Fuel System > General Information > Specifications

Specifications

Fuel Delivery System

Items	Specification	
Fuel Tank	Capacity	70 lit. (18.5 U.S.gal., 74.0 U.S.qt., 61.6 Imp.qt.)
Fuel Filter	Type	Paper type
Fuel Pressure	Low Pressure Fuel Line	495 ~ 505 kPa (5.1 ~ 5.2 kgf/cm², 71.8 ~ 73.2 psi)
	High Pressure Fuel Line	5.0 ~ 12.0 MPa (51.0 ~ 122.4 kgf/cm², 725.2 ~ 1740.5 psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor
High Pressure Fuel Pump	Type	Mechanical type
	Driven by	Camshaft

Sensors

Manifold Absolute Pressure Sensor (MAPS) #1

Type: Piezo-resistive pressure sensor type

Specification

Pressure [kPa (kgf/cm², psi)]	Output Voltage (V)
20.0 (0.20, 2.9)	0.79
46.7 (0.47, 6.77)	1.84
101.3 (1.03, 14.7)	4.0

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
50	122	1.56 ~ 1.74
60	140	0.54 ~ 0.62
80	176	0.29 ~ 0.34

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Manifold Absolute Pressure Sensor (MAPS) #2

Type: Piezo-resistive pressure sensor type

Specification

Pressure [kPa (kgf/cm², psi)]	Output Voltage (V)
20.0 (0.20, 2.9)	0.79
46.7 (0.47, 6.77)	1.84
101.3 (1.03, 14.7)	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: Variable resistor type

Specification

Throttle Angle(°)	Output Voltage (V)	
	TPS1	TPS2
0	0	5.0
10	0.48	4.52
20	0.95	4.05
30	1.43	3.57
40	1.90	3.10
50	2.38	2.62
60	2.86	2.14
70	3.33	1.67
80	3.81	1.19
90	4.29	0.71
100	4.76	0.24
105	5.0	0
C.T (6~15°)	0.29 ~ 0.71	4.29 ~ 4.71

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W.O.T (93~102°)	4.43 ~ 4.86	0.14 ~ 0.57

Item	Resistance (kΩ)
TPS1	0.875 ~ 1.625 [20°C(68°F)]
TPS2	0.875 ~ 1.625 [20°C(68°F)]

Crankshaft Position Sensor (CKPS)
Type: Hall effect type
Camshaft Position Sensor (CMPS)
Type: Hall effect type
Knock Sensor (KS)
Type: Piezo-electricity type
Specification

Item	Specification
Capacitance (pF)	850 ~ 1,150

Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
Type: Zirconia (ZrO2) [Linear] Type
Specification

Item	Specification
Heater Resistance (Ω)	2.5 ~ 4.0 [20°C(69.8°F)]

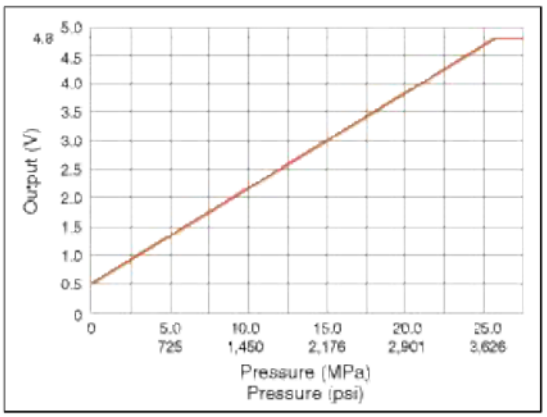
Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
Type: Zirconia (ZrO2) [Binary] Type
Specification

A/F Ratio (λ)	Output Voltage(V)
RICH	Approx. 0.9
LEAN	Approx. 0.04

Item	Specification
Heater Resistance (Ω)	3.3 ~ 4.1 [21°C(69.8°F)]

Rail Pressure Sensor (RPS)
Type: Piezo-electricity type
Specification

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EWGA Position Sensor [integrated into Electric Waste Gate Actuator (EWGA)]

Type: Hall effect, NON-Contact type

Specification

Position	Output Voltage [V]	Operating Angle[°]	Range of Rod [mm], reference
Mechanical Close end stop Position (MCP)	4.8	0	0
Electrical Close end stop Position (ECP)	4.2	12	1.8
Electrical Open end stop Position (EOP)	1	79	16
Mechanical Open end stop Position (MOP)	0.5	90	18

CVVT Oil Temperature Sensor (OTS)

Type: Thermistor type

Specification

Temperature [°C(°F)]	Resistance (kΩ)
-40(-40)	52.15
-20(-4)	16.52
0(32)	6
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	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

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Fuel Tank Pressure Sensor (FTPS)

Type: Piezo - Resistivity type

Specification

Pressure [kPa (kgf/cm², in H2O)]	Output Voltage (V)
-6.67 (-0.068, -26.8)	0.5
0	2.5
+6.67 (0.068, 26.8)	4.5

Actuators

Injector

Specification

Item	Specification
Coil Resistance (Ω)	1.25 [20°C(68°F)]

ETC Motor [integrated into ETC Module]

Specification

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

Purge Control Solenoid Valve (PCSV)

Specification

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

CVVT Oil Control Valve (OCV)

Specification

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

Fuel Pressure Regulator Valve

Specification

Item	Specification
Coil Resistance (Ω)	0.5 [20°C(68°F)]

EWGA DC Motor [integrated into Electric Waste Gate Actuator (EWGA)]

Specification

Item	Specification
Coil Resistance (Ω)	1.48 ~ 1.96 [21°C(69.8°F)]

Ignition Coil

Type: Stick type

Specification

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

RCV Control Solenoid Valve

Specification

Item	Specification
Coil Resistance (Ω)	28.3 ~ 31.1 [20°C(68°F)]

Canister Close Valve (CCV)

Specification

Item	Specification
Coil Resistance (Ω)	19.8 ~ 21.8 [20°C(68°F)]

Service Standard

Item		Specification	
Ignition Timing (°)		BTDC 6 ± 10	
Idle Speed (rpm)	A/C OFF	Neutral, N, P-range	700 ± 100
		D-range	700 ± 100
	A/C ON	Neutral, N, P-range	700 ± 100
		D-range	700 ± 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
Manifold absolute pressure sensor #1 installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Manifold absolute pressure sensor #2 installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Crankshaft position sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Crankshaft position sensor cover installation bolt (M6)	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Crankshaft position sensor cover installation bolt (M8)	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
Camshaft position sensor (Bank 1 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Camshaft position sensor (Bank 1 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Knock sensor installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
Heated oxygen sensor (Bank 1 / sensor 1) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 1 / sensor 2) installation	3.6 ~ 4.6	35 ~ 45	25.8 ~ 33.2
Rail pressure sensor installation	1.8 ~ 2.2	18.0 ~ 22.0	13.3 ~ 16.2

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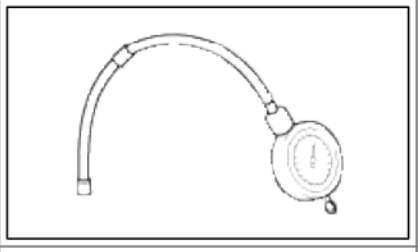
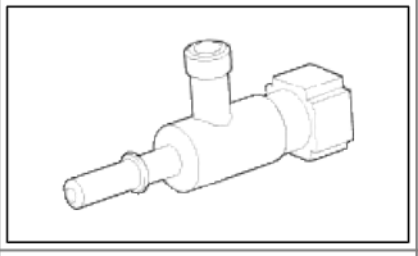
Electronic throttle body installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Purge control solenoid valve bracket installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
RCV control solenoid valve bracket installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
CVVT oil temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9

Fuel Delivery System

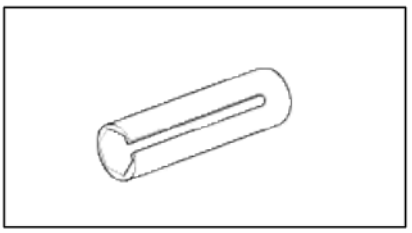
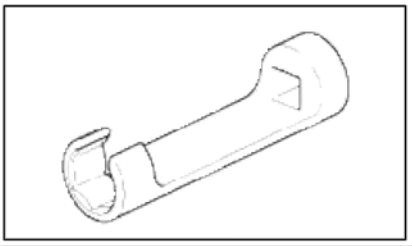
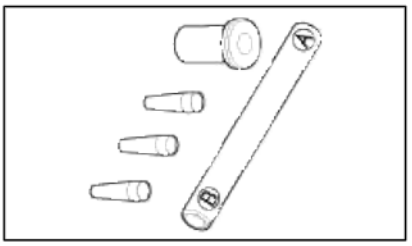
Item	kgf.m	N.m	lb-ft
Fuel tank installation nut	4.0 ~ 5.5	39.2 ~ 54.0	28.9 ~ 39.8
Fuel pump plate cover installation bolt	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Filler-neck assembly bracket installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Filler-neck assembly installation screw	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Accelerator pedal module installation nut	1.0 ~ 1.5	9.8 ~ 14.7	7.2 ~ 10.8
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 pump installation bolt	1.3 ~ 1.5	12.8 ~ 14.7	9.4 ~ 10.9
High pressure fuel pipe installation nut	2.7 ~ 3.3	26.5 ~ 32.4	19.5 ~ 23.9
High pressure fuel pipe function block installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7

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

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Heated Oxygen Sensor Socket Wrench (09392-2H100)		Removal and installation of the heated oxygen sensor
Torque Wrench Socket (09314-3Q100)		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

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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

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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.

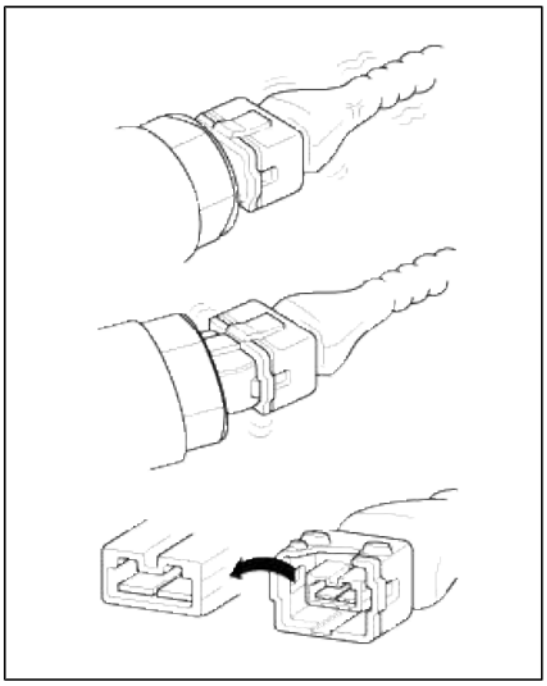
The measured resistance in except for ambient temperature (20°C, 68°F) is reference value.

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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.

> 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.

> • DO NOT heat components to the point where they may be damaged.
> • DO NOT heat the ECM directly.

● Simulating Water Sprinkling

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

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

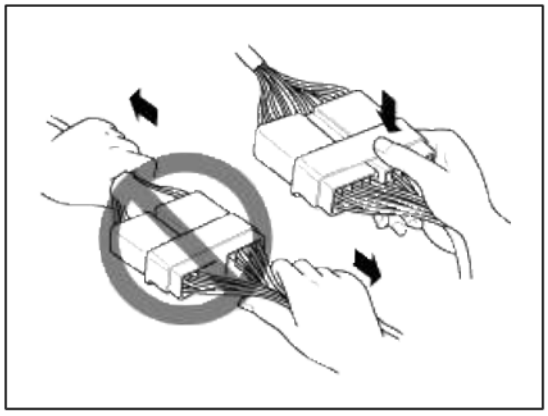
● Simulating Electrical Load

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

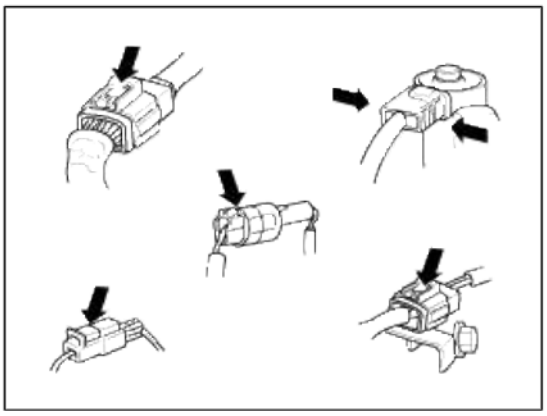
Connector Inspection Procedure

1. Handling of Connector

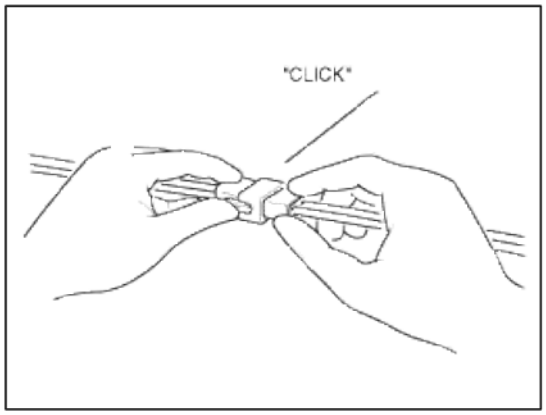
A. Never pull on the wiring harness when disconnecting connectors.



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

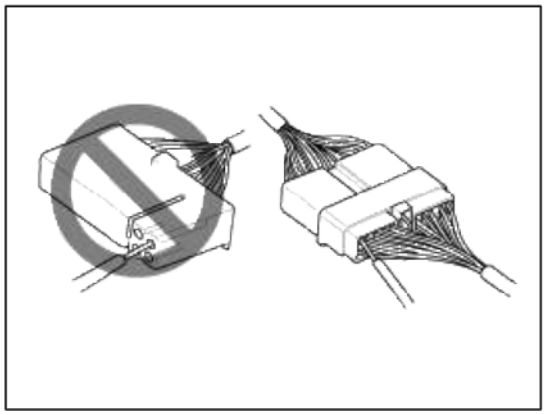


C. Listen for a click when locking connectors. This sound indicates that they are securely locked.

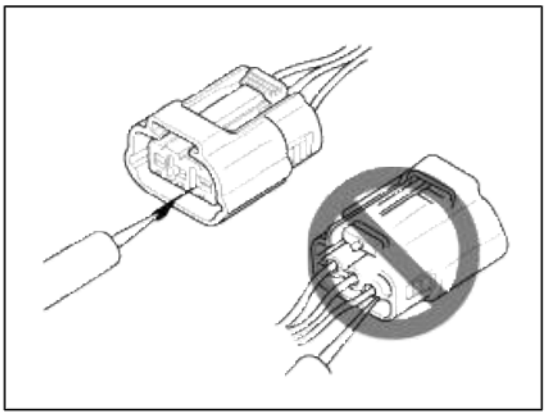


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D. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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



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

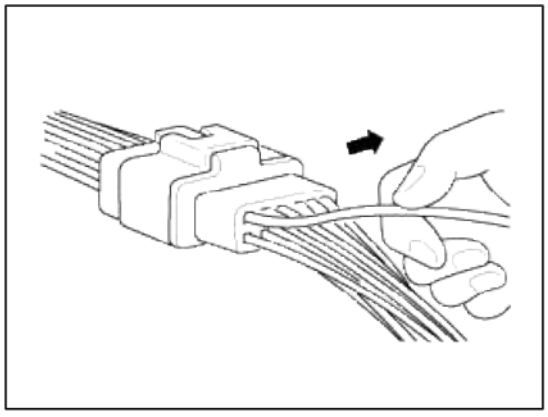
2. Checking Point for Connector

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

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

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

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



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3. Repair Method of Connector Terminal

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

> 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

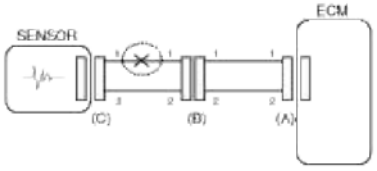
1. Procedures for Open Circuit

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



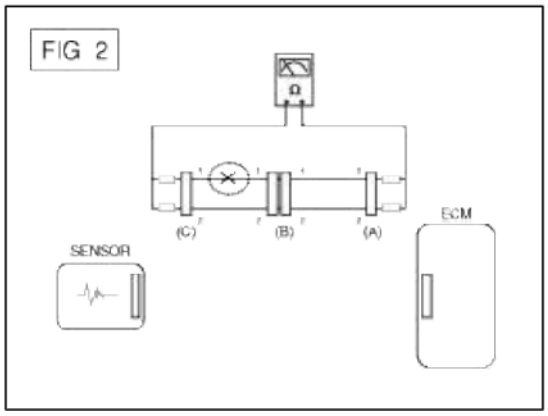
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2. Continuity Check Method

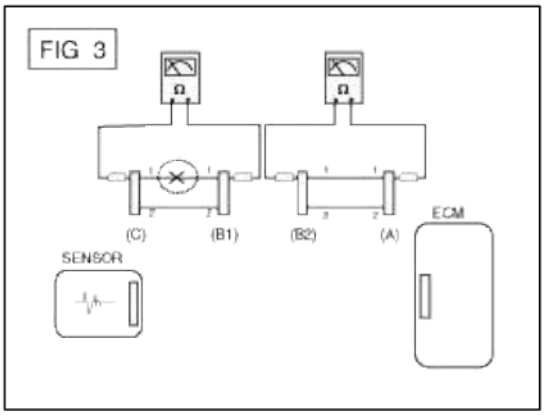
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

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.



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).

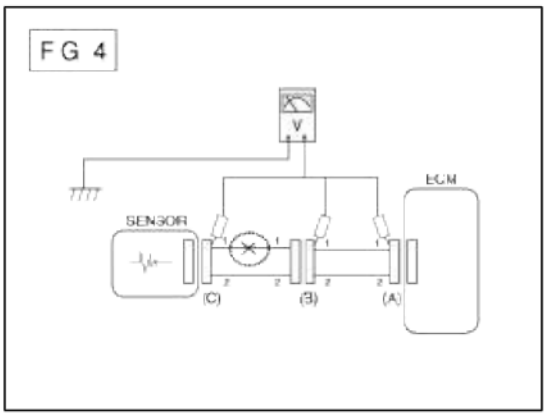


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3. Voltage Check Method

A. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].
The measured voltage of each connector is 5V, 5V and 0V respectively. So the open circuit is between connector (C) and (B).

FG 4



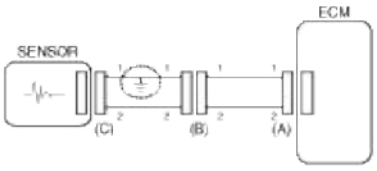
● Check Short Circuit

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)

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

Specification (Resistance)

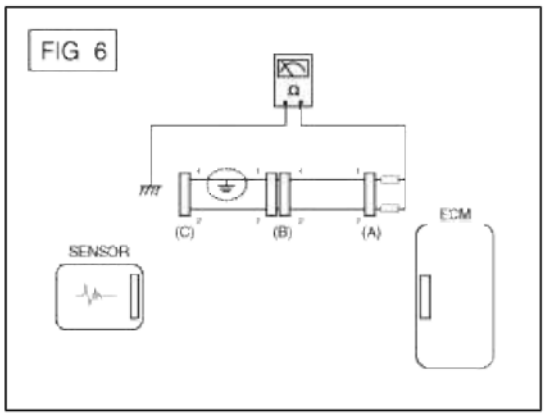
1Ω or less → Short to Ground Circuit

1MΩ or Higher → Normal Circuit

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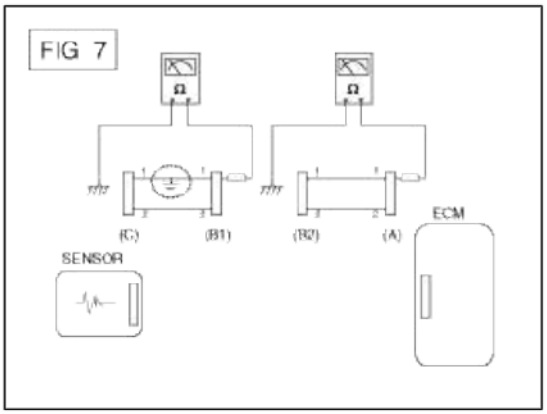
A. Disconnect connectors (A), (C) and measure for resistance between connector (A) and Chassis Ground as shown in [FIG. 6].
The measured resistance of line 1 and 2 in this example is below 1 Ω and higher than 1MΩ respectively. Specifically the short to ground circuit is line 1 (Line 2 is normal). To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

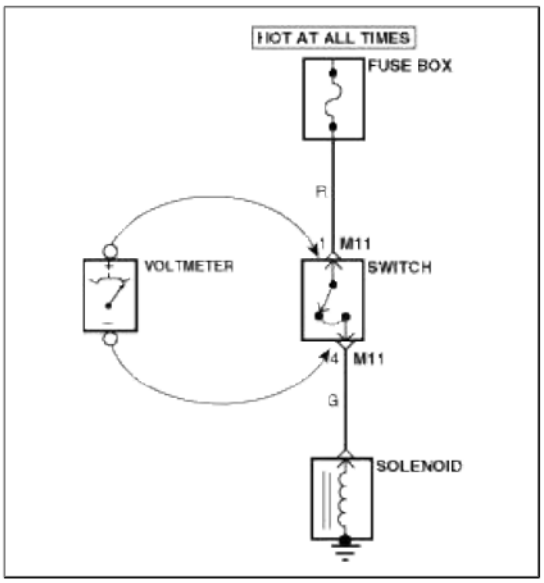


● Testing For Voltage Drop

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.

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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 ECTS 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 ECTS and circuit (Check DTC)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Engine stall	1. Test the Battery 2. Check the fuel pressure 3. Check the idle speed control circuit (Check DTC) 4. Check the ignition circuit 5. Check the CKPS Circuit (Check DTC)	• DTC • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor driving (Surge)	1. Check the fuel pressure 2. Inspect and test Throttle Body 3. Check the ignition circuit	• DTC • Low compression

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	4. Check the ECTS 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)	• 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 habits · 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 ECTS 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 canister and fuel tank air filter 4. Check the 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) identifying 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.

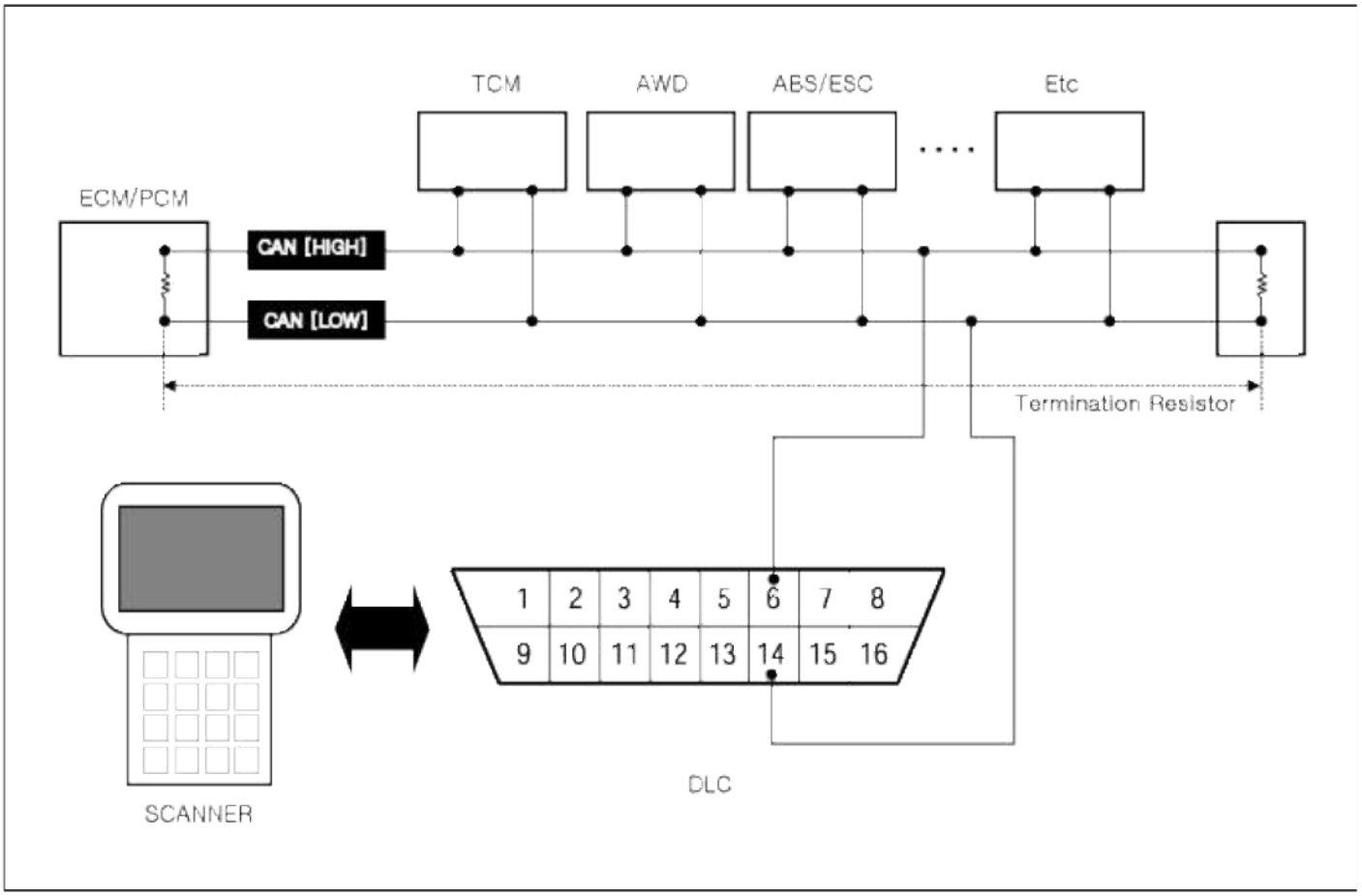
The diagnostic executive is a computer program in the Engine Control Module (ECM) or PowertrainControl Module (PCM) that coordinates the OBD-II self-monitoring system. This program controls all the monitors and interactions, DTC and MIL operation, freeze frame data and scan tool interface.

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

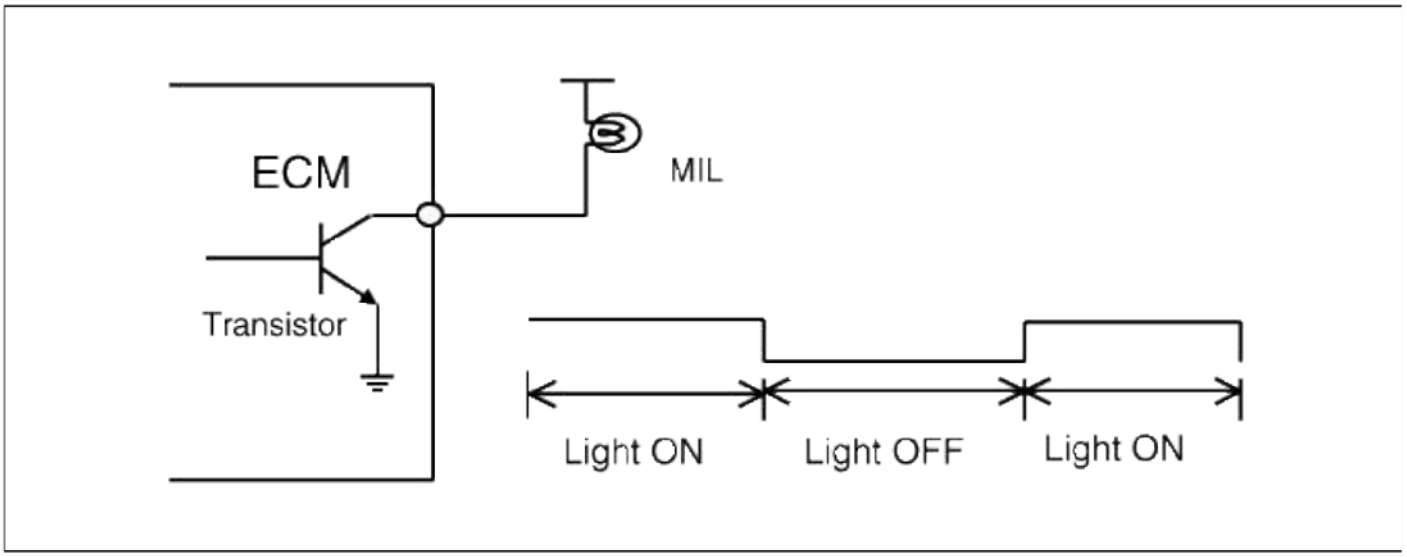
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or misfire fault is detected. This data is accessible with the scan tool to assist in repairing the vehicle.
The center of the OBD-II system is a microprocessor called the Engine Control Module (ECM) or Powertrain Control Module(PCM).
The ECM or PCM 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.

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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.

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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 occurs 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

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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

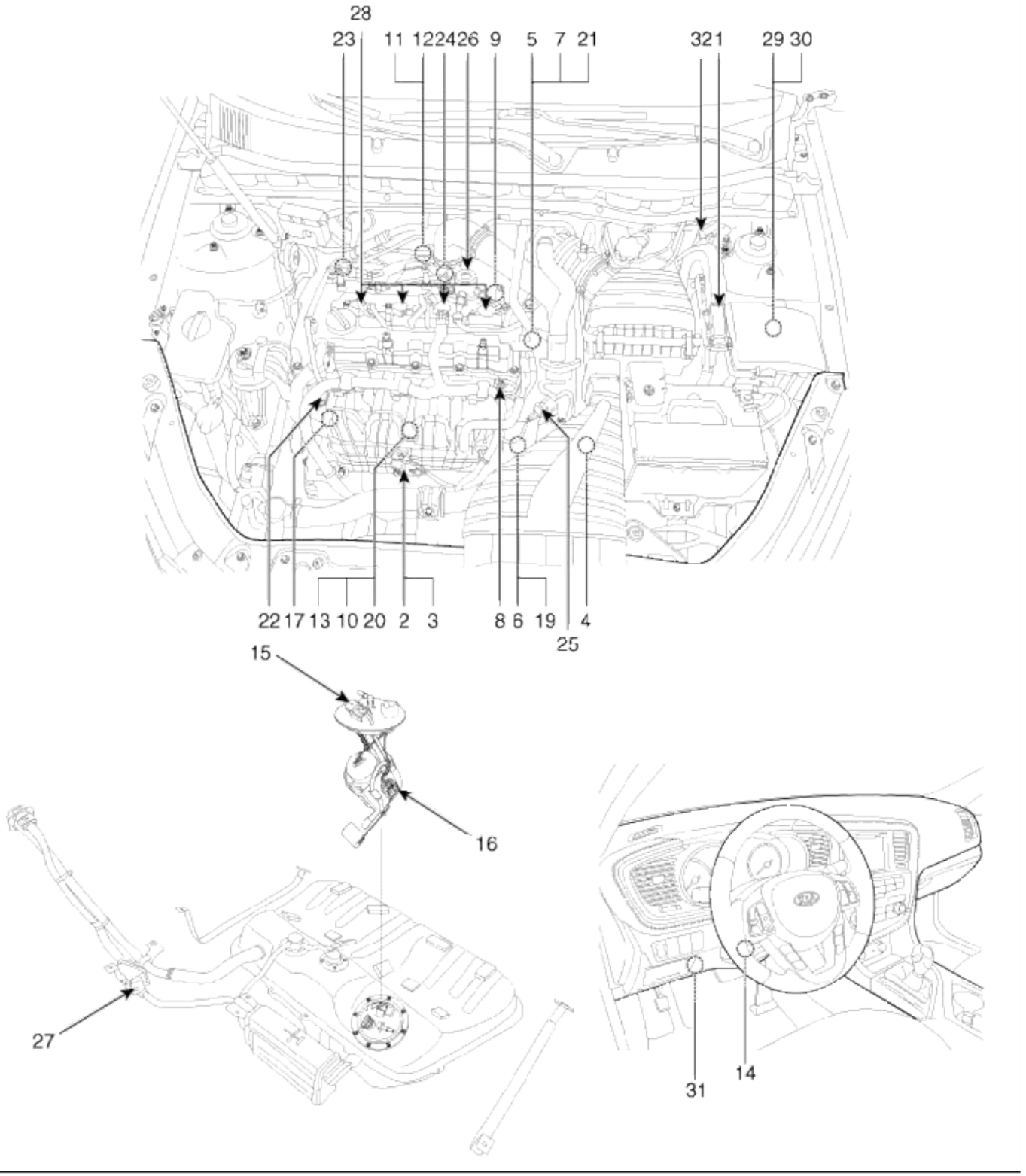
The comprehensive components monitoring is a self-test strategy within the ECM or PCM that detects fault of any electronic powertrain components or system that provides input to the ECM or PCM and is not exclusively an input to any other OBD-II monitor.
9) A/C system component monitoring

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

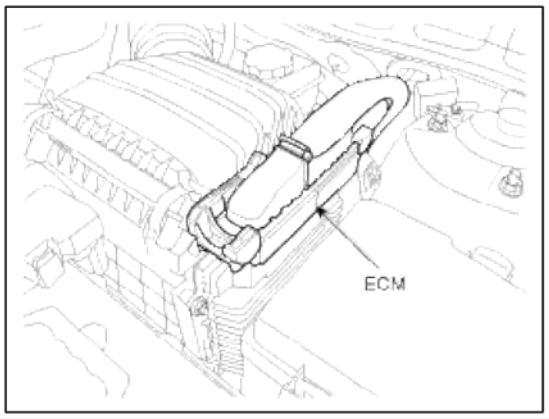
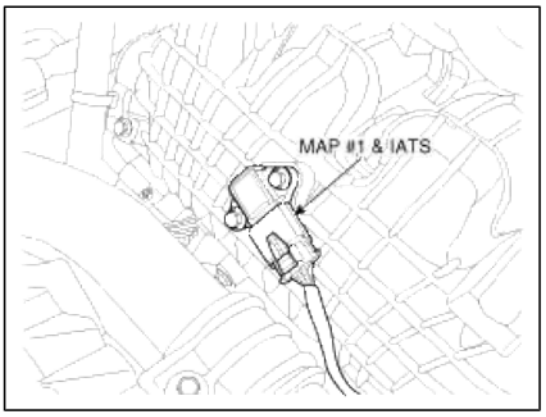
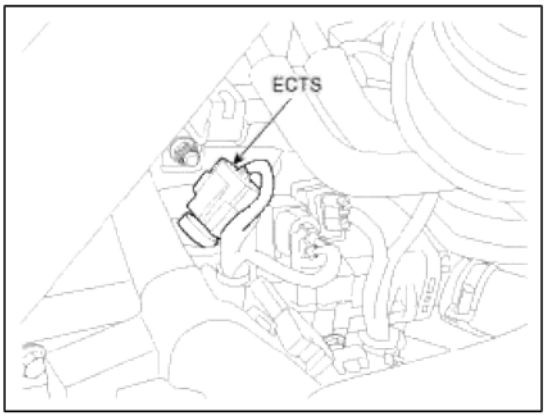
Components Location

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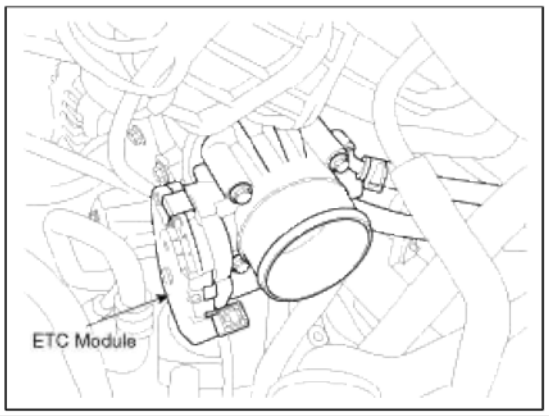


