

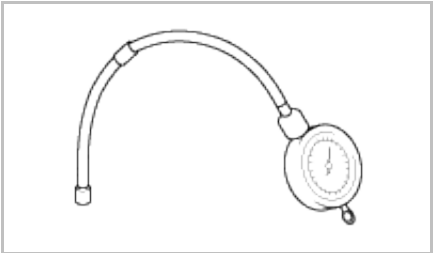
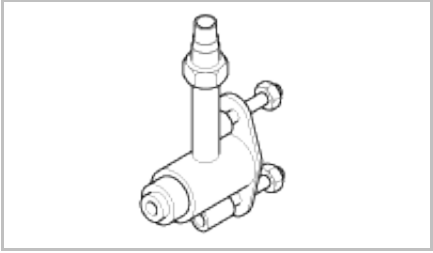
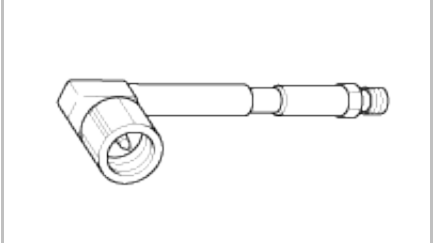


Fuel System

General Information



SPECIAL SERVICE TOOLS

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

**BASIC TROUBLESHOOTING****BASIC TROUBLESHOOTING GUIDE**

1	Bring Vehicle to Workshop
2	Analyze Customer's Problem Ask the customer about the conditions and environment relative to the issue (Use CUSTOMER PROBLEM ANALYSIS SHEET).
3	Verify Symptom, and then Check DTC and Freeze Frame Data - Connect HI-Scan (Pro) to Diagnostic Link Connector (DLC). - Record the DTC and freeze frame data.  NOTE <i>To erase DTC and freeze frame data, refer to Step 5.</i>
4	Confirm the Inspection Procedure for the System or Part Using the SYMPTOM TROUBLESHOOTING GUIDE CHART, choose the correct inspection procedure for the system or part to be checked.
5	Erase the DTC and Freeze Frame Data  WARNING NEVER erase DTC and freeze frame data before completing Step 2 MIL/DTC in "CUSTOMER PROBLEM ANALYSIS SHEET".
6	Inspect Vehicle Visually Go to Step 11, if you recognize the problem.
7	Recreate (Simulate) Symptoms of the DTC - Try to recreate or simulate the symptoms and conditions of the malfunction as described by customer. - If DTC(s) is/are displayed, simulate the condition according to troubleshooting procedure for the DTC.
8	Confirm Symptoms of Problem - If DTC(s) is/are not displayed, go to Step 9. - If DTC(s) is/are displayed, go to Step 11.
9	Recreate (Simulate) Symptom Try to recreate or simulate the condition of the malfunction as described by the customer.
10	Check the DTC - If DTC(s) does(do) not occur, refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE. - If DTC(s) occur(s), go to Step 11.
11	Perform troubleshooting procedure for DTC
12	Adjust or repair the vehicle
13	Confirmation test
14	END

CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLE INFORMATION

VIN No.		Transmission	☐ M/T ☐ A/T ☐ CVT ☐ etc.
Production date		Driving type	☐ 2WD (FF) ☐ 2WD (FR) ☐ 4WD
Odometer Reading	_____km/mile		

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

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

NOTICE

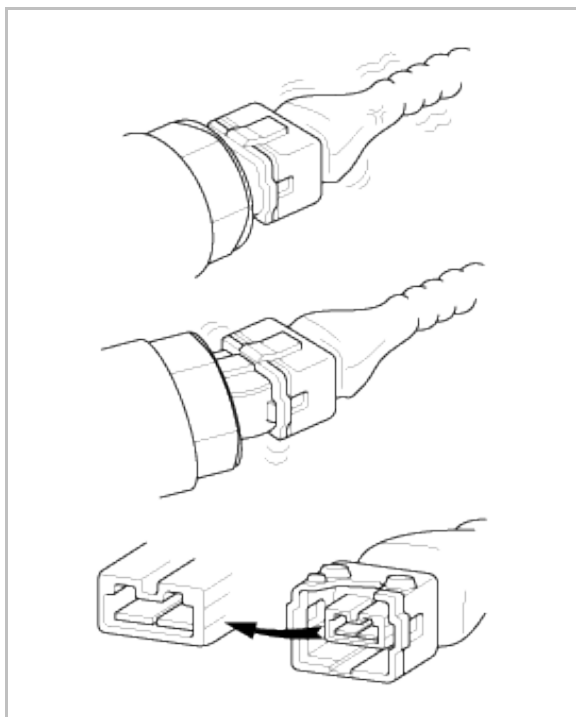
The measured resistance in except for ambient temperature (20°C, 68°F) is reference value.

Sometimes the most difficult case in troubleshooting is when a problem symptom occurs but does not occur again

during testing. An example would be if a problem appears only when the vehicle is cold but has not appeared when warm. In this case, the technician should thoroughly make out a "CUSTOMER PROBLEM ANALYSIS SHEET" and recreate (simulate) the environment and condition which occurred when the vehicle was having the issue.

1. Clear Diagnostic Trouble Code (DTC).

2. Inspect connector connection, and check terminal for poor connections, loose wires, bent, broken or corroded pins, and then verify that the connectors are always securely fastened.



3. Slightly shake the connector and wiring harness vertically and horizontally.

4. Repair or replace the component that has a problem.

5. Verify that the problem has disappeared with the road test.

- **SIMULATING VIBRATION**

- 1) Sensors and Actuators

: Slightly vibrate sensors, actuators or relays with finger.

WARNING

Strong vibration may break sensors, actuators or relays

- 2) Connectors and Harness

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

- **SIMULATING HEAT**

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

WARNING

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

- **SIMULATING WATER SPRINKLING**

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

WARNING

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

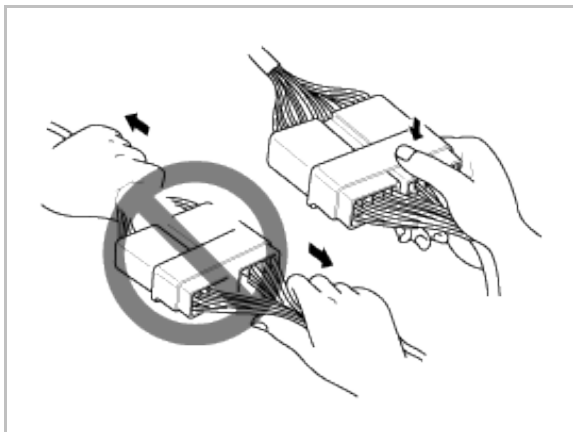
- **SIMULATING ELECTRICAL LOAD**

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

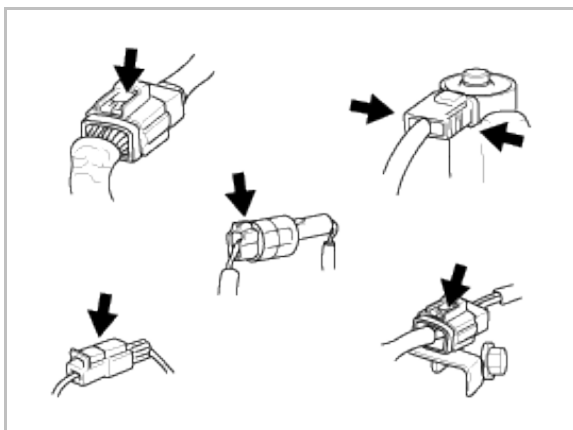
CONNECTOR INSPECTION PROCEDURE

1. Handling of Connector

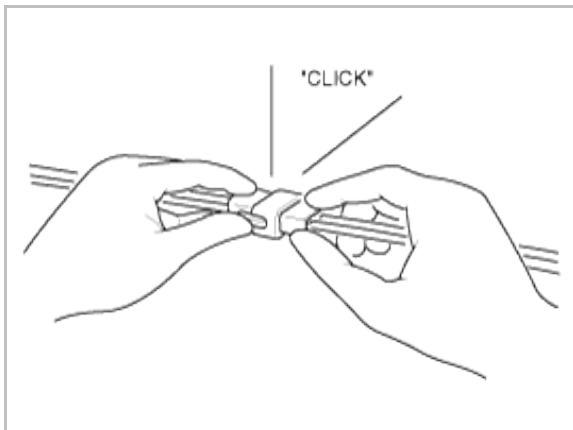
A. Never pull on the wiring harness when disconnecting connectors.



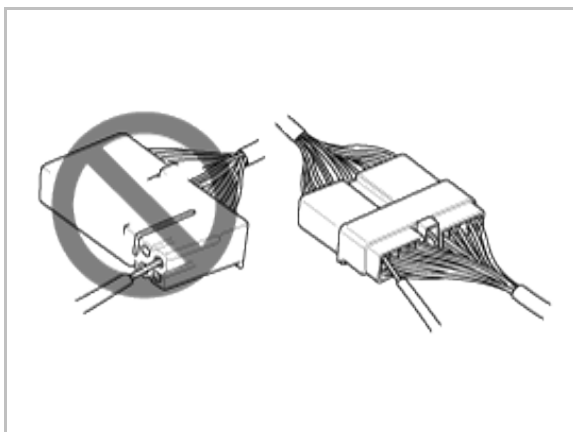
B. When removing the connector with a lock, press or pull locking lever.



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

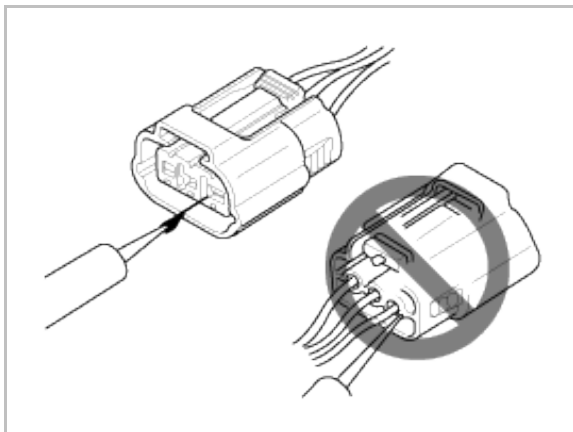


D. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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

harness side.



NOTICE

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

2. Checking Point for Connector

A. While the connector is connected:

Hold the connector, check connecting condition and locking efficiency.

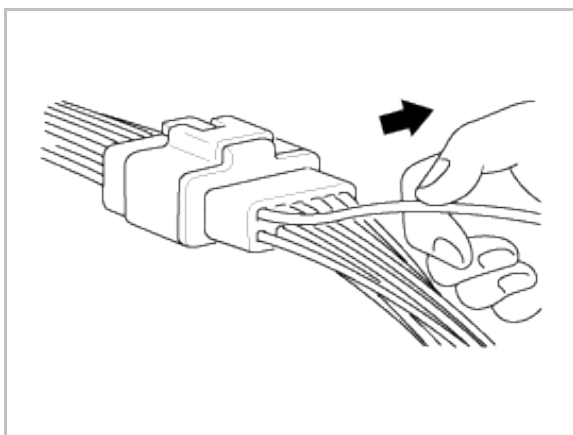
B. When the connector is disconnected:

Check missed terminal, crimped terminal or broken core wire by slightly pulling the wire harness. Visually check for rust, contamination, deformation and bend.

C. Check terminal tightening condition:

Insert a spare male terminal into a female terminal, and then check terminal tightening conditions.

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



3. Repair Method of Connector Terminal

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

NOTICE

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

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

WIRE HARNESS INSPECTION PROCEDURE

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

6. If the covering of wire harness is damaged; secure, repair or replace the harness.

ELECTRICAL CIRCUIT INSPECTION PROCEDURE

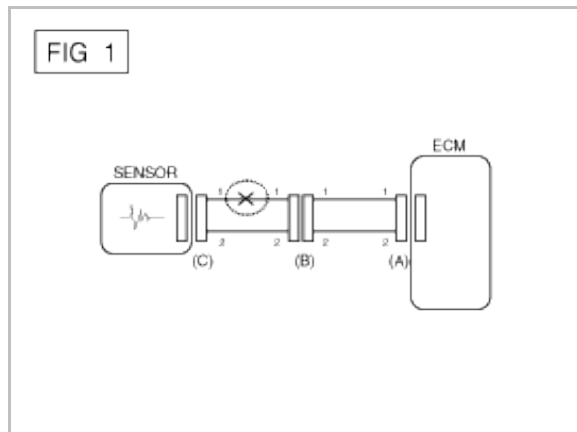
● CHECK OPEN CIRCUIT

1. Procedures for Open Circuit

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.



2. Continuity Check Method

NOTICE

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

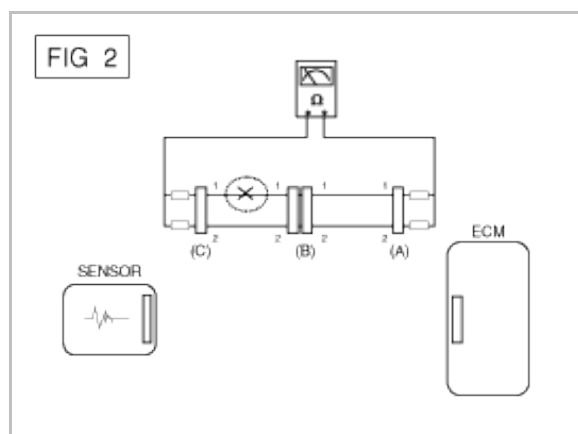
Specification (Resistance)

1 Ω or less → Normal Circuit

1M Ω or Higher → Open Circuit

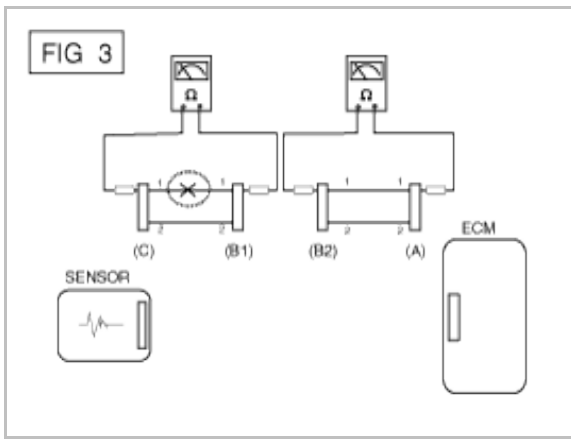
A. Disconnect connectors (A), (C) and measure resistance between connector (A) and (C) as shown in [FIG. 2].

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

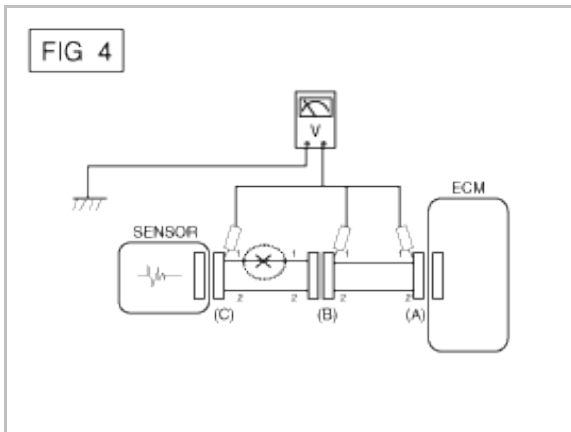
In this case the measured resistance between connector (C) and (B1) is higher than 1M Ω and the open circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).



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).

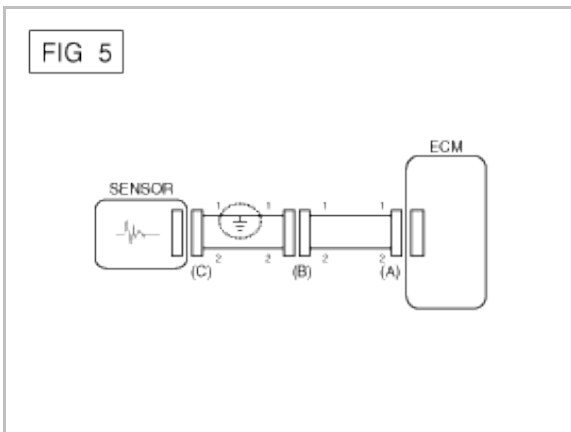


● CHECK SHORT CIRCUIT

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.



2. Continuity Check Method (with Chassis Ground)

NOTICE

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

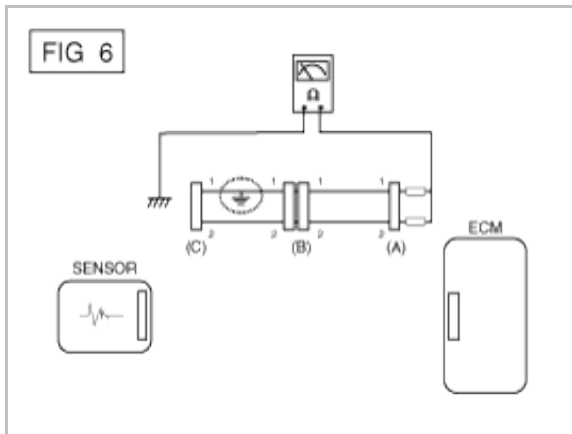
Specification (Resistance)

1Ω or less → Short to Ground Circuit

1MΩ or Higher → Normal Circuit

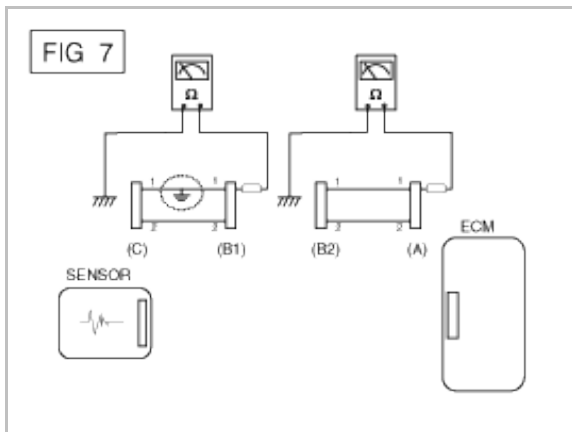
A. Disconnect connectors (A), (C) and measure for resistance between connector (A) and Chassis Ground as shown in [FIG. 6].

The measured resistance of line 1 and 2 in this example is below $1\ \Omega$ and higher than $1\text{M}\Omega$ 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.



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 $1\ \Omega$ or less. The short to ground circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).



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 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)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Knocking	1. Check the fuel pressure 2. Inspect the engine coolant 3. Inspect the radiator and the electric cooling fan 4. Check the spark plugs	• DTC • Contaminated fuel
Poor fuel economy	1. Check customer's driving habits • Is 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 EVAP. canister and air filter 4. Check the EVAP. canister	• Malfunctioning gas station filling nozzle (If this problem occurs at a specific gas station during refueling)



SPECIFICATIONS

FUEL DELIVERY SYSTEM

Items	Specification	
Fuel Tank	Capacity	80 lit. (21.1 U.S.gal., 17.6 Imp.gal.)
Fuel Filter (built in Fuel Pump assembly)	Type	High pressure type
Fuel Pressure Regulator (built in Fuel Pump assembly)	Regulated Fuel Pressure	375 ~ 385 kPa(3.82 ~ 3.92 kgf/cm ² , 54.3 ~ 55.8 psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor

SENSORS

MASS AIR FLOW SENSOR (MAFS)

▷ Type: Hot-film type

▷ Specification

Air Flow (kg/h)	Frequency (Hz)
12.6 kg/h	2,617Hz
18.0 kg/h	2,958Hz
23.4 kg/h	3,241Hz
32.4 kg/h	3,653Hz
43.2 kg/h	4,024Hz
57.6 kg/h	4,399Hz
72.0 kg/h	4,704Hz
108.0 kg/h	5,329Hz
144.0 kg/h	5,897Hz
198.0 kg/h	6,553Hz
270.0 kg/h	7,240Hz
360.0 kg/h	7,957Hz
486.0 kg/h	8,738Hz
666.0 kg/h	9,644Hz
900.0 kg/h	10,590Hz

INTAKE AIR TEMPERATURE SENSOR (IATS)

▷ Type: Thermistor type

▷ Specification

Temperature		Resistance (kΩ)
°C	°F	
-40	-40	100.87
-20	-4	28.58
0	32	9.40
10	50	5.66

20	68	3.51
40	104	1.47
60	140	0.67
80	176	0.33

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

- ▷ Type: Piezo-resistive pressure type
- ▷ Specification

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

- ▷ Type: Variable resistor type
- ▷ Specification (When reference voltage = 5.0V)

Throttle Angle (°)	Output Voltage(V)	
	TPS1	TPS2
0	0	5.0
10	0.5	4.5
20	0.9	4.1
30	1.4	3.6
40	1.8	3.2
50	2.3	2.7
60	2.7	2.3
70	3.2	1.8
80	3.6	1.4
90	4.1	0.9
100	4.5	0.5
110	5.0	0.0

Item	Sensor Resistance (k Ω)
TPS1	4.0 ~ 6.0 [20°C (68°F)]
TPS2	2.7 ~ 4.1 [20°C (68°F)]

ACCELERATOR POSITION SENSOR (APS)

▷ Type: Variable resistor type

▷ Specification (When reference voltage = 5.0V)

Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.70 ~ 0.80	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

Item	Sensor Resistance (k Ω)
APS1	0.7 ~ 1.3 [20°C (68°F)]
APS2	1.4 ~ 2.6 [20°C (68°F)]

HEATED OXYGEN SENSOR (HO2S)

▷ Type: Zirconia (ZrO₂) type

▷ Specification

A/F Ratio	Output Voltage (V)
RICH	0.80 ~ 0.92
LEAN	0.1

Item	Resistance (Ω)
Sensor Heater	3.0 ~ 4.0 [21°C (69.8°F)]

CAMSHAFT POSITION SENSOR (CMPS)

▷ Type: Hall effect type

▷ Specification

Item	Specification
Output Voltage (V)	High: 4.75 ~ 5.25
	Low: 0 ~ 0.7
Air Gap (mm)	0.5 ~ 1.5

CRANKSHAFT POSITION SENSOR (CKPS)

▷ Type: Magnetic field sensitive type

▷ Specification

Item	Specification
Coil Resistance (Ω)	630 ~ 770 [20°C (68°F)]
Air Gap (mm)	0.5 ~ 1.5

KNOCK SENSOR (KS)

▷ Type: Piezo-electricity type

▷ Specification

Item	Specification
Capacitance (pF)	950 ~ 1,350pF

CVVT OIL TEMPERATURE SENSOR (OTS)

- ▷ Type: Thermistor type
- ▷ Specification

Temperature		Resistance (kΩ)
°C	°F	
-40	-40	52.0
-20	-4	16.5
0	32	6.0
20	68	2.45
40	104	1.10
60	140	0.544
80	176	0.290
100	212	0.164
120	248	0.099

ACTUATORS

INJECTOR

- ▷ Number: 6
- ▷ Specification

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

PURGE CONTROL SOLENOID VALVE (PCSV)

- ▷ Specification

Item	Specification
Coil Resistance (Ω)	14.0 ~ 18.0 [20°C (68°F)]

VARIABLE INTAKE SOLENOID (VIS) VALVE #1 (SURGE TANK SIDE)

- ▷ Specification

Item	Specification
Coil Resistance (Ω)	29.0 ~ 35.0 [22°C (71.6°F)]

VARIABLE INTAKE SOLENOID (VIS) VALVE #2 (INTAKE MANIFOLD SIDE)

- ▷ Specification

Item	Specification
Coil Resistance (Ω)	29.0 ~ 35.0 [20°C (68°F)]

CVVT OIL CONTROL VALVE (OCV) [BANK 1]

- ▷ Specification

Item	Specification
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Coil Resistance (Ω)	6.7 ~ 7.7 [20°C (68°F)]
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CVVT OIL CONTROL VALVE (OCV) [BANK 2]

▷ Specification

Item	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 [20°C (68°F)]

ETC MOTOR

▷ Specification

Item	Specification
Coil Resistance (Ω)	1.275 ~ 1.725 [20°C (68°F)]

IGNITION COIL

▷ Type: Stick type

▷ Specification

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

SERVICE STANDARD

Ignition Timing	BTDC 7°± 10°		
Idle Speed	A/CON OFF	Neutral,N,P-range	650 ± 100 rpm
		D-range	650 ± 100 rpm
	A/CON ON	Neutral,N,P-range	650 ± 100 rpm
		D-range	650 ± 100 rpm

TIGHTENING TORQUES

ENGINE CONTROL SYSTEM

Item	kgf·m	N·m	lbf·ft
PCM installation bolts (on bracket)	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
PCM bracket installation bolts/nuts (on air cleaner assembly)	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Camshaft position sensor [Bank 1] installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor [Bank 2] installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Crankshaft position sensor installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
CVVT Oil control valve [Bank 1] installation bolt	0.8 ~ 1.0	7.8 ~ 9.8	5.8 ~ 7.2
CVVT Oil control valve [Bank 2] installation bolt	0.8 ~ 1.0	7.8 ~ 9.8	5.8 ~ 7.2
CVVT Oil temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Engine coolant temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
ETC module installation bolt	0.9 ~ 1.1	8.8 ~ 10.8	6.5 ~ 8.0
Heated oxygen sensor (Bank 1 / Sensor 1) installation	3.5 ~ 4.5	34.3 ~ 44.1	25.3 ~ 32.6
Heated oxygen sensor (Bank 1 / Sensor 2) installation	3.5 ~ 4.5	34.3 ~ 44.1	25.3 ~ 32.6
Heated oxygen sensor (Bank 2 / Sensor 1) installation	3.5 ~ 4.5	34.3 ~ 44.1	25.3 ~ 32.6

Heated oxygen sensor (Bank 2 / Sensor 2) installation	3.5 ~ 4.5	34.3 ~ 44.1	25.3 ~ 32.6
Ignition coil installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Knock sensor [Bank 1] installation	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
Knock sensor [Bank 2] installation	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4
Manifold absolute pressure sensor installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7

FUEL DELIVERY SYSTEM

Item	kgf·m	N·m	lbf·ft
Fuel tank band mounting nuts	4.0 ~ 5.5	39.2 ~ 53.9	28.9 ~ 39.8
Fuel pump assembly mounting bolts	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Delivery pipe installation bolts	0.9 ~ 1.4	8.8 ~ 13.7	6.5 ~ 10.1
Accelerator pedal module installation bolts	1.3 ~ 1.6	12.8 ~ 15.7	9.4 ~ 11.6



Fuel System

Engine Control System



DESCRIPTION

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

If any of the above conditions are noted, first perform a routine diagnosis that includes basic engine checks (ignition system malfunction, incorrect engine adjustment, etc.). Then, inspect the Gasoline Engine Control system components with the HI-SCAN (Pro).

NOTICE

- Before removing or installing any part, read the diagnostic trouble codes and then disconnect the battery negative (-) terminal.
- Before disconnecting the cable from battery terminal, turn the ignition switch to OFF. Removal or connection of the battery cable during engine operation or while the ignition switch is ON could cause damage to the ECM.
- The control harnesses between the ECM and heated oxygen sensor are shielded with the shielded ground wires to the body in order to prevent the influence of ignition noises and radio interference. When the shielded wire is faulty, the control harness must be replaced.
- When checking the generator for the charging state, do not disconnect the battery '+' terminal to prevent the ECM from damage due to the voltage.
- When charging the battery with the external charger, disconnect the vehicle side battery terminals to prevent damage to the ECM.

Malfunction Indicator Lamp (MIL)

Faults with the following items will illuminate the MIL.

- Catalyst
- Fuel system
- Mass Air Flow Sensor (MAFS)
- Intake Air Temperature Sensor (IATS)
- Engine Coolant Temperature Sensor (ECTS)
- Throttle Position Sensor (TPS)
- Upstream Oxygen Sensor
- Upstream Oxygen Sensor Heater
- Downstream Oxygen Sensor
- Downstream Oxygen Sensor Heater
- Injector
- Misfire
- Crankshaft Position Sensor (CKPS)
- Camshaft Position Sensor (CMPS)
- Evaporative Emission Control System
- Vehicle Speed Sensor (VSS)
- Idle Speed Control Actuator (ISCA)
- Power Supply
- ECM/ PCM
- MT/AT Encoding
- Acceleration Sensor
- MIL-on Request Signal
- Power Stage

NOTICE

Refer to "INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC)" for more information.

