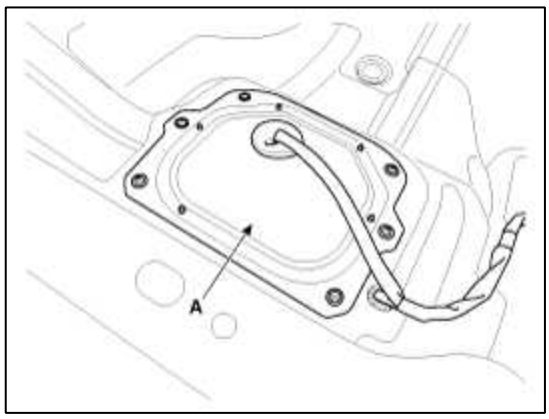
CAUTION

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

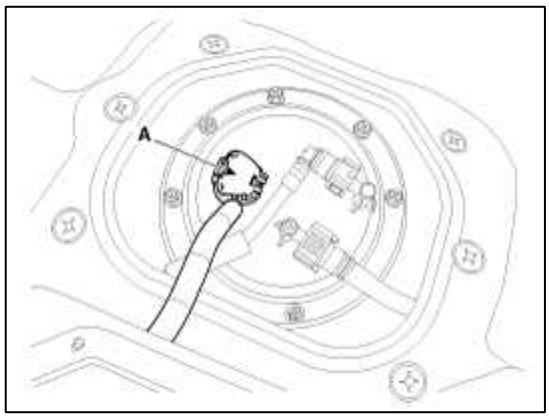
Fuel System > Fuel Delivery System > Sub Fuel Sender > Repair procedures

Removal

1. Preparation
   (1) Remove the rear seat cushion (Refer to “Seat” in BD group).
   (2) Remove the service cover of the fuel pump (A).

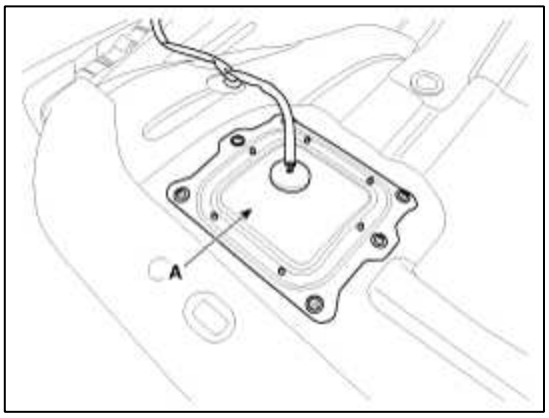


   (3) Disconnect the fuel pump connector (A).

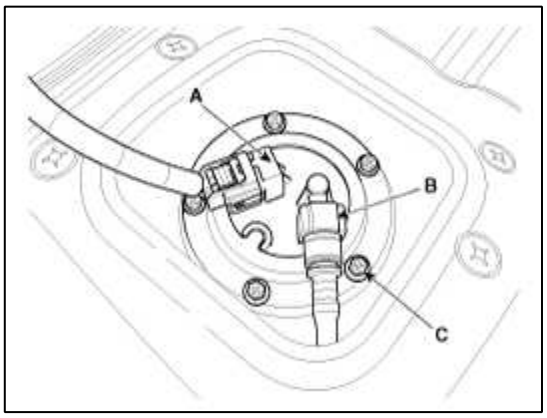


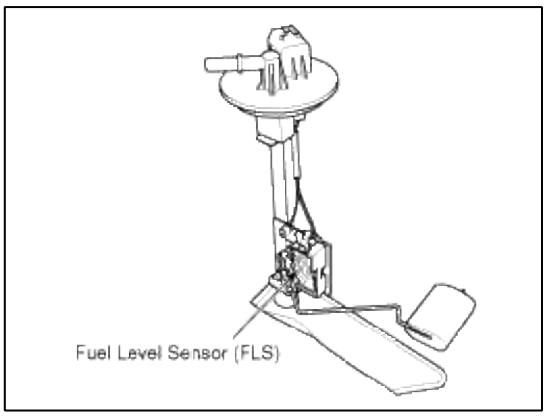
   (4) Idle the engine and wait until fuel in feed line is exhausted.
   (5) After engine stops, turn the ignition switch OFF.