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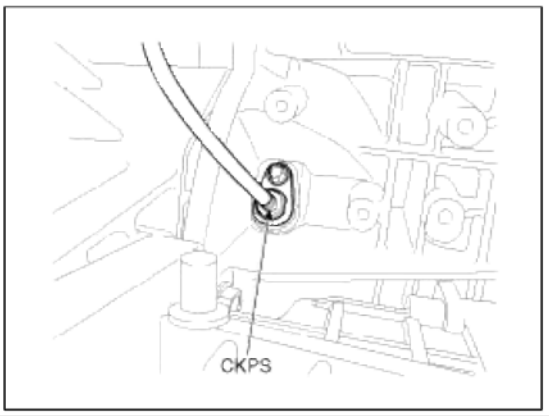
1. Engine Control Module (ECM) 2. Manifold Absolute Pressure Sensor (MAPS) #1 3. Intake Air Temperature Sensor (IATS) 4. Manifold Absolute Pressure Sensor (MAPS) #2 5. Engine Coolant Temperature Sensor (ECTS) 6. Throttle Position Sensor (TPS) [integrated into ETC Module] 7. Crankshaft Position Sensor (CKPS) 8. Camshaft Position Sensor (CMPS) [Bank 1 / Intake] 9. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust] 10. Knock Sensor (KS) 11. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1] 12. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2] 13. Rail Pressure Sensor (RPS) 14. Accelerator Position Sensor (APS) 15. Fuel Tank Pressure Sensor (FTPS) 16. Fuel Level Sensor (FLS)	17. CVVT Oil Temperature Sensor (OTS) 18. A/C Pressure Transducer (APT) 19. ETC Motor [integrated into ETC Module] 20. Injector 21. Purge Control Solenoid Valve (PCSV) 22. CVVT Oil Control Valve (OCV) [Bank 1 / Intake] 23. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust] 24. Electric Waste Gate Actuator (EWGA) 25. RCV Control Solenoid Valve 26. Fuel Pressure Regulator Valve 27. Canister Close Valve (CCV) 28. Ignition Coil 29. Main Relay 30. Fuel Pump Relay 31. Data Link Connector (DLC) [16-Pin] 32. Multi-Purpose Check Connector [20-Pin]

1. Engine Control Module (ECM)	2. Manifold Absolute Pressure Sensor (MAPS) #1 3. Intake Air Temperature Sensor (IATS)
	
4. Manifold Absolute Pressure Sensor (MAPS) #2	5. Engine Coolant Temperature Sensor (ECTS)
	
6. Throttle Position Sensor (TPS) 19. ETC Motor	7. Crankshaft Position Sensor (CKPS)

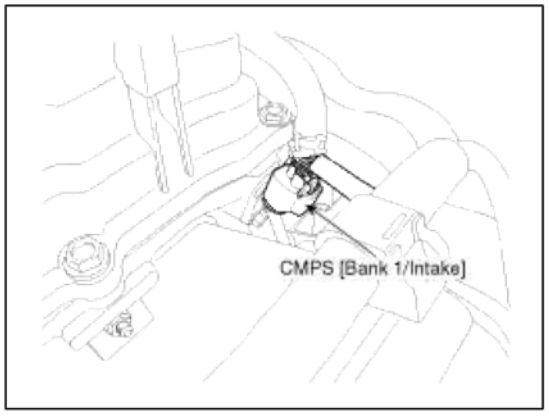
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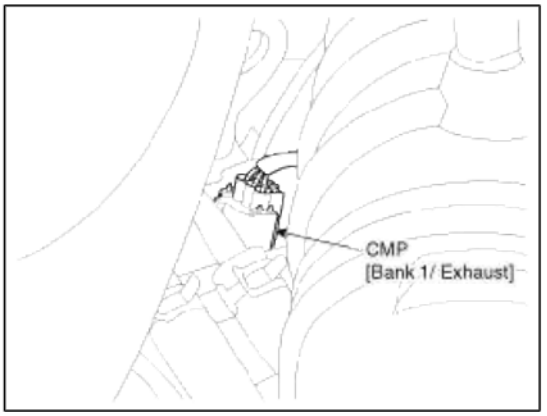
8. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]



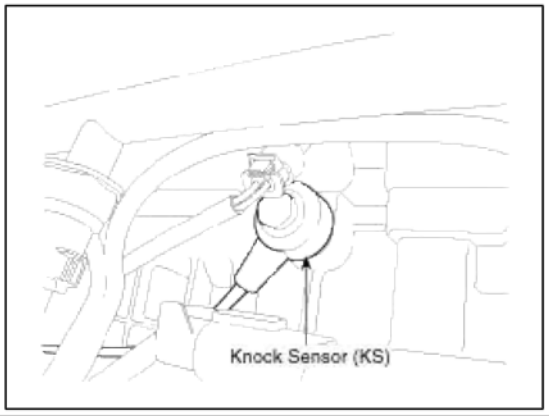
9. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]



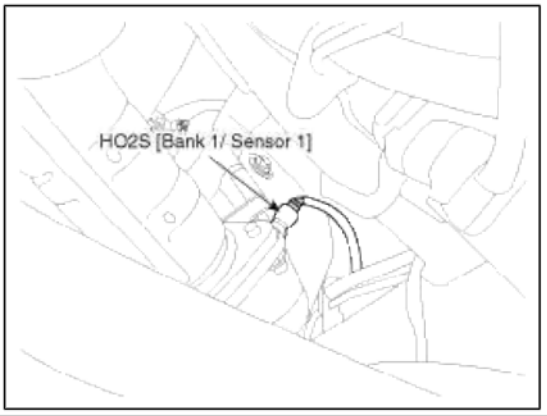
10. Knock Sensor (KS)



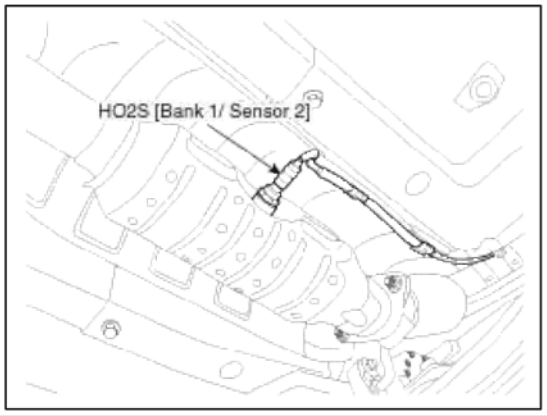
11. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]



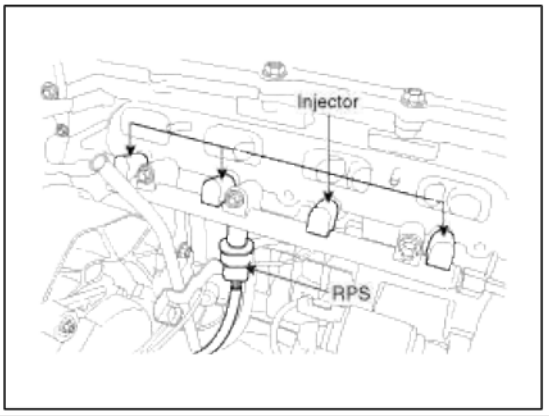
12. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]



13. Rail Pressure Sensor (RPS)
20. Injector

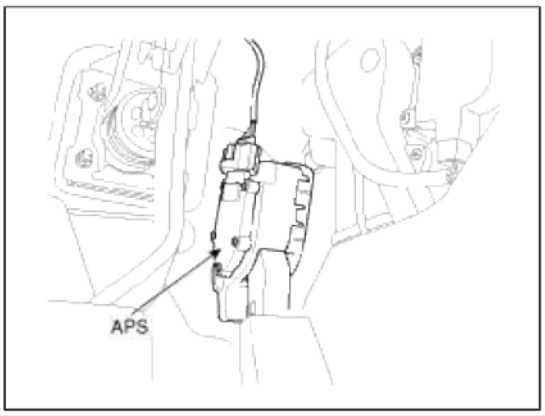


14. Accelerator Position Sensor (APS)

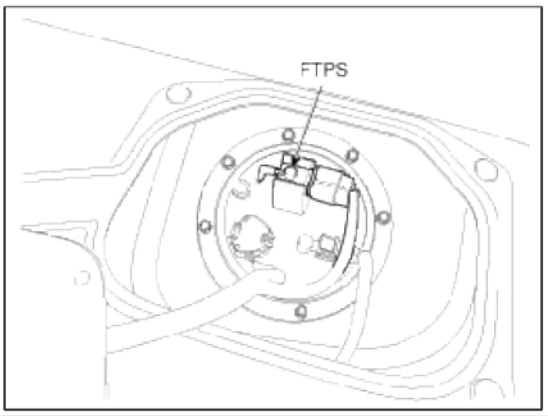


15. Fuel Tank Pressure Sensor (FTPS)

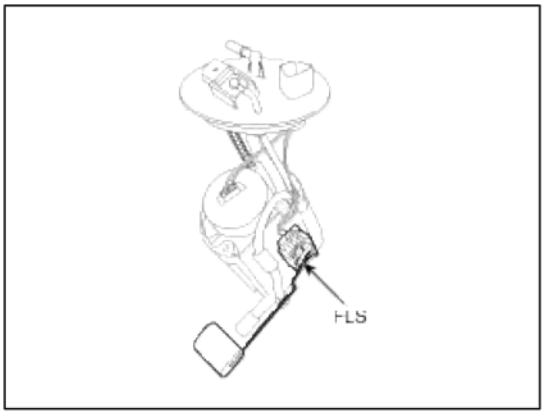
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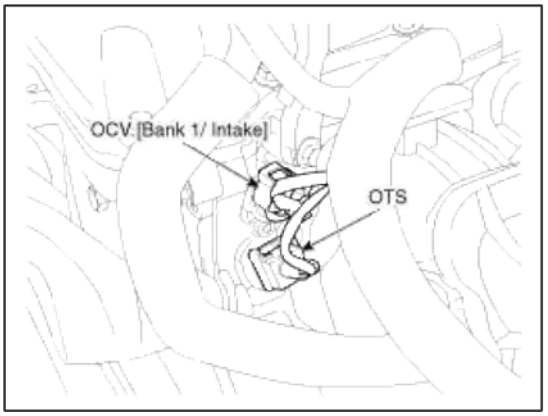
16. Fuel Level Sensor (FLS)



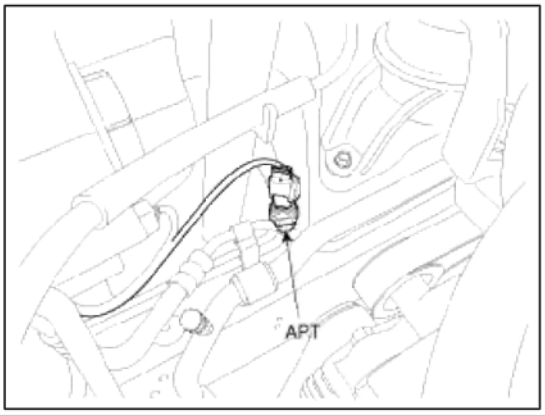
17. CVVT Oil Temperature Sensor (OTS)
22. CVVT Oil Control Valve (OCV) [Bank 1 / Intake]



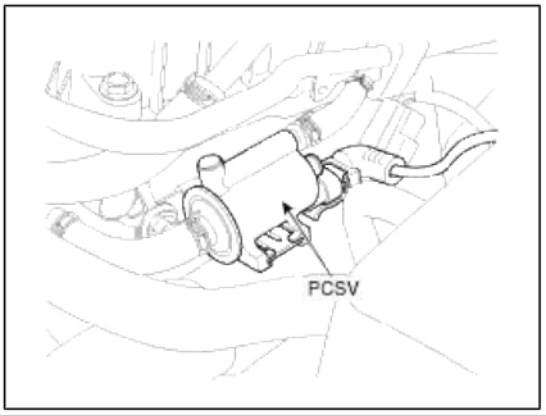
18. A/C Pressure Transducer (APT)



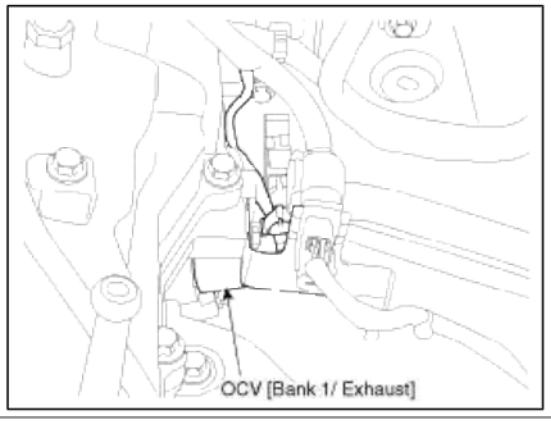
21. Purge Control Solenoid Valve (PCSV)



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



24. Electric Waste Gate Actuator (EWGA)

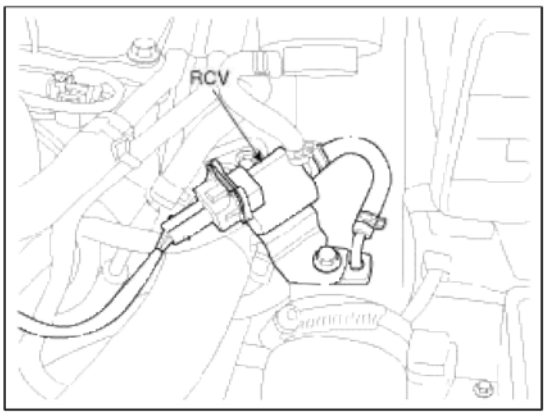


25. RCV Control Solenoid Valve

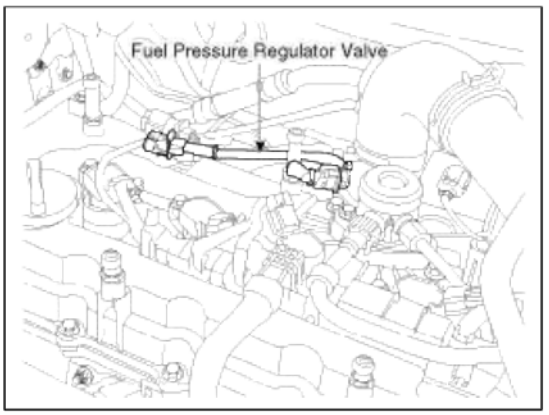


26. Fuel Pressure Regulator Valve

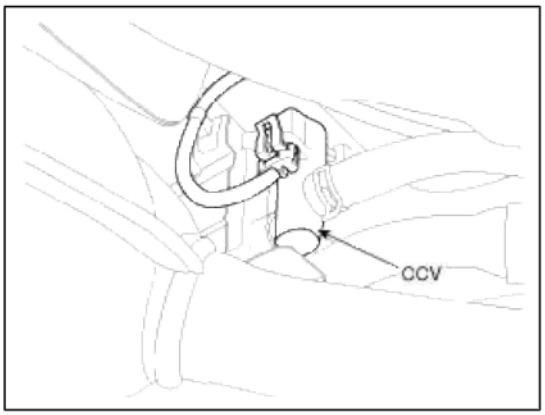
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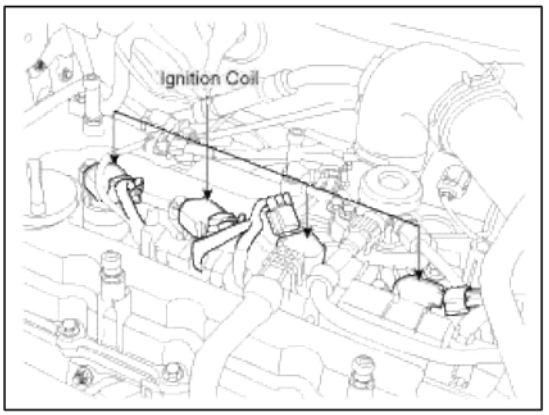
27. Canister Close Valve (CCV)



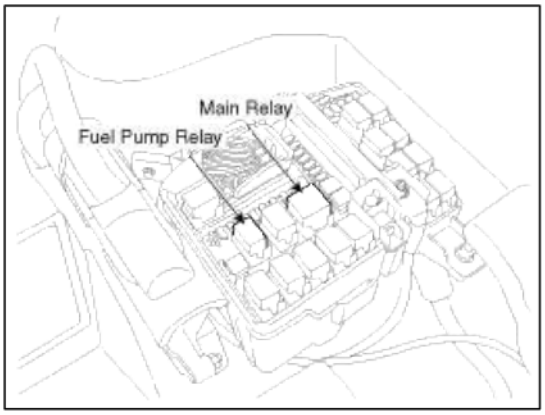
28. Ignition Coil



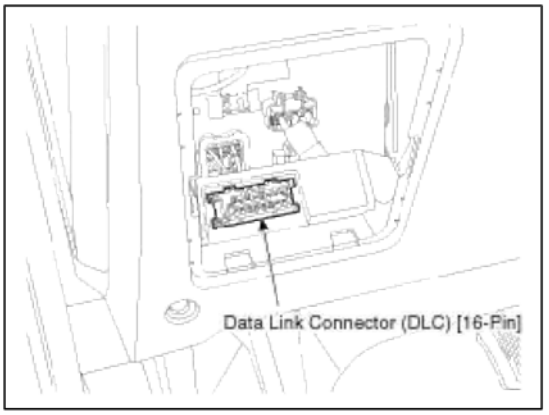
29. Main Relay
30. Fuel Pump Relay

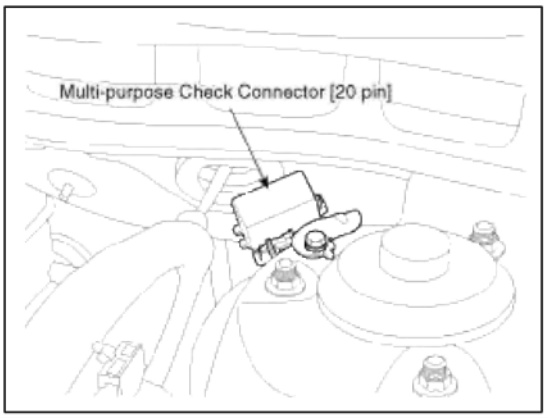


31. Data Link Connector (DLC) [16-Pin]



32. Multi-Purpose Check Connector [20-Pin]

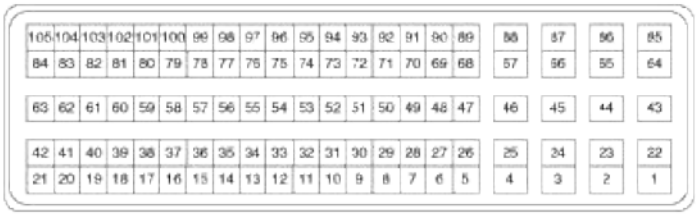




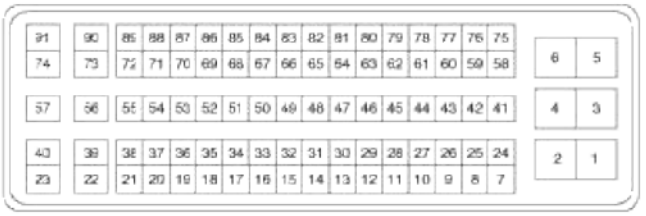
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Fuel System > Engine Control System > Engine Control Module (ECM) > Schematic Diagrams

ECM Terminal And Input/Output signal



Connector [CHTG-AG]



Connector [CHTG-BG]

ECM Terminal Function

Connector [CHTG-AG]

Pin No.	Description	Connected to
1	Ignition Coil (Cylinder #2) control output [Without Smart Key]	Ignition Coil (Cylinder #2)
	Ignition Coil (Cylinder #3) control output [Smart Key]	Ignition Coil (Cylinder #3)
2	-	
3	-	
4	-	
5	ETC Motor [+] control output	ETC Motor
6	ETC Motor [-] control output	ETC Motor
7	-	
8	-	
9	-	
10	-	
11	-	
12	Sensor power (+5V)	Electric Waste Gate Actuator (EWGA)
		Rail Pressure Sensor (RPS)
		A/C Pressure Transducer (APT)
		Manifold Absolute Pressure Sensor (MAPS) #2
		Fuel Tank Pressure Sensor (FTPS)
13	-	
14	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
15	-	
16	Electric Waste Gate Actuator (EWGA) Feed beck signal	Electric Waste Gate Actuator (EWGA)
17	CVVT Oil Temperature Sensor (OTS) signal input	CVVT Oil Temperature Sensor (OTS)
18	Manifold Absolute Pressure Sensor (MAPS)#2 signal input	Manifold Absolute Pressure Sensor (MAPS)#2

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19	-	
20	Fuel Tank Pressure Sensor (FTPS) signal input	Fuel Tank Pressure Sensor (FTPS)
21	Electric Waste Gate Actuator (EWGA) DC Motor output (-)	Electric Waste Gate Actuator (EWGA)
22	Ignition Coil (Cylinder #4) control output [Without Smart Key]	Ignition Coil (Cylinder #4)
	Ignition Coil (Cylinder #1) control output [Smart Key]	Ignition Coil (Cylinder #1)
23	-	
24	-	
25	-	
26	-	
27	-	
28	-	
29	-	
30	-	
31	-	
32	-	
33	Sensor power (+5V)	Throttle Position Sensor (TPS) 1,2
34	-	
35	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
36	-	
37	Sensor ground	Electric Waste Gate Actuator (EWGA)
38	-	
39	Rail Pressure Sensor (RPS) signal input	Rail Pressure Sensor (RPS)
40	-	
41	Sensor ground	Fuel Tank Pressure Sensor (FTPS)
42	Electric Waste Gate Actuator (EWGA) DC Motor output (+)	Electric Waste Gate Actuator (EWGA)
43	-	
44	-	
45	-	
46	-	
47	-	
48	-	
49	-	
50	-	
51	-	
52	-	

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53	-	
54	Sensor ground	Throttle Position Sensor (TPS) 1,2
55	Sensor ground	Accelerator Position Sensor (APS) 2
56	Sensor ground	Accelerator Position Sensor (APS) 1
57	Immobilizer communication line	Smart Key Control Module [Smart Key]
		Immobilizer Control Module [Immobilizer]
58	Sensor ground	CVVT Oil Temperature Sensor (OTS)
59	Intake Air Temperature Sensor (IATS) signal input	Intake Air Temperature Sensor (IATS)
60	Sensor ground	Rail Pressure Sensor (RPS)
61	Sensor ground	Manifold Absolute Pressure Sensor (MAPS)
		Intake Air Temperature Sensor (IATS)
62	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
63	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
64	Ignition Coil (Cylinder #3) control output [Without Smart Key]	Ignition Coil (Cylinder #3)
	Ignition Coil (Cylinder #2) control output [Smart Key]	Ignition Coil (Cylinder #2)
65	-	
66	-	
67	-	
68	-	
69	-	
70	-	
71	-	
72	-	
73	-	
74	-	
75	Throttle Position Sensor (TPS) 2 signal input	Throttle Position Sensor (TPS) 2
76	Accelerator Position Sensor (APS) 2 signal input	Accelerator Position Sensor (APS) 2
77	Accelerator Position Sensor (APS) 1 signal input	Accelerator Position Sensor (APS) 1
78	-	
79	-	
80	Sensor ground	A/C Pressure Transducer (APT)
81	Sensor ground	Manifold Absolute Pressure Sensor (MAPS) #2
82	Manifold Absolute Pressure Sensor (MAPS) signal input	Manifold Absolute Pressure Sensor (MAPS)
83	Rc/Rp (Pump Cell Voltage)	Heated Oxygen Sensor [Bank 1/Sensor 1]
84	VS-/IP- (Common Ground for VS, IP)	Heated Oxygen Sensor [Bank 1/Sensor 1]

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85	Ignition Coil (Cylinder #1) control output [Without Smart Key]	Ignition Coil (Cylinder #1)
	Ignition Coil (Cylinder #4) control output [With Smart Key]	Ignition Coil (Cylinder #4)
86	-	
87	-	
88	-	
89	-	
90	-	
91	-	
92	-	
93	-	
94	-	
95	-	
96	Throttle Position Sensor (TPS) 1 signal input	Throttle Position Sensor (TPS) 1
97	Sensor power (+5V)	Accelerator Position Sensor (APS) 2
98	Sensor power (+5V)	Accelerator Position Sensor (APS) 1
99	-	
100	-	
101	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)
102	-	
103	Sensor power (+5V)	Manifold Absolute Pressure Sensor (MAPS)
104	Rc (Compensative Resistance)	Heated Oxygen Sensor [Bank 1/Sensor 1]
105	VS+ (NERNST Cell Voltage)	Heated Oxygen Sensor [Bank 1/Sensor 1]

Connector [CHTG-BG]

Pin No.	Description	Connected to
1	ECM ground	Chassis ground
2	ECM ground	Chassis ground
3	Battery power (B+)	Main Relay
4	ECM ground	Chassis ground
5	Battery power (B+)	Main Relay
6	Battery power (B+)	Main Relay
7	-	
8	Crankshaft Position Sensor (CKPS) signal input	Crankshaft Position Sensor (CKPS)
9	-	
10	Brake Switch 2 signal input	Brake Switch
11	-	

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12	-	
13	-	
14	Electrical load [wiper] signal input	Wiper Relay
15	Electrical load signal input (FR)	Alternator
16	Alternator PWM signal output (COM)	Alternator
17	-	
18	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
19	Immobilizer Lamp control output	Immobilizer Lamp [Without Button Engine Start System]
20	-	
21	-	
22	Injector (Cylinder #2) [High] control output	Injector (Cylinder #2)
23	Injector (Cylinder #2) [Low] control output	Injector (Cylinder #2)
24	-	
25	Sensor ground	Crankshaft Position Sensor (CKPS)
26	-	
27	Brake Switch 1 signal input	Brake Switch
28	-	
29	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
30	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
31	-	
32	LIN communication signal input	Battery Sensor
33	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
34	-	
35	-	
36	-	
37	-	
38	-	
39	Injector (Cylinder #3) [High] control output	Injector (Cylinder #3)
40	Injector (Cylinder #3) [Low] control output	Injector (Cylinder #3)
41	Battery power (B+)	Ignition Switch
42	-	
43	-	
44	Sensor shield	Knock Sensor (KS)
45	Sensor ground	Knock Sensor (KS)
46	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Intake]

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47	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
48	-	
49	-	
50	-	
51	-	
52	-	
53	Main Relay control output	Main Relay
54	-	
55	-	
56	Injector (Cylinder #4) [High] control output	Injector (Cylinder #4)
57	Injector (Cylinder #4) [Low] control output	Injector (Cylinder #4)
58	Battery power (B+)	Battery
59	-	
60	CAN [Low]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
61	-	
62	Knock Sensor (KS) signal input	Knock Sensor (KS)
63	Clutch Switch signal input	Clutch Switch [M/T]
64	-	
65	-	
66	-	
67	-	
68	-	
69	Starter Relay control output	Starter Relay [With Smart Key]
70	Fuel Pump Relay control output	Fuel Pump Relay
71	Engine speed signal output	Smart Key Control Module
72	RCV Control Solenoid Valve control output	RCV Control Solenoid Valve
73	Injector (Cylinder #1) [High] control output	Injector (Cylinder #1)
74	Injector (Cylinder #1) [Low] control output	Injector (Cylinder #1)
75	Battery power (B+)	Battery
76	-	
77	CAN [High]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
78	Vehicle speed signal input	ESC Control Unit [With ESC]
79	-	
80	-	
81	-	
82	Starter Control Switch signal input	Smart Key Control Module [With Smart Key]

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83	Fuel Level Sender (FLS) signal input	Fuel Level Sender (FLS)
84	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust]
85	CVVT Oil Control Valve (OCV) [Bank 1/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 1/Intake]
86	Purge Control Solenoid Valve (PCSV) control output	Purge Control Solenoid Valve (PCSV)
87	Canister Close Valve (CCV) control output	Canister Close Valve (CCV)
88	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
89	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
90	Fuel Pressure Regulator Valve [High] control output	Fuel Pressure Regulator Valve
91	Fuel Pressure Regulator Valve [Low] control output	Fuel Pressure Regulator Valve

ECM Terminal Input/ Output signal

Connector [CHTG-AG]

Pin No.	Description	Condition	Type	Level
1	Ignition Coil (Cylinder #2) control output [Without Smart Key]	Engine Running	Pulse	Vpeak = 360 ~ 440V
	Ignition Coil (Cylinder #3) control output [With Smart Key]			125<Frequency<1,000Hz (333Hz at idle)
2	-			
3	-			
4	-			
5	ETC Motor [+] control output	Engine Running	Pulse	High: Battery Voltage
				Low: Max.1.0V
6	ETC Motor [-] control output	Engine Running	Pulse	High: Battery Voltage
				Low: Max.1.0V
7	-			
8	-			
9	-			
10	-			
11	-			
12	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
13	-			
14	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Idle	DC	Rich : 0.6 ~ 1.0V
				Lean : Max 0.4V

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15	-			
16	Electric Waste Gate Actuator (EWGA) Feed beck signal			
17	CVVT Oil Temperature Sensor (OTS) signal input			
18	Manifold Absolute Pressure Sensor (MAPS)#2 signal input			
19	-			
20	Fuel Tank Pressure Sensor (FTPS) signal input	Idle	Analog	-0.3 ~ 5.2V
21	Electric Waste Gate Actuator (EWGA) DC Motor output (-)			
22	Ignition Coil (Cylinder #4) control output [Without Smart Key]	Engine Running	Pulse	Vpeak = 360 ~ 440V
	Ignition Coil (Cylinder #1) control output [With Smart Key]			125<Frequency<1,000Hz (333Hz at idle)
23	-			
24	-			
25	-			
26	-			
27	-			
28	-			
29	-			
30	-			
31	-			
32	-			
33	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
34	-			
35	Sensor ground	Idle	DC	-0.3 ~ 0.5V
36	-			
37	Sensor ground			
38	-			
39	Rail Pressure Sensor (RPS) signal input	Idle	Analog	-0.3 ~ 5.2V
40	-			
41	Sensor ground	Idle	DC	-0.3 ~ 0.5V
42	Electric Waste Gate Actuator (EWGA) DC Motor output (+)			
43	-			
44	-			
45	-			
46	-			
47	-			

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48	-			
49	-			
50	-			
51	-			
52	-			
53	-			
54	Sensor ground	Idle	DC	-0.3 ~ 0.5V
55	Sensor ground	Idle	DC	-0.3 ~ 0.5V
56	Sensor ground	Idle	DC	-0.3 ~ 0.5V
57	Immobilizer communication line			
58	Sensor ground			
59	Intake Air Temperature Sensor (IATS) signal input	Idle	Analog	0 ~ 5.0V (2.55V at Idle)
60	Sensor ground	Idle	DC	-0.3 ~ 0.5V
61	Sensor ground	Idle	DC	-0.3 ~ 0.5V
62	Sensor ground	Idle	DC	-0.3 ~ 0.5V
63	Engine Coolant Temperature Sensor (ECTS) signal input	Idle	Analog	0.5 ~ 4.5V (1.02V at Idle)
64	Ignition Coil (Cylinder #3) control output [Without Smart Key]	Engine Running	Pulse	Vpeak = 360 ~ 440V
	Ignition Coil (Cylinder #2) control output [With Smart Key]			125<Frequency<1,000Hz (333Hz at idle)
65	-			
66	-			
67	-			
68	-			
69	-			
70	-			
71	-			
72	-			
73	-			
74	-			
75	Throttle Position Sensor (TPS) 2 signal input	C.T	Analog	4.2 ~ 5.0V
		W.O.T		3.3 ~ 3.8V
76	Accelerator Position Sensor (APS) 2 signal input	C.T	Analog	Max. 1.0V
		W.O.T		1.5 ~ 3.0V
77	Accelerator Position Sensor (APS) 1 signal input	C.T	Analog	Max. 1.0V
		W.O.T		Min. 4.0V
78	-			

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79	-			
80	Sensor ground	Idle	DC	-0.3 ~ 0.5V
81	Sensor ground			
82	Manifold Absolute Pressure Sensor (MAPS) signal input	Idle	Analog	0.8 ~ 1.6V (1.37V at Idle)
83	Rc/Rp (Pump Cell Voltage)	Idle	Analog	Normal: 450±50 mV Rich: Max. Normal+150 mV Lean: Min. Normal-150 mV
84	VS-/IP- (Common Ground for VS, IP)	Idle	Analog	Reference for V_IP, V_N
85	Ignition Coil (Cylinder #1) control output [Without Smart Key]	Engine Running	Pulse	Vpeak = 360 ~ 440V
	Ignition Coil (Cylinder #4) control output [With Smart Key]			125<Frequency<1,000Hz (333Hz at idle)
86	-			
87	-			
88	-			
89	-			
90	-			
91	-			
92	-			
93	-			
94	-			
95	-			
96	Throttle Position Sensor (TPS) 1 signal input	C.T	Analog	0.3 ~ 0.9V
		W.O.T		1.5 ~ 3.0V
97	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
98	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
99	-			
100	-			
101	A/C Pressure Transducer (APT) signal input			
102	-			
103	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
104	Rc (Compensative Resistance)	Idle	Analog	|Rc-Rc/Rp| <±0.1V

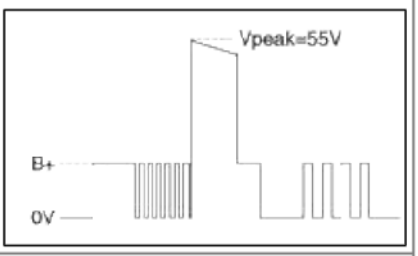
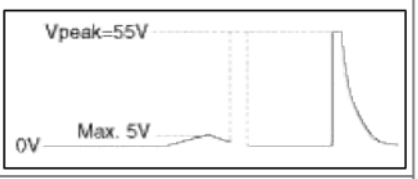
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105	VS+ (NERNST Cell Voltage)	Idle	Analog	Normal: 450±50 mV Rich: Max. Normal+150 mV Lean: Min. Normal-150 mV

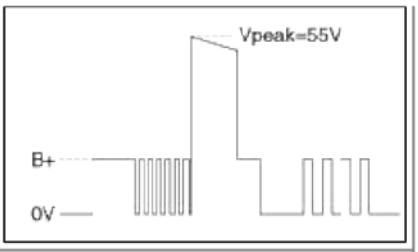
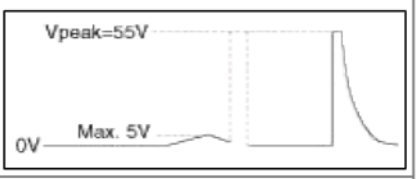
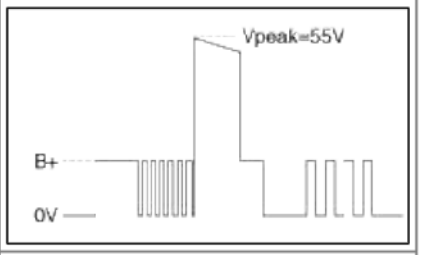
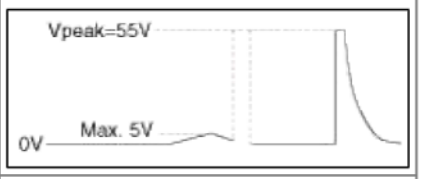
Connector [CHTG-BG]

Pin No.	Description	Condition	Type	Level
1	ECM ground	Idle	DC	-0.3 ~ 0.5V
2	ECM ground	Idle	DC	-0.3 ~ 0.5V
3	Battery power (B+)	IG OFF	DC	Max. 1.0V
		IG ON		Battery Voltage
4	ECM ground	Idle	DC	-0.3 ~ 0.5V
5	Battery power (B+)	IG OFF	DC	Max. 1.0V
		IG ON		Battery Voltage
6	Battery power (B+)	IG OFF	DC	Max. 1.0V
		IG ON		Battery Voltage
7	-			
8	Crankshaft Position Sensor (CKPS) signal input	Engine Running	Pulse	High : 4.5 ~ 5.5V Low : -0.3 ~ 0.5V Frequency: 850Hz (Idle), 3,000Hz (3,000rpm)
9	-			
10	Brake Switch 2 signal input	Brake OFF	DC	Battery Voltage
		Brake ON		Max. 0.5V
11	-			
12	-			
13	-			
14	Electrical load [wiper] signal input			
15	Electrical load signal input (FR)	Lamp OFF	DC	Battery Voltage
		Lamp ON		-0.3 ~ 0.5V
16	Alternator PWM signal output (COM)	Idle	Pulse	High: Battery Voltage Low: Max. 1.5V Frequency: 125Hz
17	-			
18	Cooling Fan Relay [High] control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V