Faults with the following items will illuminate the MIL

- Heated oxygen sensor (HO2S)
- Mass Air Flow sensor (MAFS)
- Throttle position sensor (TPS)
- Engine coolant temperature sensor (ECTS)
- Idle speed control actuator (ISCA)
- Injectors
- ECM

NOTICE

Refer to "INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC)" for more information.

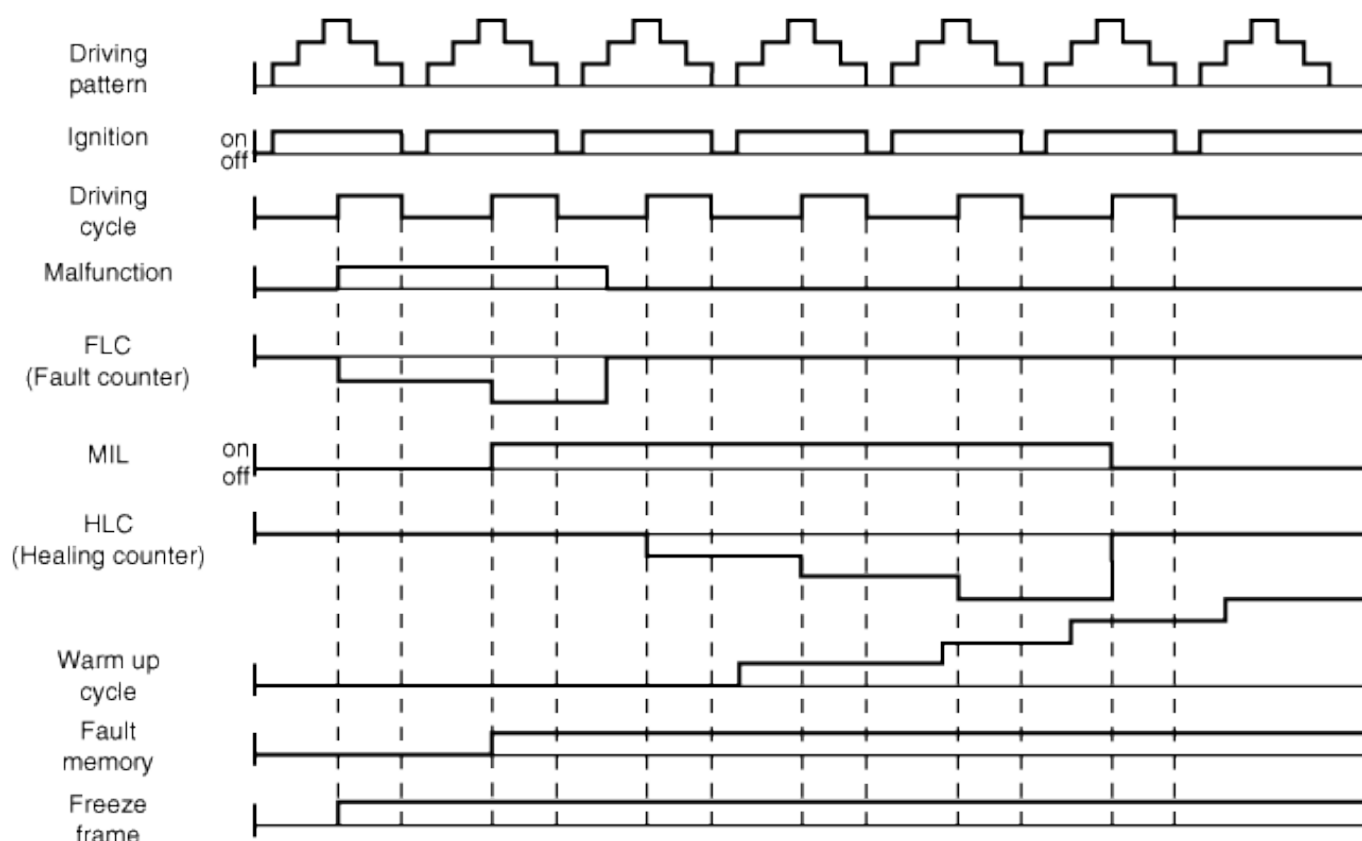
1. After turning ON the ignition key, ensure that the light illuminates for about 5 seconds and then goes out.
2. If the light does not illuminate, check for an open circuit in the harness, a blown fuse or a blown bulb.

Self-Diagnosis

NOTICE

If a sensor connector is disconnected with the ignition switch turned on, the diagnostic trouble code (DTC) is recorded. In this case, disconnect the battery negative terminal (-) for 15 seconds or more, and the diagnosis memory will be erased.

THE RELATION BETWEEN DTC AND DRIVING PATTERN IN EOBD SYSTEM



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

detected.

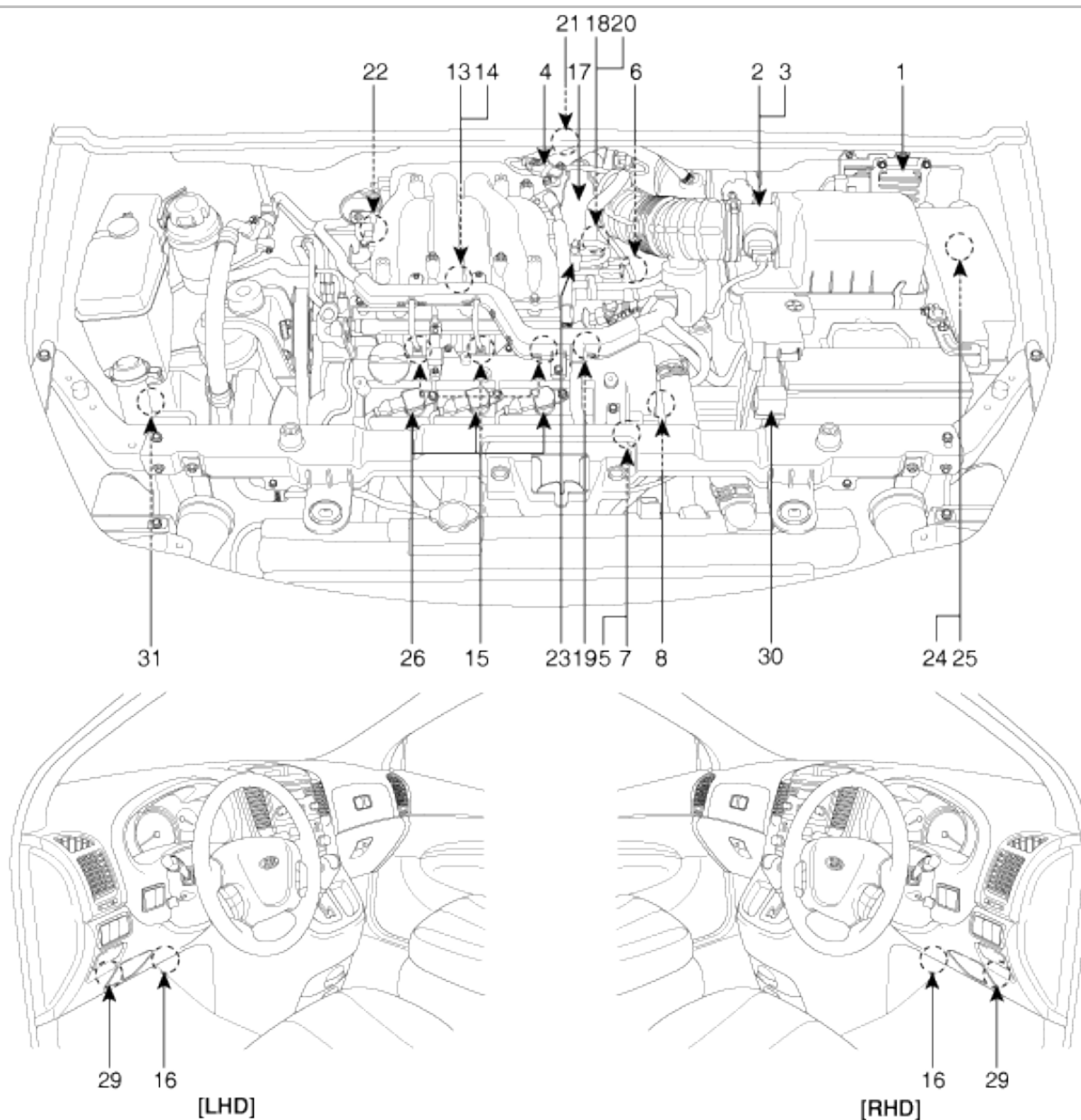
4. A Diagnostic Trouble Code(DTC) will automatically erase from ECM memory if the same malfunction is not detected for 40 driving cycles.

NOTICE

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



COMPONENT LOCATION

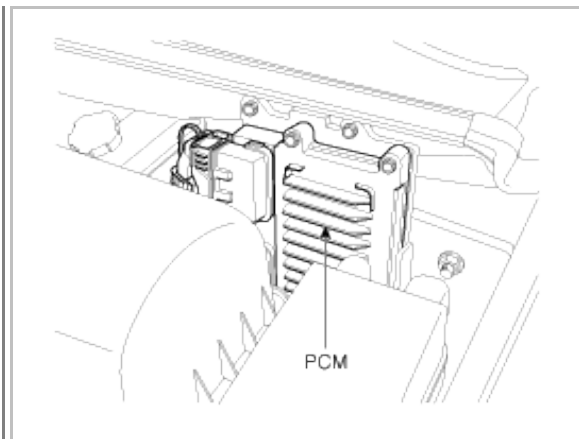


1. PCM (Powertrain Control Module)
2. Mass Air Flow Sensor (MAFS)
3. Intake Air Temperature Sensor (IATS)
4. Manifold Absolute Pressure Sensor (MAPS)
5. Engine Coolant Temperature Sensor (ECTS)
6. Camshaft Position Sensor (CMPS) [Bank 1]
7. Camshaft Position Sensor (CMPS) [Bank 2]
8. Crankshaft Position Sensor (CKPS)
9. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]
10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]
11. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]
12. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]
13. Knock Sensor (KS) [Bank 1]
14. Knock Sensor (KS) [Bank 2]
15. Injector
16. Accelerator Position Sensor (APS)

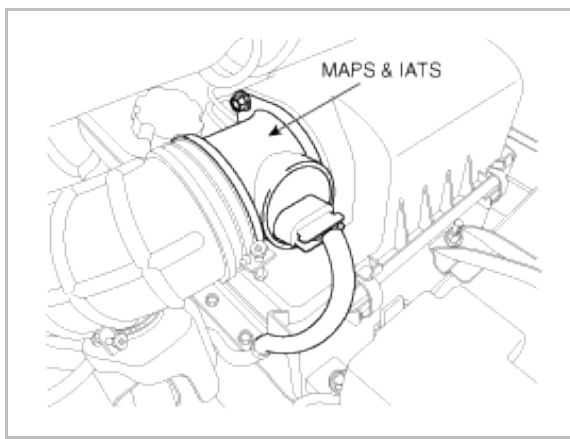
17. ETC Module [Throttle Position Sensor (TPS) + ETC Motor]
18. CVVT Oil Control Valve (OCV) [Bank 1]
19. CVVT Oil Control Valve (OCV) [Bank 2]
20. CVVT Oil Temperature Sensor (OTS)
21. Purge Control Solenoid Valve (PCSV)
22. Variable Intake Solenoid (VIS) Valve #1 (Surge Tank Side)
23. Variable Intake Solenoid (VIS) Valve #2 (Intake Manifold Side)
24. Fuel Pump Relay
25. Main Relay
26. Ignition Coil
27. Wheel Speed Sensor (WSS) [Without ABS/ESP (Euro-III/IV)]
28. Vehicle Speed Sensor (VSS) [Except for Euro-III/IV]
29. Data Link Connector (DLC)
30. Multi-Purpose Connector
31. A/C Pressure Transducer (APT)

1. PCM (Powertrain Control Module)

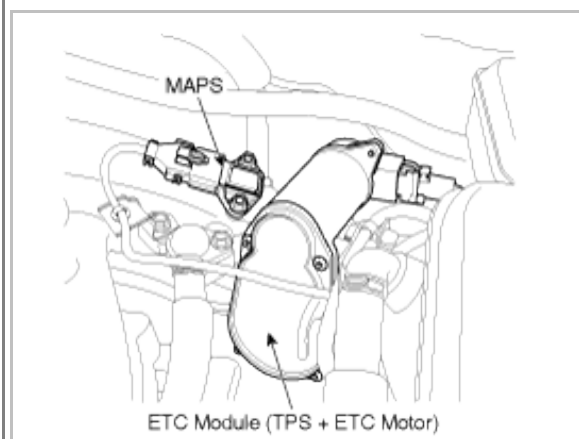
2. Mass Air Flow Sensor (MAFS)
3. Intake Air Temperature Sensor (IATS)



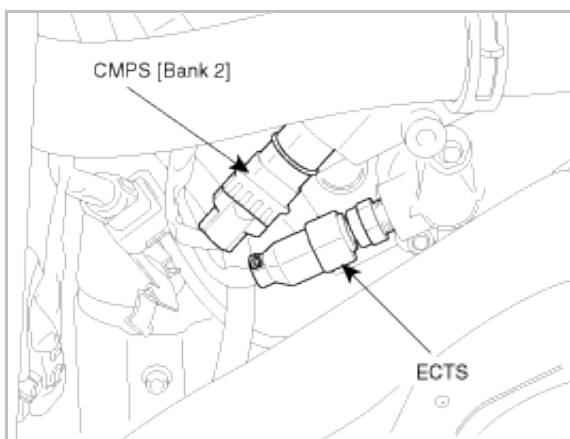
4. Manifold Absolute Pressure Sensor (MAPS)
17. ETC Module [Throttle Position Sensor (TPS) + ETC Motor]



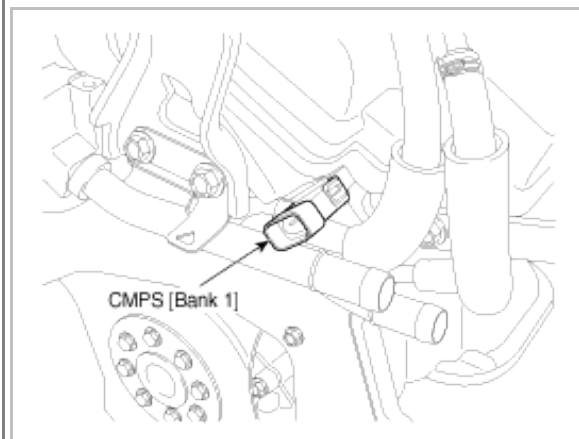
5. Engine Coolant Temperature Sensor (ECTS)
7. Camshaft Position Sensor (CMPS) [Bank2]



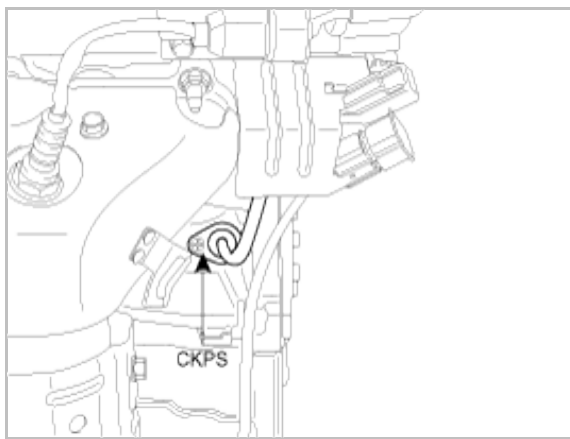
6. Camshaft Position Sensor (CMPS) [Bank 1]



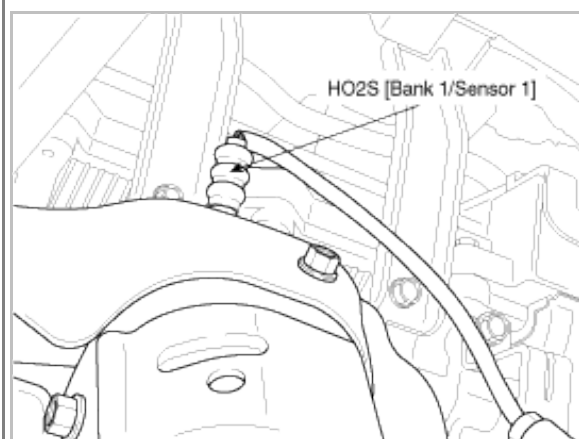
8. Crankshaft Position Sensor (CKPS)



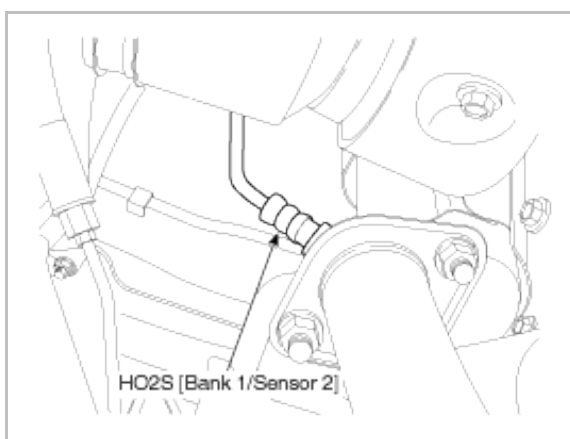
9. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]



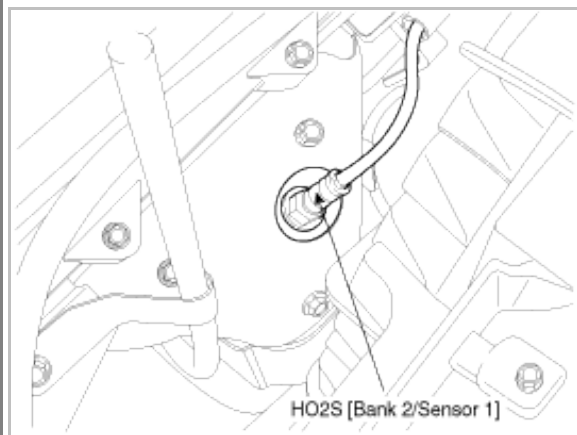
10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]



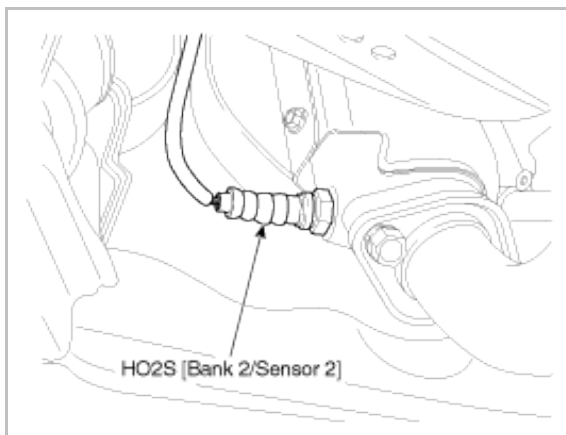
11. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]



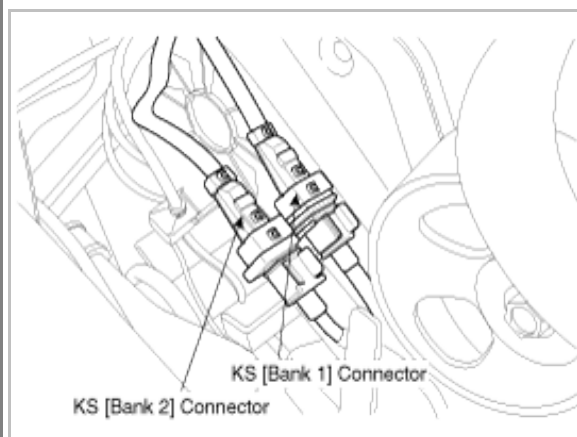
12. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]



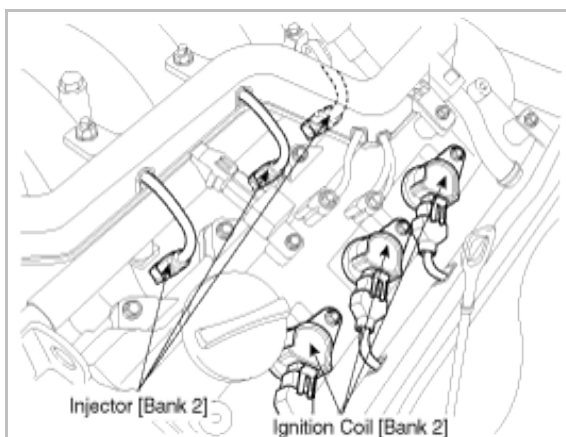
13. Knock Sensor (KS) [Bank 1]
14. Knock Sensor (KS) [Bank 2]



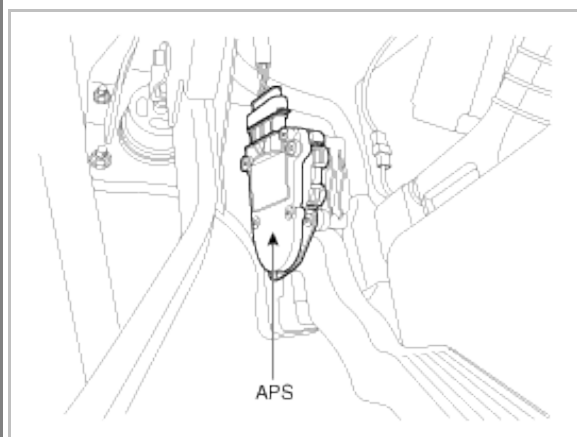
15. Injector
26. Ignition Coil



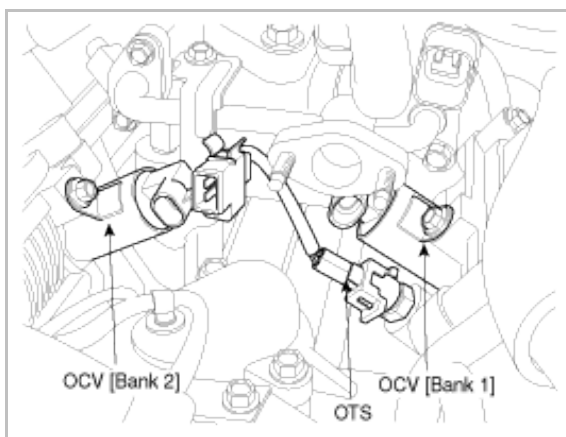
16. Accelerator Position Sensor (APS)



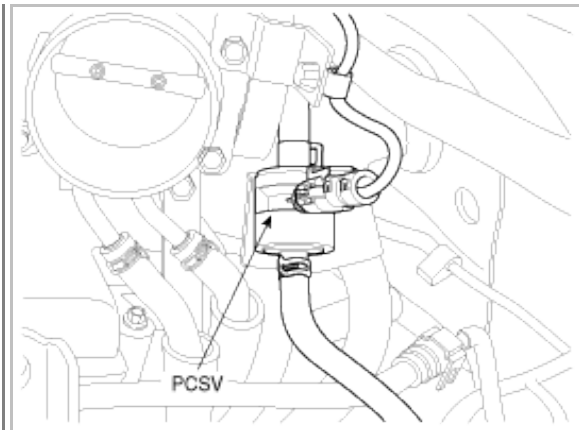
18. CVVT Oil Control Valve (OCV) [Bank 1]
19. CVVT Oil Control Valve (OCV) [Bank 2]
20. CVVT Oil Temperature Sensor (OTS)



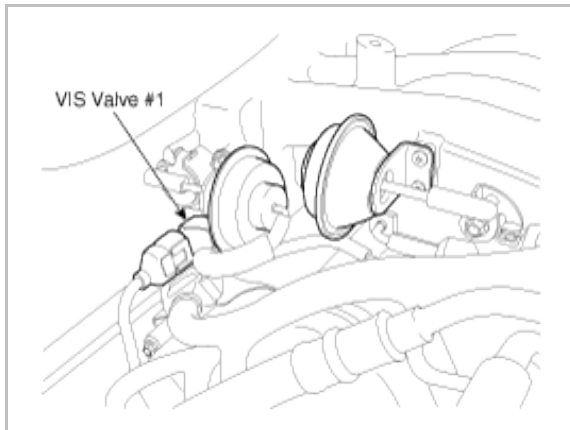
21. Purge Control Solenoid Valve (PCSV)



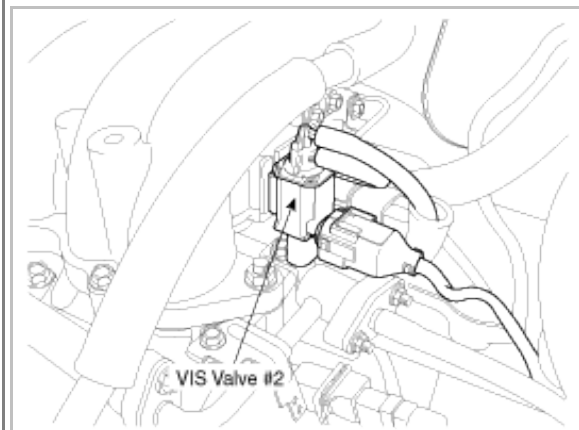
22. Variable Intake Solenoid (VIS) #1 Valve (Surge Tank Side)



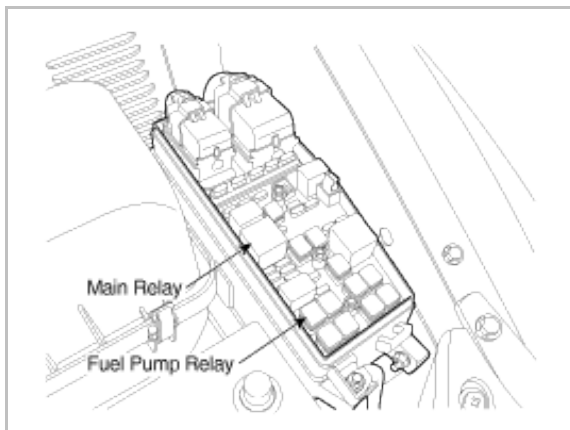
23. Variable Intake Solenoid (VIS) #2 Valve (Intake Manifold Side)



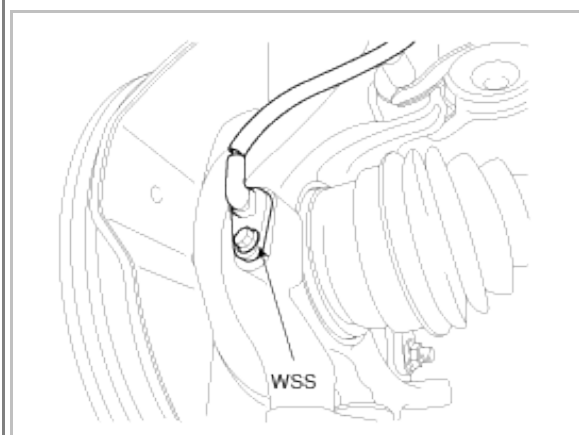
24. Fuel Pump Relay
25. Main Relay



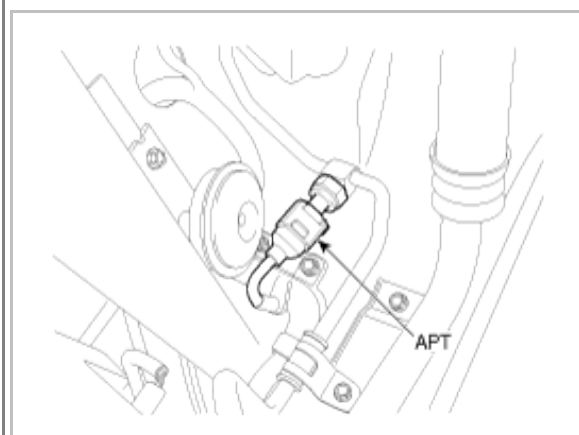
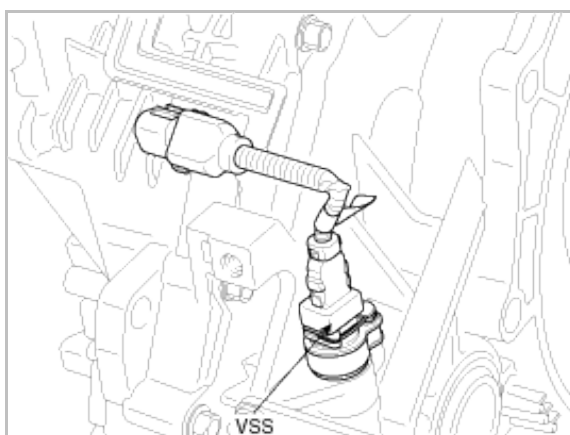
27. Wheel Speed Sensor (WSS)