2. Remove the service cover of the sub fuel sender (A).



3. Disconnect the sub fuel sender connector (A).
4. Disconnect the suction tube quick-connector (B).
5. Remove the sub fuel sender from the fuel tank after removing the installation bolts (C).





Installation

1. Installation is reverse of removal.

Sub fuel sender installation bolt :
2.0 ~ 2.9 N.m (0.2 ~ 0.3 kgf.m, 1.4 ~ 2.2 lb-ft)

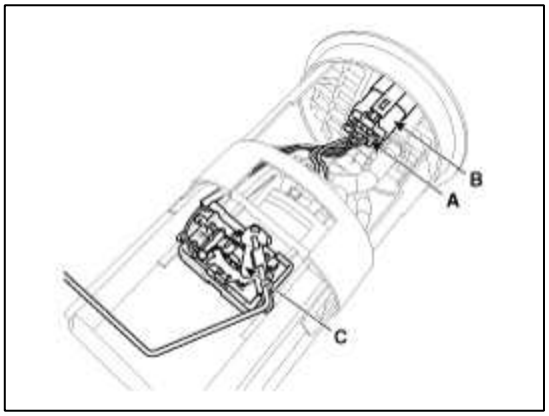
CAUTION

When installing the sub fuel sender, be careful not to get the seal-ring entangled.

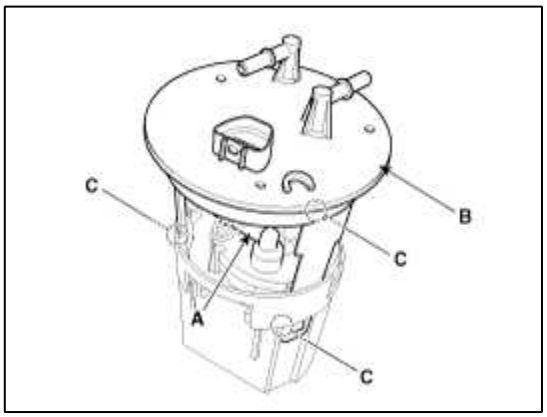
Fuel System > Fuel Delivery System > Fuel Filter > Repair procedures

Replacement

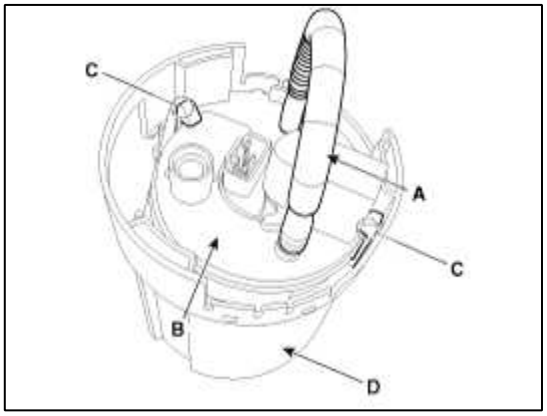
1. Remove the fuel pump (Refer to “Fuel Pump” in this group).
2. Disconnect the electric pump wiring connector (A) and the fuel sender connector (B).
3. Remove the fuel sender (C).

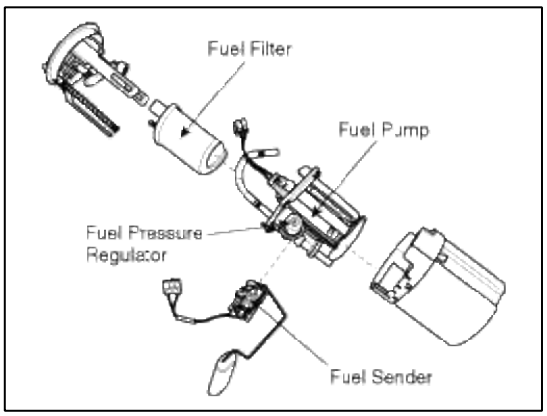


4. Disconnect the fuel feed line (A) from the fuel filter.
5. Separate the head assembly (B) with the hooks (C) released.



6. Disconnect the regulator hose (A) from the fuel filter (B).
7. Separatate the fuel filter (B) from the reservior (D) with the hooks (C) released.