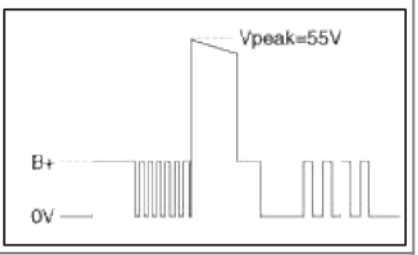
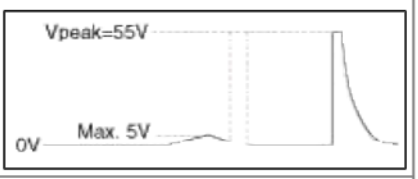
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19	Immobilizer Lamp control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		-0.3 ~ 1.2V
20	-			
21	-			
22	Injector (Cylinder #2) [High] control output	Engine Running	PWM	
23	Injector (Cylinder #2) [Low] control output	Engine Running	Pulse	
24	-			
25	Sensor ground	Idle	DC	-0.3 ~ 0.5V
26	-			
27	Brake Switch 1 signal input	Brake OFF	DC	Max. 0.5V
		Brake ON		Battery Voltage
28	-			
29	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Engine Running	Pulse	High: 4.5 ~ 5.5V Low: -0.3 ~ 0.5V Frequency: 7Hz (Idle), 25Hz (3,000rpm)
30	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Engine Running	Pulse	High: 4.5 ~ 5.5V Low: -0.3 ~ 0.5V Frequency: 7Hz (Idle), 25Hz (3,000rpm)
31	-			
32	LIN communication signal input			
33	Cooling Fan Relay [Low] control output	Relay OFF	DC	Battery Voltage
		Relay ON		-0.3 ~ 1.2V
34	-			
35	-			
36	-			
37	-			
38	-			

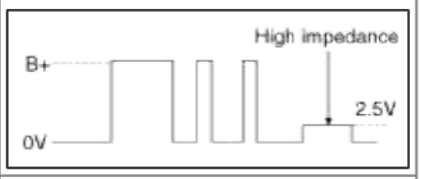
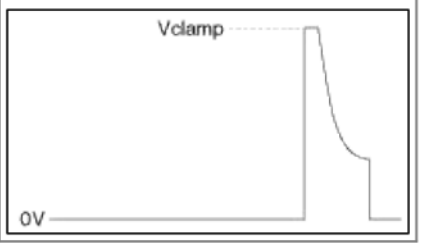
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39	Injector (Cylinder #3) [High] control output	Engine Running	PWM	
40	Injector (Cylinder #3) [Low] control output	Engine Running	Pulse	
41	Battery power (B+)	IG OFF	DC	Max. 1.0V
		IG ON		Battery Voltage
42	-			
43	-			
44	Sensor shield	Idle	DC	-0.3 ~ 0.5V
45	Sensor ground	Idle	DC	-0.3 ~ 0.5V
46	Sensor ground	Idle	DC	-0.3 ~ 0.5V
47	Sensor ground	Idle	DC	-0.3 ~ 0.5V
48	-			
49	-			
50	-			
51	-			
52	-			
53	Main Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		-0.3 ~ 1.2V
54	-			
55	-			
56	Injector (Cylinder #4) [High] control output	Engine Running	PWM	
57	Injector (Cylinder #4) [Low] control output	Engine Running	Pulse	
58	Battery power (B+)	IG OFF	DC	Max. 1.0V
		IG ON		Battery Voltage
59	-			

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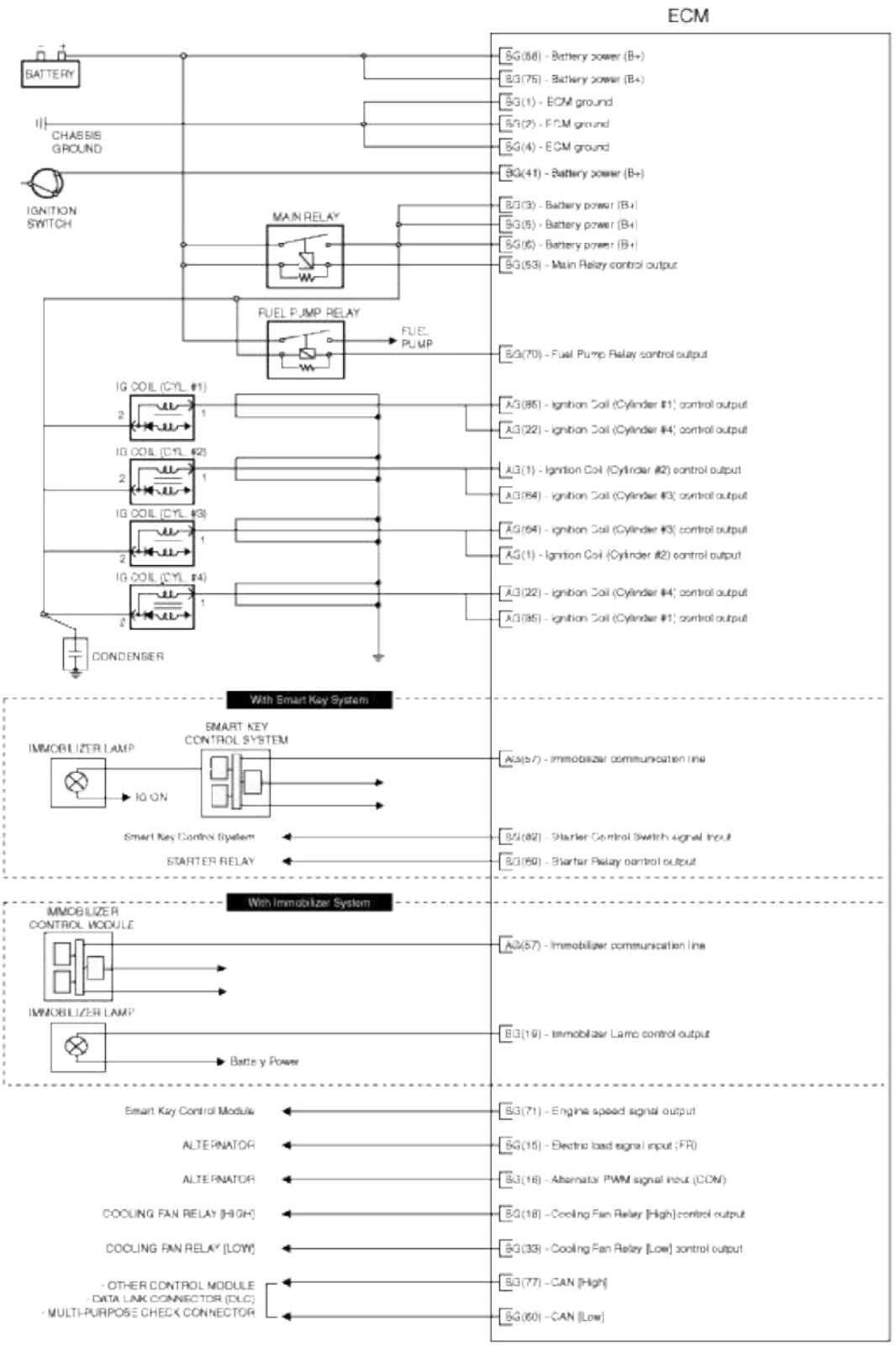
60	CAN [Low]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		2.75 ~ 4.5V
61	-			
62	Knock Sensor (KS) signal input	Knocking	Variable Frequency	-0.3 ~ 0.3V
		Normal		0V
63	Clutch Switch signal input	S/W OFF	DC	Battery Voltage
		S/W ON		-0.3 ~ 0.5V
64	-			
65	-			
66	-			
67	-			
68	-			
69	Starter Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		-0.3 ~ 1.2V
70	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		-0.3 ~ 1.2V
71	Engine speed signal output	Engine Running	Frequency	High: Battery Voltage Low: -0.3 ~ 1.0V Frequency: 26Hz (Idle), 106Hz (3,000rpm)
72	RCV Control Solenoid Valve control output			
73	Injector (Cylinder #1) [High] control output	Engine Running	PWM	
74	Injector (Cylinder #1) [Low] control output	Engine Running	Pulse	
75	Battery power (B+)	IG OFF	DC	Max. 1.0V
		IG ON		Battery Voltage
76	-			
77	CAN [High]	Recessive	Pulse	2.0 ~ 3.0V
		Dominant		2.75 ~ 4.5V
78	Vehicle speed signal input			
79	-			
80	-			
81	-			

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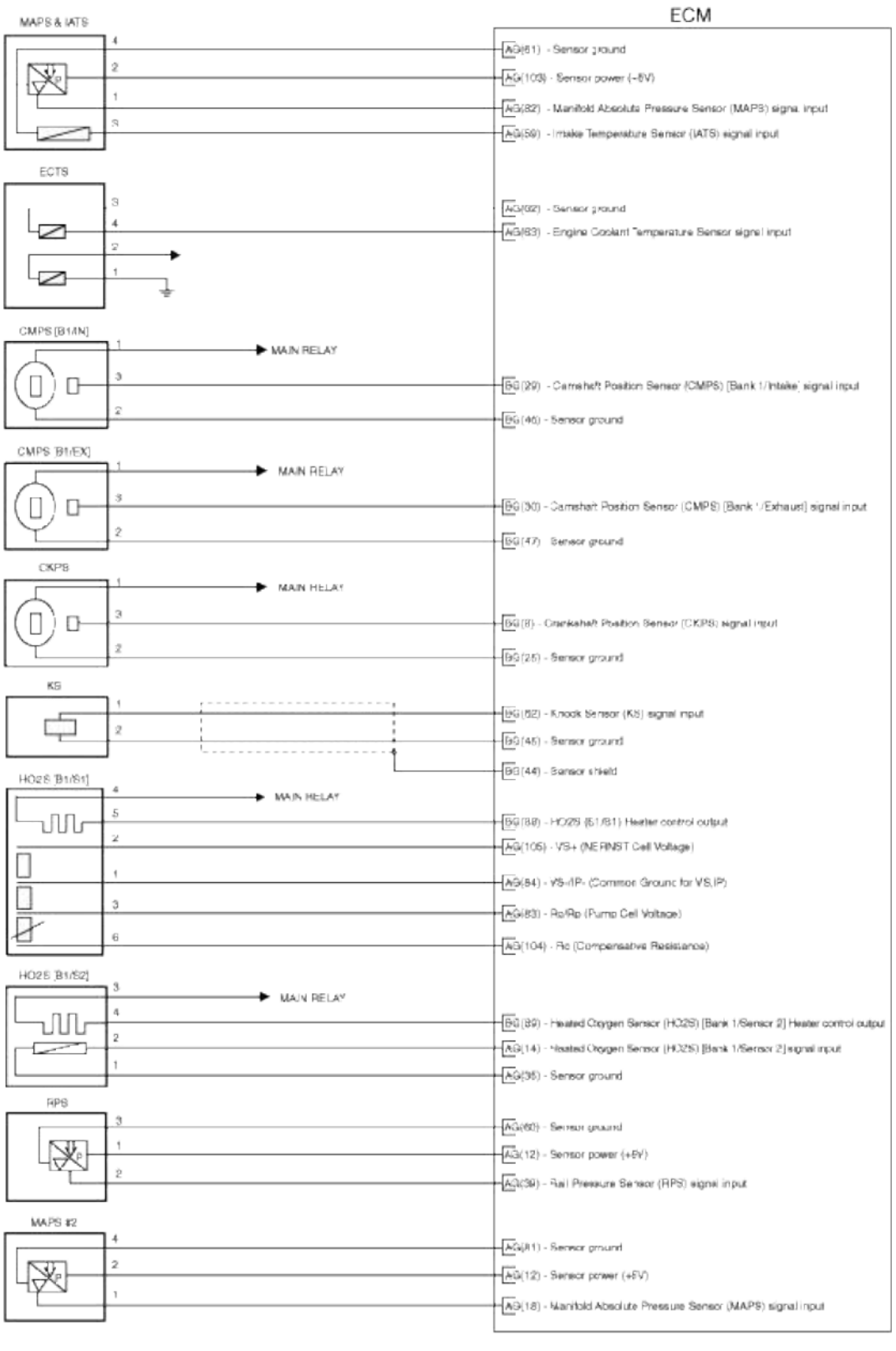
82	Starter Control Switch signal input	S/W OFF	DC	-0.3 ~ 0.5V
		S/W ON		Battery Voltage
83	Fuel Level Sender (FLS) signal input			
84	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust] control output	Idle	Pulse	High: Battery Voltage Low: -0.3 ~ 1.0V Frequency: 300Hz
85	CVVT Oil Control Valve (OCV) [Bank 1/Intake] control output	Idle	Pulse	High: Battery Voltage Low: -0.3 ~ 1.0V Frequency: 300Hz
86	Purge Control Solenoid Valve (PCSV) control output	Inactive Active	Pulse	High: Battery Voltage Low: Max. 1.0V Vpeak: 42.0 ~ 60.0V Frequency: 20Hz
87	Canister Close Valve (CCV) control output	Active Inactive	Pulse	High: Battery Voltage Low: Max. 1.0V Vpeak: 42.0 ~ 60.0V
88	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Engine Running	Pulse	High: Battery Voltage Low: -0.3 ~ 1.0V Frequency: 8 ~ 10Hz Duty: 0 ~ 100%
89	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Engine Running	Pulse	High: Battery Voltage Low: -0.3 ~ 1.0V Frequency: 8 ~ 10Hz Duty: 0 ~ 100%
90	Fuel Pressure Regulator Valve [High] control output	Engine Running	PWM	
91	Fuel Pressure Regulator Valve [Low] control output	Engine Running	Pulse	

Circuit Diagram

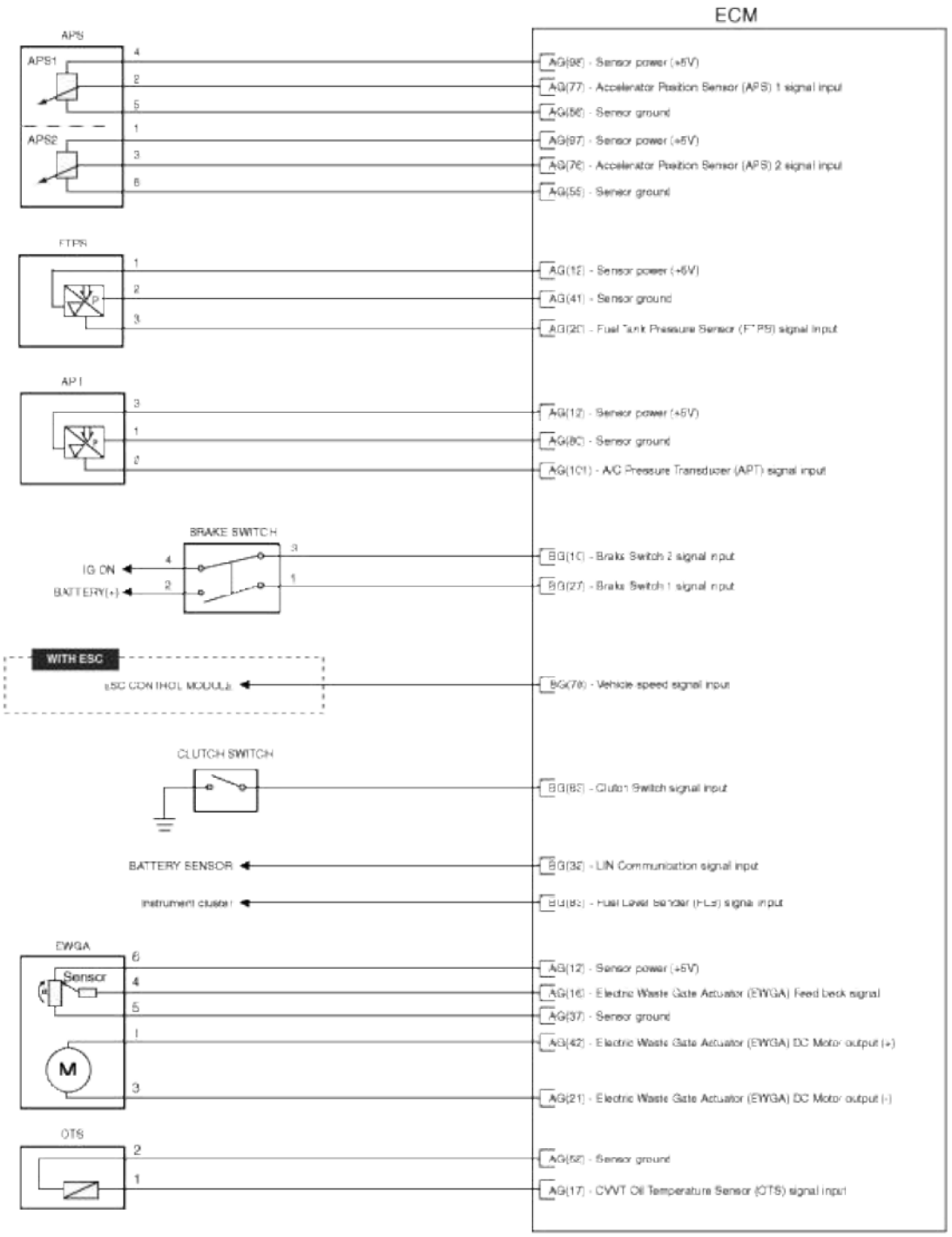
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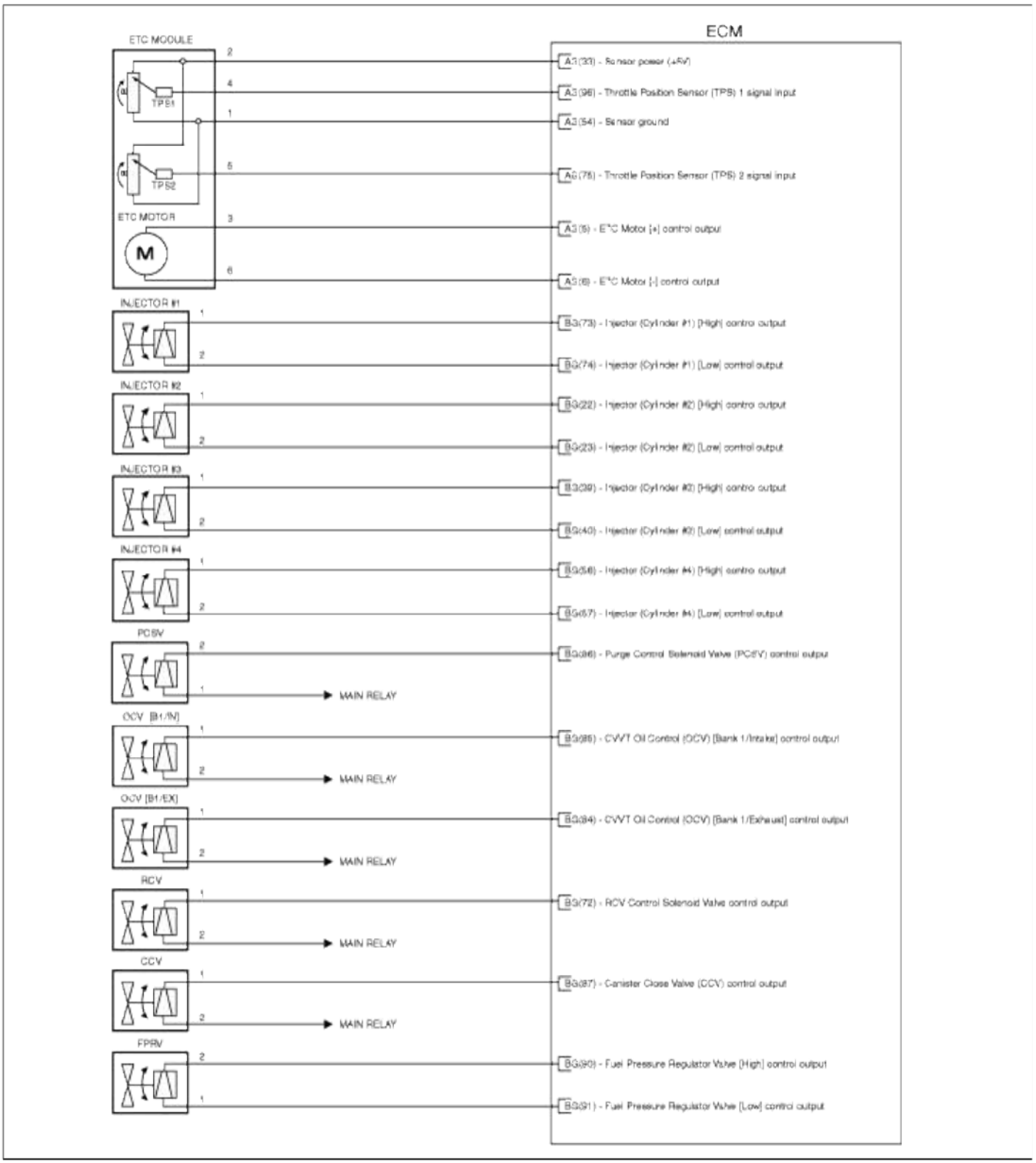
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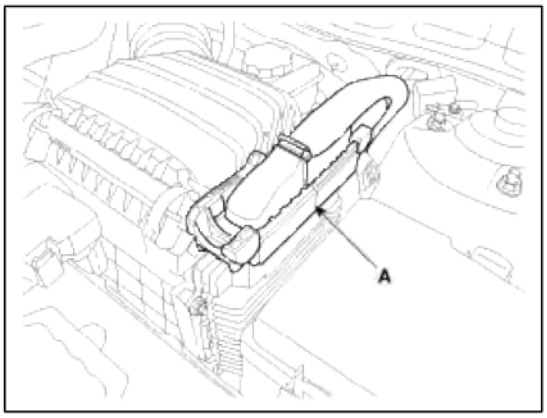
Fuel System > Engine Control System > Engine Control Module (ECM) > Repair procedures

Removal

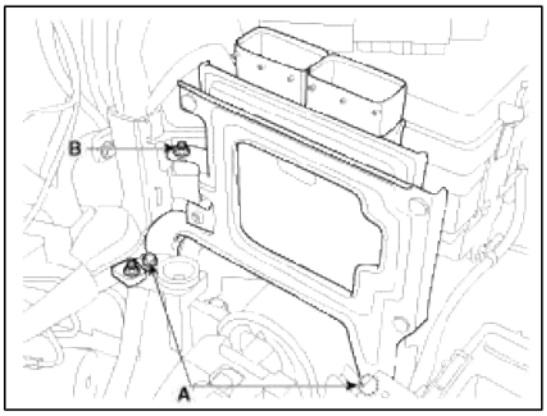
In the case of the vehicle equipped with immobilizer or button engine start system, perform "Key Teaching" procedure together (Refer to "Immobilizer" or "Button Engine Start System in BE group).

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

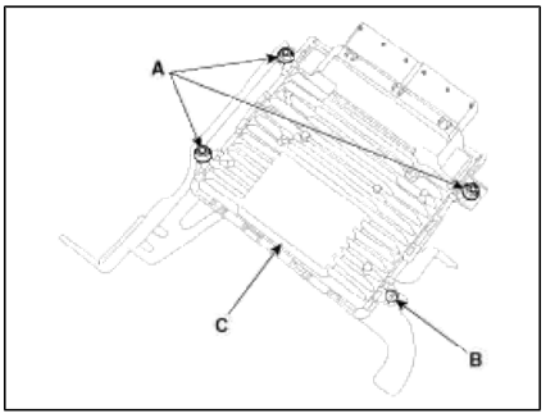
2. Disconnect the ECM Connector (A).



3. Remove the air cleaner assembly (Refer to "Intake And Exhaust System" in EM group).
4. Remove the mounting bolts (A) and nut (B), and then remove the ECM assembly (C).



5. Remove the installation nuts (A) and screw (B), and then remove the ECM (C) from the bracket.



Installation

In the case of the vehicle equipped with immobilizer or button engine start system, perform "Key Teaching" procedure together (Refer to "Immobilizer" or "Button Engine Start System in BE group).

1. Installation is reverse of removal.

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

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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

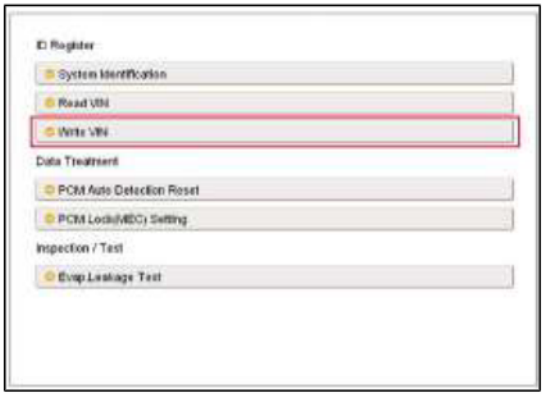
2. TEST ECM CONNECTOR: Disconnect the ECM connector and visually check the ground terminals on ECM side and harness side for bent pins or poor contact pressure. If the problem is found, repair it.
3. If problem is not found in Step 1 and 2, the ECM could be faulty. If so, make sure there were no DTC's before swapping the ECM with a new one, and then check the vehicle again. If DTC's were found, examine this first before swapping 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.

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

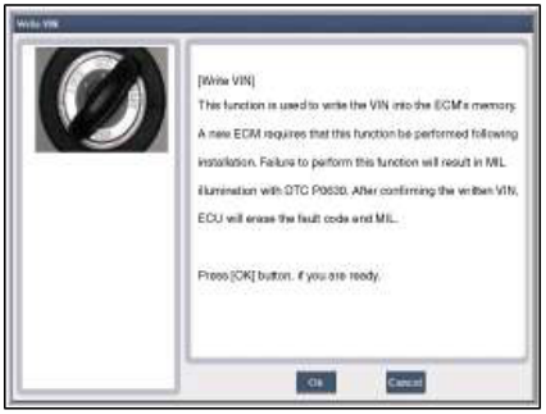
1. Select "VIN Writing" function in "Vehicle S/W Management".
2. Select "Write VIN" in "ID Register".



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3. Input the VIN.

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

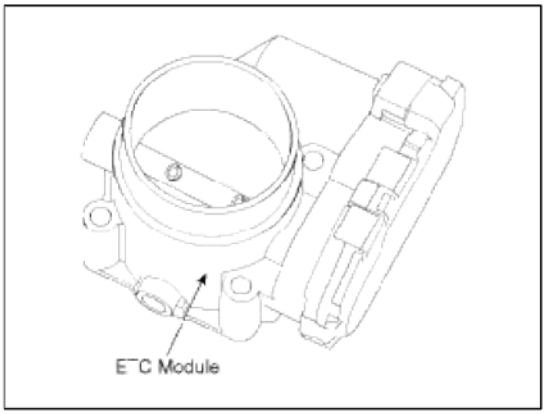


4. Turn the ignition switch OFF, then back ON.

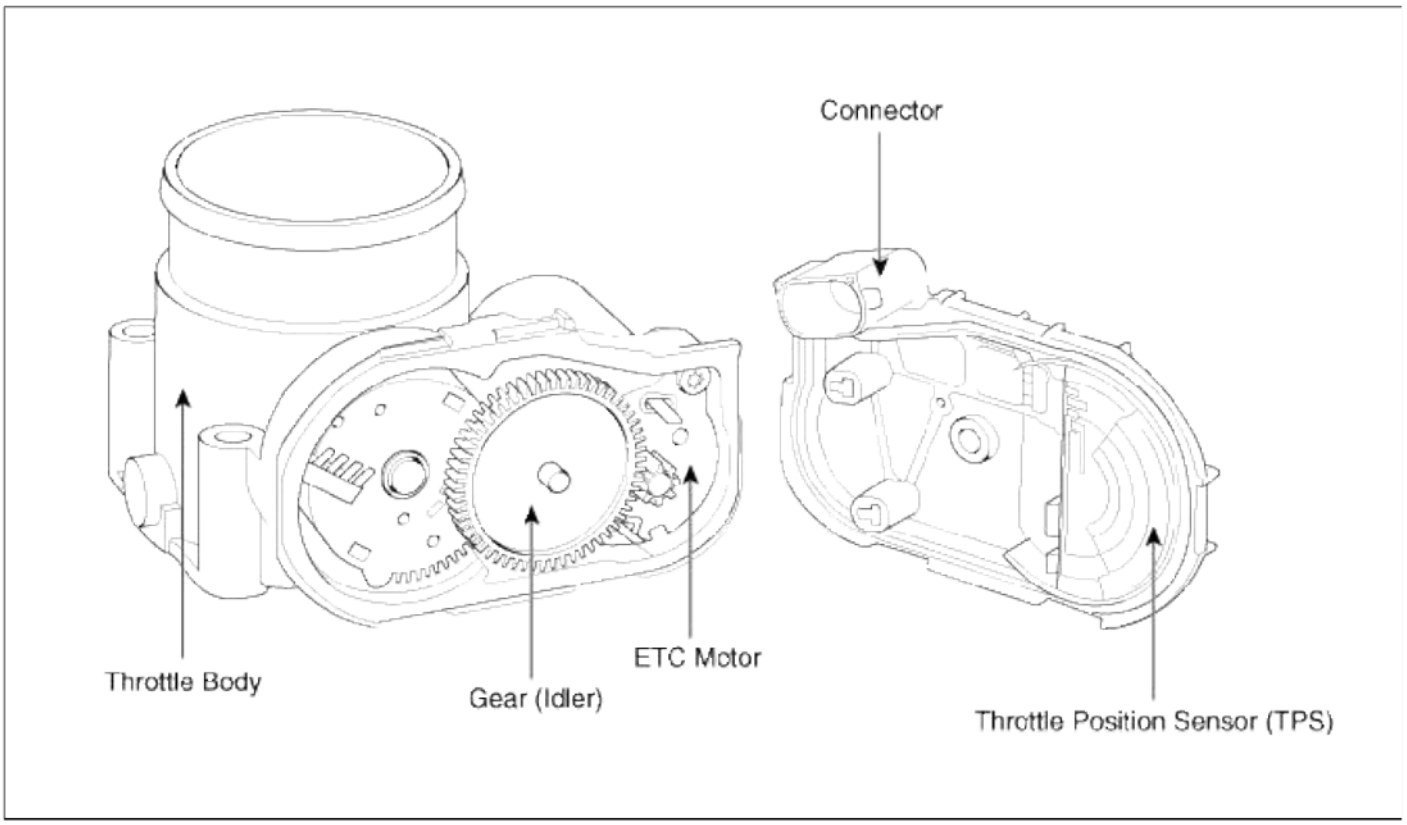
Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Description and Operation

Description

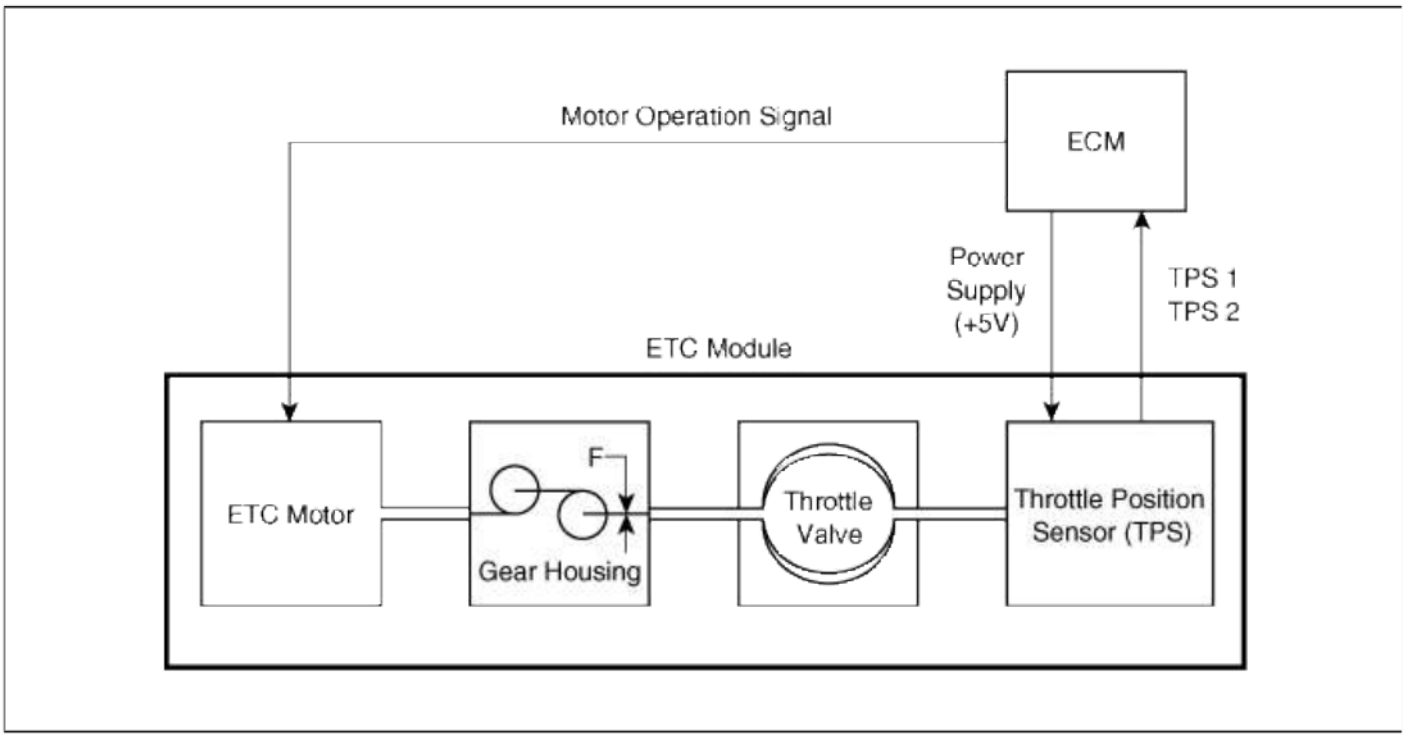
The Electronic Throttle Control (ETC) System consists of a throttle body with an integrated control motor and throttle position sensor (TPS). Instead of the traditional throttle cable, an Accelerator Position Sensor (APS) is used to receive driver input. The ECM uses the APS signal to calculate the target 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.