28. Vehicle Speed Sensor (VSS)



31. A/C Pressure Transducer (APT)

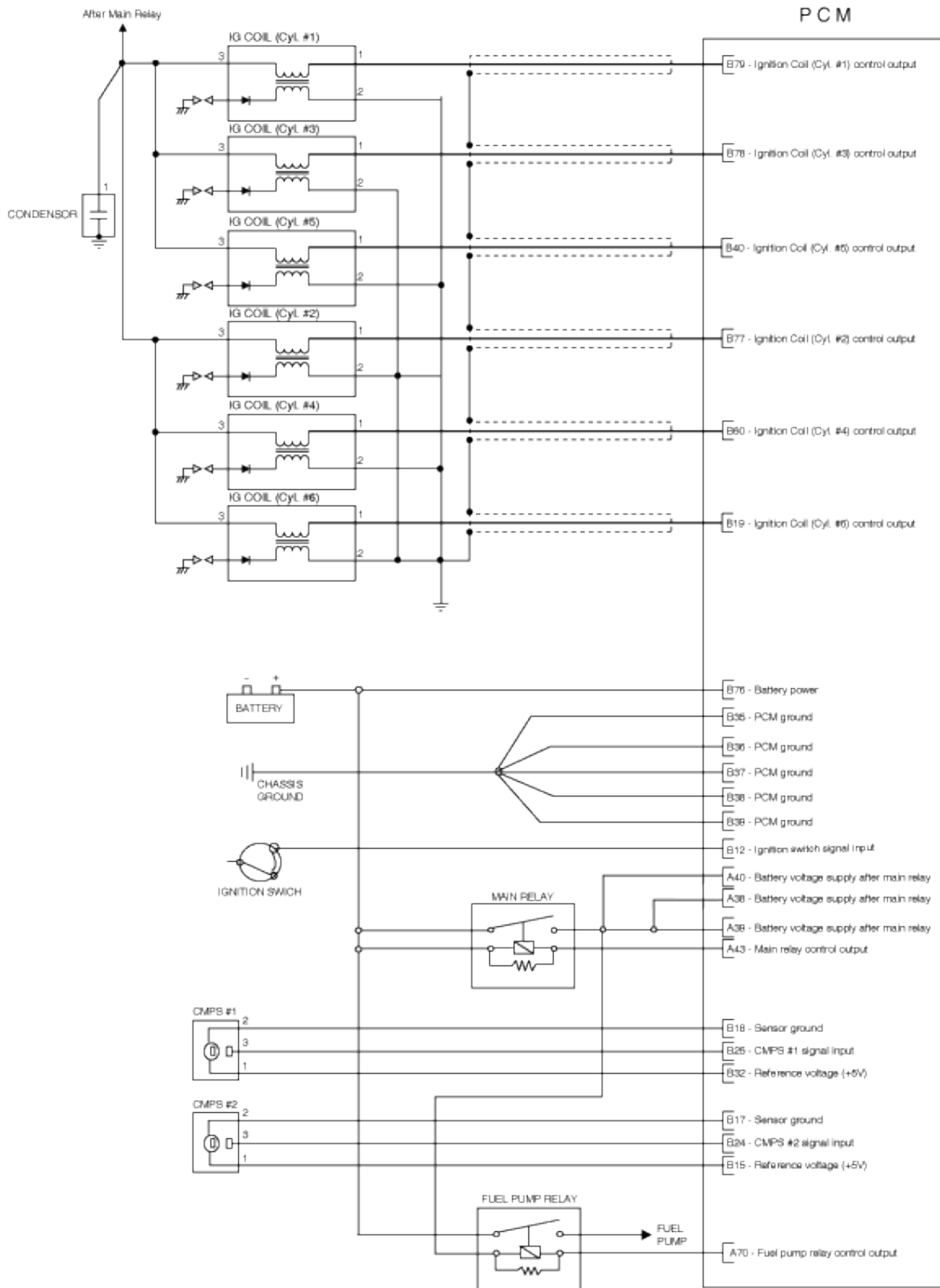


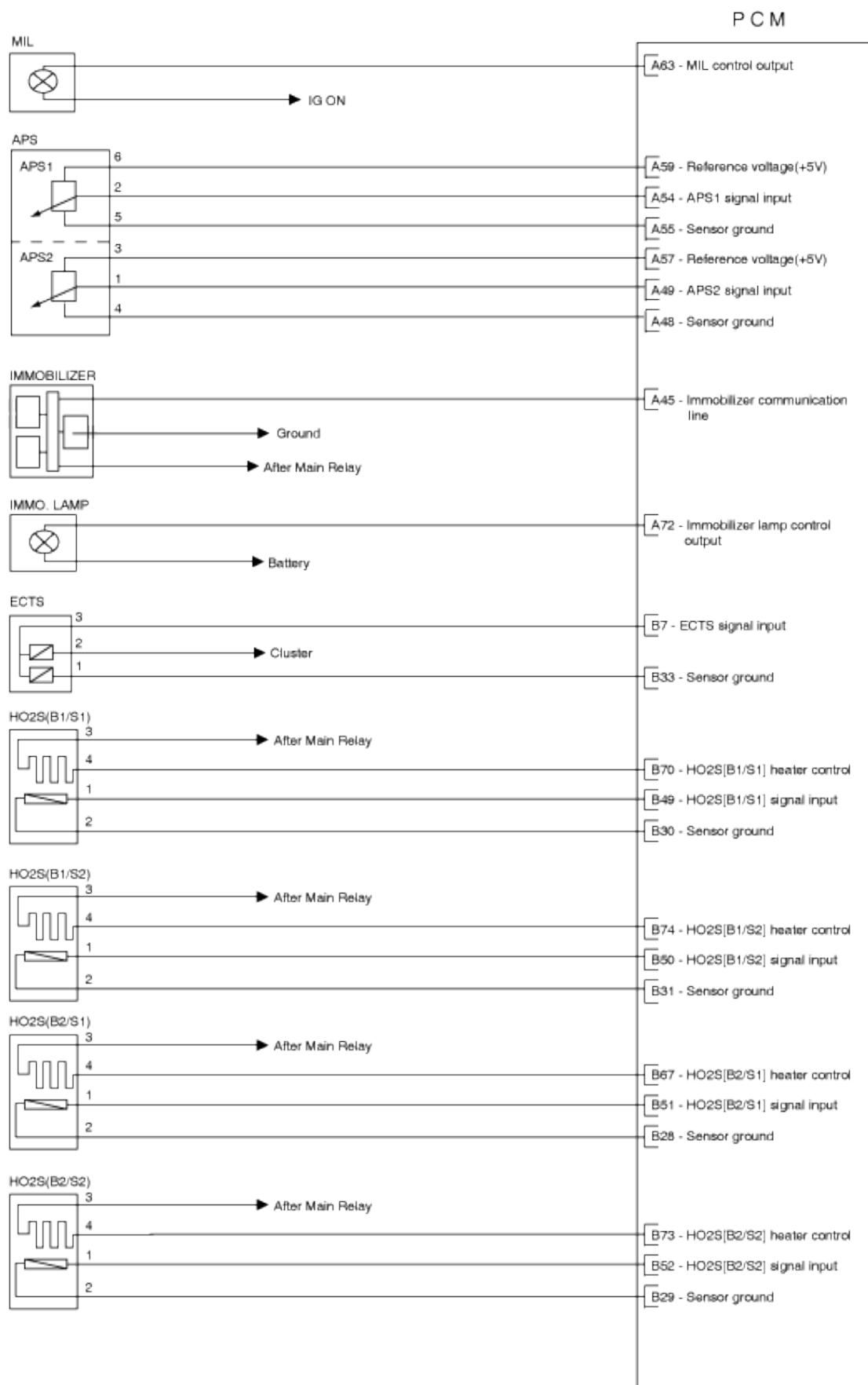


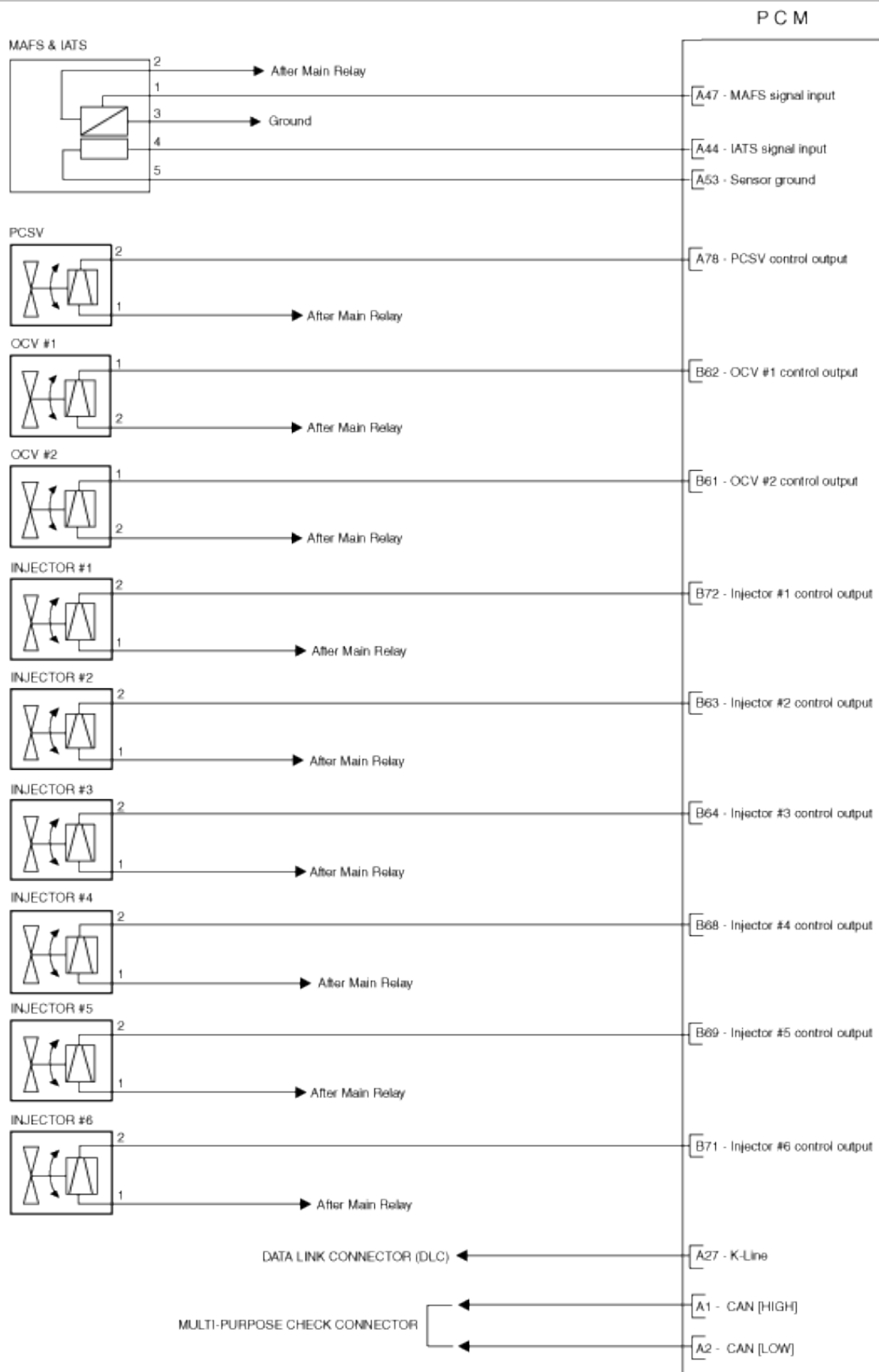
Fuel System

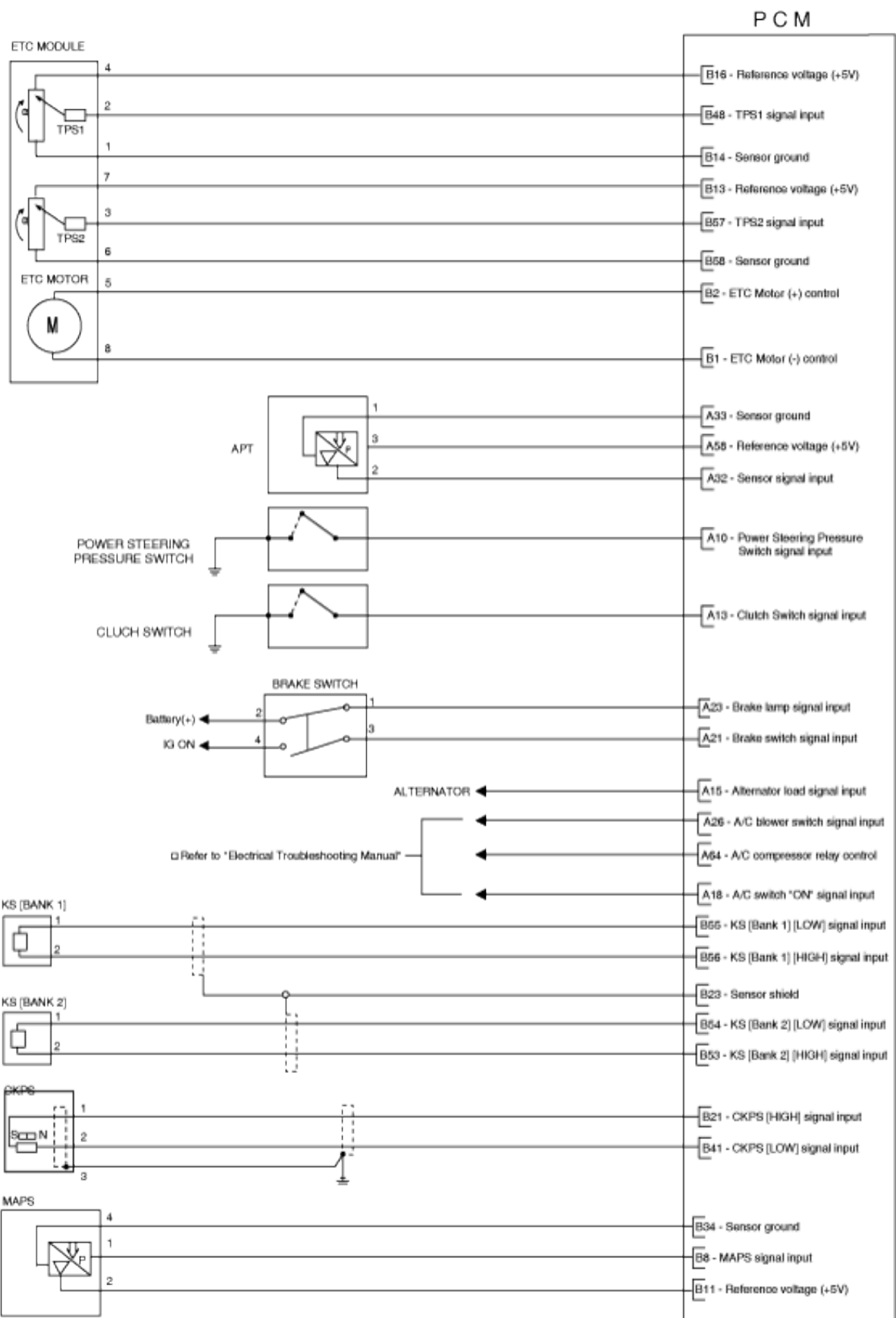
Engine Control System - Powertrain Control
Module

CIRCUIT DIAGRAM

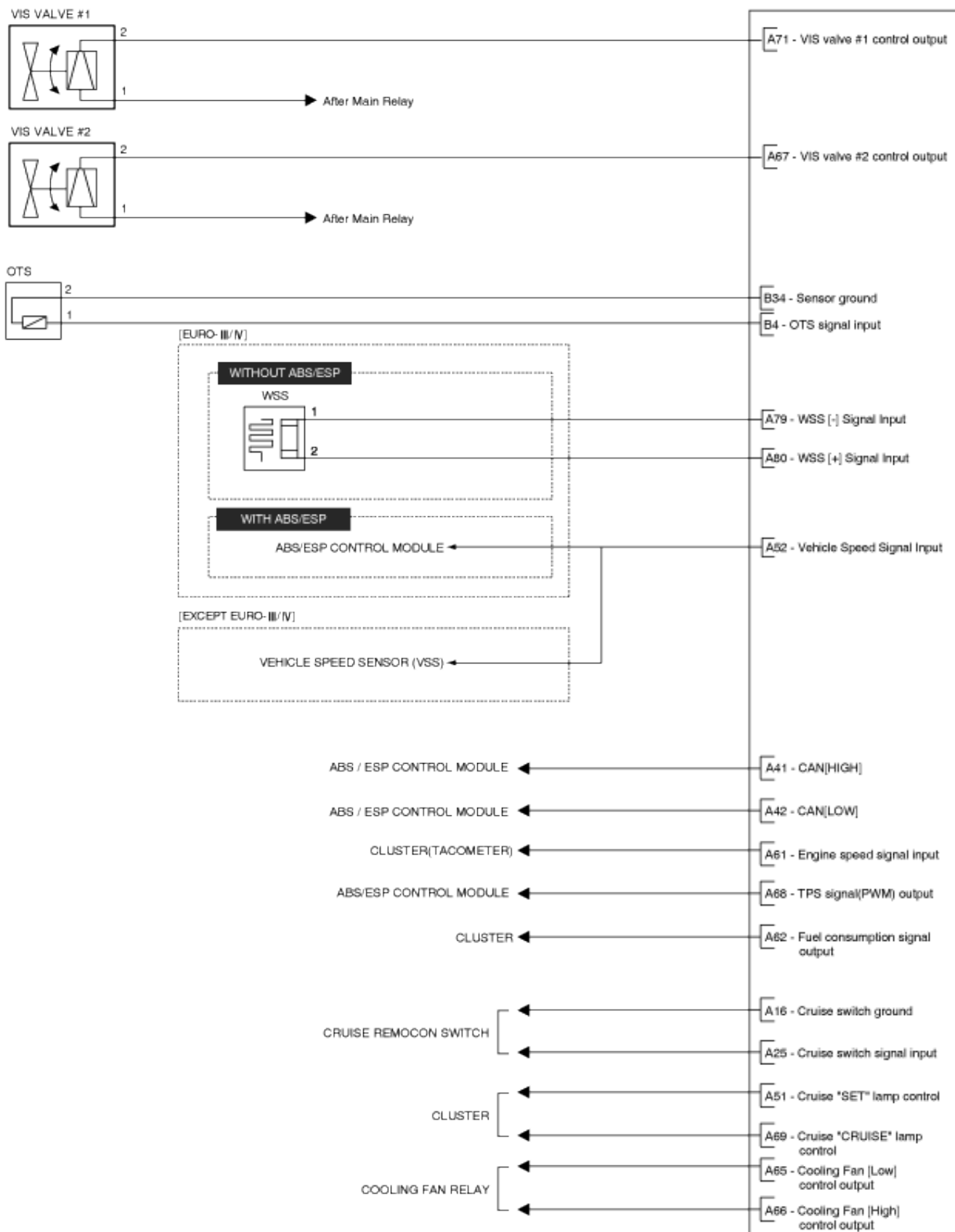








P C M





PCM PROBLEM INSPECTION PROCEDURE

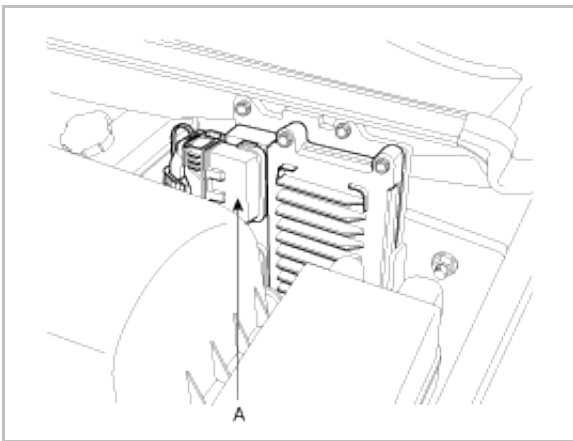
1. TEST PCM GROUND CIRCUIT: Measure resistance between PCM and chassis ground using the backside of PCM harness connector as PCM side check point. If the problem is found, repair it.

Specification (Resistance): 1Ω or less

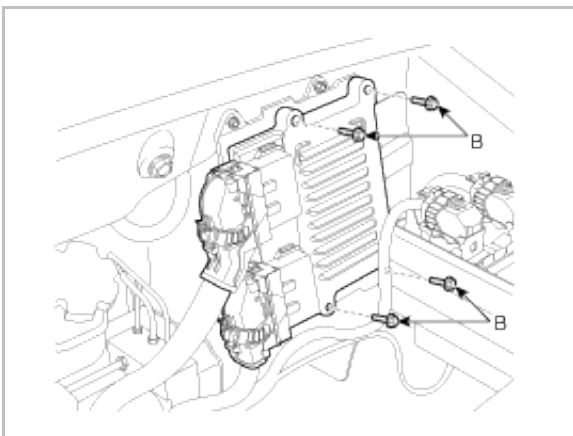
2. TEST PCM CONNECTOR: Disconnect the PCM connector and visually check the ground terminals on PCM side and harness side for bent pins or poor contact pressure. If the problem is found, repair it.
3. If problem is not found in Step 1 and 2, the PCM could be faulty. If so, replace the PCM with a new one,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

REPLACEMENT

1. Turn ignition switch off.
2. Disconnect the battery (-) cable from the battery.
3. Disconnect the PCM connectors (A).



4. Unscrew the PCM mounting bolts (B) and remove the PCM from the air cleaner assembly.



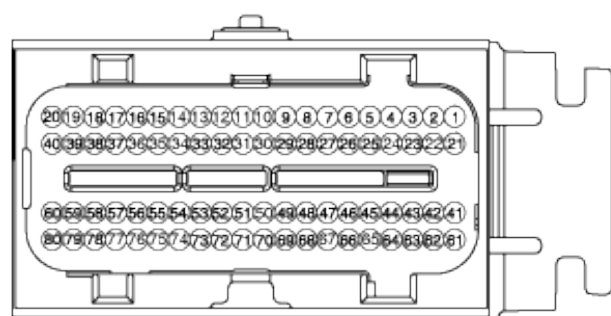
5. Install a new PCM.

PCM installation bolts: 9.8 ~ 11.8 N·m (1.0 ~ 1.2 kgf·m, 7.2 ~ 8.7 lbf·ft)

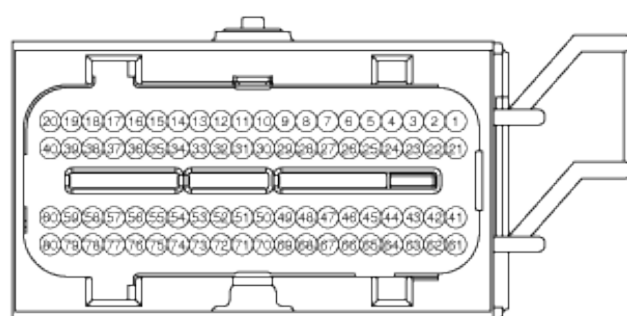


POWERTRAIN CONTROL MODULE (PCM)

1. HARNESS CONNECTOR



C151-1



C151-2

2. TERMINAL FUNCTION

CONNECTOR [C151-1]

Pin No.	Description	Connected to
1	2nd CAN [High]	Multi-Purpose Check Connector
2	2nd CAN [Low]	Multi-Purpose Check Connector
3	-	
4	-	
5	-	
6	-	
7	-	
8	-	
9	-	
10	Power Steering Switch signal input	Power Steering Switch
11	-	
12	-	
13	Clutch Switch signal input	Clutch Switch
14	-	
15	Alternator load signal input	Alternator
16	Cruise Switch ground	Cruise Switch
17	-	
18	A/C switch "ON" signal input	A/C Switch
19	-	
20	-	
21	Brake switch signal input	Brake Switch
22	-	
23	Brake lamp signal input	Brake Switch
24	-	
25	Cruise Switch signal input	Cruise Switch
26	A/C thermal switch signal input	A/C Thermal Switch
27	Diagnostic Data Line (K-Line)	Data Link Connector (DLC)

28	-	
29	-	
30	-	
31	-	
32	A/C Pressure Transducer signal input	A/C Pressure Transducer (APT)
33	Sensor ground	A/C Pressure Transducer (APT)
34	-	
35	-	
36	-	
37	-	
38	Battery voltage supply after main relay	Main Relay
39	Battery voltage supply after main relay	Main Relay
40	Battery voltage supply after main relay	Main Relay
41	CAN [High]	ABS/ESP Control Module
42	CAN [Low]	ABS/ESP Control Module
43	Main Relay control output	Main Relay
44	Intake Air Temperature Sensor signal input	Intake Air Temperature Sensor (IATS)
45	Immobilizer communication line	Immobilizer control module
46	-	
47	Mass Air Flow Sensor signal input	Mass Air Flow Sensor (MAFS)
48	Sensor ground	Accelerator Position Sensor (APS) #2
49	Accelerator Position Sensor #2 signal input	Accelerator Position Sensor (APS) #2
50	-	
51	Cruise "SET" lamp control output	Cruise "SET" Lamp
52	Vehicle speed signal input	ABS/ESP Control Module (With ABS/ESP [Euro-III/IV])
		Vehicle Speed Sensor (VSS) (Except Euro-III/IV)
53	Sensor ground	Intake Air Temperature Sensor (IATS)
54	Accelerator Position Sensor #1 signal input	Accelerator Position Sensor (APS) #1
55	Sensor ground	Accelerator Position Sensor (APS) #1
56	-	
57	Sensor (+5V)	Accelerator Position Sensor (APS) #2
58	Sensor (+5V)	A/C Pressure Transducer (APT)
59	Sensor (+5V)	Accelerator Position Sensor (APS) #1
60	-	
61	Engine speed signal output	Cluster (Tachometer)
62	Fuel consumption signal output	Trip Computer
63	Malfunction Indicator Lamp (MIL) control output	Cluster (Malfunction Indicator Lamp)
64	A/C Compressor Relay control output	A/C Compressor Relay
65	Cooling Fan [Low] control output	Cooling Fan Relay [Low]
66	Cooling Fan [High] control output	Cooling Fan Relay [High]
67	Variable Intake Solenoid Valve #2 control output	Variable Intake Solenoid (VIS) Valve #2 [Intake

67	Variable Intake Solenoid Valve #2 control output	Manifold Side]
68	Throttle Position Sensor signal (PWM) output	ABS/ESP Control Module
69	Cruise "MAIN" lamp control output	Cruise "MAIN" Lamp
70	Fuel Pump Relay control output	Fuel Pump Relay
71	Variable Intake Solenoid Valve #1 control output	Variable Intake Solenoid (VIS) Valve #1 Surge Tank Side]
72	Immobilizer lamp control output	Immobilizer Lamp
73	-	
74	-	
75	-	
76	-	
77	-	
78	Purge Control Solenoid Valve control output	Purge Control Solenoid Valve (PCSV)
79	Wheel Speed Sensor [Low] signal input	Wheel Speed Sensor (WSS)(Without ABS/ESP [Euro-III/IV])
80	Wheel Speed Sensor [High] signal input	Wheel Speed Sensor (WSS)(Without ABS/ESP [Euro-III/IV])