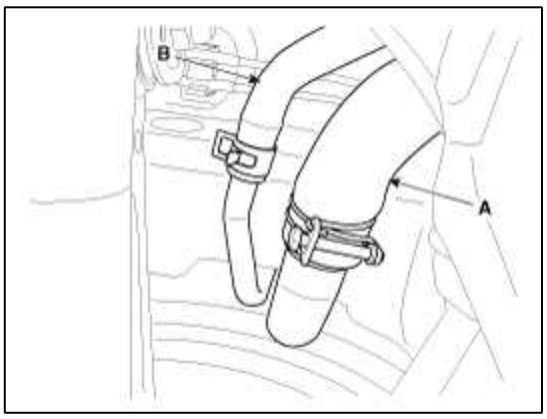




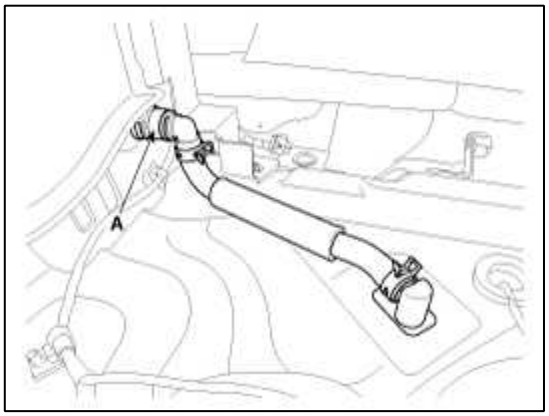
Fuel System > Fuel Delivery System > Filler-Neck Assembly > Repair procedures

Removal

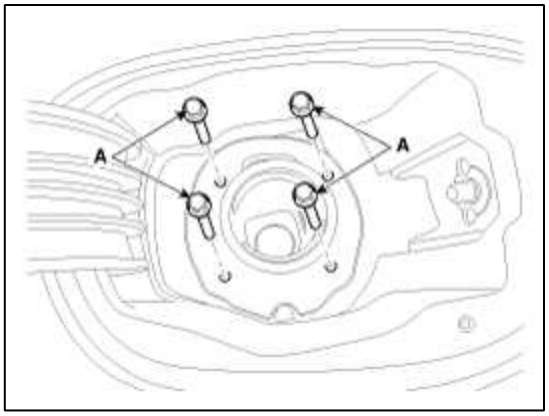
1. Disconnect the fuel filler hose (A) and the leveling hose (B).



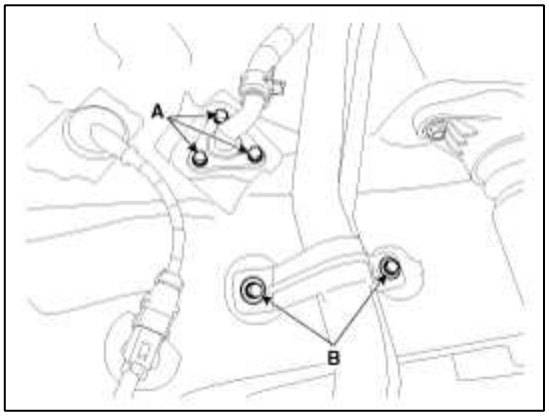
2. Disconnect the vapor hose quick-connector (A) after removing the trunk luggage trim.



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



5. Remove the filler-neck assembly from the vehicle after removing the vapor hose mounting bolts (A) and the bracket mounting bolts (B).



Installation

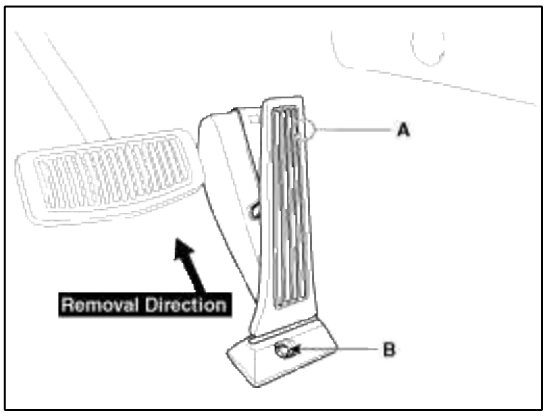
1. Installation is reverse of removal.