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Schematic Diagram



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

Fail-Safe Mode

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Item	Fail-Safe	
ETC Motor	Throttle valve stuck at 5°	
TPS	TPS 1 fault	ECM looks at TPS2
	TPS 2 fault	ECM looks at TPS1
	TPS 1,2 fault	Throttle valve stuck at 5°
APS	APS 1 fault	ECM looks at APS 2
	APS 2 fault	ECM looks at APS 1
	APS 1,2 fault	Throttle valve stuck at 5°

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

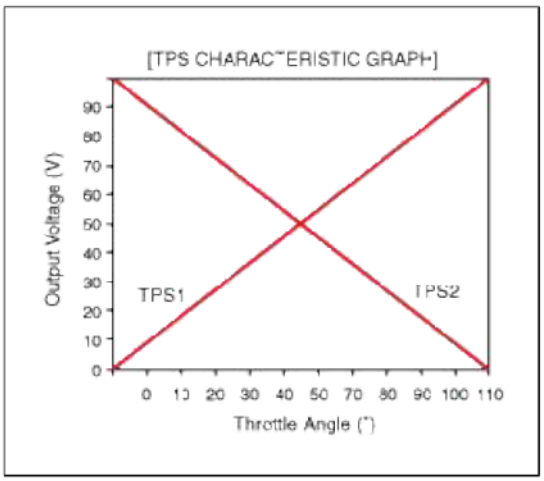
Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Specifications

Specification

[Throttle Position Sensor (TPS)]

Throttle Angle(°)	Output Voltage(V)	
	TPS1	TPS2
0	0.0	5.0
10	0.48	4.52
20	0.95	4.05
30	1.43	3.57
40	1.90	3.10
50	2.38	2.62
60	2.86	2.14
70	3.33	1.67
80	3.81	1.19
90	4.29	0.71
100	4.76	0.24
105	5.0	0
C.T (6 ~ 15°)	0.29 ~ 0.71	4.29 ~ 4.71
W.O.T (93 ~ 102°)	4.43 ~ 4.86	0.14 ~ 0.57

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Item	Sensor Resistance(kΩ)
TPS1	0.875 ~ 1.625 [20°C(68°F)]
TPS2	0.875 ~ 1.625 [20°C(68°F)]

[ETC Motor]

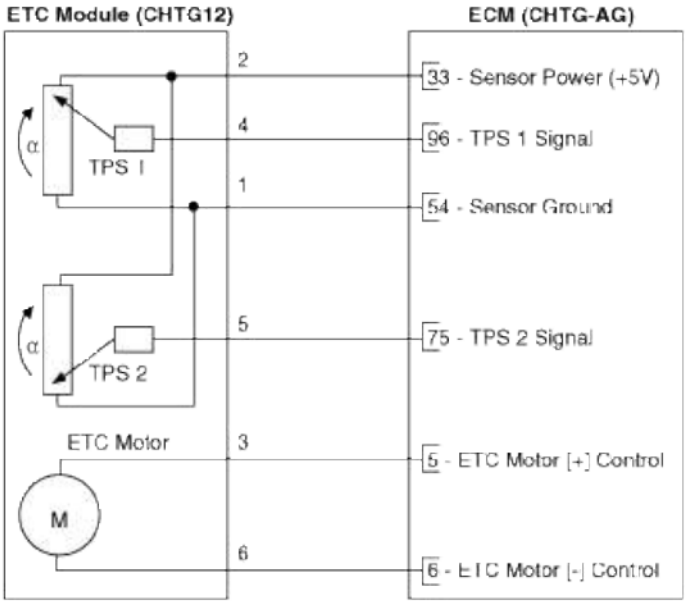
Item	Specification
Coil Resistance (Ω)	1.2 ~ 1.8 [20°C(68°F)]

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

Circuit Diagram

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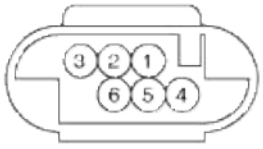
[Circuit Diagram]



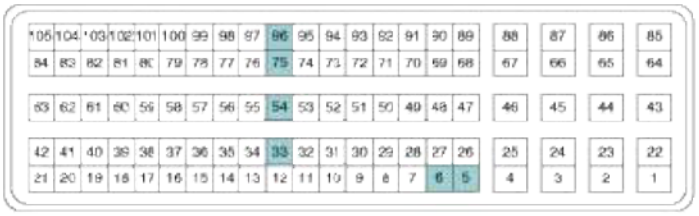
[Connection Information]

Terminal	Connected to	Function
1	ECM CHTG-AG (54)	Sensor Ground
2	ECM CHTG-AG (33)	Sensor Power (+5V)
3	ECM CHTG-AG (5)	ETC Motor [+] Control
4	ECM CHTG-AG (96)	TPS 1 Signal
5	ECM CHTG-AG (75)	TPS 2 Signal
6	ECM CHTG-AG (6)	ETC Motor [-] Control

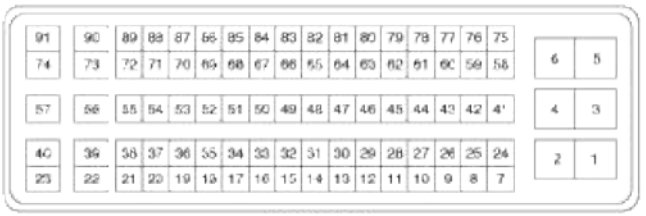
[Harness Connector]



CHTG12
ETC Module



CHTG-AG



CHTG-BG
ECM

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.

Specification: Refer to "Specification"

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

Specification: Refer to "Sensor Resistance"

ETC Motor

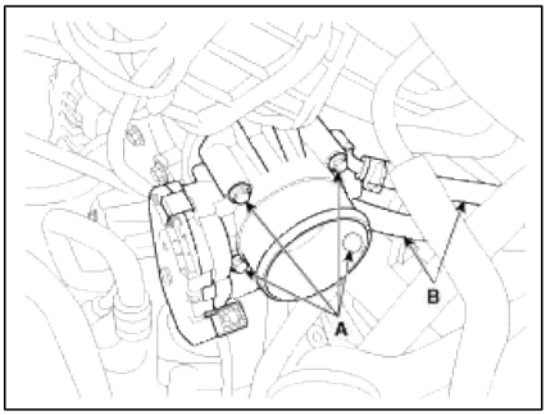
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1. Turn the ignition switch OFF.
2. Disconnect the ETC module connector.
3. Measure resistance between the ETC module terminals 3 and 6.
4. Check that the resistance is within the specification.

Specification: Refer to "Specification"

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the resonator and the air intake hose (Refer to "Intake And Exhaust System" in EM group).
3. Disconnect the ETC module connector.
4. Disconnect the coolant hoses (B).
5. Remove the installation bolts (A), and then remove the ETC module from the engine.



Installation

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

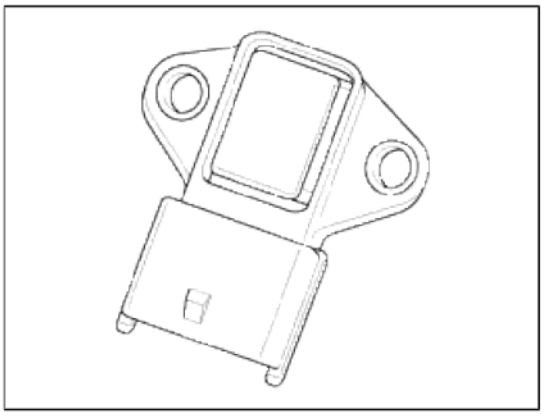
Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Description and Operation

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%

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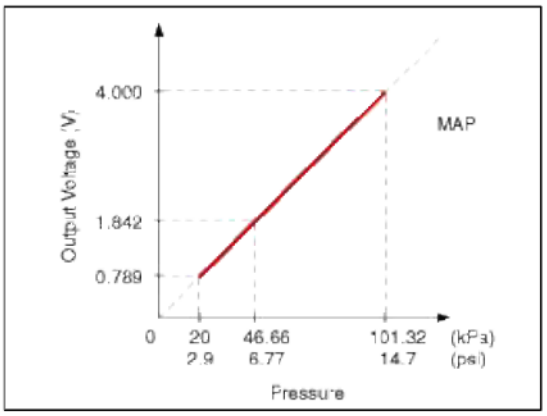
vacuum and the manifold pressure apply to both sides of the sensor respectively, this sensor can output analog signal by using the silicon variation proportional to pressure change.



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

Specification

Pressure [kPa (kgf/cm², psi)]	Output Voltage (V)
20.0 (0.20, 2.9)	0.79
46.7 (0.47, 6.77)	1.84
101.3 (1.03, 14.7)	4.0

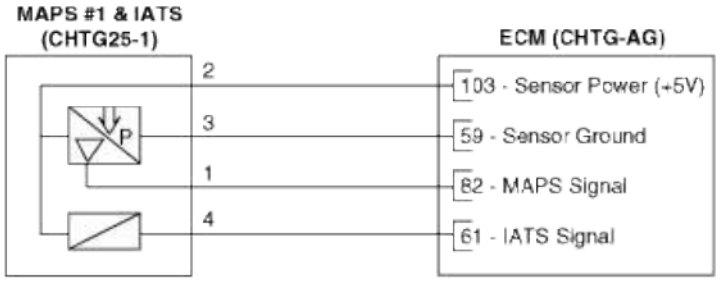


Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Schematic Diagrams

Circuit Diagram

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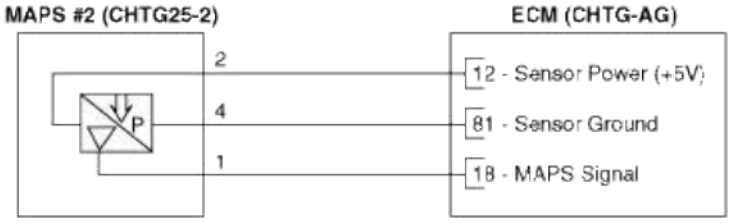
[Circuit Diagram]



[Connection Information]

MAPS #1 & IATS (CHTG25-1)

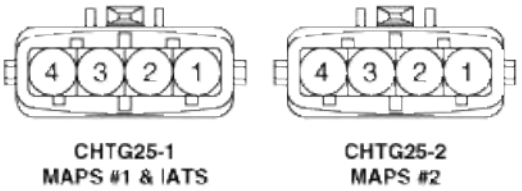
Terminal	Connected to	Function
1	ECM CHTG-AG (82)	MAPS Signal
2	ECM CHTG-AG (103)	Sensor Power (+5V)
3	ECM CHTG-AG (59)	Sensor Ground
4	ECM CHTG-AG (61)	IATS Signal

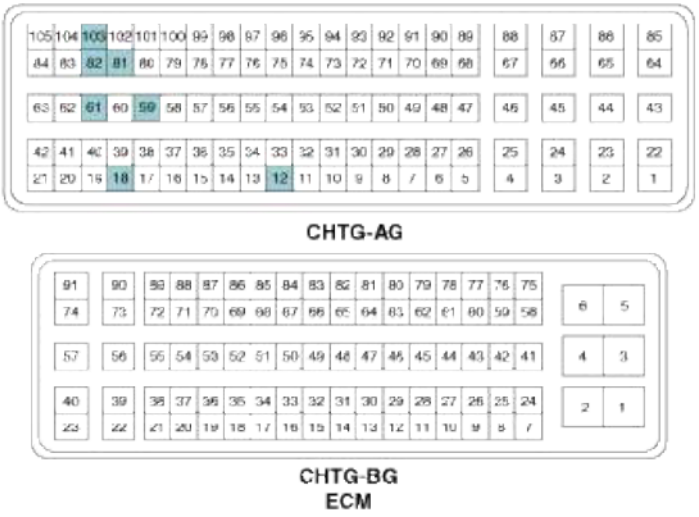


MAPS #2 (CHTG25-2)

Terminal	Connected to	Function
1	ECM CHTG-AG (18)	MAPS Signal
2	ECM CHTG-AG (12)	Sensor Power (+5V)
3	-	-
4	ECM CHTG-AG (81)	IATS Signal

[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.

Specification: Refer to "Specification"

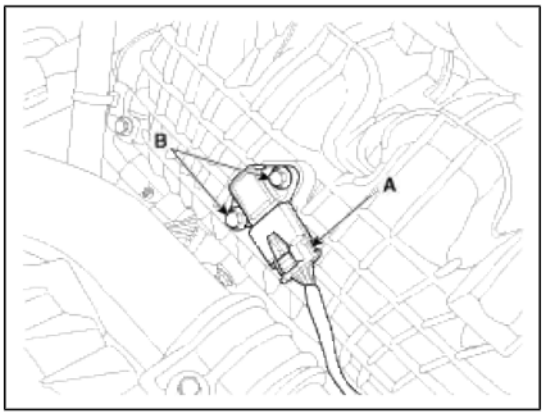
Removal

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

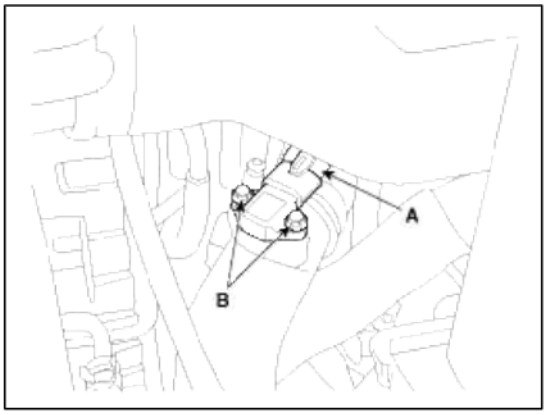
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3. Remove the installation bolts (B), and then remove the sensor from the surge tank.

[MAPS #1]



[MAPS #2]



Installation

- 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.

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

1. Installation is reverse of removal.

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

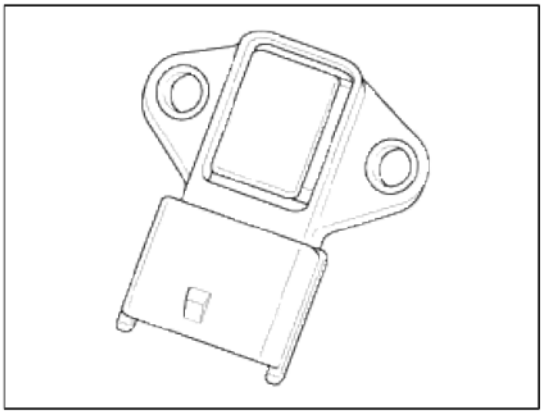
Fuel System > Engine Control System > Intake Air Temperature Sensor (IATS) > Description and Operation

Description

Intake Air Temperature Sensor (IATS) is included inside Manifold Absolute 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 MAPS signal but also IATS signal. This sensor has a Negative Temperature Coefficient (NTC) Thermister and it's resistance changes in reverse proportion to the temperature.

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

Specification

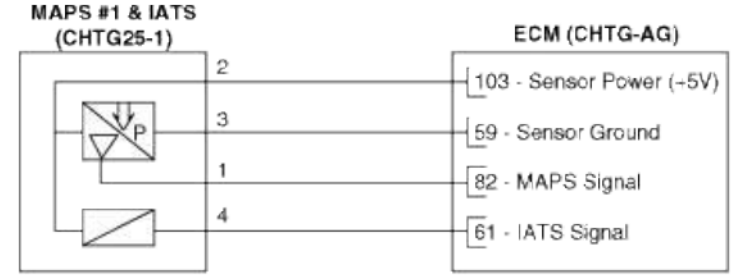
Temperature		Resistance (kΩ)
°C	°F	
-40	-40	40.93 ~ 48.35
-20	-4	13.89 ~ 16.03
0	32	5.38 ~ 6.09
10	50	3.48 ~ 3.90
20	68	2.31 ~ 2.57
40	104	1.08 ~ 1.21
50	122	1.56 ~ 1.74
60	140	0.54 ~ 0.62
80	176	0.29 ~ 0.34

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

Circuit Diagram

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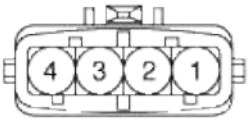
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CHTG-AG (82)	MAPS Signal
2	ECM CHTG-AG (103)	Sensor Power (+5V)
3	ECM CHTG-AG (59)	Sensor Ground
4	ECM CHTG-AG (61)	IATS Signal

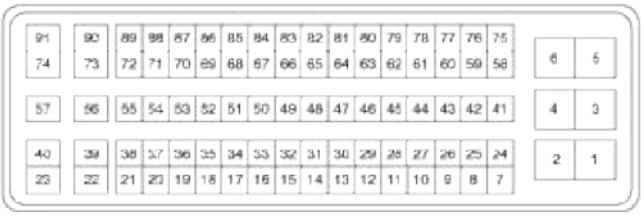
[Harness Connector]



CHTG25-1
MAPS #1 & IATS



CHTG-AG



CHTG-BG
ECM

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"

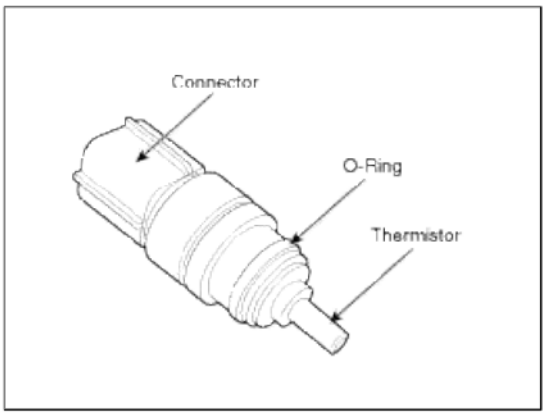
Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Description and Operation

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 that changes resistance 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.

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.

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

Specification

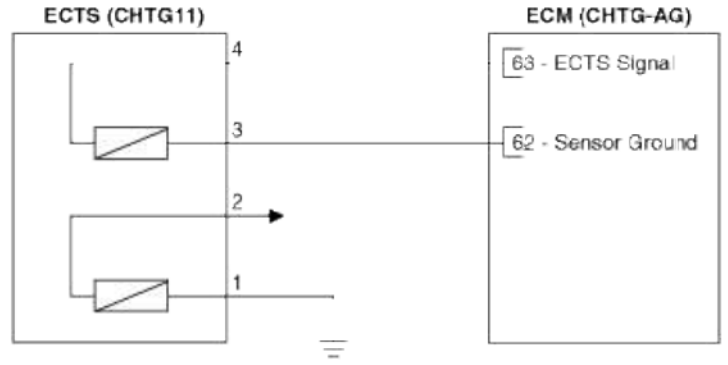
Temperature		Resistance (kΩ)
°C	°F	
-40	-40	48.14
-20	-4	14.13 ~ 16.83
0	32	5.79
20	68	2.31 ~ 2.59
40	104	1.15
60	140	0.59
80	176	0.32

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

Circuit Diagram

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[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	Chassis Ground	Sensor Ground
2	-	-
3	ECM CHTG-AG (62)	Sensor Ground
4	ECM CHTG-AG (63)	ECTS Signal

[Harness Connector]



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

Inspection

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

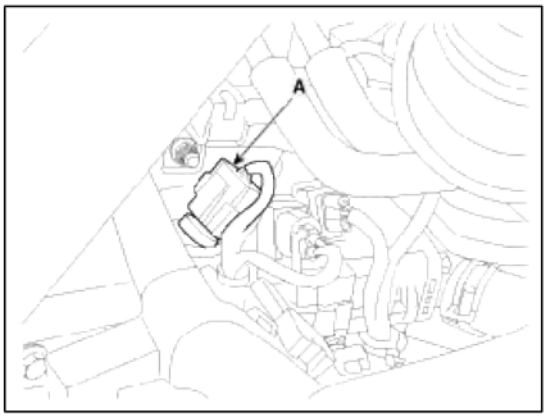
Specification: Refer to “Specification”

Removal

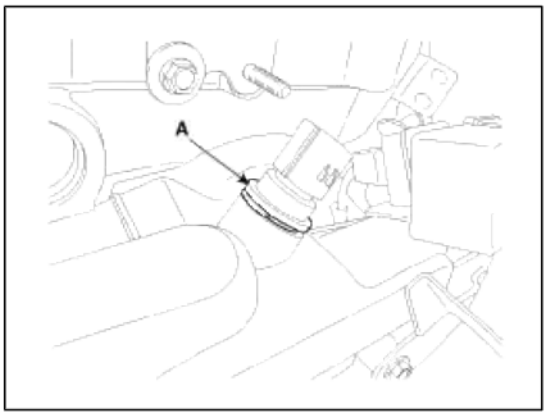
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.

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2. Disconnect the engine coolant temperature sensor connector (A).



3. Remove the spring clip (A), and then pull the sensor from the water temperature control assembly.



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

4. Supplement the engine coolant (Refer to "Cooling System" in EM group).

Installation

- 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.

- Apply the engine coolant to the O-ring.

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

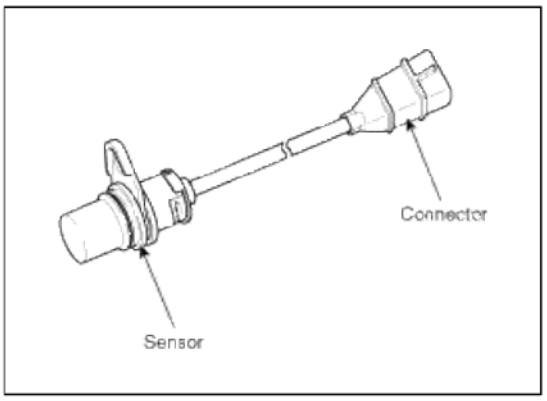
1. Installation is reverse of removal.

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

Description

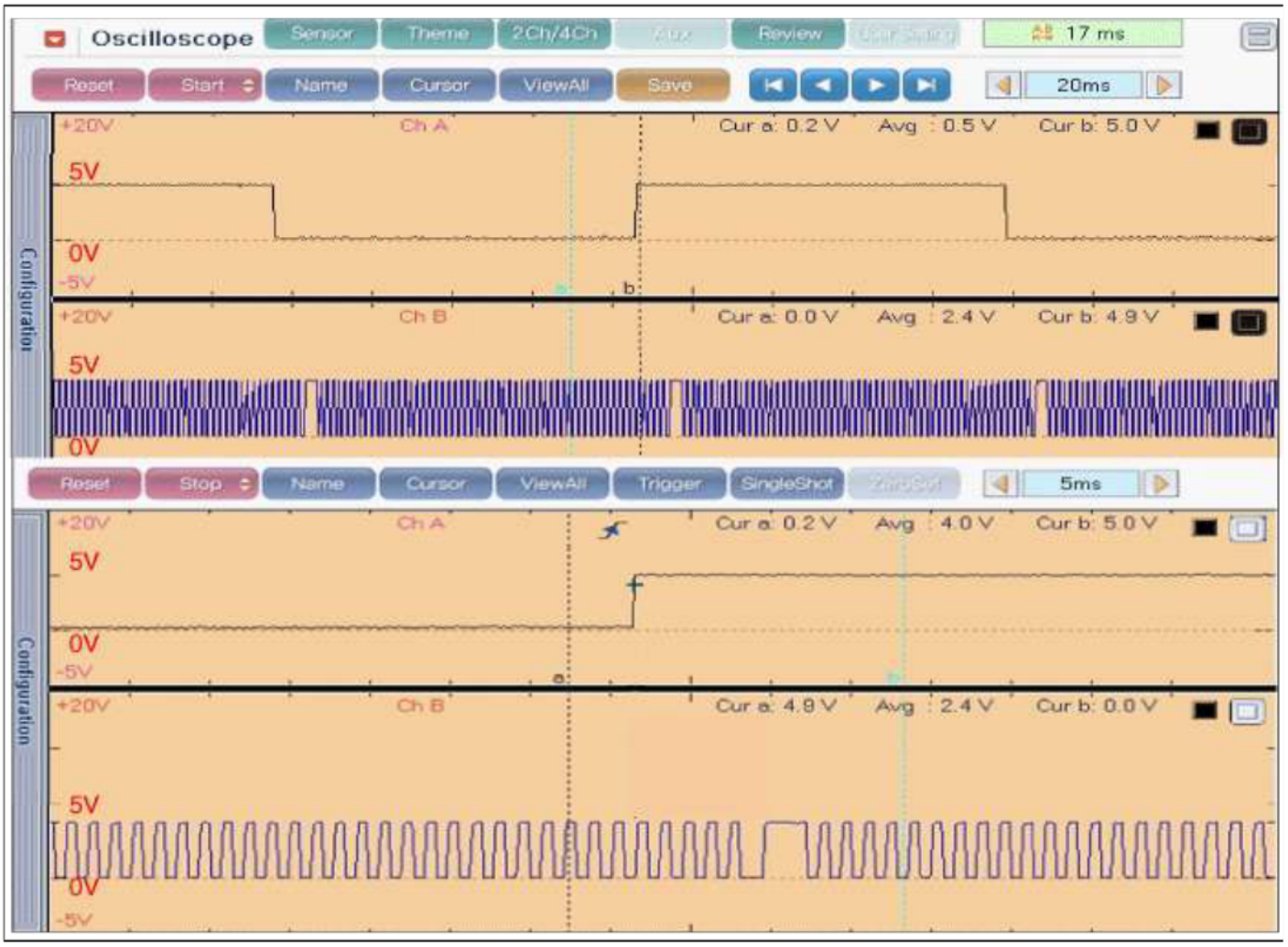
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Crankshaft Position Sensor (CKPS) detects the crankshaft position and is one of the most important sensors of the engine control system. If there is no CKPS signal input, the engine may stop because of CKPS signal missing. This sensor is installed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

Wave Form

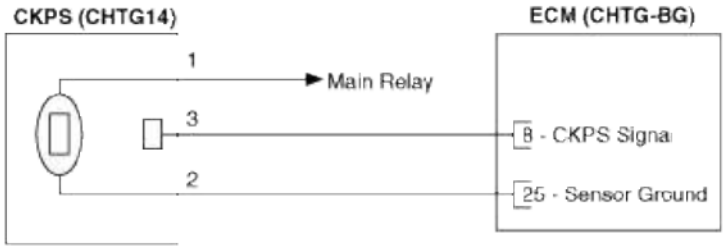


Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Schematic Diagrams

Circuit Diagram

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[Circuit Diagram]



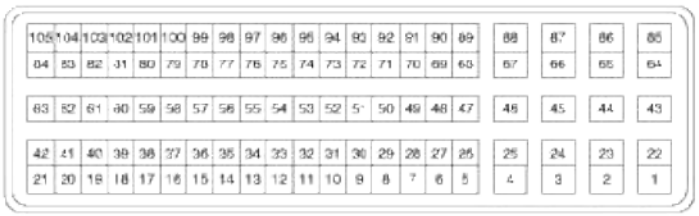
[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CHTG-BG (25)	CKPS Signal
3	ECM CHTG-BG (8)	Sensor Ground

[Harness Connector]



CHTG14
CKPS



CHTG-AG



CHTG-BG
ECM

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

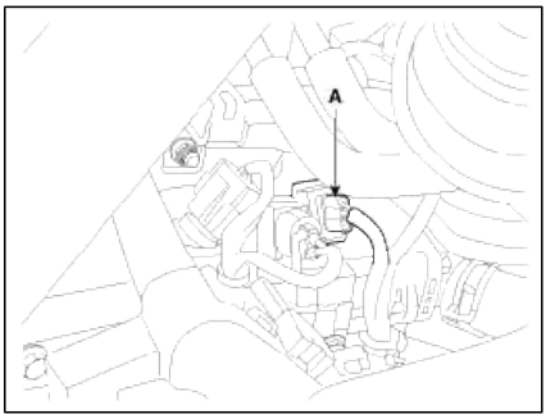
Inspection

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

Specification: Refer to "Wave Form"

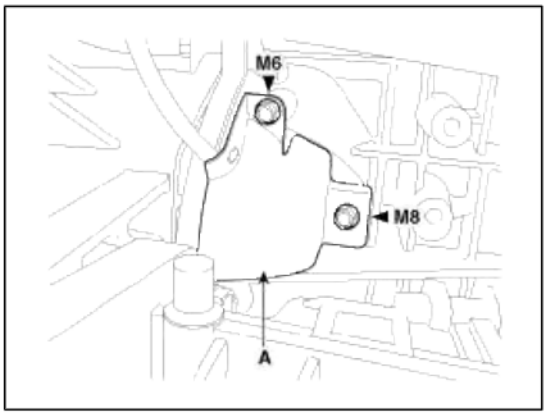
Removal

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

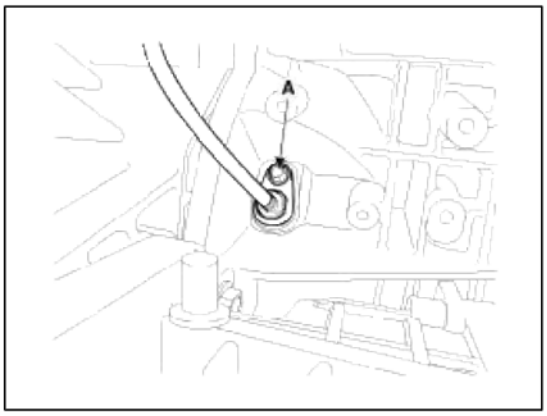


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3. Remove the protector (A).



4. Remove the installation bolt (A), and then remove the crankshaft position sensor.



Installation

- 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.

- Apply the engine oil to the O-ring.

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

1. Installation is reverse of removal.

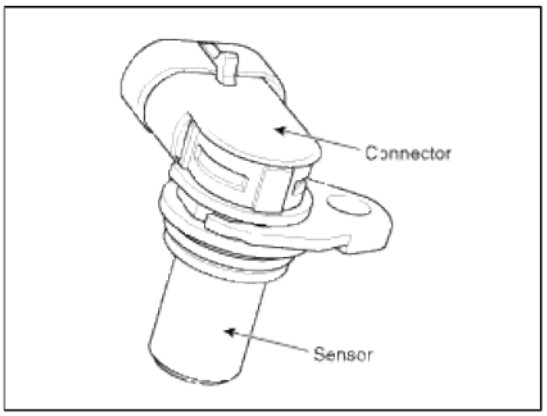
Crankshaft position sensor installation bolt: 9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)
Crankshaft position sensor protector installation bolt (M6): 9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)
Crankshaft position sensor protector installation bolt (M8): 18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)

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

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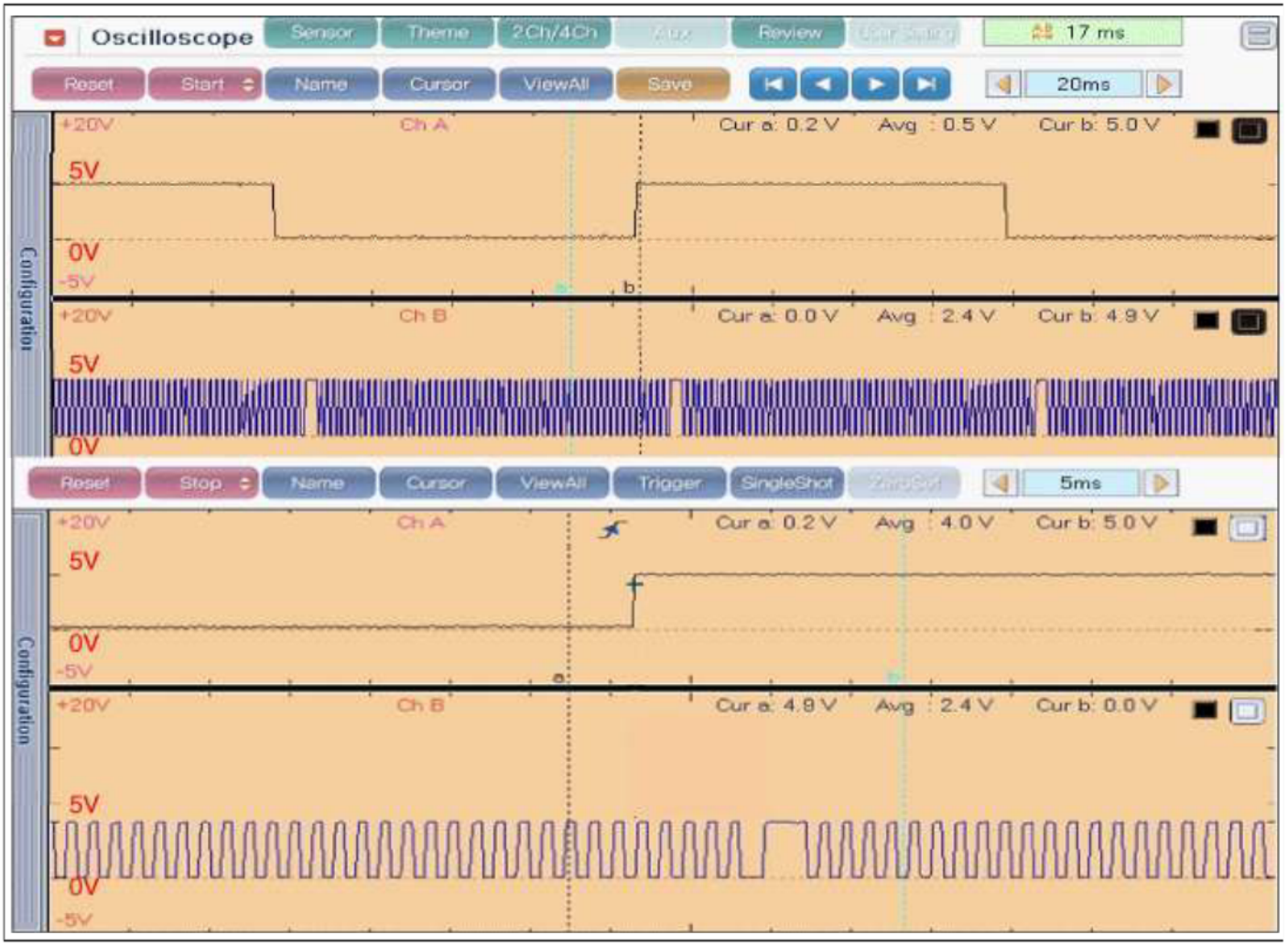
Description

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 CMPS is installed on engine head cover 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) > Troubleshooting

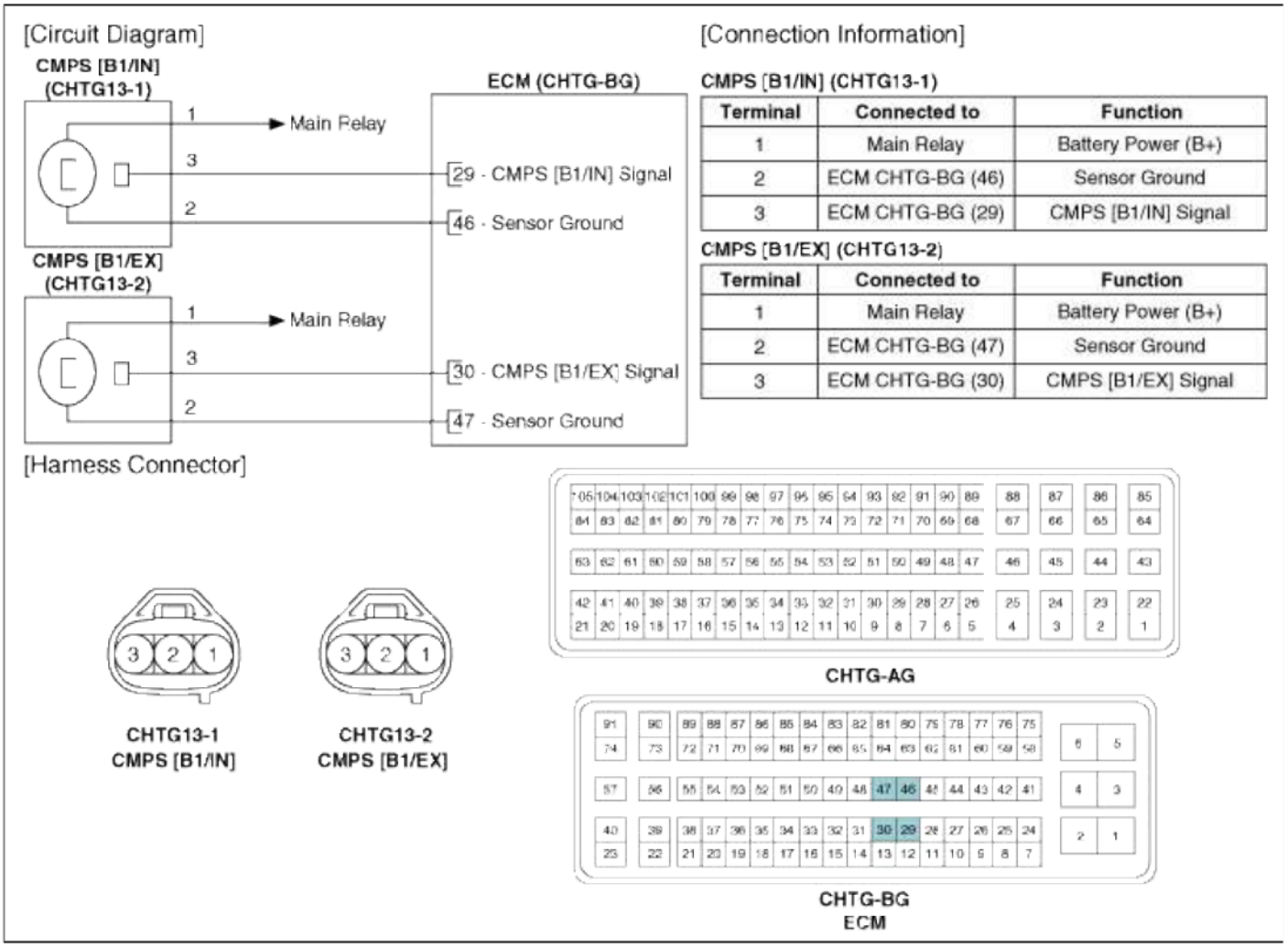
Wave Form



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

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Circuit Diagram



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

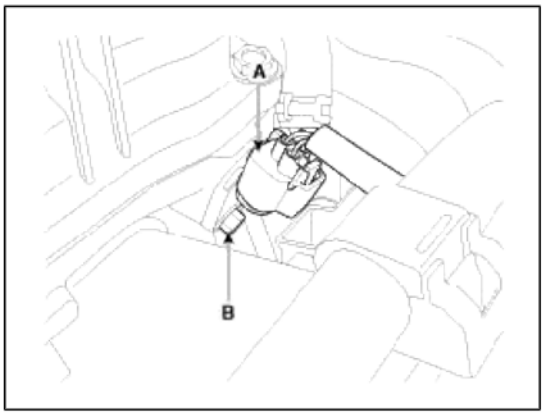
- DON'T remove the camshaft position sensor while the engine is running or right after engine is turned off. The part and engine oil is hot and can cause burns.