CONNECTOR [C151-2]

Pin No.	Description	Connected to
1	ETC Motor [-] control output	ETC Motor (in ETC Module)
2	ETC Motor [+] control output	ETC Motor (in ETC Module)
3	-	
4	CVVT Oil Temperature Sensor signal input	CVVT Oil Temperature Sensor (OTS)
5	-	
6	-	
7	Engine Coolant Temperature Sensor signal input	Engine Coolant Temperature Sensor (ECTS)
8	Manifold Absolute Pressure Sensor signal input	Manifold Absolute Pressure Sensor (MAPS)
9	-	
10	-	
11	Reference voltage (+5V)	Manifold Absolute Pressure Sensor (MAPS)
12	Battery voltage supply after ignition switch	Ignition Switch
13	Reference voltage (+5V)	Throttle Position Sensor (TPS) #2
14	Sensor ground	Throttle Position Sensor (TPS) #1
15	Reference voltage (+5V)	Camshaft Position Sensor (CMPS) [Bank 2]
16	Reference voltage (+5V)	Throttle Position Sensor (TPS) #1
17	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 2]
18	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1]
19	Ignition Coil (Cylinder #6) control output	Ignition Coil (Cylinder #6)
20	-	
21	Crankshaft Position Sensor [High] signal input	Crankshaft Position Sensor (CKPS)
22	-	
		Knock Sensor (KS) [Bank 1], Knock Sensor (KS)

23	Sensor Shield	KNOCK SENSOR (KS) [Bank 1], KNOCK SENSOR (KS) [Bank 2]
24	Camshaft Position Sensor [Bank 2] signal input	Camshaft Position Sensor (CMPS) [Bank 2]
25	Camshaft Position Sensor [Bank 1] signal input	Camshaft Position Sensor (CMPS) [Bank 1]
26	-	
27	-	
28	Sensor ground	HO2S [B2 / S1] [Except for LEADED]
29	Sensor ground	HO2S [B2 / S2] [Euro-III/IV]
30	Sensor ground	HO2S [B1 / S1] [Except for LEADED]
31	Sensor ground	HO2S [B1 / S2] [Euro-III/IV]
32	Reference voltage (+5V)	Camshaft Position Sensor (CMPS) [Bank 1]
33	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
34	Sensor ground	Manifold Absolute Pressure Sensor (MAPS), CVVT Oil Temperature Sensor (OTS)
35	Power ground	Chassis Ground
36	Power ground	Chassis Ground
37	Power ground	Chassis Ground
38	Power ground	Chassis Ground
39	Power ground	Chassis Ground
40	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4)
41	Crankshaft Position Sensor [Low] signal input	Crankshaft Position Sensor (CKPS)
42	-	
43	-	
44	-	
45	-	
46	-	
47	-	
48	Throttle Position Sensor #1 signal input	Throttle Position Sensor (TPS) #1
49	Heated Oxygen Sensor [Bank 1 / Sensor 1] signal input	HO2S (B1/S1) [Except for LEADED]
50	Heated Oxygen Sensor [Bank 1 / Sensor 2] signal input	HO2S (B1/S2) [Euro-III/IV]
51	Heated Oxygen Sensor [Bank 2 / Sensor 1] signal input	HO2S (B2/S1) [Except for LEADED]
52	Heated Oxygen Sensor [Bank 2 / Sensor 2] signal input	HO2S (B2/S2) [Euro-III/IV]
53	Knock Sensor (KS) [Bank 2] [High] signal input	Knock Sensor (KS) [Bank 2]
54	Knock Sensor (KS) [Bank 2] [Low] signal input	Knock Sensor (KS) [Bank 2]
55	Knock Sensor (KS) [Bank 1] [Low] signal input	Knock Sensor (KS) [Bank 1]
56	Knock Sensor (KS) [Bank 1] [High] signal input	Knock Sensor (KS) [Bank 1]
57	Throttle Position Sensor #2 signal input	Throttle Position Sensor (TPS) #2
58	Sensor ground	Throttle Position Sensor (TPS) #2
59	-	
60	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2)

61	CVVT Oil Control Valve [Bank 2] control output	CVVT Oil Control Valve (OCV) [Bank 2]
62	CVVT Oil Control Valve [Bank 1] control output	CVVT Oil Control Valve (OCV) [Bank 1]
63	Injector (Cylinder #2) control output	Injector (Cylinder #2)
64	Injector (Cylinder #3) control output	Injector (Cylinder #3)
65	-	
66	-	
67	Heated Oxygen Sensor [Bank 2 / Sensor 1] Heater control output	HO2S [B2 / S1] [Except for LEADED]
68	Injector (Cylinder #4) control output	Injector (Cylinder #4)
69	Injector (Cylinder #5) control output	Injector (Cylinder #5)
70	Heated Oxygen Sensor [Bank 1 / Sensor 1] Heater control output	HO2S [B1 / S1] [Except for LEADED]
71	Injector (Cylinder #6) control output	Injector (Cylinder #6)
72	Injector (Cylinder #1) control output	Injector (Cylinder #1)
73	Heated Oxygen Sensor [Bank 2 / Sensor 2] Heater control output	HO2S [B2 / S2] [Euro-III/IV]
74	Heated Oxygen Sensor [Bank 1 / Sensor 2] Heater control output	HO2S [B1 / S2] [Euro-III/IV]
75	-	
76	Battery Power	Battery
77	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3)
78	Ignition Coil (Cylinder #5) control output	Ignition Coil (Cylinder #5)
79	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1)
80	-	

3. TERMINAL INPUT/OUTPUT SIGNAL CONNECTOR [C151-1]

Pin No.	Description	Condition	Type	Level	Test Result
1	2nd CAN [High]	Idle	DC	2.0 ~ 3.0V	2.5V
2	2nd CAN [Low]	Idle	DC	2.0 ~ 3.0V	2.5V
3	-				
4	-				
5	-				
6	-				
7	-				
8	-				
9	-				
10	Power Steering Switch signal input	S/W ON	DC	Max. 0.5V	-0.125V
		S/W OFF		Battery Voltage	13.47V
11	-				
12	-				
13	Clutch Switch signal input				
14	-				

15	Alternator load signal input	Idle	Pulse	Hi: Battery Voltage	13.67V
				Lo: Max 1.5 V	-0.125mV
16	Cruise Switch ground	Idle	DC	Max. 50 mV	22.44mV
17	-				
18	A/C switch "ON" signal input	A/C Relay OFF	DC	Battery Voltage	12.37V
		A/C Relay ON		Max. 1.0V	-25mV
19	-				
20	-				
21	Brake switch signal input	Pedal Release	DC	Battery Voltage	13.97V
		Pedal Push		Max. 0.5V	-25mV
22	-				
23	Brake lamp signal input	Pedal Release	DC	Max. 0.5V	-225mV
		Pedal Push		Battery Voltage	12.97V
24	-				
25	Cruise Switch signal input	All Release	DC	4.3 ~ 4.7V	4.39V
		Main SW		Battery Voltage	13.37V
		Set SW		1.3 ~ 1.7V	1.38V
		Resume SW		2.8 ~ 3.2V	2.82V
		Cancel SW		-0.2 ~ 0.2V	-37.54mV
26	A/C thermal switch signal input	A/C OFF	DC	Max. 1.0V	-25mV
		A/C ON		Battery Voltage	12.57V
27	Diagnostic Data Line (K-Line)	When transmitting	Pulse	Hi: Min. Vbatt × 80%	11.57V
				Lo: Max. Vbatt × 20%	175mV
		When receiving		Hi: Min. Vbatt × 70%	
				Lo: Max. Vbatt × 30%	
28	-				
29	-				
30	-				
31	-				
32	A/C Pressure Transducer signal input	A/C OFF	DC	0 ~ 5V	1.36V
		A/C ON			1.83V
33	Sensor ground	Idle	DC	Max. 50 mV	22.66mV
34	-				
35	-				
36	-				
37	-				
38	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0 V	-25mV
		IG ON		Battery Voltage	12.77V
39	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0 V	-25mV
		IG ON		Battery Voltage	12.77V

40	Battery voltage supply after main relay	IG OFF	DC	Max. 1.0 V	-25mV
		IG ON		Battery Voltage	12.37V
41	CAN [High]	Recessive	Pulse	2.0 ~ 3.0 V	2.4V
		Dominant		2.75~4.5 V	3.56V
42	CAN [Low]	Recessive	Pulse	2.0 ~ 3.0 V	2.42V
		Dominant		0.5~2.25 V	1.62V
43	Main Relay control output	Relay ON	DC	Battery Voltage	0.875V
		Relay OFF		Max. 1.0V	12.47V
44	Intake Air Temperature Sensor signal input	Idle	Analog	0 ~ 5V	2.05V
45	Immobilizer communication line	When communicating after IG ON	Pulse	Hi: Min. 8.5V	11.87V
				Lo: Max. 3.5V	875mV
46	-				
47	Mass Air Flow Sensor signal input	Idle	Pulse	Hi: Vcc	4.97V
				Lo: Max. 0.5V	70mV
48	Sensor ground	Idle	DC	Max. 50 mV	22.52mV
49	Accelerator Position Sensor #2 signal input	C.T	Analog	0.3 ~ 0.9V	0.38V
		W.O.T		1.5 ~ 3.0V	2V
50	-				
51	Cruise "SET" lamp control output	Cruise OFF	DC	Battery Voltage	12.57V
		Cruise ON		Max. 1.0V	-25mV
52	Vehicle speed signal input	Vehicle Run	Pulse	Hi: Min. 5.0V	11.07V
				Lo: Max. 1.0V	-125mV
53	Sensor ground	Idle	DC	Max. 50 mV	22.37mV
54	Accelerator Position Sensor #1 signal input	C.T	Analog	0.3 ~ 0.9V	819mV
		W.O.T		4.0 ~ 4.8V	4.01V
55	Sensor ground	Idle	DC	Max. 50mV	22.6mV
56	-				
57	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V	4.95V
		IG ON		4.9 ~ 5.1V	-10mV
58	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V	4.95V
		IG ON		4.9 ~ 5.1V	-10mV
59	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V	4.95V
		IG ON		4.9 ~ 5.1V	-10mV
60	-				
61	Engine speed signal output	Idle	Pulse	Hi: Battery Voltage	13.57V
				Lo: Max. 0.5V	-25mV
				20 ~ 26Hz	
62	Fuel consumption signal output	Idle	Pulse	Hi: Battery Voltage	13.57V
				Lo: Max. 0.5V	-25mV
63	Malfunction Indicator Lamp (MIL) control output	Lamp OFF	DC	Hi: Battery Voltage	13.37V
		Lamp ON		Lo: Max. 2.0V	-25mV

64	A/C Compressor Relay control output	A/C OFF	DC	Battery Voltage	13.97V
		A/C ON		Max. 1.0V	175mV
65	Cooling Fan [Low] control output	Fan OFF	DC	Battery Voltage	13.77V
		Fan ON		Max. 1.0V	175mV
66	Cooling Fan [High] control output	Fan OFF	DC	Battery Voltage	13.57V
		Fan ON		Max. 1.0V	-25mV
67	Variable Intake Solenoid Valve #2 control output	Active	DC	Max. 1.0 V	13.77
		Inactive		Battery Voltage	-25mV
68	Throttle Position Sensor signal (PWM) output	Idle	Pulse	Hi: Battery Voltage	13.37V
				Lo: 0 ~ 0.5 V	-25mV
69	Cruise "MAIN" lamp control output	Cruise OFF	DC	Battery Voltage	12.37V
		Cruise ON		Max. 1.0V	-25mV
70	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage	12.57V
		Relay ON		Max. 1.0V	-25mV
71	Variable Intake Solenoid Valve #1 control output	Active	DC	Max. 1.0 V	175mV
		Inactive		Battery Voltage	13.77V
72	Immobilizer lamp control output	Lamp OFF	DC	Battery Voltage	12.77V
		Lamp ON		Max. 1.0V	-25mV
73	-				
74	-				
75	-				
76	-				
77	-				
78	Purge Control Solenoid Valve control output	Inactive	Pulse	Hi: Battery Voltage	13.83V
		Active		Lo: Max. 1.0V	31.54mV
79	Wheel Speed Sensor [Low] signal input				
80	Wheel Speed Sensor [High] signal input				

CONNECTOR [C151-2]

Pin No.	Description	Condition	Type	Level	Test Result
1	ETC Motor [-] control output	Idle	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max . 1.0V	-125mV
2	ETC Motor [+] control output	Idle	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max . 1.0V	-325mV
3	-				
4	CVVT Oil Temperature Sensor signal input	Idle	Analog	0 ~ 5.0V	282mV at 96°C
5	-				
6	-				
7	Engine Coolant Temperature Sensor signal input	Idle	Analog	0 ~ 5.0V	1.88V

8	Manifold Absolute Pressure Sensor signal input	IG ON	Analog	3.9 ~ 4.1V	3.96V
		Idle		0.8 ~ 1.6V	1.31V
9	-				
10	-				
11	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V	4.91V
		IG ON		4.9 ~ 5.1V	-50mV
12	Battery voltage supply after ignition switch	IG OFF	DC	Max. 0.5 V	13.87V
		IG ON		Battery Voltage	-125mV
13	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V	4.89V
		IG ON		4.9 ~ 5.1V	-70mV
14	Sensor ground	Idle	DC	Max. 50 mV	19.77mV
15	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V	4.91V
		IG ON		4.9 ~ 5.1V	-50mV
16	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V	4.91V
		IG ON		4.9 ~ 5.1V	-50mV
17	Sensor ground	Idle	DC	Max. 50 mV	21.1mV
18	Sensor ground	Idle	DC	Max. 50 mV	20.87mV
19	Ignition Coil (Cylinder #6) control output	Idle	Pulse	1st Voltage: 200~400V	278V
				ON Voltage: Max. 2V	1.97V
20	-				
21	Crankshaft Position Sensor [High] signal input	Idle	SINE WAVE	Vp_p : Min.1.0V	41.6V
22	-				
23	Sensor Shield	Idle	DC	Max. 50 mV	21.41mV
24	Camshaft Position Sensor [Bank 2] signal input	Idle	Pulse	Hi: Vcc	4.95V
				Lo: Max . 0.5V	-10mV
25	Camshaft Position Sensor [Bank 1] signal input	Idle	Pulse	Hi: Vcc	4.95V
				Lo: Max . 0.5V	-10mV
26	-				
27	-				
28	Sensor ground	Idle	DC	Max. 50 mV	20.73mV
29	Sensor ground	Idle	DC	Max. 50 mV	21.9mV
30	Sensor ground	Idle	DC	Max. 50 mV	20.16mV
31	Sensor ground	Idle	DC	Max. 50 mV	20.63mV
32	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V	4.91V
		IG ON		4.9 ~ 5.1V	-50mV
33	Sensor ground	Idle	DC	Max. 50 mV	22.52mV
34	Sensor ground	Idle	DC	Max. 50 mV	20.99mV
35	Power ground	Idle	DC	Max. 50 mV	
36	Power ground	Idle	DC	Max. 50 mV	
37	Power ground	Idle	DC	Max. 50 mV	

38	Power ground	Idle	DC	Max. 50 mV	
39	Power ground	Idle	DC	Max. 50 mV	
40	Ignition Coil (Cylinder #4) control output	Idle	Pulse	1st Voltage: 2300~400V	294V
				ON Voltage: Max. 2V	1.93V
41	Crankshaft Position Sensor [Low] signal input	Idle	SINE WAVE	Vp_p: Min.1.0V	8.24V
42	-				
43	-				
44	-				
45	-				
46	-				
47	-				
48	Throttle Position Sensor #1 signal input	C.T	Analog	0.25 ~ 0.9V	0.68V
		W.O.T		Min. 4.0V	4.27V
49	Heated Oxygen Sensor [Bank 1 / Sensor 1] signal input	Racing	DC	Rich: 0.6 ~ 1.0V	774mV
				Lean: 0 ~ 0.4V	137mV
50	Heated Oxygen Sensor [Bank 1 / Sensor 2] signal input	Racing	DC	Rich: 0.6 ~ 1.0V	
				Lean: 0 ~ 0.4V	
51	Heated Oxygen Sensor [Bank 2 / Sensor 1] signal input	Racing	DC	Rich: 0.6 ~ 1.0V	705.2mV
				Lean: 0 ~ 0.4V	82mV
52	Heated Oxygen Sensor [Bank 2 / Sensor 2] signal input	Racing	DC	Rich: 0.6 ~ 1.0V	
				Lean: 0 ~ 0.4V	
53	Knock Sensor (KS) [Bank 2] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
54	Knock Sensor (KS) [Bank 2] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
55	Knock Sensor (KS) [Bank 1] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
56	Knock Sensor (KS) [Bank 1] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3 V	
		Normal		0 V	
57	Throttle Position Sensor #2 signal input	C.T	Analog	Min. 4.0V	4.23V
		W.O.T		0.25 ~ 0.9V	703mV
58	Sensor ground	Idle	DC	Max. 50 mV	21.64mV
59	-				
60	Ignition Coil (Cylinder #2) control output	Idle	Pulse	1st Voltage: 200~400V	305V
				ON Voltage: Max. 2V	1.85V
61	CVVT Oil Control Valve [Bank 2] control output	Idle	Pulse	Battery Voltage	14.45V
				Max. 1.0V	50mV
62	CVVT Oil Control Valve [Bank 1] control output	Idle	Pulse	Battery Voltage	14.47V
				Max. 1.0V	75mV
	Injector (Cylinder #2) control			Battery Voltage	14.06V

63	Injector (Cylinder #2) control output	Idle	Pulse	Battery Voltage	14.07V
				Max. 1.0V	44.2mV
64	Injector (Cylinder #3) control output	Idle	Pulse	Battery Voltage	14V
				Max. 1.0V	38.31mV
65	-				
66	-				
67	Heated Oxygen Sensor [Bank 2 / Sensor 1] Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max. 1.0V	275mV
68	Injector (Cylinder #4) control output	Idle	Pulse	Hi: Battery Voltage	13.96V
				Lo: Max. 1.0V	55.71mV
69	Injector (Cylinder #5) control output	Idle	Pulse	Hi: Battery Voltage	14V
				Lo: Max. 1.0V	40.82mV
70	Heated Oxygen Sensor [Bank 1 / Sensor 1] Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max. 1.0V	275mV
71	Injector (Cylinder #6) control output	Idle	Pulse	Hi: Battery Voltage	13.95mV
				Lo: Max. 1.0V	55.77mV
72	Injector (Cylinder #1) control output	Idle	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max. 1.0V	56.7mV
73	Heated Oxygen Sensor [Bank 2 / Sensor 2] Heater control output	Engine Run	Pulse	Hi: Battery Voltage	13.87V
				Lo: Max. 1.0V	275mV
74	Heated Oxygen Sensor [Bank 1 / Sensor 2] Heater control output	Engine Run	Pulse	Hi: Battery Voltage	14.07V
				Lo: Max. 1.0V	275mV
75	-				
76	Battery Power	Always	DC	Battery Voltage	12.39V
				1.0 mA or below 1.5 mA	0.34mA
77	Ignition Coil (Cylinder #3) control output	Idle	Pulse	1st Voltage: 200~400V	289V
				ON Voltage: Max. 2V	1.87V
78	Ignition Coil (Cylinder #5) control output	Idle	Pulse	1st Voltage: 200~400V	279V
				ON Voltage: Max. 2V	1.93V
79	Ignition Coil (Cylinder #1) control output	Idle	Pulse	1st Voltage: 200~400V	269V
				ON Voltage: Max. 2V	1.91V
80	-				

Fuel System

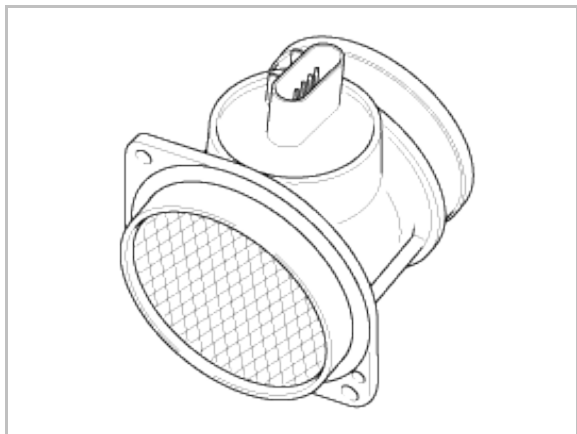
Engine Control System - Mass Air Flow
Sensor (MAFS)



INSPECTION

FUNCTION AND OPERATION PRINCIPLE

Mass Air Flow Sensor (MAFS) is a hot-film type sensor and is located in between the air cleaner and the throttle body. It consists of a tube, a sensor assembly and honeycomb cell and detects intake air quantity flowing into the intake manifold. Air flows from the air cleaner assembly through the honeycomb cell and over the hot film element. At this time, heat transfer is generated by convection and this sensor loses its energy. This sensor detects the mass air flow by using the energy loss and transfers the information to the PCM by frequency. The PCM calculates fuel quantity and ignition timing.



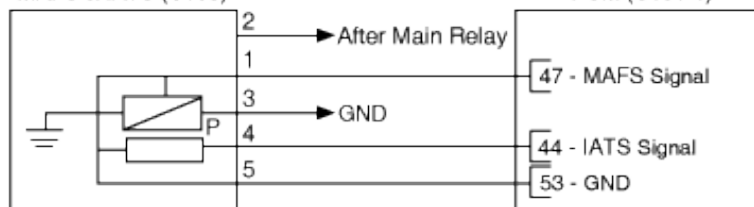
SPECIFICATION

Air Flow (kg/h)	Output Frequency (Hz)
12.6 kg/h	2,617Hz
18.0 kg/h	2,958Hz
23.4 kg/h	3,241Hz
32.4 kg/h	3,653Hz
43.2 kg/h	4,024Hz
57.6 kg/h	4,399Hz
72.0 kg/h	4,704Hz
108.0 kg/h	5,329Hz
144.0 kg/h	5,897Hz
198.0 kg/h	6,553Hz
270.0 kg/h	7,240Hz
360.0 kg/h	7,957Hz
486.0 kg/h	8,738Hz
666.0 kg/h	9,644Hz
900.0 kg/h	10,590Hz

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]

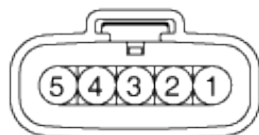
MAFS & IATS (C168)



[CONNECTION INFORMATION]

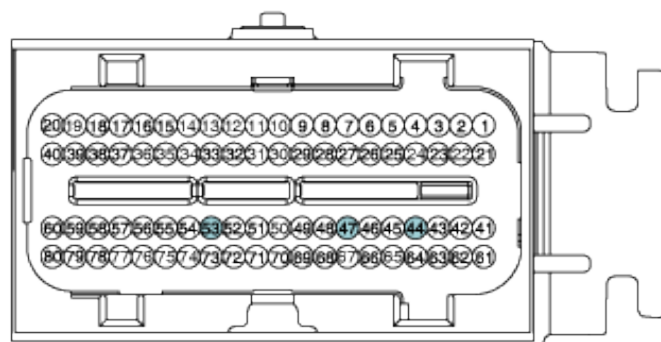
Terminal	Connected to	Function
1	PCM C151-1 (47)	MAFS Signal
2	Main Relay	Battery Voltage (B+)
3	Chassis Ground	Ground
4	PCM C151-1 (44)	IATS Signal
5	PCM C151-1(53)	Sensor Ground

[HARNESS CONNECTORS]



C168

MAFS & IATS



C151-1

PCM

COMPONENT INSPECTION

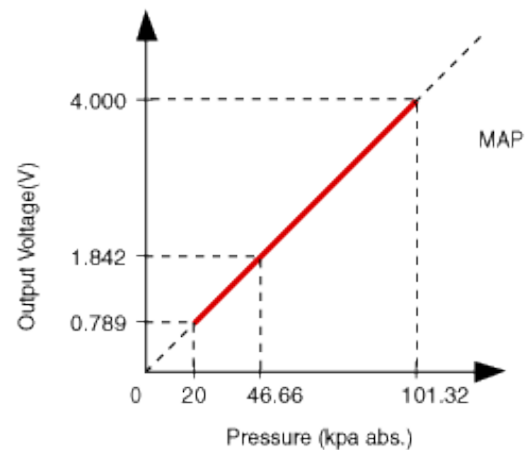
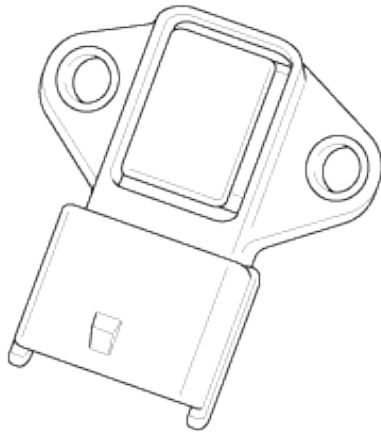
1. Check the MAFS visually.
 - A. Mounting direction correct.
 - B. Any contamination, corrosion or damage on connector.
 - C. Air cleaner's clogging or wet.
 - D. MAFS cylinder's deforming or blocking by any foreign material.
2. Check any leakage on intake system and intercooler system.

Fuel System

Engine Control System - Manifold Absolute
Pressure Sensor (MAPS)

INSPECTION

FUNCTION AND OPERATION PRICIPLE



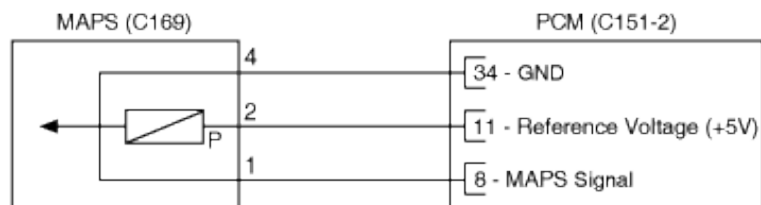
Manifold Absolute Pressure Sensor (MAPS) is speed-density type sensor and is installed on the surge tank. This MAPS senses absolute pressure in surge tank and transfers this analog signal proportional to the pressure to the PCM. The PCM calculates the intake air quantity and engine speed based on this signal. This MAPS consists of piezo-electric element and hybrid IC that amplifies the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor. 100% vacuum and the manifold pressure applies to both sides of it respectively. That is, this sensor outputs the silicon variation proportional to pressure change by voltage.