Filler-neck assembly installation bolt :
7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)
Filler-neck assembly installation nut :
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Fuel System > Fuel Delivery System > Accelerator Pedal > Repair procedures

Removal

1. Turn the ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the accelerator position sensor connector (A).
3. Remove the accelerator pedal in the direction of "Remove Direction" in the figure after removing the mounting bolt (B).



Installation

1. Installation is reverse of removal.

Accelerator pedal module installation bolt :
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Fuel System > Fuel Delivery System > Delivery Pipe > Repair procedures

Removal

WARNING

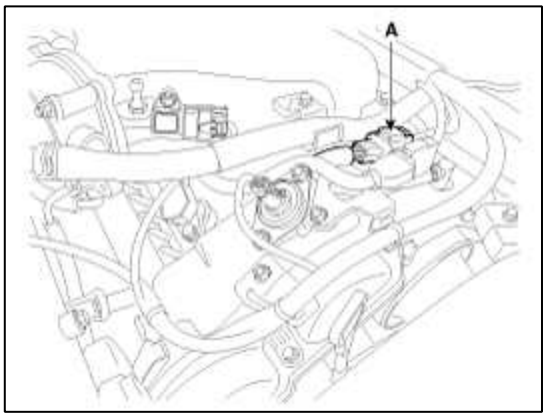
In case of removing the high pressure fuel pump, high pressure fuel pipe, delivery pipe, and injector, there may be injury caused by leakage of the high pressure fuel. So don’t do any repair work right after engine stops.

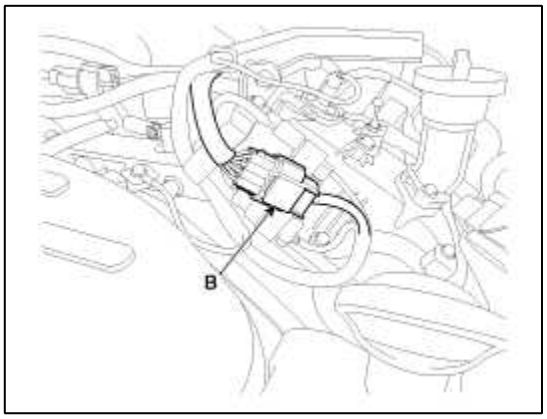
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).

CAUTION

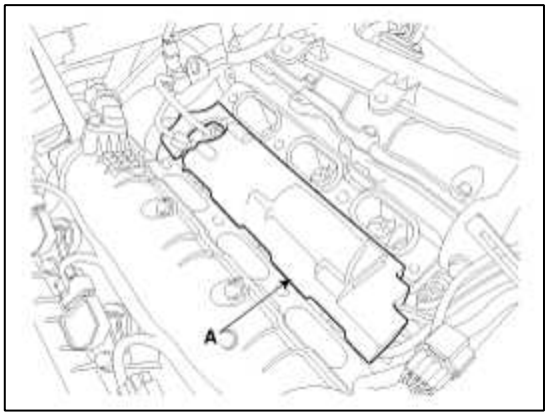
When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of “Release Residual Pressure in Fuel Line” work.