[Bank 1 / Intake]

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

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3. Remove the installation bolt (B), and then remove the sensor.



[Bank 1 / Exhaust]

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the heater protect cover (Refer to "Intake And Exhaust System" in EM group).
3. Disconnect the camshaft position sensor connector (A).
4. Remove the hanger and the protector.
5. Remove the installation bolt, and then remove the sensor.



Installation

- 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.

- Apply the engine oil to the O-ring.

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

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

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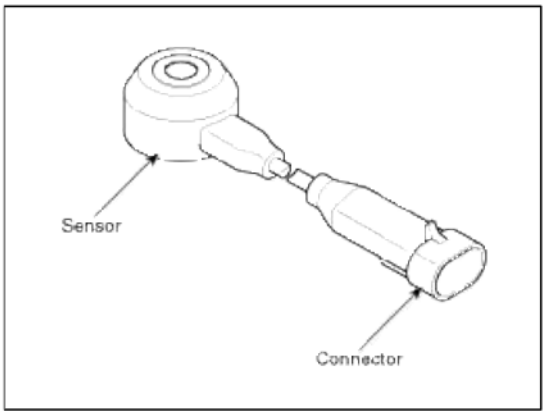
1. Installation is reverse of removal.

Camshaft position sensor 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 > Knock Sensor (KS) > Description and Operation

Description

Knocking is a phenomenon characterized by undesirable vibration and noise and can cause engine damage. Knock Sensor (KS) is installed on 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

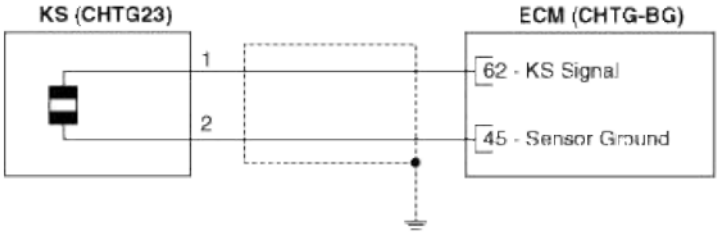
Item	Specification
Capacitance (pF)	850 ~ 1,150

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

Circuit Diagram

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[Circuit Diagram]



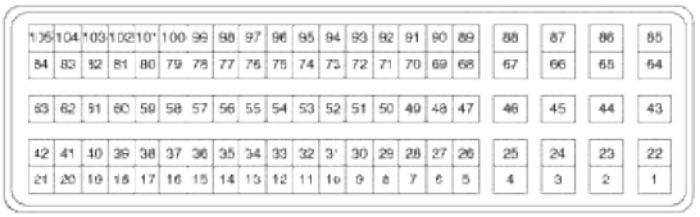
[Connection Information]

Terminal	Connected to	Function
1	ECM CHTG-BG (62)	KS Signal
2	ECM CHTG-BG (45)	Sensor Ground

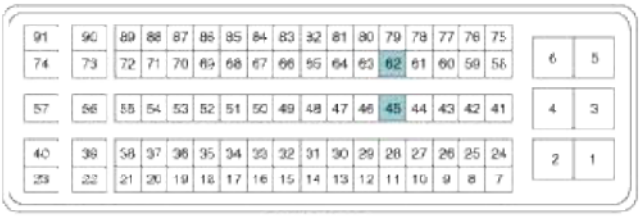
[Harness Connector]



CHTG23
Knock Sensor



CHTG-AG

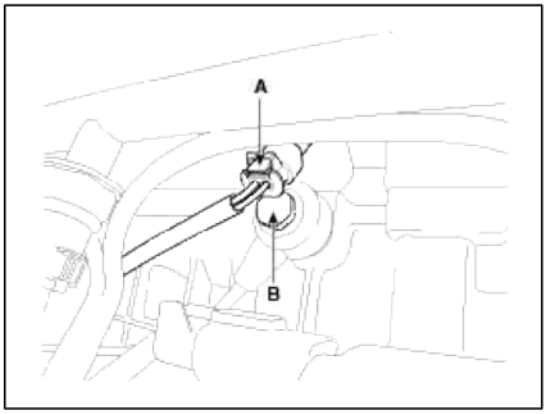


CHTG-BG
ECM

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

Removal

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 knock sensor connector (A).
4. Remove the installation bolt (B), and then remove the sensor from the cylinder block.



Installation

- 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.

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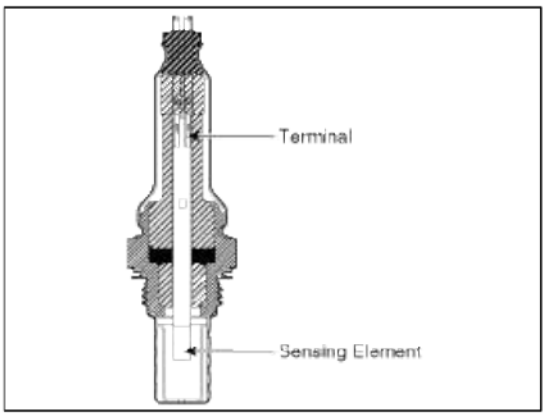
1. Installation is reverse of removal.

Knock sensor installation bolt:
18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)

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

Description

Heated Oxygen Sensor (HO2S) consists of zirconium and alumina and is installed both upstream and downstream of the Manifold Catalytic Converter. The sensor output voltage varies in accordance with the air/fuel ratio.
The sensor must be hot in order to operate normally. To keep it hot, the sensor has a heater which is controlled by the ECM via a duty cycle 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

HO2S [Bank 1/Sensor 1]

Item	Specification
Heater Resistance (Ω)	2.5 ~ 4.0 [20°C(68°F)]

HO2S [Bank 1/Sensor 2]

A/F Ratio (λ)	Output Voltage(V)
RICH	Approx. 0.9
LEAN	Approx. 0.04

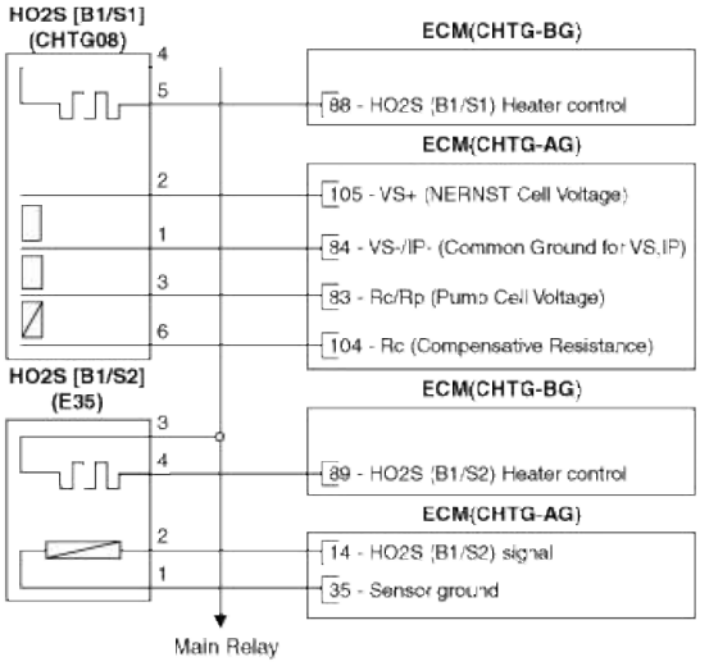
Item	Specification
Heater Resistance (Ω)	3.3 ~ 4.1Ω[21°C(69.8°F)]

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

Circuit Diagram

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[Circuit Diagram]



[Connection Information]

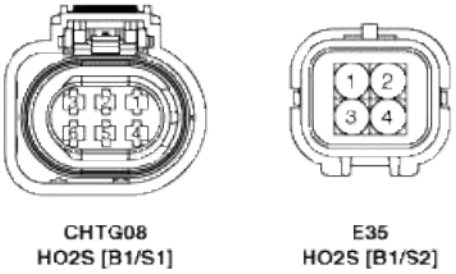
HO2S [B1/S1] (CHTG08)

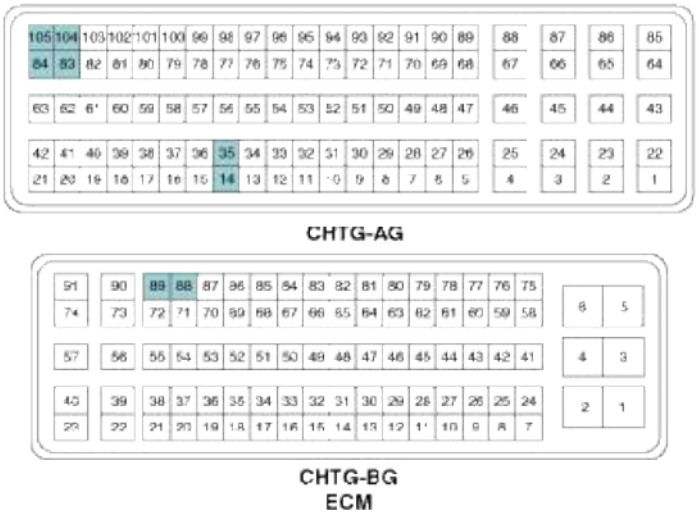
Terminal	Connected to	Function
1	ECM CHTG-AG (84)	VS-/IP- (Common Ground for VS,IP)
2	ECM CHTG-AG (105)	VS+ (NERNST Cell Voltage)
3	ECM CHTG-AG (83)	Rc/Rp (Pump Cell Voltage)
4	Main Relay	Power Supply (B+)
5	ECM CHTG-BG (88)	Heater control
6	ECM CHTG-AG (104)	Rc (Compensative Resistance)

HO2S [B1/S2] (E35)

Terminal	Connected to	Function
1	ECM CHTG-AG (35)	Sensor Ground
2	ECM CHTG-AG (14)	HO2S (B1/S2) Signal
3	Main Relay	Power Supply (B+)
4	ECM CHTG-BG (89)	Heater control

[Harness Connector]





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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 4 and 5 [B1/S1].
4. Measure resistance between the HO2S terminals 3 and 4 [B1/S2].
5. Check that the resistance is within the specification.

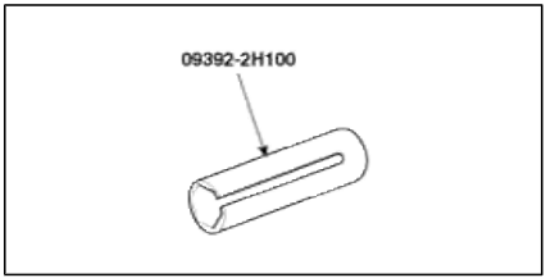
Specification: Refer to "Specification"

Removal

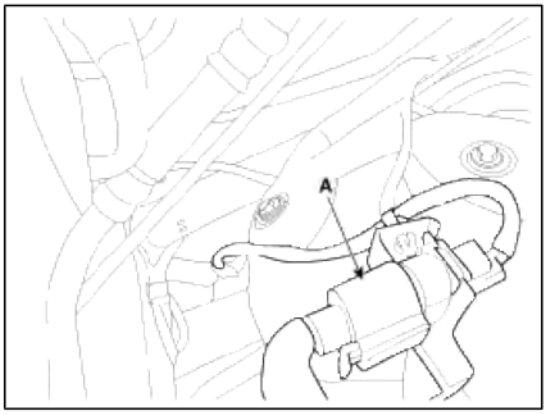
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.

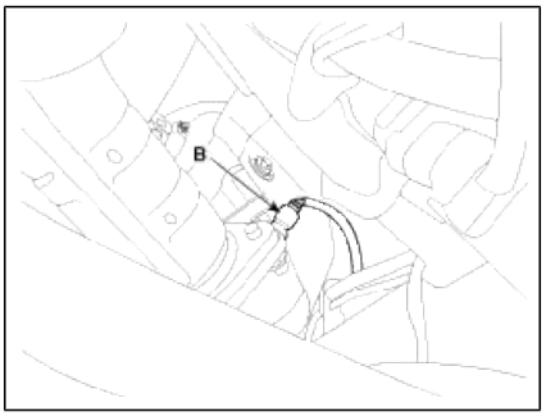
2. Disconnect the connector (A), and then remove the sensor (B).

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

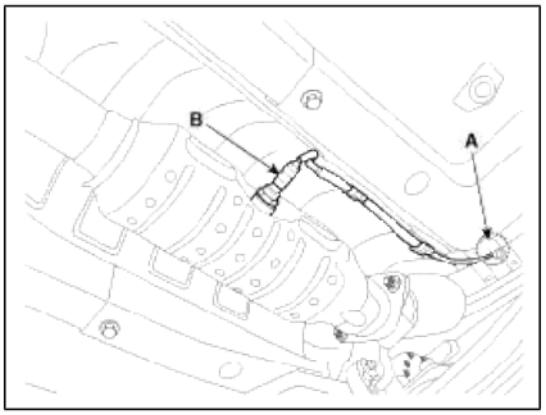


[Bank 1 / Sensor 1]





[Bank 1 / Sensor 2]



Installation

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- 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.

- 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).

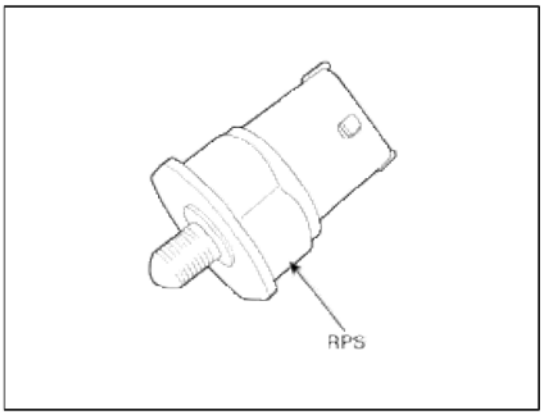
1. Installation is reverse of removal.

Heated oxygen sensor installation (Bank 1/ Sensor 1):
39.2 ~ 49.1 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)
Heated oxygen sensor installation (Bank 1/ Sensor 2):
35 ~ 45 N.m (3.6 ~ 4.6 kgf.m, 25.8 ~ 33.2 lb-ft)

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

Description

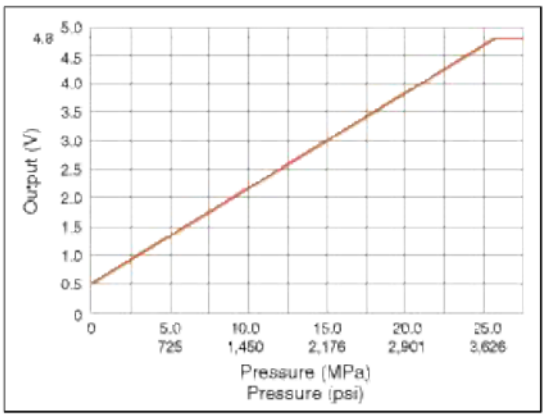
Rail Pressure Sensor (RPS) is installed on the delivery pipe and measures the instantaneous fuel pressure in the delivery pipe. The sensing element (Semiconductor element) built in the sensor converts the pressure to voltage signal. By using this signal, the ECM can control correct injection amount and 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

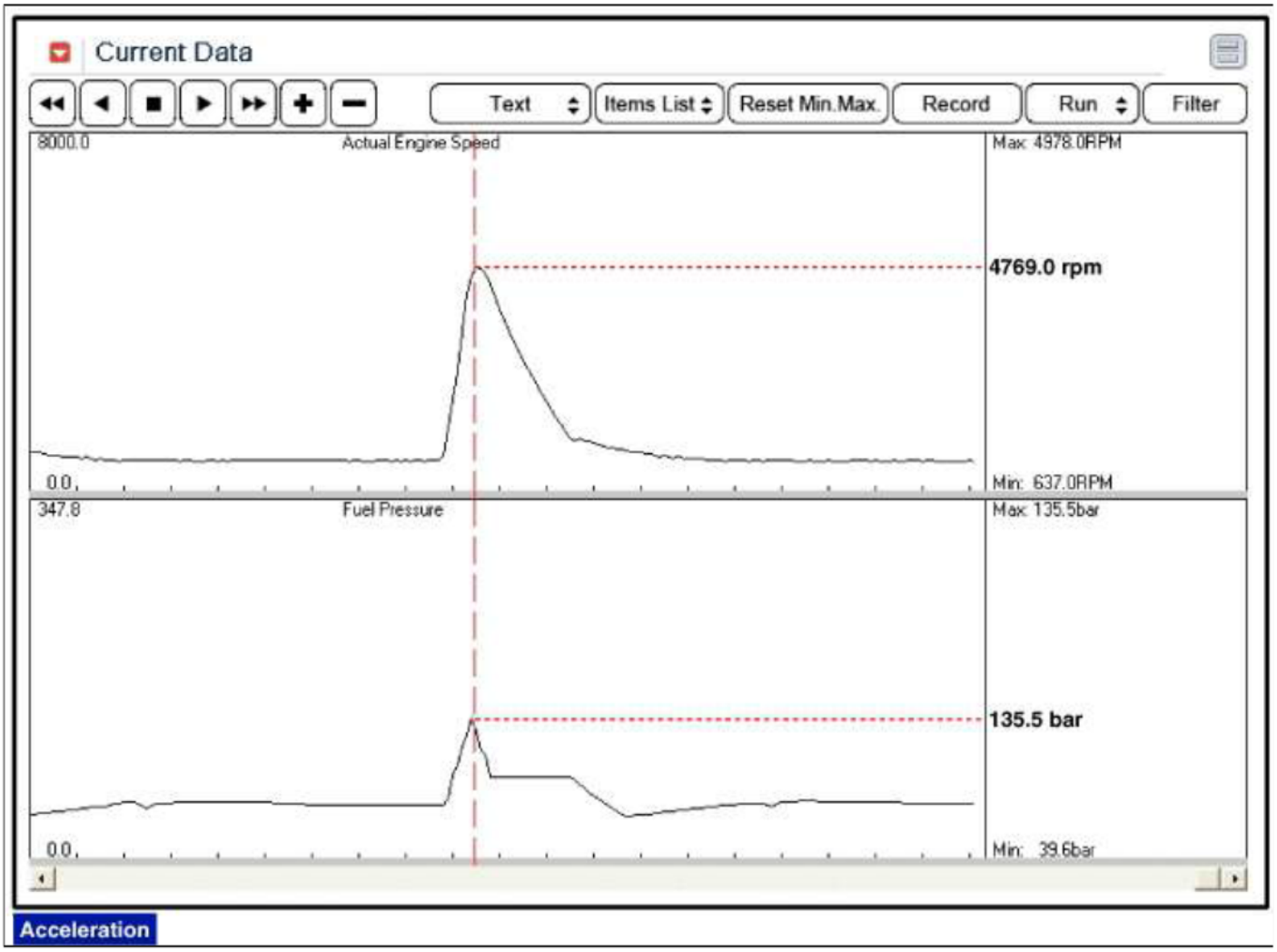
Specification

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

Signal Waveform

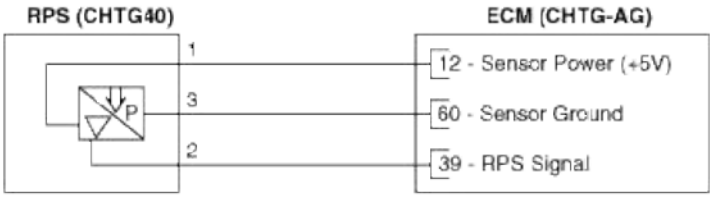


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Fuel System > Engine Control System > Rail Pressure Sensor (RPS) > Schematic Diagrams

Circuit Diagram

[Circuit Diagram]



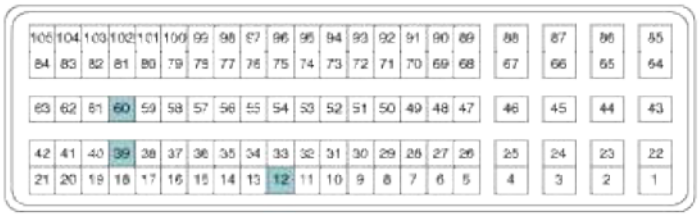
[Connection Information]

Terminal	Connected to	Function
1	ECM CHTG-AG (12)	Sensor Power (+5V)
2	ECM CHTG-AG (39)	RPS Signal
3	ECM CHTG-AG (60)	Sensor Ground

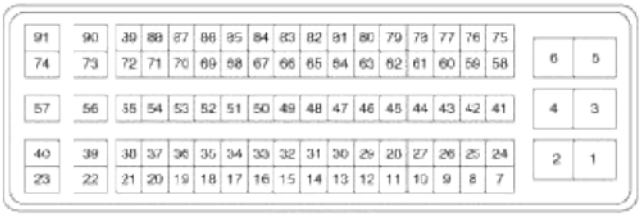
[Harness Connector]



CHTG40
RPS



CHTG-AG



CHTG-BG
ECM

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

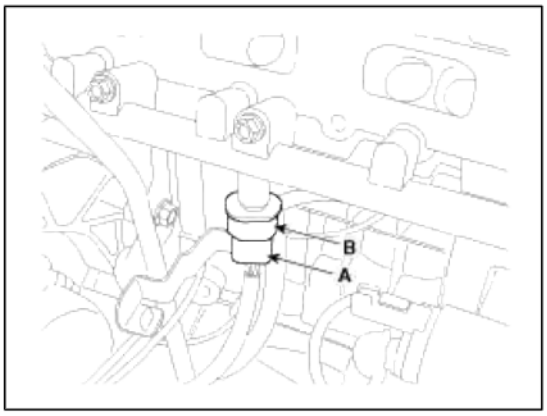
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Release the residual pressure in fuel line (Refer to "Release Residual Pressure in Fuel Line" in this group).

> 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).

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4. Disconnect the rail pressure sensor connector (A), and then remove the sensor (B) from the delivery pipe.



Installation

- 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.

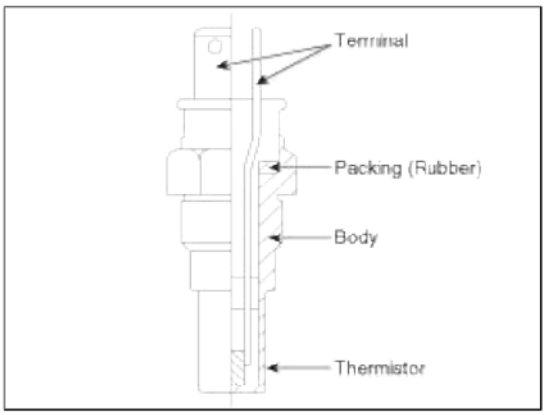
Rail Pressure Sensor Installation: 18.0 ~ 22.0 N.m (1.8 ~ 2.2 kgf.m, 13.3 ~ 16.2 lb-ft)

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 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.

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

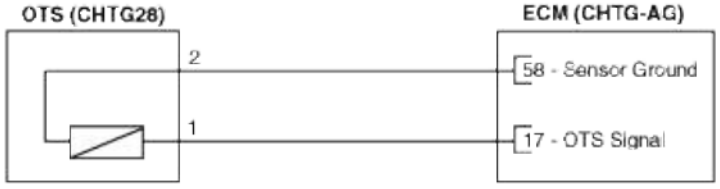
Specification

Temperature [°C(°F)]	Resistance (kΩ)
-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

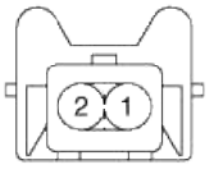
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CHTG-AG (17)	OTS Signal
2	ECM CHTG-AG (58)	Sensor Ground

[Harness Connector]



CHTG28
OTS



CHTG-AG



CHTG-BG
ECM

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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.
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.
2. Disconnect the OTS connector (A).
3. Remove the OTS.



Installation

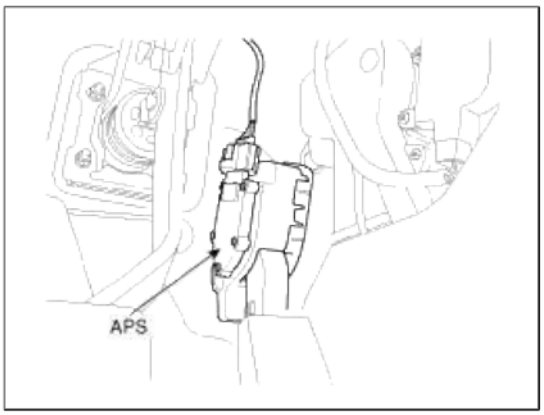
1. Installation is reverse of removal.

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.

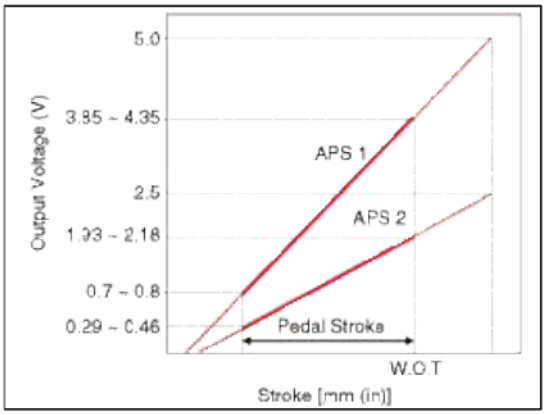
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Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Specifications

Specification

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

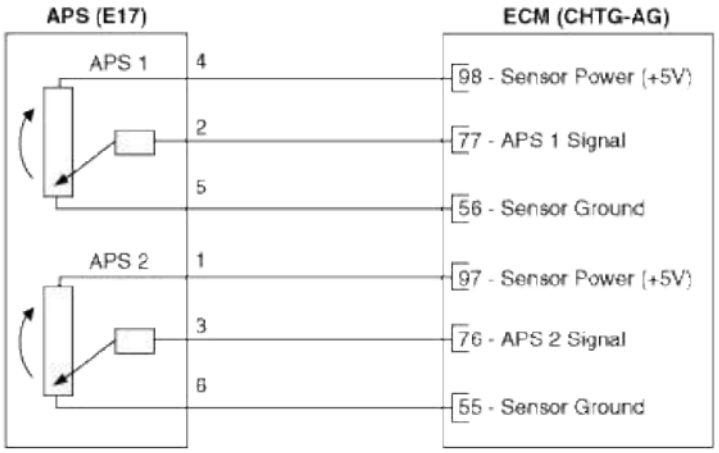


Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Schematic Diagrams

Circuit Diagram

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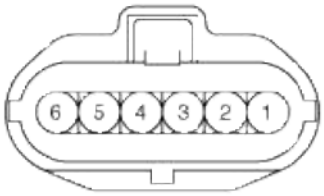
[Circuit Diagram]



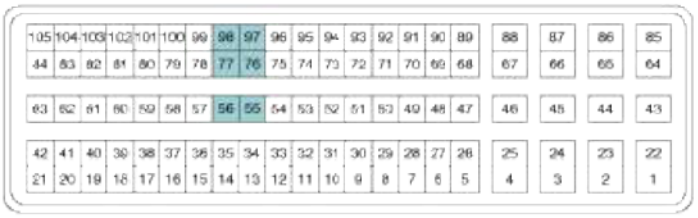
[Connection Information]

Terminal	Connected to	Function
1	ECM CHTG-AG (97)	APS 2 Sensor Power (+5V)
2	ECM CHTG-AG (77)	APS 1 Signal
3	ECM CHTG-AG (76)	APS 2 Signal
4	ECM CHTG-AG (98)	APS 1 Sensor Power (+5V)
5	ECM CHTG-AG (56)	APS 1 Sensor Ground
6	ECM CHTG-AG (55)	APS 2 Sensor Ground

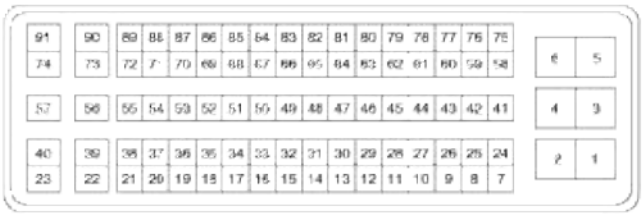
[Harness Connector]



E17
APS



CHTG-AG



CHTG-BG
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

Refer to "Accelerator Pedal" in this group.

Installation

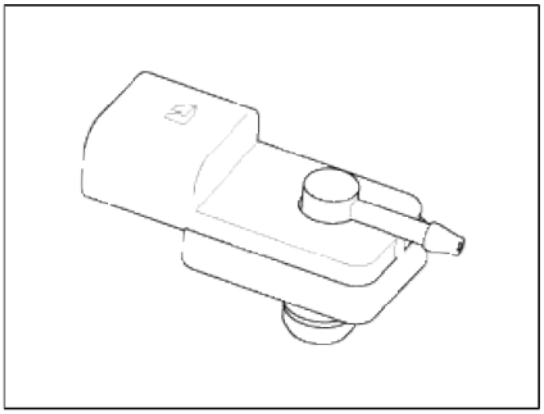
Refer to "Accelerator Pedal" in this group.

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

Description

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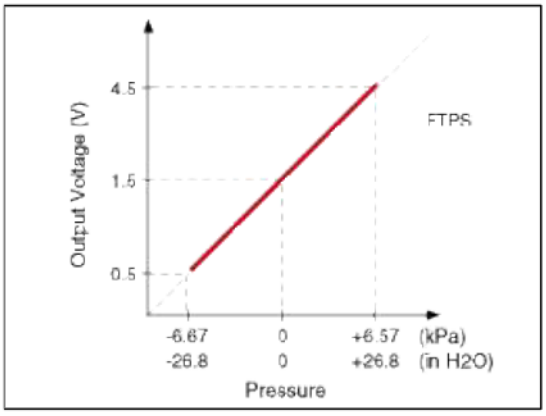
Fuel Tank Pressure Sensor (FTPS) is a component of the evaporative emission control system. It is installed on the fuel tank near the fuel pump assembly. It checks the evaporative system and detects an evaporative leak in the system.



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

Specification

Pressure [kPa (kgf/cm², in H2O)]	Output Voltage (V)
-6.67 (-0.068, -26.8)	0.5
0	2.5
+6.67 (0.068, 26.8)	4.5

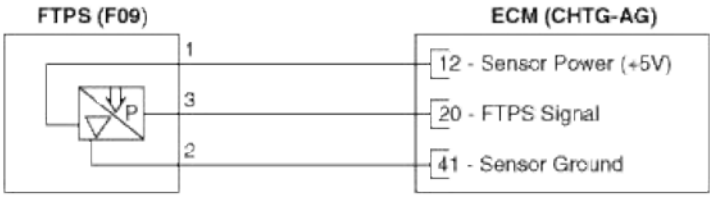


Fuel System > Engine Control System > Fuel Tank Pressure Sensor (FTPS) > Schematic Diagrams

Circuit Diagram

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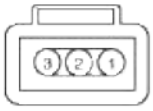
[Circuit Diagram]



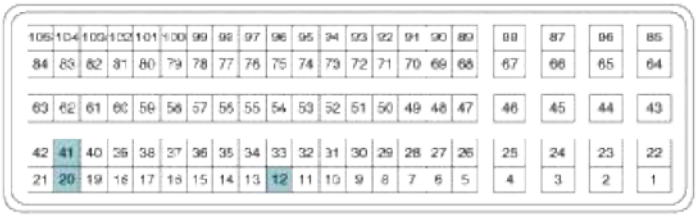
[Connection Information]

Terminal	Connected to	Function
1	ECM CHTG-AG (12)	Sensor Power (+5V)
2	ECM CHTG-AG (41)	Sensor Ground
3	ECM CHTG-AG (20)	FTPS Signal

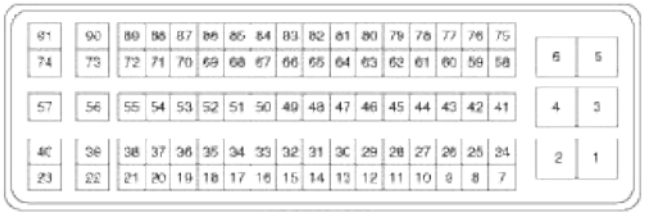
[Harness Connector]



F09
FTPS



CHTG-AG



CHTG-BG
ECM

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

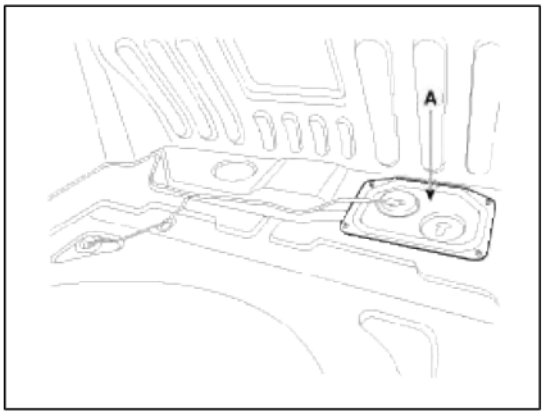
Inspection

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

Specification: Refer to "Specification"

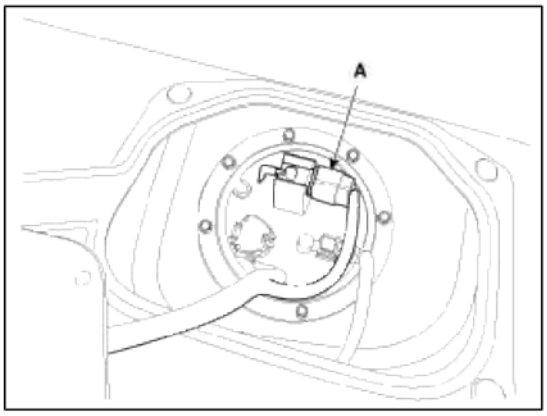
Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the fuel pump service cover (A) in the trunk.



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3. Disconnect the fuel tank pressure sensor connector (A), and then remove the fuel tank pressure sensor.



Installation

- 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.

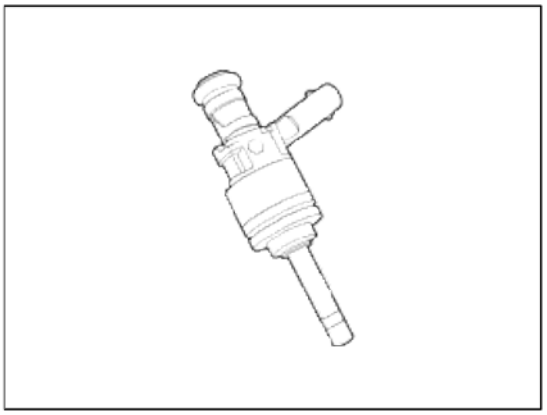
- Insert the sensor in the installation hole and be careful not to damage.