SPECIFICATION

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

CIRCUIT DIAGRAM

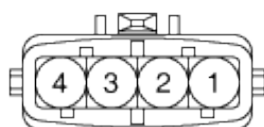
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

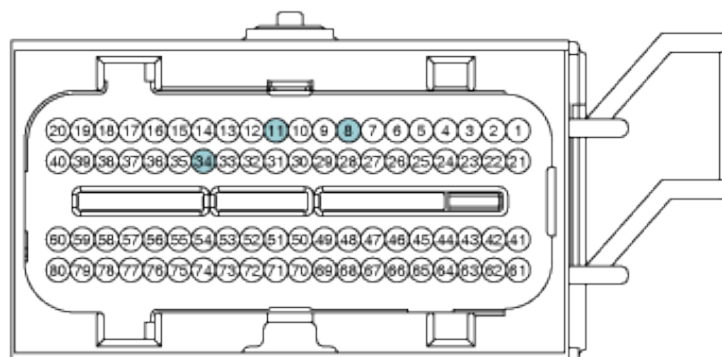
Terminal	Connected to	Function
1	PCM C151-2 (8)	MAPS Signal
2	PCM C151-2 (11)	Reference Voltage (+5V)
3	-	-
4	PCM C151-2 (34)	Sensor ground

[HARNESS CONNECTORS]



C169

MAPS



C151-2

PCM

COMPONENT INSPECTION

1. Connect a scantool on Diagnosis Link Connector (DLC).
2. Check MAPS output voltage at idle and IG ON.

Condition	Output Voltage (V)
Idle	0.8V ~ 1.6V
IG ON	3.9V ~ 4.1V

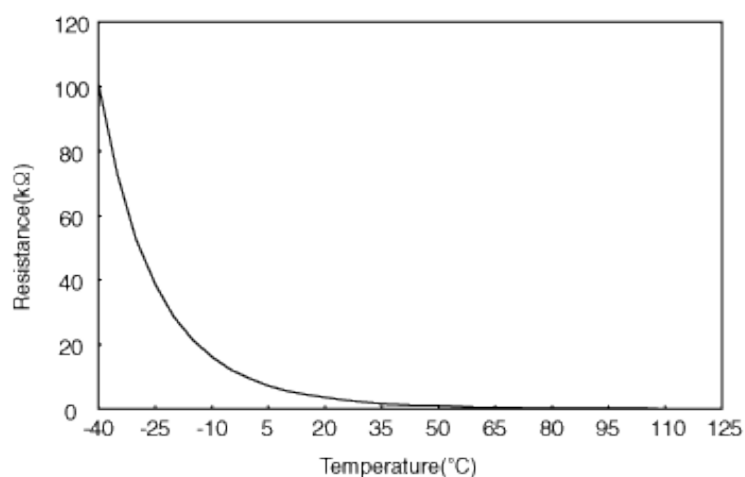
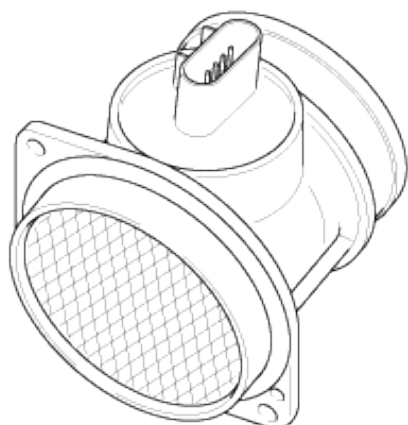
Fuel System

Engine Control System - Intake Air
Temperature Sensor (IATS)



INSPECTION

FUNCTION AND OPERATION PRICIPLE



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

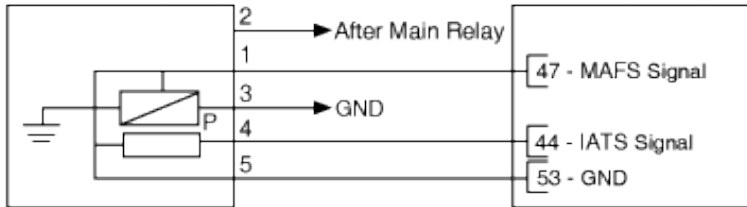
SPECIFICATION

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

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]

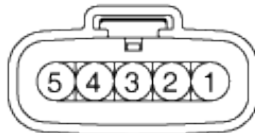
MAFS & IATS (C168)



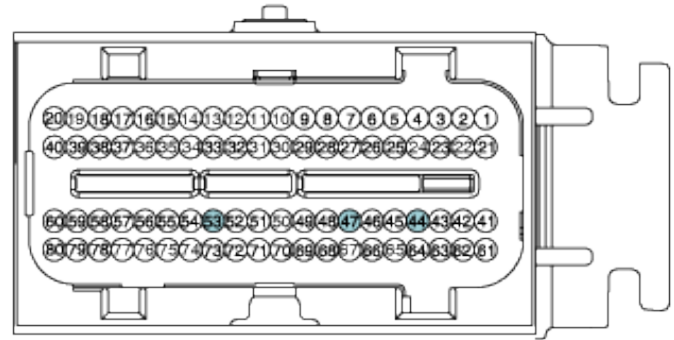
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C151-1 (47)	MAFS Signal
2	Main Relay	Battery Voltage (B+)
3	Chassis Ground	Ground
4	PCM C151-1 (44)	IATS Signal
5	PCM C151-1(53)	Sensor Ground

[HARNESS CONNECTORS]



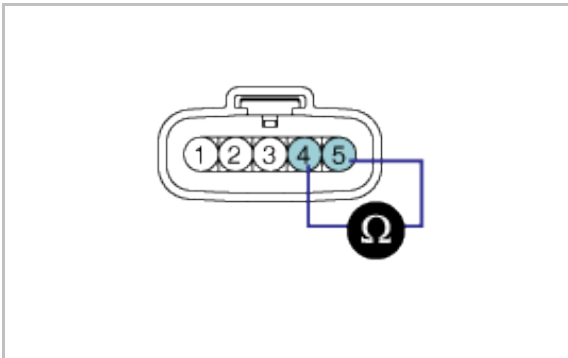
C168
MAFS & IATS



C151-1
PCM

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect IATS connector.
3. Measure resistance between IATS terminals 4 and 5.



4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

Fuel System

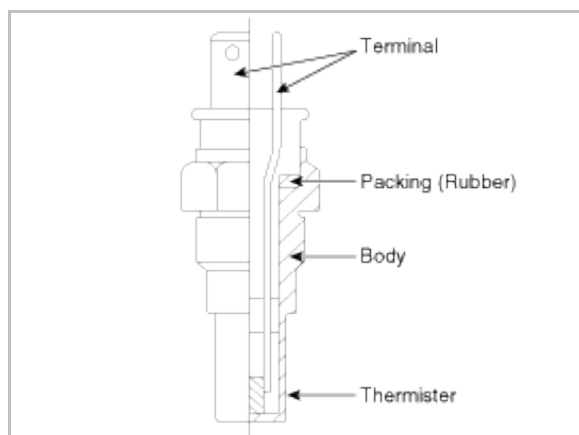
Engine Control System - Engine Coolant
Temperature Sensor (ECTS)



INSPECTION

FUNCTION AND OPERATION PRICIPLE

Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases. The reference 5 V in the PCM is supplied to the ECTS via a resistor in the PCM. That is, the resistor in the PCM 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 PCM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.

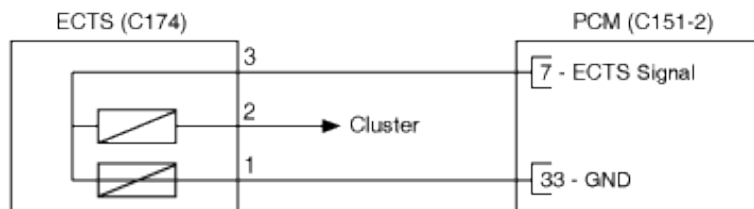


SPECIFICATION

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

CIRCUIT DIAGRAM

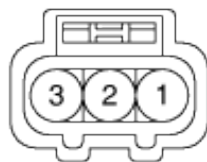
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

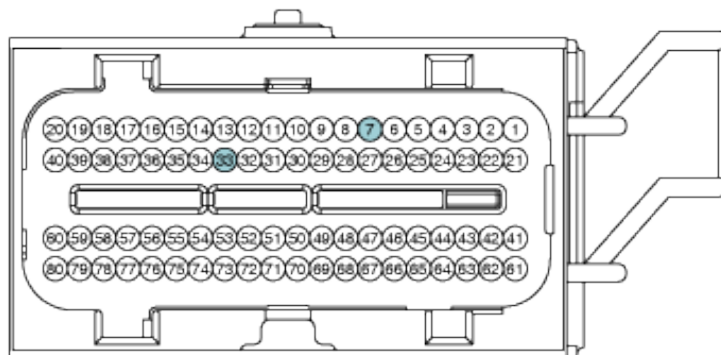
Terminal	Connected to	Function
1	PCM C151-2 (33)	Sensor ground
2	Cluster	-
3	PCM C151-2 (7)	ECTS Signal

[HARNESS CONNECTORS]



C174

ECTS

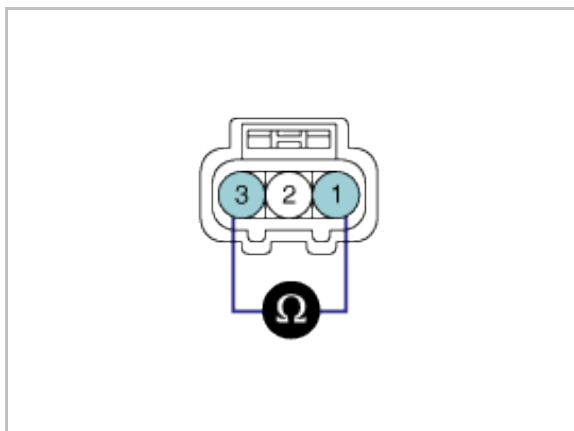


C151-2

PCM

COMPONENT INSPECTION

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



5. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

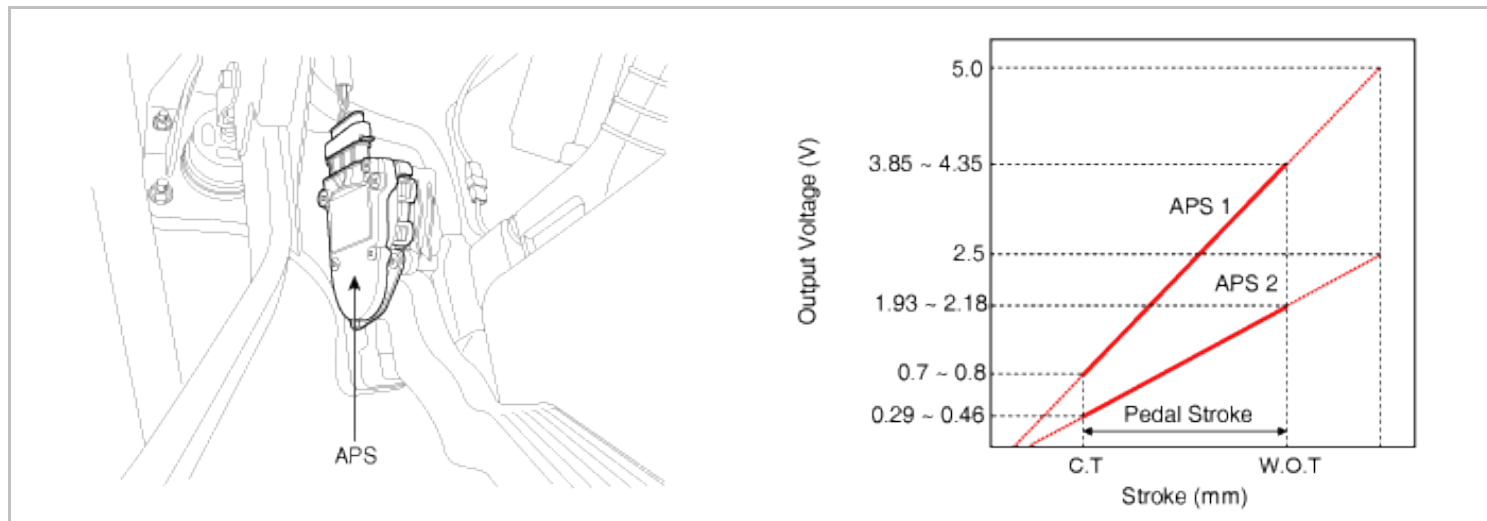
Fuel System

Engine Control System - Accelerator Position
Sensor (APS)



INSPECTION

FUNCTION AND OPERATION PRICIPLE



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

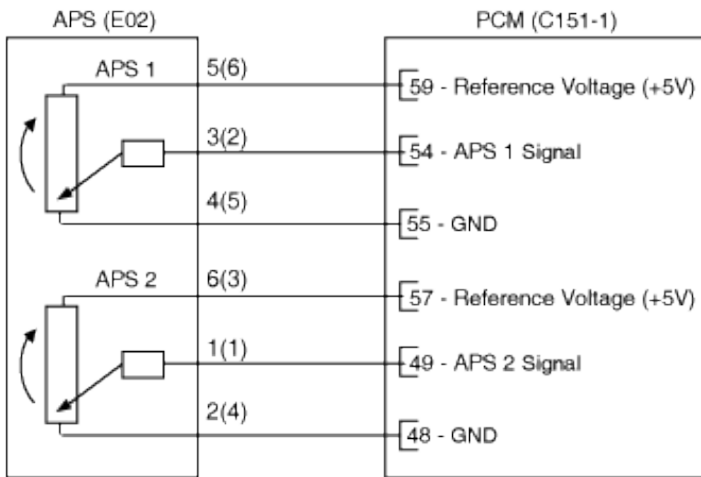
SPECIFICATION

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

Item	Sensor Resistance
APS1	0.7 ~ 1.3kΩ at 20°C (68°F)
APS2	1.4 ~ 2.6kΩ at 20°C (68°F)

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



* () : With Adjust Pedal

[CONNECTION INFORMATION]

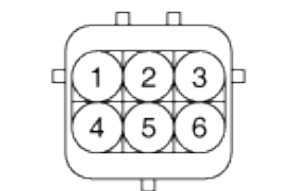
[WITH ADJUSTABLE PEDAL]

Terminal	Connected to	Function
1	PCM C151-1 (49)	APS 2 Signal
2	PCM C151-1 (54)	APS 1 Signal
3	PCM C151-1 (57)	APS 2 Reference Voltage (+5V)
4	PCM C151-1 (48)	APS 2 Ground
5	PCM C151-1 (55)	APS 1 Ground
6	PCM C151-1 (59)	APS 1 Reference Voltage (+5V)

[WITHOUT ADJUSTABLE PEDAL]

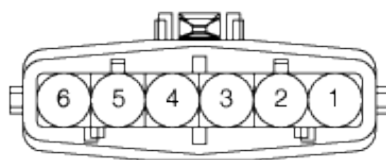
Terminal	Connected to	Function
1	PCM C151-1 (49)	APS 2 Signal
2	PCM C151-1 (48)	APS 2 Ground
3	PCM C151-1 (54)	APS 1 Signal
4	PCM C151-1 (55)	APS 1 Ground
5	PCM C151-1 (59)	APS 1 Reference Voltage (+5V)
6	PCM C151-1 (57)	APS 2 Reference Voltage (+5V)

[HARNESS CONNECTORS]



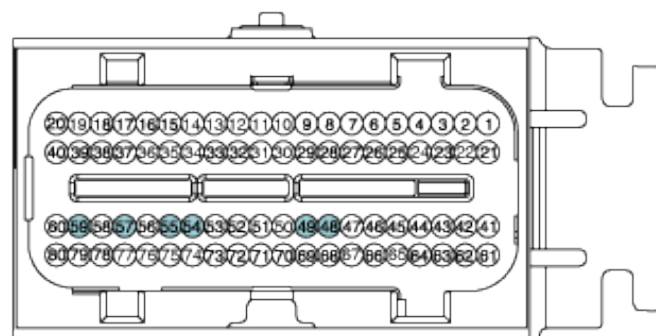
WITH ADJUSTABLE PEDAL

E02
APS



WITHOUT ADJUSTABLE PEDAL

E02
APS



C151-1
PCM

COMPONENT INSPECTION

1. Connect a scantool on Diagnosis Link Connector (DLC).
2. Start engine and check output voltages of APS 1 and 2 at C.T and W.O.T.

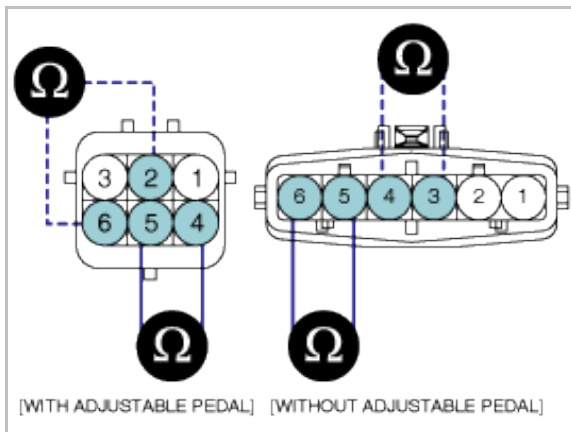
Specification

Condition	Output Voltage (V)	
	APS1	APS2
C.T	0.70 ~ 0.80	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

3. Turn ignition switch OFF and disconnect the scantool from the DLC.
4. Disconnect APS connector and measure resistance between APS terminals 5(6) and 4(5) (APS 1).

Specification: Refer to SPECIFICATION.

5. Disconnect APS connector and measure resistance between APS terminals 6(3) and 2(4) (APS 2).



Specification: Refer to SPECIFICATION.

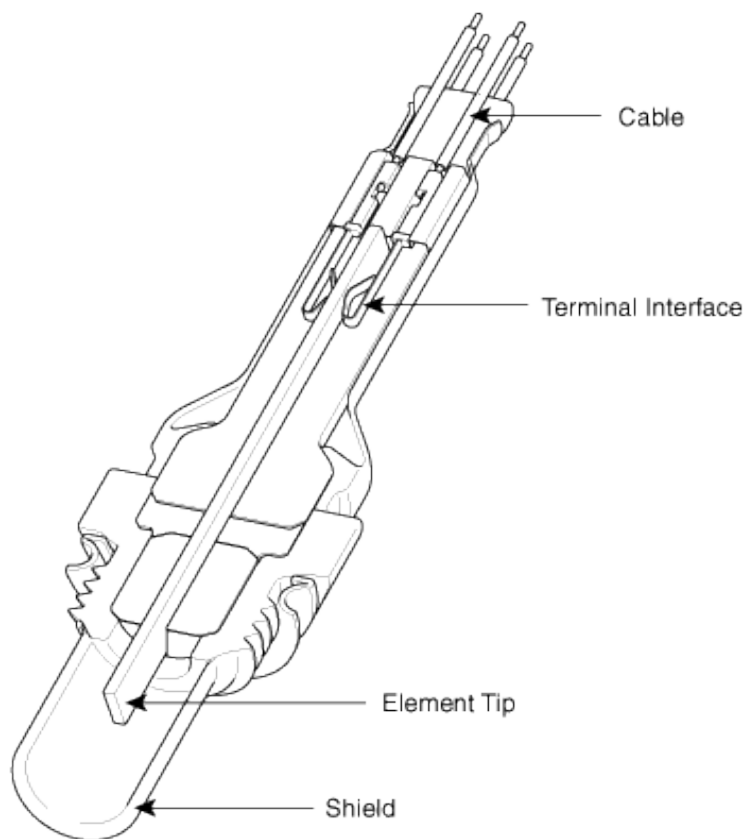
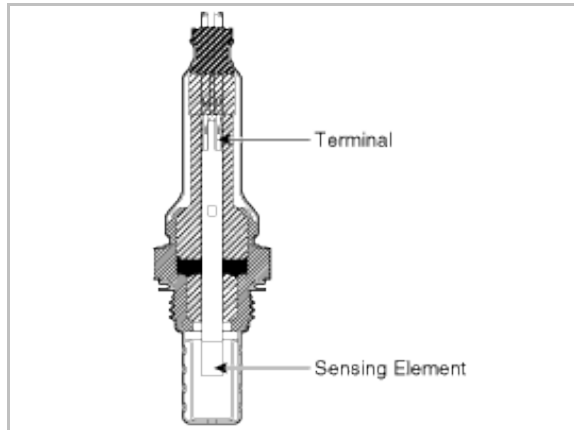
Fuel System

Engine Control System - Heated Oxygen
Sensor (HO2S)

INSPECTION

FUNCTION AND OPERATION PRICIPLE

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



SPECIFICATION

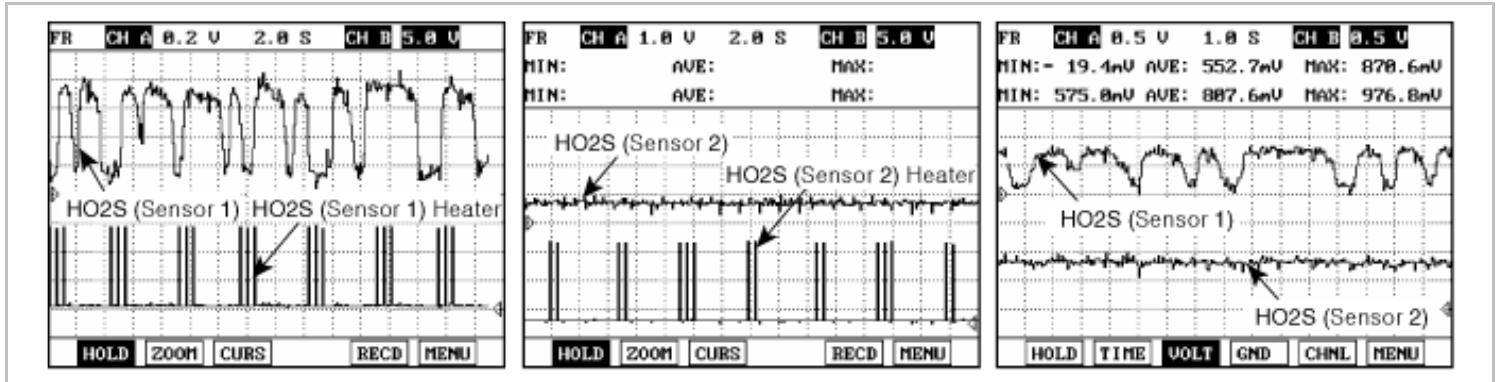
A/F Ratio	Output Voltage (V)
RICH	0.80 ~ 0.92
LEAN	0.1

Item	Specification
------	---------------

Heater Resistance (Ω)

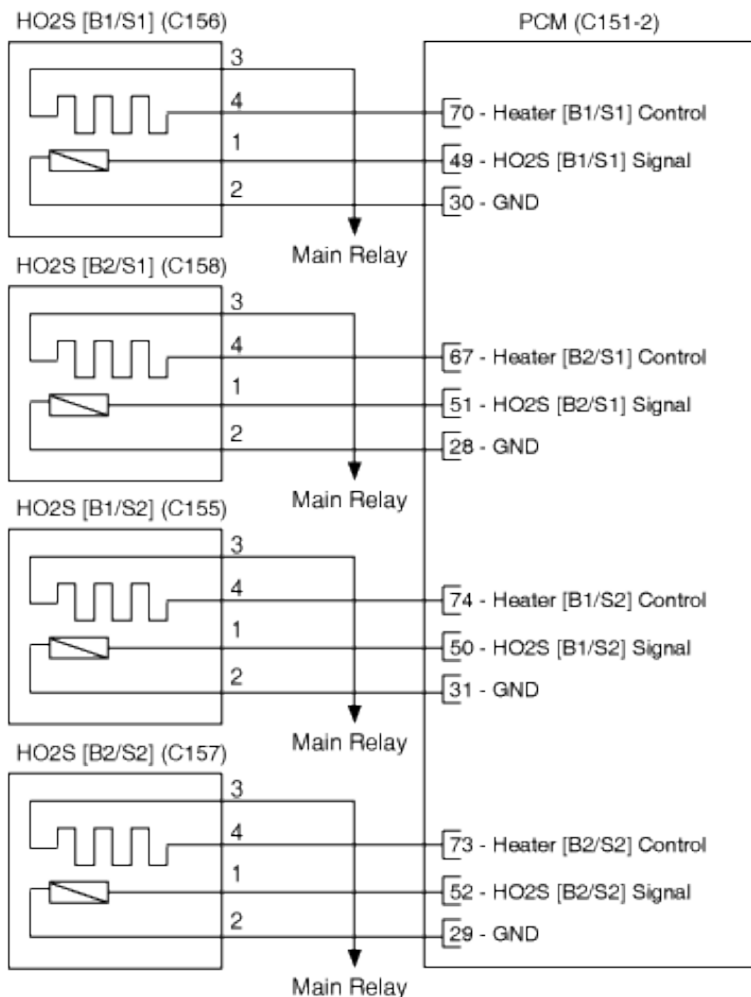
3.0 ~ 4.0 Ω at 21°C (69.8°F)

WAVEFORM



CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

HO2S [B1/S1]

Terminal	Connected to	Function
1	PCM C151-2 (49)	HO2S [B1/S1] Signal
2	PCM C151-2 (30)	Sensor ground
3	Main Relay	Battery Voltage (B+)
4	PCM C151-2 (70)	Heater [B1/S1] Control

HO2S [B2/S1]

Terminal	Connected to	Function
1	PCM C151-2 (51)	HO2S [B2/S1] Signal
2	PCM C151-2 (28)	Sensor ground
3	Main Relay	Battery Voltage (B+)
4	PCM C151-2 (67)	Heater [B2/S1] Control

HO2S [B1/S2]

Terminal	Connected to	Function
1	PCM C151-2 (50)	HO2S [B1/S2] Signal
2	PCM C151-2 (31)	Sensor ground
3	Main Relay	Battery Voltage (B+)
4	PCM C151-2 (74)	Heater [B1/S2] Control

HO2S [B2/S2]

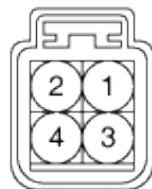
Terminal	Connected to	Function
1	PCM C151-2 (52)	HO2S [B2/S2] Signal
2	PCM C151-2 (29)	Sensor ground
3	Main Relay	Battery Voltage (B+)
4	PCM C151-2 (73)	Heater [B2/S2] Control

[HARNESS CONNECTORS]



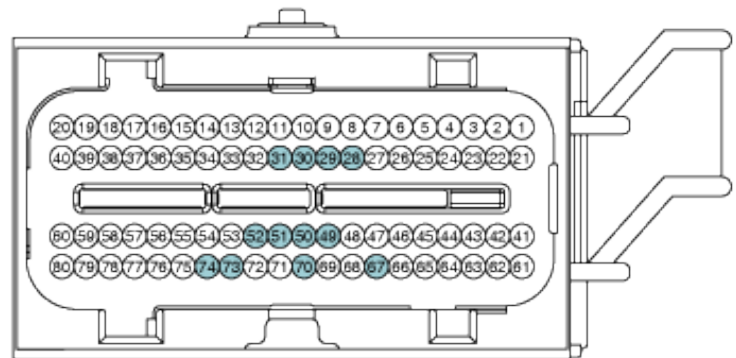
C156, C158

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



C155, C157

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



C151-2

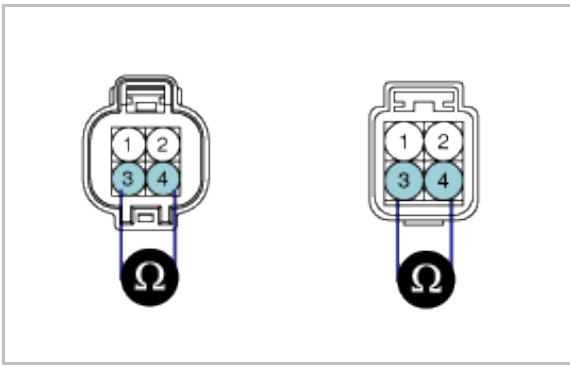
PCM

COMPONENT INSPECTION

1. Check signal waveform of HO2S using a scantool.

Specification: Refer to "waveform".

2. Disconnect the HO2S connector.
3. Measure resistance between HO2S heater terminals 3 and 4.



4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

Fuel System

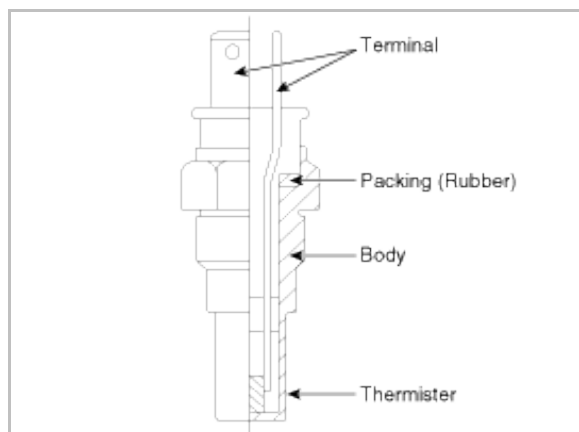
Engine Control System - CWT Oil
Temperature Sensor (OTS)



INSPECTION

FUNCTION AND OPERATION PRICIPLE

The CVVT Oil Temperature Sensor (OTS) is a negative coefficient thermistor used by the PCM tl measure engine oil temperature for the purpose of adjusting CVVT calculations.