3. Disconnect the injectors connector (A,B).

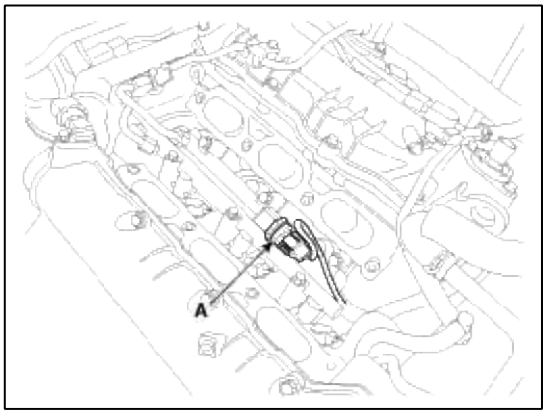




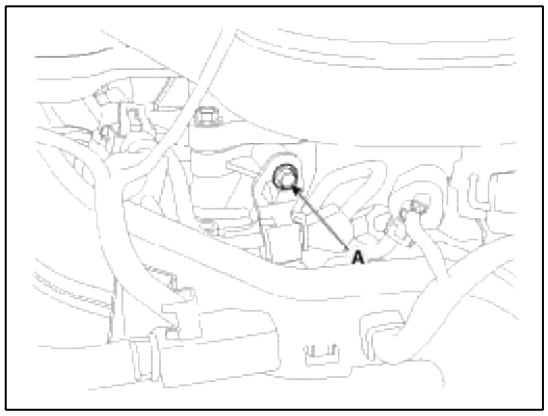
4. Remove the intake manifold (Refer to "Intake And Exhaust System" in EM group).
5. Remove the delivery pipe foam cover (A).



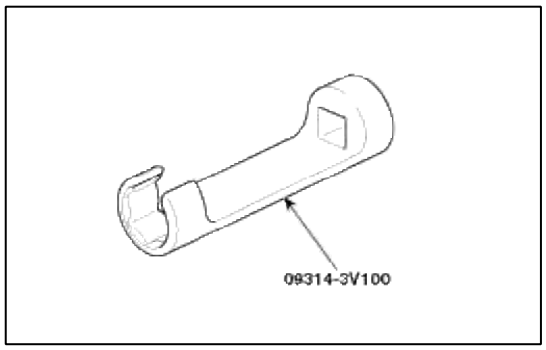
6. Disconnect the rail pressure sensor connector (A).



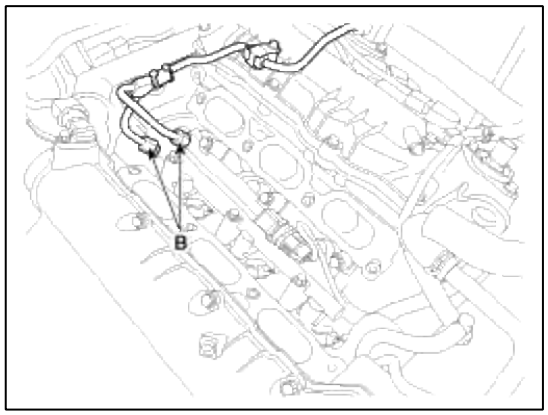
7. Remove the high pressure fuel pipe.
   (1) Remove the bracket installation bolt (A).

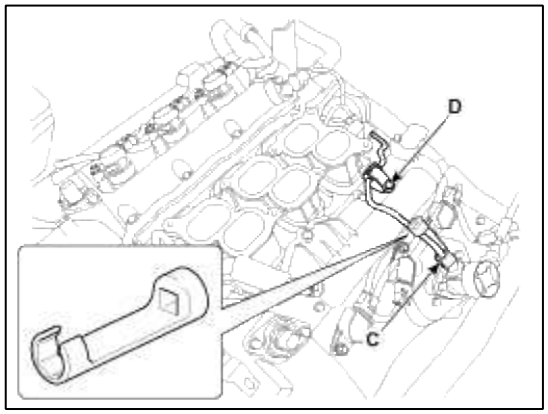


   (2) Loosen the flange nut in the order of B,C with SST(09314-3V100).

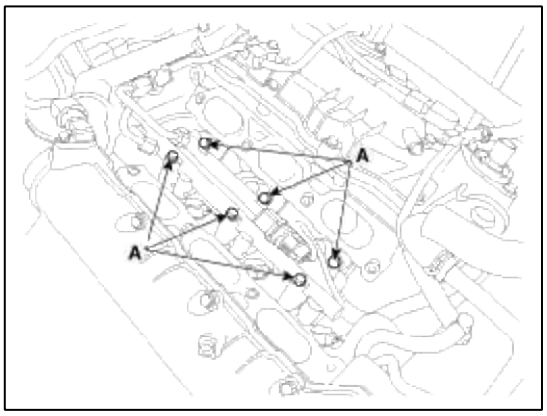


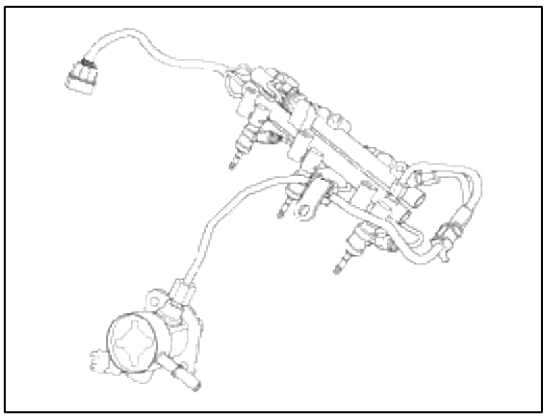
   (3) Remove the high pressure pipe bracket bolt (D).