1. Installation is reverse of removal.

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

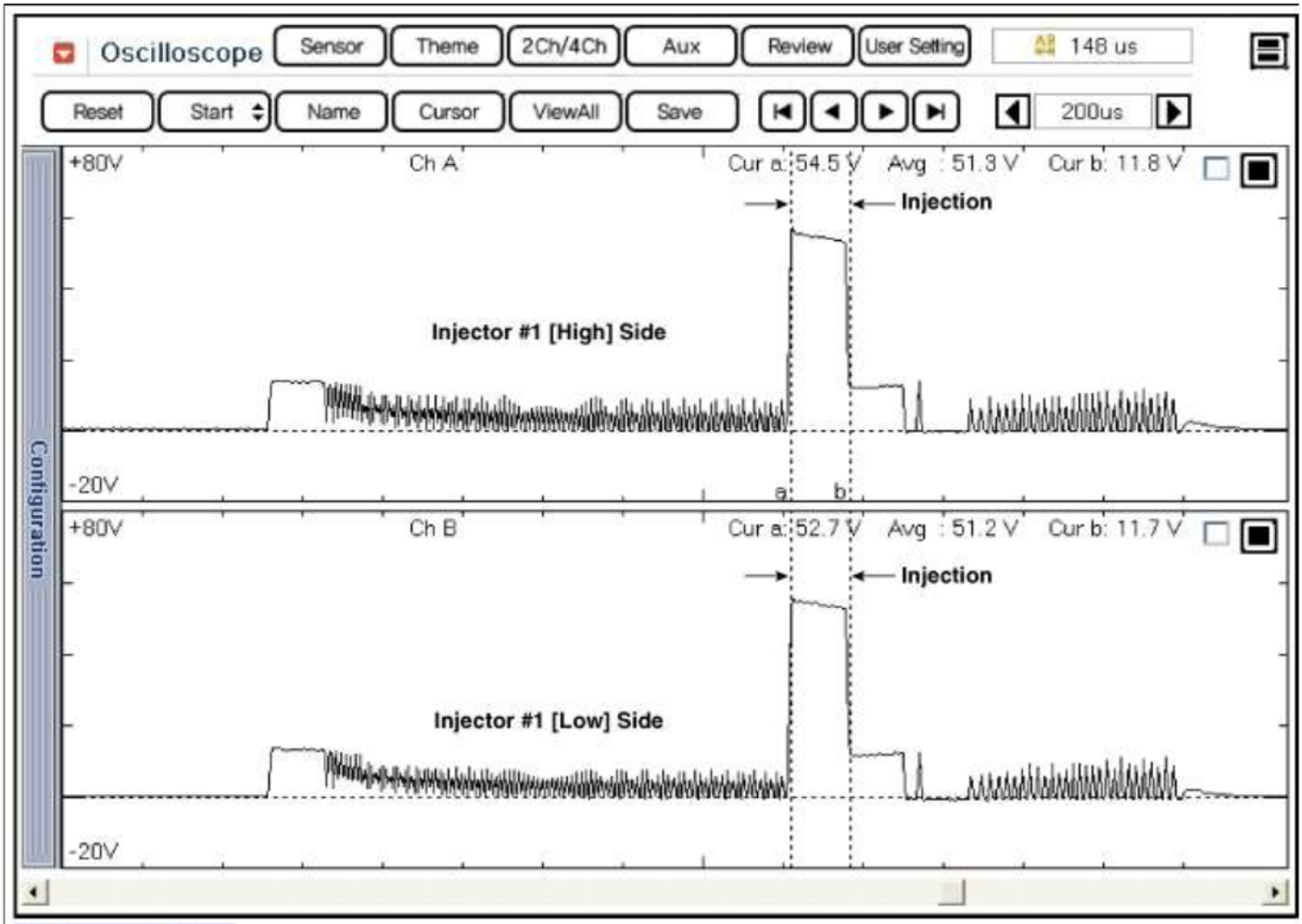
Specification

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Item	Specification
Coil Resistance (Ω)	1.25 [20°C(68°F)]

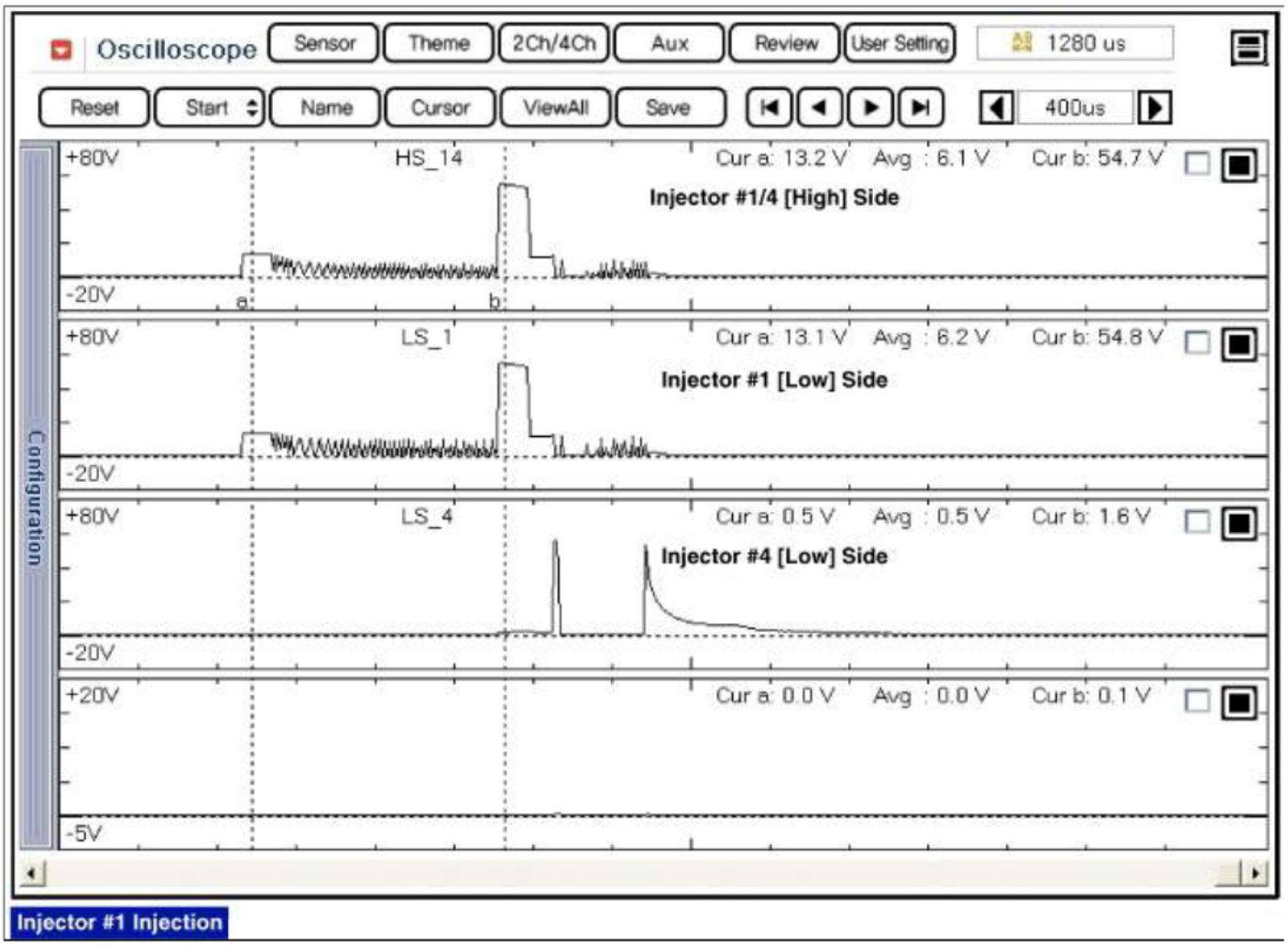
Fuel System > Engine Control System > Injector > Troubleshooting

Signal Waveform



Injector #1 Injection

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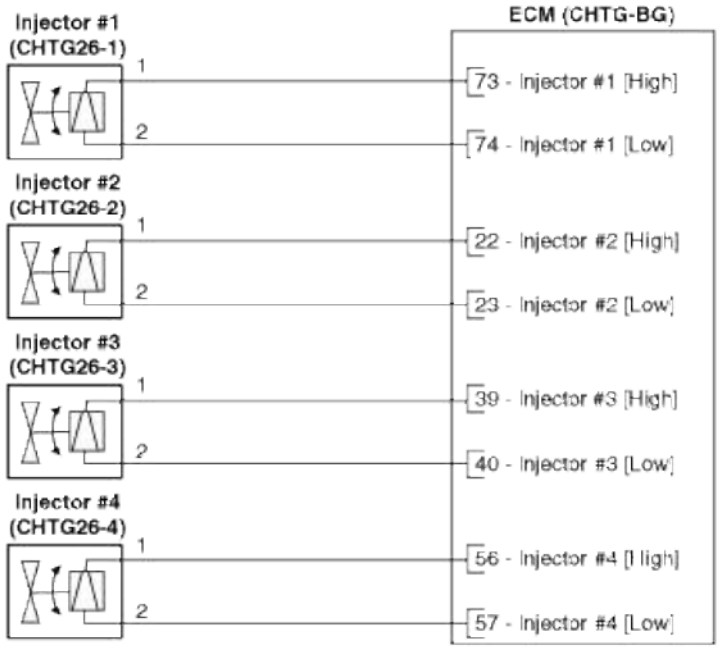


Fuel System > Engine Control System > Injector > Schematic Diagrams

Circuit Diagram

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[Circuit Diagram]



[Connection Information]

Injector #1 (CHTG26-1)

Terminal	Connected to	Function
1	ECM CHTG-BG (73)	Injector #1 [High] Control
2	ECM CHTG-BG (74)	Injector #1 [Low] Control

Injector #2 (CHTG26-2)

Terminal	Connected to	Function
1	ECM CHTG-BG (22)	Injector #2 [High] Control
2	ECM CHTG-BG (23)	Injector #2 [Low] Control

Injector #3 (CHTG26-3)

Terminal	Connected to	Function
1	ECM CHTG-BG (39)	Injector #3 [High] Control
2	ECM CHTG-BG (40)	Injector #3 [Low] Control

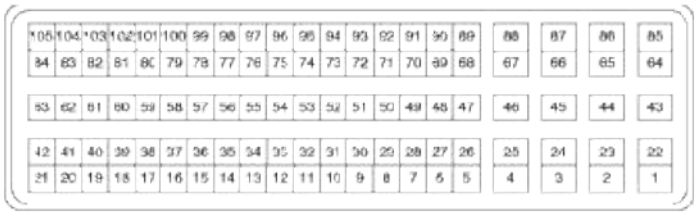
Injector #4 (CHTG26-4)

Terminal	Connected to	Function
1	ECM CHTG-BG (56)	Injector #4 [High] Control
2	ECM CHTG-BG (57)	Injector #4 [Low] Control

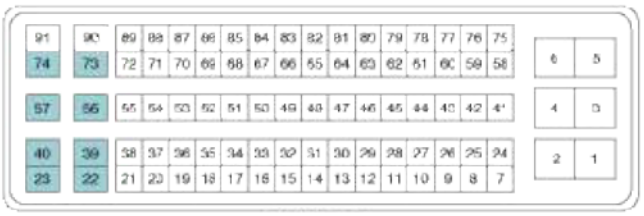
[Harness Connector]



CHTG26-1,2,3,4
Injector #1,2,3,4



CHTG-AG



CHTG-BG
ECM

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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”

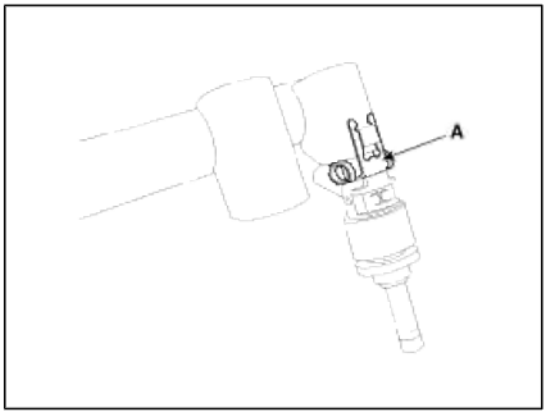
Removal

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).

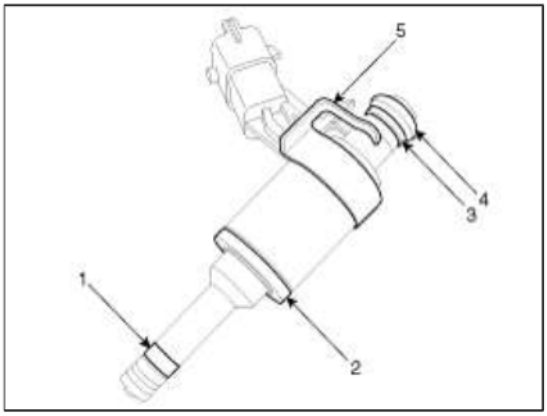
When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of "Release Residual Pressure in Fuel Line" work.

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



Installation

Do not reuse the injector retaining clip, O-ring, backup ring, washer seal or combustion sealring. Once an injector is removed, the five components must be replaced with new ones.



1. Combustion seal
2. Washer seal
3. Backup ring
4. O-ring
5. Retaining clip

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- Item 1,3 and 4 are supplied in a single kit.

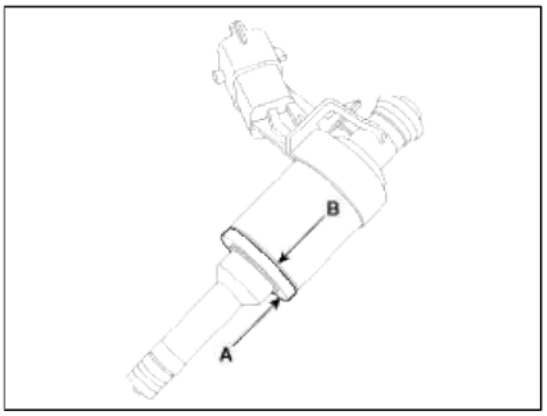
- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. If the component has been dropped, inspect before installing.

- Apply engine oil to the injector O-ring.

- Do not reuse the delivery pipe mounting bolts. Once the delivery pipe is removed, the boltsmust be replaced with new ones.

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

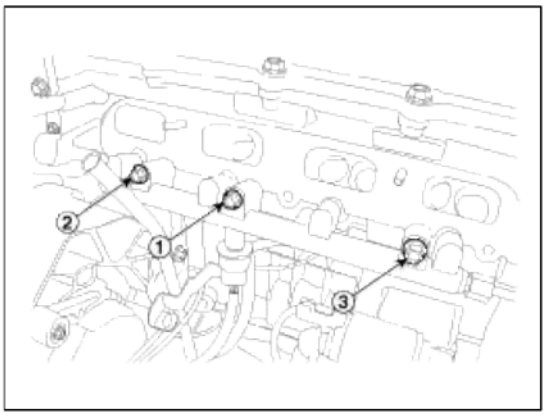
- When replacing the washer seal, the steal plate (A) part should be faced the cylinder installation part and the rubber plate (B) part should be faced the injector body part.



- Do not reuse the combustion seal.
- Be careful not to apply engine oil on the combustion seal ring.

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- Avoid dropping the fuel pipe (including injectors) or bumping it into any hard objects sincedamage to the internal components may occur. If necessary, visually inspect and confirmproper operation with performance tests prior to reuse.
- Before installing the injector into the cylinder head, clean the injector hole and avoidcontaminants from entering inside the injector hole. When installing the injector, avoid bumpingthe injector tip into any of the surrounding components since the tip may become damagedfrom the impact.
- When fastening the three fuel delivery pipemounting bolts, fully hand-tighten first, andthen tighten in the proper sequence (① → ② → ③) in several cycles up tothe specified torque. The delivery pipeshould move less than 1/8 inch (approx.3mm), whenever each bolt is tightened.

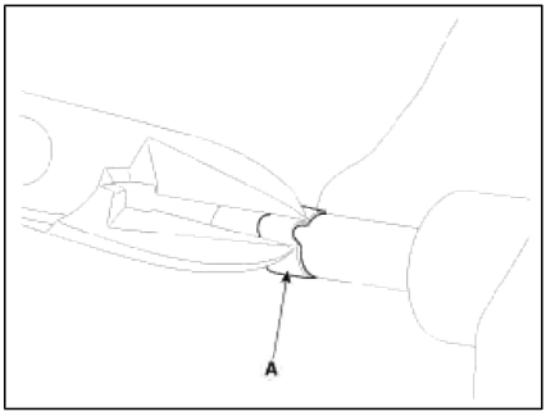


1. Installation is reverse of removal.

Replacement

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

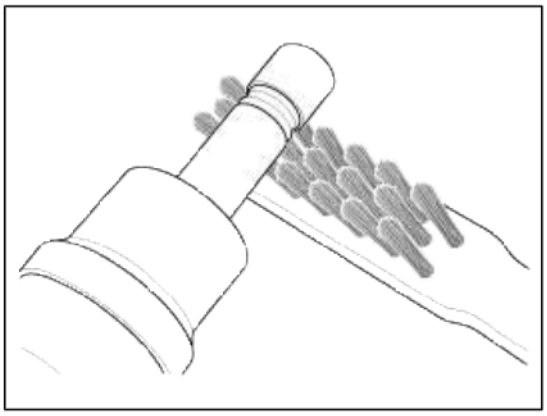
1. Remove the combustion seal (A) with a wire cutter.



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.

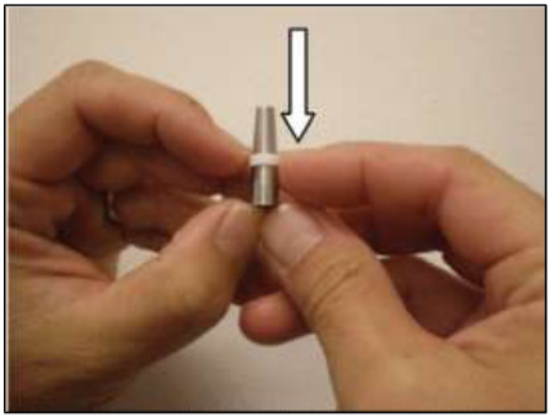
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2. Before the assembly of the sealing ring the groove must be cleaned using a clean cloth.
   Any coking of the injector sealing surface must be carefully removed with a brass-wire brush.



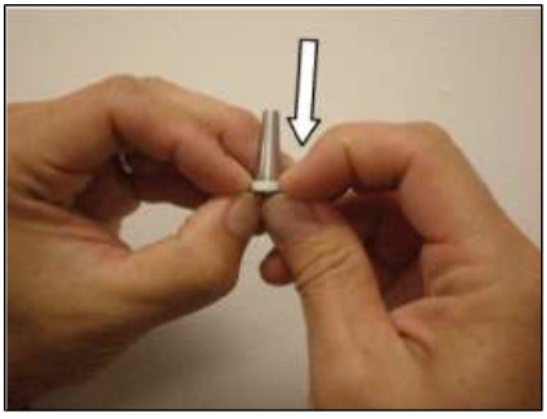
The surfaces of the new sealing ring must be clean and free of grease.

3. Place the combustion seal on the coneand pull downward on the seal as indicatedin the photo.



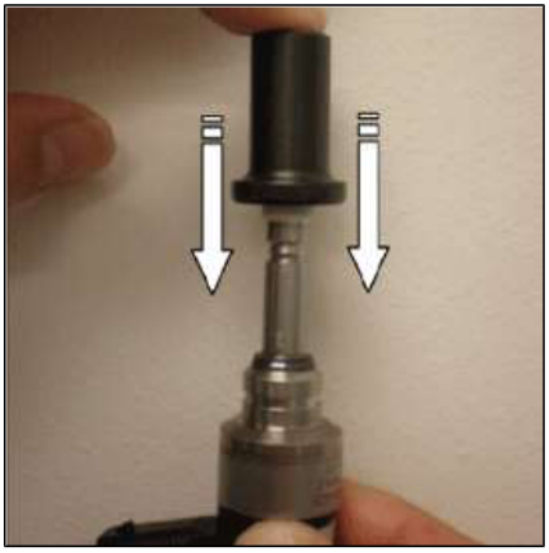
Your fingers will work better forinstalling the Combustion Seal overthe cone.

4. Pull the seal downward until it is near thebottom of the cone as shown in the photo.



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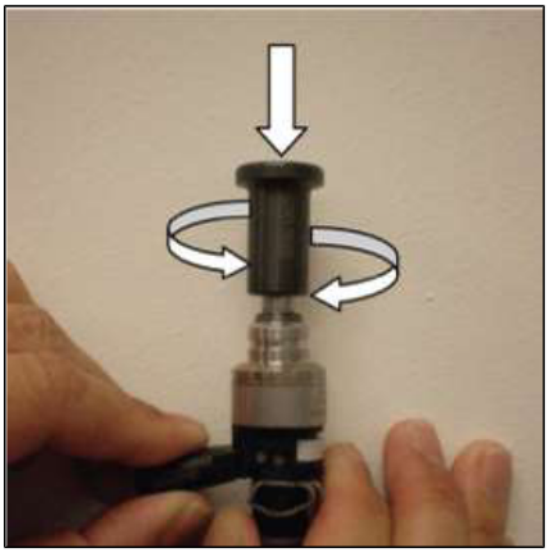
5. Place the cone (with seal) on the end ofthe injector.
   Place the sizing tool (SST No.: 09353-2B000) overthe cone. Make sure the tool flange istoward the seal as shown.
   Press down on the tool to work the sealover the injector and into the groove.



6. Because the seal will stretch as it goesover the end of the injector, it will be a bitoversized after installation.
   By letting the injector and seal set for a fewminutes, the seal may reduce in size.
   Inspect the seal for damage before continuing.



7. Place the resizing tool (flange up) over theseal. Twist the tool slightly while pushingdown over the seal. This should reduce thesize of the seal.



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Be careful not to apply engine oil on thecombustion seal ring.

8. Place injector into the head as shown.



9. Twist slightly while pressing the injectorinto position in the head.
   This should complete the resizing of theseal.
   Remove the injector and inspect the sealbefore completing the injector installation process.



10. If the injector comes with a protective steelwasher held in place by a spring clip; bothwill have to be removed before installation.



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11. Install the Washer Seal onto injector withthe rubber side (stepped) toward theinjector.



12. The stepped rubber side of the seal goes towards the injector.



13. The flat washer side of the seal goes towards the head.

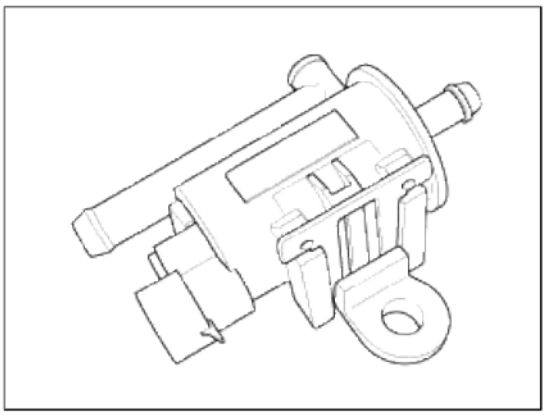


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Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Description and Operation

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)	19.0 ~ 22.0 [20°C(68°F)]

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

Circuit Diagram

[Circuit Diagram]



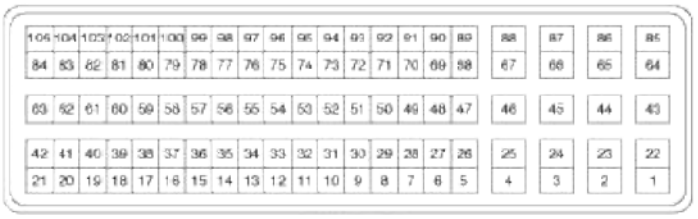
[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CHTG-BG (86)	PCSV Control

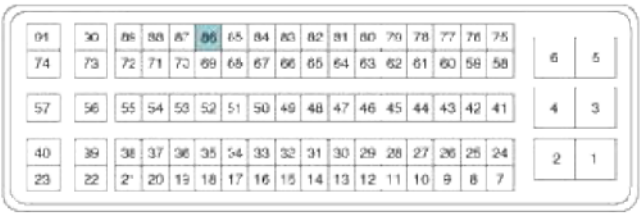
[Harness Connector]



CHTG21
PCSV



CHTG-AG



CHTG-BG
ECM

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.

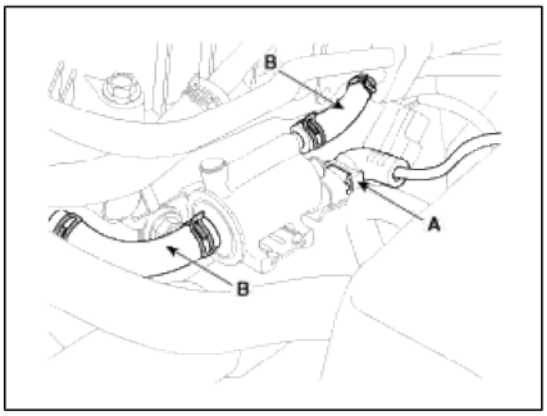
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4. Check that the resistance is within the specification.

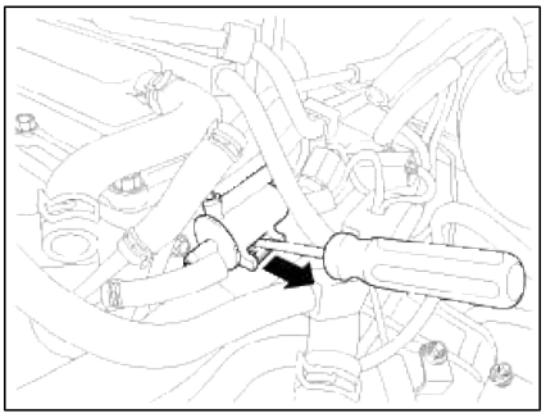
Specification: Refer to “Specification”

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 in the direction of the arrow.



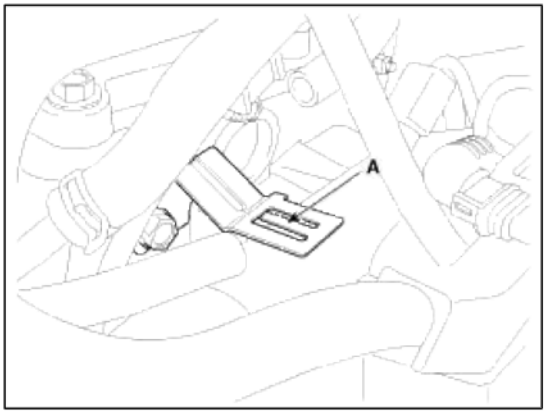
Installation

- 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.

- Use care to keep foreign material out of the valve.

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- Install the purge control solenoid valve after lifting the support pin (A) of the bracket.



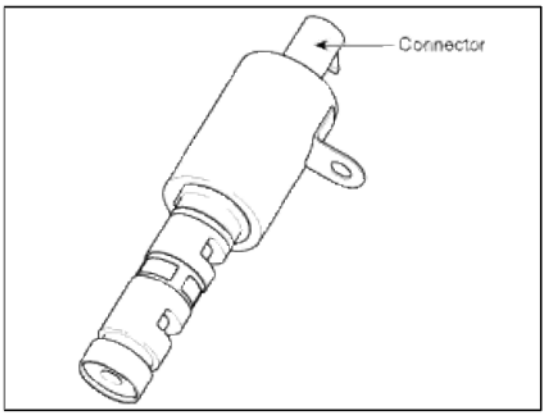
1. Installation is reverse of removal.

Purge control solenoid valve bracket 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 > 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 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 Control Valve (OCV) > Specifications

Specification

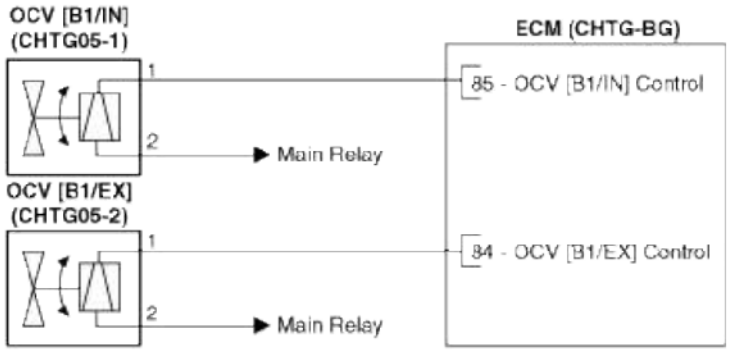
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Item	Specification
Coil Resistance (Ω)	6.9 ~ 7.9 [20°C(68°F)]

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

Circuit Diagram

[Circuit Diagram]



[Connection Information]

OCV [B1/IN] (CHTG05-1)

Terminal	Connected to	Function
1	ECM CHTG-BG (85)	OCV [B1/IN] Control
2	Main Relay	Battery Power (B+)

OCV [B1/EX] (CHTG05-2)

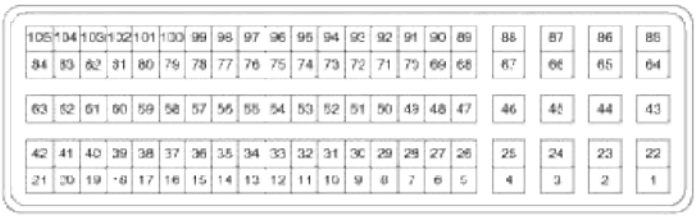
Terminal	Connected to	Function
1	ECM CHTG-BG (84)	OCV [B1/EX] Control
2	Main Relay	Battery Power (B+)

[Harness Connector]

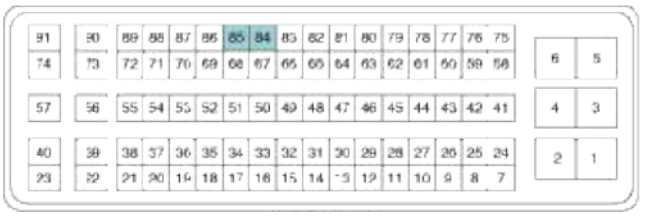


CHTG05-1
OCV [B1/IN]

CHTG05-2
OCV [B1/EX]



CHTG-AG



CHTG-BG
ECM

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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.

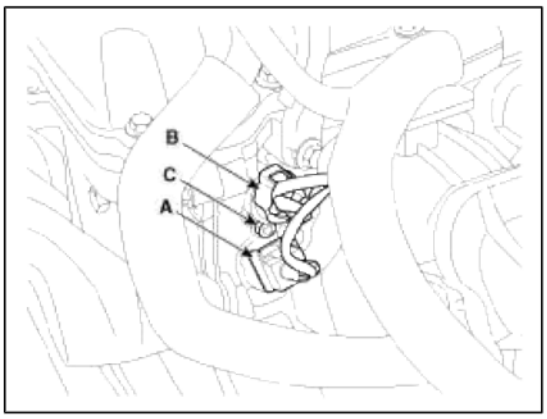
Specification: Refer to "Specification"

Removal

[Bank 1 / Intake]

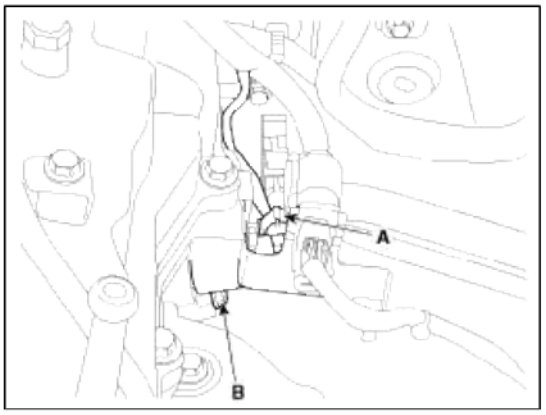
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the OTS (A).

3. Disconnect the CVVT oil control valve connector (B).
4. Remove the installation bolt (C), and then remove the valve from the engine.



[Bank 1 / Exhaust]

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the CVVT oil control valve connector (A).
3. Remove the installation bolt (B), and then remove the valve from the engine.



Installation

- 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.

- Apply engine oil to the valve O-ring.

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)

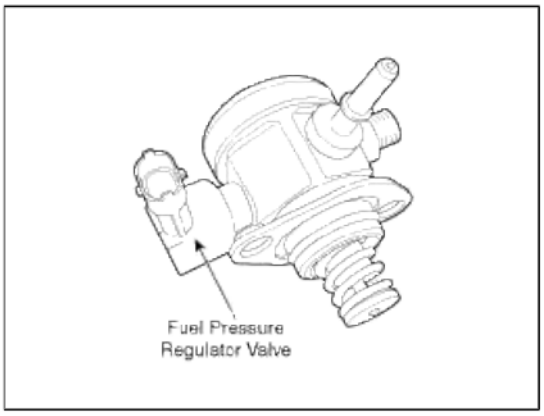
Fuel System > Engine Control System > Fuel Pressure Control Valve > Description and Operation

Description

Fuel Pressure Regulator Valve is installed on the high pressure fuel pump and controls fuel flow flowing into the

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injectors in accordance with the ECM signal calculated based on various engine condition.



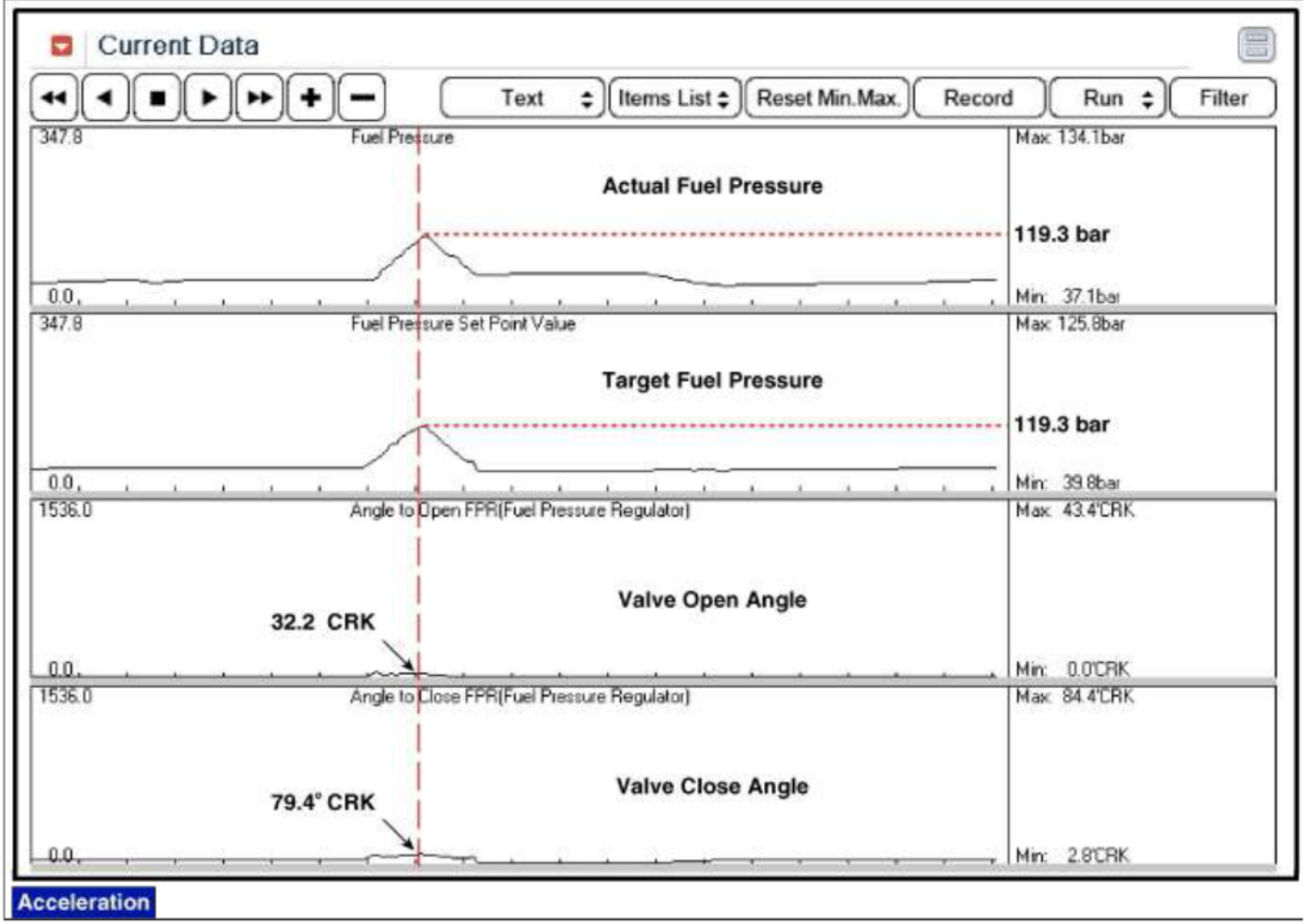
Fuel System > Engine Control System > Fuel Pressure Control Valve > Specifications

Specification

Item	Specification
Coil Resistance (Ω)	0.5 [20°C(68°F)

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

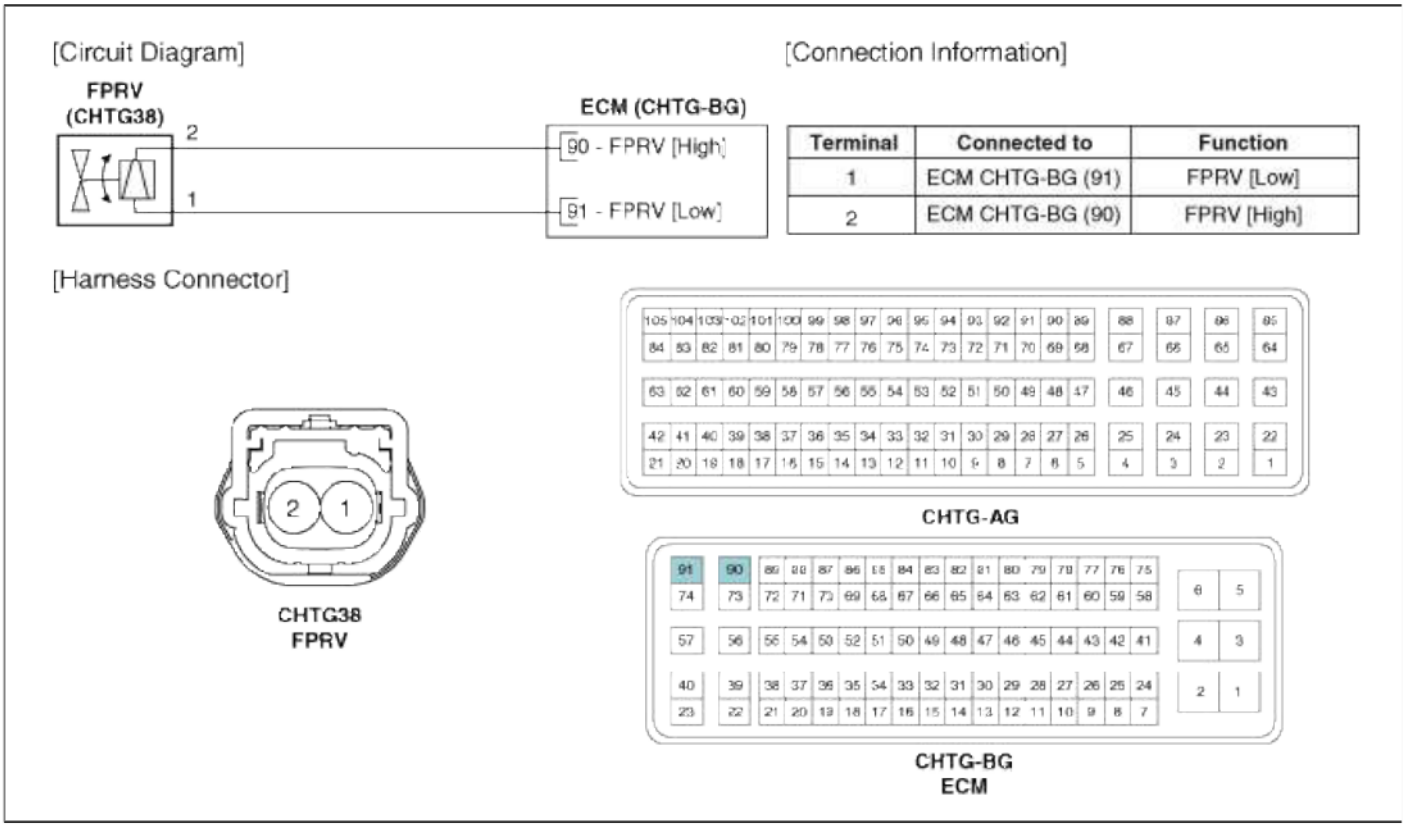
Signal Waveform



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

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Circuit Diagram



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

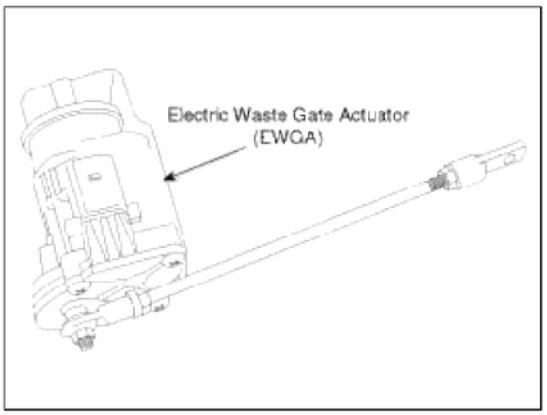
Refer to "High Pressure Fuel Pump" in this group.