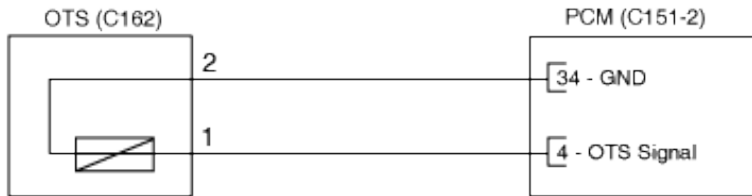


SPECIFICATION

Temperature		Resistance (k Ω)
$^{\circ}\text{C}$	$^{\circ}\text{F}$	
-40	-40	52.0
-20	-4	16.5
0	32	6.0
20	68	2.45
40	104	1.10
60	140	0.544
80	176	0.290
100	212	0.164
120	248	0.099

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



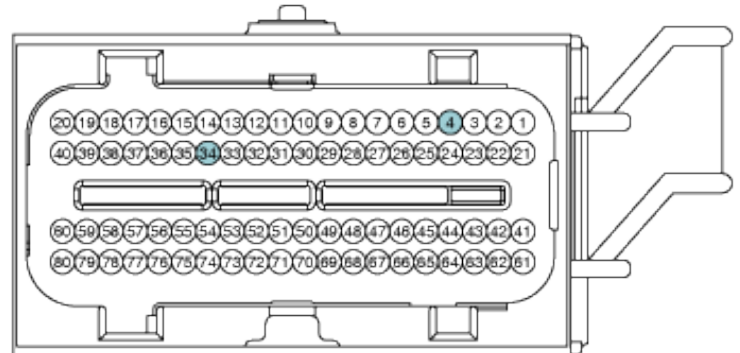
[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C151-2 (4)	OTS Signal
2	PCM C151-2 (34)	Sensor ground

[HARNESS CONNECTORS]



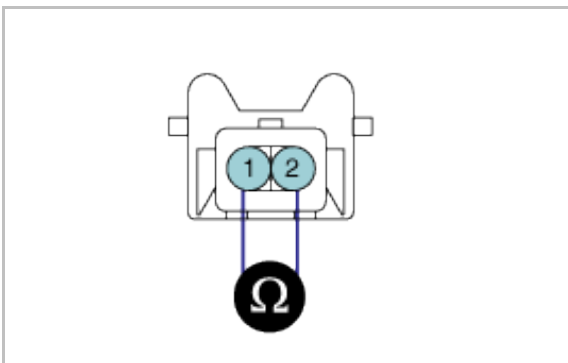
C162
OTS



C151-2
PCM

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect OTS connector.
3. Remove the OTS.
4. After immersing the thermistor of the sensor into water (or engine coolant), measure resistance between OTS terminals 1 and 2.



5. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

Fuel System

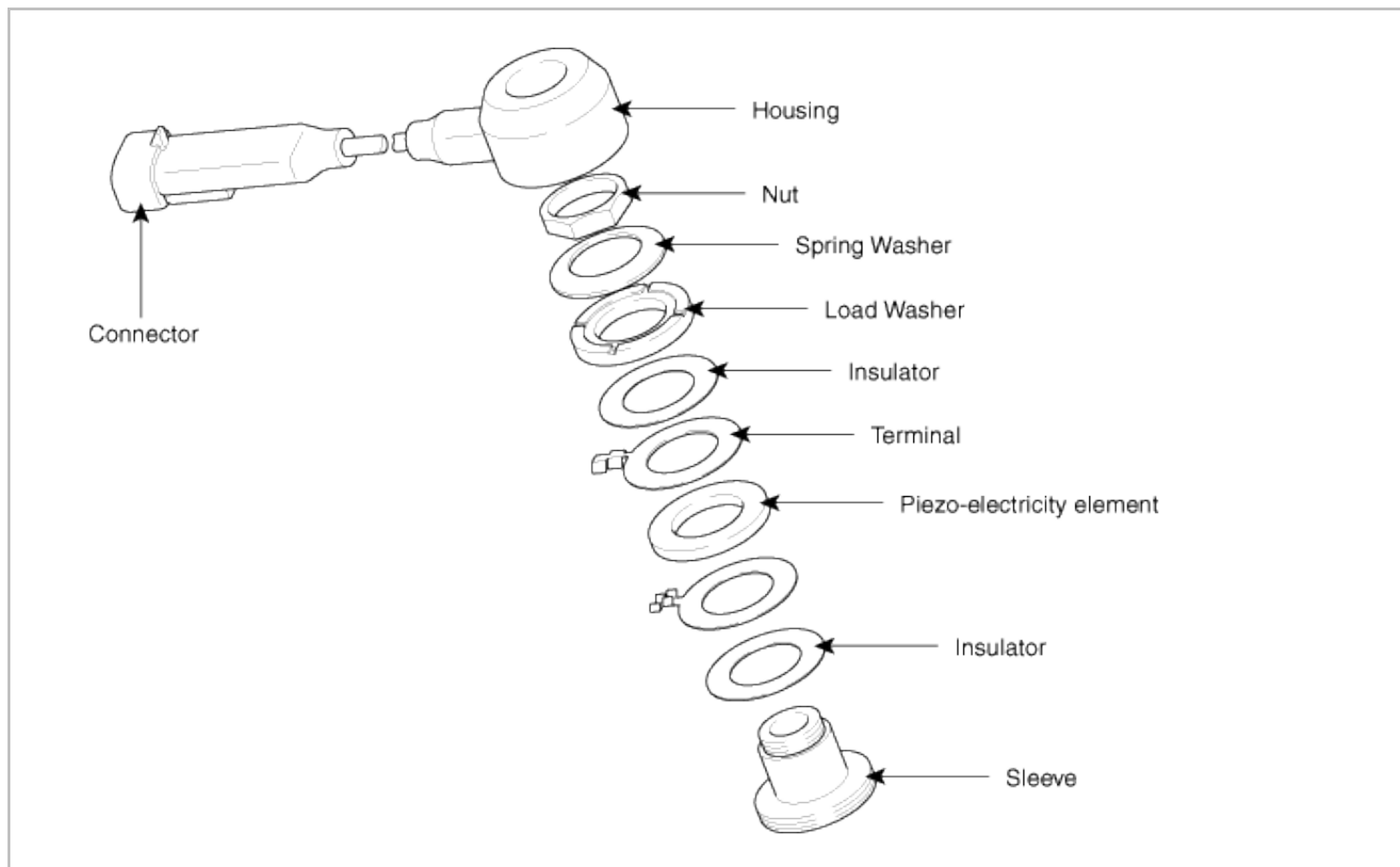
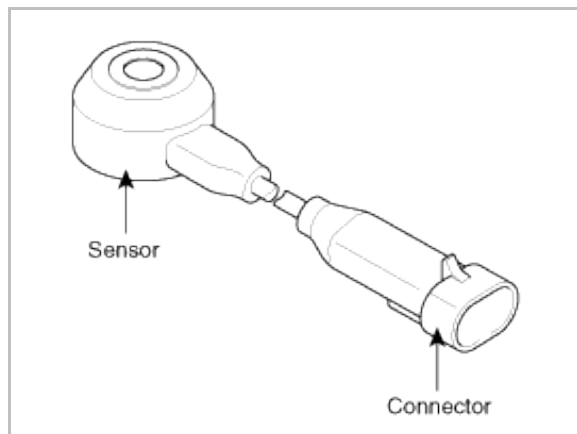
Engine Control System - Knock Sensor (KS)



INSPECTION

FUNCTION AND OPERATION PRICIPLE

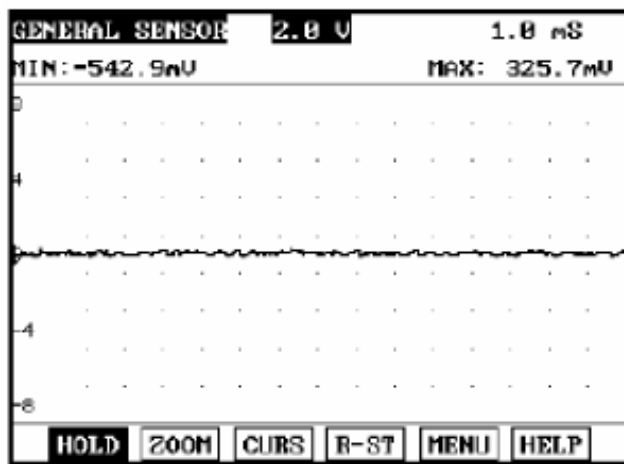
Knocking is a phenomenon characterized by undesirable vibration and noise and can cause engine damage. Knock Sensor (KS) senses engine knocking and the two sensors are installed inside the V-valley of the cylinder block. When knocking occurs, the vibration from the cylinder block is applied as pressure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



SPECIFICATION

Item	Specification
Capacitance (pF)	950 ~ 1,350pF

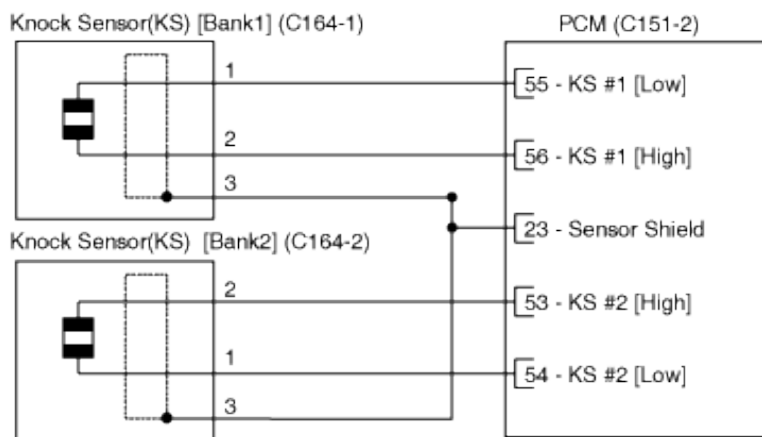
WAVEFORM



The knock sensor is installed at cycliner block to detect the vibration effectively during engine running.
The above waveform shows the signal waveform of knock sensor when knock doesn't happen. Generally, knock signal has more noise than other sensor.

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

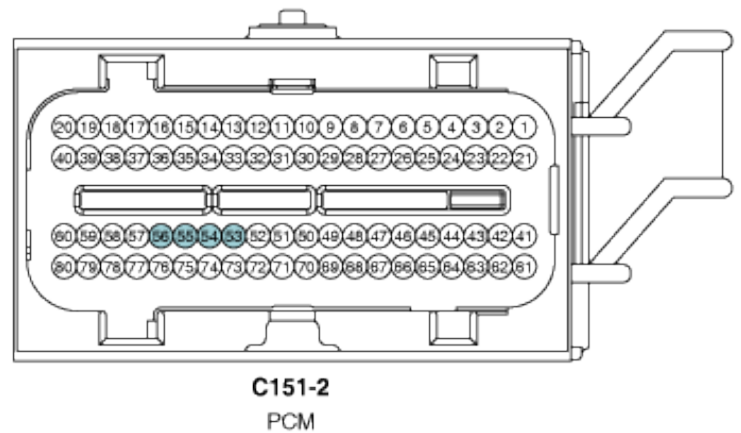
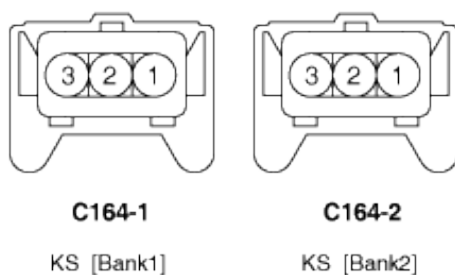
KS [Bank1]

Terminal	Connected to	Function
1	PCM C151-2 (55)	KS #1 [Low] signal
2	PCM C151-2 (56)	KS #1 [High] signal
3	PCM C151-2 (23)	Shield ground

KS [Bank2]

Terminal	Connected to	Function
1	PCM C151-2 (54)	KS #2 [Low] signal
2	PCM C151-2 (53)	KS #2 [High] signal
3	PCM C151-2 (23)	Shield ground

[HARNESS CONNECTORS]



Fuel System

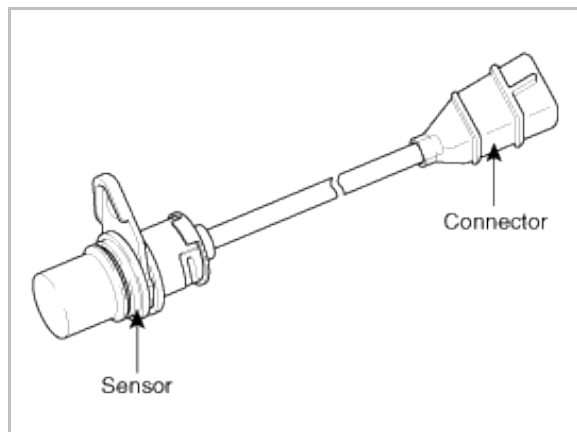
Engine Control System - Crankshaft Position
Sensor (CPKS)



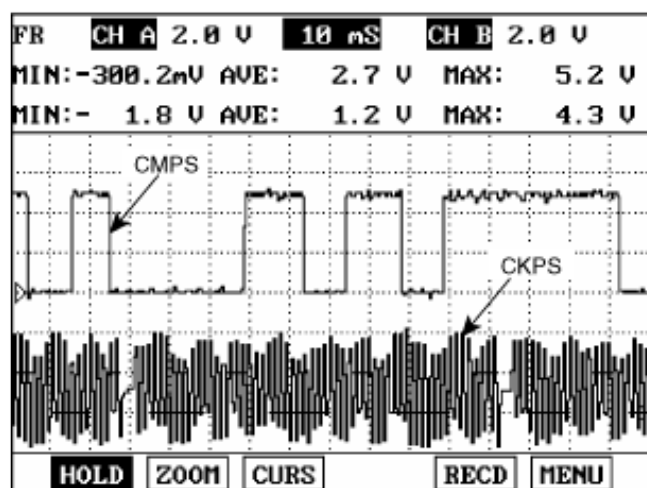
INSPECTION

FUNCTION AND OPERATION PRICIPLE

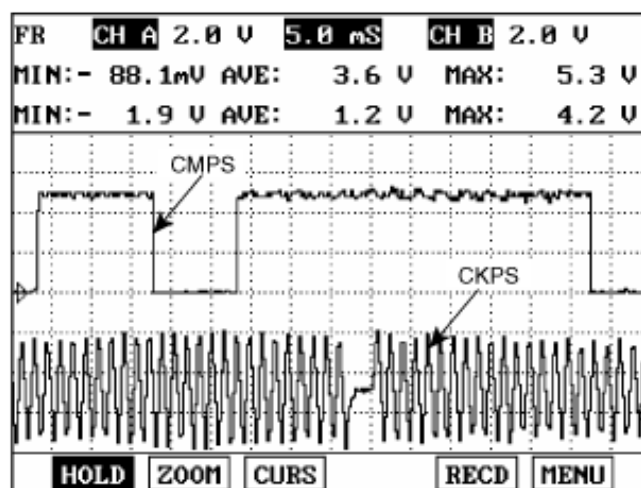
Crankshaft Position Sensor (CKPS) detects the crankshaft position and is one of the most important sensors of the engine control system. If there is no CKPS signal input, the engine may stop because of CKPS signal missing. This sensor is installed on transaxle housing and generates alternating current 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 CA (Crank Angle).



WAVEFORM



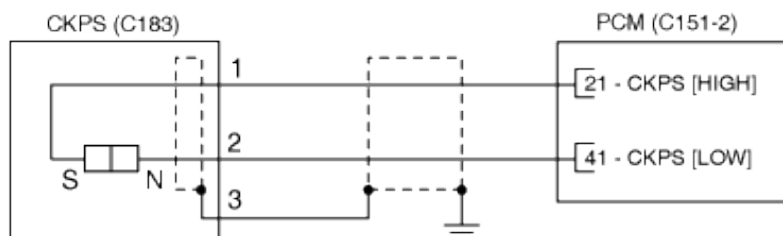
At Idle



At Idle

CIRCUIT DIAGRAM

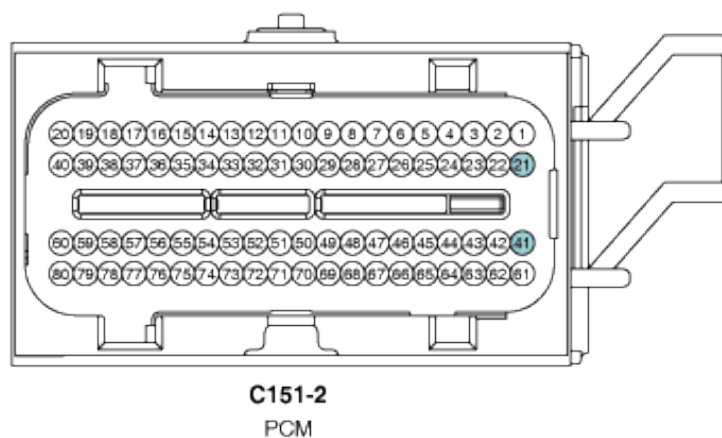
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	PCM C151-2 (21)	CKPS [HIGH] Signal
2	PCM C151-2 (41)	CKPS [LOW] Signal
3	Chassis Ground	Sensor Shield

[HARNESS CONNECTORS]



COMPONENT INSPECTION

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

Specification : Refer to "WAVE FORM"

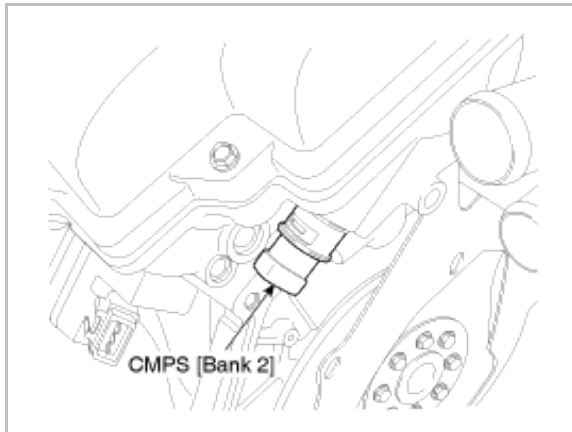
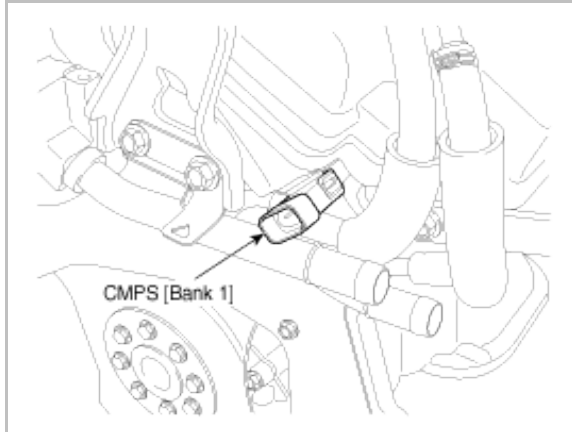
Fuel System

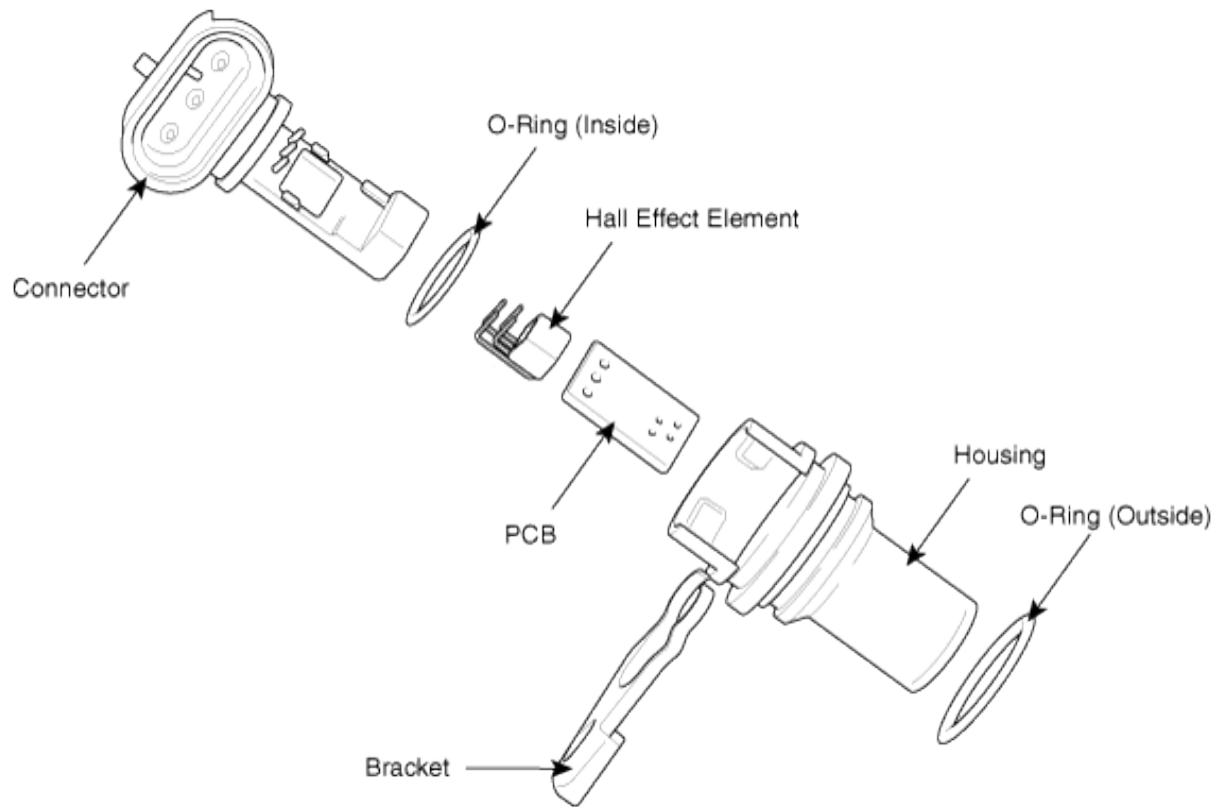
Engine Control System - Camshaft Position
Sensor (CMKS)

INSPECTION

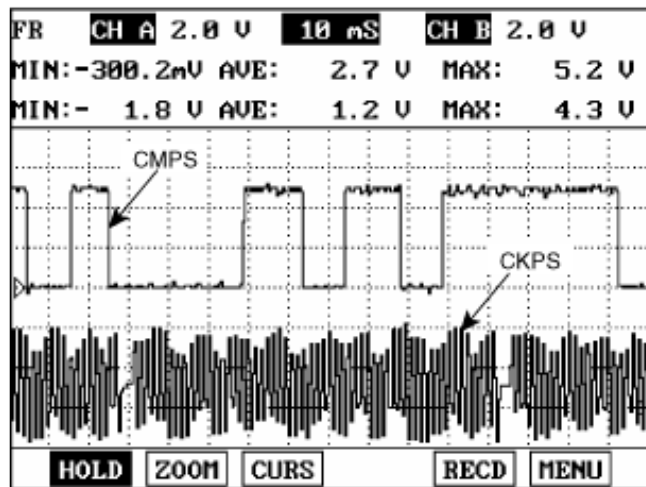
FUNCTION AND OPERATION PRICIPLE

Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element. It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect. The two CMPS are installed on engine head cover of bank 1 and 2 and uses a target wheel installed on the camshaft. This sensor has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow.

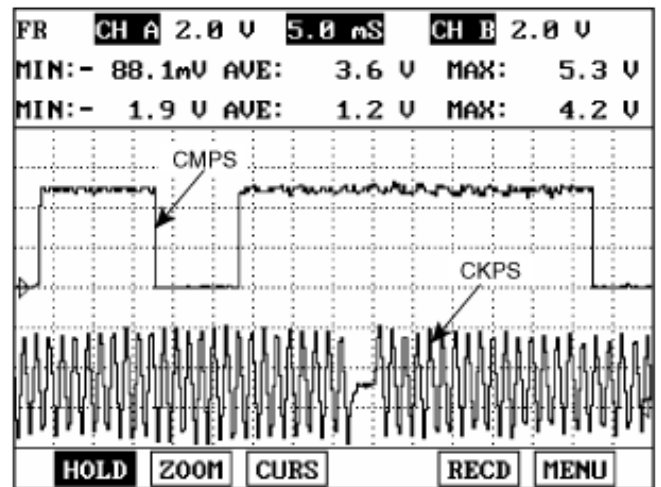




WAVEFORM



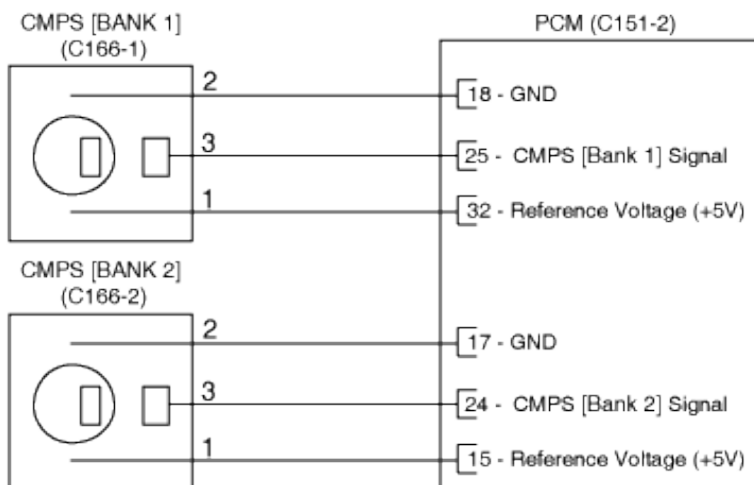
At Idle



At Idle

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

CMPS [BANK 1]

Terminal	Connected to	Function
1	PCM C151-2 (32)	Reference Voltage (+5V)
2	PCM C151-2 (18)	Sensor ground
3	PCM C151-2 (25)	CMPS [Bank 1] signal

CMPS [BANK 2]

Terminal	Connected to	Function
1	PCM C151-2 (15)	Reference Voltage (+5V)
2	PCM C151-2 (17)	Sensor ground
3	PCM C151-2 (24)	CMPS [Bank 2] signal

[HARNESS CONNECTORS]



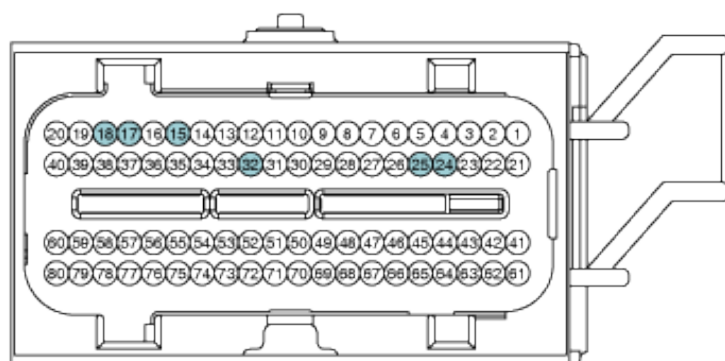
C166-1

CMPS [BANK 1]



C166-2

CMPS [BANK 2]



C151-2

PCM

COMPONENT INSPECTION

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

Specification : Refer to "WAVE FORM"

Fuel System

Engine Control System - Injector



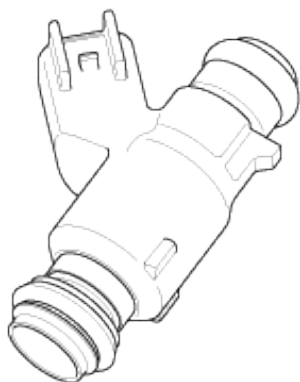
INSPECTION

FUNCTION AND OPERATION PRICIPLE

Based on information from various sensors, the PCM measures the fuel injection amount. The fuel injector is a solenoid-operated valve and the fuel injection amount is controlled by length of time that the fuel injector is held open. The PCM controls each injector by grounding the control circuit. When the PCM energizes the injector by grounding the control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the PCM de-energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should momentarily peak.