8. Remove the installation bolt (A), and then remove the delivery pipe and injector assembly from the engine.





Installation

CAUTION

- Do not use already used injector fixing clip again.

CAUTION

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

CAUTION

- Apply engine oil to the injector O-ring.
- Do not use already used injector O-ring again.

CAUTION

- Do not use already used bolt again.

CAUTION

- When insert the injector, be careful not to damage the injector tip.

1. Installation is reverse of removal.

Delivery pipe installation bolt:
18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)
High pressure fuel pipe installation nut:
29.4 ~ 35.3 N.m (3.0 ~ 3.6 kgf.m, 21.7 ~ 26.0 lb-ft)

Fuel System > Fuel Delivery System > High Pressure Fuel Pump > Repair procedures

Removal

WARNING

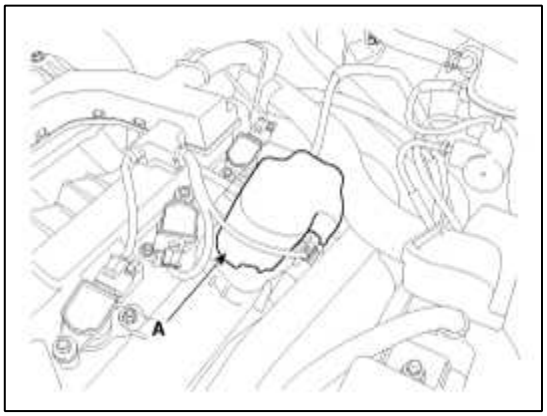
In case of removing the high pressure fuel pump, high pressure fuel pipe, delivery pipe, and injector, there may be injury caused by leakage of the high pressure fuel. So don't do any repair work right after engine stops.

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

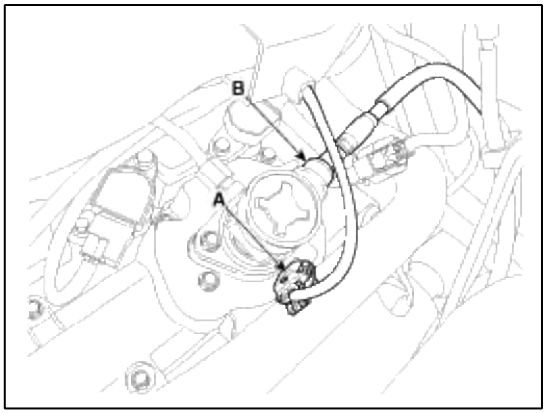
CAUTION

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

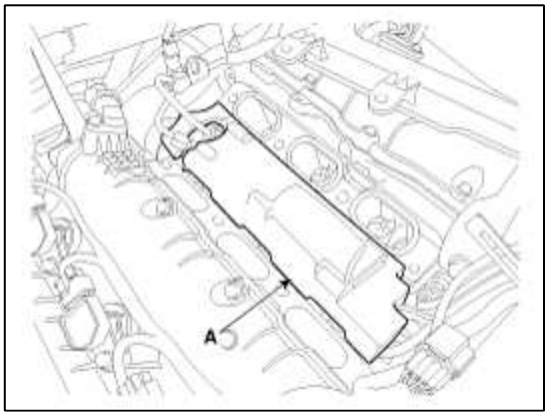
3. Remove the foam cover (A).