Fuel System > Engine Control System > Electric WGT Control Actuator > Description and Operation

Desrcription

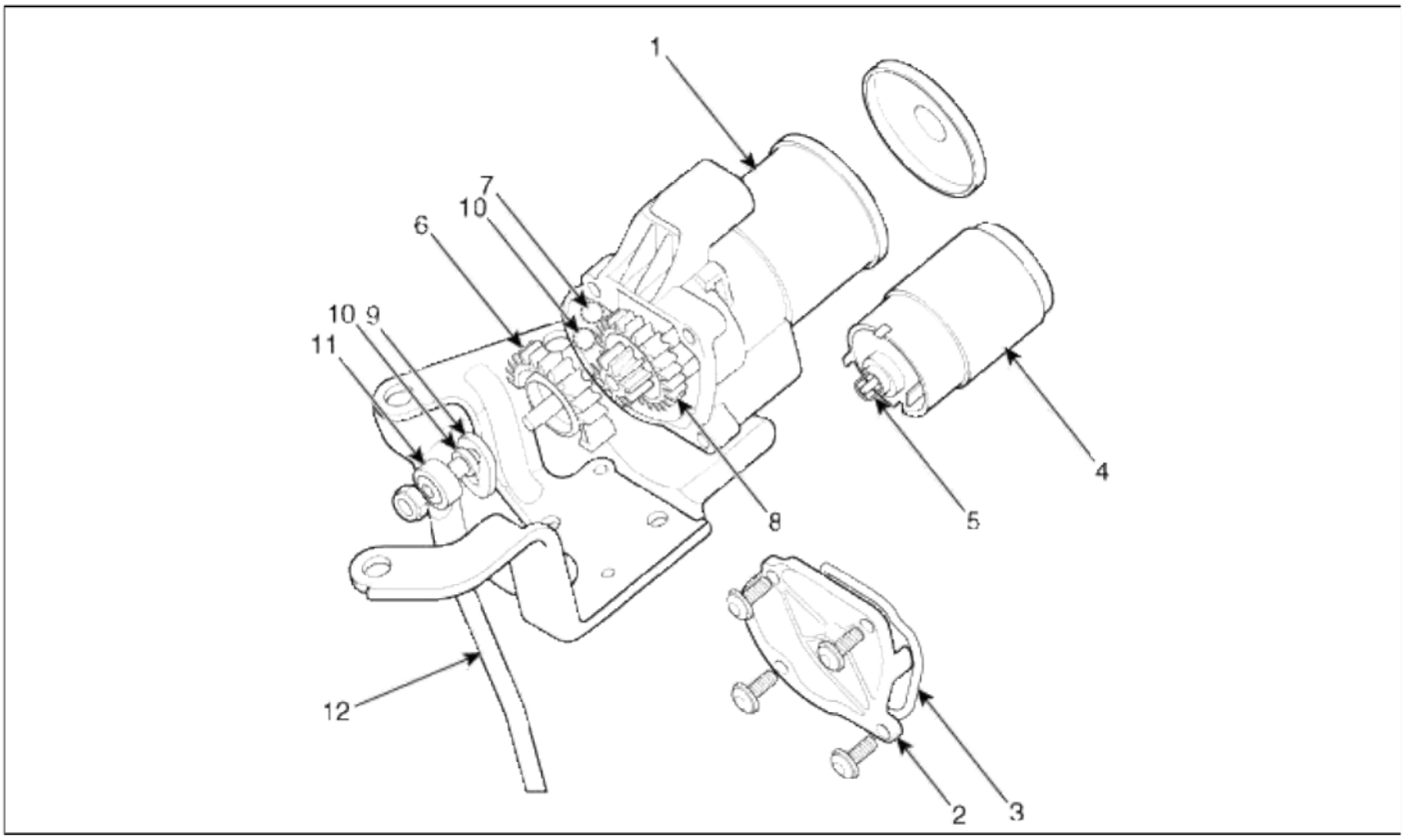
The Electric WGT Control Actuator is installed on the turbocharger.
It operates the vain in the Waste Gate Turbocharger (WGT) and regulates the compressed air amount by the ECM's PWM signal. This actuator consists of a DC motor which actuates the vane, a 2-step gear which increases torque of the DC motor, a position sensor which detects status of the vane, an electric control unit which drives the DC motor.

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Fuel System > Engine Control System > Electric WGT Control Actuator > Components and Components Location

Components



1 . Housing	7 . PCB Assembly
2 . Cover	8 . Middle Gear
3. Sealing Cover	9 . Lever
4 . Motor	10 . Lever Pin
5. Pinion	11 . Rod - End
6 . Shaft Gear	12 . Rod

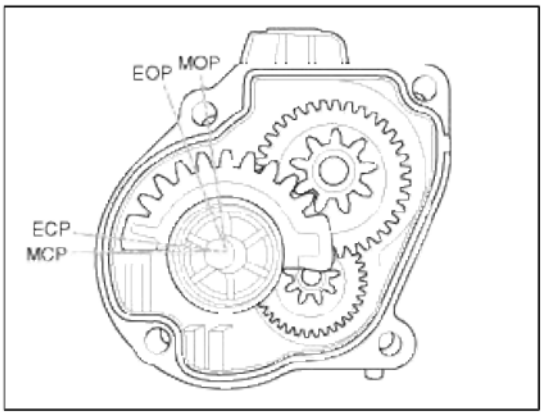
Fuel System > Engine Control System > Electric WGT Control Actuator > Specifications

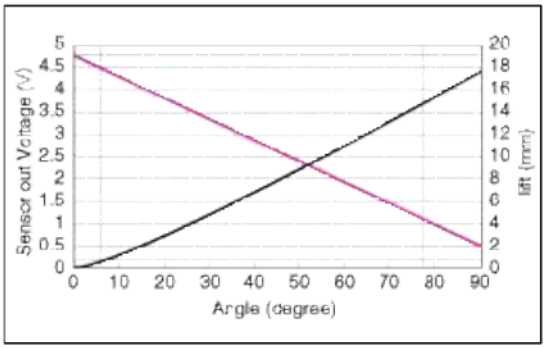
Specification

[EWGA Position Sensor]

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Position	Output Voltage[V]	Operating Angle[°]	Range of Rod [mm], reference
Mechanical Close end stop Position (MCP)	4.8	0	0
Electrical Close end stop Position (ECP)	4.2	12	1.8
Electrical Open end stop Position (EOP)	1	79	16
Mechanical Open end stop Position (MOP)	0.5	90	18





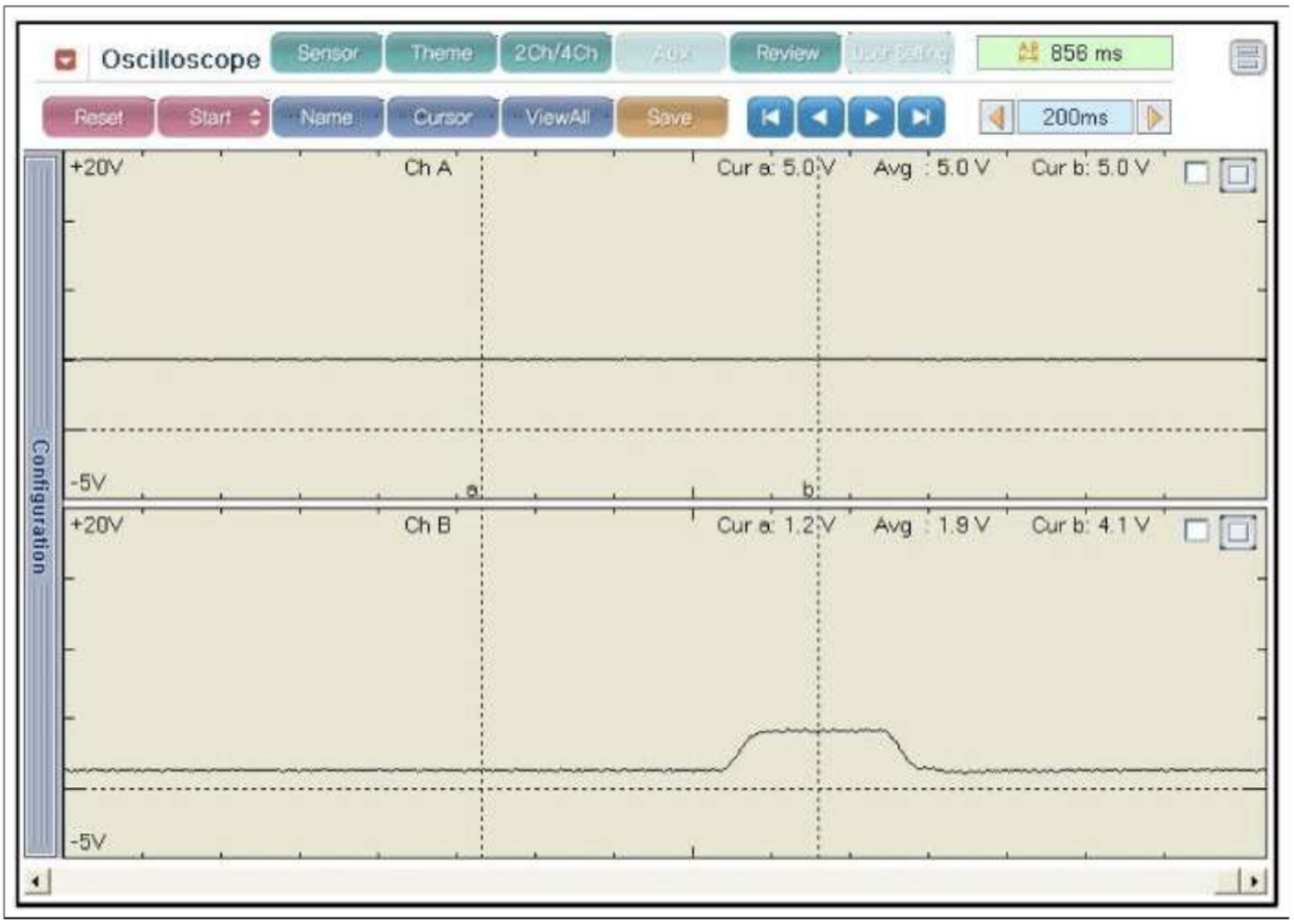
[EWGA DC Motor]

Item	Specification
Coil Resistance (Ω)	1.48 ~ 1.96 [21°C(69.8°F)]

Fuel System > Engine Control System > Electric WGT Control Actuator > Troubleshooting

Signal Waveform

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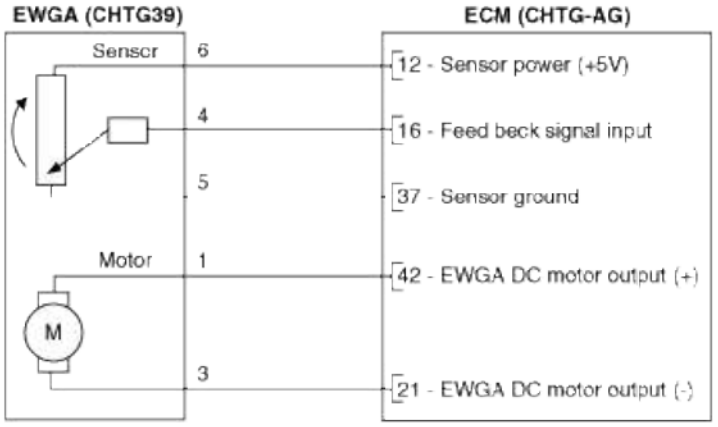


Fuel System > Engine Control System > Electric WGT Control Actuator > Schematic Diagrams

Circuit Diagram

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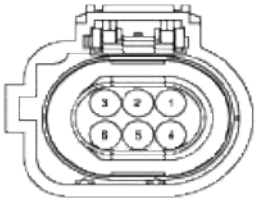
[Circuit Diagram]

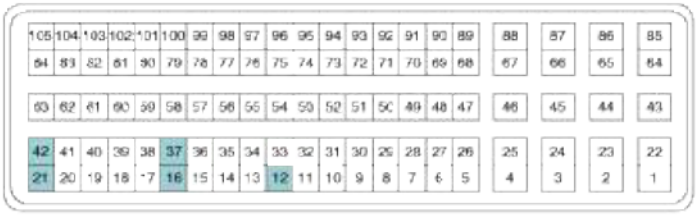


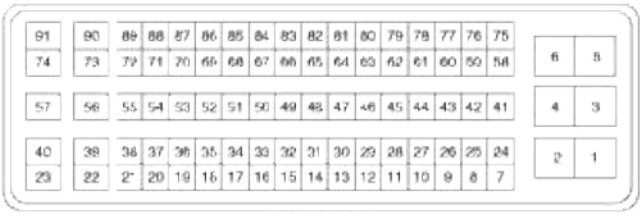
[Connection Information]

Terminal	Connected to	Function
1	ECM CHTG-AG (42)	EWGA DC Motor output (+)
2	-	-
3	ECM CHTG-AG (21)	EWGA DC Motor output (-)
4	ECM CHTG-AG (16)	Feedbeck signal input
5	ECM CHTG-AG (37)	Sensor ground
6	ECM CHTG-AG (12)	Sensor power

[Harness Connector]







Fuel System > Engine Control System > Electric WGT Control Actuator > Repair procedures

Inspection

[Motor]

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

Specification: Refer to “Specification” section.

[Position Sensor]

1. Turn ignition switch ON.
2. Connect the GDS to the data link connector(DLC).

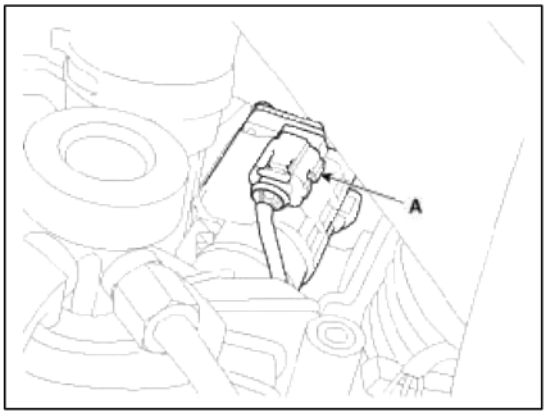
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3. Check the output voltage at each position of the EWGA position sensor on current data item within the specification.

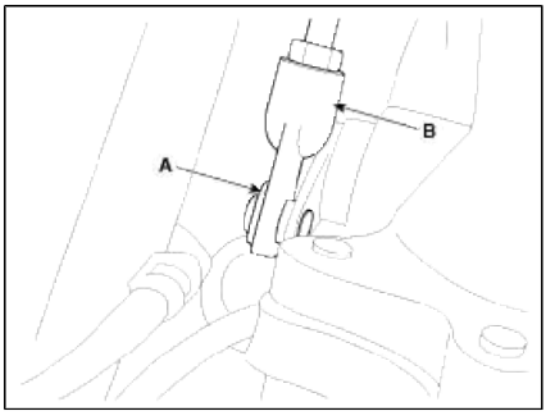
Specification: Refer to "Specification" section.

Removal

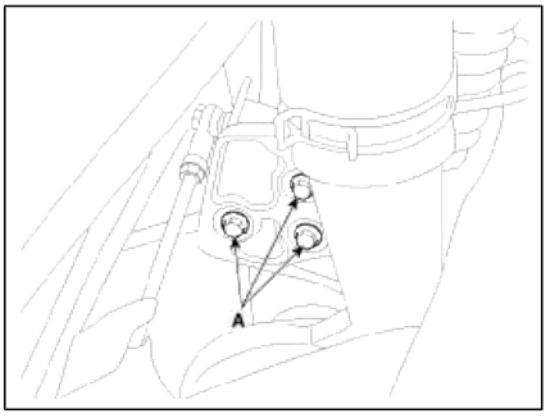
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the EWGA connector (A).



3. Remove the shaft link assembly (B) after removing the C-ring (A).



4. Remove the EWGA after removing the bolts (A).



When carrying the turbo charger, do not hold the rod of the turbo charge to prevent bending the rod.

Installation

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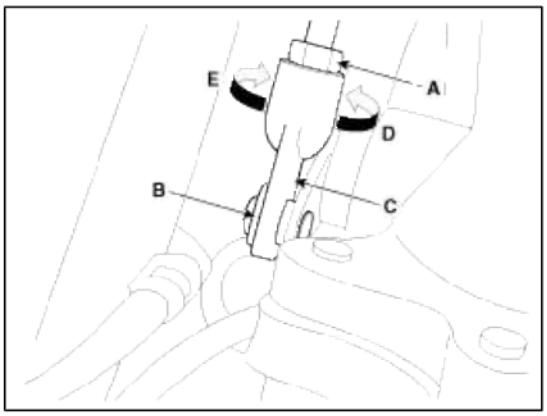
1. Installation is the reverse order of removal.

Adjustment

1. Turn ignition switch OFF.
2. Connect a GDS Data Link Connector (DLC).
3. Turn ignition switch ON.
4. Select "Current data".
5. Loosen the rod end lock nut (A) remove the C-ring (B).
6. Adjust the rod end part (C) by rotating it at the direction of clockwise or counter clockwise to satisfy the specification.
   A. If output voltage > 4.2 : Clockwise (D)
   B. If output voltage < 4.2 : Counter Clockwise (E)

   Specification : 4.2 ± 0.1V

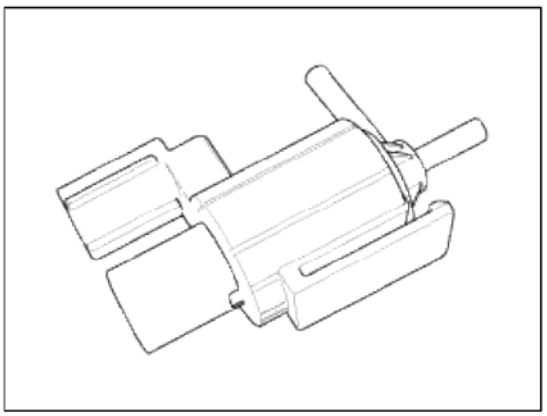
7. Check output voltage on current data in GDS after installing the rod end part (C) without the clip.
   If output voltage satisfy the specification, fix the rod end part with clip.



Fuel System > Engine Control System > RCV Control Solenoid Valve > Description and Operation

Description

RCV (Recirculation Valve) Control Solenoid Valve is installed on the intercooler inlet pipe and operates the RCV actuator which controls the by-pass passage of the turbocharger compressor.
When the throttle is closed, while the engine is running at cruise rpm (tip-out), the turbocharger boost pressure raises rapidly. The pressure wave strikes a compressor blades causing a knocking noise. To prevent this the ECM opens the recirculation valve which allows excessive boost pressure to vent back to the air cleaner side of the turbocharger compressor.



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Fuel System > Engine Control System > RCV Control Solenoid Valve > Specifications

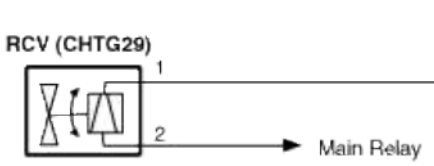
Specification

Item	Specification
Coil Resistance (Ω)	28.3 ~ 31.1 [20°C(68°F)]

Fuel System > Engine Control System > RCV Control Solenoid Valve > Schematic Diagrams

Circuit Diagram

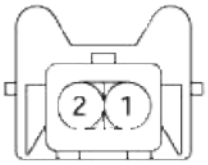
[Circuit Diagram]



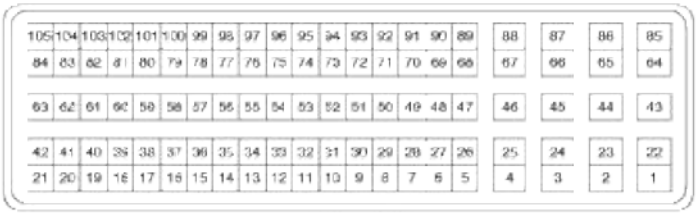
[Connection Information]

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CHTG-BG (72)	Valve Control

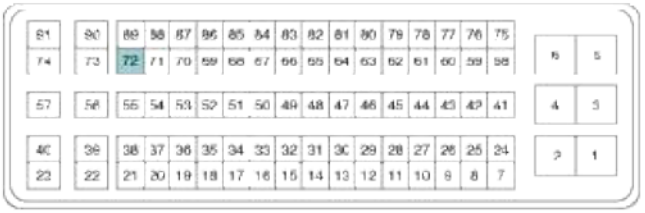
[Harness Connector]



CHTG29
RCV



CHTG-AG



CHTG-BG
ECM

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Fuel System > Engine Control System > RCV Control Solenoid Valve > Repair procedures

Inspection

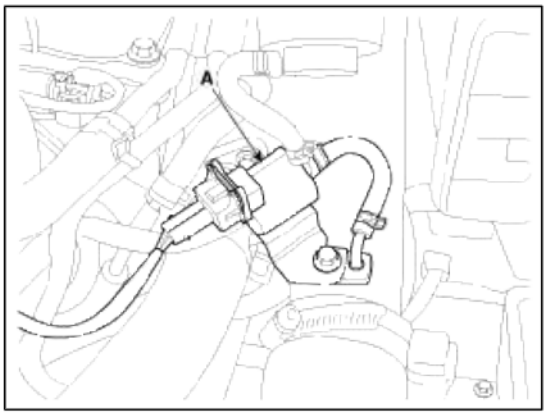
1. Turn the ignition switch OFF.
2. Disconnect the RCV control solenoid valve connector.
3. Measure resistance between the valve terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

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

2. Remove the RCV control solenoid valve (A) after disconnect the connector, bolt and hose.



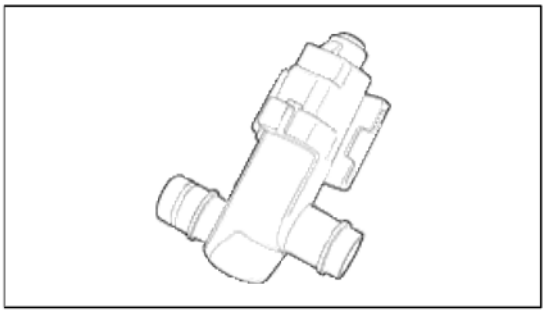
Installation

1. Installation is the reverse order of removal.

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)	19.8 ~ 21.8 [20°C(68°F)]

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

Circuit Diagram

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[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM CHTG-BG (87)	CCV Control
2	Main Relay	Battery Power (B+)

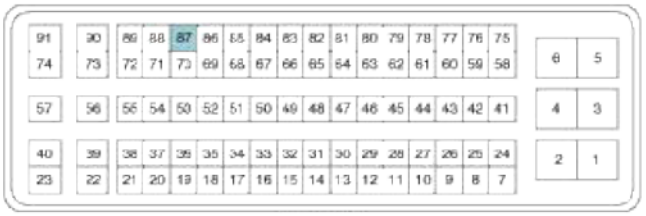
[Harness Connector]



F31
FPRV



CHTG-AG



CHTG-BG
ECM

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.

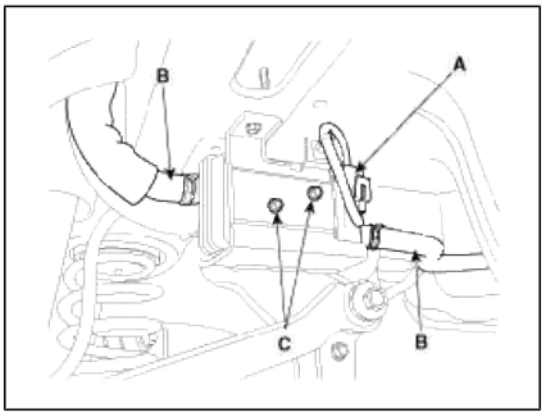
Specification: Vacuum maintained

Removal

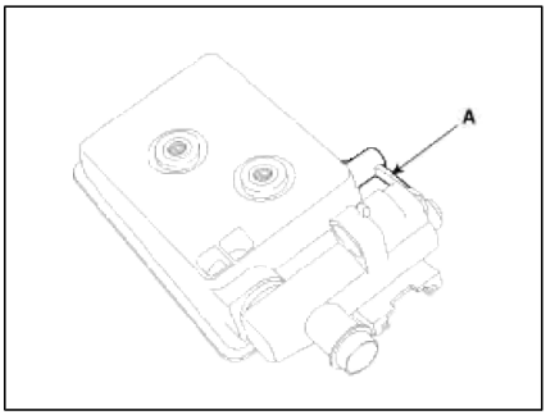
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Lift the vehicle.
3. Disconnect the canister close valve connector (A).
4. Disconnect the ventilation hose (B).

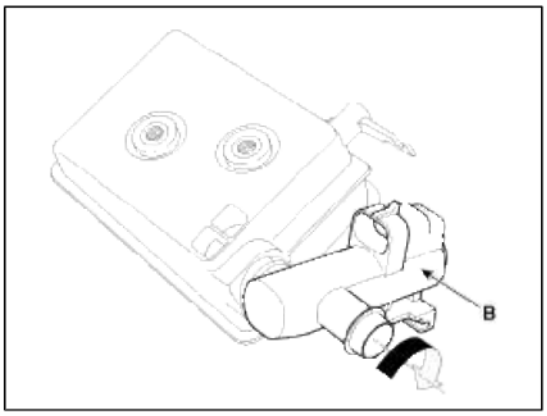
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5. Remove the fuel tank air filter after removing 2 bolts (C).

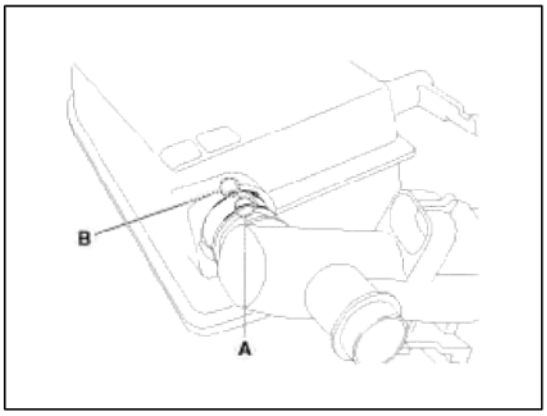


6. Release the lever (A) and then rotate the canister close valve (B) in the direction of the arrow in figure.





7. Remove CCV from the fuel tank air filter after coinciding installation parts (A,B).



Installation

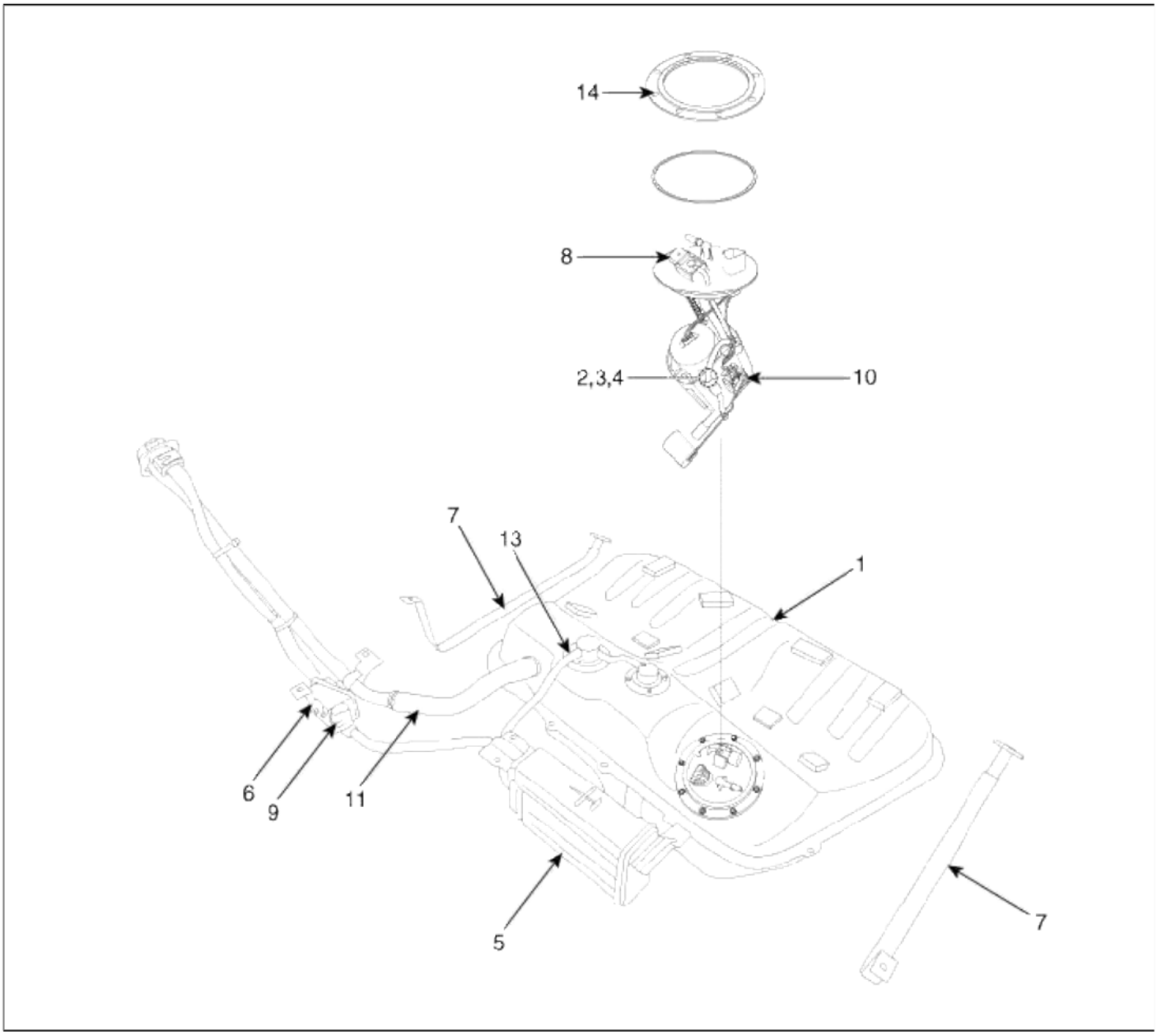
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- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. If the component has been dropped, inspect before installing.

1. Installation is reverse of removal.

Fuel System > Fuel Delivery System > Components and Components Location

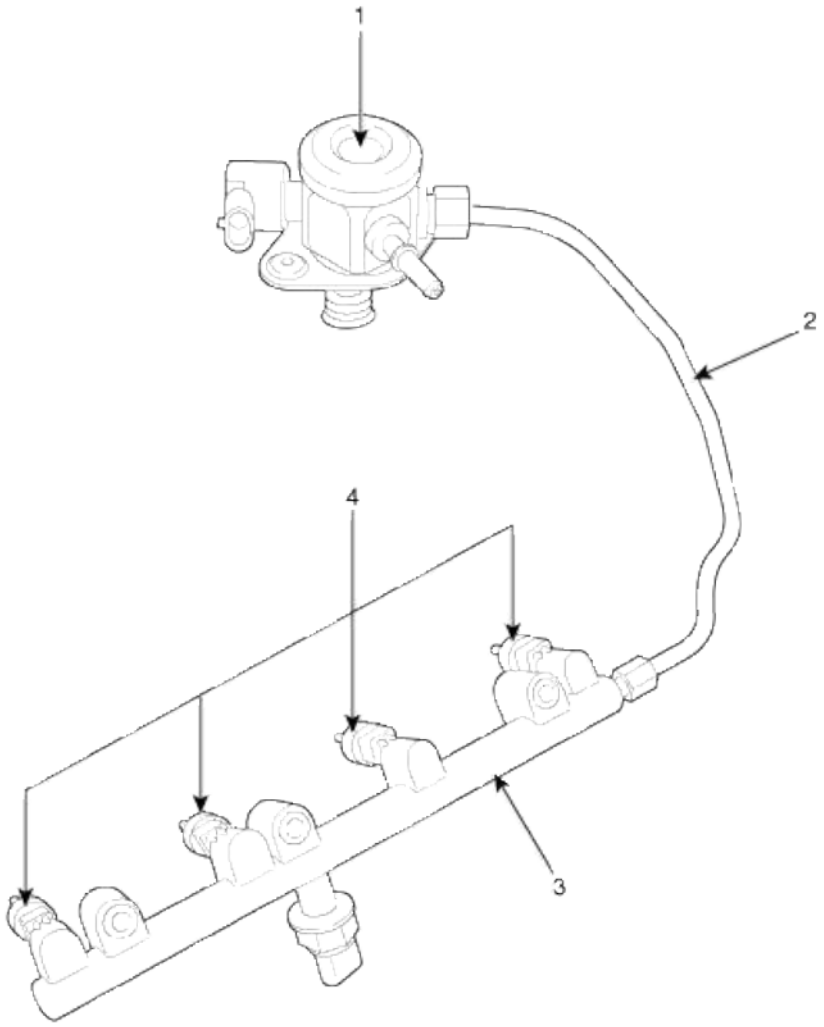
Components Location



1. Fuel Tank	8. Fuel Tank Pressure Sensor (FTPS)
2. Fuel Pump	9. Canister Close Valve (CCV)
3. Fuel Filter	10. Fuel Level Sensor (FLS)
4. Fuel Pressure Regulator	11. Fuel Filler Hose
5. Canister	12. Ventilation Hose
6. Fuel Tank Air Filter	13. Vapor Hose
7. Fuel Tank Band	14. Fuel Pump Plate Cover

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[High Pressure Fuel Line]



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

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

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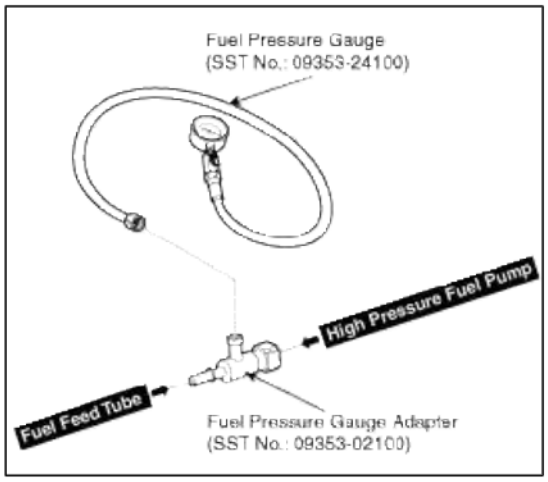
1. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).