WARNING

If an injector connector is disconnected for more than 46 seconds while the engine runs, the PCM will determine that the cylinder is misfiring and cut fuel supply. So be careful not to exceed 46 seconds. But the engine runs normally in 10 seconds after turning the ignition key off.

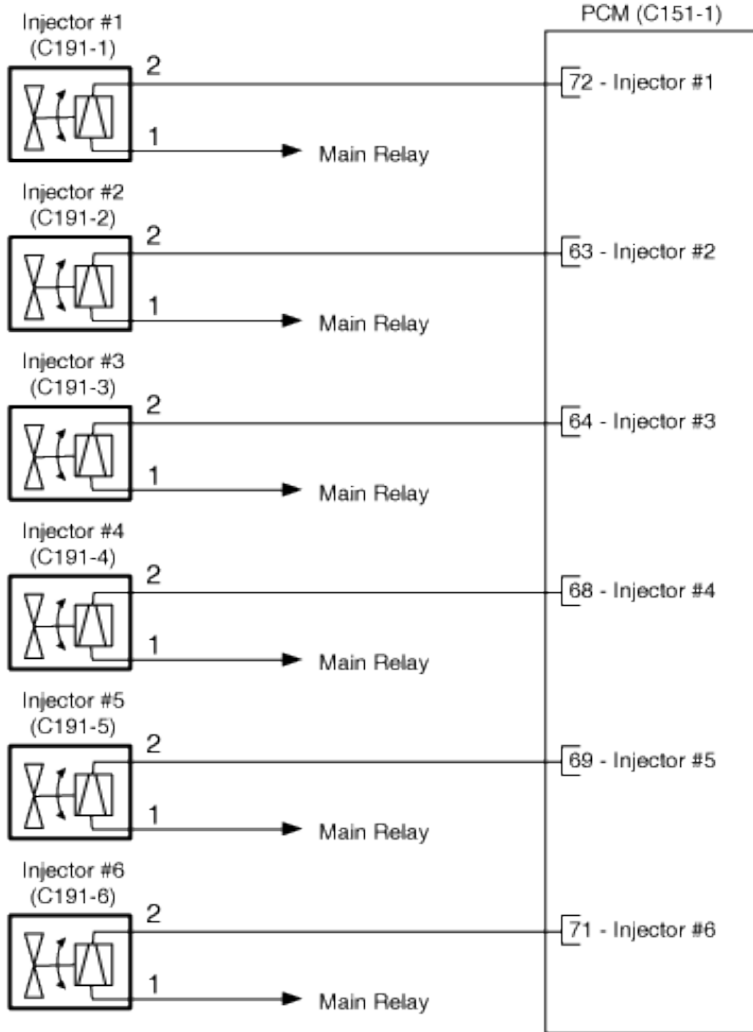


SPECIFICATION

Item	Specification
Coil Resistance (Ω)	13.8 ~ 15.2 Ω at 20°C (68°F)

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1		
Terminal	Connected to	Function
1	PCM C151-1 (72)	Injector #1 control
2	Main Relay	Battery Voltage (B+)

Injector #2		
Terminal	Connected to	Function
1	PCM C151-1 (63)	Injector #2 control
2	Main Relay	Battery Voltage (B+)

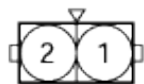
Injector #3		
Terminal	Connected to	Function
1	PCM C151-1 (64)	Injector #3 control
2	Main Relay	Battery Voltage (B+)

Injector #4		
Terminal	Connected to	Function
1	PCM C151-1 (68)	Injector #4 control
2	Main Relay	Battery Voltage (B+)

Injector #5		
Terminal	Connected to	Function
1	PCM C151-1 (69)	Injector #5 control
2	Main Relay	Battery Voltage (B+)

Injector #6		
Terminal	Connected to	Function
1	PCM C151-1 (71)	Injector #6 control
2	Main Relay	Battery Voltage (B+)

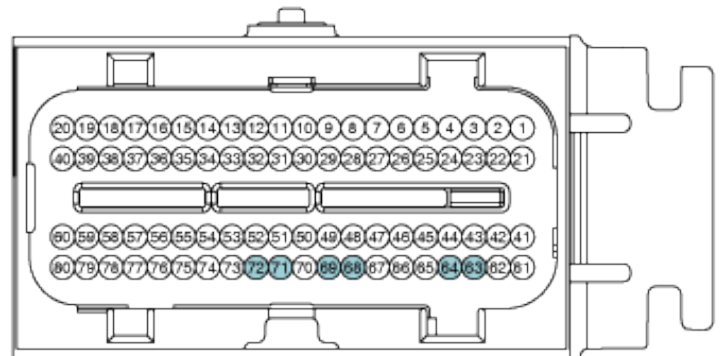
[HARNESS CONNECTORS]



C191-1,3,5
Injector #1,3,5



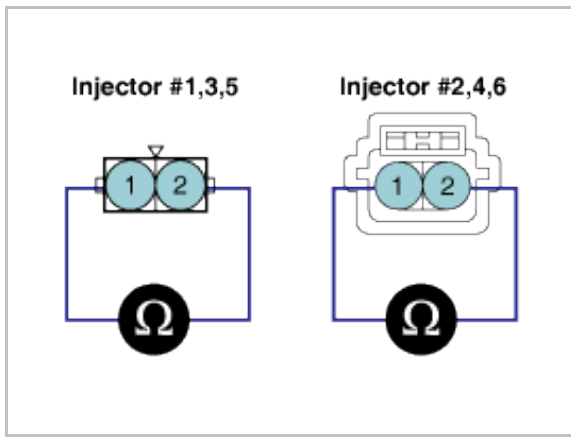
C191-2,4,6
Injector #2,4,6



C151-1
PCM

COMPONENT INSPECTION

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



4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

Fuel System

Engine Control System - CWT Oil Control
Valve (OCV)



INSTALLATION

CAUTION

If the OCVs are installed incorrectly, the vehicle may be damaged.

So when installing them, ensure the OCV and harness connector colors match(Components and harness side).

[Bank and its color]

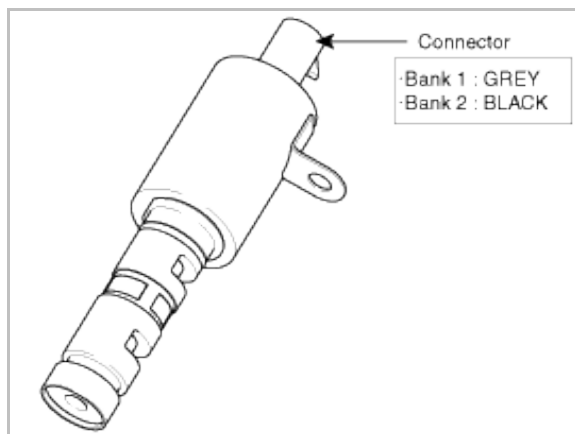
Bank	Component side	Harness side
Bank 1 (RH)	Grey	Grey
Bank 2 (LH)	Black	Black

INSPECTION

FUNCTION AND OPERATION PRICIPLE

The Continuously Variable Valve Timing (CVVT) system controls the amount of valve overlap by varying the amount of oil flow into an assembly mounted on each intake camshaft through PCM control of an oil control valve. This system uses two oil control valves, one on each bank. An Oil Temperature Sensor (OTS) is used to allow PCM monitoring of engine oil temperature. As oil is directed into the chambers of the CVVT assembly, the cam phase is changed to suit various performance and emissions requirements..

1. When camshaft rotates engine rotation-wise: Intake-Advance / Exhaust-Retard
2. When camshaft rotates counter engine rotation-wise: Intake- Retard / Exhaust- Advance

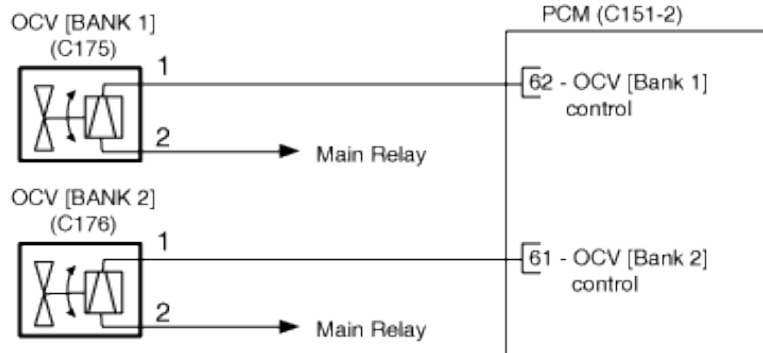


SPECIFICATION

Item	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 Ω at 20°C (68°F)

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

OCV [BANK 1]

Terminal	Connected to	Function
1	PCM C151-2 (62)	OCV [Bank 1] control
2	Main Relay	Battery Voltage (B+)

OCV [BANK 2]

Terminal	Connected to	Function
1	PCM C151-2 (61)	OCV [Bank 2] control
2	Main Relay	Battery Voltage (B+)

[HARNESS CONNECTORS]



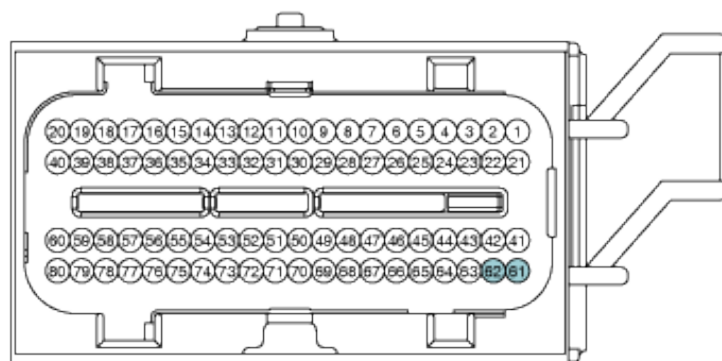
C175

OCV [Bank 1]



C176

OCV [Bank 2]

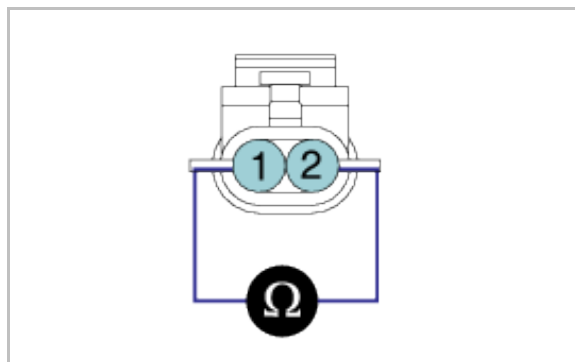


C151-2

PCM

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect OCV connector.
3. Measure resistance between OCV terminals 1 and 2.



4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

Fuel System

Engine Control System - Variable Intake
Solenoid Valve (VIS)

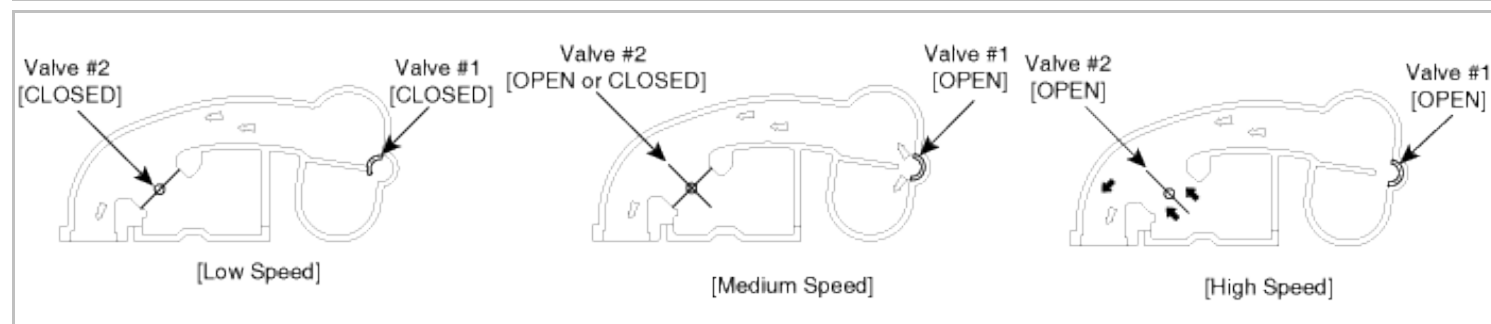
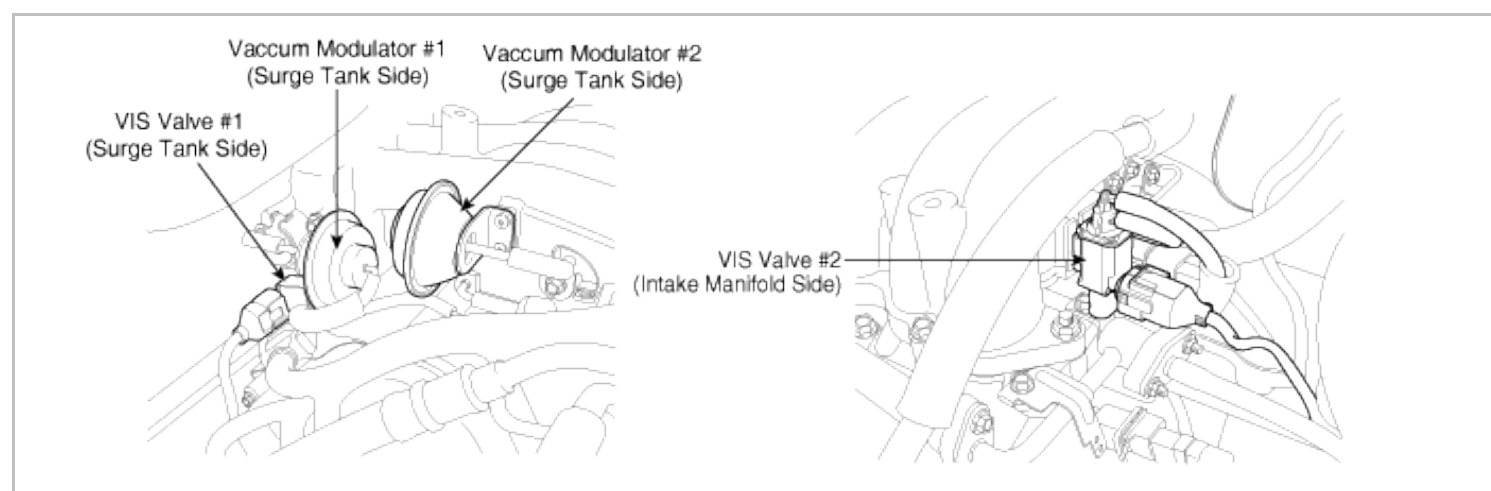


INSPECTION

FUNCTION AND OPERATION PRICIPLE

Variable Intake manifold Solenoid (VIS) valves are installed on surge tank (VIS Valve #1) and intake manifold (VIS Valve #2). These VIS valve #1 and #2 control vacuum modulators which activate valves in surge tank and intake manifold. These valves are opened or closed by PCM according to engine condition (Refer to below table).

Engine Condition	VIS Valve #1 (Surge Tank)	VIS Valve #2 (In-manifold)	Operation
Low Speed	Closed	Closed	Increasing engine performance in low engine speed by reducing intake interference among cylinders
Medium Speed	Open	Open or closed	Increasing intake efficiency
High Speed	Open	Open	Minimizing intake resistance by shortening intake manifold length and increasing area of air entrance

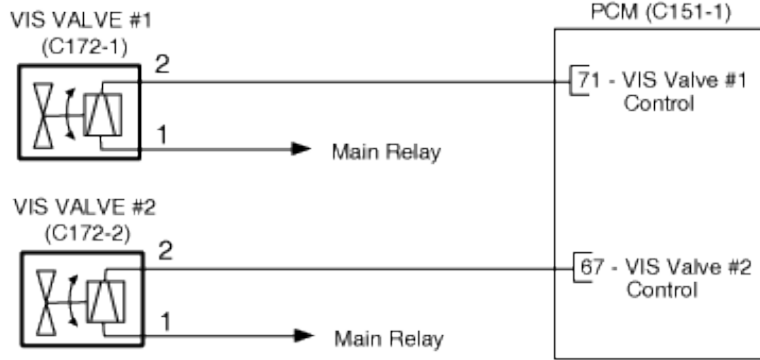


SPECIFICATION

Item	Specification
Coil Resistance (Ω)	29.0 ~ 35.0 Ω at 20°C (68°F)

CIRCUIT DIAGRAM

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

VIS VALVE #1

Terminal	Connected to	Function
1	Main Relay	Battery voltage (B+)
2	PCM C151-1 (71)	VIS Valve #1 control

VIS VALVE #2

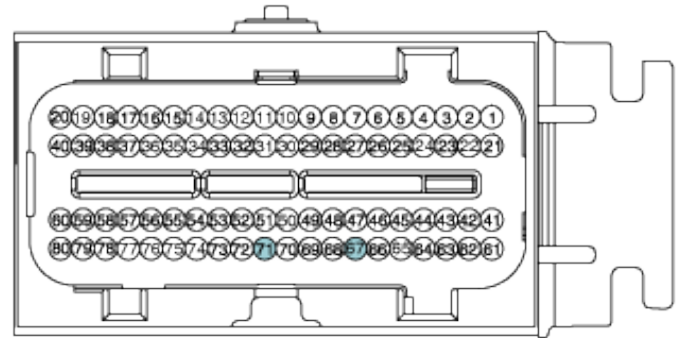
Terminal	Connected to	Function
1	Main Relay	Battery voltage (B+)
2	PCM C151-1 (67)	VIS Valve #2 control

[HARNESS CONNECTORS]



C172-1,2

VIS VALVE #1,2

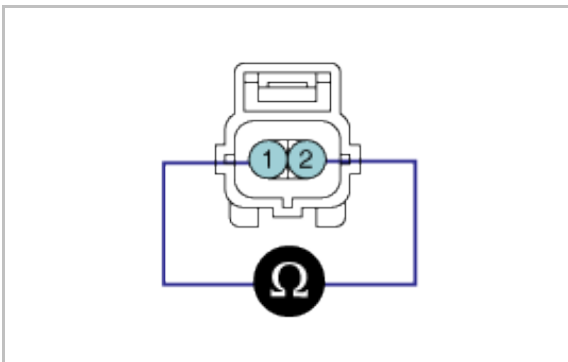


C151-1

PCM

COMPONENT INSPECTION

1. Turn ignition switch OFF.
2. Disconnect VIS Valve connector.
3. Measure resistance between VIS Valve #1,2 terminals 1 and 2.



4. Check that the resistance is within the specification.

Specification: Refer to SPECIFICATION.

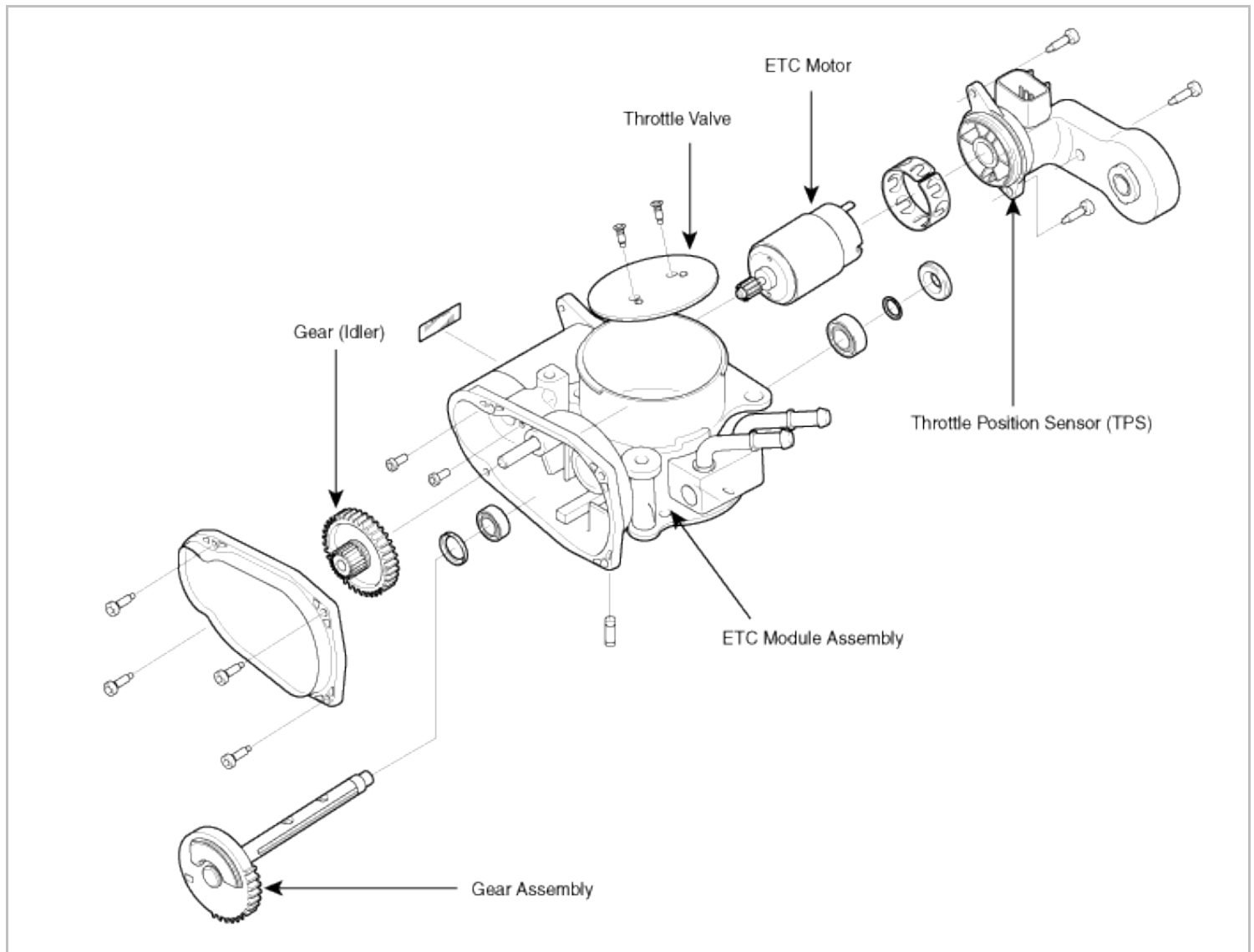
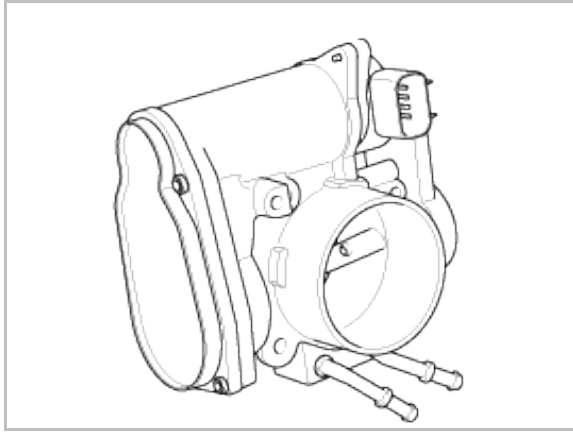
Fuel System

Engine Control System - Electronic Throttle
System

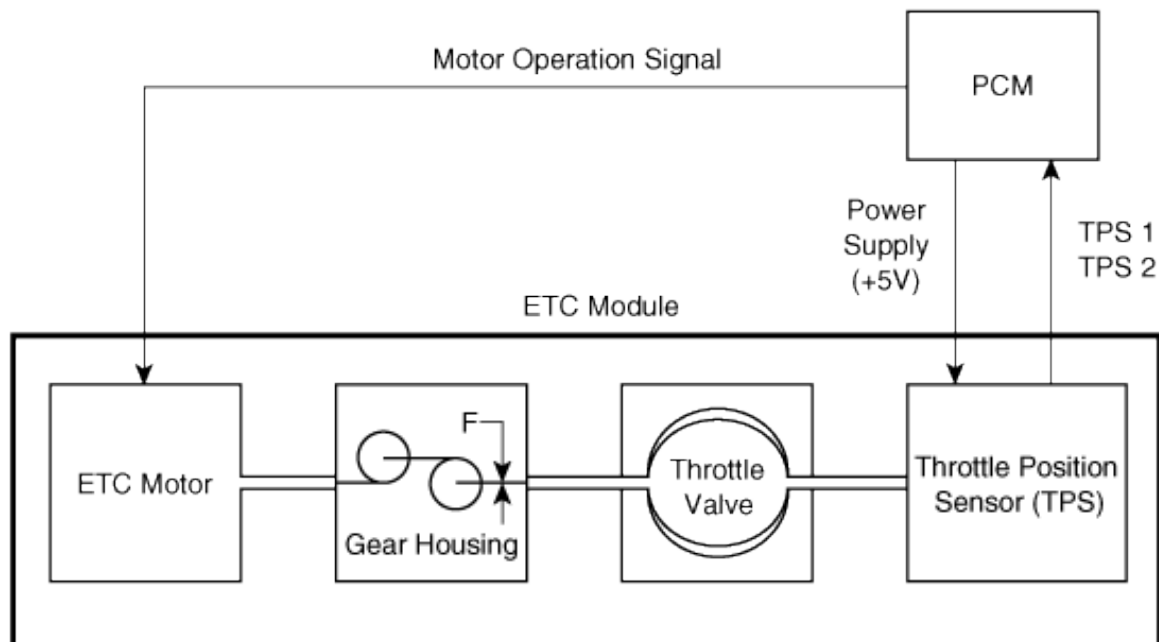
INSPECTION

FUNCTION AND OPERATION PRICIPLE

ETC (Electronic Throttle Control) system is electronically controlled throttle device which controls the throttle valve. It consists of ETC motor, throttle body and throttle position sensor (TPS). A mechanical throttle control system receives a driver's intention via a wire cable between the accelerator and the throttle valve, while this ETC system uses the signal from the Accelerator Position Sensor (APS) installed on the accelerator pedal. After the PCM receives the APS signal and calculates the throttle opening angle, it activates the throttle valve by using the ETC motor. Additionally, it can handle cruise control function without any special devices.