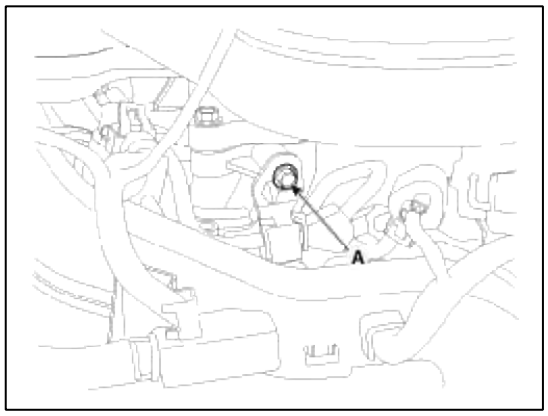
4. Disconnect the fuel pressure control valve connector (A) and the fuel feed tube quick-connector (B).



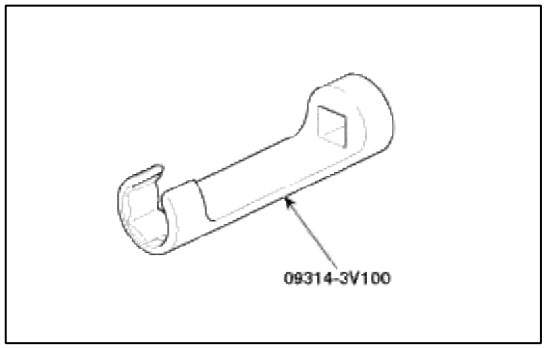
5. Remove the air cleaner and the air intake hose (Refer to "Intake And Exhaust System" in EM group).
6. Remove the pipe foam cover (A).



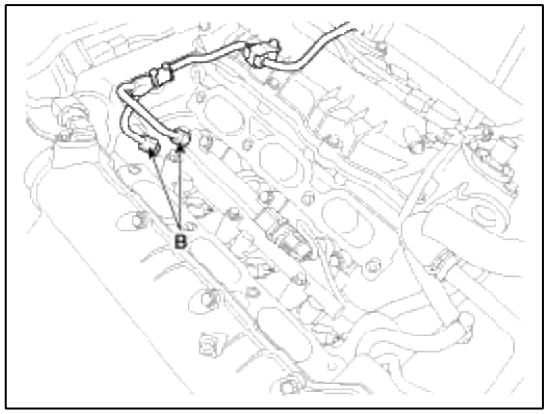
7. Remove the high pressure fuel pipe.
   (1) Remove the bracket installation bolt (A).

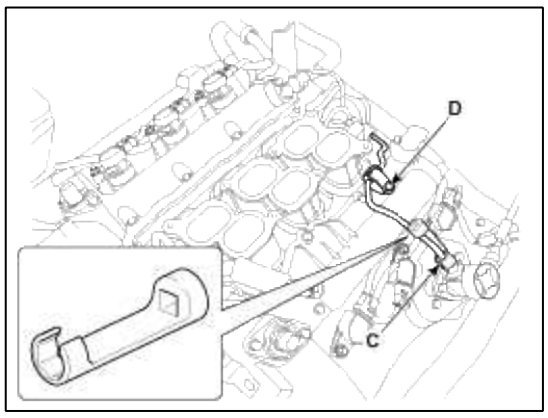


   (2) Remove the high pressure pipe flange nut (B,C) in order of A,B with the special service tool [SST No.: 09314-3V100]



   (3) Remove the high pressure pipe bracket bolt (D).