> 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.

> 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.

   (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: 495 ~ 505 kPa (5.1 ~ 5.2 kgf/cm², 71.8 ~ 73.2 psi)

> 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

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(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

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").

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

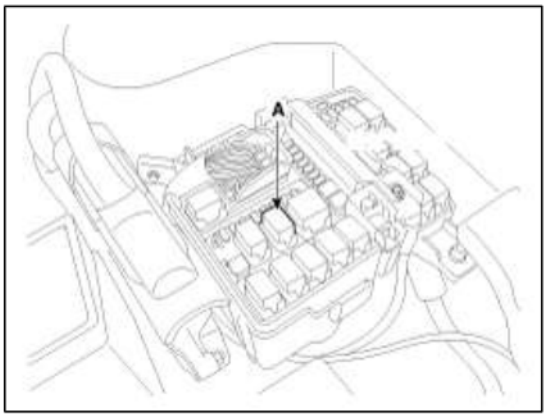
Whenever the high pressure fuel pump, fuel pipe, delivery pipe, or injector is removed immediately after shutting off the engine, an injury may be caused by the release of highly pressurized fuel. Release the residual pressure in the high pressure fuel line by referring to the "Residual fuel pressure release procedure" below before removing any high pressure fuel system components.

Wear safety glasses and fuel resistant gloves.

1. Turn the ignition off and disconnect the battery negative cable.

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2. Remove the fuel pump relay (A).

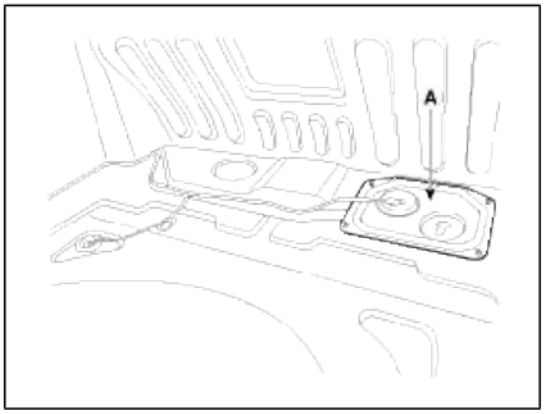


3. Disconnect the electrical connector from the high pressure fuel pump.
4. Reconnect the battery negative cable.
5. Run the engine for about 20 seconds to lower the pressure in both the high or low pressurelines. The engine may shut off within the 20 second period. If not, turn the engine off.
6. Proceed with the service or repair. Use rags to cover opening and catch spills when opening up the high pressure system.
7. Reinstall / re-connect all components in reverse order of removal. Start engine and confirm proper operation, and make sure there are no fuel leaks.
8. After completing, clear DTC(s) using GDS scan tool (the procedure described above will cause DTC to set).

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

Removal

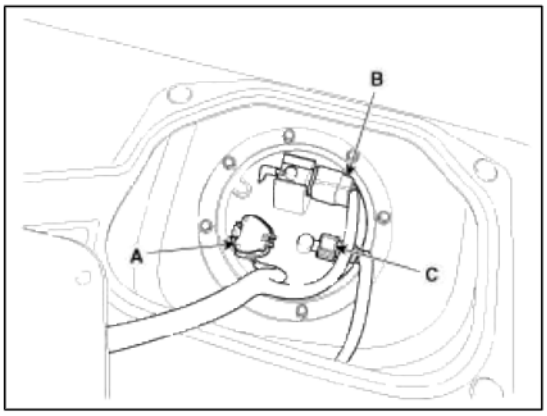
1. Release the residual pressure in fuel line (Refer to "Release Residual Pressure in Fuel Line" in this group).
2. Remove the fuel pump service cover (A) in the trunk.



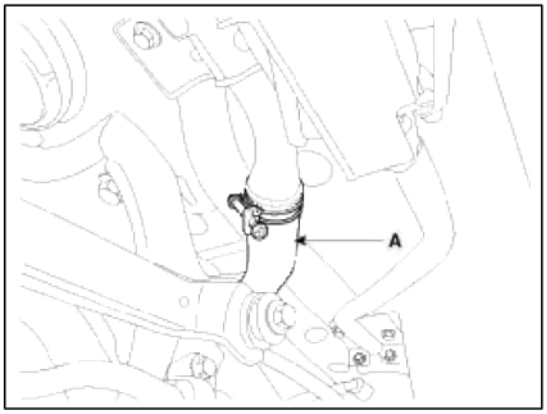
3. Disconnect the fuel pump connector (A) and the fuel tank pressure sensor connector (B).

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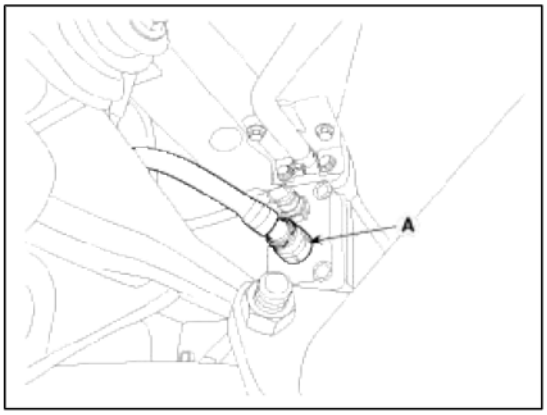
4. Disconnect the fuel feed tube quick connector (C).



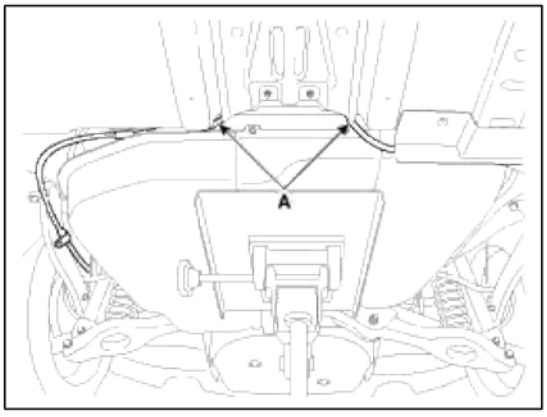
5. Lift the vehicle and support the fuel tank with a jack.
6. Remove the center muffler assembly (Refer to "Intake And Exhaust System" in EM group).
7. Disconnect the fuel filler hose (A).



8. Disconnect the vapor hose quick-connector (A).

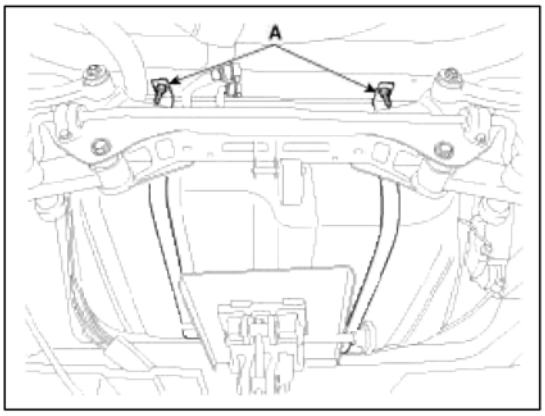


9. Remove the parking brake line (A).

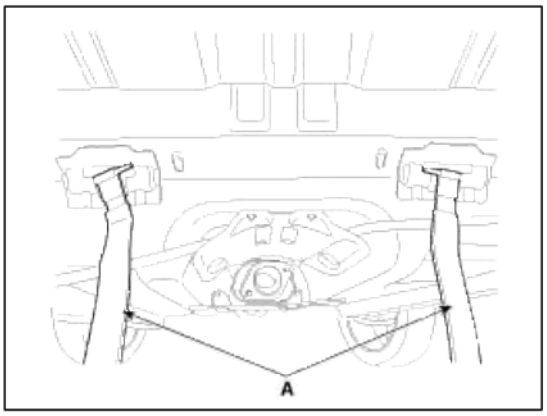


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10. Remove the fuel tank band installation nuts (A).



11. Remove the fuel tank after removing the fuel tank band (A) as below.



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

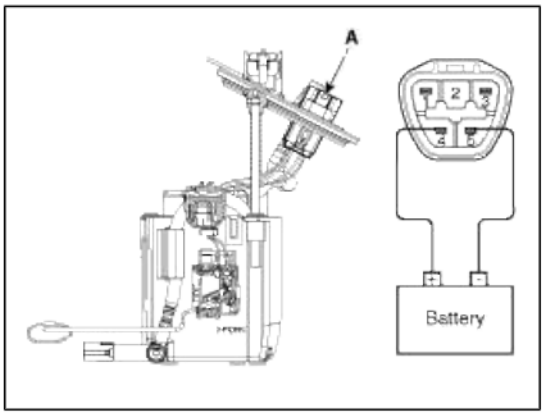
Inspection

[Fuel pump]

1. Turn the ignition switch OFF, and then remove battery (-) cable.
2. Remove the fuel pump assembly.

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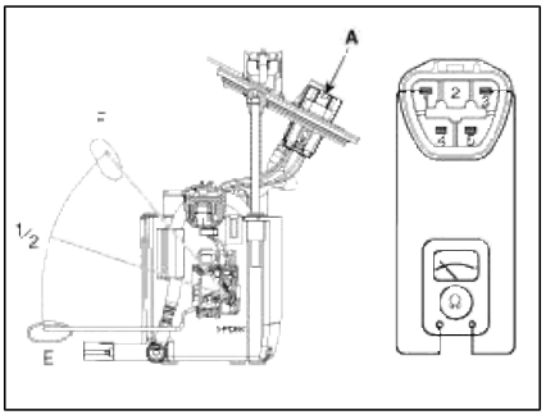
3. Check motor operation by fuel pump connector (A) connecting power (No.4) and ground (No.5).



Pin No.	Description
1	Fuel sender ground
2	-
3	Fuel sender signal
4	Fuel pump motor (+)
5	Fuel pump motor ground

[Fuel sender]

1. Turn the ignition switch OFF, and then remove battery (-) cable.
2. Remove the fuel pump assembly.
3. Using an ohmmeter, measure the resistance between terminals 1 and 3 of sender connector (A) at each float level.



Pin No.	Description
1	Fuel sender ground
2	-
3	Fuel sender signal
4	Fuel pump motor (+)
5	Fuel pump motor ground

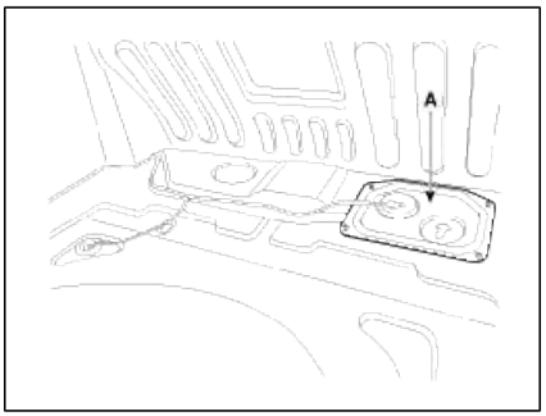
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4. Also check that the resistance changes smoothly when the float is moved from "E" to "F".

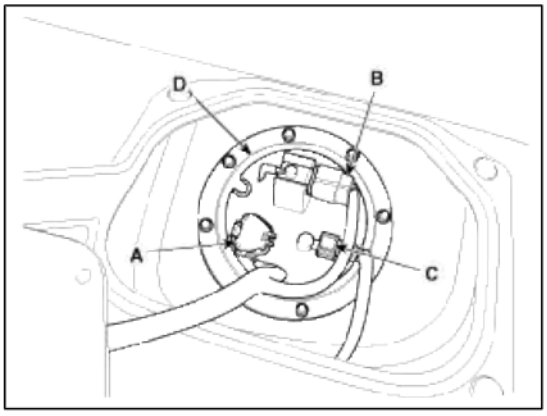
Position	Resistance(Ω)	Capacity (ℓ)
E	198~205	5
Warning lamp	168~172	8.5
1/2	65~67	37.5
Sender (F)	7~9	68

Removal

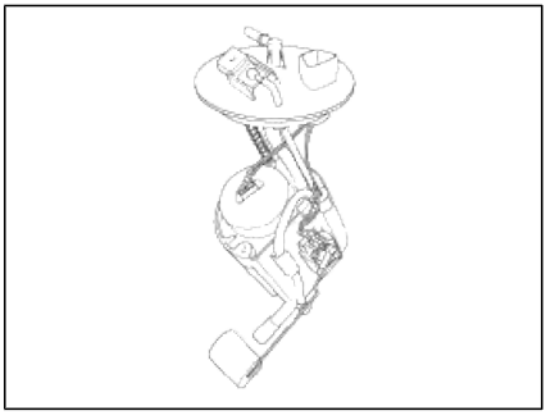
1. Release the residual pressure in fuel line (Refer to "Release Residual Pressure in Fuel Line" in this group).
2. Remove the fuel pump service cover (A) in the trunk.



3. Disconnect the fuel pump connector (A) and the fuel tank pressure sensor connector (B).
4. Disconnect the fuel feed tube quick connector (C).
5. Remove the fuel pump plate cover (D) after removing the bolts.



6. Remove the fuel pump from the fuel tank.



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Installation

1. Installation is reverse of removal.

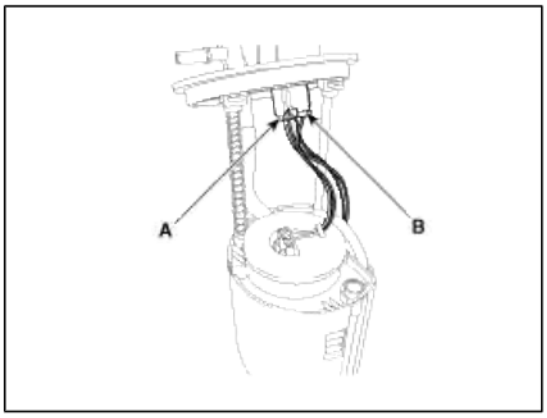
Be careful of fuel pump direction (Refer to the groove in the fuel tank).

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

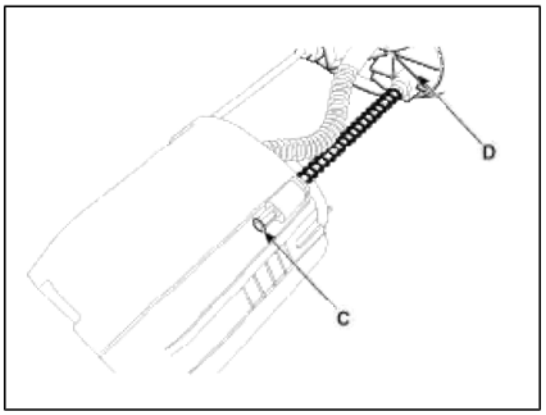
Fuel System > Fuel Delivery System > Fuel Filter > Repair procedures

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).

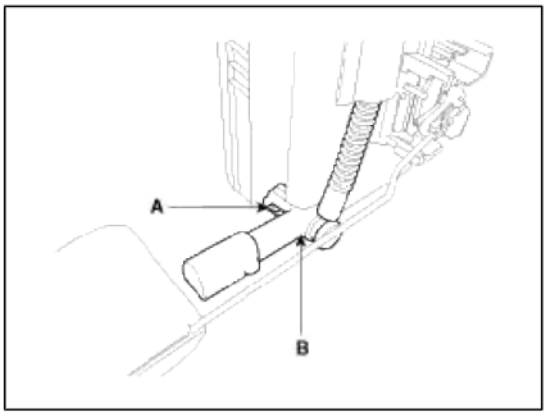


3. Remove the cushion pipe fixing clip (C), and then separate the head assembly (D).

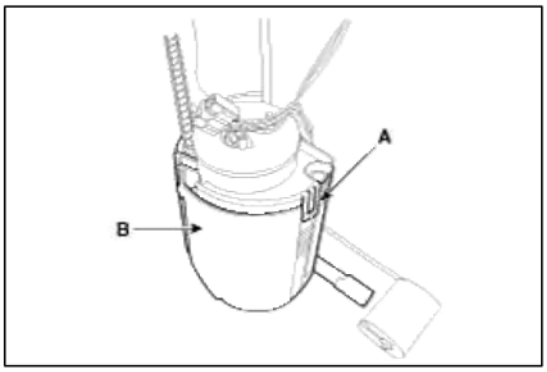


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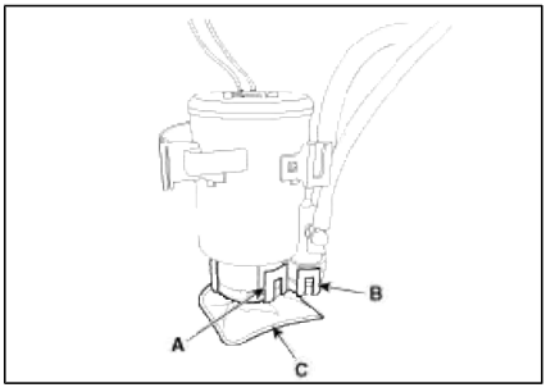
4. Remove the return nozzle (B) after releasing the fixing hook (A).



5. Remove the reservoir-cup (B) after releasing the fixing hooks (A).

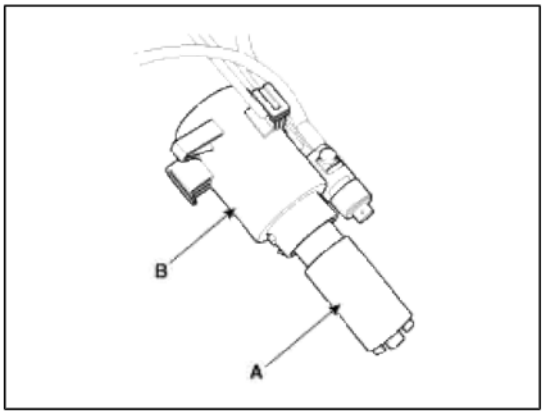


6. Remove the pre-filter (C) after releasing the fixing hooks (A,B).



Be careful of O-ring.

7. Separate the electric pump motor (A) from the fuel filter (B).

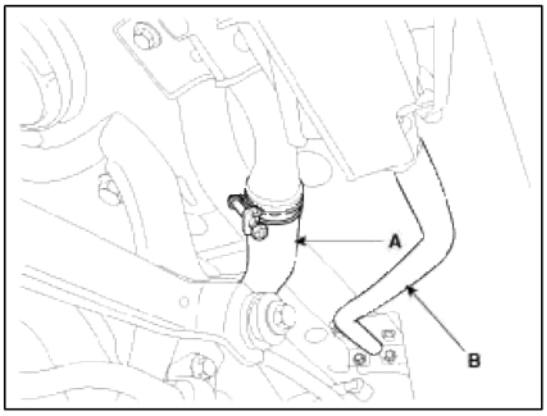


8. Replace new fuel filter.

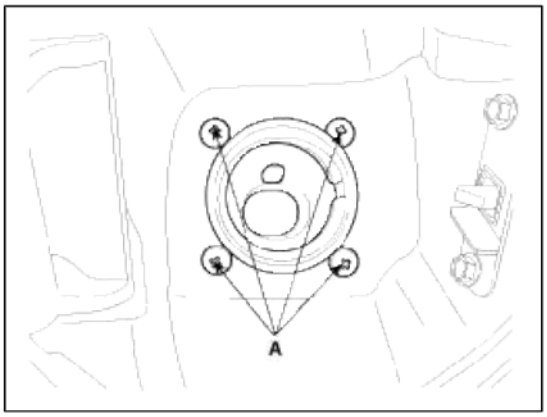
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Removal

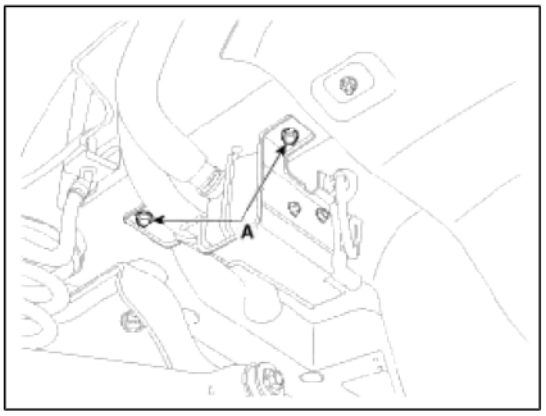
1. Lift the vehicle.
2. Disconnect the fuel filler hose (A).
3. Disconnect the ventilation hose (B) from the fuel tank air filter.



4. Open the fuel filler door and then remove the filler-neck installation screw (A).



5. Remove the rear-LH wheel, tire, and the inner wheel house.
6. Remove the filler-neck assembly from the vehicle after removing the bracket installation bolt (A).



Installation

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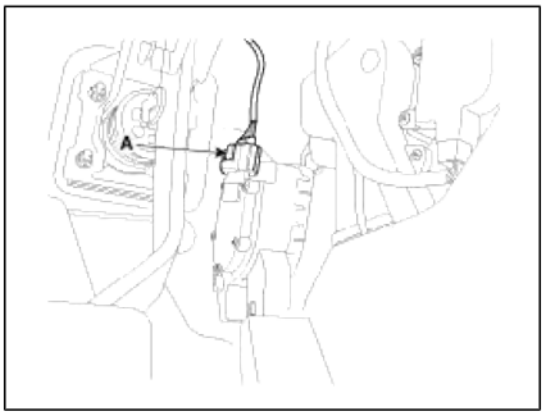
1. Installation is reverse of removal.

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

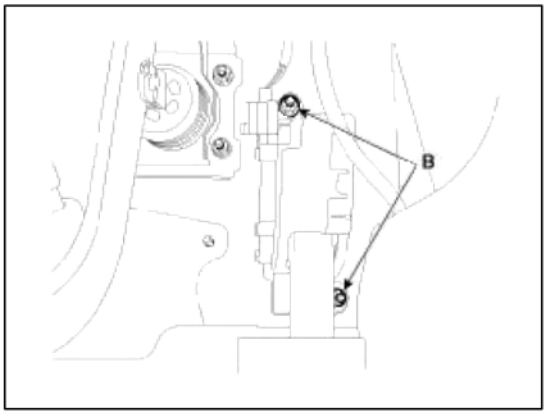
Fuel System > Fuel Delivery System > Accelerator Pedal > Repair procedures

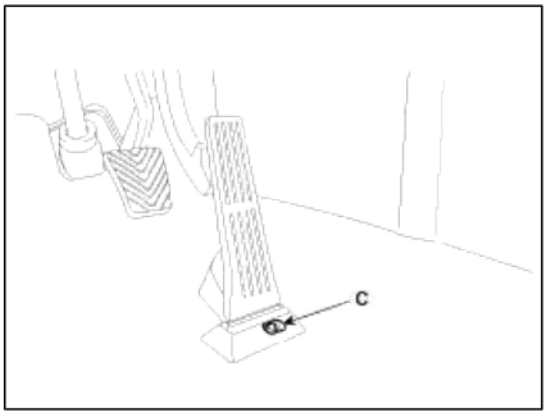
Removal

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



3. Remove the installation nuts (B) and bolt (C), and then remove the accelerator pedal module.





Installation

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1. Installation is reverse of removal.

Accelerator pedal module installation nut:
9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)
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 > Fuel Delivery System > Delivery Pipe > Repair procedures

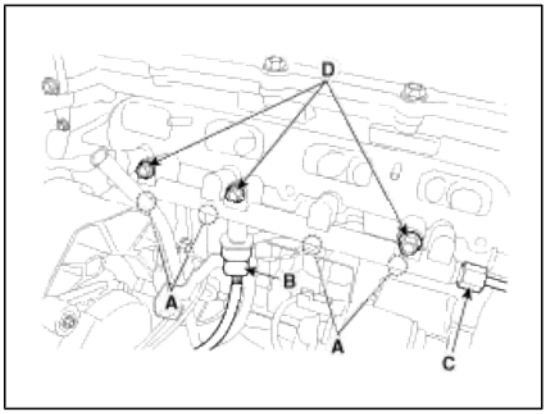
Removal

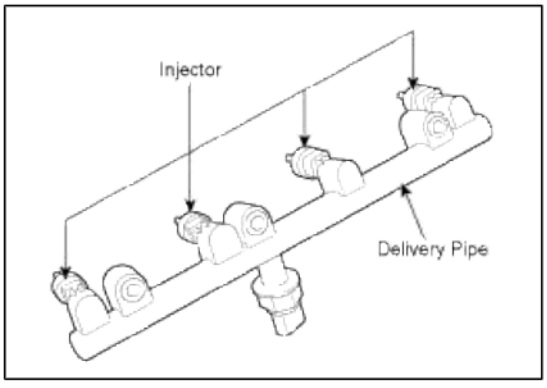
In case of removing the high pressure fuel pump, high pressure fuel pipe, delivery pipe, and injector, there may be injury caused by leakage of the high pressure fuel. So don't do any repair work right after engine stops.

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).

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 injector connectors (A) and the rail pressure sensor connector (B).
5. Remove the high pressure fuel pipe (C).
6. Remove the installation bolt (D), and then remove the delivery pipe and injector assembly from the engine.





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Installation

- Install the component with the specified torques.

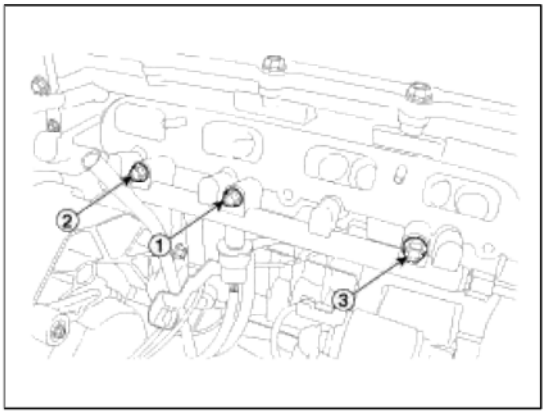
- Apply engine oil to the injector O-ring.
- Do not use already used injector O-ring again.

- Do not reuse the bolts.

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

- Use proper tooling for change of combustion seal. Take proper precautions not to damage surface during assembly or disassembly.

- Avoid dropping the fuel pipe (including injectors) or bumping it into any hard objects sincedamage to the internal components may occur. If necessary, visually inspect and confirmproper operation with performance tests prior to reuse.
- Before installing the injector into the cylinder head, clean the injector hole and avoidcontaminants from entering inside the injector hole. When installing the injector, avoid bumpingthe injector tip into any of the surrounding components since the tip may become damagedfrom the impact.
- When fastening the three fuel delivery pipemounting bolts, fully hand-tighten first, andthen tighten in the proper sequence (① → ② → ③) in several cycles up tothe specified torque. The delivery pipeshould move less than 1/8 inch (approx.3mm), whenever each bolt is tightened.



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:
26.5 ~ 32.4 N.m (2.7 ~ 3.3 kgf.m, 19.5 ~ 23.9 lb-ft)

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

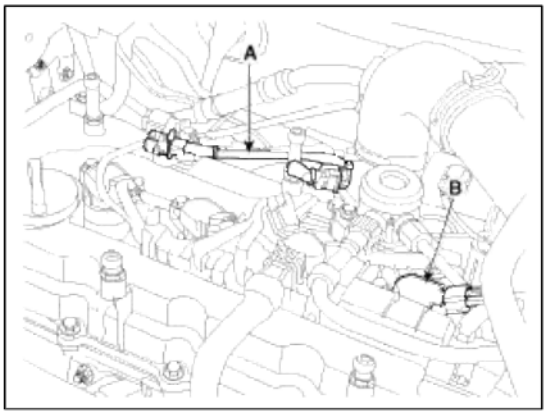
Removal

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.

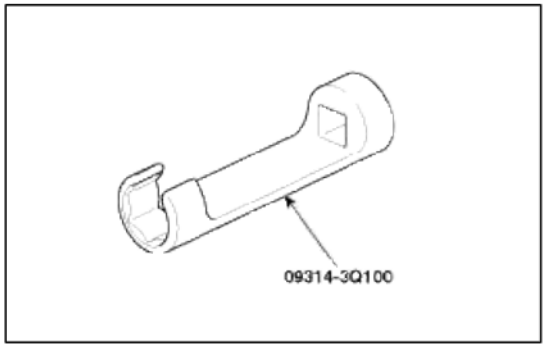
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Release the residual pressure in fuel line (Refer to "Release Residual Pressure in Fuel Line" in this group).

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 air cleaner and the air intake hose (Refer to "Intake And Exhaust System" in EM group).
4. Disconnect the fuel pressure regulator valve connector (A).
5. Remove the ignition coil (B).



6. Disconnect the fuel feed tube quick-connector (A).
7. Remove the high pressure fuel pipe.
   (1) Remove the installation nut (B) from the high pressure fuel pump with the special service tool [SST No.: 09314-3Q100]

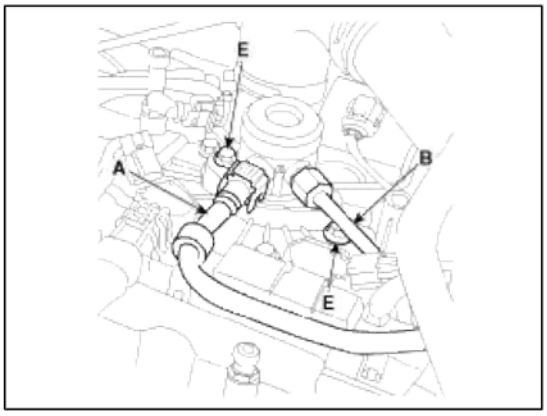


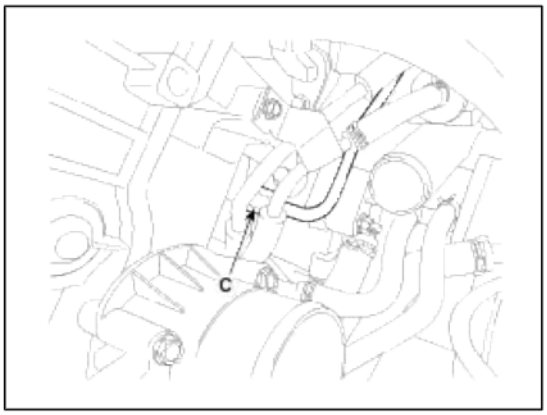
   (2) Remove the installation nut (C) from the delivery pipe with the special service tool [SST No.: 09314-3Q100]
   (3) Remove the purge control solenoid valve (Refer to "Purge Control Solenoid Valve" in this group).
   (4) Remove the function block (D), and then remove the high pressure fuel pipe.

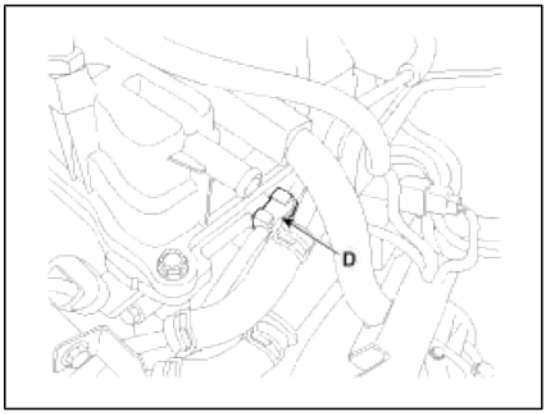
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8. Remove the installation bolts (E), and then remove the high pressure fuel pump from the cylinder head assembly.

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.



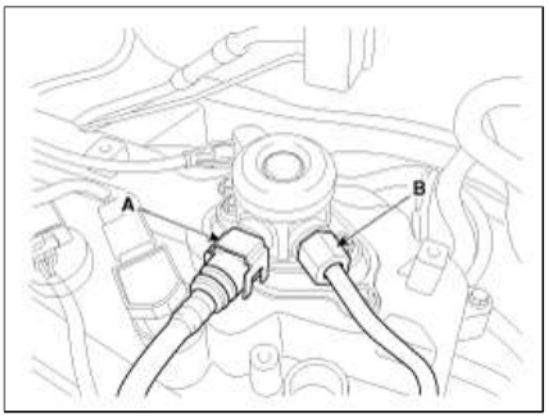




Installation

- 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.

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- 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.

- Do not reuse the bolts.

- Do not reuse the high pressure fuel pipe.

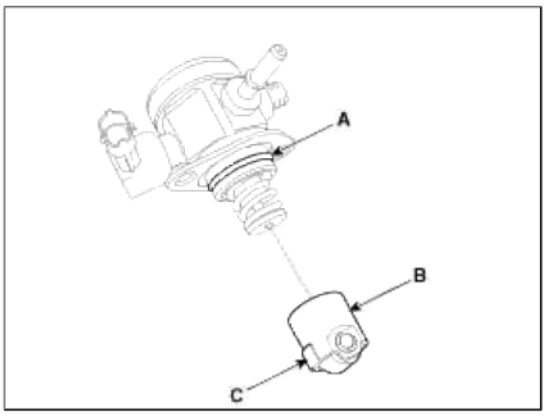
- When tightening the installation bolts of the high pressure fuel pump, tighten the bolts in 1/2 turns (0.5 turns) sequentially after tightening them by hand sequentially.

- Install the component with the specified torques.
- First hand-tighten the fasteners fully until they are not fastened any more in orderto 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 fuelleak due to broken threads.

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

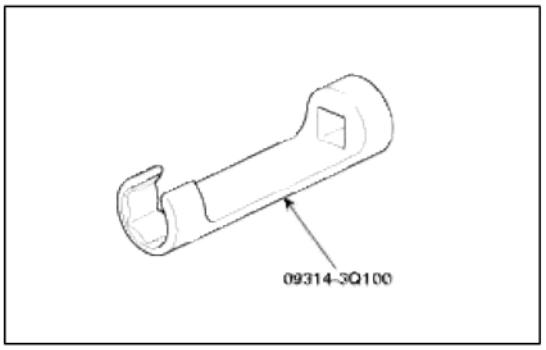
- Apply engine oil to the O-ring (A) of the high pressure fuel pump, the roller tappet (B), and the protrusion (C). Also apply engine oil to the groove on the location where the protrusion (C) is installed.

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1. Installation is reverse of removal.

Use the special service tool [SST No.: 09314-3Q100] 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: 26.5 ~ 32.4 N.m (2.7 ~ 3.3 kgf.m, 19.5 ~ 23.9 lb-ft)
High pressure fuel pipe function block installation bolt: 7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.8 ~ 8.7 lb-ft)

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