SHEMATIC DIAGRAM

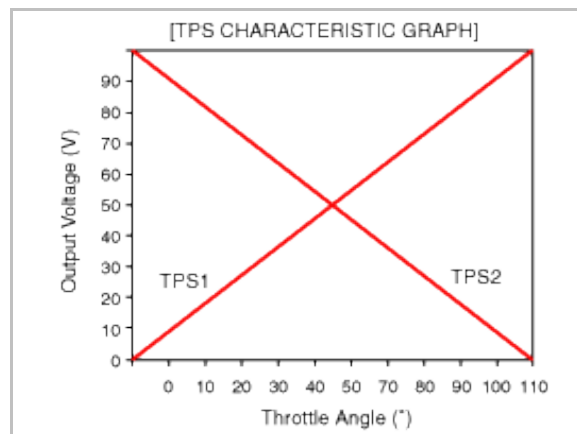


SPECIFICATION

[THROTTLE POSITION SENSOR]

Throttle Angle(°)	Output Voltage(V) [Vref = 5.0V]	
	TPS1	TPS2
0°	0V	5.0V
10°	0.5V	4.5V
20°	0.9V	4.1V
30°	1.4V	3.6V
40°	1.8V	3.2V
50°	2.3V	2.7V
60°	2.7V	2.3V
70°	3.2V	1.8V
80°	3.6V	1.4V
90°	4.1V	0.9V
100°	4.5V	0.5V
110°	5.0V	0V

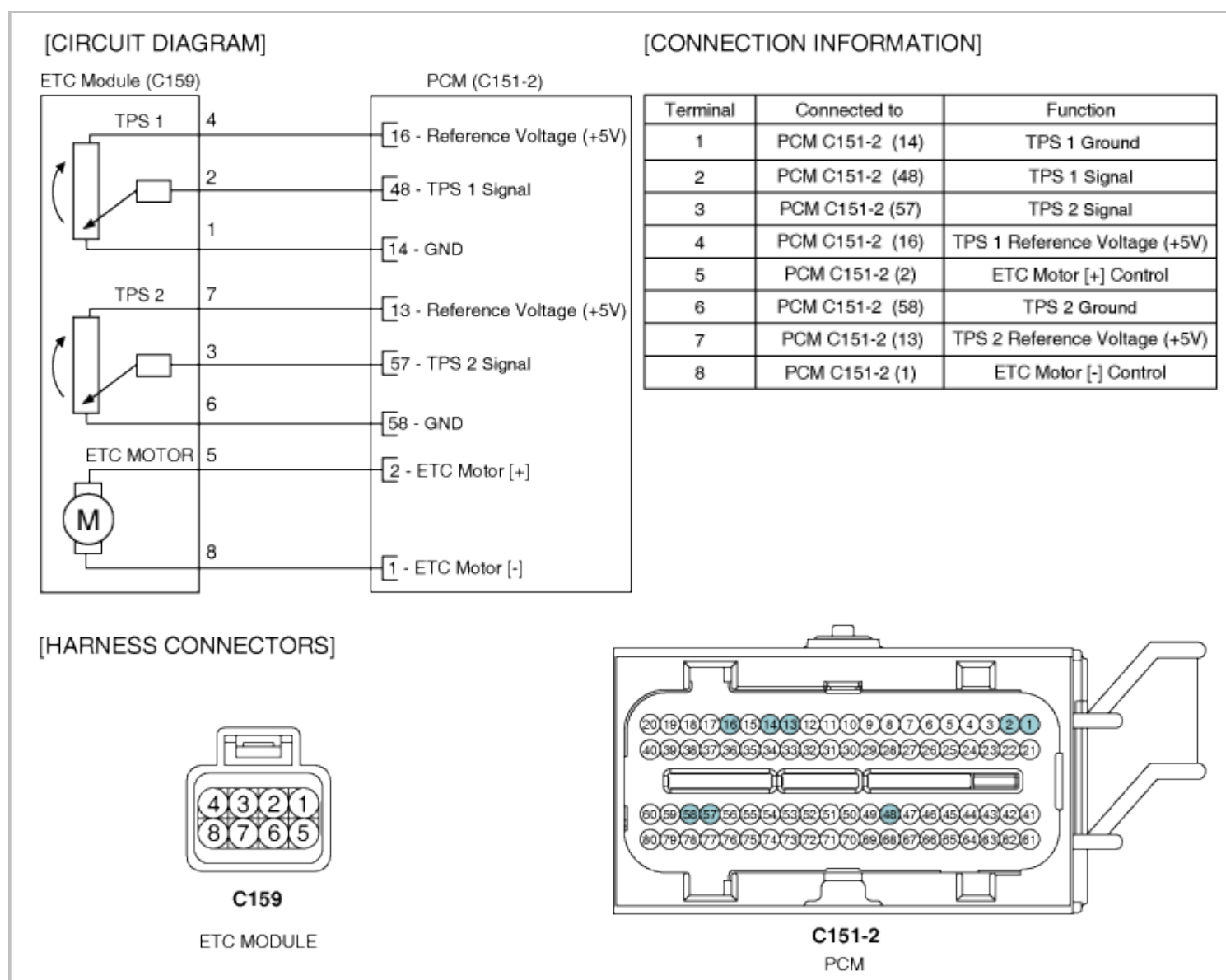
Item	Sensor Resistance
TPS1	4.0 ~ 6.0kΩ at 20°C (68°F)
TPS2	2.7 ~ 4.1kΩ at 20°C (68°F)



[ETC MOTOR]

Item	Sensor Resistance
Coil Resistance (Ω)	1.275 ~ 1.725Ω at 20°C (68°F)

CIRCUIT DIAGRAM



FAIL-SAFE MODE

Mode	Description	Symptom	Possible Cause
			• ETC system can't proceed reliable

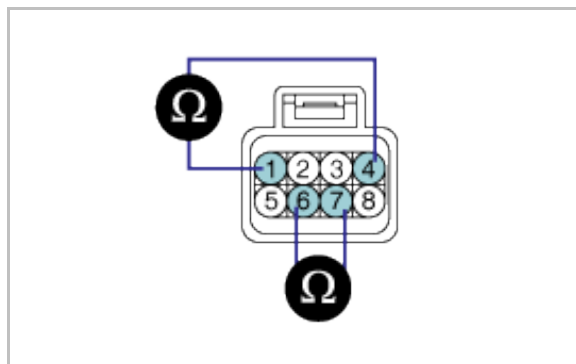
MODE 1	FORCED ENGINE SHUTDOWN	Engine stop	algorithm procedure - Fatal PCM internal programming error - Faulty intake system or throttle body
MODE 2	FORCED IDLE & POWER MANAGEMENT	Forced idle state controlled by fuel quantity regulation and ignition timing adjustment	- ETC system can't control engine power via throttle device - Disabled throttle control or broken throttle position information
MODE 3	FORCED IDLE	Forced idle state and no response for accelerator activation	- No information about the accelerator position - Malfunctioning APS 1 and 2, faulty A/D converter or internal controller
MODE 4	LIMIT PERFORMANCE & POWER MANAGEMENT	Engine power is determined by accelerator position and idle power requirement (Limited vehicle running)	ETC system can't securely control engine power
MODE 5	LIMIT PERFORMANCE	1. Engine power varies with accelerator position, but driver perceives lack of engine power. 2. MIL ON (Normal vehicle running)	- Not reliable accelerator position signal or bad maximum power generation - Faulty APS, ignition voltage or internal controller
MODE 6	NORMAL	Normal	

COMPONENT INSPECTION

1. Connect a scantool on Diagnosis Link Connector (DLC).
2. Start engine and check output voltages of TPS 1 and 2 at C.T and W.O.T.

Condition	Output Voltage (V)	
	TPS 1	TPS 2
C.T	0.25 ~ 0.9V	Min. 4.0V
W.O.T	Min. 4.0V	0.25 ~ 0.9V

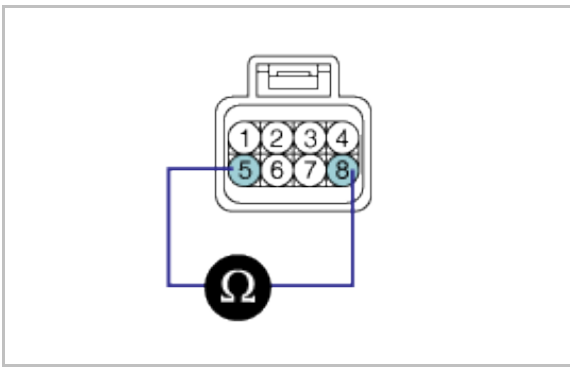
3. Turn ignition switch OFF and disconnect the scantool from the DLC.
4. Disconnect ETC module connector and measure resistance between ETC module terminals 4 and 1 (TPS 1).
5. Measure resistance between ETC module terminals 7 and 6 (TPS 2).



Specification: Refer to SPECIFICATION.

ETC MOTOR

1. Disconnect ETC module connector and measure resistance between ETC module terminals 5 and 8.



Specification: Refer to SPECIFICATION.

ETC SYSTEM INITIALIZATION

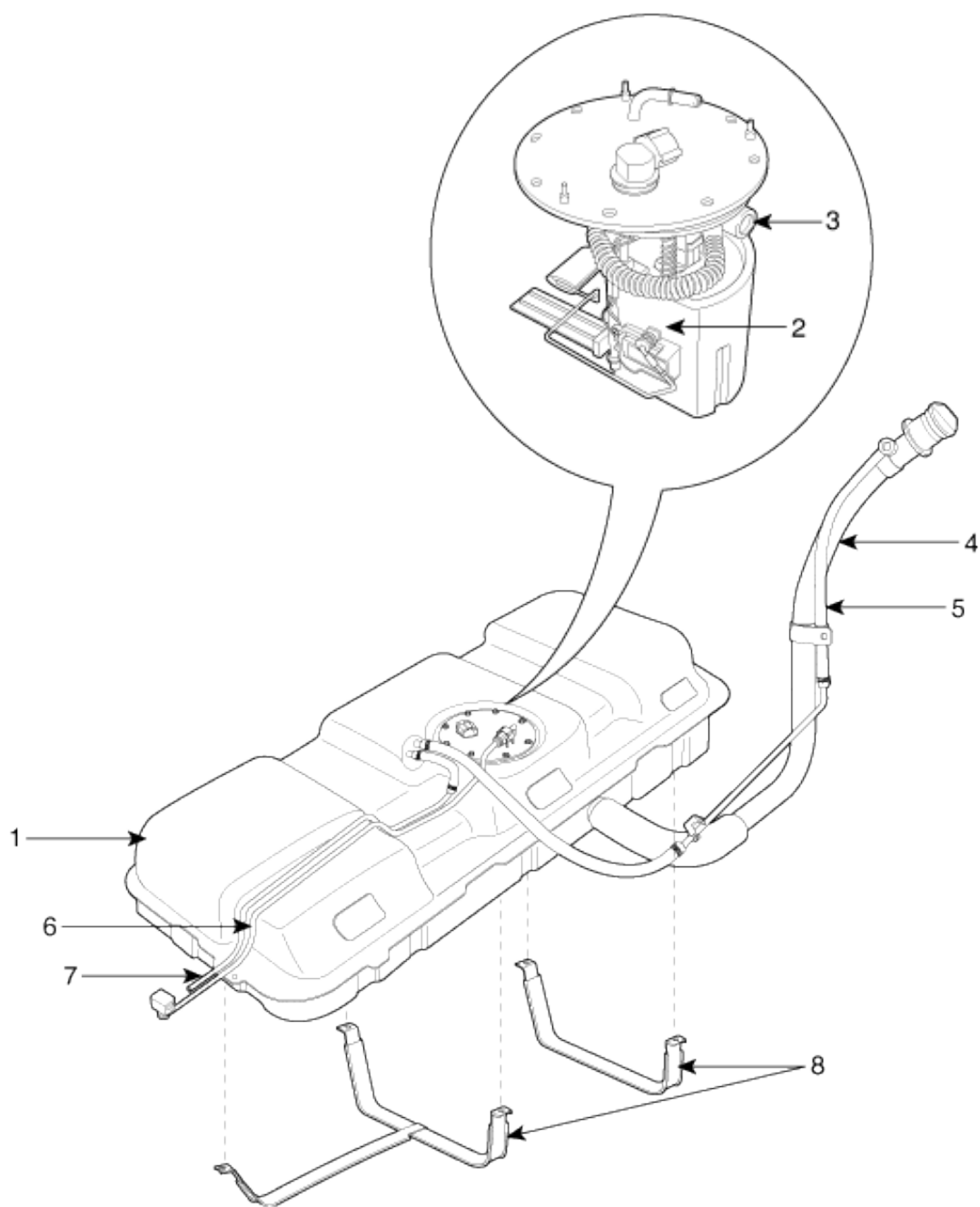
1. Erase DTC(s) memorized in PCM with a scan tool.
2. Turn ignition switch off and wait for about 10 seconds.
3. Turn ignition switch on for more then 1 second. (At this time, the PCM records initial position of ETC motor on its EEPROM).



Fuel System

Fuel Delivery System

COMPONENT LOCATION



- 1. Fuel Tank
- 2. Fuel Pump (including Fuel Filter)
- 3. Fuel Pressure Regulator
- 4. Fuel Filler Pipe

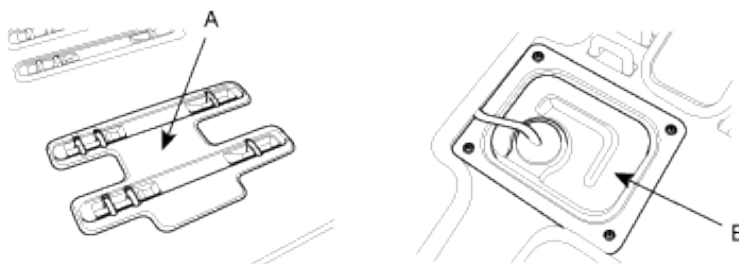
- 5. Leveling Pipe
- 6. Tube - Fuel Feed
- 7. Tube (Canister ↔ Fuel Tank)
- 8. Fuel Tank Band



FUEL PRESSURE TEST

1. PREPARING

1. Remove the 2nd seat(s) (Refer to "BD" group in this WORKSHOP MANUAL).
2. Remove the Striker Cover (A).
3. Remove the Service Cover (B).



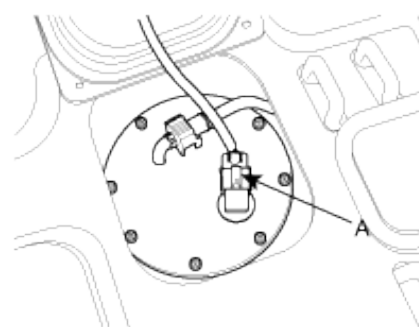
2. RELEASE THE INTERNAL PRESSURE

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



NOTE

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



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

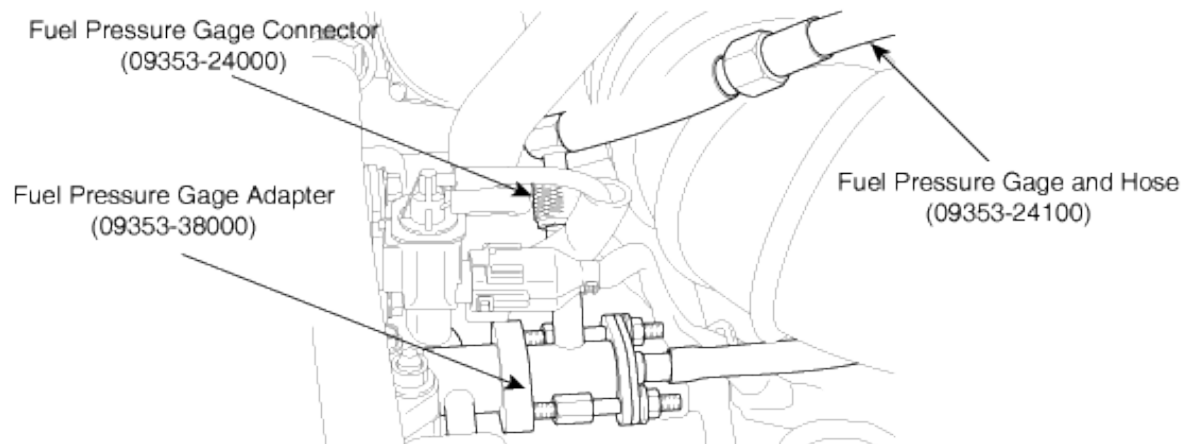
1. Disconnect the fuel feed hose from the delivery pipe.



CAUTION

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

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



4. INSPECT FUEL LEAKAGE ON CONNECTION

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

5. FUEL PRESURE TEST

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

Standard Value: 374 ~ 384 kpa (3.82 ~ 3.92 kgf/cm², 54.3 ~ 55.8 psi)

- If the measured fuel pressure differs from the standard value, perform the necessary repairs using the table below.

Condition	Probable Cause	Suspected Area
Fuel Pressure too low	Clogged fuel filter	Fuel filter
	Fuel leak on the fuel-pressure regulator that is assembled on fuel pump because of poor seating of the fuel-pressure regulator.	Fuel Pressure Regulator
Fuel Pressure too High	Sticking fuel pressure regulator	Fuel Pressure Regulator

5. Stop the engine and check for a change in the fuel pressure gauge reading.

After engine stops, the gauge reading should hold for about 5 minutes

- Observing the declination of the fuel pressure when the gauge reading drops and perform the necessary repairs using the table below.

Condition	Probable Cause	Supected Area
Fuel pressure drops slowly after engine is stopped	Injector leak	Injector
Fuel pressure drops immediately after engine is stopped	The check valve within the fuel pump is open	Fuel Pump

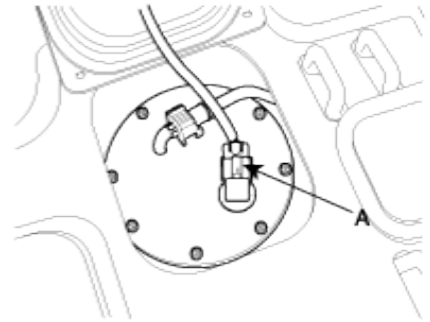
6. RELEASE THE INTERNAL PRESSURE

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



NOTE

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



7. REMOVE THE SPECIAL SERVICE TOOL (SST) AND CONNECT THE FUEL LINE

1. Disconnect the Fuel Pressure Gauge and Hose (09353-24100) from the Fuel Pressure Gauge Connector (09353-24000).
2. Disconnect the Fuel Pressure Gauge Connector (09353-24000) from the Fuel Pressure Gauge Adapter (09353-38000).
3. Disconnect the fuel feed hose from the Fuel Pressure Gauge Adapter (09353-38000).
4. Disconnect the Fuel Pressure Gauge Adapter (09353-38000) from the delivery pipe.



CAUTION

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

5. Connect the fuel feed hose to the delivery pipe.

8. INSPECT FUEL LEAKAGE ON CONNECTION

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

Fuel System

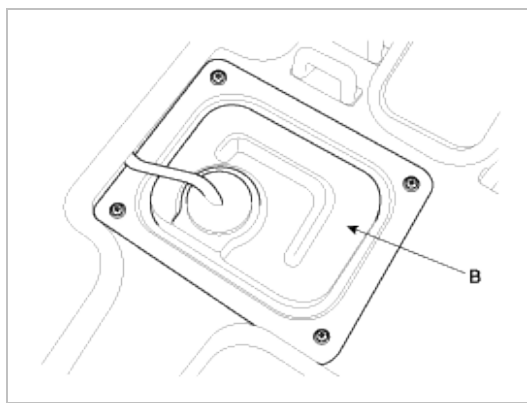
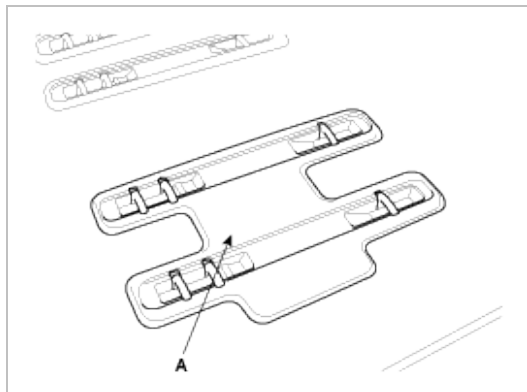
Fuel Delivery System - Fuel Tank



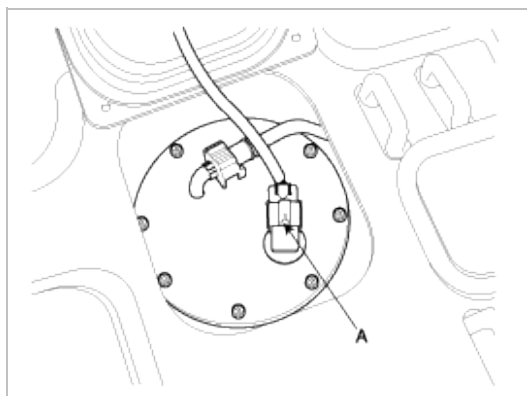
REMOVAL

1. Preparation

- (1) Remove the 2nd seat(s) (Refer to "BD" group in this WORKSHOP MANUAL).
- (2) Remove the striker cover (A).
- (3) Remove the Service Cover (B).

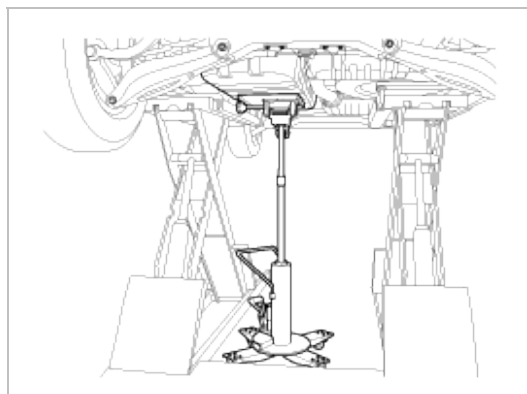


- (4) Disconnect the Fuel Pump Connector (A).

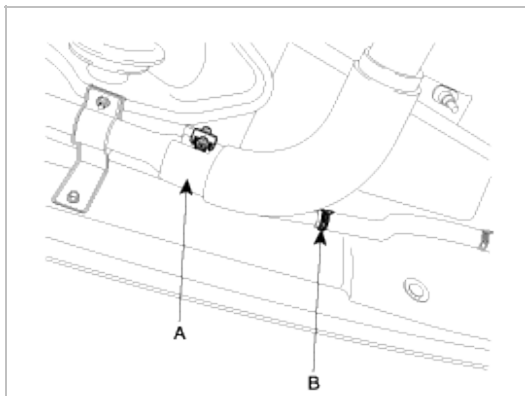


- (5) Start the engine and wait until fuel in fuel line is exhausted.
- (6) After the engine stalls, turn the ignition switch OFF.

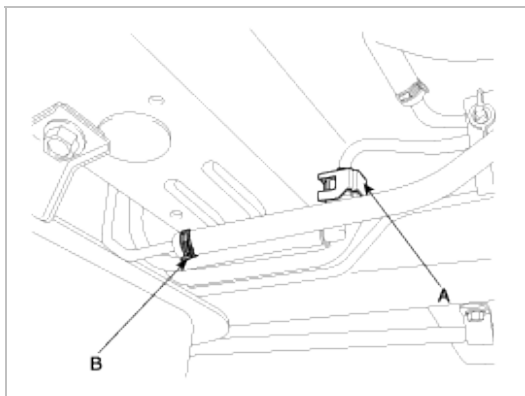
2. Lift the vehicle and support it with a jack.



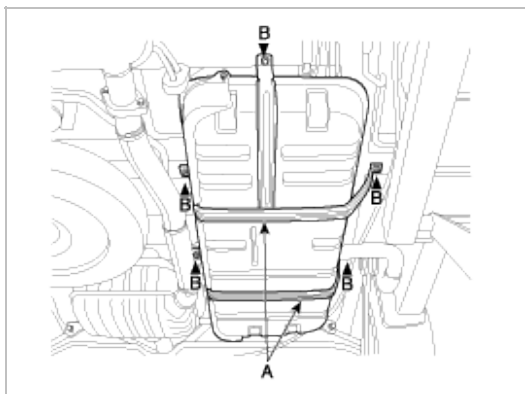
3. Disconnect the fuel filler hose (A) and the leveling hose (B).



4. Disconnect the fuel feed quick connector (A) and vacuum hose (B).



5. Remove the fuel tank band (A) with unscrewing the mounting bolts (B) and remove the fuel tank from the vehicle.



INSTALLATION

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

Fuel tank band mounting bolts :

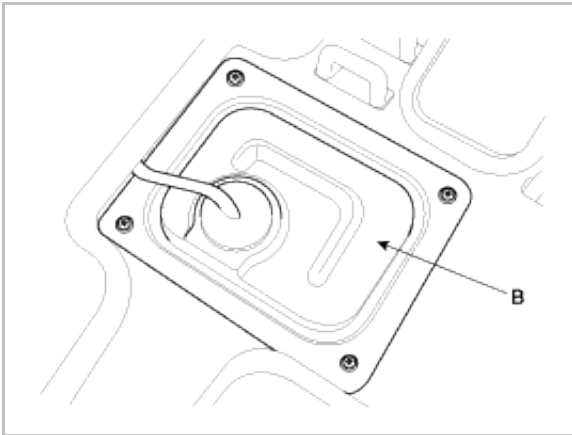
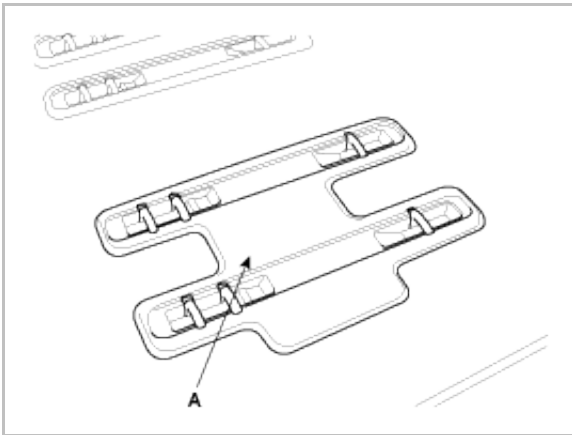
39.2 ~ 53.9 N·m (4.0 ~ 5.5 kgf·m, 28.9 ~ 39.8 lbf·ft)

Fuel System

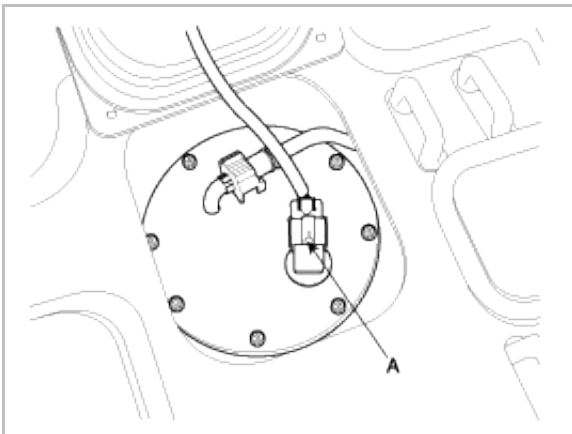
Fuel Delivery System - Fuel Pump

**REMOVAL(INCLUDING FUEL FILTER AND FUEL PRESSURE REGULATOR)****1. Preparation**

- (1) Remove the 2nd seat(s) (Refer to "BD" group in this WORKSHOP MANUAL).
- (2) Remove the striker cover (A).
- (3) Remove the Service Cover (B).

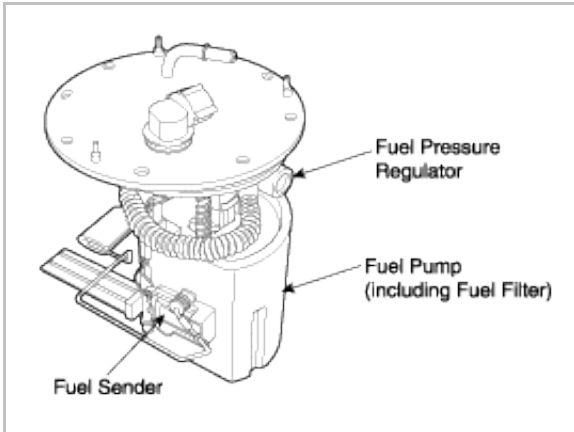
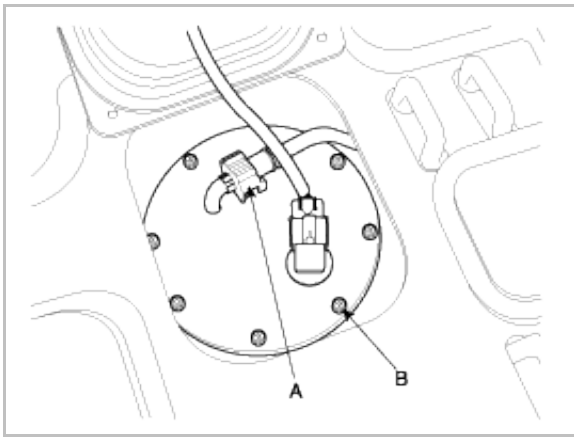


- (4) Disconnect the Fuel Pump Connector (A).



- (5) Start the engine and wait until fuel in fuel line is exhausted.
- (6) After the engine stalls, turn the ignition switch OFF.

2. After disconnecting the fuel feed quick connector (A) and unscrewing the the eight screws (B), remove the fuel pump assembly.



INSTALLATION

1. Install the Fuel Pump assembly according to the reverse order of "REMOVAL" procedure.

Fuel Pump assembly mounting bolts :

2.0 ~ 2.9 N·m (0.2 ~ 0.3 kgf·m, 1.4 ~ 2.2 lbf·ft)