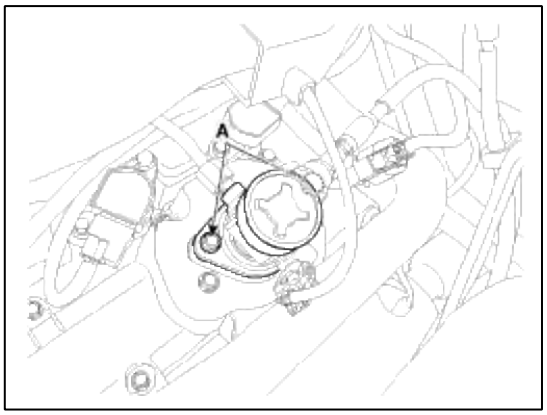




8. Remove the installation bolts (A), and then remove the high pressure fuel pump from the cylinder head assembly.

CAUTION

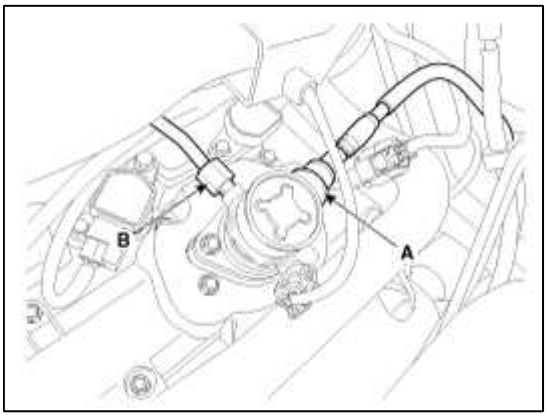
Unscrew in turn the two bolts in small step (0.5 turns). In case of fully unscrewing one of the two bolts with the other bolt installed, the housing surface of the cylinder head may be broken because of tension of the pump spring.



Installation

WARNING

- Be sure to check the low pressure fuel hose quick-connector (A) is completely connected to the high pressure fuel pump until a confirmation 'click' sound is heard.
- Be sure to re-check the low pressure fuel hose is completely connected to the high pressure fuel pump by pulling it after connecting.
- Be sure to install the high pressure fuel pipe (B) with the specified torques.
- Because fuel leak may cause fire, securely Inspect leakage of all fuel line connection parts at engine start condition.



CAUTION

- Before installing the high pressure fuel pump, position the roller tappet in the lowest position by rotating the crankshaft. Otherwise the installation bolts may be broken because of tension of the pump spring.

CAUTION

- Do not reuse the used bolt.

CAUTION

- Do not reuse the used high pressure fuel pipe.

CAUTION

- When tightening the installation bolts of the high pressure fuel pump, tighten in turn the bolts in small step (0.5 turns) after tightening them with hand-screwed torque.

CAUTION

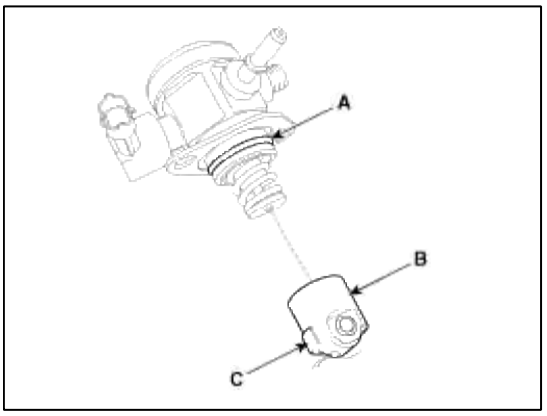
- Install the component with the specified torques.
- First hand-tighten the fasteners fully until they are not fastened any more in order to have them inserted in place and then completely tighten to the specified torque using a torque wrench.
  If not tightening the bolts or nuts in a straight line with the mating bolt holes or fittings, it may cause a fuel leak due to broken threads.

CAUTION

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

CAUTION

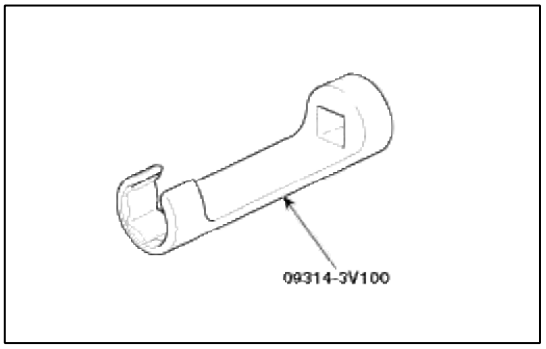
- Apply engine oil to the O-ring (A) of the high pressure fuel pump, the roller tappet (B), and the protrusion (C). Also apply engine oil to the groove on the location where the protrusion (C) is installed.



1. Installation is reverse of removal.

NOTE

Use the special service tool [SST No.: 09314-3V100] to install the high pressure fuel pipe.



High pressure fuel pump installation bolt: 12.8 ~ 14.7 N.m (1.3 ~ 1.5 kgf.m, 9.4 ~ 10.9 lb-ft)
High pressure fuel pipe installation nut: 29.4 ~ 35.3 N.m (3.0 ~ 3.6 kgf.m, 21.7 ~ 26.0 lb-ft)
High pressure fuel pipe function block installation bolt: 9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)